US Army Corps
of Engineers
New Orleans District

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT

REEVALUATION STUDY

VOLUME II

TECHNICAL APPENDIXES

JULY 1984

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT

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LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION I - HYDROLOGY AND HYDRAULICS

1. General. This appendix presents hydrologic and hydraulic design criteria and analyses, or references thereto, associated with the alternative plans studies for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project. The plans of improvement, including alinement of protective structures, are described in of this memorandum and are shown on plates. Plans of improvement considered refer to the presently authorized Barrier Low-Level Plan which protects from flooding by a Standard Project Hurricane (SPH); an Alternative High-Level Plan, no barrier, which provides for SPH protection; and a 100-year frequency hurricane Alternative High-Level Protection Plan, no barrier.

2. Tidal Hydraulics.

a. General.

(1) The Hydrology and Hydraulic Analysis Design Memorandum for the Lake Pontchartrain and Vicinity Barrier Low-Level Plan was presented in a series of three separate reports entitled Design Memorandum No. 1 and subtitled Part 1 -Chalmette, Part II - Barrier and Part III - Lakeshore. The reports were approved on 27 October 1966, 18 October 1967 and 6 March 1969, respectively. In addition, references can be made to appropriate General Design Memoranda for specific locations within the project. These memoranda present detailed descriptions of the climatology and hydrologic regimen of the area and detailed descriptions and analyses of hydraulic methods and procedures used in the design of protective features of the plan. Also included in the memoranda are essential data, assumptions and criteria used, and results of studies which provide the basis for determining surges, routings, wind tides, wave runup and overtopping, and frequencies. Essentially, all basic hydraulic information required for design of protective structures is included in Part III - Lakeshore and related Design Memoranda.

(2) The hydraulic information required for design of the alternative High-Level No Barrier protective structures is essentially as presented in the Interim Survey Report, Lake Pontchartrain, Louisiana and Vicinity, dated 21 November 1962. Methods used for determining surges, routings, wind tides, frequencies and other criteria are identical to those used for the Barrier Low-Level Plan. However, since the barrier is not part of this plan, the average hurricane lake stage, wind tide level, and wave characteristics are of greater magnitude and, consequently, result

in a higher design elevation for protective structures. Since publication of this report, minor changes due to revisions in windspeed, central pressure indices, etc., were used to revise portions of hydrology and hydraulics data in order to update design of the hurricane protective structures. Also the latest technique for computing overtopping volumes as outlined in Coastal Engineering Research Center's Shore Protection Manual, Fort Belvoir, VA, 1977, was incorporated into this reevaluation study.

(3) Parameters for the 100-year design frequency hurricane were derived from the SPH by using methods furnished by the National Weather Service and differ from the SPH only in central pressure index and windspeed. This hurricane is classified as a hurricane of moderate intensity and computations used for design of protective structures for this plan are similar to that of the two other plans.

b. Design Hurricanes.

(1) The SPH was selected as the design hurricane (DESH) due to the urban nature of the project area. A design hurricane of lesser intensity would indicate lower net grades for protective structures and expose densely populated areas to disastrous flooding in the event of the occurrence of a hurricane approximating SPH character. Hurricane parameters used to establish elevations for protective structures are identical for those used for the Barrier Low-Level Plan.

(2) Selection of the 100-year design hurricane was occasioned by a request from local interest for the purpose of comparing cost and benefits between this plan and the SPH High-Level Alternative Plan.

c. Description of Design Hurricanes.

(1) The design hurricane (SPH) for the Barrier Low-Level and the Alternative High-Level Plans represent the most severe combination of hurricane parameters that is reasonable characteristic of the area, excluding extremely rare combinations. The hurricane would approach each individual site at such a rate of movement as to produce the maximum hurricane surge at each location of interest. The design hurricane has a central pressure index of 27.4 inches of mercury; a maximum 5-minute average wind velocity offshore (in the Gulf of Mexico) of 100 mi/h 30 ft above the surface at a radius of 30 nautical miles; a forward speed of 6 knots; a frequency of once in about 300 years; and would progress along a path critical to each location of interest.

(2) The 100-year design hurricane for the Alternate High-Level No Barrier Plan was derived from the SPH according to procedures outlined in paragraph 2a. The hurricane parameters differ from the SPH only in central pressure index and windspeed. The CPI is 28.3 and the maximum 5-minute average wind velocity offshore (in the Gulf of Mexico) is 83 mi/h 30 ft above the surface.

d. Design Levee Heights and Freeboard. Height of protective structures exposed to wave runup was designed to an elevation that is sufficient to prevent all overflow from the significant wave and all lesser waves accompanying design hurricanes. Waves larger than the significant wave may overtop the protective structures, but, due to the limited number of waves larger than the significant wave, such overtopping will not endanger the security of the structure or cause damaging interior flooding. During the time of maximum surge height, the berms on the flood side of the levee become submerged and waves of lesser height than the significant wave, but of the same period, break farther up the levee slope. Sometimes runup from these smaller waves reach an elevation higher than that from the significant wave; therefore, runup from these smaller waves must also be computed. Runup was then computed for the significant wave and for smaller waves breaking on each berm and the required levee height was determined by adding the highest computed runup value to the maximum still-water elevation. Where levees and/or floodwalls are protected against wave runup, a 2-foot freeboard over the stillwater elevation has been approved as being adequate for design. Methods used for computing wave heights and runup are explained in design memoranda referred to in the preceding paragraphs. Design runup values and proposed elevations for the protective structures are shown in tables 1, 2, and 3. Typical cross-sections by reach are shown on plates A-I-36 through A-I-49.

e. Performance of Alternative Structure Sizes for the Rigolets, Chef Menteur and Seabrook Complexes. A rating curve for the Lake Pontchartrain tidal passes was developed by the Waterways Experiment Station, WES, and presented in a report titled "Reduction of Lake Pontchartrain Tidal Prism caused by Hurricane Barriers" dated April 1976. Data from several model studies including: Jamaica Bay; Narragansett Bay; and Lake Pontchartrain were used in developing this curve. The Rigolets complex has a cross sectional area equal to about 35% of the natural channel. The Chef Menteur complex has a cross sectional area equal to about 44% of the natural channel and the Seabrook complex has a cross sectional area equal to about 30% of the natural channel. Combined, considering the relative sizes of the natural channels, the control structures and navigation gates have an area equal to about 37% of the natural channels into the lake. Using the curve developed by WES in 1976, the proposed structures can pass about 95% of the natural tidal prism. If the cross section of the structure openings was increased to 50%, they could pass 98% of the natural tidal prism or if the cross section was increased to 90%, the structures could pass 99% of the natural tidal prism. Obviously, significant increases in the structure size would be required to cause minor increases in the percentage of tidal prism that the structures could pass. Thus the proposed designs have reached optimum dimensions. In 1982, WES completed extensive numerical and physical model studies of the control structures at Rigolets, Chef Menteur and Seabrook as well as the total Lake Pontchartrain system. Based on these tests, the control structures and navigation channels, which are calculated to be about 37% of the combined natural cross section can pass only 92% of the natural tidal prism rather than 95% as predicted by the WES rating curve in 1976.

f. Elevation Frequency Curves. Methodology used for the development of elevation-frequency curves is contained in Design Memorandum No. 1, Hydrology and Hydraulic Analysis Part I - Chalmette and the Interim Survey Report dated 21 November 1962. Extensive surveys were performed in 1979 for the study area. From these surveys topographic maps of the area were developed. These maps are on file in the New Orleans District for inspection. Based on these maps, local drainage patterns and local geography, many different reaches were designated as shown on plate A-I-1. Stage-storage curves were drawn for each of the various reaches. Using the hydrographs for the 10-year, 50-year, 100-year, and SPH hurricanes, free-flow and wave overtopping were computed for the proposed levees in St. Charles, Jefferson, Orleans, and St. Bernard Parishes. The cross sections of these levees are shown in Section III of this appendix. These free-flow and overtopping volumes of water were combined with the volume of water produced by the expected rainfall to occur during a hurricane (8 1/2 inches of excess rainfall) for each reach. Then these combined volumes were used as inflow to each respective reach. Using the existing drainage structures and/or pumping stations, the outflow rate for each area was developed. This routing procedure in conjunction with the stage-storage curves was used to determine the flooding elevations for the various design hurricanes. Then the elevation-frequency curves on plates A-I-2 through A-I-35 were drawn. Detailed explanation of each of the alternative plans referenced in the legend of these frequency curves is presented in Volume 1 of this report.

TABLE I
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (SPH) FOR BARRIER LOW-LEVEL PLAN

	Surge Height	Design Runup or Freeboard	Design Elevations for Protective Structures
	ft, NGVD	ft	ft, NGVD
St. Charles Parish:			
Lakeshore Levee	10.4	2.1	12.5
U.S. Hwy 61 Levee or Floodwall	8.5	3.0	11.5
St. Charles-Jefferson Parish Lateral Canal Levee or Floodwall (Lakefront to U.S. Hwy 61)	8.7-7.0	4.3-2.0	13.0-11.0-9.0
Jefferson Parish:			
Lakeshore Levee	8.7	1.3	10.0
Orleans Marina:			
Floodwall	8.5	2.0	10.5
New Orleans West of IHNC			
Lakeshore Levee	*9.15	2.85	12.0
Metairie Relief Outfall Canal Levee	8.5	5.0	13.5
Metairie Relief Outfall Canal Floodwall	8.5	9.0	17.5
Orleans Outfall Canal Levee	8.5	5.0	13.5
Orleans Outfall Canal Floodwall	8.5	9.0	17.5
London Avenue Outfall Canal Levee	8.5	5.0	13.5
London Avenue Outfall Canal Floodwall	8.5	9.0	17.5
Pontchartrain Blvd Pumping Station Floodwall	8.5	9.0	17.5
Citrus			
Levee in Lake	8.5	3.0	11.5
Levee Landside of Railroad	8.5	5.0	13.5
Floodwall Landside of Railroad	8.5	2.0-5.0	10.5-13.5

*Ponding area between seawall and levee.

TABLE I (cont'd)
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (SPH) FOR BARRIER LOW-LEVEL PLAN

	Surge Height	Design Runup or Freeboard	Design Elevations for Protective Structures
	ft, NGVD	ft	ft, NGVD
New Orleans East			
Levee Landside of Railroad	8.5	5.5	14.0
South Point to GIWW Levee			
South Point to U.S. Hwy 90	8.5-11.5	4.0-1.0	12.5
Levee U.S. Hwy 90 to GIWW	11.5-12.8	1.0	12.5-14.0
Maxent Canal Levee	8.5	6.0	14.5

TABLE II
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (SPH) FOR ALTERNATIVE HIGH-LEVEL NO-BARRIER PLAN

	Surge Height ft, NGVD	Design Runup or Freeboard ft	Design Elevations for Protective Structures ft, NGVD
St. Charles Parish:			
Lakeshore Levee	12.5	3.0	15.5
U.S. Hwy 61 Levee	10.5	3.0	13.5
St. Charles-Jefferson Parish Lateral Canal Levee or Floodwall (Lakefront to U.S. Hwy 61)	12.0-9.7	5.0-2.0	17.0-14.0-12.0
Jefferson Parish:			
Lakeshore Levee	11.5	2.5	14.0
Lakeshore Floodwall/Levee	11.5	3.0	14.5
Lakeshore I-Wall on Levee w/Barge Berm	11.5	2.0	13.5
Orleans Marina:			
Floodwall	11.5	2.0	13.5
New Orleans			
Lakeshore Levee	*12.2	5.3	17.5
Lakeshore Floodwall	*12.2	7.3	19.5
Lakeshore I-Wall on Levee w/Barge Berm	11.5	3.0	14.5
Metairie Relief Outfall Canal Levee	11.5	6.0	17.5
Metairie Relief Outfall Canal Floodwall	11.5	8.0	19.5
Orleans Outfall Canal Levee	11.5	6.0	17.5
Orleans Outfall Canal Floodwall	11.5	8.0	19.5
London Avenue Outfall Canal Levee	11.5	6.0	17.5
London Avenue Outfall Canal Floodwall	11.5	8.0	19.5
Pontchartrain Blvd Pumping Station Floodwall	11.5	8.0	19.5

*Ponding area between seawall and levee.

TABLE II (cont'd)
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (SPH) FOR ALTERNATIVE HIGH-LEVEL NO-BARRIER PLAN

	Surge Height	Design Runup or Freeboard	Design Elevations for Protective Structures
	ft, NGVD	ft	ft, NGVD
Citrus			
Levee in Lake	11.5	4.5	16.0
Floodwall Landside of Railroad	11.5	2.0-8.0	13.5-19.5
I-Wall on Levee w/Barge Berm	11.5	3.0-3.5-4.0	14.5-15.0-15.5
New Orleans East Levee			
Landside of Railroad	11.5	5.0	16.5
South Point to GIWW Levee			
South Point to U.S. Hwy 90	11.5-12.2	2.0	13.5-14.5
Levee U.S. Hwy 90 to GIWW	12.2-12.8	2.0	14.5-15.0
Maxent Canal Levee	11.5	4.5-6.0	16.0-17.5

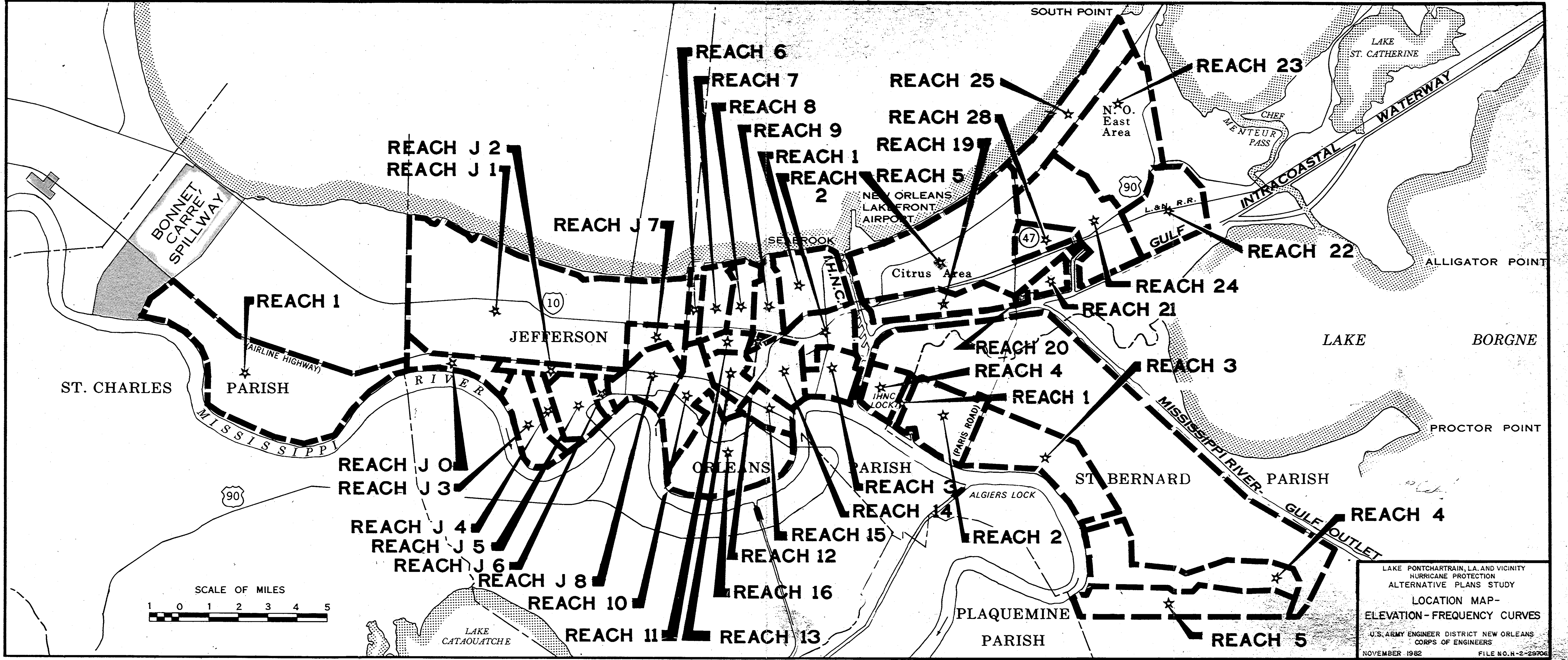
TABLE III
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (100-YEAR) FOR ALTERNATIVE HIGH-LEVEL NO-BARRIER PLAN

	Surge Height ft, NGVD	Design Runup or Freeboard ft	Design Elevations for Protective Structures ft, NGVD
St. Charles Parish:			
Lakeshore Levee	11.5	3.0	14.5
U.S. Hwy 61 Levee	9.5	3.0	12.5
St. Charles-Jefferson Parish Lateral Canal Levee or Floodwall (Lakefront to U.S. Hwy 61)	10.5-8.7	2.0	12.5-11.0
Jefferson Parish:			
Lakeshore Levee	10.5	2.5	13.0
Orleans Marina:			
Floodwall	10.5	2.0	12.5
New Orleans			
Lakeshore Levee	*11.2	5.3	16.5
Lakeshore Floodwall	*11.2	5.8	17.0
Metairie Relief Outfall Canal Levee	10.5	7.0	17.5
Metairie Relief Outfall Canal Floodwall	10.5	7.5	18.0
Orleans Outfall Canal Levee	10.5	7.5	18.0
Orleans Outfall Canal Floodwall	10.5	7.5	18.0
London Avenue Outfall Canal Levee	10.5	7.5	18.0
London Avenue Outfall Canal Floodwall	10.5	7.5	18.0
Pontchartrain Blvd Pumping Station Floodwall	10.5	7.5	18.0
Citrus			
Levee Landside of Railroad	10.5	2.0-5.5	12.5-16.0

*Ponding area between seawall and levee.

TABLE III (cont'd)
DESIGN WAVE RUNUP AND DESIGN ELEVATIONS
FOR PROTECTIVE STRUCTURES
DESIGN HURRICANE (100-YEAR) FOR ALTERNATIVE HIGH-LEVEL NO-BARRIER PLAN

	Surge Height	Design Runup or Freeboard	Design Elevations for Protective Structures
	ft, NGVD	ft	ft, NGVD
New Orleans East Levee			
Landside of Railroad	10.5	4.0	14.5
South Point to GIWW Levee			
South Point to			
U.S. Hwy 90	10.-11.5	4.0-2.0	14.5-13.5
U.S. Hwy 90 to GIWW	11.5-12.2	2.0	13.5-14.5
Maxent Canal Levee	10.5	5.0-6.0	15.5-16.5



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

LOCATION MAP-
ELEVATION-FREQUENCY CURVES

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
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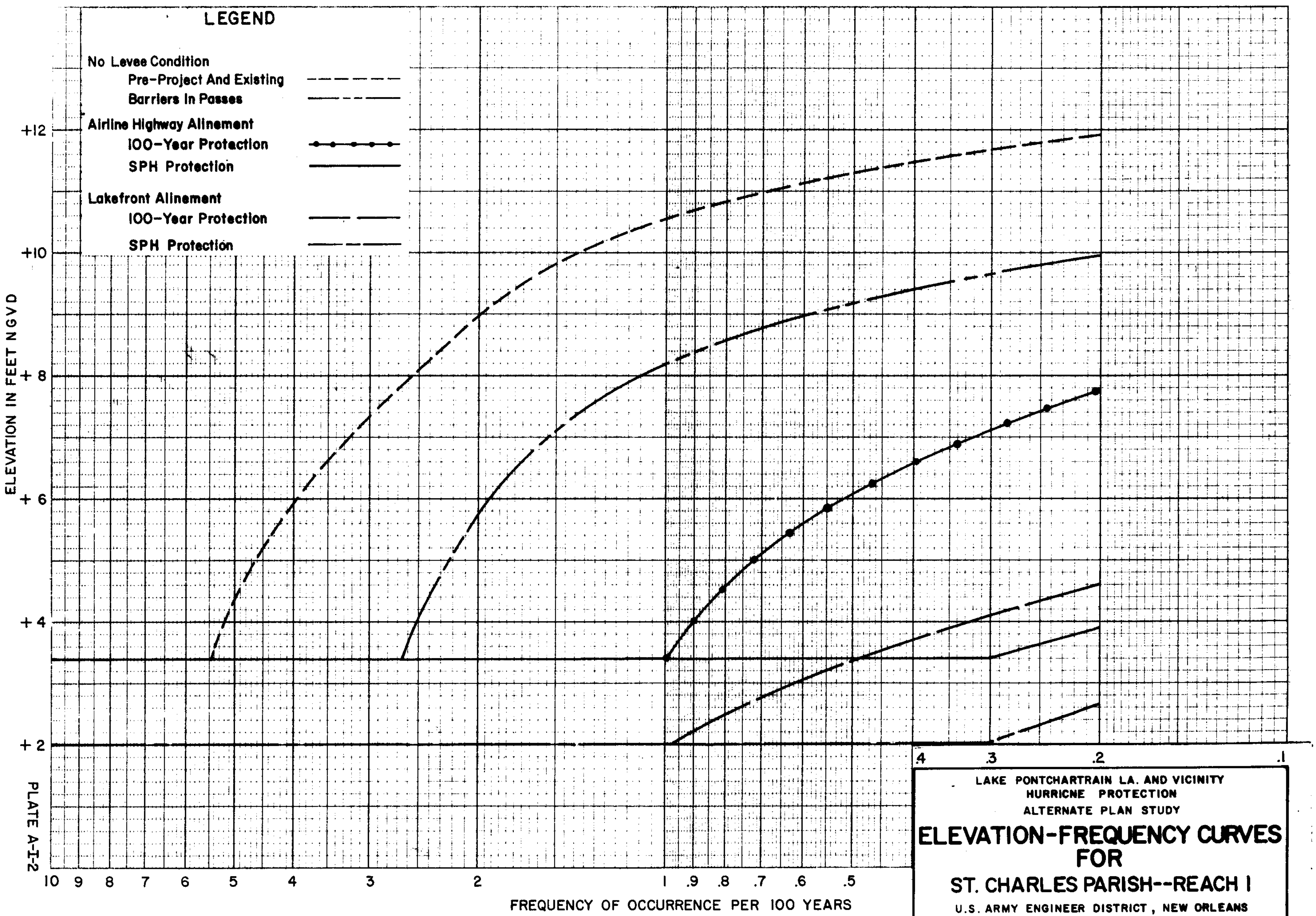
PLATE A-I-1



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ST. CHARLES PARISH--REACH I

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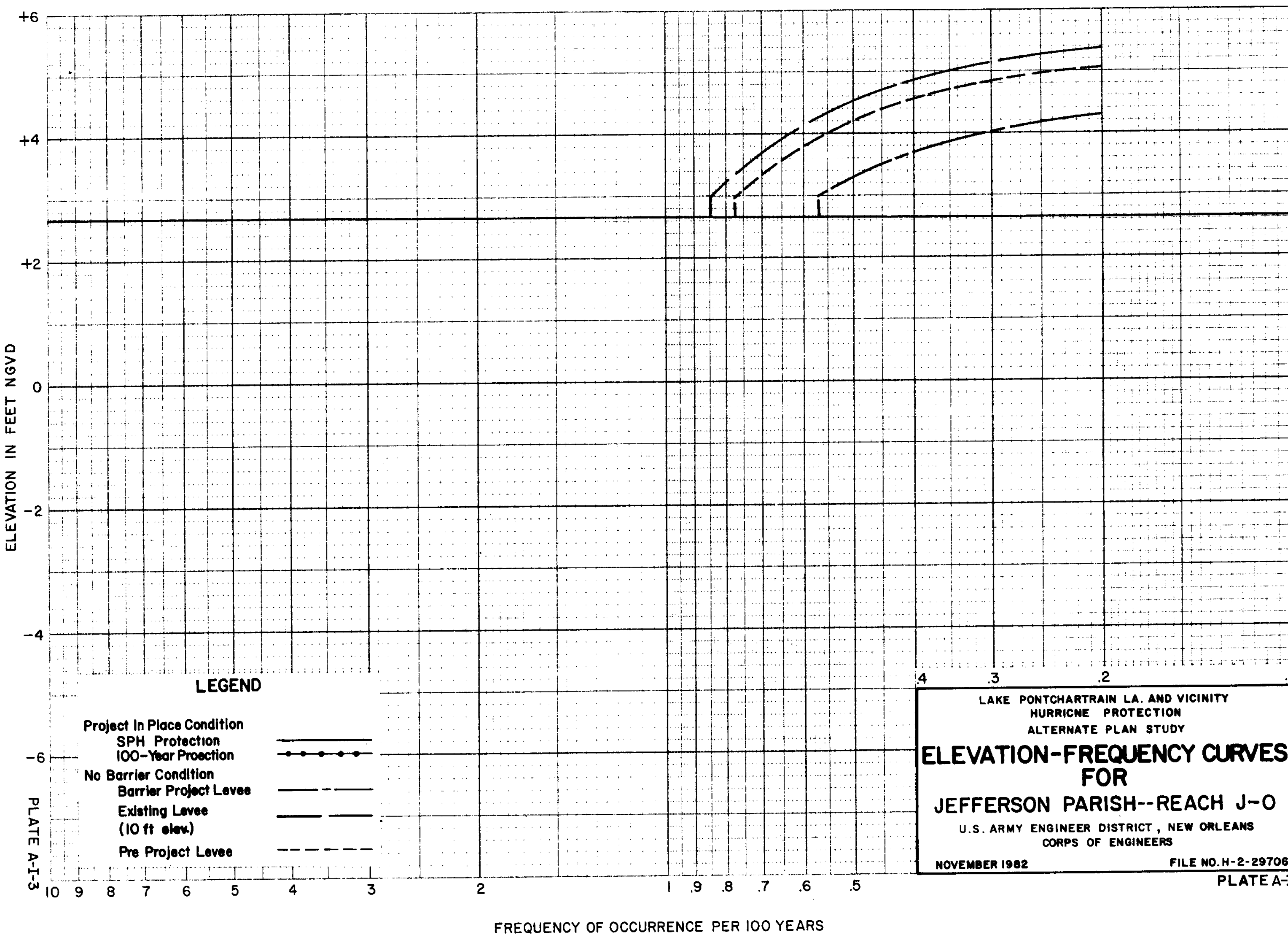

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR

JEFFERSON PARISH--REACH J-O

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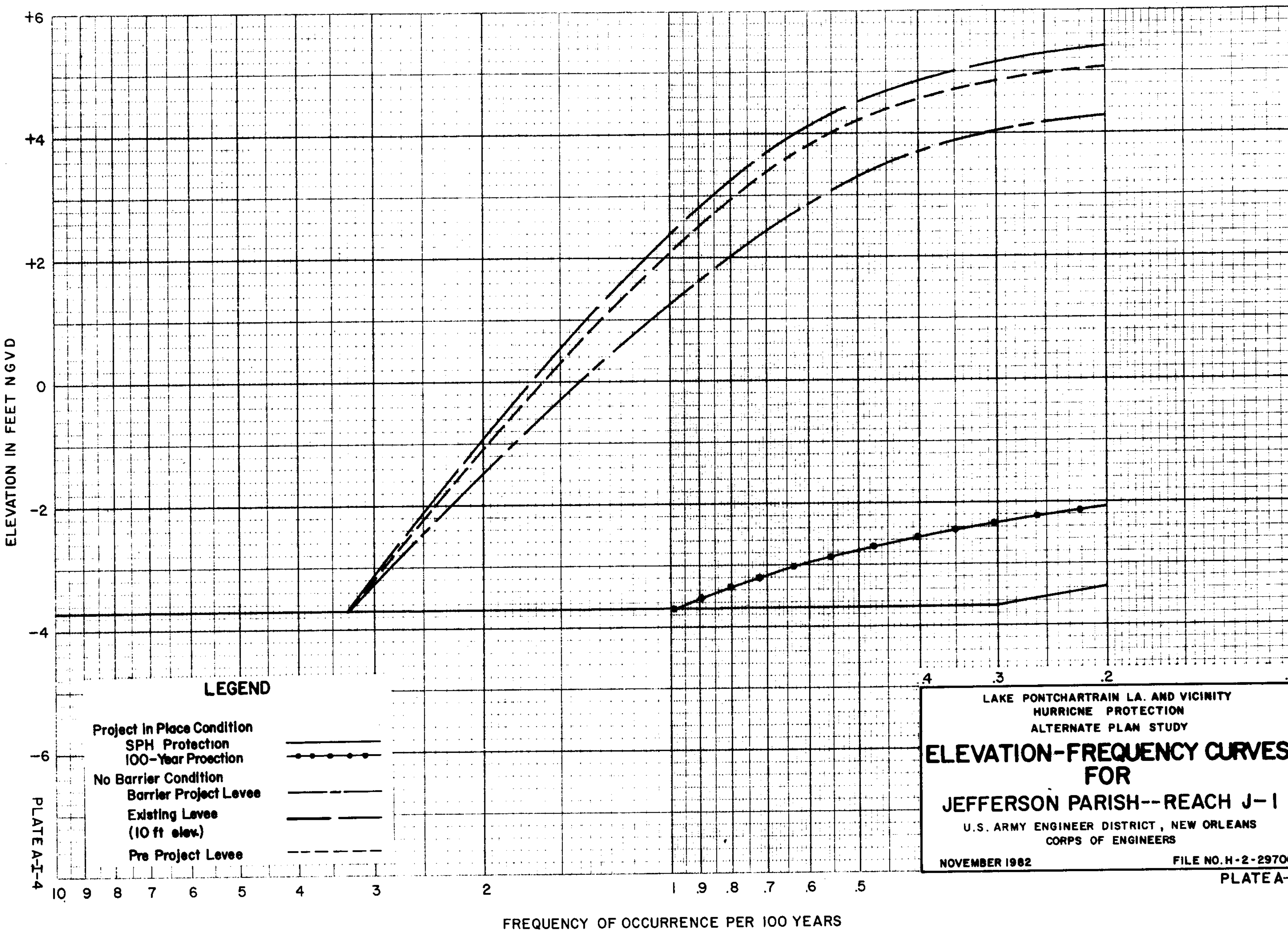
PLATE A-I-3



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR JEFFERSON PARISH--REACH J-1

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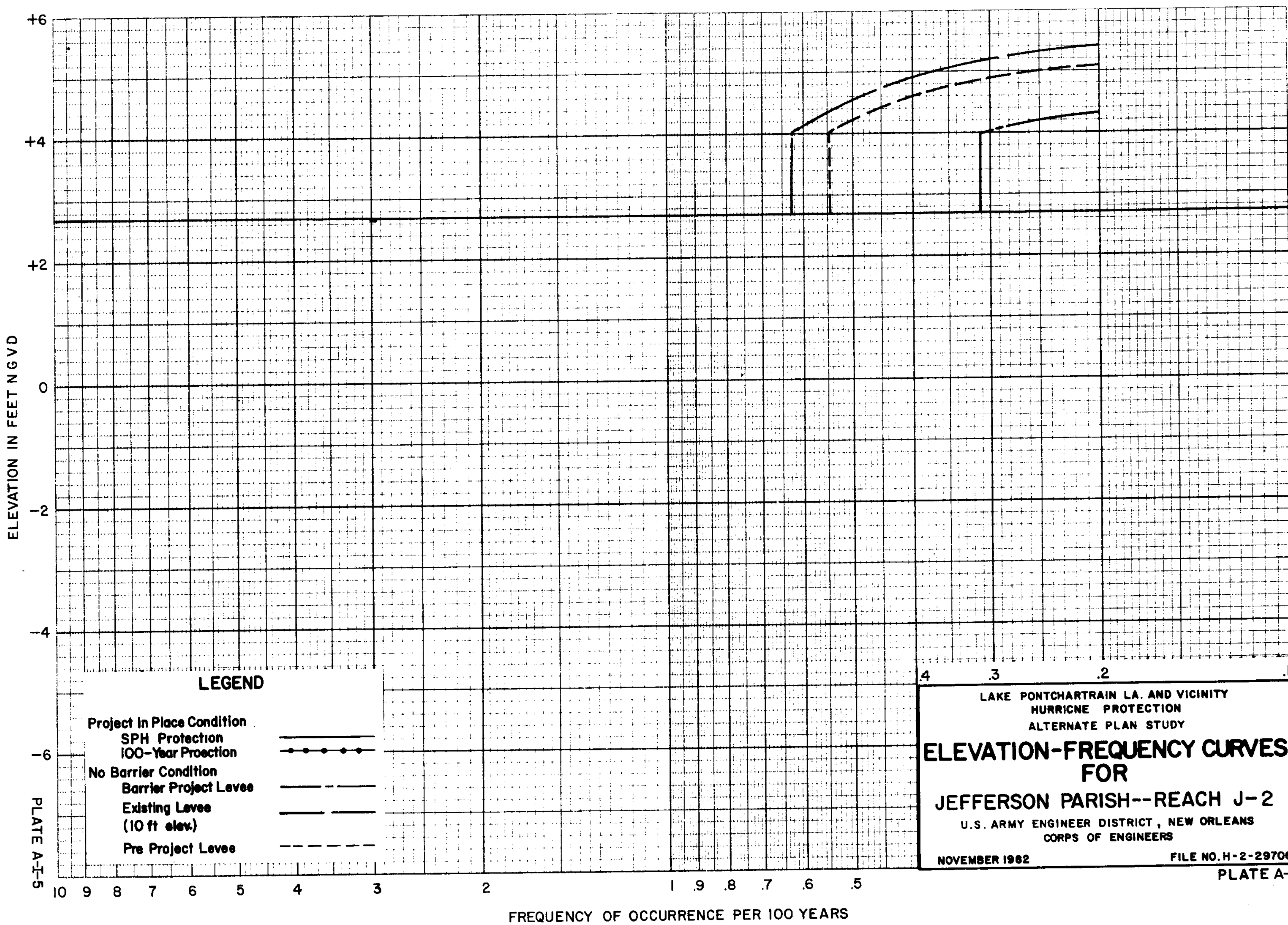

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR

JEFFERSON PARISH--REACH J-2

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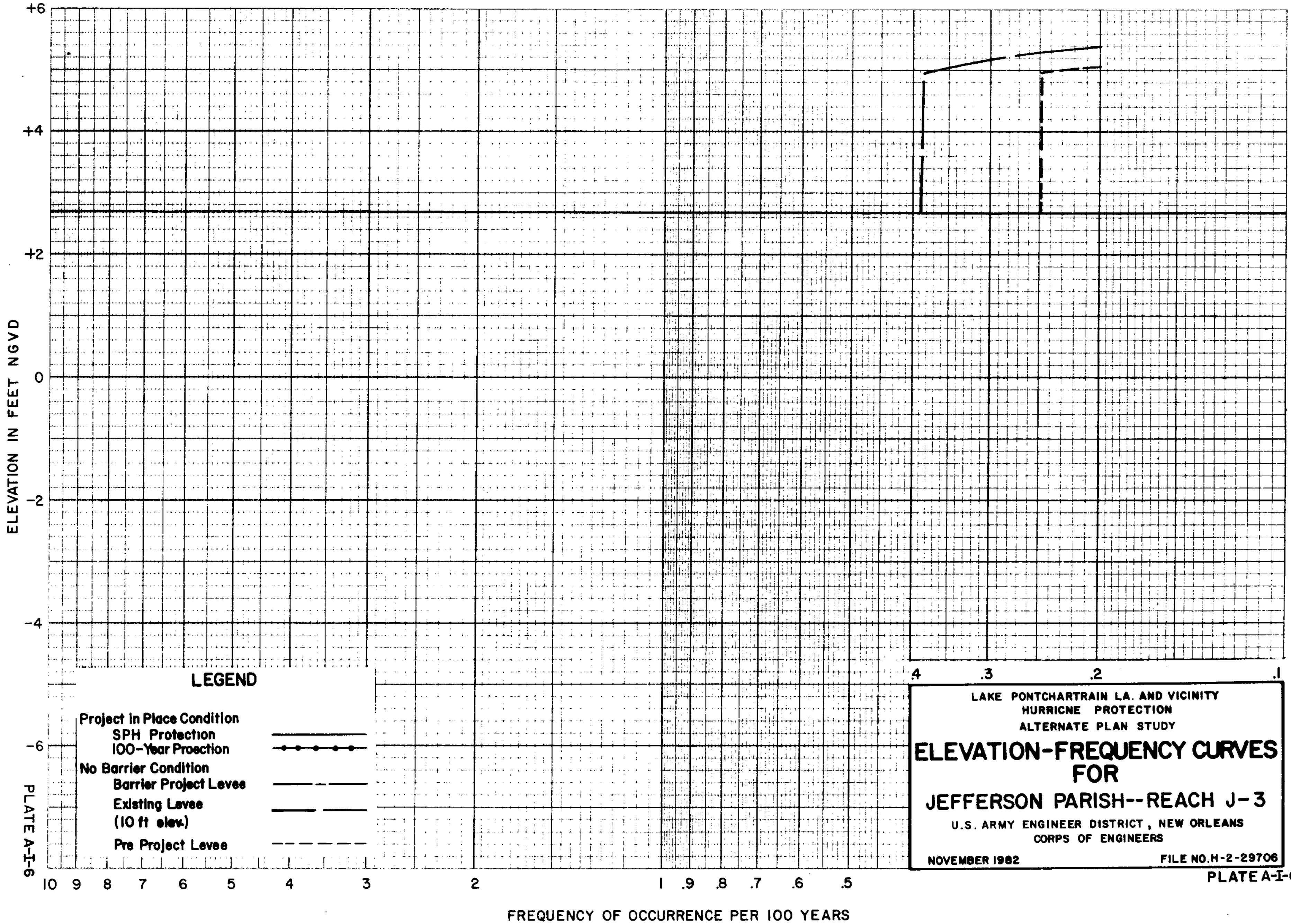
NOVEMBER 1962

FILE NO. H-2-29706

PLATE A-I-5



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR

JEFFERSON PARISH--REACH J-3

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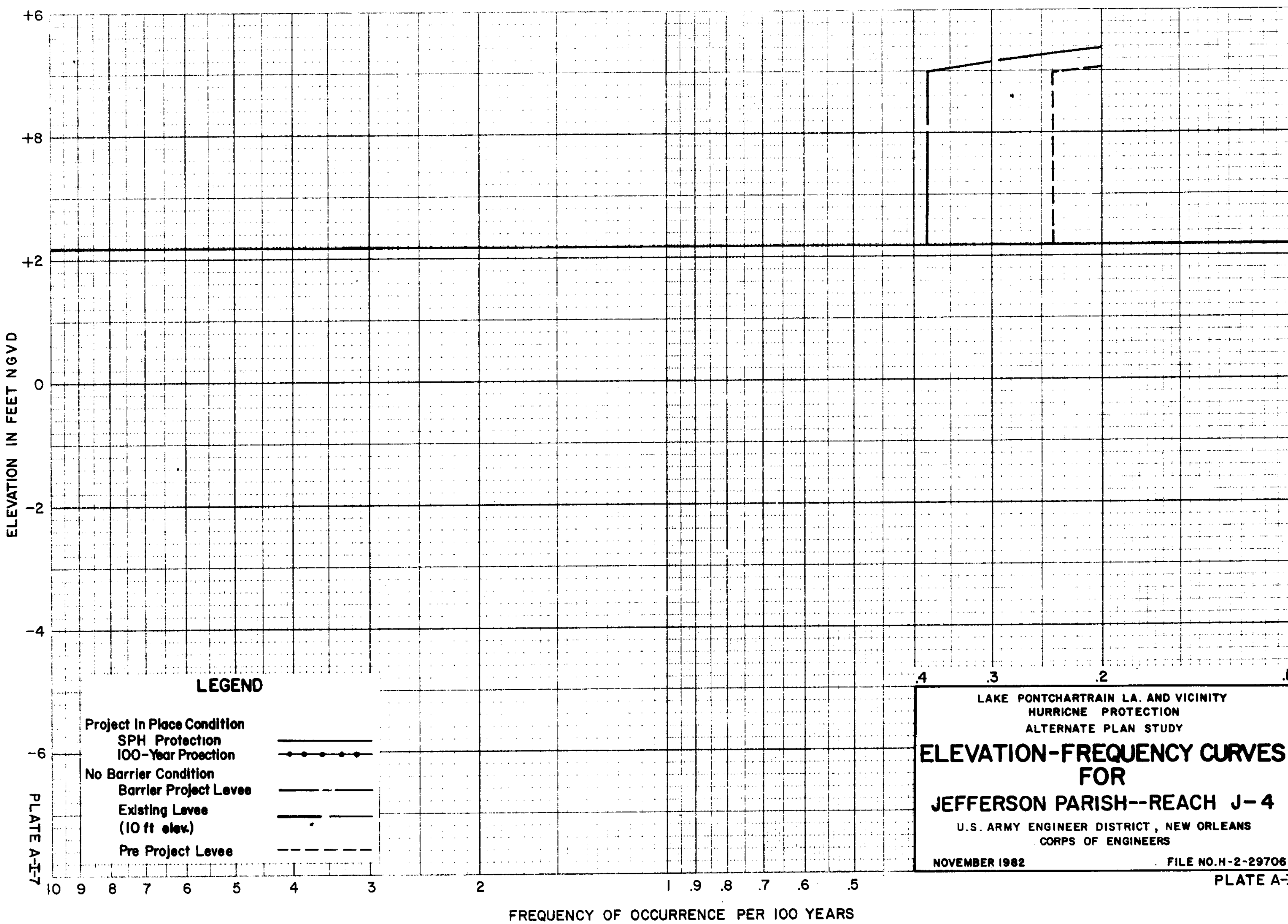
+6
+8
+2
0
-2
-4
-6
ELEVATION IN FEET NGVD
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2 .1
FREQUENCY OF OCCURRENCE PER 100 YEARS
LEGEND
Project In Place Condition
SPH Protection
100-Year Proection
No Barrier Condition
Barrier Project Levee
Existing Levee
(10 ft elev.)
Pre Project Levee
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY
ELEVATION-FREQUENCY CURVES
FOR
JEFFERSON PARISH--REACH J-4
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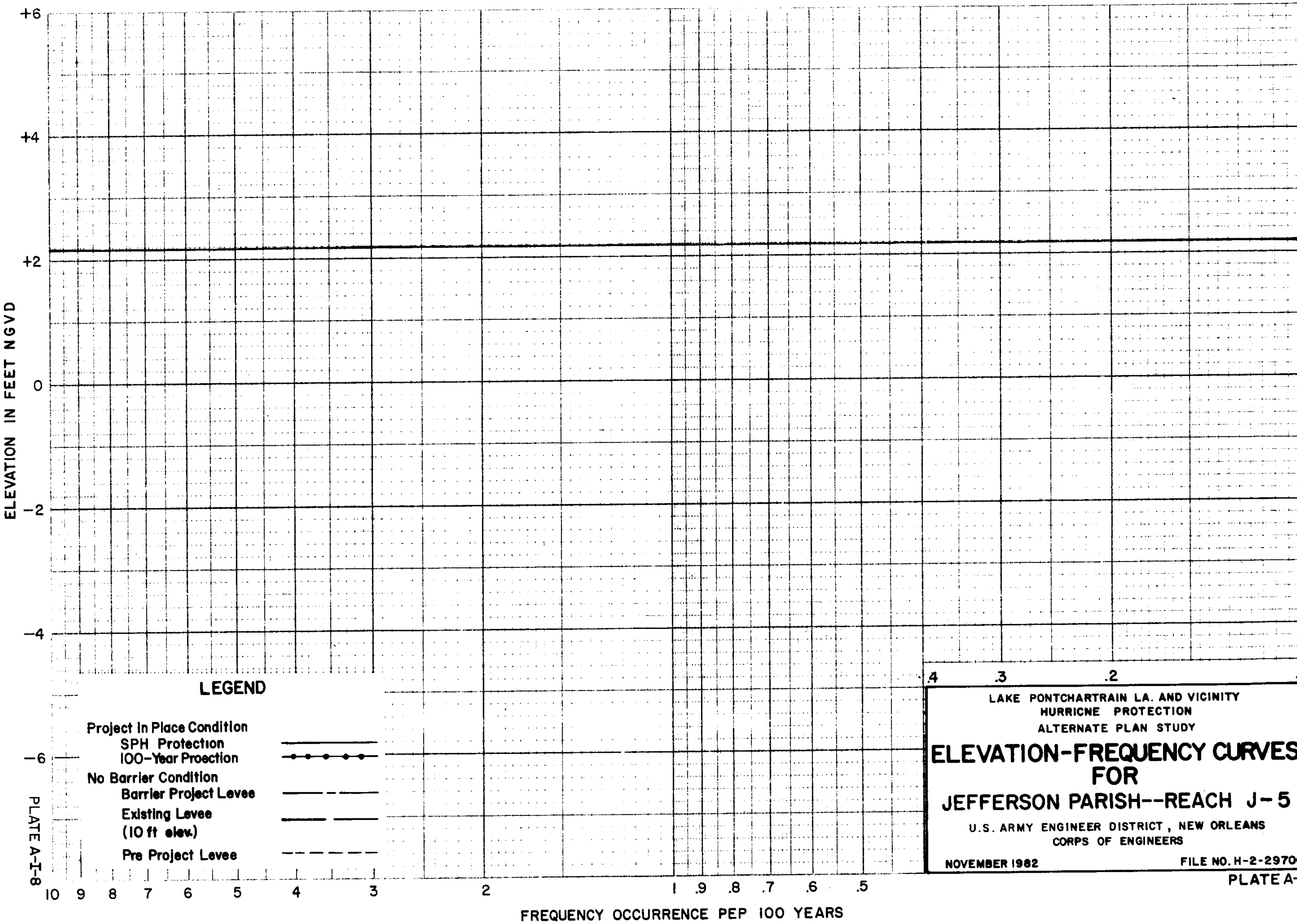
NOVEMBER 1982
FILE NO.H-2-29706
PLATE A-I-7



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR JEFFERSON PARISH--REACH J-5

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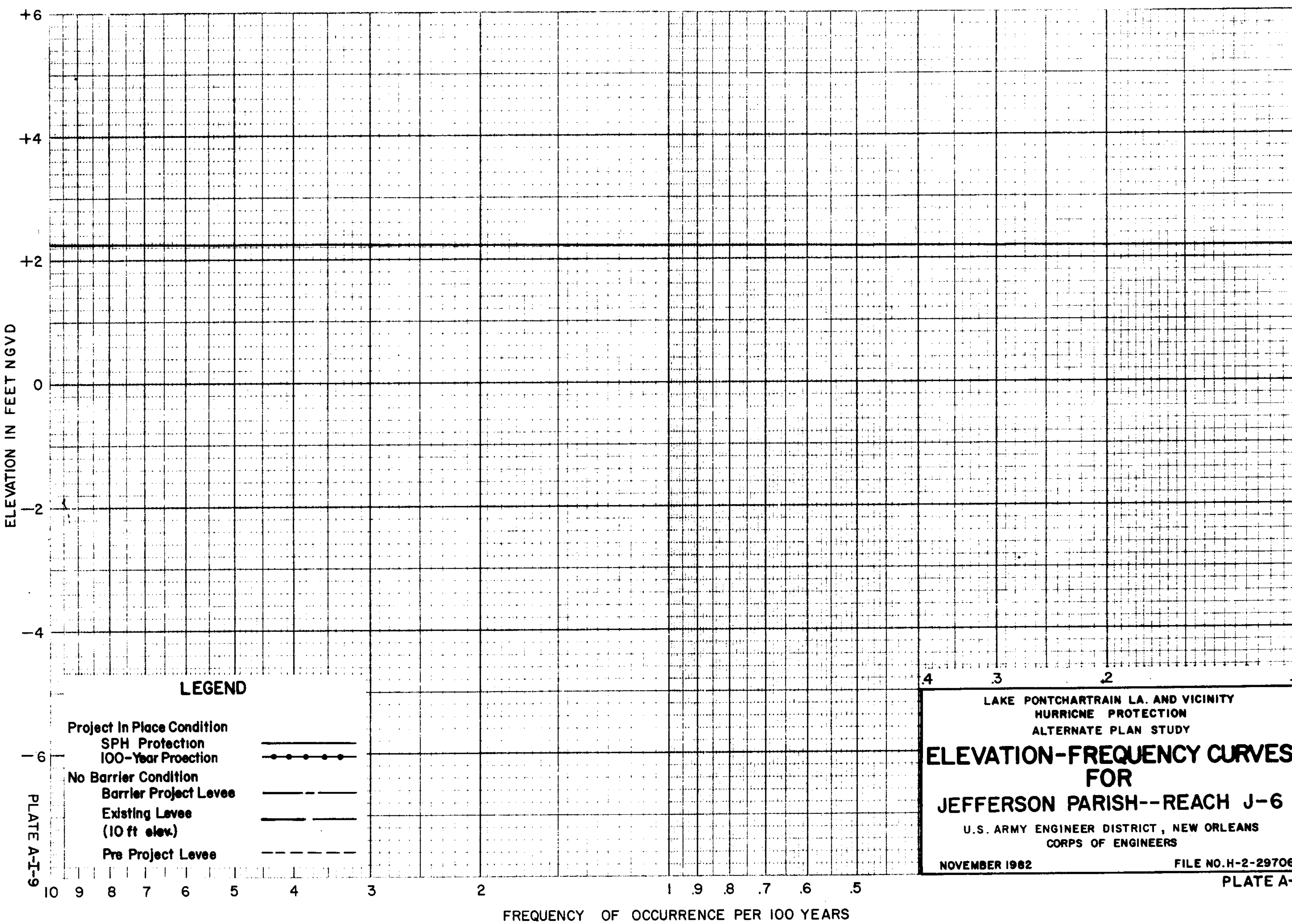
PLATE A-I-8



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR JEFFERSON PARISH--REACH J-6

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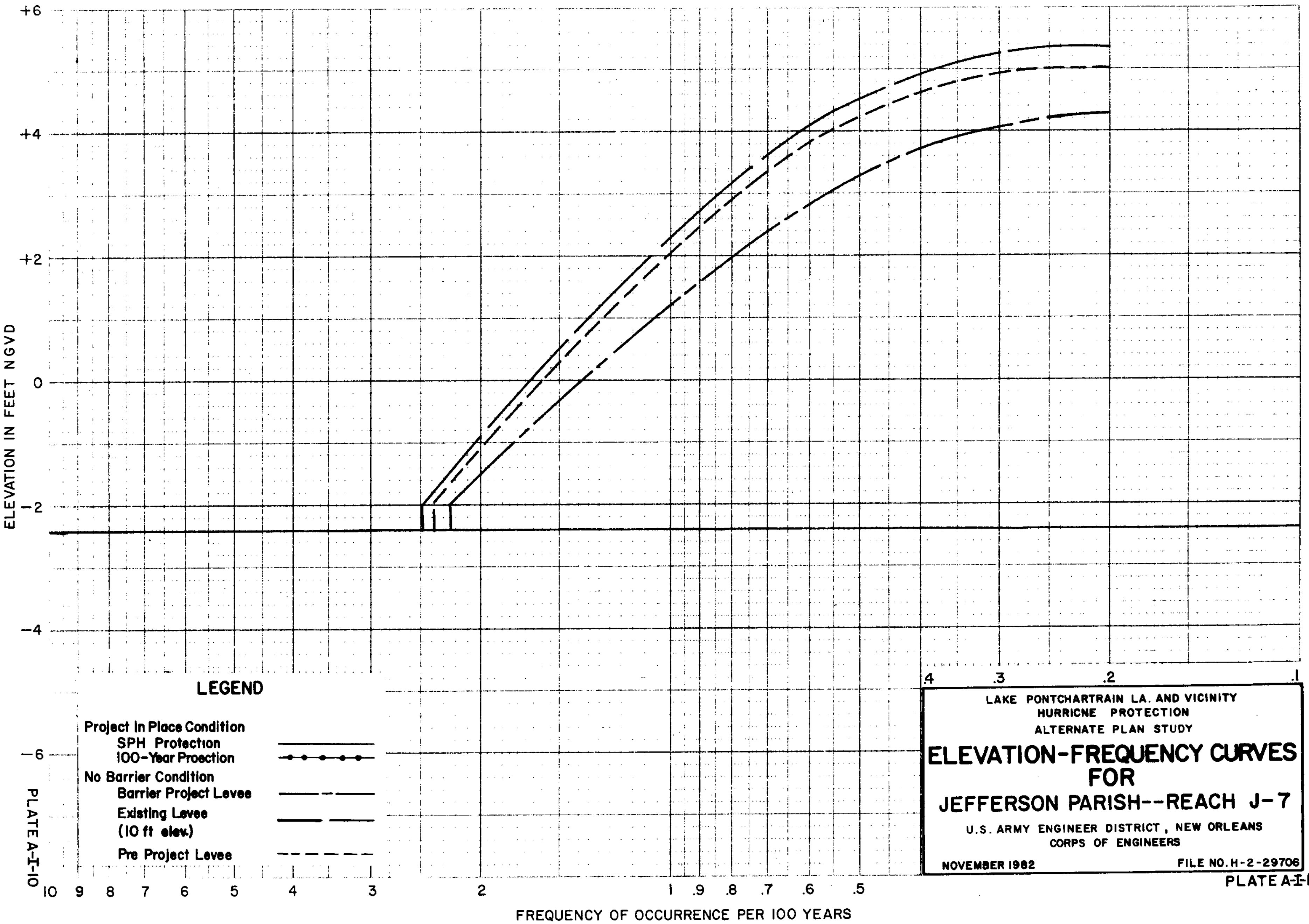
PLATE A-I-9



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR JEFFERSON PARISH--REACH J-7

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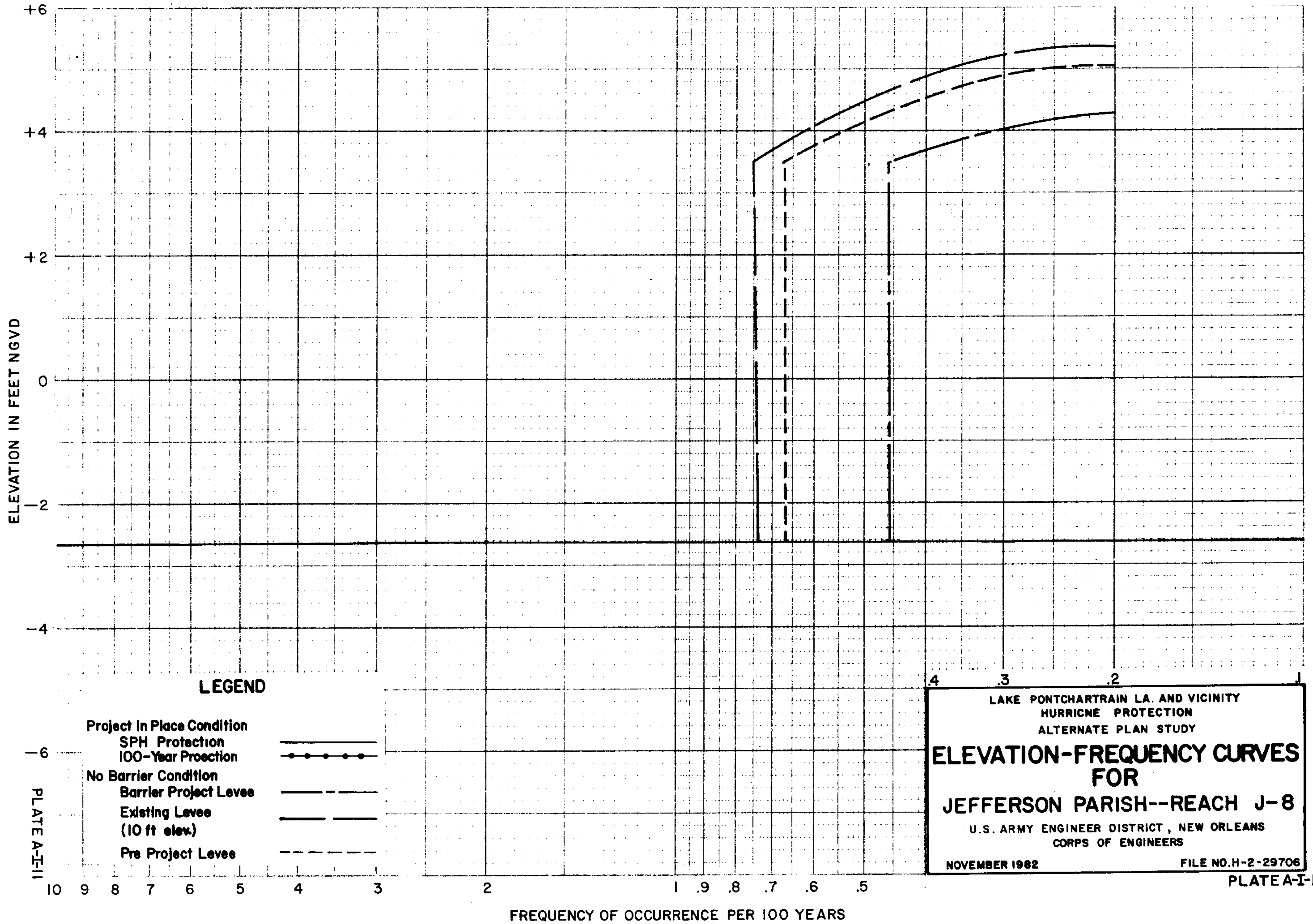

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR JEFFERSON PARISH--REACH J-8

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

NOVEMBER 1982

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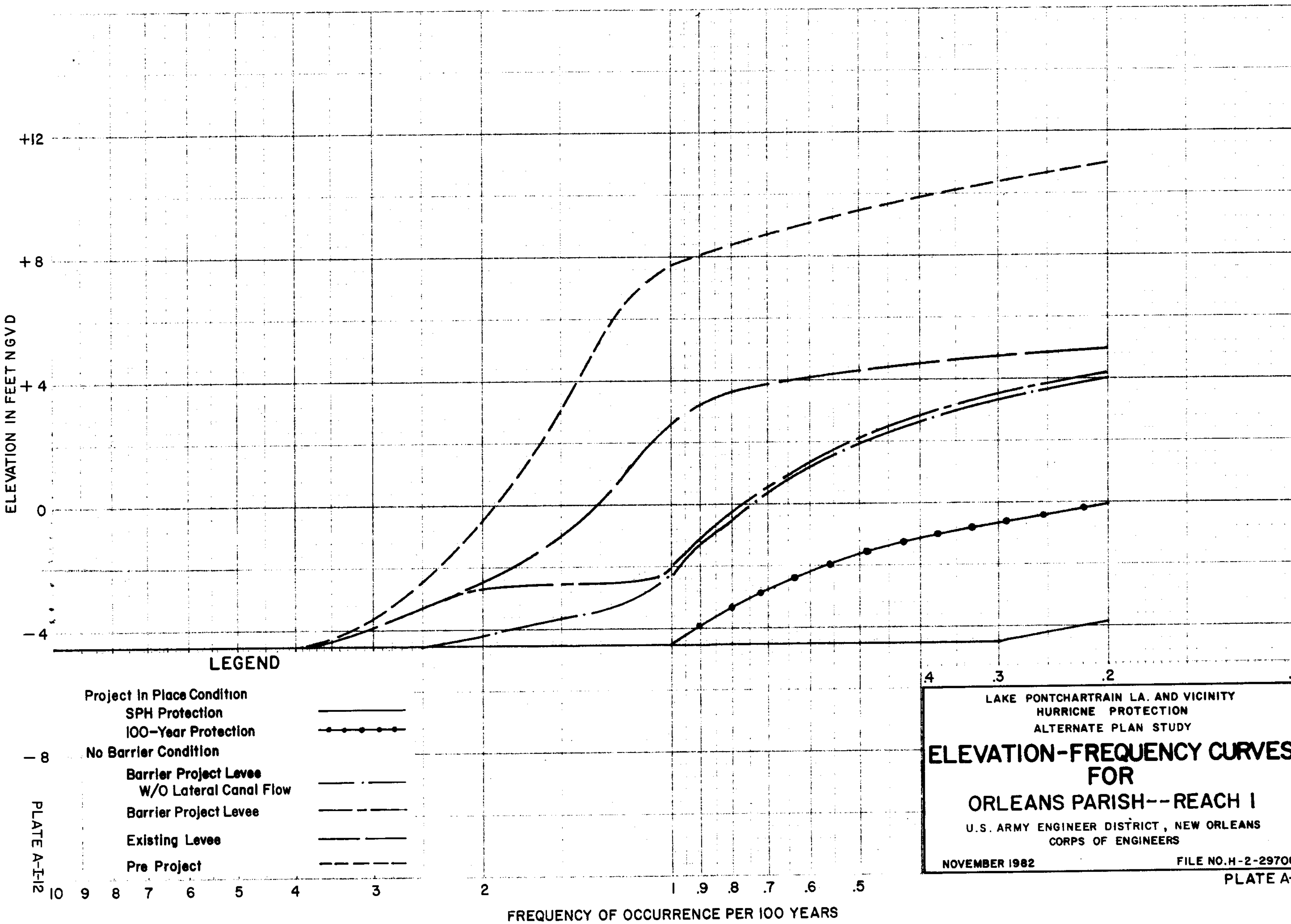

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH--REACH I

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CORPS OF ENGINEERS

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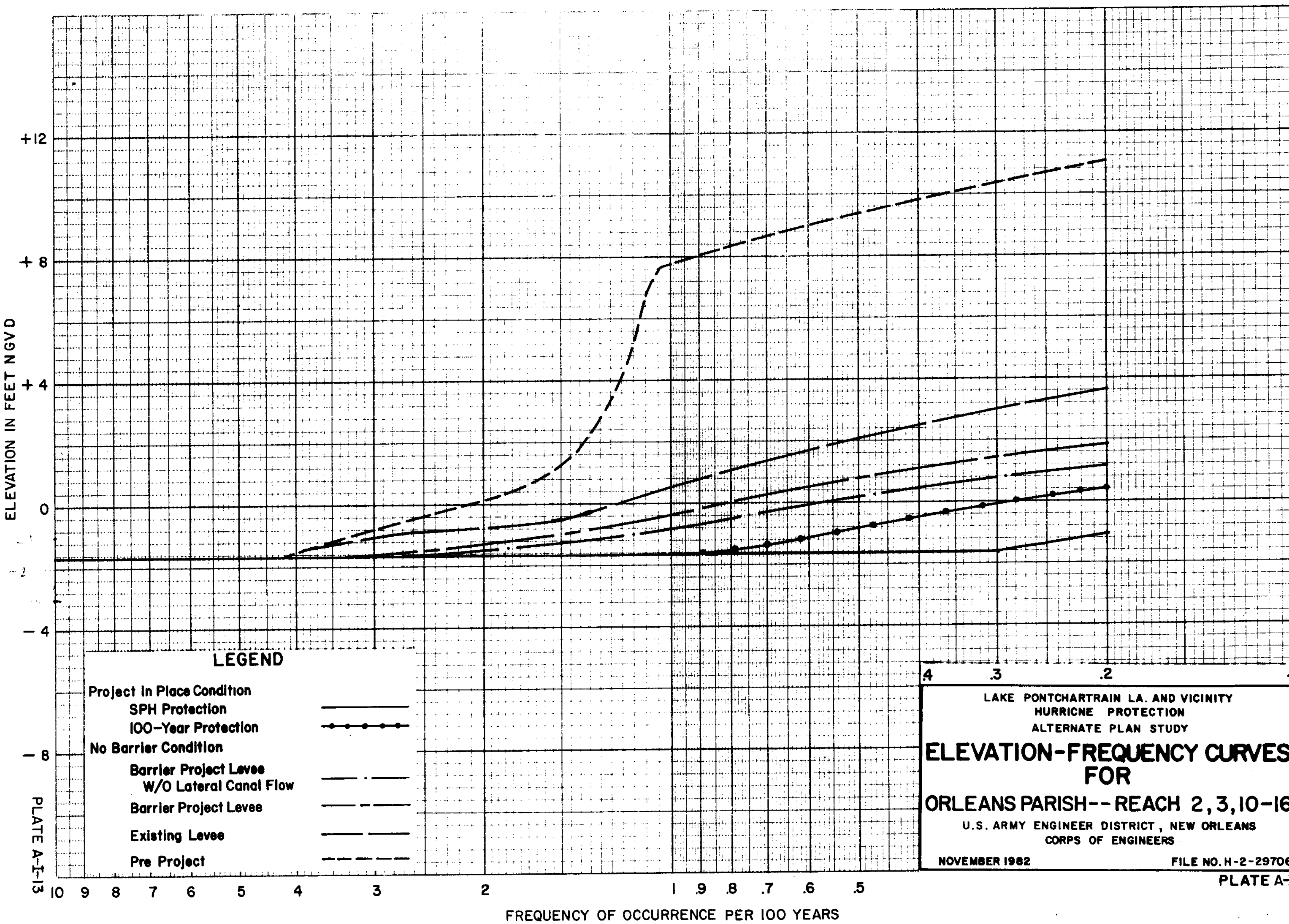
PLATE A-I-12



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH--REACH 2,3,10-16

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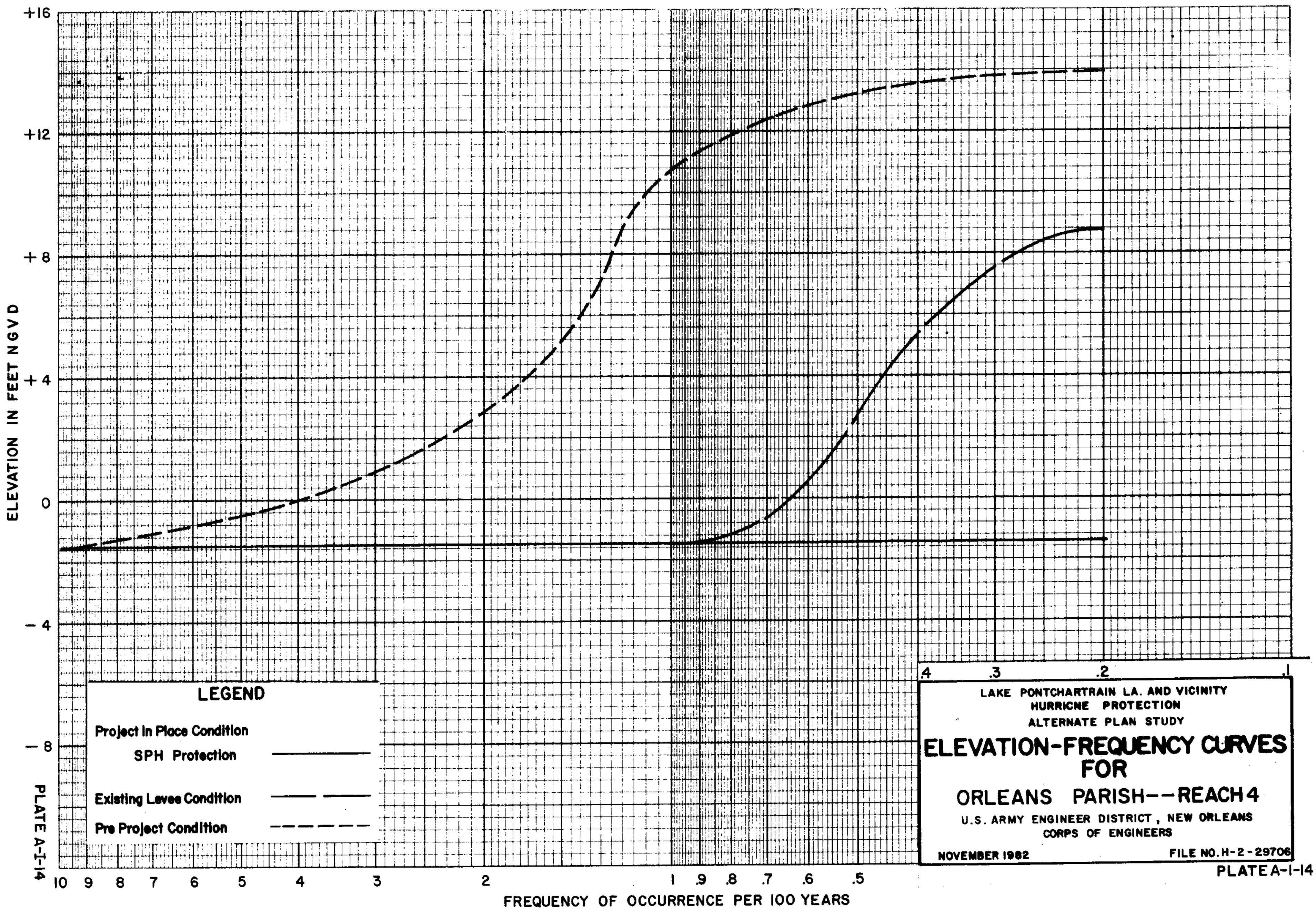
PLATE A-I-13



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH--REACH 4

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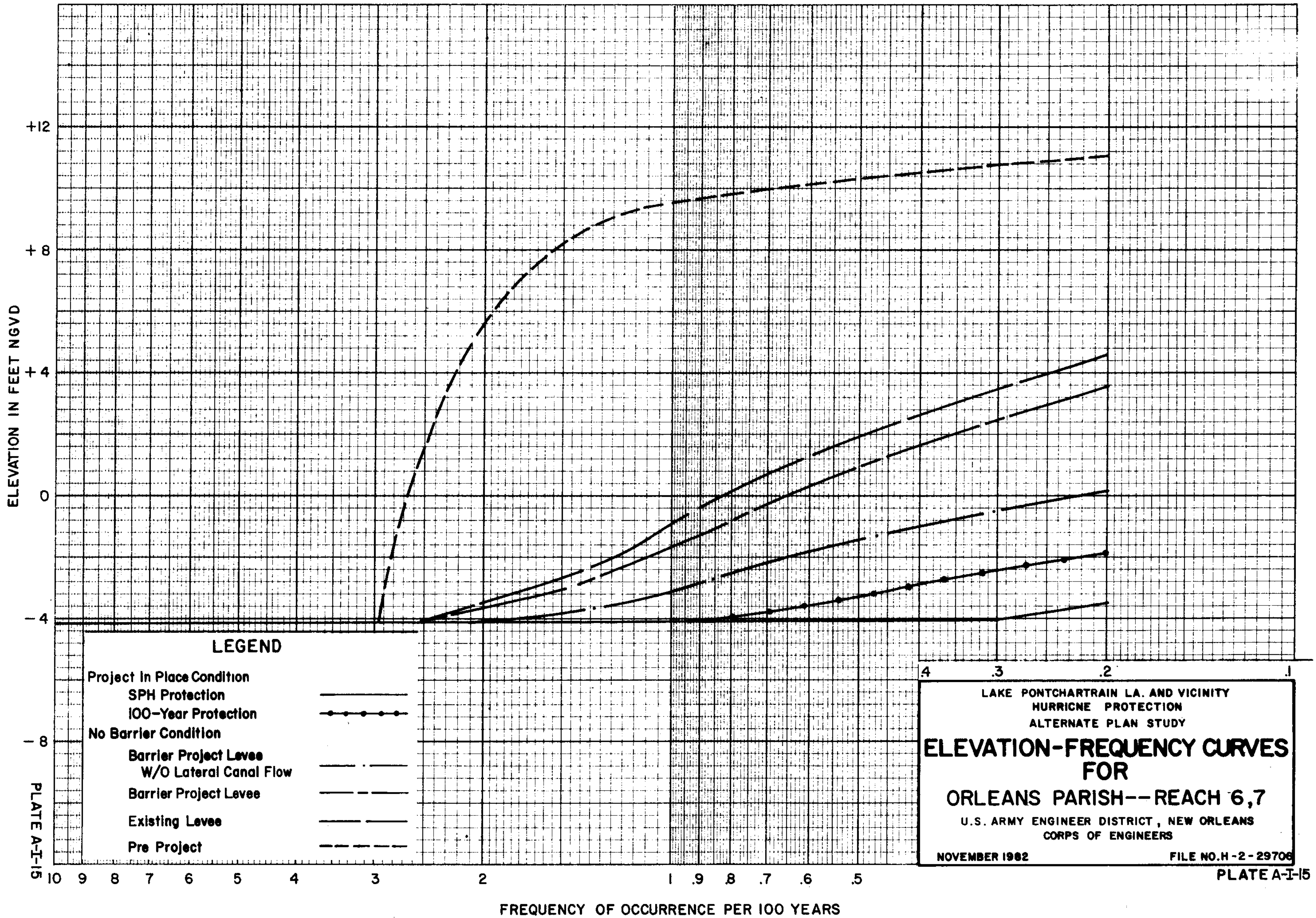
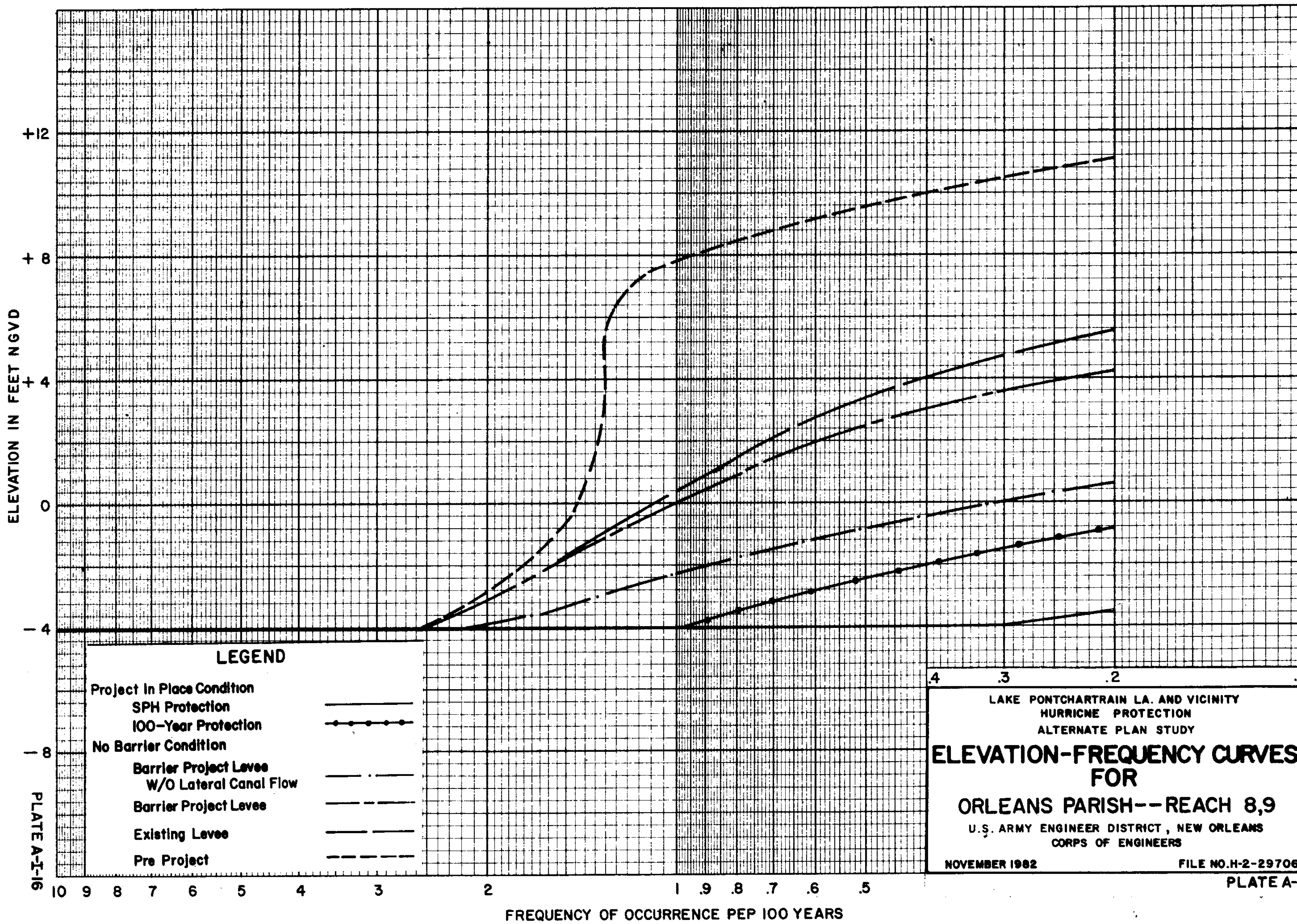
CORPS OF ENGINEERS

NOVEMBER 1982 FILE NO. H-2-29706



+12
+8
+4
0
-4
-8
ELEVATION IN FEET NGVD
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2 .1
FREQUENCY OF OCCURRENCE PER 100 YEARS
LEGEND
Project In Place Condition
SPH Protection
100-Year Protection
No Barrier Condition
Barrier Project Levee W/O Lateral Canal Flow
Barrier Project Levee
Existing Levee
Pre Project
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY
ELEVATION-FREQUENCY CURVES FOR
ORLEANS PARISH--REACH 6,7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NOVEMBER 1982
FILE NO. H-2-29706

PLATE A-I-15

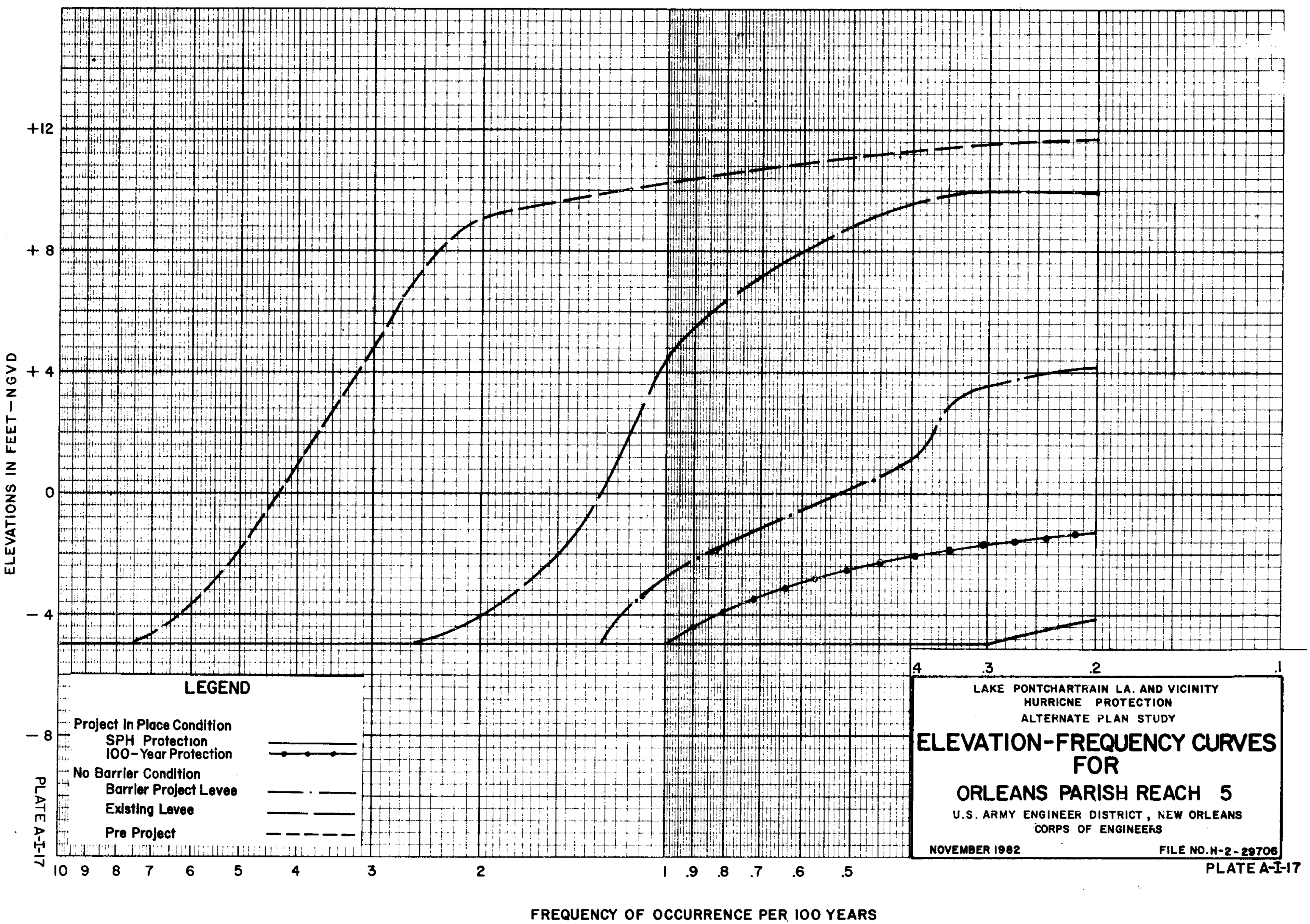


LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH--REACH 8,9

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

NOVEMBER 1982 FILE NO.H-2-29706



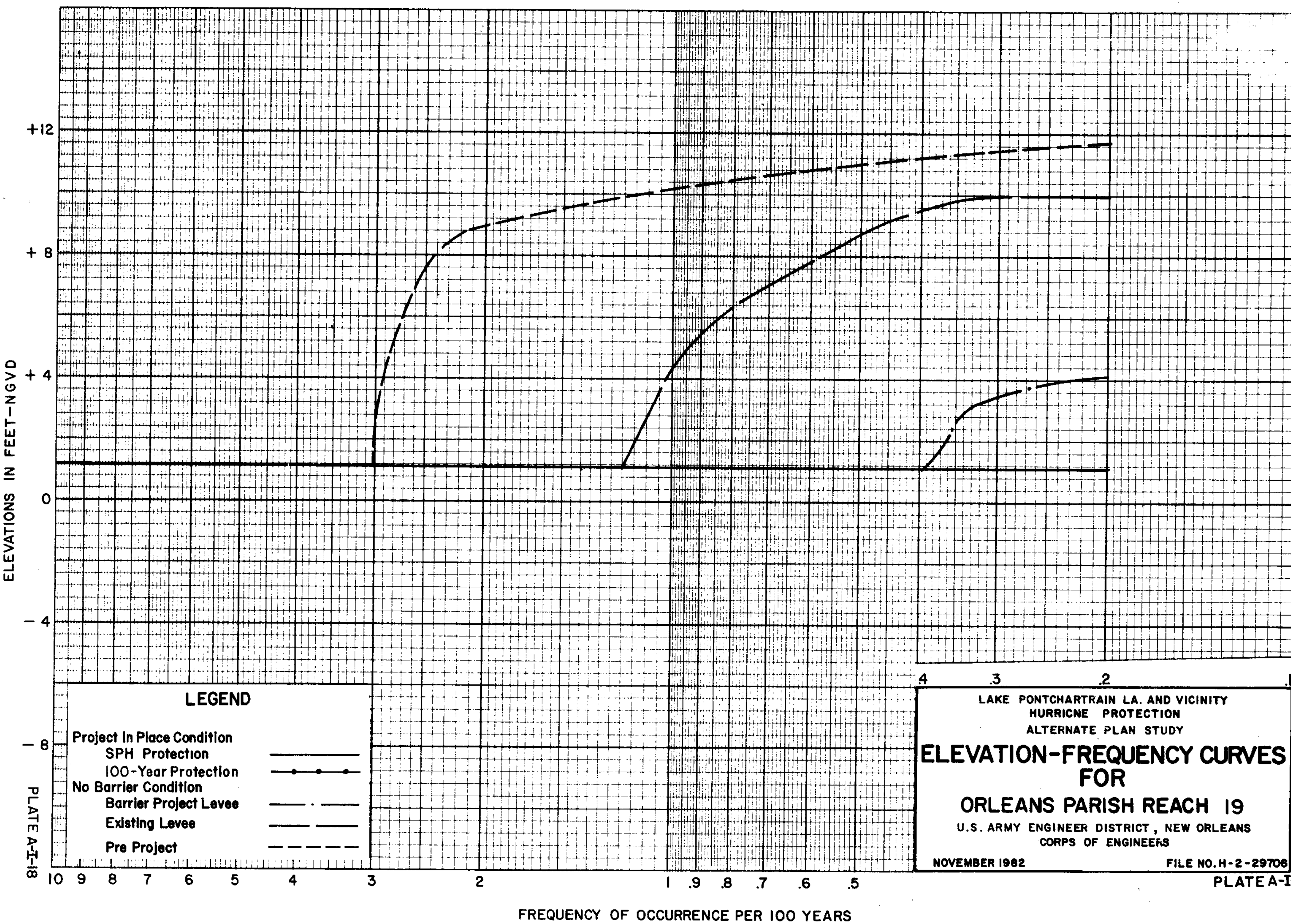
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 5

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

NOVEMBER 1982

FILE NO. H-2-29706

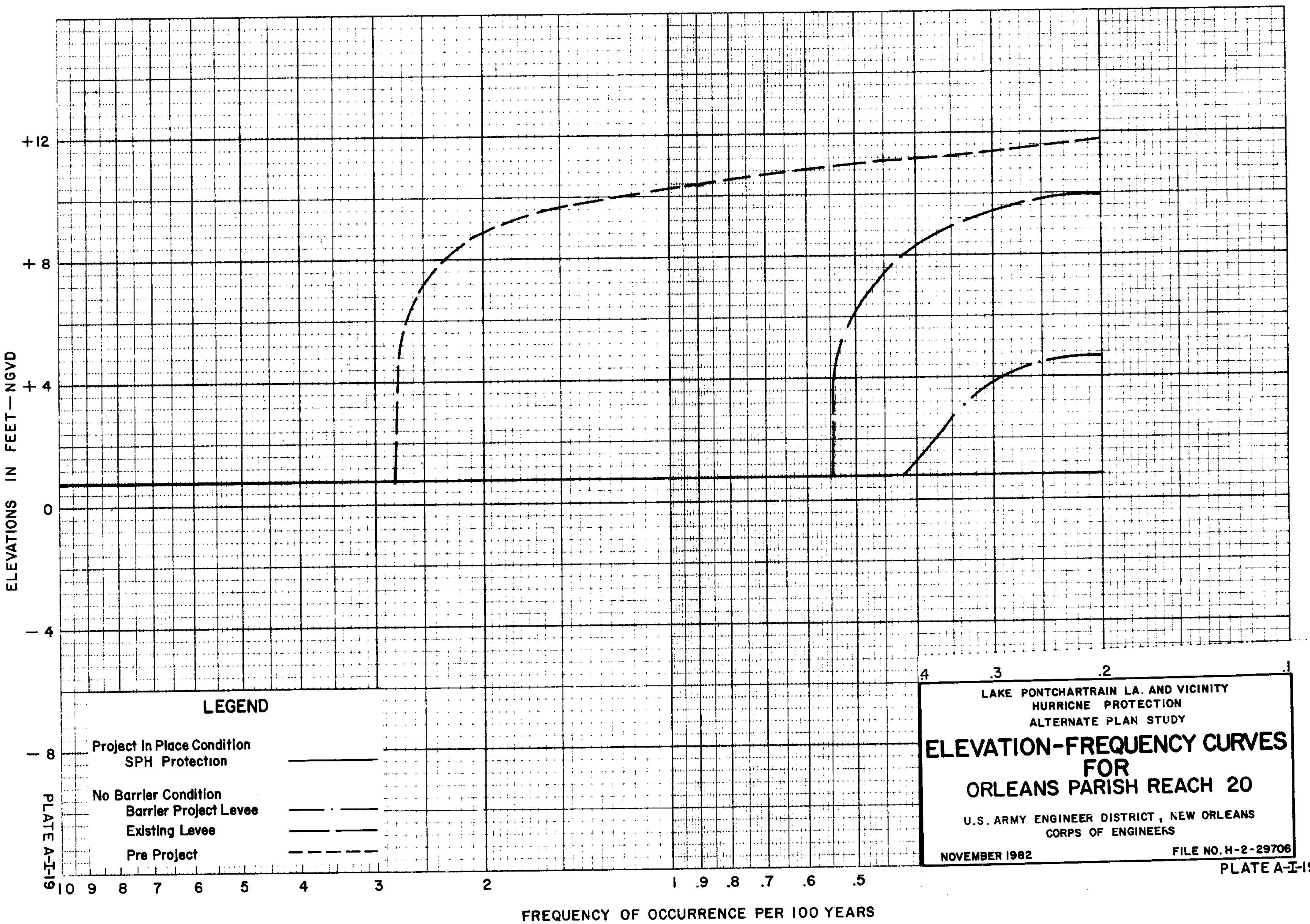


LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 19

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

NOVEMBER 1982 FILE NO. H-2-29706



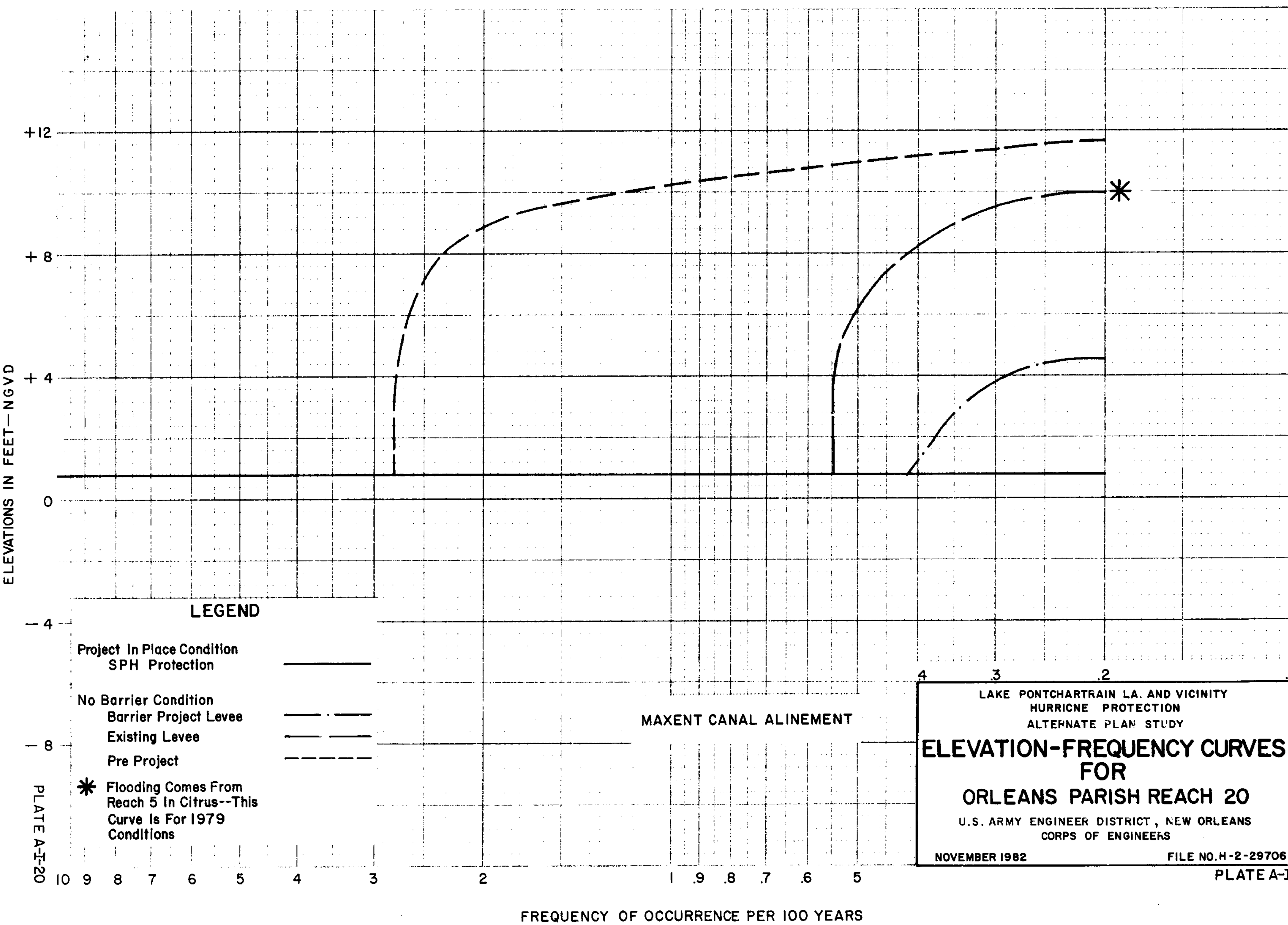
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 20

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

NOVEMBER 1982

FILE NO. H-2-29706



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

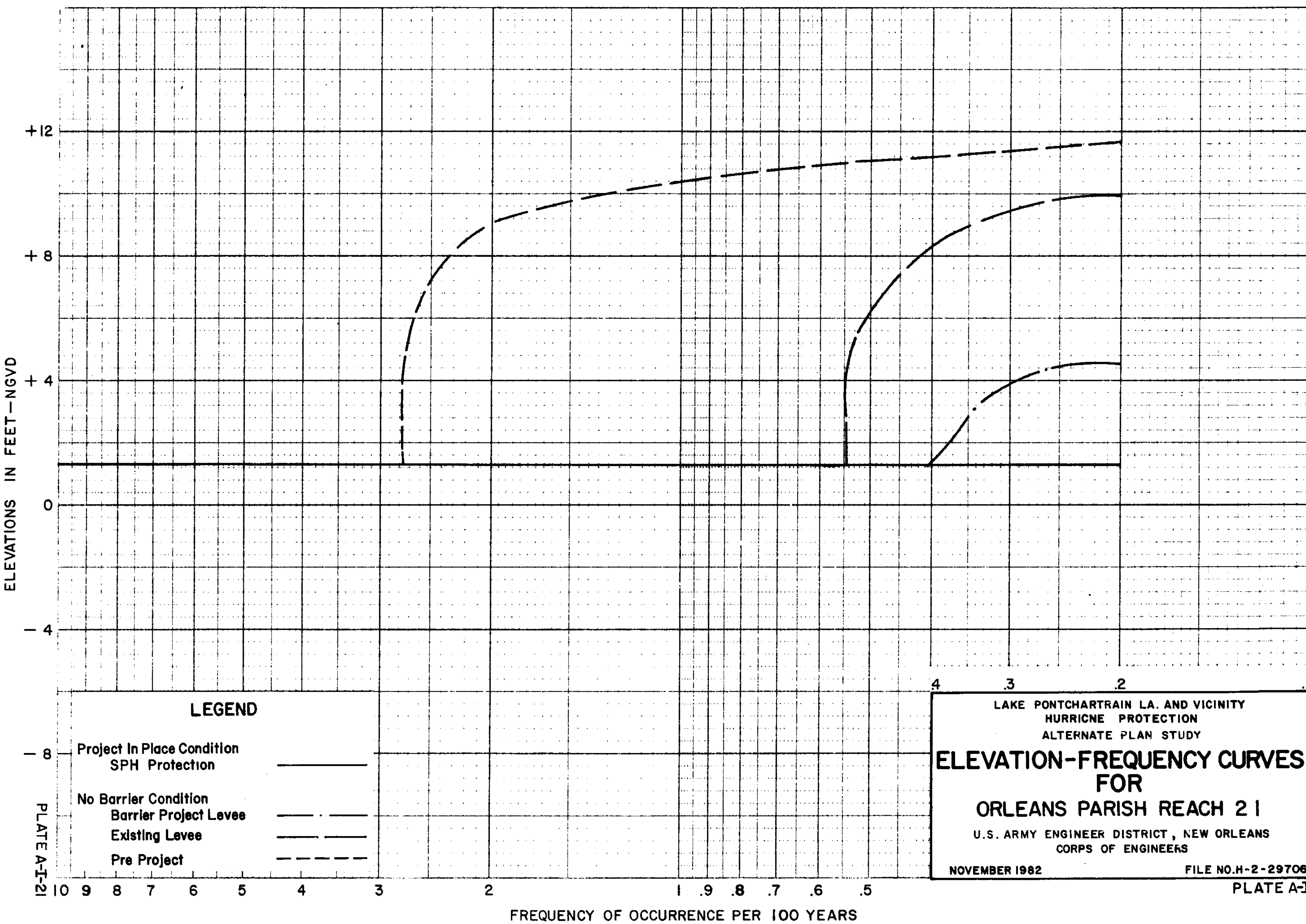
ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 20

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

NOVEMBER 1982 FILE NO. H-2-29706

PLATE A-I-20

PLATE A-I-20



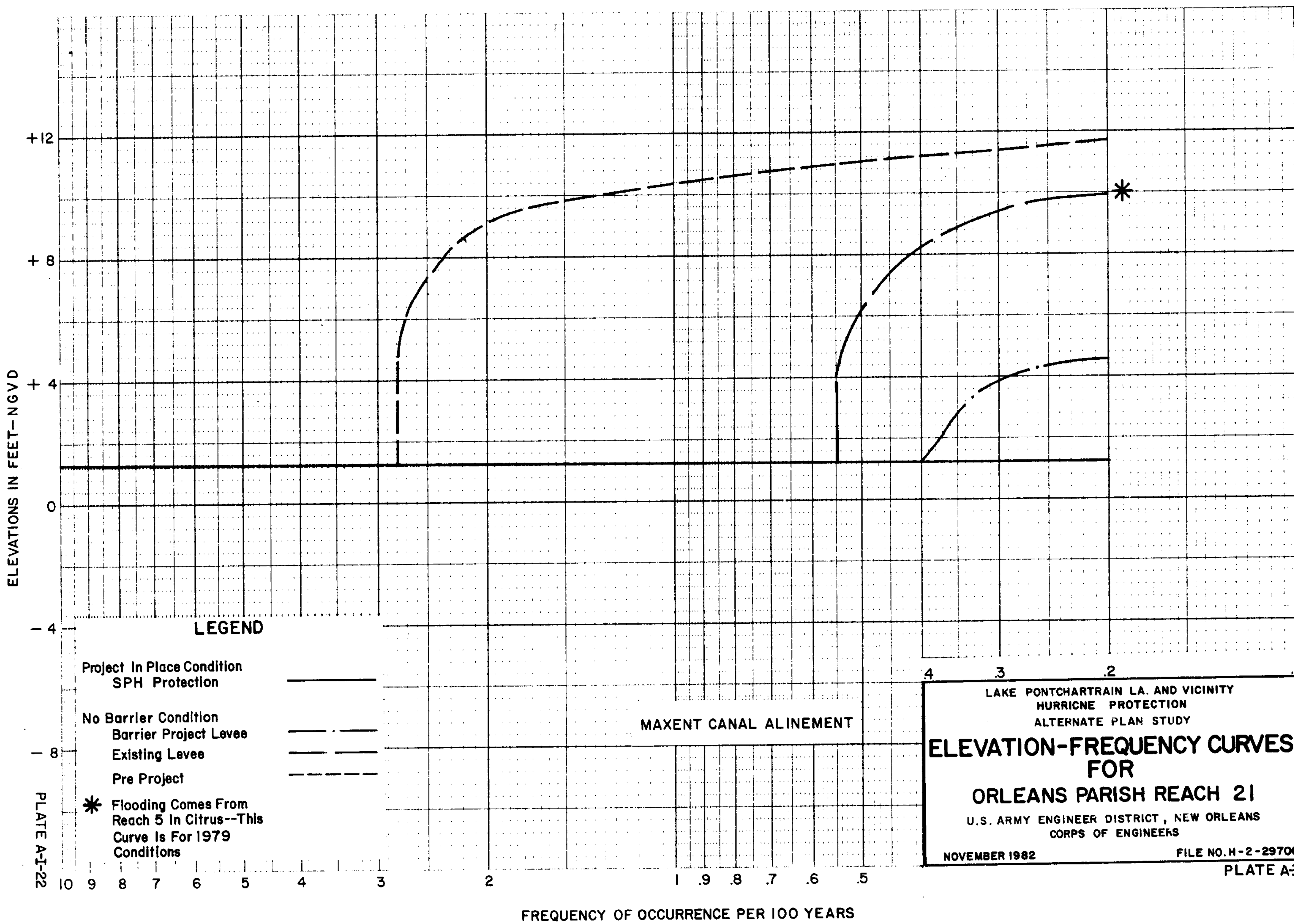
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 21

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

NOVEMBER 1982 FILE NO. H-2-29706

PLATE A-I-21



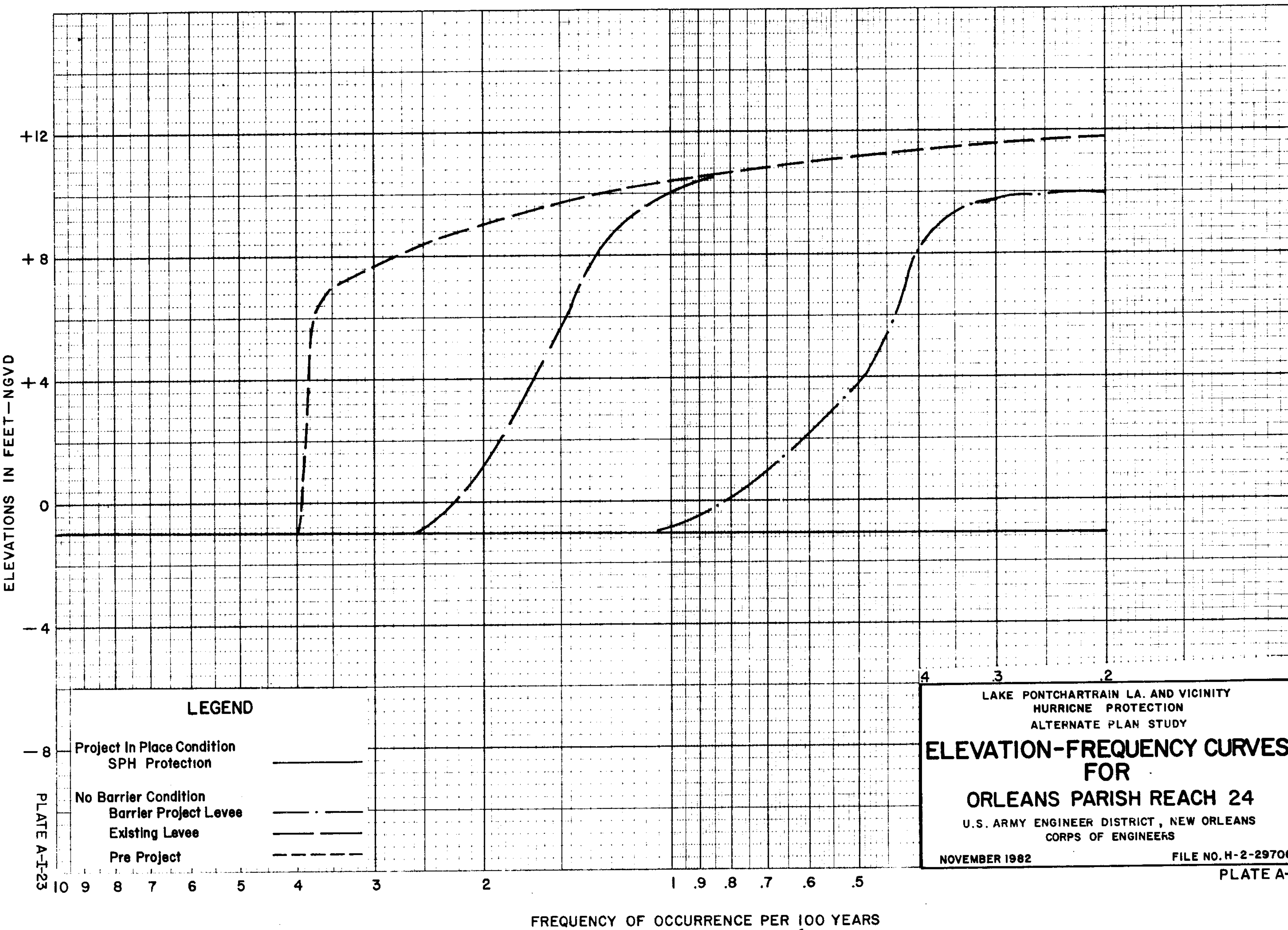
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 21

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

NOVEMBER 1982 FILE NO. H-2-29706

PLATE A-I-22



LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

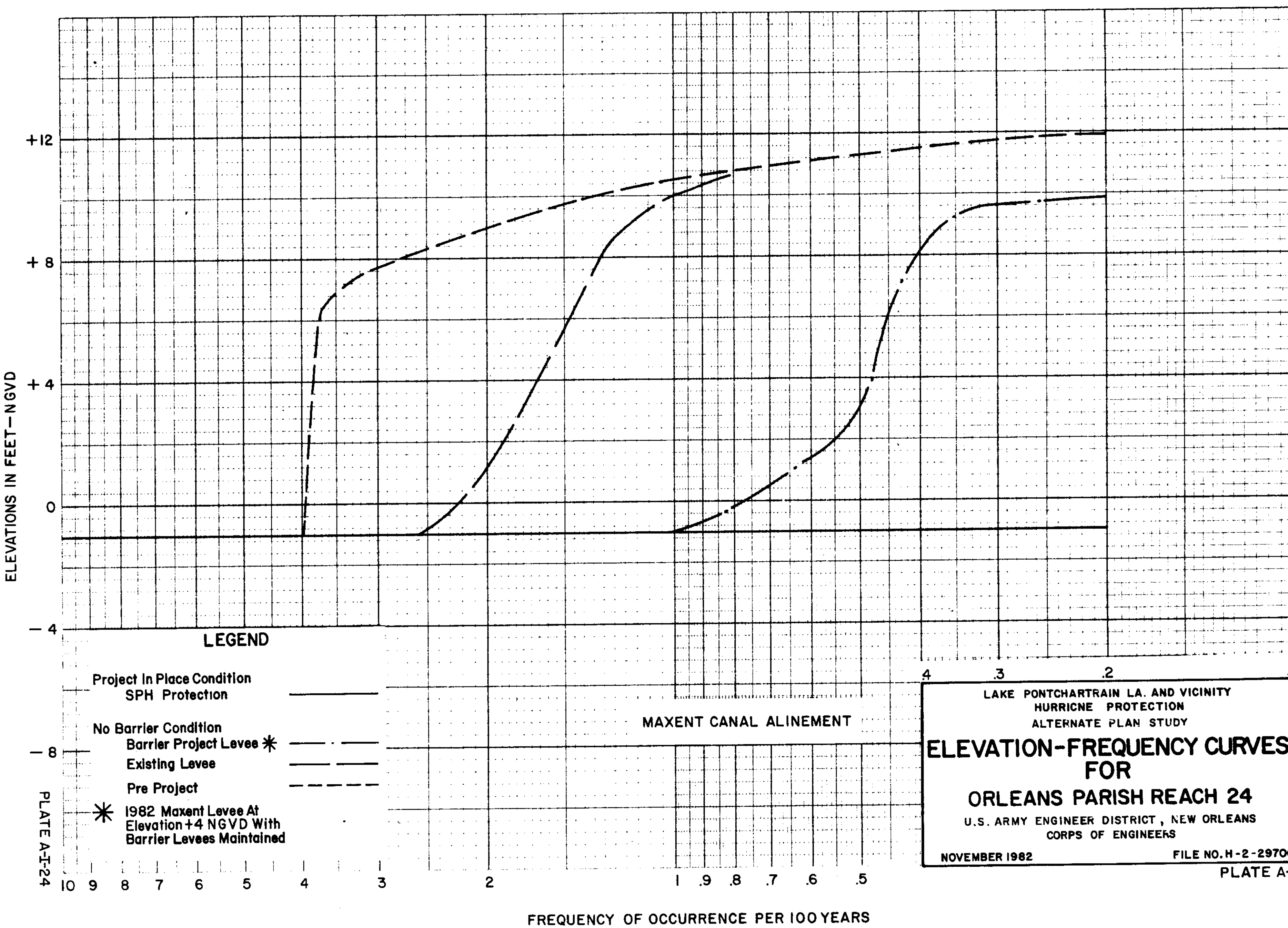
ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 24

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

NOVEMBER 1982 FILE NO. H-2-29706

PLATE A-I-23

PLATE A-I-23

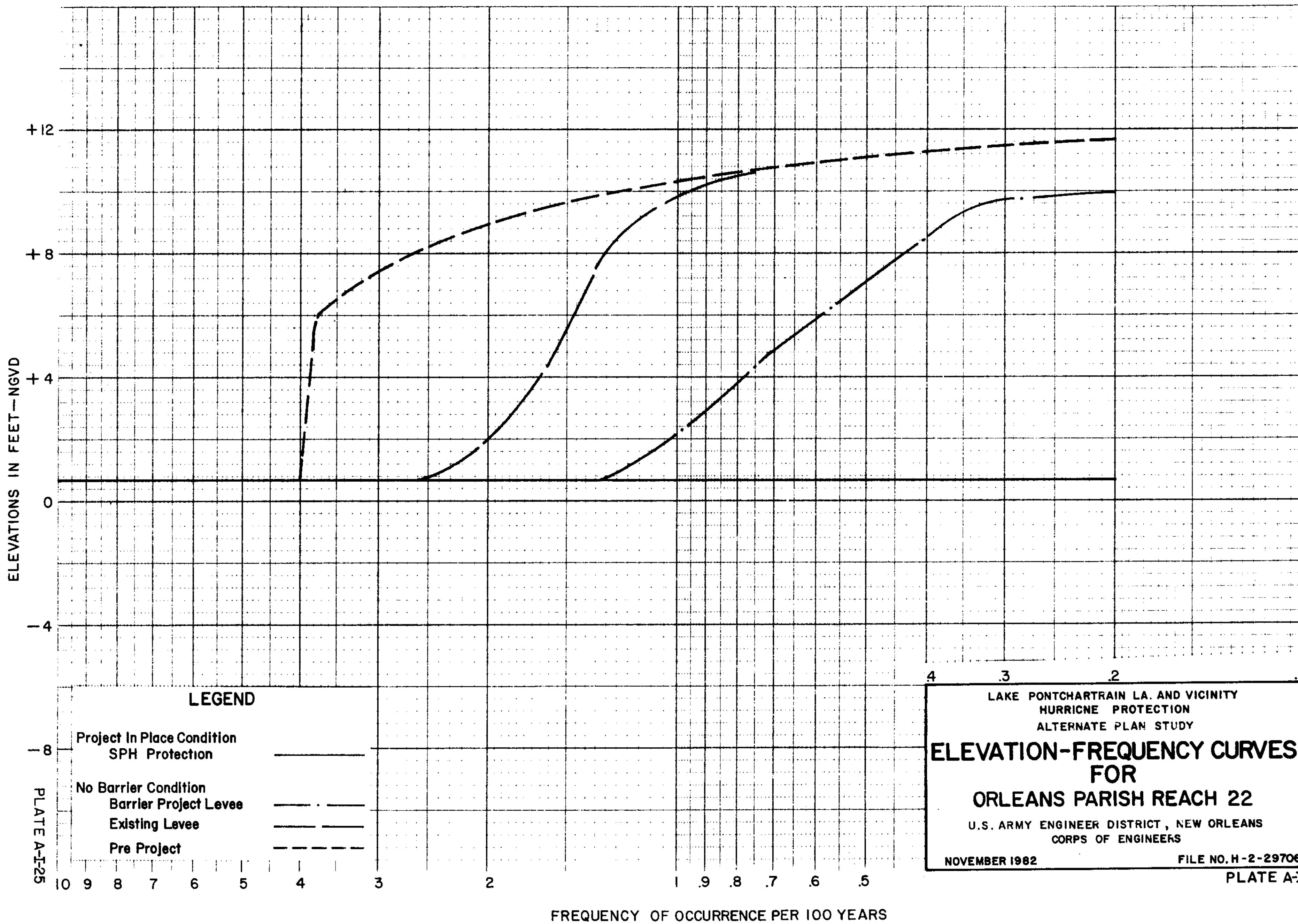


LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 24

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

NOVEMBER 1982 FILE NO. H-2-29706

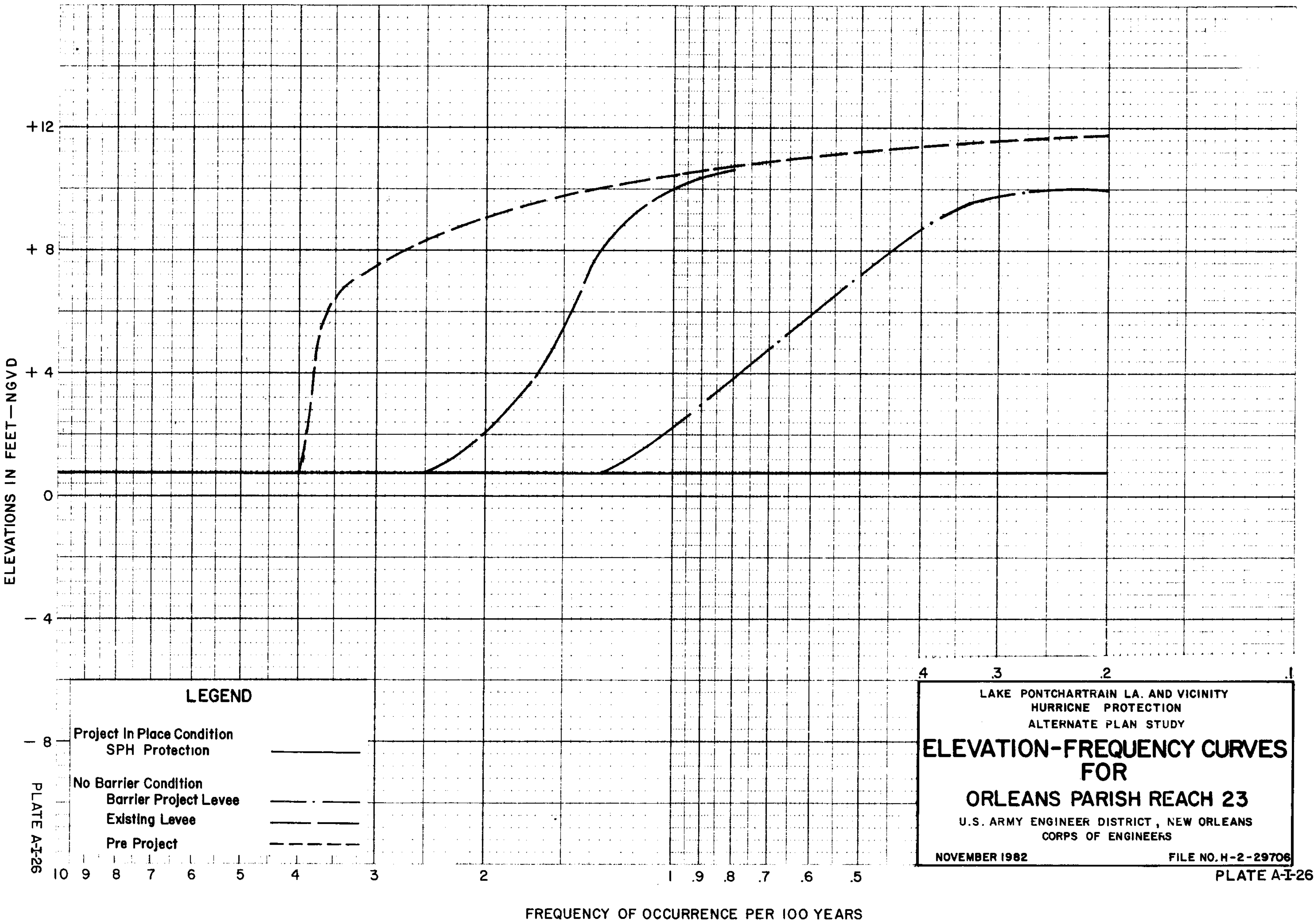


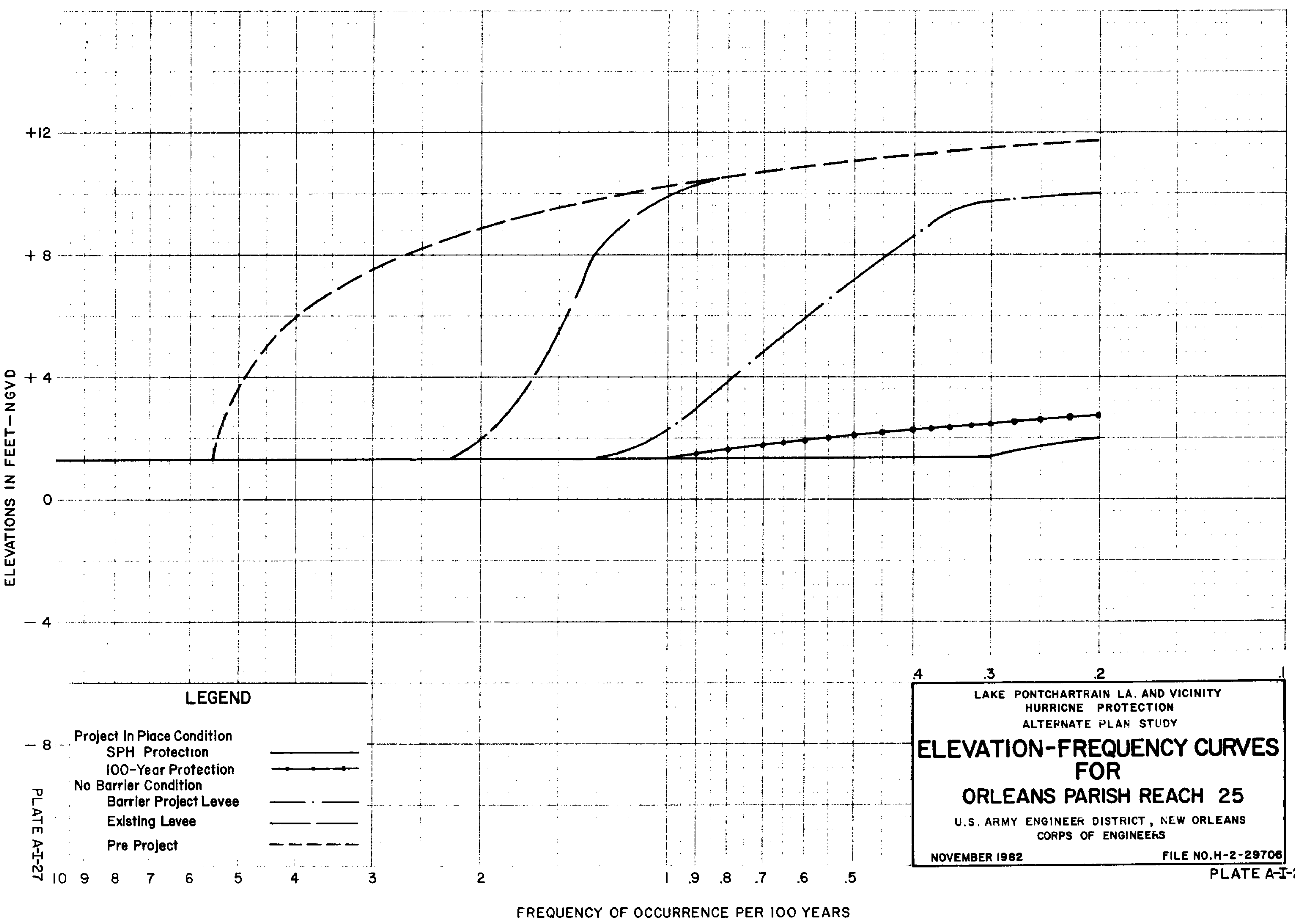
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 22

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

NOVEMBER 1982 FILE NO. H-2-29706


+12
+ 8
+ 4
0
− 4
− 8
ELEVATIONS IN FEET—NGVD
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2 .1
FREQUENCY OF OCCURRENCE PER 100 YEARS
LEGEND
Project In Place Condition
SPH Protection
No Barrier Condition
Barrier Project Levee
Existing Levee
Pre Project
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY
ELEVATION-FREQUENCY CURVES
FOR
ORLEANS PARISH REACH 23
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NOVEMBER 1982
FILE NO. H-2-29706
PLATE A-I-26



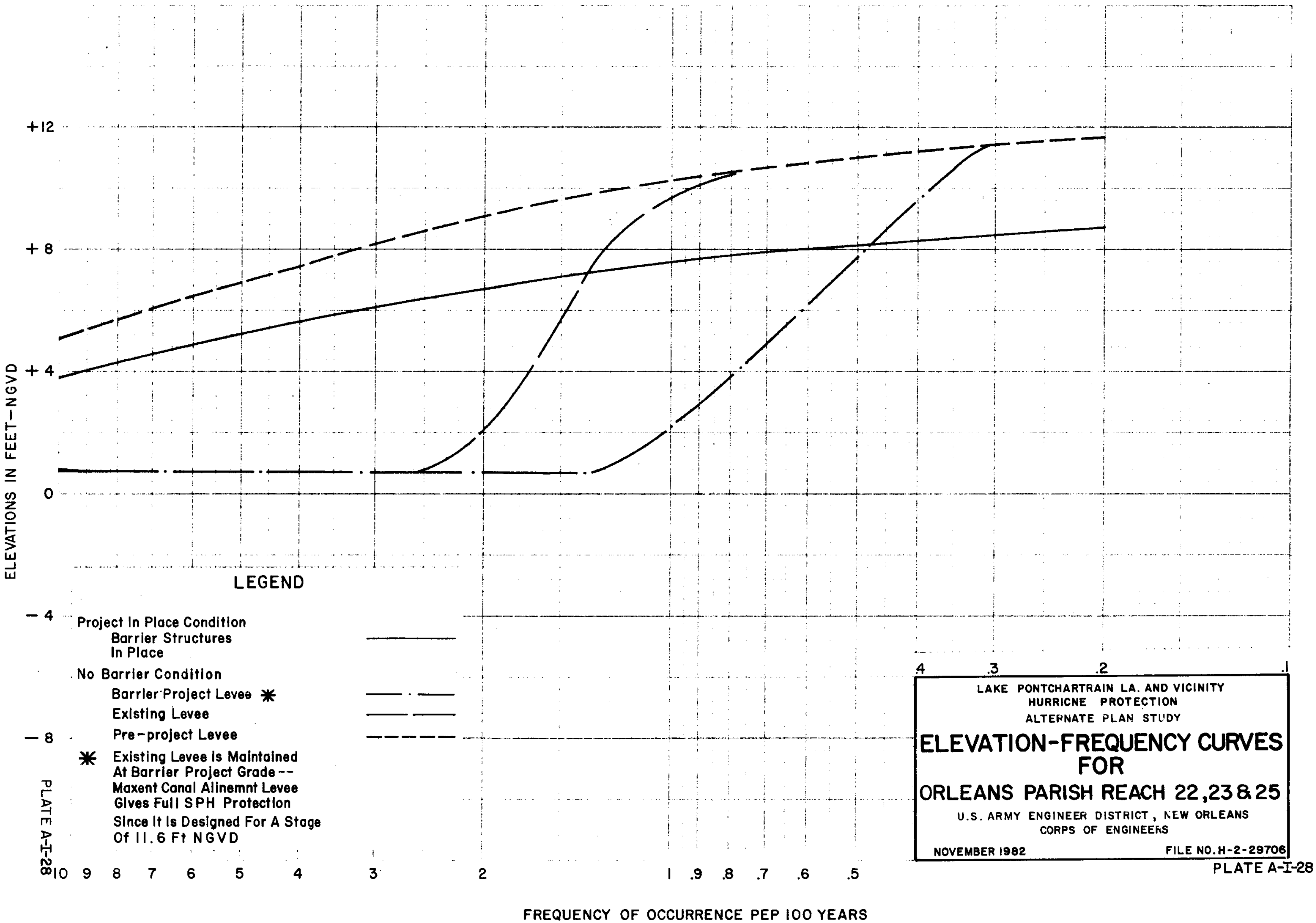
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

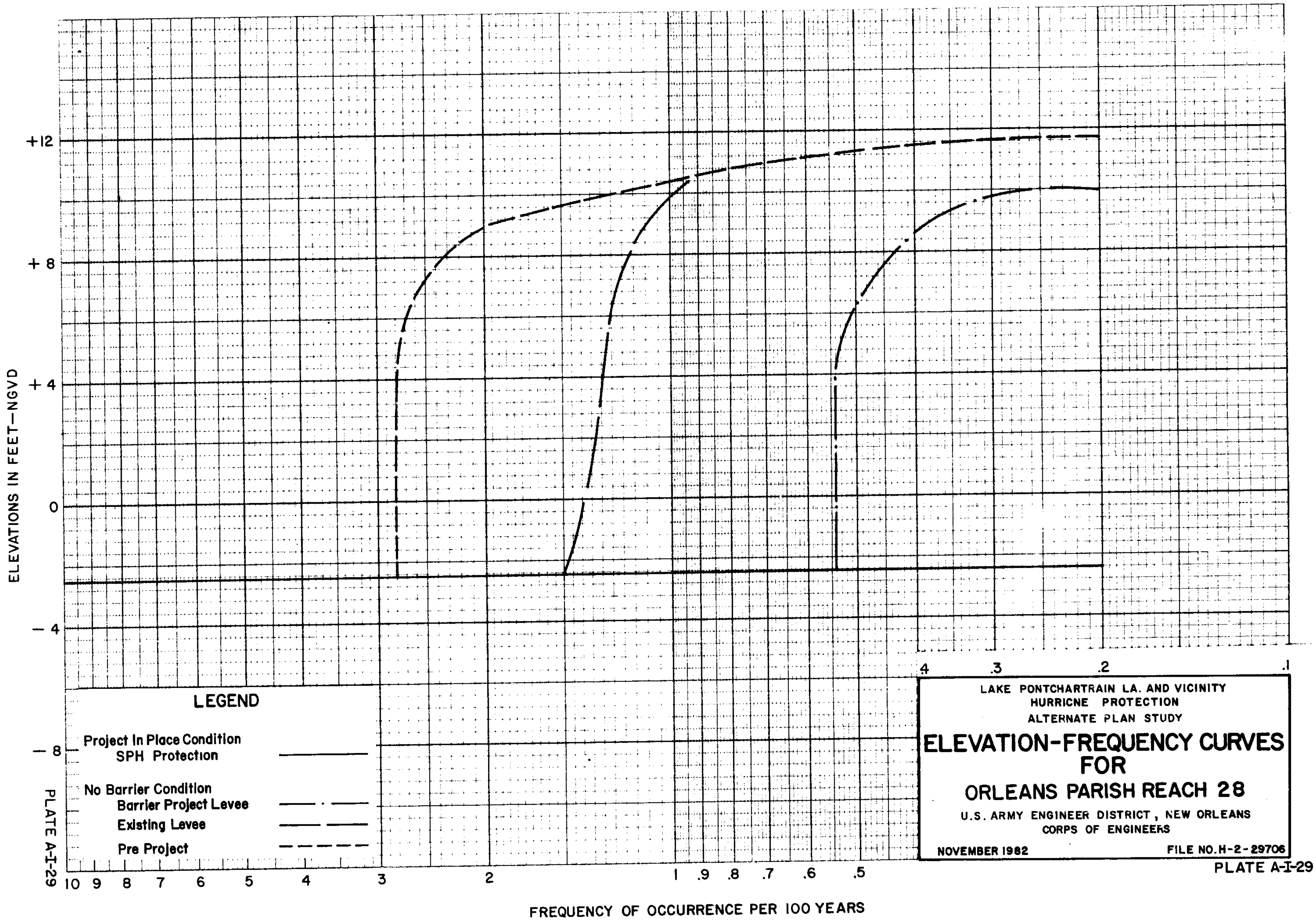
ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 25

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

NOVEMBER 1982

FILE NO. H-2-29706


+12
+8
+4
0
−4
−8
ELEVATIONS IN FEET−NGVD
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2 .1
FREQUENCY OF OCCURRENCE PEP 100 YEARS
LEGEND
Project In Place Condition
Barrier Structures In Place
No Barrier Condition
Barrier Project Levee *
Existing Levee
Pre-project Levee
* Existing Levee Is Maintained At Barrier Project Grade -- Maxent Canal Alinemnt Levee Gives Full SPH Protection Since It Is Designed For A Stage Of 11.6 Ft NGVD
PLATE A-I-28
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY
ELEVATION-FREQUENCY CURVES
FOR
ORLEANS PARISH REACH 22,23 & 25
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NOVEMBER 1982
FILE NO. H-2-29706
PLATE A-I-28

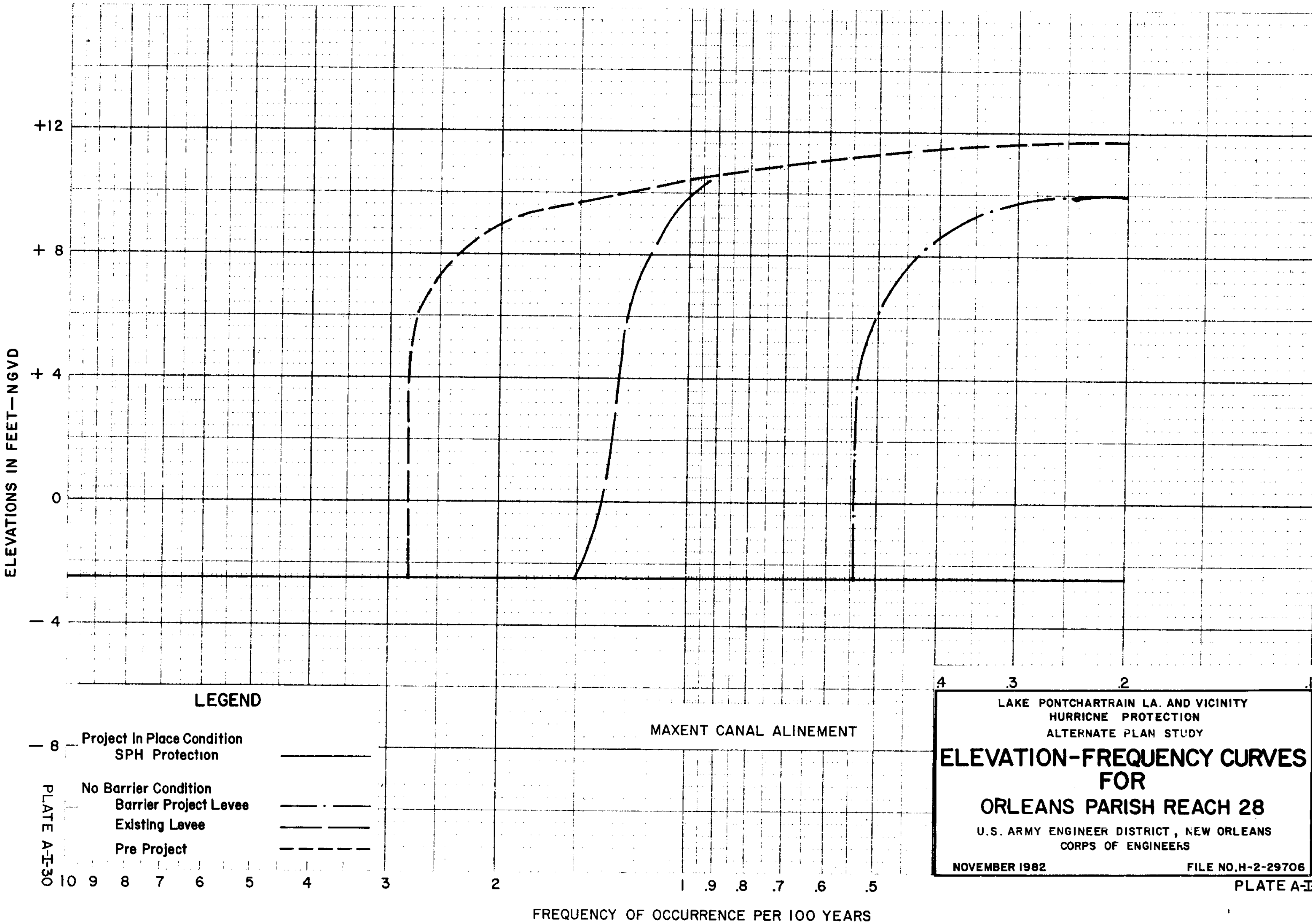


LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 28

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

NOVEMBER 1982 FILE NO. H-2-29706

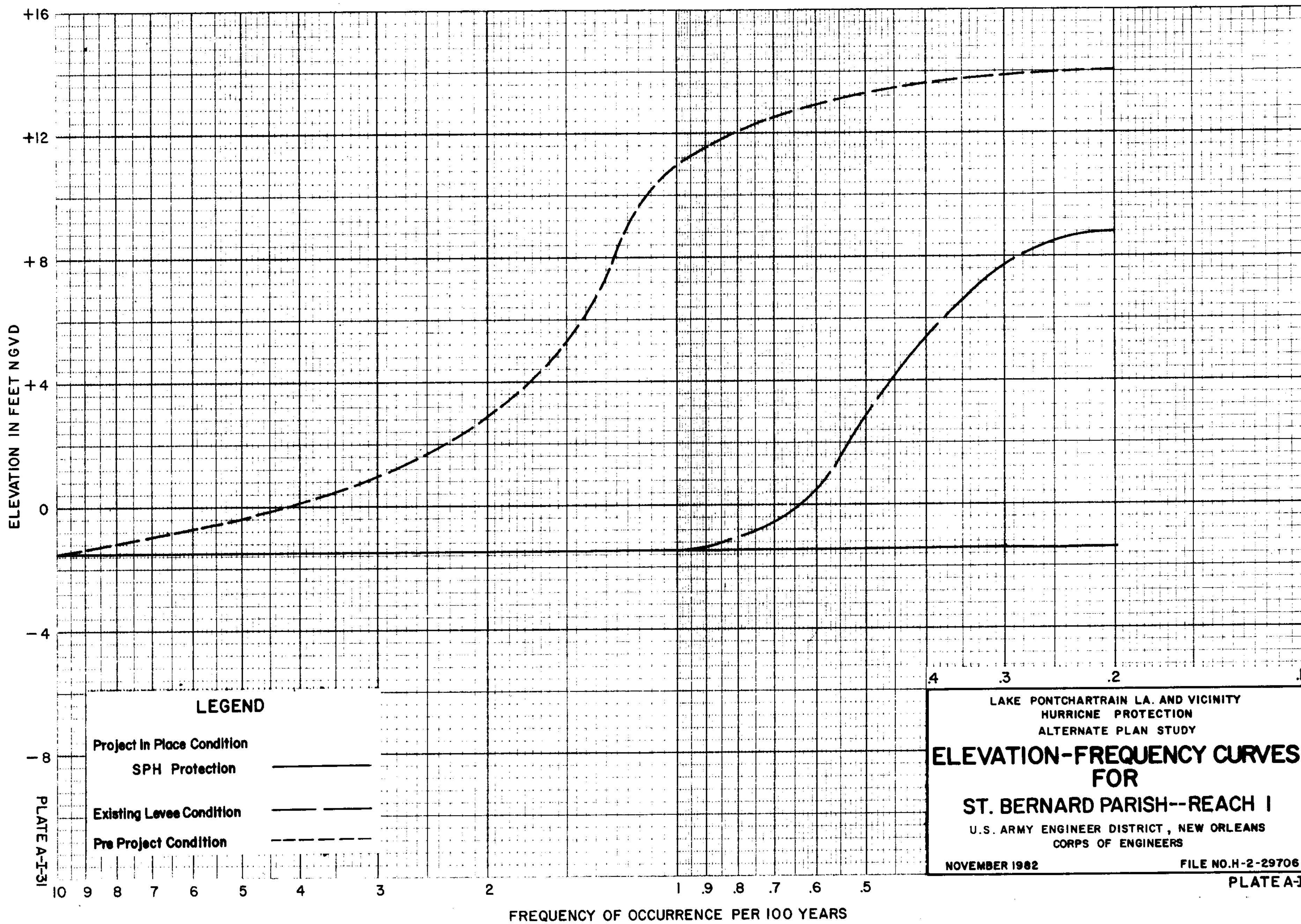


LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ORLEANS PARISH REACH 28

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

NOVEMBER 1982 FILE NO.H-2-29706



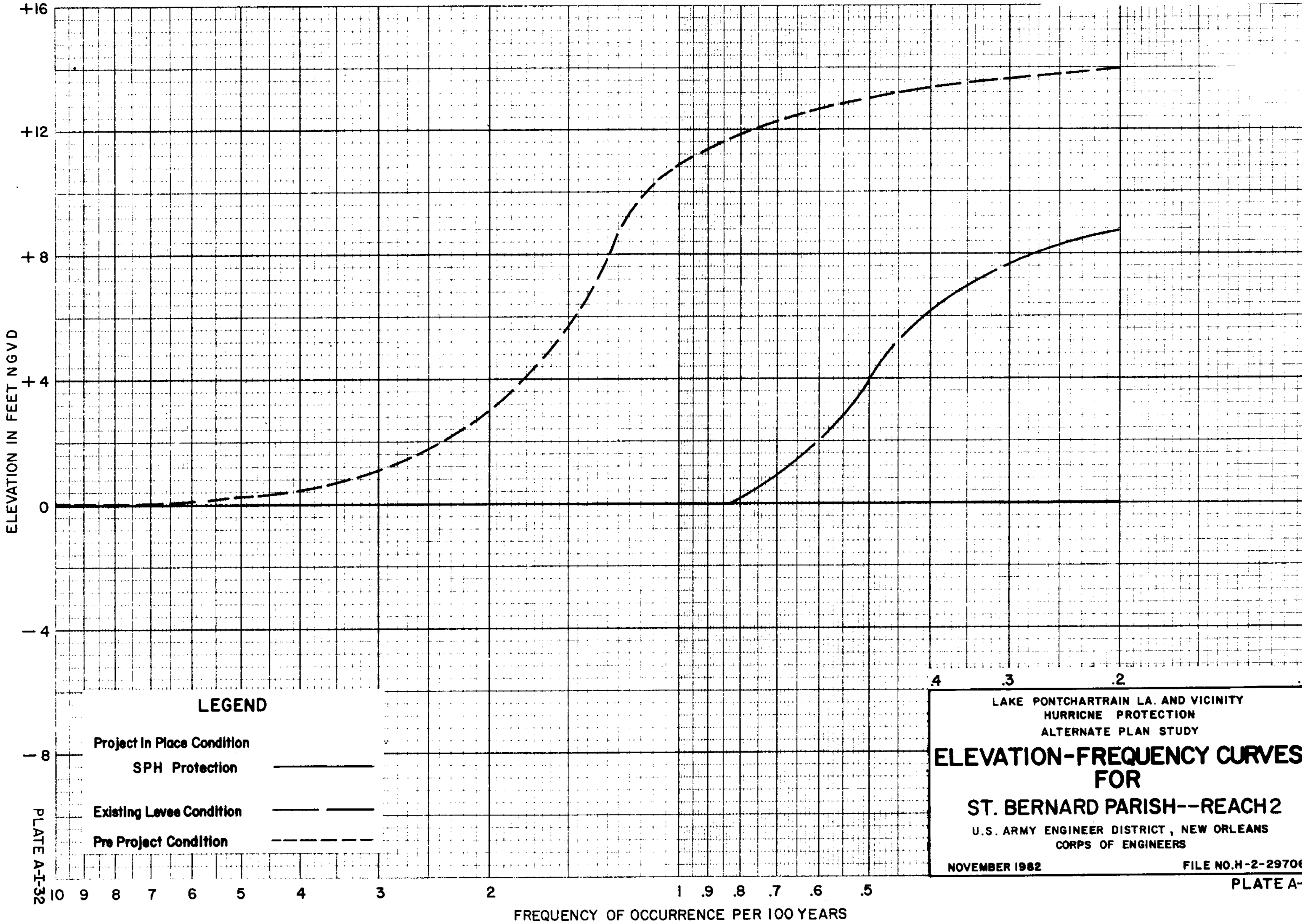
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ST. BERNARD PARISH--REACH I

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

NOVEMBER 1982

FILE NO.H-2-29706

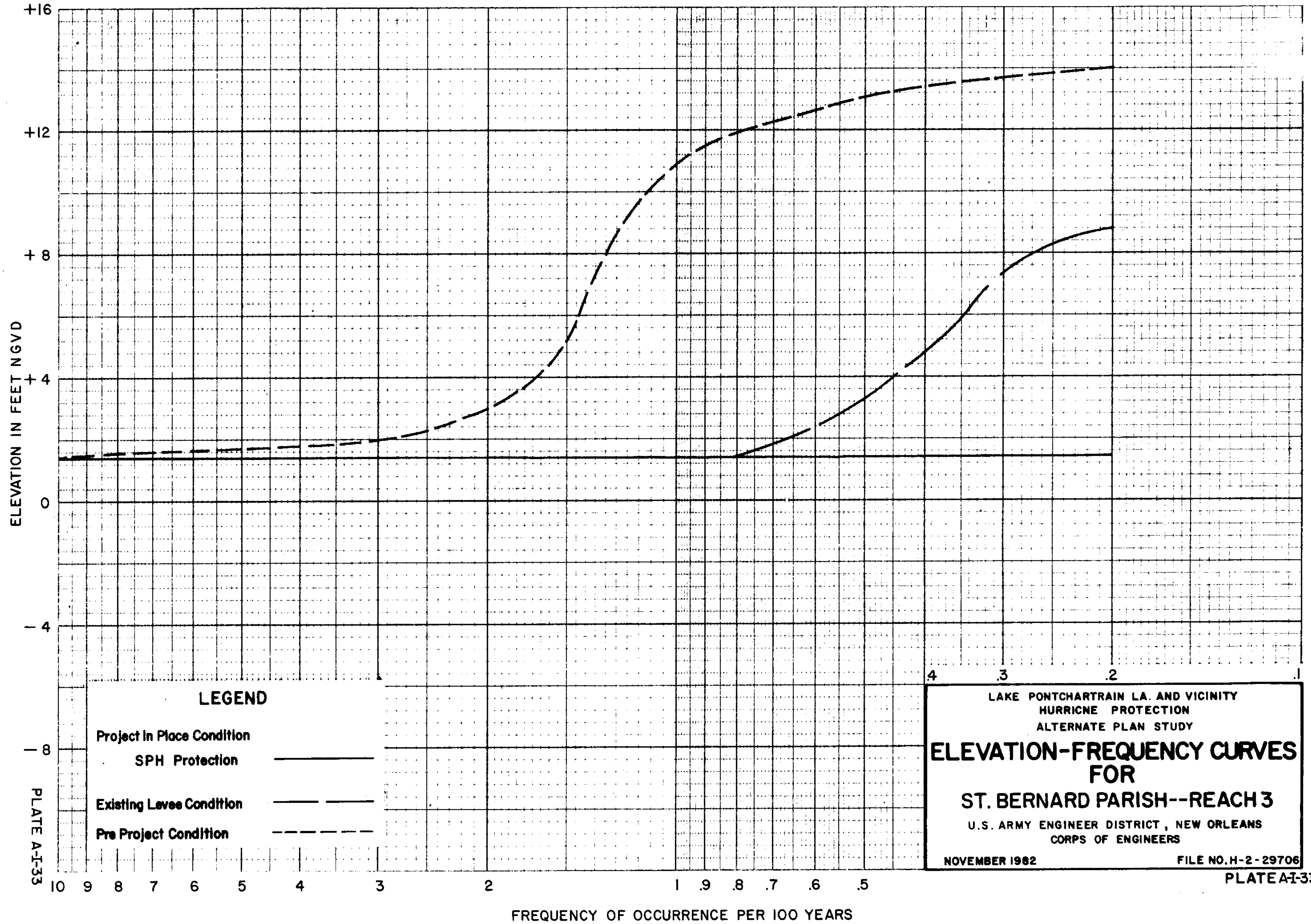


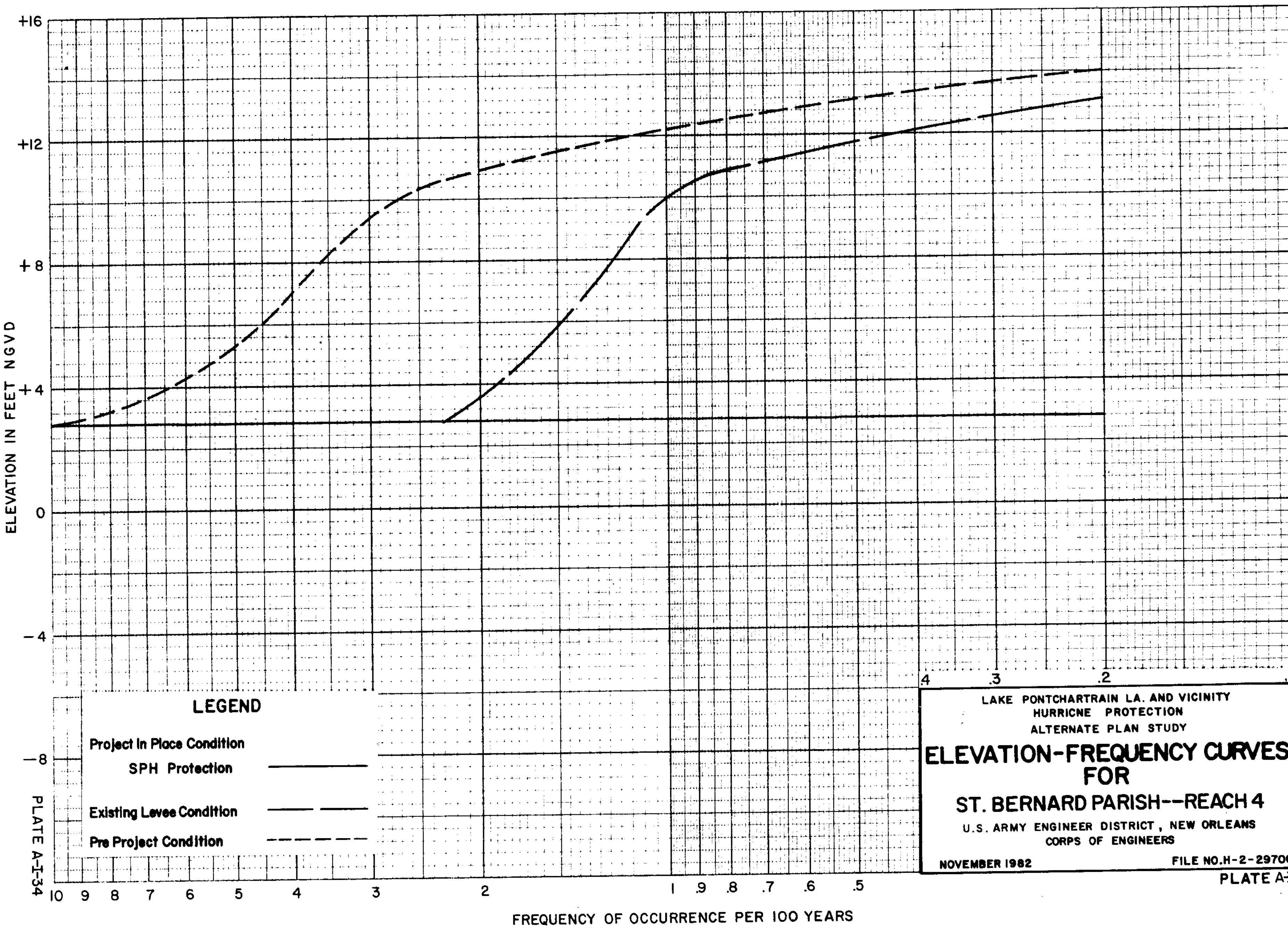
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ST. BERNARD PARISH--REACH 2

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

NOVEMBER 1982 FILE NO. H-2-29706


ELEVATION IN FEET NGVD
+16
+12
+ 8
+ 4
0
– 4
– 8
10 9 8 7 6 5 4 3 2 1 .9 .8 .7 .6 .5 .4 .3 .2 .1
FREQUENCY OF OCCURRENCE PER 100 YEARS
LEGEND
Project In Place Condition
SPH Protection
Existing Levee Condition
Pre Project Condition
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY
ELEVATION-FREQUENCY CURVES
FOR
ST. BERNARD PARISH--REACH 3
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
NOVEMBER 1982
FILE NO. H-2-29706
PLATE A-I-33
PLATE A-I-33



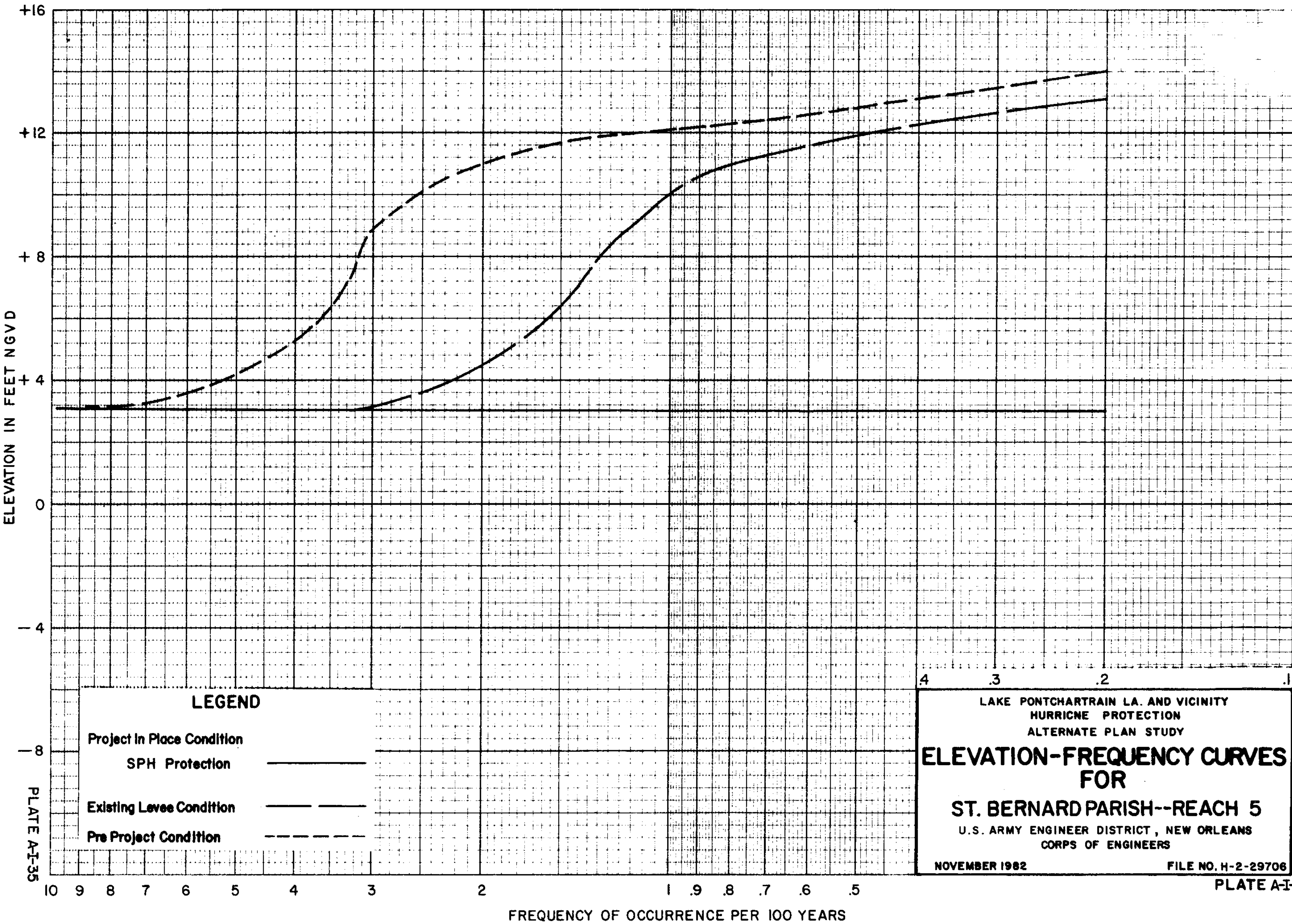
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR ST. BERNARD PARISH--REACH 4

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

NOVEMBER 1982

FILE NO.H-2-29706



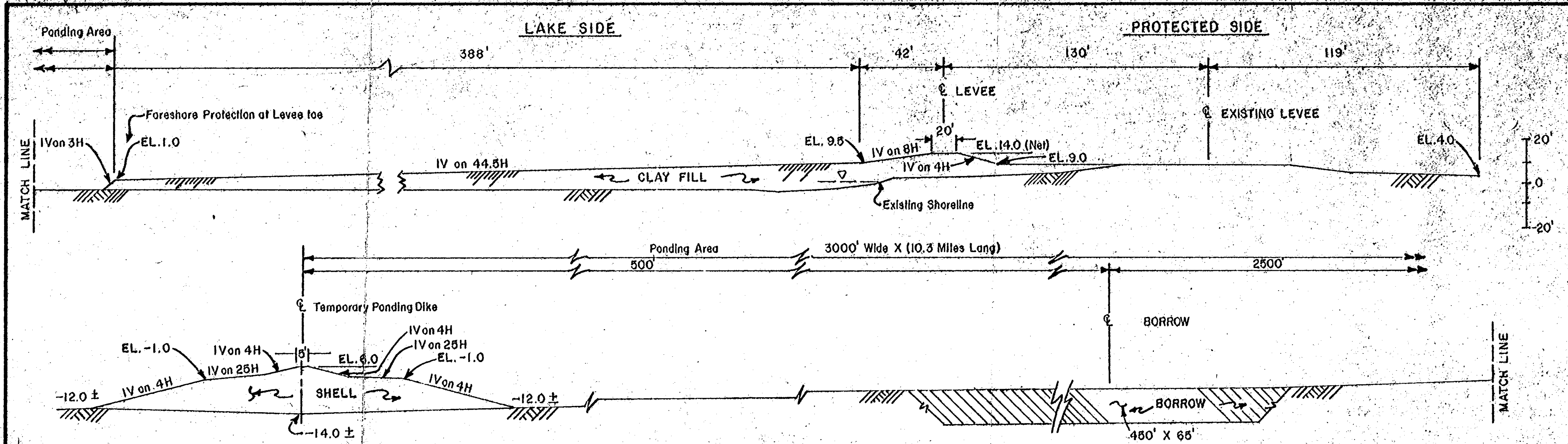
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICNE PROTECTION
ALTERNATE PLAN STUDY

ELEVATION-FREQUENCY CURVES FOR

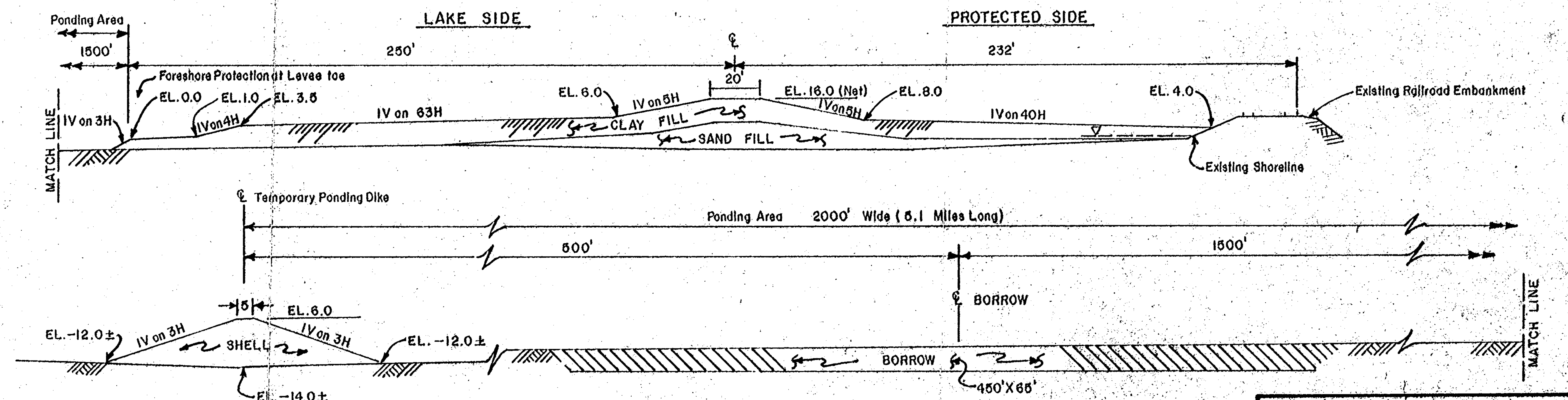
ST. BERNARD PARISH--REACH 5

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

NOVEMBER 1982 FILE NO. H-2-29706



JEFFERSON PARISH LAKEFRONT LEVEE
IN- THE - LAKE ALINEMENT - HYDRAULIC FILL
HLP—SPH PROTECTION



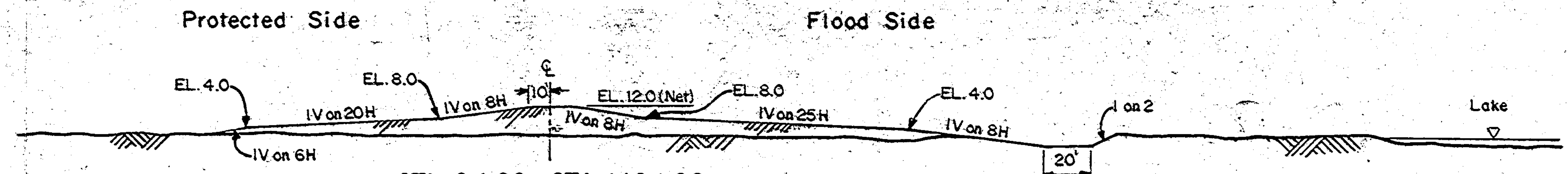
CITRUS LAKEFRONT LEVEE
IN—THE—LAKE ALINEMENT
HLP—SPH PROTECTION

NOTES:
1. Cross-Sections not-to-Scale
2. All Elevations in Ft. N.G.V.D.
3. HLP—High Level Plan
4. SPH—Standard Project Hurricane

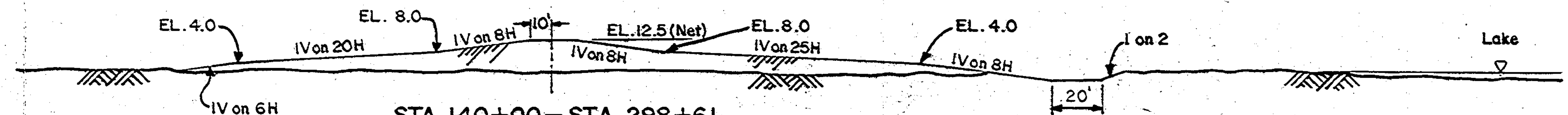
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE
CROSS-SECTIONS

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-29706

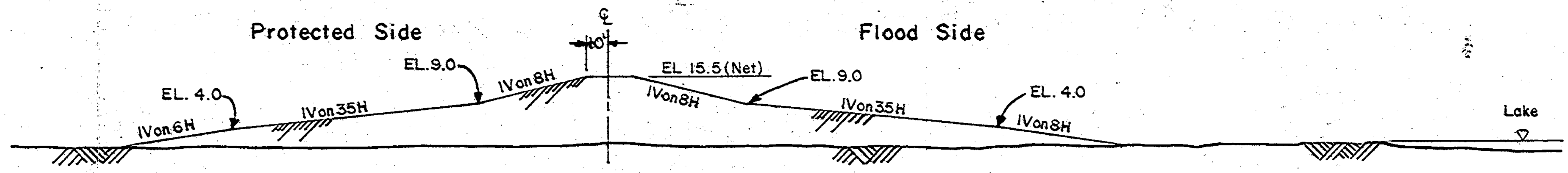


STA. 0+00 – STA. 140+00

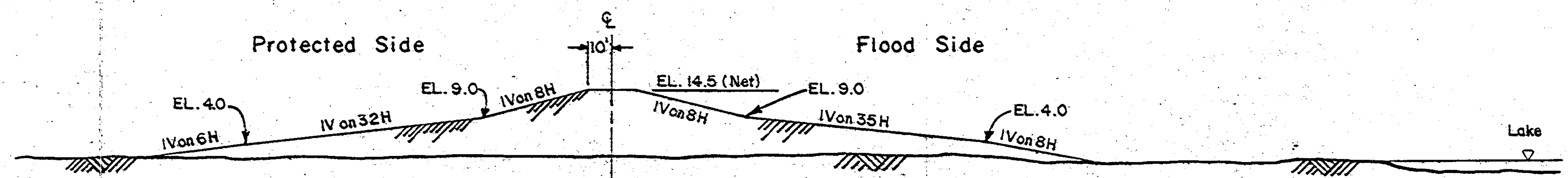


STA. 140+00 – STA. 298+61

BARRIER PLAN–SPH PROTECTION



HLP – SPH PROTECTION



HLP – 100 YRS. HURRICANE PROTECTION

ST. CHARLES PARISH - LAKEFRONT ALINEMENT

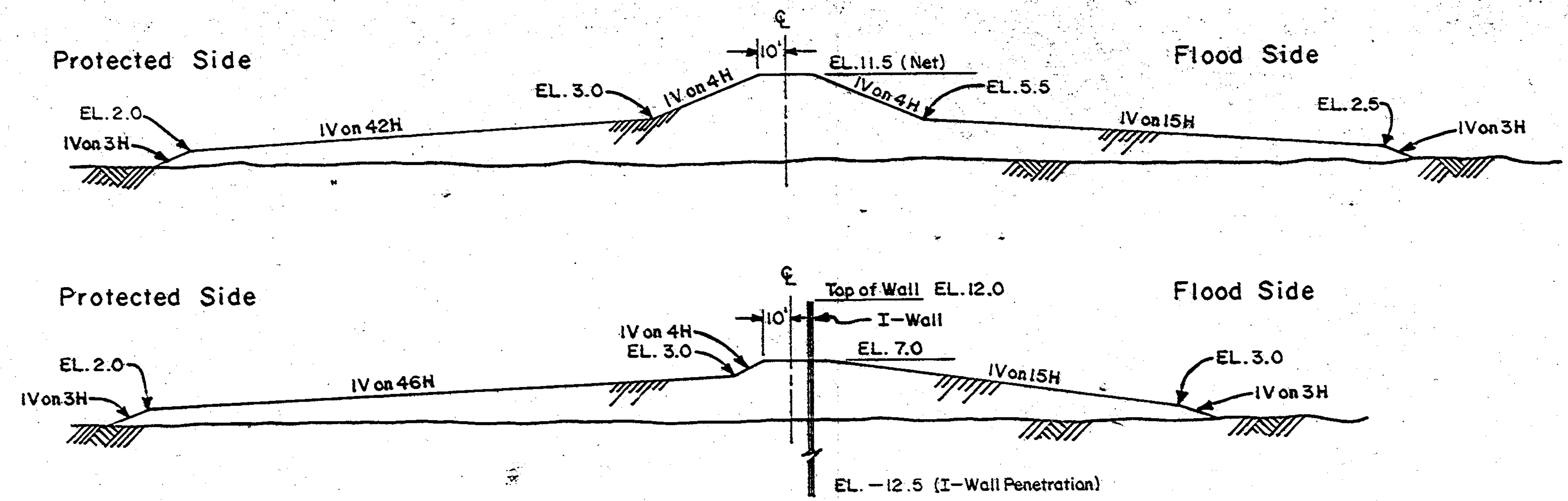
NOTE:
1. HLP - high level plan
2. SPH - standard project hurricane
3. Cross - Sections - not - to - scale
4. All Elevations in Ft. N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

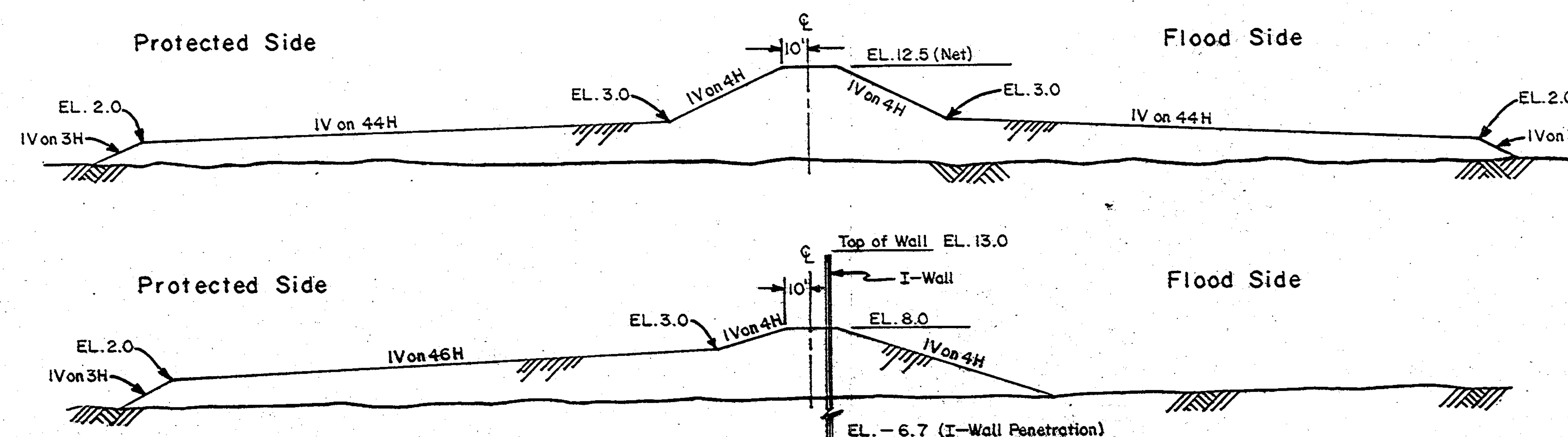
TYPICAL LEVEE
CROSS-SECTIONS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-29706

PLATE A-I-37



BARRIER PLAN-SPH PROTECTION



HLP-SPH PROTECTION

NOTE:
1. HLP-high level plan
2. SPH-standard project hurricane
3. Cross-Sections-not-to-scale
4. All Elevations in Ft. N.G.V.D.

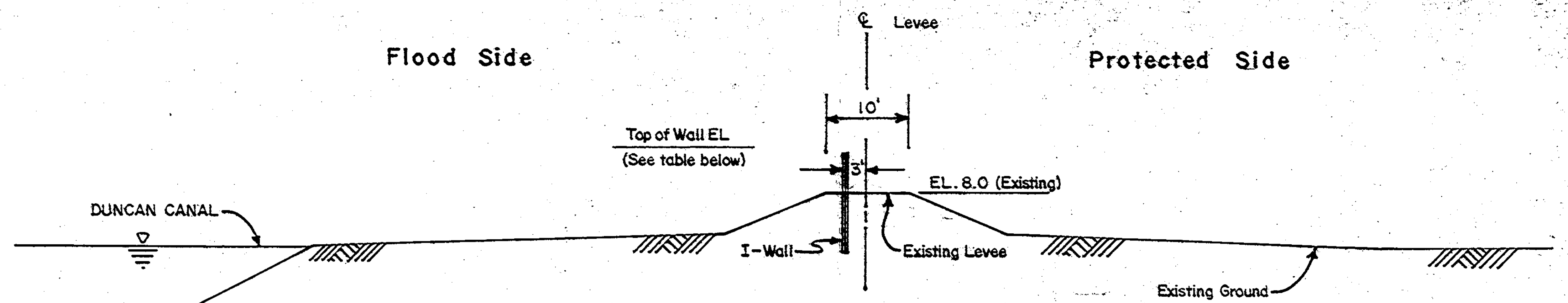
ST. CHARLES PARISH
NORTH AND SOUTH OF AIRLINE HWY.
ALINEMENTS

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

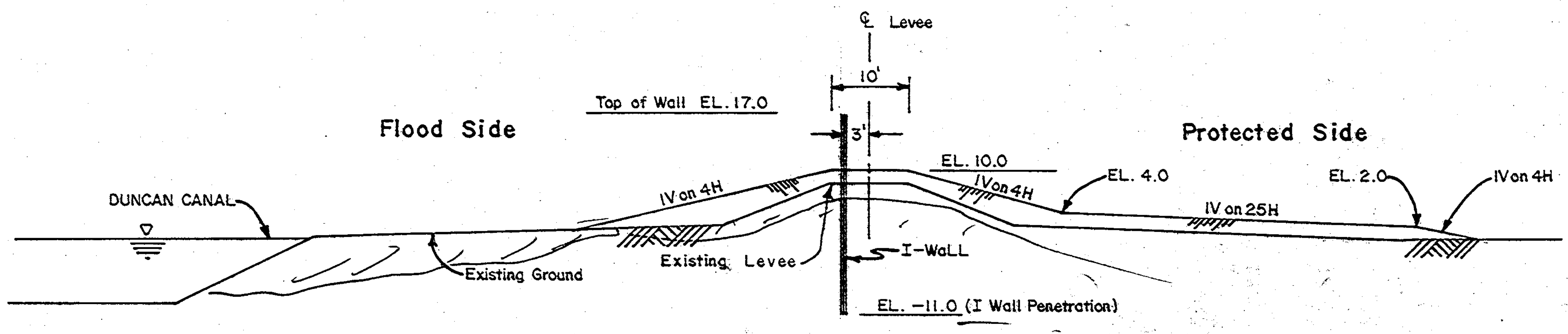
TYPICAL LEVEE
CROSS-SECTIONS

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-29706

PLATE A-I-38



SECTION 1



SECTION 2

Note:

Section 2 Applies to HLP (SPH) only
(500' Transition at North end at Junction with Jefferson Parish Lakefront Levee)

JEFFERSON - ST CHARLES PARISHES BOUNDARY LEVEE

PLAN	LOCATION	I-Wall ELEV.	
		TOP OF WALL	PENETRATION
BARRIER	SOUTH END	9.5	4.0
BARRIER	AT TRANSITION	11.0	1.0
BARRIER	NORTH END	13.0	-5.0
HLP(SPH)	SOUTH END	12.5	-4.0
HLP(SPH)	AT TRANSITION	14.0	-9.0
HLP(SPH)	NORTH END	17.0	-11.0
HLP(100 YR)	SOUTH END	11.5	-1.0
HLP(100 YR)	AT TRANSITION	13.0	-5.0
HLP(100 YR	NORTH END	13.0	-5.0

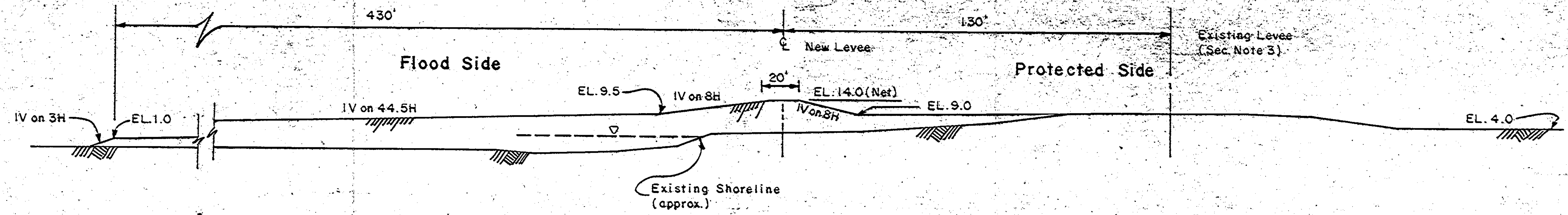
NOTE:

1. HLP-High Level Plan
2. SPH-Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

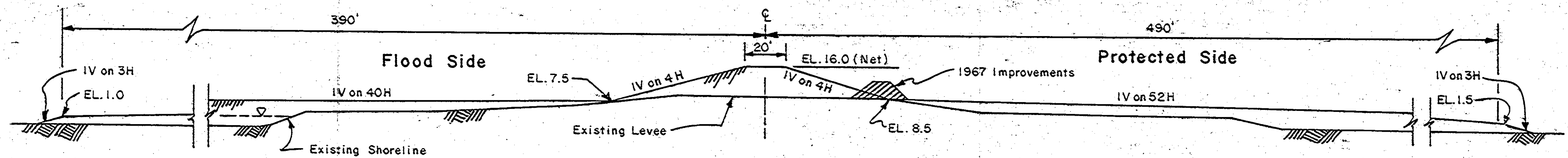
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE CROSS-SECTIONS

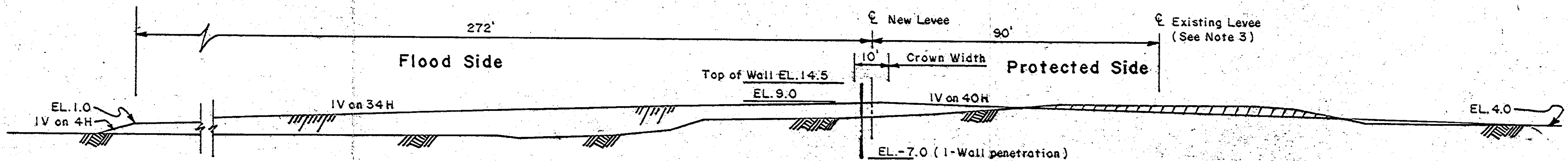
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-29706



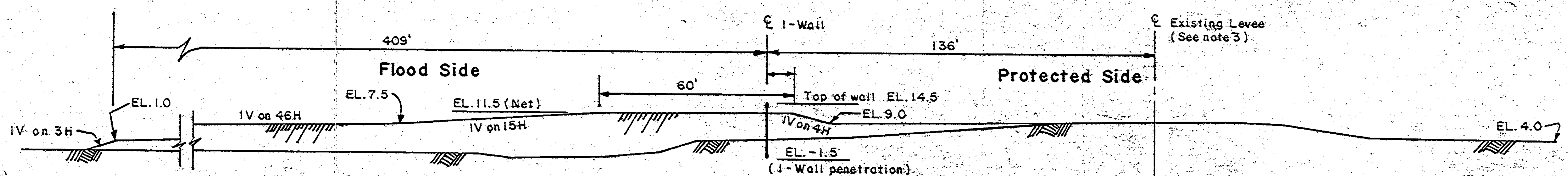
HLP (SPH) IN-THE-LAKE ALINEMENT



HLP (SPH) STRADDLE ENLARGEMENT



HLP (SPH) I-WALL or T-WALL on Levee



HLP (SPH) I-WALL on Levee w/ Barge Berm

NOTES:

1. All Elevations in Ft. N.G.V.D.
2. Cross-Section not-to-scale
3. Foreshore protection provided at levee toe (All Sections)
4. 1967 improvements not shown
5. HLP- High Level Plan
6. SPH- Standard Project Hurricane

JEFFERSON PARISH LAKEFRONT LEVEE

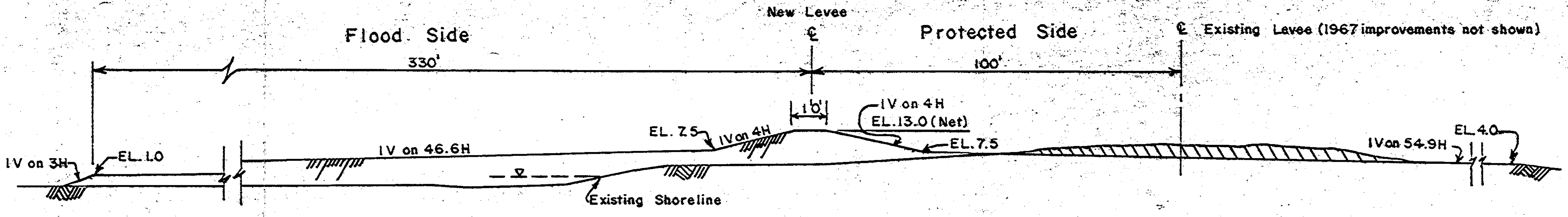
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE CROSS-SECTIONS

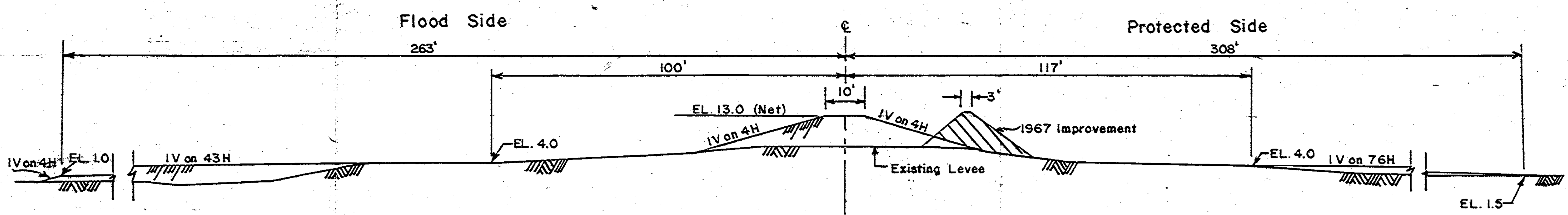
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-2-29706

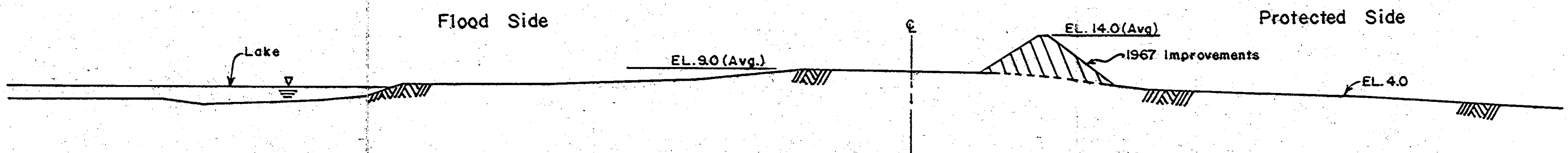
PLATE A-B-40



HLP (100YR) IN-THE-LAKE ALINEMENT



HLP (100YR) STRADDLE ENLARGEMENT



BARRIER PLAN-SPH PROTECTION
"EXISTING" LEVEE
(Only Foreshore Protection is Required)

JEFFERSON PARISH LAKEFRONT LEVEE

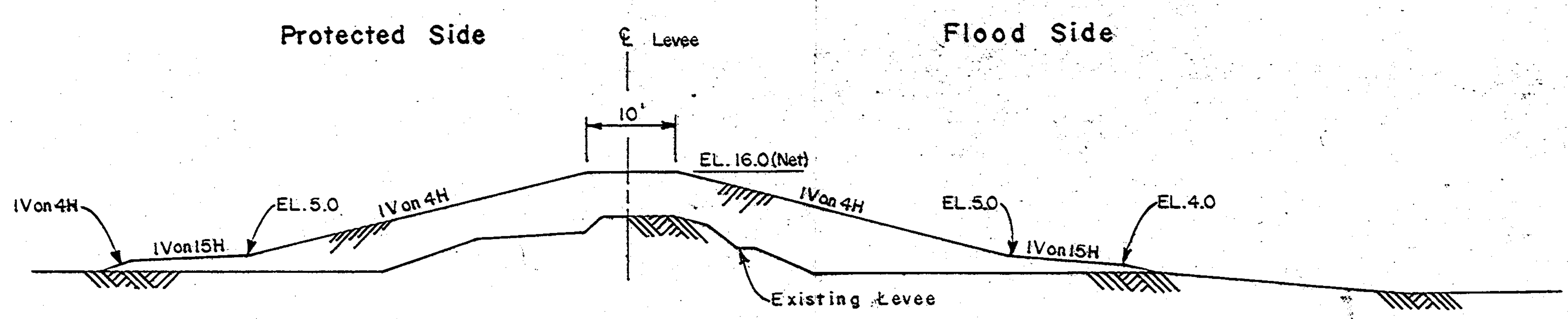
NOTE:
1. H L P-High Level Plan
2. Cross-Sections not-to-Scale
3. All Elevations in Ft. N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

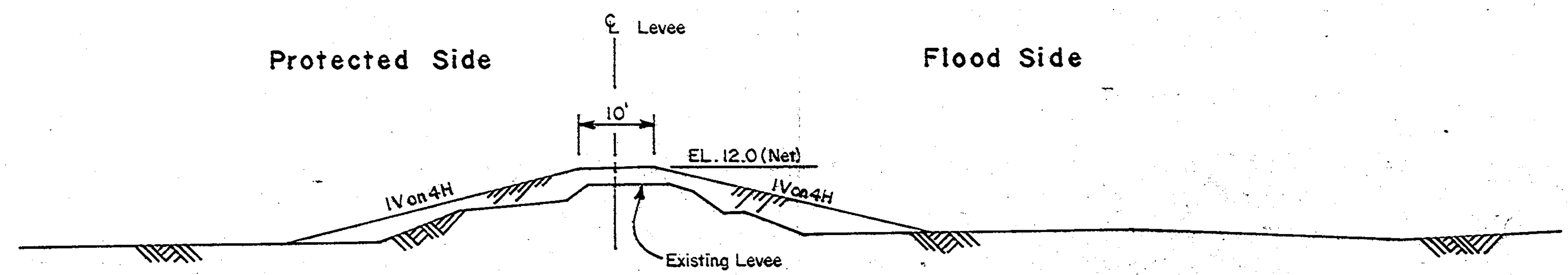
TYPICAL LEVEE CROSS-SECTIONS

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

FILE NO. H-2-29706



HLP – 100 YEAR HURRICANE PROTECTION



BARRIER PLAN–SPH PROTECTION

NEW ORLEANS LAKEFRONT LEVEE
WEST OF IHNC

NOTE:

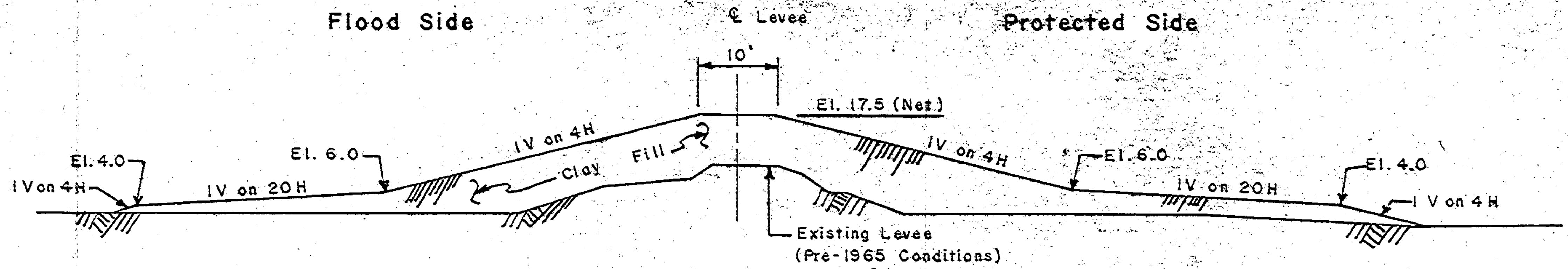
1. HLP – High Level Plan
2. SPH – Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

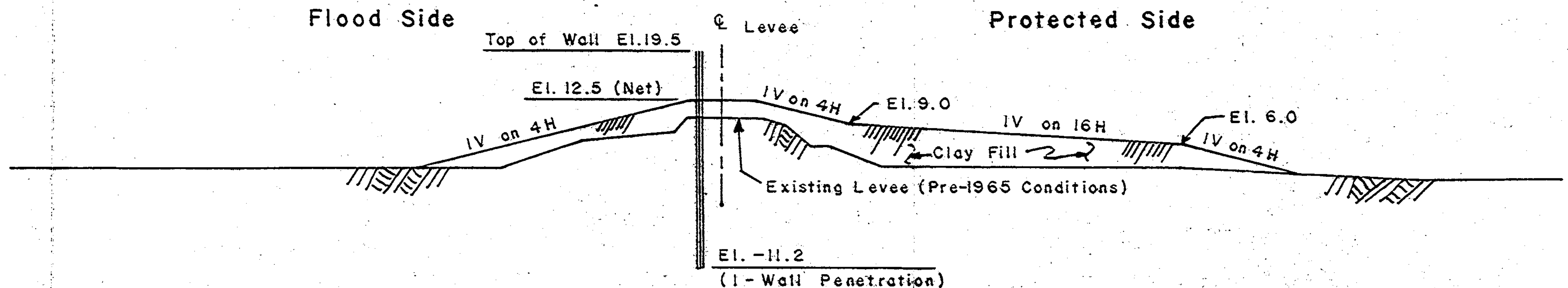
TYPICAL LEVEE
CROSS-SECTIONS

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

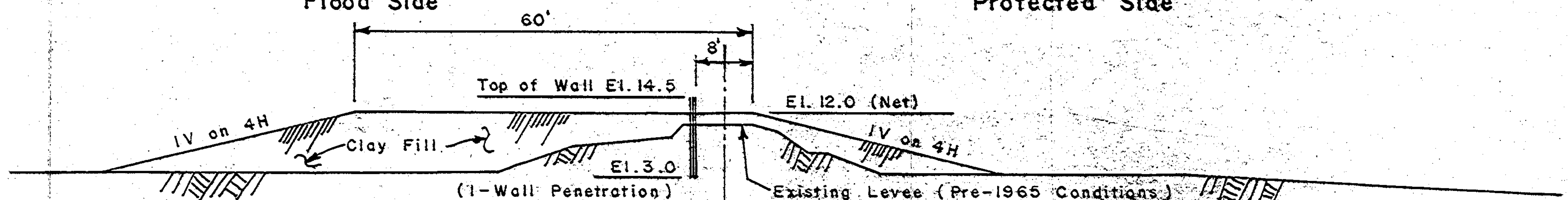
FILE NO. H-2-29706



HLP-SPH PROTECTION



HLP-SPH PROTECTION
I-WALL ON LEVEE



HLP-SPH PROTECTION
I-WALL ON LEVEE WITH BARGE BERM

NOTE:
1. HLP – High Level Plan
2. SPH – Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

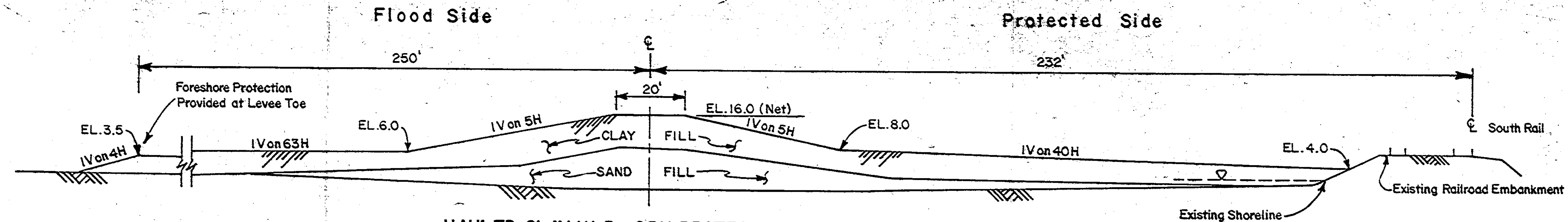
NEW ORLEANS LAKEFRONT LEVEE
WEST OF IHNC

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

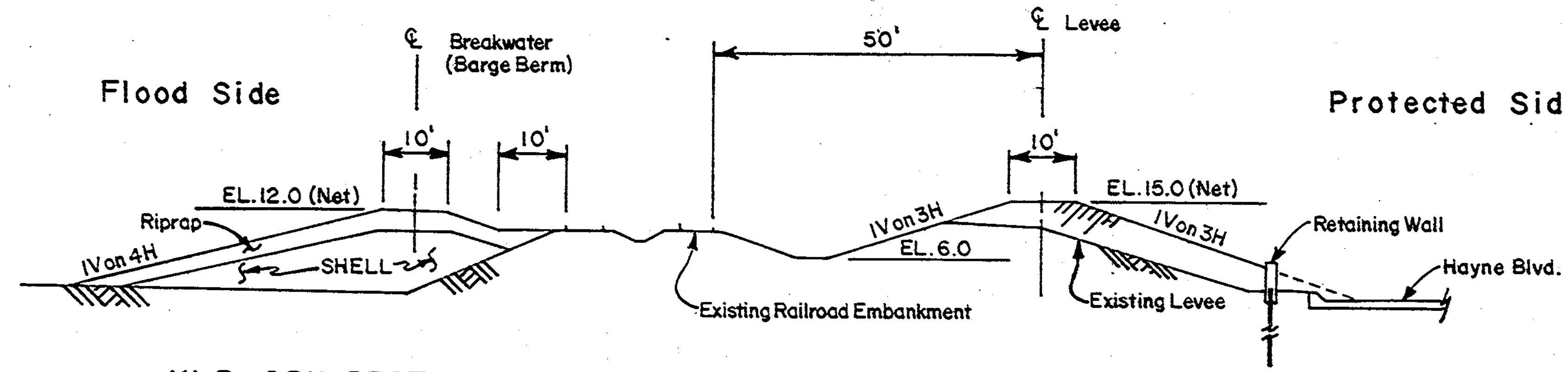
TYPICAL LEVEE CROSS-SECTIONS

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

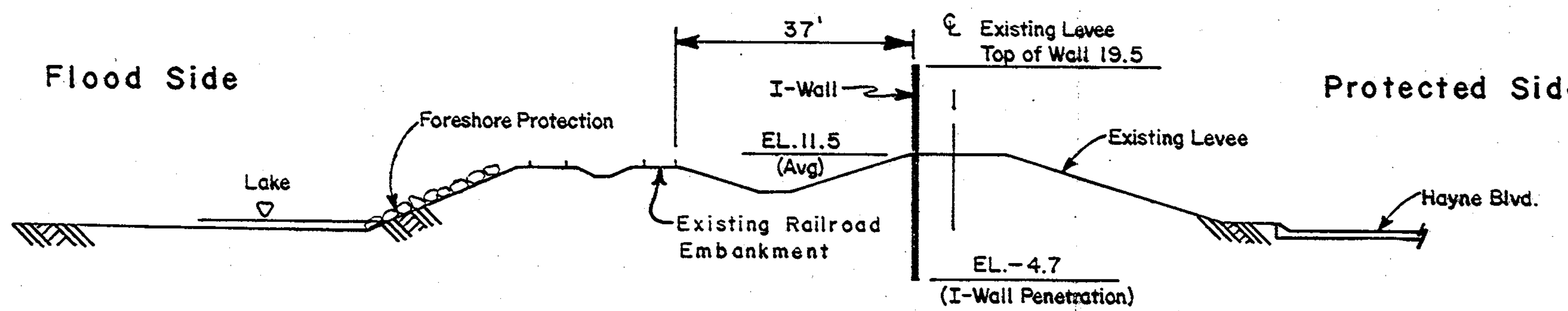
FILE NO. H-2-29706



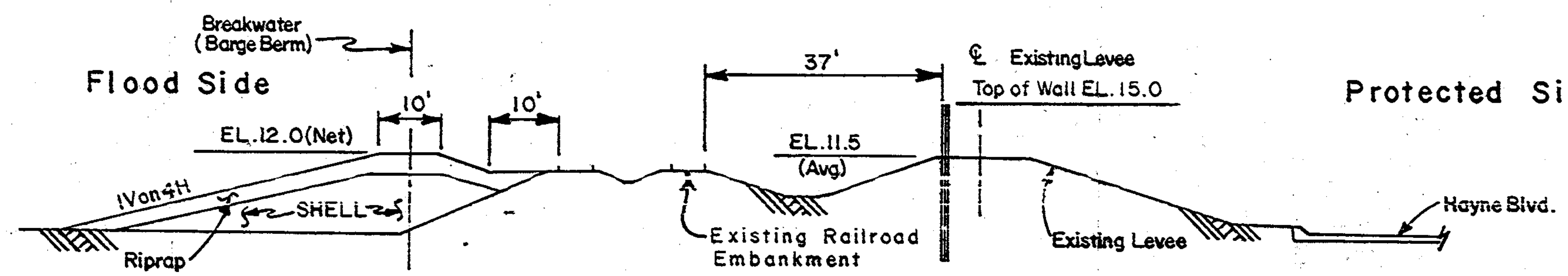
HAULED CLAY HLP- SPH PROTECTION IN-THE LAKE ALINEMENT



HLP-SPH PROTECTION-LANDSIDE ALINEMENT-LEVEE WITH RETAINING WALL



HLP-SPH PROTECTION I-WALL ON LEVEE



HLP-SPH PROTECTION I-WALL-ON-LEVEE WITH "BARGEBERM"

NOTE:
1. HLP-High Level Plan
2. SPH-Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

CITRUS LAKEFRONT LEVEE

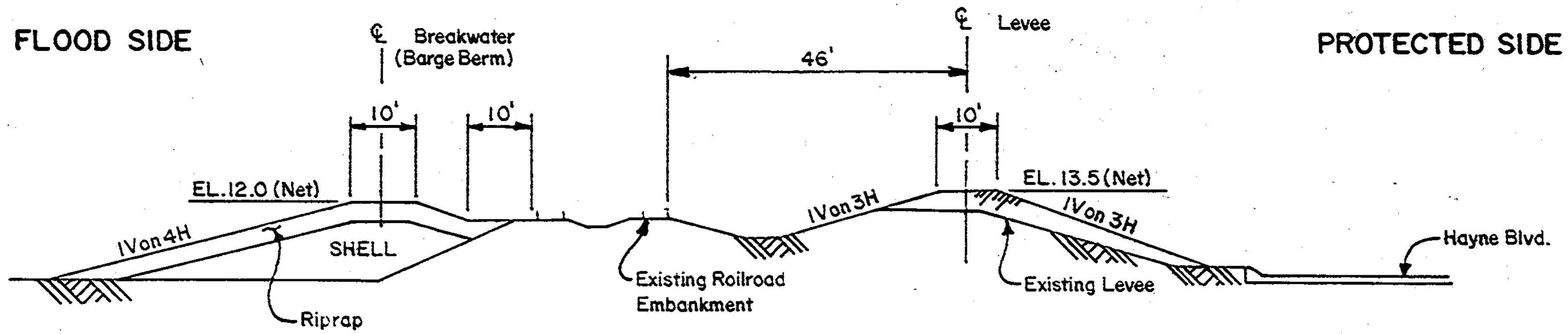
LAKE PONTCHARTRAIN, LA AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE
CROSS-SECTIONS

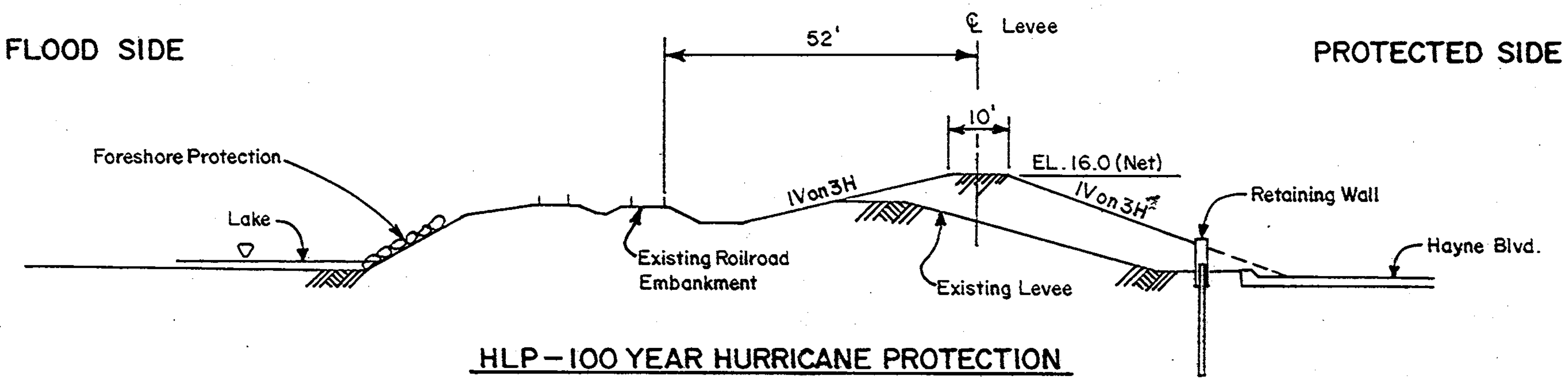
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-2-29706

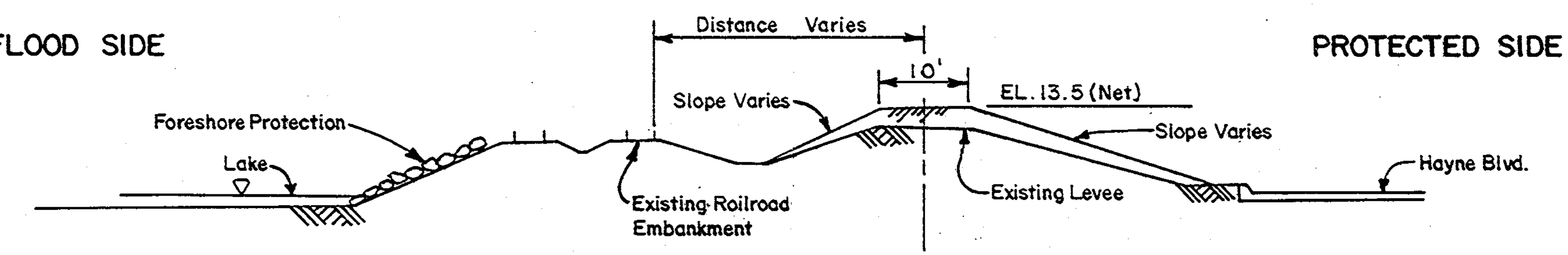
PLATE A-I-44



HLP – 100 YEAR HURRICANE PROTECTION
LEVEE WITH BARGE BERM



HLP – 100 YEAR HURRICANE PROTECTION
LEVEE WITH RETAINING WALL



BARRIER PLAN – SPH PROTECTION

CITRUS LAKEFRONT LEVEE

NOTES:

1. HLP – High Level Plan
2. SPH – Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

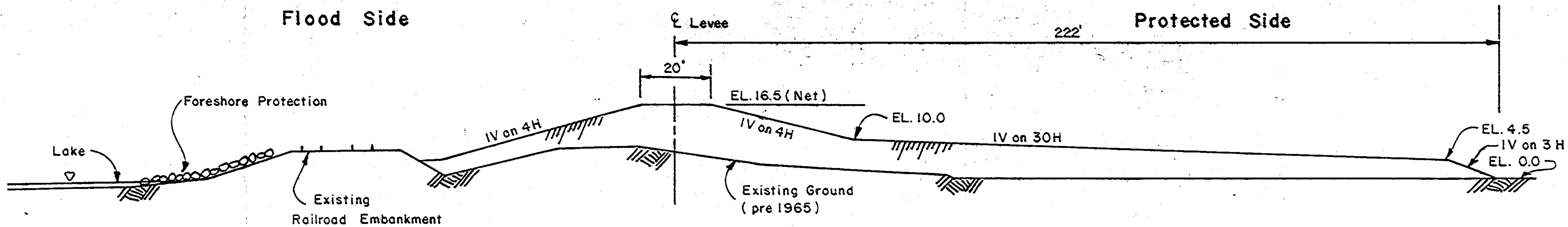
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE
CROSS-SECTIONS

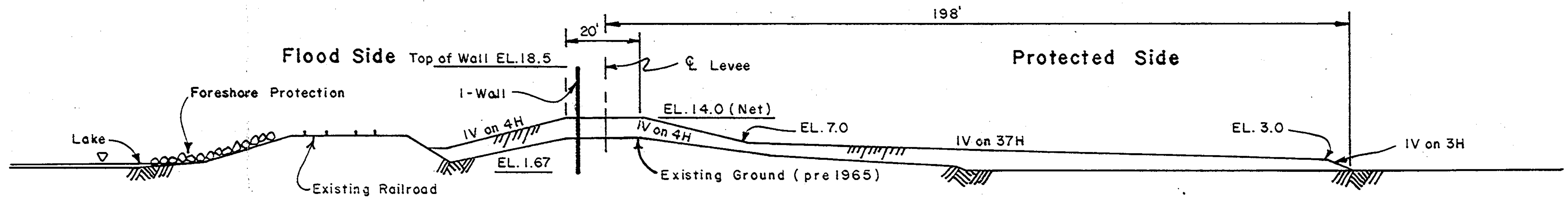
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-2-29706

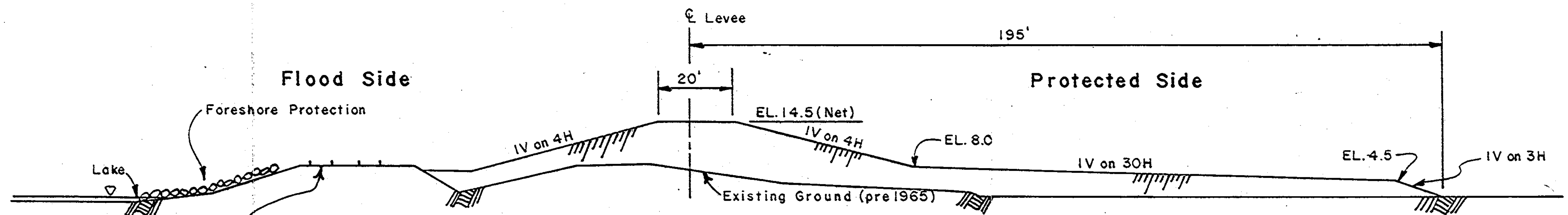
PLATE A-1-45



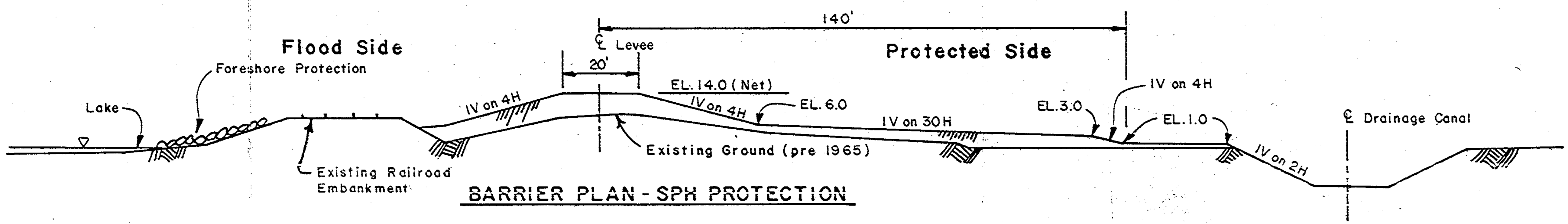
HLP-SPH PROTECTION - ALL EARTHEN LEVEE



HLP-SPH PROTECTION - I-WALL ON LEVEE



HLP - 100 YR. HURRICANE PROTECTION - ALL EARTHEN LEVEE



BARRIER PLAN - SPH PROTECTION

NEW ORLEANS EAST LAKEFRONT LEVEE

NOTE:

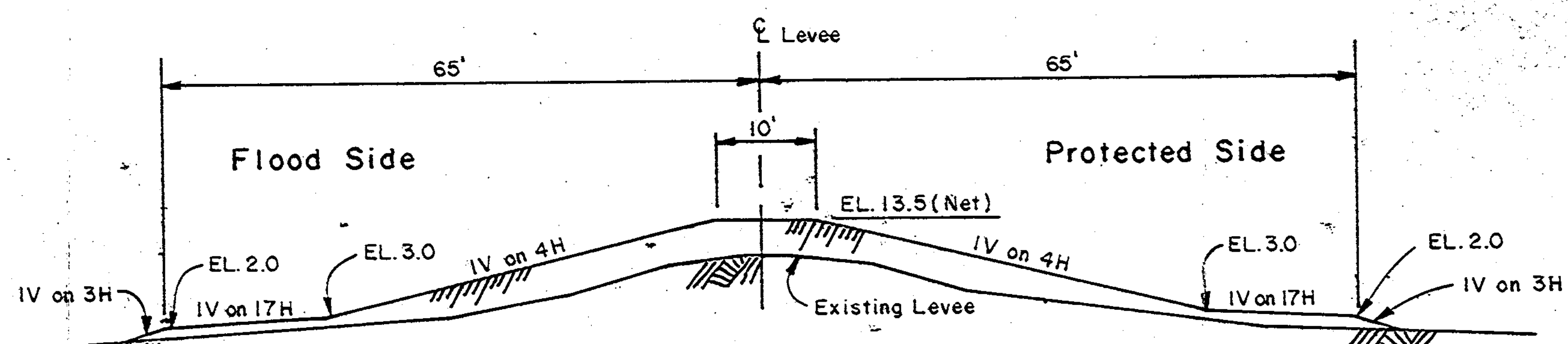
1. HLP - High Level Plan
2. SPH - Standard Project Hurricane
3. Cross-Sections not-to-Scale
4. All Elevations in Ft. N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

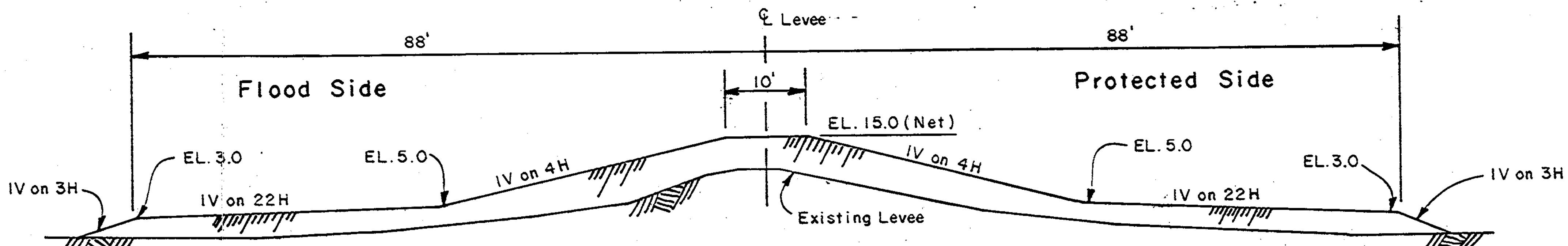
TYPICAL LEVEE CROSS-SECTIONS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-29706

PLATE A-T-46

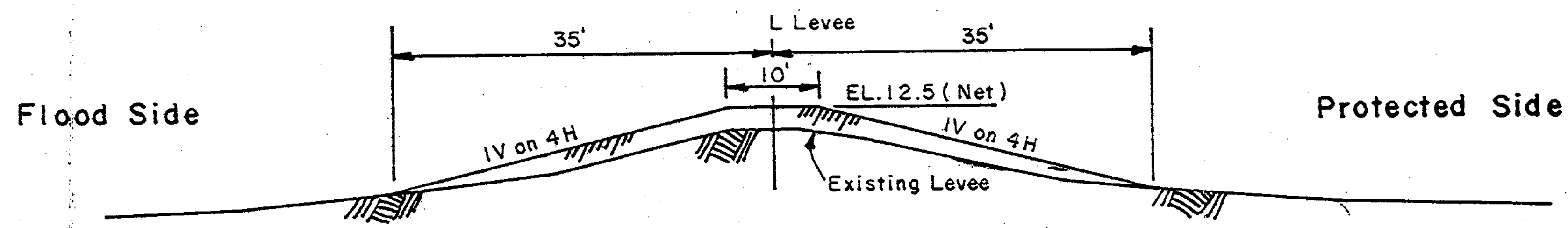


SOUTH POINT to U.S. HWY. 90

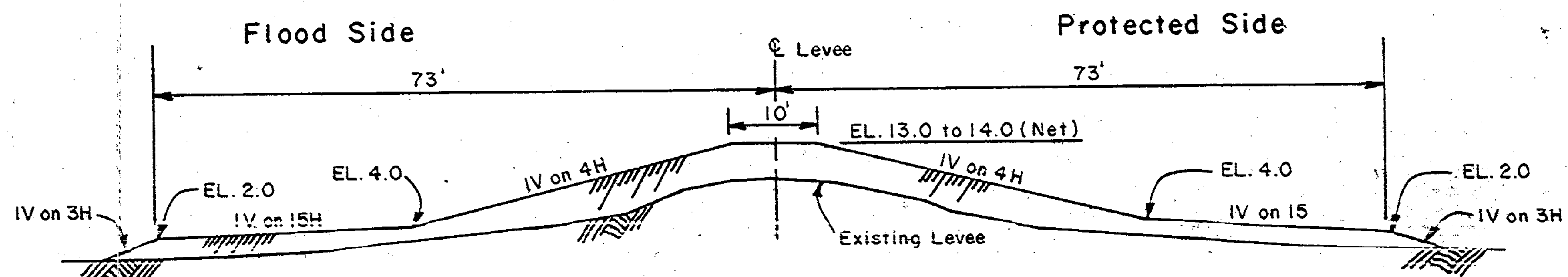


U.S. HWY. 90 to G.I.W.W.

HLP-SPH PROTECTION - ALL EARTHEN LEVEE



SOUTH POINT to U.S. HWY. 90



U.S. HWY. 90 to G.I.W.W.

HLP - 100YR HURRICANE PROTECTION

&

BARRIER PLAN - SPH PROTECTION

NOTE:

1. ~~HLP - high level plan~~
2. SPH - standard project hurricane
3. Cross - Sections - not-to-scale
4. All Elevations in Ft. N.G.V.D.

SOUTH POINT TO G.I.W.W.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

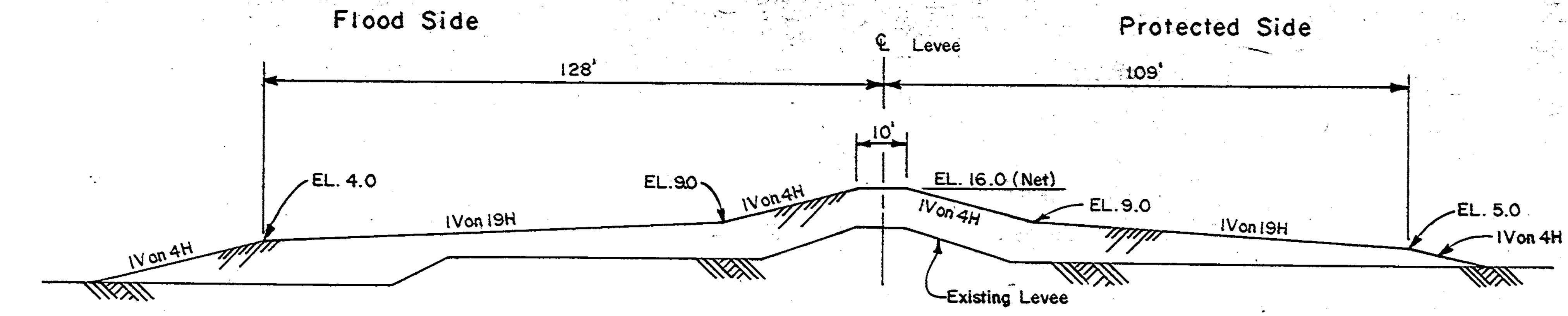
TYPICAL LEVEE
CROSS - SECTIONS

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

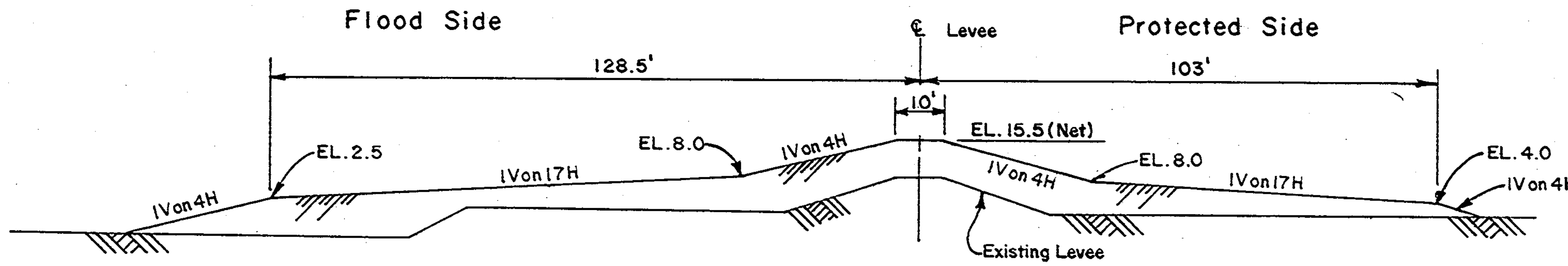
FILE NO. H-2-29706

PLATE A-I-47

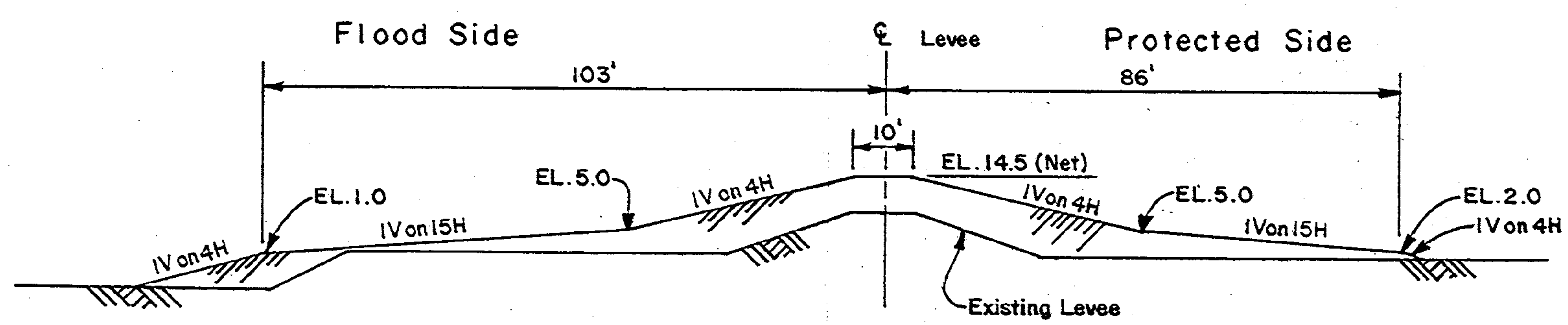
PLATE A-I-47



HLP—SPH PROTECTION



HLP—100 YEAR HURRICANE PROTECTION



BARRIER PLAN—SPH PROTECTION

LITTLE WOODS TO I-10
MAXENT CANAL LEVEE

NOTE:
1. HLP - high level plan
2. SPH - standard project hurricane
3. Cross - Sections - not - to - scale
4. All Elevations in Ft. N.G.V.D.

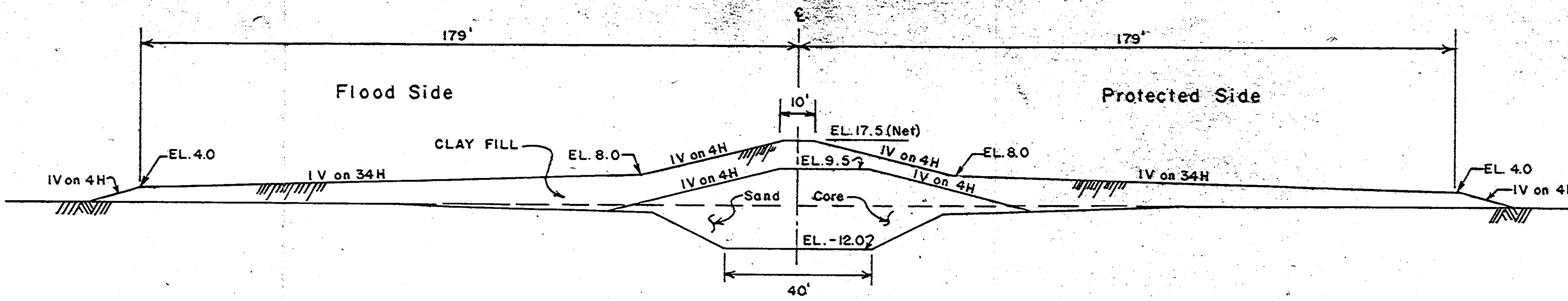
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE
CROSS-SECTIONS

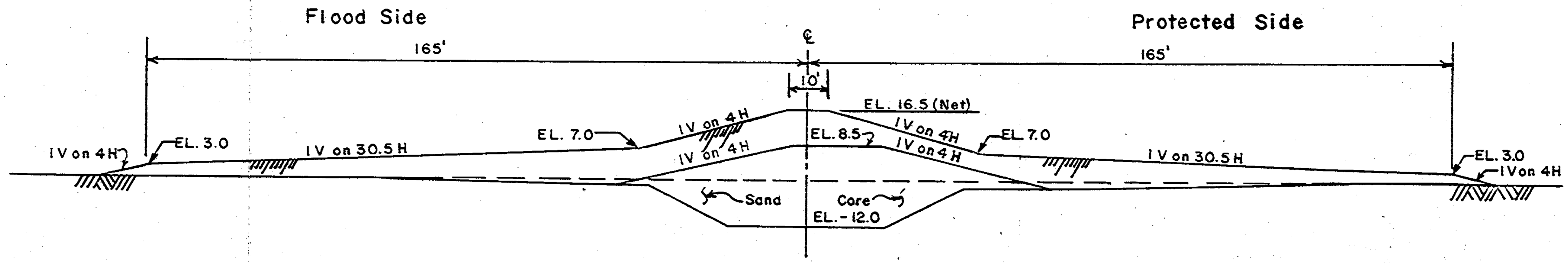
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO. H-2-29706

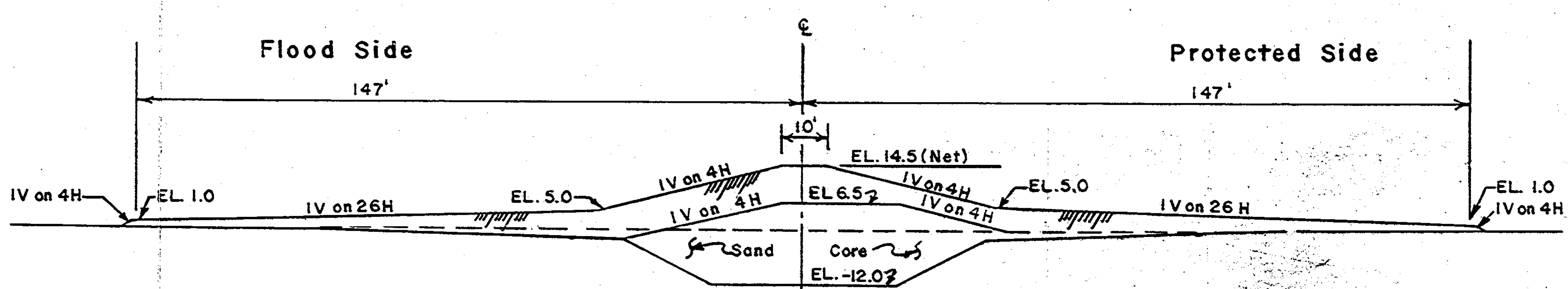
PLATE A-1-48



HLP-SPH PROTECTION



HLP — 100 YR. HURRICANE PROTECTION



BARRIER PLAN—SPH PROTECTION

I-10 TO NEW ORLEANS EAST BACK LEVEE

MAXENT CANAL LEVEE

NOTE:

1. HLP-high level plan
2. SPH-standard project hurricane
3. Cross-Sections-not-to-scale
4. All Elevations in Ft. N.G.V.D.

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

TYPICAL LEVEE
CROSS-SECTIONS

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

FILE NO. H-2-29706

PLATE A-I-49

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION II - FOUNDATION DESIGN AND GEOLOGY

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION II - FOUNDATION DESIGN AND GEOLOGY

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Table of Contents (cont'd)

SECTION II - FOUNDATION DESIGN AND GEOLOGY

Table of Contents (cont'd)

PLATES

Table of Contents (cont'd)

PLATES

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION II - FOUNDATION DESIGN AND GEOLOGY

1. Geology.

a. Physiography. The project area is located within the Central Gulf Coastal Plain Province on the northeastern flank of the Mississippi River Deltaic Plain. Physiographic features in the area include Lake Pontchartrain to the north, the Mississippi River to the south, and numerous ponds, lagoons, bayous, swamps, marshes, natural levees and abandoned distributaries. Natural relief in the area is very slight with elevations ranging from over 10 feet below the National Geodectic Vertical Datum (NGVD) in the Gentilly-New Orleans East area to slightly more than 10 feet above (NGVD) on the natural levees bordering the Mississippi River.

b. General Geology.

(1) Pleistocene Sediments. The oldest sediments that were encountered in borings taken for this project are Pleistocene in age. These deposits, known as the Prairie Formation, were laid down during the last major interglacial stage in a deltaic or shallow marine environment, were exposed to weathering and sub-aerial erosion during the last glaciation, and have been buried by onlapping Holocene deposits within the last 6,000 years. The surface of the Prairie Formation slopes Gulfward at the rate of about 2 feet per mile from its outcrop area north of Lake Pontchartrain.

The Pleistocene sediments typically consist of well-oxidized firm to stiff silty and sandy clays. In general, the silty clays are more common in the western portion of the project area while the sandy clays are more common in the eastern portion. In both cases, the sediments have a distinctively lower water and organic content and high strengths than the Holocene sediments above.

(2) Geomorphic History. The depositional history of the Holocene sediments is especially relevant to this project. At the end of the Pleistocene epoch, sea level was 400 to 450 feet lower than at present and the Mississippi River began to aggrade the final entrenchment which it had cut during the last glacial period. About 5,000 years ago, as sea level approached its present stand, the Mississippi River began to migrate laterally back and forth across the alluvial valley region. Delta lobes of the Mississippi River system began a series of progradationsto the

the south of the project area about 4,700 years ago with the initiation of the St. Bernard delta complex. As the river continued to shift to steeper gradient courses, the Bayou Sauvage distributary was initiated (about 1,900 years ago) and soon became the primary source of sediments in the project area. Deposition at first was concentrated in a depression between the older St. Bernard delta lobes to the south and Pine Island, a relict beach trend, to the north. Pine Island was gradually buried by deltaic deposits of Bayou Sauvage and its distributaries which extended to the south and east of the project area. Deposition from this source continued at a decreasing rate until about 700 years ago when the main Mississippi River course shifted south and west to the Plaquemine-Modern and LaFourche delta complexes and only occasional seasonal flooding brought new sediments into the project area. Finally, the levee systems constructed along the Mississippi River eliminated seasonal flooding of lands adjacent to the river, and consequently the annual sediment supply formerly introduced into the project area was halted.

(3) Holocene Sediments. The thickness of Holocene deposits, which lie uncomformably upon the Pleistocene in the project area, ranges from 0 at the Pleistocene outcrop, north of Lake Pontchartrain to over 100 feet near Caenarvon along the Mississippi River. Deposits in the marsh and swamplands of the project area consist of a surface stratum of peat and very soft highly organic clay up to 15 feet thick, overlying soft and very soft gray clay containing lenses and local zones of loose silt.

Underlying and adjacent to the present marsh and swamp deposits are sediments deposited directly by the Mississippi River. In the project area, these sediments are of two types -- Abandoned Distributary and Interdistributary. Abandoned Distributaries, such as Bayou Sauvage, are filled with accumulations of clayey sediments up to 50 feet thick. Coarser materials (sandy and silty clays) are generally found in the western limits of such distributaries, while finer, denser clays are found eastward. Between these ancient distributary courses, Interdistributary clay wedges form. These clays generally are less than 25 feet thick and usually have minor amounts of silt and fine sand throughout the matrix. Along the southern and eastern shores of Lake Pontchartrain, Relict Beaches, consisting of up to 40 feet of generally fine clean sand and abundant shell fragments underlie Mississippi River alluvium and rest upon the older Nearshore Gulf and Bay-Sound deposits which were created as the river prograded its St. Bernard Delta course. The Nearshore Gulf deposits consist mainly of fine-grained silty and clean sands with occasional layers and pockets of small shell fragments. The Bay-Sound deposits are characteristically non-cohesive, consisting of soft to medium gray silt, silty sand, or fine clean sand. Shells and shell fragments are abundant, being either scattered throughout the Bay-Sound deposits or concentrated into thin layers.

c. Subsidence. The project area lies in a region of active subsidence and downwarping which have been occurring since the end of the Pleistocene epoch. The Pleistocene surface has downwarped toward the south and west. From its outcrop area north of Lake Pontchartrain, it has been depressed to a depth of approximately 500 feet near the edge of the continental shelf, about 80 miles south of New Orleans. The overall rate of regional subsidence has been about 0.4 feet per century. Local subsidence within the project area has accelerated in recent years due to increased groundwater withdrawal rates and extensive land reclamation projects in the New Orleans area.

2. Foundation Investigation and Design.

a. General. This section presents the soils, foundation exploration and conditions, and the design for the alternative plans study of the Hurricane Protection Plan. All elevations shown refer to the National Geodectic Vertical Datum (NGVD). Included are designs and/or discussions for the alternative plan features based on three different hydraulic loading conditions:

(1) Standard project hurricane with the Seabrook, Chef Menteur, and Rigolets barriers in place (Barrier Plan).

(2) Standard project hurricane (SPH) without the barriers (High-Level) SPH Plan.

(3) 100-year frequency hurricane without the barriers (High-Level 100-Year Plan).

b. Field Exploration. Soil boring data from completed Barrier Plan design memoranda were available for this study. In addition, boring data for areas not included in the Barrier Plan design memoranda were made available as follows:

(1) St. Charles Parish Airline Highway Levee - North and South Alinements. Four borings were taken for this study along these new alinements. (See plates A-II-1 through A-II-4.) Boring locations are shown on plate A-III-3 of Section III of this Appendix.

(2) Jefferson Parish Return Levee Alinement. One boring was taken for this study along this alinement (plate A-II-5) to verify soils data presented in the report "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company. Boring location is also shown on plate A-III-3.

(3) Jefferson Parish Lakefront Levee Alinement. Boring data for this feature were obtained from the soils data presented in the report "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company.

(4) Orleans Parish Lakefront West of IHNC Levee Alinement. Representative boring data for this feature were obtained from a boring program taken for the incomplete Barrier Plan design memorandum on this feature. (See boring plates A-II-6 through A-II-8.) Boring locations are shown on plate 5 of the main text.

(5) New Orleans East Maxent Canal Levee Alinement. Four borings were taken for the study along this new alinement (plates A-II-9 through A-II-12). Boring data from completed Barrier Plan design memoranda at each end of this reach were also utilized. Boring locations are shown on plate A-III-7.

c. Laboratory Tests. Visual classifications were made from samples obtained from the borings. Water content determinations were made on cohesive soil samples. Unconfined compression (UC), unconsolidated-undrained (Q), consolidated-undrained (R), and consolidated-drained (S) shear tests and consolidation (C) tests were performed on representative soil samples from undisturbed borings. Liquid and plastic limits were also determined for various samples. For the features where the Barrier Plan design memoranda are complete, the boring logs and test results are presented therein. For the incomplete Barrier Plan design memoranda and for the new alinements where soil conditions vary considerably from those previously presented in completed design memoranda, boring logs with test data are shown on plates A-II-1 through A-II-12. Limited test data are available for the borings taken along the new alinements. In such cases, test data from similar borings in the area were used to supplement this limited test data (refer to discussions on stability for information on supplemental test data).

d. Foundation Conditions. Soil and geologic profiles for feature alinements included in completed Barrier Plan design memoranda are presented therein. For those alinements not included in the completed design memoranda, the following descriptions are presented:

(1) St. Charles Parish Airline Highway Levee.

(a) North Alinement. The subsurface along this alinement consists generally of 12 to 15 feet of very soft, highly organic clays overlying 40 to 50 feet of recent deposits of silts and very soft to soft clays. The recent deposit is underlain by a Pleistocene formation of overconsolidated clays and sands encountered at approximate elevation -53 on the west end at the Bonne Carre Spillway guide levee and at approximate elevation -75 on the east end at the Jefferson Parish Return Levee.

(b) South Alinement. The subsurface along this alinement is essentially the same as that for the north alinement, except that the recent deposits are of a soft to medium consistency. There is also less organic clay in the upper material.

(2) Jefferson Parish Return Levee Alinement. The subsurface consists of levee fill made up of sandy silt and soft to stiff clays from the ground surface to an approximate bottom elevation of -8. This fill material is underlain by very soft peat to approximate elevation -20. Very soft to soft clays underlie the peat extending down to the top of the Pleistocene formation at approximate elevation -75. Refer to the report "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company for more detailed description.

(3) Jefferson Parish Lakefront Levee Alinement. The subsurface consists of levee fill of clays varying from soft to very stiff underlain by a 3 to 5-foot thick layer of peat. Beneath the peat, very soft to soft clays extend to the top of medium to stiff clays and sandy clays at elevations varying from -40 to -55. Beneath the medium to stiff clays and sandy clays lies the Pleistocene formation located at approximate elevation -72 on the west end and at approximate elevation -60 on the east end. Refer to the reports, "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company, and the "Lake Pontchartrain, La., and Vicinity, Interim Survey Report", dated 21 November 1962, for more detailed descriptions.

(4) Orleans Parish Lakefront West of IHNC Levee Alinement. The available soil data on this feature indicate the subsurface consists of approximately 6 to 10 feet of levee fill. The levee fill is underlain by 5 to 10 feet of organic soft clays and peat, which is underlain by a 40 to 50-foot layer of soft to medium clay containing a buried sand beach. The buried beach varies between 3 to 6 feet thick at approximate elevation -35 on the west end, and 15 to 35 feet thick between elevations -10 and -45 on the east end of the reach. The Pleistocene formation is located below these recent deposits and varies between approximate elevation -60 on the west end and elevation -55 on the east end.

(5) Maxent Canal Levee Alinement. The subsurface along this alinement can be broken into three reaches basically consisting of 40 to 50 feet of recent deposits overlying a Pleistocene formation of stiff to hard clays, silts, and sands.

(a) New Orleans East Lakefront Levee to the Turn at I-10. The subsurface consists of 8 to 10 feet of levee fill underlain by 3 to 14 feet of medium clays and silts. Beneath this lie alternate layers of sand, silt, and soft to medium clays extending down to the top of the Pleistocene formation at approximate elevation -40.

(b) I-10 to Highway 90. The subsurface consists of 3 to 6 feet of canal dredge spoil over 7 to 10 feet of peat and highly organic, very soft clays. Beneath this lie alternate layers of sand, silt, and very soft to soft clays extending down to the top of the Pleistocene varying between elevation -35 and -40.

(c) Highway 90 to the New Orleans East Back Levee. The subsurface consists of 3 to 6 feet of canal dredge spoil over 7 to 10 feet of peat and highly organic, very soft to stiff clays. Beneath this lie very soft to medium clays, extending down to the top of the Pleistocene formation varying between elevation -40 and -50.

e. Design and Construction Problems. The low shear strengths and highly compressible nature of the recent foundation soils, relocation of utilities, and provisions for interior drainage facilities combine to produce major design and construction problems. Other problems include methods of construction, sources of fill material, and erosion protection.

f. Stability Analysis. In most cases, the low shear strengths of the highly compressible Recent deposits governed the design. Stable sections for levees and/or I-walls were determined using available soils data for each feature. Adjustments were made to the final sections to allow for estimated long-term settlements. The resulting gross sections were analyzed for stability using the method of planes analysis and available shear strengths. Factors of safety of 1.3 were applied for design. The following are discussions of the analyses performed on each feature:

(1) Chalmette Area. Only the standard project hurricane protection and the authorized alinement are considered in this study. Therefore, the design sections presented in the applicable feature Design Memoranda (GDM No. 3 and Supplement No. 1 to same) were used for this study.

(2) St. Charles Parish. Three alinements were considered in St. Charles Parish.

(a) Lakefront Levee Alinement. An all earthen embankment was considered for this alinement. Adequate Barrier Plan design sections are presented in the approved Barrier Plan GDM No. 2, Supplement No. 6; therefore, no other analyses were performed for this plan. Stable earth embankment design sections were determined for the High-Level SPH and High-Level 100-Year Plans based on soils data presented in the Barrier Plan GDM. Estimated increases in settlement were applied to the sections due to the increased loading of the higher embankments.

(b) Airline Highway North Alinement. An all-clay embankment; a sand-core embankment; and an all-clay embankment with I-wall were considered. Soil stratification was determined from the borings made along this alinement for this study, specifically borings 2-SCJU, 4-SCJU, and 5-SCJU. The design shear strengths used were based on limited test data from these borings together with test data from similar borings presented in the St. Charles Lakefront Levee GDM. Settlement was estimated to be similar to that used for the Lakefront alinement. Stable design sections were determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year - and for each type of protective structure considered.

(c) Airline Highway South Alinement. An all-clay embankment; a sand-core embankment; and an all-clay embankment with I-wall were considered. Borings 2-SCJU, 3-SCJU, and 5-SCJU, made along the south alinement for this study indicate approximately the same stratification but slightly better shear strengths than that along the north alinement. Also, the south alinement incorporates much of the north alinement. Therefore, the same design sections determined for the north alinement were applied to the south alinement.

(3) Jefferson Parish Return Levee Alinement. An earthen embankment and an earthen embankment with I-wall were considered. Soil stratification was determined from boring 1-JU taken along this alinement for this study in conjunction with the borings presented in the report "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company. Design shear strengths were based on a combination of limited test data from Boring No. 1-JU and test data presented in the above-mentioned report. Settlements were estimated and stable sections determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year - and for each type of protective structure considered.

(4) Jefferson Parish Lakefront Levee Alinement. An earthen embankment and an earthen embankment with I-wall were considered. Soil stratification and design shear strengths presented in the report, "Subsoil Investigation, Lake Pontchartrain Protection Levee, 1967 Improvements, Jefferson Parish, La.", dated 6 November 1967, by Eustis Engineering Company were used for design. Adequate Barrier Plan sections are presented in the above-mentioned Eustis report. Settlements were estimated and stable design sections were determined for the High-Level SPH and High-Level 100-Year plans and for each type of protective structure considered.

(5) Orleans Parish Lakefront West of IHNC Levee Alinement. An earthen embankment and an earthen embankment with I-wall were considered. Stratification and design shear strengths used for this feature were obtained from representative borings and testing made for the incomplete design document on this feature. Estimated settlements were small. Stable design sections were determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year - and for each type of protective structure considered.

(6) Citrus Lakefront Levee. Two alinements were considered along Citrus Lakefront. Settlement was based on that presented in the approved Barrier Plan GDM.

(a) Landside of the Southern Railway Tracks Alinement. An earthen embankment and an earthen embankment with I-wall were considered. Adequate design sections for the Barrier Plan are presented in the approved Barrier Plan GDM No. 2, Supplement No. 5A; therefore, no other analyses were performed for this plan. Stable design sections were determined for the High-Level SPH and High-Level 100-Year Plans - and for each type of protective structure considered with adjustments for estimated settlement. Stratification and design shear strengths were based on these presented in the Barrier Plan GDM.

(b) In-the-Lake Alinement. A sand-core embankment was considered for this alinement. Stable design sections were determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year. Stratification and design shear strengths were based on those presented in GDM No. 2, Supplement 5A on this feature, in conjunction with soils data presented in the feature GDM for the New Orleans East Lakefront Levee (GDM No. 2, Supplement No. 5B) from which boring data for the lake are available.

(7) New Orleans East Lakefront Levee. Two alinements were considered along New Orleans East Lakefront. Settlement was based on that presented in the approved Barrier Plan GDM.

(a) Landside of the Southern Railway Tracks Alinement. An earthen embankment was considered for this alinement. Adequate design sections for the Barrier Plan are presented in the approved GDM No. 2, Supplement 5B; therefore, no other analyses were performed for this plan. Stable earthen embankment design sections were determined for the High-Level SPH and High-Level 100-Year Plans. Stratification and design shear strengths used were based on those presented in the Barrier Plan GDM.

(b) In-the-Lake Alinement. A sand-core embankment was considered for this alinement. Stable design sections were determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year. Stable design sections were determined based on the same stratification and design shear strengths used for the Citrus Lakefront In-the-Lake alinement discussed above.

(8) Lake Pontchartrain to the GIWW Levee. Two alinements were considered to extend between the lakefront levees and the back levees along the GIWW.

(a) South Point to GIWW Alinement. An earthen embankment was considered for this alinement. Adequate design sections are as presented in the approved Barrier Plan GDM No. 2, Supplement No. 9; therefore, no other analyses were performed for this plan. Stable earthen embankment design sections were determined for the High-Level SPH and High-Level 100-Year Plans based on the stratification, design shear strengths, and estimated settlements presented in the Barrier Plan GDM.

(b) Maxent Canal Alinement. An earthen embankment was considered for this alinement. Stable design sections were determined for each plan - Barrier, High-Level SPH, and High-Level 100-Year. Stratification, design shear strengths, and estimated settlements were developed from borings taken along the alinement together with borings from the Citrus Lakefront Levee and the New Orleans East Back Levee.

(9) Barrier Structures. The analyses required for the barrier complexes - Seabrook, Rigolets, and Chef Menteur - are contained in their respective Barrier Plan Supplements to GDM No. 2. No other analyses were performed for the recommended barrier complex alinements or their alternative alinements presented in their respective feature documents and appendices thereto.

g. Floodwall Analysis.

(1) Cantilever I-Wall Shear Stability. The stability and required penetration of the sheet pile I-wall were determined by the method of planes analysis based on the short-term (Q-case) shear strengths and the long-term (S-case) shear strengths. The case which required the deepest penetration was used for design. A factor of safety of 1.5 was applied to the design shear strengths as follows: C developed = cohesion/ (factor of safety), and Ø developed = $\tan^{-1}$ [(tan Ø available)/ (factor of safety)]. Using the resulting shear strengths, net lateral water and earth pressure diagrams were determined for movement toward each side of the sheet pile. Using these distributions of pressure, the summation of horizontal forces was equated to zero for various tip penetrations. At these penetrations summations of overturning moments about the tip of the sheet pile were determined. The required depths of penetration to satisfy the stability criteria were determined as those where the summation of moments were equal to zero.

(2) T-Wall Analysis. Inverted T-type floodwalls supported by bearing piles are used at railroad and street crossing gates, control structures, pumping stations, or where conditions warrant. Adequate pile capacity analysis data is presented in the completed feature Design Memorandums for the Barrier Plan. This data is sufficient for cost estimating purposes for the High-Level SPH and 100-Year Plans; therefore, no other analyses were performed.

h. Seepage Control. Based on available soils and grain size data, seepage analyses were performed only in recognized problem areas. Representative analyses appear in the completed Barrier Plan GDM's. Where critical gradients exist, protective measures were installed into the design.

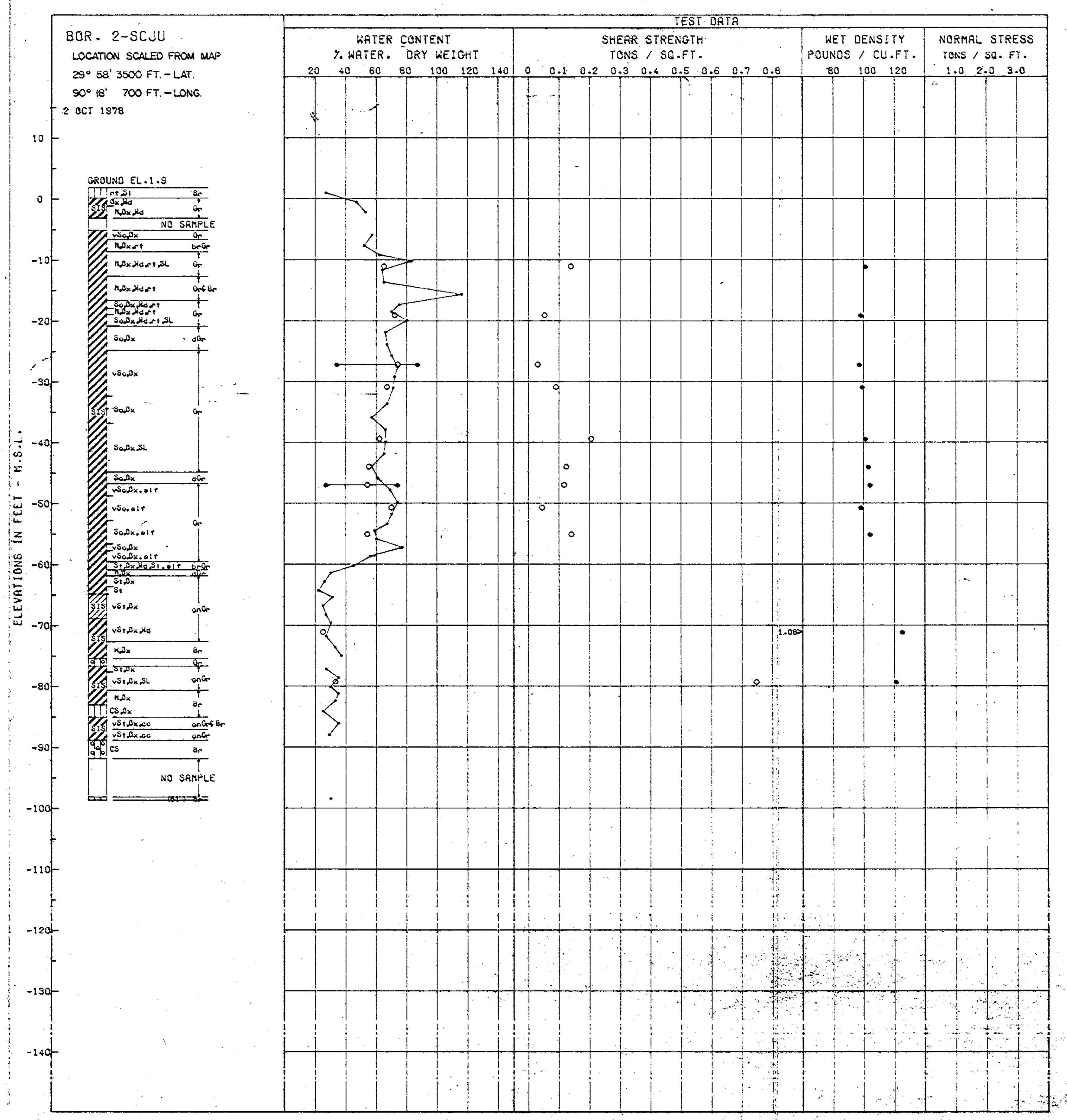
(1) Sheet Pile Cutoffs. Steel and concrete sheet piles were used beneath and adjacent to bearing pile supported structures to effectively lengthen the seepage path, thus reducing the existing gradient.

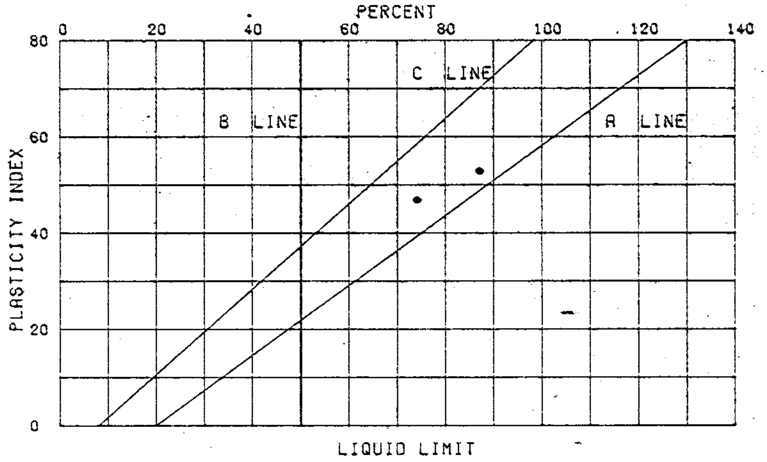
(2) Clay Plug Cutoffs. Clay plugs were used in design to provide protection against piping and to provide positive cutoff of seepage at locations where conditions were favorable for their use.

(3) Clay Blankets and Seepage Berms. Clay blankets and seepage berms were used in the design of levees to provide protection against piping and for the reduction of seepage gradients.

i. Settlement Analysis. Based on settlement data presented in completed Barrier Plan design memoranda, estimates of increased settlements from the higher High-Level design elevations were made along with estimates for new Barrier Plan protective structures. These settlement estimates were used to adjust the design sections before performing stability analyses and also to determine approximate gross yardage required in the earthen sections for cost estimating purposes. Because of the large amount of settlement that will occur on some levees, and the impracticability of providing sufficient fill in one lift to compensate for this settlement, these levees will be constructed in multi-lift stages.

j. Other Design Considerations. Other design considerations, such as methods and sequences of construction, construction excavation, construction dewatering, spoil and hydraulic effluent disposal, sources of borrow material, drainage and tidal flow flood control structures, permanent pressure relief, pile tests, erosion protection, utility and pipeline crossings, etc., are considered similar to that presented for the Barrier Plan. Therefore, these considerations, with small adjustments, may be used in the design of the High-Level Plans.





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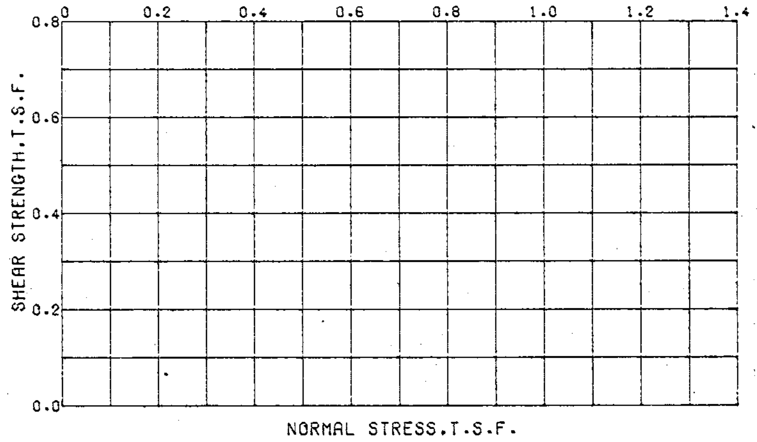

SHEAR STRENGTH DATA

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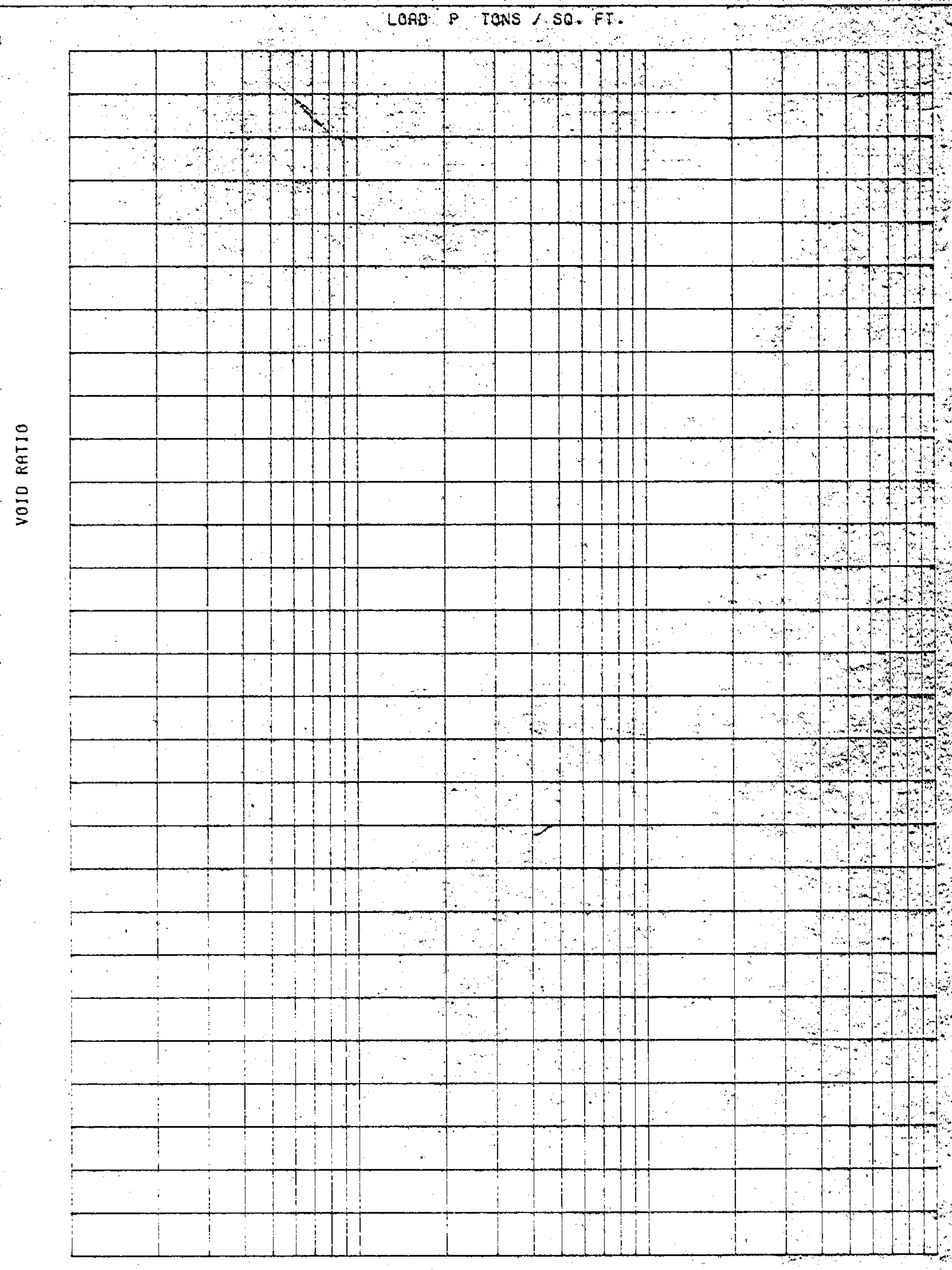

CONSOLIDATION DATA

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■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST

STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

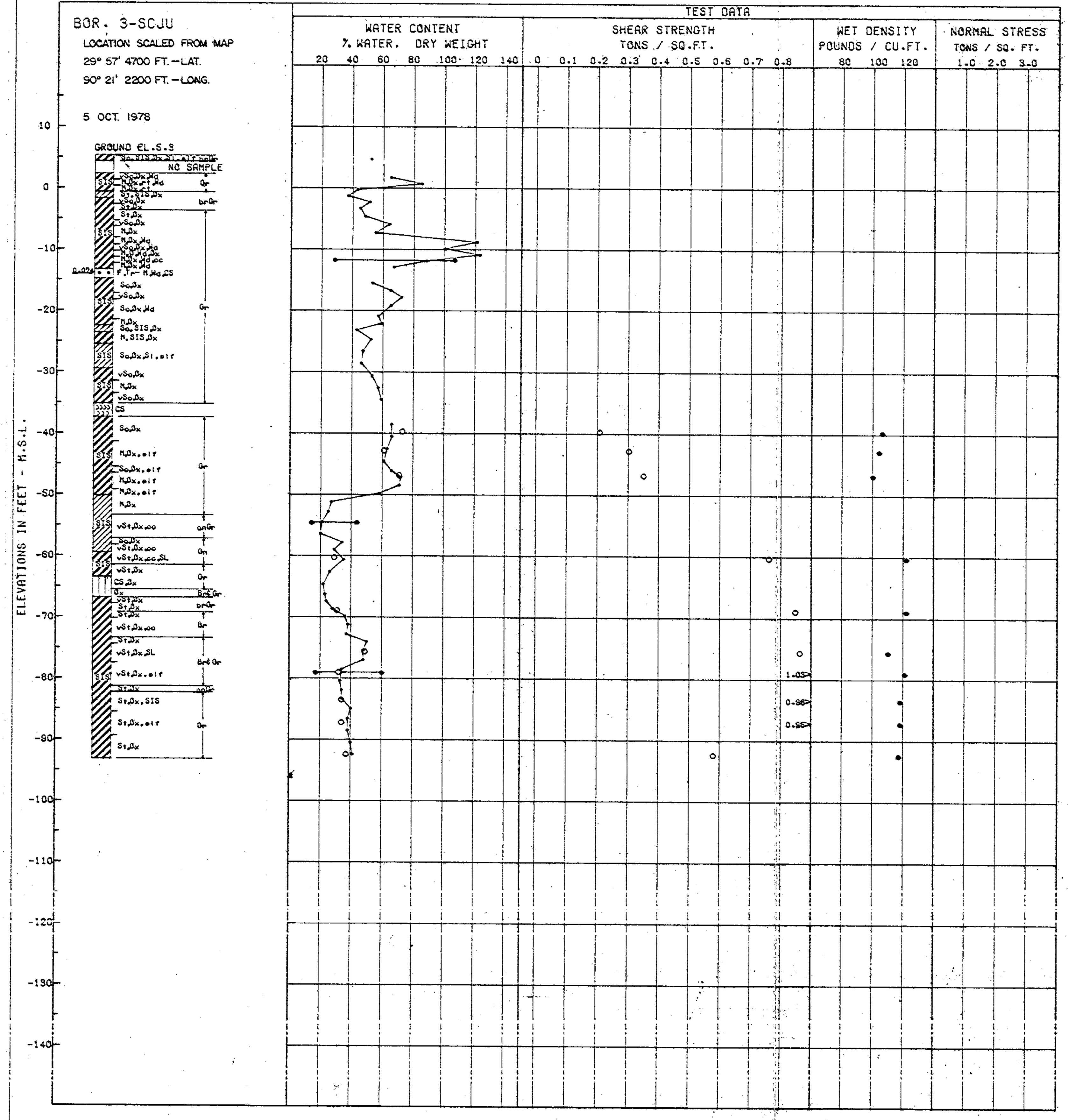
FOR LOCATION OF BORINGS SEE PLATE

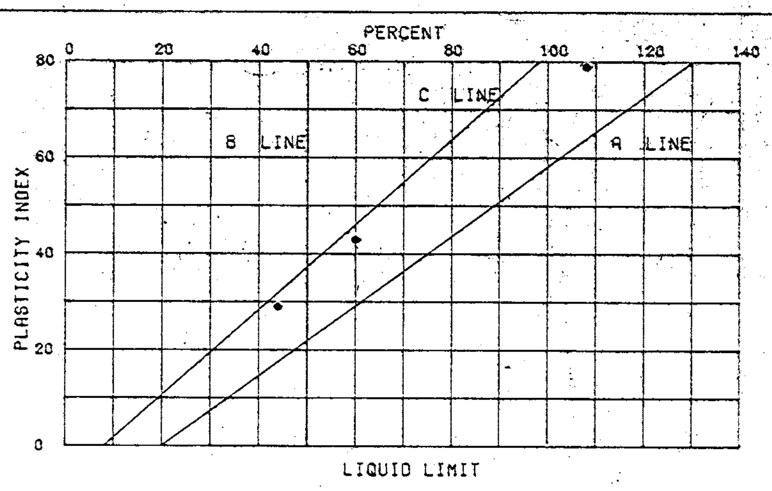
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ST. CHARLES PAR. AIRLINE HWY. LEVEE
NORTH AND SOUTH ALINEMENT

UNDISTURBED BORING DATA
BORING 2 - SCJU

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

OCTOBER 1979 FILE NO. H-2-29706





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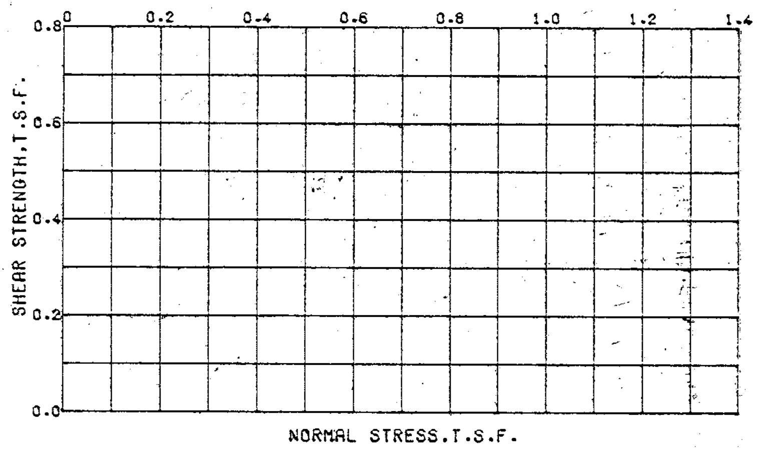

SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
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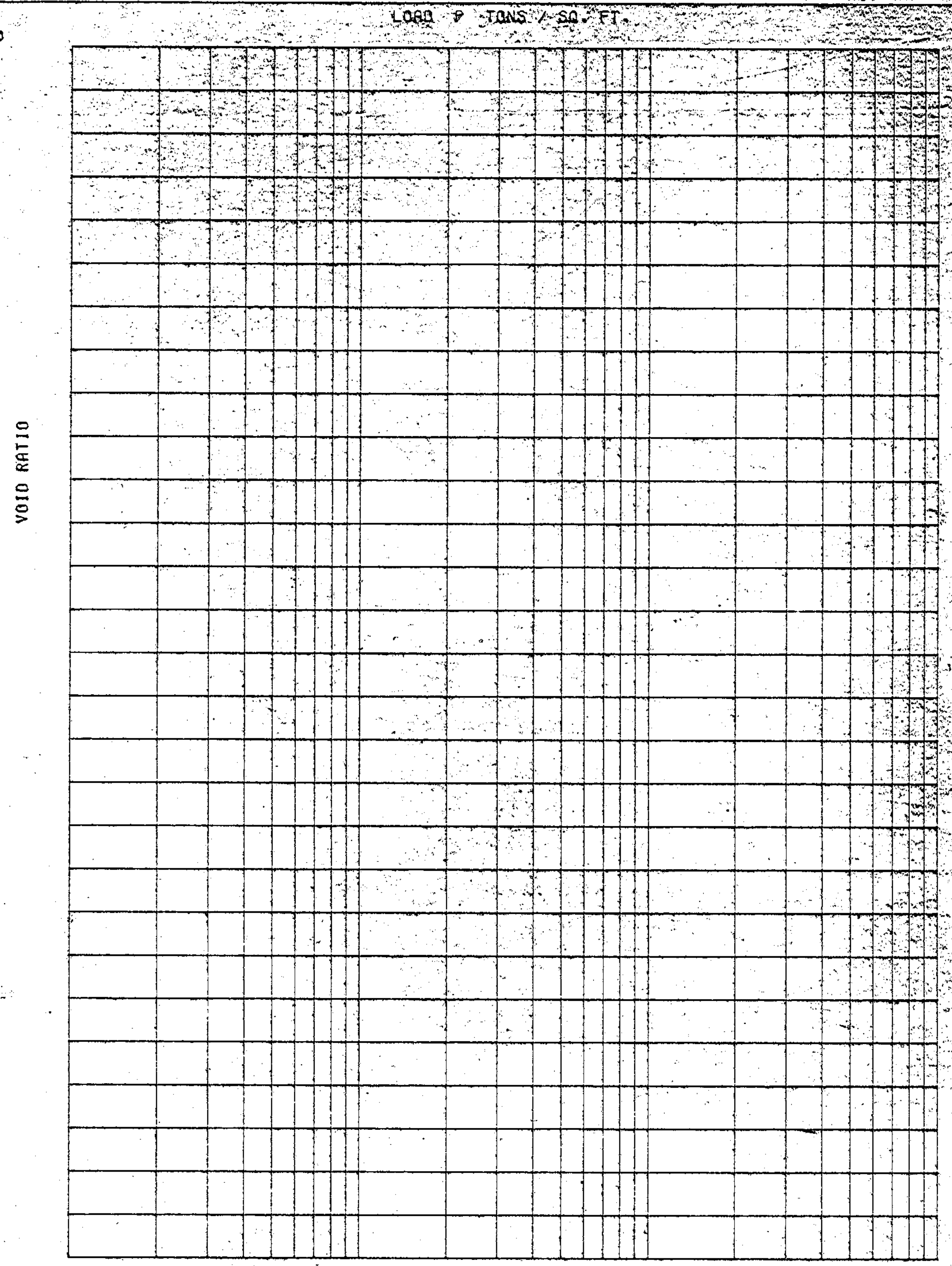

CONSOLIDATION DATA

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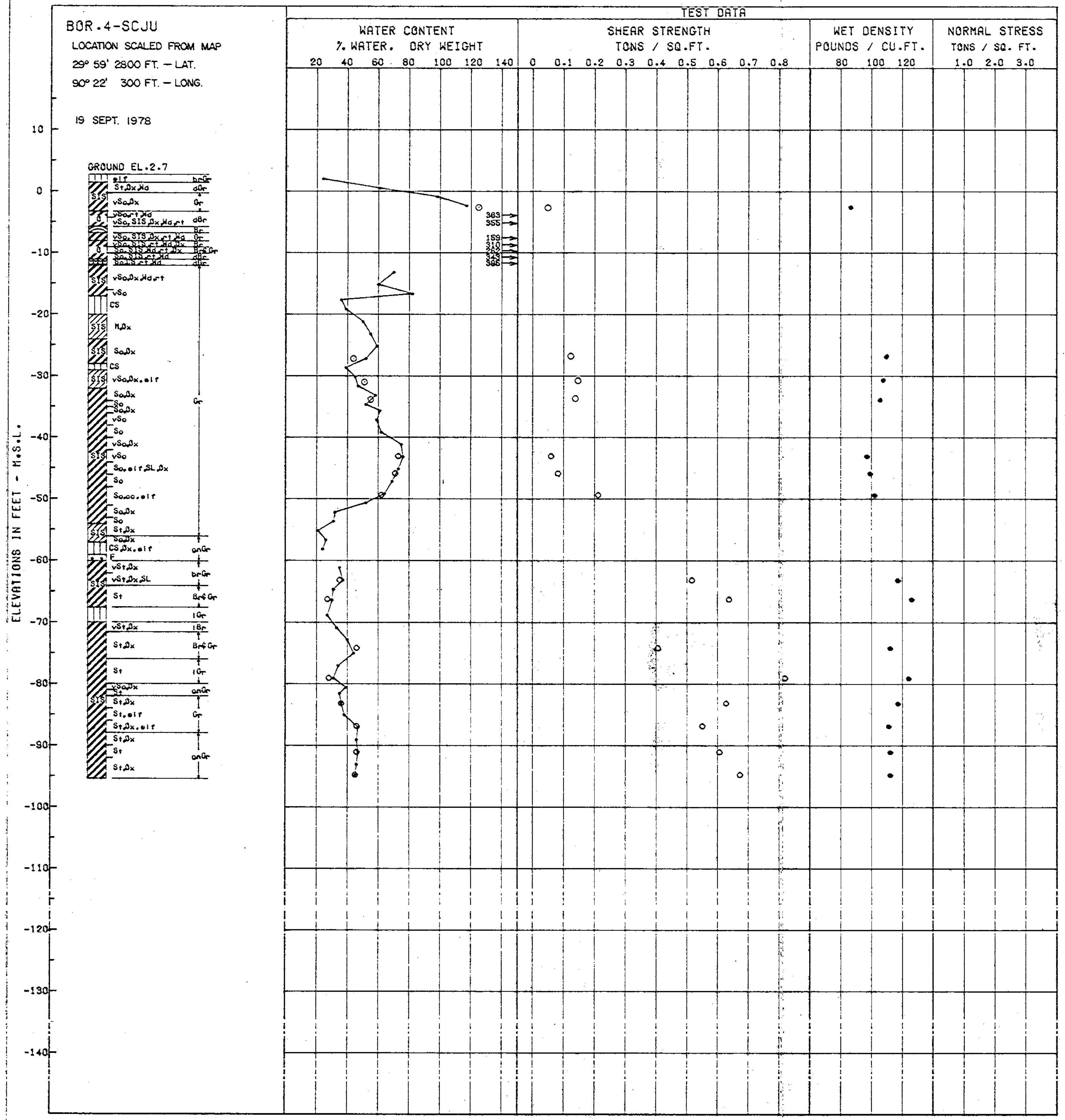
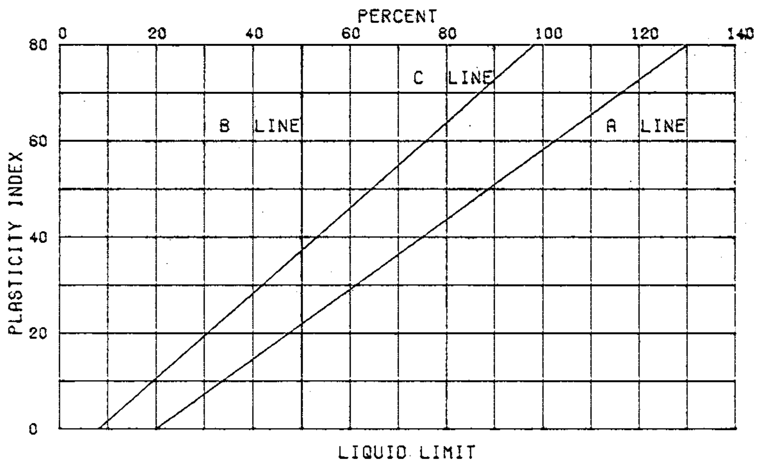
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊖ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ST. CHARLES PAR AIRLINE HWY. LEVEE
NORTH AND SOUTH ALINEMENT
UNDISTURBED BORING DATA
BORING 3 - SCJU
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979 FILE NO. H-2-29706

PLATE A- II-2





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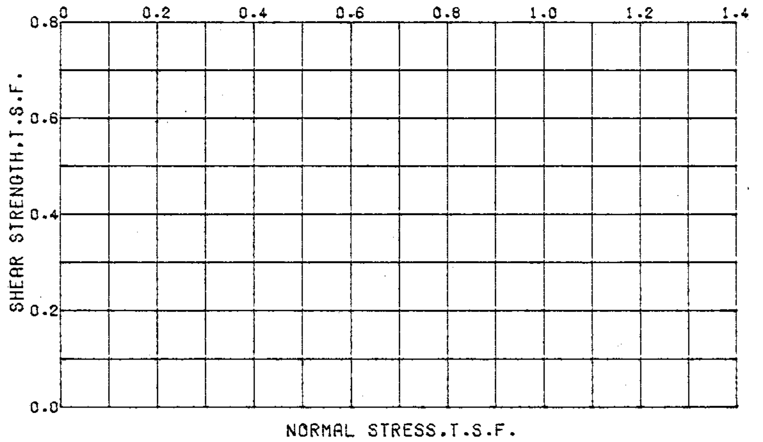

SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
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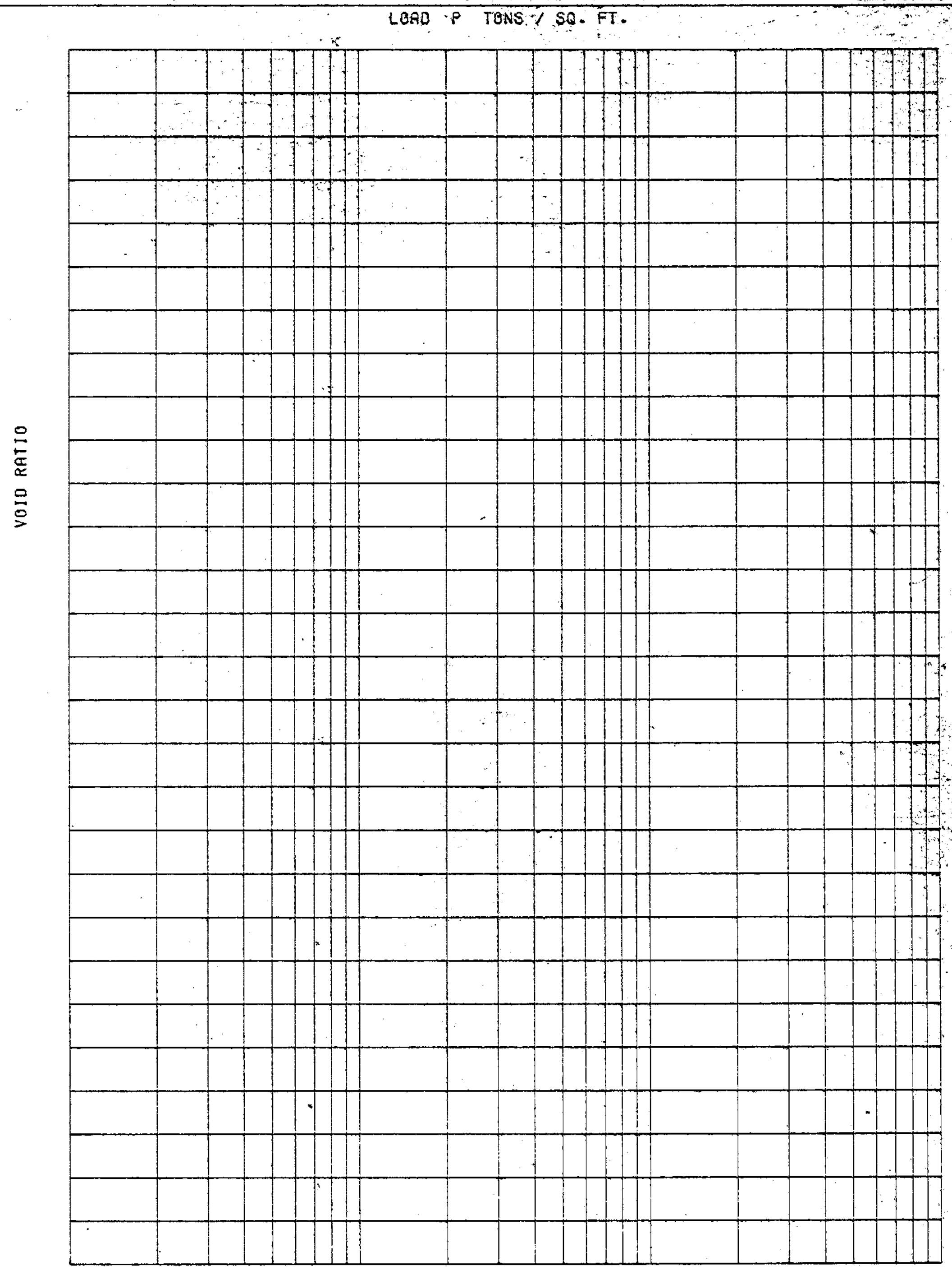

CONSOLIDATION DATA

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■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊖ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE 8
FOR LOCATION OF BORINGS SEE PLATE

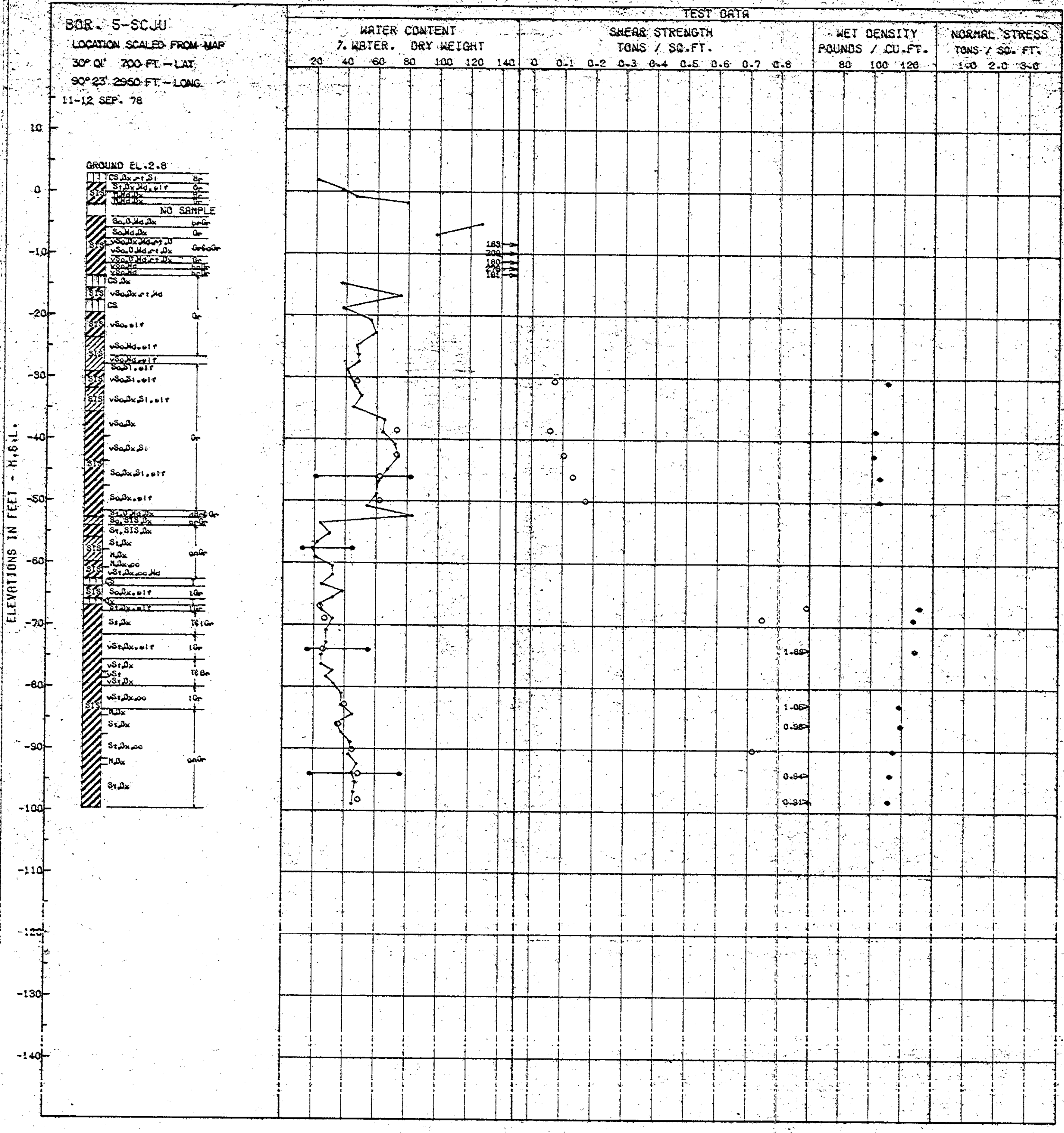
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ST. CHARLES PAR. AIRLINE HWY. LEVEE
NORTH AND SOUTH ALINEMENT

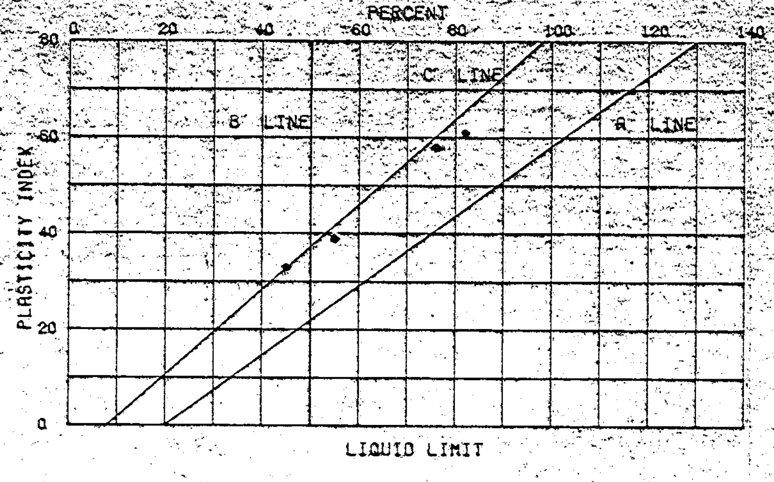
UNDISTURBED BORING DATA
BORING 4-SCJU

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

OCTOBER 1979 FILE NO. H-2-29706

BOR. 5-SCJU
LOCATION SCALED FROM MAP
30° 01' 700 FT. — LAT.
90° 23' 2950 FT. — LONG.
11-12 SEP. 78





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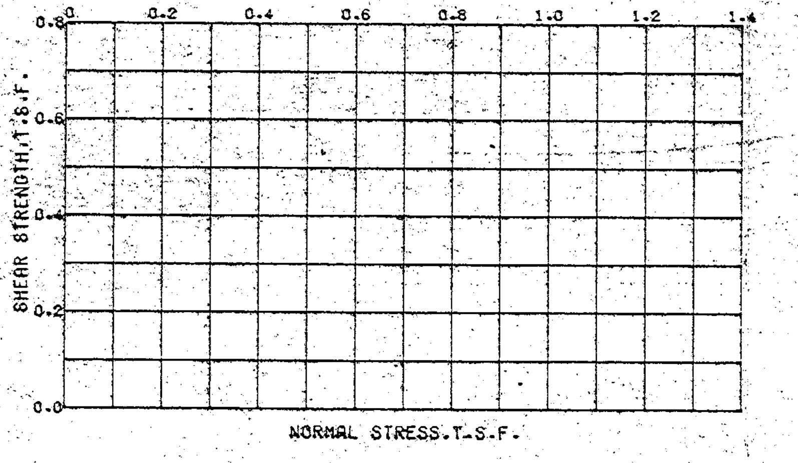

SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
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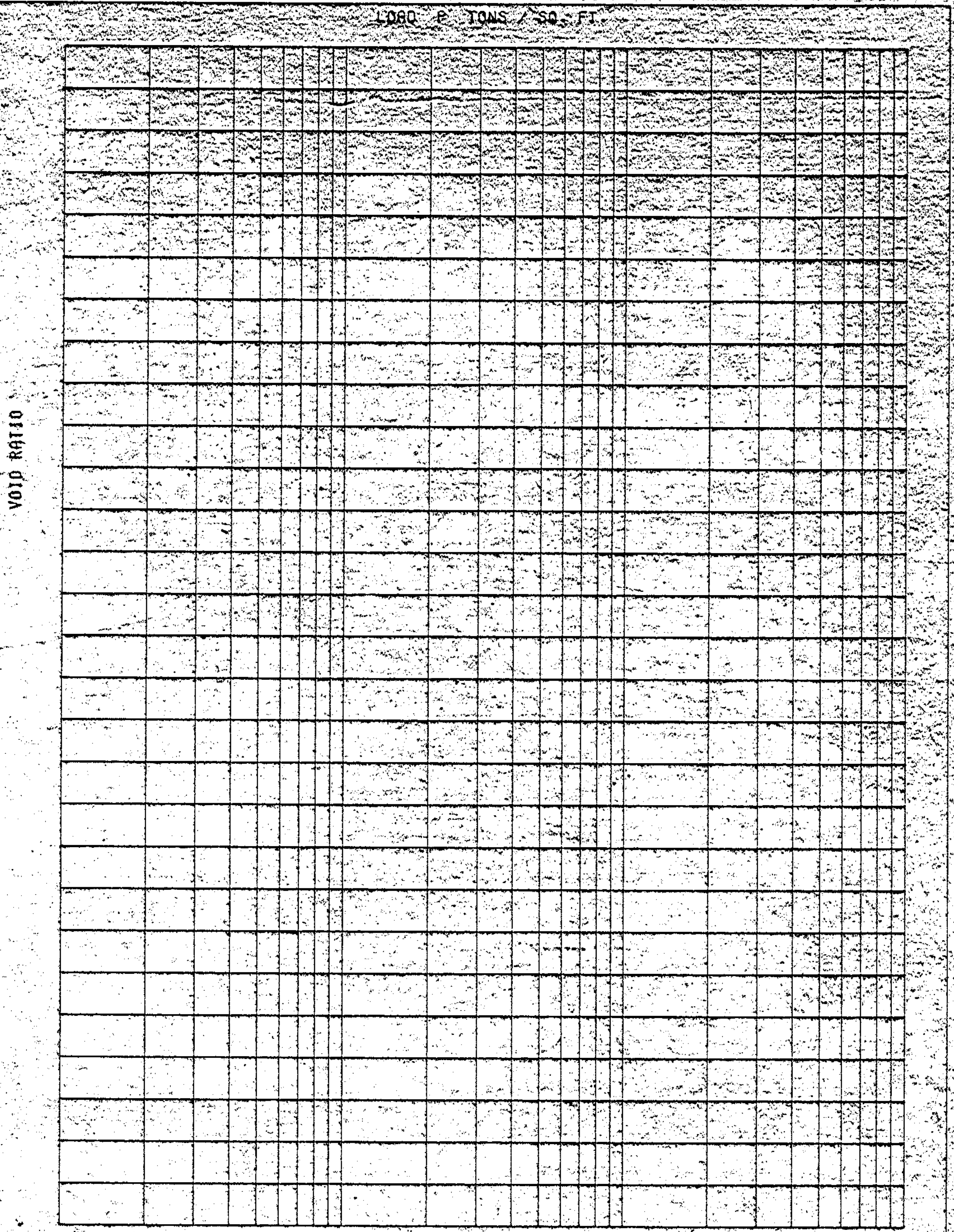

CONSOLIDATION DATA

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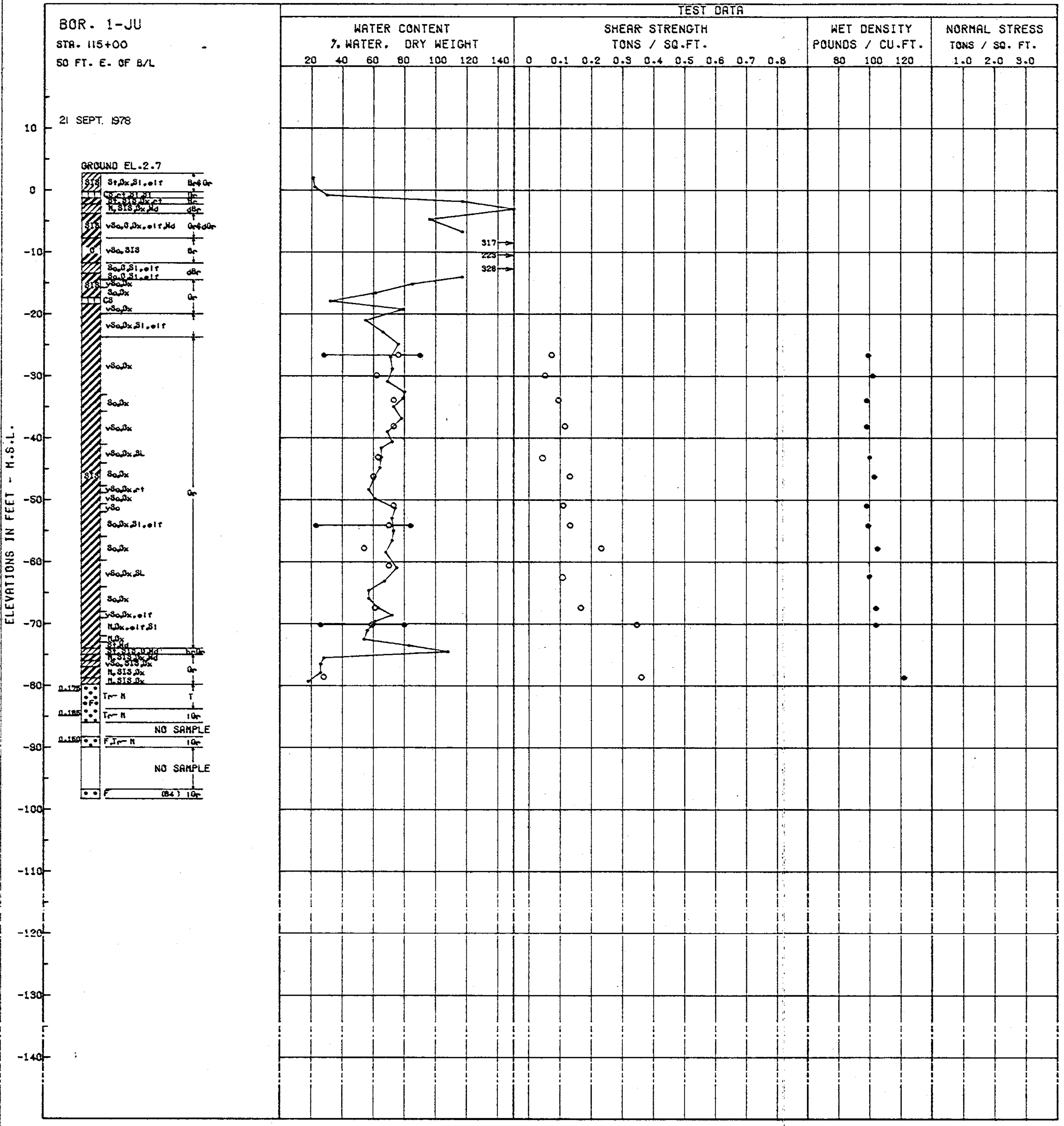
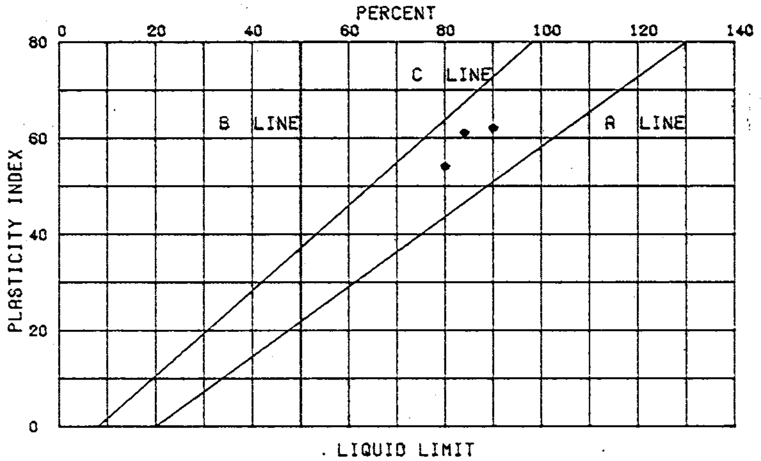
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ST. CHARLES PAR. AIRLINE HWY. LEVEE
~~NORTH AND SOUTH ALINEMENT~~
UNDISTURBED BORING DATA
BORING 5-SCJU
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979 FILE NO. H-2-29706





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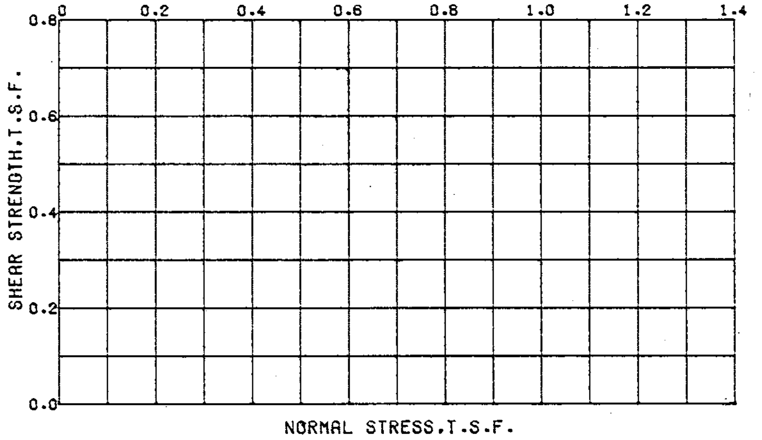

SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
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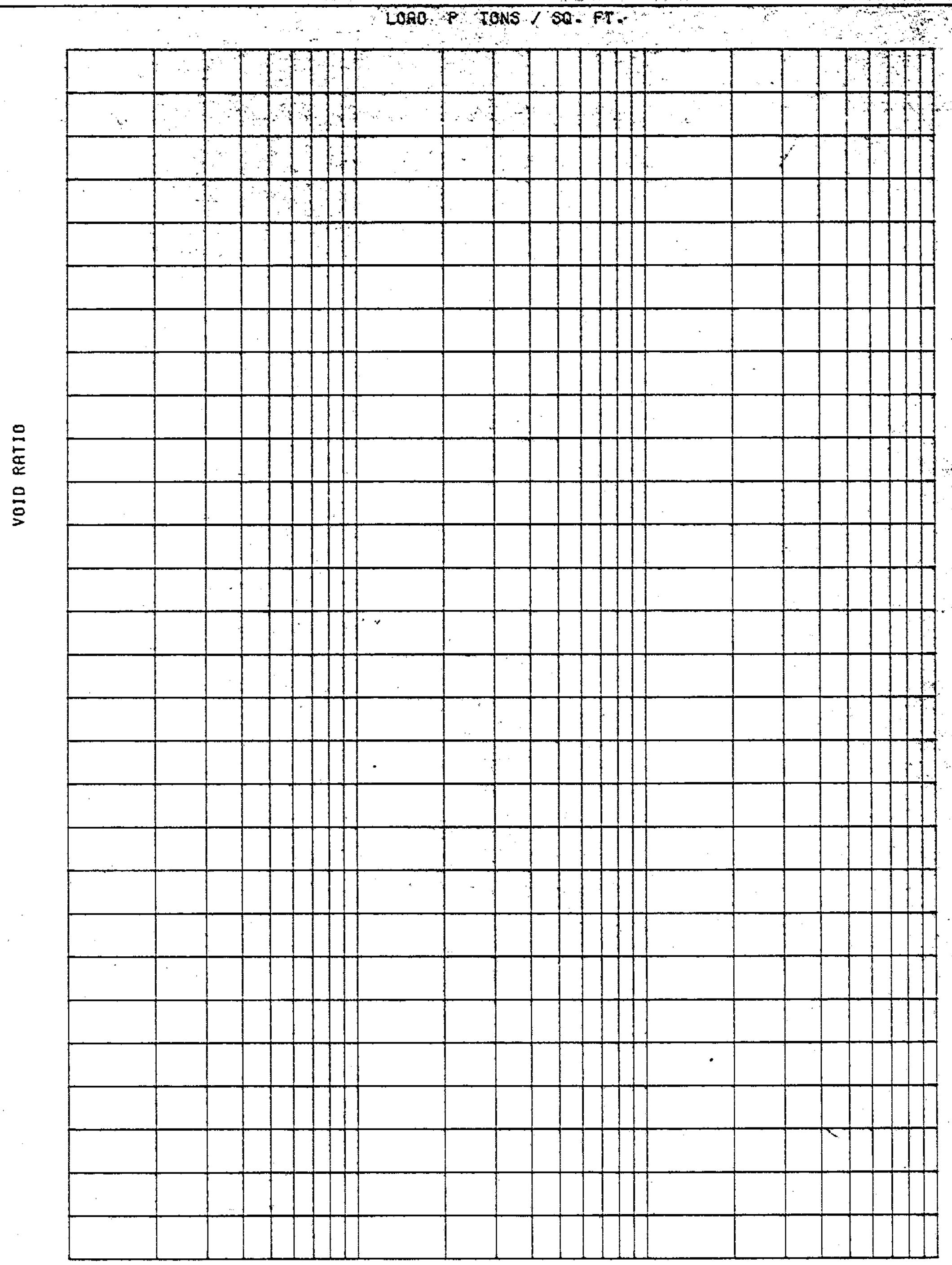

CONSOLIDATION DATA

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■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
□ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

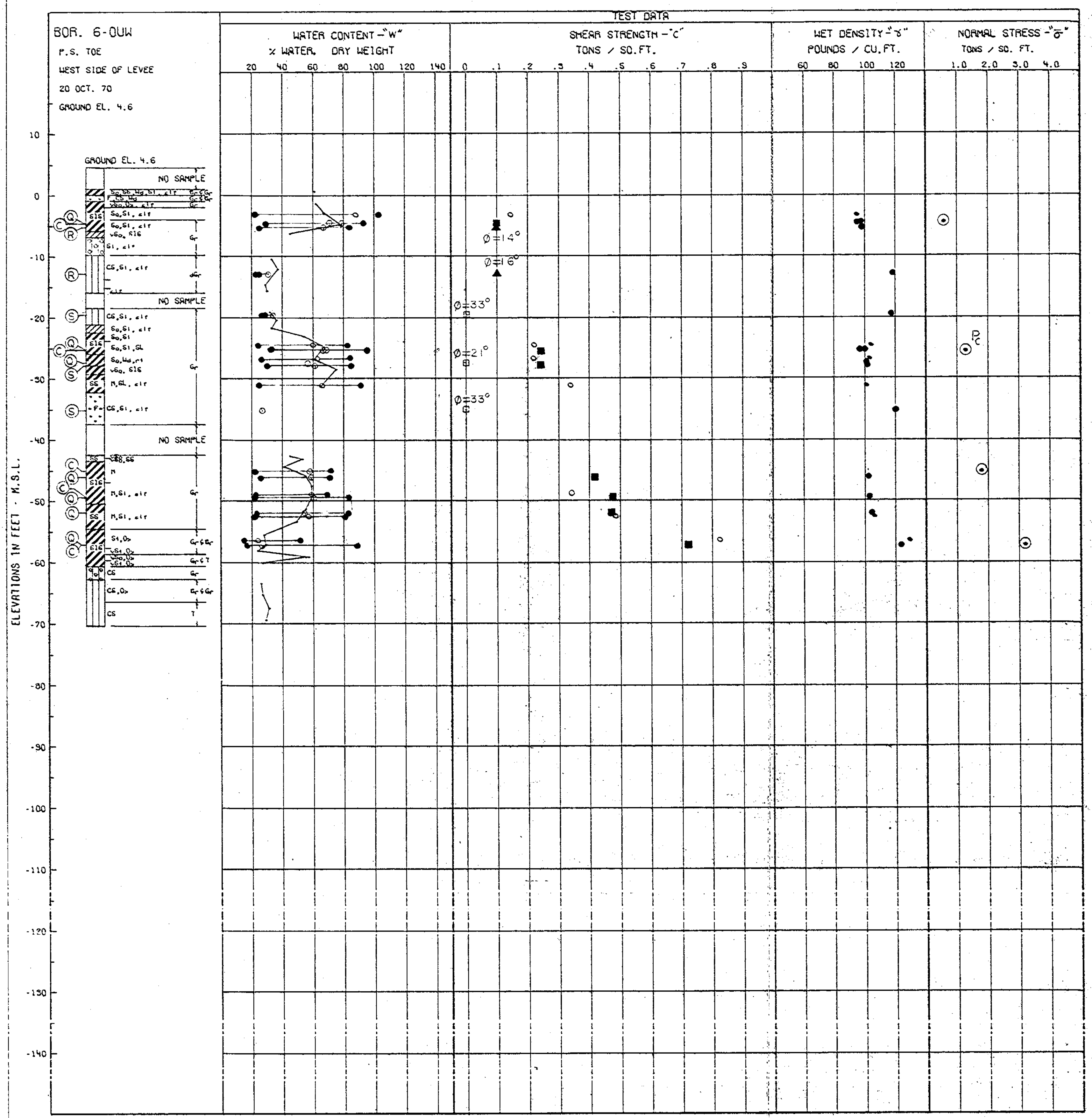
FOR SOIL BORING LEGEND SEE PLATE A

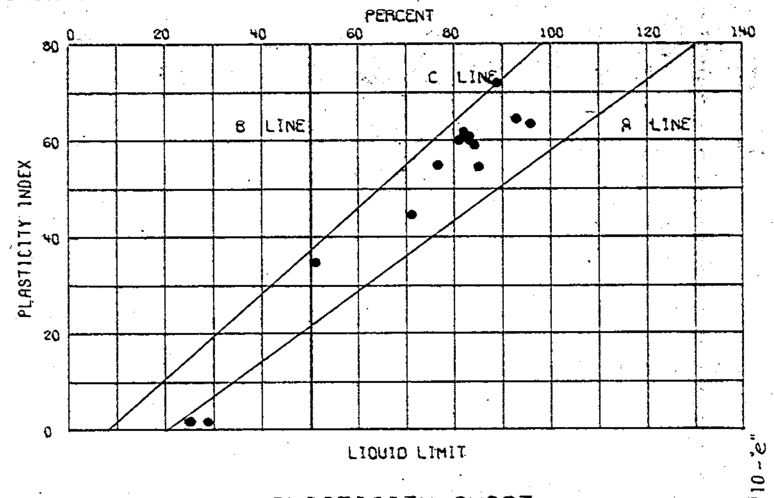
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
JEFFERSON PARISH
RETURN LEVEE
UNDISTURBED BORING DATA
BORING 1 - J U

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

OCTOBER 1979 FILE NO. H-2-29706





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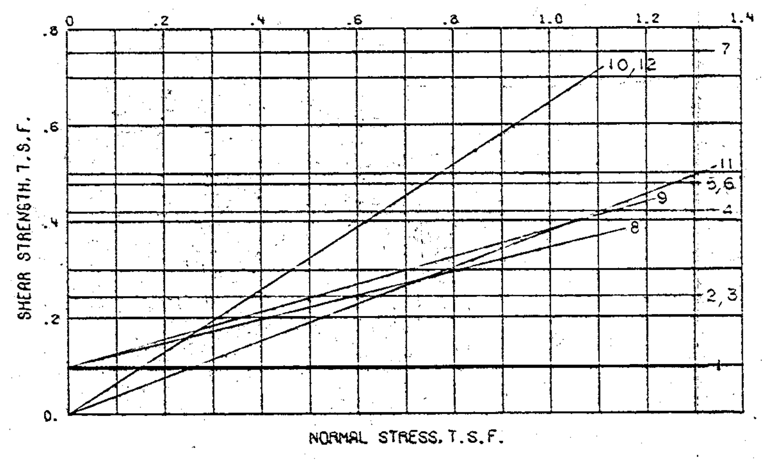

SHEAR STRENGTH DATA

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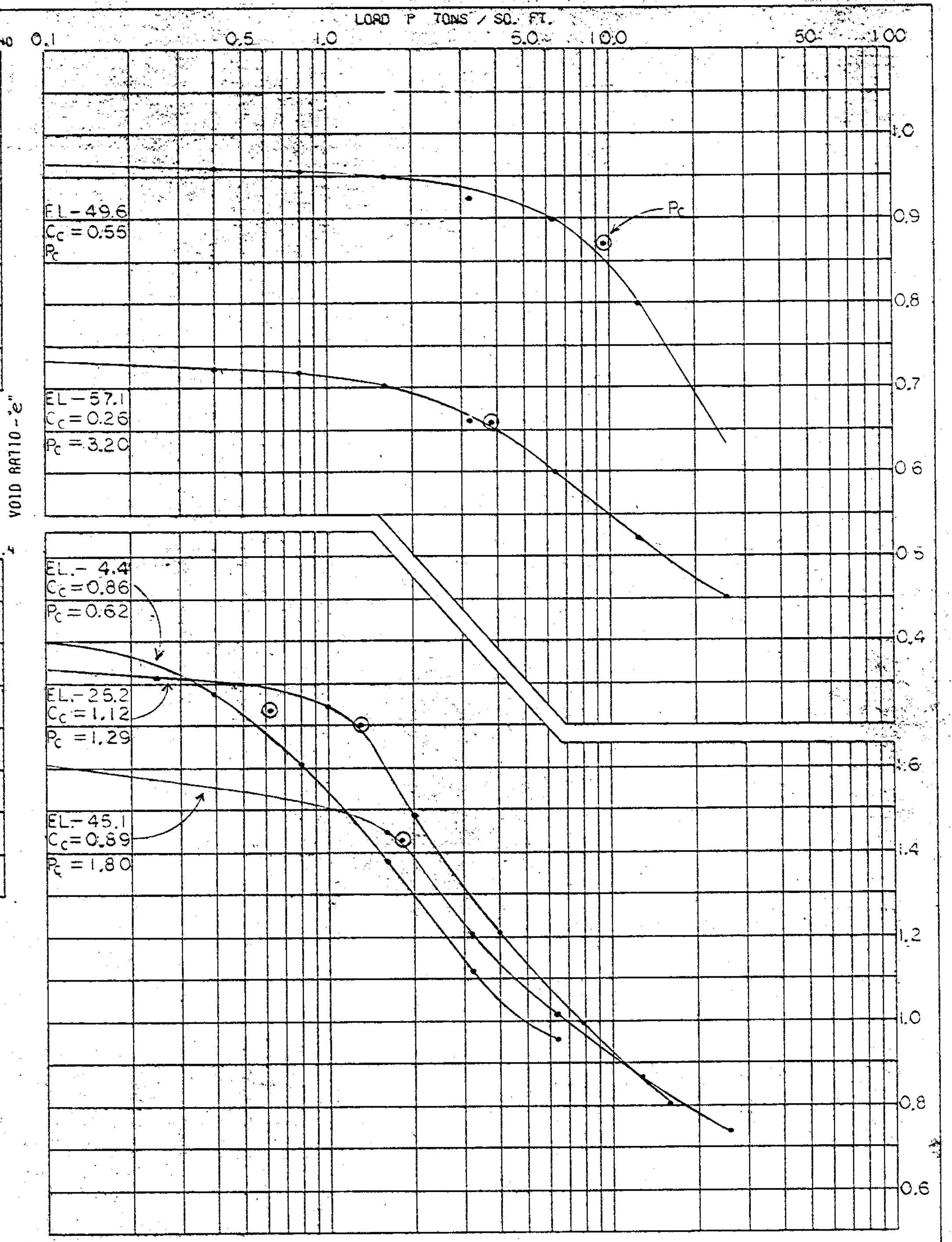
	2	-25.2		0	0.245	CH
	3	-27.4		0	0.245	CH
	4	-46.0		0	0.420	CH
	5	-49.6		0	0.478	CH
	6	-51.9		0	0.477	CH
	7	-57.1		0	0.752	CH
	8	5.2	R	14	0.100	CH
	9	-12.6		16	0.100	ML
	10	-19.4	S	33	0	ML
	11	-27.4		21	0	CH
	12	-35.2		33	0	SM



CONSOLIDATION DATA

○ - (UC) UNCONFINED COMPRESSION TEST
■ - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY

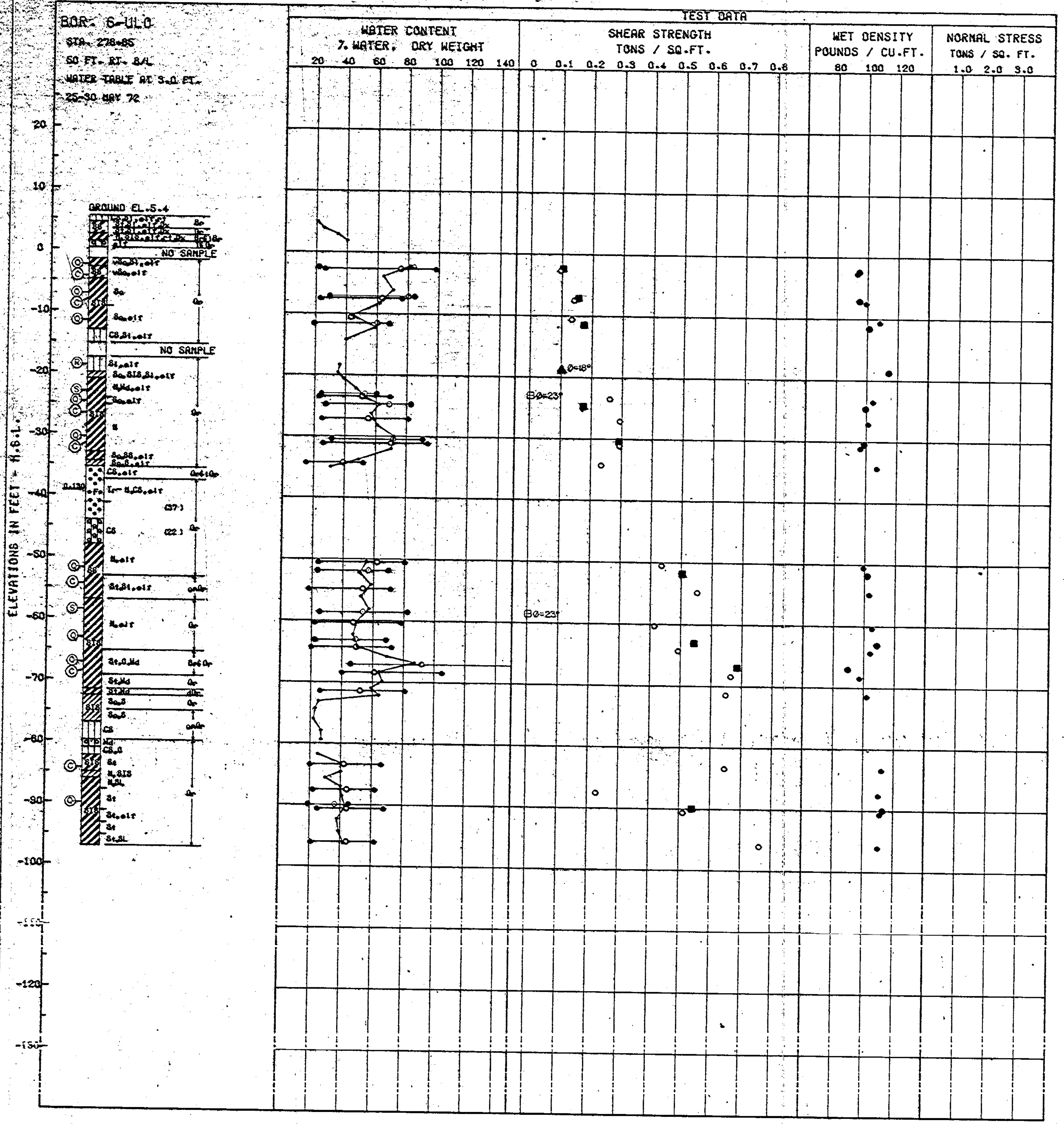
ORLEANS PARISH LAKEFRONT WEST OF IHNC LEVEE

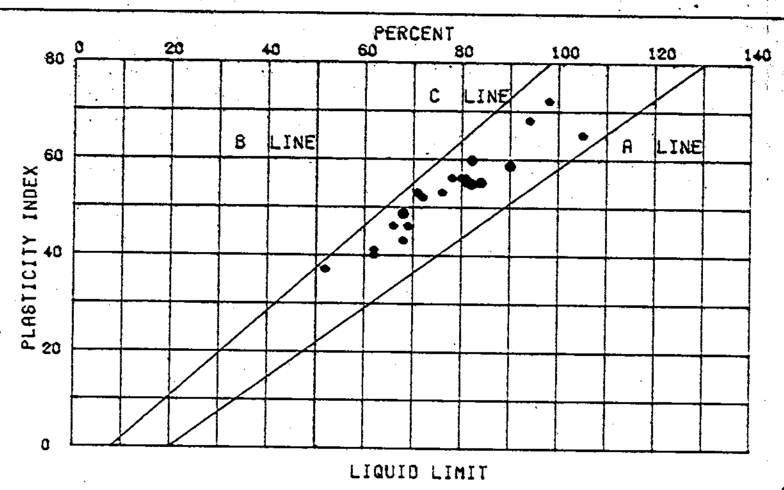
UNDISTURBED BORING DATA
BORING 6-OUW

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

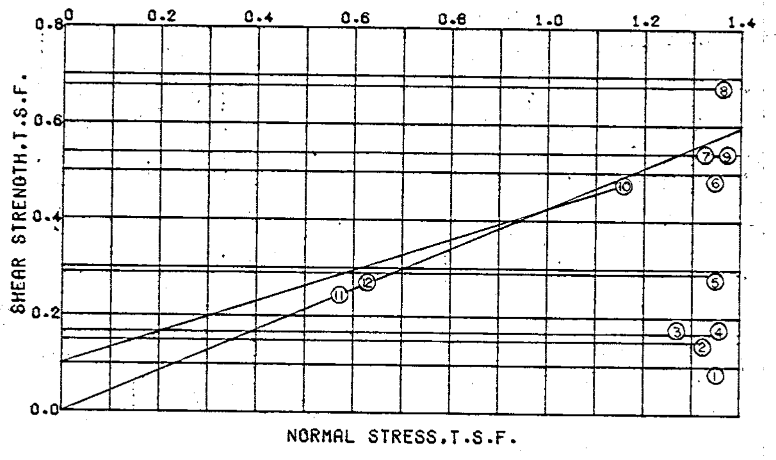
OCTOBER 1979 FILE NO. H-2-29706

PLATE A- II-6





PLASTICITY CHART



SHEAR STRENGTH DATA

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3	-11.6	Q	0	0.17	Gr
4	-24.8	Q	0	0.17	CH
5	-30.5	Q	0	0.29	CH
6	-51.9	Q	0	0.50	Gr
7	-63.0	Q	0	0.54	CH
8	-67.0	Q	0	0.68	CH
9	-90.0	Q	0	0.54	CL
10	-18.7	R	0	0.10	ML
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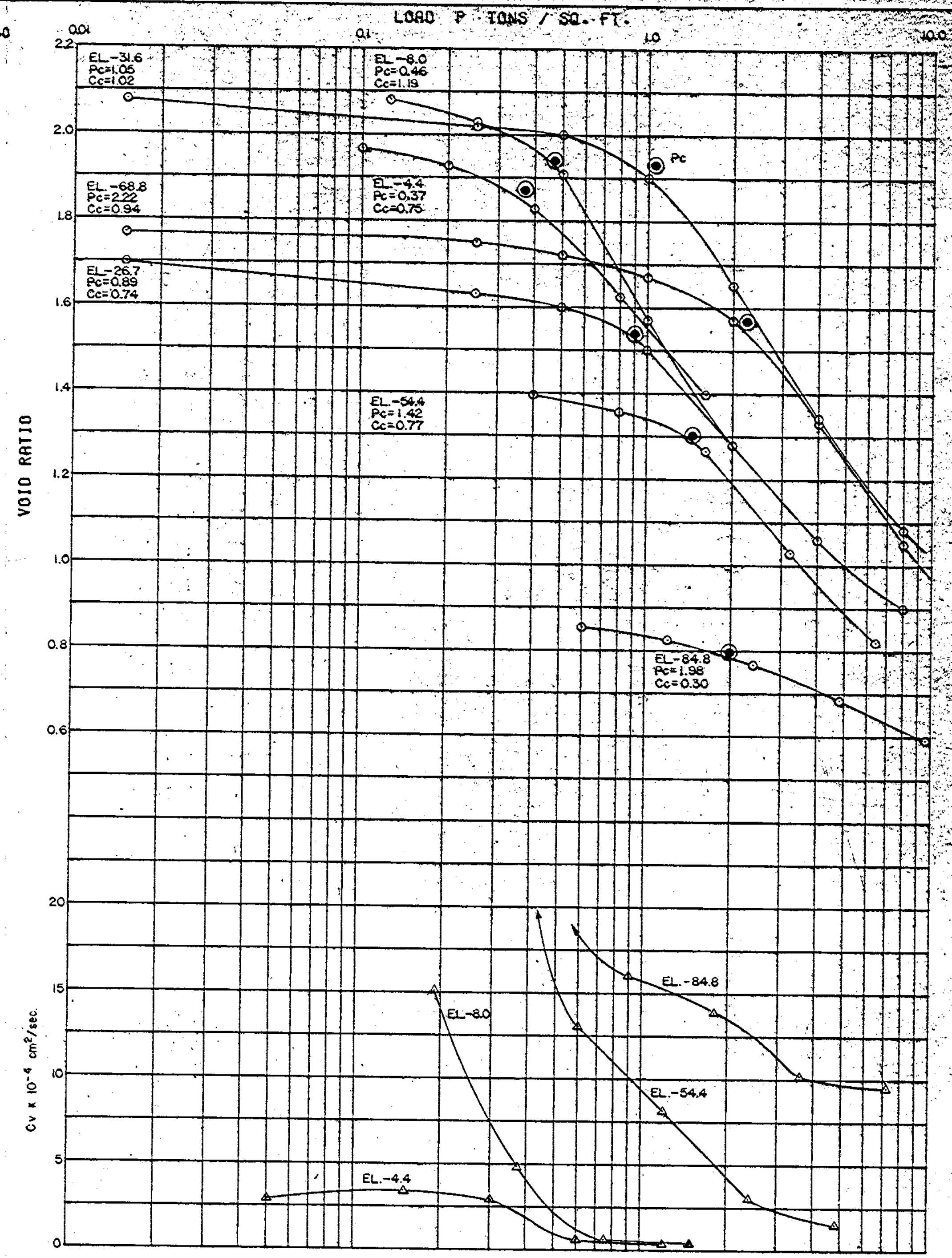

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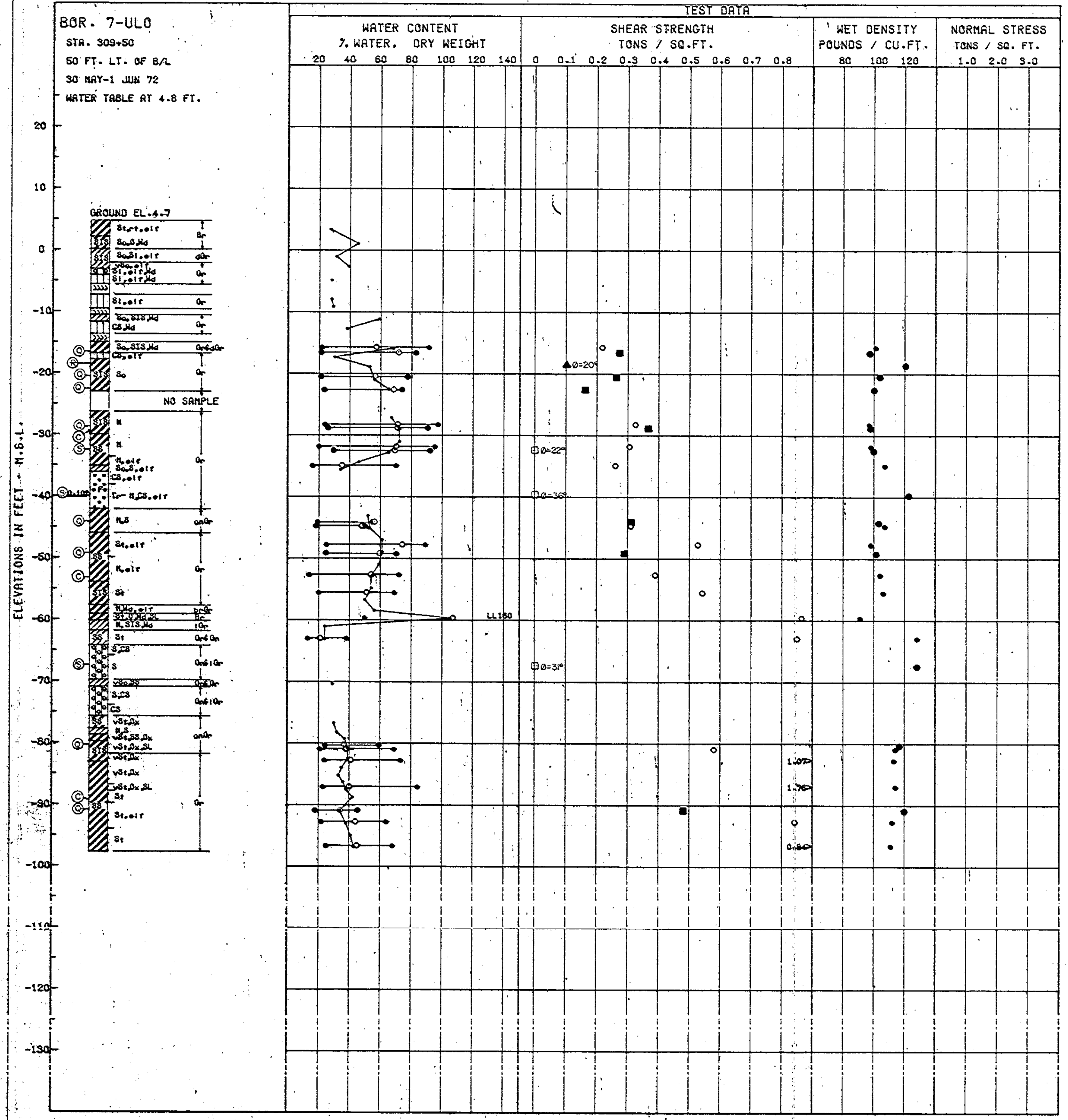
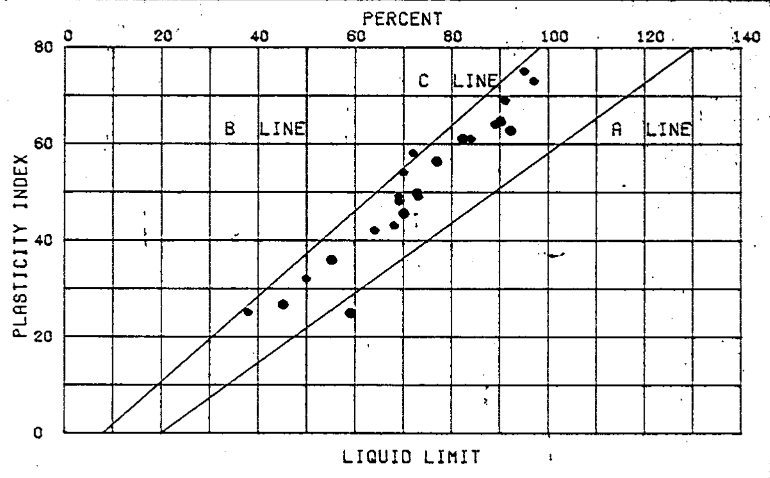
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

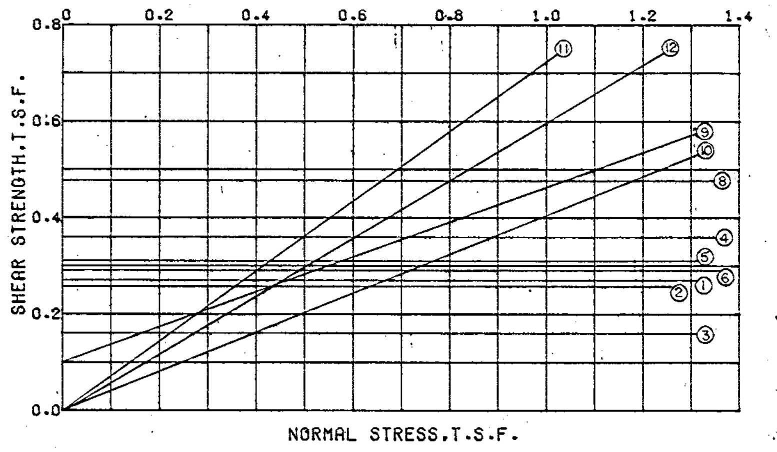
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ORLEANS PARISH LAKEFRONT WEST OF IHNC LEVEE
UNDISTURBED BORING DATA
BORING 6-ULO
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979 FILE NO. H-2-29706





PLASTICITY CHART



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3	-22.6	Q	0	0.16	Gr
4	-28.7	Q	0	0.36	Gr
5	-44.2	Q	0	0.31	CH
6	-49.2	Q	0	0.29	CH
7	-80.2	Q	0	0.93	CH
8	-90.8	Q	0	0.48	CL
9	-8.3	R	20	0.10	SM
10	-32.5	S	22	0	CH
11	-39.7	S	36	0	SM
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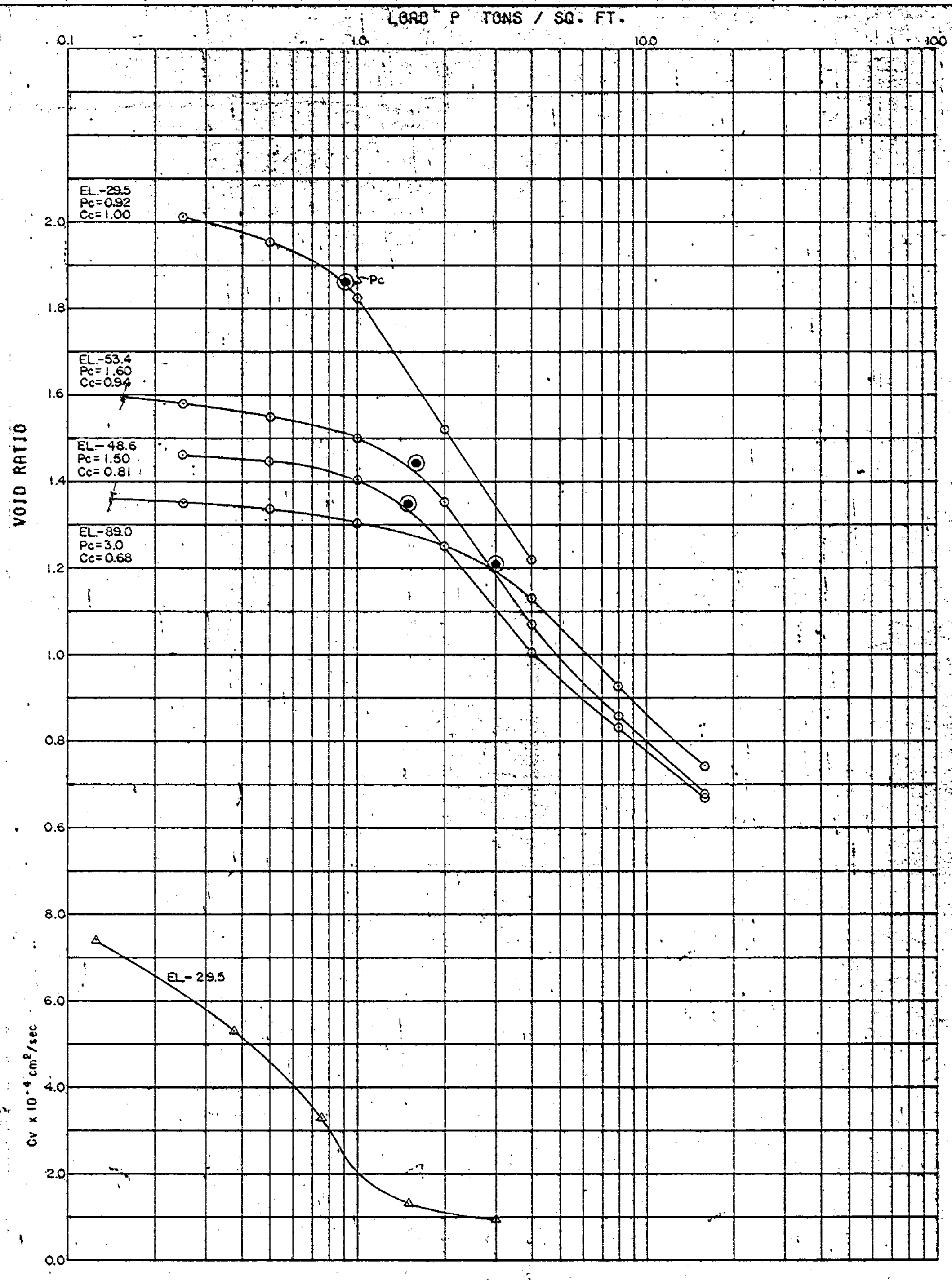

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BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

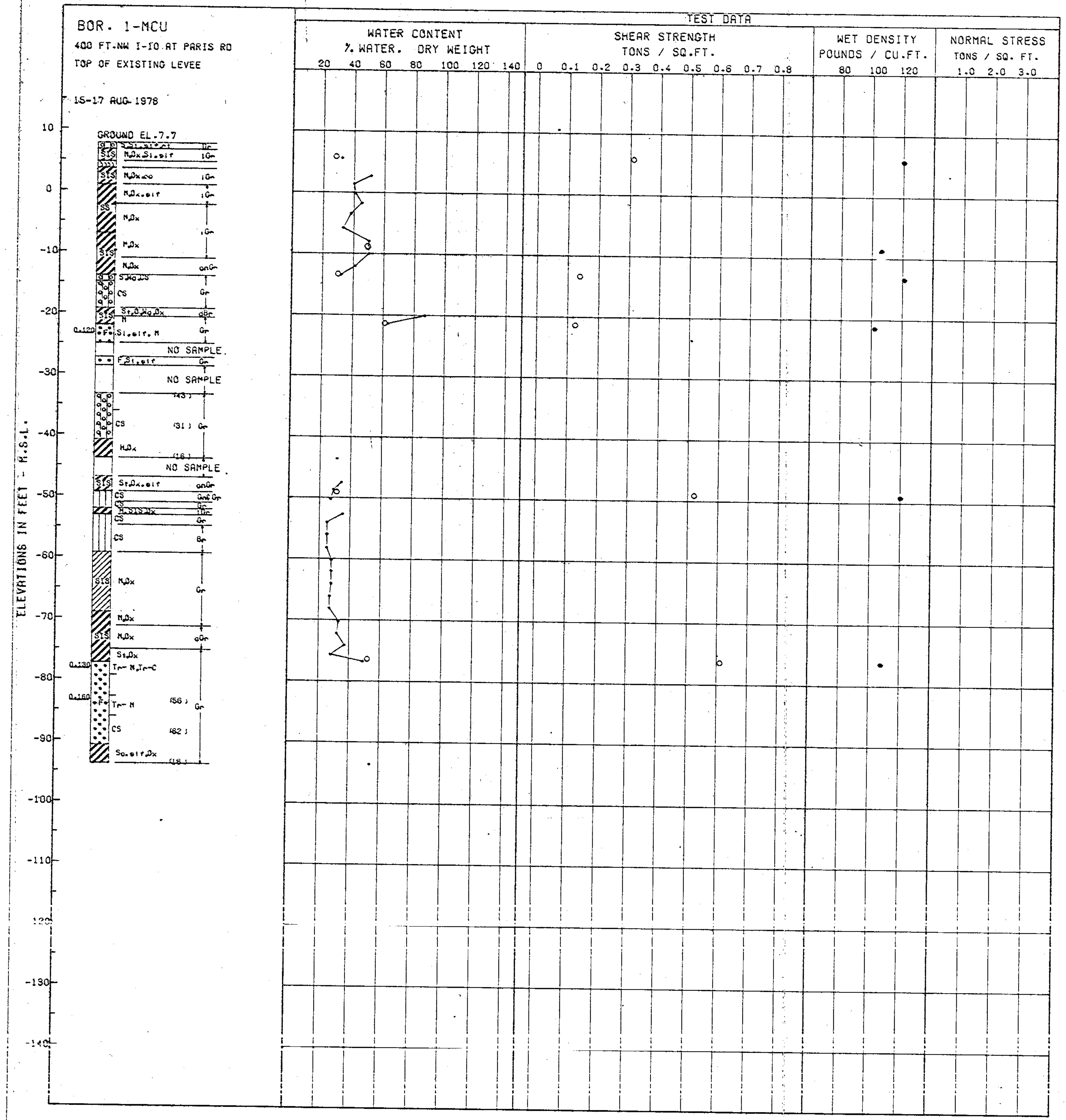
FOR LOCATION OF BORINGS SEE PLATE

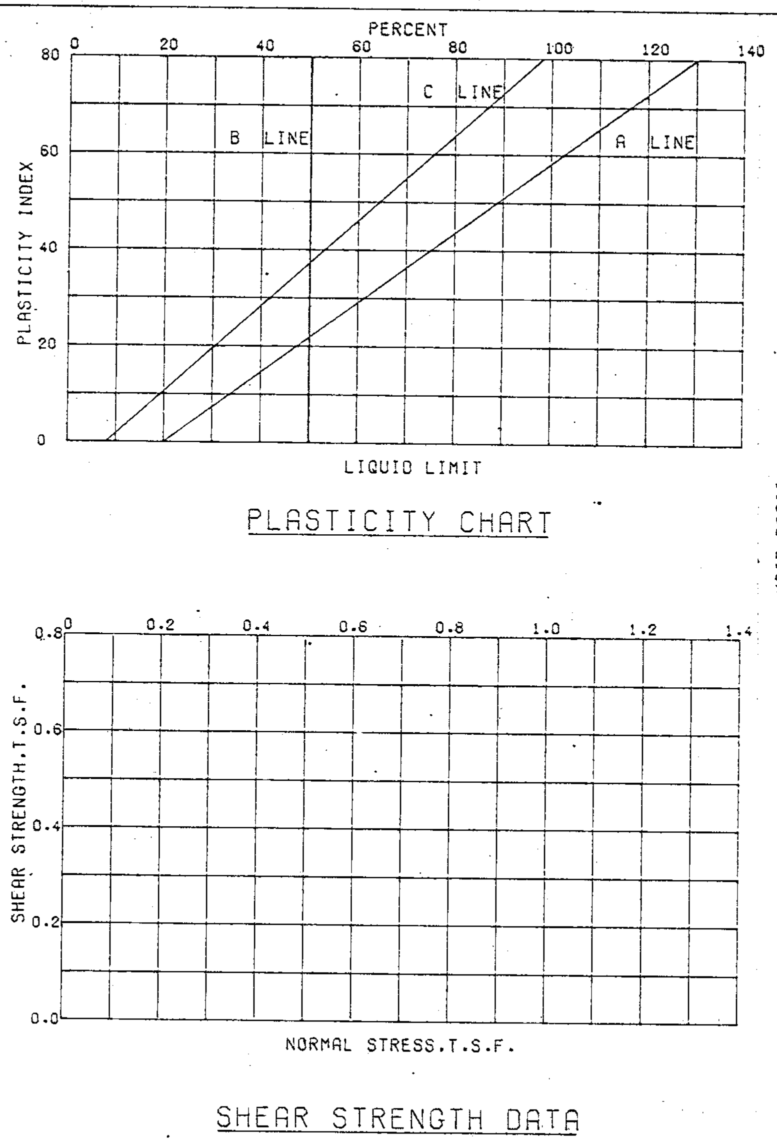
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
ORLEANS PARISH LAKEFRONT WEST
OF IHNC LEVEE
UNDISTURBED BORING DATA
BORING 7-ULO

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

OCTOBER 1979 FILE NO. H-2-29706

PLATE A- II-8





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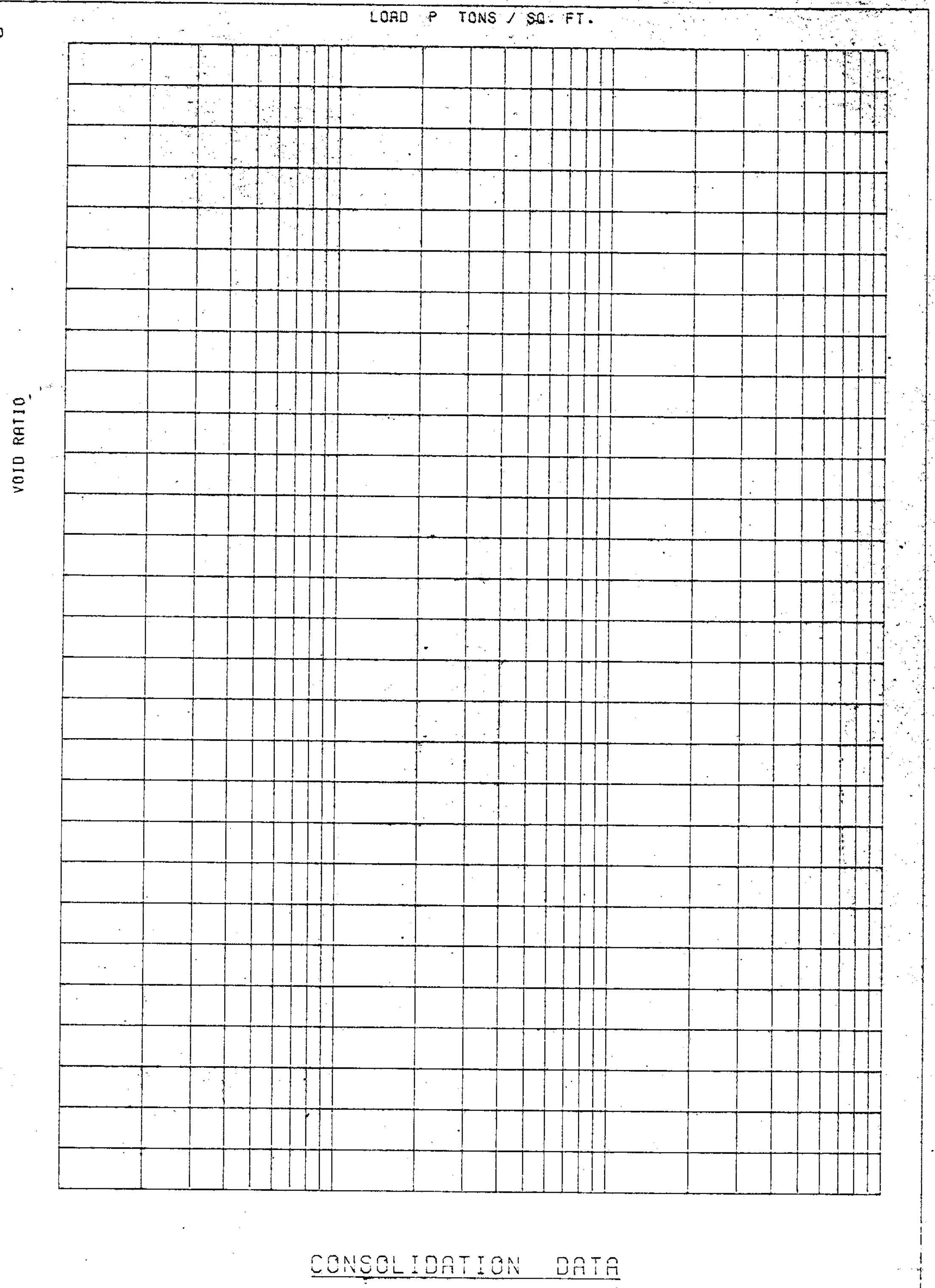

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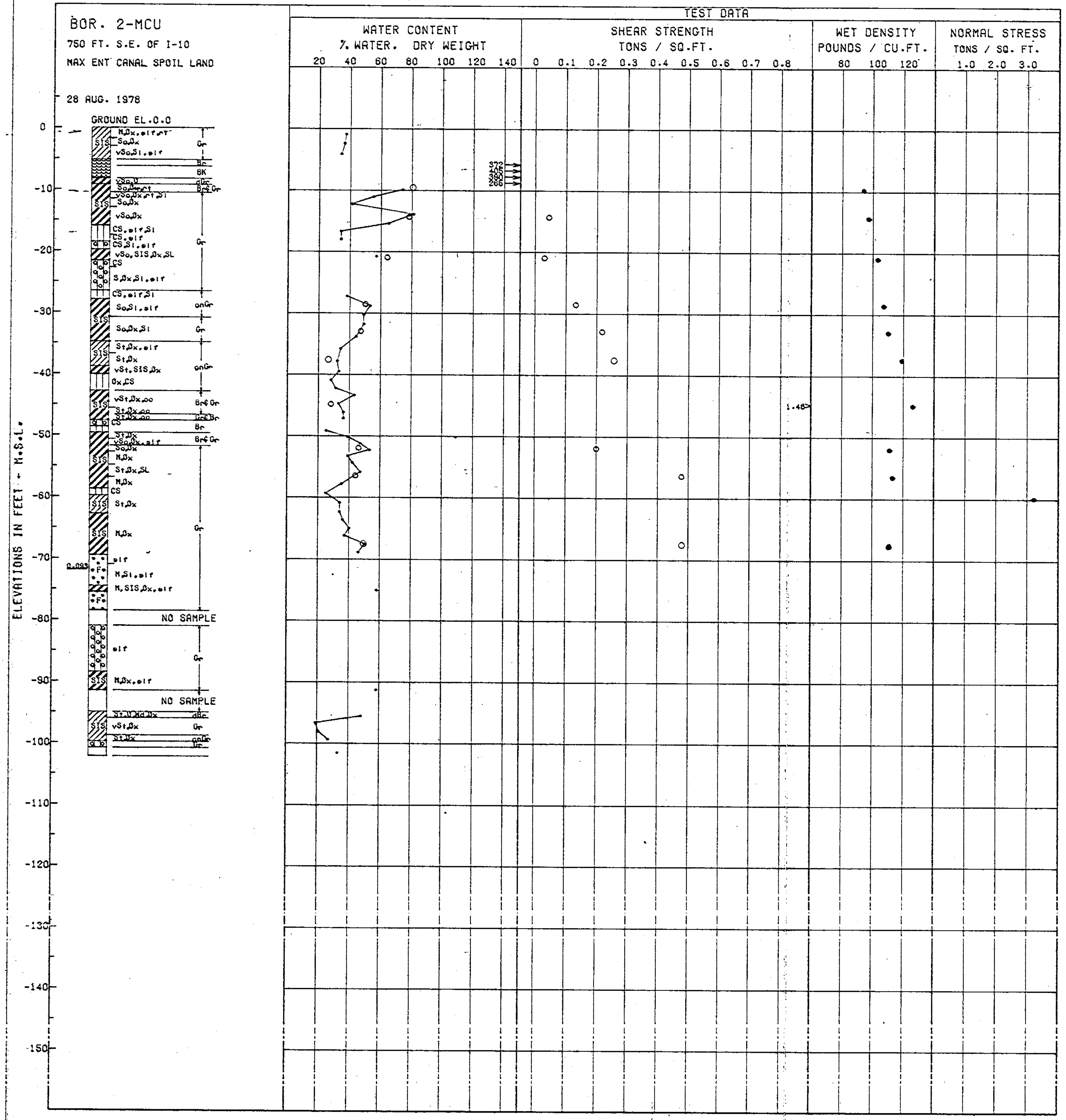
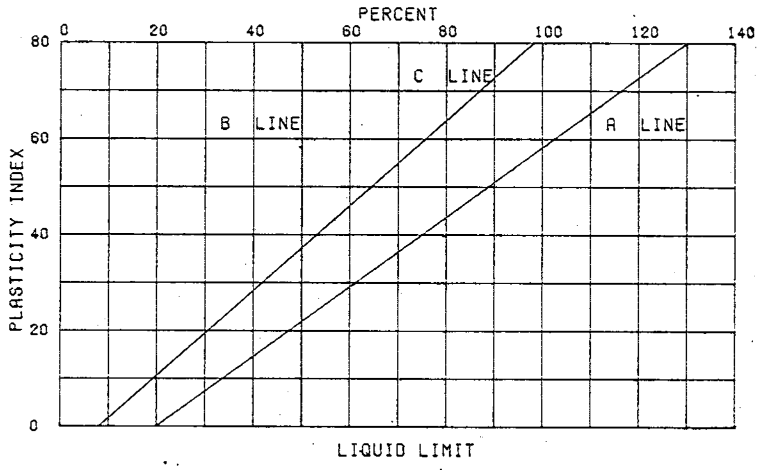
⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
NEW ORLEANS EAST
MAXENT CANAL LEVEE
UNDISTURBED BORING DATA
BORING 1-MCU
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979 FILE NO. H-2-29706

PLATE A-II-9





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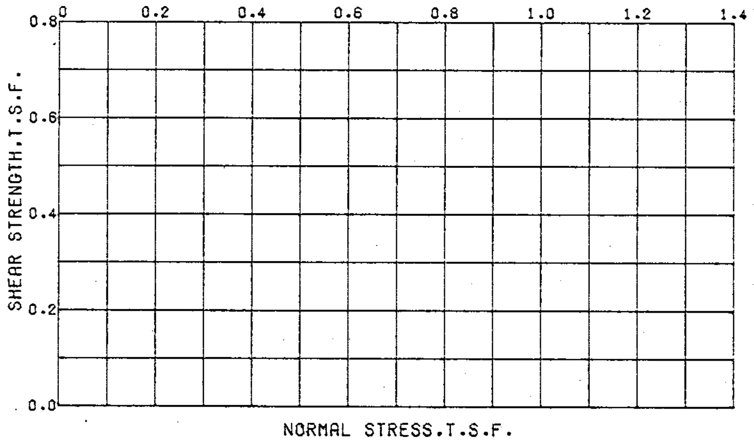

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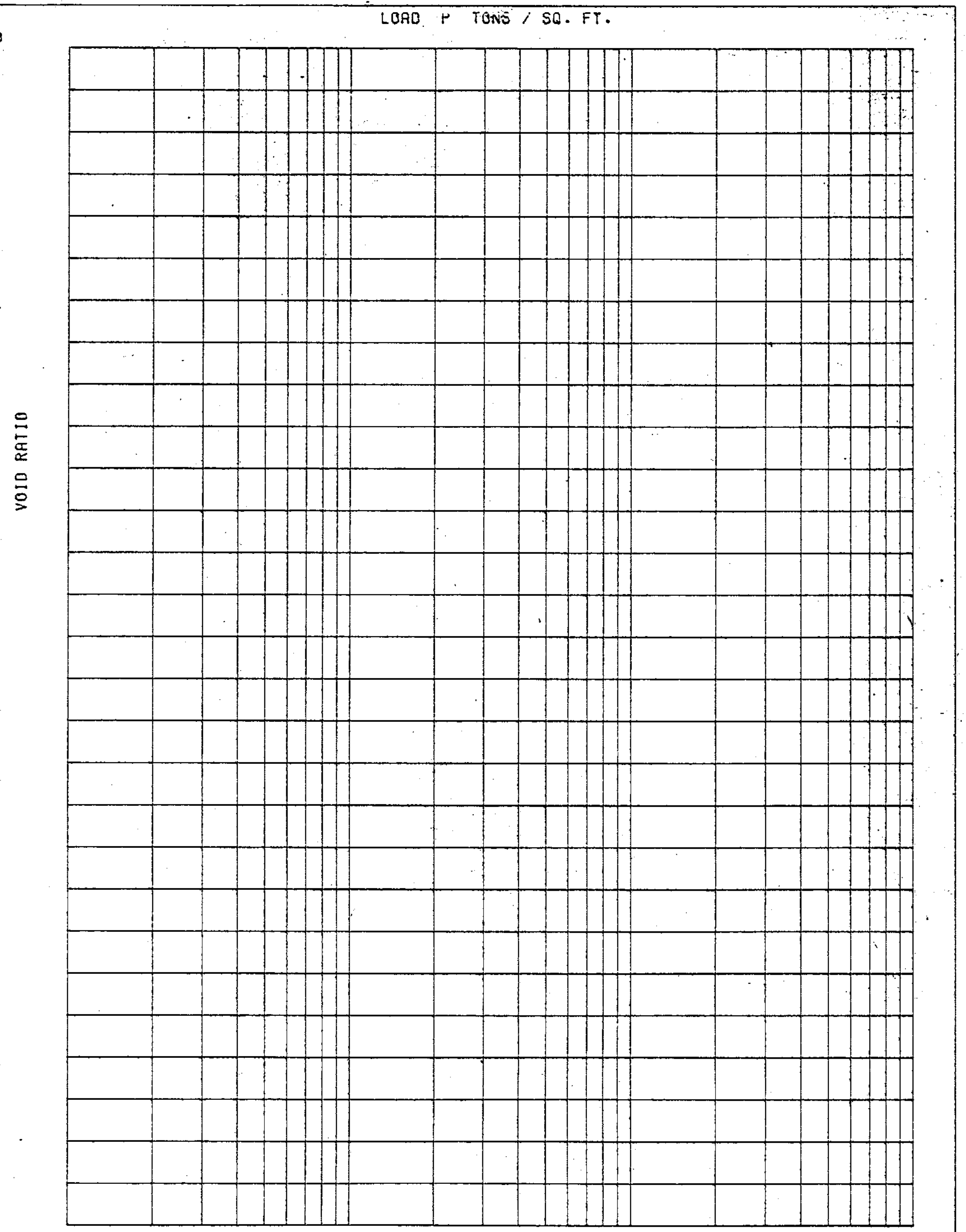

CONSOLIDATION DATA

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⊟ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

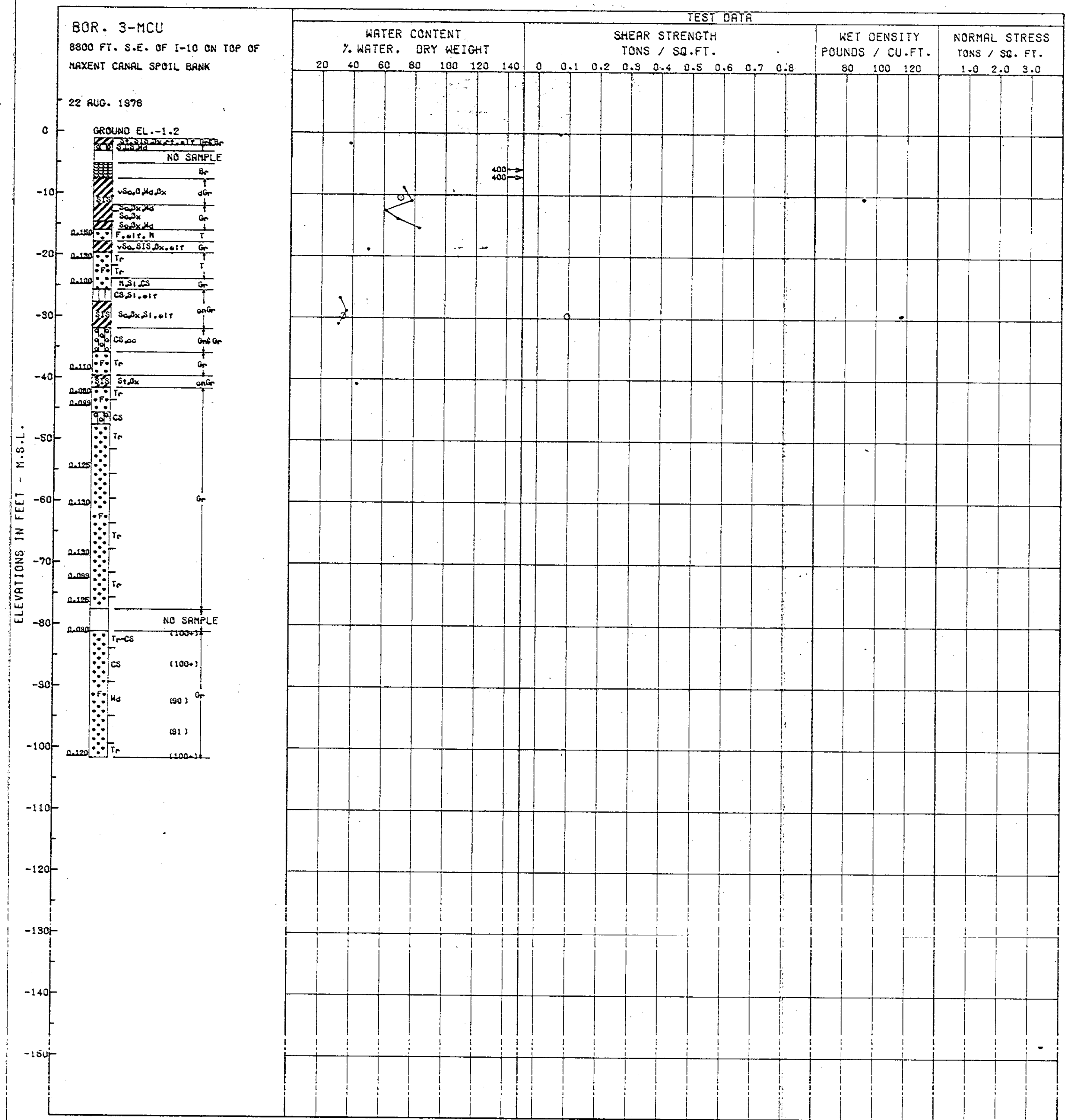
FOR SOIL BORING LEGEND SEE PLATE A

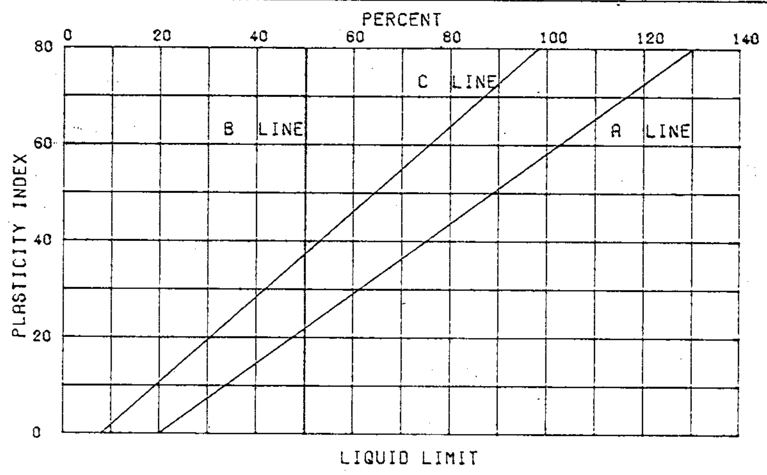
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
NEW ORLEANS EAST
MAXENT CANAL LEVEE
UNDISTURBED BORING DATA
BORING 2-MCU
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

OCTOBER 1979 FILE NO. H-2-29706

PLATE A-II-10





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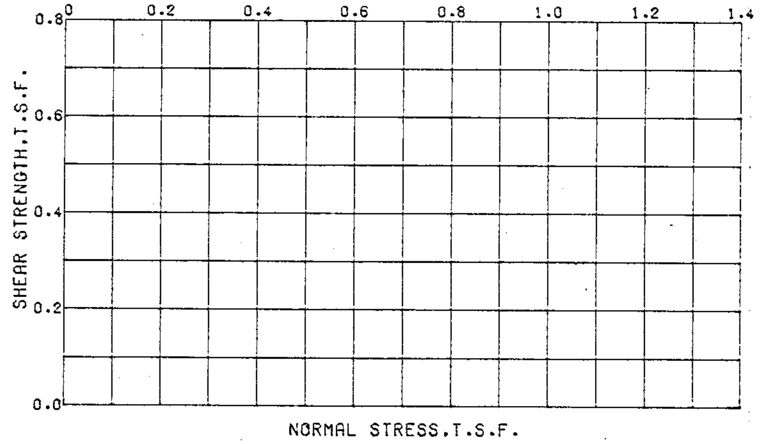

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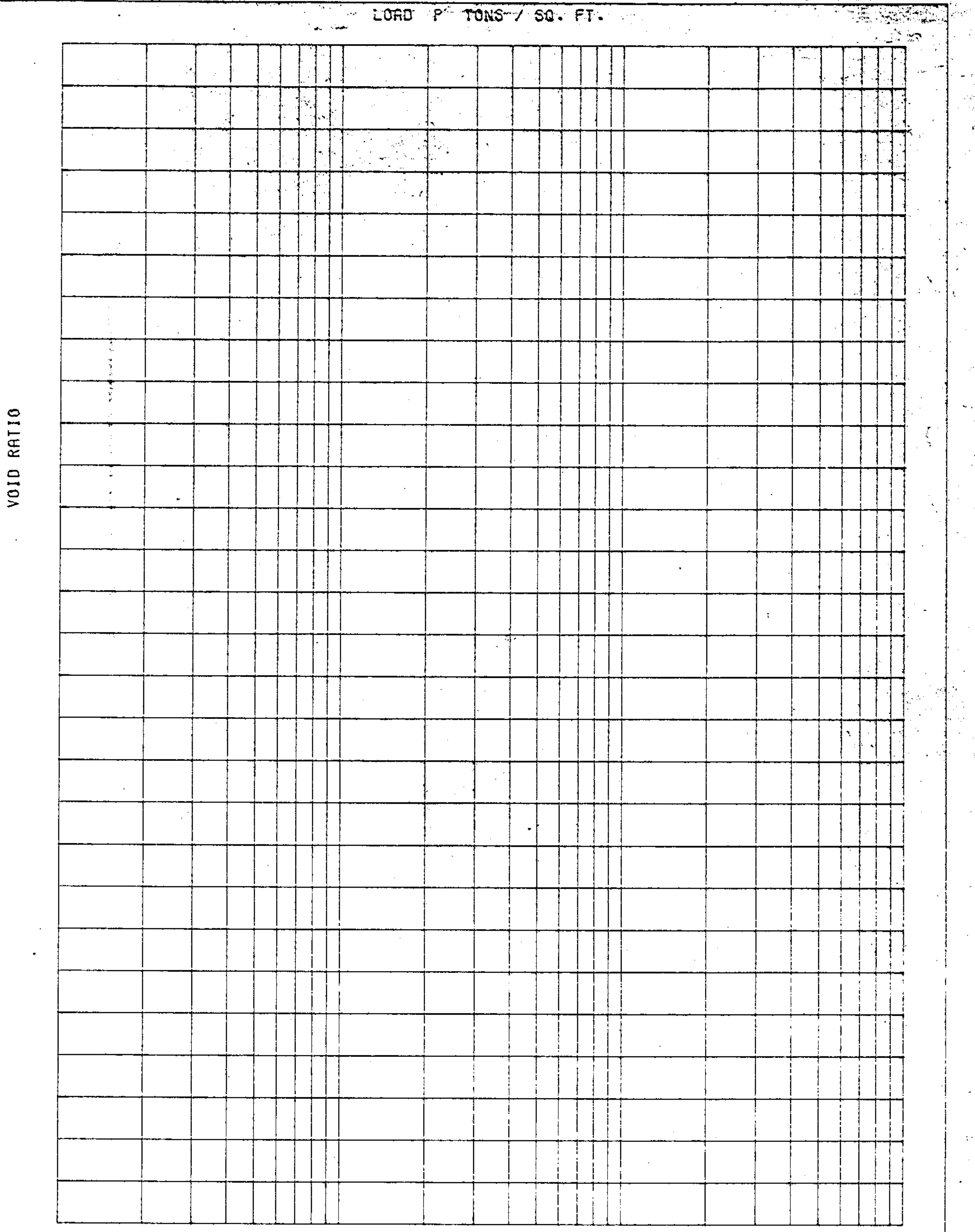

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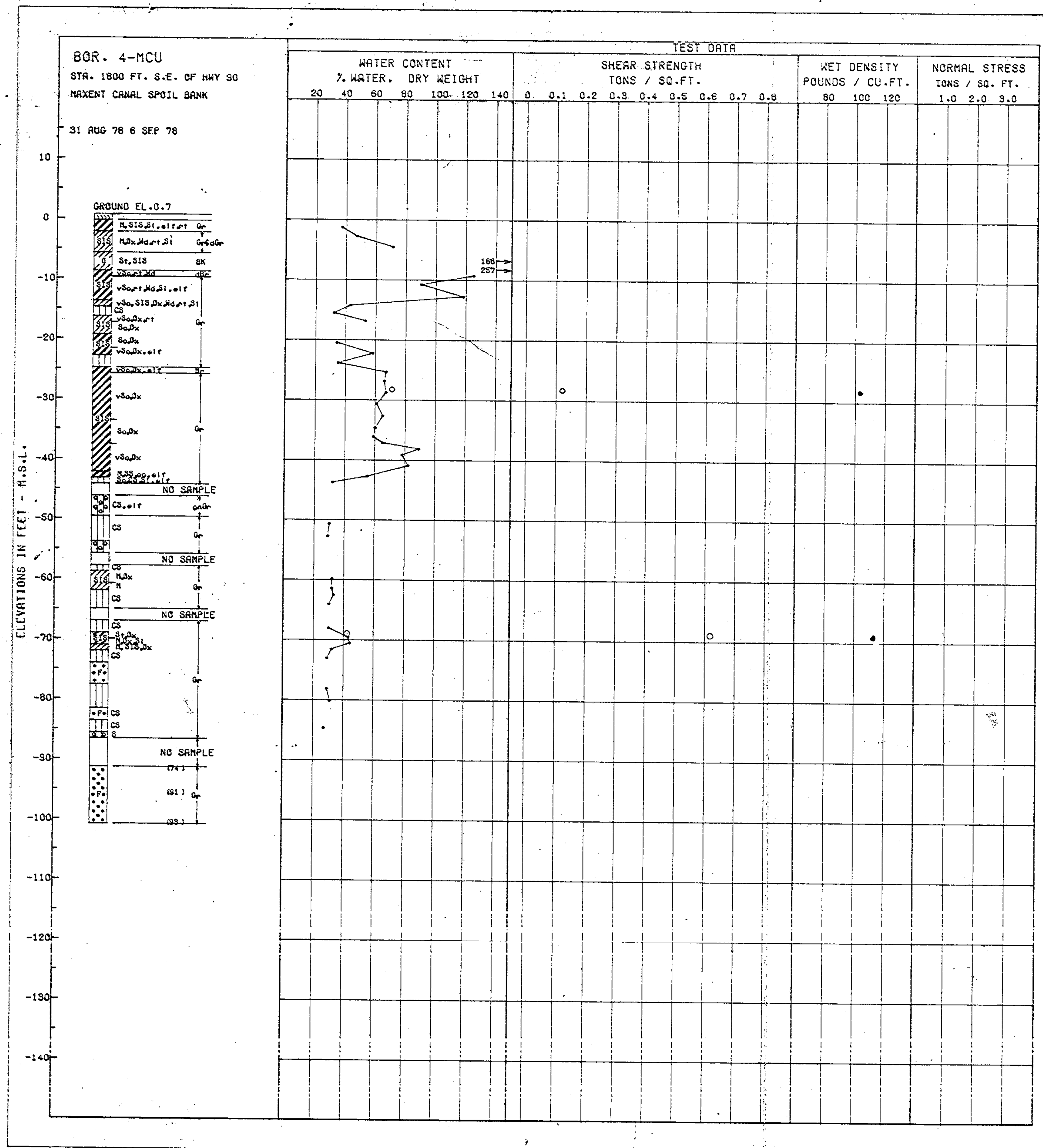
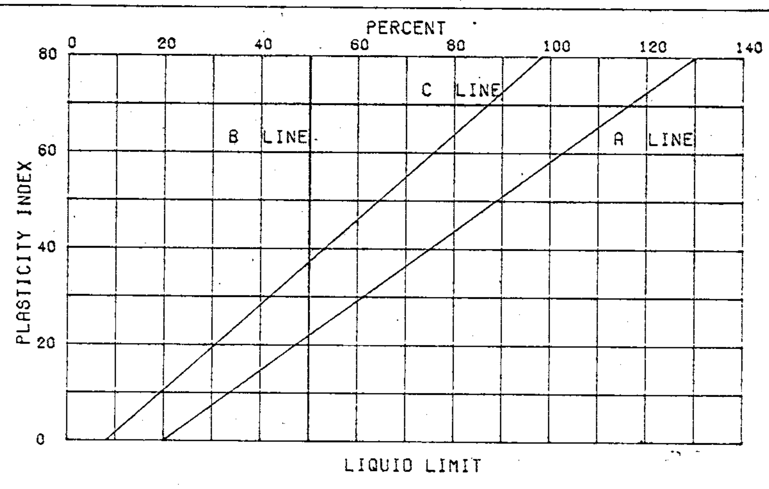
⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
NEW ORLEANS EAST
MAXENT CANAL LEVEE
UNDISTURBED BORING DATA
BORING 3-MCU
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979 FILE NO. H-2-29706





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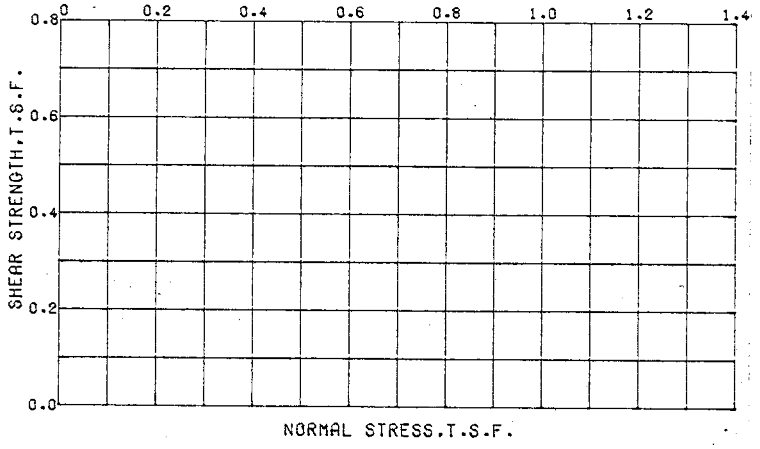

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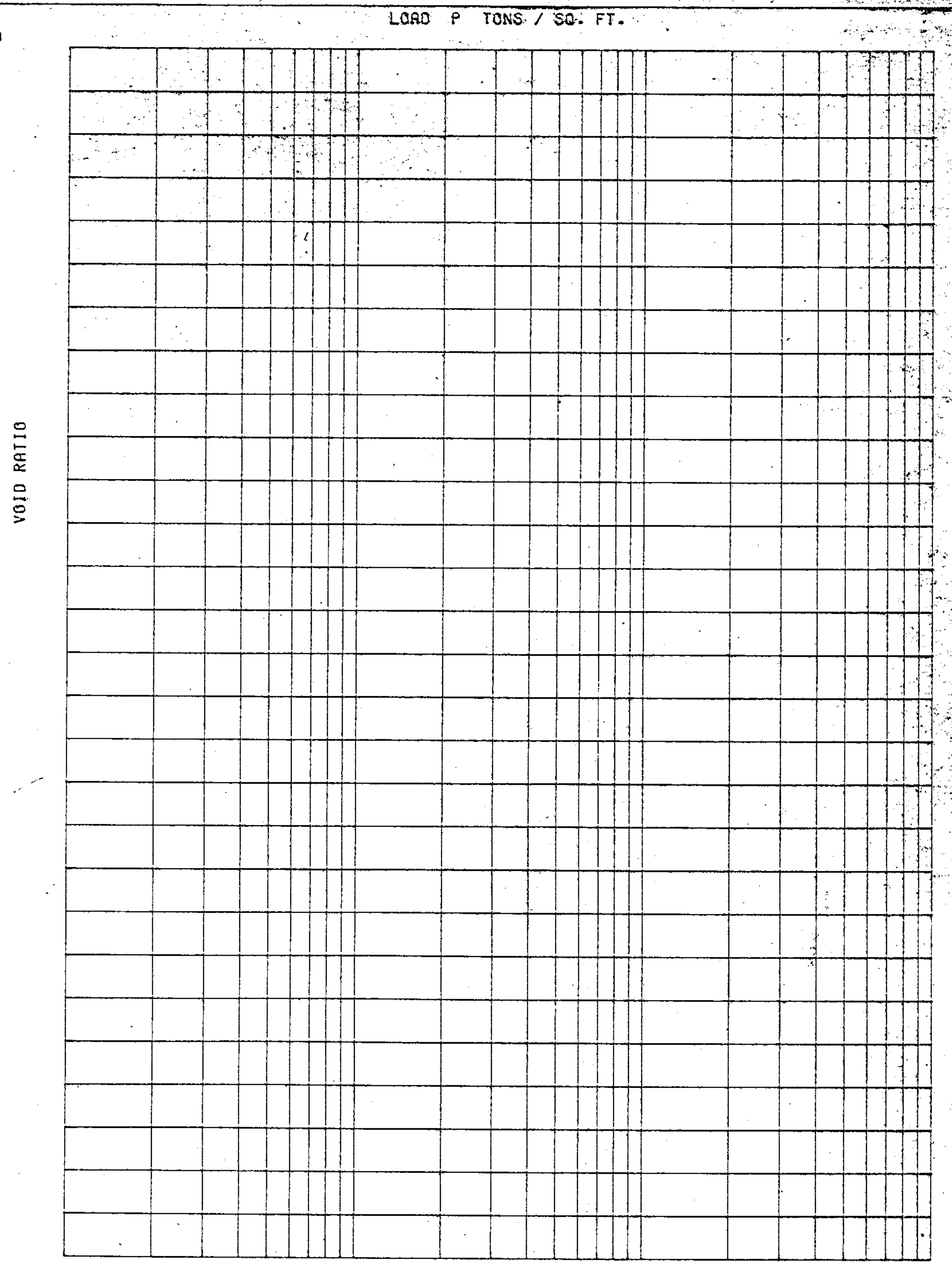

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BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORINGS SEE PLATE

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLANS STUDY
NEW ORLEANS EAST
MAXENT CANAL LEVEE
UNDISTURBED BORING DATA
BORING 4-MCU
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

OCTOBER 1979 FILE NO. H-2-29706

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION III - ENGINEERING ALTERNATIVE PLANS STUDY

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION III - ENGINEERING ALTERNATIVE PLANS STUDY

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Coastal Management Section
DAVID MEKARSKI
P.O. Box 302
HAHNVILLE LA. 70057

468-9751

·APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY HURRICANE PROTECTION PROJECT

SECTION III - ENGINEERING ALTERNATIVE PLANS STUDY

1. Purpose and Extent of Study.

a. General. On 30 December 1977 the United States Fifth District Court enjoined further construction of certain portions of the Lake Pontchartrain Hurricane Protection project pending preparation of a revised environmental impact statement. Modifications to the court order were issued on 8, 10 and 27 March 1978 reducing the scope of the injunction to include only the Chef Menteur and Rigolets Barrier Complexes. In support of the revised environmental impact statement, this document considers alternatives to the "barrier" concept of protection, as well as alternative levee alinements in the vicinities of wetlands in St. Charles Parish and in New Orleans East. Portions of the project for which alternatives are considered include the barrier complexes and the flood protection works bordering Lake Pontchartrain from the east guide levee of the Bonnet Carre Spillway to the eastern side of New Orleans East. This section is intended to present a description of all the feasible engineering alternatives and their respective costs for the Lake Pontchartrain, La. and Vicinity Hurricane Protection Project. The information contained in this appendix taken in conjunction with the respective environmental assessment and economic analyses of each plan will identify the most cost effective plan of protection for the Lake Pontchartrain area.

b. Agencies Consulted. The following agencies were consulted during the course of the study: U.S. Department of the Interior, Fish and Wildlife Service; U.S. Marine Fisheries Service; U.S. Environmental Protection Agency; and State of Louisiana, Department of Wildlife and Fisheries.

c. Support Data. Support Data, including design methods and procedures used for this study are contained in Sections I, II, and IV of this appendix.

2. Plans of Protection.

a. General.

(1) Chalmette Area. Hurricane protection for the Chalmette area is provided by a levee and floodwall system which starts and ends with the existing Mississippi River levee. The

combined effect of the hurricane protection and the Mississippi River levee is to provide a closed loop of flood protection around the Chalmette area. The Chalmette area protection is completely independent of hurricane protection for adjacent land areas. Only standard project hurricane protection and the authorized alinement are presented in this document for the Chalmette area. Plate A-III-1 shows the levee alinement for the Chalmette area plan.

(2) Other Project Areas. Protection for the remaining project areas (New Orleans East, Citrus, New Orleans West of IHNC, Jefferson Parish East of Mississippi River, and St. Charles Parish East of Mississippi River) can be accomplished either with a "barrier" concept of protection or with "high level" levees and floodwalls. Under the Barrier Plan, portions of St. Tammany and Tangipahoa Parishes bordering Lake Pontchartrain receive a degree of protection. This added degree of protection can not be achieved under the high-level plan.

(a) Barrier Plan. The barrier concept provides for a system of controls at the Rigolets, Chef Menteur, and Seabrook inlets to Lake Pontchartrain which limits the tidal rise in Lake Pontchartrain in the event of a hurricane. Protective works bordering the lake are designed accordingly and do not have to be as high as required if the hurricane surge was permitted to enter the lake. Reaches of protection directly affected include St. Charles and Jefferson Parishes, Orleans Lakefront West of IHNC, Citrus Lakefront, New Orleans East Lakefront, and the eastern side of New Orleans East. Reaches of protection not affected by the presence of the barriers are the east and west banks of the IHNC, the Citrus back levee, and the New Orleans East back levee. The repairs presently authorized for the Mandeville Seawall are irrespective of the barrier plan.

(b) High Level Plan. Under this plan the hurricane surge is permitted to enter Lake Pontchartrain and protective works bordering the lake are designed accordingly. This document presents alternative alinements and degrees of protection for protective works bordering the lake and for a portion of the New Orleans East back levee. Except for a portion of the New Orleans East back levee, protective works not bordering the lake are designed only for the standard project hurricane.

b. Alternative Alinements and Degrees of Protection. Alternative alinements and degrees of protection are presented in this document only for protective works bordering Lake Pontchartrain, which are influenced by the presence or nonpresence of the barriers, and for portions of the New Orleans East back levee. Degrees of protection considered include the standard project hurricane (with and without barriers) and the 100 year hurricane (without barriers). Alternative alinements are shown on plates A-III-2 through A-III-10. Cost estimates are summarized in table 1 and are presented in detail in Section IV.

(1) St. Charles Parish. Three alinements in St. Charles Parish are considered herein and are shown on plates A-III-2, A-III-3, and A-III-4. The lakefront alinement consists of 5.7 miles of levee and a drainage structure near the Jefferson Parish line. The north of Highway 61 alinement consists of 8.1 miles of levee, 5.7 miles of floodwall, 4 vehicular gates, and 4 drainage structures. The south of Highway 61 alinement consists of 10.4 miles of levee, 5.7 miles of floodwall, 3 road ramps, 6 vehicular gates, and 4 drainage structures.

(2) Jefferson Parish. Only the existing lakefront alinement in Jefferson Parish is considered herein. The potential for expansion of the existing levee lakeward as well as landward is considered. The lakefront alinement is shown on plate A-III-5. The existing 10.2 miles of levee is incorporated into the proposed alternatives. All alternatives provide for floodwalls in front of the four lakefront pumping stations.

(3) Orleans Lakefront West of IHNC. Only the existing lakefront alinement landside of the seawall is presented herein. This alinement is shown on plate A-III-5 and consists of 5.6 miles of levee, 1.3 miles of floodwall, 18 road ramps, 8 vehicular gates, and 4 drainage structures. All alternatives provide for gated structures and auxiliary pumping stations at the lakeward ends of the three drainage outfall canals.

(4) Citrus Lakefront. The existing levee alinement, which is between the Southern Railway embankment and Hayne Boulevard, is utilized for the barrier plan levee, the high level 100 year protection levee and SPH floodwall plan. The existing alinement is also used for high level SPH protection when coupled with a wave breaker rock dike located on the lakeside of the railroad embankment. The high level SPH protection levee without the rock dike is much wider than the barrier or 100 year levees; therefore, locating it on the existing alinement would entail the relocation either of the railroad or of Hayne Boulevard and bordering businesses/residences. Such relocations are uneconomical and highly undesirable. Therefore, the high level SPH levee without the rock dike is situated in the lake immediately north of the railroad embankment. The barrier plan protection and the 100 year protection consist of 4.8 miles of levee, 0.9 miles of floodwall, 5 vehicular gates, 2 road ramps, and 3 drainage structures. The high level SPH protection with

rock dike consists of the foregoing components as well as 4.8 miles of concrete retaining wall and 4.8 miles of rock dike. The high level SPH protection without the rock dike consists of 5.1 miles of levee, 1.3 miles of floodwall, 4 vehicular gates, 2 road ramps, and 7 drainage structures. The existing levee alinement is shown on plates A-III-6, A-III-7, and A-III-8. The in-the-lake levee alinement is shown on plates A-III-9 and A-III-10.

(5) New Orleans East Lakefront. The lakefront alinement landside of the Southern Railway tracks is presented herein. It is shown on plates A-III-6, A-III-8, and A-III-9 and consists of 6.2 miles of levee. It should be noted that no protection is required on the New Orleans East lakefront for plans using the Maxent Canal alinement.

(6) Lake Pontchartrain to the GIWW. Two alinements are presented herein. The Maxent Canal alinement, shown on plates A-III-7 and A-III-10 is located on the edge of the New Orleans East wetlands (using the wetland limits as defined in March 1978) and excludes all wetlands from the protected area. The Maxent Canal alinement consists of 7.6 miles of levee, 1 vehicular gate, and 2 road ramps. Note, if the Maxent Canal alinement is adopted and full tidal movement is permitted into the wetland area in New Orleans East, then the Interstate Highway 10 would be subject to periodic innundation by non-hurricane tides. The South Point to GIWW alinement, shown on plates A-III-6, A-III-8, and A-III-9 consists of 8.3 miles of levee, 3 road ramps, 1 vehicular gate, and 4 drainage structures.

c. Alternative Designs for Barrier Structures. Three barrier complexes are required under the barrier plan at the following locations: the Rigolets Pass; the Chef Menteur Pass; and Seabrook.

(1) Rigolets Complex. The Rigolets Complex consists of barrier levees, a control structure, a navigation lock, and a closure dam. The complex provides a barrier against tidal influx into Lake Pontchartrain under hurricane conditions, and provides for continuous tidal interchange and navigation movement in non-hurricane conditions. Since the great majority of normal tidal interchange would occur through the control structure, three control structure sizes are presented in this document. A structure 1,088 feet long would provide a cross sectional area for flow equal to approximately 35 percent of the natural cross sectional area of the pass; a structure 1,564 feet long would provide approximately 50 percent of the natural cross section; and a structure 2,856 feet long would provide approximately 90 percent

of the natural cross section. The volume of water passed with each size structure compared to that which is passed through the natural pass is discussed in Section I, paragraph 2.e of this appendix. The Rigolets Complex with the 35 percent opening is shown on figure A-1. Various structural and alinement alternatives for the Rigolets Complex are discussed below under "Other Plans".

(2) Chef Menteur Complex. The Chef Menteur Complex consists of barrier levees, a control structure, a navigation structure, and a closure dam. The complex provides a barrier against tidal influx into Lake Pontchartrain under hurricane conditions, and provides for continuous tidal interchange and navigation movement in nonhurricane conditions. Since the great majority of normal tidal interchange would occur through the control structure, three control structure sizes are presented in this document. A structure 612 feet long would provide a cross sectional area equal to approximately 41 percent of the natural cross sectional area of the pass; a structure 748 feet long would provide approximately 50 percent of the natural cross section; and a structure 1,360 feet long would provide approximately 90 percent of the natural cross section. The volume of water passed with each size structure compared to that which is passed through the natural pass is discussed in Section I, paragraph 2e. The Chef Menteur Complex with the 41 percent opening is shown on figure A-2. Various structural and alinement alternatives for the Chef Menteur Complex are discussed below under "Other Plans".

(3) Seabrook Complex. The Seabrook Complex consists of a navigation lock, a control structure, and a closure dam. The Seabrook Complex is shown on figure A-3. The complex serves three functions: during hurricane conditions, the lock and control structure are closed to provide a barrier against tidal influx into Lake Pontchartrain; during non-hurricane conditions the complex provides the means for regulating salinity levels in Lake Pontchartrain ranging from present salinity levels to levels existing prior to the opening of the Mississippi River Gulf Outlet; and the lock provides safe passage for navigation in an area where currents are a hazard to navigation. Due to the multi-purpose nature of the Seabrook Complex, alternative sizes of the control structure are not feasible.

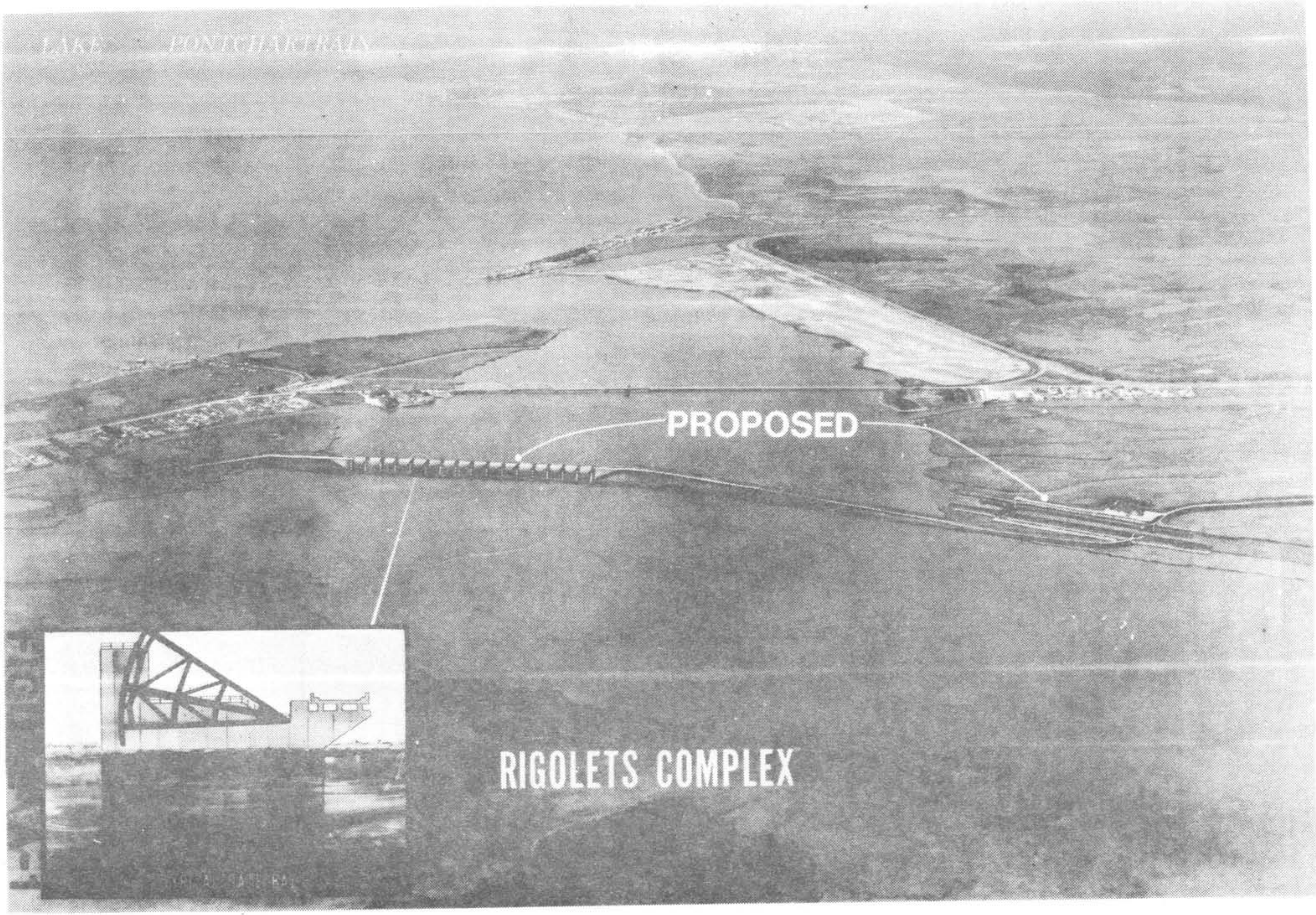
d. Other Plans. Various other plans of protection and alinements were considered and are described below.

(1) Alternative Alinement for Chef Menteur Complex. An alternative alinement for the Chef Menteur Complex is shown in plan on plate A-III-11. This alinement, which was presented in

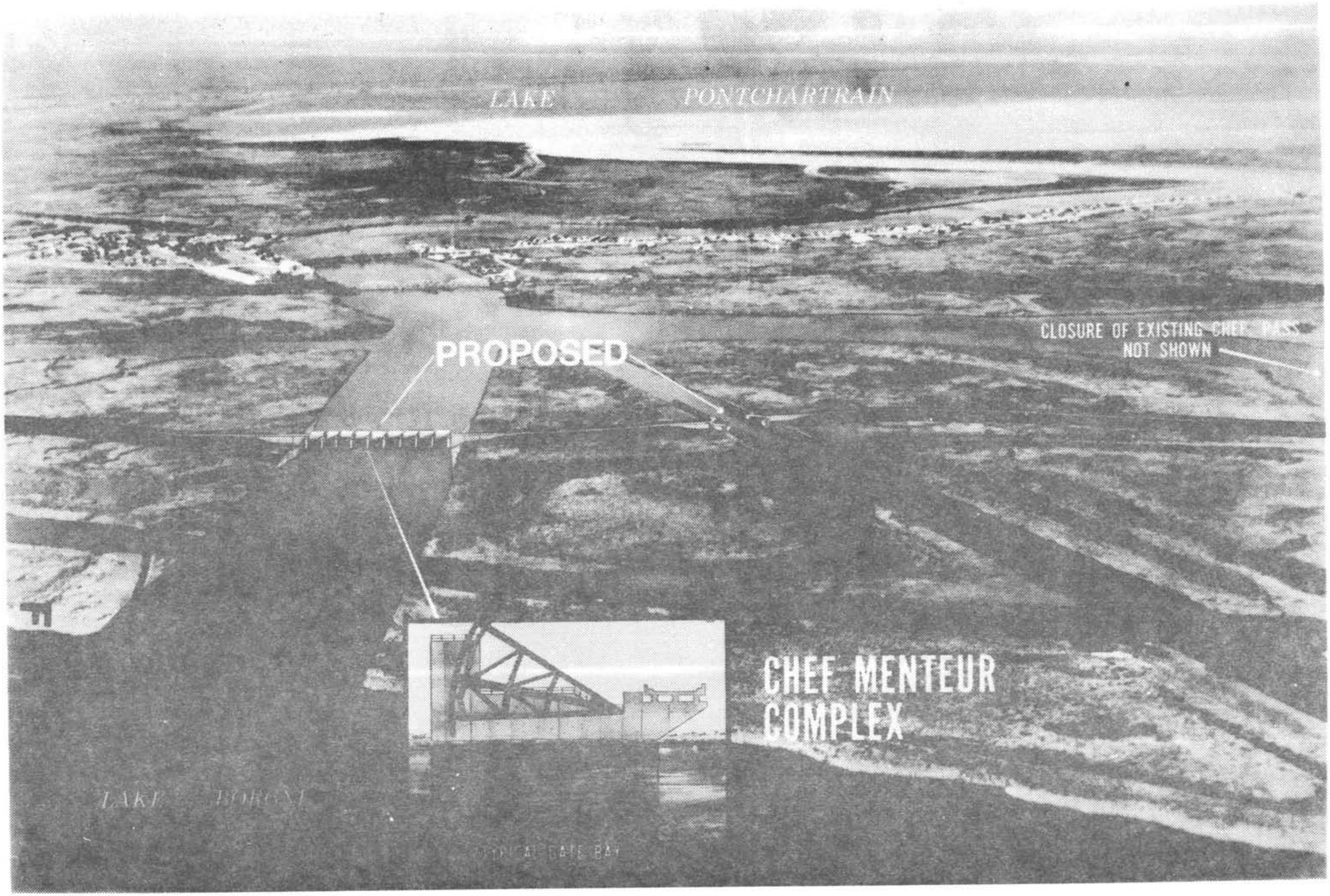
the original project authorization, was considered in detail in Appendix A of General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex dated May 1969. The design memorandum is available for review in the New Orleans District office of the Corps of Engineers. This alinement extends generally eastward from the existing New Orleans East levee along the north banks of Bayou Sauvage and Chef Menteur Pass, thence southeast across Chef Menteur Pass to the U.S. Highway 90 embankment. (Note: the alinement in the vicinity of the Rigolets complex is discussed in a later paragraph). This alinement did not compare favorably with that shown on plate A-III-6 principally because it offers no protection to the Venetian Isles subdivision and because it is not as economically justified.

(2) "Plan B" Alternative Alinement for Barrier. An alternative alinement for the entire barrier from the existing New Orleans East levee to Apple Pie Ridge in St. Tammany Parish is shown in plan on plate A-III-12. This alinement was considered in detail in Appendix A of General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex dated May 1969 and was referred to as "plan B". The design memorandum is available for review in the New Orleans District office of the Corps of Engineers. This alinement runs essentially along the north bank of the Gulf Intracoastal Waterway to a point east of Lake St. Catherine where it turns north, crosses the Rigolets Pass and ties in with Apple Pie Ridge. This alinement was not as economically justified as the alinement on plate A-III-6.

(3) "Plan C" Alternative Alinement for Barrier Complex. This alternative involves a radical departure from other plans and involves not only modifications in the Lake Pontchartrain barrier, but in the overall Lake Pontchartrain Barrier Plan and the Chalmette Area Plan as well. The alinement is shown on plate A-III-13. This plan was considered in detail in Appendix A of General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex dated May 1969 and was referred to as "plan C". The design memorandum is available for review in the New Orleans District office of the Corps of Engineers. The plan moves the primary line of hurricane defense for Orleans and St. Bernard Parishes eastward to the western shore of Lake Borgne. The modified levee alinement crosses both the MR-GO and the GIWW. An opening 400 feet wide by 40 feet deep below mean low gulf is provided where the alinement crosses the MR-GO, with closure during hurricanes to be effected by a floating gate. A navigation lock 110 feet by 1,200 feet with sill at elevation -14, located in a bypass channel, provides for uninterrupted use of the GIWW. This plan eliminates much of the levee required for the Chalmette Area Plan and drastically reduces the grade requirements


LAKE PONTCHARTRAIN
PROPOSED
RIGOLETS COMPLEX


LAKE PONTCHARTRAIN
PROPOSED
SEABROOK COMPLEX
IHNC
FIGU -3


LAKE PONTCHARTRAIN
PROPOSED
CLOSURE OF EXISTING CHEF PASS
NOT SHOWN
CHEF MENTEUR
COMPLEX
LAKE BORGNE
TYPICAL GATE BAY

of the Citrus and New Orleans East back levees and the IHNC. This plan was not as economically justified as the Barrier Plan and Chalmette Area Plan alinements shown on plates A-III-6 and A-III-1, respectively.

(4) "Plan 1" Alternative Location for Rigolets Structure. An alternative location for the Rigolets Control Structure is shown on plate A-III-14. This plan, which was contained in the original project auhorization, was considered in detail in Appendix A of General Design Memorandum No. 2, Supplement No. 1, entitled Rigolets Control Structure, Closure Dam, and Adjoining Levees, dated March 1970. The design memorandum is available for review in the New Orleans District office of the Corps of Engineers. The distinguishing features of this plan are the location of the control structure with associated channels in a land cut and the relocation of U.S. Highway 90. In comparison, the alinement shown on plate A-III-6 was found to be less costly, does not require relocation of Highway 90, and eliminates the land cut.

(5) "Plan 2" Change in Sill Elevation Rigolets Structure. A change in the depth of the Rigolets Control Structure was considered in detail in Appendix B of General Design Memorandum No. 2, Supplement No. 1, entitled Rigolets Control Structure, Closure Dam, and Adjoining Levees, dated March 1970. The design memorandum is available for review in the New Orleans District office of the Corps of Engineers. This plan, identical in alinement to that shown on plate A-III-6, considers a sill elevation for the control structure of -20.0 feet mean sea level. When compared against a control structure of the same hydraulic capacity but with a sill elevation of -30.0, this plan was found to be more costly and offered no added advantage.

(6) Navigable Opening in Rigolets Structure. It has been suggested that navigation needs at the Rigolets Pass could be served by constructing a navigable opening in the control structure in lieu of a navigation lock. This matter, among others, was addressed in the "Report on Size Selection, Chef Menteur Navigation Structure and Rigolets and Seabrook Locks", prepared in July 1970. The report is available for review in the New Orleans District office of the Corps of Engineers. In that report the requirement for navigation locks at both Rigolets and Seabrook was justified, as was the need for a navigation structure in lieu of a lock at Chef Menteur. The following excerpt in support of these positions is extracted from the above referenced report:

"Structure types. The Rigolets and the IHNC are both segments of an authorized navigation project. Both provide access to harbors of refuge in time of storms. Any attempt to provide the needed control at either location through a floodgate would result in extensive interruptions to navigation. The need for navigation locks at these two locations is, therefore, clearcut. The situation at Chef Menteur Pass is different. The pass is not part of an authorized navigation project, and the projected existence of alternate uninterrupted routes via The Rigolets and Seabrook obviates the need to provide uninterrupted access. Use of a floodgate, which will allow passage most of the time, is, therefore, appropriate."

(7) "Mouton Plan". In January 1978, Mr. William J. Mouton, Jr., a structural engineer from New Orleans, proposed the use of dual purpose control and navigation structures in both the Chef Menteur and Rigolets Passes. His proposed structures would eliminate the separate navigation structure at Chef Menteur and the lock at Rigolets; it would provide a flow area equal to approximately 90 percent of the natural cross sectional area; it would utilize prestressed concrete construction; it would serve as a potential highway crossing; and it would utilize a "needle" type closure. Plate A-III-15 illustrates the Mouton Plan. Observations relative to Mr. Mouton's proposals are as follows.

(a) For reasons stated in subparagraph (6) above, the proposed combination control and navigation structure at Rigolets does not satisfy project requirements.

(b) The needle type closure in a control structure does not provide the dependability, speed of operation, and ease of handling which is required under hurricane conditions.

(c) The remainder of Mr. Mouton's proposal, when considered from the standpoints of constructability, long life, serviceability, and function, do not meet the project needs as well as the recommended designs.

(8) Floating/Sinkable Barge. A floating/sinkable barge has been proposed for use as a control structure in the Rigolets Pass, Chef Menteur Pass, and the MR-GO/IHNC. The proposal calls for a floating barge (or other type vessel) hinged at one end to be stored parallel to each waterway. In the event of an approaching hurricane, the barges would be swung across the waterways and sunk to form barriers against tidal influx. Observations relative to this proposal are as follows:

(a) The proposal is not suited for the MR-GO/IHNC location since it does not provide the flexibility required for salinity control nor does it reduce the navigation hazard at Seabrook. (See subparagraph c(1) above.)

(b) At Rigolets a lock would be required as stated in subparagraph (6) above.

(c) The massiveness of the floating barge would make closure during an approaching hurricane exceedingly difficult, if not impossible. Such uncertainty cannot be tolerated in a hurricane protection structure.

(d) To form an effective closure, the barge would have to seat on a concrete base slab in the bottom of the channel. Considering irregularities on the base slab surface resulting from siltation and debris accumulation, proper seating of a barge would be uncertain and undependable. In summary, it was concluded that this proposal cannot satisfy project needs.

(9) Orleans Parish Offshore Breakwater. Breakwaters situated in the lake near the shoreline have been proposed for use on the New Orleans lakefront. The purpose of the breakwaters would be to reduce the height of waves striking the shoreline, thus reducing the height of the required levees and floodwalls. The breakwaters would be constructed of a sand core overlain with riprap stone. They would have a top elevation of 10 feet above mean sea level and would have to be constructed close enough to the shoreline so as to prevent regeneration of the waves. Such breakwaters would cost approximately $2,400 per linear foot or approximately $60 million for the reach from the West End Yacht Harbor to the Inner Harbor Navigation Canal. Breakwaters would adversely impact lakefront aethetics and recreational boating. When compared with the option to raise the lakefront levees and floodwalls, the breakwater plan was found to be inferior.

(10) I-Wall and T-Wall on Levee. The use of concrete capped steel pile (I-Wall) and a pile supported concrete wall (T-Wall) has been proposed as a means of achieving "high level" protection on the lakefront. Located on the shoreline of a large, open body of water (Lake Pontchartrain) where commercial and recreational vessels may be driven against the protection by storm forces, a floodwall does not provide the same degree of reliability as an earthen levee plan would under these conditions. Generally speaking, it is impractical and/or uneconomical to design long reaches of floodwall for such impact forces. However, it must be conceded that the likelihood of a vessel striking the floodwall during the height of a storm is

indeed remote. Therefore, the I-wall and T-wall designs and cost estimates were prepared and presented as separate alternative plans in this report. If these plans warrant serious consideration in future plan formulations, then it should be emphasized that the possibility of impact loading on the wall does exist. The U.S. Coast Guard has a "Hurricane Readiness Plan" dated 1 May 1979, which calls for all vessels to be removed from the lake or properly moored beginning 48 hours in advance of expected hurricane force winds. These measures can help minimize the possibility of an errant vessel impacting the wall but can never entirely eliminate the possibility. T-Walls, which are usually more expensive to construct than I-walls were considered because of the extensive amounts of fill required to make the I-wall design section stable. Because of the susceptibility of impact loading, a so called "barge berm" design in combination with the I-Wall concept was designed and costed. This plan is also included as a high level alternative plan.

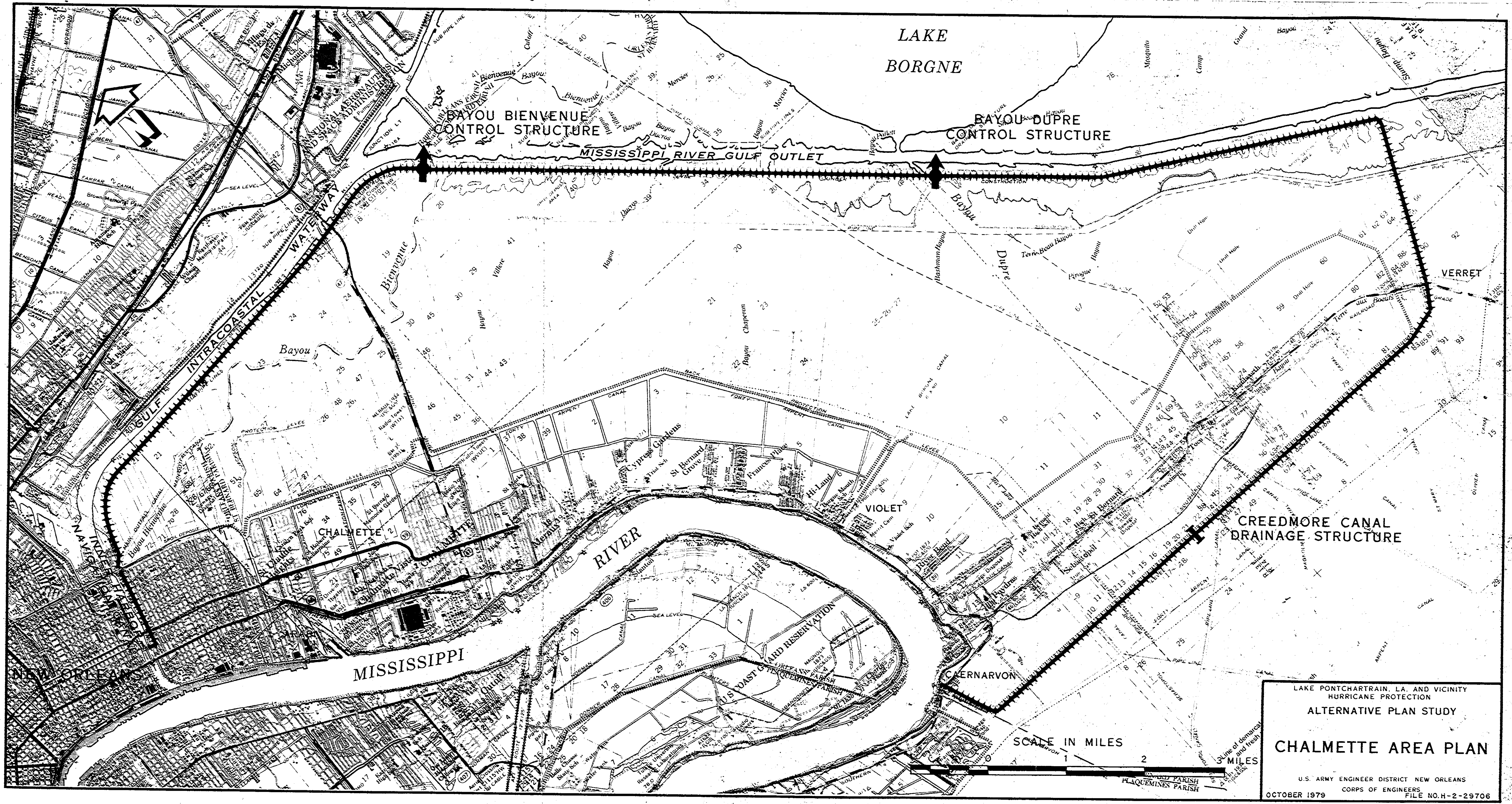
(11) "No Action Plan". The alternative of "no action" would preserve, for a time, the existing environmental dynamics of the area. It would leave the area subject to massive overflow from hurricanes, with attendant major economic loss, social disruption, and a potential for extensive loss of human life.

3. Estimates of First Cost. A summary of cost estimates for the barrier plan, the high level plan - SPH protection, and the high level plan -100 year protection is presented in table 1. These tables reflect the least costly, acceptable solutions for each reach of protection. Detailed estimates of all alinements and degrees of protection are given in Section IV of this appendix. All estimates are broken down into the following reaches: Chamette area; St. Charles Parish; Jefferson Parish; New Orleans Lakefront from Jefferson Parish line to the IHNC; West bank of IHNC; East bank of IHNC north of MRGO; Citrus Lakefront; New Orleans East Lakefront; Lake Pontchartrain to GIWW; New Orleans East back levee; Citrus back levee; Seabrook Complex; Chef Menteur Complex; Rigolets Complex; and Mandeville Seawall. All cost estimates were developed using October 1981 price levels. The base condition for estimates contained in table 1 assumes present day or existing conditions and thus table 1 estimates reflect the "cost to complete" estimate for the various project reaches. All work items that are under contract as of October 1979 were considered to be completed work items.

TABLE 1
LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION
ALTERNATIVES STUDY
SUMMARY* ESTIMATES OF COST TO COMPLETE 1/

DESCRIPTION		COST BARRIER PLAN SPH PROTECTION ($)	COST HIGH LEVEL PLAN SPH PROTECTION ($)	COST HIGH LEVEL PLAN 100 YEAR PROTECTION ($)
St. Charles Parish -	Lakefront Alinement	123,072,000	143,559,000	128,426,000
	Alinement North of Airline Hwy	37,498,000	55,721,000	N/A
Jefferson Parish Lakefront Levee	ALL EARTHEN LEVEE:			
	a.) Hauled Clay Fill (Straddle)	N/A	524,467,000	221,231,000
	b.) Hauled Clay Fill	8,871,000	249,306,000	156,119,000
	c.) Hydraulic Fill w/o Ponding Area	N/A	123,173,000	81,027,000
	d.) Hydraulic Fill w/ Ponding Area	N/A	244,061,000	201,912,000
	I-WALL ON LEVEE WITH BARGE BERM:			
	a.) Hauled Clay Fill	N/A	284,619,000	N/A
	b.) Hydraulic Fill w/o Ponding Area	N/A	155,683,000	N/A
	c.) Hydraulic Fill w/ Ponding Area	N/A	276,350,000	N/A
	I-WALL ON LEVEE:			
	a.) Hauled Clay Fill	N/A	167,708,000	N/A
	T-WALL ON LEVEE:			
	a.) Hauled Clay Fill	N/A	657,668,000	N/A
New Orleans Lakefront Levee (West of IHNC)	(Hauled Clay Fill)	188,150,000	224,311,000	207,334,000
	(I-Wall on Levee)	N/A	220,861,000	N/A
	(I-Wall on Levee w/Barge Berm)	N/A	215,813,000	N/A
Citrus Lakefront Levee	(Hauled Clay Fill)	8,571,000	60,156,000 2/	49,297,000
	(Hauled Clay Fill)	N/A	109,470,000 3/	30,382,000
	(Hydraulic Clay Fill w/o Ponding Area)	N/A	73,520,000 3/	N/A
	(Hydraulic Clay Fill w/Ponding Area)	N/A	105,194,000 3/	N/A
	(I-Wall on Levee)	N/A	37,475,000 4/	N/A
	(I-Wall on Levee w/Barge Berm)	N/A	46,854,000 5/	N/A
Maxent Canal Levee		79,920,000	120,772,000	92,962,000
New Orleans East Lakefront Levee	(Hauled Clay Fill)	12,185,000	34,843,000	24,649,000
	(I-Wall on Levee)	N/A	32,022,000	N/A
South Point to GIWW Levee		585,000	5,182,000	585,000
New Orleans East Back Levee (Michoud Canal to Sta 1006+59) with NOE/S Point to GIWW Levees		17,087,000	17,087,000	13,505,000
New Orleans East Back Levee (Michoud Canal to Sta 1006+59) with Maxent Canal Levee		9,533,000	N/A	N/A
New Orleans East Bank Levee (Michoud Canal to Maxent Canal) with Maxent Canal Levee		N/A	8,154,000	9,320,000
Citrus Back Levee (IHNC to Michoud Canal)		5,050,000	5,050,000	N/A
East Bank of IHNC (MRGO to Lake Pontchartrain		3,423,000	3,423,000	N/A
West Bank of IHNC		33,324,000	33,324,000	N/A
Mandeville Seawall		2,378,000	2,378,000	N/A
Chalmette Area Plan		65,925,000	65,925,000	N/A
Seabrook Complex	(50% of Total Cost)	45,725,000	45,725,000	N/A
Chef Menteur Complex:	43% of Natural Opening	109,301,000	N/A	N/A
	50% of Natural Opening	119,192,000	N/A	N/A
	90% of Natural Opening	151,093,000	N/A	N/A
Rigolets Complex:	35% of Natural Opening	195,501,000	N/A	N/A
	50% of Natural Opening	228,215,000	N/A	N/A
	90% of Natural Opening	325,006,000	N/A	N/A

Footnotes
1/ October 1981 Price Levels.
2/ Uses "existing" levee alinement, a retaining wall along Hayne Blvd., and a breakwater on the lakeside of R.R. tracks.
3/ In-the-Lake Alinement.
4/ Uses "existing" levee embankment.
5/ Uses "existing" levee alinement with a breakwater on the lakeside of R.R. tracks.



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

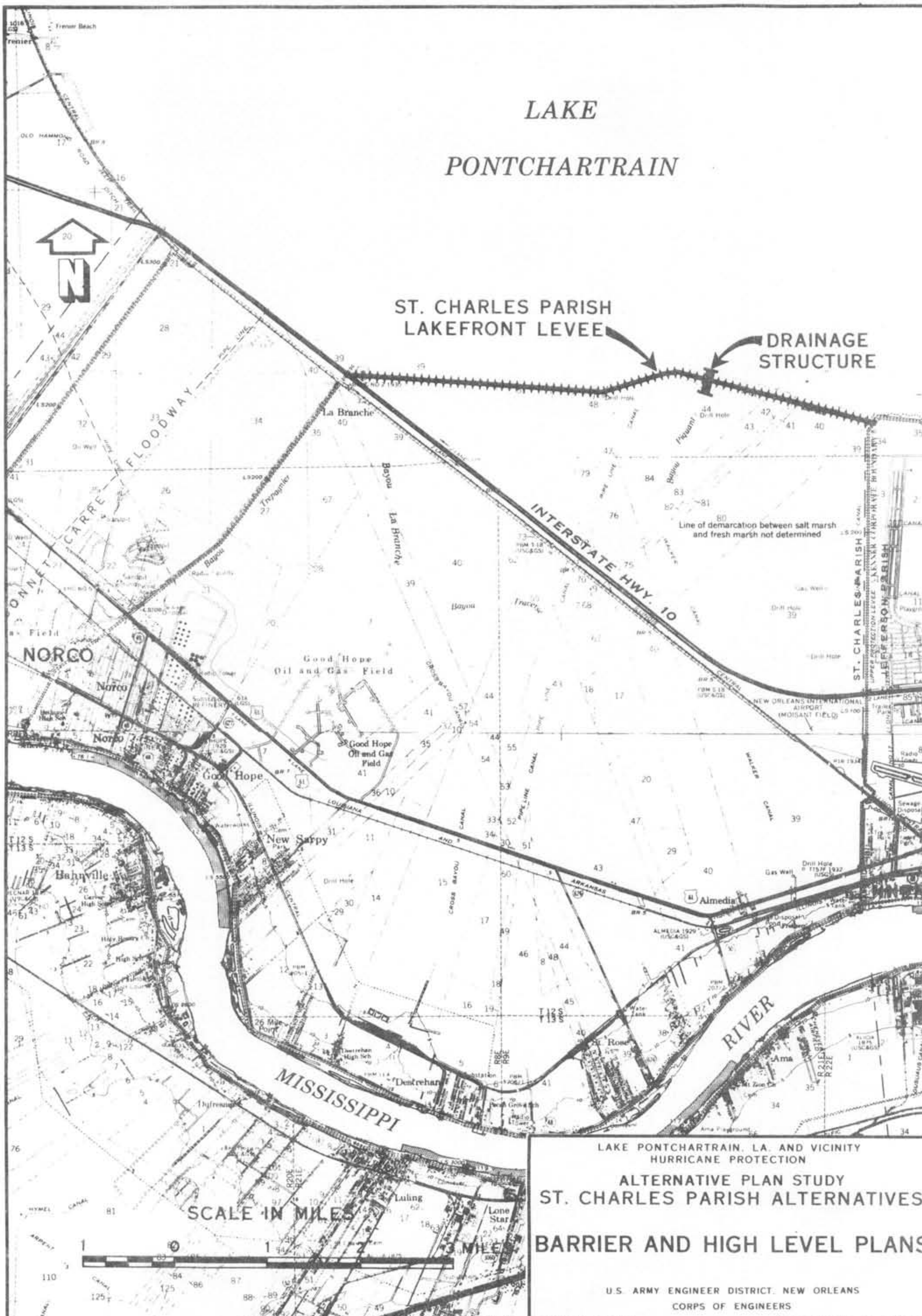
ALTERNATIVE PLAN STUDY

CHALMETTE AREA PLAN

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

OCTOBER 1979 FILE NO. H-2-29706

PLATE A-III-1



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

ALTERNATIVE PLAN STUDY
ST. CHARLES PARISH ALTERNATIVES

BARRIER AND HIGH LEVEL PLANS

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

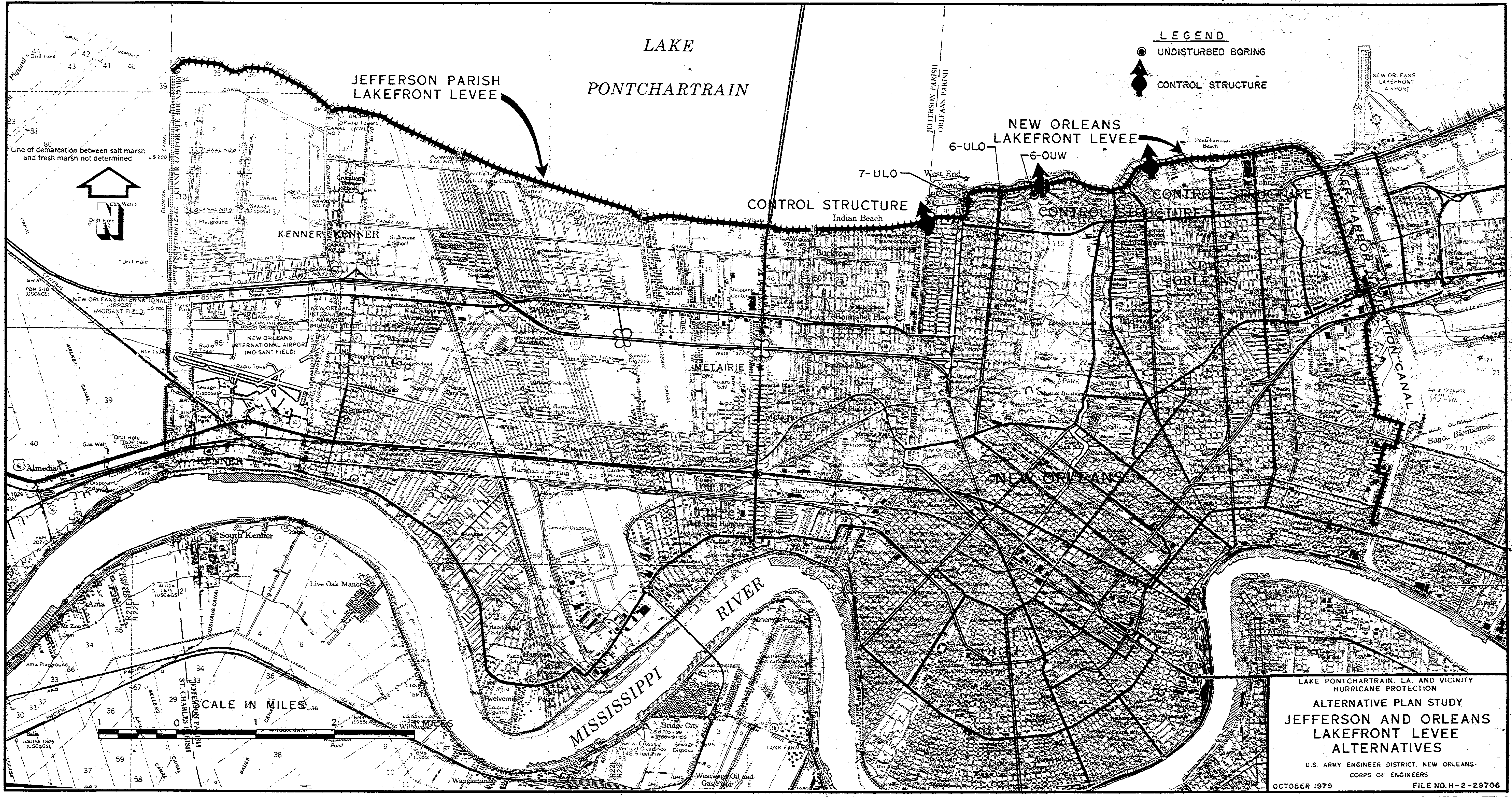
OCTOBER 1979 FILE NO. H-2-29706


LAKE
PONTCHARTRAIN
N
BONNET CARRE FLOODWAY
INTERSTATE HWY. 10
NORCO
5-SCJU
4-SCJU
3-SCJU
2-SCJU
1-JU
Good Hope Oil and Gas Field
ST. CHARLES PARISH
AIRLINE HWY. ALINEMENT
NORTH
Line of demarcation between salt marsh and fresh marsh not determined
NEW ORLEANS INTERNATIONAL AIRPORT (MOISANT FIELD)
ST. CHARLES PARISH
JEFFERSON PARISH
La Branche
Bayou La Branche
New Sarpy
Hahnville
Good Hope
Destrehan
St. Rose
Luling
MISSISSIPPI
RIVER
UNDISTURBED BORING
DRAINAGE STRUCTURE
SCALE IN MILES
1 0 1 2 3 MILES
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
ST. CHARLES PARISH ALTERNATIVES
BARRIER AND HIGH LEVEL PLANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979
FILE NO. H-2-29706

PLATE A-III-3


LAKE
PONTCHARTRAIN
N
INTERSTATE HWY. 10
BONNET CARRE FLOODWAY
NORCO
Norco
Good Hope
New Sarpy
La Branche
Bayou La Branche
Good Hope Oil and Gas Field
Line of demarcation between salt marsh and fresh marsh not determined
NEW ORLEANS INTERNATIONAL AIRPORT (MOISANT FIELD)
ST. CHARLES PARISH
JEFFERSON PARISH
AIRLINE HWY.
Hahnville
ST. CHARLES PARISH AIRLINE HWY. ALINEMENT SOUTH
MISSISSIPPI
RIVER
Destrehan
St. Rose
Ama
Luling
Lone Star
DRAINAGE STRUCTURE
SCALE IN MILES
1 0 1 2 3 MILES
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
ST. CHARLES PARISH ALTERNATIVES
BARRIER AND HIGH LEVEL PLANS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979
FILE NO. H-2-29706

PLATE A-III-4



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

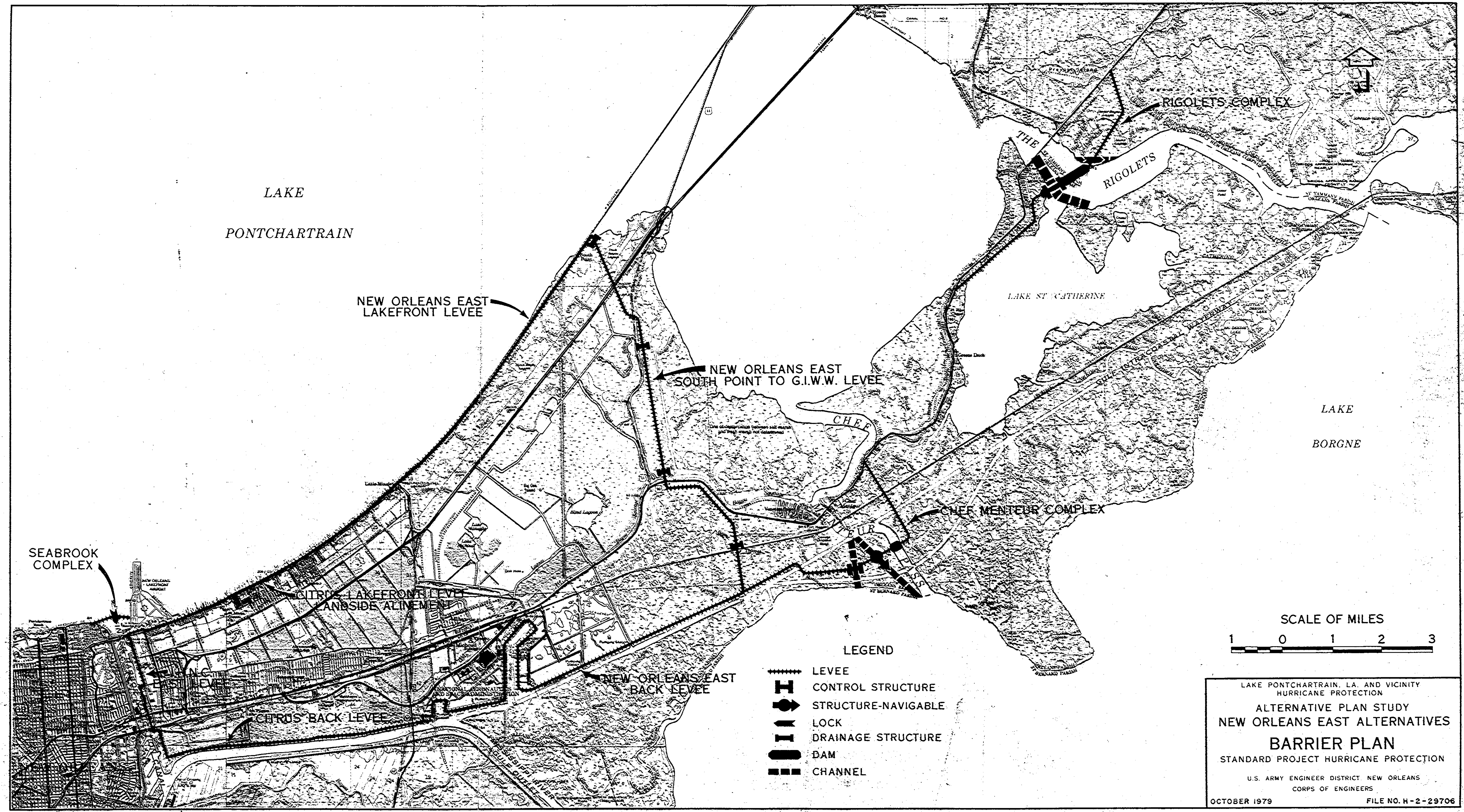
ALTERNATIVE PLAN STUDY

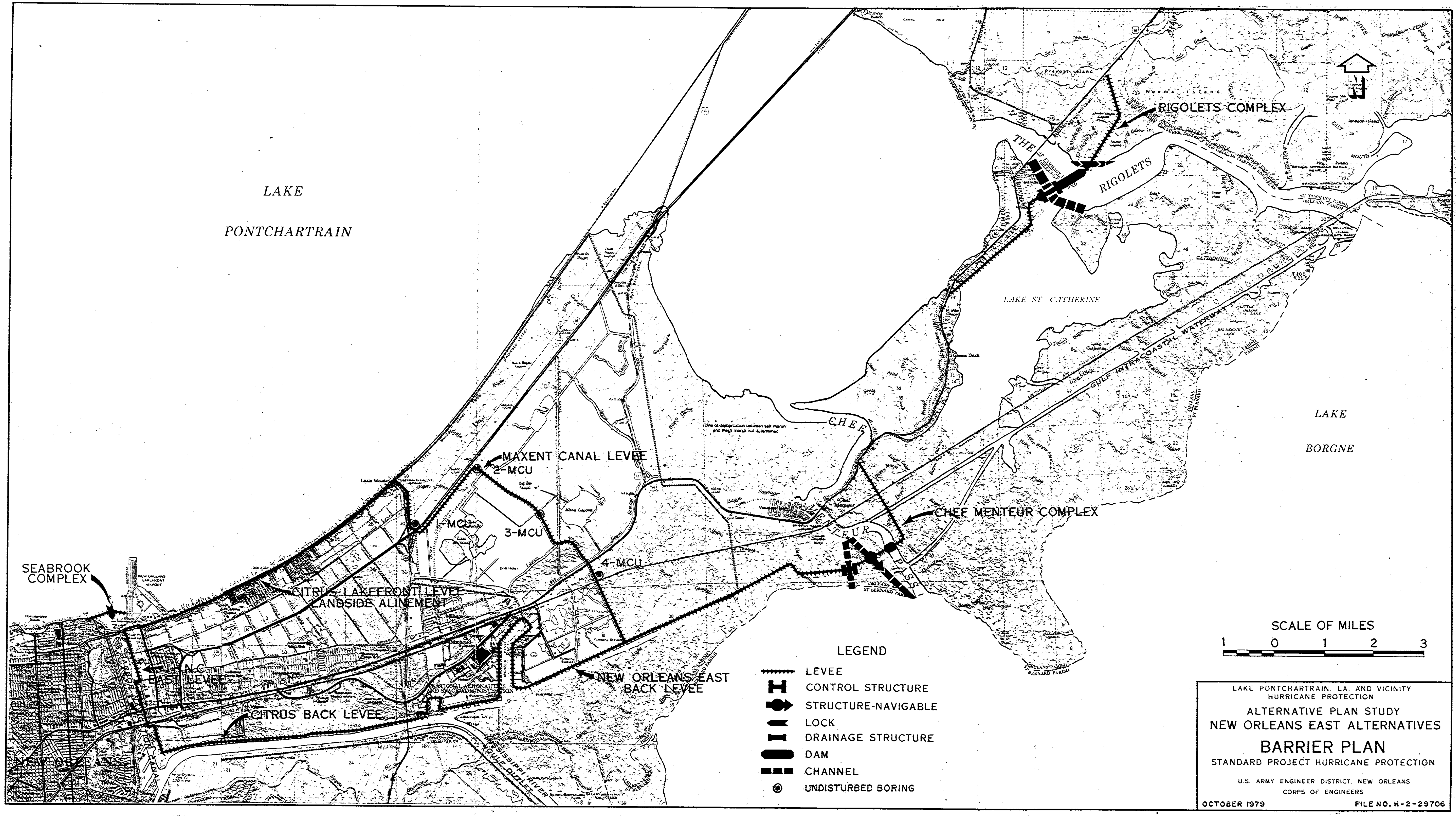
JEFFERSON AND ORLEANS LAKEFRONT LEVEE ALTERNATIVES

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

OCTOBER 1979 FILE NO. H-2-29706

PLATE A-III-5


LAKE
PONTCHARTRAIN
NEW ORLEANS EAST
LAKEFRONT LEVEE
NEW ORLEANS EAST
SOUTH POINT TO G.I.W.W. LEVEE
RIGOLETS COMPLEX
THE
RIGOLETS
LAKE ST CATHERINE
CHEF
CHEF MENTEUR COMPLEX
LAKE
BORGNE
SEABROOK
COMPLEX
CITRUS LAKEFRONT LEVEE
LANDSIDE ALINEMENT
I.H.N.C.
EAST LEVEE
CITRUS BACK LEVEE
NEW ORLEANS EAST
BACK LEVEE
GULF INTRACOASTAL WATERWAY
LEGEND
LEVEE
CONTROL STRUCTURE
STRUCTURE-NAVIGABLE
LOCK
DRAINAGE STRUCTURE
DAM
CHANNEL
SCALE OF MILES
1 0 1 2 3
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES
BARRIER PLAN
STANDARD PROJECT HURRICANE PROTECTION
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979
FILE NO. H-2-29706



LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES

BARRIER PLAN

STANDARD PROJECT HURRICANE PROTECTION

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

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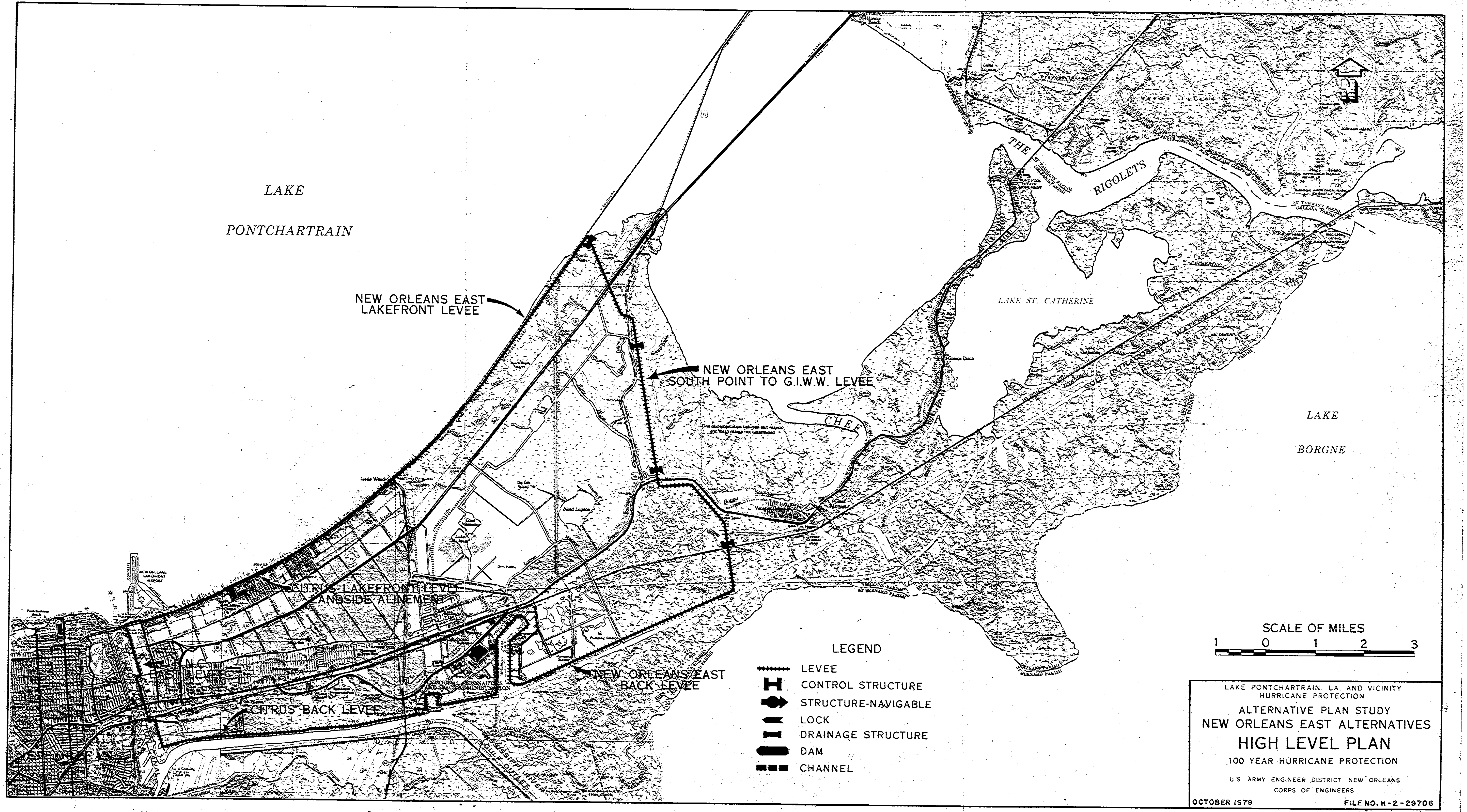
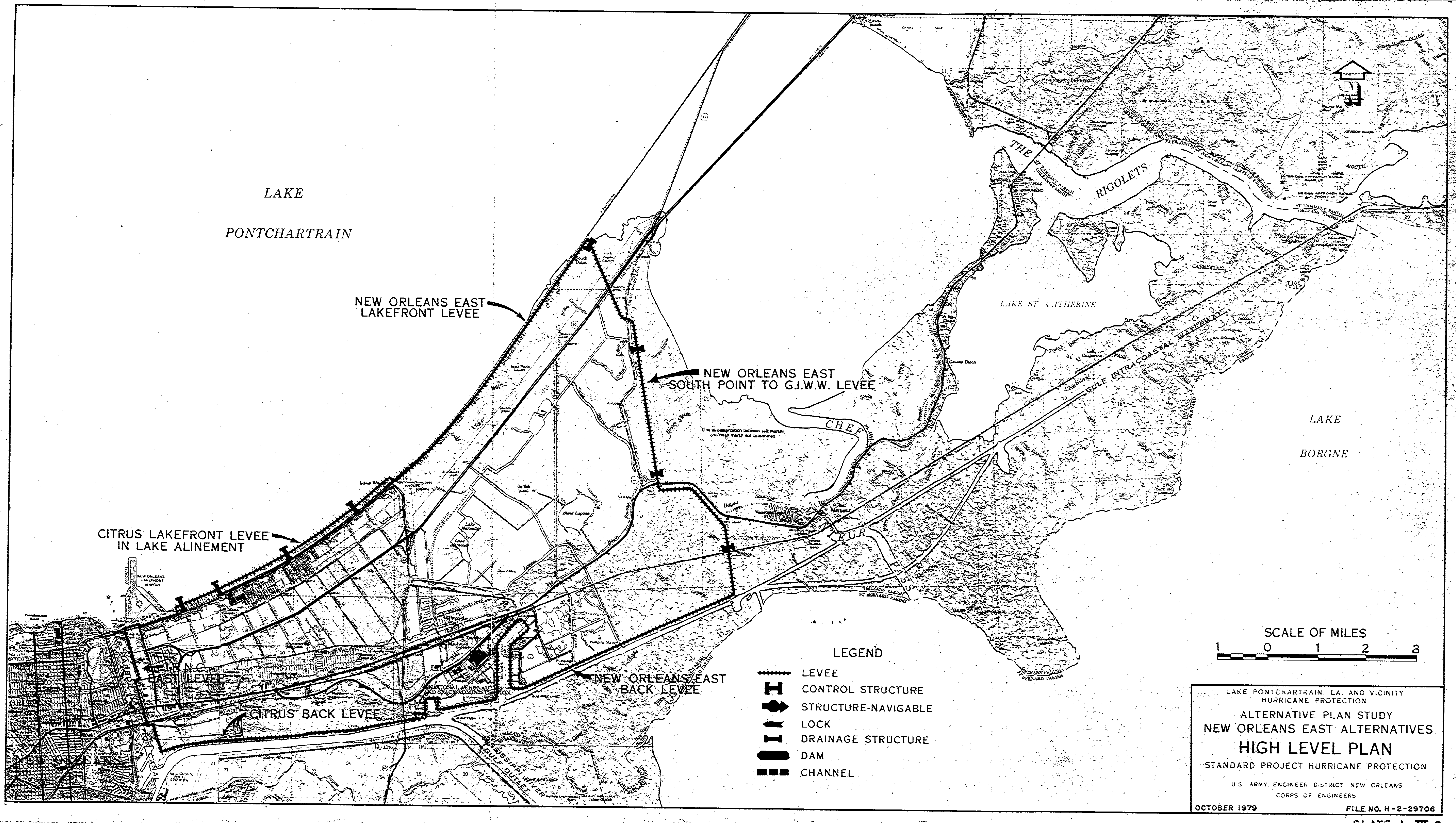

LAKE
PONTCHARTRAIN
NEW ORLEANS EAST
LAKEFRONT LEVEE
NEW ORLEANS EAST
SOUTH POINT TO G.I.W.W. LEVEE
THE RIGOLETS
LAKE ST. CATHERINE
CHEF
LAKE
BORGNE
CITRUS LAKEFRONT LEVEE
LANDSIDE ALINEMENT
N.O. EAST LEVEE
CITRUS BACK LEVEE
NEW ORLEANS EAST
BACK LEVEE
LEGEND
LEVEE
CONTROL STRUCTURE
STRUCTURE-NAVIGABLE
LOCK
DRAINAGE STRUCTURE
DAM
CHANNEL
SCALE OF MILES
1 0 1 2 3
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES
HIGH LEVEL PLAN
100 YEAR HURRICANE PROTECTION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979
FILE NO. H-2-29706


LAKE
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NEW ORLEANS EAST
LAKEFRONT LEVEE
NEW ORLEANS EAST
SOUTH POINT TO G.I.W.W. LEVEE
CITRUS LAKEFRONT LEVEE
IN LAKE ALINEMENT
I.H.N.C.
EAST LEVEE
CITRUS BACK LEVEE
NEW ORLEANS EAST
BACK LEVEE
THE RIGOLETS
LAKE ST. CATHERINE
CHEF
GULF INTRACOASTAL WATERWAY
LAKE
BORGNE
NEW ORLEANS
LEGEND
LEVEE
CONTROL STRUCTURE
STRUCTURE-NAVIGABLE
LOCK
DRAINAGE STRUCTURE
DAM
CHANNEL
SCALE OF MILES
1 0 1 2 3
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES
HIGH LEVEL PLAN
STANDARD PROJECT HURRICANE PROTECTION
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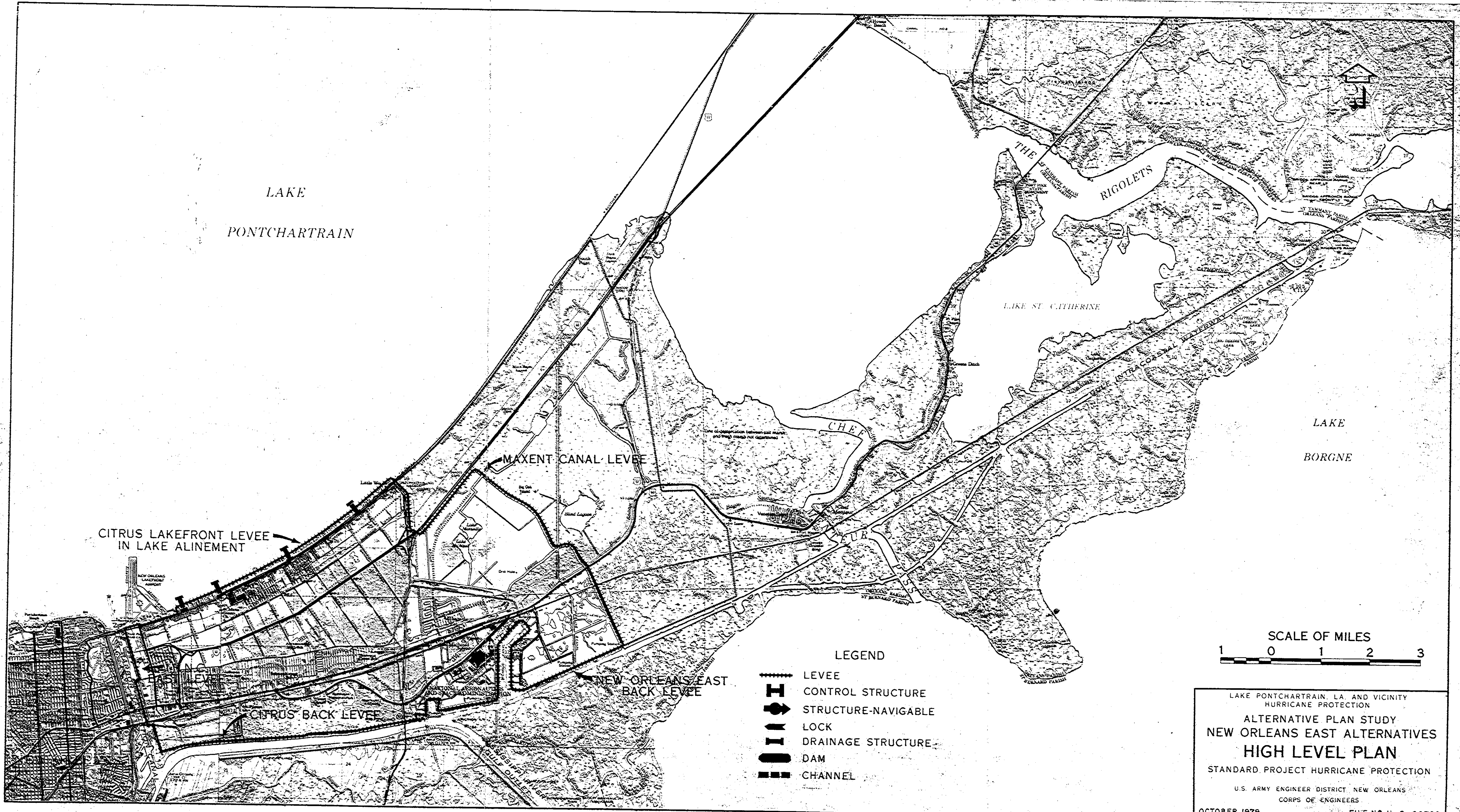


LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES

HIGH LEVEL PLAN

STANDARD PROJECT HURRICANE PROTECTION

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

OCTOBER 1979 — FILE NO. H-2-29706

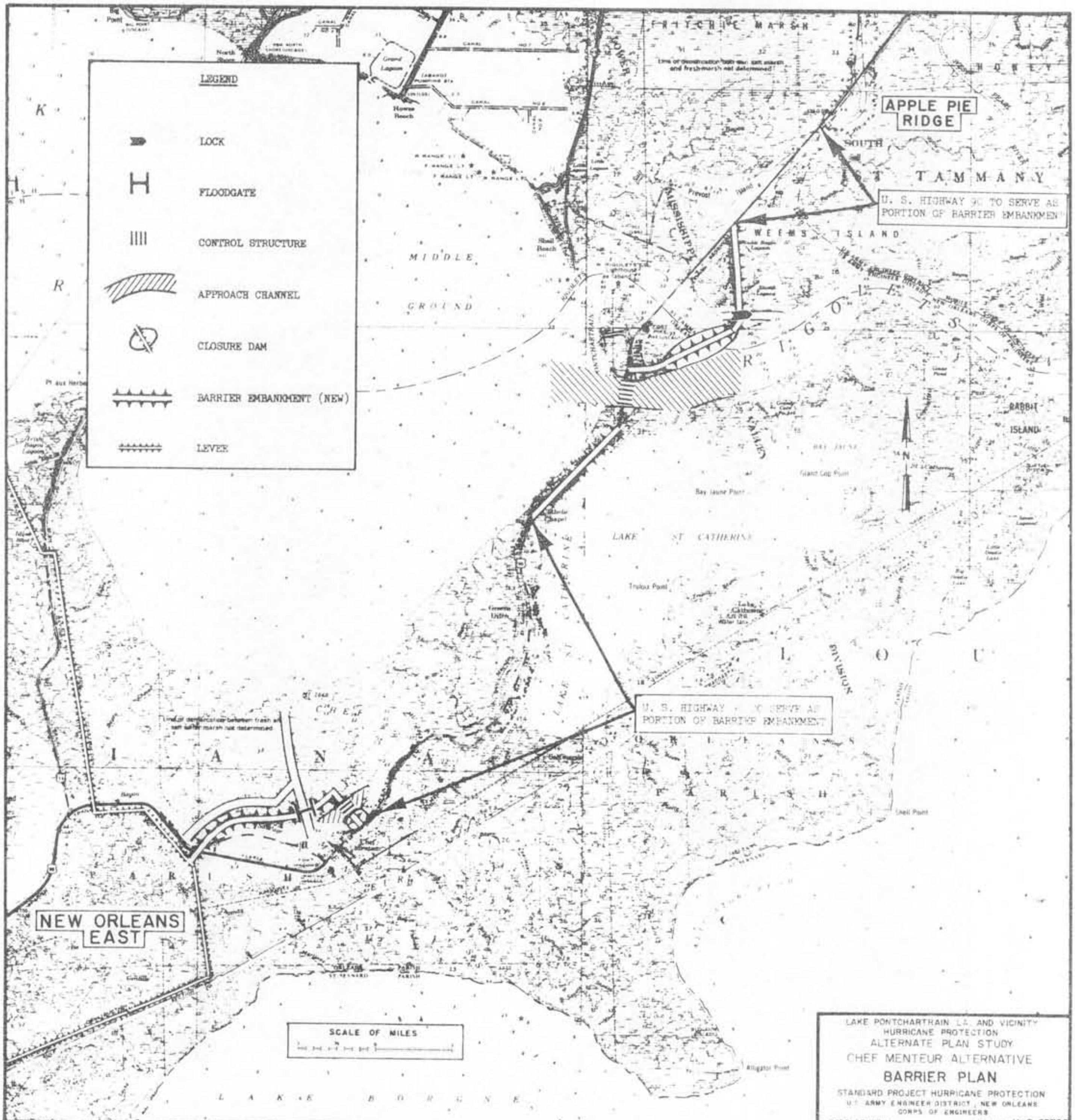
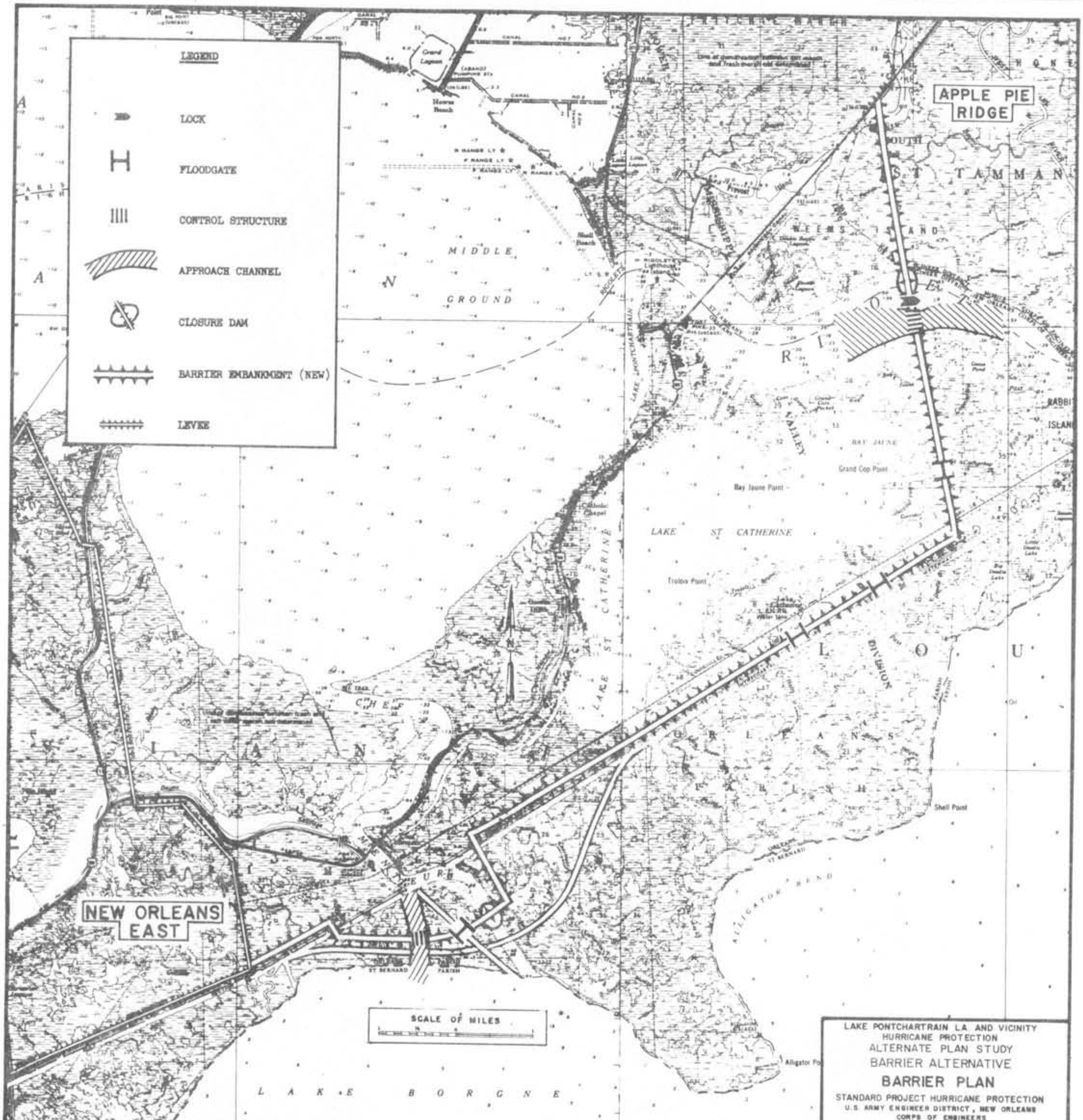


PLATE A-III-11



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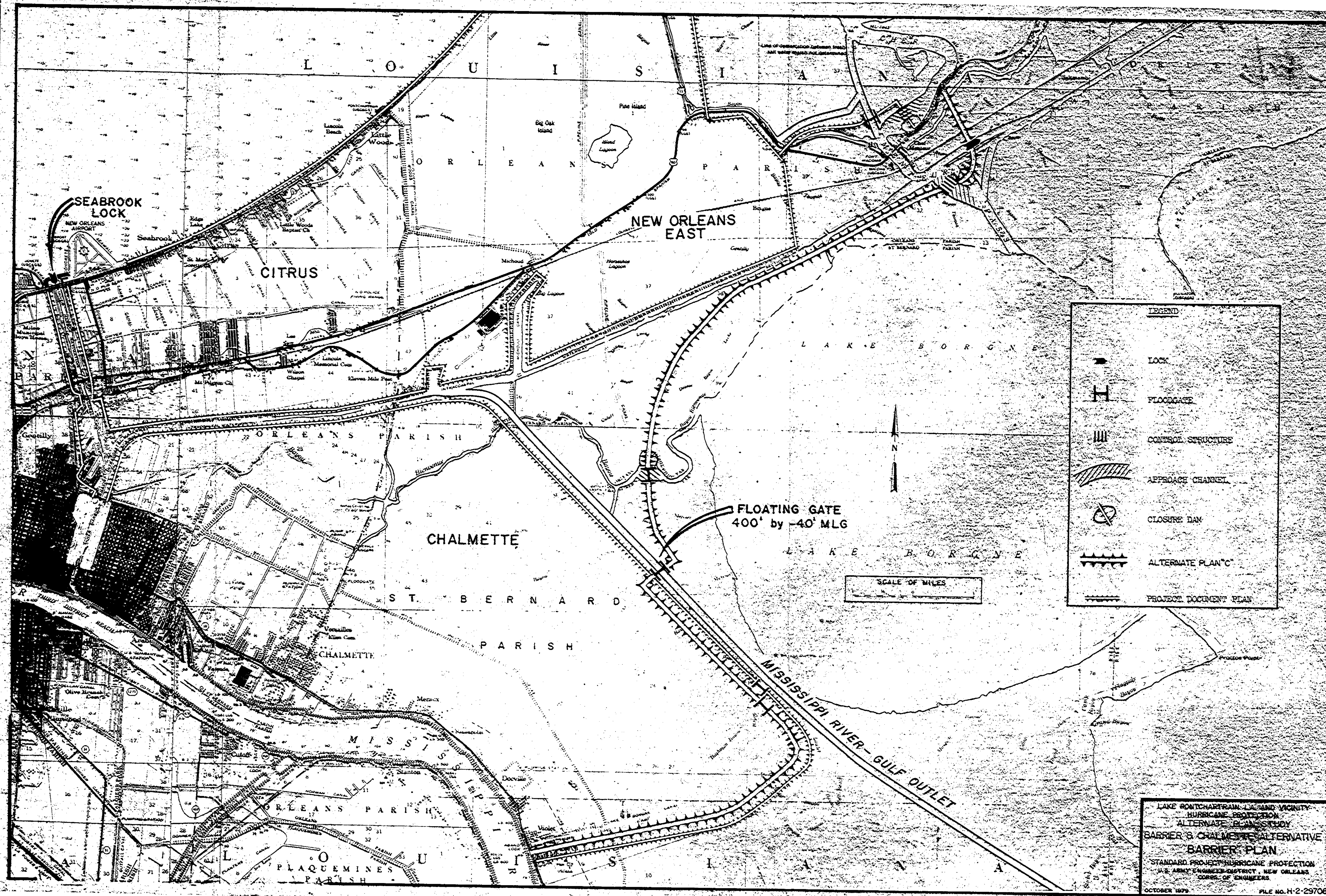

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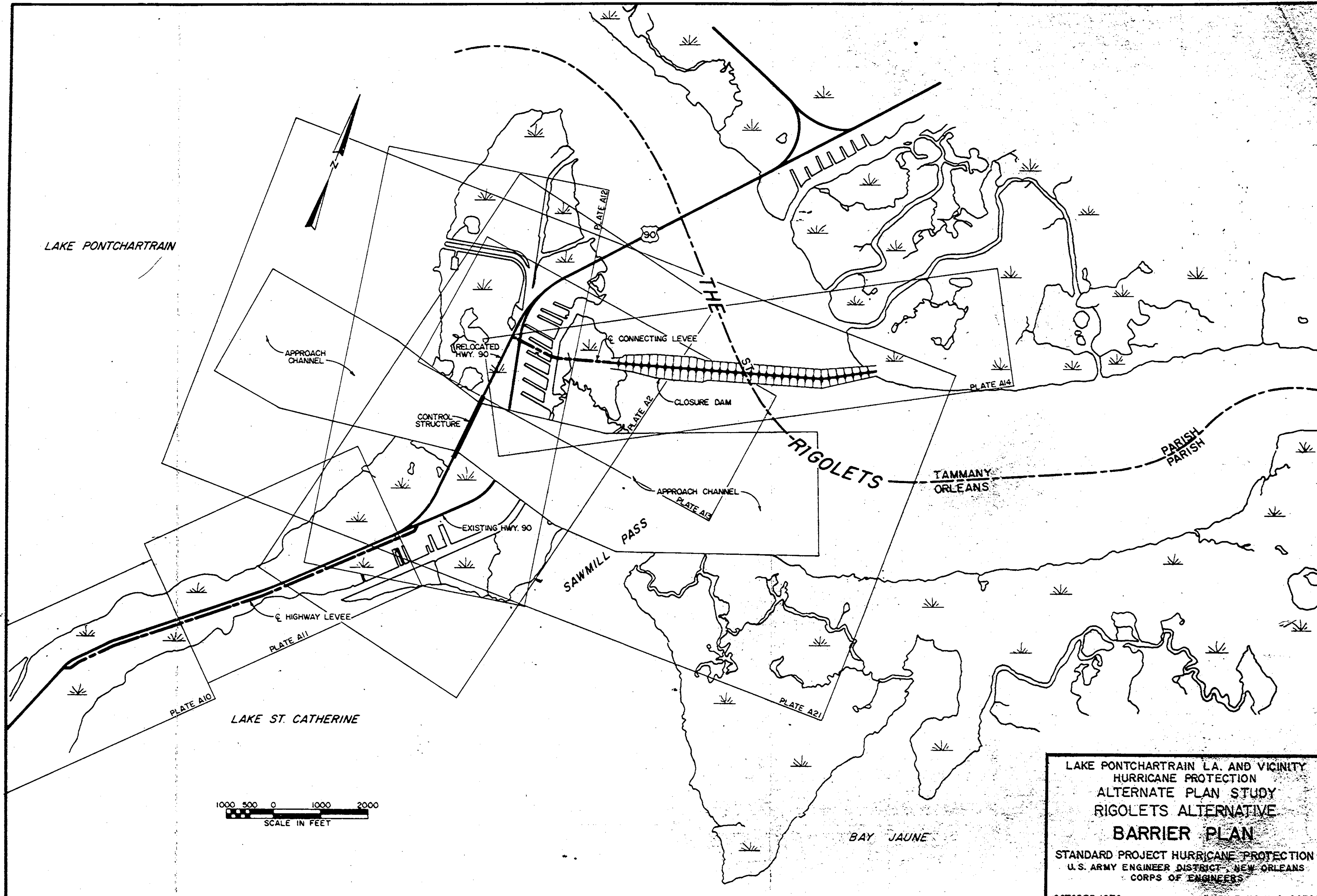
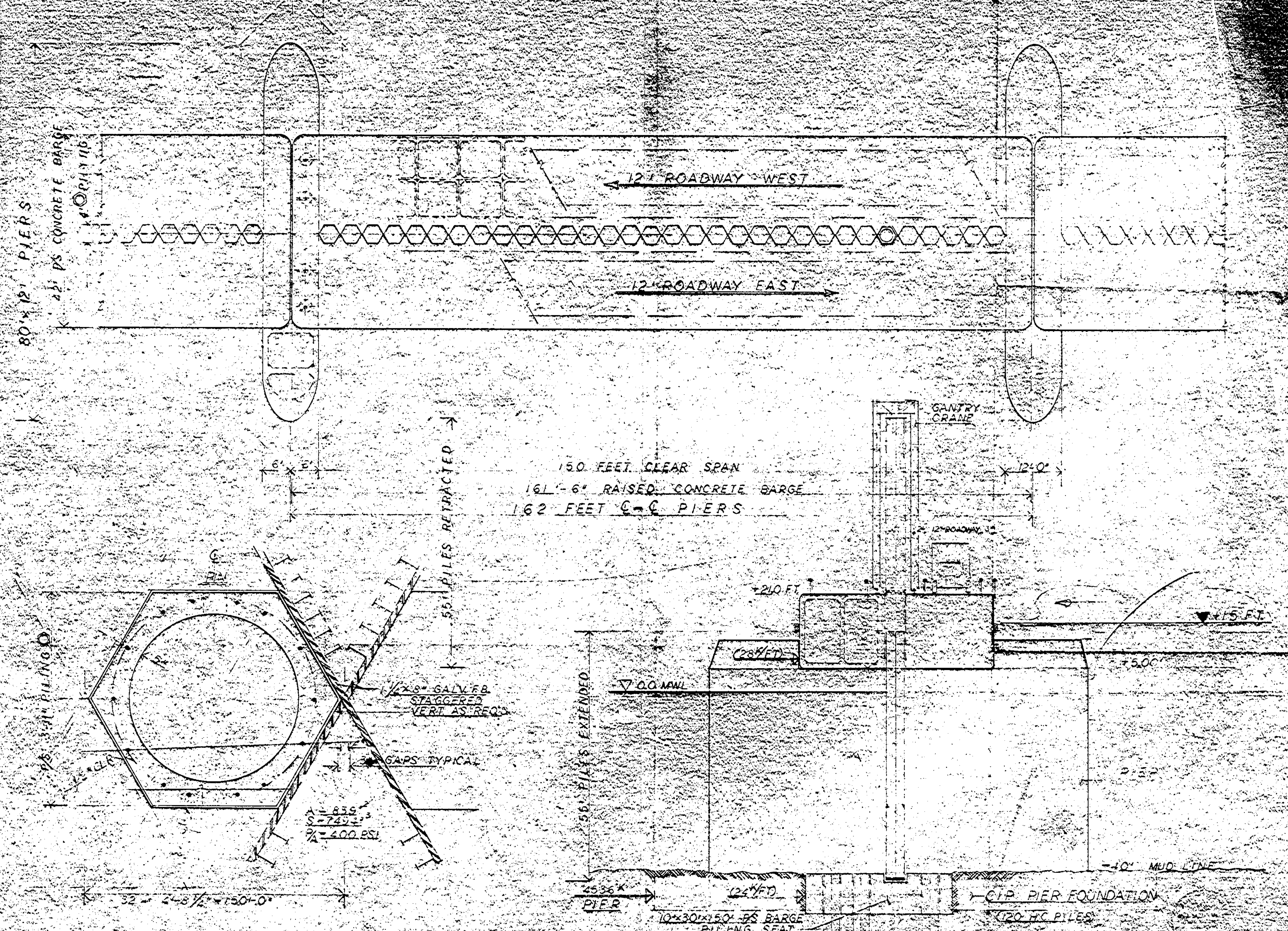


PLATE A-III-14



TIDAL CONTROL STRUCTURE

1-7-78 wjm

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATE PLAN STUDY
MOUTON ALTERNATIVE

BARRIER PLAN

STANDARD PROJECT HURRICANE PROTECTION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

OCTOBER 1979 FILE NO. H-2-29706

PLATE A-III-15

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION IV - DETAILED COST ESTIMATES

APPENDIX A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

SECTION IV - DETAILED COST ESTIMATES

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TABLES

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TABLES

SECTION IV - DETAILED COST ESTIMATES

Table of Contents (cont'd)

TABLES

SECTION IV - DETAILED COST ESTIMATES

Table of Contents (cont'd)

TABLES

OCT 81
PRICE LEVELS

COST TO COMPLETE ESTIMATE
REV 28 APR 82

TABLE 1
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
(a) First Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	410	Acre	1,400.00	574,000
Retaining and Ponding Dikes	1,100,000	C.Y.	2.25	2,475,000
Hydraulic Clay Fill	7,235,000	C.Y.	3.50	25,322,500
(b) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	410	Acre	700.00	287,000
Retaining and Ponding Dikes	600,000	C.Y.	2.25	1,350,000
Hydraulic Clay Fill	2,200,000	C.Y.	3.50	7,700,000
(c) Third Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	410	Acre	700.00	287,000
Retaining and Ponding Dikes	500,000	C.Y.	2.25	1,125,000
Hydraulic Clay Fill	1,100,000	C.Y.	3.50	3,850,000
(d) Fourth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	410	Acre	700.00	287,000
Retaining and Ponding Dikes	350,000	C.Y.	2.25	787,500
Hydraulic Clay Fill	900,000	C.Y.	3.50	3,150,000
(e) Fifth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	410	Acre	700.00	287,000
Retaining and Ponding Dikes	600,000	C.Y.	2.50	1,500,000
Hydraulic Clay Fill	200	Acre	600.00	120,000
(f) Slope Protection				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	400,000	Ton	20.00	8,000,000
Subtotal: LEVEE REACH				61,257,000

TABLE 1 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Drainage Structures (continued)				
Drainage Ditch Excavation	500,000	C.Y.	2.00	1,000,000
Shell (Stream Closures)	1,200,000	C.Y.	12.00	14,400,000
Drainage Structure @ Bayou Piquant	1	Job	Lump Sum	3,000,000
Subtotal: DRAINAGE STRUCTURES				18,400,000
Subtotal: LEVEES AND FLOODWALLS				79,657,000
Contingencies (25%±)				19,914,000
Subtotal:				99,571,000
Engineering and Design (12%±)				11,948,000
Supervision and Administration (10%±)				9,957,000
Total: LEVEES AND FLOODWALLS				121,476,000
Relocations				
16" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	64,000
30" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	120,000
Subtotal: RELOCATIONS				184,000
Contingencies (25%±)				46,000
Subtotal:				230,000
Engineering & Design (12%±)				28,000
Supervision and Administration (10%±)				23,000
Total: RELOCATIONS				281,000

TABLE 1 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way	410	Acre	500.00	205,000
Ponding Area	3,430	Acre	100.00	343,000
Subtotal:				548,000
Contingencies (25%±)				137,000
Subtotal: LANDS AND DAMAGES				685,000
Acquisition Costs				630,000
Total: LANDS AND DAMAGES				1,315,000
Summary:				
LEVEES AND FLOODWALLS				121,476,000
RELOCATIONS				281,000
LANDS AND DAMAGES				1,315,000
TOTAL				123,072,000

TABLE 2
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
(a) First Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	550	Acre	1,400.00	770,000
Retaining and Ponding Dikes	1,100,000	C.Y.	2.25	2,475,000
Hydraulic Clay Fill	5,800,000	C.Y.	3.50	20,300,000
(b) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	550	Acre	700.00	385,000
Retaining and Ponding Dikes	600,000	C.Y.	2.25	1,350,000
Hydraulic Clay Fill	2,900,000	C.Y.	3.50	10,150,000
(c) Third Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	550	Acre	700.00	385,000
Retaining and Ponding Dikes	500,000	C.Y.	2.25	1,125,000
Hydraulic Clay Fill	2,900,000	C.Y.	3.50	10,150,000
(d) Fourth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	550	Acre	700.00	385,000
Retaining and Ponding Dikes	350,000	C.Y.	2.25	787,500
Hydraulic Clay Fill	2,900,000	C.Y.	3.50	10,150,000
(e) Fifth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	550	Acre	700.00	385,000
Clay Fill (Shaping)	1,400,000	C.Y.	2.50	3,500,000
Fertilize and Seed	300	Acre	600.00	180,000
(f) Slope Protection				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	400,000	Ton	20.00	8,000,000
Subtotal: LEVEE REACH				74,632,500

TABLE 2 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Drainage Structures (continued)				
Drainage Ditch Excavation	500,000	C.Y.	2.00	1,000,000
Shell (Stream Closures)	1,200,000	C.Y.	12.00	14,400,000
Drainage Structure @ Bayou Piquant	1	Job	Lump Sum	3,000,000
Subtotal: DRAINAGE STRUCTURES				18,400,000
Subtotal: LEVEES AND FLOODWALLS				93,032,500
Contingencies (25%±)				23,258,500
Subtotal:				116,291,000
Engineering and Design (12%±)				13,955,000
Supervision and Administration (10%±)				11,629,000
Total: LEVEES AND FLOODWALLS				141,875,000
Relocations				
16" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	64,000
30" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	120,000
Subtotal: RELOCATIONS				184,000
Contingencies (25%±)				46,000
Subtotal:				230,000
Engineering & Design (12%±)				28,000
Supervision and Administration (10%±)				23,000
Total: RELOCATIONS				281,000

TABLE 2 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way	550	Acre	500.00	275,000
Ponding Area	3,430	Acre	100.00	343,000
Subtotal:				618,000
Contingencies (25%±)				155,000
Subtotal: LANDS AND DAMAGES				773,000
Acquisition Costs				630,000
Total: LANDS AND DAMAGES				1,403,000
Summary:				
LEVEES AND FLOODWALLS				141,875,000
RELOCATIONS				281,000
LANDS AND DAMAGES				1,403,000
TOTAL				143,559,000

TABLE 3
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
(a) First Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	480	Acre	1,400.00	672,000
Retaining and Ponding Dikes	1,100,000	C.Y.	2.25	2,475,000
Hydraulic Clay Fill	5,000,000	C.Y.	3.50	17,500,000
(b) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	480	Acre	700.00	336,000
Retaining and Ponding Dikes	600,000	C.Y.	2.25	1,350,000
Hydraulic Clay Fill	2,300,000	C.Y.	3.50	8,050,000
(c) Third Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	480	Acre	700.00	336,000
Retaining and Ponding Dikes	500,000	C.Y.	2.25	1,125,000
Hydraulic Clay Fill	2,300,000	C.Y.	3.50	8,050,000
(d) Fourth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	480	Acre	700.00	336,000
Retaining and Ponding Dikes	350,000	C.Y.	2.25	787,500
Hydraulic Clay Fill	2,300,000	C.Y.	3.50	8,050,000
(e) Fifth Lift				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	480	Acre	700.00	336,000
Clay Fill (Shaping)	1,200,000	C.Y.	2.50	3,000,000
Fertilize and Seed	300	Acre	600.00	180,000
(f) Slope Protection				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	400,000	Ton	20.00	8,000,000
Subtotal: LEVEE REACH				64,738,500

TABLE 3 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Drainage Structures (continued)				
Drainage Ditch Excavation	500,000	C.Y.	2.00	1,000,000
Shell (Stream Closures)	1,200,000	C.Y.	12.00	14,400,000
Drainage Structure @ Bayou Piquant	1	Job	Lump Sum	3,000,000
Subtotal: DRAINAGE STRUCTURES				18,400,000
Subtotal: LEVEES AND FLOODWALLS				83,138,500
Contingencies (25%±)				20,784,500
Subtotal:				103,923,000
Engineering and Design (12%±)				12,471,000
Supervision and Administration (10%±)				10,392,000
Total: LEVEES AND FLOODWALLS				126,786,000
Relocations				
16" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	64,000
30" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	120,000
Subtotal: RELOCATIONS				184,000
Contingencies (25%±)				46,000
Subtotal:				230,000
Engineering & Design (12%±)				28,000
Supervision and Administration (10%±)				23,000
Total: RELOCATIONS				281,000

TABLE 3 (CONTINUED)
ST. CHARLES PARISH - LAKEFRONT ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way	480	Acre	500.00	240,000
Ponding Area	3,430	Acre	100.00	343,000
Subtotal:				583,000
Contingencies (25%±)				146,000
Subtotal: LANDS AND DAMAGES				729,000
Acquisition Costs				630,000
Total: LANDS AND DAMAGES				1,359,000
Summary:				
LEVEES AND FLOODWALLS				126,786,000
RELOCATIONS				281,000
LANDS AND DAMAGES				1,359,000
TOTAL				128,426,000

TABLE 4

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
(a) First Lift				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing and Grubbing	225	Acre	1,400.00	315,000
Hauled Clay Fill	2,110,000	C.Y.	5.45	11,499,500
(b) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	225	Acre	700.00	157,500
Hauled Clay Fill	1,055,000	C.Y.	5.60	5,908,000
(c) Third Lift				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	225	Acre	700.00	157,500
Hauled Clay Fill	352,000	C.Y.	5.60	1,971,200
Fertilizing and Seeding	225	Acre	600.00	135,000
Subtotal: LEVEE REACH				20,423,700

TABLE 4 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Floodwall Reach				
(a) First Phase				
Structure Excavation	246	C.Y.	8.00	1,968
Structure Backfill	120	C.Y.	10.00	1,200
PMA-22 Steel Sheet Piling	1,800	S.F.	12.50	22,500
PZ-27 Steel Sheet Piling	7,350	S.F.	14.00	102,900
12' x 12' Prestressed Concrete Piles	2,400	L.F.	30.00	72,000
Structural Steel	24,000	Lb.	3.00	72,000
Concrete in Stabilization Slab	15	C.Y.	125.00	1,875
Concrete in T-Wall Base	111	C.Y.	200.00	22,200
Concrete in Walls and Columns	41	C.Y.	400.00	16,400
(b) Second Phase				
Cut-off Steel Sheet Piling	300	L.F.	6.00	1,800
Concrete in I-Wall Cap	86	C.Y.	400.00	34,400
Structure Excavation	134	C.Y.	8.00	1,072
Structure Backfill	90	C.Y.	10.00	900
Subtotal: FLOODWALL REACHES				351,215

TABLE 4 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
3. Drainage Works				
8 - 60" Ø CMP	2	Ea	890,000.00	1,780,000
5 - 60" Ø CMP	1	Ea	572,000.00	572,000
2 - 42" Ø CMP	1	Ea	267,000.00	267,000
Subtotal: DRAINAGE WORKS				2,619,000
Subtotal: LEVEES AND FLOODWALLS				23,393,915
Contingencies (25%±)				5,848,085
Subtotal:				29,242,000
Engineering and Design (12%±)				3,509,000
Supervision and Administration (10%±)				2,924,000
Total: LEVEES AND FLOODWALLS				35,675,000

TABLE 4 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Shell Ramps over Levee	7,855	C.Y.	14.00	109,970
6" Ø Gas Pipeline over Levee	1	Job	Lump Sum	24,000
16" Ø Gas Pipeline over Levee	1	Job	Lump Sum	64,000
30" Ø Gas Pipeline over Levee	1	Job	Lump Sum	120,000
8" Ø Oil Pipeline over I-Wall	2	Job	Lump Sum	32,000
12" Ø Oil Pipeline over I-Wall	1	Job	Lump Sum	48,000
16" Ø Oil Pipeline over I-Wall	1	Job	Lump Sum	64,000
20" Ø Oil Pipeline over I-Wall	1	Job	Lump Sum	80,000
Subtotal: RELOCATIONS				541,970
Contingencies (25%±)				135,030
Subtotal:				677,000
Engineering & Design (12%±)				81,000
Supervision and Administration (10%±)				68,000
Total: RELOCATIONS				826,000
Lands and Damages				
Rights-of-Way	226	Acre	1,300.00	293,800
Subtotal:				293,800
Contingencies (25%±)				73,200
Subtotal: LANDS AND DAMAGES				367,000
Acquisition Costs				630,000
Total: LANDS AND DAMAGES				997,000

TABLE 4 (CONTINUED)
ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
LEVEES AND FLOODWALLS				35,675,000
RELOCATIONS				826,000
LANDS AND DAMAGES				997,000
TOTAL: Exluding St. Charles/ Jefferson Parish return levee				37,498,000
Summary:				
LEVEES AND FLOODWALLS				44,923,000
RELOCATIONS				826,000
LANDS AND DAMAGES				997,000
TOTAL: Including St. Charles/ Jefferson Parish return levee				46,746,000

TABLE 5
ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
(a) First Lift				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing and Grubbing	260	Acre	1,400.00	364,000
Hauled Clay Fill	2,783,000	C.Y.	5.45	15,167,350
(b) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	260	Acre	700.00	182,000
Hauled Clay Fill	1,391,000	C.Y.	5.60	7,789,600
(c) Third Lift				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	260	Acre	700.00	182,000
Hauled Clay Fill	464,000	C.Y.	5.60	2,598,400
Fertilizing and Seeding	260	Acre	600.00	156,000
Subtotal: LEVEE REACH				26,719,350

TABLE 5 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Floodwall Reaches				
(a) First Phase				
Clearing and Grubbing	30	Acre	1,400.00	42,000
Hauled Clay Fill -Semi Compacted	320,240	C.Y.	6.30	2,017,512
PZ-27 Steel Sheet Piling	6,900	S.F.	14.00	96,600
PMA-22 Steel Sheet Piling	1,950	S.F.	12.50	24,375
12' x 12' Prestressed Concrete Piles	2,880	L.F.	30.00	86,400
Concrete in Stabilization Slab	15	C.Y.	125.00	1,875
Concrete in T-Wall Base	111	C.Y.	200.00	22,200
Structural Steel	25,500	Lb.	3.00	76,500
Structure Excavation	246	C.Y.	8.00	1,968
Structure Backfill	120	C.Y.	10.00	1,200
(b) Second Phase				
Clearing	30	Acre	700.00	21,000
Hauled Clay Fill - Semi Compacted	80,100	C.Y	6.30	504,630
Fertilizing and Seeding	30	Acre	600.00	18,000
PZ-27 Steel Sheet Piling	141,450	S.F.	14.00	1,980,300
(c) Third Phase				
Cut-Off Steel Sheet Piling	6,450	L.F.	6.00	38,700
Concrete in T-Wall Cap	2,810	C.Y.	400.00	1,124,000
Structure Excavation	2,870	C.Y.	8.00	22,960
Structure Backfill	1,920	C.Y.	10.00	19,200
Subtotal: FLOODWALL REACHES				6,118,620

TABLE 5 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
3. Drainage Works				
8 - 60" ∅ CMP	2	Ea	900,000.00	1,800,000
5 - 60" ∅ CMP	1	Ea	570,000.00	570,000
2 - 54" ∅ CMP	1	Ea	270,000.00	270,000
Subtotal: DRAINAGE WORKS				2,640,000
Subtotal: LEVEES AND FLOODWALLS				35,477,970
Contingencies (25%±)				8,869,030
Subtotal:				44,347,000
Engineering and Design (12%±)				5,322,000
Supervision and Administration (10%±)				4,435,000
Total: LEVEES AND FLOODWALLS				54,104,000

TABLE 5 (CONTINUED)

ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Shell Ramps over Levee	7,855	C.Y.	14.00	109,970
6" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	24,000
16" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	64,000
30" Ø Gas Pipeline thru Levee	1	Job	Lump Sum	120,000
8" Ø Oil Pipeline thru I-Wall	2	Job	Lump Sum	7,600
12" Ø Oil Pipeline thru I-Wall	1	Job	Lump Sum	3,800
16" Ø Oil Pipeline thru I-Wall	1	Job	Lump Sum	4,500
20" Ø Oil Pipeline thru I-Wall	1	Job	Lump Sum	4,500
Subtotal: RELOCATIONS				338,370
Contingencies (25%±)				84,630
Subtotal:				423,000
Engineering & Design (12%±)				51,000
Supervision and Administration (10%±)				42,000
Total: RELOCATIONS				516,000
Lands and Damages				
Rights-of-Way	290	Acre	1,300.00	377,000
Subtotal:				377,000
Contingencies (25%±)				94,000
Subtotal: LANDS AND DAMAGES				471,000
Acquisition Costs				630,000
Total: LANDS AND DAMAGES				1,101,000

TABLE 5 (CONTINUED)
ST. CHARLES PARISH - ALINEMENT NORTH OF AIRLINE HIGHWAY
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
LEVEES AND FLOODWALLS				54,104,000
RELOCATIONS				516,000
LANDS AND DAMAGES				1,101,000
TOTAL: Exluding St. Charles/ Jefferson Parish return levee				55,721,000
Summary:				
LEVEES AND FLOODWALLS				73,045,000
RELOCATIONS				516,000
LANDS AND DAMAGES				1,101,000
TOTAL: Including St. Charles/ Jefferson Parish return levee				74,662,000

TABLE 6
JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Structure Removal	1	Job	Lump Sum	1,900,000
Clearing	870	Acre	1,400.00	1,218,000
Clay Fill (Hauled)	11,500,000	C.Y.	10.00	115,000,000
Flotation Channel	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell*	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	750	Acre	700.00	525,000
Clay Fill (Hauled)	3,900,000	C.Y.	10.00	39,000,000
Fertilizing and Seeding	750	Acre	600.00	450,000
Subtotal: LEVEE REACH				173,513,000
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	235	C.Y.	400.00	94,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				484,630

TABLE 6 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				179,137,930
Contingencies (25%±)				44,784,070
Subtotal:				223,922,000
Engineering & Design (12%±)				26,871,000
Supervision & Administration (10%±)				22,392,000
TOTAL: LEVEES AND FLOODWALLS				273,185,000
Relocations				
Relocations of electrical power lines, water lines, sewer lines, and miscellaneous utilities	1	Job	Lump Sum	1,017,600
Subtotal: RELOCATIONS				1,017,600
Contingencies (25%±)				254,400
Subtotal:				1,272,000

TABLE 6 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations (continued)				
Engineering & Design (12%±)				153,000
Supervision & Administration (10%±)				127,000
TOTAL: RELOCATIONS				1,552,000
Lands and Damages				
Rights-of-Way:				
Sta. 0+00 to Sta. 210+06	155	Acre	209,000	32,395,000
Sta. 210+06 to Sta. 434+87	165	Acre	420,000	69,300,000
Sta. 434+87 to Sta. 550+22	85	Acre	303,000	25,755,000
Improvements	1	Job	Lump Sum	65,500,000
Severance Damage	1	Job	Lump Sum	1,500,000
Subtotal: RIGHTS-OF-WAY				194,000,000
Contingencies (25% ±)				49,000,000
Total: RIGHTS-OF-WAY				243,000,000
Acquisition Costs	1	Job	Lump Sum	2,730,000
PL-91-646	1	Job	Lump Sum	5,000,000
Total: LANDS AND DAMAGES				250,730,000
Summary:				
LEVEES AND FLOODWALLS				273,185,000
RELOCATIONS				1,552,000
LANDS AND DAMAGES				250,730,000
TOTAL:				524,467,000

TABLE 7
JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Structure Removal	1	Job	Lump Sum	1,272,000
Clearing	700	Acre	1,400.00	980,000
Clay Fill (Hauled)	3,100,000	C.Y.	10.00	31,000,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	190	Acre	700.00	133,000
Clay Fill (Hauled)	1,100,000	C.Y.	10.00	11,000,000
Fertilizing and Seeding	250	Acre	600.00	150,000
Subtotal: LEVEE REACH				59,815,000
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,100
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	1,630	S.F.	12.50	20,400
PZ-27 Steel Sheet Piling	9,360	S.F.	14.00	131,000
12"x12" Prestressed Concrete Piles	1,540	L.F.	30.00	46,200
Concrete in Stabilization Slab	10	C.Y.	125.00	1,300
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	175	C.Y.	400.00	70,000
Structural Steel	16,000	C.Y.	3.00	48,000
Subtotal: FLOODWALL REACH				331,500

TABLE 7 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				65,286,800
Contingencies (25%±)				16,322,200
Subtotal:				81,609,000
Engineering & Design (12%±)				9,793,000
Supervision & Administration (10%±)				8,161,000
TOTAL: LEVEES AND FLOODWALLS				99,563,000
Relocations				
Relocations of electrical power lines, water lines, sewer lines, and miscellaneous utilities for an area 110 feet by 55,000 feet	1	Job	Lump Sum	699,600
Subtotal: RELOCATIONS				699,600
Contingencies (25%±)				175,400
Subtotal:				875,000

TABLE 7 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE - STRADDLE ENLARGEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering & Design (12%±)				105,000
Supervision & Administration (10%±)				88,000
TOTAL: RELOCATIONS				1,068,000
Lands and Damages				
Rights-of-Way:				
Sta. 0+00 to Sta. 210+06	55	Acre	209,000	11,495,000
Sta. 210+06 to Sta. 434+87	60	Acre	420,000	25,200,000
Sta. 434+87 to Sta. 550+22	30	Acre	303,000	9,090,000
Improvements	1	Job	Lump Sum	45,000,000
Severance Damage	1	Job	Lump Sum	750,000
Subtotal: RIGHTS-OF-WAY				92,285,000
Contingencies (25% ±)				22,715,000
Total: RIGHTS-OF-WAY				115,000,000
Acquisition Costs	1	Job	Lump Sum	2,100,000
PL-91-646	1	Job	Lump Sum	3,500,000
Total: LANDS AND DAMAGES				120,600,000
Summary:				
LEVEES AND FLOODWALLS				99,563,000
RELOCATIONS				1,068,000
LANDS AND DAMAGES				120,600,000
TOTAL:				221,231,000

OCT 81
PRICE LEVELS

COST TO COMPLETE ESTIMATE
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TABLE 8
JEFFERSON PARISH LAKEFRONT LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Wavewash Protection				
Riprap (9.7 Miles)	46,100	Ton	23.00	1,060,300
Shell	11,300	C.Y.	15.00	169,500
Subtotal: WAVEWASH PROTECTION			1,229,800	
2. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	1,903,600
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	780,100
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	1,903,600
Subtotal: MAJOR STRUCTURES				4,587,300
Subtotal: LEVEES AND FLOODWALLS				5,817,100
Contingencies (25%±)				1,453,900
Subtotal:				7,271,000
Engineering & Design (12%±)				873,000
Supervision & Administration (10%±)				727,000
TOTAL: LEVEES AND FLOODWALLS				8,871,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED

Summary:

LEVEES AND FLOODWALLS	8,871,000
RELOCATIONS	NONE REQUIRED
LANDS AND DAMAGES	NONE REQUIRED
TOTAL:	8,871,000

TABLE 9
JEFFERSON PARISH LAKEFRONT LEVEE - IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with Hauled Levee Fill)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hauled)	10,200,000	C.Y.	10.00	102,000,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	680	Acre	700.00	476,000
Clay Fill	3,400,000	C.Y.	10.00	34,000,000
c. Third Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	680	Acre	700.00	476,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	680	Acre	600.00	408,000
Subtotal: LEVEE REACH				157,855,000

TABLE 9 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with Hauled Levee Fill) (continued)				
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	235	C.Y.	400.00	94,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				484,630
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 9 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with Hauled Levee Fill) (continued)				
Subtotal: LEVEES AND FLOODWALLS				163,479,930
Contingencies (25%±)				40,869,070
Subtotal:				204,349,000
Engineering & Design (12%±)				24,522,000
Supervision & Administration (10%±)				20,435,000
TOTAL: LEVEES AND FLOODWALLS				249,306,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				249,306,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				249,306,000

TABLE 10
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with hauled levee fill)				
1. Levee				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	100	Acre	1,400.00	140,000
Clay Fill (hauled)	6,100,000	C.Y.	10.00	61,000,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	370	Acre	700.00	259,000
Clay Fill (Hauled)	2,000,000	C.Y.	10.00	20,000,000
Fertilizing and Seeding	370	Acre	600.00	222,000
Subtotal: LEVEE REACH				96,901,000
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	1,630	S.F.	12.50	20,375
PZ-27 Steel Sheet Piling	9,360	S.F.	14.00	131,040
12"x12" Prestressed Concrete Piles	1,540	L.F.	30.00	46,200
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000

TABLE 10 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with hauled levee fill) (continued)				
2. Floodwall Reach (continued)				
Concrete in Walls and Columns	175	C.Y.	400.00	70,000
Structural Steel	16,000	Lb.	3.00	48,000
Subtotal: FLOODWALL REACH				331,450
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				102,372,750
Contingencies (25%±)				25,593,250
Subtotal:				127,966,000
Engineering & Design (12%±)				15,356,000
Supervision & Administration (10%±)				12,797,000
TOTAL: LEVEES AND FLOODWALLS				156,119,000

TABLE 10 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				156,119,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				156,119,000

TABLE 11

JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hydraulic)	10,200,000	C.Y.	3.50	35,700,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	680	Acre	700.00	476,000
Clay Fill (Hydraulic)	3,400,000	C.Y.	3.50	11,900,000
c. Third Lift (First Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	680	Acre	700.00	476,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	680	Acre	600.00	408,000
d. Fourth Lift (Second Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	500	Acre	700.00	350,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	500	Acre	600.00	300,000
Subtotal: LEVEE REACH				75,145,000

TABLE 11 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	235	C.Y.	400.00	94,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				484,630
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 11 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area) (continued)				
Subtotal: LEVEES AND FLOODWALLS				80,769,930
Contingencies (25%±)				20,192,070
Subtotal:				100,962,000
Engineering & Design (12%±)				12,115,000
Supervision & Administration (10%±)				10,096,000
TOTAL: LEVEES AND FLOODWALLS				123,173,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				123,173,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				123,173,000

TABLE 12
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area)				
1. Levee				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	100	Acre	1,400.00	140,000
Clay Fill (Hydraulic)	6,100,000	C.Y.	3.50	21,350,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	370	Acre	700.00	259,000
Clay Fill (Hydraulic)	2,000,000	C.Y.	3.50	7,000,000
c. Final Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	370	Acre	700.00	259,000
Clay Fill (Cast)	800,000	C.Y.	3.50	2,800,000
Fertilizing and Seeding	370	Acre	600.00	222,000
Subtotal: LEVEE REACH				47,660,000

TABLE 12 (CONTINUED)

JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT

HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra. Fill w/o Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	1,630	S.F.	12.50	20,375
PZ-27 Steel Sheet Piling	9,360	S.F.	14.00	131,040
12"x12" Prestressed Concrete Piles	1,540	L.F.	30.00	46,200
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls, Columns	175	C.Y.	400.00	70,000
Structural Steel	16,000	Lb.	3.00	48,000
Subtotal: FLOODWALL REACH				331,445
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				53,131,745
Contingencies (25%±)				13,283,235
Subtotal:				66,415,000
Engineering & Design (12%±)				7,970,000
Supervision & Administration (10%±)				6,642,000
TOTAL: LEVEES AND FLOODWALLS				81,027,000

TABLE 12 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				81,027,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				81,027,000

TABLE 13
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hydraulic)	10,200,000	C.Y.	3.50	35,700,000
Shell Ponding Dikes	6,600,000	C.Y.	12.00	79,200,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	680	Acre	700.00	476,000
Clay Fill (Hydraulic)	3,400,000	C.Y.	3.50	11,900,000
c. Third Lift (First Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	680	Acre	700.00	476,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	680	Acre	600.00	408,000
d. Fourth Lift (Second Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	500	Acre	700.00	359,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	500	Acre	600.00	300,000
Subtotal: LEVEE REACH				154,415,000

TABLE 13 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	235	C.Y.	400.00	94,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				484,630
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 13 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area) (continued)				
Subtotal: LEVEES AND FLOODWALLS				160,039,930
Contingencies (25%±)				40,010,070
Subtotal:				200,050,000
Engineering & Design (12%±)				24,006,000
Supervision & Administration (10%±)				20,005,000
TOTAL: LEVEES AND FLOODWALLS				244,061,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				244,061,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				244,061,000

TABLE 14
JEFFERSON PARISH LAKEFRONT LEVEE - IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill with Ponding Area)				
1. Levee				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Clearing	100	Acre	1,400.00	140,000
Clay Fill (Hydraulic)	6,100,000	C.Y.	3.50	21,350,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Shell Ponding Dikes	6,600,000	C.Y.	12.00	79,200,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	370	Acre	700.00	259,000
Clay Fill (Hydraulic)	2,000,000	C.Y.	3.50	7,000,000
c. Final Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	370	Acre	700.00	259,000
Clay Fill (cast)	800,000	C.Y.	3.50	2,800,000
Fertilizing and Seeding	370	Acre	600.00	222,000
Subtotal: LEVEE REACH				126,930,000

TABLE 14 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill with Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	260	C.Y.	8.00	2,080
Structure Backfill	150	C.Y.	10.00	1,500
PMA-22 Steel Sheet Piling	1,630	S.F.	12.50	20,375
PZ-27 Steel Sheet Piling	9,360	S.F.	14.00	131,040
12"x12" Prestressed Concrete Piles	1,540	L.F.	30.00	46,200
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	175	C.Y.	400.00	70,000
Structural Steel	16,000	Lb.	3.00	48,000
Subtotal: FLOODWALL REACH				331,445
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 14 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill with Ponding Area) (continued)				
Subtotal: LEVEES AND FLOODWALLS				132,401,750
Contingencies (25%±)				33,100,250
Subtotal:				165,502,000
Engineering & Design (12%±)				19,860,000
Supervision & Administration (10%±)				16,550,000
TOTAL: LEVEES AND FLOODWALLS				201,912,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				201,912,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				201,912,000

TABLE 15
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM - HAULED CLAY FILL
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hauled)	10,400,000	C.Y.	10.00	104,000,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	620	Acre	700.00	434,000
Clay Fill (Hauled)	3,500,000	C.Y.	10.00	35,000,000
c. Third Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	500	Acre	700.00	350,000
Clay Fill (Cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	500	Acre	600.00	300,000
Subtotal: LEVEE				160,439,000
2. Floodwall Reach				
Structure Excavation	24,300	C.Y.	8.00	194,400
Structure Backfill	16,180	C.Y.	10.00	161,800
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-27 Steel Sheet Piling	757,260	S.F.	14.00	10,601,640
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800

TABLE 15 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM - HAULED CLAY FILL
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
2. Floodwall Reach (continued)				
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	24,280	C.Y.	400.00	9,712,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL				21,056,890
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				186,636,190
Contingencies (25%±)				46,658,810
Subtotal:				233,295,000
Engineering & Design (12%±)				27,995,000
Supervision & Administration (10%±)				23,329,000
TOTAL: LEVEES AND FLOODWALLS				284,619,000

TABLE 15 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM - HAULED CLAY FILL
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				284,619,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				284,619,000

TABLE 16
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/O PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hydraulic)	10,400,000	C.Y.	3.50	36,400,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Clearing	620	Acre	700.00	434,000
Clay Fill (Hydraulic)	3,500,000	C.Y.	3.50	12,250,000
c. Third Lift (First Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	500	Acre	700.00	350,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	500	Acre	600.00	300,000
d. Fourth Lift (Second Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	370	Acre	700.00	259,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	370	Acre	600.00	222,000
Subtotal: LEVEE REACH				75,890,000

TABLE 16 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/O PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	24,300	C.Y.	8.00	194,400
Structure Backfill	16,180	C.Y.	10.00	161,800
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-27 Steel Sheet Piling	757,260	S.F.	14.00	10,601,640
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	24,280	C.Y.	400.00	9,712,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				21,056,890
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 16 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/O PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/o Ponding Area) (continued)				
Subtotal: LEVEES AND FLOODWALLS				102,087,190
Contingencies (25%±)				25,521,810
Subtotal:				127,609,000
Engineering & Design (12%±)				15,313,000
Supervision & Administration (10%±)				12,761,000
TOTAL: LEVEES AND FLOODWALLS				155,683,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				155,683,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				155,683,000

TABLE 17
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	280,000
Clearing	125	Acre	1,400.00	175,000
Clay Fill (Hydraulic)	10,400,000	C.Y.	3.50	36,400,000
Shell Ponding Dikes	6,600,000	C.Y.	12.00	79,200,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Stone	460,000	Ton	20.00	9,200,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	620	Acre	700.00	434,000
Clay Fill (Hydraulic)	3,500,000	C.Y.	3.50	12,250,000
c. Third Lift (First Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	500	Acre	700.00	350,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	500	Acre	600.00	300,000
d. Fourth Lift (Second Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	370	Acre	700.00	259,000
Clay Fill (cast)	1,400,000	C.Y.	3.50	4,900,000
Fertilizing and Seeding	370	Acre	600.00	222,000
Subtotal: LEVEE REACH				155,020,000

TABLE 17 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area) (continued)				
2. Floodwall Reach				
Structure Excavation	24,300	C.Y.	8.00	194,400
Structure Backfill	16,180	C.Y.	10.00	161,800
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-27 Steel Sheet Piling	757,260	S.F.	14.00	10,601,640
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	24,280	C.Y.	400.00	9,712,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALL REACH				21,056,890
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300

TABLE 17 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION
HYDRAULIC FILL W/PONDING AREA

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra Fill w/Ponding Area) (continued)				
Subtotal: LEVEES AND FLOODWALLS				181,217,190
Contingencies (25%±)				45,303,810
Subtotal:				226,521,000
Engineering & Design (12%±)				27,183,000
Supervision & Administration (10%±)				22,652,000
TOTAL: LEVEES AND FLOODWALLS				276,356,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				276,356,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				276,356,000

TABLE 18
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE PLAN
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	600	Acre	1,400.00	840,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Stripping	1	Job	Lump Sum	125,000
Clay Fill (from adjacent borrow)	425,000	C.Y.	3.50	1,487,500
Clay Fill (hauled from North Shore)	6,275,000	C.Y.	10.00	62,750,000
Fertilizing and Seeding	600	Acre	600.00	360,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Riprap	460,000	Ton	20.00	9,200,000
Subtotal: LEVEE				80,702,500
2. Floodwall				
Structure Excavation	24,300	C.Y.	8.00	194,400
Structure Backfill	16,200	C.Y.	10.00	162,000
PMA-22 Steel Sheet Piling	2,000	S.F.	12.50	25,000
PZ-27 Steel Sheet Piling	919,530	S.F.	14.00	12,873,420
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
Concrete in Stabilization Slab	10	C.Y.	125.00	1,250
Concrete in T-Wall Base	55	C.Y.	200.00	11,000
Concrete in Walls and Columns	26,280	C.Y.	400.00	10,512,000
Structural Steel	23,000	Lb.	3.00	69,000
Subtotal: FLOODWALLS				24,128,870

TABLE 18 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
I-WALL ON LEVEE PLAN
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				109,971,670
Contingencies (25%±)				27,493,330
Subtotal:				137,465,000
Engineering & Design (12%±)				16,496,000
Supervision & Administration (10%±)				13,747,000
TOTAL: LEVEES AND FLOODWALLS				167,708,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				167,708,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				167,708,000

TABLE 19
JEFFERSON PARISH LAKEFRONT LEVEE
T-WALL ON LEVEE PLAN *
HIGH LEVEL PLAN - SPH PROTECTION

* NOTE: This plan offers only a limited factor of safety (F.S. = 1.11) against failure due to impact loading imparted by a runaway Deck Barge.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee				
Mobilization & Demobilization	1	Job	Lump Sum	140,000
Clearing	600	Acre	1,400.00	840,000
Flotation Channel: (Excavation and Backfill)	1,400,000	C.Y.	2.00	2,800,000
Stripping	1	Job	Lump Sum	140,000
Clay Fill (Hauled)	6,700,000	C.Y.	10.00	67,000,000
Fertilizing and Seeding	600	Acre	600.00	360,000
Foreshore Protection:				
Shell	250,000	C.Y.	12.00	3,000,000
Riprap	460,000	Ton	20.00	9,200,000
Subtotal: LEVEE				83,480,000
2. Floodwall Reach				
Structure Excavation	370,360	C.Y.	8.00	2,962,880
Structure Backfill	157,050	C.Y.	10.00	1,570,500
PMA-22 Steel Sheet Piling	5,194,640	S.F.	12.50	64,933,000
PZ-38 Steel Sheet Piling	12,100	S.F.	18.00	217,800
12"x12" Prestressed Concrete Piles	2,100	L.F.	30.00	63,000
16"x16" Prestressed Concrete Piles	5,192,640	L.F.	40.00	207,705,600
Concrete in Stabilization Slab	16,040	C.Y.	125.00	2,005,000
Concrete in T-Wall Base	192,375	C.Y.	200.00	38,475,000
Concrete in Walls and Columns	41,255	C.Y.	400.00	16,502,000
Structural Steel	23,000	Lb.	3.00	69,000
Marine Fenders	64,910	L.F.	125.00	8,133,750
Subtotal: FLOODWALL				342,637,530

TABLE 19 (CONTINUED)
JEFFERSON PARISH LAKEFRONT LEVEE
T-WALL ON LEVEE PLAN*
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
3. Major Structures				
Floodwall and Discharge Pipes @ Pumping Station No. 1	1	Job	Lump Sum	2,108,000
Floodwall and Discharge Pipes @ Pumping Station No. 3	1	Job	Lump Sum	924,300
Floodwall and Discharge Pipes @ Pumping Station No. 4	1	Job	Lump Sum	2,108,000
Subtotal: MAJOR STRUCTURES				5,140,300
Subtotal: LEVEES AND FLOODWALLS				431,257,830
Contingencies (25%±)				107,814,170
Subtotal:				539,072,000
Engineering & Design (12%±)				64,689,000
Supervision & Administration (10%±)				53,907,000
TOTAL: LEVEES AND FLOODWALLS				657,668,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				657,668,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				657,668,000

TABLE 20

NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC

BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reaches				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	1	Job	Lump Sum	70,000
Clay Embankment (Hauled)	1,567,000	C.Y.	12.00	18,804,000
Fertilizing and Seeding	60	Acre	600.00	36,000
Subtotal: LEVEES REACHES				18,980,000
2. Floodwall Reaches				
Structure Excavation	3,000	C.Y.	8.00	24,000
Structure Backfill	1,890	C.Y.	10.00	18,900
PZ-38 Steel Sheet Piling	34,293	S.F.	18.00	617,274
PZ-27 Steel Sheet Piling	92,745	S.F.	14.00	1,298,430
PMA-22 Steel Sheet Piling	13,410	S.F.	12.50	167,625
12" x 12" Prestressed Concrete Piles	7,885	L.F.	30.00	236,550
Concrete in Stabilization Slab	47	C.Y.	125.00	5,875
Concrete in Base Slab	365	C.Y.	200.00	73,000
Concrete in Walls and Columns	2,400	C.Y.	400.00	960,000
Structural Steel	22,000	Lb.	3.00	66,000
Subtotal: FLOODWALL REACHES				3,467,654
Subtotal: LEVEES AND FLOODWALLS				22,447,654
Contingencies (25%±)				5,612,346
Subtotal:				28,060,000

TABLE 20 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering and Design (12%±)				3,368,000
Supervision and Administration (10%±)				2,806,000
Total: LEVEES AND FLOODWALLS				34,234,000
Major Structures				
Positive Cutoff at Pontchartrain Blvd. Pumping Station Discharge Canal	1	Job	Lump Sum	130,000
Sluice Gates and Auxiliary Pumping Station @ London Ave. Outfall Canal	1	Job	Lump Sum	36,350,600
Sluice Gates and Auxiliary Pumping Station @ Metairie Outfall Canal	1	Job	Lump Sum	31,609,200
Sluice Gates and Auxiliary Pumping Station @ Orleans Ave. Outfall Canal	1	Job	Lump Sum	14,675,700
Subtotal: MAJOR STRUCTURES				82,765,500
Contingencies (25%±)				20,691,500
Subtotal:				103,457,000
Engineering and Design (12%±)				12,415,000
Supervision and Administration (10%±)				10,346,000
Total: MAJOR STRUCTURES				126,218,000
Relocations				
Modifications to existing Roadways:				
Ramp @ Franklin Avenue	1	L.S.	Lump Sum	190,800

TABLE 20 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Ramp vic Seabrook Bridge	3	L.S.	Lump Sum	572,400
Ramp @ Lakeshore Dr. Crossings	13	L.S.	Lump Sum	2,480,400
Subtotal: RELOCATIONS				3,243,600
Contingencies (25%±)				811,400
Subtotal:				4,055,000
Engineering & Design (12%±)				487,000
Supervision and Administration (10%±)				406,000
Total: RELOCATIONS				4,948,000
Lands and Damages				
Rights-of-Way	70	Acre	260,000.00	18,200,000
Subtotal:				18,200,000
Contingencies (25%)				4,550,000
Subtotal: RIGHTS-OF-WAY				22,750,000
Improvements & Acquisition Costs				0
TOTAL: LANDS AND DAMAGES				22,750,000
Summary:				
LEVEES AND FLOODWALLS				34,234,000
MAJOR STRUCTURES				126,218,000
RELOCATIONS				4,948,000
LANDS AND DAMAGES				22,750,000
TOTAL:				188,150,000

TABLE 21
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reaches				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	1	Job	Lump Sum	70,000
Clay Embankment (Hauled)	2,129,000	C.Y.	11.00	23,419,000
Fertilizing and Seeding	125	Acre	600.00	75,000
Subtotal: LEVEES REACHES				23,634,000
2. Floodwall Reaches				
Removal of existing floodwall at the Orleans Marina (concrete structures, steel gates, and prestressed concrete piles only)	1	Job	Lump Sum	165,400
Structure Excavation	8,890	C.Y.	8.00	71,120
Structure Backfill	4,235	C.Y.	10.00	42,350
PZ-27 Steel Sheet Piling	52,800	S.F.	14.00	739,200
PMA-22 Steel Sheet Piling	53,130	S.F.	12.50	664,125
12" x 12" Prestressed Concrete Piles	34,610	L.F.	30.00	1,038,300
14" x 14" Prestressed Concrete Piles	76,475	L.F.	35.00	2,676,625
Concrete in Stabilization Slab	535	C.Y.	125.00	66,875
Concrete in Base Slab	3,985	C.Y.	200.00	797,000
Concrete in Walls and Columns	3,775	C.Y.	400.00	1,510,000
Structural Steel	166,800	Lb.	3.00	500,400
Subtotal: FLOODWALL REACHES				8,271,395
Subtotal: LEVEES AND FLOODWALLS				31,905,395
Contingencies (25%±)				7,976,605
Subtotal:				39,882,000

TABLE 21 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering and Design (12%±)				4,786,000
Supervision and Administration (10%±)				3,988,000
Total: LEVEES AND FLOODWALLS				48,656,000
Major Structures				
Positive Cutoff at Pontchartrain Blvd. Pumping Station Discharge Canal	1	Job	Lump Sum	130,000
Sluice Gates and Auxiliary Pumping Station @ London Ave. Outfall Canal	1	Job	Lump Sum	36,350,600
Sluice Gates and Auxiliary Pumping Station @ Metairie Outfall Canal	1	Job	Lump Sum	31,609,200
Sluice Gates and Auxiliary Pumping Station @ Orleans Ave. Outfall Canal	1	Job	Lump Sum	14,675,700
Subtotal: MAJOR STRUCTURES				82,765,500
Contingencies (25%)				20,691,500
Subtotal:				103,457,000
Engineering and Design (12%±)				12,415,000
Supervision and Administration (10%±)				10,346,000
Total: MAJOR STRUCTURES				126,218,000
Relocations				
Modifications to existing Roadways:				
Ramp @ Lake Marina Ave	1	L.S.	Lump Sum	190,800
Ramp @ Franklin Avenue	1	L.S.	Lump Sum	190,800

TABLE 21 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Ramp vic Seabrook Bridge	3	L.S.	Lump Sum	572,400
Ramp @ Lakeshore Dr. Crossings	13	L.S.	Lump Sum	2,480,400
Subtotal: RELOCATIONS				3,434,400
Contingencies (25%±)				858,600
Subtotal:				4,293,000
Engineering & Design (12%±)				515,000
Supervision and Administration (10%±)				429,000
Total: RELOCATIONS				5,237,000
Lands and Damages				
Rights-of-Way	136	Acre	260,000.00	35,360,000
Subtotal:				35,360,000
Contingencies (25%)				8,840,000
Subtotal: RIGHTS-OF-WAY				44,200,000
Improvements & Acquisition Costs				0
TOTAL: LANDS AND DAMAGES				44,200,000
Summary:				
LEVEES AND FLOODWALLS				48,656,000
MAJOR STRUCTURES				126,218,000
RELOCATIONS				5,237,000
LANDS AND DAMAGES				44,200,000
TOTAL:				224,311,000

TABLE 22
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing	1	Job	Lump Sum	70,000
Clay Embankment, Hauled	1,829,000	C.Y.	10.50	19,204,500
Fertilizing and Seeding	95	Acre	600.00	57,000
Subtotal: LEVEES AND FLOODWALLS				19,401,500
2. Floodwall Reaches				
Removal of existing floodwall at the Orleans Marina (concrete structures, steel gates, and prestressed concrete piles only)	1	Job	Lump Sum	165,400
Structure Excavation	8,435	C.Y.	8.00	67,480
Structure Backfill	3,835	C.Y.	10.00	38,350
PZ-27 Steel Sheet Piling	52,800	S.F.	14.00	739,200
PMA-22 Steel Sheet Piling	51,325	S.F.	12.50	641,563
12" x 12" Prestressed Concrete Piles	37,730	L.F.	30.00	1,131,900
14" x 14" Prestressed Concrete Piles	70,785	L.F.	35.00	2,477,475
Concrete in Stabilization Slab	535	C.Y.	125.00	66,875
Concrete in Base Slab	3,985	C.Y.	200.00	797,000
Concrete in Walls and Columns	2,965	C.Y.	400.00	1,186,000
Structural Steel	151,100	Lb.	3.00	453,300
Subtotal: FLOODWALL REACHES				7,764,543
Subtotal: LEVEES AND FLOODWALLS				27,166,043
Contingencies (25%±)				6,791,957
Subtotal:				33,958,000
Engineering and Design (12%±)				4,075,000
Supervision and Administration (10%±)				3,396,000
Total: LEVEES AND FLOODWALLS				41,429,000

TABLE 22 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures				
Positive Cutoff at Pontchartrain Blvd. Pumping Station Discharge Canal	1	Job	Lump Sum	130,000
Sluice Gates and Auxiliary Pumping Station @ London Ave. Outfall Canal	1	Job	Lump Sum	36,350,600
Sluice Gates and Auxiliary Pumping Station @ Metairie Outfall Canal	1	Job	Lump Sum	31,609,200
Sluice Gates and Auxiliary Pumping Station @ Orleans Ave. Outfall Canal	1	Job	Lump Sum	14,675,700
Subtotal: MAJOR STRUCTURES				82,765,500
Contingencies (25%±)				20,691,500
Subtotal:				103,457,000
Engineering and Design (12%±)				12,415,000
Supervision and Administration (10%±)				10,346,000
Total: MAJOR STRUCTURES				126,218,000
Relocations				
Modifications to Existing Roadways:				
Ramp @ Lake Marina Ave	1	Job	Lump Sum	190,800
Ramp @ Franklin Avenue	1	Job	Lump Sum	190,800
Ramp Vic Seabrook Bridge	3	Job	Lump Sum	572,400
Ramps @ Lakeshore Dr. Crossings	13	Job	Lump Sum	2,480,400
Subtotal: RELOCATIONS				3,434,400

TABLE 22 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				858,600
Subtotal:				4,293,000
Engineering & Design (12%±)				515,000
Supervision and Administration (10%±)				429,000
Total: RELOCATIONS				5,237,000
Lands and Damages				
Rights-of-Way	106	Acre	260,000.00	27,560,000
Subtotal:				27,560,000
Contingencies: (25%)				6,890,000
Subtotal: RIGHTS-OF-WAY				34,450,000
Improvements & Acquisition Costs				0
TOTAL: LANDS AND DAMAGES				34,450,000
Summary:				
LEVEES AND FLOODWALLS				41,429,000
MAJOR STRUCTURES				126,218,000
RELOCATIONS				5,237,000
LANDS AND DAMAGES				34,450,000
TOTAL:				207,334,000

TABLE 23
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Removal of existing floodwall at the Orleans Marina (concrete structures, steel gates, and prestressed concrete piles only)	1	Job	LumpSum	165,400
Clearing	1	Job	Lump Sum	70,000
Clay Embankment (Hauled)	1,376,000	C.Y.	11.00	15,136,000
Fertilizing and Seeding	90	Acre	600.00	54,000
Structure Excavation	20,500	C.Y.	8.00	164,000
Structure Backfill	12,000	C.Y.	10.00	120,000
PZ-27 Steel Sheet Piling	697,500	S.F.	14.00	9,765,000
PMA-22 Steel Sheet Piling	53,130	S.F.	12.50	664,125
12" X 12" Prestressed Concrete Piles	34,610	L.F.	30.00	1,038,300
14" X 14" Prestressed Concrete Piles	76,475	L.F.	35.00	2,676,625
Concrete in Stabilization Slab	535	C.Y.	125.00	66,875
Concrete in Base Slab	3,985	C.Y.	200.00	797,000
Concrete in Walls and Columns	18,275	C.Y.	400.00	7,310,000
Structural Steel	166,800	Lb.	3.00	500,400
Subtotal: LEVEES AND FLOODWALLS				38,597,725
Contingencies (25%±)				9,649,275
Subtotal:				48,247,000
Engineering and Design (12%±)				5,790,000
Supervision and Administration (10%±)				4,825,000
Total: LEVEES AND FLOODWALLS				58,862,000

TABLE 23 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures				
Positive Cutoff at Pontchartrain Blvd. Pumping Station Discharge	1	Job	Lump Sum	127,200
Sluice Gates and Auxiliary Pumping Station @ London Ave. Outfall Canal	1	Job	Lump Sum	36,350,600
Sluice Gates and Auxiliary Pumping Station @ Metairie Outfall Canal	1	Job	Lump Sum	31,609,200
Sluice Gates and Auxiliary Pumping Station @ Orleans Ave. Outfall Canal	1	Job	Lump Sum	14,675,700
Subtotal: MAJOR STRUCTURES				82,762,700
Contingencies (25%±)				20,690,300
Subtotal:				103,453,000
Engineering and Design (12%±)				12,414,000
Supervision and Administration (10%±)				10,345,000
Total: MAJOR STRUCTURES				126,212,000
Relocations				
Modifications to existing Roadways:				
Ramp @ Lake Marina Ave	1	Job	Lump Sum	190,800
Ramp @ Franklin Avenue	1	Job	Lump Sum	190,800
Ramp vic Seabrook Bridge	1	Job	Lump Sum	572,400
Ramps @ Lakeshore Dr. Crossings	13	Job	Lump Sum	2,480,400
Subtotal: RELOCATIONS				3,434,400

TABLE 23 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				858,600
Subtotal:				4,293,000
Engineering & Design (12%±)				515,000
Supervision and Administration (10%±)				429,000
Total: RELOCATIONS				5,237,000
Lands and Damages				
Rights-of-Way	94	Acre	260,000.00	24,440,000
Subtotal:				24,440,000
Contingencies (25%)				6,110,000
Subtotal: RIGHTS-OF-WAY				30,550,000
Improvements & Acquisition Costs				0
TOTAL: LANDS AND DAMAGES				30,550,000
Summary:				
LEVEES AND FLOODWALLS				58,862,000
MAJOR STRUCTURES				126,212,000
RELOCATIONS				5,237,000
LANDS AND DAMAGES				30,550,000
TOTAL:				220,861,000

TABLE 24

NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC

I-WALL ON LEVEE WITH BARGE BERM

HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Removal of existing floodwall at the Orleans Marina (concrete structures, steel gates, and prestressed concrete piles only)	1	Job	LumpSum	165,400
Clearing	1	Job	Lump Sum	70,000
Clay Embankment (Hauled)	1,800,000	C.Y.	11.00	19,800,000
Fertilizing and Seeding	85	Acre	600.00	51,000
Structure Excavation	20,500	C.Y.	8.00	164,000
Structure Backfill	12,000	C.Y.	10.00	120,000
PZ-27 Steel Sheet Piling	261,000	S.F.	14.00	3,654,000
PMA-22 Steel Sheet Piling	53,130	S.F.	12.50	664,125
12" X 12" Prestressed Concrete Piles	34,610	L.F.	30.00	1,038,300
14" X 14" Prestressed Concrete Piles	76,475	L.F.	35.00	2,676,625
Concrete in Stabilization Slab	535	C.Y.	125.00	66,875
Concrete in Base Slab	3,985	C.Y.	200.00	797,000
Concrete in Walls and Columns	13,450	C.Y.	400.00	5,380,000
Structural Steel	166,800	Lb.	3.00	500,400
Subtotal: LEVEES AND FLOODWALLS				35,287,725
Contingencies (25%±)				8,822,275
Subtotal:				44,110,000
Engineering and Design (12%±)				5,293,000
Supervision and Administration (10%±)				4,411,000
Total: LEVEES AND FLOODWALLS				53,814,000

TABLE 24 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures				
Positive Cutoff at Pontchartrain Blvd. Pumping Station Discharge	1	Job	Lump Sum	127,200
Sluice Gates and Auxiliary Pumping Station @ London Ave. Outfall Canal	1	Job	Lump Sum	36,350,600
Sluice Gates and Auxiliary Pumping Station @ Metairie Outfall Canal	1	Job	Lump Sum	31,609,200
Sluice Gates and Auxiliary Pumping Station @ Orleans Ave. Outfall Canal	1	Job	Lump Sum	14,675,700
Subtotal: MAJOR STRUCTURES				82,762,700
Contingencies (25%±)				20,690,300
Subtotal:				103,453,000
Engineering and Design (12%±)				12,414,000
Supervision and Administration (10%±)				10,345,000
Total: MAJOR STRUCTURES				126,212,000
Relocations				
Modifications to existing Roadways:				
Ramp @ Lake Marina Ave	1	Job	Lump Sum	190,800
Ramp @ Franklin Avenue	1	Job	Lump Sum	190,800
Ramp Vic Seabrook Bridge	3	Job	Lump Sum	572,400
Ramps @ Lakeshore Dr. Crossings	13	Job	Lump Sum	2,480,400
Subtotal: RELOCATIONS				3,434,400

TABLE 24 (CONTINUED)
NEW ORLEANS LAKEFRONT LEVEE - WEST OF IHNC
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations (continued)				
Contingencies (25%±)				858,600
Subtoal:				4,293,000
Engineering & Design (12%±)				515,000
Supervision and Administration (10%±)				429,000
Total: RELOCATIONS				5,237,000
Lands and Damages				
Rights-of-Way	94	Acre	260,000.00	24,440,000
Subtotal:				24,440,000
Contingencies (25%)				6,110,000
Subtotal: RIGHTS-OF-WAY				30,550,000
Improvements & Acquisition Costs				0
TOTAL: LANDS AND DAMAGES				30,550,000
Summary:				
LEVEES AND FLOODWALLS				53,814,000
MAJOR STRUCTURES				126,212,000
RELOCATIONS				5,237,000
LANDS AND DAMAGES				30,550,000
TOTAL:				215,813,000

TABLE 25
CITRUS LAKEFRONT LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Foreshore Protection:				
Riprap	230,000	Ton	22.00	5,060,000
Shell	40,000	C.Y.	14.00	560,000
Subtotal: LEVEES AND FLOODWALLS				5,620,000
Contingencies (25%±)				1,405,000
Subtotal:				7,025,000
Engineering & Design (12%±)				843,000
Supervision & Administration (10%±)				703,000
TOTAL: LEVEES AND FLOODWALLS				8,571,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				8,571,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				8,571,000

TABLE 26 *
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
Levee Embankment:				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing and Grubbing	1	Job	Lump Sum	140,000
Railroad Crossing	1	Job	Lump Sum	63,600
Clay Embankment, Semicompacted	135,000	C.Y.	10.00	1,350,000
Fertilizing and Seeding	60	Acre	600.00	36,000
Riprap (Land Placement)	340,000	Ton	22.00	7,480,000
Shell (Land Placement)	310,000	C.Y.	14.00	4,340,000
Retaining Wall:				
Structure Excavation	12,160	C.Y.	8.00	97,280
Structure Backfill	8,100	C.Y.	10.00	81,000
PZ-38 Steel Sheet Piling	766,000	S.F.	18.00	13,788,000
Concrete in Walls	16,215	C.Y.	400.00	6,486,000
Subtotal: LEVEE REACH				34,141,880
2. Floodwall Reaches				
Structure Excavation	2,125	C.Y.	8.00	17,000
Structure Backfill	1,325	C.Y.	10.00	13,250
PZ-27 Steel Sheet Piling	82,700	S.F.	14.00	1,157,800
PMA 22 Steel Sheet Piling	4,350	S.F.	12.50	54,375
Concrete Sheet Piling	1,500	S.F.	20.00	30,000
12" x 12" Prestressed Concrete Piles	5,940	L.F.	30.00	178,200
Concrete in Stabilization Slab	40	C.Y.	125.00	5,000
Concrete in T-Wall Base Slab	270	C.Y.	200.00	54,000
Concrete in Walls, Columns and Beams	2,275	C.Y.	400.00	910,000
Structural Steel	33,900	Lb.	3.00	101,700

* This alternative utilizies a breakwater on the lakeside of the R.R. tracks, and a retaining wall on the landside toe of the levee to avoid relocating Hayne Blvd.

TABLE 26 (CONTINUED) *
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
2. Floodwall Reaches (continued)				
Structure Removal	1	Job	Lump Sum	825,000
Clay Embankment, Semicompacted	6,650	C.Y.	10.50	69,825
Subtotal: FLOODWALL REACHES				3,416,150
Subtotal: LEVEES AND FLOODWALLS				37,558,030
Contingencies (25%±)				9,389,970
Subtotal:				46,948,000
Engineering & Design (12%±)				5,634,000
Supervision & Administration (10%±)				4,695,000
TOTAL: LEVEES AND FLOODWALLS				57,277,000

TABLE 26 (CONTINUED) *
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramp @ Lakeshore Drive	1	Job	Lump Sum	190,800
Removal of Concrete Walkways over Existing Levee	64	Ea.	2,544.00	162,800
Removal and Replacement of Water and Electrical Lines thru Existing Levee	110	Ea.	1,272.00	139,900
Removal and Replacement of Approx. 40' of Wooden Walkways, Water Lines and Electric Lines, for Each Camp	110	Ea.	3,180.00	349,800
Relocate Miscellaneous Utility Pipelines thru I-Wall	23	Ea.	3,180.00	73,100
Relocate Miscellaneous Utility Pipelines	1,400	L.F.	25.00	35,000
Subtotal: RELOCATIONS				951,400
Contingencies (25%±)				237,600
Subtotal:				1,189,000
Engineering & Design (12%±)				143,000
Supervision & Administration (10%±)				119,000
Total: RELOCATIONS				1,451,000
Lands and Damages (see attached appraisal)				1,428,000
Summary:				
LEVEES AND FLOODWALLS				57,277,000
RELOCATIONS				1,451,000
LANDS AND DAMAGES				1,428,000
TOTAL				60,156,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 27
CITRUS LAKEFRONT LEVEE *
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
Levee Embankment:				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing and Grubbing	1	Job	Lump Sum	140,000
Railroad Crossing	1	Job	Lump Sum	63,600
Clay Embankment, Semi-compacted	145,000	C.Y.	10.50	1,522,500
Fertilizing and Seeding	60	Acre	600.00	36,000
Riprap (Land Placement)	230,000	Ton	22.00	5,060,000
Shell (Land Placement)	40,000	C.Y.	14.00	560,000
Retaining Wall:				
Structure Excavation	10,840	C.Y.	8.00	86,720
Structure Backfill	7,225	C.Y.	10.00	72,250
PZ-38 Steel Sheet Piling	682,600	S.F.	18.00	12,286,800
Concrete in Walls	14,500	C.Y.	400.00	5,800,000
Subtotal: LEVEE REACH				25,907,870
2. Floodwall Reaches				
Structure Excavation	3,925	C.Y.	8.00	31,400
Structure Backfill	2,590	C.Y.	10.00	25,900
PZ-27 Steel Sheet Piling	174,200	S.F.	14.00	2,438,800
PMA 22 Steel Sheet Piling	3,770	S.F.	12.50	47,125
12" x 12" Prestressed Concrete Piles	5,020	L.F.	30.00	150,600
Concrete in Stabilization Slab	26	C.Y.	125.00	3,250
Concrete in T-Wall Base Slab	192	C.Y.	200.00	38,400
Concrete in Walls, Columns and Beams	4,355	C.Y.	400.00	1,742,000
Structural Steel	31,300	Lb.	3.00	93,900

* Uses "existing" levee alinement with a retaining wall along Hayne Blvd.

TABLE 27 (CONTINUED)
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
2. Floodwall Reaches (continued)				
Structure Removal	1	Job	Lump Sum	825,000
Clay Embankment, Semicompacted	6,650	C.Y.	10.50	69,825
Subtotal: FLOODWALL REACHES				5,466,200
Subtotal: LEVEES AND FLOODWALLS				31,374,070
Contingencies (25%±)				7,843,930
Subtotal:				39,218,000
Engineering & Design (12%±)				4,706,000
Supervision & Administration (10%±)				3,922,000
TOTAL: LEVEES AND FLOODWALLS				47,846,000

TABLE 27 (CONTINUED)
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramp @ Lakeshore Drive	1	Job	Lump Sum	190,800
Removal of Concrete Walkways over Existing Levee	64	Ea.	2,544.00	162,800
Removal and Replacement of Water and Electrical Lines thru Existing Levee	110	Ea.	1,272.00	139,900
Removal and Replacement of Approx. 40' of Wooden Walkways, Water Lines and Electric Lines, for Each Camp	110	Ea.	3,180.00	349,800
Relocate Miscellaneous Utility Pipelines thru I-Wall	23	Ea.	3,180.00	73,100
Relocate Miscellaneous Utility Pipelines	1,400	L.F.	25.00	35,000
Subtotal: RELOCATIONS				951,400
Contingencies (25%±)				237,600
Subtotal:				1,189,000
Engineering & Design (12%±)				143,000
Supervision & Administration (10%±)				119,000
Total: RELOCATIONS				1,451,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				47,846,000
RELOCATIONS				1,451,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				49,297,000

TABLE 28
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with hauled levee fill)				
1. Levee Reach				
Mobilization & Demobilization	1	Job	Lump Sum	420,000
Clearing & Grubbing	280	Acre	1,400.00	392,000
Flotation Channel Excavation and Backfill	700,000	C.Y.	2.00	1,400,000
Stripping	1,700,000	C.Y.	2.00	3,400,000
Hudraulic Fill Embankment (sand)	1,800,000	C.Y.	3.50	6,300,000
Clay Fill (Hauled)	4,200,000	C.Y.	10.00	42,000,000
Foreshore Protection:				
Riprap	230,000	Ton	20.00	4,600,000
Shell	270,000	C.Y.	12.00	3,240,000
Fertilizing & Seeding	240	Acre	600.00	144,000
Subtotal: LEVEE REACH				61,896,000

TABLE 28 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (with hauled levee fill) (continued)				
2. Floodwall Reach				
Removal of existing floodwall between sta. 10+13.20 and 32+47.46 W/L	1	Job	Lump Sum	795,000
Structure Excavation	2,650	C.Y.	8.00	21,200
Structure Backfill	1,760	C.Y.	10.00	17,600
PZ-27 Steel Sheet Piling	146,475	S.F.	14.00	2,050,650
PMA-22 Steel Sheet Piling	375	S.F.	12.50	4,690
12"x12" Prestressed Concrete Piles	480	L.F.	30.00	14,400
Concrete in Stabilization Slab	5	C.Y.	125.00	630
Concrete in T-Wall Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls, Columns, & Beams	4,255	C.Y.	400.00	1,702,000
Structural Steel	8,400	Lb.	3.00	25,200
Subtotal: FLOODWALL REACH				4,636,370
3. Drainage Structures				
Drainage Structures	3	Ea.	763,200.00	2,289,600
Drainage Structure	1	Ea.	254,400.00	254,400
Subtotal: DRAINAGE STRUCTURES				2,544,000
Subtotal: LEVEES AND FLOODWALLS				69,076,370
Contingencies (25%±)				17,268,630
Subtotal:				86,345,000
Engineering & Design (12%±)				10,361,000
Supervision & Administration (10%±)				8,635,000
TOTAL: LEVEES AND FLOODWALLS				105,341,000

TABLE 28 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pumping Stations concrete culverts extension (installed)	1,350	L.F.	127.00	171,500
Relocate Miscellaneous utility pipelines thru I-wall	23	Ea.	3,180.00	73,100
Removal of Campsite Structures	120	Ea.	12,720.00	1,526,400
Subtotal: RELOCATIONS				1,771,000
Contingencies (25%±)				443,000
Subtotal:				2,214,000
Engineering and Design (12%±)				266,000
Supervision and Administration (10%±)				221,000
TOTAL: RELOCATIONS				2,701,000
Lands and Damages (see attached appraisal)				1,428,000
Summary:				
LEVEES AND FLOODWALLS				105,341,000
RELOCATIONS				2,701,000
LANDS AND DAMAGES				1,428,000
TOTAL:				109,470,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 29
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
Levee Embankment:				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Clearing and Grubbing	1	Job	Lump Sum	32,000
Railroad Crossing	1	Job	Lump Sum	63,600
Clay Embankment, Semicompacted	55,000	C.Y.	10.50	577,500
Fertilizing and Seeding	10	Acre	600.00	6,000
Riprap (Land Placement)	340,000	Ton	22.00	7,480,000
Shell (Land Placement)	310,000	C.Y.	14.00	4,340,000
Subtotal: LEVEES REACH				12,569,100
2. Floodwall Reaches				
Structure Excavation	3,925	C.Y.	8.00	31,400
Structure Backfill	2,590	C.Y.	10.00	25,900
PZ-27 Steel Sheet Piling	174,200	S.F.	14.00	2,438,800
PMA 22 Steel Sheet Piling	3,770	S.F.	12.50	47,125
12" x 12" Prestressed Concrete Piles	5,020	L.F.	30.00	150,600
Concrete in Stabilization Slab	26	C.Y.	125.00	3,250
Concrete in T-Wall Base Slab	192	C.Y.	200.00	38,400
Concrete in Walls, Columns and Beams	4,355	C.Y.	400.00	1,742,000
Structural Steel	31,300	Lb.	3.00	93,900
Structural Removal	1	Job	Lump Sum	825,000
Clay Embankment, Semicompacted	6,650	C.Y.	10.50	69,825
Subtotal: FLOODWALL REACHES				5,466,200
Subtotal: LEVEES AND FLOODWALLS				18,035,300

TABLE 29 (CONTINUED)
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				4,508,700
Subtotal:				22,544,000
Engineering & Design (12%±)				2,705,000
Supervision & Administration (10%±)				2,254,000
TOTAL: LEVEES AND FLOODWALLS				27,503,000
Relocations				
Ramp @ Lakeshore Drive	1	Job	Lump Sum	190,800
Removal of Concrete Walkways over Existing Levee	64	Ea.	2,544.00	162,800
Removal and Replacement of Water and Electrical Lines thru Existing Levee	110	Ea.	1,272.00	139,900
Removal and Replacement of Approx. 40' of Wooden Walkways, Water Lines and Electric Lines, for Each Camp	110	Ea.	3,180.00	349,800
Relocate Miscellaneous Utility Pipelines thru I-Wall	23	Ea.	3,180.00	73,100
Relocate Miscellaneous Utility Pipelines	1,400	L.F.	25.00	35,000
Subtotal: RELOCATIONS				951,400
Contingencies (25%±)				237,600
Subtotal:				1,189,000
Engineering & Design (12%±)				143,000
Supervision & Administration (10%±)				119,000
Total: RELOCATIONS				1,451,000

TABLE 29 (CONTINUED)
CITRUS LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages (see attached appraisal)				1,428,000
Summary:				
LEVEES AND FLOODWALLS				27,503,000
RELOCATIONS				1,451,000
LANDS AND DAMAGES				1,428,000
TOTAL				30,382,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 30
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra. Fill w/o Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	420,000
Clearing	90	Acre	1,400.00	126,000
Sand Fill (Hydraulic)	1,800,000	C.Y.	3.50	6,300,000
Clay Fill (Hydraulic)	3,200,000	C.Y.	3.50	11,200,000
Stripping	1,700,000	C.Y.	2.00	3,400,000
Flotation Channel: (Excavation and Backfill)	700,000	C.Y.	2.00	1,400,000
Foreshore Protection:				
Shell	330,000	C.Y.	12.00	3,960,000
Stone	140,000	Ton	20.00	2,800,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	280	Acre	700.00	196,000
Clay Fill (Hydraulic)	1,000,000	C.Y.	3.50	3,500,000
Foreshore Protection:				
Stone	150,000	Ton	20.00	3,000,000
c. Final Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	280	Acre	700.00	196,000
Clay Fill (Cast)	400,000	C.Y.	3.50	1,400,000
Fertilizing and Seeding	240	Acre	600.00	144,000
Subtotal: LEVEE REACH				38,322,000

TABLE 30 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra. Fill w/o Ponding Area) (continued)				
2. Floodwall Reach				
Removal of existing floodwall between sta. 10+13.20 and 32+47.46 W/L	1	Job	Lump Sum	795,000
Structure Excavation	2,650	C.Y.	8.00	21,200
Structure Backfill	1,760	C.Y.	10.00	17,600
PZ-27 Steel Sheet Piling	146,475	S.F.	14.00	2,050,650
PMA-22 Steel Sheet Piling	375	S.F.	12.50	4,690
12"x12" Prestressed Concrete Piles	480	L.F.	30.00	14,400
Concrete in Stabilization Slab	5	C.Y.	125.00	630
Concrete in T-Wall Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls, Columns, & Beams	4,255	C.Y.	400.00	1,702,000
Structural Steel	8,400	C.Y.	3.00	25,200
Subtotal: FLOODWALL REACH				4,636,370
3. Drainage Structures				
Drainage Structures	3	Ea.	763,200.00	2,289,600
Drainage Structure	1	Ea.	254,400.00	254,400
Subtotal: DRAINAGE STRUCTURES				2,544,000
Subtotal: LEVEES AND FLOODWALLS				45,502,370
Contingencies (25%±)				11,375,630
Subtotal:				56,878,000
Engineering & Design (12%±)				6,825,000
Supervision & Administration (10%±)				5,688,000
TOTAL: LEVEES AND FLOODWALLS				69,391,000

TABLE 30 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pumping Stations concrete culverts extension (installed)	1,350	L.F.	127.00	171,500
Relocate Miscellaneous utility pipelines thru I-wall	23	Ea.	3,180.00	73,100
Removal of Campsite Structures	120	Ea.	12,720.00	1,526,400
Subtotal: RELOCATIONS				1,771,000
Contingencies (25%±)				443,000
Subtotal:				2,214,000
Engineering and Design (12%±)				266,000
Supervision and Administration (10%±)				221,000
TOTAL: RELOCATIONS				2,701,000
Lands and Damages (see attached appraisal)				1,428,000
Summary:				
LEVEES AND FLOODWALLS				69,391,000
RELOCATIONS				2,701,000
LANDS AND DAMAGES				1,428,000
TOTAL:				73,520,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 31
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra. Fill w/ Ponding Area)				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	490,000
Clearing	90	Acre	1,400.00	126,000
Sand Fill (Hydraulic)	1,800,000	C.Y.	3.50	6,300,000
Clay Fill (Hydraulic)	3,200,000	C.Y.	3.50	11,200,000
Stripping	1,700,000	C.Y.	2.00	3,400,000
Flotation Channel: (Excavation and Backfill)	700,000	C.Y.	2.00	1,400,000
Shell Ponding Dikes	1,800,000	C.Y.	11.50	20,700,000
Foreshore Protection:				
Shell	330,000	C.Y.	12.00	3,960,000
Stone	140,000	Ton	20.00	2,800,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	210,000
Clearing	280	Acre	700.00	196,000
Clay Fill (Hydraulic)	1,000,000	C.Y.	3.50	3,500,000
Foreshore Protection:				
Stone	150,000	Ton	20.00	3,000,000
c. Final Lift (Shaping)				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	280	Acre	700.00	196,000
Clay Fill (Cast)	400,000	C.Y.	3.50	1,400,000
Fertilizing and Seeding	240	Acre	600.00	144,000
Subtotal: LEVEE REACH				59,092,000

TABLE 31 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (Hydra. Fill w/ Ponding Area) (continued)				
2. Floodwall Reach				
Removal of existing floodwall between sta. 10+13.20 and 32+47.46 W/L	1	Job	Lump Sum	795,000
Structure Excavation	2,650	C.Y.	8.00	21,200
Structure Backfill	1,760	C.Y.	10.00	17,600
PZ-27 Steel Sheet Piling	146,475	S.F.	14.00	2,050,650
PMA-22 Steel Sheet Piling	375	S.F.	12.50	4,690
12"x12" Prestressed Concrete Piles	480	L.F.	30.00	14,400
Concrete in Stabilization Slab	5	C.Y.	125.00	630
Concrete in T-Wall Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls, Columns, & Beams	4,255	C.Y.	400.00	1,702,000
Structural Steel	8,400	C.Y.	3.00	25,200
Subtotal: FLOODWALL REACH				4,636,370
3. Drainage Structures				
Drainage Structures	3	Ea.	763,200.00	2,289,600
Drainage Structure	1	Ea.	254,400.00	254,400
Subtotal: DRAINAGE STRUCTURES				2,544,000
Subtotal: LEVEES AND FLOODWALLS				66,272,370
Contingencies (25%±)				16,567,630
Subtotal:				82,840,000
Engineering & Design (12%±)				9,941,000
Supervision & Administration (10%±)				8,284,000
TOTAL: LEVEES AND FLOODWALLS				101,065,000

TABLE 31 (CONTINUED)
CITRUS LAKEFRONT LEVEE IN-THE-LAKE ALINEMENT
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pumping Stations concrete culverts extension (installed)	1,350	L.F.	127.00	171,500
Relocate Miscellaneous utility pipelines thru I-wall	23	Ea.	3,800.00	73,100
Removal of Campsite Structures	120	Ea.	12,720.00	1,526,400
Subtotal: RELOCATIONS				1,771,000
Contingencies (25%±)				443,000
Subtotal:				2,214,000
Engineering and Design (12%±)				266,000
Supervision and Administration (10%±)				221,000
TOTAL: RELOCATIONS				2,701,000
Lands and Damages (see attached appraisal)				1,428,000
Summary:				
LEVEES AND FLOODWALLS				101,065,000
RELOCATIONS				2,701,000
LANDS AND DAMAGES				1,428,000
TOTAL:				105,194,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 32
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	70,000
Structure Removal	1	Job	Lump Sum	825,000
Structure Excavation	17,325	C.Y.	8.00	138,600
Structure Backfill	11,625	C.Y.	10.00	116,300
PZ-27 Steel Sheet Piling	620,560	S.F.	14.00	8,687,800
PMA-22 Steel Sheet Piling	4,350	S.F.	12.50	54,400
12" X 12" Prestressed Concrete Piles	5,940	L.F.	30.00	178,200
Concrete in Stabilization Slab	40	C.Y.	125.00	5,000
Concrete in T-Wall Base Slab	275	C.Y.	200.00	55,000
Concrete in Walls, Columns, and Beams	19,205	C.Y.	400.00	7,682,000
Structural Steel	33,900	Lb.	3.00	101,700
Miscellaneous Metalwork	1	Job	Lump Sum	19,100
Riprap	230,000	Ton	22.00	5,060,000
Shell	40,000	C.Y.	14.00	560,000
Subtotal: LEVEES AND FLOODWALLS				23,553,100
Contingencies (25%±)				5,887,900
Subtotal:				29,441,000
Engineering and Design (12%±)				3,533,000
Supervision and Administration (10%±)				2,944,000
TOTAL: LEVEES AND FLOODWALLS				35,918,000

TABLE 32 (CONTINUED)
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramps @ Lakeshore Drive	1	Job	Lump Sum	190,800
Removal of Concrete Walkways over Existing Levee	64	Ea.	2,544.00	162,800
Removal and Replacement of Water and Electrical Lines over I-Wall	110	Ea.	1,900.00	209,000
Removal and Replacement of Approx. 40' of Wooden Walkways, Water Lines, Electric Lines, for each camp	110	Ea.	3,180.00	349,800
Relocate 23 ea. Miscellaneous Utility Pipelines thru I-Wall	23	Ea.	3,180.00	73,100
Relocate Approx. 1,400 L.F. of Miscellaneous Utility Pipelines	1,400	L.F.	25.00	35,000
Subtotal: RELOCATIONS				1,020,500
Contingencies (25%±)				255,500
Subtotal:				1,276,000
Engineering & Design (12%±)				153,000
Supervision & Administration (10%±)				128,000
TOTAL: RELOCATIONS				1,557,000

TABLE 32 (CONTINUED)
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE ALTERNATIVE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				35,918,000
RELOCATIONS				1,557,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				37,475,000

TABLE 33
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demob.	1	Job	Lump Sum	140,000
Structure Removal	1	Job	Lump Sum	825,000
Structure Excavation	17,325	C.Y.	8.00	138,600
Structure Backfill	11,625	C.Y.	10.00	116,300
PZ-27 Steel Sheet Piling	618,060	S.F.	14.00	8,652,800
PMA-22 Steel Sheet Piling	4,350	S.F.	12.50	54,400
12" X 12" Prestressed Concrete Piles	5,940	L.F.	30.00	178,200
Concrete in Stabilization Slab	40	C.Y.	125.00	5,000
Concrete in T-Wall Base Slab	275	C.Y.	200.00	55,000
Concrete in Walls, Columns, and Beams	14,215	C.Y.	400.00	5,686,000
Structural Steel	33,900	Lb.	3.00	101,700
Barge Barrier:				
Shell	302,200	C.Y.	14.00	4,230,800
Riprap	345,525	Ton	22.00	7,601,600
Plastic Filter Cloth	196,200	S.Y.	5.00	981,000
Subtotal: LEVEES AND FLOODWALLS				28,766,400
Contingencies (25%±)				7,191,600
Subtotal:				35,958,000
Engineering and Design (12%±)				4,315,000
Supervision and Administration (10%±)				3,596,000
TOTAL: LEVEES AND FLOODWALLS				43,869,000

TABLE 33 (CONTINUED)
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramp @ Lakeshore Drive	1	Job	Lump Sum	190,800
Removal of Concrete Walkways over Existing Levee	64	Ea.	2,544.00	162,800
Removal and Replacement of Water and Electrical Lines over I-Wall	110	Ea.	1,900.00	209,000
Removal and Replacement of Approx. 40' of Wooden Walkways, Water Lines, Electric Lines, for each camp	110	Ea.	3,180.00	349,800
Relocate 23 ea. Miscellaneous Utility Pipelines thru I-Wall	23	Ea.	3,180.00	73,100
Relocate Approx. 1,400 L.F. of Miscellaneous Utility Pipelines	1,400	L.F.	25.00	35,000
Subtotal: RELOCATIONS				1,020,500
Contingencies (25%±)				255,500
Subtotal:				1,276,000
Engineering & Design (12%±)				153,000
Supervision & Administration (10%±)				128,000
TOTAL: RELOCATIONS				1,557,000
Lands and Damages (see attached appraisal)				1,428,000

TABLE 33 (CONTINUED)
CITRUS LAKEFRONT LEVEE
I-WALL ON LEVEE WITH BARGE BERM
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
LEVEE AND FLOODWALLS				43,869,000
RELOCATIONS				1,557,000
LANDS AND DAMAGES				1,428,000
TOTAL				46,854,000

13. Citrus Lakefront Levee*

ESTIMATE OF COSTS (Date of Value - 1 Oct 81)

	Acres	Unit Value	Total Value
(a) Lands & Damages			
Perpetual Levee Right-of-Way All additional right-of-way is located in the lake			N/A
Improvements (104 camps)			$884,000
Severance Damage			0
Total (R)			$884,000
Contingencies 25% (R)			221,000
(b) Acquisition Costs (Estimated 104 tracts)			
Non-Federal 104 @ $1,400 per tract (R)			146,000
Federal 104 @ $ 700 per tract (R)			73,000
(c) PL-91-646			104,000
(d) Total Estimated Real Estate Cost			$1,428,000

* This estimate applies to the following plans:

1. HLP (100 year) Protection
2. HLP - SPH Protection
3. In the Lake Alinement (All alternatives)

If these alternatives procede to the next level of study, a detailed legal opinion will be required to determine if compensation is due for these camps.

TABLE 34
MAXENT CANAL LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	420,000
Clearing	270	Acre	1,400.00	378,000
Stripping (Sand Borrow Area)	1,600,000	C.Y.	2.00	3,200,000
Sand Core Trench Excavation	900,000	C.Y.	2.00	1,800,000
Sand Fill (Hydraulic)	1,700,000	C.Y.	3.50	5,950,000
Clay Fill (Hauled)	2,700,000	C.Y.	8.50	22,950,000
Fertilizing and Seeding	250	Acre	600.00	150,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	270	Acre	700.00	189,000
Clay Fill (Hauled)	1,100,000	C.Y.	12.00	13,200,000
Fertilizing and Seeding	250	Acre	600.00	150,000
Subtotal: LEVEE REACH				48,457,000
2. Floodwall Reach				
Structure Excavation	130	C.Y.	8.00	1,000
Structure Backfill	62	C.Y.	10.00	600
PZ-27 Steel Sheet Piling	1,170	S.F.	14.00	16,400
12"x12" Prestressed Concrete Piles	585	L.F.	30.00	17,600
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	20	C.Y.	200.00	4,000
Concrete in Walls and Columns	30	C.Y.	400.00	12,000
Structural Steel	4,500	Lb.	3.00	13,500
Subtotal: FLOODWALL REACH				65,500
Subtotal: LEVEES AND FLOODWALLS				48,522,500

TABLE 34 (CONTINUED)
MAXENT CANAL LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				12,130,500
Subtotal:				60,653,000
Engineering and Design (12%±)				7,278,000
Supervision and Administration (10%±)				6,065,000
Total: LEVEES AND FLOODWALLS				73,996,000
Relocations				
Pipelines:				
30" Ø Gas Pipeline	1	Job	Lump Sum	636,000
24" Ø Gas Pipeline	1	Job	Lump Sum	572,400
20" Ø Gas Pipeline	1	Job	Lump Sum	508,800
16" Ø Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Modifications to Existing Roadways:				
Ramp @ I-10 Highway	1	Job	Lump Sum	445,200
Ramp @ U.S. Highway 90	1	Job	Lump Sum	445,200
Subtotal: MODIFICATION TO EXISTING ROADWAYS				890,400
Subtotal: RELOCATIONS				3,180,000
Contingencies (25% ±)				795,000
Subtotal:				3,975,000
Engineering & Design (12%±)				477,000
Supervision & Administration (10%±)				398,000
Total: RELOCATIONS				4,850,000

TABLE 34 (CONTINUED)
MAXENT CANAL LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way (Marshland)	260	Acre	1,500.00	390,000
Rights-of-Way (Reclaimed Marshland)	14	Acre	13,500.00	189,000
Improvements	1	Job	Lump Sum	175,000
Subtotal:				754,000
Contingencies (25%±)				189,000
Subtotal: RIGHTS-OF-WAY				943,000
PL-91-646	1	Job	Lump Sum	110,000
Acquisition Costs	1	Job	Lump Sum	21,000
Total: LANDS AND DAMAGES				1,074,000
Summary:				
LEVEES AND FLOODWALLS				73,996,000
RELOCATIONS				4,850,000
LANDS AND DAMAGES				1,074,000
TOTAL:				79,920,000

TABLE 35
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	420,000
Clearing	350	Acre	1,400.00	490,000
Stripping (Sand Borrow Area)	2,000,000	C.Y.	2.00	4,000,000
Sand Core Trench Excavation	900,000	C.Y.	2.00	1,800,000
Sand Fill (Hydraulic)	2,100,000	C.Y.	3.50	7,350,000
Clay Fill (Hauled)	5,000,000	C.Y.	8.50	42,500,000
Fertilizing and Seeding	310	Acre	600.00	186,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	350	Acre	700.00	245,000
Clay Fill (Hauled)	2,100,000	C.Y.	8.50	17,850,000
Fertilizing and Seeding	310	Acre	600.00	186,000
Subtotal: LEVEE REACH				75,097,000
2. Floodwall Reach				
Structure Excavation	130	C.Y.	8.00	1,000
Structure Backfill	62	C.Y.	10.00	600
PZ-27 Steel Sheet Piling	1,170	S.F.	14.00	16,400
12"x12" Prestressed Concrete Piles	585	L.F.	30.00	17,600
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	20	C.Y.	200.00	4,000
Concrete in Walls and Columns	36	C.Y.	400.00	14,400
Structural Steel	5,400	Lb.	3.00	16,200
Subtotal: FLOODWALL REACH				70,600

TABLE 35 (CONTINUED)
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Subtotal: LEVEES AND FLOODWALLS				75,167,600
Contingencies (25%±)				18,792,400
Subtotal:				93,960,000
Engineering and Design (12%±)				11,275,000
Supervision and Administration (10%±)				9,396,000
Total: LEVEES AND FLOODWALLS				114,631,000
Relocations				
Pipelines:				
30" ∅ Gas Pipeline	1	Job	Lump Sum	636,000
24" ∅ Gas Pipeline	1	Job	Lump Sum	572,400
20" ∅ Gas Pipeline	1	Job	Lump Sum	508,800
16" ∅ Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Modifications to Existing Roadways:				
Ramp @ I-10 Highway	1	Job	Lump Sum	445,200
Ramp @ U.S. Highway 90	1	Job	Lump Sum	445,200
Subtotal: MODIFICATION TO EXISTING ROADWAYS				890,400
Subtotal: RELOCATIONS				3,180,000
Contingencies (25% ±)				795,000
Subtotal:				3,975,000
Engineering & Design (12%±)				477,000
Supervision & Administration (10%±)				398,000
Total: RELOCATIONS				4,850,000

TABLE 35 (CONTINUED)
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way (Marshland)	340	Acre	1,500.00	510,000
Rights-of-Way (Reclaimed Marshland)	18	Acre	13,500.00	243,000
Improvements	1	Job	Lump Sum	175,000
Subtotal:				928,000
Contingencies (25%±)				232,000
Subtotal: RIGHTS-OF-WAY				1,160,000
PL-91-646	1	Job	Lump Sum	110,000
Acquisition Costs	1	Job	Lump Sum	21,000
Total: LANDS AND DAMAGES				1,291,000
Summary:				
LEVEES AND FLOODWALLS				114,631,000
RELOCATIONS				4,850,000
LANDS AND DAMAGES				1,291,000
TOTAL:				120,772,000

TABLE 36
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
a. First Lift				
Mobilization & Demobilization	1	Job	Lump Sum	420,000
Clearing	320	Acre	1,400.00	448,000
Stripping (Sand Borrow Area)	1,800,000	C.Y.	2.00	3,600,000
Sand Core Trench Excavation	900,000	C.Y.	2.00	1,800,000
Sand Fill (Hydraulic)	1,900,000	C.Y.	3.50	6,650,000
Clay Fill (Hauled)	3,600,000	C.Y.	8.50	30,600,000
Fertilizing and Seeding	290	Acre	600.00	174,000
b. Second Lift				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	320	Acre	700.00	224,000
Clay Fill (Hauled)	1,500,000	C.Y.	8.50	12,750,000
Fertilizing and Seeding	290	Acre	600.00	174,000
Subtotal: LEVEE REACH				56,910,000
2. Floodwall Reach				
Structure Excavation	130	C.Y.	8.00	1,000
Structure Backfill	62	C.Y.	10.00	600
PZ-27 Steel Sheet Piling	1,170	S.F.	14.00	16,400
12"x12" Prestressed Concrete Piles	585	L.F.	30.00	17,600
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	20	C.Y.	200.00	4,000
Concrete in Walls and Columns	34	C.Y.	400.00	13,600
Structural Steel	5,100	Lb.	3.00	15,300
Subtotal: FLOODWALL REACH				68,900
Subtotal: LEVEES AND FLOODWALLS				56,978,900

TABLE 36 (CONTINUED)
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				14,245,100
Subtotal:				71,224,000
Engineering and Design (12%±)				8,547,000
Supervision and Administration (10%±)				7,122,000
Total: LEVEES AND FLOODWALLS				86,893,000
Relocations				
Pipelines:				
30" Ø Gas Pipeline	1	Job	Lump Sum	636,000
24" Ø Gas Pipeline	1	Job	Lump Sum	572,400
20" Ø Gas Pipeline	1	Job	Lump Sum	508,800
16" Ø Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Modifications to Existing Roadways:				
Ramp @ I-10 Highway	1	Job	Lump Sum	445,200
Ramp @ U.S. Highway 90	1	Job	Lump Sum	445,200
Subtotal: MODIFICATION TO EXISTING ROADWAYS				890,400
Subtotal: RELOCATIONS				3,180,000
Contingencies (25% ±)				795,000
Subtotal:				3,975,000
Engineering & Design (12%±)				477,000
Supervision & Administration (10%±)				398,000
Total: RELOCATIONS				4,850,000

TABLE 36 (CONTINUED)
MAXENT CANAL LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				
Rights-of-Way (Marshland)	310	Acre	1,500.00	465,000
Rights-of-Way (Reclaimed Marshland)	17	Acre	13,500.00	229,000
Improvements	1	Job	Lump Sum	175,000
Subtotal:				870,000
Contingencies (25%±)				218,000
Subtotal: RIGHTS-OF-WAY				1,088,000
PL-91-646	1	Job	Lump Sum	110,000
Acquisition Costs	1	Job	Lump Sum	21,000
Total: LANDS AND DAMAGES				1,219,000
Summary:				
LEVEES AND FLOODWALLS				86,893,000
RELOCATIONS				4,850,000
LANDS AND DAMAGES				1,291,000
TOTAL:				92,962,000

TABLE 37
NEW ORLEANS EAST LAKEFRONT LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing and Grubbing	1	Job	Lump Sum	70,000
Hauled Fill (sand)	80,000	C.Y.	8.50	680,000
Clay Blanket (semicompacted)	40,000	C.Y.	9.00	360,000
Clay Berms (uncompacted)	15,000	C.Y.	2.00	30,000
Stone	185,000	Ton	22.00	4,070,000
Shell	22,000	C.Y.	15.00	330,000
Fertilizing and Seeding	35	Acre	600.00	21,000
Subtotal: LEVEES AND FLOODWALLS				5,701,000
Contingencies (25%±)				1,425,000
Subtotal:				7,126,000
Engineering and Design (12%±)				855,000
Supervision and Administration (10%±)				713,000
Total: LEVEES AND FLOODWALLS				8,694,000
Relocations				
30" Ø Gas Pipeline	1	Job	Lump Sum	636,000
24" Ø Gas Pipeline	1	Job	Lump Sum	572,400
20" Ø Gas Pipeline	1	Job	Lump Sum	508,800
16" Ø Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Contingencies (25%±)				572,400
Subtotal:				2,862,000

TABLE 37 (CONTINUED)
NEW ORLEANS EAST LAKEFRONT LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering & Design (12%±)				343,000
Supervision and Administration (10%±)				286,000
Total: RELOCATIONS				3,491,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				8,694,000
RELOCATIONS				3,491,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				12,185,000

TABLE 38
NEW ORLEANS EAST LAKEFRONT LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	420,000
Clearing and Grubbing	1	Job	Lump Sum	280,000
Hauled Fill (sand)	80,000	C.Y.	8.50	680,000
Clay Blanket (semicompacted)	1,130,000	C.Y.	9.00	10,170,000
Clay Berms (uncompacted)	2,155,000	C.Y.	2.00	4,310,000
Stone	185,000	Ton	22.00	4,070,000
Shell	22,000	C.Y.	15.00	330,000
Fertilizing and Seeding	210	Acre	600.00	126,000
Subtotal: LEVEES AND FLOODWALLS				20,386,000
Contingencies (25%±)				5,097,000
Subtotal:				25,483,000
Engineering and Design (12%±)				3,058,000
Supervision and Administration (10%±)				2,548,000
Total: LEVEES AND FLOODWALLS				31,089,000
Relocations				
30" 0 Gas Pipeline	1	Job	Lump Sum	636,000
24" 0 Gas Pipeline	1	Job	Lump Sum	572,400
20" 0 Gas Pipeline	1	Job	Lump Sum	508,800
16" 0 Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Contingencies (25%±)				572,400
Subtotal:				2,862,000

TABLE 38 (CONTINUED)
NEW ORLEANS EAST LAKEFRONT LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering & Design (12%±)				343,000
Supervision and Administration (10%±)				286,000
Total: RELOCATIONS				3,491,000
Lands and Damages				
Rights-of-Way	104	Acre	2,000.00	208,000
Subtotal:				208,000
Contingencies (25%±)				52,000
Subtotal: RIGHTS-OF-WAY				260,000
Acquisition Costs				3,000
TOTAL: LANDS AND DAMAGES				263,000
Summary:				
LEVEES AND FLOODWALLS				31,089,000
RELOCATIONS				3,491,000
LANDS AND DAMAGES				263,000
TOTAL				34,843,000

TABLE 39
NEW ORLEANS EAST LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing and Grubbing	1	Job	Lump Sum	280,000
Hauled Fill (sand)	80,000	C.Y.	8.50	680,000
Clay Blanket (semicompacted)	630,000	C.Y.	9.00	3,670,000
Clay Berms (uncompacted)	1,155,000	C.Y.	2.00	2,310,000
Stone	185,000	Ton	22.00	4,070,000
Shell	22,000	C.Y.	15.00	330,000
Fertilizing and Seeding	190	Acre	600.00	114,000
Subtotal: LEVEES AND FLOODWALLS				13,734,000
Contingencies (25%±)				3,434,000
Subtotal:				17,168,000
Engineering and Design (12%±)				2,060,000
Supervision and Administration (10%±)				1,717,000
Total: LEVEES AND FLOODWALLS				20,945,000
Relocations				
30" 0 Gas Pipeline	1	Job	Lump Sum	636,000
24" 0 Gas Pipeline	1	Job	Lump Sum	572,400
20" 0 Gas Pipeline	1	Job	Lump Sum	508,800
16" 0 Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Contingencies (25%±)				572,400
Subtotal:				2,862,000

TABLE 39 (CONTINUED)
NEW ORLEANS EAST LAKEFRONT LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering & Design (12%±)				343,000
Supervision and Administration (10%±)				286,000
Total: RELOCATIONS				3,491,000
Lands and Damages				
Rights-of-Way	84	Acre	2,000.00	168,000
Subtotal:				168,000
Contingencies (25%±)				42,000
Subtotal: RIGHTS-OF-WAY				210,000
Acquisition Costs				3,000
TOTAL: LANDS AND DAMAGES				213,000
Summary:				
LEVEES AND FLOODWALLS				20,945,000
RELOCATIONS				3,491,000
LANDS AND DAMAGES				213,000
TOTAL				24,649,000

TABLE 40
NEW ORLEANS EAST LAKEFRONT LEVEE
I-WALL ON LEVEE PLAN
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing and Grubbing	1	Job	Lump Sum	280,000
Hauled Fill (Sand)	80,000	C.Y.	8.50	680,000
Clay Blanket (Semicompacted)	40,000	C.Y.	9.00	360,000
Clay Berms (Uncompacted)	355,000	C.Y.	2.00	710,000
Stone	185,000	Ton	22.00	4,070,000
Shell	22,000	C.Y.	15.00	330,000
Fertilizing and Seeding	200	Acre	600.00	120,000
Subtotal: LEVEE				6,830,000
2. Floodwall				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Structure Excavation	14,550	C.Y.	8.00	116,400
Structure Backfill	9,700	C.Y.	10.00	97,000
PZ-27 Steel Sheet Piling	436,225	S.F.	14.00	6,107,200
Concrete in Walls	13,335	C.Y.	400.00	5,334,000
Subtotal: FLOODWALL REACHES				11,794,600
Subtotal: LEVEES AND FLOODWALLS				18,624,600
Contingencies (25%±)				4,656,400
Subtotal:				23,281,000
Engineering and Design (12%±)				2,794,000
Supervision and Administration (10%±)				2,328,000
Total: LEVEES AND FLOODWALLS				28,403,000

TABLE 40 (CONTINUED)
NEW ORLEANS EAST LAKEFRONT LEVEE
I-WALL ON LEVEE PLAN
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
30" 0 Gas Pipeline	1	Job	Lump Sum	636,000
24" 0 Gas Pipeline	1	Job	Lump Sum	572,400
20" 0 Gas Pipeline	1	Job	Lump Sum	508,800
16" 0 Fluids Pipeline	1	Job	Lump Sum	445,200
Railroad Signal Lines	1	Job	Lump Sum	127,200
Subtotal: RELOCATIONS				2,289,600
Contingencies (25%±)				572,400
Subtotal:				2,862,000
Engineering & Design (12%±)				343,000
Supervision and Administration (10%±)				286,000
Total: RELOCATIONS				3,491,000
Lands and Damages				
Rights-of-Way	50	Acre	2,000.00	100,000
Subtotal:				100,000
Contingencies (25%)				25,000
Subtotal: RIGHTS-OF-WAY				125,000
Acquisition Costs				3,000
TOTAL: LANDS AND DAMAGES				128,000
Summary:				
LEVEES AND FLOODWALLS				28,403,000
RELOCATIONS				3,491,000
LANDS AND DAMAGES				128,000
TOTAL				32,022,000

TABLE 41
SOUTH POINT TO GIWW LEVEEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
L&N R.R. Gate				
Mobilization & Demobilization	1	Job	Lump Sum	30,000
Clearing and Grubbing	1	Job	Lump Sum	15,000
Embankment, Semicompacted Clay Fill	5,400	C.Y.	8.50	45,900
Fertilizing and Seeding	1	Job	Lump Sum	600
Structure Excavation	120	C.Y.	8.00	1,000
Structure Backfill	80	C.Y.	10.00	800
Compacted Shell	210	C.Y.	24.00	5,000
14" x 14" Prestressed Concrete Piles	650	L.F.	35.00	22,800
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls and Columns	26	C.Y.	400.00	10,400
Structural Steel	3,900	Lb.	3.00	11,700
Temporary Falsework for R. R. Tracks	1	Job	Lump Sum	43,200
Subtotal: LEVEES AND FLOODWALLS				191,800
Contingencies (25%±)				48,200
Subtotal:				240,000
Engineering and Design (12%±)				29,000
Supervision and Administration (10%±)				24,000
Total: LEVEES AND FLOODWALLS				293,000

TABLE 41 (CONTINUED)
SOUTH POINT TO GIWW LEVEE
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramp @ U.S. Highway 90	1	Job	Lump Sum	190,800
Subtotal: RELOCATIONS				190,800
Contingencies (25% ±)				48,200
Subtotal:				239,000
Engineering & Design (12%±)				29,000
Supervision & Administration (10%±)				24,000
Total: RELOCATIONS				292,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				293,000
RELOCATIONS				292,000
LANDS AND DAMAGES				NONE REQIUIRED
TOTAL:				585,000

TABLE 42
SOUTH POINT TO GIWW LEVEEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
1. Levee Reach				
Mobilization & Demobilization	1	Job	Lump Sum	70,000
Clearing	170	Acre	1,400.00	238,000
Embankment, Semicompacted Clay Fill	235,000	C.Y.	8.50	1,997,500
Fertilizing and Seeding	145	Acre	600.00	87,000
R. R. Tracks	1	Job	Lump Sum	43,200
Subtotal: LEVEE REACH				2,392,500
2. Floodwall Reach				
L&N R.R. Gate				
Mobilization & Demobilization	1	Job	Lump Sum	30,000
Clearing and Grubbing	1	Job	Lump Sum	15,000
Embankment, Semicompacted Clay Fill	5,400	C.Y.	8.50	45,900
Fertilizing and Seeding	1	Job	Lump Sum	600
Structure Excavation	120	C.Y.	8.00	1,000
Structure Backfill	80	C.Y.	10.00	800
Compacted Shell	210	C.Y.	24.00	5,000
14" x 14" Prestressed Concrete Piles	650	L.F.	35.00	22,800
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls and Columns	26	C.Y.	400.00	10,400
Structural Steel	3,900	Lb.	3.00	11,700
Temporary Falsework for R. R. Tracks	1	Job	Lump Sum	43,200
Subtotal: FLOODWALL REACH				191,800
Subtotal: LEVEES AND FLOODWALLS				2,584,300

TABLE 42 (CONTINUED)
SOUTH POINT TO GIWW LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Contingencies (25%±)				645,700
Subtotal:				3,230,000
Engineering and Design (12%±)				388,000
Supervision and Administration (10%±)				303,000
Total: LEVEES AND FLOODWALLS				3,941,000
Relocations				
Ramp @ Highway I-10	1	Job	Lump Sum	381,600
Ramp @ U.S. Highway 11	1	Job	Lump Sum	190,800
Ramp @ U.S. Highway 90	1	Job	Lump Sum	190,800
Subtotal: RELOCATIONS				763,200
Contingencies (25% ±)				190,800
Subtotal:				954,000
Engineering & Design (12%±)				114,000
Supervision & Administration (10%±)				95,000
Total: RELOCATIONS				1,163,000
Lands and Damages				
Rights-of-Way	40	Acre	1,500.00	60,000
Subtotal: LANDS AND DAMAGES				60,000
Contingencies (25% ±)				15,000
Subtotal:				75,000
Acquisition Costs				3,000
Total: LANDS AND DAMAGES				78,000

TABLE 42 (CONTINUED)
SOUTH POINT TO GIWW LEVEE
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
LEVEES AND FLOODWALLS				3,941,000
RELOCATIONS				1,163,000
LANDS AND DAMAGES				78,000
TOTAL:				5,182,000

TABLE 43
SOUTH POINT TO GIWW LEVEEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
L&N R.R. Gate				
Mobilization & Demobilization	1	Job	Lump Sum	30,000
Clearing and Grubbing	1	Job	Lump Sum	15,000
Embankment, Semicompacted Clay Fill	5,400	C.Y.	8.50	45,900
Fertilizing and Seeding	1	Job	Lump Sum	600
Structure Excavation	120	C.Y.	8.00	1,000
Structure Backfill	80	C.Y.	10.00	800
Compacted Shell	210	C.Y.	24.00	5,000
14" x 14" Prestressed Concrete Piles	650	L.F.	35.00	22,800
Concrete in Stabilization Slab	3	C.Y.	125.00	400
Concrete in Base Slab	25	C.Y.	200.00	5,000
Concrete in Walls and Columns	26	C.Y.	400.00	10,400
Structural Steel	3,900	Lb.	3.00	11,700
Temporary Falsework for R. R. Tracks	1	Job	Lump Sum	43,200
Subtotal: LEVEES AND FLOODWALLS				191,800
Contingencies (25%±)				48,200
Subtotal:				240,000
Engineering and Design (12%±)				29,000
Supervision and Administration (10%±)				24,000
Total: LEVEES AND FLOODWALLS				293,000

TABLE 43 (CONTINUED)
SOUTH POINT TO GIWW LEVEE
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Ramp @ U.S. Highway 90	1	Job	Lump Sum	190,800
Subtotal: RELOCATIONS				190,800
Contingencies (25% ±)				48,200
Subtotal:				239,000
Engineering & Design (12%±)				29,000
Supervision & Administration (10%±)				24,000
Total: RELOCATIONS				292,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				293,000
RELOCATIONS				292,000
LANDS AND DAMAGES				NONE REQIUIRED
TOTAL:				585,000

TABLE 44
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
SPH PROTECTION

Note: The following estimate is to be used with the Paris Road to South Point and South Point to GIWW levees as depicted on plates . This estimate allows for back levee elevation of 17.5 NGVD from Michoud Canal to Station 1006+59.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
(a) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	360	Acre	700.00	252,000
Retaining and Ponding Dikes	300,000	C.Y.	2.25	675,000
Hydraulic Clay Fill	1,714,000	C.Y.	3.50	5,999,000
(b) Third Lift (Shaping)				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	360	Acre	700.00	252,000
Clay Fill (from adjacent borrow)	467,500	C.Y.	2.50	1,168,800
Fertilizing and Seeding	360	Acre	600.00	216,000
(c) Foreshore Protection				
Shell	17,000	C.Y.	12.00	204,000
Riprap	70,100	Ton	20.00	1,402,000
Subtotal: LEVEES AND FLOODWALLS				10,483,800
Contingencies (25%±)				2,621,200
Subtotal:				13,105,000
Engineering and Design (12%±)				1,573,000
Supervision and Administration (10%±)				1,311,000
Total: LEVEES AND FLOODWALLS				15,909,000

TABLE 44 (CONTINUED)
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pipelines	1	Job	Lump Sum	720,000
Subtotal: RELOCATIONS				720,000
Contingencies (25%±)				180,000
Subtotal:				900,000
Engineering & Design (12%±)				108,000
Supervision and Administration (10%±)				90,000
Total: RELOCATIONS				1,098,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				15,989,000
RELOCATIONS				1,098,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				17,087,000

TABLE 45
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
100 YEAR HURRICANE PROTECTION

Note: The following estimate is to be used with the Paris Road to South Point and South Point to GIWW levees as depicted on plates . This estimate allows for a back levee elevation of 16.0 NGVD from Michoud Canal to Station 1006+59.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
(a) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	280,000
Clearing	230	Acre	700.00	161,000
Retaining and Ponding Dikes	146,000	C.Y.	2.25	328,500
Hydraulic Clay Fill	1,300,000	C.Y.	3.50	4,550,000
(b) Third Lift (Shaping)				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	230	Acre	700.00	161,800
Clay Fill (from adjacent borrow)	350,000	C.Y.	2.50	875,000
Fertilizing and Seeding	230	Acre	600.00	138,000
(c) Foreshore Protection				
Shell	17,000	C.Y.	12.00	204,000
Riprap	70,100	Ton	20.00	1,402,000
Subtotal: LEVEES AND FLOODWALLS				8,136,100
Contingencies (25%±)				2,033,900
Subtotal:				10,170,000
Engineering and Design (12%±)				1,220,000
Supervision and Administration (10%±)				1,017,000
Total: LEVEES AND FLOODWALLS				12,407,000

TABLE 45 (CONTINUED)
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pipelines	1	Job	Lump Sum	720,000
Subtotal: RELOCATIONS				720,000
Contingencies (25%±)				180,000
Subtotal:				900,000
Engineering & Design (12%±)				108,000
Supervision and Administration (10%±)				90,000
Total: RELOCATIONS				1,098,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				12,407,000
RELOCATIONS				1,098,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				13,505,000

TABLE 46
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
BARRIER PLAN - SPH PROTECTION

Note: The following estimate is to be used with the Maxent Canal levee alinement from Lake Pontchartrain to the GIWW. This estimate allows for a back levee elevation of 17.5 NGVD from Michoud Canal to Maxent Canal, and 9.0 NGVD from Maxent Canal to Station 1006+59.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
(a) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing	160	Acre	700.00	112,000
Retaining and Ponding Dikes	130,000	C.Y.	2.25	292,500
Hydraulic Clay Fill	750,000	C.Y.	3.50	2,625,000
(b) Third Lift (Shaping)				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	160	Acre	700.00	112,000
Clay Fill (from adjacent borrow)	205,000	C.Y.	2.50	512,500
Fertilizing and Seeding	160	Acre	600.00	96,000
(c) Foreshore Protection				
Shell	17,000	C.Y.	12.00	204,000
Riprap	70,100	Ton	20.00	1,402,000
Subtotal: LEVEES AND FLOODWALLS				5,531,000
Contingencies (25%±)				1,383,000
Subtotal:				6,914,000
Engineering and Design (12%±)				830,000
Supervision and Administration (10%±)				691,000
Total: LEVEES AND FLOODWALLS				8,435,000

TABLE 46 (CONTINUED)
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO STATION 1006+59
BARRIER PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pipeline	1	Job	Lump Sum	720,000
Subtotal: RELOCATIONS				720,000
Contingencies (25%±)				180,000
Subtoal:				900,000
Engineering & Design (12%±)				108,000
Supervision and Administration (10%±)				90,000
Total: RELOCATIONS				1,098,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				8,435,000
RELOCATIONS				1,098,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				9,533,000

TABLE 47
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO MAXENT CANAL
HIGH LEVEL PLAN - SPH PROTECTION

Note: The following estimate is to be used with the Maxent Canal levee alinement from Lake Pontchartrain to the GIWW. This estimate allows for a back levee elevation of 17.5 NGVD from Michoud Canal to Maxent Canal, and no levee east of Maxent Canal.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
(a) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing	160	Acre	700.00	112,000
Retaining and Ponding Dikes	130,000	C.Y.	2.25	292,500
Hydraulic Clay Fill	750,000	C.Y.	3.50	2,625,000
(b) Third Lift (Shaping)				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	160	Acre	700.00	112,000
Clay Fill (from adjacent borrow)	205,000	C.Y.	2.50	512,500
Fertilizing and Seeding	160	Acre	600.00	96,000
(c) Foreshore Protection				
Shell	7,500	C.Y.	12.00	90,000
Riprap	30,600	Ton	20.00	612,000
Subtotal: LEVEES AND FLOODWALLS				4,627,000
Contingencies (25%±)				1,157,000
Subtotal:				5,784,000
Engineering and Design (12%±)				694,000
Supervision and Administration (10%±)				578,000
Total: LEVEES AND FLOODWALLS				7,056,000

TABLE 47 (CONTINUED)
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO MAXENT CANAL
HIGH LEVEL PLAN - SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Pipelines	1	Job	Lump Sum	720,000
Subtotal: RELOCATIONS				720,000
Contingencies (25%±)				180,000
Subtotal:				900,000
Engineering & Design (12%±)				108,000
Supervision and Administration (10%±)				90,000
Total: RELOCATIONS				1,098,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				7,056,000
RELOCATIONS				1,098,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				8,154,000

TABLE 48
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO MAXTENT CANAL
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Note: The following estimate is to be used with the Maxent Canal levee alinement from Lake Pontchartrain to the GIWW. This estimate allows for a back levee elevation of 16.0 NGVD from Michoud Canal to Maxent Canal, and no levee east of Maxent Canal.

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
(a) Second Lift				
Mobilization and Demobilization	1	Job	Lump Sum	140,000
Clearing	100	Acre	700.00	700,000
Retaining and Ponding Dikes	63,800	C.Y.	2.25	143,550
Hydraulic Clay Fill	568,000	C.Y.	3.50	1,988,000
(b) Third Lift (Shaping)				
Mobilization and Demobilization	1	Job	Lump Sum	35,000
Clearing	100	Acre	700.00	700,000
Clay Fill (from adjacent borrow)	153,000	C.Y.	2.50	382,500
Fertilizing and Seeding	100	Acre	600.00	600,000
(c) Foreshore Protection				
Shell	7,500	C.Y.	12.00	90,000
Riprap	30,600	Ton	20.00	612,000
Subtotal: LEVEES AND FLOODWALLS				5,391,050
Contingencies (25%±)				1,347,950
Subtotal:				6,739,000
Engineering and Design (12%±)				809,000
Supervision and Administration (10%±)				674,000
Total: LEVEES AND FLOODWALLS				8,222,000

TABLE 48 (CONTINUED)
NEW ORLEANS EAST BACK LEVEE
MICHOUD CANAL TO MAXTENT CANAL
HIGH LEVEL PLAN - 100 YEAR HURRICANE PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls (continued)				
Relocations				
Pipeline	1	Job	Lump Sum	720,000
Subtotal: RELOCATIONS				720,000
Contingencies (25%±)				180,000
Subtotal:				900,000
Engineering & Design (12%±)				108,000
Supervision and Administration (10%±)				90,000
Total: RELOCATIONS				1,098,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				8,222,000
RELOCATIONS				1,098,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				9,320,000

TABLE 49 *
CITRUS BACK LEVEE (IHNC TO MICHOUD CANAL)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Floodwall, Sta. 203 to 219 and 272 to 280	1	Job	Lump Sum	1,113,000
3rd Lift Levee and Seeding, Sta. 176 to 574	1	Job	Lump Sum	2,245,000
Floodwall Capping, Sta. 624 to 665	1	Job	Lump Sum	781,000
Subtotal: LEVEES AND FLOODWALLS				4,139,000
Engineering & Design (12%±)				497,000
Supervision & Administration (10%±)				414,000
TOTAL: LEVEES AND FLOODWALLS				5,050,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				5,050,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL				5,050,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

TABLE 50 *
EAST BANK OF IHNC (MRGO TO LAKE)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Capping floodwalls and raising levees	1	Job	Lump Sum	2,805,000
Subtotal: LEVEES AND FLOODWALLS				2,805,000
Engineering and Design (12% ±)				337,000
Supervision and Administration (10% ±)				281,000
Total: LEVEES AND FLOODWALLS				3,423,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				3,423,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				3,423,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corp of Engineers.

TABLE 51 *
WEST BANK OF IHNC
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Florida Avenue Complex	1	Job	Lump Sum	3,549,000
Capping Floodwalls	1	Job	Lump Sum	2,634,000
Subtotal: LEVEES AND FLOODWALLS				6,183,000
Engineering and Design (12% ±)				742,000
Supervision and Administration (10%±)				618,000
Total: LEVEES AND FLOODWALLS				7,543,000
Pumping Plant				
Pumping Station No. 19	1	Job	Lump Sum	19,942,000
Engineering and Design (12% ±)				2,393,000
Supervision and Administration (10% ±)				1,994,000
Total: PUMPING PLANT				24,329,000
Relocations				
Florida Avenue Complex	1	Job	Lump Sum	632,000
Raising Road Ramps	1	Job	Lump Sum	558,000
Subtotal: RELOCATIONS				1,190,000
Engineering and Design (12% ±)				143,000
Supervision and Administration (10% ±)				119,000
Total: RELOCATIONS				1,452,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

TABLE 51 (CONTINUED)
WEST BANK OF IHNC
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				7,543,000
PUMPING PLANT				24,329,000
RELOCATIONS				1,452,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				33,324,000

TABLE 52 *
MANDEVILLE SEAWALL

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Seawall repairs	1	Job	Lump Sum	1,949,000
Subtotal: LEVEES AND FLOODWALLS				1,949,000
Engineering and Design (12% ±)				234,000
Supervision and Administration (10% ±)				195,000
Total: LEVEES AND FLOODWALLS				2,378,000
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				2,378,000
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				2,378,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

The repairs recommended for the Mandeville Seawall are applicable to all alternative plans. Estimate reflects revised plan of repairs dated Jul 81.

TABLE 53 *
CHALMETTE AREA PLAN: SPH PROTECTION
IHNC LOCK TO CAERNARVON

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Levees and Floodwalls				
Florida Avenue Complex	1	Job	Lump Sum	3,591,000
Floodwall North of Florida Avenue	1	Job	Lump Sum	1,834,000
2nd Lift Levee, Sta. 9+80 to 65+00	1	Job	Lump Sum	450,000
Levee Enlargement, Sta. 9+80 to 65+00	1	Job	Lump Sum	181,000
2nd Lift Levee, Sta. 65 to 274	1	Job	Lump Sum	1,487,000
1st Levee Enlargement, Sta. 65 to 355	1	Job	Lump Sum	778,000
Final Levee Enlargement, Sta. 65 to 355	1	Job	Lump Sum	550,000
Floodwall under Paris Road Bridge	1	Job	Lump Sum	1,217,000 **
Levee Enlargement, Sta. 370 to 682	1	Job	Lump Sum	1,525,000
Final Levee Enlargement, Sta. 370 to 682	1	Job	Lump Sum	978,000
Pipeline Canal Closure and Levee Enlargement, Sta. 574 to 593	1	Job	Lump Sum	183,000
Final Levee Enlargement, Sta. 705 to 945	1	Job	Lump Sum	6,516,000
3rd Lift Levee, Sta. 945 to 1117	1	Job	Lump Sum	9,696,000
Final Levee Enlargement, Sta. 945 to 1117	1	Job	Lump Sum	13,588,000
Levee Enlargement, Verret Floodwall, Creedmore Drainage Structure, Sta. 1121 to 1568	1	Job	Lump Sum	5,237,000
Final Levee Enlargement, Sta. 1121 to 1560	1	Job	Lump Sum	4,500,000
Caernarvon Floodwall Capping	1	Job	Lump Sum	402,000
Subtotal: LEVEES AND FLOODWALLS				52,713,000

* Items for which "Lump Sum" estimates are shown, are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

** From contract cost.

TABLE 53 (CONTINUED)
CHALMETTE AREA PLAN: SPH PROTECTION
IHNC LOCK TO CAERNARVON

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering and Design (12% ±)				6,326,000
Supervision and Administration (10% ±)				5,271,000
Total: LEVEES AND FLOODWALLS				64,310,000
Relocations				
Florida Avenue Complex	1	Job	Lump Sum	978,000
Pipeline Vicinity of Paris Road	1	Job	Lump Sum	153,000
Pipelines and Powerlines in St. Bernard Parish	1	Job	Lump Sum	193,000
Subtotal: RELOCATIONS				1,324,000
Engineering and Design (12% ±)				159,000
Supervision and Administration (10% ±)				132,000
Total: RELOCATIONS				1,615,000
Lands and Damages				NONE REQUIRED
Summary:				
LEVEES AND FLOODWALLS				64,310,000
RELOCATIONS				1,615,000
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				65,925,000

TABLE 54 *
SEABROOK COMPLEX
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures and Channels				
Seabrook Lock & Outlet Structure	1	Job	Lump Sum	70,509,000
Seabrook Breakwater	1	Job	Lump Sum	4,450,000
Subtotal: MAJOR STRUCTURES AND CHANNELS				74,959,000
Engineering and Design (12%±)				8,995,000
Supervision and Administration (10%±)				7,496,000
Total: MAJOR STRUCTURES AND CHANNELS				91,450,000
Levees and Floodwalls				NONE REQUIRED
Relocations				NONE REQUIRED
Lands and Damages				NONE REQUIRED
Summary:				
MAJOR STRUCTURES AND CHANNELS				91,450,000
LEVEES AND FLOODWALLS				NONE REQUIRED
RELOCATIONS				NONE REQUIRED
LANDS AND DAMAGES				NONE REQUIRED
TOTAL:				91,450,000 **

* Note: Only 50% of the TOTAL cost of the Seabrook Complex is carried by the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Barrier Plan (SPH Protection); the remaining 50% is carried under the MRGO project.

TABLE 55
CHEF MENTEUR BARRIER COMPLEX
(43% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures and Channels				
Chef Menteur Navigation Structure	1	Job	Lump Sum	8,685,000
Chef Menteur Navigation Channel	1	Job	Lump Sum	819,000
Chef Menteur Control Structure (43% opening)	1	Job	Lump Sum	36,897,000
Chef Menteur Control Structure Channel	1	Job	Lump Sum	4,289,000
Subtotal: MAJOR STRUCTURES AND CHANNELS				50,690,000
Engineering and Design (12%±)				6,083,000
Supervision and Administration (10%±)				5,069,000
Total: MAJOR STRUCTURES AND CHANNELS				61,842,000
Levees and Floodwalls				
Closure Dam	1	Job	Lump Sum	19,656,000
1/ Chef West Levee, 1st Lift	1	Job	Lump Sum	5,498,000
1/ Chef East Levee, 1st Lift	1	Job	Lump Sum	4,760,000
1/ Chef East & West Levee, 2d Lift	1	Job	Lump Sum	4,710,000
1/ Chef East & West Levee, 3d Lift	1	Job	Lump Sum	730,000
1/ Chef East & West Levee, 4th Lift	1	Job	Lump Sum	450,000
1/ Roadway, Fertilizing, Seeding, and Wavewash Protection	1	Job	Lump Sum	2,010,000
1/ Chef Menteur Complex Access Road	1	Job	Lump Sum	225,000
Subtotal: LEVEES AND FLOODWALLS				38,039,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

1/ Use PB-3 estimate, effective 1 Oct 81 (Incremental)

TABLE 55 (CONTINUED)
CHEF MENTEUR BARRIER COMPLEX
(43% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering and Design (12%+)				4,565,000
Supervision and Administration (10%+)				3,804,000
Total: LEVEES AND FLOODWALLS				46,408,000
Relocations				
1/ Chef Menteur Levee	1	Job	Lump Sum	35,000
Subtotal: RELOCATIONS				35,000
Engineering and Design (12%+)				4,000
Supervision and Administration (10%+)				3,000
Total: RELOCATIONS				42,000
* Lands and Damages				
Navigation Structure	1	Job	Lump Sum	67,000
Control Structure	1	Job	Lump Sum	330,000
Chef Menteur East Levee	1	Job	Lump Sum	575,000
Subtotal: LANDS AND DAMAGES				972,000
Acquisition Cost				37,000
Total: LANDS AND DAMAGES				1,009,000

TABLE 55 (CONTINUED)
CHEF MENTEUR BARRIER COMPLEX
(43% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
MAJOR STRUCTURES AND CHANNELS				61,842,000
LEVEES AND FLOODWALLS				46,408,000
RELOCATIONS				42,000
LANDS AND DAMAGES				1,009,000
TOTAL:				109,301,000

* From PB-3, effective 1 Oct 81

1/ Use PB-3 estimate, effective 1 Oct 81

TABLE 56
CHEF MENTEUR BARRIER COMPLEX
(50% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

	Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	Major Structures and Channels				
	Chef Menteur Navigation Structure	1	Job	Lump Sum	8,685,000
	Chef Menteur Navigation Channel	1	Job	Lump Sum	819,000
	Chef Menteur Control Structure (50% opening)	1	Job	Lump Sum	43,504,000
	Chef Menteur Control Structure Channel	1	Job	Lump Sum	5,789,000
	Subtotal: MAJOR STRUCTURES AND CHANNELS				58,797,000
	Engineering and Design (12%±)				7,056,000
	Supervision and Administration (10%±)				5,880,000
	Total: MAJOR STRUCTURES AND CHANNELS				71,733,000
	Levees and Floodwalls				
	Closure Dam	1	Job	Lump Sum	19,656,000
1/	Chef West Levee, 1st Lift	1	Job	Lump Sum	5,498,000
1/	Chef East Levee, 1st Lift	1	Job	Lump Sum	4,760,000
1/	Chef East & West Levee, 2d Lift	1	Job	Lump Sum	4,710,000
1/	Chef East & West Levee, 3d Lift	1	Job	Lump Sum	730,000
1/	Chef East & West Levee, 4th Lift	1	Job	Lump Sum	450,000
1/	Roadway, Fertilizing, Seeding, and Wavewash Protection	1	Job	Lump Sum	2,010,000
1/	Chef Menteur Complex Access Road	1	Job	Lump Sum	225,000
	Subtotal: LEVEES AND FLOODWALLS				38,039,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corp of Engineers.

1/ Use PB-3 estimate, effective 1 Oct 81

TABLE 56 (CONTINUED)
CHEF MENTEUR BARRIER COMPLEX
(50% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Engineering and Design (12%±)				4,565,000
Supervision and Administration (10%±)				3,804,000
Total: LEVEES AND FLOODWALLS				46,408,000
Relocations				
1/ Chef Menteur Levee	1	Job	Lump Sum	35,000
Subtotal: RELOCATIONS				35,000
Engineering and Design (12%±)				4,000
Supervision and Administration (10%±)				3,000
Total: RELOCATIONS				42,000
* Lands and Damages				
Navigation Structure	1	Job	Lump Sum	67,000
Control Structure	1	Job	Lump Sum	330,000
Chef Menteur East Levee	1	Job	Lump Sum	575,000
Subtotal: LANDS AND DAMAGES				972,000
Acquisition Cost				37,000
Total: LANDS AND DAMAGES				1,009,000

TABLE 56 (CONTINUED)
CHEF MENTEUR BARRIER COMPLEX
(50% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Summary:				
MAJOR STRUCTURES AND CHANNELS				71,733,000
LEVEES AND FLOODWALLS				46,408,000
RELOCATIONS				42,000
LANDS AND DAMAGES				1,009,000
TOTAL				119,192,000

* From PB-3, effective 1 Oct 81

1/ Use PB-3 estimate, effective 1 Oct 81

TABLE 57
CHEF MENTEUR BARRIER COMPLEX
(90% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures and Channels				
Chef Menteur Navigation Structure	1	Job	Lump Sum	8,685,000
Chef Menteur Navigation Channel	1	Job	Lump Sum	819,000
Chef Menteur Control Structure (90% opening)	1	Job	Lump Sum	69,755,000
Chef Menteur Control Structure Channel	1	Job	Lump Sum	5,687,000
Subtotal: MAJOR STRUCTURES AND CHANNELS				84,946,000
Engineering and Design (12%±)				10,194,000
Supervision and Administration (10%±)				8,495,000
Total: MAJOR STRUCTURES AND CHANNELS				103,635,000
Levees and Floodwalls				
1/ Closure Dam	1	Job	Lump Sum	19,656,000
1/ Chef West Levee, 1st Lift	1	Job	Lump Sum	5,498,000
1/ Chef East Levee, 1st Lift	1	Job	Lump Sum	4,760,000
1/ Chef East & West Levee, 2d Lift	1	Job	Lump Sum	4,710,000
1/ Chef East & West Levee, 3d Lift	1	Job	Lump Sum	730,000
1/ Chef East & West Levee, 4th Lift	1	Job	Lump Sum	450,000
1/ Roadway, Fertilizing, Seeding, and Wavewash Protection	1	Job	Lump Sum	2,010,000
1/ Chef Menteur Complex Access Road	1	Job	Lump Sum	225,000
Subtotal: LEVEES AND FLOODWALLS				38,039,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans District Office of the Corps of Engineers.

1/ Use PB-3 estimate, effective 1 Oct 81

TABLE 57 (CONTINUED)
CHEF MENTEUR BARRIER COMPLEX
(90% OF NATURAL CROSS-SECTIONAL AREA)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
Chef Menteur Levee	1	Job	Lump Sum	34,000
Subtotal: RELOCATIONS				34,000
Engineering and Design (12%+)				4,000
Supervision and Administration (10%+)				3,000
Total: RELOCATIONS				41,000
* Lands and Damages				
Navigation Structure	1	Job	Lump Sum	67,000
Control Structure	1	Job	Lump Sum	330,000
Chef Menteur East Levee	1	Job	Lump Sum	575,000
Subtotal: LANDS AND DAMAGES				972,000
Acquisition Cost				37,000
Total: LANDS AND DAMAGES				1,009,000
Summary:				
MAJOR STRUCTURES AND CHANNELS				103,635,000
LEVEES AND FLOODWALLS				46,408,000
RELOCATIONS				41,000
LANDS AND DAMAGES				1,009,000
TOTAL				151,093,000

* From PB-3, effective 1 Oct 81

TABLE 58 *
RIGOLETS BARRIER COMPLEX
(35% of natural cross sectional area)
SPH PROTECTION

	Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
	Major Structures and Channels				
	Rigolets Lock	1	Job	Lump Sum	24,725,000
	Rigolets Navigation Channel	1	Job	Lump Sum	1,297,000
	Rigolets Control Structure (35% opening)	1	Job	Lump Sum	100,117,000
	Rigolets Control Structure Channel	1	Job	Lump Sum	651,000
	Subtotal: MAJOR STRUCTURES AND CHANNELS				126,790,000
	Engineering and Design (12% ±)				15,215,000
	Supervision and Administration (10% ±)				12,679,000
	Total: MAJOR STRUCTURES AND CHANNELS				154,684,000
	Levees and Floodwalls				
	Closure Dam	1	Job	Lump Sum	24,316,000
1/	Rigolets North Levee	1	Job	Lump Sum	3,645,000
	Rigolets Lock Levee	1	Job	Lump Sum	524,000
1/	Rigolets South Levee 1st Lift	1	Job	Lump Sum	2,790,000
1/	Rigolets South Levee 2nd Lift	1	Job	Lump Sum	320,000
1/	Rigolets Barrier Extension Levees	1	Job	Lump Sum	260,000
	Subtotal: LEVEES AND FLOODWALLS				31,855,000
	Engineering and Design (12% ±)				3,823,000
	Supervision and Administration (10% ±)				3,186,000
	Total: LEVEES AND FLOODWALLS				38,864,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans Office of the Corps of Engineers.

1/ Used PB-3 (incremental) estimate, effective 1 Oct 81.

TABLE 58 (CONTINUED)
RIGOLETS BARRIER COMPLEX
(35% of natural cross sectional area)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
1/ Rigolets South Levee	1	Job	Lump Sum	173,000
Subtotal: RELOCATIONS				173,000
Engineering and Design (12% ±)				21,000
Supervision and Administration (10% ±)				17,000
Total: RELOCATIONS				211,000
* Lands and Damages				
Rigolets Lock	1	Job	Lump Sum	185,000
Rigolets North Levee	1	Job	Lump Sum	455,000
Rigolets South Levee	1	Job	Lump Sum	879,000
Rigolets Barrier Extension Levees	1	Job	Lump Sum	185,000
Subtotal: LANDS AND DAMAGES				1,704,000
Acquisition Costs				38,000
Total: LANDS AND DAMAGES				1,742,000
Summary:				
MAJOR STRUCTURES AND CHANNELS				154,684,000
LEVEES AND FLOODWALLS				38,864,000
RELOCATIONS				211,000
LANDS AND DAMAGES				1,742,000
TOTAL:				195,501,000

* From PB-3 effective 1 Oct 81.
1/ Used PB-3 estimate, effective 1 Oct 81.

TABLE 59 *
RIGOLETS BARRIER COMPLEX
(50% of natural cross sectional area)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures and Channels				
Rigolets Lock	1	Job	Lump Sum	24,725,000
Rigolets Navigation Channel	1	Job	Lump Sum	1,297,000
Rigolets Control Structure (50% opening)	1	Job	Lump Sum	130,952,000
Rigolets Control Structure Channel	1	Job	Lump Sum	1,041,000
Subtotal: MAJOR STRUCTURES AND CHANNELS				158,015,000
Engineering and Design (12% ±)				18,962,000
Supervision and Administration (10% ±)				15,802,000
Total: MAJOR STRUCTURES AND CHANNELS				192,779,000
Levees and Floodwalls				
Closure Dam	1	Job	Lump Sum	19,906,000
1/ Rigolets North Levee	1	Job	Lump Sum	3,645,000
Rigolets Lock Levee	1	Job	Lump Sum	524,000
1/ Rigolets South Levee 1st Lift	1	Job	Lump Sum	2,790,000
1/ Rigolets South Levee 2nd Lift	1	Job	Lump Sum	320,000
1/ Rigolets Barrier Extension Levees	1	Job	Lump Sum	260,000
Subtotal: LEVEES AND FLOODWALLS				27,445,000
Engineering and Design (12% ±)				3,293,000
Supervision and Administration (10% ±)				2,745,000
Total: LEVEES AND FLOODWALLS				33,483,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans Office of the Corps of Engineers.

1/ Used PB-3 estimate, effective 1 Oct 81.

TABLE 59 (CONTINUED)
RIGOLETS BARRIER COMPLEX
(50% of natural cross sectional area)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
1/ Rigolets South Levee	1	Job	Lump Sum	173,000
Subtotal: RELOCATIONS				173,000
Engineering and Design (12% ±)				21,000
Supervision and Administration (10% ±)				17,000
Total: RELOCATIONS				211,000
* Lands and Damages				
Rigolets Lock	1	Job	Lump Sum	185,000
Rigolets North Levee	1	Job	Lump Sum	455,000
Rigolets South Levee	1	Job	Lump Sum	879,000
Rigolets Barrier Extension Levees	1	Job	Lump Sum	185,000
Subtotal: LANDS AND DAMAGES				1,704,000
Acquisition Costs				38,000
Total: LANDS AND DAMAGES				1,742,000
Summary:				
MAJOR STRUCTURES AND CHANNELS				192,779,000
LEVEES AND FLOODWALLS				33,483,000
RELOCATIONS				211,000
LANDS AND DAMAGES				1,742,000
TOTAL:				228,215,000

* From PB-3 effective 1 Oct 81.
1/ Used PB-3 estimate, effective 1 Oct 81.

TABLE 60 *
RIGOLETS BARRIER COMPLEX
(90% of natural cross sectional area)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Major Structures and Channels				
Rigolets Lock	1	Job	Lump Sum	24,725,000
Rigolets Navigation Channel	1	Job	Lump Sum	1,297,000
Rigolets Control Structure (90% opening)	1	Job	Lump Sum	209,788,000
Rigolets Control Structure Channel	1	Job	Lump Sum	1,543,000
Subtotal: MAJOR STRUCTURES AND CHANNELS				237,353,000
Engineering and Design (12% ±)				28,482,000
Supervision and Administration (10% ±)				23,735,000
Total: MAJOR STRUCTURES AND CHANNELS				289,570,000
Levees and Floodwalls				
Closure Dam	1	Job	Lump Sum	19,906,000
1/ Rigolets North Levee	1	Job	Lump Sum	3,645,000
Rigolets Lock Levee	1	Job	Lump Sum	524,000
1/ Rigolets South Levee 1st Lift	1	Job	Lump Sum	2,790,000
1/ Rigolets South Levee 2nd Lift	1	Job	Lump Sum	320,000
1/ Rigolets Barrier Extension Levees	1	Job	Lump Sum	260,000
Subtotal: LEVEES AND FLOODWALLS				27,445,000
Engineering and Design (12% ±)				3,293,000
Supervision and Administration (10% ±)				2,745,000
Total: LEVEES AND FLOODWALLS				33,483,000

* Items for which "Lump Sum" estimates are shown are identified in detail in design documents which are available for review in the New Orleans Office of the Corps of Engineers.

1/ Used PB-3 estimate, effective 1 Oct 81.

TABLE 60 (CONTINUED)
RIGOLETS BARRIER COMPLEX
(90% of natural cross sectional area)
SPH PROTECTION

Description	Estimated Quantity	Unit	Unit Price ($)	Estimated Amount ($)
Relocations				
1/ Rigolets South Levee	1	Job	Lump Sum	173,000
Subtotal: RELOCATIONS				173,000
Engineering and Design (12% ±)				21,000
Supervision and Administration (10% ±)				17,000
Total: RELOCATIONS				211,000
* Lands and Damages				
Rigolets Lock	1	Job	Lump Sum	185,000
Rigolets North Levee	1	Job	Lump Sum	455,000
Rigolets South Levee	1	Job	Lump Sum	879,000
Rigolets Barrier Extension Levees	1	Job	Lump Sum	185,000
Subtotal: LANDS AND DAMAGES				1,704,000
Acquisition Costs				38,000
Total: LANDS AND DAMAGES				1,742,000
Summary:				
MAJOR STRUCTURES AND CHANNELS				289,570,000
LEVEES AND FLOODWALLS				33,483,000
RELOCATIONS				211,000
LANDS AND DAMAGES				1,742,000
TOTAL:				325,006,000

* From PB-3 effective 1 Oct 81.
1/ Used PB-3 estimate, effective 1 Oct 81.

APPENDIX B

ECONOMIC ANALYSIS

APPENDIX B

ECONOMIC ANALYSIS

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INTRODUCTION

B.1. This appendix presents detailed information about the economic aspects of the plans addressed in the Main Report: the Barrier Plan providing Standard Project Hurricane (SPH) protection, the High Level Plan providing SPH protection, and the High Level Plan providing 100-year protection. Detailed descriptions of these plans are contained in the Main Report.

B.2. The information contained herein relates to the costs and benefits attributable to those plans that are quantifiable in monetary terms, and includes a discussion of the methodology used, a detailed cost analysis, and a benefit evaluation.

METHODOLOGY

B.3. The economic justification of the plans given detailed consideration is determined by comparing estimates of the average annual costs and average annual benefits which are expected to accrue over the life of the project. Participation in a project by the Federal Government normally requires that average annual benefits equal or exceed average annual costs.

B.4. The values estimated for benefits and costs at the time of accrual are made comparable by conversion to an equivalent time basis using a designated interest rate. The interest rate used in this analysis, 3 1/8 percent, is the rate which was in effect when construction funds for the project were first appropriated. The period of analysis, or project life, which was utilized in the analysis was 100 years. At the present time, the interest rate applicable to water resources is 7 7/8 percent, and economic data based on that interest rate are contained in the Discussion and Conclusions section of this appendix.

B.5. The benefits and costs are expressed as the average annual value of the present worth of all expenditures and all plan outputs. These expenditures and outputs are measured at a specific point in time which is referred to as the base year. The base year is the point in time when significant plan costs would be expended and significant benefits achieved. For this analysis, significant completion was the point in time when a 100-year level of protection would be achieved, which would be 1993 for the Barrier Plan and 1988 for the High Level Plan. For comparison purposes, the costs and benefits for the two plans are adjusted to a common point in time (i.e., 1988).

B.6. Because extensive property damage and potential loss of life would result from overlapping protective works surrounding such a densely populated area, the SPH was the lowest level of protection considered as adequate. For comparison purposes, however, benefits and costs were calculated for a High Level Plan which would provide protection from a 100-year storm. The barrier features of the Barrier Plan did not lend themselves to scaling down to provide a 100-year level, so no such analysis was conducted.

B.7. The costs and benefits attributable to the project were developed using applicable criteria and guidelines for project evaluation. Because of the nature of the project analysis, construction of some features was ongoing during the evaluation. It was therefore necessary to consider construction activities as frozen at some point in time. For purpose of economic analysis, the costs-to-complete reflect the construction necessary to complete the project after 1 October 1979. Both costs and benefits reflect the price levels in effect on 1 October 1981 unless other noted, and represent fair market value terms.

B.8. Another consideration in the economic analysis is maximizing net tangible benefits. This is an economic concept which has as its purpose sizing a project (or investment) to the point where the difference between benefits and costs is the greatest. This is the point where the last increment in project size has an incremental cost equal to the incremental benefit, and further increases in project size are not economically justified. It should be noted that maximization does not reflect intangible values.

B.9. An economic analysis of this nature can be sensitive to changes in interest rates, changes in estimates of costs and benefits, and various other factors. Where appropriate, the assumptions which formed the basis for the economic analysis were varied within a reasonable range to assess the sensitivity of the analysis.

COST ANALYSIS

FIRST COST

B.10. During the study, various levee/floodwall alinements, heights and methods of construction were considered to determine the particular combination most suitable for each study reach. Detailed cost estimates for each of these are contained in Appendix A, Engineering Investigations. These costs reflect the amount of work remaining after 1 October 1979 which would be necessary to complete each feature. This constraint was necessary because of the ongoing construction activities which made it necessary to "freeze" those activities at some point in time.

B.11. Unit costs were based on similar work performed in the New Orleans District, US Army Corps of Engineers, adjusted to October 1981 price levels. A contingency factor of 25 percent was added to the costs to account for the fact that the engineering estimates are completed to planning requirements, and not to the detail required for engineering design level. As the construction period for all plans is several years, it was necessary to express the costs as a gross investment cost at a base year. Expenditures occurring before the base year were compounded; those occurring after the base year were discounted back to the base year.

B.12. Summaries of costs for the three plans considered in detail are contained in Tables B-1, B-2, and B-3. Table B-1 shows cost for the Barrier Plan with SPH level of protection; Table B-2, High Level Plan with SPH level of protection; and Table B-3, High Level Plan with 100-year level of protection.

TABLE B-1

SUMMARY OF COSTS TO COMPLETE THE BARRIER PLAN[1/]
SPH LEVEL OF PROTECTION

FEATURE	FIRST COST ($1,000's)
CHALMETTE AREA PLAN	65,925
CITRUS-NEW ORLEANS	
Citrus Back Levee	5,050
New Orleans East Back Levee	17,087
South Point to GIWW Levee	585
New Orleans East Lakefront Levee	12,185
Citrus Lakefront Levee	8,571
IHNC East Bank Levee	3,423
WEST NEW ORLEANS AREA	
IHNC West Bank Levee	33,324
New Orleans Lakefront Levee[2/]	188,150
EAST BANK OF JEFFERSON PARISH AREA	
Jefferson Parish Lakefront Levee	8,871
Jefferson-St. Charles Parish Boundary Levee	9,248
EAST BANK OF ST. CHARLES PARISH AREA	
North of Airline Highway	37,498
MANDEVILLE SEAWALL	2,378
BARRIER COMPLEXES	
Seabrook (50 percent of First Costs)	45,725
Chef Menteur Pass	109,301
The Rigolets	195,501
TOTAL EXPENDITURES	742,822
GROSS INVESTMENT COST - BASE YEAR 1993 [3/]	874,238

[1/] Costs to complete from 1 October 1979; October 1981 price levels.

[2/] Includes $124,000,000 for solution to outfall canals problems.

[3/] Present worth of all expenditures expressed at the base year.

TABLE B-2

SUMMARY OF COSTS TO COMPLETE THE HIGH LEVEL PLAN[1/]
SPH LEVEL OF PROTECTION

FEATURE	FIRST COST ($1,000's)
CHALMETTE AREA PLAN	65,925
CITRUS-NEW ORLEANS	
Citrus Back Levee	5,050
New Orleans East Back Levee	17,087
South Point to GIWW Levee	5,182
New Orleans East Lakefront Levee	34,843
Citrus Lakefront Levee	46,854
IHNC East Bank Levee	3,423
WEST NEW ORLEANS AREA	
IHNC West Bank Levee	33,324
New Orleans Lakefront Levee[2/]	215,813
EAST BANK OF JEFFERSON PARISH AREA	
Jefferson Parish Lakefront Levee	123,173
Jefferson-St. Charles Parish Boundary Levee	18,941
EAST BANK OF ST. CHARLES PARISH AREA	
North of Airline Highway	55,721
MANDEVILLE SEAWALL	2,378
TOTAL EXPENDITURE	627,714
GROSS INVESTMENT - BASE YEAR 1993[3/]	653,958

[1/]Costs to complete from 1 October 1979; October 1981 price levels.

[2/]Includes $124,000,000 for solution to outfall canals problems.

[3/]Present worth of all expenditures expressed at the base year.

TABLE B-3

SUMMARY OF COSTS TO COMPLETE THE HIGH LEVEL PLAN[1/]
100-YEAR LEVEL OF PROTECTION

FEATURE	FIRST COST ($1,000's)
CHALMETTE AREA PLAN	48,044
CITRUS-NEW ORLEANS	
Citrus Back Levee	3,711
New Orleans East Back Levee	13,505
South Point to GIWW Levee	585
New Orleans East Lakefront Levee	24,649
Citrus Lakefront Levee	30,382
IHNC East Bank Levee	3,164
WEST NEW ORLEANS AREA	
IHNC West Bank Levee	30,802
New Orleans Lakefront Levee[2/]	207,334
EAST BANK OF JEFFERSON PARISH AREA	
Jefferson Parish Lakefront Levee	81,027
Jefferson-St. Charles Parish Boundary Levee	14,095
EAST BANK OF ST. CHARLES PARISH AREA	
North of Airline Highway	46,609
MANDEVILLE SEAWALL	2,378
TOTAL EXPENDITURE	506,285
GROSS INVESTMENT COST - BASE YEAR 1988[3/]	540,283

1/ Costs to complete from 1 October 1979; October 1981 price levels.

2/ Includes $124,000,000 for solution to outfall canals problems.

3/ Present worth of all expenditures expressed at the base year.

ANNUAL COST

B.13. To provide a basis for comparison with benefits, the costs to complete are expressed as an average annual value of the present worth of the expenditures measured at a base year (1993 for the Barrier Plan, 1988 for the High Level Plans). These annual costs were based on an interest rate of 3 1/8 percent and an economic project life of 100 years, and include interest and amortization of the initial investment, average annual maintenance and operation costs, annualized cost of replacement of operating equipment, fish and wildlife losses, and recreation losses. A summary of average annual charges for the Barrier Plan is contained in Table B-4. Similar information for the High Level Plan, at two levels of protection, is presented in Table B-5. Annual charges based on an interest rate of 7 7/8 percent also were calculated, and are shown in Tables B-6 and B-7.

TABLE B-4

SUMMARY OF AVERAGE ANNUAL CHARGES
BARRIER PLAN, 1993 BASE YEAR, 3 1/8 PERCENT[1/]
(in $1,000's)

ITEM	100-YEAR PROTECTION	SPH
Total Expenditure	N/A	$742,822
Value of Gross Investment at Base Year	N/A	874,238
Annual Charges		
Interest and Amortization	N/A	28,640
Operation, Maintenance, and Replacement	N/A	1,764
Fish and Wildlife Losses	N/A	75
Recreation Losses	N/A	0
TOTAL AVERAGE ANNUAL CHARGES		30,479

[1/] October 1981 Price Levels.

TABLE B-5

SUMMARY OF AVERAGE ANNUAL CHARGES
HIGH LEVEL PLAN, 1988 BASE YEAR, 3 1/8 PERCENT[1/]
(in $1,000's)

ITEM	100-YEAR PROTECTION	SPH
Total Expenditure	506,902	627,714
Value of Gross Investment at Base Year	540,285	653,958
Annual Charges		
Interest and Amortization	17,700	21,423
Operation, Maintenance, and Replacement	886	964
Fish and Wildlife Losses	6	6
Recreation Losses	376	376
TOTAL AVERAGE ANNUAL CHARGES	18,968	22,769

[1/] October 1981 Price Levels.

TABLE B-6

SUMMARY OF AVERAGE ANNUAL CHARGES
BARRIER PLAN, 1993 BASE YEAR, 7 7/8 PERCENT[1/]
(in $1,000's)

ITEM	SPH
Total Expenditure	742,822
Value of Gross Investment at Base Year	1,125,614
Annual Charges	
Interest and Amortization	88,687
Operation, Maintenance, and Replacement	1,780
Fish and Wildlife Losses	75
Recreation Losses	0
TOTAL AVERAGE ANNUAL CHARGES	90,542

[1/] October 1981 Price Levels.

TABLE B-7

SUMMARY OF AVERAGE ANNUAL CHARGES
HIGH LEVEL PLAN, 1988 BASE YEAR, 7 7/8 PERCENT[1/]
(in $1,000's)

ITEM	100-YEAR PROTECTION	SPH
Total Expenditure	506,902	627,714
Value of Gross Investment at Base Year	596,364	702,252
Annual Charges		
Interest and Amortization	46,988	55,330
Operation, Maintenance, and Replacement	916	948
Fish and Wildlife Losses	6	6
Recreation Losses	376	376
TOTAL AVERAGE ANNUAL CHARGES	48,286	56,660

[1/] October 1981 Price Levels.

BENEFIT ANALYSIS

INTRODUCTION

B.14. The primary purpose of the analysis which follows is the evaluation of benefits attributable to the National Economic Development (NED) account which are associated with the basic hurricane protection alternatives. NED benefits for each alternative were calculated under several levels of protection: pre-project (protection as of 1958); existing (protection as of 1979); Barrier Plan levees without the barrier structures, 100-year, and SPH (either the Barrier Plan or the High Level Plan). All benefit and cost estimates are in compliance with US Water Resources Council guidelines and are expressed in 1981 dollars. Discount calculations are based on the authorized project interest rate of 3 1/8 percent.

STUDY AREA DESCRIPTION

B.15. DELINEATION OF SEPARABLE PROJECT AREAS. For the purpose of the economic analysis, the Lake Pontchartrain Hurricane Protection Plan (LPHPP) study area was divided into six Separable Project Areas (SPAs): New Orleans, Jefferson, New Orleans East, Chalmette, St. Charles, and North Shore. These subdivisions, which generally coincide with parish boundaries, are delineated on Figure B-1.

B.16. The portions of Jefferson, St. Bernard, and St. Charles Parishes located to the east of the Mississippi River are contained in the SPAs of Jefferson, Chalmette, and St. Charles, respectively. The New Orleans SPA includes the area east of the Mississippi River from the Orleans-Jefferson Parish line to the Inner Harbor Navigation Canal (IHNC). New Orleans East includes that portion of Orleans Parish to the east of the IHNC. St. Tammany Parish is contained in the North Shore SPA.

B.17. POPULATION. Population from 1950 to 1980 for the parishes which are affected by the LPHPP is shown in Table B-8 with projected 1990-2030 population contained in Table B-9. These projections are based on the 1980 US Office of Business Economics - Economic Research Service, Bureaus of Economic Analysis (OBERS - BEA) Regional Projections, "no change in share"[1/] scenario for the New Orleans Standard Metropolitan Statistical Area (SMSA), plus University of New Orleans 1982 projections [2/] for St. Charles Parish, which is not contained in the SMSA. Using these data as control totals, further disaggregation by parishes was based on panel discussion methods

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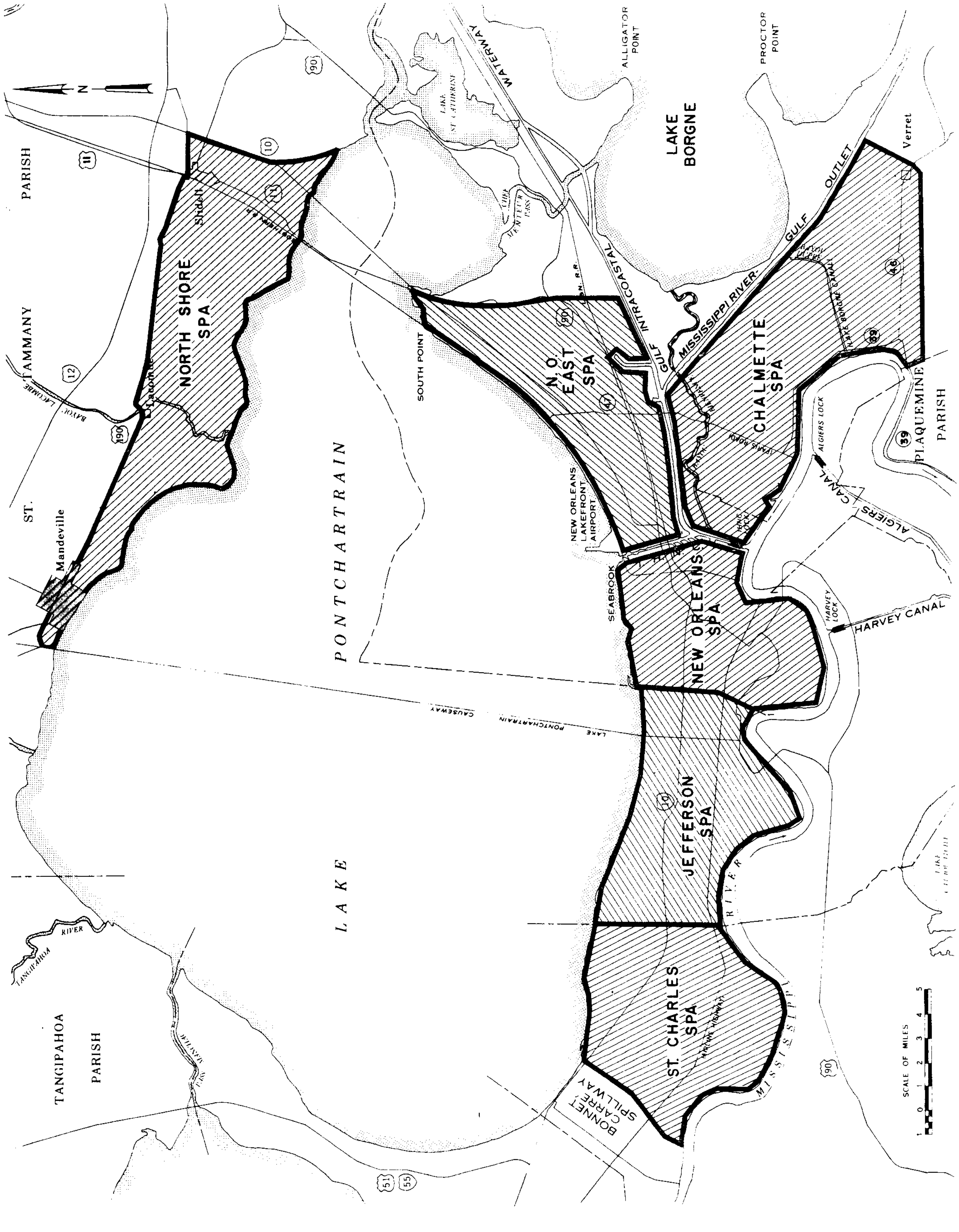
1/ The "no change in share" scenario assumes that the New Orleans SMSA will maintain its existing share of the state population.

2/ Interim Population Projections to 2000 for Louisiana. Joint publication of the University of New Orleans and Louisiana State University.



ECONOMIC SEPARABLE PROJECT AREAS (SPA)

FIGURE B-1

TABLE B-8

HISTORICAL POPULATION BY PARISH (1950 - 1980)1/

Year	St. Charles Parish	Jefferson Parish	Orleans Parish	St. Bernard Parish	St. Tammany Parish	Total
1950	13,400	103,900	570,500	11,100	27,000	725,900
1960	21,200	208,800	627,500	32,200	38,600	928,300
1970	29,600	338,300	593,500	51,200	63,600	1,076,200
1980	37,300	454,600	557,500	64,100	110,600	1,224,000

1/Census of Population

TABLE B-9

PROJECTED POPULATION BY PARISH (1990 - 2030)

Year	St. Charles Parish1/	Jefferson Parish2/	Orleans Parish2/	St. Bernard Parish2/	St. Tammany Parish2/	Total
1990	46,000	511,000	587,000	82,000	148,000	1,374,000
2000	54,000	557,000	598,000	98,000	191,000	1,498,000
2010	65,000	600,000	600,000	112,000	223,000	1,600,000
2020	77,000	638,000	607,000	132,000	253,000	1,707,000
2030	92,000	680,000	610,000	140,000	290,000	1,812,000

1/US Army Corps of Engineers, based on University of New Orleans Projections, 1982)

2/US Army Corps of Engineers, based on 1980 OBERS BEA Regional Projections "no change in share."

involving knowledgeable study area economists of the New Orleans District. This approach was considered adequate for the purposes of analysis, since plan justification and selection are insensitive to projections of population growth.

B.18. About 815,000 persons reside within the overflow limits of the SPH storm, including about 30,000 of who live on the north shore of Lake Pontchartrain, and are served only by the Barrier Plan alternative.

B.19. EMPLOYMENT. Historical employment data from 1950 to 1980 for the parishes affected by the LPHPP are displayed in Table B-10. Table B-11 shows industrial and commercial employment by parish. (Employment is shown by place of work.)

B.20. Table B-11 displays industrial and commercial employment by parish, by place of work.

B.21. MANUFACTURERS. Manufacturing establishments in the New Orleans SMSA in 1977 totalled 1,031, employing 46,800 with a payroll of $645.8 million. Value added by manufacture was $1,577.4 million. Table B-12 displays statistics of manufacturing concerns in the SMSA.

B.22. RETAIL TRADE. During 1977, the New Orleans SMSA supported a retail trade of 8,278 establishments with sales of $3,926 million. Of the total, 5,895 were retail establishments with payrolls. Those payrolls totalled about $500 million against sales of $3,800 million. Table B-13 gives applicable statistics of retail establishments for the New Orleans SMSA.

B.23. WHOLESALE TRADE. In 1977, the number of wholesale establishments in the New Orleans SMSA totalled 226, with sales of $8,987 million and a payroll of $397 million. Of the total number of establishments, 1,687 were merchant wholesalers, 341 were manufacturers' sales branches and offices, and 198 were agents, brokers,

TABLE B-10

TOTAL EMPLOYMENT BY PARISH (1950 - 1980)

Year	St. Charles Parish	Jefferson Parish	Orleans Parish	St. Bernard Parish	St. Tammany Parish	Total
1950	4,000	37,600	233,000	3,600	8,000	286,400
1960	6,200	72,000	239,700	10,200	12,300	340,400
1970	9,400	97,400	325,000	11,600	15,100	458,500
1980	18,600	161,700	361,200	15,900	23,700	581,100

Source: Data Resources, Inc.

TABLE B-11

COMMERCIAL AND INDUSTRIAL EMPLOYMENT BY PARISH (1950 - 1980)

Year	St. Charles		Jefferson		Orleans		St. Bernard		St. Tammany		Total	
	Industrial	Commercial	Industrial	Commercial	Industrial	Commercial	Industrial	Commercial	Industrial	Commercial	Industrial	Commercial
1950	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1960	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1970	4,100	3,200	32,500	42,700	52,900	200,800	4,900	3,400	2,800	6,000	97,200	256,100
1980	10,500	5,000	36,300	92,300	55,300	227,400	6,500	5,500	4,100	11,200	112,700	341,400

NA = Not Available

Source: Data Resources, Inc.

TABLE B-12

MANUFACTURING STATISTICS BY INDUSTRY (1977)
NEW ORLEANS SMSA

SIC Code	Industry	Number of Establishments	Number of Employees	Payroll (millions) ($)	Value Added (millions) ($)
20	Food and Kindred Products	149	7,500	87.1	255.3
23	Apparel and Other Textile Products	59	3.600	28.8	46.2
25	Furniture and Fixtures	28	300	3.1	7.3
26	Paper and Allied Products	21	1,800	21.8	39.3
27	Printing and Publishing	204	2,900	35.3	82.7
28	Chemicals and Allied Products	52	1,100	18.3	157.6
29	Petroleum and Coal Products	13	1,300	25.2	174.5
32	Stone, Clay and Glass Products	64	3,500	47.0	126.7
34	Fabricated Metal Products	96	2,600	37.2	74.0
35	Machinery Except Electrical	77	2,000	27.4	65.5
36	Electric and Electronic Equipment	23	300	4.7	7.7
37	Transportation Equipment	77	13,900	219.9	347.5
38	Instruments and Related Products	12	300	2.8	4.1
39	Miscellaneous Manufacturing Industry	55	700	7.7	15.7

Source: US Department of Commerce, Bureau of the Census, 1977 Census of Manufactures, Louisiana, October 1980.

TABLE B-13

STATISTICS BY KIND OF BUSINESS
RETAIL TRADE FOR THE NEW ORLEANS SMSA (1977)

SIC Code	Kind of Business	Total Number of Establishments	Total sales ($1,000's)	Number with Payroll	Sales ($1,000's)	Payroll ($1,000's)
52	Building Materials, Hardware, Garden Supply, Mobile Home Dealers	333	126,713	238	122,419	15,992
53	Merchandise group stores	166	543,659	145	542,596	87,647
54	Food Stores	1,193	994,130	822	971,983	85,813
55	Automotive Dealers	515	721,302	370	713,019	67,530
554	Gasoline Service Stations	585	266,532	517	260,088	18,332
56	Apparel and Accessory Stores	721	250,925	626	247,695	36,239
57	Furniture, Home Furnishing and Equipment Stores	545	190,486	380	183,377	24,755
58	Eating and Drinking Places	2,105	406,235	1595	388,307	96,020
59	Miscellaneous Retail Stores	1,913	296,865	1008	270,731	42,675
591	Drug and Proprietary Stores	202	129,612	194	128,657	17,453

Source: US Department of Commerce, Bureau of the Census, 1977 Census of Retail Trade, Louisiana, August 1979.

and commission merchants. Sales (in millions) in these categories were $4,538, $3,853, and $597, respectively.

B.24. Durable goods wholesalers accounted for 1,462 establishments or approximately 66 percent of the total, $4,728 million in sales, and payrolls of $268 million. Nondurable goods wholesalers numbered 764 establishments, with $4,260 million in sales, and payrolls of $129 million.

B.25. SERVICE INDUSTRIES. The total number of service industries in the New Orleans SMSA during 1977 was 9,013 with receipts of $1,271 million. Service establishments with payroll numbered 4,121, with receipts of $1,190 million and payrolls equaling $389.8 million. Statistics for selected service industries in the New Orleans SMSA are shown in Table B-14.

NED BENEFITS CONSIDERED

B.26. GENERAL. The US Water Resources Council guidelines mandate the benefit standards under which the Corps of Engineers must measure monetary project effects. These guidelines recognize three primary categories of benefits for urban flood control plans: inundation reduction (reduced damages to existing and projected structures and contents); intensification (changes to gross outputs of protected features attributable to the added investment encouraged by project provided protection); and location benefits, which consist of net savings accruing to operations or businesses in the protected area which, without protection, would have been located elsewhere. Primarily due to the lack of nearby land with appreciably lesser hurricane flood risks, the development pattern of the New Orleans metropolitan area suggests little evidence that significant levels of benefits exist which would qualify as either intensification or location benefits. Therefore, of the three primary categories of NED benefits, only inundation reduction benefits have been estimated in this analysis. A minor beneficial output also was considered,

TABLE B-14

SERVICE INDUSTRY STATISTICS
NEW ORLEANS SMSA (1977)

SIC Code	Kind of Business	Total Number of Establishments	Total sales ($1,000's)	Number with Payroll	Sales ($1,000's)	Payroll ($1,000's)
701.3	Hotel, Motel, Trailering Parks and Camps	205	205,618	159	204,018	61,581
72	Personal Services	2323	91,380	780	76,765	28,004
73	Business Services	1956	348,825	905	329,319	127,350
75	Automotive Repair Services and Garages	963	117,878	596	110,266	25,958
76	Miscellaneous Repair Services	820	96,378	397	90,377	29,990
78, 79	Amusement and Recreation Services[1/]	764	133,276	304	125,603	29,791
807	Dental Laboratories	34	4,949	25	4,718	2,235
81	Legal Services	1417	168,689	708	149,655	38,199
891	Engineering, Architectural	533	103,807	247	98,581	46,692

[1/] Includes motion pictures

Source: US Department of Commerce, Bureau of the Census, 1977 Census of Service Industries, Louisiana, January 1980.

reduction in Flood Insurance Administration (FIA) claims processing costs.

B.27. INUNDATION REDUCTION BENEFITS. Hurricane flood damages considered under this category were confined to physical damages, income losses, and emergency costs. Average annual benefits derived from the prevention of flood damages were computed by determining the difference between annual losses without the project and the losses remaining after construction of the various proposed improvements. This benefit applies to those activities whose location decisions are unaffected by any proposed plan, i.e., those which would use the flood plain without a protection project. To the extent that land use is the same with or without a project, benefits accrue primarily through the reduction in actual or potential damages associated with existing and future land use characteristics.

B.28. While some level of income loss due to a loss of wages or net profits to business over and above physical flood damages would result from a disruption of normal activities, prevention of income loss is creditable as a benefit only to the extent that such a loss cannot be compensated for by postponement of an activity or transfer of the activity to other establishments. No benefits were computed for this type of flood loss.

B.29. There are four main categories of existing land use in the study area: residential, commercial, industrial, and public. Residential property includes single-family and multi-family residences which are owned by the residents individually or cooperatively, by corporations, by government agencies, or by landlords. As shown in Table B-15, there are nearly 168,000 residences (with a total value of over $5.0 billion) that would receive benefits from hurricane protection.

TABLE B-15

SUMMARY OF STRUCTURES BY SEPARABLE PROJECT AREA

SPA	RESIDENTIAL	NONRESIDENTIAL
New Orleans	64,655	8,531
New Orleans East	14,032	702
Chalmette	14,798	598
Jefferson	64,800	3,829
St. Charles	2,647	20
North Shore	7,041	420
Total	167,973	14,100

B.30. Commerical property includes those used in retail, wholesale, and distribution operations, warehousing, office and professional buildings, etc. There are approximately 11,300 commercial establishments in the study area, with a total value of approximately $4.0 billion. There are over 1,100 structures classified as industrial property, i.e., properties on which manufacturing output or industrial production is generated. Total value is estimated at $700 million. Public property includes civic centers, court houses, schools, park facilities, and others owned by the public jurisdiction. (Roads and public works facilities are also included in this category.) There were 1,700 buildings inventoried as public property, with a value estimated at 3.7 billion dollars.

B.31. OTHER BENEFITS. As stated previously, primary damages can be classified as physical damages, income losses, and emergency costs. However, when a protection project is completed, certain indirect benefits often result. These benefits are not connected directly with physical losses, but do contribute to the NED account. Benefits that were considered in this category are confined to potential reduction in FIA claims costs. They are discussed in paragraphs B.32 and B.33.

B.32. The net national cost of the flood insurance program is the cost of administration. Potential benefits would arise from a reduction in this administrative overhead, which consists of claims adjustment, agent commissions, and the cost of servicing the policies. The FIA in Washington, DC, lists these costs per policy as follows: claims adjustment, $2.79; commissions, $15.00; and servicing costs, $16.80, for a total of $34.59.

B.33. Table B-16 displays the number of policies in the study area and the value of these policies. The FIA for Region VI was contacted to determine how many of these policies would be eliminated with SPH protection in place. According to the FIA, the number of insurance policies would not be significantly lowered since the flood insurance program covers flood losses from other sources besides hurricanes. This was substantiated by home loan associations in the area which require all homes to have flood insurance in order to qualify for a loan. The reason given was that the heavy rains in the area present a substantial flood risk. Since it could not be demonstrated that insurance policies would be eliminated because of the LPHPP, no benefits were attributed to this benefit category; however, minor savings in claims adjustment cost would be achieved to the extent storm damages are prevented.

TABLE B-16

FLOOD INSURANCE POLICIES AND VALUES

AREA	NUMBER OF POLICIES	VALUE ($)
Orleans Parish	59,154	3,195,000,000
Jefferson Parish		
Unincorporated	58,079	3,412,000,000
Kenner	10,389	642,197,700
Harahan	1,873	128,483,000
St. Bernard Parish	13,549	618,901,000
St. Charles Parish	2,388	75,370,500
St. Tammany Parish		
Unincorporated	4,281	309,117,800
Slidell	2,551	93,715,000
Total	152,264	8,474,785,000
Louisiana State Total	219,288	10,959,000,000

BENEFIT COMPUTATION - INUNDATION REDUCTION

B.34. RESIDENTIAL AND NONRESIDENTIAL STRUCTURES. Average annual damages were evaluated based on pre-project conditions (1958), existing conditions (1979), and several with-project conditions. Except as otherwise noted, all development in the flood plain, as well as the value and flood damage characteristics related to that development, were obtained under contract with a consultant, CH2M Hill of Portland, Oregon. A full description of the work assigned to the contractor is contained in Exhibit B-1. Structure values for the St. Charles SPA were developed solely by New Orleans District personnel, since detailed reanalysis of that area was not anticipated at the time of the contract work. The methods used were similar to those employed by CH2M Hill for the other SPA's.

B.35. Survey of Structures. A field survey by Regional Planning Commission traffic zones was made to compile an inventory of all structures in the study area. The structures surveyed were assigned main floor elevations based on ground elevations taken from recently prepared contour maps. Data for these traffic zones were then grouped into reaches having similar hydrologic characteristics. The six SPA's were further aggregated from groups of reaches that geographically could be served by one levee system independently of others.

B.36. Residential Structures. This category was subdivided into single-story structures, two-story structures, or mobile homes. Residential inventories were based on house counts from 1:3000 aerial photographs dated March 1979, with 1-foot contour intervals. Houses were counted between the contour lines and assigned the average elevation, i.e., houses lying between 3.0 and 4.0 feet were assigned an elevation of 3.5 feet. First floor elevations then were established by adding a value between 1.5 feet and 4.0 feet to average ground elevations, based on reach-by-reach visual observations of floor heights above ground levels.

B.37. The total number of houses at each elevation was apportioned between one-story and two-story structures based on the one-story/two-story ratio determined by field sampling. This ratio was computed for each traffic zone.

B.38. As nearly all mobile homes within the study area are located in commercial trailer parks, an initial identification was developed from the telephone directory. These areas were verified using aerial mosaics to confirm 100 percent coverage. After the trailer parks were identified, each was contacted by telephone, whenever possible, to obtain the number of trailers in the park. For those parks where the contact refused to give the information or where no one could be reached, a field count of trailers was made. Each trailer park was located on contoured aerial photos to obtain its average ground elevation. Floor elevations were then obtained by adding 2.5 feet to the ground elevations.

B.39. Nonresidential Structures. A structure inventory was derived from the Establishment-Based Employment (EBE) data file purchased from the University of New Orleans. This file contains a list of businesses, by traffic zone, in the study area. Field teams surveyed these structures for pertinent characteristics (e.g., number of structures, number of stories, types of construction, and types of foundation). Extensive field examination indicated that several businesses along certain major thoroughfares were missing from the EBE files listing. These thoroughfares were noted by the field teams and the groups did additional survey work to include the missing businesses. After all field work was accomplished, the businesses were then classified by Standard Industrial Codes (SIC's). This grouped the businesses into similar categories, such as beauty shops, grocery stores, etc. These groups were then placed into 15 categories established by the CH2M Hill contract output (Table B-17).

B.40. For each traffic zone, an average ground elevation was established. This elevation was based on the estimated average at which most nonresidential structures were located. In the New Orleans SPA, 0.5 feet was added to average ground elevations to establish first floor elevations. Surveys indicated that 1.5 feet was the appropriate increase for floor height in all remaining SPA's.

B.41. Average Structure Value, Residential. The average structure values for single- and two-story residences were computed by reach, based on data obtained through Deedfax, a real estate transfers directory for the metropolitan New Orleans area. Deedfax contains actual sales information for housing in the New Orleans metropolitan area, including the value of the house and lot, rather than that of the structure alone. Average lot values obtained from the Central Appraisal Bureau, Inc., a local agency that provides appraisals to homesteads and savings and loans, were subtracted from the Deedfax

TABLE B-17

CATEGORIES OF NONRESIDENTIAL STRUCTURES

1.	Business Services
2.	Public Gathering Places, Communications, Transportation and Utilities.
3.	Cleaning, Maintenance, Grooming
4.	Contractor Operations
5.	Department Stores
6.	Eating and Drinking Establishments
7.	Service Stations
8.	Grocery Stores
9.	Specialty Food Stores
10.	Home and Auto Supplies, Appliances
11.	Medical Buildings
12.	Drug Stores
13.	Repair Services
14.	Ready-to-wear
15.	Manufacturing, Heavy Commercial

sales values to give average structural values, shown on Table B-18. For structures over two stories high, values were estimated on a unit value per square foot basis for the lower two floors only; damaging depths did not exceed these levels in any of the SPA's. Average structure value for mobile homes was estimated based on a value of $17.30 per square foot, obtained from the Residential Cost Handbook, Marshall and Swift, 1978, and an average living area of 720 square feet. The values of air conditioning, steps and landings, and storage buildings were added.

TABLE B-18

AVERAGE RESIDENTIAL STRUCTURE VALUE[1/]

Reach	Single-Story Average Structure Value	Two-Story Average Structure Value
	($)	($)
1	32,800	39,700
2	25,400	31,600
3	20,900	28,900
4	19,200	24,600
5	46,000	58,000
6	46,000	79,600
7	48,100	63,700
8	76,400	106,000
9	50,300	64,100
10	33,500	63,200
11	41,500	59,600
12	28,600	50,600
13	32,100	49,100
14-15	26,000	44,500
16	32,500	60,600
19	25,800	25,800
20-23	No residential	No residential
24	25,800	25,800
25	No residential	No residential
28	38,700	38,700
J-0 through J-8	46,800	81,100
C-1	29,800	No two-story
C-2	37,200	75,300
C-3	43,900	47,800
C-4	38,700	51,600
C-5	38,700	51,600

[1/]October 1981 Price Levels.

B.42. Average Structural Value, Nonresidential. Nonstructural structure values were determined by interviews with management personnel of all sample establishments, and the use of unit cost per square foot estimates developed by the New Orleans District Real Estate Division. The data were arranged into a usable format by category, then summed and a weighted average calculated. This resulted in the average structure values, by category, depicted in Table B-19.

TABLE B-19

AVERAGE NONRESIDENTIAL STRUCTURE VALUES[1/]

CATEGORY	AVERAGE STRUCTURE VALUE ($)
Business Services	325,000
Public Gathering Places, Communications, Transportation, Utilities	410,000
Cleaning, Maintenance, Grooming	70,000
Contractor Operations	265,000
Department Stores	575,000
Eating and Drinking Estab.	210,000
Service Stations	120,000
Grocery Stores	340,000
Food Stores (Specialty)	55,000
Home and Auto Supplies, Appliances	110,000
Medical Buildings (Hospitals Excluded)	95,000
Proprietary (Drug) Stores	330,000
Repair Services	90,000
Ready-to-wear	115,000
Manufacturing, Heavy Commercial	2,135,000

[1/] October 1981 Price Levels.

B.43. DEPTH-DAMAGE RELATIONSHIPS FOR STRUCTURES. Depth-damage relationships are estimates of damages that would occur to structures at different elevations of flooding. Depth-damage relationships for the study area were compiled by 1/2-foot increments of flooding to a depth of 15 feet over the ground floor elevation. Damages are expressed as a percentage of the pre-flood structure value.

B.44. Residential. CH2M Hill analyzed in detail the structural components of 15 residential structure types (a total of 125 structures) to determine the depth-damage relationships for various residential structures. These were classified into three structure types: single-story, two-story, and mobile homes. Raised cottages were treated as two-story residences. Table B-20 shows the depth relationships for saltwater damage, the type which would occur by overtopping of the levees during a hurricane.

B.45. Nonresidential. Nonresidential depth-damage relationships also were developed by CH2M Hill, based on construction cost data published by Marshall and Swift Publication Co. The extent of damage is further based on the professional, architectural, and engineering expertise of the contractor's staff. CH2M Hill analyzed the structural components of five building types. The resulting data were averaged to give the relationships shown in Table B-21. (Damage data for freshwater and saltwater are the same for these structures.)

B.46. CONTENTS AS A PERCENT OF STRUCTURE VALUE. The contractor surveyed 125 residential structures, making detailed room-by-room inventories of all contents. These contents were later valued by standardized procedures using the latest catalogues of several nationwide mail-order houses. Each item was valued at current prices, and then depreciated to reflect its present-day condition (allowing for age, wear, and tear). These depreciated contents values were related as a percent of the house structure value which was determined by means discussed in paragraph B.41 above. Overall percent values were obtained by a least squares fit of these data. The results are shown in Table B-22.

TABLE B-20

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - RESIDENTIAL STRUCTURES

	PERCENT DAMAGE TO STRUCTURE		
Depth of Flooding[1/] (Feet)	One-Story (%)	Two-Story (%)	Mobile Homes (%)
-1.0	0.0	0.0	0.0
-0.5	0.5	0.5	2.0
0.0	14.0	7.5	30.0
0.5	22.9	12.3	63.5
1.0	29.3	15.7	76.8
1.5	34.0	18.3	87.0
2.0	38.0	20.7	92.0
2.5	41.3	22.8	95.6
3.0	44.3	24.4	97.8
3.5	47.0	25.8	99.4
4.0	49.0	26.4	99.8
4.5	51.4	27.9	100.0
5.0	52.9	28.6	100.0
5.5	54.4	29.2	100.0
6.0	55.7	29.9	100.0
6.5	57.0	30.0	100.0
7.0	57.9	30.0	100.0
7.5	58.7	30.0	100.0
8.0	59.5	30.7	100.0
8.5	60.0	33.2	100.0
9.0	60.8	37.0	100.0
9.5	61.3	40.0	100.0
10.0	61.5	42.3	100.0
10.5	62.0	44.3	100.0
11.5	62.3	46.1	100.0
12.0	62.4	48.2	100.0
12.5	62.5	49.3	100.0
13.0	62.5	49.9	100.0
13.5	62.5	50.1	100.0
14.0	62.5	50.3	100.0
14.5	62.5	50.4	100.0
15.0	62.5	50.5	100.0

[1/] 0.0 Ft. = Ground floor elevation

TABLE B-21

DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL STRUCTURES

FRESHWATER AND SALTWATER

Depth of Flooding [1/] (Feet)	Percent Damage to Structures (%)
0.0	0.0
0.5	4.9
1.0	8.6
1.5	11.9
2.0	14.3
2.5	16.7
3.0	18.4
3.5	19.5
4.0	20.6
4.5	21.4
5.0	22.0
5.5	22.1
6.0	22.2
6.5	22.3
7.0	22.4
7.5	23.0
8.0	23.8
8.5	24.7
9.0	25.9
9.5	27.3
10.0	29.0
10.5	30.8
11.0	33.0
11.5	35.2
12.0	37.0
12.5	38.8
13.0	40.0
13.5	41.2
14.0	41.9
14.5	42.1
15.0	42.3

[1/] 0.0 = Ground Elevation

TABLE B-22

CONTENTS AS A PERCENT OF STRUCTURAL VALUE-RESIDENTIAL STRUCTURES

STRUCTURE VALUE RANGE ($)		CONTENTS-PERCENT OF STRUCTURE VALUE (%)	CONTENTS VALUE RANGE ($)	
less than	- 12,900	75	000	- 9,700
12,901	- 25,800	72	9,300	- 18,600
25,801	- 38,700	67	17,300	- 25,900
38,701	- 51,600	62	24,000	- 32,000
51,601	- 64,500	57	29,400	- 36,800
64,501	- 77,400	52	33,500	- 40,200
77,401	- 90,300	49	38,000	- 44,200
90,301	- 103,200	48	43,300	- 49,500
103,201	- 116,100	47	48,500	- 54,600
116,101	- 129,000	47	54,600	- 60,600
more than	- 129,000	47	more than	- 60,600

B.47. The contractor also provided the required information for nonresidential contents value expressed as a percentage of structural value. These data were based on interviews with management personnel of all sample structures, and included the value of all contents, i.e., machinery and equipment, furnishings, stock, goods in process, and finished goods. Table B-23 shows the results of these determinations.

TABLE B-23

CONTENTS AS A PERCENT OF STRUCTURAL VALUE - NONRESIDENTIAL STRUCTURES

CATEGORY	CONTENTS VALUE (Percent of Structural Value)
Business Services	109
Public Gathering Places	24
Cleaning, Maintenance, Grooming	209
Contractor Operations	97
Department Stores	205
Eating and Drinking Establishments	102
Gas Service Station	83
Grocery Stores	84
Food Stores (Specialty)	98
Home and Auto Supplies, Appliances	127
Medical Buildings	41
Proprietary (Drug) Stores	129
Repair Service	152
Ready-to-Wear	190
Miscellaneous	113

B.48. DEPTH-DAMAGE RELATIONSHIPS FOR CONTENTS. Depth-damage data for residential contents were obtained from the contractor, who provided the relationships based on 15 residential structural types. Information used in these determinations was essentially that compiled in the survey of 125 residences discussed in paragraph B-44 above. Each item of household contents was individually appraised for susceptibility to flood damage at varying levels of water over the floor. These were aggregated for single-story and two-story structures. Mobile homes are included with single-story residences due to lack of sufficient samples. CH2M Hill discovered in its research that the depth-damage relationship for residential contents is about the same for either freshwater or saltwater flooding. Table B-24 displays the results.

TABLE B-24

DEPTH-DAMAGE RELATIONSHIPS - RESIDENTIAL CONTENTS
(FRESHWATER AND SALTWATER)

DEPTH OF FLOODING (Feet)	PERCENT DAMAGE TO CONTENTS	
	One-Story Structures and Mobile Homes	Two-Story Structures
0.0	0.0	0.0
0.5	11.5	10.5
1.0	21.5	16.0
1.5	31.0	20.0
2.0	39.7	23.6
2.5	46.8	26.2
3.0	52.5	28.1
3.5	57.5	30.0
4.0	61.7	30.0
4.5	64.8	32.4
5.0	67.3	33.5
5.5	69.3	34.3
6.0	70.7	35.0
6.5	71.7	35.5
7.0	72.6	36.0
7.5	73.6	36.5
8.0	74.1	37.0
8.5	74.8	37.4
9.0	75.7	37.9
9.5	76.1	38.5
10.0	76.6	39.3
10.5	77.1	41.6
11.0	77.5	44.8
11.5	77.8	47.5
12.0	78.0	50.5
12.5	78.1	53.0
13.0	78.2	55.9
13.5	78.4	59.0
14.0	78.6	62.0
14.5	78.8	64.6
15.0	79.0	66.9

B.49. Depth-damage relationships for nonresidential contents were also obtained from the contractor. CH2M Hill analyzed estimated damage to the contents and inventories of 250 sample organizations. These data are aggregated by the means of weighted averages into the 15 nonresidential categories. The resultant saltwater depth-damage relationships are shown in Table B-25. (Saltwater damage to contents of nonresidential structures is different from freshwater damage.)

B.50. STAGE-FREQUENCY CURVES. Stage-frequency curves, which express the annual probability of various levels of flooding under each condition analyzed, were developed for each reach. They are further discussed and displayed in Appendix A to the Main Report.

B.51. DAMAGE COMPUTATIONS. Using the flood plain structure inventories, values, ground elevations, and depth-damage relationships previously described, together with tables of stage-probabilities obtained from stage-frequency curves for each reach, average annual damages for each structure type were computed by reach for all conditions analyzed. These data were then aggregated into SPA's. The computerized computational model which was used is briefly described in paragraphs B.52 and B.53.

B.52. The value of each structure type was grouped according to ground floor elevation, by 1/2-foot increments. Percent-contents value, stage-probability, and depth-damage data for structures and contents were entered into computer files. An internal file of cumulative damage to both structures and contents, by 1/2-foot increments, was then calculated, and integrated with the probability of occurence of each stage. The cumulative damage probabilities were displayed as an average annual value. Also displayed was the cumulative damage to structures and contents file.

TABLE B-25

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL CONTENTS

Depth of flooding over ground Floor (Feet)	Business Services (%)	Public Gathering Places, Communications, Transportation, Utilities (%)	Cleaning, Maintenance, Grooming (%)
0.0	0.0	0.0	0.0
0.5	14.0	4.0	32.0
1.0	26.0	7.8	48.0
1.5	35.0	10.7	58.0
2.0	42.0	13.2	65.7
2.5	47.0	15.2	70.6
3.0	51.0	17.0	74.0
3.5	54.3	18.9	77.0
4.0	57.5	20.0	78.3
4.5	60.0	21.5	80.0
5.0	62.2	22.9	81.0
5.5	63.8	24.0	82.0
6.0	64.5	25.0	83.0
6.5	65.7	26.0	83.7
7.0	66.5	27.0	84.0
7.5	67.0	28.0	84.4
8.0	67.5	29.2	85.0
8.5	67.7	30.1	85.5
9.0	67.8	31.0	86.0
9.5	67.9	32.0	86.1
10.0	68.0	32.7	86.2
10.5	68.0	33.5	86.4
11.0	68.1	34.0	86.5
11.5	68.2	34.5	86.5
12.0	68.4	34.9	86.6
12.5	68.6	35.5	86.7
13.0	69.0	35.8	86.8
13.5	69.2	35.9	86.9
14.0	69.4	36.0	87.0
14.5	69.6	36.2	87.0
15.0	69.9	36.4	87.0

TABLE B-25 (Continued)

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL CONTENTS

Depth of flooding over ground Floor (Feet)	Business Services (%)	Public Gathering Places, Communications, Transportation, Utilities (%)	Cleaning, Maintenance, Grooming (%)
0.0	0.0	0.0	0.0
0.5	15.3	2.0	4.0
1.0	24.0	9.0	16.0
1.5	31.0	15.0	26.9
2.0	36.0	20.0	35.0
2.5	40.0	25.0	42.0
3.0	44.0	29.0	48.0
3.5	48.0	33.1	53.0
4.0	52.0	37.3	57.0
4.5	56.0	40.5	61.0
5.0	60.0	43.5	64.0
5.5	63.0	46.0	66.0
6.0	66.0	48.7	68.0
6.5	69.0	51.0	70.0
7.0	71.0	53.0	71.5
7.5	73.5	55.0	72.9
8.0	75.5	57.0	74.0
8.5	76.5	59.0	74.8
9.0	78.0	60.8	75.8
9.5	79.5	62.3	76.1
10.0	80.0	63.8	76.8
10.5	81.0	65.0	77.5
11.0	82.0	66.1	78.0
11.5	82.5	67.5	78.3
12.0	83.0	68.3	78.8
12.5	83.5	69.7	79.4
13.0	84.0	70.6	79.6
13.5	84.5	71.5	79.8
14.0	85.0	72.1	80.0
14.5	85.4	73.0	80.0
15.0	85.8	73.9	80.0

TABLE B-25 (Continued)

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL CONTENTS

Depth of flooding over ground Floor (Feet)	Business Services (%)	Public Gathering Places, Communications, Transportation, Utilities (%)	Cleaning, Maintenance, Grooming (%)
0.0	0.0	0.0	0.0
0.5	11.0	30.0	13.0
1.0	17.2	40.0	28.0
1.5	23.0	47.0	36.7
2.0	30.0	52.0	43.7
2.5	35.0	56.8	50.0
3.0	41.5	60.3	55.0
3.5	47.0	64.0	58.4
4.0	52.0	67.0	61.4
4.5	57.0	70.0	64.4
5.0	62.0	72.5	66.7
5.5	66.2	74.8	69.2
6.0	71.0	76.8	70.8
6.5	74.5	78.0	72.3
7.0	78.0	79.5	73.7
7.5	81.9	80.7	75.0
8.0	85.6	81.8	76.0
8.5	88.0	82.3	77.0
9.0	91.0	83.3	78.0
9.5	93.4	84.0	78.7
10.0	95.3	84.5	79.4
10.5	96.5	85.3	80.0
11.0	97.8	85.7	80.5
11.5	98.0	86.0	81.3
12.0	98.1	86.1	81.7
12.5	98.2	86.1	82.0
13.0	99.0	86.2	82.1
13.5	99.3	86.2	82.2
14.0	99.4	86.3	82.3
14.5	99.4	86.4	82.3
15.0	99.4	86.5	82.3

TABLE B-25 (Continued)

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL CONTENTS

Depth of flooding over ground Floor (Feet)	Business Services (%)	Public Gathering Places, Communications, Transportation, Utilities (%)	Cleaning, Maintenance, Grooming (%)
0.0	0.0	0.0	0.0
0.5	35.0	43.8	11.0
1.0	42.3	48.0	18.0
1.5	48.0	50.5	26.6
2.0	54.3	52.2	34.5
2.5	60.4	54.0	43.0
3.0	65.5	56.0	51.0
3.5	70.9	57.6	60.0
4.0	75.0	58.9	68.4
4.5	78.6	60.2	77.0
5.0	81.3	61.7	85.0
5.5	83.0	62.5	93.1
6.0	84.3	63.7	97.2
6.5	85.5	64.5	99.0
7.0	86.2	65.4	99.0
7.5	87.0	66.2	99.1
8.0	87.9	67.0	99.3
8.5	88.3	67.8	99.5
9.0	88.9	68.1	99.7
9.5	89.4	69.3	99.8
10.0	89.8	70.0	99.9
10.5	89.9	70.8	99.9
11.0	90.9	71.4	100.0
11.5	90.0	71.8	100.0
12.0	90.1	72.1	100.0
12.5	90.2	72.5	100.0
13.0	90.3	72.8	100.0
13.5	90.4	73.0	100.0
14.0	90.5	73.1	100.0
14.5	90.6	73.2	100.0
15.0	90.7	73.3	100.0

TABLE B-25 (Continued)

SALTWATER DEPTH-DAMAGE RELATIONSHIPS - NONRESIDENTIAL CONTENTS

Depth of flooding over ground Floor (Feet)	Business Services (%)	Public Gathering Places, Communications, Transportation, Utilities (%)	Cleaning, Maintenance, Grooming (%)
0.0	0.0	0.0	0.0
0.5	23.0	16.0	18.2
1.0	32.0	33.3	28.3
1.5	39.0	46.0	36.1
2.0	46.0	57.1	42.8
2.5	56.3	65.0	47.9
3.0	65.3	72.0	52.7
3.5	74.0	77.5	57.2
4.0	81.0	82.0	60.8
4.5	86.7	85.0	64.3
5.0	91.4	87.7	67.3
5.5	94.8	90.1	69.5
6.0	97.3	92.0	71.5
6.5	99.0	93.6	73.2
7.0	99.9	94.8	74.5
7.5	100.0	96.0	75.5
8.0	100.0	97.1	76.9
8.5	100.0	98.2	77.4
9.0	100.0	98.3	78.2
9.5	100.0	98.9	79.0
10.0	100.0	99.6	79.4
10.5	100.0	100.0	79.9
11.0	100.0	100.0	80.4
11.5	100.0	100.0	80.7
12.0	100.0	100.0	81.0
12.5	100.0	100.0	81.3
13.0	100.0	100.0	81.6
13.5	100.0	100.0	81.8
14.0	100.0	100.0	82.1
14.5	100.0	100.0	82.2
15.0	100.0	100.0	82.3

B.53. The reach totals for each structure type were then summed by SPA's for all flood scenarios (pre-project, existing, etc.) and compared. The net reduction in damages under one condition as compared to any other condition represented the benefits to that level of protection.

B.54. DAMAGE PRESENTATION. Average annual damages to existing development for each hydrologic condition, structure type (residential and nonresidential), and plan, aggregated by SPA, are displayed in Table B-26.

B.55. DAMAGES TO FUTURE DEVELOPMENT. The damages previously calculated were based on structures existing at the time of the study. While development is substantially complete in most of the relevant areas of the flood plain, projection of damages which would occur to anticipated future development was performed for those SPA's in which significant future residential development is expected. These areas are Reaches 5 and 24 in the New Orleans East SPA, Reach J-1 in the Jefferson SPA, and Reaches C-3 and C-4 in the Chalmette SPA. While additional residential development is also expected in the St. Charles SPA, past development indicates that projection of types and value of that development would be highly speculative. Since damages prevented based on existing development are conclusive with regard to plan selection, no attempt was made to estimate future residential damages in St. Charles; however, projected damages to a specific business park in the St. Charles SPA were calculated.

B.56. Damages for future improvements were estimated using the following procedures. The undeveloped portion of the reach was identified from March 1979 aerial photos, and the upper limit of development was established based on the type and density of existing development in the reach. A damage rate per developed acre was calculated for existing development, assuming that such development had been in compliance with existing FIA floor elevation criteria (Table B-27). Using the population density and the projected growth

TABLE B-26

AVERAGE ANNUAL INUNDATION DAMAGES TO EXISTING RESIDENTIAL AND NON-RESIDENTIAL STRUCTURES[1/]
(in $1,000's)

SEPARABLE PROJECT AREA	RESIDENTIAL					NONRESIDENTIAL				
	No Barrier Structure		Barrier Plan	100-Year	SPH	No Barrier Structure		Barrier Plan	100-Year	SPH
	Pre-Project Condition	Existing Condition	Levees Only	Protection	Protection	Pre-project Condition	Existing Condition	Levees Only	Protection	Protection
New Orleans	18,854	6,319	2,817	1,024	62	35,128	6,334	2,056	718	81
New Orleans East	28,588	9,434	4,333	1,800	168	13,928	4,606	1,362	363	3
Jefferson	38,036	39,623	34,412	3,675	0	14,567	15,537	12,548	357	0
Chalmette	15,391	3,246	N/A	2/	0	5,789	1,097	N/A	2/	0
St. Charles	2,111	2,111	N/A	158	0	437	437	N/A	13	0
North Shore	4,176	4,176	N/A	N/A	661	1,358	1,358	N/A	N/A	0
Total	107,156	64,909	41,562	6,657	891	71,207	29,369	15,966	1,451	84

1/ October 1981 Price Levels.

2/ Analysis incomplete

TABLE B-27

FUTURE DAMAGE RATES

REACH	RESIDENTIAL DAMAGE RATE/ACRE Existing	100-Year	SPH
	($)	($)	($)
J-1 (Jefferson SPA)	1,760	79	0
5 (New Orleans East SPA)	2,010	392	0
24 (New Orleans East SPA)	288	0	0
C-3,4 (Chalmette SPA)	272	0	0

in population, the increased acreages developed over time were determined (Table B-28). Growth of damage at the calculated rate/acre was projected in accordance with the anticipated increase in developed area for the reach, and then discounted to present worth at the year 1988, the base year for the High Level Plan, and year 1993, the base for the Barrier Plan. The average annual damages to future structures are shown in Table B-29. As required under Water Resources Council guidelines, no projections were made for more than 50 years in the future.

B.57. It should be noted that the method described produces damages to future development from storms of greater than 100-year frequency. This stems from the differences (often large) between the FIA established 100-year storm elevations, and those reflected under the various conditions represented by the NOD stage-frequency curves. Ongoing development clearly is occuring under the FIA criteria, therefore, projection of damages to future development for storms more frequent than once in 100 years is an accurate reflection of future conditions.

TABLE B-28

PROJECTED ADDITIONAL ACREAGES DEVELOPED

REACH	YEAR								
	1980	1988	1990	1993	2000	2010	2020	2030	2080
J-1	0	200	250	300	450	700	900	1,100	1,100
5	0	500	550	750	1,100	1,600	2,200	2,700	2,700
24	0	600	650	900	1,300	1,900	2,600	3,200	3,200
C-3,4	0	550	600	850	1,200	1,800	2,400	2,950	2,950

B.58. REDUCTION IN EMERGENCY COSTS. Emergency costs considered were evacuation and re-occupation costs, flood fighting, disaster relief, increased costs of operations during a flood, and increased costs of police, fire, or military patrols. Emergency cost benefits attributed to the LPHPP are by definition the elimination or lowering of these costs. In telephone interviews with emergency planners, it was determined that emergency organizations would mobilize with or without the LPHPP in place due to the damage and injury threat posed by high winds, heavy rains and tornadoes that usually accompany a severe hurricane. For example, rescue missions would be conducted for people trapped in debris, fire departments would be needed to extinguish fires, street departments would be needed to keep roads clear, the Red Cross would set up and stock shelters, and police and National Guard would be used to direct evacuation and protection of property. While there may be a slight reduction in these and other types of emergency costs, the most significant reduction would be to costs associated with re-occupation of the study area after passage of a severe storm. The re-occupation benefit is an estimate of the amount of these relocation costs which can be eliminated with the project in place.

TABLE B-29

AVERAGE ANNUAL INUNDATION DAMAGES TO FUTURE STRUCTURES ($1,000)[1/]

SPA	CONDITION (Base Year 1988)			CONDITION (Base Year 1988)		
	Existing	100-Year Protection	SPH Protection	Existing	100-Year Protection	SPH Protection
New Orleans East[2/]	3,970.3	661.3	0	4,432.2	738.9	0
Jefferson[2/]	1,217.9	54.7	0	1,369.3	61.5	0
Chalmette[2/]	503.5	0	0	563.6	0	0
St. Charles[3/]	310.5	0	0	334	0	0

1/ October 1981 Price Levels.

2/ All residential.

3/ All nonresidential.

B.59. Large numbers of study area inhabitants would evacuate under the threat of a severe storm even with the project in place, returning as soon as possible thereafter, provided their homes were not badly damaged or flooded. This estimate of benefits accruing to project features which facilitate immediate re-occupation of area homes is based on the savings of additional expense incurred should levee failure and attendant flooding necessitate lengthy relocation of these persons. In the aggregate, these expenses are a function of the duration of flooding, i.e., how long the water stays in homes, and the size of the residential area flooded.

B.60. Benefits were calculated using New Orleans District computer program U32005. Although this program was originally designed to compute inundation damages based on flood probabilities and damageable flood plain contents, studies indicated that the program input data could be modified to compute emergency benefits. There are four basic inputs to this computer program.

1. Stage-probability tables.
2. Number and value of structures at specific elevations.
3. Contents value versus structure value relationships.
4. Percent damage versus depth of flooding relationships.

B.61. In place of number and value of structures by elevation, the number of residential acres at specific elevations multiplied by the maximum relocation cost per acre was entered. No contents versus structure value data were needed. The percent damage versus depth of flooding data were replaced with a developed relationship which captured the effects of duration of flooding, as described in paragraphs B.62 and B.67.

B.62. The number of acres flooded was determined from storage curves furnished by hydraulic engineering elements of the NOD. The storage curves were referenced to determine the total number of acres flooded at each 1/2-foot of elevation. Total acres of residential property data were obtained from the "1980 Planning Data Report" furnished by the Regional Planning Commission for the New Orleans metropolitan area. A homogeneous distribution of residential property in each reach was assumed, i.e., the acres of residential property flooded at 1/2-foot increments was the ratio of total residential acres to total acres.

B.63. The total cost per acre of relocation for a 1-month period was substituted for individual structure value. It was estimated that under pre-project conditions for the 100-year hurricane flood, about 2 weeks would be required to dry the area; for the SPH or 300-year event, about 3 weeks; and for the 500-year hurricane about 4 weeks. The minimum relocation was that related to 1/2-foot of flooding for 1 day. It was further assumed that no relocations would be required for hurricanes of less than the 10-year event. Next, a relocation cost per acre per day was calculated. This cost is dependent on how many people and dwellings occupy an acre of residential property, and the expenses that they would incur in being relocated for up to 1 month. Density of dwelling units was used since this information was readily available from Regional Planning Commission data. The total number of dwelling units in a reach was divided by the total number of residential acres in the reach to determine the density of dwelling units per acre.

B.64. The cost of relocation per acre was computed for 1 day (1/2-foot of flooding) and 30 days of relocation (12.5 feet of flooding). Costs for all other depths were assumed to fall on a straight line between these two points (Table 1, Column 3). The following is a list of assumptions, and an example of the calculations.

- o Department of Commerce census data show that single person households comprised 16.7 percent, and the remaining 83.3 percent dwelling units contained an average of 3.24 persons.

- A survey of the motels and hotels showed that the average daily motel rates for the metropolitan area were about $30.00 for a single room and $36.00 for a double occupancy room.

- Costs borne by persons relocating would initially equal the Federal Permanent Change of Stations rates; that is, $37.50 per day for a single person and $93.50 per day for the average family size of 3.24 persons.

- According to the American Red Cross and Civil Defense Officials: 1 percent of the population stay in shelters; 10 percent evacuate to motels; and 89 percent of the affected people either stay with friends or relatives. Red Cross estimates it would spend $14.29 per day for each household that would use its shelters.

B.65. Table B-30 is an example cost calculation for the Jefferson SPA for the first day of relocation.

TABLE B-30

EXAMPLE COST CALCULATION-FIRST DAY OF RELOCATION[1/]
(JEFFERSON PARISH SEPARABLE PROJECT AREA)

	Stay With Friends ($)	Stay In Motels ($)	Stay In Shelter ($)	Total Weighted Cost ($)
One-Person Households - Relocation Costs in Dollars Per Acre Assuming 9.5 Dwellings per Acre				
Shelter	-	290.23	-	-
Food	43.89	43.89	135.76	-
Total	43.89	334.12	135.76	-
Percent	89.0	10.0	1.0	-
Weighted Cost	39.06	33.41	1.36	73.83

One-person households comprise 16.7 percent of the population.

0.167 X $73.83 = $12.33 ($12.00) weighted average for one person households.

	Stay With Friends ($)	Stay In Motels ($)	Stay In Shelter ($)	Total Weighted Cost ($)
Family Households - Relocation Costs in Dollars Per Acre Assuming 9.5 Dwellings per Acre				
Shelter	-	342.29	-	-
Food	484.22	484.22	135.76	-
Total	484.22	826.51	135.76	-
Percent	89.0	10.0	1.0	-
Weighted Cost	430.95	82.65	1.36	514.96

Persons living in family units comprise 83.3% of the population.
0.83.3 X $514.96 = $429.00

Weighted average cost per acre = $12.00 + $429.00 = $441.00.
(Rounded) $500.00

[1/] October 1979 Price Levels.

B.66. Table B-31 shows the calculation for the 30th day of relocation; however, additional assumptions were necessary. It was assumed that by then, the high costs of relocation would have forced people to become much more conservative; therefore, the additional food costs were eliminated. Similarly, they also have been assumed to have found less expensive places to stay. Housing costs would have fallen to $300 a month for singles and $500 a month for families.

TABLE B-31

EXAMPLE COST CALCULATION-THIRTIETH DAY OF RELOCATION[1/]
(JEFFERSON PARISH SEPARABLE PROJECT AREA)

	Stay With Friends ($)	Stay In Motels ($)	Stay In Shelter ($)	Total Weighted Cost ($)
		One-Person Households		
Shelter	-	95.00		
Food	-	-	135.76	
Total	-	95.00	135.76	
Percent	-	10	1.0	
Weighted	-	9.50	1.36	10.86
16.7% X 10.86 = $1.81				
		Family Households		
Shelter	-	158.33		
Food	-	-	135.76	
Total	-	158.33	135.76	
Percent	-	10	1.0	
Weighted	-	15.83	1.36	17.19

0.83.3 X $17.19 = $14.32
Weighted average cost per acre = $1.81 + $14.32 = $16.13
(Rounded) $20.00

[1/]October 1979 Price Levels.

B.67. The weighted daily relocation costs per acre developed above were used to calculate a depth-damage relationship as shown on Table B-32. Column six expresses each cumulative period of relocation as a percent of the maximum 30-day relocation cost of $6,082. Using the referenced computer routine, the annualized results were as shown in Table B-33. These values are at 1981 price levels; all calculations shown for examples are at 1979 price levels. Benefits to each successive higher level of protection as compared to the pre-project condition are shown on Table B-34.

B.68. SUMMARY OF NED BENEFITS. A summary of all benefits (damages prevented) attributable to the Barrier Plan and the High Level Plan is presented on Tables B-35 and B-36. These benefits are expressed as the average annual value of the present worth of all plan outputs measured at a specific point in time. This point in time is referred to as the plan base year and in this study it was selected both with regard to that point at which significant plan costs would have been expended, and at which point significant benefits would be achieved (100-year protection). For the High Level Plan, 1988 was determined to be the proper base year; for the Barrier Plan 1993 was selected.

DISCUSSION

COMPARISON OF PLANS

B.69. As the base year for the Barrier Plan is different from that for the High Level Plan, further calculations were necessary to allow comparison of the benefits of the two plans at a common point in time. The 100-year benefit stream for the Barrier Plan begins in 1993. This stream of benefits was converted to a single present worth value at the year 1988 and the equivalent average annual value for the 1988-2088 time period was calculated in order to permit direct comparison with the High Level Plan. Table B-37 shows a comparison of annual average benefits for the two plans at the same base year, 1988. That table also depicts average annual benefits for both

TABLE B-32

DEPTH-EMERGENCY COSTS (RELOCATION) RELATIONSHIP[1/]
(JEFFERSON SEPARABLE PROJECT AREA)

Elevation	Duration (Days)		Cost/Day/acre	Incremental Cost	Cumulative Cost	Percent of Maximum
	Total	Increment	($)	($)	($)	
0	0.0	0.0	0	0	0	0
0.5	0.8	0.8	500	400	400	6.58
1.0	1.1	0.3	480	144	544	8.94
1.5	1.6	0.5	460	230	774	12.73
2.0	2.2	0.6	440	264	1,038	17.07
2.5	2.8	0.6	420	252	1,290	21.21
3.0	3.2	0.4	400	160	1,450	23.84
3.5	4.5	1.3	380	494	1,944	31.96
4.0	5.5	1.0	360	360	2,304	37.88
4.5	6.5	1.0	340	340	2,644	43.47
5.0	7.5	1.0	320	320	2,964	48.73
5.5	8.7	1.2	300	360	3,324	54.65
6.0	10.0	1.3	280	364	3,688	60.64
6.5	11.2	1.2	260	312	4,000	65.77
7.0	12.3	1.1	240	264	4,264	70.11
7.5	13.2	0.9	220	198	4,462	73.36
8.0	14.4	1.2	200	240	4,702	77.31
8.5	15.5	1.1	180	198	4,900	80.57
9.0	16.9	1.4	160	224	5,124	84.25
9.5	18.3	1.4	140	196	5,320	87.47
10.0	20.0	1.7	120	204	5,524	90.83
10.5	21.5	1.5	100	150	5,674	93.29
11.0	23.4	1.9	80	152	5,826	95.79
11.5	25.5	2.1	60	126	5,952	97.86
12.0	27.5	2.0	40	80	6,032	99.18
12.5	30.0	2.5	20	50	6,082	100.00

1/ October 1981 Price Levels.

TABLE B-33

AVERAGE ANNUAL RELOCATION COST[1/]
(in Dollars)

SPA	CONDITION				
	NO BARRIER STRUCTURE				
	Pre-Project	Existing	Barrier Levees	100-Year Protection	SPH Protection
New Orleans	1,444,000	602,000	322,000	192,000	129,000
New Orleans East	379,000	128,000	76,000	58,000	46,000
Jefferson	721,000	757,000	639,000	144,000	94,000
Chalmette	567,000	142,000	65,000	65,000	65,000
St. Charles	48,000	48,000	N/A	6,000	4,000
North Shore	72,000	72,000	N/A	9,000	6,000

[1/] October 1981 Price Levels.

TABLE B-34

AVERAGE ANNUAL BENEFITS FROM REDUCTION IN EMERGENCY COSTS[1/]
(Existing Condition as Base) (in Dollars)

SPA	CONDITION: NO BARRIER STRUCTURE Existing	CONDITION: NO BARRIER STRUCTURE Barrier Levees	100-Year Protection	SPH Protection
New Orleans	Base	280,000	410,000	473,000
New Orleans East	Base	52,000	70,000	82,000
Jefferson	Base	118,000	613,000	663,000
Chalmette	Base	77,000	77,000	77,000
St. Charles	Base	N/A	42,000	44,000
North Shore	Base	N/A	63,000[2/]	66,000[2/]
TOTAL		527,000	1,275,000	1,405,000

1/ October 1981 Price Levels.

2/ Reductions in this SPA would occur only under the Barrier Plan.

TABLE B-35

BARRIER PLAN-SUMMARY OF BENEFITS[1/]

	Annual National Economic Development Benefits from Existing Condition to Indicated Condition ($1,000's): 100-Year Protection[2/]	SPH Protection
Residential		
Existing development	58,252	64,018
Future development	5,565	6,365
Subtotal	63,817	70,383
Nonresidential		
Existing development	27,918	29,285
Future development	334	334
Subtotal	28,252	29,619
Emergency operations	1,275	1,405
Total:	93,344	101,407

1/ October 1981 Price Levels; Base Year 1993.

2/ Benefits for the 100-year level of protection are slightly understated in that damages prevented in portions of the Chalmette SPA have been analyzed for only existing conditions and the SPH protection condition. Maximum possible error is less than 5 percent of total benefits for the 100-year level of protection.

TABLE B-36

HIGH LEVEL PLAN-SUMMARY OF BENEFITS[1/]

	Annual National Economic Development Benefits from Existing Condition to Indicated Condition ($1,000's)	
	100-Year Protection[2/]	SPH Protection
Residential		
Existing development	54,076	60,503
Future development	4,976	5,692
Subtotal	59,052	66,195
Nonresidential		
Existing development	26,560	27,927
Future development	310	310
Subtotal	26,870	28,237
Emergency operations	1,212	1,339
Total:	87,134	95,771

1/ October 1981 Price Levels; Base Year 1988.

2/ Benefits for the 100-year level of protection are slightly understated in that damages prevented in portions of the Chalmette SPA have been analyzed for only existing conditions and the SPH protection condition. Maximum possible error is less than 5 percent of total benefits for the 100-year level of protection.

TABLE B-37

ANNUAL NATIONAL ECONOMIC DEVELOPMENT-BENEFITS AT BASE YEARS 1988 AND 1993[1/]

	Average Annual Benefits ($1,000)			
	1988		1993	
	100-Year[2/]	SPH	100-Year[2/]	SPH
High Level Plan	87,134	95,771	N/A	N/A
Barrier Plan	80,032	86,946	93,344	101,407

1/ Evaluation of the entire project cost and benefit time streams as if viewed from 1988 and 1993. October 1981 Price Levels. See paragraph B.69.

2/ Benefits for the 100-year level of protection are slightly understated in that damages prevented in portions of the Chalmette SPA have been analyzed for only existing conditions and the SPH protection condition. Maximum possible error is less than 5 percent of total benefits for the 100-year level of protection.

100-year and SPH levels of protection. Those data show that the highest average annual benefits ($95,771,000) accrue from the High Level Plan providing the SPH level of protection.

B.70. Using cost data from Tables B-4 and B-5 and benefit data from Table B-37, a comparison of annual benefits and annual charges, calculation of benefit-cost ratios, and a determination of net benefits are possible. These summary data are shown in Table B-38. A review of the information in that table shows that the High Level Plan provides the highest ratio of benefits to cost, 4.2 to 1, and the greatest amount of net benefits, $73,002,000.

TABLE B-38

PLAN COMPARISON (VALUES IN $1,000)1/

	High Level Plan	Barrier Plan	
	Base Year 1988	Base Year 1988	Base Year 1993
	($)	($)	($)
Annual Benefits	95,771	86,946	101,407
Annual Charges	22,769	26,357	30,479
Benefit-Cost Ratio	4.2:1	3.3:1	3.3:1
Net Benefits	73,002	60,589	70,928

1/All plans provide SPH level of protection. 1981 Price Levels.

MAXIMIZATION OF NET BENEFITS

B.71. Maximizing net tangible benefits is an economic concept which relates to a procedure for sizing a project, or investment, to the point where the greatest excess of benefits over costs occurs. That would be the point where the last increment in project size has an incremental cost equal to incremental benefits, and any further increase in project size would not be justified. As shown on

Figure B-2, the increase in annual benefits to the selected plan relative to added investment is extremely favorable to additional project increments up to the approximate SPH level of protection. This figure also demonstrates the relatively low level of residual losses once SPH protection is achieved.

SENSITIVITY ANALYSIS

B.72. GENERAL. Risk and uncertainty are implicit in many aspects of planning for water resources such as the LPHPP, even though every attempt is made to project the most probable future for each of the variables which must be considered. Guidance for evaluation of risk and uncertainty, and the sensitivity analyses to be conducted, is contained in the Procedures for Evaluation of National Economic Development Benefits and Costs in Water Resources Planning (Level C); Final Rule, published in the Federal Register dated December 14, 1979. Specific analyses are required for these specific items: break-even years, discount rates, and value per structure. While these specific items are addressed in this section, other areas where risk and uncertainty may exist also are discussed.

B.73. BREAK-EVEN YEARS. A review of the data contained in Tables B-36, B-37, and B-38 indicates average annual benefits to existing development exceeds annual charges in the first year of operation.

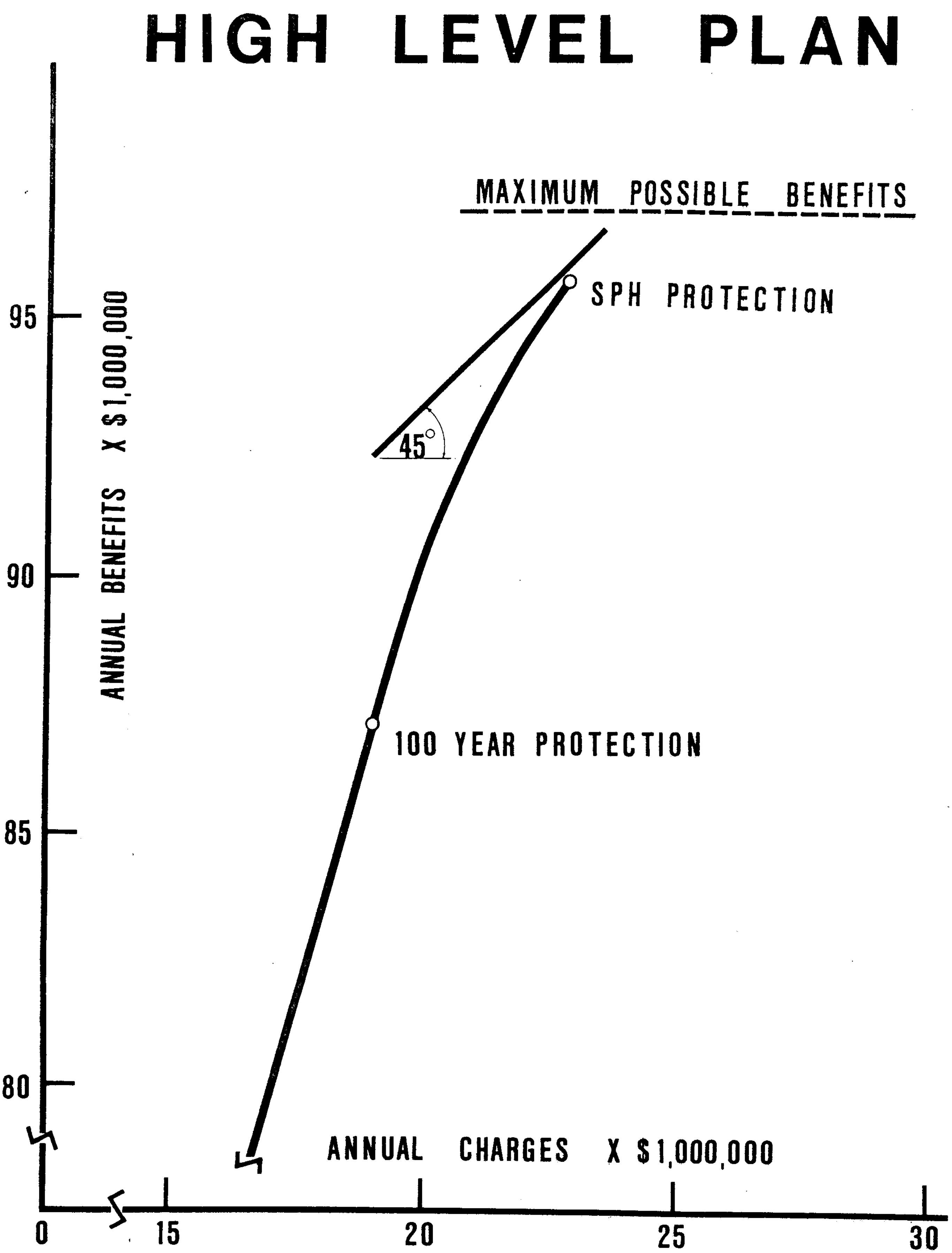
B.74. DISCOUNT RATE. When construction funds for this project were first appropriated, the interest rate in effect was 3 1/8 percent. Section 80 of the 1974 Water Resources Development Act allows the use of that discount rate for this project reevaluation; however, the same legislation also requires analysis of the project using the current Federal discount rate (7 7/8 percent). Table B-39 shows the estimated average annual charges and benefits using the 7 7/8 percent rate, and, for comparison, the same items using 3 1/8 percent.

TABLE B-39

PLAN COMPARISON AT 3 1/8 PERCENT AND 7 7/8 PERCENT INTEREST RATES[1/]
($1,000's)

ITEM	3 1/8 Percent			7 7/8 Percent		
	High Level Plan	Barrier Plan		High Level Plan	Barrier Plan	
	Base Year 1988	Base Year 1988	Base Year 1993	Base Year 1988	Base Year 1988	Base Year 1993
Annual Benefits	95,771	86,946	101,407	93,889	68,296	99,769
Annual Charges	22,769	26,132	30,479	56,660	61,979	90,542
Benefit-Cost Ratio	4.2 to 1	3.3 to 1	3.3 to 1	1.6 to 1	1.1 to 1	1.1 to 1
Excess Benefits	73,002	60,813	70,928	37,229	6,317	9,227

1/ October 1981 Price Levels.



HIGH LEVEL PLAN
MAXIMUM POSSIBLE BENEFITS
SPH PROTECTION
45°
100 YEAR PROTECTION
ANNUAL BENEFITS X $1,000,000
ANNUAL CHARGES X $1,000,000
95
90
85
80
0
15
20
25
30

FIGURE B-2

B.75. VALUE PER STRUCTURE. Projected future damages are related only to projected development and are not based on increases in the value of the structure.

B.76. POPULATION PROJECTIONS. Population projections were based on the most reliable and acceptable information available. No range of probable projected growth rates was utilized, as population projections and projected future damages do not affect the feasibility of the plans considered in detail. All such plans are economically justified based on existing population levels.

B.77. COST ESTIMATES. The cost estimates are based on unit costs of similar work performed in the New Orleans District, Corps of Engineers. To account for the fact that such estimates are planning level and not detailed estimates required for engineering design level plans, a contingency factor of 25 percent was added. This assists in insuring that costs are not undervalued. While this contingency factor could be decreased (or increased) to determine the sensitivity of the analyses to potential variations in unit costs, or estimated quantities, the value of the net benefits indicates that the feasibility of the plans would not be adversely affected by any reasonable variation in the contingency percentage. Additionally, variations in unit costs would affect all plans, and the relative difference in plans would remain approximately the same.

B.78. SIZE OF BARRIER DAMS. The Barrier Plan, as originally conceived, features barrier complexes at The Rigolets and Chef Menteur Pass which would provide 35 percent and 43 percent, respectively, of the natural opening. Subsequent investigations indicated that an increase in the size of these opening might be necessary to minimize adverse effects on the transport of biological, chemical, and physical constituents through these two tidal passes. The transport of such constituents is considered essential to the biological viability of Lake Pontchartrain. Accordingly, cost estimates have been prepared for barrier complexes which would provide 50 percent and 90 percent, respectively, of the natural openings at The Rigolets and Chef Menteur (Table B-40). (Increasing the size of the opening of the Seabrook complex from that originally considered would not significantly affect the transport of constituents to the lake.) During plan formulation, the costs used were for the originally designed complexes. While this could conceivably bias the formulation process, the fact that the High Level Plan was the most economically feasible alternative indicated that there was no need to consider the higher costs associated with the larger complexes.

TABLE B-40

ESTIMATES OF FIRST COSTS TO COMPLETE
BARRIER COMPLEXES, VARIOUS SIZES OF OPENINGS[1/]
(in $1,000's)

COMPLEX	SIZE	COST
The Rigolets	35 percent of Natural Opening[1/]	195,501
	50 percent of Natural Opening	228,215
	90 percent of Natural Opening	325,006
Chef Menteur Pass	43 percent of Natural Opening[2/]	109,301
	50 percent of Natural Opening	119,192
	90 percent of Natural Opening	151,093

[1/]October 1981 Price Levels.

[2/]1975 Designs

B.79. OUTFALL CANALS. No decision has been made with regard to the alternative to be used along three main outfall canals in New Orleans which empty into Lake Pontchartrain along the New Orleans Lakefront reach. Return levees flank these canals from the lake inland to the pumping stations. These levees have been determined to be inadequate in terms of grade and stability to provide SPH protection. Five alternatives have been formulated to address the problem. These alternatives are described in detail in the main report, and will not be repeated in this section. From a sensitivity viewpoint, the selection of any one of the five alternatives over the others would have no significant effect on the analysis. The cost for each of the outfall canal alternatives is essentially the same for either plan.

B.80. <u>DESIGN STORM</u>. Selection of a design storm, or storms, is based on a statistical analysis of storm-related data; therefore, a certain amount of risk is involved. For the LPHPP, the selected design storm was the SPH, a theoretical event representing a composite of storm parameters estimated from historic events. This design level was selected because of the potential for catastrophic destruction in the study area, a densely populated region. To insure that protection of all sections of the study area was considered to the same level, several SPH storms were evaluated, each of which would be critical to a given project reach. That is, levees along the Jefferson Parish lakefront were designed to protect against flooding from the worst probable hurricane likely to occur in that specific area. Similarly, levees in the Chalmette area were designed to protect against a similar type event, but not necessarily the same event considered critical to the Jefferson Parish lakefront. By using several SPH storms, developed using data from numerous historic events, potential errors (and increased risks) were minimized.

B.81. <u>INCREMENTAL ANALYSIS</u>. The project was divided into four separable areas for incremental analysis--St. Charles, Chalmette, New Orleans East, and Orleans-Jefferson. The rationale for the division is presented in the section on Sensitivity Analysis in the main report. Economic justification for each area at the project interest rate and the current interest rate was calculated. Tables B-41 and B-42 show the results of these analyses. All four areas are justified at the project interest rate. However, at the current interest rate, the St. Charles area has a benefit-cost ratio of 0.6 to 1 and the Chalmette area has a benefit-cost ratio of 0.8 to 1.

TABLE B-41

INCREMENTAL ANALYSIS OF THE HIGH LEVEL PLAN
AT 3 1/8 % INTEREST RATE

($1,000's October 1981 price levels)

Area	First Cost	Interest & Amortization	OM&R	Recreation Losses 1/	Total Annual Charges	Average Annual Benefits	Benefit Cost Ratio
St. Charles	55,721	1,840	39		1,879	2,902	1.5 : 1
Chalmette	65,925	2,269	249		2,518	4,924	2.0 : 1
Orleans-Jefferson	391,251	13,138	459	376	13,973	70,024	5.0 : 1
New Orleans East	112,439	4,091	216		4,307	17,921	4.2 : 1

1/ Annual fish and wildlife losses of $6,000 attributable to the entire project not assigned due to rounding.

TABLE B-42

INCREMENTAL ANALYSIS OF THE HIGH LEVEL PLAN
AT 7 7/8 % INTEREST RATE

($1,000's October 1981 price levels)

Area	First Cost	Interest & Amortization	OM&R	Recreation Losses 1/	Total Annual Charges	Average Annual Benefits	Benefit Cost Ratio
St. Charles	55,721	4,517	38		4,555	2,869	0.6 : 1
Chalmette	65,925	5,980	249		6,229	4,758	0.8 : 1
Orleans-Jefferson	391,251	33,041	451	376	33,868	69,649	2.1 : 1
New Orleans East	112,439	11,558	209		11,767	16,613	1.4 : 1

1/ Annual fish and wildlife losses of $6,000 attributable to the entire project not assigned due to rounding.

EXHIBIT B-1

SCOPE OF WORK

LAKE PONTCHARTRAIN HURRICANE PROTECTION PLAN (LPHPP)

CONTRACTOR EFFORT

IN DETERMINING FLOOD DAMAGEABILITY

CONTRACTOR EFFORT

Task Number	Task Effort
I	Non-Residential Structure Value
2	Depth-Damage for Non-Residential Structure Value
3	Non-Residential Content Value
4	Depth-Damage for Non-Residential Content Value
5	Business-Financial Losses
6	Damage to Specified Public Facilities
7	Emergency Costs due to Flooding
8	Vehicle Depth-Damage Relations
9	Depth-Damage Relationships for Residential Structures
10	Residential Structure Content Value
11	Depth-Damage Relationships for Residential Contents

1. Introduction. The Contractor shall make a detailed economic study within the Lake Pontchartrain Hurricane Protection Plan (LPHPP) study area of the New Orleans District of the Lower Mississippi Valley Division and submit the required information as outlined herein.

a. Tasks. The Contractor shall perform the following:

(1) Determine the October 1978 depreciated replacement value of all existing and planned non-residential structures for 250 organizations located within the LPHPP study area and identified by the Government for interview.

(2) Determine the damage respective saltwater and freshwater floods would cause to specified types of non-residential structures by one-half foot increments of flooding to a depth of 15 feet over the ground floor elevation and express it as a percentage of the pre-flood October 1978 depreciated replacement value of said structure type. The result will be depth-damage tables by structure type.

(3) Determine the October 1978 depreciated replacement value of the contents, including inventory, of all non-residential structures identified in Task 1 hereof by specified SIC identification numbers and by elevation

and express it as a percentage of the October 1978 depreciated replacement value of the respective structures.

(4) Determine the damage respective saltwater and freshwater floods would cause the contents identified in Task 3 hereof by one-half foot increments of flooding to a depth of 15 feet over the ground floor and express it as a percentage of the contents' pre-flood October 1978 depreciated replacement value. The result will be depth-damage tables for the contents of the respective SIC coded structures.

(5) Determine the amount of business and financial losses (other than direct physical damages and emergency costs) resulting from flooding of non-residential structures to any depth of any duration in excess of 1 hour.

(6) Determine the dollar value of repairs on roads, sewers, and bridges necessitated by respective saltwater and freshwater floods.

(7) Determine the amount of emergency costs which result from flooding.

(8) Determine the amount of damage respective saltwater and freshwater floods would cause specified vehicle types.

(9) Determine the damage respective saltwater and freshwater floods would cause to specified types of residential structures by one-half foot increments of flooding to a depth of 15 feet over the ground floor and express it as a percentage of the pre-flood value of said structures as provided by the Government. The result will be depth-damage tables by structure type.

(10) Determine the October 1978 depreciated replacement value of the contents of 125 residential structures and express it as a percentage of the pre-flood values of said structure as provided by the Government.

(11) Determine the damage respective saltwater and freshwater floods would cause the contents identified in Task 10 hereof by one-half foot increments of flooding to a depth of 15 feet over the ground floor and express it as a percentage of the contents' pre-flood October 1978 depreciated replacement value. The result will be depth-damage tables for the contents of the respective residential structure groupings.

b. Definitions and Conventions.

(1) All elevations cited herein are expressed in terms of feet above mean sea level (msl).

(2) Depth-damage relationships developed by the contractor shall assume a flood duration of 1 week.

(3) The Government will provide the contractor with the residential structure market values at October 1978 price levels.

(4) Contractor's efforts to determine ground floor elevations shall be restricted to simply recording any surveyed flood elevation which the interviewee has available.

(5) Depth-damage relationships will assume a minimum of silt and non-flowing water.

(6) The term "SIC" refers to Standard Industrial Classification Codes and are taken from the Standard Industrial Classification Manual, 1972.

(7) The term "current" as used herein refers to October 1978 conditions.

(8) The term "contents" as used herein includes non-permanent attachments such as hand-tools, forges, presses, ovens, office machinery, and inventories which are regularly kept within the structure.

(9) The term "saltwater" as used herein refers to the hurricane tidal surge of gulf seawater.

(10) The term "over floor level" as used herein refers to over ground floor level.

(11) An interview team will consist of two persons, one of whom will be an engineer, economist, social scientist or other related professional. The other member of the two-person team will be, at a minimum, a skilled technician experienced in interviewing.

(12) The term "ground floor" refers to the floor nearest to ground level which is not below ground level.

(13) Contractor can modify or use intermediate forms to fit his techniques but must provide the data in the format specified.

(14) Because of the catastrophic nature of the flooding it is not anticipated that a considerable portion of the affected populace would be able to raise a significant portion of their contents to avoid flood damage. Moreover, in those areas affected by deepwater flooding their efforts would

be largely ineffective. Because of the apparent protection offered by the levees and the area's overall performance in past hurricane experiences, alerts of possible hurricane strikes are not expected to result in appreciable reduction in damage to structures or contents.

(15) All values recorded by the contractor will be October 1978 depreciated replacement values. This is the cost of replacing the item in question in kind (to as great an extent as possible) less the depreciation it has suffered. To secure this information the contractor will have to ascertain the current replacement value, the date of purchase, and the remaining lifespan of the items. Structure values include permanent attachments but exclude land, contents, and landscaping costs.

Values provided by the Government will be October 1978 market values.

2. Area of Study. The area to be analyzed and surveyed is indicated on the Study Area Map provided as Exhibit 1.

3. Contractor Government Coordination. The project manager will at a minimum meet with the Government at the following times to discuss the progress of their effort.

a. Two weeks after beginning the residential interview effort.

b. Two weeks after beginning the non-residential interview effort.

c. Two months after receipt of the contract.

4. Task 1. Task 1 is estimated to consume some 10 percent of the Contractor's work effort. The objective of this task is to provide accurate October 1978 replacement values less depreciation for the non-residential structures operated by the 250 Government-specified organizations. SIC codes correspond with those in the SIC Manual 1972.

Procedures. The Contractor shall conduct an appraisal survey within each reach to obtain the estimated October 1978 replacement value of Government-specified non-residential structures by one-half foot increments of elevation. The Government will provide the Contractor with a list of establishments situated in the study area which the Contractor will interview using Exhibit 2. Contractor may modify Exhibit 2 as he finds necessary for those interviews which are conducted with headquarters interviews covering many sites such as fast-food chains. Contractor shall employ sound appraisal procedures and professional practices in conducting the interviews and recording the responses. Contractor will use Exhibits 3 and 4 to depict the total number and replacement value of structural improvements by major group and one-half foot increments of elevation for the individual reaches.

5. Task 2. Task 2 is estimated to consume some 10 percent of the Contractor's work effort. The objective of this task is to provide a reasonable account of the percentage damage which the following non-residential structure types would suffer due to respective saltwater and freshwater floods to a depth of 15 feet over ground floor elevation by one-half foot increments.

Non-Residential Construction Type

Metal
Brick, concrete or cinder block on slab
Brick on piers
Brick veneer on wood frame on piers
Brick veneer on wood frame on slab

Procedures. Contractor shall determine the amount of damage suffered by the respective non-residential structure types from one-half foot increments of respective saltwater and freshwater floods to a depth of 15 feet. Contractor shall employ professional practices including consultation with architects, engineers, building contractors, economists, insurance adjusters, and any other profession required to establish these depth-damage relationships. Accomplishment of this task objective will involve the use of data worksheets for the presentation of data. One worksheet will be Exhibit 5.

6. Task 3. Task 3 is estimated to consume some 10 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the October 1978 replacement value less depreciation of Government-specified non-residential structures' contents by one-half foot increments of flooding over the ground floor. The resulting figure will be expressed as a percentage of the estimated October 1978 depreciated replacement value of the structure.

Procedures. The Contractor shall conduct an appraisal survey of Government-specified non-residential structures in the study area to determine the October 1978 depreciated replacement value of their contents. Contractor will interview those parties listed for Task 2. Contractor will lay special emphasis during the interview on securing the amount of insurance coverage the establishment has secured on its contents. This is a very valuable data source because it is the result of an agreement between the insuror and the insured and is adjusted to cover those establishments which have marked fluctuations in inventory content. Contractor will employ Exhibits 3 and 4 for this effort.

7. Task 4. Task 4 is estimated to consume some 10 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the damage suffered by the contents identified in Task 3 hereof due to respective saltwater and freshwater flooding to a depth of 15 feet by one-half foot increments of flooding over ground floor.

Procedures. Contractor shall ascertain from those organizations interviewed for Task 3 the dollar value of damages those contents would suffer from one-half foot increments of respective saltwater and freshwater flooding. Contractor shall express this damage as a percentage of the pre-flood October 1978 depreciated replacement value of those contents as determined in Task 3 hereof. Contractor shall employ Exhibits 3 and 4 for this effort.

8. Task 5. Task 5 is estimated to consume some 6 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the business and financial losses (other than direct physical damages and emergency costs) which would result from the flooding of Government-specified

non-residential structures to any depth over ground floor for any duration in excess of 1 hour.

Procedures. Contractor shall ascertain from those parties interviewed for Task 3 the current dollar value of all business and financial losses (other than direct physical damages and emergency costs) resulting from the flooding of non-residential structures to any depth for any duration in excess of 1 hour. These damages shall be established as a loss per day of flooding. Flooding for 1 hour of any business day shall count as an entire day of flooding. These losses include such items as net loss of normal profits, wages, salaries, and interest. Such losses bear no consistent relationship to physical damages and must be derived from specific independent economic data for the interests and properties affected. These business and financial losses will be disaggregated to reflect only those losses which cannot be compensated by postponement of an activity or through transfer of an activity to business establishments not affected. Contractor shall employ Exhibits 3 and 6 for this effort.

9. Task 6. Task 6 is estimated to consume some 10 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the dollar value of the repairs necessitated by respective saltwater and freshwater floods on roads, sewers, and bridges by reach and depth of flooding.

Procedures. Contractor shall interview officials from appropriate city, parish, and state governments to ascertain the current cost of repairing damage caused roads, sewers, and bridges by respective saltwater and fresh-water floods through a depth of 15 feet by appropriate increments. Data shall be gathered by reach or by whatever geographic area data are maintained by cognizant personnel. Accomplishment of this task objective will require the use of an exhibit similar to Exhibit 7.

10. Task 7. Task 7 is estimated to consume some 5 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the emergency costs resulting from flooding by reach or by whatever geographic area data are maintained by cognizant personnel. Emergency costs include those additional expenses resulting from a flood which would not otherwise be incurred, such as evacuation and reoccupation; flood fighting, disaster relief; increased expense of normal operations during a flood; increased costs of police, fire, or military patrol; and abnormal depreciation.

Procedures. Contractor shall ascertain through interviews conducted with the Governmental bodies referenced in Task 6 hereof and with charitable organizations filling these needs the dollar amount of these costs. Accomplishment of this task objective will involve the use of data worksheets similar to Exhibit 8 for the presentation of data.

11. Task 8. Task 8 is estimated to consume some 4 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the damage which vehicle types specified below would suffer from 15 feet

of respective saltwater or freshwater flooding by one-half foot increments.

automobile
pickup
van
panel truck (medium duty typified by U-Haul)
tractor-trailer (tractor portion)
tractor-trailer (trailer portion)

Procedures. Contractor shall determine the amount of damage suffered by the different vehcile types specified above by one-half foot increments of saltwater and freshwater flooding to a 15-foot depth. Contractor shall employ professional practices including consultation with engineers, economists, repairmen, and any other profession required to establish these depth-damage relationships. Contractor will assume most popular configuration (MPC) for the respective vehicle types. In the case of pickups it would seem most likely that the contractor would study a 1975-76 MPC Ford. The same model years would seem appropriate for all vehicle type categories. Whereas a single representative vehicle may be studied for the other specified vehicle types, in the case of automobiles the contractor will estimate the makeup of local auto registration (full size, mid size, compact) and evaluate the depth-damageability of three individual MPC representative vehicles. The resulting depth-damage relationship will be a weighted average of the three vehicle types. Accomplishment of this task objective will involve the use of Exhibit 9 for the presentation of data.

12. Task 9. Task 9 is estimated to consume some 5 percent of the Contractor's work effort. The objective of this task is to provde a reasonable account

of the damage which residential structure types specified below would suffer from one-half foot increments of respective saltwater and freshwater floods to a depth of 15 feet over the ground floor.

Mobile homes
Single-family, single story, brick veneer or asbestos siding on wood frame on slab*
Single-family, single story, wooden weatherboard on wood frame on slab*
Multi-family, single story, brick veneer or asbestos siding on wood frame on slab*
Multi-family, single story, wooden weatherboard on wood frame on slab*
Single-family, two story, brick veneer or asbestos siding on wood frame on slab*
Single-family, two story, wooden weatherboard on wood frame on slab*
Multi-family, two story, brick veneer or asbestos siding on wood frame on slab
Multi-family, two story, wooden weaterboard on wood frame on slab

* A separate depth-damage curve will be established by the contractor for those members of these categories not constructed on slabs. The Government recognizes that non-slab structures are more likely to have wooden floors, sub-floor insulation, and floor furnaces, all of which may heighten their low level flood damages.

Procedures. Contractor shall determine the amount of damage suffered by the respective residential structure types specified above from one-half foot increments of respective saltwater and freshwater flooding up to a depth of 15 feet over the ground floor. Contractor shall employ professional practices including consultation with architects, engineers, homebuilders, economists, and any other profession required to establish these depth-damage relationships. Accomplishment of this task objective will involve the use of data worksheets. Presentation of these data will be made on Exhibit 10 and will include full explanations as to their derivation.

13. Task 10. Task 10 is estimated to consume some 15 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the October 1978 depreciated replacement value of the contents of residential structures by elevation and structure type and express it as a

percentage of the current market value of the respective residential structure type.

Procedures. The Contractor shall conduct an appraisal survey of 125 Government-specified residential structures in the study area to determine the October 1978 depreciated replacement value of their contents by respective structure types. Contractor will also record the number, model, year and parking location (garage, street, or driveway) for all vehicles normally stored at the residences. (Contractor shall employ worksheets, one of which will be Exhibit 11 for this effort.)

14. Task 11. Task 11 is estimated to consume some 15 percent of the Contractor's work effort. The objective of this task is to provide an accurate account of the damage suffered by the contents identified in Task 10 hereof due to respective saltwater and freshwater floods to a depth of 15 feet over ground floor by one-half foot increments.

Procedures. Contractor shall determine the amount of damage suffered by the contents of the respective Government-specified residential structure types from one-half foot increments to a depth of 15 feet over ground floor. Contractor shall employ professional practices including consultation with insurance adjusters, economists, and any other profession required to establish these depth damage relationships. Accomplishment of this task objective will involve the use of data worksheets for the presentation of data. One worksheet will be Exhibit 12.

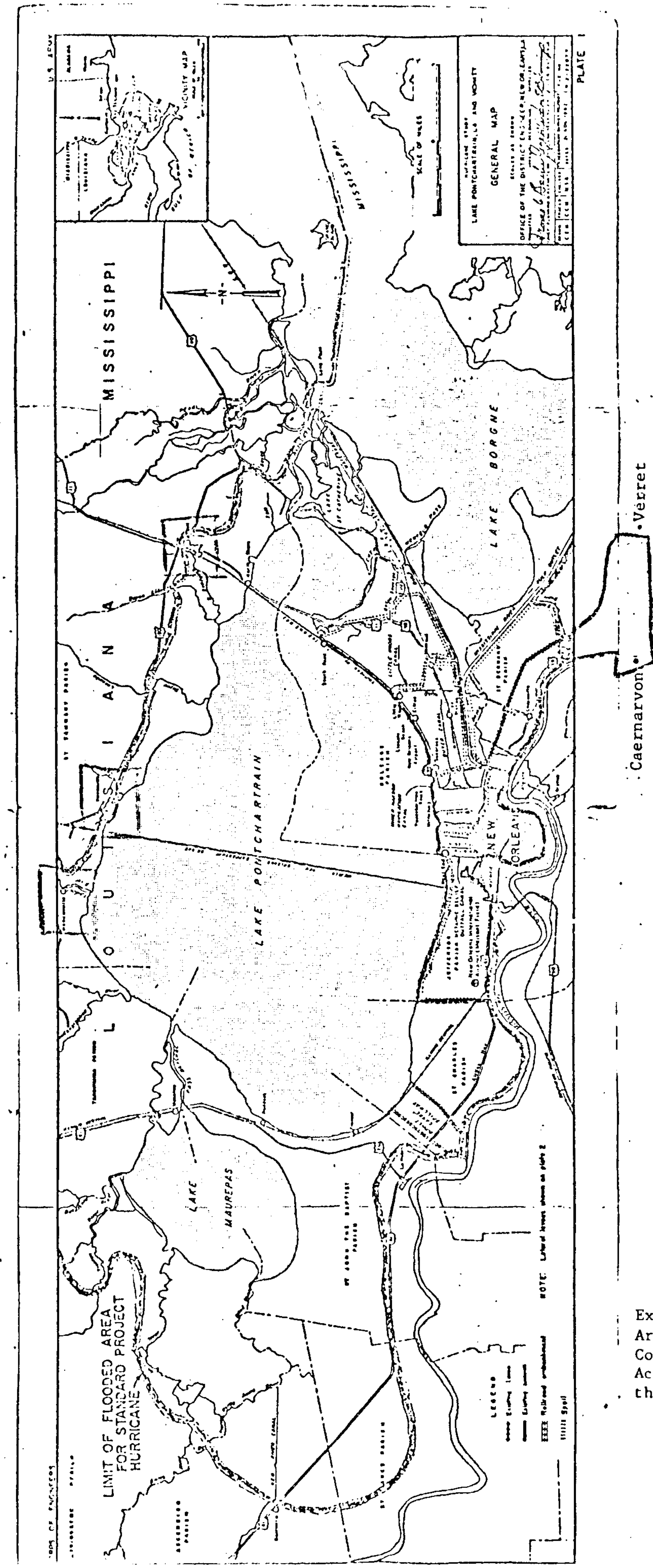


Exhibit 1
Area of
Contractor
Activity in
the LPHPP

EXHIBIT 2
NON-RESIDENTIAL STRUCTURE VALUES
LPHPP REACH ___

CATEGORY	ENTRY
Name	PROVIDED BY THE GOVERNMENT
Phone	PROVIDED BY THE GOVERNMENT
Address	PROVIDED BY THE GOVERNMENT
SIC	PROVIDED BY THE GOVERNMENT
Census Tract/Traffic Zone	PROVIDED BY THE GOVERNMENT
Construction Type	
# of Stories	
Square Footage	
Dollar Value of Story Affected by Flooding	
Ground Floor Elevation and Source	

*This is the current replacement value less depreciation of the structure possibly affected by flooding (maximum of 15' over ground floor).

EXHIBIT 3
NON-RESIDENTIAL INQUIRY

DATE: ________________
RECORDER: ____________

NAME: ______________________________ SIC INDUSTRY NUMBER: ____________________________

ADDRESS: ____ PHONE: __________________________

CONTACT NAME/POSITION: ____

MAJOR OBSERVED PROCESS, ACTIVITY, PRODUCT: ____

****

STRUCTURE

#	Ground Elevation	Floor Elevation	Construction Type	Stories	Replacement Value Less Depreciation

Definite Plans for Future Expansion
(Add the last 2 digits of the year of Estimated Construction Completion to the "Stories" column, e.g. 2-'85)

CONTENTS

Description	Value	Contents as Percentage of Structure Value

VEHICLES

#	MODEL	YEAR	STORED ELEVATION

BUSINESS AND FINANCIAL LOSSES NOT COVERED ABOVE

Net loss of wages, salaries, and profits per day of flooding (flooding here defined as standing water on the floor for one hour during the period of business). These are losses which cannot be made up through transfer of the activity to an establishment not so affected or which cannot be postponed.

Lost Wages Per Day of Flooding	Lost Salaries Per Day of Flooding	Lost Profit Per Day of Flooding	Clean-up Costs Per Flood Occurrence	Other (Specify)

DAMAGE TO STRUCTURES FROM FLOODING

Depth of Flooding over Floor	% Damage Caused by Saltwater Flooding to Structure	% Damage Caused by Freshwater Flooding to Structure
-2.0		
-1.5		
-1.0		
-0.5		
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
6.0		
6.5		
7.0		
7.5		
8.0		
8.5		
9.0		
9.5		
10.0		
10.5		
11.0		
11.5		
12.0		
12.5		
13.0		
13.5		
14.0		
14.5		
15.0		

DAMAGE TO CONTENTS OF STRUCTURES DUE TO FLOODING

Depth of Flooding Over Floor	% Damage Caused to Contents by Saltwater Flooding	% Damage Caused to Contents by Freshwater Flooding
-2.0		
-1.5		
-1.0		
-0.5		
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
6.0		
6.5		
7.0		
7.5		
8.0		
8.5		
9.0		
9.5		
10.0		
10.5		
11.0		
11.5		
12.0		
12.5		
13.0		
13.5		
14.0		
14.5		
15.0		

EXHIBIT 4

SUMMARY OF VALUES FOR NON-RESIDENTIAL STRUCTURES AND CONTENTS

(Values: $1000)

LPHPP REACH ___

FLOOR ELEVATION	#	SIN* STRUCTURE VALUE	CQ**	#	SIN STRUCTURE VALUE	CQ	#	SIN STRUCTURE VALUE	CQ	#	SIN STRUCTURE VALUE	CQ
xx.x	xxx	xxx,xxx	xx	xxx	xxx,xxx	xx	xxx	xxx,xxx	xx	xxx	xxx,xxx	xx

* SIN: SIC Identification Number provided by the Government. They correspond with the Standard Industrial Classification Manual, 1972.

** CQ: Content Value expressed as a percentage of Structure Value.

EXHIBIT 5

FLOOD DAMAGE TO NON-RESIDENTIAL STRUCTURES
LPHPP

WOOD FRAME

Depth of Flooding	Saltwater Flooding Percent Damage to Structure	Freshwater Flooding Percent Damage to Structure
-1.0	XX	XX
-0.5	XX	XX
0.0	XX	XX
0.5	XX	XX
1.0	XX	XX
1.5	XX	XX
2.0	XX	XX
2.5	XX	XX
3.0	XX	XX
3.5	XX	XX
4.0	XX	XX
4.5	XX	XX
5.0	XX	XX
5.5	XX	XX
6.0	XX	XX
6.5	XX	XX
7.0	XX	XX
7.5	XX	XX
8.0	XX	XX
8.5	XX	XX
9.0	XX	XX
9.5	XX	XX
10.0	XX	XX
10.5	XX	XX
11.0	XX	XX
11.5	XX	XX
12.0	XX	XX
12.5	XX	XX
13.0	XX	XX
13.5	XX	XX
14.0	XX	XX
14.5	XX	XX
15.0	XX	XX

EXHIBIT 6

SUMMARY OF BUSINESS AND FINANCIAL LOSSES*
LPHPP REACH __

SIC Group Number	Net Loss of Wages per Day of Flooding	Net Loss of Salaries per Day of Flooding	Net Loss of Profit per Day of Flooding	Clean-up Costs Per Flood Occurrence	Other (Specify)

---

* These losses do not include any which can be made up through transfer of work elsewhere, or through postponement of the effort at the same site.

EXHIBIT 7

SUMMARY OF FLOOD DAMAGE TO ROADS, SEWERS, AND BRIDGES
LPHPP
EAST BANK JEFFERSON PARISH

Depth	Estimated Repairs to Roads*		Estimated Repairs to Sewers		Estimated Repairs to Bridges	
	Saltwater	Freshwater	Saltwater	Freshwater	Saltwater	Freshwater
2						
4						
6						
8						
10						
15						

Source:

* Inundation for a minimum of ____ hours.

EXHIBIT 8

SUMMARY OF EMERGENCY COSTS
JEFFERSON PARISH WITHIN THE AREA OF STANDARD PROJECT FLOODING

American Red Cross Emergency Costs

Evacuation/ Reoccupation	Flood-Fighting	Disaster Relief	Extra Operational Expenses	Abnormal Depreciation	Other

1/ Per flood occurrence.

2/ Per day of flooding.

SOURCES:

EXHIBIT 9

DEPTH-DAMAGE RELATIONS – AUTOMOBILES
LPHPP

Depth of Flooding	Saltwater Flooding Percent Damage to Automobiles	Freshwater Flooding Percent Damage to Automobiles
0.0	XX	XX
0.5	XX	XX
1.0	XX	XX
1.5	XX	XX
2.0	XX	XX
2.5	XX	XX
3.0	XX	XX
3.5	XX	XX
4.0	XX	XX
4.5	XX	XX
5.0	XX	XX
5.5	XX	XX
6.0	XX	XX
6.5	XX	XX
7.0	XX	XX
7.5	XX	XX
8.0	XX	XX
8.5	XX	XX
9.0	XX	XX
9.5	XX	XX
10.0	XX	XX
10.5	XX	XX
11.0	XX	XX
11.5	XX	XX
12.0	XX	XX
12.5	XX	XX
13.0	XX	XX
13.5	XX	XX
14.0	XX	XX
14.5	XX	XX
15.0	XX	XX

SOURCES:

EXHIBIT 10
DEPTH-DAMAGE RELATIONS FOR RESIDENTIAL STRUCTURES
LPHFP

Single Family One Story

Depth of Flooding over Ground Floor	% Damage to Structure (SALTWATER FLOODING)	% Damage to Structure (FRESHWATER FLOODING)
-2.0	XX	XX
-1.5	XX	XX
-1.0	XX	XX
-0.5	XX	XX
0.0	XX	XX
0.5	XX	XX
1.0	XX	XX
1.5	XX	XX
2.0	XX	XX
2.5	XX	XX
3.0	XX	XX
3.5	XX	XX
4.0	XX	XX
4.5	XX	XX
5.0	XX	XX
5.5	XX	XX
6.0	XX	XX
6.5	XX	XX
7.0	XX	XX
7.5	XX	XX
8.0	XX	XX
8.5	XX	XX
9.0	XX	XX
9.5	XX	XX
10.0	XX	XX
10.5	XX	XX
11.0	XX	XX
11.5	XX	XX
12.0	XX	XX
12.5	XX	XX
13.0	XX	XX
13.5	XX	XX
14.0	XX	XX
14.5	XX	XX
15.0	XX	XX

Derivation:

EXHIBIT 11
RESIDENTIAL STRUCTURE QUESTIONNAIRE

LPHPP REACH ___

NAME: ______________________ DATE: ________

ADDRESS: ______________________ RECORDER: ________

CITY: ______________ SUBDIVISION OR AREA: ______________

SINGLE FAMILY /__/ MULTI-FAMILY /__/ MOBILE HOME /__/

NUMBER OF STORIES: /__/ 1 /__/ 2 /__/ OTHER

SQUARE FEET IN HOUSE: _____Sq. Ft. IN GARAGE: _____Sq. Ft.

ESTIMATED MARKET VALUE OF HOUSE AND LOT: $____________

ESTIMATED MARKET VALUE OF HOUSE, EXCLUDING LOT (if known): $____________

ANY PLANS TO ADD ON FLOOR SPACE? ____ WHEN? 19__ HOW MUCH SQUARE FOOTAGE? _____

x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x

Specify for all items either (1) the purchase price at the time of purchase or (2) your estimate of the price if purchased today. Two separate columns are provided. Also, if the approximate age of an item is unknown, please specify the condition of the item as poor (P), good (G), or excellent (E) in the age column. If you have any antiques, please put an "A" in the age column.

VEHICLES

CARS, TRUCKS, VANS	MAKE	MODEL	YEAR	STORED IN: STREET	DRIVEWAY	GARAGE
	Plymouth	Duster	1974	X		

STRUCTURE CONTENTS

Item	Number of Items	Age or Condition	Purchase Price (1) at time of purchase	Purchase Price (2) estimated if purchased today
LIVING ROOM:				
Sofa	1	4	$729	$
Chairs	1	G	149	
Tables	1	7	125	
Lamps	2	G	150	
Piano	1	20		2500
Bookcases	2	5	150	
Drapes/Curtains	1 pr	5	80	
Wall Decorations	3	5		200
Other (Specify):				
Knick-knacks				250
DINING ROOM:				
Table	1)	10		1500
Chairs	6			
Buffet				
Breakfront or China Cabinet				

(CONTINUED ON PAGE 2)

Item	of Items	Condition	Purchase	[illegible]
DINING ROOM (Continued):				
Drapes/Curtains	1 pr	5	$ 60	$
China	1 set	E		500
Chrystal	1 set	E		250
Silverware	1 set	E		750
Other (Specify):				
Linens	many			250
Table pads	1 set			50
Silver chest	1	10	25	
DEN:				
Sofa	2	1	$ 500	$
Chairs	2	1	200	
Tables	3	1	150	
	1	10		125
Desk				
Lamps	2	1	60	
TV	1	1	650	
Stereo	1	5		1000
Bookcases				
Books				
Wall Decorations	2	E		100
Records and Tapes	many	G & E		750
Other (Specify):				
Knick Knacks	many			150
Aquarium	1	2		75
Drapes/Curtains	1 pr	5	worthless	
KITCHEN/BREAKFAST ROOM:				
Stove	Built-in		$	$
Refrigerator	1	4	450	
Dishwasher	Built-in			
Microwave Oven				
Table	1	3	200	
Chairs	4			

(Continued on Page 3)

...m	No. of Items	Condition	Purchase	or Purchase Today
TCHEN (Continued):				
...dan	1 set	E	$	$ 100
...asses	many	varies		100
...es	many	varies		150
...ensils	many	varies		30.
...ainless Service	1 set	5	90	
...ns. baking	many	varies		50
...rving Pieces trays, bottles, dishes, utensils	many	varies		50
...nen placemats etc.	many	varies		25
...ectric Skillet	1	10		30
...ectric PopCorn	1			15
...ectric Fondue	1			15
...ectric Crepes	1			30
...ectric Mixer	1			20
...ectric Blender	1		60	
...ectric Toaster	1			25
...all Electric Oven	1		47	
...ectric Can Opener	1		9	
...ectric Knife	1		13	
...ectric Crock Pot	1		21	
...her (Specify):				
Freezer	1	3	$ 80	$
...ec. Bar-B-Que	1	new	70	
Curtains	1 pr	3	15	
...STER BEDROOM:				
...d frame & headboard	king		$ 250	$
...ttress & Springs	king	1	450	
...esser	1	5		200
...est of Drawers	1	5		175
...dside Tables	2	1	120	
...mps	2	10		50
...	1	5	400	
...apes/Curtains	1 pr	4	60	
...ll Decorations	2	varies		70
...airs				
...ocks	1	G		25
...dio	1	G		40
...d Linens (estimated value only)			300	
...n's Clothing (estimated value only)				750
...dies Clothing (estimated value only)				1000
...her (Specify):				
Sofa	1	4	300	
Knick Knacks	many	varies		100

Item	Number of Items	Age or Condition	(1) At Time of Purchase	OR	(2) [illegible] Purchased Today
MASTER BATH/DRESSING ROOM:					
Dressing Stool	1	1	$ 50		$
Clothes Hamper	1	1	20		
Bathroom Linens	many	varies			75
Lamps	2	10			50
Electric Razor	1	2			40
Electric Toothbrush	1	5	45		
Electric Rollers	2	[illegible]	40		
Electric Hair Dryer	1	3	30		
Other (Specify):					
Elec. Curling Irons	1	1	18		
Radio	1	G			25
GUEST BEDROOM:					
Bed(s)	Double	5	$ 225		$
Mattress & Springs	1 set	3	300		
Dresser/Chest	1	5			90
Lamps	1	8			75
Bedside Tables	1	A			
Bed Linens	many	varies			150
Chairs	1	4			30
Other (Specify):					
Bookcase					100
Books + Supplies					500
Drapes/Curtains	1 pr	1	35		
SECOND BATH:					
Bath Linens	many	varies	$		$ 75
Electric Toothbrush	1	8	28		
Other (Specify):					
Stool	1	5	20		
Curtains	1 pr	E	25		
HALLWAYS:					
Specify Items:					
Dry sink	1	5	$ 100		$
Wall Decorations	many	varies			150
Camera Equip	many	varies			475
Hobby Equip	many	varies			150

Item	of Items	Condition	Furniture	[illegible]
CHILDRENS BEDROOM:				
Bed(s)	1	A	$	$
Mattress & Springs	1 set	5-	400	
Dresser/Chest	1	3		100
Lamps	1	5		40
Bedside Tables				
Bed Linens	many	varies		100
Drapes/Curtains	1 pr	2	25	
Chairs	1	4	20	
Toy Box	1	9	22	
Toys	many	varies		250
Desk & Chair	1	3		175
Other (Specify):				
Sports Equipment	many	varies		125
Air Hockey	1	3	75	
Stereo	1	4	60	
TV	1	1	100	

Item	of Items	Condition	Furniture	[illegible]
CHILDRENS BEDROOM:				
Bed(s)			$	$
Mattress & Springs				
Dresser/Chest				
Lamps				
Bedside Tables				
Bed Linens				
Drapes/Curtains				
Chairs				
Toy Box				
Toys				
Desk				
Other (Specify):				

Item	Number of Items	Age or Condition	(1) At Time of Purchase	Estimated if Purchased Today
LAUNDRY ROOM/UTILITY ROOM AND/OR GARAGE:				
Washer	1	8	$ 250	$
Dryer	1	8	250	
Hot Water Heater	1	5	unknown	
Freezer	1	6	250	
Vacuum	3			225
Lawnmower	1	2	250	
Edger	1	3	60	
Weedeater	1	1	40	
Small Garden tools	many	varies		75
Small Hand tools	many	varies		125
Electric Saw(s)	2			80
Electric Sander	1	4	29	
Floor Scrubber/Polish	1	10		40
Electric Drill	2			80
Electric Hedge Trimmer	1	3		30
Other (Specify):				
Bicycles	2			220

x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx

CARPETING: Estimate the number of square feet of carpeting and/or the estimated value of the carpeting. Area rugs should be estimated separately.

Carpeting: __________ Square feet valued at $__________.

Area rugs: __________ Number of area rugs valued at $__________.

x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx

OTHER (Check applicable items):

Interior Walls: [X] Sheet Rock [ ] Plaster [ ] Paneling [ ] Other ______

Floors: [ ] Wood [X] Tile [ ] Terrazzo [X] Carpet over Concrete

x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx x xx

Additional Coments:

____

____

____

____

____

____

EXHIBIT B-2

EXHIBIT B-2

SOCIOECONOMIC ASSESSMENT

TABLE OF CONTENTS

LIST OF TABLES

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

EXHIBIT B-2
SOCIOECONOMIC ASSESSMENT

B.2.1. INTRODUCTION. The purpose of this assessment is to identify potential social and economic impacts of the project. It is primarily limited to comments on those items specifically required to be addressed under Section 122 of the River and Harbor and Flood Control Act (Public Law 91-611), and attempts to reflect publicly held values. Table B.2.1, Socioeconomic Impact Matrix, provides a comparison of the future without-project condition with the net effects of the two project construction alternatives: completion of a higher levee system, and construction of barriers.

B.2.2. FLOOD CONTROL. The purpose of the project is to prevent flooding effects from the surge of a standard project hurricane (SPH). Both the Barrier and High Level Plans would provide such protection. The completion of the project would provide protection both to existing developments and to some currently undeveloped areas. This process of levee construction and drainage maintenance historically has been the method used for flood protection in most of the urbanized areas of New Orleans, and is a prime aspect of economic growth.

B.2.3. LAND USE. In general, well protected land in the New Orleans area is relatively scarce and, historically, construction of floodwalls and levees has been required. Both of the construction alternatives would provide additional hurricane protection and thereby help maintain the stability of existing land, and facilitate its highest use. As discussed in Appendix B, Economic Analysis, the economic potential for port development and nearby mineral production

TABLE B.2.1

SOCIOECONOMIC IMPACT MATRIX

	With No Additional Federal Action			Barrier Plan			High Level Plan		
	–	N	+	–	N	+	–	N	+
Flood Control	M	–	–	–	–	G	–	–	G
Land Use	M	–	–	–	–	M	–	–	M
Property Values	M	–	–	–	–	M	–	–	M
Business and Industrial Activity	S	–	–	–	–	M	–	–	M
Employment	S	–	–	–	–	S	–	–	S
Displacement of People	–	N	–	–	N	–	–	N	–
Housing	S	–	–	–	–	S	–	–	S
Community Growth	S	–	–	–	–	S	–	–	S
Tax Revenues	S	–	–	S	–	S	S	–	S
Public Facilities and Services	S	–	–	–	–	S	–	–	S
Leisure Opportunities	–	N	–	S	–	–	M	–	–
Displacement of Farms	–	N	–	–	N	–	–	N	–
Noise	S	–	–	S	–	–	S	–	–
Esthetic Values	–	–	S	S	–	–	S	–	–
Community Cohesion	M	–	S	S	–	G	S	–	G
Regional Growth	–	N	–	–	–	S	–	–	S

Codes: N = None S = Slight M = Moderate G = Great has encouraged the growth of related commerce and industry. In recent years, tourist industries have become increasingly important. Growth in these areas has resulted in the development of an international air terminal and the expansion of rail and vehicular transportation systems, including six trunk line railroad companies and Interstate Highways 10, 12, and 59, and connecting arteries. This economic activity and the resultant population growth have created an increasing demand for additional land with adequate flood protection. The portion of St. Charles Parish east of the Mississippi River and St. Tammany Parish are developing rapidly; however, the largest areas which would be most severely impacted by a project hurricane include urbanized areas of Jefferson and Orleans Parishes located east of the Mississippi River, and St. Bernard Parish. Table B.2.2 indicates land us e categories in those areas which would be impacted by an SPH.

TABLE B.2.2

LAND USE IN ACRES FOR THE AREAS OF JEFFERSON, ORLEANS, AND ST. BERNARD PARISHES IMPACTED BY A PROJECT HURRICANE

LAND USE CATEGORIES	JEFFERSON PARISH	ORLEANS PARISH	ST. BERNARD PARISH	TOTAL	PERCENT OF TOTAL
Residential	9,800	11,840	2,190	23,830	23
Manufacturing	1,180	1,460	390	3,030	3
Transportation & Communication	8,440	12,290	1,640	22,370	21
Trade	850	850	150	1,850	2
Services	1,600	2,410	210	4,220	4
Cultural and Recreational	800	2,720	200	3,720	4
Extraction	1,970	100	810	2,880	3
Undeveloped	6,180	34,540	2,570	43,290	41
Total	30,820	66,210	8,160	105,190	100[1/]

[1/] Percent of total equals 101 due to rounding procedures.

SOURCE: Regional Planning Commission-Jefferson, Orleans, St. Bernard, and St. Tammany Parishes. Unpublished data. (Estimates were rounded by NOD.)

B.2.4. The figures for Manufacturing, Transportation & Communications, Trade, and Services land use reflect the area's economic base, with less emphasis on basic manufacturing industries and greater emphasis on port, rail, trucking, and air traffic, and commercial activities. Several thousand acres designated as Undeveloped include the Almonaster-Michoud Industrial District. While a large portion of this land remains undeveloped, state and local officials are participating in plans to use this land (zoned industrial) for improved port facilities and additional manufacturing industries. Another large portion of eastern New Orleans, designated as Undeveloped by the Regional Planning Commission, includes wetlands which fall within the protected areas. Development plans by private interests for some of this area have been underway for a number of years.

B.2.5. PROPERTY VALUES. As discussed in the previous subsection, and in other sections of the report, both the Barrier and High Level Plans would prevent the flooding effects of a project hurricane surge. Property values would be benefited by completion of the project to the extent that property in the project area would receive an additional level of protection.

B.2.6. BUSINESS AND INDUSTRIAL ACTIVITIES. The New Orleans metropolitan area has an economy largely centered around the port and related commercial activities, nearby mineral production and related service industries, and in recent years, a growing volume of tourist trade and associated construction. Without the completion of the project, existing and anticipated business and industrial activities could be impacted by flooding effects of a project hurricane. With the completion of the project, however, these impacts could be prevented.

B.2.7. EMPLOYMENT. With or without the completion of the project, direct employment impacts would be minor. If the project is not finished, related construction employment would be suspended. Completion of the project, in and of itself, is not expected to generate substantial employment. Indirectly, employment would be benefited to the extent that related economic activity would receive additional protection.

B.2.8. DISPLACEMENT OF PEOPLE. Since no relocations would be required, there would be no displacements of people with or without the completion of the project. As an indirect impact, however, inundation reduction resulting from the completion of the project could also prevent displacements of people living in the path of a project hurricane.

B.2.9. HOUSING. The project would add hurricane and flood protection to the current residents of the New Orleans area residing east of the Mississippi River. Anticipated population growth with or without the project will result in a growing demand for housing. A 1976 report prepared by the University of New Orleans (Segal et al.) indicates that the number of residents per household has been declining, and that this trend is expected to continue. Under these conditions, the number of housing units required in the New Orleans area will be increasing even more rapidly than the growth in population (see Table B.2.3). (A household is defined in the referenced report as an occupied dwelling unit.)

TABLE B.2.3

PROJECTED HOUSHOLD POPULATIONS PER OCCUPIED DWELLING
(1975-2000)

PARISH	YEAR 1975	1980	1985	1990	1995	2000
Jefferson	3.28	3.17	3.02	2.97	2.92	2.90
Orleans	2.72	2.54	2.36	2.26	2.16	2.09
St. Bernard	3.48	3.39	3.24	3.20	3.16	3.16
St. Tammany	3.24	3.08	3.93	2.87	2.82	2.79
St. Charles	3.64	3.50	3.34	3.29	3.24	3.23
State	3.13	2.99	2.84	2.78	2.72	2.69

SOURCE: University of New Orleans, Projections to the Year 2000 of Louisiana Population and Households, Segal et al.

B.2.10. The 1980 Census estimated the average number of persons per occupied dwelling unit in the New Orleans Standard Metropolitan Statistical Area (Jefferson, Orleans, St. Bernard, and St. Tammany Parishes) to be approximately 2.80. The average household population in areas of Jefferson, Orleans, and St. Bernard Parishes which would be impacted by a project hurricane was estimated to be 2.70. It included an average of 2.80 persons per dwelling unit in Jefferson Parish, 2.60 persons per dwelling unit in Orleans Parish, and 3.10 persons per dwelling unit in St. Bernard Parish. Population per occupied dwelling unit in St. Tammany Parish in 1980 was estimated to be 3.10 persons. Approximately 160,000 dwelling units would receive immediate benefits from completion of the High Level Plan and an additional 7,000 would benefit from the Barrier Plan.

B.2.11. COMMUNITY GROWTH. Since the population of the New Orleans area is expected to increase with or without the completion of the project, impacts to community growth have been projected to be nominal. Improved flood protection, however, could have a qualitative impact on community development.

B.2.12. TAX REVENUES. Impacts to local tax revenues would be relatively minor with or without the project. Construction of either of the various project alternatives would tend to generate tax revenues and provide a mild stimulus to the local economy. Conversely, the same tax revenues would be needed to support the additional public facilities and services which would be required as a result of the project. Should the project stimulate new industrial growth and broaden the city of New Orleans' economic base, a more significant impact would occur, temporarily increasing the city's revenue source and its overall economic stability. If the project is not completed, no significant impacts to tax revenues are anticipated.

B.2.13. PUBLIC FACILITIES AND SERVICES. Whether or not the project is completed, impacts to public facilities and services would be slight. If it is not completed, the availability of new public facilities and services could be deferred. Conversely, completion of the project could facilitate the expansion of public facilities and services.

B.2.14. LEISURE OPPORTUNITIES. Under the with no additional Federal action condition, leisure activities would not be impacted. The High Level Plan, however, would change the current pattern of walking, jogging, sightseeing, fishing, and hunting along the shore of Lake Pontchartrain in Jefferson, Orleans, and St. Charles Parishes. In Jefferson Parish, the 10.5-mile Linear Park National Recreational Trail would be replaced by a new levee. This could represent a loss of approximately 75,000 man-days of recreation. In Orleans Parish, general outdoor recreational activities along the park-like lakefront in the vicinity of levee construction would be adversely impacted. St. Charles Parish would suffer minimal losses in potential man-days of sport huntings. The primary impacts of the Barrier Plan would be a modest loss of hunting and fishing man-days in St. Charles and Orleans Parishes in the vicinity of the barrier complexes.

B.2.15. DISPLACEMENT OF FARMS. There will be no impacts with or without the project.

B.2.16. NOISE. Completion of the project would result in noise impacts associated with construction; however, these impacts would be temporary and comply with all Federal regulations regarding noise abatement. If completion of the project encouraged urban expansion in currently undeveloped areas, associated noise would result. Again, these impacts would be controlled by Federal regulation and not be expected to reach dangerous levels.

B.2.17. ESTHETIC VALUES. Completion of the hurricane protection plan would require a certain amount of alteration of the natural environment, and to that extent, esthetic qualities of the surrounding area would be adversely affected. The degree of this impact, however, is acknowledged to be a subjective judgment. While many people would consider this change in the natural environment to be significant, others may be more concerned with developing attractive urban landscapes and skylines. While these values may not be mutually exclusive, they differ from person to person. Project completion would probably involve trade-offs in esthetic values.

B.2.18. COMMUNITY COHESION. While the great concensus of community opinion favors additional flood protection, concerns over environmental impacts of the Barrier Plan represent a significant factor within the community. Such concerns regarding the High Level Plan are of a lesser magnitude and relate primarily to apprehension over the potential for project-induced development in New Orleans East beyond the Maxent Canal.

B.2.19. REGIONAL GROWTH. The with no additional Federal action conditions would probably have no significant impact on regional growth. Growth is expected to continue with or without completion of the project. Completion of the project and the additional flood protection it would provide could have a slight beneficial impact to the continued economic development of the community by adding the stability of increased flood protection to otherwise flood-prone areas.

APPENDIX C

ENVIRONMENTAL RESOURCES

APPENDIX C

ENVIRONMENTAL RESOURCES

This appendix includes the following:

SECTION 1

BIOLOGICAL ASSESSMENT OF THREATENED AND ENDANGERED SPECIES

BIOLOGICAL ASSESSMENT
OF THREATENED AND ENDANGERED SPECIES
LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
HURRICANE PROTECTION PROJECT

I. INTRODUCTION

This assessment addresses the threatened and endangered species which may be affected by the US Army Corps of Engineers' Lake Pontchartrain Louisiana and Vicinity Hurricane Protection project. Only one species, the Bald Eagle, is known in the project area. No threatened or endangered plants are known in the project area.

The proposed project, which is located in Jefferson, Orleans, St. Charles, St. Bernard, and St. Tammany Parishes, is designed to protect these parishes from hurricane flooding and it appears the High Level or Barrier Plan will be adopted. The High Level Plan, which has been tentatively selected, utilizes high level levees and floodwalls to protect Chalmette, New Orleans East, Citrus, New Orleans west of the Inner Harbor Navigation Canal, and Jefferson and St. Charles north of the Mississippi River. In Figure 1, the high level alinement can be found. The Barrier Plan involves the construction or upgrading of most of the levees in the High Level Plan as well as building a barrier across the southeast side of Lake Pontchartrain and St. Tammany Parish. The Barrier Plan alinement can be seen in Figure 2. This assessment is the result of several visits to the project area, conversations with knowledgeable persons, and a review of current literature. The historic and current occurrences of the Bald Eagle in Louisiana and the project area are summarized, and the potential impacts and cumulative effects of the project are examined.

II. SPECIES ASSESSMENT - BALD EAGLE

The Southern Bald Eagle (Haliaeetus leucocephalus, leucocephalus) is a large raptor which has undergone a pronounced population decline since the late 1940's. Including the northern races, there were an estimated 750 active nests in the continental United States in 1975 (Snow, 1973).

The greatest factor in the eagle decline is the reduced reproduction caused by pesticide accumulation through the food chain. It appears that high residue levels, especially of dieldrin, have resulted in thin eggshells. Other factors affecting the population are shooting, electrocution, severe weather, habitat loss, and human disturbance.

The opportunistic Bald Eagle is generally found in coastal areas or along rivers and lakes where they feed on dead, dying, or live prey. Although the eagles' food is variable, they forage largely on fish and birds. The fish species captured include shad, bass, catfish, mullet, and sunfish, while birds are primarily ducks, and coots.

Eagles prefer to nest in the largest tree of a stand and place the nest below the crown. Usually a clear flight path to water, a good perching tree, and open view of the surrounding area are selected. In the southeast, nests are generally constructed in living trees. The eagle is highly site tenancious. In Alaska, the territorial area varies from 28 to 112 acres, and averages 57 (Snow, 1973).

During the turn of the century, the Bald Eagle was common along the coastal and wetland areas of Southern Louisiana (Bailey, 1919, in Dugoni, 1980). Concern for the eagle began in the 1930's and by the early 1970's, the bird was uncommon (Lowery, 1974). Eagles' nests in Louisiana are predominatly located in flooded, second growth bald cypress-tupelogum and mixed hardwood swamps. These areas are common on the backslopes of reminant deltaic distributaries and most of the nests are in the old delta between the Mississippi River and Atchafalaya River. During the 1977-1980 breeding seasons, 30 eagle nests were known to exist in Louisiana, and all of these, but one, were in Terrebonne, Assumption, St. Mary, Jefferson, and St. Charles Parishes. Of these 30 nests, 19 were active and eight were alternate sites. The remainder were inactive or the status was unknown. The predominant nesting tree in Louisiana is the bald cypress (93 percent) and the remainder, live oaks. The nesting season in Louisiana is from September through May (Dugoni, 1980).

Of 10 active Louisiana nests examined, the eagles were found to feed largely on birds (42 percent) and fish (42 percent). The predominant prey, which accounted for about half the birds diet, were freshwater catfish and American coots (Dugoni, 1980). Their prey is typical of that found in shallow waters.

Organochlorine residue analysis of four prey items indicated 86 percent contained residues (Dugoni, 1980). Subnormal clutch size and hatching failure may be responsible for the reduced reproductive output in Louisiana .

There are eight Bald Eagle territories within 15 miles of the project area, and five of these were active during the period 1978 to 1980. These nests averaged 1.9 eggs per nest, and produced 1.1 young per nest during the above period (Dugoni 1980). Nest locations can be found in Table 1, and reproductive data on each in Table 2. The recently discovered Moisant nest was found to active in the 1981-82 survey by Dubuc (See Plate 1).

The White Kitchen nest (Nest number = 13, Territory = 12), in St. Tammany Parish, would be of concern if the Barrier Plan were adopted. The nest, which is located about 80 feet high in a live baldcypress tree, is surrounded (1 mile radius) with marsh ponds (1.9 percent), bay areas (4.6 percent) and the land within a 3-mile radius is composed of lakes (0.2 percent), marsh ponds (0.4 percent), bayous (5.8 percent), swamp (46.9 percent), marsh (38.6 percent), and development (8.1 percent). The development includes urban, industrial, and agricultural. The eagles prefer to perch in the swamps to the west of the nest and to forage in the marsh west or south of the nest. The nest is successful and has produced a chick each year for the last four seasons.

The newly discovered Moisant nest is located between Interstate 10 and Airline Highway (U.S. 61) and near the St. Charles, Jefferson Parish line (figure 1). The nest is located in a cypress tree and is surrounded (1 mile radius) by marsh fringed by cypress-tupelo swamp, man made canals, tidal creeks and development. Land within a 3-mile radius is composed of marsh, swamp, marsh ponds, open water, and urban-residential, and industrial developments including an airport, oil and gas production facilities and land fill operations. Since this nest was only recently discovered there is little detailed information on the inhabitants. This nest is identified as nest number 23 according to the Dubuc eagle survey. During the 1981-82 survey the nest was active and occupied by two adults while the 1982-83 data indicates the presence of 1 fledging and 2 adults (Fred Bagley personal communication).

III. IMPACTS

Seven of the eight Bald Eagle territories near the High Level Plan project area are well buffered from project by extensive marshes as well as the Mississippi River, Bonnet Carre Spillway or Lake Pontchartrain. Most construction would be at least 10 miles from an eagles' nest.

The Moisant Eagle nest is located within 1.5 miles of the Hi-Level levee alinement proposed for north of airline highway (Fig. 3). This levee would be constructed by the hauled-fill method with construction access provided via airline highway (61) and unimproved secondary roads. Approximately 213 acres of cypress tupelo swamp would be impacted by the placement of fill material for levee construction. As the fill is placed it will serve as the construction access for the remaining levee work. Due to the proximity of the nest to a highly urbanized environment and commercial airport operations the construction activities are not expected to interfere with the nesting site.

The Barrier Plan may be detrimental to the White Kitchen nest. Because this plan is an alternative and the final Apple Pie Ridge alinement has not been determined, the full impacts of this plan have not been addressed in this assessment. Although a realinement of the levee would prevent the nest from being impacted directly, it would still influence the marsh and, thus, the eagles foraging area and food resources.

IV. SUMMARY

The impacts of the High Level Plan for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project are expected to be negligible on the Bald Eagle. The Barrier Plan would impact the White Kitchen nest and, if this plan is selected, consultation will be necessary.

REFERENCES

Bailey, A.M. 1919. The Bald Eagle in Louisiana. Wilson Bull. 31 (2): 52-55.

Dugoni, J.A. 1980. Habitat Utilization, Food Habitats, and Productivity of Nesting Southern Bald Eagles in Louisiana. M.S. Thesis LSU 151 pp.

Lowery, G. 1974. Louisiana Birds. Louisiana State University Press, Baton Rouge. 650 p.

Snow, C. 1973. Habitat management series for Endangered Species, Rep. 5, Southern Bald Eagle and Northern Bald Eagle. USDI, Bur. Land Management, Portland, Oregon 58 pp.

Table 1. Locations of Bald Eagle Nests Near the Lake Pontchartrain, Louisiana, Hurricane Protection Project

Nest Name[a]	Territory[b]	Number[b]	Parish	Geographical Coordinates Longitude	Latitude
North Lafitte	2	2	Jefferson	90°06'30"	29°38'29"
South Lafitte	3	3	Jefferson	90°o06'25"	29°37'22"
Salvador-North	6	6	St. Charles	90°17'36"	29°51'33"
Paradis (south)	11	12	St. Charles	90°27'50"	29°54'06"
White Kitchen	12	13	St. Tammany	90°40'30"	30°14'09"
Paradis (north)	11	18	St. Charles	90°27'52"	29°27'09"
Lac Des Allemands	15	19	St. John the Baptist	90°34'01"	30°09'01
Moisant Nest		23[c]	St. Charles	presently	unsurveyed

[a]US Fish and Wildlife Service

[b]Dugoni, J. 1980.

[c]Dubuc, W. 1981.

Table 2. Reproductive Data on Nesting Bald Eagles Near the Lake Pontchartrain, Louisiana, Hurricane Protection Project, (Dugoni, 1980).

Breeding Territories	Nest Number(s)	Occupied[a] (Success)[b] 1977-78	1978-79	1979-80
2	2	Y(0)	Y(1)	Y(2)
3	3	Y(1)	Y(0)	Y(0)
6	6,8	Y(2)	Y(1)	Y(2)
11	12,18	Y(1)	Y(1)	Y(2)
12	13	Y(1)	Y(1)	Y(1)[c]
15	19	--	N	N
16	20	--	N	N

[a]Y=Yes, N=No
[b]number of fledgings
[c]In 1980-81, 1 young was produced

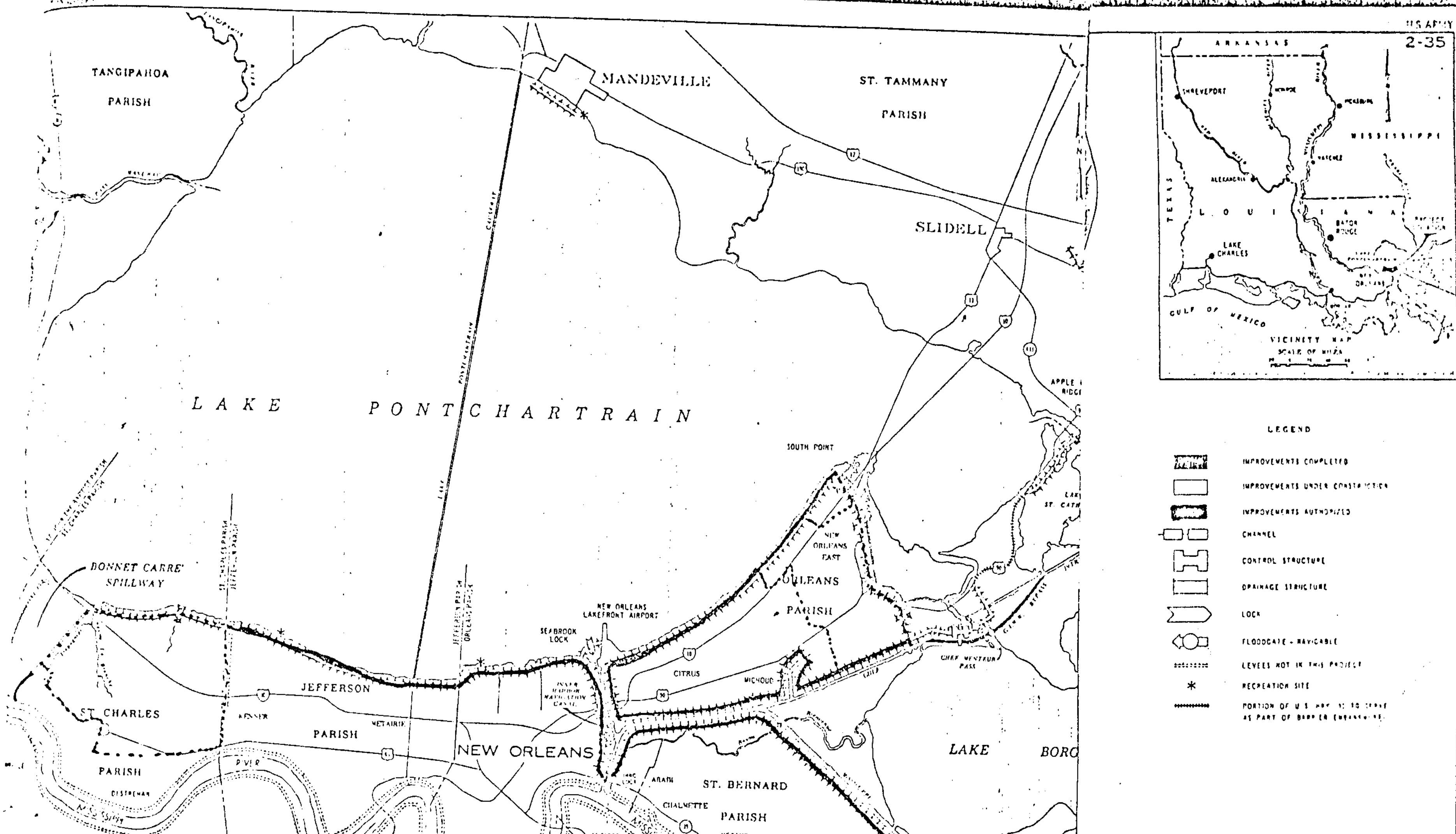


Figure 1

LOWER MISSISSIPPI VALLEY DIVISION FLOOD CONTROL GENERAL

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

SCALES AS SHOWN
OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.

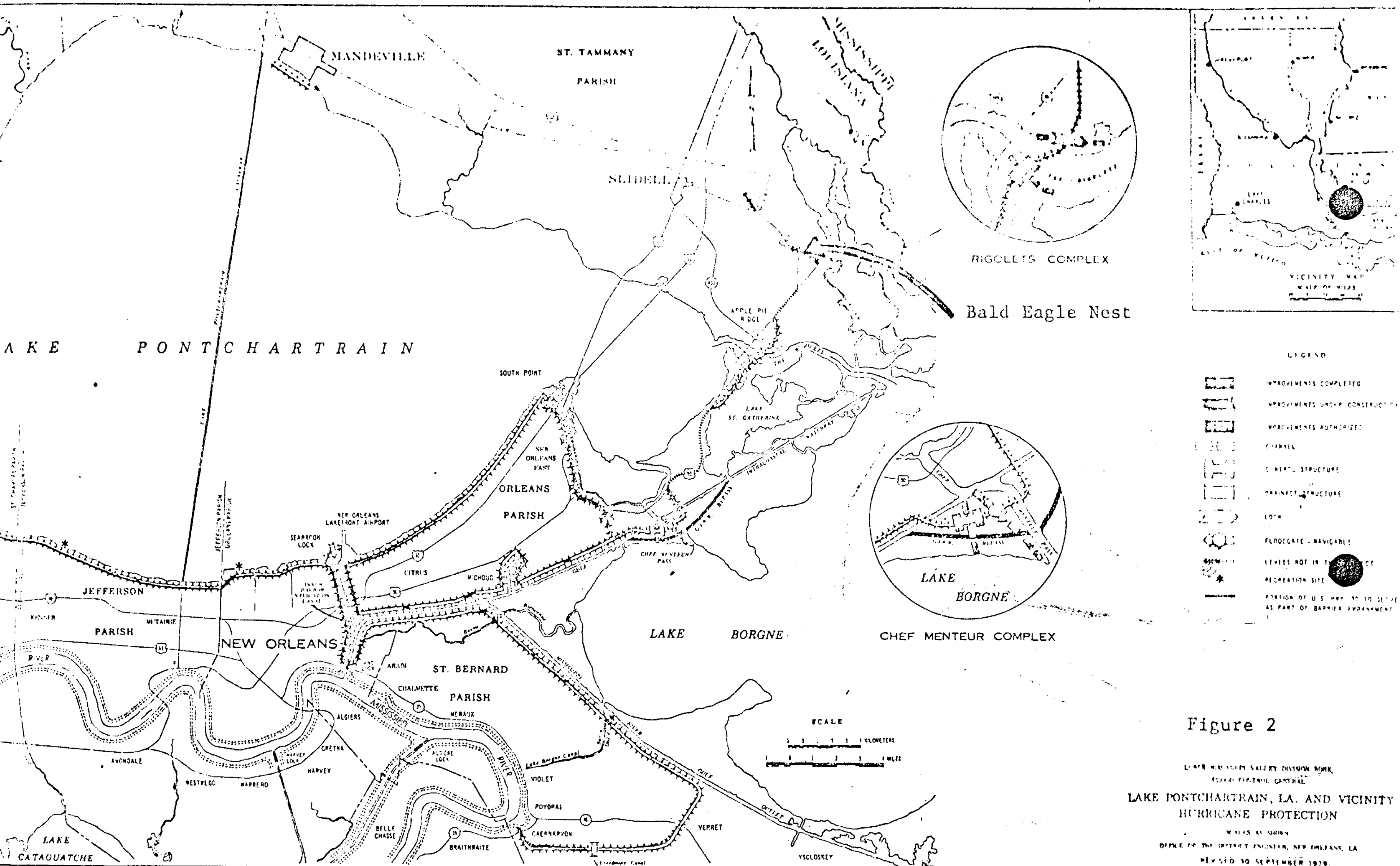


Figure 2

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

REVISED 30 SEPTEMBER 1979

LMNPD-RE

2 July 1981

Mr. Harold Allen
Acting Regional Director
National Marine Fisheries Service
9450 Koger Blvd.
St. Petersburg, FL 33702

Dear Mr. Allen:

In compliance with Section 7(c) of the Endangered Species Act Amendments of 1978, we are requesting information with respect to the threatened and/or endangered species associated with the ~~project,~~ Lake Pontchartrain and Vicinity Hurricane Protection Project located in Jefferson, Orleans, and St. Charles Parishes in New Orleans, Louisiana and vicinity (Inclosure 1). Plans would consist of features to provide hurricane protection to the Greater Metropolitan New Orleans area, while preserving and/or enhancing environmental values to the maximum extent possible.

Several plans are being considered to obtain the needed hurricane protection and are outlined as follows:

a. Barrier Plans - These plans would provide for construction of barrier structures at Lake Pontchartrain's main tidal passes which would be operated to reduce the build-up of lake stages during the approach of hurricanes in tandem with construction of levees and floodwalls.

b. High Level Plans - These plans would provide for construction of only levees and floodwalls. Levees and floodwalls associated with high-level plans would be higher than those associated with comparable barrier plans.

Both sets of plans would utilize the same alternate levee alinements.

The project area is primarily urban, surrounded by drained wetlands, intermediate marsh and brackish marsh. All of these areas have been either leveed to some extent or partially drained.

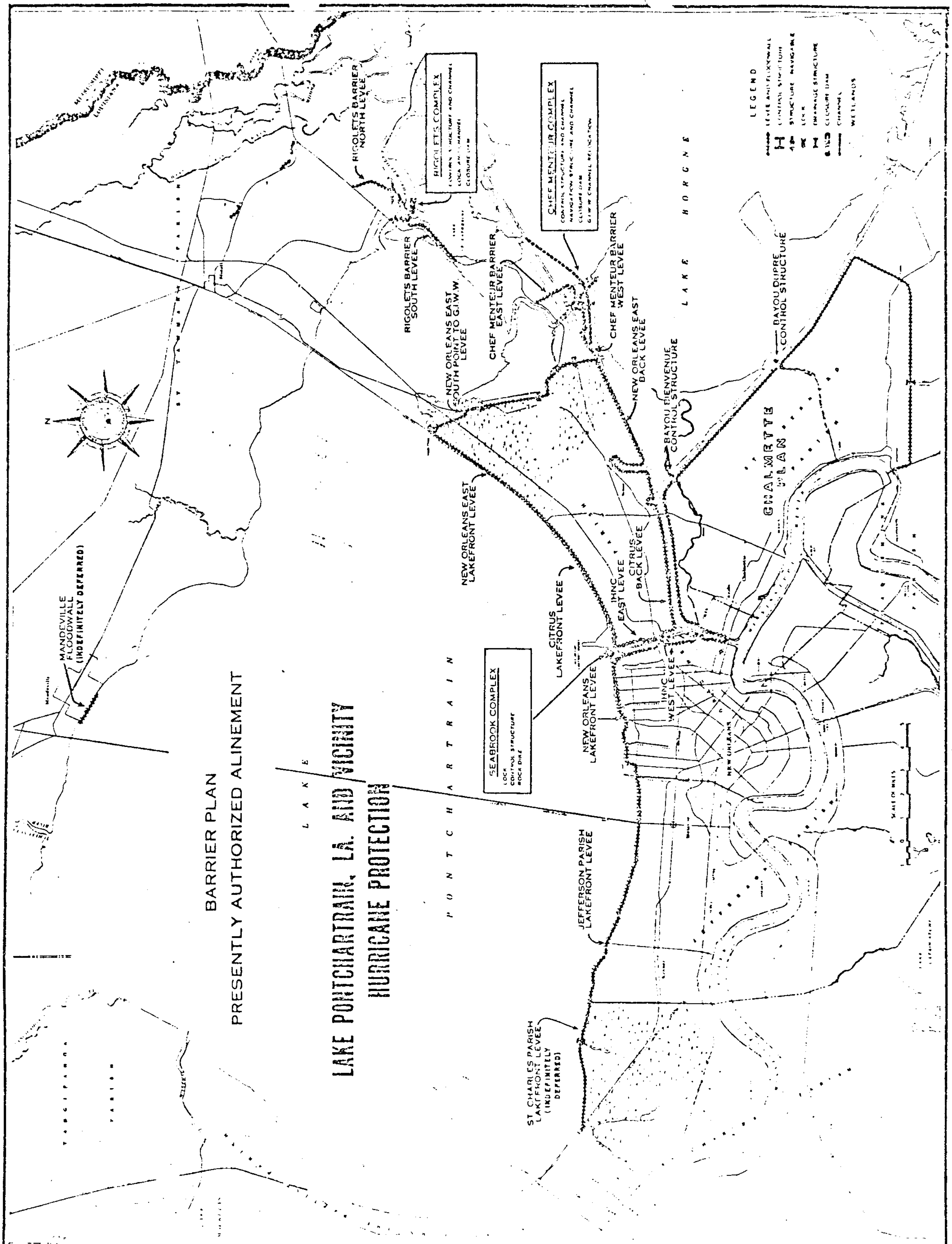
LMNPD-RE
Mr. Harold Allen

Please provide us with a list of endangered and threatened species and species proposed for listing which may occur in the project area.

Sincerely,

1 Inclosure
As stated

JAMES F. ROY
Chief, Planning Division


BARRIER PLAN
PRESENTLY AUTHORIZED ALINEMENT
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
LAKE PONTCHARTRAIN
LAKE BORGNE
CHALMETTE PLAN
N
MANDEVILLE FLOODWALL (INDEFINITELY DEFERRED)
RIGOLETS BARRIER NORTH LEVEE
RIGOLETS COMPLEX
RIGOLETS BARRIER SOUTH LEVEE
CHEF MENTEUR COMPLEX
CHEF MENTEUR BARRIER EAST LEVEE
CHEF MENTEUR BARRIER WEST LEVEE
NEW ORLEANS EAST SOUTH POINT TO G.I.W.W. LEVEE
NEW ORLEANS EAST BACK LEVEE
BAYOU BIENVENUE CONTROL STRUCTURE
BAYOU DUPRE CONTROL STRUCTURE
NEW ORLEANS EAST LAKEFRONT LEVEE
CITRUS LAKEFRONT LEVEE
IHNC EAST LEVEE
CITRUS BACK LEVEE
SEABROOK COMPLEX
NEW ORLEANS LAKEFRONT LEVEE
IHNC WEST LEVEE
NEW ORLEANS
JEFFERSON PARISH LAKEFRONT LEVEE
ST. CHARLES PARISH LAKEFRONT LEVEE (INDEFINITELY DEFERRED)
LEGEND

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

July 13, 1981 F/SER64:DLP

Mr. James F. Roy
Chief, Planning Division
New Orleans District, U. S. Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Dear Mr. Roy:

This is in response to your letter of July 2, 1981, which requested information about species which are listed or proposed to be listed as provided by the Endangered Species Act. Your area of interest is a proposed Hurricane Protection Project and for Lake Pontchartrain in Jefferson, Orleans and St. Charles Parishes in Louisiana.

We have reviewed the proposed project and have determined that no species of listed sea turtles or whales are likely to occur in the proposed project area. This concludes consultation responsibilities under Section 7 of the Endangered Species Act of 1973. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may effect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be effected by the proposed activity.

Sincerely yours,

D. R. Ekberg
D. R. Ekberg
Chief, Environmental and Technical
Services Division

cc: FWS, Atlanta, GA
FWS, Jackson, MS

Enclosure

July 1981

Endangered & Threatened Species and Critical Habitats Under NMFS Jurisdiction

Louisiana

LISTED SPECIES	Scientific Name	Status	Date listed
Green Sea Turtle	*Chelonia mydas*	Th	7/28/78
Kemp's (Atlantic) Ridley Sea Turtle	*Lepidochelys kempi*	E	12/2/70
Leatherback Sea Turtle	*Dermochelys coriacea*	E	6/2/70
Loggerhead Sea Turtle	*Caretta caretta*	Th	7/28/78

SPECIES PROPOSED FOR LISTING
None

CRITICAL HABITAT
None

CRITICAL HABITAT PROPOSED FOR LISTING
None

IN REPLY REFER TO
LMNPD-RE

2 July 1982

Mr. Gary Hickman
Area Manager
US Fish and Wildlife Service
200 East Pascagoula St., Suite 200
Jackson, MS 39201

Dear Mr. Hickman:

In accordance with Section 7 of the Endangered Species Act Amendments of 1978, the US Army Corps of Engineers, New Orleans District has conducted a Biological Assessment of threatened and endangered species of the Lake Pontchartrain and Vicinity Hurricane Protection project. The species examined were those selected by your office in a letter dated 23 July 1981 (Log No. 4-3-81-165).

The US Army Corps of Engineers has determined the construction and maintenance of the proposed High Level plan would have no adverse impact on the Bald Eagle; however, the institution of the Barrier Plan would adversely affect the White Kitchen Eagle Nest. If it appears the latter plan will be instituted, a reevaluation of the assessment and consultation will be necessary.

We appreciate your cooperation in the preparation of this assessment. If you have any questions, please contact Mr. E. Scott Clark, of this office, telephone (504) 838-2521.

Sincerely,

1 Incl
Biological Assessment

R. H. SCHROEDER, JR.
Acting Chief, Planning Division

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
200 EAST PASCAGOULA STREET, SUITE 300
JACKSON, MISSISSIPPI 39201

November 30, 1981

Colonel Robert C. Lee
District Engineer
New Orleans District
Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

This refers to your November 19, 1981, letter regarding the Biological Assessment on the Lake Pontchartrain and Vicinity Hurricane Protection Project (Log no. 4-3-81-165). In the subject letter you determined that the construction and maintenance of the tentatively selected High Level Plan would have no adverse impact on the Bald Eagle; however, the institution of the Barrier Plan would adversely affect the White Kitchen Eagle Nest. Your letter goes on to say that if it appears the latter plan will be instituted, a re-evaluation of the assessment and consultation will be necessary. We concur with your determination.

Your cooperation in this effort is appreciated.

Sincerely,

Gary L. Hickman
Area Manager

cc: Director, FWS, Washington, D.C. (AFA/OES)
RD, FWS, Atlanta, GA (AFA/SE)
ES, FWS, Lafayette, LA
Department of Wildlife and Fisheries,
New Orleans, LA

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
200 EAST PASCAGOULA STREET, SUITE 300
JACKSON, MISSISSIPPI 39201

gr PD-RL JC ZOG

July 23, 1981

IN REPLY REFER TO:
Log no. 4-3-81-165

Mr. James F. Roy
Chief, Planning Division
Department of the Army
New Orleans District, Corps of
Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Reference: LMNPD-RE

Dear Mr. Roy:

This responds to your letter of July 2, 1981, requesting endangered species information for the area of your proposed Lake Pontchartrain and Vicinity Hurricane Protection project located in Jefferson, Orleans and St. Charles Parishes, Louisiana.

The only listed species likely to occur in the project area is the bald eagle (Haliaeetus leucocephalus). An eagle nest has been reported at 90° 20' 16" w. long, 29° 59' 01" n. lat. (approximately 3 miles NNW of St. Rose) by J.A. Dugoni in his Masters Thesis on bald eagles in Louisiana (1980). Apparently this nest has not been occupied in recent years; however, the area may still provide potential eagle nesting habitat.

If you determine this project to be a major Federal action significantly affecting the quality of the human environment (i.e., one requiring an environmental impact statement), Section 7(c) of the Endangered Species Act, as amended, requires that you prepare a biological assessment identifying any listed species, species proposed to be listed, and Critical Habitat which may be affected by the proposed project, and determine the nature and extent of impact that the project may have on such species. Section 7(c) also stipulates that the biological assessment shall be completed within 180 days after the date on which initiated and before any contract for construction is entered into and before construction is begun. The assessment should include, as a minimum:

1) an on-site inspection of the area;
2) interviews with recognized experts on the species at issue;
3) a review of literature and other pertinent scientific data;
4) an analysis of the effects of the proposal on the species; and
5) a review of alternative actions that may provide conservation measures.

If you determine this action not to be one requiring an environmental impact statement, a biological assessment is not required; however, you still have an obligation to review the activity to determine if it may affect listed species or Critical Habitat and to initiate formal consultation pursuant to Section 7(a), if you find that such an affect may occur.

For additional information regarding your obligations under the Endangered Species Act, contact Fred Bagley, Endangered Species Specialist, U.S. Fish and Wildlife Service, 200 East Pascagoula Street, Suite 300, Jackson, Mississippi 39201, telephone FTS 490-4912, commercial (601) 960-4912.

We appreciate your concern for endangered species.

Sincerely,

Dennis B. Jordan

Acting for Gary L. Hickman
Area Manager

cc: RD, FWS, Atlanta, GA (ARD-FA/SE)
ES, FWS, Lafayette, LA
Department of Wildlife and Fisheries
New Orleans, LA

United States Department of the Interior
FISH AND WILDLIFE SERVICE
JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 3185
JACKSON, MISSISSIPPI 39213

July 23, 1984

Mr. Cletis R. Wagahoff
New Orleans District, Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

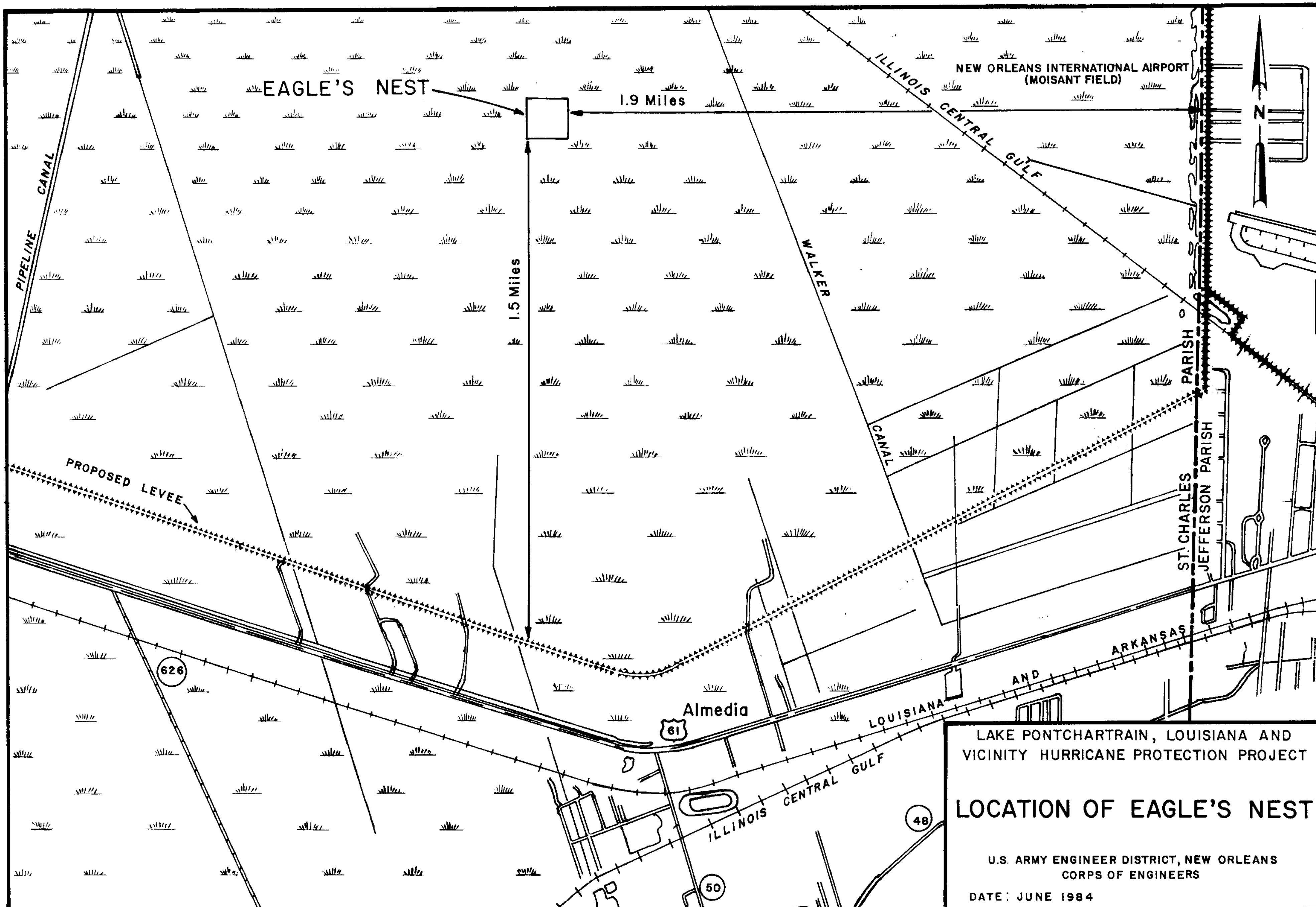
Dear Mr. Wagahoff:

This refers to your letter of June 13, 1984, which presented a biological assessment of the Lake Pontchartrain and Vicinity Hurricane Protection Project (log number 4-3-81-165). In this assessment you state that the High Level Plan (the preferred plan) is not expected to impact the bald eagle. You also state that the Barrier Plan would impact the White Kitchen nest and, if this plan is selected, consultation will be necessary. This office concurs with your findings.

Your continued cooperation on this matter is appreciated.

Sincerely yours,

for Dennis B. Jordan
Field Supervisor
Endangered Species Field Office



LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY HURRICANE PROTECTION PROJECT

LOCATION OF EAGLE'S NEST

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

DATE: JUNE 1984

PLATE 1

Section II

List of Common and Scientific Names of Plants Mentioned in the Report

Alligatorweed	Alternanthera	philoxeroides
American Elm	Ulmus	americana
Baldcypress	Taxodium	distichum
Bitter Pecan	Carya	aquatica
Black Rush	Juncus	roemarianus
Black Willow	Salix	nigra
Bulltongue	Sagittaria	falcata
Cattail	Typha	spp.
Chinese Tallow	Sapium	sebiferum
Cottonwood	Populus	deltoides
Deerpea	Vigna	luteola
Drummond Red Maple	Acer	drummondi
Duck Potato	Sagittaria	latifolia
Duckweed	Lemna	spp.
Eastern Baccharis	Baccharis	halimifolia
Hackberry	Celtis	laevigata
Hogcane	Spartina	cynosuroides
Leafy Threesquare	Scirpus	robustus
Maidencane	Panicum	hemitomon
Marsh Elder	Iva	frutescens
Nuttall Oak	Quercus	nuttalii
Oystergrass	Spartina	alterniflora
Panic Grass	Panicum	spp.
Pickerelweed	Pontederia	cordata
Pumpkin Ash	Fraxinus	tomentosa
Royal Fern	Osmunda	regalis
Saltgrass	Distichlis	spicata
Saltwort	Batis	maritima
Sawgrass	Cladium	jamaicense
Swamp Privet	Forestiera	acuminata
Sycamore	Platanus	occidentalis
Three-cornered grass	Scirpus	olneyi
Tupelogum	Nyssa	aquatica
Water Hyssop	Bacopa	monnieri
Water Oak	Quercus	nigra
Waxmyrtle	Myrica	cerifera
Wild Millet	Echinochloa	crusgalli
Wiregrass	Spartina	patens

Submerged Aquatics

Southern Naiad	*Najas*	*guadalupensis*
Spikerush	*Eleocharis*	*spp.*
Water primrose	*Ludwigia*	*spp.*
Wideongrass	*Ruppia*	*maritima*
Wild Celery	*Vallisneria*	*americana*

Section III

Fisheries Data

List of Common and Scientific

Names of Fish

Atlantic Croaker	Micropogonias	undulatus
Bay Anchovy	Anchoa	mitchilli
Blue Catfish	Ictalurus	furcatus
Bluegill	Lepomis	macrochirus
Gizzard shad	Dorosoma	cepedianum
Gulf killifish	Fundulus	grandis
Gulf menhaden	Brevoortia	patronus
Gulf pipefish	Syngnathus	scovelli
Hardhead catfish	Arius	felis
Inland Silverside	Menidia	beryllina
Least Killifish	Heterandria	formosa
Mosquito fish	Gambusia	affinis
Naked goby	Gobiosoma	bosci
Rainwater Killifish	Lucania	parva
Red Drum	Sciaenops	ocellatus
Redear Sunfish	Lepomis	microlophus
Rough Silversides	Membras	martinica
Sailfin Molly	Poecilia	latipinna
Sand Seatrout	Cynoscion	arenarius
Sheepshead Minnow	cyprinodon	variegatus
Skipjack herring	Alosa	chrysochloris
Southern Flounder	Paralichthys	lethostigma
Spotted Seatrout	Cynoscion	nebulosus
Spot	Leiostomus	xanthurus
Spotted Sunfish	Lepomis	punctatus
Stripped Mullet	Mugil	cephalus

Table 1 Seasonal occurrence of 20 most abundant species in Lake Pontchartrain, La. in 1978 (adapted from Thompson & Verret in Stone et al 1980)

JANUARY

Species	Number	Percent of Catch*
1. *Menidia beryllina*	281	35.4
2. *Anchoa mitchilli*	125	15.8
3. *Mugil cephalus*	121	15.3
4. *Micropogonias undulatus*	79	10.0
5. *Dorosoma cepedianum*	27	3.4
	633	79.9

FEBRUARY

Species	Number	% of Catch
1. *Menidia beryllina*	736	38.8
2. *Anchoa mitchilli*	525	27.6
3. *Micropogonias undulatus*	251	13.2
4. *Brevoortia patronus*	127	6.7
5. *Ictalurus furcatus*	47	2.5
	1686	88.8

MARCH

Species	Number	% of Catch
1. *Micropogonias undulatus*	716	23.3
2. *Brevoortia patronus*	685	22.3
3. *Anchoa mitchilli*	684	22.2
4. *Cyprinodon variegatus*	284	9.2
5. *Menidia beryllina*	220	7.2
	2589	84.2

APRIL

Species	Number	% of Catch
1. *Brevoortia patronus*	3419	51.5
2. *Anchoa mitchilli*	1187	17.9
3. *Micropogonias undulatus*	757	11.4
4. *Menidia beryllina*	590	8.9
5. *Leiostomus xanthurus*	260	3.9
	6213	93.6

*Represents percentage of composite of all lake samples collected with all gear types (Seine, trawl, and sill net).

Table 1 (Continued)

MAY

Species	Number	% of Catch
1. *Brevoortia patronus*	3950	61.5
2. *Anchoa mitchilli*	855	13.3
3. *Micropogonias undulatus*	831	12.9
4. *Menidia beryllina*	229	3.6
5. *Leiostomus xanthurus*	189	2.9

JUNE

Species	Number	% of Catch
1. *Anchoa mitchilli*	2019	33.6
2. *Micropogonias undulatus*	814	13.6
3. *Menidia beryllina*	731	12.2
4. *Cyprinodon variegatus*	356	5.9
5. *Fundulus grandis*	349	5.8

JULY

Species	Number	% of Catch
1. *Micropogonias undulatus*	3236	38.7
2. *Anchoa mitchilli*	2519	30.1
3. *Menidia beryllina*	854	10.2
4. *Leiostomus xanthurus*	296	3.5
5. *Syngnathus scovelli*	246	2.9
	7151	85.4

AUGUST

Species	Number	% of Catch
1. *Anchoa mitchilli*	3155	44.8
2. *Micropogonias undulatus*	799	11.3
3. *Menidia beryllina*	676	9.6
4. *Cyprinodon variegatus*	514	7.3
5. *Syngnathus scovelli*	416	5.9
	5560	78.9

Table 1 (Continued)

SEPTEMBER

Species	Number	% of Catch
1. *Anchoa mitchilli*	2797	42.1
2. *Micropogonias undulatus*	1821	27.4
3. *Menidia beryllina*	674	10.1
4. *Syngnathus scovelli*	413	6.2
5. *Arius felis*	215	3.2
	5920	89.0

OCTOBER

Species	Number	% of Catch
1. *Anchoa mitchilli*	3757	60.6
2. *Micropogonias undulatus*	543	8.8
3. *Syngnathus scovelli*	534	8.6
4. *Arius felis*	428	6.9
5. *Menidia beryllina*	245	4.0
	5507	88.9

NOVEMBER

Species	Number	% of Catch
1. *Anchoa mitchilli*	3909	63.5
2. *Micropogonias undulatus*	793	12.9
3. *Menidia beryllina*	577	9.4
4. *Syngnathus scovelli*	350	5.7
5. *Gobiosoma bosci*	76	1.2
	5705	92.7

DECEMBER

Species	Number	% of Catch
1. *Micropogonias undulatus*	727	21.5
2. *Anchoa mitchilli*	535	15.9
3. *Cyprinodon variegatus*	350	10.4
4. *Menidia beryllina*	308	9.1
5. *Poecilia latipinna*	297	8.8
	2217	65.7

Table 1 (Continued)

1978		Number	% of Catch	Cumulative
1.	Anchoa mitchilli	22067	35.2	
2.	Micropogonias undulatus	11367	18.2	
3.	Brevoortia patronus	9076	14.5	
4.	Menidia beryllina	6121	9.8	
5.	Syngnathus scovelli	2219	3.5	81.2
6.	Cyprinodon variegatus	1644	2.6	
7.	Leiostomus xanthurus	1379	2.2	
8.	Arius felis	1109	1.8	
9.	Lucania parva	938	1.5	
10.	Fundulus grandis	723	1.2	90.5
11.	Mugil cephalus	688	1.1	
12.	Cynoscion arenarius	570	0.9	
13.	Poecilia latipinna	531	0.8	94.9
14.	Gambusia affinis	520	0.8	
15.	Gobiosoma bosci	470	0.8	
16.	Trinectes maculatus	357	0.6	
17.	Cynoscion nebulosus	308	0.5	
18.	Ictalurus furcatus	270	0.4	
19.	Alosa chrysochloris	213	0.3	
20.	Membras martinica	195	0.3	97.0

Table 2 Habitats of 20 Most Abundant Fish Species in Lake Pontchartrain (adapted from Thompson & Verret in Stone et al 1980)

	Open Lake	Grassbeds	Beach	Marsh
Anchoa mitchilli	1		2	2
Micropogonias undulatus	1			
Brevoortia patronus	1		2j	2j
Menidia beryllina		2	1	2
Cyprinodon variegatus			2	1
Lucania parva		2		1
Poecilia latipinna		2		1
Syngnathus scovelli		1		
Leiostomus xanthurus	1	2j		
Gambusia affinis				1
Fundulus grandis			1	2
Arius felis	1		2j	
Mugil cephalus	1		2j	
Lepomis punctatus		2		1
Lepomis macrochirus		2		1
Cynoscion arenarius	1			
Ictalurus furcatus	1			
Lepomis microlophus		2		1
Heterandria formosa				1
Gobiosoma bosci		1		

1 - primary habitat
2 - secondary habitat
j - juveline habitat when different from adult

Commercial Fisheries Data
for Lake Pontchartrain

The following tables provide commercial landing data utilized for the basis of economic analysis. Tables 3 and 4 give the poundages and ex vessel prices of the catch. These poundages do not reflect the total poundage or value of the fishery of Lake Pontchartrain due to the large numbers of "part time commercial fishermen". These poundages and values are only those recorded and landed at commercial fish wholesalers. It has been suggested by U. S. Fish and Wildlife Service that shrimp and crab poundages should be increased by a factor of 2 to reflect the value added to the fishery by "part time" commercial fishing. These values do reflect the gross value of the catch, not the net profit to the fisherman. Economic analysis is based on the net value which takes into account cost of harvest and inflation.

Table 5 indicates the catch per acre and volume in Lakes Pontchartrain and Maurepas.

Table 3 Commercial Landings Updated Data From 1976 - 1981 Obtained From National Marine Fisheries Service

CATCHES FOR FISH AND SHELLFISH FOR CERTAIN WATER BODIES
LAKE BORGNE AND LAKE PONTCHARTRAIN

1976

	POUNDS	VALUE
BUFFALO	2,900	490
CATFISH	39,000	17,435
CROAKER	700	83
DRUM, BLK	5,800	837
DRUM, RED	24,100	7,932
FLOUNDERS	400	153
GARFISH	500	86
KING WHITING	-	-
MULLET	-	-
POMPANO	-	-
SEA CATFISH	1,000	135
SEA TROUT, SPOTTED	14,800	6,652
SEA TROUT, WHITE	2,700	457
SHAD	50,000	2,500
SHARKS	100	21
SHEEPSHEAD, FW	1,900	307
SHEEPSHEAD, SW	-	-
SPANISH MACKEREL	-	-
BL. CRABS, HARD	1,294,000	283,814
BL. CRABS, SOFT	26,500	42,800
OYSTERS	601,700	448,835
SHRIMP	1,501,800	991,983

Table 3 (Continued) Catches For Fish And Shellfish For Certain Water Bodies Lake Borgne And Lake Pontchartrain

	1977		1978		1979*	
	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE
BUFFALO FISH	3,800	646	-	-	900	162
CATFISH	100,300	46,655	85,000	41,536	30,087	21,340
CROAKER	3,000	424	1,600	248	700	84
DRUM, BLK	25,300	2,407	1,500	308	1,010	231
DRUM, RED	29,300	9,059	6,400	2,583	1,629	1,010
FLOUNDERS	1,400	543	300	109	100	50
GARFISH	400	69	4,600	2,142	3,850	801
KING WHITING	-	-	400	59	-	-
MULLET	2,700	218	-	-	-	-
POMPANO	-	-	-	-	-	-
SEA CATFISH	14,000	1,664	-	-	1,200	169
SEATROUT, SPOTTED	34,200	17,351	300	228	3,440	2,500
SEA TROUT, WHITE	1,600	328	200	81	1,844	502
SHAD	35,000	1,750	-	-	40,000	2,000
SHARKS	59,600	5,956	-	-	-	-
SHEEPSHEAD, FW	2,300	411	-	-	1,300	238
SHEEPSHEAD, SW	9,700	781	100	17	66	13
SPANISH MACKEREL	800	75	-	-	-	-
BL. CRABS, HARD	1,586,900	445,604	1,418,700	346,450	2,049,332	474,905
BL. CRABS, SOFT	64,000	169,092	1,200	3,150	63,940	154,797
OYSTERS	446,900	432,362	1,347,900	1,673,106	499,779	810,022
SHRIMP	755,900	778,153	575,870	847,296	51,900	204,058

*Preliminary

Table 3 (Continued) Catches for fish and shellfish for certain water bodies Lake Borgne and Lake Pontchartrain

	1980*		1981*	
	POUNDS	VALUE	POUNDS	VALUE
BUFFALO	-	-	-	-
CATFISH	-	-	72,247	39,337
CROAKER	450	67	473	209
DRUM, BLK	300	60	143,890	43,268
DRUM, RED	730	552	9,261	8,032
FLOUNDERS	175	100	2,618	1,942
GARFISH	-	-	-	-
KING WHITING	-	-	479	215
MULLET	-	-	130,000	41,000
POMPANO	-	-	-	-
SEA CATFISH	550	97	1,988	597
SEA TROUT SPOTTED	600	510	5928	4,939
SEA TROUT, WHITE	1,000	450	-	-
SHAD	27,000	2,700	55,000	5,500
SHARKS	-	-	-	-
SHEEPSHEAD, FW	-	-	-	-
SHEEPSHEAD, SW	-	-	462	114
SPANISH MACKEREL	-	-	978	342
BL. CRABS, HARD	2,800,127	698,431	1,521,269	481,105
BL. CRABS, SOFT	54,540	129,686	62,025	149,379
OYSTERS	459,934	779,274	884,966	1,671,725
SHRIMP	441,420	760,452	460,037	823,668

*Preliminary

Table 4 Comparison of Lakes Pontchartrain/Maurepas Commercial Shrimp Catch[1] with Louisiana Total Inshore Catch, 1963-1972[2] (from Thompson and Stone in Stone et al 1980)

Year	Pounds Pont./Maur.	Pounds Inshore	Percent of Inshore catch from Pontchartrain-Maurepas
1963	---	40,434,845	---
1964	---	23,505,408	---
1965	5,000	27,372,215	.02
1966	107,900	27,206,738	.40
1967	---	35,117,790	---
1968	60,000	36,316,453	.17
1969	73,600	43,083,911	.17
1970	409,000	44,573,201	.92
1971	154,600	47,406,401	.33
1972	335,800	38,351,009	.88
X	163,700	36,336,797	.41

[1]Data taken from National Marine Fisheries Service, New Orleans Office

[2]Data modified from Barrett and Gillespie (1973), Table 5.

[3]Percent of the Louisiana inshore shrimp catch contributed by Lakes Pontchartrain and Maurepaus.

Table 5

Commercial Catches on the Basis of the Area and Volume [1] of Lakes Pontchartrain and Maurepas, 1963-1975 [2,3] (from Thompson and Stone in Stone et al 1980)

		Lbs/acre	Lbs/acre-ft.	$/acre	$/acre-ft.
	Fish	.26	.02	.05	.004
1963	Crab	2.29	.21	.24	.022
	Shrimp	---	---	---	---
	Fish	.27	.02	.06	.005
1964	Crab	1.22	.11	.16	.014
	Shrimp	---	---	---	---
	Fish	.21	.02	.05	.005
1965	Crab	.71	.06	.10	.009
	Shrimp	.01	*	*	*
	Fish	.15	.01	.03	.003
1966	Crab	.78	.07	.09	.008
	Shrimp	.24	.02	.11	.010
	Fish	.16	.01	.03	.003
1967	Crab	1.33	.12	.13	.011
	Shrimp	---	---	---	---
	Fish	.11	.01	.03	.002
1968	Crab	1.13	.10	.15	.014
	Shrimp	.13	.01	.08	.007
	Fish	.34	.03	.06	.005
1969	Crab	1.27	.11	.19	.017
	Shrimp	.16	.01	.08	.007
Total	Fish	1.50	.13	.31	.028
1963-	Crab	8.73	.78	1.06	.095
69	Shrimp	.54	.05	.28	.025
	Fish	.31	.03	.05	.005
1970	Crab	.99	.09	.11	.010
	Shrimp	.90	.08	.20	.018
	Fish	.09	.01	.02	.002
1971	Crab	2.46	.22	.40	.036
	Shrimp	.34	.03	.08	.007
	Fish	.18	.02	.05	.004
1972	Crab	1.56	.14	.29	.026
	Shrimp	.74	.07	.30	.027
	Fish	.14	.01	.05	.004
1973	Crab	4.44	.40	.79	.071
	Shrimp	.02	*	.02	.002
	Fish	.12	.01	.03	.002
1974	Crab	2.57	.23	.54	.048
	Shrimp	.28	.03	.09	.008
	Fish	.12	.01	.02	.002
1975	Crab	2.23	.20	.49	.044
	Shrimp	.01	*	.02	.002
Total	Fish	.96	.09	.22	.020
1970-	Crab	14.25	1.28	2.61	.234
75	Shrimp	2.29	.20	.72	.065
Total	Fish	2.46	.22	.54	.048
1963-	Crab	22.98	2.06	3.68	.329
75	Shrimp	2.83	.25	1.00	.089
	Fish	.21	.02	.04	.004
$\bar{x}$1963-	Crab	1.24	.11	.15	.014
69	Shrimp	.14	.01	.07	.006
	Fish	.16	.02	.04	.003
$\bar{x}$ 1970-	Crab	2.38	.21	.44	.039
75	Shrimp	.38	.03	.12	.011
	Fish	.19	.02	.04	.004
$\bar{x}$ 1963-	Crab	1.77	.16	.28	.025
75	Shrimp	.28	.03	.10	.009

[1] Lake Pontchartrain-Maurepas area - 456,318 acres; volume - 5,098,490 acre ft. (Barrett 1970)

[2] Catch data from National Marine Fisheries Service, New Orleans Office

[3] Shrimp data missing for 1963, 1964, and 1967

*Dollar values less than $.01/acre or lbs. less than .001/acre ft.

SECTION IV

BENTHIC DATA

The purpose of the plates that follow is to provide the reader with information used as a basis for evaluating benthic impacts of dredging along with the Jefferson Parish Lakefront. Figure 1 shows the negative correlation between benthic abundance and the high organic content found along Jefferson Lakefront. Figure 2 displays the variation in species richness (number of species in a area) in Lake Pontchartrain. Figure 3 demonstrates the effect of sediment type on benthic distribution.

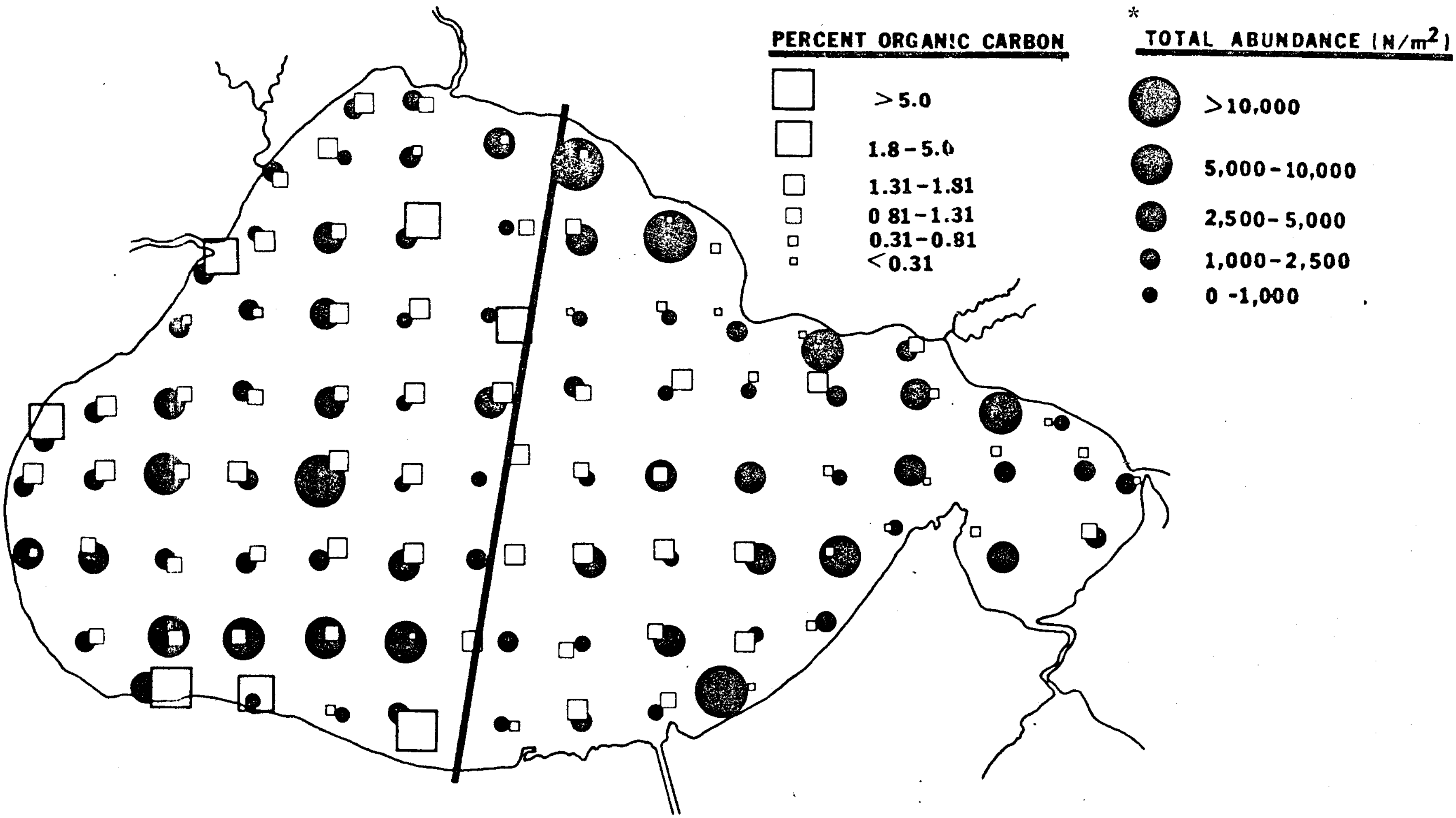


Figure 1. Organic carbon distribution of sediments in Lake Pontchartrain, LA, from 1978 survey (as adapted from Sikora & Bahr in Stone (et al 1980)

*Total abundance of macro faunal benthic organisms

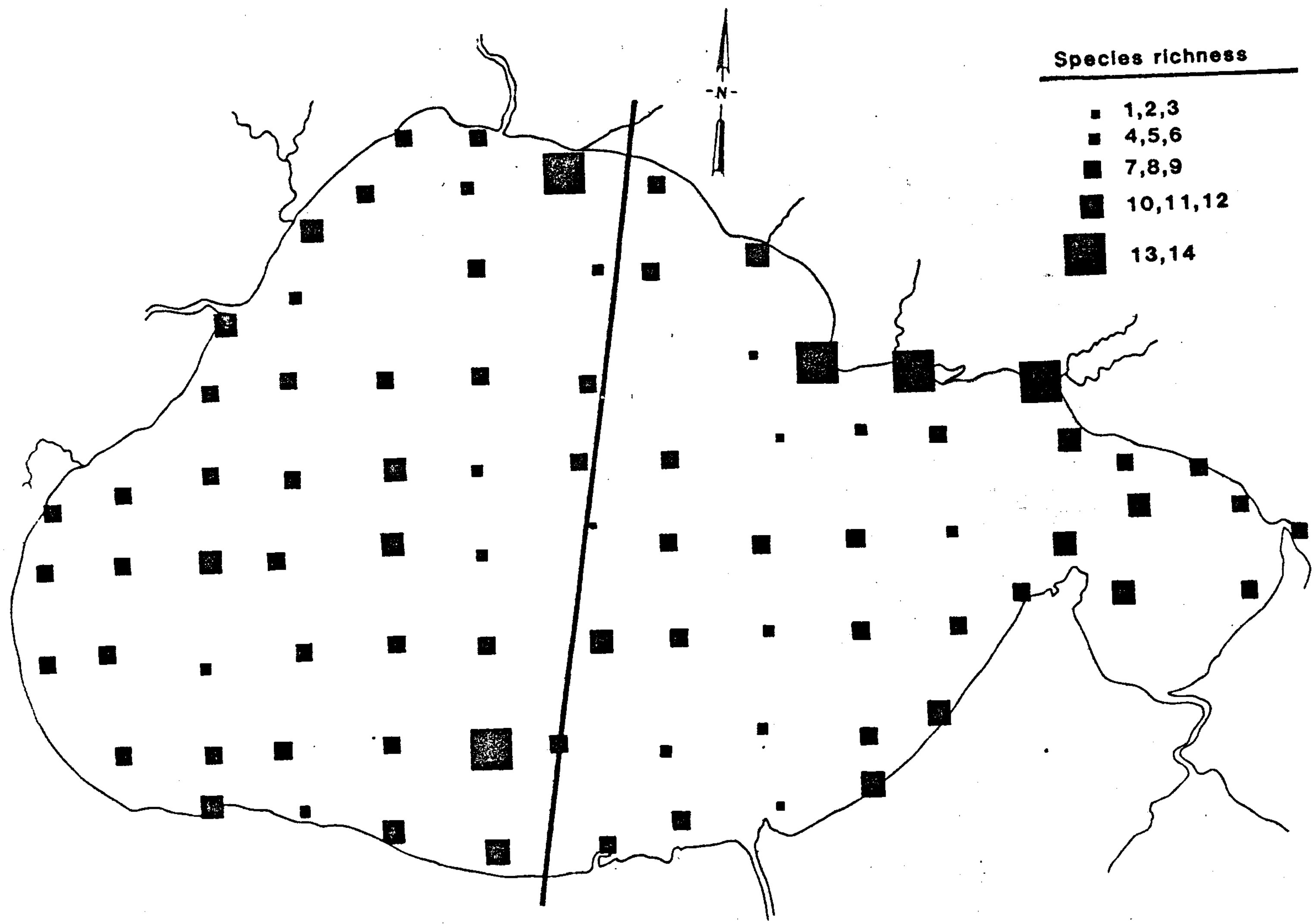


Figure 2. Total number of macrofaunal species (or taxa) found at each survey station in Lake Pontchartrain, LA, druing the present study (as adapted from Sikora & Bahr in Stone et al. 1980)

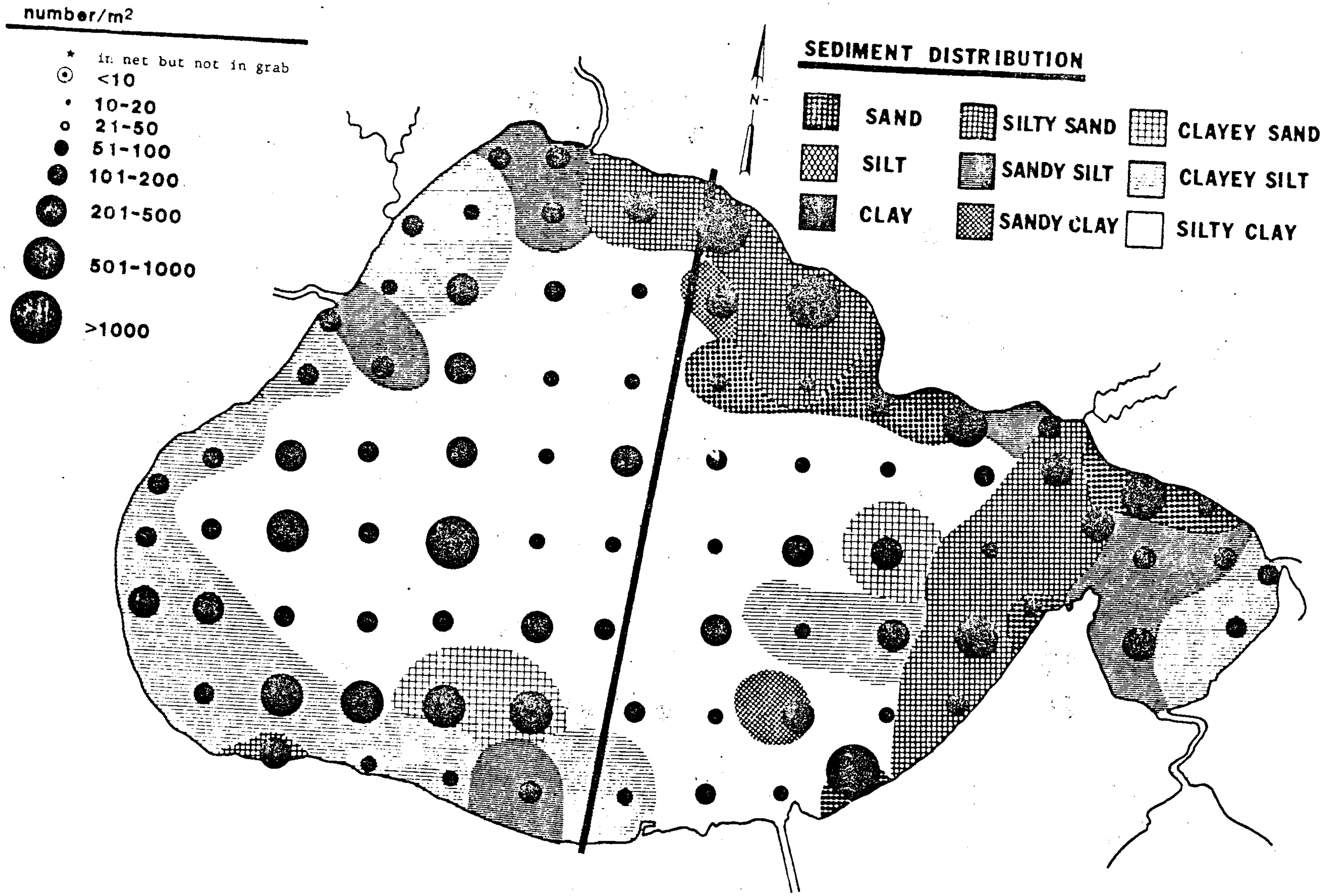


Figure 3. Distribution of total macrofaunal organisms in surface sediments of Lake Pontchartrain, La, (as adapted from Skora & Bahr in Stone et al. 1980)

SECTION V

EFFECTS OF FLOOD CONTROL BARRIERS IN PASSESS OF LAKE PONTCHARTRAIN, LOUISIANA

Report

To

District Engineer

New Orleans District

U.S. Army Corps of Engineers

EFFECTS OF FLOOD CONTROL BARRIERS IN PASSES OF LAKE PONTCHARTRAIN, LOUISIANA

L. Eugene Cronin, Ph. D.

Consultant

September 1982

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EXECUTIVE SUMMARY

* Lake Pontchartrain is a large, shallow, productive low-salinity estuarine body of water with extensive fresh-water input and connection to saltier waters only through The Rigolets, Chef Menteur and the Inner Harbor Navigation Canal (to the Mississippi River - Gulf Outlet).
* The three passes are different. The Rigolets is the largest and longest and conveys the most water. Chef Menteur is similar but smaller. The Inner Harbor Navigation Canal is smallest, with least flow, has the most saline waters and is industrialized.
* The waters and sediments of all three passes contain a wide variety of organic and inorganic pollutants, most of which are in low concentrations but some of which may be biologically injurious.
* Phytoplankton in the passes is variable and abundant, and Lake Pontchartrain populations are dominated by the euryhaline and brackish-water species which enter through the passes and require the salinity made possible by the passes.
* Zooplankton of the passes is the source of the most abundant and important food species of Lake Pontchartrain, which require a brackish environment.
* Macro-zooplankton include the larval and juvenile stages of species of great ecologic and economic value - anchovy, menhaden, croaker, sea trout, blue crabs, shrimp and others. The passes are the only source of these species and required salinity for Lake Pontchartrain.
* Nekton are diverse and abundant in the passes, and include menhaden, anchovies, croaker, spot, shrimp, crabs and others.
* The fish and invertebrates using the passes for transport are the primary basis for the fisheries of Lake Pontchartrain and an exceptionally important source of shrimp and menhaden catch outisde of the Lake.
* Benthic species are abundant and feed many larger organisms.
* Proposed changes at The Rigolets include a closure dam with a 16-bay control structure and a navigation lock. This would reduce normal flows by approximately 6%.
* At Chef Menteur, the lower pass would be damed, a new pass would be cut, a closure dam with 9 bays would be built and a navigation lock would be cut. Normal flow would be reduced approximately 3%.

* The Seabrook Complex would contain a navigation lock, a closure dam and a control structure capable of permitting maximum normal flow or any selected lower rate and pattern of exchange.
* Extensive studies of Lake Pontchartrain and direct observation in the passes establish that the passes (1) are the only exit for fresh water entering the Lake, (2) allow the entry of all of the saline water entering the Lake from the Gulf system, (3) sustain a substantial resident population, (4) provide entry of the animals and plants which are the most abundant and important biological populations in the Lake, (5) transport larvae and juveniles into the Lake for feeding and growth, (6) permit exit of fish and shrimp which range over a large area, (7) create the low-salinity environment in the Lake required by Rangia clams, the small food species and most of the fish and invertebrates there, (8) permit marine fish to enter the Lake and become available for capture, (9) allow out-flow of spill-water from Bonnet Carre' - and subsequent re-invasion of the important brackish species.
* Much, probably most, of the biological population and fisheries of Lake Pontchartrain is pass-dependent, and so are large external fisheries for shrimp and menhaden.
* Proposed dredging would destroy at least 186 acres of benthic biota and 443 acres of marsh, with extensive mortalities and reduction of productivity and habitat for many species, including invertebrates, fish, birds and mammals.
* Sediment would be released into the water column, choking the gills of fish and invertebrates, releasing chemicals and settling to smother benthic biota.
* Deep water areas would be created, some of which will be well-flushed and biologically useful but much of which (in the old pass at Chef Menteur) are likely to become catch basins for silt and detritus, depleted of oxygen, rich in toxic sulfides and biologically impoverished.
* The placement of dredged material will destroy 2556 acres of marsh at Chef Menteur and an unknown area at The Rigolets. This will smother present biota, modify local movements of water, destroy the habitat of birds and mamals, possibly release injurious chemicals and eventually produce new and different biological communities.
* Construction will release large quantities of sediment and temporarily dam various areas with biological effects.

* Rip-rap would create new and potentially useful stone substrates which will probably enhance fishing.
* The barrier structures would create higher velocities in the control structures which may have detrimental effects on eggs and larvae.
* Closing off of shoal areas, especially in The Rigolets, would reduce transport through the passes for shoal - water animals.
* New scoured areas in Lake Borgne would distribute sediments and then permit new communities to develop.
* The old lower portion of Chef Menteur may become a virtually dead-water trap for sediment and detritus with a highly unfavorable biological environment.
* Reduction of flow, ca. 6% at The Rigolets and 3% at Chef Menteur, will reduce the import of salt into Lake Borgne and reduce salinity.
* Transport of organisms between Lake Borgne and Lake Pontchartrain will be reduced, with detriment to the estuarine species of Lake Pontchartrain.
* The most important long-term impacts for Lake Pontchartrain from reduction in flow are lowered salinity and, especially, reduced import of the most important species, their food supply and their required environment.
* Standing crops of most species will be lower, nursery support for shrimp, menhaden and others will be reduced.
* Recovery from inundation from Bonnet Carre' spillway will be slower.
* The combined recreational and commercial fisheries of Lake Pontchartrain and the portion of the Gulf of Mexico system which it supports will be reduced by an amount estimated to average at least $176,800 annually at present prices. This estimate is considered to be conservative since many data are incomplete on recreational acitivity, on shrimp production and catch, on the replenishment of Rangia clams and other economically significant effects of contruction and operating the barriers.

EFFECTS OF FLOOD CONTROL BARRIERS IN PASSES OF LAKE PONTCHARTRAIN, LOUISIANA

INTRODUCTION

Lake Pontchartrain (Figure 1) is a shallow estuary of low salinity in the deltaic plain of the Mississippi River in southeastern Louisiana. It has a surface area of 1631 km^2 (629 mi^2) and an average depth of 3.7 meters (12.1 ft.). It receives fresh water from the Lake Maurepas system, from a considerable number of small rivers and bayous, from drainage from New Orleans, from small feeder streams and, under high water conditions in the Mississippi River, from that River through the Bonnet Carré Spillway. It is connected with waters of higher salinity through The Rigolets Tidal Pass and Chef Menteur Pass to Lake Borgne and through the Inner Harbor Navigation Canal (IHNC), to the Mississippi River - Gulf Outlet (MR-GO) to Breton Sound.

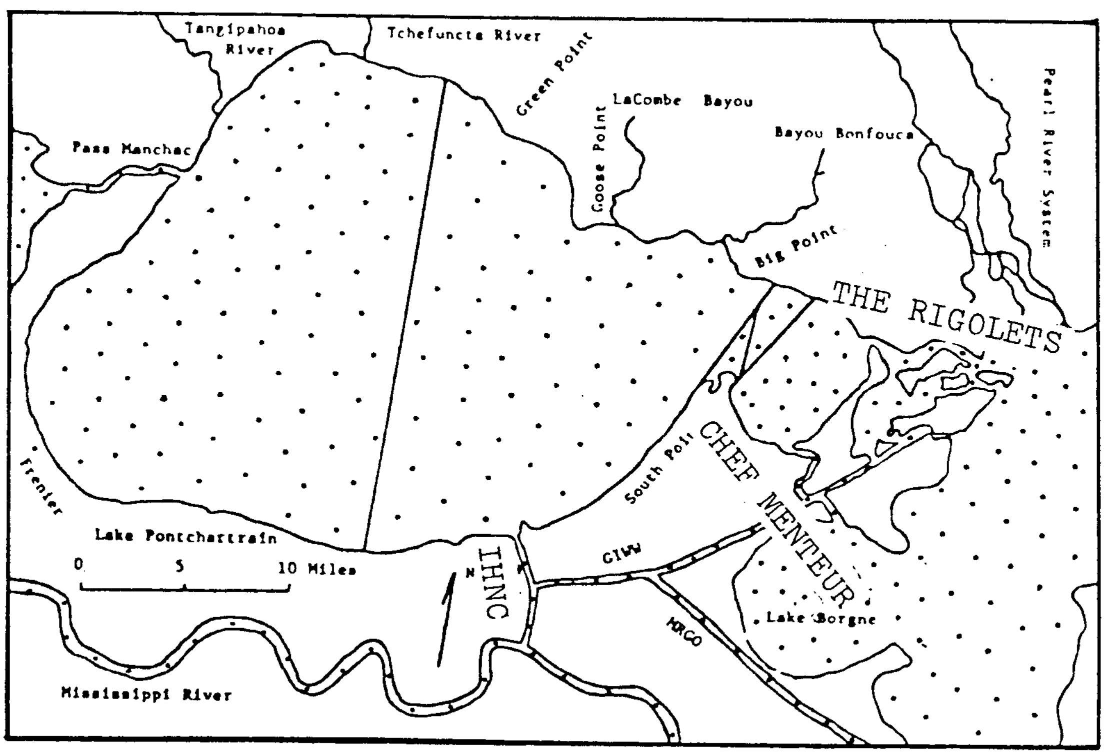


Figure 1. Lake Pontchartrain area.

One alternative among plans to protect New Orleans, other communities and property around the Lake from hurricane damage is to construct barriers across the three passes (in conjunction with elevation of levees on adjacent land masses.) The barrier structures would involve several kinds of alterations, including dredging, construction of permanent berms, establishment of locks for navigation, and placement of barrier structures in the channels. These could remain open but be positioned to block excessive in-flow from Lake Borgne and Breton Sound during hurricane conditions.

This Report provides a summary of present knowledge of the effects of construction and, more important, of long-term presence and operation of those three barrier structures. Since the biological health and usefulness of Lake Pontchartrain depends to a large extent on exchanges of water, chemicals and biota in the passes, emphasis will be upon the biota.

The most relevant and useful sets of data for considering the effects of the barriers are in "Environmental Analysis of Lake Pontchartrain, Louisiana, its Surrounding Wetlands, and Selected Land Uses", a valuable report and analysis by the faculty of the Coastal Ecology Laboratory, Center for Wetlands Resources, Louisiana State University and edited by Dr. James H. Stone, (to be referred to as Stone, Ed. 1980A) and "Recommended Sampling Program for An Analysis of Physical, Chemical and Biological Transport in the Inner Harbor Navigation Canal, Chef Menteur Pass and The Rigolets Tidal Pass, Lake Pontchartrain, Louisiana, with Reports in Preliminary Studies of these Passes" by the same Center (to be referred to as Stone, Ed. 1980B). The later report is a working document and exists in very limited numbers. It was prepared after limited sampling as the design basis for longer and more intensive year-round observations. These and other references will be cited as they may be appropriate.

DESCRIPTION OF THE PASSES

Morphometry and Hydrology

General morphometric information about the three passes is summarized in Table 1, and Figures 2, 3 and 4 show The Rigolets, Chef Menteur and the Seabrook area, respectively, as they now exist.

The Rigolets is an east-west winding pass of variable width. Part of the Pearl River system and a number of smaller waterways flow into it and Sawmill Pass to the southwest connects it with Lake St. Catherine. It is the largest pass in every characteristic. Interstate Highway 90 crosses the western end.

Chef Menteur Pass winds approximately north west - south east through old deltaic marsh areas, and is traversed by the Intracoastal Waterway and a cut section of an intended By-Pass canal. The middle portion provides shoreline for residential areas. It is crossed by U.S. Highway 90 and the Louisville and Nashville Railroad. Bayou Sauvage from the west and a number of small waterways enter the Pass.

The Inner Harbor Navigation Canal (IHNC) is an artifical canal dug in 1923, connecting Lake Pontchartrain to the Intracoastal Waterway and to the Mississippi River - Gulf Outlet system which was completed to Breton Sound in 1963. The IHNC is lined with a variety of industrial facilities and crossed by two railroad bridges and three highway bridges.

TABLE 1. Physical Characteristics of Lake Pontchartrain Passes

	The Rigolets	Chef Menteur	Inner Harbor Navigation Canal
Length - km (mi)[4]	14.5 (9.0)	11.3 (7.0)	30 (18.6)
Ave. width - km, ca.	.9		
Max. width - km	1.4		
Depth, ave. - m (ft.)	8 (26)	13 (43)	7.5 (25)
, max. channel-m (ft.)	28 (93)	25 (82)	11 (35)
, min. - channel-m (ft.)	8 (27)	8 (27)	9 (31)
Cross-section area, sq ft.[3]			
Average	84,250	82,250	1125
Minimum	73,000	33,000	8000
Current velocity-cm/sec.[5]			
Mean flood	50	40	40
Mean ebb	35	45	40
Volume of transport-M^3/sec.[5]			
Mean flood	3750	2000	700
Mean ebb	2625	2250	400
Tidal range-cm (in)	24.6 (9.6)		
Tidal flow, %[6]	60	30	10
Salt into Lake, %[5]	40	40	20
Salinity - ppt.[2]			
Average, 1978-79	3.8	4.3	6.0
Annaul range	0.1-11.0	1.5-13.0	0.6-14.5
Water transport between Lake and Gulf system - %[4]	54	39	7
Stratification[5]	Usually none	Usually none	At some times
Temperature, 0 C[2]			
Average	20.8	20.6	21.9
Range	5.0-31.0	5.8-32.6	6.8-31.0
Tidal energy to Lake, %[5]	90	10	negligible
Driving force[5]	Tides over wind @ less than 2 m/sec; equal @ 2-m/sec; wind dominates above 3 m/sec.		

Reference sources: 1. Chuang and Swensen, 1981; 2. Fannaly in Stone, Ed., 1980A; 3. Soileau, 1977; 4. Stone, Ed., 1980A; 5. Swensen in Stone, Ed., 1980A; 6. Swensen and Chuang, 1981.

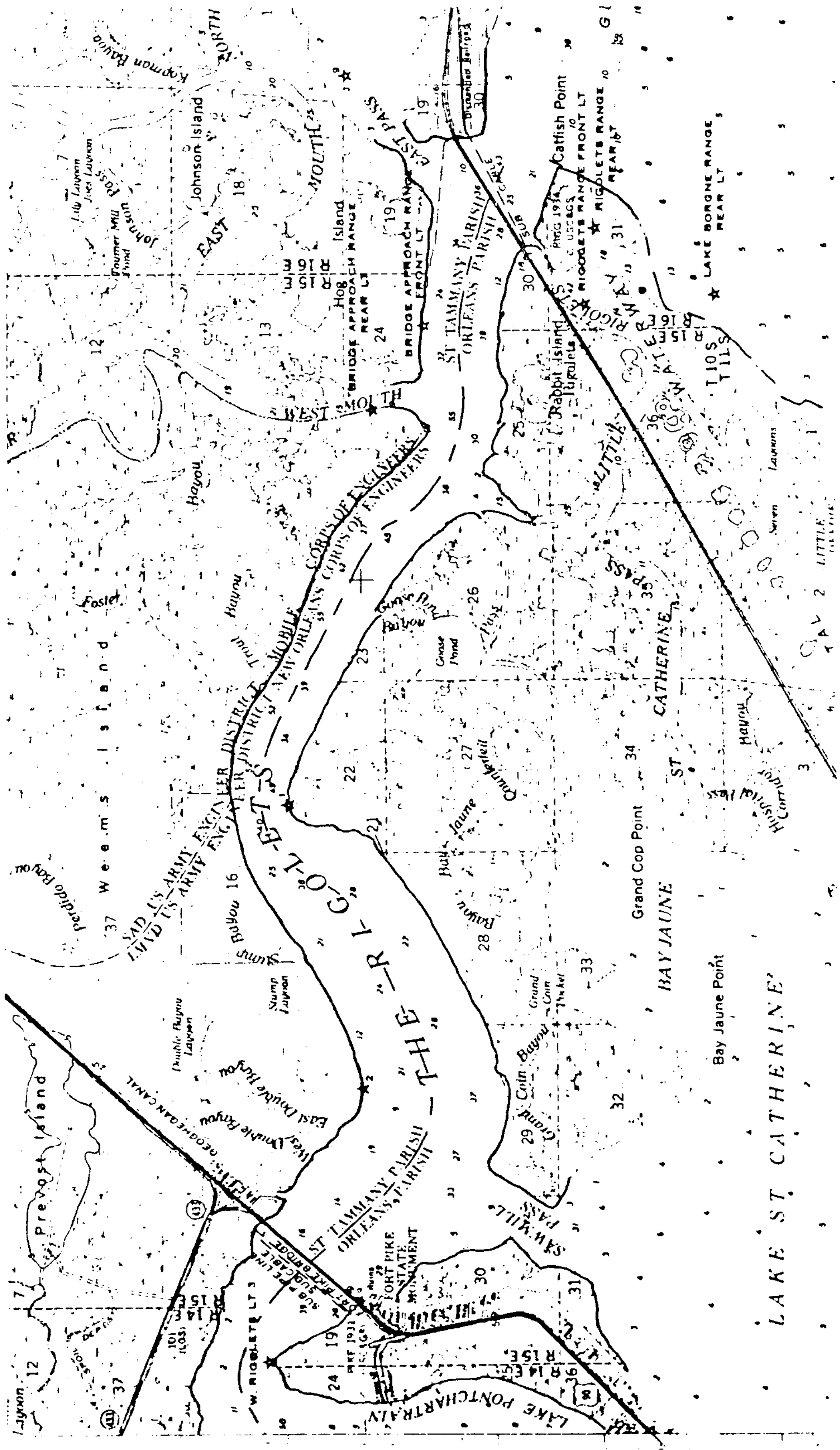
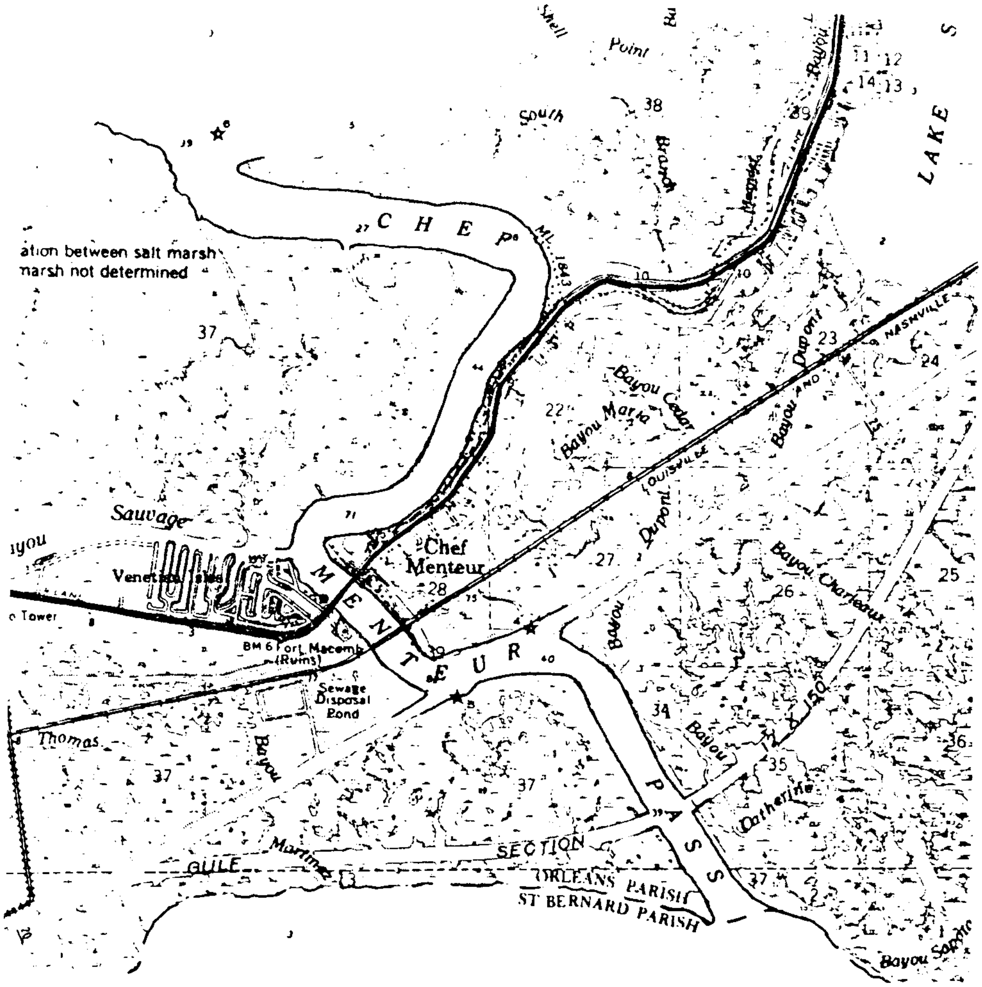


Figure 2. The Rigolets Pass and surrounding area

LAKE PONTCHARTRAIN



LAKE BORGNE

Figure 3.
Chef Menteur Pass
and surrounding
area

LAKE PONTCHARTRAIN

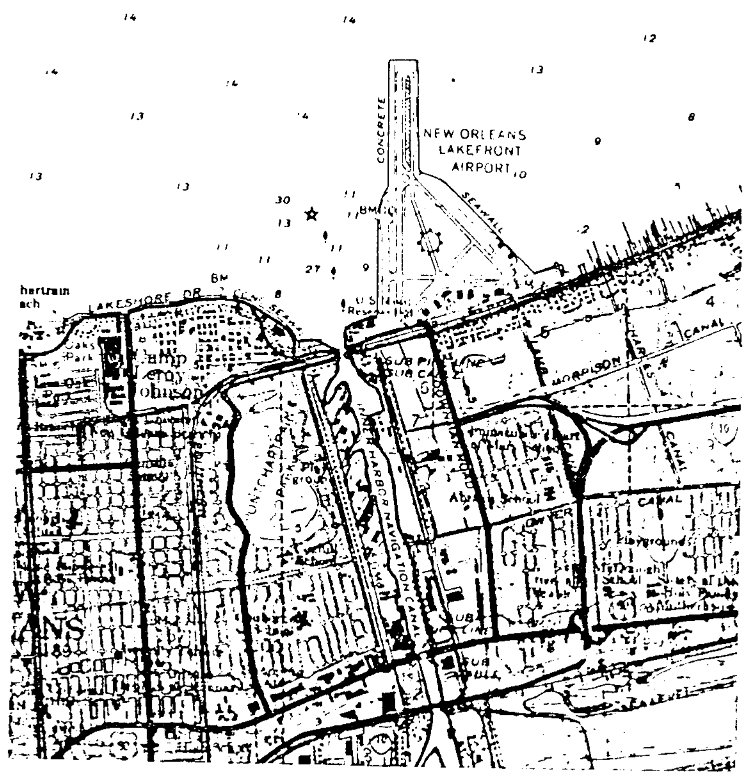


Figure 4.
Inner Harbor
Navigation Canal
and surrounding
area

Chemical Description

The Rigolets is somewhat less saline than the other two passes (Table 1), with an annual average in 1978-79 of 3.8^{o}/oo and a range from 0.1 ^{o}/oo to 11.0^{o}/oo. Salinity is affected by the flow from the Pearl River system. Chemical analyses of sediments and Rangia clams has been conducted in May and June by the Center for Bio-Organic Studies of the University of New Orleans (Lawler, Byrne et al., 1981; Lawler, Holmes et al., 1981; Ferrario and Lawler, 1981; Wong et al., 1981; Bryan and Hoffman, 1981). In the sediments, 24 of the EPA organic "priority pollutants" were present at the level of parts per billion among 95 compounds noted (Ferrario and Lawler, 1981; Lawler, Holmes et al., 1981). The burden associated with silt was, as usual, higher than with sand. Several metals - chromium, copper, nickel, lead, zinc and arsenic were present in parts per million, with zinc highest at 30 ppm. Other metals were at the parts per billion level (Bryan and Hoffman, 1981). Among pesticides and pesticide residues, Heptachlor Epoxide was present at 24 ppm, isomers of BHC were observed at 230 ppb and small quantities of other pesticides existed.

In the clam, 22 EPA organic priority pollutants occurred in parts per billion among 150 organic compounds identified (Lawler, Holmes et al., 1981, Ferrario and Lawler, 1981). The full suite of 12 metals tested was present, with zinc, nickel and copper at the level of parts per million (Bryan and Hoffman, 1981). A variety of pesticides and residues occurred at the parts per billion level, with Endosulfan Sulfate at 65 and p,p'-DDT at 10 ranking highest (Wong et al., 1981).

Sampling of the water column for asbestos gave negative results (Lawler, Byrne et al., 1981).

The Rigolets environmental contains a variety of pollutants, almost all at very low concentrations, including some of anthropogenic origin - notably pesticides.

Chef Menteur had an average salinity of 4.3^{o}/oo in the 1978-79 sampling, with a range from 1.5 to 13.0^{o}/oo (Table 1). The chemical analyses of sediments and clams in May and June, by the University of New Orleans, showed that the sediments contained 24 EPA priority pollutants at the level of parts per billion, the metals chromium, copper, nickel, lead, zinc and arsenic in parts per million, other metals in smaller concentrations and at least 15 pesticides or pesticide residues (Lawler, Holmes et al., 1981; Ferrario and Lawler, 1981; Wong et al., 1981; Bryan and Hoffman, 1981). The most abundant were Heptachlor Epoxide (19 ppm), isomers of BHC (7 ppm) and Heptachlor and Aldrin (.2-.3 ppm). Rangia clams contained 22 EPA priority organic pollutants in ppb among 150 organic compounds; metals including chromium, copper, nickel, zinc and arsenic in parts per million; and a variety of pesticides and their derivatives at the parts per billion level. Endosulfan Sulfate (40 ppb) and DDT derivatives (20 ppb) were the most abundant. No asbestos was found in the water column (Lawler, Byrne et al., 1981).

Chef Menteur sediments and a sample benthic species contain significant concentrations of some pesticides and metals and a wide variety of other pollutants at low levels.

The Inner Harbor Navigation Canal, connected as it is with the Breton - Chandeleur Sounds waters, shows the highest salinity of the Passes, and is considered to be the principal source of salt to a large portion of Lake Pontchartrain (Poirrier, 1978). As shown in Table 1, year-round average for 1978-79 was 6.0^{0}/oo, with a range from 0.6 (March) to 14.5 (July). Poirrier showed that stratification is present at the Lake end of the Canal in late spring, summer and fall, with surface waters 1-10^{0}/oo lower than the bottom layers. Surface oxygen content is higher and usually more than 50% of saturation. Wind was shown to have very important effects on stratification and the distribution of saline waters.

Chemical analysis were performed in May and June 1980 on the water column, sediments and the oyster, (Lawler, Byrne et al., 1981; Lawler, Holmes, et al., 1981; Ferrario and Lawler, 1981; Wong et al., 1981; Bryan and Hoffman, 1981). No asbestos was detected. In the water, 12 priority pollutant heavy metals were present, with zinc highest (17 ppm), and most metals were at ppb levels but higher on the ebb tide than on the flood (Lawler, Byrne, et al., 1981). 23 organic compounds of probable anthropogenic origin were present in parts per trillion. No pesticides were present at detectable levels. Benzene, toluene and ethylbenzene were present lower than 1 ppb. Phenolic compounds were present at a mean concentration of 2.5 ppb.

In sediments, all 12 priority pollutant metals were detected, with lead, chromium, copper, nickel, zinc and arsenic at levels of parts per million. 12 EPA priority organic pollutants were present at ppb or ppt levels. Several pesticides were present, of which the isomers of BHC were highest (620 ppb). The oysters contained all of the tested metals, especially zinc, and all of the 15 pesticides and their derivatives tested. Most were at less than 1 ppb, except for BHC isomers (620 ppb) and Heptachlor (3 ppb).

The IHNC contains a wide variety of pollutants at low concentrations in the water. Sediments and oysters also show the presence of organics, pesticides and metals.

Biological Content

The passes contain an important mixture of resident species and those transported by the movements of large volumes between Lake Pontchartrain and Lake Borgne, for Chef Menteur and The Rigolets, and the Mississippi River - Gulf Outlet system for the Inner Harbor Navigation Canal. While commercial and recreational fishermen "sample" the two larger passes, no data are available on the quantity and composition of their catch. The most useful information on the biota are those from Louisiana State University in Stone, Ed., 1980A and Stone, Ed., 1980B. The first of these concentrated on Lake Pontchartrain from February 1978 to April 1979, but several of the individual projects sampled in the passes over a one year period. The studies reported in the 1980B volume were specifically limited to the passes. However, they were for design purposes and confined to the period from November 1979 through March 1980, a period of lower and different biological activity for many species as compared with late spring and summer. No other direct data on the biota of the passes are available, and these two reports are the basis for description. Other studies of Lake Pontchartrain provide indirect evidence on the biological uses of the passes.

Phytoplankton populations at the Lake end of The Rigolets showed the same wide range and seasonal patterns observed in Lake Pontchartrain where chlorophyll a levels are highest in spring and lowest in winter, (Dow and Turner, in Stone, Ed., 1980A). In winter at least, concentrations at different depths vary randomly. There was an inverse relationship between chlorophyll concentrations and conductivity, indicating that Lake Pontchartrain contains the highest populations of the phytoplankton. (Oswald in Stone, Ed., 1980B). The phytoplankton of Lake Pontchartrain is dominated in abundance by euryhaline and brackish forms, which are dependant upon the passes to provide the salinity necessary for their success as populations (Stone et al. in Stone, Ed., 1980).

Zooplankton includes a wide range of sizes from micro to macro, and also involves facultative forms which are from the benthic species. Suttkus et al. (1954) found in Lake Pontchartrain a large variety of zooplankton, but dominance by a few brackish water species, which are dependent upon the passes for a favorable environment.

They listed (1) brackish plankton, (2) larval forms of brackish-water adults (crabs, barnacles, molluscs, annelids, copepods), (3) adventitious marine species and (4) adventitious fresh-water species. Acartia tonsa, "by far the most abundant copepod", survives only in brackish-water. Eighty-four species were found in winter (Linstedt et al. in Stone, Ed., 1980A). Brackish species are dominant in Lake Pontchartrain, and dependent upon the passes for a favorable environment (Stone et al. in Stone, Ed., 1980A).

Macrozooplankton, retained in nets with mesh of about 1.34 mm in these studies, includes exceptionally important organisms - the larval and juvenile stages of species of great economic and ecological value. Highly relevant data have been provided by the year-round studies of Fannaly in Stone, Ed., 1980A and winter studies in 1979-80 (Fannaly and Chambers in Stone, Ed., 1980B). Summary is useful:

- Forty-nine species of fish and crustacea were caught in the Passes over the year of sampling.
- The most common species of fish was the anchovy, followed by post-larval menhaden, juvenile croaker, gobies, silversides, sand sea trout, and a wide variety of other species in small numbers.
- The crustacea caught in largest numbers included blue crabs as larvae and young, grass shrimp juveniles, brown shrimp post-larvae, a burrowing shrimp and mud crabs.
- The assemblage varies seasonally. Menhaden, croaker and anchovy predominate from November through April; anchovy, blue crabs, gobies and grass shrimp are the most common from May through October; and a small peak of one of the gobies and larval brown shrimp was seen in April and May.
- No differences among the catch-per-sample at the three passes were detected in the raw data or by statistical analysis.
- Most species, including the fish, were more abundant at mid-depth in the Passes than at the bottom or top.
- Catches were considerably higher at night (average 22 per sample) than during the day (4 per sample), apparently related to light.
- Ichthyoplankton catch and species composition differed between the two sides of The Rigolets, but no side-to-side difference was observed in Chef Menteur.

- o Tidal effects were not statistically significant for the overall catch, but the number of menhaden, blue crabs and croakers entering the Lake on flood as macro-plankton (to use it as a nursery) was considerably larger than the number of those species existing the Lake as small organisms on the ebb.
- o There are indications that the transport of macrozooplankton into the Lake may take the form of a serial pumping movement as tidal currents cycle. On each Lake-ward flow, some but not all organisms will enter the Lake and escape the effects of the next ebb.
- o None of the important species noted spawn in the Lake - all originate in waters of higher salinity and use the Lake during part of their life cycle.

Fannaly concluded that migration through the passes is essential for maintenance of populations of most of the abundant species of Lake Pontchartrain.

For nekton, or swimming species, two limited sources of information are available on transport through the Passes. The preliminary design-oriented studies by Thompson, Levine and Verrett reported in Stone, Ed., 1980B are of value but limited to the winter and early spring of 1980. The second, necessarily indirect, source of information is in the more extensive literature on fish and other nektonic species observed in the Lake but which originated in higher-salinity waters or migrate to such waters. These studies include Suttkus, et. al, (1954), Tarver and Savoie (1976) and Thompson and Verret (1980, in Stone, Ed., 1980A).

In a variety of gear, Thompson, et. al. caught 41 species of fish and crabs and shrimp in the Passes, at a time of year not likely to be the period of greatest activity. Anchovies, menhaden, croakers, spot, gobies and hogchokers were exceptionally abundant among the fish and the blue crab was caught in larger numbers than any other invertebrate at that season. The high diversity among fish indicates that many species present in the gulf and sound waters may range into the Passes and Lake in addition to the large quantities of forage fish and others of economic importance.

Fish observed in the Lake by Suttkus et. al. (1954) which very probably used the Passes include the croaker, anchovy, spot, menhaden, sea catfish, hog-choker, sand squeteaque, silver perch, and silverside. In 1978 Thompson and Verret (1979, in Stone, Ed., 1980A) caught the following species which appear to be Pass - dependent: Anchovy, croaker, menhaden, pipefish and sea catfish were especially abundant. Mullet, spotted sea trout, sand sea trout, spot and occasional examples of other species were also present in the Lake because of transport through the Passes. In a provisional classification of all of the species of fish caught in the Lake, the authors assign 3 as anadromous, 1 as catadromous, 12 as frequent invaders from more saline waters, 8 as sporadic invaders and 29 as marine species which are known to enter the Lake - for a total of at least 53 species using the Passes.

Benthic species, associated with the bottom,are exceptionally abundant and valuable in estuarine areas. Sikora, et. al. (1980, in Stone, Ed., 1980B) provide the only, and limited, direct observation of resident benthic populations in the passes, their design - related studies during winter and early spring. Related information from Lake Pontchartrain is provided by Bahr et. al. (1980, in Stone, Ed., 1980A) and Sikora et. al. (1981). By use of box cores and benthic sleds, Sikora et. al. (in Stone, Ed., 1980B), learned, for the season studied:

- The Rigolets had about 7,000 macro-organisms per square meter of the bottom as the average for 5 stations.
- Chef Menteur provided nearly 12,000 macroorganisms per square meter for 7 stations.
- The Inner Harbor Navigation Canal contained about 16,500 organisms per square meter for 3 stations.
- The pass stations had much smaller numbers of small deposit-feeding gastropods than the eastern half of Lake Pontchartrain at the same time
- The non-mollusc macrofauna, chiefly polychaetes and small crustacea, was significantly more abundant in the passes than at Lake stations.
- All three passes had higher numbers of meiofauna, chiefly nematodes, than the eastern portion of the Lake.
- From other studies, the period of largest macrofauna standing stock is April, and of lowest is July - October. Meio-fauna peaked in March - April and November.
- Night-time plankton tows in the passes revealed that surprising numbers of benthic organisms appear in the plankton catch. Tanaids, tube-building amphipods and polychaetes are not swimmers, and their presence in passively transported plankton indicates that benthic species are being re-distributed by currents in the passes.

SUMMARY OF PROPOSED CHANGES

If the barrier plan were to be implemented, the following alterations and structure would be created at the passes:

1. The Rigolets Complex consists of barrier levees, a closure dam containing a control structure and a navigation lock (Figures 5 and 6). The control structure would be 1,088 feet in length, containing 16 tainter gates which are normally in the open or up position but can be lowered to reduce inflow into the Lake under hurricane conditions. This structure would provide a cross section of 27,720 square feet which with the lock of 1540 square feet will be equal to approximately 35% of the natural cross section of the Pass. The volume of water transported through lock and control structure Pass would be reduced to approximately 94% of the normal tidal exchange under present conditions. (Soileau, 1977).
2. The Chef Menteur Complex consists of a re-aligned channel, cut-off of the present channel, barrier levees, a navigation structure and a closure dam containing a control structure (Figures 7 and 8). The control structure would be 612 feet long and contain 9 tainter gates, open except during hurricane conditions. This would provide a cross section of 15,100 square feet, which, with the navigation gate of 1340 square feet will provide a section area equal to approximately 41% of the natural cross sectioned area of the Pass. The volume of water transported through the Pass would be reduced to approximately 97% of normal tidal flows under present conditions. (Soileau 1977).

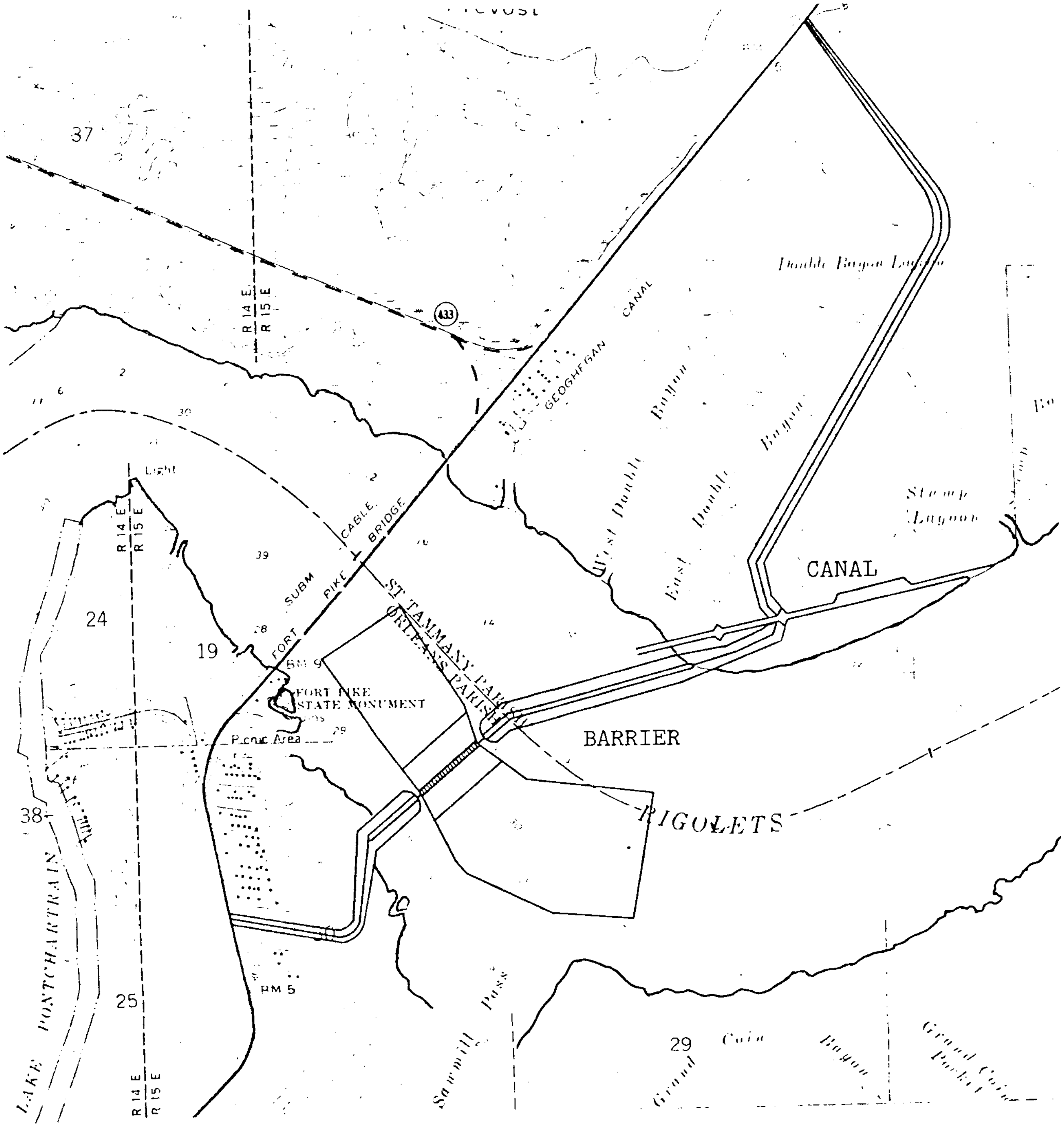


FIGURE 5 The Rigolets Barrier

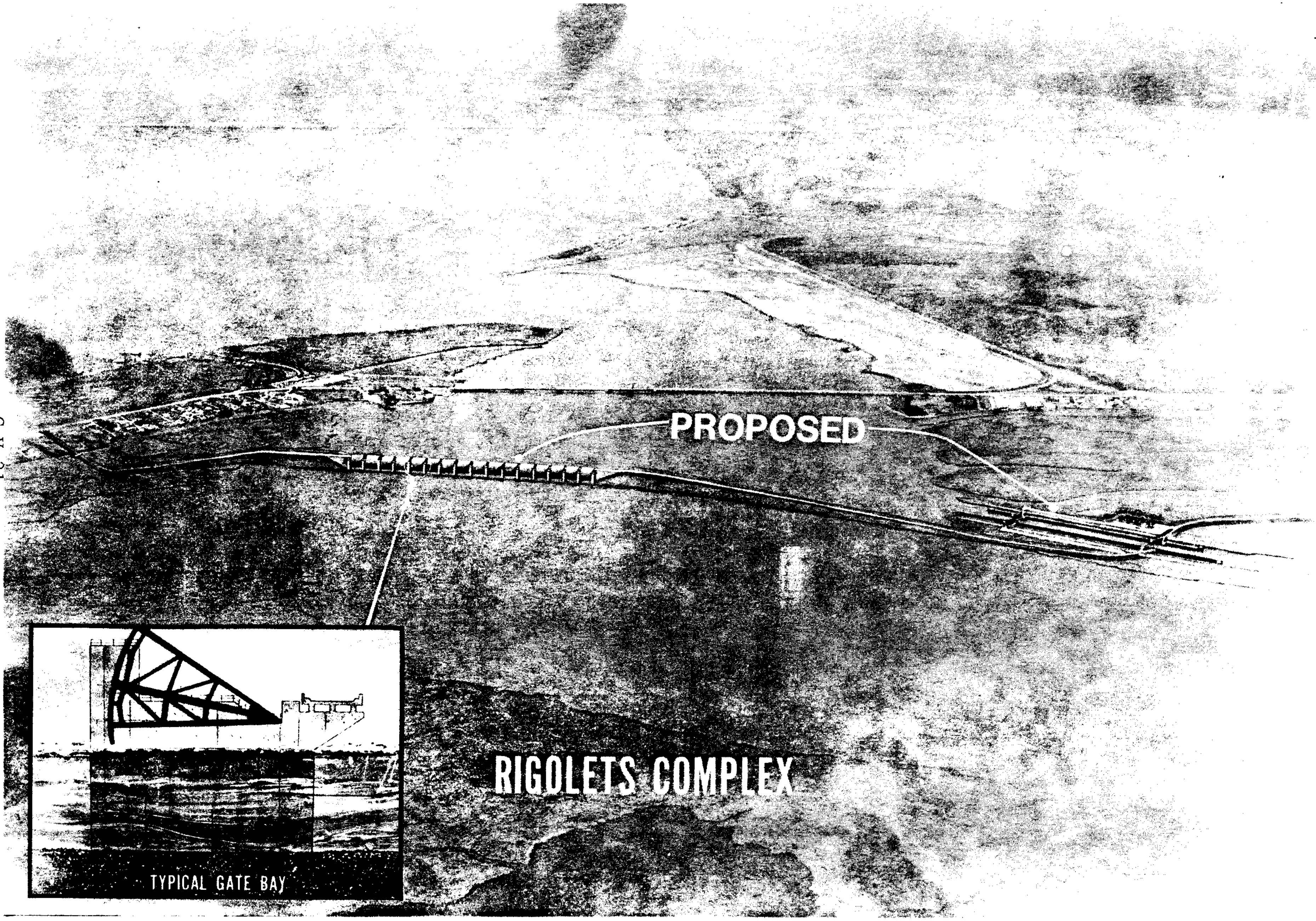


Figure 6 Lock and Barrier Design for the Rigolets.
Artist's Concept.

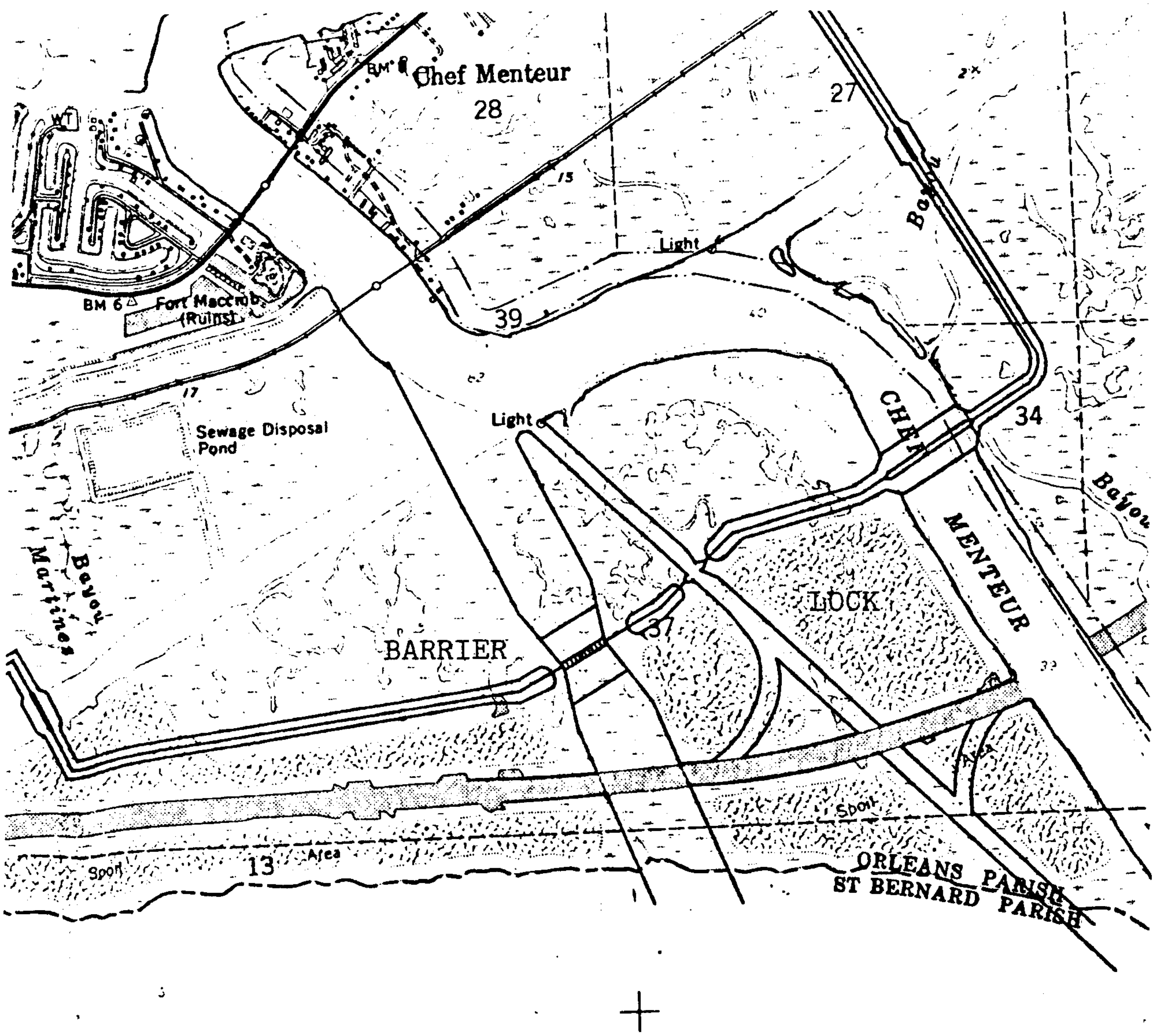


Figure 7 The Chef Menteur Barrier

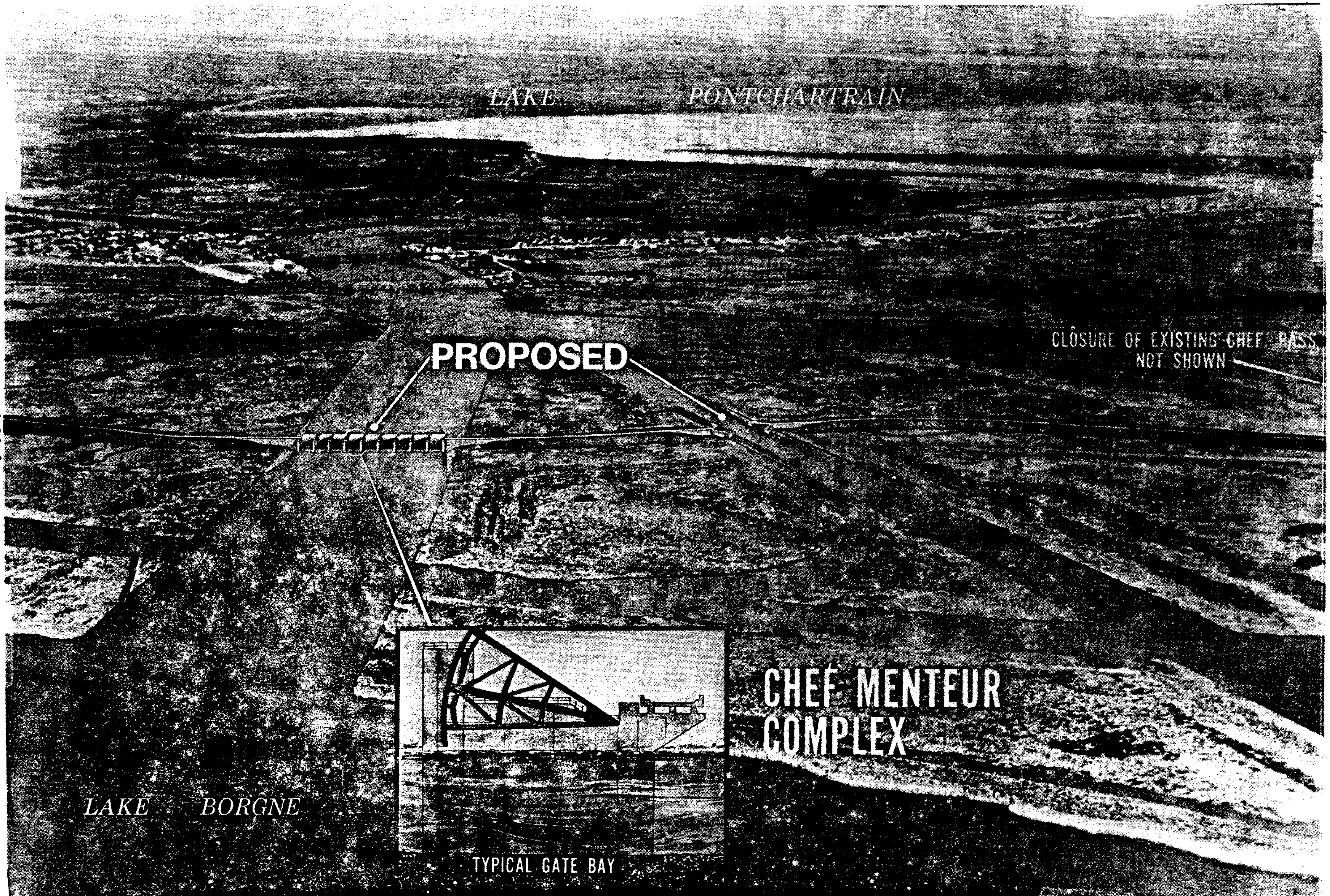
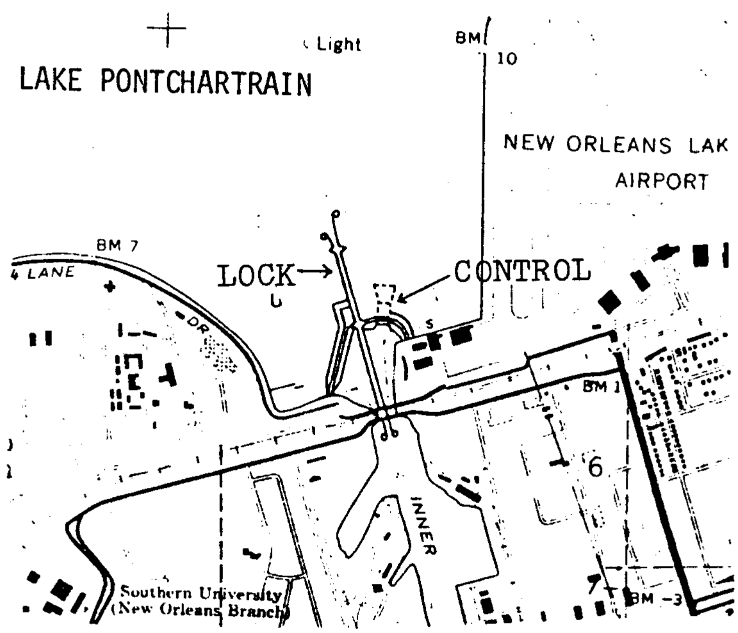


Figure 8 Lock and Barrier Design for Chef Menteur. Artist's Concept.

3. <u>The Seabrook Complex</u> consists of a navigation lock, a control structure and a closure dam (Figure 9 and 10). The lock can be kept open to permit navigation or closed when appropriate. The control structure can be closed during hurricanes, fully open to permit maximum exchange between Lake Pontchartrain and the Mississippi River - Gulf Outlet, or partially open to achieve any intermediate rate of exchange and admission of relatively saline water into the Lake.



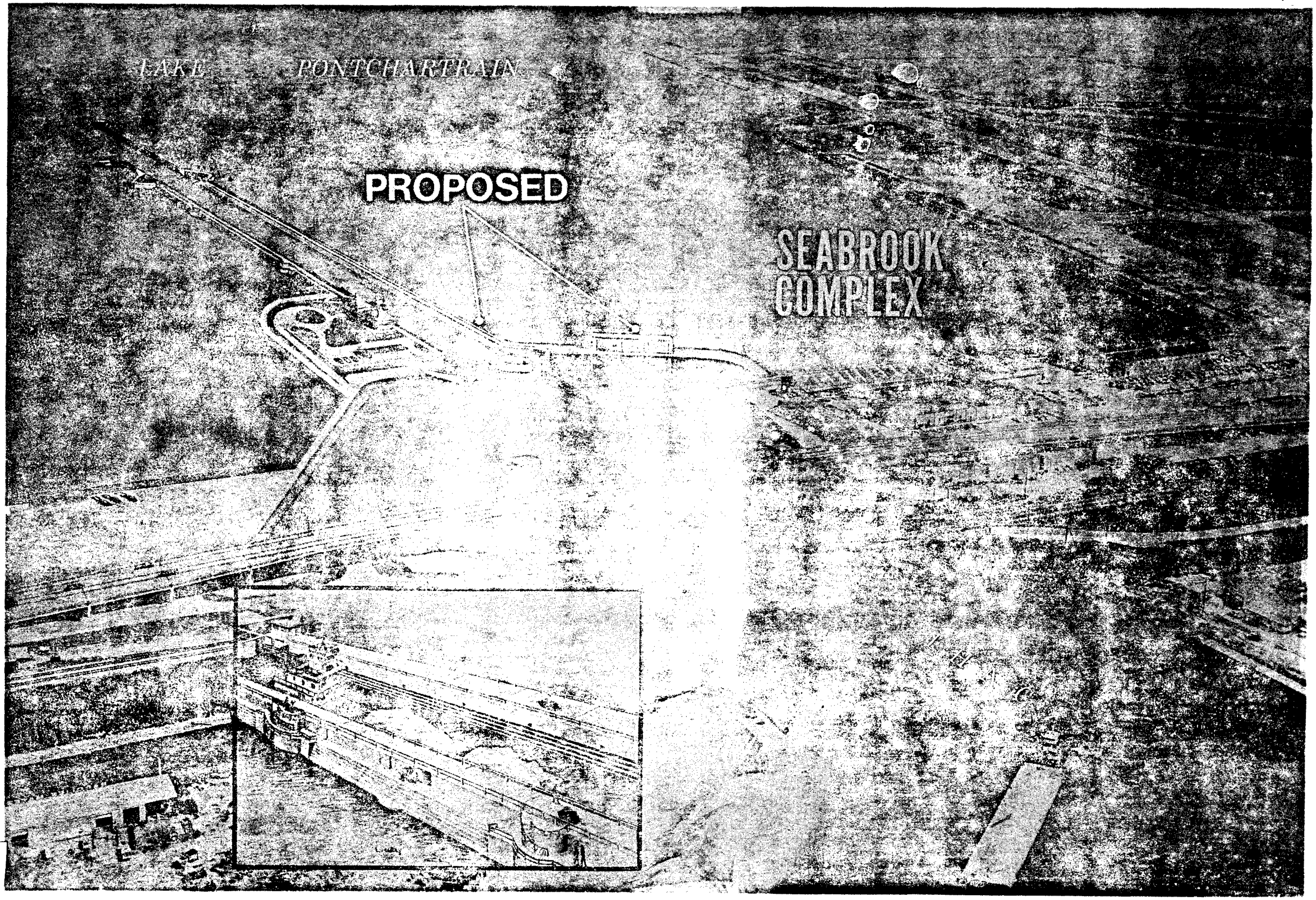


Figure 10 Seabrook Complex. Artist's Concept.

THE ROLES AND SIGNIFICANCE OF THE PASSES OF LAKE PONTCHARTRAIN

The Lake lies between the fresh-water systems of Lake Maurepas and the lands and wetlands surrounding the Lake, in the up-stream role, and the more saline water masses of Lake Borgne and Breton Sound and, by direct open connections, the Gulf of Mexico in the sea-ward position. The passes provide the only avenues for exchange between the Lake and more saline open waters. Therefore, the passes are the exclusive sources to the Lake of salt and associated marine chemicals, of all kinds of biota which are transported passively as plankton or actively as swimming nekton from Lake Borgne and Breton Sound into the Lake by tidal, wind-driven or density driven exchanges. Similarly, these are the only avenues of passive or active "escape" from Lake Pontchartrain toward the Gulf. Over time, the biota has adjusted to this access to a productive body of water of low salinity. As stated in the earlier Environmental Impact Statement on the Project "The ecology of Lake Pontchartrain depends upon the seasonal migratings of larval, yound, and adult organisms from neighboring estuaries and from the Gulf of Mexico, and the exchange of food materials and other nutrients with the habitat" (U.S. Army Engineers District, 1974).

Several studies of Lake Pontchartrain have described the physical and chemical characteristics and the biological complex which has developed in this low-salinity estuarine "lake". These include Suttkus, et al. (1954), Darnell (1958), Darnell (1959), Darnell (1962), U.S. Army Engineers District, New Orleans (1962), U.S. Army Engineers Waterway Experiment Station (1963), Stern et al. (1968), Stern and Stern (1969), Rogillio and Brassette (1974), Hinchee (1975), Tarver and Savoie (1976), Poirrier (1978), and Sikora and Sikora (1982). The most recent and extensive studies are those of Stone and his associates at LSU, including Leonard M. Bahr, Jr., Judith R. Bond, Lawrence L. Cook, Glen W. Cramer, Rezneat M. Darnell, John W. Day, Jr., Linda A. Deegan, David D. Dow, Nancy A. Drummond, Marion T. Fannaly, B. T. Gael, James J. Hebrard, Steven J. Levine, Dianne M. Lindstedt, Jean Pantell Sikora, Walter B. Sikora, Ronald K. Stoessel, James H. Stone, Erick M. Swenson, Edward C. Theriot, Bruce A. Thompson, R. Eugene Turner, J. Stephen Verret, and Ann Seaton Witzig. These are the authors of papers in the 1219 page 2-volume set of Stone, Ed. (1980A) and many of these contributed to Stone, Ed. (1980B). Research at other Gulf Coast sites which can assist interpretation of the uses and potential uses of passes by fish and other biota includes the publications of Copeland (1971), Sabins and Truesdale (1974), and Williams and Deubler (1968).

Extraction from previous sections describing the physical, chemical and chemical content of the passes provides the following summary of the roles and significance of the passes of Lake Pontchartrain.

Physically and chemically:

* The passes are the only exits for all fresh water entering the Lake from its natural drainage or from storm releases from the Mississippi River.
* The tidal and density-driven movements of more saline waters through the passes are the only source of salt and Gulf-sourced chemicals to create the brackish environment which occurs in most of Lake Pontchartrain.
* Each pass has different physical and chemical characteristics, but The Rigolets (the largest) and Chef Menteur are similar in salinity and chemical content, and in large transport between the Lake and Lake Borgne. The Inner Harbor Navigation Canal imports a smaller quantity of more saline water and bears a larger burden of pollutants. It affects the salinity and chemical composition of a substantial region of Lake Pontchartrain.
* The passes carry fresh water, nutrients and other land-sourced materials, including pollutants, sea-ward to Lake Borgne. They are not the only source.

Biologically:

* The passes provide two kinds of environment for biota, one for residence during all or most of their life histories and one as channels for active or passive transport. The residential species are almost entirely associated with the floors and walls of the passes - the benthic environment. The active nekton and passive plankton biota are principally associated with the water column. It is important to note, however, that fish, crabs and shrimp can both swim actively and settle to be closely associated with the bottom and are sometimes non-mobile. Similarly, almost all of the "benthic" species are planktonic at some stages and recent studies in the passes have provided new evidence that many of the benthic species are intermittently present in, and transported with, the water column.

* Phytoplankton is transported into and out of the Lake through the passes, but they provide the probable source and proven necessary saline environment for the dominant species in the Lake, which provides one of the primary sources of food, especially for molluscs and many larval forms.
* Zooplankton, including the food sources for many juvenile fish, are present in the passes in micro and macro assemblages. The smaller forms in the passes are the single source of the species which are the most abundant and important in Lake Pontchartrain.
* Macrozooplankton, including the larval, juvenile or adult stages of anchovy, menhaden, croaker, silversides, sea trout, blue crabs, shrimp and other species, employ the passes in large numbers to enter Lake Pontchartrain as a nursery or feeding area. Such transport is essential for maintenance of useful populations in the Lake.
* Use of the passes to enter and exit Lake Pontchartrain by juveniles substantially enhances the populations of menhaden, shrimp, blue crabs and other species which may be caught over a wider area of the Gulf Coast.
* Fish and other swimming species use the passes to enter the Lake for feeding, to exit the Lake to reach other coastal areas, to migrate to required spawning environments. This movement makes possible substantial fisheries in Lake Pontchartrain. Fisheries in the Lake for blue crabs, shrimp, shad, sea trout, silversides, and other species are totally dependant on movement through the passes.
* The four species (among 85), making up 80% of the ichthyofauna of Lake Pontchartrain are, pass-dependent, including the anchovy, <u>Anchoa mitchilli</u>; Atlantic croaker, <u>Micropogonias undulatus</u>; Gulf menhaden, <u>Brevoortia patronus</u>; and silverside, <u>Menidia beryllina</u>. In addition, all of the adult brown shrimp, adult white shrimp and blue crabs observed in this study must have come through these entry channels.
* Benthic populations are related to The Rigolets, Chef Menteur and the Inner Harbor Navigation Canal in at least three ways - larvae

are transported, adults live in or on the sediments of the Passes, and the environment in Lake Pontchartrain is favorable to some benthic species only because of the import of salt water through the passes.

* The floors of the passes provide large quantities of food organisms for fish, shrimp and crabs, probably because the active flows in the passes is highly favorable to filter feeding organisms.
* The larvae, and some adults, of many benthic species are transported into and out of the Lake by the flows of the passes.
* One important benthic species in Lake Pontchartrain, the clam Rangia cuneata, would not reproduce in the Lake without the low-salinity environment created by import of waters from Lake Borgne and Breton Sound through the passes. The dead shells are the source of 5,000,000 cubic yards per year of shells in Louisiana, mostly from Lakes Pontchartrain and Maurepas (Sikora et. al., 1981). These are not fresh-water clams, however, and reproduction and many essential functions are dependent upon a partially saline environment (Hopkins et. al., 1973). Other benthic species may have similar requirements.
* From time to time, meteorological events require release of large volumes of water from the Mississippi River through the Bonnet Carre' Spillway into the Lake. That water flushes the Lake, brings in silt and Mississippi River water, and eventually drains out through the same relatively small apertures - The Rigolets, Chef Menteur Pass and the Inner Harbor Navigation Canal. The passes then become the conduit for re-entry of many species of animals and plants and of the saline waters important to the usual inhabitants.

Collectively, these observations and the records of commercial captures of pass-dependent fish and invertebrates demonstrate thoroughly that much, perhaps most, of the biological content of Lake Pontchartrain is related to the three passes. The passes permit the Lake to produce substantial recreational and commercial fishery, to provide a nursery habitat for species which range far beyond the Lake, and to support fur harvest and waterfowl hunting and other recreational activities.

THE POTENTIAL DIRECT IMPACTS OF BARRIERS

Previous discussions of the potential effects of barriers at the passes has been limited to the Environmental Impact Statement developed in 1974 (U.S. Army Engineer District, New Orleans, 1974), Heiberg et al. (1974), U.S. Army Engineers Waterway Experiment Station (1976), and Cronin (1978A-1978B).

The changes at the passes briefly summarized in an earlier section can have the following environmental impacts.

A. From dredging:

1. At The Rigolets, three dredging activities would be associated with the barrier complex (others would be related to the elevation of levees or berms, which are not considered in this summary).

   a. 92 acres of the floor of the pass would be dredged to provide material for the approaches to the barrier structure. Potential impacts: Most of the biota occupying present sediment surface will be destroyed. Sediment will be released to the water column, where it may block light and clog the gills of fish and invertebrates, and will settle on other bottom areas where it can smother benthic species. New benthic populations will develop which may be similar to or different from those now present, depending on the nature of the new substrate and circulation.

   b. The navigation canal would be dredged to a depth of 12 feet. Potential impacts: Ca. 8 acres of marsh will be destroyed with loss of biota, productivity and habitat. A new aquatic substrate will be created and eventually occupied by a different biological population. A new small avenue for transport of water and biota from the edge of The Rigolets will be created.

   c. Additional dredging in the pass may be required for the construction of the canal walls. Potential impacts: See A.1.a. above.

2. At Chef Menteur, several significant dredging activities would be required.

   a. The new cut for the pass would require dredging of 110 acres marsh to a depth of 40 feet.

Potential impacts: 110 acres of existing marsh will be destroyed, removing the biota, reducing productivity and eliminating the habitat for birds, mammals and a variety of invertebrates. Local circulation of water will be modified with unpredictable effects. New substrates will be created at the walls and floor of the cut, which will, over a period of years, develop populations and communities which may be generally similar to those of the present pass, but may show some important differences.

b. The navigation canal and connections with the Intracoastal Waterway would require dredging of 68 acres of E2EM wetlands to a depth of 12 feet.

Potential impacts: 68 acres of existing wetlands will be destroyed with effects similar to A.1.b. above.

c. In the old channel of Chef Menteur Pass, 230 acres and 112 acres of bottom, would be dredged, with a maximum depth of 85' feet, to provide material in the 97 acre plug in the old pass.

Potential impacts: The biota of 342 acres will be destroyed. Sediment will be released into the water column, where it can reduce light availability and clog the gills of the biota, and settle on other bottom areas where it can smother existing biota. Chemicals will be released into the water column of unknown quantity and composition. The deep areas dredged are likely to become catch basins for detritus and silt, creating a soft bottom with high organic content, depleting the oxygen severely. Sulfides, which can be toxic, are likely to accummulate. Such areas may retain somewhat cooler, saltier and heavier water, especially in summer, which could be an attractive habitat for some species except that low oxygen and decay products may preclude use. Flushing will be slow because there is no mechanism for active circulation.

B. From construction:

1. At The Rigolets:

a. Turbidity, of unpredictable density, areal extent, and duration will be created.

Potential impacts: Sediment in the water column will reduce light and release stored chemicals, and may clog the gills of fish and invertibrates. When it settles, it can smother some of the benthic biota and create a new substrate which will eventually develop its own biological community. The result will vary depending on the character of the deposited sediment and the pattern of water movements.

b. New deep areas will be created as borrow sites above and below the control structures.

Potential impacts: Since these deeper areas are in a system of open and vigorous circulation, they may retain sufficient flushing to prevent oxygen depletion and other degradation. If so, they may become attractive to some species of fish and enhance fishing.

c. No sill above present depths will be established.

Potential impacts: None.

d. Coffer dams will be installed sequentially and temporarily in portions of the pass to permit construction.

Potential impacts: These will interfere with circulation, modify sediment transport, and create new local environmental situations. No details are available on the design, time sequence of installation or duration of coffer dams, so no estimate can be made of the impacts.

e. Stone rip-rap will be placed in both sides of the closure structure.

Potential impacts: A new habitat will be created for this area. Ca. 1,250,000 square feet of surface will be covered with stone, which is not naturally present in this region. This will provide a site for surface communities of animals and plants, which may become dense in the active water movement in The Rigolets. These are likely to become feeding grounds for some of the species now present and perhaps areas of concentration for some which are not now common. Fishing will probably be enhanced.

f. Short-term relatively high velocities will exist at the control structure and in the navigation canal.
Potential impacts: At strength of tide, velocities through the barrier structure openings will be at least twice as high as in the open system. This will increase the rate of transport of entrained biota, especially at mid-depth and surface, and increase hydraulic pressure on all of those species. The effects will wane with time until slack water and decline along the temporary up-current and down-current line of the channel. Short-term compressions can be injurious to eggs and larvae, but the paucity of data on pressure and duration preclude estimates of the impacts.

g. Shallow - water passage areas will be reduced and limited to the navigation canal.
Potential impacts: Shoal areas provide large portions of the cross-section of the Rigolets at the proposed location of the barrier. The lack of free passage indicates that there will be substantially less transport of the biological species and stages present in the shoal areas. Good year-round data on those species are not available, but the loss may be serious.

h. The present cross-section of 83,600 square feet would be reduced in the control struction to about 29,260 square feet, 35% of the original.
Potential impacts: See i. below.

i. Net transport of water on the normal tidal cycle will be reduced by about 6%.
Potential impacts: Biological transport will be reduced. Reduction may be porportional to the loss of flow, or might be greater if the shoal water populations have exceptional signifigance. The full impact of the reductions is expressed in ecological and economic terms in subsequent sections.

j. Inshore areas of The Rigolets will have modified patterns of circulation and may develop circular rotation with little transport motion.
Potential impacts: The evidence in model studies that there

may be inshore areas of circular motion or virtually no motion (Berger and Boland, 1976) indicates reduction in transport into and from the Lake and loss of production of the affected species. Data available do not permit estimates of magnitude.

2. At Chef Menteur:

   a. Turbidity will be created and dispersed during dredging and transfer of materials and during drainage of spoil sites. The quantity and areas of effect cannot be estimated since they will be affected by water movements due to the effects of wind, tide and turbidity flows as well as by dredging procedures.
   Potential impacts: See B.1.a. above.

   b. New deep areas will be created in Chef Menteur Pass.
   Potential impacts: See A.2.c. above.

   c. Scour may occur in Lake Borgne at the ends of the navigation canal (depth 12') and of the cut for the closure structure (depth 40'). Both open into about 3' of water in Lake Borgne.
   Potential impacts: Present benthic biota will be partially destroyed. Sediments will be washed to new sites, with attendant damages to the biota of the receiving bottom. After stability is achieved, the productivity of benthic biota in Lake Borgne affected by the new out-flow and in-flow will be enhanced.

   d. Transport of water through the southern end of the old Chef Menteur Pass will be virtually terminated.
   Potential impacts: The dead-water portions of the pass will have little flushing and become traps for sediment and for detritus. Bottom and near-bottom conditions are likely to be unfavorable to biota. The productivity and standing crops of biota in the southern portions of the pass and in near-by scoured areas of Lake Borgne will be sharply reduced.

   e. The sill of the control structure, at -30.0', will be about 10' above the floor of the approaches and slope at 1 on 10 to that floor at -40.0'.
   Potential impacts: The presence of the sill and approaches

will cover present benthic biota but create a new, well-flushed substrate which is likely to be more productive. Transported organisms will be swept up to higher positions in the water column during strength of tide, but returned to the original level after they cross the barrier structure. No harm to them is anticipated.

f. The average present cross-section of the Chef of 40,600, and minimum of 33,000, will be reduced to 15,000 square feet (including the navigational canal).

Potential impacts: See g. below.

g. Average flow of 85,000 cfs will be reduced about 3%. Spring flows of about 95,000 cfs will be only slightly diminished.

Potential impacts: See B.1.i. above.

3. At the Inner Harbor Navigation Canal:

a. Construction will result in short-term turbidity.

Potential impacts: Silt will reduce light and release chemicals in the water column and injure biota in the water column and wherever it settles.

b. A rock dike will provide a new local substrate.

Potential impacts: The rock dike substrate is different from any native surface and will develop a surface community which may be dense. It is likely to enhance local fishing by encouraging greater diversity of fish and retention of species which feed on surface biota - and those which prey on them.

c. Flow modifications may occur, but they cannot be predicted since they will be controlled by the salinity regime desired in the near-by portion of Lake Pontchartrain.

Potential impacts: Cannot now be estimated.

C. From placement of dredged materials:

1. At The Rigolets, no data are available to me on the methods and sites of placement of materials dredged in creating the navigation lock. Presumably, all dredged materials in The Rigolets will contribute to construction of the barrier.

Potential impacts: Dredged material placed on the Louisiana marshes smother present biota, modify the movement of water, destroy the habitat of any resident birds and mammals and may release injurious chemical materials. Eventually, a new and different biological community will develop.

2. At Chef Menteur, 2556 acres of coastal marsh will receive dredged material.

   Potential impacts: The schedule for placement is not known and may substantially affect the modification of water movements in the marsh. Other impacts will be those stated in C.1. above.

3. At the Seabrook Complex, I have no information on the placement of dredged materials.

POTENTIAL LONG-TERM IMPACTS OF THE BARRIERS

Ecological

If the three barrier systems are in place for longer than the period of recovery from construction, several kinds of effects are probable.

- o New deep holes will exist, with the ecological advantages of offering a new habitat and the probable disadvantages of deep-water stagnation.
- o New substrates will exist, including the paved floors of the approaches at The Rigolets and Chef Menteur, stone rip-rap at The Rigolets, and at the rock dike of the Seabrook Complex. These are likely to support growth of epi-benthic algae, other plants and animals and to favor local recreational fishing in some areas.
- o The reductions in transport of water through the Passes (ca. 6% for The Rigolets, ca. 3% for Chef Menteur and unpredictable at the Seabrook Complex) will proportionately reduce import of saline waters into the lake and reduce the passive transport of the eggs, larvae and juveniles carried into the Lake from Lake Borgne and Breton Sound. The reduction will be somewhat less than the reduction in flow, however, because planktonic species are generally more abundant at mid-depth than at the bottom.
- o Shoal areas in the Rigolets will be crossed by the solid closure dam for the barrier, so that migration will be blocked for any species limited to those areas unless thay are swept out into the channel.
- o Active migration of fish, crabs, shrimp and other macro-organisms may be affected, more likely in the direction of reduction. The quantity of effect cannot be estimated.
- o In very general terms, there will be reductions in the standing crops of forage fish, principally anchovy and silversides, reducing the quantity of food available for predator species. Nursery support for the plankton-feeding menhaden and feeding for ocean spawners like croaker, sea trout and drum will be lessened. Import of the omnivorous blue crab and shrimps will be reduced. Lowered salinities will be less favorable to the reproduction and vigorous growth of Rangia clams and

perhaps of other species dependent on brackish water.

- o The opportunistic ranging of many species from waters of higher salinity into Lake Pontchartrain will be reduced, affecting their availability for occupation of suitable portions of the Lake.
- o Recovery of salinity conditions and of the biota following periodic fresh-water immendations from the Bonnet Carre' Spillway will be slower.

Economic

It is appropriate to summarize, as accurately as available data permit, the economic uses of the Passes and of Lake Pontchartrain which might be affected by the barriers. Data are limited, because general surveys have usually been undertaken for other purposes; because Lake Pontchartrain has been lumped with Lake Borgne for some statistical purposes; because adequate census of the effort, catch and value of recreational fishing has not been undertaken at these sites; and because studies designed by LSU to answer this need have not been supported.

Several useful sources of information are, however, available and best estimates will be developed. The U.S. Fish and Wildlife Service developed estimates of recreational and commercial fishing effort, yield and value for April 1959-March 1969 (U.S. Fish and Wildlife Service, 1962). Thompson and Stone summarized available records on commercial fisheries landings for Lake Pontchartrain for the period 1963-1975 (in Stone, Ed., 1980A). An extensive economic analysis of commercial landings of blue crabs from Lake Pontchartrain and Lake Borgne, incorporating the detailed results of an interview survey of about 20% of the licensed crabbers, was published in 1982 (Roberts and Thompson, 1982). The National Marine Fisheries Service provides annual statistical summaries by area (Louisiana, Lake Pontchartrain plus Lake Borgne, etc.) and also conducts continuing studies of selected species which permit useful estimates.

Commercial fisheries

- For 1963-75, the average landing of commerically useful fish and shellfish in Lake Pontchartrain was 992,600 pounds worth $186,000 at dockside (Thompson and Stone in Stone, Ed., 1980A). Of this, 954,000 (96%) worth $176,700 (95%) were dependent on the passes. Up-dating the prices of the 1963-1975 period, centered in 1969, to 1982 prices by a multiplier of X2 yields a present estimate of $352,000 per year. Conversion to estimated total economic impact for the pass-related catch by a conversion of X3 provides a best present total economic estimate of $1,056,000 per year.
- General annual estimates may grossly underestimate the catch of some of the important species. For the blue crab, which provided an average of 783,000 pounds per year (82% of the pass-related commercial landings) in 1963-75, recent direct interview revealed that the landings and dockside value may be 6-7 times that published in catch statistics summaries (Roberts and Thompson, 1982). The survey also showed that each $1.00 of fishing income (dockside value) generates a total economic impact of $3.43.
- The economic importance of Lake Pontchartrain to areas external to the Lake is based on its use as a nursery area for menhaden, shrimp and other species which move out to other water areas before capture. No total estimate of these values is possible, but extensive studies of the important menhaden fisheries of the Gulf region permit an approximation for this estuary-dependent species. Based on recent landings at Mississippi and Louisiana processing plants and knowledge of the area of catch and movements of this species, it is estimated that about 52,000 tons of the catch, valued at $4,167,000 at the dock, were supported in their early life in Lake Pontchartrain (Chapiton, pers. comm., 1982). No estimate can be made from available data for other species.

Recreational

- The 1959-60 estimates of the U.S. Fish and Wildlife Service suggest that commercial fishing landings values were about twice the direct expenditure for recreational fishery. Since a conventional conversion from direct expenditure to total economic impact is X3, a rough best estimate is that recreational fisheries impact for pass-dependent species is near present total commercial impact of $1,000,000/year.

Summary of estimates

With all of the constraints and limitations which have been noted, it is clear that the three passes are of very high economic importance to fisheries. They contribute to, and appear to be essential for, about $2,000,000 per year in local fishing and millions more in the fisheries outside of the Lake. An estimate of $4,000,000 annual economic importance will be employed in further calculation. It is very probably conservative.

Differences among the Passes

In a one-year study of ichthyoplankton in the three passes, Fannaly found no significant differences among the passes in the species present or the average catch per sample, (in Stone, Ed., 1980A). No data are available on the movements of post-larval juveniles and adult fish and crustacea through the three passes. Therefore, the working assumption will be that all three are qualitatively similar.

The Rigolets provides about 54% of the transport of water between the Lake and the Gulf system, Chef Menteur 39% and the Inner Harbor Navigation Canal 7% (Stone, 1980A). However, The Rigolets and Chef Menteur each provide about 40% of the salt moving into the Lake, with about 10% entering through the Inner Harbor Navigation Canal (Swensen in Stone, Ed., 1980A). Because The Rigolets and Chef Menteur open directly to Lake Borgne and the Gulf System while the IHNC only connects with the MR-GO waterway at a point nearly 40 miles from the open waters of Breton Sound, the figures for percent of water transported will be used since they somewhat minimize the significance of the IHNC for biological transport.

Estimated economic impacts

For the Inner Harbor Navigation Canal, no estimate can be made of the effects of the Seabrook Complex. It will be constructed to permit the present level of exchange of water (and entrained chemicals and organisms) between the IHNC and

Lake Pontchartrain or to permit any controlled lower rate of exchange which is selected as public policy. Since no selection has been made, there is no basis for predicting effects.

The Rigolets carries about 54% of the transported water, but its flow will be reduced by 6%. If it supports 54% of the $4,000,000 stated economic value, and if that value is reduced by 6%, the annual economic loss would be about $130,000. While shoal water species might be disproportionately reduced and mid-depth species affected less than the average, data are not available to make such correcting adjustments.

Chef Menteur transports about 30% of the relevant water and its flow will be reduced by 3%. Annual economic loss may be about $46,800. It is not possible to determine or estimate whether biological use of the re-located lower Pass will differ significantly from use of the present configuration.

Therefore, the average total economic impact is estimated to be negative in the amount of at least $176,800 per year. Wide variations would occur around the average. The estimate is likely to be conservative since many data are lacking on the effects on recreational activity, shrimp production and catch, replenishment of Rangia clams and other values which might be lowered by reduced exchange between Lake Pontchartrain and Lake Borgne.

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SECTION VI

WATER QUALITY

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY HURRICANE PROTECTION

SECTION 6

WATER QUALITY

This section addresses the ambient quality of those waters that might be impacted by excavation and/or discharge of fill materials and runoff from construction sites.

Water quality data are normally available in the form of a series of repeated observations of individual parameter concentrations. The wide range of concentrations encountered, the different units of measure, and difficulty of integrating the individual parameter measurements into an overall description of water quality are often detrimental to assessment and general understanding. Such problems can generally be overcome through the use of index numbers. Index numbers can be derived that reflect the behavior of one or more water quality parameters associated with a pollution category. Water quality indices (WQIs) descriptive of Lake Pontchartrain and the Gulf Intracoastal Waterway (GIWW), are shown in tables that follow.

WQIs are presented for nine pollution categories. The index numbers are computed using a severity curve method in which WQI values are assigned according to the degree of excursion of measured concentrations above or below selected criteria. The metals criteria used to compute the index numbers are in some cases considerably higher than the most recently published (November 1980) Environmental Protection Agency (EPA) criteria. Thus the index numbers listed in the tables might be lower than would be obtained using more recent aquatic life criteria. However, the indices as computed do provide good relative, if not absolute, measures of existing water quality in the project area. The criteria used for the WQI computations are shown on Table 1.

TABLE 1
WATER QUALITY CRITERIA USED FOR WQI COMPUTATIONS

POLLUTION CATEGORY	PARAMETER		MARINE WATER CRITERIA	SHELLFISH HARVESTING AREAS
Temperature				
	Water temperature, °C		28	
Dissolved Oxygen				
	DO, mg/L		5.0	
	DO saturation, %		80-120	
pH				
	pH, S.U.		6.5-8.5	
Bacteria				
	Fecal Coliforms, colonies/100ml		200	14
Trophic/Nutrients				
	Total Inorganic Nitrogen, mg/L-N		0.3	
	Total Phosphorous, mg/L-P		0.05	
Esthetics				
	Turbidity, JTU		25	
Solids				
	Suspended Sediment, mg/L		80	
Organic Toxicity				
	Aldrin	ug/L	0.003	
	Lindane	ug/L	0.01	
	Chlordane	ug/L	0.01	
	DDT	ug/L	0.001	
	Dieldrin	ug/L	0.003	
	Endrin	ug/L	0.004	
	Ethion	ug/L	0.02	

TABLE 1 (Continued)
WATER QUALITY CRITERIA USED FOR WQI COMPUTATIONS

POLLUTION CATEGORY	PARAMETER		MARINE WATER CRITERIA	SHELLFISH HARVESTING AREAS
Organic Toxicity (Continued)				
	Toxaphene	ug/L	0.005	
	Heptachlor	ug/L	0.001	
	Heptachlor Epoxide	ug/L	0.001	
	Methoxychlor	ug/L	0.03	
	Malathion	ug/L	0.1	
	Parathion	ug/L	0.04	
	Diazinon	ug/L	0.009	
Inorganic Toxicity				
	Zinc	ug/L	400	
	Lead	ug/L	150	
	Copper	ug/L	50	
	Mercury	yg/L	0.05	
	Cadmium	ug/L	12	
	Chromium	ug/L	100	
	Arsenic	ug/L	50	

As indicated in the footnotes to the tables, the WQI scale ranges from 0 to 100 and has been segmented to associate qualitative descriptions to differing levels of water quality. A criterion is arbitrarily assigned a WQI of 20 for the analysis; consequently, WQIs between 0 and 20, for any pollution category, can be considered representative of minimal pollution. Index numbers in the range 20 to 60 are suggestive of moderate pollution and values between 60 and 100 are indicative of severe pollution. Indices are presented for each pollution category on a monthly average, annual average, and worst quarter average basis. In addition to indices for individual pollution categories, overall water quality at each station is summarized with an indexed measure of potential synergistic effects. Indices of synergistic effects are estimated using an algorithm which adds penalty points for each pollution category (except esthetics) with a monthly average WQI above 20.

Lake Pontchartrain

Water quality indices for eight sampling locations in Lake Pontchartrain are listed in Table 2. Data spanning approximately 7 years (74/06 to 81/01) were used to compute indices for six of the eight stations. Only about 2 years (79/04 to 81/01) of data were available to compute WQIs for sampling stations located at West Rigolets and Chef Menteur Pass. These two stations are located in waters designated as suitable for shellfish harvesting; consequently, WQIs for fecal bacteria pollution were computed using a lower criterion than was used for the other six stations. As shown on Figure 1, the sampling stations are generally located adjacent to major inflow points around the lake, and one station is located approximately at the lake's center. The indices presented generally reflect lake quality as influenced by inflows from Pass Manchac, the Tangipahoa and Tchefuncta Rivers, Bayou La Combe, West Rigolets and Chef Menteur Passes and the Inner Harbor Navigation Canal (IHNC).

TABLE 2 INDICES OF WATER QUALITY 1/ LAKE PONTCHARTRAIN

POLLUTION CATEGORY SAMPLING STATION	AVERAGE MONTHLY WQI												ANNUAL AVERAGE	HIGH-3-MONTH-AVERAGE	
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	WQI	WQI	MONTHS
TEMPERATURE															
Lake Pontchartrain at Pass Manchac	0	0	3	5	11	24	27	38	31	4	3	0	12.3	32.2	Jul-Sep
Lake Pontchartrain at mouth of Tangipahoa Riv.	0	1	3	6	10	20	21	33	34	4	4	0	11.3	29.7	Jul-Sep
Lake Pontchartrain at mouth of Tchefuncta Riv.	0	0	3	6	11	21	20	32	29	4	3	0	10.7	26.8	Jul-Sep
Lake Pontchartrain at Bayou LaCombe	0	1	4	6	10	22	19	25	30	4	3	0	10.3	24.6	Jul-Sep
Lake Pontchartrain at West Rigolets Pass	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lake Pontchartrain at Chef Menteur Pass	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lake Pontchartrain at IHNC	0	1	2	3	9	17	27	34	27	6	2	0	10.8	29.5	Jul-Sep
Lake Pontchartrain at Causeway	0	0	3	4	9	17	27	32	30	6	3	0	11.0	29.8	Jul-Sep
OXYGEN															
Lake Pontchartrain at Pass Manchac	2	3	4	8	9	8	10	9	10	6	4	3	6.4	9.5	Jul-Sep
Lake Pontchartrain at mouth of Tangipahoa Riv.	4	3	5	12	13	9	10	10	23	9	5	3	9.1	15.7	Jul-Sep
Lake Pontchartrain at mouth of Tchefuncta Riv.	4	3	6	10	14	9	14	14	16	9	4	5	9.0	14.8	Jul-Sep
Lake Pontchartrain at Bayou LaCombe	3	3	3	6	8	8	12	11	11	6	4	3	6.3	11.1	Jul-Sep
Lake Pontchartrain at West Rigolets Pass	1	1	2	6	7	8	9	9	8	5	3	2	5.2	8.3	Jul-Sep
Lake Pontchartrain at Chef Menteur Pass	1	1	2	6	7	8	9	9	9	5	3	1	5.1	9.0	Jul-Sep
Lake Pontchartrain at IHNC	2	1	2	5	7	7	7	6	7	6	5	1	4.7	6.8	May-Jul
Lake Pontchartrain at Causeway	2	1	3	5	6	7	7	7	6	6	3	1	4.6	7.4	Jun-Aug
pH															
Lake Pontchartrain at Pass Manchac	4	4	6	6	8	4	7	8	5	5	4	4	5.5	6.7	Jul-Sep
Lake Pontchartrain at mouth of Tangipahoa Riv.	10	5	10	8	10	7	8	11	3	8	6	8	7.8	9.2	Mar-May
Lake Pontchartrain at mouth of Tchefuncta Riv.	14	5	12	8	10	7	5	8	6	5	4	5	7.4	10.4	Jan-Mar
Lake Pontchartrain at Bayou LaCombe	3	3	5	4	7	4	9	6	2	3	4	3	4.4	6.5	May-Jul
Lake Pontchartrain at West Rigolets Pass	2	5	3	3	5	4	3	1	3	3	11	4	3.9	5.9	Oct-Dec
Lake Pontchartrain at Chef Menteur Pass	4	3	3	2	5	6	1	3	2	3	3	1	3.0	4.8	Apr-Jun
Lake Pontchartrain at IHNC	2	1	2	4	3	6	3	3	4	4	3	4	3.3	4.7	Apr-Jun
Lake Pontchartrain at Causeway	2	2	3	4	4	3	3	4	3	5	4	3	3.4	4.0	Aug-Oct

TABLE 2 (Continued) INDICES OF WATER QUALITY 1/ LAKE PONTCHARTRAIN

POLLUTION CATEGORY SAMPLING STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE WQI	HIGH-3-MONTH-AVERAGE WQI	HIGH-3-MONTH-AVERAGE MONTHS
						AVERAGE MONTHLY WQI									
Bacteria															
Lake Pontchartrain at Pass Manchac	15	7	10	7	6	5	11	11	5	7	7	7	8.0	10.4	Jan-Mar
Lake Pontchartrain at mouth of Tangipahoa Riv.	30	12	12	9	8	6	9	12	8	12	13	18	12.3	20.0	Nov-Jan
Lake Pontchartrain at mouth of Tchefuncta Riv.	25	15	14	12	8	5	11	8	11	6	9	9	11.1	18.1	Jan-Mar
Lake Pontchartrain at Bayou LaCombe	9	13	10	11	8	4	8	9	6	5	10	8	8.4	11.7	Feb-Apr
Lake Pontchartrain at West Rigolets Pass	28	4	25	8	8	9	9	9	9	6	6	20	11.8	19.0	Jan-Mar
Lake Pontchartrain at Chef Menteur Pass	11	4	18	19	9	13	6	25	16	11	6	12	12.6	17.4	Aug-Oct
Lake Pontchartrain at IHNC	16	15	12	13	14	7	4	16	12	9	7	10	11.4	14.4	Jan-Mar
Lake Pontchartrain at Causeway	5	4	4	5	3	3	11	8	4	4	4	4	4.9	7.3	Jul-Sep
Trophic State/Nutrients															
Lake Pontchartrain at Pass Manchac	19	23	25	20	16	18	11	9	12	8	11	12	15.4	22.6	Feb-Apr
Lake Pontchartrain at mouth of Tangipahoa Riv.	20	18	19	17	15	17	10	10	11	8	13	12	14.2	19.0	Jan-Mar
Lake Pontchartrain at mouth of Tchefuncta Riv.	12	11	11	13	10	14	10	13	8	7	9	14	11.1	12.7	Apr-Jun
Lake Pontchartrain at Bayou LaCombe	6	5	4	6	13	8	7	5	4	3	3	6	5.8	9.5	May-Jul
Lake Pontchartrain at West Rigolets Pass	3	9	10	7	24	16	3	2	1	2	4	6	7.3	15.7	Apr-Jun
Lake Pontchartrain at Chef Menteur Pass	2	19	9	17	26	18	1	2	0	2	3	4	8.6	20.3	Apr-Jun
Lake Pontchartrain at IHNC	15	13	12	23	30	14	5	3	10	6	8	15	12.8	22.4	Apr-Jun
Lake Pontchartrain at Causeway	7	8	7	9	12	13	6	6	7	8	5	7	7.9	11.4	Apr-Jun
Esthetics (Turbidity)															
Lake Pontchartrain at Pass Manchac	24	22	24	20	15	12	15	16	9	10	13	13	16.0	23.5	Jan-Mar
Lake Pontchartrain at mouth of Tangipahoa Riv.	22	15	16	21	14	14	8	18	14	11	10	17	15.0	17.9	Dec-Feb
Lake Pontchartrain at mouth of Tchefuncta Riv.	18	8	12	12	10	14	15	18	10	6	9	12	12.1	15.9	Jun-Aug
Lake Pontchartrain at Bayou LaCombe	11	9	15	10	10	10	9	10	5	3	3	3	8.3	11.8	Jan-Mar
Lake Pontchartrain at West Rigolets Pass	4	6	12	19	23	14	13	4	2	3	5	6	9.2	18.8	Apr-Jun
Lake Pontchartrain at Chef Menteur Pass	4	16	20	22	20	10	7	3	3	4	5	1	9.5	20.5	Mar-May
Lake Pontchartrain at IHNC	14	12	13	21	22	7	4	4	4	3	5	4	9.4	18.5	Mar-May
Lake Pontchartrain at Causeway	13	11	15	11	13	16	8	5	6	5	7	6	9.6	13.4	Apr-Jun

TABLE 2 (Continued) INDICES OF WATER QUALITY 1/ LAKE PONTCHARTRAIN

POLLUTION CATEGORY SAMPLING STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE WQI	HIGH-3-MONTH-AVERAGE WQI	HIGH-3-MONTH-AVERAGE MONTHS
SOLIDS															
Lake Pontchartrain at Pass Manchac	22	13	12	10	4	5	7	5	3	6	5	6	8.2	15.7	Jan-Mar
Lake Pontchartrain at mouth of Tangipahoa Riv.	18	14	8	18	5	8	6	15	6	8	3	19	10.6	16.9	Dec-Feb
Lake Pontchartrain at mouth of Tchefuncta Riv.	10	6	6	10	4	5	9	7	4	3	6	5	6.2	7.2	Feb-Apr
Lake Pontchartrain at Bayou LaCombe	4	7	17	6	4	4	5	5	4	4	1	2	5.3	10.1	Feb-Apr
Lake Pontchartrain at West Rigolets Pass	1	3	4	10	5	4	6	3	3	1	3	4	3.9	6.4	Mar-May
Lake Pontchartrain at Chef Menteur Pass	1	8	13	13	5	3	3	2	3	2	2	2	4.8	11.4	Feb-Apr
Lake Pontchartrain at IHNC	7	7	4	9	6	3	5	7	3	3	2	3	5.0	6.7	Feb-Apr
Lake Pontchartrain at Causeway	9	7	7	7	5	5	2	4	4	2	4	3	5.0	7.9	Jan-Mar
ORGANIC TOXICITY (Pesticides)															
Lake Pontchartrain at Pass Manchac	11	19	10	6	9	13	13	8	13	6	2	8	9.9	13.1	Jan-Mar
Lake Pontchartrain at mouth of Tangipahoa Riv.	8	10	10	3	13	7	9	8	0	6	7	12	7.7	9.9	Dec-Feb
Lake Pontchartrain at mouth of Tchefuncta Riv.	6	12	8	10	10	12	9	8	6	6	6	13	8.8	10.4	Dec-Feb
Lake Pontchartrain at Bayou LaCombe	8	3	11	3	9	3	7	8	2	4	0	7	5.5	7.7	Mar-May
Lake Pontchartrain at West Rigolets Pass	11	0	0	11	10	7	22	11	11	22	11	11	10.5	14.6	Jul-Sep
Lake Pontchartrain at Chef Menteur Pass	22	22	22	13	13	12	22	11	11	11	11	11	14.9	21.8	Jan-Mar
Lake Pontchartrain at IHNC	19	20	20	23	30	22	27	34	27	18	19	15	10.5	12.4	Dec-Feb
Lake Pontchartrain at Causeway	17	18	18	20	20	19	27	32	30	17	18	18	8.2	10.2	May-Jul
INORGANIC TOXICITY (Metals)															
Lake Pontchartrain at Pass Manchac	19	20	18	20	20	20	20	19	22	17	18	15	19.0	20.4	Jul-Sep
Lake Pontchartrain at mouth of Tangipahoa Riv.	19	19	19	19	20	20	20	17	18	16	17	17	18.5	20.0	May-Jul
Lake Pontchartrain at mouth of Tchefuncta Riv.	17	19	18	19	21	20	20	18	20	16	17	16	18.5	20.6	May-Jul
Lake Pontchartrain at Bayou LaCombe	18	18	18	21	21	19	21	20	20	17	18	15	18.9	20.5	Jul-Sep
Lake Pontchartrain at West Rigolets Pass	7	2	4	20	20	20	20	20	13	6	5	3	11.7	20.3	Jun-Aug
Lake Pontchartrain at Chef Menteur Pass	6	22	2	20	21	19	20	11	14	12	2	11	13.4	20.1	May-Jul
Lake Pontchartrain at IHNC	19	20	20	20	20	22	20	18	21	18	19	15	19.4	20.6	May-Jul
Lake Pontchartrain at Causeway	17	18	18	20	20	19	20	18	21	17	18	18	18.7	19.8	May-Jul

TABLE 2 (Continued) INDICES OF WATER QUALITY 1/ LAKE PONTCHARTRAIN

POLLUTION CATEGORY SAMPLING STATION	AVERAGE MONTHLY WQI JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE WQI	HIGH-3-MONTH-AVERAGE WQI	MONTHS
TOTAL STATION BY SYNERGISTIC AGGREGATION															
Lake Pontchartrain at Pass Manchac	16	19	17	17	11	20	22	25	24	8	8	7	16.1	23.7	Jul-Sep
Lake Pontchartrain at mouth of Tangipahoa Riv.	25	11	11	12	12	17	17	25	27	9	9	12	15.5	22.9	Jul-Sep
Lake Pontchartrain at mouth of Tchefuncta Riv.	16	9	10	11	14	18	15	22	22	7	8	8	13.4	19.8	Jul-Sep
Lake Pontchartrain at Bayou LaCombe	7	7	10	11	13	12	14	18	19	6	5	5	10.6	17.2	Jul-Sep
Lake Pontchartrain at West Rigolets Pass	14	4	12	13	17	13	17	10	6	9	6	10	10.9	15.6	May-Jul
Lake Pontchartrain at Chef Menteur Pass	10	19	14	16	22	11	15	13	7	6	4	6	12.0	17.5	Mar-May
Lake Pontchartrain at IHNC	10	9	8	19	21	14	18	21	20	7	7	7	13.4	19.7	Jul-Sep
Lake Pontchartrain at Causeway	7	7	7	10	12	10	19	19	20	7	6	5	10.9	19.4	Jul-Sep

1/ Index Scale 0 - 20 little or no pollution.
20 - 60 moderate pollution.
60 - 100 heavy pollution.

Lake Pontchartrain at Pass Manchac, near Manchac, (112WRD 30173090180000) 74/10 to 81/08.
Lake Pontchartrain at mouth of Tangipahoa Riv. near Lee Landing (112WRD 301945090161500) 74/10 to 81/01.
Lake Pontchartrain at mouth of Tchefuncta Riv. near Madisonville (112WRD 302150090102000) 74/10 to 81/01.
Lake Pontchartrain at Bayou LaCombe near LaCombe (112WRD 301500089572000) 74/10 to 81/01.
Lake Pontchartrain at West Rigolets, 5.7 miles SSE of Slidell, LA (112WRD 301015089451500) 79/04 to 81/01.
Lake Pontchartrain 2.2 miles NNW of Chef Menteur, LA (112WRD 300555089490300) 79/04 to 81/01.
Lake Pontchartrain at Inner Harbor Navigation Canal (IHNC) (112WRD 300205090015500) 74/10 to 81/01.
Lake Pontchartrain at Causeway (112WRD 301116090073300) 74/10 to 81/01.

As indicated on the table, there is but slight variation between the indices for water temperature at major inflow points and at mid-lake. Minimal stress is implied by the annual average WQIs and moderate stress is suggested during the July through September quarter at all locations for which temperature data were available.

The WQIs for the dissolved oxygen category indicate that waters at all eight stations are generally well oxygenated on an annual average basis and even during the most critical months of the year. Interestingly, the WQIs for locations influenced by inflows from the Tangipahoa and Tchefuncta Rivers are about twice as high (bad) as the mid-lake indices on both an annual average and worst quarter basis. The average annual index at the IHNC is comparable to that computed for mid-lake and the worst quarter average index at this location is 0.6 unit lower (better) than the mid-lake value. The July through September quarter is suggested by consensus as critical for the dissolved oxygen pollution category.

Generally the pH WQIs imply minimal stress at each station on both an annual average and worst quarter basis. However, the average annual and worst quarter indices for the Tangipahoa and Tchefuncta river stations are more than twice as high as those computed for mid-lake. The annual average index at the IHNC is about 3 percent lower than the mid-lake value. However, the worst quarter average index for the IHNC is about 18 percent higher than the mid-lake index. Implication of the worst quarter varies between individual stations; however, when data from all stations are aggregated the March through May quarter is indicated as critical for the pH category.

Both the annual and worst quarter average fecal bacteria indices suggest minimal pollution at the selected locations. Bacteria WQIs at the peripheral stations are considerably higher than those computed for the mid-lake station. The index values for West Rigolets and Chef

Menteur Passes are not directly comparable to the mid-lake index since lower criteria for shellfish harvesting were used to compute indices for those stations. Although there is variation among stations, the January through March quarter is indicated by consensus as critical in terms of bacteria pollution in the lake. Unfortunately, sufficient long-term data were not available to include additional sampling stations located along the south shore in the analysis. High bacteria densities have been reported to be a critical problem in areas adjacent to stormwater outfall canals along the south shore.

All of the annual average indices for the nutrients category fall into the minimal pollution range. Annual average index values for stations located near the Tchefuncta River, IHNC, Tangipahoa River, and Pass Manchac range from about 41 to 95 percent higher than the mid-lake index. The annual average nutrients pollution index for the sampling station near Bayou LaCombe is about 27 percent lower (better) than the mid-lake index. The indices for Pass Manchac, Chef Menteur, and the IHNC are within the moderate pollution range during the worst quarter. Average worst quarter indices for the remaining locations fall within the minimal pollution range. Although there is variation among stations, the April through June quarter is indicated as critical in terms of high nutrient concentrations in the lake.

WQIs for the esthetics (turbidity) category were all within the minimal pollution range on an average annual basis. Annual average indices for stations near the Tchefuncta River, Tangipahoa River and Pass Manchac ranged from about 26 to 67 percent higher than the mid-lake index. The annual average turbidity pollution index for the station near Bayou LaCombe is about 14 percent lower than the mid-lake index. The annual average index at the IHNC is about 2 percent lower than the mid-lake value. Only the turbidity indices for the Pass Manchac and Chef Menteur Pass stations were elevated to the moderate pollution range during the worst quarter. Implication of the worst quarter varies among stations; but generally the March through May quarter is indicated as critical in terms of high turbidity in the lake.

Indices for the suspended solids category fall within the minimal pollution range on both annual average and worst quarter bases. The highest (worst) index values were computed for the Tangipahoa River station and the lowest (best) indices were computed for the West Rigolets station. Indices for the station near the IHNC are comparable to or lower than the mid-lake values. Although generally variable among stations, the January through March quarter is implicated as the period of poorest water quality in terms of high suspended solids concentrations in the lake.

All annual average index values for the organic toxicity (pesticides) category and all but one of the worst quarter indices were within the minimal pollution range. The lowest indices were computed for the station near Bayou LaCombe and the highest indices were computed for the station near the Chef Menteur Pass. Annual average and worst quarter indices for the IHNC station are about 28 and 22 percent higher, respectively, than the mid-lake value. When data from all eight stations were aggregated the May through July quarter was implicated as the period when lake water quality is poorest in terms of high pesticide concentrations.

All of the annual average indices for metals fell within the minimal pollution range and all worst quarter WQIs were borderline, suggesting minimal to moderate pollution. The lowest annual average index, about 40 percent lower than the mid-lake value, was computed for the station near West Rigolets. The highest annual index was computed for the station near the IHNC; however, this value was only about 4 percent higher than the mid-lake index. The maximum variation between the highest worst quarter index (Tchefuncta River and IHNC) and the lowest worst quarter index (mid-lake) was only about 4 percent. Generally, the May through July quarter is implicated as critical in terms of high heavy metals concentration in the lake.

The station summary indices for synergistic aggregation characterize the compounded effects of the individual pollution categories on overall water quality. Significantly, all of the average annual indices for synergistic effects fall within the minimal pollution range. The highest annual average index was computed for the station near Pass Manchac and was about 48 percent higher than the mid-lake index. The lowest annual average index was computed for the station near Bayou LaCombe but was only about 3 percent lower than the mid-lake index. The annual average index for the station near the IHNC was about 23 percent higher than the mid-lake value. Average worst quarter indices for stations near Pass Manchac and the Tangipahoa River are in the moderately polluted range, indices for the six other stations indicate minimal pollution. The largest worst quarter index was also computed for the station near Pass Manachac and was about 22 percent larger than at mid-lake. The smallest worst quarter index was computed for the station near West Rigolets and was about 20 percent smaller than at mid-lake. The worst quarter index for the station near the IHNC was only about 2 percent higher than the mid-lake index. When data from all eight stations were aggregated July through September was implicated as the quarter in which the overall quality of the lake is poorest. On the basis of the WQI analysis the major inflows evaluated can be ranked, as shown in Table 3, according to their negative influence on overall lake quality.

Gulf Intracoastal Waterway

Water quality indices for a sampling station located in the GIWW near Paris Road are shown in Table 4. These index values are generally similar to those computed for Lake Pontchartrain, with exception

TABLE 3
OVERALL POOREST QUALITY INFLOW TO LAKE PONTCHARTRAIN*

ANNUAL AVERAGE WQI BASIS	WORST QUARTER AVERAGE BASIS
1. Pass Manchac	1. Pass Manchac
2. Tangipahoa River	2. Tangipahoa River
3/4 Tchefuncta River and IHNC (equally poor quality)	3. Tchefuncta River
	4. IHNC
5. Chef Menteur Pass	5. Chef Menteur Pass
6. West Rigolets	6. Bayou LaCombe
7. Bayou LaCombe	7. West Rigolets

*Ranked on the basis of water quality index computations.

TABLE 4 INDICES OF WATER QUALITY 1/ - GULF INTRACOASTAL WATERWAY (GIWW) 2/

POLLUTION CATEGORY	AVERAGE MONTHLY WQI												ANNUAL AVERAGE	HIGH-3-MONTH-AVERAGE	
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	WQI	WQI	MONTHS
Temperature	0	1	2	5	9	23	26	41	50	7	3	0	13.9	38.9	Jul-Sep
Oxygen	2	2	5	6	10	9	18	13	11	7	5	3	7.6	13.7	Jul-Sep
pH	2	2	3	3	2	3	2	2	3	4	3	3	2.6	3.1	Oct-Dec
Bacteria	38	36	32	43	71	38	46	31	30	27	28	44	38.7	56.1	May-Jul
Trophic State/Nutrients	14	10	14	20	17	9	11	10	14	10	9	20	13.1	16.8	Mar-May
Esthetics	6	6	7	11	7	10	3	5	4	3	6	3	6.1	9.4	Apr-Jun
Solids	6	7	4	6	5	4	3	4	3	4	4	4	4.6	5.7	Dec-Feb
Organic Toxicity	16	12	12	5	11	10	20	12	0	14	12	8	11.0	14.1	Jun-Aug
Inorganic Toxicity	18	19	18	19	20	18	21	19	23	17	19	17	19.1	21.0	Jul-Sep
Total Station by Synergistic Aggregation	23	21	19	27	47	29	43	36	45	16	16	26	29.2	42.1	Jul-Sep

1/ Index Scale: 0 - 20 Little or no pollution.
20 - 60 Moderate pollution.
60 - 100 Heavy pollution.

2/ Gulf Intracoastal Waterway near Paris Road (112WRD 300024089560500) 74/10 to 82/07.

of the fecal bacteria index. The GIWW is classified as suitable for shellfish harvesting; consequently, these indices should be comparable to values computed for the West Rigolets and Chef Menteur Pass stations. The annual and worst quarter bacteria indices for the GIWW station are well into the moderate pollution range and are about three times larger than the indices computed for the Chef Menteur and West Rigolet stations.

Recent Trends

The recent trend status of five pollution categories - pH, bacteria, trophic state/nutrients, esthetics (turbidity) and suspended sediment was investigated using regression analysis on deseasonalized WQIs. Periods spanning 5 to 10 water years were used for the regression analyses. Spearman's Rho and P. K. Sen's test statistics were calculated to evaluate the statistical significance of the regressions. These test statistics are rank order correlation coefficients. Since ranks are used in the computations instead of absolute parameter values the relative magnitude of changes over time are masked. Consequently, an additional, but subjective, appraisal of apparent trends was applied by evaluating the annual percentage change of the mean index values. Only those apparent trends considered both statistically and subjectively significant are discussed. Five apparent trends, in three pollution categories, were identified for five sampling locations in the project area. Summary data from the trend analyses are presented in Table 5.

As indicated in this table, three apparent increasing trends and two apparent decreasing trends were detected. An increasing trend implies degrading water quality for a pollution category, while a decreasing trend suggests improving water quality conditions.

TABLE 5
RECENT TRENDS FOR WATER QUALITY PARAMETERS IN THE PROJECT AREA

STATION POLLUTION CATEGORY	APPARENT TREND +	RHO STATISTIC	PROBABILITY *	SEN STATISTIC	PROBABILITY *	PERCENT CHANGE PER YEAR
Lake Pontchartrain at mouth of Tangipahoa River suspended sediment	decreasing	-0.327	0.006	-2.697	0.007	-11.8
Lake Pontchartrain at mouth of Tchefuncta River pH	increasing	0.284	0.017	2.427	0.015	40.5
Lake Pontchartrain at mouth of Bayou LaCombe bacteria	decreasing	-0.394	0.001	-3.064	0.002	-11.1
Lake Pontchartrain at Causeway pH	increasing	0.244	0.040	1.996	0.046	32.5
Gulf Intracoastal Waterway near Paris Road pH	increasing	0.362	0.001	3.110	0.002	13.3

+ Increasing trends imply decreasing water quality for the stated pollution category and decreasing trends imply improving water quality.
* Approximate probability that the apparent trend results solely from random sampling and analytic errors.

Regressions of data from sampling stations in Lake Pontchartrain spanned roughly 6 water years between October 1974 and January 1981. Analysis of these data indicates that the average suspended sediment index at the Tangipahoa River has decreased at a rate of about 11.8 percent per year. Similarly, the mean fecal bacteria index at Bayou La Combe has decreased at a rate of about 11.1 percent annually. Increasing trends for pH index values are indicated at the mouth of the Tchefuncta River (about 40.5 percent/year) and at mid-lake at the Causeway (about 32.5 percent/year). Analysis of data for the GIWW at Paris Road also suggests that mean index values for pH are increasing. A 13.3 percent per year rate of change is indicated for the period October 1974 through July 1982.

The identified apparent trends relate directly to the water quality index values and only indirectly to absolute parameter concentrations. For a parameter such as pH, for which both upper and lower criteria limits have been established, an increasing trend in mean indices is interpreted as increasing variation in measured absolute values. However, visual inspection of trend plots of actual pH measurements (not deseasonalized) suggest slight trends tending toward more acidic conditions. It should be noted that results obtained for the short periods evaluated might be biased by recent hydrologic events and not be totally reflective of long term tendencies.

Metals and Pesticide Criteria Exceedances

Current EPA saltwater aquatic life criteria for selected heavy metals and pesticides are presented in Table 6. Criteria exceedence summaries for samples collected from Lake Pontchartrain and the GIWW near Paris Road are presented in Tables 7 and 8. As indicated in these tables only the 24 hour average (chronic) criteria for the selected metals have been exceeded with any significant frequency.

TABLE 6
EPA AQUATIC LIFE CRITERIA

(All values in ug/L)

	Saltwater 1/ 24-hour	Saltwater 1/ Maximum	1976 Criteria
Mercury	0.1	3.7	
Lead	-	-	
Zinc	58	170	
Chromium	-	-	
Cadmium	4.5	59	
Copper	4.0	23	
Nickel	7.1	140	
Arsenic	-	-	
Aldrin	-	1.3	
Chlordane	0.004	0.09	
DDD	0.001	0.13	
DDE	0.001	0.13	
DDT	0.001	0.13	
Dieldrin	0.002	0.71	
Endrin	0.002	0.037	
Heptachlor	0.004	0.053	
Lindane	-	0.16	
PCB	0.03	-	
Toxaphene	-	0.07	
Mirex			0.001
Methoxychlor			0.03

1/ 1980 Criteria.

TABLE 7: CRITERIA EXCEEDANCE SUMMARY - LAKE PONTCHARTRAIN

(24-HOUR AVERAGE SALTWATER CRITERIA)

	STATION #1			STATION #2			STATION #3		
	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE
Cadmium	41	3	7	28	7	25	33	2	6
Copper	112	56	50	100	35	35	101	38	38
Nickel	113	7	6	100	6	6	95	9	9
Zinc	103	11	11	84	2	2	98	6	6
Mercury	25	6	24	20	5	25	21	4	19
Chlordane	155	1	1	147	0	0	149	0	0
DDD	155	0	0	147	0	0	149	0	0
DDE	155	0	0	147	0	0	149	0	0
DDT	155	1	1	147	3	2	149	0	0
Dieldrin	155	1	1	147	3	2	141	2	1
Endrin	155	0	0	147	0	0	147	0	0
Heptachlor	155	0	0	147	0	0	149	0	0
Methoxychlor	85	0	0	83	0	0	79	0	0
PCBs	155	2	1	147	2	1	149	1	1
Mirex	92	1	1	89	0	0	85	1	1

TABLE 7: (Continued) CRITERIA EXCEEDANCE SUMMARY - LAKE PONTCHARTRAIN

(24-HOUR AVERAGE SALTWATER CRITERIA)

	STATION #4			STATION #5			STATION #6		
	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE
Cadmium	39	6	15	16	1	6	16	0	0
Copper	102	31	30	63	26	41	65	34	52
Nickel	98	5	5	66	5	8	66	8	12
Zinc	103	4	4	45	2	4	48	1	2
Mercury	24	8	33	16	2	13	19	4	21
Chlordane	148	0	0	57	0	0	55	0	0
DDD	148	0	0	57	0	0	55	0	0
DDE	148	0	0	57	0	0	55	0	0
DDT	148	0	0	57	0	0	55	0	0
Dieldrin	148	1	1	57	0	0	55	1	2
Endrin	148	0	0	57	0	0	55	1	2
Heptachlor	148	0	0	57	0	0	55	0	0
Methoxychlor	78	0	0	57	0	0	55	0	0
PCBs	147	1	1	57	0	0	55	1	2
Mirex	85	0	0	57	0	0	55	0	0

TABLE 7: (Continued) CRITERIA EXCEEDANCE SUMMARY - LAKE PONTCHARTRAIN

(24-HOUR AVERAGE SALTWATER CRITERIA)

	STATION #7			STATION #8		
	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE
Cadmium	42	8	19	35	9	26
Copper	108	53	49	101	38	38
Nickel	101	12	12	98	8	8
Zinc	120	4	3	93	6	6
Mercury	19	6	32	18	2	11
Chlordane	147	0	0	146	0	0
DDD	147	1	1	146	0	0
DDE	147	0	0	146	0	0
DDT	147	0	0	146	2	1
Dieldrin	147	3	2	146	2	1
Endrin	147	0	0	146	0	0
Heptachlor	147	0	0	146	0	0
Methoxychlor	81	0	0	80	0	0
PCBs	146	0	0	146	0	0
Mirex	88	1	1	86	1	1

TABLE 7: (Continued) CRITERIA EXCEEDANCE SUMMARY - LAKE PONTCHARTRAIN

(24-HOUR AVERAGE SALTWATER CRITERIA)

Station #1: Lake Pontchartrain at Pass Manchac, near Manchac (112WRD 301730090180000) 74/06/10 to 82/07/22.

Station #2: Lake Pontchartrain at Tangipahoa River near Lee landing (112WRD 301945090161500) 74/06/10 to 81/01/79.

Station #3: Lake Pontchartrain at Tchefuncta River near Madisonville (112WRD 302150090102000) 74/06/10 to 81/01/19.

Station #4: Lake Pontchartrain at Bayou LaCombe near LaCombe (112WRD 30150089572000) 74/06/10 to 81/01/19.

Station #5: Lake Pontchartrain at West Rigolets, 5.7 miles SSE of Slidell, LA (112WRD 301015089451500) 79/04/19 to 81/01/19.

Station #6: Lake Pontchartrain 2.2 miles NNW of Chef Menteur, LA (112WRD 30055508990300) 79/04/19 to 81/01/19.

Station #7: Lake Pontchartrain at Inner Harbor Navigation Canal (112WRD 300205090015500) 74/06/10 to 81/01/19.

Station #8: Lake Pontchartrain at Causeway (112WRD 301116090073300) 74/06/10 to 81/01/19.

*Remarked data excluded.

TABLE 8

SALTWATER CRITERIA EXCEEDANCE SUMMARY

GIWW NEAR PARIS ROAD AT NEW ORLEANS, LA 1/

	24-HOUR AVERAGE SALTWATER CRITERIA			MAXIMUM SALTWATER CRITERIA		
	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE
Cadmium	55	10	18	55	0	0
Copper	64	34	53	64	2	3
Nickel	59	4	7	59	0	0
Zinc	103	14	14	103	1	1
Mercury	23	8	35	23	0	0
Chlordane	107	0	0	107	0	0
DDD	108	0	0	108	0	0
DDE	108	0	0	108	0	0
DDT	108	0	0	108	0	0
Dieldrin	107	1	1	107	0	0
Endrin	106	0	0	106	0	0
Toxaphene	-	-	-	107	0	0
Heptachlor	108	0	0	108	0	0

TABLE 8 (Continued)

SALTWATER CRITERIA EXCEEDANCE SUMMARY

GIWW NEAR PARIS ROAD AT NEW ORLEANS

	24-HOUR AVERAGE SALTWATER CRITERIA			MAXIMUM SALTWATER CRITERIA		
	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE	NO. OF SAMPLES*	NO. OF EXCEEDANCES	PERCENT EXCEEDANCE
Methoxychlor	39	0	0	–	–	–
PCBs	108	1	1	–	–	–
Mirex	46	0	0	–	–	–

1/ GIWW near Paris Road at New Orleans, LA (112WRD 300024089560500) 74/06/10 to 82/07/22.
* Remarked data excluded.

The maximum (acute) criteria for both metals and selected pesticides have been only infrequently exceeded.

Potential Long-Term Water-Quality-Related Construction Impacts

Most water-quality-related construction impacts are generally considered to be localized and relatively short term. Short-term water quality impacts attributable to construction relate principally to solids resuspension, and potential dissolution of compounds associated with those solids, during fill material placement. Generally, those short-term water quality impacts related directly to fill material discharges are addressed in the Section 404(b)(1).

Evaluation reports of the project (see Sections VII through IX of this appendix). Water quality impacts related indirectly to the fill material placement are also discussed briefly in these reports.

Potential long-term secondary impacts of the fill material discharges, relate to the quality of environments created as a result of extracting fill materials from submerged borrow sites. Generally, to obtain the large quantities of suitable fill materials for levee construction often necessitates dredging to depths which might be considered extensive in relation to local bottom topography. Current estimates indicate that material excavation to depths approximating 60 feet below local lake bottom might be required to obtain good quality construction fill for the Jefferson Parish lakefront levee. General experience with deep borrow pits in the New Orleans District indicates that, for the most part, the quality of waters within the upper portions of the pits reflect conditions in adjacent waters. However, at least during a portion of the year, the deeper waters become oxygen depleted. Decaying organic matter and dense highly saline waters tend to become trapped in the lowest depths of the borrow pits. Lake Pontchartrain, as a whole, has but weak vertical temperature and density stratification characteristics. Deep borrow pits in the lake might tend to have opposite characteristics and show marked temperature and density gradients from surface to bottom waters. Potentially, the deep borrow pits could be composed of two distinctly dissimilar environments with well oxygenated, low density, low dissolved solids waters occupying the upper regions and oxygen depleted, dense saline waters in the lower depths. Generally, the reducing conditions of the deepest waters would cause trace metals, gases of anaerobic respiration, and organic acids to accumulate. Thus the deepest waters might be hostile environments for most aquatic species.

SECTION VII

CHALMETTE AREA PLAN
SECTION 404 (b)(1) EVALUATION REPORT

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION

CHALMETTE AREA PLAN

SECTION 404 (b)(1) EVALUATION REPORT

I. INTRODUCTION. The project is located in southeast Louisiana in the general vicinity of the city of New Orleans. The area encompassed by the project includes low land and water areas between the natural levee deposits of the Mississippi River and the Pleistocene escarpment to the north and west. The dominant topographic feature of the area is Lake Pontchartrain. This lake is approximately 25 miles wide at its widest point and is about 40 miles long; it covers approximately 640 square miles and averages about 12 feet deep. Lake Pontchartrain is hydraulically connected to lesser Lake Maurepas to the northwest, and to Lake Borgne, the Mississippi Sound, and the Gulf of Mexico to the south and east. Approximately 4,900 square miles of tributary area drain into the lake.

The Lake Pontchartrain Hurricane Protection project was authorized by Congress in 1965. The Chalmette Area Plan is a wholly independent protective system included in the overall project.

The Section 404 Evaluation of the project is an iterative process. New information regarding the environmental effects of the proposed work is documented and disseminated as major design changes are incorporated into the protective plans. Initially, concerns of Section 404 of the Clean Water Act (CWA) were discussed in public notices dated 29 November 1974 and 22 January 1975, a Statement of Findings signed by the District Engineer in accordance with Federal Regulations (33 CFR 209) on 20 August 1975, and at a public meeting held 22 February 1975. These documents and meeting addressed only the Barrier, New Orleans East, and Chalmette units of the project. Due to the size and complexity of the project and continuing assessment and refinement of plan alternatives, this evaluation report will address only the Chalmette Area Plan. Companion Section 404 Evaluation reports address the New Orleans East, and the New Orleans West and Mandeville units of the recommended High Level Plan. The three reports incorporate and document the findings of evaluation factors specified in revised Guidelines for Specifications of Disposal Sites for Dredged or Fill Material (45 FR 85336-85357, Wednesday, 24 December 1980). These Guidelines require that construction involving placement of dredged or fill material after 1 October 1981 be evaluated to document that:

- No practicable alternative exists which will have less adverse impact on the aquatic ecosystem.

- Applicable state and Federal water quality standards will not be violated.

- The discharge will not contribute to significant degradation of waters of the United States.

- Appropriate and practicable steps have been taken to minimize potential adverse impacts on the aquatic ecosystem.

Further, the Guidelines require that marine sanctuaries, endangered or threatened species, and critical habitat not be jeopardized.

Construction of the total authorized project was initiated 10 May 1967 and was estimated to be about 49 percent complete as of 30 September 1981. This evaluation report will address only post-1 October 1981 fill-material discharges for the Chalmette Unit.

C-VII

II. PROJECT DESCRIPTION

a. Location. The area to be protected by features of the Chalmette Area Plan is located to the east of the left descending bank of the Mississippi River in portions of Orleans (city of New Orleans) and St. Bernard Parishes. The total area to be enclosed by the Chalmette Area Plan protective works is approximately 50,100 acres. A general plan and vicinity map is shown on Plate 1.

b. General Description. The Chalmette area hurricane protection plan includes about 1.5 miles of combination levee and floodwall and approximately 27.8 miles of levees following the alinement shown on Plate 1. Additional features of the plan include navigable control structures at Bayous Bienvenue and Dupre (these two features have been completed) and a drainage structure in the levee reach between Verret and Caernarvon at the Creedmore Canal. Except for one short reach north of Florida Avenue, all first lifts of the Chalmette unit levees have been completed. A listing of post-1 October 1981 work items subject to regulation under Section 404 is presented in Table 1.

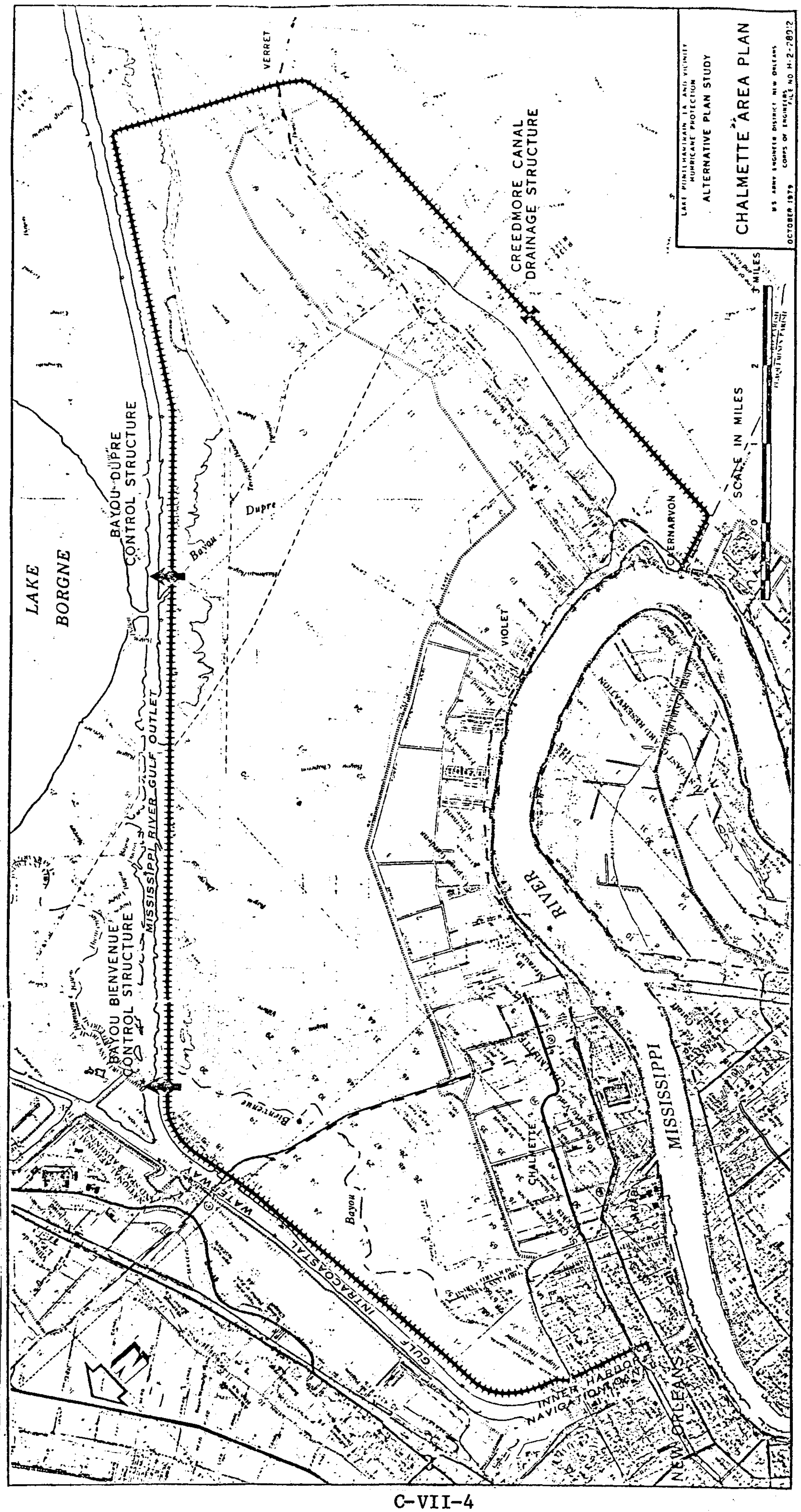
LAKE BORGNE
BAYOU DUPRE CONTROL STRUCTURE
BAYOU BIENVENUE CONTROL STRUCTURE
MISSISSIPPI RIVER GULF OUTLET
GULF INTRACOASTAL WATERWAY
INNER HARBOR NAVIGATION CANAL
NEW ORLEANS
MISSISSIPPI
RIVER
CHALMETTE
ARABI
VIOLET
CAERNARVON
VERRET
CREEDMORE CANAL DRAINAGE STRUCTURE
Bayou Dupre
Bayou Bienvenue
SCALE IN MILES
ALTERNATIVE PLAN STUDY
CHALMETTE AREA PLAN
OCTOBER 1979

Figure 1

TABLE 1

POST-OCTOBER 1981 WORK ITEMS SUBJECT TO REGULATION UNDER SECTION 404 OF THE CLEAN WATER ACT *

Description of Work Items	Contract Award or Anticipated Award Date	Duration of Contract
Paris Road Floodwall and Levee (hauled clay fill: 5,100 cy, shell fill: 225 cy)	11 January 82	300 days
First Levee Lift, North of Florida Avenue Levee and Floodwall (hauled clay fill: 7,000 cy, riprap: 15 tons)	21 April 82	548 days
First Levee Enlargement, Verret to Caernarvon Levee and Floodwall (hauled clay fill: 3,200,000 cy, sand fill: 220 cy)	September 82	2 years
Third Levee Lift, Station 945+00 to Station 1117+00 (hauled clay fill: 200,000 cy)	December 82	-
Second Hydraulic Lift, Pipeline Canal and Gap Closure (clay fill: 813,000 cy)	December 82	-
Final Levee Enlargement, Station 705+00 to Station 945+00 (hauled clay fill: 200,000 cy)	April 83	-
Second Levee Lift, Station 278+00 to Station 945+00 (hauled clay fill: 165,000 cy)	January 84	-
Final Levee Enlargement, Station 370+00 to Station 682+00	January 85	-
Levee Enlargement, Station 9+80 to Station 65+00 (hauled clay fill: 20,000 cy)	December 85	-
Final Levee Enlargement, Station 945+00 to Station 1117+00 (hauled clay fill: 215,000 cy)	April 86	-
First Levee Enlargement, Station 65+00 to Station 355+00	June 86	-
Third Levee Lift, Pipeline Canal and Gap Closure (clay fill from adjacent stockpile)	January 87	-
Final Levee Enlargement, Station 65+00 to Station 355+00	1990	-

* If settlement occurs in excess of currently estimated amounts, additional lifts and/or enlargements may be required to maintain net grades.

c. Project Authority and Purpose. The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was authorized by the Flood Control Act of 1965 (PL 89-298), approved 27 October 1965 essentially as described in House Document No. 231, 89th Congress, 1st Session. The purpose of the project is to provide hurricane protection for the Greater New Orleans Metropolitan Area which includes all or portions of Orleans, Jefferson, St. Bernard, St. Tammany, and St. Charles Parishes.

d. General Description of Dredged and Fill Material.

(1) General Characteristics of Material. The primary construction materials are clays and sands. Clays encountered in wetland borrow areas within the project area often consist of very soft clay with peat and organic matter overlying very soft to fat clays with layers of silt, sandy silt, and sand. Medium to stiff Pleistocene clays are also encountered. The composition of material extracted from the clay borrow areas is typically 70 to 85 percent clays and 15 to 30 percent sand, silt, and organic debris. Materials that are unsuitable for levee construction (primarily clays of high organic content) are deposited on nonwetland area where practical. This operation will be done primarily through hydraulic dredging techniques. Generally, sandy materials extracted from borrow areas consist of poorly-graded to well-graded sand and silty sand, and small percentages of silt and clay.

Other fill materials that may be used in selected locations include gravel, clam, cannery or reef shell, and stone of various gradations.

(2) Quantity of Material. Post-1 October 1981 construction involves the discharge of about 0.5 million cubic yards (cy) of dredged clay fill, 4.3 million cy of hauled clay, and 220,000 cy of hauled sand fill. Additionally, about 15 tons of rip-rap and small

quantities of shell will be used in constructing selected hurricane protection features.

(3) Sources of Material. Materials used for constructing the Chalmette Area levees are available from six designated borrow areas:

- North Shore of Lake Pontchartrain near Howze Beach

- GIWW and MR-GO channels

- Mississippi River and Mississippi River batture in the vicinity of English Turn Bend

- A 3-acre borrow area located on the floodside of the levee that parallels the New Orleans Sewerage and Water Board (NOSWB) Pump Station #5 Outfall Canal

- The drainage canal parallel to the Chalmette Levee between Verret and Caernarvon

Other borrow areas not specifically designated may be used at the option of Government contractors with approval of the Contracting Officer. Such extraction sites are normally located in upland areas and are required to be far removed from known potential sources of contamination to be approved for use.

e. Description of Construction Sites.

(1) Location. The levee alinement subject to regulation under Section 404 is shown on Plate 1.

(2) Size. Construction fill was stockpiled on approximately 1,612 acres of levee-fill area for the first lifts of the Chalmette

unit levees. For the most part, these areas have lost their wetland characteristics. Subsequent lifts and enlargements required to complete levee construction will take place within these same previously affected areas. Section 404 impacts associated with remaining work relate primarily to runoff from the levee-fill areas to adjacent wetlands and water bodies. It is essentially these impacts that will be addressed in subsequent paragraphs.

(3) Types of Sites. Where hydraulic dredge and fill methods are used, confining dikes are constructed to confine levee fill areas so that loss of fill material will be minimized. Where determined feasible and appropriate, dikes are also constructed to define ponding areas to capture and temporarily retain drainage for metered release to adjacent water bodies. Unconfined levee-fill areas will be used at sites where hauled fill is used for construction.

(4) Types of Habitat. Habitat types displaced include approximately 9 acres of lake bottom and 15 acres of river and canal bottom.

(5) Timing and Duration of Discharge. Large levee construction jobs are invariably broken down into more manageable units or reaches. Typically, stockpiling hydraulic fill for one of these smaller reaches might require 12 to 18 months to complete. Actual dredged material slurry pumping might occur during about 70 percent of this period - on average about 17 hours per day considering downtime to clear clogged pumps, relocate the dredge or discharge line, etc. Levees constructed using relatively dry cast or hauled fill can normally be completed in shorter periods.

f. Description of Construction Methods. The levees are built by stage-construction. The stages consist of "lifts" and "enlargements." A lift constitutes stockpiling fill material within the levee right-of-way. An enlargement involves moving the stockpiled fill from the periphery of the fill area toward the eventual levee centerline and shaping the material into an interim or final design section. Construction of a levee reach might involve multiple lifts and enlargements over a period of several years depending upon the nature of the fill material and foundation conditions at the construction site. On average, about 1 to 5 years might be allowed, if required, for foundation and fill material consolidation after a hydraulic lift has been completed and prior to initiating an enlargement. When dry hauled fill is used and foundation conditions permit, a combination lift and enlargement might be accomplished without an intervening period of consolidation. Construction will be accomplished using hydraulic dredging, bucket dredging, and truck and barge hauled fill depending upon the location of suitable construction material. Once in place, stockpiled fill will be shaped into the required sections using draglines, bulldozers, and other mechanical equipment.

III. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations

(1) Effects on Substrate Elevation and Slope. Construction of the various hurricane protection features could modify existing substrate elevations adjacent to the levee-fill areas. Adjacent marsh could become slightly elevated due to solids lost in runoff from the fill area. Side-slopes of adjacent water bodies could also become slightly elevated due to runoff containing solids.

(2) Effects on Sediment Type. Major components of the substrate along the levee alinement are generally sands and clays. Material used for remaining construction will primarily be sands and clays of similar particle dimensions. Lower water and organic matter contents and higher degree of compaction will be the primary changes in substrate physical character.

(3) Effects Due to Dredged and Fill Material Movement. For the most part, only dredged material fines escape the confining areas as the liquid and solid components of the dredged-material slurry separate. The impact of these fines should, in all but extraordinary situations, be minimal.

(4) Physical Effects on Benthos. The landside hydraulic placement of dredged material would have minimal impact on the benthic community within the levee right-of-way. The benthic littoral and bank communities within the Mississippi River-Gulf Outlet (MR-GO) adjacent to the discharge areas would receive runoff from the construction sites. The lighter suspended sediments would be transported, dispersed and diluted to a large extent by the currents in the near shore area.

Runoff and siltation might cause physical changes in the bottom substrate which could induce changes in species composition by allowing larger or smaller species to utilize the habitat and inducing or eliminating certain burrowing forms.

(5) Other Effects on Substrate at the Discharge Sites. Lower pore water and organic matter contents and higher degree of compaction will be the principal changes in substrate character. These physical changes will mediate attendant chemical changes in substrate character.

(6) Actions to Minimize Impacts. Levee alinements follow existing dredged material disposal areas where possible. Existing borrow areas or previously disturbed areas will be used to obtain fill material where feasible. Silt screens or some other form of retention device might be used to minimize siltation along productive benthic areas. The seasonal peaks for the most abundant species in the area are during the early to late fall; therefore, impacts to these species could be reduced by avoiding dredging during these months.

b. Water Circulation, Fluctuations, and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. Post-1 October 1981 work will not affect salinity. The brackish nature of the marsh will be maintained by saline water inflows through the Bayous Bienvenue and Dupre control structures.

(b) Water Chemistry. Generally, the buffer capacity of wetland surface waters should be sufficient to retard radical shifts in pH. In general, modifications of water chemistry resulting from construction material discharge will be relatively minor and highly localized.

(c) Clarity. Surface water clarity will be significantly reduced during construction material stockpiling. However, this condition should disappear rapidly on completion of this stage of construction.

(d) Color. The apparent color of surface waters where the borrowed material is discharged will intensify substantially during dredge-and-fill operations. However, this condition dissipates rapidly upon cessation of dredging.

(e) Taste and Odor. No significant effect on the taste and odor of known public or private raw water supplies is expected as a result of stockpiling of construction material.

(f) Dissolved Gas Levels. Gases of aerobic or anaerobic bacterial respiration (CO_2, CH_4, N_2, H_2S, etc) might increase in surface waters as a result of stockpiling construction material. Dissolved oxygen (DO) in the affected surface waters will be depressed due to the chemical and biochemical oxygen demands of dredged sediments. Any modification of dissolved gas levels will be highly localized (e.g., at the fringes of stockpiled dredged material) and short-term.

(g) Nutrients. Dissolved nitrogen concentrations might increase substantially in the water column during fill operations. Phosphorus is released from suspended dredged sediments to a much lesser extent, if at all. Normally, phosphorus compounds remain associated with finely divided suspended solids if oxidizing conditions are maintained.

(h) Eutrophication. Since the construction stages which have direct impact on surface waters are of relatively short duration, significant long-term enrichment of the affected surface waters, as a result of constructing the hurricane protection works, is not anticipated.

(2) Effects on Current Patterns and Circulation.

(a) Current Patterns and Flow. Construction of the hurricane protection works will not directly alter tidewater or headwater flow patterns.

(b) Velocity. Tidal velocities in the MR-GO should not be affected by construction of the hurricane protection features.

(c) Stratification. Construction of the various hurricane protection features will not affect the normal thermal or density stratification characteristics of the MR-GO. Project area wetlands do not experience stratification.

(d) Hydrologic Regime. Although tidal exchange in the protected areas has been reduced by previous levee construction, further reductions of tidal flow would not be effected by post-1 October 1981 fill material discharges. Project construction will not affect the normal hydraulic regime of the MR-GO.

(3) Normal Water Level Fluctuations. Construction of the hurricane protection features will not affect normal water-level fluctuations in the MR-GO, and only minor modification of normal water level fluctuations should be experienced in the inclosed wetlands.

(4) Salinity Gradients. Construction of the hurricane protection works will not affect salinity gradients in the MR-GO.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Construction Sites. Both suspended particulate and turbidity levels increase substantially during hydraulic fill operations. The primary impacts are experienced during the initial and subsequent dredge-and-fill stages of construction. Only minimal impact to surface waters or wetland areas is normally experienced during levee-shaping operations because the work area has long since lost its wetland character. Suspended particulate and turbidity levels decline rapidly after cessation of dredging.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Normally, light penetration and thus the depth of the photic zone is decreased as a result of increased suspended particulates and turbidity during dredge-and-fill operations. This effect does not persist after dredge-and-fill operations cease.

(b) Dissolved Oxygen. DO levels in the shallow surface waters adjacent to the levee-fill areas might be depressed or depleted by oxygen demands associated with suspended organic sediments. Absorption of radient energy by particulates in suspension can cause heating of the water column and thus reduce both the oxygen saturation concentration and rate of atmospheric reaeration. These effects are usually highly localized and of relatively short duration.

(c) Toxic Metals and Organics. Opportunities for introducing or relocating sediment-bound toxic metals and organics occur during construction materials stockpiling. Water column pollutant levels might be intensified by discharging effluents from levee fill areas, and by rainfall elutriation and leaching of structures made from dredged materials. The standard elutriate test was used to simulate the results of possible interactions between the project hydraulically-dredged sediment, the levees, and the water that they will contact during levee construction. Both core material samples and unconsolidated sediments were used to test the quality of the borrow material used for construction. Data indicating possible interactions between dredged construction materials and receiving waters are available from three sampling expeditions conducted 22 January 1976, 16 December 1980, and 22 December 1980.

Water and core material sampling was conducted on 22 January 1976. The 1976 water and core material sampling sites are shown on Figures 2 and 3, and described below.

- Core-Material Sampling Sites
  - Site 0022: Lake Pontchartrain Borrow Area at Howze Beach
  - Site 0024: GIWW (MR-GO) at the IHNC
  - Site 0026: GIWW (MR-GO) 5 miles east of the IHNC Lock
  - Site 0028: MR-GO at GIWW
  - Site 0030: MR-GO at Bayou Dupre

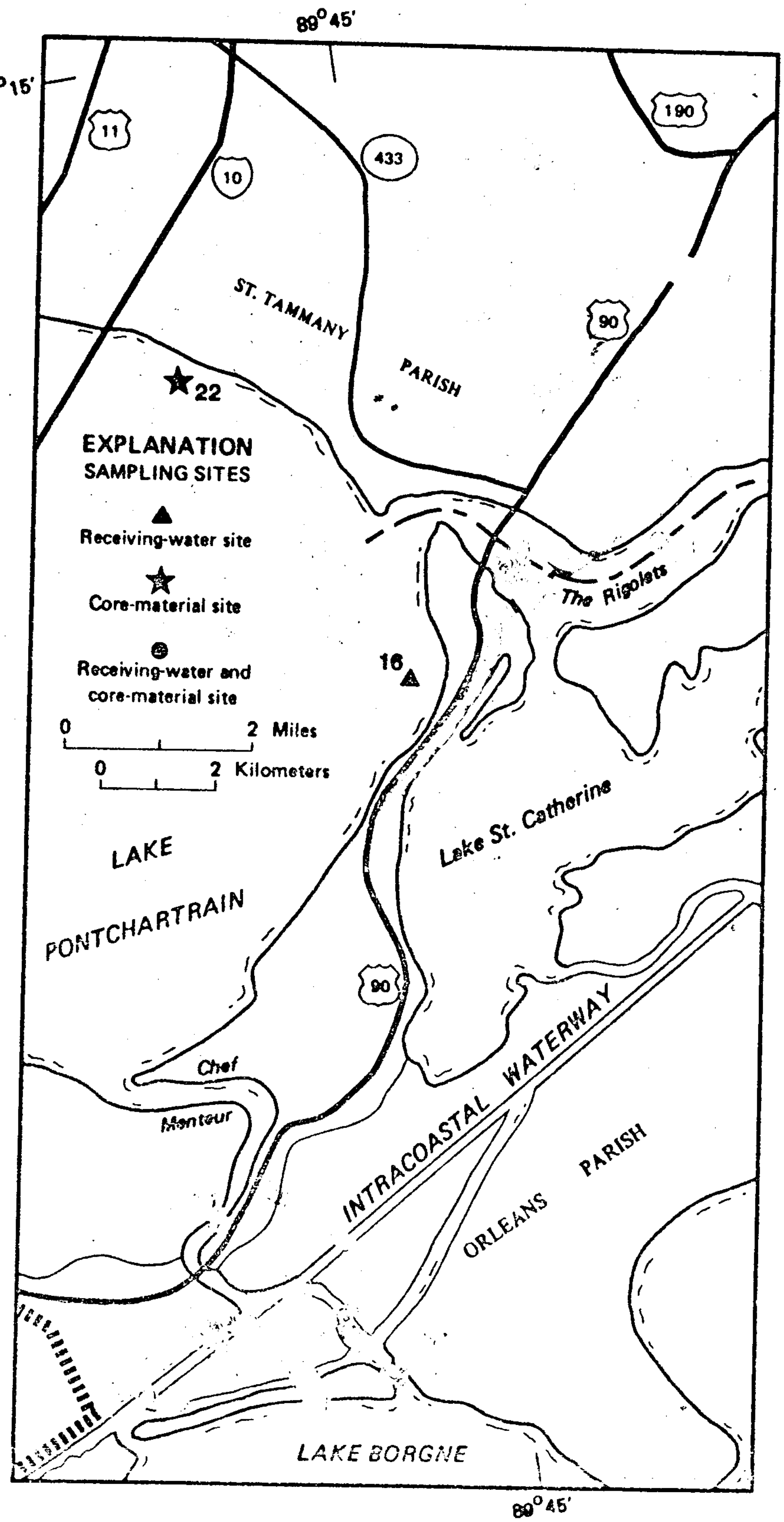

Figure 2.--Location of sampling sites

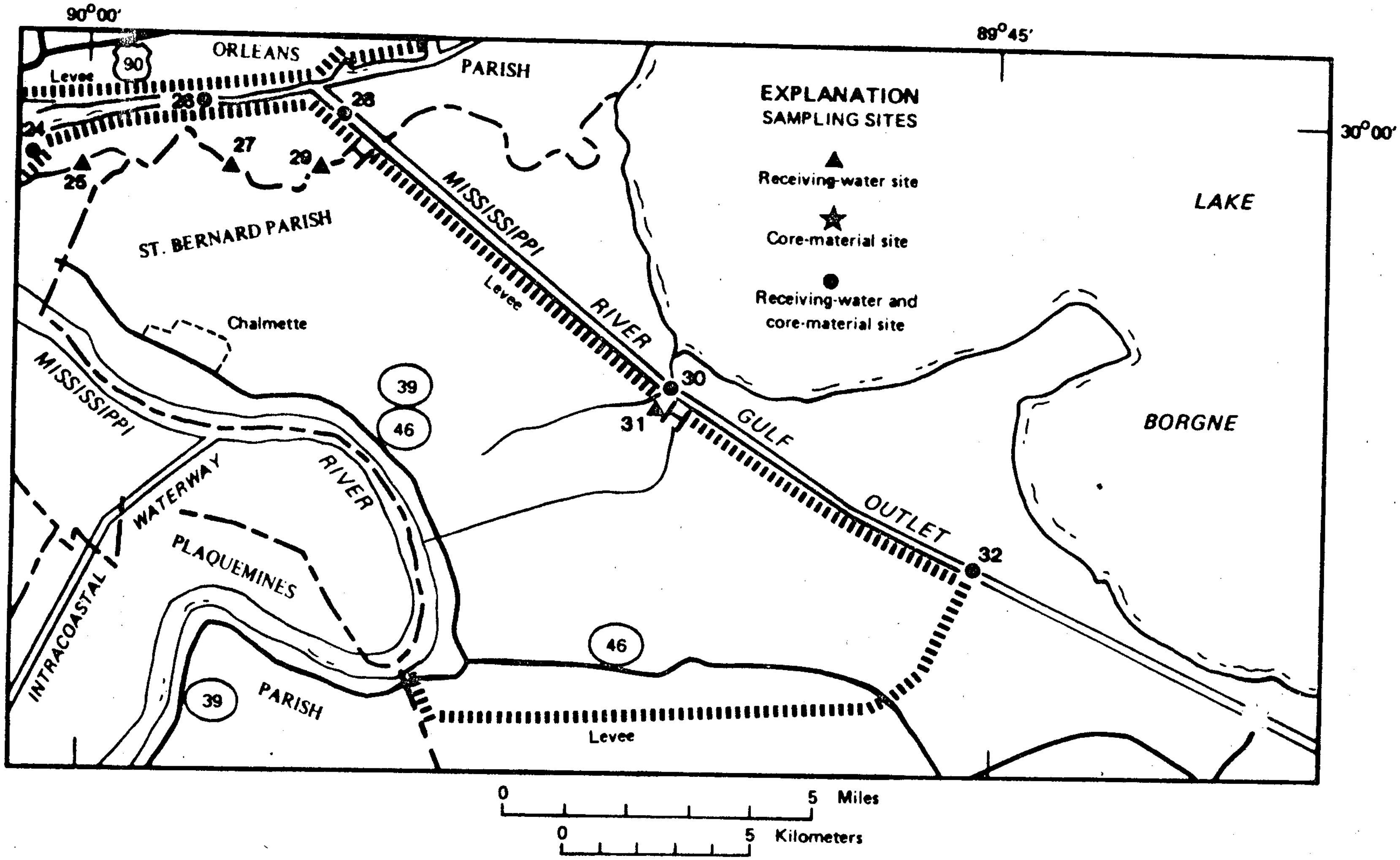

Figure 3 -Location of sampling sites in the Chalmette sector.

- Surface-Water Sampling Sites

  Site 1600: Lake Pontchartrain 1 mile west of Saw Mill Pass

  Site 2400: GIWW (MR-GO) at IHNC

  Site 2500: Bayou Bienvenue 0.8 mile east of IHNC

  Site 2600: GIWW (MR-GO) 5 miles east of IHNC Lock

  Site 2700: Bayou Bienvenue 3.6 miles west of MR-GO

  Site 2800: MR-GO at GIWW

  Site 2900: Bayou Bienvenue 1 mile west of MR-GO

  Site 3000: MR-GO at Bayou Dupre

  Site 3100: Bayou Dupre 0.6 mile west of MR-GO

Surface water and elutriate data are presented in Table 2. Sample identification numbers utilize a four-digit system in which the first two digits signify a particular receiving-water site and the last two digits signify a core-material site. For example, 2400 indicates the receiving water sampled at site 24; 0024 indicates the core material sampled at site 24; and 2424 signifies the elutriate sample prepared by mixing the water from site 24 with the core material from site 24. EPA aquatic life criteria are shown in Table 3.

Generally, the dissolved fractions of five measured parameters indicated a consistant tendency to be elevated in the elutriates compared to the receiving waters. These include Kjeldahl nitrogen (organic plus ammonia nitrogen), arsenic, phenols, zinc, and chemical oxygen demand (COD). Of these parameters, only Kjeldahl nitrogen (DKN) showed the potential to be released from the core materials in relatively substantial quantities. Arsenic, phenols, and zinc were not detected in surface waters or elutriates in excess of Environmental Protection Agency (EPA) criteria.

Surface water and unconsolidated sediment sampling was conducted 16 December 1980 and 22 December 1980. The water and sediment sampling locations are described below.

TABLE 2

SURFACE WATER AND ELUTRIATE ANALYSES

Selected Parameters	1600	1622	2400	2424	2500	2524	2600	2626	2700	2726	2800	2828
Chemical Oxygen Demand (COD) mg/L	66	59	70	120	650	140	90	110	780	140	95	120
Nitrogen, Kjeldahl as N (DKN) mg/L	0.75	1.6	0.36	12	0.92	10	0.62	14	0.61	14	0.61	13
Cyanide (CN) ug/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arsenic (As) ug/L	0	1	1	4	2	6	1	3	1	3	1	3
Cadmium (Cd) ug/L	0	0	0	0	3	0	0	0	0	0	0	0
Copper (Cu) ug/L	1	10	6	2	5	0	2	2	2	0	2	2
Lead (Pb) ug/L	0	0	0	0	0	0	0	0	0	0	0	0
Mercury Hg) ug/L	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nickel (Ni) ug/L	0	0	0	2	0	0	0	0	0	2	0	0
Zinc (Zn) ug/L	10	0	0	20	0	30	0	20	0	10	10	0
Phenols ug/L	1	0	2	19	9	10	0	6	3	11	2	6

Samples collected 22 January 1976

Chemical Analyses by US Geological Survey

TABLE 12 (Continued)

SURFACE WATER AND ELUTRIATE ANALYSES

Selected Parameter	2900	2928	3000	3030	3100	3130	3200	3232
Chemical Oxygen Demand (COD) mg/L	100	130	150	120	100	130	310	1,300
Nitrogen, Kjeldahl as N (DKN) mg/L	0.00	14	0.52	16	0.46	14	0.58	24
Cyanide (CN) ug/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arsenic (As) ug/L	1	4	0	3	1	4	1	NO DATA
Cadmium (Cd) ug/L	0	0	0	0	0	0	0	NO DATA
Copper (Cu) ug/L	3	13	1	2	3	6	15	NO DATA
Lead (Pb) ug/L	0	0	0	0	0	0	0	NO DATA
Mercury (Hg) ug/L	0.0	0.1	0.3	0.0	0.1	0.0	0.1	NO DATA
Nickel (Ni) ug/L	0	2	0	0	0	0	0	NO DATA
Zinc (Zn) ug/L	10	20	0	10	0	10	40	NO DATA
Phenols ug/L	2	15	1	5	3	8	0	NO DATA

TABLE 3

EPA AQUATIC LIFE CRITERIA

(All values in ug/L)

	Freshwater[1]		Saltwater[1]		1976
	24-hour	Maximum	24-hour	Maximum	Criteria
Mercury	0.2	4.1	0.1	3.7	
Lead	EXP[2.35 LN(Hardness)-9.48]	EXP[1.22 LN(Hardness)-0.47]	-	-	
Zinc	47	EXP[0.83 LN(Hardness)+1.95]	58	170	
Chromium	-	EXP[1.08 LN(Hardness)+3.48]	-	-	
Cadmium	EXP[1.05 LN(Hardness)-8.53]	EXP[1.05 LN(Hardness)-3.73]	4.5	59	
Copper	5.6	EXP[0.94 LN(Hardness)-1.23]	4.0	23	
Nickel	EXP[0.76 LN(Hardness)+1.06]	EXP[0.76 LN(Hardness)+4.02]	7.1	140	
Arsenic	-	440	-	-	
Aldrin	-	3.0	-	1.3	
Chlordane	0.004	2.4	0.004	0.09	
DDD	0.001	1.1	0.001	0.13	
DDE	0.001	1.1	0.001	0.13	
DDT	0.001	1.1	0.001	0.13	
Dieldrin	0.002	2.5	0.002	0.71	
Endrin	0.002	0.18	0.002	0.037	
Heptachlor	0.004	0.52	0.004	0.053	
Lindane	0.08	2.0	-	0.16	
PCB	0.014	-	0.03	-	
Toxaphene	0.013	1.6	-	0.07	
Mirex					0.001
Methoxychlor					0.03
Phenol	2,560	10,200	-	5,800	

[1]Federal Register, Vol. 45, No. 231 (EPA Water Quality Criteria Documents Availability)

- o Water and Sediment Sampling Sites

Site 3400: GIWW (MR-GO) north bank at IHNC

Site 3500: GIWW (MR-GO) south bank 1.1 miles east of IHNC

Site 3700: MR-GO) south bank about 200 feet northwest of Bayou Bienvenue

Site 3800: Bayou Bienvenue 4.1 miles west of MR-GO

Site 4000: Borrow Area "A", swamp area approximately 0.8 miles southwest of LA Highway 46 at Verret, Louisiana

Surface water and surficial sediments were collected at eight locations, and elutriate tests were performed on each of the sediment-receiving water systems. The high metals concentrations measured in the 16 December 1980 native water samples are believed to be atypical of conditions normally encountered in the vicinity of the sampling sites. Long-term ambient water quality data reinforce this judgement.

Nevertheless, the two sets of 1980 elutriate test data (not shown) indicate that dissolved nitrogen and phosphorus (TN, DKN, NO_2, TP, and PO_4^{3-}) general organics (COD and phenols), and some trace inorganics (Mn, Fe, Ni, and Cu) have moderate tendencies to be mobilized from the sediment and thus increase concentrations in receiving waters relative to background levels. Lead, cadmium, chromium, mercury, and cyanide showed low to no tendency to be elevated in the elutriates. Although some parameters were measured above EPA criteria levels in certain elutriate samples, field conditions during and following construction would not be expected to permit other than localized or temporary increases in trace metals and organics concentrations.

(d) Pathogens. Fill-material discharges cause temporary increases in bacterial densities in the water column. However, since human ingestion of the raw water at the material extraction or discharge sites is not probable, no significant effects due to increased bacterial densities are anticipated.

(e) Esthetics. Unsightly turbidity plumes are caused by solids placed in suspension during fill operations. The turbidity plumes do not persist long after dredged-and-fill operations cease.

(3) Effects on Biota.

(a) Primary Production/Photosynthesis. Primary production would be impaired by the reduction of the photic zone induced by the turbidity and sedimentation. Temporary reductions in plankton populations are possible as a result of clumping and flocculation. Phytoplankton, algae, and rooted vegetation would also be destroyed by physical abrasion. However, this temporary loss in primary productivity should not have long-term effects since phytoplankton is not the primary food source in the MR-GO.

(b) Suspension/Filter Feeders. Turbidity would interfere with filter feeding mechanisms, impede growth, and cause impairment of respiratory and excretory functions. These effects, as well as siltation, could cause death. The more mobile species would quickly migrate from the area of impact. These mobile organisms, along with others remaining on the fringe of the impacted area, would provide recruitment stocks for repopulation of the affected area.

(c) Sight Feeders. Most of the sight feeders found within the MR-GO are moderately adapted to low visibility environments and would probably escape the areas of undesirable turbidity and return after conditions improved.

(4) Actions Taken to Minimize Impacts of Suspended Particulates/Turbidity. Hydraulically-dredged construction material

will be discharged to confined levee fill areas to minimize loss of solids to adjacent surface waters when feasible. Additionally, hauled fill will be used in areas where feasible and appropriate. See Section III.a.(6) for other actions that can be taken to minimize impacts.

d. Contaminant Determinations. Evaluation of data obtained from core materials, surficial sediments, and elutriate analyses indicate that the construction material stockpiling will not introduce new contaminants nor significantly increase contaminant levels in the surface waters affected by construction of the hurricane protection works.

e. Aquatic Ecosystem and Organism Determinations.

(1) Plankton Effects. Effects on phytoplankton are discussed in Section III.c.(3)(a).

Zooplankton are susceptible to siltation and turbidity which might also impair feeding and interfere with respiratory processes. The small volume of runoff would be sufficiently diluted by the receiving waters as to cause only temporary impact.

(2) Benthos Effects. Impacts to benthos are described in Sections III.a.(4) and III.c.(3)(b).

(3) Nekton Effects. Most species would not be directly affected by the project since they would vacate the area during construction. Some planktonic feeders might be temporarily attracted to turbidity plumes for short-term feeding. During these feeding forays, the increased free carbon dioxide associated with dredging activities might tend to reduce pH, causing fishes and other biota to be more susceptible to pollutant laden silt particles (Johnston, 1981).

(4) Aquatic Food Web Effects. Impacts to the aquatic food web are expected to be minimized due to the restricting of fill placement to the area of the existing levee lifts. Short-term impacts associated with turbidity, siltation, nutrient enrichment, and changes in sediment chemistry as they affect plankton, benthos and nekton have been discussed above. The overall degradation of water quality in the affected area would produce temporary local adverse impacts on the aquatic food web in the immediate vicinity of the construction; however, no significant long-term losses are expected.

(5) Special Aquatic Sites Effects. The discharge would reduce the quality of feeding and nursery areas in the marsh affected. Subtle changes in marsh elevation could result in vegetative shifts which would induce transition to uplands.

(6) Actions to Minimize Impacts on Aquatic Ecosystems and Organisms See Sections III.a.(6) and III.c.(4).

f. Construction Site Determinations

(1) Mixing Zone Determination. Construction of the hurricane protection features does not involve "disposal" of dredged material. Rather dredged materials are usually discharged for use as construction fill into areas that are either confined or not directly adjacent to wetlands or water bodies; therefore, mixing zone determinations are not applicable.

(2) Determination of Compliance with Applicable Water Quality Stan-dards. Louisiana water quality standards applicable to surface waters affected by the construction activities are presented in Table 4. It is unlikely that construction activities will cause violations of the listed standards, with the exception of the DO standard. The DO standard might be violated in the shallow marsh

TABLE 4

LOUISIANA STATE WATER QUALITY STANDARDS

Designated River Basin Code and Sequence Number 1/

	0421	0423	0425	0427	0417	070060
Water Use Classification 2/	B,C	B,C	B,C	A,B,C,	A,B,C	B,C,D
Dissolved Oxygen (DO) mg/L	4.0	4.0	4.0	5.0	4.0	5.0
Temperature °C	35	35	35	35	35	32
pH S.U.	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0
Bacterial Standard 3/	#1	#4	#4	#4	#4	#3

1/ 417: Lake Pontchartrain - East of Highway 11 Bridge
0421: Inner Harbor Navigation Canal (IHNC)
0423: Gulf Intracoastal Waterway (GIWW)
0425: Mississippi River-Gulf Outlet (MR-GO)
0427: Lake Borgne
070060: Mississippi River: Huey P. Long Bridge to Head of Passes

2/ A: Primary Contact Recreation
B: Secondary Contact Recreation
C: Propagation of Fish and Wildlife
D: Domestic Raw Water Supply

3/ #1 Primary Contact Recreation - Based on a minimum of 5 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 exceed 400/100 mL.

#3 Public Water Supply - The monthly arithmetic average of total coliform most probable number (MPN) shall not exceed 10,000/100 mL nor shall the monthly arithmetic average of fecal colilforms exceed 2,000/100 mL.

#4 Shellfish Propagation - The monthly total coliform median MPN shall not exceed 70/100 mL and not more than 10 percent of the samples ordinarily exceed a MPN of 230/100 mL.

surface waters where construction materials are occasionally discharged. Since the hydraulic fill phases of construction are intermittant and of relatively short duration, violations of the DO standard, should they occur, will be highly localized and short-term.

(3) Potential Effects on Human Use Characteristics

(a) Municipal and Private Water Supply. The only known water supply intakes in the general areas of the construction sites are located on the Mississippi River. Construction of the hurricane protection works will not affect any known sources of public or private water supply.

(b) Recreational and Commercial Fisheries. Analysis of native water and elutriate test data indicate possible short-term deleterious effects on aquatic organisms due to levels exceeding EPA criteria for copper, nickel, lead, zinc, and dieldrin. Depending on the amounts assimilated by fishes, reproduction and behavior could be altered. The elutriate tests indicate that dissolved nitrogen and phosphorus and general organics (COD and phenols) have a moderate tendency to be mobilized from the sediment and enter the receiving waters. However, some of these pollutants measured in the associated native water samples were also excessive. Therefore, no long-term adverse impact would be anticipated.

(c) Water-Related Recreation. Project construction will not adversely affect access to or use of six boat ramps in the vicinity.

(d) Esthetics. Noise and dust levels will be high during construction. The abrupt change in the marsh topography occasioned by the hurricane protection levees will also be esthetically displeasing to some. After shaping the levees into the final design sections, they will be seeded to establish vegetative cover and to minimize erosion.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Construction of the hurricane protection works will not adversely affect access to or recreational use of local recreation areas.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The most severe effects previously incurred as a result of the project were the direct loss of habitat induced by the first lifts. These lifts and later work will have caused the loss of 50 acres of bottomland hardwood, 265 acres of fresh intermediate marsh, 15 acres of river and canal bottom, and 9 acres of lake bottom. These changes in habitat types have caused changes in species composition and diversity through limiting the types and variety of habitat available.

h. Determination of Secondary Impacts. Leveed marshes would be isolated from natural flooding by adjacent waters. This isolation would contribute to the lowering or stabilizing of water levels within the marsh making the habitat less suitable for wildlife; isolating feeding, spawning, and nursery areas; and restricting detrital export to surrounding areas.

Utilization of borrow pits in the MR-GO would result in short-term turbidity, localized removal of benthos and increases in bottom depth which could cause changes in benthic community structure. These pits could concentrate demersal fish during certain seasons of the year. However, these deep depressions could be expected to become nutrient sumps with low DO concentrations and high biochemical oxygen demand.

IV. FINDING OF COMPLIANCE FOR THE LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT: CHALMETTE AREA PLAN

1. No significant adaptations of the guidelines (40 CFR 230) were made relative to this evaluation.

2. The selected plan will have the least amount of adverse impact on aquatic ecosystems compared to other available practical alternatives after appropriate cost considerations. Violations of the Louisiana State Water Quality Standard might occur for dissolved oxygen. However, these violations, if they occur, will be highly localized and of short duration.

3. Use of the designated construction material excavation sites and levee fill areas will not harm any endangered species or their critical habitat nor violate protective measures for any marine sanctuary.

4. Construction of the hurricane protection project will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife and special aquatic sites. The life stages of aquatic organisms and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values will not occur.

5. Appropriate steps to be taken to minimize potential adverse impacts include:

- o Constructing a significant portion of the levee reaches across areas previously used for levee construction or dredged material disposal.
- o Maintaining tidal interchange between marsh inclosed within the hurricane protection levees and the MR-GO.
- o Discharging hydraulically dredged sediments to confined levee fill areas, and utilizing bucket dredging and hauled fill where feasible and appropriate.
- o Fertilizing and seeding levees after final design section shaping to promote rapid cover growth and to minimize erosion.

- Incorporating provisions in contract specifications for protection of the environment during construction activities.

6. On the basis of application of the guidelines (40 CFR 230), the sites designated for construction of hurricane protection features are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

15 Nov 82
Date

ROBERT C. LEE
Colonel, CE
District Engineer

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SECTION VIII

NEW ORLEANS EAST UNIT
SECTION 404 (b)(1) EVALUATION REPORT

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY HURRICANE PROTECTION

NEW ORLEANS EAST UNIT
SECTION 404 (b)(1) EVALUATION REPORT

1. INTRODUCTION. The project is located in southeast Louisiana in the general vicinity of the city of New Orleans. The area encompassed by the project includes low land and water areas between the natural levee deposits of the Mississippi River and the Pleistocene escarpment to the north and west. The dominant topographic feature of the area is Lake Pontchartrain. This lake is approximately 25 miles wide at its widest point and is about 40 miles long; it covers approximately 625 square miles and averages about 12 feet deep. Lake Pontchartrain is hydraulically connected to lesser Lake Maurepas to the northwest, and to Lake Borgne, the Mississippi Sound, and the Gulf of Mexico to the south and east. Approximately 4,900 square miles of tributary area drain into the lake.

The Lake Pontchartrain Hurricane Protection project was authorized by Congress in 1965. The New Orleans East Unit is an integral system within the overall project, which also includes the Chalmette Area Plan, the New Orleans West Unit, the Mandeville Unit, and the Barrier Unit.

The Section 404 Evaluation of the project is an iterative process. New information regarding the environmental effects of the proposed work is documented and disseminated as major design changes are incorporated into the protective plans. Initially, concerns of Section 404 of the Clean Water Act (CWA) were discussed in public notices dated 29 November 1974 and 22 January 1975, a Statement of Findings signed by the District Engineer in accordance with Federal Regulations (33 CFR 209) on 20 August 1975, and at a public meeting held 22 February 1975. These documents and meeting addressed only the Barrier, New

Orleans East, and Chalmette units of the project. Due to the size and complexity of the project and continuing assessment and refinement of plan alternatives, this evaluation report will address only the New Orleans East unit of the hurricane protection project. Companion Section 404 Evaluation reports address the Chalmette unit (Chalmette Area Plan) and the New Orleans West and Mandeville units of the project. These three reports incorporate and document the findings of evaluation factors specified in revised Guidelines for Specifications of Disposal Sites for Dredged or Fill Material (45 CFR 85336-85357, Wednesday, 24 December 1980). These Guidelines require that construction involving placement of dredged or fill material after 1 October 1981 be evaluated to document that:

- o No practicable alternative exists which will have less adverse impact on the aquatic ecosystem.

- o Applicable state and Federal water quality standards will not be violated.

- o The discharge will not contribute to significant degradation of waters of the United States.

- o Appropriate and practicable steps have been taken to minimize potential adverse impacts on the aquatic ecosystem.

Further, the Guidelines require that marine sanctuaries, endangered or threatened species, and critical habitat not be jeopardized.

Federal construction of the authorized Barrier Plan was initiated 10 May 1967. A 1977 Federal court injunction stopped construction of the Chef Menteur and Rigolets Barrier complexes; however, work was permitted to continue on all other features of the project. The authorized project was estimated to be about 49 percent complete as of

30 September 1981. This evaluation report addresses all post 1 October 1981 fill material discharges associated with the recommended High Level Plan, and includes discharges for components of the authorized project that would be incorporated into the High Level Plan.

II. PROJECT DESCRIPTION.

a. Location. The area to be protected in the New Orleans East unit is located wholly in Orleans Parish (city of New Orleans). This area is generally bounded by Lake Pontchartrain on the north, the Mississippi River-Gulf Outlet (MR-GO), Gulf Intracoastal Waterway (GIWW), and Mississippi River on the south, the Orleans-Jefferson Parish boundary on the west, and Bayou Sauvage on the east. A general plan and vicinity map is shown on Plates 1 and 2.

b. General Description. Levees and floodwalls of the New Orleans East unit generally would follow the alinements shown on Figures 1 and 2. This unit has been subdivided into reaches as follows:

- New Orleans Lakefront Levee, West of IHNC (This reach will be addressed separately in a supplimental report)
- Citrus Lakefront Levee
- New Orleans East Lakefront Levee
- New Orleans East South Point to GIWW Levee
- New Orleans East Back Levee
- Citrus Back Levee

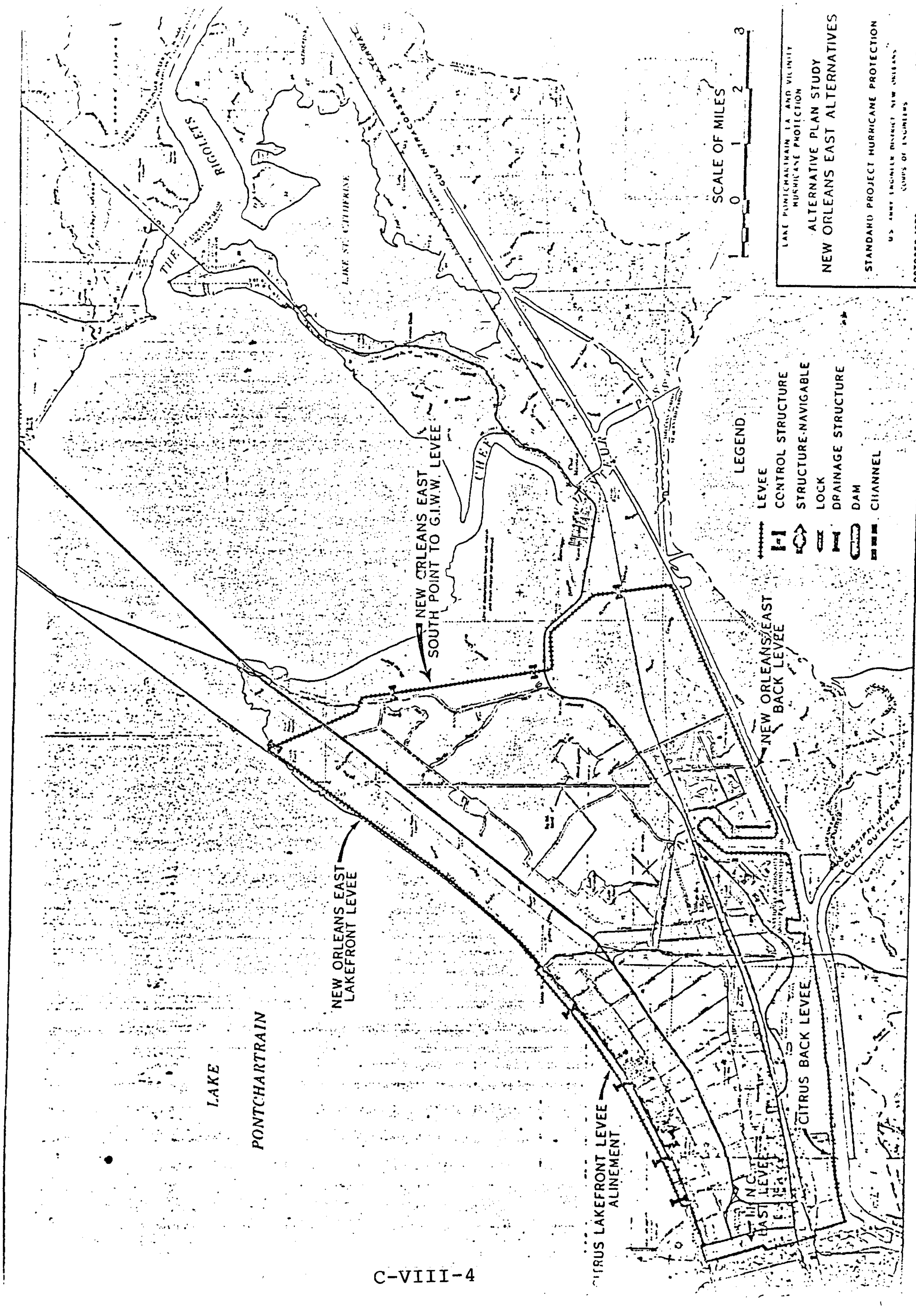
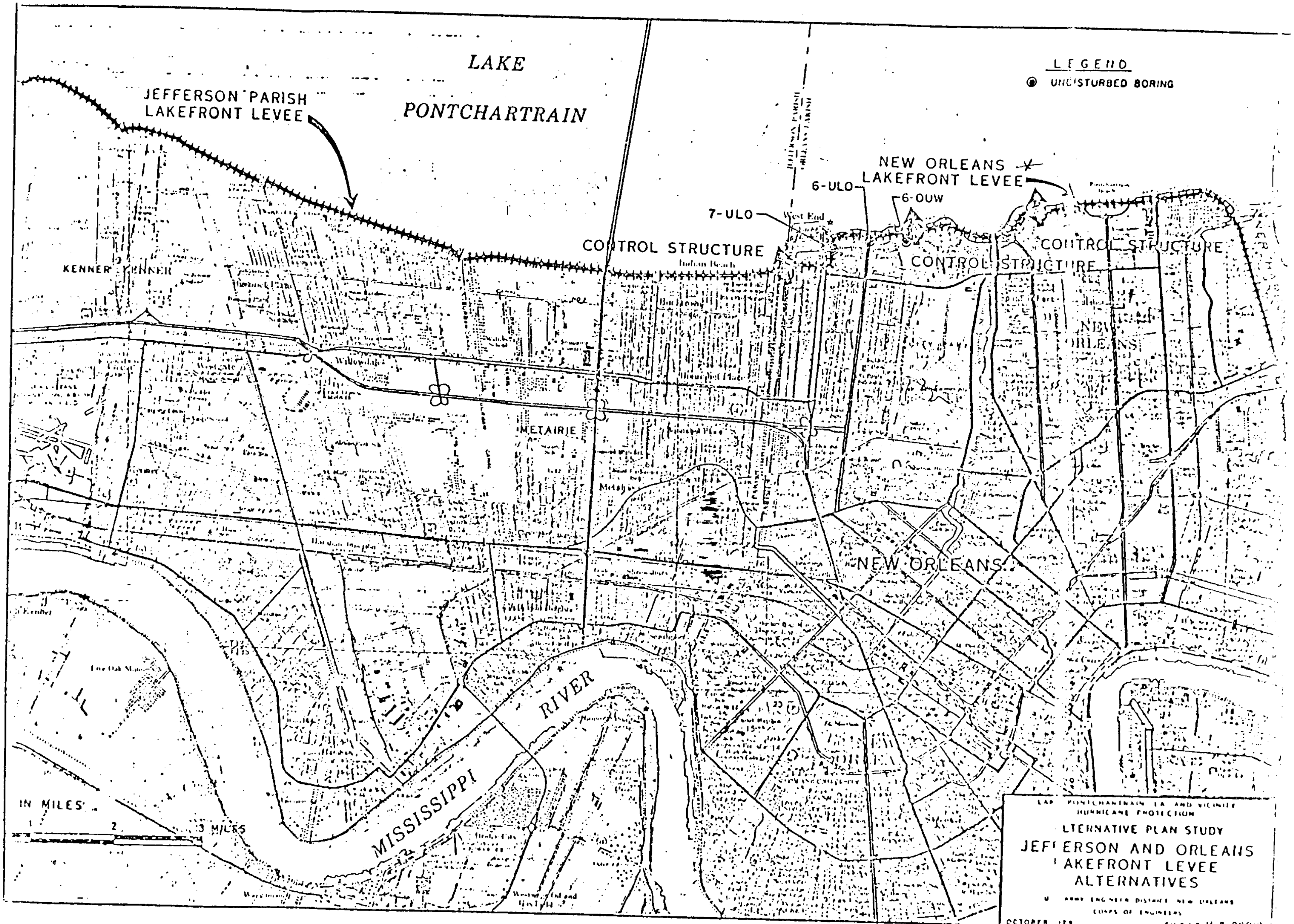

LAKE PONTCHARTRAIN
THE RIGOLETS
LAKE ST. CATHERINE
GULF INTRACOASTAL WATERWAY
NEW ORLEANS EAST SOUTH POINT TO G.I.W.W. LEVEE
NEW ORLEANS EAST BACK LEVEE
NEW ORLEANS EAST LAKEFRONT LEVEE
CITRUS LAKEFRONT LEVEE ALINEMENT
CITRUS BACK LEVEE
MISSISSIPPI RIVER GULF OUTLET
LEGEND
LEVEE
CONTROL STRUCTURE
STRUCTURE-NAVIGABLE
LOCK
DRAINAGE STRUCTURE
DAM
CHANNEL
SCALE OF MILES
1 0 1 2 3
LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
NEW ORLEANS EAST ALTERNATIVES
STANDARD PROJECT HURRICANE PROTECTION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1978
FILE NO. H-2-28912

Figure 1



*The New Orleans Lakefront Levee West of IHNC will be addressed in a supplement 404 Evaluation Report.

Figure 2

o IHNC East Levee and Floodwalls (Portions not subject to regulation.)

o IHNC West Levee and Floodwalls (Portions not subject to regulation.)

o IHNC West Levee, Florida Avenue to IHNC Lock (Portions not subject to regulation.)

A listing of post 1 October 1981 work items subject to regulation under Section 404, and addressed in this report, is presented in Table 1.

c. Project Authority and Purpose. The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project was authorized by the Flood Control Act of 1965 (Public Law 89-298), approved 27 October 1965 essentially as described in House Document No. 231, 89th Congress, 1st Session. The purpose of the project is to provide hurricane protection for the Greater New Orleans Metropolitan Area which includes all or portions of Orleans, Jefferson, St. Bernard, St. Tammany, and St. Charles Parishes.

d. General Description of Dredged and Fill Material.

(1) General Characteristics of Material. The primary construction materials are clays and sands. Clays encountered in wetland or submerged borrow sites within the project area often consist of very soft clays with peat and organic matter overlying very soft fat clays with layers of silt, sandy silt, and sand. These materials are normally in turn generally underlain by medium to stiff Pleistocene clays. The composition of material extracted from these clay borrow areas is typically 70 to 85 percent clay with the remainder consisting of variable percentages of sand, silt, and organic debris. Extracted

TABLE 1

NEW ORLEANS EAST UNIT
POST-OCTOBER 1981 WORK ITEMS SUBJECT TO REGULATION UNDER SECTION 404 OF THE CLEAN WATER ACT

Description of Work Items	Contract Award or Anticipated Award Date	Duration of Contract
New Orleans East Back Levee, Second Hydraulic Life (clay fill: 3,500,000 cy)	11 June 81	1 year
Citrus Back Levee Floodwall Capping (hauled clay fill: 5,000 cy)	7 January 82	240 days
New Orleans East Gap Closures (hauled clay fill: 78,000 cy; sand fill: 11,200 cy; shell fill: 17400 cy)	15 April 82	180 days
Citrus Lakefront Levee, IHNC to Paris Road, Foreshore Protection (shell: 302,200 cy; riprap: 34,500 tons)	October 83	-
Citrus Back Levee, Third Lift, Station 176+00 to Station 574+00 (hauled clay fill: 194,000 cy)	August 84	-
New Orleans East Lakefront Levee, Paris Road to South Point Foreshore Protection (shell: 22,000 cy; riprap: 185,000 tons)	October 84	-
New Orleans East Back Levee Enlargement, Station 773+00 to Station 1006+00 (shell: 17,000 cy; riprap, 70,100 tons)	October 85	
Citrus Lakefront Levee (hauled clay fill: 135,000 cy)	-	-
New Orleans East Lakefront Levee (hauled clay fill: 3,300,000; shand fill: 80,000 cy)	-	-
South Point to GIWW Levee (hauled clay fill: 235,000 cy)	-	-

materials that are unsuitable for levee construction, primarily clays of high organic content, are deposited in nonwetland areas where practicable. Method of deposition will depend on which particular levee reach is involved; for some areas the material will be placed hydraulically, in others it will be hauled. Generally, sandy materials extracted from borrow areas consist of poorly-graded to well-graded sand and small percentages of silt and clay.

Other fill materials that might be used in selected locations include live or dead clam, reef shell or cannery shell, stone of various gradations, concrete block, and concrete mattress.

(2) Quantity of Material. Post 1 October 1981 construction would involve the discharge of about 4.0 million cubic yards (cy) of hauled clay fill and 415,000 cy of hauled sand fill. Additionally, about 600,000 tons of riprap and 34,000 cy of shell would be used in constructing selected hurricane protection features.

(3) Sources of Material. Three borrow sites have been designated to provide construction fill for the New Orleans East unit levees:

- Lake Pontchartrain, north shore at Howze Beach

- Lake Pontchartrain, south shore near South Point

- MR-GO/GIWW channel and Michoud Canal

Other borrow areas not specifically designated may be used at the option of Government contractors with approval of the Contracting Officer. Such extraction sites are normally located in upland areas and are required to be far removed from known potential sources of contamination to be approved for use. Riprap and shell would be obtained from approved commerical sources.

e. Description of Construction Sites.

(1) Location. The levee alinement subject to regulation under Section 404 is presented on Plates 1 and 2.

(2) Size. The hurricane protection levees of the New Orleans East unit would cover approximately 56 acres of brackish/saline marsh and 3 acres of lake bottom after the levees have been shaped into the final design sections. Approximately 84 percent of the proposed new work would follow the alinements of levees and floodwalls which existed prior to initiating this project. Additional lifts and enlargements required to complete levee construction would take place within levee fill areas adjacent to or astraddle of existing levees. The Section 404 impacts of the runoff from these secondary lifts associated with the existing alinements and the initial impacts of disposal on the new alinements will be addressed in subsequent paragraphs.

(3) Types of Sites. Where hydraulic fill is used, confining dikes are constructed to define levee fill areas so that loss of fill material will be minimized. Where determined feasible and appropriate, dikes are also constructed to define ponding areas to capture and temporarily retain drainage for metered release to adjacent water bodies. Levee fill areas would be unconfined at sites where cast or hauled fill is used for construction.

(4) Types of Habitat. Habitat types displaced would include aproximately 54 acres of brackish saline marsh and 3 acres of lake bottom.

(5) Timing and Duration of Discharge. Large levee construction jobs are invariably broken down into more manageable units or reaches. Typically, stockpiling hydraulic fill for one of

these smaller reaches may require 12 to 18 months to complete. Actual dredged material slurry pumping might occur during about 70 percent of this period--on average about 17 hours per day considering downtime to clear clogged pumps, relocate the dredge or discharge line, etc. Levees constructed using relatively dry cast or hauled fill can normally be completed in shorter periods. If the High Level Plan is adopted, the total project could be completed by the year 2000.

f. Description of Construction Method. The levees would be built by stage-construction. The stages consist of "lifts" and "enlargements." A lift constitutes stockpiling fill material within the levee right-of-way. An enlargement involves moving the stockpiled fill from the periphery of the fill area toward the eventual levee centerline and shaping the material into an interim or final design section. Construction of a levee reach might involve multiple lifts and enlargements over a period of several years depending upon the nature of the fill material and foundation conditions at the construction site. On average, about 1 to 5 years might be allowed, if required, for foundation and fill material consolidation after a hydraulic lift has been completed and prior to initiating an enlargement. When dry hauled fill is used and foundation conditions permit, a combination lift and enlargement might be accomplished without an intervening period of consolidation. Construction would be accomplished using hydraulic dredging, bucket dredging, and truck and barge hauled fill depending upon the location of suitable construction material. Once in place, stockpiled fill would be shaped into the required sections using draglines, bulldozers, and other mechanical equipment.

III. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Construction of the protective works could modify existing substrate elevations

adjacent to the levee fill areas. Adjacent marsh could become slightly elevated due to solids lost in runoff from the fill areas. Side-slopes of adjacent water bodies could also become slightly elevated due to runoff containing solids.

(2) Effects on Sediment Type. Major substrate components along the levee alinements are generally sands and clays. Material used for construction would be primarily sands and clays of similar particle dimensions. Lower water and organic matter contents and higher degree of compaction would be the primary changes in substrate physical character.

(3) Effects Due to Dredged and Fill Material Movement. For the most part, only dredged material fines escape the confining areas as the liquid and solid components of the dredged-material slurry separate. The impact of these fines should, in all but extraordinary situations, be minimal.

(4) Physical Effects on Benthos. The portion of the construction to be completed using hauled fill should have minimal impact on adjacent marsh or benthos. Impacts that could occur would result from introducing leachates or highly turbid water from runoff associated with the hauled fill. Runoff would be minimal and intermittent depending on rainfall.

Hydraulic fill placement could also result in some minimal impacts. Benthic communities along the bank and littoral area of the GIWW would receive runoff containing silt and fluid muds from the construction site. Some burial might take place immediately adjacent to the construction area; however, rapid recovery would be expected, accompanied by possible changes in species composition. Introduction of fluid muds would temporarily degrade water quality in the immediate area and would interfere with the filter feeding mechanism of molluscs for the period of construction.

(5) Other Effects on Substrates at the Discharge Sites. Lower pore water and organic matter contents and higher degree of compaction would be the principal changes in substrate character. These physical changes might mediate attendant chemical changes in substrate character.

(6) Actions to Minimize Impacts. New levee construction would follow existing levee alinements where possible. Silt screens or some other form of retention device might be used to minimize siltation of productive benthic habitats.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. The Citrus area has been drained for about 50 years; consequently, salinity effects are not applicable. Most of the New Orleans East area is partially drained brackish marsh. This area is restricted from normal flooding by levees on the south, east, and west, and by the Southern Railway embankment on the north. Construction of one-way drainage structures prior to the start of this project ended tidal exchange between the marsh and Lake Pontchartrain. Since cessation of tidal interchange the marsh area has grown progressively more fresh. Generally, construction of the protective works of the New Orleans East unit would not affect salinity regimes of the IHNC, MR-GO, GIWW, or Lake Pontchartrain.

(b) Water Chemistry. Localized changes in the concentrations of inorganic ions and organics in solution and small shifts in pH might result from material discharge. Oxidation of reduced, water-logged, sulfide-bearing dredged material deposited hydraulically within the levee fill areas could result in slow leaching of acid drainage waters from the stockpiled dredged material to adjacent wetlands or surface waters. Generally, the buffer capacity of wetland surface waters should be sufficient to retard radical shifts in pH. In general, modifications of water chemistry resulting from construction material discharge would be relatively minor and highly localized.

(c) Clarity. Surface water clarity would be significantly reduced during construction material stockpiling. However, this condition should disappear rapidly on completion of this stage of construction.

(d) Color. The true and apparent color of surface waters may intensify as a result of runoff from levee fill areas. The apparent color of surface waters where the borrowed material is discharged would intensify substantially during dredge-and-fill operations. However, this condition dissipates rapidly upon cessation of dredging.

(e) Taste and Odor. No significant effect on the taste and odor of known public or private raw water supplies would be expected as a result of construction material stockpiling.

(f) Dissolved Gas Levels. Gases of aerobic or anaerobic bacterial respiration (CO_2, CH_4, N_2, H_2S, etc) may increase in surface waters as a result of stockpiling construction material. Dissolved oxygen (DO) in the affected surface waters would be depressed due to the chemical and biochemical oxygen demands of dredged sediments. Un-ionized ammonia (NH_3) concentrations also may increase if increases in total ammonia concentrations or the pH of the affected waters occur. Any modification of dissolved gas levels would be highly localized (e.g. at the fringes of stockpiled dredged material) and short-term.

(g) Nutrients. Dissolved nitrogen concentrations might increase substantially during fill operations. Phosphorus is released from suspended dredged sediments to a much lesser extent, if at all. Normally phosphorus compounds remain associated with finely divided suspended solids if oxidizing conditions are maintained.

(h) Eutrophication. Water column nitrogen concentrations might increase significantly as a result of runoff. However, the attendant increased levels of suspended solids, turbidity, and true and apparent color act to limit the depth of the photic zone and thus inhibit abundant algal growth. Since the construction stages which have direct impact on surface waters are of relatively short duration significant long-term enrichment would not be anticipated.

(2) Effects on Current Patterns and Circulation.

(a) Current Patterns and Flow. Normal current patterns and flow characteristics of the IHNC, MR-GO, GIWW, and Lake Pontchartrain would not be affected by construction of the New Orleans East unit levees and floodwalls.

(b) Velocity. Normal tidal velocities of the IHNC, MR-GO, GIWW, and Lake Pontchartrain would not be affected by construction of the New Orleans East unit levees and floodwalls.

(c) Stratification. Construction of the New Orleans East unit levees and floodwalls would not affect the normal thermal or density stratification characteristics of adjacent water bodies.

(d) Hydrologic Regime. Normal movement of runoff and drainage waters would be only minimally affected by construction of the protective works. The drainage characteristics of areas adjacent to the protective works would be only affected to the extent of modifying existing drainage structures and ditches or providing new drainage structures to fulfill project design standards.

(3) Normal Water Level Fluctuations. Construction of the New Orleans East unit levees and floodwalls would not affect normal water level fluctuations in adjacent water bodies.

(4) Salinity Gradients. Salinity gradients in adjacent surface waters would not be affected by construction of the New Orleans East unit levees and floodwalls.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Construction Sites. Both suspended particulate and turbidity levels increase substantially during hydraulic fill operations. The primary impacts are experienced during the initial and subsequent dredge and fill stages of construction. Only minimal impact to surface waters or wetland areas is normally experienced during levee shaping operations because the work area has long since lost its wetland character. Suspended particulate and turbidity levels decline rapidly after cessation of dredging.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Normally, light penetration and thus the depth of the photic zone is decreased as a result of increased suspended particulates and turbidity during dredge-and-fill operations. This effect does not persist after fill operations cease.

(b) Dissolved Oxygen. Dissolved oxygen levels in the shallow surface waters adjacent to the levee fill areas might be depressed or depleted by oxygen demands associated with suspended organic sediments. Absorption of radient energy by particulates in suspension can cause heating of the water column and thus reduce both the oxygen saturation concentration and rate of atmospheric recreation. These effects are usually highly localized and of relatively short duration.

(c) Toxic Metals and Organics. Opportunities for introducing or relocating sediment-bound toxic metals and organics occur during construction materials stockpiling. Water column pollutant levels might be intensified by discharging effluents from levee fill areas, and by rainfall elutriation and leaching of structures made from dredged materials. The standard elutriate test was used to simulate the results of possible interactions between the project hydraulically-dredged sediment and the water that they would contact during levee construction. Core material samples were used to test the quality of the borrow material used for construction. Data indicating possible interactions between dredged construction materials and receiving waters are available from sampling conducted 22 January 1976.

Water and core material sampling sites are shown on Figures 3 and 4, and described below.

- Core Material Sampling Sites
  - Site 0004: Lake Pontchartrain Borrow Area, 5.5 miles northeast of Little Woods
  - Site 0022: Lake Pontchartrain Borrow Area at Howze Beach
  - Site 0024: Gulf Intracoastal Waterway (MR-GO) at the IHNC
  - Site 0026: GIWW (MR-GO) 5 miles east of the IHNC Lock
  - Site 0028: MR-GO at GIWW
  - Site 0033: GIWW 1.5 miles west of Chef Menteur
- Surface Water Sampling Sites
  - Site 0100: Lake Pontchartrain 2.2 miles southwest of Little Woods

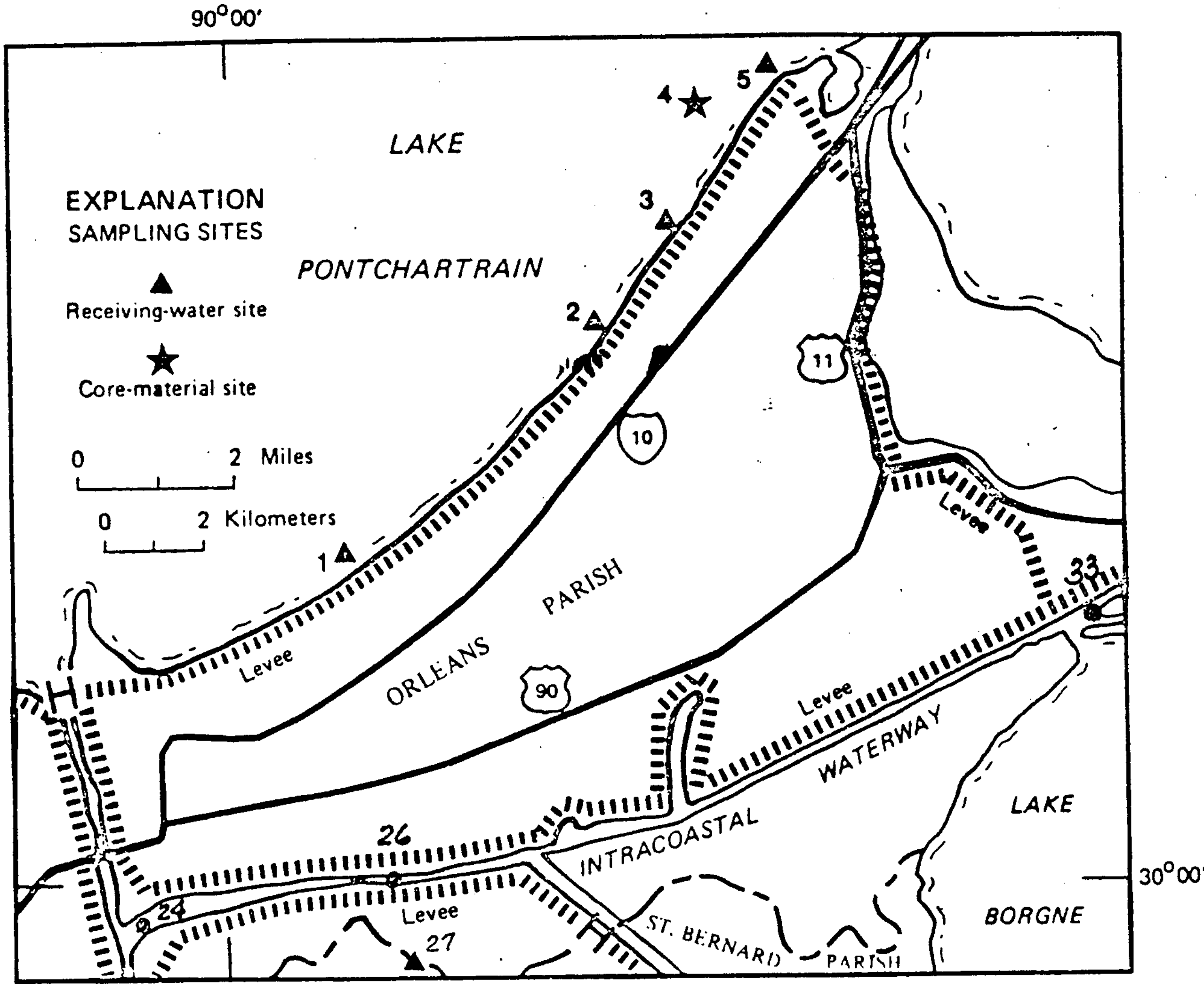


Figure 3.--Location of sampling sites in Lake Pontchartrain in the New Orleans East sector.

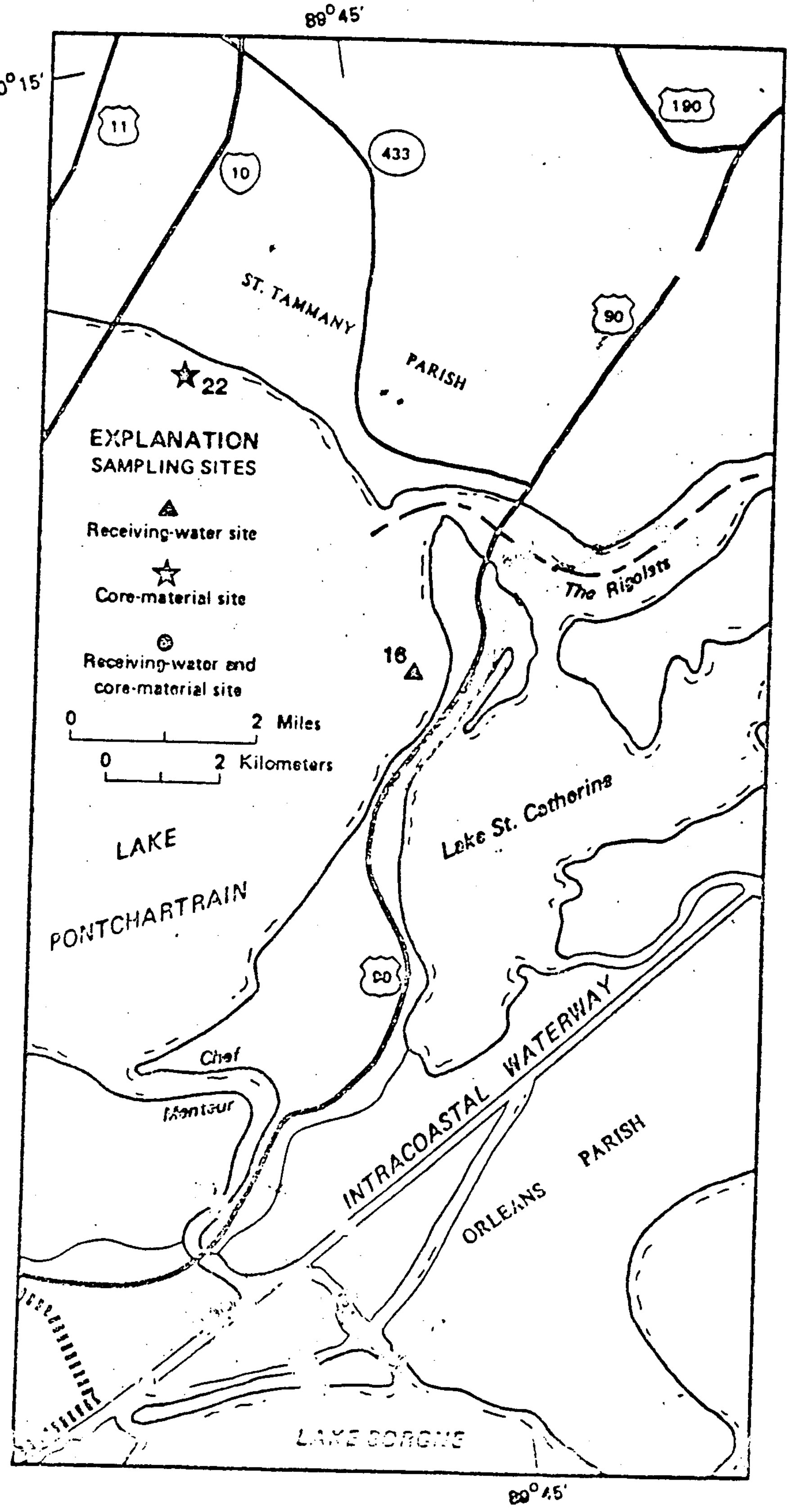


Figure 4.--Location of sampling sites

Site 0200: Lake Pontchartrain 2.0 miles northeast of Little Woods

Site 0300: Lake Pontchartrain 4.1 miles northeast of Little Woods

Site 0500: Lake Pontchartrain 6.2 miles northeast of Little Woods

Site 1600: Lake Pontchartrain 1 mile west of Saw Mill Pass

Site 2400: GIWW (MR-GO) at IHNC

Site 2600: GIWW (MR-GO) 5 miles east of IHNC Lock

Site 2700: Bayou Bienvenue 3.6 miles west of MR-GO

Site 3300: GIWW 1.5 miles west of Chef Menteur

Core material was collected at five sites, receiving water at eight sites, and elutriate tests were performed on eight specific core material-receiving water systems for the New Orleans East sector of the project.

The results of chemical analyses of the core material samples are shown in Table 2. These data are valuable as an inventory of the various compounds present in the borrow material; however, bulk sediment analyses such as these generally show a poor relationship to contaminant mobility (i.e., the propensity of contaminants to be released from the sediment).

Surface water and elutriate data are presented in Table 3. Sample identification numbers utilize a four-digit system in which the first two digits signify a particular receiving-water site and the last two digits signify a core-material site. For example, 2400 indicates the receiving water sampled at site 24; 0024 indicates the core material sampled at site 24; and 2424 signifies the elutriate sample prepared by mixing the water from site 24 with the core material from site 24. EPA aquatic life criteria are shown in Table 4.

TABLE 2
BULK SEDIMENT ANALYSES

Selected Parameter	Sampling Site Identification 0004	0022	0024	0026	0033
Chemical Oxygen Demand (COD) mg/kg	11,000	14,000	37,000	55,000	20,000
Residue Loss on Ignition (LOI) mg/kg	17,900	26,200	50,600	331,000	42,200
Nitrogen, Kjeldahl as N mg/kg	77	92	920	1,000	550
Cyanide (CN) ug/kg	0	0	0	0	0
Arsenic (As) ug/kg	4	5	11	10	9
Cadmium (Cd) ug/kg	<10	<10	<10	<10	<10
Chromium (Cd) ug/kg	<10	10	<10	<10	<10
Copper (Cu) ug/kg	10	20	20	20	20
Lead (Pb) ug/kg	<10	<10	<10	<10	<10
Mercury (Hg) ug/kg	0.06	0.01	0.09	0.17	0.08
Nickel (Ni) ug/kg	<10	20	60	20	40
Zinc (Zn) ug/kg	20	20	50	40	40

Samples collected January 1976

Chemical analyses by US Geological Survey

TABLE 3

SURFACE WATER AND ELUTRIATE ANALYSES

Selected Parameters	0100	0104	0200	0204	0300	0304	0500	0504	1600	1622
Chemical Oxygen Demand (COD) mg/L	50	20	50	65	66	60	55	150	66	59
Nitrogen, Kjeldahl as N (DKN) mg/L	1.6	2.4	0.88	0.84	0.73	1.9	1.3	1.6	0.75	1.6
Cyanide (CN) ug/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arsenic (As) ug/L	0	1	1	0	0	0	0	0	0	1
Cadmium (Cd) ug/L	0	0	0	0	3	0	0	0	0	0
Copper (Cu) ug/L	3	10	2	6	2	3	2	4	1	10
Lead (Pb) ug/L	0	0	0	0	0	0	0	0	0	0
Mercury Hg) ug/L	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Nickel (Ni) ug/L	0	0	0	0	0	0	0	0	0	0
Zinc (Zn) ug/L	0	10	0	0	10	0	20	20	20	0
Phenols ug/L	1	0	0	0	13	0	1	7	1	0

TABLE 3 (Continued)

SURFACE WATER AND ELUTRIATE ANALYSES

Selected Parameter	2400	2424	2600	2626	3300	3333
Chemical Oxygen Demand (COD) mg/L	70	120	90	110	80	85
Nitrogen, Kjeldahl as N (DKN) mg/L	0.36	12	0.62	14	0.82	18
Cyanide (CN) ug/L	0.00	0.00	0.00	0.00	0.00	0.00
Arsenic (As) ug/L	1	4	1	3	2	5
Cadmium (Cd) ug/L	0	0	0	0	0	0
Chromium (Cr) ug/L	0	0	0	0	0	0
Copper (Cu) ug/L	6	3	2	2	2	1
Lead (Pb) ug/L	0	0	0	0	0	0
Mercury (Hg) ug/L	0.1	0.0	0.0	0.0	0.0	0.0
Nickel (Ni) ug/L	0	2	0	0	0	0
Zinc (Zn) ug/L	0	20	0	20	10	0
Phenols ug/L	2	19	0	6	3	3

TABLE 4

EPA AQUATIC LIFE CRITERIA

(All values in ug/L)

	Freshwater[1]		Saltwater[1]		1976
	24-hour	Maximum	24-hour	Maximum	Criteria
Mercury	0.2	4.1	0.1	3.7	
Lead	EPX[2.35 LN(Hardness)-9.48]	EXP[1.22 LN(Hardness)-0.47]	-	-	
Zinc	47	EXP[0.83 LN(Hardness)+1.95]	58	170	
Chromium	-	EXP[1.08 LN(Hardness)+3.48]	-	-	
Cadmium	EXP[1.05 LN(Hardness)-8.53]	EXP[1.05 LN(Hardness)-3.73]	4.5	59	
Copper	5.6	EXP[0.94 LN(Hardness)-1.23]	4.0	23	
Nickel	EXP[0.76 LN(Hardness)+1.06]	EXP[0.76 LN(Hardness)+4.02]	7.1	140	
Arsenic	-	440	-	-	
Aldrin	-	3.0	-	1.3	
Chlordane	0.004	2.4	0.004	0.09	
DDD	0.001	1.1	0.001	0.13	
DDE	0.001	1.1	0.001	0.13	
DDT	0.001	1.1	0.001	0.13	
Dieldrin	0.002	2.5	0.002	0.71	
Endrin	0.002	0.18	0.002	0.037	
Heptachlor	0.004	0.52	0.004	0.053	
Lindane	0.08	2.0	-	0.16	
PCB	0.014	-	0.03	-	
Toxaphene	0.013	1.6	-	0.07	
Mirex					0.001
Methoxychlor					0.03
Phenol	2,560	10,200	-	5,800	-

1 Federal Register, Vol. 45, No. 231 (EPA Water Quality Criteria Documents Availability)

Dissolved Kjeldahl nitrogen, arsenic, and copper each showed a relatively consistant tendency to be released from the core materials and thus elevate concentrations in the elutriates over native water concentrations. Copper was the only parameter measured at concentrations in excess of the EPA 24-hour average saltwater criteria. Copper concentrations exceeded the saltwater criteria in one native water sample and four elutriates. Chemical oxygen demand, chromium, zinc, phenols, and nickel showed inconsistant tendencies to become mobilized from the core materials. Mercury, lead, cadmium, and cyanide concentrations did not increase in any of the eight elutriates over native water concentrations. None of the prepared elutriates were analyzed for pesticide or PCB concentrations.

(d) Pathogens. Fill-material discharges cause temporary increases in bacterial densities in the water column. However, since human ingestion of the raw water at the material extraction or discharge sites is not probable, no significant effects due to increased bacterial densities are anticipated.

(e) Esthetics. Unsightly turbidity plumes are caused by solids placed in suspension during fill operations. The turbidity plumes do not persist long after dredge and fill operations cease.

(3) Effects on Biota.

(a) Primary Production/Photosynthesis. Primary production would be impaired by the reduction of the photic zone induced by the turbidity and sedimentation. Temporary reductions in plankton populations are possible as a result of clumping and flocculation. Phytoplankton, algae and rooted vegetation would also be destroyed by physical abrasion. However, this temporary loss in primary productivity should not have long-term effects since phytoplankton is not the primary food source in Lake Pontchartrain.

(b) Suspension/Filter Feeders. Turbidity would interfere with filter feeding mechanisms, impede growth, and impair respiratory functions. The more motile species would quickly migrate out of the area of impact. These motile organisms, along with others remaining on the fringe of the impacted area, would provide recruitment stocks for repopulation of the affected area.

(c) Sight Feeders. Most of the sight feeders found within Lake Pontchartrain are moderately adapted to low visibility environments and would probably escape the areas of undersirable turdibity and return after conditions improved.

(4) Actions Taken to Minimize Impacts of Suspended Particulates/Turbidity. Hydraulically-dredged construction material would be discharged to confined levee fill areas to minimize loss of solids to adjacent surface waters. Additionally, hauled fill would be used in areas where feasible and appropriate. See Section III.a.(6) for other actions that can be taken to minimize impacts.

d. Contaminant Determinations. Evaluation of the data obtained from core materials and elutriate analyses indicate that the construction material stockpiling would not introduce new contaminants nor significantly increase contaminant levels in the surface waters affected by construction of the hurricane protection works. Although significant increases in the levels of some parameters were measured in the elutriates all levels measured were well below applicable criteria.

e. Aquatic Ecosystem and Organism Determinations.

(1) Plankton Effects. Effects on phytoplankton, attached algae, and rooted vegetation are discussed in Section III.c.(3)(a).

Zooplankton are susceptible to siltation and turbidity influences. The small volume of runoff from fill material would be sufficiently diluted by the receiving waters to cause only temporary impacts, however.

(2) Benthos Effects. Impacts to benthos are described in Sections II.a.(4) and II.c.(3)(b).

(3) Nekton Effects. Most species would not be directly affected by the project since they would vacate the area during construction. Some planktonic feeders might be temporarily attracted to turbidity plumes for short-term feeding. During these feeding forays, the increased free carbon dioxide associated with dredging activities might tend to reduce pH, causing of fishes and other biota to be more susceptible to pollutant laden silt particles (Johnston, 1981).

(4) Aquatic Food Web Effects. Impacts to the aquatic food web are expected to be minimized due to the restriction of fill placement to the area of the existing levee lifts. Short-term impacts associated with turbidity, siltation, nutrient enrichment, and changes in sediment chemistry as they affected plankton, benthos, and nekton have been discussed above. The overall degradation of water quality in the affected area would produce temporary local adverse impacts on the aquatic food web in the immediate vicinity of the construction; however, no significant long-term losses are expected.

(5) Special Aquatic Sites Effects. The discharge would reduce the quality of feeding and nursery areas in the marsh affected. Subtle changes in marsh elevaton could result in vegetative shifts which would induce transition to uplands.

(6) Actions to Minimize Impacts on Aquatic Ecosystems and Organisms. See Sections III.a.(6) and III.c.(4).

f. Construction Site Determinations

(1) Mixing Zone Determination. Construction of the hurricane protection features does not involve "disposal" of dredged material. Rather dredged materials are mostly discharged for use as construction fill into confined areas designed to minimize loss of solids; therefore, mixing zone determinations are not applicable.

(2) Determination of Compliance with Applicable Water Quality Standards. Louisiana water quality standards applicable to surface waters affected by the construction activities are presented in Table 5. It is unlikely that construction activities would cause violations of the listed standards, with the exception of the dissolved oxygen standard. The dissolved oxygen standard might be violated in shallow marsh surface waters where construction materials are discharged. Since the hydraulic fill phases of construction are intermittant and of relatively short duration, violations of the dissolved oxygen standard, should they occur, would be highly localized and short-term.

(3) Potential Effects on Human Use Characteristics

(a) Municipal and Private Water Supply. The only known water supply intakes in the general areas of the construction sites are located on the Mississippi River. Construction of the hurricane protection works would not affect any known sources of public or private water supply.

(b) Recreational and Commercial Fisheries. Analysis of native water and elutriate tests indicate possible deleterious effects on aquatic organisms due to levels exceeding US Environmental Protection Agency critria for copper. Depending on the amounts assimilated by fishes, reproduction and behavior could be altered. The elutriate

TABLE 5

LOUISIANA STATE WATER QUALITY STANDARDS

Designated River Basin Code and Sequence Number[1]

	0417 (W)	0417 (E)	0421	0423
Water Use Classification[2]	A,B,C	A,B,C	B,C	B,C
Dissolved Oxygen mg/L	4.0	4.0	4.0	4.0
Temperature °C	35	35	35	35
pH	6.5 to 9.0	6.5 to 9.0	6.5 to 9.0	6.5 to 9.0
Bacterial Standard[3]	#1	#4	#1	#4

[1]0417 (W): Lake Pontchartrain - West of Highway 11 Bridge
0417 (E): Lake Pontchartrain - East of Highway 11 Bridge
0421: Inner Harbor Navigation Canal (IHNC)
0423: Gulf Intracoastal Waterway (GIWW)

[2]A: Primary Contact Recreation
B: Secondary Contact Recreation
C: Propagation of Fish and Wildlife

[3]#1 Primary Contact Recreation -Based on a minimum of 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 exceed 400/100 mL.

#4 Shellfish propagation - the monthly total coliform median most probably number (MPN) shall not exceed 70/100 mL and not more than 10 percent of the samples ordinarily exceed MPN of 230/100 mL.

tests indicate that dissolved nitrogen and arsenic have a consistent tendency to be mobilized from the sediment and increase concentrations in the receiving waters relative to the background levels. However, pollutant levels measured in the associated native water samples were also excessive. Therefore, no significant adverse impacts would be anticipated.

(c) Water-Related Recreation. Several privately-owned camps are located along the Lake Pontchartrain shoreline in the Citrus lakefront levee reach. Pedestrian access to these camps would be adversely affected during the relatively short-lived levee construction period. Three boat ramps and several privately-owned camps are located in the vicinity of Irish Bayou (New Orleans East, South Point to GIWW levee reach). Also seven boat ramps are located in the Bayou Sauvage area. No long-term adverse effects on water-related recreation would occur as a result of the proposed construction. Short term effects which will be present during construction include localized turbidity, noise, and dust pollution.

(d) Esthetics. Noise and dust levels would be high during construction. The actual construction activities will be intermittant and relatively short-term. The abrupt change in the marsh topography occasioned by the hurricane protection levees also would be esthetically displeasing to some; however, revegetation of levee fill areas by volunteer growth generally occurs rapidly. After shaping the levees into the final design sections they would be seeded to minimize erosion and establish vegetative cover and thus lessen this impact.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. There are no currently open parks located along the alinements of the protective works. Lincoln Beach, a one time recreation area, is now closed. The National Park Service plans to develop a recreation area in the vicinity of Big Oak and Little Oak Islands as part of the Jean Lafitte National Park Complex. However, the park development project will be located within the leveed New Orleans East area and would not be affected by the levee construction.

The draft EIS for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project contains information regarding potential project impacts on significant cultural resources.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. The most severe effects incurred as a result of the project were the direct loss of habitat induced by the first lifts. When completed the project will have caused the following losses within the New Orleans East unit: 227 acres of brackish/saline marsh, 173 acres of which have been previously impacted under the Barrier Plan and another 54 acres which would be impacted in order to complete the High Level Plan construction. An additional 3 acres of lake bottoms are also required to complete High Level Plan construction as well as another 53 acres of river bottom which have been previously impacted. These changes in habitat types might cause changes in species composition and diversity through limiting the types and variety of habitat available.

h. Determination of Secondary Impacts on the Aquatic Ecosystem. The most obvious indirect impacts would be isolation of the marshes from natural flooding regimes afforded by adjacent waters. This isolation would contribute to the lowering or stabilizing of water levels within the marsh making the habitat less suitable for wildlife. Along with this reduction in water level comes the potential for additional marsh loss through development.

Futher utilization of borrow sites in Lake Pontchartrain will result in short-term turbidity, localized removal of benthos and increases in bottom depth which could cause changes in benthic community structure.

These pits could concentrate demersal fish during certain seasons of the year. However those deep depressions in the summer months could be expected to become nutrient sumps with low dissolved oxygen concentrations and high chemical oxygen demand.

IV. FINDING OF COMPLIANCE FOR THE LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT: NEW ORLEANS EAST UNIT

1. No significant adaptations of the guidelines (40 CFR 230) were made relative to this evaluation.

2. The recommended High Level Plan would have less overall adverse impact on aquatic ecosystems than the Barrier Plan alternative. With the High Level Plan, approximately 3.5 million cubic yards of additional sand and clay fill would be discharged to construct the New Orleans East unit protective works compared to the Barrier Plan. However, with the High Level Plan the Barrier unit would not be constructed. Consequently, an estimated 36 million cubic yards of fill required to construct the Barrier unit would not be discharged.

3. Violations of the Louisiana State Water Quality Standards might occur for dissolved oxygen. However, these violations, if they occur, should be localized and of short duration. The proposed discharges would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. Use of the designated levee fill areas will not harm any endangered species or their critical habitat nor violate protective measures for any marine sanctuary.

5. Construction of the hurricane protection project will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife and special aquatic sites. The life stages of aquatic organisms and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values will not occur.

6. Appropriate steps to minimize potential adverse impacts include:

- o Constructing a significant portion of the levee reaches across areas previously used for levee construction.

- o Discharging hydraulically dredged sediments to confined levee fill areas, and using hauled fill where feasible and appropriate.

- o Fertilizing and seeding levees after final design section shaping to promote rapid cover growth and to minimize erosion.

- o Incorporating provisions in contract specifications for protection of the environment during construction activities.

7. On the basis of application of the guidelines (40 CFR 230), the sites designated for construction of hurricane protection features are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

18 Nov 83
Date

ROBERT C. LEE
Colonel, CE
District Engineer

LITERATURE CITED

El-Sayed and Z. Sayed. 1961. Hydrological and Biological Studies of the Mississippi River-Gulf Outlet Project: A Summary Report. Texas A&M Research Foundation, Project 236, Reference No. 61-20F.

Simm, J.L., and J.P. Dyer, III. 1972. An evaluation of siltation created by bay dredging and construction company during oyster shell dredging operations in Tampa Bay, Florida. Final Research Report, University of South Florida, Tampa, FL.

SECTION IX

NEW ORLEANS WEST AND MANDEVILLE UNITS
SECTION 404 (b)(1) EVALUATION REPORT

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION

NEW ORLEANS WEST AND MANDEVILLE UNITS
SECTION 404(b)(1) EVALUATION REPORT

I. INTRODUCTION. The project is located in southeast Louisiana in the general vicinity of the City of New Orleans. The area encompassed by the project includes low land and water areas between the natural levee deposits of the Mississippi River and the Pleistocene escarpment to the north and west. The dominant topographic feature of the area is Lake Pontchartrain. The lake is approximately 25 miles wide at its widest point and is about 40 miles long; it covers approximately 625 square miles and averages about 12 feet deep. Lake Pontchartrain is hydraulically connected to lesser Lake Maurepas to the northwest, and to Lake Borgne, the Mississippi Sound, and the Gulf of Mexico to the south and east. Approximately 4,900 square miles of tributary area drain into the lake.

The Lake Pontchartrain Hurricane protection project was authorized by Congress in 1965. The New Orleans West Unit and the Mandeville Units are integral systems within the overall project, which also includes and the Chalmette Area Plan, the New Orleans East Unit, and the Barrier Unit.

The Section 404 Evaluation of the project is an iterative process. New information regarding the environmental effects of the proposed work is documented and disseminated as major design changes are incorporated into the protective plans. Initially, concerns of Section 404 of the Clean Water Act (CWA) were discussed in public notices dated 29 November 1974 and 22 January 1975, a Statement of Findings signed by the District Engineer in accordance with Federal Regulations (33 CFR 209) on 20 August 1975, and at a public meeting held 22 February 1975. These documents and meeting addressed only the

Barrier, New Orleans East, and Chalmette units of the project. Due to the size and complexity of the project and continuing assessment and refinement of plan alternatives and features, this evaluation report will address only the New Orleans West and Mandeville units. Companion Section 404 Evaluation reports address the Chalmette and New Orleans East units of the project. These three reports incoporate and document the findings of evaluation factors specified in revised Guidelines for Specifications of Disposal Sites for Dredged or Fill Material (45 FR 85336-85357, Wednesday, 24 December 1980). These Guidelines require that construction involving dredged or fill material after 1 October 1981 be evaluated to document that:

- No practicable alternative exists which will have less adverse impact on the aquatic ecosystem.

- Applicable state and Federal water quality standards will not be violated.

- The discharge will not contribute to significant degradation of waters of the United States.

- Appropriate and practicable steps have been taken to minimize potential adverse impacts on the aquatic ecosystem.

Further, the Guidelines require that marine sanctuaries, endangered or threatened species, and critical habitat not be jeopardized.

Federal construction of the total authorized project (Barrier Plan) was initiated 10 May 1967 and was estimated to be about 49 percent complete as of 30 September 1981.

II. PROJECT DESCRIPTION

a. Location. The areas to be protected by the New Orleans West unit levees and Mandeville seawall are located in portions of

Jefferson, St. Charles, and St. Tammany Parishes. The south shore area is generally bounded by Lake Pontchartrain on the north, the Orleans-Jefferson Parish boundary on the east, the Mississippi River mainline levee on the south, and the Bonnet Carre' Spillway east guide levee on the west. The Mandeville protective works will be located on the north shore of Lake Pontchartrain at the City of Mandeville, Louisiana. A general plan and vicinity map is shown on Plates 1 through 3.

b. General Description. The New Orleans West unit would involve construction of approximately 24.1 miles of levees and floodwalls subject to regulation under Section 404. The Mandeville unit would consist of about 1.5 miles of cellular concrete block mattress foreshore protection. Specific hurricane protection features addressed in this evaluation report are listed below.

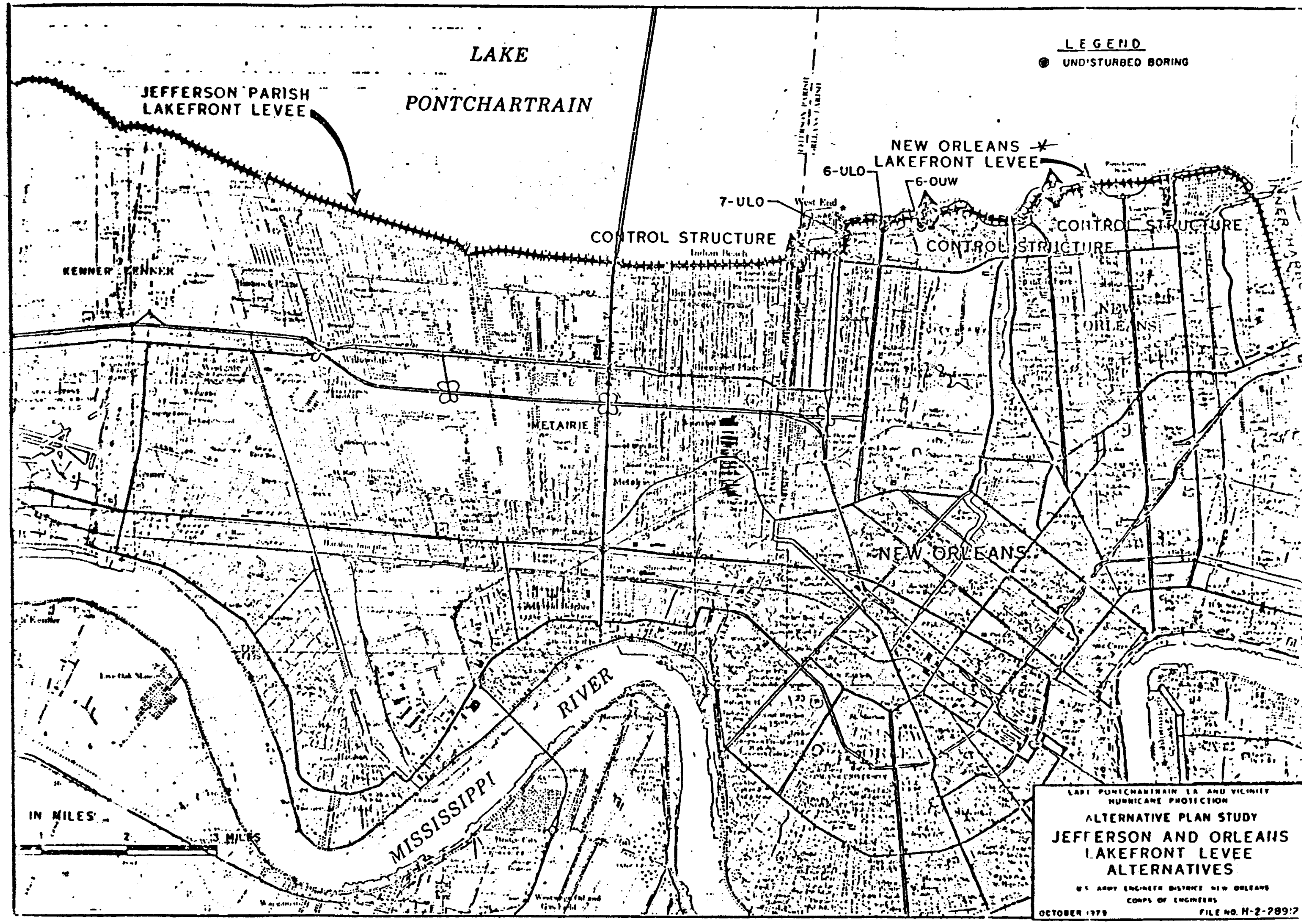
- Jefferson Parish lakefront levee

- Jefferson Parish-St. Charles Parish Boundary levee, lakefront to US Highway 61 (Airline Highway)

- St. Charles Parish levee, north of US Highway 61 (recommended alternate alinement)

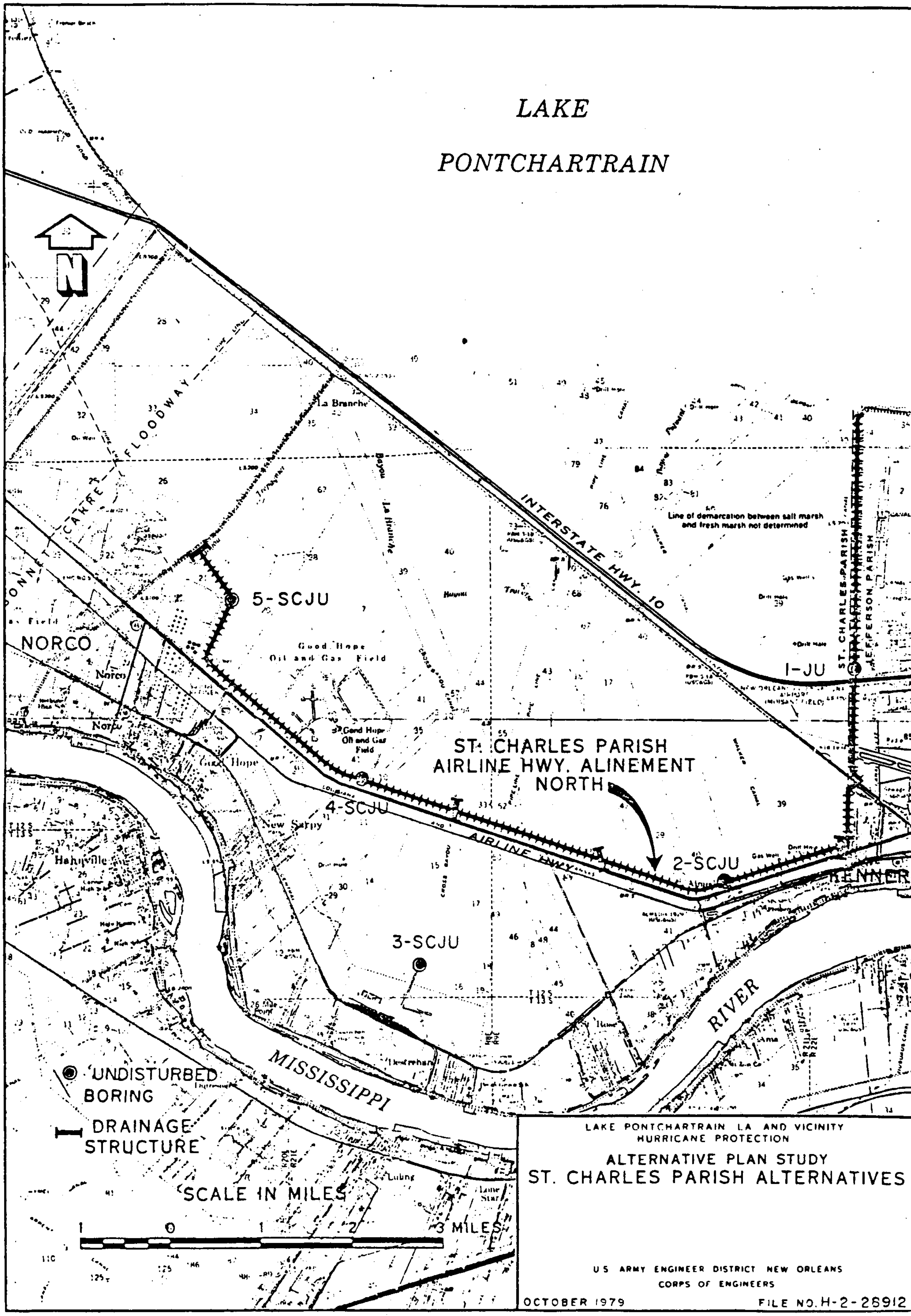
- Mandeville Seawall foreshore protection

c. Authority and Purpose. The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project was authorized by the Flood Control Act of 1965 (PL 89-298), approved 27 October 1965 essentially as described in House Document No. 231, 89th Congress, 1st Session. The purpose of the project is to provide hurricane protection for the Greater New Orleans Metropolitan Area which includes all or portions of Orleans, Jefferson, St. Bernard, St. Tammany, and St. Charles Parishes.



*The New Orleans Lakefront Levee West of IHNC will be addressed in a supplement 404 Evaluation Report.

Figure 1


LAKE
PONTCHARTRAIN
N
BONNET CARRE FLOODWAY
INTERSTATE HWY. 10
La Branche
Line of demarcation between salt marsh and fresh marsh not determined
ST. CHARLES PARISH
JEFFERSON PARISH
5-SCJU
1-JU
NORCO
Norco
Good Hope Oil and Gas Field
ST. CHARLES PARISH
AIRLINE HWY. ALINEMENT
NORTH
4-SCJU
2-SCJU
KENNER
AIRLINE HWY
New Sarpy
Hahnville
3-SCJU
Destrehan
MISSISSIPPI
RIVER
UNDISTURBED BORING
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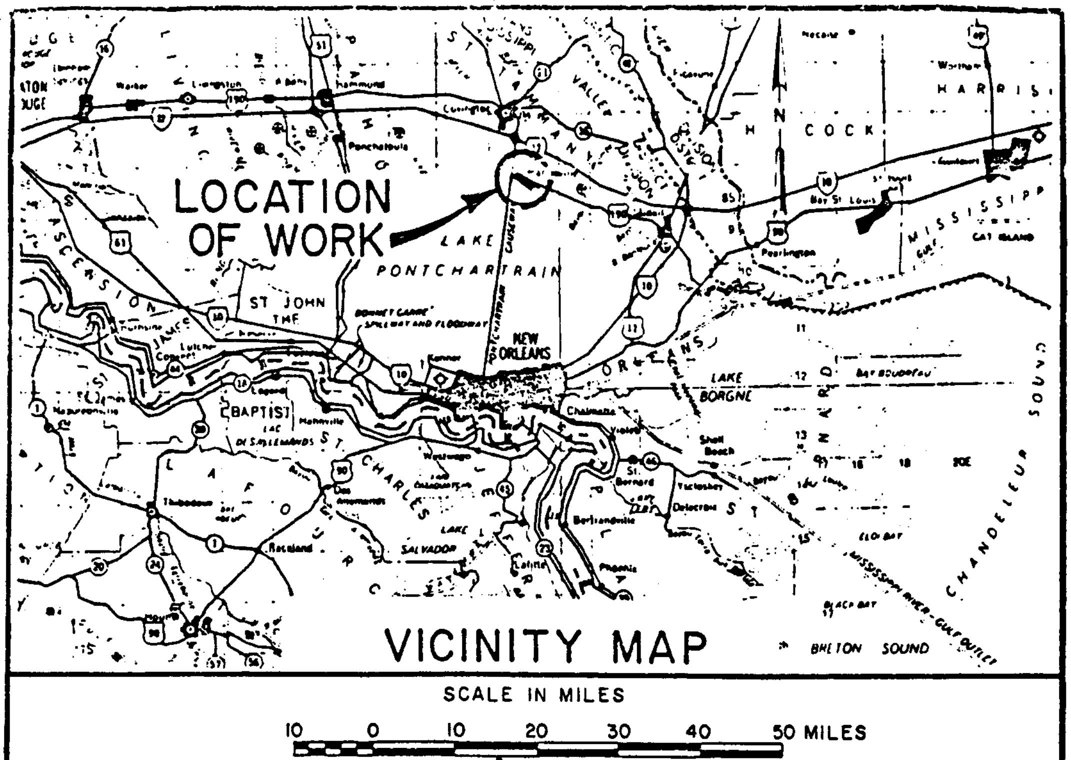
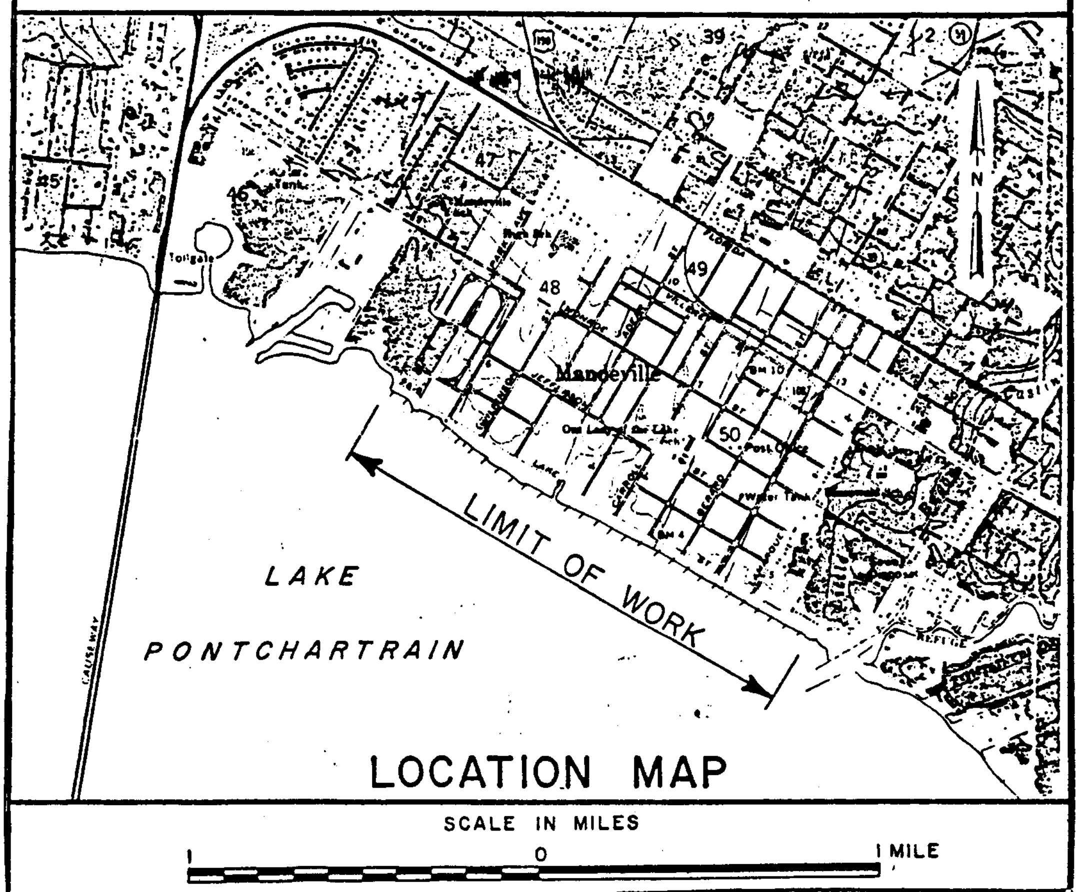
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
ALTERNATIVE PLAN STUDY
ST. CHARLES PARISH ALTERNATIVES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
OCTOBER 1979
FILE NO. H-2-26912

Figure 2





LAKE PONTCHARTRAIN, LA. AND VICINITY
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 7
MANDEVILLE SEAWALL
ST. TAMMANY PARISH, LA.

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

DATE FILE NO. H-2-29345

Figure 3

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The primary construction materials are clays and sands. Clays encountered in wetland or submerged borrow sites within the project area often consist of very soft clays with peat and organic matter overlying very soft fat clays with layers of silt, sandy silt, and sand. These materials are normally underlain by medium to stiff Pleistocene clays. The composition of material extracted from these clay borrow areas is typically 70 to 85 percent clay with the remainder consisting of variable percentages of sand, silt, and organic debris. Extracted materials that are unsuitable for levee construction, primarily clays of high organic content, are deposited in nonwetland areas along the shoreline where possible. Generally, sandy materials extracted from borrow areas consist of poorly graded to well graded sand and small percentages of silt and clay.

Other fill materials that may be used in selected locations include live or dead clam, reef or cannery shell, stone of various gradations, concrete block, and concrete mattress.

(2) Quantity of Material. Construction of the Jefferson Parish lakefront levee would involve discharging about 13.6 million cubic yards (cy) of in-place clay fill (approximately 34 million cy of dredged-material slurry) and about 10 million cy of shell. About 13.7 million cy of hauled clay fill would be used to construct the Jefferson Parish-St. Charles Parish Boundary levee and the St. Charles Parish levee north of US Highway 61 (Airline Highway). The Mandeville Seawall foreshore protection would involve discharging about 5,000 cy of hauled clay fill, 24,000 cy of shell, and incidental quantities of slope material from grading operations. Foreshore armor would consist of about 206,000 square feet of cellular concrete block mattress placed lakeward of the existing seawall.

(3) Sources of Material. Three borrow sites have been designated to provide construction fill for the New Orleans West unit levees and Mandeville foreshore protection:

- o Lake Pontchartrain, north shore at Howze Beach
- o Lake Pontchartrain, Jefferson Parish lakefront, approximately 3000 to 4000 feet from shoreline
- o Bonnet Carre' Spillway

If approved by the Contracting Officer, other borrow areas not specifically designated may be used at the option of contractors performing work for the Government. These alternate borrow sources are normally located in upland areas and are required to be far removed from known potential sources of contamination to be approved for use. Shell fill would be obtained from an approved commercial source.

e Description of the Proposed Discharge Sites.

(4) Location. The construction sites are located south of Lake Pontchartrain in Jefferson and St. Charles Parishes, and along the Lake Pontchartrain north shore at Mandeville, Louisiana. The general locations of the construction sites are shown on Plates 1 through 3.

(5) Size. Approximately 193 acres of wetlands would be impacted by the dredged- and fill-material discharges.

(6) Types of Site. Where hydraulic fill is used, confining dikes would be constructed to define levee fill areas so that loss of fill material would be minimized. Levee fill areas would be unconfined at sites where hauled fill is used for construction.

(7) Types of Habitat. Habitat types impacted by fill material discharges would include about 105 acres of cypress tupelo, 88 acres of brackish/saline marsh, and 408 acres of lake bottom.

(8) Timing and Duration of Discharge. Large levee construction jobs are invariably broken down into more manageable units or reaches. Typically, stockpiling hydraulic fill for one of these smaller reaches may require 12 to 18 months to complete. Actual dredged material slurry pumping may occur during about 70 percent of this period - on average about 17 hours per day considering downtime to clear clogged pumps, relocate the dredge or discharge line, etc. Levees constructed using relatively dry hauled fill can normally be completed in shorter periods. For the total hurricane protection project, intermittent discharges, at various locations, could occur through the year 2000 to maintain required net grades.

f. Description of Construction Method. The levees would be built by stage-construction. The stages consist of "lifts" and "enlargements". A lift constitutes stockpiling fill material within the levee right-of-way. An enlargement involves moving the stockpiled fill from the periphery of the fill area and shaping the material into an interim or final design section. Construction of a levee reach may involve multiple lifts and enlargements over a period of several years depending upon the nature of the fill material and foundation conditions at the construction site. On average, about 1 to 5 years might be allowed (if required) for foundation and fill material consolidation after a lift has been completed and prior to initiating an enlargement. When dry hauled fill is used and foundation conditions permit, a combination lift and enlargement might be accomplished without an intervening period of consolidation. Construction will be accomplished using hydraulic dredging, bucket dredging, and truck and barge hauled fill depending upon the location of suitable construction material. Once in place, stockpiled fill would be shaped into the required sections using draglines, bulldozers, and other mechanical equipment.

III. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Extensive changes in substrate elevation would occur along the Jefferson Parish lakefront, and in St. Charles Parish north of the US Highway 61 alinement. Expansion of the Jefferson Parish lakefront levee would result in conversion of about 408 acres of soft lake bottom to relatively dry firmly compacted levee slopes. The St. Charles Parish levee, north of US Highway 61, would be constructed across previously unleveed wetlands and would effect significant elevation changes over about 105 acres.

(2) Effects on Sediment Type. Major substrate components along the levee alinements are generally sands and clays. Material used for construction would be primarily sands and clays of similar particle dimensions. Lower water and organic matter contents and higher degree of compaction would be the primary changes in substrate physical character. Lakeward of the Mandeville Seawall substrate change would involve conversion of lake bank and bottom from primarily soil to concrete block and shell.

(3) Effects on Dredged/Fill Material Movement. The lakeward expansion of the Jefferson Parish lakefront levee would be constructed using hydraulic fill. The dredged material slurry could move along the lake bottom, between a retaining dike and the shoreline, in the form of a concentrated fluid mud when initially discharged. The retaining dike, located at the lakeward boundary of the levee fill area, would limit movement of this fluid mud from the fill area into the adjacent water. Generally, only dredged-material fines would escape the levee fill area as the solid and liquid components of the dredged-material slurry separate. The impact of deposition of fines outside of the levee fill area should be minimal.

(4) Physical Effects on Benthos. The littoral area westward of the Lake Pontchartrain Causeway to the St. Charles - Jefferson Parish line is primarily clay silt with occasional pockets of sandy silt and silty sand (Stone, 1980). Generally, this area has a lower density of macrofaunal organisms than habitats located further off shore. When pockets of sandy silt and silty sand are found in the nearshore area macrofaunal densities increase somewhat (Stone, 1980). However, the general nearshore area seems to have a high degree of organic enrichment and thus may be the cause of the depauperate condition of benthos in this area. The total abundance of benthics in this area is much lower compared to populations elsewhere in the lake.

Mollusc populations are very low in this area with Rangia cuneata being most common (Stone et al 1980). Vioscalba lousianae and Mulinia Ponchartrainensis are the two most dominant benthics in the lake as a whole.

The nearshore benthic habitat would be lost; however, this area is not the most productive nor highest quality benthic habitat within the lake. In addition, some repopulation of the side slopes and foreshore protection material would be nd (Stone, 1980). Generally, this area has a lower density of macrofaunal organisms than habitats located further off shore. When pockets of sandy silt and silty sand are found in the nearshore area macrofaunal densities increase somewhat (Stone, 1980). However, the general nearshore area seems to have a high degree of organic enrichment and thus may be the cause of the depauperate condition of benthos in this area. The total abundance of benthics in this area is much lower compared to populations elsewhere in the lake.

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The nearshore benthic habitat would be lost; however, this area is not the most productive nor highest quality benthic habitat within the lake. In addition, some repopulation of the side slopes and foreshore protection material would be expected to occur.

(5) Other Effects on Substrate at the Discharge Sites. Lower pore water and organic matter contents and higher degree of compaction would be the principal changes in substrate character. These physical changes might mediate attendant chemical changes in substrate character.

(6) Actions to Minimize Impacts. Levee construction would utilize existing levee alinement where possible. Additionally, retention dikes would be utilized where necessary (hydraulic dredging). Silt screens might be used to minimize siltation where feasible.

Foreshore protection material which would provide suitable benthic substrate would be utilized to the maximum extent possible. This material would provide good quality benthic habitat.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. The New Orleans West and Mandeville protective works would not alter salinity regimes in Lake Pontchartrain or adjacent wetlands.

(b) Water Chemistry. Localized changes in the concentrations of inorganic ions and organics in solution and small shifts in pH might result from material discharge. Oxidation of reduced, water-logged, sulfide-bearing dredged material deposited hydraulically within the levee fill areas could result in slow leaching of acid drainage waters from the stockpiled dredged material to adjacent wetlands or surface waters. Generally, the buffer capacity of the affected surface waters should be sufficient to retard radical shifts in pH. In general, modifications of water chemistry resulting from construction material discharge will be relatively minor and highly localized.

(c) Clarity. Surface water clarity would be significantly reduced during construction material stockpiling. However, this condition should disappear rapidly on completion of this stage of construction.

(d) Color. The true color of surface waters may intensify due to runoff from levee fill areas. The apparent color of surface waters where the borrowed material is discharged would intensify substantially during dredge and fill operations. However, this condition dissipates rapidly upon cessation of dredging.

(e) Taste and Odor. No significant effect on the taste and odor of known public or private raw water supplies would be expected as a result of construction material stockpiling.

(f) Dissolved Gas Levels. Gases of aerobic or anaerobic bacterial respiration (CO_2, CH_4, N_2, H_2S, etc.) may increase in surface waters as a result of stockpiling construction material. Dissolved oxygen (DO) in the affected surface waters would be depressed and, in some cases, depleted due to the chemical and biochemical oxygen demands of dredged sediments. Un-ionized ammonia (NH_3) concentrations also may increase if increases in total ammonia concentrations or pH of the affected waters occur. Any modification of dissolved gas levels would be highly localized (e.g., at the fringes of stockpiled dredged material) and short-term.

(g) Nutrients. Dissolved nitrogen concentrations might increase substantially during fill operations. Phosphorus is released from suspended dredged sediments to a much lesser extent, if at all. Normally, phosphorus compounds remain associated with finely divided suspended solids if oxidizing conditions are maintained.

(h) Eutrophication. Water column nitrogen concentrations might increase significantly as a result of runoff. However, the attendant increased levels of suspended solids, turbidity, and true and apparent color act to limit the depth of the photic zone and thus inhibit abundant algal growth. Nutrients released into solution are eventually recycled to sediments. Since the construction stages which have direct impact on surface waters are of relatively short duration, significant long-term enrichment of the affected surface waters as a result of constructing the hurricane protection works would not be anticipated.

(2) Current Patterns and Circulation.

(a) Current Patterns and Flow. Minor alteration of existing current and flow patterns along the Jefferson Parish lakefront might occur due to the lakeward levee expansion. The present capacity for tidal exchange that exists between the lake and the wetlands located to the south of US Highway 61 will be maintained as part of the St. Charles Parish levee construction. This increased capacity for tidal exchange might help to sustain and enhance these wetlands.

(b) Velocity. Constructing the proposed protective works would not affect normal current velocity.

(c) Stratification. Highly localized alteration of the vertical thermal and salinity stratification characteristics of the lake might occur during hydraulic fill operations.

(d) Hydrologic Regime. Construction of the hurricane protection works will not affect the normal hydrologic regime of the project area.

(3) Normal Water Level Fluctuations. Normal tide stages would not be affected by the proposed construction.

(4) Salinity Gradients. Highly localized alteration of vertical salinity gradients might occur in the vicinity of the Jefferson Parish lakefront during hydraulic fill operations.

(5) Actions That Will Be Taken to Minimize Impacts on Water Circulation, Fluctuation and Salinity. Constructing the St. Charles Parish levee following the authorized (1965) lakefront alinement would result in capturing approximately 29,000 acres of wetlands on the protected side of the levee. This alinement would cause drastic alteration of water circulation patterns in the enclosed wetlands, as well as induce development of the area. With the recommended levee alinement, however, approximately 25,000 acres of wetlands would remain directly connected to the lake. The present tidal exchange between the lake and wetlands that would be captured to the south of US Highway 61 would be maintained by drainage structures.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Construction Sites. Both suspended particulate and turbidity levels increase substantially during hydraulic fill operations. The primary impacts are experienced during the initial and subsequent dredge and fill stages of construction. Only minimal impact to surface waters or wetland areas is normally experienced during levee shaping operations because the work area has long since lost its wetland character. Suspended particulate and turbidity levels decline rapidly after cessation of dredge-material stockpiling.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Normally, light penetration and thus the depth of the photic zone is decreased as a result of increased suspended particulates and turbidity during dredge and fill operations. This effect does not persist after fill operations cease.

(b) Dissolved Oxygen. DO levels in shallow surface waters adjacent to the levee fill areas might be depressed or depleted by oxygen demands associated with suspended organic sediments. Absorption of radiant energy by particulates in suspension can cause heating of the water column and thus reduce both the oxygen saturation concentration and rate of atmospheric reaeration. These effects are usually highly localized and of relatively short duration.

(c) Toxic Metals and Organics. Opportunities for introducing or relocating sediment-bound toxic metals and organics occur during construction materials stockpiling. Water column pollutant levels might be intensified by discharging effluents from levee fill areas, and by rainfall elutriation and leaching of structures made from dredged materials. The standard and modified elutriate tests were used to simulate the results of possible interactions between hydraulically-dredged fill materials and the water that they will contact during levee construction. Preparation of the modified elutriate differs from the standard elutriate by excluding 0.45 u filtration of the sample prior to analysis. Analysis of the standard elutriate measures the dissolved concentrations in the sample filtrate, whereas, analysis of the modified elutriate measures total concentrations in the sample supernatant after 1 hour of quiescent settling. Thus, the modified elutriate reflects additional effects of particulates which do not settle readily from suspension. Both core material samples and unconsolidated sediments were used to test the quality of the borrow material to be used for construction.

Data indicating possible interactions between construction fill materials and receiving waters are available from three sampling expeditions conducted in September and November 1981.

Two water and four 20-foot core samples were collected along the Jefferson Parish lakefront and at Howze Beach in November 1981. Each core was divided into thirds for preparation of elutriates prior to chemical analyses. Analyses were then performed on surface water, the core material subsamples, and 12 standard elutriates. In September 1981, two surface water samples and five surficial sediment samples were collected in these same areas. Additionally, three surficial sediment samples were collected at the Bonnet Carre' borrow site.

The results of chemical analyses of the core material subsamples are shown in Table 1 and data from analyses of the surficial sediments are presented in Table 2. These data are valuable as an inventory of the various compounds present in the borrow material; however, bulk sediment analyses such as these generally show a poor relationship to contaminant mobility (i.e., the propensity of contaminants to be released from the sediment). One pesticide, the DDT metabolite DDD, was measured above detection limits in two core material subsamples - one from the Jefferson Parish lakefont and one collected from Howze Beach. Aldrin, DDE, and chlordane were detected in surficial sediment samples collected from the Jefferson Parish lakefront. Aldrin and DDE were measured above detection limits in the sediment sample collected north of Pumping Station No. 2 (sample LPHP2) and chlordane was detected lakeward of Pumping Station No. 3 (sample LPHP3).

Surface water and standard elutriate data are presented in Table 3 and surface water and modified elutriate data are shown in Table 4. EPA aquatic life criteria are shown in Table 5.

The DDT metabolite, DDD, was measured in excess of the EPA 24-hour average criterion (0.001 ug/L) in one standard elutriate prepared with

TABLE 1

CORE MATERIAL ANALYSES

	INDIAN BEACH									HOWZE BEACH		
	#1			#2			#3					
	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM
Total Solids, % by Weight	63.66	60.18	57.40	76.38	44.05	42.60	59.28	54.65	75.32	62.52	83.25	83.25
TVS, mg/Kg	15,350	24,850	29,500	11,350	11,020	15,500	24,400	-	12,600	18,900	10,600	10,700
Calcium, mg/Kg	852	600	667	314	928	714	1,080	849	958	65.6	10.8	14.4
Manganesium, mg/Kg	3,650	3,620	4,070	1,740	5,425	3,570	5,980	3,810	5,680	2,510	997	876
Manganese, mg/Kg	6.91	7.30	7.66	5,69	10.3	9.99	7.59	8.23	5,97	7.03	4.92	3.60
Iron, mg/Kg	21,800	26,800	27,600	7,750	31,500	16,700	22,800	24,900	16,300	4,370	4,370	4,300
Mercury, mg/Kg	0.12	0.07	0.11	0.09	0.07	0.07	0.13	0.07	0.07	0.09	<0.05	<0.05
Lead, mg/Kg	1.41	1.82	1.57	1.18	2.72	2.59	2.02	2.01	1.73	2.08	1.20	1.20
Zinc, mg/Kg	64.8	52.5	67.1	24.7	78.8	33.1	61.6	47.8	44.1	26.1	8.76	5.64
Chromium, mg/Kg	15.7	16.6	156.7	13.1	18.2	23.2	15.9	17.9	13.2	13.8	11.2	8.64
Cadmium, mg/Kg	0.14	0.02	0.02	0.01	0.05	0.02	0.02	0.02	0.01	0.02	<0.01	0.01
Copper, mg/Kg	6.12	4.65	6.62	15.8	27.2	27.5	19.6	21.0	5.98	1.60	1.56	0.24
Nickel, mg/Kg	39.0	46.4	48.6	28.4	63.3	98.8	77.4	82.0	58.9	74.7	55.6	54.8
Arsenic, mg/Kg	4.38	4.14	3.86	1.37	3.81	2.58	3.54	1.46	2.39	1.12	0.12	0.12

TABLE 1 (Continued)

CORE MATERIAL ANALYSES

(All Values Listed in ug/kg)

	INDIAN BEACH									HOWZE BEACH		
	#1			#2			#3					
	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM	TOP	MIDDLE	BOTTOM
Aldrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlordane	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
DDD	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1
DDE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
DDT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lindane	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toxaphene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mirex	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
x BHC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

TABLE 2

BULK SEDIMENT ANALYSES

(Concentration Units are mg/Kg)

	Jefferson Parish Lakefront			Bonnet Carre'			Howze Beach	
	LPHP 1	LPHP2	LPHP3	LPHP4	LPHP5	LPHP6	LPHP7	LPHP8
Total Volatile Solids, % weight	2.5	8.9	0.5	8.0	6.8	8.5	1.8	1.7
Oil & Grease mg/Kg	148	149	225	100	306	219	146	50
Total Kjeldahl Nitrogen, mg/Kg	588	1,300	1,260	488	280	631	362	341
Nitrite-N, mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate-N, mg/Kg	179	81	272	149	119	130	416	168
Total Nitrogen-N, mg/Kg	793	1,442	1,794	668	357	799	809	530
Ammonia-N mg/Kg	26	61	262	31	30	38	31	21
Manganese, mg/Kg	323	235	282	297	256	381	79	109
Iron, mg/Kg	24,900	6,810	6,340	15,400	13,000	24,100	4,760	6,740
Mercury, mg/Kg	0.2	<0.1	0.9	0.6	0.1	0.4	<0.1	<0.1
Lead, mg/Kg	9.2	8.0	7.4	8.8	7.7	14	3.4	5.1
Zinc, mg/Kg	58	29	30	54	40	80	14	36
Chromium, mg/Kg	26	9.4	8.7	22	19	40	14	5.3
Cadmium, mg/Kg	<0.09	<0.09	0.17	<0.09	<0.09	0.20	<0.09	<0.09
Copper, mg/Kg	14	6.8	9.4	12	8.0	19	1.98	3.8
Nickel, mg/Kg	23	7.1	6.0	15	14	235	3.1	4.2
Arsenic, mg/Kg	9.9	1.6	2.2	2.7	3.3	7.4	1.0	1.5
Ortho Phosphate-P, mg/Kg	62	9.28	15.4	11.4	20.8	17.1	10.2	6.67
Total Phosphate-P, mg/Kg	290	253	387	435	370	422	82	72.9
COD, mg/Kg	22,000	108,000	14,000	7,000	4,400	10,000	6,200	5,800
Cation Exhange Capacity (Meq No/100 grams)	55.9	47.4	46.9	42.8	34.4	56.3	31.1	25.0

TABLE 2 (Continued)

BULK SEDIMENT ANALYSIS

(Concentration Units are mg/Kg)

	Jefferson Parish Lakefront			Bonnet Carre'			Howze Beach	
	LPHP 1	LPHP2	LPHP3	LPHP4	LPHP5	LPHP6	LPHP7	LPHP8
Aldrin	<0.0006	0.001	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Chlordane	<0.008	<0.008	0.018	<0.008	<0.008	<0.008	<0.008	<0.008
o,p-DDD	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
p,p-DDD	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
o,p-DDE	<0.0012	0.0059	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
p,p-DDE	<0.0012	0.005	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
o,p-DDT	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032
p,p-DDT	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032
Dieldrin	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012
Endrin	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Heptachlor	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Heptachlor Epoxide	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
Lindane	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004
Toxaphene	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Mirex	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032	<0.0032
Methoxychlor	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
PCBs: Aroclor 1016	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
Aroclor 1221	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Aroclor 1232	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Aroclor 1242	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aroclor 1248	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Aroclor 1254	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Aroclor 1260	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03

TABLE 3

SURFACE WATER AND ELUTRIATE ANALYSES

(All values in mg/L)

	Surface Water		Elutriates									Lake Pontchartrain at Howze Beach				
			#1			#2			#3			Surface Water		Elutriates		
	Total	Dissolved	Total	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Total	Dissolved	Top	Middle	Bottom
COD	57	52	99	99	79	103	120	117	122	112	110	124	70	119	108	111
TKN	1.07	0.83	1.28	1.23	1.35	1.03	0.94	1.08	1.29	1.17	1.09	0.99	0.64	0.81	0.72	0.74
Nitrite-N	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01
Nitrate-N	0.07	-	0.12	0.15	0.13	0.19	0.15	0.22	0.16	0.17	0.16	-	0.02	0.12	0.07	10.06
Total Nitrogen-N	-	0.09	1.40	1.38	1.50	1.21	1.09	1.30	1.45	1.34	1.25	-	0.66	0.93	0.79	0.80
Ammonia-N	-	0.06	0.06	0.13	0.05	0.06	0.07	0.09	0.07	0.05	0.06	-	0.05	0.07	0.05	0.05
Ortho Phosphate-P	-	0.06	0.02	0.05	0.02	0.04	0.05	0.12	0.04	0.02	0.02	-	0.02	0.03	0.02	0.02
Total Phosphate-P	0.67	0.21	0.42	0.38	0.27	0.19	0.29	0.27	0.17	0.19	0.18	0.48	0.13	0.21	0.19	0.19

TABLE 3 (Continued)

SURFACE WATER AND ELUTRIATE ANALYSES

	Surface Water		Elutriates									Lake Pontchartrain at Howze Beach				
	#1	#2	#3			Surface Water			Elutriates							
	Total	Dissolved	Total	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom	Total	Dissolved	Top	Middle	Bottom
Calcium, mg/L	36.7	35.6	38.9	35.9	54.1	58.2	58.3	39.7	44.2	55.7	55.4	49.8	47.4	57.6	59.8	55.9
Manganesium, mg/L	27.8	24.0	24.1	22.2	19.5	27.8	26.5	31.9	21.9	22.1	25.6	39.3	38.4	40.2	38.0	34.7
Manganese, ug/L	23	13	32	9	6	1	<1	44	8	18	42	32	17	39	36	36
Iron, ug/L	620	170	140	90	210	110	130	140	140	450	100	160	40	110	120	80
Mercury, ug/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead, ug/L	47	34	20	34	12	30	21	28	20	26	14	45	43	25	22	16
Zinc, ug/L	43	4	2	4	6	11	7	57	6	4	1	46	10	4	1	1
Chromium, ug/L	65	15	15	14	13	15	10	35	14	21	9	73	32	15	46	34
Cadmium, ug/L	0.9	0.8	0.9	0.8	0.7	0.7	0.6	0.6	0.7	0.8	0.8	1.2	0.8	0.7	0.7	0.8
Copper, ug/L	27	4	3	4	3	1	5	2	2	1	3	52	2	2	1	21
Nickel, ug/L	8	5	40	11	63	15	1	16	4	29	10	5	2	25	16	11
Arsenic, ug/L	<1	<1	1	2	1	<1	1	<1	1	1	1	3	<1	1	1	1

TABLE 3 (Continued)

SURFACE WATER AND ELUTRIATE ANALYSES

	Lake Pontchartrain at Indian Beach												Lake Pontchartrain at Howze Beach				
	Surface Water		Elutriates										Surface Water		Elutriates		
			#1			#2			#3								
	Total	Dissolved	Total	Middle	Bottom	Top	Middle	Bottom	Top	Middle	Bottom		Total	Dissolved	Top	Middle	Bottom
Aldrin	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005
Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01
DDD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	0.002	<0.001	<0.001
DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001
Dieldrin	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002	<0.002	<0.002
Endrin	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002	<0.002	<0.002
Heptachlor	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002	<0.002	<0.002
Heptachlor Expoxide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005
Lindane	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001
PCB	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05
Toxaphene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1
Mirex	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.0095	<0.005
x BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001

TABLE 4

SURFACE WATER AND ELUTRIATE ANALYSES

	Surface Water		Elutriates			Surface Waters		Elutriates	
	Total	Dissolved				Total	Dissolved		
	(LPHP 3)		LPHP1	LPHP2	LPHP3	(LPHP8)		LPHP7	LPHP8
Calcium, mg/L	76	75	100	88	105	107	106	120	112
Mangnesium, mg/L	1,830	191	230	200	200	289	276	280	260
Manganese, ug/L	210	17	1,680	5,800	427	40	17	1,020	1,330
Iron, ug/L	340	<10	6,300	190	80	140	<10	330	30
Mercury, ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead, ug/L	<10	<10	<10	<10	<10	<10	<10	<10	<10
Zinc, ug/L	12	5	36	<1	<1	<1	<1	<1	<1
Chromium, ug/L	20	<10	40	50	50	40	20	70	90
Cadmium, ug/L	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper, ug/L	10	8	23	17	17	15	11	22	22
Nickel, ug/L	<10	<10	20	<10	<10	<10	<10	<10	<10
Arsenic, ug/L	2	2	10	4	12	1	<1	<1	8
Ortho Phosphate, as P, ug/L	110	90	90	260	440	40	30	10	30
Total Phosphorus, as P, ug/L	150	110	70	830	1,100	60	50	60	150
Total Kjeldahl Nitrogen, ug/L	530	-	1,100	9,500	36,00	380	0	5,400	3,400
Nitrite, as N, ug/L	<10	-	120	<10	<10	<10	-	50	100
Nitrate, as N, ug/L	900	-	320	20	<10	130	-	100	130
Total Nitrogen, as N, ug/L	1,620	-	2,640	19,000	58,000	630	-	11,000	7,030
Ammonia, as N, ug/L	190	-	1,100	9,500	22,000	120	-	5,400	3,400

TABLE 4 (Continued)

SURFACE WATER AND ELUTRIATE ANALYSES

	Surface Water		Elutriates			Surface Waters		Elutriates	
	Total	Dissolved				Total	Dissolved		
	(LPHP 3)		LPHP1	LPHP2	LPHP3	(LPHP8)		LPHP7	LPHP8
Aldrin	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.006	<0.006	<0.003
Chlordane	<0.04	<0.04	<0.04	<0.04	<0.04	<0.08	<0.08	<0.04	<0.04
o,p-DDD	<0.012	<0.012	<0.012	<0.012	<0.012	<0.024	<0.024	<0.012	<0.012
p,p-DDD	<0.012	<0.012	<0.012	<0.012	<0.012	<0.024	<0.024	<0.012	<0.012
o,p-DDE	<0.006	<0.006	<0.006	<0.006	<0.006	<0.012	<0.012	<0.006	<0.006
p,p-DDE	<0.006	<0.006	<0.006	<0.006	<0.006	<0.012	<0.012	<0.006	<0.006
o,p-DDT	<0.016	<0.016	<0.016	<0.016	<0.016	<0.032	<0.032	<0.016	<0.016
p,p-DDT	<0.016	<0.016	<0.016	<0.016	0.016	<0.032	<0.032	<0.016	<0.016
Dieldrin	<0.006	<0.006	<0.006	<0.006	<0.006	<0.012	<0.012	<0.006	<0.006
Endrin	<0.009	<0.009	<0.009	<0.009	<0.009	<0.018	<0.018	<0.009	<0.009
Heptachlor	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004	<0.002	<0.002
Heptachlor Epoxide	<0.004	<0.004	<0.004	<0.004	<0.004	<0.008	<0.008	<0.004	<0.004
Lindane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.004	<0.004	<0.002	<0.002
Toxaphene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.8	<0.8	<0.4	<0.4
Mirex	<0.016	<0.016	<0.016	<0.016	<0.016	<0.032	<0.032	<0.016	<0.016
Methoxychlor	<0.04	<0.04	<0.04	<0.04	<0.04	<0.08	<0.08	<0.04	<0.04
PCBs: Arochlor 1016	<0.04	<0.04	<0.04	<0.04	<0.04	<0.08	<0.08	<0.04	<0.04
Arochlor 1221	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1
Arochlor 1232	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.1	<0.1
Arochlor 1242	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.1	<0.05	<0.05
Arochlor 1248	<0.08	<0.08	<0.08	<0.08	<0.08	<0.16	<0.16	<0.08	<0.08
Arochlor 1260	<0.15	<0.15	<0.15	<0.15	<0.15	<0.30	<0.30	<0.15	<0.15

TABLE 5

EPA AQUATIC LIFE CRITERIA

(All values in ug/L)

	Freshwater[1] 24-hour	Freshwater[1] Maximum	Saltwater[1] 24-hour	Saltwater[1] Maximum	1976 Criteria
Mercury	0.2	4.1	0.1	3.7	
Lead	EXP[2.35 LN(Hardness)-9.48]	EXP[1.22 LN(Hardness)-0.47]	-	-	
Zinc	47	EXP[0.83 LN(Hardness)+1.95]	58	170	
Chromium	-	EXP[1.08 LN(Hardness)+3.48]	-	-	
Cadmium	EXP[1.05 LN(Hardness)-8.53]	EXP[1.05 LN(Hardness)-3.73]	4.5	59	
Copper	5.6	EXP[0.94 LN(Hardness)-1.23]	4.0	23	
Nickel	EXP[0.76 LN(Hardness)+1.06]	EXP[0.76 LN(Hardness)+4.02]	7.1	140	
Arsenic	-	440	-	-	
Aldrin	-	3.0	-	1.3	
Chlordane	0.004	2.4	0.004	0.09	
DDD	0.001	1.1	0.001	0.13	
DDE	0.001	1.1	0.001	0.13	
DDT	0.001	1.1	0.001	0.13	
Dieldrin	0.002	2.5	0.002	0.71	
Endrin	0.002	2.5	0.002	0.037	
Heptachlor	0.004	0.52	0.004	0.053	
Lindane	0.08	2.0	-	0.16	
PCB	0.014	-	0.03	-	
Toxaphene	0.013	1.6	-	0.07	
Mirex					0.001
Methoxychlor					0.03
Phenols	2,560	10,200	-	5,800	-

[1]Federal Register, Vol. 45, No. 231 (EPA Water Quality Criteria Documents Availability)

Howze Beach borrow material. No other pesticides were measured above detection limits in surface water or elutriates. Copper and nickel were the only trace metals measured in excess of EPA criteria. Copper concentrations exceeded the EPA maximum criterion (23 ug/L) in two surface water samples. Also the 24-hour average copper criterion (4.0 ug/l) was exceeded in 3 of 12 standard elutriates and all five of the modified elutriates. The 24-hour average criterion for nickel (7.1 ug/l) was exceeded in one surface water sample from the Jefferson Parish lakefront and in 10 of the 12 standard elutriates. The detection limit of the method used for analysis of the modified elutriates was higher than the 24-hour average criterion for nickel.

Chemical oxygen demand, nitrogen, total phosphorus, arsenic, nickel and manganese generally indicated the greatest potential to be released from sediments and thus elevate concentrations in the elutriates relative to the native water. Iron, zinc, chromium, copper, cadmium, and phosphate showed only a moderate to low tendency to be released from the sediments. Mercury and lead were not measured above background concentrations in any of the elutriates. Manganese, total Kjeldahl nitrogen, total ammonia, and total nitrogen were elevated in the modified elutriates to concentrations substantially above background levels. However, concentrations experienced outside of the levee fill area should be significantly lower due to mixing and dilution in adjacent waters.

(d) Pathogens. Fill material discharges cause temporary increases in bacterial densities in the water column. However, since human ingestion of the raw water at the material extraction or discharge sites is not probable, no significant effects due to increased bacterial densities are anticipated.

(e) Esthetics. Unsightly turbidity plumes are caused by solids placed in suspensions during fill operations. The turbidity plumes do not persist long after dredge and fill operations cease.

(3) Effects on Biota.

(a) Primary Production. Primary production would be impaired by the reduction of the photic zone. Reductions in plankton populations are possible as a result of solids clumping and flocculation. Phytoplankton, algae and rooted vegetation also would be destroyed by physical abrasion or be displaced due to dredge-material discharge. Critical plant nutrients such as phosphate and nitrates may be removed from the water by flocculation or be chemically bound in such a way as to not be biologically available. However, this temporary loss in primary productivity should not have long-term effects since phytoplankton is not the primary food source in Lake Pontchartrain.

(b) Suspension/Filter Feeders. Turbidity would interfere with filter feeding mechanisms, impede growth, and impair respiratory and excretory functions. The more motile species would quickly migrate out of the area.

These motile organisms, along with others remaining on the fringe of the impacted area, would provide recruitment stocks for repopulation of the area.

(c) Sight Feeders. Most of the sight feeders found within Lake Pontchartrain are moderately adapted to its turbid environment The demersal fish would be the most likely affected. However, these species, along with the other highly mobile species, would escape the areas of high turbidity and return when conditions improve.

(4) Actions Taken to Minimize Impacts of Suspended Particulates/Turbidity. Hydraulically-dredged construction material would be discharged to confined levee fill areas to minimize loss of solids to adjacent surface waters. Additionally, hauled fill would be

used in areas where feasible and appropriate. See Section III. a.(6) for other actions that can be taken to minimize impacts.

d. Contaminant Determinations. Evaluation of the data obtained from core materials, surficial sediments, and elutriate analyses indicates that the construction material stockpiling would not introduce new contaminants nor significantly increase contaminant levels in the surface waters affected by construction.

e. Aquatic Ecosystem and Organism Determinations.

(1) Plankton Effects. Primary productivity could be temporarily reduced by physical destruction of phytoplankton and decreased photosynthesis. Zooplankton are susceptible to siltation and turbidity influences. Turbidity and siltation, although short-lived, may impair feeding and interfere with respiratory processes resulting in a temporary reduction of the secondary food base.

Lake Pontchartrain is a wind-dominated system and as a result has frequent periods of high turbidity due to resuspension of bottom sediments. Therefore, it is expected that rapid recovery of plankton populations would occur shortly following the completion of fill placement. Critical plant nutrients, such as phosphate, may be removed from the water and certain phytoplankton may adhere to suspended particles and precipitate to the bottom. It is expected, however, that the small volume of runoff resulting from the hydraulic placement of the fill material would be sufficiently diluted by the receiving waters so that only temporary impacts would result.

(2) Benthos Effects. The affected littoral habitat located in the construction area supports a comparatively depauperate benthic population as noted in paragraph III.a.4. It is expected that these organisms would be buried by the placement of fill material. Some repopulation is to be expected. However, due to the compositional

differences between the existing substrate and the fill material, rapid recruitment of benthics may not occur. Changes in substrate could result in repopulation by different species that are more adapted to the new substrate.

(3) Nekton Effects. Most species would not be directly affected by the project since they would vacate during construction. Some planktonic feeders may be temporarily attracted to turbidity plumes for short-term feeding. During these feeding forays the increased free carbon dioxide associated with dredging activities tends to reduce pH, causing gills of fishes and other biota to be more susceptible to pollutant laden silt particles (Johnston, 1981). Therefore, some impacts could occur to fishes attracted to areas of increased turbidity.

Water quality in the immediate area of discharge would be temporarily degraded. The loss of habitat and changes in benthic organisms could locally affect the composition of the community following fill material discharge.

(4) Aquatic Food Web Effects. Approximately 408 acres of benthic habitat would be converted to berm and levee along the Jefferson Parish lakefront. However, this particular nearshore habitat is only moderately productive and is therefore a minor contributor to the food web when compared to the amount of productive shoreline remaining in the lake. While a significant part of the food base is derived from the mollusc community, the preferred species are not abundant in the area of fill placement. It is also expected that with the new substrate and hydrography provided by new levees benthic communities would repopulate and continue to contribute to the food web.

Impacts to the planktonic and nektonic components of the food web are expected to be minimized due to the placement of silt screens or other containment devices.

Short-term impacts associated with burial, turbidity, siltation, nutrient enrichment, and changes in sediment chemistry are expected as a result of levee construction and runoff from the construction sites. Impacts could result in interruption of primary production, reduction in benthic populations, interference with feeding, respiratory and reproductive activity of various nekton species. The overall degradation of water quality in the affected area would produce temporary adverse impacts on the aquatic food web in the immediate vicinity of the construction; however, no significant long-term losses to the secondary and final consumers of the food chain of the affected area would be expected. While benthic organisms would repopulate, the species composition may change. Primary production would resume as turbidity subsides and nutrients are available.

(5) Special Aquatic Sites Effects. There are no special aquatic sites other than wetlands to be considered for this portion of the project.

(6) Actions to Minimize Impacts on Aquatic Ecosystems. A significant portion of the new construction would utilize established levee alinements to minimize additional wetland impacts. Retention dikes, silt screens or other turbidity abatement methods would be utilized to the maximum extent feasible.

f. Proposed Disposal or Construction Site Determinations.

(1) Mixing Zone Determination. Construction of the hurricane protection features does not involve "disposal" of dredged material. Rather, hydraulically dredged materials are discharged for use as construction fill into confined areas designed to minimize loss of solids; therefore, mixing zone determinations are not applicable.

(2) Determination of Compliance with Applicable Water Quality Standards. Louisiana water quality standards applicable to surface

waters affected by the construction activities are presented in Table 6. It is unlikely that construction activities would cause violations of the listed standards, with the exception of the DO standard. The DO standard may be violated in shallow wetland surface waters where construction materials are discharged. Since the hydraulic fill phases of construction are intermittant and of relatively short duration, violations of the DO standard, should they occur, would be highly localized and short-term.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. Construction of the hurricane protection works would not affect any known sources of public or private water supply.

(b) Recreational and Commercial Fisheries. Shoreline and adjacent near-offshore recreational fishing would be adversely affected along the Jefferson Parish lakefront levee reach during construction. Adverse effects would be primarily experienced during the hydraulic fill phases of the levee construction (perhaps two 18 month periods). Trolling and shrimping would be temporarily affected during construction.

(c) Water-Related Recreation. Three boat launching facilities (Kenner launch in the vicinity of the Kenner race track, Williams Boulevard launch and Bonnabel launch) are located within the Jefferson Parish lakefront levee reach. Construction activities via design modification are planned to minimize disruption of the Williams and Bonnabel Blvds. launch complexes along with one fishing pier at Bonnabel Blvd., one picnic shelter in Orleans Parish, and three children's play fields in Orleans Parish. The Kenner launch will be lost due to construction. This two-lane boat ramp is in a state of disrepair and does not justify costly levee alterations.

TABLE 6

LOUISIANA STATE WATER QUALITY STANDARDS

Designated River Basin Code and Sequence Number[1]

	0417 (W)
Water Use Classification [2]	A, B, C
Dissolved Oxygen mg/L	4.0
Temperature °C	35
pH	6.5 to 9.0
Bacterial Standard[3]	#1

[1] 0417 (W): Lake Pontchartrain - West of Highway 11 Bridge

[2] A: Primary Contact Recreation
B: Secondary Contact Recreation
C: Propagation of Fish and Wildlife

[3] #1 Primary Contact Recreation - Based on a minimum of 5 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 exceed 400/100mL.

(d) Esthetics. High noise and dust levels would create esthetically displeasing environments at and near the construction sites. High suspended particulate and turbidity levels adjacent to the Jefferson Parish lakefront levee fill area would be esthetically displeasing during fill operations. Suspended particulate and turbidity levels would decline rapidly after completion of this phase of construction.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. A 10.5-mile linear park, located on the lakeside of the existing levee, would be destroyed by construction for the Jefferson Parish lakefront levee. The linear park facilities would be replaced in kind upon completion of construction. Recreational use of the park area might be curtailed for a period 6 to 9 years. However, the trail could be detoured during construction.

Bayous Trepagnier and La Branche, which are included in the Louisiana Natural and Scenic Rivers System, are located to the north of the proposed US Highway 61 levee alinement and would not be affected by the St. Charles Parish levee construction.

The draft EIS for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project contains information regarding potential project impacts on national and historic monuments and other significant cultural resources.

No designated national seashores, wilderness areas, research sites or similar preserves are located near the proposed New Orleans West or Mandeville unit construction sites.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. Construction of previous Federal and state protective works along the lakefront has resulted in the loss of lake bottom and surrounding marshes and alteration of hydrologic regimes.

The work proposed for the New Orleans West unit would result in an additional 975-acre loss of lake bottom due to construction material borrow and levee construction.

h. Determination of Secondary Impacts. Approximately 568 acres of lake bottom would be hydraulically dredged to obtain levee fill. This would result in the loss or severe alteration of offshore benthic habitat. Some repopulation of the area would be probable, however species composition is expected to be much different. The species composition of the benthic community would be expected to shift from those organisms adapted to shallow water environments to those that utilize deeper water habitats. These offshore borrow areas eventually would become shallow and species composition should slowly return to preconstruction conditions over time. The newly created deepwater areas might attract certain fish species during fall and winter months. The bottom hydrography would be affected to some degree by the borrow material excavation. Due to the depth of the borrow areas within the lake, the potential exists for poor water quality in these areas during the summer months. A more detailed discussion of effects of dredging in offshore borrow areas appears in the Supplemental Environmental Impact Statement.

IV. FINDING OF COMPLIANCE FOR THE LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT - NEW ORLEANS WEST AND MANDEVILLE UNITS

1. No significant adaptations of the guidelines (40 CFR 230) were made relative to this evaluation.

2. The recommended High Level Plan would have less adverse impact on aquatic ecosystems than the Barrier Plan alternative. With the High Level Plan, approximately 19.1 million cubic yards of additional clay fill would be discharged to wetlands to construct the New Orleans West unit protective works compared to the Barrier Plan. However, with the High Level Plan, the Barrier unit would not be constructed. Consequently, about 36 million cubic yards of fill required to construct the Barrier unit would not be discharged. Constructing the St. Charles Parish levee following the authorized alinement would result in capturing about 29,000 acres of wetlands on the protected side of the levee. However, with the recommended alinement, north of US Highway 61, approximately 25,000 of those acres would remain directly connected to Lake Pontchartrain.

3. Violations of the Louisiana State Water Quality Standards might occur for dissolved oxygen. However, these violations, if they occur, would be highly localized and of short duration. The proposed discharges would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. Use of the designated levee fill area would not harm any endangered species or their critical habitat nor violate protective measures for any marine sanctuary.

5. Construction of the hurricane protection project would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife and special

aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values would not occur.

6. Appropriate steps that would be taken to minimize potential adverse impacts include:

Discharging hydraulically dredged sediments to confined levee fill areas, and utilizing hauled fill where feasible and appropriate.

Fertilizing and seeding levees after final design section shaping to promote rapid cover growth and to minimize erosion.

Incorporating provisions in contract specifications for protection of the environment during construction activities.

7. On the basis of application of the guidelines (40 CFR 230), the sites designated for construction of hurricane protection features are specified as complying with the requirements of the guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

18 Nov 93
Date

ROBERT C. LEE
Colonel, CE
District Engineer

LITERATURE CITED

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Section X

Consistency Determination

Louisiana Coastal Zone Management Program

CONSISTENCY DETERMINATION

Louisiana Coastal Zone Management Program

C.10.1 Introduction

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq. required that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, a consistency determination has been made for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project. Coastal Use Guidelines were written in order to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Compliance with Section 307 of the Louisiana Coastal Resources Program requires compliance with applicable Coastal Use Guidelines. An evaluation of the project relative to each guideline is presented in paragraph C.10.3. A determination of the consistency of the project with the guidelines is in paragraph C.10.4.

C.10.2 Project Description

The Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project is intended to provide hurricane protection to the developed areas of Jefferson, Orleans, St. Bernard and St. Charles Parishes, Louisiana. The tentatively selected High Level Plan would provide for raising and strengthening the existing hurricane protection levee systems in Orleans and St. Bernard Parishes, and the east bank of Jefferson Parish; repairing and rehabilitating the Mandeville Seawall in St. Tammany Parish; building a new mainline hurricane levee on the east bank of St. Charles Parish just north of US Highway 61 (Airline Highway); and deferring construction of the proposed Seabrook lock until its feasibility as a feature of the Mississippi River-Gulf Outlet navigation project can be determined. Areas to be inclosed by the proposed levee and floodwall construction would be provided protection against tidal surge flooding resulting from the Standard Project Hurricane or (SPH). (The SPH is defined as being the most severe hurricane which can be reasonably expected to occur from a combination of meteorological and hydrologic events characteristic of the area.) The proposed construction involves the hauling of sand and clay from the Bonne Carre' Spillway and upland St. Tammany Parish sites, as well as the hydraulic pumping of materials from Lake Pontchartrain. Material removed from the Mississippi River-Gulf Outlet and the Intracoastal Waterway also would be utilized. To complete the project utilizing the high level/low approximately 554 acres of wetland would be permanently impacted: 315 acres of brackish/saline marsh, 50 acres of bottomland hardwoods, 105 acres of cypress tupelo, and 84 acres of estuarine open water and canals. Another 981 acres of Lake Pontchartrain bottom would be impacted--408 acres by levee construction and 573 acres for borrow material.

C.10.3. **Guidelines**

1. Guidelines Applicable to All Uses

Guideline 1.1: The guidelines must be read in their entirety. Any proposed use may be subject to the requirements of more than one guideline or section of guidelines and all applicable guidelines must be complied with.

Response 1.1: Acknowledged.

Guideline 1.2: Conformance with applicable water and air quality laws, standards and regulations, and with those other laws, standards and regulations which have been incorporated into the coastal resources program shall be deemed in conformance with the program except to the extent that these guidelines would impose additional requirements.

Response 1.2: Acknowledged.

Guideline 1.3: The guidelines include both general provisions applicable to all uses and specific provisions applicable only to certain types of uses. The general guidelines apply in all situations. The specific guidelines apply only to the situations they address. Specific and general guidelines should be interpreted to be consistent with each other. In the event there is an inconsistency, the specific should prevail.

Response 1.3: Acknowledged.

Guideline 1.4: These guidelines are not intended to nor shall they be interpreted so as to result in an involuntary acquisition or taking of property.

Response 1.4: Acknowledged.

Guideline 1.5: No use or activity shall be carried out or conducted in such a manner as to constitute a violation of the terms of a grant or donation of any lands or waterbottoms to the State or any subdivision thereof. Revocations of such grants and donations shall be avoided.

Response 1.5; Acknowledged.

Guideline 1.6: Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines.

Response 1.6; Acknowledged.

Guideline 1.7: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated and maintained to avoid to the maximum extent practicable significant:

Guideline 1.7 (a): Reduction in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

Response 1.7 (a): Most of the project area wetlands are already surrounded by levees and no freshwater flow is evident. In St. Charles Parish, water-flow structure would be installed to equal or exceed that currently provided for by Airline Highway (US 61).

Guideline 1.7 (b): Adverse economic impacts on the locality of the use and affected governmental bodies.

Response 1.7 (b): There would be no significant economic impacts, except for construction and maintenance costs.

Guideline 1.7 (c): Detrimental discharges of inorganic nutrient compounds into coastal waters.

Response 1.7 (c): Inorganic nutrients would be discharged into Lake Pontchartrain and the surrounding marshes as a result of hydraulic dredging for the lakefront levees. The open waters of Lake Pontchartrain, except the southwest corner, are in the lower mesotrophic-oligotropic trophic state. During dredging of levee materials, the elutriate test indicates a minor and temporary discharge of inorganic materials.

Guideline 1.7 (d): Alterations in the natural concentration of oxygen in coastal waters.

Response 1.7 (d): During hydraulic dredging and levee construction, suspended sediments would be released into the surrounding wetlands and water bodies. This release could decrease oxygen levels in the waters immediately surrounding the construction site by inhibiting photosynthesis or heating the water. Some particles could contain chemically reduced substances, such as sulfides, which have a high chemical oxygen demand (COD) while other particles may have micro-organisms attached which could decompose organic matter and create a biological oxygen demand (BOD). A localized and temporary reduction in dissolved oxygen would occur in the immediate area of discharge.

Guideline 1.7 (e): Destruction or adverse alterations of streams, wetlands, tidal passes, inshore waters and water bottoms, beaches, dunes, barrier, islands, and other natural biologically valuable areas or protective coastal features.

Response 1.7 (e): About 573 acres of lake bottom would be required for borrow, and approximately 408 acres of lake bottom for levee rights-of-way. The rights-of-way would impact 554 acres of wetland: 315 acres of brackish/saline marsh, 50 acres of bottomland hardwoods, 105 acres of cypress tupelo and 84 acres of estuarine open water and canals. In St. Charles Parish, the levee would parallel the Airline Highway (US 61), and sufficient number of structures would be installed to equal or exceed the present flow through Airline Highway. The acreage impacted has been reduced to the maximum extent practicable.

Guideline 1.7 (f): Adverse disruption of existing social patterns.

Response 1.7 (f): Construction of the hurricane protection levees is not expected to significantly disrupt existing social patterns. However, there is expected to be a temporary disruption of recreational use of the levees, parks, boat launching areas, and nearshore fishing waters during construction.

Guideline 1.7 (g): Alterations of the natural temperature regime of coastal waters.

Response 1.7 (g): No permanent changes in temperature regimes are expected. Increased suspended solids produced during construction could absorb incident radiation and slightly increase the temperatures of water bodies, especially near the surface. Slight increases in temperatures could occur in marsh and lake areas near unconfined disposal sites. Any increase would be temporary and not significant.

Guideline 1.7 (h): Detrimental changes in existing salinity regimes.

Response 1.7 (h): There would be no detrimental change in existing salinity regimes.

Guideline 1.7 (i): Detrimental changes in littoral and sediment transport processes.

Response 1.7 (i): The use of a 400-foot wide lake bottom borrow area for the entire length of Jefferson Parish would change the littoral and transport process adjacent to the existing levee. After construction, the processes would reestablish themselves along the new alinement.

Guideline 1.7 (j): Adverse effects of cumulative impacts.

Response 1.7 (j): The project could add to the adverse environmental impacts occurring in the wetlands surrounding New Orleans. The physical presence of more levees would destroy habitat. However, wetland destruction has been reduced to the maximum extent practicable.

Guideline 1.7 (k): Detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

Response 1.7 (k): The effluent from hydraulic dredging would contain both organic and inorganic suspended solids. Most of the project would have minimal, short-term impacts on turbidity; however, hydraulic dredging would increase turbidity during two 18-month pumping periods required for the Jefferson Parish lakefront levee.

Guideline 1.7 (l): Reduction or blockage of water flow or natural circulation patterns within or into an estuarine system or a wetland forest.

Response 1.7 (l): The high level plan would not further impact water flow or natural circulation. Except for St. Charles Parish, levees would be constructed on presently existing sites. In the St. Charles Parish alinement, structures would be installed to maintain present circulation patterns.

Guideline 1.7 (m): Discharges of pathogens or toxic substances into coastal waters.

Response 1.7 (m): Based on elutriate analysis, various pollutants already present in the environment would be temporarily relocated but levels would not be increased significantly.

Guideline 1.7 (n): Adverse alteration or destruction of archeological, historical, or other cultural resources.

Response 1.7 (n): Most of the project impact areas have been covered by cultural resources surveys which are designed to locate significant archeological and historical resources which may be affected by the project. Only one resource of possible National Register eligibility has been located in the project area. The resource is a deeply buried shell midden, site 16OR41, located along the Chalmette Area Plan. A study to relocate and assess the impacts of the project on this site is in preparation. For some portions of the project, the potential impacts on cultural resources have not yet been resolved. The magnetometer survey of the Jefferson Parish and the Howze Beach borrow areas is presently being conducted. Significant anomalies (possible historic shipwrecks) located in the borrow areas would be either avoided by re-design of the borrow area or mitigated by data recovery. Due to the preliminary level of design, the St. Charles levee alinement has not yet been subject to a cultural resources survey. At present, however, no cultural resources are recorded in the area of the alinement right-of-way. The renovation of the Mandeville Seawall is not expected to impact buried cultural remains but background data is being reviewed to confirm this assumption. The levee closure at the mouth of Bayou St. John, along the New Orleans lakefront, has been determined, through the regulatory permits process, to have no effects on historic Fort St. John. Bayou St. John itself has been determined ineligible for inclusion into the National Register of Historic Places, and thus, the closure at its mouth would not impact any National Register or Register-eligible property. No solution to the New Orleans Outfall Canal problems has been reached, and, therefore, the possible impacts cannot yet be addressed.

Guideline 1.7 (o): Fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

Response 1.7 (o): The portion of the levee reach in St. Charles Parish parallel and north of Airline Highway could provide some incentive for additional development in the wetlands south of Airline Highway. However, this area has been and is presently being developed without the increased flood protection afforded by the proposed levee. Since these levees are designed to maintain existing flow patterns through the wetlands due to culvert placement, no change is expected in the wetland designation south of Airline Highway. Therefore, any development in this area will continue to be evaluated through the Corps' permit program.

Guideline 1.7 (p): Adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife, or fishery breeding or nursery areas designated wildlife management or sanctuary areas, or forestlands.

Response 1.7 (p): The project would not impact any such unique or valuable habitats.

Guideline 1.7 (q): Adverse alteration or destruction of public parks, shoreline access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern.

Response 1.7 (q): Existing land based recreational features in proximity to the shoreline would be impacted. The Jefferson Parish lakefront levee would experience the loss of a 10.5-mile National Trail. The two recently constructed boat launch complexes (Williams and Bonnabel Blvds.) will be protected by a design modification, i.e. flood wall around facility. Planned recreational features at Bucktown and Causeway Blvd. will be modified if implemented in the new levee design. This reach of the project would suffer a loss of recreational opportunity to the existing and planned recreational facilities within the project impact zone. In Orleans Parish, the raising of the existing levee with I-wall would disrupt free-flowing access across the existing levee. Some esthetic losses would occur during construction due to the close proximity of trees and grass play fields. Few private recreational camps, if any, would be relocated due to their location within the construction right-of-way. The project would impose a reduction in the current number of recreational man-days now present on the south shore of Lake Pontchartrain. Mitigation measures would be implemented upon project completion in order to replace impacted recreational features with ones of similar or improved quality.

Guideline 1.7 (r): Adverse disruptions of coastal wildlife and fishery migratory patterns.

Response 1.7 (r): The project is not expected to disrupt any wildlife or fishery migration patterns.

Guideline 1.7 (s): Land loss, erosion, and subsidence.

Response 1.7 (s): The project will not increase land loss, erosion, and subsidence.

Guideline 1.7 (t): Increases in the potential for flood, hurricane or other storm damage, or increases in the likelihood that damage will occur from such hazards.

Response 1.7 (t): The primary objective of the project is to reduce flood damage due to hurricanes.

Guideline 1.7 (u): Reduction in the long-term biological productivity of the coastal ecosystem.

Response 1.7 (u): The project would have long-term impacts on the productivity of the lakeside borrow and levee sites. Frequently, aquatic borrow sites act as sediment sinks for particulate material, and, if circulation is poor, the holes may become anoxic. Approximately 573 acres of lake bottom would be impacted by the dredging of the existing lake bottom to obtain dredged material for the Jefferson Parish portion of the High Level Plan. The proposd depths of the remaining borrow areas in the lake would not receive proper circulation and could therefore become anoxic, nutrient sumps which could chemically or physically stratify rendering these areas unsuitable for benthic organisms for long periods of time. While the depths of this borrow area would be removed from benthic production for an extended period of time it represents approximately .2% of the offshore lake bottom in Lake Pontchartrain and approximately .1% of the total lake bottom habitat. The wetland acres impacted would be filled and converted from productive swamp, marsh, and shallow water habitats, to a much less productive upland, grass-type levees. Because the alinement would follow present levees, the project would not significantly impact the productivity of the coastal systems.

Guideline 1.8: In those guidelines in which the modifer "maximum extent practicable" is used, the proposed use is in compliance with the guideline if the standard modified by the term is complied with. If the modified standard is not complied with, the use will be in compliance with the guideline if the permitting authority finds, after a systematic consideration of all pertinent information regarding the use, the site and the impacts of the use as set forth in Guideline 1.6, and a balancing of their relative significance, that the benefits resulting from the proposed use would clearly outweigh the adverse impacts resulting from noncompliance with the modified standard and there are no feasible and practical alternative locations, methods and practices for the use that are in compliance with the modified standard and:

(a) significant public benefits will result from the use, or;

(b) the use would serve important regional, state or national interests, including the national interest in resources and the siting of facilities in the coastal zone identified in the coastal resources program, or;

(c) the use is coastal water dependent.

Response 1.8: Acknowledged.

Guideline 1.9: Uses shall to the maximum extent practicable be designed and carried out to permit multiple concurrent uses which are appropriate for the location and to avoid unnecessary conflicts with other uses of the vicinity.

Response 1.9: Acknowledged.

Guideline 1.10: These guidelines are not intended to be, nor shall they be, interpreted to allow expansion of governmental authority beyond that established by LA R.S. 49:213.21, as amended; nor shall these guidelines be interpreted so as to require permits for specific uses legally commenced or established prior to the effective data of the coastal use permit program nor to normal maintenance or repair of such uses.

Response 1.10: Acknowledged.

2. Guidelines for Levees.

Guideline 2.1: The leveeing of unmodified or biologically productive wetlands shall be avoided to the maximum extent practicable.

Response 2.1: The high level plan would utilize previously existing levee alinements to avoid further leveeing of biologically productive wetlands. The alinements in St. Charles Parish have been redesigned to avoid wetlands to the maximum extent possible.

Guideline 2.2: Levees shall be planned and sited to avoid segmentation of wetland areas and systems to the maximum extent practicable.

Response 2.2: The proposed levee alinements either follow existing alinements or have been designed to avoid segmentation of wetlands to the maximum extent practicable.

Guideline 2.3: Levees constructed for the purpose of developing or otherwise changing the use of a wetland area shall be avoided to the maximum extent practicable.

Response 2.3: Levees, as proposed by this project, are constructed for the purpose of floods associated with hurricanes.

Guideline 2.4: Hurricane and flood protection levees shall be located at the non-wetland/wetland interface or landward to the maximum extent practicable.

Response 2.4: The proposed levees would be located as near to the non-wetland/wetland interface or landward to the maximum extent practicable and still maintain the projects objectives of preventing hurricane induced flooding.

Guideline 2.5: Impoundment levees shall only be constructed in wetland areas as part of approved water or marsh management projects or to prevent release of pollutants.

Response 2.5: Proposed levees are constructed to prevent hurricane induced flooding.

Guideline 2.6: Hurricane or flood protection levee systems shall be designed, built, and thereafter operated and maintained, utilizing best practical techniques to minimize disruptions of existing hydrologic patterns, and the interchange of water, beneficial nutrients and aquatic organisms between inclosed wetlands and those outside the levee system.

Response 2.6: The proposed levee system will utilize existing levee alinements to the maximum extent possible in order to minimize disruption of flow patterns, water and nutrient exchange and transport of aquatic organisms. Where it is necessary to traverse wetlands water control structures are included in levee design in order to preserve normal flow through the area involved.

3. Guidelines For Linear Facilities

Not Applicable

4. Guidelines For Dredged Spoil Deposition.

Guideline 4.1: Spoil shall be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation, and quality.

Response 4.1: Dredged material from Lake Pontchartrain would be placed along the Jefferson Parish lakefront alinement. Minor changes in water movement, flow, circulation, could occur; however, the impacts would be negligible due to the presently existing levee alinement which is utilized as a building base.

Guideline 4.2: Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.

Response 4.2: Because dredged material would be used to construct levees, it would not be available for habitat creation. Where possible, the material would be placed on top of the present levee.

Guideline 4.3: Spoil shall not be disposed of in a manner which could result in the impounding or drainage of wetlands or the creation of development sites unless the spoil deposition is part of an approved levee or land surface alteration project.

Response 4.3: Deposition will not impound or drain wetlands.

Guideline 4.4: Spoil shall not be disposed of on marsh, known oyster or clam reefs, or in areas of submersed vegetation to the maximum extent practicable.

Response 4.4: Dredged material would not impact any oyster or clam reefs. Approximately 315 acres of brackish/as well as 105 acres of cypress tupelo, 50 acres of bottomland hardwoods, and 84 acres of estuarine open water would be affected.

Guideline 4.5: Spoil shall not be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth.

Response 4.5: The project would not create a hindrance to navigation, fishing, or timber growth.

Guideline 4.6: Spoil disposal areas shall be designed and constructed and maintained using the best practical techniques to retain the spoil at the site, reduce turbidity, and reduce shoreline erosion when appropriate.

Response 4.6: Because the lakefront area of Jefferson Parish is highly developed, levees in this area must be constructed on the shoreline and unconfined disposal is necessary because ponding areas are not practicable. Turbidity, and associated impacts, would be reduced with silt curtains.

Guideline 4.7: The alienation of state-owned property shall not result from spoil deposition activities without the consent of the Department of Natural Resources.

Response 4.7: The filling of 400 acres of Lake Pontchartrain water bottoms will be coordinated with the Department of National Resources.

5. Guidelines For Shoreline Modification

Guideline 5.1: Non-structural methods of shoreline protection shall be utilized to the maximum extent practicable.

Response 5.1: Non-structural methods are not practicable to achieve hurricane protection. An evacuation program would reduce loss-of-life, but not property loss.

Guideline 5.2: Shoreline modification structures shall be designed and built using best practical techniques to minimize adverse environmental impacts.

Response 5.2: The project areas along the lakefront would follow old, locally constructed levees. Because the hurricane levees need to be wider, about 400 acres of shallow shoreline along Lake Pontchartrain would be impacted.

Guideline 5.3: Shoreline modification structures shall be lighted or marked in accordance with U. S. Coast Guard regulations, not interfere with navigation, and should foster fishing, other recreational opportunities, and public access.

Response 5.3: The project would not impact levee alinements. The levees could be, and are currently used for recreation, and public access.

Guideline 5.4: Shoreline modification structures shall be built using best practical materials and techniques to avoid the introduction of pollutants and toxic substances into coastal waters.

Response 5.4: See Section 1.7 (m).

Guideline 5.5: Piers and docks and other harbor structures shall be designed and built using best practical techniques to avoid obstruction of water circulation.

Response 5.5: No piers, docks or harbor structures are proposed.

Guideline 5.6: Marinas, and similar commercial and recreational developments shall to the maximum extent practicable not be located so as to result in adverse impacts on open productive oyster beds, or submersed grass beds.

Response 5.6: Not applicable.

Guideline 5.7: Neglected or abandoned shoreline modification structures, piers, docks, mooring and other harbor structures shall be removed at the owner's expense, when appropriate.

Response 5.7: Not applicable.

Guideline 5.8: Shoreline stabilization structures shall not be built for the purpose of creating fill areas for development unless part of an approved surface alteration use.

Response 5.8: The levees and floodwalls are not designed to create fill areas.

Guideline 5.9: Jetties, groins, breakwaters and similar structures shall be planned, designed and constructed so as to avoid to the maximum extent practicable downstream land loss and erosion.

Response 5.9: Not applicable.

6. Guidelines For Surface Alterations

Guideline 6.1: Industrial, commercial, urban, residential, and recreational uses are necessary to provide adequate economic growth and development. To this end, such uses will be encouraged in those areas of the coastal zone that are suitable for development. Those uses shall be consistent with the other guidelines and shall, to the maximum extent practicable, take place only:

a) on lands five feet or more above sea level or within fast lands; or

b) on lands which have foundation conditions sufficiently stable to support the use, and where flood and storm hazards are minimal or where protection from these hazards can be reasonably well achieved, and where the public safety would not be unreasonably endangered; and

1) the land is already in high intensity of development use, or

2) there is adequate supporting infrastructure, or

3) the vicinity has a tradition of use for similar habitation or development

Response 6.1: Except for about nine miles of levees in St. Charles Parish, the levees would follow existing alinements surrounding the greater New Orleans area. The St. Charles levee would parallel Airline Highway, and is the most practicable alinement to protect the developed areas of St. Charles Parish.

Guideline 6.2: Public and private works projects such as levees, drainage improvements, roads, airports, ports, and public utilities are necessary to protect and support needed development and shall be encouraged. Such projects shall, to the maximum extent practicable, take place only when:

a) they protect or serve those areas suitable for development pursuant to Guideline 6.1; and

b) they are consistent with the other guidelines; and

c) they are consistent with all relevant adopted state, local and regional plans.

Response 6.2: The hurricane protection levees would protect the developed lands of the New Orleans East area. However, these wetlands have been inclosed and removed from tidal exchange with Lake Pontchartrain since 1958. They cannot be developed without a 404 Permit from the Corps of Engineers. Such a permit has been applied for and the applicant is preparing an EIS on his proposal. Since the fate of these wetlands is dependent on a regulatory decision, their loss is not attributed to this hurricane protection project. Mitigation for any wetland loss will be addressed at the time the permit is processed.

Guideline 6.3: BLANK (Deleted)

Guideline 6.4: To the maximum extent practicable wetland areas shall not be drained or filled. Any approved drain or fill project shall be designed and constructed using best practical techniques to minimize present and future property damage and adverse environmental impacts.

Response 6.4: Not applicable.

Guideline 6.5: Coastal water dependent uses shall be given special consideration in permitting because of their reduced choice of alternatives.

Response 6.5: Not applicable.

Guideline 6.6: Areas modified by surface alteration activities shall, to the maximum extent practicable, be revegetated, refilled, cleaned and restored to their predevelopment condition upon termination of the use.

Response 6.6: The levees would be vegetated, and most adjacent areas effected during construction would revert to predevelopment conditions.

Guideline 6.7: Site clearing shall to the maximum extent practicable be limited to those areas immediately required for physical development.

Response 6.7: Site clearing would be reduced to the maximum extent practicable.

Guideline 6.8: Surface alterations shall,to the maximum extent practicable, be located away from critical wildlife areas and vegetation areas. Alterations in wildlife preserves and management areas shall be conducted in strict accord with the requirements of the wildlife management body.

Response 6.8: No critical vegetation or wildlife areas would be impacted.

Guideline 6.9: Surface alterations which have high adverse impacts on natural functions shall not occur, to the maximum extent practicable, on barrier islands and beaches,isolated cheniers, isolated natural ridges or levees, or in wildlife and aquatic species breeding or spawning areas or in migratory routes.

Response 6.9: None of these unique areas would be impacted.

Guideline 6.10: The creation of low dissolved oxygen conditions in the water or traps for heavy metals shall be avoided to the maximum extent practicable.

Response 6.10: Reference Guidelines 1.7 (d) and 1.7 (m).

Guideline 6.11: Surface mining and shell dredging shall be carried out utilizing the best practical techniques to minimize adverse environmental impacts.

Response 6.11: Not Applicable.

Guideline 6.12: The creation of underwater obstructions which adversely affect fishing or navigation shall be avoided to the maximum extent practicable.

Response 6.12: No underwater obstructions would be constructed that would affect fishing or navigation.

Guideline 6.13: Surface alteration sites and facilities shall be designed, constructed, and operated using the best practical techniques to prevent the release of pollutants or toxic substances into the environment and minimize other adverse impacts.

Response 6.13: Reference Guideline 1.7.

Guideline 6.14: To the maximum extent practicable only material that is free of contaminants and compatible with the environmental setting shall be used as fill.

Response 6.14: Contaminant-free fill material compatible with the environmental setting shall be used to the maximum extent practicable.

7. Guidelines For Hydrologic And Sediment Transport Modifications

Guideline 7.1: The controlled diversion of sediment-laden waters to initiate new cycles of marsh building and sediment nourishment shall be encouraged and utilized whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall incorporate a plan for monitoring and reduction and/or amelioration of the effects of pollutants present in the freshwater source.

Response 7.1: Not Applicable.

Guideline 7.2: Sediment deposition systems may be used to offset land loss, to create or restore wetland areas or enhance building characteristics of a development site. Such systems shall only be utilized as part of an approved plan. Sediment from these systems shall only be discharged in the area that the proposed use is to be accomplished.

Response 7.2: Not Applicable.

Guideline 7.3: Undesirable deposition of sediments in sensitive habitat or navigation areas shall be avoided throught the use of the best preventive techniques.

Response 7.3: Not Applicable.

Guideline 7.4: The diversion of freshwater through siphons and controlled conduits and channels, and overland flow to offset saltwater intrusion and to introduce nutrients into wetlands shall be encouraged and utilized whenever such diversion will enhance the viability and productivity of the outfall area. Such diversions shall incorporate a plan for monitoring and reduction and/or amelioration of the effects of pollutants present in the freshwater source.

Response 7.4: Not Applicable.

Guideline 7.5: Water or marsh management plans shall result in an overall benefit to the productivity of the area.

Response 7.5: Not Applicable.

Guideline 7.6: Water control structures shall be assessed separately based on their individual merits and impacts and in relation to their overall water or marsh management plan of which they are a part.

Response 7.6: New water control structures installed in the St. Charles Parish levee would allow free movement of water. The existing structures, however, would be left "as is."

Guideline 7.7: Weirs and similar water control structures shall be designed and built using the best practical techniques to prevent "cut arounds," permit tidal exchange in tidal areas, and minimize obstruction of the migration of aquatic organisms.

Response 7.7: Refer to 7.6 above.

Guideline 7.8: Impoundments which prevent normal tidal exchange and/or the migration of aquatic organisms shall not be constructed in brackish and saline areas to the maximum extent practicable.

Response 7.8: Because the project follows the present, locally constructed levees, through brackish and saline wetlands, no further alteration of tidal exchange and or migratory routes for aquatic organisms would result.

Guideline 7.9: Withdrawal of surface and ground water shall not result in saltwater intrusion or land subsidence to the maximum extent practicable.

Response 7.9: Not Applicable.

8. Guidelines for Disposal of Wastes.

Not Applicable.

9. Guidelines for Uses that Result in the Alteration of Waters Draining into Coastal Waters.

Not Applicable.

10. Guidelines for Oil, Gas, and Other Mineral Activities.

Not Applicable.

C.10.4 **Consistency Determination**

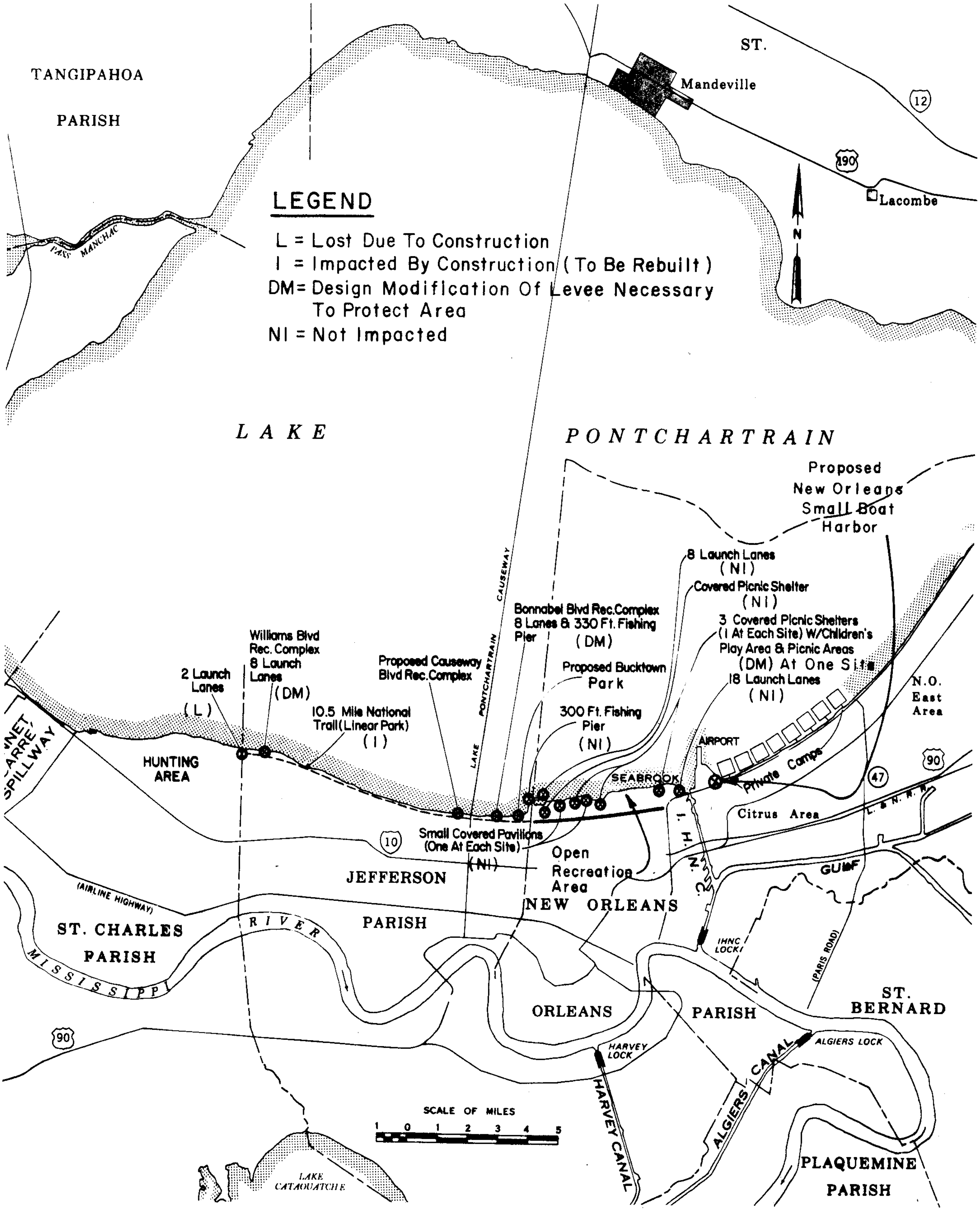
In the December 1983 Appendix to the Reevaluation Report, the New Orleans District, US Army Corps of Engineers, determined that implementation of the Lake Pontchartrain Louisiana and Vicinity project was consistent, to the maximum extent practicable, with the State of Louisiana's approved Coastal Zone Management Program. Subsequent correspondence from the Coastal Management Division of the Department of Natural Resources (CMD/DNR) is contained in Appendix D. Their final letter indicated that the St. Charles Parish levee alinement is consistent with the Louisiana Coastal Resources Program (LCRP) to the maximum extent practicable at this time. They imply that the Jefferson Parish Lakefront alinement is also consistent. They stated that the New Orleans East levee alinement may not be consistent with the LCRP and requested quantitative documentation to substantiate that no significant interchange of water and no ingress and egress of marine organisms is presently occurring between the leveed area and surrounding marshes. The New Orlenas District is continuing to coordinate with DNR to resolve the questions. A joint field trip is planned and the possibility of an organism sampling program is being considered. The Corps maintains that the proposed project is consistent to the maximum extent practicable with the Coastal Zone Management Program.

Section XI
Recreational Analysis

ENVIRONMENTAL APPENDIX

RECREATION

An abundance of recreational opportunities currently exist along the Lake Pontchartrain south shore. Structural and nonstructural recreational features exist along with rural and urban recreational settings. Wildlife and fishing oriented recreational uses also occur. The Jefferson Parish and Orleans Parish lakefront is facility oriented. Primary existing facilities in Jefferson Parish include boat launches, fishing piers, and a National Trail (Linear Park), all of which sustain heavy usage and will be impacted by the High Level Plan. Two newly constructed boat launch complexes, each with eight lanes and ancillary facilities, were completed in 1982. In order to avoid construction impacts to these facilities and protect their integrity, a levee design modification, i.e., floodwall, will be necessary. This floodwall will protect and preserve the boat launch areas in Jefferson Parish along with one covered picnic shelter located in Orleans Parish. The New Orleans Lakefront area contains four picnic shelters, two covered pavilions, three children's playfields, 72 portable picnic tables, one fishing pier, and 26 boat launches (see Figure 1). Construction of the project will not affect the pavilions, fishing pier, portable picnic tables, boat launching areas, and shoreline recreation in Orleans Parish. Other activities such as fishing, crabbing, walking, jogging, bicycling, and sightseeing which occur outside of the impact zone will not be affected. Some esthetic losses (i.e., trees, shaded picnic areas, and grass fields), along with three children's play areas and possibly one covered picnic shelter will be lost due to the construction of the High Level Plan. "Recreation Facility Use and Impact Analysis" (Table 1) presents an inventory of existing recreational resources located along the south shore of Lake Pontchartrain, their respective projected annual man-days of use, and the associated



RECREATION FACILITIES

FIGURE 1

TABLE 1

RECREATION FACILITY USE AND IMPACT ANALYSIS

EXISTING FACILITIES	Facility[1/] Standard	X High[2/] Quarter For Year	÷ Remainder[3/] of Useage Per Unit	Annual M/D[4/] Use Units	Number[5/] of Units	Annual[6/] M/D
8 Boat Lanes (Williams Blvd, Jeff. Parish)	64 MD/lane	91.5	.507	11,550	8	92,400
8 Boat Lanes (Bonnabel Blvd, Jeff. Parish)	64 MD/lane			11,550	8	92,400
2 Boat Lanes (Kenner Race Track, Jeff. Parish)	64 MD/lane			11,550	2	23,100
8 Boat Lanes (Breakwater Drive, Orleans Parish)	64 MD/lane			11,550	8	92,400
18 Boat Lanes (Seabrook Bridge, Orleans Parish)	64 MD/lane			11,550	18	207,900
1-330 Ft "T" Shaped Fishing Pier (Bonnabel Blvd Launch, Jeff. Parish)	2 MD/10 lin ft			5,956	1	5,956
1-300 Ft "T" Shaped Fishing Pier (Breakwater Drive Launch, Orleans Parish	2 MD/10 lin ft			5,414	1	5,414
1-10.5 Mile National Trail (Linear Park, Jeff. Parish)	40 MD/mile			75,799	1	75,799
72 Picnic Tables (Orleans Parish Lakefront)	7.7 MD/table			1,390	72	100,080
3 Children's Play Areas (Orleans Parish Lakefront)	31 MD/playground			5,395	3	16,785
4 Covered Picnic Shelters, w/8 Picnic Tables Each (Orleans Parish Lakefront)	61.6 MD/shelter			11,117	4	44,468
2 Covered Pavilions, w/2 Picnic Tables (Orleans Parish Lakefront)	15.4 MD/pavilion			2,779	2	5,558
Hunting Acres (2,568 Land + 898 Water)						2,039[7/]
Sport Fishing in Project Area						19,122[8/]
						783,421[9/]

1/ State Comprehensive Outdoor Recreation Plan, Average Number of High Quarter Man Days of Use Per Unit. (Given In User Days).
2/ Number of Days in Summer Quarter of Year.
3/ Factor For Off Season Use (Remainder of Year-Fall, Winter, Spring).
4/ Annual Man Days Per Facility Type.
5/ Number of Individual Units.
6/ Annual Use Per Facility Type and Location.
7/ Annual Man Days of Hunting Existing in 1984. Consult the USFWS Final Coordination Act Report, Vol. II, Sec. XIV, Table 8.
8/ Annual Man-Days of Sport Fishing Existing in 1984. Consult the USFWS Final Coordination Act Report, Vol. II, Sec. XIV, Table 8.
9/ Total Annual Man-Days of Recreational Usage (South Shore Lake Pontchartrain).

impacts of the High Level Plan, if any, on each recreational resource. Design modifications in this plan (Table 2) will save approximately 201,873 annual recreational man-days affected by the High Level Plan. Table 3 identifies 318,534 man-days of recreation that would be lost without a design modification. Loss of 318,534 man-days translates to $1,021,852.

Development of the High Level Plan in the year 2100 compared to future with no additional Federal action (FWNAFA), impacts 265 man-days of hunting and 712 man-days of fishing. This hunting loss translates into total annual losses of 77 small game man-days x $3.90 = $300.00, 15 deer man-days x $13.80 = $207 and 173 waterfowl man-days x $13.80 = $2,387, for a total sport hunting loss of $2,894. Total annual fishing losses are 712 man-days x $3.90 = $2,776. Facility based recreation would also be affected. A two-lane boat ramp at the Kenner Race Track, the Linear Park in Jefferson Parish, and a small play area located at the New Orleans Lakefront satisfying 23,100, 75,700, and 16,785 man-days, respectively with an associated annual dollar value of $373,121.

The Barrier Plan will impact the recreational hunting and fishing resource to a greater degree than the High Level Plan. A man-day analysis was conducted by the U. S. Fish and Wildlife Service (USFWS). Acreage types in the area of potential construction impact consist of 2,363 acres of marsh, 0 acres of scrub-shrub, 164 acres of cypress tupelo, 41 acres of bottomland hardwoods, and 898 acres of water.

Based upon 2,568 total land acres and 898 total acres of open water, a projected man-day impact was calculated by the USFWS.

The Barrier Plan in the year 2100 compared to FWNAFA will impact 922 man-days of hunting and 16,793 man-days of fishing. This hunting loss translates into total annual losses of 323 small game hunting man-days X $3.90 = $1,260, 16 deer hunting man-days X $13.80 = $221 and 583

TABLE 2

WITH DESIGN MODIFICATION THE FOLLOWING FACILITIES AND ANNUAL MAN-DAYS WILL BE LOST DUE TO CONSTRUCTION OF THE HIGH LEVEL PLAN (Later to be Replaced)

Existing Facilities Design Modification Cannot Save	Annual Potential Man-Day Loss		Associated Dollar Losses
2-Boat Lanes (Kenner Race Track)	- 23,100	X $3.20 =	$ 73,920
1-10.5 Mile National Trail (Linear Park, Jeff Parish)	- 75,799	X $3.20 =	242,557
3-Children's Play Areas, with Facilities	- 16,785	X $3.20 =	53,712
Hunting Small Game	- 77	X $3.90 =	300
Hunting Deer	- 15	X $13.80 =	207
Hunting Waterfowl	- 173	X $13.80 =	2,387
Fishing	- 712	X $3.90 =	2,776
Total Project M/D Losses, With Design MOD (Replacement will occur only to National Trail and Play Areas)	- 116,661		$375,859

Total Existing Recreation M/D in Project Area	783,421
M/D Losses During Construction Design MOD can not save	- 116,661
Total Recreation M/D With Design MOD Remaining in project area.	666,760

Under the assumption the High Level plan will incorporate a design modification of the planned levee in Jefferson and Orleans Parishes a total of 201,873 man-days of recreation usage will be saved. These man-days protected translate to an annual dollar saving of $645,993.

The Design Modification will protect:

8 Boat lanes (Williams Blvd, Jeff Parish)	92,400 M/D X $3.20 =	$295,680
8 Boat lanes (Bonnabel Blvd, Jeff Parish)	92,400 M/D X $3.20 =	$295,680
1-330 ft. fishing pier (Bonnabel Blvd, Jeff Parish)	5,956 M/D X $3.20 =	$ 19,059
1-Covered Picinic shelter (Orleans Parish)	11,117 M/D X $3.20 =	$ 35,574
Total Man-Days protected	201,873	$645,993

A protective structure such as an "I" wall or retaining dike in selected locations in lieu of typical levee design would protect the existing recreational developments which provide $201,873 man-days of recreation valued at $645,993, annually.

TABLE 3

WITHOUT DESIGN MODIFICATION THE FOLLOWING FACILITIES AND ANNUAL MAN-DAYS WILL BE LOST DUE TO CONSTRUCTION OF THE HIGH LEVEL PLAN

Existing Facilities	Annual Potential Man-Day Loss		Associated Dollar Losses
8-Boat Lanes (Williams Blvd, Jeff Parish)	- 92,400	X $3.20 =	$295,680
8-Boat Lanes (Bonnabel Blvd, Jeff Parish)	- 92,400	X $3.20 =	295,680
1-330 Ft "T" Shaped Fishing Pier (Bonnabel Blvd Launch, Jeff Parish)	- 5,956	X $3.20 =	19,059
1-Covered Picinic Shelter, w/8 Picnic Tables (Orleans Parish Lakefront)	- 11,117	X $3.20 =	35,574
2-Boat Lanes (Kenner Race Track)	- 23,100	X $3.20 =	73,920
1-10.5 Mile National Trail (Linear Park, Jeff Parish)	- 75,799	X $3.20 =	242,557
3-Children's Play Areas	- 16,785	X $3.20 =	53,712
Hunting Small Game	- 77	X $3.80 =	300
Hunting Deer	- 15	X$13.80 =	207
Hunting Waterfowl	- 173	X$13.80 =	2,387
Sport Fishing	- 712	X $3.90 =	2,776
Total Project M/D Losses, Includes W/O Design MOD	-318,534		$1,021,852
Total Existing Recreation M/D in Project Area	783,421		
M/D Losses Without Design MOD.	-318,534		
Total remaining recreation M/D without Design MOD.	464,887		

waterfowl man-days X \$13.80 = \$8,045 for a total sport hunting loss of \$9,526. Total annual fishing losses are 16,793 man-days X \$3.90 = \$65,493.

Man-days of recreation were calculated by first assuming that based upon a high market area demand each acre of available hunting habitat, fishing area,and each existing recreational facility afforded by the project would be used to its optimal carrying capacity for each respective activity type. The hunting and fishing carrying capacity is expressed in terms of man-days per acre for each habitat type and hunting activity type. Carrying capacity multiplied times the number of habitat acres yields man-days of potential hunting supply. Recreational facility use is determined by the capacity use method.

Unit day values (UDV's) were assigned to each hunting and recreational activity through the analysis of evaluation criteria and standards as prescribed in the Water Resources Council's Principles and Guidelines. The five criteria and associated measurement standards are designed to reflect quality, relative scarcity, development, ease of access, and esthetic features of the recreation resource to be evaluated. The evaluation of these criteria with respect to the resource yields a point value which is converted into a corresponding specific dollar value contained in a range of values (UDV's) provided in the most current published schedule. The approved fiscal year 1982 ranges of values are:

General Recreation	\$ 1.50 - \$ 4.50
General Fishing and Hunting	\$ 2.20 - \$ 4.50
Specialized Fishing and Hunting	\$10.50 - \$17.90

UDV's selected for use in this study are based upon \$3.90 per man-day of general hunting and fishing and \$13.80 per man-day of specialized hunting (deer and waterfowl) activity under the fiscal year 1982 schedule.

The analysis of the man-day value of sport hunting and fishing in the area of potential construction impact is based upon: (1) ability of a given habitat type to support a stable population, and (2) the assumption that a certain portion of a population can be harvested at a sustainable annual rate without adversely impacting that population. The species used for this analysis include those that occur within the project area in large enough numbers to be sought by hunters.

Based upon the number of man-days affected in the proceeding analysis, the High Level Plan, which is greater in land-based facility development, will have a larger impact on the man-day usage associated with recreational facilities in the project area, however, man-days of hunting and fishing will be impacted to a lesser degree. The Barrier Plan will impact predominately hunting and fishing man-days in the vicinity of the Rigolettes, Chef Menteur Pass, and St. Charles Parish. It should be noted that the High Level Plan will affect mostly land-based general outdoor recreational facilities whereas the Barrier Plan will affect only wildlife and fisheries oriented recreation.

Section XII
Cultural Resources

Cultural Resources Appendix

I. Introduction.

The purpose of this appendix is to supplement information provided in the main report and environmental impact statement. This appendix will provide a brief introduction to the project, a discussion of the cultural resource studies of the project, and a statement of future study requirements.

The Lake Pontchartrain and Vicinity Hurricane Protection project was authorized by the Flood Control Act of 1965 and Federal construction was initiated in May 1967. The project is currently under construction with many portions already completed. Most of the levees and floodwalls are existing with the exception of the St. Charles Parish levee. The work remaining to complete the Barrier Plan involves completing the existing levee system to Barrier Plan grade, construction of the barrier structures and associated levees, construction of the St. Charles Parish levee, and renovation of the Mandeville Seawall. The work remaining to construct the High Level Plan includes raising the existing levee system to the higher grade required by this plan, construction of the St. Charles Parish levee, and renovation of the Mandeville Seawall.

An archeological reconnaissance of the project area was completed in 1970 by Louisiana State University. However, the study was very cursory and did not identify the overall impacts of the project. The first intensive cultural resource surveys of the project impact areas were conducted in 1975, long after project construction was initiated. Therefore, the cultural resources studies have focused on identifying the impacts of the continued construction of the Barrier Plan and the impacts of the proposed High Level Plan.

II. Cultural Resources Studies of the Project Area.

Numerous cultural resources studies have been completed covering portions of the project impact areas. These studies are listed and annotated below.

a. Archaeological Survey of the Lake Pontchartrain Hurricane Protection Project Area, Southeast Louisiana, by Robert W. Neuman of Louisiana State University in 1970. This study was actually an archeological reconnaissance which identified project impacts only in a cursory manner. The study identified only two possible significantly archeological sites, 16SC16 and 16SC17, in the project area. Both are shell middens which would have been impacted by the lakeshore alinement of the St. Charles Levee but, neither will be affected by the North of Airline Highway alinement.

b. New Orleans East Lakefront Levee, Paris Road to South Point, Orleans Parish, Louisiana, by Robert W. Neuman of Louisiana State University in 1975. This study conducted via boat located four archeological sites along the project right-of-way. None were identified as being affected by the project.

c. Archeological Investigations Along the Gulf Intracoastal Waterway: Coastal Louisiana Area, by Coastal Environments, Inc. in 1975. This survey covered portions of the Lake Pontchartrain project impact area along the Gulf Intracoastal Waterway (GIWW). Two sites of possible National Register of Historic Places eligibility, 16OR40, and 16OR41, located along the GIWW in the vicinity of the project were identified.

d. Cultural Resources Survey of the Chef Menteur and Rigolette Passes Control Structures, Lake Pontchartrain H.P. Project, Orleans and St. Tammany Parishes, Louisiana, by Coastal Environments, Inc. in

1979. The survey covered the necessary right-of-way of the proposed barrier structures and associated levees. The survey located no significant cultural resources which would be impacted by these project features.

e. Cultural Resources Survey of the Mississippi River - Gulf Outlet, Orleans and St. Bernard Parishes, Louisiana, by Coastal Environments, Inc. in 1979. This study included survey of the Chalmette Area Plan levee alinement located on the disposal area of the Mississippi River-Gulf Outlet (MR-GO). This survey relocated archeological sites 16OR40 and 16OR41 and recommended further testing to determine National Register eligibility prior to any future project impacts.

f. Cultural Resources Survey of Almonaster - Michoud Industrial Development, by Castille and Reeves in 1980. The survey covered the proposed A-MID location which encompasses a large portion of the Citrus and New Orleans East Bank Levee along the north shore of the GIWW. The field investigation located no significant cultural remains.

g. Cultural Resources Survey of Two Proposed Levee Items Within the Lake Pontchartrain LA. and Vicinity Hurricane Protection Project, by John W. Muller of the New Orleans District in 1982. This survey covered two levee item projects not previously cleared by cultural resources surveys. These included the North of Florida Avenue Levee and floodwall item located along the GIWW and the closure of two levee gaps along the New Orleans East Lakefront Levee. No significant cultural resources were located by this survey.

h. Cultural Resources Survey of Lake Pontchartrain, LA and Vicinity, Verret Closure, Levee Shaping and Creedmore Drainage Structure B/L Station 1113+70 to B/L Sta. 1586+03, St. Bernard Parish, Louisiana, by R. A. Flayharty of the New Orleans District in 1982. The survey covered the Chalmette Area Plan levee alinement from the Caernarvon Canal to Verret, Louisiana. No significant cultural resources were located by the survey.

i. Archeological Investigations of the Linsley Site (16OR40), by New World Research, Inc. under contract to the Port of New Orleans in 1982. This study involved deep coring in an attempt to locate in situ remains of site 16OR40, discovered during dredging of the MR-GO in 1960-1962. After extensive probing, the study concludes that the site was probably destroyed during construction of the MR-GO and no in situ remains exist in the site area.

j. Cultural Resources Survey of Terrestrial and Offshore Locations, Lake Pontchartrain and Vicinity Hurricane Protection Project, Louisiana, by New World Research, Inc. under contract to the New Orleans District in 1982-1983. The survey included terrestrial survey of portions of Barrier Plan not previously surveyed and the increased levee/floodwall rights-of-way required by the High Level Plan, and magnetometer survey of the Howze Beach and Jefferson Parish offshore borrow areas. The survey located no significant cultural resources in the levee and floodwall right-of-way but located numerous magnetic anomalies in the borrow areas which could represent significant historic shipwrecks.

k. Archeological Evaluation of the Paris Road Site (16OR41), Orleans Parish, Louisiana, by Coastal Environments, Inc. under contract to the New Orleans District in 1983-1984. This study consisted of an intensive augering program of the levee right-of-way in an attempt to locate the Paris Road site. The study results indicate that the Paris Road site was probably destroyed or extensively disturbed when dredged in 1964, and any portions of the site which may remain intact in the study area would not be impacted by the project.

Further Study Requirements.

Although most of the project area has been cleared by cultural resources surveys, some additional studies are required to completely address project impacts on National Register properties and bring the project into compliance with Federal law. These studies include:

a. Completion of Mandeville Seawall Study - Preliminary investigations indicate that renovation of this seawall will not adversely affect significant buried remains nor will it cause visual impacts to the historic properties of Mandeville. However, additional map and archival study and possibly subsurface testing are required to complete this study. This study is scheduled for Fall 1984.

b. Cultural resources survey of the St. Charles Parish Levee - No survey has been accomplished yet due to the preliminary level of project design. No cultural resources are currently recorded in the proposed alinement corridor. A cultural resources survey of this feature will be conducted when a more exact project alinement and right-of-way have been determined.

c. Further testing of significant magnetic anomalies in the offshore borrow areas if avoidance is not possible - The magnetometer survey by New World Research located numerous anomalies of possible significance in the Howze Beach (a feature of both plans) and the Jefferson Parish Offshore (a feature of the High Level Plan) borrow areas. Avoidance is the most favorable management alternative but, if this is not feasible further testing and possibly mitigation will be required.

d. New Orleans Outfall Canals solution - Until a feasible solution is selected, a complete assessment of impacts on National

Register properties is not possible. The three pumping stations associated with the outfall canals have the potential for qualifying under the National Register criteria. Depending on the solution, further cultural resource studies may be required.

e. Assessment of possible visual impacts of The Rigolets and Chef Menteur barrier complexes (features of the Barrier Plan) on Forts Pike and Macomb, respectively. Further study will be required only if the Barrier Plan is selected.

Section XIII

LAND USE METHODOLOGY

In order to compare plans, it is necessary to estimate the number of acres of various habitat types that remain at the end of the project life of each plan (100 years) and to also estimate the number of acres of each type that would exist 100 years hence without the project. As explained in the summary of this EIS, the Lake Pontchartrain Hurricane Protection project has been under construction for several years. There is no true "without project" condition, only a future with no additional Federal action (FWNAFA). For purposes of this EIS, only impacts to complete each plan are considered. Thus, construction will start in 1984. Actual completion of all features will not occur until 2000 and the end of project life will thus be 2100. However, we have estimated that by 1985 all first levee lifts will be complete.

We have concurred with the US Fish and Wildlife Service in the following rationale for habitat gain and loss with no additional Federal action. Habitat maps and data from the "Mississippi Deltaic Plain Region Ecological Characterization: A Habitat Mapping Study" (Wicker 1980) were used. The acreage was measured of each habitat in 1955-56 and in 1978 for selected quadrangle maps in the project area. This information was used to predict the rate of change for each habitat and this rate was projected to stay the same for the 1984-2100 period. From the same maps, it was possible to estimate what each habitat type changed to. Marsh was thus assumed to be lost at the rate of 0.85 percent per year; of that loss, 50 percent went to scrub shrub, 33 percent went to lake bottoms, 9 percent to upland developed and 8 percent to bayou/canal. The annual loss rate for bottomland hardwoods was 2.02 percent with the entire area lost becoming upland developed. Cypress tupelo was lost at a rate of 1.09 percent per year with 96 percent of the loss becoming upland developed and 4 percent, marsh.

To simplify calculations, only acreages in the area of direct impact were calculated. The area of direct impact is defined as being any area that would be directly affected by a project feature of either plan, i.e., a levee, borrow pit, barrier structure, closure dam. The acreage in the area of direct impact is shown in Table 6.2.

In order to estimate the acreage impacted by each plan, the project features were drawn on quadrangle maps and the acreage to complete each plan was planimetered by habitat type. Table 6.1 shows the habitat type impacted and the type to which each is converted. Land that becomes levee is classified as upland developed.

Habitat type changes were fairly simple to compute in this model because there were only 7 types to deal with. Only 3 types degenerate and they become the other four types. For example, marsh erodes to lake bottoms, is filled to become scrub shrub or upland developed, or gets excavated to bayou/canal. The basic assumption is that for the FWNAFA condition, the number of acres of lake bottom in 2100 will equal the number of acres in 1984 plus the number of acres that have eroded from marsh during the intervening 116 years. Upland developed in 2100 will equal 1984 acreage plus that which comes from marsh, cypress-tupelo and bottomland hardwoods. A small percentage of cypress-tupelo becomes marsh, but these acres are so few that they are just added to the 2100 acres and no attempt is made to add them into the marsh total yearly.

In order to calculate future with no additional Federal action acreage, the following steps were taken.

a. Convert the percent/and loss per year of marsh, cypress tupelo or bottomland hardwood to its equivalent decimal fraction and subtract it from 1. This is the fraction of the habitat type remaining from one year (f).

b. This fraction is then raised to the n power with n being defined as the number of years of project life.

c. f^n is then multiplied by the number of original acres to get the number of acres remaining at the end of project life.

d. The acres remaining are subtracted from the original acres to obtain acres lost.

e. The acres lost are multiplied by the appropriate percentage to determine what habitat type they become. These acres are then added to 1984 acres of the appropriate habitat type to obtain the number of acres in 2100.

f. The acres lost are subtracted from 1984 acres to get acres in 2100.

In order to calculate the future acreage with either the High Level or the Barrier Plan, similar calculations are utilized. However, the appropriate acreages from Table 6.1 are added to or subtracted from the 1984 acreages to obtain acres present in 1985. Then the same steps described in sections a-f in the previous paragraph are completed.

It is recognized that the acreage numbers in Table 6.3 are speculative, at best. The determinations of the annual loss rate and the estimates of habitat conversion are not absolutely accurate and cannot be projected 116 years into the future with any great degree of certainty. However, the process does allow a comparison of plans.

SECTION XIV

US FISH AND WILDLIFE SERVICE
FINAL COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

July 25, 1984

Colonel Robert C. Lee
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

Attached is the Fish and Wildlife Coordination Act Report on the tentatively selected plan described in the draft Main Report, "Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project." Our report is transmitted to you under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended 16 U.S.C. 661 et seq.).

The report has been coordinated with the Louisiana Department of Wildlife and Fisheries and National Marine Fisheries Service. Copies of the letters of response from those agencies are attached.

Your cooperation in this matter is appreciated.

Sincerely yours,

Richard J. Hubert [signature]

Assistant Regional Director--
Habitat Resources

Attachment

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33702

November 10, 1983 F/SER112/DM:yj
409/766-3699

Mr. David W. Fruge
Field Supervisor
U.S. Fish and Wildlife Service
Post Office Box 4305
103 East Cypress Street
Lafayette, LA 70502

Dear Mr. Fruge:

The National Marine Fisheries Service has reviewed the draft Fish and Wildlife Coordination Act Report for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project. We received this report from you on October 21, 1983.

Our review has been limited to the adequacy of addressing marine and estuarine fishery resources utilizing the project area. Since this draft adequately addresses these resources for which we are responsible, we concur in these findings and the recommendations. We especially endorse your recommendations to ensure the maintenance of ingress and egress of marine and estuarine organisms through the levees and to provide full mitigation for unavoidable adverse impacts on these fishery resources.

Thank you for the opportunity to review and comment upon this report.

Sincerely yours,

RN Rutherford
for
Richard J. Hoogland
Chief, Environmental Assessment
Branch

LOUISIANA DEPARTMENT of WILDLIFE and FISHERIES
Office of Coastal and Marine Resources
Ecological Studies Section
(504) 342-9254

P. O. Box 15570
Baton Rouge, LA 70895

July 23, 1984

Mr. David W. Fruge'
Field Supervisor
U. S. Fish and Wildlife Service
P. O. Box 4305
Lafayette, Louisiana 70502

Re: FWCAR Lake Pontchartrain, Louisiana and Vicinity
Hurricane Protection Project

Dear Mr. Fruge':

Personnel of the Louisiana Department of Wildlife and Fisheries have reviewed the above referenced report.

We concur with your evaluation and assessment and only wish to add to the recommendations a proposal for shoreline stabilization along the St. Charles Parish portion of the lake front. A serious deterioration of the marshes and swamps is occurring just to the east of the Bonnet Carre'. The lake is encroaching here and valuable emergent wetlands are being lost to open water. The protection of the remaining habitat, the restoration of recently lost habitat and/or the enhancement of both would go a long way in mitigating the damages which will result from this project.

Shoreline recession along the entire western end of Lake Pontchartrain is a problem of immediate concern and should be addressed as an integral part of the lake ecosystem. Although the project will physically occupy only a portion of the system, the impacts will be system-wide and mitigation should be accomplished on that basis.

Thank you for requesting our comments.

Sincerely,

M. B. Watson

M. B. Watson, Coordinator
Ecological Studies Section

MBW/fsb

LAKE PONTCHARTRAIN, LOUISIANA,

AND VICINITY HURRICANE PROTECTION PROJECT

FISH AND WILDLIFE COORDINATION ACT REPORT

SUBMITTED TO

NEW ORLEANS DISTRICT

U.S. ARMY CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

PREPARED BY

ROBERT W. STRADER, FISH AND WILDLIFE BIOLOGIST

UNDER THE SUPERVISION OF

DAVID W. FRUGE, FIELD SUPERVISOR

DIVISION OF ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

RELEASED FROM

U.S. FISH AND WILDLIFE SERVICE

LAFAYETTE FIELD OFFICE

LAFAYETTE, LOUISIANA

July 1984

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EXECUTIVE SUMMARY

Attached is the Fish and Wildlife Coordination Act Report of the Fish and Wildlife Service (FWS) on the tentatively selected plan (TSP) for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The TSP is the High-Level Plan and will be referred to as such throughout the remainder of this summary. Some references are also made to the Barrier Plan, which is the plan originally authorized by the Flood Control Act of 1965 (Public Law 89-298).

The High-Level Plan is intended to provide hurricane protection primarily to the developed areas along the southern shore of Lake Pontchartrain. Two relatively undeveloped areas to be protected by the High-Level Plan include New Orleans East and a portion of St. Charles Parish. With the High-Level Plan, hurricane protection will be provided by construction or improvement of a system of levees and floodwalls. The Barrier Plan would protect a much larger area by employing barrier structures and connecting levees at the major tidal passes connecting Lakes Pontchartrain and Borgne and at the Inner Harbor Navigation Canal. Construction of the Barrier Plan began in 1967 but was stopped by a Federal Court injunction in 1977. Completed project features have impacted nearly 3,000 acres of predominantly brackish marsh and scrub-shrub habitats.

The project area supports a variety of fishes and shellfishes of sport and commercial importance. Many marine and estuarine fishes and shellfishes are dependent upon the estuarine waters of the project area for nursery habitat. Movement of fishes and shellfishes through the Chef Menteur Pass and the Rigolets, to and from essential nursery areas, is crucial to the maintenance of the fishery supported by those species. The project area also supports a diversity of game and non-game wildlife. These include wading birds, seabirds, shorebirds, migratory waterfowl, rails, gallinules, American woodcock, commercially valuable furbearers, swamp rabbit, and white-tailed deer.

With the proposed hurricane protection project, the rate of loss of productive habitats is expected to accelerate. Project impacts were estimated on the basis of projected differences in average annual acres, under with-project and without-project conditions, for the period 1984 to 2100. Compared to the without additional Federal action alternative, completion of the High-Level Plan is expected to cause the average annual loss of 5 acres of fresh/intermediate marsh, 32 acres of brackish/saline marsh, 1 acre of bottomland hardwood, 106 acres of cypress-tupelo, 431 acres of lake, 1 acre of river/canal, and 105 acres of scrub-shrub habitats. Conversely, a gain of 678 acres of upland developed habitats is projected. Completion of the Barrier Plan would cause the average annual loss of 3 acres of fresh/intermediate marsh, 1,283 acres of brackish/saline marsh, 279 acres of lake, 295 acres of river/canal, 92 acres of cypress-tupelo, and 12 acres of bottomland hardwood habitats, but a gain of 1,420 acres of scrub-shrub and 546 acres of upland developed habitats.

It is estimated that marsh losses associated with completion of the High-Level Plan will reduce the average commercial fishery catch by almost 11,200 pounds annually. This loss will reduce the annual gross exvessel value of the fishery by an estimated $2,878. Marsh loss associated with the Barrier Plan is expected to reduce the average annual commercial fishery catch by nearly 389,400 pounds, causing a net annual loss of over $100,000; this estimate does not include many of the potential impacts associated with installation of the tidal barriers in Chef Menteur Pass, and the Rigolets which could be far more severe than the direct loss of habitat through levee construction.

Sport fishing would also be adversely affected by either plan. The High-Level Plan is expected to reduce sport fishing by 712 man-days annually; this loss is valued at $2,776. The Barrier Plan would reduce sport fishing by 16,793 man-days valued at $65,493.

The High-Level Plan will cause an average annual loss of 514 man-days of sport hunting and other wildlife-oriented recreation valued at over $3,850. Commercial trapping losses with that Plan would exceed $150 annually. The Barrier Plan would cause the average annual loss of almost 1,700 man-days of sport hunting and wildlife-oriented recreation valued at over $12,500. Commercial trapping losses attributed to the Barrier Plan are valued at $2,239 annually.

The FWS's Habitat Evaluation Procedures (HEP) were used to assess impacts on wildlife habitat quality and quantity over the life of the project. Average annual habitat units (AAHU's) are used to measure changes in habitat quality and quantity. The HEP analysis revealed that all evaluation elements will be negatively impacted by the High-Level Plan. Puddle ducks (-246 AAHU's) and diving ducks (-198 AAHU's) are the two species groups that are expected to be most impacted by this plan. The combined loss for all evaluation elements is nearly 1,080 AAHU's. The Barrier Plan is expected to destroy more marsh and forested habitat and would cause a total loss of over 2,200 AAHU's. These estimates do not include damages associated with the already completed project features.

Several proposed project features are expected to have adverse, but unquantified, impacts on fish and wildlife resources. These features include the proposed borrow area in Lake Pontchartrain along the Jefferson Parish lakefront levee and the St. Charles Parish and New Orleans East levee alignments. The proposed 500-foot-wide, 9-mile-long borrow area for the Jefferson Parish lakefront levee and barge berm lies about 2,500 feet lakeward from the Lake Pontchartrain shoreline. The resultant dredge holes are expected to extend 60 feet below existing lake bottom. A review of pertinent literature indicates that salinity stratification frequently becomes a problem in holes substantially deeper than the average lake bottom. The denser, more saline water precludes flushing, which, in turn, severely restricts the replenishment of dissolved oxygen and encourages the accumulation of organic material. It is, therefore, expected that the dredge holes will at least partially fill with an anoxic layer that will likely remain in these holes for extended periods of time. The depressed oxygen levels and unconsolidated substrate will act to severely restrict the value of these areas as fish and shellfish habitat. However, short term concentration of finfishes in the dredge holes may occur during winter months, possibly facilitating sport harvest.

Levee construction, particularly in the area of St. Charles Parish and New Orleans East, may encourage drainage and development of wetlands. In the St. Charles Parish area, four gated water-control structures are planned for the levee segment protecting this area. These structures would be closed only in the event of a hurricane. With the reduced threat of hurricane impacts, attempts to drain and develop the protected area could be anticipated.

In the New Orleans East area, the area enclosed by the hurricane protection levees is slated for private development. These levees were largely in existence prior to construction of Federal hurricane protection features. Subsequent construction has virtually eliminated the already limited tidal exchange and further modified the hydrology of the project area. New Orleans Corps District personnel have determined that the Maxent Canal alternative alignment is not acceptable and contend that development of this 13,000-acre area by private interests is dependent upon issuance of a pending Section 404 (Clean Water Act) permit, and not on completion of the hurricane protection system. They also contend that no impacts associated with any development in the New Orleans East area should, therefore, be attributed to the hurricane protection project. This rationale is, however, subject to considerable question subject to the fact that:

1) current State and possible future Federal regulatory definitions and policies may exempt this area from the need for a permit;

2) if a permit is required, completion of the hurricane protection levee would increase the probability that a permit to drain and develop this 9,778-acre wetland area would be issued; and

3) completion of a levee system to protect this area from the 200- to 300-year hurricane would be expected to increase the potential developers' and/or homeowners' sense of security and safety from the threat of flooding due to hurricanes, thereby providing additional development incentive.

In order to preclude project-induced drainage of the New Orleans East wetlands, the FWS recommends that the Corps of Engineers purchase real estate easements that preclude such action. Executive Order 11990, (Protection of Wetlands) requires Federal agencies to avoid construction in wetlands unless 1) there is no practical alternative or 2) the proposed action includes all practical measures to minimize harm to wetlands which may result from such Federally-funded action. Because less-damaging alignments and other practical measures (such as acquisition of non-development easements) have not been incorporated in project plans for the New Orleans East area, it is our opinion that the proposed plan is not in compliance with Executive Order 11990.

Mitigation for this project should encompass all unavoidable, project-related losses associated with both existing and proposed

Federally-funded project features and should be implemented concurrently with other project features. Project impacts, as quantified by the HEP analysis, include the loss of 3,217 AAHU's. The FWS has formulated a combination of mitigation features which span the area of project impacts. Those features include shoreline stabilization and marsh preservation in St. Charles Parish, marsh management in St. Bernard Parish, and marsh creation in the area of the GIWW navigation channel by-pass in Orleans Parish. These features would provide a gain of 2,956 AAHU's and fully compensate, "in-kind", for all project-related damages to fish and wildlife resources.

Restoration of estuarine-dependent fisheries usage of the New Orleans East area is recommended as an enhancement feature. Such action would increase the average annual sport fishing potential by 167,700 man-days valued at over $654,000 and the commercial harvest of estuarine-dependent fish by over $1,665,400.

In summary, the FWS recommends that the following measures be taken in the interest of fish and wildlife resources:

1. The St. Charles Parish segment of the hurricane protection system should be eliminated. However, if it is determined to be in the best public interest to construct that project segment, the levee alignment should be immediately adjacent to Airline Highway. The Corps of Engineers, rather than local interests, should maintain complete control of the gated water-control structures so that water circulation and estuarine organism movement is maintained. The New Orleans District, in cooperation with the FWS, National Marine Fisheries Service (NMFS), and Louisiana Department of Wildlife and Fisheries (LDWF), should determine the optimum placement and design of those structures during the advanced engineering and design phase of this project. If these recommendations are not implemented, additional mitigation will be required to compensate for habitat losses associated with the development of those lands between the proposed hurricane protection levee and U.S. Highway 61.

2. The Jefferson Parish lakefront levee should be constructed of material hauled in from an upland area, such as the Bonnet Carre Floodway, thus eliminating the anticipated "dead zone" expected to be created in Lake Pontchartrain by the proposed borrow. If Lake Pontchartrain is the only feasible source of levee material, studies to reduce the water quality problems caused by the borrow area should be conducted during the advanced engineering and design phase of this project.

3. The mitigation features recommended in this report should be fully developed in cooperation with the FWS, NMFS, LDWF, and Corps of Engineers, incorporated into the final Main Report and Supplement to the Environmental Impact Statement, and

implemented simultaneously with construction of all proposed project features.

4. Real estate easements that preclude development of the 13,000-acre New Orleans East wetland area should be purchased. Furthermore, the existing water-control structures along the South Point to GIWW levee segment should be modified and operated, as a commercial fishery enhancement measure, to allow for water and estuarine organism movement between the enclosed wetland area and the adjacent estuary, except when storm tides are predicted or occurring.

PROJECT DESCRIPTION

The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was authorized by the Flood Control Act of 1965 (Public Law 89-298) and described in House Document 231, 89th Congress, First Session. The project is designed to provide hurricane protection to New Orleans and other developed areas surrounding Lake Pontchartrain in extreme southeastern Louisiana. The authorized project, also known as the Barrier Plan (Plate 1), includes construction of three barrier complexes with associated navigation facilities and a system of levees and floodwalls. The barrier complexes are located at the Rigolets, Chef Menteur Pass, and Seabrook (at the lakeside mouth of the Inner Harbor Navigation Channel). These barriers will allow for closure of Lake Pontchartrain's main tidal passes prior to and during a hurricane, thereby reducing the height of the storm surge in the lake and the height that hurricane protection levees and floodwalls would otherwise have to be built. Associated with the barriers is a system of channels and structures that would maintain navigation between Lake Pontchartrain, Lake Borgne, and the Intracoastal Waterway, and levees that would connect the barriers with higher land elevations to the east and a network of hurricane protection levees to the west. The 1977 Federal Court injunction and subsequent modifications preclude future construction of the Rigolets and Chef Menteur complexes and associated navigation channels until a supplement to the EIS is prepared. Construction of levees, exclusive of those associated with connecting the barriers, was allowed to continue.

The levee/floodwall system of the authorized plan includes five areas of protection: 1) the Chalmette Plan, 2) the Citrus and New Orleans East segment, 3) the New Orleans and Jefferson Parish segments, 4) the St. Charles Parish segment, and 5) the Mandeville Seawall (Plate 1). The Chalmette Plan encompasses an area generally bounded by the Mississippi River on the west, the Gulf Intracoastal Waterway (GIWW) on the north, the Mississippi River-Gulf Outlet (MR-GO) on the east, and Bayou Terre aux Boeufs on the south. The Citrus and New Orleans East segment is bounded by the Inner Harbor Navigation Canal (IHNC) on the west, Lake Pontchartrain on the north, an existing levee that extends from South Point to GIWW on the east, and GIWW on the south. The St. Charles Parish portion of the system is bounded by Bonnet Carre Floodway on the west, Lake Pontchartrain on the north, the Jefferson Parish/St. Charles Parish boundary on the east and the Mississippi River on the south. Since project authorization, the Corps of Engineers (Corps) has re-studied the St. Charles Parish alignment. Based on environmental and economic considerations, the Corps has indicated a preference for an alignment either north of Airline Highway (U.S. Highway 61) or no levee protection, in lieu of the more damaging and expensive lakefront alignment. The Mandeville Seawall was intended to protect the Town of Mandeville, which is located on the north shore of Lake Pontchartrain. Completion of this segment of the project will only require renovation of existing facilities.

Subsequent to the 1977 Federal Court injunction, the Corps has investigated several alternative plans and has selected the High-Level Plan as the tentatively selected plan (TSP) (Plate 2). The High-Level

Plan affords protection to most of the same developed areas as the Barrier Plan, but through the use of higher levees and floodwalls to prevent inundation due to hurricane surges (rather than barriers at the main tidal passes of Lake Pontchartrain). With the exception of the barriers, associated navigation channels and structures at the Rigolets and Chef Menteur Pass and connecting levees, all structural work associated with the TSP follows the same alignment as described for the authorized plan (Plate 1). Because the High-Level Plan has been selected as the TSP, studies to determine the environmental impacts of the barriers on Lake Pontchartrain were terminated before their completion, making analysis of these impacts difficult to reliably quantify. Therefore, the Barrier Plan will receive somewhat limited analysis and discussion throughout the remainder of this report.

In the Citrus and New Orleans East areas, an alternative alignment known as the Maxent Canal alignment, was considered by the Corps. This alignment would extend protection from the IHNC eastward to the Maxent Canal and eliminate a large undeveloped wetland from project hurricane protection. However, the Corps determined that this alignment was more costly and provided hurricane protection to a smaller area than the South Point to GIWW alignment (the same alignment as described for the authorized plan) and, therefore, eliminated the Maxent Canal alignment from further consideration.

To date, construction of certain portions of the authorized plan has occurred. These include:

1) the GIWW navigation channel by-pass and retaining dikes for spoil disposal, which were constructed prior to the court injunction;

2) the levee system encompassing the Chalmette Plan; and

3) levees along the GIWW and Lake Pontchartrain sides of the Citrus and New Orleans East areas.

The Chalmette Plan, Citrus, and New Orleans East levee construction has proceeded because these segments were not affected by the court injunction and are integral to any plan selected (excluding the No-Action Plan).

Portions of the levee/floodwall network make use of features constructed by other Federal and local actions, i.e., existing levees or spoil areas. It will, however, be necessary to upgrade these features to a height of 12.0 to 17.5 feet National Geodetic Vertical Datum (NGVD) to meet Corps' criteria. Levee improvement will be accomplished using hauled clay fill or floodwalls for each levee reach, except along the Jefferson Parish lakefront where levee material will be dredged from Lake Pontchartrain in a band extending parallel to and about 2,500 feet lakeward from the existing levee. The dredged area is expected to be 500 feet wide at the top with a 1 on 3 slope. The lake bottom in this area ranges from -4 to -10 feet NGVD with a majority of the area having a depth of -6 to -10 feet NGVD. To obtain the quality and quantity of material needed to upgrade the Jefferson Parish lakefront levee, the Corps has predicted the need to dredge much of this area to a depth of 60 feet below existing lakebottom.

AREA SETTING

General

The project area is located in southeastern Louisiana within the Mississippi Deltaic Plain Region (MDPR). The project area, as described in the authorizing document, includes Lakes Maurepas, Pontchartrain, and Borgne and adjacent wetlands that would be inundated by hurricane tides. Corps and FWS biologists have, however, mutually agreed to reduce the area to be described and assessed for biological impacts associated with this project, this area is more precisely described in our letter report of November 17, 1981, (Appendix A). The area generally includes Lake Pontchartrain and adjacent wetlands to the north and west, the westernmost third of Lake Borgne, the wetlands between Lakes Pontchartrain and Borgne, the area enclosed by the proposed levee in St. Bernard, Orleans, and Jefferson Parishes (Chalmette Plan, Citrus and New Orleans East segments, and the New Orleans and Jefferson Parish segments), and all of St. Charles Parish north of the left descending bank of the Mississippi River, excluding the Bonnet Carre Floodway.

Lakes Pontchartrain and Borgne constitute a major portion of the project area. These large estuarine water bodies range from fresh to brackish; water depths rarely exceed -20 feet NGVD in these lakes. Although salinities may reach as high as 18 parts per thousand (ppt) near the passes following severe storms, normal Lake Pontchartrain salinities range from 0 to 2 ppt in the extreme western portion of the lake and 1 to 8.5 ppt near the Rigolets and Chef Menteur Pass. Overall, salinities in Lake Pontchartrain average less than 5 ppt; the lowest salinities occur in May, June, and July and the highest are usually recorded in October and November. Currents in Lake Pontchartrain are heavily influenced by wind. Normal annual tidal fluctuation in Lake Pontchartrain is generally less than 3 feet.

Drainage into and through the study area is by a system of rivers, passes, and canals. Major flow into Lake Pontchartrain is provided by Pass Manchac (which drains Lake Maurepas), the Tangipahoa and Tchefuncte Rivers, and numerous canals, bayous, and lesser streams. Storm water runoff in the New Orleans area enters Lake Pontchartrain through a series of canals and pumping stations. Water flows from Lake Pontchartrain into Lake Borgne via the Chef Menteur Pass and Rigolets. The Pearl River supplies a large volume of fresh water to Lake Borgne and, to some extent, Lake Pontchartrain. Infrequent diversion of Mississippi River floodwaters into Lake Pontchartrain occurs via the Bonnet Carre Floodway.

Major man-made navigation channels include the GIWW and MR-GO. Completion of the MR-GO has facilitated the inflow of saline water from the Gulf of Mexico into Lake Pontchartrain and Lake Borgne. Consequently, salinities in those lakes have increased since completion of the MR-GO.

Climate in the area is subtropical with high humidity, long, hot summers, and mild winters. Average annual rainfall slightly exceeds 60 inches. The area is plagued by tropical storms and hurricanes that bring extremely high winds, storm tides, and torrential rains.

Land elevations in the project area are generally below 5 feet NGVD, but may reach 25 feet NGVD on some natural and man-made levees. The low elevations and subsequent flooding susceptibility has precluded development of much of the project area and limited the spatial growth of the densely populated and highly industrialized cities of New Orleans, Chalmette, Metairie, and Kenner. The population of the Greater New Orleans Metropolitan Area in 1980 exceeded 1.8 million. The proposed project will afford hurricane protection to those populated areas, as well as three largely undeveloped areas located in New Orleans East, St. Charles Parish, and the area enclosed by the Chalmette Area Plan levees.

Description of Habitats

The habitat types to be impacted by the project include fresh/intermediate marsh, brackish/saline marsh, lake, river and canal, bottomland hardwood, cypress-tupelo, scrub-shrub, and upland developed. Descriptions of these habitat types were presented in a letter report dated November 17, 1981, (Appendix A) and a planning-aid report dated November 8, 1982 (Appendix B). The marshes and the forested or developed ridges are the products of riverborne sediments transported by the Mississippi River and deposited in shallow open water. As a result of man's attempt to confine freshwater flows to the Mississippi River channel for flood control purposes, freshwater and sediment inflow into the study-area wetlands has been greatly reduced. Reduced freshwater inflow and extensive canal dredging have led to saltwater intrusion into the study area. The net result of these factors has been accelerated subsidence and erosion of marshes and swamps, and conversion of freshwater wetland plant communities to more salt-tolerant vegetation types and to sparsely vegetated and unvegetated open water areas.

Habitat types and acreages in the area of direct project impact are changing rapidly. If subsidence, saltwater intrusion, drainage projects, and/or a number of other factors continue unchecked, it is expected that these habitat changes will persist throughout the life of this project. Because of this change, habitat acreages must be presented for baseline (existing) and future without-project (FWOP) conditions (Table 1). The methodology used to predict future conditions is provided in Appendix B. Brackish/saline marsh is expected to decline from nearly 2,300 acres in 1984 to about 850 acres by the end of the project life (2100). The habitats expected to increase in extent as a result of this loss are lake, river and canal, scrub-shrub, and upland developed types.

It should be noted that the Corps and the State of Louisiana are currently studying and/or proposing several projects that would reduce coastal habitat losses. If projects that affect the area are deemed feasible and subsequently implemented, habitat change within the

Table 1. Baseline (1984) and future without-project habitat acreages for that area impacted by the proposed Barrier Plan and/or High-Level Plan.

	Habitat type[1]								
Year	F/IM	B/SM	Lake	R/C	BLH	CT	SS	UD	Total[2]
1984	1	2296	1117	1129	35	199	712	2501	7990
1987	1	2238	1136	1134	33	193	742	2515	7991
1989	1	2200	1148	1137	32	189	761	2524	7992
1996	2	2072	1190	1147	28	175	825	2552	7990
2000	2	2003	1213	1152	25	167	860	2569	7991
2010	3	1839	1267	1165	21	150	942	2604	7991
2020	4	1689	1316	1177	17	134	1017	2637	7991
2030	4	1550	1361	1188	14	120	1087	2666	7990
2040	5	1423	1403	1198	11	108	1151	2692	7991
2050	5	1307	1441	1207	9	97	1209	2716	7991
2060	6	1200	1476	1216	8	87	1265	2736	7994
2070	6	1102	1508	1223	6	78	1312	2755	7990
2080	7	1011	1538	1231	5	70	1357	2773	7992
2090	7	929	1565	1237	4	62	1399	2788	7991
2100	7	853	1590	1243	3	56	1437	2702	7991
Annualized	5	1458	1392	1195	14	113	1133	2681	7991

1. F/IM = fresh/intermediate marsh
   B/SM = brackish/saline marsh
   Lake = large open water bodies
   R/C = rivers and/or canals
   BLH = bottomland hardwood
   CT = cypress tupelo
   SS = scrub-shrub
   UD = upland developed

2. The value given for total habitat acreages is the sum of the habitat acreages before rounding to the nearest whole number and, therefore, may not represent the total of the habitat acreages displayed in this table.

project area would be expected to follow trends somewhat different from those displayed in Table 1.

Fisheries

The sport and commercial fishery resources of the Lake Pontchartrain/Lake Borgne estuarine complex are significant. A brief description of these resources is provided in Appendix A. A study conducted by the FWS in Lake Pontchartrain, Lake Borgne, and the St. Bernard marshes during 1959 and 1960 provided some insight into the sport fishery of that area. Table 2 presents a summary of the Lake Pontchartrain sport and commercial fishery harvest for the period April 1959 to March 1960.

The referenced study revealed that the greatest sport fishing success was in the extreme eastern end of Lake Pontchartrain, where salinities were usually highest (Table 3). It was also determined that marine species made up 95 percent of the sport fishery harvest, with spotted seatrout and sheepshead comprising almost 80 percent of the catch. It should be noted that the above-referenced survey was conducted prior to the construction of the MR-GO. Salinities have risen in Lake Pontchartrain since that waterway was constructed, and no detailed survey of sport and commercial fishing effort has been conducted in the affected area since that time.

The average annual reported commercial catch of fish and shellfish in Lakes Pontchartrain and Borgne from 1976 to 1978 is shown in Table 4. According to these data, the most commonly taken species include blue crab, shrimp, oysters, catfish, shad, sharks, spotted seatrout, red drum, black drum, and sheepshead. As indicated by these data, saltwater fishing in the project area is extensive; the importance of the marshes to this estuarine-dependent fishery cannot be overemphasized. These marshes produce vast amounts of organic detritus which is transported into adjacent estuarine waters. The importance of plant detritus in estuarine food webs is well documented. Darnell (1961) concluded that detritus of vegetable origin seemed to be the single most important food material ingested by the fish and invertebrate consumers of Lake Pontchartrain. The contribution of vascular plant detritus to estuarine fisheries productivity was also documented by Odum et al. (1973). Marshes and associated shallow ponds and tidal streams are important as habitat for many estuarine-dependent species in coastal Louisiana (Chambers 1980, Daud 1979, Rogers 1979, Simoneaux 1979, and White and Boudreaux 1977). A three-year investigation of a low-salinity marsh area in the Galveston Bay System of southeastern Texas revealed that shallow marsh waters were prime habitat for immature shrimp (brown and white), gulf menhaden, Atlantic croaker, sand seatrout, and southern flounder (Conner and Truesdale 1973).

There is growing evidence that the acreage of marsh is the most important factor influencing the production of estuarine-dependent species of sport and commercial importance in the Gulf area. Turner (1979) reported that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands, and that

Table 2. Fishery harvest in Lake Pontchartrain, April 1959 - March 1960, (in thousands).[1]

Fishery	Fish		Shrimp		Crabs		Total	
	Pounds	Value or man days	Pounds	Value or man days	Pounds	Value or man days	Pounds	Value or man days
Commercial	272	$44	232	$81	1,461	$133	1,965	$258
Sport	700	227	17	3	332	30	1,049	247[2]
Total lbs.	972		249		1,793		3,014	

1. From: U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife (1962).

2. Total man-days of sport fishing is less than combined subtotals because some fishermen engaged in more than one kind of fishing on the same day.

Table 3. Relation of Lake Pontchartrain fishing to salinity, April 1959 - March 1960.[1]

	Upper Lake [2]	Lower Lake [3]	Extreme Lower Lake [4]
Salinity spread (mean, in ppt)	0.3-1.4	1.4-2.3	2.3-2.7
Sport fishery			
No. fishermen (percent)	3.0	44.0	53.0
Fish caught/man-day (lbs)	0.5	3.1	5.1
Fish caught/acre (lbs)	0.01	2.5	14.4
No. crab fishermen (percent)	1.0	32.0	67.0
Commercial fishery harvest			
Marine fish (percent)	None	100.0	
Crabs (percent)	35.0	65.0	
Shrimp (percent)	100.0	Closed to harvest	

1. From: U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife (1962).

2. Bounded by Lake Pontchartrain Causeway and western shore of Lake Pontchartrain.

3. Extends from Lake Pontchartrain Causeway to U.S. Highway 11.

4. Includes area between U.S. Highway 11 and U.S. Highway 90.

Table 4. Average annual reported commercial catch of fish and shellfish in Lake Pontchartrain and Lake Borgne from 1976 to 1978.[1]

Species	Pounds	Value ($)
buffalo	2,233	379
catfish	74,767	31,392
croaker	1,767	252
black drum	7,533	1,181
red drum	19,933	6,525
flounders	700	268
garfish	1,833	766
king whiting	133	20
mullet	900	73
sea catfish	5,000	600
spotted seatrout	16,433	8,077
white seatrout	1,500	289
shad	28,333	1,417
sharks	19,900	1,992
sheepshead (freshwater)	1,400	239
sheepshead (saltwater)	3,267	266
spanish mackerel	267	25
blue crabs (hard)	1,433,200	358,623
blue crabs (soft)	30,566	71,707
oysters	798,833	851,434
shrimp	944,523	872,477
Total	3,393,021	2,208,002

1. Source: National Marine Fisheries Service data compiled by New Orleans District Corps of Engineers.

the area of estuarine water does not seem to be directly associated with average shrimp yields. Lindall et al. (1972) presented evidence that shrimp and menhaden are being harvested at or near maximum sustainable yield. An analysis by Cavit (1979) of the dependence of menhaden catch on wetlands in coastal Louisiana suggested that menhaden yields are greatest in those hydrologic units having the highest ratio of marsh to open water. Harris (1973) has stated his opinion that total estuarine-dependent commercial fisheries production in coastal Louisiana has peaked and will decline in proportion to the acreage of marsh lost. Based on these considerations, it was assumed that the magnitude of future declines in marsh acreages (Table 1) will determine the extent of future declines in sport and commercial estuarine-dependent finfish and shellfish yields.

Using this assumption and the monetary evaluation methodology discussed in Appendix C, the sport and commercial fish values of the area were calculated for the period 1984-2100 (Table 8; Tables C-1, C-2, and C-3, Appendix C). An average of over 19,100 man-days of sport fishing, valued at almost $74,600, is expended annually in pursuit of fish produced by the marsh and cypress-tupelo habitats within the area of direct project impact. These habitats are also expected to produce an average commercial harvest of 443,011 pounds of fish and shellfish per year, valued at over $113,800 (gross exvessel value).[1]

The greatest portion of that harvest includes menhaden (169,342 pounds), unclassified industrial fishes (169,854 pounds), and shrimp (63,099 pounds). Although the menhaden and unclassified industrial fish constitute over 75 percent of the total poundage, these species contribute only 16 percent ($18,654) of the total monetary value of the reported commercial fishery landings from the project area. Shrimp constitute nearly 60 percent ($67,516) of the monetary value of the commercial fishery of the area.

Wildlife

The area of direct project impact supports a variety of wildlife species that are largely dependent upon the marsh habitat. These species are broadly categorized as game, furbearer, endangered, and non-game species. A comprehensive discussion of these species is provided in our planning-aid letter of November 17, 1981 (Appendix A). Several specific items of information, which were unavailable during the preparation of the referenced planning-aid letter, warrant special mention. For the past few years, the FWS, in cooperation with State fish and wildlife agencies and other knowledgeable personnel, has been identifying key privately-owned wetland areas along the Central Gulf Coast that are considered vital habitat for wintering waterfowl. Ten of the 14 key wetland units identified are located in coastal

[1]The commercial fisheries values used in this report reflect gross exvessel value, which is frequently called dockside value. The retail values have been reported to be several times greater than the exvessel value.

Louisiana; portions of two of these, the Delacroix Unit and the St. Charles Unit, are located in the study area.

The Delacroix Unit, located in Hydrologic Unit II, is bordered by Lake Borgne and the MR-GO on the northeast, Breton Sound to the southeast, and the Mississippi River levee on the southwest and northwest sides. The Delacroix Unit was once considered to be southeast Louisiana's most productive fur and waterfowl marsh area, but now supports the smallest population of wintering waterfowl of all the key wetland areas in Louisiana. Between 1969 and 1978, this unit supported an average annual population of 19,200 wintering waterfowl. During the late 1960's, this area wintered more than 250,000 waterfowl annually. The major species utilizing this unit, in decreasing order of abundance, include American coot, gadwall, mottled duck, mallard, American wigeon, lesser scaup, green-winged teal, blue-winged teal, hooded merganser, shoveler, and pintail. The drastic decrease in wintering waterfowl in the Delacroix Unit during recent years is attributed to rapid conversion of fresh and intermediate marshes to brackish and saline marshes, much of it resulting from saltwater intrusion associated with construction of the MR-GO.

The St. Charles Unit is bordered on the north by Lake Pontchartrain, on the south by U.S. Highway 61, on the west by the Bonnet Carre Floodway, and on the east by the St. Charles/Jefferson Parish line. The Unit includes about 18,000 acres of cypress-tupelo swamp, fresh/intermediate marsh, and lake habitats. An estimated 25,000 ducks and 11,000 coots annually winter in the Unit, which is heavily utilized by hunters. Of the estimated 25,000 ducks wintering in the unit, the most numerous species, in decreasing order of abundance, include mallard, gadwall, American wigeon, scaup, pintail, green-winged teal, shoveler, ring-necked duck, and blue winged-teal. Subsidence and saltwater intrusion from the MR-GO and access canals is also causing degradation of this marsh unit.

An estimate of the man-day and monetary value of sport and commercial wildlife in the area of direct project impact was developed (Appendix C). Without additional Federal action, this area is expected to support an average of just over 2,000 man-days of small game, deer, and waterfowl hunting annually throughout the project life (1984-2100) (Table 8). This potential man-day use is valued at almost $19,000 per year. Furbearers in the project area include muskrat, nutria, mink, otter, and raccoon. The estimated furbearer and alligator harvest in this same area is valued at over $2,550 annually throughout the project life. Wildlife-oriented recreation, generally associated with non-consumptive wildlife related activities, accounts for an additional 1,374 man-days valued at over $5,350 annually for the project life.

Endangered Species

According to the FWS's Endangered Species Office in Jackson, Mississippi, the only endangered species that is likely to occur in the project area is the bald eagle. Bald eagles are associated with marshes, lakes, swamps, and streams in south Louisiana from early fall to late spring. An active eagle nest is located near White Kitchen, Louisiana. By letter dated November 30, 1981, to the Corps, the FWS's Jackson, Mississippi, Endangered Species Office indicated that construction and maintenance of the High-Level Plan would not have an adverse affect on the White Kitchen eagle nest, but that further consultation and re-assessment of project impacts would be required if the Barrier Plan is implemented. Another nest, near St. Rose in St. Charles Parish, has not been active in recent years but may still provide nesting habitat. A third eagle nest, known as the Moisant Nest, is located in St. Charles Parish between Interstate 10 and U.S. Highway 61. This nest is at least 1.5 miles from any proposed levee and, therefore, outside of the critical zone in which levee construction would be considered likely to adversely impact this nesting pair.

The American alligator is listed as "threatened" under the Similarity of Appearance clause of the Endangered Species Act of 1973 (Federal Register 1981b) throughout the State of Louisiana. Restricted harvest of this species is currently allowed and included in our discussion of monetary impacts associated with the project. The preceding discussion should not be construed as fulfilling the Corps' responsibility under Section 7 of the Endangered Species Act of 1973, as amended.

Wildlife Management Areas and Refuges

Manchac Wildlife Management Area, Joyce Wildlife Management Area, and St. Tammany Wildlife Refuge are located in the project area. These areas are State-owned and implementation of High-Level Plan is not likely to impact these areas. No Federal refuges are located within the project area; however, a large tract of marsh and wooded swamp in St. Charles Parish has been considered for inclusion into the National Wildlife Refuge system. A detailed discussion of the State-owned wildlife management areas and refuge is provided in our November 17, 1981, letter report (Appendix A).

EVALUATION METHODOLOGY

Construction of the remaining project features is expected to take about 16 years, i.e., from 1984 to 2000. Project maintenance and economic benefits are anticipated to occur for 100 years (i.e., 2000 to 2100) after project completion. Therefore, impacts to fish and wildlife resources were analyzed for the period 1984 to 2100. Our analyses included estimates of project-related changes in acreages of specific habitat types, use of the FWS's Habitat Evaluation Procedures (HEP), and completion of a man-day/monetary evaluation of the impacts of the project on recreational and commercial uses of fish and wildlife resources.

The fundamental tool used for assessing project impacts on fish and wildlife resources is the estimation of project-related changes in the acreages of specific habitat types, as compared to habitat trends expected to occur without the proposed project. These data form the basis of the other evaluations conducted. For this project, the area to be directly impacted by the project alternatives was determined by planimetering FWS habitat maps of the project area prepared from aerial photographs taken in 1956 and 1978. In order to estimate future without-project habitat acreages, it was necessary to establish historic (1956 to 1978) habitat change rates that were applicable to the project area. These change rates were then applied to the baseline (existing) acreages to predict future habitat acreages expected to be present for specific target years from the beginning of construction (1984) until the end of the project life (2100). For future conditions with the High-Level Plan and the Barrier Plan, the acreages of specific habitat types that would be impacted by each alternative were subtracted from baseline acreages, and those acres not affected by the project were projected to change at the same rates recorded for the period 1956 to 1978. For comparison of impacts, habitat acreages under each without- and with-project condition were annualized (i.e., average annual acreages were determined). A thorough discussion of the methodology used to estimate habitat change rates and acreages is provided in Appendix B.

The Service's HEP were developed to document the quality and quantity of habitat available for wildlife in a given area. Using the HEP, habitat quality and quantity can be established for baseline conditions and predicted for future without-project and future with-project conditions. This standardized methodology allows for a numeric comparison of each future condition, and hence provides an estimate of project-induced impacts to wildlife resources. The HEP have become the FWS's primary impact assessment methodology used for determining and fulfilling project mitigation needs. A complete discussion of the HEP methodology used for this project was provided in our planning-aid report dated November 8, 1982 (Appendix B).

A man-day/monetary analysis of project impacts was also performed. This evaluation method was used in an attempt to quantify project-induced changes in the sport and commercial use and associated monetary value of fish and wildlife resources in the impacted area. The results of this analysis are to be included in the overall benefit-cost analysis conducted by the Corps. A detailed discussion of the methodology used for this analysis is provided in Appendix C.

PROJECT IMPACTS

The principal project impacts on fish and wildlife resources are associated with the conversion of marsh and forested habitats to levee and/or scrub-shrub habitats and the degradation of shallow lake habitat via dredging of levee fill along the Jefferson Parish lakefront. Implementation of the uncompleted portions of the High-Level Plan is expected to cause the average annual loss of 5 acres of fresh/intermediate marsh, 32 acres of brackish/saline marsh, 1 acre of bottomland hardwood, 106 acres of cypress-tupelo, 431 acres of lake, 1 acre of river/canal, and 105 acres of scrub-shrub habitats, but a gain of 678 acres of upland developed habitats (Tables 5 and 6). Implementation of the uncompleted portions of the Barrier Plan will

Table 5. Comparison of future without additional Federal action (FWOAFA), future with Barrier Plan (FWBP), and future with High-Level Plan (FWHLP) habitat acreages excluding St. Charles Parish.[1]

Scenario (project condition)[1]	Target year	Habitat type[2]							
		B/SM	Lake	R/C	BLH	SS	UD (levee)	UD (struc)	Total[3]
FWOAFA	1984	2296	1117	1129	35	712	2488	0	7778
FWBP		2296	1117	1129	35	712	2488	0	7778
FWHLP		2296	1117	1129	35	712	2488	0	7778
FWOAFA	1987	2238	1136	1134	33	742	2496	0	7778
FWBP		2238	1136	1134	33	742	2496	0	7778
FWHLP		2188	706	1134	33	645	3072	0	7777
FWOAFA	1996	2072	1190	1147	28	825	2516	0	7778
FWBP		46	1106	883	0	2671	2764	308	7779
FWHLP		2026	759	1146	27	726	3092	0	7777
FWOAFA	2000	2003	1213	1152	25	860	2525	0	7778
FWBP		45	1107	883	0	2672	2764	308	7779
FWHLP		1958	781	1152	25	760	3101	0	7777
FWOAFA	2010	1839	1267	1165	21	942	2544	0	7778
FWBP		41	1108	883	0	2674	2764	308	7779
FWHLP		1798	834	1165	21	840	3120	0	7777
FWOAFA	2020	1689	1316	1177	17	1017	2562	0	7778
FWBP		38	1109	884	0	2675	2765	308	7779
FWHLP		1651	882	1176	17	914	3137	0	7777
FWOAFA	2030	1550	1361	1188	14	1087	2578	0	7778
FWBP		35	1110	884	0	2677	2765	308	7779
FWHLP		1516	926	1187	14	982	3152	0	7777
FWOAFA	2040	1423	1403	1198	11	1151	2592	0	7778
FWBP		32	1111	884	0	2678	2765	308	7779
FWHLP		1392	967	1197	11	1044	3166	0	7777
FWOAFA	2050	1307	1441	1207	9	1209	2605	0	7778
FWBP		29	1112	884	0	2680	2766	308	7779
FWHLP		1278	1004	1206	9	1101	3178	0	7776

(continued)

Table 5 (Continued)

		B/SM	Lake	R/C	BLH	SS	UD (levee)	UD (struc)	Total
FWOAFA	2060	1200	1476	1216	8	1263	2616	0	7778
FWBP		27	1113	884	0	2681	2766	308	7779
FWHLP		1173	1038	1214	7	1154	3189	0	7776
FWOAFA	2070	1102	1508	1223	6	1312	2626	0	7778
FWBP		25	1113	884	0	2682	2766	308	7779
FWHLP		1177	1070	1222	6	1202	3200	0	7776
FWOAFA	2080	1011	1538	1231	5	1357	2636	0	7778
FWBP		23	1114	885	0	2683	2767	308	7789
FWHLP		989	1099	1229	5	1246	3209	0	7776
FWOAFA	2090	929	1565	1237	4	1399	2644	0	7778
FWBP		21	1115	885	0	2684	2767	308	7779
FWHLP		908	1125	1236	4	1287	3217	0	7776
FWOAFA	2100	853	1590	1243	3	1437	2652	0	7778
FWBP		19	1115	885	0	2685	2767	308	7779
FWHLP		834	1150	1241	3	1324	3224	0	7776
Annualized									
FWOAFA		1458	1392	1195	14	1133	2586	0	
FWBP		175	1113	900	2	2553	2748	288	
FWHLP		1426	961	1194	13	1028	3153	0	
Net change									
FWBP		-1283	-279	-295	-12	+1420	+162	+288	
FWHLP		-32	-431	-1	- 1	-105	+567	0	

[1]FWOAFA = future without additional Federal action
FWBP = future with Barrier Plan
FWHLP = future with High-Level Plan

[2]Abbreviations for habitat types are defined in Table 1, UD (struc) = upland developed (structure)

[3]The value given for total habitat acreage is the sum of the habitat acreage before rounding to the nearest whole number and, therefore, may not represent the total of the habitat acreage displayed for a given target year in this table.

Table 6. Comparison of habitat acreages under future without-project in St. Charles Parish (FWOPSCP), future with Barrier Plan in St. Charles Parish (FWBPSCP), and future with High-Level Plan in St. Charles Parish (FWHLPSCP) conditions.

Scenario (project condition)[1]	Target year	Habitat type[2] CT	UD	F/IM	Total[2]
FWOPSCP	1984	199	13	1	213
FWBPSCP		199	13	1	213
FWHLPSCP		199	13	1	213
FWOPSCP	1987	193	19	1	213
FWBPSCP		193	19	1	213
FWHLPSCP		193	19	1	213
FWOPSCP	1989	189	23	1	213
FWBPSCP		25	187	1	213
FWHLPSCP		0	212	1	213
FWOPSCP	2000	167	44	2	213
FWBPSCP		22	190	1	213
FWHLPSCP		0	212	1	213
FWOPSCP	2010	150	60	3	213
FWBPSCP		20	192	1	213
FWHLPSCP		0	212	1	213
FWOPSCP	2020	134	75	4	213
FWBPSCP		18	194	1	213
FWHLPSCP		0	212	1	213
FWOPSCP	2030	120	88	4	213
FWBPSCP		16	196	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2040	108	100	5	213
FWBPSCP		14	197	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2050	97	111	5	213
FWBPSCP		13	199	2	213
FWHLPSCP		0	212	1	213

(continued)

Table 6. (Continued)

	Target year	CT	UD	F/IM	Total
FWOPSCP	2060	87	120	6	213
FWBPSCP		11	200	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2070	78	129	6	213
FWBPSCP		10	201	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2080	70	137	7	213
FWBPSCP		9	202	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2090	62	144	7	213
FWBPSCP		8	203	2	213
FWHLPSCP		0	212	1	213
FWOPSCP	2100	56	150	7	213
FWPSCP		7	204	2	213
FWPHLPSCP		0	212	1	213
Annualized					
FWOPSCP		113	95	5	
FWBPSCP		21	191	2	
FWHLPSCP		7	206	0	
Net change					
FWBPSCP		-92	+96	-3	
FWHLPSCP		-106	+111	-5	

[1]FWOPSCP = future without-project for St. Charles Parish
FWBPSCP = future with Barrier Plan for St. Charles Parish
FWHLPSCP= future with High-Level Plan for St. Charles Parish

[2]Abbreviations for other habitat types are defined in Table 1.

[3]The value given for total habitat acreage is the sum of the habitat acreage before rounding to the nearest whole number and, therefore, may not represent the total habitat acreage displayed in this table.

cause the average annual loss of 3 acres of fresh/intermediate marsh, 1,283 acres of brackish/saline marsh, 279 acres of lake, 295 acres of river/canal, 92 acres of cypress-tupelo, and 12 acres of bottomland hardwood, but a gain of 1,420 acres of scrub-shrub and 546 acres of upland developed habitats (Tables 5 and 6).

In portions of the impact area, project implementation will impact certain habitat types, but no change in habitat designation has been projected to occur. For example, the proposed borrow area adjacent to the Jefferson Parish lakefront levee alignment will require the deepening of the lake bottom by an estimated 60 feet. Although there is no change in habitat designation in such cases, habitat quality is expected to be greatly diminished or eliminated. A less dramatic example involves upland developed habitat where the enlargement of a levee will require the loss of residential or commercial development.

Fisheries Impacts

The HEP have not been finalized for application to assess project impacts to fish and shellfish resources. However, a partial analysis of impacts associated with the proposed project features on the harvest and monetary value of fishery resources was completed (Appendix C).

The freshwater sport and commercial fishery resources of the project area are dependent upon the marsh, shallow lake, and river/canal habitats. Habitat losses associated with implementation of either project alternative will, undoubtedly, have some negative impacts on the freshwater fishery resources of the project area. However, because catch and man-days of effort expended for sport and commercial freshwater fish harvest in the project area is difficult to reliably quantify, and because the area of suitable freshwater habitat within the area of direct project impacts is relatively small, no quantitative estimate of impacts to freshwater fisheries or associated human use of these resources was attempted.

The saltwater (estuarine/marine) fishery resources of the project area are quite extensive and largely dependent upon the marsh as nursery and feeding habitat and as an important trophic link in the overall food web. In assessing project impacts to those resources, it was assumed that saltwater fish populations will diminish as marsh habitat is lost. Estimates of project impacts to sport fishing were quantified in terms of man-days and monetary values (Table C-1, Appendix C). The anticipated marsh loss associated with implementation of either with-project alternative is expected to reduce sport fishing. Completion of the High-Level Plan is estimated to annually reduce sport fishing by an average of 712 man-days, valued at $2,776. Completion of the Barrier Plan is estimated to annually reduce sport fishing by an average of 16,793 man-days valued at $65,493 (Table 8).

An analysis of project impacts on estuarine-dependent commercial fishery resources (Appendix C) indicates that implementation of the

High-Level Plan, when compared to the future without additional Federal action alternative, will cause the average annual loss of over 11,200 pounds of fishery products valued at about $2,880 (Tables C-2 and C-3, Appendix C). The greatest average annual commercial fishery losses, in terms of total weight, are associated with menhaden (4,283 pounds annually) and unclassified industrial fishes (4,295 pounds annually). The average annual loss of shrimp harvest (1,596 pounds) makes up nearly 60 percent ($1,707) of the monetary impacts to commercial fishery resources.

Fishery losses associated with the Barrier Plan would be much more severe. The total annual loss in the estuarine-dependent commercial fish and shellfishes catch is expected to be reduced by over 389,400 pounds, valued at over $100,000. Again, menhaden (148,855 pounds annually) and unclassified industrial fishes (149,305 pounds annually) will be the two groups most affected in terms of total harvest (weight). Shrimp harvest would experience an estimated average loss of about 55,465 pounds annually; this constitutes nearly 60 percent ($59,347) of the total annual commercial fishery loss attributable to habitat alteration associated with the Barrier Plan. It should be noted that studies to determine the environmental effects of the barrier structures on Lake Pontchartrain were terminated by the Corps before their completion; therefore, a full analysis of impacts associated with that plan is not possible at this time. The above estimates reflect only the physical habitat alteration associated with levee construction and do not include adverse ecological impacts associated with construction and operation of tidal barriers in the passes (i.e., Chef Menteur, the Rigolets, and the IHNC). Should the decision be made at some future date to implement the Barrier Plan rather than the High-Level Plan, additional studies would be necessary for adequate analysis of ecological impacts associated with that plan.

Wildlife Impacts

In assessing project-induced impacts to wildlife resources, the Service's HEP and a man-day/monetary analysis were employed. The methodology and initial results for the HEP analysis were reported in a planning-aid report to the Corps of Engineers dated November 8, 1982 (Appendix B).[1] Subsequent to completion of that report, changes in the Corps' estimates of habitat acreage impacts in St. Charles Parish (Table 6) required a revision in our HEP findings using the methodology and habitat suitability indices reported in Appendix B. The revised HEP figures are shown in Table 7. The methodology and results of the man-day/monetary analysis are provided in Appendix C and summarized below.

Results of the HEP indicate that the High-Level Plan will cause the loss of 1,080 average annual habitat units (AAHU's) (Table 7).

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[1]Subsequent to completion of this analysis a slight change in habitat acreages along the Jefferson Parish lakefront levee was made; however, it was determined that these changes made an insignificant difference in our HEP analysis.

Table 7. Comparison of average annual habitat units (AAHU's) under future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP) conditions.

Evaluation species	AAHU's				
	FWOAFA	FWHLP	FWOAFA vs. FWHLP[1]	FWBP	FWOAFA vs. FWBP[1]
Nutria	1323	1147	-176	928	-395
Muskrat	1594	1441	-153	1056	-538
Raccoon	1888	1783	-105	1864	-24
Shorebirds	1416	1252	-164	1000	-416
Deer	1224	1186	-38	1582	+358
Puddle ducks	1417	1171	-246	778	-639
Diving ducks	1243	1045	-198	684	-559
Total	10,105	9025	-1080	7892	-2213

1. AAHU's for each species are determined by subtracting FWOAFA AAHU's from FWHLP AAHU's or FWOAFA AAHU's from FWBP AAHU's.

The species/species groups (evaluation elements) used in completing the HEP analysis were nutria, muskrat, raccoon, shorebirds, deer, puddle ducks, and diving ducks. Of these, puddle ducks, with a loss of 246 AAHU's, and diving ducks with a loss of 198 AAHU's were the evaluation elements most impacted by the High-Level Plan. Each of the other evaluation elements are also expected to be negatively impacted by the High-Level Plan.

The Barrier Plan is anticipated to cause the loss of 2,213 AAHU's (Table 7). Puddle ducks and diving ducks will be the evaluation elements experiencing the greatest impacts, losing 639 and 559 AAHU's, respectively. The muskrat (-538 AAHU's) is also expected to be severely impacted by this plan. Of the species used in this evaluation, only deer will benefit. Scrub-shrub habitat created near the structural complexes will benefit deer and actually create an additional 358 AAHU's.

A man-day/monetary analysis was completed to further evaluate project impacts to wildlife resources, and is included in Appendix C. The analysis of sport hunting activity is based on potential man-days of participation in small game, deer, and waterfowl hunting provided by each of the habitat types evaluated. The results of this analysis is provided in Table 8.

Implementation of the High-Level Plan is expected to cause the average annual loss of 265 man-days of sport hunting having a value of almost $2,900. Implementation of the Barrier Plan is expected to cause the average annual loss of over 900 man-days of sport hunting valued at over $9,500.

The average annual fur and alligator harvest potential in the area of direct project impact is also significant (Table 8). The proposed High-Level Plan is expected to cause a loss in harvest of pelts and alligator hides having an average annual value of over $150. The proposed Barrier Plan is expected to cause a loss of pelts and alligator hides having an average annual value of almost $2,240.

Project impacts on non-consumptive wildlife-oriented recreation (WOR) was also considered. The results of this analysis are provided in Appendix C and summarized in Table 8. It was assumed that project impacts to WOR were directly related to habitat loss. Implementation of the High-Level Plan is expected to cause an average annual decrease of 249 man-days of WOR valued at over $970. Implementation of the Barrier Plan is expected to reduce the average annual participation in WOR by 770 man-days valued at just over $3,000.

DISCUSSION

Implementation of either the High-Level Plan or Barrier Plan will significantly impact the fish and wildlife resources of the project area. However, based upon our quantification of these impacts, implementation of the High-Level Plan will have considerably less impact on these resources than the Barrier Plan. Accordingly, the

Table 8. Summary of man-day/monetary analyses under future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP) conditions.[1]

Project condition	Activity	Total man-days	Total value ($)
FWOAFA	Sport fishing	19,122	74,576
	Commercial fishing		113,781
	Sport hunting	2,039	18,991
	Trapping		2,566
	WOR	1,374	5,359
	Total	22,535	215,273
FWHLP	Sport fishing	18,410	71,800
	Commercial fishing		110,903
	Sport fishing	1,774	16,096
	Trapping		2,326
	WOR	1,125	4,388
	Total	21,309	205,513
FWBP	Sport fishing	2,329	9,083
	Commercial fishing		13,766
	Sport hunting	1,117	9,465
	Trapping		327
	WOR	604	2,355
	Total	4,050	34,996
Net Change			
(FWOAFA versus FWHLP)	Sport fishing	-712	-2,776
	Commercial fishing		-2,878
	Sport hunting	-265	-2,894
	Trapping		-158
	WOR	-249	-971
	Total	-1,226	-9,677
(FWOAFA versus FWBP)	Sport fishing	-16,793	-65,493
	Commercial fishing		-100,015
	Sport hunting	-922	-9,526
	Trapping		-2,239
	WOR	-770	-3,004
	Total	-18,485	-180,277

1. Data taken from Table C-10, Appendix C.

Service concurs with the Corps' selection of the High-Level Plan as the TSP. The Service also recognizes that construction of the TSP, as planned, will have certain other unquantifiable but substantially adverse impacts on the project area, particularly the creation of a deep borrow area in Lake Pontchartrain adjacent to the Jefferson Parish lakefront levee alignment.

A review of published and unpublished information concerning the biological implication of dredge holes along the Atlantic and Gulf Coasts was prepared by Ralph Pisapia at the FWS Annapolis, Maryland, Field Office. A copy of that review, in its draft form, is attached as Appendix D. The excavation of deep dredge holes in estuarine areas such as Lake Pontchartrain creates sumps which trap and accumulate sediments, organic matter, and pollutants. These materials frequently form an anaerobic, jelly-like, black mass that is high in hydrogen sulfide. If this hole is substantially below the unaltered bottom, water exchange and flushing, normally accomplished by tidal action or currents, is impeded. The lack of flushing then permits the accumulation of additional decaying organic matter and toxic substances. Eventually a layer of this jelly-like mass forms in these holes. This anaerobic mass and the continued lack of flushing frequently result in the development of anaerobic conditions throughout these holes. These unfavorable conditions are further compounded by temperature and salinity stratification, particularly during the productive summer months when cooler, denser, more saline water settles into these holes. This situation severely limits species diversity and often eliminates all benthic organisms except certain bacteria that can tolerate the adverse environmental conditions. Some species of fish are, however, attracted to the holes during certain times of the year, but must evacuate the area when severe oxygen stress forces them to either leave or die. Evacuation of the area may be an alternative in the late spring or summer when low oxygen levels are most likely. During the winter months when surface water may be colder than water in dredge holes, fish are often attracted to these warmer waters. However, when the colder, more dense surface water sinks into these former refuges, the fish may suffer thermal shock and resultant fish kills have reportedly occurred.

Recovery of these dredged sites appears to be a function of the original depth and other local factors. Although widespread disagreement between individuals with divergent interests certainly exists, many scientific studies indicate that recovery may take from 6 to 10 years in relatively shallow holes (6 feet below natural bottom) or, as is more frequently reported, much longer in the deeper holes.

This same series of events would be expected to occur in the proposed borrow area along the Jefferson Parish lakefront once dredging is complete. In fact, the close proximity of the proposed borrow area to several pumping stations, which pump urban stormwater containing an array of organic and inorganic pollutants, from a large portion of the New Orleans Metropolitan Area into Lake Pontchartrain, may accentuate the problem. Dead zones have already been reported in nearby areas of the lake (Sikora and Sikora 1982). These zones are indicative of the existing stressed condition of this lake, and the creation of a 9-mile long dredge hole or series of holes may further reduce aquatic productivity in Lake Pontchartrain.

In light of the foregoing discussion, the FWS recommends that the Jefferson Parish lakefront levee segment be built using material hauled in from an upland site rather than dredging from the proposed borrow area in Lake Pontchartrain. Should dredging in the lake prove to be the only feasible source for levee material and in the best public interest, additional studies should be conducted during the advanced engineering and design phase in an effort to reduce the impact of these holes on water quality.

Another unquantifiable impact is associated with the possible drainage and development of wetlands enclosed by the proposed levee system. The most notable areas that might be subject to this type of activity are in the New Orleans East and St. Charles Parish areas. The New Orleans East Area is enclosed by the New Orleans East Back Levee, Southpoint to GIWW, and New Orleans East lakefront levee segments (Plate 1). Levee construction and enclosure of this area was not stopped by the modified 1977 Federal Court injunction. Existing, non-Federal levees in this area had virtually eliminated tidal exchange and modified the hydrology of the subject area. Flap gates along the South Point to GIWW levee segment presently allow for drainage of the area when water levels on the protected side of the levee exceed water levels on unprotected side of the levee. As a result of this impoundment, natural water circulation and surface drainage have been grossly modified and plant species more characteristic of fresh and intermediate marshes have invaded the brackish marsh, which formerly dominated the 13,000-acre area. These marshes are valuable to a wide array of fish and wildlife species and still supply an undetermined amount of plant detritus to adjacent estuarine waters.

The Corps has indicated that the New Orleans East Area wetlands are not needed to absorb the growth of New Orleans within the next 50 years. However, local developers have applied for a Section 404 (Clean Water Act) permit, described in the Corps public notice LMNOD-SP (Orleans Parish Wetlands)13, dated September 1, 1981, to develop 9,770 acres of the enclosed area for residential, commercial, and industrial uses. According to the Corps, development of the area is contingent upon permit issuance, and not the hurricane protection system. This rationale may, however, be subject to considerable question subject to the fact that:

1) current State and possible future Federal regulatory definitions and policies may exempt this area from the need for a permit;

2) if a permit is required, completion of the hurricane protection levee would increase the probability that a permit to drain and develop this 9,770-acre wetland area would be issued; and

3) completion of a levee system to protect this area from the 200- to 300-year hurricane would be expected to increase the potential developers' and/or homeowners' sense of security

and safety from the threat of flooding due to hurricanes, thereby providing additional development incentive.

Based on the above rationale and because an acceptable alternative, known as the Maxent Canal alignment, would exclude most of the large undeveloped wetland from project hurricane protection, the Service must recommend that the Corps purchase real estate easements that preclude the residential, commercial, industrial, and agricultural development of this wetland area. With selection of the tentatively selected levee alignment and without the purchase of developmental easements, the Corps will, in our opinion, not be in compliance with Executive Order 11990, entitled Protection of Wetlands. This Executive Order requires Federal agencies to avoid construction in wetlands unless 1) there is no practical alternative or 2) the proposed action includes all practical measures to minimize harm to wetlands which may result from such Federally-funded action. As noted above, less-damaging alignments and other practical measures (such as acquisition of non-development easements) have not been incorporated in project plans for the New Orleans East area. In an effort to further mitigate project impacts in this area, the existing water-control structures along the South Point to GIWW levee segment should be modified and operated to allow for water and estuarine organism movement through the levee system. Implementation of this measure would restore water circulation, revitalize the marsh, restore nursery use by estuarine-dependent fishes and shellfishes, and greatly increase detrital export from this 13,000-acre area. Further discussion of this proposal is presented in Appendix E.

Mitigation

When project-induced impacts are identified on a Federal project such as this one, the planning goal should not only be the achievement of the stated project purpose but should also include mitigation measures that will offset project-induced losses to fish and wildlife resources. This philosophy is inherent in the Fish and Wildlife Coordination Act. The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

a. avoiding the impact altogether by not taking a certain action or parts of an action;

b. minimizing impacts by limiting the degree or magnitude of the action and its implementation;

c. rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

d. reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

e. compensating for the impact by replacing or providing substitute resources or environments.

The Service supports and adopts this definition of mitigation and considers its specific elements to represent the desirable sequence of steps in the mitigation planning process.

Mitigation of project-induced impacts to fish and wildlife resources can be accomplished, within the context of the above definition, in several ways. Avoidance of impacts associated with this project can only be accomplished by not taking additional Federal action to complete the hurricane protection levee system. However, mitigation would still be required for impacts associated with those Federally-constructed project features completed prior to 1984. Selection of narrower levees and/or a reduction in the area protected by the levee system would minimize the impacts, but the Corps has determined that the presently proposed alignments and levee dimensions selected are in the best public interest. Measures to rectify or reduce project impacts have been implemented. These include selection of the High-Level Plan as the TSP and installation of water control structures in the Chalmette Area and St. Charles Parish levees. Other measures that would further reduce project impacts and partially eliminate FWS concerns regarding this project include use of hauled material, rather than material dredged from Lake Pontchartrain, for the construction of the Jefferson Parish lakefront Levee and elimination of the New Orleans East and St. Charles Parish alignments from future project construction.

In order to offset unavoidable, project-induced losses of fish and wildlife habitat, mitigation measures should be provided for all quantifiable impacts associated with both existing and proposed project features (proposed project features include only the construction necessary to complete the High-Level Plan). In addition to the expected annual loss of 681 acres of valuable fish and wildlife habitat and 1,080 AAHU's (Table 7) associated with completion of the proposed High-Level Plan, there is an average annual loss of 1,793 acres of valuable fish and wildlife habitat and 2,137 AAHU's associated with the construction of existing project features (Appendix B). The total project impact for which mitigation must be provided includes the loss of 3,217 AAHU's (Table 9).

In accordance with the FWS Mitigation Policy, the HEP should be used by FWS biologists, where appropriate, to determine mitigation needs based on losses of habitat value (Federal Register 1981a). That policy further directs the Service to base mitigation planning goals and recommendations on four resource categories. These include:

<u>Resource Category 1</u> - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this resource category is that there should be no loss of existing habitat value.

<u>Resource Category 2</u> - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.

Table 9. Comparison of average annual habitat unit (AAHU's) changes associated with past and proposed project impacts and proposed mitigation impacts on evaluation elements used for the Habitat Evaluation Procedures analyses.

	AAHU's		
Evaluation element	Past and proposed project impacts[1]	Mitigation impacts[2]	Net change[3]
Nutria	-425	+822	+370
Muskrat	-535	+723	+188
Raccoon	-414	+250	-164
Shorebirds	-371	+3	-368
Shorebirds	-453	+233	-220
Puddle ducks	-554	+844	+290
Diving ducks	-438	+81	-357
Total	-3,217	+2,956	-261

1. AAHU losses from past and proposed project impacts represents the sum of AAHU losses as presented in Table B-6, Appendix B, and Table 7.

2. Estimated AAHU gains expected to result from the proposed mitigation are taken from Table E-9, Appendix E.

3. Net change in AAHU's represents the sum of AAHU's lost due to past and proposed project impacts and AAHU's gained due to the proposed mitigation.

Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.

Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Based on these criteria, the fresh/intermediate marsh, brackish/saline marsh, bottomland hardwood, and cypress tupelo habitat types were placed in Resource Category 2; the scrub-shrub, lake, and river/canal habitat types were placed in Resource Category 3; and upland developed habitat types were placed in Resource Category 4. Losses in Resource Categories 2 and 3 constitute virtually all of the habitat acres and value lost due to existing and proposed project features.

The HEP provides three methods, or compensation goals, for use in determining project mitigation. These include "in-kind replacement," "equal replacement," and "relative replacement." As prescribed by the FWS mitigation policy, FWS biologists are to recommend that project-related losses to Resource Categories 2 and 3 be replaced through "in-kind" replacement of individual impact losses to each of the affected species. Fulfillment of these goals requires that the habitat unit (HU) loss for each negatively impacted species be precisely offset. The mitigation effort can be most adequately accomplished through the creation and/or preservation of each of the habitat types that are negatively impacted.

In practice, it is rarely possible to precisely offset HU losses for each species or by habitat acres. Creation and/or preservation of habitat within a mitigation area will usually over-compensate for some species and under-compensate for other species. Therefore, selection of an area to adequately compensate for the total AAHU losses is based on the preservation potential and/or management potential of that area for the impacted species and habitat types. The ability to create and/or preserve habitat and the actual management potential of a mitigation area must be based on site-specific information.

The "in-kind" mitigation goal, which has been selected to compensate for habitat losses associated with this project specifies that compensation should precisely offset the HU losses for each negatively impacted species. The ideal mitigation plan will provide, for each species, an increase in HU's equal in magnitude to HU losses. However, the ideal plan is virtually impossible to identify and implement. The optimum compensation area is one that will optimize the achievement of the in-kind goal. This area minimizes the total HU over-compensations and under-compensations by a sum of squares technique which is used to calculate the compensation requirement.

To date, mitigation measures proposed in the coastal areas of Louisiana have involved various measures to divert fresh water, retard saltwater intrusion, and/or manage water levels in an effort to reduce marsh loss. These measures replace project-related AAHU's lost by preserving marsh habitat that would otherwise be lost during the life of the project, and improve marsh values for fish and wildlife.

For this project, a mitigation/enhancement proposal featuring habitat preservation and/or enhancement on four tracts totaling 41,406 acres within the project area are considered. These mitigation/enhancement features, which span the area of project impacts, include restoration of estuarine organism usage of New Orleans East, shoreline stabilization and marsh management in St. Charles Parish, marsh management in St. Bernard Parish, and marsh creation in the vicinity of the GIWW navigation channel by-pass. Each of these plans are discussed in more detail in Appendix E.

If all four of the proposed mitigation/enhancement features are completed, a minimum gain of 2,956 AAHU's is expected (Table 9). Puddle ducks (844 AAHU's), nutria (822 AAHU's), and muskrat (723 AAHU's) are the evaluation species receiving the greatest AAHU increases. The potential recreational usage and monetary value of the area is also expected to substantially increase (Table E-10, Appendix E). An average annual gain of 209,876 man-days of sport fishing, hunting, and wildlife-oriented recreation valued at over $782,700; a gain of nearly $1,242,400 in estuarine-dependent fisheries harvest; and an increase of over $7,700 in the value of the fur harvest are expected. In an effort to fully compensate for all past and future project damages to fish and wildlife, the FWS recommends that the St. Charles Parish, St. Bernard Parish, and Chef Menteur Pass mitigation features be implemented. Furthermore, the FWS suggests that the Corps strongly consider implementation of the New Orleans East portion of this plan as an enhancement feature of the Hurricane Protection project. Mitigation measures proposed for this project will primarily offset past project damages and will be achieved through rectification of impacts associated with other Federal projects. Therefore, the FWS suggests that the Corps consider 100 percent Federal funding of all mitigation measures.

RECOMMENDATIONS

After a thorough review of project plans and assessment of project impacts, the FWS recommends that the following measures be taken to assure that fish and wildlife resources receive equal consideration during implementation, operation, and maintenance of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

1. The St. Charles Parish segment of the hurricane protection system should be eliminated. However, if it is determined to be in the best public interest to construct that project segment, the levee alignment should be immediately adjacent

to Airline Highway (U.S. Highway 61). Furthermore, the Corps of Engineers, rather than local interests, should maintain complete control of the gated water-control structures so that water circulation and aquatic organism movement in this area will be maintained. To further assure that these control structures will be sufficient to maintain proper water circulation, the New Orleans District in cooperation with the FWS, National Marine Fisheries Service (NMFS), and Louisiana Department of Wildlife and Fisheries (LDWF) should study the optimum placement and design of the proposed structures during the advanced engineering and design phase of this project. Should these recommendations not be implemented, additional mitigation will be required to compensate for habitat losses associated with the development of those lands between the proposed hurricane protection levee and Airline Highway.

2. Levee material for the Jefferson Parish lakefront levee segment should be hauled in from an upland area, such as the Bonnet Carre Floodway, thus eliminating the anticipated "dead zone" created in Lake Pontchartrain by the proposed borrow pit. If Lake Pontchartrain is the only feasible source of levee material, studies to reduce water quality problems caused by the borrow area should be conducted during the advanced engineering and design phase.

3. The mitigation and enhancement features presented in this report should be fully developed in cooperation with the FWS, NMFS, LDWF, and Corps of Engineers, incorporated into the final Main Report and Supplement to the Environmental Impact Statement, and implemented simultaneously with other project features. Mitigation for unavoidable impacts associated with the Jefferson Parish lakefront levee should be provided if such impacts exceed any excess benefits associated with implementation of the mitigation/enhancement features presented in this report.

4. Real estate easements that preclude development of the 13,000-acre New Orleans East wetland area should be purchased. Furthermore, the existing water-control structures along the South Point to GIWW levee segment should be modified and operated to allow for water and estuarine organism exchange between that enclosed wetland area and the adjacent estuary, except when storm tides are predicted or are occurring.

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY

HURRICANE PROTECTION PROJECT

APPENDIX A

DESCRIPTION OF PROJECT AREA,

HABITATS, FISHERY RESOURCES, AND

WILDLIFE RESOURCES

United States Department of the Interior

FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
111 EAST MAIN STREET
LAFAYETTE, LOUISIANA 70502

November 17, 1981

Colonel Robert C. Lee, District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

Reference is made to the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The Fish and Wildlife Service (FWS) is working with members of your staff toward the eventual development of a Fish and Wildlife Coordination Act report and Environmental Impact Statement for the alternative to be recommended for that project. This letter is intended to help finalize the first steps in this process, namely to describe the area of primary project impact and to qualitatively define the significant fish and wildlife resources within that area. Detailed quantitative information on habitats, fish and wildlife populations, and associated human uses will be provided in subsequent reports. These comments are submitted on a planing-aid basis and do not fulfill our total responsibilities under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et.seq.)

AREA OF PRIMARY PROJECT IMPACT

The project area is in southeastern Louisiana and, as described in the authorizing document, includes Lakes Maurepas, Pontchartrain, and Borgne and adjacent wetlands that would be inundated by hurricane tides. Corps of Engineers and FWS biologists have mutually agreed, however, that the study area used to describe and assess the biological impacts of the project should be reduced. It was decided that the western boundary of this area should be U.S. Highways 51 and 61 and the Bonnet Carre Floodway. On the south, the boundary follows the left descending bank of the Mississippi River from the Bonnet Carre Floodway to near Caernarvon, thence along the southern limit of the Chalmette Plan levee and borrow area to the Mississippi River-Gulf Outlet (MR-GO), thence along a line to Proctor Point and across Lake Borgne to Long Point on Pearl River Island. The boundary then extends westward along the east bank of the Rigolets, then north along U.S. Highway 90 to just north of U.S. Highway 190 from where the line closely follows the 5-foot mean sea level contour generally westerly along the north shore of Lake Pontchartrain. West of

Madisonville near the Tangipahoa River, the boundary turns south to a dismantled railroad and follows the railroad to join the area's western boundary at U.S. Highway 51. The area of primary project impact is outlined in Figure 1. Both Corps and Service biologists realize that many estuarine species move to the more saline coastal waters well outside of the study area to complete their life cycle. It was decided that impacts to these species outside the project area could be dealt with on an individual basis.

FISH AND WILDLIFE RESOURCES

The area of primary project impact lies in the central portion of the Lake Pontchartrain Estuarine System and, thus contains many of the habitat types found in that system. A broad classification of habitats in the project area includes palustrine forested wetlands, palustrine scrub-shrub wetlands, emergent marsh, and open water areas. Each of these habitats supports a characteristic association of plants and animals. Many of the faunal species, particularly fishes and shell-fishes, are dependent upon a variety of habitat types found throughout the estuarine system to complete their life cycle.

Description of Habitats

Palustrine forested wetlands

Palustrine forested wetlands (Cowardin et al. 1979) in the project area include both bottomland hardwood and cypress-tupelo habitat types. Bottomland hardwoods are located on the higher, less frequently flooded areas generally found on the natural levees. Common vegetation includes black willow, bitter pecan, sugarberry, American elm, red maple, American sycamore, eastern cottonwood, water oak, and Nuttall oak. The cypress-tupelo or wooded swamp habitat type is found at slightly lower elevations than the bottomland hardwoods. Common vegetation in the wooded swamps include bald cypress, tupelogum, pumpkin ash, red maple, swamp privet, and duckweed.

Palustrine scrub-shrub wetlands

The more permanently flooded scrub-shrub wetlands are commonly vegetated by buttonbush, pumpkin ash, water hyacinth, duckweed, and various sub-merged aquatics, and typically found in association with cypress-tupelo swamps. Another type of scrub-shrub habitat commonly occurs in elevated locations within marsh areas. Common plant species in these areas are Eastern baccharis, marsh elder, black willow, and wax myrtle. Since the mid-1950's, there has been a substantial increase in this habitat type in the project area.

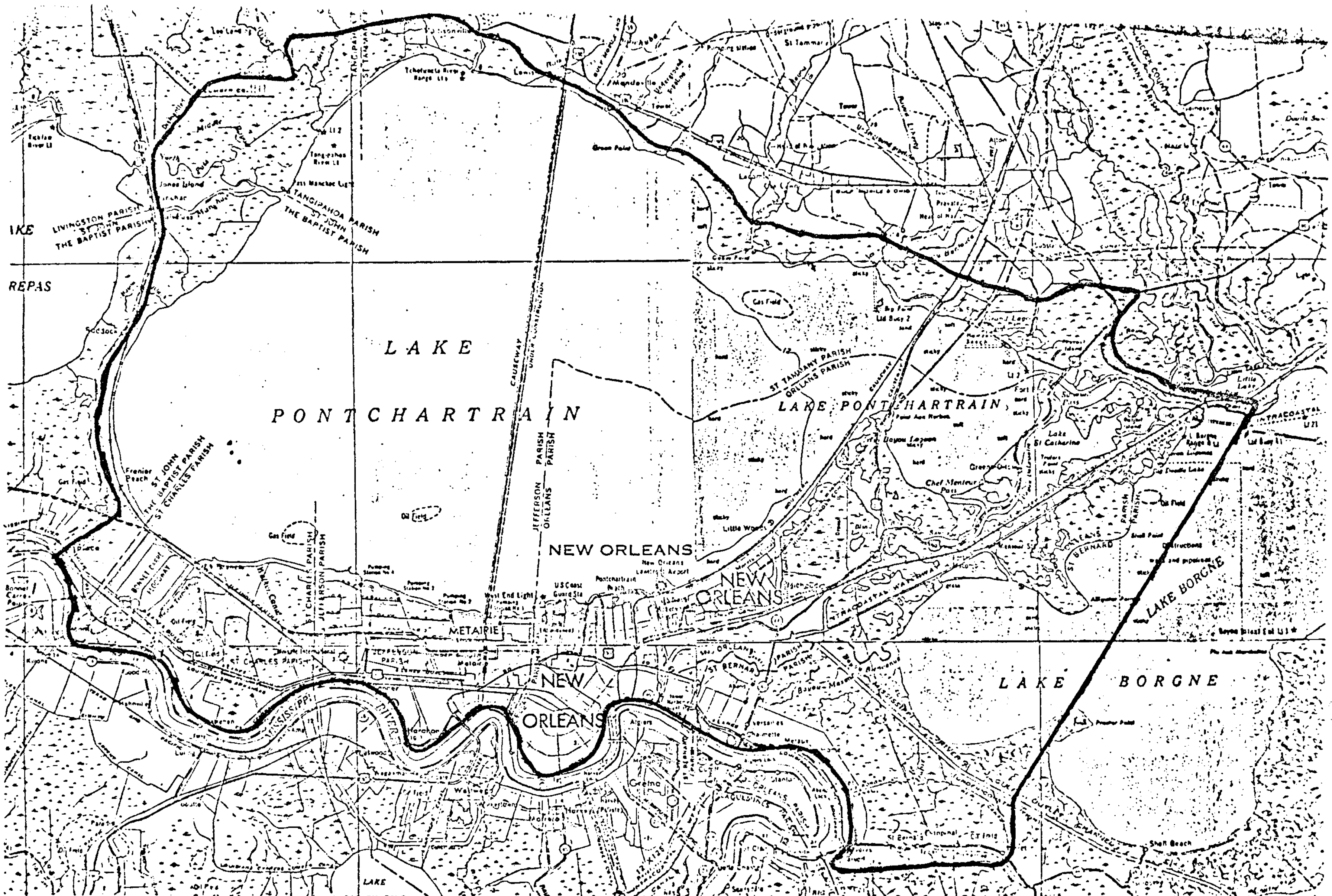

Figure 1. Project boundary, Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Emergent marsh

The marshes of the study area are classified according to the existing salinity regime and resulting vegetation as fresh, intermediate, or brackish. Chabreck and Linscomb (1978) incicated that only a small portion of the project area marshes are fresh (palustrine emergent marsh, Cowardin et al. 1979). Common vegetation in this marsh type include bulltongue, sawgrass, coast bacopa, royal fern, panic grass, cattail, deer pea, maidencane, pickerelweed, and alligatorweed.

Intermediate marshes (estuarine emergent marsh) form the transition zone between fresh and brackish marsh. Salinity in this marsh type typically ranges from less than 1 part per thousand (ppt) to 5 ppt. The predominant vegetation in this marsh type is saltmeadow cordgrass with Cyperus spp., bulltongue, Olney's threesquare, and wild millet also present.

Brackish marshes (estuarine emergent marsh) are the most extensive of all marsh types in the project area. Salinity in this marsh type typically ranges from 5 to 15 ppt. Vegetation in this area is also dominated by saltmeadow cordgrass with other common species such as saltgrass, saltmarsh cordgrass, big cordgrass, black rush, and leafy threesquare also present.

Open water areas

Lakes Pontchartrain and Borgne constitute most of the open water habitats in the area. Salinities in Lake Pontchartrain vary from less than 1 ppt in the northwestern part of the lake near freshwater inflow to as high as 18 ppt near the Chef Menteur and Rigolets Passes following severe storms. Average salinity in the lake is normally below 5 ppt; consequently, most of the lake can be classified as estuarine open water (Cowardin et al. 1979).

Numerous smaller ponds and lakes associated with the marshes have salinities which correspond to those of the surrounding marshes. Aquatic vegetation associated with these habitats varies with salinity, turbidity, and currents. Common submerged aquatic plants found in Lake Pontchartrain by Montz (1978) include wild celery, widgeongrass, southern naiad, and pondweed (Potamogeton spp). Dwarf spikerush, delta duckpotato, and coast bacopa are common in the intertidal zone along the edge of Lake Pontchartrain.

Fishery Resources

Numerous finfish and shellfish species fill a wide range of niches present in the project area habitat types. Extensive species lists are presented by the Louisiana Wildlife and Fisheries Commission (1976) and Thompson and Verret (1980). Many of these species are important to the sport and commercial fisheries of the project area. Frequently pursued sport fishes found in fresh to slightly brackish waters are largemouth bass, black crappie, white crappie, bluegill, redear sunfish, spotted sunfish, warmouth, yellow bass, channel catfish, and blue catfish. Catfishes, freshwater drum, buffalo, and gar are caught for commercial purposes in fresher waters (Thompson and Stone 1980).

Euryhaline fishes associated with more saline waters of the project area and sought for sport and/or commercial purposes are southern flounder, sheepshead, sea catfish, sand seatrout, spotted seatrout, Atlantic croaker, black drum, and red drum (Thompson and Stone 1980). Most of these species are dependent upon the entire estuarine system to complete their life cycle. They utilize the low to moderate salinity portions of the study area as nursery areas and move to more saline waters as they mature. Similarly, the most economically important shellfishes, namely blue crabs, white shrimp, and brown shrimp, utilize waters having a wide range of salinities during various parts of their life cycle. Movement of juvenile fishes and shellfishes through the Chef Menteur and Rigolets Passes to and from less saline nursery areas is essential to the maintenance of these populations in Lake Pontchartrain (Fannaly 1980).

There are non-motile macrobenthic species that are year-round residents of the project area. These species are dependent upon a small area to provide all of their life requisites. In their survey, Bahr et al. (1980) found 24 macrobenthic species or groups of species in Lake Pontchartrain. The two most economically important benthic organisms found in the project area are the Rangia clam and American oyster. Both species are harvested extensively for commercial purposes.

Wildlife Resources

Amphibians and reptiles

A list of amphibians and reptiles found in Lake Pontchartrain and its surrounding marshes and forested wetlands has been recorded by Hebrard and Stone (1980). Although less active in the winter, all of these species are year-round residents of the project area. Only a few of these species are, however, tolerant of the more saline marsh types.

The bullfrog and, less frequently, the pig frog are pursued for recreational and commercial purposes. Similarly, several species of turtles found in the study area are economically important. These include the common snapping turtle, alligator snapping turtle, spiny softshell turtle, smooth softshell turtle, and diamondback terrapin. In the project area, the American alligator, now listed as "threatened" under the Similarity of Appearance clause of the Endangered Species Act of 1973 (Federal Register 1981), is harvested for sport and commercial purposes. The alligator is found in virtually every habitat in the study area, but is most numerous in the fresh and intermediate marshes.

Birds

Numerous game and non-game species occur in the study area. However because of the migratory nature of birds, abundance and presence of most species fluctuates seasonally. Hebrard and Stone (1980) compiled, according to seasonal presence and food habits, a list of bird species which occur in the Lake Pontchartrain area. Species diversity appears to fluctuate directly with diversity in vegetation structure such that few species are found in the lake, more in the marsh and scrub-shrub communities, and the highest species diversity is found in the wooded swamps.

Migratory waterfowl are abundant winter residents of nearly every habitat type in the project area. The largest concentrations of dabbling ducks occur in the fresh and intermediate marsh types. Common species include mallard, American wigeon, gadwall, northern pintail, blue-winged teal, green-winged teal, mottled duck, and northern shoveler. Most of these ducks are found in the fresh and intermediate marshes in fall and winter with movement to the brackish and eventually to the saline marshes as food supplies dwindle and higher marshes dry. Diving ducks concentrate in the larger, deeper lakes and marsh ponds. Common divers that winter in the project area include ring-necked duck, canvasback, redhead, red-breasted merganser, hooded merganser, lesser scaup, and greater scaup. Of these, the lesser scaup are present in the largest concentrations. Over 90 percent of the lesser scaup wintering in the Mississippi Flyway occur in Louisiana. They concentrate in Lakes Pontchartrain and Borgne, and open waters of the Gulf and coastal marshes (Bellrose 1976:347).

The mottled duck, wood duck, and hooded merganser all nest in the project area. Of these, the mottled duck is the only ground-nesting duck, and it nests in all marsh types. The wood duck and hooded merganser are cavity-nesting species, which usually accept nesting sites in trees or, when available, man-made nest boxes that are over or adjacent to water. This nest-site requirement, therefore, limits these species to the forested portions of the project area for nesting, but broods are active and capable of moving into the scrub-shrub and marsh habitats.

Other common game birds in the study area include rails, gallinules, American coot, common snipe, and American woodcock. Most of these species are absent from the area in the summer. The king rail, clapper rail, purple gallinule, and common gallinule all nest in the project area marshes. The coot, a popular game bird with some waterfowl hunters, and the woodcock, found primarily in the seasonally flooded bottomland hardwoods, are frequent winter residents and occasional nesters in the area.

Wading and shorebirds are abundant in the shallow waters and along the shorelines of the project area. Wading birds such as the great blue heron, little blue heron, Louisiana heron, green heron, yellow-crowned night heron, black-crowned night heron, great egret, cattle egret, snowy egret, reddish egret, white-faced ibis, and white ibis are common in the forested wetlands and marshes. Several gulls and terns also commonly occur along the shoreline of large lakes and channels. A review of the Colonial Sea and Wading Bird Survey (Louisiana Cooperative Wildlife Research Unit 1977) indicated that only one small nesting colony occurred in the project area. This colony, of about 30 least terns, was observed at Lakefront Airport at latitude 30 03' and longitude 90 02' in Orleans Parish. The bottomland hardwoods and wooded swamps of the project area support numerous non-game birds such as the barred owl, Mississippi kite, red-shouldered hawk, blue jay, northern cardinal, several woodpeckers, and numerous others.

Mammals

Many of the numerous mammals listed by Hebrard and Stone (1980) as occurring in the study area are economically important, either from a sport or commercial aspect. White-tailed deer is the only big-game species. Although this species is generally associated with wooded habitats, significant populations also occur in the marsh habitats, especially where higher ground is available. Common small game mammals pursued by sport hunters in the area include the swamp rabbit, fox squirrel, gray squirrel, and northern raccoon. The swamp rabbit and northern raccoon are found in all forested and marsh habitats of the study area; the fox squirrel and gray squirrel are limited to the forested habitats.

Commercially important furbearers found in the project area are the nutria, muskrat, North American mink, gray fox, river otter, northern raccoon, striped skunk, bobcat, beaver, and opossum. Although commonly found in the wooded habitats, both nutria and muskrat are most abundant in marsh habitat. Nutria reach their highest populations in fresh marshes. Peak populations of muskrat are associated with brackish marshes and lush stands of Olney's threesquare. The mink, river otter, and raccoon are found in all forested and marsh habitats of the project area. Mink populations decrease with increasing salinity. The beaver, bobcat, and opossum are more closely associated with the bottomland hardwoods and wooded swamps. Commercial catch of these animals contribute to Louisiana's total fur catch, which annually leads the catch in all other states in the nation.

Endangered species

According to our Endangered Species office in Jackson, Mississippi, the only endangered species that is likely to occur in the project area is the bald eagle. An eagle nest, located near St. Rose at 90 20'16" west longitude, 29 59'01" north latitude (Dugoni 1980), has not been occuppied in recent years but may still provide eagle nesting habitat. This discussion should not be construed as fulfilling the Corps' responsibilities under Section 7 of the Endangered Species Act of 1973, as amended. The Service's contact regarding endangered species in the project area is:

Mr. Dennis B. Jordan, Asst. Area Manager
Endangered Species
U.S. Fish and Wildlife Service
200 East Pascagoula Street, Suite 300
Jackson, Mississippi 39201

Wildlife Management Areas and Refuges in the Project Area

There are two areas in the project area that are designated as either a wildlife management area or refuge. Manchac Wildlife Management Area, located in the northeastern corner of St. John the Baptist Parish, is an 8,325-acre area that is owned and operated by the Louisiana Department of the Wildlife and Fisheries. Habitat types in that area are intermediate marsh and cypress-tupelo swamp. This area is open to the public for deer, small game, and waterfowl hunting, but receives its highest usage from waterfowl hunters. The St. Tammany Refuge is in St. Tammany Parish and consists of 1,300 acres of brackish marsh habitat; it too is managed by the Louisiana Department of Wildlife and Fisheries. No hunting is allowed on this refuge. No federal refuges are located in the project area; however, a large tract of marsh and wooded swamp in St. Charles Parish has been and still is being considered for inclusion into the National Wildlife Refuge System.

We plan to continue working with members of your staff in the planning, evaluation, and design of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. As our studies progress, more detailed information will be supplied to your staff on fish and wildlife resources and associated human uses, project impacts on those resources, and measures to avoid and/or mitigate losses of fish and wildlife habitat.

Should you have any questions regarding this matter, please contact Bob Strader of this office.

Sincerely yours,

David W. Fruge
Acting Field Supervisor

cc: La. Dept. of Wildlife and Fisheries, Baton Rouge, Louisiana
    Area Office, Jackson, Mississippi

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY

HURRICANE PROTECTION PROJECT

APPENDIX B

HABITAT EVALUATION PROCEDURES ANALYSIS[1]

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1. Since completion of the November 8, 1982, Habitat Evaluation Procedures Analysis (HEP) (included as Appendix B), changes in estimated habitat acreages were made. Therefore, acreages and HEP values presented in this appendix are not the same as the updated numbers presented in the main report.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
103 EAST CYPRESS STREET
LAFAYETTE, LOUISIANA 70502

November 8, 1982

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to the authorized Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The Fish and Wildlife Service (FWS) is working with members of your staff in the evaluation of environmental impacts associated with alternative plans being considered for that project. This report includes an assessment of fish and wildlife habitat under future without-project and future with-project conditions and a comparison of these future conditions using the FWS's Habitat Evaluation Procedures (HEP). These comments are submitted on a planning-aid basis and do not fulfill our responsibilities under provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

PROJECT DESCRIPTION

The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was authorized by the Flood Control Act of 1965 (Public Law 89-298) and described in House Document 231, 89th Congress, First Session. The Project is designed to provide hurricane protection to New Orleans and other developed areas surrounding Lake Pontchartrain. The authorized project, also known as the Barrier Plan, includes construction of three tidal barrier complexes with associated navigation facilities and a system of levees and floodwalls. The barrier complexes are located at the Rigolets, Chef Menteur Pass, and Seabrook (at the lakeside mouth of the Inner Harbor Navigation Channel). These barriers would allow for closure of Lake Pontchartrain's main tidal passes prior to and during a hurricane, thereby reducing the height of the storm surge in the lake and the height to which hurricane protection levees and floodwalls would otherwise have to be built. Associated with the barriers is a system of channels and structures that would facilitate navigation between Lake Pontchartrain, Lake Borgne, and the Intracoastal Waterway, and levees that connect the barriers with higher land to the east and a network of hurricane protection levees to the west. A modified 1977 Federal court injunction precludes further construction of the Rigolets and Chef Menteur complexes until an adequate supplement to the environmental impact statement (EIS) for the project is prepared. Construction of levees, exclusive of those associated with the barriers, was, however, allowed to continue.

The levee/floodwall system of the authorized plan includes five areas of protection: 1) the Chalmette Plan, 2) the Citrus and New Orleans East segment, 3) the New Orleans and Jefferson Parish segments, 4) the St. Charles Parish segment, and 5) the Mandeville Seawall (Figure B-1). Portions of this levee/floodwall network make use of features constructed as a result of other Federal and local actions. The Chalmette Plan encompasses an area generally bounded by the Mississippi River on the west, the Gulf Intracoastal Waterway (GIWW) on the north, the Mississippi River-Gulf Outlet on the east, and Bayou Terre Aux Boeufs on the south. The Citrus and New Orleans East segment is bounded by the Inner Harbor Navigation Canal (IHNC) on the west, Lake Pontchartrain on the north, an existing levee that extends from South Point to GIWW on the east, and the GIWW on the south. The St. Charles Parish portion of the system is bounded by the Bonnet Carre Floodway on the west, Lake Pontchartrain on the north, the Jefferson Parish/St. Charles Parish boundary on the east, and the Mississippi River on the south. Since project authorization, the Corps of Engineers (Corps) has re-evaluated the St. Charles Parish alignment. Based on environmental and economic considerations, the Corps has indicated a preference for either an alignment north of Airline Highway (U.S. Highway 61) or no levee protection, in lieu of the more damaging and expensive lakefront alignment. The Mandeville Seawall is intended to protect the Town of Mandeville, which is located on the north shore of Lake Pontchartrain. Completion of this segment of the project will not require any expansion, but merely renovation of existing facilities.

Subsequent to the 1977 court injunction, the Corps has investigated several alternative plans and has selected the High-Level Plan as the tenatively selected plan (TSP). The High-Level Plan would afford protection to most of the same developed areas as the Barrier Plan, but through the use of higher levees and floodwalls to prevent inundation due to hurricane surges (rather than barriers at the main tidal passes of Lake Pontchartrain). With the exception of the barriers, associated navigation channels and structures at the Rigolets and Chef Menteur Pass, and connecting levees, all structural work associated with the TSP follows the same alignment as described for the authorized plan (Figure B-1).

In the Citrus and New Orleans East areas, an alternative alignment, known as the Maxent Canal alignment, was considered. This alignment would extend protection from the IHNC eastward to the Maxent Canal and exclude a large undeveloped wetland from project hurricane protection. However, the Corps determined that this alignment was more costly and provided hurricane protection to a smaller area than the South Point to GIWW alignment (the same alignment as described for the authorized plan) and, therefore, eliminated the Maxent Canal alignment from further consideration.

To date, construction of certain portions of the authorized plan has occurred. These include:

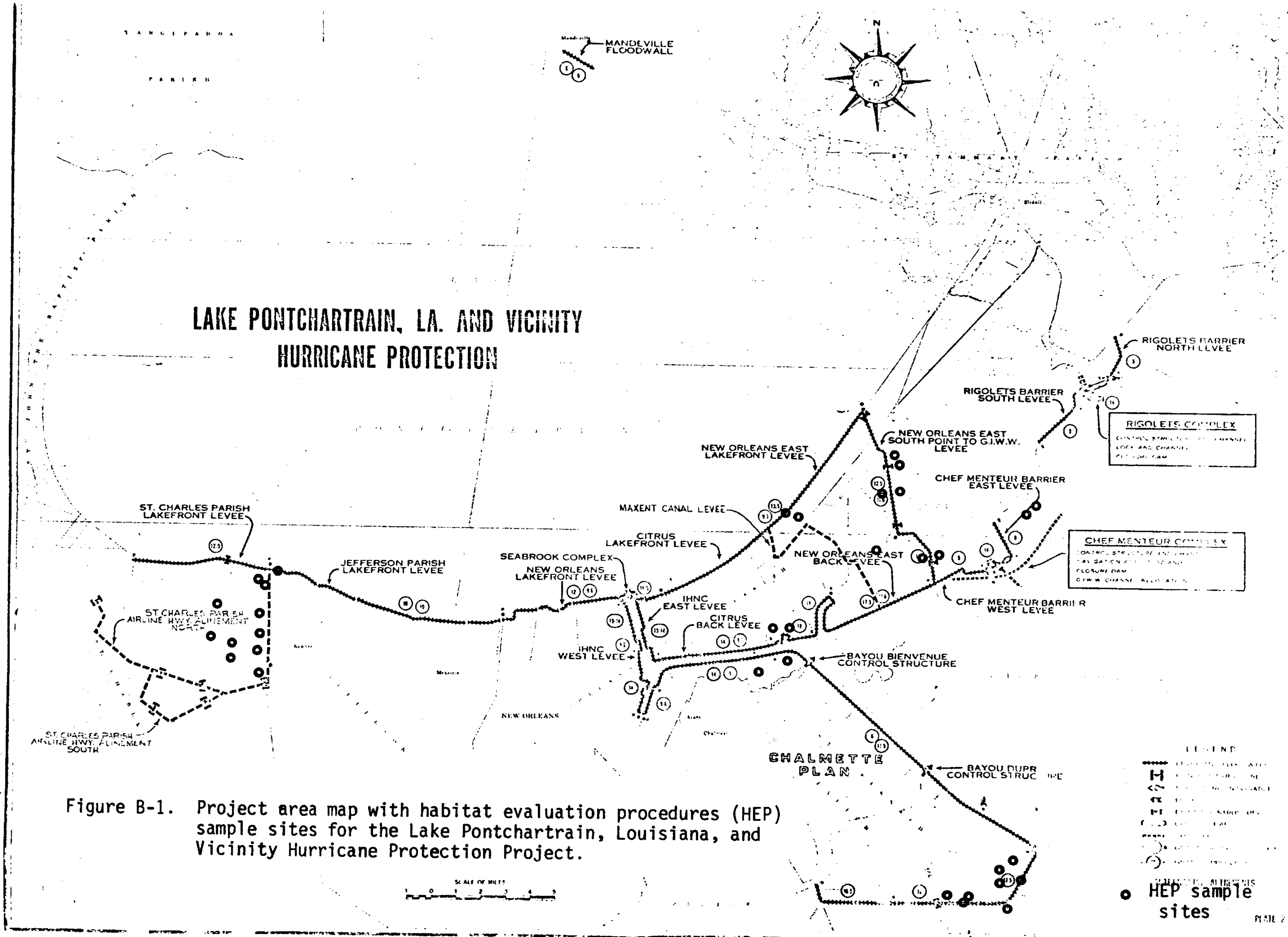

Figure B-1. Project area map with habitat evaluation procedures (HEP) sample sites for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

1) the GIWW navigation channel by-pass and retaining dikes for spoil disposal, which were constructed prior to the court injunction;

2) the levee system encompassing the Chalmette Plan; and

3) the levees along the GIWW and Lake Pontchartrain sides of the Citrus and New Orleans East areas.

The Chalmette Plan, Citrus, and New Orleans East levee construction has proceeded because those segments were not affected by the court injunction and will be needed regardless of the plan selected (excluding the No-Action Plan).

METHODOLOGY

In assessing and comparing fish and wildlife resources in the project area under future without-project (FWOP) and with-project conditions (FWP), it was necessary to quantify the amount and quality of habitat under each of several conditions. These conditions were FWOP (1967 to 2100), future with Federal action to date (FWFATD) (1967 to 2100), future with no additional Federal action (FWOAFA) (1984 to 2100), future with the Barrier Plan (FWBP) (1984 to 2100), and future with the High-Level Plan (FWHLP) (1984 to 2100). Because FWOP conditions for St. Charles Parish will be different from the rest of the project area and because there remains some question as to whether the St. Charles Parish levee will be built, the aforementioned conditions were exclusive of the St. Charles Parish portion of the project area. Project impacts in the St. Charles Parish area were assessed using three separate conditions including FWOP in St. Charles Parish (FWOPSCP) (1984 to 2100), future with the Barrier Plan (FWBPSCP) (1984 to 2100), and future with the High-Level Plan (FWHLPSCP) (1984 to 2100). For comparison, these eight project conditions were combined into three scenarios: 1) FWOP and FWFATD; 2) FWOAFA, FWBP, and FWHLP; and 3) FWOPSCP, FWBPSCP, and FWHLPSCP.

To complete these analyses, it was necessary to first identify habitat (cover) types within the project area. The eight habitat types identified were fresh/intermediate marsh, brackish/saline marsh, lakes, rivers and canals, cypress/tupelo swamp, bottomland hardwood forest, scrub-shrub, and upland developed (developed uplands). According to the classification of Cowardin et al. (1979), fresh marsh is defined as palustrine emergent wetland; intermediate, brackish, and saline marshes are termed estuarine emergent wetlands; lake habitats, which include Lake Pontchartrain and large open water bodies in the marsh, are termed lacustrine open water where salinity is less than 0.5 parts per thousand (ppt) and estuarine open water where salinities average more than 0.5 ppt; and rivers/canals are termed riverine open water and riverine open water excavated where salinity is less than 0.5 ppt and estuarine open water tidal or estuarine open water excavated where salinity is generally more than 0.5 ppt. Under that same classification system, cypress/tupelo swamp and bottomland hardwood forests are broadly termed palustrine forested wetlands, and scrub-shrub is termed palustrine or estuarine scrub-shrub depending upon the average salinity of the area. A more thorough description of most of these habitat types was provided in our planning aid letter of November 17, 1981.

Existing habitats that were not described in our November 17, 1981, report are river/canal and upland developed. River/canal habitat in the project area is characterized by generally steep-banked waterways having little or no rooted vegetation. Salinities in the river/canal habitat range widely depending upon the proximity to the Gulf of Mexico. Upland developed habitat includes those areas that have been developed for residential, commercial, or industrial use or for levees. Vegetation in these developed areas is generally limited to scattered trees and shrubs, and grasses that are mowed frequently. Upland developed habitat also includes those areas used for the structural complexes as proposed in the Barrier Plan. Upland developed (structural) will be virtually devoid of vegetation.

In St. Charles Parish, only three cover types will be affected by the proposed alignment. These habitat types are cypress/tupelo swamp, fresh/intermediate marsh, and upland developed.

Habitat acreages, taken from 1978 FWS habitat maps and from project maps, were provided to the FWS by the Corps. As a result of many factors, of which subsidence, saltwater intrusion, excavation of navigation channels, and implementation of drainage projects are the most significant, the habitats in the project area are changing at a rapid rate. Accordingly, acreages were adjusted using habitat change rates estimated from data generated by Wicker (1980) and the National Coastal Ecosystems Team located in Slidell, Louisiana (Tables B-1, B-2, and B-3). A more detailed discussion of the methodology used to estimate past and future habitat acreages in the project area is presented in Attachment A. The adjusted acreages were used to predict and compare habitat conditions under each project condition. Actual project features completed prior to 1978, under FWFATD conditions, were planimetered from 1978 habitat maps; habitat acreages impacted by this portion of the project were based on 1956 habitat maps and adjusted using the methodology discussed in Attachment A.

The Service's HEP methodology was developed to help document the quality and quantity of available habitat for fish and/or wildlife species in a given area. Using HEP, habitat quality and quantity can be measured for baseline conditions and predicted for FWP and FWOP habitat conditions. This standardized, species-based methodology allows a numeric comparison of each future condition and hence provides an estimate of project-induced impacts on fish and wildlife resources. The 1980 version of HEP was modified and used for this project.

Table B-1. Comparison of future without-project (FWOP) and future with Federal action to date (FWFATD) habitat acreages

Scenario (project condition)[1]	Target year	Habitat type[2] F/IM	B/SM	Lake	R/C	BLH	SS	UD (levee)	Total[3]
FWOP	1967	265	3737	1046	918	100	1349	527	7942
FWFATD		265	3737	1046	918	100	1349	527	7942
FWOP	1973	233	3570	1111	934	88	1449	557	7942
FWFATD		0	2615	1082	1110	44	632	2459	7942
FWOP	1984	183	3278	1223	961	71	1620	606	7942
FWFATD		0	2380	1159	1129	35	750	2489	7942
FWOP	1987	172	3202	1252	968	66	1664	618	7942
FWFATD		0	2320	1178	1133	33	780	2497	7942
FWOP	1996	141	2983	1333	988	55	1790	652	7942
FWFATD		0	2149	1235	1147	28	866	2518	7942
FWOP	2000	129	2890	1368	996	51	1842	665	7942
FWFATD		0	2076	1258	1153	25	902	2527	7942
FWOP	2010	104	2668	1449	1016	42	1966	697	7942
FWFATD		0	1906	1314	1166	21	988	2547	7942
FWOP	2020	84	2462	1523	1034	34	2080	726	7942
FWFATD		0	1751	1365	1179	17	1066	2565	7942
FWOP	2030	67	2270	1591	1050	28	2185	751	7942
FWFATD		0	1607	1412	1190	14	1138	2581	7942
FWOP	2040	54	2092	1654	1066	23	2281	773	7942
FWFATD		0	1476	1455	1201	11	1204	2596	7942
FWOP	2050	44	1927	1712	1080	18	2369	793	7942
FWFATD		0	1355	1492	1211	9	1264	2609	7942

(continued)

Table B-1. (continued)

		F/IM	B/SM	LAKE	R/C	BLH	SS	UD (levee)	Total
FWOP	2060	35	1774	1764	1092	15	2450	811	7942
FWFATD		0	1244	1531	1219	7	1320	2620	7942
FWOP	2070	28	1633	1813	1104	12	2524	827	7942
FWFATD		0	1142	1564	1228	6	1371	2631	7942
FWOP	2080	23	1503	1857	1115	10	2593	842	7942
FWFATD		0	1049	1595	1235	5	1418	2641	7942
FWOP	2090	18	1382	1898	1125	8	2655	855	7942
FWFATD		0	963	1623	1242	4	1461	2649	7942
FWOP	2100	15	1271	1936	1134	7	2713	867	7942
FWFATD		0	884	1649	1248	3	1501	2657	7942
Annualized									
FWOP		87	2307	1573	1046	35	2156	739	
FWFATD		6	1667	1399	1183	18	1136	2531	
Net Change		-81	-740	-174	+137	-17	-1020	+1792	

[1] FWOP = future without-project
FWFATD = future with Federal action to date

[2] F/IM = fresh/intermediate marsh
B/SM = brackish/saline marsh
Lake = lake bottom (includes Lake Pontchartrain and large marsh lakes and ponds)
R/C = rivers and canals
BLH = bottomland hardwood
SS = scrub-shrub
UD = upland developed

[3] The value given for total habitat acreage is the sum of the habitat acreage before rounding to the nearest whole number and, therefore, may not represent the total habitat acreage displayed for a given target year in this table for a particular year.

Table B-2. Comparison of future without additional Federal action (FWOAFA), future with Barrier Plan (FWBP), and future with High-Level Plan (FWHLP) habitat acreages excluding St. Charles Parish.[1]

Scenario (project condition)[1]	Target year	Habitat type[2] F/IM	B/SM	Lake	R/C	BLH	SS	UD (levee)	UD (struc)	Total[3]
FWOAFA	1984	0	2380	1159	1129	35	750	2489	0	7942
FWBP		0	2380	1159	1129	35	750	2489	0	7942
FWHLP		0	2380	1159	1129	35	750	2489	0	7942
FWOAFA	1987	0	2320	1178	1133	33	780	2497	0	7942
FWBP		0	2320	1178	1133	33	780	2497	0	7942
FWHLP		0	2188	743	1134	33	779	3066	0	7942
FWOAFA	1996	0	2149	1235	1147	28	866	2518	0	7942
FWBP		0	122	1148	885	0	2713	2766	308	7942
FWHLP		0	2026	796	1146	27	860	3086	0	7942
FWOAFA	2000	0	2076	1258	1153	25	902	2527	0	7942
FWBP		0	118	1149	885	0	2715	2766	308	7942
FWHLP		0	1958	818	1152	25	894	3095	0	7942
FWOAFA	2010	0	1906	1314	1166	21	988	2547	0	7942
FWBP		0	108	1153	886	0	2720	2767	308	7942
FWHLP		0	1798	871	1165	21	974	3114	0	7942
FWOAFA	2020	0	1751	1365	1179	17	1066	2565	0	7942
FWBP		0	100	1155	887	0	2724	2768	308	7942
FWHLP		0	1651	919	1176	17	1048	3131	0	7942
FWOAFA	2030	0	1607	1412	1190	14	1138	2581	0	7942
FWBP		0	91	1158	887	0	2728	2769	308	7942
FWHLP		0	1516	963	1187	14	1116	3146	0	7942
FWOAFA	2040	0	1476	1455	1201	11	1204	2596	0	7942
FWBP		0	84	1161	888	0	2732	2769	308	7942
FWHLP		0	1392	1004	1197	11	1178	3160	0	7942
FWOAFA	2050	0	1355	1494	1211	9	1264	2609	0	7942
FWBP		0	77	1163	889	0	2736	3173	308	7942
FWHLP		0	1278	1041	1206	9	1236	2770	0	7942

(continued)

Table B-2. (continued)

		F/IM	B/SM	Lake	R/C	BLH	SS	UD (levee)	UD (struc)	Total
FWOAFA	2060	0	1244	1531	1219	7	1320	2620	0	7942
FWBP		0	71	1165	889	0	2739	2771	308	7943
FWHLP		0	1174	1076	1215	8	1288	3184	0	7944
FWOAFA	2070	0	1142	1564	1228	6	1371	2631	0	7942
FWBP		0	65	1167	890	0	2742	2772	308	7943
FWHLP		0	1078	1107	1222	6	1336	3194	0	7944
FWOAFA	2080	0	1049	1595	1235	5	1418	2641	0	7942
FWBP		0	60	1168	890	0	2745	2772	308	7943
FWHLP		0	990	1136	1229	5	1381	3203	0	7944
FWOAFA	2090	0	963	1623	1242	4	1461	2649	0	7942
FWBP		0	55	1170	890	0	2747	2773	308	7943
FWHLP		0	909	1162	1236	4	1421	3212	0	7944
FWOAFA	2100	0	884	1649	1248	3	1501	2657	0	7942
FWBP		0	51	1171	891	0	2749	2773	308	7943
FWHLP		0	834	1187	1242	3	1459	3219	0	7943
Annualized										
FWOAFA		0	1510	1443	1198	13	1186	2590	0	
FWBP		0	228	1162	904	2	2606	2752	288	
FWHLP		0	1428	998	1194	14	1161	3147	0	
Net change										
FWBP		0	-1282	-281	-294	-11	+1420	+162	+288	
FWHLP		0	-82	-445	-4	+ 1	-25	+557	0	

[1] FWOAFA = future without additional Federal action
FWBP = future with Barrier Plan
FWHLP = future with High-Level Plan

[2] Abbreviations for habitat types are defined in Table 1, UD (struc) = upland developed (structure).

[3] The value given for total habitat acreage is the sum of the habitat acreage before rounding to the nearest whole number and, therefore, may not represent the total of the habitat acreage displayed for a given target year in this table.

Table B-3. Comparison of habitat acreages under future without-project in St. Charles Parish (FWOPSCP), future with Barrier Plan in St. Charles Parish (FWBPSCP), and future with High-Level Plan in St. Charles Parish (FWHLPSCP) conditions.

Scenario (project condition)[1]	Target year	Habitat type[2] CT	UDEV	F/IM	Total[3]
FWOPSCP	1984	98	6	0	105
FWBPSCP		98	6	0	105
FWHLPSCP		98	6	0	105
FWOPSCP	1987	95	9	0	105
FWBPSCP		95	9	0	105
FWHLPSCP		95	9	0	105
FWOPSCP	1989	93	11	1	105
FWBPSCP		22	82	0	104
FWHLPSCP		0	105	0	105
FWOPSCP	2000	83	22	1	105
FWBPSCP		19	84	0	104
FWHLPSCP		0	105	0	105
FWOPSCP	2010	74	30	1	105
FWBPSCP		17	86	0	104
FWHLPSCP		0	105	0	105
FWOPSCP	2020	66	37	2	105
FWBPSCP		15	88	0	104
FWHLPSCP		0	105	0	105
FWOPSCP	2030	59	44	2	105
FWBPSCP		14	89	0	104
FWHLPSCP		0	105	0	105
FWOPSCP	2040	53	50	2	105
FWBPSCP		12	91	1	104
FWHLPSCP		0	105	0	105
FWOPSCP	2050	48	55	3	105
FWBPSCP		11	92	1	104
FWHLPSCP		0	105	0	105

(continued)

Table B-3. (continued)

	Target year	CT	UD	F/IM	Total
FWOPSCP	2060	43	60	3	105
FWBPSCP		10	93	1	104
FWHLPSCP		0	105	0	105
FWOPSCP	2070	38	64	3	105
FWBPSCP		9	94	1	104
FWHLPSCP		0	105	0	105
FWOPSCP	2080	34	68	3	105
FWBPSCP		8	95	1	104
FWHLPSCP		0	105	0	105
FWOPSCP	2090	31	71	3	105
FWBPSCP		7	96	1	104
FWHLPSCP		0	105	0	105
FWOPSCP	2100	28	74	3	105
FWPBPSCP		7	96	1	104
FWPHLPSCP		0	105	0	105
Annualized					
FWOPSCP		56	47	2	
FWBPSCP		15	88	1	
FWHLPSCP		3	102	0	
Net change					
FWBPSCP		-41	+41	-1	
FWHLPSCP		-53	+55	-2	

[1]FWOPSCP = future without-project for St. Charles Parish
FWBPSCP = future with Barrier Plan for St. Charles Parish
FWHLPSCP= future with High-Level Plan for St. Charles Parish

[2]CT = Cypress-tupelo; abbreviations for other habitat types are defined in Table 1.

[3]The value given for total habitat acreage is the sum of the habitat acreage before rounding to the nearest whole number and, therefore, may not represent the total habitat acreage for a particular target year displayed in this table.

For the HEP analysis employed in this study, several species that are economically important and/or which represent various trophic levels of wildlife utilizing habitat types were selected as evaluation elements. Species or species groups selected were nutria, muskrat, northern raccoon, shorebirds, white-tailed deer, puddle ducks, and diving ducks. These species were used to evaluate all habitat types in the project area. Several sample sites within each cover type identified were visited by a team of biologists representing the Corps of Engineers, the Louisiana Department of Wildlife and Fisheries, and the FWS during the period March 8-10, 1982 (Figure B-1). In the strictest application of HEP, habitat suitability is based on actual field measurements of various parameters that limit the relative population density of a particular species. However, in an effort to accelerate the HEP process, the interagency team visited 31 sites and estimated habitat suitability for each evaluation element on a scale of 0 to 10, with 0 being the poorest and 10 being the optimal score. These estimates were based on written summaries of habitat requirements of the species involved and on the professional judgement of the biologists assigning HSI values. This rating is termed the habitat suitability index (HSI). For compatibility with the Service's HEP computer system, these ratings were converted to a scale of 0.00 to 1.00 by simply moving the decimal one digit to the left. Details regarding sample site location, individual sample site scores, and related data are on file in this office and available upon request.

The average HSI for each evaluation element over all sample sites within a particular habitat type is termed the mean cover type HSI. For each evaluation element, the products of the mean cover type HSI and the habitat acres for each cover type are summed. This sum is divided by the sum of the habitat acres to determine an evaluation species HSI for the project area in a given year. The evaluation species HSI is determined for each target year, from the baseline year to the end of the project life. Target years are established to illustrate significant changes in habitat quality and/or quantity at specific points in time. The actual target years selected for each of the three project scenarios are presented in Table B-4.

The habitat unit (HU) is the basic unit utilized in the HEP for measuring project effects on wildlife. HU's are the product of the evaluation species HSI and the acreage of available habitat for a given target year. Future HU's change according to changes in habitat quality or quantity; these changes are predicted for various target years over the project life, for without- and with-project conditions. These values are summed and annualized over the project life to determine the average annual habitat units (AAHU's) available for each species. For comparison, the total AAHU's for all evaluation species for each proposed action are summed. The change (increase or decrease) in AAHU's under each FWP alternative, compared to FWOP, provides a quantitative comparison of project impacts that are expected to occur with each project feature. An increase in AAHU's indicates that the project is beneficial to wildlife; a decrease in AAHU's indicates that the project is damaging to wildlife.

Table B-4. Target years, by project scenario, for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Scenario[1] (project condition)	Target year[2]	Reason for selecting target year
FWOP and FWFATD	1967	Baseline, start of construction
	1973	Completion of first levee lifts
	1984	Baseline for additional Federal action as proposed, start of construction for proposed High-Level Plan (HLP)
	1987	Start of construction for proposed Barrier Plan (BP), end of first levee lifts for proposed HLP
	1996	Completion of first levee lifts for proposed BP
	2000	Completion of construction for additional Federal action (BP and HLP)
	2010 . . . 2100	10-year intervals from completion of construction to end of project life
FWOAFA, FWBP, and FWHLP	1984	Baseline, start of construction for proposed HLP
	1987	Start of construction for proposed BP, completion of first lift for HLP
	1996	Completion of first lift for proposed BP
	2000	Completion of construction for proposed additional Federal action
	2010 . . . 2100	10-year intervals from completion of construction to end of project life

(continued)

Table B-4. (continued)

FWOPSCP FWBPSCP, and FWHLPSCP	1984	Baseline, start of construction for proposed HLP (excluding St. Charles Parish)
	1987	Begin construction for additional Federal action (as proposed) for St. Charles Parish
	1989	Completion of construction for proposed BP and HLP for St. Charles Parish
	2000	Completion of construction for proposed BP and HLP for St. Charles Parish
	2010 . . . 2100	10-year intervals from completion of construction to the end of project life

[1] FWOP = future without-project; FWFATD = future with Federal action to date; FWOAFA = future without additional Federal action; FWBP = future with Barrier Plan; FWHLP = future with High-Level Plan; FWOPSCP = future without-project for St. Charles Parish; FWBPSCP = future with Barrier Plan for St. Charles Parish; and FWHLPSCP = future with High-Level Plan for St. Charles Parish.

[2] Target years for future construction are based on the best available information. It should be noted that these dates may change, depending on funding or other unexpected factors that could affect construction dates.

RESULTS AND DISCUSSION

The mean cover type HSI for each habitat type under each future project condition is presented in Table B-5. It was decided by the HEP team that this mean HSI value would remain the same for each species in each habitat type throughout the project life. The habitat acreage changes that are expected to occur over the project life are provided in Tables B-1, B-2, and B-3. The HU values were computed by multiplying those acreages by the appropriate mean cover type HSI value and annualized to get the AAHU's, which provide a quantitative measure of project impacts. The AAHU's for each project condition are provided in Table B-6.

A comparison of AAHU losses, by species, for each scenario indicated that FWFATD negatively impacted all of the evaluation species (Table B-6). Deer, the species most impacted, has a loss of 415 AAHU's, and shorebirds, the species group least impacted, shows a loss of 207 AAHU's. Similarly, all evaluation species will be negatively impacted by implementation of the High-Level Plan, which will cause the loss of 188 AAHU's for puddle ducks, 186 AAHU's for diving ducks, but only 24 AAHU's for deer (Table B-6). The proposed Barrier Plan will have the greatest negative impact on puddle ducks, which would lose 587 HU's annually, diving ducks, which would lose 549 HU's annually, and muskrat, which would lose 525 HU's annually (Table B-6). The Barrier Plan, however, would positively impact deer by increasing AAHU's by 370.

In the St. Charles Parish portion of the study area, all evaluation species are expected to be negatively impacted under either of the with-project alternatives. Implementation of the Barrier Plan in St. Charles Parish would cause the greatest loss of HU's to nutria (-23 AAHU's) and puddle ducks (-22 AAHU's) (Table B-6). Similarly, implementation of the High-Level Plan in St. Charles Parish would cause the greatest loss of HU's to nutria (-30 AAHU's) and puddle ducks (-29 AAHU's) (Table B-6).

The AAHU's associated with the alternatives selected in each scenario are additive (Figure B-2). Because all work associated with the FWFATD has already occurred, the annualized loss of 1,895 acres of valuable fish and wildlife habitat (exclusive of upland developed) and 2,138 AAHU's due to this portion of the plan will be common to any future work. Thus, completion of the Barrier Plan would cause the annualized loss of 2,385 acres of valuable fish and wildlife habitat and 4,256 HU's. Completion of the TSP, or High-Level Plan, would cause the annualized loss of 2,505 acres of valuable fish and wildlife habitat and 3,124 HU's. By comparison, the Barrier Plan would cause the loss of 120 fewer acres of valuable fish and wildlife habitat annually but 1,132 more AAHU's than the High-Level Plan. These comparisons include FWFATD and all future work associated with the plan selected, i.e., the Barrier Plan or the High-Level Plan. It should be noted that these losses do not include habitat destruction associated with any project-induced drainage of wetlands enclosed by hurricane protection levees and converted to residential or commercial developments.

Table B-5. Average HSI values for each evaluation element by habitat type.

Species	Habitat Type[1]							
	F/IM	B/SM	Lake	R/C	BLH	SS	UD (levee)	UD (struc.)
(excluding St. Charles Parish)								
Nutria	0.55	0.29	0.25	0.15	0.06	0.12	0.05	0.00
Muskrat	0.25	0.46	0.28	0.15	0.05	0.13	0.05	0.00
Raccoon	0.40	0.29	0.32	0.10	0.50	0.33	0.15	0.00
Shorebirds	0.10	0.29	0.36	0.20	0.00	0.07	0.05	0.00
Deer	0.38	0.15	0.12	0.00	0.50	0.43	0.10	0.00
Puddle ducks	0.25	0.35	0.38	0.20	0.04	0.03	0.00	0.00
Diving ducks	0.10	0.30	0.38	0.20	0.00	0.00	0.00	0.00
(for St. Charles Parish)	CT	UDEV	F/IM					
Nutria	0.60	0.05	0.65					
Muskrat	0.15	0.05	0.20					
Raccoon	0.40	0.15	0.40					
Shorebirds	0.07	0.05	0.35					
Deer	0.23	0.10	0.25					
Puddle ducks	0.53	0.00	0.60					
Diving ducks	0.10	0.00	0.30					

[1]Abbreviations for habitat types are defined in Tables B-1, B-2, and B-3.

Table B-6. Comparison of Average Annual Habitat Units (AAHU's) by evaluation element for each future project condition.

Species	AAHU's		
	Without-project alternative[1]	With-project alternative[1]	Change due to project
	FWOP	FWFATD	
Nutria	1549.60	1273.13	-276.17
Muskrat	2007.31	1625.15	-382.16
Raccoon	2146.45	1837.14	-309.31
Shorebirds	1622.75	1415.55	-207.20
Deer	1598.57	1183.26	-415.31
Puddle ducks	1698.88	1390.77	-308.11
Diving ducks	1500.63	1260.89	-239.74
		Total	-2138.30
	FWOAFA	FWBP	
Nutria	1247.44	904.43	-343.01
Muskrat	1570.94	1046.15	-524.79
Raccoon	1826.66	1826.66	0.00
Shorebirds	1401.49	988.98	-412.51
Deer	1187.19	1557.59	+370.40
Puddle ducks	1353.56	766.13	-587.43
Diving ducks	1230.33	681.57	-548.76
		Total	-2046.10

(continued)

Table B-6. (continued).

	FWOAFA	FWHLP	
Nutria	1247.44	1132.42	-115.02
Muskrat	1570.94	1429.56	-141.38
Raccoon	1826.66	1748.61	-78.05
Shorebirds	1401.49	1240.94	-160.55
Deer	1187.19	1163.23	-23.96
Puddle ducks	1353.56	1165.28	-188.28
Diving ducks	1230.33	1044.44	-185.89
			Total -893.13

	FWOPSCP	FWBPSCP	
Nutria	37.15	13.96	-23.19
Muskrat	11.28	6.77	-4.51
Raccoon	30.29	19.63	-10.66
Shorebirds	6.64	5.75	-0.89
Deer	18.28	12.42	-5.86
Puddle ducks	30.79	8.65	-22.14
Diving ducks	6.13	1.57	-4.56
			Total -71.81

	FWOPSCP	FWHLPSCP	
Nutria	37.15	7.08	-30.07
Muskrat	11.28	5.57	-5.71
Raccoon	30.29	16.59	-13.70
Shorebirds	6.64	5.30	-1.34
Deer	18.28	10.95	-7.33
Puddle ducks	30.79	1.78	-29.01
Diving ducks	6.13	0.32	-5.81
			Total -92.97

[1] Abbreviations for scenarios (project conditions) are defined in Table B-4.

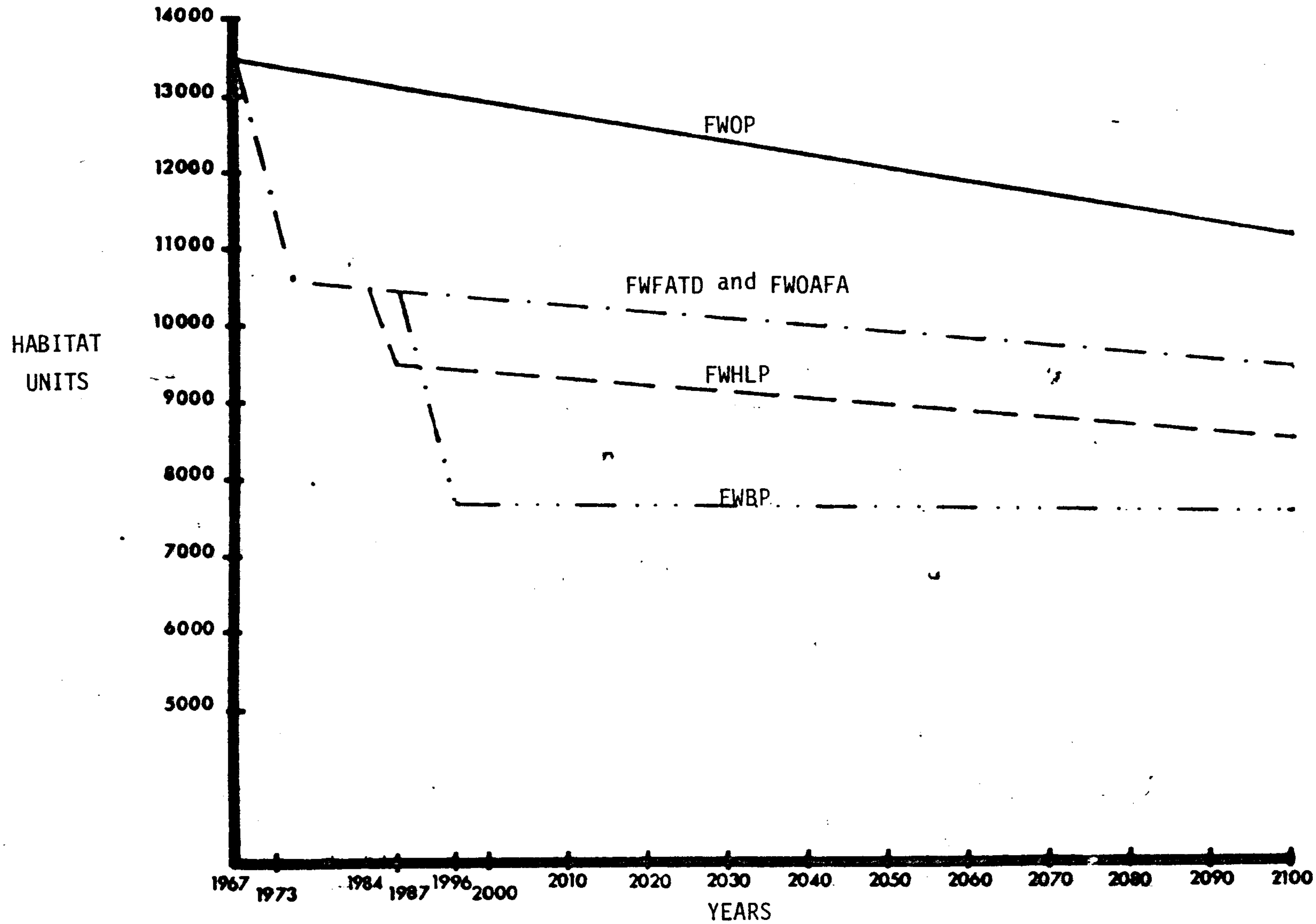

Figure B-2. Comparison of habitat units under each of the alternatives, i.e., future without-project (FWOP), future with Federal action to date (FWFATD), future without additional Federal action (FWOAFA), future with High-Level Plan (FWHLP), and future with Barrier Plan (FWBP), proposed for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The St. Charles Parish alternatives were not included in this comparison.

Whenever there is a projected loss of AAHU's associated with a project, steps must be taken to reduce and/or replace the lost AAHU's. In this case, both existing and future project features are damaging to the wildlife resources of the project area. A reduction in AAHU's lost can be attained only by project modifications such as the elimination of certain levee reaches and/or a reduction in levee widths. If such modifications are not feasible, compensation of unavoidable project damages to fish and wildlife habitat can be accomplished by several means, including preservation of habitat that would otherwise be lost and/or the addition of AAHU's through habitat improvements that benefit the species used as evaluation elements. Members of our staff will be available to work with New Orleans District Corps personnel in the development of a plan that will mitigate for unavoidable project impacts associated with the selected plan.

In addition to the habitat acreage and HEP analysis presented in this report, other methods, such as a man-day/monetary analysis, will also be used to compare project alternatives at a later date. These analyses will be provided in our forthcoming Fish and Wildlife Coordination Act Report.

The Louisiana Department of Wildlife and Fisheries has been consulted during the preparation of this report. Should you have any questions regarding this report, please contact Robert Strader of this office.

Sincerely,

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METHODOLOGY FOR ESTIMATING

HABITAT ACREAGES IN THE LAKE PONTCHARTRAIN, LOUISIANA,

AND VICINITY HURRICANE PROTECTION PROJECT AREA

ATTACHMENT 1

In order to assess project impacts to fish and wildlife resources, it was necessary to project future acreages for the various habitat types in the project area under both with- and without-project conditions. Habitat acreages under future with-project (FWP) conditions were based on acreages planimetered from 1978 habitat maps on which project levees and structures were drawn. Because all habitat types in the project area are changing due to development, drainage projects, subsidence, salt-water intrusion, and/or a number of other factors, it was necessary to establish rates of change and to predict acreages under future without-project (FWOP) conditions.

Habitat maps and other information from the "Mississippi Delta Plain Region (MDPR) Ecological Characterization: A Habitat Mapping Study" (Wicker 1980) were used to calculate the FWOP habitat change rates and future habitat acreages. That study identified and measured habitats over a large portion of Louisiana's coastal zone, including the project area. Two sets of 1:24,000 habitat maps were prepared, one set for 1955-56 and one for 1978. The habitat acreage for each time period was measured using an electronic digitizer. Fish and Wildlife Service personnel, in cooperation with Corps of Engineers representatives, utilized the information to predict the rate of change for selected habitats between the mid-1950's and 1978; that rate was projected for the period 1967 to 2100.

Major habitat types found in the study area are fresh/intermediate marsh (F/IM), brackish/saline marsh (B/SM), lakes (L), rivers and canals (RC), cypress/tupelo swamp (CT), bottomland hardwood forests (BLH), scrub-shrub (SS), and upland developed (UD). After a close examination of the acreage data and examination of the color infrared imagery and habitat maps, it was obvious that the St. Charles Parish portion of the project area demonstrated different rates of habitat change than the remainder of the area. The major part of the project area which includes New Orleans East, the Chalmette Area, and the Passes (Rigoletes and Chef Menteur), had a loss of forested and marsh habitat acreages and a gain in L, RC, SS, and UD habitat acreages between 1955-56 and 1978. Total marsh loss during that period occurred at an average rate of 0.85 percent per year; of that loss, 32.74 percent went to L, 7.95 percent went to RC, 50.21 percent went to SS, and 9.1 percent went to UD habitat. Annual habitat losses for BLH habitat averaged 2.02 percent. The BLH habitat loss was accounted for by a gain in UD habitat. The equations used to calculate habitat change rates, and past and future habitat acreages, for this portion of the project area are presented below:

Fresh/Intermediate Marsh (F/IM): There was a loss of 17,623 acres between 1956 (37,200 acres) and 1978 (19,577 acres). The average annual acres lost was divided by the original (1956) acreage to determine the annual rate of change:

$$37{,}200 \text{ acres} - 19{,}577 \text{ acres} = 17{,}623 \text{ acres lost}$$

$$\frac{17{,}623}{22 \text{ years}} = 801 \text{ acres lost per year}$$

$$\frac{801}{37{,}200 \text{ acres (1956)}} = 0.0215 \text{ (annual rate of change)}$$

The equations used to predict habitat acreages in past or future years was:

$$\text{acres F/IM}_{n-1} = \frac{\text{acres F/IM}_n}{(1 - 0.0215)}$$

or

$$\text{acres F/IM}_{n+1} = \text{F/IM}_n \times (1 - 0.0215);$$

where,

n = any given year,
n - 1 = given year minus 1, and
n + 1 = given year plus 1.

Brackish/Saline Marsh (B/SM): There was a relatively small loss of this habitat type from 74,857 acres in 1956 to 71,457 acres in 1978. The habitat acreage for past and future years was calculated by:

$$\text{acres B/SM}_{n-1} = \text{acres total marsh}_{n-1} - \text{acres F/IM}_{n-1}$$

or

$$\text{acres B/SM}_{n+1} = \text{acres total marsh}_{n+1} - \text{acres F/IM}_{n+1}$$

where, the average annual loss of total marsh was determined using the sum of F/IM and B/SM for 1956 (112,057) and 1978 (91,034):

112,057 acres - 91,034 acres = 21,023 acres lost

$$\frac{21{,}023}{22 \text{ years}} = 956 \text{ acres lost annually}$$

$$\frac{956}{112{,}057 \text{ acres (1956)}} = 0.0085 \text{ (annual rate of total marsh change)}$$

and

$$\text{acres total marsh}_{n-1} = \frac{\text{acres total marsh}_n}{(1 - 0.0085)}$$

or

$$\text{acres total marsh}_{n+1} = \text{acres total marsh}_n \times (1 - 0.0085).$$

Lakes (L): There was a gain of this habitat type from 163,299 acres in 1956 to 170,192 acres in 1978. The average annual gain of 313 acres was at the expense of total marsh habitat and determined to be 32.74 percent of total marsh lost annually. Habitat acres in past and future years were calculated by:

$$\text{acres L}_{n-1} = \text{acres L}_n - (0.3274 \times \text{acres total marsh change}_{n-1})$$

or

$$\text{acres } L_{n+1} = \text{acres } L_n + (0.3274 \times \text{acres total marsh change}_{n+1}).$$

Rivers/Canals (RC): There was a gain in the amount of river and canal habitat from 3,950 acres in 1956 to 5,622 acres in 1978. The average annual gain of 76 acres was at the expense of total marsh loss and determined to be 7.95 percent of the total annual marsh loss. Past and future acreages were calculated by:

$$\text{acres } RC_{n-1} = \text{acres } RC_n - (0.0795 \times \text{acres total marsh change}_{n-1})$$

or

$$\text{acres } RC_{n+1} = \text{acres } RC_n + (0.0795 \times \text{acres total marsh change}_{n+1}).$$

Bottomland Hardwoods (BLH): In 1956, there were 10,624 acres, but only 5,896 acres in 1978. The annual rate of change was calculated as follows:

$$10{,}624 \text{ acres} - 5{,}896 \text{ acres} = 4{,}789 \text{ acres lost}$$

$$\frac{4{,}789}{22 \text{ years}} = 215 \text{ acres lost annually}$$

$$\frac{215}{10{,}624 \text{ acres (1956)}} = 0.0202 \text{ annual rate of decline.}$$

This value was used to predict habitat acreage for past or future years:

$$\text{acres } BLH_{n-1} = \frac{\text{acres } BLH_n}{(1 - 0.0202)}$$

or

$$\text{acres } BLH_{n+1} = \text{acres } BLH_n \times (1 - 0.0202).$$

Scrub-Shrub (SS): Gains in this habitat type during the period 1956 to 1978 were also at the expense of marsh habitat. From only 45 acres in 1956, there was a gain to 10,606 acres by 1978. The average annual gain of 480 acres was at the expense of total marsh and determined to be 50.21 percent of the annual total marsh loss. Future and past habitat acreages were calculated by:

$$\text{acres } SS_{n-1} = \text{acres } SS_n - (0.5021 \times \text{acres total marsh change}_{n-1})$$

or

$$\text{acres } SS_{n+1} = \text{acres } SS_n + (0.5021 \times \text{acres total marsh change}_{n+1}).$$

Upland Developed (UD): A significant gain from 30,498 acres in 1956 to 43,448 acres in 1978 was found to have occurred in this habitat type. The average annual gain of 589 acres was at the expense of total marsh and forested habitats (BLH and CT). The changes in past and future years were determined by:

$$\text{acres } UD_{n-1} = UD_n - (0.0910 \times \text{acres total marsh change}_{n-1}) - (\text{acres BLH change}_{n-1})$$

or

$$\text{acres } UD_{n+1} = UD_n + (0.0910 \times \text{acres total marsh change}_{n+1}) + (\text{acres BLH change}_{n+1}).$$

In St. Charles Parish, similar trends were observed, but at noticably different rates. Only two habitat types, namely CT and UD, are expected to be impacted by the project. Of these, only CT has any appreciable value to fish and wildlife resources. Future and past habitat acreages were based on a loss of 1,785 acres during the 22-year period from 1956 (11,398 acres) to 1978 (8,655 acres).

The annual rate of change was calculated by:

11,398 acres - 8,655 acres = 2,743 acres lost

$$\frac{2{,}743}{22 \text{ years}} = 125 \text{ acres lost annually}$$

$$\frac{125}{11{,}398 \text{ acres (1956)}} = 0.0109 \text{ (annual rate of change)}$$

This value was used to predict habitat acreage for future years:

$$\text{acres } CT_{n+1} = \text{acres } CT_n \times (1 - 0.0109).$$

It was estimated that 95.63% of the CT acreage change went to upland developed and 4.37% went to marsh. Future habitat acreages were calculated by the following equations:

$$\text{acres } UD_{n+1} = UD_n + (0.9563 \times \text{acres CT change}_{n+1})$$

and

$$\text{acres } F/IM_{n+1} = F/IM_n + (0.0437 \times \text{acres CT change}_{n+1}).$$

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY

HURRICANE PROTECTION PROJECT

APPENDIX C

MONETARY EVALUATION OF

FISH AND WILDLIFE RESOURCES

IN THE AREA OF DIRECT PROJECT IMPACTS

INTRODUCTION

The anticipated impacts on sport and commercial fish and wildlife harvest and associated monetary values of the proposed Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project are described in this appendix. These impacts include only those associated with sport and commercial fish and wildlife harvest and, to a nominal degree, impacts associated with non-consumptive wildlife-oriented recreation (WOR). These estimates were developed by determining the carrying capacity and corresponding monetary value of each habitat type on a per-acre basis, and predicting future values based on the area of available habitat under future without additional Federal action (FWOAFA) and future with-project (FWP) conditions. An analysis is provided for the High-Level Plan and Barrier Plan, as well as for all related Federal action to date.

FISHERIES

The sport and commercial fishery resources of the Lake Pontchartrain/Lake Borgne estuarine complex are significant, and the importance of the marshes to estuarine-dependent fisheries in coastal Louisiana cannot be over-emphasized. These marshes produce vast amounts of organic detritus which is transported into adjacent estuarine waters. Plant detritus is a primary component of estuarine food webs and is reportedly the single most important food material ingested by the fish and invertebrate consumers of Lake Pontchartrain. The marshes and shallow ponds also provide nursery habitat that is critical to the production of numerous estuarine dependent fishes and shellfishes. Therefore, the basic premise for our evaluation of project impacts to fishery resources is that marsh acreage is the most important factor influencing estuarine-dependent fisheries production. In estimating the commercial fishery value of these marshes, the following additional assumptions were made: (1) that the fish and shellfish production attributable to the marshes in the project area is currently being harvested at or near maximum substainable yield, (2) that commercial estuarine fish and shellfish resources produced in the project area are caught throughout Hydrologic Unit I (Chabreck 1972) and in adjacent offshore waters, and (3) that marsh losses associated with each of the plans will cause a proportional loss in commercial fisheries harvest.

Estimates of project impacts to sport fishing were quantified in terms of man-days (Table C-1). It was assumed that, in the area of direct project impact, fish produced from each acre of marsh provide 12.9 man-days of sport fishing per year, and fish produced from each acre of cypress-tupelo forest provide 2.2 man-days of sport fishing per year (U.S. Army Corps of Engineers 1977). Annualized acreages from the area of direct project impact for each of the proposed future conditions were then multiplied by the appropriate man-day figure to estimate the average man-days of sport fishing annually.

The sum of sport fishing man-days provided by each of the two habitat types were used to compare the impact of the High-Level Plan and Barrier Plan on this recreational activity. The monetary impacts were calculated by multiplying the man-days of sport fishing by $3.90,

Table C-1. Comparison of the anticipated sport fishing effort for future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP).

Project condition	Habitat type	Annualized acreage[1]	Man-days per acre[2]		Man-days[3]	Monetary value per man-day[4]		Total monetary value ($)[5]
FWOAFA	Marsh[6]	1463	12.9		18,873	$3.90		$73,605
	Cypress-tupelo	113	2.2		249	3.90		971
				Total	19,122		Total	74,576
FWHLP	Marsh	1426	12.9		18,395	3.90		71,742
	Cypress-tupelo	7	2.2		15	3.90		58
				Total	18,410		Total	71,800
FWBP	Marsh	177	12.9		2,283	3.90		8,904
	Cypress-tupelo	21	2.2		46	3.90		179
				Total	2,329		Total	9.083
Net Change								
FWHLP					-712			-2,776
FWBP					-16,793			-65,493

1. Acreages are from Tables 5 and 6 of main report.
2. Source: U.S. Army Corps of Engineers (1977).
3. Man-days are calculated by multiplying the annualized acreage by man-days per acre.
4. The monetary value per man-day is the value used for general wildlife recreation by U.S. Army Corps of Engineers (1982: G-41).
5. The total monetary value is the product of total man-days and monetary value per man-day.
6. Marsh includes fresh/intermediate and brackish/saline marsh.

which is the monetary value for a man-day of general recreation (U.S. Army Corps of Engineers 1982: G-41).

The results of the sport fishing analysis (Table C-1) indicate that implementation of the High-Level Plan will reduce annual sport fishing activity by an average of over 700 man-days, valued at nearly $2,800. Implementation of the Barrier Plan will reduce sport fishing activity by an average of almost 16,800 man-days per year valued at $65,500. By comparison, the Barrier Plan will reduce sport fishing by an annual average of about 16,150 man-days, having a value of nearly $62,700. Using this methodology, impacts associated with Federal action to date, when compared to future without project conditions, have caused the loss of an estimated 10,591 man-days valued at over $41,300.

Using commercial landings data for Hydrologic Unit I collected by the National Marine Fisheries Service, the average annual estuarine-dependent commercial fishery harvest for the period 1963 to 1978 was estimated. This value was then divided by the total number of marsh acres in Hydrologic Unit I to establish the average harvest of fish and shellfish per marsh acre. Annualized marsh acreage estimates from the area of direct project impact for various future conditions were then multiplied by the average harvest of each species of fish and shellfish per marsh acre. A comparison of fishery harvest under FWOAFA, future with the High-Level Plan, and future with the Barrier Plan conditions was developed (Table C-2).

The average annual estuarine-dependent fisheries harvest produced in the area of direct project impact, during the 116-year period from 1984 to 2100, is estimated at over 443,000 pounds (Table C-2) having a gross ex-vessel value of nearly $113,800 (Table C-3). About 75 percent (339,200 pounds) of the total poundage is contributed by the low-priced unclassified industrial fishes and menhaden ($18,654). Nearly 63,100 pounds of shrimp, valued at over $67,500, are estimated to be produced annually in the area of direct project impact.

Marsh losses associated with each of the plans will cause a proportional loss in fisheries production. Implementation of the High-Level Plan is projected to result in an average annual loss of over 11,200 pounds of estuarine-dependent fishery production, valued at nearly $2,900. With implementation of the Barrier Plan, the average annual loss in estuarine-dependent commercial fisheries harvest is estimated at about 389,400 pounds and is valued at over $100,000. The loss of 720 acres of marsh that is associated with Federal action to date has reduced the average annual commercial fisheries harvest by over 218,000 pounds valued at nearly $56,000.

WILDLIFE

Sport

This analysis of the man-day and monetary value of sport hunting in the project impact area is based on the ability of a given habitat type to support a stable wildlife population, and the assumption that a certain portion of the wildlife population can be harvested at a sustainable annual rate without adversely impacting that population.

Table C-2. Comparison of the anticipated harvest of estuarine-dependent commercial fish produced in the area of direct project impact for future without additional Federal action (FWOAFA), future with High-Level Plan (FWHLP), and future with Barrier Plan (FWBP).

Species	Average catch (pounds per marsh acre)[1]	FWOAFA Annualized marsh acreage[2]	FWOAFA Total pounds produced[3]	FWHLP Annualized marsh acreage[2]	FWHLP Total pounds produced[3]	FWHLP FWOAFA vs. FWHLP[4]	FWBP Annualized marsh acreage[2]	FWBP Total pounds produced[3]	FWBP FWOAFA vs FWBP[4]
Shrimp[5]		1463		1426			177		
inshore	21.65		31,674		30,873	- 801		3,832	-27,842
offshore	21.47		31,411		30,616	- 794		3,800	-27,610
Total	43.13		63,099		61,503	- 1,596		7,634	-55,465
Menhaden	115.75		169,342		165,060	- 4,283		20,488	-148,855
Seatrout	1.44		2,107		2,053	- 53		255	-1,852
Spot	0.05		73		71	- 2		9	-64
Red drum	0.42		614		599	- 16		74	-540
Croaker	5.65		8,266		8,057	- 209		1,000	-7,296
Crabs									
soft	3.36		4,916		4,791	- 124		595	-4,321
hard	8.04		11,763		11,465	- 297		1,423	-10,339
Oysters	8.87		12,977		12,649	- 328		1,570	-11,407
Unclassified[6]	116.10		169,854		165,559	- 4,295		20,550	-149,305
Total	302.80		443,011		431,807	-11,204		53,597	-389,414

1. Average catch per marsh acre was calculated from data generated by National Marine Fisheries Service for the period 1963 through 1978.

2. Annualized marsh acreage is taken from Tables 5 and 6 of main report and includes the sum of brackish/saline and fresh intermediate marsh.

3. Represents the product of average marsh acreage and average commercial catch per marsh acre.

4. These values are a comparison of FWOAFA and future with-project conditions and calculated by subtracting total pounds produced under FWOAFA from FWBP, and FWOAFA from FWHLP. Calculations are made prior to rounding to the nearest integer and may, therefore, be slightly different than the numbers displayed in this table.

5. Inshore shrimp harvest reflects a threefold increase of reported landings to account for unreported commercial catch. This factor is based on surveys conducted by the Louisiana Department of Wildlife and Fisheries in Calcasieu Lake and Vermilion Bay (C.J. White, personal communication, letter dated April 23, 1979).

6. Includes an assortment of fish usually processed for commercial pet food.

Table C-3. Comparison of the anticipated monetary value of estuarine-dependent commercial fishes produced in the area of direct project impact for future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP).

Species	Monetary value, per pound[1]	Fishery Value[2]				
		FWOAFA	FWHLP	FWOAFA vs. FWHLP	FWBP	FWOAFA vs. FWBP
Shrimp	$1.07	$67,516	$65,808	-1,707	$8,168	-59,347
Menhaden	0.06	10,161	9,903	-256	1,229	-8,931
Seatrout	0.62	1,306	1,273	-33	158	-1,148
Spot	0.13	10	9	0	1	-8
Red drum	0.45	277	270	-7	33	-243
Croaker	0.21	1,736	1,692	-44	210	-1,526
Crab	0.32	5,337	5,202	-134	645	-4,691
Oyster	1.46	18,946	18,467	-479	2,292	-16,654
Unclassified	0.05	8,493	8,278	-214	1,027	-7,465
Total		113,781	110,903	-2,878	13,766	-100,015

1. The monetary value for all species except oysters represents the running average of 1974-1978 exvessel gross prices; the average price for oysters is calculated for the period 1976-1980. All monetary values are brought to 1981 price levels using the Consumer Price Index.

2. Fishery values are calculated by multiplying the monetary value by the total weight of the appropriate species (as presented in Table C-2).

Using these assumptions, potential sport hunting (man-days) per acre of habitat were computed using the following equations:

population density (animals/acre)	x	maximum sustainable annual harvest rate	=	harvestable population (animals/acre)
harvestable population	x	hunter success rate (man-days effort/ animal harvested)	=	potential number of man-days of sport hunting/acre annually

The species used for this analysis include those that occur within the project area in numbers sufficient to be sought by hunters. Potential man-day usage and monetary values for these species are provided, by habitat type, in Table C-4. A discussion of data used in obtaining these values is included in this appendix.

Under each future condition, habitat acreages and associated wildlife populations are expected to change. A corresponding change in potential man-day usage and monetary value of these resources is also expected. For comparison, rabbit, squirrel, woodcock, and marsh birds were combined into small game hunting. Deer hunting and waterfowl hunting were kept in separate categories. A comparison of these future conditions is provided in Tables C-5 and C-6.

Deer hunting - The value used for deer population density in fresh/intermediate marsh was 1 deer per 35 acres (Gosselink et al. 1978, and Joanen et al. 1981). The deer population density used for moderate quality bottomland hardwoods, such as those in the area of direct project impact, was 1 per 30 acres; the density used for wooded swamp was 1 deer per 60 acres (U.S. Army Corps of Engineers, New Orleans District 1977). Deer populations in brackish/saline marsh, lake, and scrub-shrub (in brackish marsh) habitats was considered to be negligible and, therefore, no man-day values were derived. The sustained annual harvest rate used for deer was 33 percent, a commonly accepted figure among wildlife biologists. The hunter success rate (i.e., average number of days of hunting to kill a deer) used in this analysis was 26.5 for fresh/intermediate marsh and 23.7 for bottomland hardwood and cypress tupelo (Louisiana Department of Wildlife and Fisheries, undated).

Rabbit hunting - Rabbit population estimates were obtained from Louisiana Department of Wildlife and Fisheries (LDWF) Parish Surveys for St. Charles, Orleans, and St. Bernard Parishes. These populations were 1 rabbit per 2 acres for fresh/intermediate marsh, bottomland hardwood, cypress-tupelo, and scrub-shrub habitats and 1 rabbit per 2.5 acres of brackish/saline marsh habitat. Rabbit populations in lake habitat are considered virtually non-existent and; therefore, no man-day value was derived. A sustained annual harvest rate of 60 percent is commonly accepted by wildlife biologists and was used for these estimates. A hunter success rate of 0.55 man-days of effort per rabbit harvested was taken from the LDWF's 1977-78 small game survey for District 8, which includes the area of direct project impact.

Table C-4. Sport hunting potential and value by various habitat types in the area of direct project impact.

Habitat type	Species	Potential effort per acre (man-days)[1]	Value per man-day($)[2]	Value per acre($)[3]
fresh/intermediate marsh	rabbit	0.16	3.90	0.62
	marsh birds	0.25	3.90	0.98
	deer	0.25	13.90	3.45
	waterfowl	0.49	13.80	6.76
	Total			11.81
brackish/saline marsh	rabbit	0.13	3.90	0.51
	marsh birds	0.26	3.90	1.01
	waterfowl	0.38	13.80	5.24
	Total			5.55
bottomland hardwood	rabbit	0.16	3.90	0.62
	squirrel	0.68	3.90	2.65
	woodcock	0.01	3.90	0.04
	deer	0.26	13.80	3.59
	waterfowl	0.02	13.80	0.28
	Total			7.18
cypress tupelo	rabbit	0.16	3.90	0.62
	squirrel	0.17	3.90	0.66
	deer	0.13	13.80	1.70
	waterfowl	0.09	13.80	1.24
	Total			4.31
scrub-shrub	rabbit	0.16	3.90	0.62
	woodcock	0.01	3.90	0.04
	Total			0.66

1. A discussion of assumptions made regarding potential effort per acre is provided in the text (pages C-10 to C-13).

2. Monetary values per man-day of sport hunting are from U.S. Army Corps of Engineers (1982:G-41).

3. Value per acre ($) is the product of the potential effort per acre (man-days) and the value per man-day ($).

Table C-5. Potential man-day usage by project scenario and habitat type for various sport hunting activities under future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP).

Project condition	Habitat type	Sport hunting activity	Potential effort per acre (man-days)[2]	Annualized acreage[3]	Potential effort in project area (man-days)[4]
FWOAFA	fresh/intermediate marsh	small game[1]	0.41	5	2
		deer	0.25		1
		waterfowl	0.49		2
	brackish/saline marsh	small game	0.39	1458	569
		waterfowl	0.38		554
	lake	small game	0.08	1392	111
		waterfowl	0.38		529
	bottomland hardwood	small game	0.85	14	12
		deer	0.26		4
		waterfowl	0.02		negligible
	cypress tupelo	small game	0.33	113	37
		deer	0.13		15
		waterfowl	0.09		10
	scrub-shrub	small game	0.17	1133	193
FWHLP	brackish/saline marsh	small game	0.39	1426	556
		waterfowl	0.38		542
	lake	small game	0.08	998	80
		waterfowl	0.38		379
	bottomland hardwood	small game	0.85	14	12
		deer	0.26		4
		waterfowl	0.02		negligible
	cypress tupelo	small game	0.33	7	2
		deer	0.13		1
		waterfowl	0.09		1
	scrub-shrub	small game	0.17	1161	197

(continued)

Table C-5. (continued)

Project condition	Habitat type	Sport hunting activity	Potential effort per acre (man-days)[2]	Annualized acreage[3]	Potential effort in project area (man-days)[4]
FWBP	fresh/inter-mediate marsh	small game[1]	0.41	2	1
		deer	0.25		negligible
		waterfowl	0.49		1
	brackish/ saline marsh	small game	0.39	175	68
		waterfowl	0.38		66
	lake	small game	0.08	1113	89
		waterfowl	0.38		443
	bottomland hardwood	small game	0.85	2	2
		deer	0.26		1
		waterfowl	0.02		negligible
	cypress tupelo	small game	0.33	21	7
		deer	0.13		3
		waterfowl	0.09		2
	scrub-shrub	small game	0.17	2553	434

1. Small game hunting includes rabbit, squirrel, marsh birds, and woodcock.

2. Potential effort per acre (man-days) from Table C-4.

3. Annualized acreages from Tables 5 and 6.

4. Potential effort in project area (man-days) is the product of the potential effort per acre and annualized acreage.

Table C-6. A comparison of man-day and monetary values under future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP) and future with the Barrier Plan (FWBP) for sport hunting in the area directly impacted by the project.

Project condition	Sport hunting activity[1]	Potential effort in project area (man-days)[2]	Value per (man-days)[2]	Value of project area ($)[4]
FWOAFA	small game	924	3.90	3,604
	deer	20	13.80	276
	waterfowl	1,095	13.80	15,111
	Total	2,039		18,991
FWHLP	small game	847	3.90	3,303
	deer	5	13.80	69
	waterfowl	922	13.80	12,724
	Total	1,774		16,096
FWBP	small game	601	3.90	2,344
	deer	4	13.80	55
	waterfowl	512	13.80	7,066
	Total	1,117		9,465
Net change				
(FWOAFA	small game	-77	3.90	-300
vs. FWHLP)	deer	-15	13.80	-207
	waterfowl	-173	13.80	-2,387
	Total	-265		-2,894
(FWOAFA	small game	-323	3.90	-1,260
vs. FWBP)	deer	-16	13.80	-221
	waterfowl	-583	13.80	-8,045
	Total	-922		-9,526

1. Small game includes rabbit, squirrel, woodcock, and marsh birds.

2. Data from Table C-5 have been summed to derive total potential effort in project area by all habitat types.

3. Data are from Table C-4.

4. Value of the project area is the product of potential effort in project area and value per man-day.

Squirrel Hunting - Man-day use figures for squirrels were only determined for bottomland hardwood and cypress-tupelo habitats. A population density of 2 squirrels per acre, taken from LDWF's 1975 Parish Survey for St. Bernard and St. Charles Parishes, was used for bottomland hardwoods. A population of 1 squirrel per 2 acres was used for cypress-tupelo habitat. A commonly accepted sustained annual harvest rate of 60 percent was used. The hunter success rate of 0.57 was taken from the LDWF's 1977-78 Small Game Survey for District 8.

Marsh Bird Hunting - This includes other game birds, such as coots, rails, and snipe, that are commonly found in the marsh. Man-day values for these species for all marsh habitats were taken from U.S. Army Corps of Engineers (1974:D-52). These values were averaged to obtain man-day values for fresh/intermediate marsh and brackish/saline marsh habitat types. Man-day values for lake habitats were restricted to coots only. Populations and, therefore, man-day usage of these species in bottomland hardwood, wooded swamp, and scrub-shrub is negligible.

Woodcock Hunting - Significant populations of woodcock are limited to the bottomland hardwood and scrub-shrub habitats of the project area. A man-day per acre value of 0.01 for bottomland hardwoods was taken from the U.S. Army Corps of Engineers (1977). No woodcock population estimates or man-day usage values were available for scrub-shrub habitat; however, these birds are known to congregate on ridges and spoil banks in coastal Louisiana, particularly during cold weather. It was, therefore, assumed that the annual man-day usage figure would be 0.01, the value used for bottomland hardwoods.

Waterfowl Hunting - Man-day values for migratory waterfowl hunting in fresh and intermediate marsh were based on records for public waterfowl hunting on Lacassine and Sabine National Wildlife Refuges during the 1978-79 hunting season. Values of 0.45 man-days per acre for fresh marsh and 0.52 man-days per acre for intermediate marsh were averaged to establish the 0.49 man-day per acre value used for fresh/intermediate marsh. The man-day value of 0.38 used for brackish/saline marsh was taken from U.S. Fish and Wildlife Service (1980:A5). Because lake habitat, as defined in this report, includes Lake Pontchartrain, which serves as an important wintering area for diving ducks, and large open-water bodies in the marsh, the man-day value (0.38) used for brackish/saline marsh was also used for lake habitat. For bottomland hardwood, a population density of 1 duck per 10 acres, a sustained annual harvest rate of 40 percent, and a hunter success rate of 0.4 were used to establish the 0.02 man-day per acre value (U.S. Army Corps of Engineers 1977). The man-day per acre value of 0.09 used for cypress-tupelo habitat was taken from U.S. Army Corps of Engineers (1977).

Under the FWOAFA scenario, the project area will support an average of 2,039 man-days of small game (924 man-days), deer (20 man-days), and waterfowl (1,095 man-days) hunting annually for the remainder of the project life (1984-2100) (Table C-5 and Table C-6). This potential man-day usage figure is valued at nearly $19,000 per year. For future with the High-Level Plan, 265 man-days of sport hunting valued at nearly $2,900 would be lost annually from 1984 until 2100. For future with the Barrier Plan, 922 man-days of sport hunting valued at over

$9,500 would be lost annually from 1984 until 2100. Impacts associated with Federal action to date, when compared to future without-project conditions and included in this analysis, increase the annual losses by an additional 856 man days valued at over $7,000, regardless of the future plan selected for implementation.

Waterfowl hunting is the activity most impacted by the existing and proposed Federal action plans. Construction associated with Federal action to date has caused the average annual loss of about 350 man-days of this specialized hunting valued at over $4,800. The proposed High-Level Plan, if implemented, would further reduce the average annual potential waterfowl hunting by about 170 man-days valued at almost $2,400. The proposed Barrier Plan, which is much more damaging to the marsh and lake habitat, would reduce the average annual potential waterfowl hunting by nearly 600 man-days valued at over $8,000.

Commercial

An analysis of project impacts on commercial wildlife (i.e., furbearers and alligators) was also completed for FWOAFA and FWP scenarios, using recent records of fur catch per acre and monetary values per pelt or hide (Tables C-7 and C-8). As with each of the other analyses presented in this appendix, populations are directly related to available habitat and our predictions of future harvest are based solely on the availability of suitable habitat. Although habitat loss is anticipated under each condition, habitat destruction associated with the project is expected to further reduce the annual fur harvest. The average annual value of the furbearer and alligator harvest in the area directly impacted by the project under FWOAFA is $2,565. With implementation of the High-Level Plan, the average annual furbearer and alligator harvest would decrease by nearly $160; whereas, with implementation of the Barrier Plan the annual furbearer and alligator harvest would decrease by over $2,230. The value of furs, hides, and meat lost with construction already completed for this project is over $1,450 annually.

Wildlife-oriented recreation

Participation and monetary values of the non-consumptive WOR was also considered (Table C-9). The estimate of man-day participation in WOR was made by multiplying the average man-day per acre value by the appropriate habitat acreage. The man-day per acre value used for marsh and lake habitats was 0.46, bottomland habitats was 0.50, and cypress tupelo habitats was 0.48 (U.S. Army Corps of Engineers 1977). The monetary value was determined by multiplying the average annual man-days of WOR in the area of direct project impact by $3.90 (U.S. Army Corps of Engineers 1982: G-41).

Under FWOAFA conditions, there will be an estimated average of 1,374 man-days of WOR expended in the area of direct project impact annually for the life of the project. This usage rate has a monetary value of about $5,359. Implementation of the High-Level Plan will reduce usage by about 250 man-days valued at $971 annually. Implementation of the Barrier Plan will reduce usage by almost 770 man-days valued at just

Table C-7. Fur catch and value by various habitat types for the project area.

Species	Habitat type[1]			
	F/IM	B/SM[2]	BLH	CT
Muskrat				
mean catch/acre[3]	0.088[4]	0.084	negligible	0.007
value/pelt[5]	5.43	5.43	-	5.43
value/acre	0.48	0.46	-	0.04
Nutria				
mean catch/acre	0.399	0.086	0.021	0.102
value/pelt	7.39	7.39	7.39	7.39
value/acre	2.95	0.64	0.16	0.75
Mink				
mean catch/acre	0.002	0.001	0.021	0.011
value/pelt	13.67	13.67	13.67	13.67
value/acre	0.02	0.01	0.29	0.15
Otter				
mean catch/acre	0.001	negligible	negligible	negligible
value/pelt	44.55	-	-	-
value/acre	0.04	-	-	-
Raccoon				
mean catch/acre	0.009[6]	0.008[7]	0.079	0.017
value/pelt	11.46	11.46	11.46	11.46
value/acre	0.10	0.09	0.91	0.19
Alligator				
mean catch/acre[8]	0.007	0.002	negligible	0.002
value/animal[9]	204.40	204.40	-	204.40
value/acre	1.43	0.41	-	0.41
Total value/acre	5.02	1.61	1.36	1.54

(continued)

Table C-7. (continued)

1. F/IM = fresh/intermediate marsh, B/SM = brackish/saline marsh, BLH = bottomland hardwood, CT = cypress-tupelo.

2. For consistency, the habitat type brackish/saline marsh was used; however, since there is little or no saline marsh in the area of direct project impact, average fur catch values for brackish marsh were used.

3. Except for alligator harvest, mean catch per acre in marsh habitats is taken from Palmisano (1973); catch in BLH and CT habitats is taken from Nichols and Chabreck (1973).

4. Represents the mean of the average annual harvest per acre for fresh and intermediate marsh habitat types.

5. Value per pelt is based on 1976-81 running average of prices received by the trappers, expressed in 1981 dollars, using CPI index for hides, skins, leather, and related products.

6. Represents 50 percent of the combined maximum production for fresh and intermediate marsh types, from Palmisano (1973).

7. Represents 50 percent of the maximum production for brackish marsh, from Palmisano (1973).

8. Mean catch per acre for alligators is based on the average tag allotment for specific habitat types in 1981 (Moody and Coreil 1981).

9. Based on the combined average 1981 value of $19.00 per linear foot for hide and $1.50 per pound for meat for the average alligator caught, which was 7 feet long and weighed 46 pounds.

Table C-8. A comparison of fur and alligator harvest by habitat type in the area of direct project impact for future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP) conditions.

Project condition	Habitat type[1]	Value per acre ($)[2]	Acres (annualized)[3]	Value in project area ($)[4]
FWOAFA	F/IM	5.02	5	25.10
	B/SM	1.61	1458	2,347.38
	BLH	1.36	14	19.04
	CT	1.54	113	174.02.
	Total			2,565.54
FWHLP	F/IM	5.02	0	0.00
	B/SM	1.61	1426	2,295.86
	BLH	1.36	14	19.04
	CT	1.54	7	10.78
	Total			2,325.68
FWBP	F/IM	5.02	2	10.04
	B/SM	1.61	175	281.75
	BLH	1.36	2	2.72
	CT	1.54	21	32.34
	Total			326.85
Net change (FWOAFA vs. FWHLP)	F/IM	5.02	-5	-25.10
	B/SM	1.61	-32	-51.52
	BLH	1.36	0	0
	CT	1.54	-98	-81.62
	Total			-158.24

(continued)

Table C-8. (continued)

Project condition	Habitat type[1]	Value per acre ($)[2]	Acres (annualized)[3]	Value in project area ($)[4]
(FWOAFA vs. FWBP)	F/IM	5.02	-3	-15.06
	B/SM	1.61	-1283	-2,065.63
	BLH	1.36	-12	-16.32
	CT	1.54	-92	-141.68
	Total			-2,238.69

1. Abbreviations for habitat types are as follows:
   F/IM = fresh/intermediate marsh
   B/SM = brackish/saline marsh
   BLH = bottomland hardwood
   CT = cypress tupelo

2. Value per acre is taken from Table C-7.

3. Acreage values are taken from Tables 5 and 6 pages 23 through 26 of the main report.

4. Value in project area is the product of value per acre and the number of acres.

Table C-9. A comparison of wildlife-oriented recreation for future without additional Federal action (FWOAFA), future with the High Level Plan (FWHLP), and future with the Barrier Plan (FWBP).

Project condition	Habitat type	Man-days per acre[2]	Acreage[3]	Total man-days[4]	Value per man-day[5]	Total value ($)[6]
FWOAFA	Marsh/lake[1]	0.46	2,855	1,313	3.90	5,121
	bottomland hardwood	0.50	14	7	3.90	27
	Cypress-tupelo	0.48	113	54	3.90	211
			Total	1,374	Total	5,359
FWHLP	Marsh/lake[1]	0.46	2,424	1,115	3.90	4,348
	bottomland hardwood	0.50	14	7	3.90	27
	cypress-tupelo	0.48	7	3	3.90	13
			Total	1,125	Total	4,300
FWBP	Marsh/lake[1]	0.46	1,290	593	3.90	2,313
	bottomland hardwood	0.50	2	1	3.90	4
	cypress-tupelo	0.48	21	10	3.90	39
			Total	604	Total	2,355
Net change						
FWHLP				-249		-971
FWBP				-770		-3,004

1. All marsh and lake habitats were assumed to have the same man-day usage for wildlife-oriented recreation and, therefore, were combined.

2. Man-days of wildlife-oriented recreation were taken from U.S. Army Corps of Engineers (1977).

3. Acreages were taken from Tables 5 and 6 of main report.

4. Total man-days were calculated by multiplying man-days per acre and the acreage.

5. The value per man-day ($) of $3.90 was taken from U.S. Army Corps of Engineers (1982:G41).

6. The total value ($) is the product of total man-days and value per man-day ($).

over $3,000 annually. Completion of Federal action to date has reduced man-day participation in WOR by an estimated 419 man-days, which is valued at $1,634.

SUMMARY

Although fish and wildlife resources are expected to decline under both FWOAFA and FWP conditions, the increased loss of habitat associated with implementation of the project is anticipated to significantly reduce the man-day usage and monetary value of fish and wildlife resources in the area of direct project impact. Without additional Federal action, an average of 22,535 man-days of sport fishing, sport hunting, and WOR will be available annually in the area of direct project impact from 1984 to 2100 (Table C-10). The anticipated average annual monetary value of the area of direct project impact attributable to sport and commercial fisheries, sport hunting, furbearer harvest, and WOR is $215,273 during this same period.

With implementation of the High-Level Plan, average annual participation in sport fishing, sport hunting, and WOR is expected to decrease by 1,226 man-days, and the monetary losses attributable to sport and commercial fisheries, sport hunting, furbearer harvest, and WOR are expected to exceed $9,677 annually throughout the project life. With implementation of the more damaging Barrier Plan, the average annual loss of this recreation is expected to decrease by 18,485 man-days, and the annual monetary losses are expected to exceed $180,217.

The annual man-day losses attributable to construction of project features to date total 10,563 man-days, and the average annual monetary losses of sport and commercial fish and wildlife resources total $102,315. Average annual losses due to construction of past and proposed (High-Level Plan) project features are 11,789 man-days of recreational activity and $120,353 worth of sport and commercial fish and wildlife resources.

Table C-10. Comparison of average annual man-day/monetary impacts associated with future without additional Federal action (FWOAFA), future with the High-Level Plan (FWHLP), and future with the Barrier Plan (FWBP) conditions.

Source	FWOAFA		FWHLP		Net change[1]		FWBP		Net change[2]	
	man-day	value ($)	man-day	value ($)	man-day	value ($)	man-day	value ($)	man-day	value ($)
Sport fishing[3]	19,122	74,576	18,410	71,800	-712	-2,776	2,329	9,083	-16,793	-65,493
Comm. fishing[4]	-	113,781	-	110,903	-	-2,878	-	13,766	-	-100,015
Sport hunting[5]	2,039	18,991	1,774	16,096	-265	-2,894	1,117	9,465	-922	-9,526
Trapping[6]	-	2,566	-	2,326	-	-158	-	327	-	-2,239
WOR[7]	1,374	5,359	1,125	4,388	-249	-971	604	2,355	-770	-3,004
Total	22,535	215,273	21,309	205,513	-1,226	-9,677	4,050	34,996	-18,485	-180,277

1. Net change under FWHLP conditions when compared to the FWOAFA conditions.
2. Net change under FWBP conditions when compared to FWOAFA conditions.
3. Data taken from Table C-1.
4. Data taken form Table C-3.
5. Data taken from Table C-6.
6. Data taken from Table C-8.
7. Data taken from Table C-9.

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY

HURRICANE PROTECTION PROJECT

APPENDIX D

BIOLOGICAL IMPLICATIONS OF DREDGE HOLES

DRAFT

BIOLOGICAL IMPLICATIONS OF DREDGE HOLES

RALPH C. PISAPIA

U. S. FISH AND WILDLIFE SERVICE, DRBS

ANNAPOLIS, MARYLAND

July 1974

INTRODUCTION

In a 1967 report to Congress, the U. S. Department of the Interior estimated the public had lost 7.1 percent of their important fish and wildlife estuarine habitat in the United States (U. S. 90th Congress, 1967). In a more recent report, it was estimated that 23 percent of the estuaries in the United States have been severely altered and 50 percent moderately impacted (U. S. Department of the Interior, 1970). A significant amount of this biologically important estuarine habitat has been altered by dredge and fill operations. The value of an estuary has been effectively summarized by Odum (1961) who stated "...estuaries are among the most naturally fertile areas of the world because of efficient nutrient exchange, flowing water, accessibility to light and year-round primary production."

Dredge and fill operations have the most obvious effect of destroying fish and wildlife habitat, although the environmental implications are more comprehensive. The dredging of shallow, submerged land represents the loss of grass beds, shellfish grounds; finfish breeding, nursery, and forage areas, and other productive marine habitat. This results in the direct destruction of non-motile organisms including many invertebrate species important in marine food webs. Adverse effects are compounded when dredging depths exceed the depth of the euphotic zone and the adjacent unaltered bottom. Filling of shallow submerged land represents the conversion of a productive marine environment into upland real estate with substantially less biological productivity. When the dredge or fill site is a vegetated area such as a saltmarsh or submerged grass bed, filtering and stabilizing values are also lost. As water flows over, around, and through the vegetation, particulate matter and suspended solids are filtered out. In addition, other pollutants including excessive nutrients, heavy metals, pesticides, and hydrocarbons are either taken up by the vegetation and eventually deposited as peat or absorbed onto the organic sediments of the vegetated areas (LaRoe, 1973). Thus, there is a violent disruption of biological assemblages and water quality values of both the dredged and filled areas. In the case of the dredged areas, recovery is minimal. With regard to filled areas, recovery is virtually impossible. An impact which is seldom assessed is the chronic and cumulative environmental degradation resulting from the high density upland development. The associated construction and transplanted human populations cause waste and other municipal problems which precipitate new construction and further dredge and fill pressures in a cyclic fashion.

The twofold destruction (dredge and fill) of valuable estuarine fish and wildlife habitat has resulted in major controversies. In Maryland, a request by the Worcester County Sanitary District to the Baltimore District, Corps of Engineers for a Department of the Army permit, NABOP-P (Worcester County Sanitary District)2, has enlivened the dredge and fill debate. In this particular case, a proposed 12.5 acre area in Assawoman Bay presently with an average depth of minus 3 feet mean low water, would be dredged to minus 18 feet mean low water. This action would create a sump commonly referred to as a dredge hole. In addition, approximately 14 acres of estuarine habitat are proposed to be filled for expansion requirements of a sewage treatment facility.

As agreed at the October 5, 1973, meeting of the parties concerned with plant expansion and its environmental impact, biologists with the Annapolis, Maryland, office of the U. S. Fish and Wildlife Service have summarized available literature and pertinent research (some of which is on-going or unpublished) concerning dredge holes. Information concerning dredging and dredge and fill operations related to dredge holes also are included. The objective of this literature search and compilation is to clarify the potential environmental effects of the proposed usage of the estuarine system for material borrow areas.

Creation of Dredge Holes

Dredge holes occur when the aquatic bottom is dredged to a point substantially below that of the surrounding unaltered terrain. The majority of these pits have been constructed primarily to obtain fill material. In such a project, a dredge operator will usually position his rig adjacent to the site of the proposed fill and commence pumping material from the submerged lands into the desired area. It has been estimated that for every acre of filled land created in this manner, about three acres of submerged sediments are required (Odum, 1970). When the dredge and fill operation occurs in estuaries, the dredge areas are generally shallow water zones where submerged aquatics have sufficient light for photosynthesis, and productivity is relatively high. Similar shallow water zones and valuable saltmarshes are the normal fill sites.

Incentives for Dredging and Filling

Dredging for fill material has been a common practice (Marshall, 1967). The primary incentive is financial. A secondary reason is convenience. Upland sources of fill material require a more sophisticated system of transportation and involve a greater cost per cubic yard of fill; therefore, a greater total expense. Since many State governments will sell submerged lands and marshes (public resources) at a fraction of the value of adjacent uplands, dredge and fill for the purpose of creating upland real estate is a financially lucrative enterprise. The major expense does not fall upon the developer but upon the public, and is not measured directly in dollars but in the destruction of public fish and wildlife resources.

Environments in Dredge Holes

The sump created by dredging a hole substantially deeper than the surrounding unaltered terrain has been shown to trap and accumulate sediments, organic material and other pollutants. The bottoms of dredge holes have been characterized as having unconsolidated, jelly-like, black sediments which are often anaerobic and strongly smelling of hydrogen sulfide (J. Casey, personal communication; Saloman, n.d.; Murawski, 1969; Drobeck, 1970). It has been observed that the smaller and deeper the dredge hole, the more likely these conditions will result (Murawski, 1969; Dowd, 1972). Relative depth below the surface appears to be the major factor which affects the benthic environment. When the bottom of a dredged area is substantially below the unaltered bottom, a sill is created. This sill is most often referred to when discussing dead-end canal systems (Daiber et al., 1972; Allison and Butler, 1973). However, holes dredged substantially below the unaltered terrain do possess this characteristic. Referring to areas possessing sills, Barada and Partington (1972) note that "...with rare exceptions, deep excavations are little affected by normal tidal action and currents." Bottom water exchange is thus impeded.

The lack of adequate flushing results in the accumulation of high concentrations of toxic substances and decaying organic material (Tayor and Saloman, 1968; Murawski, 1969; Drobeck, 1970; Daiber et al., 1972:

Butterfield, 1973). The decay of organic material particularly exerts a tremendous oxygen demand upon the overlying water which is often depleted to anaerobic conditions. Barada and Partington (1972) cite 16 references to emphasize that the above conditions are virtually universal when dredging occurs to depths greater than the adjacent terrain. They also note the above characteristics have been observed in areas in the open Gulf of Mexico as well as in bays, estuaries, and canal systems.

Relatively weak currents in deeper areas create particular problems for sessile organisms which are dependent upon the currents for food transport. Sanders (1958) reported that where weak currents occur, populations of filter feeding organisms (e.g. pelecyopods) are limited by the supply of food. It could be added that since the food supply is limited, so then are the more motile finfish and shellfish.

Since substantial depth differentials inhibit mixing of water, a stratification of temperature, salinity, and dissolved oxygen could occur (G. Nieswand, personal communication; Murawski, 1969; Daiber, *et al.* 1972; Lindall, *et al.* 1971). Stratification usually occurs during the highly productive summer months. Data collected in a 19-foot deep dredge hole in Assawoman Bay, Maryland, indicated salinity and dissolved oxygen (DO) stratification with very low bottom DO levels in June (4.2 mg/l), July (2.9 mg/l), and August (2.0 mg/l) (J. Casey, personal communication). In a 31-foot deep dredge hole in Florida, Saloman (n.d.) noted dissolved oxygen in most all samples was higher at the surface than the bottom, and low and critical bottom DO levels occurred from May to August. The National Advisory Committee to the Secretary of the Interior (Federal Water Pollution Control Administration), recommended in their 1968 report a minimum oxygen concentration of 4.0 mg/l for estuaries and tidal tributaries. The above criteria take into account oxygen requirements for the different stages in the life cycle of marine organisms. Oxygen concentrations which may be tolerated by mature animals with fully developed respiratory apparatus and the possible ability to escape a stressed area may be insufficient for egg and larval stages which normally have more intense metabolic requirements. In addition, low concentrations of DO may inhibit reproduction, feeding, and growth. Where the depth differential is small, it appears stratification is less likely to occur (Goodwin and Scholar, 1973; Butterfield, 1973).

In dredge holes exposed to good flushing, static conditions do not present problems. It has been shown that a paucity of benthic organisms may still, however, presist. A well flushed hole located in the side of Willoughby Bank near the Hampton Roads, Virginia, bridge tunnel construction site showed no stagnation or silting of fine particles as has been reported elsewhere (Boesch and Rackley, 1973). The community structure measures (diversity indices), however, still indicated a greater diversity and abundance of organisms in the unaltered control area. Boesch and Rackley (1973) attributed this difference to the greater number of infauna (i.e. living in the sediment) species at the control station. Drobeck (1970) found few animals, either epi- or infauna, in a dredge hole located in Sinepuxent Bay approximately 5,000 feet north of the Ocean City, Maryland, inlet where flushing is considered good as a result of strong tidal currents. It should be noted that since the paucity of animals could have been a result of the scouring action of swift tidal currents or the partial filling which were observed, Drobeck's results may not be conclusive.

Benthic Fauna and Sediment Interrelations

Reish (1960) and Rowe (1971) have noted that studies of the benthos are a good indicator of the productivity of a given area since highly variable production is integrated over a long time scale, thereby reducing large departures from the mean.

Rodgers and Darnell (1973) correlated data concerning the meiobenthos (bottom organisms, size range approximately 62 microns to 1mm) in two old dredge cuts in San Antonio Bay, Texas, with information on the sediment size distribution. It was found that modification of the particle size structure of the sediments was the probable causative factor reducing the meiofauna in the dredged areas to less than half of that in unaltered bottoms. The meiobenthos provide one of the chief food sources for many larger estuarine organisms, especially the juvenile fishes (Dineen and Darnell, 1973). The intimate relationship these share with sediment particles led Rogers and Darnell (1973) to believe the meiobenthos are probably the most sensitive biological indicators of the quality of the benthic environment.

Saloman (n.d.) observed that the quantity and variety of animal life in a 3-year old dredge hole off Treasure Island, Florida, decreased as sediment particle size decreased or depth increased. In addition to the lower abundance and diversity, Saloman noted that the size of the individuals, especially mollusks, were very small as compared to those in control areas. The hypothesis was that the substrate was not firm enough to support the weight of larger individuals. As the individuals grew and became heavier, they would sink into the substrate and die of suffocation when their siphons could no longer reach the surface. Saloman described the sediments at the bottom of this 31-foot deep hole as resembling jelly. A SCUBA diver was able to insert a 8-foot pole plus his arm's length into the bottom with little resistance, indicating the soft sediments had accumulated to a depth of at least 10 feet.

In Boca Ciega Bay, Florida, Taylor and Saloman (1968) linked the paucity of benthic invertebrates in dredged canals with the unsuitable habitat provided by the characteristic soft sediments. As compared to an average of 94 percent sand and shell in undredged areas of Boca Ciega Bay, sediments in the dredged canals averaged 92 percent silt and clay. Also in Boca Ciega Bay, a comparison of mollusks and bottom types by Sykes and Hall (1970) showed that species and individuals were much less numerous in soft sediments of canals than in the sandy sediments of undredged areas of the bay. The dredged canal sediments averaged 85 percent silt and clay as compared to natural bottoms in the bay averaging 91 percent sand and shell.

Drobeck, et al. (1969) indicated that invertebrate species of value in the diet of waterfowl wintering in Chincoteague Bay, Maryland, are associated with a sand substrate. Since experience with dredging projects has indicated to Drobeck and Company that the bottom type changes from sand to mud, they warn that dredging holes for fill material may have an adverse effect upon the waterfowl resource. While working in this same geographic area, Anderson and Holleran (1969) also expressed concern for the natural resources threatened by proposed dredge hole construction. Their experience indicated that once dredging was allowed to disturb the benthic community, there were no assurances that the community would return to the predredged diversity and abundance.

Foraminfera communities also show negative affects in relation to areas altered by dredging. In seven of eight pairs of samples taken from dredged verus undredged bottoms in San Antonio Bay, Texas, Poag (1973) observed that the number of foraminfera specimens was significantly lower in the dredged areas.

The results of Boesch and Rackley (1973) show that when a firm substrate such as shell is available, the epifauna will rapidly recolonize a dredge hole. However, it was noted that reestablishment of the infauna requires a longer period.

Taylor and Saloman (1968) observed that although the existence of soft sediments alone does not necessarily create a paucity of benthic organisms, the frequently accompanying conditions (e.g. high organic matter and low dissolved oxygen) will dictate an impoverished benthos. They cited Thorson (1957) as indicating that many benthic forms are sensitive to sediment composition and will not metamorphose from a planktonic stage until a suitable substrate is contacted.

Comparing oyster spatfall in a natural area to that in a dead-end canal system where the sediment was 41 percent silt and clay, Trent, et al. (1972) observed spatfall was about 14 times greater in the natural area. Galtsoff (1964) noted that soft mud and shifting sand were unsuitable bottom types for oyster.

A study of dredge holes in San Antonio Bay, Texas, shows dredging results in the direct destruction of benthic fauna (Harper, 1973). A very dissimilar species composition was found to have become reestablished when Harper compared the fauna in post construction dredge holes with control sites.

It has been demonstrated that environmental stress changes species percentage composition (Pisapia, 1973). Several east studies (Drobeck, 1970; Daiber, et al. 9172; and Butterfield, 1973) have shown that the benthic species composition of altered bottoms differ from control areas. Characteristic stress tolerant polychaetes frequently dominate the altered communities with a high percentage of capitellids often found. Members of this family burrow through the substrate obtaining their food by injesting organic matter in the sand and mud (Barnes, 1963). Capitellids are resistant to increased concentrations of phosphates and reduced chlorinities, and moderately resistant to oxygen stress (Reisch, 1970). Where the dissolved oxygen of bottom waters is between 1.6 and 3.5 mg O_2/liter, *Capitella capitata* is frequently the dominant polychaete preset (Reisch, 1966).

Effects of Organic Matter Accumulation

Very often, areas such as dredge holes where current velocity is low, accumulate high concentrations of organic material. Several investigations have shown dredge holes contain sediments with high amounts of organic matter and trapped decaying vegetation (Murawski, 1969; Drobeck, 1970). A concentration of organic material 15 times greater than the control area was reported by Saloman (n.d.). It is generally found that as the decomposition of organic matter increases, the density of benthic organisms decreases. Bader (1954) reported this relationship specifically for pelecyopods.

Highly organic sediments are often characterized as being black, foul smelling, anaerobic muds with little associated life other than a corresponding high number of bacteria. A high number of bacteria have a noticeable effect upon the benthic environment, depleting oxygen as a result of bacterial respiration (Zobell, 1942). Environmental changes associated with the biological consumption of oxygen includes the simultaneous decline in the oxidation-reduction potential (Eh). Linked with anaerobic conditions and a low potential is the appearance of toxicants, hydrogen sulfide (H_2S) in particular (Alexander, 1971). This toxin is deleterious to many benthic forms in low concentrations. Hydrogen sulfide is produced abundantly in anaerobic regions through the reduction of sulfates (May, 1973).

As noted above, few organisms other than bacteria are able to survive a highly reducing environment in the absence of free oxygen. Zobell (1942) observed that the absence of certain animals in the characteristically black, foul-smelling, anaerobic mud is probably not due to either the color of the sediment or directly to the highly organic content, but rather to the reducing environment.

Many estuarine organisms live within narrow tolerance ranges. Any additional stresses such as those caused by low levels of pollution (e.g. H_2S) or by decreased oxygen concentrations may exclude these organisms from the system (Odum, 1970).

Effects of Dredged Areas Upon Finfish

As a direct result of their mobility, finfish appear to be a segment of the estuarine community which are not directly impacted by dredge hole environments. However, the effect of a poor or limited supply of food organisms, ((Dineen and Darnell, 1973) in these areas are inadequate substrate conditions for demersal species (Goodwin and Sholar, 1973) does directly affect the diversity and abundance of finfish in a negative fashion.

A 19-foot deep dredge hole in Assawoman Bay, near 86th Street in Ocean City, Maryland, was investigated in 1973 (J. Casey, personal communication). In a near linear relationship, eleven finfish were observed in May samples as compared to only one finfish in the August samples. The negative trend coincides with stratification and low concentrations of dissolved oxygen in the late summer samples.

Taylor and Saloman (1968) found a 30 percent greater number of fish in Florida dead-end canals than in open bay areas, however, none were demersal species. As compared to 80 species caught in the open bay, only 49 species were collected in the canals.

During a non-quantitative survey of finfish in Chincoteague Bay, Maryland, Wiley, et al. (1970) trawled three dredge holes. Several of the 17 species collected were not commonly found in the shallow water portions of the bay. A temperature differential between the naturally shallow waters of the adjacent areas and the water in the deeper dredge holes may, as Murawski (1969) and Kinne (1963) have suggested, act as a fish concentrator. These three holes, for which no physical data are given, may therefore reflect a biased seasonal finfish population. During periods of dissolved oxygen stress, as may occur during summer months, the fish concentrated in the holes may flee (Kinne, 1963). Murawski (1969) observed that dredge holes in the Mullica River, New Jersey, maintain winter bottom temperatures 10-20°F warmer than surface water temperatures. The warmer bottom water may attract fish seeking refuge from the colder surface waters. These fish would become trapped during prolonged winter weather being unable to escape the deeper dredge hole without entering colder water. An overturn created by the denser cold water sinking to the bottom could therefore have an adverse effect upon this public resource. Thermal shock has been implied as causing winter fish kills (J. Casey and L. Shanks, personal communication).

Daiber, et al. (1972) reported significantly lower fish populations in southern Delaware dead-end canals as a result of low dissolved oxygen levels. During certain periods, the deeper waters became anoxic. A mortality study using the most abundant fish species found in these canals, the mummichog (Fundulus heteroclitus), resulted in fish kills when bottom waters of the poorly flushed canals became anoxic.

Harper (1973) examined the effects of dredge hole environments upon nektonic populations in Texas. Seasonal changed were shown. In winter, populations in holes 4 to 14 years old were higher than in control areas, whereas summer populations in the dredge holes was uniformly lower. As noted previously, the result of warmer waters in winter and low dissolved oxygen during the summer may be the cause of these seasonal population shifts.

Recovery of Dredged Sites

Biotic and abiotic recovery of dredge holes and bottoms distrubed by dredging appears to be a function of depth in relation to the undisturbed substrate, sediment particle size distribution, and local conditions. Several groups, including enthusiastic real estate developers, have contended recovery is rapid. Others, including knowledgable ecologists, indicate recovery is slow or non-existent.

A 31-foot deep dredge hole in waters 15 feet deep off Treasure Island, Florida, exhibited no signs of benthic recovery after 3 years, due primarily to an unsuitable substrate (Saloman, n.d.). Taylor and Saloman (1968) report that benthic recolonization of Florida dead-end canals had been negligible after 10 years. They indicated that it was doubtful the associated soft sediments would never support a rich or diverse infauna.

Rogers and Darnell (1973) found that recovery of the meiobenthos in dredge cuts in San Antonio Bay, Texas, was only about 80 percent complete after 13 years. Foraminiferal communities were reported by Poag (1973) to show no indication of large scale permanent environmental shifts following 20 years of shell dredging in San Antonio Bay, Texas. It was noted, however, that a maximum 12-year recovery period appeared to be required for the sedimentary conditions to regain their predredged state. Also in San Antonio Bay, Harper (1973) reported that the recovery of benthic fauna in dredge holes was rapid over a 4 to 6 year period followed by a slower rate. The dredge holes which Harper studies were relatively shallow, filling from 6 feet below the natural bottom to 1 foot below within the 4 to 6 year period. Existing dredge holes in Assawoman and Sinepuxent Bays, Maryland, and elsewhere, which are much deeper in relation to the unaltered bottom do not fill nor does the benthic community recover (J. Casey and D. Harris, personal communications; Murawski, 1969; Odum, 1970). Harper (1973) did not estimate the time required for total recovery, although a 22-year old hole he investigated was still 6 inches below the natural bottom. It appears that recovery or nonrecovery of the benthic community, including morphology of the bottom, is a function of original depth and local conditions.

In two of the dredge holes examined by Drobeck (1970), conditions existed which indicated these environments were highly stressed. One of the holes was dredged 7 years previous, the other was 15 years old. In South Biscayne Bay, Florida, a 28-year old dredge hole has accumulated large quantities of untreated sewage. Although the sewage source had virtually been abated, Odum (1970) observed that the dredged area remained barren and anoxic with reducing conditions on the sediments.

Measures Recommended to Reduce the Environmental Impact of Dredge Holes

Recommendations by various authors to relieve the impact of obtaining fill material by dredging in estuarine areas range from intricate channel systems connecting the pits (Koo, 1973) to simply imposing a limitation on the depth in the dredged area. Limiting the dredging depth to keep the bottom within the euphotic zone (Lindall, et al., 1971) or recommending the altered bottom not exceed the natural water depths of the local area (Daiber, et al. 1972) appear to be reasonable. Dredged bottoms consistent with the unaltered area would not impede flushing thereby disposing of the major factor which results in poor environmental conditions and impacted benthic communities.

deWitt (1973) proposed utilizing an artificial aeration system to mitigate low dissolved oxygen caused by possible poor water circulation in dead-end canals in Ocean City, Maryland. Mechanical failure or human mismanagement would, in this case, add to the innumerable variables upon which narrowly tolerant estuarine organisms depend.

Although it is possible to think of dredge hole or canal designs which may be relatively less harmful than those of the present, it may be wiser in the long run to think in terms of not utilizing estuarine wetlands for this purpose.

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT

APPENDIX E

MITIGATION

INTRODUCTION

The Fish and Wildlife Service (FWS), working with Corps of Engineers (Corps) biologists, has evaluated and quantified the project-related impacts to fish and wildlife resources and their habitats using the FWS's Habitat Evaluation Procedures (HEP) and a man-day/monetary analysis. The results of these analyses were reported to the Corps of Engineers via a planning-aid report dated November 8, 1982, a preliminary draft Fish and Wildlife Coordination Act (FWCA) Report dated January 28, 1983, and a draft FWCA Report dated October 13, 1983.

In each of the above-mentioned reports, the FWS discussed and/or recommended that plans for mitigation for unavoidable adverse impacts to fish and wildlife resources be developed in cooperation with the Louisiana Department of Wildlife and Fisheries (LDWF), National Marine Fisheries Service (NMFS), Corps, and FWS. In our draft FWCA Report, we recommended that compensation be accomplished by implementing marsh management and shoreline stabilization measures concurrently with other project features. Such action would assure that fish and wildlife receive equal consideration with other project features and therefore effect full compliance with the FWCA.

Because the project was not substantially complete (i.e., at least 60 percent of the construction costs obligated) prior to the enactment of the FWCA, as amended, in 1958, mitigation should be provided for all fish and wildlife losses associated with past and proposed project work (proposed project work includes only the construction necessary to complete the High-Level Plan). It is recommended that mitigation be provided to fully offset the loss of 3,217 average annual habitat units (AAHU's) as quantified in the body of our final FWCA Report. The estimated economic impact of all project features on estuarine-dependent fisheries includes the average annual loss of 11,300 man-days of recreation valued at $44,100 and over 259,800 pounds of commercial fish and shellfish having a gross exvessel value of over $66,700.

Our October 13, 1983, draft FWCA Report acknowledged that several measures to rectify or reduce project impacts have been implemented, and suggested additional modifications in project design to further reduce project damages. However, project design and associated damages to fish and wildlife resources remain virtually unchanged since release of that report.

Corps personnel indicated at the April 18, 1984, public meeting and in subsequent telephone conversations that detailed planning for mitigation and compensation for this project would begin in June 1984 and that a final mitigation plan will not be complete before 1986. However, the Main Report and Supplement to the Environmental Impact Statement are being forwarded to the lower Mississippi Valley Division and the Office of the Chief of Engineers for review in July 1984. Under this schedule, the reports will proceed forward for authorization and funding of the requested project modifications without a plan to compensate for project-related fish and wildlife losses.

The FWS, in cooperation with the LDWF and NMFS, has developed the following prioritized mitigation and enhancement measures within the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project area. These proposals are presented in as much detail as possible within the existing funding and time constraints. We recommend that those mitigation/enhancement measures be developed in sufficient detail to be incorporated into the Main Report and Supplement to the Environmental Impact Statement; such action would facilitate their concurrent approval and funding with other project features. It is recognized that specific details for the proposed mitigation will be required once these measures are authorized; we suggest that such action be completed during advanced engineering and design stages.

NEW ORLEANS EAST

The area bounded by the South Point to Gulf Intracoastal Waterway (GIWW) hurricane protection levee on the east, GIWW on the south, Maxent Canal on the west, and Lake Pontchartrain on the north is known as New Orleans East (Plate 1 and Figure E-1). This 13,000-acre area was once a productive estuarine marsh receiving free tidal exchange with Lake Pontchartrain and surrounding marshes. However, levees constructed by non-Federal interests largely eliminated tidal exchange and estuarine organism usage of the area. Flap-gated culverts along the South Point to GIWW levee segment allow drainage of the area when water levels on the protected side of the levee exceed outside water levels. Sluice gates that can be closed whenever storms are predicted have been added to the culverts to provide further protection against extremely high tides associated with such storm events. As a result of this impoundment, natural water circulation and surface drainage have been grossly modified and plant species more characteristic of fresh and intermediate marshes have invaded the brackish marsh which formerly dominated this area.

Several agencies, groups, and individuals have recommended that the Maxent Canal levee alignment be selected rather than the authorized alignment, thereby eliminating hurricane protection to the 13,000-acre wetland area. Regardless of the hurricane protection levee alignment ultimately selected for this area, tidal exchange and estuarine organism usage of New Orleans East should be re-established. To this end, it is recommended that the existing water-control structures along the South Point to GIWW levee be modified to permit estuarine organism usage of the area. Depending upon the degree of hurricane protection eventually selected for the wetland portion of New Orleans East, these water-control structures could be gated to facilitate closure when storm tides are predicted. It may also be beneficial to close these structures whenever abnormally high tides threaten to raise water levels in the New Orleans East area above existing road beds, or to prevent extensive drying of the marsh during abnormally low tides. In addition, some ditching may be necessary to improve water circulation and estuarine organism usage of the entire area.

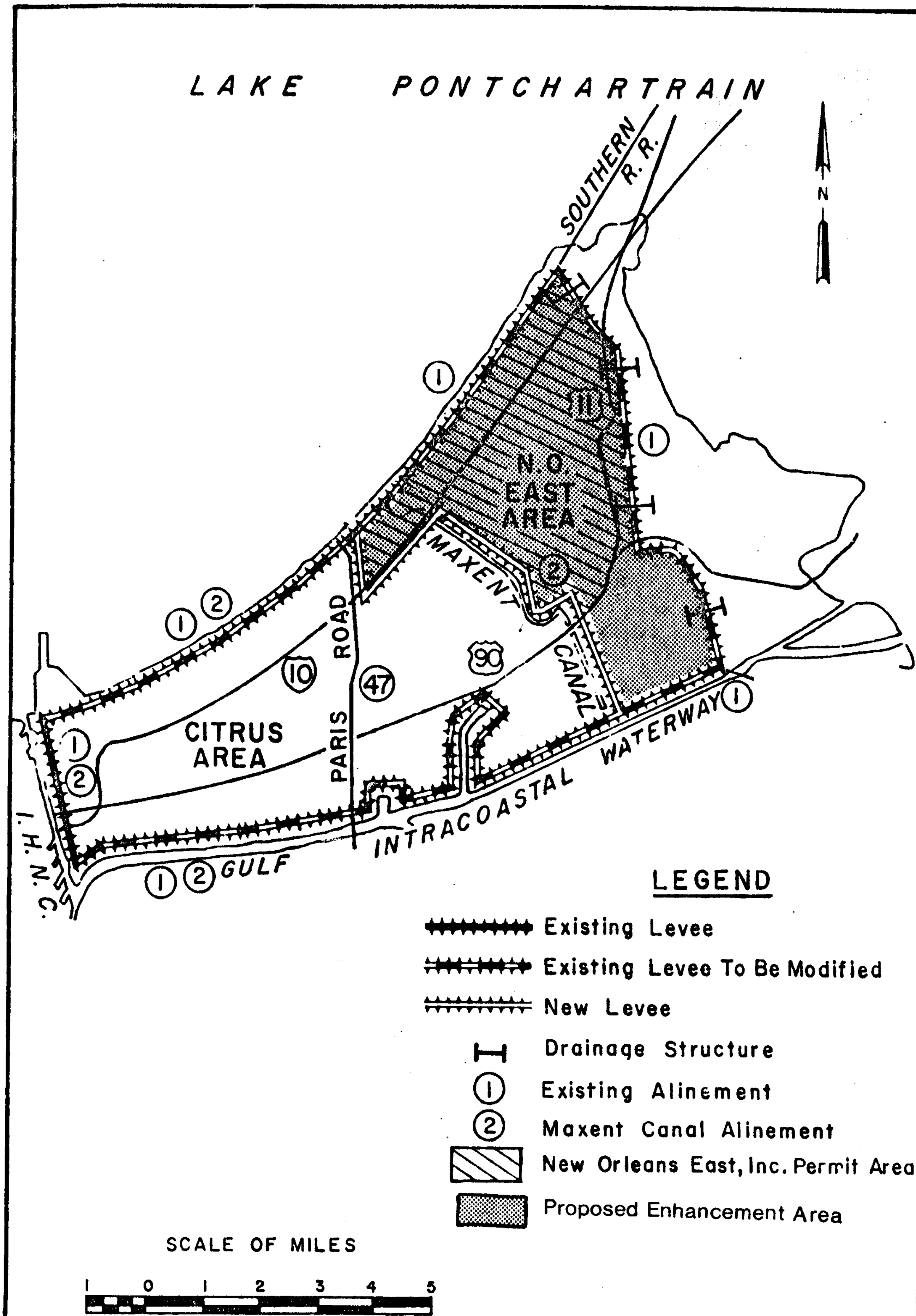

FIGURE E-1. Location of proposed enhancement feature in the New Orleans East area.

It is expected that estuarine usage will resume immediately upon re-establishment of tidal exchange. Assuming that estuarine-dependent fish and shellfish production in this 13,000-acre marsh would equal the average production of marshes in Hydrologic Unit I, the gross exvessel commercial fisheries of this area would increase by about $1.01 million annually. Sport fishing would be expected to increase by a potential 167,700 man-days valued at over $654,000 annually.

Because restoration of tidal circulation would cause increased salinities in the New Orleans East area, such action would not be expected to substantially increase the value of the area to the wildlife species used in the FWS's Habitat Evaluation Procedures (HEP) analysis. Therefore, this feature should be considered for enhancement of fishery resources. Implementation of the New Orleans East feature would require the purchase of non-development and flowage easements over the entire 13,000-acre area and modification of existing water-control structures. The benefits of such action would likely far exceed the costs of those measures.

ST. CHARLES PARISH (LABRANCHE WETLANDS)

The area considered for mitigation in St. Charles Parish is bounded by Lake Pontchartrain on the north, the St. Charles Parish-Jefferson Parish boundary to the east, U.S. Highway 61 to the south, and the Bonnet Carre Floodway to the west (Figure E-2). This area is locally known as the LaBranche Wetlands. Habitats within the LaBranche Wetlands changed drastically during the period 1956 to 1978 (Table E-1). This fact and the need to slow or halt the habitat degradation trend in this area was addressed by several State and Federal agencies and numerous individuals at the April 12, 1984, public hearing.

As indicated in Table E-1, the principal habitat changes in the area have resulted from the loss of fresh marsh and cypress-tupelo habitat to open water and upland developed habitats. It is obvious that the LaBranche Wetlands, like much of coastal Louisiana, are suffering from saltwater intrusion, subsidence, encroachment of residential/commercial/industrial development, and a host of other factors. Ecological succession following saltwater intrusion into fresher marsh types includes mortality of non-salt-tolerant vegetation. Fresh marsh vegetation is either replaced by salt-tolerant plants, or more often, the unvegetated soil oxidizes, compacts, and/or erodes to a depth not suited to re-vegetation; the latter condition fosters conversion to shallow open water habitat. Subsidence has also caused widespread conversion of marsh to open water.

Six major man-made openings into this marsh area were dug for pipeline installation and barge access to construct Interstate Highway 10. These canals have facilitated the rapid evacuation of fresh water from these marshes and allowed salt water to move further into this wetland complex. St. Charles Parish officials have been successful in getting two of these canals closed and are attempting to get funding from the State of Louisiana for the closure of the four remaining canals.

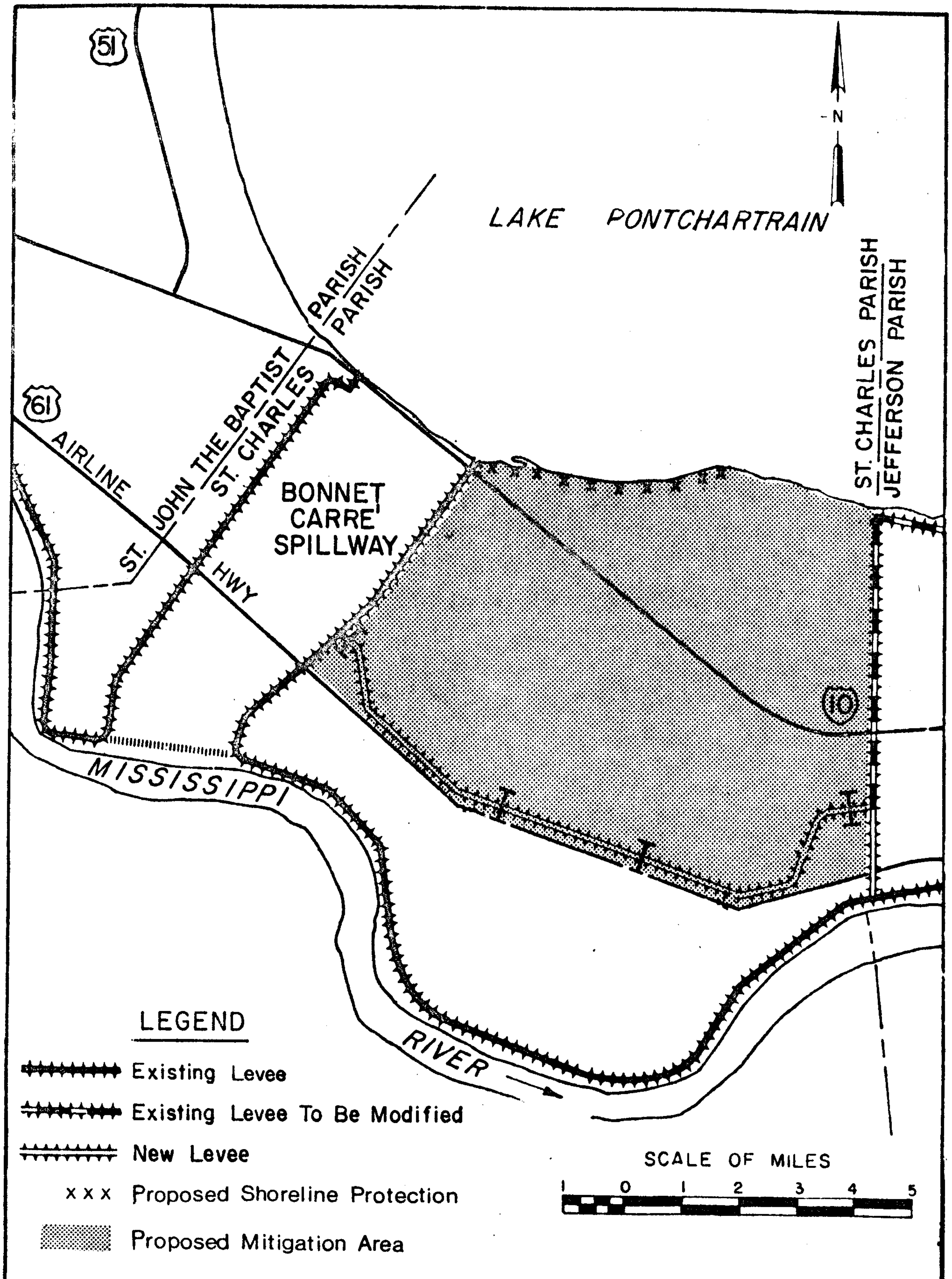

FIGURE E-2. Location of proposed mitigation in St. Charles Parish.

Table E-1. Comparison of habitat acreages in the proposed St. Charles Parish mitigation area during the period 1956 to 1978.

Habitat type	Acreages[1]		
	1956	1978	Change
Fresh marsh	3,915	348	-3,567
Non-fresh marsh	6,398	8,009	+1,611
Open water	249	3,003	+2,754
Rivers/canals	242	353	+111
Bottomland hardwood	200	37	-163
Cypress-tupelo	9,591	8,042	-1,549
Scrub-shrub	143	130	-13
Upland developed	200	1,002	+802
Total	21,038	20,954	-84

1. Acreages were planimetered by the U.S. Fish and Wildlife Service from 1956 and 1978 habitat maps.

Another serious problem in the LaBranche Wetlands is shoreline erosion. We predict that 3.25 miles of shoreline protecting the 2,190-acre area bounded by Lake Pontchartrain on the north, St. Rose Canal on the east, Illinois-Central Railroad on the south and the Bonnet Carre Floodway to the west will be breeched within the next few years. Adams et al. (1978) estimated shoreline erosion in this area to be about 9 feet per year. Local hunters and fishermen estimate the St. Charles Parish shoreline levee along Lake Pontchartrain from the St. Rose Canal to the Bonnet Carre Floodway to only be 20 to 30 feet wide in several locations at mean tide level. Based on this information, it is anticipated that this shoreline will be breached by 1987 and that Lake Pontchartrain would consume the shallow open water and soft marsh substrate between the existing shoreline and the Illinois-Central Railroad by 1989, if not sooner. Stabilization of the estimated 3.25 miles of shoreline from the St. Rose Canal to the Bonnet Carre Floodway should be accomplished to prevent this rapid degradation of marsh and shallow open water habitat.

A method of stabilizing this shoreline would be to hydraulically pump material from the lakebottom immediately lakeward from the Bonnet Carre Floodway to build a stable shoreline in the above-referenced reach. It is expected that the resultant dredge holes would fill with sediment the first time the Floodway is opened to relieve the Mississippi River of excessive floodwater. Shell or concrete mats would be draped over the new stabilized shoreline and topped with rock rip rap. It has been estimated that this work would cost about $2 million per mile of shoreline, or about $6.5 million to complete this shoreline stabilization project.

Habitat acreages under future conditions without mitigation for St. Charles Parish (FWOMSCP) were calculated using historic habitat change rates for the LaBranche quadrangle. It was also assumed that the Lake Pontchartrain shoreline will have moved to the Illinois Central Railroad embankment between the St. Rose Canal and the Bonnet Carre Floodway by 1989, thereby allowing destruction of 715 acres of marsh habitat in this area and endangering the integrity of the rest of this valuable wetland complex.

Under future conditions with mitigation for the St. Charles Parish area (FWMSCP) (i.e., the man-made openings into the LaBranche Wetlands are closed and the shoreline protecting this area is stabilized) salinities should stabilize and marsh loss should be substantially reduced. The projected marsh loss rates are expected to be reduced to 0.6 percent per year for fresh marsh and 0.5 percent per year for brackish marsh, which are the same marsh loss rates established for those portions of the Lake Pontchartrain basin where saltwater intrusion is not thought to be a problem (U.S. Army Corps of Engineers, New Orleans District 1983: D-23, D-25). By comparison, an estimated annual average of 2,646 acres more marsh habitat would be present in the LaBranche Wetlands under FWMSCP conditions than under FWOMSCP conditions (Table E-2).

In completing the HEP analysis, habitat preservation credit was given for the FWMSCP alternative, and habitat suitability indices (HSI) for muskrat, raccoon, shorebirds, and diving ducks were assumed to remain

Table E-2. Comparison of habitat acreages under future without mitigation (FWOMSCP) and future with mitigation conditions in St. Charles Parish (FWMSCP).

Project Condition	Year	Acres: Fresh marsh	Non-fresh marsh	Lake	River/ canal	Bottomland hardwood	Cypress-tupelo	Scrub-shrub	Upland developed	Total
FWOMSCP	1984	180	7718	3732	353	23	7673	127	1148	20,954
FWMSCP		180	7718	3732	353	23	7673	127	1148	20,954
FWOMSCP	1987	130	7549	4067	353	19	7495	125	1217	20,954
FWMSCP		130	7549	4067	353	19	7495	125	1217	20,954
FWOMSCP	1989	103	6716	5000	353	16	7188	124	1453	20,954
FWMSCP		114	7490	4214	353	16	7188	124	1453	20,953
FWOMSCP	2000	31	6150	6024	353	7	6595	119	1675	20,954
FWMSCP		107	7465	4632	353	7	6595	119	1675	20,953
FWOMSCP	2010	10	5645	6871	353	3	6098	114	1858	20,953
FWMSCP		101	7416	5009	353	3	6098	114	1858	20,953
FWOMSCP	2020	3	5174	7647	353	1	5639	110	2025	20,953
FWMSCP		95	7346	5383	353	1	5639	110	2025	20,953
FWOMSCP	2030	1	4742	8357	353	1	5214	106	2179	20,953
FWMSCP		89	7258	5753	353	1	5214	106	2179	20,953
FWOMSCP	2040	0	4347	9008	353	0	4822	101	2322	20,953
FWMSCP		84	7153	6118	353	0	4822	101	2322	20,953
FWOMSCP	2050	0	3986	9605	353	0	4459	97	2453	20,953
FWMSCP		79	7035	6477	353	0	4459	97	2453	20,953
FWOMSCP	2060	0	3657	10152	353	0	4123	93	2575	20,953
FWMSCP		74	6905	6830	353	0	4123	93	2575	20,953
FWOMSCP	2070	0	3356	10654	353	0	3812	90	2688	20,953
FWMSCP		70	6765	7176	353	0	3812	90	2688	20,953

(Continued)

Table E-2 (Continued)

		Acres							
Project Condition	Year	Fresh marsh	Non-fresh marsh	Lake	River/ canal	Bottomland hardwood	Cypress-tupelo	Scrub-shrub	Upland developed	Total
FWOMSCP	2080	0	3082	11115	353	0	3525	86	2792	20,953
FWMSCP		66	6617	7514	353	0	3525	86	2792	20,953
FWOMSCP	2090	0	2831	11538	353	0	3260	83	2888	20,953
FWMSCP		62	6462	7845	353	0	3260	83	2888	20,953
FWOMSCP	2100	0	2601	11927	353	0	3014	79	2978	20,953
FWMSCP		59	6303	8167	353	0	3014	79	2978	20,953
Annualized										
FWOMSCP		15	4482	8798	353	3	4921	101	2280	
FWMSCP		86	7057	6152	353	3	4921	101	2280	
Net change		+71	+2575	-2646	0	0	0	0	0	

1. FWOMSCP = future without mitigation in St. Charles Parish
2. FWMSCP = future with mitigation in St. Charles Parish

the same as under FWOMSCP and FWMSCP (Appendix B). The HSI's for nutria, deer, and puddle ducks were increased from 10 to 20 percent where appropriate in non-fresh marsh and lake habitats within 5 years after implementation, in recognition of their preference for lower salinity habitats (Table E-3). The HEP analysis indicates that completion of this mitigation project would cause an increase in the AAHU's of all evaluation species except shorebirds and diving ducks (Table E-4). These species prefer shoreline or open water, two habitats that will be reduced by the mitigation project. Consequently, the St. Charles Parish mitigation plan, on initial inspection, does not appear to be a particularly good plan for all evaluation species; this is more a result of the evaluation species selected than the mitigation plan. If shorebirds and diving ducks are eliminated from this evaluation, it was determined (using the sum of squares technique discussed in the main report) that 26,210 acres would have to be managed according to this scenario in order to fully offset losses in wildlife productivity due to the existing and proposed project features. Unfortunately, only 20,950 acres are available for mitigation in the proposed St. Charles Parish area. Therefore, additional mitigation will be required to fully compensate for project damages to wildlife resources.

A man-day/monetary analysis using the methodology described in Appendix C was also completed for this mitigation feature. This analysis indicates that an average of 36,200 man-days of sport fishing, hunting, and wildlife-oriented recreation valued at $97,940, and an increased fur catch worth $4,500, would result annually from implementation of this mitigation feature (Table E-5). In addition, an average increase of 801,200 pounds of estuarine dependent commercial fish and shellfish, having a gross exvessel value of almost $205,800 would also be harvested annually. The total monetary value of the sport and commercial fish and wildlife resources of this area is expected to increase by over $308,200.

ST. BERNARD PARISH (LAKE LERY AREA)

St. Bernard Parish officials have developed marsh management plans for much of their parish. One of these plans involves construction of low levees and water-control structures to improve and protect marsh habitat and water quality in the vicinity of Lake Lery. The Lake Lery Unit (Unit D) is bounded by the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Levee segment that extends from Verret to Caernarvon on the north, Louisiana Highway 300 on the east, and the St. Bernard/Plaquemine Parish boundary on the south and west. Saltwater intrusion and inadequate sediment inflow resulting from construction of the Mississippi River-Gulf Outlet and mainline Mississippi River levees have been largely responsible for marsh loss and habitat degradation in this area.

The Corps is presently working on the final design for an authorized Federal project to divert freshwater from the Mississippi River into adjacent marshes at Caernarvon. The freshwater diversion project is predicted to maintain fresh to intermediate marsh conditions in the Lake Lery Unit. However, construction of a spoil dike for shoreline

Table E-3. Average with-management habitat suitability index (HSI) values for each evaluation element by habitat type in the proposed St. Charles Parish mitigation area.

Evaluation element	Habitat suitability index (HSI)[1]							
	Fresh marsh	Non-fresh marsh	Lake	River canal	Bottomland hardwood	Cypress-tupelo	Scrub-shrub	Upland developed
Nutria	0.60	0.35	0.25	0.15	0.06	0.60	0.12	0.00
Muskrat	0.20	0.46	0.28	0.15	0.05	0.15	0.13	0.00
Raccoon	0.40	0.29	0.32	0.10	0.50	0.40	0.33	0.00
Shorebird	0.35	0.29	0.36	0.20	0.00	0.07	0.07	0.00
Deer	0.25	0.18	0.12	0.00	0.50	0.23	0.43	0.00
Puddle ducks	0.60	0.38	0.42	0.20	0.04	0.53	0.03	0.00
Diving ducks	0.30	0.30	0.38	0.20	0.00	0.10	0.00	0.00

1. HSI values for all evaluation elements except nutria, deer, and puddle ducks remained the same under future-without management and future-with management conditions. HSIs for nutria, deer, and puddle ducks were increased by 10 to 20 percent in non-fresh marsh habitat within 5 years after project implementation. The HSI for puddle ducks was also increased by 10 percent in lake habitat within 5 years after implementation of the mitigation features.

Table E-4. Comparison of average annual habitat units (AAHU's) under future without mitigation in St. Charles Parish (FWMSCP) and future with mitigation in St. Charles Parish (FWMSCP).

Evaluation element	AAHU'S		
	FWOMSCP	FWMSCP	FWMSCP VS FWOMSCP[1]
Nutria	6,539	7,038	+498
Muskrat	5,337	5,788	+452
Raccoon	6,164	6,281	+117
Shorebirds	4,888	4,718	-170
Deer	2,914	3,188	+274
Puddle ducks	7,610	7,969	+360
Diving ducks	5,249	5,048	-201
Total	38,701	40,030	+1,330

1. The change in AAHU's was calculated prior to rounding to the nearest whole number and, therefore, may not represent the change in AAHU's as shown in this table.

Table E-5. Man-day monetary changes due to mitigation in St. Charles Parish.

Activity	Habitat type	Average annual acreage change[1]	Man-days per acre[2]	Total man-days	Monetary value per acre[2]	Total monetary value
Sport fishing	Marsh	+2,646	12.9	+34,133	\$50.31[3]	\$82,810
Commercial fishing	Marsh	+2,646			77.77	205,779
Hunting	Fresh marsh	+71	1.2	+85	11.81	839
	Non-fresh marsh	+2,575	0.77	+1,983	5.55	14,291
Trapping	Fresh marsh	+71			5.02	356
	Non-fresh marsh	+2,575			1.61	4,146
			Total	36,201	Total	308,221

1. Average annual acreage change is calculated by subtracting the anticipated average annual acreage of a given habitat under future without mitigation from future with mitigation in St. Charles Parish (Table E-2). The only habitat types that change are fresh marsh, non-fresh marsh, and lake.

2. Man-days per acre and monetary value per acre were taken from Appendix C.

3. The monetary value per acre of sport fishing is calculated by multiplying the man-day per acre value (12.9) times the monetary value (\$3.90) for general recreation.

protection as described for Subunit D-6 and low levees and water-control structures in Subunits D-3 and D-5 as described by Wicker et al. (1982:99-105) is expected to 1) stabilize salinities and water levels and thus improve habitat suitability for selected wildlife species and 2) stabilize the existing marsh through water level manipulation and vertical accumulation of detritus (due to increased plant productivity).

Management objectives for Subunit D-3 are to use the Corps 100-acre borrow pit, a dike, and water control structures to maintain a freshwater environment for the benefit of furbearers, waterfowl, and freshwater fishery resources. According to Corps personnel, this Subunit has already been completed as partial mitigation for project damages to fish and wildlife.

The primary objectives for management of Subunit D-5 are to manipulate water levels and, to some extent, salinities to enhance nursery habitat for furbearers, waterfowl, and estuarine-dependent fisheries. Water level management will be facilitated through a system of flap-gated structures and ditches as described in the attached application for a Department of the Army permit (Attachment A).

Subunit D-6 is a long, narrow spoil levee that lies between the 80-arpent canal and Lake Lery (Attachment B). This levee has reduced wave erosion of the north shore of Lake Lery; however, the dike has been reduced in size and strength over the years. As described in the attached application for a Louisiana coastal use permit (Attachment 2), it is proposed that the 80-arpent canal be redredged to facilitate navigation and to supply material to rebuild and strengthen the spoil dike. Once the dredging operation is complete, clam shell or other suitable erosion resistant material should be added to the Lake Lery side of the spoil levee to absorb the wave energy. Strengthening the barrier dike will protect the marsh shoreline and the proposed Subunit D-5 water management structures.

The FWS's HEP analysis and a man-day/monetary analysis were completed for this mitigation feature. The HEP methodology was the same as described in Appendix B. Implementation of these management features will affect fresh/intermediate marsh (5,309 acres), lake (1,371 acres), and bottomland hardwood (248 acres) habitats. Under future-without management, the HSI's for all evaluation species were assumed to remain the same as the HSI's determined for the rest of the project area (Table B-6). Under future with-management conditions, HSI's are expected to increase for all evaluation species by 10 to 20 percent within 5 years after project implementation (Table E-6). The HEP analysis indicated that each evaluation element will receive a substantial gain in AAHU's (Table E-7). However, it would be necessary to manage about 12,700 acres in this manner to fully offset project-related AAHU losses. As only about 7,000 acres are available in St. Bernard Parish under the above-described management plans, additional mitigation features, such as those proposed for St. Charles Parish, would be necessary to fully compensate for project damages to wildlife resources.

The man-day/monetary benefits of the St. Bernard Parish mitigation plans were calculated based on a 10 to 20 percent increase in

Table E-6 Average with-management habitat suitability index (HSI) values of each evaluation element by habitat type in the proposed St. Bernard Parish mitigation area.

Evaluation element	HSI		
	Fresh/intermediate marsh	Lake	Bottomland hardwood
Nutria	.60	.28	.07
Muskrat	.28	.31	.06
Raccoon	.44	.35	.55
Shorebirds	.11	.40	.00
Deer	.42	.12	.55
Puddle ducks	.30	.46	.05
Diving ducks	.11	.46	.00

Table E-7. Comparison of average annual habitat units (AAHU's) under future without management in St. Bernard Parish (FWOMSBP) and future with management in St. Bernard Parish (FWMSBP).

	AAHU's		
Evaluation element	FWOMSBP	FWOMSBP	Change due to mitigation[1]
Nutria	3,278	3,577	+299
Muskrat	1,724	1,920	+196
Raccoon	2,686	2,944	+258
Shorebirds	1,024	1,129	+105
Deer	2,306	2,524	+218
Puddle ducks	1,858	2,224	+366
Diving ducks	1,052	1,210	+158
		Total	+1,600

1. Change due to management is calculated by subtracting AAHU's under FWOMSBP from AAHU's under FWMSBP conditions.

productivity, for wildlife only, using the methodology in Appendix C. Implementation of this plan will increase the average annual recreational usage of the area by 1,345 man-days and the total monetary value of recreational and commercial usage of the area by over $12,700 annually. According to the Corps, these marsh management structures are expected to cost about $750,000, or just over $6,800 annually over 110-year project life, well below the calculated average annual benefits. However, it may also be necessary to purchase flowage and non-development easements in this area, thereby increasing the cost of this plan.

CHEF MENTEUR PASS

The GIWW navigation channel by-pass was constructed to route GIWW traffic around the barrier structure proposed for the Chef Menteur Pass as an integral part of the originally authorized Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project. Spoil material dredged to construct the by-pass channel was deposited on 524 acres of brackish marsh. The spoil areas have since become scrub-shrub habitat of limited value to estuarine-dependent fishery resources and many wildlife species.

The NMFS has proposed that the spoil disposal areas be de-graded to marsh elevation; such action would help to mitigate previous and future project impacts. Spoil removed from these areas could be used to plug each end of the by-pass channel at its intersection with the GIWW. Any remaining spoil material could be used to at least partially fill the by-pass channel. The existing channel could also be used to deposit spoil material dredged from the GIWW during periodic maintenance operations. Completion of this proposal would re-establish estuarine-dependent fishery usage of the disposal areas and, with the change in habitat types (Table E-8), also increase the value for wildlife resources.

The HEP and man-day/monetary analyses were completed for this mitigation feature. For the HEP analysis, it was assumed that brackish marsh habitat would replace the 524 acres of scrub-shrub habitat by 1990. It was assumed that this marsh would then be lost at the same rate used for the project area (Appendix B). Evaluation species HSI's would correspond to those displayed in Appendix B for brackish marsh as well as lake, river/canal, scrub-shrub, and upland developed as these habitats replace brackish marsh habitat throughout the project area. The results of this analysis indicate that there would be a net gain of 613 AAHU's (Table E-9). It was determined, using the sum of squares technique discussed in the main report, that 2,559 acres would have to be managed according to this scenario in order to fully offset project impacts to wildlife resources.

A man-day/monetary analysis of this mitigation feature was also completed using the methodology in Appendix C. Implementation of this mitigation feature and the resulting change in acreage would be expected to produce an estimated average annual increase in estuarine-dependent fishery harvest of over 99,600 pounds valued at $25,590. This analysis also indicated an average annual increase of 4,630

Table E-8. Comparison of habitat acreages under future without mitigation (FWOMCMP) and future with mitigation conditons at Chef Menteur Pass (FWMCMP).

		Acres					
Project condition	Year	Brackish/ saline marsh	Lake	River/ canal	Scrub-shrub	Upland developed	Total
FWOMCMP	1984	0	0	0	524	0	524
FWMCMP		0	0	0	524	0	524
FWOMCMP	1987	0	0	0	524	0	524
FWMCMP		0	0	0	524	0	524
FWOMCMP	1990	0	0	0	524	0	524
FWMCMP		524	0	0	0	0	524
FWOMCMP	2000	0	0	0	524	0	524
FWMCMP		481	14	3	22	4	524
FWOMCMP	2010	0	0	0	524	0	524
FWMCMP		442	27	7	41	7	524
FWOMCMP	2020	0	0	0	524	0	524
FWMCMP		406	39	9	59	11	524
FWOMCMP	2030	0	0	0	524	0	524
FWMCMP		372	50	12	76	14	524
FWOMCMP	2040	0	0	0	524	0	524
FWMCMP		342	60	14	91	17	524
FWOMCMP	2050	0	0	0	524	0	524
FWMCMP		314	69	17	105	19	524
FWOMCMP	2060	0	0	0	524	0	524
FWMCMP		288	77	19	119	21	524

(Continued)

Table E-8. (Continued)

Project condition[1]	Year	Acres: Brackish/ saline marsh	Lake	River/ canal	Scrub-shrub	Upland developed	Total
FWOMCMP	2070	0	0	0	524	0	524
FWMCMP		264	85	21	130	24	524
FWOMCMP	2080	0	0	0	524	0	524
FWMCMP		243	92	23	141	25	524
FWOMCMP	2090	0	0	0	524	0	524
FWMCMP		223	98	24	151	27	524
FWOMCMP	2100	0	0	0	524	0	524
FWMCMP		205	104	26	160	29	524
Annualized							
FWOMCMP		0	0	0	524	0	
FWMCMP		329	57	14	108	16	
Net change		+329	+57	+14	-416	+16	

Table E-9. Comparison of average annual habitat units (AAHU's) under future-without mitigation at the Chef Menteur Pass (FWOMCMP) and future-with mitigation at the Chef Menteur Pass (FWMCMP).

Evaluation element	AAHU's		
	FWOMCMP	FWMCMP	Change due to mitigation[1]
Nutria	101	125	+25
Muskrat	110	185	+75
Raccoon	279	153	-125
Shorebirds	59	127	+68
Deer	104	363	-259
Puddle ducks	25	143	+118
Diving ducks	0	124	+124
		Total	+26

1. Change due to mitigation is calculated by subtracting AAHU's under FWOMCMP conditions from AAHU's under FWMCMP conditions. This calculation was made prior to rounding to the nearest whole number and, therefore, may not represent the actual change in AAHU's shown in this table.

man-days valued at over $18,000 in sport fishing, hunting, and wildlife-oriented recreation and an increase of $530 in the fur harvest. The total average annual monetary increase in the fish and wildlife value of the area is estimated to be $44,174.

SUMMARY

Completion of the mitigation features presented in this report would increase the total AAHU's by 2,956 (Table E-10). Evaluation elements receiving the greatest AAHU increases include puddle ducks (844 AAHU's), nutria (822 AAHU's), and muskrat (723 AAHU's). Evaluation elements receiving the least increases in AAHU's include shorebirds (3 AAHU's) diving ducks (81 AAHU's), deer (233 AAHU's), and raccoon (250 AAHU'S). These species prefer shoreline, open water, or scrub-shrub habitat, i.e., the three habitats that will be reduced under future with mitigation conditions. However, as discussed previously, marsh loss to open water and more upland habitats such as scrub-shrub is the problem of most serious concern throughout coastal Louisiana. Plans to slow this trend are preferable mitigation alternatives despite the apparent imbalance in AAHU gains by certain evaluation elements.

This imbalance does, however, make it particularly difficult to adequately compensate for project impacts to the evaluation elements selected for this project. The proposed wildlife mitigation features as presented in this appendix would benefit over 28,400 acres. Using the sum of squares technique to determine the acreage of mitigation needed to fully offset AAHU losses, it was determined that management of only 20,550 acres would be necessary to meet the compensation requirement. In some cases mitigation plans can be scaled down to reduce the area benefited by mitigation and precisely offset the AAHU losses as determined by this technique. However, implementation of all of the proposed mitigation features is needed to obtain a net positive impact for all evaluation elements. Therefore, the FWS recommends implementation of the proposed mitigation work in St. Charles Parish (LaBranche Wetlands), St. Bernard Parish, and Chef Menteur Pass to fully compensate for project-related losses to fish and wildlife resources. The FWS further recommends that estuarine fish and shellfish usage of the New Orleans East area be re-established as an enhancement feature.

The recreational usage and monetary value of the fish and wildlife resources of the project area are also expected to be substantially increased if all four of the mitigation/enhancement features are completed (Table E-11). An average annual gain of almost 209,800 man-days of sport fishing, hunting, and wildlife-oriented recreation valued at over $782,700, a gain of almost $1,242,400 in estuarine-dependent commercial fisheries harvest, and an increase of over $7,700 in the value of the fur harvest is expected.

A majority of the project impacts are due to past project damages associated with initial construction of the originally authorized barrier complexes and associated facilities, project features from which local sponsors will never receive benefits and, quite likely, never gave assurances for cost sharing on mitigation. Therefore, the

Table E-10. Total average annual habitat unit (AAHU) changes from the proposed mitigation features for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project.

	AAHU Change			
Evaluation element	St. Charles Parish[1]	St. Bernard Parish[2]	Chef Menteur Pass[3]	Total
Nutria	+498	+299	+25	822
Muskrat	+452	+196	+75	723
Raccoon	+117	+258	-125	250
Shorebirds	-170	+105	+68	3
Deer	+274	+218	-259	233
Puddle ducks	+360	+366	+118	844
Diving ducks	-201	+158	+124	81
			Total	2,956

1. AAHU change for future with mitigation in St. Charles Parish is from Table E-4.

2. AAHU change for future with mitigation in St. Bernard Parish is from Table E-7.

3. AAHU change for future with mitigation at the Chef Menteur Pass is from Table E-9.

Table E-11. Total gains in average annual man-days of recreation and monetary values associated with increased fish and wildlife productivity as a result of mitigation for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project.

Mitigation feature	Activity					
	Sport fishing	Commercial fishing	Hunting	WOR[1]	Trapping	Total
New Orleans East						
Man-days	167,700	-	-	-	-	167,700
Monetary value ($)	654,030	1,011,010	-	-	-	1,665,040
St. Charles Parish						
Man-days	34,133	-	2,068	-	-	36,201
Monetary value ($)	82,810	205,799	15,130	-	4,502	308,241
St. Bernard Parish						
Man-days	-	-	999	346	-	1,345
Monetary value ($)	-	-	11,356	1,350	2,689	15,395
Chef Menteur Pass						
Man-days	4,244	-	209	177	-	4,630
Monetary value ($)	16,552	25,586	816	690	530	44,174
				Grand total (Man-days)		209,876
				(Monetary value)		2,032,850

1. WOR = wildlife-oriented recreation.

FWS suggests that mitigation funding be a totally Federal responsibility. This rationale is further supported by the fact that the three mitigation features proposed in this appendix are designed to rectify impacts associated primarily with prior Federal projects (i.e., reduction of sediment inflow and saltwater intrusion due to the mainline levees constructed for the Mississippi River and Tributaries project, saltwater intrusion facilitated by the Mississippi River - Gulf Outlet project, and spoil deposition as a direct construction impact of the originally authorized Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project).

It should also be noted that restoring tidal exchange between the New Orleans East area and Lake Pontchartrain would primarily benefit estuarine commercial fishery resources. Applicable laws and regulations allow 100 percent Federal funding of first costs of commercial fishery enhancement projects if operation, maintenance, and replacement costs are assumed by non-Federal interests or a Federal fisheries agency.

LITERATURE CITED

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Wicker, K.M., G.C. Castille, III, D.J. Davis, S.M. Gagliano, D.W. Roberts, D.S. Sabins, and R.A. Weinstein. 1982. St. Bernard Parish: a study in wetland management. Prepared by Coastal Environments, Inc., Baton Rouge, LA, for St. Bernard Parish Police Jury, Chalmette, LA; contract No. 168-909.

APPLICATION FOR A DEPARTMENT OF THE ARMY PERMIT
For use of this form, see EP 1145-2-1

Form Approved - Office of Mgmt & Budget No. 49-R0420

ie Department of the Army permit program is authorized by Section 10 of the River and Harbor Act of 1899, Section 404 of L. 92–500 and Section 103 of P. L. 92–532. These laws require permits authorizing structures and work in or affecting navigable aters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of edged material for the purpose of dumping it into ocean waters. Information provided in ENG Form 4345 will be used in evaluating e application for a permit. Information in the application is made a matter of public record through issuance of a public notice. sclosure of the information requested is voluntary; however, the data requested are necessary in order to communicate with the plicant and to evaluate the permit application. If necessary information is not provided, the permit application cannot be pro– ssed nor can a permit be issued.

ne set of original drawings or good reproducible copies which show the location and character of the proposed activity must attached to this application (see sample drawings and checklist) and be submitted to the District Engineer having jurisdiction er the location of the proposed activity. An application that is not completed in full will be returned.

. Application number (To be assigned by Corps)

2. Date
23 FEB 1983
Day Mo. Yr.

3. For Corps use only.

. Name and address of applicant.

St. Bernard Parish Police Jury
8201 W. Judge Perez Dr., Room 202
Chalmette, LA 70043
Telephone no. during business hours
A/C (504) 277-6371 ext. 177
A/C ( )

5. Name, address and title of authorized agent.

Coastal Environments, Inc.
1260 Main Street
Baton Rouge, LA 70802
Telephone no. during business hours
A/C (504) 383-7455
A/C (504) 383-7451

. Describe in detail the proposed activity, its purpose and intended use (private, public, commercial or other) including description of the type of structures, if any to be erected on fills, or pile or float–supported platforms, the type, composition and quantity of materials to be discharged or dumped and means of conveyance, and the source of discharge or fill material. If additional space is needed, use Block 14.

he proposed work will allow surface water to be partially controlled for management of 272 acres of brackish marsh and shallow water bodies near Lake Lery, St. Bernard Parish Figure 1). The work includes installation of water control structures, dredging of trainsse ditches, and excavation of bottom material for dike construction (Figure 2). Approximately 3,050 cu. yds. will be dredged from the Creedmore Canal to construct (cont. on Sec. 14)

. Names, addresses and telephone numbers of adjoining property owners, lessees, etc., whose property also adjoins the waterway.

Mrs. Ruth P. Torres et. al, Victor Morales, Manuel Mackles, Walter Cure, Sr., Stephen Torres, Robert Melerine, Lloyd Estopinal, John Molero, Anthony Torres

. Location where proposed activity exists or will occur.

Address:
4 mi. southeast of Poydras, LA
Street, road or other descriptive location
Poydras, LA
In or near city or town
Parish - St. Bernard Louisiana
County State Zip Code

Tax Assessors Description: (If known)

Map No.	Subdiv. No.	Lot No.
	14S	13-14E
Sec.	Twp.	Rge.

. Name of waterway at location of the activity.

Bayou Mandeville, Cr[illegible]more Canal, Magnolia Canal

Attachment A

Date activity is expected to be completed unknown at present

11. Is any portion of the activity for which authorization is sought now complete? [ ] YES [X] NO
If answer is "Yes" give reasons in the remark section. Month and year the activity was completed ______. Indicate the existing work on the drawings.

12. List all approvals or certifications required by other federal, interstate, state or local agencies for any structures, construction, discharges, deposits or other activities described in this application.

Issuing Agency	Type Approval	Identification No.	Date of Application	Date of Approval
LDOTD	no objection	N.A.		pending
LDWF	no objection	N.A.		pending
LDHHR	no objection	N.A.		pending
LDNR-CMS	permit	unknown		pending
USFWS	no objection	N.A.		pending
NMFS	no objection	N.A.		pending

13. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein?

[ ] Yes [X] No (If "Yes" explain in remarks)

14. Remarks or additional information.

a 1.67 mi. dike of +3 ft. N.G.V.D. after first-year compaction. A series of 10 trainasse ditches will be dredged within the subunit to improve control of surface waters for marsh management and increase access points for fur trapping (Figure 2). Each trainasse will be approximately 0.5 mi. in length and will require 1320 cu. yds to be dredged. Spoil will be broadcast on alternating sides 100 ft. in length (Fig. 3). Water flow between the trainasse and the adjacent canal will be controlled by installation of a double flap-gate 36 in. culvert of asphalt-coated, corrugated steel at the junction of each trainasse and canal. (Fig. 4a). The culvert will be laid in the trainasse and covered with fill (Fig. 4b). In addition, 5 other water control structures will be installed in major drainages in the subunit (Fig. 2). These structures will consist of a 48 in. double flap-gated aluminum pipe set in a bulkhead with a stop-log and spillway (Fig. 5a). Assuming marsh elevation is +1.0 N.G.V.D., the invert elevation of the pipe will be -4.0 N.G.V.D. and the spillway crest elevation will be set at +0.5 N.G.V.D., or 6 in. below marsh level. An example of a typical flap-gate device is shown in Fig. 5B. The flap-gated structures will be managed to moderate salinities and partially control the hydrologic regime within the subunit to enhance habitat values for fish and wildlife. A general scenario of operation would include maintaining the gates completely open in the spring (i.e. March and April) for uninhibited ingress and egress of estuarine organisms. (cont. on next page)

15. Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

____
Signature of Applicant or Authorized Agent

The application must be signed by the applicant; however, it may be signed by a duly authorized agent (named in Item 5) if this form is accompanied by a statement by the applicant designating the agent and agreeing to furnish upon request, supplemental information in support of the application.

18 U. S. C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisioned not more than five years, or both. Do not send a permit processing fee with this application. The appropriate fee will be assessed when a permit is issued.

Water levels would then be lowered to low tide level in early summer by use of the flap-gates to promote soil aeration and enhance plant growth. During the rest of the summer water levels would be manipulated to remain at or slightly above soil surface. In the fall, water levels could be manipulated to improve conditions for marsh burning to facilitate winter trapping conditions and manage for important wildlife vegetative species. The gates would be locked closed during winter December - January to hold water and maintain access for trapping and/or waterfowl hunting. During February water levels will be gradually drawn down to low tide for detitral export and aeration of the soil prior to peak immigration of estuarine organisms. Those water control structures most directly influenced by the outfall of the proposed freshwater diversion structure at Caernarvon may have somewhat different operational scenarios to best make use of the fresh water and sediment resources for marsh management.

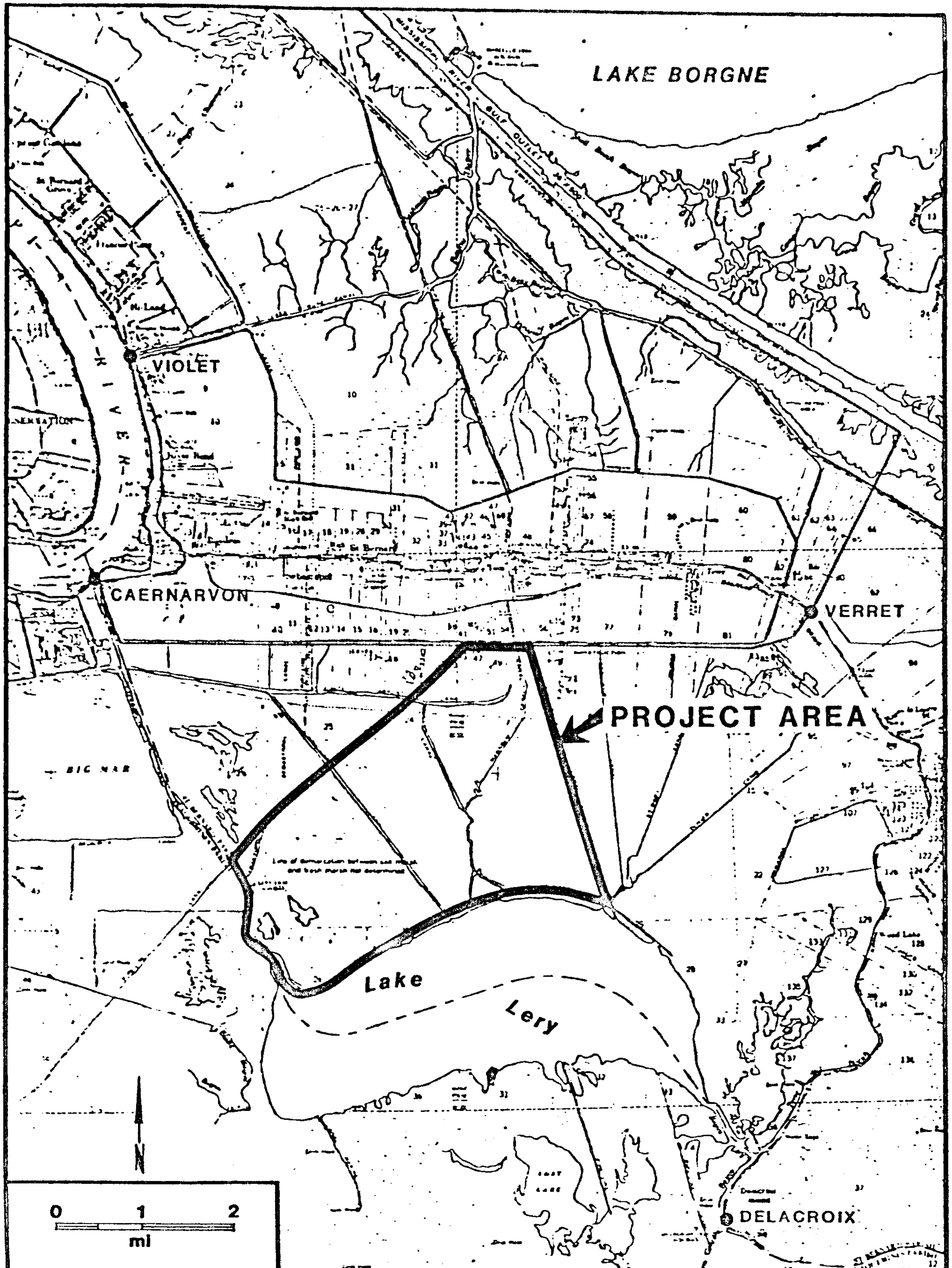


Figure 1. Vicinity map of proposed marsh management. Subunit D-5, St. Bernard Parish Wetland Management Program.

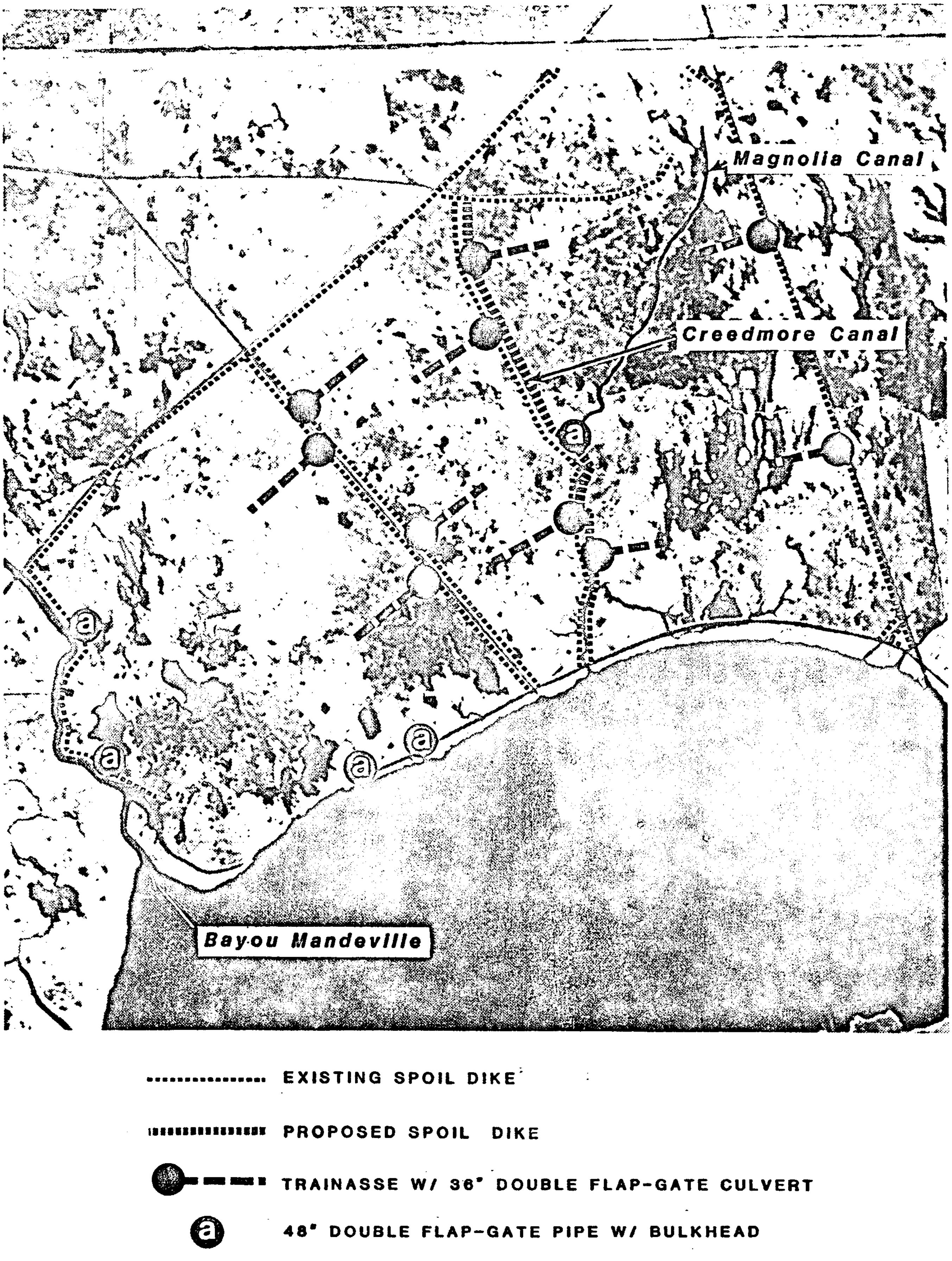


Figure 2. Extent of work proposed in Subunit D-5 to control surface waters for marsh management.

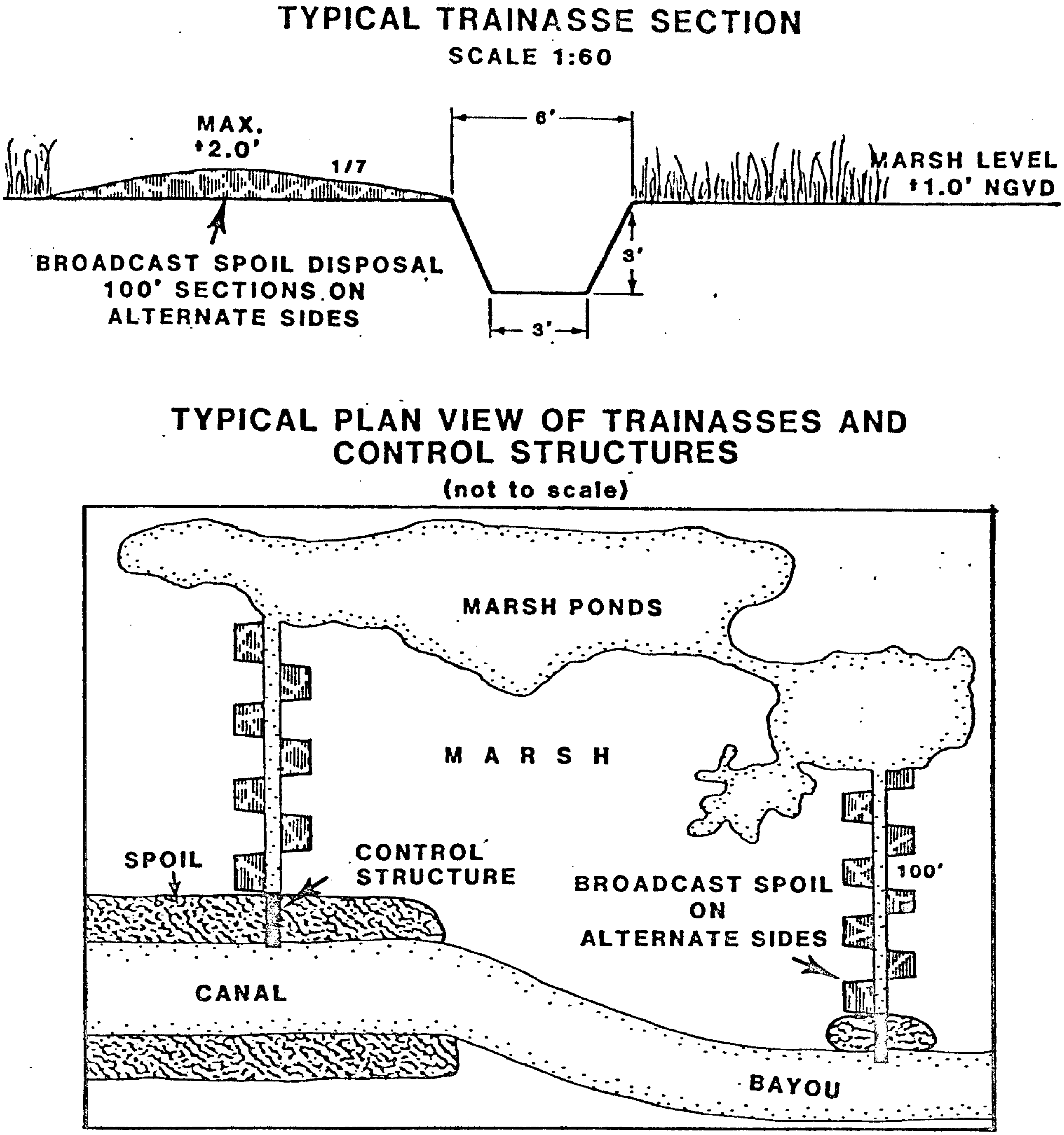


Figure 3. Section and plan view of typical trainasse ditch showing alternating spoil disposal and location of water control structures.

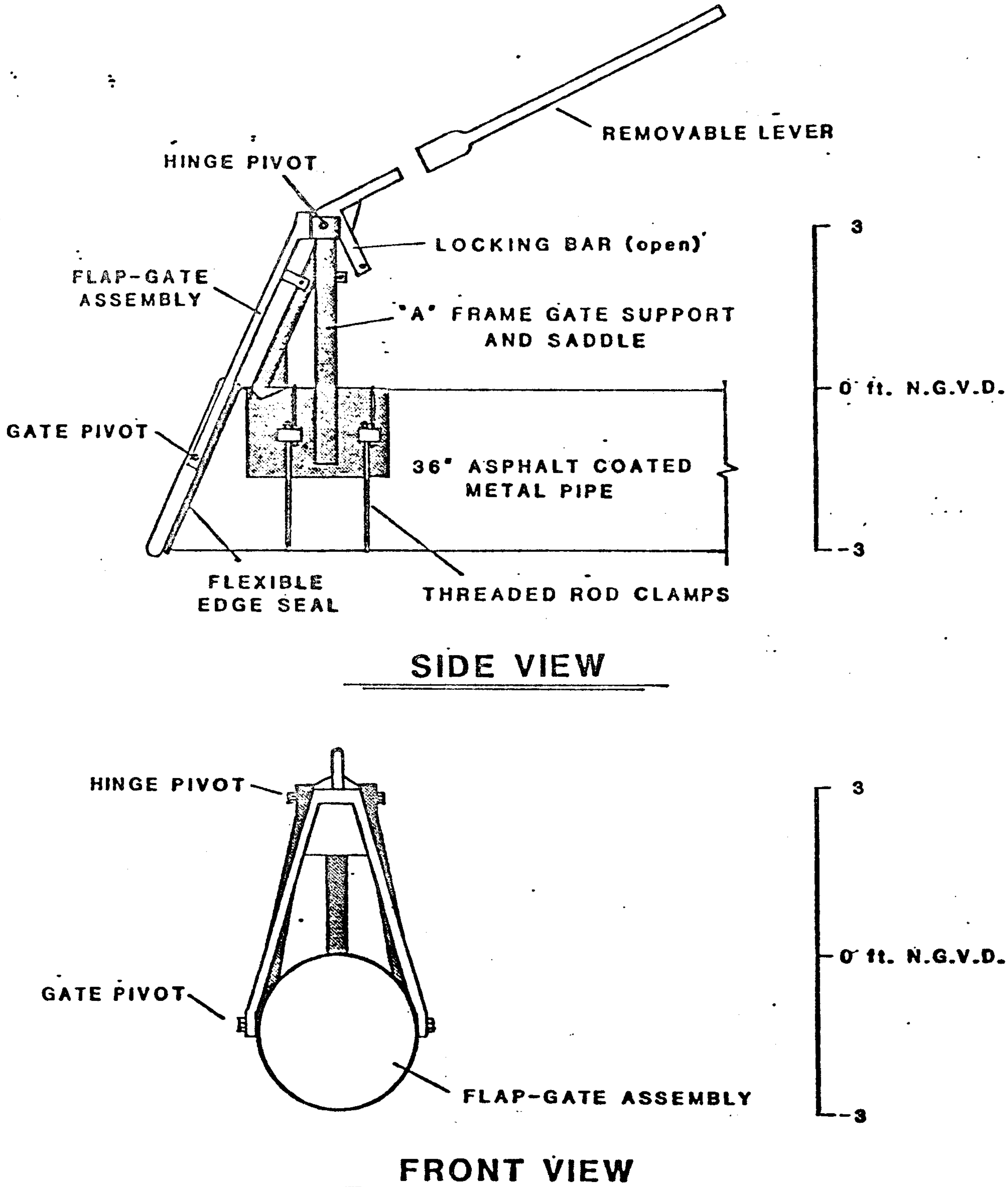


Figure 4a. Design for 36-in double flap-gated control structure to be installed in trainasse ditches.

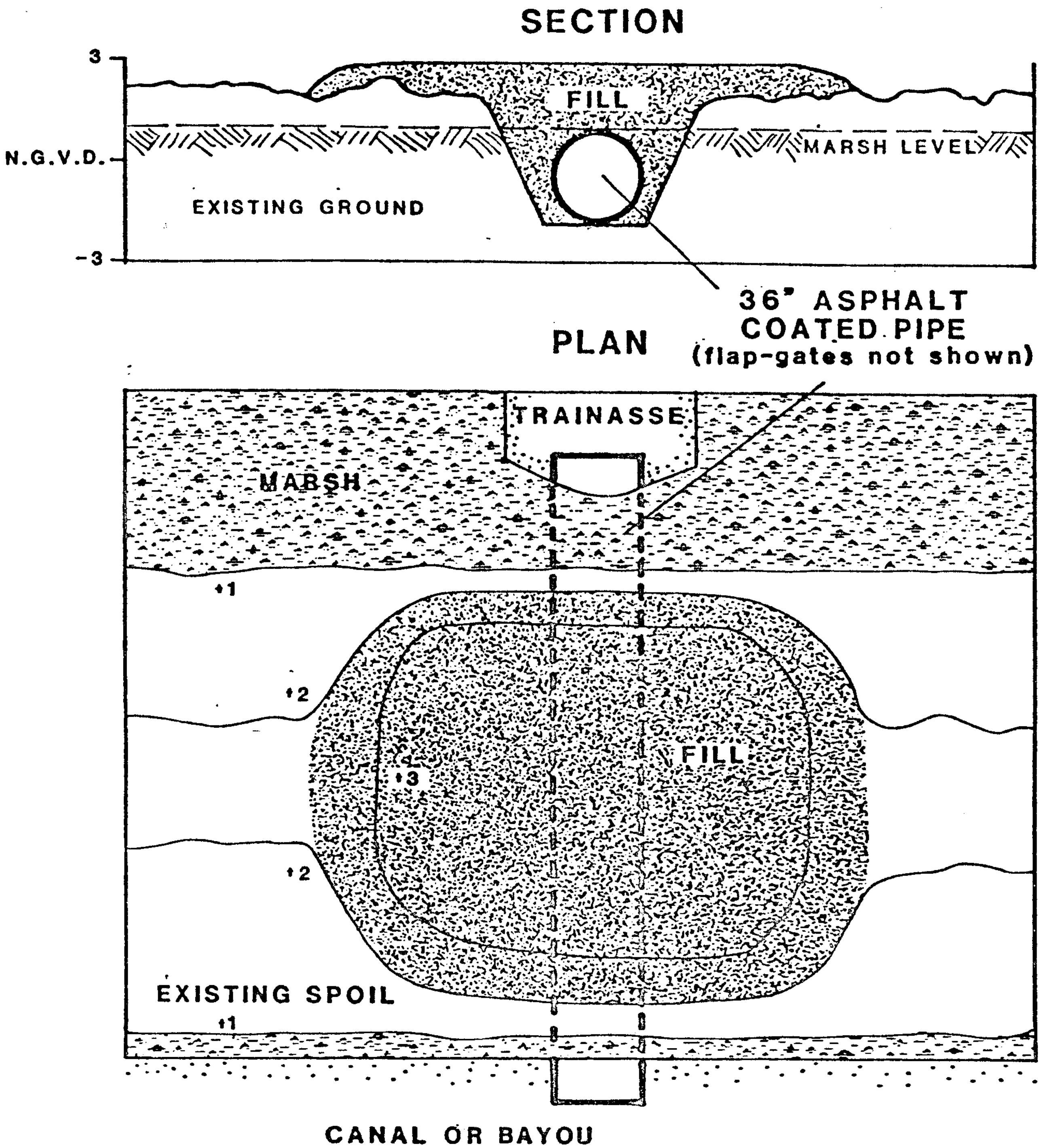


Figure 4b. View showing placement of 36 in culvert in trainasse with subsequent fill.

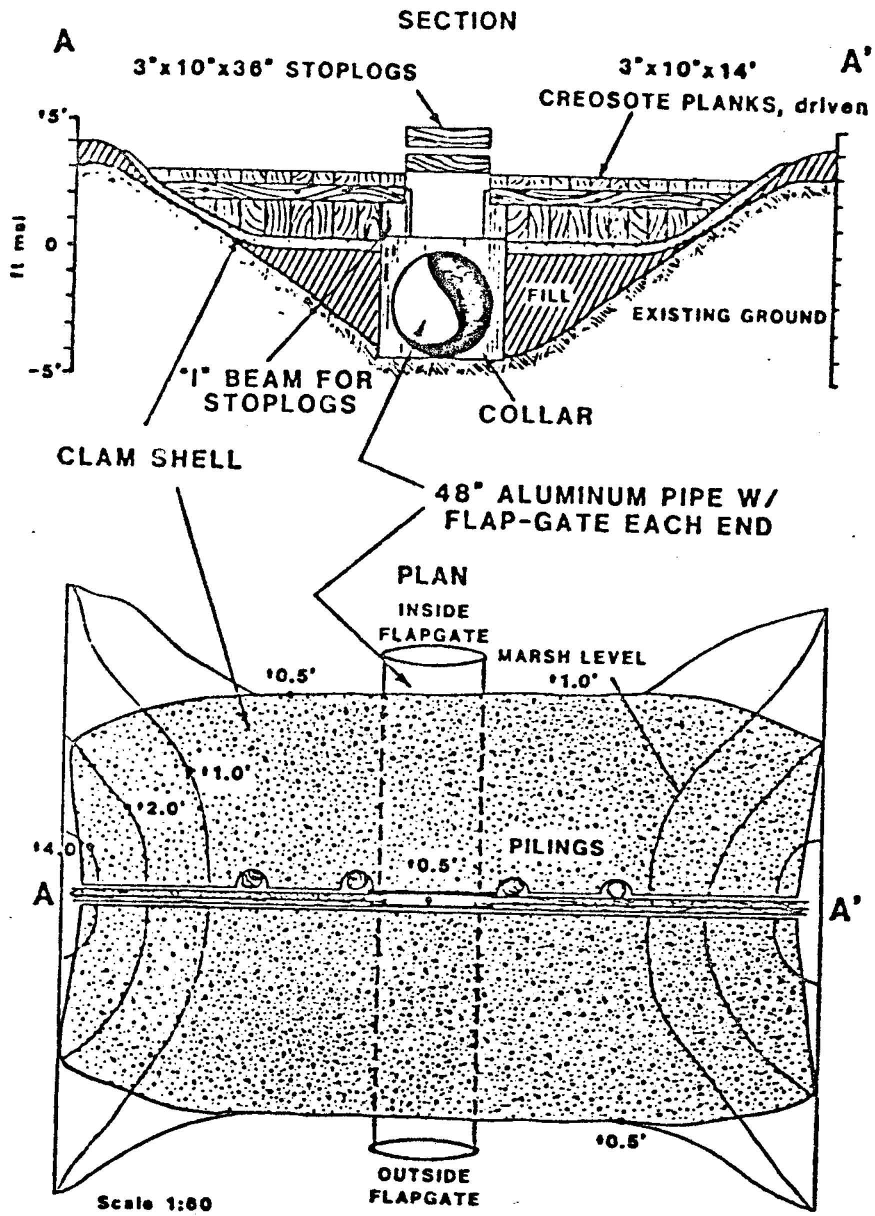


Figure 5a. Design of 48 in double flap-gated aluminum pipe control structure set in a wooden bulkhead.

PUBLIC NOTICE

LOUISIANA COASTAL USE PERMIT APPLICATION

March 15, 1983

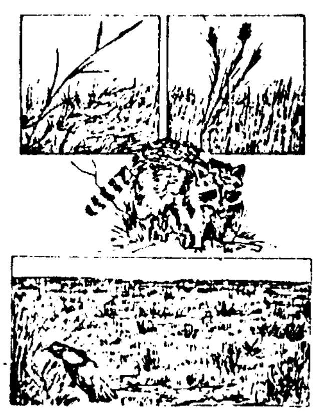
Interested parties are hereby notified that the Coastal Management Section of the La. Dept. of Natural Resources has received the following apparently complete application for a Coastal Use Permit in accordance with the rules and regulations of the La. Coastal Resources Program and R. S. 49, 213.1 - 213.21, the State and Local Coastal Resources Management Act of 1978, as amended.

C.U.P. APPLICATION # P830303 CORPS OF ENGINEERS # LMNOD-SP

Name of Applicant: St. Bernard Parish Police Jury, c/o Coastal Environments, Inc. 1260 Main St., Baton Rouge, LA 70802

Location of Work: ST. BERNARD PARISH, LA: T14S-R13-14E, 4.2 mi. NW of Delacroix, La., Eighty Arpent Canal along north shore of Lake Lery, sub-unit D-6.

Character of Work: Construct ± 4.2 mi. spoil dike for protection against shoreline erosion and storm surges; maintenance dredge Eighty Arpent Canal to a depth of -6' to -8' N.G.V.D; deposit ± 88,400 cu. yds. of spoil on land and along a 3,400' stretch of shallow open water; various dike construction techniques will be tried and compared along with various shoreline protection measures for that portion of the dike constructed in open water; ± 10.8 acres of brackish marsh to be altered by dike construction; ± 2.0 acres of land to be created in open water.

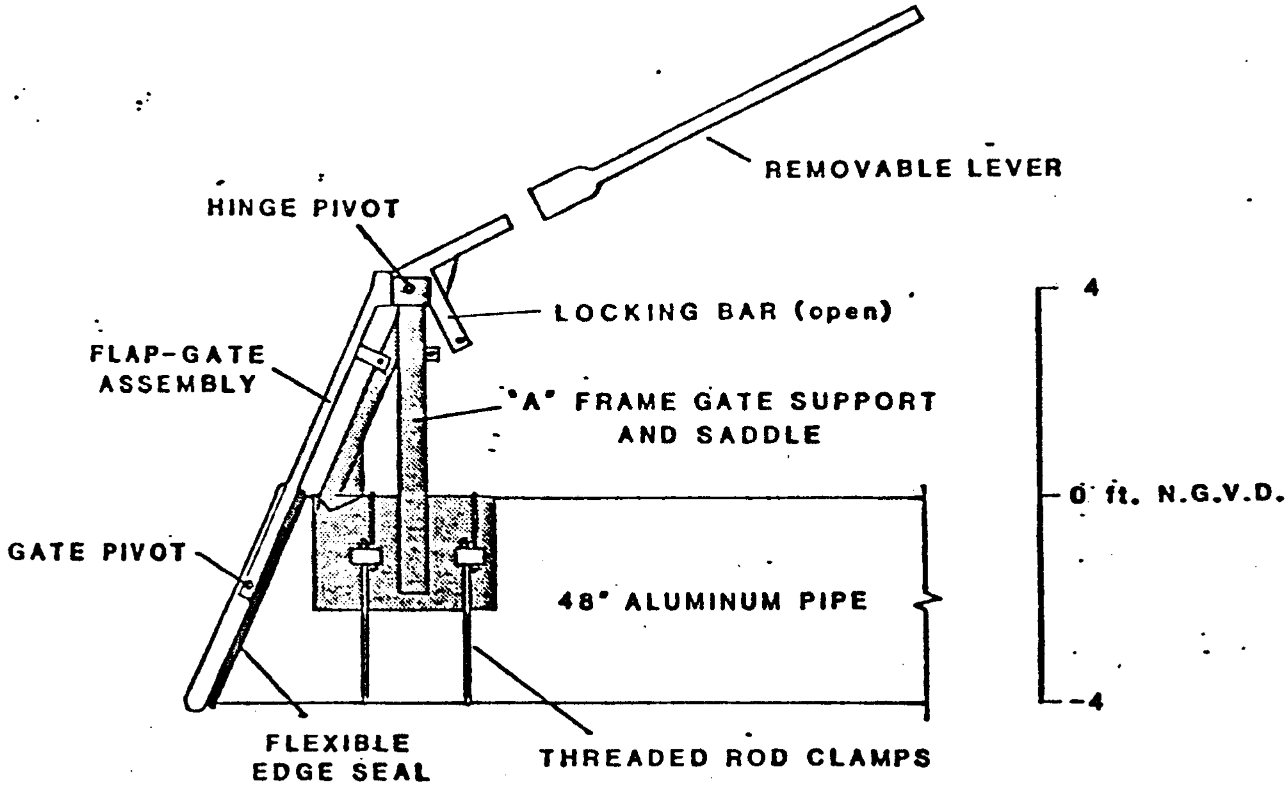


Brackish Marsh

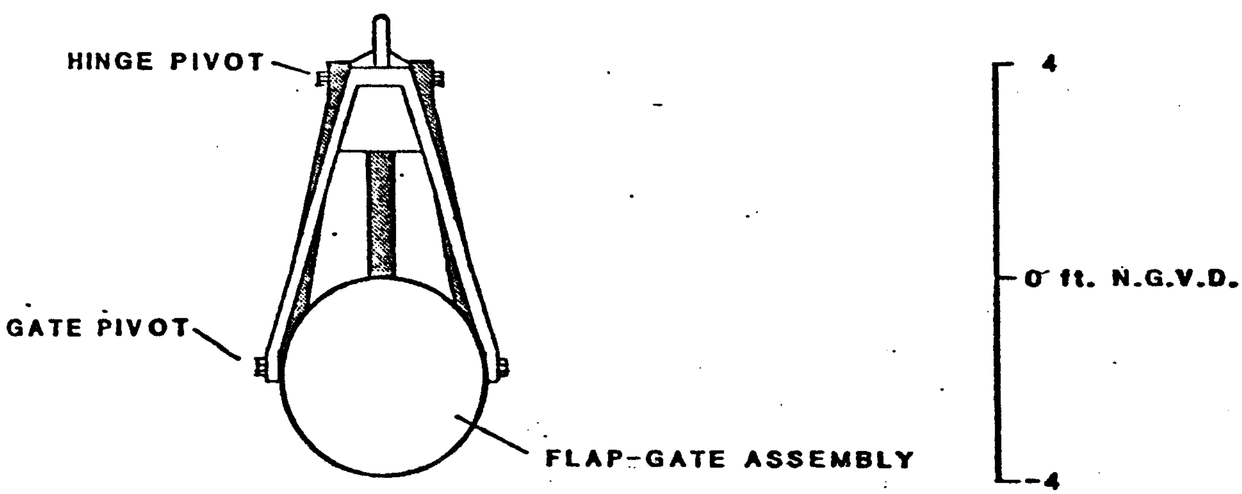
The best available information indicates that within the approximate 41,000 acre area around the project site 707 acres of coastal marshes/swamps have been lost between 1955 and 1978.

This public document was published at a cost of $0.06 per copy or $0.26 per mailed copy by the La. Dept. of Natural Resources, P. O. Box 44396, Baton Rouge, LA 70804 to inform the public about Coastal Zone Management under authority of Public Law 92-583 and R. S. 49:213. This material was printed in accordance with standards for printing by State agencies established pursuant to R. S. 43:31.

Attachment B



SIDE VIEW



FRONT VIEW

Figure 5b. Design of flap-gate assembly to be used with 48 in aluminum pipe.

The decision on whether to issue a permit will be based on an evaluation of the probable impacts of the proposed activity in accordance with the state policies outlined in R. S. 29:213.2. The decision will reflect the national concern for both protection and utilization of important resources. The decision must be consistent with the state program and approved local programs for affected parishes and must represent an appropriate balancing of social, environmental and economic factors. All factors which may be relevant to the proposal will be considered; among these are flood and storm hazards, water quality, water supply, feasible alternative sites, drainage patterns historical sites, economics, public and private benefits, coastal water dependency, impacts on natural features, compatibility with the natural and cultural setting and the extent of long term benefits or adverse impacts.

Certification that the proposed activity will not violate applicable water and air quality, laws, standards and regulations will be required before a permit is issued.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Request for public hearings shall state, with particularity, the reasons for holding a public hearing.

Plans for the proposed work may be inspected at the Office of the Coastal Management Section, 625 N. 4th Street, Room 1001, Baton Rouge, La., 504/342-7591. Written comments should be mailed within 25 days from the date of this public notice to Coastal Management Section, La. Dept. of Natural Resources, P. O. Box 44396, Baton Rouge, LA 70804.

JOEL L. LINDSEY
COASTAL MANAGEMENT ADMINISTRATOR

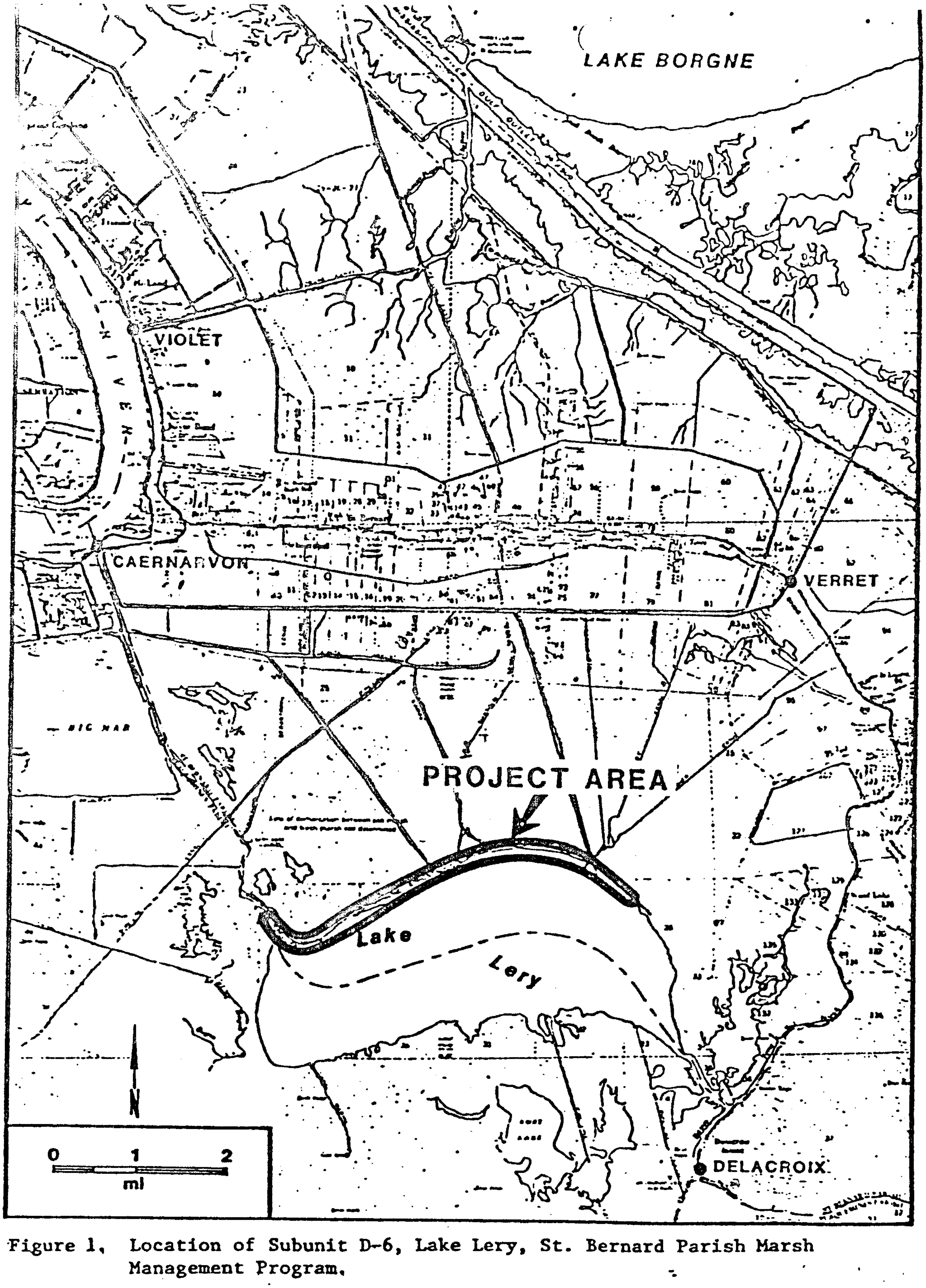


Figure 1, Location of Subunit D-6, Lake Lery, St. Bernard Parish Marsh Management Program.

P830303 1/

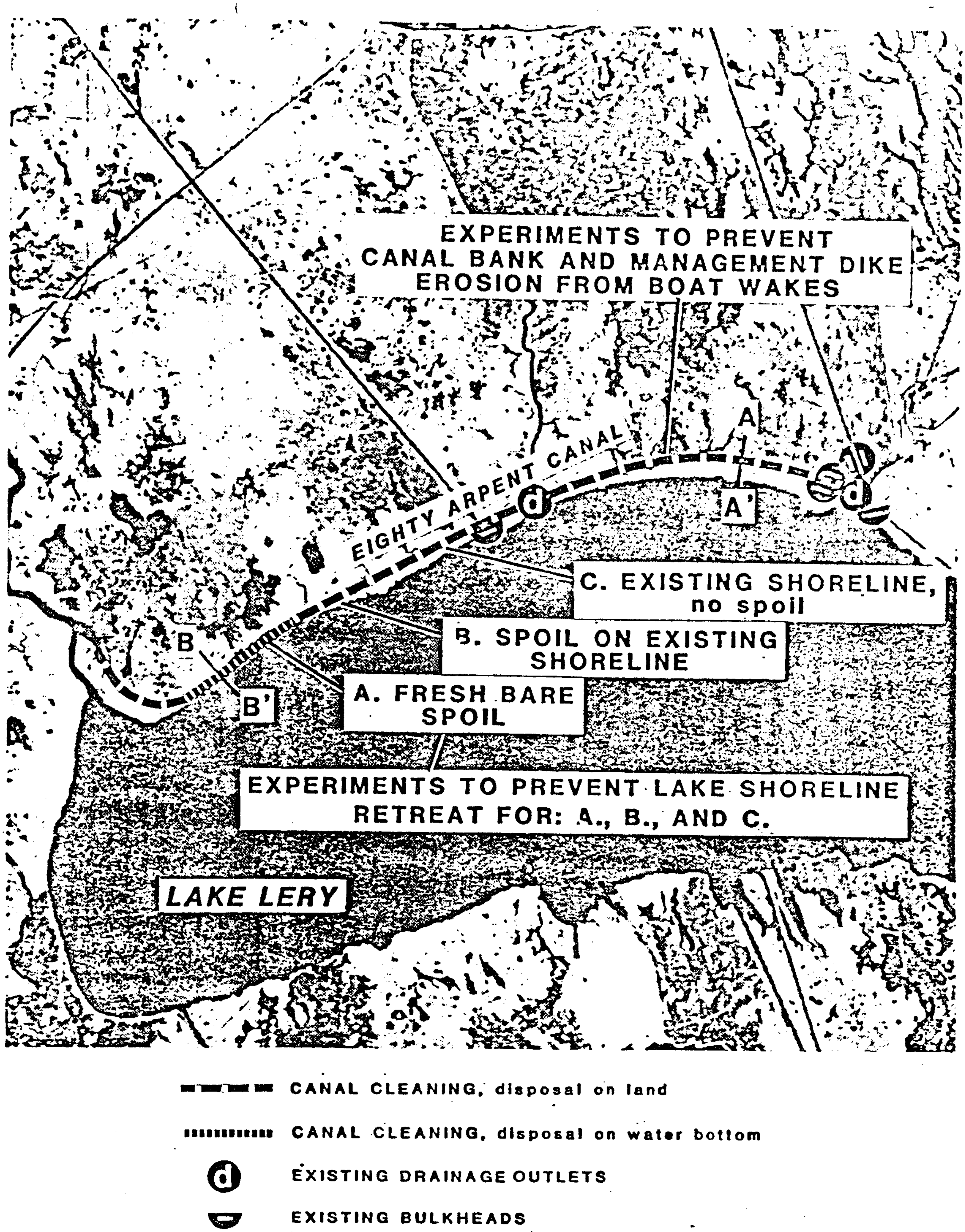


Figure 2. Extent of work proposed to allow navigation of the Eighty Arpent Canal and creation of an experimental area for testing shoreline protection measures.

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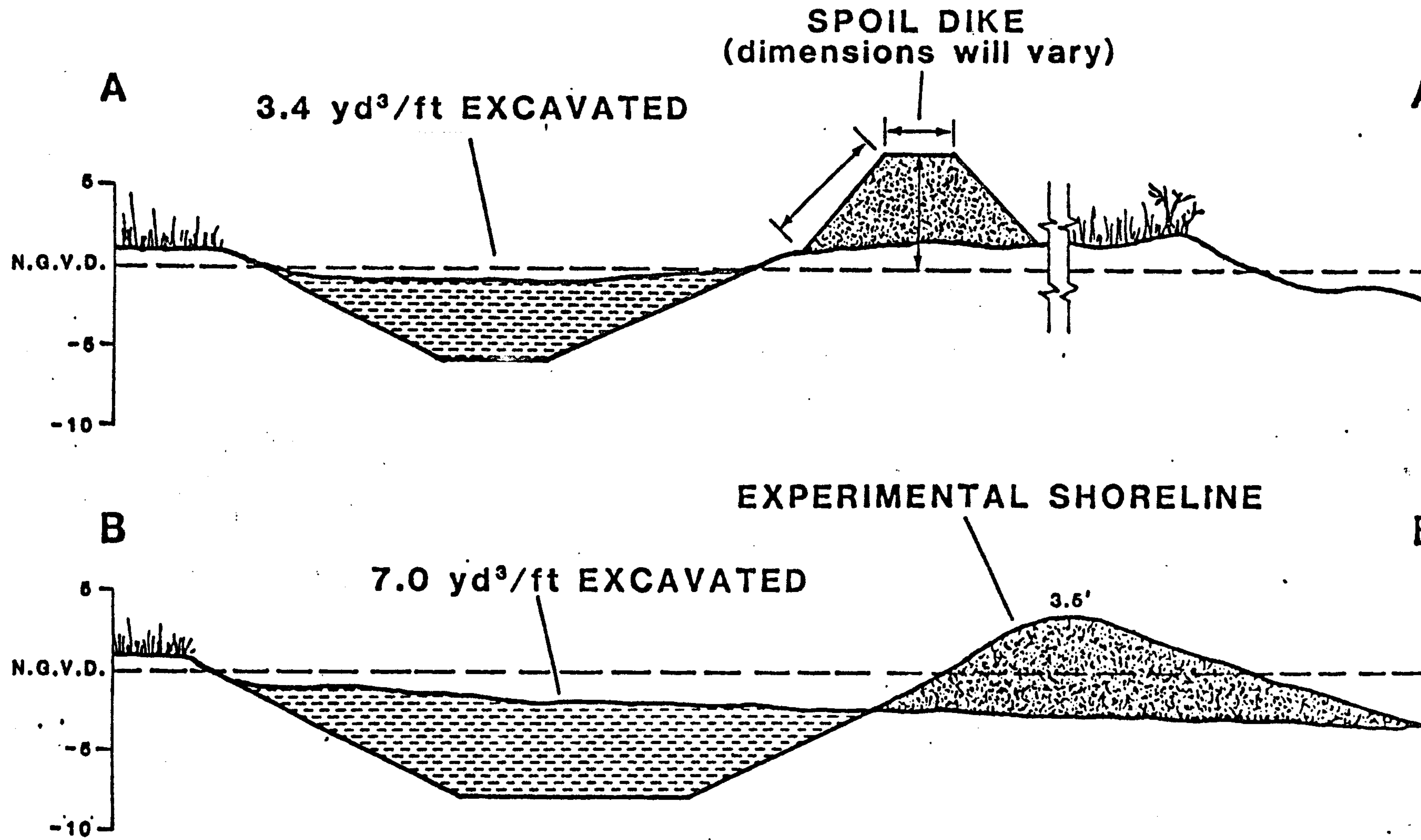

Figure 3. Typical cross-sections of proposed dredging, Eighty Arpent Canal .

P830303 31

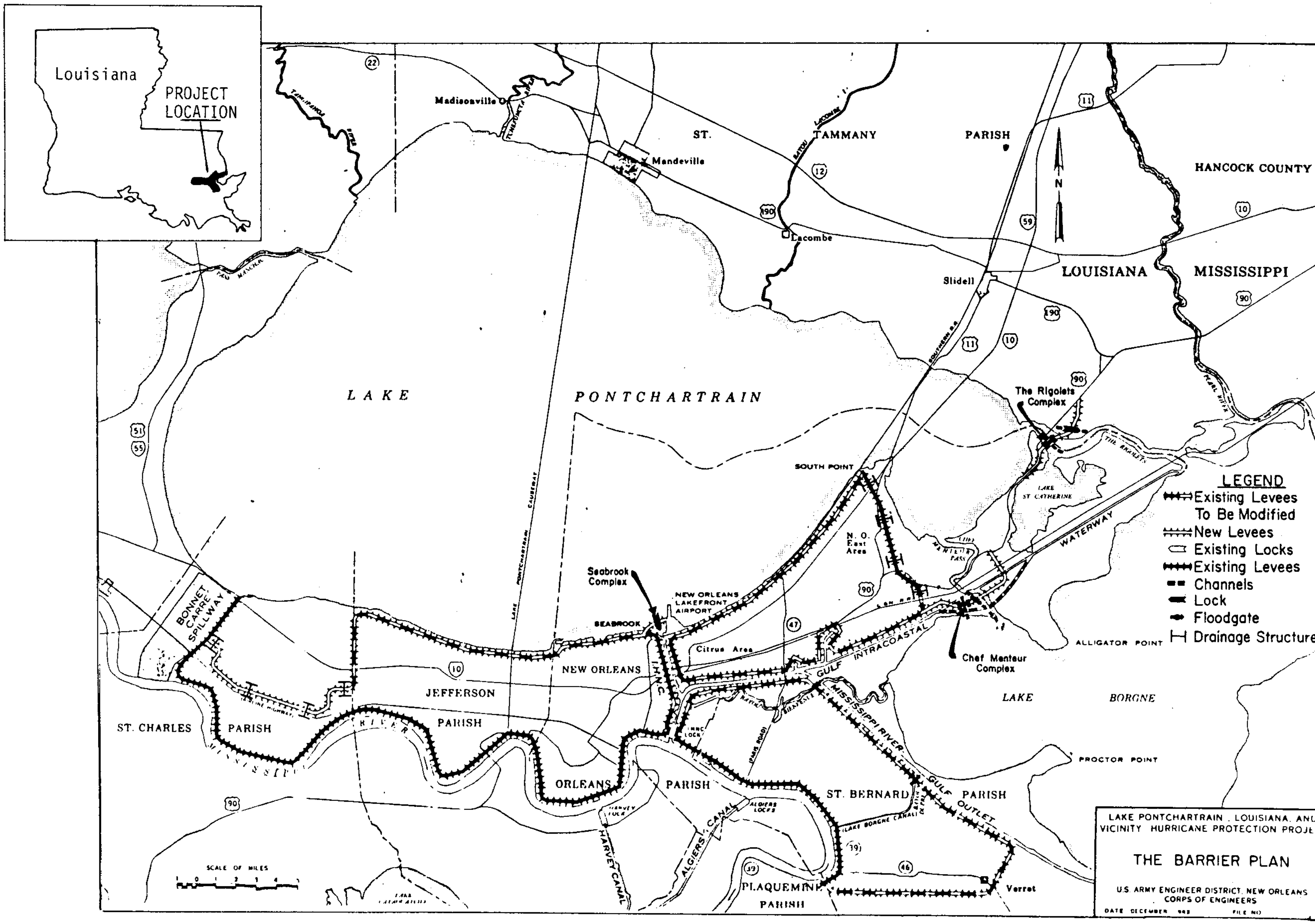

Plate 1. Barrier Plan (authorized plan), Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

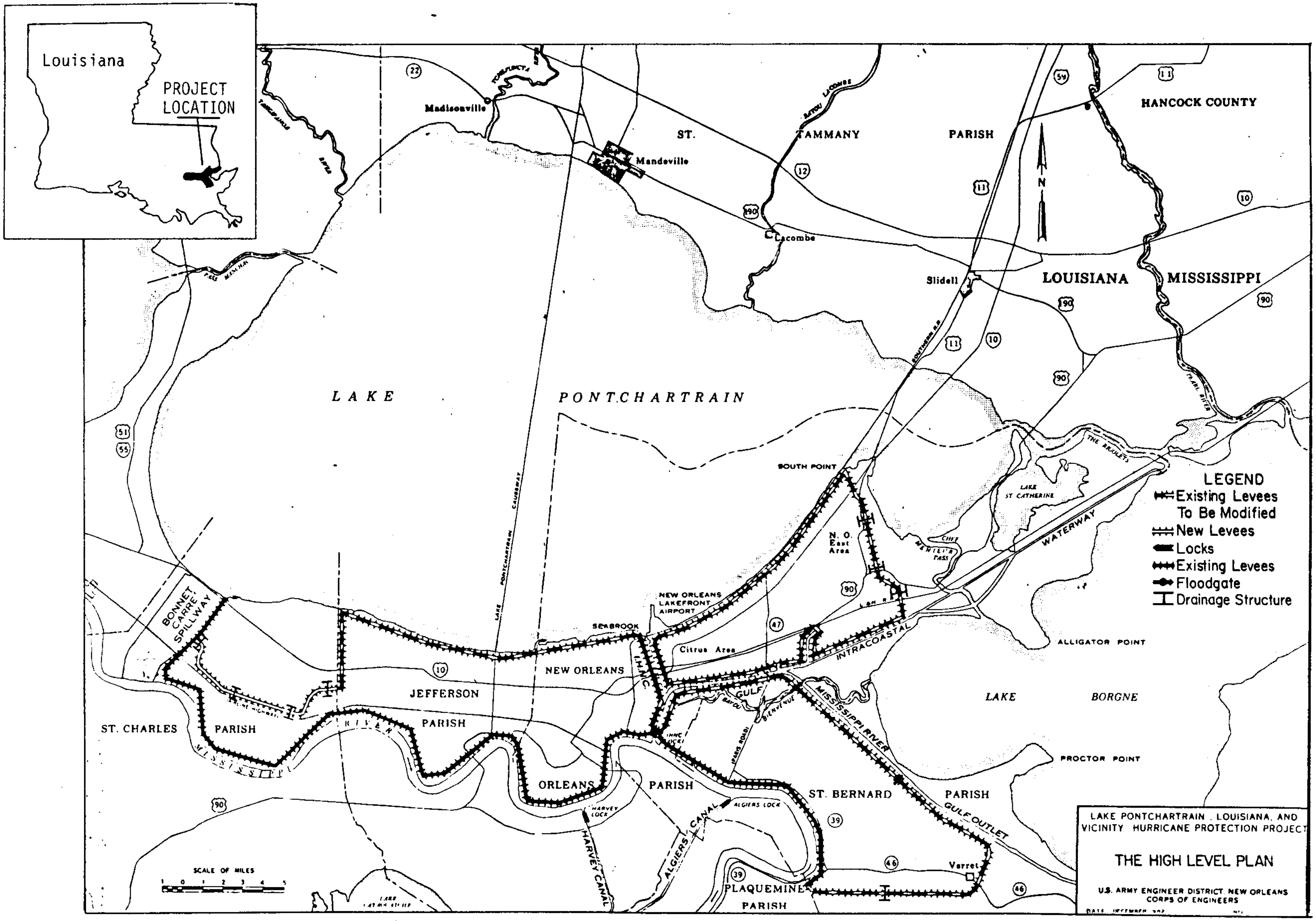

Plate 2. High-Level Plan (tenatively selected plan), Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

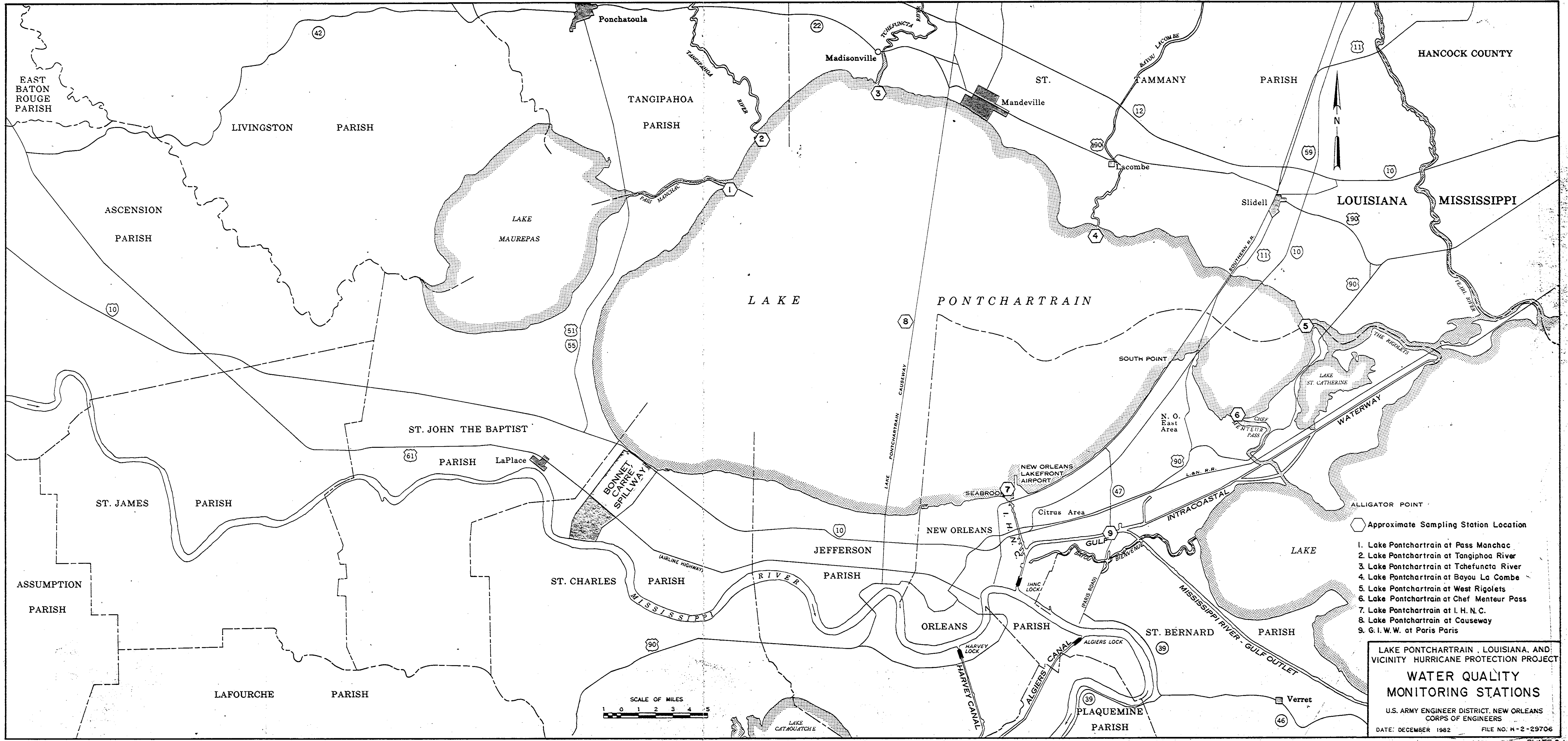
LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT
WATER QUALITY MONITORING STATIONS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: DECEMBER 1982
FILE NO. H-2-29706
Approximate Sampling Station Location
1. Lake Pontchartrain at Pass Manchac
2. Lake Pontchartrain at Tangiphoa River
3. Lake Pontchartrain at Tchefuncta River
4. Lake Pontchartrain at Bayou La Combe
5. Lake Pontchartrain at West Rigolets
6. Lake Pontchartrain at Chef Menteur Pass
7. Lake Pontchartrain at I. H. N. C.
8. Lake Pontchartrain at Causeway
9. G. I. W. W. at Paris Paris
SCALE OF MILES
1 0 1 2 3 4 5
N
LAKE PONTCHARTRAIN
LAKE MAUREPAS
LAKE ST. CATHERINE
LAKE BORGNE
LAKE CATAOUATCHE
EAST BATON ROUGE PARISH
LIVINGSTON PARISH
TANGIPAHOA PARISH
ST. TAMMANY PARISH
HANCOCK COUNTY
ASCENSION PARISH
ST. JOHN THE BAPTIST PARISH
ST. JAMES PARISH
ASSUMPTION PARISH
LAFOURCHE PARISH
ST. CHARLES PARISH
JEFFERSON PARISH
ORLEANS PARISH
ST. BERNARD PARISH
PLAQUEMINE PARISH
LOUISIANA
MISSISSIPPI
Ponchatoula
Madisonville
Mandeville
Lacombe
Slidell
LaPlace
Verret
NEW ORLEANS
N. O. East Area
Citrus Area
SEABROOK
NEW ORLEANS LAKEFRONT AIRPORT
SOUTH POINT
ALLIGATOR POINT
PASS MANCHAC
TANGIPAHOA RIVER
TCHEFUNCTA RIVER
BAYOU LACOMBE
PEARL RIVER
THE RIGOLETS
CHEF MENTEUR PASS
BONNET CARRE SPILLWAY
MISSISSIPPI RIVER
LAKE PONTCHARTRAIN CAUSEWAY
(AIRLINE HIGHWAY)
SOUTHERN R.R.
L.&N. R.R.
I. H. N. C.
IHNC LOCK
GULF INTRACOASTAL WATERWAY
BAYOU BIENVENUE
(PARIS ROAD)
MISSISSIPPI RIVER - GULF OUTLET
HARVEY CANAL
HARVEY LOCK
ALGIERS CANAL
ALGIERS LOCK

PLATE C-1