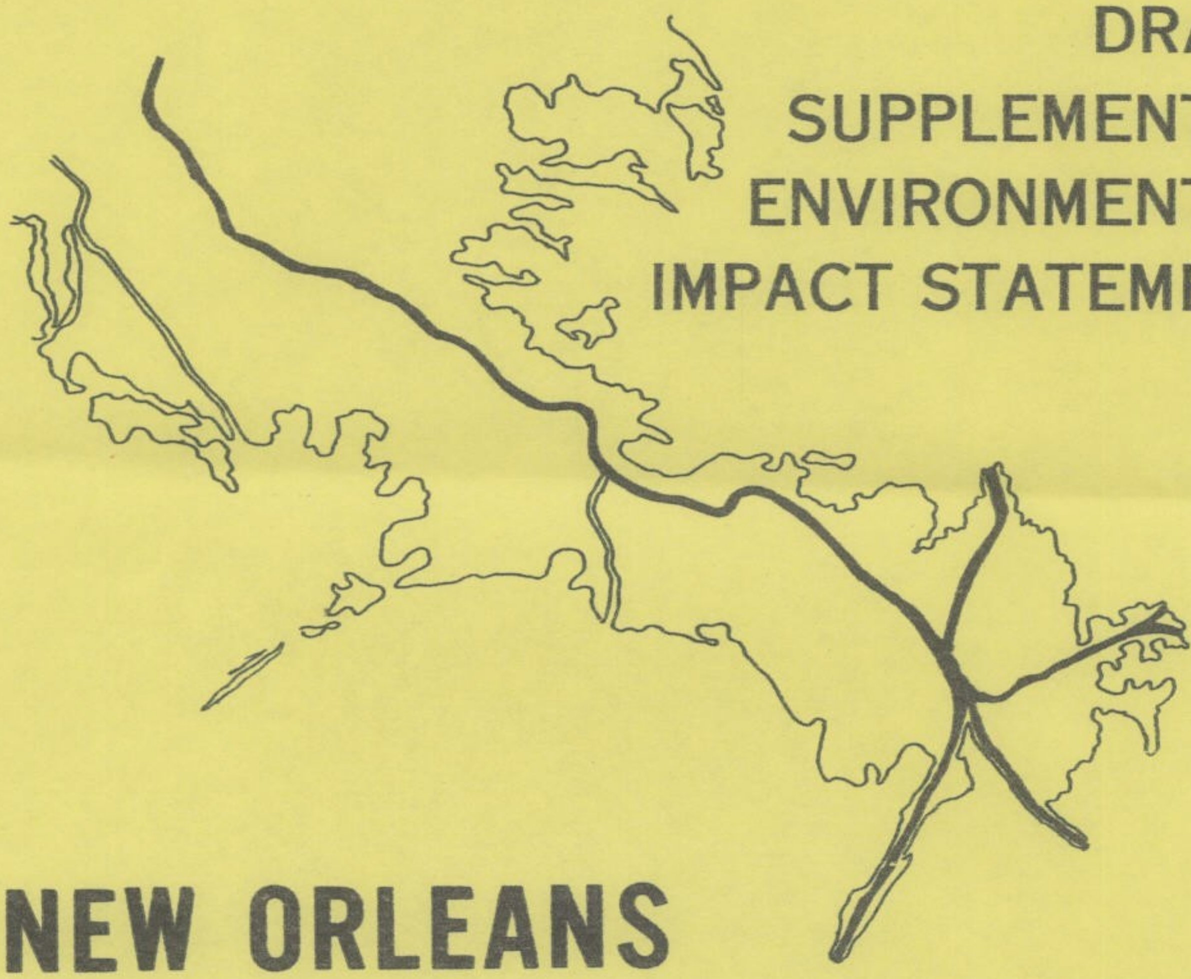
US Army Corps of Engineers
New Orleans District

February 1984



DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

NEW ORLEANS TO VENICE

LOUISIANA

APPENDIXES

HURRICANE PROTECTION PROJECT

TECHNICAL APPENDIXES

APPENDIX A

COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

CONSISTENCY DETERMINATION
LOUISIANA COASTAL ZONE MANAGEMENT PROGRAM

I. INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq. requires 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 New Orleans to Venice, Louisiana, 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 the Louisiana Coastal Resources Program, and therefore, Section 307, requires compliance with applicable Coastal Use Guidelines. An evaluation of the project relative to each guideline is presented in Section II. A determination of the consistency of the project with the guidelines is is Section III.

The New Orleans to Venice, Louisiana, Hurricane Protection project is intended to provide protection of the developed areas of Plaquemines Parish along the Mississippi River. The project would enlarge the locally constructed back levee from City Price to Venice, Louisiana, and bring the existing levee from Pheonix to Bohemia up to grade. The proposed construction involves the hydraulic pumping of sand from the Mississippi River and clay from select borrow areas in the adjacent marshes. Surface material obtained from the borrow areas, as well as suspended materials from the dredging operation, will be retained in a ponding area and the effluent released into the marsh. Approximately 3,000 acres of wetland will be permanently impacted, and 11,000 acres temporarily affected. It is proposed that the wetlands permanently lost be mitigated by the creation of marsh on the Delta National Wildlife Refuge. Additional details can be found in a Draft Fish and Wildlife Mitigation Report found in Appendix C of the Supplemental Environmental Impact Statement.

II. GUIDELINES

1. Guidelines applicable to all uses.

1.1 Guidelines must be read in their entirety.	Acknowledged
1.2 Conformance with applicable water and air quality law is necessary.	Acknowledged
1.3 General and specific guidelines are included. If inconsistent, specific guidelines apply.	Acknowledged
1.4 Guidelines shall not consist in involuntary taking of property.	Acknowledged
1.5 No use shall violate terms of a grant of or waterbottoms to the state.	Acknowledged
1.6 Information regarding numerous general factors shall be utilized in evaluating compliance.	Acknowledged
1.7a Avoid reduction in sediment and nutrients by altering freshwater flow.	Project activities would not affect sedimentation patterns. The Mississippi River no longer provides sediment and nutrients because of the present river levees and locally constructed hurricane protection systems.
1.7b Avoid adverse economic affects.	There would be no adverse economic affects.
1.7c Avoid detrimental discharge of inorganic nutrients.	Inorganic nutrients would be discharged into the marsh as a result of hydraulic dredging. Diked disposal areas would be used to confine the dredged materials; however, some nutrients would be released with the effluent. These would be reduced to the maximum extent practicable.
1.7d Avoid alteration of natural oxygen in concentration in the waters.	Diked ponding areas would be used to reduce the impacts of dredged-fill material; however, a localized and temporary reduction in dis-

1.7d (Continued)	solved oxygen would occur in the immediate area of the effluent discharge from the ponding area. These features are consistent with this guideline to the maximum extent practicable.
1.7e Avoid destruction of wetlands	Temporary and permanent impacts on the wetlands are unavoidable. About 3,000 acres of wetland would be required for borrow areas and levee rights-of-ways and about 11,000 acres for ponding areas. The ponding sites would eventually revert to marsh. Mitigation procedures are being formulated to replace these losses. Wetland impacts have been reduced to the maximum extent practicable.
1.7f Avoid disruption of existing social patterns.	Maintenance dredging would not disrupt existing social patterns.
1.7g Avoid alteration of the natural temperature regime.	Increased turbidity would result in slightly raised water temperatures at the ponding area outfalls. Because most of the sediment would fall out in the ponding sites, the effect would be very local and temporary. All features are considered to be consistent to the maximum extent practicable.
1.7h Avoid detrimental change in salinity regimes.	The dredging of borrow areas and accompanying access channels would not be plugged or filled in. This would be done to prevent the formation of stagnant water.
1.7i Avoid detrimental changes in sediment transport.	The project would have minimal impacts on sediment transport.
1.7j Avoid adverse effect of cumulative impacts.	Cumulative impacts of the project are primarily due to the reduced productivity of plants and animals in the impacted areas. This productivity loss would affect the food chain, energy transport, nursery grounds for fisheries, etc. All features comply with the guideline to the maximum extent practicable.

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES
(Continued)

1.7k Avoid detrimental discharge of suspended solids.	Ponding areas would be used to reduce the discharge of suspended solids during hydraulic filling. The effluent from the ponding area would contain minimal quantities of solids and would have a temporary impact. Bottom disturbance would result in short-term turbidity increases in the channel surrounding the dredge. This feature complies with the guideline to the maximum extent practicable.
1.7l Avoid blockage of natural circulation and flow.	The project would have a minimal effect on natural circulation. Those estuarine open water bodies in the ponding area would be filled in.
1.7m Avoid discharge of pathogens or toxic substances.	Potentially toxic materials might be in the sediments and then released during dredging. Fecal coliform, bacteria, manganese and phenol, as well as, ammonia, mercury, zinc, diazinon, and silver in the water already exceed EPA criteria. Most of these would settle in the diked disposal area; however, some would flow into the marsh in the effluent. These materials would be reduced to the maximum extent practicable.
1.7n Avoid destruction or alteration of archeological, cultural, or historical resources.	No National Register or eligible properties would be impacted by the project.
1.7o Avoid detrimental secondary effects.	Secondary effects would include increased saltwater intrusion, erosion, and subsidence. The borrow areas could become eutrophic, stagnant, or maintain a low dissolved oxygen concentration in the lower levels. Access channels used by boat traffic could erode. The increased flood protection provided by the project outweighs the negative secondary effects.

CONSISTENCY WITH COASTAL ZONE MANAGEMENT GUIDELINES (Continued)

1.7p Avoid adverse alteration of critical habitats or wildlife management areas.	The project would not impact any critical habitat or management area.
1.7q Avoid adverse alteration of public use areas.	No parks, recreational sites, or other public use area would be affected.
1.7r Avoid disruptions of wildlife and fishery migratory patterns.	Maintenance dredging would not disrupt migratory patterns.
1.7s Avoid land loss, erosion, and subsidence.	This project is not anticipated to increase land loss subsidence and erosion in the project area.
1.7t Avoid increase in flood.	This project would not significantly increase the flood potential.
1.7u Avoid reduction in long-term biological productivity.	The project would have a long-term impact on productivity in the areas used for borrow sites and levee construction. These have been reduced to the maximum extent practicable.
1.8 If benefits clearly outweigh adverse impacts of noncompliance and there are no feasible alternatives, and significant public benefits result, or the use would serve important interests, or is water-dependent, the use will be in compliance.	Acknowledged
1.9 Uses shall permit multiple concurrent uses and avoid unnecessary conflicts with other uses.	Acknowledged
1.10 Guidelines shall not expand governmental authority.	Acknowledged

2. <u>Guidelines for Levees</u>

2.1	Leveeing of biologically productive wetlands shall be avoided.	The project would not substantially increase the present leveeing effect of the local levee system.
2.2	Levees shall be sited to avoid segmentation of wetland systems.	No further segmentation would occur as a result of the project.
2.3	Levees for development shall be avoided.	The new levee would follow the present alinement.
2.4	Hurricane and flood protection levees should be at the wetland/nonwetland interface.	The levee would be placed at the present interface.
2.5	Impoundment levees only constructed as part of an approved water management project.	Not applicable.
2.6	Levees shall use best practicable techniques to minimize disruption of interchange of organisms, nutrients, and water.	The best practicable technique would be used.

3. <u>Guidelines for Linear Facilities</u> — Not applicable.

4. <u>Guidelines for Dredged Spoil Deposition</u>

4.1	Spoil shall be disposed to avoid disruption of water movement, flow, circulation, and quality.	In the hydraulically dredged areas, the diked, retention and ponding sites would be used to retain dredged materials, and spill boxes with flash boards would be used to control the settling period and rate of discharge.
4.2	Spoil shall be used to improve environmental productivity or upland disposal areas shall be used.	The ponding area should revert to marsh after the material compacts and subsides.
4.3	Spoil shall not impound or drain wetlands.	The surrounding wetlands would not be impounded or drained.
4.4	Spoil shall not be disposed on marsh, reefs, or grass beds.	Materials would be placed on marsh or estuarine open waters. Because of the 1.21 percent per year subsidence rate, much of the ponding areas would revert to marsh. Any net loss of marsh would be replaced

4.4. (Continued)	through mitigation. The marsh impacts have been reduced to the maximum extent practicable.
4.5 Spoil shall not be disposed to hinder navigation, fishing, or timber growth.	Disposal would not hinder navigation fishing, or timber growth.
4.6 Spoil areas shall be designated to retain spoil at the site, reduce turbidity, and reduce erosion.	The diked ponding sites for excess hydraulically dredged materials are designed to comply with this guideline.
4.7 Alienation of state-owned property shall not occur without consultation with Department of Natural Resources.	No alienation of state-owned property would result from the project.
5. Guidelines for Shoreline Alterations	No shoreline modifications are proposed.
6. Guidelines for Surface Alterations	Surface alterations of this project are a result of dredging and levee construction and were examined in Sections 2 and 4.
7. Guidelines for Hydrologic and Sediment Transport	The project would not substantially affect hydrologic and sediment transport.
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.

III. CONSISTENCY DETERMINATION

Based on this evaluation, the US Army Corps of Engineers, New Orleans District, has determined the New Orleans to Venice Hurricane Protection project is consistent, to the maximum extent practicable, with the State of Louisiana's approved coastal management program.

APPENDIX B

WATER QUALITY

NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION PROJECT
REACH A
Section 404(b)(1) Evaluation Report

I. INTRODUCTION. This document addresses discharges of dredged and fill material in connection with the New Orleans to Venice, Louisiana, Hurricane Protection project. Proposed dredged and fill material discharges associated with constructing Reach B of the project were initially discussed in a Public Notice dated 25 October 1974, and subsequently in a Statement of Findings dated 7 February 1975. This evaluation report addresses only Reach A of the project. The report incorporates and documents 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 dredged or fill material that takes place 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.

II. PROJECT DESCRIPTION.

a. Location. Reach A of the authorized project is located to the west of the Mississippi River and extends from the vicinity of City Price, Louisiana, to Tropical Bend Louisiana, as indicated on Plate 1.

b. General Description. The total authorized project is divided into five reaches as indicated on Plate 1 and described below.

- Reach A: City Price, Louisiana, to Tropical Bend, Louisiana
- Reach B-1: Tropical Bend, Louisiana, to Fort Jackson, Louisiana
- Reach B-2: Fort Jackson, Louisiana, to Venice, Louisiana
- Reach C: Phoenix, Louisiana, to Bohemia, Louisiana
- East Bank Barrier: Bohemia, Louisiana, to 1 mile south of Bayou Baptiste Collette

The currently approved plan involves the construction of back levees on the west bank of the Mississippi River to an elevation of 12.5 to 15.0 feet National Geodetic Vertical Datum (NGVD). The B reaches were evaluated in an October 1974, Public Notice.

Reach C of the project did not constitute a 404 action and is being constructed by local interests, and the East Bank Barrier has been deferred pending acquisition of support from local interests. This evaluation addresses only Reach A of the project.

c. Authority and Purpose. The Flood Control Act of 1962, House Document 550, 87th Congress, 2d Session, authorized improvement of existing back levee systems by increasing their height and by construction of new levees for the prevention of hurricane flood damage.

CORPS OF ENGINEERS

U.S. ARMY

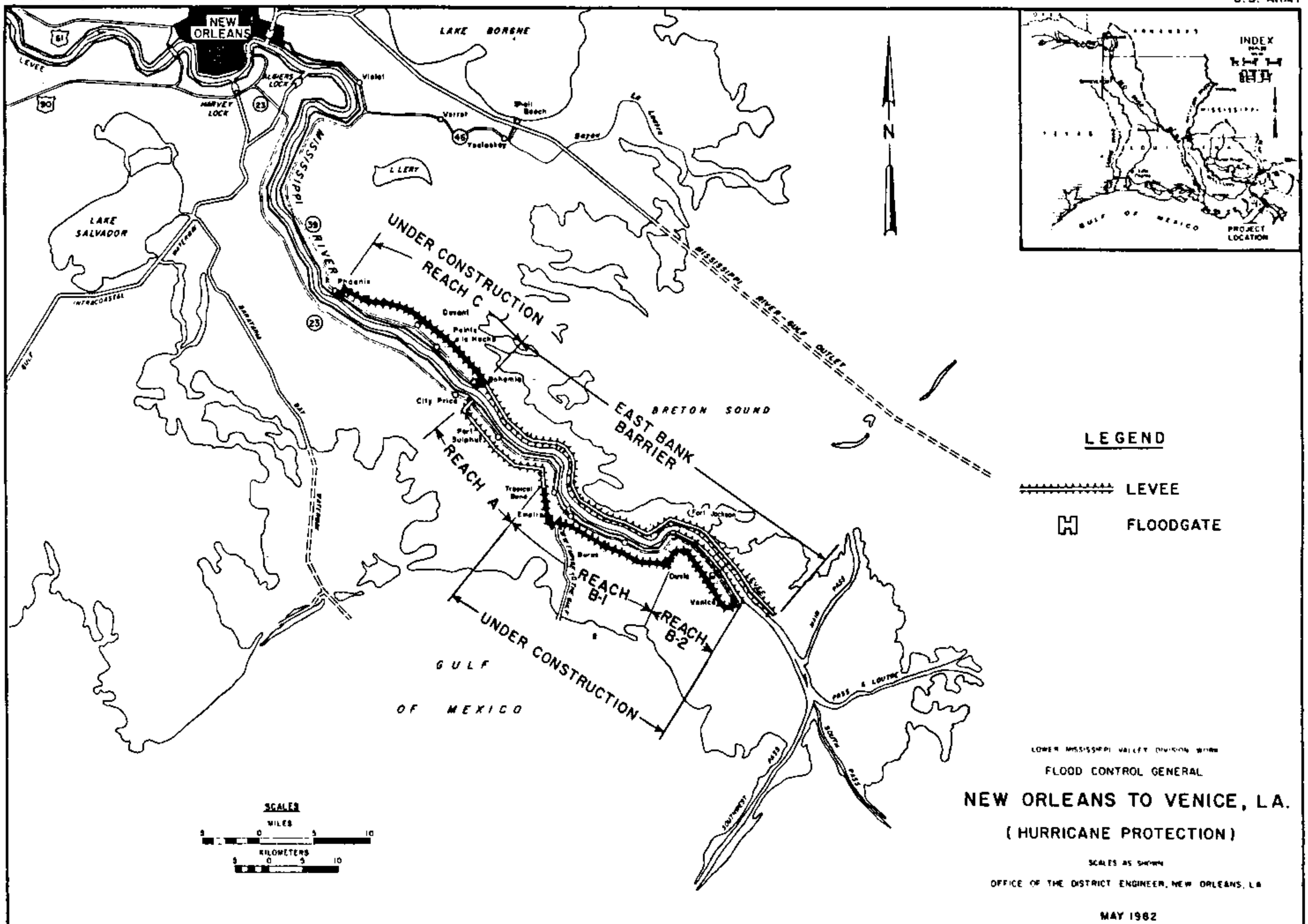


PLATE I

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The primary construction materials are clays and sands. Soil borings disclose that the clay to be removed from the marshland and open-water borrow sites consists of very soft to soft clays interlain with peat and organic matter in the top 10 to 12 feet. The underlying material consists of very soft to fat clays with intermittent layers of silt, sandy silt, and sand. The organic surface layers are not suitable for levee construction and will be wasted.

Sands are primarily used in constructing sand-filled core - clay blanket type levees. Generally, sandy materials extracted from the river 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 shell or cannery shell, stone of various gradations, concrete block, and concrete mat.

(2) Quantity of Material. The total quantity of clay that will be discharged for constructing Reach A is estimated to be 12.5 million cubic yards (cy); approximately 5.5 million cy of this total might be suitable for actual levee construction. The total quantity of sand excavation for Reach A will be about 2.3 million cy.

(3) Source of Material. Clay fill is available from borrow areas located in the estuarine area adjacent to the levee construction sites. The clay borrow areas encompass approximately 445 acres of marsh and 15 acres of estuarine open water. All sand excavation will be from extraction sites in the Mississippi River.

e. Description of the Proposed Discharge Sites.

(1) Location. The construction sites constitute marsh and estuarine open water on the floodside of the existing non-Federal backlevees as indicated on Plates 2 and 3.

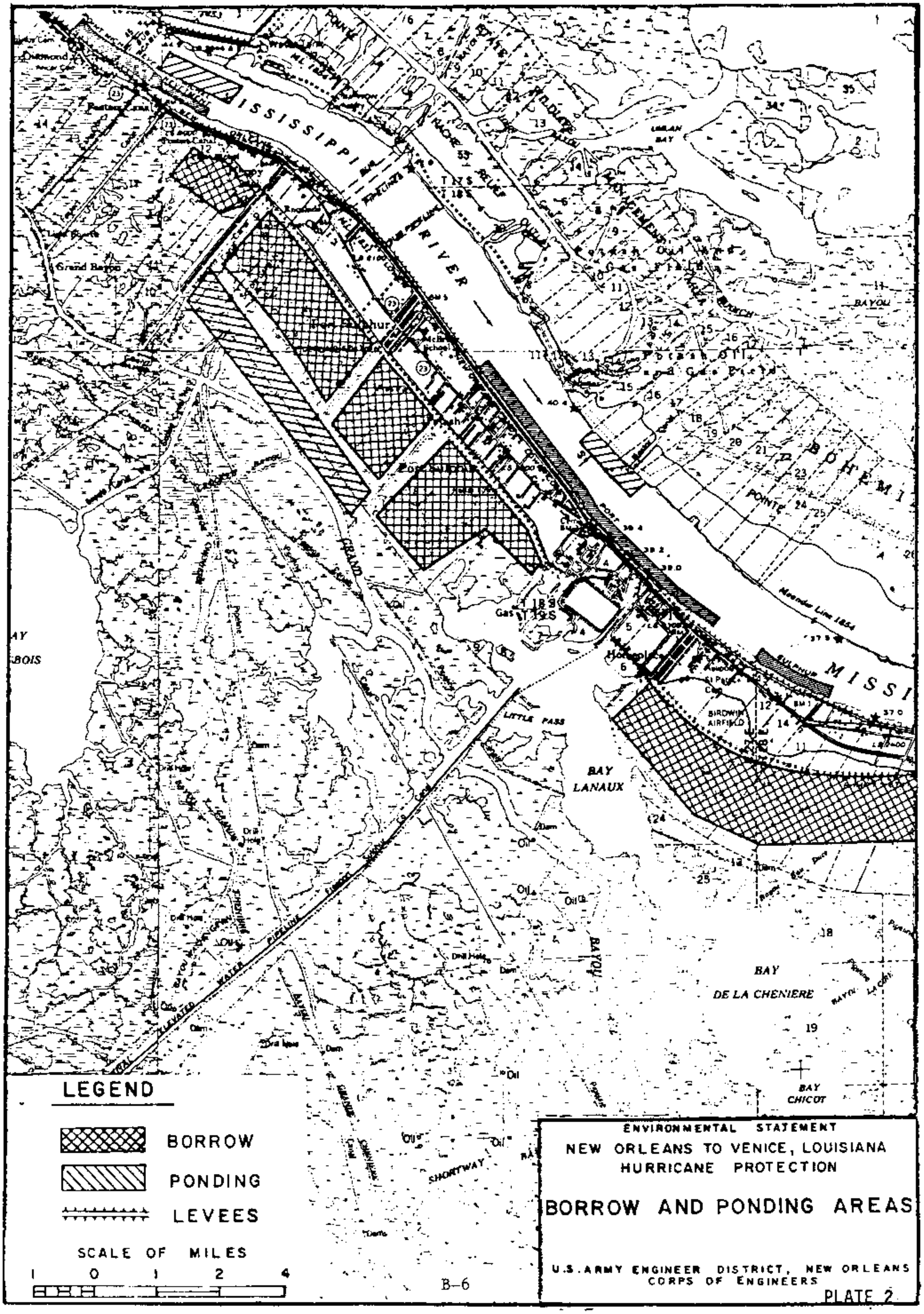
(2) Size. The discharge sites are designated as "levee fill" or "containment areas" and effluent "ponding areas." Levee fill areas will encompass about 230 acres of marsh and 20 acres of estuarine open water. Approximately 2,900 acres of marsh, and 260 acres of estuarine open water are to be used as ponding areas.

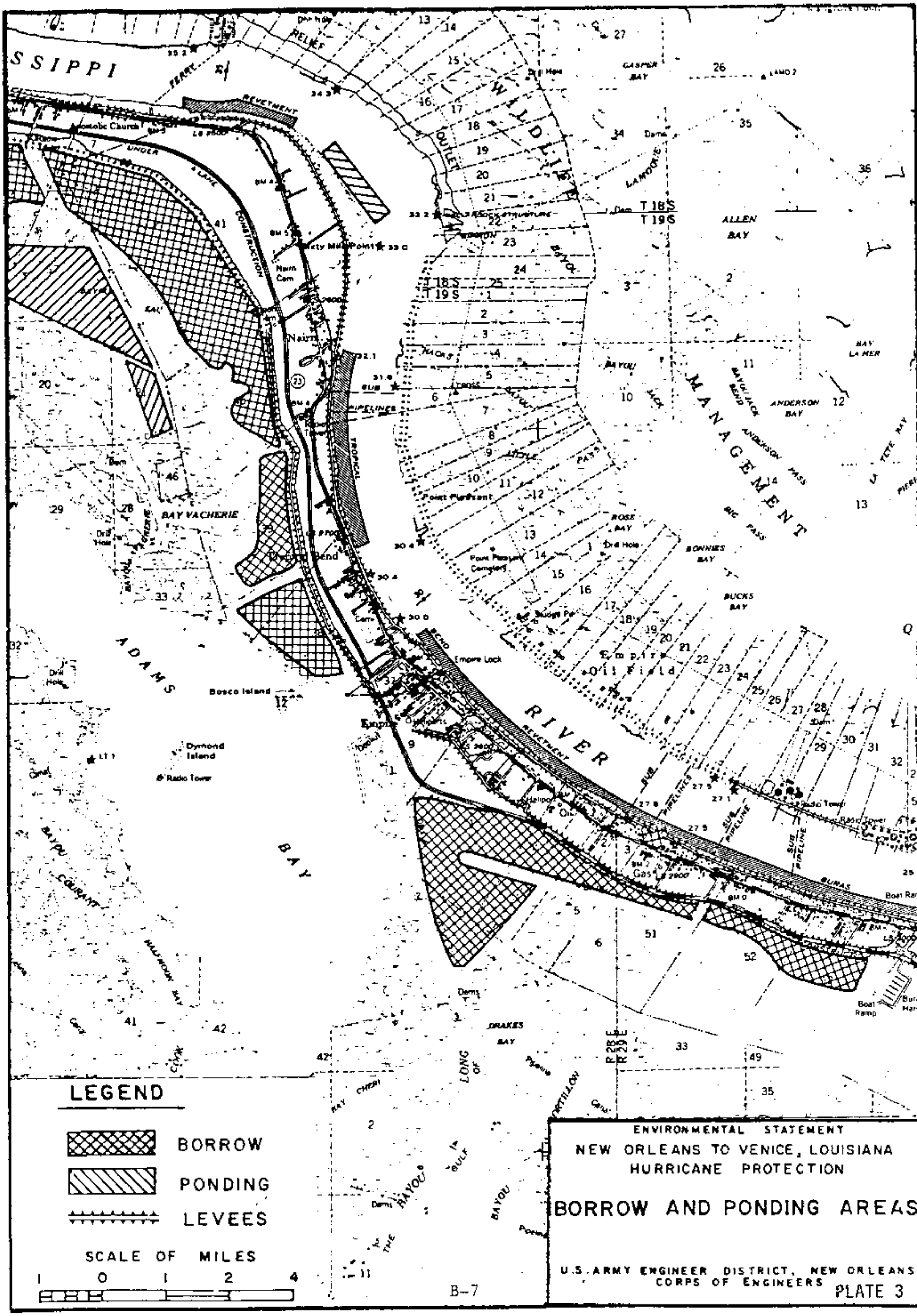
(3) Type of Site. All dredged material discharges will take place within confined levee fill and ponding areas.

(4) Types of Habitat. Habitat types impacted by the dredged-material discharges include marsh, natural estuarine open water and man made waters.

(5) Timing and Duration of Discharge. Timing of a fill-material discharge cannot be predicted precisely. However, based on previous similar work, the duration of a discharge can be estimated. Large jobs are invariably broken down into more manageable units or reaches. Typically, stockpiling hydraulic fill for one of these smaller reaches might require 18 to 24 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.

f. Description of Disposal or Construction Method. 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.


MISSISSIPPI RIVER
BAY LANAUX
BAY DE LA CHENIERE
BAY CHICOT
LITTLE PASS
SHORTWAY
BIRDWIN AIRFIELD
Meander Line 1854
LEGEND
BORROW
PONDING
LEVEES
SCALE OF MILES
1 0 1 2 4
ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
BORROW AND PONDING AREAS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
PLATE 2


ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
BORROW AND PONDING AREAS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
PLATE 3
LEGEND
BORROW
PONDING
LEVEES
SCALE OF MILES
1 0 1 2 4
SSIPPI
RIVER
WILDLIFE
MANAGEMENT
ADAMS
BAY
BAY VACHERIE
ALLEN BAY
ANDERSON BAY
BONNIES BAY
BUCKS BAY
GASPER BAY
DRAKES BAY
Empire Oil Field
Empire Lock
Bosco Island
Dymond Island
Radio Tower
Point Pleasant
Point Pleasant Cemetery
Sixty Mile Point
Nairn
Tropical Bend
T 18 S
T 19 S
Boat Ramp

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 sites. Typically, a hydraulic lift might require 18 to 24 months to complete. On average, about 3 years are allowed for foundation and fill material consolidation after a lift has been completed and prior to initiating an enlargement.

The initial construction activity consists of constructing retaining dikes along the proposed levee alinement and around ponding areas located on the floodside of, and adjacent to, the levee fill areas. When the dikes are completed, a trench is excavated along what will eventually be the centerline of the completed levee section. Sand is then hydraulically dredged and pumped from the Mississippi River into the excavated trench. The sand is then shaped by draglines to form the levee core. The clay borrow areas are first stripped by hydraulic dredge to a depth of 10 to 12 feet below existing ground. This surficial material is highly organic and is wasted in the ponding areas. The mostly inert clay remaining in the borrow areas is then hydraulically excavated and pumped into the levee fill area to blanket the previously shaped sand core. Both the hydraulically dredged sand and the clay are confined in the levee fill area by the retaining dikes. The effluent from the sand and clay dredging operations is diverted through the retaining dikes into the ponding areas to allow sedimentation of suspended materials. After retention in the ponding areas for 1 to 4 days, the effluent is discharged to the adjacent marsh. In areas where settlement of the levee foundation is extensive, pumping of additional clay from the borrow areas is required prior to final levee shaping. Levee fill and ponding areas are indicated on Plates 2 and 3.

III. FACTUAL DETERMINATION.

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. The soft, highly organic and intermittently submerged marsh substrate within the levee fill and ponding areas will be replaced by more compact, firm, and inert clays and sands. Significant alteration of substrate elevation will occur in these areas. Changes in the physical and chemical composition, and elevation of levee fill areas will be essentially permanent. Substrate within the ponding areas will be altered by the discharge of the mostly organic material initially stripped from the borrow areas. Substrate within the ponding areas will also be altered by deposition of silts and sands during clarification of dredged-material effluents. Altered physical characteristics within the ponding areas will, within 5 to 10 years after construction, revert to preconstruction conditions.

(2) Effects on Sediment Type. Major components of the substrate along the levee alinement are generally sands and clays. Material used for 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. The discharged dredged material will be semi-compacted and shaped, in stages, into the desired levee section; consequently, with the exceptions of subsidence, foundation consolidation, and erosion, significant movement of the dredged and fill materials is unlikely. For the most part, only dredged-material fines escape the confined fill and ponding 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. Construction fill for the project would impact the benthos in about 280 acres of estuarine open

water and 3,130 acres of marsh habitats. Although most of the existing benthos would be destroyed during construction, half of the 3,160 acres of ponding area would return to marsh within a few years after project completion and be recolonized. Benthic populations would be totally eliminated in the levee areas.

(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.

b. Water Circulation, Fluctuation and Salinity Determinations.

(1) Effects on Water.

(a) Salinity. Discharging dredged material into the levee fill or ponding areas will not affect existing salinity regimes.

(b) Water Chemistry. Changes in the concentrations of inorganic ions and organics in solution and small shifts in pH will result from 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. 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 upon completion of this stage of construction.

(d) Color. The true color of the marsh waters might be intensified when highly organic dredged sediments are discharged onto the levee rights-of-way. The apparent color of surface waters where the borrow material is discharged will also intensify substantially during dredge and fill operations. However, this condition dissipates rapidly upon cessation of dredging.

(e) Odor and Taste. With the exception of the Mississippi River, no known potentially-affected surface waters in the project area are used for public raw water supply. No significant effect on the taste and odor of known public or private raw water supplies is 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.) might increase in the marsh surface waters as a result of stockpiling construction material. Dissolved oxygen (DO) in the affected surface waters will be depressed and in some cases depleted due to the chemical and biochemical oxygen demands of dredged sediments. Un-ionized ammonia (NH_3) concentrations might increase also if increases in total ammonia concentrations or the pH of the affected waters occur. 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 in the water column normally increase substantially during fill-material discharge. 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. Discharging dredged material into the levee fill and ponding areas will alter local current patterns by shortening the length of existing bayous and filling portions of bays and ponds.

(b) Velocity. Local tidal velocities should not be affected by constructing the hurricane protection levees.

(c) Stratification. The stratification characteristics of local water bodies will not be affected by the material discharges.

(d) Hydrologic Regime. Generally, there will be no impact on the local hydrologic regime due to levee construction or use of ponding areas.

(3) Normal Water Level Fluctuations. Normal water level fluctuations will not be affected by construction of levees or use of ponding areas.

(4) Salinity Gradients. Local salinity gradients will not be affected by construction of levees or use of ponding areas.

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 fill operations. Construction of a levee reach will involve varying numbers of stages where dredged construction material is hydraulically stock-

piled within a confined levee fill area, allowed to settle, drain, and consolidate before being shaped into an interim or final design section. 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. The duration of a hydraulic dredge and fill operation for a levee reach is characteristically on the order of 18 to 24 months. 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 fill operations. This effect does not persist after 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 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 stockpiling construction materials. Water column pollutant levels might be intensified by discharging effluents from levee fill areas, and potentially by rainfall elutriation and leaching of structures made from dredged materials. The standard elutriate test was used to simulate the results of possible interactions among the project hydraulically-dredged sediment and the water that it will contact during levee construction. 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 a sampling expedition conducted in July 1979.

Water and sediment samples were collected from six sites described below.

Site 1: Grand Bayou near Happy Jack

Site 2: Martins Canal near Happy Jack

Site 3: Unnamed Bayou near Port Sulphur

Site 4: Grand Bayou near Port Sulphur

Site 5: Bayou Des Plantins near Empire

Site 6: Pipeline Canal near Port Sulphur

Results of chemical analyses of surficial sediment material samples are shown in Table 1, and surface water and elutriate data are presented in Table 2. The data indicate significant COD, Kjeldahl nitrogen, and ammonia nitrogen increases in each of the elutriates compared to the corresponding receiving water. Both arsenic and manganese were released in 5 of 6 elutriates. Phenols, nickel, and zinc were each released in 4 of 6 elutriates. Cadmium was released from the sediments in 1 of 6 elutriates. No mercury, PCB, or chlorinated pesticide release was indicated in any of the prepared elutriates.

(d) Pathogens. Fill-material discharges might cause temporary increases in bacterial densities in the water column. However, since human ingestion of the raw water at the material extraction sites is not probable, no significant effects due to increased bacterial densities are anticipated.

Table 1 Borrow Material Chemical Quality for Reach A of the New Orleans to Venice Hurricane Protection Project (Reach A).

PARAMETER (mg/Kg)	Surficial sediment sampling sites					
	1	2	3	4	5	6
COD	65,000	260,000	400,000	140,000	250,000	86,000
Total Volatile Solids (LOI)	740,000	--	220,000	119,000	209,000	241,000
Nitrogen, Kjeldahl as N	1,510	6,630	7,440	3,040	5,180	6,090
Nitrogen, Ammonia as N	37	380	704	57	280	390
Arsenic, As	7	8	7	6	0.6	8
Cadmium, Cd	0.24	3.88	0.75	0.28	0.66	0.89
Chromium, Cr	8	12	15	510	12	13
Copper, Cu	58	31	16	12	16	20
Mercury, Hg	0.1	0.0	0.0	0.0	0.0	0.0
Manganese, Mn	450	--	290	560	250	360
Nickel, Ni	10	15	14	10	20	20
Lead, Pb	5	65	20	10	20	25
Zinc, Zn	43	--	85	45	47	64
Aldrin, ug/Kg	0.0	0.0	0.0	0.0	0.0	0.0
Lindane	0.0	.0	0.0	0.0	0.0	0.0
Chlordane	2.0	79	4.0	3.0	1.0	6.0
DDD	0.4	56	1.6	0.0	0.6	2.6
DDE	0.0	3.3	0.1	0.9	0.0	1.8
DDT	0.0	0.0	0.0	0.0	0.0	0.0
Dieldrin	0.0	0.0	0.0	0.0	0.0	0.0
Endrin	0.0	0.0	0.0	0.0	0.0	0.0
Toxaphene	0.0	0.0	0.0	0.0	0.0	0.0
Heptachlor	0.0	0.0	0.0	0.0	0.0	0.0
PCBs	0.0	0.0	0.0	0.0	0.0	0.0

Table 2. Analyses of Receiving Waters and Elutriates for Selected Dissolved Constituents from Samples Taken for the New Orleans to Venice Hurricane Protection Project (Reach A).

PARAMETERS	RECEIVING WATER AND ELUTRIATE SAMPLES											
	1		2		3		4		5		6	
	Water	Elutriate	Water	Elutriate	Water	Elutriate	Water	Elutriate	Water	Elutriate	Water	Elutriate
COD (mg/L)	38	120	38	150	38	150	40	130	95	180	110	160
Nitrogen, Kjeldhal as N (mg/L)	1.3	3.3	1.2	11	1.2	11	1.2	2.7	0.27	--	0.87	--
Nitrogen, Ammonia as N (mg/L)	0.09	0.84	0.10	5.8	0.07	9.4	0.10	1.3	0.06	--	0.04	00
Phenols (mg/L)	1	4	2	3	2	2	4	0	0	9	0	13
Arsenic, As (ug/L)	1	3	1	1	1	4	1	5	1	2	1	5
Cadmium, Cd (ug/L)	2	0	0	0	2	0	2	1	0	0	0	1
Chromium, Cr (ug/L)	0	0	20	0	20	0	20	0	0	0	0	0
Copper, (Cu (ug/L)	3	4	4	4	4	2	2	6	2	3	0	3
Lead, Pb (ug/L)	0	0	0	0	0	1	0	0	2	0	0	1
Manganese, Mn (ug/L)	50	560	10	30	50	80	10	10	10	80	120	130
Mercury, Hg (ug/L)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
Nickel, Ni (ug/L)	2	1	2	3	3	4	0	5	52	2	2	2
Zinc, Zn (ug/L)	20	30	20	30	30	40	30	30	30	30	20	20
Aldrin (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
Lindane (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
Chlordane (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
DDD (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
DDE (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
DDT (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
Dieldrin (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
Endrin (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
Toxaphene (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
Heptachlor (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
Heptachlor Epoxide (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
PCBs (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

(e) Esthetics. Unsightly turbidity plumes are caused by solids placed in suspension during fill operations. The turbidity plumes do not persist long after fill operations cease.

(3) Effects on Biota.

(a) Primary Production/Photosynthesis. Turbidity temporarily affects primary productivity by impairing light penetration and physically destroying phytoplankton. When impacted, the food base of the aquatic ecosystem is reduced. Critical nutrients, such as phosphate, might be removed from the water and certain phytoplankton organisms might adhere to the particulate matter and precipitate to the bottom. Impacts to primary production would be minor and temporary.

(b) Suspension/Filter Feeders. High suspended solids levels can induce metabolic stress in filter-feeding organisms by clogging gills or impairing feeding, respiratory, and excretory functions. The most likely organism to be impacted by suspended materials is the oyster; however, Mackin (1967) found concentrations of up to 700 mg/L have little effect on oyster feeding or mortality. Suspended materials are not expected to exceed this level, so impacts on oysters are not expected to be severe.

(c) Sight Feeders. Sight feeders, primarily fish species, are mobile and would vacate the construction area. Inhabitants of the marshes are already adapted to high turbidity levels and so would not be adversely affected by construction generated turbidity.

(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. Additionally, bucket dredging and hauled fill will be used in areas where feasible and appropriate.

d. Contaminant Determinations. Evaluation of the data obtained from surficial sediments and elutriate analyses indicates that the construction material discharges will not introduce new contaminants nor cause significant long-term increases in contaminant levels in the surface waters affected by construction of the hurricane protection works.

e. Aquatic Ecosystem and Organism Determinations.

(1) Plankton Effects. During construction, most of the plankton in the ponding, and levee sites would be destroyed. After construction, approximately one-half of the ponding area would revert to marsh within a few years and would thus be available as plankton habitat. Construction during the late summer and early fall would have the greatest impact on plankton species.

(2) Benthos Effects. The benthic habitats in the project area would be severely disturbed during construction. Organisms in the ponding area would be covered by silts. A few years after project completion, one-half of the ponding area benthos would populate as larva and adults would migrate in from adjacent marshes and water bodies. Benthos in the levee fill area would never recover.

(3) Nekton Effects. Nekton, primarily fish species, would not be directly affected by the project because most would vacate the area during construction. The diversity and productivity of nekton in the ponding area would be greatly reduced initially; however, the marsh areas would be expected to recover to near normal levels.

(4) Aquatic Food Web Effects. A number of conditions, such as turbidity, siltation, and fill, could impact the aquatic food web during construction. This would lead to a short-term reduction in the productivity of benthic and phytoplankton populations which both constitute vital links in the food chain. After project completion, half of the ponding area would revert to wetland and recolonization

would take place within a few years. Because the ponding area marshes would initially be higher than the natural marsh, the species recolonizing this area would be different. For example, oystergrass would come into the area; however, as the marsh elevation declines, black rush would begin to invade. The aquatic system at levee site would be totally destroyed.

(5) Special Aquatic Sites Effects. Because wetland and vegetated shallow water comprise the majority of the project area, these habitats are addressed through this evaluation.

(a) Sanctuaries and Refuges. No sanctuaries or refuges would be impacted.

(b) Wetlands. Of the approximate 3,130 acres of marsh impacted by the discharge, 2,900 acres would be disposed upon for ponding areas. The 230 acres of marsh required for the levee would be permanently impacted while half of the ponding areas would eventually revert to marsh.

(c) Mud Flats. Mud flats are dispersed throughout the project area; however, the acreage present is unknown. Those flats in the ponding area and levee sites would be destroyed.

(d) Vegetated Shallows. Some of the 280 acres of shallow estuarine waters impacted by the discharge are vegetated with submerged vegetation such as widgeongrass. When these are filled the vegetation would be destroyed.

(e) Riffle and Pool Species. No riffle or pool species would be impacted.

(6) Threatened and Endangered Species. Endangered species which might occur in the project area are the Kemp's ridley sea turtle, leatherback sea turtle, eastern brown pelican, bald eagle, Arctic

peregrine falcon, Eskimo curlew, and the sperm, humpback, sei, fin, and black right whales. Threatened species would be the green sea turtle and Atlantic loggerhead sea turtle. No critical habitat of these species is known in the project area, and this project should not jeopardize the existence of any of these species. A biological assessment on the threatened and endangered species which might occur in the area was prepared for the National Oceanic and Atmospheric Administration and the US Fish and Wildlife Service. Both agencies approved the assessment with no adverse comments.

(7) Other Wildlife. Many semi-aquatic and terrestrial organisms are dependent on wetlands. Because most of these organisms are mobile, the project would have minimal impacts on the population in the project vicinity. Young or slow-moving animals would be unable to escape and could be destroyed by construction activities. Once the ponding areas are revegetated, wildlife would again inhabit them. Another effect would be the loss of levee areas, and the resultant reduction in productivity. This loss would eventually be reflected in the food chain, especially by secondary consumers, such as wading birds, shore birds, raccoons, and muskrats.

(8) Actions to Minimize Impacts on Aquatic Ecosystems and Organisms. Retention ponds and ponding sites with controllable weirs act as settling areas and are used to control the release of silt and other fine materials.

f. Construction Site Determinations.

(1) Mixing Zone Determination. 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 3. 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 shallow marsh surface waters where construction materials are discharged. Since the hydraulic fill phase of construction is intermittent 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. The approximately 3,200 acres of ponding areas would have fine silts placed into them and would make this wetland area unproductive during construction. Within a few years after project completion, about one-half of the sites would again provide a "nursery ground" for many fisheries species.

(c) Water-Related Recreation. Existing wildlife refuges in the vicinity of the project would not be affected by the construction. Eight boat ramps and one recreational marina are located in the project area. These areas would not be directly impacted by project work. Adverse effects on recreational values are not deemed significant because no developed recreational facilities are located in the impact zone. The net result of the construction will be a potential loss of a small amount of hunting, primarily rail, snipe, rabbit, and waterfowl species. In addition, some estuarine sportfishing man-days would be lost.

TABLE 3

Louisiana State Water Quality Standards

PARARAMETER	BASIN CODE AND SEQUENCE NUMBER[a]	
	070060	070080
Water Use Classification[b]	B,C,D	B,C
Dissolved Oxygen (DO) mg/l	4.0	5.0
Temperature °C	32	35
pH	6.5 to 9.0	6.5 to 8.5
Bacterial Standard[c]	#3	#4

[a]070060: Mississippi River - Huey P. Long Bridge to Head of Passes
070080: Bastian Bay, Adams Bay, Scofield Bay, Coquette Bay, Tambour Bay, and Bay Jaques

[b]B: Secondary Contact Recreation
C: Propagation of Fish and Wildlife
D: Domestic Raw Water Supply

[c]#3 Public Water Supply - The monthly arithmetic averages total coliform most probable number (MPN) shall not exceed 10,000/100 mL nor shall the monthly arithmetic average of fecal coliforms 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 and MPN of 230/100 mL.

(d) Esthetics. During construction, environments near the site would be esthetically displeasing (noise and dust levels could be high); however, the activity would be relatively short-lived. The proposed levee construction could also be esthetically displeasing to some; however, revegetation of these areas would occur rapidly and lessen this impact.

(e) Parks, National and Historical Monuments, Natural Seashores, Wilderness Areas, Research Sites, and Similar Preserves. None of these sites would be impacted by the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. Cumulative effects on the aquatic ecosystem would involve the permanent and/or temporary loss of about 3,400 acres of wetlands in Plaquemines Parish, Louisiana. One-half of the ponding area would subside and compact, and eventually revert to marsh. The 230 acres of marsh and 20 acres of open water covered by the levee would be totally unproductive.

h. Determination of Secondary Effects on the Aquatic Ecosystem. Secondary effects of the project might include salt water intrusion, increased erosion, and development. The borrow areas and access channels might allow salt water to move more freely through the estuarine area. This area would also be used by boat traffic, and result in the erosion of marsh along the edge. The ponding areas could be used for agricultural purposes, such as cattle grazing. The ponding areas might also create mosquito breeding sites, especially in areas of drying, cracking, dredged material.

Another secondary impact of the 404 action would be construction of deep borrow pits. The water quality at the bottom of these pits would be very poor, have little or no oxygen, and perhaps contain heavy metals in high concentrations. The pits would probably stratify so this poor water quality could be permanent.

IV. FINDING OF COMPLIANCE FOR THE NEW ORLEANS TO VENICE, LOUISIANA, HURRICANE PROTECTION PROJECT - REACH A

a. No significant adaptations of the guidelines (40 CFR 230) were made relative to this evaluation.

b. The available practical alternative to the selected construction method - the unconfined stockpiling of the levee construction material via hydraulic dredge - will be both expensive and severely damaging to the aquatic environment. The selected construction methodology of confined material stockpiling, retention of drainage waters, and subsequent controlled discharge of those waters will have the least adverse impact on the aquatic ecosystem. Violations of the Louisiana State Water Quality Standard might occur for DO. However, these violations, if they occur, will be highly localized and of short duration.

c. The proposed fill material disharges will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. Use of the selected levee fill and ponding areas will not harm any endangered species, their critical habitat, or violate protective measures for any marine sanctuary.

e. Because of the methodology to be used, construction 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. Adverse effects on the life stages of aquatic and terrestrial organisms will be minimal. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values would not occur.

f. Appropriate steps to minimize adverse impacts of the levee construction on aquatic ecosystems include containment of the dredged material slurry, retention of the drainage waters from the containment areas, and management of water levels within ponding areas for controlled release of water of acceptable clarity to the adjacent wetlands.

g. On the basis of the application of the guidelines (40 CFR 230), the sites designated for levee construction and ponding 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.

26 APR 83
DATE

for Robert C. Lee
Colonel, Corps of Engineers
District Engineer

(b) EXTRACTION SITE EVALUATION

(a) SECTION 404(b)(1) EVALUATION

FILL MATERIAL EXTRACTION SITE EVALUATION

Clay fill for construction of the New Orleans to Venice, Louisiana, Hurricane Protection Project levees is obtained from excavation sites located in marsh areas adjacent to the project. The hurricane protection levees are constructed by hydraulic dredge-and-fill methods. With this method of construction, fill material must be available in a quantity about twice that actually required for the levees. The excess material is lost from the levee fill area during the dredge-and-fill operation and/or is purposely wasted because it is not suitable for levee construction. To obtain the required quantity of suitable fill, government contractors are allowed to excavate clay from designated borrow areas to a maximum depth of about 70 feet.

In October 1974, a public notice was issued addressing the Section 404(b)(1) Evaluation for Reach B of the project. The National Marine Fisheries Service (NMFS), responded to the public notice expressing concerns about potential detrimental effects due to the extensive depths of the borrow pits in relation to the adjacent marsh. Similar concerns, particularly in regard to potential water quality problems, were subsequently expressed in October 1979 by the US Environmental Protection Agency (EPA) after reviewing a proposed plan for constructing Reach A of the project.

This appendix addresses water quality effects attendent to excavation of the borrow pits in the project marsh areas. The water quality related impacts resulting from excavation of the borrow pits are considered secondary to those addressed in the Section 404(b)(1) Evaluation report.

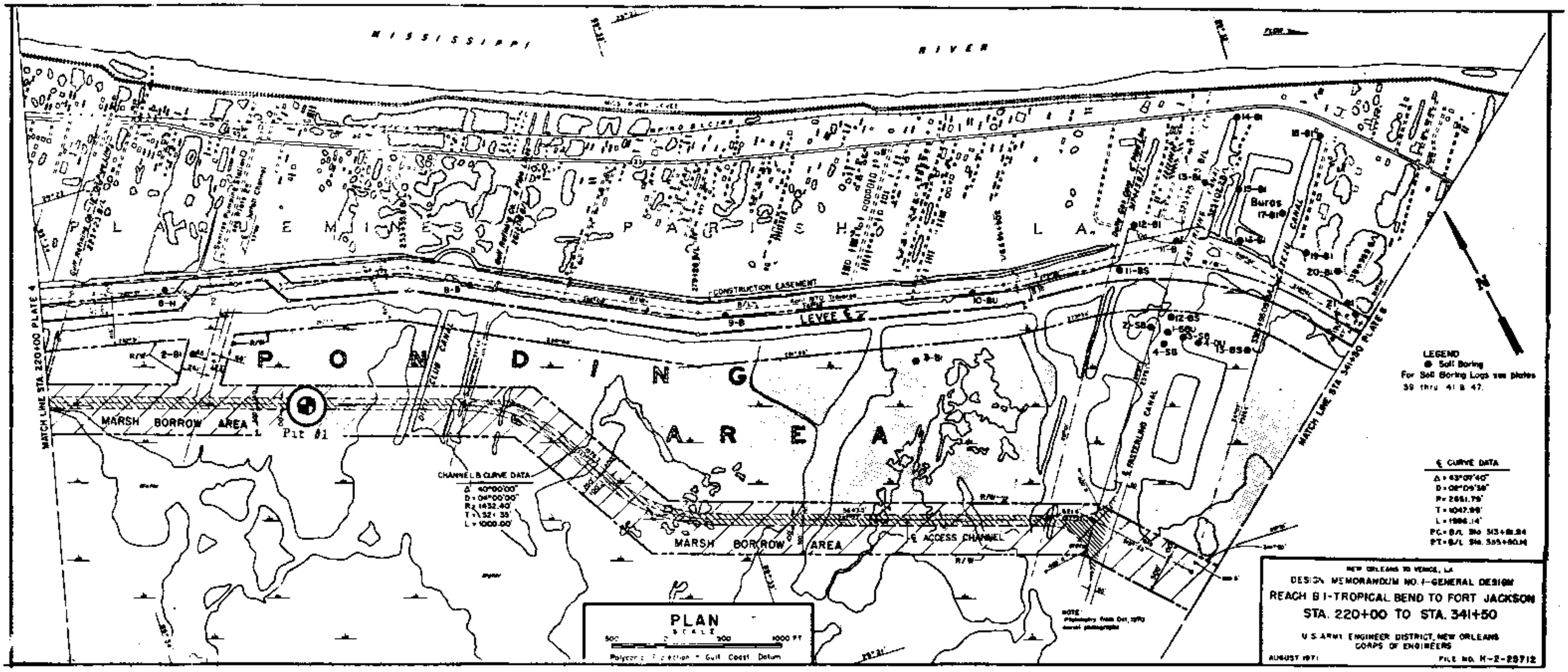
Two borrow pits created during construction of Reach B-1 were selected for the water quality evaluation. Borrow pit No. 1 was excavated in 1971 to a maximum depth of about 45 feet and extends from the Waterway - Empire to the Gulf of Mexico to the Fasterling Canal - a distance of about 3.5 miles. Pit No. 2, located to the southeast, was excavated to a maximum depth of about 55 feet in

1976. It extends a distance of about 3.9 miles from the Fasterling Canal to Bayou Grand Liard.

In April 1980, surface, mid-depth, and bottom water samples were collected at these two fill-material extraction sites. Plans showing the approximate sample collection points and the general location of the borrow pits in relation to the levee construction sites are presented as Plates 1 and 2.

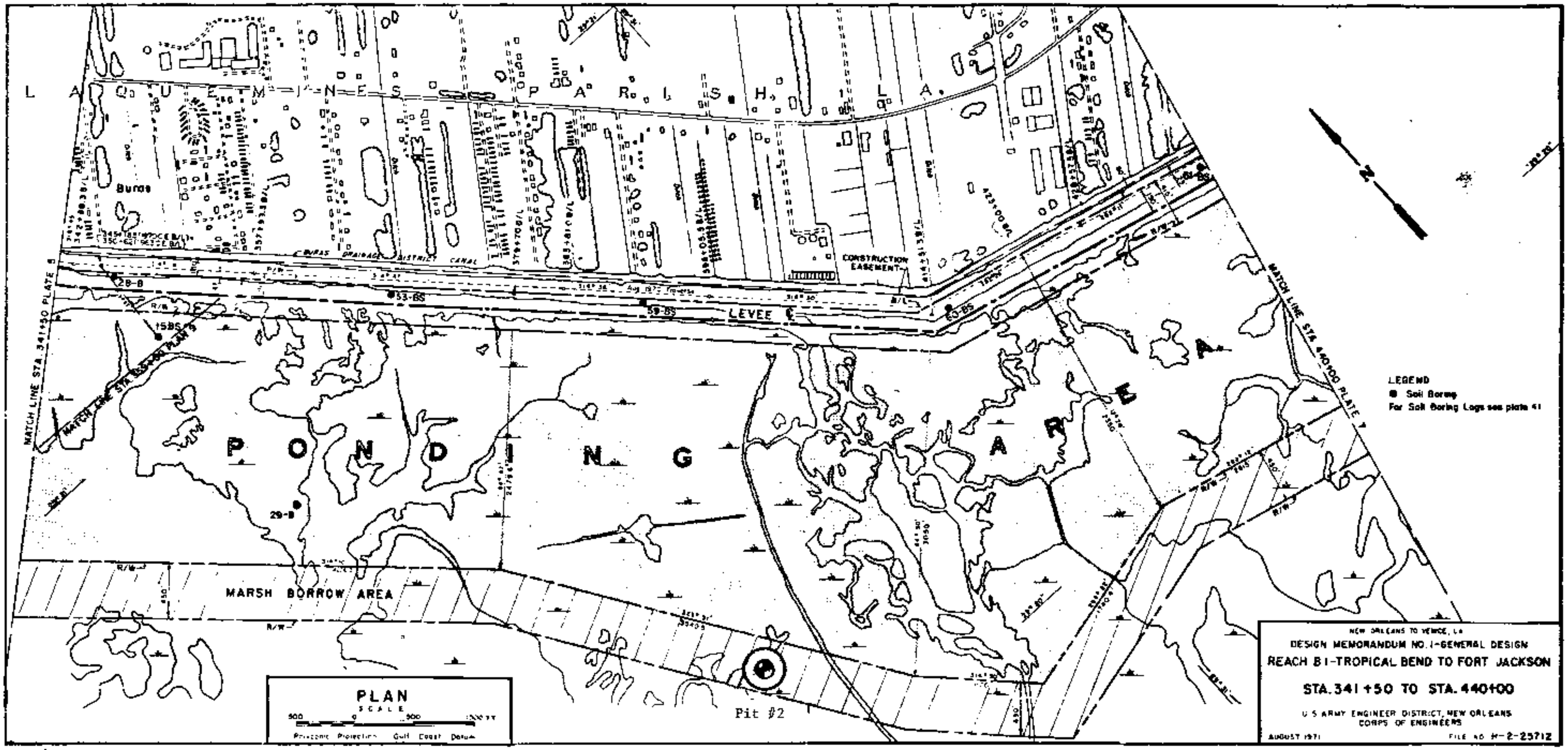
Water chemistry data from subsequent analyses of the six samples collected are presented in Tables 1 and 2, and plots of the data for selected constituents are provided as Figures 1 through 3.

Evaluation of the data indicates that the concerns expressed by the NMFS and EPA are valid for at least a portion of a given year. The data show quite vividly the variation in the concentrations of several parameters with depth on the day that the samples were collected. Dissolved oxygen (DO) measurements at the 2-foot depth (surface) in both borrow pits were very near saturation values estimated using recorded temperature and chloride concentrations. As shown in the tables and on Figure 1, DO decreased with increasing depth to values well below that considered optimal for maintaining diverse fish populations. Complete DO depletion occurred near the borrow pit bottoms. Salinity, computed from chloride concentrations measured in the borrow pit near the Sunrise Pumping Station, varied from 6.9 g/L (ppth) at the surface to 28.7 g/L at a depth of 45 feet. Similarly, salinity varied from 1.6 g/L at the surface to 21.7 g/L at 55 feet in the borrow pit near Buras. In general, these and the other data indicate that the borrow pits were stratified on the day that the samples were collected. The plots of DO, total dissolved solids, and manganese concentrations versus depth most clearly demonstrate the stratification phenomenon. Dissolved solids differentials and density variations appear to be the primary cause of the water column stratification. The variation in water column density at the two sample collection points is shown graphically in Figure 4. These data indicate about a 1.5 percent increase in water density from the surface to the borrow pit bottoms.



⊕ Borrow area sample site for water quality analyses

Plate 1



Borrow area sample site for water quality analyses

Plate 2

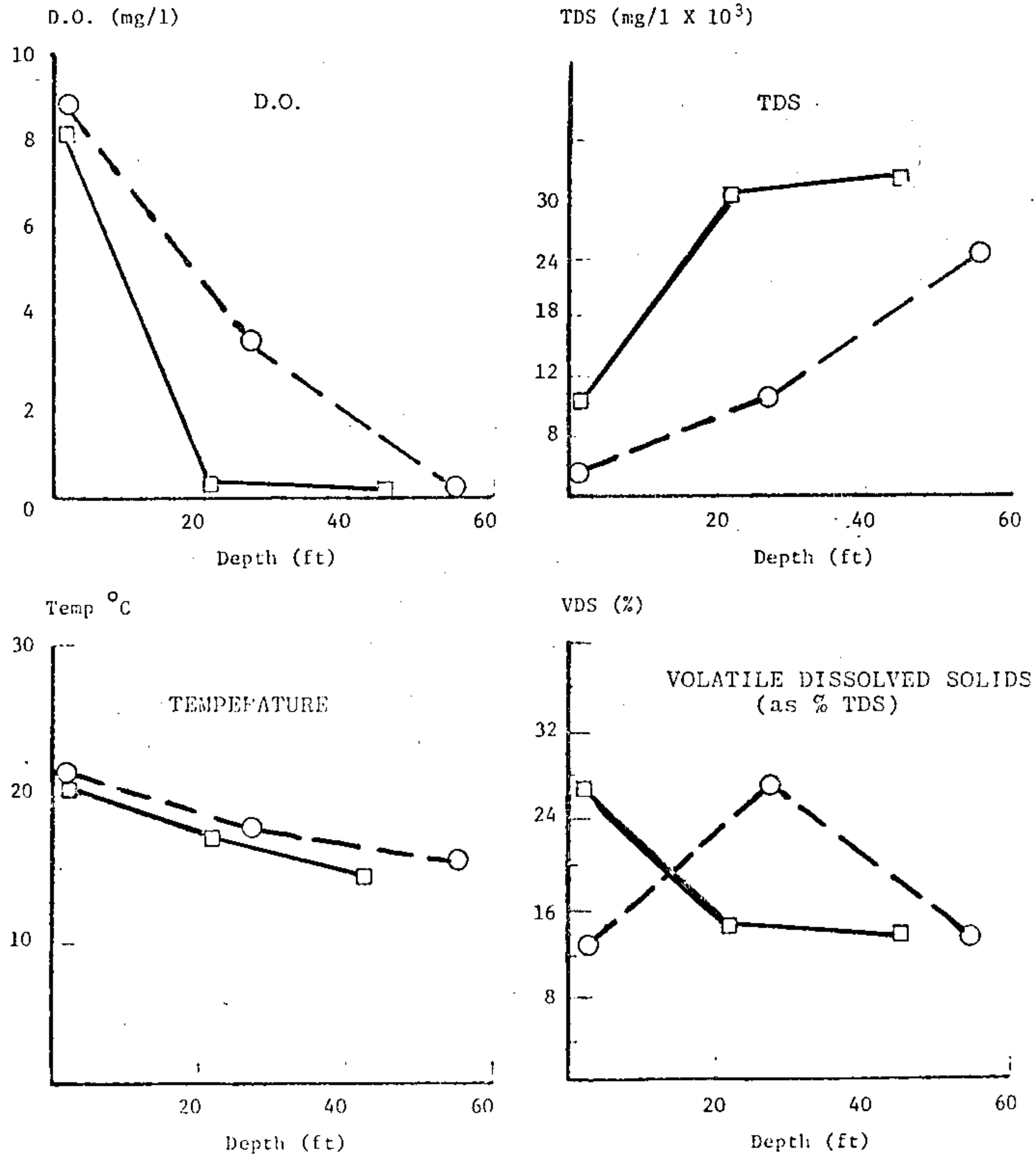
Table 1: A water quality evaluation of samples collected near the sunrise pumping station on 29 April 1980 from a borrow pit (#1) which was excavated in December of 1971 for the New Orleans to Venice Hurricane Protection Project.

CHEMICAL PARAMETER	SURFACE (2ft)	MID-DEPTH (22ft)	BOTTOM (45ft)
Turbidity JTU	4.1	1.2	2.8
Total Dissolved Solids mg/L	9,040	31,050	32,300
Total Suspended Solids mg/L	37.6	28.0	32
Fecal Coliforms Colonies/100 mL	<2.0	14	28
Total Coliforms Colonies/100 mL	60	520	380
BOD mg/L	12.8	7.0	8.9
COD mg/L	13.19	7.15	9.6
NH_4 mg/L	0.05	0.60	1.30
NO_3 mg/L	0.03	0	0
Chloride mg/L	3,794	15,566	15,885
Iron mg/L	384	402	556
Lead mg/L	0	0	0
Zinc mg/L	31	47	0
Chromium mg/L	5	8	12
Cadmium mg/L	0	0	0
Manganese mg/L	37	622	869
Nickel mg/L	0	0	0
Mercury mg/L	<0.05	<0.05	<0.05
PO_4 mg/L	0.06	0.09	0.15
NO_2 mg/L	0	0	0
Sulfate mg/L	0.5	2.09	2.21
Arsenic ug/L	5.0	3.7	3.7
Cyanide ug/L	<1.0	1.0	4.0
Chlorophyll a mg/m^3	0.25	0.28	0.03
Oil and Grease mg/L	7.8	9.4	7.9
Hydrogen Sulfide mg/L	0.64	0.64	5.41
Copper ug/L	32	32	46
Total Volatile Dissolved Solids mg/L	2,434	4,686	4,769
Total Volatile Suspended Solids mg/L	12.50	9.5	11.50
pH (Lab) S.U.	8.35	8.06	8.17
pH (Field) S.U.	7.1	7.6	7.1
DO mg/L	8.1	0.2	0.1
Temperature °C	20.8	17.0	14.8
Conductivity mmhos/cm	6.9	15.7	14.0
Salinity g/L	6.9	28.1	28.7

Table 2: A water quality evaluation of sampling collected near the Sunrise Pumping Station on 29 April 1980 from a borrow pit (#1) which was excavated in December of 1971 for the New Orleans to Venice Hurricane Protection Project.

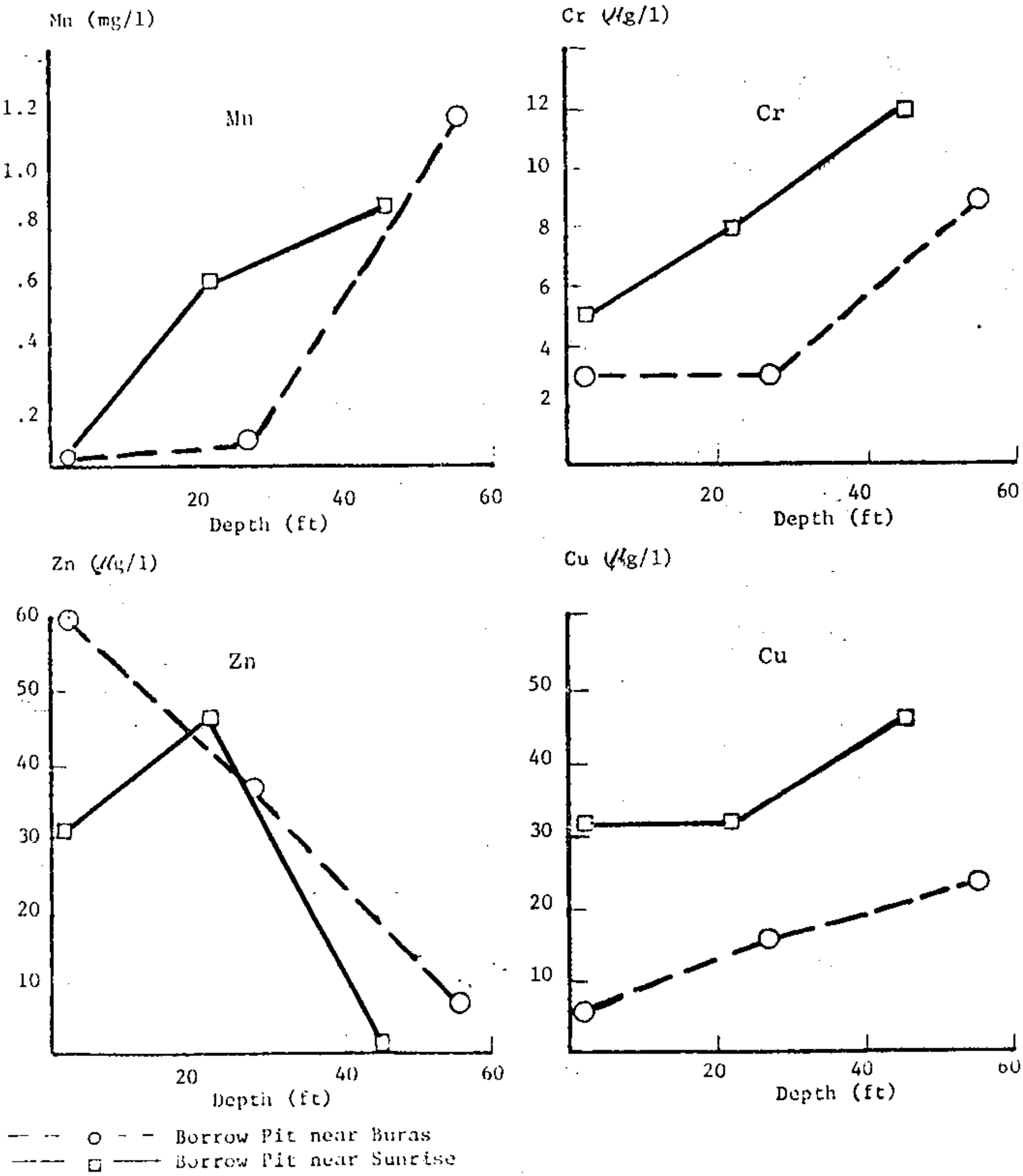
CHEMICAL PARAMETER	SURFACE 2.0ft	MID-DEPTH 27ft	BOTTOM 55ft
Turbidity JTU	9.1	3.0	5.0
Total Dissolved Solids mg/L	2,180	9,990	24,420
Total Suspended Solids mg/L	39.0	27.5	31
Fecal Coliforms Colonies/100 mL	8	2	10
Total Coliforms Colonies/100 mL	130	360	160
BOD mg/L	6.0	4.8	7.1
COD mg/L	6.51	5.31	7.09
NH_4 mg/L	0.06	1.36	1.49
NO_3 mg/L	0.04	0.00	0.04
Chloride mg/L	851	4,255	11,984
Iron ug/L	0	0	0
Lead ug/L	0	0	0
Zinc ug/L	60	37	7
Chromium ug/L	3	3	9
Cadmium ug/L	1	1	0
Manganese ug/L	25	56	1,188
Nickel ug/L	0	0	0
Mercury ug/L	<0.05	<0.05	<0.05
PO_4 ug/L	0.12	0.27	0.27
NO_2 ug/L	0	0	0
Sulfate mg/L	0.14	0.60	1.65
Arsenic ug/L	0	5.3	2.9
Chlorophyll a mg/m^3	0.33	0.35	0.13
Oil and Grease mg/L	0.3	7.2	5.9
Hydrogen Sulfide mg/L	6.10	6.54	9.0
Copper ug/L	6	16	24
Total Volatile Dissolved Solids mg/L	276	2,690	3,750
Total Volatile Suspended Solids mg/L	11.0	10.0	11.0
pH (Lab) S.U.	8.23	8.46	8.43
pH (Field) S.U.	8.4	7.4	7.0
DO mg/L	8.8	3.4	0.2
Temperature °C	21.5	17.8	15.5
Conductivity mmhos/cm	2.5	10.2	15.0
Salinity g/L	1.6	7.7	21.7

Figure 1: Water Quality Variation With Depth in Reach B Borrow Pits



— ○ — Borrow Pits near Buras
—— □ —— Borrow Pits near Sunrise
1 ft = 0.3048m

Figure 2: Water Quality Variation With Depth in Reach B Borrow Pits



1 ft = .3048m

Figure 3: Water Quality Variation With Depth in Reach B Borrow Pits

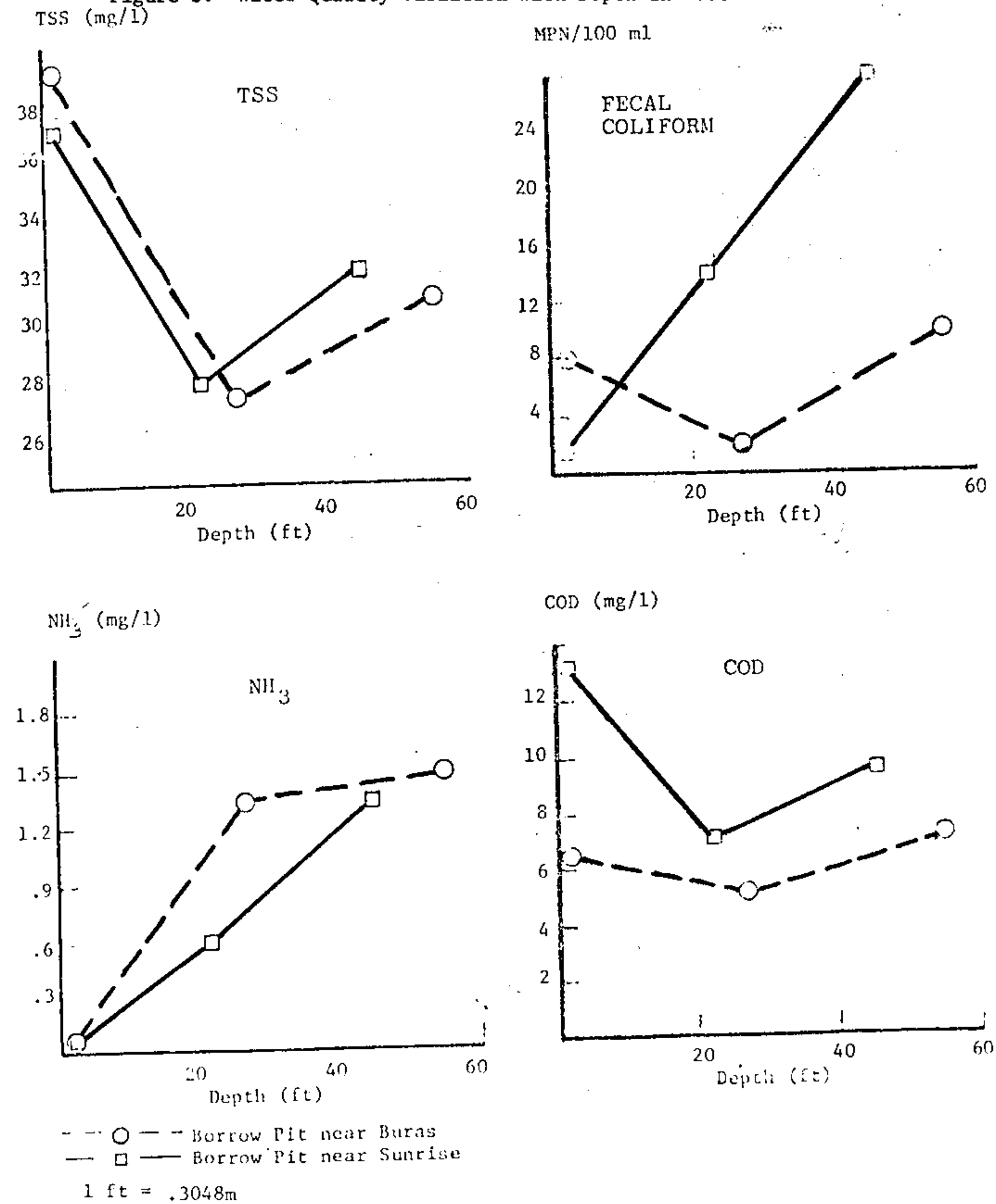
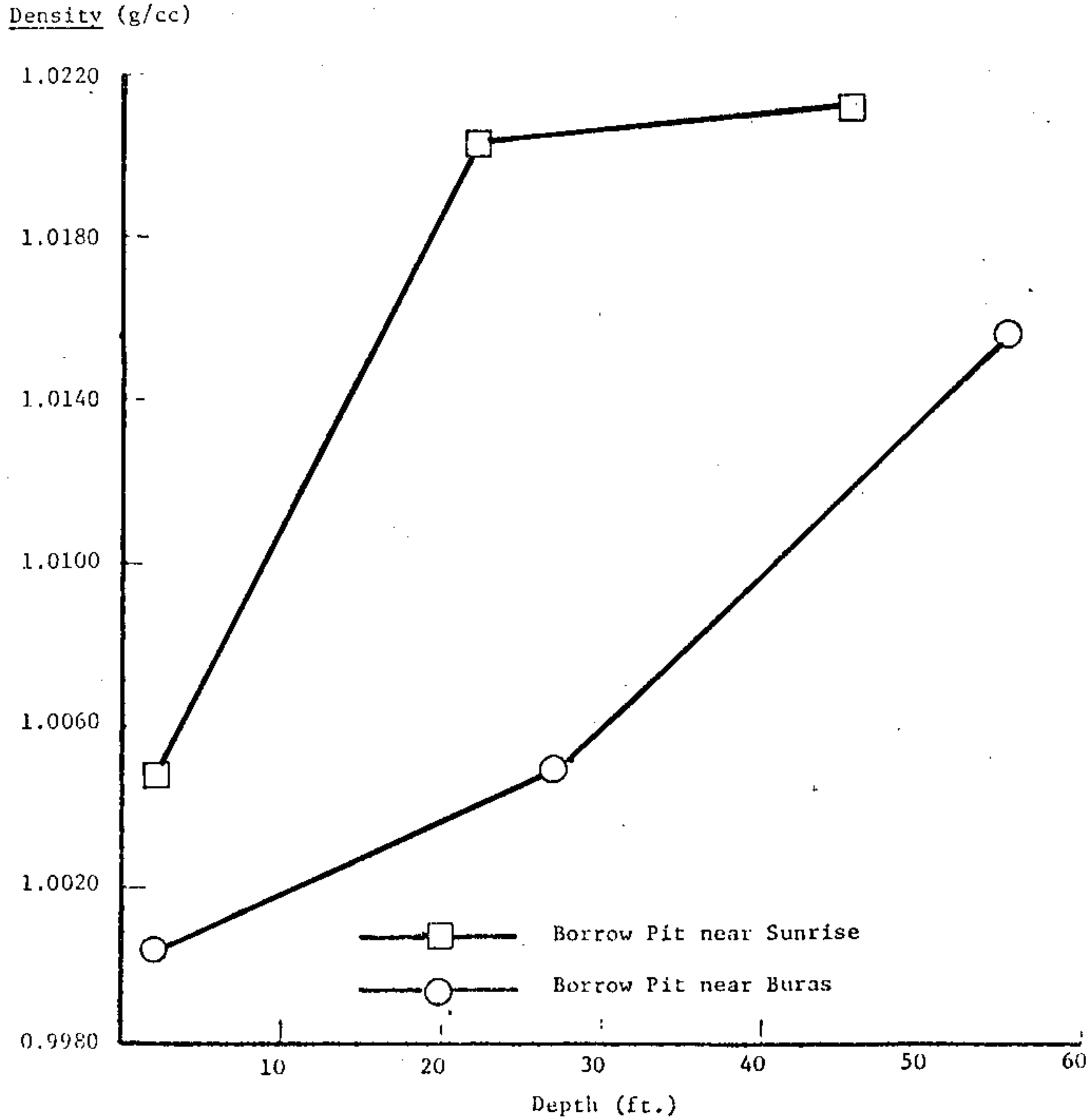


Figure 4

DENSITY VS. DEPTH FOR EXISTING BORROW PITS
IN REACH B



*1 ft = .3048m

The samples were collected in the spring, a time of year when deep water bodies typically overturn, yet the potential for overturning is not evident. Because of the relatively strong density gradients apparent in the borrow pits and the mild temperatures normally experienced in the project area, the probability of overturn is minimal. However, violent storm events in the vicinity of the borrow pits would likely provide sufficient energy to cause vertical mixing of the bottom and surface waters. Since these two water masses can be very dissimilar, degradation of surface water quality could occur. The data indicate that the most significant alterations of water chemistry resulting from the levee construction would occur in the deep clay borrow pits. Wind, wave, and tidal action cause decaying organic matter from the marsh to be deposited into the borrow pits. In the lower depths, water circulation is poor and the concentration of inorganic salts increases above that in the overlying water. The deep waters are deprived of atmospheric reaeration and subjected to oxygen depletion by microbial action on accumulated organic matter. High concentrations of reduced compounds and gases of anaerobic decomposition (N_2, H_2S, CH_4) accumulate in the poorly circulating deep waters.

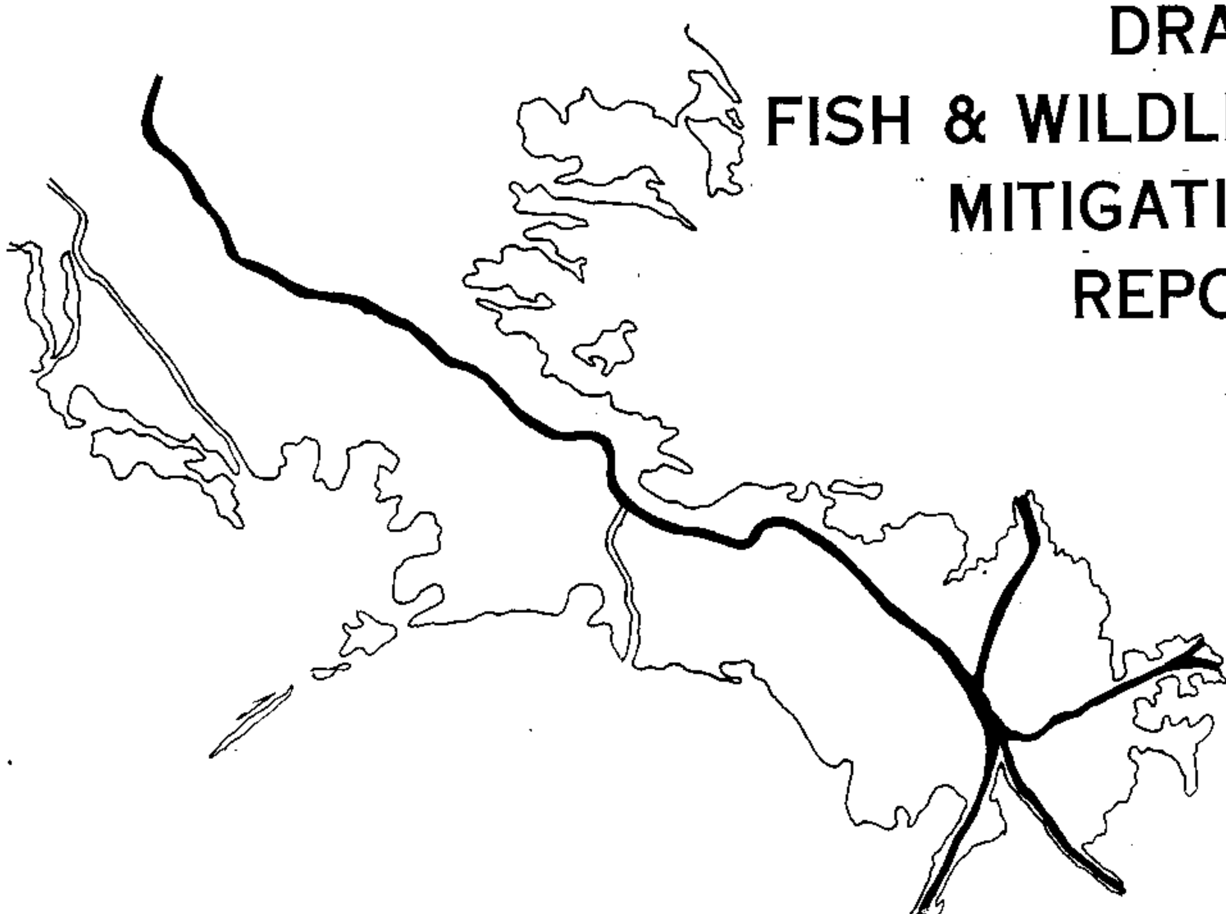
APPENDIX C

MITIGATION

US Army Corps
of Engineers
New Orleans District

February 1984

DRAFT FISH & WILDLIFE MITIGATION REPORT



NEW ORLEANS TO VENICE

LOUISIANA

HURRICANE PROTECTION PROJECT

SUMMARY

This mitigation report examines measures necessary to compensate for project-associated wetland losses incurred by the west bank work for the New Orleans to Venice Hurricane Protection project. The project would initially impact 13,915 acres of which 9,170 are marsh and 4,224 estuarine open water. An annualized loss of 168 acres of marsh, and 5,255 acres of estuarine open water, would occur. To compensate for the losses, the Corps should create, and maintain over the project life, 145 to 427 acres of marsh. Most of the estuarine open water in the ponding areas would be converted to marsh as they would be filled with light sediments. Two methods of marsh creation, dredged material and natural delta-splay, were evaluated in fresh and brackish sites. The creation, and maintenance, of 297 acres of fresh marsh on the Delta National Wildlife Refuge by the delta-splay method is recommended. This method, which is the least expensive alternative, would cost approximately $434,000 with a present value of $449,000 based on October 1982 price levels, an interest rate of 2 7/8% , and a project base year of 1993. Over the project life, mitigation would result in an average annual cost of $14,000 per year.

I. INTRODUCTION

This report recommends mitigation for project-induced losses as a result of the New Orleans to Venice Hurricane Protection project. The report is based on recommendations of the U. S. Fish and Wildlife Service and the New Orleans District of the U. S. Army Corps of Engineers.

II. AUTHORIZATION

The New Orleans to Venice Hurricane Protection project, formerly entitled Mississippi River Delta at and below New Orleans, is an authorized project of the U. S. Army Corps of Engineers. Public Law 874, 87th Congress, 2nd Session, approved 23 October 1962, authorized the construction in accordance with the recommendations of the Chief of Engineers in House Document No. 550, 87th Congress, 2nd Session.

Mitigation for project-induced lossess are allowed under Public Law 85-624, (Fish and Wildlife Coordination Act of 1958), and Public Law 91-190 (National Environmental Policy Act of 1969). The ER 1105-2-10, Chapter 2, paragraph 5 delegates to the Division Commander approval authority to add fish and wildlife mitigation measures to uncompleted, authorized projects which do not require acquisitions of additional land.

III. PROJECT DESCRIPTION

The New Orleans to Venice Hurricane Protection project is intended to provide protection to the developed areas of Plaquemines Parish along the Mississippi River below New Orleans. It involves the enlargement of the existing locally constructed back levees along the lower Mississippi River Delta from City Price to Venice (33 miles) on the west bank, and Phoenix to Mile 10 Above Head of Passes (50 miles) on the east bank. Work has not begun on the west bank section from City Price to Tropical Bend (Reach A; 13 miles); however, the portion from Tropical Bend to Venice (Reach B; 20 miles) is currently under construction. The east bank levee from Phoenix to Bohemia (Reach C; 16 miles) was constructed by local interests, and the remainder (East Bank Barrier; 34 miles) has not begun due to lack of local assurances. This report only applies to the west bank work. A project map is on Plate 1.

The Tentatively Selected Plan (TSP), sand core hydraulic clay fill (SCHC), would provide the necessary protection by the use of a hydraulically constructed sand core, clay blanket, levee. Construction involves the excavation of a central core parallel to the existing back levee and hydraulically filling the trench with 10.2 million cubic yards of sand from the Mississippi River borrow areas. A clay cover, which would be hydraulically pumped from borrow pits in the marsh, would be placed over the core. Of the 33.3 million cubic yards of materials removed from the marsh for the cover, 14.9 million cubic yards would be suitable for levee construction, and the remainder would be diverted to ponding areas. The ponding areas would retain the light, fine sediments, and reduce the turbidity of the effluent discharges into the marsh. After several years of consolidation in the retaining areas, the clay would be shaped into the final levee design with earth-moving equipment.

IV. PROJECT AREA DESCRIPTION

The project area encompasses the modern subdelta of the Mississippi Deltaic Plain region of Southeastern Louisiana and is characterized by low elevations from 5 feet National Geodetic Vertical Datum (NGVD) to sea level. Three major habitats - natural ridge, shallow water bodies, and marshes - are present.

The natural alluvial ridge, which was once covered with levee forest, contains oaks, maples, elm, and gum. Most of this area has now been cleared and supports petroleum related industries, and agricultural and urban development. This is the area to be protected by the project.

CORPS OF ENGINEERS

U.S. ARMY

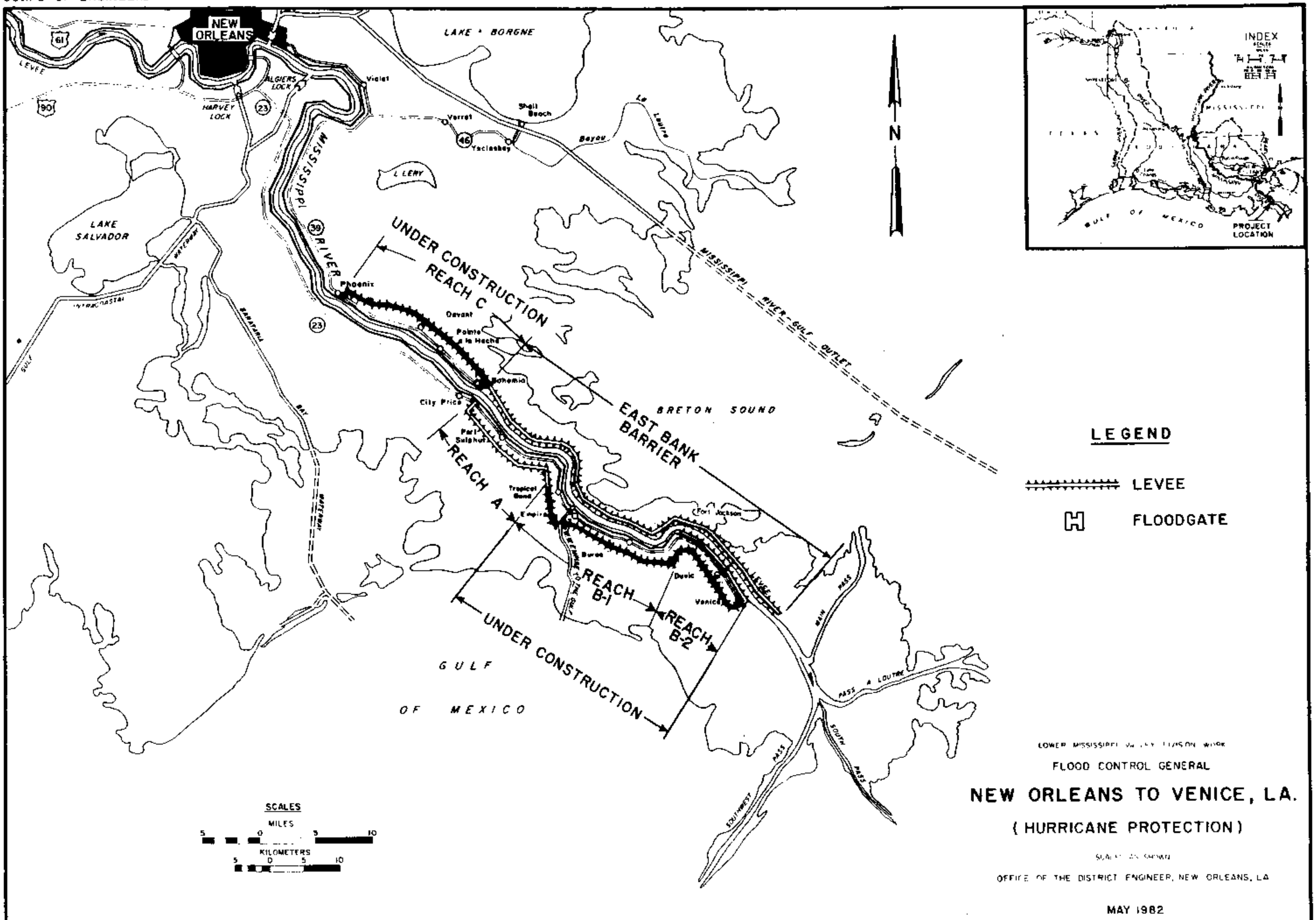


PLATE 1

Shallow water bodies include bays, ponds, lakes, bayous, and canals, that are generaly brackish or saline. Although the surrounding marshes provide most of the energy for this system, phytoplankton and benthic algae also play a role. Vascular plants are extremely limited in the ponds. Animals are predominately benthic organisms such as nematodes, copepods, and amphipods. The area is an important nursery ground for commercial and sport fish, as well as for shrimp, oysters, and crabs.

The intermediate and brackish marshes are at an elevation of 1.9 feet NGVD or less. Vegetation common to these areas include wiregrass, three-square, bulltongue, saltgrass, bulrush, and rush. Although vegetative diversity is low, marsh productivity is one to two times that of the Atlantic coast, and a large animal population is supported.

V. WETLAND VALUE

The primary value of the project area to fish and wildlife lies in the marshlands. Yet, marsh loss is a serious problem both in the project area and coastal Louisiana as a whole. Wetland losses have been primarly attributed to natural and man-induced impacts. Natural losses are a result of subsidence, compaction, and erosion. Man-induced losses include channelization, diversions, flood control reservoirs, canal dredging, and development. Coastal Louisiana is experiencing an average loss of more than 25,000 acres (39 square miles) of marsh per year, and the Mississippi Deltaic Plain is losing coastal marsh an at an annual rate of 20,600 acres (32 square miles) per year (Gosselink et al., 1979; Wicker, 1980). In the Barataria Bay Basin, the marsh loss rate is 1.1 percent per year and the marsh loss rate in the project area is 1.2 percent per year. The gradual change of fresh marsh to brackish marsh due to saltwater intrusion is directly affecting the production of muskrats, nutria, and alligators.

Louisiana's wetlands support a vast commercial and recreational shellfish and fish industry. Louisiana leads the U. S. in the volume of commercial fish landings with nearly 1.7 billion pounds, worth about $190 million dockside in 1978. In the same year, the Barataria Bay Basin had an inshore/offshore estuarine-dependent finfish and shellfish harvest of 82 million pounds (NMFS, 1979). Most of this catch was menhaden, croaker, seatrout, spot, drum, crabs, shrimp and oysters. There is growing evidence that marshes are the most important factor in influencing the production of these estuarine-dependent species. These marshes export vast amounts of organic detritus into adjacent estuarine waters where it serves as a food source for numerous invertebrate species. The productivity, and therefore production, of fish and shellfish is greatly enhanced. Turner (1979) reported that the Louisiana commerical inshore shrimp catch is directly proportional to the area of intertidal wetlands, and Cavit (1979) suggested that menhaden yields were greatest in those basins with the highest ratio of marsh to open water. These two species, shrimp and menhaden, account for most of the total volume of Louisiana's commercial landings. Harris (1973) has stated that total estuarine-dependent commercial fisheries production in coastal Louisiana has peaked and will decline in proportion to the acreage of marsh land loss. Louisiana has traditionally been the leading fur-producing area of North America, and accounts for nearly one-third of the U. S. fur take. Louisiana's coastal marshes provide wintering waterfowl habitat for more than two-thirds of the Mississippi Flyway, and over one-fourth of the North American puddle duck population winters here. Non-game species are also abundant, with the marshes supporting about 150 nesting colonies of seabirds, wading birds, and shorebirds representing approximately 800,000 individuals (Portnoy, 1977).

The fresh marshes of Louisiana are slowly declining, and much of this loss is due to the conversion of fresh to more saline types. This change is primarily the result of saltwater intrusion caused by subsidence and erosion, and accelerated by numerous navigational, drainage, and mineral exploration canals. Based on work of Chabreck and Linscombe (1978), a 17% net increase (207 mi^2) of more saline type vegetation occurred within the Barataria Bay Basin (Hydrologic Unit IV) from 1968 to 1978. From 1956 to 1978, there was a 364,000 acre (75%) loss of fresh/intermediate marsh in the delta area (Hydrologic Unit 2,3,4) (Wicker, 1980). Most of this fresh/intermediate marsh has been converted to estuarine open water due to the processes of subsidence and erosion, and the temporary gain in brackish/saline marsh is a result of saltwater intrusion into the fresher marshes.

VI. PROJECT IMPACTS

The project would impact a total of 13,915 acres of land of which 260 acres would remain levee habitat, 10,750 acres would be used for ponding sites, 1670 acres for borrow areas, and 1,235 acres for additional levee rights-of-way. About 9,710 acres of marsh and 4,224 acres of shallow open water would be affected, of which 2,899 acres would be permanently lost and 10,495 acres temporarily impacted. The permanent impacts are due to the utilization of borrow pits for clay extraction and need for additional levee rights-of-way. Temporarily, impacts are the result of constructing ponding areas necessary to control the release of pollutants and sediments. A summary of the initial project impacts is presented in Tables 1 and 2.

Based on aerial photographs taken in 1956 and 1978, marshes in the study area were found to be eroding 1.2% per year. Without the project, the 9,170 acres of natural marsh is projected to decrease to about 2,004 acres by 2094, a reduction of 78 percent. With the project, all of the natural marsh within the project area would be initially destroyed by completion of the construction phase in 1994. Because of subsidence and compaction, about 50 percent of the ponding area acreage is initially expected to reestablish as marsh, the remainder shrub-scrub. Over time, the marsh will gradually subside into open water and the shrub scrub into marsh. The total marsh acreage is expected to be about 2,586 acres by the year 2094. The projected acreages for each habitat type by target year is contained in Table 3.

In 1969, approximately, 4,244 acres of estuarine open water were present in the project area. The U. S. Fish and Wildlife Service (Hankla, 1982)

Table 1. The habitat, in acres, to be impacted by the SCHC plan.

IMPACTED AREA	HABITAT				
	Marsh	Estuarine Open Water	Shrub Scrub	Grass	Total
Borrow	1,078	586	6	0	1,670
Ponding[a/]	8,092	3,638	255	0	11,985
Present Levee	0	0	0	260	260
Total	9,170	4,224	261	260	13,915

a/ Ponding area in this table includes the retention site and the wetland area adjacent to the locally constructed levee which would be impacted by the project. The increased levee width and retention area represents a total of 1,235 acres of which 683 are marsh and 552 estuarine open water.

TABLE 2. The wetland (marsh and estuarine open water), in acres, to be impacted on a permanent and temporary nature.

HABITAT	IMPACT		
	Permanent[a/]	Temporary[b/]	Total
Marsh	1,761	7,409	9,170
Estuarine Open Water	1,138	3,086	4,224
Total	2,899	10,495	13,394

a/ Permanent impacts would be on the borrow sites and the retention/levee rights-of-way.

b/ Temporary impacts would be in the ponding area.

TABLE 3. The Habitat, in acres, impacts under the with and without project conditions for select target years.

Habitat	Projected Acreages by Target Year						
	WITH PROJECT						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	8,357	0	0	0	0	0
Estuarine open water	4,224	4,480	0	2,613	3,967	5,417	6,573
Scrub-shrub	261	476	5,375	3,965	2,924	2,157	1,591
Levee	260	320	1,495	1,495	1,495	1,495	1,495
Borrow	0	67	1,670	1,670	1,670	1,670	1,670
Ponding marsh	0	215	5,375	4,662	3,859	3,176	2,586
	WITHOUT PROJECT						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	9,059	6,771	4,994	3,684	2,717	2,004
Estuarine open water	4,224	4,335	6,623	8,400	9,710	10,677	11,390
Scrub-shrub	261	261	261	261	261	261	261
Levee	260	260	260	260	260	260	260
Borrow	0	0	0	0	0	0	0
Ponding marsh	0	0	0	0	0	0	0

has estimated that without the project, this acreage would increase by 168 percent to 11,390 acres by 2094. With the project, the acreage of estuarine open water would increase by 55 percent to 6,573 acres between 1969 and 2094. About 1,670 acres of deep-water borrow pits would be created with project implementation. Without the project, the remaining habitats, levee and scrub-shrub, would remain constant at about 521 acres; and with the project, these habitats would increase by 492 percent to 3,086 acres by the year 2094.

Because of the natural and man-made causes of marsh erosion, commerical and recreational uses of the project area would decrease; however, this decline would be accelerated as a result of the project. The U. S. Fish and Wildlife Service estimates that populations of commercially important furbearers and alligators would decrease by 3.5% with the project, and sportfish would decline by 1,008 man-days annually. The potential commercial harvest of fin and shellfish (except oysters) would decrease by 182,000 pounds annually. Rail, snipe, and waterfowl hunting potential would decrease by 96 man-days annually, and rabbit hunting would increase 540 man-days (Hankla, 1982).

VII. MITIGATION

Two methods, a Habitat Evaluation Procedure (HEP) and an economic analysis of impacted habitats, were used to evaluate the mitigation requirements. The HEP was conducted by Federal and state biologists to describe baseline habitat conditions and to predict future conditions. From this procedure, the brackish marsh necessary for mitigation was determined. The quanitity of fresh/intermediate marsh that would be required to equal the brackish marsh impacted was estimated by the use of a relative value index (RVI), based on recreational potential, economic value, and vulnerability. The economic analysis of the impacted habitats was conducted utilizing the recreational and commercial value, per acre, of the various habitats. Recreational potential was derived from a man-day analysis, and commercial data from actual trapping and fishing records. The HEP, RVI, and related U. S. Fish and Wildlife (USFWS) correspondence is contained in the USFWS

Coordination Act report in Section I and the Economic Analysis of Impacted Habitats in Section II. From the HEP, it was determined an annualized 427 acres of brackish marsh, or 297 acres of fresh marsh, would be necessary to offset the project induced losses. The economic analysis revealed that 145 acres of brackish marsh, or 430 acres of fresh marsh, would be required.

To mitigate for unavoidable project damages, two methods of marsh creation are considered feasible and appropriate for this project. One method would involve marsh creation by deposition of dredged material and the other would result in the natural creation of marsh. With the first methodology, dredged material would be deposited into shallow water to an elevation of approximately 1.9 feet NGVD and would be allowed to revegetate naturally. Such marsh creation techniques have been successfully employed by the Corps during maintenance dredging operations along Southwest Pass and in other locations. The alternative method would involve opening holes in the banks along the Mississippi River and/or its distributaries to allow sediment-rich waters to enter shallow-water areas. The result would be the development of a small delta, or delta splay, on which "natural" marsh would establish. This method duplicates the scenario under which the coastal marshes of Louisiana were originally formed and is presently naturally occurring in several locations along Mississippi River distributaries. The method would also eliminate the need for continual maintenance of "man-made marshes" to ensure their continued existence and productivity.

VII. MITIGATION METHODOLOGY

After examining potential mitigation sites, several eroding brackish marsh locations within the project area were examined as well as freshwater marsh sites below Venice, LA. The brackish marsh sites were located on the east side of Bay del la Cheniere and Bay Chicot, and the freshwater marsh sites on the Delta National Wildlife Refuge and Pass-a-Loutre State Wildlife Management area. After examining the engineering, biological, and economic aspects of these sites, we determined the creation of marsh, either by hydraulic dredging or natural accretion, was preferable in the deteriorating fresh marshes of the Delta National Wildlife Refuge adjacent to Main Pass (Plates 2 and 3).

The creation of marsh off Main Pass by hydraulic dredging would involve the placement of a discharge pipe across the pass's bank and placing dredged material in shallow piles. The pipe would be moved frequently so as to limit the top elevation to about 4 feet with side slopes of approximately 1 on 40. After subsidence and consolidation, a marsh with elevations of -0.5 to +2.0 feet would be created. About 6,000,000 cubic yards of material would be initially required to create about 300 acres of marsh, and an equivalent amount would have to be dredged every 10 years to maintain the site.

The creation of marsh by breaching the existing Main Pass bank would result in the accretiion of marsh by the "natural" deposition of sediments. A dragline would be used to create an opening in the levee similar to several naturally occurring openings which are known to accrete marsh. The proposed outlet would have a 200-foot top width, 80-foot bottom width, and would be 20 feet deep - an area of 2,800 square feet. This opening should yield about 45 acres of prime marsh. When the accretion slows and the maximum quanitity of marsh has accumulated, the outlet would be closed and another bank section would be breached until the 297 acres have been created. It will require seven openings to accomplish this. The outlet plugs would be lower than the surrounding bank, and this would allow for high-water overflow to renourish the created marsh. The concept of "moving outlets" would allow for: marsh development on a controlled basis, study of the Mississippi River flows in this area, and monitoring of the marsh. Marsh growth and vegetation analysis would be performed on a regular basis until this method is "proven." Additional details on marsh creation by the placement of dredged material and by the delta-splay method is in Section III.

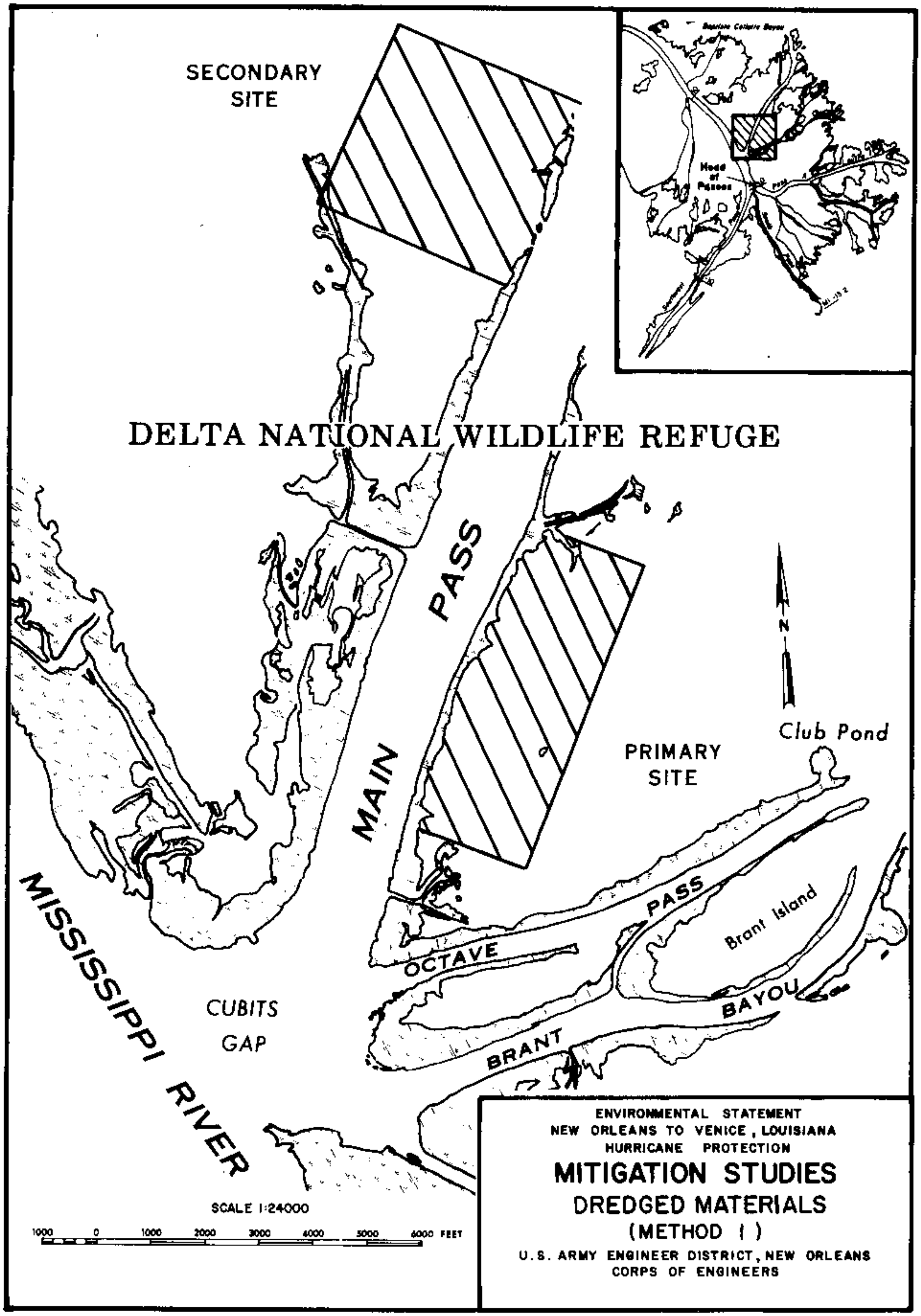
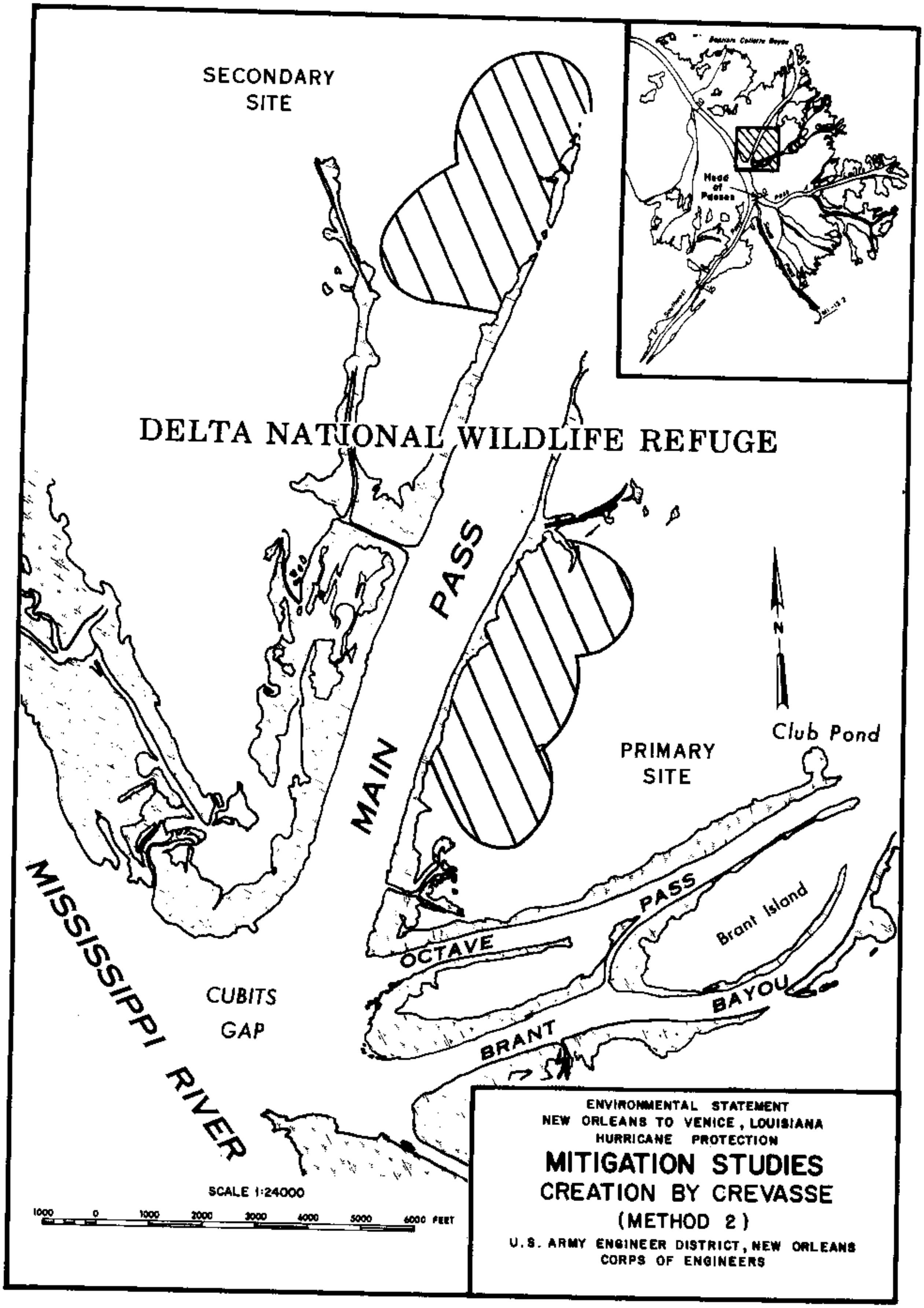

SECONDARY SITE
DELTA NATIONAL WILDLIFE REFUGE
MAIN PASS
PRIMARY SITE
Club Pond
N
OCTAVE PASS
Brant Island
BRANT BAYOU
CUBITS GAP
MISSISSIPPI RIVER
Head of Passes
SCALE 1:24000
1000 0 1000 2000 3000 4000 5000 6000 FEET
ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
MITIGATION STUDIES
DREDGED MATERIALS
(METHOD I)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 2



SECONDARY
SITE
DELTA NATIONAL WILDLIFE REFUGE
MAIN PASS
PRIMARY
SITE
Club Pond
N
OCTAVE PASS
Brant Island
BRANT BAYOU
CUBITS
GAP
MISSISSIPPI RIVER
SCALE 1:24000
1000 0 1000 2000 3000 4000 5000 6000 FEET
Head of Passes
ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
MITIGATION STUDIES
CREATION BY CREVASSE
(METHOD 2)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 3

IX. MITIGATION IMPACTS

The impacts of marsh creation in the Delta National Wildlife Refuge are discussed in the Draft Supplemental Environmental Impact Statement for the New Orleans to Venice Hurricane Protection project. Between 147 and 430 acres of shallow water bottoms would be directly affected. The plants and benthic organisms on the bottom would be destroyed, and mobile organisms displaced. The temporary release of pollutants and increased turbidity caused during dredging are important indirect impacts. The creation of marsh is a significant long-term benefit to the coastal ecosystem.

X. COST

The first costs of creating marsh using the mitigation alternatives range from $434,000 to $24,800,000 with a present value of $449,000 to $30,243,000, and the average annual costs vary from $14,000 to $3,587,000. The cost estimates, which are based on October 1982 price levels, an interest rate of 2 7/8%, and a project base year of 1993, are summarized in Table 4.

An economic analysis of impacted habitats is in Section II. Based on recreational potential (Sec. II, Table 1) and production of commercially harvested fish and wildlife (Sec. II, Table 2), the monetary value of the impacted and mitigation habitats was determined (Sec. II, Table 3). From this analysis, an annual value of $109.13 per acre was calculated for brackish marsh, $0.82 for scrub-shrub, and $37.24 for fresh/intermediate marsh. Estuarine open water was assigned no value because the recreational and commercial uses of this area are marsh dependent, and these benefits were assigned to the marsh. Utilizing annualized habitat changes, a net project-associated loss of $16,031 per year, and mitigation-associated gain of $11,060 to $46,599 was determined. Unfortunately, this type of analysis does not consider non-monetary and scarcity parameters which are particularly critical in the examination of fresh versus salt type marshes.

TABLE 4. The cost estimates of mitigation alternatives for the New Orleans to Venice Hurricane Protection Project. The average annual costs are based on a 2 7/8% interest rate, 100-year project life, October 1982 price levels, and a base year of 1993.

ALTERNATIVE	INITIAL COST		AVERAGE ANNUAL COST		
	First Costs ($)	Present Value ($)	Interest & Amortization ($)	Operation & Maintenance ($)	Total ($)
DREDGE-MATERIAL CREATION					
Brackish Marsh-147 acres	8,700,000	10,609,000	324,000	963,000	1,287,000
Brackish Marsh-427 acres	24,800,000	30,243,000	923,000	2,664,000	3,587,000
Fresh Marsh-297 acres	6,900,000	8,414,000	257,000	738,000	995,000
Fresh Marsh-430 acres	9,935,000	12,115,000	370,000	1,062,000	1,432,000
DELTA-SPLAY CREATION[a]					
Fresh Marsh-297 acres	434,000	449,000	14,000	0	14,000

[a] The delta-splay creation methodology would involve creating 7 openings at 2-year intervals. If after evaluation of the first opening it is found that 2 openings could be constructed concurrently at 3-year intervals, then the first costs would be $347,000 and the average annual cost, $12,000.

XI. DISCUSSION

Although all methods of marsh creation would be acceptable, the delta-splay method of creation is recommended. Based on a new Habitat Evaluation Procedure (HEP) performed by biologists from the U. S. Fish and Wildlife Service, Louisiana Wildlife and Fisheries, and U. S. Army Corps of Engineers, the creation of 297 of freshwater marsh in the shallow open water of the Delta National Wildlife Refuge would be the most suitable and economical. In addition to being less expensive than the hydraulic creation of marsh, the fresh marsh would be located on Federal lands and this would result in enhancement of this property for the public. The location would assure the continued existence of the mitigation land. The delta - splay method also eliminates the need for regular maintenance of "man-made marshes" to ensure the continued existence and productivity of the site. Futhermore, successful implementation of the delta-splay technique could help to perfect a potentially highly useful tool for stemming marsh loss in coastal Louisiana. The creation of fresh marsh by the delta-splay method would cost about $434,000 with a present value of $449,000 and an average annual cost of $14,000. This mitigation plan would result in $11,060 of recreational and commercial benefits per year; however, these benefits are less than the annual $16,031 of project-induced losses. As previously discussed, this difference is not considered significant when non-monetary and scarcity values of fresh marsh are examined. The use of the habitat based U. S. Fish and Wildlife Service HEP took these variables into account, and for this reason, the acreage determined by the HEP was used for mitigation.

XII. CONCLUSION

The creation of about 300 acres of freshwater marsh as mitigation for the New Orleans to Venice Hurricane Protection project would not only compensate for project-associated wetland losses incurred by the west bank work, but would also help replace a scarce and ever-diminishing resource in coastal Louisiana.

LITERATURE CITED

Cavit, M.H. 1979. Dependence of menhaden catch on wetland habitats: a statistical analysis. Unpublished report submitted to US Fish and Wildlife Service, Ecological Services Field Office, Lafayette, La. US and Fish and Wildlife Service, Office of Biological Services, National Coastal Ecosystem Team, NSTL Station, Miss. 12pp.

Chabreck, R. H. and G. Linscombe. 1978. Vegetative typemap of the Louisiana coastal marshes. Louisiana Wildlife and Fisheries Commission. Baton Rouge, LA.

Harris, A.H. 1973. Louisiana estuarine dependent commercial fishery production and values (regional summary and WRPA-10 analysis of production and habitat requirements). Unpublished report prepared for US Department of Commerece, National Marine Fisheries Service, Water Resources Division, St. Petersburg, Florida.

Hankla, D. L. 1982. U. S. Fish and Wildlife Coordination Act Report - New Orleans to Venice, Louisiana, Hurricane Protection Project. US. Fish and Wildlife Service, Division of Ecological Services, Lafayette, LA. 21 pp.

National Marine Fisheries Service. 1979. Fisheries of the United States, 1978. Curr. Fish. Stat. 7800. NOAA-S/T 79-183.

Portnoy, J.W. 1977. Nesting colonies of seabirds and wading birds--coastal Louisiana, Mississippi, and Alabama. US Fish and Wildlife Service, Biological Services Program. FWS/OBS - 77/07. 126 pp.

Turner, R.E. 1979. Louisiana's coastal fisheries and changing environmental conditions. Pages 363-370 in J.W. Day, Jr., D.R. Culley, Jr., R.E. Turner, and A.J. Mumphrey, Jr., eds. Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

Wicker, K. M. 1980. Mississippi Deltaic Plain Region ecological characterization: a habitat mapping study. A user's guide to the habitat maps. U. S. Fish and Wildlife Service, Office of Biological Services FWS/OBS-79/07, 45 pp.

SECTION I

Fish and Wildlife Coordination Act Report

Executive Summary

(The full report is in Appendix E)

NEW ORLEANS TO VENICE HURRICANE PROTECTION PROJECT

EXECUTIVE SUMMARY

The attached document is the final report of the Fish and Wildlife Service (FWS) on the alternative plans under consideration for that portion of the New Orleans to Venice Hurricane Protection Project which lies on the west bank of the Mississippi River. The project was authorized under Public Law 874 - 87th Congress, 2nd Session, approved October 23, 1962, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 550, 87th Congress, 2nd Session. The attached report was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The project essentially involves the upgrading of an existing back levee system and the enlargement of a segment of the Mississippi River levee. The entire project would be accomplished in five phases or reaches. Upon completion, the project would provide hurricane protection to residential and commercial developments along a substantial portion of the Mississippi River south of New Orleans, Louisiana.

The attached report addresses only the impacts of three phases of the project: Reach A, Reach B-1, and Reach B-2. Reach C on the east bank of the Mississippi River has been completed and will hence not be included in this study. The East Bank Barrier Reach, also on the east side of the Mississippi River, will be handled under a separate report.

Reach A would extend for approximately 13 miles from City Price to Tropical Bend, Louisiana. Activity in this reach would involve the upgrading of an existing back levee to hurricane protection standards. Two alternative plans of levee construction are under consideration for this portion of the project. The tentatively selected plan (TSP) calls for the construction of a sand core hydraulic clay (SCHC) covered levee. The alternative plan calls for construction of an "I" wall within the existing back levee, interspersed with earthen levee plugs. The plugs would function as ramps to allow vehicular access across the "I" wall.

Reach B-1 would extend from Tropical Bend to Fort Jackson, Louisiana. Reach B-2 would extend 8 miles from Fort Jackson to Venice, Louisiana. Both of these phases of the project are already under construction utilizing the SCHC method of levee construction. Both also involve the upgrading of an existing back levee to hurricane protection standards.

The primary area of project impact on fish and wildlife resources extends along 36 miles of the Mississippi River from City Price to Venice and west across the natural alluvial ridge into the coastal marshes and estuarine bays, bayous, and lagoons. This area supports an abundance of fish and wildlife. The tidal marshes, aquatic vegetation beds, and shallow estuarine waters provide necessary habitat to a variety of species of crustaceans and finfishes. National Marine

Fisheries Service records indicate that an average annual (1963-1978) estuarine-dependent finfish/shellfish harvest of over 277 million pounds is attributable to Hydrologic Unit IV. Important wildlife species in the project area include resident and migratory waterfowl, rails, numerous non-game birds, small game mammals, commercially important furbearers, reptiles, and amphibians. The majority of those species are heavily dependent upon the marsh for their existence.

In light of the previous discussion, the primary value of the project area to fish and wildlife lies in the marshlands. Yet, marsh loss is a serious problem both in the project area and coastal Louisiana as a whole. Based on recent studies conducted for the Fish and Wildlife Service, it is estimated that coastal Louisiana is experiencing an average loss of more than 39 square miles (25,000 acres) of marsh per year. The U.S. Army Corps of Engineers has calculated that the marsh loss rate in the project area is 1.21 percent per year. Implementation of the project will substantially increase the average annual marsh loss rate in the project area marshes.

An indepth analysis of quantifiable project impacts on fish and wildlife resources was performed. The FWS's Habitat Evaluation Procedures (HEP) were used to assess impacts on wildlife habitat quality and quantity (Appendix A). An analysis of project effects on selected economically important fish and wildlife species (Appendix B) was also performed. These analyses were based on a comparison of future with-project (FWP) and future without-project (FWOP) habitat acreages over the life of the project (1969 to 2094).

The major project impact on fish and wildlife habitat would be the construction of large borrow and ponding areas in an area that is predominantly brackish marsh and estuarine open water. Though 50 percent (5,375 acres) of the ponding areas are likely to redevelop as marsh, approximately 5,375 acres of non-wetland scrub-shrub habitat and 1,670 acres of deep water borrow pits will result with the TSP. Scrub-shrub and borrow areas have a relatively low value for fish and wildlife. In addition, ponding area marsh has a lower value for wildlife than the natural marsh it will replace. However, there will be a net increase, in the year 2094, of 582 acres of marsh with the project, an increase of 29 percent over FWOP conditions. This marsh increase results from the partial transition of scrub-shrub habitat to marsh habitat as it subsides ultimately to open water.

Under FWP conditions, saltwater sportfishing opportunities would decline by 1,008 man-days on an average annual basis. Average annual commercial fish production would decrease by an estimated 182,000 pounds at a cost of $15,800. With the project, annualized hunting opportunities for rabbits would increase by 540 man-days while annualized opportunities for waterfowl, and rail and snipe hunting would decrease by 64 and 31 man-days, respectively. The average annual population of commercially important furbearers and alligators would be expected to decrease by 3.5 percent with project implementation.

The HEP analysis was based upon a determination of the overall quality of the habitats in the project area. It allowed the impacts to a variety of habitats and animal species to be quantified and provided a measure of the specific mitigation needs required to offset unavoidable project impacts. The HEP analysis revealed that the project would cause a net decrease of 4,695 average annual habitat units for all evaluation elements. Severe adverse impacts would be experienced by puddle ducks, wading birds, and terns and skimmers. Moderately negative impacts would be experienced by rails, while project implementation would slightly benefit raccoons and muskrats.

A review of potential alternatives available for mitigating the project-induced loss of fish and wildlife habitat was performed by the interagency team that completed the HEP. It was concluded that, for this project, two mitigation options were available: (1) managing existing marsh to increase its habitat unit value to a level that would compensate for the value of the marsh lost through project implementation or (2) create new habitat (i.e., marsh) with a habitat value equivalent to that lost through project implementation. The interagency team, further, opted for option (2), creating new marsh in shallow open water areas. The FWS is expanding this recommendation to include marsh creation via opening holes in the banks along the Mississippi River and/or its distributaries to allow sediment-rich waters to enter shallow water areas. The result would be the development of small deltas (delta splays) on which natural marsh would establish. This method duplicates the scenario under which the coastal marshes of Louisiana were originally formed and eliminates the potential need for continual maintenance of "man-made marshes" to ensure their continued existence and productivity. Furthermore, successful implementation of the delta splay technique could help to perfect a potentially highly useful tool for stemming the drastic marsh loss in the coastal marshes of south Louisiana.

Completion of the HEP analysis of the marsh creation option yielded the following estimates of mitigation needs. With implementation of the "I" wall/levee plug plan for Reach A and continued construction of Reaches B-1 and B-2 via the SCHC levee plan, 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh would need to be created in areas of shallow open water. With implementation of the SCHC levee plan for Reaches A, B-1, and B-2, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh would need to be created to offset project-induced damages to fish and wildlife habitat.

Mitigation for unavoidable project damages must be viewed as an integral component of project planning and must be provided concurrently with implementation of other project features. Crediting marsh creation associated with other Federal water resource projects (e.g., maintenance dredging of the Mississippi River) as mitigation for this project is not acceptable.

The FWS is prepared to cooperate with the Corps in the selection of suitable sites for marsh creation via the delta splay method. We stand ready to make certain sites on the Delta National Wildlife Refuge available for marsh creation and would encourage the Corps to begin studying the feasibility of using areas of the refuge for this purpose.

In light of the previous discussion and our review of project plans, the FWS recommends that the following measures be implemented to reduce or offset fish and wildlife resources lost as a result of project construction.

1. The "I" wall/levee plug plan should be adopted for the Reach A phase of the project.

2. If the SCHC plan is implemented for Reach A, along with Reaches B-1 and B-2, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh should be created and maintained for the life of the project. Implementation of the "I" wall/levee plug plan for Reach A would reduce the amount of marsh creation needed for mitigation to 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh.

3. Marsh creation via the delta splay method should be selected over other marsh creation methods. Thorough justification for not employing this technique should be provided if an alternative method of marsh creation is selected.

SECTION II

An Economic Analysis of Impacted Habitats

Table 1. Potential value for recreation (in dollars per acre) of various habitats based on use capacity[a], exclusive of fishing[b].

ACTIVITY	HABITAT			
	Fresh Intermediate Marsh	Brackish Marsh	Shrub-Scrub	Estuarine Open Water, Levees, Borrow
Large Game Hunting	0.43	0.0	0.0	negligible
Small Game Hunting	0.67	0.54	0.82	negligible
Migratory Bird Hunting	0.77	0.77	0.0	negligible
Waterfowl Hunting	7.17	5.63	0.0	negligible
Total (In Dollars)	9.04	6.94	0.82	0.0

[a] Data from the Louisiana Coastal Area Study, 1981, US Army Corps of Engineers. Dollar values/man-days of hunting are: Large Game (deer) $14.70; Small game (rabbits, quail), $4.10; Migratory Birds, (snipes, rails, gallinules), $4.10; and waterfowl, $14.70.

[b] Recreational fishing was excluded because the inter-relationship between marsh and shallow open water is such that the recreational values for each cannot be determined independent of the other.

Table 2. Production (in dollars per acre) of commercially harvested fish and wildlife.

ANIMAL	HABITAT		
	Hydrologic[a] Unit III	Hydrologic[a] Unit IV	Open Water, Shrub-Scrub, Levee, Borrow
FISHERIES[b]			negligible
Fish	19.82	45.51	
Shrimp	4.19	46.33	
Blue Crab	0.04	1.07	
Oysters	0.0	6.50	
SUB-TOTAL	24.05	99.41	0
TRAPPING[c]			negligible
Muskrat	0.48	0.46	
Nutria	2.95	0.64	
Mink	0.02	0.02	
Otter	0.02	0.01	
Raccoon	0.11	0.89	
Alligator	0.57	0.76	
SUB-TOTAL	4.15	2.78	0
TOTAL	$28.20	$102.19	0

a/ The Mississippi Deltaic Plain Region is composed of seven hydrologic units. Unit III is the active delta area of the Mississippi River south of Venice, LA and unit IV is the Barataria Bay Basin. Unit III is primarly fresh marsh, and Unit IV is a mixture of fresh, brackish, and saline marshes. Marsh acreages are 406,000 for Unit IV, 67,000 for Unit III.

b/The data is from the 1963 to 1973 commercial catches from Hydrologic Unit III and Unit IV and value is based on 1973 exvessel prices (U.S. Department of Commerce, National Marine Fisheries Service). The catch is attributable to marsh productivity; therefore, open water is considered to have no value. Although project losses would occur in the brackish marshes of Unit IV, and mitigation in the fresh marshes of Unit III, it is not possible to separate the fishery value of fresh, brackish, or saline marshes. Unit IV has a greater value to commercial fisheries because of it's mixture of marsh types and nursey value to most estuarine dependent fish and shellfish.

c/Production was calculated by multiplying the average catch/acre by the average pelt value and was from the Louisiana Coastal Study, 1981, US Army Corps of Engineers. The catch per acre was from a Planning Aid Report on the Mississippi and Louisiana Estuarine Area Study proposed by the US Fish and Wildlife Service. Pelt value was based on a 1976-81 running average of prices received by the trapper.

Table 3. The value (in dollars per year) of fish and wildlife within the New Orleans to Venice Hurricane Protection Study Area. Recreational and commercial values are from Tables 1 and 2, and annualized habitat changes from the Fish and Wildlife Coordination Act Report.

ACTIVITY	IMPACTED[a/] HABITAT			MITIGATION HABITAT
	Brackish Marsh	Shrub Scrub	Estuarine Open Water	Fresh/ Intermediate Marsh
RECREATION				
Hunting	6.94	0.82	-	9.04
Fishing[a/]	-	-	-	-
COMMERCIAL[b/]				
Fishing[b/]	99.41	-	[c/]	24.05
Trapping	2.78	-	-	4.15
TOTAL (acre/year)	$109.13	$0.82	-	$37.24
ANNUALIZED CHANGE (in acres)	-168	+2,808	-5,225[d/]	297[g/]
TOTAL DOLLAR VALUE CHANGE	-18,334	+2,303	0	$11,060[g/]
Net Change		-$16,031[e/]		

[a/]Levee and borrow habitats have negligible values.

[b/]Recreational fishing has not been examined because of the difficulty in comparing the fish population to recreational expendature, and differentiating marsh and open water habitats value.

[c/]Includes shrimp, oysters, and blue crabs.

[d/]It is assumed commercially harvested fish, shrimp, crabs, and oysters are marsh dependent, and are therefore included in the marsh values.

[e/]The impacted estuarine open water would become marsh or shrub-scrub, and these impacts have been incorporated into the respective annualized impacted habitats.

[f/]A net annual loss of $16,031 would require 147 acres ($16,031/acre ÷ $109.13) of brackish marsh or 430 acres ($16,031/acre ÷ $37.24) of fresh/intermediate marsh for mitigation.

[g/]Proposed mitigation.

SECTION III

Mitigation Study

NEW ORLEANS TO VENICE

MITIGATION STUDIES

MAIN PASS

NEW ORLEANS TO VENICE

MITIGATION STUDIES

LIST OF FIGURES

LIST OF TABLES

NEW ORLEANS TO VENICE
MITIGATION STUDIES
MAIN PASS

1. General - This study was conducted to develop the best method of creating new marsh in the National Wildlife Refuge along Main Pass in the vicinity of Cubits Gap of the Mississippi River. The objective was to create 300 acres of marsh, and maintain it for 100 years, for the purpose of mitigating environmental losses caused by the New Orleans to Venice Hurricane Protection project.

2. Alternative Solutions

a. General

Two methods of marsh creation were considered in this study. The first method of marsh creation by disposal of dredged material has been tested extensively by the U. S. Army Waterways Experiment Station in their Dredged Material Research Program; the second method of creation by crevasse, was suggested by Gagliano and van Beek[1/] in earlier studies for the Corps and observed by the U.S. Fish and Wildlife Service on their reservation near Main Pass.

b. Method 1

In Method 1, a hydraulic dredge would be positioned in Main Pass, and the discharge pipe would be positioned across the bank so as to place dredged material in a shallow pile. In order to form marsh, the discharge pipe is moved relatively often so as to limit the top elevation of the fill to about 4 feet. Thus, the side slopes standing at about 1 on 40 would, after subsidence and consolidation, create large areas of marsh platform with an elevation of -.5 to +2.0 feet. Much documentation exists for the computation of consolidation factors, etc., which will allow us to properly size the disposal areas to arrive at 300 acres of marsh for the 100-year life of the project.

c. Method 2

In Method 2, a dragline or clamshell would be used to breach the existing bank of Main Pass, and the normal cycle of flood flows on the river would result in the diversion of water and sediments through the gap and eventually create marsh. Little information exists in the literature to determine the size of an opening which is conducive to marsh creation, or the amount of

---

1/ Gagliano, S.M., and J.L. van Beek. 1970. Geologic and geomorphic aspects of deltaic processes, Mississippi River system. Louisiana State Univ., Center for Wetland Resources, Baton Rouge. Hydrological and Geological Studies of Coastal Louisiana Rep. 1.

marsh area which would be created by a given outlet size. There are two significant advantages to marsh creation by flow diversion. The first is that this method mimics the natural creation of marsh, the resulting marsh areas would be at the correct elevation automatically and would have a natural drainage pattern so that detrital material would be able to be fed to the estuary. The second advantage is that this method should be extremely economical compared to the cost of dredging enough material to build a 300-acre marsh. The primary disadvantage of this method is that there might be adverse impacts on navigation in the river. Flow through existing beaches in the bank along Main Pass approaches 2 percent of the Mississippi River flow, and 18 percent of the flow entering Cubits Gap. If an outlet of this size is allowed to enlarge or other existing outlets approach this magnitude, the flow losses from the Mississippi River could become significant. The size of these breached outlets should be kept to a minimum and closely monitored. If flow losses from the Mississippi River should exceed 2 percent at some time in the future, the beaches in the bank should be partially closed and protected by riprap. The existing banks of the Mississippi River have already deteriorated significantly and any further loss of flow will cause an increase in maintenance dredging below Cubits Gap.

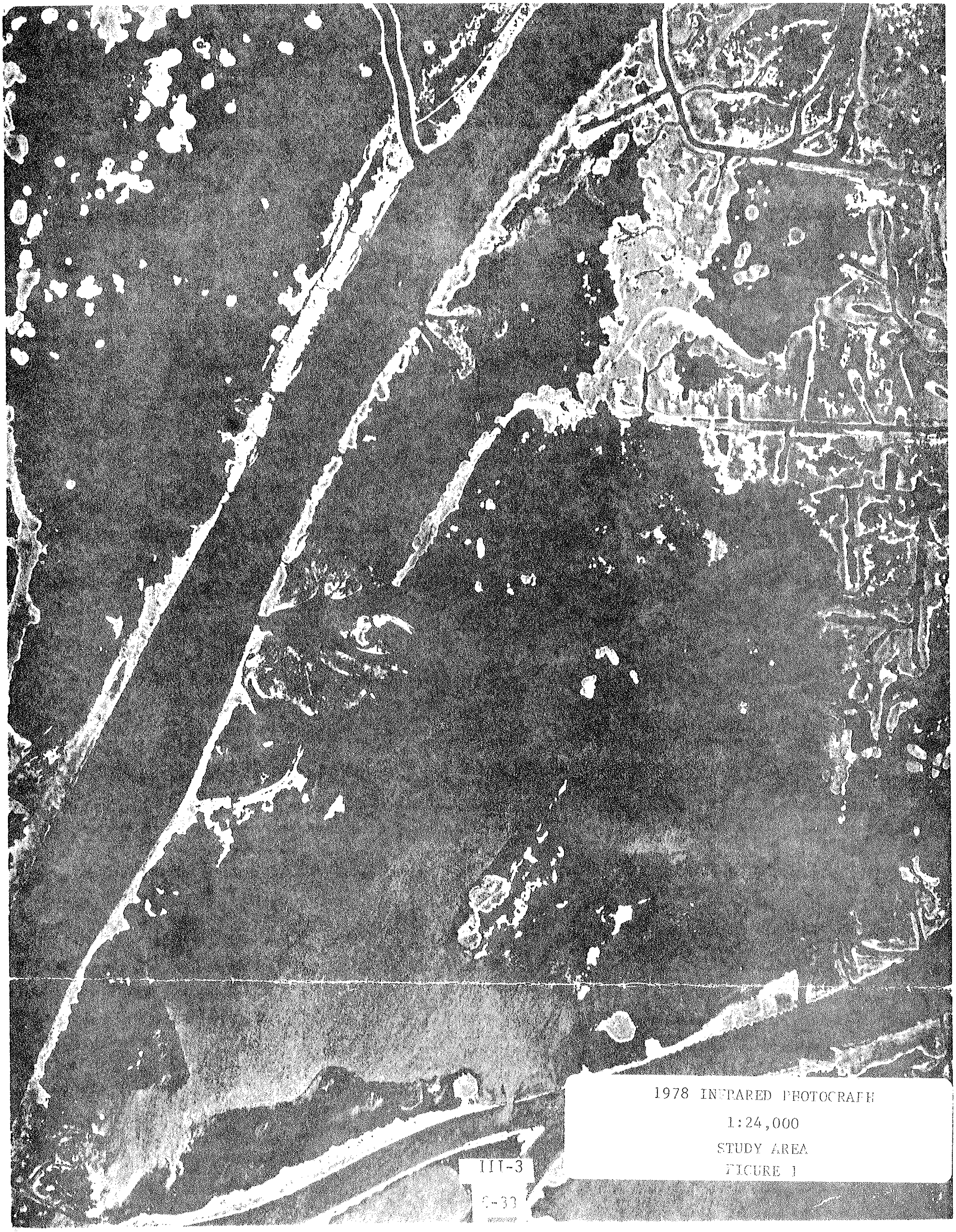
3. Studies of Marsh Development by Crevasse

a. General

As pointed out by U.S. Fish and Wildlife personnel, there is evidence of ongoing delta formation along several natural breaches in the alluvial banks of Main Pass. During the period from 1971 to 1978, the lower Mississippi River experienced three major floods. Topographic maps made from 1971 data do not show breaches which can be seen in the 1978 aerial photographs. We believe the flood of 1973 probably caused these breaches. Color infrared photography flown in 1978 at a scale of 1:24,000, shows several small deltas that formed opposite these breaches. Figure 1 is a copy of the infrared photography of Main Pass. Recent aerial inspections made on 10 June 1982 show that these deltas are still active.

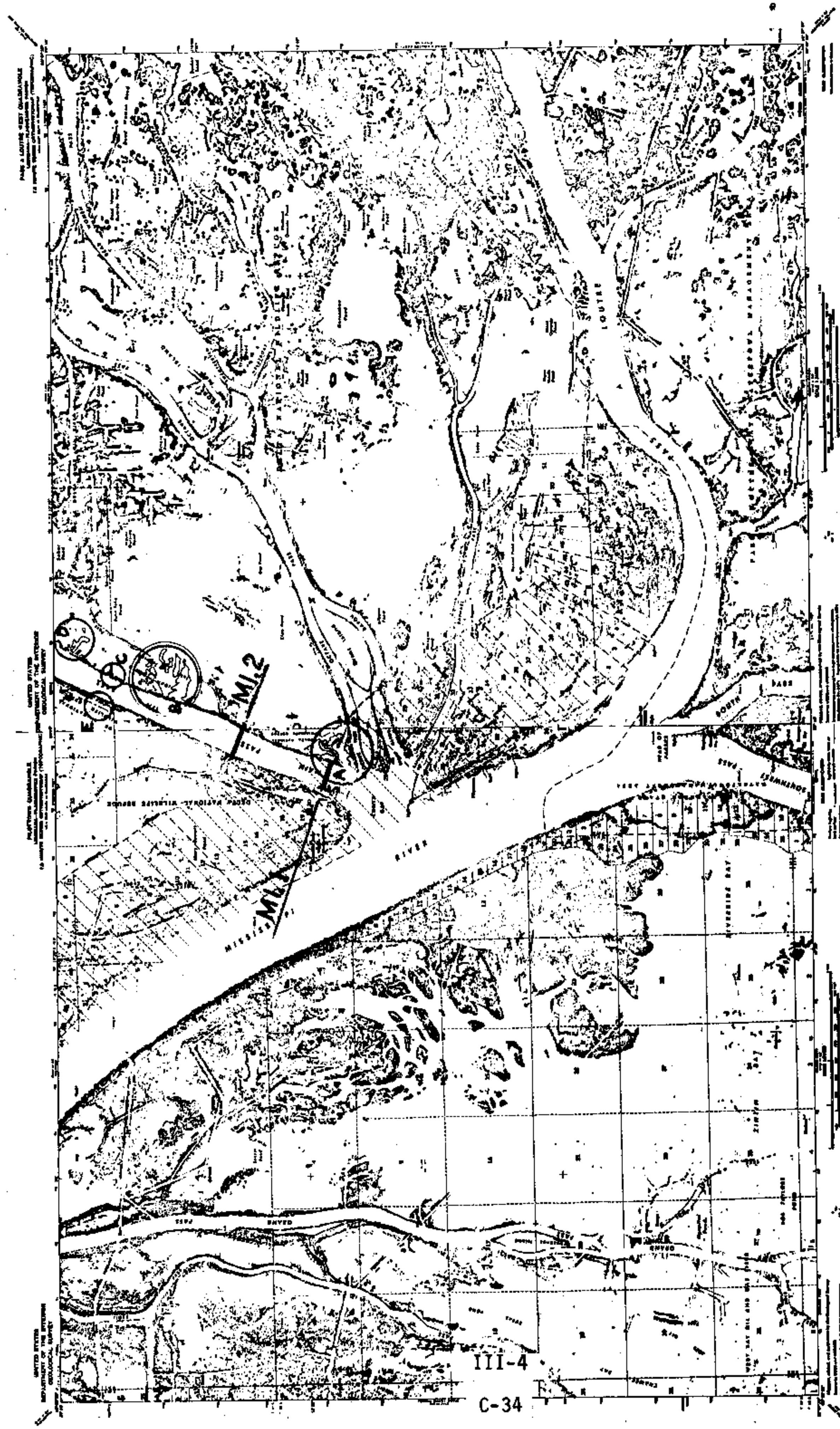
b. Data Collection on Existing Breaches

In order to study the hydraulic relationships and determine the physical characteristics of the natural openings, a data collection program was established in January 1982. Five breaches were selected for study and identified as outlets A, B, C, D, and E. See Figure 2 for a map showing the location of the breaches. Cross sections were taken at the narrowest point in the bank. Additional cross sections were also taken at 25-foot intervals to identify the bathymetry along the entrance and exit of each outlet. Table 1 gives a tabulation of the main physical dimensions of each outlet along the area of natural delta formed in the shallow bay area adjacent to the outlet.



1978 INFRARED PHOTOGRAPH
1:24,000
STUDY AREA
FIGURE 1

DATA COLLECTION AT EXISTING OUTLETS



III-4

FIGURE 2

TABLE 1

PHYSICAL CHARACTERISTICS OF THE OUTLETS

OUTLET	MAXIMUM WIDTH FEET	MAXIMUM DEPTH FEET	AREA SQUARE FEET	DELTA AREA ACRES
A	70	-1.0	39.95	36.72
B	184	-25.0	2,658.25	32.13
C	45	-1.0	30.95	2.5
D	84	-3.5	126.25	22.95
E	74	-4.0	170.13	2.4

c. Typical Cross Sections of Main Pass

As part of the monitoring program, three cross sections were taken in Main Pass at Miles 2, 5, and 8. These sections were taken for comparison purposes and are shown in Figure 3.

d. Bottom profile of Main Pass

A thalweg profile was taken along the entire length of Main Pass to further identify the geometry of Main Pass as it related to the outlets or breaches in its alluvial banks. Note, by referring to Figure 4, that Main Pass is very shallow near its mouth.

e. Comparative Cross Sections of Outlets A, B, C, D, and E

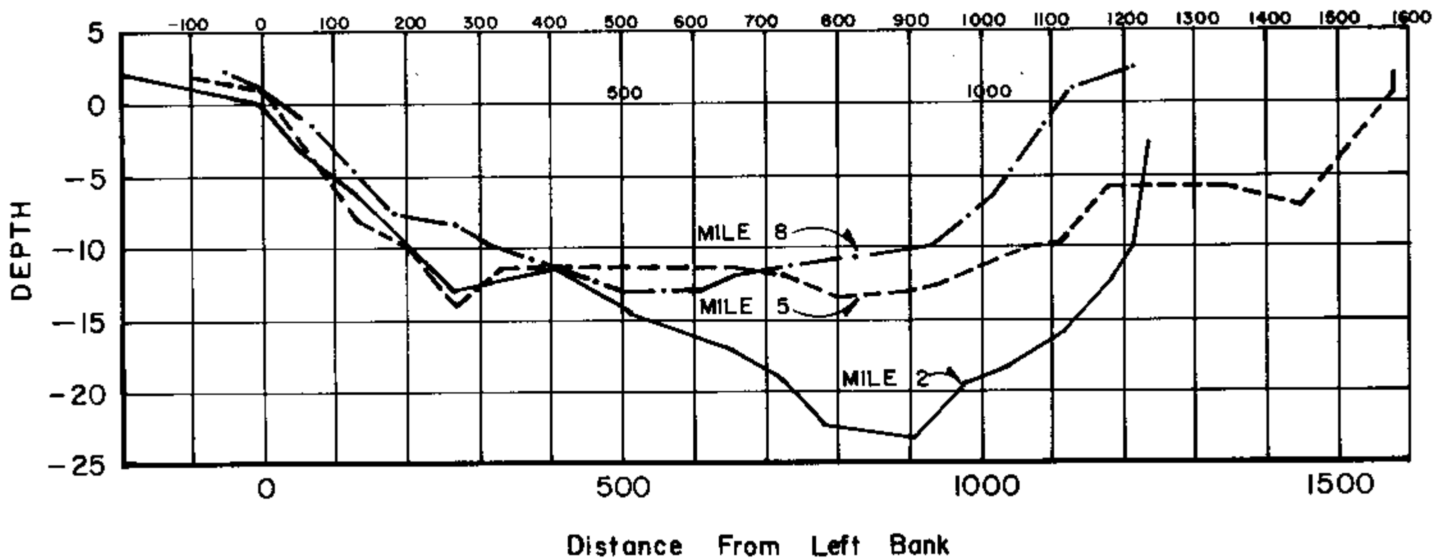
Table 1 shows a comparison of all of the outlets and it can readily be seen that outlet "B" (2,600 square feet) is by far the largest in cross-sectional area. It has an accreting delta area of approximately 32 acres which is the largest of the delta areas with the exception of the marsh opposite outlet "A". Outlet "A" has a cross-sectional area of 40 square feet and an associated delta area of 37 acres. See Table 1 for relationships of the other outlets. In order to cause natural delta growth, the most efficient opening should be selected. Our analysis has shown that the opening should be similar to outlet "B". It should have a 200-foot top width opening and should be approximately 20 feet deep to take advantage of any material moving along the bed of Main Pass. We conclude that outlet "A" at one time was the most efficient outlet, since it created 37 acres of marsh. When this outlet first breached the alluvial banks, it probably approached the cross sectional area and depth of outlet"B". Outlet "A" was also very close to Cubits Gap where shallow bar areas exist and it would receive the sediments first. Favorable alinement could also be a factor. Discharge through outlet "A" is now very small and we conclude that natural shoaling has filled the original outlet or breach. History of an outlet is obviously an important factor and future monitoring efforts should allow for periodic measurement of the size fo the outlets.

f. Velocity-Discharge Measurements

In order to establish the potential for transport through an outlet, velocity and discharge variations and direction of flow should be studied. Sediment load or transport can be computed by using the following formula: 2/

$$Qs = Qw \times Cs \times K$$

2/ This formula was extracted from techniques of Water-Resources Investigations of the Unted States Geological Survey, Book 3, Chapter 3, "Computations of Fluvial Sediment Discharge, 1972".



Mile 2 (Main Pass)	——
Mile 5	- - - -
Mile 8	·—·—

TYPICAL CROSS SECTIONS
MAIN PASS CHANNEL

FIGURE 3

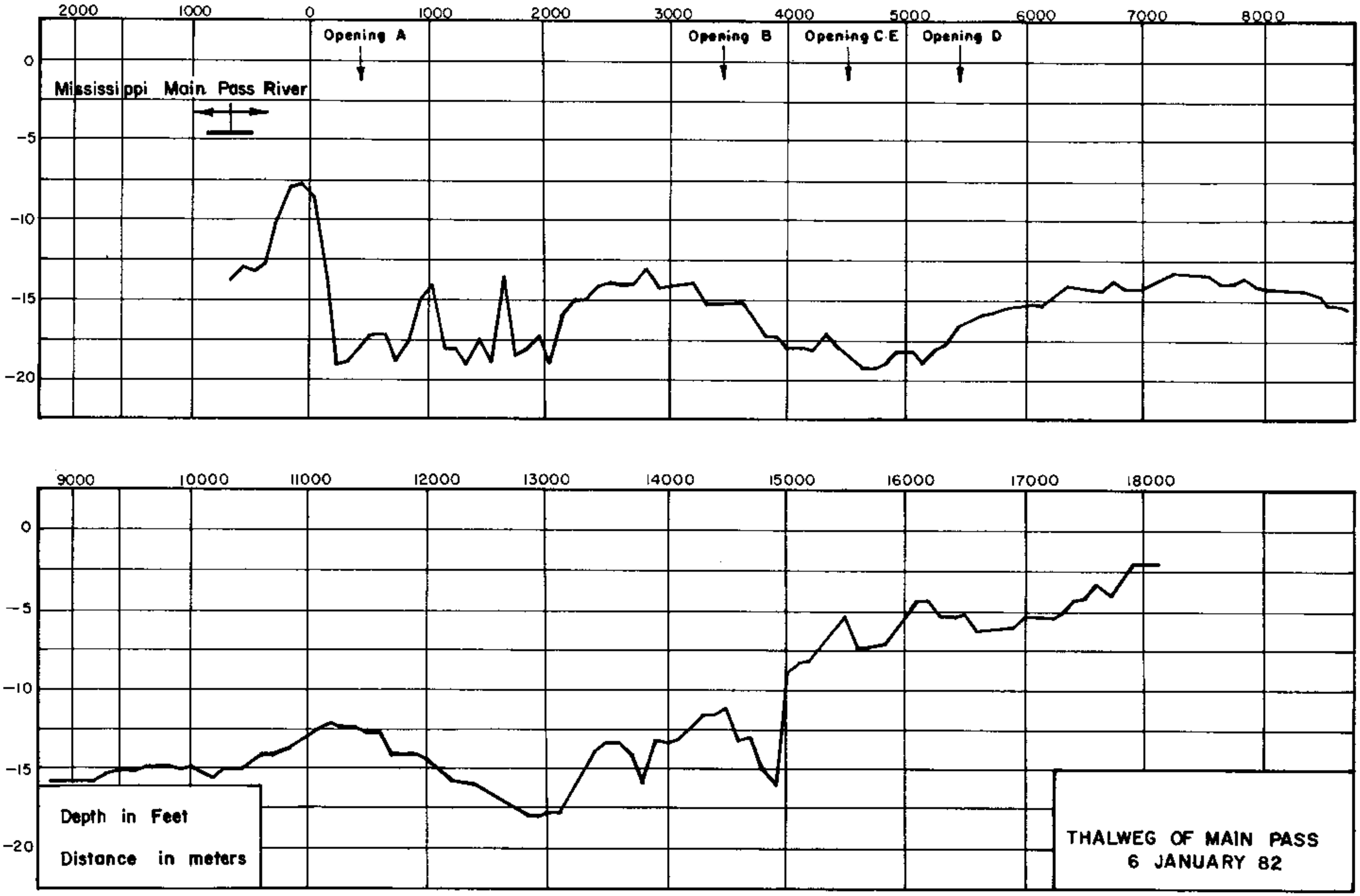

2000
1000
0
1000
2000
3000
4000
5000
6000
7000
8000
Opening A
Opening B
Opening C-E
Opening D
Mississippi Main Pass River
0
-5
-10
-15
-20
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
Depth in Feet
Distance in meters
THALWEG OF MAIN PASS
6 JANUARY 82

FIGURE 4

Where

Qs is the sediment discharge, in tons per days (tons/day);
Qw is the water discharge, in cubic feet per second (cfs);
Cs is the concentration of suspended sediment in milligrams per liter (mg/1) or parts per million (ppm)
K is a coefficient that is based on the unit of measurement of water discharge and that assumes a specific weight of 2.65 for sediment. Based on the English system of short tons this coefficient is 0.0027.

Recent trends along the Mississippi River show that suspended loafs approach 300 ppm. Seventy (70) percent of this load is silt and thirty (30) percent consists of sand. In estimating the suspended load diverted into Main Pass only the silt and load was considered. We assume that the suspended load approaches 200 PPM and the average discharge into the outlet is 2,000 cfs; The sediment transport through the outlet is equal to:

$$\begin{aligned} \text{Qs (Tons/Day)} &= 2{,}000 \text{ cfs} \times 200 \text{ ppm.} \times .0027 \\ &= 1{,}080 \text{ Tons/Day} \\ &= 394{,}000 \text{ Tons/Yr.} \end{aligned}$$

A factor of 0.74 converts tons to cu. yds. An average annual sediment discharge would equal:

$$394{,}000 \times 0.74 = 292{,}000 \text{ cubic yards/yr.}$$

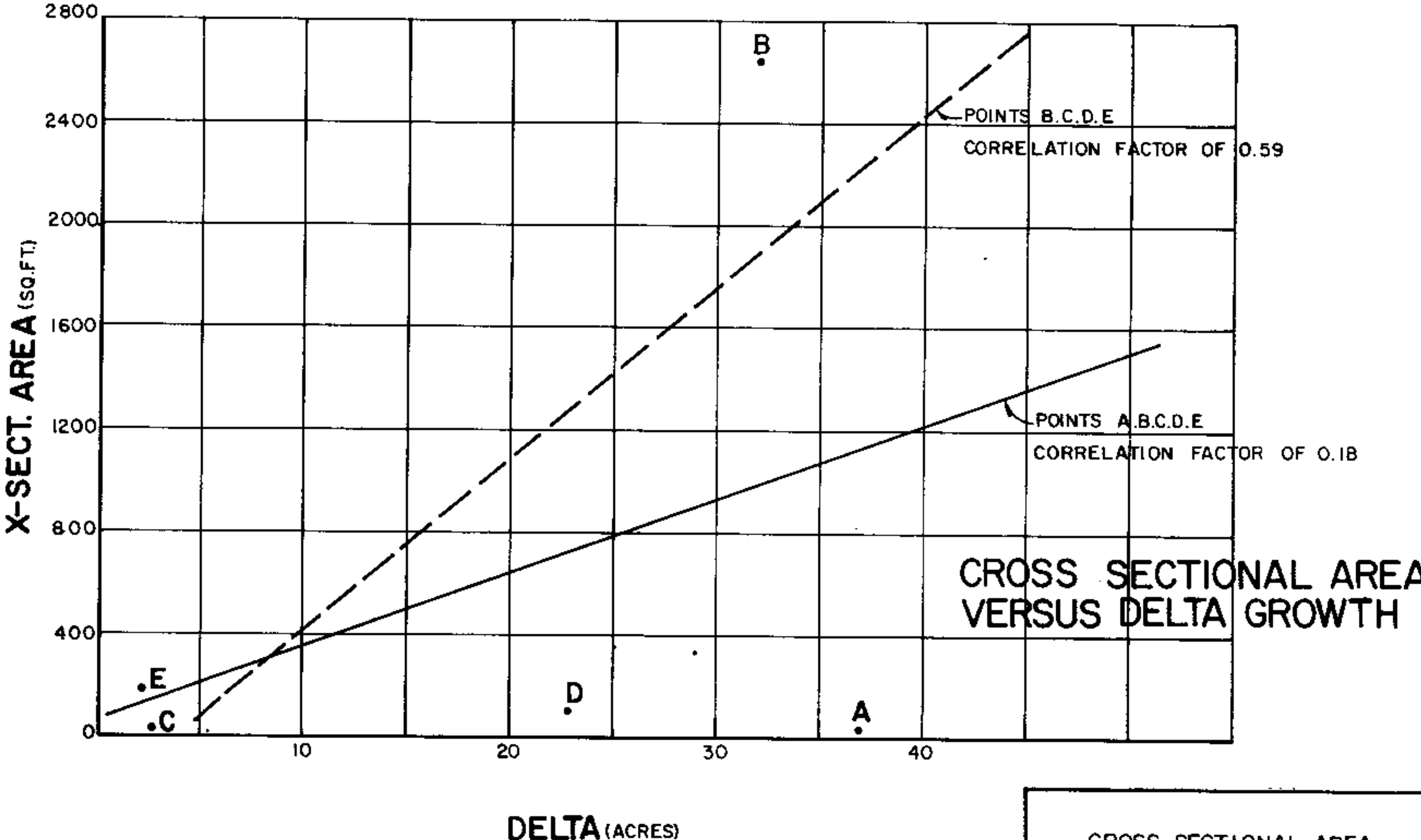
g. Relationship of Outlet Size to Natural Delta Formation

To predict the relationship of delta area acres to cross sectional area of the outlet in square feet, all of the outlets were analyzed. Two curves are shown on Figure 5. The one with the best correlation is achieved by eliminating outlet "A", which is an older outlet which has been filled.

Using an outlet of 2,800 sq. ft. with a top width of 200 ft. and a bottom width of 80 ft. over a depth of 20 ft., we calculated that 45 acres can be built with one outlet. To achieve a marsh development area of 300 acres would require 6.7 or 7 outlets. To avoid, excessive flow diversions which could affect the rest of Main Pass, we would build one outlet at a time. When this outlet has accumulated the maximum marsh area, say 45.0 acres, the outlet would be closed and a new outlet would be breached in an area conducive to building additional marsh. This concept of "moving outlets" would allow close monitoring of flows in relation to the Mississippi River and allow marsh development on a "controlled" basis.

h. Flow Distribution in the Outlets

An important factor to consider when creating marsh by crevasse is how that plan affects flow distribution on the main passes and the rate of shoaling in the Mississippi River. This method would cause some changes in the flow distribution but these changes would be confined mostly to



CROSS SECTIONAL AREA
VERSUS DELTA GROWTH

FIGURE 5

the flow distribution but these changes would be confined mostly to Main Pass. Table 2 shows a tabulation of the existing flows at outlets A, B, C, D, and E on 6 Jan 82, and shows how they related to the flow at Venice. The peak discharge through outlet "B" was about 2.0 percent of the average discharge at Venice. The peak flow of outlet "B" also accounted for 29.0 percent of the average flow through Main Pass. The average flow through Cubits Gap has been 11 percent of the Mississippi River flow at Venice, and will vary from year to year. On 6 Jan 82 it captured about 12.4 percent of the discharge at Venice. To assure that large flow changes would not occur, the "moving outlet" concept of Method 2 would be monitored closely. If large changes occur and excessive flows are diverted from the river, the appropriate outlets would be closed. Method 2 requires the eventual use of 7 outlets.

4. Analysis

For this method, the area of marsh to be maintained is created by a dredge placing material at an elevation of +2 ft. NGVD. The bottom of the receiving waters is assumed to be -2 ft. NGVD, 2 feet is allowed for subsidence, and the quantities are multiplied by 2 to account for losses and the natural repose of the dreged material. Thus, (300 acres x 43,560 sq. ft./acre (2 ft.-(-2ft) +2 ft. for subsidence) ÷ 27 cu. ft./cu.yd.) yields 2,904,000 cu. yds. which when multiplied by a factor of 2 (to account for losses from dredged quantity to in place quantity) yields 5,808,000 cu. yds., or say 6,000,000 cu. yds. As is normal, we will allow 25 percent for contingencies.

Based on our experience with dredged material placement in a similar condition along Tiger Pass, we expect that we would have to add material to this marsh at regular intervals to maintain the 300-acre area. We have estimated this replacement at the rate of 10 percent per year. Thus, every 10 years we would plan to dredge 6,000,000 cubic yards to restore the 300-acre marsh.

b. Material Quantities for Method 2

For this method, the area of marsh to be created would be built by sediment-laden river waters flowing through the outlet after an initial cut is made to open the crevasse. To determine the number and size of crevasses to be made, we plotted the individual cross-sectional areas against delta areas using information from Table 1. Based on this date, we determined a best fit straight line by the method of least squares. (See Figure 5). Each opening would have a top width of 200 ft. and a bottom width of 80 ft. at a depth of 20 feet, and the thalweg length would be 185 feet. Thus (20 (200 - 80) ÷ 2) 185 equals 518,000 cu. ft. Dividing by 27 to get cubic yards yields a net quantity of 19,500 cu. yds. (rounded) per outlet. For this method, we will assume staged construction. Thus, we would build one outlet every second year until the total of 7 outlets needed to produce 300 acres of marsh have been provided. The total dredging is reduced to 136,500 cu. yds. or about 2 1/2 percent of Method 1.

TABLE 2

FLOW DISTRIBUTION AT CUBITS GAP

6 January 1982

Location	Flow (cfs)	Time	Percent Flow Miss R	Percent Flow Cubits Gap	Percent Flow Main
Miss R Venice	239472	0900 to 1000			
Cubits Gap	29600	1313 to 1340	12.4		
Main Pass*	18411	N/A	8.0	62.0	
Main Pass "A"	52**	1700	0.02	0.17	0.28
Main Pass "B"	5300**	1700	2.0	18.0	29.0
Main Pass "C"	28**	1700	0.01	0.09	0.15
Main Pass "D"	278**	1700	0.12	1.0	2.0
Main Pass "E" ***					

* Main Pass Averages 62 percent of Cubits Gap Based on Measuirements Made in 1966, 68,69, 73, and 74.
** Peak Discharge
*** Main Pass "E" - Boat Unable to Get into Channel.

c. Based on the quantities described above, Method 1 would have a construction cost of $6,900,000 and maintenance costs of $6,900,000 every 10 years. Method 2 would have initial construction costs of $62,000 repeated 7 times over a 14-year span of staged construction for a total cost of $434,000. See Tables 3-4.

d. Conclusion

Method 1 is a tried and proven method of creating new marsh; however, its initial costs are almost sixteen times as much as Method 2. Method 2 is the most environmentally acceptable method from the standpoint of the Fish and Wildlife Service. Since the method is innovative, in that a crevasse has never been intentionally created for the diversion of riverine sediments, we recommend that an abbreviated monitoring program be undertaken using aerial photographs each September at a scale of 1:24,000, plus some additional discharge measurements before and after opening the first and second crevasse to; determine if there is an effect on flow in the Mississippi River, although we expect no measurable alteration in the existing flow regime of the river. Mitigation sites for Method 1 and 2 can be found in Figures 6 and 7.

TABLE 3
COST ESTIMATE
MARSH DEVELOPMENT IN MAIN PASS
METHOD 1 - DREDGE DISPOSAL

Item	Quantity	Unit Price	Total Cost
Mob & Demob	1	$200,000	$200,000
Dredged Material	6,000,000 cu yd	0.80	4,800,000
Subtotal			5,000,000
Contingencies	25 percent		1,250,000
Subtotal			6,250,000
E&D + S&I	11 percent		688,000
TOTAL			$6,900,000

TABLE 4
COST ESTIMATE
MARSH DEVELOPMENT IN MAIN PASS
METHOD 2 - ARTIFICIAL CREVASSE

Item	Quantity	Unit Price	Total Cost
Mob & Demob	1	$20,000	$20,000
Excavate	19,500 cu yds	1.25	24,375
Subtotal			44,375
Contingencies	25 percent		11,100
Subtotal			55,475
E&D + S&A	11 percent		6,100
TOTAL			$62,000

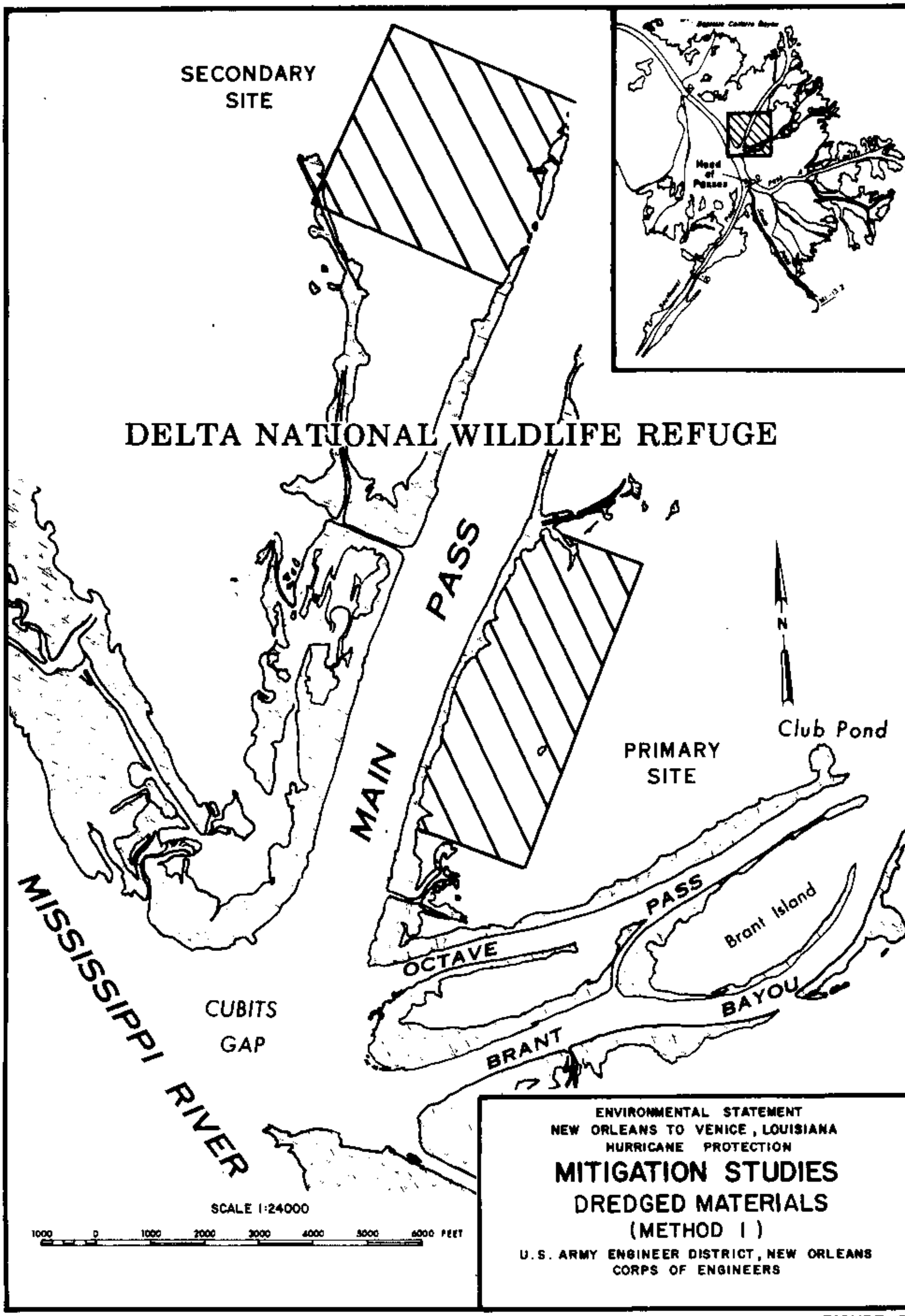

SECONDARY
SITE
DELTA NATIONAL WILDLIFE REFUGE
MAIN PASS
PRIMARY
SITE
Club Pond
N
MISSISSIPPI RIVER
CUBITS
GAP
OCTAVE
PASS
Brant Island
BRANT
BAYOU
Head of Passes
SCALE 1:24000
1000 0 1000 2000 3000 4000 5000 6000 FEET
ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
MITIGATION STUDIES
DREDGED MATERIALS
(METHOD I)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FIGURE 6

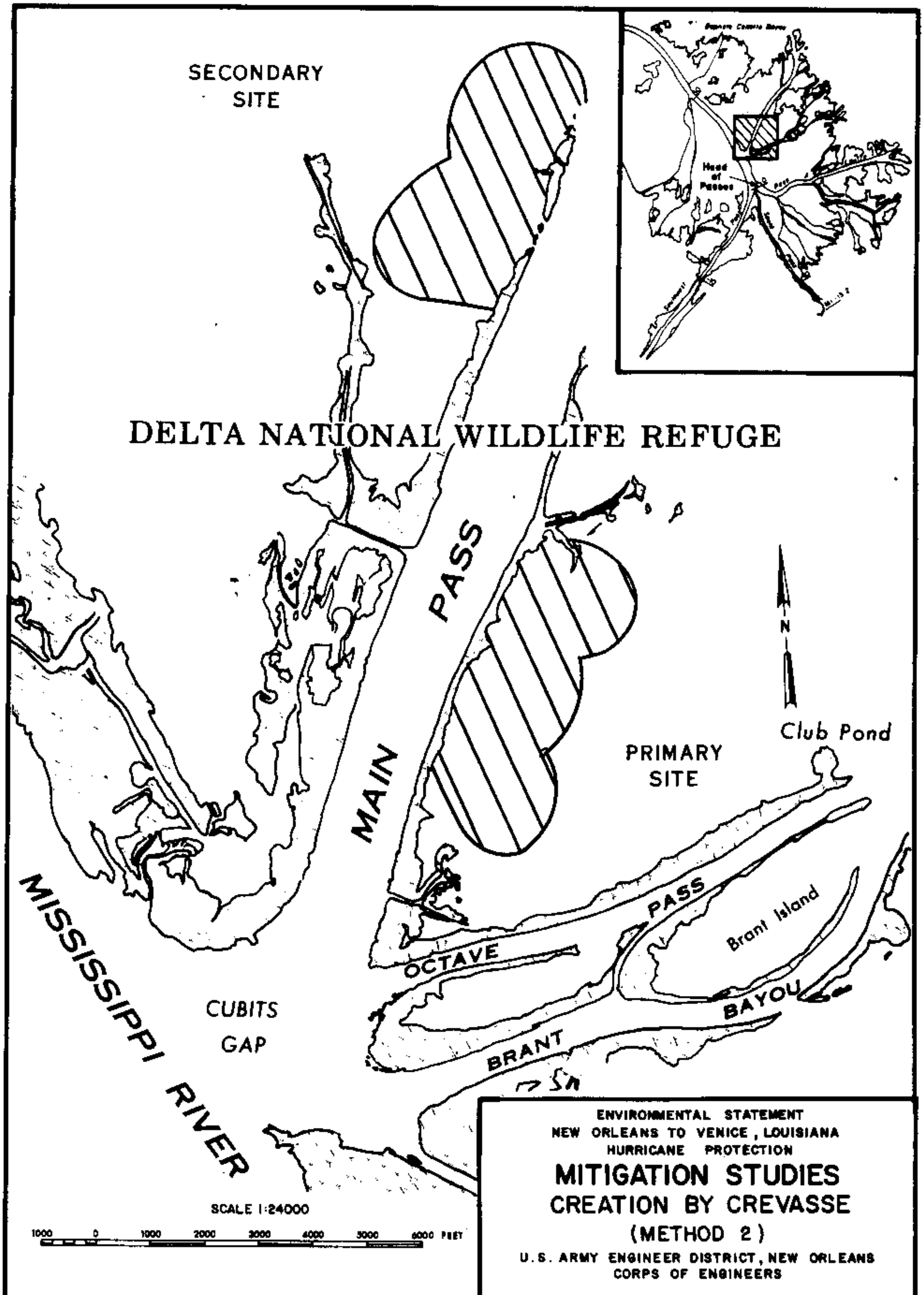

SECONDARY SITE
DELTA NATIONAL WILDLIFE REFUGE
MAIN PASS
PRIMARY SITE
Club Pond
N
MISSISSIPPI RIVER
CUBITS GAP
OCTAVE PASS
Brant Island
BRANT BAYOU
SCALE 1:24000
1000 0 1000 2000 3000 4000 5000 6000 FEET
ENVIRONMENTAL STATEMENT
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION
MITIGATION STUDIES
CREATION BY CREVASSE
(METHOD 2)
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
Head of Passes

FIGURE 7

SECTION IV

Correspondence

US FISH AND WILDLIFE SERVICE'S COMMENTS

United States Department of the Interior
FISH AND WILDLIFE SERVICE
JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE 3185
JACKSON, MISSISSIPPI 39213

June 10, 1982

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to the June 2, 1982, meeting between Fish and Wildlife Service (FWS) and U.S. Army Corps of Engineers (CE) personnel to discuss mitigation for the New Orleans to Venice Hurricane Protection Project. Project mitigation needs have been identified in our final Fish and Wildlife Coordination Act (FWCA) report of May 17, 1982. As one alternative, the Service recommended that some 300 acres of fresh-intermediate marsh be created in areas of shallow open water to compensate for unavoidable project-related degradation of fish and wildlife resources. Your agency has apparently elected to meet its mitigation obligations via this fresh-intermediate marsh creation option. The FWS concurs with the determination that this is the most feasible and desirable means of adequately mitigating project impacts.

As stated in our FWCA report, we consider two methods of marsh creation feasible and appropriate for project mitigation. One method would involve pumping dredged material into areas of shallow water to an elevation of approximately 1.9 feet mean sea level, an elevation conducive to the establishment of emergent marsh vegetation. The other method would involve opening holes in the banks along the Mississippi River and/or its distributaries to allow sediment-rich waters to enter shallow water areas. The result would be the development of a small delta or delta splay on which "natural" marsh would establish. The Service prefers utilization of the delta splay method of marsh creation as it virtually duplicates the scenario under which the Mississippi River Delta marshes were originally formed. We have also urged the Corps to consider Delta National Wildlife Refuge (NWR) as the site for marsh creation.

At the subject meeting, CE personnel presented the findings of preliminary investigations into these two methods of marsh creation. They found that, although pumping spoil to create marsh is a more precise method of creating marsh, it is much more costly. Conversely, the delta splay or "natural" marsh creation methodology, though somewhat imprecise, is substantially less expensive. These preliminary studies have resulted in a tentative proposal by the Corps to implement the delta splay method of marsh creation for project mitigation purposes.

CE personnel have studied existing delta splays along Main Pass on Delta NWR. Their plan would call for the creation of a delta splay at another site along Main Pass. This attempt at marsh creation would be intensively monitored by means of aerial photographs taken annually and periodic on-the-ground measurements of the artificial crevasse in the pass bank. The results would then be utilized to determine the number and location of the delta splays necessary to fully meet the mitigation requirement.

The FWS supports this concept of creating an opening in the bank of Main Pass and closely monitoring the ensuing marsh development. When the Corps finalizes its plans to make such an opening, the proposal can be submitted to the refuge manager at Delta NWR and our Regional Director for final approval and granting of a right-of-way, as is provided for in Public Law 89-669(80 Stat. 926: 16 U.S.C. 663d) as amended.

Please keep Mr. David Hankla of our Lafayette Field Office informed as formal plans for project mitigation are formulated. We will continue to work closely with your staff to insure that a workable mitigation plan for this project is developed.

Your cooperation in this matter is greatly appreciated.

Sincerely yours,

Ray Aycock

Acting Area Manager

cc: Manager, Mississippi Sandhill Crane NWR, Gautier, MS
ES, USFWS, Lafayette, LA

APPENDIX D

MODIFIED MAN-DAY AND HABITAT ANALYSIS

Table 1: A comparison of Future-Without-Project (Without Project) and Future-With-Project (With Project) habitat acreages for the Tenatively Selected Plan (TSP).

TARGET YEAR	HABITAT				
	Marsh	Estuarine Open Water	Shrub Scrub	Levee	Borrow
<u>1969</u>					
Base Conditions (Pre-Project)	9,170	4,224	261	260	0
<u>1994</u>					
Without Project	6,771	6,623	261	260	0
With Project	5,375	0	5,375	1,495	1,670
Net Change	- 1,936	- 6,623	+ 5,114	+ 1,235	+ 1,670
<u>2019</u>					
Without Project	4,994	8,400	261	260	0
With Project	4,622	2,163	3,965	1,495	1,670
Net Change	- 372	- 6,237	+ 3,704	+ 1,235	+ 1,670
<u>2044</u>					
Without Project	3,684	9,710	261	260	0
With Project	3,859	3,967	2,924	1,495	1,670
Net Change	+ 175	- 5,745	+ 2,660	+ 1,235	+ 1,670
<u>2069</u>					
Without Project	2,717	10,677	261	260	0
With Project	3,176	5,417	2,157	1,495	1,670
Net Change	+ 459	- 5,260	+ 1,896	+ 1,235	+ 1,670
<u>2094</u>					
Without Project	2,004	11,390	261	260	0
With Project	2,586	6,573	1,591	1,495	1,670
Net Change	+ 582	- 4,871	+ 1,330	+ 1,235	+ 1,670
Annualized Change					
Without Project	4,750	8,644	261	260	0
With Project	4,582	3,389	3,069	1,372	1,503
Net Change	- 168	- 5,255	+ 2,808	+ 1,112	+ 1,503

Table 2: A comparison of need (man-days) between Future-Without-Project (Without Project) and Future-With-Project (With Project) conditions of the Tentatively Selected Plan for sport fishing, rail/snipe hunting, rabbit hunting, and waterfowl hunting.

TARGET YEAR	MAN-DAYS			
	Sport Fishing	Rail/Snipe Hunting	Rabbit Hunting	Waterfowl Hunting
1994				
Without Project	40.262	1.273	939	2,593
With Project	32,250	1,010	1,779	2,059
Net Change	- 8,376	- 263	+ 840	- 534
2019				
Without Project	29,964	940	706	1,913
With Project	27,732	870	1,398	1,770
Net Change	- 2,232	- 70	+ 692	- 143
2044				
Without Project	22,104	693	535	1,411
With Project	23,154	725	1,091	1,478
Net Change	+ 1,050	+ 32	+ 556	+ 67
2069				
Without Project	16,302	511	408	1,041
With Project	19,056	597	829	1,216
Net Change	+ 2,754	+ 86	+ 421	+ 175
2094				
Without Project	12,024	377	315	768
With Project	15,516	486	657	990
Net Change	+ 3,492	+ 109	+ 342	+ 222
Annualized				
Without Project	28,500	893	674	1,819
With Project	27,492	861	1,213	1,755
Net Change	- 1,008	- 32	+ 539	- 64

1/These Values represent the annualized change in need that would be due to implementation of the Tenatively Selected Plan (TSP).

Table 3: A man-day analysis values, by habitat type, for sport fishing, rail/snipe hunting, rabbit hunting, and waterfowl hunting.

ACTIVITY	MAN-DAY PER ACRE					VALUE PER ACRE[a]				
	Marsh	Estuarine Open Water	Scrub Shrub	Levee	Borrow	Marsh	Estuarine Open Water	Scrub Shrub	Levee	Borrow
Sport Fishing	6.0[b]	0	0	0	0	$23.40	0	0	0	0
Rail/Snipe Hunting	.188[c]	0	0	0	0	.73	0	0	0	0
Rabbit Hunting	.131[c]	0	.200[d]	0	0	.51	0	.78	0	0
Waterfowl Hunting	.383[c]	0	0	0	0	5.28	0	0	0	0
TOTALS	6.70	0[e]	.200	0	0	29.92	0	.78	0	0

a/ Dollar value per man-day are: sport fishing, $3.90; rail/snipe hunting, $3.90; rabbit hunting, $3.90; and waterfowl hunting, $13.80.

b/ Taken from value of wetlands and bottomland hardwoods; US Army COE 1977

c/ Taken from FWS input to LA Coastal Area Study, Letter dated 6 Oct 81

d/ T. Memer., Delta NWR, US FWS, Pers Comm. 23 Apr 81

e/ Although estuarine open water is inhabited by several species of sport fishes, sport fish productivity is attributed solely to the marsh.

APPENDIX E

US FISH AND WILDLIFE SERVICE
DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Jackson Mall Office Suite 3185
300 Woodrow Wilson Avenue
Jackson, Mississippi 39213
May 17, 1982

Colonel Robert C. Lee
District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

Attached is the formal Fish and Wildlife Coordination Act Report on the alternative plans under consideration for that portion of the New Orleans to Venice Hurricane Protection Project which lies on the west bank of the Mississippi River. The 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 the National Marine Fisheries Service. Copies of the letters of response from those agencies are attached.

Your cooperation in this matter is appreciated.

Sincerely yours,

for Robert Misso

Gary L. Hickman
Area Manager

Attachments

NEW ORLEANS TO VENICE HURRICANE PROTECTION PROJECT

EXECUTIVE SUMMARY

The attached document is the final report of the Fish and Wildlife Service (FWS) on the alternative plans under consideration for that portion of the New Orleans to Venice Hurricane Protection Project which lies on the west bank of the Mississippi River. The project was authorized under Public Law 874 - 87th Congress, 2nd Session, approved October 23, 1962, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 550, 87th Congress, 2nd Session. The attached report was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The project essentially involves the upgrading of an existing back levee system and the enlargement of a segment of the Mississippi River levee. The entire project would be accomplished in five phases or reaches. Upon completion, the project would provide hurricane protection to residential and commercial developments along a substantial portion of the Mississippi River south of New Orleans, Louisiana.

The attached report addresses only the impacts of three phases of the project: Reach A, Reach B-1, and Reach B-2. Reach C on the east bank of the Mississippi River has been completed and will hence not be included in this study. The East Bank Barrier Reach, also on the east side of the Mississippi River, will be handled under a separate report.

Reach A would extend for approximately 13 miles from City Price to Tropical Bend, Louisiana. Activity in this reach would involve the upgrading of an existing back levee to hurricane protection standards. Two alternative plans of levee construction are under consideration for this portion of the project. The tentatively selected plan (TSP) calls for the construction of a sand core hydraulic clay (SCHC) covered levee. The alternative plan calls for construction of an "I" wall within the existing back levee, interspersed with earthen levee plugs. The plugs would function as ramps to allow vehicular access across the "I" wall.

Reach B-1 would extend from Tropical Bend to Fort Jackson, Louisiana. Reach B-2 would extend 8 miles from Fort Jackson to Venice, Louisiana. Both of these phases of the project are already under construction utilizing the SCHC method of levee construction. Both also involve the upgrading of an existing back levee to hurricane protection standards.

The primary area of project impact on fish and wildlife resources extends along 36 miles of the Mississippi River from City Price to Venice and west across the natural alluvial ridge into the coastal marshes and estuarine bays, bayous, and lagoons. This area supports an abundance of fish and wildlife. The tidal marshes, aquatic vegetation beds, and shallow estuarine waters provide necessary habitat to a variety of species of crustaceans and finfishes. National Marine

Fisheries Service records indicate that an average annual (1963-1978) estuarine-dependent finfish/shellfish harvest of over 277 million pounds is attributable to Hydrologic Unit IV. Important wildlife species in the project area include resident and migratory waterfowl, rails, numerous non-game birds, small game mammals, commercially important furbearers, reptiles, and amphibians. The majority of those species are heavily dependent upon the marsh for their existence.

In light of the previous discussion, the primary value of the project area to fish and wildlife lies in the marshlands. Yet, marsh loss is a serious problem both in the project area and coastal Louisiana as a whole. Based on recent studies conducted for the Fish and Wildlife Service, it is estimated that coastal Louisiana is experiencing an average loss of more than 39 square miles (25,000 acres) of marsh per year. The U.S. Army Corps of Engineers has calculated that the marsh loss rate in the project area is 1.21 percent per year. Implementation of the project will substantially increase the average annual marsh loss rate in the project area marshes.

An indepth analysis of quantifiable project impacts on fish and wildlife resources was performed. The FWS's Habitat Evaluation Procedures (HEP) were used to assess impacts on wildlife habitat quality and quantity (Appendix A). An analysis of project effects on selected economically important fish and wildlife species (Appendix B) was also performed. These analyses were based on a comparison of future with-project (FWP) and future without-project (FWOP) habitat acreages over the life of the project (1969 to 2094).

The major project impact on fish and wildlife habitat would be the construction of large borrow and ponding areas in an area that is predominantly brackish marsh and estuarine open water. Though 50 percent (5,375 acres) of the ponding areas are likely to redevelop as marsh, approximately 5,375 acres of non-wetland scrub-shrub habitat and 1,670 acres of deep water borrow pits will result with the TSP. Scrub-shrub and borrow areas have a relatively low value for fish and wildlife. In addition, ponding area marsh has a lower value for wildlife than the natural marsh it will replace. However, there will be a net increase, in the year 2094, of 582 acres of marsh with the project, an increase of 29 percent over FWOP conditions. This marsh increase results from the partial transition of scrub-shrub habitat to marsh habitat as it subsides ultimately to open water.

Under FWP conditions, saltwater sportfishing opportunities would decline by 1,008 man-days on an average annual basis. Average annual commercial fish production would decrease by an estimated 182,000 pounds at a cost of $15,800. With the project, annualized hunting opportunities for rabbits would increase by 540 man-days while annualized opportunities for waterfowl, and rail and snipe hunting would decrease by 64 and 31 man-days, respectively. The average annual population of commercially important furbearers and alligators would be expected to decrease by 3.5 percent with project implementation.

The HEP analysis was based upon a determination of the overall quality of the habitats in the project area. It allowed the impacts to a variety of habitats and animal species to be quantified and provided a measure of the specific mitigation needs required to offset unavoidable project impacts. The HEP analysis revealed that the project would cause a net decrease of 4,695 average annual habitat units for all evaluation elements. Severe adverse impacts would be experienced by puddle ducks, wading birds, and terns and skimmers. Moderately negative impacts would be experienced by rails, while project implementation would slightly benefit raccoons and muskrats.

A review of potential alternatives available for mitigating the project-induced loss of fish and wildlife habitat was performed by the interagency team that completed the HEP. It was concluded that, for this project, two mitigation options were available: (1) managing existing marsh to increase its habitat unit value to a level that would compensate for the value of the marsh lost through project implementation or (2) create new habitat (i.e., marsh) with a habitat value equivalent to that lost through project implementation. The interagency team, further, opted for option (2), creating new marsh in shallow open water areas. The FWS is expanding this recommendation to include marsh creation via opening holes in the banks along the Mississippi River and/or its distributaries to allow sediment-rich waters to enter shallow water areas. The result would be the development of small deltas (delta splays) on which natural marsh would establish. This method duplicates the scenario under which the coastal marshes of Louisiana were originally formed and eliminates the potential need for continual maintenance of "man-made marshes" to ensure their continued existence and productivity. Furthermore, successful implementation of the delta splay technique could help to perfect a potentially highly useful tool for stemming the drastic marsh loss in the coastal marshes of south Louisiana.

Completion of the HEP analysis of the marsh creation option yielded the following estimates of mitigation needs. With implementation of the "I" wall/levee plug plan for Reach A and continued construction of Reaches B-1 and B-2 via the SCHC levee plan, 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh would need to be created in areas of shallow open water. With implementation of the SCHC levee plan for Reaches A, B-1, and B-2, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh would need to be created to offset project-induced damages to fish and wildlife habitat.

Mitigation for unavoidable project damages must be viewed as an integral component of project planning and must be provided concurrently with implementation of other project features. Crediting marsh creation associated with other Federal water resource projects (e.g., maintenance dredging of the Mississippi River) as mitigation for this project is not acceptable.

The FWS is prepared to cooperate with the Corps in the selection of suitable sites for marsh creation via the delta splay method. We stand ready to make certain sites on the Delta National Wildlife Refuge available for marsh creation and would encourage the Corps to begin studying the feasibility of using areas of the refuge for this purpose.

In light of the previous discussion and our review of project plans, the FWS recommends that the following measures be implemented to reduce or offset fish and wildlife resources lost as a result of project construction.

1. The "I" wall/levee plug plan should be adopted for the Reach A phase of the project.

2. If the SCHC plan is implemented for Reach A, along with Reaches B-1 and B-2, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh should be created and maintained for the life of the project. Implementation of the "I" wall/levee plug plan for Reach A would reduce the amount of marsh creation needed for mitigation to 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh.

3. Marsh creation via the delta splay method should be selected over other marsh creation methods. Thorough justification for not employing this technique should be provided if an alternative method of marsh creation is selected.

NEW ORLEANS TO VENICE, LOUISIANA
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:

DAVID L. HANKLA, WILDLIFE BIOLOGIST

UNDER THE SUPERVISION OF

DAVID M. SOILEAU, ACTING FIELD SUPERVISOR

DIVISION OF ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

RELEASED FROM

U.S. FISH AND WILDLIFE SERVICE

JACKSON AREA OFFICE

JACKSON, MISSISSIPPI

MARCH 1982

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

NUMBER

APPENDICES

LIST OF TABLES

NUMBER

LIST OF TABLES

NUMBER

PROJECT DESCRIPTION

The New Orleans to Venice Hurricane Protection Project is located along the Mississippi River in Plaquemines Parish, Louisiana. The project was authorized under Public Law 874 - 87th Congress, 2nd Session, approved October 23, 1962, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 550, 87th Congress, 2nd Session. The project essentially involves the upgrading of an existing back levee system and the enlargement of a segment of Mississippi River levee. Upgrading the back levee system will be accomplished in five phases or reaches (Figure 1). Upon completion, the project will provide hurricane protection to residential and commercial developments along a substantial portion of the Mississippi River south of New Orleans, Louisiana.

Reach A extends for approximately 13 miles on the west bank of the Mississippi River from City Price to Tropical Bend, Louisiana. Activity in this reach will involve the upgrading of an existing back levee to hurricane protection standards. Two alternative plans of levee construction are under consideration for this portion of the project. The tentatively selected plan (TSP) calls for the construction of a sand core hydraulic clay (SCHC) covered levee. The alternate plan calls for construction of an "I" wall/levee plug (to be discussed later).

Reach B-1, also on the west bank of the Mississippi River, extends from Tropical Bend to Fort Jackson, Louisiana. This portion of the project is already under construction utilizing the SCHC method of levee construction. Reach B-2 extends 8 miles along the west bank from Fort Jackson to Venice, Louisiana. It, too, is under construction via the SCHC levee construction method. Both Reach B-1 and Reach B-2 involve the upgrading of an existing back levee to hurricane protection standards.

On the east bank of the Mississippi River Reach C extends 16 miles from Phoenix to Bohemia, Louisiana. This portion of the project has been completed; no additional work is anticipated along this reach.

The fifth phase of the project, the east bank barrier levee, involves the construction of a barrier levee for 34 miles on the east bank of the Mississippi River from Bohemia, Louisiana, to Baptiste Collette Bayou. Ten miles of Mississippi River levee enlargement on the west bank from Fort Jackson to Venice are also included in this reach of the project. Specific constructon plans for this phase have not been developed.

This report will address only the impacts of Reach A, Reach B-1 and Reach B-2. As indicated previously, Reach C has been completed and will, hence, not be included in this study. The East Bank Barrier Reach will be handled under a separate report.

Under the TSP, levees would be constructed of a sand core base covered by a clay blanket. Initially, dikes would be constructed around selected marsh areas adjacent to the existing back levees to form ponding areas for disposal of

CORPS OF ENGINEERS U.S. ARMY

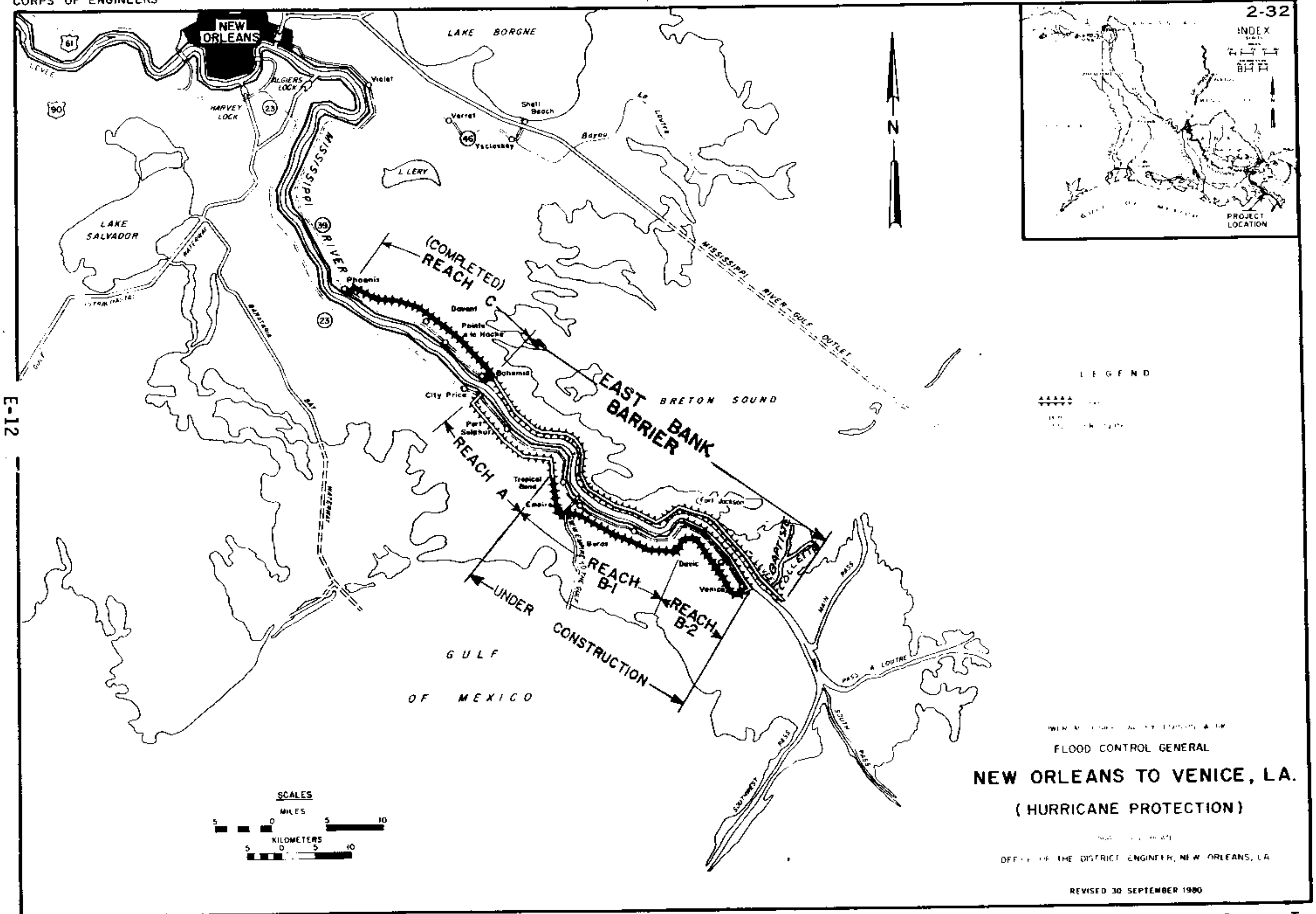


Figure T

dredged material. A trench for the sand core of the new levee would then be excavated adjacent to and on the marsh side of the existing levee. The excavated material would be deposited in the ponding areas (some of the material would be used to construct the aforementioned dikes). Sand fill would be pumped from the Mississippi River into the excavated trench and would be shaped to serve as a foundation for the new levee. Additional material (primarily clay) would be mined using a cutter-head dredge from marsh areas adjacent to the ponding areas for completion of levee construction.

Pits created from this mining operation would range from 40 to 60 feet deep. The upper ten to twelve feet of material in the borrow areas (i.e., areas to be mined) are of poor quality for levee construction. This material would be disposed of in ponding areas to allow settling of suspended material. The retention time in the ponding areas, generally two to four days, would be controlled to ensure clarity of the effluent.

The hydraulic clay fill for levee completion would then be pumped from the borrow areas to cover the sand core originally established between the retaining dike and the existing back levee. After the hydraulic clay fill dried and consolidated (generally within 3 to 4 years), the levee would be shaped into the design cross section, with some overbuild added to account for long term subsidence. The final design elevation would be 12.5 to 15.0 feet national geodetic vertical datum. The quality of the material available for construction and the degree of subsidence that occurred would dictate the number of hydraulic lifts required to achieve the design elevation.

As previously mentioned, an alternative method of levee construction is under consideration for Reach A (i.e., the "I" wall/levee plug plan). This technique would involve construction of a concrete floodwall within the existing back levee. To allow vehicular access across the levee, earthen ramps or "levee plugs" would be constructed over the "I" wall at points of convenience (i.e., marinas or points where existing bridges provide access across the drainage canal which lies inside and parallel to the existing back levee). Maximum distance between levee plugs would be one mile.

AREA SETTING

Introduction

The primary area of project impact on fish and wildlife resources extends along 36 miles of the Mississippi River from City Price to Venice and west across the natural alluvial ridge into the coastal marshes and estuarine bays, bayous, and lagoons. Natural ridges, mostly developed and inhabited, occur at elevations up to 5 feet mean sea level (m.s.l.). The marshes occurring adjacent to the natural ridges have elevations of 1.9 feet m.s.l. or less. The marshes are laced with numerous bayous, lagoons, bays, shallow marsh ponds, and oil field canals. Dredged spoil disposal areas typically form ridges adjacent and parallel to oil field and other navigation canals.

The marshes and natural ridges were formed by riverborne sediments transported down the Mississippi River and deposited in shallow open water. Engineering works along the Lower Mississippi River, coupled with upstream diversion and reservoirs, have resulted in a greatly reduced quantity of sediments reaching the marshes and shallow open waters of the delta. Consequently, deposition and marsh nourishment has not kept pace with marsh loss (estimated to be 1.21 percent per year in the project area) due to subsidence, erosion, and a surprisingly rapid rate of marsh loss is occurring in the area. Recent studies (Wicker, 1980) have shown that the total acreage of marsh in the active Mississippi River delta has declined from 134,000 acres in 1956 to approximately 66,000 acres in 1978. This rapid decline in marsh is actually occurring throughout the Mississippi Deltaic Plain Region (MDPR) of coastal Louisiana, an area extending from the Alabama-Mississippi border westerly to Vermilion Bay, Louisiana. Data compiled by Wicker (1980) show a net decline of about 464,500 acres of marsh in the MDPR between the mid-1950's and 1978. This rapid rate of marsh loss is expected to continue into the future.

Description of Habitats

Natural Levee Ridge

This habitat type was formerly forested with such tree species as live oak, sugarberry, American elm, green ash, and sweet gum but has since been cleared and developed. This is the area to be protected by the hurricane protection levee system.

Marshes

The marshes in the study area have been classified by Chabreck (1972) as intermediate, brackish, and saline (Palustrine Emergent Wetlands and Estuarine Emergent Wetlands according to Cowardin et al., 1979). Common vegetation in the intermediate marshes includes common reed, coast bacopa, dogtooth grass, saltmeadow cordgrass, freshwater threesquare, and bulltongue. Brackish marshes form a transitional zone between intermediate and saline marsh. Predominant vegetation in this type is saltmarsh cordgrass mixed with saltgrass, common reed, saltmeadow cordgrass, softstem bulrush, leafy three-square, and dwarf spikerush. Saline marshes are the most extensive in the project area vicinity. Common vegetation in this type includes saltmarsh cordgrass, saltgrass, saltwort, glasswort, and black rush.

Dredged Spoil Disposal Areas (i.e., scrub-shrub habitat)

Dredged spoil disposal areas consist of silt, clay, and sand dredged from the project area marshes primarily for navigation purposes and oil and gas exploration activities. These areas are typically but not exclusively limited to elevations above 1.9 feet m.s.l. Characteristic vegetation is rattlebox, seaside goldenrod, coastal bermuda, marsh elder, and eastern baccharis.

Riverine Open Water

Riverine open water habitat (Riverine Tidal and Riverine Lower Perennial according to Cowardin et al., 1979) in the project area consists of the Mississippi River.

Estuarine Open Water

Estuarine open water (Estuarine Subtidal and Estuarine Intertidal according to Cowardin et al., 1979) includes shallow bays, marsh ponds, lakes, bayous, canals, navigation channels, and other off-channel areas where salinities exceed 0.5 parts per thousand. In some cases, these areas support dense stands of submergent vegetation. Such stands are termed Estuarine Aquatic Bed (Cowardin et al., 1979) and are composed primarily of widgeongrass and Eurasian watermilfoil.

Fishery Resources

The diverse sport and commercial saltwater fisheries of the study area are significant. National Marine Fisheries Service records indicate that an average annual (1963-1978) estuarine-dependent finfish/shellfish harvest of over 277 million pounds is attributable to Hydrologic Unit IV. The tidal marshes, aquatic vegetation beds, and shallow estuarine waters provide necessary habitat to a variety of species of crustaceans and finfishes. Common estuarine fish and shellfish species in the project area include Gulf menhaden, blue catfish, gafftopsail catfish, sea catfish, sheepshead, black drum, Atlantic croaker, spotted seatrout, sand seatrout, red drum, spot, striped mullet, southern flounder, American oyster, white shrimp, brown shrimp, and blue crab.

The importance of coastal marshes to estuarine-dependent fisheries production cannot be over-emphasized. These marshes produce vast amounts of organic detritus which are transported into adjacent estuarine waters. This detritus is extremely important in the maintenance of fish and shellfish productivity. The contribution of vascular plant detritus to estuarine fisheries productivity is documented in a publication by Odum et al (1973). Marshes and associated shallow waters are also extremely important as habitat for many estuarine-dependent species. Recent studies conducted within the upper Barataria Basin have substantiated the value of shallow marsh areas as nursery habitat for Atlantic croaker, spot (Rogers, 1979), and menhaden (Simoneaux, 1979). Shallow marsh areas are also important as nursery grounds for white shrimp and brown shrimp in coastal Louisiana, according to studies conducted by biologists of the Louisiana Wildlife and Fisheries Commission (White and Boudreaux, 1977). Studies in Texas have also documented the importance of tidal marshes as habitat for blue crabs (More, 1969). 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. Turner (1979) reported that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands and that the area of estuarine water does not seem to be directly linked to shrimp yields. 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 marshland loss.

Wildlife Resources

Birds

Migratory waterfowl and other wetland gamebirds are common in the marshes and open water bodies of the study area. The greatest concentrations of dabbling ducks occur in the marshes and shallow water bodies, while diving ducks prefer deeper bays and lagoons. Migratory dabbling ducks include mallar, northern pintail, green-winged teal, gadwall, American wigeon, and northern shoveler. Common divers include lesser scaup, redhead, ring-necked duck, red-breasted merganser, common merganser, and hooded merganser. The resident mottled duck nests and winters in the marshes of the project area. The lesser snow goose and possibly the white-fronted goose also utilize the marshes of the project area. Other wetland gamebirds in the study area are the king rail, clapper rail, sora, Virginia rail, American coot, and common snipe.

Non-game birds include several species of wading birds, seabirds, shorebirds, and songbirds. Common wading birds include the little blue heron, great blue heron, American egret, snowy egret, cattle egret, white-faced ibis, white ibis, green heron, and yellow-crowned night heron. Seabirds include the white pelican, black skimmer, herring gull, laughing gull, and several species of terns. The locations of active seabird and wading bird nesting concentrations in the project vicinity are shown in Table 1. Common shorebirds in the project area include killdeer, American avocet, black-necked stilt, American oystercatcher, and numerous sandpipers. Other non-game birds in the project marshes include marsh wrens, boat-tailed grackle, belted kingfisher, red-winged blackbird, and seaside sparrow.

Mammals

There is a diversity of mammals in the project area. The white-tailed deer, the only big game animal in the study area, is found in limited numbers in the marshes and scrub-shrub habitat types. Small game mammals such as the swamp rabbit and raccoon also utilize the marsh and scrub-shrub habitats.

Commercially important furbearers in the project area include muskrats, nutria, mink, river otter, and raccoon. Muskrat and nutria are most abundant in the marshes while river otter and mink utilize marsh and scrub-shrub habitat in close proximity to open water.

Table 1. Seabird and wading bird nesting concentrations in the project vicinity. a/

Latitude (N)	Longitude (W)	Species
29°14'	89°21'	Little blue heron, snowy egret
29°13'	89°22'	Great egret, little blue heron, snowy egret

a/ From Portnoy (1977)

Amphibians and Reptiles

Various species of frogs, turtles, and snakes are common in the project area. Representative species include pig frog, diamondback terrapin, and western cottonmouth. The American alligator is also expected to occur in the project area in limited numbers.

Endangered Species

The project area provides habitat for several federally listed endangered species. Endangered birds known to utilize the project area for feeding include the bald eagle, brown pelican, and Arctic peregrine falcon. No nesting in the project area by these species has been recorded in recent years. The American alligator is presently classified as "threatened under similarity of appearance" within the entire State.

EVALUATION METHODOLOGY

For reporting purposes, with-project impacts were estimated based on the assumption that levee construction for Reaches A, B-1, and B-2 would be done via the TSP which calls for the SCHC method of levee construction. Without-project conditions were estimated assuming no new levee construction for any of the reaches. The "I" wall/levee plug alternative and its potential impacts are addressed only for Reach A since it is unlikely that this alternative would be selected for Reaches B-1 and B-2, where construction has already begun.

An indepth analysis of the quantifiable impacts of the project on fish and wildlife was performed. As previously noted, the major area of project impact is considered to be the 36-mile-long section along the west bank of the Mississippi River between City Price and Venice. It is within this area that construction activities will effect long-term changes in fish and wildlife habitat. No attempt was made to quantitatively assess project impacts outside that area. Our studies included use of the FWS's 1980 Habitat Evaluation Procedures (HEP) to assess project impacts on wildlife habitat quality and quantity, and a quantifiable analysis of the project's probable impacts on sport and commercial fishing, sport hunting, fur and alligator harvest, and non-consumptive wildlife-oriented recreation. Details of the HEP methodology are contained in Appendix A, while the procedures followed for the economic analysis are discussed in Appendix B.

Future without-project (FWOP) habitat changes were estimated using the trends for this region established by Wicker (1980). Data in that report were used to calculate the annual rate of total marsh loss (1.21 percent/year) and that rate was applied to the existing habitat conditions to obtain marsh acreage estimates for specific target years.

For the future with-project (FWP) condition, estimates of habitat changes caused by dredging and subsequent spoil disposal during construction of the hurricane protection levee were obtained for specific target years from the New Orleans District Corps of Engineers. These estimates were used, along with estimates of "natural" marsh acreage declines derived from data reported by Wicker (1980), to develop estimates of the acreage of selected habitat types that would be present for specific target years. These estimates are discussed in the Project Impacts section.

Several field investigations of the project area were conducted by an interagency team of biologists from the FWS, Louisiana Department of Wildlife and Fisheries, and the U.S. Army Corps of Engineers for habitat evaluation purposes. Information obtained during these investigations was augmented by interpretations of available aerial photography of the project area.

PROJECT IMPACTS

Habitat Impacts

Implementation of the "I" wall/levee plug plan would have minimal adverse impacts to fish and wildlife habitat in Reach A. Adverse impacts would result primarily from the placement of plugs to permit access across the levee; however, in light of the existing marsh loss rates, the 20 acres of marsh impacted under this plan would be negligible when considered over the life of the project. For evaluation purposes, impacts of the "I" wall/levee plug plan should be considered the same as those for FWOP conditions for Reach A. Implementation of this method of levee construction along Reach A would reduce total TSP impacts by approximately 30 percent.

With implementation of the TSP (i.e., the SCHC method of levee construction), the primary impact of the project on fish and wildlife habitat would result from the construction of large borrow and ponding areas in marsh and estuarine open water habitats. Approximately 1,670 acres of borrow pit and about 10,750 acres of ponding areas will be needed to construct the levees under the TSP. It was assumed that 50 percent of any ponding area would be elevated above 1.9 feet m.s.l. after disposal of dredged material. These sites would revegetate in scrub-shrub type habitat. The remaining 50 percent of any ponding area would remain at an elevation below 1.9 feet m.s.l. and would revegetate in marsh habitat. Ponding areas were assumed to subside over the remainder of project life at the same rate as natural marsh communities. One-half of those ponding areas establishing as scrub-shrub habitat were assumed to subside and revert to marsh. The remaining half would subside and become estuarine open water.

Approximately 9,170 acres of natural marsh existed in the project area in 1969. Under FWOP conditions this acreage was projected to decrease to about 2,009 acres by 2094, a reduction of 78 percent. Under FWP conditions, all of the natural marsh within the project area would be initially destroyed by completion of the construction phase of the project in 1994. However, since 50 percent of the ponding area acreage is expected to reestablish as marsh, total marsh acreage under FWP conditions is expected to be about 2,586 acres by the year 2094. The net (1969-2094) change between FWP and FWOP conditons is about +582 acres, an increase of about 29 percent over FWOP conditions.

Approximately 4,244 acres of estuarine open water were present in the project area in 1969; by 2094, this acreage would increase by 168 percent to 11,390 acres without the project. With the TSP, the acreage of estuarine open water would increase by 55 percent to 6,573 acres between 1969 and 2094. As mentioned previously, 1,670 acres of deep water borrow pits would be created with project implementation. The remaining habitats, levee and scrub-shrub would remain constant about 521 acres under FWOP conditons. With the project, these habitats would increase by 492 percent to 3,086 acres by the year 2094. A complete listing of the projected acreages for each habitat type by target year is contained in Table 2.

Fisheries Impacts

The HEP have not yet been developed for evaluating fish and shellfish habitats in deltaic/estuarine environments. In lieu of this, an analysis of the impacts of the project on sport and commercial fishing was conducted. Details of the analysis are discussed in Appendix B.

The marsh is an important source of plant detritus, a major driving force in estuarine food webs. The marsh also provides feeding, spawning and nursery habitat which is extremely important to fishery resources. Therefore, differences between FWOP and FWP marsh acreages were used as a basis for estimating project impacts on fishery resources.

A summary of the changes in fishing activities under FWOP and FWP conditions is displayed in Table 3. Potential saltwater sportfishing under FWP conditions would decline by 1,008 man-days on an average annual basis. Under FWP conditions, potential saltwater commercial fish harvest (shrimp, crabs, and finfish) would decrease by 182,000 pounds, worth approximately $15,800, on an average annual basis. Impacts to oysters and oyster leases would be negligible.

Wildlife Impacts

A summary of the changes in potential man-day use and wildlife supply is provided in Table 4. The rabbit population is expected to decline over project life under both the FWOP and FWP conditions. However, in comparison to FWOP, the project is expected to cause an annualized increase of 1,646 animals. Correspondingly, there will be an annualized increase of 540 man-days of rabbit hunting with the project. Adverse impacts to waterfowl hunting as well as rail and snipe hunting will occur as a result of the project. Though actual population data are not available, estimates based on Corps of Engineers (1974) figures indicate a decrease in the potential for rail and snipe hunting of 32 man-days (annualized). Similar estimates based on Fish and Wildlife Service (1980) data indicate an annualized decrease of 64 man-days in waterfowl hunting as a

Table 2. Habitats (in acres) under FWP and FWOP conditions by selected target years. a/

Habitat	Projected Acreages by Target Year						
	With Project						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	8,357	0	0	0	0	0
Estuarine open water	4,224	4,480	0	2,163	3,967	5,417	6,573
Scrub-shrub	261	476	5,375	3,965	2,924	2,157	1,591
Levee	260	320	1,495	1,495	1,495	1,495	1,495
Borrow	0	67	1,670	1,670	1,670	1,670	1,670
Ponding marsh	0	215	5,375	4,662	3,859	3,176	2,586
	Without Project						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	9,059	6,771	4,994	3,684	2,717	2,004
Estuarine open water	4,224	4,335	6,623	8,400	9,710	10,677	11,390
Scrub-shrub	261	261	261	261	261	261	261
Levee	260	260	260	260	260	260	260
Borrow	0	0	0	0	0	0	0
Ponding marsh	0	0	0	0	0	0	0

a/ Identical to Table A2 in Appendix A.

Table 3. Summary of fishing activities under FWOP and FWP conditions. a/

	Pre-project (1969)	Annualized total without project	Annualized total with-project	Annualized change with-project
Potential saltwater sport fishing (man-days)	55,020	28,500	27,492	-1008
Potential commercial saltwater fish harvest				
(pounds)	9,932,944	5,145,200	4,963,222	-181,978
(dollars)	860,605	443,786	430,021	-15,767

a/ Combines text and tabular information in Appendix B.

Table 4. Potential annualized man-day usage and populations of selected project area game species. a/

Species	Pre-project (1969)	Annualized total without project	Annualized total with project	Annualized change due to project
			Potential Man-day Use	
Rabbit	1253.47	674.45	1214.12	+539.67
Rail and snipe	1723.96	893	861.42	- 31.58
Waterfowl	3512.11	1819.25	1754.91	- 64.34
			Populations (in numbers of animals)	
Rabbit	3827	2059	3705	+1646
Rail and snipe	Unknown	Unknown	Unknown	Unknown
Mottled duck	31	16	15	-1
Other waterfowl	Unknown	Unknown	Unknown	Unknown

a/ From Table B4 in Appendix B.

result of the project. The long term population of resident mottled ducks will be virtually unaffected by the project. However, some disruption of nesting and displacement of birds will occur during construction phases of the project.

Project impacts on commercially important wildlife are shown in Table 5. In 1969, the harvestable number of alligators and commercially important furbearers in the project area was estimated to be 1,685 animals valued at about $13,300. Under FWOP conditions, the average annual total is expected to be 872 animals valued at about $6,865. With project implementation, that total is expected to be 842 animals, or about 3.5 percent less. The value of these animals is approximately $6,583, an annualized reduction of about $282.

The FWS's 1980 HEP analysis is discussed in detail in Appendix A. The results of the HEP analysis are displayed in Table 6. Project implementation will have severe adverse impacts on puddle ducks, wading birds, and terns and skimmers. These three evaluation elements will experience respective losses of 2,046, 2,069, and 2,962 average annual habitat units (AAHU's). Moderately negative impacts will be experienced by rails (-471 AAHU's) while project implementation will slightly benefit raccoons (+276 AAHU's) and muskrats (+168 AAHU's). Rabbits will greatly benefit from the project as is shown by an increase of 2,049 AAHU's. Overall, there will be a net reduction of 4,696 AAHU's with project implementation.

Endangered or threatened species of known or possible occurrence in the project area are discussed in the AREA SETTING section of the report. As indicated in a November 30, 1981, letter from the FWS's Acting Area Manager in Jackson, Mississippi, to the District Engineer, New Orleans District Corps of Engineers, it is unlikely that those species would be affected by the project.

DISCUSSION

Adverse impacts on the fish and wildlife resources of the project area are primarily the result of the construction of large borrow and ponding areas within marsh and estuarine open water habitats. Two methods, HEP and man-day use potential, were used in evaluating project related impacts on these resources. Of the two, the FWS strongly recommends the use of the HEP analysis for justifying mitigation requirements.

Analysis Preference - Man-day versus HEP

The principal weaknesses in the man-day type of analysis are its inability to measure the true value of the resource being impacted and thus its inability to provide a true measure of compensation requirements. The man-day analysis simply identifies a loss or gain in potential hunting opportunities for selected game species. Computations of the potential for hunting opportunities are based on a projected carrying capacity of a certain habitat, on a known sustained annual harvest rate, and on an estimated hunter success rate for the species being evaluated. If the actual carrying capacity of certain habitat in the

Table 5. Potential annual catch and value of selected project area furbearers and alligators. a/

Species	Fur Production 1969 (pelts or hides)	Annual Production Without Project	Annual Production With Project	Annual Change Due to Project
Muskrat	774	401	387	-14
Nutria	792	410	396	-14
Mink	10	5	5	0
Otter	2	1	1	0
Raccoon	72	37	36	-1
Alligator	35	18	17	-1
Total Number	1,685	872	842	-30
Total Value	$13,299.94	$6,865.59	$6,583.47	-$282.12

a/ Derived from Tables B5 and B6 in Appendix B.

Table 6. AAHU's by evaluation elements for FWP and FWOP conditions. a/

Species	AAHU's With Project	AAHU's Without Project	Change in AAHU's Due to Project
Puddle ducks	2,355.03	4,400.64	-2,045.61
Rabbits	3,393,98	985.46	+2,048.52
Wading birds	2,814.39	4,882.93	-2,068.54
Terns and skimmers	2,795.30	5,757.47	-2,962.17
Muskrats	1,844.01	1,675.92	168.09
Raccoon	4,614.38	4,338.86	275.52
Rails	3,827.18	4,298.50	-471.33
		Total	-4,695.52

a/ Identical to Table A3 in Appendix A.

project area is different from that projected, the computed potential man-day use would be erroneous. In effect then, there is no good, acceptable means for comparing the variances within a single habitat type with the man-day analysis approach, since that analysis does not take into consideration the quality of the habitat being impacted.

By contrast, the HEP analysis is based upon a determination of the overall quality of the habitats in the project area. It allows the impacts to a variety of habitats and animal species to be quantified and provides a measure of the specific mitigation needs required to offset unavoidable project impacts. It is based on the recognition that fish and wildlife and their habitats are of value to the nation in more than simply economic terms. The HEP analysis, in essence, can track losses or gains in habitat quality, while the man-day analysis primarily measures changes in recreational opportunities. Accordingly, the FWS views the HEP analysis as a more appropriate measure of mitigation requirements.

Mitigation and Compensation

The President's Council on Enviromental Quality defined the term "mitigation" in the National Environmental Policy Act (NEPA) 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, rehabilitation, 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) compensation for the impact by replacing or providing substitute resources or environments."

The Service supports and adopts the NEPA definition of mitigation and considers the specific elements to represent a desirable sequence of steps in the mitigation planning process. In order to consistently formulate appropriate mitigation recommendations, the FWS has developed a formal mitigation policy. This policy prioritizes habitats into four "Resource Categories," each with specific directions on the sequence of recommendations to be made to ultimately obtain suitable mitigation. The habitats in the project area fall within Resource Category 2; habitats which are relatively scarce or becoming scarce on a national basis or in the ecoregion section and which are of high value for evaluation species. For such habitats, the Service will recommend ways to avoid or minimize losses. If losses are likely to occur, the Service will recommend ways to immediately rectify them or reduce or eliminate them over time. If losses remain likely to occur, then the Service will recommend that those losses be compensated by replacement of the same kind of habitat value so that the total loss of such in-kind habitat will be eliminated.

Mitigation Scenario

A high priority in any mitigation scenario must be an attempt to minimize project impacts on the environment. Therefore, highest consideration, relative to this project, should be given to implementation of the "I" wall/levee plug plan for the Reach A phase of the project. Since substantial adverse environmental impacts from the total project, including Reaches B-1 and B-2, would occur regardless of the alternative selected for Reach A, compensation should be required to offset those impacts.

Mitigation Requirements

As has been previously stated, the HEP analysis quantifies project impacts and provides a measure of the specific mitigation needs required to offset unavoidable project impacts. For this project, two mitigation options were available: (1) managing existing marsh to increase its habitat unit value to a level that would compensate for the value of the marsh lost through project implementation or (2) create a new habitat (i.e., marsh) with a habitat value equivalent to that lost through project implementation. The mitigation option adopted by the interagency team involved marsh creation in areas of shallow open water.

Analysis of the marsh creation option yielded the following estimates of mitigation needs. With implementation of the "I" wall/levee plug plan for Reach A, 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh would need to be created in areas of shallow open water. With implementation of the SCHC plan for Reach A, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh would need to be created to offset project-induced damages to wildlife habitat.

Marsh Creation Methodology

Two methods of marsh creation, to mitigate for unavoidable project damages, are considered feasible and appropriate for this project. One method would involve pumping dredged material into areas of shallow water. The dredged material would be deposited to an elevation of approximately 1.9 feet m.s.l. and would be allowed to revegetate naturally. Such marsh creation techniques have been employed successfully during maintenance dredging operations along Southwest Pass and in numerous other locations.

The other method of marsh creation would involve opening holes in the banks along the Mississippi River and/or its distributaries to allow sediment-rich waters to enter shallow water areas. The result would be the development of a small delta or delta splay on which "natural" marsh would establish. This delta splay phenomena has occurred naturally in several locations along the lower Mississippi River, particularly on Delta National Wildlife Refuge and Pass-a-Loutre Wildlife Management Area.

Though either method of marsh creation would be acceptable, we prefer utilization of the delta splay method of marsh creation for this project. That method virtually duplicates the scenario under which coastal marshes of Louisiana were originally formed, an occurrence which has been all but eliminated by man's activities along the Mississippi River. It also eliminates the potential need for continual maintenance of "man-made marshes" to ensure their continued existence and productivity. Furthermore, successful implementation of the delta splay technique could help to perfect a potentially highly useful tool for stemming the drastic loss of the coastal marshes of south Louisiana.

RECOMMENDATIONS

Based on our review of project plans being considered for the New Orleans to Venice Hurricane Protection Project, the FWS recommends that the following measures be implemented to reduce or offset fish and wildlife resource losses anticipated as a result of project construction.

1. The "I" wall/levee plug plan should be adopted for the Reach A phase of the project.

2. If the SCHC plan is implemented for Reach A, along with Reaches B-1 and B-2, 427 acres of brackish marsh or 297 acres of fresh-intermediate marsh should be created and maintained for the life of the project. Implementation of the "I" wall/levee plug plan for Reach A would reduce the amount of marsh creation needed for mitigation to 299 acres of brackish marsh or 208 acres of fresh-intermediate marsh.

3. Marsh creation via the delta-splay method should be selected over other marsh creation methods. Thorough justification for not employing this technique should be provided if an alternative method of marsh creation is selected.

LITERATURE CITED

Chabreck, Robert. 1972. Vegetation, water and soil characteristics of the Louisiana coastal region. Louisiana State University Agricultural Experiment Station Bulletin 664. 72pp.

Conner, J.V., and F.M. Truesdale. 1973. Ecological implications of a fresh-water impoundment in a low-salinity marsh. Pages 259-276 in R.H. Chabreck, ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

Cowardin, L.M., and V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS - 79/31. 103pp.

Harris, A.H. 1973. Louisiana estuarine dependent commercial fishery production and values (regional summary and WRPA-9 and WRPA-10 analysis of production and habitat requirements). Unpublished report prepared for U.S. Department of Commerce, National Marine Fisheries Service, Water Resources Division, St. Petersburg, Florida.

More, W.R. 1969. A contribution to the biology of the blue crab (Callinectes sapidus Rathbun) in Texas, with a description of the fishery. Texas Parks and Wildlife Department. Technical Series No. 1. 31pp.

Odum, W.E., J.C. Zieman, and E.J. Heald. 1973. The importance of vascular plant detritus to estuaries. Pages 91-114 in R.H. Chabreck, ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University Divison of Continuing Education, Baton Rouge.

Rogers, B.D. 1979. The spatial and temporal distribution of Atlantic croaker, Micropogon undulatus, and spot, Leiostomus xanthurus, in the upper drainage basin of Barataria Bay, Louisiana. M.S. thesis. Louisiana State University, Baton Rouge. 96pp.

Simoneaux, L.F. 1979. The distribution of menhaden, genus Brevoortia, with respect to salinity, in the upper drainage basin of Barataria Bay, Louisiana. M.S. thesis. Louisiana State University, Baton Rouge. 96pp.

Turner, R.E. 1979. Louisiana's coastal fisheries and changing environmental conditions. Pages 363-370 in J.W. Day, Jr., D.R. Culley, Jr., R.E. Turner, and A.J. Mumphrey, Jr., eds. Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

U.S. Army Corps of Engineers, New Orleans District. 1974. Louisiana Coastal Area Study. Fish and wildlife study of the Louisiana Coastal Area and the Atchafalaya Basin Floodway. Appendix D-2: Methodology for estimating the fish and wildlife sport harvest, pp. 7-52. New Orleans, Louisiana.

U.S. Fish and Wildlife Service. 1980. A planning aid report on the Mississippi and Louisiana Estuarine areas study. Table A3. Lafayette, Louisiana.

White, C.J. and C.J. Boudreaux. 1977. Development of an area management concept for gulf Penaeid shrimp. Louisiana Wildlife and Fisheries Commission, Oyster, Water Bottoms, and Seafoods Division, Technical Bulletin 22. 77pp.

Wicker, K.M. 1980. Mississippi Deltaic Plain Region ecological characterization: a habitat mapping study. A user's guide to the habitat maps. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS 79/07.

APPENDIX A

U.S. Fish and Wildlife Service
1980 Version of the Habitat
Evaluation Procedures Analysis

The Habitat Evaluation Procedures (HEP) were developed by the Fish and Wildlife Service (FWS) to provide a method for describing baseline habitat conditions and predicting future habitat conditions in terms of habitat quality and quantity. This system is based on the assumption that all habitat has inherent value to wildlife and that impacts to wildlife habitat, in terms of modifications in quality and quantity, can be measured and compared. These procedures provide biologists with a standardized method of evaluating habitat and productivity.

In implementing the HEP for this project, species or species groups were selected for each cover type delineated and were used as evaluation elements in the determination of habitat quality. For this analysis the evaluation elements included puddle ducks, wading birds (herons, egrets, and ibises), terns and skimmers, rabbits, muskrats, raccoons, and rails. These evaluation elements were selected because they had high public interest value and were representative of the wildlife utilizing the habitats in the project area. The habitats delineated were natural marsh (brackish), ponding area marsh (brackish), estuarine open water, scrub-shrub, levee, and borrow pit. The habitat suitability of each evaluation element for each habitat type was rated on a scale of 0.05 to 0.95, with 0.05 being the poorest and 0.95 being the optimal score. This range was selected to recognize incidental usage of all habitat types by all evaluation species and potential habitat improvement through artificial habitat management or alteration.

Field sampling was conducted during October 19-21, 1981, by representatives of the FWS, the Louisiana Department of Wildlife and Fisheries, and the U.S. Army Corps of Engineers. Habitat types were sampled randomly and a Habitat Suitability Index (HSI) was obtained for each evaluation element for each habitat type by averaging the score for the sample sites. These average scores are presented in Table A1.

Table A1. Average HSI values for each species by habitat type.

	Habitat Type					
Species	Natural Marsh	Ponding Marsh	Levee	Scrub-shrub	Borrow	Estuarine Open Water
Puddle ducks	.375	.175	.050	.050	.100	.300
Rabbits	.075	.225	.200	.550	.050	.050
Wading birds	.650	.225	.100	.050	.300	.200
Terns and skimmers	.300	.050	.050	.050	.300	.500
Muskrats	.250	.250	.050	.100	.100	.050
Raccoon	.700	.600	.050	.350	.200	.100
Rails	.700	.575	.050	.200	.050	.100

In Table A2 the habitat acreage changes over the life of the project are presented. Habitat unit (HU) values were computed by multiplying those acreages by the HSI values.

Comparison of future-without project (FWOP) and future-with project (FWP) HU changes provided a measure of project-induced impacts. The average annual habitat units (AAHU's) for FWP and FWOP conditions are displayed by species in Table A3.

After annualized impacts to the evaluation elements were determined, compensation needs were computed. It was decided by Corps of Engineers and FWS biologists that mitigation requirements would be fulfilled via the "in-kind" compensation method. In this method, compensation is intended to replace losses of AAHU's for an evaluation element (species or species group) with equal gains in AAHU's for that same element. When using this methodology, only species (elements) negatively impacted by the proposed action are used in determining compensation needs.

"In-kind" compensation could be accomplished by creating and maintaining an area of marsh sufficient in size to replace the AAHU's of the negatively impacted evaluation species. The result of the HEP revealed that 427 acres (annualized) of brackish marsh, created in an area of shallow water, would be sufficient to offset impacts to those wildlife elements negatively impacted by the TSP. It was concluded by the HEP team, however, that brackish marsh creation within the project area might prove both technically and economically infeasible as there would be problems with transportation of equipment, location of suitable marsh creation sites, and acquisition of rights-of-way. It was further concluded that mitigation might be most easily accomplished via marsh creation on Delta National Wildlife Refuge or Pass-a-Loutre Wildlife Management Area since the issues described above would not be a problem. The marshes created in these areas would be of the fresh-intermediate type. Therefore, once brackish marsh creation requirements were determined via the HEP, it was necessary to devise a method of relating brackish marsh to fresh-intermediate marsh in order to determine the acres of the latter which would be needed to compensate for project damages.

The method chosen was very similar to the relative value index (RVI) method used in some options of the 1980 HEP. Species representative of both habitat types were rated according to three criteria:

1) Recreation (consumptive and non-consumptive) contribution,

2) Economic value (dollars to individuals as well as the community), and

3) Vulnerability (sensitivity of a species to the loss of marsh habitat).

Rating was done on a scale of 1 to 10 (least to most) with at least one species receiving a "1" and at least one species receiving "10" (Table A4). These numbers for each species-criteria were then totaled to give a relative weight or importance of that species (the higher the value, the greater the importance).

HSI values for each species in the two habitat types were multiplied by the corresponding relative weight for each species and totaled. These totals are representative of the value of the habitat to the elevation species (as a whole) and are useful for comparing the value of the two habitat types. The result of this relative value determination was that 1.44 acres of brackish marsh is equal to 1 acre of fresh-intermediate marsh in its importance to the evaluation species. Accordingly, 297 acres (annualized) of fresh-intermediate marsh could be created in lieu of the 427 acres of brackish marsh to mitigate for project-induced damage.

Table A2. Habitats (in acres) under FWP and FWOP conditions by selected target years. a/

Habitat	Projected Acreages by Target Year						
	With Project						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	8,357	0	0	0	0	0
Estuarine open water	4,224	4,480	0	2,163	3,967	5,417	6,573
Scrub-shrub	261	476	5,375	3,965	2,924	2,157	1,591
Levee	260	320	1,495	1,495	1,495	1,495	1,495
Borrow	0	67	1,670	1,670	1,670	1,670	1,670
Ponding marsh	0	215	5,375	4,622	3,859	3,176	2,586
	Without Project						
	1969	1970	1994	2019	2044	2069	2094
Brackish marsh	9,170	9,059	6,771	4,994	3,684	2,717	2,004
Estuarine open water	4,224	4,335	6,623	8,400	9,710	10,677	11,390
Scrub-shrub	261	261	261	261	261	261	261
Levee	260	260	260	260	260	260	260
Borrow	0	0	0	0	0	0	0
Ponding marsh	0	0	0	0	0	0	0

a/ Acreages compiled by the Corps of Engineers.

Table A3. AAHU's by evaluation elements for FWP and FWOP conditions.

Species	AAHU's With Project	AAHU's Without Project	Change in AAHU's Due to Project
Puddle ducks	2,355.03	4,400.64	-2,045.61
Rabbits	3,393.98	985.46	+2,048.52
Wading birds	2,814.39	4,882.93	-2,068.54
Terns and skimmers	2,795.30	5,757.47	-2,962.17
Muskrats	1,844.01	1,675.92	+168.09
Raccoon	4,614.38	4,338.86	+275.52
Rails	3,827.18	4,298.50	-471.33
		Total	-4,695.52

Table A4. Relative value method for equating brackish marsh to fresh-intermediate marsh. a/

Species	Recreation (R)	Economic Value (E)	Vulner-ability (V)	Relative weight (RW) = (R + E + V)	HSI-Fresh/ Intermediate (HSI-F)	(RW) X (HSI-F)	HSI-Brackish (HSI-B)	(RW) X (HSI-B)
Puddle ducks	10	10	8	28	.700	19.600	.375	10.500
Alligators	3	3	5	13	.250	3.250	.075	.975
Nutria	1	10	10	21	.450	9.450	.075	1.575
Raccoons	2	5	1	8	.300	2.400	.075	.600
Wading birds	5	3	5	13	.350	4.550	.650	8.450
Terns and skimmers	3	1	2	6	.100	.600	.300	1.800
Deer	2	1	1	4	.250	.100	.050	.200
Muskrats	1	10	10	21	.500	10.500	.250	5.250
Rabbits	5	5	3	13	.700	9.100	.700	9.100
Rails	4	2	10	16	.700	11.200	.700	11.200
					Total (RW) X (HSI-F)	71.650	Total (RW) X (HSI-B)	49.650

Total HSI-F/Total HSI-B = 71.650/49.650 = 1.440

a/ Developed jointly by the Fish and Wildlife Service and Corps of Engineers biologists.

APPENDIX B

Estimated Effects of the TSP on Sport
Fishing, Commercial Fishing, Sport Hunting
Non-consumptive Wildlife-oriented Recreation and
Fur and Alligator Harvest

IMPACTS ON FISHERY RESOURCES

The importance of marshes and swamps to estuarine-dependent fisheries production in coastal Louisiana cannot be over-emphasized. These wetlands produce vast amounts of organic detritus which are transported into adjacent estuarine waters. This detritus is extremely important in the maintenance of Louisiana's high level of fisheries productivity. 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, Louisiana. The contribution of vascular plant detritus to estuarine fisheries productivity is also documented by Odum et al. (1973). Marshes and associated shallow ponds and tidal creeks are also extremely important as habitat for many estuarine-dependent species. Recent studies conducted within the upper Barataria Basin have substantiated the value of shallow marsh areas as nursery habitat for Atlantic croaker and spot (Rogers, 1979) and menhaden (Simoneaux, 1979). Shallow marsh areas are also important as nursery grounds for brown shrimp and white shrimp in coastal Louisiana, according to studies conducted by biologists of the Louisiana Department of Wildlife and Fisheries (White and Boudreaux, 1977). Studies in Texas have also documented the importance of tidal marshes as habitat for blue crabs (More, 1969). 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 vegetated wetlands is the most important factor influencing the production of estuarine-dependent fishes and shellfishes of sport and commercial importance. Turner (1979) reported that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands, and that the area of estuarine water does not seem to be directly associated with average shrimp yields. Harris (1973) has stated his opinion that total estuarine-dependent commercial fisheries production to coastal Louisiana has peaked and will decline in proportion to the acreage of marshland lost. Based on these considerations, we have assumed, with the exception of oysters, that the magnitude of future declines in marsh acreages will determine future estuarine-dependent fisheries yields.

According to data compiled by the U.S. Army Corps of Engineers (1977), the marsh in Hydrologic Unit IV, within which the project area occurs, supports approximately 6.0 man-days of saltwater sportfishing (fishing, crabbing, shrimping) per acre. Implementation of the TSP would result in a net annualized reduction of approximately 168 acres of marsh (Table B1). This indicates that the project area would experience an average annual loss of about 1,008 man-days of saltwater sportfishing.

The Corps of Engineers (1977) also reports that 1083.2 pounds of commercial fisheries production valued at $93.85 can be expected from an acre of marsh in Hydrologic Unit IV. Table B2 displays the project's effects on annual production of these major estuarine-dependent commercial fishes, shrimp, and crabs. As shown in that table, an annualized reduction of 181,978 pounds of commercial fisheries production valued at approximately $15,767 can be expected as a result of the project.

Table B1. Comparison of FWOP and FWP acreages by habitat type for the project area. a/

Target Year	Marsh	Estuarine Open Water	Scrub-shrub	Levee	Borrow
1969 (Existing)	9,170	4,224	261	260	0
1994 FWOP	6,771	6,623	261	260	0
FWP	5,375	0	5,375	1,495	1,670
Net Change	-1,396	-6,623	+5,114	+1,235	+1,670
2019 FWOP	4,994	8,400	261	260	0
FWP	4,622	2,163	3,965	1,495	1,670
Net Change	-372	-6,237	+3,704	+1,235	+1,670
2044 FWOP	3,684	9,710	261	260	0
FWP	3,859	3,967	2,924	1,495	1,670
Net Change	+175	-5,743	+2,660	+1,235	+1,670
2069 FWOP	2,717	10,677	261	260	0
FWP	3,176	5,417	2,157	1,495	1,670
Net Change	+459	-5,260	+1,896	+1,235	+1,670
2094 FWOP	2,004	11,390	261	260	0
FWP	2,586	6,573	1,591	1,495	1,670
Net Change	+582	-4,817	+1,330	+1,235	+1,670
Annualized FWOP	4,750	8,644	261	260	0
FWP	4,582	3,389.1	3,069.4	1,371.5	1,503
Net Change	-168	-5,254.9	+2,808.4	+1,111.5	+1,503

a/ Basic acreage data supplied by the Corps of Engineers.

Table B2. Annualized effects of project implementation on estuarine-dependent commercial fisheries production. a/

	Total Production (pounds)	Value (dollars)
Pre-project (1969)	9,932,944	860,605
Annualized total without project	5,145,200	445,788
Annualized total with project	4,963,222	430,020
Annualized change with project	-181,978	-15,767

a/ Based on 1083.2 pounds of estuarine-dependent fish, crabs, and shrimp per acre at a value of $93.85 per acre (Corps of Engineers 1977).

IMPACTS ON WILDLIFE RESOURCES

Table B3 shows the man-day/acre sport hunting potential for selected habitat types in the study area. An estimate of the effect of the project on sport hunting was determined by multiplying these values by the annualized acreage change in each habitat type under FWP conditions. Table B4 illustrates the estimated annualized change in rabbit hunting, rail and snipe hunting, and waterfowl hunting with project implementation. As indicated in that table, the TSP would result in an annualized gain in rabbit hunting of 540 man-days and an annualized loss in rail and snipe hunting, and waterfowl hunting of 32 man-days and 64 man-days, respectively.

According to the FWS (1981), the potential man-day use for non-consumptive wildlife-oriented recreation is 0.6 man-days per acre on non-open water habitat types. Implementation of the TSP would produce an annualized gain in non-consumptive recreation of 2,251 man-days. This figure is obtained by summing the annualized net change in acreages for marsh, scrub-shrub, and levee habitats (Table B1) and multiplying that total by 0.6 man-days per acre.

The estimated average harvest and value per acre of fur animals and alligators in the project area marshes is shown in Table B5. Based on the data listed in that table and on the estimated annualized changes in habitat acreages under

FWP and FWOP conditions, estimates of reduction in the potential annualized fur animal and alligator harvest have been developed. These estimates are shown in Table B6. Utilizing the estimated potential catch (Table B6) and the value of the pelts and hides (Table B5), the potential total value (annualized) of selected project area furbearers and alligators has been computed (Table B7).

As shown in Tables B6 and B7, respectively, the project would reduce the average annual fur animal and alligator harvest by about 30 animals per year at a value of approximately $282.

Table B3. Estimated sport hunting potential (man-days/acre) of various habitat types in the project area.

	Rabbit Hunting	Rail and Snipe Hunting	Waterfowl Hunting
Marsh a/	.131	.188	.383
Estuarine Open Water	Neg.	Neg.	Neg.
Scrub-shrub b/	.200	Neg.	Neg.
Levee	Neg.	Neg.	Neg.
Borrow	Neg.	Neg.	Neg.

a/ Taken from Fish and Wildlife Service input into the Louisiana Coastal Area Study (1981[c]).

b/ Derived from the Louisiana Department of Wildlife and Fisheries Small Game Survey for 1977-78.

Table B4. Potential annualized man-day usage and populations of selected project area game species.

Species	Pre-project (1956)	Annualized total without project	Annualized total with project	Annualized Change due to project
		Potential Man-day Use		
Rabbit a/	1253.47	674.45	1214.12	+539.67
Rail and snipe b/	1723.96	893	861.42	-31.58
Waterfowl c/	3512.11	1819.25	1754.91	-64.34
		Populations (Numbers of Animals)		
Rabbit a/	3827	2059	3705	+1646
Rail and snipe	Unknown	Unknown	Unknown	Unknown
Mottled duck d/	31	16	15	-1
Other Waterfowl	Unknown	Unknown	Unknown	Unknown

a/ Based on a density of 0.4 rabbits/acre in marsh habitat and 0.61 rabbits/acre in scrub-shrub habitat. These densities are taken from the Louisiana Department of Wildlife and Fisheries small game survey for 1977-78.

b/ Density unknown. Man-day value taken from the U.S. Army Corps of Engineers (1974).

c/ Actual density varies. Man-days values are based upon a largely transient population of waterfowl and are taken from Fish and Wildlife Service (1980[a]).

d/ Number of breeding pairs, based on density data obtained from Louisiana Department of Wildlife and Fisheries.

Table B5. Potential fur and alligator catch and value in the project area marshes.

Species	Average catch a/ per acre	Value per c/ pelt (hide)	Value per acre
Muskrat	0.0844	$4.39	$0.3705
Nutria	0.0864	$5.74	$0.4959
Mink	0.0011	$10.70	$0.0118
Otter	0.0002	$34.20	$0.0068
Raccoon	0.0078 b/	$7.30	$0.0569
Alligator	0.0038 d/	$133.00 d/	$0.7733
	Total Average Catch per acre	Total value per acre	Total Net value e/ per acre
	0.1837	$1.7152	$1.2864

a/ Average catch per acre, unless otherwise noted, from Palmisano (1973).

b/ U.S. Fish and Wildlife Service (1980[b]).

c/ Based on 1976-1981 average prices to the trapper, compiled by the Louisiana Department of Wildlife and Fisheries.

d/ Data on hide value and harvest provided by Ted Joanen and David Richard, Louisiana Department of Wildlife and Fisheries, Grand Cheniere, Louisiana.

e/ Based on cost of harvest equal to 75% of total gross value.

Table B6. Comparison of average annual potential harvest of fur animals and alligators under FWOP and FWP conditions.

Species	Potential Annual Catch Without Project	Potential Annual Catch With Project	Change in Potential Annual Catch Due to Project
Muskrat	401	387	-14
Nutria	410	396	-14
Mink	5	5	0
Otter	1	1	0
Raccoon	37	36	-1
Alligator	18	17	-1
Total	872	842	-30

Table B7. Comparison of total annual value of selected project area furbearers and alligators under FWOP and FWP conditions.

Species	Potential Annual Value Without Project ($)	Potential Annual Value With Project ($)	Potential Annual Change Due to Project ($)
Muskrat	1,760.39	1,698.93	-61.46
Nutria	2,353.40	2,273.04	-80.36
Mink	53.50	53.50	0
Otter	34.20	34.20	0
Raccoon	270.10	262.80	-7.30
Alligator	2,394.00	2,261.00	-133.00
Total	6,865.59	6,583.47	-282.12

LITERATURE CITED

Conner, J.V., and F.M. Truesdale. 1973. Ecological implications of a freshwater impoundment in a low-salinity marsh. Pages 259-276 in R.H. Chabreck, ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

Darnell, R.M. 1961. Trophic spectrum of an estuarine community based on studies of Lake Pontchartrain, Louisiana. Ecology 42:553-568.

Harris, A.H. 1973. Louisiana estuarine dependent commerical fishery production and values (regional summary and WRPA-9 and WRPA-10 analysis of production and habitat requirements). Unpublished report prepared for U.S. Department of Commerce, National Marine Fisheries Service, Water Resources Division, St. Petersburg, Florida.

More, W.R. 1969. A contribution to the biology of the blue crab (Callinectes sapidus Rathbun) in Texas, with a description of the fishery. Texas Parks and Wildlife Department. Technical Series No. 1. 31pp.

Odum, W.E., F.C. Zieman, and E.J. Heald. 1973. The importance of vascular plant detritus to estuaries. Pages 91-114 in R.H. Chabreck, ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

Palmisano, A.W. 1973. Habitat preference of waterfowl and fur animals in the northern Gulf Coast marshes. Pages 163-190 in R.H. Chabreck, ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

Rogers, B.D. 1979. The spatial and temporal distribution of Atlantic croaker, Micropogon undulatus, and spot, Leiostomus xanthurus, in the upper drainage basin of Barataria Bay, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 96pp.

Simoneaux, L.F. 1979. The distribution of menhaden, genus Brevoortia, with respect to salinity, in the upper drainage basin of Barataria Bay, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 96pp.

Turner, R.E. 1979. Louisiana's coastal fisheries and changing environmental conditions. Pages 363-370 in J.W. Day, Jr., D.R. Culley, Jr., R.E. Turner, and A.J. Mumphrey, Jr., eds. Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University Division of Continuing Education, Baton Rouge.

U.S. Army Corps of Engineers, New Orleans District. 1974. Louisiana Coastal Area Study. Fish and wildlife study of the Louisiana Coastal Area and the Atchafalaya Basin Floodway. Appendix D-2: Methodology for estimating the fish and wildlife sport harvest, pp. 7-52. New Orleans, Louisiana.

U.S. Army Corps of Engineers, New Orleans District. 1977. Value of wetlands and bottomland hardwoods. Mimeograph report, Environmental Quality Section, New Orleans District. 30pp.

U.S. Fish and Wildlife Service. 1980[a]. A planning aid report on the Mississippi and Louisiana estuarine areas study. Table A3. Lafayette, Louisiana.

U.S. Fish and Wildlife Service. 1980[b]. A planning aid report on the Mississippi and Louisiana estuarine areas study. Table A4. Lafayette, Louisiana.

U.S. Fish and Wildlife Service. 1981[a]. Final Fish and Wildlife Coordination Act Report on the U.S. Army Corps of Engineers feasibility study entitled "Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana." Page B-22. Prepared in Lafayette, Louisiana. Released from Jackson, Mississippi.

U.S. Fish and Wildlife Service. 1981[b]. A planning aid report on the Avoca Island Levee Extension and Water Management and Land Use Controls. Page C-9. Lafayette, Louisiana.

U.S. Fish and Wildlife Service. 1981[c]. A planning aid report on the Louisiana Coastal Area Study. Table 1. Lafayette, Louisiana.

White, C.J., and C.J. Boudreaux. 1977. Development of an areal management concept for gulf Penaeid shrimp. Louisiana Wildlife and Fisheries Commission, Oysters, Water Bottoms, and Seafoods Division, Technical Bulletin 22. 77pp.

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES
400 ROYAL STREET
NEW ORLEANS 70130

JESSE J. GUIDRY
SECRETARY

DAVID C. TREEN
GOVERNOR

April 28, 1982

Mr. David W. Fruge
Acting Field Supervisor
United States Department of the Interior
Fish and Wildlife Service
Post Office Box 4305
Lafayette, Louisiana 70502

Re: New Orleans to Venice
Hurricane Protection Project Report
Fish and Wildlife Coordination Act

Dear Mr. Fruge:

Personnel of the Louisiana Department of Wildlife and Fisheries have reviewed the above referenced report and concur with the results.

We have noted the low values given to fisheries resources and recommend that additional information be given separately on consumptive and noncumptive resources.

Sincerely,

Jesse J. Guidry
FRA

Jesse J. Guidry
Secretary

JJG:FOD:fs

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Region
9450 Koger Blvd.
St. Petersburg, FL 33702

April 8, 1982

F/SER612/DM
713/766-3699

Mr. David W. Fruge
Acting Field Supervisor
U. S. Department of Interior
Fish and Wildlife Service
Post Office Box 4305
Lafayette, LA 70502

Dear Mr. Fruge:

This is in reply to your March 23, 1982 letter to Mr. Don Moore, wherein you requested our review and comments on the proposed Fish and Wildlife Coordination Act Report on the alternative plans under consideration for that portion of the New Orleans to Venice Hurricane Project located west of the Mississippi River.

The seventh paragraph of the EXECUTIVE SUMMARY and the first paragraph of AREA SETTING, Fishery Resources (page 5) should be revised to note that many of the brown and white shrimp, Gulf menhaden, Atlantic croaker, sand seatrout, etc. reared in the project area marshes are harvested in the federal Fishery Conservation Zone, seaward of the territorial waters of Plaquemines Parish.

We concur in the rest of those findings and recommendations in your report which relate to marine and estuarine fishery resources and their habitats.

Sincerely,

Richard J. Hoogland
Chief, Environmental
Assessment Branch

APPENDIX F

BIOLOGICAL ASSESSMENT OF THREATENED AND ENDANGERED SPECIES

BIOLOGICAL ASSESSMENT
OF THREATENED AND ENDANGERED SPECIES
NEW ORLEANS TO VENICE, LOUISIANA
HURRICANE PROTECTION

I. INTRODUCTION

This assessment addresses the threatened and endangered species which may be affected by the US Army Corps of Engineers' New Orleans to Venice, Louisiana, Hurricane Protection project. The species potentially affected are listed in Table 1. No threatened or endangered plants are known to occur in the project area.

TABLE 1

ENDANGERED AND THREATENED SPECIES FOUND IN THE VICINITY OF THE NEW ORLEANS TO VENICE, LOUISIANA, HURRICANE PROTECTION PROJECT, PLAQUEMINES PARISH, LOUISIANA

ENDANGERED SPECIES	
Kemp's Ridley Sea Turtle	Sperm Whale
Leatherback Sea Turtle	Humpback Whale
Eastern Brown Pelican	Sei Whale
Bald Eagle	Fin Whale
Arctic Peregrine Falcon	Black Right Whale
Eskimo Curlew	
THREATENED SPECIES	
Green Sea Turtle	Atlantic Loggerhead Sea Turtle
Due to Similarity of Appearance	
American Alligator	

The proposed project would affect the wetland areas parallel to the Mississippi River, Plaquemines Parish, Louisiana. A levee would be constructed by the hydraulic method and would consist of a sand core covered with a clay blanket. Construction would be accomplished by first excavating a trench for the sand core adjacent to and on the flood side of the existing levee. Sand would then be pumped from a borrow area in the Mississippi River into the excavated trench. Hydraulic clay fill from a marsh borrow area would be pumped on top of the sand core between retaining dikes. After the hydraulic clay fill has dried sufficiently, this material and material from the existing levee would be shaped over the sand core to the ultimate levee design section plus some overbuild to compensate for additional settlement. This method of construction would be essentially the same as is being used on the other reaches of the project.

This assessment is the result of three visits to the area, conversations and correspondences with knowledgeable persons, and a review of current literature. The historic and current occurrences in Louisiana are summarized; potential impacts, and cumulative effects of the project upon each species are examined. No difficulties were encountered in obtaining data and completing the study; however, information on sea turtles in Louisiana was found to be inadequate.

II. SPECIES ASSESSMENT

a. Kemp's Ridley Sea Turtle. Because of the Kemp's Ridley (*Lepidochelys kempii*) is a diurnal nester on a single Mexican beach, the small marine turtle is particularly suspectable to extinction. From April to August, small aggregations (arribads) of turtles lay eggs on a 14-mile stretch of beach (Rancho Nuevo) in Tamalipos. Estimates of the populations were 40,000 nesting females in 1947; however, the number has declined to about 500 as of 1978. Taking the Ridley for eggs and skins has played a major part in decline (Pritchard and Marquez, 1973). Although the Mexican Government has prohibited harvesting and protects the colony with armed guards, no upward population trend has been noted. Natural predation of hatchlings is also high. Adults are primarily restricted to the Gulf of Mexico, although juveniles have been reported as far north as Massachusetts.

The ridley is often observed foraging in shallow, rich estuarine and shore areas. The turtle consumes a variety of invertebrates, including crabs, shrimp, snails, sea urchins, fish, and marine plants. Portunid crabs (*Callinectes* spp.) are favored. Because of the turtles preferred prey, they are often caught during commercial fishing and shrimping activities. The ridley feed in the highly productive white shrimp-portunid crab beds of Louisiana from Marsh Island to the Mississippi delta. An examination of two females captured off the Louisiana coast in 1952 found the turtles had consumed *Callinectes spapidus*, and *C. ornatus*, as well as small molluscs of the genera *Nassarius*, *Nuculana*, *Corbula*, and *Mulinia* (Dobie et al., 1961). Recovery of adults tagged in Tamaulipas, Mexico, has indicated Louisiana and Campeche, Mexico, have the highest nonnesting ridley concentrations. Between 1952 and 1958, 14 ridleys were captured in Louisiana waters. Of 1,038 turtles tagged between 1966 and 1969, 51 were recaptured outside the tagging location. About 30 percent of those recaptures were off the Louisiana coast, and slightly over 50 percent of those recaptures in the United States were from Louisiana (Zwinenburg, 1977). Pritchard found about two-thirds of those turtles tagged in 1970 were recovered off the Louisiana coast (Pritchard and Marquez, 1973). In the last year, no ridleys have been observed during FWS aerial surveys; however, a dead turtle was found in May 1981 on Grand Terre Island (McGehee, personal communication, 1981).

The turtle may overwinter in a dominant state while buried in the silts in the shallow water estuarine systems of the Gulf of Mexico. Although winter torpor has not been adequately documented for the ridley, Florida ridleys are often reported covered with mud during the spring (Pritchard and Marquez, 1973).

It is improbable a dredge would encounter a ridley; however, the possibility cannot be discounted. It is felt the project would not influence the Kemp's Ridley population.

b. Leatherback Sea Turtle. The largest of all turtles, the Leatherback Sea Turtle (*Dermochelys coriacea*), is one of the rarest marine species, second only to Kemp's Ridley. The pelagic turtle, which is distributed throughout the world, is a powerful swimmer and ranges further north of any other marine turtle. The general population reduction is due to our harvesting of eggs and adults increased beach development, and hatching predation. The present population is estimated to be 29,000 to 40,000 animals (Pritchard, 1971, in NFWL, 1981).

Nesting in the United States is now restricted to the sloping, sandy beaches of Florida near deep water. During the spring and summer months, about 25 clutches are layed each year in Florida. The nocturnally nesting females may lay up to six clutches at 2- or 3-year intervals. On the gulf coast, nests or hatchlings have been reported in Walton and Okaloosa Counties of Florida.

The omnivorous leatherback is often associated with schools of Cabbagehead Jellyfish (*Stomolophus meleagris*) which are the turtles' preferred prey. They also feed on sea urchins, squids, crustaceans, tunicates, fish, and seaweed.

In 1951, two females were netted by fishermen off southeastern Louisiana, (Dunlap, 1955, in NFWL, 1981) and the species has been reported near Plaquemines Parish. The leatherback is extremely rare in Louisiana, and it has not been observed by NFWL personnel during recent monthly surveys (NFWL, personal communication, 1981). The project would leave no effect on this turtle species.

c. Brown Pelican. Historically, Brown Pelicans (*Pelecanus occidentalis*) occurred throughout coastal Louisiana and nested on several sites in the Mississippi delta. Estimates of the original pelican population were quite high. Bailey (1919) in Clapp et. al. (in press) reported a pelican population of 50,000 birds on the Mississippi River mud lumps, and Arthur (1931) in the same reference concluded the total Louisiana population was 75,000 to 85,000 birds. Oberholser (1938) estimated a breeding population of 11,500 birds in 1933, and this figure is probably more accurate. Although "thousands of adults along with young of all ages" were reported in 1958, by 1962 there were none (Lowery, 1974). The apparent cause of this sharp decline is unknown; however, pollution, freezing temperatures, hurricanes, and diseases are most likely (Blus, et al. 1979).

During the period 1968 to the 1970's, juvenile birds from Florida were transplanted to Louisiana, and released at several locations (Nesbit, 1978). Breeding in Louisiana is presently confined to the black mangrove and shell bank areas of Queen Bess Island in lower Barataria Bay,

(Figure 1) as well as North Island in the Chandeleurs. In 1981, 200 to 250 pairs of bird breed on Queen Bess and 40 on North Island. North Island is beyond the study area. Breeding often begins in November and continues through the spring. Pelicans use isolated sand spits and clumps of mangroves for loafing and roosting (McNease, personal communication, 1981).

Brown Pelicans forage predominantly by plunge-diving. Although pelicans generally feed in shallow estuarine waters within 5 miles off the coast, they have been observed 20 miles (32 kilometers) or more out to sea (Schreiber, 1978). During the nesting season, the birds feed near the colony; however, they have been observed foraging 45 miles from the breeding site. The pelicans' diet is primarly fish, especially menhaden which may form as much as 90 percent of their diet. Other fish consumed are pinfish, thread herring, top minnow, crevalle, silversides, sheepshead, and mullet (Palmer, 1962). During the summer months, Louisiana pelicans are frequently observed feeding on schooling mullet and menhaden in Barataria Bay, and in the winter they are often noted feeding along the beaches and coastal islands from Timbalier Island eastward.

Because of the Brown Pelicans ability to range over a large area and the poor quality foraging areas found in the construction site, impacts on the Brown Pelican are negligible. The nearest construction would be about 20 miles away from the colony.

d. 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, gar, mullet, and sunfish, while birds are primarly ducks and coots. The eagle prefers fish to birds, and brown bullhead (*Ictalurus nebulosus*) to other fish (Wright, 1953 *in* Snow, 1973).

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 predominantly 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 the 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 8 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. High nest success and average annual production of young fledged/active nest suggests clutch failures, not nestling mortality, inhibit the eagle population in Louisiana.

One possible Bald Eagle nest site is located in the project vicinity, and is near Venice. This is nest No. 27 of Dugoni (1980), and is located at longitude 89° 22' 22"; latitude 29° 16' 40". The nest is in a dead bald cypress and about 8 meters above the ground. About three-fourths of the land surrounding the site is marsh, and the remainder wet marsh and ponds. The nest is inactive and, because the tree is dead, will probably not be used by eagles. A one-half- to three-fourths-mile buffer has been left around the tree. Since at least the mid-70's, this nest has been sucessfully used by ospreys. The nearest active Bald Eagle nests are in two dead live oak trees near Lafitte in Jefferson Parish (No. 2 - 90° 6' 30"; 29° 38' 29"; and No. 3 - 90° 6' 25"; 29° 37' 22"). The location of these nests can be seen in Figure 1. There would be no influence on these nests by construction.

e. Arctic Peregrine Falcon. The Arctic Peregrine Falcon (*Falco peregrians tundrius*) is a migratory, medium-sized raptor which nests in the tundra area of North America and winters in Central and South America. The majority of these falcons migrate along the Atlantic coast; however, some utilize the interior of the continent. Coastal habitat are extensively used for temporary stopovers during migration, and a few individuals may overwinter along the gulf coast (Enderson, 1965).

The Peregrine Falcon hunts over open areas such as waterways, swamps, marshes, and fields where it takes a variety of avian prey. Although shorebirds and waterfowl are eaten, the food of the falcon is predominantly small passerines such as jays, flickers, sparrows, and thrushes (Cade, 1961). It appears food is not a limiting factor.

The principal cause of the Peregrine Falcon decline appears to be chlorinated pesticides, especially DDT and DDE, which have accumulated in the birds as a result of feeding on contaminated prey. Cade et al. (1971 in NFWL, 1980) found residues of organochlorines in tissues and eggs were near the abnormal reproductive threshold, and eggshell thinning approached 20 percent.

The project would have no effect on the Peregrine Falcon as it is a transient species which is endangered because of pesticide loads. It is felt the construction would have no effect on the birds food resources in the delta area.

f. Eskimo Curlew. The Eskimo Curlew (*Numenius borealis*) is a medium-sized shorebird which nests in the Arctic tundra. In the fall the bird migrates along the Atlantic coast on its way to South America and then returns in the spring through the central United States. The curlew feeds in a variety of habitat including: open grasslands, prairies, meadows, pastures, and plowed lands. During migration it uses intertidal zones and marshes to a large extent. It appears food is not a limiting factor for the bird.

Although the Eskimo Curlew was once considered abundant, no estimates of the former populations are available. The last reported sighting of a bird was in 1976 (Hagar and Anderson, 1977), and the species may be extinct. The principal cause of the decline was unrestricted market hunting during the late 1800's. Severe storms during migration and habitat alterations also may have been a contributing factor (Banks, 1977).

The Eskimo Curlew historically migrated through Louisiana during the spring, and was seen in vast numbers in the southern part of the state. Wagonloads of dead birds were shipped to markets. Although a bird was observed on the gulf coast of Texas in 1962 (Emanuel, 1962 in NFWL, 1980), the last curlew known to be in Louisiana was a bird killed in March 1889 near Acadia Parish (Lower, 1974). The project is not expected to have any effect on the Eskimo Curlew.

g. American Alligator. The American Alligator (*Alligator mississippiansis*) population reached a low point in the late 1950's and early 1960's because of over harvesting and loss of habitat. Although alligators are found in almost all fresh and brackish water habitats, they prefer large marshes. Joanen (1974 in NFWL, 1980) found the extensive coastal marshes of southern Louisiana may support the highest population anywhere. For this reason, and the population increase in alligators in Louisiana, the "gator" in coastal Louisiana has been placed in a "threatened due to similarity of appearance to endangered and threatened population" classification (40 FR 37132, 35, 25 June 1979).

Although some marsh will be permanently converted to openwater, it is not felt it will influence the alligator population in this area.

h. Green Sea Turtle. The Green Sea Turtle (*Chelonia mydas*) is distributed throughout tropical waters, and is found in shallow lagoons and shoals of the Altantic coast and Gulf of Mexico. The turtle population has been declining as a result of overexploitation of both adults and eggs, development of beaches, and drowning as a result of net entanglement.

Nesting by Green Sea Turtles in the United States is limited to the east coast of Florida and primarily during the summer months. The nocturnal turtles lay up to seven clutches each season and nest on a sloping beach with open ocean exposure. The female may only lay every 2 to 4 years (NWFL, 1981).

The herbivorous turtles forage on marine grasses and algae, although mollusks, sponges, crustaceaus, and jellyfish are occassionally consumed. The turtles are migrant, and may be observed in the open sea moving from the feeding grounds to nesting beaches. The green turtle may bury in mud and remain dominant during the winter. A small, but significant, fisheries of "greens" occurred in Louisiana and Texas during the late 1800's and first half of this century. Currently, they are rarely seen in Louisiana, and none had been noted in the last year during NFWL surveys (McGehee, personal communication, 1981). The project would have no effect on the Green Sea Turtle.

i. Loggerhead Sea Turtle. The Loggerhead Sea Turtle (*Caretta caretta caretta*) is an extremely cosmopolitan species which wanders widely throughout the temperate and tropical oceans. The current population decline is a result of drowning in commercial fishery and shrimping travels, predation of eggs and adults by natural/human predators, and reduction in nesting beaches. Lund (1974) estimated 22,000 nests in the United States. Because the turtles may nest several times each season, the number of females would be much lower.

In the United States, the nocturnally nesting loggerhead lays its eggs from May to September on various barrier islands and beaches from Virginia south to the Florida Keys and into the Gulf of Mexico. The gulf breeding is quite low and restricted to barrier islands. Three to four clutches are layed on the same beach during the summer; however, the females may only lay every 2 to 3 years (Lund, 1974).

The loggerhead is primarily carnivorous and feeds on crabs, clams, mussels, fish, sponges, and jellyfish. Marine grasses are occassionally consumed.

In Louisiana, nesting occurs on the Chandeleur Island. As many as 29 crawls have been recorded; however, many of these may be false crawls because the high shell content of the beach may make nesting difficult (Lund, 1974). Although a few loggerheads have been seen off the Louisiana coast during NFWL censuses, no nesting was observed here in 1980 (McGehee, personal communication, 1981). Like the ridley, the loggerhead may overwinter in a dormant state while buried in silts and muds. It appears as though they prefer channels and deeper holes to the shallow estuarine bottom.

The chance of encountering this turtle is remote. The project would have no effect on the Loggerhead Sea Turtle.

j. Whales. Although the Finback Whale, Humpback Whale, Right Whale, Sei Whale, and Sperm Whale are generally confined to the deeper water of the Gulf of Mexico, they have been sighted in the nearshore waters, and stranded on the Louisiana coast (Schmidly, 1981). Because the project impacts are limited to the marshes and shallow waters along the Mississippi River, the project should have no impact on any whales.

III. SUMMARY OF IMPACTS

Two of the sea turtles, the ridley and loggerhead, could be affected by the project; however, it is unlikely. Both of these turtles forage on vertebrate species in small estuarine waters and may overwinter in the estuarine silts. Because little information is known on the sea turtles populations in Louisiana, impacts to these species are speculative. Although some marsh habitat would be destroyed, the project would have minimal effects on the abundant alligator population.

The project would have minimal effects on birds, especially the raptors. Because the Brown Pelican forge in the project area, prey availability in the immediate project area might be reduced because of turbidity. This effect is minor and of short duration. The nearest construction would be about 20 miles away from the pelican colony.

Although whales have been sighted in the gulf, none are expected to occur in the shallow estuarine areas.

IV. CONCLUSION

The impacts of the New Orleans to Venice project are expected to be negligible on the endangered and threatened species examined in this assessment. Temporary, localized effects of the project would include turbidity from the dredging operations and a release of nutrients. Long-term impacts would be a loss of marsh due to the construction of ponding and borrow areas.

REFERENCES

Arthur, C.S. 1931. The Birds of Louisiana. Bull. LA Dept. Conserv. 20:1-598.

Bailey, A.M. 1918. The Brown Pelican - A Good Citizen. Wilson Bull. 30(3):65-68.

Bailey, A.M. 1919. The Bald Eagle in Louisiana. Wilson Bull. 31(2):52-55.

Banks, R.C. 1977. The Decline and Fall of the Eskimo Curlew, or Why Did the Curlew Go Extaille? American Birds 31:127-134.

Bent, Arthur C. 1937. Life Historices of North American Birds of Prey. US National Museum Bulletin 167, Part 2, 43-67.

Blus, L., E. Cromartie, L. McNease, and T. Joanen. 1979. Brown Pelican: Population Status, Reproductive Success, and Organochlorine Residues in Louisiana, 1971-1976. Bull, Environ. Contam. Toxicol. 22:128-135.

Cade, T.J. 1960. Ecology of the Peregrine and Gryfalcon Populations in Alaska. Univ. of California Publications in Zoology. 63:151-267.

Cade, T.S., J.L. Lincer, C.M. White, D.G. Roseneau, and L.G. Schwartz. 1971. DDE Residues and Eggshell Changes in Alaskan Falcons and Hawks. Science 172:955-957.

Clapp, R.B., R.C. Banks, and W.A. Hoffman. 1981. Marine Birds of the Southeastern United States. Part I. Gaviiformes through Pelecaniformes. Unpublished Draft.

Dobie, J.L., L.H. Ogren, and J.F. Fitzpatrick. 1961. Food Notes and Records of the Atlantic Ridley Turtle (Lepidochelys kempi) from Louisiana. Copeia 1:109-110

Dugoni, J.A. 1980. Habitat Utilization, Food Habits, and Productivity of Nesting Southern Bald Eagles in Louisiana. M.S. Thesis LSU 151 pp.

Dugoni, J.A. 1981. Howard, Needles, Tammeu, and Bergendoff, Baton Rouge, Louisiana. Personal Communication by phone to E. Scott Clark, 21 Apr 81.

Emanuel, V.L. 1961 Another Probable Record of an Eskimo Curlew on Galveston Island, Texas Auk 78:259-260.

Enderson, James H. 1965. A Breeding and Migration Survey of the Peregrine Falcon. Wilson Bull. 77(4):327-339.

Hagar, J.A. and K.S. Anderson. 1977. Sight Record of Eskimo Curlew. American Birds 31:135-136.

Joanen, T. 1974. Population Status and Distribution of Alligators in the Southeastern United States. Southeastern Regional End. Sp. Workshop, Wildlife Soc. Tallahassee, Florida, Sep 1974 Unpaged.

Lowery, G.H. 1974. Louisiana Birds. LSU Press, Baton Rouge, Louisiana 651 pp.

Lund, F. 1974. A Survey of Marine Turtle Nesting in the United States. Unpublished 39 pp.

National Fish and Wildlife Laboratory. 1980. Selected Vertebrate Endangered Species of the Seacoast of the United States: Arctic Peregrine Falcon. US Fish and Wildlife Service, Biological Services Program, FWS/OBS-80/01.51 9 pp.

National Fish and Wildlife Laboratory. 1980. Selected Vertebrate Endangered Species of the Seacoast of the United States: Eskimo Curlew US Fish and Wildlife Service, Biological Services Program; FWS/OBS/01.17 7 p.

National Fish and Wildlife Laboratory. 1980. Selected Vertebrate Endangered Species of the Seacoast of the United States: Green Sea Turtle. US Fish and Wildlife Service, Biological Services Program; FWS/OBS-80/01.13 9p.

National Fish and Wildlife Laboratory. 1980. Selected Vertebrate Endangered Species of the Seacoast of the United States: Kemp's (Atlantic) Ridley Sea Turtle. US Fish and Wildlife Service, Biological Services Program; FWS/OBS-80/01.30. 7p.

National Fish and Wildlife Laboratory. 1980. Selected Vertebrate Endangered Species of the Seacoast of the United States: Leatherback Sea Turtle. US Fish and Wildlife Service, Biological Services Program; FWS/OBS-80/01.12 7p.

National Fish and Wildlife Laboratory. 1981. A Review of the Biology of the Marine Turtles in OCE Areas of the Southeastern United States Including Waters of the Gulf of Mexico and Atlantic Ocean. Draft Final Report 48p.

McGehee, A. 1981. US Fish and Wildlife Service, Denver Wildlife Research Center, New Orleans Field Station, 20 May 1981, personal communication by phone to E. Scott Clark.

McNease, L. Louisiana Wildlife and Fisheries Commission, Grand Cheuier, Louisiana, Personal Communication by phone to E. Scott Clark, 21 Apr 81.

Nesbitt, N.A. L.E. Williams, Jr., L. McNease, and T. Joanen. 1978. Brown Pelican Restocking Efforts in Louisiana. Wilson Bull. 90:443-445.

Oberholser, H.C. 1938. The Bird Life of Louisiana. Louisiana Department Conservation Bull. 28:1-834.

Ogren, L. 1977. Survey and Reconnaissance of Sea Turtles in the Northern Gulf of Mexico. Unpublished Report - NMFS 7p.

Palmer, R.S., ed 1962. Handbook of North American Birds, Vol. I., Yale University Press, New Haven 567 pp.

Pritchard, P.C.H. and M. Marquez. 1973. Kemp's Ridley Lepidochelye kempi. IUCN Monograph No. 2:1-30.

Schreiber, R.W. 1978. Eastern Brown Pelican. pp. 23-24 in H.W. Kale, II (ed). Rate and Endangered Biota of Florida. Vol. II, Birds. University Presses of Florida, Gainesville, Florida ixi and 121 pp.

Schmidley, D.J. 1981. Marine Mammals of the Southeastern United States Coast and the Gulf of Mexico. US Fish and Wildlife Service, Office of Biological Services, Washington, DC FWS/OBS-80/41, in press 163p.

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.

US Fish and Wildlife Service. 1979. Loggerhead Sea Turtle, Caretta caretta. in Endangered and Threatened Species of the Southwestern United States. Region 4, Atlanta, Georgia.

Wright, B.S. 1953. The Relation of Bald Eagles to Breeding Ducks in New Brunswick. J. Wildlife Management 17(1):55-62

Zwinenburg, A.J. 1977. Kemp's Ridley, Lepidochelys kempii (Garman, 1880), Undoubtedly the most Endangered Marine Turtle Today. Bull. Maryland. Herp. Soc. 13:170-191.

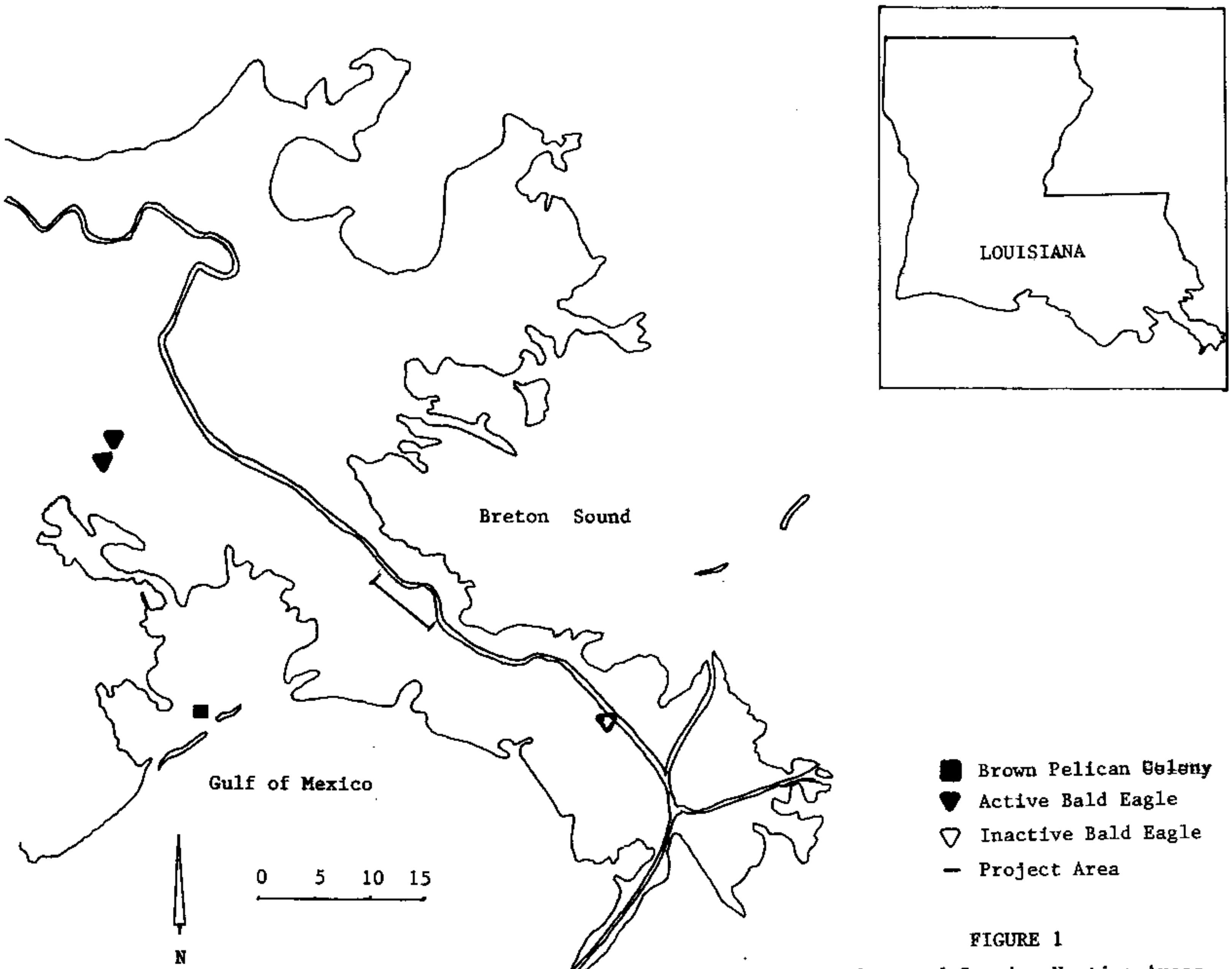


FIGURE 1

Endangered Species Nesting Areas Near the N.O. to Venice Project.

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 Biological Assessment on the New Orleans to Venice, Louisiana Hurricane Protection Project (log number 4-3-81-115). We concur with your determination that this project will not affect any threatened or endangered species. Your cooperation on this matter has been appreciated.

Sincerely,

Ray Aycock

for Gary L. Hickman
Area Manager

cc: Director, FWS, Washintgon (AFA/OES)
RD, FWS, Atlanta, GA (AFA/SE)
ES, FWS, Lafayette, LA
Department of Wildlife and
Fisheries, New Orleans, LA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Region
9450 Koger Boulevard
St. Petersburg, FL 33703

F/SER61:AM

Mr. R. H. Schroeder, Jr.
Acting Chief, Planning Division
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Mr. Schroeder:

This responds to your October 26, 1981, letter transmitting for our review the biological assessment on threatened and endangered species in the area of the New Orleans to Venice, Louisiana, Hurricane Protection Project.

We have reviewed the biological assessment and concur that the proposed action is not likely to affect endangered or threatened species of sea turtles and whales or critical habitat of such species.

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 affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified, or critical habitat is determined that may be affected by the proposed activity.

Sincerely yours,

D. R. Ekberg
Chief, Environmental & Technical
Services Division

cc: FWS, Atlanta, GA
FWS, Lafayette, LA

APPENDIX G

CULTURAL RESOURCES

A series of cultural resource surveys was conducted by the archeologists of the Corps of Engineers, New Orleans District, between 2 April and 23 April 1982. The segment from City Price to Tropical Bend (Reach B) was surveyed by the Corps of Engineers archeologists. The segment from Tropical Bend to Venice (Reach A) had been surveyed previously by contract through Tulane University in July and August of 1978 (DACW29-78-M-1873).

The prehistoric, historic, and geological background is well treated in the report on Reach A and is referenced here as the basic background necessary for this area. Archeological investigations previously conducted in this area are also adequately assessed in this report and can be consulted for information purposes (Davis, Dave D., Cultural Resources Survey, New Orleans to Venice Hurricane Protection Levee, Reach A, September 1978, Tulane University submitted to USACOE New Orleans District). The environmental background is in the above-referenced report and will not be reported here.

The field survey for Reach B was conducted intermittently during April of 1982. The survey consisted to two parts: (a) a vehicle and pedestrian coverage of the existing hurricane protection levee along Reach B, and (b) a survey by boat of all accessible waterways and lakes within and near the project areas.

The area to be surveyed consists almost entirely of marshland with very little high ground. The existing back levee provides the only view available anywhere within the project area. Observations from this location revealed an almost total lack of large oak clusters which are characteristic of archeological sites exposed above marsh level. In fact, no large trees were observed throughout the west bank of the project area. The only outstanding vegetation which was exposed above the marsh consisted of shrub associated with disposal banks of dredged canals. In the boat survey, marshes in and around the project area were explored by navigating all passable watercourses. Bank lines of all these areas were closely examined for shell and other indications of human inhabitations. No archeological remains, or evidence of possible remains, were detected throughout the project properties.

A portion of an old distributary of the Plaquemine-Modern delta complex was observed lying south-southeast just below Buras, although its precise age is unknown. The remains of long dead cypress and various bottomland hardwoods betray the channels boundaries.

Since this channel is bounded by the only subaerial levees in the project area, careful inspection of this area revealed no archeological remains or signs. The natural levees of this channel have undergone considerable subsidence. In many places the levees have subsided below marsh levee. As much as possible of this remnant levee was carefully examined; although, most of it was then marsh level and very difficult to see.

Current geological data indicate that occupation of the area could not have been after 900 A.D. As a result, any aboriginal sites should be of Coles Creek, Plaquemine, or Mississippi Age. As was noted earlier, the main settlement of these periods seem to have been preferentially located near the crests of natural levees of bayous and rivers, or on exposed beach lines bordering lakes and bayous. From this prespective, with seasonal inundation and few dry land surfaces, the project area was probably not a prime one for prehistoric population concentration. However, it is by no means clear that this preference for high levee lands was universal, especially with regard to seasonal camps or temporary food collecting stations (Davis, ob sit.).

The problem is compounded by the high subsidence rate in this project area, which may have resulted in drowning of once-exposed bayou levees. Under prevailing conditions, smaller sites of even late prehistoric data could have been drowned and buried, and thus undetectable through surface survey.

During these survey efforts, no archeological sites or cultural resources were located within the proposed project area. It is therefore recommended that no further archeological investigation of the project area be undertaken prior to project construction.