FINAL

ENVIRONMENTAL STATEMENT

FINAL COMPOSITE ENVIRONMENTAL STATEMENT FOR OPERATION AND MAINTENANCE WORK ON THREE NAVIGATION PROJECTS IN THE LAKE BORGNE VICINITY LOUISIANA

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

MARCH 1976

SUMMARY

FINAL COMPOSITE ENVIRONMENTAL STATEMENT FOR OPERATION AND MAINTENANCE WORK ON THREE NAVIGATION PROJECTS IN THE LAKE BORGNE VICINITY, LOUISIANA

( ) Draft (For Review) (X) Final Environmental Statement

Responsible Office: Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160
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1. **Name of Action:** (X) Administrative ( ) Legislative

2. **Description of Action:** The project is Operation and Maintenance of the following navigation projects in the vicinity of Lake Borgne, Louisiana: The Mississippi River-Gulf Outlet, (75.6 miles); Bayou Dupre, (7.3 miles); and Bayous La Loutre, (21.7 miles), St. Malo, (6.3 miles), and Yscloskey, (0.4 miles). Operation and Maintenance of these five navigation channels consists primarily of periodic dredging and subsequent material deposition along the total of 111.3 miles. Maintenance dredging on the Mississippi River-Gulf Outlet is accomplished by a cutter-head pipeline dredge. Material is deposited in both contained, diked disposal areas, and in open water in Breton Sound. Annual volume of material dredged on the MR-GO is about 12 million cubic yards. Maintenance dredging on the associated bayous is accomplished by hydraulic or bucket dredge operation. Material is deposited on land-confined disposal areas.

3. **Summary.**

a. **Environmental Impacts:** O&M work facilitates use of the Tidewater Port Facilities of the Port of New Orleans. The Mississippi River-Gulf Outlet is presently the only 36-foot draft link between the Tidewater Port Area and the Gulf of Mexico. Economic benefits derived from the port facilities are dependent upon O&M work. Dredged material disposal areas have been increased in elevation by O&M work. This affects biota in the disposal areas, changes the vegetational communities on the disposal areas, and provides land which may be suitable for use to help satisfy future regional development needs. The level of pollution of the material deposited in open water has not been established nor have the effects of such pollutants on biota been documented for the vicinity. O&M work is done on the basis of previous resource allocations. As such, O&M work utilizes land and bottom-of-the-sound areas designated for that purpose. O&M work represents but one aspect of all of human activity in the marshland environment of the delta southeast of the city of New Orleans.

b. Adverse Environmental Effects: O&M actions periodically change the biotic composition of the designated deposition areas. These areas thus remain in pioneer stages of development. Effects of increased levels of turbidity near dredge operation are believed to be local and temporary. Effects of resolubilization of pollutants when dredged material is resuspended are yet to be determined.

4. Alternatives to the Proposed Action: The following channel dimension alternatives are analyzed: maintenance at the 36-foot depth (present practice); maintenance at the 30-foot depth; and abandon maintenance (no-action). Material deposition alternatives include: deposition in large contained land deposition areas (present practice); exclusive use of these land deposition areas: deposition in open water (present practice); deep water deposition; and deposition of material in contained areas in Breton Sound. Variables and adjustments of O&M practices to changing environmental conditions are discussed.

5. Comments Requested:

a. Federal:

J. Bennett Johnston, US Senator
Russell B. Long, US Senator
F. Edward Hebert, US Congressman
Lindy Boggs, US Congresswoman
US Department of the Interior, Assistant Secretary - Program Policy
Environmental Protection Agency, Regional Administrator, Region VI
Environmental Protection Agency, Administrator, Washington, D. C.
US Department of Commerce, Deputy Assistant Secretary for Environmental Affairs
US Department of Commerce, Director, National Oceanic and Atmospheric Administration, National Ocean Survey
US Department of Commerce, Regional Director, National Marine Fisheries Service, Water Resources Division

US Department of Commerce, Regional Supervisor, Central Region National Oceanic and Atmospheric Administration
US Department of Commerce, National Weather Service, National Oceanic and Atmospheric Administration
US Department of Agriculture, State Conservationist, Soil Conservation Service
US Department of Transportation, Division Engineer Federal Highway Administration
US Department of Transportation, Coast Guard
US Department of Health, Education, and Welfare, Regional Director, Public Health Service, Region VI
US Public Health Service, Fort Collins, Colorado
US Department of Housing and Urban Development, Regional Administrator, Region VI
US Department of Housing and Urban Development Area Office, Director, New Orleans, Louisiana
Advisory Council on Historic Preservation
US Federal Energy Administration, Director, Environmental Impact Division

b. State:

Governor's Council on Environmental Quality
Citizen's Advisory Board to the Governor's Council on Environmental Quality
The Bureau of Environmental Health
Louisiana Department of Public Works
Louisiana Department of Highways
Louisiana Wildlife and Fisheries Commission
Louisiana State Parks and Recreation Commission
Louisiana Stream Control Commission
Louisiana Air Control Commission
Louisiana Coastal Commission
Louisiana Public Service Commission
Louisiana Forestry Commission
Louisiana Commission on Intergovernmental Relations
Louisiana Department of Conservation
Louisiana Department of Commerce and Industry
Louisiana State Department of Art, Historical, and Cultural Preservation, State Liaison Officer
Louisiana Assistant Attorney General, State of Louisiana
Louisiana Joint Legislative Committee on Environmental Quality
Register, State Land Office
Louisiana State Planning Office
Louisiana State Soil and Water Conservation Committee
Louisiana State University, Director, Louisiana Sea Grant Program, Center for Wetland Resources

Louisiana State University, Coastal Studies Institute
Louisiana State University, Curator of Anthropology,
  Department of Geography and Anthropology
University of New Orleans, Coordinator, Environmental
  Impact Section, Development of Environmental Affairs
University of New Orleans, Department of Anthropology
  and Geography

c. Local:

Office of Intergovernmental Relations, Office of the
  Governor
President, Plaquemines Parish Commission Council
St. Bernard Parish Policy Jury
Regional Planning Commission for Jefferson, Orleans,
  St. Bernard, and St. Tammany Parishes

d. Environmental:

Ecology Center of Louisiana, Inc.
Orleans Audubon Society
National Audubon Society, Library
National Audubon Society, Southwest Region
National Sierra Club, San Francisco
National Sierra Club, New Orleans
New Orleans Group Sierra Club
National Wildlife Federation, Washington, D. C.
Louisiana Wildlife Federation, Baton Rouge
Louisiana Wildlife Federation, Alexandria
Louisiana Wildlife Federation, Shreveport
Wildlife Management Institute, Washington, D. C.
Wildlife Management Institute, South-Central Field
  Representative
The Conservation Foundation
Environmental Defense Fund
National Resources Defense Council
Environmental Information Center, Inc.
League of Women Voters of US
Bass Anglers Sportsman Society of America
Slidell Sportsmen's League
The Coalition of American Rivers

e. Others:

Gulf States Marine Fisheries Commission
Louisiana Shipbuilders and Repair Association
American Institute of Merchant Shipping

6. Draft Statement to CEQ 30 April 1975.
Final Statement to CEQ 21 May 1976

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*These appendices were circulated in the draft environmental impact statement. Because no substantive comments pertinent to these appendices which would require major changes were received, the appendices were not reproduced in the final statement. Copies of these appendices are on file in the U. S. Army Engineer District, New Orleans, Louisiana.

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FINAL COMPOSITE ENVIRONMENTAL STATEMENT FOR OPERATION AND MAINTENANCE WORK ON THREE NAVIGATION PROJECTS IN THE LAKE BORGNE VICINITY, LOUISIANA

SECTION 1--PROJECT DESCRIPTION

1.01 GENERAL

The project described in this report is the operation and maintenance (O&M) of the Mississippi River-Gulf Outlet (MR-GO) and associated bayous in the Lake Borgne, Louisiana, vicinity. O&M activities are conducted under the supervision of the New Orleans District Corps of Engineers for the channels listed in Table 1-1. O&M work includes dredging to maintain the established navigation channels, deposition of dredged material, and surveillance and repair of dredged material containment dikes. This report covers O&M activities and does not include analysis of effects of construction of the jetty across Breton Sound. Implementation of O&M requires surveillance to determine dredging requirements, contract planning, and supervision of contracts to private dredge operators. Local interests are responsible for O&M of Highway 47 (Paris Road) bridge and for any maintenance required as a result of utility or other highway relocations or alterations. Management of disposal areas is the responsibility of the Corps of Engineers until such time as they are released to other agencies or private citizens. See Section 6 for a more complete description of the variables and procedures used in O&M work.

1.02 LOCATION OF THE PROJECT AREA

Plate 1 shows the project navigation channels southeast of New Orleans in relation to land areas and other water bodies. Figure 1-1 shows the project area relative to the state of Louisiana.

1.03 PURPOSE, STATUS, AND USE OF THE CHANNELS

a. The MR-GO. The MR-GO consists of a ship channel 36 feet deep by 500 feet (bottom width) and provides access for ocean-going vessels from the Gulf of Mexico to the New Orleans Tidewater Port Area and shipping-related industries in the vicinity of the Inner Harbor Navigation Canal (IHNC) and the Gulf Intracoastal Waterways (GIWW). The remainder of Port of New Orleans

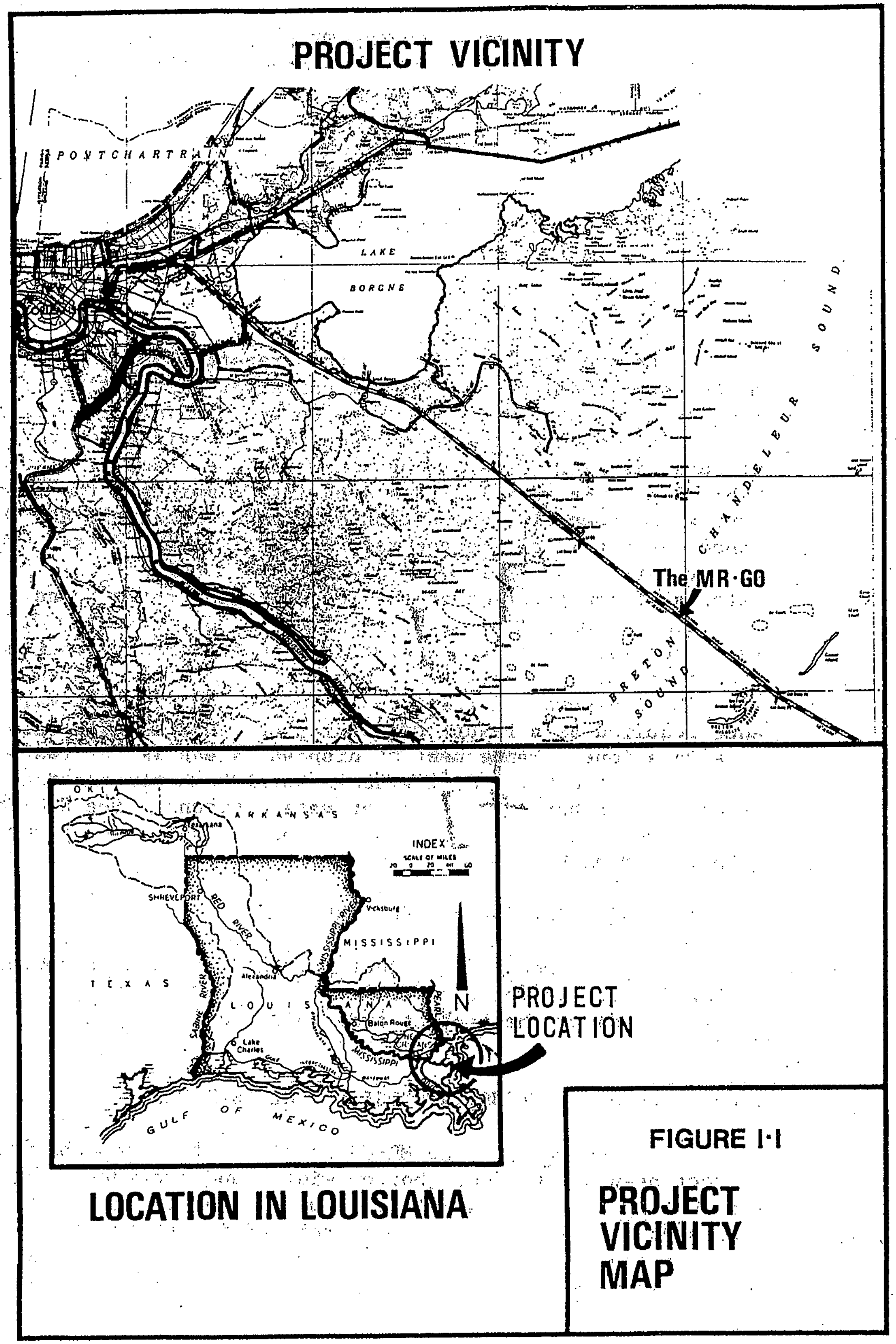


FIGURE I·I

PROJECT VICINITY MAP

TABLE 1-1
CHANNELS MAINTAINED IN THE LAKE BORGNE VICINITY

Channels	Length (miles)	Depth (feet)	Bottom Width (feet)
Mississippi River-Gulf Outlet	75.6		
Mile -9.38 to Mile 0	(9.4)	38	600
Mile 0 to Mile 66.2	(66.2)	36	500
Turning Basin	—		
Bayou Dupre	7.3		
From Violet Bridge to Lake Borgne	(6.2)	6	80
To 6' Contour in Lake Borgne	(1.1)	6	100
Turning Basin at Violet	—	6	100 x 200
Bayou La Loutre	21.7		
From Lake Eloi to Jct./St. Malo	(15.0)	6	40
From Jct./St. Malo to Hopedale	(6.7)	5	30
Bayou St. Malo	6.3	6	40
Bayou Yscloskey	0.4	5	40
Total Miles	111.3		

Source: Department of the Army, 1971 and 1973.

facilities are served by the Mississippi River. The MR-GO provides an additional navigation route to the Port. A lock providing greater depth and capacity for access from the Tidewater Port Area to the Mississippi River has been authorized, but construction has not yet begun. Extension of the jetty across Breton Sound has been authorized. Table 1-2 shows the work completed on the MR-GO and dates of completion.

b. The Bayous. Bayous La Loutre, St. Malo, Yscloskey, and Dupre are maintained for passage of small craft. The bayous provide access to the marshes, Lake Borgne, and Breton Sound, and to the petroleum industry installations. The bayous are used by recreational craft, commercial fishermen and trappers, and oil industry craft. Construction of these projects was authorized under the River and Harbor Act of 26 August 1937. Work was completed on Bayous La Loutre, St. Malo, and Yscloskey in 1956. Work on Bayou Dupre was completed in 1939. The privately-owned lock to the Mississippi River at Violet was closed in 1950.

1.04 DATA OF AUTHORIZATION

a. Authorization for the MR-GO. The River and Harbor Acts of 1945 and 1962 provide for maintenance of sufficient navigation depths for the Mississippi River, Baton Rouge to Gulf of Mexico. In 1956, this project authorization was amended to include the MR-GO project (Public Law 445). "The River and Harbor Act of 29 March 1956, House Document 245, 82nd Congress, 1st Session, provides for the construction of a seaway canal 36 feet deep and 500 feed wide from Michoud to Chandeleur Islands and increasing gradually to a width of 600 feet and depth of 38 feet to the 38-foot contour in the Gulf of Mexico with protective jetties at entrance, a permanent retention dike through Chandeleur Sound and a wing dike along islands as required. It also provides for an inner tidewater harbor consisting of a 1,000- by 2,000-foot turning basin 36 feet deep and a connecting channel 36 feet deep and 500 feet wide to the Inner Harbor Navigation Canal including construction of a suitable highway bridge with approaches to carry Louisiana State Highway No. 47 over the channel. The plan further provides for future construction, when economically justified, of a channel and lock in the vicinity of Meraux to furnish an additional connection between tidewater harbor and the Mississippi River." (Source: see Table I-2). (Note: The protective jetties at the entrance and the wing dike along the islands were not included for construction in the design memorandum.)

b. Authorization for Bayous La Loutre, St. Malo, and Yscloskey. "The River and Harbor Act of 26 August 1937, modified 2 March 1945, provides for a channel 5- by 40-feet from deep water in Lake Borgne to the shore line at the mouth of Bayou Yscloskey; a channel 6- by 40-feet from deep water in Lake

TABLE 1-2
MR-GO WORK COMPLETED TO 30 JUNE 1973

Work Items	Date Completed
Access Channel (18 by 140 feet), GIWW to Breton Sound	27 Mar 61
Interim Channel (36 by 250 feet), Paris Road to Gulf of Mexico	5 Jul 63
Project Channel (36 by 500 feet)	
Inner Harbor Navigation Canal to Vicinity of Paris Road	7 May 59
Vicinity of Paris Road to Mile -9.4	14 Mar 65
Turning Basin (Vic. Mile 66.0) and appurtenant work is physically complete	22 Jul 65
Plug at Paris Road removed (open for full operation)	<u>20 Jan 68</u>
High level bridge (Louisiana State Highway 47), intitated 1 June 1964, completed	14 Nov 67
Removal of pontoon bridge at Paris Road initiated 24 July 1967, completed	22 Sep 67
Retention Dikes:	
Shell Core and Riprap (both dikes)) to Mile 20.2	26 Aug 61
Capping (both dikes))	29 Oct 62
Rockfacing (both dikes))	3 Nov 63
Extention of Southwest Dike to Mile 14.8 (Sta. 2700). 1st phase, completed	
Extention of Southwest Dike to Mile 15.8 (Sta. 2650). 2nd phase, completed	
Remaining dike across Breton Sound not yet started	
4 Prefabricated steel survey towers and 25 timber pile station markers	23 Jun 61
3 Concrete survey towers and 25 timber pile station markers	24 July 61

Channel maintained at 36-foot depth.

NOTE:

<u>Mississippi River-Gulf Outlet</u>

Work authorized under the Act of 1956.
Work initiated 17 March 1958.

A general design memorandum is 25 percent complete. The work includes a new lock, connecting channels, return levees, a navigable floodgate, highway and railway bridges, and pipeline and utility relocations.

Source: Department of the Army, Condition of Improvement Report, 1973.

Borgne through Bayous St. Malo, La Loutre, and Eloi to deep water in Lake Eloi; a channel 5- by 30-feet in Bayou La Loutre between Hopedale and Bayou St. Malo. Langth of improvements 50 miles." (Source: see Table I-2).

c. Authorization for Bayou Dupre. "The River and Harbor Act of 26 August 1937 provides for a channel 6- by 80-feet from highway bridge at Violet to Lake Borgne, thence 6- by 100-feet to the 6-foot contour in the lake and turning basin 100- by 200-feet at Violet. Length of improvement, 7.3 miles." (Source: see Table I-2).

1.05 OPERATION AND MAINTENANCE

a. General

(1) The process. Whenever the velocity of water slows down in a navigation channel, its sediment carrying capacity decreases. Sediment drops out and settles on the channel bottom. As waves generated by winds or vessel passage reach the shoreline, the shoreline material erodes and sloughs off to the channel bottom or is suspended and dropped further downstream. Turbulent waters created by hurricanes, local thunderstorms, or strong winds remove sediment from the channel and redistribute it.

(2) Channel bank erosion. In the MR-GO, another factor has contributed to the amount of sediment to be removed from the channel in maintenance operations. The channel was originally dredged with one vertical to two horizontal feet side slopes. Slopes tend to erode near the top and fill near the bottom as they come to the equilibrium angle of repose. Since construction, the distance between the banks visible above the waterline has increased. Channel bank erosion has been a significant source of sediment in the channel through the land area.

(3) Other sediment sources. The proportion of sediment coming in from adjacent waters is not yet clearly defined. Prior to construction, Lake Borgne had no major western inlet-outlet of the magnitude now provided by the MR-GO. Channels between the MR-GO and Lake Borgne are eroding westward at a rate of about 4.5 feet per year (Department of the Army, 1973 E). Some of these sediments from Lake Borgne may be entering the MR-GO. There is no major flow into the MR-GO of silt laden Mississippi River water. Another sediment source is the marsh material released by marsh deterioration. This material may be transported to the MR-GO by tidal action, storms, and hurricanes.

b. Shoaling and dredging

(1) General. Accumulation of sediment in the channel is called shoaling. The channel must be periodically cleared of accumulated sediment to maintain established channel depths. The total volume of material dredged out of the MR-GO in maintenance operations from 1961 to May of 1974 is 166.4 million cubic yards (mcy). Several characteristics of dredged material reduce this volume as it is deposited. The dredged material is from 30 percent to 70 percent water in place before dredging, plus water sucked into the dredge pipeline. Upon deposition, the water drains away, and the material settles as the particles adjust to more compact positions. Dredge water is returned to the MR-GO through controlled spill gates. When levees were constructed with material dredged from the MR-GO channel, the yardage for inplace levee material was one-third the amount removed from the channel.

(2) Location of shoaling.

(a) MR-GO. Plate 2 shows the mile designations for the MR-GO. More than half of the O&M work volume of material dredged has been dredged from Breton Sound. Of the total volume of material dredged (166.4 million cubic yards) in O&M work and in maintenance dredging during the construction period, 18.6 percent came from the Gulf section (Mile 0 to -9); 58.7 percent came from the Breton Sound section (Mile 23-0); and 22.7 percent came from the Land Cut section (Mile 65-23). Maintenance during the construction period (that is, O&M work prior to 1965) comprised about 19.5 percent of the 166.4 mcy total. Table I-3 shows the shoaling rates and frequency of dredging calculated from dredging contract records from 1965 to 1974. Dredging after Hurricane Betsy in September of 1965 and Hurricane Camille in August 1969 required major efforts. Volume of dredging in the land area has declined in recent years. Two factors may account for this. Channel side

TABLE I-3
PREDICTION OF SHOALING RATES AND FREQUENCY
OF DREDGING, MR-GO

Location	Shoaling Feet/Month	Dredging Frequency
Mile 66.0 to Mile 41.4	0.02	6 yrs.
Mile 41.4 to Mile 24.3	0.03	4 yrs.
Mile 24.3 to Mile 14.9	0.11	2 yrs.
Mile 14.9 to Mile 6.0	0.58	1 yr.
Mile 6.0 to Mile 0.0	0.14	2 yrs.
Mile 0.0 to Mile -9.4	0.28	1 yr.

Source: Corps of Engineers, based on data, 1965 to present.

slopes may be coming closer to the equilibrium angle of repose. In addition, the channel bottom west of Lake Borgne was used as a source of construction material for hurricane protection levees. The resulting 50- to 60-foot depths in some borrow areas will not fill to the 36-foot channel depth from some time. The largest volume of material originates from shoaling in open waters. Local storm action can sometimes shoal the channel in two or three days. This type of shoaling occurs most often in spring and midsummer with prevailing southeast winds. The shoaling problem in the sound is also being studied in conjunction with planning investigations for extension of the retention dikes all the way across the sound to the Chandeleur Island Arc.

(b) Bayous. Shoaling conditions in the bayous appear to have substantially stabilized since the last marsh destructive hurricane (Camille, 1969). Conservative evaluations indicate that it is a minimal possibility that hurricanes of consequence will sweep the bayou areas in the next 30 years. In the absence of repetitive storm conditions that result in erosive runoff, tidal intrusions, and sheet flows through contiguous marshes, the existing disposal areas along these bayous can be expected to remain substantially intact and available for continuing relatively harmless disposal of dredged materials. The existence of oyster leases within Bayou Yscloskey and in water courses contiguous with Bayous La Loutre and St. Malo constrains the performance of maintenance dredging. The apparent stability of shoaling and presence of constratings explains the low frequency of maintenance dredging detailed below. Minimal urgent thrust exists for acceleration of the frequency. The bayous are not used extensively, as most crew boats use the MR-GO. Bayou Dupre is regularly used from Violet to the MR-GO to Lake Borgne. The other bayous are used regularly in the Hopedale area. The bayous are bucket dredged, and material is placed in land disposal areas as detailed below.

c. Volume of dredge material

(1) Average volume removed. On a five-year average, 4,125,000 cubic yards of material are dredged from the inland section per year, and 3,590,000 cubic yards per year are dredged from the offshore section of the MR-GO. This average does not include work associated with hurricanes. Based on records since 1965, an average of 16.7 mcy per year have been moved (average per year volume is 15.7 mcy if material moved for levee construction is not included). Based on typical volumes moved per operation at expected frequencies of dredging for the sections (Gulf, Breton Sound, and Land Cut), the typical average annual volume of material moved is 12 mcy.

(2) Future volume. The estimates in the previous paragraph indicate volume of dredged material which may have to be moved in the future. Several factors preclude definitive projections of volume of material to be dredged in future O&M work. Projections of historical data concerning the land areas could be misleading due to: 1) use of the channel for material for hurricane protection levees; 2) the possibility that the channel side slopes are coming to an equilibrium angle of repose; and 3) the possibility of riprap foreshore protection on proposed hurricane protection levees from Mile 66 to about Mile 47 which would reduce shoreline erosion on the west bank of the MR-GO. These three factors would reduce the amount of future O&M in the land area. In the open water area, shoaling rates are governed primarily by prevailing winds and storms rather than by defined or predictable tides and currents. Studies for construction of a retention dike from the land's end to the Breton Island area are underway. Dike construction would alter the location and rates of shoaling.

d. Methods of dredge operation

(1) General. Dredging operations involve pumping the bottom sediments up to a dredge and simultaneously piping the material to the deposition area. The cutterhead pipeline dredge, similar to dredges shown on Figure 1-2, is used primarily for maintenance operations in the Lake Borgne vicinity. The cutterhead pipeline dredge pumps the liquid material to a shoreline area. Clay type material may contain 10 parts water for one part solids. Sand type material may contain 5 parts of water for one part solids. When necessary, a hopper dredge is used for maintenance of the channel in the Gulf of Mexico (Mile 0 to Mile -9.38). The hopper dredge loads the dredged material, moves to deep water, and dumps the material through trap doors to the bottom. Plate 2 shows the major features of the MR-GO vicinity, the diked retention areas, and mile posts for future reference in this report.

(2) Mile 66 to Mile 23. A diked disposal area, 2,000 feet wide, is adjacent to the southwest side of the channel through the land area of the MR-GO (Mile 66-Mile 23). Deposited material spreads over the existing vegetation with each dredging operation. As the material flows outward from the pipeline and dries, a flat, cone-like mound is created.

(3) Mile 23 to Mile 0. Beyond the land's end in Breton Sound (Mile 23), material is piped to an area 3,000 feet southwest of the MR-GO channel centerline and the material settles to the bottom of the sound. Heavier particles settle out in the immediate area, but fine clay particles remain in suspension for considerable distances.

(4) Mile 0 to Mile -9.38. In the Gulf of Mexico, beyond Breton and Grand Gosier Islands, a hopper dredge has been used in the past. Dredged material is carried and dumped on the right descending side, 2,000 feet from the MR-GO centerline or is dumped into the deeper Gulf waters.

(5) Total land deposition areas. During original construction, material was pumped to contained areas north and south of the east-west segment of the MR-GO/Gulf Intracoastal Waterway (Mile 66 to Mile 60). This area will be used for expansion of Tidewater Port Facilities and related industrial expansion. Material from the MR-GO channel south of Mile 66 and west of Lake Borgne has been used for construction of hurricane protection levees. The total land area for dredged material deposition for original construction was a 4,000-foot wide strip of land (16,183 acres) on the southwest bank of the MR-GO to Mile 23. After completion of construction, servitudes on the outer 2,000 feet reverted to the grantors. Disposal servitudes in the inner 2,000 feet were retained for maintenance of the channel. However, until 1971, the entire 4,000-foot width was available for maintenance dredging by virtue of temporary servitudes obtained from time to time. Since 1971, only the inner 2,000-foot strip (10,611 acres) has been available and it appears that only this area will be available in the future. Based on its present condition and anticipated future dredging quantities, it is estimated that this 2,000-foot strip will be adequate for the next 25 to 30 years, depending on how much of the area is withdrawn for industrial development. Recent experience has borne out that the maintenance dredging quantities can be expected to progressively reduce from year to year as long as abnormal weather conditions such as hurricanes do not alter this normal progression. With normal progression, the designated disposal areas can be expected to be adequate for disposal of maintenance dredged materials for the life of the project (50 years).

(6) Dredging on the Bayous

(a) Bayou La Loutre. Bayou La Loutre was constructed in May, 1956. Dredged material disposal areas are strips 500-1,000 feet wide on both sides of the Bayou. At the time of construction, two areas (Mile 2.2 to Mile 6.4 and Mile 9.5 to Mile 21.3) were dredged, requiring 3,828 acres of the disposal areas. A portion of the Bayou from Hopedale to the MR-GO (Mile 21.7 to Mile 18.3) was dredged in 1964; the material (38,000 cubic yards) was placed in 410 acres. This Hopedale area is the busiest section of the bayous. The redredging was a sweeping out during construction of the MR-GO. It is anticipated that the extremely low frequency of dredging will continue. It is considered that since 1970, dredging has been deficient because of oyster leases in the channel bed.

(b) Bayou St. Malo. Bayou St. Malo was constructed in May, 1956. Dredged material disposal areas are strips 500-1,000 feet wide on both sides of the Bayou. At the time of construction, two areas (Mile 3.4 to Mile 4.8 and 5,000 feet into the open water of Lake Borgne) were dredged, requiring 271 acres of the disposal areas. The Bayou has not been redredged.

(c) Bayou Yscloskey. Bayou Yscloskey is reported to have been maintenance dredged in the 1930's by local interests, but is not currently dredged. The Corps of Engineers once considered maintenance of the approach channel in Lake Borgne as part of a local-Federal maintenance program. Establishment of oyster beds has virtually confined any probabilities of maintenance dredging.

(d) Bayou Dupre. Bayou Dupre was constructed in 1939. Dredged material is deposited in a 500-foot wide strip on the west side of the Bayou and a 1,000-foot wide strip on the east side of the bayou. Two areas were dredged in 1967 (Mile 6.0 to Mile 6.5 and Mile 2.3 to Mile 5.3). The 153,200 cubic yards of dredged material required 297 acres of the disposal area. Ideally, lacking constraints, if funding were available, the land cut would be dredged every eight years and the bar channel would be dredged every four years.

(7) Timing of operation. Hopper dredging (Mile 0 to Mile -9.38) is done in January or June of each year, depending upon hopper dredge availability. Dredging in the outer Gulf section is done during spring and summer months, weather permitting, if a cutterhead pipeline dredge is used. The inland section is dredged at anytime throughout the year, depending upon shoaling conditions. The channel between Mile 0 and the inner end of the jetties is usually dredged in April and September when winds are calm.

(8) Illustrations. Figure I-3 shows typical channel cross-sections of the MR-GO. Figures I-4 through I-8 show aerial overviews of the MR-GO south of the junction with Bayou La Loutre. Note the containment dikes and the drainage channel provided on the west bank of the disposal area on Figure I-5.

1.06 INTERRELATIONSHIP AND COMPATIBILITY OF PROJECT WITH EXISTING OR PROPOSED CORPS OR OTHER AGENCY PROJECTS

a. Relationship to area development

(1) Local economic functions. The MR-GO and associated bayous are an integral part of the local and regional navigation system. The system serves three local economic

functions: 1) movement of locally derived commodities (petroleum, fish, shellfish, and fur pelts) to collection/distribution points, 2) movement of commodities to points of consumption (delivery of equipment, fuel, and other durable and nondurable goods to industrial installations and commercial establishments and residences), and 3) provision of access for local recreation craft operation.

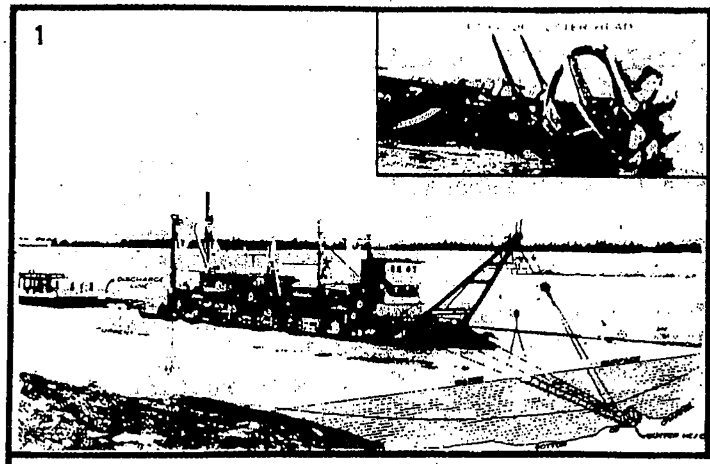
(2) Regional and national economic functions. The system serves three regional functions: 1) provision of access to the Tidewater Port Facilities for large vessels carrying both foreign and domestic goods to public facilities operated under lease from the Board of Commissioners of the Port of New Orleans (Dock Board), 2) provision of shipping access for industries located on the Gulf Intracoastal Waterway (GIWW) and for delivery of coal to the electric power generating station, and 3) provision for east-west GIWW traffic. Transfer and distribution of the goods coming into the Dock Board facilities and into the local industries have subsequent impact on the statewide and nationwide economic base. Details of the nature and extent of impact on the economy are discussed in Section 2.09.

(3) System reliability. The MR-GO serves as an alternative route to the New Orleans port, and provides navigation system reliability in case of emergency closure of navigation on the Mississippi River. Replacement of the obsolete lock on the Inner Harbor Navigation Canal (IHNC) will facilitate this function.

(4) The future. The MR-GO provides navigation access for future development and expansion of the Tidewater Port Area. To accommodate new shipping technology, new facilities have been constructed in the Tidewater Port Area for handling transfer of bulk commodities and of containerized cargo and sea-going barge/mother ship handling. The MR-GO serves the Tidewater Port Area which has more land area for cargo storage and transfer and has better access to both railway and interstate systems than river-associated facilities. This has produced greater efficiency in cargo handling. Until lock facilities are provided for a deep draft lock to the Mississippi River, the Tidewater Port Area is dependent upon maintenance of the entire length of the MR-GO. Details of these economic/navigation aspects of MR-GO operation are discussed further in Section 2.09.

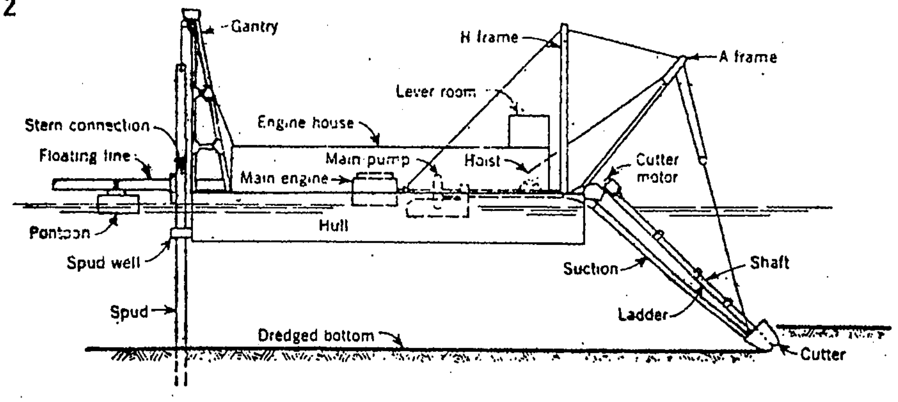
b. Compatibility. O&M work on the MR-GO and associated bayous is not in conflict with proposed land use development in the MR-GO area. Future adjustment of O&M practices may be required in conjunction with planned hurricane protection levees on the disposal areas. The issue of wise use of the delta-estuary area for natural, renewable resource/preservation functions or for economic/navigation/resource extraction functions will be a part of coastal zone planning and management deliberations and decisions. O&M work is compatible with federal, state, and local agency decisions made at the time of initial MR-GO construction.

1



① DEPARTMENT OF THE ARMY, 1968

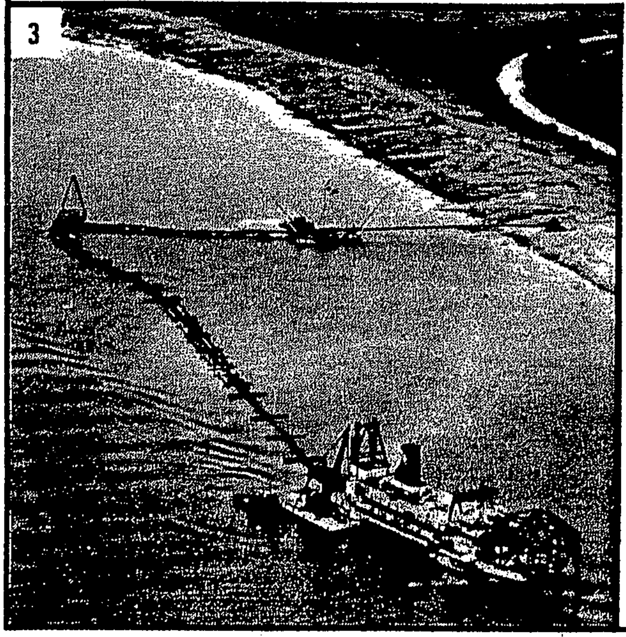
2



Dredge components

② BRUUN, 1973

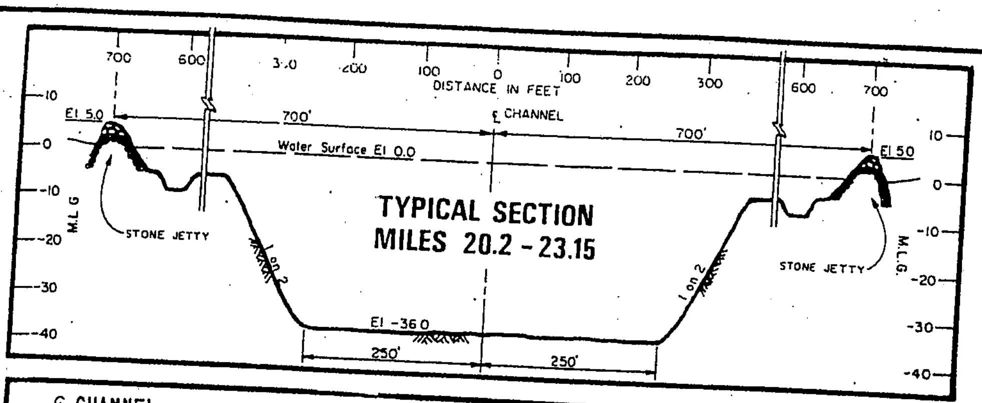
3

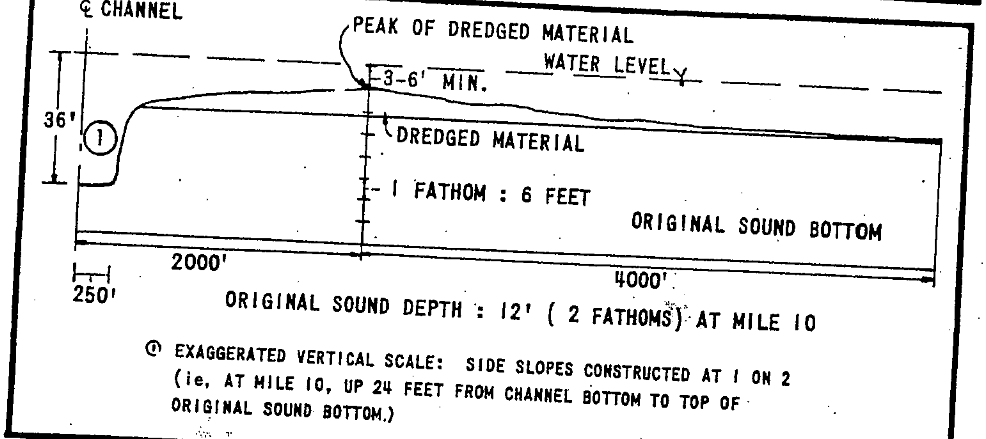


③ DEPARTMENT OF THE ARMY, 1971 & 1973

FIGURE I·2

THE CUTTERHEAD PIPELINE DREDGE

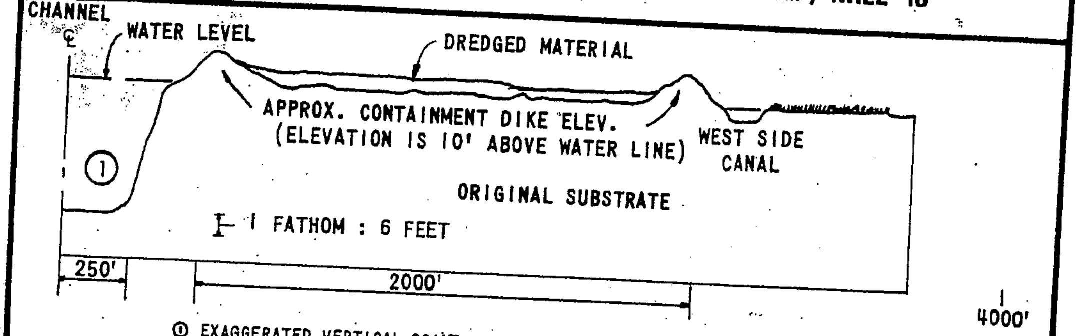




ORIGINAL SOUND DEPTH : 12' (2 FATHOMS) AT MILE 10

① EXAGGERATED VERTICAL SCALE: SIDE SLOPES CONSTRUCTED AT 1 ON 2 (ie, AT MILE 10, UP 24 FEET FROM CHANNEL BOTTOM TO TOP OF ORIGINAL SOUND BOTTOM.)

SCHEMATIC CROSS SECTION IN BRETON SOUND, MILE 10



① EXAGGERATED VERTICAL SCALE: SIDE SLOPES CONSTRUCTED AT 1 ON 2 (ie, UP 36 FEET IN 72 FEET FROM BOTTOM OF THE CHANNEL TO THE WATER LINE.)

SCHEMATIC CROSS SECTION ACROSS A LAND DISPOSAL AREA

NOTE: SEE FIGURE 2-8 FOR A LONGITUDINAL SECTION OF THE MR-GO.

SOURCE: CORPS OF ENGINEERS AND STANLEY CONSULTANTS.

FIGURE 1-3

CHANNEL CROSS SECTIONS

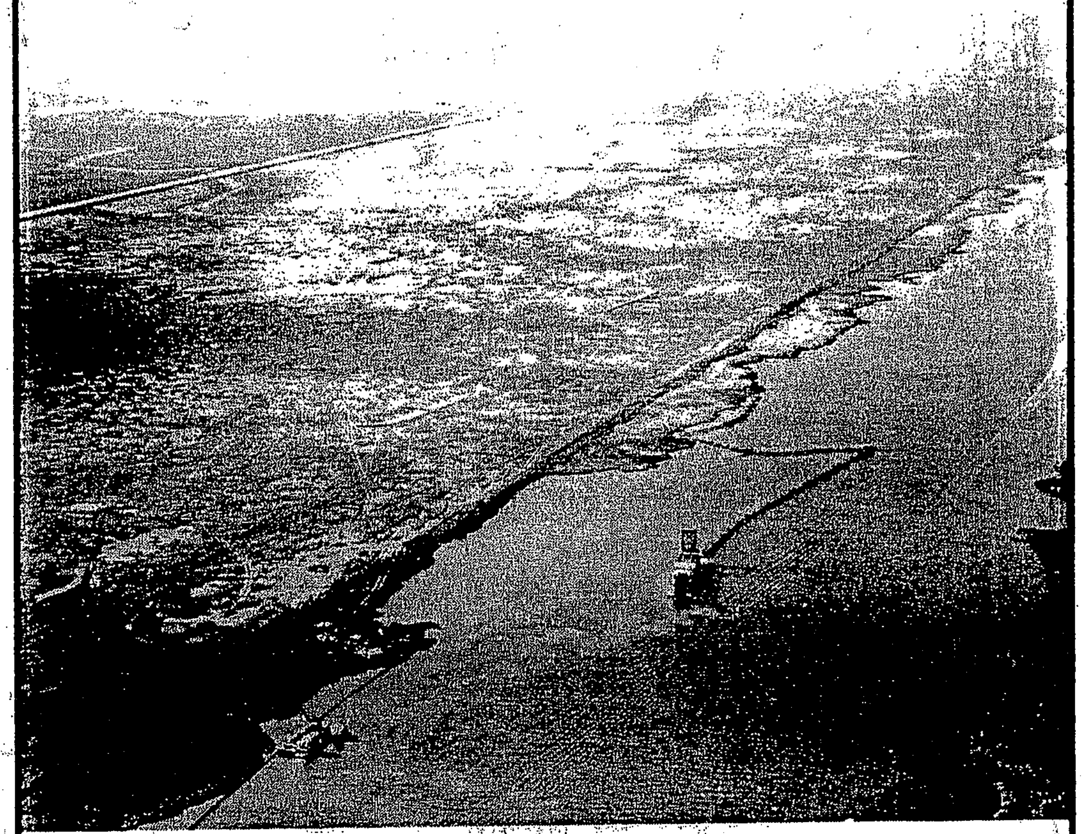


FIGURE 1·4
AERIAL VIEW OF LAND DISPOSAL AREA

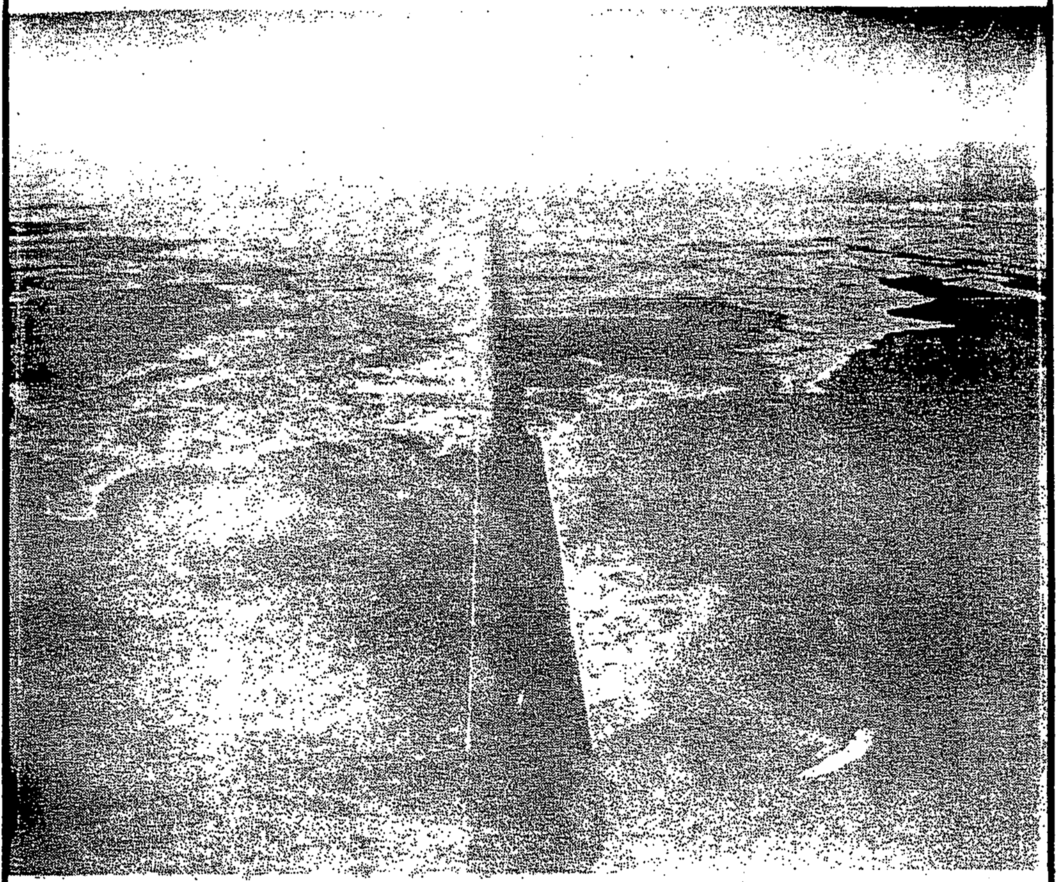


FIGURE 1-5

TYPICAL AERIAL VIEW OF THE MR-GO

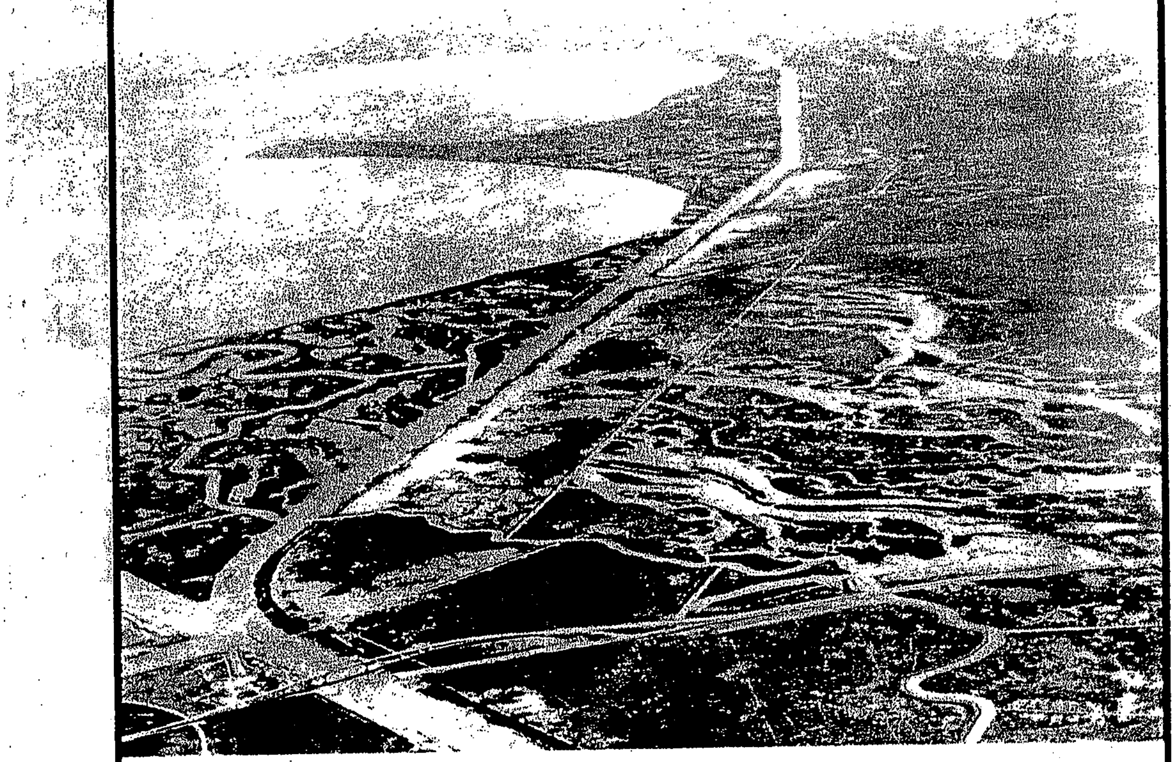


FIGURE 1-6

MR-GO: SOUTH OF PARIS ROAD BRIDGE

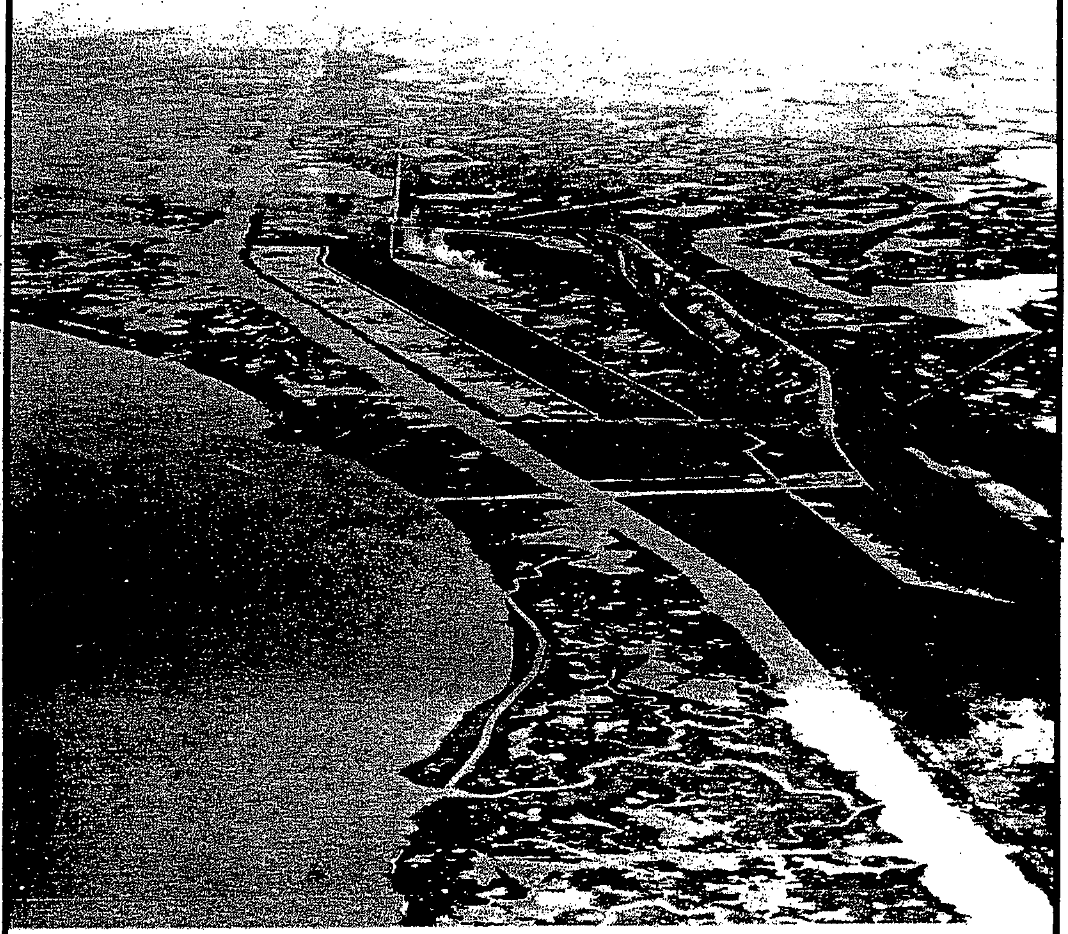


FIGURE 1·7

MR-GO: SOUTH OF LAKE BORGNE

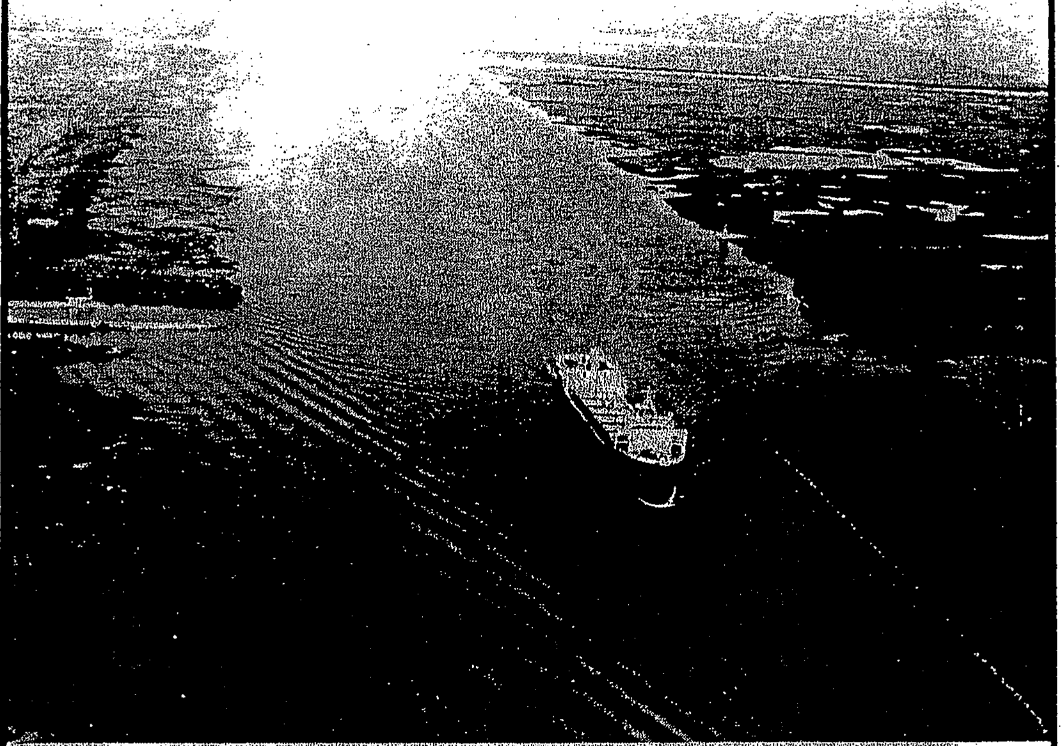


FIGURE 1·8

MR-GO NEAR LAND'S END

2.01 GENERAL

a. The project setting. The usual title for Section 2 is Existing Environmental Setting Without the Project, but in a study of project operation and maintenance (O&M) the project itself must be considered a part of Environmental Setting. Compilation of data for Section 2 facilitated identification of resources and processes that might be affected by O&M work on the Mississippi River-Gulf Outlet (MR-GO) and associated bayous. More importantly, Section 2 is a reference document that will be used in subsequent planning for O&M work. Section 2 is a compilation of data on the aspects of the environmental setting that are relevant to O&M work. Update of information presented in Section 2, as a reference document, is expected as part of O&M planning. The ecosystem is in the process of adjusting to new conditions and to trends begun with historical events. Construction of the MR-GO is a recent event. The abandonment of the St. Bernard Delta by the Mississippi River and subsequent cutoff of freshwater and sediment sources are less recent events, but also affect present environmental changes in the area. Most of the available data for description of the environmental setting have been used for describing the physical situation as it exists at one point in time. Point measurements or measurements during a short time period do not reflect the dynamics of the estuarine complex unless point or period measurements can be compared to historical data and related to the larger context of the region. Categories described in the section, (geology, hydrology, vegetation, land use, etc.), are analytical breakdowns of factors that operate in unison in the ecosystem. These aspects of the environmental setting are continually coming into new equilibria. The categories are, therefore, somewhat arbitrary. Section 2 thus emphasizes discussion of processes rather than of descriptions of the present physical forms since O&M work must be related to environmental and socio-economic factors which are constantly changing.

b. Relevance of environmental setting data to O&M work

(1) Geology. The dominant geological change of the estuarine complex is gradual subsidence of the delta due to cutoff of freshwater inflow and sediments to the old St. Bernard Delta complex. Erosion resulting from waves generated by winds and tides, and drainage flow also tend to increase the amount of open water compared to land area in the delta. Movement of eroded material and its redistribution within the channel and the sounds makes O&M work necessary. Recent alluvial sediments are not the source of material to be dredged as would be the case for an active delta area.

(2) Hydrology. Dynamics of water movement in the Lake Borgne vicinity are not well documented. Movement of water, suspended materials, and bedload material is incredibly complex in the vicinity. Furthermore, water movement caused by inflow of water and tidal action is overshadowed by influences of variable winds, of changes in salinity, temperature, density, and chemical parameters of water. Based on available data, no definitive description of hydrology can be prepared. Three main aspects of the environmental setting description are: 1) What potential sources of pollutants would account for the present water and sediment quality? 2) Which water-related factors cause the accumulation of sediments in the channel? and 3) What type and quality of material is to be dredged out of the channel and placed in disposal areas?

(3) Climatic elements. The air quality of the Lake Borgne vicinity is not directly related to O&M work. The climate is too wet for any significant dust problems associated with some dredging projects. The dominant climatic factors that affect O&M work are the direction and velocity of winds, local storms, and hurricanes.

(4) Botanical elements. O&M activities directly affect a strip of land about 2,000 feet wide adjacent to the MR-GO on the southwest side of the channel through the land portion of the MR-GO area. The vegetation on the material deposition areas is constantly in a state of revegetation subsequent to periodic deposition of material. A general description of the botanical communities is presented for reference. The value of botanical resources is identified for use in subsequent impact evaluation sections.

(5) Zoological elements. A general description of the zoological resources is presented for reference. Requirements relative to endangered or threatened species are noted. O&M dredging work primarily affects zoological species in the aquatic environment and on the deposition areas. The value of zoological resources is identified for use in subsequent impact evaluation sections.

(6) Recreation elements. Development of recreation facilities and refuge areas indicates the extent to which the area is presently recognized for its recreation values. Potential for future recreation use is summarized. The MR-GO crosses Breton National Wildlife Refuge.

(7) Archeological and historical elements. The nature of archeological and historic sites is noted.

(8) Socio-economic elements. The impetus for construction of the MR-GO came from navigation and port development needs.

Present levels of area economic development and resource utilization are described to provide a background for analysis of the economic effects of the MR-GO and associated bayous. Relative to O&M work for the MR-GO, most of the changes in the marshlands were associated with original construction. Other socio-economic uses of the estuary--for example, installation of canals for pipelines and oil exploration--continue in the area. O&M work is done on the basis of resource allocation decisions made at the time of construction. The relationship of O&M work to new resource allocation decisions must be evaluated as part of O&M planning, since O&M work will be affected by plans and policies of other agencies operating in the area.

2.02 GEOLOGICAL ELEMENTS

a. Introduction. The study area is located within the Central Gulf Coastal Plain in coastal southeastern Louisiana. North of Simmesport, the area is called the Mississippi River Alluvial Plain. From the vicinity of Simmesport (inland, northwest of New Orleans) to the Gulf of Mexico, the area is known as the Deltaic Plain. The MR-GO is situated on the St. Bernard Delta Complex, which was formed by river deposits between 700 and 4,700 years ago (see geologic map, Figure 2-1).

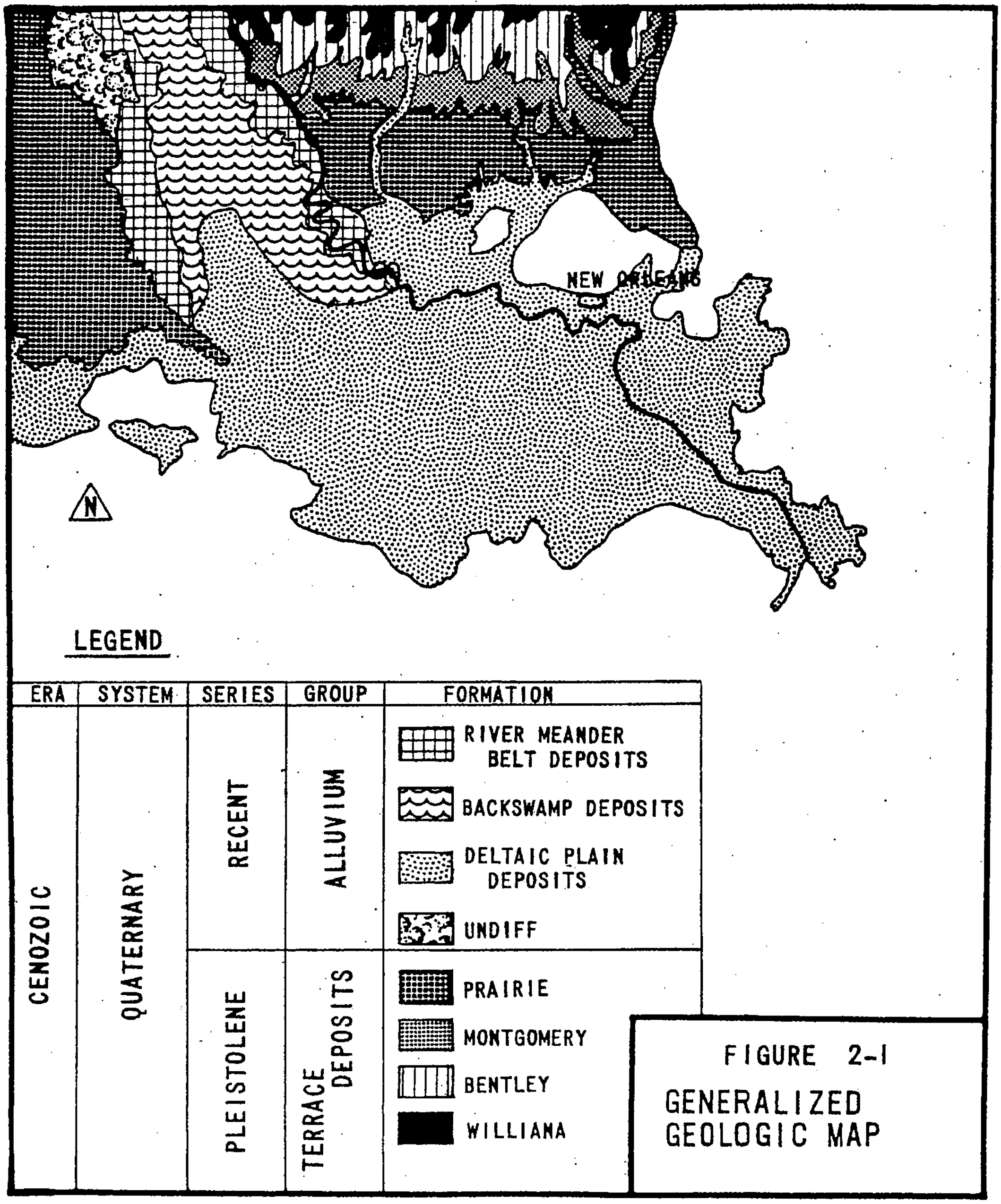


FIGURE 2-1

GENERALIZED GEOLOGIC MAP

b. Physiography and geomorphology

(1) An estimated 20,000 years ago, the sea level along eastern coastal Louisiana was approximately 400 feet below its present stand. The shoreline was located far gulfward of its present position. This Pleistocene surface rises generally toward the north and forms low coastwise terraces in the extreme northern sections of the study area.

(2) Between 17,000 and 15,000 years ago, the sea level began to rise, a result of glacial melting augmented by regional subsidence of the coastal area. Five to seven thousand years ago, the rise in sea level ceased, with gulf waters extending into what is now central and west-central Louisiana. Lobate deltas of fine-grained alluvium were formed. Deposition continued until former water bodies along the delta fringe were built-up to or above sea level.

(3) The shifting course of the Mississippi River during the past 5,000 years has resulted in the creation of the modern deltaic plain, a low-lying region of slight slope and relief. The region consists of discontinuous sandy beaches, interconnecting natural levee ridges, and marshland basins.

(4) Elevations and relief are generally low throughout the region. More than half the land in the study area is a nearly flat expanse of marsh, never rising more than two feet above mean Gulf level. In the more interior basins, surface elevations of two and four feet occur. Natural levee ridges, bordering active and abandoned courses and distributaries of the Mississippi River, were created by near channel deposition of suspended sediment during overbank flow. These natural levees have elevations of 25 to 27 feet m.s.l., and average two to three miles in width in the northern portion of the deltaic plain. Downstream at Empire, Louisiana, (29°25'N, 89°35'W), the average elevation is five feet with widths of approximately 1,500 feet. Beaches range from low, relatively flat, sandy plains, only a foot above high tide to massive sandy dune areas, such as Cat Island, reaching heights of 30 feet above sea level.

(5) Subsidence, the relative lowering of the land surface with respect to sea level, has played and continues to play an important role in southern Louisiana. Evidence of changes in relative elevations of land and sea during the Recent Epoch are common throughout coastal Louisiana. Subsidence occurs as a result of the following factors: true or actual sea level rise; basement sinking caused by sediment load and/or subcrustal flow;

consolidation of sediments of the Gulf Coastal geosyncline; local consolidation caused by the weight of minor land forms and man-made structures; tectonic activity; and withdrawal of fluids.

(a) True or actual sea level rise. True or actual sea level rise is caused by glacial melting. All glacial deposits are receding at an accelerated rate, relative to before 1930, resulting in a rise of sea level in southeast Louisiana of 0.32 feet per century.

(b) Basement sinking caused by sediment load and/or subcrustal flow. During the last 60 million years, the Louisiana coastal region has accumulated shallow water sediments approximately 40,000 feet in depth. The ever-increasing depositional load and subcrustal flow, resulting in a gradually subsiding trough, have caused an average rate of downwarp of approximately 0.07 feet per century.

(c) Consolidation of sediments of the Gulf Coastal geosyncline. A consolidation of Pleistocene and pre-Pleistocene sediments occurred as land areas were dewatered and drained during the lowering of sea level in Pleistocene time. Subsidence of Recent sediments due to consolidation is most pronounced in areas of active deposition, i.e., the deltas. Rapid rates of consolidation can be expected in the coarser intradelta materials, with interdistributary clays consolidating much more slowly.

(d) Local consolidation. Minor landforms within the delta complex often depress the regional deltaic surface in the vicinity of the land form. This downward consolidation varies greatly depending upon where the land form occurs. Man-made structures sink rapidly into deposits of low bearing capacity.

(e) Tectonic activity. Tectonic activity, primarily noted by faulting in the underlying strata, often accentuates the apparent sea level rise in southeast Louisiana. Most movement finds little obvious expression in the surface of the deltaic plain.

(6) Saltwater intrusion, resulting from a variety of factors including abandonment of the St. Bernard Delta Complex by the Mississippi River, additional restriction of eastward Mississippi River freshwater flow by levee construction, construction of the MR-GO, and subsidence, causes marsh deterioration. Where areas thickly underlain by organic sequences experience increased salinity, the marsh may break up and revert to open ponds and lakes.

(7) Geomorphic features

(a) The most prominent geomorphic features within the nearly flat modern deltaic plain are the natural levees, the slightly elevated areas that flank alluvial streams. Natural levees are formed by the deposition of coarse materials in the suspended load carried by the streams they flank. Fat clay and silt make up two-thirds of the soil types in the deposits. The remaining third of the soil types are lean clays. Thickness of natural levee deposits depends on the size of depositing streams, their distance from the mouth of the stream, and the amount the levee has subsided into underlying materials.

(b) Abandoned course deposits occur in the main channel left by the Mississippi River when it diverted at some point upstream. The abandoned course is a fairly deep elongate water body which gradually fills with fine-grained sediments carried in by flood flow. A similar process takes place along abandoned distributaries of the Mississippi River.

(c) Mud flats and mudlumps are found throughout the deltaic plain. Mud flats occur where clay and silt sediments accumulate along bay shores to within a foot or so of the average water level. Vegetative establishment tends to trap more sediment until the mud flats are exposed at low tide. Water content in mud flat deposits is consistently high. Mudlumps are slightly elongate, S-shaped islands formed by upwellings of clay near the mouths of the Mississippi River passes. These islands may rise to heights of 10 feet above sea level and encompass an area of 20 acres. Clays forming the mudlumps are believed to have worked upward from deeply buried prodelta clays through overlying coarser deltaic materials. Mudlumps are reported in the Mississippi River Delta only in those passes discharging into deep water.

(d) Inter-levee basins were formed as areas between natural levees became enclosed and cut off from tidal influence. These basins were virtually deprived of all sediment supply and marsh vegetation accumulated. Gradually, the inter-levee basins tended to fill all but the largest lakes and marsh areas with decaying vegetation.

(e) Beaches in southeast Louisiana are classified as sand beaches or shell beaches. Sand beaches are formed as sandy material deposited by an influx of deltaic sediment is piled by wave action into crescentic shapes which rise slightly above sea level. Shell beaches are located primarily along the landward shores of bays or sounds where oysters and clams develop in shallow, protected waters.

(f) Point bar deposits are created by the lateral migration of the Mississippi River or its distributaries. As medium or coarse-grained sand is scoured from the river bed, much of this material is deposited a short distance downstream, usually in bend areas. Point bar deposits are found extensively upstream from New Orleans, characterized by a series of alternating swales and ridges.

Point bar deposition is relatively insignificant within the delta region.

c. Geological formations

(1) Regional

(a) Surface stratigraphy. Surface deposits in the region are the result of the out-building of the land surfaces seaward by the advancing deltas of the Mississippi River. The major surface deposits in the study area are: Pleistocene; the basal sands--near-shore gulf and buried beaches; the basal clays--the prodelta; active delta deposits; organic deposits--swamps and marshes; and the surficial silts and sand--bay-sound and barrier beaches.

1. The Pleistocene deposits form near-sea level terraces north of Lake Borgne and Lake Pontchartrain. They rise gradually northward and are buried southward beneath the Recent deposits of the St. Bernard Delta. Pleistocene deposits are ancient deposits that were subjected to desiccation, oxidation, and erosion; and therefore, are typically preconsolidated. Logs of borings made in Pleistocene deposits in the study area indicate clays and silty clays (CH and CL) as the predominant soil types. Borings in Lake Pontchartrain show a thickness of Pleistocene deposits between 100 and 130 feet with a variability of soils. The upper portion of Pleistocene deposits is oxidized to a yellow or buff color. Where Pleistocene is buried beneath Recent deposits, the color is a mottled tan or orange and greenish gray. At depths greater than 50 feet, the deposits are a greenish-gray similar to the overlying Recent deposits. Material classified as clay falls primarily in the CH range of the Unified System. Likewise, silty clay samples are equally divided between CH and CL. Strength of Pleistocene materials is uniformly good, although a high variability in strength can be expected. Cohesive strengths of clays characteristically range from 900 to 2,100 pounds per square foot, and silty clays between 500 and 1,300 pounds per square foot. However, several clay samples have cohesive strengths greater than 3,000 pounds per square foot. Occasionally, some of the finer grained strata are found to be lacking in strength, a phenomenon attributed to a change in salt content resulting in an appreciable change in plasticity.

2. Nearshore gulf deposits and buried beaches are characterized by fine and medium-grained sands, formed in blankets of variable thickness over the Pleistocene surface as the sea rose and moved inward. Nearshore gulf deposition occurred during two distinct time periods: prior to the introduction of Mississippi River sediments, and within the past 1,000 years in a period of marine transgression. Borings indicate a thickness of

about 17 feet. Nearshore gulf deposits are poorly graded, primarily fine-grained sands. Shell, silt, and clay occur in subordinate quantities.

3. Prodelta deposits were formed by slow deposition from turbid waters swept seaward by rivers or distributed laterally by longshore currents. Thickness of prodelta deposits range from less than 10 feet near New Orleans to more than 100 feet near the Chandeleur Islands. Prodelta deposits are one of the most homogeneous materials making up the deltaic complex. Approximately 95 percent of all prodelta deposits are made up of fat clay (CH) with the finest sizes occurring with increasing distance seaward and increasing depth. These greenish-gray deposits increase in cohesive strength with depth. Cohesive strengths of prodelta clays in the area average between 200 and 600 pounds per square foot, although some strengths reach 900 to 1,300 pounds per square foot.

4. Active delta deposits are comprised of two major types: the intradelta complex and interdistributary deposits and the natural levees and point bar deposits developed as the river moves laterally. Intradelta complex materials were deposited at the mouths of minor distributaries. The intradelta complex consists of one-quarter fine sand and the remainder equally divided between clay and silt sizes. Predominant soil textures are silts and clayey silts (ML), silty clays (CL), fat clays (CH), and poorly graded fine sands (SP). Deposits of the intradelta complex range in thickness from 10 feet to approximately 40 feet. Interdistributary deposits are clays that settle out in the depressions between the distributaries. Borings characteristically encounter thin silt, or fine-sand lenses between clay layers. Water content of the interdistributary clays is high, ranging from 50 to more than 160 percent of the dry weight. Thickness of the interdistributary clays ranges from less than 10 feet to 50 feet. Cohesive strengths are relatively low, usually ranging between 150 and 300 pounds per square foot. The clays tend to consolidate and gain cohesive strength with depth.

5. Natural levees form thin surficial deposits with an average thickness of eight feet. Natural levees are primarily fat and lean clays, in equal proportions. They also contain approximately 30 percent silt and sandy silt. Cohesive strengths of these materials ranges between 800 to 1,200 pounds per square foot. Point bar deposits consist of varying thicknesses of fine-grained topstratum, underlain by relatively clean, river channel, sands. Thickness of the top stratum ranges from 20 to 75 feet, the thicker top stratum occurring downstream. The substratum sands are approximately 60 feet thick.

6. Marsh and swamp deposits cover most of the study area. Marshes contain sediments that are predominantly organic. Generally, marsh deposits consist of 60 percent or more by volume of peat and other organic matter. The remainder is predominantly clay. Fibrous peat or fibrous, organic clay can be expected in the top foot of marsh, underlain to a depth of five feet by finely divided particles of detrital peat. Detrital peat and clays are found at depths greater than five feet. Total marsh thickness is normally 10 feet. Water content of the marsh deposits varies from 80 to 800 percent dry weight.

7. Inland swamps are composed of approximately 70 percent clay and 30 percent peat and organic materials. Logs, stumps, and root systems are often incorporated with peat and clays.

8. Mangrove swamps are found extensively from the Chandeleur Islands, to the mainland areas forming the western boundary of Chandeleur Sound. Typical soils consist of a thin layer of dark gray to black, very soft, organic silty clay averaging 6 to 12 inches in thickness. Organic-rich clays to a depth of five feet are typical. Silt, shell, and fine sand content is usually high in mangrove swamp deposits.

9. The bay-sound and beach deposits are formed as coarse sands, silty sands, and silts are scoured by wave action and settle to the bottom or are piled into crescent shapes which rise above sea level. Bay-sound deposits comprise 35 percent sand, 15 percent shell, 10 percent silt, and the remainder clay-size material. Thickness of bay-sound deposits averages 10 to 15 feet. Beaches are made up primarily of fine or very fine sand (medium grain size 0.13-0.18 mm).

(b) Subsurface stratigraphy. The structural geology of the region is shown in Table 2-1. The general dip of bedrock units is toward the Gulf of Mexico. Pre-Quaternary beds are deeply covered except for isolated, small areas overlying emergent salt domes.

(2) Immediate MR-GO vicinity

(a) Surface stratigraphy and sediment analysis

1. Surface deposits along the MR-GO are characteristic of the deposits described for the region in Section c.(1)(a). Soil borings were performed in the immediate

MR-GO vicinity, as shown on Figure 2-2. These soil borings provide an interpretation of the surface stratigraphy, as shown on Figure 2-3.

2. Pleistocene deposits rise gradually northward, with the upper portion of the deposits ranging from 170 feet below m.s.l. near the Chandeleur Islands to 40 feet below m.s.l. in the New Orleans vicinity. The deposits are a mottled tan or orange and greenish-gray near New Orleans, becoming greenish-gray at depths below 50 feet m.s.l.

3. Nearshore gulf deposits occur over the Pleistocene surface from the New Orleans vicinity to the Bayou La Loutre vicinity. The deposits are also found near the Chandeleur Islands. Borings indicate thicknesses of about 17 feet.

4. Prodelta deposits increase in thickness from the New Orleans vicinity south along the MR-GO. They range in thickness from less than 10 feet to more than 100 feet.

5. Active delta deposits comprised of interdistributary and intradelta complex deposits are found from the New Orleans vicinity to Chandeleur Sound. Deposits of the intradelta complex range in thickness from 10 to 40 feet; interdistributary clays range from less than 10 to 50 feet.

6. Natural levees, such as that occurring at Bayou La Loutre, have an average thickness of eight feet. Point bar deposits at Bayou La Loutre are approximately 75 feet thick.

7. Marsh and swamp deposits cover the MR-GO vicinity from New Orleans to Chandeleur Sound. Marsh thickness is approximately 10 feet. Mangrove swamps are located on the Chandeleur Islands.

8. Bay-sound and beach deposits occur in Chandeleur Sound and the Chandeleur Islands respectively. Bay-sound deposits are approximately 10 feet to 15 feet thick. Beach deposits are formed on the gulfward side of the islands.

9. Soils. Soils of coastal Louisiana are typically peats, mucks, and clays with organic matter. Peats consist of fibrous masses of partly decomposed plant materials in which parts of the original vegetation can be identified. Mucks are made up of detrital organic particles, completely or nearly completely decomposed. Mucks have a high water content and can support little or no weight. Clays contain significant amounts

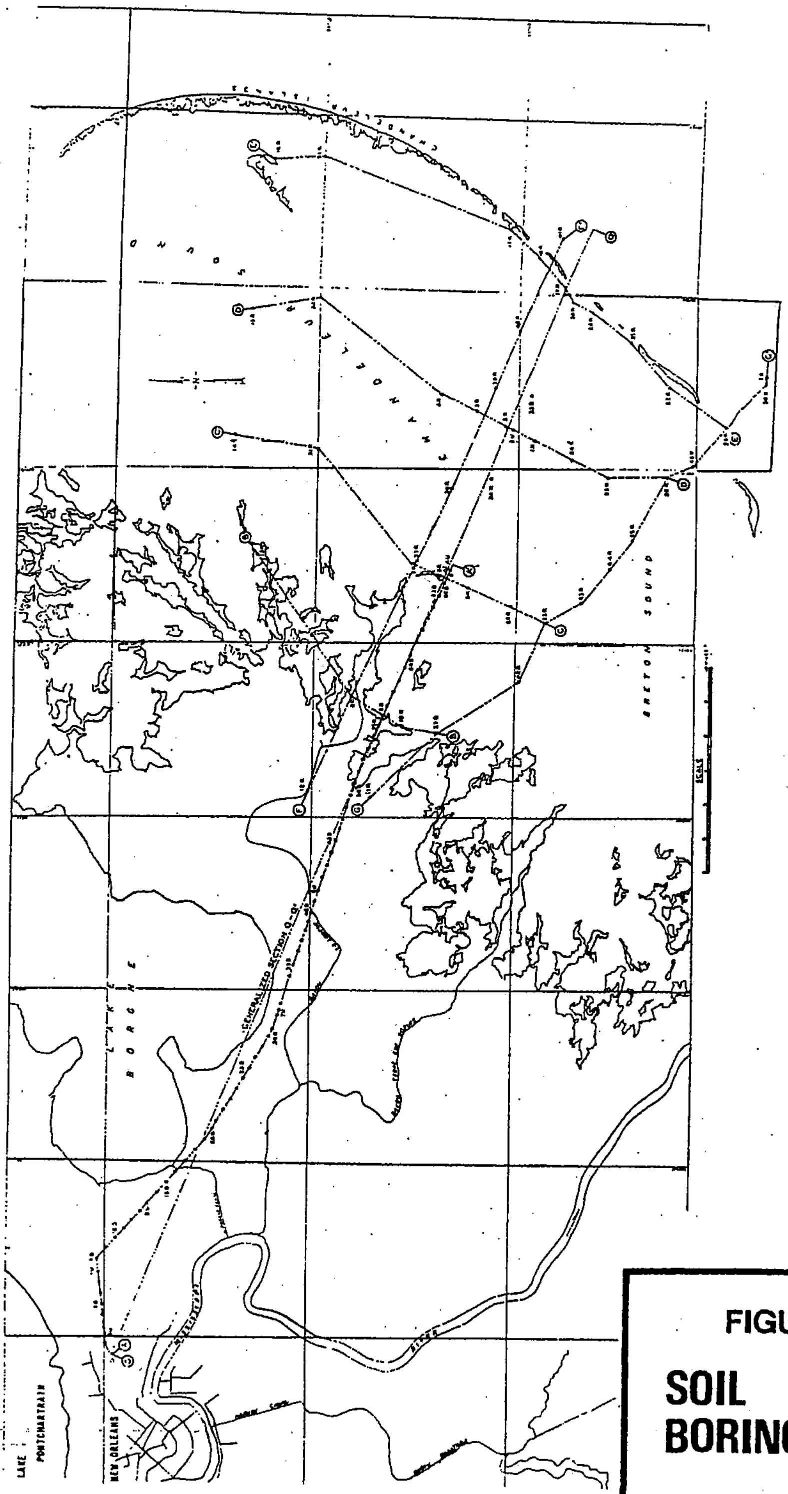


FIGURE 2·2

SOIL BORINGS

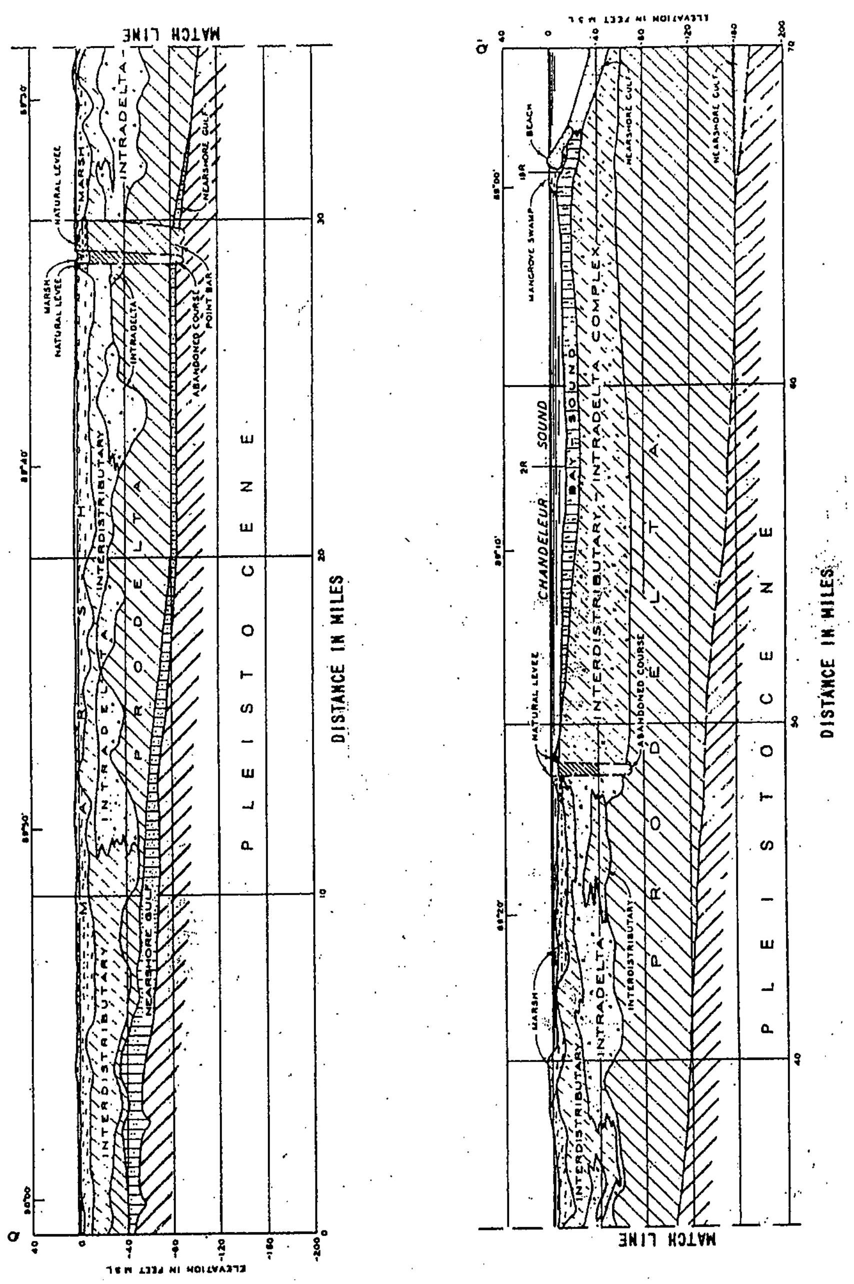


FIGURE 2-3

SURFACE STRATIGRAPHY PROFILE

of organic matter, usually completely decomposed. Peats, mucks, and clays with organic matter are usually black or dark brown in color.

10. Sediment character

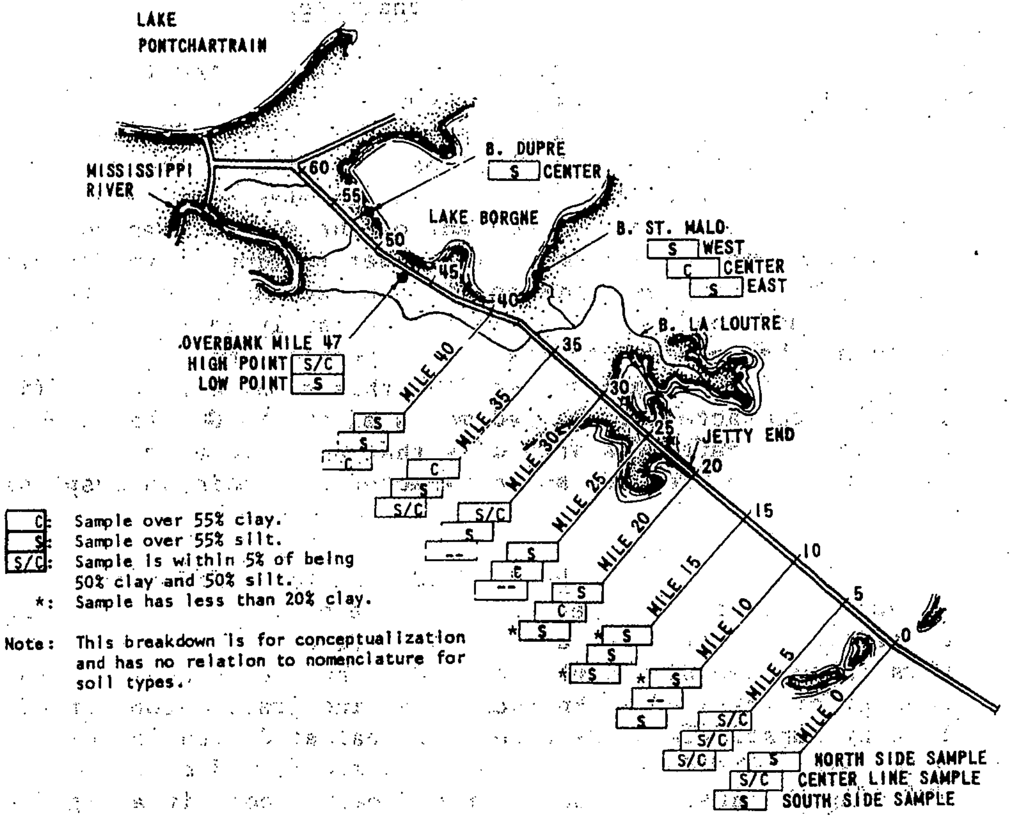
a. Results of the sediment analysis conducted for this report are shown on Figures 2-4, 2-5, 2-6 and 2-7. Samples were collected with a ponar dredge from 28 channel bottom locations and two spoil bank sites. Details of the analysis are included in Appendix C. None of the samples contained sand grain-sized material. The clay content of the samples ranged between 5.8 percent and 60 percent. The other portion of the samples was silt. These samples represent the surface sediment layers of the MR-GO channel bottom and are not necessarily representative of marsh and bay-sound deposits in the region. While the number and densities of the samples taken for this study are not sufficient to fully characterize the sediments of the MR-GO, the high content of fine clay particles indicates that about 40 percent of the sediment to be dredged can be expected to remain in suspension for four hours or more.

b. In addition to sediment types indicated by samples reported here, some sediments of the MR-GO may contain concentrations of sand, due to the interception of buried point bars, abandoned distributaries and/or buried beaches. Point bars consist of varying thicknesses of a fine grained top stratum, underlain by substratum sands often intercalcated with lenses of finer materials. Abandoned distributaries are formed by a sand wedge plugging the upstream end. Buried beaches contain a high sand content with subordinate silt and shell content. The samples taken at Miles 10 and 15 are coarser than elsewhere along the MR-GO. This may be due to recent dredging, resulting in the interception of a concentration of sand, or due to a greater amount of sorting action by currents and wave action.

(b) Subsurface stratigraphy. The structural geology of the immediate MR-GO vicinity is the same as the regional subsurface stratigraphy. Table 2-1 is a stratigraphic column showing the geologic formations in the MR-GO vicinity.

(c) Features and topography

1. The land area. The MR-GO extends northwest to southeast from the vicinity of New Orleans to the Gulf of Mexico. The channel crosses marshlands from its origin (Mile 66±)



C: Sample over 55% clay.
S: Sample over 55% silt.
S/C: Sample is within 5% of being 50% clay and 50% silt.
*: Sample has less than 20% clay.

Note: This breakdown is for conceptualization and has no relation to nomenclature for soil types.

STANLEY CONSULTANTS AND D. B. McDONALD RESEARCH

FIGURE 2-4
SEDIMENT ANALYSIS DATA GRAPHIC ILLUSTRATION OF SILT / CLAY CONTENT

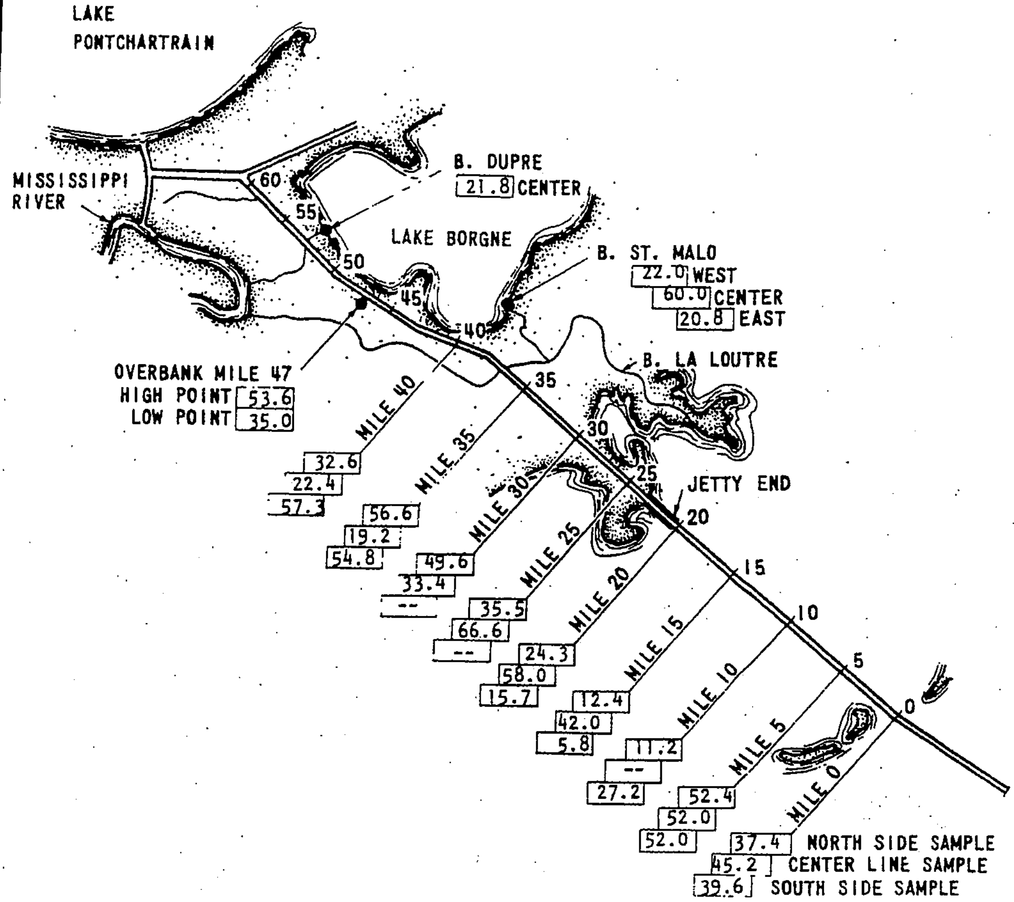


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FIGURE 2·5

SEDIMENT ANALYSIS DATA PERCENT CLAY CONTENT

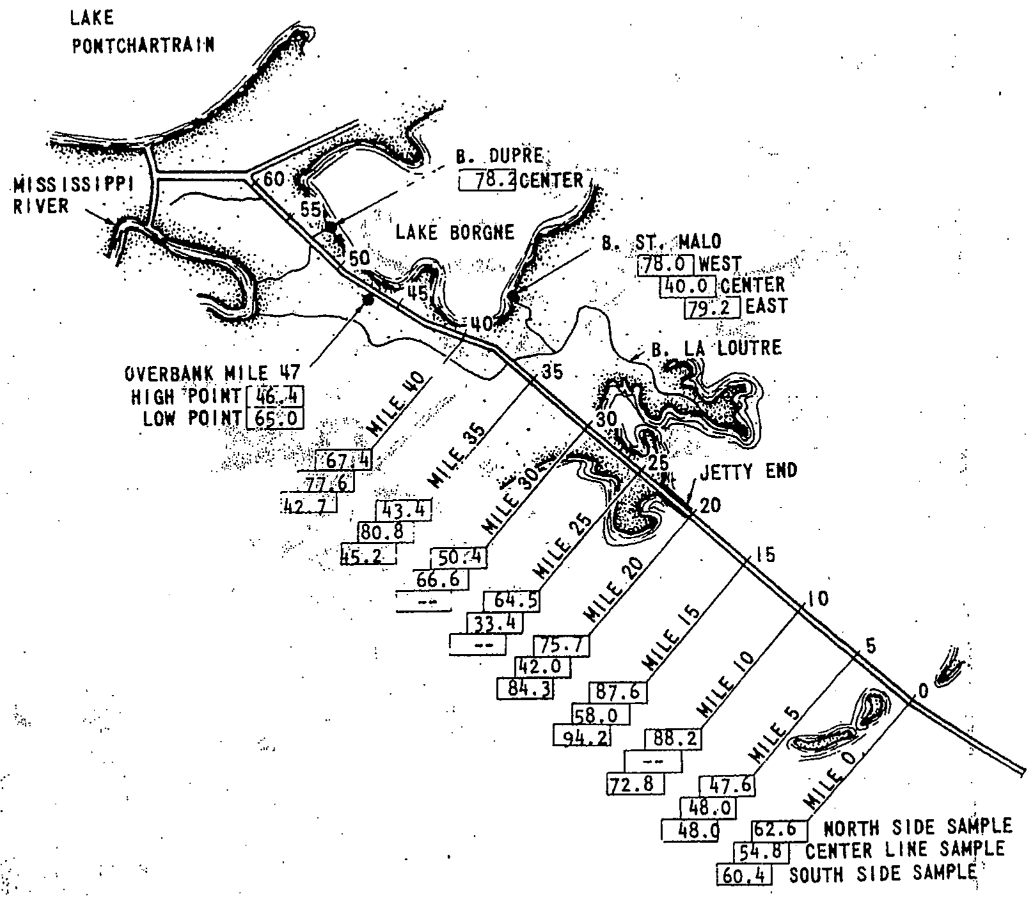

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FIGURE 2-6

SEDIMENT ANALYSIS DATA PERCENT SILT CONTENT

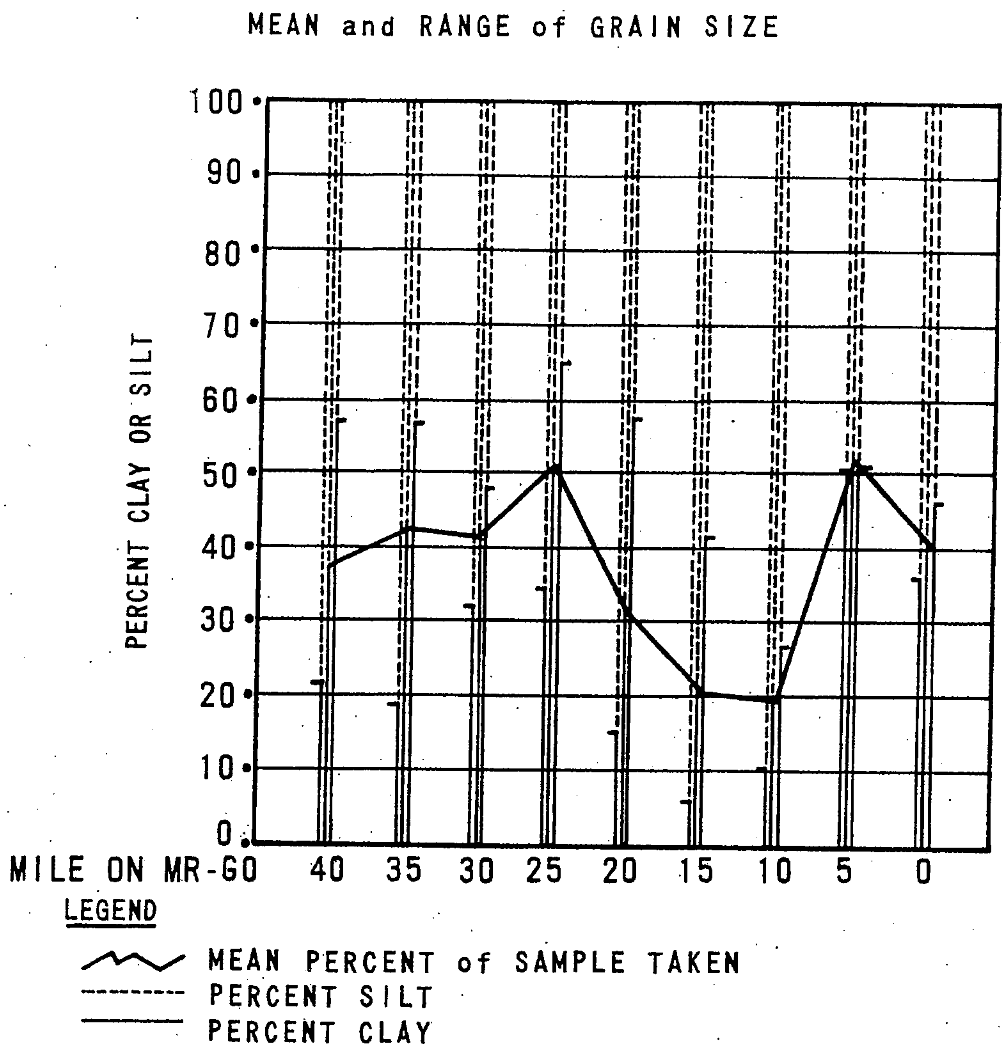

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FIGURE 2·7

GRAIN SIZE DISTRIBUTION VS THE AXIS OF THE MR-GO

TABLE 2-1
STRATIGRAPHIC COLUMN
Units Exposed at the Surface in the New Orleans District

ERA	SYSTEM	SERIES	GROUP	FORMATION
				LOUISIANA
CENOZOIC	QUATERNARY	HOLOCENE	Alluvium (Qal)	Alluvium
		PLEISTOCENE	Quaternary Terraces (Qt)	Prairie Montgom. Bentley Williana Citronelle
	TERTIARY	PLIOCENE MIOCENE	Undiff	Undiff
		MIOCENE	GRAND GULF (Mg)	Fleming Catahoula
		OLIGOCENE	VICKSBURG(O_v)	Mosley Hill
		EOCENE	JACKSON(E_j)	Danville Ldg. Moodys Branch
			CLAIBORNE(E_c)	Cockfield Cook Mountain
			WILCOX(E_w)	Undiff
		PALEOCENE	MIDWAY(E_{mi})	Undiff
MESOZOIC	UPPER CRETACEOUS	GULFIAN	NAVARRO(K_n)	Absent
			TAYLOR(K_{ta})	Absent
			AUSTIN(K_a)	Absent
			EAGLE FORD(K_{ef})	Absent
			WOODBINE(K_{wb})	Absent
	LOWER CRETACEOUS	COMANCHEAN	WASHITA(K_w)	Absent
			FREDERICKSBURG (K_f)	Absent
			Trinity(K_t)	Absent
	JURASSIC	Absent	Absent	Absent
	TRIASSIC	Absent	Absent	Absent

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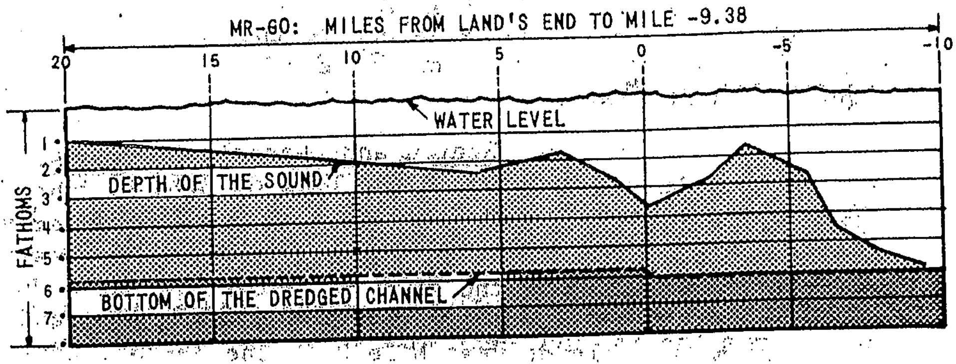
to about Mile 23 of the MR-GO. Topographic relief of the marshlands crossed is very slight, ranging from one to two feet. The highest elevations of marshlands adjacent to the channel are associated with the natural levees of old river channels such as Bayou La Loutre and St. Malo.

2. Breton and Chandeleur Sounds. From land's end to the 38-foot contour in the Gulf of Mexico, the MR-GO extends 32.4 miles through Breton Sound in a west-northwesterly to east-southeasterly direction. Chandeleur Sound is northeast of the MR-GO. The channel of the MR-GO is maintained at a 36-foot depth between the Chandeleur Islands and the land's end, and at a 38-foot depth from the islands near Mile 0 to the 38-foot contour at Mile -9.38 in the Gulf of Mexico. The MR-GO channel is thus a major physical feature of Breton Sound. Figure 2-8 shows the depth of Breton Sound relative to the depth of the MR-GO. The deepest point in Breton Sound is 4 fathoms (24 feet) between Breton and Grand Gosier Islands, with a rise to 3 fathoms (18 feet) toward the Gulf of Mexico, and thence a drop to 6 to 7 fathoms at Mile -9.39. Another physical feature of Breton Sound is the area of dredged material deposition to the right descending side of the MR-GO channel centerline. The material in the deposition area tends to spread out, but the areas rise high enough above the bottom of the sound that four passes are maintained for small craft navigation into the MR-GO from the west.

3. Chandeleur Islands. The Chandeleur Islands, a series of barrier islands, divide Breton and Chandeleur Sounds from the Gulf of Mexico (see plate 3). Mile 0 of the MR-GO lies between Breton Island and Grand Gosier Island of the island arc. Chandeleur Island, the largest, lies about 18 miles, N40°E of Mile 0 of the MR-GO. Sand dunes are common on the barrier islands. The islands, formed since the abandonment of the main distributary of the St. Bernard Delta Complex, are the result of reduced deposition, delta subsidence, and wave attack. This last process winnows out the finer material, leaving the coarser sand particles to be formed into barrier islands. The islands are not fixed features but shift as they are reshaped by wave attack. The islands tend to build on the land side, and erode on the seaward side; however, build-up can also occur on the seaward side during periods of moderate or low intensity wave action. Waves generated during storms can make cuts through the islands. There is also evidence that the islands receive river-borne sediments from the Mississippi River from discharge points below Bohemia, Louisiana.



SOURCE: DEPARTMENT OF THE ARMY, 1973,G

FIGURE 2-8
DEPTH OF THE SOUND ALONG THE LENGTH OF THE MR-GO

(d) Processes affecting land form

1. Tidal scour is the most consistently active erosional force observable in the MR-GO vicinity. Tides normally do not rise and fall more than a few inches, but during tropical storms, wind-driven tides achieve abnormal heights and water levels rise a number of feet. Most erosion occurs during intense storms as water is driven inland and rushes back out after the storm. Strong steady winds from the southeast also tend to push water up into the MR-GO and adjacent marshlands. Erosion associated with movement of wind-driven tides redistributes sediments in the channel bottoms and causes channel edges to slough off into the main channel.

2. Extensive landform changes have been made by landfilling, excavation, and deposition in the region of the

MR-GO. Landfilling is occurring in St. Bernard Parish near the urbanized areas as land is reclaimed for development. Excavation and deposition of material during construction of the MR-GO created elevated land on the west side of the MR-GO channel. Similar areas are created during pipeline construction.

3. Construction of canals for navigation and for small craft access to fishing areas and oil rigs has increased the amount of open water in the parishes. Canal construction thus increases the potential for water movement and subsequent erosion.

4. Bow and stern waves created by ocean-going and high speed small craft causes channel bank erosion. Banks of the channels are undermined and sediments migrate toward the channel center.

5. Subsidence plays an important role in the land form processes of the MR-GO vicinity. A 1970 study by Chatry and Gagliano indicated the general magnitude of land losses in the Mississippi River Delta area. In the vicinity of the northwesterly bay of Lake Borgne and in the vicinity of the MR-GO from Mile 35 to land's end, land loss was estimated to be about 50 to 100 acres per year per USGS 7 1/2 minute quad map (about 40,500 acres per quad). The loss was estimated to be over 100 acres per quad per year in the vicinity of the southwesterly bay of Lake Borgne. The most stable area, with a loss of 0 to 50 acres per quad per year was in the vicinity of MR-GO miles 52 to 45.

d. Economic geology. Sand, petroleum, natural gas, natural gas liquids, sulfur, salt and shell are the principal mineral resources produced in the study area.

(1) Gravel and sand production. St. Bernard and Plaquemines Parishes produce considerable amounts of sand for commercial use, whereas only small quantities of sand are produced in Orleans Parish. The majority of the pits or localities mined for sand and gravel in Louisiana are sporadically operated and few are worked actively for more than a few years. Thus, any attempt to list or evaluate producing localities is incomplete at best and soon out-of-date. No gravel pits are known to be active at present within the study area. Small, local sand pits are operated by Lone Star Industries and Jahke Company. These pits are of very limited economic significance and no annual production figures are available.

(2) Petroleum and natural gas

(a) Table 2-2 shows the 1972 production figures for crude oil, condensate, casinghead gas and natural gas for the three parishes within the study area.

TABLE 2-2

PETROLEUM AND NATURAL GAS PRODUCTION 1972
ORLEANS, PLAQUEMINES, AND ST. BERNARD PARISHES

Parish	Crude Oil (Bbls)	Condensate (Bbls)	Casinghead Gas (Mcf)	Natural Gas (Mcf)
Orleans	91,616	--	113,247	167,993
Plaquemines	159,269,391	10,476,131	190,997,230	651,051,054
St. Bernard	3,208,841	249	1,775,178	4,658,495

Source: Louisiana Department of Conservation, 1972.

(b) Table 2-3 indicates the fields or areas with production of petroleum and/or natural gas in Orleans, Plaquemines, and St. Bernard Parishes. Also listed are the annual and cumulative production figures for each producing area where data is available.

(3) Sulfur. Worldwide oversupply of sulfur has lowered prices and created uncertain market conditions for the sulfur industry in Louisiana. In Plaquemines Parish, the Jefferson Lake Sulfur Company closed in 1971, whereas the Freeport Sulfur Company is still in operation.

(4) Rock salt and brine. Salt is mined by the Freeport Sulfur Company in Plaquemines Parish.

(5) Shell production. Lake Pontchartrain has been the site of sustained and growing *Rangia cuneata* clam shell production since the 1930's. These shells are used in general construction (as concrete aggregate), road construction, the production of cement, hydrated lime, and quicklime; in the petroleum, glass, and chemical industries; and to a small degree, crushed in poultry and livestock feeds. Dredging of shell banks is the present method of shell

TABLE 2-3

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Orleans Parish		
Lake Borgne	N.A.	N.A.
Lake St. Catherine		
Natural Gas, Mcf(1)	167,993	5,228,389
Shell Point		
Crude, Bbls(2)	--	99,679
Casinghead Gas, Mcf	--	140,168
Unknown Pass		
Crude, Bbls	91,616	200,224
Condensate, Bbls	--	9,031
Casinghead Gas, Mcf	113,247	233,555
Natural Gas, Mcf	--	51,935
Plaquemines Parish		
Adams Bayou		
Crude, Bbls	--	37,346
Casinghead Gas, Mcf	--	24,487
Alliance		
Crude, Bbls	3,561	615,519
Condensate, Bbls	3,019	197,155
Casinghead Gas, Mcf	515	879,914
Natural Gas, Mcf	182,059	9,209,405
Balize Bayou		
Crude, Bbls	62,335	174,948
Casinghead Gas, Mcf	255,657	528,596

(1) Million cubic feet

(2) Barrels

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Bastian Bay		
Crude, Bbls	508,856	16,223,901
Condensate, Bbls	2,361,839	37,847,773
Casinghead Gas, Mcf	1,050,290	28,768,212
Natural Gas, Mcf	139,282,026	1,505,591,982
Bay Denesse		
Crude, Bbls	--	3,551
Casinghead Gas, Mcf	--	5,633
Bayou Gentilly		
Crude, Bbls	--	24,684
Condensate, Bbls	99,429	894,224
Casinghead Gas, Mcf	--	232,671
Natural Gas, Mcf	4,118,864	27,709,354
Black Bay		
Crude, Bbls	426,184	7,775,951
Condensate, Bbls	2,452	72,470
Casinghead Gas, Mcf	205,780	8,351,965
Natural Gas, Mcf	120,334	2,728,532
Blind Bay		
Crude, Bbls	--	47,625
Casinghead Gas, Mcf	--	50,098
Bohemia		
Crude, Bbls	--	35,644
Condensate, Bbls	--	527
Casinghead Gas, Mcf	--	100,544
Natural Gas, Mcf	--	39,462

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Buras		
Crude, Bbls	--	13,804
Condensate, Bbls	--	27,341
Casinghead Gas, Mcf	--	47,519
Natural Gas, Mcf	--	1,395,366
Burwood		
Crude, Bbls	1,007,505	14,757,470
Condensate, Bbls	--	12,109
Casinghead Gas, Mcf	1,052,293	19,114,639
Coquille Bay		
Crude, Bbls	349,509	10,262,559
Condensate, Bbls	35,944	707,689
Casinghead Gas, Mcf	396,089	24,453,447
Natural Gas, Mcf	5,045,481	32,120,314
Cox Bay		
Crude, Bbls	1,520,062	44,930,086
Condensate, Bbls	16,595	420,899
Casinghead Gas, Mcf	577,986	33,107,445
Natural Gas, Mcf	914,325	16,396,927
Dalcour		
Crude, Bbls	--	10,446
Condensate, Bbls	--	35,642
Casinghead Gas, Mcf	--	29,809
Natural Gas, Mcf	--	2,417,541

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Delacroix Island		
Crude, Bbls	256,955	17,358,500
Condensate, Bbls	211,444	786,708
Casinghead Gas, Mcf	636,586	27,844,881
Natural Gas, Mcf	12,108,357	43,221,490
Delta Duck		
Crude, Bbls	2,280,449	44,450,299
Condensate, Bbls	54,292	223,200
Casinghead Gas, Mcf	3,971,758	81,892,895
Natural Gas, Mcf	4,513,809	15,220,788
Diamond		
Crude, Bbls	204,144	2,457,709
Condensate, Bbls	11,249	237,164
Casinghead Gas, Mcf	526,345	9,295,302
Natural Gas, Mcf	401,544	2,373,001
East Black Bay		
Crude, Bbls	2,711,085	25,384,811
Condensate, Bbls	13,691	362,587
Casinghead Gas, Mcf	1,519,295	11,920,545
Natural Gas, Mcf	1,038,798	15,007,734
Empire		
Crude, Bbls	744,427	7,865,389
Condensate, Bbls	53,459	508,684
Casinghead Gas, Mcf	744,273	12,313,749
Natural Gas, Mcf	759,748	12,296,050

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Fort Jackson		
Condensate, Bbls	260	6,778
Natural Gas, Mcf	218,714	4,644,529
Garden Island Bay		
Crude, Bbls	12,349,097	155,473,717
Condensate, Bbls	23,322	195,884
Casinghead Gas, Mcf	10,873,208	107,019,227
Natural Gas, Mcf	1,029,536	9,152,564
Grand Bay		
Crude, Bbls	6,617,088	142,824,542
Condensate, Bbls	83,242	683,720
Casinghead Gas, Mcf	6,048,441	193,225,251
Natural Gas, Mcf	3,466,457	26,093,742
Lake Campo		
Crude, Bbls	145,834	506,114
Condensate, Bbls	522	19,107
Casinghead Gas, Mcf	32,695	229,548
Natural Gas, Mcf	1,730,062	26,683,607
Lake Hermitage		
Crude, Bbls	89,554	3,630,407
Condensate, Bbls	30,922	491,637
Casinghead Gas, Mcf	81,456	4,779,933
Natural Gas, Mcf	1,289,656	21,436,757
Lake Lery		
Natural Gas, Mcf	10,161	2,760,677

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Lake Washington		
Crude, Bbls	8,821,407	184,722,909
Condensate, Bbls	1,965,117	13,204,382
Casinghead Gas, Mcf	13,740,073	216,621,198
Natural Gas, Mcf	24,890,108	241,324,205
Magnolia		
Crude, Bbls	90,103	735,321
Condensate, Bbls	10,754	129,061
Casinghead Gas, Mcf	6,560	317,111
Natural Gas, Mcf	514,543	7,404,380
Manila Village		
Crude, Bbls	726,307	7,304,475
Condensate, Bbls	34,652	1,041,879
Casinghead Gas, Mcf	2,096,488	19,001,072
Natural Gas, Mcf	1,279,328	30,835,556
Nairn		
Crude, Bbls	—	45,809
Casinghead Gas, Mcf	—	570,739
North Black Bay		
Crude, Bbls	1,451,525	12,239,247
Condensate, Bbls	—	2,190
Casinghead Gas, Mcf	109,013	2,827,063
Natural Gas, Mcf	—	1,479,323
Pelican Point		
Crude, Bbls	—	2,110
Casinghead Gas, Mcf	—	3,451

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Phoenix	N.A.	N.A.
Pointe A La Hache		
Crude, Bbls	950,894	35,427,989
Condensate, Bbls	136,497	1,341,233
Casinghead Gas, Mcf	1,432,236	56,305,224
Natural Gas, Mcf	5,714,188	54,607,093
Potash		
Crude, Bbls	1,047,963	16,697,368
Condensate, Bbls	45,396	963,574
Casinghead Gas, Mcf	545,207	20,572,446
Natural Gas, Mcf	4,968,531	75,558,950
Quarantine Bay		
Crude, Bbls	4,318,039	141,973,869
Condensate, Bbls	22,734	276,720
Casinghead Gas, Mcf	4,789,034	177,686,780
Natural Gas, Mcf	1,993,354	16,143,405
Queen Bess Island		
Crude, Bbls	4,248	4,542
Condensate, Bbls	132,836	847,589
Casinghead Gas, Mcf	5,722	9,750
Natural Gas, Mcf	19,356,470	99,035,781
Romero Pass		
Crude, Bbls	3,094,098	75,422,189
Condensate, Bbls	144,166	1,463,838
Casinghead Gas, Mcf	7,788,457	99,944,978
Natural Gas, Mcf	18,708,973	140,522,768

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Saturday Island		
Crude, Bbls	588,132	13,240,512
Condensate, Bbls	5,396	104,043
Casinghead Gas, Mcf	2,591,757	27,765,593
Natural Gas, Mcf	211,182	5,022,141
South Adams Bay		
Crude, Bbls	--	1,269
Southeast Black Bay		
Crude, Bbls	1,607,206	10,400,209
Condensate, Bbls	11,884	150,441
Casinghead Gas, Mcf	838,765	3,593,459
Natural Gas, Mcf	976,428	5,845,854
Southeast Pass		
Crude, Bbls	1,359,755	19,790,178
Condensate, Bbls	39,368	882,484
Casinghead Gas, Mcf	1,695,300	35,419,687
Natural Gas, Mcf	6,215,820	58,089,768
Stella		
Crude, Bbls	150,732	9,609,685
Condensate, Bbls	13,897	808,951
Casinghead Gas, Mcf	52,859	5,295,406
Natural Gas, Mcf	748,860	23,607,968
Tiger Pass		
Crude, Bbls	75,008	1,237,885
Casinghead Gas, Mcf	29,297	442,998
Natural Gas, Mcf	48,703	389,578

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Tiger Ridge		
Condensate, Bbls	—	160
Natural Gas, Mcf	--	33,346
Venice		
Crude, Bbls	5,255,701	148,483,582
Condensate, Bbls	127,501	2,705,612
Casinghead Gas, Mcf	7,026,847	170,806,087
Natural Gas, Mcf	3,091,891	47,783,392
West Bay		
Crude, Bbls	9,423,069	162,135,144
Condensate, Bbls	183,562	1,821,965
Casinghead Gas, Mcf	17,711,697	288,055,846
Natural Gas, Mcf	23,750,332	157,574,998
West Black Bay		
Crude, Bbls	9,225,481	76,544,071
Condensate, Bbls	13,520	534,464
Casinghead Gas, Mcf	4,628,395	63,266,728
Natural Gas, Mcf	2,430,261	41,308,215
St. Bernard		
Bayou Biloxi	N.A.	N.A.
East Stuards Bluff	N.A.	N.A.
Eloi Bay		
Crude, Bbls	1,039,237	8,761,007
Condensate, Bbls	--	54,271
Casinghead Gas, Mcf	660,373	9,490,894
Natural Gas, Mcf	460,035	16,120,572

TABLE 2-3 (Cont.)

PETROLEUM AND NATURAL GAS FIELDS - 1972
ORLEANS, PLAQUEMINES AND ST. BERNARD PARISHES

Parish and Field	Total 1972	Accumulated Total 1972
Half Moon Lake		
Crude, Bbls	343,943	2,541,710
Casinghead Gas, Mcf	126,431	1,603,463
Natural Gas, Mcf	136,867	871,567
Kenilworth		
Crude, Bbls	--	148,237
Condensate, Bbls	--	4,257
Casinghead Gas, Mcf	--	125,573
Natural Gas, Mcf	--	372,409
Lake Athanasio		
Crude, Bbls	--	43,221
Casinghead Gas, Mcf	--	25,612
Lake Borgne	N.A.	N.A.
Lake Fortuna		
Crude, Bbls	129,173	2,831,109
Condensate, Bbls	--	41,612
Casinghead Gas, Mcf	27,574	932,527
Natural Gas, Mcf	3,895	1,316,142
Stuards Bluff		
Natural Gas, Mcf	1,615,018	5,834,786
Treasure Bay		
Condensate, Bbls	--	12
Natural Gas, Mcf	--	218,905

Sources: Louisiana Department of Conservation, 1972.
Louisiana Department of Conservation, 1973.

production employed by the Radcliff Material Company in Orleans Parish.

(6) Clay. Clay is produced from one source in St. Bernard Parish by the Louisiana Cement Company.

(7) Stone and crushed stone. There is no known production of stone or crushed stone in the study area. However, Orleans Parish does have two cement manufacturing plants and a gypsum processing plant.

(8) Carbon black. There is no known production of carbon black in the study area.

e. Ground water

(1) Numerous aquifers are found within the study area; however, local ground water supplies are available in small supplies and are of generally poor quality. Shallow aquifers, located in point bars and distributary channel sands, yield the only fresh ground water in parts of southeastern Orleans and western St. Bernard Parishes. Four other distinguishable aquifers are found within the study area: the "200-foot" sand, the "400-foot" sand, the "700-foot" sand, and the "1,200-foot" sand.

(2) Point bar deposits occur at depths of 10-30 feet below the land surface at the bends in the Mississippi River. The deposits extend to a depth of 150 feet or more. The aquifer has a small areal extent and low permeability, yielding only a few gallons per minute. Water quality is poor because of a high iron content (2.2-28 ppm) and excessive hardness (255-778 ppm).

(3) Distributary channel deposits of the St. Bernard Delta are divided into two parts, the Metairie branch and the Bayou La Loutre branch. The Metairie branch yields water with chloride contents greater than 250 ppm. Salt content increases with depth. The Bayou La Loutre branch provides small supplies of fresh water, although the water is extremely hard and has a high iron content. As with the Metairie branch, salt content increases with depth.

(4) The "200-foot" sand aquifer is poorly definable; thickening, thinning, and pinching out abruptly. Water in this aquifer, within the study area, contains approximately 500 to 900 ppm of chloride.

(5) The "400-foot" sand underlies the northwestern part of Orleans Parish where it is the potential source of large quantities

of brackish water (250-500 ppm of chloride). Ground water from this aquifer ranges from moderately hard (61-120 ppm) to very hard (greater than 181 ppm). Hardness increases as the dissolved solids and chloride increase. The "400-foot" sand ranges from 92 to 172 feet in thickness, averaging about 120 feet.

(6) The "700-foot" sand is the principal source of ground water in the New Orleans area. The aquifer generally ranges between 100 and 200 feet in thickness, averaging about 175 feet. The sand is thickest in the southwest and thins to the north and east. Wells yielding 1,000 gpm can be constructed within this aquifer. The "700-foot" sand yields fresh, soft water which is low in iron but has a distinct yellow color.

(7) The "1,200-foot" sand is little used in the New Orleans area as a source of ground water. This is due to the poor quality of the water, which ranges from slightly saline to brine. The known thickness of the aquifer ranges from 130 feet to 50 feet. Water ranges from fresh to brine, depending on the well location. Limited available data indicate that withdrawals probably never exceeded a few million gallons per day.

f. Unusual geologic features. Several unusual significant geologic features are located within the regional study area.

(1) Mudlumps are located at Southeast Pass, South Pass, and Southwest Pass at the mouth of the Mississippi River. These unusual mounds, spewing gas and mud, are significant geographic attractions.

(2) North Mud Lump is a significant attraction located at the mouth of the Mississippi River. The mudlump spews gas and mud.

(3) Thomasia Mud Lumps are located at Pass a Loutre at the mouth of the Mississippi River. The mudlump spews gas and mud.

(4) Mississippi (Balize) Delta.

2.03 HYDROLOGIC ELEMENTS

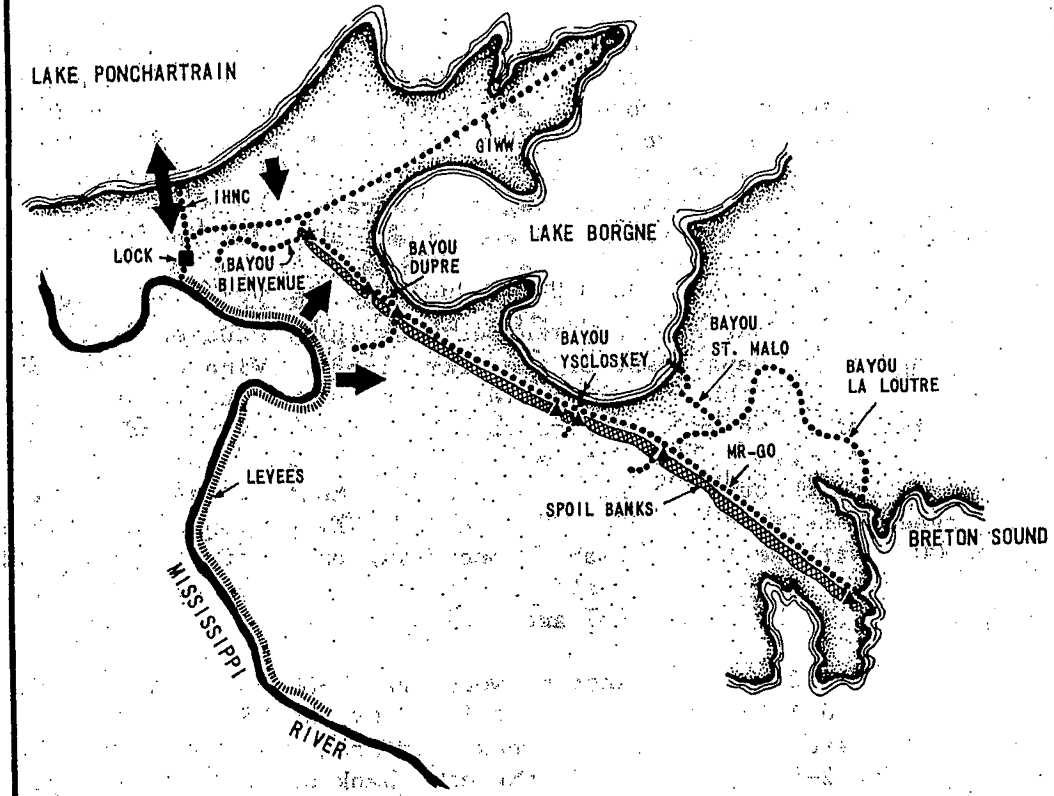
a. General

(1) Patterns of water movement in the Lake Borgne vicinity are extremely complex. A schematic diagram (Figure 2-9) shows the major water bodies and navigation channels. Details will be found on Plate 1. In addition to gravitational flow, interchange of water between these water bodies and within the marshland bayous, bays, and lagoons is caused by normal tidal variation, wind and storm induced tides, and flow due to differentials in the salinity-temperature-density regime and other chemical parameters. Interchange between the MR-GO and Lake Pontchartrain has been documented in salinity studies by the Corps of Engineers (Department of the Army, 1963). Wind effects usually mask the daily ebb and flood tide variations. Due to large annual volumes of fresh water inflow to Lake Pontchartrain and due to tides and storm surges, enormous volumes of water pass in both directions through the Rigolets and Chef Menteur passes, Lake Borgne, Mississippi Sound, Inner Harbor Navigation Canal, and the MR-GO. With so many variables operating on several elements of the system, the current patterns are continually changing (Department of the Army, 1967 and 1969).

(2) Interchange between the MR-GO and westerly marshlands and developed land is restricted by the MR-GO west side dredged material deposition areas. Interchange points are shown on Figure 2-9. The levee on the east bank of the Mississippi River and the higher elevations along the Mississippi River cause storm drainage and general flow patterns in St. Bernard Parish to be easterly. Flow of water from the Mississippi River to the Pontchartrain-Lake Borgne-MR-GO complex is blocked by the lock on the IHNC. Canals constructed north of the GIWW provide for drainage and for pumpage into the GIWW.

(3) The hydrologic pattern is thus one of multidirectional interchange rather than a pattern with prevailing flow in one direction. Erosion due to water flow is the result of: 1) wind, 2) tides, and 3) drainage flow, in that order of importance. The works of El-Sayed and Rae, (1961), Scruton, (1956), and Fisk, (1960) exhibit the specific data and fractional conclusions that indicate this order of importance.

(4) The following sections concentrate on hydrologic and sediment quality factors as they relate to O&M work. Specifically these are: 1) water quality, 2) sediment analysis, 3) natural and scenic river status, and 4) a summary of uses of water in the Lake Borgne vicinity.



- DIRECTION OF GRAVITATIONAL FLOW
▲ INTERCHANGE POINTS TO WEST

GIWW : GULF INTRACOASTAL WATERWAY
IHNC : INNER HARBOR NAVIGATION CANAL
MR-GO : MISSISSIPPI RIVER - GULF OUTLET

FIGURE 2·9
SCHEMATIC DIAGRAM OF WATER BODIES

STANLEY CONSULTANTS

b. Water quality of surface waters

(1) Water quality relative to standards - summary. Based on a limited amount of water quality data, waters in the MR-GO area are relatively free of organic pollution. Biochemical oxygen demand (BOD) is generally low and dissolved oxygen (DO) is near saturation. Bacterial levels generally appear to meet state water quality criteria for secondary contact recreation but do not meet standards for shellfish propagation north of Bayou La Loutre. Certain heavy metal concentrations (lead and mercury) are above proposed EPA water quality criteria. Limited toxicity level data for aquatic organisms prevent any definite conclusions as to the harmful effects of these heavy metals. Details of water quality and salinity are discussed in the following sections.

(2) Stream classification and state standards. The waters of MR-GO have been classified by the Louisiana Stream Control Commission as suitable for secondary contact recreation and for propagation of fish and wildlife. Secondary contact recreation includes fishing, wading, boating, etc., but not swimming, water skiing, skin diving, etc. The following summary of numerical criteria for water quality from the State of Louisiana Water Quality Criteria (Louisiana Stream Control Commission, 1973) apply to the MR-GO:

Dissolved Oxygen - Dissolved Oxygen concentrations in estuaries and tidal tributaries shall not be less than 4 mg/1 at any time or place except in naturally dystrophic waters or where natural conditions cause DO to be depressed.

Temperature - Temperature differential

(1) Maximum of 4°F (2.2°C) rise above ambient during October through May.
(2) Maximum 1.5°F (0.83°C) during the period June through September.

Maximum temperature - 85°F (35°C) except when natural conditions elevate temperature above this level.

pH - Range between 6.5 to 9.0

Bacterial Standards - Shellfish Propagation - The Monthly total coliform median MPN (most probable number) shall not exceed 70 per 100 ml., and no more than 10 percent of the samples ordinarily exceed an MPN of 230 per 100 ml. (This Class 4 criterion is applicable because of shellfish propagation.)

Bacterial Standards - Secondary Contact Recreation - Based on a minimum of not less than 5 samples taken over not more than a 30-day period, the fecal coliform content shall not exceed a log mean of 1,000/100 ml. nor shall more than 10 percent of the total samples during any 30-day period equal or exceed 2,000/100 ml.

Toxic Substances - None present in quantities that alone or in combination will be toxic to animal or plant life. In all cases, the level shall not exceed the $TLM_{96}/10$. Bioassay techniques will be used in evaluating toxicity utilizing methods and species of test organisms suitable to the purpose at hand. In cases where the stream is used as a public water supply, the level of toxic substances shall not exceed the levels established by the United States Public Health Service drinking water standards latest edition.

(3) EPA proposed water quality criteria. In October, 1973, the EPA published proposed criteria, which are largely based on a 1972 National Academy of Sciences report. These proposed water quality criteria will be the basis for revision of State standards. The proposed criteria for marine and estuarine waters are shown in Table 2-4. Concentrations of constituents shown should not exceed the indicated fraction of the 96-hour LC_{50} when known, and concentrations above the indicated numbers are unacceptable. LC_{50} concentrations for various organisms are sketchy, but the EPA proposed water quality report does indicate some values for American oysters (Crassostrea virginica), an organism of specific interest in the MR-GO area.

Constituent	LC_{50}	Period of Exposure
Cadmium	0.2 mg/1	8 weeks
	0.1 mg/1	15 weeks
Lead	0.5 mg/1	12 weeks

Since the EPA proposed water quality criteria set concentrations as 1/100 and 1/50 of the 96-hour LC_{50} for cadmium and lead, respectively, it is difficult to compare these longer exposures to 96-hour exposures.

TABLE 2-4

1973 EPA PROPOSED WATER QUALITY CRITERIA

MARINE AND ESTUARINE

Constituent	Aquatic Life	Recreation
pH Range (units)	6.5-8.5	6.7-8.5
Ammonia (nonionized)	1/10 LC_{50}(1) 0.4 mg/1	
Arsenic	1/100 LC_{50} 0.05 mg/1	
Cadmium	1/100 LC_{50} 0.01 mg/1	
Chromium	1/100 LC_{50} 0.1 mg/1	
Copper	1/100 LC_{50} 0.05 mg/1	
Lead	1/50 LC_{50} 0.05 mg/1	
Mercury	1/100 LC_{50} 0.001 mg/1	
Zinc	1/100 LC_{50} 0.1 mg/1	
Fecal Coliform Bacteria (Monthly Average)		200/100 ml(2)
Dissolved Oxygen	Minimum acceptable DO levels are 6.0 mg/1, except when temporary natural phenomena cause this value to be decreased. DO concentrations below 4.0 mg/1 are unacceptable.	

(1) 96-hour LC_{50}, the lethal concentration to 50 percent of the test organisms over a 96-hour exposure.

(2) Primary contact waters (includes swimming, etc.).

Source: United States Environmental Protection Agency, 1973, B

(4) Water quality of the MR-GO and associated bayous. One water quality concern for the MR-GO is related to water quality in oyster growing areas north and south of the MR-GO. Bacterial contamination measured by coliform counts and heavy metal concentrations are the pollutants that oyster growers are most concerned about. The Louisiana Bureau of Environmental Health is responsible for the monitoring and enforcement of the shellfish sanitation program.

(a) Coliforms. Coliform counts in the MR-GO are highest northwest of Bayou La Loutre. Counts are low from Bayou La Loutre out to Breton Sound. The MR-GO receives drainage water from Chalmette, Arabi, Violet, and eastern New Orleans by way of Bayou Bienvenue, the Violet Canal, Bayou Dupre, and the Gulf Intracoastal Waterway (GIWW). Drainage from Yscloskey and Hopedale, and from habitations along the natural levees of Bayou La Loutre have access to the MR-GO through Bayou Yscloskey and Bayou La Loutre. The most significant source of coliforms is storm water run-off from New Orleans via Bayou Bienvenue. Other sources are from untreated sewage discharges from small developments in the Bayou La Loutre area. No other major industrial or municipal wastewaters are discharged directly or indirectly into the MR-GO. Figure 2-10 shows the median and mean values for total and fecal coliform counts for samples taken from mid-1972 to December of 1974 by the Louisiana Bureau of Environmental Health (Pers. Comm. Memphis, 1974). Stations 1, 2, 3, 28, 30, 32, and 33 were sampled 11 to 14 times in that period. Other stations were sampled 4 to 7 times. North of Station 29, the highest recorded total coliform counts exceeded 1,600. For fecal coliforms, highest values exceeded 1,600 north of Station 32, ranged from 220 to 240 at Stations 30, 29 and 28, and were below 79 for the rest of the stations except Station 33 at Bayou La Loutre which had a high of 94. In the MR-GO itself, total median coliform counts exceed standards (total median: 70 per 100 ml) north of Station 28 but would be suitable for shellfish harvest at Station 63 and south.

MISSISSIPPI RIVER·GULF OUTLET WATER QUALITY SURVEY

·COLIFORMS·

MAP LOCATION	STATION	TOTAL COLIFORMS		FECAL COLIFORMS	
		MEDIAN	MEAN	MEDIAN	MEAN
1	3	920	821	79	218
2	1	1600	1210	195	696
3	2	350	703	74.5	201
4	32	210	406	38	213.1
5	30	205	459	22	51
6	29	130	630	33	126
7	28	350	243	49	75
8	63	41	418	23	22.4
9	33	06.1	347	3.2	21.5
10	34	03.1	14.6	< 1.8	9.6
11	35	02.0	6.2	< 1.8	4.8

COUNT PER 100 MILLILITERS: DATA: MID-1972-DECEMBER 1974

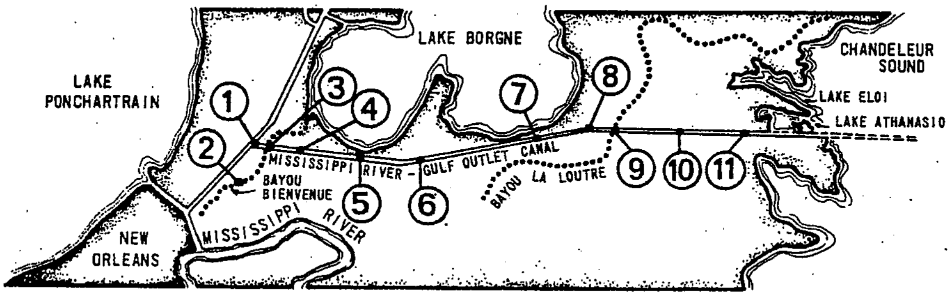


FIGURE 2·10

COLIFORM COUNTS IN THE MR·GO

LOUISIANA BUREAU OF ENVIRONMENTAL HEALTH, PERS. COMM., MAPHIS, 1974

(b) Organic pollution parameters - data

1. General. Water quality in the MR-GO area has been monitored by the Corps of Engineers from 1963 to the present. Parameters measured and sampling periods vary considerably. Much of the data has not been summarized. Results from 1972-73 are summarized in Tables 2-5 and 2-6. Locations of the samples are shown on Figure 2-11. Most of the samples indicate low levels of organic pollution.

2. Biochemical oxygen demand. BOD levels below 3 mg/l generally indicate a high quality water from the standpoint of oxygen-consuming organic material. All of the samples show BOD levels below 3 mg/l except at Station 4 on the GIWW and at Station 8 on the Inner Harbor Navigation Canal (IHNC). BOD concentrations of 9.9 and 7.7 mg/l at these stations indicate a moderate degree of organic pollution.

3. Dissolved oxygen. All samples indicate DO's close to saturation for average water temperatures. None of the values fail the EPA's proposed criteria of 6 mg/1. Dissolved oxygen (DO) levels reflect the low level of oxygen-demanding material in the waters. DO saturation concentrations vary with temperature and salinity. (The MR-GO salinity varies between 2,000 to 10,000 mg/l.) At a chloride concentration of 5,000 mg/l, the solubility of oxygen in water varies with temperature as follows:

Temp., °C	Saturation Concentration, mg/l
5	12.09
10	10.73
15	9.65
20	8.73
25	7.96
30	7.25

4. Nutrients and ammonia. It is more difficult to evaluate the significance of nutrients such as nitrogens (NH_3 and NO_3) and phosphorus. No numerical values are given for nutrients in Louisiana Water Quality Standards, which state, "The naturally occurring nitrogen-phosphorus ratio shall be maintained. On completion of detailed studies on the naturally occurring levels of the various macro and micro nutrients, the state will establish numerical limits on nutrients where possible" (Louisiana Stream Control Commission, 1973). As yet no numerical

TABLE 2-5
WATER QUALITY DATA
HEAVY METALS

LOCATION		HEAVY METALS Average Concentrations, mg/l						
Station	Waterway	Lead	Mercury	Zinc	Cadmium	Copper	Arsenic	Chromium
1	MR-GO @ Bayou Dupre	<0.5 (1)	$\boxed{0.0163}$ (1)	<0.1 (1)	--	--	--	--
2	MR-GO & GIWW Junction	$\boxed{0.496}$ (3)	$\boxed{0.0154}$ (3)	<0.1 (9)	<0.1 (9)	<0.2 (9)	0.0147 (9)	<0.15 (9)
3	GIWW @ N.O. Public Service Elec.near Paris Road Bridge	<0.5 (7)	$\boxed{0.1304}$ (7)	<0.1 (7)	<0.1 (7)	<0.2 (7)	0.0139 (7)	<0.15 (7)
4	GIWW near Paris Road Bridge	<0.5 (8)	$\boxed{0.0807}$ (8)	<0.1 (8)	<0.1 (8)	<0.2 (8)	<0.01 (8)	<0.15 (8)
5	GIWW @ Mile 63.0	--	--	--	--	--	--	--
6	GIWW @ Mile 64.9	--	--	--	--	--	--	--
7	Junction of GIWW & IHNC	<0.5 (11)	$\boxed{0.010}$ (11)	<0.1 (11)	--	--	--	--
8	IHNC & Gentilly Road Bridge	--	--	--	--	--	--	--
9	Bayou Dupre 0.5 Miles West MR-GO	<0.5 (1)	$\boxed{0.0272}$ (1)	<0.1 (1)	--	--	--	--
10	Lake Borgne @ Entrance to Bayou Dupre	<0.5 (1)	$\boxed{0.0163}$ (1)	<0.1 (1)	--	--	--	--
11	Lake Borgne @ Entrance to Bayou Bienvenue	<0.5 (1)	$\boxed{0.0068}$ (1)	<0.1 (1)	--	--	--	--
12	Lake Borgne 1.0 Miles East of Bayou Bienvenue	<0.5 (1)	$\boxed{0.0106}$ (1)	<0.1 (1)	--	--	--	--

Numbers in parenthesis under the lines indicate the period of record: Source: The Corps of Engineers, New Orleans District.

(1) Summary 50-hour water quality observations 16, 17, 18, December, 1972.
(2) Period of record March, 1972 - May, 1973.
(3) Period of record October, 1972 - May, 1973.
(4) Period of record June, 1972 - April, 1973.
(5) Period of record October, 1972 - June, 1973.
(6) Period of record June, 1972 - December, 1973.
(7) Period of record April, 1973 - June, 1973.
(8) Period of record April, 1973.
(9) Period of record April, 1973 - May, 1973.
(10) Period of record July, 1972 - April, 1973.
(11) Period of record October, 1972 - December, 1972.

Water quality sample points - reference number to Corps stations.

1: 85764
2: 76030
3: 76042
4: 76040
5: 76190
6: 76180
7: 76064
8: 76063
9: 86020
10: 85766
11: 85769
12: 86769

▭ = Above Proposed EPA Criteria

TABLE 2-6
WATER QUALITY DATA
ORGANIC POLLUTION

LOCATION		ORGANIC POLLUTION PARAMETERS							
		Average Values						Coliforms	
Station	Waterway	Temp, °C	BOD_5	DO	NH_3-N	NO_3-N	P	Total	Fecal
1	MR-GO @ Bayou Dupre	9.6 (1)	2.6 (1)	10.3 (1)	0.2 (1)	0.1 (1)	0.06 (1)	$\boxed{609}$ (1)	48 (1)
2	MR-GO & GIWW Junction	20.1 (2)	2.0 (3)	8.5 (2)	0.43 (3)	0.35 (3)	0.16 (3)	$\boxed{1,180}$ (3)	104 (3)
3	GIWW @ N.O. Public Service Elec. near Paris Road Bridge	27.8 (6)	1.9 (5)	7.1 (6)	0.34 (5)	0.49 (5)	0.21 (5)	$\boxed{2,240}$ (7)	177 (7)
4	GIWW near Paris Road Bridge	22.2 (4)	9.9 (8)	8.5 (4)	0.23 (8)	0.35 (8)	0.92 (8)	$\boxed{11,667}$ (8)	$\boxed{1,287}$ (8)
5	GIWW @ Mile 63.0	20.3 (10)	--	8.1 (10)	--	--	--	--	--
6	GIWW @ Mile 64.9	20.2 (10)	--	8.1 (10)	--	--	--	--	--
7	Junction of GIWW & IHNC	20.0 (10)	1.1 (11)	8.0 (10)	0.84 (11)	0.19 (11)	0.10 (11)	$\boxed{3,450}$ (11)	$\boxed{413}$ (11)
8	IHNC & Gentilly Road Bridge	20.6 (10)	7.7 (10)	8.2 (10)	--	--	--	--	--
9	Bayou Dupre 0.5 Miles West MR-GO	9.2 (1)	2.4 (1)	9.1 (1)	0.5 (1)	0.1 (1)	0.09 (1)	$\boxed{793}$ (1)	$\boxed{410}$ (1)
10	Lake Borgne @ Entrance to Bayou Dupre	9.2 (1)	2.8 (1)	10.8 (1)	0.2 (1)	0.1 (1)	0.11 (1)	62 (1)	20 (1)
11	Lake Borgne @ Entrance to Bayou Bienvenue	9.0 (1)	0.4 (1)	9.8 (1)	0.2 (1)	0.0 (1)	0.05 (1)	$\boxed{3,600}$ (1)	25 (1)
12	Lake Borgne 1.0 Miles East of Bayou Bienvenue	8.8 (1)	2.0 (1)	9.6 (1)	0.2 (1)	0.1 (1)	0.06 (1)	$\boxed{96}$ (1)	24 (1)

Numbers in parenthesis under the lines indicate the period of record:

(1) Summary 50-hour water quality observations 16, 17, 18, December, 1972.
(2) Period of record March, 1972 - May, 1973.
(3) Period of record October, 1972 - May, 1973.
(4) Period of record June, 1972 - April, 1973.
(5) Period of record October, 1972 - June, 1973.

Source: The Corps of Engineers, New Orleans District.

(6) Period of record June, 1972 - December, 1973.
(7) Period of record April, 1973 - June, 1973.
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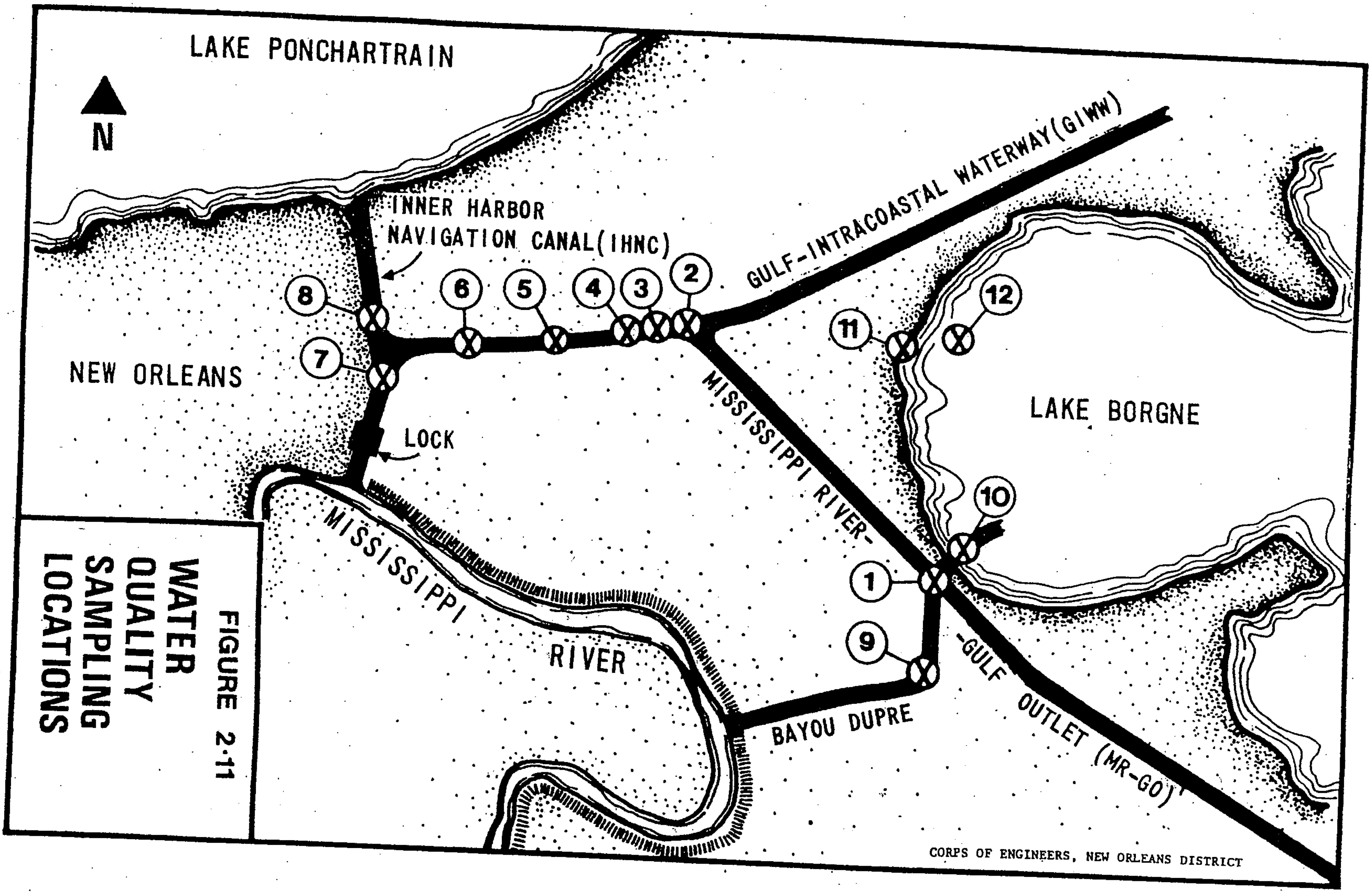
$\boxed{}$ = Above Proposed EPA Criteria



CORPS OF ENGINEERS, NEW ORLEANS DISTRICT

FIGURE 2·11

WATER QUALITY SAMPLING LOCATIONS

limits have been established for waters of the MR-GO. The proposed EPA criteria set a limit of unionized ammonia of 0.4 mg/1. At the pH's encountered in estuarine waters, most of the ammonia is in the ionized (NH_4+) form. The ammonia concentrations shown in Table 2-6 are total ammonia. The nonionized faction of the total ammonia would be considerably below 0.4 mg/1 in all cases.

5. Coliforms. Average total coliforms at all stations (except No. 10) are greater than the median allowable value of 70 per 100 ml. Average values may be distorted when they include extremely high coliforms levels after run-off conditions. Median values may, in many of the cases, be below 70. The relationship between mean and median coliform values may be observed from the oyster water quality survey shown on Figure 2-10. Three of the sampling stations show fecal coliforms above the proposed EPA criteria of 200/100 ml. The EPA criteria are monthly averages. These three stations indicate unacceptable fecal contamination, particularly Station 4 with a fecal coliform level of 1,287/100 ml.

(c) Heavy metals

1. Criteria. EPA proposed criteria for concentrations of heavy metals are shown in Table 2-4. In Table 2-5, most of the available data on concentrations are given as being below a certain level (less than 0.5 mg/1); therefore, actual concentrations are not available. Numerical standards for heavy metals are not given in Louisiana Water Quality Standards. The standard calls for levels not to exceed one-tenth of the TLM_{96}, which is the concentration that will cause irreversible damage to 50 percent of the test organisms during a 96-hour exposure. Toxicity levels for various aquatic organisms in the MR-GO area are not readily available.

2. Ambient sea water levels. The 1968 report of the National Technical Advisory Committee on Water Quality gives ambient concentrations of various metals in sea water, as follows:

Arsenic	0.003 mg/1
Cadmium	0.08 mg/1
Chromium	0.00005 mg/1
Copper	0.003 mg/1
Mercury	0.00003 mg/1
Lead	0.00003 mg/1
Nickel	0.0054 mg/1
Zinc	0.01 mg/1

3. Comparisons. Concentrations shown in Table 2-5 appear to be considerably above these ambient concentrations. Comparison of heavy metal concentrations with the proposed EPA water quality criteria (Table 2-4) indicates the following for each constituent for the available data:

Arsenic - Concentrations are below the standard of 0.05 mg/1.

Cadmium - Concentrations are below 0.1 mg/1, but still could be above the unacceptable level of 0.01 mg/1.

Chromium - Concentrations are below 0.15 mg/1 and may be below the unacceptable level of 0.1 mg/1.

Copper - Concentrations are below 0.2 mg/1, but still could be above the unacceptable level of 0.05 mg/1.

Lead - One value (Station 2) is considerably above the proposed EPA criteria of 0.05 mg/1. Other concentrations are less than 0.5 mg/1 and quite probably are above 0.05 mg/1.

Mercury - All concentrations are considerably above the unacceptable level of 0.001 mg/1.

Zinc - Concentrations are below the unacceptable level of 0.1 mg/1.

It appears that the heavy metals, lead and mercury, are considerably above acceptable levels. Whether these concentrations are high enough to be toxic to aquatic organisms is speculative at this time. As mentioned in the following discussion of waste discharges, it does not appear that there are sufficient industrial or municipal wastewater discharges of the type or magnitude to cause the elevated levels of heavy metals. Stormwater run-off can contain high lead concentrations and could be the source of much of the lead found in the waters and sediments of the MR-GO and associated waterways.

(5) Wastewater discharges

(a) Summary. Based on presently available data, it appears that municipal and industrial discharges into the MR-GO area are of neither the type, nor of sufficient magnitude to be significant sources of organic or heavy metal pollution. In contrast, stormwater run-off, particulary run-off pumped into Bayou Bienvenue, may be of sufficient magnitude to cause significant pollution from both the organic and heavy metal (primarily lead) standpoint.

(b) Nature and dispersion of wastewater discharges. Pollutants may enter the MR-GO from a variety of sources. These sources may be categorized into municipal wastewater discharges, industrial wastewater discharges, and stormwater run-off. Municipal and industrial discharges are more or less continuous in nature. Stormwater run-off is intermittent as a result of precipitation, but may occur daily in the rainy seasons. All existing wastewater discharged into the MR-GO, the GIWW, and the IHNC were summarized. The summary of municipal and industrial discharges is based on the report by Burke and Associates, Inc., 1973. Maintenance of water quality and of quality of dredged material will be dependent upon control of incoming discharges. The objective of this portion of the report is determination of present sources of incoming pollutants.

(c) Municipal wastewater discharges. Table 2-7 shows the municipal wastewater discharges. Municipal wastewater treatment plant effluents primarily contain pollutants in the nature of organic material, nutrients, and coliforms, with few if any, heavy metals. None of the listed municipal wastewater treatment facilities discharge directly into the MR-GO. The total municipal wastewater discharge of 4.3 million gallons per day (MGD) (6.7 cfs) is very small relative to the dilution volume available in the receiving waterways. This cannot be considered a significant pollutant source.

TABLE 2-7

MUNICIPAL WASTEWATER DISCHARGES

Community	Receiving Waterway	Treatment	Average Discharge, MGD
Venetian Isles	GIWW	Oxidation Pond	0.21
New Orleans East	GIWW	Activated Sludge	1.5
St. Bernard Sewer District #1	Forty Arpent Canal		0.5
St. Bernard Sewer District #2	Forty Arpent Canal		2.0
St. Bernard Canal Street	Lake Borgne Canal	Oxidation Pond	0.04
St. Bernard River Bend	Forty Arpent Canal	Oxidation Pond	0.06
		Total	4.31 MGD

Source: Burk and Associates, 1973

(d) <u>Industrial wastewater discharges</u>. Industrial wastewater discharges are shown in Table 2-8 listed by receiving waterway. Industrial wastewaters may contain almost any kind of pollutant depending on the product manufactured or produced. It has been assumed that if a pollutant was not listed in the Burke Report that significant quantities of that particular pollutant were not present in the wastewater discharge. The majority of discharges are into the IHNC. If the cooling water discharges of the two New Orleans Public Service power plants of 114 and 603 MGD are removed the total industrial wastewater discharge is only 4.06 MGD (6.3 cfs). There also appears to be no significant industrial discharge of heavy metals.

TABLE 2-8

INDUSTRIAL WASTEWATER DISCHARGES

Industry	Receiving Waterway	Average Discharge, MGD	Wastewater Discharge lb/day							
			BOD	COD	V.S.	NO_3	Pb	Hg	Ni	Zn
Owens-Ill., Inc.	IHNC	0.2	12.2	103	134	0.16	0.016	0.002	0.016	0.63
Southern R.R.	IHNC	0.022	5.8		25.4					
Lone Star Industries	IHNC	0.04								
U. S. Gypsum Co.	IHNC	0.65	94	1,323	3,253					
Belden Concrete	IHNC	0.001			5.1					
NOPSI A. B. Patterson Plt	IHNC	114								
Ideal Cement Co.	IHNC	0.002								
Jahncke Service, Inc.	IHNC	1.06	115	1,503	4,066	2.3				
Johns-Manville	Florida Ave. Canal	0.04	62.4		26.6					
NOPSI Michoud Plant	Miss. River & MR-GO	603	8,046							
Airco	GIWW	0.062								
Air Products & Chemicals, Inc.	GIWW	0.59								
Louisiana Cement Co.	Michoud Canal & GIWW	0.84	159	2,768	4,427					
Union Texas Petro Toca Plant	Caernarvon Canal to Lake Levy	0.55	50	77	75.7					

Source: Burk and Associates, Inc., 1973.

(e) Stormwater run-off

1. The New Orleans situation. Stormwater run-off from the City of New Orleans enters the waterways at a variety of locations. Stormwater run-off from urban areas may be a significant source of pollutants. The quantity and quality of stormwater run-off depends on many interrelated factors such as the intensity, duration, and areal distribution of storms; the time interval between storms; topography of the drainage area; land uses; population densities; and size and layout of the drainage system. New Orleans is served by a separate stormwater and sanitary sewer system. The geologic formations under the City are in a continual state of shifting and subsidence. This has caused a considerable amount of sewer line settlement and breakage, which results in leakage from sanitary sewers to storm sewers and vice-versa. Therefore, much of the stormwater run-off is contaminated with domestic sewage.

2. Pumping capacity. The City of New Orleans has a stormwater sewer system that drains approximately 50,000 acres. With an annual mean precipitation of 57 inches, a considerable amount of stormwater run-off is generated each year. Stormwater is collected at pumping stations, with a total maximum pumping capacity of 50,000 cfs, and pumped into the receiving body of water. The large majority of the storm water is pumped into Lake Pontchartrain. A total of five pumping stations discharge stormwater run-off into either the IHNC, the Michoud Canal, the GIWW, or the MR-GO as shown in Table 2-9. These five pumping stations have a total capacity of 3,352 cfs which is 6.7 percent of the total stormwater pumping capacity of 50,000 cfs for the City of New Orleans. Personal communication with the Superintendent of the New Orleans Sewage and Water Board indicates that all stormwater pumps have averaged about 100 hours of operation per year. If Pumping Station No. 5 is used as an example, it can be calculated that a 2,360 cfs capacity for 100 hours per year results in a total yearly pumpage of 850,000,000 cubic feet, or an average 17.3 million gallons per day (MGD). The stormwater run-off is intermittent in nature, and after a particularly heavy rainfall the volume of run-off pumped into the Bayou Bienvenue could be a significant "slug load" of pollutants to the MR-GO.

TABLE 2-9

STORMWATER PUMPING STATION CAPACITIES

Pumping Station	Receiving Waterway	Maximum Capacity (cfs)
Pumping Station #5	Bayou Bienvenue to MR-GO	2,360
Pumping Station #15	Michoud Canal to MR-GO	750
Elaine Street	GIWW	90
Grant Street	GIWW	32
Dwyer Street	IHNC	120
TOTAL		3,252

Source: Pers. Comm. Sullivan, 1974

3. Characteristics of stormwater run-off

a. A study, conducted on hypochlorination of a stormwater pumpage at New Orleans (Pontius, Pavia, and Crowder, 1973) determined pollutant concentrations in stormwater over a 22 month period in 1967 and 1968. Selected results of this investigation are summarized in Tables 2-10 and 2-11. Pumping Stations No. 3, 4, and 7 pump stormwater run-off in the London Avenue and Orleans Avenue Canals that flow into Lake Pontchartrain. Table 2-10 summarizes stormwater characteristics at the suction end of the pumping stations and Table 2-11 summarizes bacterial concentrations of samples taken both at the suction end and from the Canals.

b. Mean BOD concentrations in stormwater pumpage are considerably above concentrations found in the waters of the MR-GO and DO concentrations are considerably below concentrations found in the MR-GO (Table 2-6). For normally distributed data approximately 67 percent of the data fall between plus or minus one standard deviation from the mean. Therefore at Pumping Station No. 7, a BOD concentration equal to 26.5 mg/1 (the mean plus one standard deviation) was exceeded approximately 16 percent of the time [100% - (50% + 1/2 x 67%)].

c. Table 2-10 shows that total and fecal coliform bacteria are quite high. All concentrations are well above bacterial standards set for the waters of the MR-GO. This indicates that stormwaters are contaminated by domestic sewage and can be a significant source of pollutants to the MR-GO, if discharges are of a sufficient magnitude.

d. No data are available on heavy metal concentrations in New Orleans stormwater run-off. The most significant heavy metal is lead, a result of motor vehicle exhausts. Stormwater run-off from urban areas may contain lead in concentrations up to 2 mg/1 (Pers. Comm. Sullivan, 1974).

e. In contrast to the municipal and industrial wastewater discharges, stormwater run-off appears to be a significant source of pollutants to the MR-GO. In particular, the pumping station discharging into Bayou Bienvenue is probably a quite significant source of pollutants during high run-off conditions.

TABLE 2-10

NEW ORLEANS STORMWATER CHARACTERISTICS

(for period of March, 1967 to November, 1968)

Constituent	Concentrations, mg/1	
	Pumping Sta. #4	Pumping Sta. #7
BOD		
Mean	6.7	15.2
Std. Dev.	4.9	11.3
COD		
Mean	56.3	76.3
Std. Dev.	37.9	48.9
DO		
Mean	4.3	2.8
Std. Dev.	4.0	1.8
Suspended Solids		
Mean	27.4	35.5
Std. Dev.	22.8	36.6
pH		
Mean	7.7	7.6
Std. Dev.	0.4	0.3

Samples taken at suction to pumping stations

Source: Pontius, Pavia and Crowder, 1973

TABLE 2-11

NEW ORLEANS STORMWATER COLIFORM BACTERIA CONCENTRATIONS

(for period of March, 1967 to November, 1968)

Location	Percentile Concentrations, organisms/100 ml					
	Total Coliform			Fecal Coliform		
	25%	Median or 50%	75%	25%	Median or 50%	75%
London Ave. Canal (Pumping Sta. #3 & #4)	16,000	80,000	470,000	650	4,900	21,000
Orleans Ave. Canal	105,000	1,050,000	6,000,000	5,500	40,000	250,000

Source: Pontius, Pavia and Crowder, 1973.

c. Other characteristics of water

(1) Surface water and salinity. The movement of surface water was discussed in subsection a. Water quality was discussed in subsection b. The region traversed by the MR-GO has been disassociated from the Mississippi River for about 2,000 years. The fresh water which comes into the area is derived from local rainfall, and from fresh water sources of Lake Pontchartrain. Intrusion of salt water into the marshlands is naturally a result of long-term geological processes associated with subsidence of the delta, as well as being a result of the presence of the MR-GO. Table 2-12 shows the yearly average sailinities and the ranges that occurred at various sampling stations in the MR-GO vicinity from 1960 through 1968 (Fontenaut and Rogillio, 1970). Average salinities in the MR-GO vary from 5.5 p.p.t. (parts per thousand) of chlorides at the upper end of the inland reach to 13.1 p.p.t. at the lower end near Breton Sound. Salinities in the open water in Breton Sound approach 18 p.p.t. of chlorides.

(2) Tides. Tides on the MR-GO are essentially diurnal. The mean range varies between 1.0 at the IHNC and 1.5 feet at Gardner Island near Mile 20 of the MR-GO. The mean tide level varies between 0.5-foot at the IHNC to 0.8-foot at Gardner Island. The maximum spring range at Gardner Island is 2.8 feet, and is comprised of a -0.8-foot low and a 2.0-foot high (referenced to m.l.w. datum). The neap tides are semidiurnal and have a range of 0.1 feet. Wind and storm tides reach levels of 6 to 8 feet above sea level in Louisiana, and hurricane surges produce heights of 12 feet or more along the coast line.

(3) Current observations on Chandeleur Sound. Table 2-13 shows a tabulation of current velocities which were measured in conjunction with construction of the MR-GO. Observations were made fairly continuously for 23 months at two stations located north of the present alignment of the MR-GO. The data were analyzed to determine the proportion of time the current direction had northerly or southerly directional components and the mean velocities for each component. The data indicate the predominance of northerly flow in the circulation pattern of Chandeleur Sound (Department of the Army, 1964). In Breton Sound, current velocities average about 0.3 feet per second (fps) annually and about 0.7 fps during the period July through November. During hurricanes, velocities may exceed 4.4 fps.

(4) Currents in the MR-GO. Currents in the MR-GO are influenced by the stages and freshwater inflows into Lake Pontchartrain. During periods of low stages and inflows, July through November, surface ebb and bottom flood velocities average about 0.8 and 1.7 fps, respectively, and both may exceed 2 fps. The mean annual velocity in the channel is about 0.6 fps. Flood and ebb velocities predominate at the lake and gulf end of the channel, respectively.

TABLE 2-12

YEARLY AVERAGE SALINITIES (ppt) AND RANGES THAT OCCURRED AT THE VARIOUS SAMPLING STATIONS FOR PERIOD JULY 1960 - JULY 1968.

Year	Lake Borgne		Lena Lagoon		Stump Lagoon		Brick Lagoon		Lake Eloi	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
1960-61	5	3-8	7.5	3.5-15					18	7-31
1961-62	4	1-9	8	1-17.5	9	3-22			11.5	2-17.5
1962-63	10.5	7-14	16	11-26	20	17-24			24.5	18-31
1963-64	4	1-8.5	12	9-16	15	10.5-18	4	2-8	21.5	15-31
1964-65	7	3-10	12	7-16	13	6-18.5	7	3.5-12	14	8-23
1965-66	10	6-18	14	8-20	16	6.5-20	12	7-19	15	8-21
1966-67	10	5-13	13.5	4.5-19	14.5	11-19.5	9	1-14	16	10-24
1967-68	11	7.5-13.5	14	8.5-19	14	10-18	10.5	7-13.5	16	10-21

Source: Fontenaut and Rogillio, 1970

TABLE 2-13

TABULATION OF CURRENT VELOCITIES FROM NORTH AND SOUTH OF CHANNEL ALIGNMENT "D"

Current Vel. (ft./sec.)	No. Obs.	(300°-0-120°) Current Component from North to South	(121°-299°) Current Component from South to North
Station C (Tower in Chandeleur Sound)			
0.34	519	179	340
0.51	139	33	106
0.68	47	13	34
0.85	16	3	13
1.02	2	0	2
Totals	723	228	495
Station B (Tower in Chandeleur Sound)			
0.34	367	122	245
0.51	99	35	64
0.68	27	3	24
0.85	13	2	11
1.02	3	2	1
1.19	2	1	1
Totals	511	165	346

Source: Department of the Army, 1964.

d. Sediment analysis*

(1) Sample collection and criteria. Samples of sediment from the MR-GO, from the Lake Borgne entrances to Bayou Dupre and Bayou St. Malo, and two disposal bank samples near Mile 47 were collected in conjunction with this impact statement. At the nine sampling stations on the MR-GO, a centerline sample and a north side and south side sample were taken. Thirty samples were collected with a ponar dredge and analyzed for the following parameters: sediment grain-size (silt/clay/sand content), percentage of Total Solids, percentage of Volatile Solids, Chemical Oxygen Demand, Total Kjeldahl Nitrogen, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc. On June 26, 1973, the EPA Region VI Office proposed a set of criteria for open water disposal of dredged material. These criteria are shown in Table 2-14.

(2) Results of sediment sample analysis. The number and densities of samples taken for this study are not sufficient to fully characterize the sediments to be dredged in future O&M work. The results of this analysis compared to EPA criteria are presented in Table 2-15. Sample parameters for total Kjeldahl nitrogen, chromium, copper, and nickel were below the criteria. Tables 2-16 and 2-17 summarize the sample data relative to the criteria. Figure 2-12 shows the locations of sample station where the parameters were greater than or equal to the EPA criteria. Detailed results and lab procedures for the sediment sample analysis for this impact statement are contained in Appendix C. Of the total number of bottom sample locations on the MR-GO (27), all but two failed one or more EPA criteria. Both overbank samples failed four criteria. All four samples at the Lake Borgne entrances to Bayous Dupre and St. Malo failed at least one criterion.

(3) Implications of sample analysis results

(a) These samples show that there is necessity for subsequent analysis of sediment quality prior to dredging operations, particularly from Mile 30 to Mile 10 where samples indicate that concentrations for lead, mercury, or zinc exceed the proposed criteria. The samples taken for this study measured the total amount of heavy metals in the samples, which includes ionic and precipitated forms. The primary concern in dredging is the amount of material that may be resuspended or resolubilized in water and thus made available for uptake by biota and subsequent introduction into the food chains.

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*Final interim guidelines for disposal of dredged or fill material in navigable waters have been published by EPA in the Federal Register (FR 41:292) on 5 September 1975. A discussion of the guidelines with respect to water quality is attached as Appendix D in the environmental statement.

TABLE 2-14

EPA REGION VI DREDGED MATERIAL CRITERIA
MAXIMUM CONCENTRATIONS
JUNE 26, 1973

Parameter	EPA Region VI Criteria	
	Percent	ppm
Volatile Solids	8.0	80,000
Chemical Oxygen Demand	5.0	50,000
Total Kjeldahl Nitrogen	0.10	1,000
Mercury	0.0001	1
Lead	0.005	50
Zinc	0.0075	75
Arsenic	0.0005	5
Cadmium	0.0002	2
Chromium (total)	0.01	100
Copper	0.005	50
Nickel	0.005	50

All values are in percent by dry weight.

Source: Corps of Engineers

TABLE 2-15

SAMPLES EQUAL TO OR ABOVE PROPOSED EPA CRITERIA OF 6/26/73

Parameter	Number of Samples		
	MR-GO	Bayous	Overbank
	(Total = 27)	(Total = 4)	(Total = 2)
Percent Volatile Solids	17	4	2
Chemical Oxygen Demand	11	1	0
Total Kjeldahl Nitrogen	0	0	0
Lead	1	0	1
Mercury	6	0	1
Zinc	2	0	0
Arsenic	13	2	2
Cadmium	8	0	2
Chromium	0	0	0
Copper	0	0	0
Nickel	0	0	0

Source: Stanley Consultants and D. B. McDonald Research.

TABLE 2-16

ORGANIC POLLUTION PARAMETERS IN SEDIMENT SAMPLES

Location	Volatile Solids (in percent)			COD (in ppm in thousands)			Total Kjeldahl Nitrogen (ppm)		
	S*	C*	N*	S	C	N	S	C	N
MR-GO									
Mile 40	$\boxed{14.4}$	$\boxed{13.3}$	$\boxed{10.7}$	$\boxed{61}$	$\boxed{53}$	$\boxed{53}$	120	320	120
Mile 35	$\boxed{17.6}$	$\boxed{8.1}$	$\boxed{19.1}$	$\boxed{79}$	46	$\boxed{88}$	110	210	270
Mile 30	$\boxed{12.1}$	$\boxed{15.9}$	$\boxed{12.3}$	$\boxed{56}$	$\boxed{60}$	38	140	280	120
Mile 25	$\boxed{13.4}$	$\boxed{12.4}$	$\boxed{10.3}$	$\boxed{75}$	$\boxed{86}$	48	250	400	200
Mile 20	4.5	$\boxed{10.9}$	4.6	18	$\boxed{68}$	19	67	450	90
Mile 15	3.0	$\boxed{9.0}$	4.5	10	49	22	64	220	87
Mile 10	4.5	$\boxed{9.7}$	3.8	25	$\boxed{51}$	12	100	450	75
Mile 5	--	$\boxed{10.0}$	7.4	33	35	20	290	400	150
Mile 0	5.1	$\boxed{8.5}$	7.7	22	31	27	190	210	330
Bayou Dupre	NS	$\boxed{8.2}$	NS	NS	43	NS	NS	100	NS
Bayou St. Malo (W, C, E)	$\boxed{8.1}$	$\boxed{14.9}$	$\boxed{8.0}$	22	$\boxed{57}$	22	81	210	140
Overbank (high)		$\boxed{8.6}$			11			120	
Overbank (low)		$\boxed{8.2}$			2.6			170	
EPA Criteria		8.0			50			1,000	

Total Solids Sample Range: 30.2% to 77.6%. No EPA Criteria.

☐ Samples equal to or above EPA Criteria.
* S = South, C = Centerline, N = North.
NS - No Samples.

Source: Stanley Consultants and D. B. McDonald Research.

TABLE 2-17

METALS IN SEDIMENT SAMPLES

Location	Lead ppm			Mercury ppm			Zinc ppm			Arsenic ppm			Cadmium ppm		
MR-GO	S*	C*	N*	S	C	N	S	C	N	S	C	N	S	C	N
Mile 40	25	38	40	<0.5	<0.5	<0.5	56	30	72	$\boxed{5.5}$	4.2	3.5	$\boxed{2}$	$\boxed{2}$	1
Mile 35	38	34	36	<0.5	0.5	<0.5	40	31	34	3.0	4.3	$\boxed{8.6}$	$\boxed{2}$	1	1
Mile 30	36	34	38	<0.5	<0.5	<0.5	48	40	$\boxed{100}$	$\boxed{6.0}$	4.1	4.4	$\boxed{2}$	1	1
Mile 25	$\boxed{62}$	39	41	<0.5	<0.5	<0.5	$\boxed{200}$	48	47	4.2	$\boxed{5.5}$	1.9	$\boxed{9}$	1	$\boxed{2}$
Mile 20	39	41	34	0.7	$\boxed{2.2}$	$\boxed{9.0}$	34	39	34	3.5	$\boxed{5.5}$	3.6	1	1	$\boxed{2}$
Mile 15	34	41	20	<0.5	$\boxed{1.5}$	$\boxed{3.0}$	45	34	26	3.2	$\boxed{6.8}$	4.3	1	1	1
Mile 10	27	41	38	<0.5	$\boxed{2.5}$	$\boxed{4.0}$	47	48	23	4.5	$\boxed{5.7}$	2.6	$\boxed{2}$	1	1
Mile 5	12	10	9	<0.5	<0.5	<0.5	21	22	20	$\boxed{6.5}$	$\boxed{6.7}$	$\boxed{6.8}$	0.5	1	0.5
Mile 0	8	14	10	<0.5	<0.5	<0.5	20	23	20	$\boxed{6.7}$	$\boxed{7.5}$	$\boxed{7.2}$	1	0.5	1
Bayou Dupre	NS	40	NS	NS	0.5	NS	NS	48	NS	NS	$\boxed{7.5}$	NS	NS	1	NS
Bayou St. Malo (W, C, E)	6	10	8	<0.5	<0.5	<0.5	5	16	12	$\boxed{6.6}$	2.9	4.3	0.5	0.5	0.5
Overbank (high)		$\boxed{54}$			<0.5			47			$\boxed{6.6}$			$\boxed{2}$	
Overbank (low)		34			$\boxed{5.5}$			62			$\boxed{8.1}$			$\boxed{2}$	
EPA Criteria		50			1			75			5			2	

Other Metals - All sample locations:

Chromium:	Sample Range; 1 to 49 ppm:	EPA Criteria; 100 ppm
Copper :	Sample Range; 2 to 27 ppm:	EPA Criteria; 50 ppm
Nickel :	Sample Range; 1 to 37 ppm:	EPA Criteria; 50 ppm

☐ Samples equal to or above EPA Criteria.
* S - South, C - Centerline, N - North.
NS - No Sample.

Source: Stanley Consultants and D. B. McDonald Research

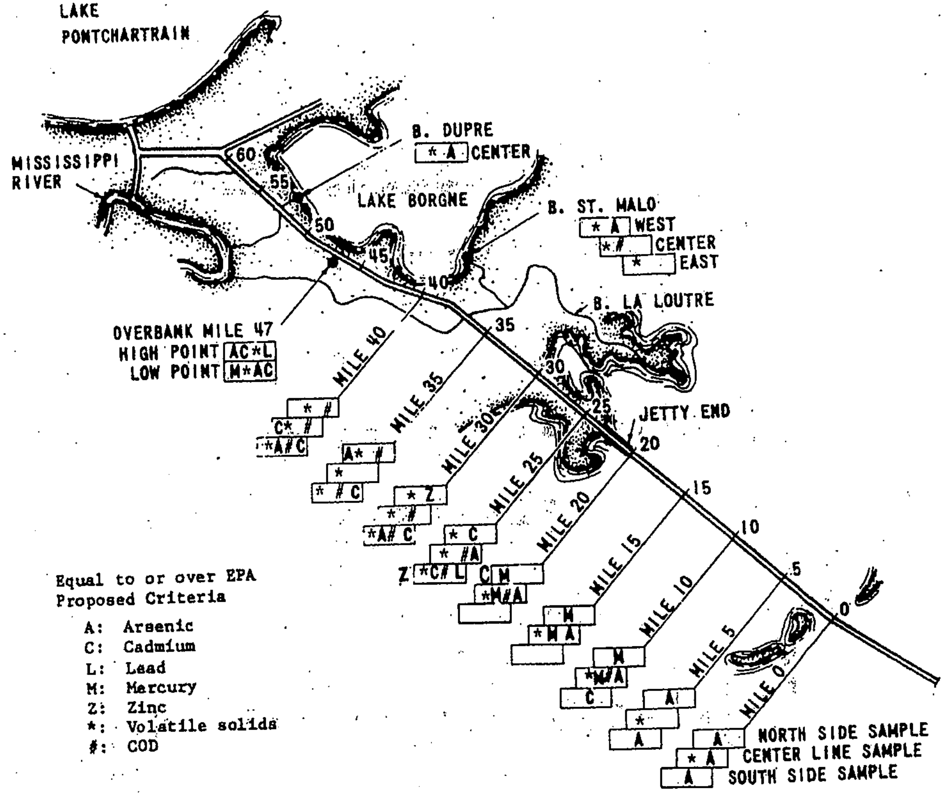

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FIGURE 2-12
SEDIMENT ANALYSIS DATA SAMPLES OVER EPA CRITERIA

(b) In response to the problem of measuring the amount of pollutant material that may be resuspended or resolubilized in dredging operations, the elutriate test has been developed. Regulations specifying procedures for conducting the standard elutriate test as one criterion to determine the pollution status of dredged material for subsequent disposal are contained in ER 1130-2-408 issued by the Corps of Engineers on 17 January 1974. In addition, new regulations for federal disposal of dredged material in navigable or ocean waters went into effect 22 July 1974 (Title 33, Code of Federal Regulations, Chapter II, Part 209.145). Future O&M work on the MR-GO and associated bayous will conform to the new regulations and monitoring requirements of the Environmental Protection Agency.

(c) A number of factors influence whether or not the EPA will oppose plans for disposal of dredged material. Decisions have to be made on a case by case basis with consideration of the following factors:

<u>1</u>. Volume of dredged material.

<u>2</u>. Existing and potential quality and use of the water in the disposal area.

<u>3</u>. Other conditions at the disposal site such as depth and currents.

<u>4</u>. Time of year of disposal (in relation to fish migration and spawning, etc.).

<u>5</u>. Method of disposal and alternatives.

<u>6</u>. Physical, chemical, and biological characteristics of the dredged material.

<u>7</u>. Likely recurrence and total number of disposal requests in a receiving water area.

<u>8</u>. Predicted long- and short-term effects on receiving water quality.

e. Natural or scenic rivers. There are no rivers or water bodies in the Lake Borgne vicinity that are designated as natural, wild, or scenic rivers by Federal agencies. By Louisiana's Act 655, 1975 Louisiana Legislature, Bayous Dupre and Bienvenue have been designated as natural and scenic rivers. Bayou Dupre is designated from the Lake Borgne Canal to Terre Beau Bayou; Bayou Bienvenue is designated from Bayou Villere to Lake Borgne.

f. <u>Uses of surface waters</u>. Surface waters in the Lake Borgne vicinity are an integral part of the delta estuary complex. Surface waters and associated wetlands are the source of the renewable biotic resources taken from the coastal environment. Wetlands serve important natural biological functions including food production, general habitat and nesting, spawning, rearing and sites for aquatic and land species. The wetlands shield inland areas from wave action, erosion, and storm damage. The barrier islands and the marshlands adjacent to the MR-GO provide protection for the urbanized areas around New Orleans. Direct human uses of the surface waters of the MR-GO and associated bayous include the following:

(1) The MR-GO is used for transportation of foreign and domestic cargo to the Tidewater Port Facilities.

(2) The MR-GO and associated bayous are used for access to the Gulf and estuary areas for harvest of marine biota. These waters are also used for recreation navigation and for access for exploration of and extraction of oil and gas resources.

(3) The waters in the Lake Borgne vicinity are also used as a source of cooling water for production of electricity, for reception of municipal and industrial wastewater discharges, and for reception of stormwater run-off from New Orleans and the urban areas on the east bank of the Mississippi River.

2.04 CLIMATIC AND AIR QUALITY ELEMENTS

a. Dust and air quality. Due to the wet, humid subtropical climate, O&M work will not produce persistent dust problems or other significant air pollution problems. Discussion of ambient air quality is thus not germane to this report.

b. Shoaling, channel alignment and storms. Analysis of sedimentation patterns and area hydrology reveal that the major shoaling problems occur as a result of wind-generated waves, local storms and hurricanes rather than from normal tidal and current-related factors. Climatic data for the New Orleans area is presented on Figures 2-13 and 2-14. On Figure 2-14, note the direction of prevailing winds relative to the alignment of the MR-GO. Most of the local storm-related shoaling that causes problems in the sound occurs in spring and summer with prevailing southeast winds. Hurricanes which occur mostly in late summer and fall cause major shoaling to occur. After Hurricane Betsy (September 1965), 20.1 million cubic yards of material were dredged from the channel in Breton Sound in 1967. After Hurricane Camille (August 1969), 25.6 million cubic yards were dredged from the channel in Breton Sound in 1970. There have been 10 major hurricanes in the area since 1893, of which three have occurred in the last 20 years. Hurricanes contribute to shoaling problems in three ways: 1) redistribution of bottom sediment due to wave action, 2) erosion of land areas with in-surge of hurricane-generated waves, and 3) erosion due to the backrush of the storm surge.

	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Normal Monthly Temperatures (1)	57.1	56.0	58.2	62.8	69.7	76.8	82.3	83.4	83.5	80.2	72.6	62.0
Normal Monthly Rainfall (2)	4.7	4.4	4.7	6.2	5.4	5.1	5.5	7.9	6.3	6.0	3.2	3.7
(Max. Monthly Rainfall) (3)	14.4	12.7	13.8	21.1	14.9	18.7	16.0	18.2	22.7	16.6	25.1	14.4
Prevailing Winds (4)		South-Southeast								Northeast-East N.E.		
						Winds Calm 10-16% of Time						
Hurricane Season (4)									Hurricanes			
Rainy Seasons (4)	Heavy Winter Rains						P.M. Thundershowers					

Temperatures:(4)	Average Summer Temperature	83.1° F
	Average Winter Temperature	57.1° F
	Mean Annual Temperature	70° F
	Extreme Low	7° F in 1899
	Extreme High	102° F in 1954
Rainfall:(4)	Average Annual Rainfall	63 inches per year
	Annual High	85.7 inches in 1875
	Annual Low	31.3 inches in 1899
Snowfall:(4)	Last Recorded	4.5 inches in December, 1963

(1) U. S. Weather Bureau Normals, 1931-1960

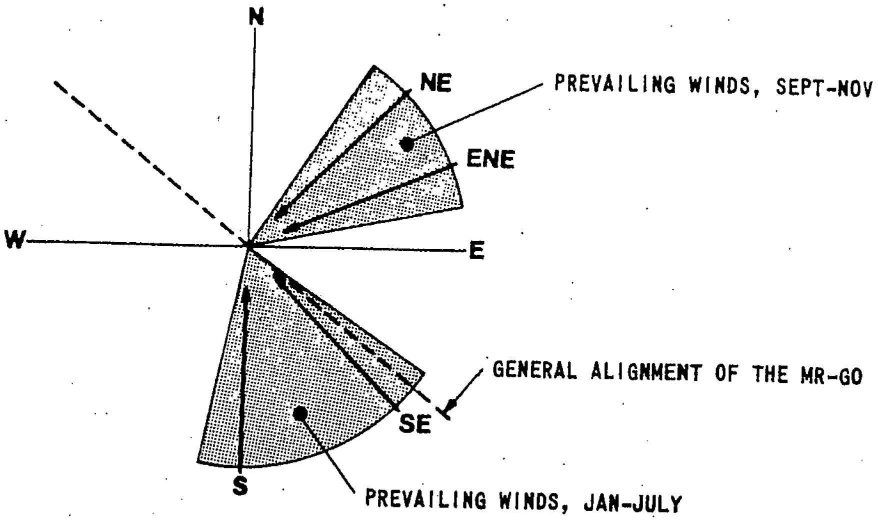
(2) U. S. Weather Bureau Normals, 1931-1960

(3) Based on Records from 1870-1968

(4) (Gagliano, 1972)

FIGURE 2·13

CLIMATE DATA SHEET 1



AVERAGE MONTHLY WIND VELOCITY

m.p.h.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
	PERCENT OF TIME											
0-7	39.2	37.0	33.4	32.1	35.9	45.6	56.0	63.1	63.8	51.9	51.1	42.5
8-12	32.9	33.4	32.8	32.6	33.6	34.3	32.9	28.7	28.1	29.2	28.8	30.2
13-18	21.8	22.3	25.9	27.1	24.8	17.3	10.4	7.4	7.4	15.8	16.1	20.5
19+	6.1	7.3	7.9	8.2	5.7	2.8	0.7	0.8	0.7	3.1	4.0	6.8

ANNUAL WIND DIRECTION SUMMARY

N SSW (inclusive) = 66.61% of the time
SW NNW (inclusive) = 22.51% of the time
Calm = 10.88% of the time

ANNUAL WIND VELOCITY SUMMARY

0-12 mph = 77.51% of the time
13-18 mph = 18.01% of the time
19 mph + = 4.48% of the time
Average annual wind velocity = 8.6 mph

(1) Gagliano, 1972, Based on U. S. Weather Bureau Records.
New Orleans International Airport
Moisant Field (1949-1964)

FIGURE 2-14

CLIMATE DATA SHEET 2

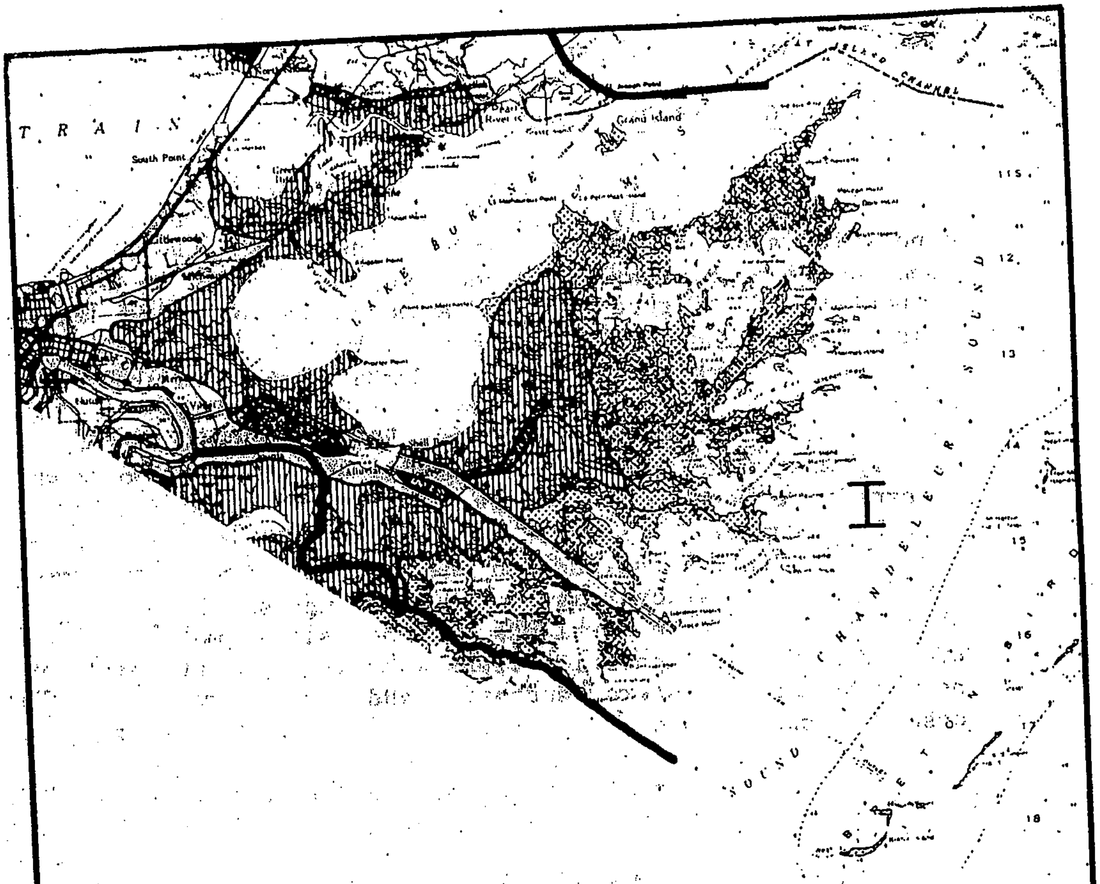
2.05 BOTANICAL ELEMENTS

a. General description

(1) The area traversed by the MR-GO and associated bayous consists mainly of marshlands, elevated dredged material deposition areas on the west side of the MR-GO channel, and remnants of an old natural levee roughly parallel to Bayou La Loutre. See Figure 2-15. Plants typical of saline marshes near Breton Sound are oystergrass, saltgrass, black rush, black mangrove, wiregrass, and Batis. Plants typical of brackish water marshes adjacent to a large proportion of the length of the MR-GO include wiregrass, saltgrass, three-cornered grass, oystergrass, black rush, widgeongrass, and dwarf spike rush. The intermediate marshlands, mostly near the old natural levee, typically support wiregrass, roseau, bulltongue, and others. The intermediate marshlands on the natural levees sometimes support live oak, dead baldcypress, and other nongrass, nonsedge associations. These highlands, the occasional mounds, and the dredged material deposition areas may also support shrubs such as marsh-elder, eastern baccharis, and blackberry. More complete descriptions of each of the vegetational communities follow.

(2) Several studies of the vegetation of the MR-GO vicinity have been conducted: Texas A&M in 1958-60, the U. S. Department of Interior in 1962, Valentine in 1968, Lemaire, 1961, etc. Some of the more recent studies used in this report include Chabreck, 1970, 1972, and 1973; Chabreck et al., 1968; and Palmisano, 1970 and 1971. Other studies include those by Lloyd and Tracy, 1901; Brown, 1936; Penfound and Hathaway, 1938; Humm, 1956; and Chamberlain, 1957. The discussion which follows is based primarily on Chabreck and Lemaire.

(3) Chabreck uses four Louisiana coastal marsh type designations: fresh, intermediate, brackish, and saline. All but freshwater marshes are found in the MR-GO vicinity. Figure 2-15 shows the general locations of these marsh types relative to the MR-GO and the city of New Orleans. Penfound and Hathaway, 1938, mentions that "the most important factors in accounting for the various salt marsh and zonal communities are water level, soil moisture, and salinity of soil water." The relationship between salinity and vegetation type according to Penfound's classification is shown on Table 2-18. Penfound and Hathaway, 1938, stress the importance of elevation in determination of vegetation type, stating "The transition from one community to another is conditioned by a change in elevation of as little as three inches. On a transect taken from the Oak Island cheniere, they found that the fall from forest to shrub zone is at least 14 inches, the fall from shrub to cane is about 6 inches, and the fall from cane to marsh proper is about 2 inches."



▒ *SALINE MARSHES* - Typical vegetation is oystergrass (<u>Spartina alterniflora</u>), <u>Salicornia sp.</u>, black rush (<u>Juncus roemerianus</u>), <u>Batis maritima</u>, black mangrove (<u>Avicennia nitida</u>), and saltgrass (<u>Distichlis spicata</u>)

▥ *BRACKISH MARSHES* - Marshes of moderate salinity with typical vegetation consisting of wiregrass (<u>Spartina patens</u>), three-cornered grass (<u>Scirpus olneyi</u>), coco (<u>Scirpus robustus</u>), and widgeongrass (<u>Ruppia maritima</u>)

▓ *INTERMEDIATE MARSHES* - Marshes of low salinity with typical vegetation consisting of wiregrass, deer pea (<u>Vigna repens</u>), bulltongue, wild millet (<u>Echinochloa walteri</u>), bullwhip (<u>Scirpus californicus</u>) and sawgrass (<u>Cladium jamaicense</u>)

☐ *NON-MARSH AREAS*

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August, 1968

COOPERATING AGENCIES
Louisiana Wildlife and Fisheries Commission
U S Army Corps of Engineers
Louisiana Cooperative Wildlife Research Unit L S U

FIGURE 2-15

VEGETATION MAP

TABLE 2-18
SALINITY: RANGE, MEAN Na CONTENT AND pH OF MARSH TYPES

Type	Salinity Range (ppt)	Mean Na Content (ppt)	Mean pH
Saline Vegetation Type	> 20	4.11	6.49
Brackish Vegetation Type	10-20	3.26	5.71
Intermediate Vegetation Type	5-10	1.51	5.54
Freshwater Vegetation Type	< 5	0.62	5.42

Source: Penfound and Hathaway, 1938.

b. Community descriptions. Plant species in the project area are listed in tables in Appendix A by life form, i.e., trees, shrubs, woody vines, and herbaceous plants. Table 2-19 shows the percentage of plant cover for the major species in each of the three marsh types of the MR-GO vicinity according to Chabreck, 1972.-

TABLE 2-19
MAJOR SPECIES FOR SALINE, BRACKISH, AND INTERMEDIATE MARSHES
(Of Hydrologic Unit 1)

Species	Vegetative Type		
	Saline	Brackish	Intermediate
	———— Percent ————		
	Hydrologic Unit 1		
Cyperus sp.	--	--	2.21
Distichlis spicata	10.47	7.09	--
Juncus roemerianus	19.36	4.48	--
Sagittaria sp.	--	--	2.21
Scirpus olneyi	--	3.11	9.93
Scirpus robustus	--	4.35	--
Spartina alterniflora	65.65	5.72	--
Spartina cynosuroides	--	3.66	--
Spartina patens	1.81	67.99	84.99
Other species	2.71	3.60	0.66

Source: Chabreck, 1972.

In 1974, dominant (most abundant) plants in the MR-GO vicinity were identified (Department of the Army, 1974, C). The species noted are as follows:

Scirpus robustus	Coco
Juncus roemerianus	Black Rush
Spartina alterniflora	Oystergrass
Spartina cynosuroides	Hogcane
Spartina patens	Wiregrass
Distichlis spicata	Saltgrass
Sagittaria sp.	Arrowhead
Scirpus sp.	Bullrush
Iva frutescens	Marsh-elder
Baccharis sp.	Baccharis
Daubentonia texana	Rattlebox
Salix interior	Sandbar Willow
Salix nigra	Black Willow
Taxodium distichum	Baldcypress
Quercus virginiana	Live Oak
Sabal minor	Palmetto

(1) *Saline marsh*

(a) Saline marsh is located adjacent to the MR-GO from about Mile 30 or 33 to land's end (about Mile 23--see Figure 2-15). All the land bordering on Breton and Chandeleur Sounds is classified as saline marsh. Black rush and oystergrass are the major constitutents of this marsh area (Department of the Army, 1973, D).

(b) In general, saline marshes are subjected to daily or diurnal tide fluctuations. Underlying soils are high in total soluble salts and generally have a higher mineral content than other marsh types. Vegetation is typically dwarfed and composed only of a few salt tolerant species (Penfound and Hathaway, 1938, and Chamberlain, 1957). Other species found in saline marshes include saltgrass, wiregrass, and *Batis*. The species noted as saltwater species by Lemaire (listed in Appendix A) are still likely to be present in the area. Saline marshes are considered to be highly productive areas and are an integral component of the food webs of the gulf-estuarine complex.

(2) *Brackish marsh*. According to Chabreck's 1972 map of the vegetative types of the Louisiana coastal marshes, the majority of land adjacent to the MR-GO is brackish marsh. These marshes have moderate salinity ranges, between 10-20 parts per thousand. Wiregrass is generally considered to be the dominant species. Table 2-19 indicates that about 68 percent

of the plant cover in brackish marsh is wiregrass. Other species are saltgrass, three-cornered grass, oystergrass, black rush, widgeon-grass, and dwarf spike rush. Minor species found in brackish marshes are indicated in the tables in Appendix A. Brackish marshes have at least as high secondary production as saline marshes, and may be especially important as a nursery area for shrimp and fish. Tidal influences are less and water depths are usually greater in brackish marshes than in saline marshes. In general, the vegetation of brackish marsh is more diverse than that of the saline marsh. Chabreck listed 40 plant species found in the brackish marshes.

(3) Intermediate marsh. Intermediate marshes in the project area are located west of the MR-GO roughly between Miles 44 and 50 and along Bayou La Loutre. The areas are characterized by a fairly diverse plant community and relatively low salinities. Intermediate marshes were formerly conspicuous in the project area. Since the construction of the MR-GO, marshes in the area are undergoing rapid successional changes toward more saline types. Chabreck identified 54 plant species in the intermediate marsh. Wiregrass is dominant in this type of marsh. Other species classified as major are roseau and bulltongue. Eleven species are listed as secondary, namely: alligatorweed, waterhyssop, Walter's millet, spike rush, sprangletop, feathergrass, camphor weed, three-cornered grass, deer pea, Cyperus odoratus, and Paspalum viginatum. Five species are listed as minor and none of the remaining 35 species comprised more than one percent of the plant cover. The area mapped by El Sayed and Rae, 1961, as intermediate marsh was classified as brackish marsh in 1968 by Valentine and in 1970 by Palmisano.

(4) High ground vegetation. Lemaire's 1961 study resulted in a preliminary annotated checklist of the vascular plants of the marshes and included higher lands of St. Bernard Parish. The habitat noted as higher lands on the tables in Appendix C were found by Lemaire on Indian shell mounds, or on canal spoil banks, bayou natural levees, and oak ridges. Due to changes in salinity in the area, some species reported by Lamaire may not now be present except in the more urbanized portions of the parish. Plants found on the natural levees are generally similar throughout the project area. Some variation due to the salinity of the adjacent marsh is evident. The most common species on levees in brackish areas include marsh-elder, eastern baccharis, wiregrass, Bermuda grass, blackberry, and roseau. Levees in the intermediate marsh are dominanted by eastern baccharis, with big cord grass present in smaller numbers. Occasional trees include black willow and live oak.

(5) Dredged material disposal areas

(a) The table in Appendix A notes the plant species commonly found on spoil areas in the region around New Orleans. Dredged material areas support a wide range of species, particularly pioneer species which invade disturbed sites. Taller vegetation in these areas includes eastern baccharis, marsh-elder, wax myrtle, sea oxeye, black mangrove, sweet acacia, yaupon, and palmetto. Appendix A lists grasses, weeds, sedges, and other herbaceous plants found in these areas. In general, succession on the dredged material disposal areas is interrupted by periodic dredging operations. Preliminary observations indicate that plant populations begin to develop within 12-18 months following new material deposition. The areas, particularly those near old natural levees, appear to support a highly diverse flora.

(b) On the elevated disposal areas, zonation of vegetation is related to topography and resultant conditions of drainage and ground water availability. Since 1963, the areas adjacent to the west side of the MR-GO have been reused about four times; in 1963-64, in 1966, 1969, and in 1972. The re-vegetation period is usually two to three years. The whole area within the containment dikes may not be disturbed each time the channel is dredged. As spoil flows outward from the end of the dredge pipeline, a flat cone-shaped mound is created. If elevations of these mounds are significant, revegetation occurs in concentric zones around the mounds. This concentric zonation is found mostly toward the land area of the southern portion of the MR-GO. The elevation changes within the disposal areas result in a greater diversity of vegetation and animal life than would be the case if the disposal area were entirely level. The only revegetation problems occur in areas where dredge operations have encountered layers of sand or prodelta clays. These areas occur primarily toward the southern portion of the disposal area toward land's end. In future operations, some of these areas may be covered by dredged material from recent channel sediment deposition and would revegetate like the remainder of the disposal areas. Usually the containment dikes are not disturbed greatly during spoil deposition except at the points where the pipeline is placed across them.

(6) Marine grasses. Marine plants in the vicinity of the Chandeleur Islands have been studied extensively by Humm, 1956; and by Lemaire, 1961. Their studies indicate that five species occur in the shallow water near the islands. Shoal grass grows closest to the shore and is occasionally found off the outer beaches, but usually occurs adjacent to the sheltered inner beaches in water 6 inches to 2 feet deep. The most abundant sea grass is

turtle grass which grows in shallow waters on both sides of the islands. Lemaire reported turtle grass to be only infrequently found in the vicinity of Breton Island. Manatee grass is often mixed with turtle grass, but is less abundant. Halophilia has been reported in deeper waters, is not abundant, and has been observed growing among the taller turtle and manatee grasses. Expansion of the grass beds, destruction during hurricanes, and reexpansion is a natural pattern for the grass beds. Hurricane Camille in August of 1969 reduced the size of the grass beds but regrowth is occurring.

(7) Phytoplankton. Studies indicate that diatoms are the most abundant type of phytoplankton in the Gulf area. A study by Simmons and Thomas, 1962, of the area from Main Pass to Blind Bay and near Breton Island indicated that salinity plays a significant role in the phytoplankton composition of the area. In general, river species are dominant during the periods of high water from February to June, and a mixture of river and gulf species occur in the fall. Dinoflagellates, also an abundant constituent of the phytoplankton, are an important source of food for zooplankton. Phytoplankton species expected in the area are listed in Appendix A.

c. Endangered and threatened species. The Endangered Species Act of 1973 directed the Secretary of the Smithsonian Institution to review species of plants which are or which may become endangered; to suggest methods of conserving such species; and to report the results of the review to Congress. The list, presented to Congress in January, 1975, was published by the Department of the Interior, Fish and Wildlife Service, in the Federal Register (FR 40:127), 1 July 1975. The publication is to alert any concerned parties that the 2,000 plants listed are being considered for addition to the lists of Threatened or Endangered Species. The State of Louisiana does not yet have a state list of rare and endangered plants. The listing of occurrence in the region or in the project area on the tables in Appendix A refers to abundance and not to rare or endangered status.

d. Recreation and esthetic uses. State parks, federal and state wildlife areas, historical recreation sites, and other recreation areas within the study area are shown on Figure 2-16. Within these managed units and the remainder of the marshland vegetational communities, the predominant recreational activities are hunting, trapping, fishing, and general enjoyment of the outdoor areas. The value of various species for cultural, esthetic, and scientific purposes is noted for each plant species on the tables in Appendix A. In the immediate MR-GO vicinity, lack of good access limits recreational use of the area.

e. Wildlife uses. The relative importance of each plant species for wildlife habitat, food, or cover value is noted on the tables in Appendix A. The marshes supply habitat for a wide variety of animal life. Even plants which are not listed as individually important species are integral in the marshland complex.

f. Economic uses. The vegetation in the MR-GO is economically valuable as habitat, food, and cover for aquatic and terrestrial species harvested in the marshlands, and for species which depend on the marshlands as spawning and nursery areas. Few plants in the vicinity are harvested directly. Some agricultural land occurs adjacent to State Route 46, but none is in the immediate vicinity of any land affected by O&M work.

2.06 ZOOLOGICAL ELEMENTS

a. *General*. Zoological resources of the Louisiana Coastal Zone in the vicinity of the Mississippi River-Gulf Outlet are extensive. The temperate climate characteristic of large estuarine marsh and upland complexes provides an ideal habitat for many terrestrial and aquatic animal species. This section describes only the most important species. Species lists, compiled from available literature, are presented in Appendix B.

b. *Endangered and threatened species*

(1) In accord with the *Endangered Species Act* of 1973, the former lists of native and foreign endangered species have been combined by the United States Department of Interior, Office of Endangered Species to comprise a new Endangered Species list. Title 33, Code of Federal Regulations, Chapter II, Part 209.145 relative to disposal of dredged material in navigable or ocean waters specifies that:

> "The *Endangered Species Act* of 1973 (16 U.S.C. 66aa-668cc-6, P.L. 93-205,87 Stat. 884) requires Federal agencies in the administration of their respective programs to provide for conservation of endangered species and to insure that these programs will not jeopardize the continued existence of species which have been identified by the Secretary of Interior as endangered or threatened, or result in the destruction or modification of the habitat of such species."

(2) Eleven species listed on the tables in Appendix B are included in the May, 1974, United States list of endangered fauna. Discussion of each species follows:

MAMMALS:

Trichechus manatus	West Indian (Florida) Manatee
Balaenoptera physalus	Finback Whale
Balaenoptera borealis	Sei Whale

BIRDS:

Pelecanus occidentalis	Brown Pelican
Haliaeetus leucocephalus leucocephalus	Southern Bald Eagle
Falco peregrinus anatum	Peregrine Falcon
Dendrocopos borealis	Red-cockaded Woodpecker

FISH:

None

AMPHIBIANS:

None

REPTILES:

Alligator mississipiensis	American Alligator
Eretmochelys imbricata	Atlantic Hawksbill Turtle
Lepidochelys kempii	Atlantic Ridley Turtle
Dermochelys coriacea	Atlantic Leatherback Turtle

The West Indian manatee is listed as a wandering migrant of casual occurrence in the project area. It is on the list of species observed infrequently. Both the fin-backed whale and the sei whale are on the list of mammals expected to be observed in the project area, but these wandering migrants are rare. All of these mammal species would be expected to avoid the site of dredge operation. The red-cockaded woodpecker occurs in southeastern Louisiana and breeds in the state, but its preferred nesting habitat is pine woodlands. It would be very unlikely to occur in the project area. The brown pelican, southern bald eagle, and peregrine falcon all might be sighted in the project area. Unless their nesting sites were near the site of dredge operation or disposal, no major disturbance of them would be expected. The three sea turtle species are listed in Appendix B as infrequently observed, casual wandering migrants. These species would be expected to avoid the site of dredge operation. The American alligator is the only species listed with a notation of habitat alteration as an impact. Alligators have been sighted near the MR-GO although they generally prefer fresher water habitat. In accord with provisions of 33 CFR 209.145 procedures, prior to dredge contract letting for O&M work, a field team surveys the sites to be affected. The Corps of Engineers field team is accompanied by personnel from the Louisiana Wildlife and Fisheries Commission, the National Marine Fisheries Service of the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, the Fish and Wildlife Service of the U. S. Department of Interior, and others. The field survey team makes recommendations for protecting marshland biotic resources. The Corps of Engineers will comply with these recommendations if possible. The quality of dredged material will also be monitored as required by the U. S. Environmental Protection Agency.

c. Zoological resources

(1) Mammals

(a) Aquatic mammals which have been reported in the Louisiana coastal waters include the Atlantic bottle-nosed dolphin, finback whale, West Indian manatee, sei whale, spotted dolphin, and short-finned pilot whale. The Atlantic bottle-nosed dolphin, a frequent inhabitant of bays and seashore waters, is commonly observed in the MR-GO vicinity. The other aquatic mammals are not common inhabitants of the area. In general, little information is available concerning actual population levels of terrestrial mammals within the Louisiana Coastal Zone other than the commercial and sport species. Locally, populations of species such as rats and mice may undergo drastic changes. Fluctuation of commercially important species (such as furbearers) is more frequently recorded.

(b) Commercially important furbearing animals found in the project area include nutria (Myocastor coypus), common muskrat (Ondatra zibethicus), North American mink (Mustela vison), neartic river otter (Lutra canadensis), and northern raccoon (Procyon lotor). Other furbearers of lesser importance are the Virginia opossum (Didelphis virginiana) and striped skunk (Mephitis mephitis).

(c) Common muskrat are frequently present in the project area where they construct muskrat "houses" approximately three to six feet in diameter and two to four feet high. These houses are very conspicuous in the marsh and are readily visible from the air. Distribution of muskrats in the Louisiana coastal marshes was estimated by using aircraft and strip censusing techniques (Palmisano, 1971). Muskrat preference is highest for the brackish vegetative type all along the coastal region.

(d) The nutria, introduced into Louisiana in 1937, has become well established and has extended its range over all the coastal marshes of Louisiana and up the streams and swamps to southern Arkansas. The greatest population densities occur in fresh and intermediate marshes. The most important nutria food plants in the fresh marshes include alligatorweed, cat-tail, bullwhip, and numerous other species. In brackish marsh, three-cornered grass, wiregrass, leafy three-square grass, and hogcane are heavily utilized.

(e) Two species of rabbits are present in the coastal and nearby upland areas. These are the eastern cottontail (Sylvilagus floridanus) and the swamp rabbit (Sylvilagus aquaticus). Cottontails are primarily found in well-drained areas such as furrows, woodlots, and miscellaneous woody areas. Swamp rabbits prefer wooded swamps and spoil banks in the marshes.

(2) Birds. The Louisiana coastal marshes and adjacent open gulf areas support a varied bird fauna of both resident and nonresident species. The coastal marshes furnish habitat for many migrant birds, overwintering waterfowl, shore, and wading birds, and a number of pelagic species that are found mainly over the open Gulf. Four tables in Appendix B list the species of birds expected in southeastern Louisiana. Table I contains 162 species which breed in the state. Table II contains 93 species which are migrant winter or summer residents. Table III contains 49 species which are migrant only, and Table IV lists 31 species which are extremely rare or irregular. According to Lowery, 1974, the outlying coastal marshes such as those in the MR-GO vicinity are not used by migrants coming from the south unless bad weather forces them to land. The vast Louisiana coastal marshes provide excellent overwintering habitat for a variety of waterfowl species. Although no extensive studies of waterfowl in the immediate vicinity of the MR-GO were reviewed, a comprehensive aerial census conducted during December, 1972, indicated that an estimated 2,261,000 ducks and 1,017,000 coots were present in the southeast Louisiana coastal marshes and ricelands at the time of the census. The most abundant dabbling duck was the gadwall. Green-winged teal, American wigeon, pintail, and mallard were also quite numerous. Scaup were the most prevalent divers, with ringnecked ducks and hooded mergansers also abundant.

(3) Reptiles and amphibians. A total of 89 species and subspecies of terrestrial, semiaquatic, and aquatic herptiles are listed as expected or marginal in the MR-GO vicinity in the tables in Appendix B. Species listed include 12 salamanders, 15 frogs and toads, 22 turtles, 10 lizards, 29 snakes, and the American alligator.

(4) Fish

(a) The fish fauna throughout the project area are predominantly marine in nature. Pearse and Gunter have noted that the fauna of brackish water is typically marine. With few exceptions, most of the fish are tolerant of wide variation in water salinity (euryhaline). Fish species expected to occur in the MR-GO vicinity are noted in Appendix B. This list is based on occurrence reported in a 1960 to 1968 study of sport fishes of the Biloxi Marsh Complex (Fontenot and Rogillio, 1970) and a 1968-1969 study for the Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana, (Louisiana Wildlife and Fisheries Commission, 1971). The table notes species of commercial and sport fish value.

(b) Intensive studies. Intensive studies of the fishery of the MR-GO project area were conducted by the Texas A&M Research Foundation between July 1959 and March 1961 (El-Sayed and Rae, 1961). A total of 23,872 fish representing 82 species were collected. The spot, *Leiostomus xanthurus*, was caught in greatest numbers, constituting 28 percent of the total fish taken. Together with the anchovy, *Anchoa* sp., they made over 50 percent of the total catch. Ninety-five percent of the catch was made up by 20 species. The spot was most abundant during May 1960 in each of the study areas. Catches declined during the fall and winter. The spawning period of the spot was late fall and early winter (Welsh and Breder, 1923). In the Texas A&M study, the youngest spot first appeared during February 1960 and 1961. Observations indicate that it is likely that, following the exodus of ripe adults from the bays, the juvenile spots re-enter the project area from the Gulf for further development. Most of the anchovies collected in the Texas A&M study were identified as *Anchoa mitchilli diaphana*, with a small percentage tentatively identified as *Anchoa hepsetus*. Gunter and Springer and Woodburn state that salinity is of minor importance in the distribution of the anchovies. Gunter found *A. hepsetus* principally in Gulf waters with a salinity range between 2.5 and 36.9 ppt. while *Anchoa mitchilli diaphana* were taken at salinities less than 5 ppt. Simmons (1972) found both *Anchoa hepsetus* and *Anchoa mitchilli diaphana* in salinities as high as 75-80 ppt, indicating complete euryhalinity. During the Texas A&M study, 42 percent of the total anchovy catch was taken in salinities less than 5 ppt. while 37 percent was taken at 22 ppt. Next to the anchovies, the croaker ranked third in the number of fish caught. Like the spot, large croakers were found only in areas of high salinity. The virtual disappearance of the adult specimens during late fall and winter appeared to be related to their Gulfward migration. Although Welsh and Breder stated that spawning took place in estuaries, other authors seem to agree that spawning occurs offshore, usually around the mouths of passes. Other forms reported in the study area in 1961 included menhaden (*Brevoortia* sp.), sand seatrout (*Cynoscion arenarius*), channel catfish (*Ictalurus punctatus*), hogchoker (*Trinectes maculatus*), and the spotted seatrout (*Cynoscion nebulosus*). Throughout the project area, the peak of the catch occurred during May, 1960, which was followed by a considerable reduction in subsequent months. The decline in the numerical abundance of the fish population in late fall and winter months could be due to their departure to areas of greater depth.

(5) Crustaceans. A variety of crustaceans are known to occur in the project area. During the Texas A&M study (El-Sayed and Rae, 1961) penaeid shrimp found throughout the project area included the white shrimp (*Penaeus setiferus*), the brown shrimp (*Penaeus aztecus*), the pink shrimp (*Penaeus duorarum*), and the sea bob (*Xiphopeneus kroyeri*). Other crustaceans reported from the area include grass shrimp (*Palaemonetes vulgaris*), snapping shrimp (*Alpheus heterochaelis*), mantis shrimp (*Squilla empusa*), hermit crab (*Pagurus longicarpus*), blue crab (*Callinectes sapidus*), and mud crab (*Panopeus herbstii*) (Perret, 1971). River shrimp (*Macrobrachium* sp.) and crayfish (*Cambarus* sp.) have also been collected. The white and brown shrimp and the blue crab are of major significance in the commercial fishery of the area. During the Texas A&M study, white shrimp and brown shrimp were the most common shrimp taken. White shrimp were taken from waters with a salinity range of 1.13 to 25.43 ppt with the greatest numbers taken in salinities between 5 and 6 ppt. Very few were taken at salinities greater than 20 ppt. Peak abundance occurred during October 1959. By December, the shrimp had left the sampling grounds and did not return until the end of June of the following year. Brown shrimp were taken in waters with a salinity range of 1.3 to 24.51 ppt with the greatest numbers occurring at salinities of 4-5 ppt. Brown shrimp were found to be dominant during the summer months while white shrimp were more common during the fall period. Both species were essentially euryhaline and were widely distributed in the project area. The blue crab is a valuable food commodity and is also important in the food web of many fish and were commonly taken in the Texas A&M study. Although euryhaline, these organisms were most common in waters of low salinity (1-10 ppt) with the maximum number occurring in salinities of 3-4 ppt.

(6) Molluscs. Appendix B lists molluscs found in the vicinity of the project area. The Texas A&M study (El-Sayed and Rae, 1961) listed 14 species of pelecypods, 10 species of gastropods, and one species of cephalopod. Three species of

pelecypods, (Brachiodontes recurvus, Macoma mitchelli, and Rangia cuneata), are common throughout the project area. Forms typical of brackish waters in the Lake Pontchartrain, Bayou Dupre Area included Spisula solidissima and Rangia cuneata, a brackish water clam, important for the shell dredging industry. The commercial oyster, Crassostrea virginica, was the dominant molluscan species in the more saline waters southeast of Hopedale. Extensive oyster beds are present in this area. See Plate 3 for locations of oyster harvest and reserve areas.

(7) Zooplankton. The Texas A&M study (El-Sayed and Rae, 1961) of zooplankton of the estuarine waters of Louisiana indicated that the copepod, Acartia tonsa, was the most common and ubiquitous species in the area (sometimes exceeding 92 percent of the total zooplankton population). Other forms commonly found in the area include Eurytemora hirundoides, Pseudodiaphtomus coronatus, Paracalanus crassirostus, and Tortanus setacaudatus. The pattern of zooplankton distribution is mainly affected by tidal cycle and residual water movement. Seasonal cycles also occur. Salinity preference is apparent in many forms. During the Texas A&M study, Paracylops sp. and certain cladocerans were typical of the less saline water areas while Paracalanus, Oikopleura, Tomopteris, and Pseudodiaptomus were more common in the saline waters of the Lake Eloi-Athanasio region. The zooplankton list in Appendix B presents data from the Texas A&M study and the 1971 Cooperative Gulf of Mexico inventory report.

(8) Benthos. Studies of the benthic fauna of the Louisiana continental shelf indicate that the greatest number of species occurred in higher salinity waters (35-45 ppt) (Parker 1956). As salinity decreased, species diversity also decreased.

d. Recreation and esthetic uses. The zoological resources of the Lake Borgne vicinity afford both tangible and intangible recreational benefits. Excellent hunting and sport fishing opportunities exist, but are somewhat limited by poor accessibility. Figure 2-16 shows several state and federal wildlife areas, parks, and recreation areas in the region. These areas provide hunting, fishing, and outstanding opportunity for nature appreciation activities such as bird watching.

e. Hunting areas. The vast expanse of Louisiana coastal marshes offers excellent hunting opportunity. During the 1970-1971 hunting season, approximately 146,000 hunting licenses were sold in the coastal parishes. The most important game species are white-tailed deer, rabbit, rail, snipe, squirrel, and waterfowl. State and federal wildlife areas provide some hunting opportunity and are more easily accessible, hence, hunting pressure on these areas is high.

f. Economic value

(1) The zoological resources of the Louisiana coastal marshes are very important economically. Fur trapping and commercial fishing operations in the region account for millions of dollars in harvest annually. According to the Corps of Engineers, the sale of fur pelts and/or meat for the screwworm stabilization program and pet food totalled nearly 12 million dollars during the two trapping seasons, 1969-1970 and 1970-1971. The 1972-1973 total fur catch was valued at about 9.6 million dollars (Louisiana Advisory Commission on Coastal and Marine Resources, 1973). Nutria, muskrat, and mink catches comprise about 85 percent of the total, with nutria accounting for the largest amount.

(2) Table 2-20 shows the comparative takes of fur animals in Louisiana at ten-year intervals from 1930 to 1973, including the 1972-73 season. Also shown is the total value of the furs by species, with five species common to southeast Louisiana listed (muskrat, raccoon, opossum, mink, and nutria). Fur animals uncommon to the study area are listed as "others."

(3) In 1970, the total commercial fish and shellfish catch in Louisiana was $62,516,831 (ibid, 1973). Shrimp comprised 50.5 percent, menhaden 30.3 percent, oysters 5.8 percent, and crabs 1.7 percent of the total. Catfish, crawfish, and other miscellaneous species comprised the remaining 6.7 percent. Extensive amounts of leased grounds for oyster production exist in the immediate MR-GO vicinity. Plate 3 shows the general areas leased for oyster harvest. Table 2-21 displays the production and value of major commercial estuarine-dependent fisheries by species in Breton and Chandeleur Sounds. Production is based on the average annual harvest during a five-year period (1963-67). Values are based on 1971 ex-vessel prices.

TABLE 2-20

COMPARATIVE TAKES AND VALUES OF FUR ANIMALS IN LOUISIANA FROM 1930 TO 1973

Species	1930-31 Season		1940-41 Season		1950-51 Season		1960-61 Season		1970-71 Season		1972-73 Season	
	Take	Value	Take	Value	Take	Value	Take	Value	Take	Value	Take	Value
Muskrat	4,068,114	$1,627,246	5,778,750	$5,778,750	2,477,464	$3,096,830	961,287	$1,057,416	777,960	$1,230,246	346,787	$1,430,497
Raccoon	52,065	156,195	169,531	169,531	104,420	44,901	65,588	98,382	55,726	71,089	149,274	821,733
Opossum	127,725	51,090	131,045	13,105	27,308	5,734	11,450	4,580	3,563	1,782	17,065	21,331
Mink	45,390	136,170	114,323	457,292	184,552	2,386,257	32,272	225,904	21,648	108,240	44,062	264,372
Nutria	--	--	--	--	78,422	364,662	716,435	716,435	1,226,739	2,980,217	1,611,623	6,737,775
Other	14,355	23,967	22,937	13,044	7,156	58,864	4,191	61,491	5,125	121,395	11,521	353,123
Total	4,307,649	$1,994,668	6,216,586	$6,431,722	2,879,322	$5,957,248	1,791,226	$2,164,208	2,090,761	$4,512,969	2,180,332	$9,628,831

Source: Lowery, George H., Jr., 1974.

TABLE 2-21

PRODUCTION AND VALUE OF MAJOR COMMERCIAL ESTUARINE-DEPENDENT FISHERIES IN BRETON AND CHANDELEUR SOUNDS

(Data based on five-year (1963-67) average annual harvest and 1971 ex-vessel prices)

Species	Production (Millions of Pounds)	Value (Millions of Dollars)
Shrimp	18.30	8.60
Manhaden	159.33	2.54
Oyster	4.68	2.06
Blue Crab	3.66	.40
Seatrout	1.41	.16
Croaker	4.33	.09
Catfish and Bullheads	0.16	.05
Red Drum	0.23	.04
Spot	0.57	.01
Total	192.68	13.95

Source: Lindall, W. N., Jr.; Hall, J. R.; Sykes, J. E.; and Arnold, E. L., Jr.; 1972.

2.07 RECREATION ELEMENTS

a. General

(1) The estuary-gulf environment of St. Bernard Parish offers opportunity for water-based activities such as fishing, boating, water skiing, sailing, canoeing, crabbing, crawfishing, floundering, frogging, and shrimping. The study area is part of the whole recreation complex which includes Lake Pontchartrain, Lake Borgne, the Mississippi River, the marshlands, bays, bayous, Breton and Chandeleur Sounds, and the offshore islands. Some areas also offer opportunity for primitive camping, nature study, hunting, waterfowl hunting, and picnicking, as well as for general enjoyment of being out-of-doors. Sites near the Mississippi River and its associated flood control structures are suited for trails and associated development. The area is rich in historical and cultural resources, but most of these are associated with the more urbanized portions of Orleans, St. Bernard, and Plaquemines parishes.

(2) Table 2-22 shows the major recreation areas in the area east and southeast of New Orleans on the east side of the Mississippi River. The only national park in the area is Chalmette National Historic Park, located on the Mississippi River in St. Bernard Parish. The total acreage in wildlife management areas and national refuges listed in Table 2-22 is 194,031 acres. The locations of these areas is shown on Figure 2-16. The figure also shows locations of proposed recreation areas.

(3) The recreation areas in the immediate MR-GO vicinity include a small boat marina situated about one mile south of the channel on Bayou Beinvenue. Residents of the communities of Shell Beach, Yscloskey, Alluvial City, and Hopedale are principally involved in commercial fishing or services relating to recreation and sports fishing. The MR-GO passes between Breton and Grand Gosier Islands which are part of the Breton National Wildlife Refuge, a 4,500-acre shorebird sanctuary.

b. Recreation Supply and Demand. Recreation supply and demand have been analyzed for the Louisiana State Parks and Recreation Commission. As shown in the Comprehensive Outdoor Recreation Plan for 1970-1975, there is a high demand for recreation facilities in the New Orleans area which is not being met by existing supplies. The region around New Orleans (Region 1) contains approximately 30 percent of the state's population. One of the actions being taken to increase the supply of recreation facilities is planning underway for a new state park on the Mississippi River in St. Bernard Parish. The areas listed on Figure 2-16 "proposed" are those inventoried as potential areas in various local and regional recreation and open space plans.

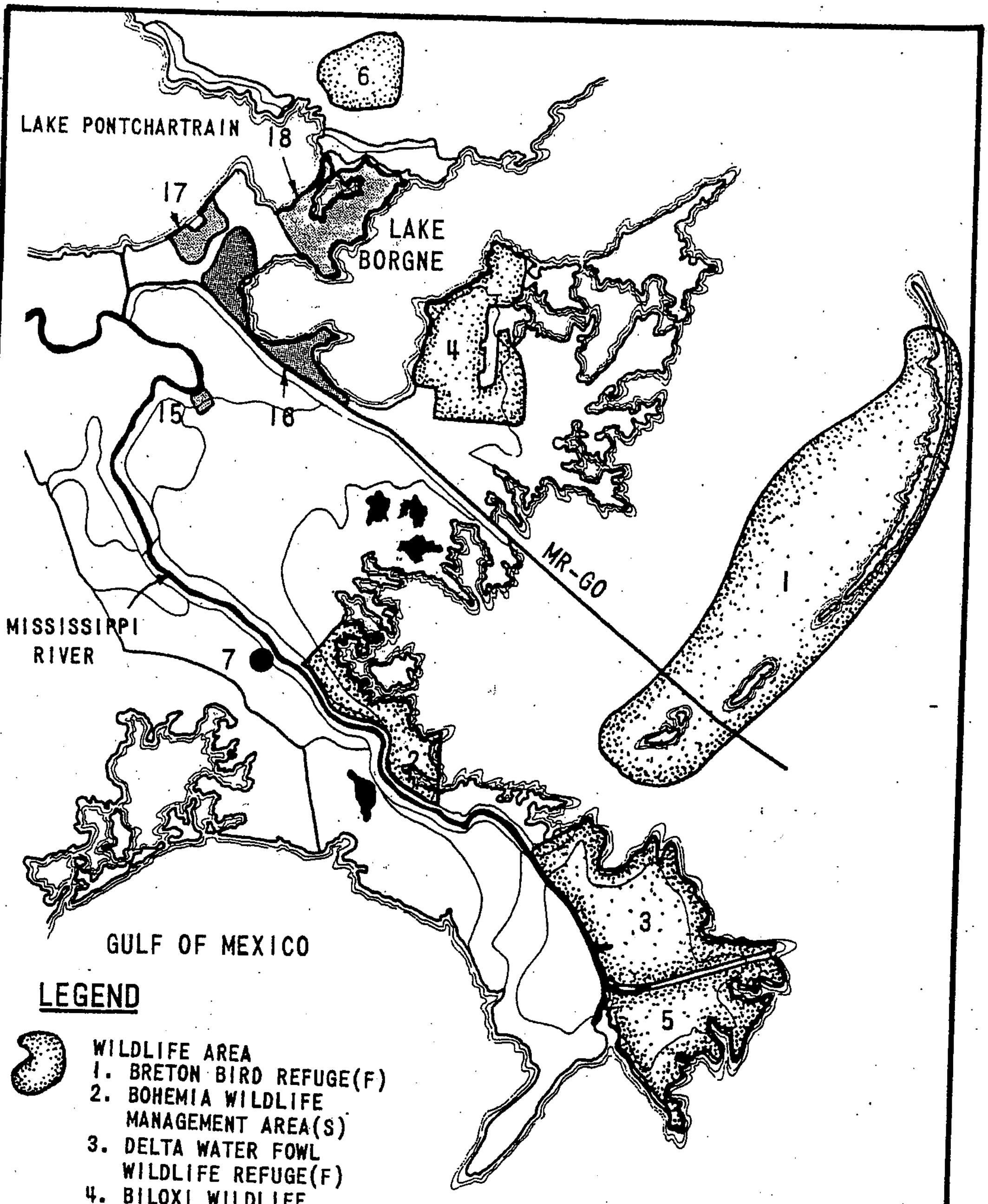
TABLE 2-22

RECREATION AREAS IN PLAQUEMINES AND ST. BERNARD PARISHES

Type of Area	Parish	Name	Acres
National Park	St. Bernard	Chalmette National Historic Park	142
National Wildlife Refuges	Plaquemines	Delta National Wildlife Refuge	48,791
	*Plaquemines & St. Bernard	Breton National Wildlife Refuge	7,512
Wildlife Management Areas	Plaquemines	Bohemia State Wildlife Management Area	33,000
	Plaquemines	Pass-a-Loutre State Waterfowl Management Area	65,000
	St. Bernard	Biloxi State Wildlife Management Area	39,728
Research and Education Areas	Plaquemines	Louisiana Agriculture Station	
National Historic Sites	Plaquemines	Fort de la Boulaye	
	Plaquemines	Fort Jackson	
	Plaquemines	Fort St. Phillip	
	St. Bernard	Chalmette	
State Historic Sites	There are 30 state historic sites in Plaquemines Parish and 39 in St. Bernard Parish		
Louisiana Recreation Areas	There are 42 recreation sites listed within Plaquemines and St. Bernard Parishes, excluding New Orleans. These recreation areas are under local sponsoring agencies.		

* The MR-GO traverses the area for approximately 3 miles between Breton and Gosier Island.

Source: Engineering Agency for Resources Inventories, 1973



LEGEND

░ WILDLIFE AREA
1. BRETON BIRD REFUGE(F)
2. BOHEMIA WILDLIFE MANAGEMENT AREA(S)
3. DELTA WATER FOWL WILDLIFE REFUGE(F)
4. BILOXI WILDLIFE MANAGEMENT AREA(S)
5. PASS-A-LOUTRE WILDLIFE MANAGEMENT AREA(S)
6. PEARL RIVER STATE WILDLIFE MANAGEMENT AREA(S)

● 7. RESEARCH STATION

▒ PROPOSED RECREATION AREA
15. ST. BERNARD STATE PARK
16. BLIND LAGOON PARK
17. BIG OAK & LITTLE OAK PARK
18. RIGOLETS WILDERNESS PARK

ENGINEERING AGENCY FOR RESOURCES INVENTORIES, 1973

FIGURE 2·16
MAJOR RECREATION AREAS NEAR NEW ORLEANS

c. Recreation needs.

(1) Recreation needs calculated by the Louisiana State Parks and Recreation Commission for Region 1A (the New Orleans metropolitan area within Jefferson, Orleans, and St. Bernard Parishes) and Region 1B (St. Tammany and Plaquemines Parishes) are shown in Table 2-23. Recreation need is expressed in number of user days. This is calculated by subtracting the number of user days provided by existing facilities, from the number of user days demanded for various activities for the 1970 population. The ranking in the table is based upon the relative number of user day needs to be met with new facilities. User day needs can be translated into the number of physical facilities required to satisfy the needs. The need for facilities for 1970 is shown in Table 2-24.

d. Recreation potential. The pressure for development of recreation facilities and for use of the coastal environment for recreation can be seen from the following data. The total acreage of Region 1 is 2.79 million acres, of which 0.99 million acres are water. The area needed to satisfy Region 1 hunting demand is 1.09 million acres, roughly one-third of the entire regional area is needed. To satisfy Region 1 fishing demand, access is needed to 101,504 acres of water suitable for fishing. To satisfy Region 1 motor boating demand, access is needed to 89,700 acres of water. Region 1 needs indicate that 976 boat ramps for fishing craft and 345 boat ramps for motor boating are required. In Region 1, areas suitable for boating facility construction which also have good access to New Orleans via road are limited compared to the vast amount of area to which boating access is required. Future boating and fishing usage is likely to be concentrated around these access points and along major access routes such as the MR-GO and associated bayous.

TABLE 2-23

REGIONAL USER DAY NEEDS NOT MET BY EXISTING FACILITIES - 1970

Activity	Region 1A User Day Needs	Region 1A Rank	Region 1B User Day Needs	Region 1B Rank
Beach Swimming	76,578	3	3,516	2
Fishing	78,250	1	5,491	1
Pool Swimming	77,993	2	887	8
Playing Outdoor Games	54,080	4	1,200	7
Picnicking	44,675	5	1,882	4
Hunting	38,800	6	2,701	3
Motor Boating	38,727	7	1,638	5
Trailer Camping	19,040	8	480	10
Horseback Riding	17,540	9	1,520	6
Tent Camping	13,776	10	308	11
Hiking	7,230	12	570	9
Water Skiing	13,104	11	S(1)	
Golf	5,644	13	S	
Total	485,437		20,193	

(1) Surplus within Region 1B only

Source: Louisiana State Parks and Recreation Commission, 1971.

TABLE 2-24

FACILITIES NEEDED TO MEET 1970 USER DAY NEEDS

Facility	Region	Number or Size of Facilities Needed
Boat Ramps for motor boating	1A	331 with access to 86,060 acres of water
	1B	14 with access to 3,640 acres of water
Boat Ramps for fishing	1A	912 with 94,848 acres of water suitable for fishing
	1B	64 with 6,656 acres of water suitable for fishing
Swimming Pools	1A	71 pools
	1B	1 pool
Swimming Beaches	1A	28 with 39 acres of supporting water
	1B	1 with one acre of supporting water
Play Fields	1A	901 fields
	1B	20 fields
Hunting Area	1A	1,021,052 acres
	1B	71,078 acres
Picnic Tables	1A	5,871 tables
	1B	245 tables
Trailer Camping	1A	4,760 trailer camping spurs or spaces
	1B	120 trailer camping spurs or spaces
Tent Camping	1A	3,444 tent camping spurs
	1B	---
Horseback Riding Trails	1A	146 trails
	1B	12 trails
Hiking Trails	1A	---
	1B	5 trails

Source: Louisiana State Parks and Recreation Commission, 1971.

2.08 ARCHEOLOGICAL AND HISTORIC ELEMENTS

a. Archeology

(1) The natural transportation routes and abundant wildlife and edible plants in Louisiana's coastal deltaic areas have supported human occupation for 3,700 years. To adapt to coastal climatic conditions (flooding and storms), early inhabitants occupied natural levees and ridges, often built-up with earthen or shell mounds. The earliest known sites in the St. Bernard Delta are from the Poverty Point period (circa 1250 B.C.). The Linsley site, uncovered during construction of the MR-GO, dates from 1740 B.C. By 600 A.D., the St. Bernard Delta complex was the locus of Indian occupation in the area. A major ceremonial center is near Bayou La Loutre, and numerous small villages and camps evidence occupation by people practicing agriculture, fishing, hunting, and gathering. Many other mounds and middens have been found in the delta area: 66 in St. Bernard Parish, 52 in Orleans Parish, and 35 in Plaquemines Parish.

(2) Natural forces and human intrusion caused deterioration which resulted in loss of archeological resources; therefore, existing sites in undisturbed areas are valuable. A number of prehistoric shell middens are along the route of the MR-GO and associated bayous. An aerial survey was conducted on August 28, 1973, by R. W. Neuman, Curator of Anthropology, Louisiana State University, Baton Rouge. A number of prehistoric shell middens, including four specifically identified sites between Yscloskey and Lake Borgne, were noted along the route of the MR-GO. Three sites and shell middens were noted along Shell Beach Bayou. In Orleans Parish two midden sites were noted on the south side of the GIWW. Surveys were conducted by Neuman on December 5 and 23, 1974, by helicopter and boat to locate archeological deposits that may exist in the areas of Bayous La Loutre, St. Malo, and Yscloskey. Although high water conditions prevailed, two sites were recorded and documented along Bayou La Loutre, and another area was identified for investigation prior to any dredging operations.

(3) Internal procedures as defined in 33 CFR Part 305 (Federal Register, 8 Spetember 1975) will be followed in situations where O&M work may affect previously undisturbed areas. These procedures will be part of project planning and investigations which precede O&M contract letting in accordance with requirements of 33 CFR 209.145.

b. History

(1) New Orleans and the Mississippi Delta are in the Gulf Coast geosyncline, a slowly subsiding portion of the earth's crust. Since the beginning of the Tertiary period (60 million years ago), sediment to a depth of over 40,000 feet has been deposited in coastal Louisiana. When the Mississippi River diverted to the west (1270 A.D.-1720 A.D.), the St. Bernard Delta Complex, no longer receiving the freshwater inflow from the river, acquired its present character. This area is considered one of the state's important estuaries.

(2) Coastal Louisiana was inhabited by Tunican Indians, tribes ranging from skilled, civilized, fishers, hunters, and trappers to relatively uncivilized farmers and fishermen. Louisiana natives taught early settlers farming, hunting, and trapping. Many bayous, rivers, towns, and parishes retain Indian names. Following European settlement, Indian populations declined from disease, intertribal wars, and migration. Recent history of the New Orleans/St. Bernard Delta area combines French, Spanish, Creole, Acadian, Native American, Black, and Carribean influences. Modern day city and local cultures reflect the intercultural diversity of coastal Louisiana settlers.

(3) The delta's geologic formation, estuarine environment, commerce, navigation, seafood, industries, and cultures have been significantly influenced by the presence and history of the Mississippi River. Mississippi River explorations included expeditions by Alvarez de Pinepa, Cabez de Vaca, Hernando de Soto, Joliet and Marquette, and LaSalle. In 1682, LaSalle claimed the territory for France and named the land for Louis the XIV. Unsuccessful French attempts to settle near the river mouth included expeditions by Iberville and Bienville. In 1718, New Orleans was founded, and German laborers and African slaves worked on French plantations. In 1762, Louisiana was ceded to Spain, and following a brief French uprising, Spanish rule was established and economic and cultural progress ensued. When freedom of navigation was granted in 1795, the number of ships and boats arriving in New Orleans more than doubled. By the 1800's, the New Orleans area was the largest trading and business region on the Gulf Coast.

(4) In 1803, the United States bought the Louisiana territory for $15 million from Napoleon, who had reacquired the territory. At the time, most of the territory was undeveloped, but the Mississippi River's importance for commerce and navigation had been recognized. In 1812, Louisiana became the 18th state, and following the War of 1812, development increased as traders and

planters settled. Louisiana joined the Confederacy, and experienced severe setbacks after the Civil War from carpetbagger rule, floods, and yellow fever. Levees and mosquito control measures were successful by 1900, and commercial and industrial expansion resumed. Since 1950, tremendous population growth has resulted in greater use of the wetlands and marshes in the St. Bernard Delta.

(5) The influence of many cultures is reflected in New Orleans and the Mississippi delta area. French descendents (Creoles) of original French settlers, Cajuns (descendents of the French Acadians who migrated to southern Louisiana in the late 18th century), and descendents of French emigrants from Santo Domingo contribute the important French Catholic influences in festivities, law, civil subdivisions, food, names, education, and architecture. Spanish influences are reflected in food, architecture, and names. German, African, European, and Carribean peoples also contribute to coastal Louisiana's culture and history.

c. Historic sites

(1) The National Register of Historic Places as published in the Federal Register dated 19 February 1974 and the monthly supplements thereto have been consulted and no National Register properties are listed which would be affected by the proposed project. A copy of the draft environmental statement was sent to the Advisory Council on Historic Preservation and to the Louisiana Department of Art, Historical, and Cultural Preservation for their review and comments. The comments of the Advisory Council on Historic Preservation are included in Section 9. No comments were received from the Louisiana Department of Art, Historical, and Cultural Preservation. The Corps is in compliance with Executive Order 11593, 13 May 1971, "Protection and Enhancement of the Cultural Environment," and Section 106 of the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915, U.S.C. 470 et. seq.). One National Register site, Chalmette National Historical Park, is located in St. Bernard Parish, but will not be affected by operation and maintenance of the MR-GO. The park is located about 2.5 miles southeast of New Orleans on the Mississippi River.

(2) Four historic sites listed in Louisiana's inventory list (State Plan, not yet published) are near or adjacent to the MR-GO. Bayou Bienvenue, connecting Lake Borgne to New Orleans, is crossed by the MR-GO near New Orleans. Fort Martello (also known as Martello Castle, Twoer Duprey, Tower Dupre, Tower Philippon) is 0.3 miles northeast of the MR-GO at the Lake Borgne end of the

Lake Borgne Canal. The Paris Road, or Chemin de Paris, Louisiana Highway 47, crosses the MR-GO in Orleans Parish. Yscloskey, or Proctorville, is a town on Louisiana 46, approximately one mile west of the MR-GO. Two other sites not listed in the State Plan are near the MR-GO: Old Fort Beauregard Ruins near Shell Beach, and Battery Bienvenue Ruins at the junction of Bayous Bienvenue and Villere.

2.09 SOCIO-ECONOMIC ELEMENTS

a. Areas and political subdivisions. The MR-GO is located in eastern Orleans Parish, St. Bernard Parish, and an uninhabited portion of Plaquemines Parish as shown on Plate 4. The segment of the MR-GO within Orleans Parish is within the corporate boundary of the City of New Orleans (Engineering Agency for Resources Inventories, 1973).

b. Population. Table 2-25 shows population data and projections for the New Orleans Standard Metropolitan Statistical Area (SMSA), and for Orleans and St. Bernard Parishes from 1950 to 2020. Projections from three sources are presented. The first series in Table 2-25 is based on the OBERS Series E projections performed in 1972 (U. S. Department of Commerce, 1974). The St. Bernard Parish proportion of the SMSA population has continually increased since 1950 and is likely to continue growing. Out-migration from older parts of the New Orleans and suburbanization in outlying parts of the metropolitan area have resulted in a continuing decline of the Orleans Parish proportion of SMSA population. This trend will likely reverse if the Pontchartrain New Town in Town project is successful. This proposed 4,000 to 8,900 acre community in northeastern Orleans Parish is intended to house a population of 90,000 by the year 2000 (Wallace, McHarg, Wallace & Todd, 1973). The second series projection in Table 2-25 was performed by Gladstone and Associates for the developers of the Pontchartrain new town (Gladstone and Associates, 1973). The original 1970-1990 Gladstone projection was extrapolated to 2020 by linear regression. This projection for the SMSA is somewhat higher than that of the first series and approaches the upper range for future regional growth. The third series of projections in Table 2-25 is an expansion of projections performed by the Regional Planning Commission for Jefferson, Orleans, St. Bernard, and St. Tammany Parishes in 1970 (Regional Planning Commission, 1973). Forecasts beyond 1990 were extrapolated by linear regression. Long-range growth in Orleans Parish is projected to be somewhat lower than in the first series, as the Orleans Parish proportion of total SMSA population is expected to continue declining. St. Bernard Parish will continue to gain population, though at a more modest rate than in the first series projection. Use of the three series suggests that population of the New Orleans SMSA will range between 1,281,000 and 1,946,000 by the year 2020 compared to the 1970 population of 1,045,809. Population of Orleans Parish might be 616,000 compared to the 1970 population of 593,471. St. Bernard Parish 2020 population might be 156,000 compared to the 1970 population of 51,185. The St. Bernard Parish population would thus be about three times what it was in 1970.

TABLE 2-25
POPULATION CHANGE
NEW ORLEANS SMSA 1950-2020

Year	Series 1 OBERS Series E Projections New Orleans SMSA	Series 2 Gladstone and Associates Projections New Orleans SMSA	Series 3 Regional Planning Commission Projections New Orleans SMSA	Series 3 Regional Planning Commission Projections Orleans Parish	Series 3 Regional Planning Commission Projections St. Bernard Parish
1950	712,393	712,393	712,393	570,445	11,087
1960	907,123	907,123	907,123	627,525	32,186
1970	1,045,809	1,046,500	1,045,809	593,471	51,185
1980	1,101,200	(1,193,000)	(1,236,675)	(598,114)	(72,856)
1990	1,178,100	1,352,000	1,427,545	602,756	94,528
2000	1,221,700	(1,518,000)	1,593,980	(609,012)	(114,634)
2010	1,258,700	(1,672,512)	1,770,020	(612,527)	(135,389)
2020	1,281,000	(1,829,957)	1,946,061	(616,042)	(156,144)

NOTE: Figures in parentheses were extrapolated by Stanley Consultants, Inc.

Source: (See text).

c. Area economy

(1) Because of its port facilities and favorable orientation to economically valuable natural resources, New Orleans has become one of the leading industrial centers of the South. Products of the New Orleans SMSA include rocket boosters, beer and soft drinks, sugar, ready-to-wear clothing, building materials, and refined petroleum products. Shipbuilding and repairing and the production of aluminum are major manufacturing sectors in the immediate area of the MR-GO.

(2) Employment for Orleans and St. Bernard Parishes for 1970 is shown in Table 2-26 (United States Department of Commerce, 1970 A.). Employment in the service categories far exceeded that in the manufacturing and construction sectors. A major proportion of the Transportation, Communications, Utilities employment category is in water transportation (dock workers, etc.) The two parishes shown comprise 61.5 percent of the total SMSA employment in 1970. In 1970, unemployment rates, as a percent of the total labor force were: New Orleans SMSA, 5.0 percent; Orleans Parish, 5.8 percent; and St. Bernard Parish, 4.9 percent. Continued development of port facilities should result in further development of industries oriented to land and ocean-going water transportation.

d. Income. Personal income, as forecasted by the U. S. Department of Commerce, Bureau of Economic Analysis, is expected to continue rising (8). Historical and projected personal income is shown in Table 2-27. All figures are in 1967 constant dollars, so inflation is not a factor contributing to the increases shown. The year 2020 estimate of $16.4 billion from this set of projections would result in an average *per capita* income of approximately $12,900 if divided by the projected 2020 SMSA population of 1,281,000. Average family income would be about 40,000 uninflated dollars in the year 2020.

TABLE 2-26

RESIDENT EMPLOYMENT NEW ORLEANS SMSA 1970

Category	Orleans Parish		St. Bernard Parish		New Orleans SMSA	
	Employees	Percent	Employees	Percent	Employees	Percent
Agriculture, Forestry, Fishing	1,364	0.65	225	1.28	3,158	0.86
Mining	3,576	1.71	356	2.03	9,230	2.51
Construction	12,061	5.78	1,785	10.19	26,519	7.20
Manufacturing	24,830	11.89	3,777	21.56	51,948	14.11
Transportation, Communication, Utilities	22,125	10.60	2,195	12.52	40,012	10.86
Wholesale-Retail Trade	48,682	23.32	4,038	23.05	86,439	23.47
Business and Personal Services	63,530	30.43	3,882	22.16	100,873	27.39
Health and Educational Services	32,619	15.62	1,263	7.21	50,082	13.60
Total	208,787	100.00	17,521	100.00	368,261	100.00

Source: United States Department of Commerce, 1970 A.

TABLE 2-27

PERSONAL AND FAMILY INCOME
NEW ORLEANS SMSA
1950-1990

	1967 Constant Dollars				
	1950	1962	1970	1980	1990
Total Personal Income (In Millions of Dollars)	$1,505.4	$2,283.3	$3,412.8	$4,906.7	$6,775.2
Per Capita Personal Income (In Dollars)	2,113.2	2,517.1	3,263.3	4,455.8	5,751.0
Family Income (In Dollars)	6,552.6	7,805.0	10,118.8	13,816.4	17,832.6

Source: United States Department of Commerce, 1974.

e. Land use

(1) Existing land use for the MR-GO study area, including the northern portion of Plaquemines Parish, is shown on Plate 4. Urbanization in the immediate area of the MR-GO is limited. Most present residential, commercial, and industrial development is located within the city of New Orleans. Some urbanization has extended along Route 90 north of Lake Borgne and along Route 46 in St. Bernard Parish (Engineer Agency for Resources Inventories, 1973). The city of Chalmette, located on the Mississippi River, contains several residential areas and intensive industrial land uses. The only urban development in the immediate MR-GO area is located at Yscloskey, Shell Beach, and Hopedale and is primarily residential. Agricultural activities are located on the higher, well drained lands which parallel the Mississippi River. Agricultural land is also located along Route 46, between Caernarum and Yscloskey.

(2) The dominant factors which have contributed to urban and agricultural development of lands in the MR-GO area are presence of flood and storm protection, availability of highway access, and high elevation and potential for adequate drainage. Most lands in the immediate area of the MR-GO do not presently have the above factors, and thus are undeveloped. Further development is planned for much of the area, and land use plans are described in Section 3 of this report. With construction of the hurricane protection levees, the spoil areas adjacent to the MR-GO will become protected, elevated ground. If levee top access were provided from the Tidewater Port

Area to Shell Beach and Highway 46, development of recreation facilities and possibly urban development would be expected on the spoil areas (barring governmental constraints on development).

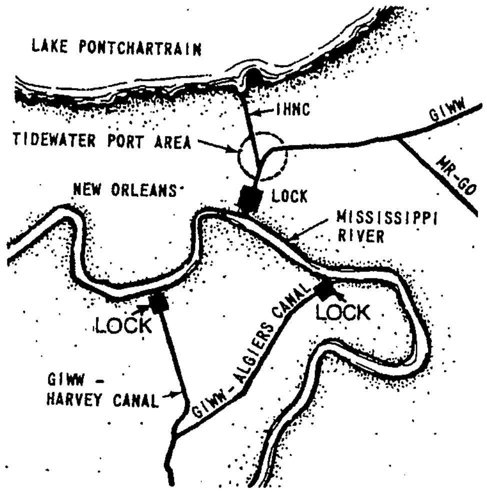
f. Navigation system development. This section presents data on cargo handling through the Port of New Orleans, and through the MR-GO as a part of the total navigation system. A key factor is recent and projected development of facilities in the New Orleans Tidewater Port Area in the Inner Harbor Navigation Canal - Mississippi River-Gulf Outlet area. The Port of New Orleans is recognized as the world's third largest port in volume of waterborne commerce, and the nation's second largest, both in volume and in value of foreign trade (Port of New Orleans, 1974).

(1) The navigation system

(a) The basic navigation system serving the Port of New Orleans is illustrated on Figure 2-17. The Mississippi River proper has been the major arterial waterway throughout the history of the settlement and development of the central United States. The Mississippi River system is navigable as far north as Minneapolis-St. Paul, Minnesota; as far west as Sioux City, Iowa; and as far east as Pittsburgh, Pennsylvania. The system is comprised of the Mississippi, Missouri, Arkansas, Red, Illinois, Ohio, Cumberland, and Tennessee Rivers and numerous other waterways. Over 6,200 miles of the system are maintained at a controlled depth of nine feet or more. A link is provided via the Mississippi and Illinois Rivers from the Great Lakes to the Gulf of Mexico, thereby permitting waterway transportation between many of the major cities of the U. S.

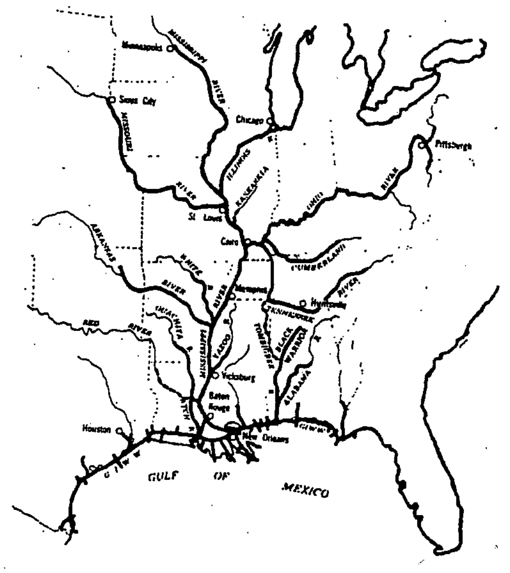
(b) The Gulf Intracoastal Waterway (GIWW) junctions with the Mississippi River at New Orleans. The Waterway is maintained at a navigable depth of at least twelve feet from Brownsville, Texas, on the west to St. Marks, Florida, on the east. The GIWW connects some of the major cities of the gulf coast, including Houston, Galveston, Port Arthur, New Orleans, and Gulfport. Extending inland through tributaries, the GIWW reaches Mobile, Montgomery, and Birmingham, Alabama, and Columbus, Georgia. Eventually, this system will be extended inland toward Fort Worth and Dallas, Texas, via the Trinity River.

(c) The navigation system near New Orleans consists of port facilities along the Mississippi River and the Tidewater Port Area at the junction of the IHNC and GIWW/MR-GO. The navigation channels, (shown on Plate 1), are the Mississippi



NAVIGATION SYSTEM
NEAR NEW ORLEANS

MISSISSIPPI RIVER
NAVIGATION SYSTEM



From Mississippi River Navigation; Department of the Army, Mississippi River Commission and Lower Mississippi Valley Division, Corps of Engineers; Vicksburg, Mississippi; 1971; p. ii

FIGURE 2·17

THE NAVIGATION SYSTEM

River for river and sea-going vessels, the Gulf-Intracoastal Waterway (GIWW) for east-west shallow draft traffic, the MR-GO for sea-going vessels, and the Inner Harbor Navigation Canal between Lake Pontchartrain and the Mississippi River. These waterways and the entire navigation system are shown on Figure 2-17.

(2) Elements of the Port of New Orleans

(a) General. The Port itself is a complex conglomerate of public and private facilities. Most general cargo and grain passing through the Port is handled over public wharves under the jurisdiction of the Commissioners of the Port, while private facilities are used for almost all bulk liquid cargo. Public facilities also handle a portion of dry bulk cargo, especially if it is part of foreign trade; however, most dry bulk cargo is handled in private facilities located outside of the Port's limits. The Board of Commissioners of the Port of New Orleans (Dock Board) sets all policies and makes all major decisions regarding the vast commercial, industrial, and transportation facilities complex. The Board's decisions are carried out by the Director of the Port, a paid executive who supervises various departments and approximately 800 employees. The current budget for Port maintenance repairs and construction of new facilities is approximately one million dollars per month (Port of New Orleans, 1974). The Board of Commissioners own wharves and leases facilities which have a total frontage of 59,789 lineal feet and afford an area of 15,185,434 square feet for cargo handling.

(b) Port facilities. Public facilities owned or controlled by the Port are largely located on the left descending (east) bank of the Mississippi River and are available to all traffic on the Mississippi River. The Tidewater Port Area is located along the Inner Harbor Navigation Canal. These port facilities have sea level access to ocean-going traffic traversing the MR-GO. Access is also available to the Mississippi River through a lock located near the entrance to the Inner Harbor Navigation Canal. This lock, constructed in 1923, has a sill depth of 31.5 feet and a chamber 75 feet by 640 feet. Up to 36 lockages can be performed in a day, although 24 is more typical. The largest part of the traffic through the lock consists of slow-moving barge tows with no alternative means of moving to or from the eastward intracoastal waterway. Traffic through the lock is generally considered to have reached saturation and ships try to avoid delays at the lock by staying on the Mississippi River as much as possible, thereby reducing traffic along the MR-GO. Information relative to cargo handling through the Port of New Orleans can be gathered from examination of the cargo profile presented in Plate 6. This summary presentation outlines the major categories of cargo handled and an indication of the intra structure requirements for material handling (Bechtel Corporation, 1970).

(c) Waterways serving the Port and volume of cargo moved. The locations of the IHNC, the GIWW, and the MR-GO are shown on Figure 2-17 and Plate 1. The IHNC has a controlling depth of 30 feet and is from 125-300 feet wide and 5 1/2 miles long. The GIWW from the Lake Borgne Light No. 29 to the IHNC is 12 feet deep by 150 feet wide. The MR-GO for sea-going vessels is maintained at a 36-foot depth with a width of 500 feet for its 75.6 miles to the Gulf of Mexico. The Mississippi River from New Orleans to Head of Passes is maintained at a 40-foot depth, 1,000 feet wide. South Pass and Southwest Pass Bar Channel are maintained at 40-foot deep, and South Pass and South Pass Bar are maintained at 30 feet. The MR-GO is 40 miles shorter between the Gulf of Mexico and New Orleans than is the river route. Table 2-28 shows the volume of freight moved through these channels from 1963 to 1973. Figure 2-18 shows the types of cargo moved on the MR-GO in 1973, both foreign and domestic (Department of the Army, 1974 F.). A small volume of cargo is moved in the Lake Borgne vicinity on Bayous Dupre, La Loutre, St. Malo, and Ysčloskey. Volumes of cargo moved in 1972 and 1973 are shown in Table 2-29. Table 2-30 shows the number and draft of vessels using the MR-GO and the bayous in 1972 and 1973.

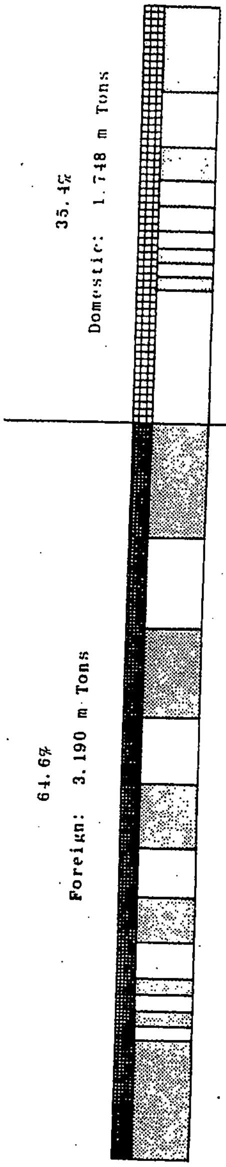
TABLE 2-28

VOLUME OF TRAFFIC, NEW ORLEANS AREA
(1963-1973 in Millions of Short Tons)

Year	Mississippi River	IHNC	GIWW East	GIWW West	MR-GO	MR-GO as a % of Mississippi River
1963	99.6	6.2	8.9	45.8	1.2	1.2%
1964	105.3	7.9	10.7	45.0	1.7	1.6%
1965	112.0	8.3	13.0	48.1	2.1	1.9%
1966	125.6	8.4	13.4	54.2	2.9	2.3%
1967	138.2	7.8	15.3	58.7	2.8	2.0%
1968	142.2	8.4	16.2	59.8	3.5	2.4%
1969	145.4	7.8	16.1	65.5	3.1	2.1%
1970	157.6	8.5	16.1	65.1	4.0	2.5%
1971	162.2	8.7	18.7	70.6	4.0	2.5%
1972	171.4	7.9	21.6	68.9	3.9	2.2%
1973	182.3	8.5	19.3	62.3	4.9	2.7%
Factor increase of 1973 compared to 1963(1)	x1.83	x1.37	x2.17	x1.36	x4.08	

(1) Example: The volume of cargo for 1973 on the Mississippi River is 1.83 times the volume of cargo for 1963.

Source: Department of the Army, 1974 F.



m Tons	%	Type
.374	21.4	Crude Petroleum
.230	13.1	Basic Chemicals, Petro Asphalts, Solvents
.143	8.2	Marine Shells, unmanufactured
.113	6.5	Soybeans
.108	6.2	Corn
.086	4.9	Coke, Petroleum Coke
.071	4.1	Phosphate Rock
.063	3.6	Commodities
.059	3.3	Liquefied Gases
.501	28.7	Other
	100%	of Total Domestic Cargo
.499	15.7	Sugar
.390	12.2	Coke, Petro Ásphalts, Solvents
.358	11.2	Iron and Steel Scrap
.299	9.4	Basic Chemicals and Products, etc.
278	8.7	Non-metallic Minerals, etc
.216	6.8	Limestone
.193	6.0	Corn
.156	4.9	Soybeans
.077	2.4	Grain Mill Products
.077	2.4	Aluminum Ores, Concentrates
.069	2.2	Ferroalloys
.067	2.1	Iron Ores, Concentrates
.511	16.0	Other
	100%	of Total Foreign Cargo

TOTAL

4.938 Million Tons of Foreign and Domestic Cargo.

272,415,145 Ton-Miles, all Traffic

Source: Waterborne Commerce of the U.S., Part 2, 1974, Corps of Engineers.

FIGURE 2-18

TYPES OF CARGO ON MR-GO

1973 (in Millions of short Tons)

TABLE 2-29

VOLUME OF CARGO ON BAYOUS IN SHORT TONS, 1972 AND 1973

Cargo Type	Bayou Dupre		Bayous La Loutre, St. Malo, and Yscloskey	
	1972	1973	1972	1973
Fresh Fish, Except Shellfish	7	20	26	53
Shellfish, Except Prepared	658	1,265	1,725	3,794
Marine Shells, Unmanufactured	24,318	60,928	2,545	--
Gasoline	96,796	25,712	--	--
Distillate Fuel Oil	--	100	177	266
Liquefied Gases	49,797	59,384	--	--
Waterway Improvement Mat	--	3,683	--	--
Clay	--	--	--	200
Machinery, Except Electrical	390	--	--	--
Total	171,966	151,092	4,473	4,273
Total Ton Miles	302,929	481,072	22,896	20,913

Source: Department of the Army, 1972 B and 1974 F.

TABLE 2-30

NUMBER OF VESSELS AND DRAFT
1972 AND 1973

Waterway and Draft	1972	1973
MR-GO Upbound:		
31 to 36 feet-	29	55
19 to 30 feet-	234	274
18 feet and less-	3,761	5,321
Total	4,024	5,650
MR-GO Downbound:		
31 to 36 feet-	23	58
19 to 30 feet-	216	223
18 feet and less-	3,778	5,340
Total	4,017	5,621
Bayou Dupre:		
East: 8 feet and less-	611	681
West: 8 feet and less-	612	681
Bayous La Loutre, St. Malo, and Ycloskey:		
East: 6 feet and less-	679	1,205
West: 6 feet and less-	680	1,204

Source: Department of the Army, 1972 B and 1974 F.

(d) Transportation system interface. One of the reasons for development of the Tidewater Port Facilities was the lack of land area for expansion and cargo handling adjacent to the Mississippi River near downtown New Orleans. The Tidewater Area was also provided for better access to regional highway and railway facilities. The Port of New Orleans is the focal point of numerous land-based transportation links. A web of major railroad systems provide one-day service as far away as Memphis, Tennessee; Montgomery, Alabama; and Shreveport, Louisiana. Second-day rail delivery extends as far as Chicago, Illinois; Louisville, Kentucky; Atlanta, Georgia; Jacksonville, Tennessee; and Dallas, Texas. The rail system extends to every terminal in the Port through the service of the New Orleans Public Belt Railroad which acts as switching agent for all seven main line railroads. The interstate highway system also links New Orleans and major interior systems. First-day truck delivery area from the Port of New Orleans includes most of Louisiana, as well as Houston, Memphis, Birmingham, and Mobile. Second-day truck delivery extends as far as San Antonio, Dallas, Fort Worth, Kansas City, Chicago, Indianapolis, Cincinnati, Louisville, Atlanta, Savannah, St. Petersburg, and Pensacola. Interstate Highway 10 provides the necessary connecting link from the Port area to major arterial highways extending east-west and north from New Orleans.

(e) The Tidewater Port - MR-GO complex

1. The Tidewater Port. The Tidewater Port Area along the Inner Harbor Navigation Canal is closedly tied with the operation of the MR-GO. Significant expansion of the Tidewater Port has taken place since 1963. Continuing developing of the Tidewater Port is an essential element of the Port's long-range growth plans. The Port presently has an investment of approximately $25,000,000 in the public bulk terminal, $15,000,000 in France Road Container terminal, and approximately $13,000,000 in the IHNC and the MR-GO. In fiscal year 1974, revenues from the use of public facilities in the Tidewater Area represented 25 percent of operating revenues generated from public port facilities (Port of New Orleans, 1974). The diversity and importance of traffic through the MR-GO is illustrated in Table 2-31 which summarizes the six major commodity classifications for freight traffic in both foreign and domestic components.

TABLE 2-31

RANKING OF FOREIGN AND DOMESTIC COMPONENTS OF CARGO, MR-GO, 1973

Ranking	Commodities	Foreign or Domestic Component
1	Basic chemicals and products	Foreign and Domestic
2	Sugar	Foreign primarily
3	Coke, petroleum asphalts, and solvents	Foreign primarily
4	Iron and steel scrap	Foreign primarily
5	Crude petroleum	Domestic primarily
6	Non-metallic minerals	Foreign primarily

These commodities represent about 50 percent of cargo handled on MR-GO.

Source: Department of the Army, 1974 F.

2. The master plan. Plate 6 illustrates the recommended master plan layout for the year 1990 as developed for the Board of Commissioners of the Port of New Orleans (Bechtel Corporation, 1970). As shown, a significant portion of anticipated expanded Port capability is along the convergent sections of the GIWW and the MR-GO. Major cargo handling features of the master plan include expanded container terminal facilities, barge-carrier terminal, steel terminal, bulk terminal, banana terminal, and break bulk terminal. These facilities will be coordinated with the private industrial development which will be taking place in the designated areas.

3. The locks. To relieve congestion at the existing lock on the IHNC, a new channel and lock has been authorized between the Mississippi River and the MR-GO. The exact location for this channel has not yet been designated. The new lock and channel will have a significant impact upon traffic through the harbor as well as along the MR-GO. Deep draft vessels will have access to the harbor either directly down the MR-GO or through the lock to the Mississippi River. This development will permit an increase in overall port activity, but will reduce present dependence upon the MR-GO as the only approach to the Tidewater Port Area for ocean-going vessels.

(3) Present utilization of the MR-GO and navigation restraints. Present utilization of the MR-GO is on the order of three vessels per day average. Considerable limitations presently inhibit maximum development of Port facilities in this area. These include the following (Port of New Orleans, 1974):

1. Limited navigation aids in the MR-GO channel inhibit traffic, especially nighttime passages. The Coast Guard is presently working on a program to improve the navigational aids situation.

2. The rate of shoaling in the MR-GO has previously been cited as a major operation and maintenance expense item. It is anticipated that the shoaling rate will decrease in the future as a result of stabilization of the channel side slopes. However, the future rate of shoaling is difficult to project at present.

3. The obsolete and limiting locks in the IHNC are carrying the maximum traffic volume possible. Increased development in the Tidewater Port Area will rely on ocean-going turnaround traffic into and out of the Tidewater Port, improvement of the existing locks, or construction of a new channel and lock to the Mississippi River as outlined in the master plan development.

g. Water resources development. Surface waters are utilized for navigation, resource extraction, recreation, and wastewater disposal as described in Section 2.03f. Use for navigation is dependent upon periodic dredging of channels when they fill with sediment. Use for recreation and for extraction of biotic resources is dependent upon maintenance of good water quality. Use for wastewater disposal without decrease in water quality depends on adequate treatment and sufficient flow for dispersion of pollutants. Protection from wind induced tides associated with storms is accomplished by levee construction. Flood gates and provisions for internal drainage are required. Traditional methods of marshland drainage are employed to drain land and make it available for urban development. All of these uses of water resources or methods for minimizing hazards from presence of water affect the hydrologic regime. Salinity of groundwater limits the availability of water for human consumption in the majority of the land area in St. Bernard Parish. Intrusion of salt water into fresh groundwater sources is a concern in the New Orleans SMSA. Changes in both fishing and shellfishing harvest areas in Lake Pontchartrain and Lake Borgne and changes in the vegetational communities in the area reflect changing salinity of waters. Hurricane protection will be provided by the Lake Pontchartrain, Louisiana and Vicinity project. This project will include a lock and control structure at the Rigolets, a navigation structure and control structure at

Chef Menteur Pass, and a lock and control structure at Seabrook. The structures at Seabrook can be operated to modify salinities in Lake Pontchartrain. The structures at the Rigolets and Chef Menteur will be designed and operated to maintain existing hydrologic conditions in Lake Pontchartrain.

h. Transportation and communication system development.

(1) Highways and airports. Existing and proposed highways are shown on Figure 2-19. Most noted are Routes 46 and 47, which are in the immediate MR-GO area. Route 46 provides access to land as far west as Hopedale and is the principal traffic artery for St. Bernard Parish. The three civilian airports are shown on Figure 2-19. There is one naval airport near New Orleans. Scheduled commercial flights utilize New Orleans International Airport (Moisant Field). The other civilian facilities serve only general aviation.

(2) Railroads. Existing railroads are shown on Figure 2-20. The MR-GO area is served by the six following major railways: Southern Pacific, Gulf Central, Louisville and Nashville, Southern, Missouri Pacific-Texas and Pacific, and Kansas City Southern. The only railroad lines within two miles of the MR-GO are Louisville and Nashville Line and a spur of the New Orleans Public Belt Line, which serves the Tidewater Port.

(3) Pipelines. With the extensive gas and petroleum extraction and refining in the New Orleans area, a complex network of pipelines has been established. Major gas and oil pipelines are shown on Figure 2-21. Table 2-32 indicates those pipelines which traverse the MR-GO.

(4) Transmission lines. Transmission lines in the MR-GO area are shown on Figure 2-22. Operators in the area shown are the Louisiana Power and Light Company and New Orleans Public Service, Inc. Crossings of the MR-GO are shown in Table 2-32.

(5) Communications. The only major communications facility that crosses the MR-GO is the underground cable maintained by South Central Bell Telephone Company at Mile 41.6 near Shell Beach.

i. Sociological elements. With the exception of settlements at Yscloskey, the areas adjacent to the MR-GO are largely uninhabited. Data pertaining to racial, ethnic, and economic characteristics for the few inhabitants of the area are unavailable. Operation and maintenance of the MR-GO will likely have no effect on the sociological composition of the area.

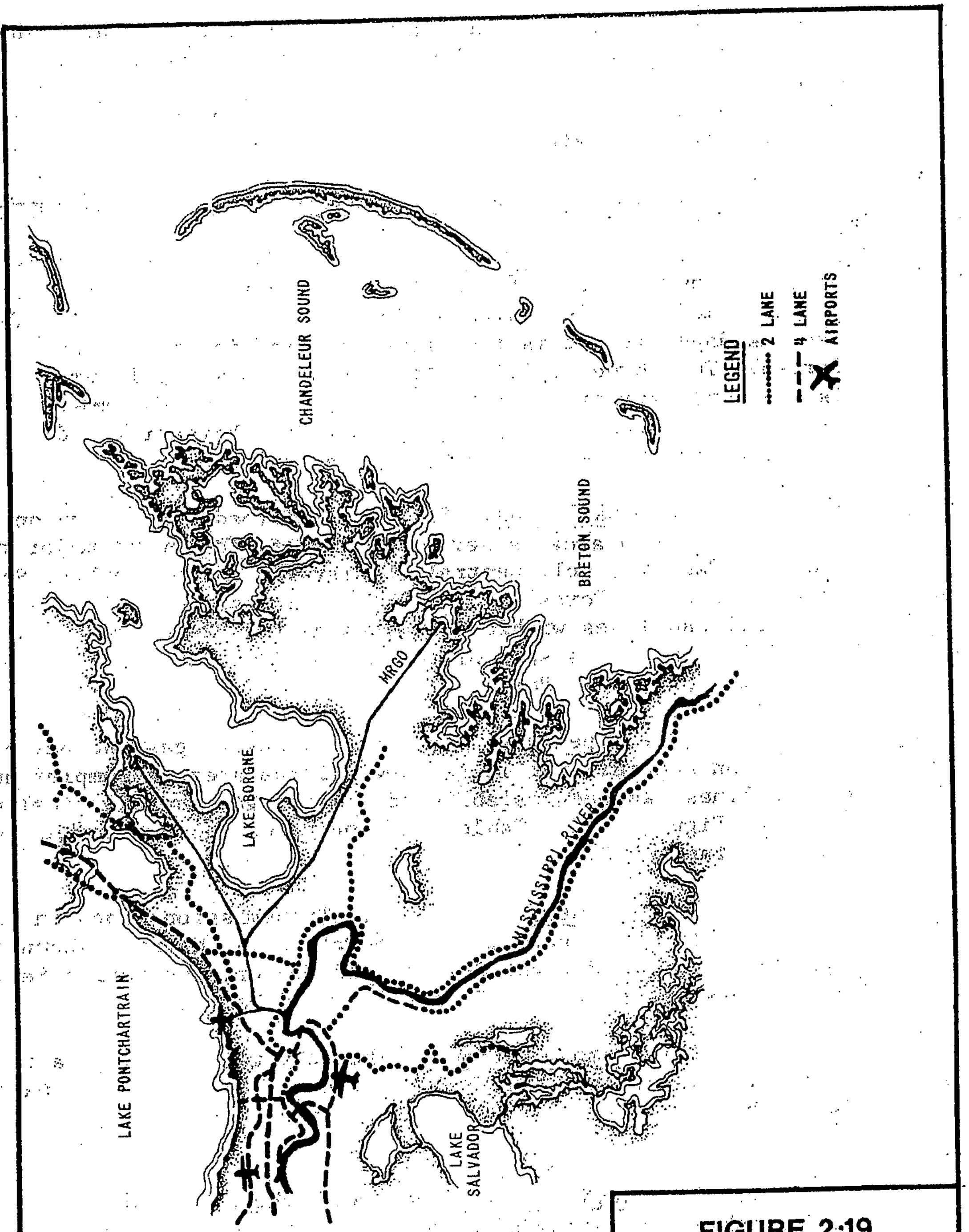


FIGURE 2-19

HIGHWAYS AND AIRPORTS

ENGINEERING AGENCY FOR RESOURCES INVENTORIES, 1973

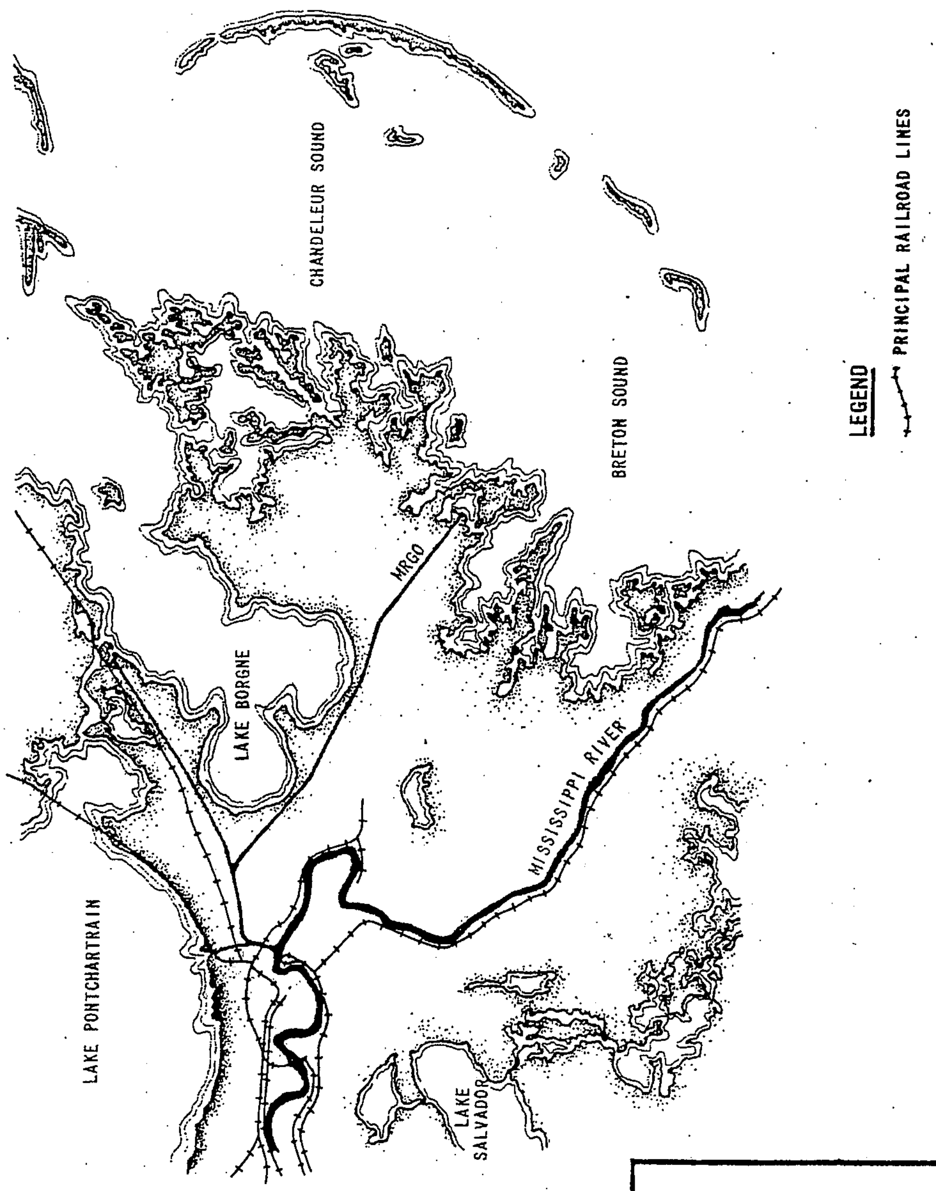


FIGURE 2-20

PRINCIPAL RAILROAD LINES

ENGINEERING AGENCY FOR RESOURCES INVENTORIES, 1973

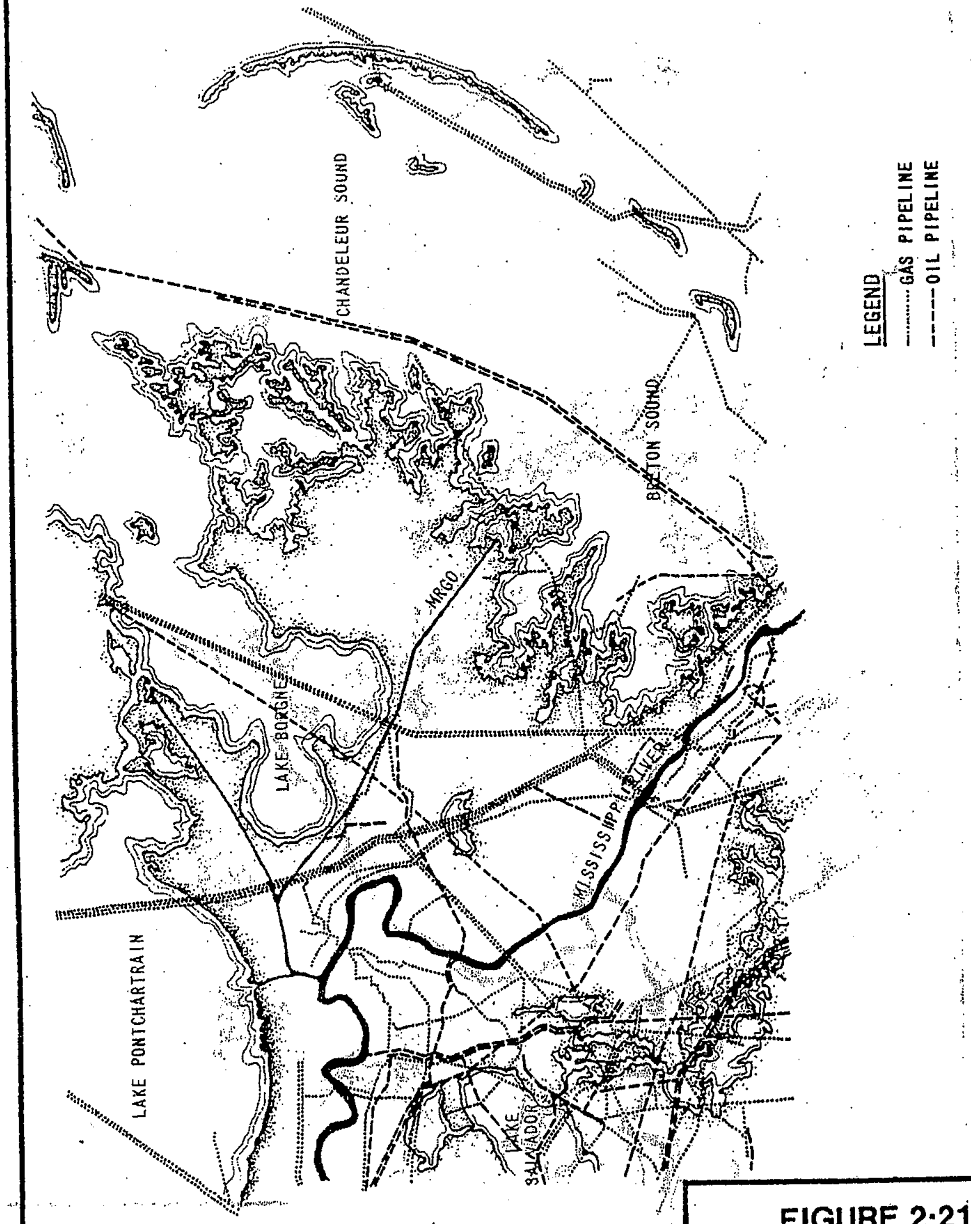


FIGURE 2·21

PIPELINES

ENGINEERING AGENCY FOR RESOURCES INVENTORIES, 1973

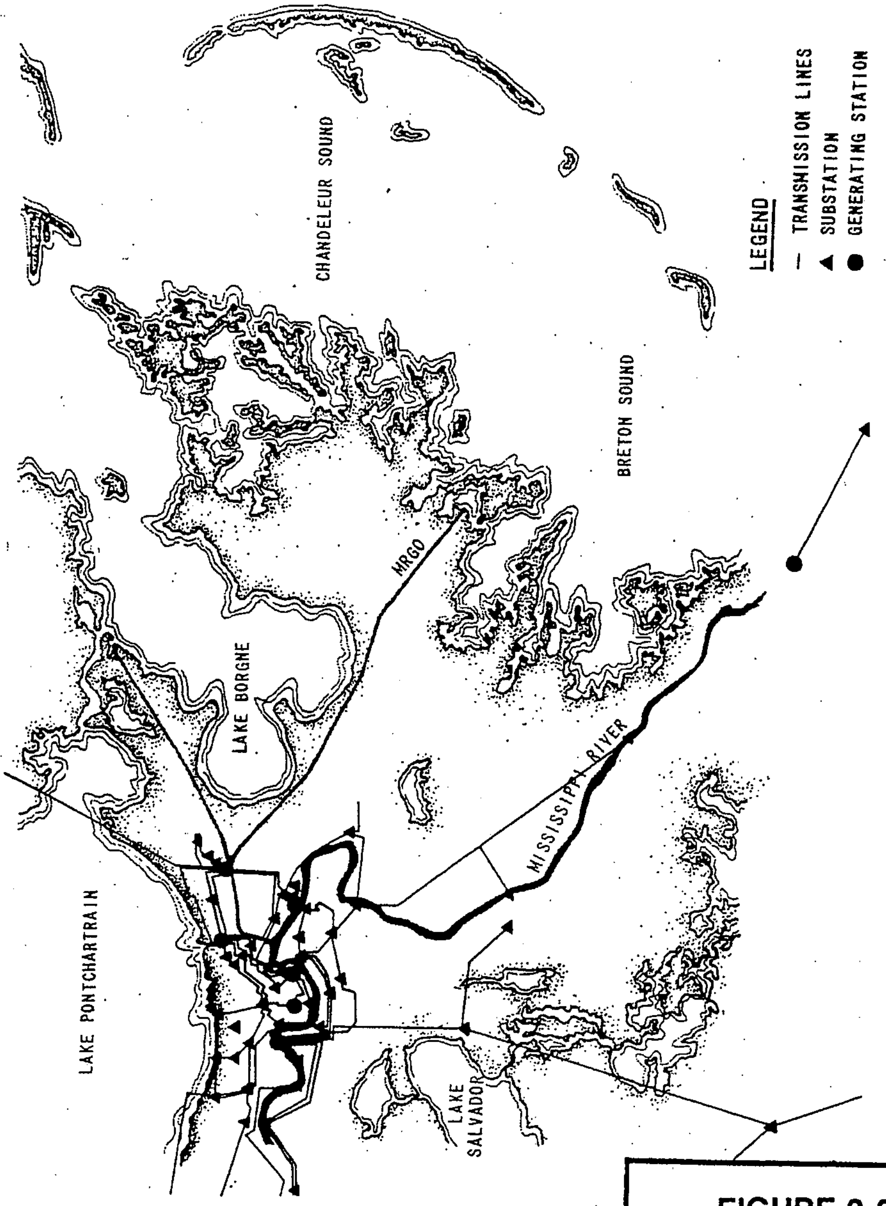


FIGURE 2-22

TRANSMISSION LINES

ENGINEERING AGENCY FOR RESOURCES INVENTORIES, 1973

TABLE 2-32

UTILITY LINES WHICH CROSS THE MR-GO
1973

Mile	Type	Number	Size	Owner
-4.8	Sub Gas(1)	1	12"	Chandeleur Pipe Line Co.
-4.7	Sub Gas	3	12",16",20"	Chandeleur Pipe Line Co.
-4.4	Gas	1	24"	Texas Eastern Trans. Corp.
3.5	Gas	2	4"	Kerr-McGee Corp.
9.3	Sub Gas	1	6"	Oil & Gas Futures, Inc. of Texas
13.9	Oil	2	20"	Cal-Ky Pipe Line Co.
14.0	Oil	1	20"	Cal-Ky Pipe Line Co.
23.6	Sub Gas	1	6"	Southern Natural Gas
41.6	Aerial Crossing			Louisiana Power & Light
41.6	Sub Tel & Tel			South Central Bell Tel. Co.
42.6	Sub Gas	2	30",36"	Tenn. Gas Trans. Co.
44.7	Petrol	1	20"	Gulf Refining Co.
54.9	Sub Gas	3	20",24",30"	Southern Natural Gas Pipeline Co.
58.1	Sub Gas	1	12"	Creole Gas Pipeline Co.
60.5	Aerial Crossing			New Orleans Public Service
60.9	Sub Gas	2	24"	New Orleans Public Service
61.0	Sub Gas	3	12"	New Orleans Public Service
63.8	Sewer	1	48"	New Orleans Public Service
65.7	Aerial Crossing			New Orleans Public Service

(1) Sub Gas: i.e., underground.

Source: Department of the Army, 1973 G.

2.10 FUTURE ENVIRONMENTAL CONDITIONS OF THE PROJECT AREA WITHOUT THE PROJECT

Future conditions of the project area depend on the trends and processes described in the foregoing text. Future conditions will result from the interplay of agency actions described in the next section. The relationship between O&M work and future conditions is described in Section 6. If maintenance of the MR-GO and associated bayous were discontinued, the channels would become more shallow as channel banks continue to erode. The channels would not fill in and become marshland again, but would continue to be open water.

2.11 INTERRELATIONSHIP OF PROJECT AND ACTIONS PROPOSED OR IN OPERATION BY ANY AGENCY OR ORGANIZATION

a. Resource allocation decisions. The future environment of the project area depends on the interplay of joint decisions (or conflicting policies) of governmental agencies and actions of private interests. Development by private interests will continue to affect the area; for example - use of marshland for urban development, use of estuary resources for harvest of biotic resources, and extraction of nonrenewable resources (oil, gas, sulfur, clay, etc.). Action individuals cannot take by themselves will be taken by them through the governmental agencies. O&M work on the MR-GO is conducted on the basis of resource allocation decisions made prior to 1956. Construction of the MR-GO and subsequent maintenance satisfy needs for navigation improvements for resulting economic benefits. Needs for use of the marshland resources, in addition to use of the area for navigation, include: preservation and management of the estuary for harvest of biotic resources; continued use of the area for extraction of nonrenewable resources; and use of the marshlands for recreation. Some of these needs, particularly those related to marshland preservation, have been given more attention during the past several years. New resource allocation decisions may be required in conjunction with regional coastal zone management. The State of Louisiana is presently seeking to develop state level management capability for coastal resource management. The state is also refining its means and management capability for protection of environmental quality. Continued O&M work on the MR-GO and associated bayous will be influenced by future governmental environmental policies and resource allocation decisions.

b. Actions proposed or in operation by various agencies. At the present time, agency actions in the MR-GO vicinity relate to four recognized needs. These needs are listed in the left-hand column of Table 2-33. The table summarizes the type of actions being taken by each agency. Previous action by these facilitating agencies have altered the estuary-delta ecosystem significantly. Future actions are expected to continue to alter the environment. Human activities have had and will have significant, long-range impacts upon the estuary resources. O&M work is a part of this on-going change in the estuarine environment. Section 6 discusses effects which future projects and governmental policies may have on O&M work on the MR-GO and associated bayous.

TABLE 2-33

GOVERNMENTAL AGENCY ACTIONS

Needs	Actions	Sector Responsible
Need for Protection of Urban Land Uses from Hurricanes		
	Hurricane Protection. Levee Construction.	Corps of Engineers.
Need for Economic Growth		
	Construction of Port Facilities.	Board of Commissioners and the Port of New Orleans.
	Maintenance of Navigation Channels.	Corps of Engineers.
	Maintenance of Navigation Aids.	Coast Guard.
	Urban/Industrial Facility Construction & Mineral Extraction.	The private sector & local & state government regulation.
Need for Protection of Biotic Resources and Water Quality		
	Water Quality Monitoring and Standard Enforcement.	The Federal EPA & State Agencies responsible for Water Quality Control.
		State Regulation of Mineral Extraction.
		Local Sewer & Water Treatment Agencies.
	Shellfish Monitoring Program.	State Bureau of Environmental Health.
Need for Space for Urban Development		
	Land Use Planning & Other Programs.	Parish & Regional Planning Commissions.
	Expansion of present facilities.	The private sector & the Pontchartrain New Town.

Source: Stanley Consultants, Inc.

SECTION 3

RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

3.01 CONFORMITY OF PROJECT WITH LAND USE PLANS

a. General. Land use plans for the MR-GO area have been prepared by the Regional Planning Commission for Jefferson, Orleans, St. Bernard, and St. Tammany Parishes and by the Board of Commissioners of the Port of New Orleans. The St. Bernard Parish Planning Commission is currently in the process of adopting a land use plan.

b. Regional Interim Land Use Plan. The 1990 Interim Land Use Plan (Regional Planning Commission, 1973) for the southern portion of the New Orleans SMSA region is shown on Plate 5. Industrial land use is proposed for the lands adjacent to the west side of the MR-GO north of Bayou Bienvenue. Lands east of the MR-GO/GIWW intersection would remain as marsh. This plan is of a general nature and is not specific enough to show disposal areas in relationship to overall land development. The 1990 plan assumes continued population growth, an expanding economy, development of the proposed north-south interstate highway, hurricane protection, and utility system improvements in the MR-GO development area. These improvements would have a significant impact on land use in St. Bernard Parish. Impact of these elements would overshadow the secondary land use/economic impact of O&M work.

c. New Orleans Centroport Plan. The 1990 Land Use Plan for the proposed Centroport Harbor development is shown on Plate 6. The plan makes no special provision for disposal of dredged material. Material has been used as landfill material and for construction of hurricane protection levees. The Board of Commissioners of the Port of New Orleans performs maintenance dredging adjacent to its facilities. This type of cooperation between agencies for accomplishing O&M work is expected in the future. The Centroport Harbor plan (Bechtel Corporation, 1970) also calls for expanding the MR-GO to 750 feet wide and 50 feet deep through the Tidewater Port Area. At present, the Centroport tidewater facilities depend on continued O&M work on the MR-GO.

d. St. Bernard Parish Planning Study. The St. Bernard Parish Planning Commission has developed three alternative land use plans. Each designates the land traversed by the MR-GO as a wildlife-conservation area. Dredged material deposition in the contained disposal areas is expected to continue. In the future when hurricane protection levees are complete, the MR-GO disposal areas will be elevated, protected land. If a levee top access road were provided between the Tidewater Port Facilities and Shell

Beach, urban or recreation facility development on the MR-GO disposal areas could be expected. Environmental impact associated with this type of development would be significant. Planning for these facilities, or exclusion of them, would depend upon governmental policies restricting development of the access road, retention of disposal areas for O&M use, and/or land use regulation by St. Bernard Parish.

e. State plans affecting the MR-GO vicinity. Plans for development of state recreation facilities in the area involve construction of facilities at St. Bernard State Park on the Mississippi River. This project is not expected to affect the MR-GO directly; however, a focal point for boating activity in the area might lead to increased recreation traffic on the MR-GO and associated bayous. State transportation plans may involve construction of an interstate loop south of New Orleans across the river. Completion of this loop to the east might involve the Paris Road bridge area. Future state action relative to coastal zone management may affect use of the marshlands southeast of New Orleans.

f. Related Corps of Engineers projects. Numerous Corps of Engineers studies and projects have affected the MR-GO area and will affect its future (Department of the Army, 1971 and 1973). Examples of these projects are listed below. The segment of the MR-GO from about Mile 47 to Mile 20 is the only segment that is not directly affected by future projects now being planned.

(1) The Lake Pontchartrain and Vicinity Hurricane Protection project (and Citrus Back Levee Project, etc.) is under construction to protect developed areas from hurricane tides. Floodwalls and levees along the IHNC, MR-GO, and in Chalmette are presently under construction.

(2) Construction is underway for the MR-GO/Michoud Canal project just north of the point near the MR-GO/GIWW junction. Initial dredging is complete.

(3) A study is presently in progress to determine the feasibility of measures to reduce shoaling in the MR-GO channel through Breton Sound. Extension of the jetty across the Sound is one possibility. This project is authorized for construction.

(4) Replacement of the old lock on the Inner Harbor Navigation Canal to provide a deeper draft link between Tidewater Port Facilities and the MR-GO/GIWW is authorized. Size and location of the new lock are in planning stages.

(5) Various Flood Insurance Studies have been completed for three areas of St. Bernard Parish and the New Orleans Inner harbor area. The Corps of Engineers is participating in the New Orleans Area Urban Study now underway.

3.02 CONFLICTS OF PROJECT WITH LAND USE PLANS

O&M work on the MR-GO and associated bayous does not conflict with resource allocation choices made prior to construction of the MR-GO. O&M work primarily affects only the areas allocated for disposal areas for the MR-GO. Secondary effects on estuary biota are discussed in subsequent sections. The socio-economic impacts of O&M work (or conflicts with land use plans) are overshadowed by socio-economic impact of regional development associated with growth of the New Orleans metropolitan area and with use of the coastal area for extraction of mineral resources and harvest of biotic resources.

SECTION 4

THE PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT

4.01 GENERAL NATURE OF IMPACTS

a. Assessment of impacts. Discussion of the environmental and economic impact of O&M work on the MR-GO and associated bayous is divided into three categories: (1) effects related to all other actions and changes which affect the MR-GO vicinity; (2) general effects related to the O&M process; and (3) site-specific effects. Definition of the significance and magnitude of impacts included consideration of the following: the duration, permanence, and areal extent of the effect; the proportion of the resource affected; and the chain of events which might occur as a result of the impact. Where quantification is meaningful, impacts are measured in physical terms such as acres, miles, change in species composition of communities, etc. Other impacts are described in terms of environmental or economic changes which relate to or which may be caused by the specific impact being discussed.

b. Effects related to other actions and changes. In the Lake Borgne vicinity, O&M work is but one of many human and natural processes causing changes in the marshland environment. Other dredging operations conducted in conjunction with oil and gas exploration and extraction, installation of pipelines, and channel cutting for small craft access to marshland areas are causing environmental changes similar to those caused by O&M of the MR-GO. The marshlands are being affected by expansion of the urbanized land in St. Bernard Parish, particularly in the GIWW/MR-GO/Bayou Bienvenue area. Construction of hurricane protection levees is another example of changes in the Lake Borgne vicinity. In addition to changes caused by human activities, the environment is still in the process of coming to an equilibrium in response to subsidence of the delta, decrease in freshwater inflow, etc. Table 4-1 summarizes changes presently influencing the environmental setting of the MR-GO vicinity.

TABLE 4-1

SUMMARY OF SOME OF THE EVENTS AND ACTIONS WHICH AFFECT THE ENVIRONMENTAL SETTING

HISTORICAL ACTIONS: The ecosystem is still in the process of coming to equilibrium as a result of the changes caused by abandonment of the St. Bernard Delta Complex by the Mississippi River, of changes caused by construction of Mississippi River levees and the MR-GO. Present environmental trends are a continuation of changes associated with these events.

Abandonment of the St. Bernard Delta Complex by the Mississippi River:

The delta area stopped building up and extending.

Subsidence continues.

Erosion continues, with resultant increase in the proportion of open water.

Salinity of water increases. Freshwater inflow now comes primarily from the Pearl River, from precipitation on the immediate area, or from infrequent opening of the Bonnet Carre Spillway.

Levee Construction on the Mississippi River:

Additional restriction of eastward Mississippi River freshwater flow.

Same general effects as above.

Construction of the MR-GO:

Alteration of marshland for economic benefit.

Continuation of salt water intrusion caused by several processes and actions, and resultant marsh deterioration in some areas. Gradual shift in biotic community composition toward greater proportion of species tolerant to higher salinity levels in response to changes in system hydrology and salinity.

Creation of permanent high-ground dredged material deposition areas on west bank of MR-GO and resultant effects on area hydrology and biotic resources.

TABLE 4-1 (Cont.)

SUMMARY OF SOME OF THE EVENTS AND
ACTIONS WHICH AFFECT THE ENVIRONMENTAL SETTING

HISTORICAL AND CONTINUING DIRECT ACTIONS: All of these actions create environmental changes. O&M activities and resultant changes occur within this context. Natural drainage off the marshlands and use of waterways for urban stormwater run-off alter quality of water and sediment.

Operation of vessels on the MR-GO:

Resultant turbidity and shoreline erosion.

Construction of canals for pipelines, for access to areas of oil extraction and for access to marshland areas for fishing, trapping, and recreation:

Effects similar to those described for O&M work.

Land development in St. Bernard Parish:

Land filling and drainage in the Bayou Bienvenue/Paris Road area.

Residential development along Highway 46 and in the communities such as Hopedale and Shell Beach; and resultant increases in stormwater run-off and sanitary wastewater.

Construction of hurricane protection levees:

Elevation of the land adjacent to the MR-GO on the west channel bank, eventually to Mile 47. Borrow of fill material from the channel bottom of the MR-GO.

Use of Bayou Bienvenue and the GIWW/MR-GO for discharge of stormwater and other wastewater:

Decrease in water quality if wastewater is untreated.

TABLE 4-1 (Cont.)

SUMMARY OF SOME OF THE EVENTS AND
ACTIONS WHICH AFFECT THE ENVIRONMENTAL SETTING

FUTURE ACTIONS: ANTICIPATED, PROPOSED, OR PLANNED: All of these planned actions would affect the Lake Borgne vicinity should the proposals be implemented. O&M work ties into these proposals in that Tidewater Port Facilities and expansion plans are dependent upon continued O&M work. The hurricane protection levees, planned on the west side of the MR-GO channel will require fill from the channel, and will take up dredged material disposal space. Foreshore protection plans may affect the future rate of shoaling in the land area. Jetty extension across Breton Sound is related to both navigation needs and O&M dredging requirements. Future use of the dredged material disposal areas will depend upon the Port Authority, the Corps of Engineers, and St. Bernard Parish policies, plans, and regulations.

Source: Stanley Consultants, Inc. based on Section 2 data.

c. General effects. Not all of the effects of typical O&M work apply to O&M of the MR-GO and associated bayous. In the MR-GO, bottom-dwelling biota are in a pioneer stage of succession and are constantly disrupted by vessel traffic and periodic dredging. The significance of disturbance of these pioneer stage communities is not as great as it would be if the channel to be dredged were an established, diverse riverbed community. O&M work maintains the designed channel depth and does not produce a significantly different set of channel dimensions. However, the following quotation from the preface to Disposal of Dredge Spoil, Problem Identification, and Assessment, and Research Program Development, by the U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, 1972, provides the general background of concerns relative to the general effects of O&M work.

> "Much of the concern over the actual dredging process is related to the direct destruction of benthic (bottom-dwelling) organisms. Such organisms are known to play an important role in the aquatic ecosystem, and include commercially valuable species such as oysters and clams. Although the direct effects of dredging on benthic organisms may appear to be obvious, there is little information available that permits the

prediction or assessment of the overall extent, significance, and duration of the effects. In addition to the direct effects of dredging operations, concern also exists over the possible indirect effects on biological communities. The potential for indirect effects on biological communities is usually attributed to physical alterations of the environment such as changes in bottom geometry and bottom substrate which trigger subsequent alterations in water velocity and current patterns, salinity gradients, and the exchange of nutrients between bottom sediments and the overlying water. Each of these physical changes can, either singly or in combination, initiate varying responses within the biological communities. As an example, a change in the saltwater gradient may be beneficial for young fish and crab transport, yet, due to the greater penetration of predators, detrimental to oysters. Within the current state of knowledge, it is not always possible to definitely assess such effects or to judge whether they are of an adverse or beneficial nature.

Most of the concern over the dredging-disposal process is directed toward the effects of open water disposal on water quality and aquatic organisms. It has long been known that, depending on individual circumstances, bottom sediments are continuously being resuspended by natural processes. Thus, under cursory examination, the open water disposal of bottom sediments may be viewed as an extension of natural processes. However, in contrast to the natural phenomenon of sediment resuspension, open water disposal often results in the resuspension of large volumes of sediments over a relatively short period of time, in a relatively small area. Further, the dredging and redeposition of certain types of polluted sediment may convert a localized problem in a noncritical location to a serious regional problem as pollutants are dispersed by currents and/or carried to critically important areas such as oyster grounds and coral reefs. The effects of open water disposal are, therefore, often similar to effects resulting from normal resuspension, but the intensity and range of the effects can be increased.

One of the direct effects of open water disposal is sediment buildup, resulting in the smothering of benthic organisms, changes in spawning areas, reduced habitat diversity, changes in sediment/water chemical interchange, and reduced or changed vegetative cover.

> In addition, increased levels of turbidity reduce light penetration (thus altering biological productivity), decrease the availability of food, and alter the chemistry and temperature of the water. Finally, because most of the sediments in the nation's waters have become contaminated with chemical pollutants, there are grave concerns that man-induced resuspension of such sediments may increase the availability of these pollutants, thus directly affecting biological communities and, indirectly, man. Because of the poor understanding of the possible consequences of these changes and alterations, definitive research is needed to assess all aspects of the open water disposal of dredged sediments.
>
> Primarily because of the concern over the open water disposal of polluted sediments, a trend toward land disposal has developed. Yet, without definitive research, it is not possible to determine from an overall environmental viewpoint in which cases land disposal is in fact a wise alternative to open water disposal. Land disposal often involves marshlands or other wetlands, which are among the most biologically productive areas on earth. The effects of disposal on the role of marshlands as breeding areas, nurseries, and zones of biological production are only marginally understood. In addition to the rather special case of marsh disposal, there are other environmental concerns that must be considered common to all types of land disposal. One of the more intensive concerns involves the possible pollution of groundwater reservoirs and the subsequent effects on man. Land disposal also alters vegetation assemblages and local relief, thereby triggering changes in drainage patterns and wildlife migration. The relocation of sediments from one biotope to another (e.g., the ocean to the coastal plain) can be an alien intrusion that concerns many ecologists. Finally, as is always the case, each of these alterations can initiate further sequences of events, not only in the terrestrial regime, but the aquatic regime as well."

d. <u>Site - specific effects</u>. Each O&M work contract affects specific locations -- the area from which material is dredged and the disposal location. Temporary turbidity created by dredge operation and open water material disposal changes both the local and adjacent aquatic environments. Each time dredged material is placed in the land disposal areas, the existing vegetation is covered, and the elevation of the land is increased slightly.

(1) Effects of dredging. As the cutterhead pipeline dredge sucks up material from the channel bottom, the bottom-dwelling biota and free-floating species are taken up with the sediment. These individual organisms die if placed on the land disposal areas, but some of those deposited in open water may survive.

(2) Effects of disposal in open water. When material is deposited in open water, heavier material settles immediately to the bottom of Breton Sound. Bottom dwelling, nonmobile organisms that cannot escape the flow are covered. Approximately 27.5 square miles of open water disposal (about 17,600 acres) have been affected. O&M work directly affects the immediate disposal site near the dredge within this 27.5 square mile area. About 40 percent of the dredged material can be expected to remain suspended in the water for four hours or more. Current velocities measured in Breton Sound indicate a range of 0.34 to 1.19 feet per second (Department of the Army, 1964). In a four-hour period, sediment could be carried from about nine-tenths to 3.2 miles. Dredge operations would normally occur during periods of lower current velocity. The suspended material is dispersed as it is carried along with the current. Turbidity levels decrease with the distance from the dredge. Turbidity varies greatly under normal conditions and organisms in the estuary-delta region are adapted to these changes. Case histories of dredging (Mackin, 1959) indicate that silt was carried a maximum of 1,300 feet from the dredge and was subjected to rapid dispersal and dilution of sediments. A maximum of one percent of the material drifted away from the operation site. On most days, turbidities were negligible at 100 feet from the discharge pipe, and did not exceed natural levels beyond a few hundred feet. Suspended sediment reduces light available to organisms. The amount of sediment taken in by fish and the small filter feeders increases. If sediments containing heavy metals which can be resolubilized are resuspended, metals may be taken in by biota, concentrated in tissues and made available to other organisms in the food web (for example, oysters or large fish-eating birds). Another direct effect of resuspension of sediments would occur if the biochemical oxygen demand of the sediments were high. Due to the abundance of dissolved oxygen in receiving waters, reduction of available oxygen by sediment BOD is not anticipated to be significant for biota in Breton Sound or in the MR-GO channel.

(3) Effects of disposal on land. Direct effects on vegetation and elevation of the 10,617 acres of land disposal area are significant for the specific disposal sites. Because

of containment dikes around the designated disposal areas, previously disturbed areas rather than undisturbed marshland are affected. The designated disposal areas comprise 3.25 percent of the land area of St. Bernard Parish. Each time material is placed on the disposal area, the herbaceous plants and shrubs of that area are covered. In a year to 18 months, the dredged material disposal areas revegetate and terrestrial animals return. Terrestrial animals that cannot escape the dredged material are lost. Some individuals may also die from stress of overcrowding if they move to adjacent habitat which is already supporting its capacity of animals. Dredge operations might coincide with nesting times of birds and other animals. Nest disruption would be adverse to some populations. Secondary and cumulative effects follow direct impacts. As material is deposited on the land, the elevation of the diked areas increases, thus: 1) providing space for botanical and zoological species that require high ground, 2) providing or maintaining a barrier to water interchange, and 3) making the disposal areas potentially suitable for urban development. The dredged material settles as particles compact, thus the increases in elevation are not significant in the short-term, but over a long period of time elevations increase. Much of the dredged material is not good foundation material. This limits usefulness of most of the disposal areas for urban development. Lack of access to the area is another primary constraint for urban development. These secondary effects are not considered significant in the short-term time frame.

4.02 BENEFICIAL AND ADVERSE IMPACTS

a. <u>General</u>. Classification of impact as adverse, beneficial, or not significant requires definition of the perspective from which the action or effect is viewed. For example, from the single perspective of preserving the marshland, effects of O&M could be classed as adverse human intrusions; while from the human perspective of economic development, effects of O&M work are classed as beneficial. In Table 4-2, the five following perspectives have been defined for classification of impact:

The perspective of economic development.
The perspective of viability of the ecosystem.
The perspective of land use planning.
The perspective of resource management for biota.
The perspective of ecosystem preservation.

Effects resulting from the following actions are discussed: provision for navigation and access to Tidewater Port Facilities;

provision of elevated land; loss of vegetation and local terrestrial biota on the dredged material disposal areas; disturbance of channel bottom-dwelling biota; increase in local turbidity of receiving waters during open water disposal; and the possibility of resuspension and resolubilization of heavy metals in the sediment. The above actions would be considered adverse from the fifth perspective, ecosystem preservation defined in the most narrow sense.

TABLE 4-2

CLASSIFICATION OF IMPACT

Impact/Action — Classification/Discussion

PROVISION FOR NAVIGATION AND ACCESS TO TIDEWATER PORT FACILITIES:

Considered Beneficial from the Perspective of Economic Development:

The Port of New Orleans is of nationwide significance in volume of cargo and value of cargo handled. The Tidewater Port Facilities comprise 25 percent of the Dock Board's present operating revenues. Maintenance of the MR-GO provides for a principal route to the Port of New Orleans.

O&M work facilitates movement of small craft on the associated bayous, thus serving the local biota harvest economic sector, the oil and gas extraction economic sector, and the recreation craft related economic sector.

PROVISION OF ELEVATED LAND:

Considered Beneficial from the Perspective of Economic Development:

Material dredged in construction and maintenance of the MR-GO provides land area for Tidewater Port Facility expansion and for related industrial expansion.

O&M work provides elevated land adjacent to the MR-GO which may be suitable for urban or recreation development in conjunction with provisions

TABLE 4-2 (Cont.)

CLASSIFICATION OF IMPACT

Impact/Action	Classification/Discussion
PROVISION OF ELEVATED LAND (Cont.)	for hurricane protection. This would be a long-term rather than a short-term benefit, dependent upon land use planning.
	<u>Considered Insignificant or Slightly Beneficial from the Perspective of Viability of the Ecosystem</u>:
	High ground habitat is created by O&M work. Species occur in the marshlands which otherwise would not be there. The species composition on the disposal area remains in pioneer development stages. O&M work also offsets the effects of subsidence and compaction of the local disposal area. The elevated disposal areas appear to retard the westward erosion of the MR-GO channel bank. The elevated areas might be managed for the benefit of wildlife at some future date, should O&M be discontinued, however, the area would not be considered prime from a wildlife management viewpoint.
	<u>Considered Adverse from the Perspective of Viability of the Ecosystem</u>:
	O&M work is a human intrusion into a sensitive estuarine environment. Presence of the dredged material disposal areas affects the northeast/southwest movement of water.
	Secondary and tertiary adverse effects upon the estuarine environment would occur due to use of the disposal areas for urban development and associated air, water, and noise pollution.
	<u>Considered Beneficial from the Perspective of Land Use Planning</u>:
	The disposal areas are compatible with plans for hurricane protection levees.

TABLE 4-2 (Cont.)

CLASSIFICATION OF IMPACT

Impact/Action	Classification/Discussion
PROVISION OF ELEVATED LAND (Cont.)	The disposal areas north of Bayou Bienvenue are designated for future industrial use in land use plans. The St. Bernard Parish planning study anticipates retention of the disposal areas for nonurban uses, and designates the areas for wildlife management.
LOSS OF VEGETATION AND LOCAL TERRESTRIAL BIOTA ON MATERIAL DISPOSAL AREAS:	Considered Adverse from the Perspective of Resource Management for Biota: O&M work is a part of on-going change in the estuary environment. Preservation of resource quality essential for shellfish production, trapping, fishing, etc. is more difficult with intrusion of O&M work and vessel traffic. Biota on the disposal areas are disturbed and/or lost each time new dredged material is placed. Carrying capacity of adjacent areas may limit number of fauna which can be absorbed when they move away from the areas of material deposition.
DISTURBANCE OF CHANNEL BOTTOM DWELLING BIOTA:	Considered Insignificant from the Perspective of Ecosystem Viability: The channel is constantly disturbed by vessel traffic and periodic O&M work. Biota lost are not unique components of the ecosystem.

TABLE 4-2 (Cont.)

CLASSIFICATION OF IMPACT

Impact/Action	Classification/Discussion
INCREASE IN LOCAL TURBIDITY OF RECEIVING WATERS DURING OPEN WATER DISPOSAL:	<u>Considered Insignificant from the Perspective of Ecosystem Viability, and Resource Management for Biota</u>: Turbidity of water generated by dredge operations is within the normal variation of turbidity except in the immediate vicinity of the pipeline outlet (within 100 feet or so). Biota in the area are adapted to changes in turbidity.
POSSIBILITY OF RESUSPENSION AND RESOLUBILIZATION OF HEAVY METALS IN THE SEDIMENT:	<u>Considered Potentially Adverse from all Perspectives</u>: Proposed EPA criteria for allowable concentrations of metals in material to be disposed of in open water were exceeded (according to the sampling program conducted for this report) for lead, mercury, zinc, arsenic and cadmium. Five of 27 sample locations did <u>not</u> exceed EPA criteria for at least one metal parameter, and only two sample locations did not exceed any EPA criteria (See Figure 2-12 in Section II). <u>IF</u> a significant amount of metal is being resolubilized when sediment particles are resuspended during dredge operation, and are entering the food web, the effects would be considered adverse. Tests remain to be done. Effects upon biota are not presently determined. If effects of suspended sediment are not adverse for local biota, effects on biota affected by long distance drift from the dredge would not be expected to be significant.

Source: Stanley Consultants, Inc.

4.03 REMEDIAL, PROTECTIVE, AND MITIGATION MEASURES

a. The Corps of Engineers has developed a dredged material research program at the Waterways Experiment Station in Vicksburg, Mississippi. The scope of the dredged material research program is broad and problem investigation is conducted on a nationwide scale. The Office of Dredged Material Research research tasks shown on Table 4-3 are presently underway or planned for the near future. The results of the research being done will be reviewed by the Corps of Engineers, New Orleans District, and applied to district O&M work as appropriate. Evaluation of opportunities for creative use of dredged material and for diminuation of potential adverse effects will be a part of the New Orleans District O&M planning program. Review of Table 4-3 also indicates the "unknowns" involved in the present state-of-the-art for O&M work.

b. For any of the habitat creation possibilities, planning and project installation will be coordinated with the state agencies responsible for wildlife, fisheries, trapping, and coastal zone management. An impact assessment will be made on any major program change. Monitoring sediment movement in Breton Sound is an annual Corps of Engineers project. The environmental impact of jetty extension across the Sound will be evaluated. The possibility of creation of contained disposal areas in conjunction with jetty extension will be analyzed. Use of dredged material to block the eroding channels between Lake Borgne and the MR-GO is a beneficial use of dredged materials which may be evaluated.

c. Retention of the present on-land disposal areas for their present use would allow the areas to remain as wildlife habitat in contrast to the possibility of becoming available for urban and industrial uses. A wildlife habitat management program is possible. Potentials for revegetation of disposal areas through sprigging or seeding of desired species should be investigated. Dredge operation contracts might specify areas to be used for material so that some areas could remain undisturbed for longer periods. An example of such an area would be a strip near the containment dike for establishment of shrubs and trees useful for wind protection, esthetic interest, and reduction of erosion. These wildlife management possibilities and possibilities for marsh building will be considered in conjunction with 33 CFR 209.145 dredging contract reviews with the National Marine Fisheries Service, U. S. Department of Interior, Fish and Wildlife Service, the Louisiana Wildlife and Fisheries Commission and the U. S. Environmental Protection Agency.

TABLE 4-3
DREDGED MATERIAL RESEARCH PROGRAM
AS OF JULY, 1974

Project/Task		Objective
Aquatic Disposal Research Project		
1A	Coastal Disposal Area Field Research	Determine the magnitude and extent of effects of disposal sites on organisms and the quality of surrounding water, and the rate, diversity, and extent such sites are recolonized by benthic flora and fauna.
1B	Movements of Dredged Material	Develop techniques for determine the spatial and temporal distribution of dredged material discharged into various hydrologic regimes.
1C	Effects of Dredging and Disposal on Water Quality	Determine on a regional basis the short- and long-term effects on water quality due to dredging and discharging bottom sediment containing pollutants.
1D	Effects of Dredging and Disposal on Aquatic Organisms	Determine on a regional basis the direct and indirect effects on aquatic organisms due to dredging and disposal operations.
1E	Pollution Status of Dredged Material	Develop techniques for determining the pollutional properties of various dredged material types on a regional basis.
Habitat Development Research Project		
2A	Upland and Marsh Disposal Environmental Impacts	Identification, evaluation, and monitoring of specific short-term effects and more general long-term effects of confined and unconfined disposal of dredged material on uplands, marsh, or other wetlands.
4A	Artifical Marsh and Island Creation	Development, testing, and evaluation of habitat creation concepts with particular attention devoted to marsh creation and dredged material island habitats.
4B	Habitat Development Research	Investigation of requirements for and technical feasibility of enhancing land and water habitats, including development and testing of wildlife and fisheries-oriented multiple-use concepts for confined disposal areas.

(CONTINUED ON NEXT PAGE)

TABLE 4-3
DREDGED MATERIAL RESEARCH PROGRAM (CONTINUED)
AS OF JULY, 1974

Project/Task	Objective
Disposal Operations Research Project	
2C Containment Area Operation Research	Development of new or improved methods for the operation and management of confined disposal areas and associated facilities.
5A Dredged Material Densification	Development and testing of promising techniques for dewatering or densifying dredged material using mechanical, biological, and/or chemical techniques prior to, during, and after placement in containment areas.
5C Disposal Area Reuse Research	Investigation of dredged material improvement and rehandling procedures aimed at permitting the removal of material from containment areas for landfill or other uses elsewhere.
6B Treatment of Contaminated Dredged Material	Evaluation of physical, chemical, and/or biological methods for the removal and recycling of dredged material constituents.
6C Turbidity Prediction and Control	Investigation of the problem of turbidity and development of a predictive capability as well as physical and chemical control methods for employment in both dredging and disposal operations.
7A Basic Equipment Related Studies	Investigation of dredging equipment modifications and improvements and operational improvements applicable to environmental impact reduction.
Productive Uses Project	
3A Aquatic Disposal Concepts Development	Investigation of environmental and economic factors involved in deep-water (oceanic) disposal, disposal in subaqueous borrow pits, and related possibilities.
3B Upland Disposal Concepts Development	Evaluation of new disposal possibilities such as using abandoned pits and mines and investigation of systems involving long-distance transport to large inland disposal facilities.
4C Land Improvement Research	Evaluation of the use of dredged material for the development, enhancement, or restoration of land for agriculture and other uses.
4D Products Research	Investigation of technical and economic aspects of the manufacture of marketable products.
5D Disposal Area Land Use Concepts	Assessment of the technical and economic aspects of the development of disposal areas as landfill sites and the development of recreation-oriented and other public or private land-use concepts.

NOTE: This technical structure reflects the first major program reevaluation made after the first full year of research accomplishment and is effective as of June 1974.

4.04 OPERATION AND MAINTENANCE DREDGING PROJECTS WHICH ARE SEGMENTS OF A TOTAL SYSTEM

The total systems which include O&M work are: (1) the Corps of Engineers District dredging program; (2) the biotic system of the marsh/sound/gulf complex; and (3) the system of intergovernmental regulation of dredging activities and coastal zone resource use. The proportion of New Orleans District O&M work done in the MR-GO vicinity varies from year to year. The average volume of dredged material moved in a year is about 12 or 13 million cubic yards (23 percent) of the district total of 55 million cubic yards per year. Frequency of dredging, volumes, and methods were discussed in Section 1. Locations of disposal areas are shown on Plate 2. Vegetation disturbed by disposal operations are primarily associations in a pioneer stage of development. Areas are subject to material deposition approximately every 2 to 3 years. Local biota on the disposal areas will be lost when they are covered by dredged material. Recolonization of the disposal sites with similar organisms has been observed. A determination of the significance of pollutant levels in sediments and resultant resolubilization of metals when sediments are resuspended by dredging operations, and a definition of what measures will be appropriate for protection of marshland biotic resources must be made in the future by those state and Federal agencies involved. The 33 CFR 209.145 process is one means through which this can be accomplished.

SECTION 5

ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

5.01 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

a. Summary. Covering existing biota on the designated disposal areas cannot be avoided. Plant succession on land deposition areas (10,611 acres) consists of periodic revegetation by pioneer plants following each O&M operation. The MR-GO channel bottom is in a state of disturbance from vessel passage and periodic dredging. Biota in both the MR-GO channel and the disposal areas in Breton Sound remain in a recolonization stage of development. Local organisms and transitory organisms not covered by dredged material are subject to temporary increases in turbidity near dredge operations. Elevated land areas are created by deposition of dredged material inside containment dikes. The presence and use of these areas for deposition cannot be avoided with present O&M practices. Terrestrial biota which cannot escape the flow of dredged material, young birds, or animals still in nests would be lost.

b. Analysis by resource category

(1) General. Unavoidable effects are: 1) increases in local water turbidity, 2) deposition of dredged material over aquatic and terrestrial organisms, 3) disturbance of bottom dwelling biota in dredge operation, and 4) creation of disposal areas elevated above the adjacent marshlands.

(2) Land resources. The 10,611 acres of designated, contained disposal areas are periodically covered with dredged material. Elevation of the disposal areas gradually increases.

(3) Water resources. Water becomes more turbid from discharge from the dredge pipe outlet and from runoff from disposal areas. Turbidity is generally local, temporary, and/or is within variations characteristic of the area. The chemical characteristics of the water are changed in the immediate vicinity of dredge operation. As sediments are disturbed, the ratio of particle surface to water increases, thus increasing the potential for resolubilization of chemicals in the water. The degree of resolubilization of chemicals and the resultant effects on water quality and on biota are yet to be defined. The interface between sediment on the channel bottom and the bottom of the sound is disturbed. The underlying sediments that were blanketed by overlying sediments become exposed to the direct sediment/water interface.

(4) Air resources. Noise and air pollution from operation of the dredge are local disturbances.

(5) Botanical resources. Vegetation on the disposal areas is periodically covered. Revegetation occurs as herbaceous plants become established within one year to 18 months. The plant community remains in a pioneer stage of development. Increased elevations are expected to provide habitat for vegetation characteristic of higher ground.

(6) Zoological resources. Terrestrial animal species which cannot escape the flow of dredged material over contained disposal areas are lost. Nesting species are vulnerable if material deposition occurs at nesting times. As plants become established, some animal species reoccupy the area. Aquatic species in the designated disposal areas (about 17,600 acres) in Breton Sound and the Gulf are lost when covered by dredged material at those disposal sites in the vicinity of dredge operation. The area is recolonized with species adapted to frequent habitat disturbance. Sediment is carried away from the dredge where material is deposited in open water. The sediments disperse and settle, but 40 percent of the sediment can be expected to remain in suspension for four hours or more. Current velocities indicate that the sediments could be carried from 0.9 to 3 or 4 miles. Effects on zoological species (including oyster larvae) cannot be determined until data are available to indicate that sediments contain metals or other industrial pollutants which would be resolubilized and made available to the food web in harmful concentrations. It is possible that oyster harvest or oyster reserve areas may be adversely affected.

(7) Recreation resources. No adverse effect on existing recreation areas is expected.

(8) Archeological and historic resources. No historic sites of national significance are affected by O&M work.

(9) Socio-economic effects. No adverse economic or socio-cultural effects are anticipated from O&M work.

(10) Other. None.

SECTION 6

ALTERNATIVES TO THE PROPOSED ACTION
(i.e., to Present Operation and Maintenance Practices)

6.01 INTRODUCTION

a. Structural and nonstructural O&M practices. O&M work requires continual adjustment of practices to changing conditions. Planning for dredging and deposition of dredged material is an on-going process, requiring continual assessment of changing conditions and subsequent selection of a course of action from numerous O&M practice alternatives. The following structural and nonstructural O&M practices vary with time and project-related conditions:

Structural Practices:

Location of dredging.
Location of disposal areas.
Construction of disposal area containment dikes.
Maintenance of disposal areas and containment facilities.

Nonstructural Practices:

Frequency of operations.
Seasonal timing of operations
Type of equipment used.
Adjustment of equipment during operation (regulating the rate of flow of material, changing the location of the pipeline outlet, etc.).

b. Project-related conditions that affect O&M work. Numerous variables in project-related conditions are associated with the following changing conditions:

(1) Changes in dredging technology and equipment availability.

(2) Changes in operation and maintenance costs.

(3) Changes in shipping technology, navigation requirements, and traffic volumes.

(4) Changes in locations of shoaling resulting from prevailing winds, local storms, hurricanes, and/or changes in stability of channel side slopes.

(5) Changes in dredging requirements due to related projects (for example, foreshore protection, new levee construction, extension of jetties).

(6) Changes in environmental quality (for example, changes in pollution level of sediments, or potential use of disposal areas for enhancement or mitigation of area environmental problems).

(7) Changes resulting from new legislation or regulations or from public input (for example, changes in federal dredging project regulations, a state coastal zone management plan, etc.).

Any significant change in project-related conditions may require a corresponding adjustment in O&M practices. Adjusted O&M practices in turn: (1) may affect project-related conditions other than the condition that required the new O&M practice; and (2) may significantly affect navigation, socio-economic resources, or environmental resources.

6.02 METHOD OF ANALYSIS

a. Structural alternatives to be discussed. Two categories of structural alternatives have been selected for analysis, the first relating to channel dimensions, the second relating to dredged material deposition.

Channel Dimension Alternatives

1. Maintenance at 36 feet (present practice).
2. Maintenance at 30 feet (Alternative 2).
3. Abandonment of the MR-GO (the no-action alternative).

Dredged Material Deposition Alternatives

1. Deposition in large contained areas on land (present practice).
2. Deposition in open water, uncontained (present practice).
3. Deep water deposition (Alternative 3).
4. Exclusive use of contained land deposition areas (Alternative 4).
5. Deposition of material in contained areas adjacent to the channel in Breton Sound between land's end and Chandeleur Islands (Alternative 5).
6. The no-action alternative is discussed in the previous set of alternatives.

b. Description of channel dimension alternatives. Alternative 2 would differ from present practice in that O&M work would be discontinued until the channel reached the 30-foot depth. Much O&M work is done in Breton Sound as result of storms, thus the management capability for emergency operation would still be maintained. After the channel reached the 30-foot depth, O&M work would be resumed. Alternative 3, abandonment of the MR-GO, would mean discontinuation of all O&M work.

c. Description of dredged material deposition alternatives. Alternative 3, deep water deposition, would entail discontinuation of pipeline dredge deposition and transportation of the dredged material by hopper dredge to deep water beyond the continental shelf in the Gulf of Mexico. Alternative 4, exclusive use of contained land deposition areas, would entail transporting material dredged in Breton Sound to the land area and piping the material to the existing land disposal areas. Alternative 5, deposition of material in contained areas adjacent to the channel in Breton Sound, would entail construction of containment facilities from land's end to Breton Island and use of the cutterhead pipeline dredge to pump the material into the containment structures. A subalternative would be construction of island shaped containment structures rather than a continuous jetty-type containment structure.

d. Comparison of alternatives. Effects of the present practices on environmental and socio-economic parameters are discussed in Section 3 through 8. Effects of alternatives are compared to effects of present practices in general terms, i.e., same, less, greater. Table 6-1 shows a comparison and discussion of the three channel dimension alternatives. Table 6-2 shows a comparison and discussion of the five dredged material deposition alternatives. Each table contains:

1. Comparison of changes in O&M practices.
2. Comparison of new conditions created.
3. Comparison of effects on navigation.
4. Comparison of effects on the Tidewater Port Facilities.
5. Comparison of effects on land, water, and biotic resources.
6. Comparison of effects on cultural and socio-economic resources.

Effects of alternatives on specific resources not discussed in the tables are considered to be similar to effects of present practices.

TABLE 6-1

COMPARISON OF CHANNEL DIMENSION ALTERNATIVES

COMPARISON OF CHANGES IN O&M PRACTICES:

Maintenance at 36-Feet -- Present Practice:

O&M practices as described in Section 1.

Effects are described in Sections 3 through 8.

Maintenance at 30-Feet -- Alternative 2:

O&M work would be discontinued until the channel shoaled to the 30-foot depth. Management capability for emergency operation would have to be maintained to clear the channel if it were shoaled by major storms. In the interim no-dredging period, cost of O&M work would be less than at present. Costs would again be incurred with resumption of dredging.

Abandonment of the MR-GO -- The No-Action Alternative:

O&M work would be permanently discontinued. There would be no expenditure of federal funds for O&M work in the vicinity.

TABLE 6-1 (Cont.)

COMPARISON OF CHANNEL DIMENSION ALTERNATIVES

COMPARISON OF NEW CONDITIONS CREATED:

Maintenance at 36-Feet -- Present Practice:
Conditions and processes as described in Section 2.

Maintenance at 30-Feet -- Alternative 2:
The channel would become more shallow in some areas. Vegetation on the land disposal areas would develop more fully during the no-dredging period. More mature botanical and zoological communities would thus be disturbed with resumption of O&M work. Resumption of O&M work would convert the land disposal areas to present conditions. Maintenance of the containment dikes would continue so that they would be functional when O&M work resumed.

Abandonment of the MR-GO -- The No-Action Alternative:
The environmental setting would not be disturbed by O&M work done by the Corps of Engineers. Other dredging work in the marshlands would most likely continue. Some vessel traffic would continue to disturb the channel bottom. Containment dikes on the disposal areas might fail and dredged material could erode into adjacent marshland and the channel. Channel bank erosion would continue and the MR-GO would remain an open water area.

COMPARISON OF EFFECTS ON NAVIGATION:

Maintenance at 36-Feet -- Present Practice:
The navigation system would operate as described in Section 2.

Maintenance at 30-Feet -- Alternative 2:
Vessels requiring a depth greater than 30 feet could not use the MR-GO. For example, for the year 1973, 55 to 60 deep draft vessels (1 percent of the number of cargo vessels on the MR-GO) would have been unable to navigate the 30 foot channel. Navigation for other vessels might be more hazardous with less depth between vessel bottoms and the shoals and channel bottoms. Cargo traffic on the MR-GO, particularly that transported in large bulk quantities on 30-36-foot draft vessels would decline.

TABLE 6-1 (Cont.)

COMPARISON OF CHANNEL DIMENSION ALTERNATIVES

COMPARISON OF EFFECTS ON NAVIGATION: (Cont.)

Abandonment of the MR-GO -- The No-Action Alternative:

As sediment accumulated in the channel and as local shoals developed, vessels requiring both a 36-foot and a 30-foot draft could not use the MR-GO. For example, for the year 1973, 280 to 329 vessels (5 to 6 percent of the number of cargo vessels on the MR-GO) would have been unable to navigate a channel less than 19 feet. With severe shoaling, passage of the 1973 vessels with drafts of 18 feet or less (about 5,650) would have been difficult. The margin of safety for vessel passage would be reduced. The volume of cargo moved on the MR-GO would decline.

COMPARISON OF EFFECTS ON THE TIDEWATER PORT FACILITIES:

Maintenance at 36-Feet -- Present Practice:

Benefits as described in Sections 2 through 8.

Maintenance at 30-Feet -- Alternative 2:

Vessels requiring a 36-foot channel could not use the Tidewater Port Facilities until a new lock could be installed to link the area to the Mississippi River. The number of vessels using the MR-GO would increase if smaller vessels carried a comparable volume of cargo. Tidewater Port Facility investment, predicated upon accommodation of new shipping technology and large vessels would not be realized until completion of a link to the Mississippi River.

Abandonment of the MR-GO -- The No-Action Alternative:

Present navigation technology would not be accommodated if deeper draft vessels had no access to Tidewater Port Facilities. The 12-foot depth would possibly be maintained naturally. A reduction in the volume of cargo handled at the Tidewater Port would be expected. Tidewater Port Facilities would possibly have to be relocated on the Mississippi River, hence loss of original investment, unless the link to the river could be made promptly.

TABLE 6-1 (Cont.)

COMPARISON OF CHANNEL DIMENSION ALTERNATIVES

COMPARISON OF EFFECTS ON LAND, WATER, AND BIOTIC RESOURCES:

Maintenance at 36-Feet -- Present Practice:

Effects as described in Section 3 through 8.

Maintenance at 30-Feet -- Alternative 2:

Less land area would be used for disposal of dredged material. Disposal areas in Breton Sound would likewise not be disturbed unless emergency storm-related dredging were required. Long-range effects on land, water, and biotic resources would be the same as those described for present operations. When O&M work resumed after the no-dredging period, more mature botanical and zoological communities would be disturbed. The net result might be more negative than present practice.

Abandonment of the MR-GO -- The No-Action Alternative:

The project area would not return to conditions which existed prior to construction of the MR-GO. Land, water, and biotic resources would not be disturbed by O&M work. Unless stormwater runoff were diverted to the Mississippi River, no significant improvement in water quality would be expected. Channel bank erosion and subsidence of the disposal areas would continue. Failure of containment dikes would be expected. Channel bottom biota and aquatic biota in Breton Sound would encounter less disturbance from vessel traffic.

COMPARISON OF EFFECTS ON CULTURAL AND SOCIO-ECONOMIC RESOURCES:

Maintenance at 36-Feet -- Present Practice:

Effects as described in Sections 3 through 8.

Maintenance at 30-Feet -- Alternative 2:

Effects upon recreational, archeological, and historical resources would not differ from the present situation. Some loss in economic benefits might be associated with curtailment of the cargo coming into Tidewater Port Facilities on vessels requiring a 36-foot channel depth. (See page VI-5 for quantification.)

TABLE 6-1 (Cont.)

COMPARISON OF CHANNEL DIMENSION ALTERNATIVES

COMPARISON OF EFFECTS ON CULTURAL AND SOCIO-ECONOMIC RESOURCES: (Cont.)

Abandonment of the MR-GO -- The No-Action Alternative:

Effects on recreational, archeological, and historical resources would not differ from the present situation. Economic loss to the area would be associated with the decline in navigation, port development, and related industrial development until relocation of facilities or the Mississippi River link were completed (See page VI-6 for quantification). Present disposal areas have potential for subsequent urban use. If abandoned, the areas would lose this potential as subsidence and erosion continue.

Source: Stanley Consultants, Inc.

TABLE 6-2

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

COMPARISON OF CHANGES IN O&M PRACTICES:

Deposition in Large Contained Areas on Land -- Present Practice:

O&M practices are described in Section 1.
Effects are discussed in Sections 3 through 8.

Deposition in Open Water -- Present Practice:

O&M practices are described in Section 1.
Effects are discussed in Sections 3 through 8.

Deep Water Depositions -- Alternative 3:

Deep water deposition would entail discontinuation of cutterhead pipeline dredge operation. Material would be loaded into hopper dredges and transported to deep water beyond the continental shelf in the Gulf of Mexico. Additional cost and commitment of energy resources would accrue from increased transportation requirements.

Exclusive Use of Contained Land Deposition Areas -- Alternative 4:

O&M practices for the MR-GO through the land area would be continued. From land's end to Mile -9.38 (approximately 32 miles) material would be loaded in hopper dredges or onto barges, transported to the land area, and pumped to the existing land disposal areas. Additional cost and commitment of energy resources would accrue from increased transportation requirements.

Deposition in Contained Areas Adjacent to the Channel in Breton Sound -- Alternative 5:

O&M practices for the MR-GO through the land area would be continued. In Breton Sound and the Gulf of Mexico, the cutterhead pipeline dredge would be used to pump material into containment facilities adjacent to the channel. Such containment structures might parallel the channel in a jetty-like extension, or the structures might be created as islands. Additional cost and commitment of energy resources would accrue from containment facility construction.

COMPARISON OF NEW CONDITIONS CREATED:

Deposition in Large Contained Areas on Land -- Present Practice:

Effects as described in Sections 3 through 8.

TABLE 6-2 (Cont.)

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

COMPARISON OF NEW CONDITIONS CREATED (Cont.):

Deposition in Open Water -- Present Practice:

Effects as described in Sections 3 through 8.

Deep Water Deposition -- Alternative 3:

A new condition would be created when the hopper dredge is unloaded. Discharge of material from a pipeline dredge is continuous. Biota can probably escape from pipeline discharge more easily than large loads released suddenly from the hopper dredge. However, the hopper dredge releases the entire load at once.

Exclusive Use of Contained Land Deposition Areas -- Alternative 4:

About 73 percent of the material dredged in O&M work comes from the open water area. The contained areas would thus be receiving material from the land portion of the channel plus an amount approximately three times as great from the open water area. Capacity of the contained land areas would be reached more quickly creating the potential problem of acquisition of more marshland for new deposition areas.

Deposition in Contained Areas Adjacent to the Channel in Breton Sound -- Alternative 5:

The lineal jetty-type containment structure or the island-type containment structures would be new features in the Sound. These features would change present patterns of water movement and sediment deposition.

COMPARISON OF EFFECTS ON NAVIGATION:

Deposition in Large Contained Areas on Land -- Present Practice:

Effects as described in Sections 3 through 8.

Deposition in Open Water -- Present Practice:

Effects as described in Sections 3 through 8.

Deep Water Deposition -- Alternative 3:

Some interference with other channel traffic might be expected as the hopper dredge moves back and forth between dredge sites and disposal sites.

TABLE 6-2 (Cont.)

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

COMPARISON OF EFFECTS ON NAVIGATION (Cont.):

Exclusive Use of Contained Land Deposition Areas -- Alternative 4:

Interference with other channel traffic would be greater than that expected for Alternative 3 due to a more confined channel space through the land area, and time required to pump the material to the disposal areas.

Deposition in Contained Areas Adjacent to the Channel in Breton Sound -- Alternative 5:

This alternative would not interfere with navigation on the MR-GO, but cross-channel (southwest-northeast traffic in the sound) might be restricted by a jetty-type containment structure. Storm induced current movement between island-type structures might increase navigation problems for vessels.

COMPARISON OF EFFECTS ON TIDEWATER PORT FACILITIES:

Unless movement of vessels containing dredge material interfered with commercial vessel traffic, effects of alternatives on Tidewater Port Facilities would not be different from present practice. Alternative 4, exclusive use of contained land disposal areas, would most likely interfere with commercial vessel traffic, and hence would cause a decline in the volume of traffic arriving at the port facilities.

COMPARISON OF EFFECTS ON LAND, WATER, AND BIOTIC RESOURCES:

Deposition in Large Contained Areas on Land -- Present Practice:

Effects as described in Sections 3 through 8.

Deposition in Open Water -- Present Practice:

Effects as described in Sections 3 through 8.

TABLE 6-2 (Cont.)

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

COMPARISON OF EFFECTS ON LAND, WATER, AND BIOTIC RESOURCES (Cont.):

Deep Water Deposition -- Alternative 3:

Deposition of dredged material in deep water beyond the continental shelf involves more "unknowns" related to effects upon the aquatic environment. Disposal of slug loads upon bottom-dwelling organisms involves a sudden, significant change from ambient conditions. Less is known about the types of organisms which would be affected. Biota in Breton Sound would benefit from disposal of the material elsewhere. Effects on terrestrial biota would be similar to those for the No-Action alternative.

Exclusive Use of Contained Land Deposition Areas -- Alternative 4:

Exclusive use of the land disposal areas would leave the Breton Sound disposal area biota undisturbed. Sediments to be dredged might contain significant pollutants which are resuspended and resolubilized when disposed of in open water. The risk of contaminating aquatic biota would probably be reduced by land disposal if this were the case. However, the risk of effects upon terrestrial biota would remain. The land disposal areas would be used more frequently than is presently the case. Terrestrial biota would not have the revegetation and recovery time which they now have because disposal would be a fairly continuous process. Elevation of the disposal areas would increase more rapidly. When the areas reached capacity, new areas would need to be created in the vicinity. The estimated area presently designated as the deposition area is about 17,600 acres. Space on land in presently designated, or new areas would be needed. Because deposition areas in the Sound are uncontained, less than 17,600 acres of new area would be required. Recall that more than three-quarters of the total project O&M volume originates from Breton Sound and the Gulf section; on the order of about 11 million cubic yards of material each 1 to 2 years.

Deposition in Contained Areas Adjacent to the Channel in Breton Sound -- Alternative 5:

Compared to the present situation, biota of Breton Sound would be less disturbed by disposal of material in contained areas in the Sound. Problems associated with increased turbidity levels

TABLE 6-2 (Cont.)

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

COMPARISON OF EFFECTS ON LAND, WATER, AND BIOTIC RESOURCES (Cont.):

Deposition in Contained Areas Adjacent to the Channel in Breton Sound--Alternative 5: (Cont.)

would be eliminated. Flow of material from the immediate disposal site would be restrained by containment structures, hence a smaller area would be affected by deposition. Eventually, the contained areas might be built up to support vegetation. The contained areas (or marsh building areas) would require something less than about 17,600 acres. Influence of the contained areas on water movement and sediment deposition in the Breton Sound is not yet defined, but might have significant effects upon biota.

COMPARISON OF EFFECTS ON CULTURAL AND SOCIO-ECONOMIC RESOURCES:

Deposition in Large Contained Areas on Land -- Present Practice:

Effects as described in Sections 3 through 8.

Deposition in Open Water -- Present Practice:

Effects as described in Sections 3 through 8.

Deep Water Deposition -- Alternative 3:

No significantly different effects on existing recreational, cultural, or socio-economic resources would be expected compared to present practice. Potential uses of the land deposition areas for urban-related development would be curtailed if the areas were not maintained as high ground. Adverse effects upon port-related income might be experienced if O&M dredged material transport significantly interfered with commercial vessel traffic.

Exclusive Use of Contained Land Deposition Areas -- Alternative 4:

The land deposition areas might become available for urban-related development sooner than would be the case under present practice. This new condition might be considered beneficial from a perspective of economic development, but adverse from the perspective of maintenance of marshland habitat. Adverse effects upon port-related income might be experienced if O&M dredged material transport and unloading interfered significantly with commercial vessel traffic. If containment of dredged material is required to avoid contamination of open water biota from pollutants in the sediment, the biotic harvest sector of the economy would benefit.

TABLE 6-2 (Cont.)

COMPARISON OF DREDGED MATERIAL DEPOSITION ALTERNATIVES

Deposition in Contained Areas Adjacent to the Channel in Breton Sound -- Alternative 5:

If containment of dredged material is required to avoid contamination of open water biota from pollutants in the sediment, the biotic harvest sector of the economy would benefit. Potential for eventual use of the contained areas for recreation would be beneficial. The contained areas might eventually be suitable for island habitat wildlife management. Adverse as well as beneficial effects would be expected unless the project were carefully planned.

Source: Stanley Consultants, Inc.

e. Summary for the MR-GO

(1) Resource allocation decisions involve choosing one benefit over another benefit. A choice may mean loss of one benefit in return for another. Decisions involving a balance of benefits and losses are referred to as trade-offs. Implementation of the no-action alternative or selection of the 30-foot channel dimension alternative would mean loss of economic and navigation benefits in trade for lesser adverse effects upon the biotic resources of the marshlands and water. Compared to present O&M costs, the 30-foot channel would entail less O&M cost, and the no-action alternative would entail none. Implementation of land containment of all dredged material would increase adverse effects on terrestrial biota but decrease adverse effects on the aquatic environment. Contained land disposal of all material would increase O&M cost compared to present practice.

(2) The trade-off between present deposition practices and contained material deposition in the Sound would involve greater effects on hydrology versus lesser effects of sediments upon ambient water quality. Contained material deposition in Breton Sound would replace aquatic habitat with terrestrial habitat. O&M costs of contained deposition would be greater compared to present practice. Deep water deposition entails more unknown factors than does present practice. Effects on deep water habitat would be traded for effects on shallow aquatic habitat closer to the shoreline. Aquatic biota would be subjected to slug load disposal rather than to a continuous pipe discharge of material. O&M costs for deep water disposal are expected to be higher compared to present costs.

f. Summary for the associated bayous. Discontinuance of infrequent O&M work on the associated bayous could result in navigation restrictions on small craft. This would result in regional economic losses due to lack of access for harvest of biotic resources and extraction of mineral resources.

6.03 FUTURE STUDIES AND FUTURE ANALYSIS

a. As detailed in Section 3, several studies are anticipated or are underway for the MR-GO vicinity. The segment of the MR-GO from about Mile 47 to Mile 20 is the only segment that is not directly affected by future projects now being planned. See Section 3 for details.

b. Implementation of new federal regulations relative to disposal of dredged material (Title 33, Code of Federal Regulations, Chapter II, Part 209.145) involve more public review of O&M work than was previously the case. For each project, a public notice will be prepared and public hearings will be held as necessary. Collection and display of information required for the public notices may entail studies of each O&M contract. The public notice will contain the following information:

1. Project description.
2. Specific locations of disposal sites.
3. Quantities and type of material to be dredged.
4. Method of dredging and schedule.
5. Property adjacent to the disposal areas.
6. Dredging done by others.
7. EPA designation of disposal sites.
8. List of coordination with others.
9. Status of the environmental impact statement.
10. Historic places and scenic rivers affected.
11. Availability of detailed plans.
12. Any special qualifications or restrictions relative to disposal of material in navigable or ocean waters.

c. The elutriate test of the material to be dredged was performed in the spring of 1975, in accordance with Corps of Engineers regulation ER 1130-2-408 issued January 17, 1974. The results of the test were submitted to EPA 8 April 1975 and are summarized in Appendix D.

d. New Orleans District implementation of the 33 CFR 209.145 O&M contract review also includes field survey expeditions by Corps of Engineers personnel and appropriate federal and state agencies. These agencies provide suggestions for modification of or monitoring of the contract under consideration. The New Orleans District will make efforts to accommodate other agency review comments whenever possible.

SECTION 7

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 GENERAL

a. Economic and land use aspects. O&M of the MR-GO has long-term implications for continued use, and for expansion of Tidewater Port Facilities. Beneficial impact is derived primarily from economic and navigation benefits associated with initial MR-GO construction. Continued functioning of the MR-GO is dependent upon O&M work. O&M work on associated bayous facilitates local traffic which has regional economic benefit. Disruption of biota on local channel bottoms and channel banks is the trade-off for this benefit. O&M work does not conflict with land use plans proposed for the area.

b. Biological aspects. The dredged material disposal areas adjacent to the MR-GO were designated for material deposition in previous resource allocation decisions. Immediate physical effects on the areas are local and short-term. Revegetation ensues after deposition of dredged material and zoological species return, but development and successional patterns are limited by continued O&M operations. This latter represents a long-term implication of O&M work. O&M work has a short-term physical effect on aquatic biota. Temporary increases in turbidity occur near the dredge pipeline outlet. Biota that cannot escape dredged material which settles to the underwater disposal areas are lost. The disposal areas are subsequently repopulated by similar species. Motile species are adapted to changing turbidity levels and are not expected to be adversely affected by O&M work. The short-term and long-term effects of resuspension of sediments and resolubilization of metals (or other industrial pollutants) from the sediments are still under investigation. If significant, local and neighboring biota would be affected.

SECTION 8

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES AS O&M WORK CONTINUES

8.01 GENERAL

Fuel used in dredge operation, labor and time committed to O&M work, and materials used in construction of equipment are irretrievable commitments of resources for O&M work. A previous commitment of 16,183 acres of marshland for dredged material deposition was made for the project. O&M work presently requires 10,611 acres of this area for dredged material deposition. Subaqueous disposal areas in Breton Sound are likewise committed for O&M use. Continuous maintenance results in irreversible and irretrievable commitment of local botanical and zoological resources during each O&M operation. Increasing elevation of the disposal areas adjacent to the MR-GO represents a long-range environmental change. Irreversible and irretrievable changes in biota resulting from pollution levels of water and sediment are yet to be defined.

SECTION 9

COORDINATION AND COMMENT AND RESPONSE

9.01 GOVERNMENT AGENCIES

Copies of the draft environmental impact statement were sent to all Federal and state agencies listed in paragraph 5 of the Summary. The agencies were requested to submit their views and comments. Comments received are summarized or quoted below and copies of the replies are included in Section 9.

a. Environmental Protection Agency, Region VI

Comment: We suggest that the final statement include an analysis of the benefits and costs of the three proposed operation and maintenance projects. This analysis should contain sufficient information in order to compare and weigh equally the cost of project implementation with the beneficial and adverse impacts of each action. Inclusion of a benefit/cost ratio would be helpful in better understanding the economic benefits of continued operation and maintenance on the project channels and the environmental trade-offs that could occur.

Response: To assure that the average tax dollar is invested in worthy water resource ventures, an overall analysis of the project justification is a pre-requisite to authorization and subsequent construction. Determination of the B/C ratio entails an extensive investigation into all aspects of first-round benefits and costs expected to result from installation of the project. Operation and maintenance charges usually represent but a small portion of the total annual project's costs which include, among other things, the interest and amortization charges on the initial investment. Thus, operation and maintenance costs normally are not the over-riding factor in the B/C ratio computation and are meaningless when used alone for this purpose. Because these economic studies frequently are lengthy as well as costly, and due to the relatively minor role of operation and maintenance charges, it is not considered practicable to conduct current economic analysis on operation and maintenance projects.

Comment: We suggest that additional information be provided on Bayous La Loutre, St. Malo, Dupre, and Yscloskey. Specifically, it appears that the dredged material disposal acreage figure given in the statement applies to the MR-GO project alone. If this is the case, we suggest that disposal acreage figures for the additional project channels be given in the final statement.

Response: Data for Bayous La Loutre, St. Malo, Dupre, and Yscloskey have been included in Section I.

Comment: While it is clear that gated effluent release structures will be used at the MR-GO on-land disposal sites, it is not clear if similar structures will be employed at the other sites. This should be clarified in the final statement.

Response: Dredged materials will be disposed of in diked areas with effluent spillgate controls except in those locations where the fishery and wildlife and water quality agencies determine that localized areas of marsh vegetation can be better preserved or favorably enhanced by omission of confining dikes.

Comment: We are particularly concerned with the possible resuspension of heavy metals (lead, mercury, zinc, arsenic, and cadmium) and their unknown effects on the aquatic community. . . We would recommend that in order to determine the effects of dredging on the resuspension and resolubilization of pollutants (particularly heavy metals) in the water column during maintenance activities, a monitoring program be implemented which would, at a minimum, record dissolved oxygen, total suspended solids, Total Kjeldahl Nitrogen, and heavy metal concentrations, before, during, and after dredging operations.

Response: A monitoring program is being developed to determine the effects of pollutants and operation and maintenance work on the aquatic community. Additional investigations include the elutriate test results, reported in Appendix D, which has been added to this EIS. A continuing monitoring program is in effect prior to, during, and after dredging operations to determine whether or not operations can continue without modification of the project.

Comment: We suggest that the elutriate test be conducted for the parameters which were exceeded in the sediment analysis and the results included in the final statement. This information would be helpful in evaluating the impacts of the proposed dredging operations.

Response: The elutriate test was conducted in the spring and early summer of 1975. Compliance guidelines and results are summarized in Appendix D.

<u>Comment</u>: The draft statement should discuss the associated long-term project induced impacts resulting from the construction of the Mississippi River-Gulf Outlet system in more detail. Secondary impacts include modified water regime in the system, alteration of the hydrology and water chemistry of adjacent estuarine and wetland areas, and salt water intrusion and increased salinity levels.

<u>Response</u>: Construction of the MR-GO resulted in certain recognized socio-economic and environmental changes. Secondary impacts are still underway and will continue until a state of equilibrium on natural dynamics is obtained. This environmental statement concerns only actions necessary to operation and maintenance of the MR-GO and associated bayous, and is not intended to address impacts of original construction.

<u>Comment</u>: Subsequent maintenance operations will result in degraded water quality during the dredging cycle and perpetrate the increased salinity levels in the Borgne-Pontchartrain Lake Systems. In order to minimize the existing adverse and future long-term (secondary) impacts of the MR-GO, we recommend that mitigative measures that could reduce salinity levels in the Lake Borgne-Pontchartrain System be incorporated into the operation and maintenance of the MR-GO project.

<u>Response</u>: This statement recognizes the temporary water quality problem inherent in all dredging operations. Completion of the Seabrook Lock Complex as covered in the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection project will reduce salinity levels in Lake Pontchartrain. The proposals for salinity control measures in the MR-GO system would require authorization for new construction features. Such new construction features would require environmental and socio-economic investigation and impact analysis. Consideration of these measures in this assessment of the impacts of the project operation and maintenance is not appropriate.

<u>Comment</u>: The statement should contain additional information in order to allow for complete assessment of the interrelated impacts of MR-GO and other local, state, and Federal projects in southern Louisiana. An environmental evaluation of the adverse and beneficial effects of the interrelated projects in the vicinity of MR-GO should be included in the final statement (GIWW, Lake Pontchartrain, and Vicinity Hurricane Protection, MR-GO, Michoud Canal).

<u>Response</u>: The MR-GO, from Mile 23 out, is the only project of those mentioned requiring annual dredging operations. Maintenance dredging of the other projects is less frequent. Lack of

availability of dredging equipment and contractors tends to limit activity during any one season or year. Dredged material from the GIWW and MR-GO is used for the Hurricane Protection System. Environmental impact statements have been or will be completed for all interrelated Corps of Engineers projects listed in Section III.

b. U. S. Department of Commerce, the Assistant Secretary for Science and Technology

Comment: Another possible sediment source that should be included in Section I is the marsh material released by marsh deterioration in the project area as a result of saltwater intrusion. This material may be transported to the MR-GO by tidal action, storms, and hurricanes.

Response: This information has been incorporated into the text, Section I, 1.05 a. (3).

Comment: Numerous geodetic control survey monuments and tidal bench marks are located within the proposed project area. If there is any planned activity which will disturb or destroy these monuments, the Department of Commerce, National Ocean Survey (NOS, of which the National Geodetic Survey is a part) requires not less than 90 days notification in advance of such activity in order to plan their relocation. NOS recommends that funding for this project include the cost of any relocation required for NOS monuments.

Response: The New Orleans District of the Corps of Engineers uses the NOS survey markers and will take appropriate action to protect these markers, including advance notification if relocation of any markers is necessary.

Comment: Page IV-13. Retention of the existing on-land disposal areas for their continued use would also greatly reduce any need to utilize adjacent marshes as disposal areas in the future.

Response: This statement confirms information that was included in the draft EIS. It is now included in paragraph 4.03 of this EIS.

Comment: Section VI - Alternatives, should contain a discussion of possible economic use of the dredge soil.

Response: The quality, location, and cost of transportation is a limiting factor in use of this material. Large volumes of dredged materials are being used for hurricane levee construction. The New Orleans Port Commission is considering use of this dredged material for development of their future port facilities.

c. U. S. Department of Transportation, Federal Highway Administration

Comment: We have reviewed the draft environmental statement for the above project and have no comments. The project should not have any significant effect on any existing highway facilities, and we do not know of any proposed highway projects in this area.

Response: We concur with the statement.

d. U. S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control

Comment: HEW's letter expresses concern regarding the possibility of increase in the vector habitat. With limitations on the application of chemicals, an engineering approach involving environmental manipulation is becoming increasingly important in vector control.

Response: Research concerning vector control and dredged material disposal is being conducted by the Waterways Experiment Station and other agencies. We have cited research being done on Table IV-3. This research is being done as a result of the need to investigate problems encountered in dredged material deposition.

e. Advisory Council on Historic Preservation

Comment: Results of the survey of historic, architectural, and archeological properties under Federal agency control or jurisdiction, required by Section 2 (a) of Executive Order 11593 should be included in the environmental statement as evidence of compliance. The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition, or substantial alteration of eligible National Register properties under Federal jurisdiction.

Response: There are no Federally owned or controlled properties on this project.

Comment: Federal agencies are required to establish procedures regarding the preservation and enhancement of non-Federally owned historic, architectural, and archeological properties in the execution of the plans and programs. The environmental statement should contain a determination as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-Federally owned districts, sites, buildings, structures, and objects of historical, architectural, or archeological significance.

Response: The project will not contribute to either the degradation or the preservation and enhancement of non-Federally owned districts, sites, buildings, structures, and objects of historical, architectural, or archeological significance.

Comment: The Federal agency is required to consult with the appropriate State Historic Preservation Officer.

Response: The Louisiana State Historic Preservation Officer was send a copy of the draft environmental impact statement. He was also sent a copy of the survey referenced in paragraph 2.08 of this environmental impact statement.

f. U. S. Department of the Interior, Office of the Secretary, Southwest Region

Comment: Pages I-6 through I-10, Subsection 1.05 - This section should be expanded to include a discussion of the location of shoaling, anticipated volume of material to be removed, method and timing of dredge operations for Bayous La Loutre, St. Malo, Yscloskey, and Dupre.

Response: Data for Bayous La Loutre, St. Malo, Yscloskey, and Dupre have been included in Section I.

Comment: The list of causes of subsidence in Section II should include that subsidence also results from the withdrawal of fluids, especially water and petroleum.

Response: The text has been changed to include this cause.

Comment: 2.08 a. (3) - The procedures for investigation and identification of archeological sites should be available for review by the Advisory Council on Historic Preservation and the National Park Service when such procedures are further defined.

Response: The paragraph has been revised to specifically reference the Federal Register source for the procedures.

Comment: Paragraph 2 on page IV-10 states that the elevated spoil disposal areas constrain the westward erosion of the MR-GO channel bank. We do not believe this is correct.

Response: We do not agree with the comment because:

1. The banks in their natural state are composed of highly organic soils with a very high water content which conditions cause the banks to be highly susceptible to erosion.

2. The elevated areas, or dredged materials deposited and remaining at a level above natural ground, were formed by material excavated from depths as great as 40 feet and are composed of finer grained soils (lean and fat clays) mixed with some sand, silt, humus, etc. which material composition is heavier and has greater cohesive characteristics. The surface materials in these areas have dried and the underlying materials as well as the foundation on which these materials were deposited have become compressed or consolidated and have thereby substantially gained in strength and resistance to erosion.

Comment: Page IV-12, paragraph 3: A brief synopsis of the published results of the effects of heavy metals on the biota in other areas could be referenced and discussed in this section as they may relate to this project area.

Response: Information on the effects of heavy metals on biota is referenced in Annotated Bibliography on Biological Effects of Metals in Aquatic Environments, Ecological Research Studies, National Environmental Research Center, U. S. Environmental Protection Agency, February, 1973. The effects in the project area would probably be similar to those documented for areas that are characteristically similar.

Comment: Four corrections in the zoological species list.

Response: The corrections have been made on the reference copy in the New Orleans District Office.

g. Louisiana Department of Public Works

Comment: Page II-116, paragraph g, last sentence: Expand to a more meaningful and factual statement the reference to the locks at Rigolets and Seabrook. A more full explanation is needed to understand that the two structures mentioned do not themselves provide hurricane protection nor control salinity changes.

Response: Hurricane protection will be provided by the Lake Pontchartrain, Louisiana and Vicinity project. This project will include a lock and control structure at the Rigolets, a navigation structure and control structure at Chef Menteur Pass, and a lock and control structure at Seabrook. The structures at Seabrook can be operated to modify salinities in Lake Pontchartrain. The structures at the Rigolets and Chef Menteur will be designed and operated to maintain existing hydrologic conditions in Lake Pontchartrain.

Comment: On Page V-1, paragraph (b), the discussion on turbidity resulting from dredging should reflect that increases in local water turbidity is for short, temporary periods. Readers could assume that the turbidity is long-term in its effects.

Response: The text on Page V-1 has been revised to read: "Turbidity is generally local, temporary, and . . . ."

h. Louisiana Wild Life and Fisheries Commission

Comment: Dredging can produce multiple adverse effects in marsh and estuarine environments: turbidity, siltation, silt accumulation on channel bottom unsuitable for most bottom dwelling species, and resuspension of pollutants.

Response: The adverse impacts of dredging are recognized and are included in Section IV of this EIS.

Comment: Adverse effects may be heightened during storms which can flush out large volumes of anaerobic and polluted sediment layers from dredged channels into adjacent waters causing a precipitous decline in water quality. The Waters of Breton Sound of Lake Borgne could well be affected in this manner by stormwater from the MR-GO and associated bayous following dredging in these channels.

Response: We recognize the potential of hurricane derived forces to redistribute large volumes of material which affect water quality.

Comment: Saltwater intrusion into normally brackish or freshwater areas is a problem of considerable magnitude which is causing significant ecological changes in the marshlands and estuaries of south Louisiana. The MR-GO has contributed to this process and implementation of the proposed project would enhance the adverse effects of this channel and result in further deterioration of high quality marsh and water bottoms.

Response: This EIS recognizes the continual changes resulting from previous actions. We know of no definitive evidence which indicates that discontinuation of dredging operations would restore the salinity levels to pre-1960 conditions. Salinity control measures would require new construction features necessitating environmental and socio-economic investigation and impact analysis. Consideration of these measures in this assessment of the impacts of project operation and maintenance is not appropriate.

Comment: Of the spoil deposition alternatives presented, soil deposition in large contained areas in land appears to be the least environmentally damaging. In that this, in fact, has been past practice along the southwest side of the MR-GO, further deposition, if adequately contained, would be confined to an area that has already been effectively removed as a productive unit of the marsh ecosystem. Presently undisturbed marshland would be spared, although secondary growth of plants and shrubs would be destroyed in the disposal area along with terrestrial animal species unable to escape during spoil deposition operations.

Response: The comment is noted and concurred in. See Section IV.

i. Louisiana State Soil and Water Conservation Committee

Comment: Requests correction on Page iii of the listing of the agency, which, although housed on the Louisiana State University Campus, is a separate and distinct agency of the State Government.

Response: The list has been corrected.

9.02 LOCAL, ENVIRONMENTAL, AND OTHER GROUPS

Copies of the draft environmental impact statement were sent to all local, environmental, and other groups listed in paragraph 5 of the Summary. The groups were requested to submit their views and comments. No comments were received from these groups.

9.03 PUBLIC PARTICIPATION

The draft statement was made available to the general public. The following persons, organizations, and agencies requested copies of the statement, but did not comment.

Dr. John Day
Center for Wetland Resources
LSU
Baton Rouge, Louisiana 70803

H. Paul Friesena
Center for Urban Affairs
Evanston, Illinois 60201

Office of Public Affairs
Environmental Defense Fund
Washington, D. C. 20036

Cornelia Carriere
Environmental Reporter
The Times-Picayune
New Orleans, Louisiana 70125

9.04 LETTERS RECEIVED BY THE DISTRICT ENGINEER ON THE DRAFT ENVIRONMENTAL STATEMENT

Agency	Page
Environmental Protection Agency, Region VI	IX-11
U. S. Department of Commerce, The Assistant Secretary for Science and Technology	IX-14
U. S. Department of Agriculture, Soil Conservation Service	IX-16
U. S. Department of Transportation, Federal Highway Administration	IX-17
U. S. Department of Health, Education, and Welfare, Regional Office	IX-17
U. S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control	IX-18
Advisory Council on Historic Preservation	IX-19
U. S. Department of the Interior, Office of the Secretary, Southwest Region	IX-20
Louisiana Department of Public Works	IX-21
Louisiana Wild Life and Fisheries Commission	IX-22
Louisiana Commission on Intergovernmental Relations	IX-23
Louisiana State Soil and Water Conservation Committee	IX-23
Port of New Orleans, Centroport, U.S.A.	IX-24

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON
DALLAS, TEXAS 75201

July 14, 1975

Colonel E. R. Heiberg, III
District Engineer
New Orleans District
Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

The Environmental Protection Agency has received the Composite Draft Environmental Impact Statement for Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity, Louisiana.

A failure in our telecommunication system which transmits the Council on Environmental Quality (CEQ) due dates to our office has caused a delay in responding to the statement. We expect to respond no later than July 28, 1975.

Please accept our apologies for this delay.

Sincerely yours,

Clinton B. Spotts
Regional EIS Coordinator

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

July 24, 1975

OFFICE OF THE
REGIONAL ADMINISTRATOR

Colonel E. R. Heiberg, III
District Engineer
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

We have reviewed the Composite Draft Environmental Impact Statement for Operation and Maintenance work on three navigation projects in the Lake Borgne Vicinity, Louisiana.

We are submitting the following comments for your consideration in preparing the final statement:

1. We suggest that the final statement include an analysis of the benefits and costs of the three proposed operation and maintenance projects. This analysis should contain sufficient information in order to compare and weigh equally the costs of project implementation with the beneficial and adverse impacts of each action. Inclusion of a benefit/ cost ratio would be helpful in better understanding the economic benefits of continued operation and maintenance on the project channels and the environmental trade-offs that could occur.

2. The composite statement addresses three navigation projects; however, the majority of the information provided relates specifically to the MR-GO project. In order to strengthen the statement, we suggest that additional information be provided on Bayous La Loutre, St. Malo, Dupre and Yscloskey. Specifically, it appears that the dredged material disposal acreage figure given in the statement applies to the MR-GO project alone. If this is the case, we suggest that disposal acreage figures for the additional project channels be given in the final statement.

Also, while it is clear that gated effluent release structures will be used at the MR-GO on-land disposal sites, it is not clear if similar structures will be employed at the other sites. This should be clarified in the final statement.

3. It appears from the sediment quality data provided in the statement that the resuspension and resolubilization of certain pollutants could occur in the project streams. We are particularly concerned with the possible resuspension of heavy metals (lead, mercury, zinc, arsenic and cadmium) and their unknown effects on the aquatic community. We agree that additional sediment sampling should be undertaken prior to dredging operations, as stated on page II-61 of the statement. We would recommend that in order to determine the effects of dredging on the resuspension and resolubilization of pollutants (particularly heavy metals) in the water column during maintenance activities, a monitoring program be implemented which would,at a minimum, record dissolved oxygen, total suspended solids, Total Kjeldahl Nitrogen and heavy metal concentrations before, during and after dredging operations. If pollutant concentrations exceed existing background levels or if dissolved oxygen concentrations fall below levels necessary to support aquatic life as a result of dredging, we recommend that temporary suspension, reduction or other modification of the operation be considered until such time that the concentrations of these parameters return to previous background levels. Also, if it is determined that the dredged material is polluted, consideration should be given to monitoring the supernatant effluent at the point of discharge from the land disposal sites. Release of the supernatant to the receiving streams should be controlled in a manner which would minimize the pollutant concentration increases for the above mentioned parameters. Finally, we suggest that the elutriate test be conducted for the parameters which were exceeded in the sediment analysis and the results included in the final statement. This information would be helpful in evaluating the impacts of the proposed dredging operations.

The draft statement should discuss the associated long term project induced impacts resulting from the construction of the Mississippi River-Gulf Outlet System in more detail. While construction of the project has resulted in serious primary environmental impacts (e.g., loss of approximately 23,000 acres of marsh), severe secondary impacts have also occurred. For example, construction of the MR-GO has resulted in a modified water regime in the Lake Borgne-Pontchartrain system thereby disrupting extremely productive biological communities. Specifically, channel construction and dredged material placement have altered the hydrology and water chemistry of adjacent estuarine and wetland areas. At present, the MR-GO provides an open channel for the ingress and egress of tidal water. Saltwater intrusion and associated increases in salinity levels have been well documented and are in part responsible for wetland and estuary deterioration in the project area. For instance, average surface salinity levels in Lake Borgne, at certain sampling stations, have ranged from 3.0 ppt (1959-1961) to 10.4 ppt (1962-1964). Furthermore, the poorly consolidated sediments through which the channel was excavated is extremely unstable and requires frequent maintenance dredging. Subsequent maintenance operations will result in degraded water quality during the dredging cycle and perpetuate the increased salinity levels in the Borgne-Pontchartrain Lake Systems.

EPA's Policy Statement on the protection of our nation's wetlands (F.R. 2 May 1973) requires us to give particular cognizance and consideration to any proposal that has the potential to damage wetlands and to protect and preserve them from misuse. It is also this agency's policy to minimize alterations in the quantity or quality of the natural flow of water that nourishes wetlands.

Under Section 404 of P.L. 92-500, our agency is authorized to deny or restrict the use of any area as a disposal site when it is evident that such activity will have an adverse impact on shellfish needs, fishery areas, wildlife, recreational areas or water supplies. Furthermore, recent proposed regulations (F.R. 6 May 1975) state that EPA should avoid approving disposal sites that significantly disrupt the chemical, physical and biological integrity of the aquatic ecosystem.

The Army Corps of Engineers, in regulations published on July 22, 1974 has also recognized the unique qualities of wetland areas and the need for their preservation. The Corps in discussing wetlands states, "As environmentally vital areas, they constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest."

Therefore, in order to minimize the existing adverse and future long-term (secondary) impacts of the MR-GO, we recommend that mitigative measures that could reduce salinity levels in the Lake Borgne-Pontchartrain System be incorporated into the operation and maintenance of the MR-GO project. For example, such measures could include the completion of the Seabrook Lock in the Inner Harbor Navigation Canal System, controlled releases of freshwater from the Mississippi River, and saltwater intrusion barriers. Without control measures, salt water intrusion and water quality degradation will continue to be a major problem in the project area.

4. Finally, the statement should contain additional information in order to allow for complete assessment of the interrelated impacts of MR-GO and other local, state and Federal projects in southern Louisiana. An environmental evaluation of the adverse and beneficial effects of the interrelated projects in the vicinity of MR-GO should be included in the final statement (e.g., GIWW, Lake Ponchartrain and Vicinity Hurricane Protection, MR-GO, Michoud Canal).

These comments classify your Draft Environmental Impact Statement as ER-2. Specifically, we have environmental reservations concerning potential adverse water quality impacts resulting from the dredging operations. We are also requesting that additional information be included in the final statement. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

f/ John C. White
Regional Administrator

Enclosures

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

July 3, 1975

Colonel E. R. Heiberg III
District Engineer-New Orleans District
Corps of Engineers
U. S. Department of the Army
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

The composite draft environmental statement for Operation and Maintenance work on three Navigation Projects in the Lake Borgne Vicinity, Louisiana, "The Mississipi River - Gulf Outlet, Bayous La Loutre, St. Malo, and Ycloskey Bayou Dupre," which accompanied your letter of April 30, 1975, has been received by the Department of Commerce for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

GENERAL COMMENTS

Discussion of Mississippi River - Gulf Outlet (MR-GO) operation and maintenance work dwarfed that of the associated navigation projects. More detailed information should be included on the size and status of the dredged material disposal sites and the frequency of maintenance dredging for Bayous La Loutre, St. Malo, Ycloskey, and Dupre.

SPECIFIC COMMENTS

SECTION 1 - PROJECT DESCRIPTION
1.05 OPERATION AND MAINTENANCE
  a. GENERAL
  (3) OTHER SEDIMENT SOURCES

Page I-6, paragraph 5. Another possible sediment source that should be included in this section is the marsh material released by marsh deterioration in the project area as a result of saltwater intrusion. This material may be transported to the MR-GO by tidal action, storms, and hurricanes.

SECTION 2 - ENVIRONMENTAL SETTING

Numerous geodetic control survey monuments and tidal bench marks are located within the proposed project area. If there is any planned activity which will disturb or destroy these monuments, the Department of Commerce, National Ocean Survey (NOS), of which the National Geodetic Survey is a part, requires not less than 90 days notification in advance of such activity in order to plan their relocation. NOS recommends that funding for this project include the cost of any relocation required for NOS monuments.

2.03 GEOLOGICAL ELEMENTS
  (2) IMMEDIATE MR-GO VICINITY
  (d) PROCESSES AFFECTING LAND FORM

Page II-22, paragraph 1. Another process that should be included in this section is marsh deterioration resulting from saltwater intrusion. A study on the MR-GO (Anon., 1973) cited studies by Chabreck (1970) and Palmisano (1970) which reported that saltwater intrusion into fresh and brackish marshes results in maximum loss of marsh. The MR-GO study (Anon., 1973), in discussing saltwater intrusion, stated "...when salinity is increased in areas underlain by thick organic sequences, instead of being replaced by saline grasses, the marshes simply break up and revert to open ponds and lakes."

SECTION 4 - THE PROBABLE IMPACTS OF THE PROPOSED ACTION ON THE ENVIRONMENT
4.01 GENERAL NATURE OF IMPACTS
  b. EFFECTS RELATED TO OTHER ACTIONS AND CHANGES
TABLE 4-1 SUMMARY OF SOME OF THE EVENTS AND ACTIONS WHICH AFFECT THE ENVIRONMENTAL SETTING (CONSTRUCTION OF THE MR-GO)

Page IV-2. The statement, "Change toward more salt-tolerant vegetation and zoological resources of immediate and adjacent areas in response to changes in system hydrology and salinity," should be documented. This statement is in conflict with the studies cited in our above comments on Section 2 - Processes Affecting Land Form, regarding information on marsh deterioration as a result of saltwater intrusion. Such information should be included in this table.

4.02 BENEFICIAL AND ADVERSE IMPACTS
a. GENERAL
TABLE 4-2 CLASSIFICATION OF IMPACT

Pages IV-12, paragraph 4. Under the topic of heavy metals in the sediment, it is stated "If effects of suspended sediment are not adverse for local biota, effects on biota affected by long distance drift from the dredge would not be expected to be significant." This statement should be qualified and documented, because the long distance drift may extend into an ecosystem with biota having more sensitive tolerances to heavy metals than those of the local biota.

4.03 REMEDIAL, PROTECTIVE, AND MITIGATION MEASURES
c.

Page IV-13, paragraph 3. Retention of the existing on-land disposal areas for their continued use would also greatly reduce any need to utilize adjacent marshes as disposal areas in the future.

SECTION 6 - ALTERNATIVES TO THE PROPOSED ACTION

This section should contain a discussion of possible economic use of the dredge spoil.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving eight copies of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Attachment

LITERATURE CITED

Anon. 1973. Environmental Considerations of an expanded Mississippi River - Gulf Outlet. Report prepared for St. Bernard Parish Police Jury by Coastal Environments, Inc., Baton Rouge, Louisiana. 58p.

Chabreck, R. H. 1970. Marsh zones and vegetation types in the Louisiana coastal marshes. Ph.D. Dissertation, Department of Botany and Plant Pathology, Louisiana State University, Baton Rouge, Louisiana.

Palmisano, A. W. 1970. Plant community - soil relationships in Louisiana coastal marshes. Ph.D Dissertation, Department of Botany and Plant Pathology, Louisiana State University, Baton Rouge, Louisiana.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Post Office Box 1630 - Alexandria, La. 71301

May 12, 1975

Colonel E. R. Heiberg, III, CE
District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

RE: LMNPL-RR Composite Draft Environmental Statement for Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity Louisiana

We have reviewed the draft environmental impact statement for the above project and have no comments to offer.

We appreciate the opportunity to review this document.

Very truly yours,

Alton Mangum
State Conservationist

cc: Kenneth E. Grant
Administrator, SCS
Washington, D.C. 20250

Council on Environmental Quality (5 copies)
722 Jackson Place, N.W.
Washington, D.C. 20006
Att: General Counsel

Office of the Coordinator of
Environmental Quality Activities
Office of the Secretary, USDA
Washington, D.C. 20250

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Post Office Box 1630 - Alexandria, Louisiana 71301

May 12, 1975

Colonel E. R. Heiberg, III, CE
District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

RE: LMNPL-RR DRAFT, Environmental Statement for Operation and Maintenance dredging of four projects located south of the Gulf intracoastal waterway in Terrebonne Parish, Louisiana

We have reviewed the draft environmental statement and have no comments to offer. We appreciate the opportunity to review this document.

Very truly yours,

Alton Mangum
State Conservationist

cc: Kenneth E. Grant
Administrator, SCS
Washington, D.C. 20250

Council on Environmental Quality (5)
722 Jackson Place, N.W.
Washington, E.C. 20006
Attention: General Counsel

Office of the Coordinator of
Environmental Quality Activities
Office of the Secretary, USDA
Washington, D.C. 20250

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX
750 Florida Boulevard
Baton Rouge, Louisiana 70801

June 23, 1975

IN REPLY REFER TO

Draft EIS for Maintenance of
Mississipi River-Gulf Outlet,
Bayou LaLoutre and Bayou Dupre

Colonel E. R. Heiberg III, CE
District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

We have reviewed the draft environmental statement for the above project and have no comments. The project should not have any significant effect on any existing highway facilities, and we do not know of any proposed highway projects in this area.

We appreciate the opportunity for review of this statement.

Sincerely yours,

for M. C. Reinhardt
Division Engineer

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

May 13, 1975

Our Reference: EI# 1275-536
(LMNPL-RR)

Colonel E. R. Heiberg
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Heiberg:

RE: Mississippi River - Gulf outlet
Bayour La Loutre

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2) (c) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with State, County, and local environmental laws and regulations.

We, therefore, have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

William F Crawford

William F. Crawford
Regional Environmental Officer

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

BUREAU OF LABORATORIES
VECTOR-BORNE DISEASES DIVISION
POST OFFICE BOX 2087
FORT COLLINS, COLORADO 80521

May 28, 1975

Colonel E. R. Heiberg, III
District Engineer
New Orleans District
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Re: LMNPL-RR

Dear Colonel Heiberg:

In response to your request for review of the composite draft environmental statement on Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity, Louisiana (The Mississippi River - Gulf Outlet; Bayous La Loutre, St. Malo, and Yscloskey; Bayou Dupre), we are forwarding our comments in regard to vector-borne disease problems associated with this project.

Earlier this month, we submitted comments to your office on vector-borne disease problems related to dredging and spoil deposition. Remarks submitted in this review are similar to those made previously. Our concern regards diseases transmitted to man and other animals by insects and other arthropods. Almost of equal importance is the serious discomfort caused by these biting pests.

Impacts upon the environmental quality and man's well-being, in respect to the possibility that mosquito and other vector-producing habitats may be created by the terrestrial deposition of dredged spoil material, are not mentioned in the statement. In the Classification of Impacts (Table 4-2, pages IV-8 through IV-12), no consideration is given to the possibility that the project will produce an impact upon man's health or well-being. The deposition of millions of cubic yards of spoil material will cover over 10,000 acres, some of which is shown on Plate 2 to be within a mile of the City of New Orleans. Creation of mosquito-producing habitats so near a heavily populated area is an adverse environmental impact that must be considered in your assessment.

The climate and topography of southern Louisiana favor mosquito production, and man-made habitats should not be created. Serious mosquito problems in coastal areas are caused by spoil deposition. Loading procedures, and poor dewatering and drainage characteristics of spoils. These result in creation of extensive habitats for the production of salt marsh mosquitoes (*Aedes sollicitans* and *Aedes taeniorhynchus*). Further, as the spoil ages, ecological conditions change and the southern house mosquito (*Culex quinquefasciatus*) or the malaria mosquito (*Anopheles quadrimaculatus*) may be produced in waters impounded by spoils or dikes. All of these mosquitoes are common and abundant in Orleans and St. Bernard Parishes. *Psorophora confinnis*, *Culiseta inornata*, tabanids, and other biting flies also are common, frequently in large numbers. These species exhibit wide choices of habitat-types as well. This information is taken from "Distribution and Relative Abundance of Mosquito Species in Louisiana," E. B. Johnson, 1959, Louisiana Mosquito Control Association, Technical Bulletin No. 1, New Orleans, Louisiana.

Table 4-3 (pp. IV-14 and IV-15) states the Corps of Engineers "Dredged Material Research Program as of July, 1974." Project 2A, Upland and Marsh Disposal Impacts, has as its objective: "Identification, evaluation, and monitoring of specific short-term effects and more general long-term effects of confined and unconfined disposal of dredged material on uplands, marsh, and other wet lands." Entomological research, in particular mosquito and mosquito habitat study on spoil disposal sites, could easily fall within the scope of this project. We would like to know if such research has been considered as an effect produced by spoil deposition.

Our staff has not had the opportunity to visit spoil deposition sites in Louisiana, and thus we are unable to make specific recommendations regarding the prevention of vector production or vector-borne disease problems there. However, Mr. Roy Hayes, Chief, Solid Waste and Vector Control Section, Louisiana State Department of Health, should be able to provide consultation regarding engineering procedures for the prevention of vector habitats in the areas described in the environmental impact statement. With limitations on the application of chemicals, an engineering approach involving environmental manipulation is becoming increasingly important in vector control.

We appreciate the opportunity to cooperate with your office in reviewing this statement. If we can further clarify any point or furnish any other information relative to vector-borne disease control, please let us know.

Sincerely yours,

Richard O. Hayes

Richard O. Hayes, Ph.D., M.P.H.
Chief, Water Resources Branch

cc:
Mr. Roy Hayes

Advisory Council
On Historic Preservation
1522 K Street N.W. Suite 430
Washington D.C. 20005

Colonel E. R. Heiberg, III
District Engineer
Corps of Engineers, New Orleans District
Department of the Army
P. O. Box 60267
New Orleans, Louisiana 70160

MAY 1 3 1975

Dear Colonel Heiberg:

This is in response to your request of April 30, 1975 for comments on the environmental statement for operation and maintenance work on three navigation projects in the Lake Borgne vicinity, Louisiana: the Mississippi River-Gulf Outlet, Bayous La Loutre, St. Malo and Yscloskey, and Bayou Dupre. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that while you have discussed the historical, architectural, and archeological aspects related to the undertaking, the Advisory Council needs additional information to adequately evaluate the effects on these cultural resources. Please furnish additional data indicating:

I. <u>Compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971.</u>

A. Under Section 2(a) of the Executive Order, Federal agencies are required to locate, inventory, and nominate eligible historic, architectural and archeological properties under their control or jurisdiction to the National Register of Historic Places. The results of this survey should be included in the environmental statement as evidence of compliance with Section 2(a).

B. Until the inventory required by Section 2(a) is complete, Federal agencies are required by Section 2(b) of the Order to submit proposals for the transfer, sale, demolition, or substantial alteration of federally owned properties eligible for inclusion in the National Register to the Council for review and comment. Federal agencies must continue to comply with Section 2(b) review requirements even after the initial inventory is complete, when they obtain jurisdiction or control over additional properties which are eligible for inclusion in the National Register or when properties under their jurisdiction or control are found to be eligible for inclusion in the National Register subsequent to the initial inventory.

The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition or substantial alteration of eligible National Register properties under Federal jurisdiction. If such is the case, the nature of the effect should be clearly indicated as well as an account of the steps taken in compliance with Section 2(b). (36 C.F.R. Part 800 details compliance procedures.)

C. Under Section 1(3), Federal agencies are required to establish procedures regarding the preservation and enhancement of non-federally owned historic, architectural, and archeological properties in the execution of their plans and programs.

The environmental statement should contain a determination as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-federally owned districts, sites, buildings, structures and objects of historical, architectural or archeological significance.

II. <u>Contact with the State Historic Preservation Officer.</u>

The procedures for compliance with Section 106 of the National Historic Preservation Act of 1966 and the Executive Order 11593 require the Federal agency to consult with the appropriate State Historic Preservation Officer. The State Historic Preservation Officer for Louisiana is Jay R. Broussard, Director, Department of Art, Historical and Cultural Preservation, Old State Capitol, North Boulevard, Baton Rouge, Louisiana 70801.

Should you have any questions or require any additional assistance, please contact Michael H. Bureman of the Advisory Council staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946.

Sincerely yours,

John D. McDermott
Director, Office of Review
and Compliance

United States Department of the Interior
OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87101

June 26, 1975

ER-75/474

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

Dear Sir:

This is in response to your request for the Department of the Interior's review and comment on the draft environmental impact statement for the proposed Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity, Louisiana.

We offer the following comments for your consideration:

General Comments

In general, the statement is comprehensive and well written. However, we believe the statement could be improved in certain areas.

Specific Comments

Project Description

Pages I-6-10, subsection 1.05 - This section should be expanded to include a discussion of the location of shoaling, anticipated volume of material to be removed, method and timing of dredge operations for Bayous La Loutre, St. Malo, Yscloskey, and Dupre.

Pages II-6 and II-6, b.5 - The statement appears to be adequate in most respects in its treatment of geology and water resources. However, one change is needed in the list of causes of subsidence. Subsidence also results from the withdrawal of fluids, especially water and petroleum. 1/

Page II-97, (3) - The procedures for investigation and identification of archeological sites should be available for review by the Advisory Council on Historic Preservation and the National Park Service when such procedures are further defined.

The Probable Impacts of the Proposed Action on the Environment

Pave IV-10, paragraph 2 - It is stated that the elevated spoil disposal areas constrain the westward erosion of the MR-GO channel bank. We do not believe this is correct. The channel bank-water interface along the elevated disposal areas is far below the vegetated surface of these disposal areas. Undercutting of wave action will be facilitated because the soil-binding roots of plants growing on the disposal areas are located above the zone of wave erosion. Similar situations exist along portions of the Gulf Intracoastal Waterway in Louisiana. The statement should be revised to reflect this situation.

Page IV-12, paragraph 3 - We agree that additional research is needed regarding the effects of heavy metals on aquatic life in the project area. However, a brief synopsis of the published results of the effects of heavy metals on the biota in other areas could be referenced and discussed in this section as they may relate to this project area.

Zoological Species List

Page B-19 - The fulvous tree duck is considered to be common in summer and uncommon in winter in coastal Louisiana.

Page B-23 - The occurrence of the American coot in the project area should be listed as common in winter and rare in summer.

Page B-38 - The Canada goose and white-fronted goose are believed to be rare and unlikely in southeastern Louisiana.

Page B-39 - The gadwall is considered common in the project area.

We hope these comments will be helpful in preparing the final statement.

Sincerely yours,

Willard Lewis

Willard Lewis
Special Assistant to the Secretary

1/ Poland, J.F. and Davis, G.H., 1969, Land subsidence due to withdrawal of fluids: Geological Society of America Reviews in Engineering Geology II.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

ROY AGUILLARD
DIRECTOR

State of Louisiana
DEPARTMENT OF PUBLIC WORKS
P. O. BOX 44155, CAPITOL STATION
BATON ROUGE, LOUISIANA 70804

May 30, 1975

Col. Elvin R. Heiberg III
U. S. Army Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNPL-RR

Dear Col. Heiberg:

Your letter dated April 30, 1975, transmitted a Composite Draft Environmental Statement (EIS) for the continued operation and maintenance of three projects including: (1) Mississippi River-Gulf Outlet, (2) Bayous LaLoutre, St. Malo, and Yscloskey, and (3) Bayou Dupre. You requested review and comment on this composite draft EIS.

The Louisiana Department of Public Works has been designated by Governor Edwin Edwards of Louisiana as his representative in the review and coordination of water resources projects, studies, and reports affecting the State. The Department is the State agency responsible for planning, coordination, and orderly development of the State's vast water resources. We are, therefore, pleased to submit these comments on behalf of the Governor of Louisiana and for the Department of Public Works:

(a) On Page II-116, Paragraph (g), the last sentence should be expanded to provide a more meaningful and factual statement. The persons who are vaguely or less familiar with the purposes and functions of the locks at Rigolets and Seabrook will not understand the full association and purpose in the overall project and will probably conclude that that two structures mentioned do not themselves provide hurricane protection nor would they control salinity changes. A more full explanation is needed.

(b) On Page V-1, Paragraph (b), there is a discussion presented referring to turbidity resulting from dredging. Under Paragraph (b), Items 1 and 3 should reflect that increases in local water turbidity is for short, temporary periods. This could be significant since some readers could assume that the turbidity was long-term in its effects.

It is very evident that careful and comprehensive considerations have been utilized in the preparation of this Composite Draft EIS. We compliment the New Orleans District for a job well done and urge its final acceptance and approval.

On behalf of the Governor and the State of Louisiana, the Department of Public Works sincerely appreciates this opportunity to comment on this Composite Draft EIS.

Sincerely yours,

Roy Aguillard
ROY AGUILLARD
Director

GRD/cjh

State of Louisiana

J BURTON ANGELLE
DIRECTOR

WILD LIFE AND FISHERIES COMMISSION
400 ROYAL STREET
NEW ORLEANS 70130

EDWIN EDWARDS
GOVERNOR

July 11, 1975

Colonel E.R. Heiberg III
District Engineer
United States Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana

Dear Colonel Heiberg:

Personnel of the Louisiana Wildlife and Fisheries Commission have reviewed the Draft Composite Environmental Impact Statement for operation and maintenance work on three navigation projects in the Lake Borgne vicinity, Louisiana.

This Draft Environmental Statement describes proposed operation and maintenance projects involving the Mississippi River-Gulf Outlet (MR-GO) and Bayous La Loutre, St. Malo, Yscloskey and Dupre. The projects include dredging operations, dredge spoil disposal and maintenance of spoil containment dikes. The immediate effects of dredging and spoil deposition operations of this kind are habitat destruction and loss of aquatic and terrestrial organisms in the project area and areas proximate to these operations.

Dredging can produce multiple adverse effects in marsh and estuarine environments. High turbidity levels and siltation are effects which may extend a considerable distance from the immediate project site. Silt deposits can accumulate in dredged channels and form a soft, unstable, anaerobic bottom which is unsuitable for most bottom dwelling species. Dredging operations may also resuspend pollutants that are absorbed onto sediments with detrimental results to local aquatic and terrestrial biota.

These effects may be heightened during storms which can flush out large volumes of anaerobic and polluted sediment layers from dredged channels into adjacent waters causing a precipitous decline in water quality. The waters of Breton Sound or Lake Borgne could well be affected in this manner by stormwater from the MR-GO and associated bayous following dredging in these channels.

Salt water intrusion into normally brackish or fresh water areas is a problem of considerable magnitude which is causing significant ecological changes in the marsh lands and estuaries of South Louisiana. The MR-GO has contributed to this process and implementation of the proposed project would enhance the adverse effects of this channel and result in further deterioration of high quality marsh and water bottoms.

Of the spoil disposition alternatives presented, spoil deposition in large contained areas on land appears to be the least environmentally damaging. In that this, in fact, has been past practice along the southwest side of the MR-GO, further deposition, if adequately contained, would be confined to an area that has already been effectively removed as a productive unit of the marsh ecosystem. Presently undisturbed marshland would be spared, although secondary growth of plants and shrubs would be destroyed in the disposal area along with terrestrial animal species unable to escape during spoil deposition operations.

We appreciate having the opportunity to comment on this environmental impact statement.

Sincerely yours,

J. Burton Angelle

J. Burton Angelle
Director

JBA:CK/sd

STATE OF LOUISIANA

COMMISSION ON INTERGOVERNMENTAL RELATIONS

P O Box 44455
Baton Rouge, Louisiana 70804
389-5664

May 28, 1975

Colonel E. R. Heiberg, III
District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNPL-RR

Dear Colonel Heiberg:

We have reviewed the Draft Composite Environmental Statement for Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity, with respect to agency impact and responsibility.

We find the list of state agencies from which comments were requested to be sufficient.

Sincerely,

DeWitt H. Braud, Jr.
DeWitt H. Braud, Jr.
Environmental Coordinator

DHB:amb

LOUISIANA STATE SOIL AND WATER CONSERVATION COMMITTEE

LOUISIANA STATE UNIVERSITY
P. O. DRAWER CS
Telephone 389-5017
BATON ROUGE, LOUISIANA

May 30, 1975

U. S. Army Engineer District
Corps of Engineers
Post Office Box 60267
New Orleans, LA 70160

Gentlemen:

We have reviewed the Composite Draft Environmental Statement for Operation and Maintenance Work on three navigation projects in the Lake Borgne Vicinity Louisiana.

We would like to call your attention to Page iii. Even though this agency is housed on the Louisiana State University Campus, it is a separate and distinct agency of the State Government. The way this agency is listed on Page iii should be corrected.

We have no other comments to make at this time.

Sincerely,

Charley S. Staples
Executive Director

CSS;p

PORT OF NEW ORLEANS
CENTROPORT U.S.A.

August 6, 1975

Brigadier General E. R. Heiberg, III
District Engineer
Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Subject: Composite Draft Environmental Statement for Operation and Maintenance Work on Three Navigation Projects in the Lake Borgne Vicinity, La.

Dear General Heiberg:

The Board of Commissioners of the Port of New Orleans has reviewed the above referenced draft environmental impact statement. We find no significant detrimental effects which will result from the project on the quality of the human environment.

Very truly yours,

Herbert R. Haar

Herbert R. Haar, Jr
Associate Port Director

BOARD OF COMMISSIONERS OF THE PORT OF NEW ORLEANS • POST OFFICE BOX 60046 • NEW ORLEANS, LOUISIANA 70160
Tel: 504-522-2551
An Agency of the State of Louisiana
Cable: CENTROPORT

SECTION X

ANNOTATED BIBLIOGRAPHY

NOTE: The following bibliography was compiled for use in preparation of the draft and final environmental impact statements. In the text, citations may include a capital letter (for example Department of the Army, 1974, A), to specify the publication used when more than one publication by the same author in the same year is included in the bibliography.

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The report develops a comprehensive master plan for the long-range phased development of the Port based upon critical evaluation and analysis of projected needs.

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Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1973. "Botanical Appendices." Government Printing Office; Washington, D. C. F

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Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1973. Navigation Maps of Gulf Intracoastal Waterways. Includes Mississippi River Gulf Outlet. G

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The study is a regional investigation of the coast of the Gulf of Mexico from Brownsville, Texas, to Tampa, Florida. The basic objectives are to identify the advantages or disadvantages of using large tankers to import foreign crude oil and to determine the most feasible deep water port system for possible development.

Department of the Army, United States Corps of Engineers, 1973. Floods and Flood Control on the Mississippi 1973. Cooperative effort by the United States Corps of Engineers affiliated with controlling the Mississippi River. United States Government Printing Office; Washington, D. C. I

Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1974. Calcasieu River at Coon Island, Louisiana, Ship Channel, Water Quality Report. New Orleans, Louisiana. A

Department of the Army, Corps of Engineers, Vicksburg, Mississippi, District Office, 1974. Demonstration of a Methodology for Dredged Material Reclamation and Drainage, Contract Report D-74-5. Prepared by Dames & Moore for Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station. B

A controlled field demonstration was conducted to evaluate the effectiveness of a methodology for reducing the volume and improving the physical characteristics of dredged material in confined disposal areas.

Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1974. Draft Environmental Statement - Deep Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana. C

Basic report contains basic economic data, extracted from United States Army Corps of Engineers Survey Report, as well as the environmental impact of the project on the surroundings.

Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1974. Public Notice 8 October 1974. New Orleans, Louisiana. D

The notice notifies interested parties that annual maintenance dredging on the Mississippi River-Gulf Outlet in Louisiana will be performed by the Corps of Engineers.

Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, received Stanley Consultants, November 20, 1974. Unpublished master lists of mammals, marine and estuarine fish, freshwater fish, birds, reptiles and amphibians, and invertebrates. New Orleans District Office; New Orleans, Louisiana. E

A basic species list on the title's listing including general habitat, range in the state, and range in United States.

Department of the Army, United States Corps of Engineers, New Orleans, Louisiana, District Office, 1974. Waterborne Commerce of the United States of 1973; Port Waterways and Harbors, Gulf Coasts, Mississippi River System and Antilles. United States Government Printing Office; Washington, D. C. F

Department of the Army, United States Corps of Engineers. Engineering and Design, Tidal Hydraulics. Department of the Army, Office of the Chief of Engineers; Washington, D. C.

Dohm, Christian Frederick, 1936. Petrography of Two Mississippi River Sub-Deltas, Louisiana Geological Survey Bulletin. University of Louisiana; Baton Rouge, Louisiana.

A study of the Plaquemines and St. Bernard subdeltas was undertaken to determine by petrographic and mechanical analyses any change in transporting ability undergone by the Mississippi since the deposition of St. Bernard subdelta. Various types of land forms were sampled and the samples mechanically analyzed.

Doyle, Harry. "Sediment Transport in a Mississippi River Distributary: Bayou Lafourche," United States Geological Survey. Water Supply Paper 2008.

Dunham, Fred, 1972. "A Study of Commercial Important Estuarine - Dependent Industrial Fishes," Technical Bulletin Number 4. Louisiana Wild Life and Fisheries Commission; New Orleans, Louisiana.

El-Sayed, S. Z. and Rae, K. M., 1961. Hydrologic and Biological Studies of the Mississippi River--Gulf Outlet Project: Summary Report. Texas A & M Research Foundation Project No. 236, Texas A & M University; College Station, Texas.

A collection of baseline data gathered to judge the effects of the Mississippi River-Gulf Outlet on the local environment.

Engineering Agency for Resources Inventories and United States Army Engineer Topographic Laboratories, 1973. Inventory of Basic Environmental Data, South Louisiana, Mermentau River Basin to Chandeleur Sound with Special Emphasis on the Atchafaylaya Basin. Prepared for Department of the United States Army, Corps of Engineers; New Orleans, Louisiana, District Office.

The purpose of this inventory is to provide a ready reference source on the primary environmental components of a particular study area in southern Louisiana.

Everett, Duane, 1971. Hydrologic and Quality Characteristics of the Lower Mississippi River. Louisiana Department of Public Works Technical Report No. 5. Louisiana Department of Public Works; Baton Rouge, Louisiana.

Fassett, Norman C., 1968. A Manual of Aquatic Plants. University of Wisconsin Press; Milwaukee, Wisconsin.

The text is essentially a manual of directions for the identification of aquatic plants.

Fernald, M. L., 1970. Gray's Manual of Botany, eighth edition. D. Van Nostrand Company; New York, New York.

The text is an extensive collection of information on vegetation including species lists, their varieties, descriptions of each, and numerous illustrations for helpful identification. It is a manual for identification of vascular and aquatic plants of the northeastern U. S.

Ferrell, R. E. et al, 1971. "Comparative Mineralogy of Recent and Pleistocene Sediments from the Deep Gulf of Mexico," Quaternary of the United States, Geological of Louisiana Continental Shelf.

Field, R. and Struzeski, E. J., 1972. "Management and Control of Combined Sewer Overflows," Journal Water Pollution Control Federation, 44, 7, 1393. Washington, D. C.

Fisher, W. L. and Brown, C. A., Delta Systems in Oil and Gas Occurrence, University of Texas Delta Systems in the exploration of oil and gas. University of Texas; Austin, Texas.

Deltas are excellent targets for oil and gas exploration because 1) sands provide potential reservoirs, 2) high in situ organic productivity, and 3) rapid deposition emphasizes differential compaction as potential traps. The article discussed these facets of deltas using the Gulf Coast tertiary as an example.

Fisk, H. N., 1944. Geological Investigation of the Alluvial Valley of the Lower Mississippi River. United States Army Corps of Engineers, Mississippi River Commission; Vicksburg, Mississippi.

Fisk, H. N., 1949. "Depositional Environment of Mississippi Delta," Oil and Gas Journal. Petroleum Natural Gas Company; Tulsa, Oklahoma.

Fisk, H. N., 1951. "Mississippi River Valley Geology, Relation to River Regime," American Society of Civil Engineering Transaction V. New York, New York.

Fisk, H. N., 1952. *Geological Investigations of the Atchafalaya Basin and the Problem of Mississippi River Diversion.* United States Army Corps of Engineers, Waterways Experiment Station; Vicksburg, Mississippi.

Fisk, H. N., et al., 1954. "Sediment Framework of the Modern Mississippi Delta," Journal of Sediment Petrology.

Studies the distribution of sediments within the delta and compares it with the structure of a leaf. The authors conclude the rate of sedimentation based on a 450 year growth period is .06 cu miles/yr or 495 x 10^6 ton. As deposition has proceeded uniformly, it has resulted in seaward elongation of distributaries. It has given rise to a pattern of diverging finger-like bar deposits of sands and sandy silts, separated by wedges of silty clay. These sediment units, with an underlying thin layer of prodelta marine clay, form the framework of the delta platform, which has advanced gulfward into waters about 300 feet deep.

Fisk, H. N., and McFarlan, Edward, 1955. "Late Quaternary Deltaic Deposits of the Mississippi River in Crust of the Earth," Special Paper 62. Geological Society of America; Boulder, Colorado.

Well data from coastal Louisiana marshlands and Continental Shelf and cores from the Gulf floor allow generalizations about the deposition, thickness, and facies of late quaternary deltaic deposits. The area of deltaic deposition is defined, volume of sediment carried by the river to the Gulf is estimated and amount of continental margin downwarping in depositional area gaged.

Fisk, H. N., 1955. "Sand Facies of Recent Mississippi Delta Deposits," World Petroleum Congress, 4th Rome.

A description of delta-front sheet sands, delta-margin island and bar deposits, bar-fingers, channel fillings, and abandoned beaches or cheniers. These recent deposits are related to similar bodies in older rocks which form petroleum reservoirs and facies relationship in the delta complexes provide guides for interpretation of environmental conditions under which sand deposits developed.

Fisk, H. N., and McClelland, B., 1959. "Geology of the Continental Shelf Off Louisiana - Its Influence on Offshore Foundation Design," Bulletin V. 70. Geological Society of America; Boulder, Colorado.

The engineering problem of offshore drilling structures is related to shearing strength and scour resistance of scar-surface late quaternary continental shelf deposits. The findings show that the recently deposited underconsolidated clays of the birdfoot delta have the poorest inundation conditions. Time is seen as the important factor in establishing full consolidation of clay sediments under existing overburden pressures.

Fisk, H. N., 1960. Recent Mississippi River Sedimentation and Peat Accumulation: Compte Rendu du quartrieme Congres pour l'advancement des estudes de Stratagraphie et de Geologie du Carbonifere. Heerlen, 15-20 Setenbre 1958.

The formation of peat through sediment compaction and regional subsidence is studied. Facies of shoal-water Mississippi River Delta is discussed with details of floral progressions. The distribution of peat and organic muck in the coastal Louisiana lowlands supports the idea that some ancient coals may have originated in deltaic plans, but it is doubtful that large coal deposits could develop in the deltaic plain of a river like the Mississippi which carries a preponderant load of fine sediment. Subsidence proceeds rapidly and peat forming environments are likely to be destroyed before thick organic sediments can develop.

Fisk, H. N., 1961. "Bar-Finger Sands of Mississippi Delta in Geometry of Sand Stone Bodies," American Association of Petroleum Geologists; Tulsa, Oklahoma.

An outdated concept describing thick, lenticular bodies of sand and silt underlying the principal distributaries or passes which are referred to as bar-finger sands. This theory has been discarded in favor of mudlumps, but this is a good background article by a Mississippi delta specialist.

Fisk, H. N., 1964. "Environments of Peat Accumulation in Coastal Louisiana," Geological Society of America, annual meeting; Boulder, Colorado.

Fontenot, Bennie, J., Jr. and Rogillio, E., Howard, 1970. A Study of Estuarine Sport Fisheries in the Biloxi Marsh Complex, Louisiana. Louisiana Wild Life and Fisheries Commission; Baton Rouge, Louisiana.

Ford, T. B., Dr., May 6, 1974, personal communication. Assistant Director of Sea Grants Program; Topic - The Salinity Change in the Lake Borgne Vicinity on Oysters. Louisiana State University; Baton Rouge, Louisiana.

Frazier, D. E. and Osanik, 1961. "Point Bar Deposits, Old River Locksite," Louisiana, Gulf Coast Association, Geological Societies Transaction.

Frazier, D. E., 1967. "Recent Deltaic Deposits of the Mississippi River; Their Development and Chronology," Transactions - Gulf Coast Association of Geological Societies, V. 17.

Sixteen separate delta lobes have been formed in the Mississippi River in the past 6,000 years. Each is genetically related to a major Mississippi River course.

Delta lobes were defined by detailed facies analyses of sediment cores from shallow borings combined with lithologic and faunal data from additional boring. Each lobe was found to consist of basal fine-grained prodelta facies, an overlying sandy delta-front facies, and uppermost fine-grained delta-plain facies.

Radiocarbon age determinations made on discrete delta-plain peats were used to establish the chronology of the 16 delta lobes. These data indicate the development of each delta complex was not a continual process, instead river shifting caused the temporary cessation of development in one delta complex as progradation occurred in another.

Gagliano, Sherwood M., 1969. <u>Sand Deposition in the Mississippi Delta System</u>. Geographic Science Division, United States Corps of Engineers, Topographic Laboratories. Government Printing Office; Washington, D. C.

Gagliano, Sherwood M., 1971. "Building New Marshes and Estuaries in Coastal Louisiana through Controlled Sedimentation," American Association of Petroleum Geologists Bulletin 55. Tulsa, Oklahoma.

Gagliano, Sherwood M., 1971. <u>Water Balance Evaluation of Salinity Management in Louisiana</u>, American Geophysical Union Transcript. American Geophysical Union; Washington, D. C.

Gagliano, Sherwood M. and St. Bernard Parish Police Jury, 1972. <u>Environmental Baseline Study</u> and <u>Study Ship Channel Project</u>, Volume 2. Coastal Environments, Inc.; Baton Rouge, Louisiana.

The purpose of this study was to investigate the environmental impacts of the Gulf of Mexico and associated water bodies encroaching on St. Bernard Parish.

Gagliano, Sherwood M., 1972. "The Mississippi River Delta System, Parts A and B" in Aernaceous Deposits, Sediment and Diagenisis. Alberta Society Petrology-Geology, University Department Extension; Alberta, Canada.

Gagliano, Sherwood M., 1973. "New Era for Mudlumps," Water Spectrum, 5(1):25-31. Louisiana Wildlife and Fisheries Commission; New Orleans, Louisiana.

Gladstone and Associates, 1973. Pontchartrain New Town in Town, Volumes 1, 2, 4, 10; additional volumes: Environmental Supplemental Report and Environmental Management Plan. New Orleans, Louisiana.

Volumes 1 through 10 research and study the methods for creating a community responsive to people's needs. It encompasses problems of environment, technology, and growth.

Gagliano, Sherwood M., "Environmental Management in Mississippi Delta," Bulletin 57. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Gonzalez, Juan G., 1957. Copepods of the Mississippi Delta Region. Master of Science thesis, Texas A & M University. College Station, Texas.

Gordy, William J. and White, Charles J., 1973. "Investigations of Commercially Important Penaeid Shrimp in Louisiana Estuaries," Technical Bulletin Number 8. Louisiana Wild Life and Fisheries Commission; New Orleans, Louisiana.

Gould, H. R., and McFarlan, E., Jr., 1962. "Geological History of the Chenier Plain Southwest Louisiana," Geology of Gulf Coast and Central Texas and Guidebook. Houston Geological Society for GAS; Houston, Texas.

The chenier plains have been studied through means of radiocarbon dating. They range in age from 300-2800 years and record progressive changes in the configuration of the shoreline as it advanced seaward more than 10 miles to its present position.

Also in Gulf Coast Geological Society Transcript V. 9, p. 261-70.

Gould, H. R., 1970. "Mississippi River Delta Complex in Deltaic Sedimentation - Modern and Ancient," SEPM Special Paper 15.

A comprehensive description of the history of the modern Mississippi River Delta complex. Lengthy description of the birdfoot delta, its development and facies. Includes information on the fauna characterizing the birdfoot delta facies.

Greenman, N. N., and Le Blanc, 1956. "Recent Marine Sediments and Environments of the Northwest Gulf of Mississippi," American Association of Petroleum Geologists; Tulsa, Oklahoma.

Grim, Ralph E., 1958. "Clay Mineral Composition of Recent Sediments from the Mississippi River Delta," Journal of Sediment Petrology, Volume 28.

Gulf South Research Institute and Louisiana State Parks and Recreation Commission, 1973 of Louisiana State Parks Plan. Louisiana State Parks and Recreation Commission; Baton Rouge, Louisiana.

Gunter, G., 1938. "The Relative Numbers of Species of Marine Fish on the Louisiana Coast," American Naturalist. University of Chicago Press; Chicago, Illinois.

Gunter, G., 1945. "A List of the Fishes of the Mainland of North and Middle America Recorded From Both Fresh Water and Sea Water," American Midland Naturalist 29(2):305-306. Notre Dame, Indiana.

Gunter, G., 1945. Studies on Marine Fishes of Texas, Public Maritime Science Institute. University of Texas; Austin, Texas.

An attempt to systematically study the relation of marine animals to the salinity factor. The whole population of fishes of a portion of the Texas coast was studied each month. The chief aims of the study were to gather information on the distributions of fish to temperature change and develop a general view of the population and distributions of fishes in the shallow Gulf and bay waters and their changes during the seasons of the years.

Some conclusions of the study were: 1) during the fall most fishes in the bays began to move toward the Gulf, 2) spring is the time of greatest spawning activity, 3) smaller specimens were usually found in fresher water and largest were found in saltier water, and 4) practically every fish living at lower salinities can also live in sea water.

Gunter, G., 1950. Seasonal Population Changes and Distribution as Related to Salinity of Certain Invertebrates of the Texas Coast Including the Commercial Shrimp. Public Institute of Maritime Science, University of Texas; Austin, Texas.

A study of Texas marine fishes in the area extending from the headwaters of Copano Bay, through Aransas Bay, to five miles down the Gulf beach of the north end of Mustang Island. This covered a stable salinity gradient from near fresh water to pure sea water.

The primary aim of the program was to gather information on the distributions and general seasonal movements of the fishes.

The number of each species taken, the date of the catch, salinities, temperatures at which taken are included in the data.

Some general conclusions of the study are: 1) most of the species can withstand high salinities, but many cannot withstand low salinities, 2) the fauna of brackish water is marine and not derived from fresh water, 3) many species grow up in bays during the warmer months. Certain Gulf species invade the bay in the spring and summer and move to the Gulf when temperatures fall, and 4) invertebrates in less salty water usually average smaller than those of the same species in high salinities.

Hinley, P. J., 1973. "Deviation In Louisiana Gulf Coast in 1972," Bulletin 57. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Hinthong, Chaiyan, 1972. Geological Aspects and Engineer Analysis of Some Louisiana Soils. Master of Science Thesis, Louisiana Technical Institute; Ruston, Texas.

Hitchcock, A. S., 1950. Manual of the Grasses of the United States. Government Printing Office; Washington, D. C.

A manual for the identification of grasses in the United States.

Holle, C. G., 1952. "Sedimentation at the Mouth of the Mississippi River," Conference on Coastal Engineering Proceedings 2d. National Council on Marine Resources and Engineering Division. Government Printing Office; Washington, D. C.

Huang, Ter-Chien, 1970. "Sediments and Sedimentary Processes of Eastern Mississippi Cone, Gulf of Mexico," American Association of Petroleum Geologists; Tulsa, Oklahoma.

Humm, H. J., 1956. "Sea Grasses of the Northern Gulf Coast," Maritime Science Gulf and Caribbean Bulletin. National Council on Marine Resources and Engineering Division. Government Printing Office; Washington, D. C.

Hurley, P. M., et al., 1961. "K-Anage Studies of Mississippi and Other River Sediments," Bulletin 72. Geological Society of America; Boulder, Colorado.

Huston, John, P. E., 1970. Hydraulic Dredging, Theoretical and Applied. Cornell Maritime Press, Inc.; Cambridge, Maryland.

Johns, W., and Grim, 1958. "Clay Mineral Composition of Recent Sediments from the Mississippi River Delta," Journal of Sediment Petrology, Volume 28.

Johnson, B. H., 1974. "Investigation of Mathematical Models for the Physical Fate Prediction of Dredged Material," Technical Report, D-74-1. United States Army Corps of Engineers, Waterways Experiment Station; Vicksburg, Mississippi.

Jones, Paul H., 1970. "Hydrology of Quaternary Delta Deposits of the Mississippi River," Symposium on the Hydrology of Deltas, V. 1; United Nations Educational, Scientific, and Cultural Organization, Studies and Reports in Hydrology No. 9; New York, New York.

Quaternary delta deposits on the Mississippi River, together with interbedded marine sediments, have a cumulative maximum thickness greater than 13,000 of which the delta deposits are about half. The deltaic mass contains almost no fresh groundwater, due to the expulsion of saline H_2O's from deltaic sediments having a common framework and parent trunk-stream source. Discharge of H_2O is continuing as the delta grows and causes landward movements of saline ground water, threatening existing fresh H_2O supplies.

Keeley, J. W. and Engler, R. M., 1974. Discussion of Regulatory Criteria for Ocean Disposal of Dredged Materials: Elutriate Test Rationale and Implementation Guidelines, Miscellaneous Paper, D-74-14. United States Army Engineer Waterways Experiment Station, Office of Dredged Material Research; Vicksburg, Mississippi.

Kill, Charles R., and Van Lopik, 1966. "Depositional Environments of the Mississippi River Deltaic Plain - Southeast Louisiana," Deltas in Their Geologic Framework. Houston Geologic Society; Houston, Texas.

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Kolb, C. R., Geological Aspects of Control of Mississippi-Atchafalaya Diversion in Engineering Geological Case Histories, V. 2. Geological Society of America; Boulder, Colorado.

Koll, Charles R., 1963. Sediments Forming the Bed and Banks of the Lower Mississippi River and Their Effect on River Migration, Sedimentology, Volume 2.

Physiographic features and depositional history of the sediments forming the bed and banks of the lower 200 miles of the Mississippi River are summarized. River migration is also studied.

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Krumbein, W. C., 1939. Tidal Lagoon Sediments on the Mississippi Delta in Recent Marine Sediments. American Association of Petroleum Geologists. Tulsa, Oklahoma.

Lankford, Robert R., 1959. Distribution and Ecology of Forminifera from East Mississippi Delta Margin. American Association of Petroleum, Geologists. Tulsa, Oklahoma.

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Lankford, Robert. "Facies Interpretations in Mississippi Delta Borings," Journal of Geology, Volume 68(4). University of Chicago; Chicago, Illinois.

Lawson, Andrew C., 1942. "Mississippi Delta, A Study in Isostasy," Bulletin 53(8). Geological Society of America; Boulder; Colorado.

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Lemaire, Robert, 1961. A preliminary annotated checklist of the vascular plants of the marshes and included higher lands of St. Bernard Parish, Louisiana, Proceedings of the Louisiana Academy of Science. Louisiana State University; Baton Rouge, Louisiana.

A listing of vascular plants of the marshes compiled by Lemaire for St. Bernard Parish, Louisiana.

Lloyd, Francis E. and Tracy, S. M., 1901. "The Insular Flora of Mississippi and Louisiana," Bulletin of the Torrey Botanical Club.

A brief report on the vegetation of the islands of Mississippi and Louisiana.

Louisiana Advisory Commission on Coastal and Marine Resources, 1973. Louisiana Wetland Prospectus. Louisiana Office of State Planning and Louisiana State University Center for Wetland Resources; Baton Rouge, Louisiana.

The study assesses the need for coastal zone management in Louisiana.

Louisiana Department of Conservation, 1972. Louisiana Annual Oil and Gas Report 1972. Baton Rouge, Louisiana.

The publication is a computation of oil and natural gas production by field for 1972 within Louisiana.

Louisiana Department of Conservation, 1973. Summary of Field Statistics and Drilling Operations Louisiana 1973. Baton Rouge, Louisiana.

The summary includes lists of fields by parishes and appropriate statistics, drilling operations report in 1973, a salt water disposal report, a miscellaneous well report and waste disposal well data.

Louisiana Bureau of Environmental Health, 1964. Louisiana Oyster Water Survey, Growing Area I - Coastal Marshes, St. Bernard Parish. Baton Rouge, Louisiana.

A comprehensive report on the data collected from surveys of the Louisiana shellfish growing waters.

Louisiana Congress. Draft of Proposed Coastal Commission Legislation. Revisions of R. S. 34:2251-2255. (Lacks necessary information for complete reference.)

Louisiana Department of Highways, 1973. Action Plan for Consideration of the Social, Economic and Environmental Effects of Highways. Baton Rouge, Louisiana.

Louisiana Department of Public Works, 1971. Drainage Area of Louisiana Streams, Basic Records, Report Number 6. Baton Rouge, Louisiana.

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Louisiana State Parks and Recreation Commission, 1971. State of Louisiana Comprehensive Outdoor Recreation Plan - 1970-1975. Baton Rouge, Louisiana.

This document identifies the present and future needs for outdoor recreation in Louisiana and recommends ways and means of meeting these needs.

Louisiana Stream Control Commission, 1973. State of Louisiana Water Quality Criteria, Baton Rouge, Louisiana.

Louisiana Wildlife and Fisheries Commission, 1971. Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana, Phase 1 - Area Description, Phase II - Hydrology, Phase III - Sedimentology, Phase IV - Biology. United States Government Printing Office; Washington, D. C.

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This document includes state legislation and administrative procedures used for the maintenance of Louisiana's natural and scenic streams.

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Lowery, George H., Jr., 1974. The Mammals of Louisiana and Its Adjacent Waters. Louisiana State University Press; Baton Rouge, Louisiana.

A brief summary on the mammals and their Louisiana habitat, histories, and habits.

Ludwick, J. C., 1964. "Sediments in Northeast Gulf of Mexico," Papers in Marine Geology. Shepard Communications; McMillan Co.; New York, New York.

Mackin, J. G., 1959. "Canal Dredging and Silting in Louisiana Bays," Contributions in Marine Science, Volume 7. Texas A & M Research Foundation Marine Laboratory; College Station, Texas.

The effects of dredging on oysters were studied in shallow bays of Louisiana and discussed relative to the normally high turbidities of an eroding marsh area.

Maphis, 1974. Personal communication, Bureau of Environmental Health. Topic - Mr. Maphis called to give water quality data on coliform counts in the Mississippi River - Gulf Outlet. New Orleans, Louisiana.

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A guide to wildlife food habits, the use of trees, shrubs, weeds, and herbs by birds and mammals of the United States.

McAlleland, B., 1967. "Heavy Foundations in Underconsolidated Interdistributary Clays of the Lower Mississippi Delta." Geological Society of America, annual meeting; Tulsa, Oklahoma.

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McCammon, Richard B., 1972. "Map Pattern Reconstruction from Sample Data: Mississippi Delta Region of Southeast Louisiana," Journal of Sediment Petrology.

McFarlan, Edward, 1961. "Radiocarbon Dating of Late Quaternary Deposits, Southern Louisiana," Bulletin, Volume 72. Geological Society of America; Boulder, Colorado.

Montz, Glen, 1972. "A Seasonal Study of the Vegetation on Levees," Castanea. Southern Appalachian Botanical Club; Morgantown, West Virginia.

The frequency and percent composition of plants was determined on levees in East St. Charles Parish. Field notes indicate oernal, estival and autumnal flowering periods in the area.

Moore, G. T., 1970. "Role of Salt Wedge in Bar-finger Sand and Delta Development," Bulletin, Volume 54. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Morgan, J. P., 1952. "Mudlumps at the Mouths of the Mississippi River," Conference on Coastal Engineering Processes.

Morgan and Treadwell, 1954. "Cemented Sandstone slabs of the Chandeleur Islands, Louisiana," Journal of Sediment Petrology.

Morgan. J. P., 1961. "Mudlumps at the Mouth of the Mississippi River," (in) Genesis and Paleontology of the Mississippi River Mudlumps. Louisiana Department of Conservation Geological Bulletin, No. 35; Baton Rouge, Louisiana.

The physiography, sedimentary nature, structural characteristics, and developmental history of mudlump islands are discussed. An attempt is made to predict future mudlump activity at the mouths of passes affected by this phenomenon.

Mudlumps are upswellings of plastic clay which occur just beyond the mouths of Mississippi River passes. Localized forces, arising from the static pressure of accumulating sedimentary deposits, are relieved through the upwarping of near-surface sediments. Though often exhibiting several periods of uplift, individual mudlump islands are temporary features, either being recovered by wave erosion in a few years or else becoming incorporated into marshland.

Morgan, James P., Coleman and Gagliano, 1963. "Mudlumps at the Mouth of South Pass, Mississippi River," Sediment, Paleontology, Structure, Origin and Relation to Deltaic Processes. Louisiana State University; Baton Rouge, Louisiana.

The purposes of this study are a more complete understanding of the geomorphic history of mudlumps, their distribution at the South Pass and their relationship to Deltaic sediments, establishment of late Quaternary stratification sequence of the mouth of South Pass; and the interpretation of structural origin and history of mudlumps. A drilling and core recovery program was undertaken and the cores are analyzed for such elements as grain size, clay material, carbonate, and faunal content. The mudlumps origin and history is discussed in detail.

Morgan, J. P., Coleman, J. R., and Gagliano, S. M., 1968. "Mudlumps; Diapiric Structures in Mississippi River Delta Sediments," Diapirism and Diapirs. American Association of Petroleum Geologists; Tulsa, Oklahoma.

The stratigraphy and structure of mudlumps at the South Pass mouth have been studied by means of a drilling and coring program. The information obtained establishes the relationship between older shelf and prodeltaic river deposits and younger, progradational delta-front and river-mouth bar sediments.

Mudlumps are interpreted as the near-surface expressions of the diapiric intrusion of older shelf and prodelta clays into and through overlying bar deposits. In new mudlumps, there are surface exposure of shelf deposits uplifted and thrust from depths of more than 350 feet.

Rapid deposition of thick, localized masses of heavier bar sediments directly upon lighter, plastic clays leads to instability which is relieved by diapiric intrusion of the clay with the resulting formation of mudlumps.

Morgan, J. P., editor, 1970. Deltaic Sediment: Modern and Ancient, Special Publication #15, SPEM; Tulsa, Oklahoma.

Proceedings of a symposium on deltaic sediment - a basic reference in the subject. See especially Gould article on Mississippi Delta Complex, Morgan article on depositional processes in deltas, Curtis on Miocene deltaic sediment.

Morgan, James P., 1971. "Quaternary Geology of the Louisiana Continental Shelf," Technical Report 3. Department of Geology, Louisiana State University; Baton Rouge, Louisiana.

Morgan, James P., "Depositional Processes and Products in the Deltaic Environment," in Deltaic Sediment, Modern and Ancient, SEPM Special Paper 15; Tulsa, Oklahoma

Factors controlling depositional processes and products are analyzed for 3 major river delta systems; these 3 have developed varied geomorphic forms. Four basic factors are found to control and influence delta formation 1) river regime-particle size and quantity of materials, 2) coastal processes - waves, tides and current, 3) structural behavior and relation of sea level to depositional site, 4) climatic factors, especially those affecting vegetation. Mississippi River Delta is not affected by 2.

Murphy, W. L., and Neigler, T. W., 1974. Practices and Problems in the Confinement of Dredged Material in Corps of Engineers Projects, Technical Report D-74-2. Department of the Army Corps of Engineers, Waterways Experiment Station, Soils and Pavements Laboratory; Vicksburg, Mississippi.

Murray, G. E., 1960. "Geologic Framework of Gulf Coastal Province of United States," Recent Sediments, Northwest Gulf of Mexico. American Association of Petroleum Geologists; Tulsa, Oklahoma.

The Gulf Coastal province of the U. S. is a segment of the Mesozoic-Cenozoic coastal geosyncline of eastern North America which can be traced continuously from Newfoundland to Guatemala. The Gulf Coastal portion of the geosyncline has an area of more than 150,000 sq. miles.

Strata of the Gulf geosyncline possess general gulfward slope and constitute a great sedimentary structural arc from Florida to Mexico.

Stratigraphic studies indicate that major sedimentary units are arranged in belts subparallel to the modern northern shoreline of the Gulf of Mexico. During the Jurassic and Cretaceous time the major source of sediments for the region was apparently eastern and central U. S. In the Cenozoic, much material has come from western U. S.

National Technical Advisory Committee to the Secretary of the Interior, 1968. Water Quality Criteria; Washington, D. C.

National Water Commission, 1973. Water Policies for the Future. Final Report to the President and to the Congress of the United States; Washington, D. C.

Newton, O. H., 1964. "Dew in the Mississippi Delta in the Fall," Monthly Weather Review. Government Printing Office; Washington, D. C.

Norman, William. "Clay Mineral Zonation; a Key to Recent Deltaic Chronology," Quaternary Geology of Louisiana Continental Shelf.

Office of State Planning, Office of the Governor, 1973. Louisiana Planning Directory, 1973. Baton Rouge, Louisiana.

O'Neill, T., 1931. An Ecological Study of the Cypress Tupelo Community. Masters Thesis, Tulane University; New Orleans, Louisiana.

O'Neill, T., 1949. "The Muskrat in the Louisiana Coastal Marshes," Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana. Louisiana Wild Life and Fisheries Commission, publication; New Orleans, Louisiana.

Orr, Donald G., and Quick, James R., 1974. "Construction Materials in Delta Areas," Photogrammetric Engineering. American Society of Photogrammetry; Falls Church, Virginia.

Procedures for identifying likely sources of materials for engineering construction with multispectral remote sensor are applied to a part of the Mississippi Delta. The highest potential sources of construction materials in this area were within the cheniers, point bars, river bars and active beaches. Color infrared photos are preferred to detailed analysis in delta environment.

Palmisano, A. W., 1970. Plant Community - Soil Relationships in Louisiana Coastal Marshes. Unpublished dissertation, Louisiana State University; Baton Rouge, Louisiana.

This study was undertaken to determine the basic ecological factors influencing the distribution of marsh plants in coastal Louisiana.

Regression analysis was used to interpret the effects of salinity on seed germination. Salinity significantly reduced the germination and growth of all species tested except Sesuvium portulacastrum. Salinity also significantly affected plant growth.

Field studies consisted of a systematic sampling of the vegetation, soils and water of coastal Louisiana. Saline marsh communities, brackish marshes, and fresh marshes were compared on the bases of extractable nutrients, water and soil salinity, plant growth, and organic matter. Brackish marshes were found to be ideal for rapid plant and animal growth.

Palmisano, A. W., 1971. Quoted in Report on *Gulf Coast Deep Water Port Facilities, Texas, Louisiana, Mississippi, Alabama, and Florida*, Appendix F, Volume II of V. Department of the Army, Corps of Engineers; New Orleans, Louisiana.

See Gulf Coast Report for annotation.

Palmisano, A. W. and Chabreck, R. H., 1972. *The Relationship of Plant Communities and Soils of the Louisiana Coastal Marshes*. Department of Wildlife and Fisheries; New Orleans, Louisiana.

Parker, R. H., 1956. "Macro-invertebra Assemblages as Indicators of Sedimentary Environments in East Mississippi Delta Region," Bulletin 40:295-376. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Parker, Robert H., "Ecology and Distributional Patterns of Marine Macroinverts, North Gulf Mexico," *Recent Sediments Northwest Gulf of Mexico*.

Eleven macrofaunal assemblages are recognized in lagoons and estuaries along the north coast of the Gulf. Which type is present is varied climatically. The purpose of this paper is to assess the relationship of the sediments. One of the areas given detailed study is the Mississippi River Delta.

Pearse, A. S., 1936. *The Migration of Animals from Sea to Land*. Duke University Press; Durham, North Carolina.

The origin of life, the sea as the original home of life, and a comparison of ocean, freshwater, and land habitats are discussed in this book on migrations of animals from land to sea.

The routes taken by animals in this migration, causes of migrations (including salinity toleration ranges of animals), and physical changes in land animals which have migrated from sea to land are also discussed.

Pearse, A. S., 1950. *The Emigrations of Animals from the Sea*. Sherwood Press, Dryden, New York.

The emigrations of animals from sea to land are considered in detail; the routes followed; the reasons the animals left the dependable, stable, ocean for a precarious life on land; the changes that have taken place in the structures and functions of the animals that have adjusted their systems of activities to land life; and the successes of those animals that have progressed to land environments.

Penfound, W. T., and Hathaway, E. S., 1938. "Plant Communities in the Marshland of Southeastern Louisiana," Ecology Monographs. Duke University Press; Durham, North Carolina.

The article inspects a considerable number of marsh areas in the southern part of Louisiana and reports data collected on a monthly routine on marsh habitats outside of New Orleans.

Perrett, W. S. et. al., 1971. Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana. Phase I, Area Description and Phase IV, Biology. Louisiana Wildlife and Fisheries Commission; New Orleans, Louisiana.

The study measured salinity and water temperature, dissolved oxygen, turbidity, various nutrients, tide, barometric pressure, rainfall, and wind speed and direction for data on determining the characteristics of Louisiana marshlands.

Perrett, C., May 7, 1974, personal communication. Director of Division of Oysters, Water Bottoms and Seafoods. Topic-Area hydrology, water quality maps of oyster leases and sensitive areas. Louisiana Wildlife and Fisheries Commission; New Orleans, Louisiana.

Peterson, Roger Tory, 1959. A Field Guide to the Birds. The Riverside Press Cambridge, Houghton Mifflin Company; Boston, Massachusetts.

A field identification book for birds, their habits, range, habitat, etc.

Phleger, Fred, 1955. "Ecology of Foramnifers in Southeast Mississippi Delta Area," Bulletin 39(5):712-52. Association of American Petroleum Geologists; Tulsa, Oklahoma.

Pollard, J. F., 1973. "Experiments to Re-Establish Historical Oyster Seed Grounds and to Control the Oyster Drill," Technical Bulletin Number 6. Louisiana Wild Life and Fisheries Commission; New Orleans, Louisiana.

Pontius, Uwe R., Pavia, Edgar H., and Crowder, Donald G., 1973. Hypochlorination of Polluted Stormwater Pumpage at New Orleans, Project #11023 FAS. Prepared by Research and Development Representative, Region VI, EPA for Office of Research and Development, EPA; Washington, D. C.

The report demonstrates the feasibility of reducing total coliform and fecal coliform levels in large volumes of storm water by chemical disinfection and the effectiveness of using open channels as treatment facilities.

Port of New Orleans Annual Directory, 1974. Centroport; New Orleans, Louisiana.

Price, W. A. "Environment and Formation of the Chenier Plain," Quaternaria, Volume 2.

Defines strand plains, concentrating on the chenier plain variety.

Rae, K. M., 1961. "Hydrological and Biological Studies of the Mississippi River - Gulf Outlet Project," Texas A&M Final Report. Texas A&M University; College Station, Texas.

Ragan, James G., 1972. "Infection of Brown Shrimp, Penaeus aztecus Ives by Prochristianella benali Kruse in Southeast Louisiana Bays," Transactions American Fish Society; Washington, D. C.

The plerocercus was found to be a common parasite of Penaeus aztecus and setiferus. The cestode was found in 42 percent of 971 subadulta; P. aztecus taken from different estuaries. Shrimp drawn from various parts of an estuary are found to show differences in infection. Infection patterns are discussed relative to the ecology of the sampled area and habits of hosts in the life cycle.

Rainwater, E. H., 1972. "Petroleum in Deltaic Sediments," Mineral Fuels, Section 5, International Geological Congress, Proceedings. Congress Geological International, Program #24.

Ray, Pulak, 1972. "Variability and Genesis of Sediment Structure of Mississippi River Bar (Plaquemine Pt., Louisiana)," Doctoral thesis, Louisiana State University; Baton Rouge, Louisiana.

Regional Planning Commission, 1973. Interim Land Use Plan. Regional Planning Commission for Jefferson, Orleans, St. Bernard, and St. Tammany Parishes; New Orleans, Louisiana.

The Interim Land Use Plan provides a general functional distribution of basic land uses, allowing for current review and testing in the preparation of the Regional Comprehensive Plan.

Reikenis, R., Elias, V., and Drabkowski, E. F., 1974. Regional Landfill and Construction Material Needs in Terms of Dredged Material Characteristics and Availability, Volume 1 - Main Text, Volume 2 - Appendices A, B, C, and D. Prepared for United States Army, Corps of Engineers, Waterways Experiment Station; Vicksburg, Mississippi. Prepared by Green Associates, Inc.; Lawson, Maryland.

Richards, Horace G., 1954. "Mollusks from the Mississippi Delta," Notulae Naturae. Academy of Natural Sciences of Philadelphia; Philadelphia, Pennsylvania.

Riley, J. A., 1960. "Climate of the Delta Area of Mississippi," Mississippi Agricultural Experiment Station, State College, Bulletin #605. Texas A&M University; College Station, Texas.

Study of long-term weather trends includes data on precipitation, temperature, sunlight, evaporation, relative humidity, winds. Includes data on trend and average of tropical storms, discusses the changing climate of the delta.

Ritchie, William, 1972. "A Preliminary Study of the Distribution and Morphology of the Caminada/Moreau Sand Ridges." Southeast Geology 14(2):113-25.

Robbins, Chandler S., Bruum, Bertel, and Zim, Herbert S., 1966. Birds of North America. Golden Press; New York, New York.

A guide to field identification of birds in North America.

Rochester Regional Group of the Sierra Club, 1972. Rochester Harbor Dredging Study, Final Report. Rochester, New York.

Roibmayr, Charles M. "Seasonal Occurrence of Brevoortia patronus in the Northern Half of Mexico," Transactions of American Fisheries Society. Washington, D. C.

A study of the occurrence of large-scale menhaden winter on the inner and middle continental shelf area near the Delta.

Rollo, J. R., 1960. "Groundwater in Louisiana," Louisiana Department of Public Works and Louisiana Conservation, Geological Survey, Water Resources Bulletin; Baton Rouge, Louisiana.

Rollo, J. R., 1966. "Ground-Water Resources of the Greater New Orleans Area," Louisiana Water Resources, Bulletin No. 9. Department of Conservation and Louisiana Department of Public Works; Baton Rouge, Louisiana.

The report is one of a series whose general purpose is to evaluate the groundwater resources of the greater New Orleans Area. Specifically, the report evaluates the "700-foot" sand aquifer and its potential of meeting future demands for ground water.

Rowe, D. Z., 1971. "Dieldrin and Endrin Concentrations in a Louisiana Estuary," Pesticides Monitoring Journal.

Objective was to determine the endrin and dieldrin concentration in H_2O, bottom sediment, and oysters in an estuarine area of Louisiana. Minimum d and e concentrations in oysters was 1-1.3 ppb and maximum was 2.4-3.4. Highest level of diel in bottom sediments - 4 ppb H_2O samples <1.

Russell, Richard J., 1936. "Physiography of the Lower Mississippi River Delta," Louisiana Department of Conservation Geological Bulletin. New Orleans, Louisiana.

Russell, Richard J., 1939. "Mississippi River Delta Sedimentation," Recent Marine Sediments, American Association of Petroleum Geologists. Tulsa, Oklahoma.

Russell, Richard J., 1940. "Quaternary History of Louisiana," Bulletin Volume 51. Geological Society of America. Boulder, Colorado.

Russell, Richard J., and Fisk, 1942. "Isostatic Effects of Mississippi River Delta Sedimentation," International Association of Geology, General Assembly.

Sakou, T., 1963. "Salinity Regime and Exchange Characteristics of a Shallow Coast Bay System," Technical Report 63-21T. Department of Oceanography, Texas A&M University; College Station, Texas.

Data from prototype and hydraulic model observations for the Lake Pontchartrain and Lake Borgne system have been used in the analysis of the salinity regime and exchange characteristics.

Saucier, Roger T., 1963. "Recent Geomorphic History of the Pontchartrain Basin," Louisiana State University, Baton Rouge, Louisiana.

Interprets the basin's history based on geomorphic and archeological evidence. A study of the effects of Mississippi River crevasses on the basin indicates that the river has not been a significant source of sediment for the past 1,200 years. Now that the river is artifically controlled, subsidence and erosion will continue to overbalance sediment and the basin area, and other abandoned deltaic areas will continue to deteriorate.

Sauer, V. B., 1967. "Unit Hydrographs for Southeastern Louisiana and Southwest Mississippi," Technical Report. Department of Public Works; Baton Rouge, Louisiana.

Schmidt, Gene W., 1973. "Interstitial H_2O Composition and Geochemistry of Deep Gulf Coast Shales and Sandstones," American Association of Petroleum Geologists; Tulsa, Oklahoma.

Scott, A. J., and Fisher. "Introduction to Delta Systems and Deltaic Deposition," Delta Systems in the Exploration for Oil and Gas. University of Texas; Austin, Texas.

Examines basic concepts of depositional systems and classifies modern and ancient delta systems according to stratigraphy. Also covers basic types and patterns of delta facies and systems recognizable in ancient basin fills.

Scrubon, P. C., 1960. "Delta Building and the Deltaic Sequence," in Recent Sediments, Northwest Gulf of Mexico. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Scruton, P. C., and Moore, D. G., 1953. "Distribution of Surface Turbidity of Mississippi Delta," Bulletin, Volume 34. American Association Petroleum Geologists; Tulsa, Oklahoma.

Aerial and boat observations for determining the distribution of turbidity were made in Breton Sound and the Main Pass and Pass La Loutre. These observations showed great quantities of suspended sediment in the water close inshore. The amount of material in suspension, controlled chiefly by volume of river flow and distance from source, in general decreases to a small value a few miles offshore, but under certain conditions turbid water extends to sea for distances of at least 65 miles as long plumes off the mouths of the important passes. The intensity of surface turbidity generally can be correlated with the rate of deposition in any area.

Scruton, P. C., 1956. "Oceanography of Mississippi Delta Sedimentary Environments," Bulletin, Volume 40. American Association of Petroleum Geologists; Tulsa, Oklahoma.

The currents, waves, salt content, temperature, and suspended sediment of the delta are considered and related to one another.

Regional or semipermanent currents are produced by winds blowing over the Gulf and by regional density differences acted upon by gravity. In addition, there are local currents produced by tides, winds, and river discharge. Tidal currents affect the entire water column.

Data on average monthly winds and river discharges can be used to estimate river water and sediment distribution seaward in the Gulf. The amount of sediment delivered to the Gulf is huge but unknown.

Waves in the Gulf are small, and the largest occur seasonally.

The delta oceanography is the sum of the effects of the Gulf, river and atmosphere. These elements combine to create a complex natural sedimentation system.

Sever, Julia R., et al, 1972. "Lipid Geochemistry of a Mississippi Coastal Bog Environment," Contributions to Marine Science. National Council on Marine Resources and Engineering Division. Government Printing Office; Washington, D. C.

The lipid composition of a group of primitive higher plants was investigated from an organic geochemistry point of view.

Shaw, Samual P., and Fredine, Gordon C., 1971. "Wetlands of the United States," Circular 39, Fish and Wildlife Service. United States Department of the Interior; Washington, D. C.

A summary classification of wetland types.

Shepard, F. P., 1956. "Marginal Sediments of the Mississippi Delta," American Association of Petroleum Geologist. Tulsa, Oklahoma.

Shepard, Francis P., and Lankford, 1959. "Sediment Facies from Shallow Borings in Lower Mississippi Delta," Bulletin 43. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Shepard, F. P., 1960. "Gulf Coast Barriers," Recent Sediments, Northwest Gulf of Mexico. American Association Petroleum Geologists; Tulsa, Oklahoma.

The barriers which skirt the greater part of the northern Gulf Coast constitute sand bodies with widths up to several miles and thicknesses of 20 to 60 feet. Sand bodies are usually bordered on both sides by muddy sediments. Large barriers usually have at least four facies - beaches, dune belts, barrier flats or marshes, and inlets. Each has distinctive sediment characteristics. The barrier islands have formed either during or since the rise in sea level at the end of the last glacial epoch. The source of sand necessary to maintain the barriers is to a great extent the sand deposits of the continental shelf.

The purpose of this paper is to attempt to coordinate information on Texas and Louisiana coastal areas with data from other barriers, particularly from those east of the Mississippi Delta.

Shepard, F. P., "Delta-front Valleys Bordering the Mississippi Distributaries," GSA Bulletin, Volume 66. Geological Society of America; Boulder, Colorado.

Shallow discontinuous valleys crease the upper part of the continental slopes to the region of the shelf of the Mississippi Delta. Mass movements of the earthflow type appear to be the cause of the valleys rather than turbidity currents.

Shlemon, R. J., 1973. "Atchafalaya Bay, Louisiana: Regional Subsidence and Contemporary Delta Formation," American Association of Petroleum Geologists, Bulletin 57. Tulsa, Oklahoma.

Simmons, Ernest G., and Thomas, W. H., 1962. "Phytoplankton of the East Mississippi Delta," Institute of Marine Science Publication, University of Texas; Austin, Texas.

A study of phytoplankton samples gathered from 100 stations ranging from fresh to sea water from 6-55 through 5-57.

Simmons, 1972. Quoted in Report on Gulf Coast Deep Water Port Facilities, Texas, Louisiana, Mississippi, Alabama, and Florida, Appendix F, Volume II of V. Department of the Army, Corps of Engineers; New Orleans, Louisiana.

See Gulf Coast report for annotation.

Sloss, R., 1971. "Drainage Area of Louisiana Streams," Basic Records Report #6. Louisiana Department of Public Works; Baton Rouge, Louisiana.

Smith, Robert Leo, 1966. Ecology and Field Biology. Harper and Row Publishers; New York and London.

Snowden, J. O., 1971. "Chemical Water Quality and Sediment - H_2O Reactions in Louisiana and Mississippi Estuaries," National Coastal Shallow Water Resource Conference Abstract.

Soras Associates. Evaluation of Offshore Terminal System Concepts. Department of Commerce, Maritime Administration; Washington, D. C.

Springer, V. G., and Woodburn, K. Dl, 1960. "An Ecological Study of the Fishes of the Tampa Bay Area," Professional Papers No. 1. Florida State Board of Conservation; Tallahassee, Florida.

St. Amant, Lyle S., 1959. Louisiana Wildlife Inventory and Management Plan. Louisiana Wild Life and Fisheries Commission; New Orleans, Louisiana.

Stanton, Robert J., 1972. "Community Structures and Sampling Requirements in Paleocology," Journal of Paleocology.

Defines 10 communities of Mollusca, Mississippi Region.

Sullivan, Joseph G., 1974, personal communication. General Superintendent, New Orleans Sewage and Water Board; Topic - New Orleans storm water run-off and pumping station; New Orleans, Louisiana.

Swanson, R. L., 1973. "Recent Subsidence Rates Along the Texas and Louisiana Coasts as Determined from Tide Measurements," Journal of Geophysical Research. American Geophysical Union; Washington, D. C.

Taggert, M. S., and Kaiser, 1960. "Clay Mineralology of Mississippi River Deltaic Sediments," Bulletin 71.521-30. Geological Society of America; Boulder, Colorado.

Thieret, John W., 1972. "Aquatic and Marsh Plants of Louisiana, a Checklist," Louisiana Society for Horticultural Research Journal. University of Southwestern Louisiana; Lafayette, Louisiana.

Compilation of vascular plant listings, both herbaceous and woody species.

Thomann, Gary C., 1973. "Remote Measurement of Salinity in an Estuarine Environment," in Remote Sensing of Earth Resources, Volume II. Privately published, Tullahoma, Tennessee.

Thomas, William H. and Simmons, 1960. "Phytoplankton Production in the Mississippi Delta," Recent Sediments, Northwest Gulf of Mexico. American Association of Petroleum Geologists; Tulsa, Oklahoma.

At 138 stations, located inshore in the east Mississippi delta, area measurements were made of phytoplankton productions chlorinity, temperature, etc. Some conclusions drawn: 1) surface phytoplankton production of the delta is less than that of tropical or subtropical areas, 2) surface production can vary as much as 7 fold from day to day, 3) there were no overall statistical differences between river plume and gulf areas at any given season, 4) in May with high river discharge, surface production seaward is less than in fall, 5) calculations of rate of sedimentation of organic carbon of the delta were compared to phytoplankton production.

Todd, Thomas W., 1968. "Dynamic Diversion-Influence of Longshore Current-Tidal Flow Interaction on Chenier and Barrier Island Plains," Journal of Sedimentary Petrology.

Towbridge, A. C., 1930. "Building of the Mississippi Delta," Volume 14. American Association of Petroleum Geologists; Tulsa, Oklahoma.

Treadwell, R. C., 1955. "Sediment and Ecology of Southeast Coastal Louisiana," CSI Technical Report 6.

Trabant, Peter et al, 1972. "High Resolution Subbottom Profiles and Sediment Characteristics of the Mississippi Delta," Gulf Coast Association of Geological Society Transactions.

Traver, Johnnie W. and Dugas, Ronald J., 1973. "Experimental Oyster Transplanting in Louisiana," Technical Bulletin 7. Presented at the Spring meeting of the Gulf States Marine Fisheries Commission; Tampa, Florida.

Traver, Johnnie W., 1973. "Occurrence, Distribution, and Density of Rangia cuneata in Lakes Pontchartrain and Maurepas, Louisiana," Technical Bulletin Number 1. Presented at the Fall meeting of the Gulf States Marine Fisheries Commission; New Orleans, Louisiana.

Traver, Johnnie W. and Dugas, Ronald J., 1973. "A Study of the Clam, Rangia cuneata, in Lake Pontchartrain and Lake Maurepas, Louisiana," Technical Bulletin 5. Louisiana Wild Life and Fisheries Commission; New Orleans, Louisiana.

United States Department of Commerce, Maritime Administration, 1965. *United States Seaports, Gulf Coast*, United States Government Printing Office; Washington, D. C.

United States Department of Commerce, 1970. *General and Social Economic Characteristics, Louisiana*. Bureau of the Census; Washington, D. C.

Date includes population, income, and employment statistics for the United States and protectorates.

United States Department of Commerce, 1970. *General Population Statistics*. Bureau of the Census; Washington, D. C.

Report includes statistics on population and family characteristics.

United States Department of Commerce, 1972. Series E, *OBERS Projections, Economic Activity in the United States by Economic Area, Water Resources Regions and Subarea*, and *State Historical, and Projected - 1929-2020*. Bureau of Economic Analysis; Washington, D. C.

Projections are based on population, income, employment and past trends and projections.

United States Department of Commerce, Bureau of Economic Analysis (OBE), 1974. *Summary Population Projections for Standard Metropolitan Statistical Areas* (SMSAs) Extracted from the *OBERS Series "E" Population Projections*; Washington, D. C.

Summary of employment and income for standard metropolitan areas.

United States Environmental Protection Agency, Office of Air and Water Programs, Water Quality and Non-Point Source Control
A Division, 1973. *Identification and Control of Pollution from Salt Water Intrusion*. United States Government Printing Office; Washington, D. C.

The report contains informational guidelines for identifying and evaluating the nature and extent of pollution from salt water intrusion.

United States Environmental Protection Agency, 1973. *Proposed Criteria for Water Quality*, Vol. 1. Government Printing
B Office; Washington, D. C.

United States Department of the Interior, Bureau of Sport Fisheries and Wildlife, Bureau of Commercial Fisheries, 1970. National Estuary Study, Volume 1 - Main Report, Volume 3 - Appendix B - Management Studies in Specific Estuaries, Volume 4 - Appendix C - Additional Support Data for Biophysical Profiles, Volume 5 - Appendix E - Some Economic Factors Affecting the Estuarine Zone Including Market Outlooks for Selected Products. United States Government Printing Office; Washington, D. C.

United States Department of the Interior, 1970. Catalog of Information on Water Data: Index to Areal Investigations and Miscellaneous Water Data Activities. United States Geological Survey, Office of Water Data Coordination; Washington, D. C.

United States Department of the Interior, 1972. Catalog of Information of Water Data, United States Geological Survey, Office of Water Data Coordination; Washington, D. C.

United States Department of the Interior, 1973. Threatened Wildlife of the United States. Bureau of Sport Fisheries and Wildlife, Resource Publication 34. New Orleans, Louisiana.

This publication presents data on the status of species or subspecies of vertebrates whose existence is threatened in the United States, the District of Columbia, Virgin Islands, and the Commonwealth of Puerto Rico.

United States Department of the Interior, Bureau of Land Management, 1974. Draft Environmental Statement Proposed 1974 Outer Continental Shelf, Oil and Gas General Lease Sale, Offshore Louisiana, Volume 1 and 2. National Technical Information Service; Washington D. C.

University of Texas, 1968. Delta Systems in the Exploration for Oil and Gas. Departments of Economics and Geology; Austin, Texas.

A collection of articles on basic delta systems and deposition. Lengthy consideration is given to Gulf Coast tertiary delta and North Texas Panhandle delta; other oil-bearing deltas are also discussed. See Scott and Fisher, p. 10-29 and Fisher and Brown, 54-66.

Valentine, J. M., Jr., 1968. The Vegetation of Upper Plaquemines and St. Bernard Parishes (Mimeograph). Department of the Interior, Bureau of Sport Fisheries and Wildlife; Washington, D. C.

Van Andel, T. H. and Poole, 1960. "Sources of Recent Sediments in the Northern Gulf of Mexico," Journal of Sedimentary Petrology.

Van Lopik, 1955. "Recent Geology and Geomorphic History of Central Coastal Louisiana," Louisiana Technical Report 7.

Walker, J. R. and Massingill, J. O., 1970. "Slump Features on the Mississippi Fan, Northeast Gulf of Mexico," Volume 81. Geological Society of America; Tulsa, Oklahoma.

Wallace, McHarg, Roberts, and Todd, 1973. Pontchartrain, New Town in Town - New Orleans, Louisiana. Volumes 1, 2, 4, 10; Additional Volumes: Environmental Supplement Report and Environmental Management Plan. Authors assisted by the Coastal Resource Unit, Center for Wetland Resources, Louisiana State University; Baton Rouge, Louisiana.

The 10 volumes include an ecological planning study of a 32,090 acre tract of land for the proposed 8,400 acre New Town.

Welder, F. A., 1959. Processes of Deltaic Sedimentation in the Lower Mississippi River, Louisiana State University Coastal Studies, Technical Report 12. Louisiana State University; Baton Rouge, Louisiana.

This text explains the processes in the development of the Mississippi River Delta. The initial portion of the report is essentially a physiographic description while the latter part deals with principles and processes of deltaic sedimentation.

Welsh, W. W. and Breder, C. M., Jr., 1923. Contributions of the Life Histories of Sciaenidae of the Eastern United States Coast. United States Bureau of Fisheries, Government Printing Office; Washington, D. C.

A systematic attempt at studying the life histories of the Sciaenidae. Large numbers of young fish were taken at different times and places and measured. Also the scales of adult fish were measured to confirm results obtained by measurements of the young.

Twelve genera and 18 species are found on the Eastern coast. The fish disappear during winter months. This is theorized to be the result of a southern migration.

None of the species spawns in water more than five fathoms deep. Growth of the fish almost ceases in winter, even in the South. Age at time of first spawning varies from one to three or four years.

Wicker, C. F., Evaluation of Present State of Knowledge of Factors Affecting Tidal Hydraulics and Related Phenomena. United States Corps of Engineers; Vicksburg, Mississippi.

Woodburn, 1960. Quoted in Report on Gulf Coast Deep Water Port Facilities, Texas, Louisiana, Mississippi, Alabama, and Florida, Appendix F, Volume II of V. Department of the Army, Corps of Engineers; New Orleans, Louisiana.

See Gulf Coast report for annotation.

Wright, L. D., 1970. "Above-bottom Acoustic Reflections, Mississippi River Delta," American Association of Petroleum Geologists, Volume 54.

Acoustic fathometric reflections from depths well above the bottom are common phenomena of the Mississippi River Delta. The author contributes these to strong salinity contrasts. The degree of the contrasts and the presence of the reflections are correlative of direction of tidal flow.

Wright, L. D., 1970. "Circulation, Effluent Diffusion and Sediment Transport: Mouth of South Pass, Mississippi River Delta," Technical Report 84. Louisiana State University; Baton Rouge, Louisiana.

Yancey, R. K., Vanishing Delta Hardwoods and Their Wildlife Resources. Louisiana Wildlife and Fisheries Commission; New Orleans, Louisiana.

SECTION 11

GLOSSARY

BOD - Biochemical oxygen demand or the amount of oxygen required by microorganisms while stabilizing biodegradable organic material under aerobic conditions. BOD is usually measured as the oxygen used over a standard five-day period (BOD_5) at 20° C and is expressed as mg/1.

mg/1 - Milligrams per liter or the concentration of a substance expressed as weight (milligrams) per unit volume (one liter).

DO - Dissolved oxygen or the concentration of free dissolved oxygen dissolved in water. Expressed as mg/1.

EPA - United States Environmental Protection Agency.

MPN - Most Probable Number. An index of the number of coliform bacteria which, more probably than any other number, would give the results obtained by the multiple tube fermentation test for coliform bacteria.

pH - A measure of the hydrogen ion (H^+) concentration in the water. More specifically the pH is the negative logarithm (base 10) of the hydrogen ion concentration.

ml - A milliliter which is a unit of volume equal to 1/1000 of a liter.

Total Coliforms - A group of bacteria predominantly inhabiting the intestines of man or animal but also found elsewhere. Tests for detection and enumeration of such as indicator organisms are used due to the impossible task of assessing presence of pathogenic organisms. Coliform organisms are facultative, gram negative, non-sporeforming bacilli which ferment lactose with production of gas. Also included are all bacteria that produce a dark purplish-green colony with metallic sheen by membrane-filter technique. Incubation temperature is maintained at 35 ± 0.5° C.

Fecal Coliforms - Organisms which are a part of the total coliform group but of fecal origin rather than from both fecal and nonfecal sources. This resolution is performed by using a higher incubation temperature (44.5 ± 0.2° C) and a different nutrient medium that used in the total coliform test.

MGD - Million gallons per day. A flow rate commonly used to describe capacity of wastewater treatment plants.

cfs - Cubic feet per second. A flow rate commonly used to describe stream discharge rates and pumping capacities.

$>$ - Greater than.

$<$ - Less than.

Standard Deviation - A statistical term used to describe the dispersion (or spread) of data. With normally distributed data, 68 percent of the data fall within plus or minus one standard deviation from the mean of all the data.

$TLM_{96/10}$ - One-tenth of the median tolerance limit determined for a 96-hour test period. The median tolerance limit is the concentration producing 50 percent mortality in appropriate test organisms within the specified time limit using accepted bioassay techniques.

LC_{50} - The concentration of a substance that is lethal to 50 percent of the organisms within a specified time limit. Same as TLM.

APPENDIX A

BOTANICAL SPECIES LISTS

APPENDIX B

ZOOLOGICAL SPECIES LISTS

These appendices were circulated in the draft environmental impact statement. Because no substantive comments pertinent to the appendices which would require major changes were received, the appendices were not reproduced in the final statement. Copies of these appendices are on file in the U. S. Army Engineer District, New Orleans, Louisiana.

APPENDIX C

REPORT OF SEDIMENT SAMPLE COLLECTION
PROCEDURES AND RESULTS

Collection and Laboratory Analysis:

D. B. McDonald Research, Inc.
Iowa City, Iowa

Data Presentation:

Stanley Consultants, Inc.
Muscatine, Iowa

APPENDIX C

DATA OF SEDIMENT SAMPLE COLLECTION: PROCEDURES AND RESULTS

C.01 PROCEDURES

Twenty-seven MR-GO channel bottom sediment samples, four bayou bottom samples and two deposition bank samples were collected with a ponar dredge in May and early June of 1974. The following laboratory analysis procedures were used for sediment analysis for this report:

Chemical Oxygen Demand
Sutron 220. Standard Methods

Volatile Solids
Sutron 224B. Standard Methods

Total Kjeldahl Nitrogen
Sutron 216. Standard Methods

All Metals
Sediment samples were digested in accordance with Section 4.1.4. Methods for Chemical Analysis of Water and Wastes, 1971, EPA. The extractant was analyzed on a Jarrall Ash Model 280 Atomosorb Atomic Absorption Spectrophotometer.

All sample data is expressed on a dry-weight basis except the sample grain-size distribution analysis (silt/clay content) which was determined by standard hydrometer analysis. Clay-size particles were defined as less than 0.0039 mm median grain diameter. None of the samples contained sand grain-sized material.

C.02 DATA

The summaries of results are contained in the following figures and tables:

Table C-1	Organic Pollution Parameters in Sediment Samples
Table C-2	Metals in Sediment Samples
Figure C-1	Samples over EPA Criteria
Figure C-2	Graphic Illustration of Silt/Clay Content

The tables and figures presenting the sample data relative to the sample locations in the vicinity of the MR-GO are as follows:

Figure C-3	Percent Volatile Solids
Figure C-4	Chemical Oxygen Demand
Figure C-5	Total Kjeldahl Nitrogen

C.03 SUMMARY

Figure C-1 shows the locations of samples which were over the EPA June 26, 1973, criteria. Of the total number of bottom sample locations on the MR-GO (27 samples), all but 2 failed one or more EPA parameters. Both overbank samples failed four criteria. All four samples at the Lake Borgne entrances to Bayous Dupre and St. Malo failed at least one criterion. On the MR-GO, the samples failing EPA criteria for metals were located primarily between Mile 30 and Mile 10. One of the two overbank samples failed the lead criterion and one failed the mercury criterion. Thirteen MR-GO channel samples failed the criterion for arsenic, and eight failed the cadmium criterion. All land area and MR-GO centerline samples were above EPA criteria for volatile solids. COD samples were over EPA criteria on 11 of the 27 MR-GO sample points (41%).

TABLE C-1

ORGANIC POLLUTION PARAMETERS IN SEDIMENT SAMPLES

Location	Volatile Solids (in percent)			COD (in ppm in thousands)			Total Kjeldahl Nitrogen (ppm)		
MR-GO	S*	C*	N*	S	C	N	S	C	N
Mile 40	$\boxed{14.4}$	$\boxed{13.3}$	$\boxed{10.7}$	$\boxed{61}$	$\boxed{53}$	$\boxed{53}$	120	320	120
Mile 35	$\boxed{17.6}$	$\boxed{8.1}$	$\boxed{19.1}$	$\boxed{79}$	46	$\boxed{88}$	110	210	270
Mile 30	$\boxed{12.1}$	$\boxed{15.9}$	$\boxed{12.3}$	$\boxed{56}$	$\boxed{60}$	38	140	280	120
Mile 25	$\boxed{13.4}$	$\boxed{12.4}$	$\boxed{10.3}$	$\boxed{75}$	$\boxed{86}$	48	250	400	200
Mile 20	4.5	$\boxed{10.9}$	4.6	18	$\boxed{68}$	19	67	450	90
Mile 15	3.0	$\boxed{9.0}$	4.5	10	49	22	64	220	87
Mile 10	4.5	$\boxed{9.7}$	3.8	25	$\boxed{51}$	12	100	450	75
Mile 5	—	$\boxed{10.0}$	7.4	33	35	20	290	400	150
Mile 0	5.1	$\boxed{8.5}$	7.7	22	31	27	190	210	330
Bayou Dupre	NS	$\boxed{8.2}$	NS	NS	43	NS	NS	100	NS
Bayou St. Malo (W, C, E)	$\boxed{8.1}$	$\boxed{14.9}$	$\boxed{8.0}$	22	$\boxed{57}$	22	81	210	140
Overbank (high)		$\boxed{8.6}$			11			120	
Overbank (low)		$\boxed{8.2}$			2.6			170	
EPA Criteria		8.0			50			1,000	

Total Solids Sample Range: 30.2% to 77.6%. No EPA Criteria.

☐ Samples equal to or above EPA Criteria.
* S = South, C = Centerline, N = North.
NS - No Samples.

Source: Stanley Consultants and D. B. McDonald Research.

TABLE C-2

METALS IN SEDIMENT SAMPLES

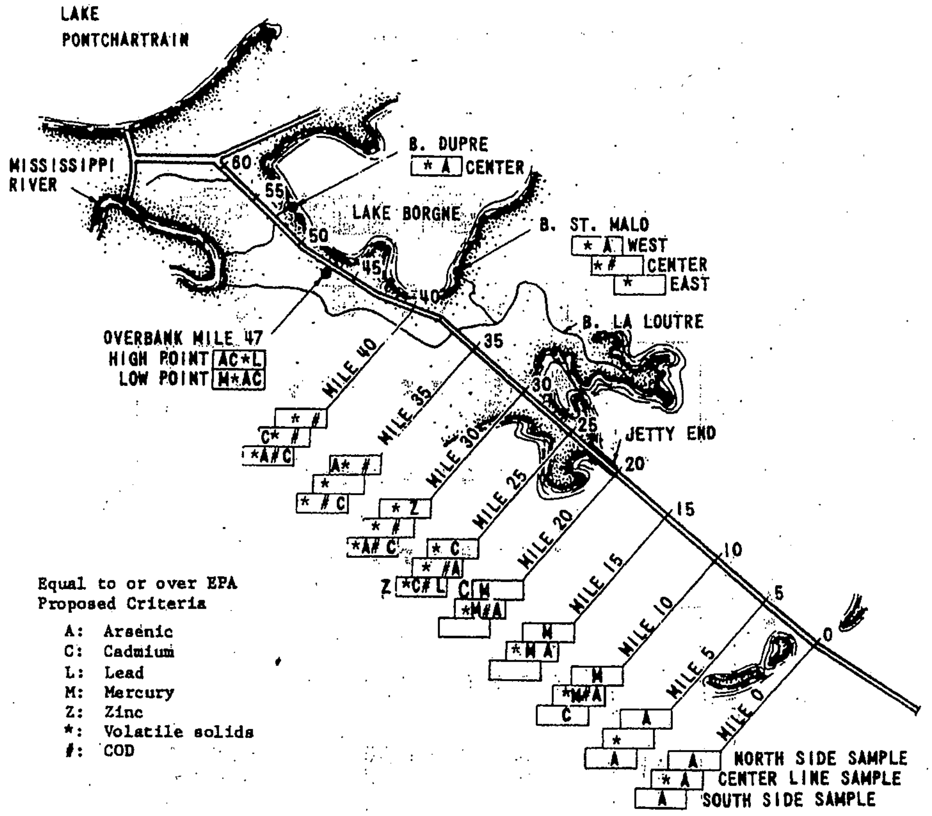
Location	Lead ppm			Mercury ppm			Zinc ppm			Arsenic ppm			Cadmium ppm		
MR-GO	S*	C*	N*	S	C	N	S	C	N	S	C	N	S	C	N
Mile 40	25	38	40	<0.5	<0.5	<0.5	56	30	72	$\boxed{5.5}$	4.2	3.5	$\boxed{2}$	$\boxed{2}$	1
Mile 35	38	34	36	<0.5	0.5	<0.5	40	31	34	3.0	4.3	$\boxed{8.6}$	$\boxed{2}$	1	1
Mile 30	36	34	38	<0.5	<0.5	<0.5	48	40	$\boxed{100}$	$\boxed{6.0}$	4.1	4.4	$\boxed{2}$	1	1
Mile 25	$\boxed{62}$	39	41	<0.5	<0.5	<0.5	$\boxed{200}$	48	47	4.2	$\boxed{5.5}$	1.9	$\boxed{9}$	1	$\boxed{2}$
Mile 20	39	41	34	0.7	$\boxed{2.2}$	$\boxed{9.0}$	34	39	34	3.5	$\boxed{5.5}$	3.6	1	1	$\boxed{2}$
Mile 15	34	41	20	<0.5	$\boxed{1.5}$	$\boxed{3.0}$	45	34	26	3.2	$\boxed{6.8}$	4.3	1	1	1
Mile 10	27	41	38	<0.5	$\boxed{2.5}$	$\boxed{4.0}$	47	48	23	4.5	$\boxed{5.7}$	2.6	$\boxed{2}$	1	1
Mile 5	12	10	9	<0.5	<0.5	<0.5	21	22	20	$\boxed{6.5}$	$\boxed{6.7}$	$\boxed{6.8}$	0.5	1	0.5
Mile 0	8	14	10	<0.5	<0.5	<0.5	20	23	20	$\boxed{6.7}$	$\boxed{7.5}$	$\boxed{7.2}$	1	0.5	1
Bayou Dupre	NS	40	NS	NS	0.5	NS	NS	48	NS	NS	$\boxed{7.5}$	NS	NS	1	NS
Bayou St. Malo (W, C, E)	6	10	8	<0.5	<0.5	<0.5	5	16	12	$\boxed{6.6}$	2.9	4.3	0.5	0.5	0.5
Overbank (high)		$\boxed{54}$			<0.5			47			$\boxed{6.6}$			$\boxed{2}$	
Overbank (low)		34			$\boxed{5.5}$			62			$\boxed{8.1}$			$\boxed{2}$	
EPA Criteria		50			1			75			5			2	

Other Metals - All sample locations:

Chromium: Sample Range; 1 to 49 ppm: EPA Criteria; 100 ppm
Copper : Sample Range; 2 to 27 ppm: EPA Criteria; 50 ppm
Nickel : Sample Range; 1 to 37 ppm: EPA Criteria; 50 ppm

☐ Samples equal to or above EPA Criteria.
* S - South, C - Centerline, N - North.
NS - No Sample.

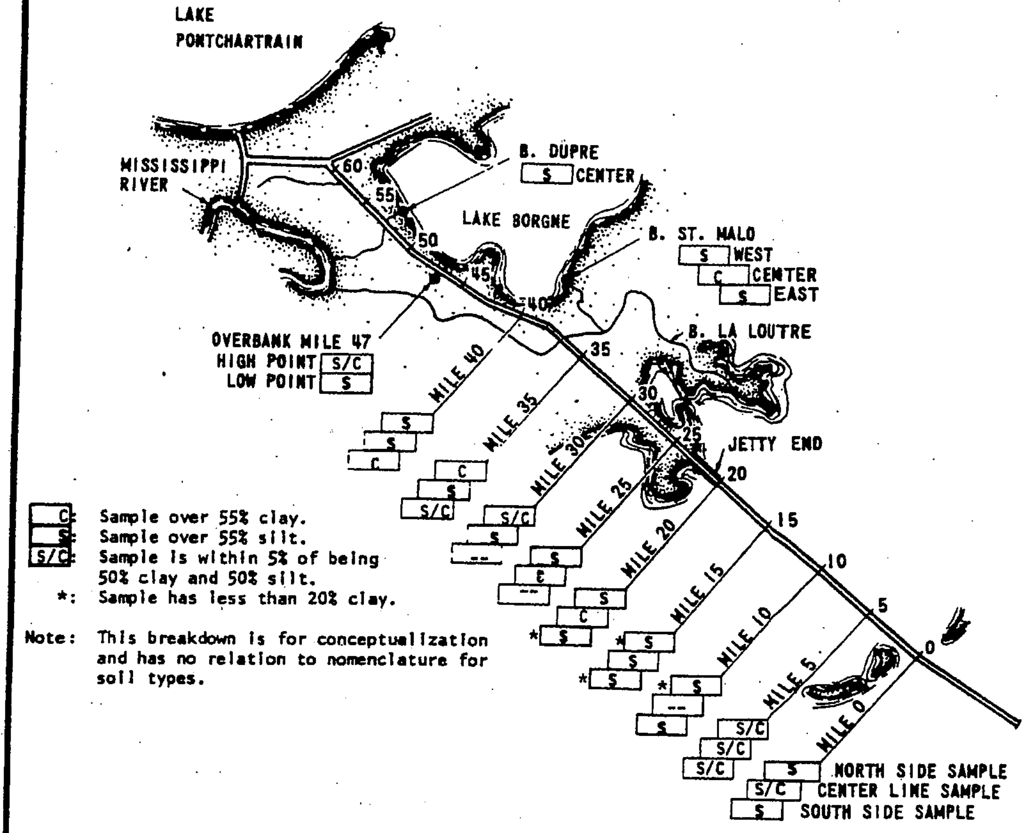
Source: Stanley Consultants and D. B. McDonald Research



Equal to or over EPA
Proposed Criteria

A: Arsenic
C: Cadmium
L: Lead
M: Mercury
Z: Zinc
*: Volatile solids
#: COD

FIGURE C-1
SEDIMENT
ANALYSIS DATA
SAMPLES OVER
EPA CRITERIA



C: Sample over 55% clay.
S: Sample over 55% silt.
S/C: Sample is within 5% of being 50% clay and 50% silt.
*: Sample has less than 20% clay.

Note: This breakdown is for conceptualization and has no relation to nomenclature for soil types.

FIGURE C-2

SEDIMENT ANALYSIS DATA GRAPHIC ILLUSTRATION OF SILT/CLAY CONTENT

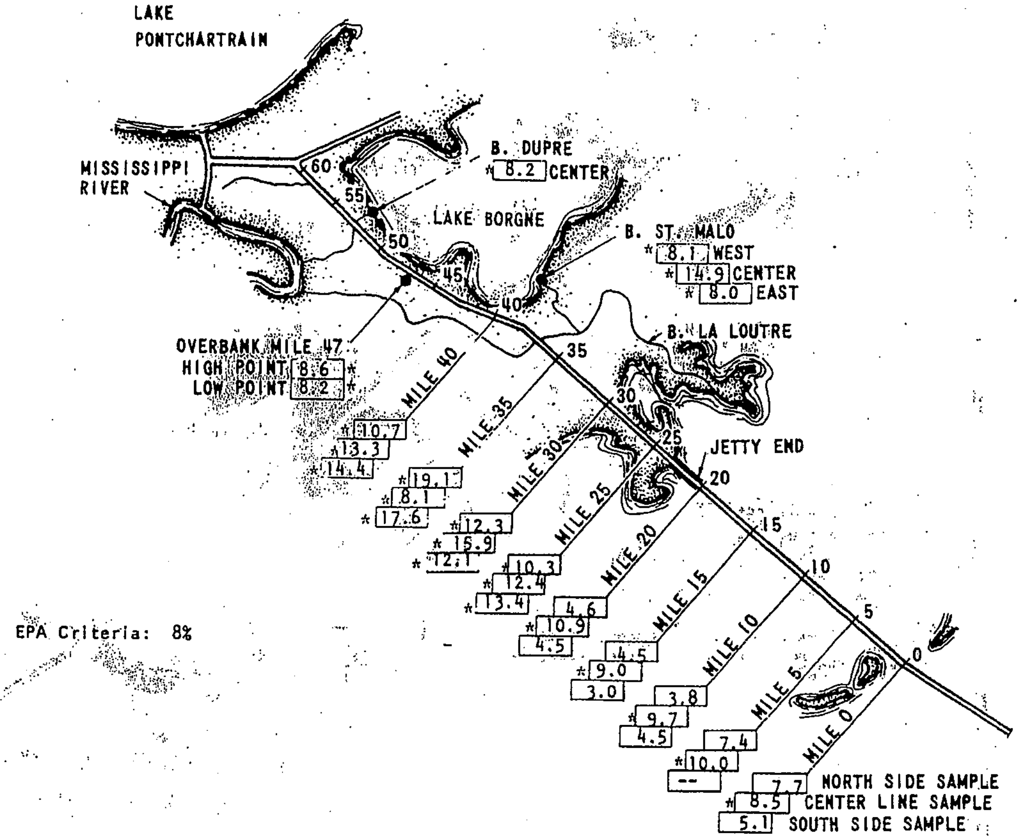


FIGURE C-3
SEDIMENT ANALYSIS DATA PERCENT VOLATILE SOLIDS

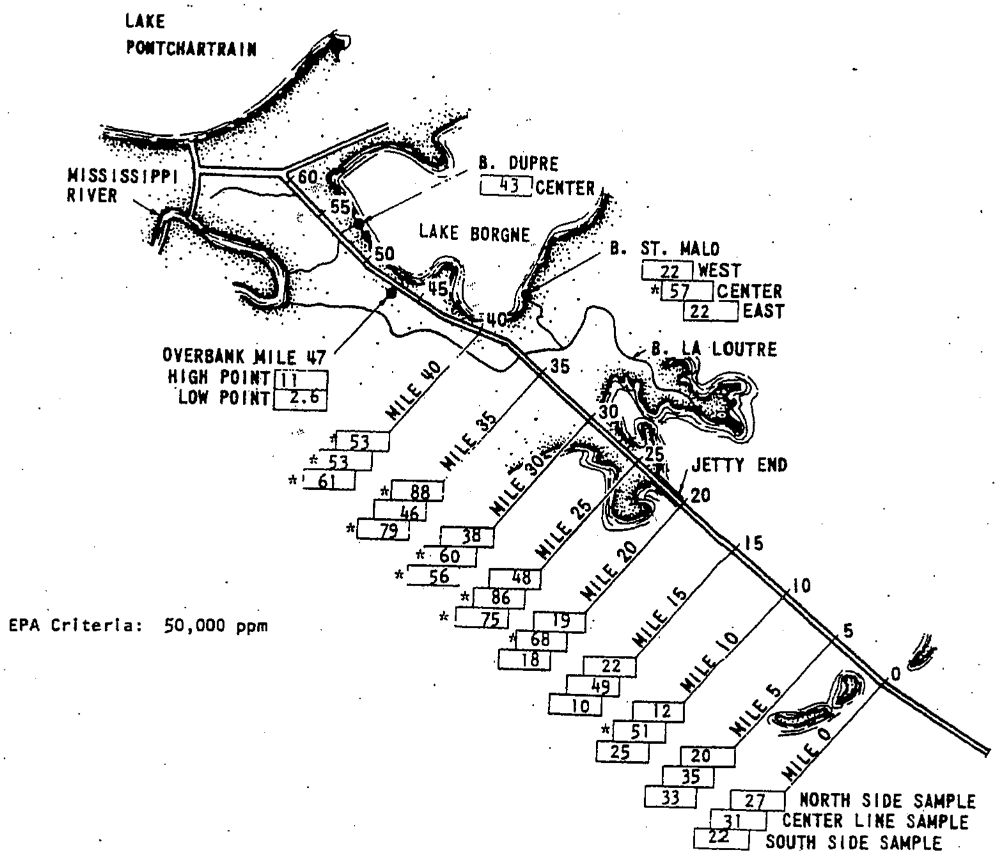
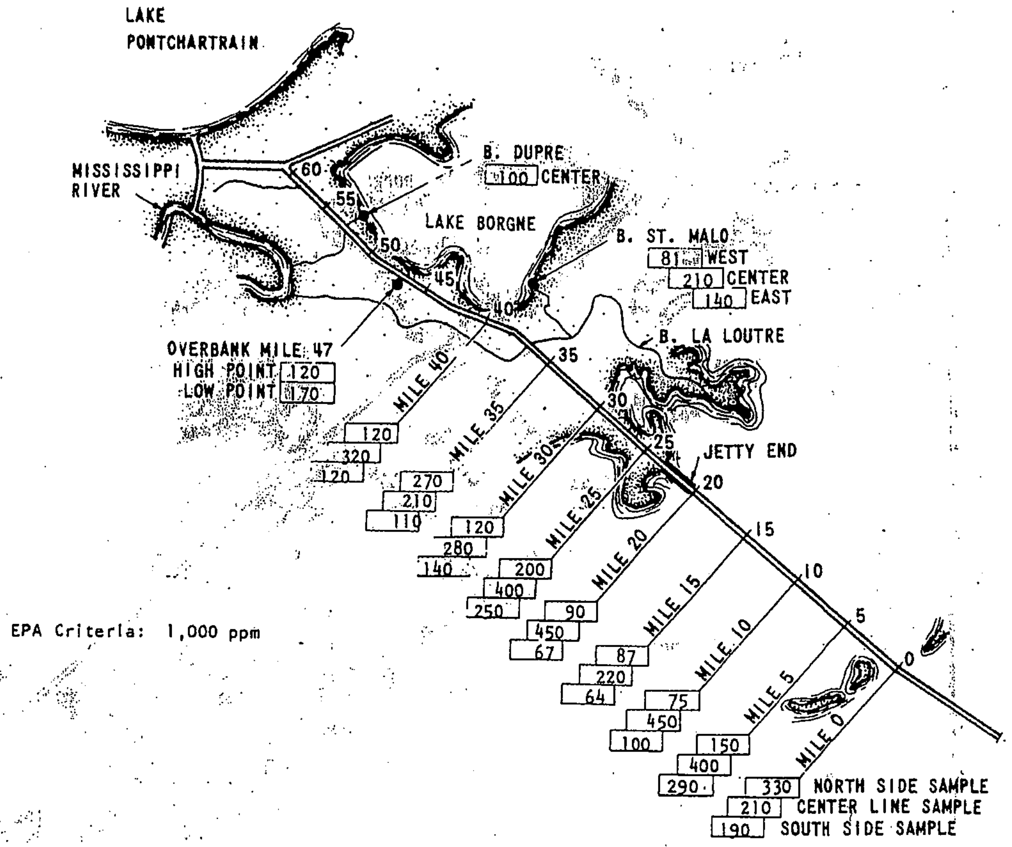


FIGURE C-4

SEDIMENT ANALYSIS DATA CHEMICAL OXYGEN DEMAND

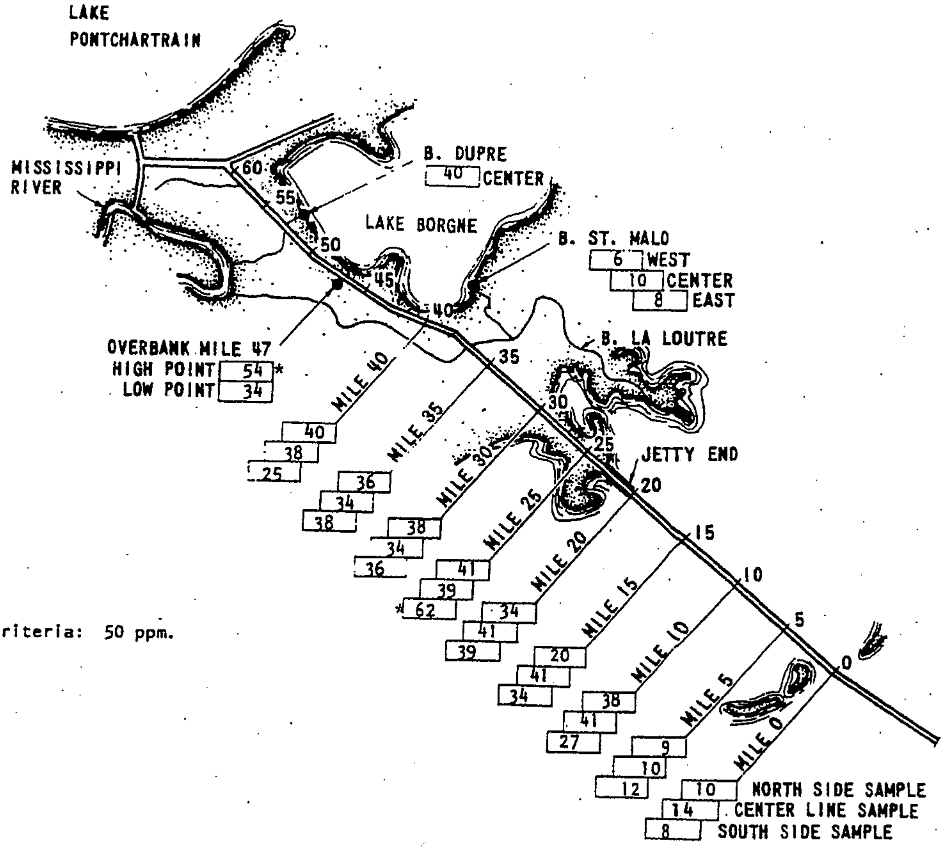
(in PPM; in Thousands) eg

43,000 PPM at DUPRE



EPA Criteria: 1,000 ppm

FIGURE C-5
SEDIMENT ANALYSIS DATA TOTAL KJELDAHL NITROGEN, IN PPM



EPA Criteria: 50 ppm.

FIGURE C-6

SEDIMENT ANALYSIS DATA LEAD, IN PPM

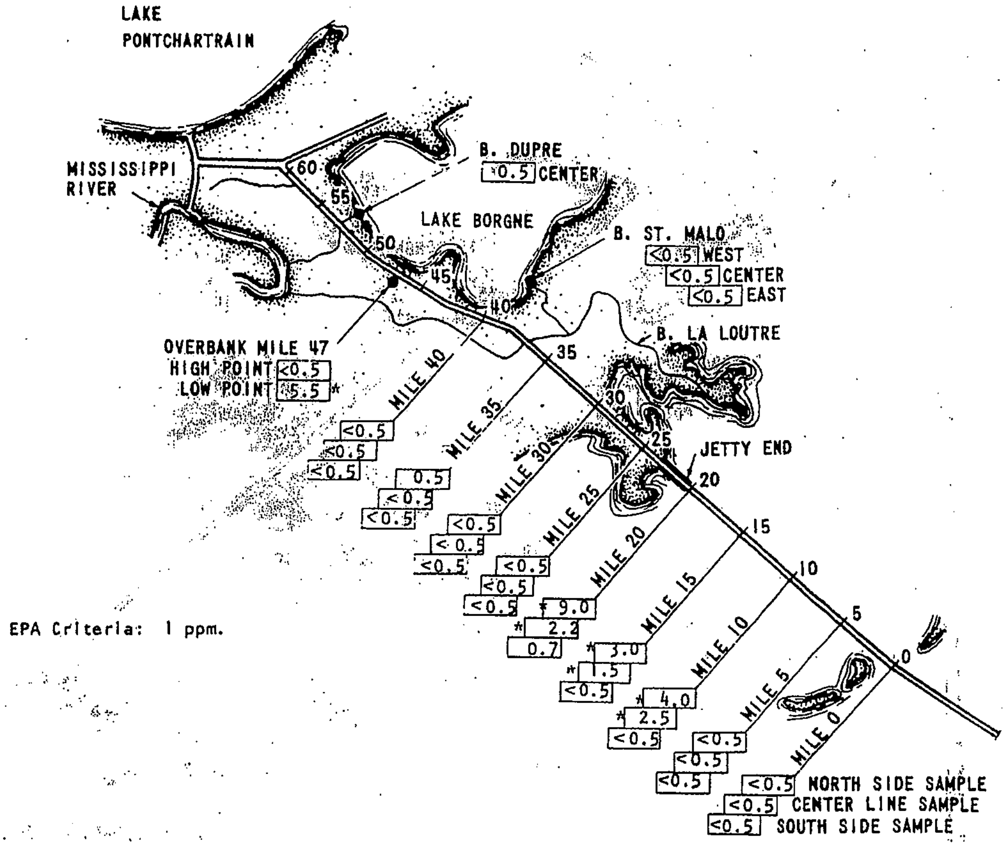


FIGURE C-7

SEDIMENT ANALYSIS DATA MERCURY, IN PPM

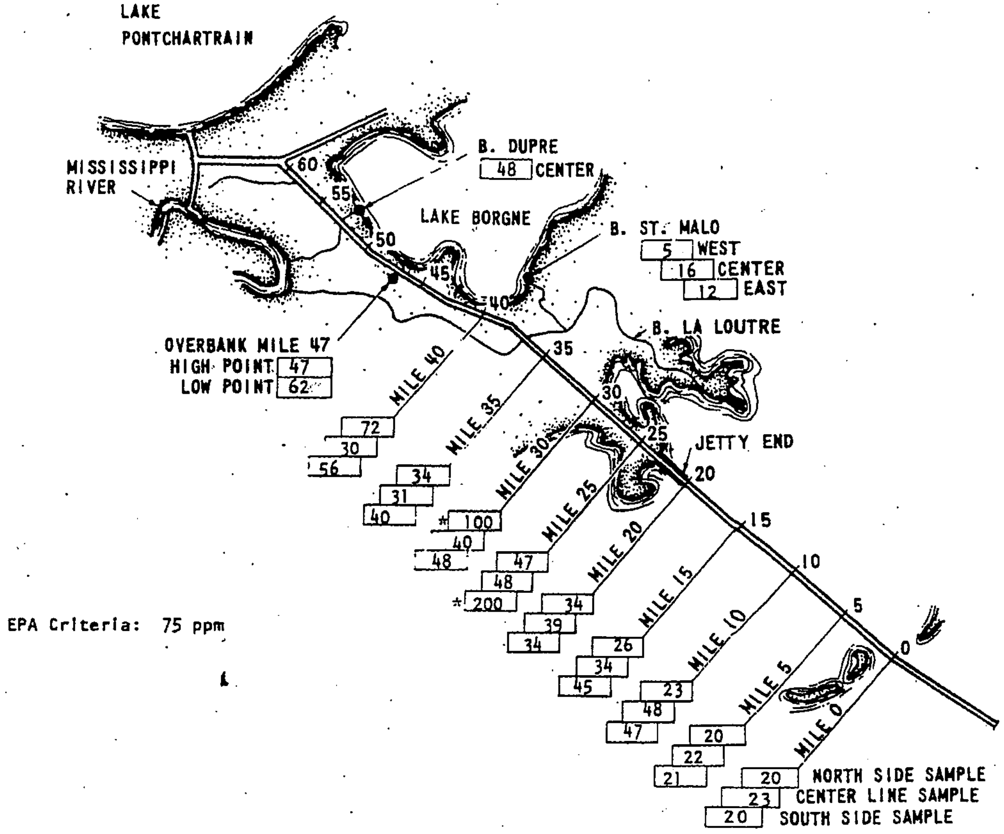


FIGURE C-8

SEDIMENT ANALYSIS DATA ZINC, IN PPM

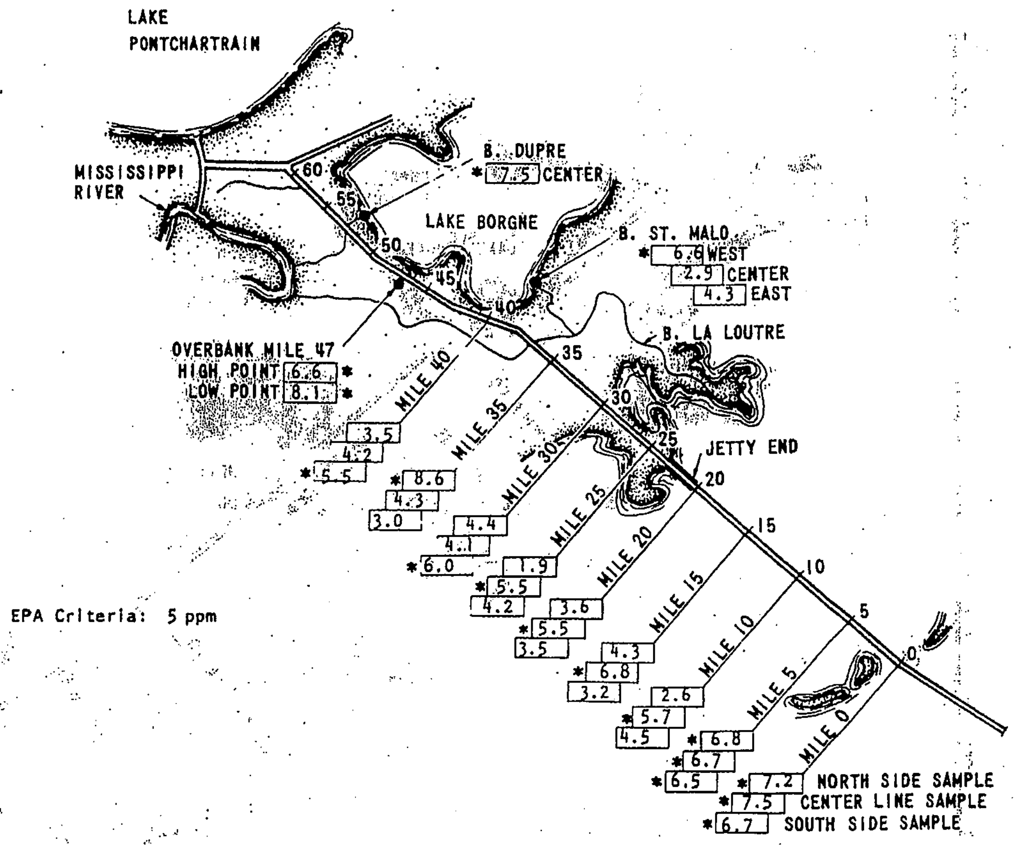
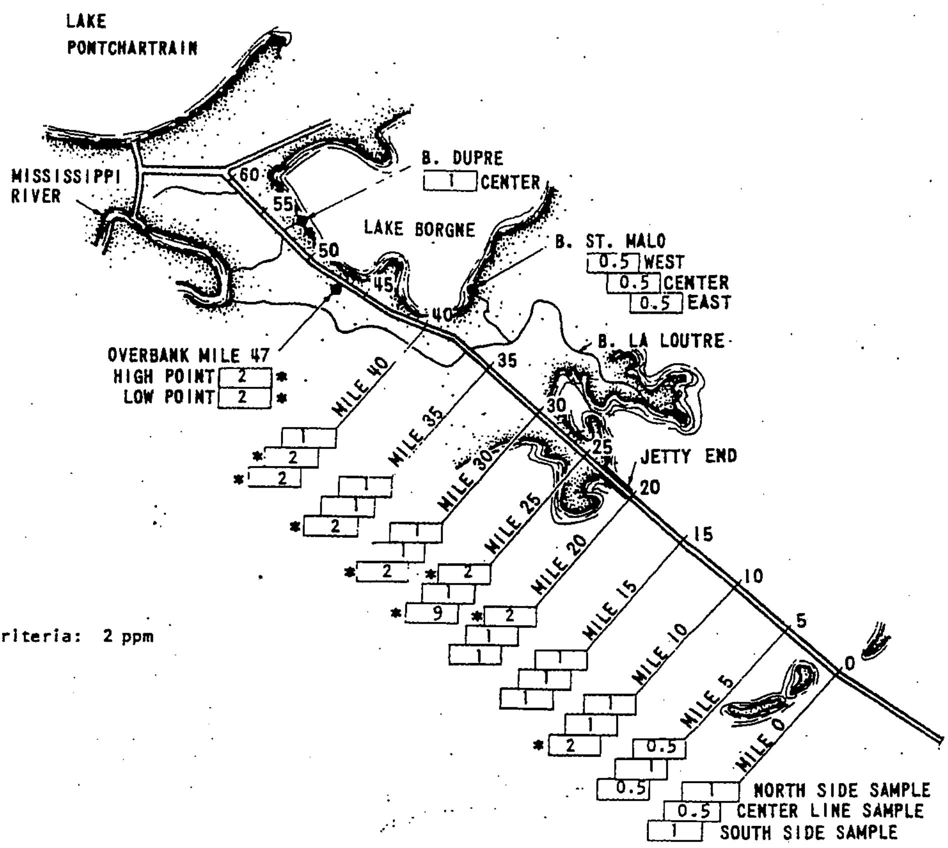


FIGURE C-9

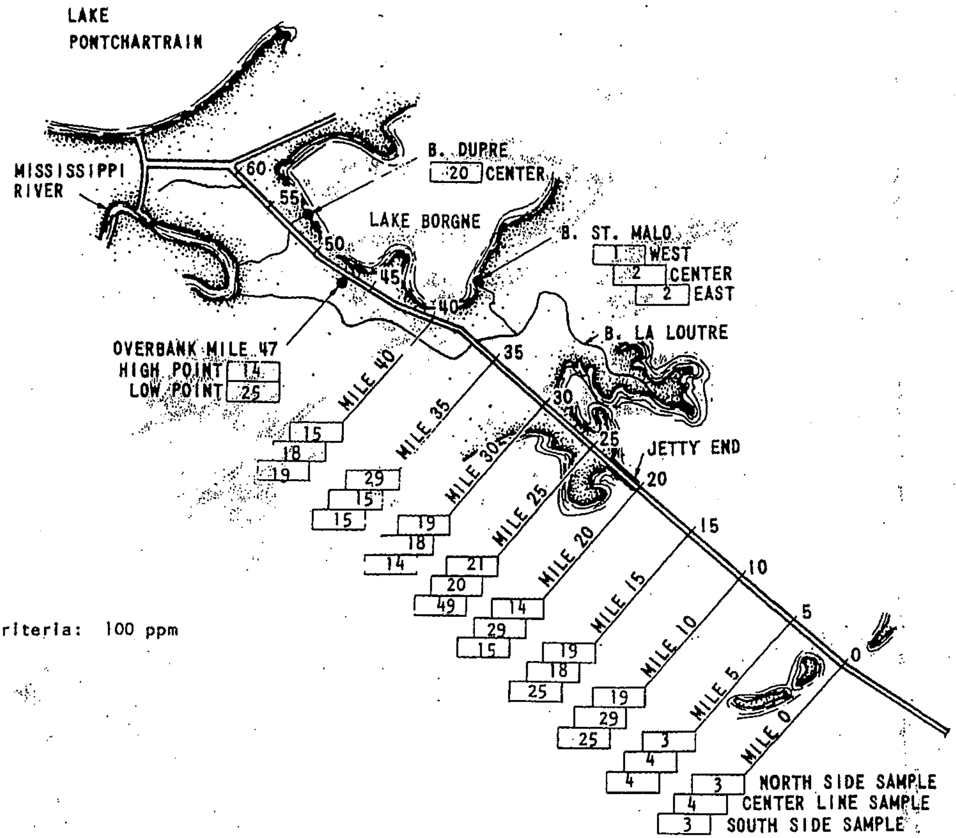
SEDIMENT ANALYSIS DATA ARSENIC, IN PPM



EPA Criteria: 2 ppm

FIGURE C-10

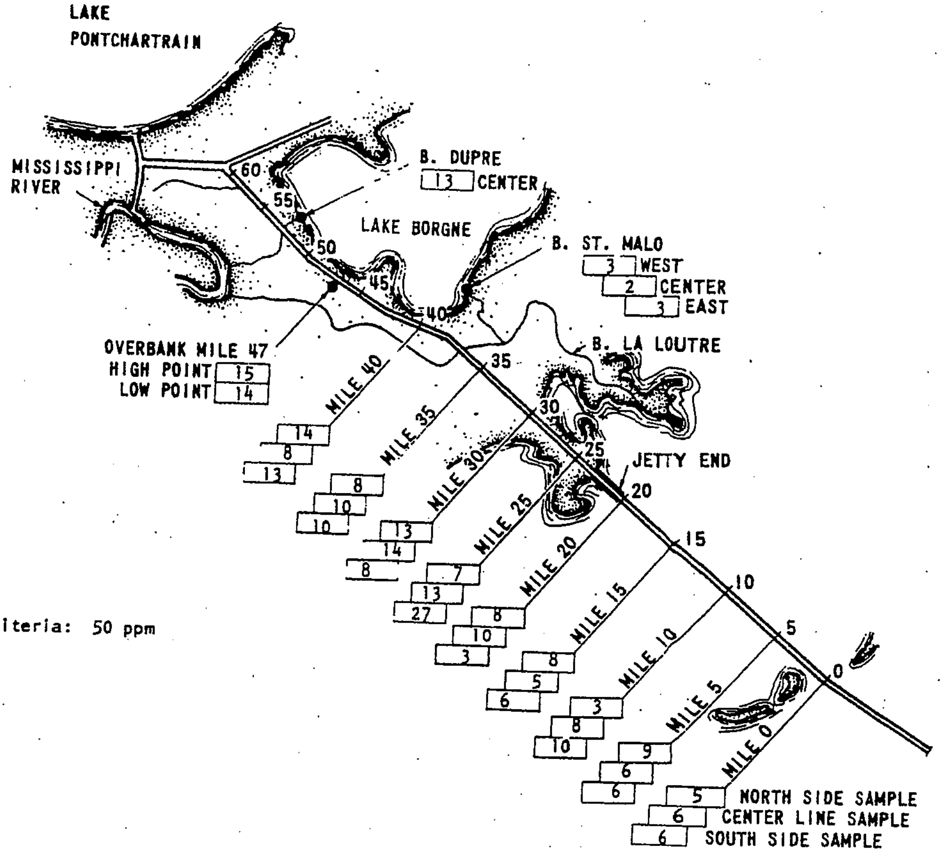
SEDIMENT ANALYSIS DATA CADMIUM, IN PPM



EPA Criteria: 100 ppm

FIGURE C-11

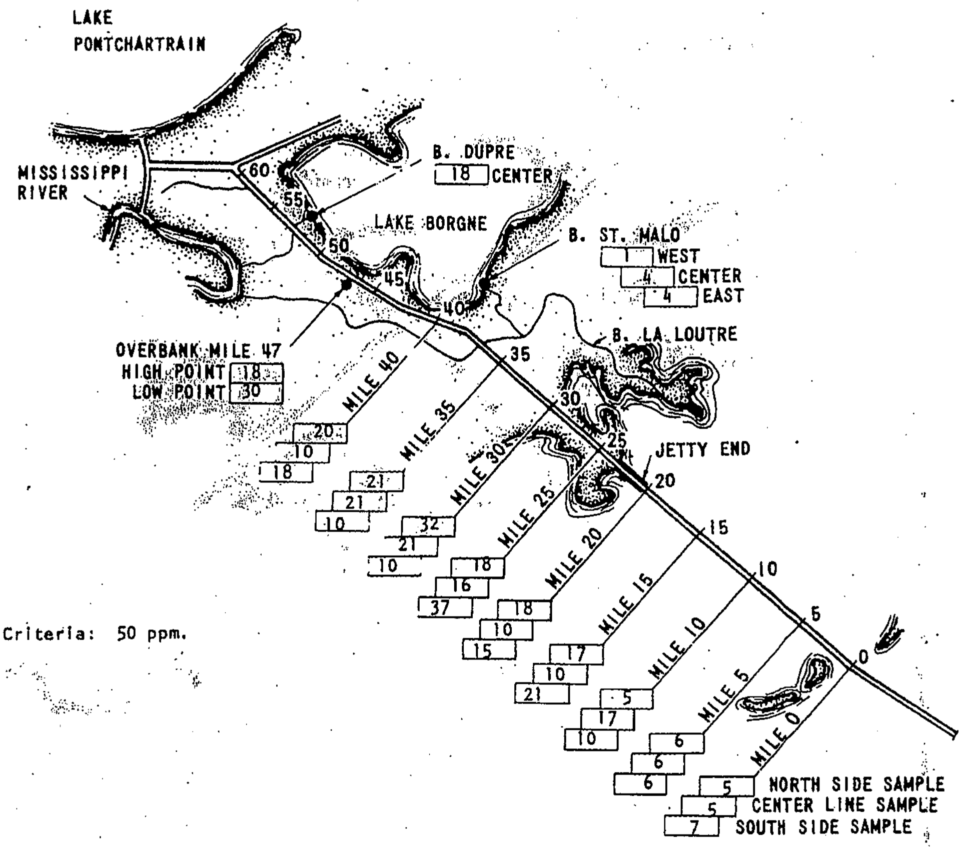
SEDIMENT ANALYSIS DATA CHROMIUM, IN PPM



EPA Criteria: 50 ppm

FIGURE C-12

SEDIMENT ANALYSIS DATA COPPER, IN PPM



EPA Criteria: 50 ppm.

FIGURE C-13

SEDIMENT ANALYSIS DATA NICKEL, IN PPM

TABLE C- 3

SILT-CLAY GRAIN-SIZED DISTRIBUTION OF SAMPLES TAKEN FOR THIS STUDY

Sample Station	% Silt	% Clay
MR-GO Mile 0		
A - Center	54.8	45.2
B - N. Side	62.6	37.4
C - S. Side	60.4	39.6
Mean for Mile 0	59.3	40.7
MR-GO Mile 5		
A - Center	48.0	52.0
B - N. Side	47.6	52.4
C - S. Side	48.0	52.0
Mean for Mile 5	47.9	52.1
MR-GO Mile 10		
A - Center	--	--
C - N. Side	88.2	11.2
B - S. Side	72.8	27.2
Mean for Mile 10	80.5	19.5
MR-GO Mile 15		
A - Center	58.0	42.0
B - N. Side	87.6	12.4
C - S. Side	94.2	5.8
Mean for Mile 15	79.9	20.1
MR-GO Mile 20		
A - Center	42.0	58.0
B - N. Side	75.7	24.3
C - S. Side	84.3	15.7
Mean for Mile 20	67.3	32.7
MR-GO Mile 25		
A - Center	33.4	66.6
B - N. Side	64.5	35.5
C - S. Side	--	--
Mean for Mile 25	49.0	51.0

TABLE C-3 (Cont.)

SILT-CLAY GRAIN-SIZED DISTRIBUTION OF SAMPLES TAKEN FOR THIS STUDY

Sample Station	% Silt	% Clay
MR-GO Mile 30		
A - Center	66.6	33.4
B - N. Side	50.4	49.6
C - S. Side	--	--
Mean for Mile 30	58.5	41.5
MR-GO Mile 35		
A - Center	80.8	19.2
B - N. Side	43.4	56.6
C - S. Side	45.2	54.8
Mean for Mile 35	56.5	43.5
MR-GO Mile 40		
A - Center	77.6	22.4
B - N. Side	67.4	32.6
C - S. Side	42.7	57.3
Mean for Mile 40	62.6	37.4
MR-GO Mile 47		
Dredge Spoils		
A - High Point	46.4	53.6
B - Low Point	65.0	35.0
Mean for Mile 47 spoils	55.7	44.3
Bayou Dupre		
A - Center	78.2	21.8
Bayou St. Malo		
A - Center	40.0	60.0
B - E. Side	79.2	20.8
C - W. Side	78.0	22.0
Mean for Bayou St. Malo	65.7	34.3

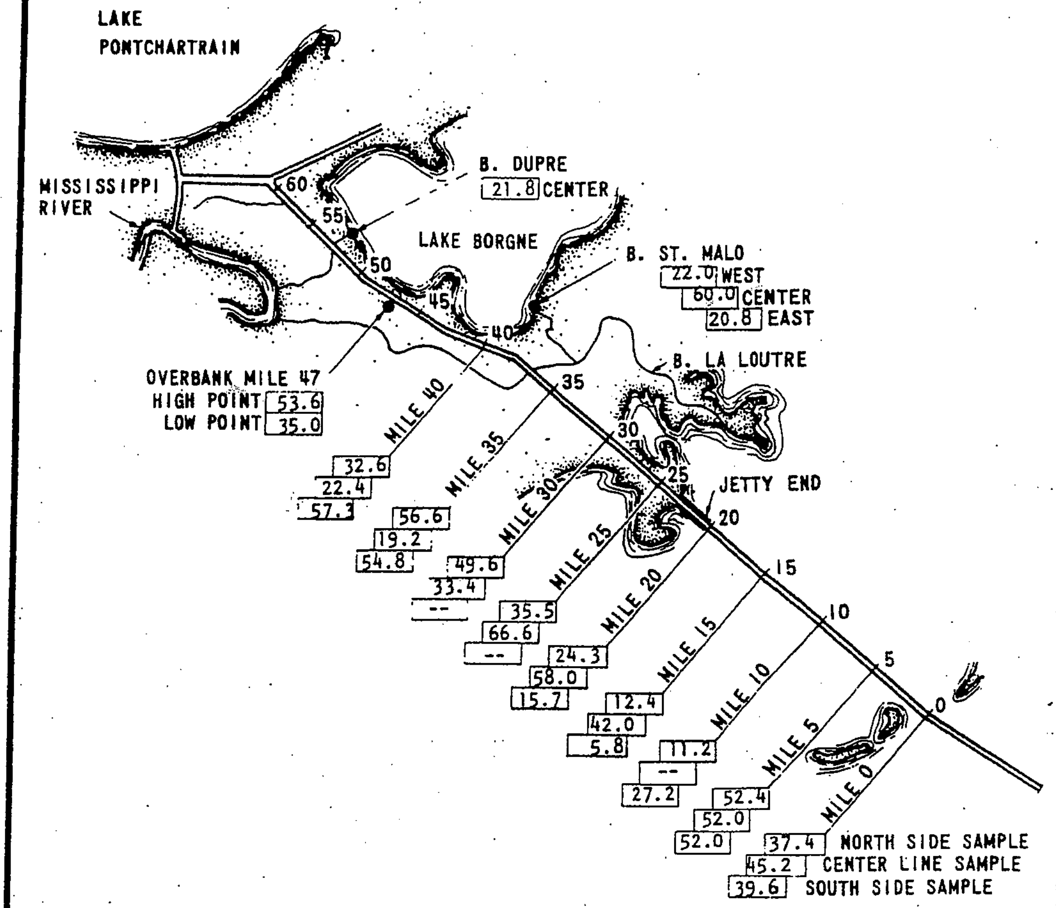


FIGURE C-14

SEDIMENT ANALYSIS DATA PERCENT CLAY CONTENT

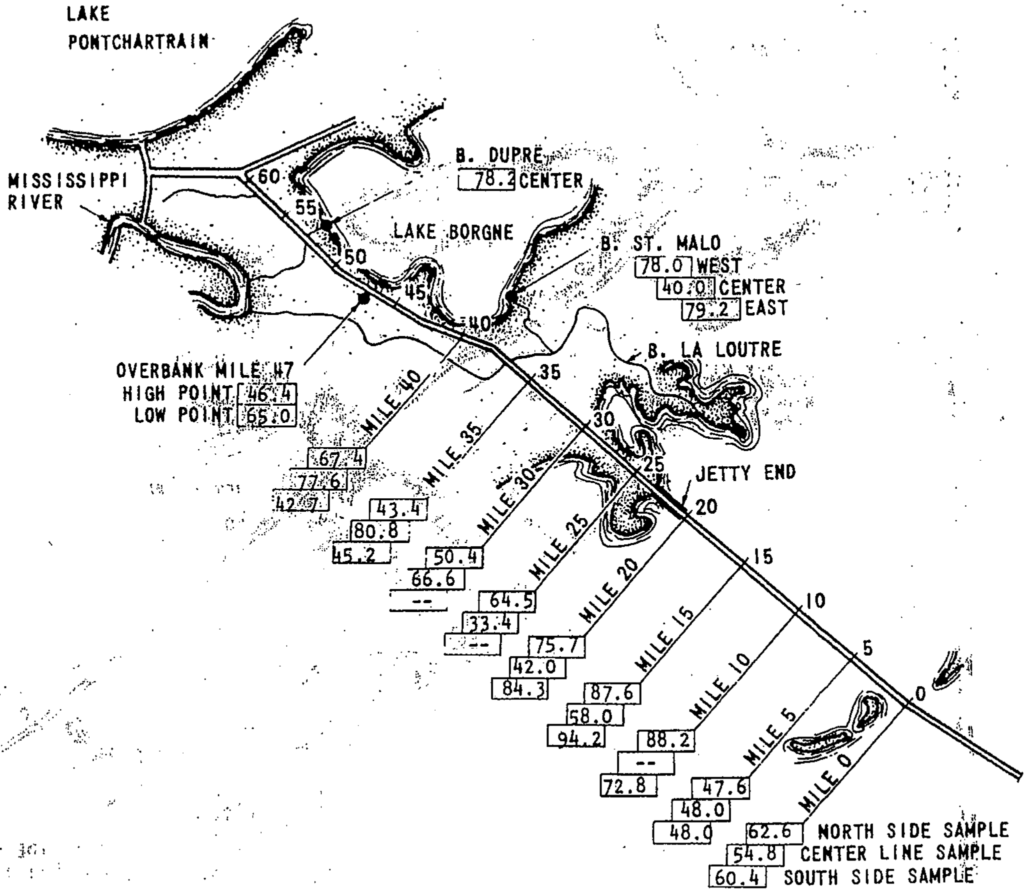


FIGURE C-15

SEDIMENT ANALYSIS DATA PERCENT SILT CONTENT

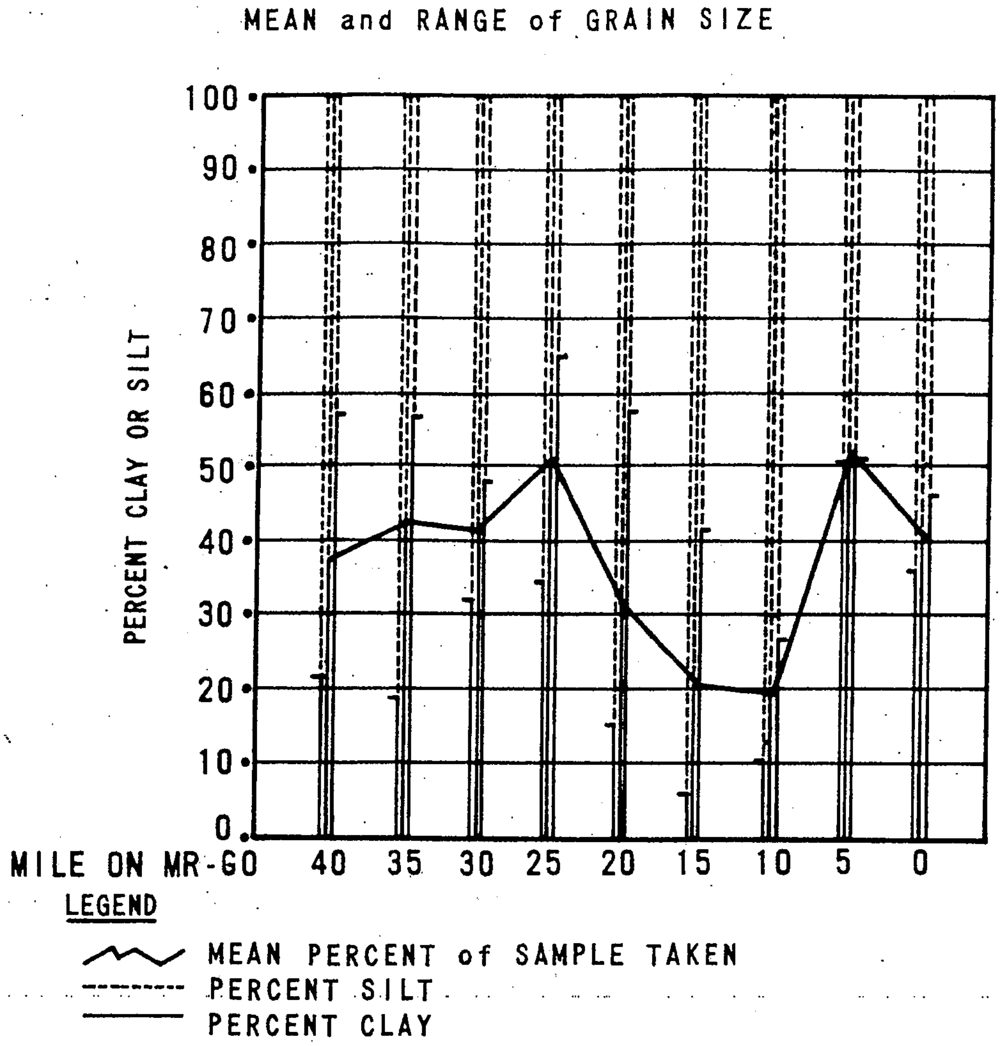


FIGURE C-16

GRAIN SIZE DISTRIBUTION VS THE AXIS OF THE MR-GO

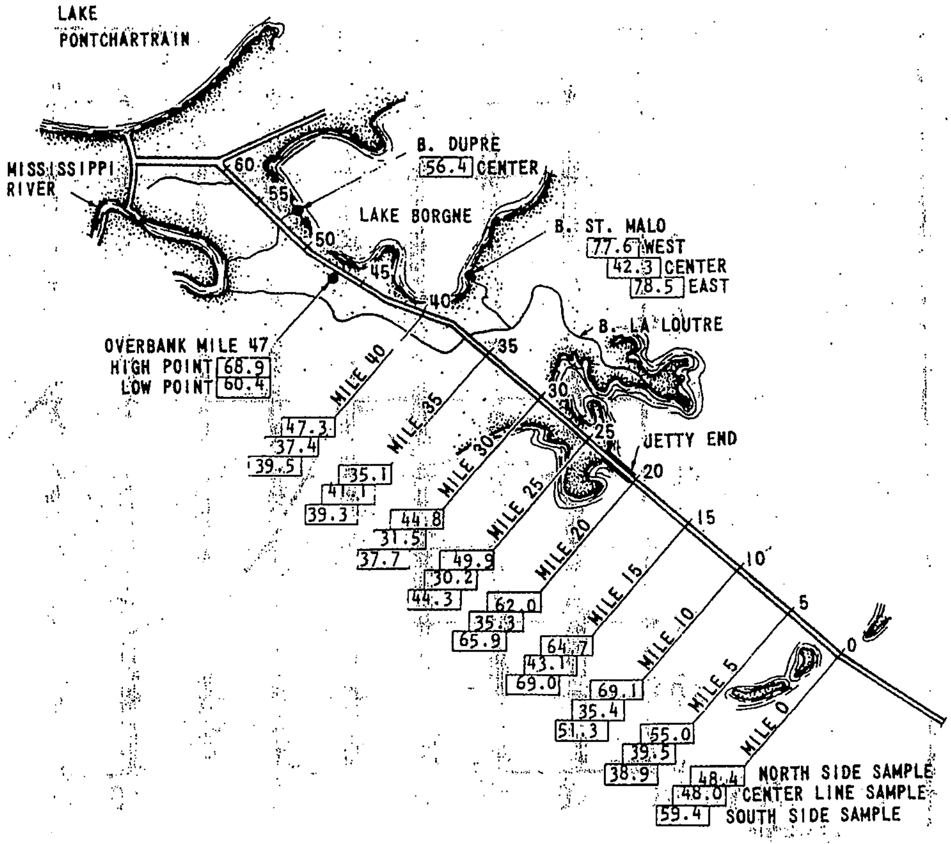


FIGURE C-17

SEDIMENT ANALYSIS DATA PERCENT TOTAL SOLIDS

APPENDIX D

5 SEPTEMBER 1975 EPA INTERIM FINAL GUIDELINES FOR DISCHARGE OF DREDGED OR FILL MATERIAL IN NAVIGABLE WATERS

APPENDIX D

5 SEPTEMBER 1975 EPA INTERIM FINAL GUIDELINES FOR DISCHARGE OF DREDGED OR FILL MATERIAL IN NAVIGABLE WATERS

On 26 June 1973, the Environmental Protection Agency (EPA), Region VI, issued proposed regional bottom sediment criteria to be used in evaluating the suitability of disposal of dredged or fill materials. On 15 October 1973, the EPA published in the Federal Register "Environmental Protection Agency Criteria for Evaluation of Permit Applications for Ocean Dumping" (40 CFR 227, 38 FR 28618). These criteria were to be used in evaluating the suitability of discharge of dredged or fill material in the ocean and, until guidelines were promulgated, in inland waters also. These guidelines developed the Standard Elutriate Test. Dredged or fill material was considered to be unacceptable if the ratio of the constituent concentration in the standard elutriate to the constituent concentration in the receiving water was greater than 1.5. The standard elutriate results from a mixture of 4 part unfiltered receiving water to one part dredged material.

On 6 May 1975, the EPA in conjunction with the Corps of Engineers published the inland water criteria for dredged or fill material entitled: "Navigable Waters Procedure and Guidelines for Disposal of Dredged or Fill Material" (40 CFR 230, 40 FR 19794). As previously stated, the Ocean Dumping Criteria's elutriate test requires that after the material to be dredged has been vigorously mixed for 30 minutes with four parts of the water to which it is to be discharged and the supernatent from the mixture has been filtered through a 0.45 micron filter, the concentration of the constituents shall be equal to or less than 1.5 times the concentration of those same constituents in the water before mixing. The new proposed (6 May 1975) Navigable Water Criteria (for inland dredged material disposal) allows for application of a 10:1 dilution of the standard elutriate. Mathematical expression of the above relationships is as follows:

$$\frac{Ce}{Cw} \leq 1.5 \qquad (1)$$

$$\frac{(0.1\ Ce + 0.9\ Cw)}{Cw} \leq 1.5 \qquad (2)$$

Where Ce = Concentration from the standard elutriate test (dissolved)
Cw = Concentration in the receiving water (dissolved)

The newer proposed guidelines (40 CFR 230, 6 May 1975) have been revised on 5 September 1975 (40 CFR 230, 40 FR 41292). These new interim final guidelines, entitled "Environmental Protection Agency - Navigable Waters - Discharge of Dredged or Fill Material," have eliminated both the 1.5 elutriate criteria as well as the 10:1 elutriate dilution of the May 6 guidelines. As a substitute, the new guidelines recommended (1) comparing the elutriate to applicable narrative and numerical guidance contained in such water quality standards as are applicable by law, and (2) possibly performing a total sediment chemical analysis. In addition, the guidelines note that EPA and the Corps of Engineers in the coming months will prepare and publish a procedures manual that will cover summary and description of tests, definitions, sample collection and preservation, procedures, calculations, and references.

In view of the changing nature of the evaluation basis, this appendix has been attached to the Environmental Impact Statement in order to comply with the 5 September 1975 EPA interim final regulations.

Original sampling by Stanley Consultants was for only sediment analysis. The results have been discussed in Section 2.03 (d) of this EIS. Subsequent to the Stanley Consultants' sediment analysis, sampling was conducted by the U. S. Army Corps of Engineers in conjunction with the United States Geological Survey on two separate occasions.

The first sampling took place in the MR-GO from 27 March 1975 through 4 April 1975. These samples were analyzed for both the sediment analysis as well as the Standard Elutriate Test. The need to dispose of some of the dredged materials in open waters resulted in additional samples being collected on 28 May through 2 June 1975 at various locations northeast and southwest of the project in both Breton Sound and Chandeleur Sound up to approximately 2 1/4 miles from the project. These samples also underwent both sediment and elutriate analyses. The detailed results of these samplings are available upon request in a report entitled "Mississippi River Gulf Outlet Maintenance Dredging Sediment and Water Quality Assessment" (August, 1975). The sediment analyses generally agreed with the sediment analyses discussed in Section 2.03 (d) of this EIS. The elutriate test results will be summarized in this appendix.

Arsenic, which consistently failed EPA Region VI criteria of 5 mg/kg also consistently failed the Ocean Dumping elutriate test. Of the 15 elutriate test results available, 14 failed the elutriate test. Of these fourteen, only three produced elutriates with arsenic concentrations of 10 μg/l or greater (18 μg/l, 11 μg/l, and 10 µg/1). The remaining 11 elutriates contained arsenic concentrations of 8 µg/1 or less, usually in the 0 µg/1 to 5 µg/1 range.

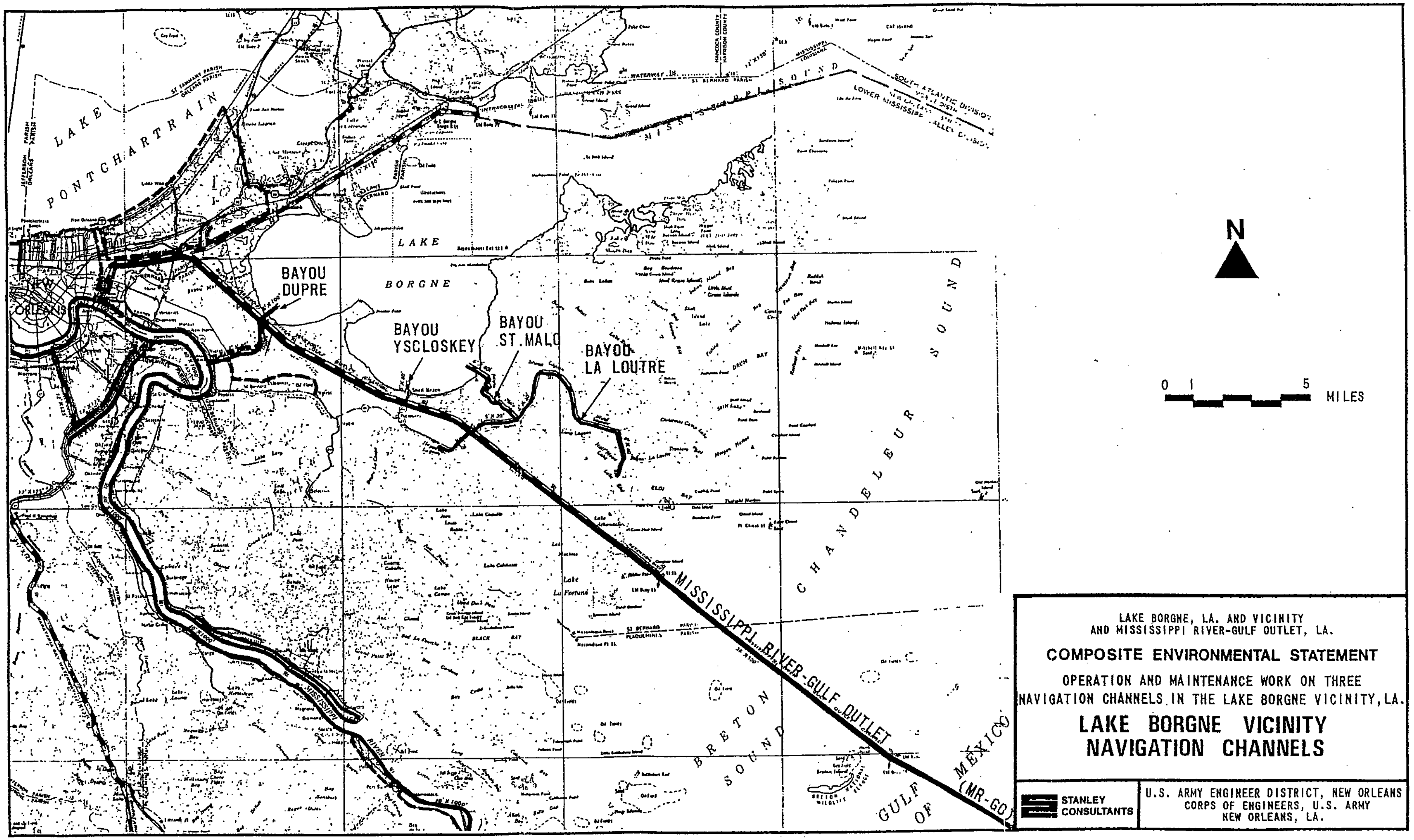
Total Kjeldahl Nitrogen (TKN) values consistently failed the elutriate test also. Concentrations of TKN were increased from values in the .13 mg/1 to .41 mg/1 range in the background water to values in the 2.0 mg/1 to 4.7 mg/1 range in the elutriate.

Several other metals failed several of the samples for various metals, particularly zinc, lead, and nickel.

The results of the samples that were collected in both Breton Sound and Chandeleur Sound show comparable values in the sediment of COD, TKN, mercury, lead, zinc, arsenic, chromium, copper, and nickel to those values in the MR-GO channel. Cadmium showed slightly higher results in the channel as compared to Breton Sound and Chandeleur Sound.

Elutriate results of the samples collected from Breton and Chandeleur Sounds are similar to those of the MR-GO. Arsenic, for example, failed the elutriate test in 13 of 19 samples. The magnitude of the arsenic values in the elutriate samples from the two Sounds were also comparable with both locations recording high values of 18 µg/1.

An analysis of the data indicates that arsenic and TKN are the parameters of major concern in ocean disposal of dredged material from the MR-GO ship channel. As pointed out previously, most of the arsenic values in the elutriate from the channel were in the 0 µg/1 to 5 µg/1 values, but with a few values as high as 18.0 µg/1. Water quality criteria for marine estuarine waters proposed by EPA in 1973 set a maximum allowable concentration of arsenic as 50 µg/1. The highest arsenic value in the elutriate was 18 µg/1, far below the maximum allowable concentration. As a result, it can be concluded that while several sediment and elutriate tests fail for arsenic, arsenic should not have a serious adverse effect on the water quality in the area of MR-GO ship channel. In addition, sediment and elutriates as far away as 2.25 miles from the project contain similar amounts of arsenic.



LAKE BORGNE, LA. AND VICINITY
AND MISSISSIPPI RIVER-GULF OUTLET, LA.

COMPOSITE ENVIRONMENTAL STATEMENT

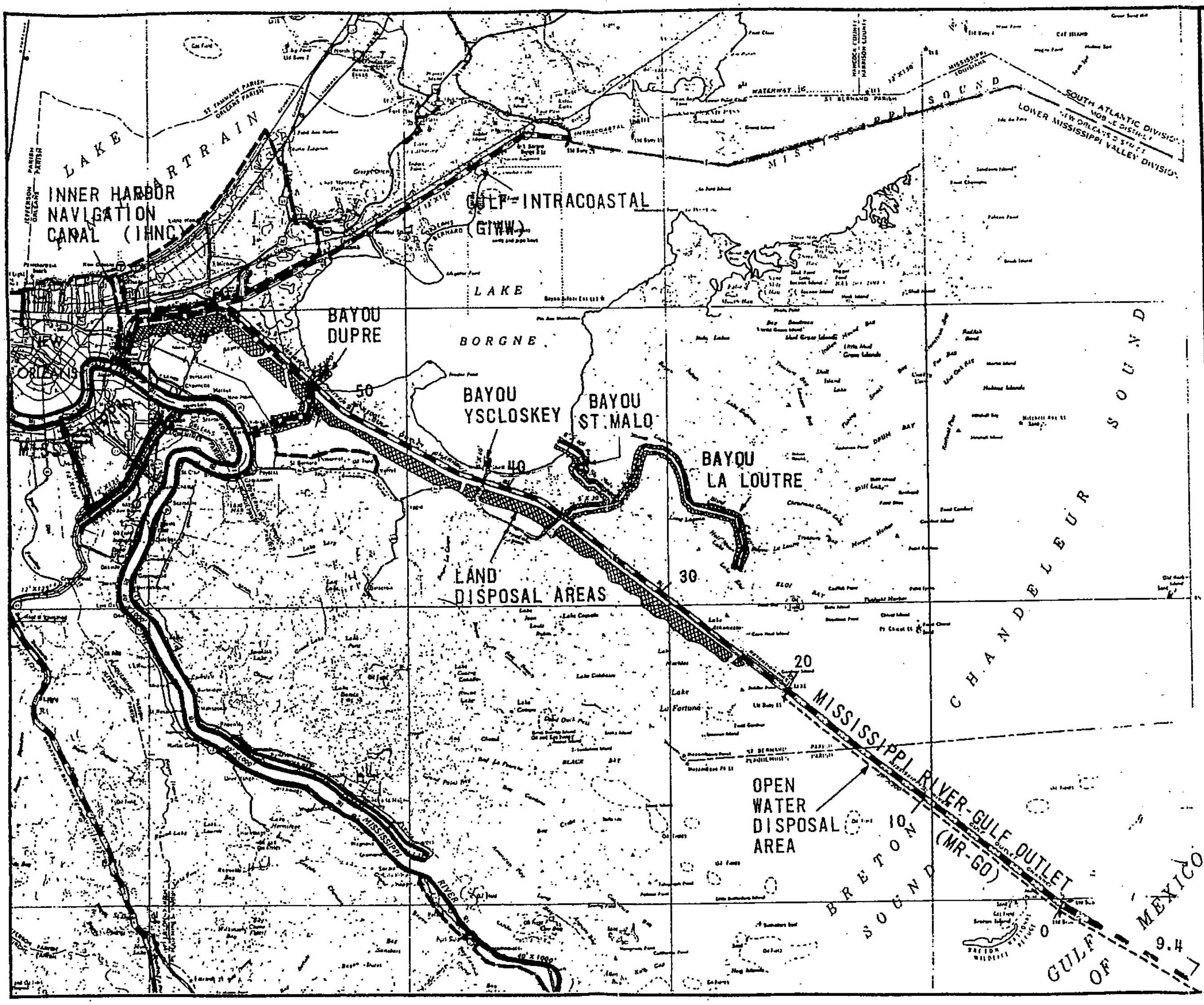
OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

LAKE BORGNE VICINITY NAVIGATION CHANNELS

STANLEY CONSULTANTS

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

PLATE 1



MR-GO DISPOSAL AREAS

LOCATION		AREA
MILE 66-MILE 61 SOUTH TO BAYOU BIENVENUE	=	1,427 ACRES
MILE 61-MILE 59 SOUTH TO BAYOU BIENVENUE	=	713 ACRES
MILE 59-MILE 47 TO 4000' I MI	=	2,911 ACRES
MILE 47-MILE 24 TO 2000' I MI (FROM 2000' TO 4000' NOT BEING USED FOR SPOIL)	=	5,560 ACRES
		10,611 ACRES

LAKE BORGNE, LA. AND VICINITY
AND MISSISSIPPI RIVER-GULF OUTLET, LA.

COMPOSITE ENVIRONMENTAL STATEMENT

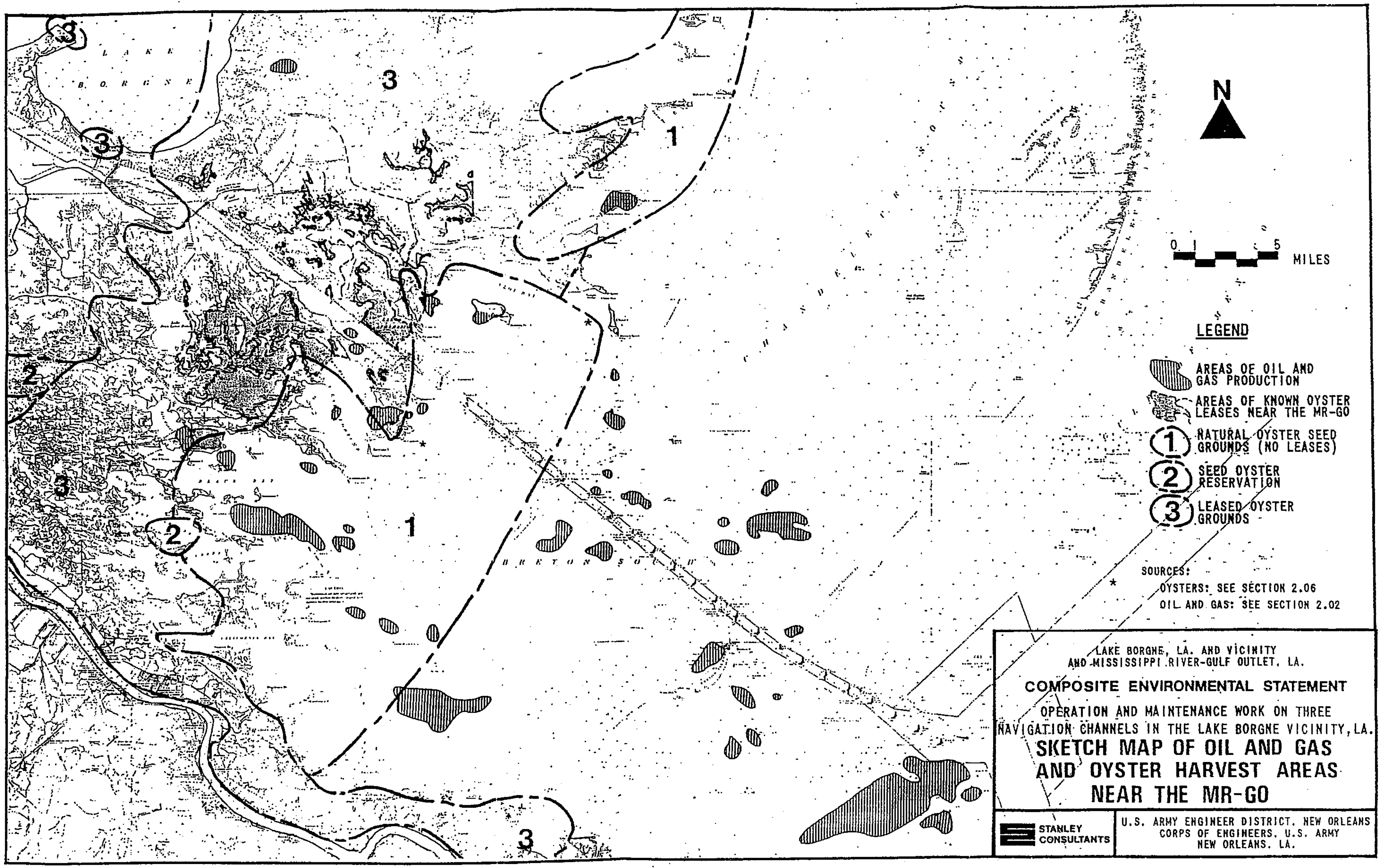
OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

MAJOR FEATURES OF THE MR-GO AND DISPOSAL AREAS

STANLEY CONSULTANTS

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

PLATE 2



LAKE BORGNE, LA. AND VICINITY
AND MISSISSIPPI RIVER-GULF OUTLET, LA.

COMPOSITE ENVIRONMENTAL STATEMENT

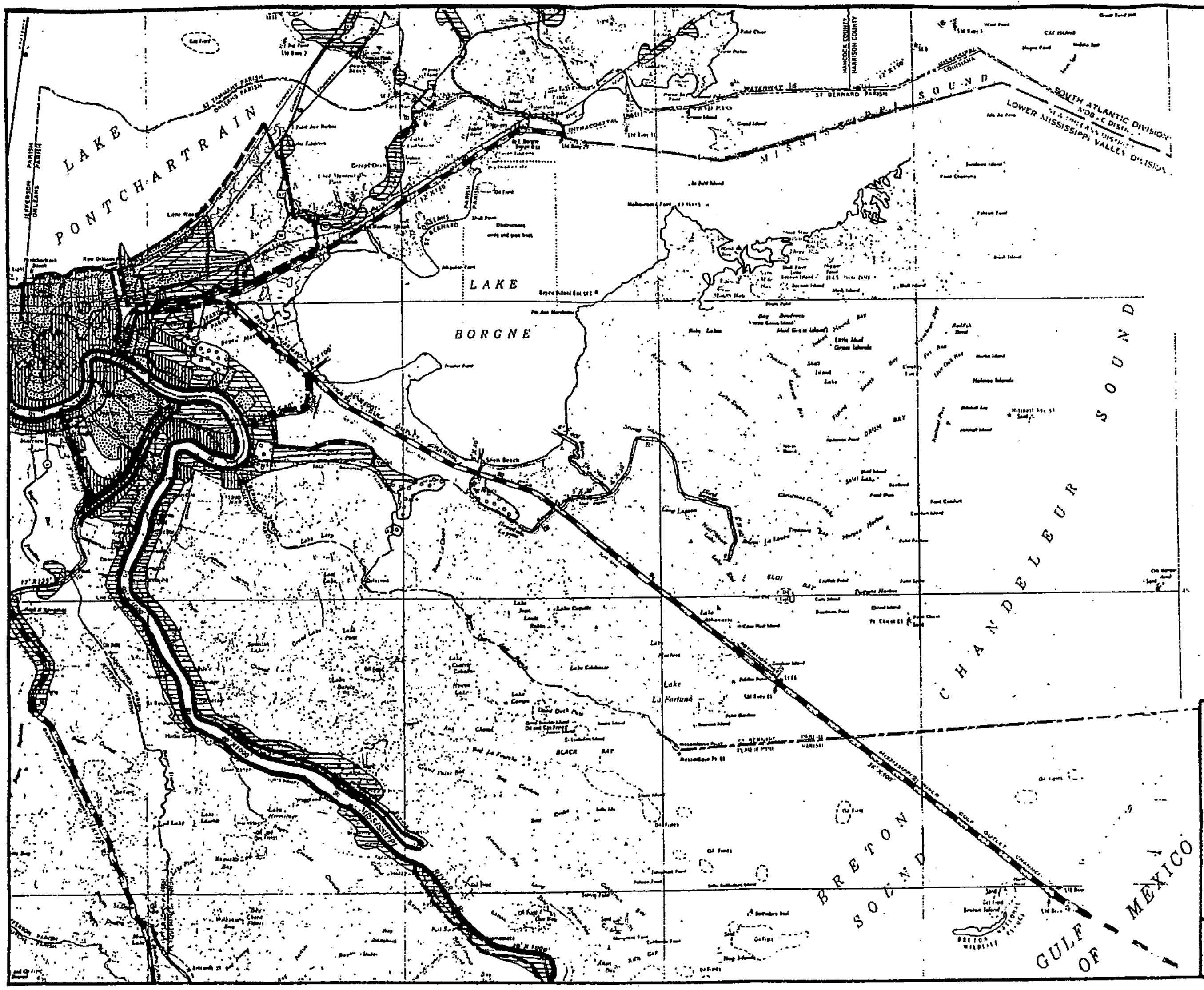
OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

SKETCH MAP OF OIL AND GAS AND OYSTER HARVEST AREAS NEAR THE MR-GO

STANLEY CONSULTANTS

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

PLATE 3



N

0 1 5 MILES

LEGEND

- ▨ URBAN RESIDENTIAL
- ▥ URBAN COMMERCIAL/ INDUSTRIAL
- ▤ AGRICULTURAL OR VACANT
- ⁘ STRIP AND CLUSTERED SETTLEMENT
- ⎍ NEW ORLEANS CITY LIMITS

LAKE BORGNE, LA. AND VICINITY
AND MISSISSIPPI RIVER-GULF OUTLET, LA.

COMPOSITE ENVIRONMENTAL STATEMENT

OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

EXISTING LAND USE

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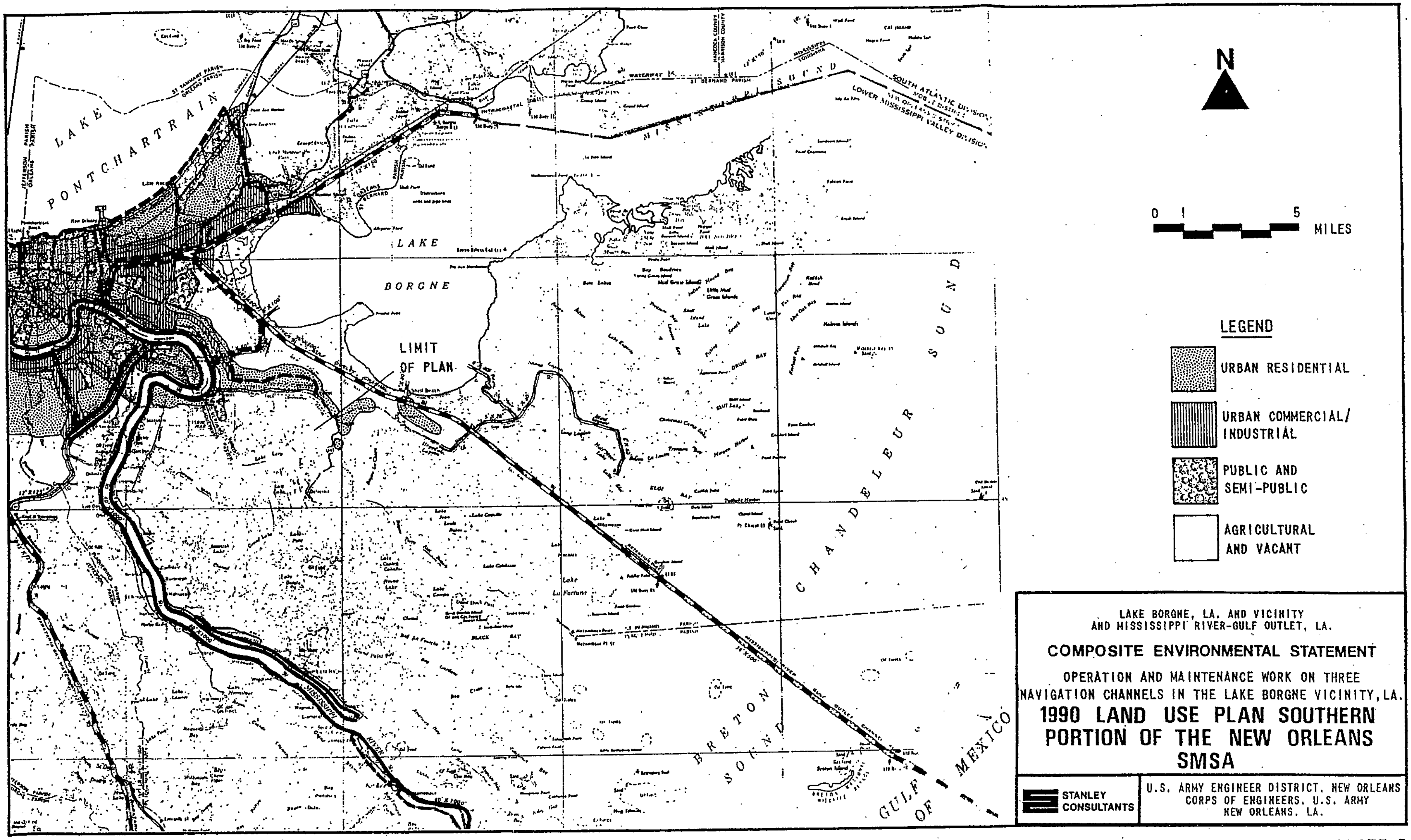
CORPS OF ENGINEERS, U.S. ARMY
NEW ORLEANS, LA.

PLATE 4



LAKE BORGNE, LA. AND VICINITY
AND MISSISSIPPI RIVER-GULF OUTLET, LA.

COMPOSITE ENVIRONMENTAL STATEMENT

OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

1990 LAND USE PLAN SOUTHERN PORTION OF THE NEW ORLEANS SMSA

STANLEY
CONSULTANTS

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

PLATE 5

CARGO PROFILE IN PORT OF NEW ORLEANS

CARGO		AVG. QUANTITIES IN RECENT YEARS (SHORT TONS/YEAR)(1)	FACILITIES		TRADE(3)		PRIMARY SHIPMENT(4)						TRANSSHIPMENT(5)		
CATEGORY	GROUP AND MAJOR COMMODITIES IN THE GROUP		PUBLIC	PRIVATE	FOREIGN	DOMESTIC	FREIGHTERS	CONTAINER SHIPS	BARGE CARRIERS	TANKERS	DRY BULK CARRIERS	BARGES	BARGE	RAIL	TRUCK
GENERAL CARGO	RAW COTTON	210,000	■		■		■	●▲	●▲					■	●
	BANANAS	400,000	■		■		■							■	
	FRUITS, VEGETABLES, MEAT & DAIRY PROD.	140,000	■		■	●	■	■▲						■	●▲
	LOGS, TIMBER, LUMBER, VENEER, PLYWOOD	280,000	●	■	■	●	■		●▲				●	■	
	PULP PAPER AND PRODUCTS	600,000	■		■		■	●▲	■▲				●	■	
	IRON AND STEEL FORMS, SHAPES, SHEETS, PIPE	1,600,000	■	●	■	●	■		●▲			●	●	●	
	AUTOMOBILES, BOATS, TRANSPORT EQUIPMENT	100,000	■		■	●	■	●▲	●▲					■	●
	OTHER GENERAL (COFFEE, RUBBER, MACHINERY, ETC.)	2,000,000	■	●	■	●	■	●▲	●▲			●	●	■	●▲
DRY BULK	GRAIN AND MILL PROD. (CORN, WHEAT, SOYBEAN)	15,000,000(2)	●	●	■		●		●▲	●▲	■		■	●	
	DOMESTIC BULK (SHELLS, COAL, PHOSPHATE, SAND, ETC.)	11,000,000		■		■				●▲	●	●	■	●	
	FOREIGN BULK (SUGAR, ALUMINA, SULPHUR, ETC.)	3,500,000	●	●	■		●		●▲	●▲	■		●	●	
BULK LIQUID	PETROLEUM CRUDE AND REFINED	40,000,000		■		■				■		●	■		
	WATER	750,000		■		■						■			
	SULPHUR (LIQUID)	3,300,000		■		■				●		●			
	MOLASSES, OILS, FATS	1,000,000	●	■	●	●	■		●▲				■	●	
	ALCOHOLS, ACIDS, BASIC CHEMICALS	100,000		■	●	■	●			■		●	■	●	

CARGO		WHARF HANDLING					TERMINAL STORAGE				CONTAINERIZATION(6)		
CATEGORY	GROUP AND MAJOR COMMODITIES IN THE GROUP	SHIPS GEAR	CONVEYORS AND SCOOPS	PIPELINE	RORO	SHORE CRANES	OPEN OR CONTAINERIZED	COVERED	REFRIGERATED	TANKS	LIKELY	POSSIBLE	UNLIKELY
GENERAL CARGO	RAW COTTON	■					●▲	■				■	
	BANANAS		■						■			■	
	FRUITS, VEGETABLES, MEAT & DAIRY PROD.	■				■▲			■		■		
	LOGS, TIMBER, LUMBER, VENEER, PLYWOOD	■				●▲	■	●				●	■
	PULP, PAPER AND PRODUCTS	■				■▲	●▲	■			■	●	
	IRON AND STEEL FORMS, SHAPES, SHEETS, PIPE	■				●▲	●	●			●		●
	AUTOMOBILES, BOATS, TRANSPORT EQUIPMENT	■			●▲	●	■	●			●		■
	OTHER GENERAL (COFFEE, RUBBER, MACHINERY, ETC.)	■			●▲	■▲	■▲	■			■		●
DRY BULK	GRAIN AND MILL PROD. (CORN, WHEAT, SOYBEAN)		■							■		●	■
	DOMESTIC BULK (SHELLS, COAL, PHOSPHATE, SAND, ETC.)		■				■						■
	FOREIGN BULK (SUGAR, ALUMINA, SULPHUR, ETC.)		■				■			●		●	■
BULK LIQUID	PETROLEUM CRUDE AND REFINED			■						■			■
	WATER			■						■			■
	SULPHUR (LIQUID)			■						■			■
	MOLASSES, OILS, FATS			■						■			■
	ALCOHOLS, ACIDS, BASIC CHEMICALS			■						■			■

LEGEND

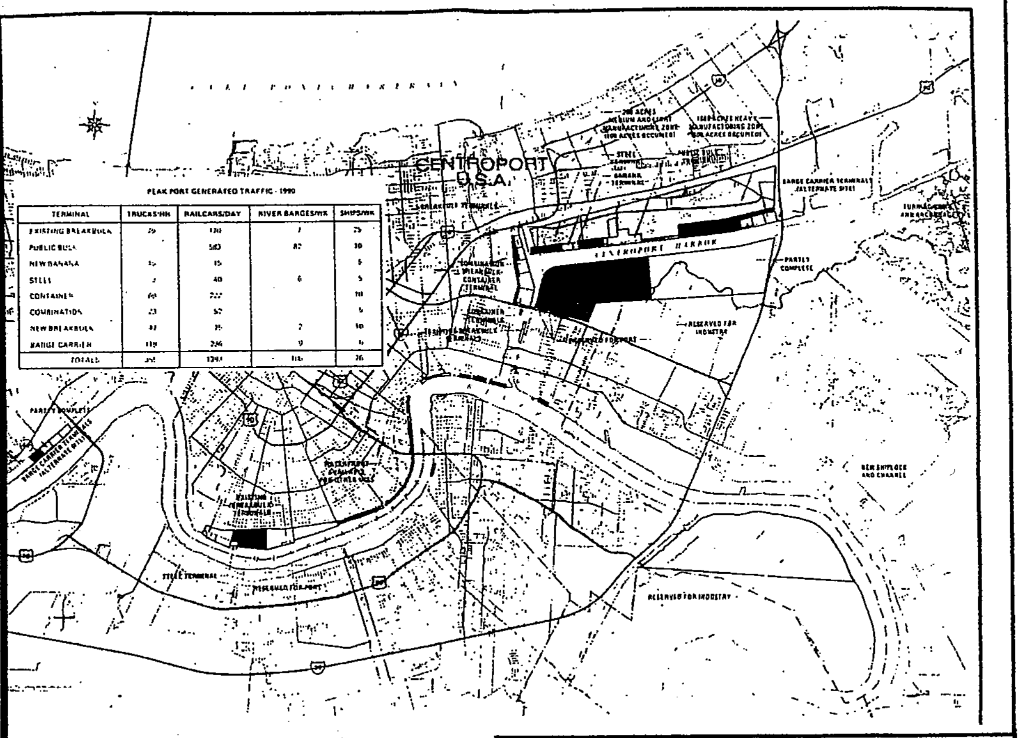
- ■ DOMINANT (80% OR MORE)
- ● CONSIDERABLE (30% TO 80%)
- ◆ SOME (10% TO 30%)
- ▲ FUTURE

NOTES

(1) BASED ON DEPARTMENT OF COMMERCE AND CORPS OF ENGINEERS STATISTICS BUT WITHOUT BARGE-SHIP DOUBLE COUNTING
(2) HANDLED BY 5 GRAIN ELEVATORS AND 1 BULK MEAL FACILITY
(3) FOREIGN - IMPORTS AND EXPORTS. DOMESTIC - COASTWISE, INBOUND AND LOCAL
(4) INDICATES PROPORTION OF VARIOUS TYPES OF WATER TRANSPORTATION IN PORT SHIPMENTS AND RECEIPTS, EXCLUDING BARGE TRANSSHIPMENT TRAFFIC
(5) INDICATES PROPORTION OF BARGE, RAIL AND TRUCK TRANSPORTATION IN DISTRIBUTING AND COLLECTING OCEANGOING CARGO
(6) INCLUDES POTENTIAL CARGO FOR CONTAINERSHIP AND BARGE CARRIERS

From New Orleans Centroport USA Master Plan for Long-Range Development; Board of Commissioners of the Port of New Orleans; Bechtel Corporation; 1970.

PORT OF NEW ORLEANS MASTER PLAN YEAR 1990



PEAK PORT GENERATED TRAFFIC - 1990

TERMINAL	TRUCKS/HR	RAILCARS/DAY	RIVER BARGES/HR	SHIPS/WK
EXISTING BREAKBULK	29	170	7	25
PUBLIC BULK		583	82	30
NEW BANANA	15	15		5
STEEL	2	40	6	5
CONTAINER	60	222		10
COMBINATION	23	57		5
NEW BREAKBULK	41	35	2	10
BARGE CARRIER	119	236	9	6
TOTALS	[illegible]	1340	106	96

LAKE BORGNE, LA. AND VICINITY
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COMPOSITE ENVIRONMENTAL STATEMENT

OPERATION AND MAINTENANCE WORK ON THREE
NAVIGATION CHANNELS IN THE LAKE BORGNE VICINITY, LA.

MASTER PLAN

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

PLATE 6