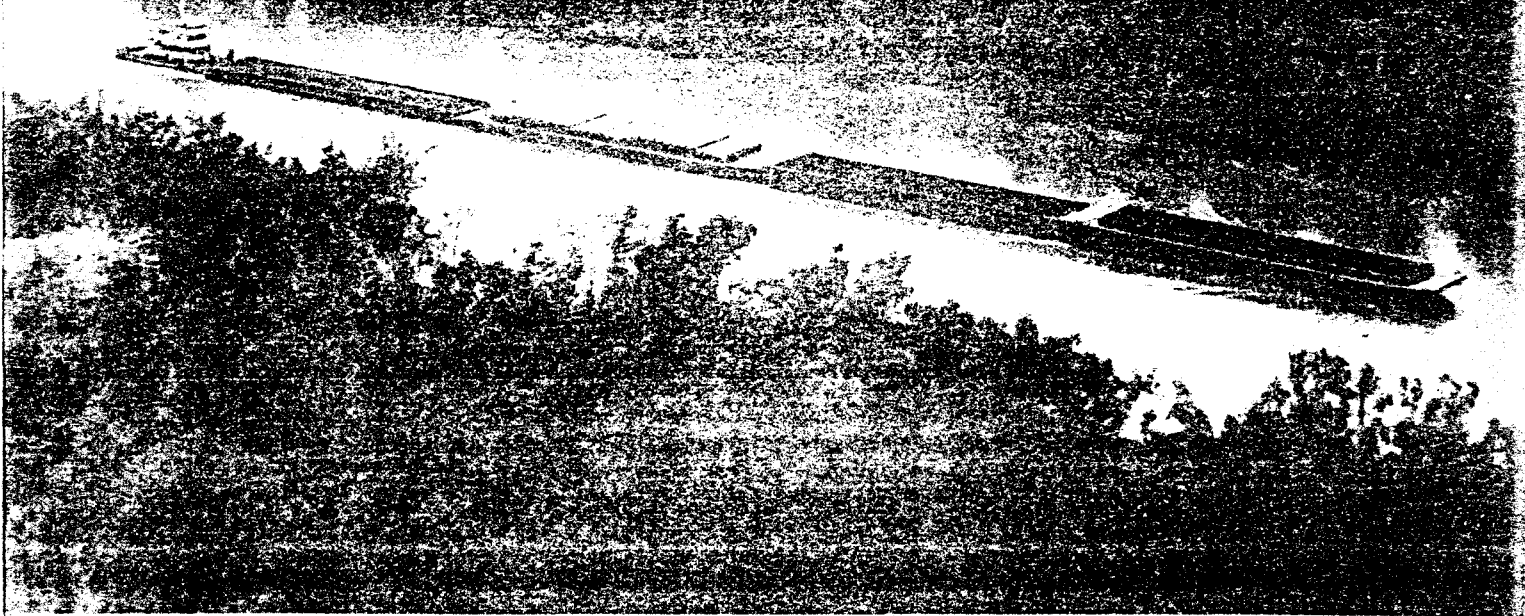


Gulf Intracoastal Waterway: Louisiana
To-Texas Section.

Draft Plan of Study Corps of Engineer
Galveston, Texas 1978

Box 47

Gulf Intracoastal Waterway, Louisiana-Texas Section



DRAFT PLAN OF STUDY



MAY 1978

PREPARED IN THE OFFICES OF THE DISTRICT ENGINEERS
NEW ORLEANS DISTRICT CORPS OF ENGINEERS,
NEW ORLEANS, LOUISIANA AND GALVESTON DISTRICT
CORPS OF ENGINEERS, GALVESTON, TEXAS

"DRAFT"

GULF INTRACOASTAL WATERWAY,
LOUISIANA - TEXAS SECTION

PLAN OF STUDY

Table of Contents

<u>Title</u>	<u>Page</u>
<u>THE STUDY</u>	
PURPOSE AND AUTHORITY	1
SCOPE OF THE STUDY	2
THE REPORT	3
STUDY PARTICIPANTS AND COORDINATION	4
PRIOR STUDIES AND REPORTS	5
<u>RESOURCES AND ECONOMY OF THE STUDY AREA</u>	
ENVIRONMENTAL SETTING AND NATURAL RESOURCES	8
CLIMATE	8
DRAINAGE AND ELEVATION	8
TRIBUTARY CHANNELS AND STREAMS	9
WATER QUALITY	15
WATER SUPPLY	15
FISH	16
WILDLIFE	17
VEGETATION	18
ARCHEOLOGICAL ELEMENTS	21
HISTORICAL ELEMENTS	21
RECREATION AND WILDLIFE MANAGEMENT	23
HUMAN RESOURCES	25
DEVELOPMENT AND ECONOMY	26
GENERAL ECONOMY	26
LAND USE	26
TRANSPORTATION	28
MANUFACTURING	30
AGRICULTURE	32
MINERAL PRODUCTION	32

Table of Contents
Cont'd

<u>Title</u>	<u>Page</u>
<u>PROBLEMS AND NEEDS</u>	34
STATUS OF EXISTING PLANS AND IMPROVEMENTS	34
THE EXISTING PROJECT	34
STATUS OF EXISTING NAVIGATION PLANS	39
STATUS OF EXISTING FLOOD CONTROL PLANS	40
STATUS OF EXISTING HURRICANE PROTECTION PLANS	42
IMPROVEMENTS DESIRED	44
PLANNING OBJECTIVES	45
<u>FORMULATING A PLAN</u>	48
FORMULATION AND EVALUATION CRITERIA	48
TECHNICAL CRITERIA	48
ECONOMIC CRITERIA	49
ENVIRONMENTAL CRITERIA	51
SOCIAL CRITERIA	51
FORMULATION OF ALTERNATIVES	52
BASE CONDITION	53
WITHOUT CONDITION	53
MOST PROBABLE FUTURE	54
OPTIMISTIC FUTURE	54
PESSIMISTIC FUTURE	54
PRELIMINARY MEASURES	54
IMPACT ASSESSMENT AND EVALUATION	61
ALTERNATIVES TO BE CONSIDERED FURTHER	67
DATA REQUIREMENTS	69
ECONOMIC STUDIES	69
ENVIRONMENTAL STUDIES	70
ENGINEERING STUDIES	71
SOCIAL STUDIES	73
OTHER STUDIES	74

Table of Contents
Cont'd

<u>Title</u>	<u>Page</u>
CONSTRAINTS AND CONTROLS	74
PUBLIC INVOLVEMENT	77
STUDY SCHEDULE	79
STUDY COST	81
<u>RECOMMENDATION</u>	81

TABLES

<u>No.</u>	<u>Title</u>	
1	FEDERAL NAVIGATION PROJECTS INTERSECTING GULF INTRACOASTAL WATERWAY	11
2	PUBLICLY ADMINISTERED TRANSPORTATION AGENCIES	29
3	AGRICULTURE STATISTICAL SUMMARY	33
4	NAVIGATION LOCKS ALONG GULF INTRACOASTAL WATERWAY	35
5	PROBLEMS AND NEEDS: IMPROVEMENTS DESIRED AND OTHER EXPRESSED CONCERNS	46
6	STAGE I MEASURES AND THE PLANNING OBJECTIVES THEY ADDRESS	55
7	SCHEDULED MILESTONES	80

PLATES

<u>No.</u>	
1	GIWW, LA-TEX (GENERAL MAP)
2	GIWW, LA-TEX (LOUISIANA SECTION)
3	GIWW, LA-TEX (EAST TEXAS SECTION)
4	GIWW, LA-TEX (WEST TEXAS SECTION)
5	STUDY SCHEDULE

Table of Contents
Cont'd

ATTACHMENTS

No.

- 1 PB-6
- 2 LISTING OF REFERENCE MATERIALS AND AVAILABLE DATA

THE STUDY

The study will be conducted in three stages: preliminary examination, alternative development, and study recommendations. Each stage undertaken results in the preparation of a study document: the Plan of Study (POS), study alternatives, and the final report.

This document serves as the Plan of Study. It outlines the study objective, addresses methods of public participation in the planning process, delineates the study area, and describes available data. It further relates the study objective with existing water resource projects and planning efforts. Estimates of time and cost required to perform the study and a schedule of major milestones in study accomplishments are provided.

In short, the plan of study serves as the primary management tool and informative aid for the conduct of the study.

PURPOSE AND AUTHORITY

The purpose of this study is to investigate the Federal project on the Gulf Intracoastal Waterway (GIWW) between the Mississippi River at New Orleans, Louisiana, and Brownsville, Texas, in order to determine the adequacy of the existing and authorized channel dimensions and to develop the most suitable plan for improving the efficiency and safety of waterway operations in this reach. It will be equally important to protect the surrounding environment and to insure the compatibility of any proposed plans with those of other Federal, state, and local agencies.

Authority for the study is contained in the following resolutions of Congress:

Resolution at the request of Senators Long and Edwards of Louisiana, adopted by the Committee on Public Works of the United States Senate on 29 September 1972, that the "Board of Engineers for Rivers and Harbors, be, and is hereby, requested to review the reports on the Gulf Intracoastal Waterway (Louisiana - Texas Section, including the Morgan City - Port Allen Route) submitted in House Document 556, 87th Congress, Second Session, and subsequent reports, with a view to determining the advisability of modifying the existing project in any way at this time, particularly with regard to widening and deepening the existing and/or authorized channel."

Resolution at the request of Congressman Jack Brooks of Texas, adopted by the Committee on Public Works of the United States House of Representatives on 12 October 1972, that the "Board of Engineers for Rivers and Harbors, be, and is hereby, requested to review the reports on the Gulf Intracoastal Waterway (Louisiana - Texas Section, including the Morgan City - Port Allen Route) submitted in House Document 556, 87th Congress, second session, and subsequent reports, with a view to determining the advisability of modifying the existing project in any way at this time, particularly with regard to widening and deepening the existing and/or authorized channel."

SCOPE OF THE STUDY

The study will encompass the 748.1 miles of the Gulf Intracoastal Waterway and its surrounding environs between the Mississippi

River at New Orleans, Louisiana, and the waterway's termination at Brownsville, Texas, as shown on plates 1 through 4. Investigations will be made of the area consisting of the fourteen Louisiana parishes¹ and the eighteen Texas counties² with proximity to the waterway, to determine: the nature and extent of navigation inefficiencies and safety hazards associated with channel dimensions and alignment, lock placement, sizes and operations, and bridge crossings; the magnitude of the environmental problems associated with waterway operation and maintenance, bank erosion, and saltwater intrusion; the measures available for improving waterway operations and protecting the surrounding environment; the accompanying costs and benefits; and the selection of the most feasible plans. The study will be coordinated with concerned agencies and the public and will be made in the depth and the detail needed to permit plan selection and to establish its feasibility.

THE REPORT

The final report for the study will be written in a concise, straightforward manner, understandable to a layman. It will consist of a main report backed up by several technical appendixes. The main report will be a self-contained summary document; the appendixes will contain detailed presentations of the economic, engineering, and environmental considerations.

¹Louisiana Parishes: Orleans, Plaquemines, Jefferson, Lafourche, Terrebonne, St. Mary, St. Martin, Iberville, Assumption, West Baton Rouge, Iberia, Vermilion, Cameron, and Calcasieu.

²Texas Counties: Orange, Jefferson, Chambers, Galveston, Harris, Brazoria, Matagorda, Calhoun, Victoria, Jackson, Aransas, Refugio, San Patricio, Nueces, Klebert, Kenedy, Willacy, and Cameron.

An environmental impact statement (EIS) will accompany the report. This EIS will provide environmental assessments and evaluations of investigated alternatives and will be coordinated along with the report documents to form a complete report, which contains both engineering and environmental considerations and conclusions.

STUDY PARTICIPANTS AND COORDINATION

The study of the Gulf Intracoastal Waterway, Louisiana - Texas Section will be conducted jointly by the New Orleans and Galveston Districts. The New Orleans District will be responsible for the overall management of the study and report preparation.

The study will be coordinated with interested Federal, state and local agencies, and the public. The newly created Louisiana Coastal Commission will furnish technical assistance and help coordinate with various participants from the State of Louisiana. Technical assistance will be provided by several canal and towing associations in the study area. Technical assistance and review will be provided by the Texas Water Development Board. Drainage, irrigation, and land use studies will be coordinated with the Soil Conservation Service. Recreation, fish and wildlife, and certain environmental studies will be coordinated with the US Fish and Wildlife Service, National Marine Fisheries Service, Texas Parks and Wildlife Department, and Louisiana Wildlife and Fisheries Commission. Water and air quality, water quantity, and certain environmental quality studies will be coordinated with the US Environmental Protection Agency. Technical, hydraulic, and hydrologic assistance will be provided by the Coastal Engineering and Research Center. Input on mineral exploration and production will

be provided by the Bureau of Mines. The National Park Service will provide input on archeological sites and historic landmarks in the study area. Technical assistance with respect to navigation and shipping requirements and trends will be provided by the US Coast Guard, the Waterborne Commerce and Statistics Center, and various waterway and towing associations, as well as the port authorities of the various ports along the waterway. Contact will be maintained with councils of governments in both states to insure continued public cooperation and participation. All phases of the study will be presented to the public for review and recommendations.

PRIOR STUDIES AND REPORTS

There have been numerous reports on the Gulf Intracoastal Waterway, dating back to 1873. Those pertinent to this study are as follows:

Preliminary Examination, Intracoastal Waterway from the Mississippi River at or near New Orleans, Louisiana, to Corpus Christi, Texas, April 1924 (published as House Document 68-238).

Review of Reports, Colorado River, Texas, December 1936.

Review of Reports, Intracoastal Waterway from the Mississippi River at or near New Orleans, Louisiana, to Corpus Christi, Texas, March 1939 (published as House Document 76-230).

Review of Reports, Intracoastal Waterway from Corpus Christi, Texas, to the Rio Grande, September 1941 (published as House Document 77-402).

Review of Reports, Gulf Intracoastal Waterway in the Vicinity of Aransas Pass, Texas, July 1946 (published as House Document 79-700).

Review of Reports, Gulf Intracoastal Waterway in South Galveston Bay, Texas, May 1949 (published as House Document 81-196).

Review of Reports, Intracoastal Waterway from the Mississippi River at New Orleans, Louisiana, to Corpus Christi, Texas (Alternate connection with the Mississippi River in the vicinity of Algiers at New Orleans, April 1944 (published as Senate Document 188, 78-2)).

Review of Reports, Plaquemine - Morgan City Route, Intracoastal Waterway, April 1946 (published as Senate Document 242, 79-2).

Mermentau River and Tributaries and Gulf Intracoastal Waterway and connecting Water, Louisiana, April 1946 (published as Senate Document 231, 79-2).

Review of Reports, Gulf Intracoastal Waterway, Channel to Port Mansfield, Texas, February 1959 (published as Senate Document 11, 86-1).

Review of Reports, Gulf Intracoastal Waterway, Louisiana - Texas Section, September 1962 (published as House Document 87-556).

Final Environmental Statement: Gulf Intracoastal Waterway; Petit Anse, Tigre and Carlin Bayous; and Bayou Grosse Tete, Louisiana, September 1976 (Final Statement filed with CEQ 4 February 1977).

Final Environmental Statement: Maintenance Dredging Gulf Intracoastal Waterway Texas Section, October 1975 (Final Statement filed with CEQ 26 January 1976).

These reports will be a valuable source for background data on past improvements, navigation, commodity movement, history, water quality, geological formations, and environmental conditions.

RESOURCES AND ECONOMY OF THE STUDY AREA

The first Federal project for an inland shallow-draft channel on the gulf coast was authorized in 1828 when Congress appropriated \$18,000 for construction of a channel from Mobile Bay to the Mississippi Sound. From then until 1942, the inland waterway developed in sections as needs arose, gradually becoming more extensive with interconnecting waterways and with heavily used sections being deepened and widened. The connected shallow-draft channel system became known as the Gulf Intracoastal Waterway.

The Gulf Intracoastal Waterway intersects all deep-draft ship channels along the gulf coast and connects with many navigable waterways to shallow-draft ports in Texas, Louisiana, Mississippi, Alabama, Georgia, and Florida. This system of channels serves as the primary pathway for nearly all small commercial and recreational vessels berthed on the United States gulf coast. The channel follows a course generally paralleling the gulf shoreline and offers a shortened, protected route between major ports allowing shallow-draft vessels to transport cargo that would otherwise require larger gulf vessels.

The following section of this Plan of Study briefly summarizes the environment, natural and human resources, and the development and economy of the portion of the GIWW currently under study. A summary of available reports and data which will be helpful in this study follows at the end of this section.

ENVIRONMENTAL SETTING AND NATURAL RESOURCES

CLIMATE. The climate in the study area varies from subtropical marine at New Orleans to a semiarid regime at the Texas - Mexico border. Summer temperatures are generally high while moderate temperatures prevail in the winter months. Cold periods are generally of short duration associated with rapid movement of cool high pressure air masses from the northwest. Average annual temperatures vary from 70°F in the eastern portion of the study area to 74°F in the western portion. Precipitation across the study area varies from an average of 60 inches at New Orleans to 26 inches at Brownsville, Texas. Fog is most frequent in the winter months. Snow rarely occurs in the study area. Tropical cyclones (hurricanes) frequently occur along the coastal study area bringing unusually heavy rainfall and winds in excess of 74 miles per hour. These storms generally occur during the months of June through October; the frequency of occurrence of these storms ranges from none to several per year. The most severe damage resulting from these storms is generally confined to an area less than 100 miles wide. The major causes of damages during a hurricane are inundation by tidal surge and/or torrential rains and structural damage from high winds.

DRAINAGE AND ELEVATION. About two thirds of the Gulf Intracoastal Waterway lies within the coastal region of Louisiana and Texas. The general hydrology of the study area reflects the influence

of the major rivers and their distributaries, and the relationship with warm, saline waters of the Gulf of Mexico. The coastal area is laced with both manmade canals and drainage features as well as major river and tributary systems. Also prevalent are marshes, bayous, and swamps. The hydrology is often complex, a result of both natural and man-induced modifications which are reflected in the saline, brackish, and freshwater conditions of the system. Natural drainage patterns and basin flow are directionally southward but are often diverted or intercepted by manmade hydrologic features.

Elevations along the waterway are generally less than 5 feet above mean sea level (m.s.l.)³ although occasional higher elevations occur at dredged material disposal areas with elevations to about 10 feet. A salt dome near High Island in Texas has a maximum elevation of 25 feet. Although some barrier islands average 20 feet in elevation and ancient dune ridges in the vicinity of Corpus Christi average 30 feet in elevation, lands immediately adjacent to the waterway remain near 5 feet.

TRIBUTARY CHANNELS AND STREAMS. Throughout the Louisiana-Texas portion of the Gulf Intracoastal Waterway, the canal crosses or intersects many major rivers, navigation channels, and smaller streams and bayous. During the course of the study, detailed consideration will be given to these tributaries and assessments made as to the impacts the various alternatives may have on them. For the purposes of the Plan of Study, it is important to identify those tributaries which are maintained for navigation and which

³ All elevations and stages in this POS are in feet mean sea level unless otherwise noted.

contribute to the overall commerce of the Louisiana-Texas portion of the waterway. Pertinent data on Federal navigation projects is provided in table 1.

In Louisiana, the waterway crosses six major rivers: the Mississippi River, Atchafalaya River, Mermentau River, Calcasieu River, Vermilion River, and the Sabine River on the border between Louisiana and Texas. In addition, the waterway crosses the manmade Wax Lake Outlet and numerous other navigation canals and bayous including; Bayou Segnette, Bayou Barataria, Bayou Lafourche, Bayou Terrebonne, the Houma Navigation Canal, Franklin Canal, Bayou Petit Anse, Schooner Bayou, Freshwater Bayou, and the Vinton Waterway.

In Texas, the waterway crosses five major rivers which, including the previously mentioned Sabine, are the Neches River, the Brazos River, the San Bernard River, and the Colorado River. Other navigation channels either crossed or intersected by the waterway in Texas are: Offatts Bayou Channel, Chocolate Bayou Channel, Palacios Channel, Victoria Channel, Channel to Seadrift, Rockport Channel, Aransas Pass Channel, Port Mansfield Channel, Channel to Herlingen via Arroyo Colorado, Port Isabel Side Channel, Port Isabel Small Boat Harbor and alternate routes in Galveston and Aransas Bays. Other channels serving as connecting links to recreational, manufacturing, and industrial areas include: The Sabine-Neches Waterway, Houston Ship Channel, Galveston Harbor and Channels, Texas City Channel, Port Bolivar Channel, Freeport Harbor, Matagorda Ship Channel, Corpus Christi Ship Channel, and Brazos Island Harbor.

Floodgates and navigation locks assist vessels navigating between or across some rivers from the waterway. These are located on the Mississippi, Atchafalaya, Vermilion, and Calcasieu Rivers

TABLE 1
FEDERAL NAVIGATION PROJECTS INTERSECTING GULF INTRACOASTAL WATERWAY

Project Name	Location (Mile West of Harvey)	Channel Length (miles)	Channel Size (feet)	Percent Complete	Remarks
Mississippi River Baton Rouge to the Gulf of Mexico	0	129.3 4.1 17.5 86.7	40 X 500 40 X 600 40 X 800 40 X 1000	100 100 100 100	
Algiers Alternative Route	6	9.8	12 X 125	100	
Bayou Segnette	15	12.2	9 X 60	63	Interim 6' X 80' channal complete
Barataria Bay Waterway	15	36.9	12 X 125	100	
Bayou Lafourche	35	13.2 8.7 17.7	12 X 125 9 X 100 6 X 60	100 100 100	Additional old route to Lockport and back to GIWW 100% complete at 9' X 100'
Lafourche-Jump Waterway	37	30.4	12 X 125	13	
Bayou Terrebonne	57	24.1	6 feet deep	100	
Bayou LeCarpe	58	1.6	10 X 45	100	
Houman Navigation Canal	59	30.5 (land) 10.0 (bay) 3.9 (gulf)	15 X 150	100	

TABLE 1 (continued)
FEDERAL NAVIGATION PROJECTS INTERSECTING GULF INTRACOASTAL WATERWAY

Project Name	Location (Mile West of Harvey)	Channel Length (miles)	Channel Size (feet)	Percent Complete	Remarks
Atchafalaya River & Bayous Chene Boeuf, & Black	86	52.0	20 X 400	-	Approximately 23 miles complete in Atchafalaya Bay. Land cut not begun.
Morgan City-Port Allen Route	95.5	64.1	12 X 125	100	
Atchafalaya River - Morgan City to Gulf of Mexico	96-98	15.8	20 X 200	100	
Franklin Canal	121	6.0	8 X 50	100	
Charenton Canal	122	6.5	12 X 50	100	
Petit Anse, Tigre, and Carlin Bayous	147	2.7 6.1 7.6	7 X 60 9 X 80 9 X 80	100 100 100	GIWW to Gulf Bayou Petit Anse Bayou Carlin
Bayou Teche and Vermilion River	157	5.0 47.0	8 X 80 9 X 100	100 100	Vermilion Bay to GIWW GIWW to Head of Navigation
Freshwater Bayou	161	3.2 (bay) 19.5 (land)	12 X 125	100	

TABLE 1 (continued)
FEDERAL NAVIGATION PROJECTS INTERSECTING GULF INTRACOASTAL WATERWAY

Project Name	Location (Mile West of Harvey)	Channel Length (miles)	Channel Size (feet)	Percent Complete	Remarks
Mermentau River, Bayous Nezpique and Des Cannes	203	83.0	12 X 125	100	12' X 200' channel through Lake Arthur
Calcasieu River and Pass	242	23.6	42 X 800	100	Gulf Section
		35.0	40 X 400	100	Gulf to Lake Charles
		2.0	35 X 250	100	Lake Charles to I-10
			Clear & snag	100	I-10 to Phillips Bluff
Vinton Waterway	258	9.7	9 X 60	Authorized	GIWW to Vinton
Sabine River Channel	266-276	10.5	30 X 200	100	
Sabine-Neches Canal	276-288	11.4	40 X 400	100	
Offatts Bayou	358	2.2	12 X 125	100	
Houston Ship Channel	350	38.9	40 X 400	100	
		8.7	40 X 300	100	
		1.5	36 X 300	100	40' X 300' Authorized
		1.4	36 X 300	100	
Texas City Channel	351	6.8	40 X 400	100	
Chocolate Bayou	376	8.2	12 X 125	Authorized	10' X 100' completed by local
		5.2	9 X 100		to mile 8.2

TABLE 1 (continued)
FEDERAL NAVIGATION PROJECTS INTERSECTING GULF INTRACOASTAL WATERWAY

Project Name	Location (Mile West of Harvey)	Channel Length (miles)	Channel Size (feet)	Percent Complete	Remarks
Freeport Harbor	395	3.2 2.3	36 X 200 30 X 200	100 100	45' X 400' Authorized
San Bernard River	405	26.0	9 X 100	100	
Colorado River Channel	441	15.5	9 X 100	100	
Channel to Palacios	465	17.0	12 X 125	100	
Matagorda Ship Channel	471	22.2	36 X 200	100	
Channel to Victoria	492	35.0	9 X 100	100	
Channel to Rockport	523	2.0	9 X 200	100	
Tributary Channel to Aransas Pass	534	6.0	12 X 125	100	14' X 125' authorized
Corpus Christi Ship Channel	540	31.5	40 X 400	100	45' X 400' under construction
Channel to Port Mansfield	632	9.6	14 X 100	100	
Channel to Harlingen	646	26.0	9 X 100	100	
Port Isabel Side Channels	666 668	1.5 1.0 1.0	7 X 75 12 X 125 12 X 233-60	100 100 100	
Brazos Island Harbor	669	20.5	36 X 200	42	Work remaining: widening 3.5 mile to 300' - 1,000', extension of north jetty.

in Louisiana and on the Brazos and Colorado Rivers in Texas. During periods of extreme flooding in Texas, vessel traffic is occasionally halted until river stages and flows subside to safe levels. Vessels generally experience little difficulty in crossing other rivers and streams in the study area.

WATER QUALITY. There are two existing Federal projects in the Louisiana portion of the study area which maintain water quality standards (prevention of saltwater intrusion) in the Gulf Intracoastal Waterway: the Vermilion Lock and the Calcasieu Lock projects.

Major water quality problems in the waterway stem from increasing saltwater intrusion into the coastal zone; industrial and stormwater pollution in the vicinity of New Orleans, Morgan City to Vermilion Bay, and in the Calcasieu River; bacterial pollution in these same areas; and pesticide pollution in the agricultural zones.

Point and nonpoint pollution of the open waters of many Texas bays and along various reaches of the GIWW exceed EPA criteria of 1976 for one or more parameters. These levels of pollutants are directly attributed to a combination of agricultural runoff, urban stormwater runoff, and industrial effluents. Bacterial pollution from domestic and commercial sources is also evident in portions of Texas coastal bays and pesticide problems occur primarily in the southern portion of Laguna Madre.

WATER SUPPLY. Along the Louisiana-Texas portions of the study area, the primary uses of surface waters include transportation, commercial fishing, recreation, industrial water supply, farming (rice and catfish), and dilution of untreated industrial and domestic effluent.

Between New Orleans and Morgan City, surface water withdrawals account for the majority of the municipal water supplies with water being withdrawn from the Mississippi and Atchafalaya Rivers, Bayou Lafourche, and the GIWW. From Morgan City to the Texas border, municipal water supplies are withdrawn almost entirely from ground water sources.

Heavy industrial withdrawals of ground water in the Lake Charles area and accelerated ground water withdrawal for agricultural purposes in the Vermilion River Basin has resulted in significant saltwater intrusion.

Along the Texas portion of the study area, ground water aquifers have long been a principal source of fresh water for municipal, industrial, and agricultural uses. However, in most of the urban areas, surface water from impoundments on rivers is being used to supplement declining ground water levels. Significant water-level declines have occurred in the aquifers in the Houston-Galveston area and the Winter Garden area of south Texas.

Heavy withdrawals of ground water have resulted in saltwater encroachment in the Galveston-Texas City area and the Matagorda-Old Gulf area in Matagorda County.

FISH. The more important freshwater sport fish include white and yellow bass, largemouth bass, white and black crappie, green sunfish, redear sunfish, bluegill, and other sunfish, blue and channel catfish, and freshwater drum. Freshwater commercial fish species are various catfishes and bullheads, gars, carp, buffalo-fish, and gizzard shad. Marine and estuarine-dependent sport and

commercial fish include tarpon, sea catfish, gray snapper, red and black drum, sea trout, pompano, crevalle jack, spot, Atlantic croaker, kingfish, flounder, Spanish mackerel, mullet, bay anchovy, and gulf menhaden. The adjacent gulf waters provide habitat for numerous other commercial and sport fish species.

The study area also provides abundant habitat for aquatic invertebrates. Those of significant commercial importance include white, brown, and pink shrimp, blue crab, crawfish, clams, and oysters.

WILDLIFE. Major mammalian wildlife species occurring in the study area include white-tailed deer, gray fox, squirrels, rabbits, muskrat, nutria, mink, otter, raccoon, opossum, skunk, beaver, bobcat, coyote, red wolf, bats, armadillo, wild boar, nilgai antelope, and bottle nose porpoise. Birds of significance include the mottled duck, fulvous tree duck, wood duck, mallard duck, redhead duck, canvasback, ruddy duck, green-winged teal, pintail, shoveler, gadwall, American lesser scaup, and many other varieties of duck. The species of geese found in the study area include canada, snow, blue, and white-fronted goose. Other game birds found are the coot, bobwhite, dove, various rails and gallinules, snipe, woodcock, and turkey. Other birds of significance include the white pelican, brown pelican, double crested cormorant, great blue heron, yellow crowned night heron, cattle egret, reddish egret, sand hill crane, woodpeckers, ibises, bitterns, roseate spoonbills, ruik, various gulls, terns, and sand pipers and a wide variety of song birds.

Many reptiles and amphibians are found in abundance throughout the study area; most significantly they include a wide variety of snakes, turtles, and the American alligator.

Several species listed as "endangered" are known to, or are suspected to exist within, or adjacent to the study area. Those species known to exist within the study area are the American alligator, brown pelican, southern bald eagle, arctic peregrine falcon, Bachman's warbler, eastern cougar, red wolf, Houston toad, whooping crane, Eskimo curlew, Atwater's greater prairie chicken, Florida manatee, and ocelot. Those species suspected to exist in the study area include the Atlantic ridley turtle, Atlantic hawksbill turtle, Atlantic leatherback turtle, ivory-billed woodpecker, and the red-cockaded woodpecker. The right whale, sperm whale, blue whale, and finback whale are suspected to exist in the adjacent gulf waters.

An area along the mid-Texas coast which includes the Aransas National Wildlife Refuge and portions of Aransas, San Antonio, and Espiritu Santo Bays has been proposed by the US Fish and Wildlife Service as critical habitat for the whooping crane.

VEGETATION. Major plant communities occurring in the study area are: bottomland and swamp forest; fresh, intermediate, and brackish marsh; cleared lands; vegetation growing on chenieres; and dredged material disposal areas. The Louisiana portion of the study area is comprised mostly of coastal marshes with the exception of the Morgan City-Port Allen alternate route which passes mostly through swamp forest and bottomland areas. Of the three marsh communities in Louisiana, fresh marsh is most abundant.

The east Texas portion is characteristic of the marsh communities found in Louisiana; however, marshlands are primarily brackish with some freshwater marsh occurring in isolated ponded areas. Cattails, sedges, rushes, and various grasses are common

in these freshwater marsh areas. Tidal marshes consist predominately of smooth cordgrass and saltgrass. Higher marsh areas consist mainly of marshhay and gulf cordgrass, saltgrass, sea ox-eye, and saltflat grass. These marsh areas contribute nutrients to the waterway in the form of detritus, which provides nourishment for many forms of aquatic life.

Vegetation in existing disposal areas generally consists of a combination of species occurring in marshlands and distributed prairies. Common plants are glasswort, saltwort, cordgrass, saltgrass, sea lavender, saltmarsh elder, and Carolina wolfberry.

Low-lying prairies which consist mainly of hardy grasses and annuals provide good habitat for a variety of wildlife. Many of these prairies have been overgrazed and have been invaded by acacias, smutgrass, ragweed, and cactus. Live oak grassland savannahs occur occasionally between Port Bolivar and Sabine Pass.

Submerged aquatic vegetation is practically nonexistent between Sabine Lake and Galveston Bay primarily due to high natural turbidities. Between Galveston Bay and Matagorda Bay marshlands, low-lying prairies, shallow bay areas, and disposal sites provide habitats for a diversity of plant species. Marshlands are primarily salt to brackish. Vegetation is characterized by such species as cordgrass, glasswort, sea ox-eye, cattails, sedges, and rushes. These marsh areas are important because they contribute nutrients to the waterway and provide important habitat for wildlife.

Low-lying prairies are characterized as flat to gently rolling grasslands. Typical plants include bluestems, Indiangrass, broom-sedge, smutgrass, and sparse areas of mesquite and cactus.

Shallow, near shore areas in the bays provide habitat for submerged aquatic vegetation. This submerged vegetation provides high quality habitat used by many species of fish and crustaceans as feeding, breeding, and nursery habitat. Two of the more abundant species include widgeongrass and shoal grass. Vegetation on disposal sites generally consists of such species as glasswort, cordgrass, saltgrass, saltwort, and Carolina wolfberry. Black willow is the dominant tree observed along most disposal areas.

Marshlands, disposal areas, and shallow water areas provide habitat for vegetative communities between Corpus Christi and Brownsville. Salt marsh is lacking in this reach except in a few areas such as the back shore of the North Laguna Madre and in the deltaic flats of the Rio Grande. Gulf cordgrass, glasswort, sea ox-eye, saltwort, and black mangrove are species found in these areas. Common plants associated with disposal areas include saltwort, sea lavender, saltgrass, and Carolina wolfberry.

Shallow, clear bays in this reach provide ideal growing conditions for submerged vegetation. Large areas of submerged vegetation composed of such species as shoalgrass, widgeongrass, and turtlegrass provide high quality feeding and nursery habitat for many species of fish and crustaceans.

In Louisiana, only one plant has been nominated as "endangered" for the state. This plant is the quillwort, but it is not expected to occur in the study area. Nine plants in Louisiana have been nominated as "threatened;" however, only one, the skullcap, is likely to occur in the study area.

In Texas, numerous plants have been nominated as threatened or endangered for the state. Several of these plants may be expected to occur in the coastal zone.

ARCHEOLOGICAL ELEMENTS. The area traversed by the Gulf Intracoastal Waterway is rich in cultural history. More than 600 documented archeological sites occur in the Louisiana coastal zone. Of these more than half are coastal midden. Through a survey conducted by Dr. S. M. Gagliano (1975) for the New Orleans District, 150 prehistoric sites and 42 historic sites were identified within the general vicinity of the GIWW. Of these, 78 prehistoric and 11 historic sites were exposed along the banks of the waterway and bayous or were within existing or potential dredged material disposal areas.

Numerous investigations into the archeological and historical sites of coastal Texas have revealed the existence of several hundred in this portion of the study area. A complete listing of publications and reports on these investigations is given in attachment 2.

During the course of this study more specific information will be obtained on the significance of all archeological sites and the impact the proposed action may have on these locations. Close coordination will be maintained with appropriate Federal and state agencies and archeological societies.

HISTORICAL ELEMENTS. The Gulf of Mexico is noted for storms and squalls which occur with such suddenness and severity that small craft, even a short distance offshore, often find escape difficult. Consequently, since the days of the first settlers, the many bays

and sounds that indent and parallel the gulf coast have been used wherever possible for protected passage. Because of the swamp and marsh characteristics of the country bordering much of the gulf coast, other modes of transportation in the area were slow to develop, and in many cases these sheltered waters were the only means whereby commerce could be carried on between coastal settlements.

Prior to any development of inland navigation projects, a minimum depth of 3 feet existed between Mobile Bay and New Orleans via the Mississippi Sound and Lakes Borgne and Pontchartrain. During high water a navigable route also existed from the Mississippi River to the Teche country via Bayou Plaquemine, until extension of the Mississippi River levees in 1867 severed the connection. The only remaining route, a long and difficult one via Old River and down the Atchafalaya River, was eventually abandoned due to frequent shoaling.

In 1828 Congress adopted a project and appropriated \$18,000 for construction of a Mobile Bay-Mississippi Sound channel. Improvement of a channel in Lake Pontchartrain was first authorized in 1852. Between 1851 and 1853 the Galveston and Brazos Canal was dredged 100 feet wide and about 6 feet deep by private interests to afford an inland passage for light-draft boats between Galveston and the Brazos River. Between 1873 and 1895 Congress approved a channel from Galveston to Oyster Bay, Texas, and a waterway from Plaquemine to Grand Lake, Louisiana, including a lock connecting Bayou Plaquemine with the Mississippi River.

At the turn of the century two young Texas businessmen, Clarence S. E. Holland and Roy Miller, envisioned a connecting waterway from Florida to the Mexican Border. During the next 25 years a series of 5- by 40-foot connecting channels were constructed.

By 1925 the Government had purchased the Harvey lock and Canal and several other privately owned channels. A continuous Government-owned waterway now existed from the Mississippi River to the Sabine River.

By 1938 a 9- by 100-foot waterway extended from Apalachee Bay, Florida, to Corpus Christi, Texas. In 1942 Congress authorized enlargement of the entire waterway to a minimum depth of 12 feet and width of 125 feet and extended the canal to the Mexican Border at Brownsville. Early in the afternoon of June 18, 1949 the entire waterway, essentially as it exists today, was opened for public use.

The evolution of navigation along the gulf coast has also witnessed modernization of the vessels transporting commodities. From the early use of canoes and keel boats, then modern steamers and later use of barges and tow boats of increasing size, navigation along the waterway has become faster, safer, and substantially more efficient.

RECREATION AND WILDLIFE MANAGEMENT

Louisiana abounds with recreational opportunity. Because of the marsh habitat, proximity to the warm gulf waters, and an overall environment hospitable to the support of wildlife, the parishes of this portion of the study area contain many state parks and national and state wildlife refuges. There are nine state parks in the study area with a combined size of over 1,729 acres. Six national wildlife refuges are located in four of the coastal parishes containing a total of 230,533 acres. Eight state wildlife refuges add another 268,648 acres in seven of the parishes.

Additionally, eight parishes contain one or more sites listed on the National Register of Historic places. Bayou Des Allemands in Lafourche Parish and Bayou Penchant in Terrebonne Parish are listed as Natural and Scenic Rivers (Act 398, Louisiana Legislature, 1970 Session).

The coastal parish areas, other than those specifically managed, afford the residents much opportunity for fishing, hunting, aquatic sports, exploration, and scenic enjoyment.

The Texas coast offers an excellent opportunity for recreation activities and contains a number of state and county parks, bird sanctuaries, wildlife refuges, and a national seashore.

Seven state and county parks or recreational areas are located along the GIWW and in the adjacent gulf areas between Sabine Pass and the Mexican Border. These facilities provide opportunities for fishing, swimming, picnicking, and camping. Padre Island National Seashore, an 80 mile strip comprising 134,000 acres of the 113 mile-long Padre Island, is located south of that portion of the waterway between Corpus Christi and the channel to Port Mansfield. Leisure activities for this area include swimming, surfing, scuba diving, water skiing, fishing, and bird watching.

Laguna Atascosa National Wildlife Refuge, Aransas National Wildlife Refuge, San Bernard National Wildlife Refuge, Brazoria National Wildlife Refuge, Anahuac National Wildlife Refuge, and Murphree Wildlife Management Area are all located along the GIWW. These five national refuges and one state management area encompass approximately 135,000 acres. Aransas National Wildlife Refuge is of extreme importance in that the only natural population of the endangered whooping crane winters at the refuge.

Sidney Island bird sanctuary (near Sabine Pass), North Deer Island, Vingt-et-un Island and West Bay Bird Island (Galveston Bay), Green Island, Medio Island, and Primero Island (lower Texas coast) are all bird sanctuaries for shore and wading birds and are controlled by the National Audubon Society.

HUMAN RESOURCES

The 14 Louisiana parishes and 18 Texas counties located along the Gulf Intracoastal Waterway and its alternate routes had a total 1970 population of 4,441,867 according to the US Census. This number represents a 21 percent increase over the 3,674,107 recorded in the 1960 census or an average annual increase of approximately 2 percent. During this 10-year period, 12 Texas counties and 13 Louisiana parishes registered positive gains in population, while 6 Texas counties and 1 Louisiana parish showed a decreasing population. The largest percentage of population growth in both states was found to occur in the urban areas.

In the Louisiana portion of the study area, the white population is about 70 percent of the total population, which is also characteristic of Louisiana, as a whole. The Texas portion of the study area, however, varies slightly in the racial composition of its population (82.6 percent white) from that of Texas, as a whole, (87.1 percent white). Predominant minorities throughout the study area are blacks and Spanish speaking Americans. In Louisiana 66 percent of the study area residents live in urban areas, while 80 percent of the Texans are urban residents. Approximately 10 percent of the residents of both states are over 65 years of age, and approximately 62 percent of the residents of both states over the age of 14 are married.

According to the Office of Business Economics-Economic Research Service (OBERS) series "E" projections, the study area population should continue to increase with a year 2020 population projected to be approximately 6,900,000 inhabitants, which represents a compound annual growth rate of 0.9 percent over the 1970-2020 period. The projections include a continuing trend toward further urbanization with the Standard Metropolitan Statistical Areas (SMSA's) of both states accounting for the largest percentages of projected increases. Over the next 50 years, 5 parishes and 1 county are expected to experience a population decrease.

DEVELOPMENT AND ECONOMY

GENERAL ECONOMY. The study area is a major contributor to the economies of Louisiana and Texas. It is in this area that much of these states' trade and commerce is conducted and a large portion of the industry is located. The immediate and adjacent areas are blessed with rich deposits of hydrocarbon fuels, minerals, and abundant supplies of water. Louisiana and Texas rank as the country's top producing states in petroleum, natural gas, salt, and sulphur, with most of this production coming from the coastal and adjacent offshore areas. The estuaries of these two states are the most productive in the Nation in terms of fish and wildlife resources. Important commercial seafood items harvested include shrimp, blue crab, crawfish, oysters, and menhaden.

LAND USE. The 14 Louisiana parishes of the study area have a total combined area of more than 8 million acres. The predominant features of this area are the existence of coastal marshland, which accounts for nearly 40 percent of the total. Bays, lakes, and other water bodies account for another 20 percent of the total acreage. Agriculture is the predominant land use in the Louisiana

portion of the study with 27 percent of the total used for this purpose. Forested land comprises the second largest use with approximately 18 percent of the total⁴. A little over 1.5 percent of the area has been developed for urban uses with the New Orleans SMSA (Orleans, Jefferson, St. Bernard, and Plaquemines parishes) and the Lake Charles SMSA (Calcasieu Parish) containing nearly 50 percent of the developed lands in the Louisiana portion of the study area.

Figures for Texas, similar to those reported for Louisiana, are not readily available due to the statistical data reporting differences between the two states. The predominant land use in the 18 county Texas portion of the study area is cropland which accounts for over 60 percent of the total land area. The addition of range and pastureland increases this percentage to nearly 80 percent. Forested land accounts for approximately 8 percent of the land in the Texas portion of the study area. Available references reported a combined urban and Federal land use category for the Texas counties with an amount of about 10 percent of the area's total land. The vast majority of the urban lands are located in the five coastal SMSA's of Beaumont-Port Arthur-Orange, Houston, Galveston-Texas City, Corpus Christi, and Brownsville-Harlingen-San Benito.

Typically throughout the study area, heavy industry is located near population centers and adjacent to the Gulf Intracoastal Waterway and connecting canals and harbors. This trend is expected to continue because of the economic advantage of manufactured

⁴ Note: Reporting discrepancies and some dual classification of land use result in the total of these approximations adding to over 100 percent.

commodity and raw material transportation over the navigation network of the coastal area relative to other transportation modes.

TRANSPORTATION. An extensive transportation network, which includes navigation, railroads, pipelines, highways, and airports, serves the study area. Of primary interest in this study will be the relationships between such modes of bulk commodity transportation.

A major percentage of the commerce moving over the Gulf Intracoastal Waterway is in the form of crude petroleum and petroleum products. At the time of preparation of this document, three possible future events could impact greatly on the amount of these materials currently moving on the Louisiana portion of the waterway:

1. Petroleum production in the state is expected to slowly decrease as most of the economically productive oil fields have been extensively depleted;
2. Continued pipeline construction may result in less petroleum moving by way of navigation routes; and
3. Construction of the planned Louisiana Offshore Oil Port (LOOP) could either increase or decrease navigation demands depending upon the transportation method selected to move this product from the terminal facilities in coastal Louisiana. However, sufficient river-front land exists along the Mississippi River to accommodate projected development of refineries, as well as petrochemical complexes. Should these developments occur, it is reasonable to expect that additional waterway movement of these commodities will also occur.

Three deep-water ports are under consideration for Texas. Seadock would be a single point mooring facility located 30 miles offshore of Freeport. Onshore ports are the principal subject of studies at Galveston and near Corpus Christi. All of the facilities are designed to be transfer points for large quantities of imported crude petroleum primarily for Texas coastal refineries. Some of the petroleum is projected to move via pipeline to inland Texas and the Midwest. Additionally, the onshore ports have a potential for increasing dry bulk commodity movements. It seems reasonable to assume that development of one or all of these ports will stimulate additional traffic on the GIWW.

Declining petroleum production in the inland area of Texas is expected to continue despite further growth in offshore petroleum production. Transportation of petroleum products via pipeline should increase with the construction of new pipelines. It is assumed that barge transportation will also increase throughout the entire Texas section of the GIWW.

Within the study area there are numerous agencies which control various transportation facilities (table 2). In addition to these publicly administered facilities there are many private wharves and industry-owned terminal and transfer facilities.

TABLE 2
PUBLICLY ADMINISTERED TRANSPORTATION AGENCIES

LOUISIANA

Deep Draft Harbor and Terminal Authority (New Orleans)
Port of New Orleans
Greater Jefferson Port Commission
Lafourche Port Commission
Terrebonne Port Commission

TABLE 2 (Continued)
PUBLICLY ADMINISTERED TRANSPORTATION AGENCIES

Morgan City Harbor and Terminal District
New Iberia Port District
Abbeville Harbor and Terminal District
Delcambre Port Commission
Vinton Harbor and Terminal District
East Cameron Port, Harbor, and Terminal District
Lake Charles Harbor and Terminal District

TEXAS

Orange County Navigation and Port District
Beaumont Navigation District
Port of Beaumont Navigation District of Jefferson County
Port of Port Arthur Navigation District of Jefferson County
Chambers-Liberty Counties Navigation District
Galveston County Navigation District No. 1
Galveston Wharves
Port of Houston Authority
Brazos River Harbor Navigation District of Brazoria County
Matagorda County Navigation District No. 1
Port of Bay City Authority of Matagorda County
Jackson County Navigation District
Calhoun County Navigation District
City of Port Lavaca Port Commission
West Side Calhoun County Navigation District
Victoria County Navigation Commission
Refugio County Navigation District
Aransas County Navigation District No. 1
San Patricio County Navigation District No. 1
Nueces County Navigation District No. 1
Willacy County Navigation District
Arroyo Colorado Navigation District of Cameron and Willacy
Counties
Port Isabel-San Benito Navigation District
Brownsville Navigation District
Port of Brownsville

MANUFACTURING. Throughout the Louisiana-Texas coastal zone included in the study area, the primary industries that have led to industrial development are oil, chemical, primary metals, metal fabrication, and commercial fishing. These industries have been the main source of nonregional revenue necessary for the regional

growth. The income generated therefrom filters down to secondary industries and thus increases the economic development of the region.

In 1946 Louisiana passed a new industry tax exemption law which granted new industry an exemption period of 10 years. Since then, a considerable amount of industry has developed in southern Louisiana. This industrial growth has been the major contributing factor in current transportation requirements for shipment of raw materials and finished products, much of which moves over the waterway.

In the Louisiana portion of the study area, significant manufacturing activity includes production of transportation equipment in Orleans Parish; primary metals in St. Mary and Terrebonne parishes; fabricated metal in Orleans, Jefferson, and St. Mary parishes; machinery in Jefferson, Orleans, and the coastal parishes between Iberia and Lafourche; and paper, lumber, and their related products in Calcasieu and other east-central parishes. Overall, mining (oil and gas extraction) and manufacturing are the major contributors to the economy of the area.

In Texas the largest oil refineries are located in the gulf ports from Corpus Christi to Beaumont, Port Arthur, and Nederland. Most of the larger plants producing bulk chemicals are located in the port areas along the gulf coast, particularly in the Beaumont-Port Arthur-Orange, Houston, Galveston-Texas City, and Corpus Christi SMSA's. Fabricated metal production and machinery manufacture is significant in these same SMSA's.

The transportation savings associated with the ports and the Gulf Intracoastal Waterway have had a significant effect on the manufacturing development throughout the study area.

The coastal marshlands, estuaries, and adjacent gulf are responsible for both states being the Nation's leaders in the commercial fishing industry. Seafood processing has long been a substantial industry throughout the study area.

AGRICULTURE. In the Louisiana portion of the study area, nearly 27 percent of the total land area is presently used for cropland, pasture, and range. This percentage is extremely low when compared with the 80 percent figure for the Texas portion. The disparity obviously exists because much of Louisiana's coastal zone is comprised of marshlands and other low-lying areas subject to periodic inundation and is unsuitable for agricultural uses.

In both states the value of agricultural products sold increased substantially between 1969 and 1974. Texas registered a slight increase in land used for agricultural purposes during that 5-year period; however, the opposite was true for Louisiana. Table 3 shows significant agricultural statistics for both states.

Principal cash crops for the 14 Louisiana parishes are cotton, rice, corn, sugarcane, and soybeans. In Texas this listing includes citrus, cotton, forestry products, grain sorghum, livestock and livestock products, rice, soybeans, sugarcane, and vegetables.

MINERAL PRODUCTION. Texas and Louisiana are the Nation's two leading producers of petroleum and petroleum related products. Other economic resources of a geologic nature include gravel, sand, stone, crushed stone, clam and oyster shells, clay, natural gas, carbon black, rock salt and brine, and sulphur. The value of the 1973 mineral production for the 14 Louisiana parishes and 18 Texas counties was \$4.9 billion and \$1.2 billion, respectively.

TABLE 3

AGRICULTURE STATISTICAL SUMMARY

<u>Acres of Land Study Area</u>	<u>Acres of Cropland</u>		<u>Value of Agricultural Products Sold (in \$1,000) in</u>	
	<u>1969</u>	<u>1974</u>	<u>1969</u>	<u>1974</u>
			\$	\$
<u>LOUISIANA</u>				
6,805,952	1,958,740	1,828,270	91,229	293,790
100%	28.8%	26.9%		
<u>TEXAS</u>				
9,721,934	6,641,416	6,646,300	213,758	439,941
100%	68.3%	68.4%		
<u>TOTAL</u>				
16,527,886	8,600,156	8,474,570	304,987	733,731
100%	52.0%	51.3%		

PROBLEMS AND NEEDS

In any geographical area as large and complex as the 14 Louisiana parishes and 18 Texas counties included in this study, there could be derived a long listing of environmental, recreational, social and economic, and other water resource related problems and needs. Although this is the case throughout the length of this study area, the scope of the investigations leading to preparation of the final report will be limited to those problems and needs directly associated with providing an improved waterway and the upkeep of that waterway. The purpose of this section is to set forth those water and related resource problems and needs for which this study seeks solutions.

STATUS OF EXISTING PLANS AND IMPROVEMENTS

THE EXISTING PROJECT. For descriptive purposes the portion of the Gulf Intracoastal Waterway under review has been divided into five reaches:

1. Mississippi River, La., to Sabine River, Texas. This reach is 266 miles long. Harvey lock provides a connection with the Mississippi River at New Orleans (see summary table 4 for lock dimensions). This lock prevents flood waters from the Mississippi River from entering the Gulf Intracoastal Waterway to the west.

An alternate connection with the Mississippi River at New Orleans is through the Algiers lock and canal which are located 10 miles below Harvey lock. The alternate connection is 9 miles long and connects with the existing waterway 6 miles west of Harvey lock.

TABLE 4

NAVIGATION LOCKS ALONG GULF INTRACOASTAL WATERWAY

Lock	Useable Length in Feet	Width	Elevation of Sill in Feet	Completed	Remarks
Port Allen Lock	1202	84	-13.75 MLG ¹	Jul 1961	
Bayou Sorrel Lock	797	56	-14 MLG	Oct 1952	
Plaquemine Lock	260	55	-10 MLG	1909	Closed Sep 1961
Bayou Boeuf Lock	1156	75	-13 MLG	1954	
Vermilion Lock	1182	56	-11.3 MLG	1934	Replacement authorized 110 X 1200 at -15 MLG
Calcasieu Lock	1206	75	-13 MLG	1950	
Harvey Lock	425	75	-12 MLG	1935	
Algiers Lock	760	75	-13 MLG	1956	
Berwick Lock	300	45	-9.8 MSL	1951	Connects Bayou Teche with GIWW at Morgan City
Colorado River Locks	1200	75	-15 MLT ²	1954	One lock located on each side of Colorado River

¹MLG (Mean Low Gulf) = -0.78 MSL

²MLT (Mean Low Tide) at this location = -1.43 MSL

At a distance of 93.5 miles west of Harvey lock, the Bayou Boeuf lock prevents floodwaters of the Atchafalaya River from entering the waterway to the east.

An alternate connection with the Mississippi River at Baton Rouge is through the Morgan City-Port Allen route. This alternate connection is 64.1 miles long and connects with the GIWW at mile 95.5 west of Harvey lock.

The Gulf Intracoastal Waterway also crosses the Atchafalaya River at mile 95.5 west of Harvey lock. At mile 107.5 west of Harvey lock the waterway crosses the Wax Lake Outlet, an additional outlet constructed in 1963 which conveys approximately 30 percent of the flows from the Atchafalaya Basin to the gulf. At mile 120.6 west of Harvey lock, the Franklin Canal joins the Intracoastal Waterway. The Franklin Canal is the only feeder channel in the Louisiana section of the waterway which is authorized under the Gulf Intracoastal Waterway project.

At mile 162.7 west of Harvey lock, the Vermilion lock serves as a saltwater barrier, protecting the Mermentau River Basin from the intrusion of saline waters. The 1976 Water Resources Development Act authorized a replacement lock at this location. Present plans call for the replacement of this structure to be completed by September 1981.

The Calcasieu lock is located 238.9 miles west of Harvey lock and also protects the Mermentau River Basin from intrusion of saltwater through the Calcasieu River.

Between the Calcasieu and Sabine Rivers, the waterway follows the Lake Charles Deep Water Channel (an authorized 30- by 125-foot

Federal ship canal project) for about 25 miles. The Lake Charles Deep Water Channel has not been maintained since completion of the Calcasieu ship channel in 1941. Present controlling depth between the Calcasieu and Sabine Rivers is 20 feet.

2. Sabine River to the Houston Ship Channel. This segment of the GIWW is approximately 94.7 miles in length. Westward from the Sabine River at Orange, Texas, the GIWW traverses 22.3 miles of deepwater channels of the Sabine - Neches Waterway. These deepwater channels are in excess of the channel improvements under consideration in this report, and no improvement in this reach is required. From the Sabine-Neches Waterway, the Gulf Intracoastal Waterway extends in a southwesterly direction, approximately 36 miles to East Bay Bayou (mile 325) near High Island. The waterway continues southwesterly and generally parallels the bay side of Bolivar Peninsula for about 25 miles to deep water in Bolivar Roads (mile 350) and its intersection with the Houston Ship Channel. In this portion the waterway is partially land locked and partially traverses open bay water.

3. Houston Ship Channel to Corpus Christi Bay, Texas. This section of the main channel is 189.3 miles long via the alternate channel in South Galveston Bay, north of Pelican Island and the main channel relocation between Aransas Bay and Corpus Christi Bay. The GIWW main channel extends across Bolivar Roads, intersecting the Texas City Channel and the Houston Ship Channel, then through the southern portion of Galveston Bay into West Bay. An alternate channel extends from the west end of Galveston Channel and joins the main channel in Galveston Bay in the vicinity of Teichman and Virginia Points (mile 356). The channel continues in a near westerly direction past North Deer Island in West Bay, across the

mouth of Jones Lake, then intersects the north shore of West Bay (mile 363). From this point, the GIWW is primarily landlocked and traverses saltwater and brackish-to-freshwater marshes, some prairie grasslands, fluvial woodlands, and shallow bays and lakes, until it enters Matagorda Bay near Palacios Point (mile 455). Near channel miles 400 and 441 on the Brazos and Colorado Rivers, respectively, a series of locks are operated by the Corps of Engineers to prevent floodwaters on these rivers from entering the GIWW and also to reduce shoaling at these intersections.

The channel crosses Matagorda Bay to Port O'Connor (mile 472) where it once again becomes mostly landlocked. From Port O'Connor to Corpus Christi Bay, the GIWW traverses more saltwater marshes, prairie grasslands, sand flats, shallow bays with sparse marine grasses, and grassflats. The channel then crosses the open waters of Corpus Christi Bay and enters the Laguna Madre near Encinal Peninsula.

4. Corpus Christi Bay to Texas-Mexico Border. This section of the main channel is about 134 miles long. It extends from upper Laguna Madre at its intersection with Corpus Christi Bay southward through the full length of the Laguna Madre to the deepwater turning basin near Port Isabel and Brownsville Channels to the deepwater turning basin near Brownsville, Texas. The shallow-draft channel terminates near Port Isabel where it joins the deep-draft Brownsville Ship Channel which is in excess of the dimensions considered in this report and, therefore, will not be considered further.

5. Morgan City - Port Allen. This alternate route (64.1 miles) provides a 12- by 125-foot wide channel from Morgan City to Port Allen, Louisiana, via the east Atchafalaya Basin protection

levee borrow pit, Bayou Sorrel lock, lower Grand River, and Bayou Plaquemine to Indian Village; thence, via Bayou Grosse Tete and a new land cut to the Mississippi River passing through a terminal lock in the levee at Port Allen opposite Baton Rouge.

STATUS OF EXISTING NAVIGATION PLANS. The River and Harbor Act of October 1962 authorized deepening and widening of the Louisiana-Texas Section of the Gulf Intracoastal Waterway and some channel relocations. The 1962 act stipulated that local interests provide: all lands, easements, and rights-of-way required for construction and subsequent maintenance; accomplish all relocations of pipelines, cables, and other utilities; and to bear 42 percent of the construction cost in connection with the Houma-Louisiana bypass. To this date local interests have been unwilling to provide those items and, therefore, with the exception of the relocation of the channel in Corpus Christi Bay, none of the 1962 authorized improvements listed below have been implemented.

The authorized enlargement of the GIWW provides for:

1. a channel 16 x 150 feet through the reach between the Mississippi and Atchafalaya Rivers;
2. a channel 16 x 150 feet through the Algiers Alternate Canal;
3. a channel 16 x 150 feet through the bypass route around Houma;
4. a channel 16 x 200 feet through the reach from the Atchafalaya River to the Sabine River;

5. a channel 16 x 150 feet through the reach from the Sabine River to the Houston Ship Channel;

6. a channel 12 x 125 feet through the relocated channel in Matagorda Bay;

7. a channel 12 x 125 feet through the relocated channel in Corpus Christi Bay; (has been completed)

8. a channel 12 x 125 feet to be maintained through the existing 12- x 125-foot Lydia Ann Channel between Aransas Bay and Aransas Pass;

9. maintenance of the existing channel alinement through Houma, Louisiana;

10. and abandonment of those channels shortened by new channels in the Texas section.

STATUS OF EXISTING FLOOD CONTROL PLANS. Throughout the Louisiana portion of the study area, many flood control projects are in various stages of completion. For the purposes of this Plan of Study only those projects which are immediately adjacent to the Gulf Intracoastal Waterway and which could be affected by channel improvements will be mentioned.

Small projects include snagging and clearing of Bayou L'Eau Bleu near Houma, completed in 1948. A small flood control project was completed in Bayou Choupique southwest of Lake Charles in 1954, and another, the Harvey Canal Bayou Barataria Levee, is authorized for Jefferson Parish.

The Mississippi River and Tributaries project authorized under the Flood Control Act of 15 May 1928 and its amendments, includes a vast network of associated flood control and drainage projects. Of interest in this study are the mainline Mississippi River levees in the vicinity of Harvey and Algiers locks. Some enlargement of these levees is nearing completion at the present time. In the vicinity of Morgan City, levees of the Atchafalaya Basin Floodway generally follow the waterway from Morgan City to Bayou Boeuf lock. West of Berwick, an extensive levee network follows the north side of the waterway to provide flood protection to the area between the waterway and the floodway to the north. Several drainage structures and pumping stations have been completed to improve interior drainage. Drainage facilities in this section adjacent to the waterway include those at mile 104. All levees in this section are in place; however, grade and section enlargements have been authorized and are under construction.

In the Texas portion of the study area, flood protection is provided to Matagorda, Texas, by levees which encircle the town. It is located at the intersection of the Colorado River and the GIWW. Between the GIWW and the Gulf of Mexico, the Colorado River has been enlarged to accommodate flood discharges.

The Highland Bayou Channel Rectification Project provides for flood protection to the cities of La Marque and Hitchcock, Texas, and is scheduled for completion in 1980. A new diversion channel empties into West Bay near GIWW mile 362.

Enlargement of Taylor Bayou and its major tributaries, construction and enlargement of diversion channels, a gated

saltwater barrier, and enlargement of 1.3 miles of the GIWW were authorized by the Flood Control Act of 1965. The project is designed to provide flood protection for portions of Beaumont, Texas, and improve drainage for the agricultural lands in the watershed. Construction of the project is being delayed pending assessment of environmental impacts.

STATUS OF EXISTING HURRICANE PROTECTION PLANS. Public Law 858, approved 30 June 1948, authorized construction of approximately 10 miles of earthen levee from the Roussel pumping station to the Harvey Canal in Jefferson Parish, south along the Gulf Intracoastal Waterway to Crown Point. The project is designed to protect the lands adjacent to Harvey Canal and Bayou Barataria from hurricane flooding and includes construction of two new pumping stations and three drainage ditches to facilitate interior drainage. The first lift in the levee was completed in June 1973 with Federal money. As a result of Section 404 procedures of the Federal Water Pollution Control Act of 1972, the pumping station at Bayou aux Carpes and the closure of Bayou des Familles have been deleted and flood gates are required at these locations. Local interests are responsible for construction of these structures and completion of the levee. Completion of this project has been delayed due to litigation by land owners and environmental interests with opposing points of view.

The Larose to Golden Meadow hurricane protection project authorized by the Flood Control Act of 27 October 1975 is presently under construction in Lafourche Parish. The levees generally follow either side of Bayou Lafourche with the northern boundary including approximately 3 miles of levee along the GIWW and construction of a floodgate across the bayou at its intersection with the waterway.

Public Law 89-298, approved 27 October 1965, authorized hurricane protection works for St. Mary Parish in the vicinity of Morgan City. Much of the authorized hurricane protection project in this area is an integral part of the Atchafalaya Basin Floodway project, with common features being a part of both. This protection calls for increasing levee grades and section between Berwick and Wax Lake Outlet; approximately 6 miles of levee, several drainage structures, and a pumping plant along the north bank of the waterway between the Wax Lake Outlet and Bayou Sale. Minor levee works are authorized in the vicinity of Bayou Boeuf lock at Morgan City. At this time, all pumping stations have been completed under the authority of the Atchafalaya Basin Floodway project. The General Design Memorandum (GDM) for the levee enlargement between Berwick and Wax Lake Outlet has been completed; however, the local assuring agency has not provided the necessary 25 percent cost sharing required. This action has resulted in postponing construction and further work on the GDM covering the levees in the vicinity of Bayou Boeuf lock.

In Texas, three hurricane-flood protection projects are in the final stages of completion.

The Flood Control Act of 1962 authorized a project to provide protection from hurricane flood tides to Port Arthur and vicinity. The project includes 36.3 miles of levees and floodwalls of which 9.5 miles are adjacent to the Sabine Neches Canal. Completion is scheduled for 1979.

The Texas City Hurricane-Flood Protection Projection was authorized by the Flood Control Act of 1958 and is designed to provide protection to the cities of Texas City and LaMarque. The

project includes a navigation and tide control structure at the entrance to Moses Lake. Completion is scheduled for 1981.

The Freeport Hurricane-Flood Protection Project is scheduled for completion in 1979. It was authorized by the Flood Control Act of 1962 and includes 40 miles of levees of which 5 miles are adjacent to the GIWW. Also included is a navigation and tide control structure across Old River.

A completed hurricane protection project is the Galveston Seawall which parallels the city's beach front for a distance of 16,000 feet. It affords protection from hurricane waves and prevents erosion of the island and damage to the navigable channels in Galveston Bay.

IMPROVEMENTS DESIRED

Various private individuals, local groups, and national groups have expressed interest in the study of navigation improvements for the GIWW. From the aspect of commerce, local commercial operators as well as national water transportation firms support the enlargement of the waterway. Parish and county governments have generally supported waterway improvements but many have not been willing to participate because they were financially unable or because they considered the waterway to be a national artery. Environmental interests have expressed reservations about improving the waterway at the expense of additional wetlands losses, of reduction of habitat for wildlife and waterfowl, or of contaminating surrounding reaches by dredged material disposal.

Three public meetings were conducted during the initiation of this study. They were held on 12 November, 16 November, and 17 November 1976, in Lafayette, Louisiana; Galveston, Texas; and New Orleans, Louisiana, respectively.

A summary of the improvements desired and concerns expressed at these meetings are shown in table 5.

PLANNING OBJECTIVES

In establishing planning objectives consistent with the needs of the study area and the authority for preparation of this report, only those needs for which some reasonably feasible solution may exist will be addressed in the report.

The planning objectives for the study are:

- a. The provision of a safe and efficient commerce between New Orleans, Louisiana, and Brownsville, Texas.
- b. Protection of the adjacent coastal lands from further damages associated with saltwater intrusion.
- c. Control of bank erosion along the waterway.
- d. Preservation of the environment and associated fish and wildlife resources which may be effected by the operation, maintenance, or any improvements to the waterway.

Throughout the course of this study, all viable alternatives will be evaluated for their contributions toward the national objectives of National Economic Development (NED) and Environmental Quality (EQ). ER 1105-2-200, "Planning Process, Multiobjective Planning Framework," requires that these objectives be treated as co-equal. In addition to treating NED and EQ objectives equally, the effects of any proposed plans toward these objects will be displayed along with elements of social well being and regional development in a system of accounts.

TABLE 5
PROBLEMS AND NEEDS:
IMPROVEMENTS DESIRED AND OTHER EXPRESSED CONCERNS

Categories of general Improvements Desired	Presented by the following numbers of				
	Federal, State, and Local Agencies	Navigation Interests	Environmental Conservation Groups	Private Associations	Individuals
1. Enlarge Gulf Intracoastal Waterway	6	6	-	1	1
2. Straighten and widen hazard areas	1	6	-	-	-
3. Enlarge Bayou Sorrel lock	1	1	-	-	-
4. Provide fixed span high level bridges at various locations	1	-	-	-	1
5. Make Morgan City - Port Allen alternate route the main channel	-	-	-	-	1
6. Improve aids to navigation	-	1	-	-	-
7. Use dikes to restrict dredged material spreading	2	1	-	-	1
8. Provide vector control in disposal areas	1	-	-	-	-
9. Prevent bank erosion	2	2	-	-	4
10. Reduce saltwater intrusion	1	-	-	-	1
11. Improve freshwater flow patterns	-	1	-	1	1
12. Provide bypass around city of Houma	3	1	-	1	2

TABLE 5 (continued)
PROBLEMS AND NEEDS:
IMPROVEMENTS DESIRED AND OTHER EXPRESSED CONCERNS

Categories of general Improvements Desired	Presented by the following numbers of				
	Federal, State, and Local Agencies	Navigation Interests	Environmental Conservation Groups	Private Associations	Individuals
13. Reduce congestion on waterway	4	1	-	-	2
14. Improve operating efficiency of waterway	2	4	-	-	-
<u>Other Expressed Concerns</u>					
15. Disposal area acquisition by US	1	1	-	-	1
16. Mitigate environmental losses	2	1	4	1	1
17. Reduce industrial pollution	-	-	-	1	-
18. Establish user fees	-	-	-	4	1
19. Pipeline relocations costs should be paid by US and/or owner	2	1	-	-	1
20. Rights-of-way costs paid by US	2	2	-	-	-
21. Create new industry and jobs	-	-	-	-	1
22. Take No Action	-	-	1	-	-

FORMULATING A PLAN

This section will set forth a methodology to be used to formulate logical plans to meet the previously established planning objectives. Because of the wide variety of problems and opposing nature of some needs, no alternative will meet or satisfy all interests. This section will describe preliminary measures which will be joined into alternatives during Stage II planning and set forth formulation and evaluation criteria with which to judge the preliminary measures.

FORMULATION AND EVALUATION CRITERIA

The Water Resource Council's Principals and Standards for Planning require that Federal and Federally-assisted water and related land planning be directed to achieve National Economic Development and Environmental Quality as equal national objectives. National Economic Development is to be achieved by increasing the value of the Nation's output of goods and services and through improvements in national economic efficiency. Environmental Quality is to be achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. All Federal planning must be evaluated for contributing toward these goals. Criteria used to evaluate the alternative resource management plans by the above accounts will include technical, economic, environmental, and social considerations.

TECHNICAL CRITERIA. Technical criteria to be used in the formulation and evaluation of alternatives are:

1. The selected plan must be physically feasible to implement.
2. The selected plan should be complete in that all required investments or other actions necessary to assure full attainment of the plan have been incorporated.
3. The selected plan should be consistent with local, regional, and state goals for port and industrial growth.
4. The selected plan must be consistent with local and regional land use plans.
5. Dimensions (depth, width, and alinement) of the selected plan should be adequate to accommodate expected user vessels over the project life.
6. The selected plan should be compatible with existing and authorized improvements for flood control, major drainage, and saltwater intrusion protection.
7. The selected plan should be scheduled for implementation in relation to needs so that desired beneficial effects are achieved effectively.

ECONOMIC CRITERIA. Economic considerations are:

1. Tangible benefits exceed project economic costs (national economic development).
2. Comparison of benefits of each separable unit or purpose to its costs.

3. The savings in the movement of commodities on the proposed waterway when compared with movement via existing alternative modes and/or the savings attributable to deeper loadings of the commodities now moving over the waterway.

4. The willingness of shippers to pay for navigation improvements which reflect a change in their net income.

5. The unit savings measured as the difference between the charges shippers actually incur for transportation at the time of the study and the charges they would likely incur for transportation via the improvement.

6. Projected increases or decreases in commodities expected to move over the waterway.

7. Comparison of the scope of the proposed development to that which provides maximum net benefits. Proposed development providing less than the economic optimum may be recommended if appropriate gains in environmental quality and social well-being are shown.

8. Determine if a more economical means, evaluated on a comparable basis and accomplishing the same purpose(s), would be precluded from development if the plan were undertaken. This concept applies to those alternative possibilities that would be physically displaced or economically precluded from development if the project were undertaken.

9. Evaluation of average annual benefits and costs will be based on current price levels and conditions, reflecting anticipated future conditions.

ENVIRONMENTAL CRITERIA. Environmental considerations are:

1. Evaluation of the environmental impact of any proposed action; the adverse environmental effects which could not be avoided including any probable need for increased vector mitigation, should a proposal be implemented; and the alternatives to the proposed action.
2. Determination of any irreversible and irretrievable commitment of natural resources and biological systems as a result of implementation of an alternative.
3. Determination of the relationship between local short-term uses and the maintenance and enhancement of long-term productivity.
4. Management, protection, and enhancement of valuable or outstanding archeological, historical, biological, and geological resources and ecological systems.

SOCIAL CRITERIA. Social considerations to be used, but are not limited to, are:

1. Possible loss of life and hazards to health and safety of the affected people under with and without conditions.
2. Preservation and enhancement of social, cultural, educational, and historic values in the area.
3. Preservation of esthetic values and other desirable environmental effects.

4. Effects of project modification plans on:
 - a. Air, noise, and water pollution.
 - b. Manmade or natural resources, esthetic values, community cohesion, and public facilities and services.
 - c. Employment, taxes, and property values.
 - d. Displacement of people and businesses.
 - e. Desirable community and regional growth.
5. Provisions for improving the recreational resource opportunity of the study area.

FORMULATION OF ALTERNATIVES

Many of the problems and needs mentioned earlier, while influencing navigation safety and efficiency, are relatively localized in nature, while others are widespread in scope and affect many people. The preliminary measures listed in this section would contribute to varying degrees to the planning objectives established on the bases of the problems and needs in the first iteration of the planning process.

In addition to the problems and needs that exist at this point in time, analysis of changes that might occur in the immediate future must be examined to insure that future solutions are addressed and that preliminary measures involved in this section are not short of the scope of future problems.

A primary consideration in formulating alternative plans responsive to public concerns will be the projected volume of commerce moving over the waterway in the future. Therefore, accurate projections of future navigation requirements will be a crucial part of advanced planning stages. During the preparation of this Plan of Study, it was not possible to obtain the wide variety of commerce and transportation industry data necessary to develop these projections.

The creation and existence of the waterway has had a dramatic impact on industrial development in the coastal portions of Louisiana and Texas and the population increases accompanying this development. It is assumed that the improvements under study will have little or no significant impact on existing or projected future industrial or population expansion.

BASE CONDITION. In 1976 approximately 59.1 million tons of commerce moved over the reach of the waterway from Harvey lock to the Sabine River; 41.9 million tons moved from the Sabine River to Galveston, Texas; 18.2 million tons from Galveston to Corpus Christi; and 1.9 million tons from Corpus Christi to the Mexican border. Of these tonnages on the Mississippi River to the Sabine reach, 60 percent were petroleum or petroleum related products; crude petroleum accounted for 18 percent of the total.

WITHOUT CONDITION. The without condition is defined as that future which seems most likely to develop in the absence of project implementation. It is unlikely that the physical capacity of the channel will be a controlling element of the entire system within the foreseeable future. However, physical and economic capacities of the locks in the system will present a deterrent to future expansion of waterway commerce.

MOST PROBABLE FUTURE. The most probable future appears at this time to be the anticipated movement of commodities as forecast by the OBERS Series "E" projections. It is expected that changes in future offshore petroleum production will necessitate modifications to these projections with respect to commodity movement. Under this condition crude oil movements over the waterway are expected to remain at current levels, with the shortfall in coastal refinery feedstocks made up by imported crude transported via pipelines.

OPTIMISTIC FUTURE. This condition is the same as the most probable future with the following exceptions: Crude oil production in the gulf will increase sufficiently to support a growth of waterway commodity movements corresponding with current Series "E" rates, and increased quantities of coal and lignite will move over the waterway to supply the industrial fuel needs of the study area.

PESSIMISTIC FUTURE. Under this scenario nonpetroleum related movements would grow in accordance with Series "E" rates, while offshore crude production would not be sufficient to sustain even today's crude oil traffic levels. Furthermore, refinery feedstocks would not be maintained at a level high enough to justify the current Series "E" rates for refined product movements even when supplemented with imported crude. Therefore, refined products would remain approximately at current levels.

PRELIMINARY MEASURES. Alternative plans incorporating the preliminary measures and others which may be identified will be formulated during later stages of the planning process. Table 6 presents a listing of the preliminary structural and nonstructural measures to be considered in developing a plan. Additionally, table 6 matches

TABLE 6

STAGE I MEASURES AND THE PLANNING OBJECTIVES THEY ADDRESS

Preliminary Measure	Structural (S) or Non-Structural (N)	Provide Safe & Efficient Waterway	Protect Adjacent Land From Saltwater Intrusion	Control Bank Erosion	Preservation of Environmental & Fish & Wildlife Resources
Deepen Waterway	(S)	X		*	
Widen Waterway	(S)	X		*	
Houma Bypass	(S)	X		*	
Provide High-Level Bridges	(S)	X			
Clear and snag mile 6: Straighten bends at miles 17-25, 80-88, 111, 118-122, 211-212, 235, 390-395	(S)	X		*	
Relocate or replace Brazos River Floodgates	(S)	X			
Widen approaches to San Bernard River Crossing	(S)	X			
Relocate Colorado River Locks	(S)	X			
Extend Port O'Connor Jetties	(S)	X			
Adopt Morgan City - Port Allen Route	(S)	*		*	*
Construct Spoil Retention Dikes	(S)		X		X
Provide Mooring Buoys	(S)	X			

X May have significant impact

* Impact probably of less significance

TABLE 6 (continued)

STAGE I MEASURES AND THE PLANNING OBJECTIVES THEY ADDRESS

Preliminary Measure	Structural (S) or Non-Structural (N)	Provide Safe & Efficient Waterway	Protect Adjacent Land From Saltwater Intrusion	Control Bank Erosion	Preservation of Environmental & Fish & Wildlife Resources
Enlarge Bayou Sorrel Lock	(S)	X			
Protect channel banks from erosion	(S)			X	X
Provide saltwater barriers	(S)		X	*	X
Use dredged material for marsh building	(S)			*	X
Regulate tow speed and spacing	(N)	*		X	
One-way traffic	(N)	*		X	
Limit tow size	(N)	*		X	
Improve and update navigation charts	(N)	*			
No action	(N)				*

X May have significant impact

* Impact probably of less significance

preliminary measures against the previously stated planning objectives indicating impacts of the solution for the objectives. The following is a brief description of preliminary measures listed in table 6.

1. Deepen Gulf Intracoastal Waterway. Investigations will consider deepening the waterway from the existing depth of 12 feet to a maximum depth of 16 feet. Consideration will be given to incremental deepening of selected portions of the waterway dependent on volume of traffic and vessel size. Should the desired 16-foot depth prove justifiable, the benefits of greater depths will be investigated.

2. Widen Gulf Intracoastal Waterway. The feasibility of widening the waterway will be investigated; studies will include widths ranging from the present 125 feet to a maximum of 300 feet. As with deepening, consideration will be given to widening selected reaches dependent on the volume of navigation and other pertinent factors.

3. Houma bypass. This alternative measure will consider the feasibility of relocating the main route of the waterway to a location presumably south of all development in the city of Houma, thereby reducing the present interruptions to vehicular traffic caused by navigation through low-level draw bridges in the city. Investigations will also consider maintaining the present channel through Houma to provide navigation access to the existing port facilities within the city.

4. High-level bridges. Of particular interest in this study will be the provision of a high-level bridge crossing the bypass around Houma if, in fact, a new route should be recommended.

Other investigations will determine the degree to which existing bridges across the waterway may inhibit navigation should a channel enlargement be recommended. In the interest of improvements to navigation, the benefits of replacing selected, existing bridges with fixed span high-level bridges, will be compared with the costs of such action.

5. Clear and snag mile 6; straighten bends at miles 17 to 25, 80 to 88, 111, 118 to 122, 211 to 212, 235, and 390 to 395. The feasibility of widening, relocating, and increasing the radius of curvature, or otherwise straightening the waterway in any or all of the locations shown, will be investigated. These measures are desired to improve safety, maneuverability, and speed in the waterway.

6. Relocate or replace the Brazos River floodgates. The feasibility of relocating the floodgates at the Brazos River to provide a longer distance between gates will be investigated. Other methods of improving navigation across this river, such as widening the channel between the floodgates or replacing the floodgates with locks to facilitate navigation crossings during river rises, will be investigated.

7. Widen approaches to San Bernard River crossing. Preliminary investigations indicate that only minor navigational problems currently exist at the San Bernard River crossing on the GIWW and, therefore, no further studies are needed.

8. Relocate Colorado River locks. The feasibility of relocating these locks to increase the distance between them and widening the connecting channel will be investigated.

9. Extend Port O'Connor jetties. To improve access to Port O'Connor, the feasibility of widening the approach channel and extending the existing jetties will be investigated.

10. Adopt Morgan City - Port Allen route. Investigate the feasibility of making this present alternate route the main navigation channel. Consideration of this measure would include preservation and maintenance of the existing Harvey lock to Morgan City portion of the waterway as an alternate route.

11. Construct dredged material retention dikes. The construction of dikes to confine dredged material thereby reducing the loss of wetlands will be investigated.

12. Provide mooring buoys. The feasibility of adding mooring facilities at selected locations where congestion and delay are a problem will be investigated.

13. Enlarge Bayou Sorrel lock. The feasibility of enlarging Bayou Sorrel lock to increase navigation efficiency and reduce congestion and lockage time will be investigated.

14. Protect channel banks from erosion. Various methods of reducing wave wash and resulting bank erosion will be investigated. Measures to be considered may include bulkheads or revetments on the channels; tow speed, size, and draft limitation; and other methods such as bank stabilization or sloping to prevent tow-generated waves from washing against channel banks.

15. Provide saltwater barriers. The extent to which any modification to the existing waterway may increase saltwater intrusion into the coastal marshes will be investigated. Should

it be found that appreciable adverse impacts may occur through increased saltwater intrusion, various methods of preventing or reducing this intrusion will be studied, including the feasibility of providing barriers at selected locations.

16. Use dredged material for marsh building. Beneficial use of dredged material for creation of new marsh will be investigated, particularly in openwater reaches where current disposal practice employed during maintenance dredging destroys bottom plant growth and reduces water depths.

17. Regulate tow speed and spacing. Investigate the feasibility of reducing congestion, reducing bank erosion, and improving safety through more stringent control of the traffic navigating the waterway.

18. One-way traffic. Investigate the possibility of restricting traffic on the waterway, in selected heavy use areas and during certain portions of the day, to one-way traffic, in an effort to bring about the same benefits mentioned in 17. above.

19. Limit tow size. Towboat and barge size and loading may be limited to increase maneuverability and reduce wave wash.

20. Improve and update navigation charts. The need to improve and update current navigation charts will be investigated as a means of improving navigation safety.

21. No action. The social, economic, and environmental consequences of no action will be thoroughly investigated and evaluated.

IMPACT ASSESSMENT AND EVALUATION

Detailed environmental impact assessment of the preliminary measures to be considered is beyond the scope of this Plan of Study. All of the measures mentioned in the preceding section will have both beneficial and adverse effects on the accounts of national economic development, environmental quality, regional development, and social well-being. At this time, general and broad statements can be made with respect to the contribution of these measures toward these accounts.

1. Deepen the Gulf Intracoastal Waterway. Beneficial contributions would entail increased efficiency in tow operations and a possible reduction in tow generated wave wash.

Adverse contributions would be: increased requirement for dredged material disposal areas, loss of privately owned land to Federal ownership, increased maintenance requirements, increased saltwater intrusion in some areas, possible further interruption of natural flow patterns, and required pipeline and cable relocations.

2. Widen the Gulf Intracoastal Waterway. Beneficial contributions would be: reduced congestion on the waterway, increased efficiency in tow operations, possible reduced tow-generated wave wash, and an increased margin of navigation safety.

Adverse contributions would be: increased requirement for dredged material disposal areas, loss of privately owned land to Federal ownership, increased maintenance requirements, required pipeline and cable relocations, increased saltwater intrusion in some areas, and possible further interruption of natural drainage patterns.

3. Houma bypass. Beneficial contributions would be: less interruption of vehicular traffic in Houma, reduction of noise and slight improvement of air quality in the city, reduction in the possibility of collisions between tows and vehicular crossings in the city, reduction of congestion in terminal areas, possible improvement in water quality in the city, and a reduction in erosion along channel banks.

Adverse contributions would be: loss of privately owned land to Federal ownership, loss of wetlands and agricultural land to waterway construction, relocation of families and physical property from the project area, interruption of natural drainage patterns, intrusion of saltwater, creation of another barrier to vehicular traffic and utilities, further subdivision of Terrebonne Parish, and loss of wildlife habitat.

4. Construct high-level bridges. Beneficial contributions would be: reduced obstructions to navigation and vehicular traffic, improved reliability of hurricane evacuation routes, reduced need for bridge operating personnel, and decreased yearly operating cost.

Adverse contributions would be a larger financial demand on local assuring agencies and additional highway relocation requirements.

5. Clear and snag mile 6; straighten bends at miles 17 to 25, 80 to 88, 111, 118 to 122, 211 to 212, 235, and 390 to 395. Beneficial contributions would be: improvements to navigation safety, possible reduction in waterway congestion through increased allowable speeds in selected areas, and improved efficiency in navigation operations.

Adverse contributions would be: increased loss of wetlands and other lands to channel realignment and disposal areas, loss of privately owned land to Federal ownership, relocation of families and physical property from the project area, loss of wildlife habitat, and possible isolation of private property.

6. Relocate or replace Brazos River floodgates. Beneficial aspects of this proposed improvement are increased operational efficiency and navigation safety during periods of high flow on the Brazos River.

Adverse contributions would include loss of wetlands and other wildlife habitat due to relocation of the floodgates and the channel.

7. Relocate Colorado River locks. Beneficial contributions would be improved and safer navigation through the locks and better alignment for barges when crossing the river, primarily during periods of high river flow. Shoaling rates on the GIWW may also be reduced, which would in turn reduce the amount of maintenance dredging required in the area.

Adverse contributions would include loss of wetlands and other wildlife habitat due to relocation of the locks and the channel.

8. Extend Port O'Connor jetties. Beneficial contributions would be reduced congestion and decreased possibility of vessel collision near the jetty entrance.

Adverse contributions would include the alteration and loss of bay bottom resulting from construction and enlargement of the channel.

9. Adopt Morgan City - Port Allen route. Beneficial contributions would be: elimination of the need for acquiring more coastal wetlands for possible channel enlargement, reduced maintenance costs, minimal relocation of families and property, reduction in the number of bridge obstructions to navigation, possibility of fewer pipeline and cable relocations, reduced congestion, reduced obstruction of vehicular traffic, and reduced bank erosion in the Morgan City to Harvey lock reach.

Adverse contributions would be: a longer route, increased navigation costs, increased traffic on the Mississippi River, loss of wildlife habitat, and loss of privately owned land to Federal ownership.

10. Construct dredged material retention dikes. Beneficial contributions would be: controlling the disposal of dredged material and limiting the areas effected, minimizing the loss of fish and wildlife habitat, and improved water quality during dredging operations.

Adverse contributions would be increased costs associated with dredging; increased financial commitment from local assuring agencies; increased problems associated with vector control; and localized changes in flora and fauna.

11. Provide mooring buoys. Beneficial contributions would be: the provision of anchorage systems in areas which frequently are sites of delay, conservation of energy during times of delay, and minimize the potential for collision in congested areas.

Adverse impacts would be those associated with increased annual maintenance costs.

12. Enlarge Bayou Sorrel lock. Beneficial contributions associated with lock enlargement would be: improvement in navigation efficiency, a decrease in congestion, decrease in lockage time, and possible improvement in safety of navigation.

Adverse impacts would be: acquisition of more privately owned land for Federal ownership, navigation channel and levee relocation, and loss of wildlife habitat.

13. Protect channel banks from erosion. Beneficial contributions would be: a reduction in channel bank erosion, a reduction in the annual loss of wetlands and other lands due to erosion, possible reduction in channel maintenance requirements, and preservation of the environment adjacent to the waterway.

Adverse contributions would be greatly increased maintenance requirements on the protective works, dependent on the type of construction used.

14. Provide saltwater barriers. Beneficial contributions would be: a reduction and control of saltwater intrusion through the waterway, improvement in freshwater supply in some areas, possible hurricane protection benefits depending on structure design, and possible reduction in loss of wetlands.

Adverse contributions would be: changes in existing water circulation, obstructions to navigation, alteration of fish migration routes, and possible local to widespread changes in water chemistry.

15. Use dredged material for marsh building. Beneficial contributions would be the creation of productive and valuable

new marsh habitat, thereby replacing some of that lost through erosion and more conventional dredge material disposal practices.

Adverse contributions would be a loss of some natural open-water areas to marshland and possible changes in water circulation.

16. Regulate tow speed and spacing. Beneficial contributions would be: improved safety in the waterway, possible reduced congestion in some areas, and a reduction in channel bank erosion.

Adverse contributions would be: increased travel time, increased congestion in holding areas, reduced navigation efficiency, increased energy required for transportation, and probable increases in navigation costs.

17. One-way traffic. Beneficial contributions would be: increased navigation safety, reduction in channel bank erosion, and increased speed allowable in short reaches of the waterway.

Adverse contributions would be: an overall increase in travel time, need for sophisticated vessel movement control system, increased congestion in holding areas, and increased navigation costs.

18. Improve and update navigation charts. Beneficial contributions would be improved navigation efficiency and safety.

No adverse contributions can be foreseen.

19. No action. Beneficial contributions would be: no expenditure of funds or resources for construction, no relocation of families or property, no financial charges to local agencies, and no alteration of the resources of the project area.

Adverse impacts would be: increased traffic congestion in the waterway, continued erosion, further saltwater intrusion, decreasing margin of safety, and loss of navigation efficiency.

ALTERNATIVES TO BE CONSIDERED FURTHER

From the list of possible solutions shown in table 6, the preliminary evaluation indicates that several of these measures may be eliminated from further consideration on the basis of available information.

1. Widen approaches to San Bernard River crossing. Preliminary investigations indicate that the navigation problems associated with crossing the San Bernard River are either nonexistent, or of such minor magnitude that no further improvements are considered necessary.

2. Adopt Morgan City - Port Allen route. To adopt the Morgan City to Port Allen route and discontinue use of the Morgan City to New Orleans reach of the GIWW would impose economic impacts of such a magnitude that this measure will not be further considered. Establishing the Morgan City - Port Allen route as the main channel, while maintaining the present route through Houma as an alternate, would only constitute a name change. A substantial amount of the traffic between Morgan City and New Orleans serves the ports and industries presently located on the Gulf Intracoastal Waterway between these two cities.

3. Regulate tow speed and spacing. Control of tow speed and spacing would require an extensive and sophisticated navigation control system. Although, with the present state of the art, control may be practiced in congested harbor areas, it is not considered appropriate for use along the entire waterway. This

concept is polar to the prime objective of a navigation project - savings in transportation costs.

4. One-way traffic. This measure would require a navigation control system similar to the one mentioned in the paragraph above and the creation of large staging areas for tows awaiting movement. Efficiency of the waterway would be substantially reduced, accompanied by increased travel time and transportation costs. This again would reduce transportation savings that the waterway is designed to foster.

5. Limit tow size. The navigation industry continually strives for improvements in the efficiency of their equipment and operations which will result in a reduction of transportation costs. Historically these improvements have constituted increased tow boat size and capacity for barges. Equipment size limitations would either reduce present efficiency or preclude development or use of more modern vessels on the waterway in the future. In this case, transportation costs can be expected to substantially increase, as will congestion on the waterway through increased commodity movement.

The remainder of the preliminary measures listed in table 6 are considered to be appropriate for more detailed studies in intermediate (Stage II) planning. As the next phase of planning progresses, some of these measures will necessarily be eliminated because of social, economic, or institutional infeasibility, or environmental unacceptability.

The number of possible alternatives is extensive and, therefore, no attempt has been made in this Plan of Study to select the most reasonable alternatives. During Stage II planning, all alternatives will be considered in detail to determine which among them meets the social, economic, and environmental needs of the project area.

DATA REQUIREMENTS

The reports listed earlier as being pertinent to this study contain considerable useful information. The environmental impact statements recently prepared for the maintenance dredging in the Gulf Intracoastal Waterway's Louisiana and Texas reaches by the New Orleans District and the Galveston District contain a vast amount of data which will be useful in the conduct of this study. Also, the Corps review of reports presents considerable useful information; however, much of this must be updated and refined for the current study.

Although much data developed in past studies can be utilized in the current investigation, there are many gaps in the existing data which must be filled in order to perform a sound study. Although some projections were made in the 1961 review of reports, time and changes in petroleum production have, and will continue to result in, considerable differences in the commerce projected in the 1961 document and that seen today or in future years. Therefore, a portion of the available data and past work is no longer valid. A listing of available data sources is presented in attachment 2.

The following paragraphs outline the studies required to fill the existing gaps.

ECONOMIC STUDIES

1. Studies will be required to establish base conditions and indicators for use in project evaluation and justification. Data derived from those studies will be used in all phases of the planning process. Economic evaluations will be conducted in

conformance with the Principles and Standards for Planning Water and Related Land Resources dated 10 September 1973 and applicable Corps of Engineers directives.

2. Studies of existing commerce moving over the waterway will be made, as well as studies which will enable predictions to be made of the volume of commerce which would be expected to move over the waterway in the future. The ability of the existing channel, combined with other transportation facilities in the area, to meet future commerce movement requirements will be investigated, and costs of movement over a deeper and wider channel will be presented.

3. Evaluation of the local benefits that will accrue from modification of the existing waterway will be made, as well as evaluation of regional and national benefits.

4. A determination of the impact that modification of the existing waterway may have on the economy of the study area, with respect to industrial expansion and expanded labor force, will also be made.

ENVIRONMENTAL STUDIES

1. A complete inventory of flora and fauna will be required for this study. Particular attention will be given to existing dredged material disposal areas to provide data on habitat types and wildlife associated with these manmade areas. Further concentration will be on those areas which would be lost to channel improvements and the availability of similar adjacent areas which may provide habitat for displaced wildlife.

2. It will be necessary to determine the extent to which channel-induced saltwater intrusion has changed marsh types or destroyed marshes in the project area. This information will be used to evaluate the changes in the fishery resources of the area resulting from changes in saltwater and freshwater distribution.

3. Many archeological, paleontological, prehistoric, and historic sites have been identified. These locations will be considered in preparation of alternative plans and new sites will be considered as they become known.

4. The 1977 Gulf Intracoastal Waterway Environmental Impact Statement filed by the New Orleans District and the Outdoor Recreation Plans of both Texas (1975) and Louisiana (1974) contains substantial documentation of the recreational needs for the study area. The study will require evaluation of any effect on the existing recreational resources which may be occasioned by project modification and to determine the potential for development of increased recreational resources within the scope of the project. All alternatives will be evaluated for their effect in the recreation plans of the States of Louisiana and Texas.

ENGINEERING STUDIES

1. Extensive hydrologic studies will be required to determine: the extent and flow patterns of saltwater intruding into the coastal areas by way of the canal, the extent of interrupted freshwater flow patterns, the potential for hurricane flooding due to construction or modification of the canal, the effect the canal may have on surface freshwater flooding. The effects of modification

on water supplies of the study area and the various methods of reducing or preventing saltwater intrusion will also be studied.

2. Hydrographic surveys along the canal are conducted on a request basis; therefore, recent surveys exist for some reaches, while in others the data may be 5 to 10 or more years old. Extensive surveys will be required along the entire Louisiana-Texas portion of the canal with additional surveys required in the areas where widening or channel relocation may be recommended.

3. Investigations will be made of soil conditions which are conducive to bank erosion. Boring investigations will be made for evaluation of proposals for deepening and widening of the waterway. Foundation investigations will be made for evaluation of proposals for deepening and widening of the waterway. Foundation investigations will be needed at sites of any proposed structures. The availability of construction materials for any structural alternative will be ascertained.

4. Determine the location and extent of erosion along the waterway and in areas where potential erosion problems may exist in the future. Investigate methods of preventing or retarding this erosion, such as bulkheads, wave breakers, or wave dampening.

5. Investigate the potential hazards of existing low-level bridges across the waterway and the extent to which these crossings may obstruct future traffic on the canal.

6. Thoroughly investigate the requirements for dredged material disposal areas, with emphasis on selection of areas and disposal methods which will minimize adverse environmental impacts.

7. Investigate the potential need for replacing existing locks and other navigational features of flood control structures along the waterway with larger structures, to improve navigation efficiency.

8. Investigate potential energy savings resulting from increased efficiency of the waterway.

9. After alternatives have been selected, preliminary designs will be made. From these designs, estimates will be made of costs of construction for the project, costs to relocate existing physical property effected by the project, and costs to operate and maintain the project.

SOCIAL STUDIES

1. The assessment of the social impact of the proposed project upon the designated study area will follow guidelines established by Section 122 of the River and Harbor and Flood Control Act of 1970, Public Law 91-611.

2. Socioeconomic profiles describing the study area will be established in order to fully delineate the base conditions upon which alternative impacts will be measured. Data pertaining to the derivation of base conditions will be gathered through detailed field studies, employment of relevant secondary data sources, and acquisition of pertinent data from representatives of social groups.

3. The social impact assessment will address sources of, and measurement of, probable social changes as related to the proposed improvements to the Gulf Intracoastal Waterway. The study will

identify the various groups subject to social changes, both directly and indirectly, from implementation of the proposed improvement and each alternative.

4. Major social changes are not expected to occur as a result of the modification of existing facilities. However, possible changes in employment, population, earnings, and personal income may affect the quality of life in the socioeconomic area of influence of the project.

OTHER STUDIES

1. Land cost data will be required to properly evaluate any alternative. These data will include appraisals of land and rights-of-way acquisition, relocation assistance, and administrative costs to acquire land. Administrative costs include costs for mapping and surveying, appraisals, title evidence, purchase and closing, condemnation, relocation assistance, and real estate management.

2. Investigate aids to navigation and determine the needs for additions, modifications, and other improvements.

3. Investigate the need to provide access to property isolated or otherwise cut off from adjacent lands due to original construction of or modifications to the waterway.

CONSTRAINTS AND CONTROLS

This Plan of Study is to act as an outline for the completed report; however, it is reasonable to anticipate that as studies

progress, other viable alternative measures may be identified and will be incorporated into the work. Therefore, this Plan of Study is by no means final, and it will be subject to future revision to provide a working guide for preparation of the final report. Submission of future draft reports will be based on expansion of the data presented in this and subsequently revised documents. The study cost estimates and work schedules presented in this section will be used as tools to measure the progress of the study.

The study will be conducted by an interdisciplinary team made up of designated individuals with expertise as indicated below:

Study Manager
Environmental Specialist
Economist
Engineering Coordinator

Both the New Orleans and Galveston districts will have such an interdisciplinary team with expertise relative to their section of the waterway. The New Orleans District will have the responsibility for coordinating programming and budgeting for the study.

The team approach will be utilized throughout the study with all participants having an equal opportunity to be involved. Participants will be called upon for input when their skills or particular knowledge could have a material effect on study progress and output. The study manager will also serve as the plan formulation specialist, and as a water resources planner he will have a working knowledge of the other disciplines involved in the team.

He will coordinate with the Galveston district to insure timely input of information needed for the Texas portion of the study area.

In addition to the above described study team, the normal work units of the Corps will be called upon to provide the mass of data and information required for the study. Selected non-Corps individuals such as representatives of ports, environmental and conservation groups or agencies, and various navigation interests will be asked to contribute to the study effort by applying a unique knowledge of problems in the study area.

During Stage II planning, the economics of those measures under consideration will be developed to the degree necessary to determine whether or not further investigations and refinement of alternatives are warranted. Should it be determined that the cost of the alternatives under consideration exceeds the benefits, the study will be terminated.

In addition to the constraints considered in the Formulation and Evaluation Criteria section, some physical and social constraints may also effect the formulation of alternatives. In Cameron Parish, the Gulf Intracoastal Waterway passes through the Lacassine National Wildlife Refuge. The US Fish and Wildlife Service (F&WS) has requested that no alternatives be considered which would adversely affect these lands. In Aransas County, Texas, the waterway forms the southern boundary of the Aransas National Wildlife Refuge, which is the wintering area of the endangered whooping crane. The F&WS and environmental and conservation organizations have requested that certain sections of the waterway be relocated to reduce potential hazards to the cranes and that no

alternatives be considered which would result in the waterway further encroaching on this valuable refuge.

PUBLIC INVOLVEMENT

Effective study management is held together and perpetuated by the ability of various parties to communicate. Public involvement is the exchange of information between the US Army Corps of Engineers and interested groups, both Federal and non-Federal agencies, political governments, public interest groups, and the public at large. In recent years, and for numerous reasons, there has been a definite increase in the demand by groups and individuals to participate in choices by governments and corporations which deal with natural resource development. An effective public involvement program provides access to the decision-making process and permits close public scrutiny of planning efforts and outputs. This attitude greatly aids the communications effort and furthers public interest and understanding of the planning process.

At the time of completion of this Plan of Study, a detailed public involvement program had not been completed; however, it is anticipated that such a program will be undertaken toward the end of Stage II studies when alternatives are being formulated. Three basic purposes will guide the preparation of the program:

1. Promote public understanding of the Corps planning process.
2. Keep the public informed about the status, findings, and implications of the study.

3. Solicit public input regarding problems, needs, preferences for solutions, objections, and suggestions.

The general public will be informed by news releases, media interviews, newsletters, public meetings, and workshops. Periodic briefings will be made to various agencies, associations, and civic groups.

The initial set of public meetings have been held. Additional public meetings will be conducted as needed, with a minimum of two sets to be held during the later stages of the study. One public meeting (probably conducted at several locations) will be held when the final array of alternatives has been formulated. At that meeting, the public's views and preferences will be sought with respect to the alternatives presented. The final public meeting will be conducted by the District Engineer to present his recommended plan and to obtain public views on that plan.

The general purposes of all the public meetings to be held are to:

1. Inform the public about studies underway.
2. Give all interested persons an opportunity to fully and publicly express their views concerning such studies.
3. Obtain and exchange information which will assist all those involved in arriving at sound conclusions and recommendations.
4. Contribute to interagency coordination.

Copies of the draft of this Plan of Study will be sent to the Federal agencies concerned with water resources development in accordance with DIVR 1120-2-9, dated March 1973. Their official comments will be appended to the final Plan of Study.

STUDY SCHEDULE

Based on funding of \$3,060,000, it is estimated that the study will be completed in 6 years, 3 months (commencing in July 1977). Plate 5 shows a composite work/flow diagram for the entire study. The diagram shows a general outline of activities to be undertaken during Stage I, Stage II, and Stage III planning, and also indicates milestones for appropriate activities. The projected dates for the milestones shown on plate 5 are also shown in table 7.

The sequence for conducting the necessary investigations into the preliminary measures developed in this Plan of Study is shown in plate 5. It should be noted that study progress as indicated in plate 5 is dependent on timely submission of outside input and timely funding of the study.

If Stage II studies are undertaken, it is possible that alternative measures or features thereof would be unwarranted or unjustified; it is also possible that no improvement is justified or warranted. Unjustified components will be withdrawn from consideration as they occur. If no improvements are considered justified, the study will be terminated.

Stage III studies would be undertaken if improvement alternatives exist. Stage III studies would select the best plan and make recommendations thereon.

Table 7

SCHEDULED MILESTONES

<u>Milestone*</u>	<u>Date</u>	<u>Activity</u>
1	Oct 76	Study initiation
2	Jul 78	Approval of Plan of Study
3	Oct 81 **	Submit Stage II Report to Division
4	Nov 81 **	Stage II checkpoint conference
5	Dec 81 **	Completion Action on a District/ Division Memorandum for Record
6	Jan 83 **	District submittal of draft report and draft EIS to Division
7	Feb 83 **	Stage III checkpoint conference
8	Mar 83 **	Complete action on Memorandum for Record
9	Mar 83 **	Coordination of draft report and EIS
10	Jun 83 **	Submit Final Report and Revised Draft EIS to Division
11	Oct 83 **	Release of Division Engineer's Public Notice and submit report to BERH/OCE *

* Milestones based on DIVR 1105-2-2

** Dependent upon economic data produced from Waterway Simulation (WATSIM) model.

STUDY COST

At the time of preparation of this draft Plan of Study, study costs are estimated at \$3,060,000. Meetings are currently being conducted with the US Fish and Wildlife Services' area offices having responsibility for Louisiana and Texas. These meetings will result in determining the services' costs associated with their coordination efforts during the study and allow finalization of a current study cost estimate, which will be included in the final Plan of Study document scheduled for distribution in July 1978.

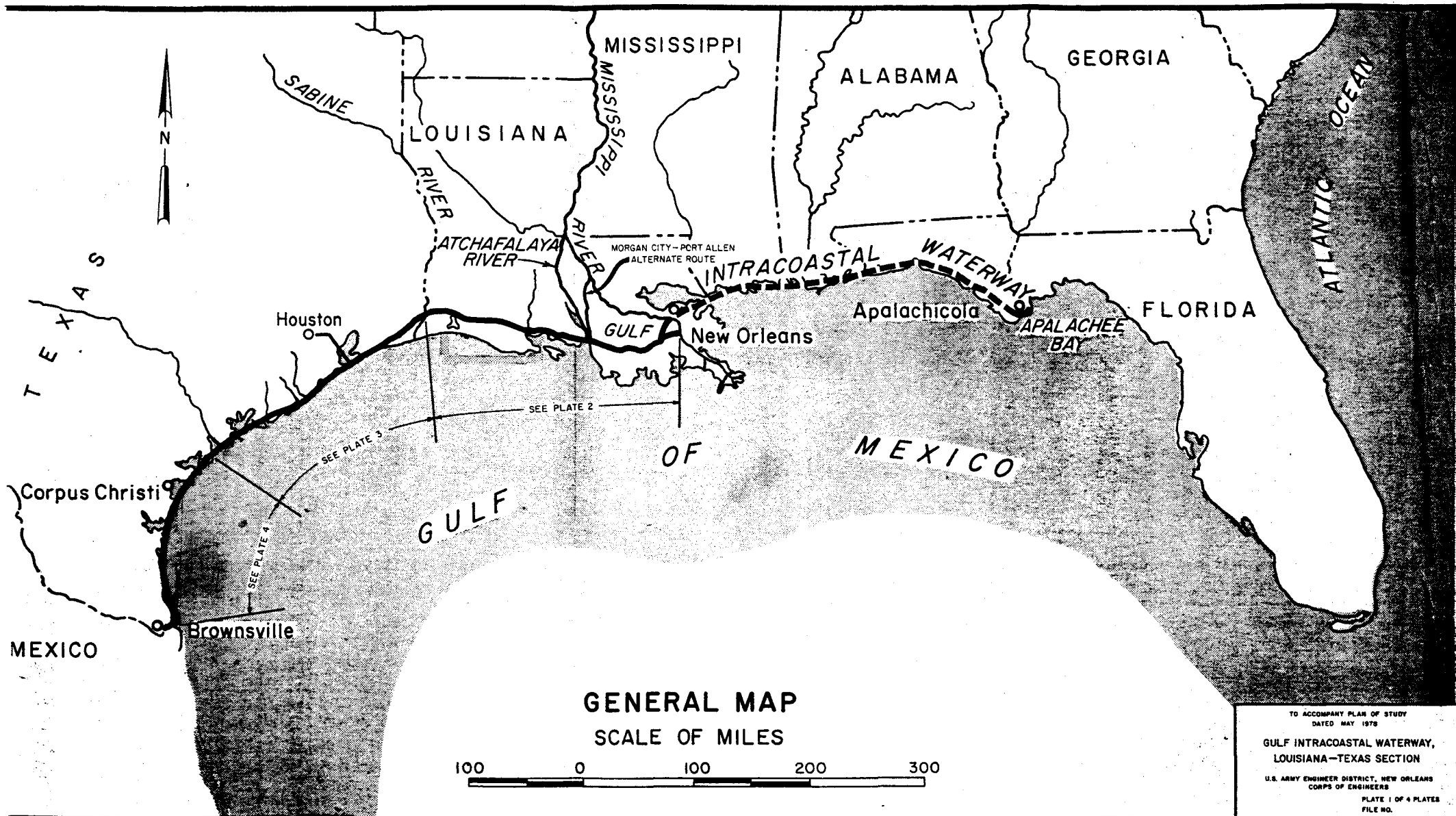
RECOMMENDATION

Approval of this Plan of Study is recommended.

2 Attachments

1. PB-6
2. Listing of Reference
Materials and Available
Data

EARLY J. RUSH III
Colonel, CE
District Engineer



SCALE OF MILES

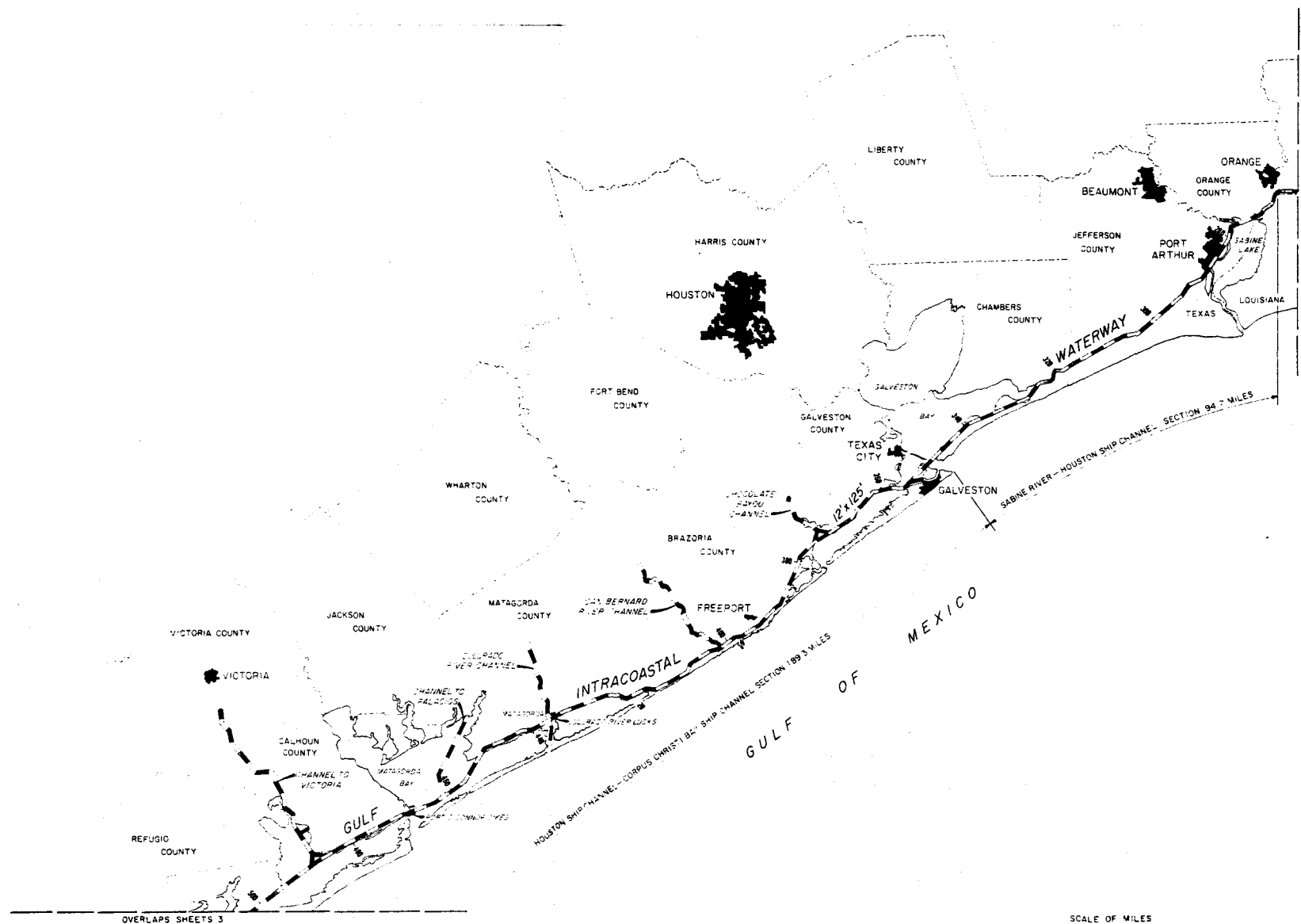
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TO ACCOMPANY PLAN OF STUDY
DATED MAY 1978

GULF INTRACOASTAL WATERWAY,
LOUISIANA-TEXAS SECTION

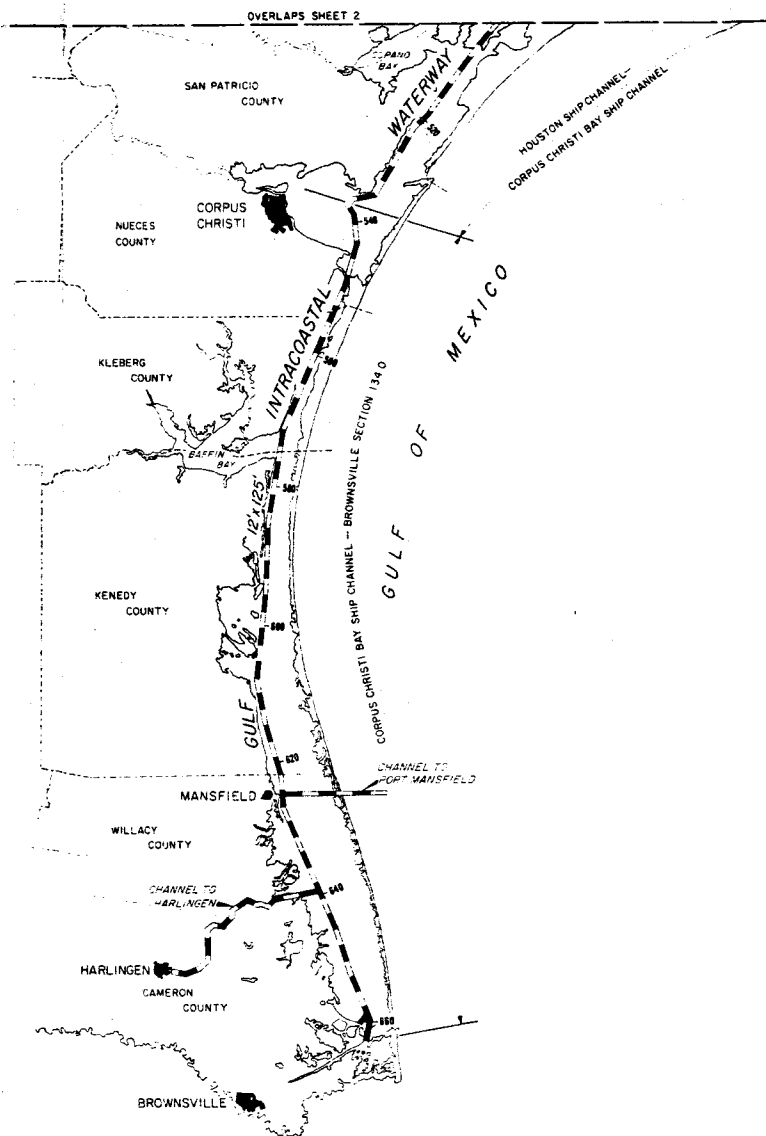
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE 2 OF 4 PLATES
FILE NO.



SCALE OF MILES
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TO ACCOMPANY PLAN OF STUDY
DATED MAY 1976
**GULF INTRACOASTAL WATERWAY,
LOUISIANA-Texas SECTION**
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
PLATE 3 OF 4 PLATES
FILE NO.



TO ACCOMPANY PLAN OF STUDY
DATED MAY 1978

**GULF INTRACOASTAL WATERWAY,
LOUISIANA-Texas SECTION**

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

PLATE 4 OF 4 PLATES
FILE NO.

GIWW, LOUISIANA-TEXAS SECTION

PLATE 5

STUDY COST ESTIMATE (PB-6) (\$000) For use of this form, see ER 11-2-220			APPROPRIATION TITLE: General Investigations				NAME OF STUDY GULF INTRACOASTAL WATERWAY, LOUISIANA-TEXAS SECTION 10032	
			CATEGORY SURVEYS					
			CLASS NAVIGATION				SUBCLASS	
LINE NO.	SUBACCOUNT		CURRENT FEDERAL COST ESTIMATE				PREVIOUS FEDERAL COST ESTIMATE AND DATE APPROVED (31 Mar 78)	REMARKS
	NUMBER	TITLE	ACCOUNT			TOTAL		
			STAGE 1	STAGE 2	STAGE 3			
			1	2	3			
a	b	c	d	e	f	g	h	
1	.00	Costs through 30 Sep 78	183	165	-	348	348	
2	.01	Public involvement		34	36	70	68	
3	.02	Institutional studies		2	4	6	6	
4	.03	Social studies		24	16	40	34	
5	.04	Cultural resource studies		24	26	50	48	
6	.05	Environmental studies		331	69	400	392	
7	.06	Fish and wildlife studies		29	21	50	43	
8	.07	Economic studies		254	41	295	273	
9	.08	Surveying and mapping		72	78	150	124	
10	.09	Hydrology and hydraulics		56	59	115	115	
11	.10	Foundations & materials invest.		99	81	180	180	
12	.11	Designs and cost estimates		168	82	250	238	
13	.12	Real estate studies		19	31	50	50	
14	.13	Study management		19	26	45	44	
DATE PREPARED 31 May 78		DIVISION Lower Mississippi Valley DISTRICT New Orleans				REGION Lower Mississippi BASIN Coastal Louisiana		Page 1 of 2

ATTACHMENT 1

LISTING OF REFERENCE MATERIALS
AND AVAILABLE DATA

The following listing of useful publications and available data is not intended to be all inclusive but rather a summary of data which are available and considered to be the most helpful in providing background information. During the course of this study, many specific references will be utilized to obtain necessary information; these references will be cited in the final report. Available reference materials are listed below:

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- Slotta, L.S. and K.J. Williamson (1975). Estuarine Impacts Related to Dredge Spoiling. In: Proceedings of the Sixth Dredging Seminar, Texas A and M University, 25 January 1974, Center for Dredging Studies Report No. eds-176:2037.
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Young, D.R., Young, C.S., and Hlavka, G.E., 1973. "Sources of Trace Metals from Highly-Urbanized Southern California to the Adjacent Ecosystem," in "Cycling and Control of Metals." Environmental Protection Agency Research Center, Cincinnati, Ohio.

Available Data

On the Louisiana section of the GIWW, uncontrolled reconnaissance (thalweg) surveys are available semi-annually from 1965 to date. Shoreline erosion surveys are available throughout the reach.

On the Texas Section, surveys are taken prior to maintenance dredging which for all intents and purposes is a continuous operation at various locations.