87th Congress, 2d Session - - - - - - - - - House Document No. 556

GULF INTRACOASTAL WATERWAY, LOUISIANA AND TEXAS

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED JULY 6, 1962, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A REVIEW OF THE REPORTS ON THE GULF INTRACOASTAL WATERWAY, LOUISIANA AND TEXAS, REQUESTED BY A RESOLUTION OF THE COMMITTEE ON PUBLIC WORKS, HOUSE OF REPRESENTATIVES, ADOPTED JUNE 11, 1952

SEPTEMBER 13, 1962.—Referred to the Committee on Public Works and ordered to be printed with five illustrations

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1962

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C.

IN REPLY REFER TO:

September 11, 1962

Honorable John W. McCormack

Speaker of the House of Representatives

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 6 July 1962, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on a review of the reports on the Gulf Intracoastal Waterway, Louisiana and Texas, requested by a resolution of the Committee on Public Works, House of Representatives, adopted 11 June 1952.

In accordance with Section 1 of Public Law 14, 79th Congress, and Public Law 85-624, the views of the States of Louisiana and Texas and the Department of the Interior are set forth in the inclosed communications.

The Bureau of the Budget advises that there is no objection to the submission of the proposed report to the Congress; however, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project modification, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Bureau of the Budget is inclosed.

Sincerely yours,

Cyrus Vance

Cyrus R. Vance
Secretary of the Army

1 Incl (dup)
Rept w/accompg
papers & illus

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
WASHINGTON 25, D.C.

August 29, 1962

Honorable Cyrus R. Vance
Secretary of the Army
Washington 25, D. C.

Dear Mr. Secretary:

Assistant Secretary Schaub's letter of July 13, 1962, submitted the report of the Chief of Engineers on the Gulf Intracoastal Waterway, Louisiana and Texas, in response to a resolution of the Committee on Public Works, House of Representatives, adopted June 11, 1952.

The Chief of Engineers recommends, subject to certain stated conditions of local cooperation, modification of the existing Gulf Intracoastal Waterway project to provide for a channel 16 feet deep and 150 feet wide from the Mississippi River to the Atchafalaya River, and from the Sabine River to the Houston Ship Channel; a channel 16 feet deep and 200 feet wide from the Atchafalaya River to the Sabine River; five relocations to improve channel alignment; and resumption of maintenance of Lydia Ann Channel in Aransas Bay, Texas. The total Federal construction cost is estimated at $25,240,000. The Federal cost of maintenance of the waterway would be increased by $56,000 annually after the proposed modifications are constructed. The stated benefit-cost ratios for the separable parts range from 1.1 to 3.3, with an aggregate stated benefit-cost ratio of 2.2.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the proposed report to the Congress. No commitment, however, can be made at this time as to when any estimate of appropriation would be submitted for construction of the project modification, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation.

Sincerely yours,

E. Fenton Shepard

E. Fenton Shepard
Acting Chief, Resources and
Civil Works Division

COMMENTS OF THE STATE OF LOUISIANA

State of Louisiana

CLAUDE KIRKPATRICK
DIRECTOR

DEPARTMENT OF PUBLIC WORKS
BATON ROUGE 4

May 14, 1962

Lieutenant General W. K. Wilson, Jr.
Chief of Engineers
Department of the Army
Office of the Chief of Engineers
Washington 25, D. C.

Dear General Wilson:

In accordance with your letter of 28 March 1962, enclosing your report, together with those of the Board of Engineers for Rivers and Harbors, and of the Division and District Engineers on the Gulf Intracoastal Waterway, Louisiana and Texas, the Department of Public Works has reviewed these reports and generally concurs in the findings and recommendations made therein.

Also in accordance with your letter, the comments of the Wild Life and Fisheries Commission on the proposed report have been obtained, and are given in the attached letter from the Director of that agency.

Very truly yours,

Claude Kirkpatrick

CLAUDE KIRKPATRICK
Director

/an
Attachment

State of Louisiana

WILD LIFE AND FISHERIES COMMISSION
400 ROYAL STREET
NEW ORLEANS 16

L. D. YOUNG, JR.
DIRECTOR

May 11, 1962

Mr. Claude Kirkpatrick, Director
Department of Public Works
State of Louisiana
Baton Rouge, Louisiana

Dear Mr. Kirkpatrick:

Reference is made to your letter of April 11, 1962 concerning our comments on the report entitled "Gulf Intracoastal Waterway, Louisiana - Texas Section." This past week we were able to borrow a copy of this report from the New Orleans Section Corps of Engineers and have reviewed the report.

Our recommendations are included among those of the Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service, and we have no further comments to offer at this time.

Thank you for calling this to our attention.

Sincerely,

L. D. Young, Jr.,
Director

LDYJr/sl.

COMMENTS OF THE GOVERNOR OF TEXAS

EXECUTIVE DEPARTMENT
AUSTIN 11, TEXAS

PRICE DANIEL
GOVERNOR

May 11, 1962

Lt. General W. K. Wilson, Jr.
Chief of Engineers
U. S. Army Corps of Engineers
Washington 25, D. C.

Dear General Wilson:

This has further reference to your letter of March 28, 1962, transmitting copy of the proposed report on the Gulf Intracoastal Waterway, Louisiana and Texas.

At my request, the Texas Water Commission reviewed this report and approved its feasibility, as evidenced by the attached copy of a Commission Order. I concur in the findings and conclusions of the Commission.

Sincerely yours,

Price Daniel

PD:gs

Enclosure

cc: Hon. Joe D. Carter, Chairman
Texas Water Commission
Capitol Station, Box 2311
Austin 11, Texas

TEXAS WATER COMMISSION

AN ORDER approving the feasibility of the proposed Federal Project to modify the existing project for the Gulf Intracoastal Waterway, Louisana and Texas, as proposed in the "Review on Gulf Intracoastal Waterway, Louisana-Texas Section" by the Corps of Engineers, United States Army.

BE IT ORDERED BY THE TEXAS WATER COMMISSION:

Section 1. Statement of Authority. Article 7472e, Vernon's Annotated Civil Statutes, provides that upon receipt of any engineering report submitted by a Federal Agency seeking the Governor's approval of a Federal Project, the Texas Water Commission shall study and make recommendations to the Governor as to the feasibility of the Federal Project. The Commission shall cause a public hearing to be held to receive the views of persons or groups who might be affected should the Federal Project be initiated and completed.

Section 2. Statement of Jurisdiction. (a) By letter dated April 4, 1962, the Honorable Price Daniel, Governor of Texas, requested the Texas Water Commission to study and make recommendations concerning the proposed Federal Project to modify the existing project for the Gulf Intracoastal Waterway, Louisana and Texas, as described in the review of reports of the Corps of Engineers, United States Army, entitled "Review of Reports on Gulf Intracoastal Waterway, Louisana-Texas Section", initially dated 25 August 1961, and to enter its order finding said project to be feasible or not feasible. (b) In accordance with Article 7472e, the Commission caused a public hearing after due notice by publication and mail, to be held on May 4, 1962, at 9:00 o'clock A.M., in the offices of the Texas Water Commission, 201 East Fourteenth Street, Austin, Texas, on said project, and at which time all those interested or who may be affected should the project recommended in said Report be initiated and completed were requested to come forward and give testimony.

Section 3. After fully considering all the evidence and exhibits presented by persons and groups who may be affected should the project be initiated and completed, including the matters set forth in Section 4 of Article 7472e, the Commission finds that said project is feasible and that the public interest will be served thereby.

Section 4. The Commission recommends, but not as a condition to its approval or as a requirement of the project proposed in said Review of Reports, that Congress further authorize modification of the existing project for the Gulf Intracoastal Waterway, Louisana and Texas, to provide a channel with a width of 200 feet and a depth of 16 feet in that section of the Waterway between the common boundary of Louisana and Texas and the City of Corpus Christi, Texas.

Section 5. It is further ordered that a certified copy of the Order be transmitted to the Governor.

Section 6. This Order shall take effect on the 4th day of May, 1962, the date of its passage, and it is so ordered.

SIGNED IN THE PRESENCE OF THE
TEXAS WATER COMMISSION

H. A. Beckwith, Acting Chairman

ATTEST:

Ben F. Looney, Jr., Secretary

I certify that the foregoing order was adopted by the Texas Water Commission at a meeting held on the 4th day of May, 1962, upon motion of Commissioner Dent, seconded by Commissioner Beckwith, Commissioner Beckwith voting "aye", Commissioner Dent voting "aye", and Chairman Carter voting "aye".

Ben F. Looney, Jr., Secretary

STATE OF TEXAS |
COUNTY OF TRAVIS |

I, Ben F. Looney, Jr., Secretary of the Texas Water Commission do hereby certify that the foregoing is a true and correct copy of an order of said Commission, the original of which is filed in the permanent records of said Commission.

Given under my hand and the seal of the Texas Water Commission, this the 11th day of May, A.D., 1962.

Ben F. Looney, Jr., Secretary

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

6 July 1962

Dear General Wilson:

This is in reply to your letter of March 28 transmitting copies of the reports on Gulf Intracoastal Waterway, Louisiana and Texas. The proposed project contemplates enlarging the channel of the intracoastal waterway between the Mississippi River and Houston Ship Channel.

The Bureau of Sport Fisheries and Wildlife, in reporting jointly with the Bureau of Commercial Fisheries, recommended measures concerning the selection of spoil areas, method of disposal, and channel relocation. Two reports, covering the Louisiana and Texas portions of the project area respectively have been submitted. The District Engineer recognizes these reports and comments on the recommendations contained in the report covering the Texas segment but comments only in a general way on the recommendations for the Louisiana segment.

There are no foreseeable benefits to fish and wildlife resources that can be assigned to this project at this time, but there will be substantial losses. Partial mitigation of these losses can be accomplished by adoption of the recommendations contained in the reports prepared by the Fish and Wildlife Service.

It is essential that the project provide for the preservation of as much as possible of the rapidly dwindling fish and wildlife habitat of the extensive area which will be effected. All feasible protective measures should be included.

It is noted that the District Engineer's Report states that the U. S. Fish and Wildlife Service, Texas Game and Fish Commission, and the Louisiana Wild Life and Fisheries Commission will be consulted during the detail planning and design studies in order that all recommendations and proposals for the protection of fish and wildlife may be fully considered.

The Fish and Wildlife Service will be pleased to cooperate with the Corps of Engineers and the respective State wildlife agencies in detailed studies after project authorization to develop plans for all feasible means of protecting fish and wildlife resources from the potential damaging effects of the project.

Your proposed report states that "However, I find that no significant local advantage will result from provision of dikes, bulkheads, and embankments for the retention of spoil and that local provision of these measures or the cost thereof is not necessary in the public interest." The provision of dikes, bulkheads and embankments to retain spoil will undoubtedly be an important part of some of the measures which will be needed to minimize or prevent damages to fish and wildlife resources. We assume that the cost of such facilities would become a Federal cost of the project. This Department would have no objection to the inclusion of the cost of facilities for the retention of spoil as a Federal cost of the project since such facilities will minimize damages to fish and wildlife habitat in many instances.

The opportunity to review this report is appreciated.

Sincerely yours,

Assistant Secretary of the Interior

Lt. General Walter K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

GULF INTRACOASTAL WATERWAY, LOUISIANA AND TEXAS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

IN REPLY REFER TO

ENGCW-PD

6 July 1962

SUBJECT: Gulf Intracoastal Waterway, Louisiana and Texas

TO: THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, in response to a resolution of the Committee on Public Works, House of Representatives, United States, adopted 11 June 1952, with a view to determining the advisability of modifying the existing project for the Gulf Intracoastal Waterway, Louisiana and Texas, in any way at this time, particularly with respect to widening and deepening the existing channels.

2. The District and Division Engineers recommend modification of the existing project to provide for enlarging the channel, except at existing structures and through intensively developed areas, to 16 feet deep and 150 feet wide from the Mississippi River to the Houston Ship Channel, including additional widening within this section to provide a width of 200 feet between the Atchafalaya River and the Sabine River, and three relocations, one of which would bypass the existing channel at Houma, Louisiana. The recommended modification would also provide for relocations of the 12-foot by 125-foot waterway in Matagorda Bay and in Corpus Christi Bay, and for maintenance to 12 feet deep and 125 feet wide of the existing Lydia Ann channel between Aransas Bay and Aransas Pass and of the existing channel through Houma, Louisiana. They estimate the first cost to the United States, exclusive of $134,000 for navigation aids, at $25,540,000 for construction. The Federal cost for maintenance is estimated at $56,000 annually in addition to that now required. The reporting officers estimate the first cost to local interests for lands, easements, rights-of-way, and bridges at $7,238,000, and the cost to them for maintenance and operation of bridges at $66,000 annually. Thus, the total first cost is estimated at $32,778,000 for construction. Total annual charges are estimated at $1,398,000, and average annual benefits at $3,008,000. The benefit-cost ratio is 2.2.

3. The Board of Engineers for Rivers and Harbors concurs in general in the findings of the reporting officers and recommends modification of the existing project to provide for the further improvements and changes as planned by the District Engineer, subject to certain conditions of local cooperation.

4. I concur generally in the views of the Board. However, I find that no significant local advantage will result from provision of dikes, bulkheads, and embankments for the retention of spoil and that local provision of these measures or the cost thereof is not necessary in the public interest. With this exception I concur in the recommendations of the Board.

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

CORPS OF ENGINEERS, U. S. ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
WASHINGTON 25, D.C.

ENGBR

25 January 1962

SUBJECT: Gulf Intracoastal Waterway, Louisiana and Texas

TO: Chief of Engineers
Department of the Army

1. Authority.--This report is in response to the following resolution, adopted 11 June 1952, as follows:

> Resolved by the Committee on Public Works of the House of Representatives, United States, 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), submitted in House Document No. 238, 68th Congress, 1st 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 channels.

2. Description.--

a. General.--The Gulf Intracoastal Waterway is a Federal shallow-draft project extending 1,115 miles from Apalachee Bay, Florida, to Brownsville, Texas, on the Mexican Border. This report considers the portion west of the Mississippi River. It includes, along the original main route from the river opposite New Orleans to Brownsville, 266 miles in Louisiana and 418 miles in Texas. The channel in this reach is generally 12 feet deep and 125 feet wide except at structures. The waterway generally traverses marshland at distances of one-half mile to 50 miles from the Gulf of Mexico. These lands are largely undeveloped except for the alluvial ridges along the streams intersected. The mean range of tide is about 1 foot. Strong northerly winds have depressed the water surface as much as 2 feet, and tropical hurricanes have raised the water surface to as much as 10 feet in the Louisiana section and 15 feet in the Texas section.

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b. Alternative routes.--The Gulf Intracoastal Waterway as originally constructed connects with the Mississippi River through Harvey Lock opposite New Orleans. This lock is the zero of the mileage system for the section under consideration. A second route leaves the Mississippi River at Algiers Lock, 10 miles below Harvey Lock, and extends through Algiers Canal to connect with the original channel at about mile 6. The Plaquemine-Morgan City route leaves the Mississippi about 113 miles above New Orleans through the Plaquemine Lock and extends south 56 miles through a channel containing Bayou Sorrel Lock and connects with the main channel at Morgan City, Louisiana, on the Atchafalaya River, at mile 95.5 west of Harvey Lock. This route is being extended northward by an intersecting channel to connect with the Mississippi River through a lock at Port Allen opposite Baton Rouge, Louisiana. The distance from Morgan City to Port Allen is 65 miles.

c. Locks and floodgates.--The locations and dimensions of the several locks on the Gulf Intracoastal Waterway, including its alternative routes, are shown in the following table:

Lock	Mileage or Location	Feet			Remarks
		Width	Length	Sill Depth BMLGL*	
Port Allen	Mississippi River	84	1,200	14	
Plaquemine	Mississippi River	55	260	10	
Harvey	Mississippi River	75	425	12	
Algiers	Mississippi River	75	760	13	
Bayou Boeuf	93.5	75	1,160	13	
Bayou Sorrel	Atchafalaya River	56	760	14	
Vermilion	162.7	56	1,182	11.3	Salt-water lock
Calcasieu	238.9	75	1,180	13	Salt-water lock
Brazos River	400.6	75	--	15	Floodgates
Colorado River	441.3	--	1,200	--	Flood locks

* Below mean low Gulf level.

d. Main route.--The main route of the waterway intersects the following major rivers, waterways, and points of interest to this study:

Points on Gulf Intracoastal Waterway

Location	Approximate mileage
Houma, Louisiana	58
Atchafalaya River	95
Vermilion River	159
Calcasieu River	239
Sabine River	266
Neches River	277
Port Arthur Canal	288
High Island	320
Houston Ship Channel	350
Freeport Channel	395
Brazos River	400
Colorado River	440
Relocation No. 4-Matagorda Bay	454
Relocation No. 5-Port Aransas-Corpus Christi Waterway	539
Brownsville Ship Channel	669

3. Tributary channels.--There are 10 authorized tributary channels to the Gulf Intracoastal Waterway; one in Louisiana, the others in Texas, as listed below:

Name of channel	Authorized dimensions (feet) Depth below MLW	Bottom width	Turning basin	Length (miles)	Gulf Intracoastal (mileage)
Franklin Canal, Louisiana	8	60	100x300	5.9	121
San Bernard River Channel	9	100	(1)	31.0	405
Colorado River Channel(2)	9	100	400x500	17.0	441
Channel to Palacios	9	100	(3)	5.7	462
Channel to Rockport	9	200	(3)	2.0	524
Channel to Aransas Pass	12	125	300x2200	6.1	538
Channel to Barroom Bay	6	60	None	0.4	474
Channel to Victoria	9	100	(1)	35.2(4)	492
Channel to Port Mansfield(5)	14	100	(6)	10.0	632
Arroyo Colorado to Harlingen	12	125	400x500	33.0	645

(1) Turning basin to be provided by local interests.
(2) Under construction. Scheduled completion date February 1962.
(3) Turning basin provided by local interests.
(4) First 14 miles dredged by local interests.
(5) Includes entrance channel 16 x 250 feet from Gulf of Mexico and jetties at entrance.
(6) Turning basin 14 x 400 x 1200 feet, shrimp basin 12 x 350 x 1450 feet, and small-craft basin 8 x 160 x 800 feet.

A total of 27 Federal navigation projects, with channels ranging from 5 feet deep and 40 feet wide to 40 feet deep and 400 feet wide and from 2.0 miles to 116.8 miles long, intersect the Gulf Intracoastal Waterway within the section under consideration. All are listed in the District Engineer's report.

4. Bridges.--Twenty-five highway bridges and three railway bridges cross the main channel. The limiting horizontal clearance is 75 feet and all fixed bridges have vertical clearances of 73 feet or more above mean high water, except one for which an unbridged bypass channel is available. The Plaquemine-Morgan City channel is crossed by two highway and two railway bridges with limiting clearances of 56 feet horizontally and 52.4 feet vertically.

The authorized modification of this channel will be crossed by four additional bridges which will probably have clearances at least equivalent to those over the existing waterway. The Algiers Canal is crossed by one railway and one highway bridge, both with clearances of 125 feet horizontally and 100 feet vertically.

5. Prior and existing projects.--Several prior projects provided for inland waterways 5 feet deep and 40 feet wide from New Orleans to Sabine River, on the Louisiana-Texas boundary, and between Galveston Bay and Corpus Christi, Texas. The River and Harbor Acts of 1925 and 1927 provided for a channel 9 feet deep and 100 feet wide from the Mississippi River to Corpus Christi, and for an alternate channel of the same dimensions from the Mississippi River to Morgan City, Louisiana, via the Plaquemine River. The existing dimensions of 12-foot depth and minimum width of 125 feet were provided for by the River and Harbor Act of 1942. The existing project in Texas also provides for the nine feeder or tributary channels listed in paragraph 3 above, two side channels at Port Isabel, a railroad bridge over the main channel near High Island, floodgates or locks at the Brazos and Colorado Rivers, a flood-discharge channel in the Colorado River extending from the main channel of the Gulf Intracoastal Waterway near Matagorda to the Gulf of Mexico, and a harbor of refuge at Seadrift.

6. Terminal facilities.--Extensive terminal and transfer facilities, both public and private, suitable for barge commerce are available. These are located generally on the deepwater channels that are intersected or traversed in part by the waterway. However, many are on the main waterway and its connecting feeder channels.

7. Tributary area and resources.--The area from New Orleans to Brownsville is an industrial region in which production is increasing rapidly. It has an abundance of minerals, rich soils, and a temperate climate. There are 10 deepwater ports, including New Orleans, with connections to the interior. Approximately 100 chemical plants have located in the area since 1940. Mineral production consists of petroleum, gas, sulphur, cement materials, clay, gypsum, and salt. Petroleum, representing more than 80 percent of the mineral production, is being produced at a rate of one billion barrels of crude oil and distillate annually in Texas fields, and 265 million barrels annually in Louisiana fields. Sulphur mines in the area produce 6 million tons annually, and salt production is about 5 million tons annually. The coastal waters

support oyster, crab, shrimp, and fin-fish fisheries, with the annual production amounting to about 325,000 tons.

8. Commerce.--Commerce on the entire Intracoastal Waterway between Apalachee Bay, Florida, and Brownsville, Texas, has increased from 5.7 million tons in 1937 to 51.3 million tons in 1959. Traffic over the several sections of the waterway considered in this report varies considerably as shown below for 1959:

Reach	Million tons
Algiers Alternate Canal	6.7
Plaquemine-Morgan City	3.1
Mississippi River-Atchafalaya River	11.3
Atchafalaya River-Sabine River	19.0
Sabine River to Houston Ship Channel	16.3
Houston Ship Channel to Port Aransas-Corpus Christi Waterway	4.6
Port Aransas-Corpus Christi Waterway	0.8

The average tonnages in percentages by commodity types for the 23-year period was approximately: petroleum and products, 70; sea shells, unmanufactured, 11; chemicals and products, 4; iron, steel, and other metals, 4; and all other, 11. Two- and three-barge tows carry 80 percent of all commerce. Vessel and barge trips during 1959 for the several sections of the waterway are shown in the following table:

Reach	Total	
	Vessels	Barges
Mississippi River to Sabine River	54,519	78,100
Sabine River to Galveston	16,997	30,148
Galveston to Corpus Christi	20,386	14,940
Corpus Christi to Brownsville	11,784	2,375
Total	103,686	125,563

Drafts of vessels ranged from 1 to 12 feet. The trips of vessels and barges with drafts in excess of 6 feet, included in the above totals, are 36,308 and 43,639, respectively. The maximum size tows permitted on the waterway have a length of 1,000 feet, exclusive of towing vessels, and a width of 55 feet. Records indicate that the drafts of barges transporting cargo over the waterway have not increased appreciably in recent years. Depths of connecting waterways and possible routes of travel limit the drafts.

9. Navigation difficulties.--The most serious navigation difficulties result from the present width and depth of the channel which restrict efficient operation of marine equipment. Several bends are too sharp to be negotiated with modern tows except at slow speed. A large portion of the power required for towing is expended in overcoming the drag, or friction, caused by the limited channel dimensions. This characteristic also increases vessel damages and insurance rates. Furthermore, tows experience difficulty in passing in the channel. In a 6-mile reach at Houma, Louisiana, the short sight distances at several bends, the narrow width of channel and bridge openings, and erosion of the channel banks, make it necessary for craft to proceed slowly. However, the delays that occur and hazards that exist are not considered sufficient to influence the future development of traffic.

10. Improvements desired.--Local interests desire that the Gulf Intracoastal Waterway be improved by:

a. Enlarging the main stem and its alternative routes to the maximum width and depth economically justified;

b. Constructing such cutoffs and realinements as may be feasible and economical;

c. Increasing the channel width at least 20 percent over the present width at all sharp bends; and

d. Widening the channel at the entrance to all waterway crossings.

11. District Engineer's findings.--The District Engineer finds that enlargement of the existing channel will reduce operating costs of tows by reducing friction losses and facilitating the passing of tows. His plan for improvement includes easing at bends and general enlargement to provide a channel 16 feet deep and 150 feet wide on the main stem from the Mississippi River to the Atchafalaya River and from the Sabine River to the Houston Ship Channel, and a channel 16 feet deep and 200 feet wide between the Atchafalaya River and the Sabine River. It also includes five relocations, to improve alinement and navigation conditions, and the resumption of maintenance of an old tributary channel in Aransas Bay, designated as Lydia Ann Channel. He also determines that further improvement of the main

reaches from the Houston Ship Channel to Brownsville and of the Plaquemine-Morgan City route is not justified economically at this time. Within the reaches to be improved, enlargements would not be made at existing bridges, tunnels, lock structures, and through intensively developed areas. The lengths which do not require improvement and the lengths which will remain restrictive in the several reaches are as follows:

Reach	Excluded lengths in miles	
	Adequate	Restricted
Mississippi River to Atchafalaya River	-	12.95
Atchafalaya River to Sabine River	29.5	2.40
Sabine River to Houston Ship Channel	23.17	2.03
Algiers Alternate Canal	-	0.76
	52.67	18.14

12. Costs and economic justification.--The District Engineer estimates the first costs, annual charges and benefits, and the benefit-cost ratios as follows. The first costs are based on December 1960 prices, and the benefit-cost ratios on a 50-year period of analysis.

Item	First cost ($1,000) Federal	Non-Federal	Total	Benefit-cost ratio
Mississippi River to Atchafalaya River via Algiers Canal				
Construction (16' x 150')	$ 3,770	$ 1,990	$ 5,760	
Aids to navigation	10	-	10	
Preauthorization studies	16	-	16	
Total	$ 3,796	$ 1,990	$ 5,786	1.5
Houma Bypass, Relocation No. 1				
Construction (16' x 150')	$ 1,280	$ 3,790	$ 5,070	
Contribution for bridges	1,780	(1,780)	-	
Preauthorization studies	5	-	5	
Total	$ 3,065	$ 2,010	$ 5,075	1.4
Atchafalaya River to Sabine				
Construction (16' x 200')	$12,800	$ 2,880	$15,680	
Aids to navigation	20	-	20	
Preauthorization studies	30	-	30	
Total	$12,850	$ 2,880	$15,730	2.5
Sabine River to Houston Ship Channel, Including Relocations Nos. 2 & 3				
Construction (16' x 150')	$ 5,080	$ 330	$ 5,410	
Aids to navigation	20	-	20	
Preauthorization studies	12	-	12	
Total	$ 5,112	$ 330	$ 5,442	2.7
Houston Ship Channel to Port Aransas-Corpus Christi - Relocation No. 4, Mi. 454.3 to 471.3				
Construction (12' x 125')	$ 682	$ 28	$ 710	
Aids to navigation	66	-	66	
Preauthorization studies	2	-	2	
Total	$ 750	$ 28	$ 778	1.1
Port Aransas-Corpus Christi to Brownsville - Relocation No. 5, Mi. 539.4 to 550.0				
Construction (12' x 125')	$ 152	-	$ 152	
Aids to navigation	18	-	18	
Preauthorization studies	1	-	1	
Total	$ 171	-	$ 171	3.3
Lydia Ann Channel-Port Aransas (No first costs, maintenance only)				
(12' x 125')	-	-	-	1.5
Total (adjusted for rounding)	$25,740(1)	$ 7,238	$32,979	2.2

(1) Includes $66,000 for preauthorization studies and $134,000 for navigation aids. The total annual charges for the improvements, including $56,000 for Federal channel maintenance in addition to that now required, are estimated at $1,398,000 and the average annual benefits at $3,008,000.

13. Recommendations of reporting officers.--The District Engineer recommends modification of the existing project for the Gulf Intracoastal Waterway to provide for further improvement of the Louisiana and Texas sections, Algiers Lock route, in general accordance with his plan, subject to certain local cooperation. The Division Engineer concurs.

14. Public notice.--The Division Engineer issued a public notice stating his recommendations and affording interested parties an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

15. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. Deepening and widening of the Gulf Intracoastal Waterway without change through congested areas and controlling structures, the relocations proposed, and the maintenance of Lydia Ann Channel are justified by the prospective benefits. The recommended requirements of local cooperation are considered appropriate. The Board believes the relocations selected by the reporting officers are well justified. While they appear to be the most favorable at this time, future developments and additional detailed studies may indicate the desirability of modifications within the discretion of the Chief of Engineers. In any future construction and reconstruction of bridges, careful consideration should be given to the advantages of providing structures which will be consistent with possible future increase in the controlling dimensions of the waterway.

16. Recommendations.--The Board accordingly recommends that the existing project for the Gulf Intracoastal Waterway be modified to provide for channels of the following dimensions through the reaches listed, except at existing locks and other structures and through intensively developed areas:

A channel 16 feet deep and 150 feet wide from the Mississippi River, via Algiers Canal and a bypass route at Houma, Louisiana, to Atchafalaya River;

A channel 16 feet deep and 200 feet wide through the reach from the Atchafalaya River to the Sabine River;

A channel 16 feet deep and 150 feet wide through the reach from the Sabine River to the Houston Ship Channel with two relocations;

A channel 12 feet deep and 125 feet wide through a relocated route in Matagorda Bay (mile 454.3 and mile 471.3);

A channel 12 feet deep and 125 feet wide through a relocated route in Corpus Christi Bay (mile 439.4 and mile 550);

Maintenance of channel 12 feet deep and 125 feet wide through the existing Lydia Ann Channel between Aransas Bay and Aransas Pass; and

Maintenance of the existing waterway to 12 feet deep and 125 feet wide between mile 50.5 and mile 63.5, the reach which would be shunted by the Houma Bypass;

all generally in accordance with the plan of the District Engineer and with such modifications as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $25,540,000 for construction, including 58 percent of the construction cost of bridges at Houma (an amount presently estimated at $1,780,000), and $56,000 annually for maintenance in addition to that now required. This work is recommended subject to the provision that prior to accomplishment of construction and maintenance, other than as now authorized, local interests agree to:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works;

b. Accomplish and maintain without cost to the United States all alterations to pipelines, cables, and any other utilities necessary for the construction of the project;

c. Construct, maintain, and operate all bridges desired in connection with the bypass route around Houma, Louisiana; and

d. Hold and save the United States free from damages resulting from the construction work and the maintenance of the channels.

It is further recommended that improvement and maintenance of any of the reaches mentioned above be permitted to be undertaken independently of the others whenever funds for that purpose are available and the prescribed local cooperation for the reach has been furnished.

FOR THE BOARD:

KEITH R. BARNEY
Major General, USA
Chairman

REVIEW OF REPORTS ON GULF INTRACOASTAL WATERWAY, LOUISIANA-TEXAS SECTION

SYLLABUS

The Gulf Intracoastal Waterway is one of the most important inland waterways of the United States. The tonnages of crude oil, chemicals, sulphur, and other commodities have reached large proportions, and further increases in the future are expected. Exploitation of the inshore and offshore oil lands and development of the petrochemical and allied industries along the Gulf shore assure the future heavy use of the waterway with tonnages increasing over those now being handled.

The restricted channel dimensions of the existing 12 x 125-foot project produce extensive losses for tows and large vessels now moving on the waterway. Local interests and waterway users request that the waterway be enlarged to afford increased efficiency.

Traffic existing and reasonably prospective on the waterway is adequate to justify enlargement of the waterway to provide: a 16 x 150-foot channel from the Mississippi River to the Atchafalaya River, including the Algiers Alternate Canal and one channel relocation at Houma, La.; a 16 x 200-foot channel from the Atchafalaya River to the Sabine River; a 16 x 150-foot channel from the Sabine River to the Houston Ship Channel, including two channel relocations; relocation of the existing main channel at dimensions of 12 x 125 feet in Matagorda Bay and in Corpus Christi Bay; and resumed maintenance of the formerly authorized 12 x 125-foot Lydia Ann Channel from Aransas Bay to the Port Aransas-Corpus Christi Waterway near Aransas Pass.

Federal first cost and annual charges (exclusive of the cost of navigation aids and preauthorization studies) of these improvements are estimated at $25,544,000 and $992,000, respectively; while the corresponding non-Federal items would be $7,238,000 and $403,000. Density of traffic over the various reaches of the Gulf Intracoastal Waterway varies. Favorable benefit-cost ratios were determined for each segment of the recommended improvements listed above. The benefit-cost ratio of the entire plan of improvement is 2.2 to 1.

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
Foot of Prytania Street
New Orleans, Louisiana

25 August 1961

SUBJECT: Review of Reports on Gulf Intracoastal Waterway, Louisiana - Texas Section

THRU: Division Engineer
U. S. Army Engineer Division
Lower Mississippi Valley
Vicksburg, Mississippi

TO: Chief of Engineers
Department of the Army
Washington, D. C.

SECTION I - AUTHORIZATION, PURPOSE, AND SCOPE

1. AUTHORITY

This review of reports is submitted in response to a resolution adopted by the Committee on Public Works, House of Representatives, United States, June 11, 1952, as follows:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, 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), submitted in House Document No. 238, 68th Congress, 1st 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 channels."

2. PURPOSE AND EXTENT OF STUDY

a. The purpose of this report is to determine whether the existing Federal project on the Gulf Intracoastal Waterway between the Mississippi River at New Orleans, La., and Brownsville, Texas, should be modified at this time.

b. Office studies were made of maps, charts, and prior reports on the waterway, as well as condition surveys of the waterway by fathometer, consisting of cross-sections and centerline soundings, and surveys of the waterway after maintenance dredging.

c. The economic survey included a study of lock records, commercial statistics, and barge sizes. Considerable study also was made of barge resistance in shallow and constricted channels, and of the push horsepower available for overcoming fleet resistance for various sizes of towboats.

d. Information and data relating to the Texas section of the Gulf Intracoastal Waterway contained in this report were furnished by the U. S. Army Engineer District, Galveston, Texas.

e. The following agencies and interested parties were consulted in connection with the review of reports:

American Waterways Operators, Inc.
Oil Companies
Towing Companies
U. S. Bureau of Public Roads
U. S. Fish and Wildlife Service
Louisiana Department of Public Works
Louisiana Department of Wild Life and Fisheries
Police Juries of Louisiana
Louisiana Department of Highways
Navigation Districts in Texas
Texas Game and Fish Commission
Texas Highway Department
County Authorities in Texas

SECTION II - DESCRIPTION

3. DESCRIPTION

a. General. The Gulf Intracoastal Waterway extends for 1,115 miles from Apalachee Bay, Florida, to the Mexican Border. At New Orleans, it connects with the Mississippi River which, with its tributary system, affords water transportation to the major river basins in central United States. To the east of New Orleans the Gulf Intracoastal Waterway connects with Pearl River, the Mobile, Tombigbee, and Warrior River systems, and the Apalachicola River, all of which provide water transportation into the interiors of Mississippi, Alabama, Florida, and Georgia.

b. Louisiana-Texas section. The portion under review extends 684 miles from the Mississippi River at New Orleans, Louisiana, to Brownsville, Texas, of which 266 miles are in Louisiana and 418 miles

in Texas via Galveston and Port Aransas, Texas. (See plate 1.) The channel in this reach has dimensions 12 feet x 125 feet except as noted below. Throughout this reach the waterway generally traverses marshland at distances from the Gulf of Mexico varying from one-half to 50 miles. Except for the alluvial ridges along the streams that it crosses, where the towns and cities are located, the waterway traverses land that is undeveloped and largely uninhabited. The mean range of tide is about one foot. Strong northerly winds have depressed the water surface as much as two feet, and tropical hurricanes have raised the water surface in the Louisiana section to as much as 10 feet, while in the Texas section the water surface has been raised as much as 15 feet. For descriptive purposes the portion of the Gulf Intracoastal Waterway under review has been divided into five reaches, the Mississippi River to Atchafalaya River, Louisiana; the Atchafalaya River to Sabine River, Louisiana; the Sabine River to Houston Ship Channel, Texas; the Houston Ship Channel to Port Aransas-Corpus Christi Waterway, Texas; and the Port Aransas-Corpus Christi Waterway to Port Isabel deepwater turning basin, Texas. These five reaches are described in detail in the paragraphs which follow and the principal waterways which these reaches intersect are shown in table 2.

c. Physiography (general). The Gulf Intracoastal Waterway, Mississippi River, Louisiana, to Brownsville, Texas, is located along the gulfward margin of the West Gulf Coastal Plain, which is a region of extremely low relief. Major physiographic features along the route of the waterway are: the Mississippi River deltaic plain between New Orleans and Vermilion Bay, Louisiana; the low-lying coastal marshlands between Vermilion Bay, Louisiana, and Galveston Bay, Texas; the barrier islands and lagoons between Galveston Bay and the Mexican border; the broad submerged continental shelf paralleling the coast; and the uplands that border the marshlands and lagoons between Vermilion Bay, Louisiana, and the Mexican border. The deltaic plain, marshlands, and barrier islands and lagoons are of Recent age. The uplands, consisting of the Prairie formation in Louisiana and the Beaumont clay in Texas, are of Pleistocene age. These Pleistocene formations dip toward the gulf and are buried beneath the Recent formation.

(1) Mississippi River deltaic plain. Dominant features of the Mississippi River deltaic plain are the streams with natural levee ridges which mark the positions of ancient courses of the Mississippi and its distributary channels, and the swamp and marshlands that lie between the natural levee ridges. Elevations of the crests of the natural levee ridges range from about 8 to 4 feet above mean low Gulf level and the swamp and marshlands are only a foot or two above Gulf level.

(2) Coastal marshlands. The marshlands between Vermilion Bay, Louisiana, and Galveston Bay, Texas, are only a foot or two above mean low Gulf level, and contain estuary-like, shallow lakes at the mouths of the principal rivers. At the boundary with the marshland,

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the surface of the Pleistocene generally is at the same elevation as the marshland but slopes upward towards the mainland about 1 to 2 feet per mile. The boundary line between the Recent and Pleistocene is very irregular.

(3) Barrier islands and lagoons. From Galveston Bay to the Mexican boundary, the coast is bordered by barrier islands and lagoons, and the rivers discharge into estuaries, except at the Rio Grande, Brazos, and Colorado Rivers where deltas of these rivers have filled or partially filled the estuaries and lagoons in their vicinity. The barrier islands are commonly 10 to 20 feet above mean low Gulf level and the lagoons are very shallow. In Laguna Madre, much of the area is exposed as mud flats at normal tide.

d. General geologic history. During the final stage of the Pleistocene epoch, the Mississippi River built a large deltaic plain which extended from the Texas-Louisiana boundary on the west to the Louisiana-Mississippi boundary on the east, and to the south considerably beyond the present coastline of Louisiana. Sediments carried westward by marine currents from the mouths of the Mississippi and the numerous small rivers that drained the coastal plain in western Louisiana and Texas were deposited along the coast and continental shelf of Texas and also built this coastline beyond its present position. At the end of the Pleistocene epoch, gulf level dropped and the Mississippi River and other rivers along the gulf coast became deeply incised in the Pleistocene deposits. Since that time, gulf level rose gradually, subsequently remained constant, and the incised stream valleys became partially filled with Recent alluvium. Sediments carried westward by marine currents from the Mississippi River were deposited along the coast in southwest Louisiana and formed the coastal marshlands. Sands eroded from the continental shelf and sediments from the rivers draining the coastal plain were deposited along the Texas coast and formed the barrier islands, and partially filled the lagoons behind the barriers. The quantity of sediments carried downstream by most of the small rivers draining the coastal plain is small and has been insufficient to completely fill the estuaries at their mouths. At present, very little, if any, sediments from the Mississippi River are being carried westward. The outgrowth of the coastal marshlands in western Louisiana has ceased; and slow retreat of the shoreline is occurring. The barrier islands along the Texas coast appear to be stable but the lagoons are slowly being filled with sands blown from the barrier islands and sediments carried by tidal currents from the rivers that discharge into the estuaries.

e. Subsurface conditions - Mississippi River deltaic plain. Generally, the subsurface of the swamp and marshlands of the deltaic plain consist of soft fat clays over 80 feet in thickness, containing much organic matter in the upper 10 to 15 feet. All of the waterway across the deltaic plain, except where it crosses the natural levees and ancient stream courses, is located in this material. Along the

ancient stream courses, the subsurface consists predominantly of inorganic silt with some sand and lean clays, which comprise the natural levees and partially fill the ancient channels. The principal ancient stream courses crossed by the waterway are Bayou Lafourche at Larose, Bayou Terrebonne at Houma, and Bayou Boeuf at Morgan City.

(1) Coastal marshlands. Between Vermilion Bay, Louisiana, and Galveston Bay, Texas, the Recent sediments comprising the marshlands and partially filling the estuaries consist principally of very soft organic clays that overlap the older and firmer Pleistocene formations. These very soft Recent clays vary in thickness from a few inches at their boundary with the Pleistocene to over 50 feet at the shoreline. The waterway is located generally along the boundary between the Recent and Pleistocene and, therefore, lies irregularly in these two deposits. Throughout most of the route in this area where the waterway is located in the Recent, the Pleistocene is encountered in the lower part of the channel. It is only where the route crosses the estuaries at the mouths of the rivers that the Recent soils extend in depth below the bottom of the waterway channel.

(2) Barrier islands and lagoons. The barrier islands and the sediments filling the lagoons, and the mainland adjacent to the lagoons between Galveston Bay and the Mexican border are of Recent age. These sediments are underlain by Pleistocene deposits at depths ranging from a few inches to over 80 feet. The barrier islands are composed entirely of sand. The fillings in the lagoon depressions consist predominantly of silt and clay between Galveston and Corpus Christi Bays, and of sand and silt with some clay between Corpus Christi Bay and the Rio Grande River. An exceptional feature in the fillings of Laguna Madre is the presence of gypsum in the sand and clay deposits. Some gypsum layers are as much as 3 inches thick, and layers of laminated clay and gypsum have a maximum thickness of 5 feet. The barrier islands and lagoon deposits overlie an ancient surface of the mainland that was deeply indented and frayed by erosion. Therefore, the depth to the underlying Pleistocene soils varies considerably and is irregular. Generally, the waterway is located in the lagoons near the mainland and its channel cuts through both the Recent and Pleistocene deposits. Exceptions are across the estuaries where only Recent deposits are encountered.

(3) Summary. The soils comprising all of the Recent deposits, in both Louisiana and Texas, are generally soft and easy to excavate, and the silts, sands, and highly organic soils are subject to erosion by wave action. An exception is the layers of gypsum, and clay laminated with gypsum, which occur in Laguna Madre, and are somewhat rocklike. The Pleistocene soils are much more compacted than the Recent soils, and are, therefore, more difficult to excavate and more resistant to erosion. The barrier islands in Texas appear to be stable in position; however, fluctuating changes (cut in some places and fill in others) of the order of 100 to 500 feet in 60 years may have occurred as a result

of hurricanes. All of the bays and lagoons along the Texas coast are shoaling at an average rate of about 1 to 2 feet per century.

f. Mississippi River to Atchafalaya River. This reach is 95.5 miles long. Harvey Lock provides a connection with the Mississippi River at New Orleans and mileages along the main waterway are measured from this lock. Harvey Lock is 75 feet wide, with a chamber length of 425 feet, and a depth of 12 feet over the sill at mean low Gulf level. Bayou Boeuf Lock, 93.5 miles west of Harvey Lock, has a width of 75 feet, a lock chamber 1,160 feet long, and a depth of 13 feet over the sill at mean low Gulf level. It prevents flood waters from the Atchafalaya River from entering the Intracoastal Waterway to the east.

(1) The Algiers Canal, which connects with the Mississippi River near New Orleans, La., was completed and opened to navigation in April 1956. This alternate connection, with dimensions of 12 x 125 feet, leaves the Mississippi River 10 miles below Harvey Lock through Algiers Lock which is 75 feet wide, with a chamber length of 760 feet, and a depth of 13 feet over the sill at mean low Gulf level. The alternate connection is about 9 miles long and connects with the existing waterway about 6 miles west of Harvey Lock.

(2) The Plaquemine-Morgan City alternate route with a present depth of 9 feet over a bottom width of 100 feet extends 56 miles from the Mississippi River through a lock at Plaquemine, La., (mile 208 above Head of Passes), and thence through Bayou Plaquemine and Lower Grand River to and through a lock at Bayou Sorrel in the East Atchafalaya Basin protection levee, a feature of the project Mississippi River and Tributaries, thence through the levee borrow pit channel in the Atchafalaya Basin Floodway to and through Berwick Bay to Morgan City, La., where the main channel is joined 95.5 miles west of Harvey Lock. Plaquemine Lock has a width of 55 feet, with a chamber length of 260 feet, and a depth of 10 feet over the sill at mean low Gulf level. Bayou Sorrel Lock, which is necessary to confine Atchafalaya River flood flows, has a width of 56 feet, a chamber length of 760 feet, and a depth of 14 feet over the sill at mean low Gulf level.

(3) The authorized extension and modification of the Plaquemine-Morgan City alternate route are now under construction. This modification, 65 miles in length, consists of enlargement of the waterway to 12 x 125 feet from the vicinity of Morgan City, La., to Indian Village, La., and its extension through Bayou Grosse Tete and a new land cut to and through a new terminal lock and entrance channel to the Mississippi River in the vicinity of Port Allen, La., at mile 228.5 above Head of Passes of the Mississippi River.

g. Atchafalaya River to Sabine River. This reach is 170.5 miles long. Vermilion Lock is located on the waterway at mile 162.7 west of Harvey Lock, and has a width of 56 feet, a chamber length of

1,182 feet, and a depth of 11.3 feet over the sill at mean low Gulf level. Calcasieu Lock is located 238.9 miles west of Harvey Lock and has a width of 75 feet, a chamber length of 1,180 feet, and a depth of 13 feet over the sill at mean low Gulf level. Both Vermilion and Calcasieu Locks are salt water barriers to protect the Mermentau River Basin from the intrusion of saline waters from the Vermilion and Calcasieu Rivers.

(1) Between the Calcasieu and Sabine Rivers the waterway for 25 miles follows the Lake Charles Deep Water Channel, an authorized 30 x 125-foot Federal ship canal project. The Lake Charles Deep Water Channel originally was dredged by local interests to facilitate the movement of deep-draft navigation between the Sabine and Calcasieu Rivers, but since completion of the Calcasieu Ship Channel, the project is no longer used by deep-draft vessels and it is not maintained to the project dimensions of 30 x 125 feet. Present controlling depth between the Calcasieu and Sabine Rivers is 20 feet. Elsewhere through this reach the channel has been dredged to dimensions of 12 x 125 feet.

(2) 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 was authorized under the Gulf Intracoastal Waterway project. The Franklin Canal extends from Franklin, La., on Bayou Teche for 5.15 miles to Bayou Portage, a section of "The Inland Waterway from Franklin to the Mermentau River, La.," and through Bayou Portage for 0.75 miles to the Gulf Intracoastal Waterway. Authorized dimensions of the Franklin Canal are 8 feet deep and 60 feet wide, with a width of 100 feet in the upper 300 feet at Franklin, La.

h. Sabine River to Houston Ship Channel. The Gulf Intracoastal Waterway from the junction of the Lake Charles Deep Water Channel and the Sabine River to near the southern limits of Port Arthur, Texas, traverses about 22.3 miles of deepwater channels of the Sabine-Neches Waterway. The deepwater channels are in excess of the channel improvements under consideration in this report, and no improvement of this reach is required. From the Port Arthur Canal, the Intracoastal Waterway extends about 61.4 miles generally across low-lying marshy lands to deep water in Galveston Bay and the Houston Ship Channel near Port Bolivar, Texas. Approximately 3.6 miles of the main channel are located in coastal bay waters and 57.8 miles in land cuts. In the vicinity of Port Bolivar the main channel has a channel connection 2.6 miles long through natural deep water to the east end of the deepwater Galveston Channel.

i. Houston Ship Channel to Port Aransas-Corpus Christi Waterway, Texas. As considered in this report, this section of the main channel is about 189.3 miles long via the alternate channel in South Galveston

Bay and the main channel relocation between Aransas Bay and Corpus Christi Bay. The main channel intersects and has a connection to the deepwater Texas City Channel about 1.5 miles southwest of the Houston Ship Channel. An alternate dredged channel 12 feet deep, 125 feet wide, and about 4.0 miles long extends from the west end of the Galveston Channel and joins the main channel about 6.3 miles southwest of the Houston Ship Channel. Improvement of the alternate channel is not under consideration in this report The main channel intersects the deepwater Freeport Channel at mile 394.9 and joins the deepwater Port Aransas-Corpus Christi Waterway at mile 539.4. Floodgates are located on the main channel on both sides of the Brazos River (mile 400.6) and locks are located on the main channel on both sides of the Colorado River crossing (mile 441.3). These structures protect the main channel from siltation and excessive currents and aid navigation across the rivers during flood stages. A flood discharge channel is maintained in the Colorado River from the Intracoastal Waterway crossing downstream to the mouth in the Gulf of Mexico to protect the main channel from excessive siltation during high water stages.

j. Port Aransas-Corpus Christi Waterway to Brownsville, Texas. This section of the main channel is about 144.4 miles long. From mile 539.4 the main channel traverses the deepwater Port Aransas-Corpus Christi Waterway about 1.8 miles, thence the deepwater channel to Encinal Peninsula for about 1.9 miles, thence southward across Corpus Christi Bay and throughout the full length of Laguna Madre to the deepwater turning basin near Port Isabel, thence westward via the deepwater Port Isabel and Brownsville channels to the deepwater turning basin near Brownsville, Texas. These deepwater channels and basins have a total length of about 14.8 miles and are in excess of the channel improvements considered in this report and require no further enlargement to serve the prospective needs of the Gulf Intracoastal Waterway in this area.

k. Tributary channels in Texas. Nine tributary channels to the Texas section of the waterway are authorized. These channels, with project dimensions and stage of completion, are listed in the following tabulation:

AUTHORIZED TRIBUTARY CHANNELS TO
GULF INTRACOASTAL WATERWAY IN TEXAS

Name of channel	Authorized dimensions: Depth below MLW (feet)	Bottom width (feet)	Turning basin (feet)	Length (miles)	Completed length (miles)
San Bernard River Channel	9	100	(1)	31.0	26.0
Colorado River Channel	9	100	400x500(2)	17.0(2)	0.4
Channel to Palacios	9	100	(3)	5.7	5.7
Channel to Rockport	9	200	(3)	2.0	2.0
Channel to Aransas Pass	12	125	300x2200	6.1	6.1
Channel to Barroom Bay	6	60	None	0.4	0.0
Channel to Victoria	9	100	(1)	35.2	25.0(4)
Channel to Port Mansfield(5)	14	100	(6)	10.0	1.4
Arroyo Colorado to Harlingen	12	125	400x500	33.0	25.7

(1)Turning basin to be provided by local interests.
(2)Under construction. Scheduled completion date February 1962.
(3)Turning basin provided by local interests.
(4)First 14 miles dredged by local interests.
(5)Includes entrance channel 16 x 250 feet from Gulf of Mexico and jetties at entrance.
(6)Turning basin 14 x 400 x 1200 feet, shrimp basin 12 x 350 x 1450 feet, and smallcraft basin 8 x 160 x 800 feet.

1. Maps. Reference is made to United States Coast and Geodetic Survey Charts Nos. 884 through 898 and 1050, 1051, and 1279 through 1288; Corps of Engineers' publication titled "The Intracoastal Waterway, Part II, Gulf Section;" Navigation Maps of Intracoastal Waterway, Gulf Section, New Orleans, La., to Port Arthur, Tex., published by the Mississippi River Commission; Navigation Maps of Gulf Intracoastal Waterway, Port Arthur to Brownsville, Texas, published by the Galveston District, and to plates 1, 2, and 3, accompanying this report.

4. TRIBUTARY AREA

a. In a project of the magnitude of the Louisiana-Texas section of the Gulf Intracoastal Waterway, with direct connections to the Mississippi River and the Gulf of Mexico, all sections of the United States can be said to have some interest in the waterway, and

to have realized some benefit, direct or indirect, from its construction. However, for purposes of this report the tributary area will be confined to Louisiana and Texas and portions of the neighboring states which realize direct benefits from this important waterway project.

b. The entire portion of the Gulf crescent from New Orleans to Brownsville is a thriving new industrial frontier. It possesses an abundance of raw materials in the form of oil, gas, salt, sulphur, fresh water shell, rich soil, and a temperate climate. In addition to New Orleans, nine deepwater ports are facing the outside world, with rail, highway, pipeline, and inland waterway networks tying them to the rich interior heart of America. This portion of the Gulf Coast possesses the chemical trinity, acids, hydrocarbons, and fresh water - in virtually unlimited quantities. This is the reason for the shift of the industrial-chemicals industry to this area. Since 1940, approximately one hundred chemical plants have been built here, more than half of them since the end of World War II.

c. The population of the cities and towns on or near the Intracoastal Waterway is shown as follows:

City or town	POPULATION 1930	1940	1950	1960
		LOUISIANA		
New Orleans	458,762	494,537	570,445	627,525
Baton Rouge	30,729	34,719	125,629	152,419
Gretna	9,584	10,879	13,813	21,967
Westwego	3,987	4,992	8,328	9,815
Thibodaux	4,442	5,851	7,730	13,403
Houma	6,531	9,052	11,505	22,561
Morgan City	5,985	6,969	9,759	13,540
Berwick	1,679	1,906	2,619	3,880
Franklin	3,271	4,274	6,144	8,673
Abbeville	4,356	6,672	9,338	10,414
Gueydan	1,313	1,506	2,041	2,156
Kaplan	1,653	2,838	4,562	5,267
Lafayette	14,635	19,210	33,541	40,400
New Iberia	8,093	13,747	16,467	29,062
Jeanerette	2,228	3,362	4,692	5,568
Lake Arthur	1,692	2,131	2,849	3,541
Jennings	4,036	7,343	9,663	11,887
Welsh	1,514	1,822	2,416	3,332
Rayne	3,710	4,974	6,485	8,634
Crowley	7,656	9,523	12,784	15,617
Lake Charles	15,791	21,207	41,272	63,392
Sulphur	1,888	3,504	5,996	11,429
Vinton	1,989	1,787	2,597	2,987
St. Martinville	2,455	3,501	4,612	6,468
Breaux Bridge	1,399	1,668	2,492	3,303
		TEXAS		
Orange	7,913	7,472	21,174	25,605
Beaumont	57,732	59,061	94,014	119,175
Port Neches	2,327	2,487	5,448	8,696
Houston	292,352	384,514	596,163	938,219
Port Arthur	50,902	46,140	57,530	66,676
Pasadena	1,647	3,436	22,483	58,737
Baytown	-	-	22,983(1)	28,159
Texas City	3,534	5,748	16,620	32,065
Galveston	52,938	60,862	66,568	67,175
Freeport	3,162	2,579	6,012	11,619
Palacios	1,318	2,288	2,799	3,676
Port Lavaca	1,367	2,069	5,599	8,864
Rockport	1,140	1,729	2,266	2,989
Aransas Pass	2,482	4,095	5,396	6,956
Corpus Christi	27,741	57,301	108,287	167,690
Port Isabel	1,177	1,440	2,372	3,575
Brownsville	22,021	22,083	36,066	48,040
Victoria	-	11,566	16,126	33,047

(1)Consolidation of Goose Creek, Pelly, and Baytown after 1940 census.

d. The area immediately adjacent to the section of the waterway under review and its tributary channels consists of a belt approximately 50 miles wide and about 700 miles long, which is exceptionally rich in materials and well-adapted to agricultural pursuits.

e. Mineral production in the area is of major importance. These consist of petroleum, gas, sulphur, magnesium, stone, cement materials, clays, gypsum, and salt. Petroleum represents more than 80 percent of the total mineral production of the area. Approximately 1,000,000,000 barrels of crude oil and distillate are produced annually in Texas fields and 265,000,000 barrels in Louisiana fields. These production figures are on the increase. Sulphur mines in the area have an output of about 6,000,000 tons annually, of which 4,000,000 tons are in Texas and 2,009,000 tons in Louisiana. Salt production in the area amounts to about 5,000,000 tons annually, of which 3,000,000 tons are produced in Louisiana.

f. The coastal waters adjacent to the Gulf Intracoastal Waterway support important fisheries, with the shrimp fishery being the most important. The oyster fishery is also one of major importance, followed by the crab and fin-fish fisheries. The annual production of these items is shown below:

Commodity	Louisiana (pounds)	Texas (pounds)
Shrimp	55,000,000	57,100,000
Oysters	7,700,000	700,000
Crabs	13,500,000	250,000
Fin-Fish	2,300,000	2,800,000

The menhaden fishery in the Gulf of Mexico is of increasing importance. The annual catch of menhaden in Louisiana is about 455,000,000 pounds, while Texas produces 55,700,000 pounds. The coastal area of Louisiana and Texas supports a fur-trapping industry of considerable national importance. The fur production of Louisiana ranks first in the United States with an annual value of about $2,500,000.

g. There are 58 petroleum refineries in Texas with a total capacity of over 2,250,000 barrels a day, and 15 refineries in Louisiana with a capacity of 780,000 barrels a day. Large oil refineries in Louisiana are located at Baton Rouge, Norco, Lake Charles, and New Orleans, while in Texas, large refineries are to be found at Beaumont, Port Arthur, Port Neches, Baytown, Texas City, Houston, Freeport, Corpus Christi, Port Isabel, and Brownsville.

h. Petrochemical and chemical plants are being attracted rapidly into this area because of the raw materials, readily available power, and fresh water. The number of these industries is increasing at a rapid rate. Other industries include rice mills, shipyards, and ship-building plants, steel smelting and fabricating plants, food processing

plants, packing houses, paper mills, brass and iron foundries, machine shops, cement plants, carbon black plants, synthetic rubber plants, cotton compresses, breweries, container manufacturing plants, building material plants, alumina and aluminum production plants, cotton oil mills, cotton gins, brick and tile plants, fertilizer plants, canneries, creameries, and numerous wholesale, retail, and service establishments. Logging for both paper mills and mill work products, lumber farming, and the processing and manufacturing of locally produced crops are of commercial importance.

i. Major crops are cotton, rice, cane, corn, grains, truck crops, forage crops, potatoes, yams and citrus fruits. The raising of livestock is of major importance and includes beef and dairy cattle, hogs, sheep, goats, horses, mules, chickens, turkeys, and other fowl.

j. Transportation throughout the area is provided by mainline railroads, numerous highways (both Federal and State), oil and gas pipelines, and connecting waterways between inland points and the Gulf of Mexico.

k. One of the major connections with the Gulf of Mexico is the Mississippi River. The Mississippi River accommodates traffic of all types, from seagoing vessels to small craft. During the year 1959 the Mississippi River carried a total of 47,779,749 tons above New Orleans, of which 28,473,533 tons were in barge tows, 300 tons rafted, and 19,305,916 tons were in seagoing vessels.

5. BRIDGES.

a. The following tabulation shows bridges across the Gulf Intracoastal Waterway:

Location of bridge, nearest town and mile(1)	Owner	Type and use	Date built	Clearance (feet) Horizontal	Clearance (feet) Vertical (above MHW)	Plans approved by Dept. of Army
			LOUISIANA			
Harvey Mile 0.21	TP-MP RR	Bascule Rwy.	1929	75	9.9(2)	Built by U.S.
Harvey Mile 0.24	La.Hwy. Dept.	Bascule Hwy.	Feb '35	75	13.1(2)	Yes
Barataria Mile 12.5	La.Hwy. Dept.	Swing Hwy.	Dec '31	75	9.1(2)	Yes

Location of bridge, nearest town: and mile[1]	Owner	Type and use	Date built	Clearance (feet) Horizontal	Clearance (feet) Vertical (above MHW)	Plans approved by Dept. of Army
LOUISIANA (cont'd)						
Larose Mile 35.0	La.Hwy. Dept.	Pontoon Hwy.	Aug '42	91.3	-	Yes
Larose Mile 35.8	La.Hwy. Dept.	Vert.Lift Hwy.	Jan '61	125.0	73	Yes
Houma Mile 57.6	La.Hwy. Dept.	Vert.Lift Hwy.	Nov '58	122.0	73	Yes
Houma Mile 57.64	La.Hwy. Dept.	Bascule Hwy.	Jan '37	78	9.2[2]	Yes
Houma Mile 58.9	Sou.Pac. RR	Swing Rwy.	Oct '30	86	3.9[2]	Yes
Houma Mile 59.8	La.Hwy. Dept.	Swing Hwy.	Mar '52	123.5	5.5[2]	Yes
North Bend Mile 113.05	La.Hwy. Dept.	Vert.Lift Hwy.	Jul '55	125.0	80.0	Yes
Cypremort Mile 133.9	St.Mary Ph.	Swing Hwy.	Jun '36	80	7.9[2]	Yes
Forked Island Mile 169.8	La.Hwy. Dept.	Pontoon Hwy.	1953	126	-	Yes
Gibbstown Mile 219.6	La.Hwy. Dept.	Pontoon Hwy.	Feb '57	151.0	-	Yes
Hackberry Mile 243.8	La.Hwy. Dept.	Pontoon Hwy.	Nov '56	151.0	-	Yes
TEXAS						
Port Arthur[3] Mile 284.7	City of Port Arthur	Bascule Hwy.	Oct '31	200	11[2]	Yes
Port Arthur Mile 288.6	State of Texas	Bascule Hwy.	Apr '33	100	10[2]	Yes
High Island Mile 319.1	Dept.of Army	Swing Rwy.	Aug '34	100	10[2]	Yes

Location of bridge, nearest town: and mile[1]	Owner	Type and use	Date built	Clearance (feet) Horizontal	Clearance (feet) Vertical (above MHW)	Plans approved by Dept. of Army
TEXAS (cont'd)						
High Island Mile 319.1	State of Texas	Swing Hwy.	Apr '35	100	10[2]	Yes
Galveston Mile 357.0	Galv.Co. & RR's	Bascule Rwy.	Oct '32	100	10[2]	Yes
Galveston Mile 357.1	State of Texas	Bascule Hwy.	Dec '38	105	15[2]	Yes
Galveston Mile 357.1	State of Texas	Fixed Hwy.	(4)	105	73	Yes
Freeport Mile 393.6	State of Texas	Fixed Hwy.	Aug '54	201	73	Yes
Freeport Mile 397.0	State of Texas	Pontoon Hwy.	May '59	130	-	Yes
Sargent Mile 417.9	State of Texas	Pontoon Hwy.	Oct '42	100	-	Yes
Matagorda Mile 440.6	State of Texas	Pontoon Hwy.	Unknown	100	-	Yes
Aransas Pass Mile 532.9	State of Texas	Fixed Hwy.	Sep '59	125	48	Yes
Corpus Christi Mile 554.6	Nueces County	Pontoon Hwy.	Jun '50	150	-	Yes
Port Isabel Mile 667.9	Cameron County	Pontoon Hwy.	Feb '54	146	-	Yes

(1)Mileage west of Harvey Lock near New Orleans, La.
(2)Above high water when bridge is closed, unlimited when open.
(3)Across Sabine-Neches Waterway.
(4)Under construction June 1961.

Vertical clearances are given above mean high water.

b. The railroad bridge located at mile 319.1 is owned and operated by the Federal government. Modification or alteration of existing bridges is not necessary at this time.

c. The Plaquemine-Morgan City route of the Gulf Intracoastal Waterway is crossed by the following listed bridges:

Location of bridge, nearest town and mile[1]	Owner	Type and use	Date built	Clearance (feet) Horizontal	Clearance (feet) Vertical (above MHW)	Plans approved by Dept. of Army
Plaquemine Mile 0.3	T&P RR Co.	Bascule Rwy.	Dec '23	110	15	Yes
Plaquemine Mile 0.3	La.Hwy. Dept.	Vertical Lift-Hwy.	Aug '50	85	52.4	Yes
Amelia Mile 65.5	Sou.Pac. RR	Swing Rwy.	Dec '10	56	6.9	Yes
Amelia Mile 66.0	La.Hwy. Dept.	Fixed Hwy.	Jul '59	125	76.0	Yes

[1]Miles south of Plaquemine Lock.

d. A modification of the Plaquemine-Morgan City route is authorized and construction on the modification is under way. The modified waterway will be crossed by four additional bridges. The railroad bridges at Morley and Port Allen, La., are vertical lift bridges, providing horizontal clearances of 125 and 84 feet, respectively, and vertical clearances of 73 feet above mean high water when in the raised position. The railroad bridges at Morley and Port Allen, La., were completed in July 1958 and May 1960, respectively. The highway bridge at Port Allen, La., completed in August 1960, is a fixed, high level bridge with horizontal and vertical clearances of 84 feet and 64.2 feet above high water, respectively. The highway bridge at Indian Village, La., now under construction, is to be a swing bridge with horizontal clearance of 125 feet and vertical clearance of 2.5 feet above high water when bridge is closed.

e. The Algiers Canal is crossed by two bridges listed below:

Location of bridge, nearest town and mile(1)	Owner	Type and use	Date built	Clearance (feet) Horizontal	Clearance (feet) Vertical (above MHW)	Plans approved by Dept. of Army
Algiers Mile 1.5	La.Hwy. Dept.	Vert.Lift Hwy.	1955	125	100	Yes
Belle Chasse Mile 4.2	NO&LC RR	Vert.Lift Rwy.	1956	125	100	Yes

(1)Mileage from Algiers Lock westward.

6. PRIOR REPORTS

a. The reports under review are those contained in House Document No. 238, 68th Congress, 1st Session, and subsequent reports. House Document No. 238 contains a preliminary examination and survey of the Intracoastal Waterway from the Mississippi River at or near New Orleans, Louisiana, to Corpus Christi, Texas. It recommends a waterway 9 feet deep and 100 feet wide between New Orleans and Aransas Pass, Texas, and between the Mississippi River and Morgan City, via Plaquemine Waterway, with such passing places, widening at bends, locks, or guard locks, and railway bridges over artificial cuts, as are necessary, subject to certain specified conditions of local cooperation. The recommended channel from the Mississippi River to Galveston Bay was authorized by the River and Harbor Act of March 3, 1925, and the recommended channel from Galveston Bay to Aransas Pass, Texas, was authorized by the River and Harbor Act of January 21, 1927.

b. The latest published report on the entire Louisiana-Texas section of the waterway under review is contained in House Document No. 230, 76th Congress, 1st Session. It recommended that the 9 x 100-foot project be modified to provide a channel 12 feet deep with a bottom width of 125 feet from the Mississippi River through Harvey Lock, near New Orleans, La., to Corpus Christi, Texas; subject to conditions of local cooperation. The Act of Congress approved July 23, 1942, authorized enlargement of the Gulf section of the Intracoastal Waterway from the Mississippi River to Corpus Christi, Texas, and its extension to the vicinity of the Mexican Border, so as to provide throughout the entire length of the waterway a channel 12 feet deep by a minimum width of 125 feet. Table 1 gives pertinent data on prior reports and Congressional action taken.

7. EXISTING CORPS OF ENGINEERS' PROJECTS

a. Prior to the adoption of the existing project, several separate projects provided for an inland waterway 5 feet deep and 40 feet wide from New Orleans, La., to the Sabine River, and between Galveston Bay and Corpus Christi, Texas. Authorizing acts for prior projects are listed in table 1. The total costs for all previous projects prior to operation under the existing projects were as follows: For the Louisiana section between the Mississippi River and the Sabine River, $5,323,905, of which $4,320,698 was for new work, $454,259 for maintenance, and $548,948 for operation and care of structures; and for the Texas section, Galveston to Corpus Christi, $2,043,000, of which $534,000 was for new work, $1,465,000 for maintenance, and $44,000 for operation and care of structures.

b. The existing project was authorized by the River and Harbor Acts of March 3, 1925; January 21, 1927; August 26, 1937; June 20, 1938; July 23, 1942; March 2, 1945; July 24, 1946; May 17, 1950; July 12, 1952; September 3, 1954; and September 9, 1959. The River and Harbor Acts of 1925 and 1927 adopted a project for the Louisiana-Texas Intracoastal Waterway in accordance with the recommendations contained in House Document No. 238, 68th Congress, 1st Session. The project provided for a channel 9 feet deep and 100 feet wide from the Mississippi River at or near New Orleans, La., to Corpus Christi, Texas; and for an alternate channel of the same dimensions from the Mississippi River to Morgan City, La., via the Plaquemine Waterway; with such passing places, widening at bends, locks, or guard locks, and railway bridges over artificial cuts as necessary. The project authorized by the Acts of 1925 and 1927 has been completed.

c. The River and Harbor Act of July 23, 1942 adopted a modification in accordance with the recommendations of House Document No. 230, 76th Congress, 1st Session, to provide for enlargement of the Gulf section of the Intracoastal Waterway from the Mississippi River to Corpus Christi, Texas, and its extension to the vicinity of the Mexican border so as to provide throughout the entire length of the waterway a channel 12 feet deep with a minimum width of 125 feet. Enlargement of the waterway has been completed.

d. The River and Harbor Act of March 2, 1945 adopted a modification to the Intracoastal Waterway in accordance with the recommendations contained in Senate Document No. 188, 78th Congress, 2nd Session, to provide for an additional lock and connecting channel between the Intracoastal Waterway and the Mississippi River below Algiers, La., to supplement the facilities now afforded by Harvey Lock. This modification was completed in April 1956.

e. The River and Harbor Act of July 24, 1946, adopted a modification to the Intracoastal Waterway in accordance with the recommendations contained in Senate Document No. 242, 79th Congress, 2nd Session, to provide for a channel 12 feet deep and 125 feet wide for the

Plaquemine-Morgan City route from the Mississippi-Atchafalaya section of the waterway in the vicinity of Morgan City, through Lower Atchafalaya River (Berwick Bay) and the borrow pit of the East Atchafalaya Basin protection levee to and through Bayou Sorrel Lock (constructed under the existing project "Flood Control, Mississippi River and Tributaries"), thence via the present waterway through Lower Grand River to Indian Village, and thence by way of Bayou Grosse Tete and a new land cut to and through a new terminal lock and entrance channel to the Mississippi River in the vicinity of Port Allen opposite the lower limit of the Port of Baton Rouge. The lock nearing completion at Port Allen, La., has a width of 84 feet, a chamber length of 1,200 feet, and a depth over the sill of 14 feet at mean low Gulf level. The Act of July 24, 1946 also adopted a modification in accordance with recommendations contained in Senate Document No. 231, 79th Congress, 2nd Session, to provide for a salt water guard lock in the Intracoastal Waterway at or near mile 231 west of Harvey Lock. The construction of the salt water guard lock (Calcasieu Lock) was completed at mile 238.9 west of Harvey Lock in December 1950. The act further authorized rerouting the main channel along the north shore of Redfish Bay between Aransas Bay and Corpus Christi Bay with no change in authorized dimensions in accordance with the recommendation contained in House Document No. 700, 79th Congress, 2nd Session. This work was completed in November 1960.

f. An alternate main channel, 12 feet deep and 125 feet wide, extending across South Galveston Bay from the main channel at Port Bolivar to the main channel at the Galveston Causeway, was authorized by the River and Harbor Act of May 17, 1950, in accordance with the recommendation contained in House Document No. 196, 81st Congress, 1st Session. This work was completed in May 1954.

g. The existing project in Texas also provides for nine feeder or tributary channels, two side channels at Port Isabel, Texas, a railroad bridge over the main channel near High Island, flood gates or locks at the Brazos and Colorado Rivers, a flood-discharge channel in the Colorado River extending from the main channel of the Gulf Intracoastal Waterway near Matagorda, Texas, to the Gulf of Mexico, and a harbor of refuge at Seadrift, Texas.

h. The total cost of the existing project for the Gulf Intracoastal Waterway in the New Orleans District to June 30, 1959, was $74,299,764, of which $48,054,171 was for new work, $14,220,032 for maintenance, and $12,025,561 for operation and care of locks and bridges. The total cost from the Sabine River to Brownsville to June 30, 1959, was $49,567,751, of which $27,445,750 (including $360,000 value of useful work performed by local interests) was for new work, $16,511,212 for maintenance, and $5,610,789 for operation and care of structures. The estimated cost of new work on the Texas section is as follows: (Federal) $37,454,000 as of July 1959, exclusive of amount expended on previous projects and (non-Federal)

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$11,900,000, including $395,000 voluntarily expended. The latest (1955) approved estimate for annual cost of maintenance of the entire Gulf Intracoastal Waterway in the New Orleans District is $2,000,000, including $820,000 for regular maintenance, and $1,180,000 for operation and care of locks and dams, and costs pertaining to use of necessary State-owned facilities in connection with the Inner Harbor Navigation Canal. The current estimate for annual cost of maintenance between the Sabine River and Brownsville is $2,099,000, including $259,000 for operation and care of structures. Present approved estimates for maintenance and operation are considered adequate.

i. The Mississippi River and Tributaries project has had some bearing on the Gulf Intracoastal Waterway. This is true where the waterway enters or leaves areas protected by levee systems. The Bayou Sorrel and Bayou Boeuf Locks on the Intracoastal Waterway were constructed with funds for Flood Control, Mississippi River and Tributaries, and are being maintained and operated from the same fund.

8. LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

The acts authorizing the main channel of the Gulf Intracoastal Waterway required that local interests furnish free of cost to the United States all necessary rights-of-way and suitable spoil disposal areas; defray the cost of constructing or remodeling all highway bridges, together with their subsequent maintenance and operation; and furnish satisfactory assurances to the Secretary of the Army that adequate vessels, terminals, and auxiliary equipment would be available on completion of the channel for the economical handling of at least 500,000 tons of commerce annually on the New Orleans-Sabine section; at least 400,000 tons of commerce annually on the Sabine River-Galveston Bay section; and at least 300,000 tons annually on the Galveston Bay-Corpus Christi section. Local interests have complied fully with all requirements of local cooperation on the completed portions of the main channel. The cost to local interests of this cooperation is large, but records of its amount are not available.

9. OTHER IMPROVEMENTS

a. Throughout the coastal region of Louisiana traversed by the Intracoastal Waterway, local interests, both public and private, have dredged numerous canals to facilitate logging operations, oil exploration and operation, local navigation, and drainage. No estimate of the number of these canals or of their cost is on record. The Police Jury of Calcasieu Parish spent more than $6,000,000 to build the Lake Charles Deep Water Channel (now a Federal project).

b. Prior to the adoption of a Federal project for an inland waterway between the Sabine River and Corpus Christi, a number of channels were dredged by local interests, both public and private, to permit shallow-draft navigation between the coastal bays. These

improvements included the Galveston and Brazos Canal between Galveston Bay and the Brazos River, a channel between the Brazos River and Matagorda Bay, the Morris and Cummings Cut between Aransas Bay and Corpus Christi Bay, and a number of other small channels through shell reefs in several of the bays. The cost of these works is not available. Local interests have not undertaken any other improvements of the main channel in Texas since its authorization as a Federal project.

10. TERMINAL AND TRANSFER FACILITIES

a. Petroleum, its products, and petrochemicals are the leading commodities transported over the Intracoastal Waterway, and extensive facilities for handling these products are available throughout the length of the waterway and its tributaries. Some of the most extensive are located at New Orleans, Norco, Baton Rouge, Lake Charles, Beaumont, Port Arthur, Texas City, Houston, Port Aransas, Ingleside, and Corpus Christi.

b. Extensive terminal and transfer facilities, both public and private, suitable for receiving and shipping commodities by barge are available at the principal cities in Texas and Louisiana. These terminals are located generally on the deepwater channels that are intersected or traversed in part by the Intracoastal Waterway. Adequate terminal facilities are located at New Orleans, Norco, Baton Rouge, Harvey, Morgan City, Lake Charles, Orange, Beaumont, Port Neches, Port Arthur, Galveston, Texas City, Pasadena, Baytown, Houston, Freeport, Port Aransas, Corpus Christi, Port Mansfield, Port Isabel and Brownsville.

c. In general, facilities on the main waterway include both public and privately-owned terminals, slips, wharves, warehouses, and oil storage and handling equipment. On the feeder channels and connecting waterways are many such installations.

SECTION III - PROBLEMS UNDER INVESTIGATION

11. IMPROVEMENTS DESIRED

a. To determine the nature and extent of the improvements desired by local interests and to afford all interested persons an opportunity to express their views regarding the requested improvement, public hearings were held in Galveston, Texas, on January 29, 1953, and in New Orleans, La., on February 19, 1953. The hearing in Galveston was attended by 52 persons and the hearing in New Orleans by 77 persons. The attendance of both hearings was composed of representatives of Federal, State, County, Parish, and local agencies; civic organizations, businesses, industries, railroads, shipping, and navigation interests; and other interested parties.

b. All persons who presented testimony at the hearings advocated modification of the existing project for the Gulf Intracoastal Waterway to provide for the maximum enlargement of the existing 12-foot by 125-foot main channel and certain of its main alternate routes west of the Mississippi River.

c. The Intracoastal Canal Association of Louisiana and Texas presented the following comprehensive program for improvement of the waterway, which it recommended for consideration and adoption by the Federal Government:

(1) Widening or widening and deepening the main stem of the canal westward of the Mississippi River to a width and depth, the cost of which would be justified on a reasonable ratio of benefits and costs.

(2) Improving the Morgan City-Port Allen route to approximate the dimensions of the main stem of the canal.

(3) Constructing such cutoffs and realignment projects as may be feasible and economical.

The Association suggested that engineering studies give consideration to the economic feasibility of widening the existing main channel to widths of 175, 250, and 300 feet, and to deepening the channel to 14 feet at widths of 175, 250, and 300 feet. The Association stated that the improvements to the tributary or feeder channels of the project are not requested at the present time. The Intracoastal Canal Association also requested construction of the authorized realinements in South Galveston Bay and the vicinity of Aransas Pass, Texas; and the cutoff and lock at Algiers, La.

d. The Sabine Transportation Company of Port Arthur, Texas, operators of a fleet of 11 tugs of 275 to 1,325 horsepower, and 20 tank barges in Texas and Louisiana, requested, in addition to widening and deepening of the main channel, the following:

(1) That at all short radius bends, the channel width be increased at least 20 percent over the present width for a distance of 1,000 feet beyond the bend and then taper into the channel.

(2) That at all points where the Intracoastal Canal crosses a river, bayou, or another dredged canal, the entrance width should be at least twice the width of the canal and taper, in 1,000 feet, to the width of the canal.

The improvement requested in paragraph (1) above relates to the widening of curves on the waterway and is so considered in this report. The proposed enlargement of entrances requested in paragraph (2) above involves a comparatively small amount of dredging and some right-of-way.

Such improvements can be accomplished as maintenance features under existing law and, accordingly, it is unnecessary to consider this request in the current report.

e. The Nueces County Navigation District, Corpus Christi, Texas, requested, in addition to enlargement of the main channel, that the project be further modified to provide for extending the authorized (undredged) channel along the north shore of Redfish Bay near Aransas Pass, Texas, southwestward from the intersection of the Port Aransas-Corpus Christi Waterway through the spoil bank to deep water in Corpus Christi Bay. In support of the requested enlargement of the main channel, the local interests state:

(1) That the deepening and widening of the waterway would result in much greater use since the trend is toward the use of larger barges which cannot satisfactorily use the waterway at its present authorized dimensions.

(2) That the increase in tonnage carried on the waterway due to the rapid increase of huge industries now operating, under construction, and in the blue print or formative stage, makes it necessary to increase the project dimensions to provide for present and prospective traffic.

(3) That the deepening and widening would reduce operating hazards of collisions and damages to equipment from striking or scraping the sides of the waterway.

(4) The deepening, widening, and easing of curves will result in benefits through reduced operating costs and greater speeds.

(5) That the deepening and widening are necessary to provide a protected inland waterway that will serve as an important defense artery in time of war. In support of providing the new route across Corpus Christi Bay, the navigation district stated that the dredging of this extension, even before the cutoff channel near Aransas Pass has been completed, would mean a great saving in transportation costs by decreasing the travel distance and time of boats servicing oil fields south of the Port Aransas-Corpus Christi Waterway. The extension would shorten the waterway to the Rio Grande Valley and would remove waterway traffic from the route it now travels through the center of a U. S. Navy seaplane landing area. The proposed relocation also would permit oil exploration drilling operations to proceed along the present route except where restricted by the Navy's operation.

f. Several oil companies stated that although they are not opposed to the deepening and widening of the main channel, the restriction of drilling operations within the 2,000-foot area along authorized channels in Texas imposes a hardship on the oil interests. The restriction makes it necessary to drill more expensive directional

wells to tap oil reserves beneath the canal areas. They also stated that establishment of such restricted zones along duplicate, alternate, or by-pass channels is not in the public interest and requested that restricted areas be lifted on channels that have been abandoned by reason of rerouting the authorized project.

g. Interests were generally in agreement that the existing 12 x 125-foot channel of the Intracoastal Waterway is inadequate to serve efficiently the type and volume of traffic in that reach from New Orleans west, at least as far as Corpus Christi, Texas.

h. An increase in size to a depth of 16 feet over a bottom width of 300 feet seems to be the general consensus of the towing industry as represented by the American Waterways Operators, Inc., and as presented in the brief of that organization. In support of their request, the brief contains data to show that considerable economy in operation will result from such an increase in size of the channel. This claim is based on the results of model studies and a report thereon made by the Dravo Corporation. They also stated that unless some increase in width and depth is provided, the waterway soon will be inadequate to accommodate the reasonably prospective growth in traffic.

i. At the public hearing in New Orleans, a discussion developed between the presiding officers and the representative of the American Waterways Operators, Inc., relative to bridges. In this discussion, it was brought out for the sense of the hearing that alteration of bridges was not being considered; rather, only the enlargement of the channel was being considered, and the alteration of bridges was being left for later and separate consideration when and if necessary.

j. The Houma-Terrebonne Chamber of Commerce, Houma, La., and the Police Jury of the Parish of Terrebonne, La., presented a joint brief in which they opposed the enlargement of the waterway in its present location through the city of Houma, primarily, on account of delays to land transportation resulting from frequent bridge openings. The brief discussed two alternate channel relocations to by-pass the city. The one nearest the city was opposed as being too near the city and necessitated four new bridges. The other was suggested to "make acquisition of rights of way conceivably more simple than in other areas," and as appearing to be a "solution of a complex problem." This latter alternate route would introduce one new bridge where it crosses Louisiana State Highway No. 24 south of Larose; thence via an alinement nearer the coast through the southern part of Terrebonne Parish. Such a route would avoid all existing roads and the lock at Bayou Boeuf near Morgan City, La.

k. Subsequent to the public hearing at New Orleans, a conference was held with representatives of the city of Houma, Police Jury of Terrebonne Parish, Houma-Terrebonne Chamber of Commerce, and the State of Louisiana, Department of Public Works, relative to the bypass routes

south of Houma, La. At the conference, which was held on December 22, 1955, at New Orleans, the representatives agreed that the route nearest the city of Houma would be acceptable to all concerned and that the right-of-way for this route could be secured.

1. Subsequent to the public hearing at Galveston, the local interests requested that the existing route of the Gulf Intracoastal Waterway between Aransas Bay and Aransas Pass be continued for maintenance when the authorized relocated route is constructed. The River and Harbor Act of July 24, 1946, authorized rerouting the main channel of the Gulf Intracoastal Waterway along the north shore of Redfish Bay between Aransas Bay and Corpus Christi Bay and discontinuing maintenance of the present route from mile 525.9 to mile 546.2 when the new route is constructed (House Doc. 700, 79th Congress, 2nd Session). The local interests now desire that the present route not be abandoned when the new route is constructed but that it be continued for maintenance to its present dimensions. The local interests state that this section of the present channel is used extensively by commercial fishing and recreation craft that move between the Rockport and the Aransas Bay areas to Port Aransas and the Gulf of Mexico through Aransas Pass inlet and by commercial shallow draft oil-barge traffic that now moves to and from the oil terminals opposite Port Aransas. This traffic would have to travel about five miles longer distance by using the authorized relocated route to the town of Aransas Pass, thence through the Aransas Pass tributary channel to Port Aransas and the Aransas Pass inlet.

12. EXISTING AND PROSPECTIVE COMMERCE

a. Existing commerce. Prior to 1937, traffic records on the Intracoastal Waterway were compiled by sections, and the through-traffic recorded in one section was duplicated in the next section. Traffic records from 1937 to and through 1959 on the Intracoastal Waterway from Apalachee Bay, Florida, to Brownsville, Texas, are shown as follows:

	Year	Tons	Ton-Mileage
Pre World War II	1937	5,753,000	581,328,000
do	1938	6,590,000	751,266,000
do	1939	8,168,000	1,046,019,000
do	1940	11,643,000	1,748,444,000
do	1941	17,350,000	2,862,202,000
World War II	1942	21,268,000	3,477,479,000
do	1943	22,045,000	3,985,230,000
do	1944	24,085,000	5,805,112,000
do	1945	23,044,000	4,783,791,000
Post World War II	1946	20,457,000	4,003,054,000
do	1947	22,801,000	4,763,789,000
do	1948	27,866,000	5,903,342,000
do	1949	28,291,000	4,592,285,000
do	1950	31,520,000	5,219,582,000

	Year	Tons	Ton-Mileage
Post World War II	1951	35,528,000	6,071,979,000
do	1952	42,198,000	7,764,746,000
do	1953	41,727,000	7,334,006,000
do	1954	36 982 000	6,564,777,000
do	1955	41,379,000	7,157,779,000
do	1956	45,354,000	7,624,007,000
do	1957	48,104,000	8,207,765,000
do	1958	46,008,000	7,818,576,000
do	1959	51,306,000	8,128,879,000
23-year total		659,467,000	116,195,437,000
23-year average		28,672,400	5,051,976,000

(1) The average percentage distribution of the tonnage by commodity types for the 23-year period was approximately: petroleum and products, 70%; sea shells, unmanufactured, 11%; chemicals and products, 4%; iron, steel, and other metals, 4%; limestone and shale, 2%; sulphur, 2%; and all other, 7%.

(2) Traffic over each of the following-listed reaches of the Intracoastal Waterway between the Mississippi River and the Houston Ship Channel in 1959 varied from 11,276,000 to 19,069,000 tons, and in the reach between Houston Ship Channel and Port Aransas-Corpus Christi Waterway was 4,630,000 tons. In the reach between Port Aransas-Corpus Christi Waterway and Brownsville, traffic dropped to 777,000 tons. Average traffic in 1959 over the various reaches of the Intracoastal Waterway under consideration for improvement in this report is shown below:

Reach	Tons
Mississippi River-Atchafalaya River, La.	11,276,000
Atchafalaya River-Sabine River, La.-Texas	19,069,000
Sabine River to Houston Ship Channel, Texas	16,337,000
Houston Ship Channel to Port Aransas-Corpus Christi Waterway, Texas	4,630,000
Port Aransas-Corpus Christi Waterway-Brownsville, Texas	777,000
Algiers Alternate Canal	6,653,000

(3) Very little tonnage on the Intracoastal Waterway is moved by common carrier. Most of the tonnage handled is carried by contract or company-owned equipment. About 60% of the tonnage is long-haul traffic, being destined to or originating at points in the Mississippi River Valley, or other distant points. Approximately 40% of the tonnage on the Intracoastal Waterway is short-haul traffic, moving between points on the waterway, or between points on the

Intracoastal Waterway and points on the tributary or feeder channels. Table 3 shows the traffic density for 1959 over each reach of the Gulf Intracoastal Waterway between the Mississippi River at New Orleans and Brownsville, as well as the traffic to and from tributary channels.

(4) The tonnage handled over the presently existing Plaquemine-Morgan City route from 1937 through 1959 has been as follows:

Year	Tons	Ton-Miles
1937	540,000	23,920,000
1938	506,000	17,279,000
1939	585,000	23,847,000
1940	630,000	26,085,000
1941	1,540,000	71,447,000
1942	3,477,000	182,630,000
1943	3,284,000	151,554,000
1944	2,358,000	114,025,000
1945	1,693,000	46,817,000
1946	1,533,000	63,321,000
1947	1,878,000	105,179,000
1948	2,158,000	123,563,000
1949	2,191,000	133,720,000
1950	1,819,000	110,108,000
1951	2,054,000	94,570,000
1952	2,184,000	94,356,000
1953	2,235,000	96,404,000
1954	1,532,000	52,709,000
1955	2,497,000	123,683,000
1956	2,890,000	142,054,000
1957	2,902,000	138,646,000
1958	2,876,000	132,876,000
1959	3,122,000	136,520,000
23-year total	46,484,000	2,205,313,000
23-year average	2,021,000	95,883,000

(5) The authorized modification of the Plaquemine-Morgan City route to 12 x 125 feet with an added connection to the Mississippi River through a new lock at Port Allen, La., will cause a redistribution of the tonnage over the main channel of the Intracoastal Waterway east of the Atchafalaya River, and possibly the tonnage over the Plaquemine-Morgan City route.

(6) With the completion of the modified Plaquemine-Morgan City route, an improved and shorter route will be available for traffic moving to Baton Rouge from points on the Intracoastal Waterway from Morgan City west and vice versa. It is expected also that part of the interchange freight which now moves via New Orleans

will be diverted to the Port Allen Lock because of the saving in operating time. Interchange traffic is that traffic which now moves through Harvey Lock at New Orleans for points up-river from Baton Rouge. It is carried to New Orleans by one operator and carried from that point by a different operator. Because of the inaccessibility of the Old River-Mississippi River junction, lack of adequate mooring facilities and difficulty of providing service, it is expected that interchange of barges at that location will be slow in developing and is not considered a factor in this analysis.

(7) It is estimated that 350,000 tons of traffic from and to Baton Rouge will be diverted from Plaquemine to Port Allen Lock, and that 1,500,000 tons of interchange traffic likewise will be diverted from Harvey Lock to Port Allen Lock. This diversion of traffic will take a total of 1,850,000 tons (350,000 tons and 1,500,000 tons) off the main channel of the Intracoastal Waterway east of the Atchafalaya River, leaving a net tonnage of 9,776,000.

(8) Assuming that Plaquemine Lock will be abandoned upon completion of the modified route and the construction of Port Allen Lock, the total tonnage for the Port Allen route will be approximately 4,050,000 tons (350,000 tons; 1,500,000 tons; and 2,200,000 tons from Plaquemine Lock).

b. Prospective commerce. Past experience and the present rapid expansion of oil production and of industries allied to the petroleum industry, which expansion is expected to continue for an indefinite period, indicate that tonnages of crude oil, petroleum products, petrochemical products, materials used in those industries, and miscellaneous cargo will increase throughout the life of the project.

(1) The demand for energy is increasing constantly, and its growth is expected to continue at a rate of 3% annually for an indefinite period. As crude oil and petroleum products are major sources of energy, it is estimated that the tonnages of these commodities will increase during the first 25 years at the same rate that the energy demand is expected to increase. The demand for crude oil and petroleum products as a source of energy is expected to be offset by energy from other sources during the latter 25 years of the project life. Therefore, during the latter period of the life of the project, these tonnages are expected to remain constant. The tonnages of crude oil and petroleum products which are expected to be handled over the various reaches of the Gulf Intracoastal Waterway in the first 25 years of the life of the project and in the last 25 years of the life of the project are shown in table 1, appendix B.

(2) Cargo other than crude oil and petroleum products is expected to increase throughout the life of the project. The increase of this cargo is expected to be in proportion to the increase in

population, or at a rate of 1.7% annually. General tonnages which are expected to be handled over the various reaches of the waterway throughout the life of the project are shown in table 2 of appendix B.

13. VESSEL TRAFFIC

a. Table 5 gives trips and drafts of vessels on the Intracoastal Waterway between the Mississippi River and Brownsville, Texas, from 1937 through 1959. During the year 1959, the trips and drafts of vessels over the reaches of the waterway are shown as follows:

Draft feet	Miss.River to Sabine River	Sabine River to Galveston	Galveston to Corpus Christi	Corpus Christi to Brownsville
		MOTOR VESSELS		
12	70	1,030	5	-
11	1,369	2,359	36	-
10	1,128	863	499	76
9	3,212	1,696	439	27
8	6,143	3,553	1,439	81
7	6,951	2,418	2,079	835
6 and less	35,646	5,078	15,889	10,765
		BARGES		
12	36	14	3	-
11	124	205	63	3
10	2,615	1,829	201	8
9	7,945	6,667	2,245	285
8	7,391	4,733	1,614	183
7	3,815	1,354	1,659	647
6 and less	56,174	15,346	9,155	1,249

Drafts of vessels ranged from 1 to 12 feet. Vessels sizes ranged from outboard motor craft to tows of the maximum length and size permitted on the waterway. Federal regulations limit tow sizes to a length of 1,000 feet (exclusive of towing vessel) and to a width of 55 feet. Towing vessels on the waterway range from small tugs of very modest power to the latest-type towboats with horsepowers of over 3,600.

b. Table 6 shows the number and drafts of barges over the Gulf Intracoastal Waterway between the Mississippi River and the Sabine River since 1932. It can be seen that an increase in the number of bottoms drawing between 9 and 12 feet has occurred since 1947. This increase is attributable to the initiation of offshore drilling in the Gulf of Mexico and is brought about by drilling and allied equipment which moves only short distances over the waterway; for instance,

from the Mississippi River into the Gulf Intracoastal Waterway in the vicinity of Harvey for repairs and then back to the Mississippi River; or to and from the Gulf of Mexico via the Atchafalaya River, via the Calcasieu River and Pass, or via the Lake Charles Deep Water Channel and Sabine River. Records indicate that the drafts of barges transporting cargo over the Intracoastal Waterway have not increased to any appreciable degree.

c. Depths of connecting waterways and possible routes of travel would limit the drafts of tows. Short-haul tows to adjacent points on the waterway could be loaded to deeper drafts but this would comprise a very small portion of the total tonnage. Depths of authorized Federal projects connecting into the Gulf Intracoastal Waterway are as follows:

Waterway	Project depth (feet)	Waterway	Project depth (feet)
G.I.W.W.(East of N.O.)	12(1)	San Bernard River	9
Barataria Bay Waterway	5(2)	Victoria Channel	9
Port Allen to Morgan City Alternate Route	9(2)	Port Lavaca Channel	12
Bayou Petit Anse	9	Trinity River Channel	9
Bayou Vermilion	9	Mississippi River	
Bayou Terrebonne	6	Minneapolis to Ohio R.	9
Bayou Lafourche	6(3)	Ohio R. to Baton Rouge	12
Bayou Segnette	9	Baton Rouge to Gulf	35 & 40
Atchafalaya River		Chocolate Bayou	4
Old River to Morgan City	12	Freeport Harbor	38
Morgan City to Gulf	20(4)	Palacios Channel	9
Freshwater Bayou, La.	12(5)	Guadelupe River to Victoria	9
Mermentau River, Bayou Nezpique, and Bayou des Cannes, La.	9	Port Aransas-Corpus Christi Waterway	40
Calcasieu River & Pass	40	Arroyo Colorado	12
Sabine-Neches Waterway	36 & 30	Houston Ship Channel	40

(1) Not being considered for improvement.
(2) Now being enlarged to 12 x 125 feet.
(3) Auxiliary channel now authorized for 12 x 125 feet.
(4) Now maintained to 14 feet.
(5) Authorized but not yet constructed.

Other connecting waterways on which Federal projects do not exist are of lesser depths. Therefore, no indication is seen for any significant increase in the drafts of vessels over the Gulf Intracoastal Waterway in the foreseeable future.

d. Trips of vessels over the Plaquemine-Morgan City route are:

Year	Steamers	Motors	Barges
1937	238	8,163	1,231
1938	292	4,025	1,570
1939	218	3,500	1,649
1940	102	2,674	1,504
1941	128	2,133	3,091
1942	64	3,697	6,157
1943	18	4,278	5,577
1944	66	2,751	4,246
1945	8	1,627	2,248
1946	2	2,640	2,876
1947	15	3,354	3,511
1948	42	2,286	3,704
1949	2	2,142	3,683
1950	-	2,465	3,681
1951	-	2,728	4,060
1952	3	2,755	4,173
1953	-	2,886	4,346
1954	-	2,597	3,093
1955	-	3,704	4,541
1956	-	4,499	5,804
1957	-	4,639	5,875
1958	-	4,225	5,896
1959	-	4,015	6,289

A breakdown of the trips and drafts of vessels over the Plaquemine-Morgan City route for the year 1959 is:

Draft (feet)	Motors	Barges
9	363	1,084
8	548	878
7	438	244
6	754	313
5	980	338
4	855	290
3	65	466
2	11	2,372
1	1	304
	4,015	6,289

e. The existing Plaquemine-Morgan City route is a 9 x 100-foot project, and with the congested condition and bad curve existing at Plaquemine Lock, the tows over this section of the waterway are

considerably smaller than those over the main stem of the waterway. With the authorized modification to 12 x 125 feet completed and the new lock at Port Allen, tows will be comparable to those now operating over the main channel of the Intracoastal Waterway.

f. Trips and drafts of vessels through the Algiers Lock and Canal since its completion in April 1956 are:

	1956 Apr.-Dec.		1957		1958		1959	
Draft (feet)	Motors	Barges	Motors	Barges	Motors	Barges	Motors	Barges
10	197	103	238	304	169	140	82	87
9	818	480	888	1,007	763	682	608	489
8	1,062	1,392	1,693	2,111	1,534	1,966	1,051	1,672
7	1,352	1,274	2,133	2,272	1,929	1,982	1,599	1,498
6	1,727	1,027	2,586	1,671	2,718	1,770	2,353	1,340
5	3,008	1,155	4,178	1,804	2,668	2,452	2,160	2,103
4	1,364	609	1,487	832	1,071	1,039	763	695
3	588	586	719	938	431	725	307	567
2	254	1,676	279	4,179	275	2,174	155	1,803
1	61	3,815	70	4,616	129	6,979	73	5,635
TOTALS	10,431	12,117	14,271	19,734	11,687	19,909	9,151	15,889

14. DIFFICULTIES ATTENDING NAVIGATION

a. Although enlargement of the old 9 x 100-foot project to the existing project dimensions of 12 x 125 feet obviated many of the difficulties attending navigation at that time, a large number of curves still exist where the degree of curvature is too acute to be negotiated with modern equipment except at slow speed. The contention of towing interests that the curvature of all bends in the waterway should be reduced wherever practicable seems substantiated.

b. Navigation interests have stressed that the most serious difficulties are the restrictions imposed upon efficient operations of marine equipment by the present width and depth of the channel. A large portion of the power required for towing is expended in overcoming the drag of the vessel and increased channel dimensions would reduce its effect. Another reason advanced by spokesmen of towing interests at the hearing is one of safety. They cited the increase in the damage, and the increase in insurance rates of waterway traffic. The accident rate for the waterway has continued to be relatively high, even after the enlargement to the existing project dimensions. Many of the sinkings result from causes that are not influenced by the inadequacy of the channel. Tugs and towboats have burned, and barges have sunk from slow leaks. Tugs towing barges on short hawsers are sometimes run down and sunk by their own tows when the tug runs aground or attempts to

negotiate a sharp bend. Cross winds tend to blow the tow to the side of the channel, and sometimes force it to tie-up until the wind abates. The sternmost barge of tows on hawser frequently drags along the bank. In an effort to eliminate some of the accidents occurring on the waterway, navigation regulations restrict the size of tows to 1,000 feet in length (exclusive of towing vessel) and to a width of 55 feet.

c. Vessels with tows experience difficulty in passing in the canal at the present time. When tows pass, it is necessary for them to pull hard over to the bank, and after the passing to pull back into the channel. With pusher tows this necessitates the towboat scraping along the bank which increases the bank erosion problem. Navigation throughout the Gulf Intracoastal Waterway often is made difficult for short periods due to strong cross-channel winds which frequently occur from the south or southeast during the summer months and from the north during the winter season. In land cut channels, moderate to strong winds force the tows, especially empty barges, to the side of the channel where they frequently ride the bank for considerable distances. This action slows the tows and requires time for maneuvering into proper position in the channel for passage of other barge tows or for transits through bridge, gate, or lock structure. In the open bays, strong winds cause large waves that tend to break up the tows attempting to cross the area, and to force the tows from the channel which occasionally results in the tows being grounded on the adjacent shoals. The operators report that at times it is necessary to hold the tows in the land cut channels until the weather has moderated sufficiently to permit a safe crossing of the bays.

d. Fogs occur along the Gulf coast area generally during the winter and early spring months and have a considerable effect on navigation. The heavy fogs and severe storms cause complete cessation of traffic on the waterway for short periods of time.

e. The present route of the Intracoastal Waterway through Houma, La., contains a long, sharp curve on the north and several short curves on the south city limits. The waterway is crossed by a highway bridge at the southern city limits as shown on plate 2. The bridge adjacent to the south side of Bayou Terrebonne has a clearance of only 75 feet between fenders. Northward of this bridge the channel has a considerable reach dredged to about 90 feet because of rights-of-way limitations. A bulkhead wall has been constructed along each side of this reach to prevent erosion of the channel banks. In unprotected areas erosion of the channel bank is undermining several buildings and considerable property. Because of the short sight distance through the curves, the narrow width of the channel and bridge openings, detrimental erosion of the channel banks, and adverse winds and weather it is necessary for towboats and other watercraft to proceed slowly in order to navigate safely through this reach for a distance of about 6 miles. It is considered that, on the average, tows of two or more barges experience a loss of about 30 minutes of operating time in traversing the reach of waterway through Houma.

f. The water level in the reach of the Intracoastal Waterway between North Bend, La., (mile 113 west of Harvey Lock) and Vermilion

Lock (mile 163 west of Harvey Lock) is particularly subject to tidal variation. North winds frequently cause a depression of the water surface of as much as two feet. During these periods of extremely low tides navigation is severely handicapped in attempting to traverse this section of the waterway.

g. The Port Allen Lock on the Plaquemine-Morgan City route was opened to navigation on 14 July 1961. However, channel enlargement to 12 x 125 feet has not been completed. Plans call for completion by 31 October 1961. When full dimensions become available navigational difficulties will be the same as those now experienced on the main channel of the Intracoastal Waterway.

h. Traffic through the Algiers Lock and Canal experiences the same operational difficulties as now are being experienced on the main channel due to limited width and depth.

i. Navigation on the Gulf Intracoastal Waterway in Texas sometimes is made difficult for short periods of time during floods on the rivers and bayous that are traversed or crossed by the main channel. Floods on these streams cause strong eddy currents and adverse conditions at the crossings that are particularly hazardous to navigation because of the difficulty in controlling barge tows traversing the crossing. At the crossing of the Colorado River, navigation locks permit crossings by barge tows during floods except for infrequent periods of excessive velocities in the river. Navigation across the Brazos River is difficult during floods because of excessive velocities and excessive differential in head on floodgates, which have been provided at this crossing. Shoaling in the forebays of the gates and locks at these river crossings, which results from floods, sometimes causes delays to navigation. In the reach between the Sabine River and the Mississippi River, shoaling at river crossings, with the exception of the Wax Lake Outlet, is not excessive. Dredging at the Wax Lake Outlet is required every two or three years in order to maintain authorized dimensions. Shoaling in the forebays of all locks connecting with the Mississippi River is also experienced and requires frequent dredging.

j. Barge traffic on the Gulf Intracoastal Waterway encounters some difficulty in navigating the entrances to the land cut channels from the coastal bays and at crossings of deepwater channels near the Gulf of Mexico. The normal tide cycle causes excessive currents across the waterway at the entrances to the land cuts and deepwater channels. Such conditions are experienced at the junction of the main channel and Port Arthur Canal, which often result in barge tows colliding with the fender systems of the bascule lift bridge on State Highway 87. Difficulties also are experienced at the mouth of East Bay Bayou, Galveston Bay, and at the crossing of the Freeport Harbor Channel. Wind and tide in the Laguna Madre section of the waterway often create excessive currents in the main channel which impede navigation. At Wax Lake Outlet

a special crossing has been provided in order to allow tows to cross the channel during periods when current velocities are high due to flood waters. Other crossings in Louisiana do not present undue navigational hazards.

k. Local interests report that many accidents have occurred on the main channel and state that enlargement of the channel would eliminate the difficulties to navigation which largely are responsible for the accidents. One operator reported that the company experienced a total of about $116,000 in damage costs in the period 1951 through 1952, caused by a total of 105 collisions or groundings, and by increased insurance rates. Information regarding damages sustained by other operators caused by collisions and groundings on the waterway under consideration is not available. Operators on the waterway are required by law to report to the United States Coast Guard all marine accidents involving loss of life, any serious injury to persons, or any material damages affecting the seaworthiness or efficiency of the vessels, and accidents involving damages of $1,500 or more. The records of the United States Coast Guard do not show the actual cost of the damages sustained by the several companies. In addition to the reported marine accidents, a large number of bank strikings, groundings, and minor collisions have occurred during adverse weather conditions. On the average, excluding accidents at bridges, gate and lock structures, the occurrence of collisions on the waterway proper is not very large.

l. While some delays occur and hazards exist on the waterway, these are not considered to be unduly restrictive, nor of sufficient magnitude to influence the future development of traffic over the waterway.

m. Vermilion Lock (mile 163 west of Harvey) is restrictive due to smaller dimensions than other locks on the waterway and slow operation but since its replacement by a modern lock in the near future is being considered under authority of the River and Harbor Act of 3 March 1909, no study of further improvement is considered in this report.

n. It is believed that the present waterway is physically able to accommodate present and prospective traffic. However, tows now operate inefficiently because of the depth and width of the present 12 x 125-foot channel.

o. The existing locks on the main stem of the waterway, except for Vermilion Lock, are considered adequate for future increased traffic on the waterway.

p. A feasibility study is being made to determine the advisability of converting the existing floodgates at the Brazos River crossing near Freeport, Texas, into navigation locks. This study has not been completed; however, existing authority would permit the conversion to be accomplished if approved by the Chief of Engineers.

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15. WATER POWER AND OTHER SPECIAL SUBJECTS

a. The section of the main channel of the Gulf Intracoastal Waterway being considered is tidal throughout and no question of water power is involved.

b. In connection with furnishing the necessary rights-of-way and spoil disposal areas for the existing project between Port Arthur and High Island, Texas, local interests were required to install 15 concrete drainage culverts at various locations through the spoil banks. The culverts were designed, primarily, for the drainage of excess fresh water and to prevent the intrusion of salt waters from the channel into the adjacent marshy areas which are used for cattle grazing. The culverts have been inoperative for many years and no longer serve any useful purpose. In view thereof, it is considered that it would be unnecessary for local interests to replace these culverts for the proposed channel enlargement.

c. That part of the main channel of the Intracoastal Waterway between Vermilion Lock (mile 163 west of Harvey Lock) and Calcasieu Lock (mile 238.9 west of Harvey Lock), traverses the Mermentau River Basin. The Mermentau River Basin furnishes irrigation water for the rice fields in southwestern Louisiana and salt water intrusion into the basin is prevented by a system of guard structures, of which the Vermilion and Calcasieu Locks are units. The improvements considered in this report will not be detrimental to the Mermentau River project.

d. In the Louisiana section, the Intracoastal Waterway crosses streams at a considerable distance from the Gulf of Mexico and consequently at points where salinities are normally of low intensity. In the Texas section the waterway generally follows the Gulf rim where salinities are normally high. The proposed improvement of the Intracoastal Waterway will not appreciably affect salt water intrusion.

e. The Plaquemine-Morgan City route of the Intracoastal Waterway for a portion of its length traverses the Atchafalaya River and the borrow pit channel of the East Atchafalaya Floodway protection levee. The improvements considered herein will have no effect on the Atchafalaya Floodway project.

f. The Algiers Canal section of the Intracoastal Waterway is tidal, and no special problems are involved on this section of the waterway.

SECTION IV - PROPOSED SOLUTION AND PROJECT FORMULATION

16. SOLUTIONS CONSIDERED

a. The desires of local interests for modification of the existing project for the Gulf Intracoastal Waterway are set forth in paragraph 11. They are summarized as follows:

(1) Widen, or widen and deepen, the main stem of the canal westward of the Mississippi River to a width and depth, the cost of which would be justified on a reasonable ratio of benefits to costs.

(2) Improve the Plaquemine-Morgan City route (as modified) to approximately the dimensions of the main stem of the canal as improved.

(3) Construct such cutoffs and realinement projects as may be feasible and economical.

(4) For all short radius bends, the channel width be increased at least 20 percent over the present width for a distance of 1,000 feet beyond the bend and then taper into the channel.

(5) At all points where the Intracoastal Canal crosses a river, bayou, or another dredged canal, the entrance width should be at least twice the width of the canal and taper, in 1,000 feet, to the width of the canal.

b. Enlargement of the existing 12- x 125-foot channel is desirable as it will reduce operating costs of tows by reducing the friction losses now being experienced in the existing channel, and also will allow greater ease in passing. A reduction in friction losses can be realized by enlarging the channel to provide greater depths and widths, however, available information indicates that increases in depth are more effective in reducing friction than are increases in width. Therefore, in order to provide increased efficiency and ease in passing a number of possible solutions involving channel enlargement were considered. The existing Gulf Intracoastal Waterway utilizes natural waterways where depths and widths exceed the maximum dimensions requested by local interests, and in other reaches it coincides with and is a part of other Federal projects having channel dimensions in excess of those studied. The reaches of the waterway which are adequate for any of the plans considered are listed below:

LOUISIANA SECTION

Reach of waterway	Name of natural stream or of Federal project	Comment
Mile 95.5 to mile 98.2	Atchafalaya River	Natural depths and widths adequate
Mile 239.2 to mile 241.2	Calcasieu River	do
Mile 241.2 to mile 266.0	Lake Charles Deepwater Channel	A 30- x 125-foot Federal project. Not being maintained to full dimensions but existing depths and widths are adequate

TEXAS SECTION

Reach of waterway	Name of natural stream or of Federal project	Comment
Mile 266 to mile 272.3	Sabine-Neches Waterway	A 30 x 200-foot Federal project. Adequate depth and width
Mile 272.3 to mile 276.8	Sabine-Neches Canal	do
Mile 276.8 to mile 288.1	Sabine-Neches Canal	A 36 x 400-foot Federal project. Adequate depth and width
Mile 288.1 to mile 288.4	Port Arthur Canal	do
Mile 669.0 to mile 683.8	Brownsville Channel	A 36 x 200-foot Federal project. Adequate depth and width

c. Widening of the channel at present depth of 12 feet would afford users of the waterway relief in passing tows and vessels, but the reduction in friction losses which would be brought about by widening only would be inconsequential. Because of the small benefits, plans involving only widening of the channel were discarded.

d. Plans involving enlargement of the waterway by both deepening and widening offer the maximum benefits. Deepening and widening of the waterway results in a considerable reduction in friction loss and provides relief for tows in passing.

e. Relocations of the waterway have also been studied in order to eliminate congested areas, improve alinement, and afford a shorter route.

f. In the development of the modified plan, it was not considered necessary to provide a uniform depth throughout. The trend toward deeper loading of tows is not established. Some increase in the drafts of barges using the waterway has occurred since the offshore area in the Gulf of Mexico was first developed in 1947. However, such craft generally use the waterway for only short distances before turning into waterways (such as the Mississippi River, Bayou Lafourche, Atchafalaya River, Calcasieu River, or other streams) which connect directly to the Gulf of Mexico. Table 6 indicates a moderate increase in the number of barges with drafts between 9 and 12 feet, which is attributable almost entirely to

the craft used in the development of the offshore area in the Gulf of Mexico. Because no large scale increase in the deeper drafts is evident, plans involving deepening do not include deepening through bridges or locks, since such deepening would serve no useful purpose inasmuch as tows must slow down and proceed with caution while navigating through bridges and while transiting locks.

g. An alternative to deepening and widening the existing channel which was considered involved the possibility of increasing the towboat horsepower to achieve comparable increases in speed in the existing 12 x 125-foot channel. It was determined that the increased cost per ton-mile to accomplish a given increase in speed through increased horsepower was greater than the cost for channel enlargement. Increasing the horsepower of the towing vessel had one other disadvantage in that it resulted in a greater operation cost per ton-mile than is now the case over the existing waterway. Also, if the larger towboat were to be considered as operating in an enlarged channel the benefits would be greater than those realized by the present towboats operating in the enlarged channel. Consequently, a solution based on increasing the horsepower of the towing vessel and maintaining the 12 x 125-foot channel was eliminated from further study.

h. All plans for enlarging the existing waterway are based on curves being eased to a maximum of one degree wherever practicable without extensive relocations or damage to existing structures. At the present time this can be accomplished without excessive rights-of-way and will require a comparatively small amount of dredging. Widening in bends or at points where the waterway crosses other channels can be accomplished when necessary during maintenance of the channel.

17. PROJECT FORMULATION

a. In order to arrive at the most desirable and economical plan of improvement, enlargement of the waterway to dimensions of 14 x 150, 16 x 150, 16 x 200, 16 x 250, and 16 x 300 feet was investigated. Modification of the project through locks and bridges was not included. The reaches which are not to be improved are given in appendix A.

b. The materials to be encountered in dredging consist of silts, clays, sands, and shells of various thickness and mixtures. These materials should offer no unusual difficulties to dredging. Spoil areas for disposition of the dredged materials are located in close proximity to the proposed channel enlargements and relocations. Information is given in appendix A relative to the extent of rights-of-way and spoil disposal areas required for the channel enlargements.

c. The estimated costs for the various size channels for the different reaches of the main stem of the waterway are shown as follows:

SECTIONS OF THE GULF INTRACOASTAL WATERWAY

Sections of the waterway	Channel sizes (feet) 14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
	$	$	$	$	$
Miss.-Atch.River					
First cost	4,290,000	6,260,000	10,750,000	16,490,000	22,240,000
Annual charges	265,000	258,000	431,000	647,000	897,000
Atch.-Sabine River					
First cost	7,260,000	9,930,000	15,730,000	24,030,000	32,730,000
Annual charges	308,000	404,000	632,000	950,000	1,350,000
Sabine River-Houston Ship Channel					
First cost	3,912,000	5,442,000	9,273,000	12,770,000	15,474,000
Annual charges	169,000	225,000	385,000	535,000	656,000
Houston Ship Channel-Port Aransas-Corpus Christi Waterway					
First cost	12,123,000	16,237,000	-	-	-
Annual charges	645,000	802,000	-	-	-
Port Aransas-Corpus Christi Waterway-Brownsville					
First cost	10,419,000	13,602,000	-	-	-
Annual charges	471,000	587,000	-	-	-

d. Comparison of first costs and annual charges (see appendix A for details) with benefits (see appendix B for details) indicates that the channel which is justified on the main stem between the Mississippi River and the Atchafalaya River, and between the Sabine River and the Houston Ship Channel is 16 feet deep and 150 feet wide, and in the reach between the Atchafalaya River and the Sabine River a channel 16 feet deep and 200 feet wide is justified because of the heavier traffic density (see table 3).

18. PLAN OF IMPROVEMENT

a. The plan of improvement for the Gulf Intracoastal Waterway provides for enlargement of the main channel to the following dimensions:

(1) Mississippi-Atchafalaya River section. A 16 x 150-foot channel from mile 5.0 west of Harvey Lock to the Atchafalaya River (mile 95.5 west of Harvey Lock), including the Algiers Alternate Canal.

(2) Atchafalaya-Sabine River section. A 16 x 200-foot channel from the Atchafalaya River (mile 98.2 west of Harvey Lock), to the Sabine River (mile 266 west of Harvey Lock).

(3) Sabine River-Houston Ship Channel section. A 16 x 150-foot channel from the Sabine River (mile 266 west of Harvey Lock) to the Houston Ship Channel (mile 350.4 west of Harvey Lock).

b. The following additional improvements are included in the plan:

(1) Channel relocation, Houma, La. Between mile 50.5 and mile 63.5 west of Harvey Lock, a bypass will be constructed south of Houma, La., as shown on plate 2 to dimensions of 16 x 150 feet. This bypass will eliminate considerable curvature on the existing route, and shorten the waterway by 3.5 miles. Three new highway bridges cross the waterway and one new highway bridge over Bayou Terrebonne will be required to handle existing and prospective land traffic. The existing route through Houma, La., would be maintained at present dimensions.

(2) Channel relocation, east approach to Gulf Colorado & Santa Fe Railway bridge, Texas. The proposed relocation between mile 316.4 and 319.1 west of Harvey Lock would provide a channel 16 x 150 feet having flat curves of about one degree and an increased length of tangent to the east approach to the Gulf Colorado and Santa Fe Railway bridge at mile 319.1 west of Harvey Lock, as shown on plate 3. The proposed relocation would be about 0.3 mile longer than the existing route and would eliminate a sharp curve and short tangent approach to the bridge. The existing channel would be abandoned and not maintained.

(3) Channel relocation between mile 320.1 and mile 325.4, Texas. The proposed relocation would provide a channel 16 x 150 feet on a tangent alinement with flat connecting curves, as shown on plate 3. The proposed alinement would be about 0.7 mile shorter than the existing alinement and would eliminate 7 alinement curves. The existing channel would be abandoned and not maintained.

(4) Channel relocation in Matagorda Bay, Texas. The proposed relocation in Matagorda Bay (between miles 454.3 and 471.3 west of Harvey Lock) would provide a channel 12 x 125 feet on the previously abandoned route through Oyster Bay, Palacios Point, and Matagorda Bay, as shown on plate 3. The proposed route is more favorable to navigate and maintain, and is about 0.1 mile shorter than the existing route which would be abandoned and not maintained.

(5) Channel relocation in Corpus Christi Bay, Texas. The plan of improvement also provides for relocation of a channel 12 x 125 feet across Corpus Christi Bay from the junction of the authorized

main channel along the north shore of Redfish Bay and the Port Aransas-Corpus Christi Waterway (between miles 539.4 and 550 west of Harvey Lock), as shown on plate 3. The proposed route would be marked with navigation aids, and would be about 2.1 miles shorter than the existing route which would be abandoned and not maintained from the Encinal Channel across Corpus Christi Bay.

(6) Lydia Ann Channel maintenance. The plan of improvement also provides for the Federal government to resume maintenance of 12 x 125 feet dimension of the old alinement of the Gulf Intracoastal Waterway extending from about mile 522 in Aransas Bay to its junction with the Port Aransas-Corpus Christi Waterway near Port Aransas, as shown on plate 3. Abandonment of this section of the waterway was authorized by the River and Harbor Act of July 24, 1946, and was dependent on construction of the main channel along the north shore of Redfish Bay. Local interests request that the section of the old alinement of the waterway between mile 522 and the Port Aransas-Corpus Christi Waterway be maintained to project dimensions of 12 x 125 feet. It is proposed that this portion of the waterway be considered as a tributary channel to the Gulf Intracoastal Waterway, and that it be designated as Lydia Ann Channel.

c. Enlargement to the new dimensions is not contemplated at existing bridges, tunnels, lock structures, through developed areas, nor in reaches where present depths and widths are adequate, and the reaches which will not be improved because of these reasons are listed below:

NET LENGTHS OF CHANNEL TO BE EXCLUDED
FROM THE PROPOSED PLAN OF IMPROVEMENT

Mississippi River to Atchafalaya River Section

Miles west of Harvey Lock	Net lengths of channel to be excluded from plan (miles)	Reason for not making improvement
0.0 - 5.0	5.00	Congested area. Tows and vessels must proceed at reduced speed to avoid damage to moored craft and structures. Also right-of-way and spoil area would not be available in this reach.
12.5	0.38	La. Hwy. 45 bridge
35.0	0.47	La. Hwy. 308 bridge
35.6	0.47	La. Hwy. 1 bridge

Miles west of Harvey Lock	Net lengths of channel to be excluded from plan (miles)	Reason for not making improvement
55.0 - 61.0	6.00	Houma, La. Congested area and tows and vessels must proceed at reduced speed to avoid damage to moored craft and structures. Also right-of-way in this reach will not be provided by local interests.
93.5	0.63	Bayou Boeuf Lock
Total for reach	12.95	

Atchafalaya River to Sabine River Section

95.5 - 98.2	2.70	Atchafalaya River. Natural channel has widths and depths in excess of those recommended.
113.7	0.38	La. Hwy. 60 bridge
133.7	0.38	La. Hwy. 83 bridge
162.7	0.63	Vermilion Lock
169.6	0.38	La. Hwy. 35 bridge
238.9	0.63	Calcasieu Lock
239.2 - 241.2	2.00	Calcasieu River. Natural channel has widths and depths in excess of those recommended.
241.2 - 266.1	24.80	Lake Charles Deep Water Channel. While this reach is not presently maintained to its authorized 30 x 125-foot dimensions, existing depths and widths are comparable to those recommended.
Total for reach	31.90	

Sabine River to Houston Ship Channel

266.1 - 288.4	22.30	Sabine-Neches Waterway. Widths and depths now available are in excess of those recommended.
288.6	0.47	Texas Hwy. 87 bridge
316.4 - 319.1	0.27	Channel relocation(1)
319.1	0.62	GC&SF RR bridge and Texas Hwy. 124 bridge
320.1 - 325.4	0.67	Channel relocation(2)

Miles west of Harvey Lock	Net lengths of channel to be excluded from plan (miles)	Reason for not making improvement
350.1	0.87	Houston Ship Channel. Widths and depths now available are in excess of those recommended.
Total for reach	25.20	
	Algiers Alternate Canal	
Algiers Canal	0.38	Railroad bridge
Algiers Canal	0.38	Highway bridge
Total for reach	0.76	

(1)Net increase in length of channel involved in the relocation.
(2)Net decrease in length of channel involved in the relocation.

d. The plan provides that wherever practical without extensive relocations or damage to existing structures, curves on the waterway be eased to a maximum of one degree. Five curves will be eased in the reaches to be enlarged. This can be accomplished without excessive rights-of-way and will require a comparatively small amount of dredging.

19. SHORELINE CHANGES

The proposed improvements under consideration in this report are modifications of existing and authorized channels and would not adversely change the configuration of the adjacent shoreline.

20. REQUIRED AIDS TO NAVIGATION

The Commander, 8th Coast Guard District, New Orleans, Louisiana, has been consulted as to aids to navigation, and has furnished estimates of the number and types of aids to navigation and the cost of their relocation, installation, construction, and maintenance for the several plans of channel enlargement considered in connection with this report.

SECTION V - ECONOMIC ANALYSIS

21. ESTIMATES OF FIRST COST

a. Detailed estimates of first cost for the recommended improvement of the several sections of the main channel of the Gulf Intracoastal Waterway from the Mississippi River to Corpus Christi, Texas

and the Algiers Alternate Canal, in accordance with the plan of improvement set forth in paragraph 18 of this report, are given in appendix A, tables 6, 7, 10, 14, and 15. The unit prices used in estimating the first costs of the improvements are based on costs experienced on similar work in the area during December 1960. The division of first costs between the Federal and non-Federal interests is based on the requirements set forth in paragraphs 24b and 24c. The estimated first costs of construction include contingencies. The estimates of first costs for improvement of the main channel in the reach between the Sabine River and the Houston Ship Channel include the first costs for relocating the 12 x 125-foot channel to improve channel alinement as considered in the plan of improvement. The plan of improvement also provides for relocation of the existing 12 x 125-foot channel in Matagorda Bay and in Corpus Christi Bay without any increase in channel dimensions. The detailed estimates of the channel relocations in Texas are given in appendix A. The estimates of first cost for the recommended improvement of the several sections of the Gulf Intracoastal Waterway and the relocations are summarized below:

Item of cost	Federal	Non-Federal	Total
MISSISSIPPI RIVER TO ATCHAFALAYA RIVER			
Mississippi River to Atchafalaya River, to dimensions of 16' x 150' excluding the Houma Bypass Channel and the Algiers Alternate Canal			
Dredging	$3,150,000	$ -	$3,150,000
Rights-of-way, dredging	-	242,000	242,000
Spoil disposal areas	-	270,000	270,000
Severance	-	23,000	23,000
Improvements	-	147,000	147,000
Lower pipelines and cables	-	1,078,000	1,078,000
Total construction	$3,150,000	$1,760,000	$4,910,000
Engineering and design	61,000	37,000	98,000
Supervision and administration	256,000	145,000	401,000
Real estate acquisition costs	33,000	48,000	81,000
Aids to navigation	10,000	-	10,000
Total first cost	$3,510,000	$1,990,000	$5,500,000
Preauthorization studies	15,000	-	15,000
TOTAL COST	$3,525,000	$1,990,000	$5,515,000

Item of cost	Federal	Non-Federal	Total
Houma Bypass Channel, 16' x 150'			
Dredging, dragline	$1,106,000	$ -	$1,106,000
Clearing for dredging	55,000	-	55,000
Rights-of-way, dredging	-	161,000	161,000
Spoil disposal areas	-	105,000	105,000
Severance	-	22,000	22,000
Lower pipelines and cables	-	196,000	196,000
Install aerial crossings	-	172,000	172,000
Bridges, highway, swing	-	2,782,000	2,782,000
Total construction	$1,161,000	$3,438,000	$4,599,000
Engineering and design	23,000	69,000	92,000
Supervision and administration	94,000	280,000	374,000
Real estate acquisition costs	2,000	3,000	5,000
Subtotal	$1,280,000	$3,790,000	$5,070,000
Federal contribution to bridges	1,780,000	-1,780,000	-
Total first cost	$3,060,000	$2,010,000	$5,070,000
Preauthorization studies	5,000	-	5,000
TOTAL COST	$3,065,000	$2,010,000	$5,075,000
Algiers Alternate Canal, 16' x 150'			
Dredging	$ 245,000	$ -	$ 245,000
Total construction	$ 245,000	$ -	$ 245,000
Engineering and design	5,000	-	5,000
Supervision and administration	20,000	-	20,000
Total first cost	$ 270,000	$ -	$ 270,000
Preauthorization studies	1,000	-	1,000
TOTAL COST	$ 271,000	$ -	$ 271,000
ATCHAFALAYA RIVER TO SABINE RIVER, 16' x 200'			
Dredging	$11,560,000	$ -	$11,560,000
Rights-of-way, dredging	-	413,000	413,000
Spoil disposal areas	-	419,000	419,000
Severance	-	29,000	29,000
Improvements	-	175,000	175,000
Lower pipelines and cables	-	1,484,000	1,484,000
Total construction	$11,560,000	$2,520,000	$14,080,000
Engineering and design	230,000	50,000	280,000
Supervision and administration	940,000	210,000	1,150,000
Real estate acquisition costs	70,000	100,000	170,000
Aids to navigation	20,000	-	20,000
Total first cost	$12,820,000	$2,880,000	$15,700,000
Preauthorization studies	30,000	-	30,000
TOTAL COST	$12,850,000	$2,880,000	$15,730,000

Item of cost	Federal	Non-Federal	Total
SABINE RIVER TO HOUSTON SHIP CHANNEL, 16' x 150'			
Dredging	$4,612,000	$ -	$4,612,000
Rights-of-way, dredging	-	133,000	133,000
Spoil disposal areas	-	98,000	98,000
Severance	-	69,000	69,000
Total construction	$4,612,000	$ 300,000	$4,912,000
Engineering and design	92,000	6,000	98,000
Supervision and administration	376,000	24,000	400,000
Aids to navigation	20,000	-	20,000
Total first cost	$5,100,000	$ 330,000	$5,430,000
Preauthorization studies	12,000	-	12,000
TOTAL COST	$5,112,000	$ 330,000	$5,442,000
HOUSTON SHIP CHANNEL TO PORT ARANSAS-CORPUS CHRISTI WATERWAY			
Relocation in Matagorda Bay, mile 454.3 to mile 471.3, 12' x 125'			
Dredging	$ 589,000	$ -	$ 589,000
Rights-of-way, dredging and spoil area	-	25,000	25,000
Total construction	$ 589,000	$ 25,000	$ 614,000
Engineering and design	13,000	1,000	14,000
Supervision and administration	80,000	2,000	82,000
Aids to navigation	66,000	-	66,000
Total first cost	$ 748,000	$ 28,000	$ 776,000
Preauthorization studies	2,000	-	2,000
TOTAL COST	$ 750,000	$ 28,000	$ 778,000
PORT ARANSAS-CORPUS CHRISTI WATERWAY TO BROWNSVILLE			
Relocation in Corpus Christi Bay, mile 539.4 to mile 550.0, 12' x 125'			
Dredging	$ 131,000	$ -	$ 131,000
Engineering and design	3,000	-	3,000
Supervision and administration	18,000	-	18,000
Total construction	$ 152,000	$ -	$ 152,000
Aids to navigation	18,000	-	18,000
Total first cost	$ 170,000	$ -	$ 170,000
Preauthorization studies	1,000	-	1,000
TOTAL COST	$ 171,000	$ -	$ 171,000

b. Lydia Ann Channel. For the purpose of this report, it is considered there would be no first costs involved for the Federal government to resume the responsibility of maintaining the Lydia Ann Channel.

c. Summaries of the first costs of all channel sizes studied are given below:

FIRST COSTS FOR THE IMPROVEMENT OF THE VARIOUS SECTIONS OF THE GULF INTRACOASTAL WATERWAY(1)

Section of the waterway	Channel sizes (feet)				
	14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
Miss.-Atch. River	4,290,000	6,260,000	10,750,000	16,490,000	22,240,000
Atch.-Sabine River	7,260,000	9,930,000	15,730,000	24,030,000	32,730,000
Sabine River-Houston Ship Channel	3,912,000	5,442,000	9,273,000	12,770,000	15,474,000
Houston Ship Channel-Port Aransas-Corpus-Christi Waterway	12,123,000	16,237,000	-	-	-
Port Aransas-Corpus-Christi Waterway-Brownsville	10,419,000	13,602,000	-	-	-
Plaquemine-Morgan City Route (as modified)	3,952,000	5,726,000	-	-	-

(1) Excludes improvements from Harvey Lock (mile 0.0) to mile 5.0, the section through Houma, La. (mile 55.0 to mile 61.0), and other reaches listed in table 1, appendix A.

22. ESTIMATES OF ANNUAL CHARGES

a. Estimates of annual charges for the improvement of the several sections of the main channel of the Gulf Intracoastal Waterway between the Mississippi River and Corpus Christi, including the Algiers Alternate Canal, are given in appendix A, tables 6, 7, 10, 12, 14, and 15, and in paragraphs 10-13. The estimates of annual charges do not include costs for investment, on the basis that benefits would accrue as the work progresses. The estimates of annual maintenance costs of the enlarged channels are based on the shoaling experience of the existing channels of the waterway and costs prevailing in the several areas during December 1960. The estimated additional annual maintenance cost is $56,000. The estimates of annual charges for maintenance and operation of the several highway bridges required in connection

with the Houma Bypass Channel were furnished by the State of Louisiana, Department of Highways. The estimates of annual charges for improvement of the several sections of the Gulf Intracoastal Waterway are summarized in the following tabulations:

Item of cost	Federal	Non-Federal	Total
MISSISSIPPI RIVER TO ATCHAFALAYA RIVER			
(1) Mississippi River to Atchafalaya River, excluding the Houma Bypass Channel, and the Algiers Alternate Canal			
Interest	$ 93,000	$ 80,000	$ 173,000
Amortization	35,000	13,000	48,000
Maintenance, channel	8,000	-	8,000
Total	$ 136,000	$ 93,000	$ 229,000
(2) Houma Bypass Channel			
Interest	$ 80,000	$ 80,000	$ 160,000
Amortization	30,000	13,000	43,000
Maintenance, channel	9,000	-	9,000
Maintenance, bridges	-	31,000	31,000
Operation, bridges	-	35,000	35,000
Total	$ 119,000	$ 159,000	$ 278,000
(3) Algiers Alternate Canal			
Interest	$ 7,000	$ -	$ 7,000
Amortization	3,000	-	3,000
Maintenance, channel	1,000	-	1,000
Total	$ 11,000	$ -	$ 11,000
ATCHAFALAYA RIVER TO SABINE RIVER			
Interest	$ 337,000	$ 115,000	$ 452,000
Amortization	127,000	19,000	146,000
Maintenance, channel	34,000	-	34,000
Total	$ 498,000	$ 134,000	$ 632,000
SABINE RIVER TO HOUSTON SHIP CHANNEL			
Interest	$ 134,000	$ 13,000	$ 147,000
Amortization	51,000	2,000	53,000
Maintenance, channel	25,000	-	25,000
Total	$ 210,000	$ 15,000	$ 225,000

Item of cost	Federal	Non-Federal	Total
HOUSTON SHIP CHANNEL TO PORT ARANSAS-CORPUS CHRISTI WATERWAY			
Channel relocation in Matagorda Bay, mile 454.3 to mile 471.3			
Interest	$ 20,000	$ 1,500	$ 21,500
Amortization	7,000	500	7,500
Maintenance, channel (credit)	-21,000	-	-21,000
Total	$ 6,000	$ 2,000	$ 8,000
PORT ARANSAS-CORPUS CHRISTI WATERWAY TO BROWNSVILLE			
Channel relocation in Corpus Christi Bay, mile 539.4 to mile 550.0			
Interest	$ 4,500	$ -	$ 4,500
Amortization	1,500	-	1,500
Maintenance, channel	(1)	-	(1)
Maintenance and replacement of aids to navigation	3,000	-	3,000
Total	$ 9,000	$ -	$ 9,000

(1) Maintenance of the relocated channel would be approximately the same as the existing channel which has been of negligible amount.

b. Lydia Ann Channel. The annual charges for the Lydia Ann Channel involve only the cost of annual maintenance of the existing 12 x 125-foot channel and are estimated at $6,000 based on a period of 10 years.

c. Summaries of the annual charges for all channel sizes studied are:

ANNUAL CHARGES FOR THE IMPROVEMENT OF THE VARIOUS SECTIONS OF THE GULF INTRACOASTAL WATERWAY(1)

Sections of the waterway	Channel sizes (feet)				
	14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
	$	$	$	$	$
Miss.-Atch. River	187,000	258,000	431,000	647,000	897,000
Atch.-Sabine River	308,000	404,000	632,000	950,000	1,350,000
Sabine River-Houston Ship Channel	169,000	225,000	385,000	535,000	656,000
Houston Ship Channel-Port Aransas-Corpus Christi Waterway	645,000	802,000	-	-	-
Port Aransas-Corpus Christi Waterway-Brownsville	471,000	587,000	-	-	-
Plaquemine-Morgan City route (as modified)	155,000	219,000	-	-	-

(1) Excludes improvement from Harvey Lock (mile 0.0) to mile 5.0, the section through Houma, La. (mile 55.0 to mile 61.0), and other reaches listed in table 1, appendix A.

23. ESTIMATES OF BENEFITS

a. The frictional resistance to movement encountered in the transit of tows on a confined waterway at a given speed is dependent on the depth and width of the waterway. The friction that must be overcome in moving tows is less on deep and wide reaches of the waterway. Conversely, on shallow and narrow reaches of the waterway, more power must be expended to propel the tow.

b. The reduction in frictional resistance to be obtained by deepening and widening of the waterway is equivalent to a saving in the power required to move the tow at the same speed. This surplus power may be utilized either to achieve an increased speed of the tow, or to move more cargo at the same speed, or to achieve some increase in cargo with an increase in speed. A greater ton-mileage per unit of time will result from the reduced frictional resistance, with a commensurate reduction in operating cost per ton-mile.

c. Extensive model tests of tow resistance with variable tow size, channel dimensions, and speed are recognized as reliable guides in evaluating prototype conditions, and results of these tests, supplemented by limited prototype observations on the waterway, are used in evaluating the savings and benefits which will result from the proposed improvement. Details of the analysis are contained in appendix B.

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d. Tonnage on the Intracoastal Waterway is carried in tows of one, two, three, four or more barges of various sizes. However, it is estimated that about 80% of the commerce handled on the waterway is handled by two- and three-barge tows. It also is estimated that the bulk of local traffic on the waterway will be handled in an average tow composed of two 35 x 195-foot barges propelled by an 800-horsepower towboat, while through traffic on the waterway will be handled in an average two consisting of three 50 x 250-foot barges propelled by a 1600-horsepower towboat. Loaded drafts of local and through tows are estimated to average about 8.5 feet.

e. Little prospect exists for increasing the number of barges handled in each tow. Under present regulations governing lengths of tows on the waterway, the tows composed of 35 x 195-foot barges could be increased to five barges, while the tows composed of the 50 x 250-foot barges could be increased to four barges. The fact that more tows are not of the maximum size permitted on the waterway is due to many factors which tend to limit the size of tows. These factors include quantity of material to be moved; urgency of need for the material, which would preclude the delay of shipment until other material is required at the same destination; extent of storage facilities at origin which would permit the collection of large amounts of dry or liquid cargo; extent of storage facilities at the destination so that large quantities of dry or liquid cargo can be received, stored, or handled; ability of consignee to utilize large quantities of cargo; and ability of towing vessels to handle large tows. Rarely do factors occur which allow the towing operators to move maximum tows, therefore, in estimating the benefits to accrue from the improvement of the waterway, tow formations of two and three barges have been used. The two and three-barge tow seems certain of continuation in the future, whereas tows of increased size are an unlikely prospect.

f. The loaded draft of through tows may increase somewhat in the future when the authorized depth of 12 feet on the Mississippi River is realized. However, there is no real prospect for deeper loading of any important percentage of the barges handled over the waterway. Accordingly, for purpose of estimating the benefits from the proposed improvements, draft of barges is estimated at 8.5 feet. When the authorized 12-foot project on the Mississippi River is completed, as well as a 12-foot project on the Ohio River which is proposed, it is anticipated that the draft of barges on through tows that would traverse these rivers will increase to 9 or 9.5 feet. No allowance has been made for the additional benefits to be obtained by such extra loading since the dates for the completion of these projects are at present unknown.

g. The savings per ton-mile for the two and three-barge tows were found to be approximately the same and the averages considered

representative of the savings that can be expected from channels of the dimensions shown are tabulated below:

Channel size in feet	Increase in savings in mills per ton-mile over 12 x 125-foot project
14 x 150	0.225
16 x 150	0.320
16 x 200	0.395
16 x 250	0.465
16 x 300	0.525

Details of the derivation of these factors and other benefit calculations in the following paragraphs are presented in appendix B.

h. Alteration of bridges and enlargement of the channel to allow tows to negotiate bridges without any reduction in the rate of speed is not incrementally justified (see appendix B, paragraph 16). Accordingly, enlargement of the existing waterway through bridges and locks and approaches thereto is not contemplated and, consequently, there will be no benefit to traffic through those reaches of the waterway.

i. Information concerning the reaches which will not be improved is given in appendix A. The benefits on the various reaches which are subject to the unit savings are reduced accordingly to take into account these unimproved reaches. In the Texas section certain reaches of the waterway traverse wide, shallow bays. In such reaches the full measure of benefits from the improvement will not be derived, and the benefits on these reaches have been reduced accordingly. Details concerning the computation of these benefits may be found in appendix B.

j. Certain sections of the waterway are presently of greater depth and width than the proposed enlargement and traffic will not be benefited in passing through those reaches. Other reaches, because of intense developments along the banks, cannot be improved either because of non-availability of right-of-way and/or because moored craft along the banks and at wharves would preclude increased speed even with an enlarged waterway. Regulations prohibit the navigation of vessels and tows in any manner that will endanger and cause damage to moored craft or other vessels on the waterway. Therefore, through reaches where moored craft are present speed of vessels and tows must be reduced. Aside from this regulation there are no speed regulations on the Gulf Intracoastal Waterway in Louisiana or Texas.

k. The estimated benefits to be realized from the various sized channels studied are shown below:

Sections of the waterway	Channel sizes (feet) 14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
	$	$	$	$	$
Miss.-Atch.River(1)	243,000	345,000	426,000	501,000	566,000
Atch.-Sabine River	908,000	1,292,000	1,595,000	1,877,000	2,120,000
Sabine River-Houston Ship Channel(2)	461,000	605,000	719,000	825,000	916,000
Houston Ship Channel-Port Aransas-Corpus Christi Waterway(3)	295,000	417,000	513,000	602,000	678,000
Port Aransas-Corpus Christi Waterway to Brownsville(4)	78,000	93,000	104,000	115,000	124,000
Algiers Alternate Canal	16,000	23,000	28,000	33,000	38,000
Plaquemine-Morgan City route (as modified)	87,000	124,000	153,000	180,000	203,000

(1) Benefits based on Houma Bypass being in place.
(2) Includes $120,000 for two relocations of existing 12 x 125-foot channel.
(3) Includes $9,000 for one relocation of existing 12 x 125-foot channel.
(4) Includes $45,000 for two relocations of existing 12 x 125-foot channel.

l. Benefits for the Houma Bypass are the sum of the benefits to waterway traffic and land transportation. Waterway benefits comprise the difference between the cost of moving the prospective tonnage over the present route and the cost over the improved bypass route. Benefits to land transportation, as estimated by the State of Louisiana, Department of Highways, in cooperation with the U. S. Bureau of Public Roads, comprise the difference in costs to prospective land traffic moving over arteries and bridges that would be developed if the present waterway route were retained and similar costs of operation over arteries and bridges that would be developed for the proposed bypass. Low level movable bridges were found to afford a most favorable benefit-cost factor. The average annual savings to navigation are estimated at $227,000 and those to highway traffic at $163,000.

m. Relocation of the east approach to the Gulf Colorado and Santa Fe Railway bridge between miles 316.4 and 319.1 will result in a saving of $4,800 in transportation costs, $5,700 from reduction in delays to navigation, and $8,000 from reduction in hazards to navigation, or a total of $18,500 annually.

n. The relocation of the channel between miles 320.1 and 325.4 will result in a saving of $95,700 in transportation costs, and $6,000 annually from a relief of hazards and increased safety through the reach, or a total of $101,700 annually.

o. A relocation of the present channel across Matagorda Bay between miles 454.3 and 471.3 will afford annual benefits estimated at $9,000, of which $5,000 are savings in transportation costs and $4,000 from reduction in hazards to navigation.

p. A relocation of the present channel across Corpus Christi Bay will afford total annual benefits estimated to be $30,000, of which $27,000 are savings in transportation costs, and $3,000 are saved by virtue of increased safety and convenience to navigation.

q. Maintenance of the Lydia Ann Channel between Aransas Bay and Aransas Pass will afford total annual benefits estimated to be $9,000 in transportation costs of 2,000 round-trips of commercial fishing boats, recreation boats, and other craft.

r. No detailed estimates of benefits from reduction of damages from collisions and groundings that would accrue to the enlargement of the waterway were submitted by the local interests. Collisions, groundings and bank scraping do occur on the waterway, but practically all of the more frequent and serious accidents occur at bridges, locks, and gate structures. Many of the difficulties on the waterway, as discussed in paragraphs 15 b. and c., result from improper operation of the tows. The barge tows now operating on the waterway have an average draft of about 8.5 feet. At this depth, the 16 x 150-foot channel would have a width of about 200 feet and the 16 x 200-foot channel, a width of about 250 feet. Light or empty barge tows would have a greater width because of the lesser draft. The widening provided by the 16 x 150-foot improvement and the easing of curves would reduce considerably many of the difficulties and damages now experienced on the waterway. Damages such as those sustained at bridges, locks, and gate structures, and from causes that are not influenced by the inadequacy of the channel would not be eliminated and these residual damages would prevail regardless of the degree of channel widening. At the present time, it is necessary for tows using the waterway to reduce speed and pass with caution. During times of bad weather, such as fog, high winds, and storm, operations on the waterway cease until conditions improve. With the enlargements recommended it still will be necessary to reduce speed when passing and to suspend operations during bad weather. It is considered that the aggregate of benefits to be derived by elimination of incremental hazards would not be very large for any of the several reaches of the waterway considered in this report, and that such benefits would be inconsequential towards justifying additional widening of these reaches. Accordingly, no benefit from reduction of hazards has been assigned to the several channel improvements considered in this report.

s. The estimated annual benefits to be derived by improvement of the main channel of the Gulf Intracoastal Waterway from the Mississippi River to the Houston Ship Channel, the channel relocation in Corpus Christi Bay and the Lydia Ann Channel are summarized as follows:

SUMMARY OF BENEFITS

Section of waterway	Estimated annual benefits
MISSISSIPPI RIVER TO ATCHAFALAYA RIVER(1)	
Mississippi River to Atchafalaya River, mile 5.0 to mile 50.5 and mile 63.5 to mile 95.5	$ 347,000
Houma Bypass Channel	390,000(2)
Algiers Alternate Canal	23,000
ATCHAFALAYA RIVER TO SABINE RIVER(3)	1,595,000
SABINE RIVER TO HOUSTON SHIP CHANNEL(4)	485,000
Relocations(5)	120,000
HOUSTON SHIP CHANNEL TO PORT ARANSAS-CORPUS CHRISTI WATERWAY	
Channel relocation in Matagorda Bay	9,000
PORT ARANSAS-CORPUS CHRISTI WATERWAY TO BROWNSVILLE	
Channel relocation in Corpus Christi Bay	30,000
Lydia Ann Channel	9,000
TOTAL BENEFITS FOR ENTIRE PLAN	$3,008,000

(1) 16 x 150-foot channel.
(2) Includes $163,000 annual benefits to highway traffic.
(3) 16 x 200-foot channel.
(4) 16 x 150-foot channel.
(5) Benefits were estimated first on the basis of relocating the channel to dimensions of 12 x 125 feet, after which benefits were estimated for enlarging the entire reach, including the relocations.

24. COMPARISON OF BENEFITS AND COSTS

A comparison of benefits and costs for the improvement of the main channel of the Gulf Intracoastal Waterway to 16 x 150 feet from the Mississippi River to the Atchafalaya River, including Algiers Alternate

Canal and the Houma Bypass separately; 16 x 200 feet between the Atchafalaya River and the Sabine River; 16 x 150 feet between the Sabine River and the Houston Ship Channel (including two channel relocations to the modified dimension); the relocations of the 12 x 125-foot main channel of the Gulf Intracoastal Waterway in Matagorda Bay and Corpus Christi Bay, and the continued maintenance of the Lydia Ann Channel is summarized as follows:

Reach of waterway	Annual benefits	Annual charges	Benefit-cost ratio
MISSISSIPPI RIVER TO ATCHAFALAYA RIVER(1)			
Mississippi River to Atchafalaya River, mile 5.0 to mile 50.5 and mile 63.5 to mile 95.5	$ 347,000	$ 229,000	1.5 to 1
Houma Bypass Channel	390,000(2)	278,000	1.4 to 1
Algiers Alternate Canal	23,000	11,000	2.1 to 1
ATCHAFALAYA RIVER TO SABINE RIVER(3)	1,595,000	632,000	2.5 to 1
SABINE RIVER TO HOUSTON SHIP CHANNEL(1)(4)	605,000	225,000	2.7 to 1
HOUSTON SHIP CHANNEL TO PORT ARANSAS-CORPUS CHRISTI WATERWAY(5)			
Channel relocation in Matagorda Bay	9,000	8,000	1.1 to 1
PORT ARANSAS-CORPUS CHRISTI WATERWAY TO BROWNSVILLE(5)			
Channel relocation in Corpus Christi Bay	30,000	9,000	3.3 to 1
Lydia Ann Channel	9,000	6,000	1.5 to 1

(1) 16 x 150-foot channel.
(2) Includes $163,000 annual benefits to highway traffic.
(3) 16 x 200-foot channel.
(4) Includes $120,000 added benefits for two relocations of 12 x 125-foot channel (see appendix B for details).
(5) Relocation of existing 12 x 125-foot channel.

SECTION VI - COORDINATION AND LOCAL COOPERATION

25. PROPOSED LOCAL COOPERATION

It is proposed that the following local cooperation be prescribed:

(1) Provide without cost to the United States all lands, easements and rights-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works.

(2) Accomplish and maintain without cost to the United States all alterations to pipelines, cables, and any other utilities necessary for the construction of the project.

(3) Construct, maintain, and operate all bridges desired in connection with the bypass route around Houma, La. The United States will contribute 58% ($1,780,000 based on current estimate) of the construction costs of these bridges.

(4) Hold and save the United States free from damages resulting from construction and maintenance of the project.

26. APPORTIONMENT OF COSTS AMONG INTERESTS

a. The apportionment of costs between Federal and non-Federal agencies is set forth in paragraph 21, ESTIMATES OF FIRST COST, and in paragraph 22, ESTIMATES OF ANNUAL CHARGES.

b. The costs of the bridges necessary in connection with the Houma Bypass route were apportioned between the United States and local interests on the basis of the ratio of the estimated benefits to navigation and to highway traffic as determined in appendix B. This resulted in apportionment of 58% to the United States and 42% to local interests.

c. A summary of apportionment of first costs and annual maintenance costs between Federal and non-Federal interests for the recommended improvement of the Gulf Intracoastal Waterway in Louisiana and Texas is shown as follows:

FIRST COSTS

Item of cost	
Federal	
Dredging and related construction	$23,764,000
Contribution to bridge construction	1,780,000
Aids to navigation	134,000
Total Federal construction cost	$25,678,000
Preauthorization studies	66,000
Total Federal first cost	$25,744,000
Non-Federal	
Lands and rights-of-way	$ 2,709,000
Relocations, utility lines	3,244,000
Bridges	1,285,000
Total Non-Federal first cost	$ 7,238,000
Total first cost	$32,982,000

ANNUAL MAINTENANCE COSTS

Federal	
Maintenance channel	$ 56,000
Maintenance and replacement of aids to navigation	3,000
Total Federal	$ 59,000
Non-Federal	
Maintenance, bridges	$ 31,000
Operation, bridges	35,000
Total Non-Federal	$ 66,000
Total annual maintenance costs	$ 125,000

27. COORDINATION WITH OTHER AGENCIES

a. The State and Federal agencies and local organizations consulted are listed in paragraph 2, PURPOSE AND EXTENT OF STUDY.

b. The official views of the United States Department of the Interior, Fish and Wildlife Service, relative to the section of the Intracoastal Waterway in Louisiana are contained in appendix C, and the views of the State of Louisiana, Wild Life and Fisheries Commission, are contained in appendix E.

c. The United States Fish and Wildlife Service recommends that: (a) boom-type equipment be utilized for excavation; (b) the District Engineer advise the Service and Louisiana Wild Life and Fisheries Commission when preparation of detailed contract specifications is initiated so that fish and wildlife requirements may be discussed with Corps representative who will prepare such specifications; (c) the Service and Louisiana Wild Life and Fisheries Commission be given the opportunity to conduct adequate field studies after the proposed realinement of channel segments is staked out on the ground; (d) contract specifications not be completed for about eight months when present studies of this project will be completed by the Louisiana Wild Life and Fisheries Commission; (e) specific recommendations on spoil deposition and dike formation following these studies be included in the detailed contract specifications; and (f) a representative of the Service or the Louisiana Wild Life and Fisheries Commission be assigned to the construction job to advise the contracting party or parties relative to the execution of those provisions in the contract which concern the conservation and development of fish and wildlife resources, the cost of this service to be assigned to the project.

d. The desires of the wild life interests will be followed where it is practical to do so and advance notice will be given so that they may have an opportunity to make suggestions as to disposition of spoil, or to other matters relative to conservation of wild life resources.

e. The Southwestern Regional Director, Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service, submitted a letter report prepared in cooperation with the Texas Game and Fish Commission, dated July 19, 1960, on the effect of the proposed improvements to the Gulf Intracoastal Waterway in Texas on fish and wildlife. A copy of this letter also is included in appendix C, and the official views of the Texas Game and Fish Commission are contained in appendix D. The letter report concludes: (1) Where spoil is deposited in bays or marsh habitats, fish and wildlife production will be eliminated and where spillage of spoil penetrates these areas fish and wildlife production will be temporarily eliminated; (2) The proposed relocation of the channel in the vicinity of State Highway 124 could very well eliminate a habitat which now receives about 10 million waterfowl-days' use annually and which produces about 20,000 muskrats annually; (3) Spoil banks along the edge of bays, marshes and mud flats may form barriers to the movement of larval shrimp, fishes and crabs to estuarine habitat and also prevent adequate exchange of water in these areas. These barriers may also cause flooding of marshes with fresh water and prevent

intrusion of tides, all of which would result in an improper balance of saline and fresh water in marshes and ecological changes to marshes; and (4) Channel cuts through bay areas temporarily increase turbidity in bays and resultant spoil banks and erosion of spoil banks ultimately eliminate vegetated areas important to the productivity of shrimp, crabs, and fishes, and as food sources for waterfowl.

f. Based on these conclusions, the following recommendations were made by the Bureau of Sport Fisheries and Wildlife: (1) That spoil from land-cut sections of the waterway through marsh areas, except the reach between Port Arthur and East Bay, be deposited in narrow, high, spoil banks on the seaward side of the channel with adequate openings to insure entrance and exit of larval shrimp, crabs and fish to marshlands, the location and design of said openings to be determined in cooperation with the Bureau of Sport Fisheries and Wildlife and the Texas Game and Fish Commission; (2) That spoil from channel dredging in the reach between Port Arthur and East Bay be placed in a continuous embankment on both sides of the waterway with control structures as designed by the Soil Conservation Service placed in the levees to control water levels in the marshes; (3) That spoil dredged from the channel through Redfish Bay be placed landward to the channel; (4) That selection of spoil areas and method of disposal of spoil from other reaches of the waterway, particularly on or in the vicinity of Aransas National Wildlife Refuge, be determined jointly with the Bureau of Sport Fisheries and Wildlife and the Texas Game and Fish Commission; (5) That there be no channel relocation in the vicinity of State Highway 124 in Chambers County; (6) That such reasonable modification be made in the authorized project facilities as may be agreed upon by the Director of the Bureau of Sport Fisheries and Wildlife, the Executive Director of the Texas Game and Fish Commission, and the Chief of Engineers for the conservation of fish and wildlife resources.

g. The selection of spoil areas and method of disposal of excavated material from the proposed improvements would be fully coordinated with the Fish and Wildlife Service during preconstruction planning of any improvements which might be authorized for construction. At that time any recommended locations and methods found practicable and economically justified would be adopted. It is pointed out, however, that all costs in connection with acquisition and use of spoil disposal areas must be borne by local interests and their concurrence would be required in any action that would increase these costs above the minimum necessary for construction of the project. Since the recommendation is general in nature, it is not practicable to evaluate benefits and costs for the proposal at this time. Relative to recommendation No. 3 above, it is pointed out that disposal of spoil on adjacent private property normally is performed through permission granted in spoil disposal easements. Adjacent lands suitable for disposal of spoil generally are used for grazing and the property owners probably would not permit permanent flooding of marshes. Adoption of the recommendation probably would involve purchase or

acquisition of flowage easements on the affected land. Such action probably would be adamantly opposed by the property owners. At this time, no information is available which could be used for estimating benefits and costs of the proposal.

h. With respect to the recommendation that there be no cutoff channels in the vicinity of State Highway 124 in Chambers County, it is noted that the Bureau of Sport Fisheries and Wildlife fears that construction of the cutoff channels would eliminate a habitat which now receives about 10 million waterfowl-days' use annually and which produces about 20,000 muskrats annually. In view of the existing high waterfowl usage and the heavy productivity of muskrats, it is evident that construction of the present channel a short distance away from the proposed realinement has had little or no adverse effects on the habitat of the waterfowl and muskrats. No logical reason is evident as to why construction of short reaches of similar channels a short distance away from the present channel would destroy the adjacent habitat. In the absence of evaluated damages from construction of the proposed realinements and in view of the substantial benefits to navigation that would result from construction of these improvements, it is considered that such benefits would more than offset any slight adverse effects to the wildlife habitat.

i. The United States Fish and Wildlife Service, Texas Game and Fish Commission, and the Louisiana Wild Life and Fisheries Commission will be consulted during the detail planning and design studies in order that all recommendations and proposals for the protection of fish and wildlife may be fully considered.

j. The Governors of the States of Louisiana and Texas have agreed to cooperate in furnishing items of local cooperation.

k. The Department of Commerce has informed the Chief of Engineers that Federal aid highway funds are not available to defray any part of the costs of altering Federal aid highways for water resource projects where local interests are required to assume the cost of such adjustment as part of the local construction.

SECTION VII - RESULTS OF THE INVESTIGATION

28. DISCUSSION

a. Growth of traffic on the Gulf Intracoastal Waterway was rapid during the early years of the waterway and has continued at a substantial and steady rate to the present time. The development of the offshore oil lands will result in a great amount of additional tonnage being moved over the waterway. The bulk of the tonnage on the Intracoastal Waterway is now petroleum and its products. Authorities in the oil industry expect the tidelands in the Gulf of Mexico to contribute as much oil production as the equivalent area inland from the Gulf coast.

b. Development and expansion of the petrochemical industry in the region served by the waterway will further increase tonnage over this waterway. Industrialization of the area immediately adjacent to the waterway will also add tonnage to that now being transported. The normal growth of the area along the Gulf Intracoastal Waterway during the life of the project also will bring additional tonnage. The demand for energy sources has been increasing at a steady rate also, and this increase can be expected to continue in the future. The tonnages of crude oil and petroleum products have been projected for 25 years at a 3% rate of increase annually, while other tonnages have been projected at an increase of 1.7% annually over the 50-year life of the project (see paragraph 12b.).

c. Local interests allege that the existing 12 x 125-foot waterway from the Mississippi River to Brownsville, including the Plaquemine-Morgan City route (as modified), is inadequate for existing tonnage and that future development of the resources of the area will be impaired seriously unless the present waterway is improved by widening and deepening. Additional improvements requested include realignments and cutoffs where feasible, elimination of excess curvature, and widening at major stream crossings.

d. Restricted channels result in considerable resistance being encountered by tows. This fact has been verified by actual experience and by model tests. Resistance is reduced as the channel is increased in depth and width, and vessel speed is increased with the same propulsive power. This increased speed is a measure of benefits from the improvement.

e. At the present time the average tow on the Gulf Intracoastal Waterway is composed of two to three barges. Existing operating regulations would permit substantially larger tows (1000 feet exclusive of towboat) but practical considerations limit the tows to a much shorter length. It is expected that similar operating conditions in the future even with increased traffic will make it impractical to utilize the maximum tow in most of the operations. Therefore, no great increase in tow size is anticipated in the foreseeable future. Although some increase in the drafts may be anticipated, the percentage of such deeper draft traffic will be small and for purpose of this analysis drafts of 8.5 feet have been assumed.

f. Analysis shows that improvement of the main stem of the waterway to dimensions of 16 x 150 feet is incrementally justified between the Mississippi River and the Atchafalaya River, and between the Sabine River and the Houston Ship Channel. In the reach between the Atchafalaya River and the Sabine River a 16 x 200-foot channel is justified. Traffic through the Algiers Alternate Canal justifies the enlargement of that reach to provide a 16 x 150-foot channel. Justification is lacking at this time for improvement between the Houston Ship Channel and the Port Aransas-Corpus Christi Waterway and between the Port

Aransas-Corpus Christi Waterway and Brownsville. The Plaquemine-Morgan City route (as modified) is also lacking in justification for improvement to dimensions greater than the existing 12 x 125-foot channel.

g. The plan of improvement considered for improving the Gulf Intracoastal Waterway will provide the following channel dimensions through the various reaches shown:

Reach	Channel dimensions
Algiers Alternate Canal	16 x 150-foot
Mississippi River to Atchafalaya River, with Houma Bypass	16 x 150-foot
Houma Bypass	16 x 150-foot
Atchafalaya River to Sabine River	16 x 200-foot
Sabine River to Houston Ship Channel	16 x 150-foot
Relocation in Matagorda Bay	12 x 125-foot
Relocation in Corpus Christi Bay	12 x 125-foot

In addition to the enlargement and relocations shown above, the plan also provides that the Federal government continue the maintenance of the existing 12 x 125-foot Lydia Ann Channel extending from Aransas Bay to the Port Aransas-Corpus Christi Waterway near Port Aransas, abandonment of which was authorized by the River and Harbor Act of July 24, 1946; and that the section of channel between mile 50.5 and mile 63.5, which is to be shunted by the Houma Bypass route, be maintained by the Federal government to dimensions of 12 x 125 feet. The total first cost for the recommended improvement is $32,982,000, of which $25,744,000 is Federal and $7,238,000 non-Federal. The additional annual cost for channel maintenance is $56,000. The benefit-cost ratio for the entire plan of improvement is 2.2 to 1.

h. For ease and safety in navigation it is desirable to have as much clearance as possible for the passing of tows and large vessels. The enlargement of the channel to 16 x 150 feet will provide an additional width of about 49 feet at the 12-foot depth. At a draft of 8.5 feet, the improved channel would have a total width of 194 feet and will lessen passing hazards to a considerable degree. The provision of a 16 x 200-foot channel in the reach between the Atchafalaya River and the Sabine River provides additional room for passing in the reach which handles the greatest tonnage. The total length of the Gulf Intracoastal Waterway between the Mississippi River and Brownsville, Texas, is 684 miles. The recommended plan of improvement will provide a 16 x 150-foot and a 16 x 200-foot channel over 295 miles (including 8 miles over the Algiers Canal). A total of 397 miles of the waterway will remain at the present dimensions of 12 x 125 feet.

i. Enlargement of bridges or lock structures is not justified and conditions through and adjacent to these structures will remain unchanged.

As no changes in regulations governing tow sizes over the waterway are contemplated these structures will not be unduly restrictive to navigation (see paragraph 28.e.).

j. Additional information on recommended and alternative projects called for by Senate Resolution 148, 85th Congress, adopted 28 January 1958, is contained in attachment to this report.

SECTION VIII - CONCLUSIONS

29. CONCLUSIONS

a. The plan of improvement found to be the most economically justified for the Gulf Intracoastal Waterway is as follows:

(1) Improvement of the Gulf Intracoastal Waterway to provide a channel of 16 x 150 feet between the Mississippi River and the Atchafalaya River, including a bypass of the same dimensions around Houma, La.; a 16 x 150-foot channel through the Algiers Alternate Canal; a 16 x 200-foot channel between the Atchafalaya River and the Sabine River; a 16 x 150-foot channel between the Sabine River and the Houston Ship Channel, including two minor channel relocations in Texas; except at locks, tunnels, and existing bridges, and through developed areas.

(2) Relocation of the main waterway to dimensions of 12 x 125 feet between mile 454.3 and mile 471.3 in Matagorda Bay.

(3) Relocation of the main waterway to dimensions of 12 x 125 feet between mile 539.4 and mile 549.7 in Corpus Christi Bay.

(4) The Federal government to assume responsibility for maintaining the existing 12 x 125-foot Lydia Ann Channel between Aransas Bay and Aransas Pass, and for the continued maintenance of the section of channel between mile 50.5 and mile 63.5, which is to be shunted by the Houma Bypass route, to dimensions of 12 x 125 feet.

b. The total Federal first cost for the recommended work is $25,744,000, including $134,000 for aids to navigation and $66,000 for preauthorization studies. The additional annual cost for channel maintenance is estimated at $56,000.

c. While the improvement of the Gulf Intracoastal Waterway to a channel with dimensions of 16 x 150 feet and 16 x 200 feet differs from that requested by local interests, channels of those dimensions provide 61% and 75% of the benefits which would be afforded by the 16 x 300-foot channel which was requested, and are incrementally justified, whereas channels of greater width are not.

d. The improvement of the reaches from the Houston Ship Channel to the Port Aransas-Corpus Christi Waterway; from the Port Aransas-Corpus Christi Waterway to Brownsville, Texas; and the Plaquemine-Morgan City route (as modified) is not justified economically at this time.

SECTION IX - RECOMMENDATIONS

30. RECOMMENDATIONS

a. It is recommended that the existing project for the Gulf Intracoastal Waterway be modified to provide channels of the following dimensions through the reaches of the waterway listed, except at existing locks, tunnels, and bridges, and through developed areas (as set forth in the plan of improvement in this report):

(1) A channel of 16 x 150 feet through the reach between the Mississippi River and the Atchafalaya River;

(2) A channel of 16 x 150 feet through the Algiers Alternate Canal;

(3) A channel 16 x 150 feet through the bypass route around Houma, La.;

(4) A channel of 16 x 200 feet through the reach from the Atchafalaya River to the Sabine River;

(5) A channel of 16 x 150 feet through the reach from the Sabine River to the Houston Ship Channel;

(6) A channel of 12 x 125 feet through the relocated channel in Matagorda Bay (mile 454.3 and mile 471.3);

(7) A channel of 12 x 125 feet through the relocated channel in Corpus Christi Bay (mile 539.4 and mile 549.7);

(8) A channel of 12 x 125 feet to be maintained through the existing 12 x 125-foot Lydia Ann channel between Aransas Bay and Aransas Pass.

b. It also is recommended that the existing waterway between mile 50.5 and mile 63.5, which would be shunted by the Houma Bypass, be maintained to 12 x 125 feet; and that reaches of the existing waterway in Texas shunted by relocations recommended in this report be abandoned and no longer maintained after construction of the realinement.

c. The modifications of the existing project are recommended for accomplishment, subject to such minor changes as may be approved by the Chief of Engineers at an estimated Federal first cost of $25,544,000, exclusive of aids to navigation, and an estimated Federal annual cost of $56,000 for maintenance dredging in addition to that now required.

d. The recommended improvements are subject to the following items of local cooperation:

(1) Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works.

(2) Accomplish and maintain without cost to the United States all alterations to pipelines, cables, and any other utilities necessary for the construction of the project.

(3) Construct, maintain, and operate all bridges desired in connection with the bypass route around Houma, La. The United States will contribute 58% of the construction costs of the four crossings included in the plan recommended herein.

(4) Hold and save the United States free from damages resulting from construction and maintenance of the project.

G. M. COOKSON
Colonel, CE
District Engineer

89225 O-62—7

[First endorsement]

LMVGN (NOD Rpt 25 Aug 61)
SUBJECT: Gulf Intracoastal Waterway, Louisiana-Texas Section

U. S. Army Engr Div, Lower Mississippi Valley, Vicksburg, Miss., 29 Sep 61

TO: Chief of Engineers, Department of the Army, Washington 25, D. C.

I concur in the findings and recommendations of the District Engineer.

T. A. LANE
Major General, USA
Division Engineer

TABLE 1
REVIEW OF REPORTS ON THE GULF INTRACOASTAL WATERWAY

PRIOR REPORTS

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Ship canal between the waters of Galveston Bay and Sabine Lake, Texas	Survey	Reported on canal 6 feet deep by 50 feet wide between Sabine Lake and Galveston Bay			1873 p 677	
Survey for connecting inland waters along the margin of the Gulf of Mexico from Donaldsonville in Louisiana to the Rio Grande in Texas by cuts and fills	Survey	Reported cost and route of channel 6 feet deep by 60 feet wide			1875 p 876	
Survey of Aransas Pass and Bay to Rockport and Corpus Christi, Texas, and Corpus Christi Pass and Channel	Survey	A channel 10 feet deep by 100 feet wide from Aransas Pass to Rockport and to Corpus Christi, Texas		Ex Doc 1/46/2	1879 p 298	
Survey of a route for a canal to connect Galveston with the Brazos River, Texas	Survey	Improvement to provide channel 6 feet deep by 80 feet wide from Galveston Bay to the Brazos River		Ex Doc 1/47/1	1881 pp 1376-1379	13 Jul 1892

TABLE 1 (cont'd)

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Aransas Pass and Bay, Texas, to Half Moon Reef	Prelim exam	Unfavorable			1891 p 1943	
Preliminary Examination of West Galveston Bay, Texas from Christmas (Christians) Point with a view of reopening the channel through West Bay	Prelim exam	Full survey for a channel $3\frac{1}{2}$ feet deep and 200 feet wide				
Survey of West Galveston Bay, Texas from Christmas (Christians) Point with a view of reopening the channel through West Bay	Survey	A channel $3\frac{1}{2}$ feet deep and 200 feet wide	15 Dec 1891	Ex Doc 22/52/1	1892 pp 1566-1572	8 Jul 1896
Examination and Survey of San Bernard River, Texas	Survey	A channel 4 feet deep and 100 feet wide from San Bernard River to Brazos River and from San Bernard River to Caney Creek	19 Feb 1900	H.D. 446/56/1		

TABLE 1 (cont'd)

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Channel between Brazos River and Galveston Bay, Texas	Prelim exam	Unfavorable		H.D. 89/54/2	1897 p 1809	13 Jun 1902
Matagorda Bay, Texas, a channel to Matagorda	Prelim exam	Unfavorable for improvement	9 Dec 1905	H.D. 154/59/1		
Aransas Pass to and up the Guadalupe River to Victoria and from Victoria to Cuero, Texas	Survey	Unfavorable for improvement		H.D. 336/59/2		2 Mar 1907
Inland Waterway from Mississippi River at Donaldsonville, La., and to Rio Grande, in Texas	Prelim exam	A channel 5 feet deep by 40 feet wide from Aransas Pass to Pass Cavallo; Brazos River to Galveston; Donaldsonville to Franklin; Franklin to Mermentau River	1 Feb 1907	H.D. 640/59/2		2 Mar 1907
Inland Waterway from Rio Grande to Mississippi River (Brazos River to Matagorda Bay, Texas)	Survey	A channel 5 feet deep by 40 feet wide and the construction of a dredge	28 Dec 1908	H.Comm.Doc. 3/61/2		25 Jun 1910 2 Mar 1919

TABLE 1 (cont'd)

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Channel from Aransas Pass Harbor to Rockport, Texas	Prelim exam & survey	Unfavorable for improvement	1 Mar 1910	H.D. 734/61/2		
Channel from Aransas Pass Harbor to Rockport, Texas	Report	Review report by Board of Engineers, unfavorable for improvement by deepening channel at Murrays Reef	5 Dec 1910	H.Comm.Doc. 54/61/3		
Inland Waterway from the Rio Grande, Texas, to the Mississippi River	Report	A channel 5 feet deep by 40 feet wide from Galveston to the Sabine River	19 Aug 1913	H.Comm.Doc. 7/63/1		
Intracoastal Waterway-St.Georges Sound to the Rio Grande Section	Report	A channel 5 feet deep by 65 feet wide	16 Jan 1914	H.D. 610/63/2		
Waterway from Corpus Christi to Baffins Bay via Laguna Madre, Texas	Prelim exam & survey	A channel 5 feet deep by 100 feet wide from Corpus Christi to Baffins Bay	5 Mar 1915	H.D. 1668/63/3		

TABLE 1 (cont'd)

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Intracoastal Waterway from Galveston Bay to Rockport and Corpus Christi, Texas; Channel from Harbor Island, Port Aransas, Texas, to Rockport, Texas; Turtle Cove Channel, Texas; and Channel from Aransas Pass to Corpus Christi, Texas	Prelim exam & survey	A channel 9 feet deep by 100 feet wide between Galveston Bay and Matagorda	21 Sept 1922	H.D. 395/67/2		
Intracoastal Waterway from the Mississippi River at or near New Orleans, La., to Corpus Christi, Texas	Prelim exam	A waterway 9 feet deep by 100 feet wide between New Orleans, La., and Aransas Pass, Texas	3 Apr 1924	H.D. 238/68/1		3 Mar 1925
Louisiana and Texas Intracoastal Waterway, Galveston to Gulf, Texas; Bridges	Survey	Unfavorable (Report dated 2 Oct 1933)		Not printed		
Corpus Christi to Point Isabel, Texas Waterway, including Arroyo Colorado and Baffins Bay, Texas	Survey	Unfavorable (Report dated 4 Dec 1933)		Not printed		

TABLE 1 (cont'd)

Title of report	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Louisiana and Texas Intracoastal Waterway from New Orleans to Rio Grande; Bridges	Survey	Unfavorable (Report dated 19 June 1935)		Not printed		
Louisiana and Texas Intracoastal Waterway at Port O'Connor, Texas	Survey	Unfavorable (Report dated 19 April 1941)		Not printed		
Colorado River, Texas	Review of reports	Maintenance of a suitable discharge channel in the Colorado River channel from Matagorda to the Gulf of Mexico	10 Dec 1936	Sen.Comm.Prt 75/1		26 Aug 1937
Intracoastal Waterway from the Mississippi River at or near New Orleans, La., to Corpus Christi, Texas	Review of reports	Provision of a waterway 12 feet deep by 125 feet wide from the Mississippi River near New Orleans, La., to Corpus Christi, Texas	21 Mar 1939	H.D. 230/76/1		23 Jul 1942

TABLE 1 (cont'd)

Title of reports	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Intracoastal Waterway from Corpus Christi, Texas, to the Rio Grande	Review of reports	Extension of the IWW to provide for a channel 9 feet deep by 100 feet wide from Corpus Christi to Port Isabel and Harlingen, Texas, via the Laguna Madre	30 Sept 1941	H.D. 402/77/1		23 Jul 1942 (1)
Gulf Intracoastal Waterway in the vicinity of Aransas Pass, Texas	Review of reports	Relocation of the main channel along the northwest shore of Red Fish Bay between Aransas Bay and Corpus Christi Bay	2 July 1946	H.D. 700/79/2		24 Jul 1946
Gulf Intracoastal Waterway in South Galveston Bay, Texas	Review of reports	A bypass channel 12 feet by 125 feet wide across south Galveston Bay from Bolivar Peninsula to the draw bridge in the Galveston Causeway	10 May 1949	H.D. 196/81/1		17 May 1950

(1) Dimensions of 12 feet depth and 125 feet width authorized in Act (P.L. 675/77th Cong.)

TABLE 1 (cont'd)

Title of reports	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Intracoastal Waterway from the Mississippi River at New Orleans, La., to Corpus Christi, Texas (Alternate connection with the Mississippi River in the vicinity of Algiers at New Orleans)	Review of reports	Alternate connection with the Mississippi River in the vicinity of Algiers at New Orleans	13 Apr 1944	Sen.Doc. 188, 78th Cong., 2d Session		2 Mar 1945
Plaquemine-Morgan City route, Intracoastal Waterway, Louisiana	Review of reports	Enlargement and extension of the Plaquemine-Morgan City route from the Mississippi-Atchafalaya section of the waterway, in the vicinity of Morgan City, to and through a new terminal lock and entrance channel to the Mississippi River in the vicinity of Port Allen, opposite the lower limit of the Port of Baton Rouge	25 Apr 1946	Sen.Doc. 242, 79th Cong., 2d Session		24 Jul 1946

TABLE 1 (cont'd)

Title of reports	Scope	Recommendations	Date of transmittal to Congress	Where published: Congressional Document	Where published: Annual Report to C. of E.	Authorized by R. & H. Act of
Mermentau River and Tributaries, and Gulf Intracoastal Waterway and Connecting Waters, La.	Review of reports	A salt water guard lock in the Intracoastal Waterway at mile 238 west of Harvey Lock	16 Apr 1946	Sen. Doc. 231, 79th Cong., 2d Session		24 Jul 1946
Gulf Intracoastal Waterway, Channel to Port Mansfield, Texas	Review of reports	A project providing, generally, a 14 by 100-foot channel from the Gulf of Mexico to Port Mansfield, Texas and 3 harbor basins at Port Mansfield and connecting to GIWW near Port Mansfield	2 Feb 1959	Sen. Doc. 11, 86th Cong., 1st Session		9 Sept 1959

TABLE 2

FEDERAL NAVIGATION PROJECTS INTERSECTING THE GULF INTRACOASTAL WATERWAY

Mile west of Harvey Lock	Name of project	Authorized dimensions (feet)	Length (miles)
16.0	Barataria Bay Waterway, La.	12 x 125(1)	37.0*
16.0	Bayou Segnette, La.	9 x 60	12.5
35.4	Bayou Lafourche, La.	12 x 125(2)	57*
	do	9 x 100(2)	11
	do	6 x 60	56.6
57.6	Bayou Terrebonne, La.	6' depth (No bottom width specified)	24.0
58.8	Waterway from Intracoastal Waterway to Bayou Dulac, La.	5 x 40	16.3
95.5	Atchafalaya River-Morgan City to the Miss. River via Old River, La.	12 x 125	116.8
95.5	Atchafalaya River, Morgan City to the Gulf of Mexico, La.	20 x 200	15.8*
123.0	Charenton Drainage and Navigation Canal (Flood Control)	15 x 150	6.0
145.8	Petit Anse, Tigre & Carlin Bayous, La.	9 x 80	13.7
	do	5 x 40	2.4
159.0	Vermilion River, La.	9 x 100	48.5
	do	8 x 80	3.5
161.2	Freshwater Bayou, La.	12 x 125(2)	19.8
201.8	Mermentau River, Bayous Nezpique and des Cannes, La.	9 x 100	36.0
238.5	Calcasieu River and Pass, La.	40 x 400(2)	42.0
266.0	Sabine-Neches Waterway, La.	30 to 37 x 200 to 800	70.0*
266.8	Adams Bayou, Texas	12 x 100	2.0
269.0	Cow Bayou, Texas	13 x 100	7.0
350.9	Houston Ship Channel, Texas	40 x 300 & 400	50.0
351.6	Texas City Channel, Texas	40 x 400	5.0
352.4	Galveston Harbor and Channel, Texas	36 x 800 & 1200	10.0*
379.6	Chocolate Bayou, Texas	4 x 70	6.0
398.6	Freeport Harbor, Texas	36 x 200	5.0*
474.3	Matagorda Ship Channel, Texas	36 x 200(3)	73.8*
538.1	Port Aransas-Corpus Christi Waterway, Texas	34 to 40 x 150 to 700	38.0
548.2	Channel to Encinal Peninsula	30 x 200(4)	9.0
675.0	Brazos Island Harbor, Texas	36 to 38 x 200 to 300	18.0*

*Provides connection with the Gulf of Mexico.

(1)Under construction.

(2)Authorized, but not under construction.

(3)Includes 12 x 125-foot channel to Port Lavaca and 6 x 100-foot channel to Red Bluff, Deepwater Channel from Gulf of Mexico to Point Comfort authorized but not under construction.

(4)Project considered inactive.

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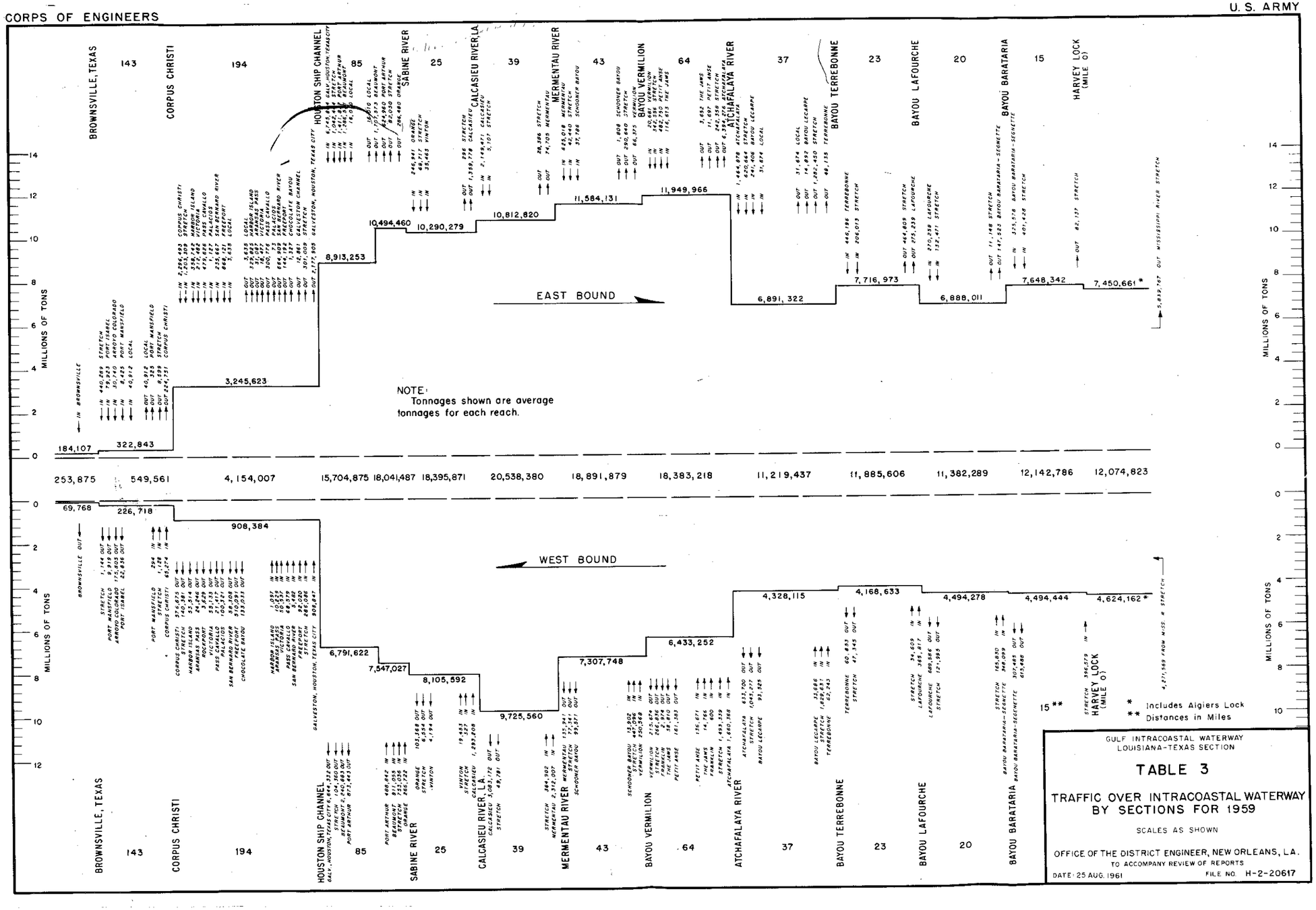

NOTE:
Tonnages shown are average tonnages for each reach.

GULF INTRACOASTAL WATERWAY
LOUISIANA-TEXAS SECTION

TABLE 3

TRAFFIC OVER INTRACOASTAL WATERWAY BY SECTIONS FOR 1959

SCALES AS SHOWN

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, LA.
TO ACCOMPANY REVIEW OF REPORTS
DATE: 25 AUG. 1961 FILE NO. H-2-20617

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TABLE 5

GULF INTRACOASTAL WATERWAY
COMBINED EAST AND WEST TRIPS AND DRAFTS OF VESSELS

Year	Mississippi to Sabine			Sabine to Galveston			Galveston to Corpus Christi			Corpus Christi to Brownsville		
	Steamers	Motors	Barges	Steamers	Motors	Barges	Steamers	Motors	Barges	Steamers	Motors*	Barges
1937	110	26,438	15,373	-	2,059	2,327	Not constructed			Not constructed		
1938	(1)	20,100	14,937	(1)	3,203	5,106	"	"		"	"	
1939	(1)	16,368	15,970	(1)	4,030	6,214	"	"		"	"	
1940	(1)	17,124	20,591	(1)	8,913	13,915	(1)	24,819(2)	3,272	"	"	
1941	(1)	20,120	29,165	(1)	10,745	19,258	(1)	31,487(2)	7,301	"	"	
1942	(1)	24,481	34,160	(1)	11,925	23,852	(1)	6,688	7,286	"	"	
1943	(1)	21,099	35,134	(1)	11,996	22,789	(1)	9,855	8,499	"	"	
1944	(1)	20,909	35,990	(1)	11,987	24,699	(1)	5,864	8,070	"	"	
1945	(1)	21,561	34,409	(1)	11,841	23,412	(1)	6,191	8,060	"	"	
1946	(1)	24,875	26,711	(1)	8,854	17,569	(1)	8,221	11,108	"	"	
1947	(1)	28,268	30,043	(1)	9,730	19,306	(1)	7,743	10,564	"	"	
1948	(1)	37,329	42,123	(1)	9,927	18,632	(1)	9,491	8,127	(1)	7,772	189
1949	159	41,999	48,149	463	16,106	24,606	-	11,567	11,990	-	25,235	587
1950	37	46,890	53,999	119	20,295	25,871	3	13,589	11,975	-	15,828	1,258
1951	20	47,893	56,746	7	18,961	26,353	2	9,717	13,991	-	18,205	296
1952	15	48,644	62,890	8	18,884	27,968	1	11,054	18,772	-	6,908	1,340
1953	69	46,035	61,497	17	19,035	27,957	-	10,801	17,508	-	19,013	1,311
1954	4	43,713	57,324	-	16,785	24,446	-	10,483	13,217	-	16,586	1,632
1955	(3)	48,397	65,593	(3)	16,625	24,635	(3)	9,395	12,641	(3)	14,377	1,706
1956	(3)	50,842	70,798	(3)	17,853	27,481	(3)	10,029	15,369	(3)	17,490	1,417
1957	(3)	54,380	75,807	(3)	18,802	29,502	(3)	10,040	13,378	(3)	14,253	1,674
1958	(3)	51,904	73,013	(3)	17,152	28,004	(3)	16,556	14,637	(3)	11,663	2,541
1959	(3)	54,519	78,100	(3)	16,997	30,184	(3)	20,386	14,955	(3)	11,784	2,376

(1) Included with motors.
(2) Includes ferry trips.
(3) Not distinguished from motors.
Minimum draft 1 foot. Maximum draft 12 feet.
*Includes a large number of commercial fishing craft movements.

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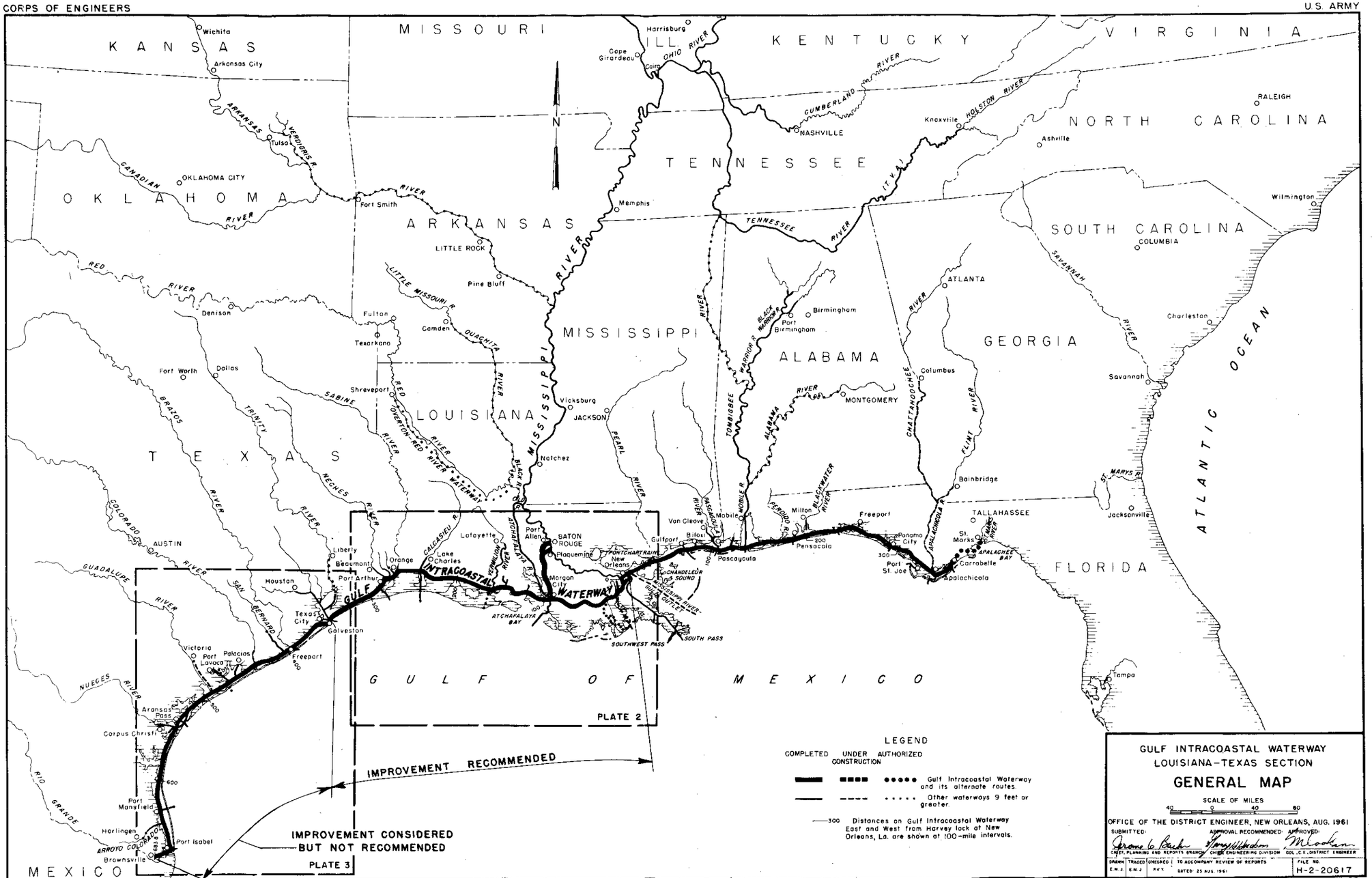

GULF INTRACOASTAL WATERWAY
LOUISIANA–TEXAS SECTION

GENERAL MAP

SCALE OF MILES 40 0 40 80

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, AUG. 1961

SUBMITTED: Jerome L. Bush, CHIEF, PLANNING AND REPORTS BRANCH
APPROVAL RECOMMENDED: Harry Wilhelm, CHIEF ENGINEERING DIVISION
APPROVED: M. Lockett, COL., C.E., DISTRICT ENGINEER

DRAWN	TRACED	CHECKED	TO ACCOMPANY REVIEW OF REPORTS	FILE NO.
E.M.J.	E.M.J.	P.V.Y.	DATED: 25 AUG. 1961	H-2-20617

PLATE 1

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CORPS OF ENGINEERS

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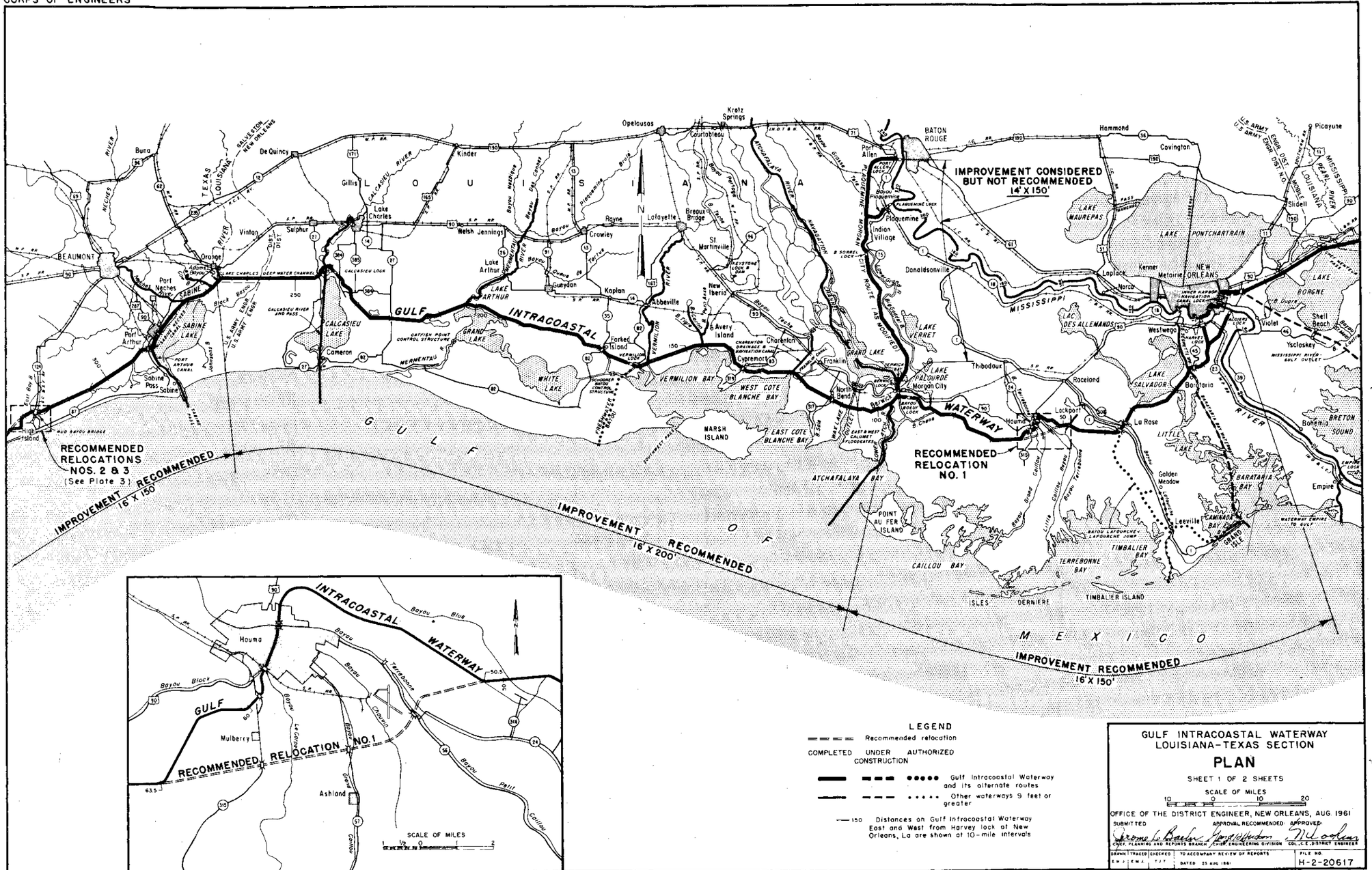

LEGEND

Recommended relocation

COMPLETED UNDER AUTHORIZED CONSTRUCTION

Gulf Intracoastal Waterway and its alternate routes

Other waterways 9 feet or greater

150 Distances on Gulf Intracoastal Waterway East and West from Harvey lock at New Orleans, La are shown at 10-mile intervals

GULF INTRACOASTAL WATERWAY
LOUISIANA-TEXAS SECTION

PLAN

SHEET 1 OF 2 SHEETS

SCALE OF MILES 10 0 10 20

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, AUG 1961

SUBMITTED: Jerome P. Baehr, CHIEF, PLANNING AND REPORTS BRANCH
APPROVAL RECOMMENDED: Jos. H. Hudson, CHIEF ENGINEERING DIVISION
APPROVED: M. Woodson, COL., C.E., DISTRICT ENGINEER

DRAWN	TRACED	CHECKED	TO ACCOMPANY REVIEW OF REPORTS	FILE NO.
E.W.J.	E.W.J.	T.J.T.	DATED 25 AUG 1961	H-2-20617

PLATE 2

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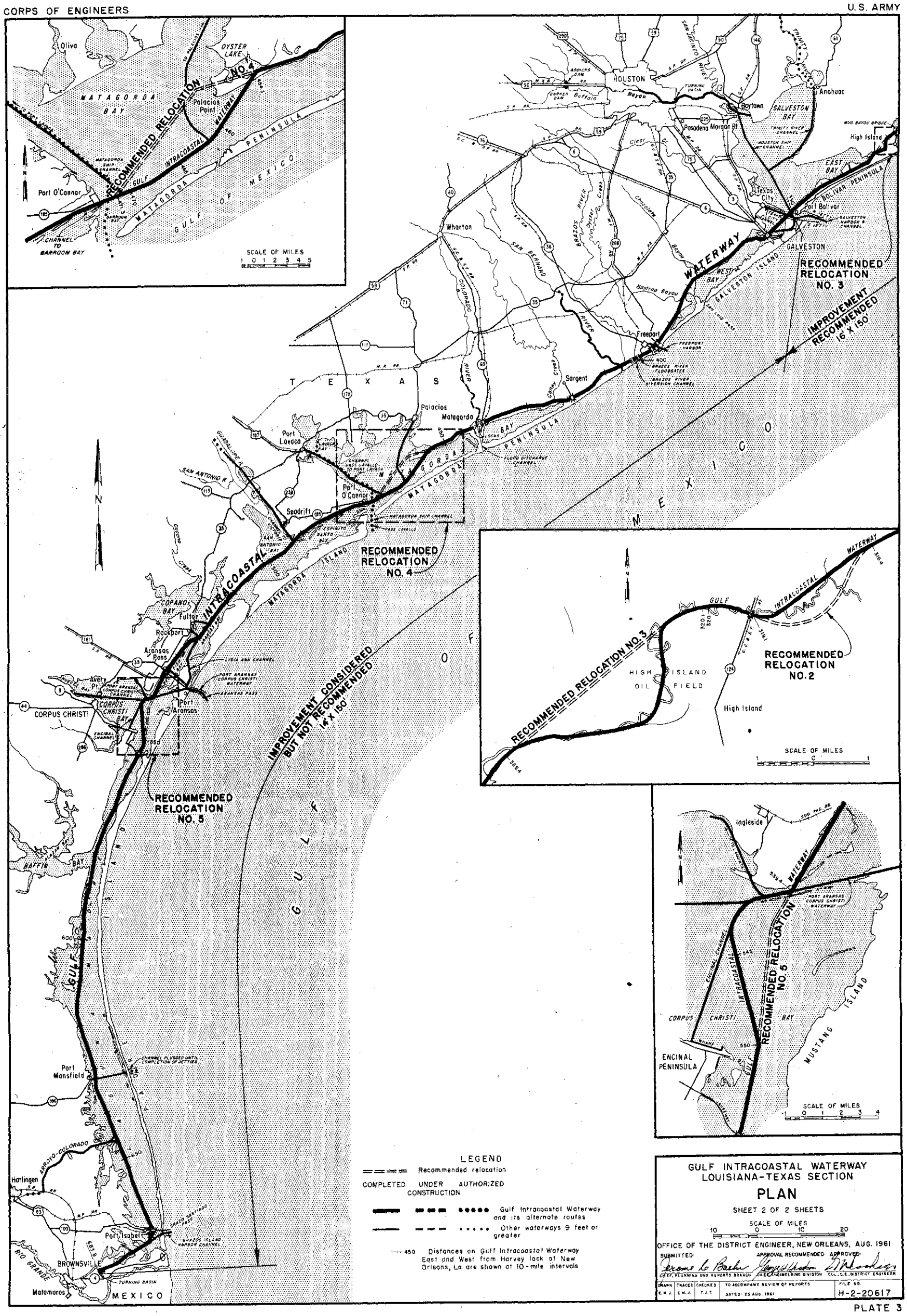
CORPS OF ENGINEERS

U.S. ARMY



GULF INTRACOASTAL WATERWAY
LOUISIANA-TEXAS SECTION

PLAN

SHEET 2 OF 2 SHEETS

SCALE OF MILES 10 0 10 20

OFFICE OF THE DISTRICT ENGINEER, NEW ORLEANS, AUG. 1961

SUBMITTED: Jerome E. Basha, CHIEF, PLANNING AND REPORTS BRANCH
APPROVAL RECOMMENDED: [signature], CHIEF, ENGINEERING DIVISION
APPROVED: [signature], COL., C.E., DISTRICT ENGINEER

DRAWN	TRACED	CHECKED	TO ACCOMPANY REVIEW OF REPORTS	FILE NO.
E.M.J.	E.M.J.	T.J.T.	DATED: 25 AUG. 1961	H-2-20617

PLATE 3

APPENDIX A

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

1. General. This appendix gives information concerning the engineering features of the proposed enlargement of the Gulf Intracoastal Waterway and estimates of first costs and annual charges for the various size enlargements considered.

2. Plans of improvement. To determine the most feasible plan of improvement investigation was made of plans of improvement providing for enlargement of the existing 12- x 125-foot waterway to a depth of 14 feet and a bottom width of 150 feet, and a depth of 16 feet at bottom widths of 150, 200, 250, and 300 feet. The increase in bottom width from the existing 125 feet to 150 feet was considered necessary for safe passage of tows. See appendix B for further discussion.

a. The main channel in Louisiana includes the waterway from Harvey Lock at the Mississippi River to the Sabine River; the Algiers Alternate route; and the modified Plaquemine-Morgan City route. In Texas, the main channel includes the waterway from the Sabine River to Brownsville, Texas, via the alternate channel in South Galveston Bay and the relocated main channel along the north shore of Redfish Bay between Aransas Bay and Corpus Christi Bay.

3. Unchanged sections of waterway. Sections of the main channel which cannot be feasibly enlarged, or are already enlarged by reason of being part of a deepwater channel are also excluded from improvement. These sections are discussed in the following paragraphs.

a. In the reach between Harvey Lock, mile 0.0, and the Sabine River, mile 266.0, a total of 11.0 miles will remain unchanged because of the impracticability of improving the waterway because of improvements along both banks. The reaches which will remain unchanged are shown below:

Miles west of Harvey Lock	Distance not to be improved	Reasons for not making improvement
0.0 - 5.0	5.0 miles	Impractical because of industrial improvements
55.0 - 61.0	6.0 miles	City of Houma, La., impractical because of improvements along banks.
	11.0 miles	

b. The cost of improving the channel of the existing waterway through a typical bridge, and replacement of the present bridge with one which would not restrict the speed of vessels and tows is shown in table 17. The reach selected was that through the pontoon bridge on Louisiana Highway No. 308 at mile 35.0 west of Harvey Lock. In order to eliminate the need for vessels and tows to reduce speed, a high-level bridge with no piers in the waterway has considered essential.

4. Retention of existing channel at bridge crossings. The plans of improvement for enlargement of the waterway under consideration provide that deepening or widening of the existing channel will not be performed within certain limits of the bridge.

a. In Louisiana and Texas, the unimproved reaches at bridges were estimated as follows:

Miles west of Harvey Lock	Distance not to be improved (feet)	Bridge
	LOUISIANA SECTION	
12.5	2,000	La. Hwy. No. 45, swing, 75-foot horizontal clearance
35.0	2,500	La. Hwy. No. 308, pontoon, 90-foot horizontal clearance
35.6	2,500	La. Hwy. No. 1, pontoon, 108-foot horizontal clearance
113.1	2,000	La. Hwy. No. 60, vertical lift, 125-foot horizontal and 80-foot vertical clearance
133.7	2,000	La. Hwy. No. 83, swing, 80-foot horizontal clearance
169.6	2,000	La. Hwy. No. 35, pontoon, 125-foot horizontal clearance
	13,000 feet, or 2.5 miles	
	TEXAS SECTION	
288.6	2,500	Texas Hwy. 87, bascule, 100-foot horizontal clearance
319.1	3,200	GC&SF Ry. and Texas Hwy. 124, both 100-foot horizontal clearance

Miles west of Harvey Lock	Distance not to be improved (feet)	Bridge
	TEXAS SECTION (cont'd)	
357.1	3,600	Santa Fe RR, bascule, 100-foot clearance, Texas Hwy. 75, bascule, 105-foot horizontal clearance, and Texas Hwy. 75 fixed, 105-foot horizontal clearance, 73-foot vertical clearance
393.6	400	Surfside Hwy. fixed, 201-foot horizontal, 73-foot vertical clearance
397.0	800	Quintana Hwy. pontoon, 130-foot horizontal clearance
417.9	400	Caney Creek Hwy., pontoon, 100-foot horizontal clearance
440.6	400	Matagorda Hwy., pontoon, 100-foot horizontal clearance
532.9	400	Nueces County Causeway
554.6	400	Texas Hwy. 358, pontoon, 150-foot horizontal clearance
667.9	400	Cameron County, pontoon, 150-foot horizontal clearance
Total	12,500 feet, or 2.4 miles	

5. Retention of existing channel at locks and gate structures. On the main stem of the Gulf Intracoastal Waterway, the 12- x 125-foot channel will be retained for the following distances at the lock structures:

Miles west of Harvey Lock	Distance not to be improved (feet)	Lock
	LOUISIANA SECTION	
93.5	3,300	Bayou Boeuf Lock
162.7	3,300	Vermilion Lock
238.9	3,300	Calcasieu Lock
Total	9,900 feet, or 1.9 miles	

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Miles west of Harvey Lock	Distance not to be improved (feet)	Lock
	TEXAS SECTION	
400.6	20,800	Brazos River Floodgates
441.3	7,400	Colorado River Locks
Total	28,200 feet, or 5.35 miles	

a. In the Texas section, it is proposed that the east and west approach channels to the Colorado River locks be retained as 12- x 125-foot channels for a distance of 1,000 feet beyond the ends of the guide walls. At the Brazos River crossing, it is planned at some future date to provide locks on each side of the crossing. Final determination of this problem has not been solved. Conversion of the existing floodgates on the west side of the river into locks by construction of an additional set of gates west of the existing floodgates would necessitate relocation of a considerable length of the main channel to provide an adequate tangent approach channel to the lock from the southwest. It may be more feasible to provide for a westward diversion of the lower portion of the Brazos River, relocation of the main channel to cross the river diversion channel providing sufficient forebay to the proposed locks, conversion of the existing set of floodgates to serve as a lock structure on the east side of the river diversion channel and construction of two sets of gates to form a lock on the west side of the river diversion channel. Because of the uncertain requirements at this crossing, it is proposed that no enlargement of the existing waterway be undertaken between about mile 400 and 404.

6. Existing channel at deep draft waterways. The Gulf Intracoastal Waterway in Louisiana follows the Atchafalaya River from mile 95.5 to mile 98.2, and while the Atchafalaya River is not a Federal project for depths greater than those of the existing Intracoastal Waterway, the natural depths and widths of the river are greatly in excess of those to which improvement is being considered. From mile 239.2 to mile 241.2, the Intracoastal Waterway follows the Calcasieu River, and like the Atchafalaya River this stream provides depths and widths in excess of those to which improvement is being considered. From mile 241.2 to mile 266.0, the Intracoastal Waterway follows the Lake Charles Deep Water Channel, a Federal project with an authorized depth of 30 feet over a bottom width of 125 feet, and while the Lake Charles Deep Water Channel has not been maintained to full dimensions in recent years, the depths and widths existing are in excess of those to which improvement is being considered.

a. The main channel of the Gulf Intracoastal Waterway from mile 266, to the mouth of the Sabine River, mile 272.3, coincides with the authorized 30-foot deep by 200-foot wide Sabine River channel of

the Sabine-Neches Waterway. At a depth of 18 feet, the natural river section exceeds a width of 300 feet. From mile 272.3, to the mouth of the Neches River, mile 276.8, the main channel traverses the authorized 30-foot by 200-foot Sabine-Neches Canal located along the north shore of Sabine Lake. In this reach, the Sabine-Neches Canal has a channel width greater than 300 feet at a depth of 18 feet as a result of sloughing of its soft underwater side slopes. The main channel from mile 276.8 to mile 288.1 coincides with the existing 36-foot by 400-foot Sabine-Neches Canal and from mile 288.1 to 288.4 with the 36-foot by 400-foot Port Arthur Canal. The total length of the deepwater channels between the Lake Charles Deep Water Channel and the junction of the main channel and the Port Arthur Canal is 22.3 miles.

b. The main channel of the Gulf Intracoastal Waterway intersects the Houston Ship Channel (40x400) at mile 350.4, the Texas City Channel (40x400) at mile 350.7, the Freeport Harbor Channel (36x200) at mile 395.2, and the Port Aransas-Corpus Christi Waterway (40x400) at mile 539.4. The total combined length of the main channel at these crossings is estimated at 1,800 feet, which will not require any enlargement.

c. The main channel from its junction with the Port Isabel turning basin to and including the Brownsville turning basin traverses the deepwater channels and basins of the Brazos Island Harbor projects. The channels and basins have a minimum authorized depth of 36 feet and width of 200 feet. They constitute a total length of 78,144 feet.

7. Modification of existing channel alinement. In planning an extensive major channel enlargement of the Gulf Intracoastal Waterway, the first question that presents itself is should the existing channel alinement be modified to improve navigation characteristics, increase safety, or reduce cost of operation. Investigation indicates that improvement of channel alinement would be very desirable. Involved are some minor curve easing and some major relocations. Information regarding the proposed alinement improvements is given in the following paragraphs.

8. Proposed curve easing. In general, the alinement of most of the existing channel under consideration for enlargement consists of comparatively long tangent courses. Between mile 0 and mile 266 of the Intracoastal Waterway there are approximately 67 curves. Curves in this reach other than those at Houma, La., are not unduly restrictive or hazardous to the navigation now traversing the waterway. The proposed enlargement of the waterway will afford a reduction in the difficulties now experienced in negotiating the curves, and the Houma bypass will eliminate those curves at Houma that are restrictive.

a. Between the Port Arthur Canal and the Port Isabel turning basin, there is a total of 113 curves in the 381 miles of channel. Of these, 18 curves exist between Port Arthur and the Houston Ship Channel,

a distance of about 61 miles; 80 curves between the Houston Ship Channel and the Port Aransas-Corpus Christi Waterway, a distance of about 189 miles; and 15 curves between the Port Aransas-Corpus Christi Waterway and Port Isabel, a distance of about 128 miles. The maximum curving of the channel alinement is 2 degrees 18 minutes, which corresponds to a radius of about 2,490 feet.

b. Traffic on the Gulf Intracoastal Waterway consists of vessels of all types from small pleasure boats to integrated tows of two or more barges. The multiple barge tows are generally less than the maximum size permitted by existing regulations which limit the length to not more than 1,000 feet, exclusive of the towboat, and the width to not more than 55 feet. Passage of maximum length tows through curves of maximum curving is hazardous and unsafe to navigation.

c. Investigation of the feasibility of easing the curves on the waterway to a maximum of one degree, or about 5,730-foot radius, revealed that such easing could be accomplished without requiring excessive rights-of-way and with a comparatively small amount of dredging. Such curve easing is more than justified to provide for reasonably free, easy, and unobstructed navigation conditions through the curves of the waterway. Accordingly, all plans of improvement under consideration in this report provide for easing of curves to a maximum of one degree.

9. Proposed channel relocations. One major channel relocation in the Louisiana section and five relocations in the Texas section have been considered. Details concerning the channel relocation around the city of Houma, Louisiana, are given in paragraph 21 of this appendix. In the Texas section (Sabine River to the Houston Ship Channel), channel relocations at the east approach to the GC&SF Ry. bridge and between mile 320.1 to 325.4 were first relocated along the proposed alinement to existing dimensions of 12 x 125 feet with side slopes of 1 on 3 including an allowance of 2 feet for overdepth dredging. After establishment of the economic justification for relocation of the 12-x 125-foot channel, the entire reach, with the relocations, was considered as an entity in arriving at the justification for the deeper and larger size channels. Other relocations in Texas are to maximum dimensions of 12 x 125 feet. The economic analysis of the proposed channel relocations are given in Appendix B. Information relative to the plans of proposed channel alinement modification, including detailed estimates of first costs and annual charges, is given in the following paragraphs for each of the following proposals:

a. Channel relocation, east approach to GC&SF Ry. Bridge.

b. Channel relocation, mile 320.1 to 325.4.

c. Channel relocation in Matagorda Bay.

d. Channel relocation in Corpus Christi Bay.

e. Channel relocation at Port Isabel, Texas.

10. Channel relocation, east approach to GC&SF Ry. Bridge. In order to improve navigation conditions at this location, it is proposed to relocate the east approach channel as shown on plate 3. The plan provides a channel 12 feet deep and 125 feet wide extending on tangent alinement for a distance of 1,320 feet east of the centerline of the railroad thence 12 feet deep and 125 feet wide with side slopes of 1 on 3 throughout the remainder of the proposed relocation consisting of two flat curves of 5,730 feet radii with 1,000 feet of tangent channel between the reverse curves. The proposed relocation would have a total length of 15,120 feet. The quantity of channel excavation including an allowance of 2 feet of overdepth is estimated at 1,355,000 cubic yards. The existing channel between the limits of the proposed relocation would be abandoned and not maintained. Rights-of-way for the channel relocation is estimated at 122 acres and sufficient spoil disposal area is available under existing easements. The materials to be encountered in construction of the channel consist of various thicknesses of soft clays, medium to hard clays, fine sands, and sandy clays. These materials would offer no unusual difficulties for dredging. The proposed channel relocation is but 1,406 feet, or 0.3 mile, longer than the length of existing channel between the limits of pro-proposed relocation. The cost of maintaining this additional length of channel is estimated at $400 annually, based on annual cost of maintaining the existing channel. The first cost and annual charges for this proposed channel relocation are estimated as follows:

RELOCATION OF
APPROACH TO GC&SF RY. BRIDGE

FIRST COST

Feature	Federal	Non-Federal	Total
Dredging, 1,355,000 cu.yds. at 23¢ per cu.yd.	$ 311,000	$ -	$ 311,000
Land, channel right-of-way, 122 acres at $85 per acre	-	10,000	10,000
Severance, lump	-	6,000	6,000
Subtotal	$ 311,000	$ 16,000	$ 327,000
Contingencies	47,000	2,000	49,000
Subtotal	$ 358,000	$ 18,000	$ 376,000
Engineering and design	7,200	400	7,600
Subtotal	$ 365,200	$ 18,400	$ 383,600
Supervision and administration	37,300	1,300	38,600
Total cost	$ 402,500	$ 19,700	$ 422,200

ANNUAL CHARGES

Interest	$ 10,600	$ 800	$ 11,400
Amortization	4,000	200	4,200
Maintenance	400	-	400
Total	$ 15,000	$ 1,000	$ 16,000

11. Channel relocation, mile 320.1 to mile 325.4. The proposed relocation would have a total length of 4.66 miles and contain 2 flat curves of 5,730 feet radii and a total of 48 degrees of curve. On the basis of existing channel dimensions of 12 feet deep and 125 feet wide, the proposed relocation would involve an estimated 2,100,000 cubic yards of excavation, including 2 additional feet of overdepth excavation. The materials to be encountered in construction of the relocation consist of various thicknesses of soft clays, medium to hard clays, fine sands, and sandy clays. These materials should offer no unusual difficulties for dredging. Right-of-way for channel excavation is estimated at 170 acres and spoil area for the disposition of materials dredged from the channel is estimated at 290 acres. The proposed channel is 3,552 feet, or 0.7 mile, shorter than the existing channel between the limits of the proposed relocation. The existing channel between the limits of the proposed relocation would be abandoned and not maintained. Because of the reduced length, the annual cost of maintaining the relocated channel would be about $1,000 less than the cost of maintaining the existing channel. The first cost and annual charges for the proposed relocation are estimated as follows:

RELOCATION, MILES 320.1 TO 325.4

FIRST COST

Feature	Federal	Non-Federal	Total
Dredging, 2,100,000 cu.yds. at 23¢ per cu.yd.	$ 483,000	$ -	$ 483,000
Land, right-of-way and spoil disposal area, 460 acres at $85 per acre	-	39,000	39,000
Severance, lump	-	24,000	24,000
Subtotal	$ 483,000	$ 63,000	$ 546,000
Contingencies	72,000	-	72,000
Subtotal	$ 555,000	$ 63,000	$ 618,000
Engineering and design	11,000	1,000	12,000
Subtotal	$ 566,000	$ 64,000	$ 630,000
Supervision and administration	68,000	6,000	74,000
Total cost	$ 634,000	$ 70,000	$ 704,000

ANNUAL CHARGES

Interest	$ 16,600	$ 3,000	$ 19,600
Amortization	6,300	500	6,800
Maintenance (credit)	-1,000	-	-1,000
Total	$ 21,900	$ 3,500	$ 25,400

12. Channel relocation in Matagorda Bay. This plan proposes the reestablishment of the old route extending from about mile 454.3 through Oyster Lake, Palacios Point, and Matagorda Bay to mile 471.3 on the existing channel, as shown on plate 3. The proposed alinement would be about 0.04 mile shorter than the existing alinement between mile 454.3 and 471.3. It would contain two curves of about 5,730 feet radii and a total of about 66 degrees of curve as compared to three curves of 5,730 feet radii and a total of 74½ degrees of curve on the existing alinement. The existing channel between the limits of the proposed relocation would be abandoned and not maintained. The proposed relocation would have a total length of 18.1 miles and in general would require excavation of about 2,100,000 cubic yards to provide a channel 12 feet deep and 125 feet wide including an allowance of 2 feet of overdepth. The material to be excavated consists of silts, clays, and fine sands which would offer no unusual difficulties to dredging. The proposed relocation would require additional rights-of-way and spoil disposal area estimated at a total of 485 acres. Aids to navigation to be relocated are 12 light structures, 26 nun and 34 can buoys, at an estimated cost of $66,000.

a. The annual cost of maintaining the proposed channel would be considerably less than the cost of the existing channel between the limits of relocation. The proposed relocation would provide 3 additional miles of protected channel. It also would be afforded partial protection by its proximity to Halfmoon Reef projecting southwestward of Palacios Point. Halfmoon Reef is about 3½ miles long and is submerged in depths of 1 to 2 feet, which deflects shoreline currents, and reduces wave action caused by southeast winds. Investigation reveals that maintenance dredging of the existing 12- x 125-foot channel for the 10-year period, 1945 through 1954, amounted to 525,000 cubic yards annually, as compared to an annual average of 260,000 cubic yards, for the abandoned 9- x 100-foot channel. It is estimated that maintenance of the proposed 12-x 125-foot channel would not be over 400,000 cubic yards annually. The saving in maintenance cost is estimated at $21,000 annually, which is creditable to the proposed channel relocation.

b. The first cost and annual charges for the proposed channel relocation are estimated as follows:

RELOCATION IN MATAGORDA BAY
MILE 454.3 TO MILE 471.3

FIRST COST

Feature	Federal	Non-Federal	Total
Dredging, 2,100,000 cu.yds. at 24¢ per cu.yd.	$ 504,000	$ -	$ 504,000
Land, channel and spoil areas, 485 acres at $45 per acre	-	22,000	22,000
Aids to navigation	66,000	-	66,000
Subtotal	$ 570,000	$ 22,000	$ 592,000
Contingencies	85,000	3,000	88,000
Subtotal	$ 655,000	$ 25,000	$ 680,000
Engineering and design	13,000	1,000	14,000
Subtotal	$ 668,000	$ 26,000	$ 694,000
Supervision and administration	80,000	2,000	82,000
Total first cost	$ 748,000	$ 28,000	$ 776,000
Preauthorization studies	2,300	-	2,300
Total cost	$ 750,300	$ 28,000	$ 778,300

ANNUAL CHARGES

Interest	$ 19,600	$ 1,100	$ 20,700
Amortization	7,400	200	7,600
Maintenance (credit)	-21,000	-	-21,000
Total	$ 6,000	$ 1,300	$ 7,300

13. Channel relocation in Corpus Christi Bay. It is proposed to relocate the portion of the Gulf Intracoastal Waterway across Corpus Christi Bay as shown on plate 3. The proposed plan provides for relocating the channel on a straight extension of the cutoff channel to a point in Corpus Christi Bay, about 10,600 feet from its intersection with the Port Aransas-Corpus Christi Waterway, thence southward about 34,500 feet to a point on the existing waterway in Corpus Christi Bay about 4,000 feet offshore from Beacon No. 3.

a. The proposed alinement would have a length of 45,100 feet and would contain two curves of about 5,700 feet radii and a total of about 30 degrees of curve. The existing channel between the limits of proposed relocation has a total length of about 56,000 feet and contains two curves totaling about 130 degrees of curve, excluding the authorized connection curve to the Port Aransas-Corpus Christi Waterway, (the connection curve on the north side of the crossing of the Port Aransas-Corpus Christi Waterway was previously authorized with the cutoff channel).

b. At present, there is no designated connecting channel between the channel from the city of Corpus Christi to the Gulf Intracoastal Waterway extending southward to Port Isabel, and none is proposed in this report. The traffic between Corpus Christi and the southern ports traverses Corpus Christi Bay via undesignated routes, a s sufficient depth of waterway is available throughout most of the bay area. In general, the Gulf Intracoastal Waterway traffic crossing Corpus Christi Bay traverses a route as shown on plate 3, which has not required any maintenance dredging except in the vicinity of the Port Aransas-Corpus Christi Waterway. The existing channel from the Encinal Channel to the southern limit of the relocation would be abandoned and not maintained.

c. The proposed channel would require some new work dredging through the spoil bank of Port Aransas-Corpus Christi Waterway and for a distance of about 10,000 feet south of the spoil bank. The remainder of the channel is at a depth of 12 feet, which is the same depth available on the existing route. The total excavation to provide a channel 12 feet deep and 125 feet wide including an allowance of 2 feet of overdepth through the spoil bank and for 10,000 feet beyond is estimated at 407,000 cubic yards. The materials to be excavated consist of silts, clays, and some sand and shell, which would offer no unusual difficulties for dredging.

d. The proposed channel relocation would not require any rights-of-way or spoil disposal areas as it is located within coastal waters. It is proposed that aids to navigation be provided to mark the full length of the channel, which would require 4 new range light structures and 22 new buoys. Maintenance of the proposed channel would be approximately the same as the existing channel, which has been of negligible amount. Accordingly, it is estimated that there will be no increase or decrease in the annual cost of maintaining the proposed channel.

e. The first cost and annual charges for the proposed channel relocation are estimated as follows:

RELOCATION IN CORPUS CHRISTI BAY
MILE 539.4 TO MILE 550.0

FIRST COST

Feature	Federal	Non-Federal	Total
Dredging, 407,000 cu.yds. at 28¢ per cu.yd.	$ 114,000	$ -	$ 114,000
Aids to navigation:			
4 new lighted range markers at $2,575 each	10,300	-	10,300
22 new buoys at $240 each	5,300	-	5,300
Subtotal	$ 129,600	$ -	$ 129,600
Contingencies	19,400	-	19,400
Subtotal	$ 149,000	$ -	$ 149,000
Engineering and design	3,000	-	3,000
Subtotal	$ 152,000	$ -	$ 152,000
Supervision and administration	18,000	-	18,000
Total first cost	$ 170,000	$ -	$ 170,000
Preauthorization studies	1,000	-	1,000
Total cost	$ 171,000	$ -	$ 171,000

ANNUAL CHARGES

Interest	$ 4,500	$ -	$ 4,500
Amortization	1,700	-	1,700
Maintenance, aids to navigation	1,900	-	1,900
Replacement of aids to navigation	600	-	600
Total	$ 8,700	$ -	$ 8,700

14. Channel relocation at Port Isabel, Texas. The proposed improvement of the main channel near Port Isabel, Texas, provides for the relocation of the channel on the Laguna Madre side of the Cameron County Causeway. The existing 12- x 125-foot channel is located adjacent to the southern limits of the city of Port Isabel, thence at a point about 700 feet inland of the east shoreline the channel curves to the north for a distance of 4,647 feet on a radius of about 3,425 feet through a total angle of 79° 59' 00". Thence the channel extends northwestward on a tangent course near the middle of Laguna Madre. The curve has been widened to 275 feet throughout its length except for about 1,300 feet at its shoreward end. About 1,100 feet of the tangent channel adjoining the north end of the curve have also been widened to 275 feet. The ends of the widened channel taper to the 125-foot wide channel in a distance of about 600 feet.

a. The Cameron County Causeway extending between Port Isabel and Padre Island crosses the main channel by means of a swing pontoon highway bridge providing a horizontal clearance of 146.0 feet. The bridge is located at a tangent distance of about 117 feet from the south end of the channel curve. Timber fenders extend on both sides of the channel for a distance of 68 feet from the bridge towards the channel curve. A hydraulic fill to elevation 6 feet above mean low tide adjoins the bridge and extends eastward into Laguna Madre for a distance of one mile, thence the causeway consists of about one mile of trestle and 1,500 feet of fill which adjoins Padre Island. Construction of the causeway was completed in 1954. The flow of tides in the Laguna Madre causes adverse currents in the main channel at and eastward of the pontoon bridge. Several marine accidents have occurred at the bridge.

b. Shipping interests request that a greater length of tangent approach channel be provided on the Laguna Madre side of the pontoon bridge. The proposed channel relocation provides for a tangent channel extending eastward of the bridge for a distance of 1,500 feet. Thence the channel would extend on a curve of 5,730 feet radius through a left deflection angle of 110 degrees, thence on a 3,700-foot tangent and continue on a curve of 5,730 feet radius through a right deflection angle of 30 degrees to a junction with the existing channel at about mile 671.8 in Laguna Madre. The relocation would have a total length of 19,200 feet, about 0.6 mile longer than the existing route. The existing channel between the limits of the proposed relocation would be abandoned and not maintained. Construction of the channel would require about 1,084,000 cubic yards of excavation. The first cost of providing the channel relocation is estimated at $350,000, of which about $347,000 would be for dredging and $3,000 for aids to navigation, with annual charges estimated at about $15,000.

15. Lengths of channel to be excluded in the proposed plan of improvement. The lengths of sections to be left unimproved on the main channel from the Mississippi River to Brownsville, Texas, are given in table 1.

16. Excavation of main channel - proposed channel enlargements. The proposed channel improvements are enlargements of existing or authorized project channels. The existing channel was constructed and subsequently maintained by hydraulic pipeline dredges. The materials to be encountered in dredging the proposed enlargement, based on previous dredging borings and on borings in undredged channels, consist of silts, clays, sands, and shells of various thicknesses and mixtures. Between miles 580 and 595, there are exposures of thin layers of sandstone formations. Similar formations were encountered in dredging the existing channel and were removed by undercutting and without blasting. The materials to be excavated for the channel enlargements should offer no unusual difficulties. It is proposed to use spoil disposal areas located in close proximity to the dredging work.

a. The estimated quantities of dredging required for the several proposed channel enlargements are based on side slopes of 1 on 2 and 1 on 3 in land cuts and open bay areas, respectively, and include an allowance of 2 feet of overdepth dredging. Unit costs for dredging vary because of quantity of yardage to be removed, and also because of the more remote location of spoil disposal areas along some reaches of the waterway. The remote location of spoil areas has a marked influence on dredging costs in the reach from the Mississippi River to the Atchafalaya River.

b. Estimates of costs for annual maintenance dredging from the channel enlargements considered in this report were based on experienced shoaling rates of the existing channels of the waterway, and also considered the possible effects of future traffic on bank erosion. Estimated costs for maintenance dredging were based on use of modern suction steam turbine dredges with an average daily output of about 40,000 cubic yards of material for a 20-hour dredging day. Reductions in current maintenance costs attributable to the relocations of the 12- x 125-foot channel were considered in arriving at the additional maintenance necessary for the enlarged channel. The following amounts have been included for additional annual maintenance:

Reach of waterway	Amount included
Mississippi-Atchafalaya River	$ 8,000
Houma Bypass Channel	9,000
Algiers Alternate Canal	1,000
Atchafalaya-Sabine River	34,000
Sabine River-Houston Ship Channel	25,000

17. Rights-of-way and spoil disposal areas. a. It is proposed that local interests be required to furnish free of cost to the United States all additional rights-of-way and spoil disposal areas necessary for construction of the channel enlargements and subsequent maintenance of the enlarged channels. In addition, local interests would be required to bear the cost of removing or relocating buildings, drainage structures, fencing, cattle ramps, and utility lines that would be involved in the proposed channel enlargements.

b. The Governors of the States of Louisiana and Texas have offered to cooperate in the furnishing of items of local cooperation. However, in Louisiana two reaches exist on which it will be impossible to secure rights-of-way and spoil areas without resort to condemnation proceedings. These two reaches are the Algiers Alternate Canal and the main channel of the Gulf Intracoastal Waterway through Houma, La., between miles 55.0 and 61.0. Because of the attitude of local interests in regard to these reaches, it is not advisable to resort to condemnation proceedings in order to secure rights-of-way. The improvement of the Algiers Alternate Canal to provide a 16- x 150-foot channel can be accomplished with the rights-of-way and disposal areas that now are

available. The improvement of the reach between mile 55.0 and mile 61.0 is not important in view of the bypass route between mile 50.5 and mile 63.5. Even without a bypass channel, the unimproved reach will not be unduly restrictive.

c. Enlargement of the channel located in the coastal waters of Texas would not require acquisition of channel rights-of-way or spoil areas by local interests. These areas come within the purview of the Submerged Lands Act passed by the United States Congress and approved May 22, 1953. Under this law, the United States has the paramount right to use the submerged areas below mean high tide for the improvement of commerce without cost or requirement of deed or conveyance. It is proposed to continue the use of existing spoil disposal areas in the coastal waters. These areas, located in close proximity to the channel, afford the most economical location for disposal of material from the channel enlargements. Furthermore, it is proposed to deposit the spoil material on alternate sides of the channel as can be reasonably accomplished without increasing the cost of dredging.

d. A considerable acreage for spoil disposal is now under easement and available for use. Additional spoil areas would not be required for disposal of spoil extending into water areas. Additional spoil areas would be necessary in certain reaches of the waterway, and for those relocations involving land cuts. It is considered that no land enhancement would result from deposition of spoil materials in these areas.

e. Costs for additional dredging area and spoil disposal areas have been estimated on the prevailing market value of land in the areas involved. The costs are considered to be the actual value of the land.

18. Relocation of aids to navigation. The Commander, 8th Coast Guard District, New Orleans, La., furnished estimates of the number, type, and cost of relocating and establishing aids to navigation to properly mark the main channel of the Intracoastal Waterway. In connection with relocation and establishment of aids to navigation between the Sabine River and Port Isabel, the Commander advised as follows:

> "It should be noted that these estimates are of necessity very rough and include the moving of all lights which would be affected if the widening was done on both sides of the waterway. Some reduction in cost would be effected by planning the dredging on the proper side of the waterway. Accurate estimates could only be made up after the dredging was actually planned and definite routes selected, particularly in the Corpus Christi area."

The detailed estimates of first cost for the several plans of channel enlargement provide for small differences in the number of aids to navigation proposed by the Commander.

19. Relocation of utility crossings. The pipelines and cables which will require lowering for enlargement of the Intracoastal Waterway are shown in table 2.

20. Summary of estimated first costs and annual charges. The first costs and annual charges for improvement of the Gulf Intracoastal Waterway from the Mississippi River to Brownsville, Texas, to dimensions of 14 x 150, 16 x 150, 16 x 200, 16 x 250, and 16 x 300 feet are given in tables 3 and 4. These estimates do not include the main channel from Harvey Lock to mile 5.0, the Algiers Canal, and the section through Houma, La., mile 55.0 to mile 61.0. The data shown in tables 3 and 4 were used in determining the preferred plan of improvement.

21. Estimates of costs and annual charges for Houma Bypass. The city of Houma, La., requested that the Intracoastal Waterway be relocated so as to relieve the congestion to highway traffic caused by the frequent opening of the bridges crossing the waterway. The present location of the waterway passes through a major portion of Houma and seriously hinders and delays business in the area to the south of the Intracoastal Waterway.

a. Local interests requested that the waterway be relocated far enough to the south to avoid the crossing of any of the existing highways in the area, and if that were not possible they would like the relocation as far to the south as possible. Relocation of the waterway so as to avoid highways has the disadvantage of increasing the length of the waterway and increases the dredging cost to a point where economic justification of the route is not possible. These bypass routes are discussed in paragraphs 9 a. and 9 b., appendix B.

b. The relocation which presents the greatest economic gain is that between mile 50.5 and mile 63.5. This route reduces the length of the waterway by about 3.5 miles and is capable of accomplishment with a minimum amount of dredging. As this route traverses agricultural land for some distance, the unrestricted spread of spoil from hydraulic dredging is not possible. It is necessary to use dragline methods for the control of spoil through the agricultural section.

c. The estimate of benefits to accrue from the improvement of the main channel of the Gulf Intracoastal Waterway indicates that the plan of improvement which would present a favorable benefit-to-cost ratio would be the plan providing a channel 16 feet deep over a 150-foot bottom width. Accordingly, the estimate of providing a bypass around the city of Houma, La., was based on providing a channel 16 x 150 feet.

d. In estimating the benefits to accrue to highway traffic because of the relocation of the waterway, it was necessary to consider

movable and high level bridges. Estimates of first cost and annual charges based on the two types of bridges for the bypass route are given in tables 5 and 6.

e. The bypass channel joins the Intracoastal Waterway at mile 50.5 and at mile 63.5. The first cost and annual charges of improving the existing Intracoastal Waterway from mile 5.0 to mile 50.5 and from mile 63.5 to mile 95.5 are shown in table 7.

22. Estimates of costs and annual charges for improvement of Gulf Intracoastal Waterway - Mississippi River to Atchafalaya River via existing route. The estimates of cost for improvement of the Gulf Intracoastal Waterway - Mississippi River to Atchafalaya River via the existing route through Houma, La., are given in table 8.

23. Main channel. The detailed estimates of first costs and annual charges for improving the Gulf Intracoastal Waterway from the Mississippi River to Brownsville, Texas, including the bypass at Houma, La., are given in the following tables:

Mississippi River to Atchafalaya River

Mississippi River to Atchafalaya River, via but not including, the Houma Bypass Channel - 16 x 150 feet	Table 7
Houma Bypass Channel - 16 x 150 feet	Table 6

Atchafalaya River to Sabine River

16 x 150 feet	Table 9
16 x 200 feet	Table 10

Sabine River to Houston Ship Channel - 16 x 150 feet	Table 14
Houston Ship Channel to Port Aransas-Corpus Christi Waterway - 14 x 150 feet	Table 12
Port Aransas-Corpus Christi Waterway to Brownsville, Texas - 14 x 150 feet	Table 13

24. Algiers Alternate Canal. The Algiers Alternate Route provides an additional connection with the Mississippi River just below the city of New Orleans. The estimates of first cost and annual charges for the enlargement of this connection to 16 x 150 feet are given in table 15.

25. Plaquemine-Morgan City route (as modified). The Plaquemine-Morgan City route, the modification of which has been authorized to provide for its extension to Port Allen with a lock connection, is an

additional section of the Gulf Intracoastal Waterway in Louisiana. Construction of the modification of the Plaquemine-Morgan City route has been commenced. Detailed estimates of first cost and annual charges for improving this waterway to 14 x 150 feet are given in table 16.

TABLE 1

SUMMARY OF NET LENGTHS OF CHANNEL
TO BE EXCLUDED IN THE PROPOSED PLANS OF IMPROVEMENT

Miles west of Harvey Lock	Net lengths of channel to be excluded from plans (miles)	Reason for not making improvement
	Mississippi River to Atchafalaya River	
0.0 - 5.0	5.0	Congested area. Tows and vessels must proceed at reduced speed to avoid damage to moored craft and structures. Right-of-way and spoil area would not be available in this reach.
12.5	.38	La. Hwy. 45 bridge.
35.0	.47	La. Hwy. 308 bridge.
35.6	.47	La. Hwy. 1 bridge.
55.0 - 61.0	6.00	Houma, La. Congested area and tows and vessels must proceed at reduced speed to avoid damage to moored craft and structures. Right-of-way in this reach will not be provided by local interests.
93.5	.63	Bayou Boeuf Lock
Total	12.95	
	Atchafalaya River to Sabine River	
95.5 - 98.2	2.70	Atchafalaya River. Natural channel has widths and depths in excess of those being considered.
113.7	.38	La. Hwy. 60 bridge.
133.7	.38	La. Hwy. 83 bridge.
162.7	.63	Vermilion Lock
169.6	.38	La. Hwy. 35 bridge.
238.9	.63	Calcasieu Lock
239.2 - 241.2	2.00	Calcasieu River. Natural channel has widths and depths in excess of those being considered.
241.2 - 266.1	24.80	Lake Charles Deep Water Channel. While this reach is not presently maintained to its authorized 30-x 125-foot dimensions, existing depths and widths are comparable to, or exceed, those being considered.
Total	31.90	

TABLE 1 (cont'd)

Miles west of Harvey Lock	Net lengths of channel to be excluded from plans (miles)	Reason for not making improvement
	Sabine River to Houston Ship Channel	
266.1 - 288.4	22.3	Sabine-Neches Waterway. Widths and depths now available are in excess of those being considered.
288.6	.47	Tex. Hwy. 87 bridge
316.4 - 319.1	.27	Channel relocation(1)
319.1	.62	GC&SF RR bridge and Tex.Hwy.124 bridge
320.1 - 325.4	.67	Channel relocation(2)
350.1	.87	Houston Ship Channel. Widths and depths now available are in excess of those being considered.
Total	25.20	
	Houston Ship Channel to Port Aransas-Corpus Christi Waterway	
350.6	.10	Texas City Channel. Widths and depths now available are in excess of those being considered.
357.2	.68	Santa Fe RR bridge and 2 Texas Hwy. 75 bridges
393.6	.08(3)	Surfside Hwy. bridge.
394.9	.10	Freeport Harbor Channel. Widths and depths now available are in excess of those being considered.
397.0	.16	Quintana Hwy. bridge
400.6	3.94	Brazos River Floodgates
417.9	.08	Caney Creek Hwy. bridge
440.6	.08	Matagorda Hwy. bridge
441.3	1.41	Colorado River Locks
454.3 - 471.3	.04	Channel relocation(2)
532.9	.08	Nueces County Causeway
Total	6.75	
	Port Aransas-Corpus Christi Waterway to Brownsville, Texas	
539.4 - 550.0	2.06	Channel relocation(2)
554.6	.08	Tex. Hwy. 358 bridge
664.9 - 667.8	+0.60	Channel relocation(1)
667.8	.08	Cameron County Hwy. bridge
669.0 - 683.8	14.80	Brazos Island Harbor Channels and basins. Widths and depths now available are in excess of those being considered.
Total	16.42	

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TABLE 1 (cont'd)

Miles west of Harvey Lock	Net lengths of channel to be excluded from plans (miles)	Reasons for not making improvement
	Algiers Canal	
Algiers Canal	.38	Railroad bridge
Algiers Canal	.38	Highway bridge
	Plaquemine-Morgan City Route (as modified)	
36.0	0.57	Bayou Sorrel Lock
46.0	0.38	La. Hwy. 77 bridge
56.0	0.38	T&P RR bridge
64.2	0.81	La. Hwy. 1 bridge and T&P RR bridge and Port Allen Lock
Total	2.14	

(1) Net increase in length of channel involved in the relocation.
(2) Net decrease in length of channel involved in the relocation.
(3) Exclude this reach in plans for deepening only.
(4) With the Houma Bypass, main channel improvement between miles 50.5 - 63.5 would be eliminated. The bypass would provide a 3.5-mile decrease in length of waterway.

TABLE 2

PIPELINE AND SUBMARINE CABLE CROSSINGS TO BE LOWERED

Miles west of Harvey Lock	No. and type of crossing	Owner
	LOUISIANA SECTION	
	East of Atchafalaya River	
9.5	1 - 6" pipeline	Southern Natural Gas Co.
10.15	1 - 12-3/4" pipeline	"
12.1	1 - 20" "	Shell Pipe Line Corp.
12.3	1 - 6" and 1-8" pipeline	Texas Pipe Line Co.
12.5	1 - 3" and 1-8" "	Jefferson Ph. Police Jury
14.6	1 - 6" pipeline	Texas Pipe Line Co.
15.0	1 - 3" "	Bateman Drilling Co.
15.6	1 - 4" "	Southern Natural Gas Co.
21.0	1 - 20" "	United Gas Pipe Line Co.
21.9	2 - 8" "	The Texas Co.
32.1	1 - 4" "	Humble Oil & Refin. Co.
34.05	1 - 12" "	Interstate Oil Pipe Line Co.
34.9	1 - 6" "	Standard Oil Co. of La.
35.2	1 - 14" "	Lafourche Ph.Waterworks Dist.
35.3	1 - 12" "	"
35.35	2 - 4" "	South Coast Gas Co., Inc.
37.0	2 - 14" "	The Texas Co.
46.4	1 - 12" "	Gulf Interstate Gas Co.
48.6	1 - 2½" and 1-3½" pipeline	Texas Gulf Producing Co.
	2 - 3½" pipelines	"
	1 - 6" and 1 - 2" pipeline	Fohs Oil Co.
48.7	1 - 12" pipeline	United Gas Pipe Line Co.
49.5	1 - 20" "	Gulf Interstate Gas Co.
49.6	1 - 12" and 1-30" pipeline	United Gas Pipe Line Co.
49.9	1 - 6" pipeline	Terrebonne Ph. Waterworks Dist. #1
50.1	2 - 12" pipelines	The Texas Pipe Line Co.
50.3	4 - 2" pipeline	Union Producing Co.
50.5	1 - 2" "	"
51.0	1 - 12" "	United Gas Pipe Line Co.
51.2	2 - 4", 5 - 2", and 1 - 3" pipelines	Cities Service Develop. Co.
51.9	1 - 6" pipeline	Gulf Interstate Gas Co.
54.2	1 - 3½" "	U. S. Naval Air Station
54.6	1 - 4" "	Gulf Natural Gas Corp.
54.7	1 - 4" "	"
54.8	1 - 6" "	United Gas Pipe Line Co.
63.9	1 - 20" "	"

TABLE 2 (cont'd)

Miles west of Harvey Lock	No. and type of crossing	Owner
66.2	1 - 8" pipeline	United Gas Pipe Line Co.
68.1	2 - 2" pipelines	Union Oil Co. of Calif.
68.9	1 - 4" pipeline	"
73.0	1 - 20" pipeline	Transcontinental Pipe Line Co.
75.7	1 - 4" "	Union Oil Co.
80.1	1 - 20" "	United Gas Pipe Line Co.
84.9	1 - 8" "	Tennessee Gas Trans. Co.
86.6	1 - 20" "	Gulf Interstate Gas Co.
89.5	1 - 22" "	Texas Pipe Line Co.
89.5	1 - 8" "	"
90.6	1 - 20" "	Texas Gas Trans. Corp.
92.1	1 - 6" "	Central La. Elect. Co.
94.3	1 - 2" "	Avoca Duck Club
	West of Atchafalaya River	
96.2	1 - 8" pipeline	The Texas Co.
96.3	1 - 22" "	The Texas Pipe Line Co.
96.45	2 - 16" pipelines	Gulf Interstate Gas Co.
96.5	2 - 16" "	Texas Gas Trans. Corp.
98.4	1 - 2½" and 1-8" pipeline	Texas Pipe Line Co.
98.7	1 - 2" pipeline	The Texas Co.
	4 - 5" "	City of Morgan City
	1 - 3" and 2-2½" pipelines	The Texas Co.
	1 - 8" pipeline	Texas Pipe Line Co.
98.8	2 - 4" pipelines	Town of Berwick
98.9	1 - 16" pipeline	Olin Gas Trans. Corp.
99.1	1 - 6" "	Central La. Elec. Co.,Inc.
99.7	1 - 8" pipeline	The Texas Co.
104.8	1 - 24" "	Tennessee Gas Trans. Co.
111.3	1 - 12-3/4" pipeline	Southern Natural Gas Co.
112.8	1 - 26" pipeline	United Gas Pipe Line Co.
112.9	1 - 12" "	Gulf Interstate Gas Co.
112.95	1 - 12" "	Tennessee Gas Trans. Co.
113.1	1 - 4" and 1-6" pipeline	Standard Oil Co. of La.
	2 - 4" pipelines	Interstate Oil Pipe Line Co.
113.2	1 - 8" "	The Texas Co.
129.7	3 - 4" "	Shell Oil Co.
131.2	2 - 4" "	United Carbon Co.
134.0	2 - 3" "	Shell Oil Co.
135.9	1 - 4" pipeline	The Texas Co.
136.5	1 - 2" "	Shell Oil Co.
137.05	3 - 4" pipelines	Humble Oil & Refining Co.
137.4	2 - 2½" and 1-4" pipeline	"

TABLE 2 (cont'd)

Miles west of Harvey Lock	No. and type of crossing	Owner
137.6	3 - 4" pipelines	Humble Oil & Refining Co.
	2 - 4" "	Interstate Oil Pipe Line Co.
137.7	2 - 4" "	Shell Oil Co.
137.8	1 - 3" and 2-4" pipelines	"
	4 - 2½" pipelines	Humble Oil & Refining Co.
138.0	1 - 6" pipeline	Shell Oil Co.
	2 - 4" pipelines	"
138.7	2 - 3" "	"
139.3	2 - 3" "	"
147.9	1 - 12" pipeline	Tennessee Gas Trans. Co.
	2 - 2½" pipelines	Union Oil Co. of Calif.
149.2	1 - 10" pipeline	Texas Pipe Line Co.
158.5	2 - 6" and 1-4" pipelines	Houston Oil Co.
159.6	2 - 8-5/8" pipelines	Monterey Oil Co.
165.0	1 - 14" pipeline	Humble Oil & Refining Co.
170.4	1 - 16" "	Transcontinental Gas Pipe Line Corp.
	1 - 12" "	"
173.1	1 - 12" "	"
193.0	1 - 20" "	Tennessee Gas Trans. Co.
193.3	1 - 16" "	Gulf Interstate Gas Co.
198.5	1 - 6" "	La. Natural Gas Co.
200.4	1 - 12-3/4" and 5-3½" pipelines	Superior Oil Co.
201.1	1 - 24" pipeline	"
204.0	1 - 12" "	Trunkline Gas Co.
204.1	1 - 16" "	America La. Pipe Line Co.
212.8	1 - 26" "	Tennessee Gas Trans. Co.
217.8	1 - 20" "	United Gas Pipe Line Co.
219.5	1 - 12" "	Tennessee Gas Trans. Co.
225.7	1 - 12" "	Gulf Interstate Gas Co.
231.3	1 - 6" and 2-3" pipelines	Pelican Crude, Inc.
233.4	2 - 4" pipelines	Stanolind Oil & Gas Co.
234.1	2 - 4" "	Pan American Petroleum Co.
	East of Atchafalaya River	
12.5	1 - Submarine cable	Southern Bell Tel. & Tel. Co.
12.6	3 - "	"
14.4	1 - "	"
35.40	1 - "	"
35.45	1 - "	"
35.50	1 - "	Lafourche Telephone Co.
35.7	1 - "	"
48.6	1 - "	"
49.8	1 - "	Southern Bell Tel. & Tel. Co.
93.5	1 - "	"

TABLE 2 (cont'd)

Miles west of Harvey Lock	No. and type of crossing	Owner
	West of Atchafalaya River	
98.1	1 - Submarine cable	Southern Bell Tel. & Tel. Co.
98.7	1 - "	"
113.2	1 - "	"
	1 - "	"
133.9	1 - "	State of La., Dept. of Hwys.
169.7	1 - "	S.W.La.Electric Member Corp.
169.8	1 - "	Southern Bell Tel. & Tel. Co.
219.8	1 - "	Jeff.Davis Elec.Cooperative,Inc.
231.4	1 - "	Southern Bell Tel. & Tel. Co.
	Plaquemine-Morgan City Route (as modified)	
Miles above Morgan City	No. and type of crossing	Owner
0.7	1 - 4" pipeline	Unknown
14.3	1 - 30" "	United Gas Pipe Line Co.
18.6	1 - 16" "	Interstate National Gas Co.,Inc.
19.0	1 - 8-5/8" pipeline	Olin Gas Trans. Corp.
20.5	1 - 16" and 1-20" pipeline	Southern Natural Gas Co.
23.0	1 - 6" pipeline	Coastal Transmission Corp.
38.7	1 - 2" "	Police Jury, Iberville Ph.
39.5	1 - 6" "	Interstate Oil Co.
40.2	4 - 2½" "	Union Producing Co.
43.0	1 - 8" "	Unknown
45.95	1 - 2" "	Unknown
55.2	1 - 14" "	Coastal Transmission Corp.
61.0	1 - 16" "	Olin Gas Transmission Corp.
61.2	1 - 10" and 1-4" pipeline	Interstate Oil Pipe Line Co.
63.85	1 - 12" pipeline	Solvay Process
64.01	1 - 16" "	"
0.3	2 - Submarine cables	Southern Bell Tel. & Tel. Co.
0.5	3 - "	"
2.9	1 - "	"
14.4	1 - "	Shell Oil Co.
37.0	1 - "	Unknown
38.8	1 - "	Southern Bell Tel. & Tel. Co.
39.0	1 - "	"
39.8	1 - "	Interstate Oil Co.
44.0	1 - "	Pointe Coupee Elec. Membership Corp.
45.95	1 - "	Southern Bell Tel. & Tel. Co.
56.0	2 - "	"
63.8	1 - "	Western Union Tel. & Tel. Co.
64.02	1 - "	Southern Bell Tel. & Tel. Co.

TABLE 2 (cont'd)

Miles west of Harvey Lock	No. and type of crossing	Owner
	Algiers Alternate Route	
No pipelines or submarine cables to be lowered.		
	TEXAS SECTION	
430.0	1 - 8" pipeline	Coastal Transmission Corp.
473.2	1 - Submarine cable	U. S. Air Force
476.8	1 - 3" pipeline	Houston Natural Gas Corp.
478.4	1 - 4" "	Dow Chemical Co.
487.0	1 - 8" "	Lavaca Pipe Line Co.
533.8	1 - 6" "	Tennessee Gas Trans. Co.
534.8	1 - 8" "	Nueces County Water Control & Improvement Dist. #4
534.9	1 - 2" "	Phillips Petroleum Co.
536.5	1 - 16" "	Sunray Oil Co.
	1 - 16" "	United Gas Pipe Line Co.
539.0	1 - 12" "	Tennessee Gas Trans. Co.

TABLE 3

SUMMARY OF ESTIMATES OF FIRST COSTS FOR IMPROVEMENT
OF THE GULF INTRACOASTAL WATERWAY, MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS

Section of waterway	Size of channel improvement (feet)				
	14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
	$	$	$	$	$
Mississippi River to Atchafalaya River(1)	4,290,000	6,260,000	10,750,000	16,490,000	22,240,000
Atchafalaya River to Sabine River	7,260,000	9,930,000	15,730,000	24,030,000	32,730,000
Sabine River to Houston Ship Channel(2)	3,912,000	5,442,000	9,273,000	12,770,000	15,474,000
Houston Ship Channel to Port Aransas-Corpus Christi Waterway(3)	12,123,000	16,237,000	24,253,000	31,267,000	39,735,000
Port Aransas-Corpus Christi Waterway to Brownsville, Texas(4)	10,419,000	13,602,000	19,919,000	25,276,000	30,189,000

(1) Excludes improvement of the main channel from Harvey Lock to mile 5.0, the Algiers Canal and the section through Houma, Louisiana, mile 55.0 to mile 61.0.
(2) Includes the cost of relocating two sections of the existing 12-x 125-foot channel near Mud Bayou Bridge.
(3) Includes the cost of relocating one section of the existing 12-x 125-foot channel in Matagorda Bay.
(4) Includes the cost of relocating one section of the existing 12-x 125-foot channel in Corpus Christi Bay, and in Laguna Madre near Port Isabel.

NOTE: These estimates of first cost are based on December 1960 prices.

TABLE 4

SUMMARY OF ESTIMATES OF ANNUAL CHARGES FOR IMPROVEMENT
OF THE GULF INTRACOASTAL WATERWAY - MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS

Section of waterway	Size of improvement (feet)				
	14 x 150	16 x 150	16 x 200	16 x 250	16 x 300
	$	$	$	$	$
Mississippi River to Atchafalaya River(1)	187,000	258,000	431,000	647,000	897,000
Atchafalaya River to Sabine River	308,000	404,000	632,000	950,000	1,350,000
Sabine River to Houston Ship Channel(2)	169,000	225,000	385,000	535,000	656,000
Houston Ship Channel to Port Aransas-Corpus Christi Waterway(3)	645,000	802,000	1,259,000	1,860,000	2,496,000
Port Aransas-Corpus Christi Waterway to Brownsville, Texas(4)	471,000	587,000	950,000	1,293,000	1,621,000

For footnotes, see Table 3.

TABLE 5

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
FOR 16-x 150-FOOT HOUMA BYPASS CHANNEL WITH HIGH LEVEL BRIDGES
(Between miles 50.5 and 63.5)

Item of cost	Quantity	Unit cost	FIRST COSTS Federal	Non-Federal	Total
Channel excavation:					
Dragline dredge	5,325,000 cu.yds.	18¢/cu.yd.	$ 958,500	$ -	$ 958,500
Rights-of-way:					
Dredging	573 acres	job	-	145,350	145,350
Spoil areas	1,888 acres	job	-	94,400	94,400
Clearing for channel	185 acres	$250/acre	46,250	-	46,250
Severance	job	job	-	20,000	20,000
Relocations:					
Lower pipelines	7	$20,000/each	-	140,000	140,000
Lower submarine cables	3	10,000/each	-	30,000	30,000
Install aerial crossings	3	50,000/each	-	150,000	150,000
Fixed high-level bridges:					
State Highway 24	1	job	-	2,466,000	2,466,000
State Highway 57	1	job	-	2,466,000	2,466,000
Movable low-level bridges:					
State Highway 315	1	job	-	730,000	730,000
Bayou Terrebonne	1	job	-	228,000	228,000
Subtotal			$1,004,750	$6,469,750	$7,474,500

TABLE 5 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Brought forward			$1,004,750	$6,469,750	$7,474,500
Contingencies:					
Federal			156,250	-	156,250
Non-Federal:					
Right-of-way and spoil area, 10%			-	29,000	29,000
Bridges and relocations, 15%			-	934,250	934,250
Subtotal			$1,161,000	$7,433,000	$8,594,000
Engineering and design			23,000	148,000	171,000
Subtotal			$1,184,000	$7,581,000	$8,765,000
Supervision and administration			94,000	606,000	700,000
Real estate acquisition costs			2,000	3,000	5,000
TOTAL FIRST COST			$1,280,000	$8,190,000	$9,470,000
Preauthorization studies			5,300	-	5,300
TOTAL COST			$1,285,300	$8,190,000	$9,475,300

TABLE 5 (cont'd)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest:			
Federal, 2-5/8%	$ 33,000	$ -	$ 33,000
Non-Federal, 4%	-	328,000	328,000
Amortization:			
Federal	13,000	-	13,000
Non-Federal	-	53,000	53,000
Maintenance:			
Dredging	9,000	-	9,000
Bridges:			
State Highways 24 and 57	-	17,000	17,000
State Highway 315	-	9,000	9,000
Bayou Terrebonne	-	4,000	4,000
Operation of bridges:			
State Highway 315	-	9,000	9,000
Bayou Terrebonne	-	8,000	8,000
TOTAL	$ 55,000	$ 428,000	$ 483,000

This estimate is based on December 1960 prices.

TABLE 6

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES
FOR 16-x 150-FOOT HOUMA BYPASS CHANNEL WITH SWING BRIDGES
(Between miles 50.5 and 63.5)

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Dragline dredge	5,325,000 cu.yds.	18¢/cu.yd.	$ 958,500	$ -	$ 958,500
Rights-of-way:					
Dredging	573 acres	job	-	145,350	145,350
Spoil areas	1,888 acres	job	-	94,400	94,400
Clearing for channel	185 acres	$250/acre	46,250	-	46,250
Severance	job	job	-	20,000	20,000
Relocations:					
Lower pipelines	7	$20,000/each	-	140,000	140,000
Lower submarine cables	3	10,000/each	-	30,000	30,000
Install aerial crossings	3	50,000/each	-	150,000	150,000
Movable, low-level bridges:					
State Highway 24	1	job	-	730,000	730,000
State Highway 57	1	job	-	730,000	730,000
State Highway 315	1	job	-	730,000	730,000
Bayou Terrebonne	1	job	-	228,000	228,000
Subtotal			$1,004,750	$2,997,750	$4,002,500

TABLE 6 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Federal	Non-Federal	Total
Brought forward	$1,004,750	$2,997,750	$4,002,500
Contingencies:			
Federal, 15%	156,250	-	156,250
Non-Federal:			
Right-of-way and spoil area, 10%	-	29,000	29,000
Bridges and relocations, 15%	-	411,250	411,250
Subtotal	$1,161,000	$3,438,000	$4,599,000
Engineering and design	23,000	69,000	92,000
Subtotal	$1,184,000	$3,507,000	$4,691,000
Supervision and administration	94,000	280,000	374,000
Real estate acquisition costs	2,000	3,000	5,000
Subtotal	$1,280,000	$3,790,000	$5,070,000
Federal contribution to bridges	1,780,000	-1,780,000	-
TOTAL FIRST COST	$3,060,000	$2,010,000	$5,070,000
Preauthorization studies	5,300	-	5,300
TOTAL COST	$3,065,300	$2,010,000	$5,075,300

TABLE 6 (cont'd)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest:			
Federal, 2-5/8%	$ 80,000	$ -	$ 80,000
Non-Federal, 4%	-	80,000	80,000
Amortization:			
Federal	30,000	-	30,000
Non-Federal	-	13,000	13,000
Maintenance:			
Dredging	9,000	-	9,000
Bridges:			
State Highways 24,57, and 315	-	27,000	27,000
Bayou Terrebonne	-	4,000	4,000
Operation of bridges:			
State Highways 24, 57, and 315	-	27,000	27,000
Bayou Terrebonne	-	8,000	8,000
TOTAL	$ 119,000	$ 159,000	$ 278,000

This estimate is based on December 1960 prices.

TABLE 7

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING THE
GULF INTRACOASTAL WATERWAY - MISSISSIPPI RIVER TO ATCHAFALAYA RIVER -
TO PROVIDE A 16- x 150-FOOT CHANNEL BETWEEN MILE 5.0 TO MILE 50.5 AND BETWEEN MILE 63.5 TO MILE 95.5

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Hydraulic dredge	9,115,000 cu.yds.	30¢/cu.yd.	$2,734,500	$ -	$2,734,500
Rights-of-way:					
Dredging	2,360 acres	job	-	220,000	220,000
Spoil areas	16,184 acres	job	-	245,500	245,500
Severance	job	job	-	21,000	21,000
Improvements	job	job	-	133,500	133,500
Relocations:					
Lower pipelines	42	$20,000/each	-	840,000	840,000
Lower submarine cables	10	10,000/each	-	100,000	100,000
Subtotal			$2,734,500	$1,560,000	$4,294,500
Contingencies:					
Federal, 15%±			415,500	-	415,500
Non-Federal:					
Relocations, 15%±			-	140,000	140,000
Rights-of-way and spoil areas, 10%±			-	60,000	60,000
Subtotal			$3,150,000	$1,760,000	$4,910,000

TABLE 7 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Brought forward			$3,150,000	$1,760,000	$4,910,000
Engineering and design			61,000	37,000	98,000
Subtotal			$3,211,000	$1,797,000	$5,008,000
Supervision and administration			256,000	145,000	401,000
Real estate acquisition costs			33,000	48,000	81,000
Subtotal			$3,500,000	$1,990,000	$5,490,000
Navigation aids			10,000	-	10,000
TOTAL FIRST COST			$3,510,000	$1,990,000	$5,500,000
Preauthorization studies			15,000	-	15,000
TOTAL COST			$3,525,000	$1,990,000	$5,515,000
		ANNUAL CHARGES			
Interest:					
Federal, 2-5/8%			$ 93,000	$ -	$ 93,000
Non-Federal, 4%			-	80,000	80,000
Amortization:					
Federal			35,000	-	35,000
Non-Federal			-	13,000	13,000
Maintenance dredging			8,000	-	8,000
TOTAL			$ 136,000	$ 93,000	$ 229,000

This estimate is based on December 1960 prices.

TABLE 8

ESTIMATES OF FIRST COST AND ANNUAL CHARGES FOR IMPROVING
THE GULF INTRACOASTAL WATERWAY - MISSISSIPPI RIVER TO ATCHAFALAYA RIVER SECTION,
BETWEEN MILES 5.0 TO 55.0 AND MILES 61.0 TO 95.5 - 16-x 150-FOOT CHANNEL

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Hydraulic dredge	10,370,000 cu.yds.	30¢/cu.yd.	$3,111,000	$ -	$3,111,000
Rights-of-way:					
Dredging	2,641 acres	job	-	241,240	241,240
Spoil area	17,757 acres	job	-	281,540	281,540
Severance	job	job	-	21,000	21,000
Improvements	job	job	-	133,500	133,500
Relocations:					
Lower pipelines	49	$20,000/each	-	980,000	980,000
Lower submarine cables	10	$10,000/each	-	100,000	100,000
Subtotal			$3,111,000	$1,757,280	$4,868,280
Contingencies:					
Federal, 15%			467,000	-	467,000
Non-Federal:					
Relocations, 15%			-	164,000	164,000
Rights-of-way and spoil area, 10%			-	69,720	69,720
Subtotal			$3,578,000	$1,991,000	$5,569,000

TABLE 8 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Brought forward			$3,578,000	$1,991,000	$5,569,000
Engineering and design			72,000	40,000	112,000
Subtotal			$3,650,000	$2,031,000	$5,681,000
Supervision and administration			290,000	162,000	452,000
Real estate acquisition costs			40,000	57,000	97,000
Subtotal			$3,980,000	$2,250,000	$6,230,000
Navigation aids			10,000	-	10,000
TOTAL FIRST COST			$3,990,000	$2,250,000	$6,240,000
Preauthorization studies			20,300	-	20,300
TOTAL COST			$4,010,300	$2,250,000	$6,260,300
		ANNUAL CHARGES			
Interest			$ 105,000	$ 90,000	$ 195,000
Amortization			39,000	15,000	54,000
Maintenance dredging			9,000	-	9,000
TOTAL			$ 153,000	$ 105,000	$ 258,000

This estimate is based on December 1960 prices.

TABLE 9

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING
THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 16- x 150-FOOT CHANNEL
FOR THE ATCHAFALAYA RIVER TO SABINE RIVER SECTION, BETWEEN MILES 95.5 AND 266.0

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Hydraulic dredge	22,330,000 cu.yds.	25¢/cu.yd.	$5,582,500	$ -	$5,582,500
Rights-of-way:					
Dredging	5,278 acres	job	-	284,065	284,065
Spoil area	33,127 acres	job	-	358,645	358,645
Severance	job	job	-	25,000	25,000
Improvements	job	job	-	159,500	159,500
Relocations:					
Lower pipelines	60	$20,000/each	-	1,200,000	1,200,000
Lower submarine cables	9	$10,000/each	-	90,000	90,000
Subtotal			$5,582,500	$2,117,210	$7,699,710
Contingencies:					
Federal, 15%			835,500	-	835,500
Non-Federal:					
Relocations, 15%			-	194,000	194,000
Rights-of-way and spoil area, 10%			-	85,790	85,790
Subtotal			$6,418,000	$2,397,000	$8,815,000

TABLE 9 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Brought forward			$6,418,000	$2,397,000	$8,815,000
Engineering and design			128,000	48,000	176,000
Subtotal			$6,546,000	$2,425,000	$8,991,000
Supervision and administration			524,000	195,000	719,000
Real estate acquisition costs			70,000	100,000	170,000
Subtotal			$7,140,000	$2,740,000	$9,880,000
Navigation aids			20,000	-	20,000
TOTAL FIRST COST			$7,160,000	$2,740,000	$9,900,000
Preauthorization studies			30,000	-	30,000
TOTAL COST			$7,190,000	$2,740,000	$9,930,000
		ANNUAL CHARGES			
Interest			$ 189,000	$ 109,000	$ 298,000
Amortization			71,000	18,000	89,000
Maintenance dredging			17,000	-	17,000
TOTAL			$ 277,000	$ 127,000	$ 404,000

This estimate is based on December 1960 prices.

TABLE 10

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING
THE GULF INTRACOASTAL WATERWAY - ATCHAFALAYA RIVER TO SABINE RIVER -
TO PROVIDE A 16- x 200-FOOT CHANNEL BETWEEN MILES 95.5 AND 266.0

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Hydraulic dredge	40,210,000 cu.yds.	25¢/cu.yd.	$10,052,500	$ -	$10,052,500
Rights-of-way:					
Dredging	6,994 acres	job	-	375,555	375,555
Spoil area	35,151 acres	job	-	380,725	380,725
Severance	job	job	-	26,000	26,000
Improvements	job	job	-	159,500	159,500
Relocations:					
Lower pipelines	60	$20,000/each	-	1,200,000	1,200,000
Lower submarine cables	9	$10,000/each	-	90,000	90,000
Subtotal			$10,052,500	$ 2,231,780	$12,284,280
Contingencies:					
Federal, 15%			1,507,500	-	1,507,500
Non-Federal:					
Relocations, 15%			-	194,000	194,000
Rights-of-way and spoil area, 10%			-	94,220	94,220
Subtotal			$11,560,000	$ 2,520,000	$14,080,000

TABLE 10 (cont'd)

FIRST COSTS (cont'd)

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Brought forward			$11,560,000	$ 2,520,000	$14,080,000
Engineering and design			230,000	50,000	280,000
Subtotal			$11,790,000	$ 2,570,000	$14,360,000
Supervision and administration			940,000	210,000	1,150,000
Real estate acquisition costs			70,000	100,000	170,000
Subtotal			$12,800,000	$ 2,880,000	$15,680,000
Navigation aids			20,000	-	20,000
TOTAL FIRST COST			$12,820,000	$ 2,880,000	$15,700,000
Preauthorization studies			30,000	-	30,000
TOTAL COST			$12,850,000	$ 2,880,000	$15,730,000
		ANNUAL CHARGES			
Interest			$ 337,000	$ 115,000	$ 452,000
Amortization			127,000	19,000	146,000
Maintenance dredging			34,000	-	34,000
TOTAL			$ 498,000	$ 134,000	$ 632,000

This estimate is based on December 1960 prices.

TABLE 11

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 14-x150-FOOT CHANNEL FOR THE SECTION FROM THE SABINE RIVER TO THE HOUSTON SHIP CHANNEL

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation	12,761,000cu.yds.	22¢/cu.yd.	$ 2,807,000	$ -	$ 2,807,000
Rights-of-way:					
Dredging	1,316 acres	$85/acre	-	112,000	112,000
Spoil area	1,403 acres	$60/acre	-	84,000	84,000
Severance	job	job	-	56,000	56,000
Subtotal			$ 2,807,000	$ 252,000	$ 3,059,000
Contingencies			423,000	39,000	462,000
Subtotal			$ 3,230,000	$ 291,000	$ 3,521,000
Engineering and design			70,000	6,000	76,000
Subtotal			$ 3,300,000	$ 297,000	$ 3,597,000
Supervision and administration			260,000	23,000	283,000
Subtotal			$ 3,560,000	$ 320,000	$ 3,880,000
Aids to navigation			20,000	-	20,000
TOTAL FIRST COST			$ 3,580,000	$ 320,000	$ 3,900,000
Preauthorization studies			12,000	-	12,000
TOTAL COST			$ 3,592,000	$ 320,000	$ 3,912,000

TABLE 11 (cont'd)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 94,000	$ 13,000	$ 107,000
Amortization	35,000	2,000	37,000
Maintenance dredging	25,000	-	25,000
TOTAL	$ 154,000	$ 15,000	$ 169,000

This estimate is based on December 1960 prices.

TABLE 12

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING
THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 14- x 150-FOOT CHANNEL
FOR THE SECTION FROM THE HOUSTON SHIP CHANNEL TO THE PORT ARANSAS-CORPUS CHRISTI WATERWAY

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation	41,835,000 cu.yds.	21¢/cu.yd.	$ 8,785,000	$ -	$ 8,785,000
Rights-of-way:					
Dredging	1,661 acres	$125/acre	-	208,000	208,000
Spoil area	1,796 acres	$160/acre	-	287,000	287,000
Relocations:					
90 3-pile dolphins	job	job	16,000	-	16,000
10 pipelines	job	job	-	59,000	59,000
1 cable crossing	job	job	-	2,000	2,000
Subtotal			$ 8,801,000	$ 556,000	$ 9,357,000
Contingencies			1,350,000	80,000	1,430,000
Subtotal			$10,151,000	$ 636,000	$10,787,000
Engineering and design			207,000	13,000	220,000
Subtotal			$10,358,000	$ 649,000	$11,007,000
Supervision and administration			832,000	51,000	883,000
Subtotal			$11,190,000	$ 700,000	$11,890,000
Navigation aids			210,000	-	210,000
TOTAL FIRST COST			$11,400,000	$ 700,000	$12,100,000
Preauthorization studies			23,000	-	23,000
TOTAL COST			$11,423,000	$ 700,000	$12,123,000

TABLE 12 (cont'd)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 299,000	$ 28,000	$ 327,000
Amortization	113,000	5,000	118,000
Maintenance dredging	200,000	-	200,000
TOTAL	$ 612,000	$ 33,000	$ 645,000

This estimate is based on December 1960 prices.

TABLE 13

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING
THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 14- x 150-FOOT CHANNEL
FOR THE SECTION FROM THE PORT ARANSAS-CORPUS CHRISTI WATERWAY TO BROWNSVILLE, TEXAS

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation	32,502,000 cu.yds.	25¢/cu.yd.	$ 8,126,000	$ -	$ 8,126,000
Contingencies			1,239,000	-	1,239,000
Subtotal			$ 9,365,000	$ -	$ 9,365,000
Engineering and design			192,000	-	192,000
Subtotal			$ 9,557,000	$ -	$ 9,557,000
Supervision and administration			773,000	-	773,000
Subtotal			$10,330,000	$ -	$10,330,000
Aids to navigation			70,000	-	70,000
TOTAL FIRST COST			$10,400,000	$ -	$10,400,000
Preauthorization studies			19,000	-	19,000
TOTAL COST			$10,419,000	$ -	$10,419,000

ANNUAL CHARGES

Interest			$ 273,000	$ -	$ 273,000
Amortization			103,000	-	103,000
Maintenance dredging			90,000	-	90,000
Maintenance of navigation aids			5,000	-	5,000
TOTAL			$ 471,000	$ -	$ 471,000

This estimate is based on December 1960 prices.

TABLE 14

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 16 X 150-FOOT CHANNEL FOR THE SECTION FROM THE SABINE RIVER TO THE HOUSTON SHIP CHANNEL

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation	18,227,000 cu.yds.	22¢/cu.yd.	$4,010,000	$ -	$4,010,000
Rights-of-way:					
Dredging	1,358 acres	$85/acre	-	115,000	115,000
Spoil area	1,403 acres	$60/acre	-	85,000	85,000
Severance	job	job	-	60,000	60,000
Subtotal			$4,010,000	$ 260,000	$4,270,000
Contingencies			602,000	40,000	642,000
Subtotal			$4,612,000	$ 300,000	$4,912,000
Engineering and design			92,000	6,000	98,000
Subtotal			$4,704,000	$ 306,000	$5,010,000
Supervision and administration			376,000	24,000	400,000
Subtotal			$5,080,000	$ 330,000	$5,410,000
Navigation aids			20,000	-	20,000
TOTAL FIRST COST			$5,100,000	$ 330,000	$5,430,000
Preauthorization studies			12,000	-	12,000
TOTAL COST			$5,112,000	$ 330,000	$5,442,000

ANNUAL CHARGES

Interest			$ 134,000	$ 13,000	$ 147,000
Amortization			51,000	2,000	53,000
Maintenance dredging			25,000	-	25,000
TOTAL			$ 210,000	$ 15,000	$ 225,000

This estimate is based on December 1960 prices.

TABLE 15

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING THE GULF INTRACOASTAL WATERWAY TO PROVIDE A 16 X 150-FOOT CHANNEL FOR THE ALGIERS ALTERNATE CANAL

FIRST COSTS

Item of Cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Dragline dredge	1,090,000 cu.yds.	19½¢/cu.yd.	$ 212,550	$ -	$ 212,550
Rights-of-way: (No additional rights-of-way for dredging or spoil disposal required)					
Relocations: (No pipelines or submarine cables to be lowered)					
Subtotal			$ 212,550	-	$ 212,550
Contingencies			32,450	-	32,450
Subtotal			$ 245,000	-	$ 245,000
Engineering and design			5,000	-	5,000
Subtotal			$ 250,000	-	$ 250,000
Supervision and administration			20,000	-	20,000
TOTAL FIRST COST			$ 270,000	-	$ 270,000
Preauthorization studies			1,000	-	1,000
TOTAL COST			$ 271,000	-	$ 271,000
ANNUAL CHARGES					
Interest			$ 7,000	-	$ 7,000
Amortization			3,000	-	3,000
Maintenance dredging			1,000	-	1,000
TOTAL			$ 11,000	-	$ 11,000

This estimate is based on December 1960 prices.

TABLE 16

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR IMPROVING
THE PLAQUEMINE-MORGAN CITY ROUTE (AS MODIFIED)
TO PROVIDE FOR A 14- x 150-FOOT CHANNEL

FIRST COSTS

Item of cost	Quantity	Unit cost	Federal	Non-Federal	Total
Channel excavation:					
Hydraulic dredge	10,535,000 cu.yds.	25¢/cu.yd.	$2,633,750	$ -	$2,633,750
Spoil relocation	223,000 cu.yds.	15¢/cu.yd.	33,450	-	33,450
Rights-of-way:					
Dredging	No additional R/W required				
Spoil area	No additional R/W required				
Relocations:					
Lower pipelines	16	$20,000/each	-	320,000	320,000
Lower submarine cables	13	$10,000/each	-	130,000	130,000
Subtotal			$2,667,200	$ 450,000	$3,117,200
Contingencies:					
Federal, 15%			401,000	-	401,000
Non-Federal:					
Relocations, 15%			-	67,500	67,500
Subtotal			$3,068,200	$ 517,500	$3,585,700
Engineering and design			61,400	10,500	71,900
Subtotal			$3,129,600	$ 528,000	$3,657,600
Supervision and administration			250,400	42,000	292,400
TOTAL FIRST COST			$3,380,000	$ 570,000	$3,950,000
Preauthorization studies			2,000	-	2,000
TOTAL COST			$3,382,000	$ 570,000	$3,952,000

TABLE 16 (cont'd)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 89,000	$ 23,000	$ 112,000
Amortization	33,000	4,000	37,000
Maintenance dredging	6,000	-	6,000
TOTAL	$ 128,000	$ 27,000	$ 155,000

This estimate is based on December 1960 prices.

TABLE 17

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES FOR
REPLACEMENT OF BRIDGE AT MILE 35.0 WEST OF HARVEY LOCK
AND FOR IMPROVEMENT OF THE WATERWAY
TO PROVIDE AN UNRESTRICTED 16- x 150-FOOT CHANNEL

Item of cost	Federal	Non-Federal	Total
Dredging 16- x 150-foot channel, 100,000 cu.yds. @ 25¢/cu.yd.	$ 25,000	$ -	$ 25,000
Removal of existing pontoon bridge at La. Hwy. 308	20,000	-	20,000
Construction of high-level bridge with no piers in channel	3,080,000	-	3,080,000
Subtotal	$3,125,000	$ -	$3,125,000
Contingencies	470,000	-	470,000
Subtotal	$3,595,000	$ -	$3,595,000
Engineering and design	72,000	-	72,000
Subtotal	$3,667,000	$ -	$3,667,000
Supervision and administration	293,000	-	293,000
TOTAL COST	$3,960,000	$ -	$3,960,000
ANNUAL CHARGES			
Interest	$ 104,000	$ -	$ 104,000
Amortization	39,000	-	39,000
Maintenance:			
Channel(1)	100	-	100
Bridge(2)	-	-5,000	-5,000
TOTAL	$ 143,100	$ -5,000	$ 138,100

(1)In addition to that for 12- x 125-foot channel.
(2)Compared to operation and maintenance of existing pontoon bridge.

This estimate is based on December 1960 prices.

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APPENDIX B

ECONOMIC ANALYSIS

1. General. It has been known for a long time that the speed of marine vessels was influenced by the size of the channel in which they were operating. Experience showed that without change in power, the speed of a vessel increased when moving from a restricted channel into wider and/or deeper water and decreased when moving from open water into restricted channels. These experiences have been confirmed by tests and model studies. The provision of a deeper and wider waterway will result in a decrease in drag which the present dimensions of the waterway impose on existing traffic.

a. An alternative method of increasing the speed of vessels in the existing 12 x 125-foot channel was considered. This method would achieve the increase in speed through the use of a towboat with sufficient horsepower to realize the same speed in the present channel as would be realized in the recommended channels. The cost a ton-mile through the use of increased horsepower is greater than the cost a ton-mile for the enlarged channels. Aside from being more expensive, increasing the horsepower to achieve the same speed in the 12 x 125-foot channel would result in the towboats operating more inefficiently than the smaller towboats are presently operating.

b. Another alternative in achieving increased speed would be to route all traffic via the Gulf of Mexico and have them use entrance channels with adequate depths and widths, such as the Mississippi River and Calcasieu River and Pass. This method would not be practical because it would force operators to use equipment licensed for outside operation in the Gulf of Mexico and would thereby raise transportation costs. Another drawback is that it would not be a feasible method for tows destined to points not located on or near adequate entrance channels. Tows destined to points on the Mermentau River, Atchafalaya River, and other similar waterways would have to use a circuitous route to reach their destination or continue to utilize the present channel.

c. The benefit to be derived from modification of an existing project to provide greater depth and bottom width will be the reduction in operation cost over the waterway. The following paragraphs outline the method used to arrive at the reduction in operating cost and an estimate of the benefits derived from such reduction.

2. Size of barge tows. Tonnage on the Intracoastal Waterway is carried in barges of many different sizes and in tows of 1, 2, 3, 4 or more barges. However, about 80% of the commerce is handled in

two- and three-barge tows. It is estimated that on the average, the bulk of local traffic on the waterway will be handled in two 35 x 195-foot barges propelled by an 800-horsepower towboat, while through traffic on the waterway will be handled in tows consisting of three 50 x 250-foot barges propelled by a 1,600-horsepower towboat. Draft of both local and through tows will average 8.5 feet.

3. Model tests of barge resistances. The data relative to barge tows used in this study are from the model tests made at the University of Michigan for the U. S. Army Engineer District, Pittsburgh, Pa. The model tests covered trapezoidal channels of various depths and widths. Barge formations tested included 35 x 195-foot barges in tow formations of two barges in tandem; four barges, two abreast, and two in tandem; six barges, two abreast, and three in tandem; six barges, three abreast and two in tandem; and 54 x 250-foot barges in tow formation of a single barge, and also two barges in tandem. The 35 x 195-foot barges were tested at drafts of 3, 5, and 8.5 feet, and the 54 x 250-foot barges were tested at drafts of 3, 8.5, and 14 feet. The results of these tests were plotted as graphs showing the resistance in pounds for each short ton of displacement.

4. Resistance of barge tows. In order to secure figures for resistance of the two 35 x 195-foot and two 54 x 250-foot barges at 8.5-foot draft in channels of dimensions not covered by the test data, resort was made to interpolation. Graph No. 1 shows the resistance per ton of displacement of two 35 x 195-foot barges in channels 12 x 125; 14 x 150; 16 x 150; 16 x 200; 16 x 250; 16 x 300; and in deep water, where bottom drag and side resistance are negligible. Graph No. 2 shows the resistance in pounds per ton of displacement for two 54 x 250-foot barges in channels of these same dimensions.

a. A further interpolation is necessary in order to secure resistance of the three 50 x 250-foot barges which comprise the average through tow. It was first necessary to establish graphs for three 54 x 250-foot barges. This was done by assuming that the total resistance per ton of displacement was composed of bow resistance, side resistance and drag resistance, and that the addition of a third barge would not change the bow resistance. The bow resistance was taken as 30% of the total, with 70% remaining for side and drag resistance, or 35% for each barge. The resistance per ton of displacement for the three-barge tow would be 30%T plus 3 (35%T), or 135%T (where T is the resistance in pounds per ton of displacement for the two 54 x 250-foot barges). The ratio of the tonnages of the two-barge tow to the three-barge tow is 2/3. Therefore, the resistance per ton of displacement for the three-barge tow will be 2/3 of 135%T or 90%T.

b. It was assumed that the unit resistance was proportional to the width of the barge. The ratio of the 50-foot wide barge to

the 54-foot wide barge is 92.6%. Applying the 92.6% factor to the 90% factor for the three 54 x 250-foot barge tow gives a factor of 83.3% for the unit resistance of the three 50 x 250-foot barge tows.

c. The total displacement tonnage of the three 50 x 250-foot barge tow is 9,250 tons, with a cargo tonnage of 7,680. The total displacement tonnage of the two 35 x 195-foot barge tow is 3,340 tons, with a cargo tonnage of 2,770.

d. It is now possible to determine the total push required for these two tows. By taking 83.3% of the unit resistance shown on graphs 2 and 3, and multiplying by the total displacement (9,250 tons) the push required at various speeds can be determined for the three 50 x 250-foot barge tow. The values shown on graph 1 when multiplied by the total displacement tonnage (3,340) gives the push required for the 35 x 195-foot barge tow at various speeds.

e. By combining the graphs of the total push required for each of the tows with the graph of the push available at the bow of the towboat the optimum speed for the various size channels can be determined. This has been done for various horsepower towboats and the results are shown in graphs 3 and 4. With the payload known for the 35 x 195-foot barges (2,770 tons) and for the 50 x 250-foot barges (7,680 tons), it is possible to calculate the cargo ton-miles per hour for the optimum speed of each tow on the different size channels.

5. Operating cost of tows and unit saving in cost. a. The cost of a 1,600-horsepower towboat is $51.88 an hour. The cost of a 50 x 250-foot dry cargo barge is $3.98 an hour, and the cost of the same size barge for liquid cargo is $4.90 an hour. Based on a division of 70% of all cargo being crude petroleum and products, and 30% being dry cargo, the average hourly cost of the 50 x 250-foot barge is $4.62. The total cost of a tow consisting of the 1,600-horsepower towboat and three 50 x 250-foot barges is $65.74 an hour. The hourly cost of an 800-horsepower towboat is $31.37. The cost of a 35 x 195-foot barge for liquid cargo is $2.19 an hour, and $1.84 an hour for a dry cargo barge of the same size, making an average hourly cost of $2.08 for the 35 x 195-foot barge. The total hourly cost of the 800-horsepower tow is $35.53.

b. Operating costs for the various size channels are shown below, together with the savings in operating cost when compared to the 12 x 125-foot project. These costs were used for determining the ton-mile costs used in this report.

800-HORSEPOWER TOW WITH TWO 35 x 195-FOOT BARGES

Channel size in feet	Speed in M.P.H.	Cargo ton-miles/hour	Cost per hour of tow in mills	Cost per ton-mile in mills	Savings in mills per ton-mile over 12 x 125-ft. project
12x125	5.70	15,789	35,530	2.25	-
14x150	6.30	17,451	35,530	2.04	0.21
16x150	6.58	18,227	35,530	1.95	0.30
16x200	6.85	18,974	35,530	1.87	0.38
16x250	7.15	19,806	35,530	1.79	0.46
16x300	7.45	20,637	35,530	1.72	0.53
Deep water	8.50	23,545	35,530	1.51	0.74

1,600-HORSEPOWER TOW WITH THREE 50 X 250-FOOT BARGES

12x125	4.72	36,250	65,740	1.81	-
14x150	5.46	41,933	65,740	1.57	0.24
16x150	5.79	44,467	65,740	1.48	0.33
16x200	6.10	46,848	65,740	1.40	0.41
16x250	6.40	49,152	65,740	1.34	0.47
16x300	6.65	51,072	65,740	1.29	0.52
Deep water	8.45	64,896	65,740	1.01	0.80

c. Since the savings in mills for the tows are so close to being equal, the average of the two would be representative of the savings to be derived. The following table gives the average savings for a tow operating in the channel sizes shown.

Channel size in feet	Savings in mills per ton-mile over 12 x 125-foot project
14 x 150	0.225
16 x 150	0.320
16 x 200	0.395
16 x 250	0.465
16 x 300	0.525
Deep water	0.770

6. Waterway commerce. The ton-mileage data for year 1959 are utilized in the following economic analysis of this appendix for the various reaches into which the waterway is subdivided.

a. In 1959, the annual tonnage between the Mississippi and Atchafalaya Rivers averaged 11,276,000 tons. The modified Plaquemine-Morgan City route to Port Allen will, when completed, divert 331,000 tons from and to Baton Rouge and 1,527,000 tons of interchange traffic from the waterway east of the Atchafalaya River. Thus, east of the

Atchafalaya River a total of 1,858,000 tons will be diverted from the 1959 total of 11,276,000 tons, leaving 9,418,000 tons to be benefited by the main stem improvement.

b. The Algiers Lock and Canal which connects the Mississippi River to the Intracoastal Water at mile 6.4 west of Harvey Lock handled 6,653,000 tons of traffic, leaving 2,765,000 tons of through traffic between mile 0 and mile 6.4.

c. On the remaining reaches of the waterway between the Atchafalaya River and Brownsville, no traffic will be diverted so that the 1959 data may be used unchanged.

d. The Gulf Intracoastal Waterway has enjoyed a substantial and steady growth of traffic since its construction. This traffic growth has been far beyond that envisioned in the initial studies and subsequent reviews. Conservative evaluation of existing conditions and developments adjacent to the waterway and in the tributary basin, both inshore and offshore, indicates that traffic may be expected to grow substantially in the future.

e. The demand for energy is constantly growing and is expected to increase at the rate of 3% annually[1] for an indefinite period. Since petroleum is a major source from which energy is derived, it is estimated that the tonnages of crude oil and petroleum products will increase during the first 25 years at the same rate that energy demand will increase. However, it is expected that the demand for petroleum and petroleum products as a source of energy will be offset by the use of other sources of energy during the latter 25 years of the project life, and the petroleum tonnages are expected to remain constant during this latter period. On this basis, the prospective tonnage of liquid cargo will increase to 210% of the present tonnage at the end of the twenty-sixth year of the life of the project and will remain constant thereafter.

f. Petroleum resources are expected to be able to supply this magnitude of increase. "There is a firm basis for believing

[1] "Domestic Petroleum Exploration - Achievements and Prospects," by Morgan J. Davis, President, Humble Oil and Refining Co., The Humble Way, March-April 1959.

that discoveries and reserves of petroleum can keep pace with increasing domestic requirements over a long period. In the next 20 years, with little allowance for increased recovery due to improved techniques, a minimum additional supply of 70 billion barrels of crude oil can be counted upon from fields already discovered and acreage already under lease."[2] Similar conclusions have been expressed by other investigators.[3]

g. The remaining tonnage handled over the Gulf Intracoastal Waterway has been projected on the basis of a 1.7% annual increase. This assumption is made in the belief that the commodities comprising this tonnage will be influenced more directly by the population growth rate than any other factor. The average rate of population increase in the United States in the past 75 years has been 1.7%.[4]

h. The combined total average annual tonnages of crude oil and petroleum products and average annual tonnages of all other commodities are shown in table 1.

7. Estimated savings in transportation costs. a. The savings to be expected from any channel improvement will be those brought about by increased efficiency in the operation of the tows using the Gulf Intracoastal Waterway. The reduction in the operating cost of tows because of increased efficiency will in turn reduce the ton-mile cost of freight transported over the waterway.

b. The total average annual ton-mileages expected on the various reaches of the waterway are shown in table 1. When these

[2] "Domestic Petroleum Exploration - Achievements and Prospects," by Morgan J. Davis, President, Humble Oil and Refining Co., The Humble Way, March-April 1959.

[3] Productive Uses of Nuclear Energy Report on Nuclear Energy and the U. S. Fuel Economy 1955-1980, by Perry D. Teitelbaum, National Planning Association, Washington, D. C., p. 13; Productive Uses of Nuclear Energy, Report on Energy Requirements and Economic Growth, by Edward S. Mason, National Planning Association, Washington, D. C.; Hearings Before the Subcommittee on Automation and Energy Resources of the Joint Economic Committee of the United States, Eighty-sixth Congress, First Session, Pursuant to Section 5(a) of Public Law 304, 79th Congress, United States Government Printing Office, Washington, D.C., 1959, p. 150.

[4] National Economic Projections, 1962-1965, 1970, by National Planning Association, Washington, D. C., 1959.

ton-mileages are used with the savings in mills a ton-mile as shown in paragraph 5c of this appendix, the total or gross benefits to accrue to traffic over the various reaches from the different size channels can be derived for each year of the project life. When the benefits for each year are brought back to present worth and spread over the life of the project, the average annual benefit is derived. Table 1 gives the average gross benefits for a 16 x 150-foot channel on the main channel of the Gulf Intracoastal Waterway as well as for the Plaquemine-Morgan City route, as modified. Benefits for channels of other dimensions may be found by the application of the ton-mile unit savings.

c. As indicated in appendix A, paragraph 3, certain sections of the waterway would not be improved. The non-improvement of these sections would be because of existing structures such as bridges, locks, and gate structures; sections where it is not feasible to enlarge the waterway because of development along the channel and the consequent non-availability of right-of-way; and sections where the existing channel has been enlarged to dimensions greater than those considered or sections where the size of the natural channel exceeds the dimensions of the improvement being considered. The reaches which are not to be improved are shown below:

REACH BETWEEN MILE 0.0 AND MILE 6.4

Miles west of Harvey Lock	Distance not to be improved	Reasons for not making improvement
0.0 to 5.0	5.0 miles	Impractical because of industrial improvements and non-availability of right-of-way

REACH BETWEEN MILE 6.4 AND ATCHAFALAYA RIVER (MILE 95.5)

12.5	0.38 mile	La. Hwy. No. 45, Swing Bridge, 75-foot Horizontal Clearance
35.0	0.47 mile	La. Hwy. No. 308, Pontoon Bridge, 90-foot Horizontal Clearance
35.8	0.47 mile	La. Hwy. No. 1, Vertical Lift Bridge, 125-foot Horizontal Clearance, 73-foot Vertical Clearance

REACH BETWEEN MILE 6.4 AND ATCHAFALAYA RIVER (MILE 95.5) (cont'd)

Miles west of Harvey Lock	Distance not to be improved	Reasons for not making improvement
55.0 - 61.0	6.00 miles	City of Houma, La. Impractical because of improvements along banks and non-availability of right-of-way
93.5	0.63 mile	Bayou Boeuf Lock
Total unimproved distance	7.95 miles	

REACH BETWEEN MILE 95.5 AND MILE 266.0

95.5 - 98.2	2.70 miles	Atchafalaya River. Existing Channel Adequate
113.1	0.38 mile	La. Hwy. No. 60, Vertical Lift Bridge, 125-foot Horizontal and 80-foot Vertical Clearance
133.9	0.38 mile	La. Hwy. No. 83, Swing Bridge, 80-foot Horizontal Clearance
162.7	0.63 mile	Vermilion Lock
169.8	0.38 mile	La. Hwy. No. 35, Pontoon Bridge, 125-foot Horizontal Clearance
219.6	0.38 mile	La. Hwy. No. 27, Pontoon Bridge, 151-foot Horizontal Clearance
238.9	0.63 mile	Calcasieu Lock
239.2 - 241.2	2.00 miles	Calcasieu River. Existing Channel Adequate
241.2 - 266.0	24.80 miles	Lake Charles Deepwater Channel. Dimensions Adequate
243.6	0.38 mile	La. Hwy. No. 27, Pontoon Bridge, 151-foot Horizontal Clearance
Total unimproved distance	32.66 miles	

REACH BETWEEN MILE 95.5 AND MILE 266.0 (cont'd)

Miles west from Algiers Lock	Distance not to be improved	Reasons for not making improvements
	ALGIERS CANAL	
0.0	0.63 mile	Algiers Lock
1.0	0.38 mile	La. Hwy. No. 1509, Vertical Lift Bridge, 125-foot Horizontal Clearance, 100-foot Vertical Clearance
3.75	0.38 mile	New Orleans & Lower Coast (Mo. Pac.) Railroad Bridge, Vertical Lift, 125-foot Horizontal Clearance, 100-foot Vertical Clearance
Total unimproved distance	1.39 miles	

PLAQUEMINE-MORGAN CITY ROUTE, AS MODIFIED

Miles above Morgan City, La.	Distance not to be improved	Reasons for not making improvements
36.7	0.63 mile	Bayou Sorrel Lock
47.0	0.38 mile	La. Hwy. No. 77, Swing Bridge, 125-foot Horizontal Clearance
56.0	0.38 mile	Texas & Pacific Railway Bridge, Vertical Lift, 125-foot Horizontal Clearance, 73-foot Vertical clearance
64.0	-	Texas & Pacific Railway Bridge, Vertical Lift, 84-foot Horizontal Clearance, 73-foot Vertical Clearance
64.0	0.60 mile	La. Hwy. No. 1, High Level, Fixed Bridge, 84-foot Horizontal Clearance, 64.2-foot Vertical Clearance
64.1	-	Port Allen Lock
Total unimproved distance	1.99 miles or 2.0 miles	

REACH FROM SABINE RIVER TO HOUSTON SHIP CHANNEL - MILE 266 TO MILE 350.75

Miles west of Harvey Lock	Distance not to be improved	Reasons for not making improvements
266.1 to 288.4	22.30 miles	Sabine-Neches Waterway
288.6	0.47 mile	Texas Hwy. 87, Bascule Bridge, 100-foot Horizontal Clearance
319.1	0.62 mile	GC&SF Ry. and Texas Hwy. 124, Bascule Bridge, both 100-foot Horizontal Clearance
Total unimproved distance	23.39 miles or 23.4 miles	

REACH FROM HOUSTON SHIP CHANNEL TO PORT ARANSAS-CORPUS CHRISTI WATERWAY, MILE 350.6 TO MILE 539.4

350.6	0.10 mile	Texas City Channel
357.2	0.68 mile	Santa Fe RR, Bascule Bridge, 100-foot Horizontal Clearance, Texas Hwy. 75, Bascule, 105-foot Horizontal Clearance, and Texas Hwy. 75, Fixed, 105-foot Horizontal Clearance, 73-foot Vertical clearance
393.6	0.08 mile	Surfside Hwy. Fixed Bridge, 201-foot Horizontal Clearance, 73-foot Vertical Clearance
394.9	0.08 mile	Freeport Harbor
397.0	0.16 mile	Quintana Hwy., Pontoon Bridge, 130-foot Horizontal Clearance
400.6	4.00 miles	Brazos River Floodgates
417.9	0.08 mile	Caney Creek Hwy. Pontoon Bridge, 100-foot Horizontal Clearance

REACH FROM HOUSTON SHIP CHANNEL TO PORT ARANSAS-
CORPUS CHRISTI WATERWAY, MILE 350.6 TO MILE 539.4 (cont'd)

Miles west of Harvey Lock	Distance not to be improved	Reasons for not making improvements
440.6	0.08 mile	Matagorda Hwy. Pontoon Bridge, 100-foot Horizontal Clearance
441.3	1.40 miles	Colorado River Locks
Total unimproved distance	6.66 miles or 6.7 miles	

REACH FROM PORT ARANSAS-CORPUS CHRISTI WATERWAY
TO BROWNSVILLE - MILE 538.0 TO MILE 691.0

554.6	0.08 mile	Texas Hwy. 358, Pontoon Bridge, 150-foot Horizontal Clearance
667.8	0.08 mile	Cameron County Pontoon Bridge, 150-foot Horizontal Clearance
669.0 - 683.8	14.8 miles	Brownsville Channel
Total unimproved distance	14.96 miles or 15.0 miles	

d. In the Texas reaches, the waterway traverses wide, open bays of varying water depths. In reaches where the widths of the bays are greatly in excess of the widths of the improvement under consideration the benefits to be derived will be further reduced because the original 12 x 125-foot channel is not completely restricted. In order to allow for the existing overbank depths which prevail in the various reaches the benefits must be reduced by a factor which is representative of the overbank depths and additional width. Factors have been estimated for the various reaches, and are given in table 2.

e. When the unimproved reaches are eliminated and the allowances for the existing overbank depths and excess widths are deducted from the gross benefits for the various reaches, the average annual benefits for improvement to 14 x 150 and 16 x 150 are computed as follows:

Reach of waterway	Average annual benefits for 14x150-foot channel	Average annual benefits for 16x150-foot channel
Mile 0.0 - mile 6.4	$ 1,300	$ 1,900
Mile 6.4 - Atchafalaya River (mile 95.5)	265,000	377,000
Atchafalaya River (mile 95.5) - Sabine River (mile 266)	908,000	1,292,000
Algiers Canal	16,000	23,000
Plaquemine-Morgan City Route, as modified	87,000	124,000
Sabine River to Houston Ship Channel (mile 266 to mile 350.4)	461,000	485,000
Houston Ship Channel to Port Aransas-Corpus Christi Waterway (mile 350.4 to mile 539.4)	295,000	417,000
Port Aransas-Corpus Christi Waterway to Brownsville (mile 539.4 to mile 683.8)	78,000	93,000

f. Comparisons of benefits to annual charges for the improvement of the various reaches of the Gulf Intracoastal Waterway, Mississippi River to Brownsville, Texas, to provide channels of 14 x 150 feet, 16 x 150 feet, 16 x 200 feet, 16 x 250 feet, and 16 x 300 feet, are shown in table 3. Excluded from improvement are the reach from Harvey Lock (mile 0.0) to mile 5.0, the section through Houma, La. (mile 55.0 to mile 61.0), and those reaches listed in table 1 of appendix A.

g. Table 4 gives comparisons of the incremental annual benefits to the incremental annual charges for the various reaches of the Gulf Intracoastal Waterway, Mississippi River to Brownsville, Texas. The maximum size channel with a favorable incremental benefit-cost ratio for the various reaches of the waterway is shown below:

Reach of waterway	Maximum size channel with favorable incremental benefit-cost ratio	Incremental benefit-cost ratio
Mississippi-Atchafalaya River[1]	16 x 150-foot	1.6 to 1
Atchafalaya-Sabine River	16 x 200-foot	1.3 to 1
Sabine River-Houston Ship Channel	16 x 150-foot	2.6 to 1
Houston Ship Channel-Port Aransas-Corpus Christi Waterway	12 x 125-foot	-
Port Aransas-Corpus Christi Waterway-Brownsville	12 x 125-foot	-
Plaquemine-Morgan City Route (as modified)	12 x 125-foot	-

[1]Includes Algiers Alternate Canal

8. Benefits - channel relocation - Houma, La. a. The City of Houma, La., has requested that the Intracoastal Waterway be rerouted to the south of the city in order to eliminate the costly delay to highway traffic which is the result of the frequent bridge openings. The economics of three bypass routes were investigated. Of the three bypass routes, two were found to lack justification.

b. One bypass route considered would leave the Intracoastal Waterway at mile 37.0 (just west of Larose) and run in a southerly and southwesterly direction so as to pass south of all existing highways, then westerly and northwesterly, rejoining the main Intracoastal Waterway at mile 106.0 (east of Wax Lake). This route is 80 miles in length, 11 miles longer than the existing channel. It did, however, eliminate the necessity of through-tows going through the four bridges at Houma and the Bayou Boeuf Lock. One bridge would be required where the bypass route cut Louisiana Highway No. 24 near Larose. The additional length introduced by this bypass route resulted in only a minor reduction in transportation costs when compared to the cost of transportation over the existing Intracoastal Waterway Channel.

c. Investigation was made of a bypass route which would leave the present Intracoastal Waterway at mile 37.0 and extend in a southerly and southwesterly direction, then northwesterly, rejoining the main channel of the Intracoastal Waterway at mile 70.0. This route would cut the highways extending along Bayou Petit Caillou, Bayou Grand Caillou, and Bayou du Large, and would require at least one highway bridge at each of those bayous in addition to the one required near Larose. The number of bridges which a tow would have to

negotiate would remain the same on this route as on the existing route, and the Bayou Boeuf Lock would continue to be on the new route. This bypass route would be 8 miles longer than the existing channel. The cost of transporting cargo over this route would be slightly greater than over the existing route.

d. The bypass route which affords the best economic ratio would leave the existing waterway at mile 50.5, and extend westerly crossing Bayous Terrebonne and Petit Caillou north of Presquile, crossing Bayou Grand Caillou south of Woodlawn, crossing Bayou du Large south of Crozier, and rejoining the main Intracoastal Waterway at mile 63.5. This bypass route would shorten the distance 3.5 miles, and require three bridges.

e. The average tonnage over the reach of waterway being considered was 9,418,000 tons in 1959. Approximately 60% of this tonnage is through traffic and will be handled in a tow of three 50 x 250-foot barges propelled by a 1,600-horsepower towboat and 40% is local traffic which will be handled in a tow of two 35 x 195-foot barges propelled by an 800-horsepower towboat. This will amount to 73,460,000 ton-miles (13 x 9,418,000 x .6) for the 3-barge tow and 48,974,000 ton-miles (13 x 9,418,000 x .4) for the 2-barge tow.

f. The estimated cost of transporting the 1959 tonnage over the existing 12 x 125-foot channel between mile 50.5 and mile 63.5 is as follows:

Transportation Cost Between Miles 50.5 and 63.5 Over Existing Waterway

73,460,000 ton-miles by 3-barge tows at 1.81 mills/ton-mile	$ 133,000
48,974,000 ton-miles by 2-barge tows at 2.25 mills/ton-mile	110,000
Lost time of 30 minutes at 4 bridges:	
For 3-barge tows 13,337,000 ton-miles (4.72 mph/2 x 5,651,000 tons) at 1.81 mills/ton-mile	24,000
For 2-barge tows 10,736,000 ton-miles (5.70 mph/2 x 3,767,000 tons) at 2.25 mills/ton-mile	24,000
Lost time of 30 minutes through narrow congested reach in Houma: For 3-barge tows	24,000
For 2-barge tows	24,000
Total estimated cost over existing waterway	$ 339,000

g. The estimated cost of transporting the same tonnage over the bypass route for a 16 x 150-foot channel is shown below:

Transportation costs over bypass route between miles 50.5 and 63.5 for 16 x 150-foot channel

53,685,000 ton-miles (5,651,000 tons x 9.5 miles) for 3-barge tows at 1.48 mills/ton-mile	$ 79,000
35,787,000 ton-miles (3,767,000 tons x 9.5 miles) for 2-barge tows at 1.95 mills/ton-mile	70,000
Lost time of 25 minutes at 3 bridges: For 3-barge tows 14,492,000 ton-miles (5,651,000 tons x 6.15 mph x .417 hr.) at 1.48 mills/ton-mile	21,000
For 2-barge tows 10,839,000 ton-miles (3,767,000 tons x 6.9 mph x .417 hr.) at 1.95 mills/ton-mile	21,000
Total estimated transportation cost	$ 191,000

h. Saving for the 16 x 150-foot Houma bypass over the existing waterway is as follows:

Cost of transportation over existing waterway	$ 339,000
Cost of transportation over 16 x 150-foot bypass	191,000
Saving based on 1959 traffic	$ 148,000
Total average annual saving to waterway traffic over life of project	$ 227,000

i. Benefits to highway traffic for the bypass route to the south of Houma were determined from studies made by the State of Louisiana, Department of Highways, in cooperation with the U. S. Bureau of Public Roads. A study was made of the cost to highway traffic along the existing waterway, referred to in the following as Case I. This study assumed that a 4-lane, high-level bridge would be in place at Honduras Street. Because of increasing vehicular traffic, it was considered necessary to add a 4-lane, high-level bridge in 1976; another in 1992, and a third in 2003. The average annual cost to highway transportation over the next 50 years without the bypass is $424,000 (Case I).

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j. For Case II, it is assumed that all existing bridges over the present waterway will be in operation, and that in addition thereto a 4-lane, high-level bridge or a vehicular tunnel will be in operation at Honduras Street, Houma, La. Increasing vehicular traffic will make necessary the addition of new 4-lane, movable bridges over the present canal; one in 1976; one in 1992; and one in 2003. To adequately carry highway traffic over the bypass canal, movable bridges will be required for State Highways 24, 57 and 315. In order to accommodate traffic to and from the area east of Bayou Terrebonne and north of the bypass canal, a movable bridge is necessary for Bayou Terrebonne. The annual cost to highway transportation in this case is $261,000.

k. In Case III, bridges are the same as for Case II with the exception that the bridges on State Highways 24 and 57 are to be high-level bridges instead of movable bridges. The annual cost to highway traffic for Case III is $172,000.

l. The following tabulation shows the cost to highway traffic for each of the cases studied, and the benefits accruing to highway traffic for each case as compared to Case I (the existing condition):

	Annual cost to highway traffic	Saving over existing conditions
Case I	$ 424,000	$ -
Case II	261,000	163,000 (Benefit)
Case III	172,000	252,000 (Benefit)

m. The total annual benefits for the 16 x 150-foot bypass route over the life of the project, including both benefits to navigation and to highway traffic, are shown below:

	Savings over existing channel	Savings to highway traffic	Total benefits for bypass route
Case II	$ 227,000	$ 163,000	$ 390,000
Case III	227,000	252,000	479,000

n. In order to determine the total benefits on the section of the waterway between the Mississippi River and the Atchafalaya River with the Houma bypass route considered in place, it is necessary to add the benefits from the bypass route to those benefits accruing from improvement of the present main stem of the waterway between mile 0.0 and mile 50.5, and between mile 63.5 and mile 95.5.

o. Benefits accruing from a 16 x 150-foot channel on the main stem of the waterway with the Houma bypass considered in place are shown below:

Reach of waterway	Transportation benefits
Mile 0.0 - 6.4	$ 1,900
Mile 6.4 - 50.5	198,000
Mile 63.5 - 95.5	145,000
Total	$344,900

p. The total benefits accruing from the 16 x 150-foot channel on the section between the Mississippi River and the Atchafalaya River with the Houma bypass considered in place are shown below:

Reach of waterway	Waterway transportation benefits	Highway transportation benefits from movable bridges	Highway transportation benefits from high level bridges
Main stem from mile 0.0 to 50.5 and mile 63.5 to 95.5	$ 345,000	-	-
Houma bypass, between mile 50.5 and mile 63.5	227,000	$ 163,000	$ 252,000

q. Comparisons of the annual benefits and annual charges for the provision of a 16 x 150-foot bypass channel around Houma with movable bridges and with high-level, fixed bridges are given in table 5. The benefit-cost ratio of a 16 x 150-foot channel with high-level, fixed bridges is slightly below unity, whereas the benefit-cost ratio of a channel with low-level, movable bridges is 1.4 to 1.

9. Channel relocations in Texas section. In the reach of the Intracoastal Waterway from the Sabine River to Brownsville, Texas, benefits will accrue not only from the improvement of the main waterway, but also from the following channel relocations:

a. Channel relocation, east approach to GC&SF Ry. Bridge.

b. Channel relocation, mile 320.1 to 325.4.

c. Channel relocation in Matagorda Bay.

d. Channel relocation in Corpus Christi Bay.

e. Channel relocation at Port Isabel, Texas.

10. Benefits - channel relocation, east approach to GC&SF Ry. Bridge. Relocation of the east approach channel to the Gulf Colorado and Santa Fe Railway Bridge between miles 316.4 and 319.1 would afford substantial benefits to navigation by reducing transportation costs through more efficient and faster operation of vessels and by a reduction in the hazards to barge traffic. About 80% of the tonnage reported for the Sabine River to Galveston Bay section moved through the railroad bridge at mile 319.1. Analysis was made of the reported transit of barge traffic through the bridge for the year 1959. The composition and number of barge tows passing through the bridge in 1959 are summarized in table 7.

a. Analysis of data in table 7 shows that there were 5,496 eastbound transits and 5,407 westbound transits. Approximately 23% of the transits were 1-barge tows, 38% were 2-barge tows, and 16% were 3-barge tows. The remainder of the transits amounting to 23% consisted of motor vessels, tugs, and barges in tows of 4 to 8 barges. It is estimated that prospective traffic on the waterway during the life of the proposed improvement will amount to about 25% more than existing traffic. The cost of operating towboats and barges in the reach of the main channel under consideration is estimated at an average of $49.48 per hour while running or maneuvering the barge tows for transit through the bridge. Barge tows traversing the main channel in land cuts in the Galveston District operate at average speeds of 4 miles per hour with loaded barges and 7 miles per hour with empty barges.

b. Under present conditions, barge tows moving westbound on the east approach channel must proceed at reduced speed to navigate safely the sharp curve and short tangent distance to the bridge. Eastbound tows leaving the bridge do not encounter this navigation hazard. Under improved conditions the westbound barge tows could operate at full speed throughout the full length of the realined channel. Between the limits of the proposed relocation, the existing channel has a length of 13,714 feet, of which 2,764 feet consist of curves and tangent channel through which towboats operate at about one-half speed. The total length of proposed channel realinement is 15,120, or 1,406 feet longer than the existing channel.

c. The cost of operating empty tows under existing conditions between the limits of the proposed channel relocation is estimated at $22.06 per tow, whereas, under proposed channel conditions the cost is estimated at $20.23 per tow, as shown in table 8. The saving in transportation costs of operating a barge tow on the proposed channel is evaluated at $1.83 per trip. The total saving in

transportation costs on the prospective movement of 2,600 westward, empty barge tows, over the relocated channel would amount to about $4,800 annually.

d. Both east and westbound barge traffic traversing the east approach channel suffer delays caused by moderate to strong northerly and southerly cross winds. This is particularly so for the transits of empty barges. These cross winds force the barge to the side of the channel quite frequently and the barges ride the channel bank for considerable distances. This slows the tow and requires time for maneuvering the tow into proper position in the channel. During strong north winds, which frequently occur in the winter months, barge tows often bump and drag along the south bank requiring considerable backward maneuvering of the towboat to free the barge tow from the bank and to aline it for safe passage through the bridge fenders. These delays on the approach channel would be largely overcome by the proposed channel relocation consisting of flat curves and long tangent approach distance to the bridge. On the basis of data shown in table 7, it is estimated that the total prospective empty barge tows would amount to about 4,800 per year. Records of delay to navigation due to adverse winds are not available; however, in the best judgment of the District Engineer, the benefits from reduction in delays on the relocated channel would approximate $5,700 annually.

e. A total of 56 marine accidents between barge tows and the east approach fender system has occurred during the 6-year period, January 1954 through December 1959. A breakdown of the marine accidents at Mud Bayou railroad bridge indicates that the westbound crossing accidents outnumber the eastbound crossing accidents by about 11 to 1. These accidents have caused total damages in the 6-year period amounting to about $81,000, as shown in the following tabulation:

MARINE COLLISIONS

Year	Number	Damages
1954	8	$ 3,503
1955	15	13,516
1956	8	2,500
1957	6	12,645
1958	9	7,110
1959	10	41,485
	56	$ 80,759

f. Analysis of the reports covering each accident reveals that in most accidents strong winds apparently held the barges to a side of the channel and the towboats were unable to aline the barges

on centerline before reaching the outer edge of the fenders. Several accidents resulted from misunderstood signals. The lack of adequate sight distance to observe conditions on the channel was also a contributing factor. The proposed channel relocation would aid navigation materially in providing adequate sight distance to the bridge. It would also afford additional tangent distance in which to aline better the towboats for safe passage through the bridge. The reported marine collisions have caused an average annual damage of about $13,500. The proposed improved conditions would reduce the number and cost of collisions with the bridge fenders. In the best judgment of the District Engineer the benefits from reduction in hazards to navigation and in collision damage would approximate $8,000 annually.

g. The total benefits from relocation of the east approach channel to the Gulf, Colorado and Santa Fe Railway bridge are estimated at $18,500 annually, of which $4,800 are from savings in transportation costs, $5,700 from reduction in delays to navigation, and $8,000 from reduction in hazards to navigation.

11. Benefits - channel relocation, mile 320.1 to 325.4. The proposed channel relocation between mile 320.1 and 325.4, as described in appendix A will afford substantial benefits to navigation by reducing transportation costs by means of a shorter travel distance and reducing hazards to barge traffic now experienced in traversing the existing channel extending through the High Island oil field.

a. The proposed channel is located 1 mile west of the Gulf, Colorado and Santa Fe Railway bridge. A total of 10,903 barge-tow transits of the bridge was made in 1959. It is estimated that the barge-tow traffic will increase an average of 25% during the life of the proposed channel, amounting to a total of about 13,600 transits, of which it is estimated that 8,800 transits would be loaded barges.

b. The proposed channel is 3,552 feet, or 0.67 miles shorter than the existing channel between the limits of the proposed relocation. The saving in transportation cost, based on speeds and operating costs given in paragraph 5 on the proposed channel as compared to the existing channel, is evaluated at $8.29 per trip for loaded barges and $4.74 a trip for empty barges. The total saving in transportation costs on the prospective transits is estimated at $95,700 annually.

c. Barge tow operation on the existing waterway in this area involves considerable difficulties and hazards in navigating the 9 existing curves having a total length of 2.79 miles. These adverse conditions would be largely eliminated by the proposed channel, which has only two flat curves with total length of about one mile. Elimination of waterway traffic through the oil field would also provide conveniences and economy in development, operation and maintenance of the oil field westward of the existing channel. It

is not possible to establish a firm monetary evaluation of the benefits from improved navigation, increased safety, and convenience to navigation on the proposed channel; however, in the best judgment of the District Engineer these benefits would approximate $6,000 annually. The total benefits from the proposed channel are estimated at $101,700 annually.

12. Benefits - channel relocation in Matagorda Bay. The proposed relocation of the project channel across Matagorda Bay between mile 454.3 and 471.3 is favored by shipping interests because it provides better and safer navigating conditions across the bay. They state that the section of the existing channel paralleling Matagorda Peninsula constitutes a real hazard to navigating this section of the waterway during the occurrence of rough seas due to severe "northers" in the winter season. They state that barge tows are often blown off course with great danger of being grounded on the north shore of the Matagorda Peninsula. The proposed relocation traverses the open bay in a more north-south direction which would eliminate the present cross wind difficulty and would afford better navigating conditions during all seasons of the year. There are no records of barges going aground on Matagorda Peninsula, however, the hazard appears to be real and probable. In addition, the more sheltered conditions along the north mainland shore would improve navigation conditions by affording more efficient towboat operation during "northers," increase safety and provide greater convenience to navigation. These benefits, in the best judgment of the District Engineer, would approximate $4,000 annually.

a. Shipping interests also favor the proposed relocation because it provides a shorter route to Palacios and Port Lavaca for traffic movement to and from eastern ports. The saving in distance for such traffic to and from Palacios would be about 7 miles. In 1959, a total of 102,273 tons of commerce was moved over the channel to Palacios and the last 5-year average amounts to about 93,400 tons of commerce. Most of the tonnage consists of sea shell inbound to Palacios from Matagorda Bay and some ice, fish and seafood products to and from the Gulf of Mexico by way of Freeport and Aransas Pass. It is estimated that on the average about 8,000 tons of commerce annually would benefit by the proposed relocation which would result in a saving in transportation costs of about $200 annually.

b. The saving in distance for traffic between Port Lavaca and eastern ports would be about four miles. An average of about 735,000 tons of commerce moved over the channel to Port Lavaca during the 5-year period 1955 through 1959. About 1,157,000 tons of commerce moved over the channel in 1959 of which about 287,000 tons was local movement of sea shells, and 444,000 tons of crude petroleum moved to eastern ports. Miscellaneous products to and from eastern ports amounted to about 42,000 tons. It is estimated that 486,000 tons could move on the proposed channel through Palacios Point at a saving of about $5,000 annually.

c. The total benefits from the proposed relocation of the channel across Matagorda Bay are estimated at $9,200 annually, of which $5,200 are savings in transportation costs, and $4,000 from reduction in hazards to navigation.

13. Benefits - channel relocation in Corpus Christi Bay. The proposed relocation of the project channel across Corpus Christi Bay would afford substantial benefits to navigation by reducing transportation costs resulting from the shorter distance of travel between ports north of and south of Corpus Christi Bay. In addition, some benefit to navigation would be provided by reducing the number and amount of curves of the channel by eliminating considerable barge traffic from the Port Aransas-Corpus Christi Waterway, and by affording easy and safe navigation.

a. In 1956, the commerce on the section of the waterway between the Port Aransas-Corpus Christi Waterway and Brownsville amounting to about 903,000 tons was handled by 723 barges eastbound and 694 barges westbound, representing approximately 708 barge-tow transits. Practically all of these barge transits would have benefited by the proposed channel. In 1959, a total of about 1,063,000 tons of commerce was moved over this waterway with 1,177 barge-tow transits. The prospective barge tows operating on the channel are estimated at 1,470 annually. In the open bay waters, the barge tows operate at an average speed of about 7 miles per hour when light and 5 miles per hour when loaded. About 30% of the barge tows are empty and 70% are loaded. The relocation would save 2.06 miles travel distance for all traffic. The average cost of operating barge tows is estimated at $49.48 per hour. On the above basis, the saving in transportation costs of the prospective barge tows is estimated at a total of $27,400, of which $6,400 is from operation of empty barge tows and $21,000 is from operation of loaded barge tows.

b. It is not possible to establish a firm monetary evaluation of the benefits from improved navigation, increased safety, and convenience to navigation on the proposed channel as compared to navigation on the existing channel. However, in the best judgment of the District Engineer these benefits would approximate $2,500 annually. The total benefits from the proposed channel are estimated at $29,900, of which $27,400 is savings in cost of transportation and $2,500 is convenience and increased safety to navigation.

14. Benefits - channel relocation at Port Isabel, Texas. The lack of adequate tangent sight distance to the Cameron County Causeway swing bridge at Port Isabel is a definite hazard to navigation which would be corrected by the proposed channel relocation. The added tangent distance would also provide better navigating conditions to aid in overcoming the adverse currents through the bridge, and to eliminate marine accidents at the bridge. Conditions make impracticable a firm monetary evaluation of the benefits to be

derived from the improved navigating conditions on the proposed channel. The District Engineer is of the opinion that the adverse conditions on the existing approach channel are such that further expenditures for enlargement of the existing channel are not warranted. He is of the opinion that relocation of the approach channel should be included in the plans of improvement providing for enlarging the main channel from Corpus Christi to Brownsville. Accordingly, relocation of the approach channel is incorporated in the plans for enlargement of the main channel. The benefits from the proposed channel relocation are estimated to be equal to the annual charges for the proposed channel relocation estimated at $15,000.

15. Economic analysis of waterway improvements. The economic analysis of the various main-stem channels studied is summarized in table 3.

16. Need for additional widening. a. Under present conditions the tows composed of two 35 x 195-foot barges make about 5.7 miles per hour in the existing channel, and the tows composed of three 50 x 250-foot barges make about 4.7 miles an hour, when not forced to reduce speed because of other factors. When passing other tows and vessels, it is generally necessary that speed be reduced and the passing made as accurately as possible. In times of heavy fog, on exceptionally windy days, or during periods of storm tows must cease operations. Consequently, the actual speed of tows over the waterway is somewhat less than the theoretical speed, however, any estimate as to the amount of reduction would be strictly arbitrary. Therefore, the theoretical speed was used in all computations.

b. In an enlarged channel tows will still have to slow down when passing other vessels and tows. In times of exceptionally bad weather, vessels will have to cease operations as at present. Consequently, as in the case of the 12 x 125-foot channel, the theoretical speed will not be realized in actual practice, and the losses will approximate those now being experienced. Therefore, no adjustment was attempted.

c. It is believed that benefits which might be realized from additional widening of the channel beyond that now recommended will not be sufficient to warrant such widening.

17. Incremental justification of channel widening at bridges and locks. a. The benefits to be realized from the alteration of bridges and the improvement of the channel through altered bridges were analyzed on an incremental basis for an existing bridge. The bridge selected for analysis was the pontoon bridge at mile 35.0. The selection of a pontoon bridge resulted in a very small expenditure for the removal of the existing bridge, and consequently, resulted in a better benefit-cost ratio than would be derived if a substantial existing bridge, such as the swing bridge at mile 12.5, were used. In order to insure

sustained speed through a bridge, it was necessary to consider the removal of all piers from within the waterway and it was also necessary to consider that the replacement bridge be high level so that no delay would be necessitated by an approaching tow having to signal for an opening of the bridge. The details, first costs and annual charges of the bridge alteration and improvement of the channel are given in appendix A. The total annual charges amount to $138,000.

b. The benefits to be realized by navigation from the bridge alteration are outlined in the following paragraphs:

(1) The present total average annual traffic through this bridge is 9,418,000 tons. It is estimated that a time delay of about 8 minutes is occurring at this bridge at the present time. This delay is brought about by tows approaching the bridge, signalling, and then slowing down on the approach and then traveling at reduced speed for a considerable distance before regaining normal speed. This delay results in the following costs a ton for the 2-barge and 3-barge tows:

Cost of navigating through the present bridge

Length of unimproved reach	0.4 mile
Speed of tow through reach (0.4 mile in 8 minutes)	3.0 mph
Cost a ton-mile for 3-barge tow $\frac{(\$65.74)}{(7680 \times 3)}$	2.85 mills
Cost a ton-mile for 2-barge tow $\frac{(\$35.53)}{(2770 \times 3)}$	4.28 mills
Tonnage handled by 3-barge tows (9,418,000 x 0.6)	5,651,000 tons
Ton-mileage handled by 3-barge tows (5,651,000 x 0.4)	2,260,000 ton-miles
Tonnage handled by 2-barge tows (9,418,000 x 0.4)	3,767,000 tons
Ton-mileage handled by 2-barge tows (3,767,000 x 0.4)	1,507,000 ton-miles
Total cost for 3-barge tows (2,260,000 x 2.85 mills)	$6,442
Total cost for 2-barge tows (1,507,000 x 4.28)	$6,449
	$12,891

Cost of navigating through reach without bridge piers in the waterway, but with a 16 x 150-foot channel

Cost a ton-mile for 3-barge tow (par. 5b)	1.48 mills	
Cost a ton-mile for 2-barge tow (par. 5b)	1.95 mills	
Total cost for 3-barge tows	$3,345	
Total cost for 2-barge tows	$2,938	
Total cost for 2-barge and 3-barge tows	$6,283	
Saving accruing from alteration of bridge and improvement of channel ($12,891 - $6,283)		$6,608

(2) The benefit-to-cost ratio for the alteration is 0.05 to 1.

c. Modification of the locks cannot be accomplished so that delays to tows will be eliminated. The only needs for modification of the locks would be: (1) if the depths over the sills were inadequate or would become inadequate for prospective traffic; (2) if the physical size of the locks were inadequate to care for the size of the tows being operated on the waterway; and (3) if the locks were physically unable to accommodate the number of bottoms which might desire lockage in the future.

d. No evidence is available to indicate any decided trend toward deeper draft for craft using the waterway (see par. 13b of report). A slight increase in the bottoms drawing over 9 feet has occurred since 1947, the year in which offshore oil exploration began. The increase is attributable to the equipment used in the offshore oil industry which utilizes the Gulf Intracoastal Waterway for only short distances to and from supply points and building and repair yards before using one of the tributary streams to and from the Gulf of Mexico. A study of the number of the vessels with the deeper drafts reveals that the number of vessels of deeper draft showed a decided decrease during the years 1952-1954 when a moratorium was placed on exploratory drilling for oil in the Gulf of Mexico. This fact confirms the nature of the vessels contributing to the number of those vessels drawing over 9 feet. Vessels in the offshore development do not contribute appreciably to the through traffic of the waterway, using tributary channels to and from the Gulf of Mexico. No alteration of the existing locks is warranted by the prospects of increased depths of cargo-carrying equipment, or because of craft being utilized in the offshore oil industry.

e. The number of tons of cargo which can be carried in a tow is not dependent on the mere availability of the cargo, or on

the quantity to be moved in a year. Many factors influence the size of tows operating over the Gulf Intracoastal Waterway. Among these factors are: (1) number of tons to be moved between two points; (2) storage facilities existing at both ends of the movement which govern the accumulation of tonnage at the point of origin as well as determine the amount which can be handled and stored at destination; (3) urgency; and (4) competition. Under present conditions most of the movements taking place on the Gulf Intracoastal Waterway are in tows which are considerably less than the maximum size of tows allowed on the waterway. The fact that the great majority of tows are considerably less than the maximum legal size indicates that factors which contribute to the size of the tow are heavily weighted in favor of the smaller tow. No radical change from the past or present pattern is indicated. The tonnages of the various commodities handled over the various reaches of the main channel of the Gulf Intracoastal Waterway and their percentage of the total are shown below:

Commodity	Miss. River to Sabine River		Sabine R. to Galveston		Galveston to Corpus Christi		Corpus Christi to Brownsville	
	Tons[1]	%	Tons[1]	%	Tons[1]	%	Tons[1]	%
Petroleum and products	21,600	63.3	16,100	69.7	5,000	63.3	800	72.7
Iron, steel, metal	2,200	6.5	1,500	6.5	600	7.5	-	-
Sulphur	800	2.3	700	3.0	-	-	-	-
Non-metallic minerals	1,900	5.6	500	2.2	100	1.3	300	27.3
Sea shells	3,600	10.6	1,800	7.8	1,300	16.5	-	-
Chemicals and products	2,400	7.0	2,000	8.6	700	8.9	-	-
Other	1,600	4.7	500	2.2	200	2.5	-	-
Totals	34,100	100.0	23,100	100.0	7,900	100.0	1,100	100.0

[1]Thousands of tons

f. Factors which limit the size of tows will be operative on all commodities. The only ones which might be capable of some expansion in makeup of tows would be some commodities moving on common carrier rates. These commodities would be included under the general heading of "Other," which makes up only a small percentage of the total tonnage. From a practical standpoint, factors which tend to limit the

size of bulk tows will also tend to limit the tonnage in the tows of common carriers. The major limiting factors in this connection will be the tonnage to be handled between the origin and destination, and competition.

g. The remaining reason for modification of the locks would be the inadequacy of the locks to accommodate tows of sufficient size and number to adequately care for the prospective traffic. The total prospective tonnages in each reach of the waterway in the final year of the 50-year life of the waterway are shown below:

Reach	Tonnage
Mile 0.0 - 6.4	5,947,000
Mile 6.4 to Atchafalaya River (mile 95.5)	20,259,000
Atchafalaya River (mile 95.5) to Sabine River (mile 266.0)	41,013,000
Sabine River to Houston Ship Channel	35,143,000
Houston Ship Channel to Port Aransas-Corpus Christi Waterway	9,963,000
Port Aransas-Corpus Christi Waterway to Brownsville	1,668,000
Algiers Canal	14,310,000
Plaquemine-Morgan City Route, as modified	8,715,000

(1) The lock which affords access to the reach from mile 0.0 to mile 6.4 is Harvey Lock which connects the Intracoastal Waterway to the Mississippi River. Harvey Lock prior to the completion of the Algiers Lock in 1956 handled a maximum of about 15,289,000 tons in 1955; therefore, the anticipated 5,947,000 tons can be adequately accommodated by the existing lock at Harvey.

(2) Bayou Boeuf Lock at mile 93.5 west of Harvey Lock is the only lock in the reach between mile 6.4 and the Atchafalays River (mile 95.5). The theoretical maximum number of lockages which this lock can handle (based on 15 minutes a lockage) is about 35,000 annually. Bayou Boeuf Lock handled a total of 14,871,000 tons in 15,798 lockages in 1955; and in 1959 handled 11,534,000 tons in 5,841 lockages. The difference in the number of lockages between 1955 and 1959 is accounted for by a change in the regulations for the operation of this lock. The lock is now closed only when the flow of water is from the east to the west. As a result of this policy, the lock remains open for the better part of

the day. Bayou Boeuf Lock, therefore, can take care of the prospective tonnage without difficulty.

(3) In the reach between the Atchafalaya River (mile 95.5) and the Sabine River (mile 266.0) two locks are located. These locks are the Vermilion Lock at mile 162.7 and Calcasieu Lock at mile 238.9 west of Harvey Lock. In 1957, Vermilion handled a total of 19,159,000 tons in 4,922 lockages while in 1959, it handled 18,855,000 tons in 7,769 lockages. In 1959, Calcasieu Lock handled 21,763,000 tons in 7,133 lockages. The maximum theoretical number of lockages in a year at both Vermilion and Calcasieu Locks is about 35,000 (same as at Bayou Boeuf Lock). There is no reason to believe that either of these locks will be unable to accommodate the prospective tonnage.

(a) Vermilion Lock is scheduled for replacement in the fiscal years 1963 and 1964 at a total estimated cost of $5,200,000. The reason for replacement of this lock is that the 56-foot width of the lock is not compatible with the 75-foot width of other locks on the main stem of the Gulf Intracoastal; the gates are tumble-type, and the depth over the gate when lowered is only 11.3 feet at mean low gulf level.

(4) No lock is located in the reach between the Sabine River (mile 266.0) and the Houston Ship Channel (mile 350.75).

(5) In the reach between the Houston Ship Channel (mile 350.75) and the Port Aransas-Corpus Christi Waterway (mile 538.0), there are two control structures: the Brazos River Floodgates between mile 404 and mile 404.5; and the Colorado River Locks at mile 444.7 and mile 445.4. The floodgates and the locks are capable of caring for the maximum prospective tonnage without difficulty.

(6) The Algiers Lock which connects the Algiers Canal to the Mississippi River is capable of handling more tonnage annually than the Harvey Lock and can care for the maximum prospective tonnage of 14,310,000 annually without undue delay to marine traffic.

(7) The Plaquemine-Morgan City Route, as modified, will have two locks when completed. One lock, the Bayou Sorrel Lock, is located at mile 36.7 above Morgan City, and the Port Allen Lock at mile 64.1 above Morgan City, when completed, will provide a connection with the Mississippi River. These locks will have no trouble in accommodating the prospective traffic which is expected to develop on this reach, as they will have approximately the same capabilities as other similar locks on the waterway.

(8) The capacities of both the Colorado River locks and the Brazos River floodgates are adequate to accommodate the total prospective commerce in the Houston Ship Channel-Corpus Christi section with little or no interference other than that now experienced

by existing traffic. At the Brazos River floodgates, existing vessel traffic is delayed during periods of high water when the structure's sector gates cannot be opened because of the head differential between the water in the river and that in the waterway. A study is now in progress to determine whether the delays being experienced at this time are sufficient to warrant the construction of locks. If locks are found warranted, they can be constructed under the existing authority for the waterway which authorizes such structures. The principal delay that would be encountered at the Colorado River locks is the time required to break up tows and move barges singly across the river because of extreme currents. Again, the need to lock vessels at the Colorado River is infrequent and the delays experienced to date are insufficient to warrant consideration of further improvements.

TABLE 1

COMPUTATION OF ANNUAL BENEFITS BY REACHES ACCRUING FROM ENLARGEMENT OF GULF INTRACOASTAL WATERWAY TO DIMENSIONS OF 16X150 FEET

	Mile 0 to Mile 6.4	Mile 6.4 to Atch.River	Atch. River to Sabine River	Sabine River to Houston Ship Chan.
Petroleum tonnage				
First year-tons	1,936,000	6,593,000	13,348,000	11,436,000
Present worth factor-first 26 yrs	20.6576	20.6576	20.6576	20.6576
Present worth-tons	39,993,000	136,196,000	275,738,000	236,240,000
Tonnage 27th to 50th years-tons(1)	4,052,000	13,804,000	27,946,000	23,946,000
Present worth factor	3.88073	3.88073	3.88073	3.88073
Present worth 27th to 50th years-tons	15,725,000	53,570,000	108,451,000	92,928,000
Total present worth	55,718,000	189,766,000	384,189,000	329,168,000
Other tonnage				
First year-tons	830,000	2,825,000	5,721,000	4,901,000
Present worth factor-50 yrs	25.37268	25.37268	25.37268	25.37268
Present worth-tons	21,059,000	71,678,000	145,157,000	124,351,000
Total present worth	76,777,000	261,444,000	529,346,000	453,519,000
Forward spreading factor	.05478	.05478	.05478	.05478
Average annual tonnage	4,206,000	14,322,000	28,998,000	24,844,000
Length of haul-miles	6.4	89.1	170.5	84.4
Average annual ton-miles	26,918,000	1,276,090,000	4,944,159,000	2,096,896,000
Saving in mills per ton-mile	.32	.32	.32	.32
Average annual savings-dollars	8,615	408,350	1,582,150	671,000

(1)First year tonnage times $(1.03)^{25}$

TABLE 1 (cont'd)
COMPUTATION OF ANNUAL BENEFITS BY REACHES ACCRUING FROM ENLARGEMENT OF GULF INTRACOASTAL WATERWAY TO DIMENSIONS OF 16X150 FEET

	Houston Ship Channel to Port Aransas-Corpus Christi Waterway	Port Aransas-Corpus Christi Waterway to Brownsville	Algiers Canal	Plaquemine-Morgan City Alt. Route
Petroleum tonnage				
First year-tons	3,241,000	544,000	4,657,000	2,835,000
Present worth factor-first 26 yrs	20.6576	20.6576	20.6576	20.6576
Present worth-tons	66,951,000	11,238,000	96,202,000	58,564,000
Tonnage 27th to 50th years-tons(1)	6,789,000	1,137,000	9,751,000	5,940,000
Present worth factor	3.88073	3.88073	3.88073	3.88073
Present worth 27th to 50th yrs-tons	26,346,000	4,412,000	37,841,000	23,052,000
Total present worth	93,297,000	15,650,000	134,043,000	81,616,000
Other tonnage				
First year-tons	1,389,000	233,000	1,996,000	1,215,000
Present worth factor-50 yrs	25.37268	25.37268	25.37268	25.37268
Present worth-tons	35,243,000	5,912,000	50,644,000	30,828,000
Total present worth	128,540,000	21,562,000	184,687,000	112,444,000
Forward spreading factor	.05478	.05478	.05478	.05478
Average annual tonnage	7,041,000	1,181,000	10,117,000	6,160,000
Length of haul-miles	189.3	144.4	8.5	64.1
Average annual ton-miles	1,332,861,000	170,536,000	85,995,000	395,112,000
Saving in mills per ton-mile	.32	.32	.32	.32
Average annual savings-dollars	426,500	54,550	27,500	126,450

(1) First year tonnage times $(1.03)^{25}$

TABLE 2

REDUCTION FACTORS

Overbank depth feet	Mile	Eff. factor	Reduction factor	Reduced mile
Port Arthur - Houston Ship Channel				
0	57.8	.801	1.000	57.8
0-2	1.5	.805	.995	1.5
2-4	1.0	.817	.980	1.0
10-12	.1	.893	.885	.1
12-14	.1	.893	.885	.1
14-16	.1	.893	.885	.1
16 and over	0.8	.919	.853	.7
Total	61.4	.804	0.996	61.3
Houston Ship Channel - Port Aransas-Corpus Christi Waterway				
0	113.8	.801	1.000	113.8
0-2	27.2	.805	.995	27.1
2-4	13.3	.817	.980	13.0
4-6	9.4	.832	.961	9.0
6-8	1.4	.867	.918	1.3
8-10	5.2	.893	.885	4.6
10-12	6.9	.893	.885	6.1
12-14	11.8	.893	.885	10.4
14-16	0.2	.893	.885	.2
16 and over	0.1	.919	.853	.1
Total	189.3	.816	.981	185.6
Port Aransas - Corpus Christi Waterway - Port Isabel				
0	29.2	.801	1.000	29.2
0-2	26.9	.805	.995	26.8
2-4	32.2	.817	.980	31.6
4-6	12.5	.832	.961	10.4
6-8	15.0	.867	.918	13.8
8-10	4.9	.893	.885	4.3
10-12	0.6	.893	.885	.5
12-14	6.4	.893	.885	5.7
Total	127.7	.825	.970	122.3

TABLE 3

COMPARISON OF ANNUAL BENEFITS AND ANNUAL CHARGES FOR IMPROVEMENT OF THE GULF INTRACOASTAL WATERWAY, MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS; THE PLAQUEMINE-MORGAN CITY ROUTE (AS MODIFIED); AND THE ALGIERS ALTERNATE CANAL

SECTIONS OF THE GULF INTRACOASTAL WATERWAY[1]

Channel size and items	Miss.-Atch. River	Atch.-Sabine River	Sabine River-Houston Ship Channel[2]	Houston Ship Channel-Port Aransas-Corpus Christi Waterway[3]	Port Aransas-Corpus Christi Waterway-Brownsville[4]	Plaq.-Morgan City Route (As Modified)	Algiers Alternate Canal
	$	$	$	$	$	$	$
14x150-foot							
First cost	4,290,000	7,260,000	3,912,000	12,123,000	10,419,000	3,952,000	
Annual benefits	266,000	908,000	461,000	295,000	78,000	87,000	16,000
Annual charges	187,000	308,000	169,000	645,000	471,000	155,000	
Benefit-cost ratio	1.4 to 1	2.9 to 1	2.7 to 1	0.46 to 1	0.16 to 1	0.56 to 1	
16x150-foot							
First cost	6,260,000	9,930,000	5,442,000	16,237,000	13,602,000	5,726,000	271,000
Annual benefits	379,000	1,292,000	605,000	417,000	93,000	124,000	23,000
Annual charges	258,000	404,000	225,000	802,000	587,000	219,000	11,000
Benefit-cost ratio	1.5 to 1	3.2 to 1	2.7 to 1	0.52 to 1	0.16 to 1	0.57 to 1	2.1 to 1
16x200-foot							
First cost	10,750,000	15,730,000	9,273,000	-	-	-	-
Annual benefits	465,000	1,595,000	719,000	-	-	-	-
Annual charges	431,000	632,000	385,000	-	-	-	-
Benefit-cost ratio	1.1 to 1	2.5 to 1	1.9 to 1	-	-	-	-

TABLE 3 (cont'd)

COMPARISON OF ANNUAL BENEFITS AND ANNUAL CHARGES FOR IMPROVEMENT OF THE GULF INTRACOASTAL WATERWAY, MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS; THE PLAQUEMINE-MORGAN CITY ROUTE (AS MODIFIED); AND THE ALGIERS ALTERNATE CANAL

SECTIONS OF THE GULF INTRACOASTAL WATERWAY[1]

Channel size and items	Miss.-Atch. River	Atch.-Sabine River	Sabine River-Houston Ship Channel[2]	Houston Ship Channel-Port Aransas-Corpus Christi Waterway[3]	Port Aransas-Corpus Christi Waterway-Brownsville[4]	Plaq.-Morgan City Route (As Modified)	Algiers Alternate Canal
	$	$	$	$			
16x250-foot							
First cost	16,490,000	24,030,000	12,770,000	-	-	-	-
Annual benefits	548,000	1,877,000	825,000	-	-	-	-
Annual charges	647,000	950,000	535,000	-	-	-	-
Benefit-cost ratio	0.9 to 1	2.0 to 1	1.5 to 1	-	-	-	-
16x300-foot							
First cost	22,240,000	32,730,000	15,474,000	-	-	-	-
Annual benefits	618,000	2,120,000	916,000	-	-	-	-
Annual charges	897,000	1,350,000	656,000	-	-	-	-
Benefit-cost ratio	0.7 to 1	1.6 to 1	1.4 to 1	-	-	-	-

[1]Excludes improvement from Harvey Lock (mile 0.0) to mile 5.0, the section through Houma, La. (mile 55.0 to mile 61.0), and other reaches listed in table 1, appendix A.

[2]Includes benefits of $120,200 for two relocations of the existing 12x125-foot channel.

[3]Includes benefits of $ 9,200 for one relocation of the existing 12x125-foot channel.

[4]Includes benefits of $ 44,900 for two relocations of the existing 12x125-foot channel.

TABLE 4

COMPARISONS OF INCREMENTAL ANNUAL BENEFITS AND INCREMENTAL ANNUAL CHARGES FOR IMPROVEMENT OF THE GULF INTRACOASTAL WATERWAY, MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS

SECTIONS OF THE GULF INTRACOASTAL WATERWAY[1]

Channel size and items	Mississippi-Atchafalaya River	Atchafalaya-Sabine River	Sabine River-Houston Ship Channel	Houston Ship Channel-Port Aransas-Corpus-Christi Waterway	Corpus Christi Waterway-Brownsville
	$	$	$	$	$
14x150-foot[2]					
Annual benefits	266,000	908,000	461,000	295,000	78,000
Annual charges	187,000	308,000	169,000	638,000	471,000
Benefit-cost ratio	1.4 to 1	2.9 to 1	2.7 to 1	0.46 to 1	0.16 to 1
16x150-foot[3]					
Annual benefits	113,000	384,000	144,000	-	-
Annual charges	71,000	96,000	56,000	-	-
Benefit-cost ratio	1.6 to 1	4.0 to 1	2.6 to 1	-	-
16x200-foot[4]					
Annual benefits	86,000	303,000	114,000	-	-
Annual charges	173,000	228,000	160,000	-	-
Benefit-cost ratio	0.5 to 1	1.3 to 1	0.71 to 1	-	-
16x250-foot[5]					
Annual benefits	83,000	282,000	-	-	-
Annual charges	216,000	318,000	-	-	-
Benefit-cost ratio	0.4 to 1	0.9 to 1	-	-	-

TABLE 4 (cont'd)

COMPARISONS OF INCREMENTAL ANNUAL BENEFITS AND INCREMENTAL ANNUAL CHARGES FOR IMPROVEMENT OF THE GULF INTRACOASTAL WATERWAY, MISSISSIPPI RIVER TO BROWNSVILLE, TEXAS

SECTIONS OF THE GULF INTRACOASTAL WATERWAY[1]

Channel size and items	Mississippi-Atchafalaya River	Atchafalaya-Sabine River	Sabine River-Houston Ship Channel	Houston Ship Channel-Port Aransas-Corpus-Christi Waterway	Corpus Christi Waterway-Brownsville
	$	$	$	$	$
16x300-foot[6]					
Annual benefits	-	-	-	-	-
Annual charges	-	-	-	-	-
Benefit-cost ratio	-	-	-	-	-

[1]Excludes improvement from Harvey Lock (mile 0.0) to mile 5.0, the section through Houma, La. (mile 55.0 to mile 61.0), and other reaches listed in table 1, appendix A.

[2]Incremental benefits and annual charges over existing 12x125-foot channel.

[3]Incremental benefits and annual charges over 14x150-foot channel.

[4]Incremental benefits and annual charges over 16x150-foot channel.

[5]Incremental benefits and annual charges over 16x200-foot channel.

[6]Incremental benefits and annual charges over 16x250-foot channel.

TABLE 5

COMPARISONS OF ANNUAL BENEFITS AND ANNUAL CHARGES FOR PROVIDING A 16 X 150-FOOT BYPASS CHANNEL BETWEEN MILE 50.5 AND MILE 63.5 OF THE GULF INTRACOASTAL WATERWAY AT HOUMA, LA.

Item	16 x 150-foot channel with high-level, fixed bridges	16 x 150-foot channel with low-level, movable bridges
First cost	$ 9,465,000	$ 5,067,000
Annual benefits[1]	479,000	390,000
Annual charges	482,500	278,000
Benefit-cost ratio	0.99 to 1	1.4 to 1

[1]Includes $227,000 navigation benefits.

TABLE 6

COMPARISONS OF ANNUAL BENEFITS AND ANNUAL CHARGES FOR PROVIDING A 16 X 150-FOOT CHANNEL FROM THE MISSISSIPPI RIVER TO THE ATCHAFALAYA RIVER WITH THE HOUMA BYPASS ROUTE IN PLACE BETWEEN MILE 50.5 AND MILE 63.5

Item	Mississippi River to the Atchafalaya River (Mile 5.0 to mile 50.5 and mile 63.5 to mile 95.5)	Houma Bypass Route with swing bridges
First cost	$ 5,515,000	$ 5,070,000
Annual benefits	345,000	390,000
Annual charges	229,000	278,000
Benefit-cost ratio	1.5 to 1	1.4 to 1

TABLE 7

COMPOSITION AND TRIPS OF VESSEL TRAFFIC THROUGH GULF, COLORADO AND SANTA FE RY BRIDGE, MILE 319.1 AND COLORADO RIVER LOCKS, MILE 441.3 - JANUARY THROUGH DECEMBER 1959

Composition of vessel traffic	Trips of vessel traffic							
	Eastbound			Westbound			Grand total	Percent
	Loaded	Light	Total	Loaded	Light	Total		
Gulf, Colorado and Santa Fe Ry Bridge								
MV & tugs	700	-	700	765	-	765	1,465	13
1-barge tow	755	487	1,242	589	659	1,248	2,490	23
2-barge tow	1,298	846	2,144	1,077	963	2,040	4,184	38
3-barge tow	509	394	903	517	334	851	1,754	16
4-barge tow	250	29	279	156	112	268	547	5
5-barge tow	112	22	134	97	8	105	239	2
6-barge tow	41	6	47	67	3	70	117	1
7-barge tow	17	7	24	31	1	32	56	1
8-barge tow	13	10	23	28	-	28	51	1
Total	3,695	1,801	5,496	3,327	2,080	5,407	10,903	100
Colorado River Locks								
MV & tugs	62	-	62	16	-	16	78	2
1-barge tow	500	154	654	181	567	748	1,402	35
2-barge tow	949	82	1,031	168	760	928	1,959	48
3-barge tow	263	14	277	38	233	271	548	14
4-barge tow	20	2	22	5	17	22	44	1
5-barge tow	5	-	5	1	-	1	6	-
6-barge tow	3	2	5	4	-	4	9	-
Total	1,802	254	2,056	413	1,577	1,990	4,046	100

TABLE 8

ESTIMATED COST PER BARGE-TOW OPERATION ON EXISTING AND PROPOSED EAST APPROACH CHANNEL TO GULF, COLORADO SANTA FE RAILWAY BRIDGE NEAR HIGH ISLAND

EXISTING CHANNEL CONDITIONS

Channel, 12 feet deep by 125 feet wide.

Total length, 13,714 feet, including 2,764 feet of curve and tangent distance to bridge which is traversed at one-half speed.

Estimated cost of barge tow operation via existing channel between limits of proposed relocation.

a. Time required for one transit on existing channel between limits of proposed channel relocation.

(1)	10,950 feet at 7 miles per hour	0.296 hours
(2)	2,764 feet at 3½ miles per hour	0.150 hours
(3)	Total time	0.446 hours

b. Cost of operating barge tow for one transit on existing channel between limits of proposed channel relocation.

(1) 0.446 hours at $49.48 per hour - $22.06

PROPOSED CHANNEL CONDITIONS

Channel, 12 feet deep by 125 feet wide.

Total length, 15,120 feet, including flat curve and tangent distance to bridge which can be traversed at full speed.

Estimated cost of barge tow operation via proposed channel between limits of proposed channel relocation.

a. Time required for one transit on improved channel between limits of proposed channel relocation.

(1) 15,120 feet at 7 miles per hour 0.409 hours

b. Cost of operating barge tow for one transit on improved channel between limits of proposed channel relocation.

(1) 0.409 hours at $49.48 per hour - $20.23

APPENDIX C

UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service

OFFICE OF REGIONAL DIRECTOR
Peachtree-Seventh Building
Atlanta 23, Georgia

District Engineer
Corps of Engineers, U. S. Army
New Orleans, Louisiana

August 8, 1956

Dear Sir:

This letter constitutes the preliminary report by the Fish and Wildlife Service on the Corps of Engineers' authorized plan for further development of the Gulf Intracoastal Waterway in the section of Louisiana from the Mississippi River west to the Sabine River. These comments were prepared at your request and pursuant to the Act of August 14, 1946 (60 Stat. 1080).

The section of the Intracoastal Waterway under consideration is for the most part a constructed channel through the coastal area. It passes in close proximity to the following major cities: New Orleans, Houma, Morgan City, and Lake Charles, all in Louisiana, and Orange, Texas. Under the existing project the channel is maintained to 12-foot depth and 125-foot width. The project now under study by the Corps of Engineers consists of enlarging and deepening the existing channel and providing a cutoff to bypass the City of Houma. Dimension of the enlarged channel is tentatively set at 18 x 150 feet, according to a letter from you dated March 6, 1956.

Marsh types, as defined in a publication of the Louisiana Wild Life and Fisheries Commission, through which the channel passes are freshwater marsh, floating fresh marsh, floating three-corner grass marsh, and saw-grass marsh. Above the marsh zone the lands are mainly agricultural with scattered woodlands occupying the wetter sites. The general distribution of marsh types is shown on Plate 1.

Fish and wildlife resources in the vicinity of the Intracoastal Waterway are of major regional and national importance. The waterway passes through valuable waterfowl habitat in many reaches and bisects the Lacassine National Migratory Waterfowl Refuge. Deer and rabbits are also present in important numbers in several areas. Commercial harvest of fur animals is high in most reaches of the marsh adjacent to the project. Fishery resources are moderate to high in the waterway and in adjacent open waters.

Effect of channelization on the marsh has already occurred with the excavation of the original channel and the marsh types now prevailing are an expression of soil and water conditions with the waterway in operation. Enlargement of the channel will in itself not significantly affect fish and wildlife resources. However, spoil resulting from excavation would seriously decrease wildlife values in adjacent marshes if it were promiscuously dumped. Specific information as to type of equipment to be used or the manner of spoil deposition is not available from the planning agency, so that accurate appraisal of effects upon fish and wildlife resources is not possible. The new channel to be excavated as a bypass around the City of Houma would pass through an area largely devoted to agriculture. Effects upon fish and wildlife resources would be relatively minor.

As previously stated, major concern of fish and wildlife interests in this project is with the probable effects of spoil deposition on the marshlands contiguous to the waterway. If spoil were placed according to the need of fish and wildlife resources in individual marsh areas, much of the detrimental affect of the project would be eliminated and in all probability wildlife habitat in general would be improved. Along the length of the proposed project there are six marsh types which, in general, must be treated as separate units in discussion of spoil deposition. The desires of landowners would be a deciding factor as to whether the marsh would be utilized in the best interests of fish and wildlife production or for some other purpose.

A generalized discussion of spoil placement in the affected marsh types is presented below. The areas of each marsh type in the vicinity of the Intracoastal Waterway are outlined on the appended map, Plate 1.

Of first consideration is the type of equipment to be used in enlargement of the channel. Excavation by boom-type equipment would be less detrimental to fish and wildlife habitat as compared to hydraulic work in that less marsh would be affected by sedimentation. Also, spoil could be more effectively placed to provide management in the marsh.

Deposition of spoil in the areas of fresh-water marsh type should be designed to improve conditions for the important wildlife species now utilizing this habitat, principally nutria, mink, raccoon, and wintering waterfowl. Where landowners desire that wildlife resources be improved, spoil generally should be deposited on the north bank of the channel in a continuous levee. Earthen material should be used to plug drains originating in the marsh interior.

Generally, in floating fresh marsh, excessively drained salt marsh, and saw-grass marsh types, deposition of spoil along both banks of the channel in continuous levees is preferred where the

landowner desires increased production of wildlife resources on his property. Here again, drains originating in the marsh interior should be plugged with earthen material.

The remaining two marsh types to be affected, floating three-corner grass marsh and brackish three-corner marsh grass, are generally the most productive muskrat habitat along the Louisiana coast. Spoil placement should be designed to preserve the existing drainage pattern and water conditions in the general area. Deposition of spoil equally along both sides of the channel in a discontinuous levee, with care to leave drainways unobstructed, would be desired.

The above discussion of desirable spoil placement along the Intracoastal Waterway is generalized for the major areas of marsh types through which the channel passes. Within any zone of marsh outlined there are undoubtedly many local areas that differ from the whole and would necessarily require treatment more specific to its needs. Such specification would commence as detailed engineering plans are being drawn and continue through the construction period.

In the reach of the channel that bisects the Lacassine National Wildlife Refuge, the Service, as the landowner, desires that spoil be placed in a continuous levee along the south bank of the channel. The spoil bank would facilitate development of a permanent waterfowl pool in the southern portion of the refuge. Design and construction of the project also should take into consideration the existing water-control structures and levees to the north of the channel to insure that the structures would not be jeopardized by project construction.

In summary, the Fish and Wildlife Service concludes that effects of the project will depend upon the type of equipment utilized to enlarge the waterway and method of spoil disposal.

The Service, therefore, recommends that: (a) boom-type equipment be utilized for excavation; (b) the District Engineer advise the Service and Louisiana Wild Life and Fisheries Commission when preparation of detailed contract specifications is initiated so that fish and wildlife requirements may be discussed with Corps representative who will prepare such specifications; (c) the Service and Louisiana Wild Life and Fisheries Commission be given the opportunity to conduct adequate field studies after the proposed realignment of channel segments is staked out on the ground; (d) contract specifications not be completed for about 8 months when present studies of this project will be completed by the Louisiana Wild Life and Fisheries Commission; (e) specific recommendations on spoil deposition and dike formation following these studies be included in the detailed contract specifications; and (f) a representative of the Service or the Louisiana Wild Life and Fisheries Commission be assigned to the construction job to advise the contracting

party or parties relative to the execution of those provisions in the contract which concern the conservation and development of fish and wildlife resources, the cost of this service to be assigned to the project.

Please advise me of your views and proposed action on the above recommendations.

Sincerely yours,

H. W. Terhune
Acting Regional Director

UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
P. O. Box 1306
Albuquerque, New Mexico

July 19, 1960

District Engineer
U. S. Army, Corps of Engineers
P. O. Box 1229
Galveston, Texas

Dear Sir:

This letter constitutes the report of the Bureau of Sport Fisheries and Wildlife for the Corps of Engineers' survey report which will consider the feasibility of deepening and relocating portions of the Gulf Intracoastal Waterway from the vicinity of Port Arthur to Corpus Christi, Texas. The Bureau of Sport Fisheries and Wildlife has coordinated this report with the Bureau of Commercial Fisheries; therefore, it represents the views of both agencies. This report has been prepared in accordance with the Fish and Wildlife Coordination Act, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq., in cooperation with the Texas Game and Fish Commission, and has received the concurrence of that agency by letter dated July 8, 1960, signed by H. D. Dodgen, Executive Secretary.

The Gulf Intracoastal Waterway is an existing channel from Apalachee Bay, Florida, to Brownsville, Texas. The section of the Waterway under consideration in this report, for the most part, is from the vicinity of Port Arthur, Texas, westward along the Texas coast to the junction of the Port Aransas-Corpus Christi Waterway. The Waterway has a depth of 12 feet and a bottom width of 125 feet except for a short reach in the deep-draft channel of the Port Aransas-Corpus Christi Waterway.

It is understood that the proposed plan of improvement in Texas is to deepen the Waterway to 18 feet over a bottom width of 125 feet from its junction with the Sabine-Neches Waterway to the Port Aransas Corpus Christi Waterway near Ingleside, Texas, by way of the alternate channel routes in south Galveston Bay and across Redfish Bay. Improvements in the channel will not be made under bridges and through locks and floodgate structures. Channel relocations are proposed in the vicinity of State Highway 124 bridge in Chambers County, mile 317 to mile 319.7, and mile 320.7 to mile 326, and in Matagorda Bay in the vicinity of Oyster Lake, mile 458 to 475.

About 251 miles of the Waterway are in the proposed plan of improvement. Approximately 158 miles are land cut and 83 miles are in open water. About 40 miles of the Waterway will be relocated and abandoned and replaced by about 42 miles of new cut channel. Approximately 34 miles of the new channel will be bay cut and 8 miles land cut. About 10 miles of the Waterway will not be improved where it traverses deep-draft channels, bridges, locks and floodgate structures.

An estimated 66,571 cubic yards will be dredged to deepen the Waterway from the vicinity of Port Arthur to the Port Aransas-Corpus Christi Waterway. It is proposed to place spoil from deepening the Waterway on existing spoil banks when available, but additional spoil areas will be required where relocations will be made. Approximately 1,067 acres will be required for right-of-way and spoil areas for deposition of dredged materials from land-cut relocations; an additional 3,300 acres will be required for the remaining Waterway reach. It is proposed to place spoil from relocation of the Waterway in bays into open water.

The purpose of the project is to provide more economical, efficient, and safer means of water transportation from Beaumont to Corpus Christi, Texas, and intermediate points.

The Texas portion of the project area lies in the Coastal Prairie physiographic region. From the Sabine River to Galveston Bay, the Waterway is land cut through deep marsh vegetal types characterized by an abundance of bulrushes, spikerushes, duck potatoes, cordgrass, saltgrass, and millet. From Galveston Bay to San Antonio Bay, the Waterway traverses shallow bays and land cuts through shallow marsh vegetal types that have growths of cordgrasses and saltgrasses. Thereafter, to the junction of Port Aransas-Corpus Christi Waterway, the channel, for the most part, crosses shallow bays which have large beds of shoalgrass, widgeon grass, and turtlegrass.

The coastal economy is primarily dependent on agriculture and petroleum production, with additional benefits received from hunting, sport fishing, commercial fishing, shipping, and industries associated with minerals and metals. The population increase of the coastal area has been phenomenal in the past 20 years. About 3 million people now reside within 100 miles of the coast. By the year 2010, the cities of Houston, Beaumont, Victoria, and Corpus Christi expect a population increase of 200 percent.

Temperatures in the coastal area are mild, with an annual average temperature of 69° F. Annual precipitation ranges from 53.6 inches in the Beaumont area to 28 inches in the Corpus Christi area. The frost-free period is almost equal throughout the project area and averages about 300 days.

Fish and wildlife resources in the vicinity of the Gulf Intracoastal Waterway are of local and national importance. In addition to providing fishing and hunting opportunities to over a million people annually, the bays, and their associated marsh areas serve as nursery grounds for young shrimp, squeteague, redfish, blue crabs, and menhaden and feeding, resting, and wintering areas for waterfowl. The bays, marshes, and offshore islands are important nesting and feeding areas for herons, ibises, terns, gulls, spoonbills, and several species of shore birds. The marsh areas adjacent to the Waterway on the upper Texas coast are important for the production of muskrats, and there are important wintering grounds in the vicinity of Blackjack Peninsula for the rare whooping crane population. The major producing live-oyster reefs in Texas occur from Galveston Bay to Corpus Christi Bay. The Waterway traverses the Aransas National Wildlife Refuge in Aransas County and the State's Big Hill Bayou Waterfowl Management Area in Jefferson County.

The principal and most sought species of fish and crustaceans that are dependent on or occur in bays are sand squeteague, spotted spueteague, flounder, gafftopsail catfish, redfish, black drum, croaker, mullet, sheepshead, menhaden, shrimp, blue crab, and oyster. The above species form the backbone of the sport and commercial fish industry.

From a recent survey 1/ of marine fishing on the Texas coast, it was determined that about 635,000 residents fished about 5,800,000 man-days in bay waters from Sabine Lake to Corpus Christi Bay and caught 32 million pounds of fish during the period August 1957 to September 1958. In addition, many thousands of pounds of shrimp, blue crabs, and oysters were taken. The greatest percentage of the fisherman use came from persons living within 100 miles of the coast. Nonresident-fishing use in the above reach was not determined in the survey, but it is estimated to be about 1,000,000 man-days annually. Their harvest is estimated to be 5,000,000 pounds of fish.

Trends indicate an increase in population in the next 50 years, and paralleling a population increase will be an increase in fishing pressure. About 14,500,000 man-days of resident fishing annually are expected to occur within the reach of the project's influence, and annual sportsmen's expenditures associated with fishing are expected to exceed $140,000,000. It is reasonable to assume that nonresident-fishing use will increase to 1,500,000 man-days annually and nonresident sportsmen's expenditures to $20,000,000.

The commercial fishery industry of the Texas Gulf Coast is of high value. In 1958, within theproject's boundaries, approximately

1/ Belden Survey, 1958

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115,729,000 pounds of fish, shrimp, oysters, and crabs, with an estimated dockside value of $18,040,032 or retail value of $63,000,000, were taken from Texas bays or in the Gulf of Mexico and landed at Texas ports. Fish and crustaceans reported in the Gulf catch were only those species that spend some portion of their life cycle in bay waters. About 70,055,600 pounds were fish; 44,800,000 pounds, shrimp; 303,500 pounds, oysters; and 569,900 pounds, crabs. About 98 percent of the fish caught were menhaden, taken in Gulf waters.

With the expected increase in human population during the next 50 years, the demand for salt-water fishery resources can be expected to increase proportionately. In all likelihood, the increased use of species presently of low demand will add to the total harvest. The increased use of low-value species plus the higher price which the increased demand will create for the good food fishes will result in an average annual dockside value in excess of $20,000,000 to commercial fishing. This would result in a retail value of about $100,000,000.

The Gulf Intracoastal Waterway traverses coastal bays and marshes that are important habitat for myriads of wildlife. Practically its entire reach is associated with important waterfowl habitat. The deep marsh-rice belt east of Galveston Bay, the tidal marsh south of Matagorda Bay, and the shallow marsh-rice belt occupying the remaining coastal area provide some of the most valuable winter habitat for waterfowl in the United States. Principal species of wintering waterfowl are Canada, snow, and blue geese; and mallard, baldpate, pintail, green-winged teal, redhead, and lesser scaup. Lesser numbers of all waterfowl species in the Central and Mississippi Flyways also winter here. In fact, about 50 to 60 percent of the Central Flyway waterfowl winter along the Texas coast. Mottled ducks and fulvous tree ducks nest on the coastal plains. Waterfowl use within close proximity to the project area is estimated at 94 million bird-days annually, of which geese comprise 23 million bird-days; ducks, 65 million bird-days; and coots, 6 million bird-days.

Demands for waterfowl hunting on the Texas coast are heavy and are greater than can be met by existing waterfowl facilities and resources. These demands will increase further, as the population in the State is expected to more than double within the next 50 years. This situation will bring about a need for more waterfowl and more places to hunt. About 565,000 man-days annually with associated sportsman's expenditures of $6,000,000 are expected to be spent hunting waterfowl in the immediate area of project influence.

The Texas marshes, bays, and offshore islands are nesting and feeding areas for herons, gulls, ibises, pelicans, terns, skimmers, spoonbills, and many other species of birds. Great numbers of birds use the coast as a migration route and wintering area. Probably the

greatest publicized of these birds are the whooping cranes which spend the winter on the Aransas National Wildlife Refuge. These birds have been known to attract about 20,000 visitors annually to the refuge, and it has been estimated that these visitors spend about $1,000,000 in Texas. Thousands of bird enthusiasts also come to the coast where many species of birds are known to appear during the year.

The marsh area between Sabine Lake and Galveston Bay is the best muskrat and alligator habitat in Texas. Income from taking these animals varies from year to year as animal populations and fur markets fluctuate. Income from trapping muskrats averages about $150,000 annually and for alligators, $8,000 annually.

The declining acreage and quality of marsh and bay habitats along the Texas coast is adversely affecting the fish and wildlife resources. Drainage of land, industrialization, upstream flood control developments, pollution, and dredging with its resultant spoil deposits have contributed to habitat destruction.

Of major concern to fish and wildlife interests in the project development are the effects of spoil deposition in bays and on marshlands contiguous to the Waterway and the channel relocation in the vicinity of State Highway 124 in Chambers County. The essential biological problems posed by the Waterway are mitigation of marsh losses and preservation of bay habitat to achieve maximum fish and wildlife productivity.

Prevention of marsh losses is essential to productivity of shrimp, crabs, and several species of fish and to the continuation of the shrimp and crab industry. It also is essential to the preservation of the rapidly dwindling waterfowl habitat which is required to provide a huntable population of waterfowl in the future. Tidal marshes are being drained both deliberately and indirectly from lowered water table effects. Areas formerly appraised as being too brackish for rice farming have in the drought years been subjected to drainage. A considerable acreage also has been made nonfunctional as tidal nursery areas because of devices which obstruct ingress and egress of larval fish, shrimp, and crabs. In consequence, the area of tidal marshlands has dwindled so rapidly that the remaining marshes are critical to the continuation of the fisheries and wildlife involved.

That portion of the bay or marsh habitat where spoil is deposited will be lost to fish and wildlife production. That portion of the marsh and bay habitat where spillage of spoil occurs will be either temporarily or permanently eliminated to fish and wildlife use, depending upon the extent of spillage from channel deepening and periodic maintenance dredging. Proposed relocation of the channel in the vicinity of State Highway 124 could very well eliminate a

habitat which now receives about 10 million waterfowl-days use annually and which produces about 20,000 muskrats annually.

Where the Waterway traverses the edge of bays, marshes, and mud flats, spoil banks may form barriers to movement of larval shrimp, fishes, and crabs to estuarine habitat and also prevent adequate exchange of waters in these areas. These barriers may cause flooding of marshes with fresh water and prevent intrusion of tides, all of which would result in an improper balance of saline and fresh water in marshes and in ecological changes to marshes. Placement of spoil on high ridges in all areas except through the marshes between Port Arthur and East Bay will result in minimum loss of marsh area, and tidal action into these areas will be less impaired. In the Port Arthur-East Bay reach, placement of spoil in continuous embankments on each side of the Waterway, with control structures to regulate water levels in the marshes, would be desirable. If spoil mounds were high, less marsh area would be covered and less erosion would probably occur from the mounds into the Waterway.

Channel cuts through bay areas temporarily increase turbidity in bays and the resultant spoil banks and erosion of spoil banks ultimately eliminate vegetated areas important to the productivity of shrimp, crabs, and fishes and as food for waterfowl. In Redfish Bay alone, approximately 15 million waterfowl-days use occurs annually. If spoil from channel dredging through Redfish Bay were placed landward to the channel, loss of the vegetation important to fish and wildlife resources would be reduced. The spoil here could be used for land fill and its use changed from a nuisance to a benefit.

At points where spoil must be placed in bays, it is desirable that spoil deposits be placed to occupy a minimum of bay area, contain maximum amount of spoil, and be as widely separated as possible. At bay entrances it may be more beneficial to depart from high, round mounds to a bar-shaped spoil bank extending in the direction of least harm from current blockage.

Pollution is inseparable from waterway traffic. Carelessness and malfeasance respecting pollution, by even a few vessels, can be harmful in bays having improper exchange of water.

Research is urgently needed to determine more specifically the value of bays and marshland areas to fish and wildlife and the effects spoil deposition has on these resources. It also is important to ascertain the immediate and long-range effects on marine habitat that may occur when natural conditions are altered. At this time, there are many losses but no foreseeable benefits which we can assign to the project.

It is recommended:

(1) That spoil from land-cut sections of the Waterway through marsh areas, except the reach between Port Arthur and East Bay, be deposited in narrow, high, spoil banks on the seaward side of the channel, with adequate openings to insure entrance and exit of larval shrimp, crabs, and fish to marshlands. Location and design of said openings to be determined in cooperation with the Bureau of Sport Fisheries and Wildlife and the Texas Game and Fish Commission.

(2) That spoil from channel dredging in the reach between Port Arthur and East Bay be placed in a continuous embankment on both sides of the Waterway, with control structures as designed by the Soil Conservation Service placed in the levees to control water levels, in the marshes.

(3) Thatspoil dredged from the channel through Redfish Bay be placed landward to the channel.

(4) That selection of spoil areas and method of disposal of spoil from other reaches of the Waterway, particularly on or in the vicinity of Aransas National Wildlife Refuge, be determined jointly with the Bureau of Sport Fisheries and Wildlife and the Texas Game and Fish Commission.

(5) That there be no channel relocation in the vicinity of State Highway 124 in Chambers County.

(6) Thatsuch reasonable modification be made in the authorized project facilities as may be agreed upon by the Director of the Bureau of Sport Fisheries and Wildlife, the Executive Director of the Texas Game and Fish Commission, and the Chief of Engineers for the conservation of fish and wildlife resources.

Sincerely yours,

/s/ John C. Gatlin
John C. Gatlin
Regional Director

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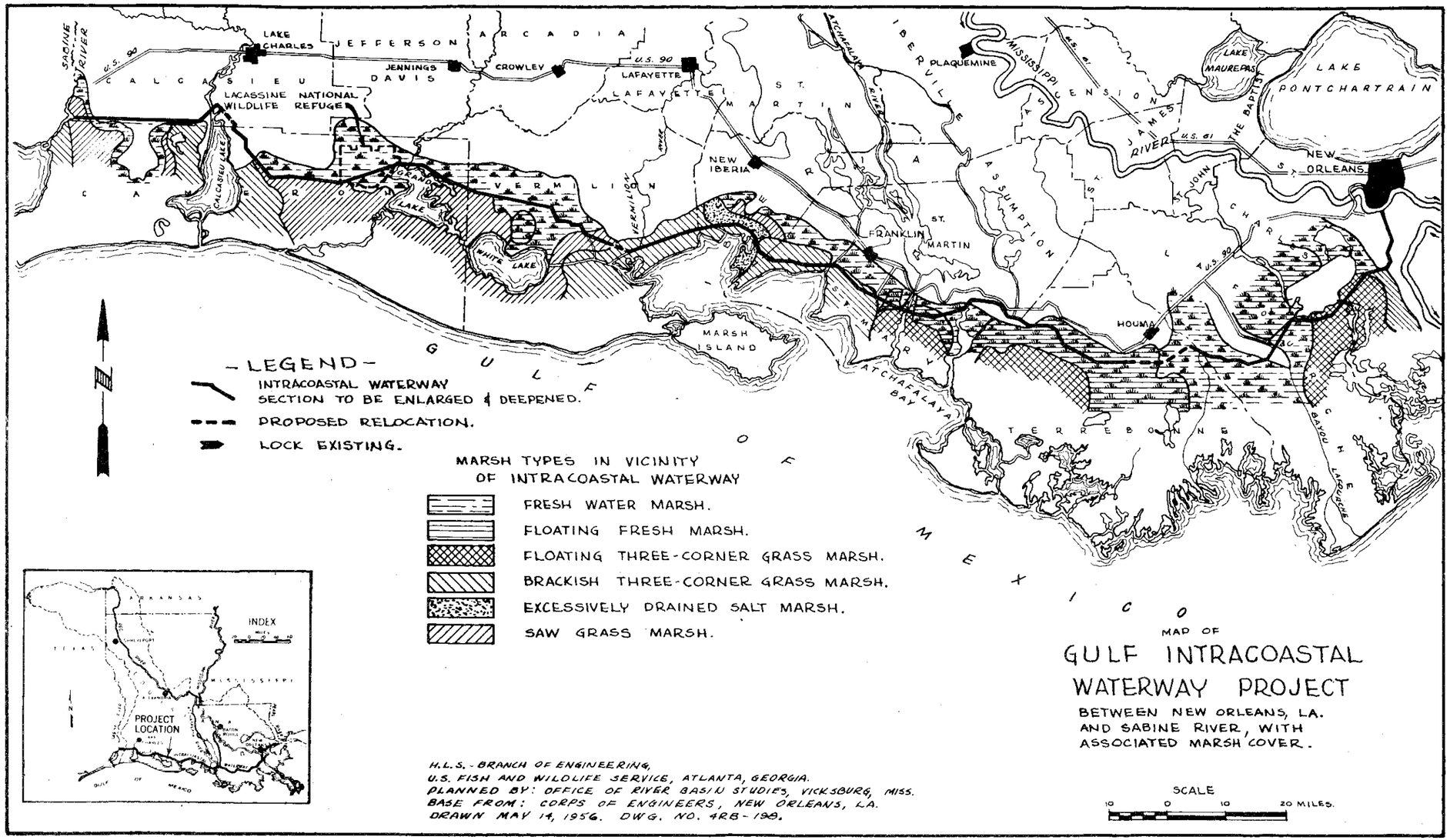
Distribution: (next page)

Distribution:

(2) Executive Secretary, Texas Game and Fish Commission, Austin, Tex.
(1) Director, Marine Laboratory, Texas Game and Fish Commission, Rockport, Tex.
(2) Regional Director, Region 2, Bureau of Commercial Fisheries, St. Petersburg Beach, Florida
(1) Director, Biological Laboratory, Bureau of Commercial Fisheries, Galveston, Tex.
(2) Regional Director, Region 3, National Park Service, Santa Fe, New Mexico
(2) Regional Engineer, Region VII, Public Health Service, Department of Health, Education, and Welfare, Dallas, Tex.
(2) Field Supervisor, Branch of River Basin Studies, Bureau of Sport Fisheries and Wildlife, Fort Worth, Tex.



MAP OF

GULF INTRACOASTAL WATERWAY PROJECT

BETWEEN NEW ORLEANS, LA. AND SABINE RIVER, WITH ASSOCIATED MARSH COVER.

SCALE 10 0 10 20 MILES.

H.L.S. - BRANCH OF ENGINEERING,
U.S. FISH AND WILDLIFE SERVICE, ATLANTA, GEORGIA.
PLANNED BY: OFFICE OF RIVER BASIN STUDIES, VICKSBURG, MISS.
BASE FROM: CORPS OF ENGINEERS, NEW ORLEANS, LA.
DRAWN MAY 14, 1956. DWG. NO. 4RB-198.

89225 O - 62 (Face p. 200)

FILE NO. H-2-20617

APPENDIX D

TEXAS
GAME AND FISH COMMISSION

Marine Laboratory
Rockport, Texas
5-24-55

Lt. Colonel H. Richardson, Jr.
Executive Officer
Corps of Engineers, U. S. Army
606 Santa Fe Building
Galveston, Texas

Dear Colonel Richardson:

In reply to your letter of May 5 concerning the proposed enlargement of the Gulf Intracoastal Waterway in Texas, we are of the following opinion. As shown in the folio of maps, the enlargement and disposition of spoil is satisfactory. The use of existing spoil banks where possible is recommended, as is retention of the spoil to these banks. It is believed that the realignment and proposed changes will not at this time cause any serious changes in the existing conditions with regard to fishery organisms.

We would appreciate being advised when the proposed changes are begun.

The cooperation of the personnel and hospitality shown on the inspection trip was very much appreciated.

Yours very truly,

/s/ Howard T. Lee

Howard T. Lee
Marine Biologist

HTL:mfb

APPENDIX E

STATE OF LOUISIANA
WILD LIFE AND FISHERIES COMMISSION
126 Civil Courts Bldg.
NEW ORLEANS 16, LA.

Aug. 2, 1956

District Engineer
New Orleans District
Corps of Engineers, U. S. Army
P. O. Box 267
New Orleans, La.

Dear Sir:

This is in reply to your letter of July 25, 1956, requesting our views relative to fish and wildlife in regard to the proposed widening and deepening of the Gulf Intracoastal Waterway from Harvey Lock to the Sabine River.

The Louisiana Wild Life and Fisheries Commission has cooperated with the Fish and Wildlife Service in the preparation of this report, which will be submitted to you by the Service in the very near future. Our Commission concurs in this report and hereby requests the opportunity of working closely with you during the detailed planning stages of the project. We further request that our biologists have the opportunity of working closely with you during construction of the project.

Sincerely yours,

/s/ E. S. Clements

ERNEST S. CLEMENTS
Director

ESC:hn

89225 O-62—15

ATTACHMENT TO
REVIEW OF REPORTS ON
GULF INTRACOASTAL WATERWAY,
LOUISIANA-TEXAS SECTION

Information called for by Senate
Resolution 148, 85th Congress,
Adopted 28 January 1958

1. Project description and economic life.

a. The proposed modification is the enlargement of the existing 12 x 125-foot navigation channel between the Mississippi River at New Orleans, La., and Brownsville, Texas, to provide channels of the following dimensions for the reaches shown:

Channel size	Reach
16 x 150-foot	Algiers Alternate Canal
16 x 150-foot	Mississippi River (mile 5.0) to the Atchafalaya River (mile 95.5) via the Houma Bypass
16 x 200-foot	Atchafalaya River to Sabine River
16 x 150-foot	Sabine River to Houston Ship Channel

Improvement of other reaches was not economically justified.

b. The costs and benefits of the proposed project were computed on the basis that the channel will have a useful life of 50 years.

2. Project costs.

a. The following tables give the first cost and the annual charges for the recommended modifications, based on a life of 50 years:

ALGIERS ALTERNATE CANAL

FIRST COST

Item of cost	Federal	Non-Federal	Total
Dredging(1)(2)	$ 245,000	-	$ 245,000
Engineering and design	5,000	-	5,000
Supervision and administration	20,000	-	20,000
TOTAL CONSTRUCTION COST	$ 270,000	(3)	$ 270,000
Preauthorization studies	1,000	-	1,000
TOTAL COST	$ 271,000	(3)	$ 271,000

ANNUAL CHARGES

Interest	$ 7,000	-	$ 7,000
Amortization	3,000	-	3,000
Maintenance dredging (addl.)	1,000	-	1,000
TOTAL ANNUAL CHARGES	$ 11,000	-	$ 11,000

MISSISSIPPI RIVER TO THE ATCHAFALAYA RIVER
(Mile 5.0 to mile 50.5 and mile 63.5 to mile 95.5)

FIRST COST

Dredging(1)(2)	$3,150,000	-	$3,150,000
Rights-of-way and spoil disposal areas	-	$ 512,000	512,000
Severance	-	23,000	23,000
Improvements	-	147,000	147,000
Relocations	-	1,078,000	1,078,000
Subtotal	$3,150,000	$1,760,000	$4,910,000
Engineering and design	61,000	37,000	98,000
Supervision and administration	256,000	145,000	401,000
Subtotal	$3,467,000	$1,942,000	$5,409,000
Real estate acquisition costs	33,000	48,000	81,000
Subtotal	$3,500,000	$1,990,000	$5,490,000
Navigation aids	10,000	-	10,000
TOTAL FIRST COST	$3,510,000	$1,990,000	$5,500,000

(1) Includes contingencies.
(2) Includes 2-foot overdepth dredging.
(3) Non-Federal expenditures not required.

Item of cost	Federal	Non-Federal	Total
Brought forward	$3,510,000	$1,990,000	$5,500,000
Preauthorization studies	15,000	-	15,000
TOTAL COST	$3,525,000	$1,990,000	$5,515,000
ANNUAL CHARGES			
Interest	$ 93,000	$ 80,000	$ 173,000
Amortization	35,000	13,000	48,000
Maintenance dredging	8,000	-	8,000
TOTAL ANNUAL CHARGES	$ 136,000	$ 93,000	$ 229,000

HOUMA BYPASS CHANNEL WITH SWING BRIDGES
(Between mile 50.5 and mile 63.5)

FIRST COST			
Dredging(1)(2)	$1,106,000	-	$1,106,000
Clearing for channel	55,000	-	55,000
Rights-of-way and spoil disposal area	-	$ 266,000	266,000
Severance	-	22,000	22,000
Relocations	-	368,000	368,000
Swing bridges	-	2,782,000	2,782,000
Subtotal	$1,161,000	$3,438,000	$4,599,000
Engineering and design	23,000	69,000	92,000
Supervision and administration	94,000	280,000	374,000
Subtotal	$1,278,000	$3,787,000	$5,065,000
Real estate acquisition cost	2,000	3,000	5,000
Subtotal	$1,280,000	$3,790,000	$5,070,000
Federal contribution to bridges	1,780,000	-1,780,000	-
TOTAL FIRST COST	$3,060,000	$2,010,000	$5,070,000
Preauthorization studies	5,000	-	5,000
TOTAL COST	$3,065,000	$2,010,000	$5,075,000

(1) Includes contingencies.
(2) Includes 2-foot overdepth dredging.

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 33,000	$ 152,000	$ 185,000
Amortization	13,000	24,000	37,000
Maintenance:			
Dredging	9,000	-	9,000
Bridges	-	31,000	31,000
Operation bridges	-	35,000	35,000
Subtotal	$ 55,000	$ 242,000	$ 297,000
Interest and amortization on Federal contribution to bridges	64,000	-83,000	-19,000
TOTAL	$ 119,000	$ 159,000	$ 278,000

ATCHAFALAYA RIVER TO SABINE RIVER
(Mile 95.5 to mile 266.0)

FIRST COST

Dredging(1)(2)	$11,560,000	-	$11,560,000
Rights-of-way and spoil disposal areas	-	$ 832,000	832,000
Severance	-	29,000	29,000
Improvements	-	175,000	175,000
Relocations	-	1,484,000	1,484,000
Subtotal	$11,560,000	$2,520,000	$14,080,000
Engineering and design	230,000	50,000	280,000
Supervision and administration	940,000	210,000	1,150,000
Subtotal	$12,730,000	$2,780,000	$15,510,000
Real estate acquisition costs	70,000	100,000	170,000
Subtotal	$12,800,000	$2,880,000	$15,680,000
Navigation aids	20,000	-	20,000
TOTAL FIRST COST	$12,820,000	$2,880,000	$15,700,000
Preauthorization studies	30,000	-	30,000
TOTAL COST	$12,850,000	$2,880,000	$15,730,000

(1) Includes contingencies.
(2) Includes 2-foot overdepth dredging.

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 337,000	$ 115,000	$ 452,000
Amortization	127,000	19,000	146,000
Maintenance dredging	34,000	-	34,000
TOTAL	$ 498,000	$ 134,000	$ 632,000

SABINE RIVER TO HOUSTON SHIP CHANNEL
(Mile 266.0 to mile 350.1)

FIRST COST

Dredging(1)(2)	$4,612,000	-	$4,612,000
Rights-of-way and spoil disposal areas	-	$ 231,000	231,000
Severance	-	69,000	69,000
Subtotal	$4,612,000	$ 300,000	$4,912,000
Engineering and design	92,000	6,000	98,000
Supervision and administration	376,000	24,000	400,000
Subtotal	$5,080,000	$ 330,000	$5,410,000
Navigation aids	20,000	-	20,000
TOTAL FIRST COST	$5,100,000	$ 330,000	$5,430,000
Preauthorization studies	12,000	-	12,000
TOTAL COST	$5,112,000	$ 330,000	$5,442,000

ANNUAL CHARGES

Interest	$ 134,000	$ 13,000	$ 147,000
Amortization	51,000	2,000	53,000
Maintenance dredging	25,000	-	25,000
TOTAL	$ 210,000	$ 15,000	$ 225,000

(1) Includes contingencies.
(2) Includes 2-foot overdepth dredging.

b. Details of first cost (based on December 1960 prices) are contained in Appendix A of the report.

c. The first cost for the proposed project, based on a life of 100 years, will be the same as that for the 50-year life. The annual charges for the modification, based on a 100-year life, are shown below:

ALGIERS ALTERNATE CANAL

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 7,000	-	$ 7,000
Amortization	600	-	600
Maintenance dredging	1,000	-	1,000
TOTAL	$ 8,600	-	$ 8,600

MISSISSIPPI RIVER TO THE ATCHAFALAYA RIVER
(Mile 5.0 to mile 50.5 and mile 63.5 to mile 95.5)

ANNUAL CHARGES

Interest	$ 93,000	$ 80,000	$ 173,000
Amortization	7,500	1,600	9,100
Maintenance dredging	8,000	-	8,000
TOTAL	$ 108,500	$ 81,600	$ 190,100

HOUMA BYPASS CHANNEL WITH SWING BRIDGES
(Between mile 50.5 and mile 63.5)

Interest	$ 33,000	$ 152,000	$ 185,000
Amortization	3,000	3,100	6,100
Maintenance:			
Dredging	9,000	-	9,000
Bridges	-	31,000	31,000
Operation of bridges	-	35,000	35,000
Subtotal	$ 45,000	$ 221,100	$ 266,100
Interest and amortization on Federal contribution to bridges	51,000	-73,000	-22,000
TOTAL	$ 96,000	$ 148,100	$ 244,100

ATCHAFALAYA RIVER TO SABINE RIVER
(Mile 95.5 to mile 266.0)

ANNUAL CHARGES

Item of cost	Federal	Non-Federal	Total
Interest	$ 337,000	$ 115,000	$ 452,000
Amortization	27,000	2,300	29,300
Maintenance dredging	34,000	-	34,000
TOTAL	$ 398,000	$ 117,300	$ 515,300

SABINE RIVER TO HOUSTON SHIP CHANNEL
(Mile 266.0 to mile 350.1)

ANNUAL CHARGES

Interest	$ 134,000	$ 13,000	$ 147,000
Amortization	11,000	300	11,300
Maintenance dredging	25,000	-	25,000
TOTAL	$ 170,000	$ 13,300	$ 183,300

3. Benefit-cost ratios

a. The tangible benefits which will accrue to the proposed improvement of the various reaches have been estimated (based on an economic life of 50 years) to be:

Reach	Benefits
Algiers Alternate Canal	$ 23,000
Mississippi River to Atchafalaya River with Houma Bypass	347,000
Houma Bypass	390,000(1)
Atchafalaya River to Sabine River	1,595,000
Sabine River to Houston Ship Channel	485,000

(1) Includes $227,000 navigation benefits and $163,000 highway benefits.

b. The details relative to the determination of these benefits are contained in appendix B.

c. Analysis of the project benefits on the basis of an economic life of 100 years would be conjectural.

d. The benefit-cost ratios of the proposed modifications of the various reaches, based on an economic life of 50 years, are:

Reach	Project cost	Project annual charges	Project benefits	Benefit-to-cost ratio
Algiers Alternate Canal	$ 271,000	$ 11,000	$ 23,000	2.1 to 1
Mississippi River to Atchafalaya River with Houma Bypass	5,515,000	229,000	347,000	1.5 to 1
Houma Bypass	5,075,000	278,000	390,000	1.4 to 1
Atchafalaya River to Sabine River	15,730,000	632,000	1,595,000	2.5 to 1
Sabine River to Houston Ship Channel	5,442,000	225,000	485,000	2.2 to 1

4. Intangible project benefits. The proposed modifications will provide benefits from increased ease in passage of towboats and may also contribute to the elimination of some damage to vessels and barges. A firm monetary estimate of such benefits is extremely difficult and to a large extent is one of opinion.

5. Physical feasibility and cost of providing for future needs.

a. The proposed modifications will require additional rights-of-way for both dredging and spoil disposal. However, such areas can be made available by local interests.

b. No physical limitation to the recommended enlargement exists at the present time. Future developments may make the enlargement of short reaches uneconomical but present prospects are that improvements to the major part of the waterway will be possible throughout its life.

6. Allocation of costs. No problem of the allocation of costs is involved.

7. Extent of interest in project.

a. Local interests have displayed interest in the proposed project. The public hearing at Galveston was attended by 52 persons, and the one at New Orleans by 77 persons. Persons attending the public hearings were representatives of industry, shipping, civil organizations, and Federal, State, and local governmental agencies.

b. The modifications to the waterway are endorsed by the State of Louisiana, Department of Public Works; the Intracoastal Canal Association of Louisiana and Texas; the various navigation districts in Texas; and users of the present channels.

c. No objections to the proposed modifications have been expressed.

d. The Governors of the States of Louisiana and Texas have offered to fulfill the requirements of local cooperation.

8. Repayment schedules. None are involved in connection with this project.

9. Effect of project on State and local governments.

a. The proposed improvements will not result in any increased cost to local government, aside from expenses necessary to fulfill the terms of local cooperation.

b. The proposed enlargements will result in improved navigation over the Intracoastal Waterway and will encourage the location of industries along the route of the waterway. It is expected that expansion of existing facilities and the location of new ones will offset the small amount of taxes that will be lost from the area required for construction and spoil disposal.

10. Alternative projects.

a. Alternative proposals considered in the study included the provision of channels of the following dimensions:

14 x 150 feet
16 x 150 feet
16 x 200 feet
16 x 250 feet
16 x 300 feet

b. The reaches which are recommended for enlargement are incrementally justified when compared to channels of the next depth, or width increment. The 16 x 150-foot channel is justified over the

14 x 150-foot channel, and the 16 x 200-foot channel over the 16 x 150-foot channel. On reaches where even the 14 x 150-foot channel is not economically justified, no enlargement has been recommended.

11. Conclusions. Improvement of certain reaches of the Gulf Intracoastal Waterway is economically justified. The reaches economically justified are shown below:

Algiers Alternate Canal
Mississippi River to the Atchafalaya River
Houma Bypass
Atchafalaya River to the Sabine River
Sabine River to the Houston Ship Channel

Improvement of these reaches to channel dimensions larger than those recommended is not incrementally justified at this time.