

COLORADO RIVER AND TRIBUTARIES, TEXAS,
COVERING MOUTH OF COLORADO RIVER

LETTER
FROM
THE SECRETARY OF THE ARMY
TRANSMITTING

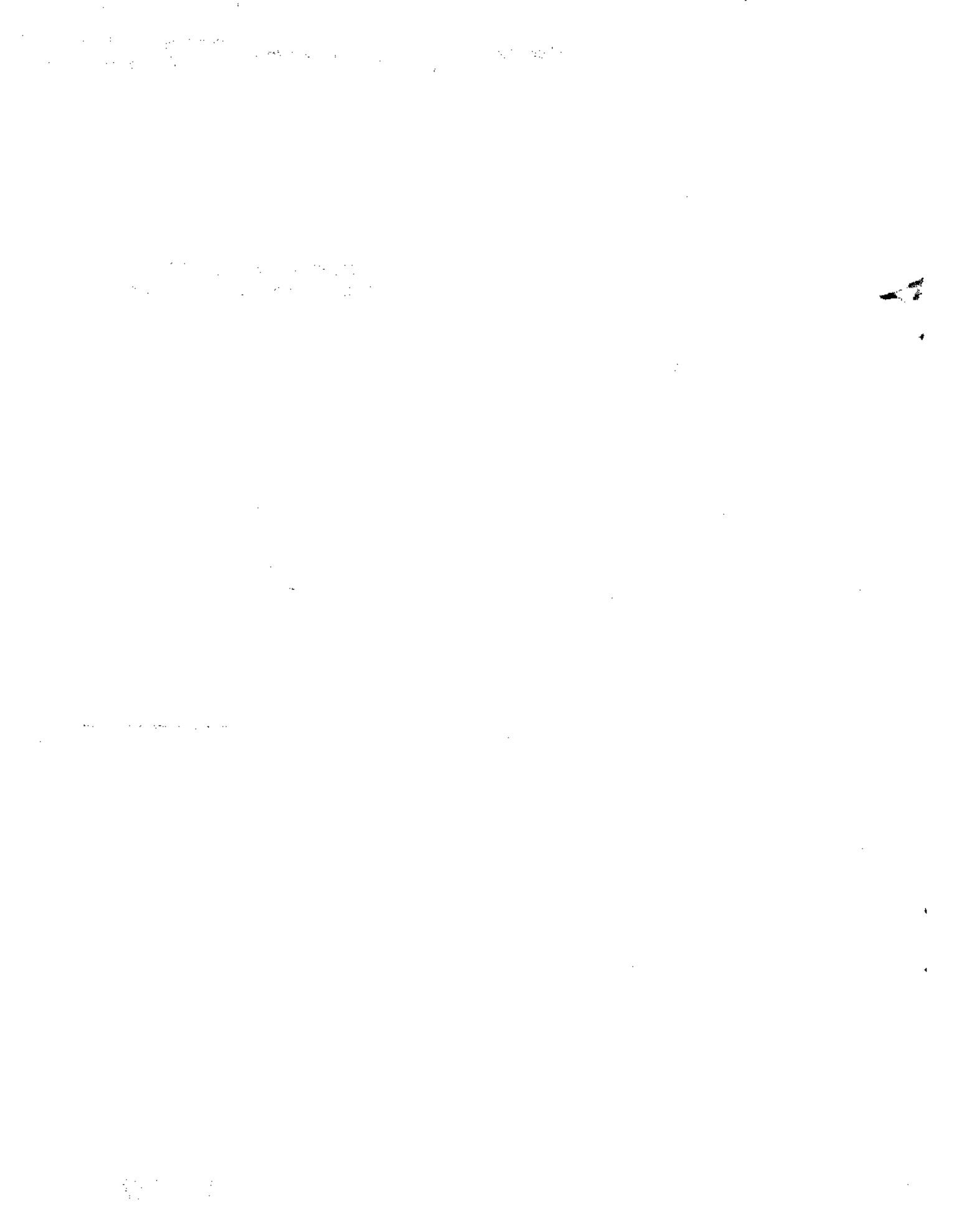
A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED JULY 23, 1968, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON COLORADO RIVER AND TRIBUTARIES, TEXAS, COVERING MOUTH OF COLORADO RIVER, IN PARTIAL RESPONSE TO A RESOLUTION OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, ADOPTED AUGUST 4, 1936



PRESENTED BY MR. RANDOLPH

JULY 29, 1968.—Referred to the Committee on Public Works and ordered to be printed with illustrations

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1968



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(Only Appendix III printed)

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**ILLUSTRATIONS ACCOMPANYING THE REPORT OF THE
DISTRICT ENGINEER**
(Only Plate 1 printed)

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310



July 25, 1968

Honorable Jennings Randolph
Chairman, Committee on Public Works
United States Senate
Washington, D. C. 20510

Dear Mr. Chairman:

I am transmitting herewith a favorable report dated 23 July 1968, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on Colorado River and Tributaries, Texas, Covering Mouth of Colorado River, in partial response to a resolution of the Committee on Commerce, United States Senate, adopted 4 August 1936.

The views of the Governor of Texas and the Departments of the Interior and Transportation are set forth in the inclosed communications.

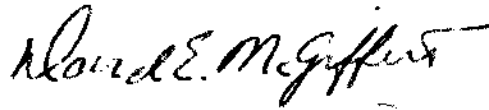
The Bureau of the Budget is concerned with the marginal justification for the navigation channel element of the recommended plan and expects that prior to initiating construction a reanalysis of the costs attributable to the navigation channel will be made. The complete views of the Bureau of the Budget are inclosed.

I concur in the views of the Bureau of the Budget. If the project is authorized and before any request for funds to initiate construction, the Chief of Engineers will analyze all costs attributable to each project feature and make a cost allocation through the appropriate allocation procedure.

Subject to consideration of the above, 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, 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,

A handwritten signature in cursive script, reading "David E. McGiffert". The signature is written in dark ink and is positioned above the typed name.

DAVID E. MCGIFFERT
Acting Secretary of the Army

1 Incl
Report

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT

BUREAU OF THE BUDGET

WASHINGTON, D.C. 20503

Honorable Stanley R. Resor
Secretary of the Army
Washington, D. C. 20310

24 July 1968

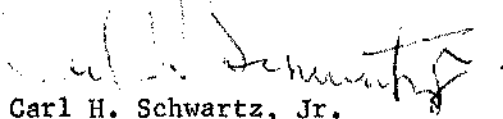
Dear Mr. Secretary:

Mr. Robert E. Jordan's letter of July 24, 1968, submitted the favorable report of the Chief of Engineers on Colorado River and Tributaries, Texas, Covering Mouth of Colorado River, in partial response to a resolution of the Committee on Commerce, United States Senate, adopted August 4, 1936.

The Bureau of the Budget is concerned with the marginal justification for the navigation channel in alternative E. We note that its justification hinges on the assumption that none of the costs of the river diversion channel and dam are allocated to the navigation channel. In view of statements by the District Engineer in the initial report, and by the Committee on Tidal Hydraulics we find that assumption difficult to accept. Particularly noticeable is the absence of the usual separable cost-remaining benefits analysis. If the project is authorized and before any request is made to initiate construction, the Bureau of the Budget will expect the Chief of Engineers to analyze all costs attributable to the navigation channel and demonstrate that the proper cost allocation has been made to each project feature through the appropriate allocation procedure.

Subject to your consideration of the above, 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, 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,


Carl H. Schwartz, Jr.
Director, Natural Resources
Programs Division

COMMENTS OF THE GOVERNOR OF TEXAS



JOHN CONNALLY
GOVERNOR OF TEXAS

July 16, 1968

Lt. Gen. William F. Cassidy
Chief of Engineers
Washington, D. C.

Dear General Cassidy:

It has come to my attention that you will submit a bill recommending the Colorado River Jettys in the mouth of the Colorado River Discharge Channel in this year's omnibus bill. It is my understanding that the interim report by the Capitol District and Regional Office of U. S. Army Engineers carries a favorable report for this project.

I have been advised that the state agencies (The Texas Water Development Board, The Texas Water Rights Commission, and The Texas Parks and Wildlife Department) concur in the proposed improvements, based on the preliminary field report.

This project certainly appears to be one which will produce great benefits to Texas, and I will lend my support to it in whatever way possible.

With kindest regards,

Sincerely,

A handwritten signature in cursive script that reads "John Connally".

John Connally

COMMENTS OF THE DEPARTMENT OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

19 July 1968

Dear General Cassidy:

This is in reply to your letter of July 10, 1968, requesting our comments on your proposed report on Colorado River and Tributaries, Texas, Covering Mouth of Colorado River.

The Fish and Wildlife Service is pleased that the proposed improvement provides for that Tiger Island Channel be closed should this become necessary to prevent tidal flows from entering Matagorda Bay. The Service notes that the recommended plan does not provide for fisherman access to the east jetty as previously considered. The Bureau of Sport Fisheries and Wildlife requests the opportunity to participate in your detailed planning for the project with a view to including this enhancement feature.

The Bureau of Outdoor Recreation advises that the proposed channel and basin improvements along the lower 7 miles of the Colorado River at Matagorda, Texas, would enhance outdoor recreation opportunities and would help to meet existing needs for water-based recreation within the area. The proposed recreation and fish and wildlife developments are in accord with the objectives of the Texas statewide comprehensive outdoor recreation plan.

The Federal Water Pollution Control Administration indicates that the water quality aspects have been given reasonable consideration and that the proposed channel changes are not likely to adversely affect the water quality in the area.

The requirements of local cooperation providing for spoil disposal areas and necessary diking as well as regulations prohibiting discharge of pollutants to project areas should assist in the prevention and control of pollution. Particular attention in this area should be given to the discharge of wastes from vessels using the harbor area.

Appropriate sanitation facilities will be needed for shore and boat activities. Problems with wastes associated with boating are now receiving increased attention.

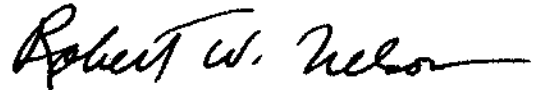
To minimize damage to water quality during the construction period, however, the Administration recommends that the Corps of Engineers include appropriate provisions in construction contracts to assure that contractors will:

1. Exercise care in the relocation of petroleum product pipelines and other hazardous materials to prevent accidental spills that would be harmful to fish and wildlife.
2. Provide and operate sanitary facilities to adequately treat and dispose of domestic wastes in conformance with Federal and State water pollution control regulations.
3. Schedule dredging operations and disposal of spoil so as to reduce turbidity and siltation to the lowest level practicable. Spoil produced during dredging operations should be confined behind dikes or otherwise disposed of in such a way to preclude its flowing back into the Bay.

The National Park Service requests that the Corps of Engineers contact the Chief, Southwest Archeological Center, Box 1562, Gila Pueblo, Globe, Arizona 85501, to arrange for the completion of archeological investigations and any needed salvage prior to initial construction.

The opportunity of presenting our views is appreciated.

Sincerely yours,



Deputy Assistant Secretary of the Interior

Lt. General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D. C. 20315

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION



OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY

18 July 1968

General William F. Cassidy
Lieutenant General, USA
Chief of Engineers
Department of the Army
Washington, D. C. 20315

Dear General Cassidy:

This is in response to your letter of July 10 to Secretary Boyd concerning your proposed report on the Colorado River in Texas.

Your recommended improvements, found in Alternate Plan E, consist of an entrance channel 15 feet deep and 200 feet wide protected by two jetties at the mouth of the existing Colorado River Channel, a navigation channel 12 feet deep and 100 feet wide from the Gulf shore to Matagorda, Texas, a turning basin adjacent to the north side of the Gulf Intracoastal Waterway at Matagorda, and a new diversion channel carry the Colorado River flows into Matagorda Bay. The estimated first cost of Alternate Plan E at \$7,386,000, and it has a benefit/cost ratio of 1.6 to 1.

In reviewing your report, the U. S. Coast Guard noted that project implementation would require the installation of aids to navigation having an estimated first cost of \$37,000 and an annual maintenance expense of \$3,000. Also the traditional Coast Guard search and rescue and safe boating services might be increased due to the projected growth in recreational boating and fishing in this area.

I appreciate the opportunity you have provided the Department to furnish comments in regard to this proposal.

Sincerely yours,

A handwritten signature in black ink that reads "M. Cecil Mackey". The signature is written in a cursive style with a large, sweeping "M" and "C".

M. Cecil Mackey
Assistant Secretary
for Policy Development

COLORADO RIVER AND TRIBUTARIES, TEXAS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY



DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20315

IN REPLY REFER TO

ENGCW-PD

23 July 1968

SUBJECT: Colorado River and Tributaries, Texas

THE SECRETARY OF THE ARMY

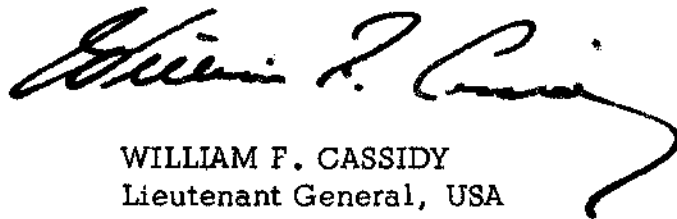
1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, on the Mouth of Colorado River, Texas, in partial response to a resolution of the Committee on Commerce of the United States Senate, adopted 4 August 1936, requesting the Board to review the reports on Colorado River, Texas, submitted in House Document Number 361, Seventy-first Congress, Second Session, and previous reports, with a view to determining if improvement in the interest of commerce and flood control is advisable at the present time. The report is confined to consideration of the lower 7 miles of the Colorado River from its mouth at the Gulf of Mexico to the town of Matagorda, Texas, with a view to improvements in the interest of navigation, flood control, enhancement of fish and wildlife, and development of the recreation potential of the area. Other reports in response to the resolution will be submitted later.
2. The reporting officers recommend improvements in the mouth of the Colorado River, Texas, to provide for an entrance channel 15 feet deep and 200 feet wide with jetties at the mouth of the existing Colorado River channel; a navigation channel 12 feet deep and 100 feet wide from the Gulf shore to Matagorda, Texas, including public use areas with recreation facilities and bank protection along the Tiger Island channel; a turning basin 12 feet deep, 350 feet wide, and 1,450 feet long, with an entrance channel, adjacent to the north side of the Gulf Intracoastal

Waterway at Matagorda; and a diversion channel, 250 feet wide and varying in depth from 20 to 23 feet to divert the Colorado River flows into Matagorda Bay, including a closure dam across the present river channel. This improvement is designated as Plan A in the District Engineer's report. The cost is estimated at \$11,740,000, of which \$11,426,000 would be the Federal cost for construction, and \$314,000 would be the non-Federal cost for lands, easements, rights-of-way, construction of spoil-disposal levees and spillways, and one-half the separable construction cost allocated to recreation. Annual charges are estimated at \$660,000, including \$166,000 for operation and maintenance, of which \$24,000 would be non-Federal. The annual benefits are estimated at \$837,000. The benefit-cost ratio is 1.3.

3. The Board of Engineers for Rivers and Harbors, after review of the reports of the District and Division Engineers and supplemental information furnished by the District Engineer at the Board's request, recommends improvement in accordance with Alternate Plan E, as described in the Board's report. Alternate Plan E is essentially the same as Plan A of the District Engineer, except that shorter jetties are provided and alternative maintenance facilities are added. The total first cost of Plan E is presently estimated at \$7,163,000, exclusive of navigation aids, lands, easements, rights-of-way, and spoil areas. Annual charges are estimated at \$500,700, including \$187,000 for operation and maintenance in addition to that now required, exclusive of navigation aids, and annual benefits are estimated at \$798,500. The benefit-cost ratio is 1.6.

4. The Board also recommends that local interests share in the costs for recreation facilities, including an appropriate part of the costs of the channel and jetties, such cost sharing to be determined by the Chief of Engineers in accordance with applicable general policy pertaining to recreation facilities and to small-boat harbors.

5. I concur in the views and recommendations of the Board.



WILLIAM F. CASSIDY
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS



DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
WASHINGTON, D.C. 20315

IN REPLY REFER TO

ENGBR

9 July 1968

SUBJECT: Colorado River and Tributaries, Texas, Mouth of Colorado River

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

1. Authority.--This interim report is in partial response to the following resolution adopted 4 August 1936:

Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on Colorado River, Texas, submitted in House Document Numbered 361, Seventy-first Congress, second session, and previous reports, with a view to determining if improvement in the interest of commerce and flood control is advisable at the present time.

2. Description.--The reach of the Colorado River under consideration in this report is the lower 7 miles from the mouth at the Gulf of Mexico to the crossing of the Gulf Intracoastal Waterway near Matagorda, Texas. The Gulf Intracoastal Waterway is generally 12 feet deep and 125 feet wide, and crosses the Colorado River approximately 85 miles southwest of Houston, Texas. The existing channel of the Colorado River was dredged by local interests in 1935-1936, and a Federal project for maintenance of a flood discharge channel in the river was authorized in 1937 as part of the Gulf Intracoastal Waterway project. There are no specific dimensions authorized for the flood discharge channel in the Colorado River.

3. Tributary area and commerce.--The area considered commercially tributary to the improvements under investigation includes a section of the Gulf of Mexico approximately 36 miles wide extending offshore to the 35-fathom line. From 1959 to 1963 the annual shrimp catch from this offshore area averaged 5,524,000 pounds. At present, this catch is landed by boats operating out of Port O'Connor and Freeport Harbor with an average one-way travel distance of 52 miles. At the head of the proposed navigation improvement is the town of Matagorda, Texas, a small town with an estimated population of 700 persons in 1965.

4. Improvements desired.--Local interests have requested the Federal Government to construct and maintain a shallow-draft navigation channel in the present Colorado River channel from the Gulf Intracoastal Waterway crossing to the Gulf of Mexico, with a jetty-protected entrance into the Gulf.

5. Plan of improvement.--The District Engineer finds that the requested navigation channel would reduce vessel transportation costs, hazards to navigation, and operating costs for vessels using the Colorado River as a harbor of refuge. He finds that the demand for additional water-oriented recreation in Colorado, Matagorda, Wharton, Brazoria, and Jackson counties, Texas, justifies the provision of a jetty walkway and other facilities to enhance the recreation potential of the navigation channel. He further finds that the diversion of the Colorado River into Matagorda Bay would reduce maintenance dredging in the navigation channel, flood damages along the present Colorado River channel, and the salinity level in Matagorda Bay, thereby increasing the population of oysters, blue crabs, shrimp, and finfishes and result in a considerable increase in the commercial seafood catch.

6. Accordingly, the District Engineer proposes a plan of improvement consisting of an entrance channel 15 feet deep and 200 feet wide with jetties at the mouth of the existing Colorado River channel; a navigation channel 12 feet deep and 100 feet wide from the Gulf shore to Matagorda, Texas, including public use areas with recreation facilities and bank protection along the Tiger Island channel; a turning basin 12 feet deep, 350 feet wide, and 1,450 feet long, adjacent to the north side of the Gulf Intracoastal Waterway at Matagorda; and a new diversion channel,

250 feet wide and varying in depth from 20 to 23 feet to divert the Colorado River flows into Matagorda Bay, including a closure dam across the present river channel.

7. Costs and justification.--Based on May 1967 prices, the District Engineer estimates the first cost of the proposed improvements at \$11,740,000, of which \$11,426,000 would be Federal for construction and \$314,000 would be non-Federal for lands, damages, spoil-disposal levees and spillways, and one-half the separable construction cost of the recreation facilities. Using the current Federal interest rate of 3-1/4 percent and a 50-year period of analysis, the annual charges are estimated at \$660,000, including \$166,000 for operation and maintenance, of which \$24,000 would be non-Federal. He estimates the average annual benefits at \$837,000, consisting of \$210,000 for savings in the transportation of shrimp, \$21,000 for reduction in hazards to navigation, \$21,000 for providing access to a harbor of refuge, \$15,000 for prevention of flood damages, \$225,000 for recreation, and \$345,000 for increased commercial seafood catch. The benefit-cost ratio is 1.3. The District Engineer recommends that the improvements be authorized as a part of the Gulf Intracoastal Waterway project. The Division Engineer concurs.

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

9. Supplemental information.--Subsequent to submission of the reports of the District and Division Engineers, review by the staffs of the Office, Chief of Engineers, the Coastal Engineering Research Center, and the Board of Engineers for Rivers and Harbors indicated a need for additional study to consider a plan of improvement, designated as Alternate Plan E, which would provide for a less costly means of protecting the channel entrance to the Gulf. The reporting officers have furnished information to the Board on that plan.

10. Alternate Plan E consists of an entrance channel 15 feet deep and 200 feet wide, protected by an east jetty at the mouth of the existing Colorado River channel, 3,500 feet long extending to the 12-foot depth

contour at mean low water and a shorter west jetty, 2,900 feet long extending to the 5-foot depth contour; facilities for maintaining depths in the inlet and transferring dredged material to the downdrift shore; a navigation channel 12 feet deep and 100 feet wide from the Gulf shore to Matagorda, Texas, including public use areas with recreation facilities and bank protection along the Tiger Island channel; a turning basin 12 feet deep, 350 feet wide and 1,450 feet long, adjacent to the north side of the Gulf Intracoastal Waterway at Matagorda; and a new diversion channel, 250 feet wide and varying in depth from 20 to 23 feet to divert the Colorado River flows into Matagorda Bay, including a closure dam across the present river channel. Based on May 1967 prices, the District Engineer estimates the first cost of Alternate Plan E at \$7,386,000, with costs for project features as follows:

<u>Item</u>	<u>Cost</u>
Lands and damages	\$ 171,000
Dams	14,000
Channels	2,713,000
Jetties	4,266,000
Bank stabilization	70,000
Levees (spoil)	15,000
Recreation facilities	100,000
Aids to navigation	<u>37,000</u>
Total	\$7,386,000

Using the current Federal interest rate of 3-1/4 percent and a 50-year period of analysis, the annual charges are estimated at \$500,700, including \$187,000 for operation and maintenance. The annual benefits are \$798,500, consisting of \$210,000 for savings in transportation costs, \$21,000 for reduction in hazards to navigation, \$21,000 for providing access to a harbor of refuge, \$15,400 for prevention of flood damages, \$186,000 for recreation, and \$345,100 for increased commercial seafood catch.

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

11. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views of the reporting officers. The improvements are needed and economically feasible. However, based on consultation with the staffs of the Office, Chief of Engineers, and the Coastal Engineering Research Center, the Board believes that Alternate Plan E is preferable to Plan A for maintaining a protected channel at the entrance to the Gulf of Mexico. Also, additional local cooperation is considered appropriate in view of the benefits to recreational boating. In accordance with general policy, the Board believes that local interests should share in the cost of the project allocated to recreational boating, as may be determined by the Chief of Engineers.

12. Recommendations.--Accordingly, the Board recommends the construction of a shallow-draft navigation channel from the Gulf of Mexico through a jetty-protected entrance to the town of Matagorda, with a turning basin at Matagorda, a flood discharge diversion channel and dam to divert the Colorado River into Matagorda Bay, and related recreation facilities, all generally as described in Alternate Plan E in supplemental information furnished by the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost of \$7,163,000 for construction, exclusive of navigation aids, and \$187,000 annually for operation and maintenance in addition to that now required: Provided that, prior to construction, 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, aids to navigation, and public use areas, upon 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 also provide and maintain necessary retaining dikes, bulkheads, and embankments therefor or the costs of such retaining works;

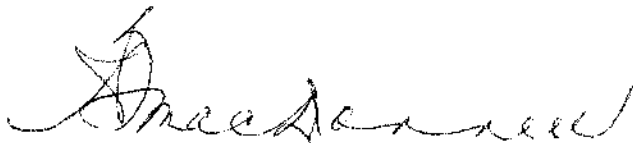
b. Hold and save the United States free from damages due to construction and maintenance of the recommended improvements;

- c. Construct a seafood processing plant at Matagorda;
- d. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including a public landing with suitable supply facilities, open to all on equal terms;
- e. Accomplish without cost to the United States all relocations or alterations of powerlines, pipelines, utility lines, cables, and highway facilities when and as required for construction of the project;
- f. Share in the costs for recreation facilities, including an appropriate part of the costs of the channel and jetties, such cost-sharing to be determined by the Chief of Engineers in accordance with applicable general policy pertaining to recreation facilities and to small-boat harbors; and
- g. Establish regulations prohibiting discharge of pollutants into the waters of the proposed improvement by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control:

Provided further, that no dredging shall be done within 50 feet of any established pierhead line, wharf, or other structure.

13. It is further recommended that maintenance of the flood discharge channel in the Colorado River authorized by the River and Harbor Act of 1937 be discontinued and that the improvements at the mouth of the Colorado River recommended herein be authorized as a part of the Gulf Intracoastal Waterway project.

FOR THE BOARD:



R. G. MacDONNELL
Major General, USA
Chairman

MOUTH OF COLORADO RIVER, TEXAS

SUPPLEMENTAL INFORMATION

ALTERNATE PLAN OF IMPROVEMENT E

5 JULY 1968

JULY 1968

ALTERNATE PLAN OF IMPROVEMENT E

5 JULY 1968

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ALTERNATE PLAN OF IMPROVEMENT E

1. INTRODUCTION.- On the instructions of the Office of the Chief of Engineers, the following engineering and economic analysis of a fifth alternate plan of improvement for the mouth of the Colorado River has been prepared, in conformance with recommendations of the Coastal Engineering Research Center.
2. RECOMMENDATIONS OF THE COASTAL ENGINEERING RESEARCH CENTER.- As a fifth alternate to the plans of improvement investigated in the interim report on the Mouth of the Colorado River dated 29 December 1967, CERC has recommended that the jetty design be modified to provide a weir type east jetty and impoundment basin to provide for the dual purposes of channel maintenance and prevention of downdrift beach erosion; that the east jetty be terminated at the 12-foot depth contour; and that the west jetty be shortened to the minimum feasible length.
3. DESCRIPTION OF PLAN E.- Plan E consists of all of the features included in Plan A, the recommended plan of improvement of the interim report, with the exception of a modified jetty design and deletion of the jetty walkway. Consideration was given to the provision of a pier across the weir to provide access to the outer portion of the jetty to accommodate jetty fishing as was proposed in Plan A. It was found, however, that the benefits attributable to jetty fishing would not justify the cost of providing these facilities.
4. The modified jetty plan is shown on figure 1. The jetties would be rubble mound stone construction as described in the interim report, with crest elevation at 8 feet above MLT. A 1000-foot section of the east jetty, extending from the shoreline seaward, would have a crest elevation of 0 MLT to allow passage of beach material across the jetty to an impoundment basin inside the jetty. The impoundment basin would be dredged periodically and the material pumped across the west jetty and deposited on the downdrift beach. The east jetty would terminate at the 12-foot depth contour. The west jetty would terminate at the 5-foot depth contour. Typical jetty sections, stone sizes, and jetty profiles are shown on figure 1.
5. LITTORAL DRIFT.- As indicated in paragraph 47, page 36 of the interim report, the littoral movement of beach materials is predominantly south-westward. Recent aerial photographs of the Matagorda Ship Channel jetties indicate substantial accretion at the east jetty and slight accretion at the west jetty. Calculations based on this photographic evidence indicate a net southwesterly movement of beach materials of approximately 200,000 cubic yards per year.
6. IMPOUNDMENT BASIN.- The impoundment basin is designed to trap and accumulate the littoral material passing over the weir in the east jetty. It is estimated that over the life of the project an average of 92,000 cubic yards per year will be removed from this basin and deposited across the west jetty for nourishment of the downdrift beach. This material together with material removed from the navigation channel during maintenance dredging is expected to be adequate for prevention of downdrift beach erosion.

7. JETTY DESIGN.- Design of the modified jetty plan is based on the criteria presented in Appendix II of the interim report. Lengths and configuration of the east jetty and weir section are based on recommendations of the Coastal Engineering Research Center. The length of the west jetty was determined on the basis of the amount of accretion at the west jetty of Matagorda Ship Channel (24 miles to the southwest), and is considered to be the minimum feasible length. A modification in coverstone size was also incorporated into the alternate jetty design. Experience subsequent to design of the jetties proposed in the interim report has shown that the 2-4 ton coverstone is subject to frequent displacement. This and the fact that 2-4 ton stone has a much higher placement cost than 4-6 ton stone resulted in the decision to eliminate 2-4 ton stone from the alternate jetty design. This modification would also be applicable to the jetty design proposed in the interim report. The effect of this modification on first costs of the interim report design has not been evaluated.

8. ESTIMATES OF FIRST COST AND ANNUAL CHARGES.- Estimates of first cost and annual charges are presented in tables 1 and 2. Estimates are based on unit prices used in the interim report and on an interest rate of $3\frac{1}{4}$ percent. The first cost of the alternate plan is estimated at approximately \$7,385,600. The total annual charges are estimated at approximately \$500,700.

9. APPORTIONMENT OF COSTS.- The apportionment of first costs and annual maintenance costs of the proposed improvements between the Federal Government and the local interests would be in accordance with Congressional policies expressed in legislation applicable to projects for general navigation, in accordance with Federal law applicable to flood control projects, and in accordance with provisions of the Federal Water Resources Projects Recreation Act. The Federal Government would bear the project costs except for the costs of lands, relocations, spoil retaining levees and one-half of the cost of recreation facilities. The Federal Government would bear the cost of maintenance dredging of the channels and turning basin and maintenance and replacement of jetties. Local interests would administer, maintain, and replace, as required, the facilities in the public use areas, maintain necessary public mooring and supply facilities at the turning basin, and maintain the spoil levees. The apportionment between Federal and Non-Federal interests of project costs and annual operation, maintenance, and replacement costs is shown in table 3.

TABLE 1

DETAIL ESTIMATE OF FIRST COST
ALTERNATE PLAN B

Item	Unit	Quantity	Unit Cost	Cost
FEDERAL COST				
NAVIGATION FEATURES				
02.0 Channels & canals, excavation				
channel	CY	475,714	0.35	166,500
Jetty entrance channel	CY	406,896	0.50	203,500
Turning basin	CY	405,714	0.35	142,000
Impoundment basin	CY	588,800	0.35	206,100
Subtotal				<u>718,100</u>
Contingencies				<u>179,500</u>
Total Channels & Canals				<u>897,600</u>
10.0 JETTIES				
Blanket Stone $\frac{1}{2}$ "-200#	Ton	91,100	8.20	747,000
Core stone 200#-1000#	Ton	45,800	9.20	421,400
Core stone 200#-2000#	Ton	90,100	8.70	783,900
Filler stone $\frac{1}{2}$ "-4"	Ton	15,900	7.80	124,000
Cover stone 4-6 tons	Ton	40,300	11.00	443,300
Cover stone 6-8 tons	Ton	8,300	8.20	68,100
Cover stone 8-10 tons	Ton	42,500	6.50	276,300
Cover stone 10-12 tons	Ton	15,800	5.60	88,500
Excavation	CY	21,900	1.10	24,100
Dredge	CY	8,900	0.35	3,100
Subtotal				<u>2,979,700</u>
Contingencies				<u>744,900</u>
Total Jetties				<u>3,724,600</u>
14 Recreation facilities				
Roads (Gravel)	Miles	0.3	20,000	6,000
Parking areas (Gravel)	Sq ft	304,000	0.10	30,400
Launching ramps (concrete)	Ea	9	1,400	12,600
Sanitary Units	Ea	3	2,000	6,000
Water supply units	Ea	3	4,000	12,000
Signs & buoys	Job	Job	L.S.	<u>3,000</u>
Subtotal				<u>70,000</u>
Contingencies				<u>17,500</u>
Total Recreation				<u>87,500</u>

TABLE 1 (CONT'D)

Item	Unit	Quantity	Unit Cost	Cost
16.0 Bank stabilization				
Bank protection at Tiger Island Channel				
Riprap 4"-200#	CY	6,333	\$ 7.50	\$ 47,500
Excavation	CY	2,110	0.71	1,500
Subtotal				49,000
Contingencies				12,500
Total bank stabilization				61,500
Total 09.0 - 16.0				4,771,200
30.0 Engineering & design				334,000
31.0 Supervision and administration				357,800
Aids to navigation				37,000
Total navigation features				5,500,000
RIVER DIVERSION FEATURES				
04.0 Dams (River diversion)	CY	167,000	0.06	10,000
Contingencies				2,500
Total dams				12,500
09.0 Channels & canals, excavation				
River diversion channel	CY	3,364,285	0.35	1,177,500
Contingencies				294,400
Total channels & canals				1,471,900
Subtotal 04.0 - 09.0				1,484,400
30.0 Engineering & design				103,900
31.0 Supervision & administration				111,300
Total river diversion features				1,699,600
Total Federal cost*				7,199,600
<u>NON-FEDERAL COSTS</u>				
Navigation features				
01.0 Lands and damages				
ROW channels & jetties east of channel	AC	64.3	350.00	22,500

* Includes \$50,100 of reimbursable cost for recreation facilities.

TABLE 1 (CONT'D)

Item	Unit	Quantity	Unit Cost	Cost
West of channel	AC	10.8	\$ 130.00	\$ 1,400
Turning basin	AC	25.6	390.00	10,000
Recreation area	AC	17.2	350.00	6,000
ROW spoil areas				
Channel	AC	316.8	65.00	20,600
Turning basin	AC	50.5	390.00	19,700
Subtotal				<u>80,200</u>
Contingencies				19,900
Acquisition cost				8,500
Total				<u>108,600</u>
11.0 Levees				
Spoil retaining levees				10,000
Contingencies				3,000
Total				<u>13,000</u>
Subtotal 01.0 - 11.0				<u>121,600</u>
30.0 Engineering & design				1,000
31.0 Supervision & administration				1,000
Total navigation features				<u>123,600</u>
RIVER DIVERSION FEATURES				
01.0 Lands & damages				
ROW channel				
Diversion channel & dam	AC	159.5	195.00	31,100
ROW spoil area				
Diversion channel	AC	210.8	65.00	13,700
Subtotal				<u>44,800</u>
Contingencies				11,100
Acquisition costs				6,500
Total 01.0				<u>62,400</u>
Total River Diversion Features				62,400
Total Non-Federal Cost				186,000
Total Project First Cost				<u>7,385,600</u>

TABLE 2

FIRST COST, ANNUAL CHARGES, ANNUAL BENEFITS AND
RATIO OF BENEFITS TO COSTS

<u>FIRST COST</u>	<u>FEDERAL</u>	<u>NON-FEDERAL</u>	<u>TOTAL</u>
Navigation facilities	\$ 5,500,000	\$ 123,600	\$ 5,623,600
River diversion facilities	<u>1,699,600</u>	<u>62,400</u>	<u>1,762,000</u>
Total project	7,199,600	186,000	7,385,600
 <u>ANNUAL MAINTENANCE</u>			
Navigation facilities			
Channel maintenance	78,000		78,000
Jetty rehabilitation	60,000		60,000
Bank protection for Tiger Island Channel	1,000		1,000
Recreation facilities			
Spoil levees		15,000	15,000
Beach erosion prevention	32,000	1,000	33,000
Aids to navigation	<u>3,000</u>	-	<u>3,000</u>
Total navigation facilities	174,000	16,000	190,000
River diversion facilities			
Channel maintenance	(No increased maint. over existing flood discharge channel)		None
TOTAL ANNUAL MAINTENANCE			\$ 190,000
 <u>INVESTMENT COST</u>			
Navigation facilities			
First cost	5,500,000	123,600	5,623,600
Int. during const.	<u>178,800</u>	<u>4,000</u>	<u>182,800</u>
Total investment	5,678,800	127,600	5,806,400
River Diversion Fac.			
First cost	1,699,600	62,400	1,762,000
Int. during const.	<u>55,200</u>	<u>2,000</u>	<u>57,200</u>
Total investment	1,754,800	64,400	1,819,200
TOTAL PROJ. INVESTMENT	7,433,600	192,000	7,625,600

TABLE 2 (CONT'D)

<u>ANNUAL CHARGES</u>	<u>FEDERAL</u>	<u>NON-FEDERAL</u>	<u>TOTAL</u>
<u>Navigation facilities</u>			
Int. & Amort. @ 3 $\frac{1}{4}$ %	\$ 231,300	\$ 5,200	\$ 236,500
Annual maintenance	174,000	16,000	190,000
Total	<u>405,300</u>	<u>21,200</u>	<u>426,500</u>
 <u>River Diversion Facilities</u>			
Int. & amort. @ 3 $\frac{1}{4}$ %	71,500	2,700	74,200
Annual maintenance	-	-	-
Total	71,500	2,700	74,200
Total Proj. annual charges	<u>476,800</u>	<u>23,900</u>	<u>500,700</u>
<hr/>			
<u>ANNUAL BENEFITS</u>			
<u>Navigation Features</u>			
Savings in transportation costs			\$ 210,000
Reductions in hazards to navigation			21,000
Access to harbor of refuge			21,000
Recreation			186,000
Total navigation benefits			<u>438,000</u>
 <u>River diversion facilities</u>			
Increase in commercial seafood catch			345,100
Prevention of flood damages			15,400
Total river diversion benefits			<u>360,500</u>
 Total project benefits			798,500.
 <u>B/C RATIO</u>			
Navigation facilities			1.03
River diversion facilities			4.9
Total project			1.6

TABLE 3
APPORTIONMENT OF COSTS

Item	First costs		OM & R	
	Federal	Non-Federal	Federal	Non-Federal
Lands & damages	-	171,000	-	-
Dams	14,000	-	(2)	-
Channels	2,713,000(1)	-	78,000	-
Jetties	4,266,000	-	60,000	-
Bank stabilization	70,000	-	1,000	-
Levees (spoil)	-	15,000	-	1,000
Recreation facilities	50,000	50,000(3)	-	15,000
Beach erosion prevention	-	-	32,000	-
Aids to navigation	37,000(4)	-	3,000(4)	-
Total	7,150,000	236,000	174,000	16,000

- (1) Includes construction of impoundment basin.
(2) Maintained by replenishing dam with spoil from channel dredging as required.
(3) One-half separable cost for public use facilities.
(4) U.S. Coast Guard.

TABLE 4
(ADJUSTED TO ALTERNATE PLAN E)

ESTIMATED ANNUAL RECREATION ATTENDANCE - MOUTH OF COLORADO RIVER

Item	Year		
	1975	2000	2025
<u>Prospective Visitation to be Derived from Service Area (SA)¹:</u>			
Number of fishermen (SA)	29,000	46,000	128,000
Fisherman-days (SA)	303,000	481,000	1,344,000
Gulf Fisherman-days (SA)	288,000	457,000	1,277,000
<u>Prospective Visitation for Channel:</u>			
Fisherman-days (SA)	98,000	155,000	434,000
Fisherman-days (OSA) ²	20,000	31,000	87,000
Total Fisherman-days	118,000	186,000	521,000
Other Recreation-days (SA)	20,000	31,000	87,000
Other Recreation-days (OSA)	4,000	6,000	17,000
Total Other Recreation-days	24,000	37,000	104,000
<u>Expected Increase in Visitation Resulting from Additional Recreation Facilities:</u>			
Fisherman-days (SA)	5,000	7,000	21,000
Fisherman-days (OSA)	1,000	1,000	4,000
Total Increase in Fisherman-days	6,000	8,000	25,000
Other Recreation-days (SA)	4,000	5,000	16,000
Other Recreation-days (OSA)	1,000	1,000	3,000
Total Increase in Other Recreation-days	5,000	6,000	19,000
<u>Total Visitation for Channel With Recreation Facilities:</u>			
Fisherman-days	124,000	194,000	546,000
Other Recreation-days	29,000	43,000	123,000
Total Visitation	153,000	237,000	669,000

¹(SA) Refers to the visitation to be derived from the Colorado River channel service area,
²(OSA) Refers to visitation to be derived from outside the service area.

10. ECONOMIC ANALYSIS OF ALTERNATE PLAN E.- An economic analysis was made of alternate plan E to determine the revised benefits attributable to the proposed changes to the navigation and river diversion features. These changes to the recommended plan of improvement, are listed below:

a. In lieu of constructing the east jetty and walkway, as described in the interim report, a weir and 1600 feet of jetty would be constructed.

b. Shortening of the west jetty by about 1600 feet. These revisions are described in paragraph 4 and are shown in figure 1.

11. All benefits were reexamined and it was determined that the only benefits subject to change were fishing and recreation benefits applicable to the east jetty. No recreation benefits were credited to the west jetty in the interim report; therefore, the proposed shortening of this jetty would have no effect on the evaluation of jetty fishing and other recreation contained in the project report.

12. A review of the criteria used to estimate the annual recreation attendance, shown in table 4, indicates that only the "Expected Increase in Visitation Resulting from Addition Recreation Facilities" would be affected by the proposed changes. This portion of the table shows the expected increase in visitation resulting from additional recreational facilities; which include the proposed walkway, railings, and other associated recreational facilities.

13. The alternate plan, which eliminates the proposed walkway and railing on the east jetty, would reduce these additional fisherman and recreational visitations. It is estimated that the loss of surf and tidal river fishing from the jetty will decrease the number of fisherman-days and other recreation days to 6000/yr and 5000/yr, respectively in the year 1975. A summary of the Estimated Annual Recreation Attendance is shown in the adjusted table 4.

14. Savings derived from the proposed improvements are based on the same values set forth in the interim report. Fisherman days are valued at \$1.00/man-day and other recreation days are valued at \$0.50/man-day. An estimate of these benefits is given in the adjusted table 5.

TABLE 5
(ADJUSTED TO ALTERNATE PLAN E)
ANNUAL RECREATION BENEFITS FOR MOUTH OF COLORADO RIVER

	<u>1975</u>	<u>2000</u>	<u>2025</u>
Navigation without recreation facilities	\$98,000	\$ 154,000	\$ 433,000
Navigation with recreation facilities	106,000	166,000	468,000

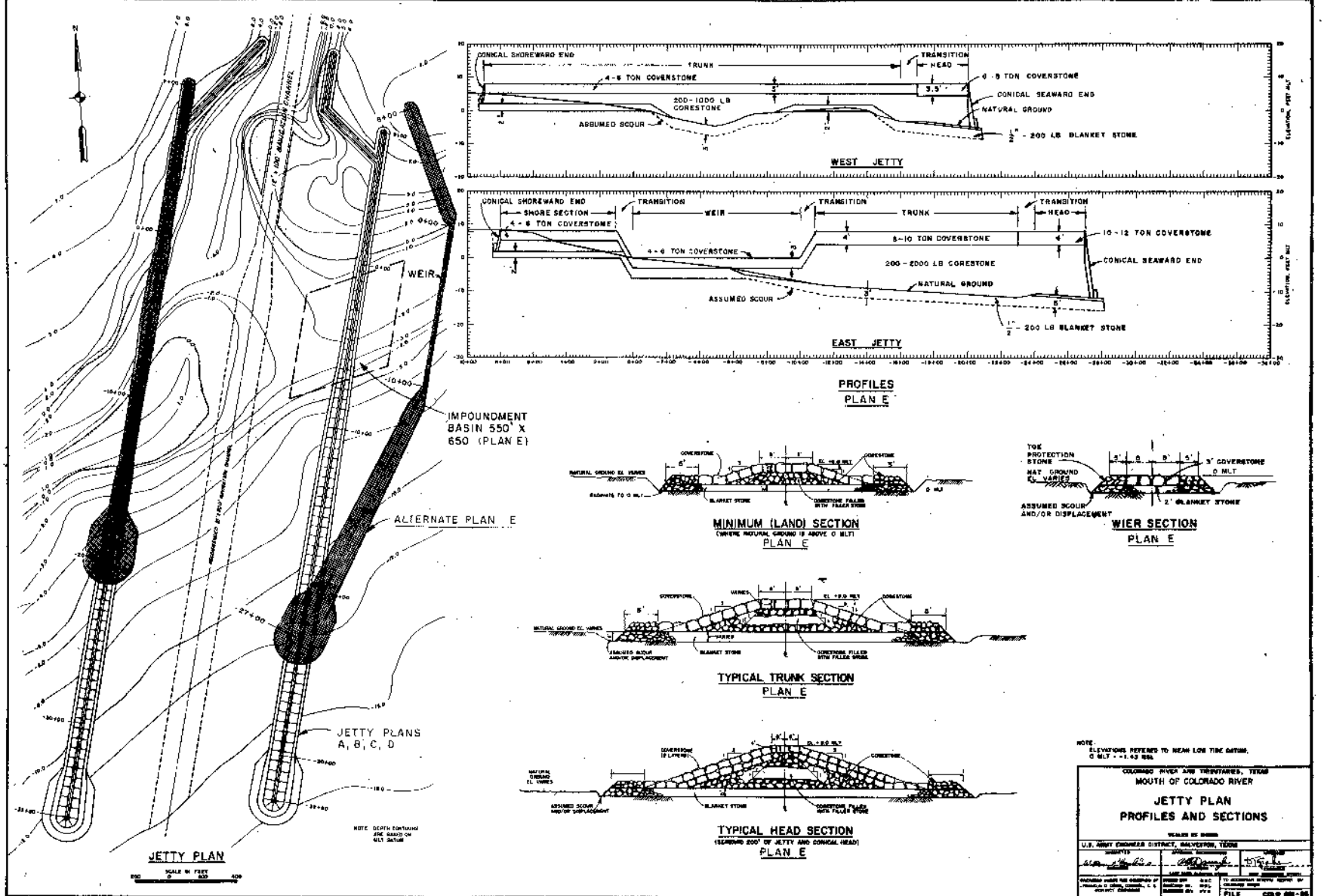
15. AVERAGE ANNUAL EQUIVALENT RECREATION BENEFITS.- The average annual equivalent benefits for project related recreation in plan E, calculated on a $3\frac{1}{4}$ percent interest rate and a 50-year period of evaluation, have been reduced from \$225,000, as shown in the interim report, to \$186,000. A summary of the total benefits applicable to the river diversion features and the navigation features of the project is shown in the adjusted table 6.

TABLE 6
(ADJUSTED TO ALTERNATE PLAN E)
SUMMARY OF AVERAGE ANNUAL EQUIVALENT BENEFITS

River diversion features:	
Prevention of flood damages	\$ 15,400
Increase in commercial seafood catch	345,100
Subtotal	<u>\$ 360,500</u>
Navigation features:	
Savings in transportation costs (shrimp boats)	210,000
Reduction in hazards to navigation	21,000
Access to harbor of refuge	21,000
Recreation	186,000
Subtotal	<u>438,000</u>
Total benefits	<u>\$798,500</u>

16. COMPARISON OF BENEFITS AND COSTS.- Based on a 50-year project life and an interest rate of $3\frac{1}{4}$ percent, the average annual benefits for the river diversion features are \$360,500, the annual charges are \$74,200, and the benefit-to-cost ratio is 4.9; the average annual benefits for the navigation features are \$438,000, the annual charges are \$426,500, and the benefit-to-cost ratio is 1.03. The benefit-to-cost ratio for alternate plan E is 1.6 to 1.

17. CONCLUSION.- The economic analysis of alternate plan E shows that construction savings would result from the proposed changes to the recommended plan in the project report. As given in the above paragraph, the benefit-cost ratios for both the navigation and river diversion features are greater than unity. These benefit-cost ratios are greater than those derived in the interim report. Therefore, the navigation channel in plan of improvement for plan E is incrementally justifiable.



NOTE:
ELEVATIONS REFERRED TO MEAN LOW TIDE DATUM,
0 M.L.T. = 114.25 M.

COLORADO RIVER AND TRIBUTARIES, TRUSS
MOUTH OF COLORADO RIVER

**JETTY PLAN
PROFILES AND SECTIONS**

SCALE BY DIMS

U.S. ARMY ENGINEERS DISTRICT, DENVER, COLORADO

DESIGNED BY: [Signature]
CHECKED BY: [Signature]
DATE: [Date]

PROJECT NO. 100-1000
JOB NO. 100-1000
DRAWING NO. 100-1000
FILE COLP 00-100

FIGURE 1

REPORT OF THE DISTRICT ENGINEER

INTERIM REPORT ON COLORADO RIVER AND TRIBUTARIES, TEXAS MOUTH OF COLORADO RIVER

SYLLABUS

This report comprises the results of an investigation to determine the advisability of further improvement at the mouth of the Colorado River, Texas, in the interest of navigation, flood control, and related purposes. It is found that the best plan to meet the present and future needs of the area would provide for diversion of the Colorado River into Matagorda Bay and conversion of the existing river channel into a navigation channel with jetties at the Gulf shore line and a turning basin at the town of Matagorda.

The plan provides specific measures to satisfy needs for a navigable channel from the town of Matagorda, Texas, to the Gulf of Mexico, and to develop the recreation potential of the area. The improvements under this plan also realize benefits from reduction of flood damages to existing developments along the Colorado River channel below the point of diversion and from increase in commercial seafood catch.

The estimated first cost to the United States for all recommended new work is \$11,554,000, of which \$128,000 would be reimbursed by local interests. The estimated increase in annual maintenance cost for the project is \$166,000, including \$24,000 non-Federal annual maintenance cost. The annual charges of the recommended project are estimated at \$660,000 and the annual benefits are estimated at \$837,000. The ratio of annual benefits to cost is 1.3. The recommendation is subject to certain specified provisions of local cooperation.

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
GALVESTON, TEXAS

December 29, 1967

SUBJECT: Interim Report on Colorado River and Tributaries, Texas,
Covering Mouth of Colorado River for Navigation, Flood
Control, Recreation, and Fish and Wildlife Enhancement

THRU: Division Engineer, Southwestern

TO: Chief of Engineers

INTRODUCTION

1. AUTHORITY.- This interim report on the mouth of the Colorado River is submitted in partial response to the following Congressional authorization:

Resolution by the Committee on Commerce, United States Senate, adopted August 4, 1936:

"Resolved by the Committee on Commerce of the United States Senate, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be and is hereby, requested to re-view the reports on Colorado River, Texas, submitted in House Document Number 361, Seventy-first Congress, second Session, and previous reports, with a view to determining if improvement in the interest of commerce and flood control is advisable at the present time."

2. Submission of an interim report was authorized by the Chief of Engineers in 2nd Indorsement dated May 4, 1966 to SWGGA letter dated March 24, 1966, subject: "Request to Submit an Interim Report on Colorado River Jetty Channel, Texas."

3. ARRANGEMENT OF REPORT.- This report consists of a main text which contains a summary of the findings, conclusions, and recommendations of the study and the following four appendixes which contain detailed technical data on which the conclusions are based:

- Appendix I - Project Evaluation
- Appendix II - Engineering and Cost Data
- Appendix III - Comments of Other Agencies
- Appendix IV - Digest of Public Hearing

4. SCOPE.- This interim report comprises a study of survey scope to determine the advisability of Federal improvements in the lower 7 miles of the Colorado River, Texas, from its mouth at the Gulf of Mexico to the town of Matagorda, Texas, in the interest of navigation, flood control, recreation, and fish and wildlife enhancement.

5. PURPOSE AND EXTENT OF STUDY.- In this report special consideration is given to the navigation problems at the mouth of the Colorado River and to improvements that would fulfill the needs for navigation, flood control, enhancement of fish and wildlife, and development of the recreation potential of the area. All studies were coordinated with the long-range planning for the Colorado River Basin and adjacent coastal areas to insure that the improvements recommended in this report would conform to the plan for comprehensive improvement of the river basin.

6. At a hearing held on April 24, 1962 in Columbus, Texas, local interests requested Federal construction of a shallow-draft navigation channel in the Colorado River channel from the Gulf Intracoastal Waterway crossing at Matagorda to the Gulf of Mexico. Local interests also requested that the channel be protected by jetties at the shoreline. Appendix IV of this report is a digest of public views expressed at the hearing. The Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, requested during early phases of planning that the Colorado River be relocated so as to divert the flow of the river into Matagorda Bay. The views of the Tidal Hydraulics Committee, Corps of Engineers, were obtained concerning use of the river channel for navigation and flood control. The Committee recommended against use of a combined channel for navigation and flood control. The Tidal Hydraulics Committee report is an exhibit in appendix II and the Bureau of Sport Fisheries and Wildlife report is included in appendix III.

7. Studies for this interim report consisted of analysis of benefits and costs which would be derived from each of the alternate plans of improvement presented in appendix II. Field investigations were limited to hydrographic and topographic surveys at the mouth of the river, subsurface investigation, real estate appraisal, and area reconnaissance. Numerous conferences were held with local interests to determine their views as alternate plans were developed for providing a navigable channel to the mouth of the river. Coordination of studies by agencies directly concerned with effects of fresh water inflow into Matagorda Bay was carried out by the Fort Worth Office of the Bureau of Sport Fisheries and Wildlife, United States Department of the Interior.

DESCRIPTION

8. GENERAL.- The reach of the Colorado River under consideration in this report is the lower 7 miles from the mouth at the Gulf of Mexico to the crossing of the Gulf Intracoastal Waterway near the town of Matagorda, Texas. The study area is shown on Plate 1 and on United States Coast and Geodetic Survey chart No. 1284. The river mouth is located about 94 miles southwest of Galveston, 83 miles northeast of Aransas Pass, 47 miles southwest of Freeport Harbor and 32 miles northeast of Pass Cavallo.

9. Prior to 1930 the Colorado River flowed into Matagorda Bay, with its mouth near the mainland shore at Matagorda, Texas. The river channel between 21 and 45 miles above the mouth, was filled with tangled masses of logs and brush imbedded in silt which restricted the outflow of flood waters. In 1929 conservation and reclamation districts in Matagorda and Wharton Counties cleared the channel by removing key logs and allowing the material to be carried downstream by river currents. These materials accumulated in Matagorda Bay, enlarging the delta at the mouth of the river until it extended about half way across the bay to Matagorda Peninsula, the offshore bar between the bay and the Gulf of Mexico. In 1934 and 1935, Matagorda County Conservation and Reclamation District No. 1 dredged a straight channel from one of the river outlets in this delta, across Matagorda Bay, and through Matagorda Peninsula to the Gulf of Mexico, placing spoil on both sides of the channel to confine the low flows of the river within the channel. This channel from the Intracoastal Waterway crossing to the Gulf is now maintained by the Corps of Engineers as the Colorado River Flood Discharge Channel. There are no specific dimensions authorized for the project.

10. The Flood Discharge Channel has a mean bank to bank width of about 210 feet. Its depth, at mean low tide, varies from a minimum of 1 foot to a maximum of 28 feet. The mouth of the river is obstructed by a wide bar extending into the Gulf of Mexico, over which the controlling depth, normally, is about 1 to 2 feet at mean low tide. The depths over the bar and locations of the tidal channels change as a result of floods on the river and storms in the Gulf. The shallow depth and shifting channel limit navigation across the bar to small vessels. Depths in the Gulf immediately offshore are indicated on plate 3. The slope of the bottom decreases from about 1% at the shoreline to about 0.6% at the 15-foot depth contour and 0.1% at the 30-foot depth contour.

11. The existing project for the Gulf Intracoastal Waterway provides for a shallow-draft channel 12 feet deep and 125 feet wide extending along the Gulf Coast from Apalachee Bay, Florida, to Brownsville, Texas. The waterway crosses the Colorado River at a point 6.5 miles above the river mouth near Matagorda, Texas. Locks are provided in the main channel of the waterway on each side of the river to facilitate navigation crossing

during floods on the river, and to prevent excessive currents and sedimentation in the waterway. A tributary navigation channel, 9 feet deep and 100 feet wide in the Colorado River, extends from the main channel crossing upstream for a distance of about fifteen miles, to the vicinity of Bay City. The terminal for this channel is the upstream limit of the tidal reach of the Colorado River. Channel distances from the Colorado River crossing by the way of the Intracoastal Waterway to the nearest ports are as follows:

<u>Port</u>	<u>Channel distance from Colorado River(miles)</u>
Freeport	46.2
Palacios	35.8
Port O'Connor	32.3
Port Lavaca	49.2

12. The mean diurnal tidal range in the lower Colorado River is about 1.0 foot. Prolonged north winds in the winter season depress the water surface several feet below mean low tide. Prolonged south and southeast winds raise the water surface as much as 3 feet above mean low tide. Hurricanes have raised the water surface in the vicinity of Matagorda as much as 13 feet above mean low tide for short periods. River floods have reached elevations of 11.7 feet above mean low tide at Matagorda. Elevations in this report refer to the Corps of Engineers mean low tide datum which is 1.43 feet below the Coast and Geodetic Survey mean sea level datum.

13. In the half mile reach immediately below the Intracoastal Waterway the river channel is bordered by spoil areas having an elevation of about 10 feet. Downstream from the spoil area the bank height is about 5 feet and decreases to about 2 feet at the mouth. Sand dunes on the barrier island in the vicinity of the mouth of the river are 8 to 10 feet high. Land surfaces of the river banks slope away from the river toward the bay. The wide delta of the Colorado River, from the mainland to the Matagorda Peninsula, is mostly low swamp land except in the area adjacent to the river. The delta area is shown on plate 2.

14. The bankfull capacity of the Colorado River is about 40,000 second-feet at Matagorda, but increases to 50,000 second-feet a few miles above Matagorda. Discharges greater than 50,000 second-feet overflow the river banks above Matagorda and flow across the flood plain to the bay. During major floods, the overflow in the flood plain affects the Intracoastal Waterway for a considerable distance on both sides of the Colorado River. The Flood Discharge Channel, through the delta area across Matagorda Bay, has a bankfull capacity of about 12,600 second-feet about one-half mile below the Intracoastal Waterway and decreases to 5,500 second-feet near the mouth.

15. **MATAGORDA BAY.**- Matagorda Bay, including the small adjoining bays, covers more than 300 square miles. A map of the bay is included in Appendix II. Pass Cavallo, the natural entrance to the bay, is located in the southwest end of the bay about 29 miles southwest of the mouth of the Colorado River. The deep-draft Matagorda Ship Channel enters Matagorda Bay through a jettied entrance channel across Matagorda Peninsula at a point 24 miles southwest of the mouth of the Colorado River and 5 miles northeast of Pass Cavallo. The Colorado River delta and spoil banks on both sides of the Flood Discharge Channel have divided the bay into two parts. Matagorda Bay is separated from the Gulf of Mexico by the long narrow barrier island known as Matagorda Peninsula.

16. Natural depths of 11 to 12 feet occur over a large portion of Matagorda Bay proper. The mean diurnal tidal range in Matagorda Bay is about 0.7 feet. Lavaca Bay, an arm of Matagorda Bay, has depths of 6 to 7 feet. East Matagorda Bay, the severed portion of the Bay northeast of the Colorado River, has depths of 4 to 5 feet. No information is available on the tidal range in East Matagorda Bay. The only opening from this bay to the Gulf of Mexico is Brown Cedar Cut located 21 miles northeast of the mouth of the Colorado River. This small intermittent cut has a very small tidal prism and at present is practically closed.

17. Matagorda, Texas, had a population of 650 persons according to the 1960 census. The estimated 1965 population is 700 persons. The major sources of income of its inhabitants are from a large mud-shell plant and from commercial and recreational fishing and boating. A Texas Highway Department equipment garage and 19 small business establishments are located in the town. Matagorda is located in Matagorda County about 83 air miles southwest of Galveston, Texas, and 107 air miles northeast of Corpus Christi, Texas. The Gulf Intra-coastal Waterway bounds it on the southeast and the Colorado River bounds it on the west. The town is located in the east flood plain of the Colorado River about 7 miles above its mouth, and is protected against the standard project river and hurricane floods by a Federally constructed levee system.

CLIMATOLOGY

18. **CLIMATOLOGICAL DATA.**- The lower Colorado River watershed lies in a humid region with a warm summers and mild winters. The proximity of the watershed to the Gulf of Mexico, the prevalence of southerly winds, and the absence of marked topographic relief features result in high relative humidity, warm summers, and mild winters. Freezing temperatures are infrequent and of short duration. Data from the U. S. Weather Bureau city station at Houston, Texas, which is about 95 miles northeast from the mouth of the river, indicates that the mean annual temperature is about 70 degrees Fahrenheit. Temperatures at this station have ranged

from a summer maximum of 108 degrees to a winter minimum of 5 degrees. January, the coldest month, has an average mean temperature of 53.8 degrees; and August, the warmest month, has an average mean temperature of 84.2 degrees.

19. The prevailing winds are from the south or southeast, except for short periods when high pressure air masses approaching from the north bring northerly winds.

20. PRECIPITATION.- The mean annual precipitation at Houston is 45.37 inches, based on 79 years of records for the city station from 1885 through 1964. The annual precipitation has ranged from a maximum of 72.86 inches in 1900 to a minimum of 17.66 inches in 1917. The maximum 24 hour rainfall recorded in the vicinity is 15.65 inches which occurred at the U. S. Weather Bureau airport station at Houston in 1945. The area is subject to intense local thunderstorms of short duration, general storms which extend over a period of several days, and to torrential rainfall associated with hurricanes and other tropical disturbances.

21. FOG.- Fog occurs frequently along the Texas Coast but is generally of short duration and local in nature.

22. FLOODS.- Floods may be experienced throughout the basin at any time during the year. Because of the physiographic variations of the Colorado River Basin, floods differ in character. In the lower basin where the average annual rate of rainfall is highest, there are broad, flat valleys and the drainage channels have gentle slopes. These conditions produce broad, flat-crested, slow moving floods which cause protracted periods of inundation. Existing flood control reservoirs have a regulating effect on run-off from 26,900 square miles, which is about 88 percent of the contributing area. Existing reservoirs and reservoirs under investigation are shown on exhibit 1, appendix II. Table 1 shows maximum known flood flows at selected locations in the lower basin.

TABLE 1
LOWER COLORADO RIVER BASIN
MAXIMUM FLOODFLOWS

Location	Drainage area (square miles)	Date	Discharge (c.f.s.)
at Austin	26,298	7 Jul 1869	500,000
at La Grange	28,344	9 Jul 1869	380,000
at Columbus	29,009	Jul 1869 & 6 Dec 1913	300,000
at Wharton	29,294	12 Jul 1869 & 8 Dec 1913	207,000

PRIOR REPORTS

23. A report on the Flood Discharge Channel was submitted to Congress on September 1, 1936 and printed in Senate Committee Print on Colorado River, Texas, 75th Congress, 1st Session. The recommendation in this report, that the Federal Government undertake maintenance of the Flood Discharge Channel, was authorized by River and Harbor Act of August 26, 1937. A report on survey of a channel from the Gulf of Mexico to Matagorda Bay was submitted on October 15, 1955. This report, printed as House Document 388, 84th Congress, 2nd Session, recommended construction of the Matagorda Ship Channel to Point Comfort, Texas. The recommended improvement was authorized by the River and Harbor Act of July 3, 1958. A report of preliminary examination scope considering improvement of the mouth of the Colorado River was submitted on February 1, 1956. The report recommended that no survey be made at that time of the proposed improvement of the lower reach of the Colorado River from the Gulf Intracoastal Waterway crossing to the Gulf of Mexico, including jetties at the mouth. A list of prior reports pertinent to the mouth of the Colorado River is contained in appendix II.

EXISTING CORPS OF ENGINEERS PROJECTS

24. The existing Federal project on the reach of the Colorado River under consideration was authorized by the River and Harbor Act of August 26, 1937. The project provides for maintenance of a suitable flood discharge channel in the Colorado River from the Gulf Intracoastal Waterway to the Gulf of Mexico as a part of the Gulf Intracoastal Waterway. Dimensions for the project channel were not specified. The Flood Discharge Channel was authorized for the purpose of reducing silt deposition and resulting maintenance costs on the Gulf Intracoastal Waterway and to reduce traffic interruptions on that waterway. In addition to the Flood Discharge Channel, the Corps of Engineers has constructed a 9-foot by 100-foot tributary navigation channel in the Colorado River extending from the Gulf Intracoastal Waterway crossing at river mile 6.5 to a terminal 15.5 miles upstream. The project terminates in a 400-foot by 500-foot off-channel turning basin.

LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

25. Local interests have fully complied with requirements for cooperation on the Flood Discharge Channel. This consisted of furnishing necessary rights-of-way and fulfilling local cooperation requirements for the Gulf Intracoastal Waterway within the 5-year period after authorization of the Flood Discharge Channel.

TERMINAL AND TRANSFER FACILITIES

26. Existing terminal and transfer facilities are located on the Colorado River between Matagorda, Texas, and the mouth of the river at five boat slips on the Gulf Intracoastal Waterway and on the turning basin near Bay City. Three slips are located about three-fourths of a

mile east of the Colorado River, one is about 1.7 miles east of the river and one is about 3.4 miles east of the river.

27. The facilities on one boat slip on the north side of the Intra-coastal Waterway and on the south side are privately owned. On each slip is a fishhouse with seafood handling and processing facilities. Facilities on a third boat slip on the north side of the Intracoastal Waterway are owned by Matagorda County and leased to the Matagorda Yacht Club. These facilities consist of boathouses, mooring piles, and equipment for servicing pleasure boats. Approximately 40 pleasure boats are berthed in this slip at present.

28. Facilities on the Colorado River at Matagorda above the Intra-coastal Waterway crossing consist of a privately owned fishhouse with unloading wharf and equipment for processing and icing seafoods caught in the Bay or Intracoastal Waterway, and a privately owned shell unloading facility. The shell wharf has rail connections and all of the facilities have highway access.

29. The Matagorda County Navigation District No. 2 has constructed a wharf and warehouse facility on the turning basin located 15.5 channel miles upstream from the Intracoastal Waterway crossing. This terminal is equipped to handle all types of commerce for barge shipment.

30. On the east side of the river, between the Intracoastal Waterway and the mouth of the river, approximately 30 small boat wharves have been constructed by owners of vacation cottages located on the river bank. Most of these wharves are 3 to 4 feet wide and 10 to 20 feet long. Five of these wharves are being used for commercial fishing; the others are used for private pleasure boats.

IMPROVEMENTS DESIRED

31. A public hearing was held in Columbus, Texas, on April 24, 1962, to give all interested parties an opportunity to express their views concerning improvements of the Colorado River. The hearing was attended by 189 persons including State government officials, representatives of civic organizations, businesses, oil companies, navigation interests, and seafood products companies; operators of farms and ranches; and other interested parties. A member of Congress was present. Additional information on the public hearing is contained in appendix IV.

32. At this hearing Matagorda County Navigation District No. 2 requested the Federal Government to construct a shallow-draft navigation channel along the present route of the Colorado River Flood Discharge Channel from the Gulf Intracoastal Waterway crossing to the Gulf of Mexico. They also requested that the entrance of the channel into the Gulf be protected by jetties.

33. Supporting briefs, letters and statements were furnished by the Governor of Texas, the Texas State Parks Board, and Texas Fish and Game Commission (now the Texas Parks and Wildlife Department), Texas Industrial Commission, Texas Highway Department; county officials of Matagorda and Wharton counties; city officials of Bay City and Palacios; Chambers of Commerce of Bay City, Wharton and Palacios; and numerous seafood companies, marine and navigation interests, and other interested persons. Matagorda County Navigation District No. 2 offered to provide required items of local cooperation.

EXISTING AND PROSPECTIVE COMMERCE

34. EXISTING COMMERCE.- The commerce on the Flood Discharge Channel consists of seafood caught in the Gulf and adjacent bays and landed at the wharves located along the river and Gulf Intracoastal Waterway channels. No information is available on the quantity of this commerce but very little is moved in from the Gulf because of the limited size of boats that can navigate the mouth of the river.

35. PROSPECTIVE COMMERCE.- The local interests claim that construction of jetties at the mouth of the river would promote a considerable commerce. Extensive offshore drilling and exploration is taking place in the area immediately off the mouth of the Colorado River. Off-shore gas wells are being placed in production in the area and gas is being piped ashore from a field located 5 miles east of the recommended jetty site.

36. Hazardous navigation conditions in the mouth of the Colorado River force shrimp boats based at Matagorda to work in Matagorda Bay. These boats reach Matagorda Bay through the Gulf Intracoastal Waterway with a minimum travel distance of about 20 miles to shrimp grounds. Most of the shrimp processed at Matagorda is used locally for bait. The movement of seafood in the lower river would increase with construction of jetties. Local interests claim that 5,000,000 pounds of the annual offshore shrimp catch would land at Matagorda.

37. The U. S. Bureau of Commercial Fisheries reports for grid zone 0190, extending from Freeport to Rockport, Texas, reported an average annual catch of 12,280,000 pounds of shrimp for the period 1959 through 1963. Information obtained from a survey of local fishermen and seafood industry representatives indicated that about 45 percent of the zone catch was normally caught in the area tributary to the recommended project. This tributary area is referred to in this report as the project's "shrimping area," and is shown on figure 1, appendix I. Based on records of landings at ports in grid zone 0190, and statements of representatives of the fishing industry, it is estimated that the average annual catch in the projects "shrimping area" is 5,524,000 pounds and that all of this catch would move through the recommended project. There is a considerable amount of offshore drilling activity in the vicinity of the mouth of the Colorado River. It is probable that oil field supplies and equipment will

be moved through the recommended project. Appendix I presents details on prospective commerce.

VESSEL TRAFFIC

38. Local interests state that if sufficient depth were available larger commercial fishing boats would use Matagorda as a base for fishing in the Gulf. Boats normally employed in the shrimping industry have drafts of 5 to 7-1/2 feet. The larger shrimping vessels draw as much as 10 feet. To move the prospective annual commerce in seafoods through the recommended project would require about 3,890 round trips by shrimp trawlers. In addition it is probable that a large number of oil field service boats and offshore commercial party and sport fishing boats would utilize the project.

PROJECT FORMULATION

39. GENERAL.- The navigation channel design is predicated on diversion of the Colorado River into Matagorda Bay to separate the navigation channel from the river discharge channel. The diversion to the bay is based on economics of providing a navigation channel without river sediment problems and providing fresh water flow into Matagorda Bay to enhance the marine and wildlife habitat. The diversion channel is designed to provide a channel with the average bankfull capacity of the lower Colorado River. The diversion channel would have a 250-foot bottom width with 1 on 4 side slopes and would have a capacity of 50,000 cubic feet per second. The diversion channel size is considered to be of optimum design because a smaller channel would cause backwater effects at Matagorda, seriously affecting the interior drainage of the levee system at Matagorda. A larger channel could not be utilized because river flows greater than the channel design capacity overflow the banks of the river upstream and enter Matagorda Bay in channels parallel to the Colorado River. The jetty design is based on protecting a channel adequate for the larger seagoing shrimp boats which have loaded drafts of up to 10 feet. The 15-foot by 200-foot entrance channel between jetties is required for safe operation under severe weather conditions. The 12-foot by 100-foot channel from the jetties to Matagorda is considered to be the minimum channel adequate for the prospective traffic. The existing river channel will not have to be enlarged for the navigation project. The 100-foot width is adequate for the larger shrimp boats which have beams of about 22 feet. A deeper channel is not needed because there is no prospective deep-draft traffic. A shallower channel would not accommodate the larger shrimp boats expected to use the project. The navigation channel size is therefore considered to be optimum. The spacing of the jetties is adequate for enlarging the project at a later date if deep-draft commerce should develop. Public use recreation facilities are designed to accommodate the anticipated visitors to the facilities. The plan recommended was selected from four alternate plans. The four alternate plans considered are discussed in more detail in appendix II.

40. ALTERNATE PLANS CONSIDERED. - Plan A consists of a 15-foot by 200-foot jettied entrance channel at the mouth of the existing Flood Discharge Channel, a 12-foot by 100-foot navigation channel from the Gulf shore to Matagorda, public use areas with recreation facilities and bank protection along Tiger Island Channel. The plan includes diversion of the river into Matagorda Bay at a point immediately below the Gulf Intracoastal Waterway crossing. The channel would have an inbank capacity of 50,000 second feet. A diversion dam would be constructed in the existing discharge channel about 3,000 feet downstream from the Colorado River crossing of the Gulf Intracoastal Waterway. The plan includes a turning basin at Matagorda.

41. Plan B consists of a jettied entrance channel at the mouth of the existing channel, a navigation channel from the Gulf shoreline to Matagorda, a turning basin at Matagorda, public use areas with recreation facilities, and a leveed floodway and discharge channel to the Gulf of Mexico on an alignment about 4,000 feet west of and paralleling the existing channel. The floodway would be approximately 5,000 feet wide and the discharge channel would have an inbank capacity of approximately 30,000 second feet. The plan includes a diversion dam in the present discharge channel and closure of Tiger Island Channel.

42. Plan C consists of a jettied entrance channel and navigation channel to Matagorda, located about 4,000 feet east of and paralleling the existing channel. The plan includes continuous spoil embankment on both sides of the navigation channel, a high level bridge over the navigation channel, providing access to the beach east of the channel, public use areas with recreation facilities, and a turning basin at Matagorda, Texas. The plan included improvement of the present flood discharge channel to provide an increased capacity of 50,000 second feet.

43. Plan D consists of improving the present flood discharge channel to provide both an increased discharge capacity of 50,000 second feet and shallow-draft navigation from the Gulf of Mexico to the GIWW. The plan includes jetties at the mouth of the existing channel, a turning basin at Matagorda, Texas, public use areas with recreation facilities, and bank protection in Tiger Island Channel.

44. Estimates of first cost, annual charges, annual benefits and ratio of benefits to cost of each plan are summarized in table 2.

TABLE 2
FIRST COSTS, ANNUAL CHARGES, ANNUAL BENEFITS
AND BENEFIT-COST RATIOS FOR ALTERNATE PLANS

Plan	: First : cost : \$1000	: Annual : charges : \$1000	: Annual : benefits : \$1000	: Benefit : cost : ratio
Plan A - Diversion of river to Matagorda Bay and improvement of existing channel for navigation	11,740.0	660.0	837.0	1.3
Plan B - New floodway channel to Gulf and navigation channel in existing flood discharge channel	14,039.0	756.0	492.0	0.7
Plan C - Enlargement of existing flood discharge channel and separate navigation channel	17,535.0	908.0	492.0	0.5
Plan D - Multiple purpose improvement of flood discharge channel for navigation and flood control	14,633.0	819.0	492.0	0.6

PLAN OF IMPROVEMENT

45. Recommended Plan A is shown on plate 2. Plan, profiles, and cross sections of the proposed jetties are shown on plate 3. Plan and profile of the relocated river discharge channel are shown on plates 4 and 5. Plan A would provide the following:

a. A 12-foot deep by 100-foot wide channel from the Gulf Intracoastal Waterway to the present Gulf shoreline.

b. A 15-foot deep by 200-foot wide jetty entrance channel from the 15-foot depth in the Gulf to the present Gulf shoreline.

c. A 350-foot by 1,450-foot by 12-foot deep turning basin at Matagorda, Texas.

d. Bank protection for the existing natural Tiger Island Channel which extends from mile 2 of the existing Flood Discharge Channel into Matagorda Bay, to prevent enlargement of Tiger Island Channel. Wildlife interests have asked that this channel be left open at the present time.

After construction of jetties and enlargement of the mouth of the river, there is a possibility that increased tidal action would enlarge the present channel if it were not protected.

e. Public use areas with facilities for project recreation and fish and wildlife visitation. Public use facilities would be included in the plan to make use of the project related recreation potential. Facilities would be limited to those specific facilities and lands clearly required to meet the project related needs, and would consist of land, access roads, parking areas, sanitary facilities, boat launching ramps, water supply and a walkway with handrail on the east jetty. Public use facilities would require about 17.2 acres of land for access roads, parking areas, launching ramps and sanitary facilities. These facilities would be adjacent to the navigation channel and would be accessible via County Road 2031 which extends from the town of Matagorda to the Gulf, paralleling the navigation channel.

f. Parallel jetties spaced 1200 feet apart extending from the shoreline to the 18-foot depth in the Gulf. Jetties would be spaced to accommodate future enlargement of the channel for deep draft vessels.

g. Relocation of the Colorado River channel with a diversion dam in the existing channel to divert flow of the river to the Bay and prevent river sedimentation in the navigation channel. The diversion channel would have a 250-foot bottom width with 1 on 4 side slopes.

46. Lands required for channel improvement include a 600-foot wide right-of-way along the channel alignment. The east channel right-of-way line would be the approximate east shore line of the present Flood Discharge channel. Spoil from construction and maintenance of the project would be deposited in existing spoil areas on the west side of the channel. Lands for the river diversion channel consist of a 1,000-foot wide right-of-way extending from the Gulf Intracoastal Waterway to Matagorda Bay.

SHORELINE CHANGES

47. The proposed jetties would interfere with normal shore processes along Matagorda Peninsula by stopping or impeding the littoral drift. Aerial photographs of the project location indicate a net westward movement of beach materials of considerable magnitude. The proximity and similarity of the shorelines at the Matagorda Ship Channel and the project location indicate that shore processes and the effects of jetties at the two locations will be essentially the same. It was not possible to detect any recession of the downdrift beach from the photographs of the Matagorda Ship Channel jetties. Evidence is insufficient to allow any prediction of the possible magnitude or effect of any such shoreline recession in the vicinity of the proposed project. The inaccessibility and consequent low land values of Matagorda Peninsula west of the proposed jetties makes it

improbable that there would be any need to consider replenishment of the beaches should any shoreline recession occur. Plate 6 shows the predicted shoreline changes which would occur as the result of construction of the proposed jetties.

REQUIRED AIDS TO NAVIGATION

48. The Commander, Eighth Coast Guard District, New Orleans, Louisiana, by letter dated September 14, 1964, advised that aids to navigation for the entrance channel would consist of 24 day beacons, 25 unlighted buoys and 2 lighted buoys. He estimated the cost of establishing these aids to navigation at \$37,000.

ESTIMATES OF FIRST COST AND ANNUAL CHARGES

49. Estimates of first cost and annual charges are summarized in tables 3 and 4. Estimates of cost include an allowance of 25 percent for contingencies. Prices used in estimating the first cost are based on May 1967 price levels. Computation of interest and amortization is based on a project life of 50 years and an interest rate of $3\frac{1}{4}$ percent. A detailed breakdown of the cost estimate is given in appendix II.

TABLE 3
ESTIMATED FIRST COST
FOR RECOMMENDED PLAN OF IMPROVEMENT
(PLAN A)

Item	Cost
<u>Federal first cost</u>	
Dams	\$ 10,000
Channels and canals	1,604,000
Jetties	6,205,000
Recreation facilities	179,000
Bank stabilization	49,000
Contingencies	2,012,000
Engineering and design	704,000
Supervision and administration	754,000
Aids to navigation (U. S. Coast Guard)	<u>37,000</u>
Total Federal cost	\$11,554,000 *
<u>Non-Federal first cost</u>	
Lands and damages	125,000
Contingencies	31,000
Acquisition cost	15,000
Total lands and damages	<u>171,000</u>
Levees	10,000
Contingencies	3,000
Engineering and design	1,000
Supervision and administration	1,000
Total non-Federal cost	<u>186,000</u>
Total project first cost	<u>\$11,740,000</u>

* Includes \$128,000 of reimbursable cost for recreation facilities which is one half of the estimated first cost of proposed recreation facilities.

TABLE 4
ESTIMATE OF INVESTMENT AND ANNUAL CHARGES
FOR RECOMMENDED PLAN OF IMPROVEMENT
(PLAN A)

<u>Investment cost</u>	<u>Federal</u>	<u>Non-Federal</u>	<u>Total</u>
First cost	\$ 11,554,000*	\$186,000	\$ 11,740,000
Interest during construction	<u>376,000</u>	<u>6,000</u>	<u>382,000</u>
Total investment	11,930,000	192,000	12,122,000
 <u>Annual charges (50 year life)</u>			
Interest and amortization	486,000	8,000	494,000
Annual maintenance			
Dredging	78,000		78,000
Jetty rehabilitation	60,000		60,000
Tiger Island Channel bank protection	1,000		1,000
Aids-to-navigation	3,000		3,000
Recreation facilities and spoil retention levees		<u>24,000</u>	<u>24,000</u>
Total annual charges	<u>628,000</u>	<u>32,000</u>	<u>660,000</u>

* Includes \$128,00 of reimbursable cost. (See note table 3)

ESTIMATES OF BENEFITS

50. Benefits from the proposed project would consist of savings in transportation costs, reduction in hazards to navigation, recreational use of the area, and increased commercial fishing. The analysis of benefits is based on information obtained from a field survey of the project area, and records and data furnished by the Bureau of Sport Fisheries and Wildlife, commercial fishermen, and seafood industry representatives. Published reports and statistical data of the Texas Parks and Wildlife Department, U. S. Bureau of Commercial Fisheries, and U. S. Weather Bureau, were also consulted for information pertinent to the project. Detailed explanation of analysis of benefits is contained in appendix I.

51. SAVINGS IN TRANSPORTATION COSTS.- A navigation entrance channel at the mouth of the Colorado River would provide a savings in transportation cost to commercial fishing boats operating in the area. The 1963 Annual Report of the U. S. Bureau of Commercial Fisheries indicates that the 15 million pounds of shrimp caught in the vicinity of the mouth of the Colorado River represents 34 percent of all shrimp taken in both the Gulf and the bays of Texas. A total of 44 million pounds of shrimp, valued at almost \$27 million, was landed in Texas in the year 1963.

52. It has been estimated by representatives of the shrimp industry that more than 5 million pounds of shrimp would be landed and processed at Matagorda upon completion of the project. Other local interests state that one-half of the over 300 shrimpers that operate in the Freeport-Port O'Connor area would regularly use the proposed navigation channel throughout the year.

53. Savings in transportation are derived from estimated savings to existing shrimp vessels working in an area in the Gulf about 36 miles wide off the mouth of the Colorado River. The southwestern boundary of this area is a line equally distant from Port O'Connor and Matagorda, and the north-eastern boundary line is equally distant from Matagorda and Freeport, Texas. The estimated 5.5 million pound annual catch from this area is based on an area ratio proportion of shrimp catch reported in the 1959-63 annual summaries of the "Gulf Coast Shrimp Data" published by the U. S. Bureau of Commercial Fisheries. It is estimated that \$210,000 annually, would be realized from savings in transportation costs, because of the proximity of port facilities to these fishing grounds. These savings should remain constant throughout the 50-year period of analysis.

54. Bay fishermen working out of Matagorda at present spend little time in Gulf fishing. These fishermen estimate that their fish catch would double if fishing banks in the Gulf were accessible to them. Data pertaining to existing commercial fishing traffic in the area are too indefinite to evaluate at this time, however, the proposed improvement would permit smaller commercial fishing boats to spend more fishing time on the fishing grounds. This increased fishing time would result in a larger annual catch and an increased annual income for the boat operators. Because of the speculative nature of this increased income, no evaluation of benefits on increased catch based on increased fishing time was made.

55. HAZARDS TO NAVIGATION.- A safe and dependable entrance channel would afford benefit from reduction in hazards to navigation for vessels traversing the entrance channel to the Colorado River. The existing Colorado River channel is the only entrance channel to inland waters between the Matagorda Ship Channel and the Freeport Harbor for vessels seeking refuge from severe weather disturbances in the Gulf. The distance between the two entrance channels is about 82 miles and on occasions vessels caught in the Gulf off the mouth of the Colorado River must attempt to enter the river. Under existing conditions the alignment and controlling depth of the mouth of the river changes constantly causing very hazardous navigation conditions. Many vessels suffer severe damages and some are lost in trying to navigate the entrance. The proposed project would prevent these losses. Benefits from reduction in hazards to navigation are estimated at \$21,000, annually.

56. HARBOR OF REFUGE.- The proposed improvement would provide a saving in transportation cost for shallow draft vessels in the Gulf seeking refuge. A section of the river, about 10 river miles above Matagorda, Texas, offers one of the best natural harbors of refuge available along the Texas Gulf Coast. Along this portion of the river the banks rise about 20 feet above mean low tide to provide a windbreak from the high winds that accompany hurricanes and heavy squalls. In addition, there are large trees along the banks that provide moorings for vessels using this protected anchorage.

57. During hurricane Carla, 217 shallow-draft vessels valued at over \$3,500,000 used the Colorado River for a harbor of refuge. All of the boats entered the river from the Gulf Intracoastal Waterway. The impassable entrance channel made it necessary for the vessels in the Gulf, off the mouth of the Colorado River, to seek this protected anchorage via either the Freeport or Pass Cavallo channels at a greater travel distance.

58. Benefits to the proposed project would be derived from savings in operating costs of vessels using this channel in lieu of other existing entrances. The U. S. Weather Bureau records show that during a 72-year period (1886-1958), there were 50 tropical storms and 31 hurricanes which moved inland along the Texas Gulf Coast. Based on this storm frequency, the combined savings in operating costs and the reduction of damages because of hurricanes or other tropical disturbances is estimated at \$21,000, annually.

59. INCREASE IN COMMERCIAL SEAFOOD CATCH.- The proposed project plan would affect fish habitat in the Colorado River downstream from the Gulf Intracoastal Waterway and in 186,000 acres of Matagorda Bay. The bay provides good fishing for many people who come from far distances to fish. The lower 6-mile reach of the Colorado River also supports good fishing. Large populations of finfish, blue crabs, shrimp, and oysters bolster the estuarine commercial fishery. Available records indicate that Matagorda Bay and the 6-mile reach of the Colorado River produce a fish and crustacean catch of 70,091,000 pounds annually. About 94 percent of the

harvest is comprised of estuarine-dependent species nurtured in Matagorda Bay and the Colorado River but taken in the Gulf of Mexico. Construction of the navigation channel and the Matagorda turning basin and relocation of the flood discharge channel would add approximately 2.7 miles of stream amounting to 12 acres of new estuarine fish habitat.

60. Diversion of the Colorado River into the eastern portion of Matagorda Bay would reduce the salinity of the water in the bay. Over a period of years, the addition of freshwater could be expected to establish a salinity gradient in the bay that would accommodate an increased population of oysters, blue crabs, shrimp, and fish. Incoming sediments would add nutrients to the bay water. The sediments also would build up a marsh delta where the flood discharge channel enters Matagorda Bay. For a few years, the incoming sediment would improve fish habitat, but incoming sediment eventually would cause fish habitat in the portion of the bay displaced by the fill to deteriorate gradually in quality. Projected over the period of analysis, however, the average productivity of the bay would increase. The Bureau of Sport Fisheries and Wildlife estimates that diversion of Colorado River flows into Matagorda Bay would provide annual benefits estimated at \$1,148,000 attributable to the increase in commercial fishing. These estimated benefits are based on historical river flow records; however, increased upstream use and diversion of the river flow will materially reduce the flow available for diversion to Matagorda Bay. Available estimates of probable future flows indicated benefits of about \$345,000 annually from an increase in commercial seafood catch.

61. RECREATION.- The proposed jetty entrance channel at the mouth of the Colorado River would attract a considerable number of visitors for recreational activities. The excellent Gulf fishing in the project area would be used by many surf and Gulf fishermen. The attractiveness of the Gulf beaches coupled with the recreation facilities to be provided at the site would attract other recreationists such as sightseers, swimmers, picnickers, hikers, etc. The magnitude of this visitation depends upon the character and number of sportsmen who will reside within the study area during the project life. Recent trends in outdoor recreation indicate that these factors will vary appreciably during the period of evaluation. Increases in population, leisure time, disposable income, etc., are expected to increase substantially the future demand for recreation facilities. Benefits attributable to recreation are measured by the fee a person is willing to pay, if required, to enjoy the recreation features of the project, and the net visitation to the project. The unit values established as a fee a visitor is willing to pay are based on the uniqueness of the experience, e.g., saltwater sport fishing will have higher value than picnicking. The unit values are for one visitor-day and are the same whether the visitor engages in one or more activities.

The delta that would eventually be formed by diversion into Matagorda Bay would afford increased waterfowl hunting estimated by the Bureau of Sports Fisheries and Wildlife at \$13,500 annually. However, no additional recreational benefits for this sport activity is credited to the project. The estimates of annual visitation and benefits for 1975, 2000, and 2025, and the equivalent average annual benefits over the 50-year life of the navigation channel from Matagorda to the Gulf, presented in the above paragraphs, are summarized in table 5.

TABLE 5
ESTIMATES OF ANNUAL VISITATION AND BENEFITS
OF THE MULTIPLE-PURPOSE COLORADO RIVER JETTY CHANNEL

	: Annual visitation :			: Annual benefits :			: Equivalent
	: (1000 visits) :			: (\$1000) :			: average
	:	:	:	:	:	:	: annual
	:	:	:	:	:	:	: benefits
	: 1975 :	: 2000 :	: 2025 :	: 1975 :	: 2000 :	: 2025 :	: (\$1000)
No additional water resources improvement	34	53	147	-	-	-	-
Navigation channel & jetties - no recreation facilities	142	223	625	98	154	433	173
Navigation channel & jetty recreation plan (1)	180	284	795	126	202	565	225

(1) Includes jetty walkway and handrail, public use areas and facilities and launching ramps.

62. FLOOD CONTROL.- The proposed diversion would provide flood protection to existing camps along the lower river from river flooding. The reduction in flood damages is estimated at \$15,000 annually.

SUMMARY OF AVERAGE ANNUAL BENEFITS

63. The benefits creditable to the recommended project are shown in the following tabulation:

Savings in transportation costs	\$210,000
Reduction in hazards to navigation	21,000
Access to harbor of refuge	21,000
Recreation	225,000
Prevention of flood damages	15,000
Increase in commercial seafood catch	345,000
Total	<u>\$ 837,000</u>

COMPARISON OF ANNUAL BENEFITS AND COSTS

64. The ratio of estimated annual benefits to annual charges, based on a 50-year project life and an interest rate of 3-1/4 percent, is 1.3. In addition to the evaluated direct benefits, this project would provide important intangible benefits in economic and social terms to the Matagorda area, the State of Texas, the region, and the nation. The recommended project would significantly increase the economic efficiency of the fishing industry along the Texas Coast. The jettied channel would reduce the threat to lives as well as equipment of Gulf fishermen. These intangible benefits cannot be evaluated in monetary terms, however, they are of major significance.

APPORTIONMENT OF COSTS

65. The apportionment of first costs and annual maintenance costs of the proposed improvements between the Federal Government and the local interests would be in accordance with Congressional policies expressed in legislation applicable to projects for general navigation, in accordance with Federal law applicable to flood control projects, and in accordance with provisions of the Federal Water Resources Projects Recreation Act. The Federal Government would bear the project costs except for the costs of lands, relocations, spoil retaining levees and one-half of the cost of recreation facilities. The Federal Government would bear the cost of maintenance dredging of the channels and turning basin and maintenance and replacement of jetties. Local interests would reimburse the Federal Government the cost of maintenance and replacement of the walkway on the jetty. Local interests would administer, maintain and replace as required, the facilities in the public use areas, maintain necessary public mooring and supply facilities at the turning basin, and maintain the spoil levees.

The apportionment between Federal and Non-Federal interests of project costs and annual operation, maintenance, and replacement costs is shown in table 6.

TABLE 6
APPORTIONMENT OF COSTS

Items	: First cost		: Operation, maintenance	
	: Federal	: Non-Federal	: Federal	: Non-Federal
Lands and damages		171,000	-	-
Dams	14,000	-	(2)	-
Channels & turning basin	2,296,000	-	78,000	-
Jetties	8,881,000	-	60,000	-
Bank stabilization	70,000	-	1,000	-
Levees (spoil)	-	15,000	-	1,000
Recreation facilities	128,000	128,000(1)	-	23,000
Aids to navigation	37,000(3)	-	3,000(3)	-
Total	11,426,000	314,000	142,000	24,000

- (1) One-half separable cost for public use facilities.
 (2) Maintained by replenishing dam with spoil from channel dredging as required.
 (3) U. S. Coast Guard.

PROPOSED LOCAL COOPERATION

66. The proposed project would be a navigation project subject to the requirements of local cooperation generally specified for navigation projects and in addition to the requirements of local cooperation under the Federal Water Project Recreation Act. It is proposed that local interests be required to participate in the project as follows:

a. Provide without cost to the United States all lands easements, and rights-of-way required for construction and subsequent maintenance of the project, aids-to-navigation, and public use areas upon 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 also provide and maintain necessary retaining dikes, bulkheads, and embankments therefor or the cost of such retaining works.

b. Hold and save the United States free from damages that may result from construction of the project.

c. Provide and maintain without cost to the United States necessary mooring facilities and utilities including a public landing with suitable supply facilities open to all on equal terms.

d. Accomplish without cost to the United States all alterations of powerlines, pipelines, utility lines, cables and highway facilities when and as required for construction of the project.

e. Agree to assume a share of costs for recreation facilities in accordance with the Federal Water Project Recreation Act of 1965 (Public Law 89-72) generally as follows: (1) Not less than one-half of the separable construction costs allocated to recreation; (2) Cost of administering project land and water areas for recreation; and (3) Cost of operation and maintenance of the recreation facilities and replacements thereof.

f. Establish regulations prohibiting discharge of pollutants in the waters of the proposed improvement by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

67. The local interests shall administer public use areas for recreation in accordance with provisions of the Federal Water Project Recreation Act. The local interests shall operate, maintain and provide replacement of, as required, facilities in public use areas except that the Federal Government shall maintain and replace, at local interest expense, recreation facilities constructed upon the jetties. Matagorda County Navigation District No. 2 has agreed to provide the required local cooperation.

COORDINATION WITH OTHER AGENCIES

68. INITIATION OF STUDIES.- Copies of the notice of public hearing held in Columbus, Texas, on 24 April 1962 were sent to all known Federal, State and local agencies that were believed to have a possible interest in improvement in the lower Colorado River basin.

69. BUREAU OF SPORT FISHERIES AND WILDLIFE.- The Fort Worth Office of River Basin Studies, Bureau of Sport Fisheries and Wildlife, was informed of alternate plans under study by letter dated 18 August 1964. The Bureau made comments regarding each of the proposed plans. By letter report dated 3 July 1967 the Regional Director commented favorably on the recommended plan, furnished estimates of benefits for increased sport and commercial fishing, and recommended closing of Tiger Island Channel in the future at an appropriate time determined by the Bureau and the Texas Parks and Wildlife Department.

DISCUSSION

70. This report summarizes the findings of an investigation of the water resource needs in the vicinity of the mouth of the Colorado River, Texas. Results of the investigation indicate that the local

shrimping and fishing industry at Matagorda, Texas and surrounding area cannot develop efficiently the area fishing resources because of inadequate navigation facilities. It was also determined that the commercial fish catch on the Gulf Coast would significantly increase if fresh water flows of the Colorado River were diverted into Matagorda Bay. The study also revealed that the mouth of the Colorado River has an excellent recreation potential which is only partly utilized because of lack of adequate public use facilities.

71. Four alternate plans were considered; all four plans would provide for a jettied entrance channel from the Gulf of Mexico and a navigation channel from the jettied entrance to the town of Matagorda. A turning basin would be provided at Matagorda to accommodate the commercial fishing fleet. Public use facilities would be included in all plans.

72. Plan A provides for diversion of the Colorado River into Matagorda Bay. The existing river channel would be used as part of the navigation channel from the Gulf of Mexico to Matagorda. Plan A includes bank protection for Tiger Island Channel which extends from Matagorda Bay into the existing Flood Discharge Channel at a point about two miles from the mouth of the river. This protection is to prevent possible enlargement of Tiger Island Channel when the bar at the mouth of the river is removed. Enlargement of Tiger Island Channel would be detrimental to the project because the enlarged channel would permit greater quantities of high salinity sea water to enter the bay. There is also the possibility that this channel may have to be closed at a later date and any channel enlargement would add to closure costs.

73. Plan B would provide a new discharge channel to the Gulf on an alignment to the west of the existing channel. The existing Flood Discharge Channel would be used as part of the navigation channel from the Gulf to Matagorda, Texas. Tiger Island Channel would be permanently closed.

74. Plan C would provide a single-purpose navigation channel located to the east of the existing Flood Discharge Channel and Plan D would provide a combination channel for flood control and navigation. Plan C was found to have excessive first costs. Plan D would have excessive maintenance costs because of the heavy dredging required to remove river sediment from the combined navigation and flood control channel. Plan B would not provide fresh water flow into Matagorda Bay. Plan A was therefore selected for detailed study.

75. Economic analysis showed construction of Plan A is economically justified and is needed for timely development of the water resources of the area. In addition, an emergency entrance for small craft working in the shrimping and oil and gas production areas off the mouth of the

Colorado River is needed. Construction of navigation facilities and development of the recreation potential would improve the general welfare of the people in the area. Fresh water inflow into Matagorda Bay would improve the marine and wildlife habitat and increase the fish catch. The diversion of the Colorado River into Matagorda Bay and the improvement of the existing river channel for navigation are considered to be inseparable increments of the multiple-purpose plan of improvement. The Committee on Tidal Hydraulics of the Corps of Engineers recommended that a separate independent jettied channel with a straight alignment, or with as few curves as possible, be provided for navigation between the Gulf Intracoastal Waterway and the Gulf of Mexico. The Committee further stated that a single dual-purpose navigation-flood discharge channel should not be provided, except as a last resort. The benefits which would be provided by Plan A, but not by the other three plans considered, would be an estimated \$345,000 annual increase in the catch of oysters, blue crabs, shrimp, and fish, and an estimated savings in annual channel maintenance costs of \$37,000 over plans B, C, and D.

76. Studies of the effects of the sediment load of the Colorado River on Matagorda Bay was one of the main considerations in development of the plan of improvement. Studies indicated that practically all of the sediment presently flowing into the Gulf originates from the watershed area below a series of dams constructed at and above Austin, Texas, which control 89 percent of the 42,344-square mile Colorado River Basin. The present sediment load at the mouth of the river is estimated to be about 1,665 acre-feet annually based on a unit sediment weight of 70 pounds per cubic foot. This sediment load would be greatly reduced if the recommended Columbus Bend Reservoir and the proposed Matagorda Reservoir are constructed in the lower basin.

77. The present sediment load would create a small delta in Matagorda Bay, but the rate of growth of the delta would not seriously affect the bay except in the immediate vicinity of the mouth of the diversion channel. Maintenance dredging of the diversion channel would reduce the rate of delta growth. Serious consideration was given throughout the study to problems which might occur if sediment inflow into the bay and delta growth greatly exceeded estimated rates. If rapid delta growth should occur, the diversion channel would be extended by maintenance dredging as the delta formed. This would eventually result in the channel being extended across Matagorda Bay and through Matagorda Peninsula into the Gulf of Mexico. If this should occur additional openings would have to be provided along the channel to permit fresh water flow to enter the bay during periods of low flow when the sediment concentrations of the river flow are relatively low. It is believed, however, that occurrence of major delta formation in Matagorda Bay is unlikely even if additional reservoirs are not constructed in the lower basin and detailed planning of facilities to reduce sediment damage to the bay is not warranted. As discussed in the previous paragraph, the

maintenance program for the diversion channel could be carried out in such a way as to remedy ordinary sedimentation problems if they should occur.

78. Diversions of the Colorado River flows into Matagorda Bay would provide fresh water to reduce the salinity in the waters of the bay. These diversions also would add nutrients to the bay waters. Fish and wildlife habitat would improve in the bay. The shallow bay areas would produce dense growths of widgeongrass or shoalgrass depending upon the salinity level of the water in the area. Both plants are desirable food for waterfowl.

79. Several conservation storage reservoirs are proposed in the Colorado River Basin. Freshwater flows into Matagorda Bay would be reduced upon completion of each of these reservoirs thus threatening maintenance of the improved habitat for fish and crustaceans. Under this condition, tidal flows through the Tiger Island Channel would allow an undesirable increase of salinity in Matagorda Bay.

80. When freshwater flows into Matagorda Bay are reduced substantially, provision should be made to close Tiger Island Channel to prevent tidal exchange. The Bureau of Sport Fisheries and Wildlife and the Texas Parks and Wildlife Department, cooperatively, would determine the appropriate time when closure of Tiger Island Channel would be advantageous to the fish and wildlife. The closure of the channel possibly could be made during maintenance dredging of the navigation channel.

81. Model studies of Matagorda Bay, made in connection with the Matagorda Ship Channel design memorandum studies, investigated the effects of Colorado River discharge on Matagorda Bay and the Matagorda Ship Channel located about 30 miles west of the mouth of the Colorado River. Examination of the model test results indicates the major effect of Colorado River discharges into Matagorda Bay would be on salinities within the bay. The effect of the discharges on tides and currents would be relatively minor for normal flows. All model tests, which simulated a Colorado River discharge into Matagorda Bay, involved introduction of an average discharge of 10,000 c.f.s. on a sustained basis. The Colorado River discharge normally varies annually between a minimum of less than 1000 c.f.s. and a maximum of about 40,000 c.f.s. It is possible that appreciable effects on salinities, tidal elevations and current would occur when sustained high discharges occur over a period of several days. The model tests indicate the order of magnitude by which the bay would be affected by Colorado River inflow. Maximum current and velocities in the Matagorda Ship Channel and bay reaches of the Gulf Intracoastal Waterway would not exceed those presently experienced during abnormally high tide.

82. The reach of the Gulf Intracoastal Waterway in open waters of Matagorda Bay is located a minimum of 15 miles from the mouth of the recommended diversion. It is unlikely that a significant amount of river

sediment will be transported through 15 miles of bay and deposited in the Gulf Intracoastal Waterway or transported 30 miles and deposited in the Matagorda Ship Channel. The proposed diversion of river flows into Matagorda Bay should not increase the maintenance costs for the Matagorda Ship Channel or the Matagorda Bay sections of the Gulf Intracoastal Waterway.

83. Local interests diverted the Colorado River from Matagorda Bay into the Gulf by construction of the existing Flood Discharge Channel in 1934 and 1935. The shore line of the Gulf side of Matagorda Peninsula did not change as a result of introduction of Colorado River sediment onto the beaches. It is therefore doubtful that diverting the sediment laden river flows into Matagorda Bay would cause changes in the Gulf shore line. There is a possibility that part of the Colorado River sediment load is transported by littoral action to the east jetty of the Matagorda Ship Channel. Diversion of river flows to Matagorda Bay would reduce the rate of accretion at that jetty.

84. The direction of predominant littoral transport is from east to west. Construction of the proposed jetties at the mouth of the Colorado River will cause accretion of littoral material on the east side of the east jetty. The outer ends of the jetties were extended to a depth 3 feet greater than the project depth of the entrance channel so that littoral material passing the ends of the jetties would not be deposited in the navigation channel. There is a possibility that some beach erosion will occur to the west of the jetties because of interruption of the littoral drift by the jetties. Consideration would be given during detailed planning to stockpiling suitable material dredged from the entrance channel on the beach west of the project as a shore protection measure. However, the inaccessibility of the west beach and the low value of adjoining lands did not warrant detail planning of artificial beach nourishment at this time.

85. The project initial cost is estimated at \$11,740,000 and the annual maintenance cost at \$166,000. The annual benefits are estimated at \$837,000 and the project has a favorable benefit to cost ratio of 1.3. Matagorda County Navigation District No. 2 has the ability and desire to sponsor the project and has made a formal commitment with respect to furnishing assurances for the local interest requirement including an agreement to participate in the project recreation facility program under provisions of the Federal Water Resource Project Recreation Act.

86. Since the project interconnects with facilities of the Gulf Intracoastal Waterway and the existing Flood Discharge Channel is part of the GIWW, the mouth of the Colorado River project would be constructed as a modification of the Gulf Intracoastal Waterway.

CONCLUSIONS

87. Economic analysis of the selected plan for providing an entrance channel shows an immediate need for construction of this project for timely development of the water resources of the area. In addition, an emergency entrance from the shrimping and oil and gas production areas off the mouth of the Colorado River is needed. The economic savings which would result from reducing travel distance for fish and oil company service craft and development of the recreation potential would improve the general welfare of the people in the area. The Bureau of Sport Fisheries and Wildlife Report indicates fresh water inflow into Matagorda Bay will improve the marine and wildlife habitat and increase the fish catch. The recommended plan of improvement presented in this report is economically justified for immediate construction.

RECOMMENDATIONS

88. Accordingly, it is recommended that a Federal project be authorized for navigation improvements in the mouth of the Colorado River, Texas to provide for a shallow-draft channel from the Gulf of Mexico through a jetty protected entrance to a turning basin at the town of Matagorda, for a diversion dam and channel to divert the Colorado River into Matagorda Bay, and for recreation facilities, all generally as described under Plan A in this report, with such modifications thereof as in the discretion of the Chief of Engineers, may be advisable, at an estimated first cost of \$11,740,000 for construction and an increase in maintenance cost estimated at \$166,000 annually.

89. The first cost to the United States for construction of the recommended improvements is estimated at \$11,554,000, including an estimated \$128,000 for recreation facilities to be reimbursed by the local interests. The annual cost to the United States for maintenance, operation and replacements is estimated at \$142,000, including \$3,000 for aids-to-navigation.

90. The foregoing recommendations shall be subject to the conditions that prior to initiation of construction, responsible non-Federal interests shall 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, aids-to-navigation, and public use areas upon 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 also provide and maintain necessary retaining dikes, bulkheads, and embankments therefor or the costs of such retaining works.

b. Hold and save the United States free from damages that may result from construction of the project.

c. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including a public landing with suitable supply facilities open to all on equal terms.

d. Accomplish without cost to the United States all alterations of powerlines, pipelines, utility lines, cables, and highway facilities when and as required for construction of the project.

e. Agree to assume a share of costs for recreation facilities in accordance with the Federal Water Project Recreation Act of 1965 (Public Law 89-72) as follows: (1) Not less than one-half of the separable construction costs of recreation facilities; (2) Cost of administering project land and water areas for recreation; and (3) Cost of operation and maintenance of the recreation facilities and replacements thereof.

f. Establish regulations prohibiting discharge of pollutants in the waters of the proposed improvement by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State and local authorities responsible for pollution prevention and control.

91. The first cost to local interests is estimated at \$314,000 of which \$171,000 is for land and damages, including \$6,000 for public use area lands, \$15,000 for spoil levees, and one half of the cost for recreation facilities estimated at \$128,000. The annual cost to the local interests for maintenance and operation of the recreation facilities and spoil levees is estimated at \$24,000.

92. The recommendations are subject to the condition that no dredging shall be done within 50 feet of an established pierhead line or any wharf or structure.

93. It is further recommended that maintenance of the Flood Discharge Channel in the Colorado River authorized by River and Harbor Act of 1937 be discontinued and that the improvements at the mouth of the Colorado River recommended herein be authorized as a part of the Gulf Intracoastal Waterway project.

- 3 Incl
1. Plates 1 thru 6
2. Appendixes I thru IV
3. Sen. Resol. 148
attachment

FRANKLIN B. MOON
Colonel, CE
District Engineer

[First endorsement]

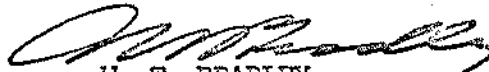
SWDPL-F

SUBJECT: Interim Report on Colorado River and Tributaries, Texas,
Covering Mouth of Colorado River for Navigation, Flood
Control, Recreation, and Fish and Wildlife Enhancement

Div Engr, SWDiv, CE, 1114 Commerce St, Dallas, Tex 75202, 2 Feb 68

TO: Chief of Engineers

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



W. T. BRADLEY
Brigadier General, USA
Division Engineer

INTERIM REPORT
ON
COLORADO RIVER AND TRIBUTARIES, TEXAS

MOUTH OF COLORADO RIVER

APPENDIX III
COMMENTS BY OTHER AGENCIES

INTRODUCTION

1. In accordance with the Interagency Agreement on Coordination of Water and Related Land Resources Activities approved by the President on 26 May 1954, the recommended plan of improvement was furnished to all Federal agencies believed to have possible interest in navigation improvements for Colorado River for field level review. Letters from these agencies containing their views are presented in this appendix.

2. This appendix also presents a letter from Matagorda County Navigation District No. 2. In this letter the District indicates its acceptance of the recommended plan of improvement, and their willingness to furnish the required items of local cooperation.

DISCUSSION

3. Significant field level review comments on the interim report were received from the Texas Water Development Board (exhibit 9), the Bureau of Sport Fisheries and Wildlife (exhibit 10), and the Bureau of Outdoor Recreation (exhibit 13). These comments are summarized and discussed in the following paragraphs.

4. TEXAS WATER DEVELOPMENT BOARD.- The Executive Director of the Board referred to table 1, appendix I, and stated that their projected populations for the years 2000 and 2020 for Colorado, Matagorda, Wharton, Brazoria and Jackson Counties are higher than those shown in the interim report, and that use of the TWDB population projections would have resulted in larger benefits attributable to recreation.

5. The Executive Director states that under future conditions of reduced flows of the Colorado River, projected return flows and their accompanying nutrients from the lower basin could cause enrichment in parts of the bay, and that this could result in excessive algal growth, suppressed DO, and critically high pH because of excessive algal activity.

6. The Executive Director states that with reduced Colorado River flows, and without the proposed Matagorda Dam in place, the tide-affected reach of the river could extend for an undesirable distance upstream. He qualifies this comment by stating that, since tidal variations in Matagorda Bay (mean diurnal range is about 0.7 feet) are less than in the Gulf, this effect would perhaps be minimized if the Colorado River were diverted into Matagorda Bay as proposed in the interim report.

7. The Executive Director states, in summary, that the proposed project is feasible and would be compatible with facilities proposed in the preliminary Texas Water Plan. No changes were made in the interim report as a result of the comments by the Texas Water Development Board.

8. BUREAU OF SPORT FISHERIES AND WILDLIFE.- The Regional Director of the Bureau noted that the interim report considered that elements of the Texas Water Plan would be existing, and stated that their report (exhibit 1) was based on the assumption that none of the elements of the Texas Water Plan will be existing. He pointed out that some of the features of the Texas Water Plan are not scheduled for completion until about the year 2000, midway in the 50-year period of project analysis (1975-2025), and inquired whether the project evaluation reflects an assumption that elements of the Texas Water Plan were existing over the 50-year period rather than for the actual period of the elements' existence.

9. The estimate of the average annual benefits from increased commercial fish catch to be realized from the diversion of the Colorado River into Matagorda Bay (paragraph 43, appendix I) is based on the assumption that elements of the Texas Water Plan for the Colorado River Basin would be in being early in the project life. If construction of these elements, such as Matagorda and Columbus Bend Reservoirs, etc., is delayed beyond the year 2000, the estimated average annual benefits from increased commercial fish catch during the period 1975-2000 would be greater. Because of uncertainty as to the nature of the final Texas Water Plan for the Colorado River Basin, no changes were made in the interim report except to clarify paragraph 43 of appendix I to indicate that the required and expected flows of 300,000 acre-feet per year and 100,000 acre-feet per year, respectively, are minimums.

10. The Regional Director objects to the fact that the Bureau's estimates of the benefits to be expected from increased sport fishing and increased waterfowl hunting were not used in the interim report. If the Bureau's estimates were used, the effect would be to increase the annual recreation benefits from \$225,000 to \$927,500. A comparison of the two estimates is as follows:

<u>Item</u>	<u>C of E</u>	<u>BSF&WL</u>
Sport Fishing:		
Increase in man-days	191,000	391,000
Average annual benefits	\$ 191,000	\$880,000
Waterfowl hunting:		
Increase in man-days	-	3,000
Average annual benefits	-	\$ 13,500

11. Paragraph 40, appendix I, was revised after receipt of this letter to show a true comparison of the Corps and Bureau estimates of sport fishing benefits.

12. BUREAU OF OUTDOOR RECREATION.- The Regional Director of the Bureau notes that the proposed plan of improvement provides for only 17.2 acres of land for recreation, and does not include enough facilities for the swimmers, surfers, picnickers and campers who would use the project. He states that additional land should be acquired and additional facilities, including picnic tables, trash barrels, etc., should be provided if all the indicated benefits are to be claimed.

13. The detailed estimate of recreation facilities in table 3, appendix II, includes 17.2 acres of land (7 acres of which is for parking areas), 9 launching ramps, 3 sanitary units, 3 water supply units, and a walkway and handrail on one of the jetties. The estimate includes \$44,000 as a contingency allowance, which should be adequate to cover the cost of any additional facilities, such as picnic tables, trash barrels, etc., determined to be required during subsequent detailed pre-construction planning of the project.

14. The Regional Director states that the State of Texas Comprehensive Outdoor Recreation Plan (SCORP) points out that a 20-mile stretch of Matagorda Peninsula extending northeast from the Colorado River, possesses one of the most valuable lengths of beach on the Texas Coast. He proposes that after authorization, during pre-construction planning stages, an in-depth study be conducted to determine the feasibility of acquiring and developing land for a park facility along the Gulf beach of Matagorda Peninsula. This proposal, although meritorious, is considered to be outside the scope of the proposed project. It is considered that recreation planning for the proposed project should be limited to that required to develop the full recreation potential of the proposed project channel and jetties.

15. The Regional Director notes that local interests would be required to pay \$128,000, or 57 percent of the \$223,000 cost of the recreation facilities, and suggests that the local share be reduced to 50 percent in accordance with Public Law 89-72. The \$223,000 figure quoted by the Regional Director is the estimated cost of the recreation facilities plus the contingency allowance, but does not include the estimated cost of engineering and design or supervision and administration, which increase the estimated total cost of the recreation facilities to \$256,000. The local share was computed as 50 percent of \$256,000.

16. All other agencies replying after reviewing the report either offered no comment or favored the recommended improvement.



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

July 3, 1967

District Engineer
Corps of Engineers, U. S. Army
Post Office Box 1229
Galveston, Texas

Dear Sir:

Mr. D. T. Graham's letter of March 9, 1967, informed us that the Corps of Engineers was preparing an interim report to the Colorado River survey report and requested the Bureau of Sport Fisheries and Wildlife analysis of the project's effects on fish and wildlife. The interim report is being prepared to study the feasibility of a navigation channel with jetties at the mouth of the Colorado River, Matagorda County, Texas.

This report has been prepared under the authority of and in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and has been coordinated with the Bureau of Commercial Fisheries. It has received concurrence from the Texas Parks and Wildlife Department as shown in the enclosed copy of the letter dated July 19, 1967, signed by Mr. J. R. Singleton, Executive Director.

The project would be located on the lower reach of the Colorado River downstream from the Gulf Intracoastal Waterway. Purposes of the project would be navigation, fish and wildlife, and recreation.

The Colorado River proper rises in north-central Dawson County, Texas, about 10 miles northeast of Lamesa. The characteristically silt-laden stream follows a tortuous course throughout its length, meandering back and forth across the valley for a distance of 890 miles to the Gulf of Mexico. The average annual flow of the stream at the Wharton Gage at river mile 67 was 2,063,000 acre-feet for a 32-year period (1919-21; 1922-25; and 1938-65). The maximum annual flow was 6,847,000 acre-feet, and the minimum annual flow was 446,400 acre-feet. Since 1938, the river below Austin, Texas, has been regulated by upstream reservoirs.

A large percentage of the Colorado River sediment load is contributed by the watershed between Austin, Texas, and Columbus, Texas. The sediment contribution above the Bureau of Reclamation's proposed Columbus

EXHIBIT 1
APPENDIX III

Bend Reservoir amounts to about 80 percent of the estimated sediment load of 1,665 acre-feet annually at the mouth of the river. Upon completion of the Bureau of Reclamation's proposed Columbus Bend Reservoir, the sediment load at the mouth of the Colorado River would be about 310 acre-feet annually.

The proposed plan of development would include the following elements:

1. A 12-foot deep and 100-foot wide channel from the present shoreline of the Gulf of Mexico to the Gulf Intracoastal Waterway. The channel would follow the present Colorado River channel from the Gulf of Mexico shoreline to a point about 5,000 feet downstream from the Gulf Intracoastal Waterway. Here, the channel would curve eastward and terminate at the Waterway at a point about 700 feet east of the existing east lock.
2. A 15-foot deep by 200-foot wide entrance channel from the 18-foot depth in the Gulf of Mexico to the present Gulf shoreline.
3. A 350-foot wide by 1,450-foot long by 12-foot deep shallow draft turning basin at Matagorda, Texas. The basin would be located to the north and adjacent to the Gulf Intracoastal Waterway about 4,000 feet east of the new channel's entrance to the Waterway.
4. A 50,000 second-foot flood discharge channel from the Colorado River near the Gulf Intracoastal Waterway across the Colorado River delta to the northeastern portion of Matagorda Bay.
5. A diversion dam on the Colorado River slightly downstream from the proposed flood discharge channel.
6. Parallel jetties extending from the shoreline to the 18-foot depth in the Gulf of Mexico.
7. Bank protection of Tiger Island Channel.
8. If Columbus Bend Reservoir, or another upstream reservoir to control silt, is not authorized by the time project construction begins, measures to prevent excessive amounts of sediment from entering Matagorda Bay would be included in project plans.

9. Public use areas with construction of appropriate facilities. Facilities would consist of lands, access roads, parking areas, sanitary facilities, boat-launching ramps, water supply, and a walkway on the East Jetty. The facilities would be included in the project under provisions of the Federal Water Project Recreation Act (79 Stat. 213) whereby local interests would bear not less than one-half of the separable costs allocated to establishment of the facilities.

Dredging of all channels and the turning basin would be done by hydraulic dredge, and the spoil would be placed and contained on dry land adjacent to the work areas.

An analysis for a 50-year period (1970-2020) has been made of the fish and wildlife resources associated with project developments.

FISH

The proposed plan of development would influence fish habitat in about 6 miles of the Colorado River downstream from the Gulf Intracoastal Waterway and in 186,000 acres of Matagorda Bay, exclusive of Lavaca Bay.

Matagorda Bay is one of the most productive estuaries on the Texas coast. It supports valuable fish habitat for finfishes and crustaceans, such as red drum, black drum, flounders, spotted seatrout, gafftopsail catfish, saltwater sheepshead, croakers, mullet, menhaden, blue crabs, shrimp, and oysters. The bay provides good fishing for many people who come from far distances to fish. The lower 6-mile reach of the Colorado River also supports good fishing for many of the same species of finfishes and crustaceans that are taken from Matagorda Bay.

Without the project, estuarine sport fishing would amount to 1,060,000 man-days annually in the project area of influence. About 1,050,000 man-days of this use would occur in Matagorda Bay and 10,000 man-days in the Colorado River.

Large populations of finfishes, blue crabs, shrimp, and oysters bolster the estuarine commercial fishery. It is estimated that Matagorda Bay and the 6-mile reach of the Colorado River produce a harvestable fish and crustacean catch of 70,091,000 pounds annually. About 94 percent of the harvest would comprise estuarine-dependent species nurtured in Matagorda Bay and the Colorado River but taken in the Gulf of Mexico.

Construction of the navigation channel and the Matagorda turning basin and relocation of the flood discharge channel would add approximately 2.7 miles of stream and 12 acres of new estuarine fish habitat.

Diversion of freshwater flood flows from the Colorado River into the eastern portion of Matagorda Bay would reduce the salinity level concentration in the bay. Over a period of years, the addition of freshwater could be expected to establish a salinity gradient in the bay to accommodate an increased population of oysters, blue crabs, shrimp, and finfishes.

Incoming sediments would add nutrients to the bay water. The sediments also would build up a marsh delta where the flood discharge channel enters Matagorda Bay. For a few years, the incoming sediment would improve fish habitat, but incoming sediment eventually would cause fish habitat in the bay to deteriorate gradually in quality. In time, portions of the bay would be displaced by the fill. Projected over the period of analysis, however, the average productivity of the bay would increase.

The lower 6-mile reach of the Colorado River would be deprived of freshwater flows from the Colorado River, and the salinity in this area would approximate that of seawater. Without access facilities, this reach would support about 30,000 man-days of fishing annually. Providing access and sanitary facilities, launching ramps, and parking areas in this reach and providing a walkway on the East Jetty would cause many more people to come to this area to fish. As a result, sport fishing would increase in the reach to 100,000 man-days annually.

With the project, total sport fishing in Matagorda Bay and in the Colorado River would amount to 1,381,000 man-days annually if no access facilities are provided. With access facilities, the total sport fishing would amount to 1,451,000 man-days annually.

Commercial harvest of finfishes and crustaceans produced in Matagorda Bay and in the lower 6-mile reach of the Colorado River would increase to about 87,115,000 pounds annually.

WILDLIFE

The project area of influence for wildlife would include 186,000 acres of Matagorda Bay, exclusive of Lavaca Bay.

Matagorda Bay is important to waterfowl and water-loving birds such as brown pelicans, gulls, terns, lesser sandhill cranes, egrets, glossy ibises, and herons. The principal waterfowl are mallards, pintails, shovelers, lesser scaups, American widgeons, blue-winged and green-winged teals, gadwalls, mottled ducks, fulvous tree ducks, black-bellied tree ducks, wood ducks, snow geese, blue geese, white-fronted geese, Canada geese, and coots.

The American alligator also is found here. It is classified as an endangered species by the Bureau of Sport Fisheries and Wildlife. The project would have no effect on these crocodilians.

Waterfowl use of Matagorda Bay is heavy, primarily during the winter months, with most of the use made by resting waterfowl. Some species find the saltmarsh cordgrass along the shoreline of the bay and the shoalgrass in the shallow bay areas particularly attractive feeding areas.

Waterfowl hunting in the project area is moderate and is dependent upon the movement of birds between the feeding areas and resting areas. About 5,000 man-days of waterfowl hunting occur in the project area annually. This amount of hunting would occur over the period of analysis.

Diversion of flows from the Colorado River to Matagorda Bay would result in ecological changes to the bay vegetation. The shallow fresh-water areas would have dense growths of widgeongrass, while the shallow saltier areas would harbor dense growths of shoalgrass. No adverse effects would occur to the saltmarsh cordgrass along the shoreline of the bay.

The deposition of sediment in Matagorda Bay would form a marsh delta where the flood discharge channel enters the bay. The materials would add nutrients to the bay and improve the bay area for the growth of waterfowl food plants. As a result of improved habitat, more waterfowl would use the bay and waterfowl hunting would increase. With the project, waterfowl hunting would amount to 8,000 man-days annually.

DISCUSSION

Diversions of the Colorado River flows into Matagorda Bay would provide fresh water to reduce the salinity level concentration resulting from the recent modification of the Matagorda Ship Channel. These diversions also would add nutrients to the bay waters. Fish habitat

would improve in the bay. Similarly, waterfowl habitat would improve in the bay area. The shallow bay areas would produce dense growths of widgeongrass or shoalgrass depending upon the salinity level of the water in the area. Both plants would be useful as foods for waterfowl.

Several conservation storage reservoirs are proposed in the Colorado River Basin. Freshwater flows into Matagorda Bay would be reduced gradually upon completion of each of these reservoirs thus threatening the maintenance of the improved habitat for finfishes and crustaceans. Under this condition, tidal flows through the Tiger Island Channel would allow an undesirable increase of salinity in Matagorda Bay.

When freshwater flows into Matagorda Bay are reduced substantially, provision should be made to close Tiger Island Channel to prevent tidal exchange. The Bureau of Sport Fisheries and Wildlife and the Texas Parks and Wildlife Department, cooperatively, would determine the appropriate time when closure of Tiger Island Channel would be advantageous to the fish and wildlife. The closure of the channel possibly could be made during maintenance dredging of the navigation channel.

It is recommended that:

1. Tiger Island Channel be closed to prevent tidal flows from entering Matagorda Bay when freshwater flows into the bay have been drastically reduced. The Bureau of Sport Fisheries and Wildlife and the Texas Parks and Wildlife Department would determine the appropriate time when closure of the channel would be advantageous to fish and wildlife.

In summary, the project would result in a substantial increase in both sport and commercial fishing. Without public access facilities along the lower Colorado River, sport fishing would increase by 320,000 fisherman-days annually. With access facilities provided, the increased sport fishing would be 390,000 fisherman-days annually. The commercial fish harvest would be increased by 17,024,000 pounds annually. Benefits attributable to sport fishing would amount to \$720,000 annually without access facilities and \$880,000 with access facilities. Benefits attributable to the increase of commercial fishing would be \$1,148,000 annually.

Additional waterfowl hunting accruing with the project would amount to 3,000 man-days annually. Benefits attributable to waterfowl hunting would be \$13,500 annually.

Recommendation No. 1 proposes the closure of Tiger Island Channel to tidal flows when freshwater flows into Matagorda Bay have been reduced substantially by upstream reservoir developments.

The opportunity to comment on the project plan is appreciated.

Sincerely yours,


William T. Krummes
Regional Director

Enclosure

Copies (10)

Distribution:

- (5) Executive Director, Texas Parks and Wildlife Department,
Austin, Texas
- (2) Regional Director, Bureau of Commercial Fisheries, Region 2,
St. Petersburg Beach, Florida
- (2) Laboratory Director, Biological Laboratory, Bureau of Commercial
Fisheries, Galveston, Texas
- (1) Regional Coordinator, Southwest Field Committee, USDI,
Muskogee, Oklahoma
- (1) Area Director, Bureau of Mines, Area 4, Bartlesville, Oklahoma
- (1) Regional Director, Federal Water Pollution Control Administration,
South Central Region, Dallas, Texas
- (2) Regional Director, National Park Service, Southwest Region,
Santa Fe, New Mexico
- (2) Field Supervisor, Bureau of Sport Fisheries and Wildlife,
Division of River Basin Studies, Fort Worth, Texas

TEXAS
PARKS AND WILDLIFE DEPARTMENT

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J. R. SINGLETON
EXECUTIVE DIRECTOR
ROBERT G. MAUERMANN
DEPUTY DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

June 19, 1967

Mr. Lewis R. Garlick
Assistant Regional Director
Cooperative Services
Bureau of Sport Fisheries and Wildlife
P.O. Box 1306
Albuquerque, New Mexico

Dear Mr. Garlick:

This is in response to your letter of June 9, 1967 and the attached review draft of your report concerning the Corps of Engineers' Colorado River Jetty Channel, Texas.

We have reviewed this draft and concur with the report as presented.

Sincerely yours,

A handwritten signature in cursive script that reads "J. R. Singleton".

J. R. Singleton
Executive Director

JRS:AJS:lc

cc: Mr. John Degani, Field Supervisor, Division of River Basin Studies,
1104 T & P Building, Fort Worth, Texas

EXHIBIT 1
APPENDIX III

Matagorda County Navigation District No. 2

Owners and Operators of The Port of Bay City

POST OFFICE BOX 1426

BAY CITY, TEXAS 77414

December 15, 1967

Colonel Franklin B. Moon,
District Engineer.,
U. S. Army Engineer District,
P. O. Box 1229,
Galveston, Texas. 77550.

BOARD OF COMMISSIONERS:

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LEE M. PIERCE, SECRETARY
HARRY S. SHANNON
RICHARD C. BACHMAN
FRED T. FRIDAY
J. D. SUTHERLAND

GENERAL MANAGER:

JAS H. HARTZOG

Dear Colonel Moon:

At a special session of the Board of this District, at which all members were present, on Thursday the 14th of December 1967, and so recorded in the minutes of Volume 2, page 5 thereof, there was unanimous agreement with the improvements you propose to recommend for the Colorado River and Tributaries, Texas, Mouth of the Colorado River, as outlined in your letter of 8 December 1967.

If the project is authorized by Congress and reiterating the previous action of this District, as expressed to the Galveston District Engineer by letter dated April 23, 1962, copy attached, we will provide the following items of local cooperation in connection with the project:

1. Provide without cost to the United States all lands, easements and right-of-way required for construction and subsequent maintenance of the project, aids to navigation, and public use areas upon the request of 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 also provide necessary retaining dikes, bulkheads and embankments therefor or the cost of such retaining works.
2. Hold and save the United States free from damages that may result from construction of the project.
3. Provide and maintain without cost to the United States necessary mooring facilities and utilities, including a public landing with suitable facilities open to all on equal terms.
4. Accomplish without cost to the United States all alterations of power lines, pipelines, utility lines, cables and highway facilities when and as required for construction of the project.

EXHIBIT 2
APPENDIX III

5. Agree to assume a share of cost for fish and wildlife enhancement in accordance with the Federal Water Project Recreation Act of 1965 (Public Law 89-72) as follows:

- a. Not less than one-half of the separable cost of construction allocated to recreation and fish and wildlife enhancement.
- b. Cost of administering project, land and water areas for recreation and fish and wildlife enhancement.
- c. Cost of operation and maintenance of the recreation and fish and wildlife facilities and replacement thereof.

It is agree and understood that the local share of the first cost, presently is estimated at \$314,000, and the local share of the annual cost, presently is estimated at \$24,000, but that the actual cost to the Navigation District will be determined after completion of the project.

In conclusion the undersigned is authorized to further assure you of our fullest cooperation in any other requirements that may be necessary towards facilitating the project.

Yours very truly



Jas. H. Hartzog

cc - Hon. John Young,
Texas Congressman - 14th District.
House of Representatives,
Washington, D. C.



UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
SOUTHWEST REGION
FEDERAL BUILDING, P. O. BOX 1487
MUSKOGEE, OKLAHOMA 74402

January 4, 1968

District Engineer
Department of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, Texas 77550

Attention: Mr. D. G. Graham

Dear Sir:

This is in reply to your letter of December 29th concerning the advance copy of the interim report on the Colorado River and Tributaries, Texas. I do not have any comments now concerning the report but would like to keep it for reference. Consequently I will appreciate receiving any subsequent corrected pages.

Sincerely yours,

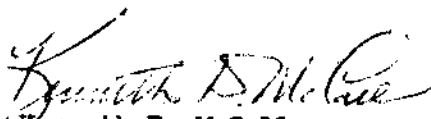

Kenneth D. McCall
Regional Coordinator

EXHIBIT 3
APPENDIX III

TEXAS WATER RIGHTS COMMISSION

COMMISSIONERS

JOE D. CARTER, CHAIRMAN
GREENWOOD 5-2453

WILLIAM E. BERGER
GREENWOOD 5-2452

O. F. DENT
GREENWOOD 5-2451



SAM HOUSTON
STATE OFFICE BUILDING
P. O. BOX 12396
CAPITOL STATION
AUSTIN, TEXAS 78711

F. R. BOOTH
EXECUTIVE DIRECTOR

AUDREY STRANDTMAN
SECRETARY

AREA CODE 512
GREENWOOD 5-4514

January 8, 1968

Mr. D. T. Graham, Chief
Engineering Division
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, Texas 77550

Re: SWGED-B

Dear Mr. Graham:

We thank you for the advance copy of the interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River, which you submitted to Executive Director F. R. Booth for review and comments. Mr. Booth passed this report to me for staff action.

I have made a rapid review of the report and conclude that Plan A which you have selected and recommended is beneficial and the most desirable of the four plans studied. There are no appropriative water rights of record which would be impaired by this project.

We are retaining the copy of this report you furnished for our future reference and use and will appreciate receiving corrected pages for insertion as they are released.

Sincerely yours,

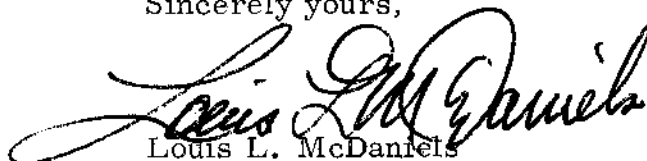

Louis L. McDaniel
Chief Hydrologist

EXHIBIT 4
APPENDIX III

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 648
Temple, Texas 76501

January 10, 1968

Colonel Franklin Moon
District Engineer
Corps of Engineers, U. S. Army
606 Santa Fe Building
P. O. Box 1229
Galveston, Texas 77550

Dear Colonel Moon:

This is in reply to your recent request for comments on the interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River.

The proposed project provides for the diversion of the Colorado River into Matagorda Bay, conversion of the existing river channel into a navigation channel with jetties at the Gulf shoreline, construction of a turning basin at Matagorda, and public use areas with facilities for project recreation and fish and wildlife visitation. The plan would provide a navigable channel from Matagorda, Texas, to the Gulf of Mexico and facilities to develop the recreational potential of the area. The project would provide flood protection to existing developments along the Colorado River channel below the point of diversion. Benefits would also be derived from an increase in commercial seafood catch.

The estimated total Federal first cost of the project is \$11,554,000, which includes \$128,000 of reimbursable cost for one-half of the estimated first cost of the proposed recreation facilities. The total non-Federal first cost is \$186,000 for land and damages and spoil-retaining levees. In addition, non-Federal interests would be required to reimburse the Federal Government \$128,000, which is one-half of the cost of the recreation facilities.

The annual Federal cost for operations, maintenance, and replacements is \$142,000, which includes \$3,000 for aids-to-navigation. The annual cost to local interests for operation, maintenance, and replacement of the recreation facilities and spoil levees is estimated at \$24,000.

The annual charges of the proposed project are estimated to be \$660,000, of which \$494,000 is for interest and amortization. The annual benefits are expected to be \$837,000. The benefit -to-cost ratio is 1.3 to 1.

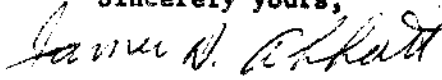
EXHIBIT 5
APPENDIX III

Construction of the proposed works would have no adverse effects upon the water and related land resource projects of this office.

We will keep the copy of the report for our files. It is our understanding that you will send us corrected pages for insertion as the need arises.

The opportunity to review and comment on this report is appreciated.

Sincerely yours,



For H. N. Smith
State Conservationist



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

REGIONAL OFFICE - REGION 5
P. O. BOX 1609
AMARILLO, TEXAS 79105

IN REPLY
REFER TO: 5-730

January 12, 1968

Col. Frank B. Moon
District Engineer
Galveston District, Corps of Engineers
Post Office Box 1229
Galveston, Texas 77550

Dear Colonel Moon:

Please refer to your letter of January 3, 1968, furnishing an advance copy of the interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River, for our review and comment.

The plan of improvement presented in the report would not adversely affect any existing or potential Bureau of Reclamation project.

Your courtesy in furnishing the report for our review is appreciated.

Sincerely yours,

Regional Director

EXHIBIT 6
APPENDIX III

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SIX
FORT WORTH, TEXAS 76102

819 Taylor Street

January 12, 1968

IN REPLY REFER TO

06-00.1

Mr. D. T. Graham
Chief, Engineering Division
Department of the Army
Galveston District, Corps of Engineers
P.O. Box 1229
Galveston, Texas 77550

Dear Mr. Graham:

Your letter of January 3 requested that we review the interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River by January 15. We note from the report that no relocations or alterations of existing facilities will be required for construction or maintenance of the project. Also, the proposed diversion of flow from the Colorado River into Matagordo Bay would protect the existing road which is on the Federal-aid secondary system, along the east bank of the river from flooding. It is expected that this protection would substantially reduce the county's maintenance costs.

We have no comments on other items in the report. The report is being returned for your use.

Sincerely yours,


J. J. Crowley
Assistant Regional Federal
Highway Administrator

Enclosure

EXHIBIT 7
APPENDIX III



UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
South Central Region
1114 Commerce Street
Dallas, Texas 75202

January 12, 1968

Your reference:
SWGED-B

District Engineer
U.S. Army Engineer District, Galveston
P. O. Box 1229
Galveston, Texas 77550

Dear Sir:

Your interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River, has been reviewed as requested in your January 3, 1968 transmittal letter.

Since no reservoir construction is proposed, our review was limited to a determination of compliance with Executive Order 11288, Sections 1(3) and 1(7), Section 4(a), and Sections 6 and 7.

It is noted that recreation facilities are proposed for development in conjunction with this project. All sanitary facilities which are a part of the project should provide secondary treatment as required by the Executive Order.

Comments on water pollution aspects during the construction phase of this project will be provided during the interagency review of the survey report.

Sincerely yours,

William C. Galegar
WILLIAM C. GALEGAR
Regional Director

EXHIBIT 8
APPENDIX III

TEXAS WATER DEVELOPMENT BOARD

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BROWNWOOD

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LIVINGSTON

W. E. TINSLEY
AUSTIN

* * *

HOWARD B. BOSWELL
DEVELOPMENT FUND MANAGER



AREA CODE 512
GREENWOOD 5-3187

January 15, 1968

SAM HOUSTON
STATE OFFICE BUILDING
201 EAST 14TH STREET

P. O. BOX 12386
CAPITOL STATION
AUSTIN, TEXAS 78711

JOE G. MOORE, JR.
EXECUTIVE DIRECTOR

G. R. STANFORD
ADMINISTRATIVE ASSISTANT

JOHN J. VANDERTULIP
CHIEF ENGINEER

C. R. BASKIN
ASS'T. CHIEF ENGINEER

L. B. SEWARD
ASS'T. CHIEF ENGINEER

DONALD B. YARBROUGH
GENERAL COUNSEL

GORDON CARLSON
CHIEF, STAFF SERVICES

District Engineer
Galveston District
Corps of Engineers
Department of the Army
P. O. Box 1229
Galveston, Texas 77550

Your Ref: SWGED-B

Attention: Mr. D. T. Graham
Chief, Engineering Division

Dear Sir:

Your letter of January 3, 1968 transmitted the advance copy of the interim report on Colorado River and Tributaries, Texas, Mouth of Colorado River, for our review and field level comments.

As Appendix III of the proposed report reflects the concurrence of the Texas Parks and Wildlife in the report of the Bureau of Sports Fisheries and Wildlife on this project we did not request further comments of the Parks and Wildlife Department.

The report contains the following proposed developments:

- a. A 12-foot deep by 100-foot wide channel from the Gulf Intercoastal Waterway to the present Gulf shoreline.
- b. A 15-foot deep by 200-foot wide jetty entrance channel from the 15-foot depth in the Gulf to the present Gulf shoreline.

EXHIBIT 9
APPENDIX III

- c. A 350-foot by 1,450-foot by 12-foot deep turning basin at Matagorda, Texas.
- d. Bank protection for the existing natural Tiger Island Channel which extends from mile 2 of the existing Flood Discharge Channel into Matagorda Bay, to prevent enlargement of Tiger Island Channel. Wildlife interests have asked that this channel be left open at the present time. After construction of jetties and enlargement of the mouth of the river, there is a possibility that increased tidal action would enlarge the present channel if it were not protected.
- e. Public use areas with facilities for project recreation and fish and wildlife visitation. Public use facilities would be included in the plan to make use of the project related recreation potential. Facilities would be limited to those specific facilities and lands clearly required to meet the project related needs, and would consist of land, access roads, parking areas, sanitary facilities, boat launching ramps, water supply and a walkway with handrail on the east jetty. Public use facilities would require about 17.2 acres of land for access roads, parking areas, launching ramps and sanitary facilities. These facilities would be adjacent to the navigation channel and would be accessible via County Road 2031 which extends from the town of Matagorda to the Gulf, paralleling the navigation channel.
- f. Parallel jetties spaced 1200 feet apart extending from the shoreline to the 18-foot depth in the Gulf. Jetties would be spaced to accommodate future enlargement of the channel for deep draft vessels.
- g. Relocation of the Colorado River channel with a diversion dam in the existing channel to divert flow of the river to the Bay and prevent river sedimentation in the navigation channel. The diversion channel would have a 250-foot bottom width with 1 on 4 side slopes. The channel would have an inbank capacity of 50,000 second feet.

The report reflects that benefits calculations have been made in accordance with recognized procedures and are conservative in nature, costs have been allocated in accordance with recognized procedures and are realistic in view of the May, 1967 price level, and that the proposed project is economically justified.

Your attention is invited to the fact that the population projections used in the report for Colorado, Matagorda, Wharton, Brazoria and Jackson Counties are from the report of the U.S. Study Commission-Texas, March 1962 and do not correspond to subsequent projections used by the Texas Water Development Board. The report's projections vary from the Texas Water Development Board projections as shown in the following table:

Population For the Mouth of the Colorado River
Five-County Area

Year	USC of E	TWDB
1960	172,600	172,600
1975	300,400	279,385
2000	441,500	530,226
2020	---	897,998
2025	677,400	---

Use of the TWDB population projections would have resulted in larger benefits attributable to recreation.

Implementation of the plan as set forth in the report would greatly improve navigation, provide some flood control, and under existing conditions reduce salinity levels in Matagorda Bay (provided Tiger Island Channel is properly operated). The apportionment of costs and responsibilities has been agreed to by the Matagorda County Navigation District No. 2. With Columbus Bend Reservoir in operation to reduce sediment loads, the diverted Colorado channel could serve as a means of providing future controlled releases to satisfy part of the fresh water requirements of Matagorda Bay, if desired salinity gradients throughout the bay would result.

Under future conditions of reduced flows of the Colorado River,

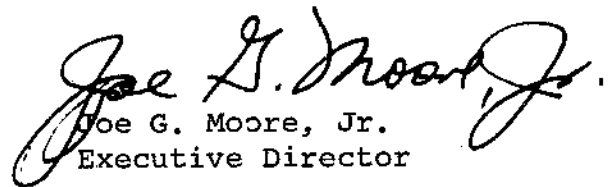
projected return flows and their accompanying nutrients from the lower basin could, however, cause extreme enrichment in parts of the bay. This could result in excessive algal growth, suppressed DO, and critically high pH due to excessive algal activity.

With reduced Colorado River flows, without Matagorda Dam in place the tide-affected reach of the river could extend for an undesirable distance upstream. However, since tidal variations in Matagorda Bay (mean diurnal range is about 0.7 feet) are less than in the Gulf, this effect would perhaps be minimized with the Colorado diversion project.

In summary, the proposed project is feasible and would be compatible with facilities proposed in the preliminary Texas Water Plan.

The opportunity to review the proposed report is appreciated.

Very truly yours,


Joe G. Moore, Jr.
Executive Director



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

January 16, 1968

AIRMAIL

District Engineer
Corps of Engineers, U.S. Army
P.O. Box 1229
Galveston, Texas

Dear Sir:

Mr. D. T. Graham's letter of December 29, 1967, referenced SWGED-B, requested our review and comment concerning your proposed interim report on the Colorado River and Tributaries, Texas, covering the Mouth of the Colorado River.

We are pleased to note that this Bureau's report of July 3, 1967, is included in Appendix III and that our recommendation to close Tiger Island Channel to prevent excessive tidal flows from entering Matagorda Bay has been included in the Corps of Engineers plan of development.

We are concerned regarding your office's approach to evaluations of the project. Your office considered that elements of the Texas Water Plan would be existing. Our report was based on the assumption that none of the elements would be existing. This assumption was based on understandings reached with members of your staff during our investigation of the project in the early part of 1967.

It is pointed out that some of the features of the Texas Water Plan are not scheduled for completion until about the year 2000. The year 2000 is only midway in the 50-year period of analysis for the project (1975-2025). We wonder whether the Corps project evaluation reflects an assumption that elements of the Texas Water Plan were existing over the 50-year period rather than for the actual period of the elements' existence.

EXHIBIT 10
APPENDIX III

The benefits attributed to fishing appear to be a mixture of estimates obtained from many sources. Sport fishing evaluations used were made by the Corps while commercial fishing evaluations appear to be based only partly on information contained in this Bureau's report. No benefits were attributed to increased waterfowl hunting, yet this Bureau's report indicated substantial benefits.

We believe that fishing and hunting benefits used in your report should be based on data supplied cooperatively by this Bureau, the Bureau of Commercial Fisheries, and the Texas Parks and Wildlife Department. If the project plan of development has changed since our report was released, we would be pleased to provide up-to-date data.

The opportunity provided this office to comment on your proposed report is appreciated.

Sincerely yours,



William T. Krummes
Regional Director

cc:

Executive Director, Texas Parks and Wildlife Department, Austin, Texas
Regional Director, Bureau of Commercial Fisheries, St. Petersburg,
Florida

Laboratory Director, Biological Laboratory, BCF, Galveston, Texas
Field Supervisor, BSFW, Div. of River Basin Studies, Fort Worth, Texas



Office of
AREA DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
AREA IV
Mineral Resource Office

ROOM 206 FEDERAL BUILDING
BARTLESVILLE, OKLAHOMA 74005

January 18, 1968

Mr. D. T. Graham
Chief, Engineering Division
U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77550

Refer to: SWGED-B

Dear Mr. Graham:

We have reviewed the interim report on Colorado River and Tributaries, Texas, covering Mouth of the Colorado River, for evidence of mineral involvement, as requested in your letter of January 3, 1968.

Matagorda County is the source of crude oil, natural gas, natural gas liquids, shell, sulfur, sand and gravel, and clays, output of which was valued at \$58.8 million in 1966. According to available office records, none of the mineral industries or resources is known to be within project limits.

Although no field examination was made, it appears that the recommended construction probably would not interfere with mineral installations or the availability of mineral resources. Bureau of Mines Area IV Mineral Resource Office would not object to the project.

Sincerely yours,


Floyd D. Everett
Acting Area Director

EXHIBIT 11
APPENDIX III

TEXAS
PARKS AND WILDLIFE DEPARTMENT

COMMISSIONERS

WILL E. ODOM
CHAIRMAN, AUSTIN

JAMES M. DELLINGER
MEMBER, CORPUS CHRISTI

HARRY JERSIG
MEMBER, SAN ANTONIO



J. R. SINGLETON
EXECUTIVE DIRECTOR

ROBERT G. MAUERMANN
DEPUTY DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

January 18, 1968

Mr. D. T. Graham
Chief, Engineering Division
Department of the Army
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, Texas 77550

Dear Mr. Graham:

Reference is made to the Interim Report on Colorado River and Tributaries, Texas, covering Mouth of the Colorado River.

We have reviewed this report and the Parks and Wildlife Department has no comments or changes to suggest at this time.

Sincerely yours,

A handwritten signature in cursive script that reads "J. R. Singleton".

J. R. Singleton
Executive Director

JRS:KJ:pw

EXHIBIT 12
APPENDIX III



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
MID-CONTINENT REGION
BUILDING 41, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:
D6427TG

January 23, 1968

District Engineer
U. S. Army Engineer District
Corps of Engineers
P. O. Box 1229
Galveston, Texas 77550

Dear Sir:

In response to your request of December 29, 1967, we have reviewed your report covering the proposed Mouth of the Colorado River Project, Texas, and are happy to supply the following comments.

Our remarks are based primarily on the relationship of your report to P. L. 89-72, the Federal Water Project Recreation Act.

The purpose of the project is to provide Federal improvements in the lower seven miles of the Colorado River, Texas, from its mouth at the Gulf of Mexico to the town of Matagorda, Texas, for navigation, flood control and related purposes. The Corps of Engineers found that the best plan to meet the present and future needs of the area would provide for diversion of the Colorado River into Matagorda Bay and conversion of the existing river channel into a navigation channel with jetties at the Gulf shoreline and a turning basin at the town of Matagorda.

It is understood from the report that recreation benefits assigned to the project are in part attributed to increased recreation use by swimmers, surfers, picnickers and campers, as the result of the construction of recreation facilities. However, the table on page 16, Appendix II, Detail of First Cost for recreation facilities, indicates that few facilities will be constructed for swimming, surfing, camping and picnicking. Also, the only land to be acquired for recreation purposes is 17.2 acres near the mouth of the channel.

It appears that provisions should be made in the development plan for additional facilities to serve the above recreation activities if all the benefits indicated are to be claimed.

Additional facilities should include picnic tables, trash barrels and other camping, picnicking and swimming related facilities compatible with the setting. Additional land would have to be acquired to provide these additional facilities.

EXHIBIT 13
APPENDIX III

The project is in an area of substantial recreation significance and warrants additional acreage for recreation enhancement.

Matagorda Peninsula possesses an as yet unrealized recreation potential valuable to surrounding population centers and the State as a whole. The State of Texas Comprehensive Outdoor Recreation Plan (SCORP), points out that a 20-mile stretch of Matagorda Peninsula extending northeast from the Colorado River, possesses one of the most valuable lengths of beach on the Texas Coast.

The SCORP also states that the 20-mile stretch is presently threatened by non-recreational development and that "it is important that action to preserve this beach for public use soon be taken."

To capture the optimum recreation potential of the project, it is proposed that after authorization, during pre-construction planning stages, an in-depth study be conducted to determine the feasibility of acquiring and developing land for a park facility along the Gulf beach of Matagorda Peninsula.

The State of Texas Parks and Wildlife Department has indicated an interest in the peninsula for recreation purposes. They should be encouraged to share in any additional recreation development cost under the provisions of the Federal Water Project Recreation Act, P.L. 89-72.

It is also understood that of the total \$223,000 in first cost for recreation facilities, indicated in the project plan, 57 percent of \$128,000 is reimbursable.

It is suggested that the cost of recreation facilities be on a 50-50-cost sharing basis between Federal and non-Federal interests in accordance with the Federal Water Project Recreation Act (P.L. 89-72).

Thank you for the opportunity to review your report.

Sincerely yours,

R. N. Shary
fa Maurice D. Arnold
Regional Director

INTERIM REPORT
ON
COLORADO RIVER AND TRIBUTARIES, TEXAS

MOUTH OF THE COLORADO RIVER

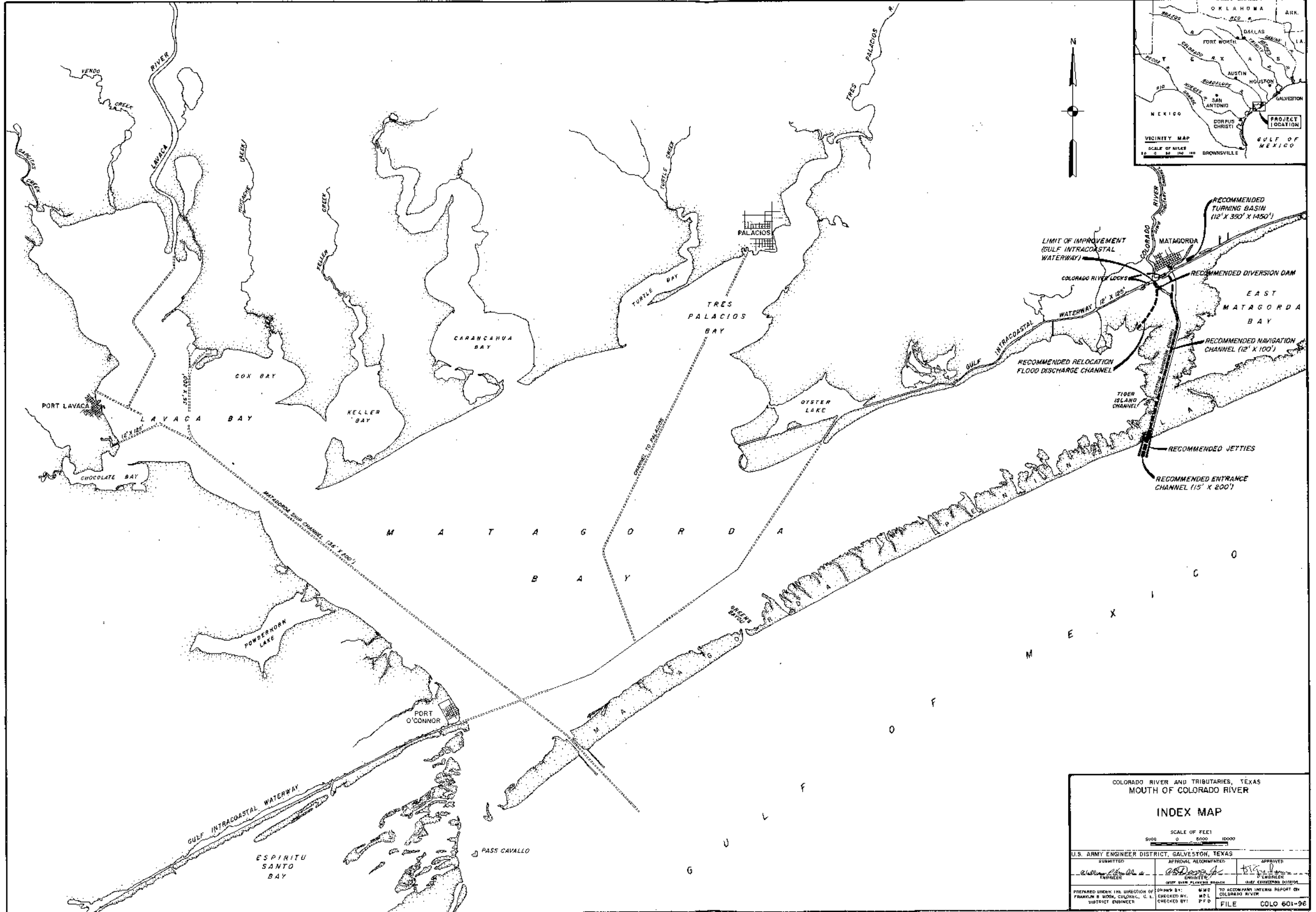
INFORMATION CALLED FOR BY SENATE RESOLUTION NO. 148, 85TH CONGRESS
ADOPTED JANUARY 28, 1958

1. AUTHORITY.- The following information is furnished in response to Senate Resolution No. 148, 85th Congress, adopted January 28, 1958.

2. REQUESTS BY LOCAL INTERESTS.- At a public hearing held in Columbus, Texas, on 24 April 1962, the Matagorda County Navigation District No. 2 requested the construction of a jettied channel at the mouth of the Colorado River, to provide for dependable access from the Gulf to the river for fishing and recreation boats and shallow draft vessels engaged in offshore oil exploration and production.

3. IMPROVEMENTS CONSIDERED.- A plan of improvement for construction of jetties at the mouth of the river together with diversion of the Colorado River into Matagorda Bay was found justified and is recommended for authorization and construction. This is essentially the improvement desired by local interests. Economic analysis for the plan investigated was on the basis of a 50-year project life. The ratio of annual benefits to annual charges for the 50-year period is 1.3 and for the 100-year period is 1.5.

4. The improvements proposed under the recommended plan of improvement have been discussed with local interests that would be responsible for providing the local cooperation required, if and when the plan is adopted. They have expressed satisfaction with the recommended plan of improvements.



COLORADO RIVER AND TRIBUTARIES, TEXAS MOUTH OF COLORADO RIVER		
INDEX MAP		
SCALE OF FEET 0 500 1000 1500 2000		
U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS		
SUBMITTED BY: <i>[Signature]</i> ENGINEER	APPROVED/RECOMMENDED BY: <i>[Signature]</i> ENGINEER	APPROVED BY: <i>[Signature]</i> ENGINEER
PREPARED UNDER THE DIRECTION OF FRANKLIN B. SMITH, COLONEL, U.S. ARMY DISTRICT ENGINEER	DRAWN BY: <i>[Signature]</i> ENGINEER	CHECKED BY: <i>[Signature]</i> ENGINEER
TO SECONDARY INTEREST REPORT ON COLORADO RIVER		FILE COLO 601-96

97-387 O-68 (Face blank p. 86)

