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INTRACOASTAL WATERWAY

BEAUFORT, N. C., TO KEY WEST, FLA., SECTION

LETTER FROM
THE ACTING SECRETARY OF WAR

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORT ON SURVEY OF THE BEAUFORT, N. C., TO KEY WEST, FLA., SECTION OF THE PROPOSED CONTINUOUS INLAND WATERWAY FROM BOSTON, MASS., TO THE RIO GRANDE



SEPTEMBER 11, 1913.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations

WASHINGTON
1913


UNITED STATES OF AMERICA
GOVERNMENT PRINTING OFFICE

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LETTER OF TRANSMITTAL.

WAR DEPARTMENT,
Washington, September 10, 1913.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the Chief of Engineers, United States Army, dated August 11, ultimo, together with copies of reports, with illustrations, from a special board of engineer officers, dated July 1, 1911, and April 12, 1912, on a survey of the Beaufort, N. C., to Key West, Fla., section of the proposed continuous inland waterway from Boston, Mass., to the Rio Grande, made by it in compliance with the provisions of the river and harbor act approved March 3, 1909.

Very respectfully,

HENRY BRECKINRIDGE,
Acting Secretary of War.

REPORT ON INTRACOASTAL WATERWAY—BEAUFORT, N. C., TO KEY WEST, FLA., SECTION.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, August 11, 1913.

From: The Chief of Engineers, U. S. Army.
To: The Secretary of War.
Subject: Survey for intracoastal waterway from Beaufort, N. C., to Key West, Fla.

1. There are forwarded herewith for transmission to Congress reports dated July 1, 1911, and April 12, 1912, prepared by a special board of engineer officers, in accordance with a provision contained in the river and harbor act approved March 3, 1909, as follows:

SEC. 13. * * *

The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the localities named in this section, as hereinafter set forth. * * *

* * * * * * *

Survey for the construction of a continuous waterway, inland where practicable from Beaufort, North Carolina, to the Cape Fear River, North Carolina; thence to Winyah Bay, South Carolina; thence to Saint Johns River, Florida; thence to Key West, Florida, for the purpose of ascertaining the cost of a channel with a maximum depth of twelve feet or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring the same.

The report of this special board has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, to whose reports herewith, dated December 18, 1911, and June 10, 1912, attention is invited.

2. As the first report of the special board recommending a 10-foot depth waterway indicated costs in excess of what was considered advisable by the Board of Engineers for Rivers and Harbors and myself, under present conditions, a second report was called for to show estimates of cost for a lesser depth—that of 7 feet—considered necessary for 6-foot-draft boats. The costs per section of the waterway for the two depths of 10 and 7 feet, respectively, are as follows:

	10-foot depth.	7-foot depth.
Beaufort–Cape Fear River	$4,336,000.00	$2,872,111.00
Cape Fear–Little River	3,811,000.00	3,724,219.00
Little River–Winyah Bay	6,330,000.00	5,677,800.00
Winyah Bay–Charleston Harbor	2,645,000.00	1,227,800.00
Charleston Harbor–Savannah River	897,000.00	427,400.00
Savannah River—Fernandina	437,000.00	195,000.00
Fernandina–St. Johns River	657,000.00	251,726.75
St. Johns River–Indian River	3,528,000.00	2,491,056.03
Indian River–Key West	8,413,000.00	2,127,950.68
Total	31,054,000.00	18,995,063.46

3. The special board recommends an expenditure of $31,000,000 for a complete continuous inland waterway with a canal section of 10-foot depth and a minimum bottom width of 100 feet for use by barges of about 8 feet draft and 1,000 tons load; the work to be completed in six years, but the Board of Engineers for Rivers and Harbors found itself unable to concur in the desirability of such expenditure, even for a single one of the nine subdivisions. The Chief of Engineers does not exactly concur with either board, concurring with the special board as to the line of route selected and as to the need of some continuous waterway, and concurring with the Board of Engineers for Rivers and Harbors as to the lack of urgency for a 10-foot depth at present. The Chief of Engineers believes, however, that in view of the fact that there is already an 8-foot depth inside route all the way from Delaware River to Beaufort, N. C., and a 12-foot route already recommended from Long Island Sound to Beaufort, N. C., and that there is already a 6 to 7 foot depth inside route from Charleston, S. C., to Jacksonville, Fla. (either in fact or approved), and the same depth for about 170 miles up the St. Johns River to Sanford, Fla., it is already time to look ahead to the completion of a 7-foot depth route for the intermediate section between Beaufort, N. C., and Charleston, S. C., so that barges, gasoline boats, steam hoisters, light-draft dredges, and other light craft can go from the south New England coast to lower Florida without danger from heavy Atlantic gales. Moreover, the Chief of Engineers believes that, as it is impracticable to improve each of the smaller rivers of the Atlantic coast to the extent of allowing to each a free access for ocean steamers, it will be very advantageous in the end to connect the lower ends of all these smaller streams by a belt line or coastal canal which shall afford at an early date a 6-foot draft (7-foot depth) waterway connection to the nearest ocean port and later a 12-foot depth through connection (2 feet deeper than named by the special board) all the way from Long Island Sound to the St. Johns River, the order of work to be gauged by the urgency of its needs.

4. From personal knowledge the Chief of Engineers knows the Beaufort to Cape Fear section to be the most difficult and dangerous for small boats, which must to-day go outside into an unfriendly ocean for about 100 miles and pass around the dangerous Cape Fear Shoals with no safe inlets to run into if caught in bad weather, and with not enough good daylight to make a safe through run. After boats have reached the Cape Fear River safely on a southbound passage they have only 75 miles farther to go outside to reach Winyah Bay in a part of the ocean usually favorable to such a length of trip and usually allowing a safe passage between morning and evening twilight. Once arrived at Winyah Bay small boats of 6 feet draft can already go the rest of the way to the St. Johns River by waiting for tides at the shallow places, and larger boats have many good inlets where they can seek shelter in bad weather. Once arrived at the St. Johns River, boats of 8 feet draft will, under existing projects, be soon able to go freely up this river 170 miles to Sanford, on Lake Monroe, to within a short distance of the northern boundary of the Everglade basin, whose drainage and small-boat canals are now under consideration by the State or local corporations. Beyond the St. Johns River and along the Florida east coast population is sparse and the customary boat travel, except

such as is seeking the Gulf or such as is adapted to existing small-boat channels, is occasional and can afford to wait for quiet weather in which to follow existing routes suitable to its draft, so that a 7-foot inside route along this Florida coast for through Atlantic coast travel is not at present urgent, and an improvement of the present 3 to 4 foot route appears too local for Federal consideration. Moreover, when the time comes that boats will need a better route than that of to-day from St. Johns River to the Gulf the new route should be one across the State and not around it.

5. Because of his belief and personal knowledge, as above given, taken in connection with the report and recommendations of the special board, the Chief of Engineers concurs with the special board so far as to report an early need of an intracoastal waterway from Beaufort, N. C., to the St. Johns River, Fla., but he recommends favorably at present only a waterway of 6 feet draft (or 7 feet depth) over this route at a total cost of about $14,400,000, further recommending that the first section to be undertaken be that from Beaufort, N. C., to Cape Fear at about $2,900,000; the next, that from Winyah Bay to Charleston at about $1,230,000, and from Charleston to the St. Johns River at about $870,000, so much of this $2,100,000 to be expended as may then be found necessary or desirable in the improvement of its then existing 6-foot draft routes; and the next, that from Cape Fear River to Little River and Winyah Bay, commencing with the northern end, at about $9,400,000; total about $14,400,000, the first half of the work to progress at the rate of about $800,000 per year, and the progress on the last half to gauged by the results of the first half.

6. I have, therefore, following the instructions of Congress, as to this section of intracoastal waterway, to report that the improvement by the United States of this intracoastal route is deemed advisable so far as to give a 6-foot draft (or 7-foot depth) inland waterway from Beaufort, N. C., to the upper St. Johns River, Fla., following in general the route and methods recommended in the accompanying report of the special board and the order of work stated above, at a total estimated cost of $14,400,000 for first construction, this estimate being based on annual appropriations of at least $800,000 per year.

W. H. Bixby,
Chief of Engineers, United States Army.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON PROJECT FOR 10-FOOT DEPTH.

War Department,
The Board of Engineers for Rivers and Harbors,
Washington, D. C., December 18, 1911.

Sir: 1. Having fully considered the report of the special board on the surveys made in compliance with the act of March 3, 1909, for the construction of a continuous waterway, inland where practicable, from Beaufort, N. C., to Key West, Fla., the Board of Engineers for Rivers and Harbors has the honor to submit the following report thereon.

2. The item of law calling for the investigation is quoted in the report. The special board outlines the principal factors which determined the scope and nature of the survey and describes in general terms the country to be traversed. Preliminary consideration was given to all feasible routes, and the most practicable of these were selected for actual survey.

3. The entire route from Beaufort to Key West, about 925 miles, is divided into nine reaches, and the work proposed may be briefly described as follows:

(*1*) *Beaufort to Cape Fear River.*—Sea-level canal following the coast closely through natural lagoons or low-lying marsh lands. There will be required on this section ordinary excavation, three bridges, and at Cape Fear River entrance two stone jetties and a guard lock. The estimated cost is $4,336,000.

(*2*) *Cape Fear River to Little River.*—Six miles sea level and 6-foot level for balance of reach. The canal crosses a series of sand ridges, small creeks, and rivers, the latter to be dammed below the line of the canal and raised to the 6-foot level. This section requires ordinary excavation, one lock, seven dams, four highway bridges, beacons, etc., at an estimated cost of $3,811,000.

(*3*) *Little River to Winyah Bay.*—Two locks of 12-foot and 10-foot lift at eastern end rising from the 6-foot level of the Cape Fear–Little River reach, making a 28-foot level extending to Waccamaw River. The summit-level water supply will be obtained from a reservoir to be created by damming the valley of the Waccamaw River at Pireway. From this reservoir a feeder will run to the canal, a distance of about 31,000 feet, the supply being regulated by control gates at each end. From the 28-foot level the canal is dropped to a 9-foot level at the Waccamaw by means of two locks at Bear Bluff. Here a 9-foot level in the river itself is to be maintained by a dam at Conway and with some straightening and widening the river channel is to be followed. At Conway the canal level is dropped to normal low-water level of the Waccamaw, 3.4 feet. From this point the open river now under improvement will be followed to Winyah Bay. This reach requires for the main canal, Mullets Creek to Bear Bluff, four locks, two at each end, two bridges and two dwellings; a feeder canal with two control works, a reservoir dam at Pireway, a river dam and lock at Conway, canal and river excavation, straightening of channel and erection of beacons, all at an estimated cost of $6,330,000.

(*4*) *Winyah Bay to Charleston Harbor.*—This route utilizes the existing Estherville–Minim Creek Canal of 6 feet depth, crosses the North and South Santee Rivers, and continues through marsh land and natural waterways, terminating in deep water in Charleston Harbor, at the entrance to Sullivans Island Cove. This reach is to be sea level, and the work required is excavation, the erection of beacons, and, at South Santee River, the construction of training walls. The estimated cost is $2,645,000.

(*5*) *Charleston Harbor to Savannah River.*—On this reach the existing inland route is utilized as far as practicable. It is deemed advisable, however, to depart from this at times in order to overcome undue crookedness or to avoid the dangers of exposed reaches. This section is to be at sea level, and the only work required is dredging and the erection of necessary beacons. The estimated cost is $897,000.

(6) *Savannah River to Fernandina.*—There is over this reach an existing natural inland waterway, which has been improved by the United States to provide a channel 75 feet wide at bottom and 7 feet deep at mean low water. With one change this route is to be followed. It is a sea-level reach and merely requires dredging and the construction of beacons, although provision is made in the estimate for a moderate amount of training-wall work that may become necessary. The estimated cost is $437,000.

(7) *Fernandina to St. Johns River.*—Over this reach also there is an existing waterway of limited dimensions, which affords light-draft navigation. This line will have to be departed from to fit it as a part of a useful through route, but is adhered to where practicable. The only work contemplated on this section is dredging, at an estimated cost of $657,000.

(8) *St. Johns River to Indian River.*—This section of the canal follows generally the channel of the St. Johns, which has a depth in excess of 10 feet for 93.5 miles and is being improved for a further distance of 73.7 miles to Sanford on Lake Monroe under a project which contemplates a channel 8 feet deep and 100 feet wide. From Lake Monroe to Lake Harney—22.6 miles—the channel is being improved to a depth of 5 feet. The natural channel is very crooked, however, and for a canal of the dimensions proposed for the intracoastal waterway can not be closely followed, and marsh cuts must be substituted. From Lake Monroe the route follows Salt River, Lake Ruth, Lake Shad, Salt Lake, and thence 15 miles across the divide between St. Johns and Indian Rivers. As Salt Lake is 6 to 7 feet in elevation above Indian River a lock will be provided near Indian River. There will be required on this reach ordinary excavation, beacons, one lock, and two bridges, at an estimated cost of $3,528,000.

(9) *Indian River to Key West.*—Indian River has for the most part a depth of 6 feet or more, and some work has been done in it by the Government. The line of deepest water is generally followed.

The route passes through Indian River, past St. Lucie Inlet, the canal of the Florida East Coast Canal Co., and connecting waterways partly improved by that company, to Miami on Biscayne Bay, and thence through Hawk Channel to Key West. No work is required through Hawk Channel to Key West, as the natural depth is sufficient. This reach requires ordinary dredging, rock excavation, construction of beacons, and the purchase of the Florida East Coast Canal, at a total estimated cost of $8,413,000, of which $211,308.30 is for the purchase of the canal.

4. Recapitulating the above estimates, we have:

Beaufort–Cape Fear River	$4,336,000
Cape Fear River–Little River	3,811,000
Little River–Winyah Bay	6,330,000
Winyah Bay–Charleston Harbor	2,645,000
Charleston Harbor–Savannah River	897,000
Savannah River–Fernandina	437,000
Fernandina–St. Johns River	657,000
St. Johns River–Indian River	3,528,000
Indian River–Key West	8,413,000
Grand total	31,054,000

Annual maintenance, 2 per cent of original cost, or $620,000.

5. The maximum depth specified by the law is 12 feet, but the special board's investigations led it to the conclusion that the most economical vessels for use in this waterway would be 1,000-ton barges with a draft of 8 feet, handled by towboats of no greater draft, and that a depth of 10 feet would accommodate the barge traffic anticipated as well as all types of craft now used or likely to be used in the local zone traffic. The board states that the 10-foot depth will be much less expensive than 12 feet, and will be sufficiently well adapted to military and naval purposes.

In view of all considerations, the board has selected 10 feet as the correct depth for this canal, from end to end.

A minimum width at bottom of 100 feet is given, increasing in bends and in open waters up to a maximum of 200 feet, with side slopes of 1 on 2 to 1 on 4. Turning or passing basins are to be provided where needed, one at least in each 3 miles of length, the actual location to be left to the constructing officer. The special board gives details and estimates of cost for the different items of construction that enter into the work.

6. *Commercial, naval, and military utilization—Commercial utilization.*—It is expected that two kinds of commerce will develop—local or zone traffic and through traffic.

Local or zone traffic.—Traffic of this character is expected to develop first, as there is now considerable business done on existing inland waters, including the coastal lagoons, canals, and small rivers, the traffic centering at the principal seaports. With better coastal connection between the rivers and the business centers this traffic should increase. There is now a commerce of this character on the North Carolina coast amounting to about 108,745 tons, valued at $2,866,135. On the principal rivers of northern South Carolina, the commerce amounts to about 283,738 tons, valued at $3,429,390, the concentration point being Georgetown, which has a limited harbor depth. The special board believes that this commerce would be greatly increased if an adequate inland coastal connection with Charleston and Savannah were available. Along the coast of Georgia, where the inland waterways are better than farther north, there is at present a well-established traffic amounting to about 55,000 tons, valued at $2,500,000, not including rafted logs and timber. A larger commerce is predicted to result from better navigation facilities. The proposed coastal route would be of especial value to Florida, where other means of transportation are inadequate to meet the rapidly growing trade adjacent to the line of the canal route. No reliable estimate of prospective zone commerce can be given, but a study of existing conditions indicates that it would be large. The special board states that on the assumption that the canal will develop a commerce in proportion to that of the existing restricted inland waterway in Georgia, a total zone traffic of approximately $30,000,000 per annum may be expected.

Through traffic.—While the prospect of establishing a through traffic of any considerable size in competition with seagoing vessels is uncertain, the special board believes that there is a fair prospect for the growth of such traffic, principally in coal, lumber, naval

stores, fertilizers, and perhaps other items, at least to the extent of carrying the commerce that through lack of sufficient ocean bottoms is now refused.

Naval and military utilization.—The special board discusses these uses of the canal and states that the waterway may have considerable value for such purposes under certain more or less remote contingencies.

7. *Recommendations.*—After a comparison of the cost with prospective utilization, the special board concludes that the canal is worthy of construction by the United States, considered from the standpoint of local or zone business alone, and adds, " When to the increase in concentration and distribution is added the prospect of economical through traffic, and when it is recalled that the cost of carrying the work forward from 'zone' to 'through' development, will be but a small part of the total, it is clear that the through canal should be undertaken as a whole."

8. *Order of work.*—It is believed by the special board that in actual construction the first effort should be directed toward zone extension from the large ports outward, supplemented by completion of the connecting links about the time when zone communications shall have reached a state of high efficiency. It considers it unwise to undertake the work in an intermittent way or under any program which contemplates extending the work over a long period of years, and asserts the practicability of economically completing the canal in six years. A program for expenditures on this basis is presented, the amounts being for successive years $3,942,000, $6,194,000, $7,000,000, $5,964,000, $3,900,000, $4,054,000, a total of $31,054,000.

9. *Private canals.*—While there are several private canals on the South Atlantic coast, there is only one which follows closely the line proposed and which should be taken into consideration, namely, that of the Florida Coast Line Canal & Transportation Co., connecting the waters of Jupiter Inlet and Biscayne Bay. Owing to the small cross section of this canal, it will not be of great value in connection with the proposed waterway, but it could be utilized with some saving. It was not possible to ascertain the probable cost of acquiring this private canal, but the saving in excavation by its use has been estimated at $211,308.30. The extent of the right of way of this private canal appears indefinite, but is insufficient to meet the requirements of an enlarged canal. A route parallel to the existing canal is practicable, and the opinion is expressed that the price above named, $211,308.30, plus a fair valuation for the right of way, represents the value of the canal to the United States, and if the demands of the canal company exceed this sum the parallel location is recommended.

10. The Board of Engineers for Rivers and Harbors has given careful consideration to the report outlined above and to the advantages and benefits to be derived from the proposed improvement. It agrees with the special board generally in the conclusion that the greatest benefits would be felt in certain zones tributary to the larger commercial centers, and that by far the greater part of the commerce developed would be of local or zone type. It does not believe that there would be any great amount of through commerce. The dis-

tance the through commerce would have to be transported to reach the markets at Baltimore, Philadelphia, or other northern ports would be very great, vessels suited to the restricted waterway would be limited in capacity and speed, and in the opinion of the board could not compete with seagoing vessels. There are on this section of the coast a number of good seaports at no great distance apart, with harbors of sufficient capacity to accommodate ocean traffic, namely, Wilmington, Georgetown, Charleston, Savannah, Brunswick, Fernandina, and Jacksonville, all having an established trade by sea with northern ports. The board does not believe that commerce would pass these ports in a restricted inland waterway in preference to taking the open sea in large carriers.

11. Taking up the question of zone traffic, the recapitulation of the estimates given above shows that the first four and the last two sections range in cost from $2,645,000 to $8,413,000. There appears to be no prospect of the development of local traffic on any of these sections of such amount as to warrant the very large expenditures involved. The other three sections are those from Charleston Harbor to Savannah River, costing $897,000; Savannah River to Fernandina, costing $437,000; and Fernandina to St. Johns River, costing $657,000. All of these three sections have existing through channels. The waterway from Charleston to Savannah has at present a small boat traffic concentrating country products at Charleston and Savannah and distributing supplies as return cargoes. The amount is unknown, but is thought to be somewhat in excess of 40,000 tons per year. Neither the present nor prospective commerce of this section appears to justify the expenditure proposed for the improvement of existing facilities. This section includes within its limits Archers Creek, S. C., which is under consideration by the board and will be reported upon separately, under the act of June 25, 1910. The section from Savannah River to Fernandina is already provided with a waterway 7 feet deep, which appears to meet the present and reasonably prospective requirements of commerce, and no further improvement is recommended. The section from Fernandina to St. Johns River is under examination as a separate project, in accordance with a provision in the river and harbor act of February 27, 1911. Report upon a survey of this route is now before the board, from which it appears that the present commerce is about 28,000 tons. Even allowing for a large increase in commerce, the traffic would not be sufficient to make advisable the improvement of this section to a depth of 10 feet, at a cost of $657,000.

12. The board has given consideration to the military and naval purposes that might be served by the proposed waterway, and is of opinion that such uses are not of sufficient importance to modify the conclusions reached from a consideration of the commercial aspects of the question.

13. In conclusion, the board reports that, in its opinion, it is not advisable for the Government to undertake the construction of a waterway 10 feet deep from Beaufort, N. C., to Key West, Fla., as recommended in the accompanying report.

14. In compliance with law, the board reports that there are no questions of terminal facilities, waterpower, or other related sub-

jects which could be coordinated with the improvements proposed in such manner as to render them advisable in the interests of commerce and navigation.

For the board.

Very respectfully,

WM. T. ROSSELL,
Colonel, Corps of Engineers,
Senior Member of the Board.

The CHIEF OF ENGINEERS, UNITED STATES ARMY.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON PROJECT FOR 7-FOOT DEPTH.

[Fourth indorsement.]

THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, June 10, 1912.

1. Respectfully returned to the Chief of Engineers, United States Army.

2. The Board of Engineers for Rivers and Harbors has had before it the supplemental estimates submitted by the special board for a waterway having a depth of 7 feet between Beaufort and Key West. The location of this waterway is identical with that proposed for the 10-foot project, and its cost is estimated, in round numbers, at $19,000,000, or $12,000,000 less than for the deeper channel.

3. The board has considered this lesser waterway, both in its bearing upon through commerce and upon the local or zone commerce of the different seaports. The board does not believe that the benefits to be derived from a through waterway of 7-foot depth would be commensurate with the large expenditure required, the basis of this opinion being the improbability of the development of any great through commerce, as explained in the board's report upon the larger project. Considered in its relation to zone traffic, a continuous waterway does not seem to be essential. Individual sections were considered in the board's report of December 19, 1911, and, on account of the large cost of construction as compared with the existing and reasonably prospective commerce, no improvement was recommended, but reference was made to the fact that separate examinations of certain sections had been ordered by Congress and would be reported upon thereafter.

4. Attention is invited to the board's reports of January 15, 1912, in reference to Archers Creek, between Charleston and Savannah, and of December 26, 1911, in reference to the waterway from St. Johns River to Cumberland Sound, in which the improvement of these waterways was recommended to depths of 6 and 7 feet, respectively. Having in mind the fact that a channel 7 feet deep is now available between Savannah and Fernandina, it will be seen that these recommendations provide for inland navigation from Charleston to Jacksonville, embracing the most promising sections of the intracoastal waterway. The board believes that the improvement of

the remaining sections to a depth of 7 feet is not advisable at the present time.

For the board.

WM. T. ROSSELL,
Colonel, Corps of Engineers,
Senior Member of the Board.

SURVEY OF THE BEAUFORT, N. C., TO KEY WEST, FLA., SECTION OF THE PROPOSED CONTINUOUS INLAND WATERWAY FROM BOSTON, MASS., TO THE RIO GRANDE.

REPORT OF A SPECIAL BOARD OF ENGINEERS.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., July 1, 1911.

SIR: The board of officers appointed to conduct the—

Survey for the construction of a continuous waterway, inland where practicable, from Beaufort, North Carolina, to the Cape Fear River, North Carolina; thence to Winyah Bay, South Carolina; thence to St. Johns River, Florida; thence to Key West, Florida, for the purpose of ascertaining the cost of a channel with a maximum depth of twelve feet, or such lesser depths along any section or sections of the said waterway as may be found to be sufficient for commercial, naval, or military purposes. Such survey shall include an examination of all practicable routes, the preparation of plans and estimates of cost along the most available route, and a report upon the desirability of utilizing as a part of such waterway any existing public or private canal, or any part thereof, and the probable cost of acquiring same—

in accordance with the act approved March 3, 1909, has the honor to report:

SECTION I.—PRELIMINARY.

The board deems it advisable at the outset to state the conceptions which have determined the scope and nature of the surveys and which have governed the board in reaching its conclusions.

The wording of the act as quoted above clearly contemplates a "through" route. To meet this requirement the waterway should be as short and direct as practicable. Thus, long or expensive detours, designed to reach or pass through interior cities, are inadmissible; inland communities must gain access to the through route by using the intersecting river systems, all of which reach the proposed waterway at or near their seaward ends. Again, a "through" route should be one which imposes a minimum of impediment upon through traffic. Thus, other conditions being equal, locks and variations of level are inhibited.

Under these conceptions the waterway has been designed to follow, as nearly as possible, the general alignment of the coast; and has been carried as near the coast as conditions have permitted, departures inland having been resorted to only where high land comes down to the sea, where the marine marsh and sea island formations are lacking, or where wave-washed sand beaches afford the only locations for shore-line canals. Also, the canal has been made sea-level

whatever reasonably practicable. Impediments and uncertainties involved in the introduction of locks and high levels and dependence upon questionable summit-level water supplies have been avoided.

SECTION II.—THE COUNTRY TRAVERSED.

A general description of the coast precedes discussion of possible routes:

From Beaufort, the northern terminus, to the Cape Fear entrance the coast line is of regular form, tending southwesterly in a long curve. The shore itself consists of a series of low sand ridges paralleling the ocean line, broken at intervals by small inlets. In rear of the beach ridges marine marshes and open sounds are practically continuous, varying from the broad expanses of Bogue Sound on the north to the lesser widths and more constricted areas south of New River, and gradually narrowing and tailing out toward the lower end of Cape Fear Peninsula. Landward of the marine marsh the country rises to gently undulating regions, generally heavily wooded, exhibiting large areas of swamp permeated and drained by the tributaries of the Neuse, Newport, White Oak, New, and North East Cape Fear Rivers.

Continuing from the Cape Fear entrance the coast line trends again southwesterly in a long curve to Winyah Bay; but here the topography differs markedly from that found in the previous section. The beach ridges persist southward to Little River Inlet, but the marine marsh is little in evidence, being replaced by narrow longitudinal depressions parallel to the shore line, above sea level, and in general covered by upland fresh-water swamp growths. South of Little River the land rises directly from the sea to the upland pine barrens and swamps. Inland from this coastal fringe are broad table-lands, generally wooded, sparsely inhabited, ill drained and swampy.

Southward from Winyah Bay the coastal topography again changes. First comes the broad Santee Delta area, succeeded by the island formations of the Carolina, Georgia, and Florida coasts, which continue as far south as the mouth of the St. Johns River. In this section nature has already gone far toward providing an inland waterway. The coast line consists of a chain of sea islands sheltering a broad expanse of marine marsh, the latter being traversed by many tidal creeks and passages. From the Santee Delta to Charleston Harbor limited inland communication can now be had by way of these tidal sloughs; from Charleston to the Savannah River the passages are of capacity sufficient to carry a considerable small-boat trade, while on the Georgia and northern Florida coasts, excepting at a few constricted points, the inland waterway is broad and open, accommodating schooners and light-draft steamers. There is little occasion for considering the adjacent back country, as the continuous belt of marine marsh affords an exceptional location for a coastwise canal.

Continuing southward from the St. Johns River entrance the topography is somewhat less favorable. The coast remains low and sandy, but while for portions of the distance long lagoons, lying behind the beach ridges, appear to offer a suitable location, there

are several stretches, notably south of Mayport and south of Mantanzas Inlet, where conditions are distinctly obstructive. On the other hand, varying from 15 to 25 miles inland the St. Johns Valley leads far southward, and finally southeasterly toward the northern end of the Indian River, while the Indian River itself, with St. Lucie and Hobe Sounds, all of which lie sheltered behind the broad outer beaches, offer obvious prolongation of an inland passage southward to Jupiter Inlet.

Continuing southerly the coastal fringe remains low and sandy, the beach ridges of the shore being practically continuous and the longitudinal depressions in the rear of the beach ridges varying from low marsh land to open lagoons, such as Lake Worth and the Hillsboro River, with the usual rising landward of the depressions. This formation persists as far as Biscayne Bay, where the depressions widen to form a broad shallow sound protected by sandy islands to seaward.

To the south of Biscayne Bay all conditions are again materially altered. In rear of the sounds the shore line of the mainland swings off to the southwest and west, rounding the tip of the Florida Peninsula, while the ocean beach line swings out from the mainland, gradually increasing its distance, trending southwesterly, and is prolonged to Key West by a series of coral islands or keys. The water area inclosed between the mainland and the line of keys is generally shallow, studded with small islands and reefs, and offers no location for an interior waterway. But immediately seaward of the line of keys is the well-known Hawk Channel, sheltered by outlying reefs and having a controlling depth of 10 feet. This navigable passage is continuous from Biscayne Bay entrance to the harbor at Key West, and is now in general use by light-draft craft, so that in its present condition the Hawk Channel constitutes the logical extension of a coast-line canal from the mainland of Florida to the island harbor of Key West.

SECTION III.—ALTERNATIVE ROUTES.

The above general description indicates the existence along certain sections of the coast of more than one feasible route, notably in the North Carolina and Florida sections.

Many of the possible alternatives have previously been well surveyed and reported upon, so that the board had in advance considerable information upon which to plan the present survey. All previous reports and other available topographical data were collected and considered, after which the preliminary work was laid out to cover reexamination of the reasonably practicable known routes, and thorough investigation of the sections upon which little information had hitherto been secured. This advance work developed the variants discussed below.

1. BEAUFORT TO CAPE FEAR.

(*a*) *The Kearney line.*—This is an interior route, surveyed by Lieut. Col. J. Kearney, topographical engineer, in 1828, and is reported on page 38 of Senate Document No. 35, Forty-fourth Congress,

first session. The route was resurveyed by S. T. Albert, United States civil engineer, the report being found in the same Senate document. The line passes through Neuse River, leads by Slocums Creek past Big Lake, thence down the White Oak River; thence by Grants Creek, a tributary of the White Oak; across country to the northeast branch of New River; across this branch and up the southwest branch; thence across country into and down Holly Shelter Creek to point of confluence with the northeast branch to Cape Fear River; thence down the northeast branch to Cape Fear River proper. This survey has been reexamined, and estimates based upon the type of canal now required to accommodate barge traffic show a probable total cost by this route of $12,000,000.

(*b*) *The Phillips interior line.*—This route was surveyed in 1878 and 1880 by Capt. Charles B. Phillips, Corps of Engineers, whose report is found on page 851, Annual Report of the Chief of Engineers for 1880. The line passes up Neuse River to the mouth of the Trent River; thence up Trent River to Pollocksville; thence across country, parallel to the present location of the Atlantic Coast Line Railroad, to the White Oak River near Maysville; thence across country via Starkeys Creek to the Big Northeast Branch of New River; thence to and down New River to Sneads Ferry; thence along the course of the coastal sand ridges to a point near Hampstead; thence to Northeast Cape Fear River via Harrisons Creek. No satisfactory location for the canal could be found on this line, which fact led to the making of the survey covered by (*c*) below.

(*c*) *The Phillips shore line.*—This route followed the general line of the coast, passing through Bogue Sound and the marine marshes to the southward to Whiskey Creek, crossing at that point via Whiskey Creek and Bernards Creek directly into the Cape Fear River. This survey demonstrated the practicability of constructing a canal on this line, and indicated a probable reasonable cost. Estimates based upon the type of canal now desired showed a probable cost of $4,000,000.

Reexamination of the above three possibilities showed that the interior routes (*a*) and (*b*) are impracticable on account of excessive cost of sea-level canals and on account of absence of adequate water supply for summit levels of lock canals. The whole country between the Neuse and Cape Fear Rivers was also actually explored by reconnoissance parties, with a view to locating any other reasonably practicable routes. None were found. The board, therefore, determined upon a detailed survey along the general route of the shore lines.

2. CAPE FEAR RIVER TO WINYAH BAY.

(*a*) *The Livingston Creek-Juniper Creek line.*—This interior route was surveyed in 1881 by Capt. James Mercur, Corps of Engineers, and is reported in the Annual Report of the Chief of Engineers for 1882. The line passes up Cape Fear River and its northwest branch to Livingston Creek, a tributary of the latter; thence up this creek and overland through Green Swamp to Juniper Creek, a tributary of the Waccamaw River; thence down the Waccamaw Valley to Winyah Bay. A canal on this line would necessarily be a lock canal, and, at that, would involve very heavy excavation. The

survey shows no sufficient water supply for summit levels, and shows unusual engineering difficulties and prohibitive cost.

(*b*) *The Town Creek line.*—This interior route was surveyed at the same time as the previous and is similarly reported. The line passes up the Cape Fear River to Town Creek; thence up Town Creek and across Green Swamp directly to Waccamaw River. Here also elevations and cost were found to be prohibitive and water supply for summit levels inadequate.

(*c*) *The shore line.*—The possibility of constructing a canal by this route was indicated by topographic information in possession of the board, and an examination was instituted. The line leaves Southport at the mouth of Cape Fear River; thence by Elizabeth River, crossing the divide to Davis Creek and Lockwoods Folly River; across the latter and across a second divide to Little Shallotte River; down this valley to and across the Shallotte River; thence up Saucepan Creek and across the divide to Calabash River, which empties into Little River near the inlet; this to be prolonged to Winyah Bay either by shore line, following the coast, or by crossing from Little River directly to Waccamaw River and down the latter.

As in the previous section, the detailed information in the possession of the board demonstrated the impracticability of the high-level interior routes. The board selected the third variant and instituted a survey for a shore line from Southport to Little River Inlet, and for both cross-country and coastal lines from Little River Inlet to Winyah Bay.

An instrumental reconnoissance of the Waccamaw peninsula soon developed the fact that a shore location from Little River to the vicinity of Winyah Bay would be impracticable and unduly costly on account of the absence of any low line for a sea-level canal and the absence of water supply for a canal at higher level. The results of the reconnoissance thus determined that the final location for a route from Cape Fear River to Winyah Bay should follow the shore line only as far as Little River Inlet, crossing from that point to the Waccamaw Valley, and so down to Winyah Bay.

3. WINYAH BAY—CHARLESTON HARBOR.

Within this section there are few variants to be considered. Beginning at Winyah Bay, an inland waterway such as is now proposed will naturally follow the line of the Estherville-Minim Creek Canal, already constructed, leading southward to North Santee River.

The question of connecting Santee River and Charleston Harbor by a suitable inland route has long been under consideration and discussion, many locations having been proposed. This problem was made the subject of investigation in the course of a preliminary examination of "Waterways, Columbia and Camden to Charleston," in accordance with the act of June 25, 1910. At that time five possible routes were passed upon; but of these only two can here be considered, as the remaining, even were they otherwise feasible and economical, leave the Santee at points too far up the river to permit of their forming a part of an intracoastal way. The two routes which can be considered are the Wambraw-Wando interior route and the coastal route, both of which have been advocated by local interests.

The investigations above referred to showed that the Wambaw-Wando route would be unduly costly and yet have no material advantage over the coast route. For this reason the board selected the shore line for detailed survey.

4. CHARLESTON HARBOR—SAVANNAH RIVER.

In this section no questions of alternative route arise. Inland navigation is already well established through the marine marshes in rear of the sea islands upon passages which in general lend themselves to improvement to the depths now proposed. There are no practicable interior routes.

5. SAVANNAH RIVER—ST. JOHNS RIVER.

Here, as in the previous section, there are no questions of alternative routes, the inland passages through the marine marshes being already well established and susceptible at very moderate cost of further improvement to the depths now contemplated. No interior lines are worthy of consideration.

6. ST. JOHNS RIVER—INDIAN RIVER.

In this section several alternatives present themselves, all of which have been investigated, with results as follows:

(*a*) *The shore line.*—This is strictly shore line location parallel to and near the ocean, extending from St. Johns River at Pablo Creek to a point about 5¼ miles north of Titusville. While this route is direct and short, the advance examinations developed the necessity of heavy cutting, some of which is in rock, and preliminary estimates indicated a cost of approximately $5,500,000. The use of this line is also complicated by the fact that it is now occupied by a small private canal, which, while of little value as saving excavation for the intracoastal canal, would nevertheless have to be acquired at a cost to be added to the figure stated above.

(*b*) *The Crescent Lake route.*—This line follows the St. Johns River from Pablo Creek to Dunns Creek; thence through Dunns Creek to Crescent Lake and Haw Creek and by the Florida East Coast Canal to a point 5½ miles north of Titusville. The route is longer than the previous and while engineering difficulties appear approximately the same, the cost would be only slightly less. The preliminary estimates indicated a probable expense of about $5,900,000.

(*c*) *The Lake Harney route.*—This line follows up the St. Johns River to Lake Harney; thence across country by canal to the Indian River and to a point 5½ miles north of Titusville. This again is a line longer than the previous, but has the advantage of utilizing a great part of the St. Johns River, which lends itself well to improvement for the depths contemplated. Engineering difficulties are less than in the preceding routes; preliminary estimates indicated a cost somewhat over $4,400,000.

(*d*) *The Lake Shad-Salt Lake route.*—This line also follows up the St. Johns Valley, passing Lake Harney, and leading up to Salt

Run; thence through Lake Shad and Salt Lake; and thence across country by a short canal to the Indian River near Titusville. This route has all the advantages urged for the immediately preceding and at the same time promises less construction difficulty and less initial cost; preliminary estimates place the latter at less than $4,000,000.

The board examined these four alternatives, selecting the last as being the most advantageous, and directed its detailed survey.

7. INDIAN RIVER–BISCAYNE BAY.

Here no alternatives are offered. The canal must follow the lagoons and depressions parallel to and in rear of the ocean beaches.

8. BISCAYNE BAY–KEY WEST.

Between these two points nature has provided a 10-foot waterway in the Hawk Channel. No reasonable alternative presents itself.

SECTION IV.—DESCRIPTION OF ROUTE AS FINALLY SURVEYED AND ADOPTED.

The major variants discussed above having been canvassed, the final surveys were organized to cover the selected general location. It was expected that the detailed work would develop minor variants. The field surveys covered all such and placed the board in possession of the information required to make a final determination of the line upon which to base its estimates.

1. BEAUFORT–CAPE FEAR RIVER.

Beginning at Beaufort Harbor the line leads up the present navigable channel within Bogue Sound, generally near the northern shore, to a point about 5 miles from Swansboro. In the first 10 miles this channel varies in natural depth from 8 to 9 feet and in width from 300 to 400 feet, requiring little further dredging; the remainder has a navigable depth of about 2 feet at mean low water. Continuing the located line departs from the existing channel, passing through the marine marshes close to the northern shore, crossing into the White Oak River at Swansboro. In actual excavation of these stretches it is proposed that the material shall be deposited to the south of the dredged channel to form a continuous bank rising above high water and isolating the canal from the main body of the sound. This disposal of dredged material will protect the cut from encroaching sand. In the vicinity of Swansboro the layout of the channel should be noted, the purpose here having been to avoid cross currents and prevent deterioration of the channel by reason of tidal flow in and out of Bogue Inlet.

Continuing from Swansboro to New River, the located line passes through broad marine marshes cut up by numerous sloughs and creeks. No attempt has been made to follow the existing channel, as this is too tortuous for present purposes. The new location is made to follow close to the shore line of the mainland. Opposite

these stretches there are two small inlets—Bear and Brown—having a depth of from 2 to 4 feet upon their bars, but fairly stable in position. If in these stretches the dredged material is deposited on the seaward side, forming a continuous dike, protecting the cut and confining the tidal flow to the New River and White Oak River entrances, cross currents in the canal will be obviated and no deleterious effects from the tidal flow through Bear and Brown Inlets need be anticipated.

In crossing New River, as at White Oak River, the canal location is designed to avoid cross currents, being carried up through Howards and Salliers Bay, on the east, into the wide portion of the main river, and well around the marine marshes of the interior delta. This arrangement also gives access to the channel of New River.

Continuing from New River to Cape Fear River, the canal location passes through five small sounds, each connected to the ocean by an inlet. Within the sounds there is an intricate network of channels, but none of sufficient capacity to be included as a section of the intracoastal way. The inlets referred to are responsible for detrimental effects against which the design must guard. Storm tides carry through and deposit within the inlets large quantities of sand, forming nuclei for growth of marine marsh; and the ordinary tidal flow entering at the several inlets deposits such sediment at intermediate points known as "dividings." So that, in this section, as previously, it is advisable to deposit dredged material in such way as to form a continuous dike to seaward of the cut, protecting the canal from disturbances and utilizing only one or two of the larger inlets to pass the tidal flow. In view of these considerations the location line, departing from New River, enters Chadwicks Bay across a narrow neck of land projecting into the marine marshes, and passes down Alligator Bay, Stump, Topsail, Masonboro, and Myrtle Sounds, following close to the mainland until it reaches a point near the southern end of Myrtle Sound, where the marshes nearly tail out. Here the line is but 1 mile distant from the Cape Fear River, being separated by a low ridge of sand hills about 25 feet in height.

Special investigations were undertaken to determine the best location for the crossing into Cape Fear River. The following locations were considered:

(*a*) *Scotts Hill Crossing.*—A trial line was run through Foys Creek northward past Scotts Hill, thence to the head of and down Island Creek to the Northeast Cape Fear River, at a point from which a depth of 10 feet is available continuously down the stream. This crossing is 7 miles long and has a maximum elevation of 54 feet at Scotts Hill. Excavation of a sea-level canal at this point would involve the removal of 6,728,139 cubic yards of earth, and construction of a guard lock to shut out the 10-foot floods of the Northeast Cape Fear. Moreover, the material is such that instability of side slopes must be expected, making maintenance charges probably high. This crossing would also involve an increase in length of the canal of 24 miles. The cost of the crossing alone is estimated at $1,800,000.

(*b*) *Hewletts Creek Crossing.*—This possible line leaves the marshes at Hewletts Creek, just below Wrightsville, passing across the divide to Bernards Creek, on the Cape Fear River, the maximum elevation being 42 feet, with total length of cut of 8 miles. The ex-

cavation involved is large. The cost of the crossing alone is estimated at $1,600,000.

(*c*) *The Carolina Beach Crossing.*—Here, as indicated before, the marine marshes lie but 1 mile to the east of the Cape Fear River, and a crossing can readily be effected, encountering no elevation greater than 30 feet. This is estimated to cost $166,000.

While the higher crossings (*a*) and (*b*) have been advocated by the citizens of Wilmington for the reason that they would bring the canal line past or close to their city, the board, in conformity with the general principles established for a through route, has considered such arguments inadmissible and has selected the lower or Carolina Beach crossing as being the least costly and most advantageous.

As adopted the line leaves the marine marshes at a point opposite Carolina Beach, passes directly across the divide and into the Cape Fear River by Telford Creek. Here the Cape Fear River is about 2 miles in width and the deep channel is found along the western shore, so that it will be necessary to carry the inland waterway across the mud flats of the eastern shore to reach deep water. This is to be accomplished by prolonging the canal between stone dikes until it reaches a slough on the eastern side, thence down the slough into the main dredged channel. Additional training walls may be required below the canal entrance in order to obviate cross sections. With these constructions the prolongation of the canal can be made to hold its depths.

In general it is believed that the canal location as adopted from Beaufort to Cape Fear River can be accepted with assurance of permanence and stability. It is sea level throughout and, while located quite close to the ocean, should not be open to seriously disturbing influences. It has been stated that the coast line appears to be undergoing slow degradation, but the rate of recession, in case such there is, has been extremely small. The principal changes in the past 50 years have occurred in the neighborhood of the inlets. Some former inlets have entirely closed up, some new inlets have formed, while others have shifted their positions by distances varying from a few hundred feet to several hundred yards. But there appears to have been no great recession of the general line of the coast; in fact, at points the fore shore has advanced, so that it now appears that the coast line fluctuates slightly on both sides of what may be termed a "mean" position, there being periods of recession and subsequent periods of advance. In any case the rate of change in the past 50 years and more has been so slight that no disturbance of the canal as located need be anticipated.

2. CAPE FEAR—LITTLE RIVER.

The canal line leaves deep water of Cape Fear River at Southport, about 3 miles from the ocean entrance; continues at sea level for 6 miles up the marshes bordering Elizabeth River, running approximately parallel to the coast at a distance inland of about 1½ miles. At the head of the Elizabeth River the canal is to be stepped by a standard lock to a 6-foot level and continued at this level to Little River, the end of this section.

From the beginning of the 6-foot level the canal passes through the longitudinal depressions to Davis Creek, a tributary of Lock-

woods Folly River. The maximum elevation herein encountered is 30 feet above mean low water. The mouth of Davis Creek is to be closed by a fixed earthen dam retaining the 6-foot level. The canal is then carried from Davis Creek across a small neck, maximum elevation 20 feet, into Lockwoods Folly River, the latter also being closed by a concrete dam to retain the 6-foot level.

Continuing from Lockwoods Folly the canal line is carried through a series of low sand ridges and valleys, maximum elevation being 30 to 32 feet, into Little Shallotte River and thence down to Shallotte River proper. Here the crossing will be effected as previously by the construction of a concrete dam, raising the Shallotte River to the 6-foot level, and the canal carried forward through low sand ridges and valleys into Saucepan Swamp, Saucepan Creek, and Calabash Creek. Following down Calabash River, which is to be backed up by a 6-foot earthen dam, the canal line reaches a point opposite Little River Inlet and is turned inland at Mulletts Creek as the first stage of crossing into the Waccamaw River.

In the foregoing section, Cape Fear to Little River, consideration was had of both sea-level and 6-foot-level canals. While the latter will require locks it will involve much less excavation; perfect protection against tidal currents will be had; no cross currents at Lockwoods Folly River and Shallotte River will be encountered, and the prism of excavation will be kept well above underlying rock. Adequate water supply can be had at all periods of the year by retaining the discharge of Shallotte and Lockwoods Folly Rivers as herein proposed.

3. LITTLE RIVER—WINYAH BAY.

The location within this section was determined by three practical considerations. First, on account of the height of the ridge between the ocean and the Waccamaw River, running up to 50 feet, it was necessary to select the shortest line of crossing in order to hold down excavation cost. Second, the whole back country being comparatively flat, it was necessary to keep the summit level down to an elevation such that water could be supplied to the canal prism. Third, the material encountered in the Waccamaw Peninsula being of a comparatively unstable character, it was necessary, within the limitations of the two preceding considerations, to reduce the depth of cut to a minimum in order to hold down deterioration and incident high maintenance charges.

A thorough reconnoissance was made of the region lying between the ocean and the Waccamaw Valley. The crossing from Mulletts Creek directly to Worthams Bridge on the Waccamaw River was selected as that which offered least probable excavation. The Waccamaw Valley was then surveyed to determine low-water and flood elevations in order that available water supply might be computed. This survey disclosed the fact that it would be necessary to obtain the water from some site above the crossing, as the low-water elevation in the Waccamaw River at Worthams Bridge is approximately 14, and the practicability of damming the valley at that point and of raising the water to any considerably greater level was small. The survey was continued upstream to locate the nearest suitable dam site. This was found at Pireway, where, by the construction of a

dam of low profile entirely across the valley from high land to high land, it would be possible to back up the water to any elevation not exceeding 30.

Tentative computations were then made to determine the economical elevation for the crossing. Costs of 20-foot, 24-foot, 26-foot, and 28-foot summit levels were computed and compared, with the result that the 28-foot level was shown to be the least costly and, all conditions considered, that which promised the least expense in maintenance. No greater elevation could well be taken without forfeiting water supply.

To accomplish the crossing at this elevation two locks, one of 12 and one of 10-foot lift, will be required at the eastern end, where suitable marl foundations have been developed. The excavation will be carried through nonresisting material at reasonable initial cost; but it will probably be necessary to flatten the side slopes considerably below those of the normal prism, say to 1:3, as much of the material is saturated with water and may prove less stable than that found in the adjacent country. Provision for this is included in the estimates.

To feed the summit level the design contemplates the construction of a fixed dam at Pireway, extending from high land on the west side of the valley, crossing the channel of the river as a concrete gravity section, and thence across the river swamp as a concrete and crib spillway, to high land on the eastern side of the valley. The elevation of the crest of the dam proper is to be 30, that of the spillway 30.5. It is also advisable to extend the concrete sill from the 30-foot knoll on the eastern side of the valley across to the opposite high and dry land, this section to be at 32 in order to prevent overflow between the knoll and the high land opposite.

The Pireway Dam creates a reservoir at elevation 30 impounding the water over an area of approximtely 13,000 acres and collecting the run-off from the watershed of 625 square miles of comparatively flat country. The water supply so obtained is adequate, the discharge being never less than 225 cubic feet per second.

The reservoir is to be connected with the canal at elevation 28 by a feeder about 31,000 feet long, the supply being regulated by control gates at each end. Cross section of the feeder is fixed at 30 feet bottom width, with side slopes of 2:3, this being sufficient, with the given difference of head, to carry a discharge somewhat greater than the normal low-water discharge of the Waccamaw River. The feeder is to reach the canal proper in the vicinity of Worthams Bridge.

The crossing into the Waccamaw Valley having been determined, the question arose as to whether the canal should be carried down the river proper throughout, or as a lateral canal throughout, or in part by each method. Surveys disclosed that the last alternative would provide the correct solution. The Upper Waccamaw from Worthams Bridge down to Red Bluff is exceedingly tortuous; during low-water periods it is of very small prism, and has prohibitive slope. To use this section of the river in open-channel work would be impracticable. To canalize, in view of the breadth of the valley, would be very costly. On the other hand, the slopes on the western side disclose an excellent location for a lateral line, where construction will be comparatively inexpensive, and by which the 28-foot level can be prolonged well

down the valley, thus being kept above floods and freed from liability to disaster.

From Red Bluff down to Conway both low and high water slopes are much gentler; and while the channel is still quite tortuous, it has larger cross section and offers reasonable possibility for open channel work. A lateral canal having been determined upon for the section above Red Bluff, it then became a question of locating a satisfactory point at or below Red Bluff for entering the main channel of the river. This was found at Bear Bluff, where the slopes of high land are bordered by the main channel of the river, and where access to the main channel can be had without crossing the swamps. Suitable lock foundations upon stiff clay were here developed.

To proceed downstream from Bear Bluff, tentative estimates were made upon the probable cost of straight open channel work. It was found that, by reason of many shoals between Bear Bluff and Conway, the total excavation would be large; and that in view of the character of the river, maintenance charges would probably be high. Investigations were then undertaken to determine the practicability of raising the water level. The construction of the valley proper at Conway was found to offer a site for a dam of low profile (similar in all respects to that proposed for Pireway) by which the low-water level, normally +3.4, might be raised to +9 without flooding any land other than that normally subject to flood each year, and without materially raising the flood plane. By this means the open river work in the section Bear Bluff–Conway can be reduced to comparatively limited dredging and straightening of bends, and an economical and satisfactory channel will be obtained in which only slight deterioration need be expected.

Upon this design the canal is dropped from 28 to 9 by two locks placed at Bear Bluff, and continues at Conway at 9 within the straightened and widened channel of the river.

At Conway the canal level is again dropped to normal low-water level of the Waccamaw River, 3.4. From this point downstream the slope is exceedingly small and the lunar tidal effects are pronounced; the canal will be carried in the open river as straightened and deepened by projects now in course of execution. It may be noted that the United States is already committed to the creation of a 12-foot open-river navigation from Conway down to Winyah Bay, as this project has been adopted and is now under way.

It is a comparatively simple work, can be accomplished by dredging alone, and will be confined to the 22 miles above the mouth of Bull Creek. But the board has reason to believe that the estimates under which this project is now being carried on are inadequate, and it seems proper to include in this report an estimate for funds sufficient unquestionably to complete the projected work to a depth of 10 feet.

From Bull Creek to Winyah Bay the Waccamaw River has a channel at no point less than 12 feet deep, and at no point less than 100 feet wide, so that no further work will be required.

4. WINYAH BAY—CHARLESTON HARBOR.

It should be noted at the beginning that the United States is now engaged in excavating an 18-foot channel from Georgetown, through

Winyah Bay, to the sea. The channel follows the so-called western line, passing close to the western shore of the bay, so that intracoastal traffic passing down the Waccamaw River can reach the mouth of the Estherville-Minim Creek Canal without any improvement other than that now in progress.

The canal line then enters the Estherville Canal, already constructed under Federal appropriations. This passage, having at present a depth of 6 feet, leads through low land in rear of Cat Island, reaching Minim Creek, a tributary of the North Santee River. Enlargement to full prism and limited dredging in Minim Creek and Crow Island Crossing will be required. Passing on, the canal crosses deep water of the North Santee to a point opposite the delta, where a solid cut is to be made through the low-lying marsh land, giving access to the South Santee.

Unlike the north branch, the South Santee has little fresh water discharge, its flow being largely tidal. As a consequence its depths are considerably less than those of the north branch, and in order to effect a crossing to the mouth of Alligator Creek it will be necessary to build training walls, as shown on the plan, and probably to establish a channel by dredging. It should be understood that the training walls are for purposes of effecting the crossing only; and it is believed that once the channel has been established it will be held permanently in position with full depth.

Leaving the South Santee River the canal line passes across a neck of land into Alligator Creek; following up that creek, utilizing its prism so far as practicable, to the broad marsh area of the Cape Romain Peninsula.

Here again the canal utilizes the tidal passages where they have sufficient depth to offer economical location; otherwise crosses the marshes by direct cuts, terminating eventually in the straight, deep reaches of Harbor River south of McClellanville.

From this point it is necessary to carry the canal through the marshes in rear of Bull Bay, as the latter is broad, open, and exposed to gales from the east. Existing tidal passages are utilized where practicable, and the route follows generally the cuts already effected in the course of the construction of a 4-foot waterway to McClellanville.

From Bull Bay southward to Charleston Harbor the work is less difficult. There is already in existence a waterway having depth of 4 feet at mean low water, from which few departures are made. The line is continuously in rear of the sea islands, well sheltered, and economical of construction.

Throughout this section, Winyah Bay to Charleston Harbor, the work leads continuously through soft and low lying material, such as can readily be removed by hydraulic dredges. Technically, it is necessary only to note that where the line is carried across broad, open sounds, having naturally little depth, it will be advisable, as on the North Carolina coast, to deposit the material to seaward of the cut, closing minor sloughs to seaward but leaving open the large tidal entrances and being particular to close no sloughs to landward.

The canal location in this section terminates in deep water of Charleston Harbor at the entrance to Sullivans Island Cove.

5. CHARLESTON HARBOR—SAVANNAH RIVER.

Within this section inland navigation is already well established, and in general the canal location follows the line now in use, leaving deep water of Charleston Harbor in the Ashley River at the entrance to Wappoo Creek, passing up that creek, up Stono River, through Church Flats, down Wadmelaw River, across North Edisto and up Dawho. These passages will require enlargement and limited rectification to make them suitable links to the intracoastal way.

Halfway through Dawho the first variant is introduced, the line being carried up North Creek and directly across country into South Edisto River, this departure being designed to shorten the route and eliminate the tortuous upper Dawho.

Passing down South Edisto and through the Fenwick Island Cut the line reaches Ashepoo River. Here a second variant is introduced. Vessels now pass down Ashepoo River into and across St. Helena Sound, but at considerable risk. This sound is broad, open, and exposed, and obstructed by long sand spits reaching well out toward the ocean. It has been deemed advisable to eliminate this hazardous crossing by carrying the canal across the marshland of Hutchinsons Islands, following the tidal creeks where practicable, and so into the sheltered waters of Coosaw River. This work involves considerable excavation, but the expense is justified by the superior convenience and safety of the route so secured.

The canal line is then carried up deep water of Coosaw River to and through Brickyard Creek to Beaufort River, passing down the latter to Port Royal.

Here, again, a departure from the present route is made to obviate the necessity of crossing Port Royal Sound, where conditions are similar to those at St. Helena. This can be accomplished at small expense by enlarging Archers Creek and the Rose Islands Passage, thus providing a sheltered way from the Beaufort River across Broad River and down Chechessee to mouth of Skull Creek.

From this point on, by way of Skull Creek, Calibogue Sound, and Cooper River, which are adequate without improvement, the small passage called Ramshorn Creek can be reached. The Ramshorn is to be dredged and straightened, the canal line following thence to and down the deep waters of New and Wrights Rivers to Mud River. The latter, having now depths varying from 6.5 to 10 feet, will, with little dredging, carry the route through to deep water of Savannah River.

All of the work from Charleston Harbor to Savannah River can be accomplished by hydraulic dredges of moderate power. No hard material will be encountered, all excavation being in mud, shell, and sand.

6. SAVANNAH RIVER—FERNANDINA.

On the coast of Georgia there has always existed a sheltered or inside waterway which has been known and used from the time of the earliest settlement of the colony. The extensive sea marshes and large sea islands lend themselves readily to the formation of such a route.

The natural waterway has been improved and shortened by the Federal Government, first by works undertaken at detached localities, later under a general project as a single work. Expenditures to date have sufficed to secure a channel having a depth of 7 feet at mean low water and a bottom width of 75 feet minimum. The mean rise and fall of the tide along the route is about 7 feet, so that by taking advantage of the flood it is possible for vessels to pass through drawing as much as 12 feet.

The development of this route to the dimensions required for the intracoastal waterway is comparatively a simple matter, being merely a question of dredging at a few localities. Only one change from the route now used is recommended, namely, the sections for Front and Sapelo Rivers, which are designed to avoid the difficult passage through Mud River.

In detail, the canal location leaves the Savannah River by St. Augustine Creek, at the mouth of which a very small amount of dredging will be required, and passes down Wilmington River into Skidaway Narrows. The latter is one of the few constricted points of this section; to increase its prism to that herein contemplated, excavation to the amount of 650,000 yards will be required. Leaving Skidaway Narrows the line passes into Burnside River, which will require some enlargement; thence into and down Vernon River to and through Hell Gate and by Ogeechee River to the Florida Passage. The latter is another constricted section where excavation amounting to 83,000 yards will be necessary. Continuing southward the line passes through Beaver River, across into St. Catherine Sound, and up Newport River to and through Waldburg and Johnsons Creeks. Here again a small amount of dredging will open the way to projected width and depth. From Johnsons Creek the line passes into South Newport River, across and up Sapelo Sound and to the mouth of Front River. Passing through Front River, Creighton Narrows, South Sapelo Dividings, and Old Teakettle Creek many shoals and constrictions are encountered, the removal of which will require excavation aggregating 642,000 yards. From this region the line passes down to and across Doboy Sound, through Darien River, into Old South River and Little Mud River, where further dredging, about 251,600 cubic yards in amount, is needed; thence to and across Altamaha Sound, up Buttermilk Sound, and through Frederica River to St. Simon Sound. The Frederica Passage, like the previous dividings, will require a limited amount of dredging. Leaving St. Simon Sound the line passes through Jekyl Creek, now under improvement, but requiring additional dredging to the amount of 268,000 yards to secure the prism now designed. Passing Jekyl Creek the line crosses St. Andrews Sound, passes up Cumberland River and down Cumberland Sound to Fernandina, requiring only limited dredging at the dividings en route to provide the full waterway.

On the Georgia coast no rock will be encountered. The material is such as can readily be handled by hydraulic dredges of moderate power. It may later be found necessary for purposes of maintenance to construct training walls at a few localities; and for this purpose $50,000 has been included in the estimates.

7. FERNANDINA—ST. JOHNS RIVER.

This section is quite similar to that of the Georgia coast, with the exception that the existing inland channel is more constricted and tortuous, especially in that portion of the section from Nassau Sound to the St. Johns River.

Leaving Fernandina on Cumberland Sound, the line of the canal follows up Amelia River, through Kingsleys Cut and South Amelia River to Nassau Sound, with no work required except a cut through a neck of marshland and to avoid a difficult bend in Kingsleys Cut and light dredging at occasional points in that cut and South Amelia River. Leaving South Amelia River, the route, by a cut across a neck of marshland, enters Sawpit Creek and follows that stream for a distance of a little over 1 mile, and thence, in preference to following the crooked, constricted channel of Sisters Creek, leads by a short marsh cut to Cedar Point; thence through a short section of Sisters Creek and through a second marsh cut, following the general depression of Hannah Mills Creek to the St. Johns River in rear of the White Shells training wall, which, built in connection with the improvement of that stream, forms a satisfactory protection to the channel extending from the marsh cut to the main channel of the St. Johns.

No material is encountered along any portion of this section which can not be economically removed by a hydraulic dredge of moderate power.

8. ST. JOHNS RIVER–INDIAN RIVER.

(*a*) *St. Johns River section.*—The canal through this section follows the existing channel in the St. Johns River, which now provides a depth in excess of 10 feet to a point 93.5 miles south of the entrance of the canal from Fernandina. From this point to Sanford, on Lake Monroe, a farther distance of 73.7 miles, the river is now being improved by dredging and rectification, under a project which contemplates securing a convenient channel 8 feet deep and 100 feet wide. As a general thing the canal alignment follows that of the existing project, the work required being merely that of enlargement to the prism adopted by the board. In addition a number of bends, sufficiently convenient for an 8-foot channel but too sharp to meet the requirements of the intracoastal way, are avoided by cuts across points. The inconsiderable slope of the stream and the slight elevation of the land on the point to be thus treated simplify exceedingly the engineering features of the work.

Between Lake Harney and Lake Monroe, a distance of 22.6 miles, the river is very crooked, the banks low and ill defined, and for most of the distance wide expanses of marshy land, interspersed with shallow sloughs and ponds, border the stream. Above Lake Harney to Salt Creek the conditions are very similar, the marshes being even more extensive, the bends and twists more pronounced.

The Federal Government is already committed to a project for the improvement of that section of the stream between Lakes Harney and Monroe, which contemplates securing an available depth of 5 feet and ample width for boats of light draft. The work required is

slight and consists mainly in the removal of the shoals at the outlet of Lake Harney and inlet of Lake Monroe, and a limited amount of dredging here and there to deepen or widen the existing channel.

For a waterway of the magnitude of the one under consideration, utilization of this inadequate and crooked stream is neither economical nor advisable at many places. The line adopted, therefore, while it follows the river where practicable, notably from Mullet Lake to Lake Harney, substitutes marsh cuts for the existing channel between Lakes Mullet and Monroe, while between Lake Harney and Salt Run it adheres more to the river lowland than to the thread of the stream. No trouble is anticipated from this character of treatment, as there is no appreciable difference in elevation between Salt Run and Lake Harney, either at high or low water stages, and only four-tenths of a foot difference between Lakes Harney and Monroe at low water and one and six-tenths feet at high water. All of the excavation can be readily accomplished by hydraulic dredges.

(*b*) *Salt Run–Lakes Ruth, Shad, and Salt.*—Entering Salt Run at point of confluence with the St. Johns River, 193 miles south of its entrance into the latter stream, the canal follows the general alignment of Salt Run, through Lake Ruth in a general easterly direction, thence northeasterly into and through Shad Lake, and again easterly into and through Salt Lake to the edge of the divide between the valleys of the St. Johns and Indian Rivers. These lakes and connecting waterways have a depth of 2.5 feet at low water and at such a stage cover an area of about 1,100 acres. At high water the lakes are all connected, the surrounding country becoming one large lake, covering thousands of acres and extending to Lake Harney. Both at high and low water differences in water surface elevations are slight, and little trouble need be anticipated from excessive currents. To allow for the depression of water elevations at higher points due to the increased prism of flow, excavation, which can be all done by hydraulic means, is estimated below mean low water of the river at Lake Harney.

(*c*) *Salt Lake–Indian River.*—This section consists of a cut 15.5 miles long, through the divide between the St. Johns and Indian River Valleys. In the first mile from Salt Lake leading eastwardly the ground rises to + 16 feet, from this point to the fourth mile gradually to + 28 feet, descends in the fifth mile to + 20 feet, and in the last half mile to + 4 feet, the mean high-water stage of the Indian River.

In the westerly 4 miles of the canal line the country through which the route extends is principally marsh, hammock, and open pine lands, uncultivated and with no population. The easterly mile and a half is through a well-settled country interspersed with valuable orange groves.

Borings taken throughout the proposed prism indicate that for the most part sand is to be expected, with some coquina rock in thin layers.

The low-water level of Salt Lake is + 6, while that of the Indian River is about 0.0, the high-water elevations being, respectively, + 12.7 and + 4. To provide against an undue current through the canal in this section, and also against possible injury to the St. Johns River between Salt Run and Lake Monroe by a diversion through an

open cut of the river flow in high stages, a standard lock is provided for, which will have a low-water lift of 4.8 and a possible maximum lift of 12.7 feet.

Two railroad bridges at the standard unit cost are provided for in the estimates to carry the main line and a branch line of the Florida East Coast Railroad, and excavation has been placed at the figure adopted for steam-shovel work.

9. INDIAN RIVER–KEY WEST, FLA.

(*a*) *Indian River–Jupiter Inlet.*—The Indian River, more properly a salt-water lagoon, varying in width from three-fourths of a mile to 5 miles, except at Indian River Narrows, where the stream is divided into many narrow channels, extends from a point about 7 miles north of Titusville to St. Lucie Inlet, its present mouth. Before the opening of St. Lucie Inlet the discharge of the stream was at Jupiter Inlet, about 16 miles farther south. This inlet is closed at the present time, but may be expected to break open at times of heavy rains, closing again as the fresh-water flow decreases.

While the channel of the Indian River is for the most part deeper than 6 feet, and over a considerable mileage has a depth equal to or exceeding that of the waterway being considered, it was originally obstructed at various points by sand shoals, upon the removal of which, to an available depth of 5 feet, the Federal Government has expended some $59,342.98.

Entering the Indian River from the cut through the St. Johns-Indian River divide, the canal extends under the protection of suitable parallel dikes to the main channel of the stream, which is followed thence southerly to Jupiter Inlet.

The work required consists in dredging and rock excavation to adapt the present channel to the needs of the proposed canal. The shifting sands of the St. Lucie Inlet crossing, always a troublesome locality, are avoided by a cut through the short neck of mangrove swamp lying between Great Pocket and Pecks Lake.

(*b*) *Jupiter Inlet–Lake Worth.*—From Jupiter Inlet the line passes southerly through Jupiter Sound, where widening and deepening of an existing channel are required, into Lake Worth Creek, a small navigable stream which has been improved by the Florida East Coast Canal Co., and, by widening, deepening, and straightening, follows that stream to Lake Worth. This body of water, more properly a salt-water lagoon, varies in width from about 1,000 feet to 1 mile, has a length of 21 miles in a north and south direction, and a depth in excess of 6 feet for 60 per cent of its length, and for the remainder a depth of from 3 to 6 feet. The only work here required is that of widening and deepening.

(*c*) *Lake Worth—Hawk Channel.*—Leaving the south end of Lake Worth the alignment follows that of the Florida East Coast Canal for a distance of 15.1 miles to the Hillsboro River.

The work required will consist of widening and deepening this canal, the water-surface width of which is but 60 feet and the mid-channel depth 5 feet to standard section, which will necessitate the rehandling of at least one-half of the material excavated by the canal company. Except for a total distance of about 3 miles, where rock

will be met with at depths ranging from —7 to —8, the material to be excavated will be mud and sand.

The Hillsboro River, a small but navigable tidal stream, discharging at Hillsboro Inlet, about 3.2 miles south of its source, has been improved by the Florida East Coast Canal Co. by widening and deepening, and the line follows generally the alignment of that company's work, departing from it where necessary to avoid sharp bends. The material to be encountered is sand and mud, except for a distance of something less than 1 mile, through which rock excavation is required below —8 feet.

Avoiding the shifting sands at the mouth of Hillsboro Inlet by 2,500 feet of cut across the marsh, the line again enters the Florida East Coast Canal and follows it to New River Inlet, departing from it to avoid that inlet by a cut across the marshes into and through Lake Mable and into New River.

New River is followed for a distance of about 1 mile, when the Florida East Coast Canal is again entered, and advantage is taken of the excavation of its prism thence to Biscayne Bay, except for a distance of 1 mile through Dumfounding Bay.

Entering Biscayne Bay at its northern extremity, the canal is located to take advantage of the deepest water, which varies from 4 to 6 feet to Miami, where an artificial channel excavated by the Florida East Coast Railroad for their Nassau-Miami boats is entered and followed to Hawk Channel. Little work will be required in this latter section, as the depth is already in excess of 10 feet for most of the distance. Widening at bends and in constricted portions will be necessary, but will all be in sand, easily removable.

(*d*) *Hawk Channel—Key West, Fla.*—No work is required in this section, as the existing channel offers an available depth of 10 feet or over with an ample width for the entire distance.

10. The results of the detailed surveys covered by the foregoing description of the final location are shown on the maps[1] submitted with this report, as follows:

Beaufort to Little River Inlet: 1 index sheet, 23 local map sheets.

Little River Inlet to Winyah Bay: 1 index sheet, 7 local map sheets.

Winyah Bay to Charleston Harbor: 1 index sheet, 14 local map sheets.

Charleston Harbor to Savannah River: 1 index sheet, 12 local map sheets.

Savannah River to Fernandina: 1 index sheet, 9 local map sheets.

Fernandina to Key West: 8 index sheets, 89 local map sheets.

Section V.—Engineering Considerations.

1. DEPTH.

As the language of the act distinctly contemplates the construction of a through waterway, the board holds that the canal should be of uniform depth throughout. To introduce any link of depth less than the remainder would be to defeat the primary purpose; similarly to reduce the depth at either end section would only in less degree hamper through traffic.

[1] Not printed.

To fix upon the uniform depth for adoption the board has taken into consideration, first, the language of the act, which mentions a maximum depth of 12 feet, and, second, the probable cost and form of utilization. As to the 12-foot depth, it may be said that this appears to be neither here nor there; it is not great enough to carry vessels of large size; it is greater than need be for carrying light-draft or barge traffic. It appears at once that some lesser depth will accomplish all the purposes to be accomplished by a 12-foot depth, and naturally at much less cost.

Viewing this as a strictly inland waterway, the board has endeavored to ascertain what will be the most economical type of craft for handling the traffic. A conclusion should not be based solely upon existing economical types of boats. It is necessary to bear in mind that this is a work of magnitude, and it is quite certain that if the demands of commerce are so pressing as to justify the work these demands will also justify the adoption of an economical and advantageous form of transportation regardless of forms now in use. The board finds that barges carrying 1,000 tons on an 8-foot draft, handled by towboats of no greater draft, provided probably the best and least costly means of moving freight on sheltered waterways, and experience on this coast indicates that such will be provided in place of the types now engaged in the inland navigation.

This gives a good criterion for determining the proper depth for the intracoastal canal; it is largely to meet the requirements of such traffic that the board has fixed upon 10 feet for its present design. This depth will well accommodate the barge traffic anticipated, even permitting slight deterioration without interrupting commerce. It will also accommodate all types of craft now used in the local zone traffic on these coasts or any others likely to be used.

But any depth less than 10 feet will probably be insufficient for through traffic, while a depth greater than 10 feet within the limits specified by the act will accommodate no additional traffic.

Passing for the time being the usability of the 10-foot as against a 12-foot canal, the question of relative costs is determinative. Through ordinary country, where the work will be simple, a 12-foot canal will cost approximately 30 per cent more than a 10-foot canal. Through difficult sections, where cutting is heavy, the increase of cost will be much greater, and there are many miles of this latter. Moreover, the 10-foot canal as designed passes through many sections where 10 feet can be excavated in favorable material at reasonable cost, but where 12-foot excavation would encounter rock. A similar consideration is found in sections such as Indian River, where 10 feet of cutting already reaches rock at many points and where the additional 2 feet will be simply so much more rock cutting. More important yet, an unavoidable feature of this waterway will be the inclusion of the Hawk Channel from Biscayne Bay to Key West. This has a controlling depth of 10 feet, and if for any minor purposes 12 feet should be selected as against 10 it would involve the large additional work of improving the Hawk Channel.

The foregoing discusses depths mainly from the commercial and financial points of view. So far as naval uses are concerned the 12-foot depth mentioned in the act would accommodate few naval vessels which could not with equal facility navigate a 10-foot canal; and on the other hand, 10 feet is about the least that can be used by

vessels of the Navy. For military purposes there is no particular significance either way; a 10-foot depth is sufficiently well adapted.

In view of all considerations the board has selected 10 feet as the correct depth for this canal, from end to end.

2. WIDTH AND SIDE SLOPES.

Experience on the South Atlantic coast indicates that a minimum width of 100 feet will be required. This should obtain upon long tangents where the canal passes through marsh or solid land in such way that the banks furnish visual guides. At bends the width should be increased to a degree such that as between adjacent tangents a curve of 1,000 feet radius will lie within the channel. Also, where the canal passes through broad, open waters, there being no visual guides, the width should be increased to 150 or 200 feet. In brief, the board has selected the following bottom widths:

Through marsh or solid cut, 100 feet.

Through open waters showing a lateral expanse of 1,000 feet, the bottom width shall be 150 feet.

Through open waters showing a lateral expanse of 1 mile or more, the bottom width shall be 200 feet.

For the complete prism, basing its action upon experience on this coast, the board has determined that through the soft material of the sea-level sections side slopes shall be one-fourth where the bottom width is 100 feet, and one-third where the bottom width is greater than 100 feet. In the sections of solid excavation across country the prism is to have side slopes of one-half to an elevation of 2 feet above the water surface where a 10-foot berm is to be provided on each side, and above the berm side slopes are to continue one-half.

In addition to these requirements as to bottom width and side slopes, the board inserts a recommendation that turning and passing basins, where they do not already exist, shall be provided at least once in each 3 miles of length, but leaves the actual location of these basins to the constructing officer. Amounts sufficient to cover the additional excavation have been included in the estimates.

3. STRUCTURES.

(*a*) *Locks.*—Based largely upon the type of barge probably to be used on this canal, the board has determined that locks shall have usable length of 400 feet, with width of 45 feet. Locks are to be of concrete, of simple design, on piles and surrounded by sheet piles where necessary; are to be provided with steel gates, hand operated, and with filling and emptying culverts in the walls; miter sills and quoins to be of granite.

At certain of the locks the water supply will at times be limited. In these cases locks should be provided with intermediate gates at half length, and in extreme cases with an additional set of intermediate gates at one-fourth length, these being intended to reduce the loss of water involved in the lockage of small craft.

(*b*) *Dams.*—Where dams are placed across flowing rivers, as in the Waccamaw, the portions which cross the river proper are designed to be of concrete, gravity section, with heavy back fill of earth, and the portions which cross the swamps are to consist of suitable forms of concrete spillway with sheet-pile water seal, and

concrete or stone pavings to prevent undercutting at the toe. Where dams are placed as spillways across quiet rivers, such as Shallotte and Lockwoods Folly, they should be of concrete with gravity section, founded upon piles and provided with sheet-pile water seals upstream. Where dams are used on the coast sections for closing tidal streams, they are to be of earth with flat slopes, to include a concrete core wall founded upon piles and provided with sheet-pile water seals under and built up into the core wall, and riprap or concrete protection against wave wash.

(*c*) *Bridges.*—As the proposed waterway must cross railroads and highways, it is necessary to include in the estimate provision for construction of highway and railroad bridges. There appears to be no occasion for determining at this time precisely what types shall be used. It is sufficient to say that these bridges should be designed each to fit its particular locality; that in general they should be of steel, of simple design, and permanent in character, founded upon masonry piers. At each bridge it will be necessary to provide a bridge keeper's dwelling, which also should be of simple character.

(*d*) *Training walls and breakwaters.*—Few of these will be required, but at those points where such constructions must be had, they should be of stone, in large fragments.

(*e*) *Beacons.*—As indicated later in the estimates, it has been necessary to include provision for marking the channels. These marks will, in general, be of the reenforced-concrete pile type, surmounted where necessary by light steel towers.

Section VI. Estimate of Cost.

1. EXCAVATION.

From the description of the route as adopted it will have been gathered that the undertaking will involve but few classes of work. By far the largest items are those of excavation, and conditions in the different sections are sufficiently similar to permit the reduction of excavation for purposes of estimate to three classes, namely:

That which can be accomplished by hydraulic dredging.
That which lies well above sea level through solid earth and is to be accomplished by steam shovels.
That which must be accomplished by special means, where rock is found lying above the bottom level of the canal.

The general conditions under which these classes will in the various localities be undertaken are so similar that the board has felt justified in adopting for each class a single unit price.

In case of hydraulic dredging the board acts in the light of long experience in methods and costs on this coast. It is found that where work of this character can be let in large quantities, or where it is undertaken by day labor with first-class plant, the cost reaches approximately 15 cents per cubic yard. This figure is taken as the unit price for this class of work.

In the case of ordinary earth excavation above sea level and where the excavation is accomplished by the usual steam-shovel methods the board finds that on well-managed railway and similar work in these sections the work has generally cost 25 cents per cubic yard. This is taken as the unit price for upland-earth excavation.

Rock removal is found principally upon the Florida coast. This rock is in general coral or coquina of no great hardness or compactness, but nevertheless not easily removed. Experience with previous work of this character indicates the advisability of placing the unit cost at 75 cents per cubic yard, which is used in these estimates.

2. STRUCTURES.

(*a*) *Locks.*—It is found that all of the locks to be provided in the course of this construction are to be built at locations where approximately the same conditions prevail. Costs should be very nearly the same in all cases. The board has therefore estimated the cost of a typical lock, arriving at the figure of $450,000, which is used for each case and which includes cost of lock keeper's dwellings and all accessories.

(*b*) *Dams.*—Unlike the locks, the dams will vary greatly in character. Each one is figured according to conditions obtaining at the particular locality and according to the type to be built.

(*c*) *Training walls.*—Here again each is figured according to the conditions obtaining at the particular locality.

(*d*) *Bridges.*—Highway bridges will be of approximately the same design throughout. These are figured at $20,000 each, with bridge keeper's dwelling at $5,000. For railway bridges $75,000 each is allowed.

(*e*) *Beacons.*—The board has included in the estimates amounts to cover the cost of marking the channels. This is believed to be advisable in this case, as during the progress of dredging and excavation it will be necessary to erect a great many marks, and as operations will be continued over a period of years it will be found economical to make these marks of a more or less permanent character. This suggests that the marks may with propriety be made actually permanent and similar to those ordinarily used in lighting navigable waterways. The board proposes therefore to provide in this way for the expense of erecting suitable permanent day marks, and proposes that these marks shall later be turned over to proper authority for lighting. The cost has been placed at $200 each.

(*f*) *Rights of way.*—Where the canal location line passes through navigable water ways, open sounds, or marine marshes, no estimate for acquisition of right of way has been included.

Where the line passes through habitable, privately owned, or cultivated lands, amounts have been included in the estimate sufficiently large to cover the cost of acquisition of right of way 1,000 feet wide, based upon unit costs ascertained by inquiry in the particular locality affected.

(*g*) *Finally.*—To cover all additional surveys which must precede construction, to meet changes in conditions likely to arise before work is actually began, and to provide for all accidental costs and charges which can not well be foreseen, the customary 10 per cent for contingencies is added to the amount of all the foregoing estimates.

The general estimates follow:

1. Beaufort, N. C., to Cape Fear River, N. C.

21,116,000 cubic yards hydraulic dredging	$3,167,400
1 bridge at Wrightsville, Tidewater Power Co	25,000
1 bridge at New Hanover Transit Co.'s Railroad	25,000

1 bridge, Wilmington to Federal Point Highway	$20,000
Right of way, 10,217 acres	171,000
1 guard lock	450,000
Stone jetties, Cape Fear River	80,000
Beacons	3,500
Contingencies	394,100
Total	4,336,000

2. Cape Fear River to Little River, N. C.

Excavation of 3,542,000 cubic yards by steam shovel	$885,500
Excavation of 10,626,000 cubic yards hydraulic dredging	1,593,900
2,750 acres of right of way	82,500
940 acres of clearing	47,000
Damages to property	63,000
400 acres of land submerged	12,000
1 lock near the head of Elizabeth River	450,000
Davis Creek dam	11,750
Lockwoods Folly River dam	100,000
Little Saucepan Creek dam	4,170
Big Saucepan Creek dam	6,400
Shallotte River dam	100,000
Calabash Creek dam	21,000
Mulletts Creek dam	6,000
4 highway bridges, at $20,000 each	80,000
Beacons	1,500
Contingencies	346,280
Total	3,811,000

3. Little River to Winyah Bay.

(*a*) Main canal, Mulletts Creek–Bear Bluff:		
Right of way, 1,000 feet wide, 2,326 acres	$69,780.00	
Clearing and grubbing one-half right of way, 1,163 acres	58,150.00	
Excavation, 6,840,972 cubic yards	1,710,243.00	
4 locks	1,800,000.00	
2 bridges	40,000.00	
2 dwellings	10,000.00	
		$3,688,173.00
(*b*) Feeder canal:		
Right of way, 500 feet wide, 356 acres	10,680.00	
Clearing and grubbing, 356 acres	17,800.00	
Excavation, 760,583 cubic yards	190,145.75	
2 control works, at $20,000	40,000.00	
		258,625.75
(*c*) Pireway reservoir:		
Land flooded to elevation 35, 25,477 acres at $1	25,477.00	
Pireway Dam	700,000.00	
		725,477.00
(*d*) Bear Bluff to Conway:		
Right of way, 392 acres	11,760.00	
Clearing and grubbing one-half right of way, 196 acres	9,800.00	
Excavation, 843,000 cubic yards	210,750.00	
		232,310.00
(*e*) Lock and dam at Conway:		
Lock	450,000.00	
Dam	250,000.00	
		700,000.00
(*f*) Conway to Bull Creek, open-river work		150,000.00
(*g*) Engineering and contingencies		575,414.25
Total		6,330,000.00

4. Winyah Bay to Charleston Harbor.

	Excavation.	Cost.
	Cubic yards.	
Estherville-Minim Creek Canal and North Santee River	2,420,892	$363,133.80
Santee Delta Crossing and South Santee River	629,480	94,422.00
Training walls, South Santee River	.....	364,000.00
South Santee to Mud Bay	2,375,834	356,375.10
Through Oyster Bay to Bull River	836,302	125,445.30
Bull River to Harbor River	365,528	54,829.20
Harbor River to Van Ross Creek and Bull Bay Marsh	2,124,116	318,617.40
Sewee Bay	667,037	100,055.55
Bull Narrows	524,706	78,705.90
Santee Pass and Dewees Inlet to Bullyard Sound	1,353,273	202,990.95
Seven Reaches through Long Island Creek	1,519,618	227,942.70
Sullivans Island Narrows and The Cove	767,723	115,158.45
Aggregate	.....	2,401,676.35
Beacons	.....	3,000.00
Engineering and contingencies	.....	240,323.65
Total	.....	2,645,000.00

5. Charleston Harbor to Savannah River.

	Excavation.	Cost.
	Cubic yards.	
Wappo Creek	367,295	$55,094.25
Stono River	474,416	71,162.40
Church Flats	156,919	23,537.85
New Cut	279,376	41,906.40
Wadmelaw River	44,100	6,615.00
Dawho River	579,349	86,902.35
From Dawho through North Creek	650,220	97,533.00
From Edisto to Coosaw River	1,282,168	192,325.20
Coosaw River and Brickyard Creek	323,672	48,550.80
Archers Creek	525,681	78,852.15
Rose Islands Passage	41,572	6,235.80
Ramshorn Creek	331,891	49,783.65
Mud River	290,606	43,590.90
Aggregate	.....	802,089.75
Beacons	.....	4,800.00
Engineering and contingencies	.....	90,110.25
Total	.....	897,000.00

6. Savannah River to Fernandina.

	Excavation.	Cost.
	Cubic yards.	
Mouth of St. Augustine Creek	25,000	$3,750.00
Skidaway Narrows	650,000	97,500.00
Burnside River	107,000	16,050.00
Florida Passage	83,000	12,450.00
Waldburg Creek	13,000	1,950.00
Johnsons Creek	20,000	3,000.00
Front River: Creighton Narrows	575,000	86,250.00
South Sapelo River dividings	33,000	4,950.00
Old Teakettle Creek	34,000	5,100.00
Old South River: Little Mud River	251,600	37,740.00
Altamaha Sound	18,000	2,700.00
Buttermilk Sound	65,000	9,750.00
Frederica River	15,000	2,250.00
Jekyl Creek	268,000	40,200.00
Cumberland dividings	20,000	3,000.00
Aggregate	.....	326,640.00
Regulating works	.....	50,000.00
Beacons	.....	3,000.00
Contingencies	.....	57,360.00
Total	.....	437,000.00

7. Fernandina to St. Johns River.

Hydraulic dredging, 3,970,941 cubic yards	$595,641.15
Rock, 565 cubic yards	423.75
Contingencies	60,935.10
Total	657,000.00

8. St. Johns River to Indian River.

(*a*) St. Johns River section:	
Hydraulic dredging, 9 517,105 cubic yards	$1,427,565.75
Right of way, 411 acres	4,110.00
Beacons	15,000.00
Contingencies	145,324.25
Total	1,592,000.00
(*b*) Lakes Ruth, Shad, and Salt Lake sections:	
Hydraulic dredging, 2,901,590 cubic yards	435,238.50
Right of way—	
182 acres	1,820.00
345 acres	5,175.00
Contingencies	44,766.50
Total	487,000.00
(*c*) Salt Lake, Indian River section:	
Steam-shovel excavation, 2,759,296 cubic yards	689,824.00
Lock	450,000.00
Right of way, 381 acres	27,065.00
	1,166,889.00
2 bridges	150,000.00
Contingencies	132,111.00
Total	1,449,000.00

9. Indian River.

(*a*) Indian River—Jupiter Inlet:	
Hydraulic dredging, 17,640,952 cubic yards	$2,646,142.80
Rock, 697,992 cubic yards	523,494.00
Right of way—	
15 acres	750.00
282 acres	2,820.00
Beacons	20,000.00
Contingencies	321,793.20
Total	3,515,000.00
(*b*) Jupiter Inlet—Lake Worth section:	
Hydraulic dredging, 5,202,280 cubic yards	780,342.00
Right of way—	
417 acres	4,170.00
10 acres	10,000.00
	794,512.00
Value Florida East Coast Canal excavation, 389,825 cubic yards	58,473.75
Beacons	5,000.00
Contingencies	86,014.25
Total	944,000.00

(*c*) Lake Worth—Biscayne Bay section:	
Hydraulic dredging, 12,717,799 cubic yards	$1,907,669.85
Rock, 1,380,800 cubic yards	1,035,600.00
Right of way, 5,030 acres	150,900.00
Beacons	5,000.00
Value Florida East Coast Canal excavation, 1,018,897 cubic yards	152,834.55
Contingencies	327,995.60
Total	3,580,000.00
(*d*) Biscayne Bay—Hawk Channel:	
Hydraulic dredging, 1,395,844 cubic yards	209,376.60
Rock, 161,300 cubic yards	120,975.00
Beacons	10,000.00
Contingencies	33,648.40
Total	374,000.00

10. Hawk Channel—Key West.

No work required.

SUMMARY OF THE ESTIMATES.

1. Beaufort—Cape Fear River	$4,336,000.00
2. Cape Fear River—Little River	3,811,000.00
3. Little River—Winyah Bay	6,330,000.00
4. Winyah Bay—Charleston Harbor	2,645,000.00
5. Charleston Harbor—Savannah River	897,000.00
6. Savannah River—Fernandina	437,000.00
7. Fernandina—St. Johns River	657,000.00
8. St. Johns River—Indian River	3,528,000.00
9. Indian River—Hawk Channel	8,413,000.00
10. Hawk Channel—Key West	.00
Grand total	31,054,000.00

Maintenance.—To undertake at this stage a precise estimate of cost of maintenance is to enter upon a problem in which there are many unknown quantities. However, the board has examined this question in the light of all experience had on the South Atlantic coast, computing maintenance in several ways, as by estimating the items of plant required, and the cost of operating them; by estimating the probable deterioration of channels and the usual cost of restoration, and in other similar ways, comparing ultimately the maintenance costs so deduced. Taking each geographical section by itself, it is found that these independently computed costs are reasonably consistent; that in each section the annual cost of maintenance works out at approximately 2 per cent of the first cost of construction, and in this are included all ordinary charges for operation and care.

On these grounds, believing that maintenance charges should not accrue during the period of actual construction, the board estimates that the annual cost of maintenance and operation can reasonably be placed at 2 per cent of the initial cost of the work, i. e., $620,000 per annum, and it is expected that as time goes on this figure will be underrun rather than exceeded.

SECTION VII. COMMERCIAL, NAVAL, AND MILITARY UTILIZATION.

1. COMMERCIAL.

The history of commercial development on this coast demonstrates that utilization of an inland waterway will be of two distinct kinds, the first being that which will develop within local zones and the second being that which will pass from zone to zone; in other words, "local" and "through" traffic.

(*a*) *Local zone traffic.*—The board believes that development will take place first within the local zones. There are now many usable harbors on the South Atlantic coast. The productions of the country adjacent to these harbors seek the ports as outlets, and where inland waterways now exist it is found that much commerce passes from the interior down the river systems to points of intersection with the inland ways, and so to the nearest commercial ports. Similarly, the harbor cities are centers of distribution for materials and supplies required in the interior. Commodities come to the ports by ocean-going ships and are distributed to the interior via the inland waterways and river systems. A considerable development of this traffic of concentration and distribution within zones tributary to the seaports has already taken place on the coast of Georgia, and less on the coasts of South Carolina, North Carolina, and Florida.

A few figures and detailed statements are given to illustrate the present, and to furnish some basis of estimate of prospective conditions.

The North Carolina coast.—A regular commerce is carried on between Swansboro and Newbern, a line of small steamers running continuously between these points. During the fiscal year 1910 there were reported 26 steamers and 75 sailing vessels as having used this route. The freight consisted principally of timber, general merchandise, fertilizer, and marine products, amounting to 25,347 tons, valued at $522,655.

Between Swansboro and New River there is a limited traffic carried on by gasoline boats and sailing vessels handling fertilizer, general merchandise, timber, naval stores, and marine products. This amounted during 1910 to 4,590 tons, valued at $151,520.

At Swansboro the canal line crosses the White Oak River, which may be expected to act as a tributary feeder, and although the tonnage carried on that river is not compiled annually the report of the last preliminary examination estimated its commerce at 21,532 tons, valued at $413,625, consisting of lumber, timber, and general merchandise.

Similarly New River, which connects with the canal and leads up to Jacksonville, N. C., may be considered as a commercial feeder. The records show New River navigated during 1910 by 10 steamers and 10 sailing vessels, which carried in that year 44,320 tons, valued at $379,667, of lumber, timber, naval stores, general merchandise, and marine products. While the Jacksonville, N. C., freight is now carried largely by the Atlantic Coast Line Railroad, it is believed that with communication from that point to Wilmington via the proposed canal a large part of the incident traffic will be diverted to water transportation, reaching possibly a value of $500,000 annually.

Between New River and Cape Fear River there is a section of coast which at present supports no water-borne traffic, but which should contribute to the commerce of the intracoastal canal to an amount, judging by conditions existing in the adjacent territory, of about $500,000 per annum.

South of Cape Fear entrance the proposed canal line will pass through a section of country now without any means of inland communication with any seaport. A line of sharpies and small steamers run outside between Wilmington and Little River, carrying supplies for a large section of country tributary to the latter. Sharpies also ply between Wilmington and Lockwoods Folly and Shallotte Rivers. The commerce of Lockwoods Folly River in 1905, when last tabulated, amounted to 2,005 tons, valued at $47,568; it is believed to be larger at the present time. Commodities are cotton, corn, hay, naval stores, lumber, and general merchandise. The trade of the Shallotte in 1909 amounted to 5,000 tons, valued at $200,000, consisting principally of naval stores, lumber, cotton, fertilizer, and general merchandise. There is also a small commerce upon the Elizabeth River, estimated in 1910 to be about 2,000 tons, valued at $23,690.

The foregoing traffic of the North Carolina coast is tabulated below:

	Tons.	Year.	Value.
Beaufort to Swansboro	25,347	1910	$522,655
Swansboro to New River	4,590	1910	151,520
New River	44,320	1910	379,667
New River to Cape Fear River	12,000	(1)	500,000
Wilmington to Lockwoods Folly	5,000	(1)	200,000
Wilmington to Shallotte	5,000	1910	211,368
Wilmington to Little River	10,488	1907	497,568
Elizabeth River	2,000	1910	23,690
Total	108,745		2,486,468

[1] Estimated.

It is expected that the North Carolina tonnage will be more than doubled as soon as facilities are provided by the proposed waterway; in addition there should work up a large new traffic in coal, lumber, fertilizer, cotton, and other products as between Wilmington and regions now inaccessible.

The South Carolina coast.—Local zone traffic here shows two phases and its possibilities are promising.

In the first place, there is the ordinary coastal trade picked up in localities adjacent to the coast and carried to the nearest port and the return distribution from ports to strictly coastal regions. This is exemplified upon the Charleston-McClellanville waterway, which, while now only 4 feet deep, nevertheless carries approximately 40,000 tons per annum, valued at slightly over $1,000,000. A similar small-boat traffic is carried by the waterways to the south of Charleston, concentrating country products at Charleston and Savannah and distributing supplies as return cargoes. No figures are now available, though this traffic is understood to be somewhat larger than that to the north of Charleston.

In the second place, there is traffic upon the interior rivers, notably the Waccamaw, Great Peedee, Santee, and Congaree systems, all of

which is of the concentration and distribution order, reaching considerable volume. Thus, in 1910 the figures were as follows:

	Tons.	Value.
Waccamaw River	111,097	$1,431,121
Great Peedee River	66,785	1,502,695
Santee River	79,502	164,360
Congaree River	26,354	331,214
Total	283,738	3,429,390

All of this is at present necessarily carried on through the port of Georgetown. Imports reach Georgetown by ocean-going vessels and are distributed by river steamers. Exports are shipped from the interior to Georgetown for delivery to deep-sea carriers. It is a question of reaching the coast at the only accessible port, and the commerce does as well as it can under the limitations of Georgetown's 15-foot harbor. A study of the situation shows that were these river systems connected with Charleston, Savannah, or Wilmington the increased convenience and economy should lead to rapid multiplication of business. Such connections would be effected by the intracoastal canal.

The coast of Georgia.—Over this section of the route, which is in much better condition than that to the north, the commerce is large and varied. Eight combined freight and passenger steamers make regular runs. Barges carry naval stores, crossties, lumber, and miscellaneous freights to and from the ports of Savannah, Brunswick, and Fernandina, the volume being about 55,000 tons per annum, valued at approximately $2,500,000. In addition, the inside route is extensively used for rafting timber from the interior down the rivers to the coast and thence to the ports; this amounts annually to about 60,000,000 feet b. m., valued at $800,000. Also many small craft and yachts utilize this route for business and pleasure.

As in South Carolina, a canal line on the Georgia coast will tie together the river systems and should, by giving ready access to the ports, largely increase the river commerce.

The Florida coast.—Here a usable coastal route will be of especial value in the development of local traffic, as transportation facilities of other kinds are unable to meet the pressing demands. Until the last few years the growth of Florida has been very slow; but the State is now developing its phosphate, lumber, fruit, and vegetable industries at a rapidly increasing rate, and it has been found in the past two years that the rail and other means of transportation have been unable to cope with the volume of business offered. Valuable products have gone to waste because of the impossibility of shipping them.

While the railroad facilities can and will be increased, it is doubtful whether they will be enlarged with rapidity sufficient to aid development. On the other hand, Florida is peculiarly well provided with rivers, lakes, and sounds, and since the advent of motor boats, furnishing economical transportation, the proper development of the waterways of the State will be of unusual value.

No precise estimate can be given of the prospective business for the intracoastal canal, but the following tables are significant:

Water-borne commerce at different points adjacent to the Florida section of the intracoastal waterway.

Locality.	Tonnage, 1909.	Value.	Increase over previous year.
			Per cent.
Fernandina.....short tons..	582,000	$11,065,000	5.9
Jacksonville.....do.....	2,015,820	77,323,286	26.8
St. Johns River at Orange Mills Flats.....do.....	379,864	.....	9.2
St. Johns River, Palatka to Lake Harney.....do.....	85,670	.....	28.4
Oklawaha River.....do.....	109,000	.....	35.7
St. Lucie Inlet.....do.....	54,000	.....	.....
Biscayne Bay.....do.....	297,001	.....	36.8
Key West.....do.....	218,692	.....	15.5

Traffic statement of Florida East Coast Railroad for 1909.

Commodity.	Freight originating on this road.	Freight received from connecting roads and other carriers.	Total freight tonnage.
	Tons.	*Tons.*	*Tons.*
Products of agriculture	152,406	13,557	165,963
Products of animals	8,224	3,897	12,119
Products of mines	49,752	13,628	63,380
Products of forests	92,365	18,549	110,914
Manufactures	130,043	36,247	166,290
Merchandise	8,672	5,316	13,988
Miscellaneous: Other commodities not mentioned above	38,741	8,464	47,205
Total tonnage	480,203	99,656	579,859

The latter table shows existing commerce now largely carried by rail, and transportation conditions in Florida appear to be such that a large fraction of the above, together with considerable newly developed business, should seek the water route to the ports.

All of the foregoing shows the existence of considerable local-zone commerce on these coasts, though but few sections have inland ways in any sense adequate, and long stretches are wholly without inland communication. A fair criterion of what may be expected when the whole coast shall have been developed may be found in the commerce of the coast of Georgia, where reasonably good communication can now be had.

The Georgia coast and back country are not materially different from the remaining South Atlantic region, but with inland waterways of 7-foot depth the local communities have built up a commerce valued at about $3,500,000 per year. Now, the Georgia coast occupies only 100 statute miles of ocean front out of a total of 925 statute miles herein under consideration. If we can assume that the intracoastal canal will develop in other sections a local commerce at all comparable with that in existence on the Georgia coast, we may fairly say that the local traffic induced should approximate $30,000,000 per annum, a value equaling in a single year the whole cost of canal construction. This view is believed to be rea-

sonable and to fairly discount the future; in fact, it is conservative, as it omits consideration of the increased development to be anticipated in response to provision not merely for 7-foot local channels, but for 10-foot channels extending lateral zones to the utmost.

(*b*) *Through traffic.*—The prospect of development of through traffic is less certain, though some considerations point to favorable expectation. The advocates of this work are able to show that barge traffic is inexpensive. Such has certainly the advantage of being carried on in small rather than large containers, and in this way can reach points not otherwise accessible. Similarly, the small container lends itself to use by small companies and by individuals of limited means, who, while able to receive or send barge loads, may be quite unable to charter ships or, indeed, engage transportation on ships.

Advocates of this improvement also state that the number of seagoing carriers now operating on the South Atlantic coast is too small. Many instances are brought forward in which freight has been offered for shipment only to be refused.

The advocates also point to the fact that a through route will have an uncommonly large number of feeders in the numerous river systems of the South Atlantic States, which, in general, flow normal to the coast, intersecting the canal at their seaward ends, and thus are able to contribute a considerable water-borne commerce.

Examining the prospect of through traffic from another point of view, there is now in evidence a large commerce in commodities such as coal, lumber, building materials, sugar, hardware, supplies, and truck which passes up and down the coast by either coastwise steamers, schooners, or rail. While it can not be expected that for strictly through traffic a barge canal can ultimately deflect shipments from seagoing steamships, it can be expected that freight now refused by steamships and shipped at high expense by rail will seek the barge canal as an economical outlet. And in view of the small-cargo feature, freight now originating in large ports, destined for communities not reached by ocean-going steamers, should be more economically distributed from a large port than under the present system from large port to small port and thence to community.

A definite conception of the through traffic to be anticipated can be gained only by an examination of the commerce of the south Atlantic seaports.

Wilmington, N. C.—Cotton to the value of about $25,000,000 per annum is shipped from this port, principally in foreign steamers chartered direct. Owing to the difficulty at times experienced in chartering steamers it may be that a certain amount of this cotton will be barged to the larger northern ports, where ships are always to be had. It is certain that cotton will seek the inland route for export when handled in less than cargo lots. Lumber and naval stores to the value of $1,000,000 per annum are shipped coastwise to northern ports. A large part of this might seek the inland waterway owing to the lack of freight facilities on ocean routes. Fertilizers, fertilizer materials, oils, and gasoline to the value of about $3,000,000 are imported each year. A part of this may come in over the inland way on account of increased facility of distribution.

Charleston, S. C.—Much coal arrives at Charleston Harbor by coastwise vessels, varying from 60,000 to over 100,000 tons per an-

num. A great part of this comes from Norfolk in schooners, encountering the hazards of Cape Hatteras en route. It would seem that this might well be transported over the inland waterway in barges. Similarly from 25,000 to 50,000 tons of cement, lime, and similar building materials come southward to Charleston by coastwise steamers; oils, 16,000 tons in amount, come by coastwise barges. Any part of either of these items might be carried on the inland way. As for export, Charleston ships at an average 150,000 tons of lumber each year, sending it almost exclusively to northern coastwise ports by schooner. Here again the inland route would enable these shipments to pass Hatteras in safety. Charleston also exports about 50,000 tons of cotton per annum, which, as at Wilmington, might seek the ships of northern ports passing through the inland way. All other coastwise traffic of Charleston Harbor aggregates about 200,000 tons per annum, but it is hardly likely that any part of this, unless influenced by the small-package distribution idea, would seek the inland way, as it is now carried very economically by regular lines of ocean-going steamers.

Savannah and the smaller Georgia ports.—Here the most promising items are 450,000,000 feet of lumber shipped out and about 140,000 tons of coal brought in by coastwise vessels. This may fairly be regarded as possible through traffic for the intracoastal canal. There is in addition a southward movement of 65,000 tons of fertilizer material, 56,000 tons of grain, 7,000 tons of salt, and 48,000 tons of cement, of which the canal might get part or all.

The total ocean-going coastwise trade of the Georgia coast is estimated at 2,500,000 tons, valued at $150,000,000; it is, however, unlikely, except for the items enumerated above, that any very large portion of this would be diverted to a barge canal.

Jacksonville, Fla.—For through traffic, the importation of coal amounting to 186,000 tons and the exportation of lumber and crossties amounting to nearly 800,000 tons offer the greatest possibilities. The coal must reach Jacksonville coastwise from Norfolk, Wilmington, or Charleston, and seems a likely commodity for barge transportation. Lumber is even now shipped north in barges. The Florida lumber companies have found it economical to construct special ocean-going barges for this purpose, and handle them in fleets by means of powerful towboats, which might with equal economy and greater safety operate upon an inland way. Other commodities aggregating somewhat over 1,000,000 tons per annum may or may not contribute to the inland traffic.

On the whole, the board is inclined to believe that there is a fair prospect for the growth of through traffic. Such may not take exactly the form of shipment from port to port. It is more likely to take the form of distant distribution. Thus, whereas merchandise originating in New York and destined for distribution on the North Carolina coast is now carried to Wilmington in ocean-going ships and then distributed by rail or small craft, the existence of the canal may give rise to distribution directly from New York by barges to points of consumption. Similarly, while commodities destined for South Carolina are now carried from New York to three separate ports—Georgetown, Charleston, and Savannah—by three separate services, an almost certain result of construction of a barge canal would be inception of distribution from New York through

Charleston or Savannah alone, or, indeed, distribution direct from New York. The economy of such concentration of effort in the greater ports, even to the detriment of smaller ports, is obvious.

It is in this possibility of distant distribution that the board finds one of the most valid reasons for undertaking a "through" route. The very magnitude of the completed work will be its best guaranty. Were it to be merely a series of local sections, commerce of any one section might be throttled by any of a number of hostile agencies; but as a "through" route continuity makes impossible the oppressive tactics often resorted to in overcoming water competition. A "through" canal should be able to compete upon favorable terms.

2. NAVAL AND MILITARY.

Whether or not this canal will be of great value to the Navy seems to be an open question.

The canal will be of depth and width insufficient to pass any of the larger type of fighting craft or even the usual type of gunboat. On the other hand, it can be used by all of the torpedo boats and by many of the destroyers.

Naval officers are understood to have expressed themselves as being strongly in favor of the construction of such an inland route, stating that it will be invaluable in affording an interior line by which small craft can be moved from any harbor to any other without exposure either to the dangers of ocean navigation or to hostile attack. This view has some weight, for while construction of torpedo boats has largely been abandoned in favor of construction of destroyers, there are still many torpedo boats on hand and serviceable, and if, as has at times been contemplated, torpedo boats are to play a useful part in the defense of harbors and in opposing raids or blockades it may be that the possibility of rapidly and safely concentrating a flotilla of such craft will, in emergency, make available a powerful weapon. On the other hand, the value of the canal for naval purposes is one which seems to have been largely overestimated in the lay mind. A certain value, as above, can be foreseen; but as to its ultimate function in naval strategy the opinion of the naval authorities might well be invited.

It has similarly been urged that this waterway would in war be of great value to the Nation for military purposes.

The board is disinclined to lay too much stress upon this point. The canal is not likely to be used for any extensive movement of troops on account of the direction in which it lies; large movements are likely to be radial from centers of population rather than lateral along the coast. The board, however, can conceive of circumstances in which the canal would be of value in the movement of troops or munitions of war coastwise in concentrating forces against threatened points of attack and especially so when the use of the open sea was forbidden by the fleet of the enemy and the railroads paralleling the coast were taxed to their utmost capacity.

SECTION VIII. RECOMMENDATION OF BOARD.

Comparing the prospective cost with the prospective utilization, the board has no hesitation in expressing the opinion that this project is worthy of execution by the United States. It is believed

in the first place to be worthy on the basis of development of local zone business alone, and might properly be undertaken were it to be expected that no other remunerative form of business could be developed. When to the increase in concentration and distribution is added the prospect of economical through traffic, and when it is recalled that the cost of carrying the work forward from "zone" to "through" development will be but a small part of the total, it is clear that the "through" canal should be undertaken as a whole.

Section IX. Order and Rate of Prosecution of the Work.

In submitting an estimate of cost, the board deems it advisable to present a program under which the work can be logically and economically prosecuted. The board bears in mind that the probable first development will be that of local-zone traffic, and that this will be immediately remunerative, while the development of through traffic will be more gradual and more remotely remunerative, and the board believes that in actual construction the first efforts should be directed toward zone extension from the great ports outward. Work on the links between the zones should, of course, not be deferred until the local extension is completed; it should be carried on simultaneously, but the program should nevertheless contemplate securing the maximum development of the local zones at the earliest practicable date, supplemented by completion of the connecting links at about the time when zone communication shall have reached a state of high efficiency.

The board also believes that it will be unwise to undertake this work in any intermittent way, or under any program which contemplates extending it over a long period of years. The board's estimates of cost are based upon the presumption that work will be authorized in large blocks; that large contracts can be let at advantageous prices with resulting economy; and that construction can be carried on under a definite program such as will reduce fixed and contingent expense and permit continuous utilization of plant and force.

With all this in view the board asserts the practicability of economically completing the canal in six years, and submits the following program of appropriations arranged to accomplish that end in the most advantageous manner.

Section.	First year.	Second year.	Third year.	Fourth year.	Fifth year.	Sixth year.	Total.
Beaufort–Cape Fear River	$500,000	$1,300,000	$1,300,000	$1,236,000	.....	.....	$4,336,000
Cape Fear River–Little River	500,000	900,000	800,000	700,000	$700,000	$211,000	3,811,000
Little River–Winyah Bay	500,000	1,000,000	1,000,000	1,000,000	1,000,000	1,830,000	6,330,000
Winyah Bay–Charleston Harbor	645,000	1,000,000	1,000,000	.....	.....	.....	2,645,000
Charleston Harbor–Savannah River	397,000	500,000	.....	.....	.....	.....	897,000
Savannah River–Fernandina	200,000	237,000	.....	.....	.....	.....	437,000
Fernandina–St. Johns River	300,000	357,000	.....	.....	.....	.....	657,000
St. Johns River–Indian River	900,000	900,000	900,000	828,000	.....	.....	3,528,000
Indian River–Biscayne Bay	.....	.....	2,000,000	2,200,000	2,200,000	2,013,000	8,413,000
Biscayne Bay–Key West	.....	.....	.....	.....	.....	.....	.....
Total for each year	3,942,000	6,194,000	7,000,000	5,964,000	3,900,000	4,054,000	31,054,000

Section X. Private Canals.

As explicitly directed in the act, the board has considered the desirability of utilizing as a part of this waterway any existing public or private canals or any part thereof, and the probable cost of acquiring the same.

While there are several private canals on the South Atlantic coast, there is only one which follows the line herein described and which can so receive the consideration called for by the act. This is the canal owned by the Florida Coast Line Canal & Transportation Co. connecting navigable waterways between Jupiter Inlet and Biscayne Bay. This canal has a very small cross section, and, while its prism can be made use of in the construction of the intracoastal canal, with some saving in excavation, the value of that saving will be but a small percentage of the total cost of the excavation required for the proposed canal.

The board, through one of its members, has communicated with the owners of this canal with a view to ascertaining the "probable cost" of acquiring it, but as yet has received no response. It is, therefore, impossible for the board to state what the "probable cost" will be. It has been possible for the board, however, to arrive at the saving in excavation, which can be made by acquiring the canal and utilizing it as part of the prism of the larger waterway, and this amounts to 1,408,722 cubic yards. The value of this excavation to the United States, based upon the unit prices herein adopted, would be $211,308.30.

It is not understood that the Florida Coast Line Canal & Transportation Co. owns or controls a right of way of a width adequate for the intracoastal canal. It is understood, however, that for a considerable portion of the length of the canal a right of way 200 feet wide is owned; at some points the width owned is in excess of 200 feet, while at others, due to difficulties in securing title, no right of way, other than an easement for the canal itself, is under the control of the company. It is quite impossible for the board to determine accurately just what amount of right of way could at a future date be delivered by the canal company. It would probably exceed 1,000 acres, having a value of about $35,000.

A location of the intracoastal canal parallel to the private canal can be made, which will not be more expensive than that along the existing canal if payment for acquirement in accordance with the above estimate of its value is to be included; and the board is, therefore, of the opinion that should the demand of the canal company exceed $211,308.30, plus a fair value for the right of way which can be delivered, the canal should not be acquired and a location parallel to it should be adopted.

Section XI. General Recommendations.

In recommending the construction of this waterway the board also deems it advisable to state that many considerations other than those of cost and utility have arisen. Certain of these are deemed to be of primary importance and to be worthy of discussion, with a view to indicating their bearing upon incident legislation.

1. RIGHT OF WAY.

While the estimates are drawn to include cost of acquisition of certain rights of way the board is nevertheless of the opinion that this charge against the United States may well be saved. It should be borne in mind that a waterway of this character confers upon local communities great commercial advantages, and that new developments and increments in land values will provide new objects of taxation, upon which it may reasonably be expected that the States will not be slow to levy. But these objects of taxation will not be accessible to the United States. It is clear that increments of value will be of local rather than national concern; and, in view of this, it is deemed proper that the States should, having their own material advantage in mind, make a certain contribution toward the execution of the project. This may properly take the form of cession, free of charge, of the required rights of way. And to the same end it is believed that the States should be called upon to protect the United States from all claims for land damages of all kinds whatsoever. These conditions should be acceptable to State and local governments, and provisos such as will insure the indicated cooperation should be drafted into the law.

2. TERMINAL FACILITIES.

Were this a canal designed to pass through or by large commercial communities a discussion of terminal facilities and requirements might be pertinent, but as it is to be a through waterway to which commercial communities are to have access by the river systems it is believed that questions of terminal facilities are essentially questions to be considered in connection with the river systems—the feeders—and that these matters need be the subject of no action in connection with the legislation for the intracoastal waterway.

3. WATER POWER.

No appreciable water powers can be developed by this canal. The reservoirs created can not be made to serve this purpose, and dams, where used, are of small lift, with small possibility of continuous or usable overflow.

4. FLOOD CONTROL.

The structures herein proposed can not be made to serve in control of freshets. Generally speaking, the rivers utilized as sections of the waterway are little subject to disastrous floods, and the intersecting rivers, on which flood conditions are detrimental, are invariably crossed at points well down toward their seaward ends, so that the canal structures can exert no influence upon freshets.

5. DRAINAGE.

In the nature of things this canal work can not be coordinated with any scheme for drainage. In the one case a sea-level canal, as herein proposed throughout the greater part of the distance, can have no

great effect upon drainage. In the other case, where the canal is designed to cross high levels, success will depend upon conservation rather than withdrawal of water. While in many of the South Atlantic States the idea persists that a canal of this type will be of use in draining the country, it will readily be seen that the two purposes—navigation and drainage—are incompatible. This waterway can not be combined with any drainage scheme—general or local.

6. In closing its report the board desires especially to make clear that its efforts have been directed toward securing a thorough survey and reliable estimate of cost for a waterway following the most practicable and economical route. At the same time the project as herein presented should be regarded as being of a general character; it can be accepted as a basis for future work; but it should nevertheless be recognized that when work is actually undertaken, changed conditions will doubtless indicate advisability of minor variations in location or in types of structures; and the board deems it important to recommend that legislation be drafted in such way that, while adopting the project, it shall still not bind the department or the constructing officers to rigid adherence to details of plans herein presented.

Respectfully submitted.

DAN C. KINGMAN,
Colonel, Corps of Engineers.
EARL I. BROWN,
Captain, Corps of Engineers.
E. M. ADAMS,
Captain, Corps of Engineers.
GEO. R. SPALDING,
Captain, Corps of Engineers.

The CHIEF OF ENGINEERS, UNITED STATES ARMY.

For report of the Board of Engineers for Rivers and Harbors on 10-foot depth see pp. 11–17.

ESTIMATE OF THE SPECIAL BOARD FOR A CANAL OF 7-FOOT DEPTH.

[Second indorsement.]

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., April 12, 1912.

1. Respectfully returned to the Chief of Engineers, United States Army, with an estimate of the cost of constructing this inside water route with an actual depth of 7 feet, affording a navigable depth of 6 feet—this with a view to its subsequent enlargement to 10 feet when occasion requires. All locks, dams, and permanent structures are provided for in the estimate as for a 10-foot canal.

2. The location of the 6-foot canal is identical with that proposed for the 10-foot canal. The cost of the canal, with reduced depth, in round numbers, is $19,000,000, or $12,000,000 less than for the canal with a 10-foot depth.

3. There is inclosed a sheet giving a summary of the estimates for the 7-foot canal, arranged exactly as in the case of the 10-foot canal shown on page 44 of the report.

DAN C. KINGMAN,
Colonel, Corps of Engineers.

UNITED STATES ENGINEER OFFICE,
Savannah Ga., April 12, 1912.

Estimate for 6-foot draft navigation (7-foot depth of channel) following the same route as that adopted for 10-foot depth by the Board of Engineer officers.

1. Beaufort to Cape Fear River	$2,872,111.00
2. Cape Fear River to Little River	3,724,219.00
3. Little River to Winyah Bay	5,677,800.00
4. Winyah Bay to Charleston	1,227,800.00
5. Charleston to Savannah	427,400.00
6. Savannah to Fernandina	195,000.00
7. Fernandina to St. Johns River	251,726.75
8. St. Johns River to Indian River	2,491,056.03
9. Indian River to Key West	2,127,950.68
Total	18,995,063.46
Or in round numbers	19,000,000.00

Estimate for 6-foot draft navigation (7-foot depth of channel) for continuous waterway, inland where practicable, from Fernandina, Fla., to Key West, Fla.

1. Fernandina–St. Johns River:	
Hydraulic dredging, 2,288,425 cubic yards	$228,842.50
Contingencies	22,884.25
Total	251,726.75
2. St. Johns River–Indian River:	
(*a*) St. Johns River section—	
Hydraulic dredging, 3,213,506 cubic yards	551,269.40
Right of way, 411 acres	4,110.00
Beacons	15,000.00
Contingencies	57,037.94
Total	627,417.34
(*b*) Lakes Ruth, Shad, and Salt Lake sections—	
Hydraulic dredging, 864,689 cubic yards	86,468.90
Right of way, 182 acres	1,820.00
Right of way, 345 acres	5,175.00
Contingencies	9,346.39
Total	102,810.29
(*c*) Salt Lake–Indian River section—	
Steam-shovel excavation, 3,275,930 cubic yards	982,779.00
Lock	450,000.00
Right of way, 381 acres	27,065.00
2 bridges	150,000.00
Contingencies	150,984.40
Total	1,760,828.40
3. Indian River:	
(*a*) Indian River–Jupiter Inlet—	
Hydraulic dredging, 2,762,466 cubic yards	399,383.45
Rock, 12,540 cubic yards	9,405.00
Right of way, 15 acres	750.00
Right of way, 282 acres	2,820.00
Beacons	20,000.00
Contingencies	43,238.85
Total	475,597.30

Indian River—Continued.	
(*b*) Jupiter Inlet–Lake Worth section—	
Hydraulic dredging, 1,903,475 cubic yards	$203,839.75
Right of way, 417 acres	4,170.00
Right of way, 10 acres	10,000.00
Value Florida East Coast Canal excavation, 389,825 cubic yards	58,473.75
Beacons	5,000.00
Contingencies	28,148.35
Total	309,631.85
(*c*) Lake Worth–Biscayne Bay section—	
Hydraulic dredging, 8,079,108 cubic yards	846,284.80
Rock, 32,970 cubic yards	24,727.50
Right of way, 5,030 acres	150,900.00
Contingencies	117,974.68
Value Florida East Coast Canal excavation, 1,018,897 cubic yards	152,834.55
Contingencies	117,974.68
Total	1,297,721.53
(*d*) Approximate estimate of value of right of way owned by Florida East Coast Canal Co	35,000,00
(*e*) Biscayne Bay–Hawk Channel section, beacons	10,000.00
4. Hawk Channel–Key West.—No work required.	

Summary of the estimates.

1. Fernandina–St. Johns River	$251,726.75
2. St. Johns River–Indian River	2,491,056.03
3. Indian River–Hawk Channel	2,127,950.68
Grand total	4,870,733.46

Order and rate of prosecution of the work.

Section.	First year.	Second year.	Third year.	Fourth year.	Fifth year.	Sixth year.	Total.
Fernandina–St. Johns River	$114,000.00	$137,726.75					$251,726.75
St. Johns River–Indian River	598,000.00	698,000.00	$598,000.00	$597,056.03			2,491,056.03
Indian River–Biscayne Bay			532,000.00	532,000.00	$532,000.00	$531,950.68	2,127,950.68
Hawk Channel–Key West							
Total for each year	712,000.00	835,726.25	1,130,000.00	1,129,056.03	532,000.00	531,950.68	4,870,733.46

For report of the Board of Engineers for Rivers and Harbors, see pp. 17–18.

LETTER OF MR. R. A. PARSLEY, SECRETARY AND TREASURER OF THE HILTON LUMBER CO.

WILMINGTON, N. C., *December 2, 1912.*

DEAR SIR: Referring to our conversation this morning relative to the intracoastal canal, the following points, in brief, seem to me to justify the reach from Beaufort, N. C., to Cape Fear River:

SAFETY.

The distance from Beaufort Harbor by sea into Southport Harbor is 120 miles. This necessarily means that slow-moving craft, like barges or large light-draft freighters, run much risk at sea between these points, owing to the fact that it means from 15 to 24 hours at sea without reasonable chance of dodging in from sudden bad weather. There are no harbors between these points except for very small and very light-draft vessels. There are only such

small inlets like Moores or Masonboro and Topsail, which would afford little, if any, aid to a vessel of any size or drawing more than 5 to 6 feet. A vessel caught between these points in a sudden northeaster or southeaster or even a strong easterly wind is in jeopardy unless she is quite seaworthy and under considerable power.

The reaches to the south of us are probably in better shape in this regard, for we have by sea—

	Miles.
From Southport to Little River, S. C	40
From Little River to Georgetown, S. C	65
From Georgetown to Charleston	45

This means that craft taking the sea route and moving only 5 miles per hour could make from one safe point to another during daylight for most of the year and would not often risk having to spend the night at sea.

FREIGHT RATES.

Unquestionably the only safeguard from excessive transportation charges is the barge and other vessels of moderate cost and cheap operation. As an evidence of this, right at hand, the rail freight rate from Newbern, N. C., to New York is 20 cents per 100 pounds; Wilmington, N. C., to New York is 21 cents per 100 pounds.

This is in carload lots and means that Newbern can reach New York by rail for 25 cents per 1,000 feet b. m. less than Wilmington, notwithstanding the fact that the Atlantic Coast Line handles this business from Newbern through Wilmington and hauls it 87 miles farther from Newbern than from Wilmington.

	Miles.
Distance (Atlantic Coast Line) Newbern to Norfolk	325
Distance (Atlantic Coast Line) Wilmington to Norfolk	238
Distance (Atlantic Coast Line) Wilmington to Newbern	87

It is probable that most of the lumber moving from Newbern to eastern cities goes via the Norfolk Southern Railroad, but the Atlantic Coast Line nevertheless bids actively for this business and gets as much of it as it can. The rate from Newbern was formerly one-half cent only lower than Wilmington, but in about 1907, when the inland waterway seemed assured, this rate was lowered another half cent. And it is probable that it would be even lower than this but for the fact that the Norfolk Southern Railroad practically owns or dominates the chief lumbering interest and timber-holding company at Newbern.

BARGE SERVICE.

As you are aware, only large seagoing barges are possible for the Wilmington service and the water rate from Wilmington to Baltimore and New York via barges or schooners is about $5 to $5.50 per 1,000 feet on lumber. Newbern is at present putting lumber on barges of moderate size and cost for the canal service at about $2.50 per 1,000 feet freight for Baltimore and around $4.50 to New York.

EFFECT OF BARGE SERVICE, OR THE POSSIBILITY THEREOF, ON RAILROAD FREIGHT RATES.

It is a positive fact, no longer denied I believe, that railroad rates are in no sense arrived at by the cost of transportation. They are made by traffic managers as high as the traffic will bear, and are regulated, not by arbitrary power of commerce commissions or other bodies, but solely by water competition in most cases. Water competition, in its most effective sense, means competition by small individuals with small units possessing the possibility of large competition in the aggregate. Steamship lines are no longer to be considered as constituting "water competition," for they are owned body and soul by the railroad companies.

IN GENERAL.

There is no doubt in my mind that the canal from Beaufort to Wilmington would immediately bear large quantities of lumber, anthracite coal, fertilizer materials, and general merchandise, the latter especially, from and to the Baltimore market. And I believe also that bituminous coal and grain in large quantities would use the canal immediately and continue to do so until the railroads found that this competition made absolutely necessary an actual as well as a physical connection with the coal mines of southwest Virginia and the grain fields of the Central West. Bituminous coal and grain probably would cease to move via the canal in a comparatively short time, but even if this be so the canal is there as a practical route for this traffic whenever it is necessary or convenient to use it.

I believe this covers the views expressed to you this morning, and I trust same may be of service.

Yours, truly,

R. A. PARSLEY.

Mr. HUGH MACRAE, *City*.

LETTER OF MR. J. A. TAYLOR.

WILMINGTON, N. C., *December 3, 1912*.

DEAR SIR: In compliance with your request to submit some reasons in support of the report of the special board of engineers favorable to the extension of the intracoastal waterway south of Beaufort, N. C., I give herewith what seems to me the controlling reasons for this waterway. Necessarily I can but indicate without elaborating the argument, and for convenience will divide the points by numerals.

ARGUMENT.

First. The intracoastal waterway is essentially a commercial proposition, resting on the twofold ground of interchange of commodities between the States and encouragement to local production. The military feature is necessarily subordinate and incidental, made so by the limitations of the project itself.

Waterway transportation is not only the recognized cheapest means of communication, but in addition to the fact per se has an inevitable effect on rail transportation, and this is recognized by all the commercial nations of the world. One of the most serious problems to-day confronting our Government in the matter of waterway developments is the ways and means for making most effective these improvements, and any project which will have this effect would be justified by results.

Second. It is true, as the general board of engineers concede, that the intracoastal waterway would operate favorably upon the south Atlantic ports, but the implication that this result would be of itself of minor importance and that the benefits would be confined virtually to the ports themselves is, we submit, an erroneous view of the matter. That the ports should benefit by local production is only to say that territories now unoccupied and undeveloped would come to a market through the medium of the canal, so that the incidental benefits to the ports would be but a sequence to the larger benefits accruing to local development; and as respects the effect on the ports through interchange of commerce by the States, this is the real crux of the matter when we consider that the problem reaches beyond the Atlantic seaboard States, which as a matter of fact would be a very small portion of the benefits to the country at large.

Third. The value of a means of transportation is its ability to attract commerce, hence the question of rate is controlling. This brings us to the question, What would be the effect on the south Atlantic ports of the construction of the intracoastal waterway? If this query can not be answered in favor of the canal, the project is admittedly of small value. Happily, the effect of the canal on transportation rates to the south Atlantic ports would be so far-reaching in its benefits as to remove all doubt as to the value of the canal as an economy of transportation.

The Erie Canal is the key to all of the north Atlantic rates, both export and inland. This is recognized by everyone at all familiar with the rate adjustments of the north Atlantic ports, and the extension of an inland waterway south would be in effect a continuation of the Erie Canal, and what this facility

has brought to the north Atlantic ports would accrue to the south Atlantic ports under like conditions. We are not unmindful of the fact that the ports south of New York in the north Atlantic group enjoy lower rates than New York itself, but this fact does not militate against the soundness of the contention that the Erie Canal is the key to the situation and made possible the original New York rate, and the present adjustment of rates between New York and its southern rivals in the north Atlantic group is due to causes wholly remote from the influence of the Erie Canal and are of comparatively recent date.

Fourth. Under the present system of water rates from the northern to the southern ports the blanket system prevails, as is demonstrated by the fact that the rate from New York to Wilmington, N. C., by water is substantially the same as from New York to Jacksonville, Fla., and intermediate points from Wilmington to Jacksonville. Moreover, and speaking specifically in reference to Wilmington, the rail lines refuse to pro rate with water lines through these ports on any equitable division of revenue, exacting from water lines for the nearest rail point the full revenue accruing to the rail line as would obtain under all-rail shipments from same point of origin. The effect of this is to limit the benefits of water transportation to the ports themselves, and at the same time to hamper and retard the commercial development of the ports.

Fifth. With the construction of the intracoastal waterway and the extension of the canal rate to southern ports, the effect would be to put the southern ports on a virtual parity with the northern ports in the all-important overland traffic from the West and in inland rates through the ports, and with this an accomplished fact the arbitrary discrimination which now divides the Atlantic ports into a northern and a southern group would forever disappear. This is the arbitrary work of the railroads and can only be undone by water competition.

The Panama Canal is a national undertaking and is justified on no other ground than of a nation-wide benefit. Under the present adjustment of rates between the North Atlantic and South Atlantic ports the latter would share in no benefits of the Panama Canal, because commerce moves on economic lines and not on sentiment. The present discrimination against the South Atlantic ports in favor of the northern ports could have no other effect than to confine and limit the great benefits of the Panama Canal to the North Atlantic and Gulf ports, and to avert such an injustice to South Atlantic ports and the interior territory which would base on these ports by reason of geographical proximity, the Government is under every consideration of fairness bound to adopt and put through any measures of relief. The intracoastal canal would solve the problem, and while this canal could not be completed as early as the Panama Canal, the fact that the project had been approved and entered upon by the Government would in all probability cause the railroads serving these southern ports to anticipate the effect of the completion of the canal by gradual reduction in rates.

The question is of momentous consequence to the South Atlantic ports, and the project would meet the demand of Congress that waterways shall produce their greatest economic efficiency, which condition can not be realized as long as the railroads control or hinder the actual and potential economies of water transportation, which is notoriously the situation in the South Atlantic States to-day.

In conclusion it may be said that the effect of the canal from Beaufort to the Cape Fear River would be to relieve shipping from the dangers of Frying Pan Shoals. This may appear on the first thought to be purely a matter of local concern, but as a matter of fact it is quite the contrary. Unless the dangers of the coast be protected by an inland waterway between the points named there would be no possibility of a canal south of the Cape Fear River which could procure a continuous and practicable watercourse to the north.

Yours, truly,

J. A. TAYLOR.

Mr. H. B. BRANCH,
Secretary Chamber of Commerce, Wilmington, N. C.

LETTER OF MR. EDGAR D. WILLIAMS.

DECEMBER 14, 1912.

MY DEAR SIR: I beg to call your attention to the great distance of Frying Pan Shoals to Cape Fear Bar, where the lightship is moored, to the end of Frying Pan Shoals—22 miles from the bar to the lightship; 85 miles from Frying Pan Lightship to Cape Lookout.

During my experience of 47 years in the towboat business on the coast and Cape Fear River I have known vessels bound north to lay in harbor at Southport for 12 to 15 days waiting for favorable wind to proceed on their voyage. This was on account of the prevailing wind in the winter time, which is from the north to northeast, and it is only the large class of vessels, say, from 600 to 1,000 tons, that will venture out and make any headway along the coast bound north.

We have no inlets from Beaufort to the Cape Fear Bar of any note and with any depth of water; vessels can scarcely make harbor. With the New Inlet near Fort Fisher we did an immense trade with eastern counties, vessels of a small class bringing corn to this port.

Of course, this inlet being north of the Frying Pan Shoals, vessels with a northerly wind can track the land up as far as Beaufort; as it is now this class of vessels would not take the risk, as it would be too hazardous on account of Frying Pan Shoals.

We beg to call your attention again to the great advantage this port would have by the increase in commerce by having this inland waterway to come by or near Wilmington, as I am sure that it would increase our trade and commerce considerably.

There have been numerous vessels of different classes lost on the coast from Cape Lookout to Frying Pan Shoals and on the Frying Pan Shoals of late years, with their cargoes and no tidings of their crews.

You will please note the charts from Cape Hatteras to Cape Romain, S. C., Frying Pan Shoals extending a greater distance than either Hatteras or Cape Lookout.

The distance from Cape Hatteras Lighthouse to lightship being 14 miles, Cape Lookout, or Hatteras, to Lookout Lightship is 13½ miles; from Cape Lighthouse or Cape Fear Bar to Frying Pan Lightship, on the end of the shoal, is 22 miles, and more dangerous, in my experience, than either Cape Lookout or Cape Hatteras.

Yours, very respectfully,

EDGAR D. WILLIAMS,
Master and Pilot.

Mr. M. W. DIVINE,
President Inland Waterways Association, City.

LETTER OF MR. WM. L. DE ROSSET.

WILMINGTON, N. C., *December 14, 1912.*

Mr. HUGH MACRAE, *City:*

Without any extended explanation, etc., I am desirous of laying before your committees information for presentation in behalf of the continuation of the inland waterways to our city.

Sailing vessels loaded with cement have been chartered on the basis of 20 cents per barrel. Due to the hazardous risk and the loss of three or four cargoes of cement the past year, the rate of freight has increased to 32 to 35 cents, and charters are difficult to make at that. A year ago cement sold at $1 per barrel net; to-day it is $1.30 per barrel net, and hard to get at that.

Using barges through the inland waterways, I should think, would materially reduce the risk of cargo and vessel as well as life, and, of course, naturally reducing the cost of cement to the consumer. The same principle would apply to many other commodities.

With best wishes for your committee's success, I am,

Yours, very truly,

WM. L. DE ROSSET.

STATEMENT FURNISHED BY MR. THOMAS PURSE, SECRETARY SAVANNAH BOARD OF TRADE.

Inward and outward tonnage and valuation of commerce by water at the port of Savannah, Ga., calendar year 1911.

	Received.		Departed.	
	Short tons.	Value.	Short tons.	Value.
Foreign	576,607	$6,279,562	574,867	$82,028,929
Coastwise steamship	531,665	75,496,430	501,833	71,260,286
Coastwise sailing vessel	229,410	2,492,625	275,285	2,064,636
	761,075	77,989,055	777,118	73,324,922

Inward and outward tonnage, inland waterways, 139,500 tons, valued at $6,609,000.

	Short tons.	Value.
Tonnage and valuation of commerce inward and outward, 1911	2,954,814	$246,678,077
Tonnage and valuation of commerce inward and outward, 1910	2,920,060	224,512,440

Greatest draft arrived, 1911, 26 feet 3 inches. Greatest draft cleared, 1911, 27 feet 7 inches. Amount of duties collected, 1911, $81,777.78.

THOMAS PURSE, *Secretary.*

SAVANNAH BOARD OF TRADE,
December 2, 1912.

SAVANNAH, GA.

As indicative of the rapid growth of the shipping business of this port, in consequence of gradually increasing depth of channel, the following figures are given to show the relative position of principal export ports of the Atlantic coast, with gain and loss of commerce, for the fiscal year ended June 30, 1912, as compared with 1909, a period of four years:

Exports.	1912	1909	Gain.	Gain.
				Per cent.
New York	$812,897,414	$607,239,481	$205,657,933	33½
Savannah	104,288,887	50,900,156	53,388,731	104½
Baltimore	92,034,875	77,550,658	14,484,217	18½
Philadelphia	68,875,300	84,286,440	15,411,140	[1]18¼
Boston and Charlestown, Mass	69,667,494	76,157,558	6,490,064	[1]8½

[1] Decrease.

Savannah's exports for the year 1910 were $63,428,155; for 1911, $72,076,045. The 1912 record places Savannah in fourth place in all the United States, the order being New York, New Orleans, Galveston, Savannah.

Savannah's imports also show steady growth, Government figures for fiscal year ended June 30 being as follows: 1909, $2,152,441; 1910, $3,855,373; 1911, $5,296,746; 1912, $5,130,979.

The arrival book in the United States customs office at Savannah show total arrivals in port, all classes, foreign and coastwise, year ending August 31, 1912, 1,354, an average of 113 vessels each month.

Similar records show vessels, coastwise, cleared through customs at Savannah, year ending August 31, 1912, as follows:

	Vessels.	Net tonnage.	Average.
			Tons.
Entered	741	1,955,953	2,640
Cleared	609	1,579,099	2,593

The harbor master's report for calendar year 1911 shows total vessels arriving Savannah as follows:

	Vessels.	Net tonnage.
American:		
Steamers	789	1,886,573
Sail	181	112,184
Foreign:		
Steamers	315	720,742
Sail	5	3,451
Tugs and oil barges	18	23,806
Total	1,308	2,746,756

Right here should be considered statement furnished by Mr. Thomas Purse, secretary of the Savannah Board of Trade, covering "inward and outward tonnage and valuation of commerce by water at the port of Savannah for calendar year 1911."

Cotton receipts at Savannah for the year 1911–12 were uplands, 2,329,076 bales; sea islands, 63,105 bales.

The growth and prestige of Savannah has been largely the result of her port and shipping business, therefore facts indicative of this growth are of interest.

Census 1910 showed 65,064 population, not embracing a manufacturing settlement since taken into the city and other contiguous suburbs which at this time give a total estimated population of 100,000.

She has 7.11 square miles territory in city limits. Street mileage 150 miles. Paved streets December 31, 1911, 50.57 miles. House drainage, 51 miles. Storm drainage, 28 miles. Trolley mileage, city and suburban, 58.15 miles.

City taxable values 1911, $51,171,691. New improvements 1911, taxable valuation, $866,400.

Six railroads with total mileage 16,482 miles. Terminals include about 3,000 acres of land and trackage 150 miles.

Coastwise steamship lines with regular schedules, passenger and freight:

Ocean Steamship Co., 3 ships each way weekly, between Savannah and New York; 2 ships each way weekly between Savannah and Boston; total tonnage, 35,815 tons.

Merchant & Miners' Transportation Co., 3 ships each way weekly between Savannah-Jacksonville and Baltimore; 3 ships each way weekly between Savannah and Philadelphia.

Also numerous small steamboats plying near-by waterways.

Post-office receipts, year ending June 30—

1909	$218,543
1910	232,254
1911	248,979
1912	263,982

Banking institutions, figures of July 12, 1912; Number 18; paid in capital surplus and undivided profits, $9,154,124; deposits, $24,421,987.

Bank clearings:

1909	$240,227,835
1910	271,994,461
1911	291,172,893

Savannah has never had a bank failure.

PROBLEM AFFECTING HUMAN WELFARE.

SIR: In advocating the building of the intercoastal canal it is difficult to assemble and to present what are often termed "fixed facts." The engineering data is of course accurate, and the estimate of approximate cost can be relied on; but when we speak of the value of the canal and its importance to present and future generations we can not, in reaching a wise conclusion, be dogmatic; because we are dealing with things not proven. We must make use of prophetic vision as well as sound judgment.

If the project under consideration is to be a factor in great growth and development, then we must necessarily be optimistic as to the possibilities of that growth and development.

It may be considered that any great work to be undertaken requires optimism to the extent of having faith in the future. Pessimism is fatal to great enterprises.

What I have to say therefore in regard to this canal project is from the standpoint of believing absolutely in its importance as a national work, and in the benefits that will follow in the development of commerce, industry, and agriculture; in the increase of wealth and the advancement of civilization; not only in the immediate territory which the canal will serve, but also in a very much larger area which will receive sympathetic stimulation.

This intercoastal canal will be of direct service to a group of States which are far from being developed to their maximum possibilities, but which have remarkable potential wealth.

It seems that there are three great beneficial influences that would be exerted by this intercoastal canal: First, its effect in stimulating ocean commerce; second, the development of the coastal section which it traverses; and, third, its influence on the reduction of freight rates on heavy commodities. These three distinct lines will prove to be reciprocal and each will greatly contribute to the growth of the others.

As to the benefit to ocean commerce it is evident that the class of freight conveyers which can handle the heavy commodities at the lowest rates are not available now to any extent for business along the South Atlantic coast. The dangers in rounding Cape Hatteras and the Frying Pan Shoals and the long reaches which it is necessary to make from one port of safety to another are prohibitive. The use of small craft and of barges would be safe under conditions which permitted of fair-weather travel for distances of 40 to 50 miles from one harbor of refuge to another; but it would be quite unsafe for this same class of craft to attempt voyages which required remaining at sea for distances of from 100 to 300 miles. It might be said that the dangers from storms increase as the squares of the distances to be traveled under conditions of exposure.

In illustration of this, a case was mentioned to me within the last few days by a man who ships large quantities of cement from northern ports to Wilmington. He stated that three ships carrying cement had been lost off Hatteras, and the freight rate was immediately raised from 20 to 30 cents per barrel, or an increase of 50 per cent. Now, cement is a commodity which moves in large volume and can easily be handled in barges. If these barges, upon the approach of bad weather, could seek the protection of an inland waterway and the dangers of storms be eliminated the freight rates would be much lower.

Another illustration of the importance of safety to small craft is seen in the fact that 35 years ago Wilmington had a very large business with the eastern coast of North Carolina, and all of the freight was carried in small sloops, known as "corn crackers." These "corn crackers" usually brought in cargoes of corn or other country produce, and carried back merchandise and fertilizers. These small vessels could go in and out of several inlets along the coast, and in case of storms were not necessarily exposed to danger. They came through New Inlet, of Cape Fear River, which at that time was open. When New Inlet was closed, in order to deepen the harbor, that trade at once became extinct, due largely, if not entirely, to the fact that the small craft in which that coasting business was necessarily done could not afford to take the danger of exposure in going the long route around Frying Pan Shoals. On the other hand, Wilmington has maintained a very profitable business in the direction of Little River, where these small craft can go with perfect safety. This traffic with small craft would spring up again if the facilities were provided by an inland canal. An example of this can be seen in the traffic of this kind which comes

to Norfolk, Portsmouth, and Baltimore, near which cities there are large bodies of inland water which can be safely navigated by small craft.

As to the adjacent coastal country, we believe that the canal would have a most important influence. This coastal country for a distance inland of 50 to 70 miles is very rich agriculturally, but much of it is wholly undeveloped; and if this cheap means of transportation was provided for the crops, it would result in thousands of farmers settling on these fertile lands of the coastal plain and the development of the wealth of that region. This in turn would stimulate the growth of towns and manufacturing centers and thereby increase the traffic on the canal, on the ocean, and also on the railroads.

For several years I have been making a study of the agricultural possibilities of lands typical of the coastal plain between Norfolk and Jacksonville, and have formed the opinion that no part of the United States presents a better field for development than that section. It has a combination of the three fundamental things—excellent soil types, temperate climate, and abundance of rainfall—surpassing in this combination any other part of the country. All that is needed is a stimulant in the way of good transportation facilities.

As to the effect on the railroads, it is a recognized fact that the rail rates are governed by competing water rates. It is far more effective and probably better where possible to influence rail rates favorably by some natural competition than by arbitrary legislation.

The capital invested in the main railroad systems serving the Southern States and touching at the southern ports must approximate six or seven hundred million dollars. If an investment of $31,000,000 in an intracoastal canal will build up water transportation so as to have a decided influence on the rates charged by the great railroad systems, certainly the amount of money invested in the canal would seem to be small as measured by the results obtained; but I believe that this result could be accomplished with even less expenditure, and that an investment of $6,000,000 would bring about many of the advantages desired and would prove beyond question the importance of the greater project and would justify the investment of the additional $25,000,000.

If the present canal is extended from Beaufort into the Cape Fear River at Wilmington, at a cost of $4,300,000, and the canal completed between Charleston and Jacksonville at the very moderate cost of $1,700,000, as estimated in the Engineers' Report, it will connect up the point of greatest traffic in Florida—Jacksonville—with Fernandina, Brunswick, Savannah, and Charleston (all great shipping points), and would connect Fayetteville, Wilmington, Newbern, Norfolk, Richmond, Baltimore, and Washington, leaving only a short stretch of comparatively safe coast between Charleston and Wilmington without the canal. On this very short stretch there are two harbors of safety—Georgetown, 45 miles distant from Charleston, and Little River, 60 miles distant from Georgetown and 40 miles distant from Southport. This zone of danger would be insignificant, as compared with the exposures now necessary. The amount of canal completed at present is not sufficient to induce the building up of commerce in small craft. Therefore freight is carried from the northern ports outside to the southern ports in ships which are large enough to navigate with comparative safety. Even then we must consider that every ton of freight moved in the South, either by rail or water, pays its tribute to the dangers of Cape Hatteras and Frying Pan Shoals. This is too much.

The farmer who is unwilling to plow the ground certainly can not look forward to planting a crop; and we are all accustomed to the idea that a "man who does not sow can not reap." Similarly, if there are great possibilities of development along the southern coast, and we do not take the steps to stimulate these, there will be no successful reaping. We must remain in truth a "frontier."

To illustrate that vast developments sometimes grow from improvements to navigation we can point to what has occurred near London and on the River Clyde. A Scotch lady (Mrs. Alexander Sprunt, the mother of our esteemed townsman, Mr. James Sprunt) once told me that when she was a girl only fishing smacks about the size of our "corn-crackers" could get up as far as London and only the same class of vessels could enter the Clyde above Glasgow. To-day the greatest steamships of the world are built on the upper Clyde. Clipping dated London, November 30, inclosed.[1]

[1] Not printed.

The *Aquitania* and her launching above the city of Glasgow could not have been dreamed of at the time that fishing smacks were the largest craft on that river; and while one would now hesitate to make comparisons of what the results would be along the southern coast if given an impetus by the building of this canal, it would not be unreasonable to expect, along certain lines, some very great development.

It is often said that the Erie Canal made New York. In this brief statement no one supposes that all of the business of New York came from the Erie Canal. The canal simply gave New York the impetus and acted as a stimulant to certain lines of business, which reacted favorably on other conditions, bringing about an enormous concentration of business at that point. Now all classes of business are so great in New York that the Erie Canal can almost be overlooked except for its probable continued beneficial influence on freight rates. The Erie Canal, far from hurting the railroads, has greatly helped them by aiding in the increase of all classes of business. The same thing would undoubtedly occur in the South and the railways would gain far more than they would lose.

To-day the barge service between Wilmington and New York is only possible in large seagoing barges, and the freight rate is about $5 to $5.50 per thousand feet of lumber. Newbern is at the present time putting lumber on barges of moderate size and cost suitable for the canal service and delivering it in Baltimore at about $2.50 per thousand feet.

The canal if extended from Beaufort to Wilmington would, in the opinion of those who are engaged in business which would be affected and who have given this matter study, bear large quantities of lumber, grain, anthracite coal, cement, fertilizing materials, and general merchandise, the latter especially from the Baltimore market. At the present time, while Baltimore should be one of the best markets for the coast of North Carolina south of Beaufort, and while a business could be built up which would in a measure govern the rates on business done with other large commercial centers both east and west, there is practically no business done with Baltimore by water. If heavy commodities were moved from Baltimore through the canal to Wilmington and other points south, it would bring about competition from the coal fields of southwestern Virginia and the grain fields of the Central States direct to all of the southern ports, and the canal rate, combined with the rate to Baltimore from the West, would naturally be the basis of rates made by the other routes.

It has been pointed out that after the intracoastal canal is completed the barges used on the Erie Canal and other canals in the North, which are frozen in winter, will be available during the winter months for traffic in the southern canal.

During prosperous times the railroads are congested with heavy freight which is relatively unprofitable, and this canal route would tend to relieve this congestion and in reality would help the railroads by developing the classes of business which could afford to pay higher rates.

A great factor in the development of some sections is the influence of tourists and those who travel for pleasure. California, Florida, and western North Carolina have been particularly benefited by this tourist travel. The influence of pleasure travel can also be plainly seen along certain portions of Chesapeake Bay and in southern Maryland. The building of this canal would turn a steady stream of travel up and down the southern coast and would cause the rapid development of the opportunities which are there presented to the investor.

It was impossible for any man to forecast accurately the effect of the Suez Canal. It is now impossible to estimate in advance the full outcome from the traffic of the Panama Canal. Both of these great works were probably initiated by dreamers, but no one can now question their importance to the commerce of the world.

If the inland waterway builds up local or zone traffic, it will induce through traffic in large volume. If Baltimore, Richmond, and Norfolk, which are now in great measure cut off from the South, are given easy and safe access to the cities of Jacksonville, Savannah, and Wilmington by water, the stimulation to commerce will be tremendous. These trade centers will be developed and will in turn be contributors of through freight.

Fortunately the section of this canal which would cost the least would produce the greatest and most immediate growth of commerce, would give the facilities needed to the most important ports, and would eliminate the greatest dangers to small shipping. It would prove at this time a great factor in taking care of the new life to be stirred by the completion of the Panama Canal.

This canal would be supplemental to and make more effective many of the large projects which have been completed or to which the Government is committed. It connects at will with 400 miles of navigable water.

It seems that an initial investment of $6,000,000 and the probable future investment of $25,000,000 is a conservative expenditure in order to insure the miracle of development which would surely follow as the result of this undertaking. We feel that these States and their ports are entitled to this consideration in the great general scheme of public improvements which are undertaken throughout the country for the public benefit.

Gen. WM. H. BIXBY,
Chief of Engineers, United States Army.

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EXPLANATION

Canal lines considered

With the exception of railroads this map was traced from "The outline map of the United States and Territories prepared in the office of the Chief of Engineers U.S.A. * * * * compiled from annual report of 1907. Scale 50 miles to 1 inch". The railroads were taken from map of the United States published by the U.S.Geological Survey, Scale 1:2,500,000, dated 1910.

Canal lines indicated by heavy black lines were taken from map of "Canals and Navigable Rivers of the United States and Canada * * * * by Henry A. Van Alstyne, State Engineer and Surveyor. New York 1905".

ENGINEER DEPARTMENT UNITED STATES ARMY

UNITED STATES INTRA - COASTAL WATERWAYS

GENERAL MAP

BOSTON MASS. - RIO GRANDE TEXAS

DIVISIONS

BOSTON MASS.- BEAUFORT INLET N. C. BEAUFORT N. C.- KEY WEST FLA.

TRANS FLORIDA CANAL. ST. GEORGES SOUND FLA.- MISSISSIPPI RIVER.

MISSISSIPPI RIVER - RIO GRANDE

PREPARED UNDER THE DIRECTION OF BOARDS CONVENED BY PAR. 1, 2, 3,

S. O. 10, WAR DEPT. OFFICE CHIEF OF ENGINEERS, MARCH 8, 1909.

Dan C. Kingman
COL CORPS OF ENGINEERS

W. M. Black
COL. CORPS OF ENGINEERS

Lansing H. Beach
LT. COL. CORPS OF ENGINEERS

SENIOR MEMBERS

SCALE OF MILES

50 0 50 100 200

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House Doc. 229; 63d Cong., 1st Sess.

WAR DEPARTMENT

CORPS OF ENGINEERS U. S. ARMY



UNITED STATES INTRA-COASTAL WATERWAYS.

BEAUFORT INLET, N. C. KEY WEST, FLORIDA, DIVISION.

BEAUFORT INLET, N. C. - LITTLE RIVER, S. C. SECTION.

WAR DEPARTMENT.

UNITED STATES ENGINEER OFFICE, WILMINGTON, N. C.

SEA LEVEL AND LOCK CANAL PROJECTS.

SEA COAST AND INLAND ROUTES.

NORTH CAROLINA.

INDEX MAP

FROM SURVEYS OF 1876, '78, '79, '82, 1909, AND 1910.

SCALE 1:200,000

1 0 1 2 3 6 12 MILES

PREPARED UNDER DIRECTION OF

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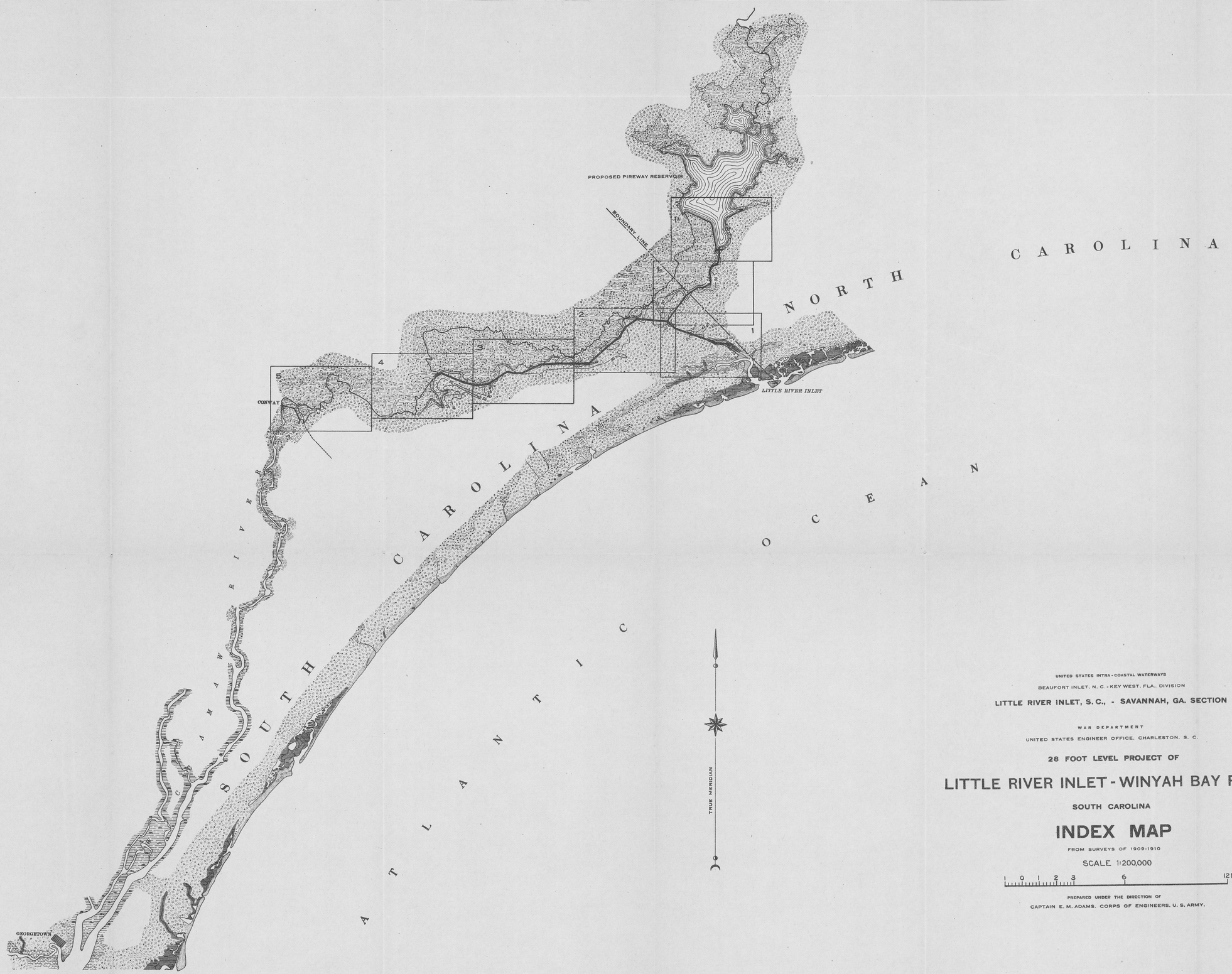
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INTRA-COASTAL WATERWAY (INDEX MAP.)

House Doc. 229; 63d Cong., 1st Sess

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY.



UNITED STATES INTRA-COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLA. DIVISION

LITTLE RIVER INLET, S. C., - SAVANNAH, GA. SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, CHARLESTON, S. C.

28 FOOT LEVEL PROJECT OF

LITTLE RIVER INLET - WINYAH BAY ROUTE

SOUTH CAROLINA

INDEX MAP

FROM SURVEYS OF 1909-1910

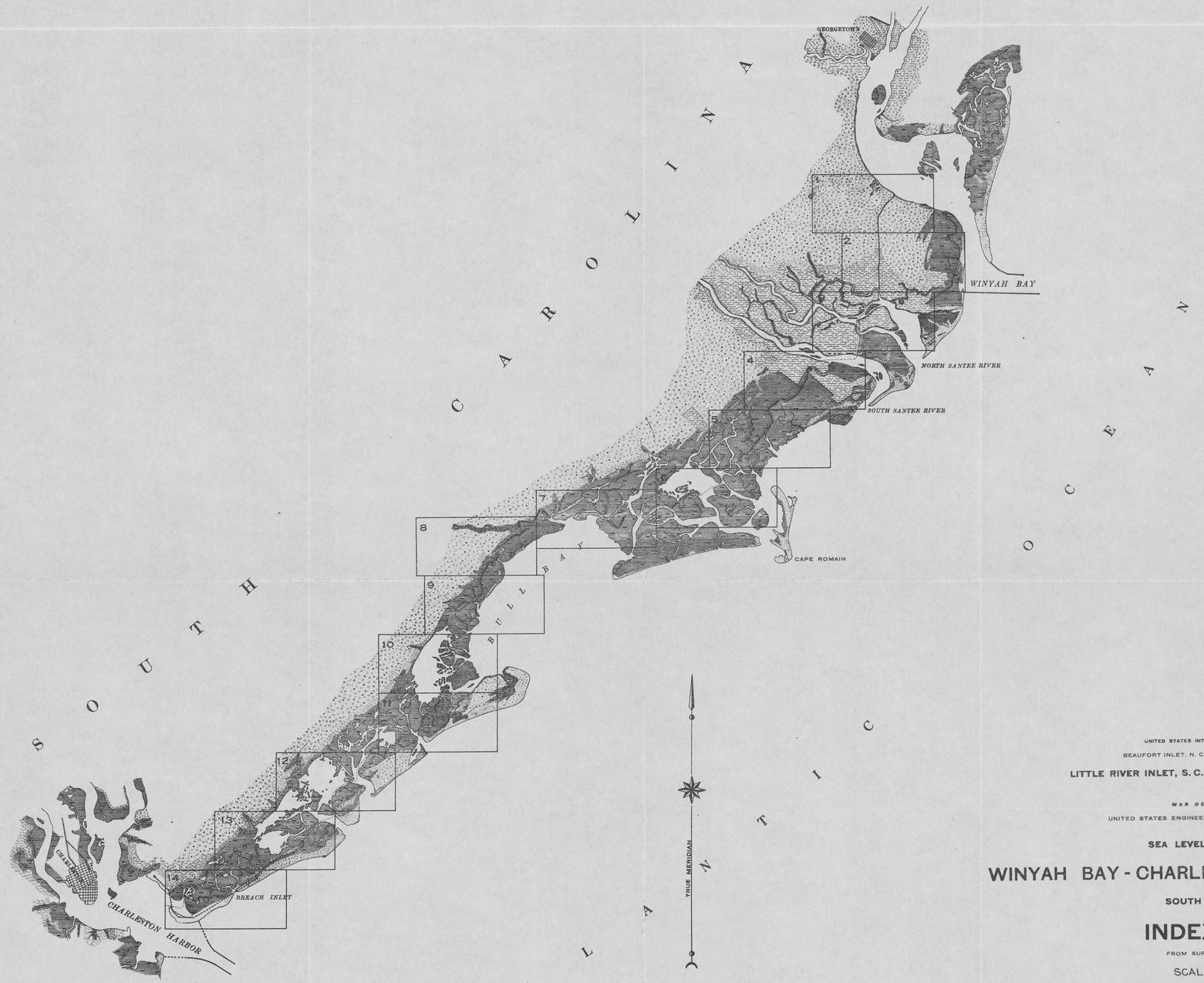
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UNITED STATES INTRA-COASTAL WATERWAYS

BEAUFORT INLET, N. C.-KEY WEST, FLA. DIVISION

LITTLE RIVER INLET, S. C., - SAVANNAH, GA. SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, CHARLESTON, S. C.

SEA LEVEL PROJECT OF

WINYAH BAY - CHARLESTON HARBOR ROUTE

SOUTH CAROLINA

INDEX MAP

FROM SURVEYS OF 1909

SCALE 1:200,000

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PREPARED UNDER THE DIRECTION OF

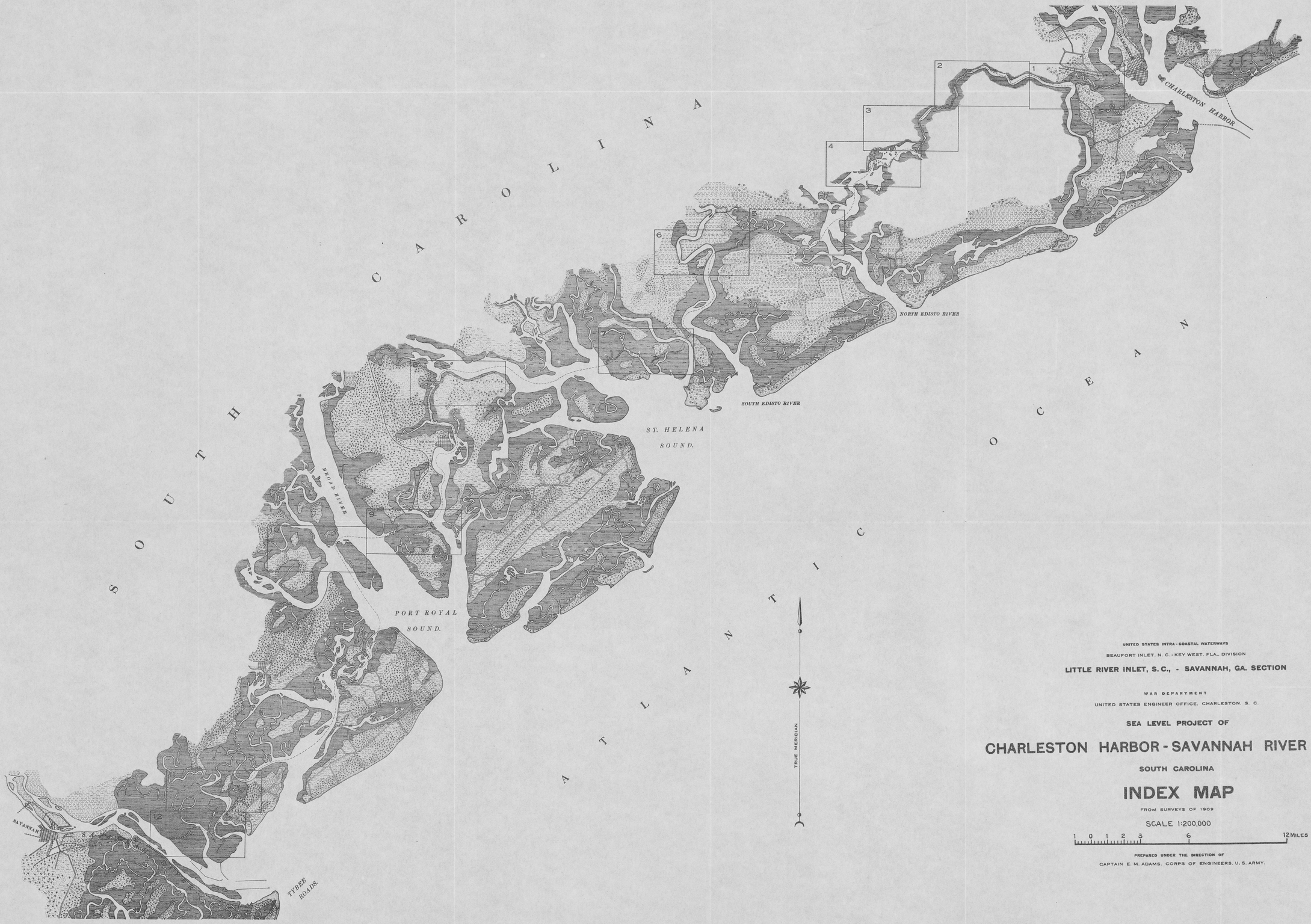
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CORPS OF ENGINEERS, U. S. ARMY.



UNITED STATES INTRA-COASTAL WATERWAYS

BEAUFORT INLET, N. C.-KEY WEST, FLA., DIVISION

LITTLE RIVER INLET, S. C., - SAVANNAH, GA. SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, CHARLESTON, S. C.

SEA LEVEL PROJECT OF

CHARLESTON HARBOR - SAVANNAH RIVER ROUTE

SOUTH CAROLINA

INDEX MAP

FROM SURVEYS OF 1909

SCALE 1:200,000

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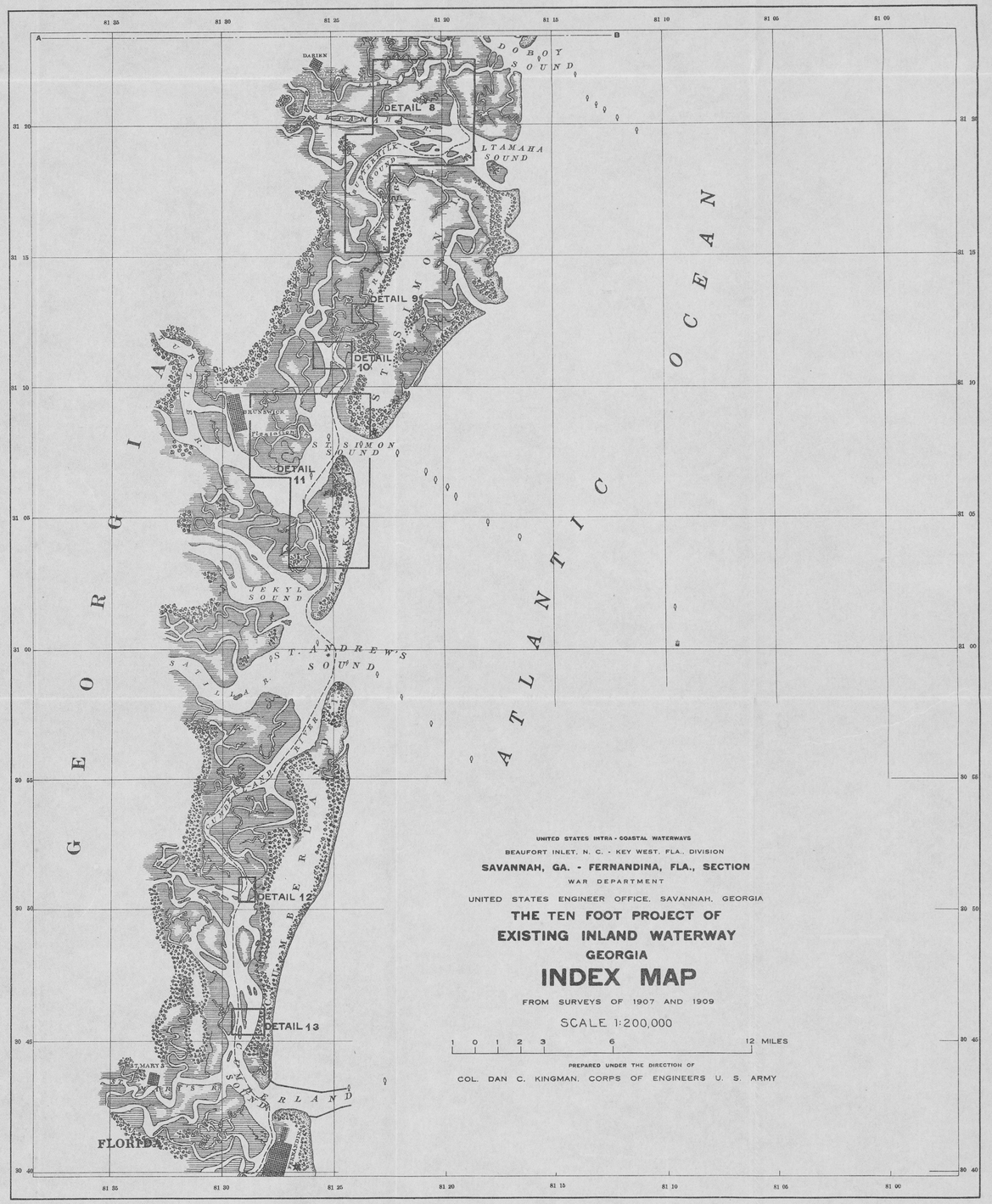
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UNITED STATES INTRA-COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLA., DIVISION

SAVANNAH, GA. - FERNANDINA, FLA., SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, SAVANNAH, GEORGIA

THE TEN FOOT PROJECT OF EXISTING INLAND WATERWAY GEORGIA

INDEX MAP

FROM SURVEYS OF 1907 AND 1909

SCALE 1:200,000

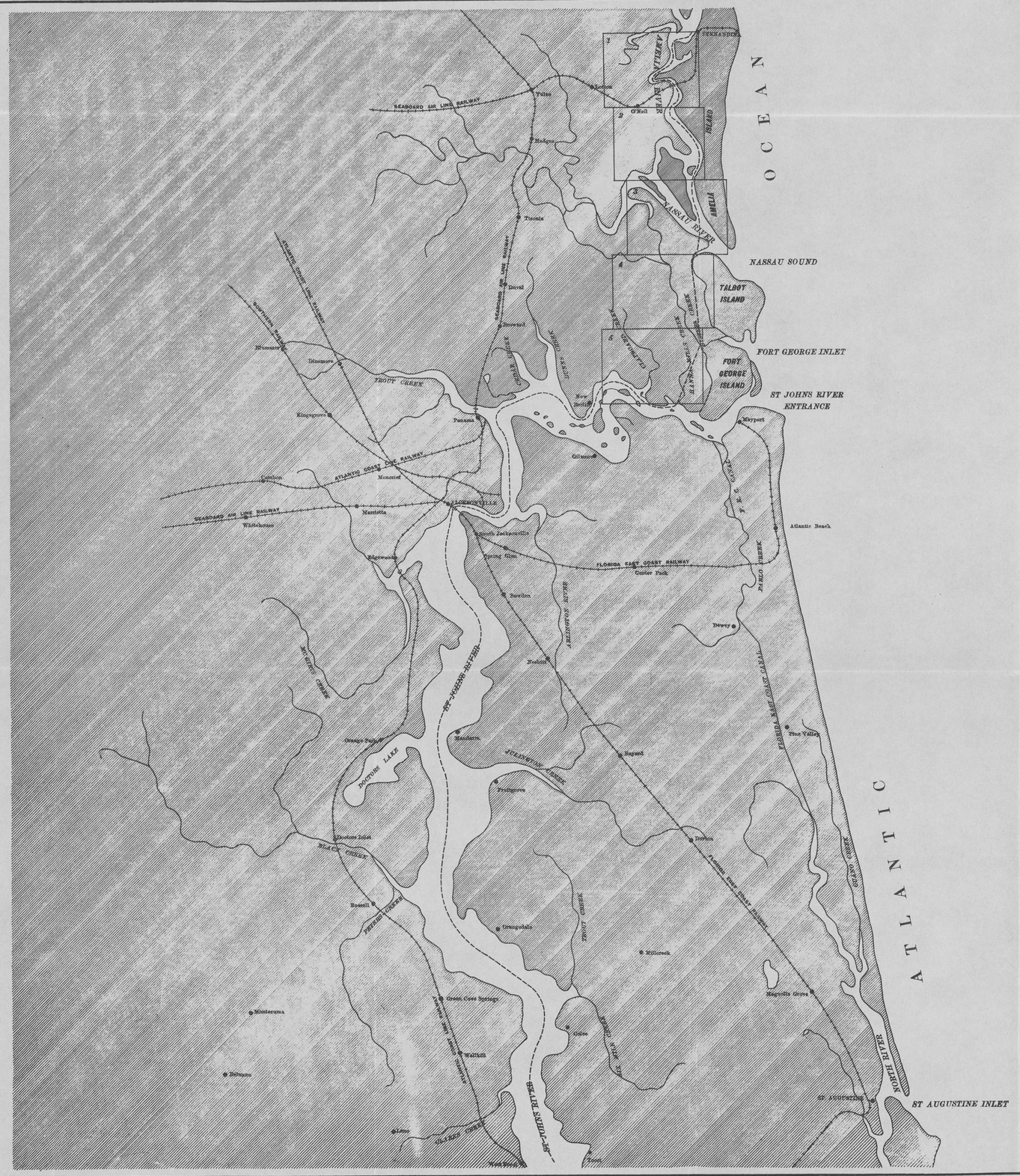
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NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 1

FROM SURVEYS 1909-1910

Scale 1:200,000

1 0 1 2 3 4 5 6 7 8 9 MILES

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DRAWING AND PRINTED BY THE U.S. GOVERNMENT PRINTING OFFICE



NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

TRUE MERIDIAN

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 2

FROM SURVEYS 1909-1910

Scale 1:200,000

1 0 1 2 3 4 5 6 7 8 9 MILES

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NOTE
PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 3

FROM SURVEYS 1909-1910

Scale 1:200,000

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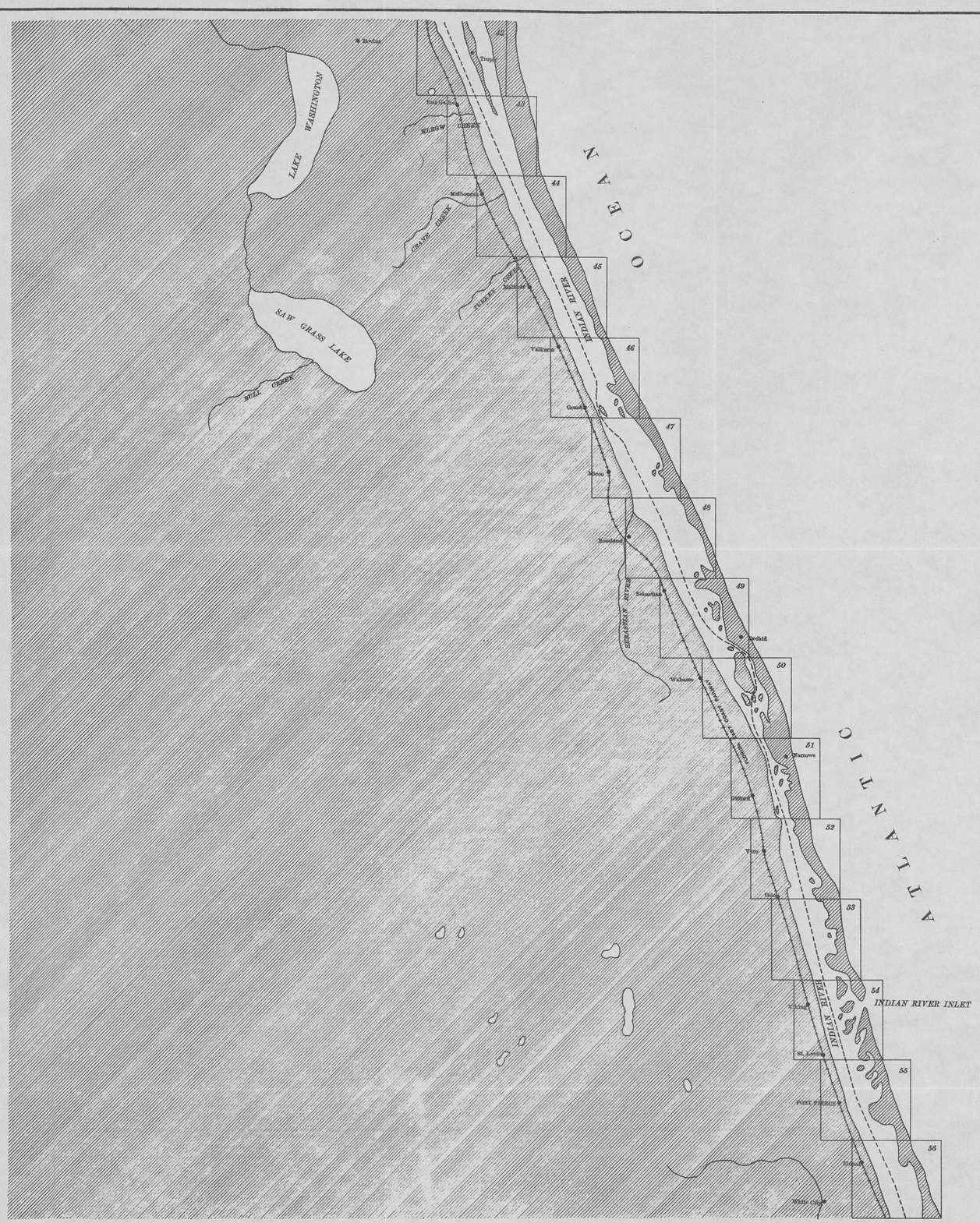
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CORPS OF ENGINEERS. U. S. ARMY



TRUE MERIDIAN

NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 4

FROM SURVEYS 1909-1910

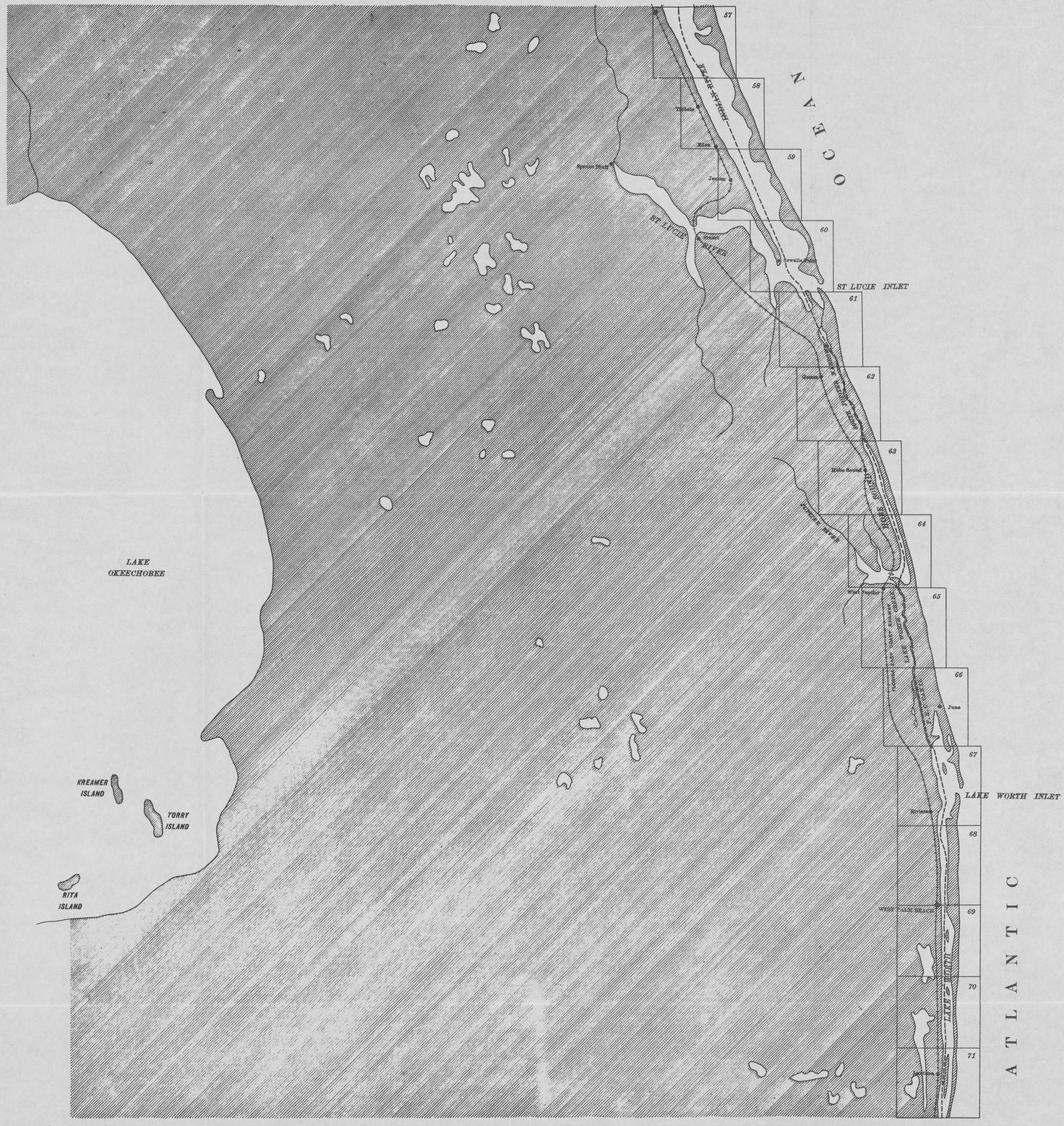
Scale 1:200,000

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NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 5

FROM SURVEYS 1909-1910

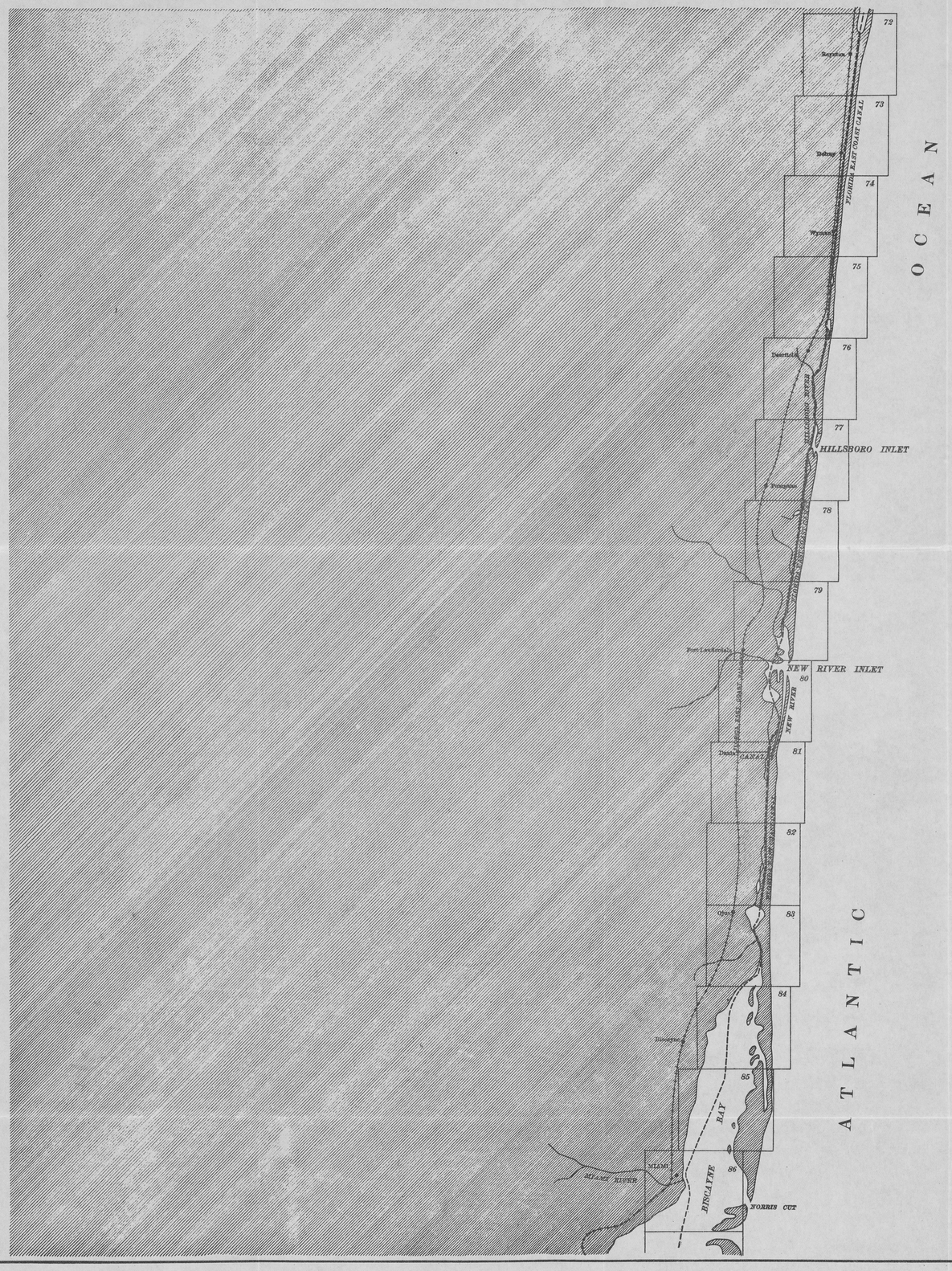
Scale 1:200,000

1 0 1 2 3 4 5 6 7 8 9 MILES

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NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA. DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA. SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA. DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 6

FROM SURVEYS 1909-1910

Scale 1:200,000

1 0 1 2 3 4 5 6 7 8 9 MILES

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NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE

UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 7

FROM SURVEYS 1909-1910

Scale 1:200,000

1 0 1 2 3 4 5 6 7 8 9 MILES

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NOTE

PROPOSED ROUTE OF INTRA-COASTAL WATERWAYS FERNANDINA - KEY WEST SHOWN BY HEAVY DASH LINE



UNITED STATES INTRA - COASTAL WATERWAYS

BEAUFORT INLET, N. C. - KEY WEST, FLORIDA, DIVISION

CUMBERLAND SOUND - KEY WEST, FLORIDA, SECTION

WAR DEPARTMENT

UNITED STATES ENGINEER OFFICE, JACKSONVILLE, FLORIDA, DISTRICT

ST. JOHNS - INDIAN RIVERS ROUTE

FLORIDA

INDEX MAP

SHEET NO. 8

FROM SURVEYS 1909-1910

Scale 1:200,000

0 1 2 3 4 5 6 7 8 9 MILES

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