82D CONGRESS } HOUSE OF REPRESENTATIVES { DOCUMENT
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HUMBOLDT BAY, CALIF.

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED OCTOBER 23, 1950, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A PRELIMINARY EXAMINATION AND SURVEY OF HUMBOLDT BAY, CALIF., AUTHORIZED BY THE RIVER AND HARBOR ACT APPROVED ON MARCH 2, 1945

MAY 24, 1951.—Referred to the Committee on Public Works and ordered to be printed with one illustration

LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY,
Washington, D. C., May 17, 1951.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated October 23, 1950, from the Chief of Engineers, United States Army, together with accompanying papers and an illustration, on a preliminary examination and survey of Humboldt Bay, Calif., authorized by the River and Harbor Act approved on March 2, 1945.

In accordance with section 1 of Public Law 14, Seventy-ninth Congress, the views of the State of California and the Department of the Interior are set forth in the enclosed communications.

Although the Bureau of the Budget advises that there is no objection to the submission of the report to Congress, it states that any estimate of appropriation for the initiation of this project, if authorized by Congress, must be justified in accordance with the policy set forth in the President's letter to the Secretary of the Army dated July 21, 1950, concerning curtailment of civil public works. The complete views of the Bureau of the Budget are contained in the attached copy of its letter.

Sincerely yours,

FRANK PACE, JR.,
Secretary of the Army.

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D. C., May 2, 1951.

The honorable the SECRETARY of the ARMY.

(Through the Budget Officer for the Department of the Army.)

MY DEAR MR. SECRETARY: Receipt is acknowledged of your letter dated November 16, 1950, submitting the report of the Chief of Engineers on Humboldt Bay, Calif., authorized by the River and Harbor Act approved March 2, 1945.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the report to Congress.

The President in his letter to you, dated July 21, 1950, directed that all civil public works be considered with the objective, as far as practical, of deferring, curtailing, or slowing down those projects which do not directly contribute to defense or to civilian requirements essential in the changed international situation. Therefore, any estimate of appropriation for the initiation of this project, if authorized by the Congress, must be justified in accordance with the policy set forth in the President's letter referred to above or any modifications thereof.

Sincerely yours,

WM. F. MCCANDLESS,
Assistant Director, Estimates.

COMMENTS OF THE STATE OF CALIFORNIA

STATE OF CALIFORNIA,
DEPARTMENT OF PUBLIC WORKS,
Sacramento, August 8, 1950.

Maj. Gen. LEWIS A. PICK,
Chief of Engineers, United States Army,
Washington, D. C.

DEAR SIR: Your proposed report on preliminary examination and survey of Humboldt Bay, Calif., was received on July 24, 1950, and transmitted on the same date to the division of water resources of this department for review and report thereon.

The report of the division of water resources has been received and is transmitted herewith in accordance with the provisions of Public Law 14, Seventy-ninth Congress, first session.

I concur in the recommendations contained in the report of the division of water resources and it is requested that said report be considered as expressing the views and recommendations of the State of California on your proposed report on preliminary examination and survey of Humboldt Bay, Calif. It is further requested that the report of the division of water resources, dated August 8, 1950, on this subject be transmitted to the President of the United States and to the Congress along with the other material that may be so transmitted.

Yours very truly,

C. H. PURCELL,
Director of Public Works.

Review by State Division of Water Resources of the Proposed Report of the Chief of Engineers, United States Army, on the Preliminary Examination and Survey of Humboldt Bay, Calif.

By letter dated July 17, 1950, to C. H. Purcell, Director of Public Works, the Chief of Engineers, Department of the Army, submitted his proposed report on a preliminary examination and survey of Humboldt Bay, Calif., for comments and recommendations. There were transmitted with the proposed report of the Chief of Engineers, reports of the Board of Engineers for Rivers and Harbors, dated June 20, 1950, of the district engineer, dated February 10, 1950, and of the division engineer, dated February 10, 1950.

The proposed report was received by the Director of Public Works on July 24, 1950, and referred on the same date to the State engineer for review and report thereon. On July 28, 1950, the report was referred by the State engineer to the division of highways, department of natural resources, and State lands commission for comment. The comments of these three State agencies have been received and are included herein.

AUTHORIZATION

The report of survey was submitted in compliance with section 6 of the River and Harbor Act of March 2, 1945, quoted in part as follows:

* * * The Secretary of War is hereby authorized and directed to cause preliminary examination and surveys to be made at the following-named localities:

* * * * * * *

Humboldt Bay, Calif. * * *

PRIOR REPORTS

A public hearing on the necessity of a preliminary examination and survey of Humboldt Bay, Calif., held by the Corps of Engineers in Eureka, Calif., on August 10, 1945, was attended by a member of the staff of the division of water resources. According to the report of the district engineer, dated February 10, 1950, a report of preliminary examination, submitted on February 8, 1946, was reviewed by the Board of Engineers for Rivers and Harbors, and a survey was assigned by the Chief of Engineers on April 24, 1946.

DESCRIPTION OF PRESENT CONDITIONS

The following is quoted from the proposed report of the Chief of Engineers on preliminary examination and survey of Humboldt Bay, Calif.:

Humboldt Bay is on the coast of California, 225 nautical miles north of San Francisco. The bay is about 14 miles long parallel to the coast and 0.5 mile to 4 miles wide. Natural depths in the bay are in general insufficient for large seagoing cargo vessels. Its ocean entrance, about 4 miles north of the south end of the bay, is a jetty-protected opening about 0.5 mile wide through a narrow land strip which forms the west shore of the bay. * * * North of the entrance the bay is known as North Bay and south of the entrance as South Bay. The city of Eureka fronts on North Bay midway along its eastern shore. Arcata is at the north extremity of North Bay and Samoa is near the midpoint of its west shore. Fields Landing is on the east shore of South Bay. The completed

Federal project for Humboldt Harbor and Bay provides for rubble-mound jetties, 4,500 feet and 5,100 feet long, at the entrance; an entrance channel 30 feet deep and 500 feet wide from which a channel with natural depths of 26 feet or more extends to the vicinity of Eureka; a channel 26 feet deep and 400 feet wide from that deep water to N Street, Eureka, mile 6.3; a channel 26 feet deep and 300 feet wide from the same deep water in the bay to Samoa, mile 5.84; a channel 18 feet deep and 150 feet wide to a wharf at Arcata; and a channel 26 feet deep and 300 feet wide to Fields Landing, mile 3.16, with a turning basin 26 feet deep, 600 feet wide, and 800 feet long at its inner end. Costs to the United States for improvements to June 30, 1949, were $5,040,259 for new work, exclusive of $95,000 contributed by local interests, and $4,819,162 for maintenance. * * *

Humboldt Bay, in a generally mountainous region forested with redwood, fir, pine, and other species, serves as an outlet for timber resources of Humboldt and Del Norte Counties. These two counties contain nearly 70 percent of the world's stand of redwood timber, and processing of forest products is the most important industry in the tributary area. The ocean-borne commerce of Humboldt Bay consists principally of shipments of lumber and petroleum products. Because of channel depths, the existing project in Humboldt Bay is no longer adequate for deep-draft cargo vessels which are now in use and will continue to be used in the future. Local interests desire further improvement of the harbor, and a public hearing was held by the Corps of Engineers, Department of the Army, on August 10, 1945, to investigate and consider the project.

RECOMMENDATIONS OF THE CHIEF OF ENGINEERS

After considering the plans of the district engineer and the report of the Board of Engineers for Rivers and Harbors, the Chief of Engineers made the following recommendation:

8. After due consideration, I concur in the views of the Board (Board of Engineers for Rivers and Harbors) and accordingly recommend modification of the existing project for Humboldt Harbor and Bay, Calif., to provide for a bar and entrance channel 40 feet deep at mean lower low water, tapered from a width of 1,600 feet at seaward mile 0.91 to 500 feet at seaward mile 0.18 and thence 500 feet wide to mile 0.75, thence a new North Bay channel 30 feet deep and 400 feet wide to mile 4.29 with easing of the bend at mile 0.75, and depths of 30 feet in Eureka and Samoa Channels over their existing project widths from mile 4.29 to miles 5 and 5.84, respectively; generally in accordance with the plans of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $406,500 for construction and $49,000 annually for maintenance in addition to that now required; subject to the condition that local interests, through the medium of a suitable public body, agree to (*a*) provide and maintain, adjacent to Eureka and Samoa Channels, suitable wharf and terminal facilities, with approach and berthing areas fully adequate for large modern cargo vessels, open to all on equal terms for the storage, handling, and shipment of lumber and general commerce; (*b*) furnish without cost to the United States all lands, easements, and rights-of-way, and suitable spoil-disposal areas for the new work and for subsequent maintenance when and as required, and if they desire the dredge spoil placed in areas of their selection, bear the excess cost over and above the cost for the most economical method of dredging otherwise applicable; and (*c*) hold and save the United States free from damages due to construction and maintenance of the project.

COST OF PROPOSED WORKS

The estimated first cost and annual charges for the proposed plan of improvement are set forth in the report of the district engineer, as follows:

Cost of improvement—recommended project

Improvement	Annual charges				
	First cost	Interest	Amortization	Increased maintenance	Total
Federal investment:					
Bar and entrance channel	$148,400	$4,450	$1,320	$39,600	$45,370
North Bay (new)	149,600	4,490	1,330	9,900	15,720
Samoa Channel	67,300	2,020	600		2,620
Eureka Channel	41,200	1,240	360		1,600
Aids to navigation	3,500	110	30		140
Total	410,000	12,310	3,640	49,500	65,450

The direct benefits representing savings in transportation costs that would result from the proposed improvement to Humboldt Bay are summarized in the report of the district engineer, as follows:

Estimate of annual benefits

Classification	Total future commerce	Commerce requiring 30-foot channels and resultant saving					
		Tributary to North Bay		Transferred from South Bay for shipment		Total	
		Commerce	Saving	Commerce	Saving	Commerce	Saving
Lumber shipments (intercoastal):	*Tons*	*Tons*		*Tons*		*Tons*	
Dutton shipments	180,000	135,000	$73,450			135,000	$73,450
Others	30,000	7,500	7,875	7,500	$7,875	15,000	15,750
To United States possessions	30,000	7,500	5,400	7,500	5,400	15,000	10,800
Foreign export	120,000	15,000	15,750	15,000	15,750	30,000	31,500
Lumber totals	360,000	165,000	102,475	30,000	29,025	195,000	131,500
Petroleum receipts	200,000	200,000	27,800			200,000	27,800
Total benefits	560,000	365,000	130,275	30,000	29,025	395,000	159,300
Less added transportation charges					13,000		13,000
Net benefits	560,000	365,000	130,275	30,000	16,025	395,000	146,300

On the basis of the foregoing estimates, the district engineer finds that the ratio of evaluated annual benefits to annual charges is 2.24 to 1.

COOPERATION BY LOCAL INTERESTS

By resolution, adopted May 2, 1949, the Board of Supervisors of the County of Humboldt, State of California, advised the Corps of Engineers of the willingness of the board to comply with the requirements of the Corps of Engineers to—

(*a*) Provide without cost to the United States all lands, easements, rights-of-way, and suitable disposal areas with impounding works for dredged material as may be required for the construction and maintenance of the project and if they desire the dredge spoils be placed in areas of their selection that they bear the excess cost over and above the most economical method of dredging otherwise applicable.

(*b*) Hold and save the United States free from all claims for damages due to initial construction and subsequent maintenance of the project.

(c) Make available to all shippers a dock or docks with adequate facilities, including approach and berthings, open to all on equal and reasonable terms for the storage, handling, and loading of cargo, other than petroleum products.

CALIFORNIA DIVISION OF HIGHWAYS

G. T. McCoy, State highway engineer, submitted the following comments on July 31, 1950:

Reference is made to your interdepartmental communication of July 28, 1950, your file No. 360.21, submitting for review the report of the Chief of Engineers on a preliminary examination and survey of channel and harbor improvement of Humboldt Bay.

It is understood that the Chief of Engineers' report essentially concurs in the report of the district engineer submitted to this department on February 23, 1950. The division of highways, under date of March 14, 1950, concurred in the conclusion that the proposed harbor improvement would have no adverse effect on interests of the division of highways. This is on the assumption that the disposal of dredging material will not encroach on State facilities or drainage. It is understood that the authorization for this project is confined to channel improvement and related essentials and cannot give consideration to shore line protection opposite the mouth of the harbor.

DEPARTMENT OF NATURAL RESOURCES

Gen. Warren T. Hannum, Director of Natural Resources, stated in his communication dated August 1, 1950, that the comments submitted on March 6, 1950, with reference to the report of the district engineer were applicable to the project proposed by the Chief of Engineers. Those comments are as follows:

In response to yours of February 23 transmitting copy of the subject report, the executive officer of the division of fish and game, who has reviewed the report recommends that—

(1) Construction and dredging should be so carried out as not to interfere with the free movement of fish between Humboldt Bay and the ocean.

(2) Care should be taken that no dredged materials are placed where they would damage clam and oyster beds. There is considerable concern that past dredging practices have resulted in deposition of dredged material on the clam and oyster beds.

(3) The Wildlife Conservation Board and the Fish and Game Commission have authorized the purchase of the southern spit of Humboldt Bay as a recreational fishing and hunting area. It is urged that no dredged materials be deposited in such a way that they would adversely affect this valuable recreational area.

The undersigned recommends that in execution of the project the Federal agency charged therewith, consult with the State Division of Fish and Game with a view to avoiding damage to the conservation of fish life, including shellfish. Since the south spit is overtopped occasionally during severe storms it is recommended that, if found economical in disposal of dredged material, the Division of Fish and Game be consulted with a view to precluding such overtopping.

STATE LANDS COMMISSION

Col. Rufus W. Putnam, executive officer of the State lands commission, submitted the following comments on March 24, 1950, which are considered pertinent to the report under review:

We have reviewed the San Francisco District Engineer's Survey Report on Humboldt Bay, Calif., dated February 10, 1950, transmitted with your letter of February 23, 1950.

In your comments on the report, please include assurance from the State lands division that full cooperation will be forthcoming from this division in the matter of providing disposal areas for dredger spoils. Additional public benefit might be derived from the project as recommended if arrangements can be made to use the dredger spoil to fill and reclaim adjacent shallow tidelands of the State.

CONCLUSIONS

The following conclusions are reached with respect to the plan recommended in the proposed report of the Chief of Engineers, United States Army, for the improvement of Humboldt Bay, Calif., giving consideration to (*a*) the need for the project; (*b*) the engineering feasibility and effectiveness of the proposed works; and (*c*) the economic justification of the project:

1. The recommended improvement is needed to provide improved facilities for deep-draft vessels now in use.

2. The proposed works for improvement of the harbor are feasible from an engineering standpoint, and will function effectively for the purposes for which they are designed.

3. Local interests appear to be willing and able to extend the required cooperation and the public body required to regulate the harbor may be established either through county interest or sponsorship or through extension of duties, authorities, and responsibilities of the legally authorized State board of harbor commissioners for Humboldt Bay.

4. The estimated costs of the project have been reviewed and appear reasonable. Based on the annual benefits as determined by the district engineer, the project is economically feasible.

5. The use of the proposed works for navigation will not conflict with any beneficial consumptive use, present or future, of waters for domestic, municipal, stock-water, irrigation, mining, or industrial purposes or any development in connection therewith.

RECOMMENDATIONS

It is recommended that the project for improvement of navigation, Humboldt Bay, Calif., as outlined in the proposed report of the Chief of Engineers, United States Department of the Army, be approved and authorized; and it is further recommended that Federal funds be appropriated for its construction.

A. D. EDMONSTON, *State Engineer.*

SACRAMENTO, CALIF., *August 8, 1950.*

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D. C., October 10, 1950.

Maj. Gen. LEWIS A. PICK,
Chief of Engineers, Department of the Army,
Washington, D. C.

MY DEAR GENERAL PICK: By letter dated July 17, 1950 (ENGWD) you transmitted, for the information and comments of the Department, copies of your proposed report on a preliminary examination and survey of Humboldt Bay, Calif., together with the reports of the Board of Engineers for Rivers and Harbors and of the district and division engineers.

The report was the subject of letters of the Fish and Wildlife Service of this Department dated April 20 and May 31, 1950, sent by

the regional office to the Board of Engineers for Rivers and Harbors. These letters describe the importance of the eelgrass beds in Humboldt Bay which provide food for migratory waterfowl, particularly black brant. Since Humboldt Bay is one of the principal wintering areas for this species and there is no replacement area available, concern was expressed for the maintenance of this excellent waterfowl habitat. It appears that the spoil from dredging operations would be placed outside the entrance channel and on predetermined land areas in the central portion of the bay. None of the spoil areas proposed in the report are near the eelgrass areas in either the North Bay or South Bay. Consequently, the project as presently planned will have little effect on the waterfowl utilization of Humboldt Bay.

The California Division of Fish and Game has expressed the desire that dredging material be disposed of in such a way that it will not be deposited as silt over the clam beds in the bay. Present plans of the Corps of Engineers indicate that damage to the clam beds from siltation will be kept to a minimum. Although the Fish and Wildlife Service cannot foresee any measurable losses to fish and wildlife as a result of this project, the Department recommends that—

1. Dredging activities and the transportation and deposition of spoils be managed so as to keep dispersal of silt to a minimum throughout Humboldt Bay.

2. Spoils deposited on the shores of Humboldt Bay be so placed that silt will not be washed into the bay where it would cause siltation of eelgrass and clam beds or interfere with the recreational development of the South Spit.

If, at such time as the project is authorized, spoil locations are contemplated other than described in the report, the Fish and Wildlife Service would like to be notified by the district engineer so that means can be explored for the solution of any wildlife problems which may arise.

The Department has been advised that the California Division of Fish and Game is acquiring ownership of the South Spit, along the west side of South Humboldt Bay, for surf fishing, waterfowl management, and general recreational purposes. Therefore, any changes in project plans that might involve the South Spit will be of particular interest to that agency.

I am pleased to advise you that the recommendations will not adversely affect the interests of this Department providing the above stipulations with reference to the disposal of dredging spoils are carried out.

Opportunity to review the report is appreciated.

Sincerely yours,

WILLIAM E. WARNE,
Assistant Secretary of the Interior.

REPORT OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., October 23, 1950.

Subject: Humboldt Bay, Calif.
To: The Secretary of the Army.

1. I submit for transmission to Congress my report with accompanying papers on preliminary examination and survey of Humboldt Bay, Calif., authorized by the River and Harbor Act approved March 2, 1945.

2. Humboldt Bay is on the coast of California, 225 nautical miles north of San Francisco. The bay is about 14 miles long parallel to the coast and 0.5 mile to 4 miles wide. Natural depths in the bay are in general insufficient for large seagoing cargo vessels. Its ocean entrance, about 4 miles north of the south end of the bay, is a jetty-protected opening about 0.5 mile wide through a narrow land strip which forms the west shore of the bay. Zero of the mileage system for the bay channels is between the jetties and approximately in line with the ocean shore. North of the entrance the bay is known as North Bay and south of the entrance, as South Bay. The city of Eureka fronts on North Bay midway along its eastern shore. Arcata is at the north extremity of North Bay and Samoa is near the midpoint of its west shore. Fields Landing is on the east shore of South Bay. The completed Federal project for Humboldt Harbor and Bay provides for rubble-mound jetties, 4,500 feet and 5,100 feet long, at the entrance; an entrance channel 30 feet deep and 500 feet wide from which a channel with natural depths of 26 feet or more extends to the vicinity of Eureka; a channel 26 feet deep and 400 feet wide from that deep water to "N" Street, Eureka, mile 6.3; a channel 26 feet deep and 300 feet wide from the same deep water in the bay to Samoa, mile 5.84; a channel 18 feet deep and 150 feet wide to a wharf at Arcata; and a channel 26 feet deep and 300 feet wide to Fields Landing, mile 3.16, with a turning basin 26 feet deep, 600 feet wide, and 800 feet long at its inner end. Costs to the United States for improvement to June 30, 1949, were $5,040,259 for new work, exclusive of $95,000 contributed by local interests, and $4,819,162 for maintenance. Tides have a mean range of 6.7 feet at Eureka. The wharf and project channel at Arcata have not been used for many years and are not maintained. The principal terminal facilities adjacent to the deep-water channels are a lumber wharf, fishing wharf, and whaling station at Fields Landing; a lumber wharf at Samoa; two oil-company wharves on North Bay south of Eureka; a lumber wharf near mile 4.9 at Eureka; and a number of other wharves in that vicinity.

3. Humboldt Bay is in a generally mountainous region forested with redwood, fir, pine, and other species. In the immediate vicinity of the bay are plains and low hills partially devoted to farming. The bay serves as an outlet for the timber resources of Humboldt and Del Norte Counties and adjacent areas. These two counties have a population of 61,500 including 21,380 at Eureka, the largest city. They contain nearly 70 percent of the world's stand of redwood timber. Processing of forest products is the most important industry in the

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tributary area. Lumber production in 1948 approached 1 billion board-feet or 1,500,000 tons. During the period 1920 to 1948, inclusive, the ocean-borne commerce on Humboldt Bay averaged 316,390 tons annually, principally shipments of lumber and receipts of petroleum products. Recently commerce has been hampered by strikes in the maritime and lumber industries, increased costs for vessel operation, and the inadequacy of the existing channels for the larger vessels now in general use. In 1948 the ocean-borne commerce of the bay totaled 179,365 tons, consisting of 151,311 tons of petroleum products, 15,415 tons of lumber products, and 12,639 tons of sea food. In that year reported traffic on the bay exclusive of movements of fishing vessels and ferry taxis consisted of 109 in-bound and out-bound vessel trips, 8 of which were made by steamers drawing in excess of 24 feet. The preponderance of dry-cargo vessels now in service in the intercoastal and offshore trade have a full-load draft of about 28 feet. Coastwise tankers now in general use vary in full-load draft from 25 to 30 feet. The bay area is served by improved highways, a common-carrier railroad, and private logging railroads.

4. Local interests desire further improvement of Humboldt Harbor and Bay to provide an entrance channel 40 feet deep; depths of 30 feet in all the inner channels leading to the principal terminals and in the turning basin at Fields Landing; a width of 400 feet in Fields Landing Channel along an improved alinement; a width of 900 feet in the Fields Landing turning basin; and an easier bend from the entrance channel into North Bay. They state that cargo vessels now in general use need improvements of these dimensions for safety, full loading, and avoidance of tidal delays. Ship operators consider it desirable to improve the entrance as proposed in order that large vessels may use the bay as a harbor of refuge. Local interests indicate that suitable conditions of local cooperation will be met.

5. The district engineer presents a plan for further improvement of the entrance channel to Humboldt Bay and of the channels in North Bay to Eureka and Samoa. The plan includes deepening the entrance channel to 40 feet, widening it to 1,600 feet at the outer end at seaward mile 0.91, thence tapering to 500 feet at seaward mile 0.18 and continuing at that width to mile 0.75; deepening the natural channel in North Bay to provide a depth of 30 feet for a width of 400 feet from mile 0.75 to mile 4.29 including easing the bend at mile 0.75; deepening Eureka Channel between miles 4.29 and 5 to 30 feet over the existing project width of 400 feet; and deepening Samoa Channel to 30 feet from mile 4.29 to mile 5.84 for the existing project width of 300 feet. He estimates the cost to the United States for this new work at $406,500, exclusive of $3,500 for establishing navigation aids, and the Federal annual carrying charges at $65,450 including $49,500 for additional maintenance. He finds that such costs as may be incurred by local interests will be offset by terminal charges. The district engineer estimates the prospective annual commerce for transport on these channels, in vessels requiring depths of between 26 feet and 30 feet in the interior channels, at 195,000 tons of lumber shipments and receipts of 200,000 tons of petroleum products. He evaluates the benefits of his plan at $146,300 annually. This consists of $159,300 for savings in vessel operation costs in the movement of these commodities reduced by $13,000 for increased cost of land transportation to deliver 30,000 tons of the lumber to terminals on

North Bay. The benefit-cost ratio is 2.24. He estimates the incremental annual charges for improving Fields Landing Channel as desired, enlarging and deepening the basin, and rebuilding the Fields Landing lumber wharf to withstand dredging to depths of 30 feet alongside, at $28,250, of which $6,600 is for the wharf. For these improvements the prospective commerce requiring channel depths of between 26 and 30 feet consists of the 30,000 tons of lumber mentioned above on which the saving in vessel operation costs is estimated at $29,025 annually. However, the same saving in vessel operation costs could be realized by land transportation of this lumber to North Bay terminals at an additional annual cost of $13,000. Therefore the incremental benefit attributable to improvement of Fields Landing Channel and Basin including the wharf is estimated at $13,000, and the benefit-cost ratio is 0.46. The district engineer concludes that this work is not economically justified at this time.

6. The district engineer recommends modification of the existing project for Humboldt Harbor and Bay to provide for further improvement of the entrance channel and the channels in North Bay in accordance with his described plan, subject to the condition that local interests, through the medium of a suitable public body, give satisfactory assurances that they will provide and maintain, adjacent to the Eureka and Samoa Channels, adequate wharf and terminal facilities open to all on equal and reasonable terms for the storage, handling, and shipment of lumber and general commerce; provide and maintain adequate depths in the approach and berthing areas of these wharves; provide rights-of-way and spoil areas, and if they desire the dredge spoil placed in areas of their selection, bear the cost in excess of the cost of the most economical method of dredging otherwise applicable; and hold the United States free from claims for damages. The division engineer concurs.

7. The Board of Engineers for Rivers and Harbors, after consideration of the additional information presented by local interests at a hearing before the Board and in separate communications, agrees that additional improvement of Humboldt Bay as recommended by the reporting officers is advisable. It computes the prospective benefits at $141,800 annually and the benefit-cost ratio at 2.17. The Board recommends further improvement of the harbor and bay in general accordance with the plans of the district engineer subject to certain conditions of local cooperation.

8. After due consideration, I concur in the views of the Board and accordingly recommend modification of the existing project for Humboldt Harbor and Bay, Calif., to provide for a bar and entrance channel 40 feet deep at mean lower low water, tapered from a width of 1,600 feet at seaward mile 0.91 to 500 feet at seaward mile 0.18 and thence 500 feet wide to mile 0.75, thence a new North Bay Channel 30 feet deep and 400 feet wide to mile 4.29 with easing of the bend at mile 0.75, and depths of 30 feet in Eureka and Samoa Channels over their existing project widths from mile 4.29 to miles 5 and 5.84, respectively; generally in accordance with the plans of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $406,500 for construction and $49,500 annually for maintenance in addition to that now required; subject to the condition that local interests, through the medium of a suitable public body, agree to (*a*) provide and main-

tain, adjacent to Eureka and Samoa Channels, suitable wharf and terminal facilities, with approach and berthing areas fully adequate for large modern cargo vessels, open to all on equal terms for the storage, handling, and shipment of lumber and general commerce; (*b*) furnish without cost to the United States all lands, easements, and rights-of-way, and suitable spoil-disposal areas for the new work and for subsequent maintenance when and as required, and if they desire the dredge spoil placed in areas of their selection, bear the excess cost over and above the cost for the most economical method of dredging otherwise applicable; and (*c*) hold and save the United States free from damages due to construction and maintenance of the project.

LEWIS A. PICK,
Major General,
Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

[Second endorsement]

THE BOARD OF ENGINEERS
FOR RIVERS AND HARBORS,
Washington, D. C., June 20, 1950.

Subject: Humboldt Bay, Calif.
To: The Chief of Engineers, United States Army.

1. Local interests were informed of the recommendations of the reporting officers and afforded an opportunity to present additional information to the Board of Engineers for Rivers and Harbors. At their request, the Board held a public hearing in Washington, D. C., at which local interests urged further improvement of Humboldt Bay in accordance with the plan presented by the district engineer. They pointed out that adjacent areas contain extensive publicly and privately owned forests constituting one of the last major blocks of virgin timber in the United States and that in addition to redwood the forests include large stands of fir and other species only recently recognized as being of major importance in meeting the demand for lumber. The data presented indicate that lumbering activities in this region are rapidly increasing. Local interests stated that harvesting and marketing of the timber is hampered by lack of sufficient rail- and water-transportation facilities. Due to the rugged terrain and consequent difficulties in construction of connecting railroads, Humboldt Harbor is the natural outlet for timber shipment by water. However, sufficient depth to accommodate the deep-draft vessels now engaged in the trade is necessary for the economic and full use of the harbor. They maintained that the improvements proposed at Humboldt Bay would facilitate use of the region as a source of large quantities of lumber on a sustained-yield basis and would be an excellent investment in the interest of the general public.

2. Request was made in one communication for extension of the project channel, approximately 2,200 feet above N Street in Eureka, mile 6.3, to permit barge shipments of petroleum products to a terminal at T Street, the construction of which is now under advisement. The cost of this extension as estimated by the Board is $144,000 for initial dredging and $2,700 annually for maintenance. No proponents of this improvement appeared at the hearing. Representatives of the

harbor committee of the Board of Supervisors for Humboldt County and other local officials stated that they had no knowledge of any final action being taken that would assure construction of a terminal at that locality and did not request the channel extension. Due to lack of assurance that the tentative plan to barge petroleum products to T Street will be adopted and a terminal provided, and for the reason that adequate depths are available to the site at high tide, the Board considers it inadvisable to recommend the channel extension at this time.

3. After taking into account the additional information and views presented by local interests at the hearing and in separate communications received, the Board of Engineers for Rivers and Harbors agrees that further improvement of Humboldt Bay as recommended by the reporting officers is warranted. This work, with the existing project channel to Fields Landing, will in the opinion of the Board suitably meet the needs of commerce which can be regarded with reasonable certainty as prospective at this time. The district engineer estimates the annual benefits of the further improvement at $118,500 for savings in the cost of lumber shipments and $27,800 for savings in tanker operation costs applicable to the receipt of petroleum products. The Board, using lower daily costs for tanker operation which it finds to be more realistic, evaluates the savings on prospective receipt of 200,000 tons of petroleum products at $23,300 annually. It thus estimates the combined benefits at $141,800. This, compared with the estimated annual carrying charges of $65,450 for the work, indicates economic justification by a benefit-cost ratio of 2.17.

4. Accordingly the Board recommends modification of the existing project for Humboldt Harbor and Bay, Calif., to provide for a bar and entrance channel 40 feet deep at mean lower low water, tapered from a width of 1,600 feet at seaward mile 0.91 to 500 feet at seaward mile 0.18 and thence 500 feet wide to mile 0.75, thence a new North Bay Channel 30 feet deep and 400 feet wide to mile 4.29 with easing of the bend at mile 0.75, and depths of 30 feet in Eureka and Samoa Channels over their existing project widths from mile 4.29 to miles 5 and 5.84, respectively; generally in accordance with the plans of the district engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $406,500 for construction and $49,500 annually for maintenance in addition to that now required; subject to the condition that local interests, through the medium of a suitable public body, agree to: (*a*) provide and maintain, adjacent to Eureka and Samoa Channels, suitable wharf and terminal facilities, with approach and berthing areas fully adequate for large modern cargo vessels, open to all on equal terms for the storage, handling, and shipment of lumber and general commerce; (*b*) furnish without cost to the United States all lands, easements, and rights-of-way, and suitable spoil-disposal areas for the new work and for subsequent maintenance when and as required, and if they desire the dredge spoil placed in areas of their selection, bear the excess cost over and above the cost for the most economical method of dredging otherwise applicable; and (*c*) hold and save the United States free from damages due to construction and maintenance of the project.

For the Board:

J. S. Bragdon,
Brigadier General, Chairman.

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The district engineer finds that the deep-water commerce of Humboldt Bay consists almost wholly of lumber shipments and receipts of petroleum products; that although the total volume of commerce in these products was but 166,726 tons in 1948, commercial activity is expected to develop in the near future to 560,000 tons annually; that channel depths are inadequate for navigation by fully loaded, deep-draft, cargo vessels at the lower stages of tide. He further finds that the improvement of all the channels of the Bay, as originally requested by local interests, is not required to meet the needs of commerce. However, the improvement of the bar and entrance channel, the North Bay and Samoa Channels, and the lower portion of Eureka Channel would be justified by tangible benefits in the form of reduced transportation costs and the intangible benefits from its increased value as a harbor of refuge and would provide for existing and future prospective commerce. The district engineer, therefore, recommends that the existing project for Humboldt Harbor and Bay, Calif., be modified to provide for a bar and entrance channel 40 feet deep at mean lower low water and tapered from a 1,600-foot width at seaward mile 0.91 and 500 feet at seaward mile 0.18, thence 500 feet wide to mile 0.75; for a new North Bay Channel 30 deep feet at mean lower low water and 400 feet wide to extend from mile 0.75 to mile 4.29; for deepening the lower portion of the Eureka Channel, from mile 4.29 to the first bend in the channel at mile 5. to a depth of 30 feet at mean lower low water, the bottom width to remain at 400 feet as provided for in the existing project; for the deepening of Samoa Channel to 30 feet below mean lower low water, from mile 4.29 to mile 5.84, the bottom width to remain at 300 feet as provided for in the existing project; all at an estimated Federal first cost of $410,000 for new work, including $3,500 for additional aids to navigation, and at an estimated increased annual maintenance cost of $49,500. The district engineer further recommends that the proposed improvements to Humboldt Bay be made subject to the condition that local interests, through the medium of a public body legally and financially qualified to assume the necessary obligations, shall give assurances satisfactory to the Secretary of the Army that they will:

(*a*) Provide and maintain, adjacent to the Eureka and Samoa Channels, adequate wharf and terminal facilities, open to all on equal and reasonable terms, for the storage, handling, and shipment of lumber and general commerce.

(*b*) Provide and maintain, in the approach and berthing areas of the aforementioned wharves, depths fully adequate for the large modern cargo vessels which will use the adjacent project channels.

(*c*) Provide without cost to the United States all lands, easements, rights-of-way, and suitable disposal areas for dredged material as may be required for the construction and maintenance of the project, and if they desire the dredge spoils placed in areas of their selection, bear the excess cost over and above the most economical method of dredging otherwise applicable.

(*d*) Hold and save the United States free from all claims for damage due to construction and maintenance of the project.

CORPS OF ENGINEERS, UNITED STATES ARMY,
OFFICE OF THE DISTRICT ENGINEER,
SAN FRANCISCO DISTRICT,
San Francisco, Calif., February 10, 1950.

Subject: Survey report, Humboldt Bay, Calif.
Through: The Division Engineer, South Pacific Division, Corps of Engineers, United States Army, Oakland, Calif.
To: The Chief of Engineers, United States Army, Washington, D. C.

AUTHORITY

1. *Legislative authority.*—This report of survey is submitted in compliance with section 6 of the River and Harbor Act of March 2, 1945, quoted in part as follows:

* * * The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities:

* * * * * * *

Humboldt Bay, California

* * * * * * *

SCOPE OF SURVEY

2. *Departmental assignment.*—A report of preliminary examination, submitted on February 8, 1946, was reviewed by the Board of Engineers for Rivers and Harbors, and a survey was assigned by the Chief of Engineers on April 24, 1946.

3. The scope of this survey includes consideration of modification of the existing Corps of Engineers project to permit use of the harbor by vessels of deeper draft, to increase traffic capacity, and to increase safety of navigation. Investigation was made of the present utilization of all parts of the project and of the potential use. Present industrial and commercial activities of the area were studied with particular attention to lumbering and petroleum activities. Representatives of these industries furnished much useful information, as did shippers, ship operators, and the Eureka Chamber of Commerce.

4. A complete hydrographic-topographic survey of the bay and its adjoining land areas was prepared, and field reconnaissances were made to complete the investigations necessary for this report.

DESCRIPTION

5. *Location.*—Humboldt Bay, a land-locked harbor on the coast of northern California, is about 225 nautical miles north of San Francisco and about 156 nautical miles south of Coos Bay, Oreg. The entrance is protected by two rubble-mound jetties, which are about one-half mile apart, and extend from the ends of two long, narrow sand spits separating the bay from the ocean. The width of the bay varies from ½ to about 4 miles, and the length is 14 miles. The high and low water areas are 24.5 and 7.8 square miles, respectively. Humboldt Bay is shown on United States Coast and Geodetic Survey Chart No. 5832 and on the map, enclosure 1, accompanying this report.

6. The southern portion of Humboldt Bay extends about 4 miles south from the entrance, widening gradually from ½ mile to 2¼ miles in width. A dredged channel extends for some 2 miles from the entrance to Fields Landing, which lies about midway along the east side of the South Bay.

7. North of the entrance, a fairly deep natural channel closely follows the north spit for about 4 miles to the junction of the Samoa and Eureka Channels. The latter channel, following Eureka slough, is dredged for almost 2 miles along the waterfront of the city of Eureka. The northern or Samoa Channel is dredged across Indian Island Shoal for about 1 mile to Samoa on the north spit. A natural channel extends in a northeasterly direction from Samoa, through the shoal waters of Arcata Bay to a channel about 1 mile long originally dredged to serve the city of Arcata. No maintenance work has been done or requested on the Arcata Channel for over 15 years. Wharves and piers related to that channel have been either removed or allowed to go unrepaired. No traffic occurs on this waterway and no requests for its improvement have been made.

8. *Tidal range.*—The tidal range between mean lower low water and mean higher high water is 6.4 feet at the south jetty and 6.7 feet

at Eureka. The extreme range is 12.5 feet at the south jetty and 12 feet at Eureka. Tides more than 2 feet below mean lower low water have been recorded. All depths and elevations used in this report are referred to the datum of mean lower low water unless otherwise noted.

9. *Adjacent harbors.*—Humboldt Bay is the only existing harbor of any commercial importance, or of value for refuge, to large vessels between San Francisco and Coos Bay, Oreg. The nearest improved harbors useful to small craft are at Noyo River, 95 nautical miles to the south, and at Crescent City, 62 nautical miles to the north.

10. *Local drainage, etc.*—The drainage area tributary to Humboldt Bay comprises 223 square miles. The principal streams are Jacoby Creek, Mad River slough, and Eureka slough to the north and northeast, Elk River to the east, and Hookton slough to the south. Except for log rafting and the boating engaged in by sportsmen, the tributary streams are seldom used for navigation. No bridges cross the bay or entrance channel.

TRIBUTARY AREA

11. *Description.*—The area directly tributary to Humboldt Bay considered as an outlet to the timber resources of the region, includes all of Humboldt and Del Norte Counties and a portion of Trinity and Siskiyou Counties. On the basis of petroleum products, which are transported by water to terminal facilities at Eureka, the tributary area extends well into southern Oregon and as far east as Yreka in north central California.

12. The immediate terrain in the vicinity of Humboldt Bay, and extending for about 35 miles along the ocean from the Eel River Delta to near Trinidad, consists of a relatively narrow-benched triangular-shaped coastal plain. This plain generally is grass covered in the delta and low hill area with some cultivated fields, and with brush and tree growths on the higher slopes. Another similar but smaller coastal plain is located to the north, extending from Crescent City to Smith River. With the exception of these two coastal plains, the tributary area is generally mountainous with numerous narrow valleys and canyons and is densely forested. Mountain elevations are predominantly from 3,000 to 5,000 feet with some peaks exceeding 6,000 feet. Principal streams traversing the area are, from north to south, the Smith, Klamath, Mad, and Eel Rivers.

13. Of the almost 4,600 square miles of land in Humboldt and Del Norte Counties, 64 percent is privately owned. Approximately 32 percent of the area is classified as land in farms. However, only about 2 percent, or 60,000 acres, is in crops. The remainder is woodland or range land. Cattle are grazed on the hill slopes, bench lands, and on the higher ranges. About 85 percent of the publicly owned land is in national forests and parks. Timberland comprises 72 percent of the total area in Humboldt County, 63 percent of Del Norte County, and 73 percent of the tributary area in Trinity and Siskiyou Counties.

14. *Cities and population.*—The principal cities in the bay area are Eureka and Arcata, with populations of about 21,380 and 3,800 respectively. Eureka is the urban center of the entire north coastal area of California and the site of many service and wholesale businesses. Humboldt State College is located at Arcata. Crescent

City, 85 miles north of Eureka by highway, is the only incorporated city in Del Norte County and is now estimated to have a population of approximately 3,000. The total population of Del Norte and Humboldt Counties is estimated at almost 62,000. The trend of population is indicated in the following table:

TABLE I.—*Population trends*

	1910	1920	1930	1940	1948
Del Norte County	2,417	2,759	4,739	4,745	6,500
Humboldt County	33,857	37,413	43,233	45,812	55,000
Total	36,274	40,172	47,972	50,557	61,500

15. *Resources.*—The distinctive natural resource of the tributary area is its extensive forests of redwood, fir, pine, and other species. Humboldt and Del Norte Counties contain almost 70 percent of the world's stand of redwood timber. The total volume for all species of standing timber is over 61 billion feet, board measure, distributed as follows:

TABLE II.—*Timber volume, by county and ownership, tributary to Humboldt Bay*

County	Ownership	Volume (millions of board feet)		
		Redwood	Fir, pine, and other	Total
Del Norte	Public	1,751	3,632	5,383
	Private	4,497	1,964	6,461
	Total	6,248	5,596	11,844
Humboldt	Public	1,756	7,108	8,864
	Private	18,127	18,928	37,055
	Total	19,883	26,036	45,919
Trinity (tributary area)	Public	----------	2,439	2,439
	Private	----------	224	224
	Total	----------	2,663	2,663
Siskiyou (tributary area)	Public	----------	1,050	1,050
	Private	----------	25	25
	Total	----------	1,075	1,075
Total tributary area	Public	3,507	14,229	17,736
	Private	22,624	21,141	43,765
	Total	26,131	35,370	61,501

16. Cool summers, mild winters, abundant rainfall, and year-round green pastures give this region exceptional advantages for dairying and all forms of livestock production. The value of agricultural production within the area during 1947 was estimated at approximately $17 million, of which approximately one-half was derived from dairy products. Lamb raising and wool production was next in importance followed by beef cattle and poultry production. Truck and field crops, apples, nuts, and other fruits are grown. The area is also noted for the production of berries, flowers, nursery stock, and seeds.

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17. Although largely undeveloped, there are numerous and substantial deposits of manganese, chromite, iron, quicksilver, lime, clay, and coal within the area. In 1945, mineral production in Humboldt and Del Norte Counties amounted to approximately $542,000, largely because of a wartime revival of manganese and chromite mining. Natural gas is obtained from wells 16 miles south of Eureka in sufficient quantity to supply the needs of Humboldt County.

18. Numerous species of fish and shellfish are caught in waters off the Humboldt coast. In 1946, rockfish, sole, and crab accounted for 75 percent of the more than 20 million pounds landed at docks within Humboldt Bay.

19. *Industry.*—Processing of forest products is the most important industry of the tributary area. In Humboldt County alone there are 62 mills with an estimated daily output of from ten to forty-nine thousand feet, board measure; 13 from fifty to ninety-nine thousand feet; 5 from one hundred to one hundred and ninety-nine thousand feet; and 2 with over two hundred thousand feet. The annual cutting capacity of all mills within the county, based on a 5-day week, is almost 900 million board feet. In addition, Humboldt County has 2 large plywood mills with another under construction, 21 shingle and shake mills, and 24 mills producing water-cooling towers, cross arms, and various other wood products.

20. It is estimated that lumber production within the tributary area has averaged approximately 376 million feet, board measure, annually since 1920. Production in 1947 was approximately 711 million feet, and about 1 billion feet in 1948. It is estimated by United States Forest Service authorities that timber production during the next 30 or 40 years will average close to a billion feet per year and, if better forest practices are followed, the sustained yield of this area should be close to that volume. With greater utilization of the tree for lumber and plywood, an even greater recovery may be made.

21. Within Humboldt County, principally in the Humboldt Bay-Eel River area, there are 9 plants engaged in the processing of dairy products, 3 meat packers, 4 foundries and steel works, 5 building-material manufacturers, and 11 fish-processing plants.

22. *Transportation services and utilities.*—The Northwestern Pacific Railroad connects the locality with San Francisco. Several private logging railroads connect the interior lumbering operations with the Northwestern Pacific Railroad and the harbor terminal facilities. Highways U S 101 and 299 provide access from north, south, and east, and an adequate system of local roads serves the general area. Humboldt County Airport is now used by United Air Lines and Southwest Airways operating to the Pacific Northwest from San Francisco. Adequate telephone and telegraph service to all points is available, and the area is served with electric power by the Pacific Gas & Electric Co.

BRIDGES

23. No bridges exist across any portion of Humboldt Bay proper.

PRIOR REPORTS

24. *Pertinent reports.*—There have been numerous reports concerning Humboldt Harbor and Bay, either alone or in combination with

other localities. The reports authorizing the several portions of the existing project are as follows:

TABLE III.—*Prior reports*

Document containing report	Recommendation	Adopted by River and Harbor Act of—
H. Doc. 950, 60th Cong., 1st sess.	Rebuilding the jetties	June 25, 1910
H. Doc. 755, 69th Cong., 2d sess.	Eureka Channel, 20 feet deep, 300 feet wide Samoa Channel, 20 feet deep, 250 feet wide Arcata Channel, 18 feet deep, 150 feet wide Fields Landing Channel, 20 feet deep, 250 feet wide.	July 3, 1930
Rivers and Harbors Committee Doc. 14, 74th Cong., 1st sess.	Entrance Channel, 30 feet deep, 500 feet wide	Aug. 30, 1935
Rivers and Harbors Committee Doc. 11, 75th Cong., 1st sess.	Eureka Channel, 26 feet deep, 400 feet wide Samoa Channel, 26 feet deep, 300 feet wide Fields Landing Channel, 26 feet deep, 300 feet wide. Turning basin off Fields Landing wharf, 26 feet deep, 600 feet wide, and 800 feet long.	Aug. 26, 1937

EXISTING CORPS OF ENGINEERS' PROJECT

25. *History and present status.*—The first Corps of Engineers' project for the improvement of Humboldt Bay was adopted by the River and Harbor Act of March 3, 1881. Work was begun under contract in 1881 and a channel dredged 10 feet deep, 240 feet wide, and 4,100 feet long in front of Eureka. Dredging of the Samoa and Arcata Channels as well as a channel to Hookton began shortly thereafter. The River and Harbor Act of July 5, 1884, provided for a single rubble-mound jetty along the south side of the Entrance Channel. This project was modified in 1888 and again in 1891 to provide for two parallel rubble-mound jetties, including shore-protection enrockments. Construction of the south jetty began in 1889 and the north jetty in 1891. The original jetties have since been entirely rebuilt. The existing project provides for two rubble-mound jetties at the entrance, the north jetty about 4,500 feet in length and the south jetty 5,100 feet long, not including shore revetments; for an entrance channel 30 feet deep and 500 feet wide; for a channel 26 feet deep and 400 feet wide from deep water in Humboldt Bay to the foot of N Street, Eureka; a channel 26 feet deep and 300 feet wide across Indian Island Shoal to Samoa; a channel 18 feet deep and 150 feet wide to Arcata wharf; and a channel 26 feet deep and 300 feet wide to Fields Landing, with a turning basin 26 feet deep, 600 feet wide, and 800 feet long off the Fields Landing wharf. The project was completed in 1939.

26. *Costs of project and maintenance.*—The total cost of all work to June 30, 1949, was $9,954,421 of which $5,135,259 was for new work and $4,819,162 was for maintenance. (These costs include $95,000 contributed by local interests.)

27. The latest approved estimate (1949) for annual cost of maintenance, representing the actual maintenance costs during the fiscal years 1931 to 1949 inclusive, adjusted to current price levels, is $200,000. The total cost of maintenance for the 5-year period ending June 30, 1949, was $333,986. Dredging maintenance during this period was about average, while jetty repairs were only a fraction of those of previous years.

LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

28. Local interests contributed $95,000 toward the cost of the existing project and also provided disposal areas for dredge spoils. In addition, they expended $24,385 for dredging channels later included in the project. Approximately 41 acres of land at the north end of the South Spit were contributed by local interests, in 1887–88, as required for construction and maintenance of the south jetty. The requirements of local cooperation have been fulfilled.

OTHER IMPROVEMENTS

29. *Navigation.*—No navigation improvements other than those of the Corps of Engineers' project have been made.

TERMINAL AND TRANSFER FACILITIES

30. *Facilities.*—The terminal facilities in Humboldt Bay include about 36 wharves and 7 small-boat landings, of which all but 2 are privately owned. Rail connections exist for 14 of the wharves and 10 of them have warehouse-storage facilities. Some of the wharves are in poor condition. The Arcata wharf is not usable and has been abandoned.

31. *Jurisdiction.*—Nominally, Humboldt Bay is controlled by a State board of harbor commissioners for Humboldt Bay, composed of three members appointed by the Governor with the advice and consent of the State senate. In actuality, however, practically all of the board's duties and authorities are also performed by other agencies. The activities of the board appear to be limited to the gathering of harbor statistics, the guarding of State tideland interests, and the inspection of structures affecting navigation.

32. *Facilities in use.*—The principal wharves adjacent to deep-water channels are the Pacific Lumber Co.'s Fields Landing wharf at the southeasterly end of the bay; a wharf for fishing boats, and the whaling station just north of Fields Landing; the Standard and Union Oil Co.'s wharves near the southerly limits of the city of Eureka; the Coast Pacific Lumber Co. wharf near the entrance to Eureka channel; a number of contiguous wharves along the water front of Eureka; and the Hammond Lumber Co.'s facilities at Samoa, midway along the North Spit.

33. *Future expansion.*—There is ample space available for the development of deep-water terminal facilities. The undeveloped waterfront area immediately south of the city of Eureka appears best suited for future expansion. This area is adjacent to naturally deep water and to rail and highway connections.

IMPROVEMENTS DESIRED

34. *Hearing.*—A public hearing was held by the district engineer on August 10, 1945, at Eureka, Calif. The hearing was attended by approximately 37 persons representing public agencies, chambers of commerce, and the lumber, petroleum, and shipping interests. A transcript of the proceedings accompanied the report on the preliminary examination.

35. *Desires.*—Local interests have expressed the following desires:

(*a*) That the Bar and Entrance Channel be deepened to 40 feet.

(*b*) That the Samoa Channel be deepened to 30 feet.

(*c*) That the Fields Landing Channel be widened to 400 feet, the depth increased to 30 feet, and its alinement improved.

(*d*) That the turning basin at the end of the Fields Landing Channel be deepened to 30 feet, and widened to 900 feet.

(*e*) That the turn from the entrance channel to the North Bay be eased.

36. *Justification.*—The principal reasons advanced in justification of the desired improvement were—

(*a*) Deep-draft cargo vessels, which are now in use and will continue to be employed in the future, have loaded drafts of between 27 and 29 feet. Because of present channel depths, these vessels can only partially load at Humboldt Bay and must proceed to other ports to top off with other cargo. Therefore, additional travel and costs are incurred.

(*b*) To permit maximum loading, vessels often proceed to Humboldt Bay in a light condition and are, therefore, less seaworthy in rough weather.

(*c*) Loaded ships must wait for favorable tides. Deeper channels would permit regular loading and sailing schedules, and would prevent lost time.

(*d*) A safer entrance would prevent ships from being bar-bound and would make the harbor available to vessels in distress.

(*e*) Because of existing conditions, shipowners are forced to omit Humboldt Bay as a port of call and shippers must resort to rail or truck for distribution of their products.

COMMERCE

37. Water-borne commerce through Humboldt Harbor consists principally of lumber shipments and receipts of petroleum products. The tonnage of commerce for oceangoing vessels (exclusive of local traffic), reported to this office for the calendar years 1920 through 1948, is contained in the following table.

TABLE IV.—*Total ocean-borne commerce*

Year	Shipments (short tons)					Receipts (short tons)					Total commerce short tons
	Lumber products			Other (all domestic)	Total	Foreign	Domestic			Total	
	Foreign	Domestic	Total				Petroleum products	Fresh fish	All other		
1920	55,090	97,805	152,895	7,246	160,141	-------	32,574	[1] 1,500	51,324	85,398	245,539
1921	15,032	112,230	127,262	5,971	133,233	-------	33,600	[1] 1,500	43,667	78,767	212,000
1922	78,851	246,665	325,516	9,265	334,781	-------	33,904	[1] 1,500	47,168	82,572	417,353
1923	124,630	301,170	425,800	7,596	433,396	2,000	38,080	[1] 1,500	49,519	91,099	524,495
1924	64,337	407,455	471,792	8,200	479,992	-------	41,920	[1] 1,500	62,336	105,756	585,748
1925	58,154	306,725	364,879	43,927	408,806	-------	54,720	1,570	114,209	170,499	579,305
1926	128,845	256,000	384,845	40,529	425,374	-------	54,500	1,400	117,617	173,517	598,891
1927	117,998	326,563	444,561	9,660	454,221	-------	60,000	1,200	86,720	147,920	602,141
1928	75,190	276,894	352,084	47,000	399,084	-------	60,000	1,100	118,501	179,601	578,685
1929	106,784	245,234	352,018	50,399	402,417	-------	93,615	1,414	122,406	217,435	619,852
1930	29,032	255,421	284,453	11,795	296,248	-------	150,502	1,200	96,300	248,002	544,250
1931	11,615	197,815	209,430	6,269	215,699	1,006	141,238	12,454	42,405	197,103	412,802
1932	4,834	64,132	68,966	4,036	73,002	-------	128,469	3,070	37,147	168,686	241,688
1933	14,068	182,271	196,339	4,672	201,011	-------	118,082	3,096	37,330	158,508	359,519
1934	11,907	138,743	150,650	7,096	157,746	-------	126,562	3,870	55,481	185,913	343,659
1935	25,725	144,503	170,228	4,508	174,736	-------	99,110	2,516	29,679	131,305	306,041
1936	40,494	104,449	144,943	2,701	147,644	-------	103,822	2,823	22,796	129,441	277,085
1937	35,018	111,239	146,257	4,932	151,189	-------	154,847	3,210	23,672	181,729	332,918
1938	38,301	57,331	95,632	2,048	97,680	-------	68,671	3,277	12,030	83,978	181,658
1939	2,511	85,382	87,893	1,433	89,326	-------	49,148	3,273	17,813	70,234	159,560
1940	4,123	14,328	18,451	27	18,478	-------	66,307	4,319	2,715	73,341	91,819
1941	1,025	8,276	9,301	0	9,301	-------	57,428	4,412	0	61,840	71,141
1942	0	480	480	0	480	-------	73,447	2,623	841	76,911	77,391
1943	0	0	0	0	0	-------	70,087	3,238	1,595	74,920	74,920
1944	36,941	19,786	56,727	1,359	58,086	-------	56,501	6,718	9,932	73,151	131,237
1945	132,553	4,250	136,803	0	136,803	-------	40,615	10,260	0	50,875	187,678
1946	0	0	0	0	0	-------	77,762	7,773	0	85,535	85,535
1947	0	6,075	6,075	0	6,075	-------	128,942	17,812	0	146,754	152,829
1948	0	15,415	15,415	0	15,415	-------	151,311	12,639	0	163,950	179,365
1920–48 average	41,829	137,471	179,300	9,678	188,978	104	81,585	4,233	41,490	127,412	316,390

[1] Estimated. Fresh fish receipts not classified from 1920 through 1924.

38. *Past commerce.*—Over the past 29 years, lumber shipments averaged 179,296 tons annually, of which approximately 23 percent were made to foreign ports. Total shipments of lumber products have varied from a maximum of 471,792 tons in 1924 to zero in 1943 and 1946. Even prior to the last war, a downward trend was evident. During that period a large proportion of the lumber produced in the tributary area was carried to west coast ports in vessels owned and operated by the major lumber companies. Rising shipping costs, the obsolescence of former lumber vessels, and changing business practices had practically removed the lumber companies from the shipping business by the time of the entry of the United States into World War II. Waterborne shipments from Humboldt Bay have been negligible since 1940, with the exception of the years 1944 and 1945 when a comparatively large volume of lumber was shipped on Government orders and under Government guaranties with loads conforming to existing channel conditions.

39. The decline in water-borne commerce is not restricted to Humboldt Bay, but is a reflection of conditions with respect to water-carrier shipments in the United States in general, and on the Pacific coast in particular. In 1939, 62 vessels of more than 1,000 gross tons were in operation in the United States Pacific coastwise trade. According to the most recent information of the Maritime Commission there are now only 10 freighters of this class engaged in such com-

merce. The latter vessels are operated by one common-carrier line, two contract carriers, and one private lumber carrier. Approximately 143 vessels carried 8,500,000 tons of cargo in the intercoastal trade in 1939 compared with less than 60 vessels and 3,500,000 tons in 1947, the last postwar year without a major strike in the maritime services. Prior to the last war, coastal and intercoastal and other domestic operations furnished the major employment for American vessels. Profitable domestic operation, exclusive of bulk coastwise movements (petroleum and coal) is now so small that few companies have indicated any willingness to resume operation for their own account. At present the major portion of the American dry-cargo fleet is engaged in offshore shipping. While there has not been a corresponding drop in volume of foreign tonnage, largely due to the Economic Cooperation Administration program, the economic recovery of the foreign export market is required to sustain foreign shipments.

40. The tremendous loss of domestic water-borne commerce is largely due to the great increase in vessel-operating costs and cargo-handling charges. The maritime services, especially on the Pacific coast, have been saddled with long and costly strikes which have caused shippers to seek more certain and cheaper means of cargo transport. This in turn has altered business practices. Many of these altered business practices have been to the detriment of marine shipping and will be difficult to change even though a long period of economic stability in marine commerce should be forthcoming. Lumber shipments from Humboldt Bay have been additionally hampered by a prolonged lumber strike during 1946 and 1947.

41. *Future commerce.*—Irrespective of past developments, it is considered that the disruption of marine commerce through strikes and economic change is but a temporary occurrence. It is entirely possible that with harbor improvements, a revival of the offshore trade from Humboldt Bay equaling or perhaps exceeding its former volume may be reached in the not-too-far-distant future. The demand for redwood in Australia, New Zealand, South Africa, India, and parts of South and Central America, where its resistance to heat, moisture, decay, and attack by insects makes it highly desirable, is increasing with the resumption of construction in the postwar years. A revival of lumber shipments to the east coast may be in the offing as indicated by letters from shipping interests (appendix IV).[1] A comparison of shipping and handling charges between Humboldt Bay and east coast ports indicates that water movement for lumber would be less costly than transportation by rail on a port-to-port basis. These comparative rates are presented in appendix III.[1]

42. Coastwise shipments of lumber from Humboldt Bay in the past have been made almost exclusively to the San Francisco and Los Angeles areas. Comparison of present rail and vessel shipping and handling charges for such movements reveals that the rail shipping charges are substantially lower than the vessel shipping costs. The margin is so great that operators of deep-draft vessels do not expect to regain this lost business. Present experiments with light-draft vessels in an effort to reduce handling and port costs may result in resumption of the water-borne coastwise movements of lumber. These light-draft vessels would not require the deeper channels

[1] Not printed.

considered in this report. Therefore, no estimate of the possible future movements of lumber from Humboldt Bay in coastwise trade has been made herein.

43. Based on the assumption that present shipping facilities and handling methods in the harbor area are comparable to the prewar years of 1936 to 1938, inclusive, forecasts of future lumber movements may be based, in part, on statistics covering that period. These years were removed from the business recession of the early thirties and the disruptive war period so that conditions at that time were neither particularly adverse nor advantageous to shipment by water. From 1936 through 1938, the annual lumber production of the tributary area is estimated to have been 318 million board feet, or 477,000 tons. Water shipments from Humboldt Bay during that period accounted for 27 percent of the total production and may be further divided as follows: intercoastal, 2 percent; offshore to United States possessions, 2 percent; foreign export, 8 percent; domestic Pacific coast ports, 15 percent. Lumber production in the tributary area during 1948 approached 1 billion board feet, the United States Forest Service estimate for sustained annual production. On the basis of an annual sustained production of 1 billion board feet, it is estimated that future lumber shipments by water from Humboldt Bay will be about 30,000 tons to domestic Atlantic ports, 30,000 tons to United States possessions, and 120,000 tons in foreign trade.

44. The Dutton Lumber Co. is currently developing plans to barge lumber from Crescent City to Humboldt Bay, where it will be transshipped to ocean-going steamers for movement to ports on the Atlantic coast. This company proposes to ship 15,000 to 18,000 tons monthly in this fashion. Since this development represents a new producer and market, with different shipping methods, intercoastal commerce from Humboldt Bay may be increased by 180,000 tons annually (15,000 tons per month), or the total volume of trade in this category may be estimated at 210,000 tons per year.

45. Due to its position as a receiving point for bulk shipments of petroleum products, Humboldt Bay is the distribution center of an extensive and rapidly expanding market area in northern California and southern Oregon. Since 1940, the population of the area has increased by more than 20 percent, the lumber cut has almost doubled, and other industrial development has increased extensively. In view of these factors, waterside storage facilities of the major oil companies are being rapidly increased, and it is believed reasonable to expect an annual receipt of 200,000 tons of petroleum products within a short time.

46. Commerce originating from the Dutton Lumber Co. development at Crescent City and that involving the receipt of petroleum products will be conducted exclusively in the North Bay area. A precise forecast of the division of the remaining lumber shipments from the North and South Bay areas cannot be made on the basis of past commerce. The facilities at Samoa can now accommodate vessels of greater draft than can those at Fields Landing. This is not only due to the tortuous character of the South Bay Channel and its tendency to shoal, but to the lack of deep water alongside the Fields Landing wharf where berthing areas have been allowed to deteriorate to a point where depths are now considerably less than in the adjoining project channel. With the exception of the Hammond and

Pacific Lumber Cos., owners of the wharves on the Samoa and Fields Landing Channels, respectively, most lumber companies could ship equally well from either a North or South Bay facility. Therefore, it may be assumed that should North and South Bay Channels be equally improved, future commerce, other than that specifically mentioned above, would be equally divided.

47. The estimated future commerce in Humboldt Bay is summarized as follows for both light-draft and modern deep-draft vessels:

TABLE V.—*Estimated future annual commerce—Humboldt Bay* [1]

Classification	Total commerce			Commerce requiring 30-foot channels [2]		
	North Bay	South Bay	Total	North Bay	South Bay	Total
Lumber shipments (intercoastal):	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Dutton shipments	180,000		180,000	[3] 135,000		[3] 135,000
Others	15,000	15,000	30,000	7,500	7,500	15,000
To United States possessions	15,000	15,000	30,000	7,500	7,500	15,000
Foreign export	60,000	60,000	120,000	15,000	15,000	30,000
Lumber total	270,000	90,000	360,000	165,000	30,000	195,000
Petroleum receipts	200,000		200,000	200,000		200,000
Total	470,000	90,000	560,000	365,000	30,000	395,000

[1] Based on improvement to both North and South Bay Channels.
[2] Excluding light-draft vessel tonnage.
[3] 90,000 tons full shiploads plus 45,000 tons partial shiploads.

VESSEL TRAFFIC

48. *Past and existing traffic.*—Trips and drafts of in-bound and out-bound vessels for the years 1935, 1938, 1945, and 1946 are tabulated below. Data for the year 1935 might be fairly typical of the prewar years with the total volume of commerce being but slightly less than the average for the past 29 years. The year 1938 is included as the last of the prewar years, while 1945 indicates an approach to the manner in which volume shipments are carried under existing conditions. Data for 1946, aside from traffic of fishing craft, barges, etc., represent only vessels carrying bulk shipments of petroleum products.

TABLE VI.—*Trips and drafts of vessels, Humboldt Harbor and Bay, steamers and motor vessels*

Draft	In-bound				Out-bound			
	1935	1938	1945	1946	1935	1938	1945	1946
28 to 30 feet				1			3	
26 to 28 feet				3			6	
24 to 26 feet	1	16	2	2		3	13	
22 to 24 feet	7	14		4	3		4	1
20 to 22 feet	8		1	8	49	12	1	5
18 to 20 feet	19	29	2	4	47	23	1	14
16 to 18 feet	103	188	12		115	194	1	2
14 to 16 feet	137	8	15		103	1		
12 to 14 feet	110	1	7		50		3	
12 feet and under	5	158	9		24	178	18	
Fishing craft, barges, lighters, tugs, and launches	13,367	15,304	11,790	8,874	13,367	15,304	11,790	8,874
Total	13,757	15,718	11,838	8,896	13,758	15,715	11,840	8,896

49. Due to the almost complete collapse of marine commerce in the postwar years, few conclusions can be drawn from past commercial statistics other than that vessels with a full-load draft of less than 16 feet have been almost completely retired as commercial cargo carriers. In view of the limiting depths within the bay, it is apparent that some of the deep-draft vessels dock and undock at high tide despite consequent delays.

50. *Prospective traffic.*—The great preponderance of dry-cargo vessels in service today in the intercoastal and offshore trade have a full-load draft of approximately 28 feet. Deeper channels in Humboldt Bay would permit vessels to complete loading at that port, a factor which should increase vessel traffic and cargo loadings to a considerable degree.

51. Based on an average load of 2,000 tons, with the exception of that to be carried by the Dutton Lumber Co. as full cargoes, it is estimated that 135 vessel trips would be required annually to transport the prospective lumber shipments. It is further estimated that, channel conditions permitting, slightly less than 40 percent of these vessels would depart from the harbor with drafts exceeding 24 feet. However, should all interior channels be dredged to 30 feet, only 15 vessel trips in this category and primarily in the export trade could be expected to make use of the Fields Landing Channel. Facilities in the North Bay are more than ample to accommodate this relatively small volume of deep-draft commerce should it be transferred to that area for ocean shipment.

52. Coastwise tankers now in common use vary in full-load draft from 25 to 30 feet, and deeper-draft carriers are appearing. It is not expected that there will be a rapid change in vessel operation though there will be a tendency toward the use of larger vessels wherever possible.

DIFFICULTIES ATTENDING NAVIGATION

53. The greatest hazards attending navigation of the entrance and interior channels of Humboldt Bay are as follows:

(*a*) A bar with a minimum depth of 22 feet, located approximately two-thirds of a mile northwesterly from the jetties, partially obstructs the entrance. The usual approach to the harbor is made from the southwest where depths exceed 30 feet between the bar and the south jetty. The strong currents that are encountered and the abrupt turn into the entrance channel at the end of the jetty constitute dangers.

(*b*) The channel between the jetties is within an area of rapid changes and considerable wave action and must be navigated with caution.

(*c*) The turn from the entrance channel to the North Bay presents some difficuly to large tankers.

(*d*) At the lower stages of the tide the existing controlling depths of all interior channels are insufficient for navigation by the ocean-going freighters in use today under full-load conditions. In addition, the Fields Landing Channel is too tortuous for easy passage by such vessels. The recurring shoals in this channel have made maintenance difficult and have necessitated undue maneuvering by vessels using the channel.

WATER POWER AND OTHER SPECIAL SUBJECTS

54. No problems of water power, irrigation, flood control, or other special water uses are involved in the proposed plan for the improve-

ment of Humboldt Harbor and Bay for navigation. Shore-line changes are discussed elsewhere in this report.

PLAN OF IMPROVEMENT

55. *Improvements required.*—Any plan of improvement for Humboldt Bay should attempt to achieve the following results within the limitations of economic feasibility and necessity:

(*a*) Provide an entrance channel to the bay of sufficient depth and width to allow the deep-draft cargo vessels now in use to enter and depart from Humboldt Bay in reasonable safety, with full loads, at any stage of the tide.

(*b*) Provide channels within the bay of sufficient depth and width for safe navigation by modern vessels.

56. *Means considered for accomplishment.*—(*a*) Hazardous entrance conditions: In addition to high waves, the hazardous condition at the entrance to Humboldt Bay is due to three factors: lack of adequate depth; the abrupt change of course from the approach channel into the channel between the jetties; and the proximity of the channel to the seaward end of the south jetty. The first of these conditions may be alleviated by provision of an approach or bar channel 40 feet deep to permit passage of fully loaded ships of modern design during periods of inclement weather. A channel depth 10 feet greater than that of interior bay channels is required to allow for heavy swell conditions, and is in line with project depths at Coos Bay, Oreg., a similar deep-draft lumber port 180 miles to the north, where corresponding sea conditions exist. The second and third conditions may be alleviated by widening the channel at the entrance and providing a flare in the approach channel from the southwest.

(*b*) Inadequate interior channels: In order to navigate safely, under full load, modern cargo vessels require a minimum of 30 feet of water at least 400 feet in width in a tortuous channel. To provide for safe navigation to all existing deep-water wharves would require the Samoa Channel, the lower portion of the Eureka Channel, and the Fields Landing Channel to be deepened to 30 feet and the latter to be widened to 400 feet due to its tortuous course. In addition, a channel should be provided in the North Bay to allow full access to Samoa, the Coast Pacific Lumber Co.'s wharf above the entrance to Eureka Channel, and the docks of the Standard and Union Oil Cos. This channel should also have a minimum depth of 30 feet and a width of 400 feet. The Eureka Channel above the first bend requires no modification at this time since oceangoing cargo carriers no longer call at wharves along this section of the Eureka water front. Traffic in the Eureka Channel above the Coast Pacific Lumber Co. wharf is confined almost exclusively to light-draft fishing vessels.

57. *Recommended plan.*—Based upon economic considerations and the extent of improvements required to meet the needs of modern cargo vessels in carrying prospective commerce, further improvements should be confined at present to the North Bay area. The most practicable plan for the betterment of Humboldt Harbor would provide for the following:

(*a*) Deepening and widening the bar and entrance channel to a depth of 40 feet and a width of 1,600 feet at the entrance tapered to 500 feet between the jetties.

(*b*) Deepening the natural channel in the North Bay to provide a new North Bay channel 400 feet wide and 30 feet deep extending from the bar and entrance channel to the entrance of the Eureka and Samoa Channels.

(*c*) Deepening the lower portion of Eureka Channel, from the entrance to the first turn at mile 5.0, to 30 feet; the bottom width to remain at 400 feet as provided for in the existing project.

(*d*) Deepening the Samoa Channel to 30 feet; the bottom width to remain at 300 feet as provided for in the existing project.

ALTERNATIVE PLANS

58. Alternative plans studied in connection with this report considered the possibility of reducing wave heights in the entrance by removal of the bar, the further improvement of Fields Landing Channel, and the prevention of further erosion of Buhne Point with a consequent reduction in shoaling of the Fields Landing Channel. These plans are discussed briefly in the following paragraphs and in greater detail in the appendices to this report.

59. Complete removal of the bar to a depth of 40 feet would not appreciably reduce wave heights throughout the entrance. Such a plan, as well as one providing a realined channel with a more direct approach to the Bay, was therefore not considered advisable since it would only serve to increase the cost of initial work without corresponding benefit.

60. To dredge the Fields Landing Channel to a depth of 30 feet and a width of 400 feet, and to enlarge and deepen the existing turning basin at its terminus, would require the removal of almost 1,600,000 cubic yards of material and would more than double the first cost of the recommended improvement. A lesser plan, involving a narrower channel, could not be assumed to accomplish the same degree of benefit. Realinement of the channel to provide for greater width at the turns and a 300-foot width on the longer reaches would not materially reduce the volume of material to be removed. As indicated in table V, should the Fields Landing Channel be deepened and widened, 30,000 tons of lumber would be transported from the South Bay in vessels requiring the improved channel. If it were not improved, this tonnage would have to be hauled by rail or other form of land transportation to a deep-water outlet in the North Bay—an added distance which in no case would amount to more than 6 miles. The added annual hauling charges are less than one-half of the annual costs of improving the Fields Landing Channel even when considered as an incremental improvement. Further improvement of the South Bay Channel is therefore not economically justified at this time.

61. Two plans for the prevention of further erosion of Buhne Point with a consequent reduction in the shoaling of the Fields Landing Channel were studied in connection with this report. One plan considered the construction of a 1,200-foot impermeable barrier groin extending from Buhne Spit in a northwesterly direction parallel to the eastern shore section of the south jetty. The groin, of 12-foot top width and 1 to 1½ side slopes, would be constructed to elevation +12 of quarry-run material faced with 2- and 5-ton armor stone. The second method involved the construction of a 3,900-foot rubble wall extending from the existing revetment along the Northwestern Pacific

Railroad right-of-way to a terminus on the western edge of the bluff at Buhne Point. The rock wall would extend from −3.0 to +10.0 feet in elevation, and would also be constructed of quarry-run stone protected with armor stone. Preliminary estimates of costs indicate that neither of these plans can be justified economically at this time.

AIDS TO NAVIGATION

62. The district commander of the United States Coast Guard has been consulted in regard to the establishment of additional navigational aids which would be required for the recommended improvement. He estimates that, aside from the relocation of certain existing buoys (Nos. 3 and 4 within the entrance), the only additional aid required will be a 3-pile minor light at the end of the improved Samoa Channel at a total cost of $3,500.

SHORE-LINE CHANGES

63. *Shore-line changes.*—A study of the Pacific Ocean shore line and offshore depth changes in the vicinity of Humboldt Bay and of the interior channels in Humboldt Bay has been made to determine: first, the effect of the recommended bar and entrance channel on the adjacent ocean shore line; and, second, the effect of the erosion at, and in the vicinity of, Point Humboldt (Buhne Point) on the deterioration of Fields Landing Channel. The results of the study are given in detail in appendix I[1] and are summarized in the following subparagraphs:

(*a*) Effect of bar and entrance channel: The Humboldt Bar is characteristic of those which form at tidal inlets. The bar, created and fed by littoral material, serves as the path by which littoral material makes its way around the jettied inlet and continues its passage along the coast. The direction of littoral movement, in the vicinity of Humboldt Bay, is predominantly downcoast (north to south). The relative stability of the bar in recent years indicates that substantially all littoral drift is passing the entrance to Humboldt Bay and is maintaining the south spit and downcoast shores. If the bar and entrance channel is enlarged as proposed, it is believed that littoral drift will encroach on the channel and will require the dredging of about 400,000 cubic yards annually as maintenance. If the littoral material dredged from the proposed channel is deposited south of the south jetty in a depth not greater than 30 feet, it will probably resume normal travel with no detriment to the shore. If deposited in deeper water it will remain, and the south spit will erode a corresponding amount.

(b) Shoaling of Fields Landing Channel: During the period from 1940 to 1947, Fields Landing Channel shoaled at an annual rate of approximately 80,000 cubic yards. The material shoaling this channel is believed to be derived from the erosion of Point Humboldt and from the deepening of the offshore area between Point Humboldt and Elk River Spit. Wave and current action deposit the eroded material in the Fields Landing Channel. Revetment of the shore at Point Humboldt or the construction of a barrier groin, starting from a suitable point on Buhne Spit and extending 1,200 feet to the 12-foot

[1] Not printed.

depth curve, would probably stabilize the eroding shore at Point Humboldt and reduce shoaling of the Fields Landing Channel substantially. As previously stated, neither of these plans can be economically justified at this time.

ESTIMATES OF FIRST COSTS AND ANNUAL CHARGES

64. *Dredging requirements.*—The dredging requirements of the recommended plan of improvement are summarized as follows:

TABLE VII.—*Dredging requirements*

Channel	Depth (feet)	Width (feet)	Material to be removed (cubic yards)		
			To depth proposed	2 feet over-depth	Total
Recommended plan:					
Bar and entrance	40	[1] 500	753,000	239,000	992,000
North Bay (new)	30	400	215,000	249,000	464,000
Eureka (to first bend, mile 5.0)	30	400	33,000	69,000	102,000
Samoa	30	300	46,000	113,000	159,000

[1] 1,600 feet at entrance, tapered to 500 feet at seaward mile 0.18, thence 500 feet to mile 0.75.

65. The estimated first cost and annual charges for the proposed plan of improvement are contained in table VIII. Estimates are based on current prices and work to be done by hopper dredge. Interest and amortization charges for the Federal investment are computed at 3 percent over a 50-year period. Details of the estimates are contained in appendix II.[1]

TABLE VIII.—*Cost of improvement, recommended project*

Improvement	First cost	Annual charges			
		Interest	Amortization	Increased maintenance	Total
Federal investment:					
Bar and entrance channel	$148,400	$4,450	$1,320	$39,600	$45,370
North Bay channel (new)	149,600	4,490	1,330	9,900	15,720
Samoa Channel	67,300	2,020	600	----------	2,620
Eureka Channel	41,200	1,240	360	----------	1,600
Aids to navigation	3,500	110	30	----------	140
Total	410,000	12,310	3,640	49,500	65,450

ESTIMATE OF BENEFITS

66. *Basis of estimate.*—The principal tangible benefits to accrue from the proposed improvements would be from general savings in shipping costs of lumber and petroleum products. These products are generally most suited to water transport wherever adequate port and harbor facilities exist. Transportation costs of petroleum products from refineries to distribution centers are less by water than by rail or truck for all but the shortest intraport hauls. Vessel shipping and handling charges have risen within the last 10 years to a point

[1] Not printed.

where water carriers can no longer compete with rail for the once substantial lumber movements from Humboldt Bay to the San Francisco and Los Angeles areas. As previously mentioned under the heading "Commerce," a comparison of transportation charges indicates that under existing conditions, on a port-to-port basis, lumber may be conveyed by water carrier to domestic Atlantic coast ports at less cost than by rail. If no harbor improvements were in existence at Humboldt Bay, the benefits of a proposed improvement could be based upon the difference between the costs of land and water transportation. However, for the additional improvements proposed herein, the benefits are based upon the difference in cost of water shipments under proposed and existing conditions. The proposed improvements would permit larger vessels to carry full cargoes, or to top off with a partial, or deck load, of lumber, resulting in more flexible vessel operation and corresponding reduction in operating costs. An incidental benefit, not evaluated, would result from the increased value of the bay as a harbor of refuge.

67. *Savings in transportation costs, lumber shipments.*—Benefits from the deepening of bay channels would apply only to those vessels that would normally depart fully loaded or with drafts exceeding 24 feet. It is believed that the lumber so carried annually would approximate 195,000 tons consisting of 15,000 tons to United States possessions (principally Hawaii), 150,000 tons in the intercoastal trade, and 30,000 tons to foreign exports. Based on present loadings, the average lumber cargo would be about 2,000 tons per vessel trip for all of the above shipments with the exception of 90,000 tons which would be carried to the east coast by the Dutton Lumber Co. as full cargoes. The total number of vessel trips per year to which savings in transportation costs would accrue may thus be computed as 7.5 to United States possessions, 42.5 to the Atlantic coast, and 15 to foreign ports. Since existing channel depths do not permit vessels to carry the afore-mentioned cargo as full or top-off loads, the cargo carriers are forced to arrive in a much lighter condition, load only to a 24-foot draft, and then backtrack varying distances to other ports in order to obtain a full load before proceeding to destination. The least additional travel required is an added trip to San Francisco at a cost of $1,440 for vessels carrying cargo to United States possessions, and a round trip to Coos Bay, Oreg. at a cost of $2,100 for vessels in the intercoastal and foreign-export trade. The indicated benefits from the shipment of lumber may thus be estimated at $131,500 annually. However, an expenditure, estimated at $13,000 annually, will be required of local interests to transport 30,000 tons of lumber from the South Bay to the North Bay for shipment. The net savings in transportation costs are therefore estimated to be $118,500 annually.

68. *Savings in transportation costs, petroleum products.*—At present petroleum products are shipped to Humboldt Bay in partially loaded deep-draft tankers. On a basis of existing 26-foot interior channels, the limiting loaded draft may be taken as 24 feet. With 30-foot interior channels, the permissible loaded draft of tankers entering Humboldt Bay will be increased, comparably, to 28 feet, thus allowing increased cargoes per vessel to be shipped at almost identical cost. Shipments are made from Richmond and Oleum in San Francisco Bay and involve a 3-day round trip, including a 24-hour discharge period in Humboldt Bay. At an estimated tanker operating cost of

$7,760 for the round trip, a net saving of $0.139 per ton would result with use of tankers of 8,200 gross tons, loaded to 28-foot draft, the largest now employed on the San Francisco-Humboldt Bay run. The average annual saving would be $27,800 for the estimated 200,000 tons of in-bound petroleum products per year.

69. *Summary of benefits.*—The direct benefits representing savings in transportation costs that would result from the proposed improvement to Humboldt Bay are summarized below. Details of the estimate of benefits are contained in appendix III.[1]

TABLE IX.—*Estimate of annual benefits*

Classification	Total future commerce	Commerce requiring 30-foot channels and resultant saving					
		Tributary to North Bay		Transferred from South Bay for shipment		Total	
		Commerce	Saving	Commerce	Saving	Commerce	Saving
Lumber shipments (intercoastal):	*Tons*	*Tons*		*Tons*		*Tons*	
Dutton shipments	180,000	135,000	$73,450			135,000	$73,450
Others	30,000	7,500	7,875	7,500	$7,875	15,000	15,750
To United States possessions	30,000	7,500	5,400	7,500	5,400	15,000	10,800
Foreign export	120,000	15,000	15,750	15,000	15,750	30,000	31,500
Lumber total	360,000	165,000	102,475	30,000	29,025	195,000	131,500
Petroleum receipts	200,000	200,000	27,800			200,000	27,800
Total benefits	560,000	365,000	130,275	30,000	29,025	395,000	159,300
Less added transportation charges					13,000		13,000
Net benefits	560,000	365,000	130,275	30,000	16,025	395,000	146,300

COMPARISON OF BENEFITS AND COSTS

70. The annual cost of the recommended project involving the improvement of the bar and entrance channel and the North Bay channels, as described under the heading "Plan of Improvement," is $65,450. The economic ratio of the recommended plan of improvement is $146,300 to $65,450 or 2.24 to 1.00.

71. The alternative (not recommended) plan for complete improvement of all channels, which includes the widening and deepening of the Fields Landing Channel, adds $21,650 to the annual cost of channel improvement plus $6,600 as the annual cost of rebuilding the face of the Fields Landing wharf which, in its present state, would not withstand alongside dredging to a 30-foot depth. Increased benefits would be $13,000 since the additional transportation charges would not be involved. The incremental benefit-cost ratio of adding the South Bay development would thus be $13,000 to $28,250 or 0.46 to 1.00.

PROPOSED LOCAL COOPERATION

72. *Required cooperation.*—Existing terminal facilities for the shipment of lumber from Humboldt Bay are owned and operated by three private lumber companies. These companies have agreed to unload,

[1] Not printed.

place in storage, and handle to shipside such lumber as other producers may desire to export. They, however, retain priority in the use of the facilities, and at their sole discretion, may refuse to accept lumber from a shipper when, in their opinion, the existing facilities are inadequate or are needed for their own business. In addition, agreements drawn up by the wharf owners assign charges, liabilities, etc., that could possibly preclude the facility from being open to all on equal and reasonable terms. These arrangements cannot be interpreted as meeting the requirements of public usage desirable for Federal participation in the recommended project. Therefore, local interests, through the medium of a public body legally and financially qualified to assume the necessary obligations should:

(*a*) Provide and maintain, adjacent to the Eureka and Samoa Channels, adequate wharf and terminal facilities, open to all on equal and reasonable terms, for the storage, handling, and shipment of lumber and general commerce.

(*b*) Provide and maintain, in the approach and berthing areas of the afore-mentioned wharves, depths fully adequate for the large modern cargo vessels which will use the adjacent project channels.

(*c*) Provide without cost to the United States all lands, easements, rights-of-way, and suitable disposal areas for dredged material as may be required for the construction and maintenance of the project, and if they desire the dredge spoils placed in areas of their selection, bear the excess cost over and above the most economical method of dredging otherwise applicable.

(*d*) Hold and save the United States free from all claims for damages due to construction and maintenance of the project.

73. The Humboldt County Board of Supervisors has passed a resolution expressing its interest in the project and giving assurances that the requirements of local cooperation would be met. Local interests appear to be willing and able to extend the required cooperation. The public body required to regulate the harbor may be established either through county interest or sponsorship or possibly through extension of the duties, authorities, and responsibilities of the legally authorized State board of harbor commissioners for Humboldt Bay.

ALLOCATION OF COSTS

74. The direct benefits from the proposed improvement are savings in transportation costs which may be passed on to the general public in the form of lower prices. For this reason the entire cost of the proposed improvement should be borne by the Federal Government. It is found that such costs as may be incurred by local interests in meeting the requirements of local cooperation are those customarily required for navigation projects and will be offset by terminal charges.

COORDINATION WITH OTHER AGENCIES

75. In connection with the preparation of this report, Government and commercial agencies, civic bodies, and private individuals were consulted for advice and assistance. Among these were the United States Coast Guard; the United States Maritime Commission; the Interstate Commerce Commission; the United States Forest Service; the secretary of the State board of harbor commissioners for Humboldt

Bay; officials of various steamship, railroad, and lumber companies; officials of the Standard Oil Co. of California and the Union Oil Co.; the Board of Supervisors of Humboldt County, and the Eureka Chamber of Commerce. Local interests have examined the plan of improvement and concur, in general, with the recommended modifications and new extensions to the existing project.

DISCUSSION

76. Lumber shipments and receipts of petroleum products have accounted for more than 80 percent of the total ocean-borne commerce in Humboldt Bay during the past 30 years. These products were responsible for more than 90 percent of the shipping during the representative period 1936–38, inclusive, and for 100 percent of the trade since 1944. Substantial imports of general commodities (other than petroleum) are not required to meet the needs of the sparsely populated tributary area either for consumption or industrial and processing activities.

77. In estimating the future commerce for Humboldt Bay, all pertinent factors have been considered. During the past 10 years water-borne commerce in Humboldt Bay, particularly the shipment of lumber, has declined. The decline in water-borne commerce is not restricted to Humboldt Bay, but is a reflection of conditions affecting water-carrier shipments in the United States in general, and on the Pacific coast in particular. To base estimates of future commerce upon shipping volumes of the past 10 years would lead to gross error. The Second World War; the subsequent chaotic economic condition abroad; domestic-labor strife, particularly in the lumber and water-borne shipping industries; and inadequate depths in harbor channels have combined to reduce commercial activity in Humboldt Bay to a fraction of its potentialities. The tributary area contains one of the last major blocks of virgin timber in the United States and, according to estimates made by the United States Forest Service, is capable of maintaining a sustained yield of a billion board-feet per year. The capacity for development of this area has only recently been realized. Lumber production in 1947 was almost twice that of the previous 30-year average and more than 40 percent greater than for any prior year. It is expected that production figures for 1948 will show an excess over 1947 of an additional 40 percent. The development of the Dutton Lumber Co. is indicative of the relation of this tremendous new growth in lumber production to increased commercial activity. Receipts of petroleum products within the last few years have shown substantial increases. Receipts in 1948 were 100 percent greater than the average of the previous 10 years.

78. The factors which have disrupted marine commerce during the past decade must be assumed to be temporary in nature, particularly in regard to petroleum products and lumber, which are well suited to economical transportation by water. The world-wide demand for lumber, the chief resource of the area tributary to Humboldt Bay, should aid in the revival of shipping of that commodity from the harbor. It is estimated that the future water-borne commerce of Humboldt Harbor will amount to 360,000 tons of lumber and 200,000 tons of petroleum products annually. The economic justification is based on the finding that 395,000 tons of the above total would be

carried by modern cargo vessels requiring 30-foot channels, and that a favorable benefit-cost ratio of 2.24 to 1 would result.

79. The existing project was completed in 1939; the north jetty was completed in 1925, the south jetty in 1927, and the Fields Landing Channel and turning basin and the Eureka and Samoa Channels in 1939. The improvements were adequate for vessels then in use. The costs and expenditures by the United States for the existing project to the end of fiscal year 1949 were $9,954,421. It is apparent that the United States has a continuing interest in the development of the harbor and the enlargement of existing project channels so that it can be used by the larger, modern cargo vessels. This, in turn, would remove one of the transportation handicaps of the lumber industry.

80. Local interests have proposed a plan for the deepening and widening of the bar and entrance channel and also for further improving interior channels in both the North and South Bays. The district engineer has considered this plan carefully. All except one of the terminal facilities for deep-draft vessels are now located in the North Bay. The North Bay facilities are adequate to handle all of the estimated portion of the commerce which would be carried in vessels requiring channels greater than 26 feet in depth. Cargo, that would move through the Fields Landing Channel by virtue of its improvement, may be hauled by land transport to North Bay wharves for ocean shipment at less than one-half the incremental cost of improving the Fields Landing Channel. Therefore, it is proposed to improve only the bar and entrance channel and the North Bay interior channels at this time. There is no doubt that the Fields Landing Channel will continue to be used by light-draft vessels or partially loaded deep-draft vessels requiring but 26-foot channels. This channel would be maintained according to its existing authorized dimensions until such time as future commerce may warrant its further improvement.

81. In connection with this study several alternative plans of improvement were considered. In addition to the requested improvement of Fields Landing Channel these included the advisability of removing a greater portion of the bar with a view toward reducing wave heights, of realining the entrance channel, and of preventing the further erosion of Buhne Point to reduce the shoaling of project channels. Studies of these plans are discussed in more detail in the appendixes [1] to this report. None of the plans resulted in producing the desired effects to the extent that would make them economically feasible.

82. The plan of improvement proposed in this report would provide for:

(*a*) Deepening and widening the bar and entrance channel to a depth of 40 feet and a width of 1,600 feet at the entrance tapered to 500 feet between the jetties.

(*b*) Deepening the natural channel in the North Bay to provide a new North Bay Channel 400 feet wide and 30 feet deep extending from the bar and entrance channel to the junction of the Eureka and Samoa Channels at mile 4.29.

(*c*) Deepening the lower portion of Eureka Channel, from the entrance to the first turn at mile 5, to a depth of 30 feet; the bottom width to remain at 400 feet as provided for in the existing project.

(*d*) Deepening the Samoa Channel to a depth of 30 feet; the bottom width to remain at 300 feet as provided for in the existing project.

[1] Not printed.

83. The estimated first cost of the plan of improvement is $410,000 for new work, including $3,500 for aids to navigation. The estimated additional annual maintenance cost is $49,500. It is estimated that the annual tangible benefits in the form of reduced transportation costs resulting from the improvement would amount to $146,300. The corresponding estimated annual charges would be $65,450, and the resultant benefit-cost ratio of 2.24 to 1 indicates that the recommended improvement would be well justified.

84. The monetary benefits which have been evaluated herein are savings in transportation costs of commodities. Such savings probably would be passed on to the general public. Therefore, the cost to effect such savings has been allocated to the United States.

85. The terminal facilities in Humboldt Bay are all privately owned and are under only nominal control of the State board of harbor commissioners for Humboldt Bay. Although the companies owning these facilities have agreed to handle commodities for other firms they do this at their own discretion. Therefore, it is desirable that some of the facilities be open to the public on equal and reasonable terms. This could be effected through public ownership or through regulation by a public body. In addition, a public body could plan the future development of the harbor facilities more effectively than has been done in the past.

86. It is possible that local interests may, at the time of prosecution of the work, desire that dredge spoils be used for land reclamation for harbor development or other purposes. If so, local interests should bear the excess cost over and above the most economical method of dredging otherwise applicable. Provision for this alternative, and for the regulation of terminal facilities as discussed in the preceding paragraph, have been included in the proposed local cooperation.

CONCLUSIONS

87. The district engineer finds that—

(*a*) Ocean-borne commerce in Humboldt Bay consists primarily of shipments of lumber and receipts of petroleum products.

(*b*) During the past 10 years this commerce, particularly the shipment of lumber, has declined.

(*c*) The factors causing this decline are believed to be temporary and it is estimated that, with the needed harbor improvements, the future ocean-borne commerce will average 560,000 tons annually, of which 395,000 tons would be carried by deep-draft vessels requiring channels generally 30 feet deep.

(*d*) The existing channel depths and widths are inadequate and hazardous for the large deep-draft vessels now in use.

(*e*) Adequate and safe channels for handling that portion of future commerce to be carried in deep-draft vessels could be provided by deepening and widening the bar and entrance channel; providing a new North Bay channel; and deepening the Samoa Channel and the lower portion of the Eureka Channel.

(*f*) These channel improvements would be economically justified by general savings in transportation costs.

(*g*) In view of the general nature of the benefits, the cost of the work should be borne by the United States.

(*h*) Local interests should operate or regulate terminal facilities in the harbor through the medium of a public body to insure the equitable use of the harbor facilities.

(*i*) The estimated first cost to the United States of making the improvements is $406,500, exclusive of $3,500 for additional aids to navigation, and funds in this amount should be provided in one lump sum.

RECOMMENDATIONS

88. The district engineer recommends that the project for Humboldt Harbor and Bay, Calif., be modified, and extended substantially as shown on the plan of improvement submitted herewith, to provide for a bar and entrance channel 40 feet deep at mean lower low water and tapered from a 1,600-foot width at seaward mile 0.91 to 500 feet at seaward mile 0.18, thence 500 feet wide to mile 0.75; for a new North Bay channel 30 feet deep and 400 feet wide to extend from mile 0.75 to mile 4.29; for a depth of 30 feet and a width of 400 feet in the Eureka Channel from mile 4.29 to the first bend in the channel at mile 5.0; for a depth of 30 feet and a width of 300 feet in the Samoa Channel from mile 4.29 to mile 5.84; all at an estimated Federal first cost of $410,000 for new work, including $3,500 for additional aids to navigation, and at an estimated increased annual maintenance cost of $49,500, subject to the condition that local interests, through the medium of a public body legally and financially qualified to assume the necessary obligations, shall give assurances satisfactory to the Secretary of the Army that they will:

(*a*) Provide and maintain, adjacent to the Eureka and Samoa Channels, adequate wharf and terminal facilities open to all on equal and reasonable terms, for the storage, handling, and shipment of lumber and general commerce.

(*b*) Provide and maintain, in the approach and berthing areas of the afore-mentioned wharves, depths fully adequate for the large modern cargo vessels which will use the adjacent project channels.

(*c*) Provide without cost to the United States all lands, easements, rights-of-way, and suitable disposal areas for dredged material as may be required for the construction and maintenance of the project, and if they desire the dredge spoils placed in areas of their selection, bear the excess cost over and above the most economical method of dredging otherwise applicable.

(*d*) Hold and save the United States free from all claims for damage due to construction and maintenance of the project.

F. S. TANDY,
Colonel, Corps of Engineers,
District Engineer.

[First endorsement]

SOUTH PACIFIC DIVISION,
CORPS OF ENGINEERS, UNITED STATES ARMY,
OAKLAND ARMY BASE,
Oakland, Calif, February 10, 1950.

To: the Chief of Engineers, United States Army, Washington, D. C.

I concur in the conclusions and recommendations of the district engineer.

W. D. LUPLOW,
Colonel, Corps of Engineers,
Acting Division Engineer.

LIST OF ENCLOSURES MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

(Only enclosure No. 1 printed)

No. 1. Map, plan of improvement, drawing 5–1–41.
No. 2. Resolution of Humboldt County Board of Supervisors, dated May 2, 1949.

LIST OF APPENDIXES MADE IN CONNECTION WITH THE REPORT OF THE DISTRICT ENGINEER

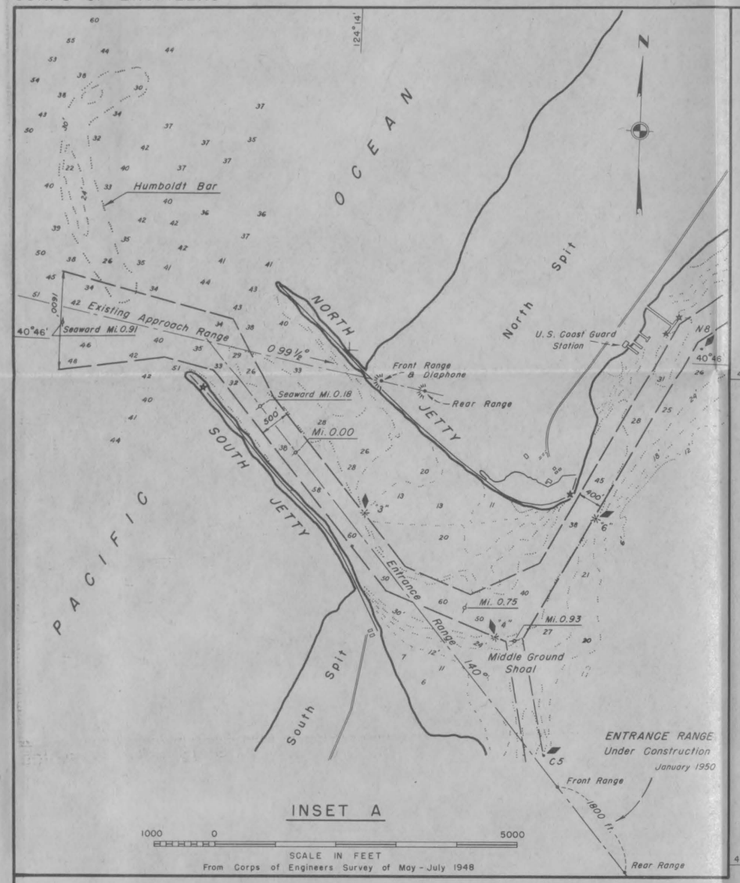
(Not printed)

I. Shore-line changes.
II. Cost of improvement.
III. Estimate of annual benefits.
IV. Supporting letters.

○

CORPS OF ENGINEERS

U.S. ARMY

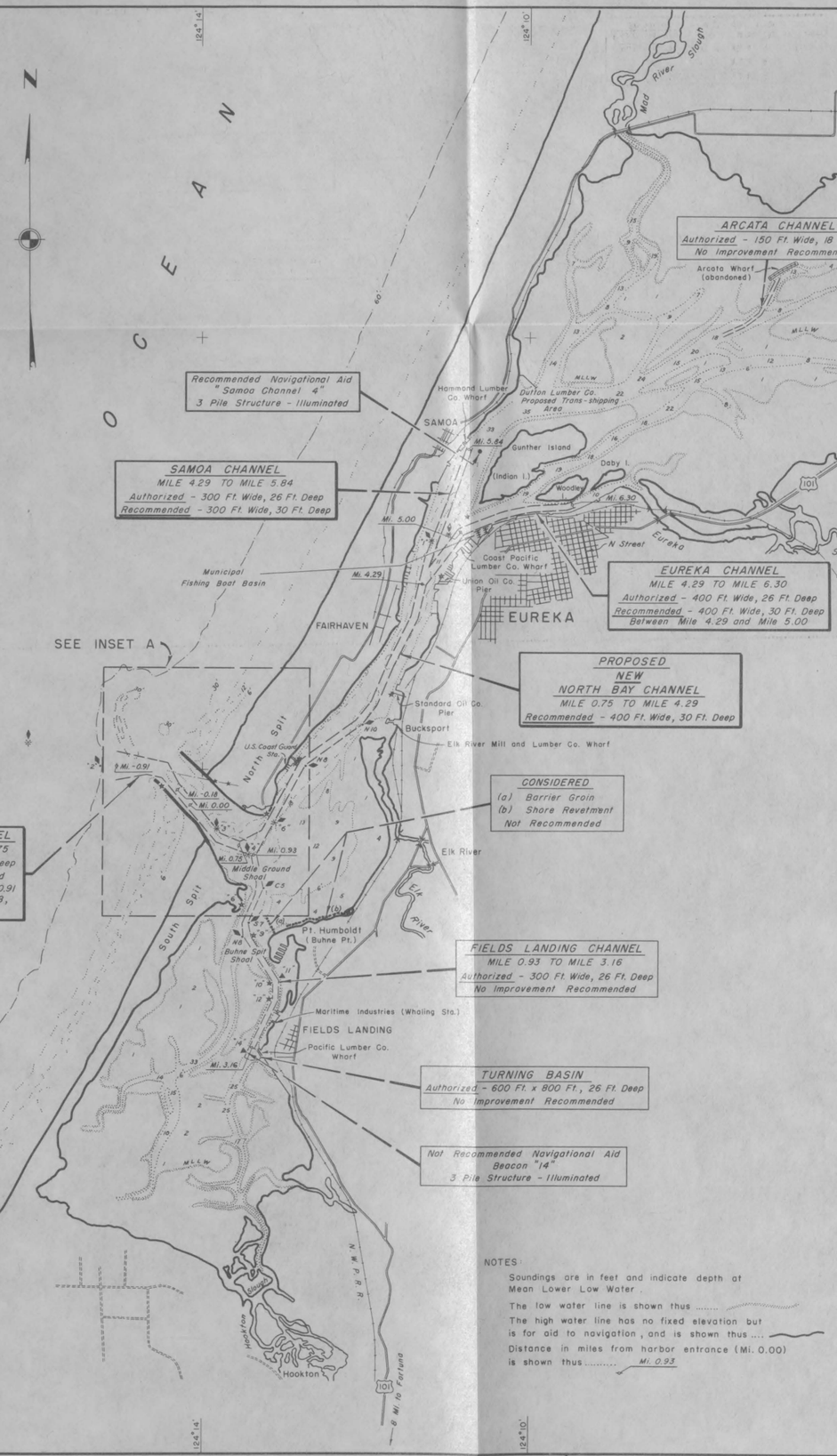


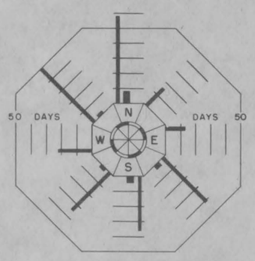
INSET A

1000 0 5000

SCALE IN FEET

From Corps of Engineers Survey of May - July 1948





VELOCITY RANGE - MILES PER HR.

4 - 15 ——

16 - 31 ——

32 & OVER —

WIND DIAGRAM

BASED ON OBSERVATIONS AT EUREKA, CALIF.
U.S. WEATHER BUREAU STA. JULY 1939 - DEC. 1942.

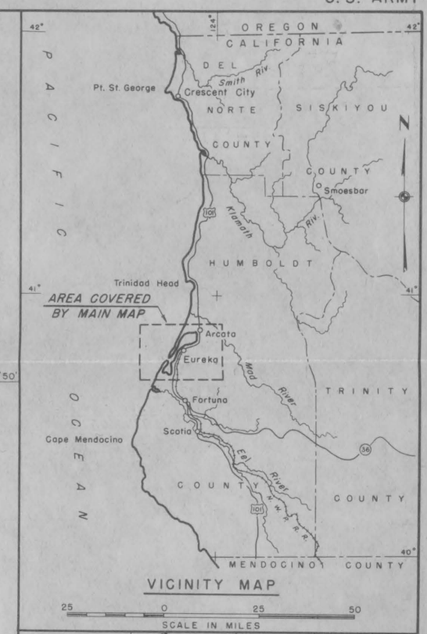
NOTES:

Soundings are in feet and indicate depth at Mean Lower Low Water.

The low water line is shown thus .....

The high water line has no fixed elevation but is for aid to navigation, and is shown thus ....

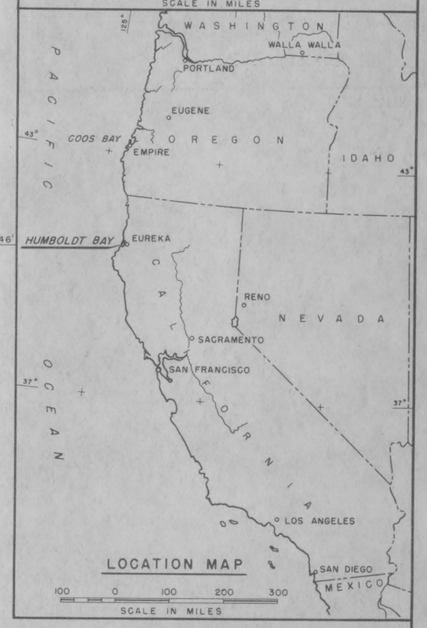
Distance in miles from harbor entrance (Mi. 0.00) is shown thus..... Mi. 0.93



VICINITY MAP

25 0 25 50

SCALE IN MILES



LOCATION MAP

100 0 100 200 300

SCALE IN MILES

SURVEY REPORT

EUREKA CALIFORNIA

HUMBOLDT BAY

PLAN OF IMPROVEMENT

IN 1 SHEET SHEET NO. 1

5000 0 5000 10,000 15,000

SCALE IN FEET

SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS, U.S. ARMY

SUBMITTED: _____ CHIEF, CIVIL WORKS BRANCH

APPROVAL RECOMMENDED: _____ CHIEF, ENGINEERING DIVISION

APPROVED: _____ COL., CORPS OF ENGINEERS

DRAWN: W.L.W.
TRACED: W.L.W.
CHECKED: O.F.W.

TRANSMITTED WITH REPORT DATED 10 FEBRUARY 1950

DOC. FILE	FILE	DIV.	SHEET
	5	1	41

INCL. 1

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