

YAQUINA RIVER AND TRIBUTARIES, OREGON

LETTER

FROM

THE SECRETARY OF WAR

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED MARCH 31, 1941, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A PRELIMINARY EXAMINATION AND SURVEY OF YAQUINA RIVER AND TRIBUTARIES, OREGON, AUTHORIZED BY THE FLOOD CONTROL ACT APPROVED JUNE 22, 1936, AND BY ACT APPROVED JULY 1, 1935

JULY 1, 1941.—Referred to the Committee on Flood Control and ordered to be printed, with two illustrations

WAR DEPARTMENT,
Washington, June 25, 1941.

THE SPEAKER OF THE HOUSE OF REPRESENTATIVES.

DEAR MR. SPEAKER: I am transmitting herewith a report dated March 31, 1941, from the Chief of Engineers, United States Army, on preliminary examination and survey of Yaquina River and tributaries, Oregon, authorized by the Flood Control Act approved June 22, 1936, and the act approved July 1, 1935, together with accompanying papers and illustrations.

The Bureau of the Budget has been consulted and advises that authorization of the project recommended by the Chief of Engineers could not be in accord with the program of the President at this time.

Sincerely yours,

HENRY L. STIMSON,
Secretary of War.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, March 31, 1941.

Subject: Yaquina River and tributaries, Oregon.
To: The Secretary of War.

1. I submit for transmission to Congress my report with accompanying papers and illustrations on examinations of Yaquina River and tributaries, Oregon, authorized by the Flood Control Act approved June 22, 1936, and the act approved July 1, 1935.

2. Yaquina River has its source in the coast range in west central Oregon, flows west 50 miles and discharges into Yaquina Bay 115 miles south of the mouth of the Columbia River. It drains an area of 242 square miles. In the upper basin streams flow through a rugged mountainous country in narrow valleys. In the lower 21 miles of its course the river is tidal, the mean range between mean lower low water and mean higher high water being 8.1 feet at the town of Toledo 9 miles above the mouth. The highest tides rise 11 feet above mean lower low water. The basin had a population of 4,000 in 1930, Toledo with 2,100 being the largest town. The principal natural resource of the basin is timber and lumbering is the principal industry. Rail and highway facilities are reasonably adequate for present needs. The authorized navigation project provides for a channel 20 feet deep at the bay entrance, 18 feet deep through the bay to the town of Yaquina and 10 feet deep thence up Yaquina River to Toledo.

3. Floods, which occur normally during the period November through January, cause no material damage as streams are well entrenched between high banks in the upper basin and the effects of high stages are soon dissipated in the tidal sections of the river. A considerable acreage in the lower basin, however, is subject to overflow by high tides which makes them generally unsuitable for agricultural use unless protected by dikes. Local interests at and in the vicinity of Toledo have constructed low dikes for the protection of 300 acres against tidal overflow and have constructed earth dams with tide gates on Depot and Olalla Sloughs thereby reclaiming 200 acres. In the Mill Four district downstream from Toledo 170 acres of tide lands also have been partially protected by dikes. All of the existing dikes are inadequate in size and cross section and have failed in several places. In the Mill Four district drainage canals have been constructed to carry bottom land overflow to Boones and Nutes Sloughs. Local interests desire rehabilitation and strengthening of dikes and protection of new areas at and in the vicinity of Toledo, the closure of Boones and Nutes Sloughs to protect lands in the Mill Four district and protection of lands adjacent to Pooles Slough.

4. The district engineer has investigated the possibilities of providing suitable protection to tidal areas at and in the vicinity of Toledo and on Pooles Slough but finds that the costs of the necessary works would exceed the benefits. The only improvements found justified at this time are for the protection of lands in the Mill Four district. The plan provides for the closure of Boones and Nutes Sloughs by earth dams equipped with tide gates to take care of interior drainage. The estimated costs of the project are \$71,600 for construction and \$1,100 for lands and rights-of-way, a total of \$72,700. Estimated annual charges, including \$900 for maintenance, would be

\$4,500. The improvements would protect an area of 683 acres against tidal overflow and would effect benefits estimated to average \$7,700 annually. The district engineer finds the project to be justified and recommends its construction at an estimated cost to the United States of \$71,600, subject to conditions of local cooperation. The division engineer concurs.

5. The Board of Engineers for Rivers and Harbors, having fully considered the reports of the district and division engineers and the information presented by local interests at a hearing before the Board, finds that protection to areas in the vicinity of Toledo and along Pooles Slough is not justified, that the most suitable plan for protecting lands in the Mill Four district provides for construction of closure dams across Boones and Nutes Sloughs and that the benefits that would result from construction of those works are substantially in excess of the costs and the project is economically justified. The Board recommends construction of the Mill Four district project at an estimated cost to the United States of \$72,000, subject to conditions of local cooperation.

6. After due consideration of these reports I concur in the views of the Board. Substantial areas of bottomlands along the lower Yaquina River and its tributary sloughs are subject to inundation by high tides with the result that these lands are either wholly unsuited for agricultural purposes or their usefulness is materially curtailed. Of the improvements desired by local interests only the one for protecting tidal lands in the Mill Four district by means of closure dams, is economically justified at this time. I recommend construction of the Mill Four district project, substantially as outlined in the report of the district engineer, at an estimated cost to the United States of \$72,000, subject to the provisions that a responsible local agency give assurances satisfactory to the Secretary of War that it will provide without cost to the United States all lands, easements and rights-of-way necessary for the construction of the project, hold and save the United States free from claims for damages resulting from the improvement and maintain all works after completion in accordance with regulations prescribed by the Secretary of War.

J. L. SCHLEY,
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., March 3, 1941.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. Local interests were advised of the nature of the division engineer's report and invited to submit additional information to the Board. At their request the Board visited the area and held a public hearing. Local interests stressed the need for conserving for agricultural use as much as possible of the bottom lands and urged the

protection of areas in addition to those recommended by the district engineer.

2. The Board is of the opinion that protection of tidal lands at and in the vicinity of Toledo and along Pooles Slough is not justified at this time. The plan found most suitable for protecting lands in the Mill Four district provides for construction of closure dams equipped with tide gates across Boones and Nutes Sloughs. Benefits that would result from construction of these works are substantially in excess of costs and in the opinion of the Board the project is economically justified, although some of the benefits have apparently been duplicated in the district engineer's report. The Board recommends construction of the Mill Four district project, substantially as outlined in the report of the district engineer, at an estimated cost to the United States of \$72,000; subject to the provisions that a responsible local agency give assurances satisfactory to the Secretary of War that it will provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project, hold and save the United States free from claims for damages resulting from the improvement, and maintain all works after completion in accordance with regulations prescribed by the Secretary of War.

For the Board:

THOMAS M. ROBINS,
Brigadier General, Corps of Engineers,
Senior Member.

SURVEY OF YAQUINA RIVER AND TRIBUTARIES, OREGON

SYLLABUS

The district engineer finds that flood-control works for Yaquina River and tributaries are justified to the extent of closing Boones and Nutes Sloughs to prevent tidal overflow of lands adjacent to these sloughs, all at an estimated cost of \$71,600, and recommends that such work be undertaken by the United States, provided local interests will cooperate to the extent prescribed by the requirements of section 3 of the Flood Control Act of June 22, 1936.

WAR DEPARTMENT,
OFFICE OF THE DISTRICT ENGINEER,
Portland, Oreg., December 26, 1940.

Subject: Survey for flood control on Yaquina River and tributaries, Oregon.

To: The Division Engineer, North Pacific Division, Portland, Oreg.

1. *Authority.*—This report is submitted in accordance with the following acts of Congress:

[PUBLIC No. 185—74TH CONG.]

[H. R. 5776]

AN ACT To authorize a preliminary examination of Yaquina River and its tributaries in the State of Oregon with a view to the control of its floods

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is hereby authorized and directed to cause a preliminary examination to be made of the Yaquina River and its tributaries in the State of Oregon, with a view to the control of its floods in accordance with the provisions of section 3 of an Act entitled "An Act

to provide for control of the floods of the Mississippi River and of the Sacramento River, California, and for other purposes", approved March 1, 1917, the cost thereof to be paid from appropriations heretofore or hereafter made for examinations, surveys, and contingencies of rivers and harbors.

Approved, July 1, 1935.

[PUBLIC No. 738—74TH CONG.]

[H. R. 8455]

AN ACT Authorizing the construction of certain public works on rivers and harbors for flood control, and for other purposes

Approved June 22, 1936.

Section 6 of the above act provides as follows:

SEC. 6. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control at the following-named localities:

* * * * *

Yaquina River and tributaries, Oregon.

* * * * *

2. A preliminary examination was made as prescribed by law, was reviewed by the Board of Engineers for Rivers and Harbors, and a survey authorized July 29, 1937. No limits were set on the scope of the survey.

3. *Description of the area.*—The Yaquina River Basin lies almost entirely in Lincoln County, with small headwater areas in Benton and Polk Counties. The river rises in the coast range mountains in west central Oregon near the easterly boundary of Lincoln County, flows generally westward for 50 miles, and empties into Yaquina Bay. The bay, 4 miles long, extends westward to the Pacific Ocean, 115 miles south of the mouth of the Columbia River. In its upper reaches above tidal influence the river is a small mountain stream. In this section it traverses rugged country with narrow valleys and the river's banks are high. The lower 21 miles of the river is tidal and sluggish and its lower 9 miles becomes a branch of the bay. At mile 18 the river has a width of 100 feet. From mile 18 to mile 9 the width increases to 800 feet. In the lower 10 miles there are a number of tidal sloughs, the principal of which are Pooles, Boones, Nutes, Depot, and Olalla Sloughs. Along the banks of the main stream and sloughs there are tide flats that are covered by low tides and bottom lands that are overflowed by the higher tides. The range of tide at Toledo, mile 9, from mean lower low water to mean higher high water is 8.10 feet. The highest tides rise 11 feet above mean lower low water. The range at Newport, near the bay entrance, is only slightly greater than at Toledo. (See United States Coast and Geodetic Survey chart No. 6058, and pl. I herewith.)

4. There is a navigation project for Yaquina River and also for Yaquina Bay and Harbor. These projects provide for twin jetties at the bay entrance with a channel depth of 20 feet; for a channel in the bay 18 feet deep and 200 feet wide to Yaquina, and a channel in the river 10 feet deep and generally 150 feet wide from Yaquina to Toledo.

5. Mountain slopes of the basin are covered with scattered stands of old growth timber, patches of second growth, and with underbrush and ferns. In the creek bottoms there are growths of alder, vine maple, and sallal forming a dense tangle of vegetation. A large

portion of the original heavy stands of Douglas fir and spruce timber in this region was destroyed by an early fire (date unknown) which covered an extensive area along the coast of Oregon. Within this burned-over area there are places where natural reseeding has taken place and the second-growth timber has reached commercial size. In other places the timber has not been restored by natural reseeding, but some replanting has been done by the United States Forest Service.

6. The topography is rugged and the terrain is cut by numerous creeks and spring branches in the sections above tide and by many sloughs in the sections below tide. Rock formations are, in general, of sedimentary character, consisting of sandstone, shale, and conglomerate, with some out-croppings of diorite.

7. The drainage basin of Yaquina River and its tributaries covers an area of 242 square miles. The only tributary of any size is Big Elk Creek, a mountain stream which drains an area of about 87 square miles in the southeastern part of the basin and joins the main stream at Elk City, 17 miles above the mouth.

8. The 1930 census shows the population within the basin to be about 4,000. Most of the people are located along the tidal reach of the river, principally in the vicinity of the town of Toledo which had a population of 2,100 at that time. The balance of the area is very sparsely settled. The town of Newport, at the entrance to the bay, and just outside the limits of the basin, had a population of 1,500 in 1930.

9. *Railways*.—A branch line of the Southern Pacific Co. extends from the main line at Albany in the Willamette Valley, down the Yaquina River to its present terminus at Toledo. The original terminus was at Yaquina on the north side of the bay, 4 miles from the entrance, but operations between Toledo and Yaquina were abandoned by order of the Interstate Commerce Commission in 1937. There are also three logging railroads extending into the adjacent timbered areas tributary to Yaquina River.

10. *Highways*.—The Oregon Coast Highway, U. S. No. 101, crosses Yaquina Bay at Newport on a bridge which was completed in 1937. State highway No. 26 from Newport passes through Toledo and connects with the Pacific Highway, U. S. No. 99 W., at Corvallis in the Willamette Valley. A secondary highway extends from Toledo to Siletz and other gravel roads serve the various communities in the region.

11. *Bridges*.—There is one highway bridge across the bay at Newport and two across the Yaquina River, one near Toledo at mile 9½ and one near mile 17. The Elk City Lumber Co. also has a bridge located at mile 17. In addition to these bridges over the bay and main stream there are railroad and highway bridges across Olalla and Depot Sloughs. All of these bridges are fixed and none of them would be affected by the proposed plan of flood control. There are railroad trestles across Nutes and Boones Sloughs on the sections of railroad abandoned by the Southern Pacific Co. Negotiations have been completed for the use of these trestles as highway bridges. The one over Nutes Slough may be affected by flood-control improvements.

12. *Prior reports*.—There are no prior reports dealing with the control of floods on the Yaquina River and its tributaries.

13. *Resources and development.*—The principal natural resource of the Yaquina Basin is its timber, estimated at 900,000,000 feet board measure. Lumbering is the principal industry, and there are several mills within the basin. At Toledo there are two mills, the larger having a capacity of 400,000 feet board measure per 8-hour shift. A large part of the lumber cut and processed at Toledo is from logs brought in from the Siletz River Basin to the north. About one-half of the lumber produced is shipped by water and the other half by rail. A factory at Toledo produces two carloads of wood products daily, which are shipped by rail. Dairying, fishing, and oyster culture are industries of some importance. Newport, a beach resort, enjoys considerable tourist business during the summer months.

14. *Climate and precipitation.*—The climate in the western part of the Yaquina River Basin is mild. The extremes of temperature range from 10° to 100° with a mean annual temperature of 50°. The average growing season extends from April to November. Annual precipitation in the basin varies considerably from year to year. At Newport, just inside the entrance to the bay, the annual precipitation has varied from a recorded minimum of 37 inches in 1930 to a maximum of 92 inches in 1896. Rainfall at Toledo is considerably heavier than at Newport, while at Summit, on the divide between the Yaquina and Willamette River Basins, it is about the same. Snowfall to a depth of 12.5 inches has been recorded at Newport and Toledo. The snowfall at Summit rarely exceeds 4 feet. The following tabulation shows the average monthly and annual precipitation for the three stations.

Average precipitation, Yaquina River Basin, Oreg.

Station	Years record	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Newport----	44	10.16	8.08	7.55	4.82	3.72	2.53	0.74	0.90	2.94	5.00	10.50	11.02	67.96
Toledo-----	36	11.41	10.06	8.97	6.01	3.85	2.59	.62	.84	2.89	5.48	11.87	11.10	75.69
Summit-----	20	10.34	7.55	7.24	4.36	2.84	1.71	.48	.69	2.55	4.53	10.43	10.02	62.74

15. *Characteristics of basin storms, run-off and flood frequencies.*—Intense storms accompanied by heavy rainfall occur frequently during the months of November, December, and January. The generally steep slopes and rugged nature of the basin result in a rapid run-off during periods of heavy precipitation. Consequently flood discharges of the main stream and its tributaries are directly affected by the duration and intensity of the rainfall. There are no stream gaging stations on the Yaquina River, and there are no authentic records of flood heights or discharges. The low water discharge at Toledo is about 100 second-feet. Testimony of residents of the river communities shows that the ordinary recurring floods have little effect on the river stages in the tidal reach. There are no data on major floods since none have occurred within the memory of the present population. However, the general storms which caused the floods of 1861 and 1862 in the Pacific Northwest must have also affected the Yaquina Basin.

16. The town of Toledo is situated on high ground and most of the improvements are well above ordinary flood stages and high tides. Owners of farms having tidal and bottom lands have placed their

important improvements on high ground where they are not subject to overflow. It does not appear that stages of a major flood, even such as probably occurred in 1861, would materially affect the improvements in the river communities or on the farms. The tide lands and low bottom lands are subject to inundation due to high tides which occur independently of river stages. Even though the river rises to flood stages almost annually topographic conditions are such that only tide flats and low bottom lands are subject to any overflow.

17. *Yaquina Basin agricultural and flood problem.*—The tillable lands in Lincoln County amount to only 3 percent of the total area of the county. The areas of arable lands in the Yaquina River Basin are along the river and tributary creeks and sloughs. These areas are small in extent. With the exception of a few widely scattered farms located on the narrow creek bottoms most of the agricultural development consists of dairy ranches and is confined to the tidal reach of the main stream and along the various sloughs between the mouth of the river and Toledo. There is a considerable acreage in low-tide flats that is not available for agricultural use nor suitable for protection.

18. The agricultural land available in the basin is not sufficient for the production of crops necessary for the use of the present population. Most of the foodstuffs consumed in the basin are shipped in from other sources. Neither are there sufficient lands available for the production of all the feed needed for the stock in the basin. In order to provide a balanced ration for dairy herds, it is necessary to purchase a considerable tonnage of forage and root crops from other sections. This shortage of land in the basin is one of the principal reasons for the petitions for flood control and the protection of tidal lands.

19. In the vicinity of Toledo homesites on small protected tracts are needed for millworkers and their families. Logging and lumbering operations have been sporadic and uncertain, and when the mills have been closed, even temporarily, the workers have had to leave the community and find employment elsewhere. County officials believe that the millworker population could be held in the county if they could be placed on tracts that would provide garden areas for the families. The Federal Resettlement Administration made considerable study and plans of 2,476 acres near Nutes and Boones Sloughs with a view of arranging the lands so that desirable small tracts could be utilized for homesites and gardens in addition to dairying and other farming operations. About 900 acres of this area is subject to tidal overflow.

20. The basin lands that are usable for agricultural purposes lie on three levels: Above the tide flats are low tidal lands which are subject to continual overflow in winter months and occasional overflow in summer months; bottom lands which are subject to occasional overflow by high tides or by tides and freshets combined; and the higher bench lands which are not subject to any overflow. The tidal lands, which have not been disturbed by cultivation, grow perennial crops of native grasses and rushes that appear to be nutritious for beef cattle but poor feed for dairy herds. When diked and cultivated, these lands produce an abundant growth of forage crops and seeded pasturage. The bottom lands are suitable for cultivated forage and other crops. These bottom lands, which can be cultivated without crop losses in ordinary years, are not of sufficient extent to provide

areas for the crop production necessary in the basin. Except in occasional years the higher bench lands do not receive enough moisture for consistent crop production. The bench lands do provide some winter and early spring pasture. However, the native grasses grown on these bench lands do not furnish sufficient nutriment for dairy stock and supplemental feeding is required. Agriculturists have stated that in order to make a livelihood on a farm in the Yaquina River Basin the operator must have access to the acreage of all three classes of land.

21. *Flood damages.*—In this survey no detailed estimate nor appraisal of flood damages was made. The losses appear to be principally agricultural. Bank erosion is not a serious problem on most of the reaches of the Yaquina River. Along the upper reaches the river banks are in general protected by a growth of brush and trees, while along the lower reaches the current is sluggish and erosion, where evident, is the result of wave action. However, the rate of erosion is in general very slow. Property owners claim considerable loss of livestock on the tidal lands as a result of the animals being trapped by the tides. The lower tidal lands which have not been diked provide only intermittent pasturage when not submerged. The lands which have been improved by low dikes are not protected from overflow by higher tides and, consequently, they are only used for pasture lands. Either of these areas, however, are usable in most years for only a few months as the continual overflow by higher tides leaves a salty scum on the grass that ruins it for grazing. The bottom lands which are subject to overflow only by the higher winter tides are not of sufficient acreage to support dairy stock without using the pasturage supplied by the lower tidal lands. In years of continual high tides and freshets the pasturage on the lower tidal lands is destroyed and other forage crops on the bottom lands are so reduced that dairy production falls very low. Many of the cows dry up and dairymen claim that there is always some depletion of the herds from improper and low-nutrient feed. Local interests have made an estimate of their annual losses as follows:

Crop losses.....	\$10,000
Loss of livestock.....	2,600
Damage to fences.....	100
Damage to protective works.....	1,400
Damage to roads and bridges.....	300
Total annual damage.....	14,400

These estimates are based on about 2,160 acres of usable lands in the overflow areas. About 1,270 acres of these lands are subject to continual overflow by moderate tides and freshets.

22. *Improvement works undertaken by local interests.*—In the vicinity of Toledo there are 6 miles of low earth dikes which were constructed to protect an area of about 300 acres from tidal overflow. These dikes are located along the main stream and at the mouths of Depot and Olalla Sloughs. About 25 percent of these dikes have been wholly or partially destroyed by erosion. Local interests have also constructed earth dams with tide gates at points about 1 mile above the mouths of Depot and Olalla Sloughs, thereby closing the sloughs and reclaiming about 200 acres in tide lands above the dams. About 170 acres are partially protected in the Mill Four district by approximately 3 miles of low dikes. All of the existing dikes are of small section,

averaging about 4 to 6 feet above the land, from 2 to 5 feet wide on top, and having side slopes of 1 to 1. The Mill Four drainage district, comprising 2,476 acres, has constructed an artificial channel about 4,000 feet in length to connect the upper reaches of Boones and Nutes Sloughs, and three other drainage canals from 900 to 1,200 feet in length to carry bottom land overflow to the sloughs. The material excavated from these drainage canals was used for the construction of low dikes along the canals. About 5 miles of low dikes were constructed in this district of which 40 percent have been destroyed.

23. Most of the construction work for the protection of these lands along the river and sloughs has been done by drainage district organizations. Three of these have been incorporated in Lincoln County for operations in the Yaquina River Basin. No investigation has been made of the various district organization records to ascertain the amounts that have been expended by local interests on any of these improvements.

24. *Improvements desired by local interests.*—At the preliminary hearing for flood control of the Yaquina River most of the arguments for flood control were presented by representatives of 23 landowners of the Mill Four drainage district for the purpose of urging the closure of Boones and Nutes Sloughs. The County court of Lincoln County was instrumental in obtaining recognition of the flood problem on Pooles Slough. The county, having taken over considerable land in that area on tax foreclosures, has become one of the principal owners. In addition to their general interest in making the lands in that district suitable for agricultural use and providing home sites, their particular interests lies in getting the lands back on the tax rolls. Officials of the city and port of Toledo joined with other local interests in proposing the repair and raising of old dikes, which had been destroyed by erosion, so that an area adjacent to the city limits between Depot and Olalla Sloughs and an area across the river from Toledo might be protected and rehabilitated. County and city officials and other local interests proposed the protection of several small tidal areas below Toledo which they believed could be brought into agricultural production.

25. *Local cooperation.*—No offers of financial cooperation have been made toward reducing the cost to the United States of any desired flood-control improvements. Should flood-control measures be adopted it is believed that local cooperation would be limited to the requirements of section 3 of the Flood Control Act of 1936. The laws of the State of Oregon provide for the forming of flood-control improvement districts with authority to enter into contracts with the United States; and, it is believed, that local interests would form organizations with legal authority to assume the degree of cooperation required.

IMPROVEMENTS INVESTIGATED

26. *Areas A and B.*—This tidal land, up-stream and adjacent to the city limits of Toledo, was formerly in one continuous area. When the Yaquina River highway bridge was built, a pile trestle approach was constructed across the area. This trestle has recently been filled and the embankment was raised and widened in 1938. The highway embankment separates the area into two sections which have been designated "Areas A and B." The entire area was protected by about

7,600 feet of main dike and 2,600 feet of lateral and cross dikes with timber tide boxes which had been constructed by local interests. These dikes were built too near the banks of the river and sloughs, with side slopes too steep for seep line allowances and the dikes were not high enough for protection against the higher tides. After partial destruction of the dikes, the land soon became unsuitable for use as a crop-producing area. Some portions of the tracts are being used for pasturage in summer months. At the upper end of this area 2,230 feet of the old dike was built along the river and Olalla Slough, together with 500 feet of cross dike to the Southern Pacific Railroad grade for the protection of only 13 acres of land. These dikes have been destroyed. The acreage is now broken by several cross sloughs and it has been subjected to overflow and erosion until the topsoil has been taken away and only a clay subsoil remains. This 13 acres is now unsuitable for use without considerable expenditure for building up the land in addition to diking.

27. The construction of new dikes at a proper distance from the river banks would further reduce the acreage in these tracts. The acreage that would be left in area A, between the highway embankment and Olalla Slough, suitable for protection, is 45 acres. In area B, from the highway embankment to Depot Slough, the acreage remaining would be 60 acres. The protection of area A would require the construction of 2,800 feet of dike and three tide boxes which it is estimated would cost \$10,900 or \$242 per acre for the area protected. The protection of area B would require the construction of 3,040 feet of dike and three tide boxes which it is estimated would cost \$8,000 or \$133 per acre.

28. *Areas C and D.*—Area C is located across the river from Toledo. Back of a wide tide flat there is an area of higher ground which extends downstream in a narrow strip. This area between the tide flat and the toe of hill land comprises about 75 acres. Local interests have constructed about 1,300 feet of dikes with timber tide boxes for the protection of about 10 acres at the lower end of this area. The protection of the entire area would require the construction of 7,930 feet of dikes and four tide boxes at an estimated cost of \$22,200 which is equivalent to \$297 per acre for the area protected.

29. Area D is adjacent to the right bank about 2 miles downstream from Toledo. There are about 46 acres of usable land in the area of which 31 acres are subject to tidal overflow. The protection of this area would require the construction of 3,050 feet of dike and two tide boxes at an estimated cost of \$10,000 or \$323 per acre for the area protected.

30. *Impracticability of small tidal tract protection in interests of flood control.*—An investigation of areas A, B, C, and D was made for the reason that they are typical of a number of small areas along the river in the vicinity of and downstream from Toledo. Local interests believe that these areas are suitable for development and that the returns from agricultural production would justify expenditures for protection. It is apparent that various landowners have made a considerable investment per acre in main and lateral dikes and tide boxes to protect small acreages. Claims of benefits are based upon low dikes with insufficient freeboard for protection against the higher tides and drainage through small plank tide boxes which result in lower construction costs. Individual claims of the benefits resulting

from such improvements are also affected by the location of the tracts with respect to the holdings of other classes of land adjacent to the tidal lands. High expenditures per acre for the protection of these small, narrow areas of tidal lands might be justified in a colonization plan where ownerships could be so distributed that each individual operator would have available a small tract of tidal land along with sufficient acreages of bottom and hill land. However, it does not appear that Federal expenditures for the protection of these areas are justified under present conditions of ownership, land use, and crop production, nor in the interests of flood control.

31. *Pooles Slough*.—The mouth of Pooles Slough is 6 miles downstream from Toledo. The main slough extends back into the hills about $2\frac{1}{2}$ miles from the mouth. This slough is practically a continuation of Wright Creek which is a short stream about $4\frac{1}{2}$ miles in length. Wright Creek and its four tributaries have their source in the rugged, broken, hill country west of Salado. It flows in a narrow valley which becomes very flat in the lower reach of $1\frac{1}{2}$ miles above the slough. The drainage area of Pooles Slough and Wright Creek above the mouth of the slough is about 5,800 acres. The bottom lands adjacent to Pooles Slough are subject to ordinary tidal overflow and those along the lower reach of Wright Creek to overflow by higher tides. The overflow lands comprise about 270 acres. The combination of tides and run-off from the Wright Creek drainage area subject these lands to almost continual overflow in winter months.

32. Lincoln County officials state that there are 1,200 acres in the Pooles Slough and Wright Creek district that are suitable for agricultural use and could be profitably operated if the continual use of the overflow lands was assured. They further state that former attempts at farm operations in the area were unsuccessful for the reason that the landowners did not attempt to dike the tidal lands and the hill lands alone would not provide adequate forage. The county assessor's records show that the bottom and tidal lands in the Pooles Slough district are owned in 11 private holdings in addition to tracts taken over by Lincoln County and the State of Oregon. The claim of farmers in the Yaquina Basin that the use of the bottom and tidal lands is essential to their operation appears to be substantiated by the attempts to operate in the Pooles Slough and Wright Creek district with only occasional availability of these tidal land areas.

33. At present the district is served by only one road leading from Toledo which crosses Wright Creek about 3 miles above the mouth of the slough. The road from Ona, in the Beaver Creek Valley, to the lower reaches of Pooles Slough, was recently abandoned by the county after so many of the settlers had abandoned their holdings. The lower reaches of the slough are now accessible only by boats from the river; however, there is a county road surveyed and planned from Toledo down the river to Pooles Slough.

34. There are 64 acres of tidal lands and 27 acres of water area in the reach extending from the mouth to mile 0.7. Oyster beds have been planted in this reach and several families are engaged in the oyster culture. Most of the oyster beds have been planted from the mouth to mile 0.2 and along this reach there are about 30 acres of tidal lands. It is believed to be in the best interests of the community to leave the oyster beds below mile 0.2 undisturbed and accessible to river boats for the reason that the potential income from the 30

acres of tidal land in this reach would not be commensurate with the income that could be derived from the oyster culture.

35. A site for the closure of Pooles Slough has been selected just above mile 0.2 where a highway crossing has been surveyed by Lincoln County. Above this location, including Wright Creek with its tributaries, there is a drainage area of about 5,720 acres. Along Pooles Slough and the lower reach of Wright Creek there are 240 acres of bottom and tidal lands and 110 acres of water area. A closure at this location will require 1,100 feet of levee, 320 feet of cabled pile bulkheads and a 32-foot bridge with tide gates. It is estimated that this closure would cost about \$30,000 which is equivalent to \$125 per acre for the usable bottom and tidal lands that would be protected.

36. Closing Pooles Slough to tidal overflow would add 240 acres to the lower Yaquina Basin agricultural lands and aid in relieving the shortage of suitable lands in an area where the demands of industrial and business growth have already exceeded the supply of dairy production. Such a closure would undoubtedly benefit the private landowners and allow Lincoln County and the State of Oregon to dispose of their holdings to operating owners. Based on reasonable expectation of returns from land use, the benefits would exceed the cost by about 43 percent. However, at the present time Pooles Slough is the only transport way available to residents of that district and the lower reaches of Wright Creek. It is also the only means of access to the properties along sections of the abandoned road about a mile west of the slough. In the past, this slough has been used for rafting logs, and while logging operations are now inactive, they may be resumed at any time. Oyster beds now extend for about one-half mile above the selected location for a closure. In order to close this slough to other than agricultural operations, local interests would have to construct roads into the area and also arrange for the purchase and replanting of the oyster beds above the closure. In view of the present interests of navigation and oyster culture, it appears that the closure of Pooles Slough at this time is not advisable.

37. *Mill Four drainage district.*—The areas contiguous to Nutes and Boones Sloughs constitute all of the lands in the incorporated Mill Four drainage district. These sloughs are connected in their upper reaches by tributary sloughs and a canal which makes a continuous waterway at high tides. The drainage basin of the two sloughs comprises about 3,110 acres. Of this area about 680 acres are usable bottom and tidal lands. There are 260 acres in the water area of the two main sloughs, tributary sloughs, and ditches and 70 acres of waste tidal lands on Boones Slough. The upper areas of the district are served by branch roads leading from the Toledo-Yaquina County Road. The lower areas are now accessible by vehicular traffic using the abandoned roadbed of the Southern Pacific Co. The bottom and tidal land areas in the district, which are subject to overflow, have been used principally for intermittent pasturage. Only about 170 acres, which are partially protected by low dikes, have been usable for cultivated crops. The soils in the partially protected areas are representative of the bottom and tidal land soils in the district. Landowners state that the crop production from these partially protected lands is illustrative of the possible production in the area when fully protected from overflow. Any consideration for the protection of the overflow lands in the Mill Four drainage district must necessarily include the closure of both Nutes and Boones Sloughs.

38. *Nutes Slough*.—The mouth of Nutes Slough is 2.7 miles downstream from Toledo. There are about 1,490 acres of drainage area above the mouth of the slough. The usable bottom and tidal lands in the Nutes Slough area comprise about 430 acres of which 327 acres are subject to continual tidal overflow in winter months and 103 acres subject to overflow by the higher tides only. There are about 90 acres of water area in the main slough, tributary sloughs and ditches. In consideration of the areas suitable for protection adjacent to and directly above the mouth of Nutes Slough a site just above the abandoned railroad trestle, crossing the slough near the mouth, is the most feasible location for a closure that will protect the maximum area. A levee, 950 feet in length, will be required for a closure at this location. Also 200 feet of pile bulkheads on each side of the levee in the main slough section, cabled transversely above mean low water, will be required to break the wave action and provide supports for baffles during construction of the embankment. Three 60-inch circular culverts with tide gates appear to be sufficient to drain the area above the closure during all except intense winter storms. Fresh water overflow of the lower lands for short periods during these storms should not damage the lands nor such crops as may be growing or dormant at that time. It is estimated that the closure of Nutes Slough will cost \$41,300 which is equivalent to \$95 per acre for the protection of all the usable bottom and tidal land area.

39. *Boones Slough*.—The mouth of Boones Slough is 3.1 miles downstream from Toledo. The drainage area above the mouth of the slough is about 1,620 acres. The bottom and tidal lands comprise about 320 acres. Included in this acreage is 70 acres of low-tide lands extending above the mouth for about three-quarters of a mile which are badly broken by tributary sloughs. Above the mouth there are about 170 acres in water areas in the main slough, tributary sloughs and ditches. The mouth of the slough is in two channels about 1,000 feet apart both of which would have to be closed in order to protect all of the lands above the mouth. The most feasible location for a closure appears to be at a site about three-quarters of a mile above the mouth where local interests have constructed 1,300 feet of dike. On the other side of the slough a timbered point, which extends into the bottoms, provides a desirable end for a levee. Above this dike and timbered point there are about 1,260 acres in the drainage area, 253 acres of bottom and tidal lands, and 68 acres of water area. A closure at this location would require 1,575 feet of levee, with 400 feet of cabled piling bulkheads and two 60-inch culverts with tide gates and timber headwalls. It is estimated that such a closure would cost \$31,400 which is equivalent to \$124 per acre for all of the usable bottom and tidal lands in the area that would be protected by the improvement.

40. *Summary of proposed improvements*.—It appears from the investigations and estimates of the cost of the improvements necessary for adequate protection of the bottom and tidal lands that only particular areas in the Yaquina River Basin may be protected at costs which can be justified under ordinary conditions of occupancy and land use. The areas which appear to justify improvements at the present time are adjacent to Nutes and Boones Sloughs. The total cost of the proposed improvements are estimated to be \$72,700 as shown in the following summary:

Location	Estimated cost	Acreage directly benefited	Equivalent cost per acre
Mill Four drainage district:			
Nutes Slough.....	\$41,300	430	\$95
Boones Slough.....	31,400	253	124
Total estimated cost.....	72,700	683	106

¹ Includes \$1,100 non-Federal cost for lands and rights-of-way. A distribution of the estimated cost of these improvements is set forth in table No. 1. The areas investigated and the location of the proposed improvements with typical sections are shown on plate II.

41. *Economic justification of the proposed improvements.*—Dairying interests in the lower Yaquina River Basin, having tidal and bottom lands available for pasturage and forage crops, are generally of the opinion that dairy operations will return a comparable income with other land use. However, most of the areas, with present development, are unable to grow root crops, corn for ensilage, legumes and seeded grasses to supply a balanced ration, and dependence upon natural forage further lowers the quantity and quality of milk production. Investigation and studies made by the Agricultural Experiment Station of Oregon State College for dairy-farm operation in coastal basin areas show that the average production of 250 pounds of butterfat will give a net return of \$37.50 per cow, or \$15 per acre annually. These figures are based on the use of an average of 2½ acres of bottom lands to each producing cow, butterfat at 40 cents per pound, and a cost of production at 62½ percent of the gross return.

42. Under present conditions in the Nutes and Boones Slough district, beef-cattle production from home-raised or feeder stock and minor dairying are the main sources of income. Agriculturists claim that soil and forage tests show that these areas are comparable to more fully developed sections along other coastal streams. However, a change to exclusive dairying operations, after elimination of the flood hazard, cannot be expected to return immediately the average annual incomes earned in other sections. It is reasonable to expect that the average net return in this district should amount to about 75 percent of the average return for dairy operations in other coastal areas. Local operators in other protected or partially protected areas of the lower basin claim a net return of about \$29 per cow which is about 25 percent below the normal return for the coastal region. On this basis, the Nutes and Boones Slough district could expect an average annual net return of about \$11.60 per acre. With bottom-land areas protected from inundation, a reasonable increase in the cow-carrying capacity of the district can be anticipated, which at this net return, would be equivalent to about \$7,900 of increased net annual income. This estimate of earnings from exclusive dairying operations would be creditable to flood control, and it provides a check on the actual flood-control benefits from reduction of present flood damages and increased returns from present undeveloped acreage.

43. Local interests estimate that crop losses, including damages to the land and clearing debris, average about \$4.64 per acre annually. The loss of livestock caught in the overflow areas is the second major item of flood damage. It is estimated that this loss annually is equivalent to \$1.26 per acre. Other items of flood damage make the

total estimated average annual damage equivalent to \$6.67 per acre. These average damages are based on all of the overflow areas in the lower basin of which about 60 percent are subject to intermittent and extensive overflow. (See par. 21.) The damages for the Nutes and Boones Slough district are included in this estimate. Inasmuch as this district comprises more than 30 percent of the total overflow area, for which the estimate was made, the average damages are representative and applicable to the district. Due to the limited use of the bench and hill lands, the small acreages of usable bottom lands have to produce all of the forage and other crops and also provide practically all of the pasturage. The destruction of crops from flooding and damage to natural and seeded pasture makes it necessary for farmers to purchase feed in the open market, or to take additional loss by the reduction of herds before they are ready for shipment. It is believed that the damages estimated by local interests are reasonable and not excessive. For the Nutes and Boones Slough district it is estimated that the average damage amounts to \$4,556 annually. A distribution of the annual damage is shown in the following summary:

	Nutes Slough	Boones Slough	District total
Acreage subject to overflow.....	430	253	683
Average crop and land damage at \$4.64 per acre.....	\$1,995	\$1,174	\$3,169
Average damage to livestock at \$1.26 per acre.....	542	319	861
Average miscellaneous damages at \$0.77 per acre.....	331	195	526
Estimated average annual flood damage.....	2,868	1,688	4,556

44. In addition to prevention of flood damages, flood protection, combined with other measures, is expected to produce additional benefits by bringing into significant agricultural use land which is now of minor agricultural value. Local interests believe that a large proportion of these silty bottom soil areas would be readily adaptable for higher use when protected from overflow, leveled and drained. They point out the advantages for these areas in being situated where climatological conditions allow the production of several crops in the same season; the proximity of markets in Newport and North Lincoln County beach towns, and the production of late crops, such as asparagus, lettuce, and peas, which would bring a higher price in the Portland and Seattle metropolitan markets. Local interests also anticipate that protection from overflow would permit the larger properties, now used principally for stock raising, to be subdivided into smaller holdings for increased land use with an important increase in land values. It is reasonable to expect that producing sections of the district might reach values of \$225 to \$250 per acre for dairy operations, as these values are prevalent in other protected areas of the coastal region. While protection and development of the balance of the properties for higher use will materially increase their value, it is believed, on a conservative estimate, that \$270 to \$290 per acre would represent firm values for this acreage after development. The undeveloped areas comprise about 58 and 47 percent, respectively, of the Nutes and Boones Slough lands. Due to extensive overflow these properties are now only usable for occasional pasturage. This land in its present

state does not have any significant productive value but does have a nominal speculative value. Unless and until the flood hazard is removed, the future use of this land does not justify the cost of leveling and drainage. After deducting present earnings, flood damage and cost of development, it is estimated that the earning from increased land use of these properties will provide \$3,134 of additional annual benefit. In the following tabulation the net income and deductible items are estimated on an annual basis per acre, and the total increase in net earnings is computed for the acreage involved.

	Nutes Slough	Boones Slough	District total
Acreage now subject to extensive overflow	250	120	370
Estimated average annual net income after development	<i>Per acre</i> \$12.60	<i>Per acre</i> \$13.20	-----
Less present average annual earnings60	.80	-----
Less present annual flood damages50	.50	-----
Less estimated annual cost of development	3.61	2.22	-----
Total deductions	4.71	3.52	-----
Estimated increased net annual income	7.89	9.68	-----
Estimated total earning from increase in net income	1.972	1.162	\$3.134

The total annual benefits from elimination of flood damages and net earnings from increased land use, on the basis of this estimate, amount to \$7,690 which is about 3 percent less than the benefits estimated for earnings from increased land use by exclusive dairying operations (par. 42).

45. Certain indirect and intangible benefits have not been evaluated. There is considerable testimony and evidence to show that without the use of the overflow lands, agricultural operations on the adjacent lands have been unprofitable and impracticable. Consequently, substantial benefits will accrue to all of the agricultural lands adjacent to the protected bottom and tidal areas and to the general community of the Mill Four drainage district, comprising a total of 2,476 acres. (See par. 19.) There are 50 acres of shallow water areas in the Nutes and Boones Slough district outside the main sloughs. In the course of years a large percentage of these areas will fill up from natural soil accretions, and many of these minor sloughs and ditches will be filled by the landowners and become available for agricultural use. These areas have not been included in the compilation of benefits from the proposed improvements. Other indirect and intangible benefits include increase in productivity of the lands resulting from improved drainage, enlargement of the local tax base, expansion of local business, and increased social security of residents in the district.

46. *Comparison of estimated annual improvement costs and benefits.*—For the Nutes and Boones Slough district, where improvements are proposed, there is presented in table No. 2 in the appendix a comparison of the estimated annual costs of the improvement and annual benefits. The estimated total Federal expenditure has been extended at 3½ percent interest and the non-Federal expenditure at 4½ percent on the investments. Amortization costs on structures

have been based on a 25-year period and the costs of the other improvements on a 40-year period. The small item of non-Federal amortization cost has been included with maintenance. The annual cost of maintenance has been estimated and averaged over the life of the project. The total annual cost of the improvements is estimated at \$4,510. The total estimated average annual benefits that have been credited to the proposed improvements include reduction of flood damages, \$4,556; and net earnings from increased land use, \$3,134, which amount to \$7,690. These annual benefits exceed the estimated total annual costs by 70 percent.

47. *Storage and power.*—So far as known, there are no desirable storage or power sites on the Yaquina River or its tributaries. There are no hydroelectric power developments in the basin. Flood control by storage, either with or without the development of power, is neither necessary nor practicable.

48. *Irrigation.*—Irrigation has not been utilized in the Yaquina Basin. There is a shortage of rainfall during the months of July and August. However, such crops as are grown in the basin are planted to mature before the dry months, and dairymen depend on subirrigated lands for natural pasturage. Irrigation by pumping fresh water from interior sloughs may be developed if this is found to be desirable.

DISCUSSION

49. There is no record of the discharge of the Yaquina River or its tributaries, but this lack of information is of little importance as the annual freshets and periodic floods cause no losses of any consequence. The only material damages occurring in the basin are the result of the overflow of tidal lands by salt water during high tides, and these areas are all so far downstream that the effect of the run-off discharges on the river stages is negligible.

50. The tracts along the Yaquina River itself, which are subject to overflow, are in narrow strips with long frontages on the river. The small area of land that can be benefited in comparison with the large amount of dike construction involved makes any project for their protection economically unsound.

51. The tidal and bottom lands adjacent to Nutes and Boones Sloughs are subject to the combined overflow by tides and run-off from the respective drainage areas. About 680 acres of tidal and bottom lands in these districts can be protected from tidal overflow by closing these sloughs with substantial levees and installing adequate drainage openings with tide gates. When tidal overflow is excluded from these areas there will be sufficient storage capacity in the main slough channels to provide for the interior run-off except in periods of intense storms.

52. In addition to the protection of the areas of tidal and bottom lands about 1,700 acres of adjacent lower hill land areas in the Nutes and Boones Slough districts will be benefited as profitable operation of these tracts is dependent upon the concurrent use of the tidal and bottom lands.

53. The estimated cost of closing these sloughs has been based on levee sections and structure designs which have been proven necessary for such closures under similar conditions in other localities. The

impracticability of obtaining suction dredge equipment and considerations of the use of other equipment for this work has materially increased the estimated cost.

54. The benefits which would result from the work proposed have been estimated on the basis of exclusive dairying operations and also on dairying in conjunction with other land use. The latter appears to be the more conservative estimate. However, although the estimated benefits are considerably below the average for protected agricultural areas in other coastal stream basins, they appear to be sufficiently in excess of the costs to justify the proposed improvement.

55. With the exception of the localities mentioned and the investigations outlined herein, there are no other flood-control problems on the Yaquina River or any of its tributaries and there is no need for the consideration of reservoirs for purposes of flood control.

CONCLUSIONS AND RECOMMENDATION

56. From the investigations made and estimates of resulting benefits as compared with costs of work proposed, it appears that the closure of Boones and Nutes Sloughs to prevent overflow of adjacent lands by tidewater is justified as a Federal undertaking.

57. It is accordingly recommended that flood-control works on Yaquina River and tributaries to the extent of closing Boones and Nutes Sloughs with adequate levees and drainage outlet structures be undertaken by the United States at an estimated cost of \$71,600, provided local interests will cooperate to the extent prescribed in section 3 of the Flood Control Act of June 22, 1936.

C. R. MOORE,
Major, Corps of Engineers,
District Engineer.

[First endorsement]

OFFICE, DIVISION ENGINEER, NORTH PACIFIC DIVISION,
Portland, Oreg., January 30, 1941.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY.

1. I concur in the report and recommendations of the district engineer.

R. PARK,
Colonel, Corps of Engineers,
Division Engineer.

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