1505-22 SKAGIT RIVER, FEASIBILITY REPT
1963

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18 JAN 1963

NPSEN-PR-R

SUBJECT: Feasibility Report, Skagit River, Washington (Navigation)

TO: Division Engineer
U. S. Army Engineer Division, North Pacific

1. Reference is made to the following:

a. Letter dated 31 December 1959, subject, "Review of Reports, Skagit River, Washington," from the Seattle District, and seven indorsements thereto. The basic letter stated that improvement of the Lower Skagit River for navigation, as originally desired by local interests, is infeasible; but that recent developments indicate the possible feasibility of improving the river for navigation between Mt. Vernon and Concrete, and that additional funds in the estimated amount of $5,400 would be needed for the study. By 6th Indorsement dated 28 [illegible] 1960, the Office, Chief of Engineers approved expenditure of about $[illegible] and a revised study cost estimate of $30,000 to clarify the necessity for a more detailed investigation or to provide data for completion of an [illegible] report.

b. First Indorsement dated 21 July 1961, subject, "Study Cost Estimate (72-6) - Skagit River, Wash. (Navigation), "in which the Division Engineer approved increasing the study cost estimate to $50,000.

2. History of Study. - The Skagit River navigation study was authorized by resolution of the House of Representatives Public Works Committee adopted 13 May 1947, as follows:

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Skagit River, Washington, contained in House Documents Numbered 311, Seventieth Congress, First Session, and 167, Seventy-third Congress, Second Session, with a view to determining if any modification of the existing project in the interest of navigation is advisable."

3. By 2d Indorsement dated 6 June 1947, subject, "Review of Reports on Skagit River, Washington (letter from Committee on Public Works, House of Representatives, to OCE dated 13 May 1947)," the Office, Chief of Engineers directed submission of a report. At a public hearing held

at Mount Vernon, Washington, on 12 April 1949, and attended by 80 people, navigation interests requested improvement of the lower Skagit River for navigation by dredging and maintaining a channel 100 feet wide and 6 feet deep through the entrance bar (see map, inclosure No. 1) and upriver to Mount Vernon, and thence 4 feet deep to Hamilton. In accordance with Presidential policy on curtailment of noncritical project studies during the Korean War, work on the study was suspended before a preliminary report could be prepared.

4. Informal conferences were held with local navigation and flood control groups in September 1954, September 1955, and January and April 1956, relative to the channel improvement, particularly the shoaling problem on the Skagit River delta. With an allotment of $3,000 by the Office, Chief of Engineers in May 1956, the study was resumed.

5. A preliminary report was submitted and a detailed survey was authorized in 1957.

6. Funds were allotted and the detailed survey was initiated in FY 1958. Hydrographic surveys, stream gaging, hydraulic studies, and cost and benefit estimates were accomplished. Results of this work indicated that improvement of the lower part of the river for navigation was not economically justified because of the excessive cost of maintaining the channel through the entrance bar, and the limited and declining amount of navigational use. An unfavorable report was under preparation in September 1959 when local interest was expressed in improvement of the channel above Mount Vernon to Concrete. Upon a reconnaissance of this reach of the river and a preliminary evaluation of benefits, there appeared to be a reasonable possibility that improvement of this reach would be feasible. However, the latest detailed survey of the river is 50 years old and not suitable for estimating dredging requirements under present conditions. The letter report described in paragraph 1a was therefore submitted for the purpose of obtaining $45,400, additional funds needed to complete the study. Funds in the amount of $[illegible],000 were received to accomplish feasibility studies, and work was resumed in FY 1962. An additional sum of $20,000 was received in FY 1962 to be applied to completion of the study.

7. The results of the studies to date and a recommendation for a more detailed investigation are contained in the remainder of this report. Evidence of strong local interest in the proposed navigation improvement is evidenced by 39 letters received by Senator Warren G. Magnuson from local interests, and transmitted by him to the Chief of Engineers by letters dated 22 August, 14 November, 13 and 16 December 1960, and 23 January 1961.

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8. Description. - Skagit River is the largest stream tributary to Puget Sound. It rises in British Columbia 23 miles north of the International Boundary, and flows southwestward 135 miles to Skagit Bay, an arm of the Sound. (see map, Inclosure No. 2). About 7 miles above the mouth, the river divides into two main distributaries, the North and South Forks. Both Forks have been used for navigation, but in recent years traffic has been confined mainly to the North Fork. The major portion of the basin lies in the mountainous eastern areas of Whatcom, Skagit and Snohomish Counties, and is largely occupied by National Forest lands. The upper reaches of the Skagit River and its tributaries are in precipitous mountain valleys which broaden, but maintain their steep mountain walls in their lower reaches. The main river flows in a valley one to three miles wide from Rockport to Sedro Woolley. Below Sedro Woolley to salt water, the valley widens to a flat, fertile outwash plain.

9. The Skagit River is considered navigable for the 78 miles from Marblemount to its mouth. Before rail and highway transportation were available, small steamers plied the Skagit to the mouth of the Sauk during ordinary high water and to a point a few miles above Marblemount during extreme high water stages. Log rafts were towed from Marblemount as late as the early 1950's. Regular river freighter service to Mount Vernon, and tows of log rafts from above Mount Vernon ceased about two years ago. During the period 1951 through 1961, vessel traffic varied from a maximum of 15,900 tons in 1954 to a minimum of 2,300 tons in 1960. Rafted traffic dwindled from 402,000 tons in 1951 to 86,000 tons in 1960, and to 4,000 tons in 1961. This drop is due to the gradual cessation of all rafted traffic above Mount Vernon, and to a temporary closing of a log dump at Mount Vernon because of forest management requirements of a private timberland owner. This dump is being maintained, and the owner expects to raft a sustained average of 90,000 tons of logs annually from Mount Vernon.

10. Skagit County, in which most of the lower Skagit basin area is situated, had a population of about 43,000 in 1950 and 51,900 in 1960. Corresponding populations of principal cities in the basin are as follows:

City	Population 1950	1960
Mount Vernon	5,200	7,900
Sedro Woolley	3,300	3,700
Burlington	2,350	3,000
Concrete	760	840

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11. The principal industries of Skagit County are farming, processing of farm products and logging. In 1959, farm products sold were valued at $15,900,000. In 1958, 117,000,000 board-feet of timber were harvested in Skagit County, largely from the Skagit River valley. Half of this harvest was from Federal forest lands within Skagit County. However, Federal forest lands in the Skagit River valley include extensive areas outside Skagit County for which logging data are included with statistical reports for adjacent counties. Harvest records are not published for Federal lands in the Skagit River valley, but approximately 120,000,000 board-feet annually will be harvested on a sustained yield basis from all Federal forest lands in the valley.

12. Navigation Requirements. - Contacts with local interests indicate that the following traffic would develop on the Skagit River if a suitable channel were provided:

a. Barges of 1,000 tons capacity would be towed from Concrete to Seattle, Washington. These barges would be approximately 50 feet wide, 150 feet long, would have a draft of 5 feet, and would require a 6-foot deep channel when fully loaded. Tugs would draw 3½ to 4 feet of water, and would require a 4½-foot minimum channel depth for safe navigation.

b. Log rafts (flat type) would be towed from log dumps at convenient locations on the Skagit River [illegible] from Concrete to Puget Sound ports. The rafts would contain about 150 to 200 thousand board-feet of timber, and would require a channel 3½ to 4 feet deep. The tugs used for towing the rafts would draw about 2½ feet of water.

c. Lumber, fabricated steel products and machinery would be barged from Sedro Woolley to Puget Sound ports, and steel supplies would be barged in from Seattle to Sedro Woolley. The lumber would be moved in 500-to 1,000-ton loads, and steel supplies in 300-ton loads, requiring channel depths of 4 to 6 feet. Fabricated steel and machinery items would involve loads of 60 to 125 tons.

13. Tug operators who have had experience on the Skagit River advise that a 100-foot channel width and a 6-foot depth would be sufficient for foreseeable navigation requirements. Except for minor shoaling, the channel below Mount Vernon is navigable in its present condition. Traffic would follow the North Fork to Skagit Bay, and would move over the entrance bar at high tide. Tidal effects extend to the vicinity of Mount Vernon at low river stages.

14. Proposed Improvement. - The proposed improvement would provide for a barge channel 6 feet deep and 100 feet wide through bars in the Skagit River between Mount Vernon, about mile 14, and Concrete, Washington

about mile 34. The estimated bottom and a typical section of the proposed channel are shown on inclosure No. 3. The channel depth would be measured below the water surface profile for a flow of 9,000 cubic feet per second. Channel side slopes would be 1, vertical, on 6, horizontal. The channel would be in the deepest part of the natural streambed. Spoil would be deposited within the banks of the high water channel, but as far outside the dredged channel as possible. No attempt would be made to maintain the channel at a fixed location, but as streambed conditions change, maintenance dredging would be accomplished along the most favorable alinement. After project completion, barges and log rafts towed from upriver points would be assembled in the vicinity of Mount Vernon or in the North Fork until tide conditions are favorable. The tows would then be moved through the North Fork and out over the entrance bar at high tide. Minor shoals below Mount Vernon would be dredged to the extent necessary to permit barges to reach the lower part of the North Fork in time to move out at high tide.

15. From visual inspections and past experience in minor dredging along the Skagit River, the material to be dredged is known to vary from sand, in the vicinity of Mount Vernon, to heavy gravel and cobbles above Lyman, about mile 35. A few large boulders would have to be removed by blasting. No ledge rock is expected within the area to be dredged. About 1,500,000 cubic yards of material, including the material from one foot of overdepth dredging, would be removed in providing the proposed channel.

16. The dredging quantity estimate was based on a fathometer survey of the thalweg. Vertical control was obtained at profile points which had been established along the river at intervals of one to four miles. The river profile for a flow of 9,000 cubic feet per second was based on water surface elevations observed when the boat with the fathometer passed these points. The thalweg, observed water surface, estimated 9,000 cubic feet per second water surface and proposed channel bottom profiles are shown on inclosure No. 3. The proposed channel bottom is seven feet below the 9,000 cubic foot per second profile, which allows for a one-foot lowering of the water surface and a 6-foot channel after dredging.

17. The estimated water surface profile and the dredging quantities, based on these surveys, are not sufficiently accurate for a survey report recommendation where the benefit-cost ratio is near unity. However, the surveys are considered to be sufficiently accurate to indicate the possibility of a feasible project when, as in this study, a favorable benefit-cost ratio is indicated.

18. Maintenance of channel depths. - From an inspection of daily hydrographs of the Skagit River near Concrete, for the period 1945 through 1959 (Exhibit No. 1), average daily flows of less than 9,000 cubic feet per second may be expected for periods of about three months each year. Releases from power dams on the Skagit and Baker Rivers produce, typically,

double peaks each day during low flow periods. The effect of these peaks is that during average daily flows as low as 7,[illegible] cubic feet per second, slugs of water of 9,000 cubic feet per second would travel downstream from Concrete. Towboat operators could utilize these slugs for [illegible] loaded barges downstream. The towing of empty barges [illegible] would require a channel depth of four feet. A study of records [illegible] the Dalles (Concrete), for the low flow period of [illegible] 1961, indicates that a four foot channel depth would [illegible] available during average daily flows of about 6,[illegible] cubic [illegible] per second. Partially loaded barges from Concrete, log rafts, and the [illegible] barges and partially loaded barges from Sedro Woolley could also be towed downstream with channel depths of four feet. Therefore, there would be few extended interruptions of river traffic, except for the movement of cement rock and cement from Concrete, provided the channel were maintained to the designed bottom profile. The Lone Star Cement Corporation normally carries a 3-month supply of cement and rock at Concrete, and would not be inconvenienced by a cessation of shipments for this length of time. In years of normal or better than normal low water conditions, navigation in the proposed channel would not be severely interrupted, even if the channel were shoaled as much as two feet.

13. There is no known accurate method for estimating the amount of annual maintenance dredging to be expected for the proposed Skagit River channels. Using the Schoklitsch formula, the estimated amount of bedload carried annually by the Skagit River is about 700,000 cubic yards. There is no practical means of checking the accuracy of this estimate. However, we know that extensive deposits of sand and finer particles are formed at the river mouth, and that only sand and finer particles move through the lower reaches of the stream. The streambed in the upper reaches where most of the proposed dredging would be done is composed largely of coarse gravel and cobbles. As these large particles are not carried into the lower reaches, they obviously cannot compose a predominant part of the bedload movement. Consequently, the major portion of the bedload must be fine particles eroded from river banks, washed into the stream from adjacent land, and derived from the wearing away of coarser particles. Only minor quantities of the fine material could be expected to be deposited in the reach of the stream under study. Estimated velocities up to [illegible] feet per second are expected in the steeper portions of this [illegible] during large floods. During high flows, coarse material would be carried [illegible] the dredged channel slopes and from natural stream banks and deposited [illegible] in the dredged channel. A natural paving of coarse gravel and [illegible] in the streambed would minimize this process in normal years. [illegible] extreme floods could result in relatively extensive shoaling [illegible] channel. In 1947, 1951 and 1954, shoals were dredged, using a [illegible] Corps-owned suction dredge, near river miles 33, 34.5, 42 and 43, to provide 6-foot channel depths for log raft tows. The work was accomplished under the project "Puget Sound and Its Tributary Waters, Wash." Channel depths were based on "approximate low water profile." Quantities dredged

were 128,000, 30,000, 5,000 and 12,000 cubic yards, respectively. A channel change has since by-passed the [illegible] and the [illegible] have been lost. However, during an [illegible] operator who was still towing rafts down stream, indicated that dredging which was accomplished at the other shallow was still available. The old spoil banks along the edge of the channel were visible. On the basis of the foregoing remarks, the shoals to be improved each year are assumed to average about 250,000 cubic yards - one-fourth the amount of the initial dredging.

20. Although extended low water stages sometimes occur during the winter, such stages are normally expected during the months of August, September and October. Most of the channel shoaling would occur during freshets in the period October through June. Only three months of dredge operation would normally be required each year. Dredging would have to begin in April or May and be completed before the end of July to insure suitable navigable depths in August. In a dry year, two dredges might be required to complete the work on this schedule. River flows in April through mid-July are normally high enough to provide a navigable route over proposed channel lines sufficient for tugs to [illegible] intermittent operations, except at locations [illegible] will have to be dredged on one side of the shoal and the [illegible] to a steep bank. Fisheries interests would be consulted prior to completion of the survey studies relative to acceptable methods of spoil disposal.

21. Cost Estimate:

a.	Dredging: 1,520,000 C.Y. at $0.90	$1,368,000
b.	Removal of boulders	4,000
c.	Contingency 15%	206,000
d.	Total direct cost	1,578,000
e.	Engineering:	
	(1) Design Memo:	
	Surveys (39 river miles)	$65,000
	Foundation explorations (39 river miles)	50,000
	Hydraulics & Hydrology	4,000
	Preliminary Planning & coordination	4,000
	Designs and estimates	9,000
	Economic studies	2,000
	Real estate checking	2,000
	Report	4,000
	Total Design Memo	$140,000

(2) Plans and specs	[illegible]		
(3) Engineering during construction	[illegible]		
(4) Total Engineering			[illegible]
f. Supervision and administration:			
(1) Dredging surveys (72 hours)	63,000		
(2) Inspection and District Office costs	99,000		
(3) Overhead	40,000		
(4) Total supervision & administration			[illegible]
g. Total cost			[illegible],000

22. Annual charges:

a. Interest at 2-7/8% and amortization for 50 years			72,000
b. Annual maintenance:			
(1) Dredging 380,000 C.Y. at $0.80		$304,000	
(2) Contingency, 15%		[illegible]	
(3) Total direct cost		$350,000	
(4) Engineering		22,000	
(5) Supervision and admin.		[illegible]	
(6) Total annual maintenance			[illegible]
c. Total annual charges			$474,000

23. Benefits. - Discussions of benefit derivations and summaries of the estimated benefits are contained in paragraphs 24 through 28. Prints of benefit computations are inclosed.

24. Cement and cement rock. -

a. The Lone Star Cement Corp. owns two cement plants, one at Concrete with a capacity of 1,750,000 bbls., annually, and the other at Seattle with a capacity of 1,250,000 bbls., annually. Cement rock for the Concrete plant is obtained at a nearby quarry and moved to the plant by an aerial tramway. This rock was originally used at the Seattle plant for the Seattle plant. Transportation was by rail from a quarry to the end of the Concrete tramway. In recent years, increased rail transportation costs have forced the company to purchase limestone for the Seattle operation from owners of a quarry on Texada Island off the coast of British Columbia. Increased rail costs have also forced the company to concentrate as much of its cement production as possible at Concrete. However, the reputation of the company's products in the market was built on the excellent quality of its higher early-strength cement, produced from Concrete cement rock. The company prizes the quality of this cement to the extent that it is willing to pay the extra transportation cost required to utilize the Concrete rock. All of its higher early-strength cement and its masonry cement (insignificant in volume) are produced at Concrete and transported by rail to Seattle for distribution to customers. All its other marketed products are manufactured at Seattle. The company also considers that maintenance of quality for its low alkali cement requires that 90 percent of the rock used in producing this cement be from the Concrete quarry. This rock is transported by rail from Concrete to Seattle. All other rock used in the Seattle plant comes from Texada Island. The Concrete quarry, owned by Lone Star has proven supplies of 90 million tons, and additional large supplies described as "unlimited" reserves.

b. The company desires improvement of the Skagit River to permit transportation of cement or rock from Concrete to Seattle. It would then benefit from reduced transportation and raw material costs, from eliminating the necessity for depending upon a foreign source of supply for its raw material and the corresponding control over future prices and [illegible] of continued supply; and from income tax allowances for raw material reserve depletions. Because of hesitancy in possibly revealing to competitors its future plans, the company has not made an official commitment that it would concentrate all production at Concrete if the river channel were improved. However, it has purchased a 2.1 acre site at the confluence of the Baker and Skagit Rivers and has an option on a 20-acre site (the preferred site) on the Skagit River downstream from Concrete for a barge terminal in anticipation of a Federal project for improvement of the Skagit River channel for navigation. The company also has a 40-acre site purchased several years ago adjacent to the Concrete plant for future plant expansion. The company has furnished a written assurance that, in event of improvement of the Skagit River, it would use one of three plans: Manufacture of all its products at Concrete, using barges to transport the cement to Seattle for redistribution to customers; manufacture of all its products at Seattle, using

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rock barged from Concrete as its sole source of supply; or a combination of the other two plans, involving cement manufacture at Concrete and Seattle, and barging of cement and rock to Seattle. We also have unpublished confidential information indicating that the company is contemplating plans for the construction within 5 or 10 years, of a new plant either at Concrete or Seattle to carry its entire production. Location of the plant would depend upon whether the Skagit River will be made navigable for barge transportation. Cost analyses indicate a considerable saving in the [illegible] costs for concentration of production at Concrete, because of the lower tonnage. One ton of Concrete rock yields about 0.46 ton of cement, which can be transported to Seattle at a cheaper rate than one ton of rock. The existing Concrete plant is old, but capable of producing cement competitively with newer plants. The Seattle plant silos and equipment would make an excellent storage and distribution center, without modification. The mill portion could be placed in a standby status and reopened on short notice at a future time. We have been informed that Lone Star would initiate planning and design of new facilities as soon as a project for improvement of Skagit River is authorized, and that about two years would be required before design would be completed. A new plant would cost 10 to 15 million dollars.

c. For the purpose of estimating benefits, we have assumed that Lone Star would continue operations, using the existing plants. Initially, all production would be concentrated at Concrete, so that cost saving could thereby be insured; that the Seattle plant would be used only for storage and distribution until production needs exceed the Concrete plant capacity; that the Seattle plant would eventually be utilized for production of the Concrete plant; and that new plant capacity would be constructed at Concrete when demand exceeds the capacities of both existing plants. The company has not yet fully recovered the customers lost during a 6-month strike in the Seattle and Concrete plants in 1957. However, they expect to recover and double present production in about 5 or 10 years. For benefit determinations, Lone Star is assumed to maintain its present portion of the northwest cement market, and that market consumption will increase at the same rate as population in the Puget Sound Region where the major portion of its sales are made. Based on a 50-year projection, the population of the four major counties of the region will be 263 percent, and of the ten smaller counties will be 150 percent of the present populations. An analysis of cement use in the United States indicates that rapidly-growing areas use more cement per capita than do slowly-growing areas. On the basis of this analysis, the rapidly-growing four major counties would use cement at a rate of 2.2 barrels per capita; and the other counties at a rate of 1.6 barrels per capita. Applying these rates to present and future populations, the cement use in the Puget Sound Region (and Lone Star's production) 50 years hence will be 263 percent of the present amount.

d. Existing rail transportation rates were taken from public tariffs. Costs for rock from Texada Island and at Concrete were estimated

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on the basis of information received from the Lone Star Cement Corp. Estimated barge transportation rates were furnished by Dunlap Towing Co., which has made a thorough study of the problem and has furnished these rates to Lone Star Cement Corp. on a firm basis. The annual saving which Lone Star would enjoy immediately after completion of the proposed Skagit River improvement is valued at $[illegible],000. After 50 years, the estimated annual saving would increase in the amount of $[illegible],000. Assuming straight line growth and interest at 2-7/8 percent, the average annual benefit of this increase would be $[illegible],000. Therefore, the gross average annual benefit to Lone Star totals $[illegible],000.

c. Before the company could enjoy these benefits, it would have to construct facilities at Concrete for loading barges: a small silo for storing cement prior to loading barges; and a cement conveyor from the plant to the silo. The total estimated cost of these facilities is $298,000. Interest and amortization on this investment plus maintenance is estimated at $20,000 annually, and would be a charge against annual benefits. The net annual benefit to Lone Star would, therefore, amount to $373,000.

25. Log transportation. -

a. Sources of information used in the study:

(1) "Forest Statistics for Skagit and Whatcom Counties, Washington," Forest Survey Report No. 133, dated September 1959 and prepared by the Pacific Northwest Forest and Range Experiment Station, of the U. S. Forest Service, Department of Agriculture.

(2) Forest Supervisor, Mt. Baker National Forest, Post Office Building, Bellingham, Washington.

(3) District Administrator, Washington State Department of Natural Resources, Route 2, Sedro Woolley, Washington.

(4) Manager, Timber Department, Puget Sound Pulp and Timber Co., Bellingham, Washington .

(5) Mr. Bob Sheldon, and others of the Scott Paper Co., Everett, Washington.

(6) Washington State Public Service Commission Tariff, No. 4a.

(7) Dunlap Towing Co., LaConner, Washington.

(6) Twenty-three other individuals and firms having an interest in or knowledge of log production in the Skagit Valley were also contacted. Their views and information were given consideration in deriving log transportation benefits.

b. Log transportation benefits were derived by comparing only the costs for movement by water and movement by truck, as rail transportation of logs from Skagit Valley has virtually ceased. Log rafting above Mount Vernon has also ceased. Timber movements were considered only for forest areas in the Skagit River valley where rafting down river would result in appreciable reductions in truck haul distances. The assumption is made that over the life of the proposed Skagit River navigation project, the average timber harvest from the tributary areas would be equal to the harvest which could be sustained forever without depletion of the resource. Estimates of annual timber harvests on a sustained yield basis were obtained from personnel identified in paragraph 1b, c, d and e of the preceding paragraph. Deductions were made from these sustained yields to allow for timber which could be more easily trucked out through adjacent river valleys; for timber which would be used by local mills; and for special timber which for various reasons would be trucked direct to mills located on salt water sites. Such timber would include special peeler logs, long poles and logs required in special emergencies when delays for water movement might not be acceptable to mill owners. On this basis, a net of 91,000,000 board-feet annually, out of a total sustained yield of 250,000,000, would move down the Skagit River to salt water, if significant savings in transportation and handling costs could be obtained.

91,000(3.75) = 341,000

c. All timber would be transported from the forests on trucks. Timber to be rafted down the river would be dumped at the nearest log dump after the truck reaches the Skagit valley highway below Concrete. Under present practice, logs are trucked direct to mills on Puget Sound or on estuaries adjoining the Sound; or they are trucked to salt water dumps from which they are towed in rafts to mills. With insignificant exceptions, the logs are dumped into water where they are easily sorted, scaled and rafted. The costs for dumping, sorting, scaling and rafting are about the same under present practice as they would be for logs rafted down river, if the channel were improved. Larger operators would probably provide their own riverside dumps. Dunlap Towing Co. has stated that it would construct dumps, as needed, for small and medium operators, charging the same rate as salt water dump owners. Therefore, the only costs that need to be considered in determining benefits from log transportation on the proposed Skagit River channel improvement are the reduction in trucking costs, less the cost of equivalent log raft towing.

d. Prospective log dump sites along the Skagit River were selected on the advice of men who, in past years, have towed logs down

the river. To simplify the computations, three river mileage points were chosen to represent the means of log-dump-site mileages for major timber producing areas. The percentages of timber moving from each area to the four principal salt water dumping locations were based on estimates by the timber managers for each major timber area. Trucking costs which would be eliminated by rafting down the river were based on a rate of $0.155 per thousand board-feet per mile (source para. d(6)). Raft towing costs were based on tariffs for Skagit River tows established by the Dunlap Towing Co., plus established tariffs for towing rafts from near the mouth of the River to salt water dumping locations. The Dunlap Towing Co. has had experience in towing log rafts down the River, has expended considerable effort in studying navigation of the proposed channel improvement, and is considered reliable. Also, there is no other operator qualified to make raft towing estimates for the Skagit River. Its estimates are, therefore, accepted for use in this study.

c. On the basis of the foregoing discussion, a net annual benefit of approximately $162,000 would be realized from reduced log transportation costs if the proposed Skagit River channel improvement were accomplished.

26. Skagit Corp. at Sedro Woolley. -

a. The Skagit Corp. (formerly Skagit Steel and Iron Works) manufactures heavy log-handling machines and equipment for unloading and unloading containers from ships. Special steel supplies are received by vessel from the East Coast, unloaded at Seattle and transported by truck to Sedro Woolley. Other steel supplies are trucked from a mill at Seattle. The trucks are owned and operated by Skagit Corp. If the Skagit River channel is improved, Skagit Corp. plans to purchase two barges which will be used for transporting supplies and products, mainly between Seattle and Sedro Woolley. In addition, the barges will be used for storing steel used in the plant, thus reducing warehousing costs. The barges would be towed by the Dunlap Towing Co. which furnished estimated barge transportation rates.

b. Ship container loader shipments. - An average of 12 ship container loaders, weighing 135 tons each, are manufactured annually. They are transported to Seattle by trucks and loaded aboard ships for transportation to West Coast, Gulf and East Coast Ports for installation on vessels. Some are installed on vessels at Seattle. Rail transportation to Seattle is generally not competitive with captive truck transportation. The container loaders are placed aboard ship in parts weighing from 20 to 60 tons. These parts must be disassembled before they are loaded on trucks and reassembled, inspected and tested before placing

1,500

aboard ships. If the Skagit River were improved, the Skagit Corp. would move the container loader parts, without disassembly, on the plant dollies about a mile to a wharf at Sedro Woolley. The parts would be placed by crane aboard a barge, moved to ship side at Seattle, and loaded aboard ship. An overall saving in anticipated on freight and shipping, consisting of disassembly, reassembly, lubrication and testing costs amounting to about $2,750 per ship container loader. An annual saving of $44,000, attributable to the proposed improvement of the Skagit River, can therefore be realized.

c. Steel manufacturing. - No transportation saving could be expected from barging steel produced by the Seattle mill, because of the high cost of handling and trucking steel from the mill to the barge at Seattle. However, about 1,250 tons annually of steel used for commercial items are received from vessels at Seattle and trucked to Sedro Woolley. This steel could be loaded directly aboard the Skagit Corp. barge and moved to Sedro Woolley at an estimated annual saving of $2,000. This saving would be attributable to the proposed Skagit River improvement.

d. Log-handling machine shipments to Vancouver, B. C. - An average of six log-handling machines, annually, are sold to customers who take delivery aboard barges at Vancouver, B. C. The machines weigh about 60 tons each, and must be disassembled and loaded aboard trucks for transportation to Vancouver, B. C., reassembled, inspected and tested before loading aboard the barge. If the Skagit River were improved, the machines could be moved aboard a Skagit Corp. barge at Sedro Woolley without disassembly, and under their own power, transported to Vancouver, B. C., and moved aboard the customer's barge. Therefore, an annual saving of $1,000, attributable to the proposed Skagit River improvement, would be attainable.

e. Log-handling machine shipments to Alaska. - An average of 3 log-handling machines, annually, are shipped to Alaska. The machines are disassembled, loaded on trucks and moved to Seattle where they are reassembled, inspected and tested before loading aboard vessels bound for Alaska. If the Skagit River were improved, the machines would be moved aboard a Skagit Corp. barge at Sedro Woolley without disassembly, and under their own power, moved to Seattle, and loaded aboard the vessel. Therefore, an annual saving of $1,000 would be possible.

f. The savings described above would require the purchase and maintenance of two barges having a capacity of about 300 tons, and two cranes for handling cargo. The initial investment in this equipment is estimated at $96,000. Interest and amortization on this investment, plus maintenance is estimated at $9,000 annually. As the equipment would be

used for other purposes than for transporting the items described above, only $6,000 of this amount is considered as an annual charge against the estimated Skagit Corp. benefits. The net benefit to Skagit Corp. from the proposed improvement of Skagit River is $42,000, summarized as follows:

Ship container loader shipments	$44,000
Steel receipts	2,000
Log-handling machine shipments	[illegible]
Gross Annual saving	$46,000
Less annual charges on barges and cranes	[illegible]
Net annual benefit to Skagit Corp.	$42,000

27. Sedro Woolley Lumber Shipments. - Two mills at Sedro Woolley sell annually, an average of 10,500,000 board-feet of lumber to the U. S. Army. The lumber is trucked to Anacortes where it is loaded aboard ships. If the Skagit River channel were improved, the lumber would be loaded aboard barges at Sedro Woolley, barged to Anacortes, and loaded aboard ships from the barges. Use of barges would result in annual savings of $24,000 through reduced transportation, handling and inspection costs.

10,500 (1.6845) = 17,700 tons

28. Benefit summary. - A small barge terminal would be required at Sedro Woolley to permit lumber shipments and receipt and shipment of commodities to the Skagit Corp. A suitable terminal could be constructed at a cost of $113,000. Interest and amortization on this investment, plus annual maintenance, would amount to an estimated $9,000 annually, and would be a cost chargeable against all benefits from Sedro Woolley operations. Benefits are summarized as follows:

Skagit Corp. at Sedro Woolley	$42,000
Lumber shipments at Sedro Woolley	[illegible]
Total gross benefits at Sedro Woolley	$66,000
Less barge terminal charges at Sedro Woolley	[illegible]
Net annual benefits, Sedro Woolley Operations	$57,000
Log transportation	162,000
Cement and cement rock	373,000
Total annual benefits	$592,000

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29. Comparison of benefits and costs. - The ratio of annual benefits ($592,000) to annual costs ($474,000) is 1.25.

30. Funds required for study completion. -

a. Study completion cost:

(1)	Surveys: Vertical control and cross-sections, including computing and drafting	$21,500
(2)	Geological investigation	1,000
(3)	Hydrology and hydraulics	3,500
(4)	Designs and estimates	4,000
(5)	Completion of economic studies	2,000
(6)	Report preparation	4,000
(7)	Contingency, supervision and overhead	9,000
(8)	Total funds required to complete study	$45,000

b. Estimated funds available for FY-1963 20,000

c. Balance required to complete study $25,000

Surveys would require about 3-1/2 months and should be completed before the end of June 1963 to permit accomplishment before the low water season which usually starts in July, and to permit effective use of District field personnel before the heavy seasonal workload starts in the late spring season. Funding requirements to meet this schedule and provide for necessary supervision and miscellaneous studies are as follows:

a.	Estimated funds available for FY-63	$20,000
b.	Additional funds required before 1 Mar. 1963	10,000
c.	Funds required in FY-1964	15,000
d.	Total funds required to complete study	$45,000

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31. Recommendations. - The Skagit River navigation study has been authorized and intermittently underway since 1945. In view of this fact, the favorable benefit-cost ratio based on limited field surveys, and the importance of the proposed project to the local economy, an effort should be made to complete the study as soon as practicable. Therefore, the District Engineer recommends that a minimum of $10,000, in addition to funds presently available, be allocated to the Skagit River navigation study not later than 1 March 1963, and the remaining $15,000 needed to complete the study be allocated early in Fiscal Year 1964.

5 Incl
1. Map, File No. E-6-6-175
2. " " " E-6-6-84
3. " " " E-6-148.1 (in 4 shts)
4. Exhibit No. I (Hydrographs)
5. Benefit Computations

ERNEST L. PERRY
Colonel, Corps of Engineers
District Engineer

Hopkins
Holmes
Burley
Steinborn
[illegible]
Col. Perry /s/
THRU STEINBORN
ED P&R Br

cc: Burley