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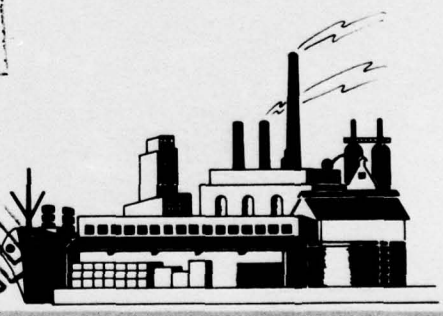
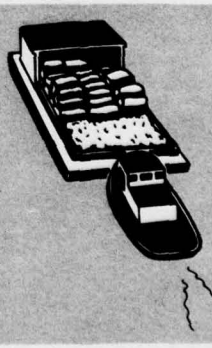


APPENDIX I

NAVIGATION



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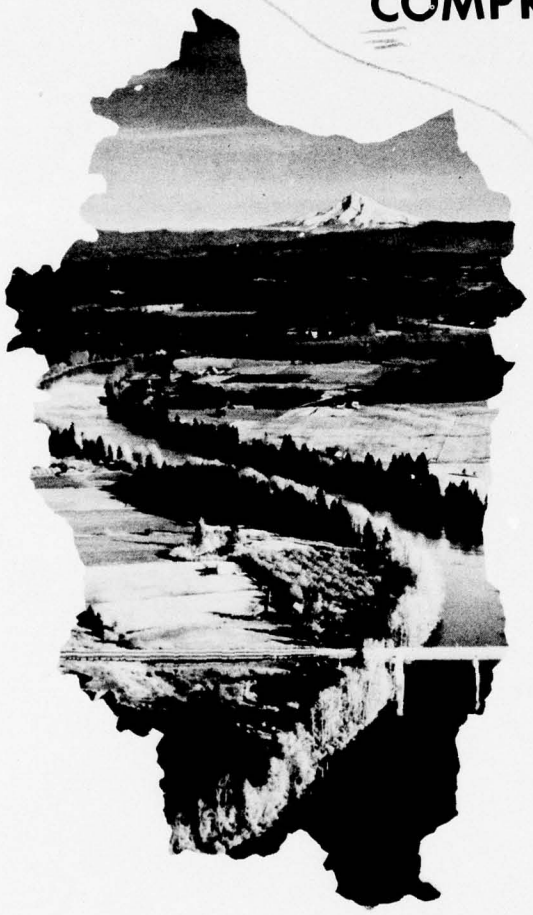

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CREDITS

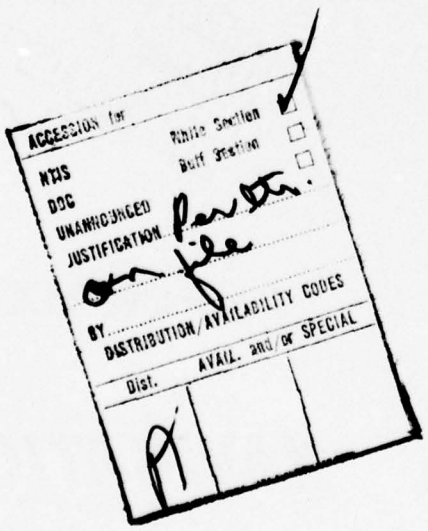
This is one of a series of appendices to the Willamette Basin Comprehensive Study main report. Each appendix deals with a particular aspect of the study. The main report is a summary of information contained in the appendices plus the findings, conclusion, and recommendations of the investigation.

This appendix was prepared under the general supervision of the Willamette Basin Task Force and by the Navigation Committee. The committee was chaired by the Corps of Engineers and included representation from the following groups and agencies:

Port of Portland

Oregon State Marine Board

Oregon State University



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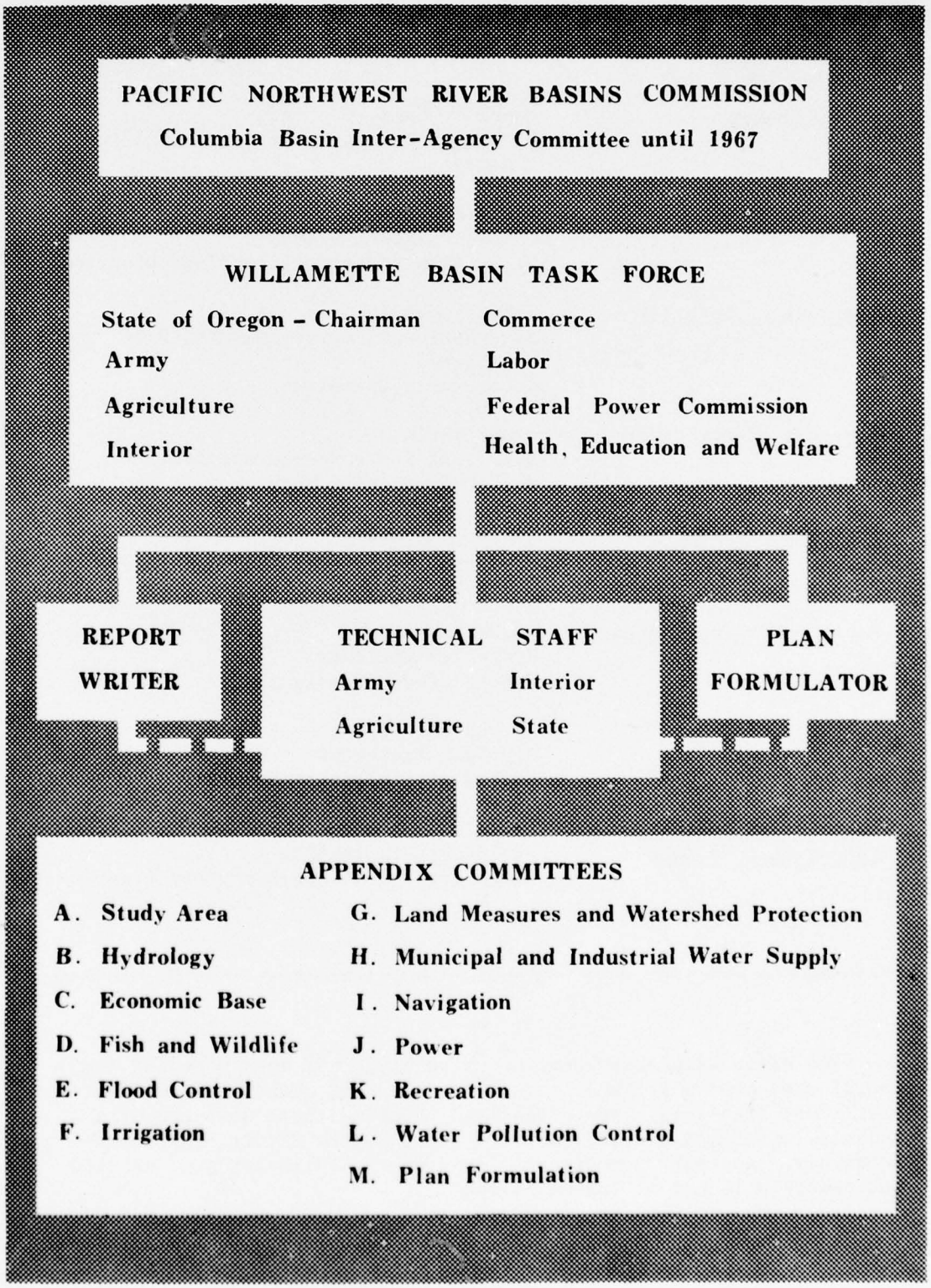

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Federal Power Commission	Gordon N. Boyer Hydraulic Engineer Federal Power Commission
Department of Labor	Horace Harding Regional Economist Bureau of Employment Security
Department of Health, Education & Welfare	Francis L. Nelson Public Health Service Water Supply and Sea Resources Program

The Willamette Basin Comprehensive Study has been directed and coordinated by the Willamette Basin Task Force, whose membership as of April 1969 is listed above. The Task Force has been assisted by a technical staff, a plan formulator, and a report writer - Executive Secretary. Appendix committees listed on the following page carried out specific technical investigations.

APPENDIX COMMITTEES

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A - Study Area	OSWRB - Chairman:	FWPCA, USBPA, USBLM, USBM, USBOR, USBR, USBSF&WL, USCE, USERS, USFS, USGS, USNPS, USSCS, OSDC, OSDF, OSDG&MI, OSS&WCC, OSU
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M - Plan Formulation	Plan Formulator - Chairman:	USCE, USDA, USDI, OSWRB

FPC - Federal Power Commission
FWPCA - Federal Water Pollution Control Administration
USBPA - Bonneville Power Administration
USBCF - Bureau of Commercial Fisheries
USBLM - Bureau of Land Management
USBM - Bureau of Mines
USBOR - Bureau of Outdoor Recreation
USBR - Bureau of Reclamation
USBSF&WL - Bureau of Sport Fisheries and Wildlife
USCE - Corps of Engineers
USDA - Department of Agriculture
USHEW - Department of Health, Education and Welfare
USDI - Department of Interior
USDL - Department of Labor
USERS - Economic Research Service
USFS - Forest Service
USGS - Geological Survey
USNPS - National Park Service
USSCS - Soil Conservation Service
USWB - Weather Bureau

OSBH - Oregon State Board of Health
OSDC - Oregon State Department of Commerce
OSDF - Oregon State Department of Forestry
OSDG&MI - Oregon State Department of Geology and Mineral Industries
OSE - Oregon State Engineer
OSFC - Fish Commission of Oregon
OSGC - Oregon State Game Commission
OSHD-PD - Oregon State Highway Department - Parks Division
OSMB - Oregon State Marine Board
OSS&WCC - Oregon State Soil and Water Conservation Committee
OSWRB - Oregon State Water Resources Board
OSU - Oregon State University
PSC-PR&C - Portland State College - Center for Population Research and Census Service
UO - University of Oregon
LCPD - Land County Parks Department
OCPA - Oregon County Parks Association
POP - Port of Portland

BASIN DESCRIPTION

Between the crests of the Cascade and Coast Ranges in northwestern Oregon lies an area of 12,045 square miles drained by Willamette and Sandy Rivers--the Willamette Basin. Both Willamette and Sandy Rivers are part of the Columbia River system, each lying south of lower Columbia River.

With a 1965 population of 1.34 million, the basin accounted for 68 percent of the population of the State of Oregon. The State's largest cities, Portland, Salem, and Eugene, are within the basin boundaries. Forty-one percent of Oregon's population is concentrated in the lower basin subarea, which includes the Portland metropolitan area.

The basin is roughly rectangular, with a north-south dimension of about 150 miles and an average width of 75 miles. It is bounded on the east by the Cascade Range, on the south by the Calapooya Mountains, and on the west by the Coast Range. Columbia River, from Bonneville Dam to St. Helens, forms a northern boundary. Elevations range from less than 10 feet (mean sea level) along the Columbia, to 450 feet on the valley floor at Eugene, and over 10,000 feet in the Cascade Range. The Coast Range attains elevations of slightly over 4,000 feet.

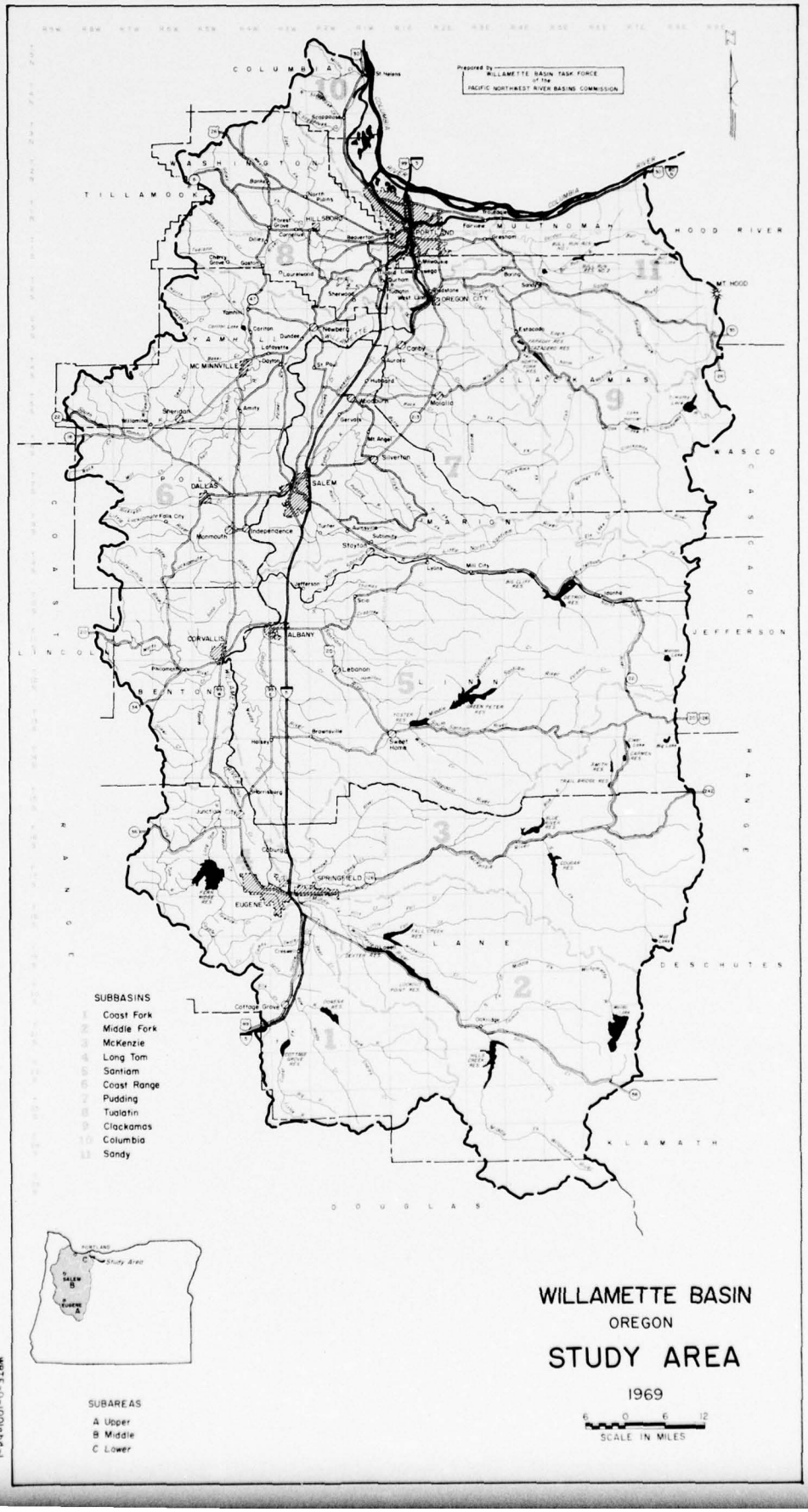
The Willamette Valley floor, about 30 miles wide, is approximately 3,500 square miles in extent and lies below an elevation of 500 feet. It is nearly level in many places, gently rolling in others, and broken by several groups of hills and scattered buttes.

Willamette River forms at the confluence of its Coast and Middle Forks near Springfield. It has a total length of approximately 187 miles, and in its upper 133 miles flows northward in a braided, meandering channel. Through most of the remaining 54 miles, it flows between higher and more well defined banks unhindered by falls or rapids, except for Willamette Falls at Oregon City. The stretch below the falls is subject to ocean tidal effects which are transmitted through Columbia River.

Most of the major tributaries of Willamette River rise in the Cascade Range at elevations of 6,000 feet or higher and enter the main stream from the east. Coast Fork Willamette River rises in the Calapooya Mountains, and numerous smaller tributaries rising in the Coast Range enter the main stream from the west.

In this study, the basin is divided into three major sections, referred to as the Upper, Middle, and Lower Subareas (see map opposite). The Upper Subarea is bounded on the south by the Calapooya Mountains and on the north by the divide between the McKenzie River drainage and the Calapooia and Santiam drainages east of the valley floor and by the Long Tom-Marys River divide west of it. The Middle Subarea includes all lands which drain into Willamette River between the mouth of Long Tom River and Fish Eddy, a point three miles below the mouth of Molalla River. The Lower Subarea includes all lands which drain either into Willamette River from Fish Eddy to its mouth or directly into Columbia River between Bonneville and St. Helens; Sandy River is the only major basin stream which does not drain directly into the Willamette.

For detailed study, the three subareas are further divided into 11 subbasins as shown on the map.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SALEM
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DALLAS
McMINNVILLE
OREGON CITY
SPRINGFIELD
MT HOOD
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
Study Area
A
B
C
SUBAREAS
A Upper
B Middle
C Lower
WILLAMETTE BASIN
OREGON
STUDY AREA
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INTRODUCTION

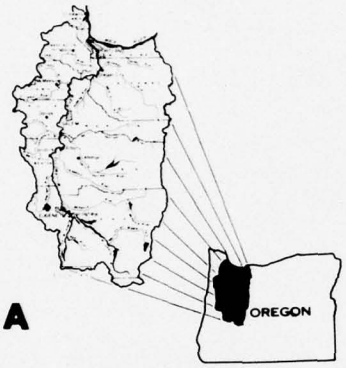
PURPOSE AND SCOPE

This appendix outlines the development of navigation in Willamette Basin and evaluates existing navigation structures and programs in terms of ability to meet present and anticipated future needs. Alternative proposals are presented where present facilities or measures are found to be inadequate to meet existing needs or those anticipated to arise from future growth through the years 1980, 2000, and 2020. Projected needs are based on a realistic economic balance between commercial utilization of waterways and use of alternative means such as highway, rail, pipeline, and air transport. Recreational benefits, which could accrue as a result of improved pleasure boating through navigational development, have also been considered.

Willamette River can be divided into two distinct but interrelated sections: (1) from its mouth to river mile 14 (Ross Island Bridge), designated as Portland Harbor, where the emphasis is on deep-draft navigation and ocean shipping; and (2) from river mile 14 to Harrisburg (approximately river mile 163), where the emphasis is on shallow-draft navigation directed toward intra-basin movement of goods.

RELATIONSHIP TO OTHER PARTS OF REPORT

The Navigation Appendix relies upon supporting data contained in the Study Area, Hydrology, and Economic Base Appendices. There has also been an interchange of pertinent information between this and other appendices, particularly Appendix K - Recreation, and Appendix M - Plan Formulation. The data in this appendix provide the background for the navigation aspects of the main report. → Next page



A

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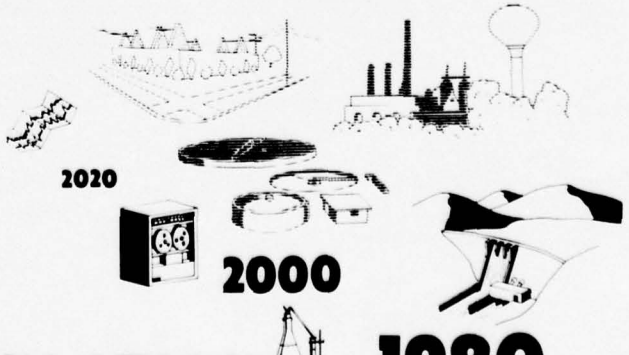


M

PLAN FORMULATION

1980

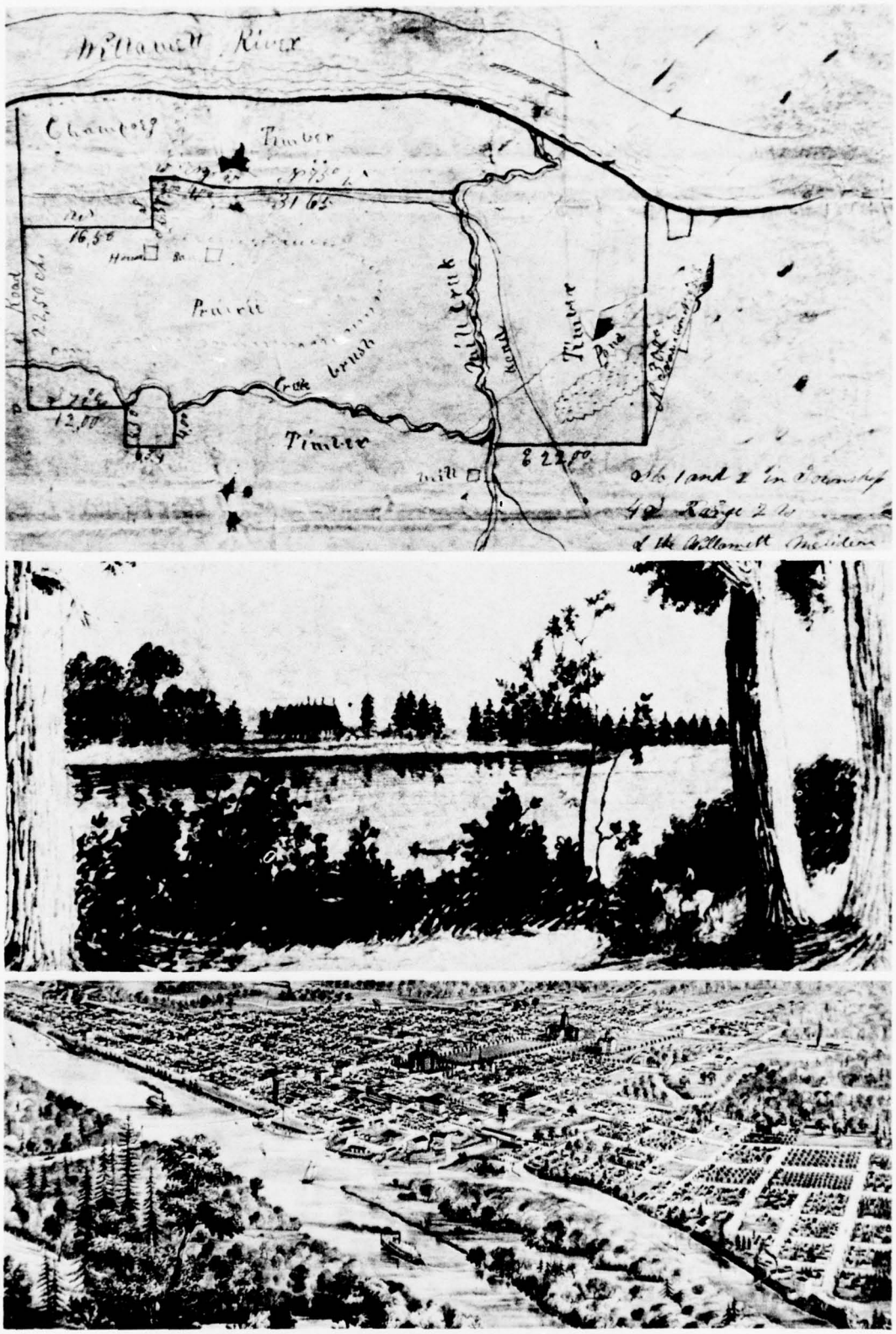


Photo I-1 An early property survey map on the Willamette River at Champoeg; a sketch of the first missionary encampment on the Willamette River, (1841); an 1876 sketch of Salem showing the ferry and various navigation facilities. (Oregon State Library)

H I S T O R Y

Navigation has been a part of the history of Willamette Basin since the earliest days of exploration and settlement. As time passed, the use of waterways for transportation changed progressively, influenced by the ever-expanding population, improvements in vessels, changing import and export cargoes, and the expansion of land-based transportation.

The sea route to Willamette Valley was discovered in 1792. Captain Robert Gray, an American sea captain in search of furs for the China trade, located the mouth of Columbia River, and in the same year, Lieutenant William R. Broughton, under command of Captain George Vancouver of the British Navy, explored Columbia River in a small boat up to Vancouver Point, a few miles above the mouth of the Willamette.

EARLY DEVELOPMENT

Early settlers favored townsites adjacent to the river primarily for the advantage of water transportation. The first valley settlement was at Champoeg, some 20 miles above Willamette Falls, in the late 1820's. From 1792 to 1840, sailing vessels, mostly from England, plied lower Columbia River to Cascade Falls, 147 miles from the sea, and to Willamette Falls, 26 miles upstream from the confluence of Willamette and Columbia Rivers. Commerce moved by sailing ships, long boats, canoes, and bateaux. Mechanization was introduced to river navigation in 1836 when the first steamboat--*The Beaver*, a 100-foot side-wheeler built in England--was placed in service with the Hudson's Bay Company on Columbia and lower Willamette Rivers.

The first cargo of export lumber produced by steam-powered sawmills was loaded from wharves at Portland in 1851. From that time, Portland began its development as an important national and international port, contributing greatly to the commerce and growth of the Willamette Valley, the Pacific Northwest, and the Nation. In 1868, the first cargo of export wheat grown on Willamette Valley farms was shipped to England, inaugurating many years of wheat shipments to that country via the Hawaiian Islands and Cape Horn.

On the upper Willamette, bateaux, rigged with sail and sweeps, were still being used during the 1840's to carry passengers, household goods and general merchandise downstream. The first steamboat to work above Willamette Falls was the *Hoosier*, a sidewheel steamer made from a ship's long boat; in 1851, she was making three trips a week from Canemah, just above the falls, to Dayton on the Yamhill River. Also in 1851, the sidewheel steamer *Multnomah* was assembled above the falls and began service between Canemah and Corvallis. Freight rates were high--wheat was carried down the Willamette at 50¢ per bushel and general freight upriver for about $35 per ton.

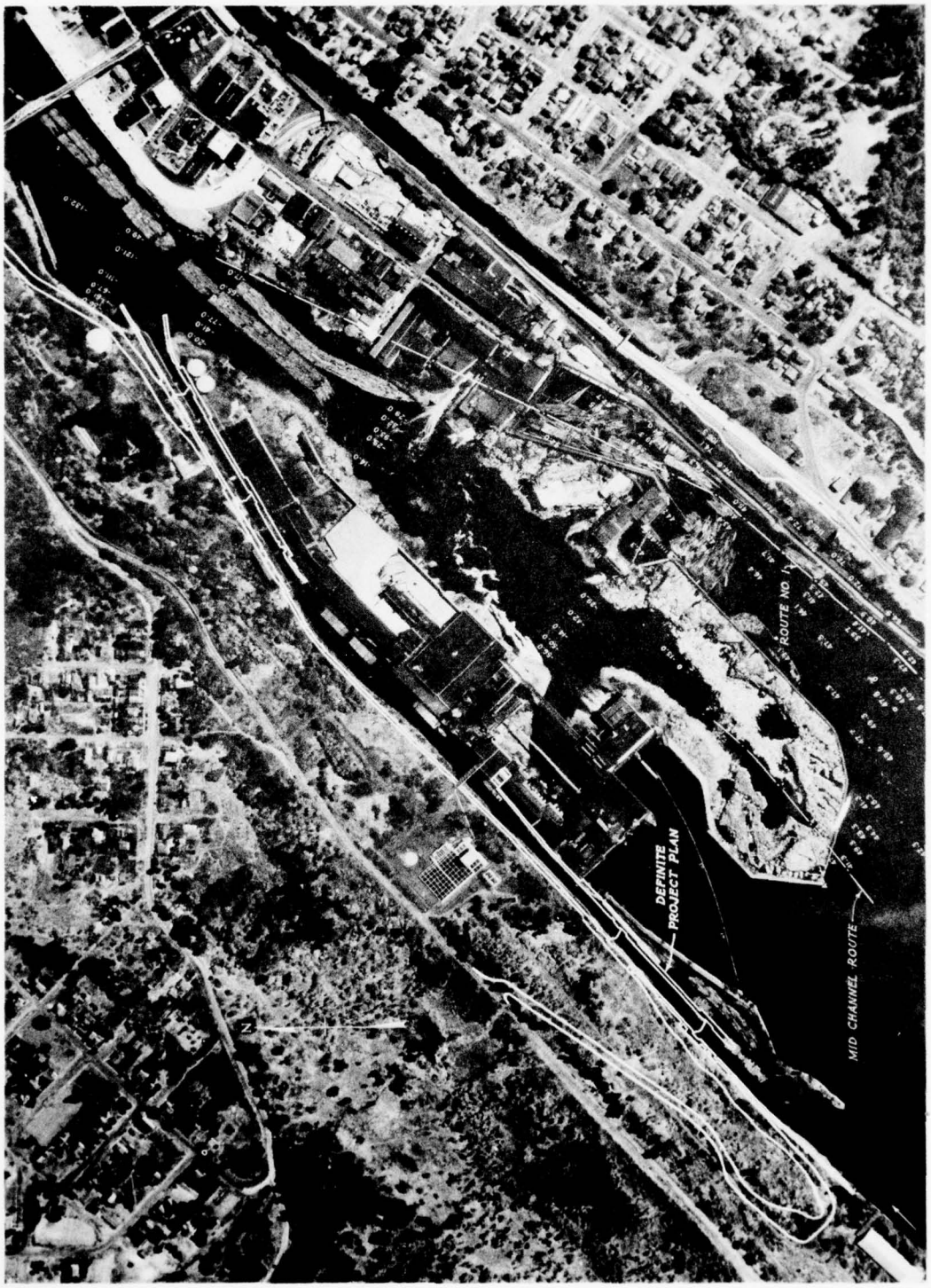


Photo I-2 An aerial view of Willamette Falls showing the existing locks with the authorized lock improvement superimposed in white lines. (USCE Photo)

The first sternwheel steamboat--the *James Clinton*--was launched in 1855 on upper Willamette River and began freight service between Canemah and Eugene. Initially, freight was carried around the falls by ox-drawn wagons, and later by a railway portage between Oregon City and Canemah. The People's Transportation Company was formed in 1862 to operate between Portland and Eugene. Within a decade after its formation, that company achieved a monopoly of steamboat service on the upper river. At its peak, it operated seven steamboats upstream from the falls and two downstream.

For several years beginning in 1867, small steamboats navigated Tualatin River between mile 3.5 and Cornelius. Freight from Tualatin Valley was transferred at the downstream terminus to a tramway extending 1-1/2 miles overland to Lake Oswego, where it was then transferred to a lake steamer which forwarded it to vessels on Willamette River. Later, a private canal replaced the tramway and logs to be used in making charcoal were rafted from the upper reaches of the Tualatin to an iron blast furnace on Lake Oswego.

CHANNEL IMPROVEMENT AND NAVIGATION PROJECTS

On both Columbia and Willamette Rivers, it soon became clear that improved navigation channels would be required if large-scale commerce were to become a reality. Following the Civil War, funds were raised at Oregon City to deepen the channel at Clackamas Rapids--on the Willamette near Milwaukie--and the City of Portland purchased a bucket dredge to deepen channels through bars on the Columbia and lower Willamette Rivers. In 1868, the Willamette Falls Locks and Canal Company was organized to construct locks on the west bank of the falls. In 1873, the locks were opened for river traffic. The lock system included a flight of four locks (each 210 feet long and 40 feet wide) with a lift of about 10-1/4 feet), a canal basin 1,250 feet long, and a guard lock 210 feet by 40 feet. Construction was aided by a grant from the State of Oregon covering about one-third of the estimated total cost of $600,000. Subsequent removal of obstructions in the river below the locks, with resultant lowering of the river, increased the total lift to about 50 feet.

Congress has underwritten Federal participation in navigation improvement through many Rivers and Harbors Acts dating back to 1866. The first Federal navigation project in the basin was authorized March 3, 1871, for improvement of Willamette River above Portland. The Columbia and Lower Willamette Rivers project was approved by the Chief of Engineers in 1877 and Congress made funds available the following year.

The Acts of 1866 and 1876, inclusive, had enabled the Corps of Engineers to dredge various bars in Columbia and Lower Willamette Rivers for temporary relief before the projects were authorized. During that period, a total of $221,780 was expended for temporary dredging. The Corps also engaged the steamboat *Success* to remove obstructions from upper Willamette River.

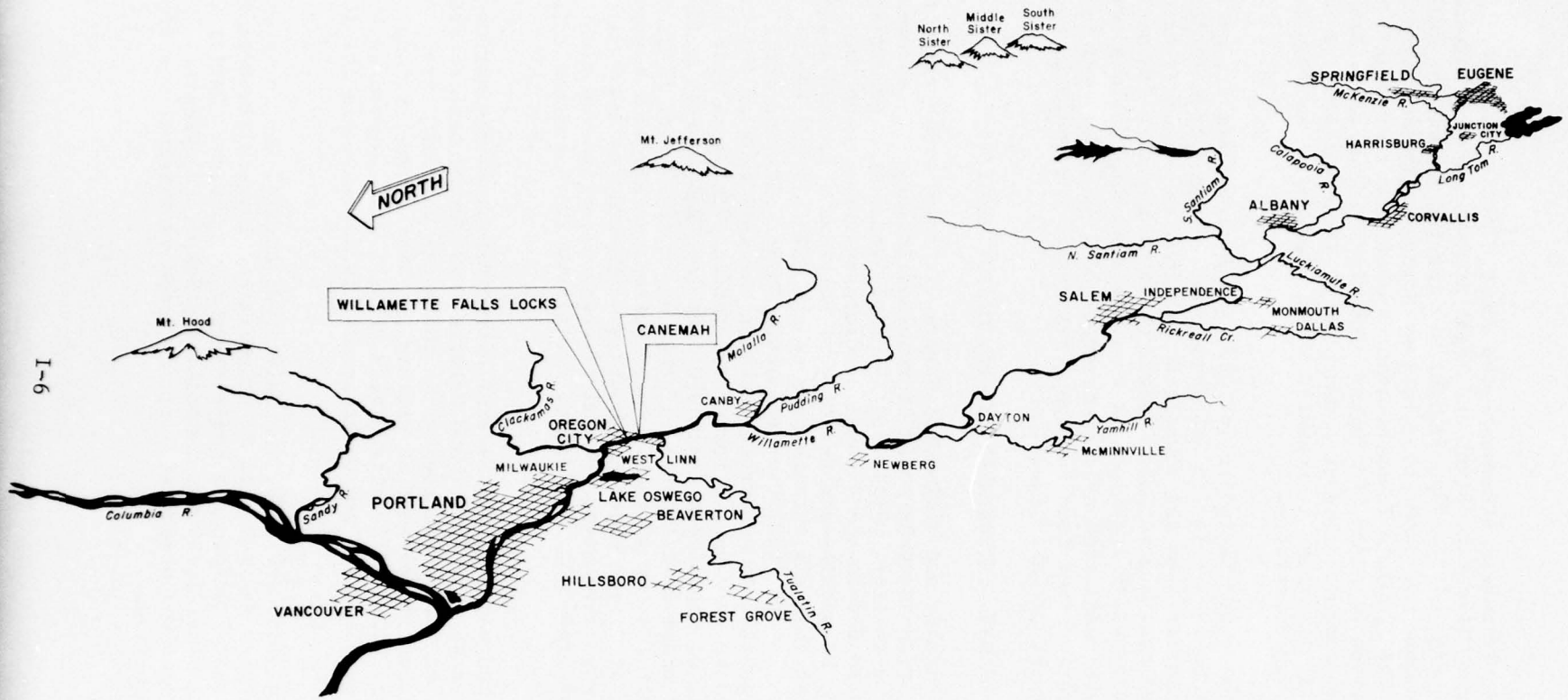


Figure I-1. Oblique view of Willamette River Valley.

A

Upper Willamette River

The 1871 Act provided for the following low-water channel depths: 6 feet from Portland to Willamette Falls; 2.5 feet thence to the mouth of Yamhill River; and 1 foot thence to Eugene. Under that authority, the Corps of Engineers removed snags, boulders, and overhanging trees, constructed training walls, and scraped shoal bars.

In 1872, the Corps of Engineers acquired its first snag boat, the *Corvallis*, equipped with a steam-powered winch for removing snags and pulling scrapers. The following year the Corps purchased its first bucket dredge. To deepen shoal bars, it was customary to drag a scraper over the bars or to anchor steamers which flushed gravel off the bar with their rapidly revolving wheels. Also, temporary brush and gravel groins to deflect the flow of water into the main channel and permanent pile dikes to close a number of side channels were constructed by the Corps to supplement the dredging operations.

In 1896, Congress authorized construction of a dam and locks on Yamhill River near Lafayette, to provide a 4-foot channel, 60 feet wide, from the mouth to McMinnville, a distance of 18 miles; these were completed in 1900. In 1899, a project authorized for Long Tom River provided for removal of obstructions to navigation from the mouth to Monroe, a distance of 10 miles. During that period, steamboats on the river were suffering severe competition from the railroads, and traffic gradually declined. However, traffic in barges and log rafts began to build up at the same time.

Subsequent to the Chief of Engineers' Annual Report of 1904, the navigation project between Harrisburg and Eugene was abandoned, only snagging work was carried on between Corvallis and Harrisburg, and maintenance work on Long Tom River was discontinued. The channel between Portland and Corvallis was maintained to a depth of 2.5 to 3.5 feet.

In 1915, Willamette Falls Locks were purchased by the Federal government for $375,000. The locks had passed through many private ownerships. Under Federal ownership, the locks were deepened to about six feet at the lower sill, and a concrete division wall was constructed to separate the navigation canal from a waterpower intake to a power plant. Late Rivers and Harbors Acts provided for alterations and then enlargement of the locks. The Act of 1945 authorized construction of a new single-lift lock--clear dimensions 56 by 400 feet, and depth over the sills 9.5 feet--to replace the existing locks. No construction has taken place under this authorization.

In 1912, Congress authorized a six-foot channel between Portland and Oregon City, its width to be 150-200 feet below Clackamas Rapids and 100 feet above. The 1930 Act authorized that channel to be modified to its present dimensions: depth of eight feet, and width of 200 feet from Portland to Cedar Island and 150 feet thence to Oregon City; that work virtually eliminated Clackamas Rapids.

Above Oregon City, maintenance of the authorized channel depths varied over the years as navigation needs changed. No attempt was made to maintain the channel upstream from Salem between 1920 and 1933 because of the lack of use. Since 1933, increased log traffic on the river has necessitated maintaining authorized project depths. In 1954, the part of the project on Yamhill River was abandoned for lack of traffic; in 1963, Yamhill lock and dam were breached to provide improved fish passage.

Through fiscal year 1965, Federal appropriations for the upper Willamette navigation project totaled about $0.9 million for new work and $12.4 million for maintenance. In addition, $0.5 million for new work and $5.0 million for maintenance have been appropriated for Willamette Falls Locks.

In 1962, the Port of Portland, at the request of the Oregon Portland Cement Company, dredged a channel 20 feet deep from the Ross Island Bridge to Lake Oswego, costing approximately $88,000. This improvement enabled the cement company to use large, ocean-going barges for transporting limestone to its plant at Lake Oswego.

Columbia and Lower Willamette Rivers

The original Columbia and Lower Willamette Rivers navigation project provided for a channel depth of 20 feet from Portland to the sea. In 1892, Congress modified the project to provide a 25-foot channel from Portland to the sea. A previously authorized project from Vancouver to the mouth of the Willamette was incorporated into the Columbia and Lower Willamette project in 1916. Since 1912, Congress has authorized further deepening and widening of the channel three times--to 30 feet in 1912, to 35 feet in 1930, and to 40 feet in 1962; authorized width was increased from 300 to 600 feet in the Columbia River and up to 1,900 feet in Portland Harbor. Since the project was originally authorized,

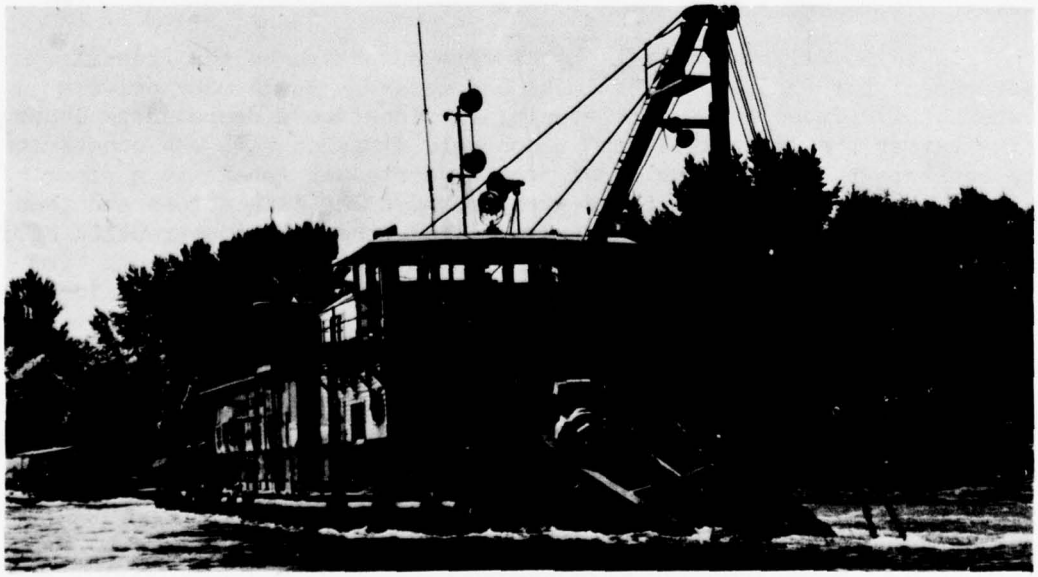


Photo I-3 A dredge deepening the Willamette River channel upstream from Salem. (USCE Photo)

Federal appropriations have been $10.1 million for new work and $51.4 million for maintenance through fiscal year 1965.

In 1884, Congress appropriated the first money for construction of jetties at the mouth of the Columbia. In 1905, a 40-foot channel depth at the bar was authorized and work was completed in 1918. In 1954, a 48-foot depth was authorized and dredging was completed in 1957. Other work included the authorization for Columbia River at the Mouth is still in progress.

Since its creation by the Oregon Legislature in 1891, the Port of Portland has actively cooperated with the Corps of Engineers in work on the deep-draft ship channel. In the early years, the Port dug and maintained the channel from Portland to Eureka, 65 miles downstream, and the Corps accepted responsibility from that point on to the sea. Some Federal money was available for Port-sponsored dredging, but it was estimated that well over half the expenses of building and maintaining the channel in the early years were met by the Port.

In 1912, when the 30-foot ship channel was authorized, the Federal Government accepted responsibility for all maintenance in Columbia River and constructed two 24-inch pipeline dredges for that work. The new project was contingent upon the Port's agreement to continue maintenance of Portland Harbor and all of the ship channel within Willamette River. Though not a part of the agreement, the Port continued to assist the Corps of Engineers in the Columbia River when additional dredges were needed.

In 1930, when a 35-foot channel was authorized, the Port's assistance was made a formal part of the agreement. In return for the increased channel depth and for extension of Federal responsibility for maintenance into Portland Harbor as far as the Broadway Bridge, the Port agreed to maintain one or more dredges on an operating-cost basis for the Corps' use and to provide areas for disposal of spoil along Willamette River below Portland. From 1891 to 1958, the Port's investment for channel and harbor maintenance and improvement totaled $19.3 million; for that work more than $8 million were paid for by revenues from dredging operations and the remainder from other receipts.

COMMERCE

Upper Willamette River

Complete records of commerce are not available. Records of traffic through the Willamette Falls Locks after 1915, when the locks were purchased by the Federal Government, are available.

Passenger traffic began during early settlement of the Willamette Valley, had a strong growth after the Civil War, and reached a peak in 1893 with about 218,000 passengers. By 1915, however, it had declined to about 10,000 per year because of increased competition from the railroads. Over the next 3-1/2 decades, river passenger traffic declined

even further, as motor buses and private automobiles became more common, and ended completely in 1945. Passenger traffic on Willamette River upstream from Portland is shown in Figure I-2.

Downstream traffic in wheat, other grains, and flour, which began during early settlement, increased after the Civil War to a maximum of about 63,000 tons in 1879. However, extension of the railroad along both sides of Willamette River in the 1880's contributed to the decline of that traffic, which, after 1924, never exceeded 1,000 tons per year. Upriver traffic of general merchandise also increased during the post-Civil War period, only to decline as railroads were extended into the valley after 1880.

Diversion of freight to trucking also contributed to the cessation of steamboat operations. In 1918, the Oregon City Transportation Company, which had held a virtual monopoly on upriver traffic since 1904, withdrew its steamboats for lack of business. Later attempts were made to establish regular boat service but each venture failed.

After 1900, barge and towboat traffic--as distinguished from general merchandise traffic--began to increase on the Willamette. Fuel oil moved upstream and paper and pulp produced by mills at Willamette Falls were barged downstream. By 1910, a small volume of rafted logs was moving through the locks at Willamette Falls to sawmills on lower Willamette and Columbia Rivers. Barges loaded with sand, gravel, and building stone also began to move on the Willamette near Portland.

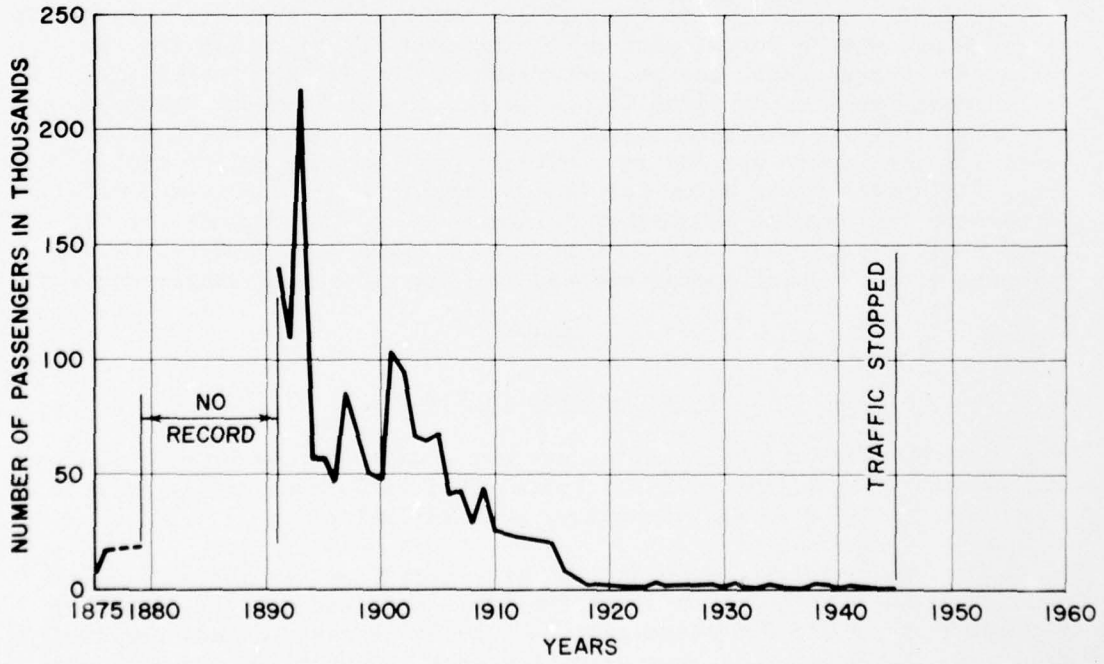


Figure I-2. Total Passenger Traffic on Willamette River upstream from Portland and on Yamhill River.

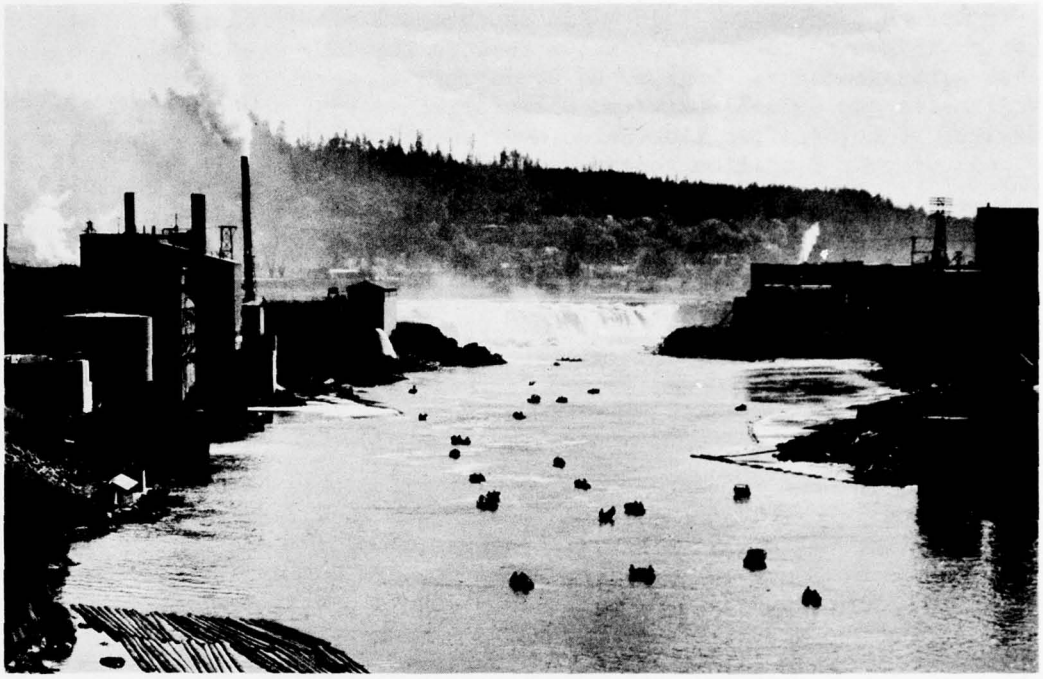


Photo I-4 Salmon fishing below Willamette Falls. The river between Portland and the falls is used extensively for commercial navigation and for recreational boating. (OSHD Photo)

Photo I-5 An aerial view of Willamette River at Lake Oswego. Note gravel barge in center foreground, an industrial dock facility in the right foreground and Lake Oswego in the background. (OSHD Photo)

Movement of rafted logs began to increase significantly on the upper Willamette in 1933, renewing demands for increased depths and channel maintenance. Logs moved downstream to sawmills on lower Willamette and Columbia Rivers, where original timber stands had been depleted. Log traffic fluctuated over the next two decades, reaching a peak of over 2 million tons annually during World War II.

Total commerce on Willamette River above Portland has averaged more than four million tons annually in recent years (Table I-1). Rafted logs and sand, gravel and crushed stone have been the leading commodities. Traffic in rafted logs decreased by about one-half in the 11-year period 1954 through 1964, but sand, gravel, and crushed stone have taken up the slack as rafted log shipments fell off. During that period, between 50 and 80 percent of the total traffic moving through Willamette Falls Locks was rafted logs; in 1964, it was more than 60 percent.

Other changes in river commerce have also taken place in the 11-year period. Petroleum shipments (mostly residual fuel oil) fell off sharply after 1957, when a pipeline between Portland and Eugene was completed. Shipments of paper products doubled during the period (from 180,000 to over 400,000 tons) but have since fallen off; these have fluctuated rather widely. Barging of wastes from the Willamette for discharge into the Columbia has increased fourfold, to over 270,000 tons annually. Limestone traffic increased greatly in 1962, when the 20-foot channel to Lake Oswego was completed.

Vessel and rafted traffic on Willamette River upstream from Portland, and through Willamette Falls Locks, are shown in Figure I-3.

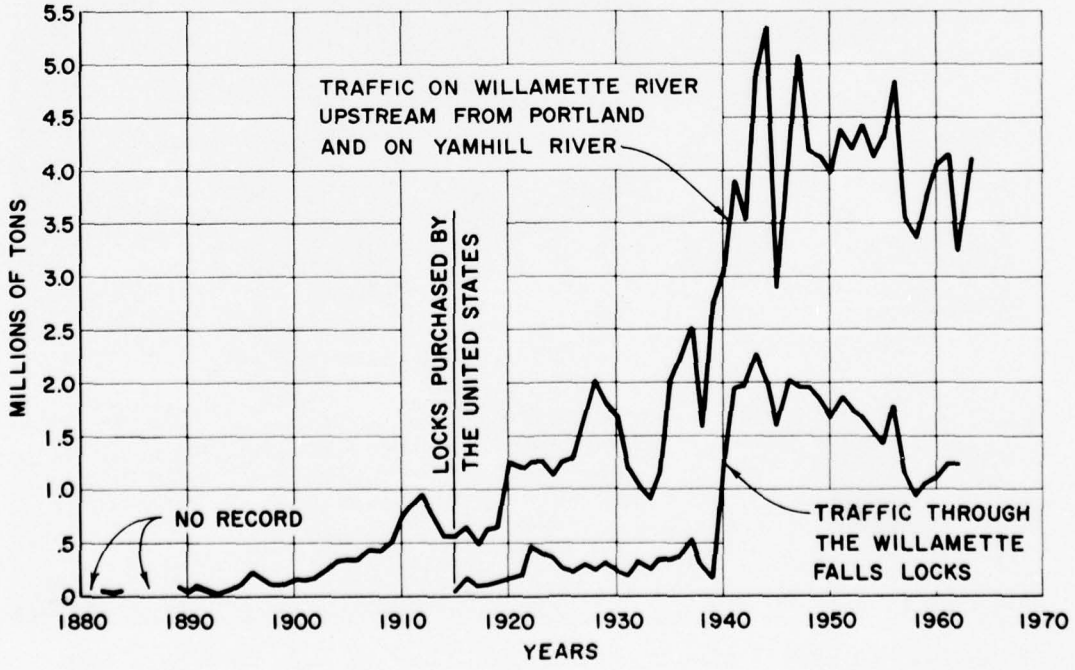


Figure I-3. Total Vessel and Rafted Traffic on the Willamette River upstream from Portland and on Yamhill River, and through Willamette Falls Locks.

Table I-1
Commerce on Willamette River above Portland
(in tons of 2,000 pounds)

Year	Rafted logs and piling	Wood pulp	Paper Products	Petroleum products	Limestone	Sand, gravel and crushed stone	Waste Materials	Other 1/	Total	Total, Willamette Falls Locks
1954	2,394,935	26,139	180,636	201,847	7,820	1,111,026	63,360	123,019	4,108,782	1,597,448
1955	2,358,361	21,972	203,378	169,337	9,530	1,313,382	101,280	112,482	4,289,722	1,430,903
1956	2,782,699	16,416	206,370	173,979	9,204	1,467,961	117,600	73,371	4,847,620	1,178,090
1957	1,961,426	7,112	200,711	15,492	10,085	1,153,347	166,625	63,312	3,578,110	1,794,855
1958	1,782,272	11,195	187,456	22,032	9,435	1,143,018	169,115	49,231	3,373,754	957,694
1959	1,976,133	16,447	208,062	25,775	9,140	1,226,352	209,765	51,971	3,723,645	1,087,865
1960	1,831,247	15,879	223,042	39,316	9,535	1,615,263	187,328	143,100	4,064,710	1,091,982
1961	1,636,612	12,140	283,732	45,087	10,135	1,848,871	199,650	136,743	4,172,970	1,103,479
1962	1,409,923	8,995	406,274	37,613	90,772	1,580,261	196,900	91,396	3,822,134	1,246,594
1963	1,393,685	7,834	351,651	14,145	292,857	2,144,527	246,690	152,881	4,604,270	1,184,250
1964	1,752,728	7,603	267,874	11,947	330,623	2,177,858	272,776	136,506	4,957,915	1,090,520

1/ This category includes pulpwood, building cement, clays and earths, sulfur, chemicals, manufactured goods, and other commodities in minor amounts.

Portland Harbor

As Portland became an important seaport, traffic increased rapidly, much of it originating in upper Columbia Basin. In 1914, all products shipped from Portland aggregated 8,043,263 tons. Foreign exports were mainly wheat, lumber, barley, and merchandise. Foreign imports were principally bags and burlap, coal, sulphur, fire brick and clay, and oriental goods. Domestic deep-sea tonnage was made up mainly of fuel oil, lumber, wheat, barley, cement, flour, sugar, logs, and general merchandise. Commerce handled by shallow-draft river vessels consisted of dairy products, flour, fruit, grain, livestock, logs, lumber, fuel oil, paper and pulp, piling, sand and gravel, stone, wood, and general merchandise.

Development of navigation facilities in Portland Harbor continues to have a major impact on the shallow-draft segment of Willamette River. Portland is the terminus for intra-basin movement of goods and the outlet for national and international shipments via both land- and water-based transportation media. At present, major exports include wheat, other grains, flour, lumber and paper pulp products, and fruit and vegetables. Imports include salt, metal ores, steel and other metals, motor vehicles, chemicals, and wood products. Waterborne commerce through Port of Portland for the years 1954 through 1964 is shown in Table I-2.

Portland is the ninth-ranking seaport in the United States and third (behind Los Angeles and San Francisco) on the Pacific Coast. For many years, Portland and Seattle have competed for maritime leadership in the Pacific Northwest; Portland has led 6 out of 7 recent years of record. In 1965, traffic through Portland Harbor was about 16.7 million tons, two million tons greater than the Puget Sound city. Portland leads the Pacific Coast in wheat and grain exports.

Table I-2
Freight Traffic through Port of Portland, Oregon
(in tons of 2,000 pounds)

Year	Animal products	Wheat, grain, flour	Vegetables, fruits, products	Logs, piling	Lumber	Pulp, paper products	Petroleum products	Sand, gravel and crushed stone	Other	Total
1954	30,352	845,684	119,682	484,827	282,887	649,032	6,549,601	1,213,773	1,161,137	11,336,975
1955	29,230	1,012,141	93,425	494,762	231,774	635,177	7,428,364	1,230,440	1,437,514	12,592,827
1956	42,376	1,594,433	110,820	609,522	168,934	736,561	7,529,388	1,553,540	1,462,955	13,788,529
1957	26,568	2,382,597	93,785	750,198	192,333	730,534	6,386,473	732,201	1,926,436	13,221,125
1958	36,218	2,037,445	116,749	595,978	131,885	744,971	5,445,392	1,225,632	1,271,209	11,605,479
1959	35,598	2,043,338	142,037	1,070,664	139,295	800,260	6,091,206	1,724,930	1,434,336	13,481,664
1960	44,480	2,720,856	126,866	791,062	179,649	756,489	5,930,684	1,540,106	1,459,140	13,549,332
1961	55,603	2,410,753	131,254	995,020	159,287	1,048,108	5,923,759	1,734,106	1,600,178	14,058,068
1962	51,430	2,554,407	140,147	817,930	133,858	988,963	5,959,979	1,508,076	1,621,202	13,775,992
1963	59,786	3,339,460	139,627	975,812	180,862	1,214,430	5,849,256	1,982,379	1,708,102	15,449,714
1964	52,324	2,796,079	144,611	925,655	185,683	994,048	5,982,354	2,106,184	2,024,242	15,211,180

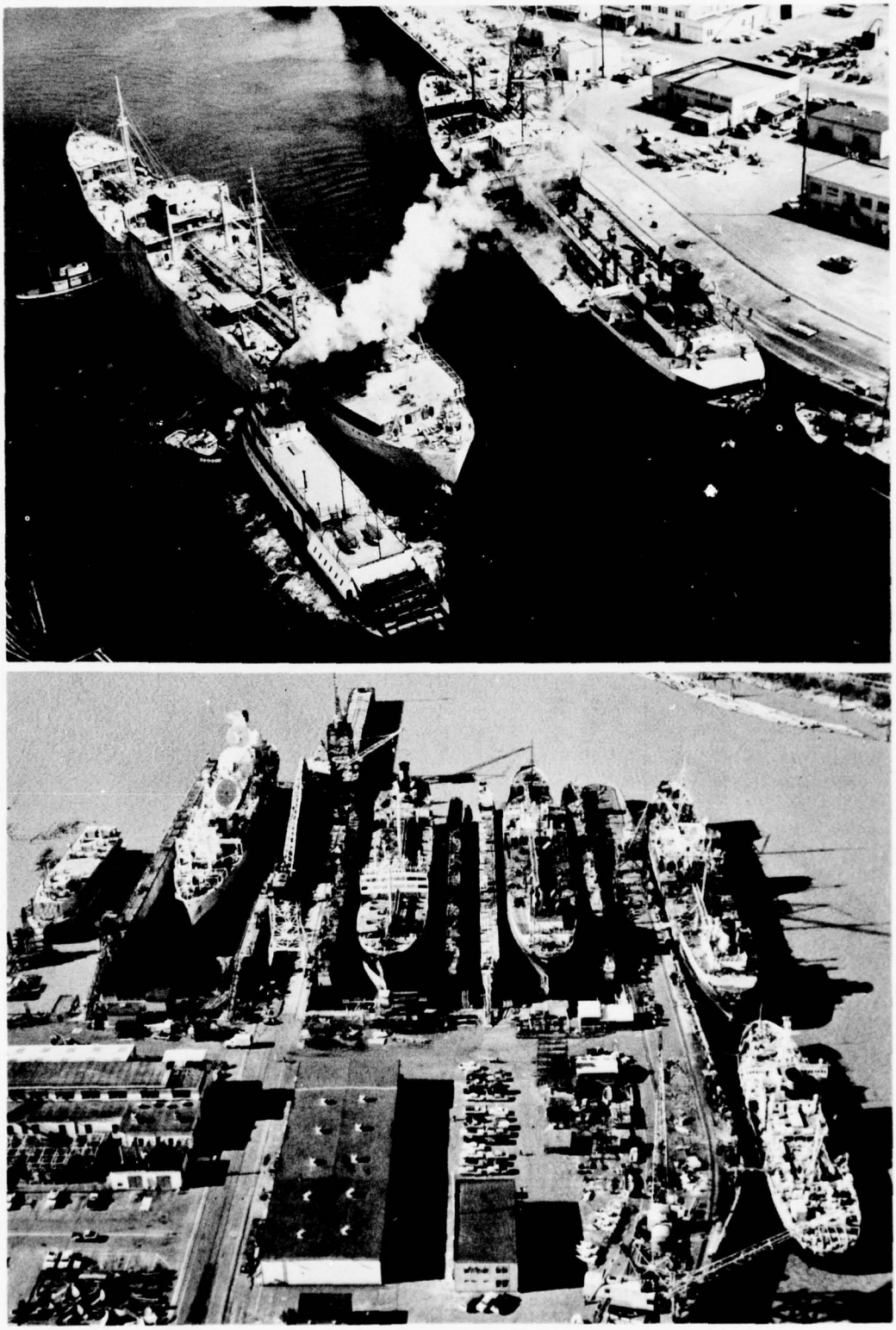
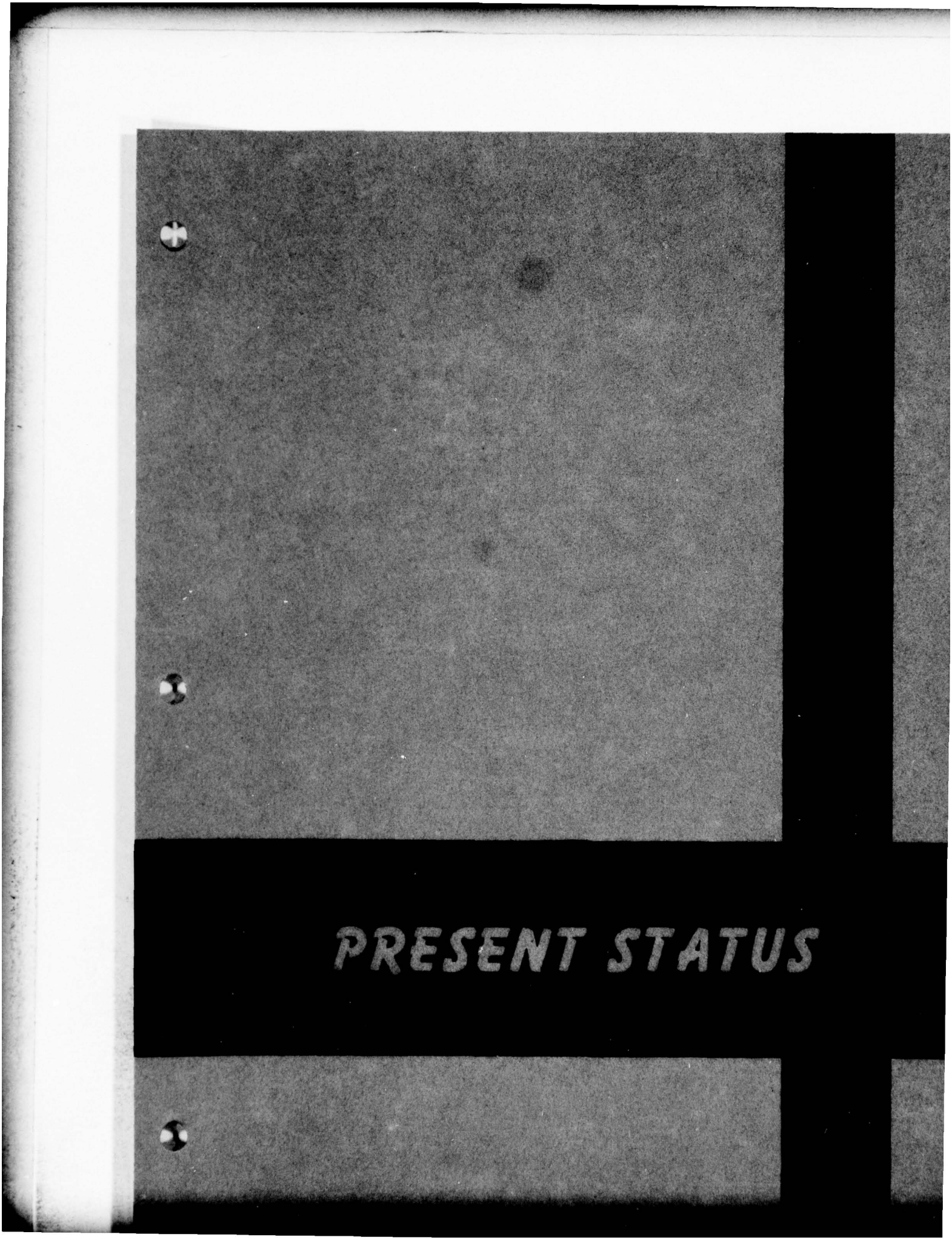


Photo I-6 The Port of Portland provides maintenance services for ocean-going vessels. (Port of Portland Photos)


PRESENT STATUS

EXISTING PROJECT

Navigation projects make Portland Harbor an important ocean-shipping port by providing deep-draft access to the sea. On both the Columbia and Willamette Rivers, deep-draft and inland-waterway projects meet in the Portland-Vancouver metropolitan area. Goods are also exchanged here between land-based transportation media and ocean-going vessels. Thus, Portland is an important transhipping point for imported and exported goods. With few exceptions, ocean-going ships and barges do not call upstream from Portland or Vancouver.

The sequence of authorization and development for navigation projects on Columbia and Willamette Rivers is recounted in Part I, History, of this appendix.

DEEP-DRAFT CHANNELS

The authorized deep-draft projects provide for a 48-foot channel over the Columbia River bar, and a 40-foot channel, 600 feet wide, from that point to the mouth of Willamette River (101 miles) and on to Vancouver. Willamette River deep-draft channels are maintained throughout the Portland Harbor reach--40 feet deep and 600-1,900 feet wide from the mouth to the Broadway Bridge (river mile 11.6), thence 30 feet deep and 300 feet wide to the Ross Island Bridge (river mile 14.0). Work is still in progress on the deep-draft channel.

INLAND WATERWAYS

Inland-waterway projects feed into Portland from both Columbia and Willamette Rivers. The Columbia River inland waterway extends to Pasco, Washington, and to Lewiston, Idaho, on Snake River. The inland waterway on Willamette River extends from Portland (Ross Island Bridge) to Harrisburg (mile 163); channel depths are maintained upstream to Corvallis, snagging thence to Harrisburg.

The Willamette River inland waterway consists of a system of locks near Oregon City and a number of controlling and contraction works to maintain channel depths. The locks, with a total lift of about 50 feet, have four chambers--each with a maximum length of 175 feet and a clear width of 37 feet. Controlling depth is 8.4 feet in the lower chamber and 6 feet in the upper.

The channel-control portion of the project, estimated at the end of fiscal year 1966 to be 37 percent complete, provides an 8-foot channel between Portland and Oregon City, and a 2.5- to 3.5-foot channel between Oregon City and Corvallis. Work required to complete the project consists of those contraction works and channel improvements necessary, with reservoir regulation, to secure a 6-foot channel, at low water, from Oregon City to the mouth of Santiam River and a 5-foot channel thence upstream to Albany.

As of June 1966, the prevailing depth from Portland to Lake Oswego was 20 feet; Oswego to Oregon City, 8 feet; and Oregon City to Corvallis, 3.5 feet.

HAZARDS TO NAVIGATION

At present, the navigation channels are maintained by removing snags, constructing training walls, and dredging. Channel depths between Oregon City and Corvallis are frequently less than authorized because increased flows contemplated under the latest authorizations are not yet fully available, and because sand and gravel bars change with streamflow at certain times of the year. Channels in the Willamette are normally dredged to the authorized depths plus one to two feet of overdepth.

BRIDGE AND UTILITY CROSSINGS

Bridges, submerged pipelines, overhead wires, and cables which cross Willamette River between its mouth and Eugene are listed in Table A-1, Addendum A.

TRAFFIC

In the Portland Harbor reach, traffic includes both shallow- and deep-draft vessels and a great variety of pleasure craft. Between Portland and Willamette Falls, traffic consists principally of tugs, barge tows, rafted logs, and pleasure craft. The narrow widths at Willamette Falls Locks restrict most barges, which occasionally move upstream as far as Salem. Upstream from the locks, only shallow depths have been maintained because of the limitations of the locks themselves, and rafted logs comprise the majority of commerce. For further details on types and quantities of traffic, see Part I - History, of this appendix and "Waterborne Commerce of the United States," published by the Department of the Army, Corps of Engineers.

The present level of maintenance is adequate for the volume of traffic now using the waterways. In general, dredging required to maintain the channel is expected to decline in the future as channel-control works are completed and as additional low-water flows from storage become available.

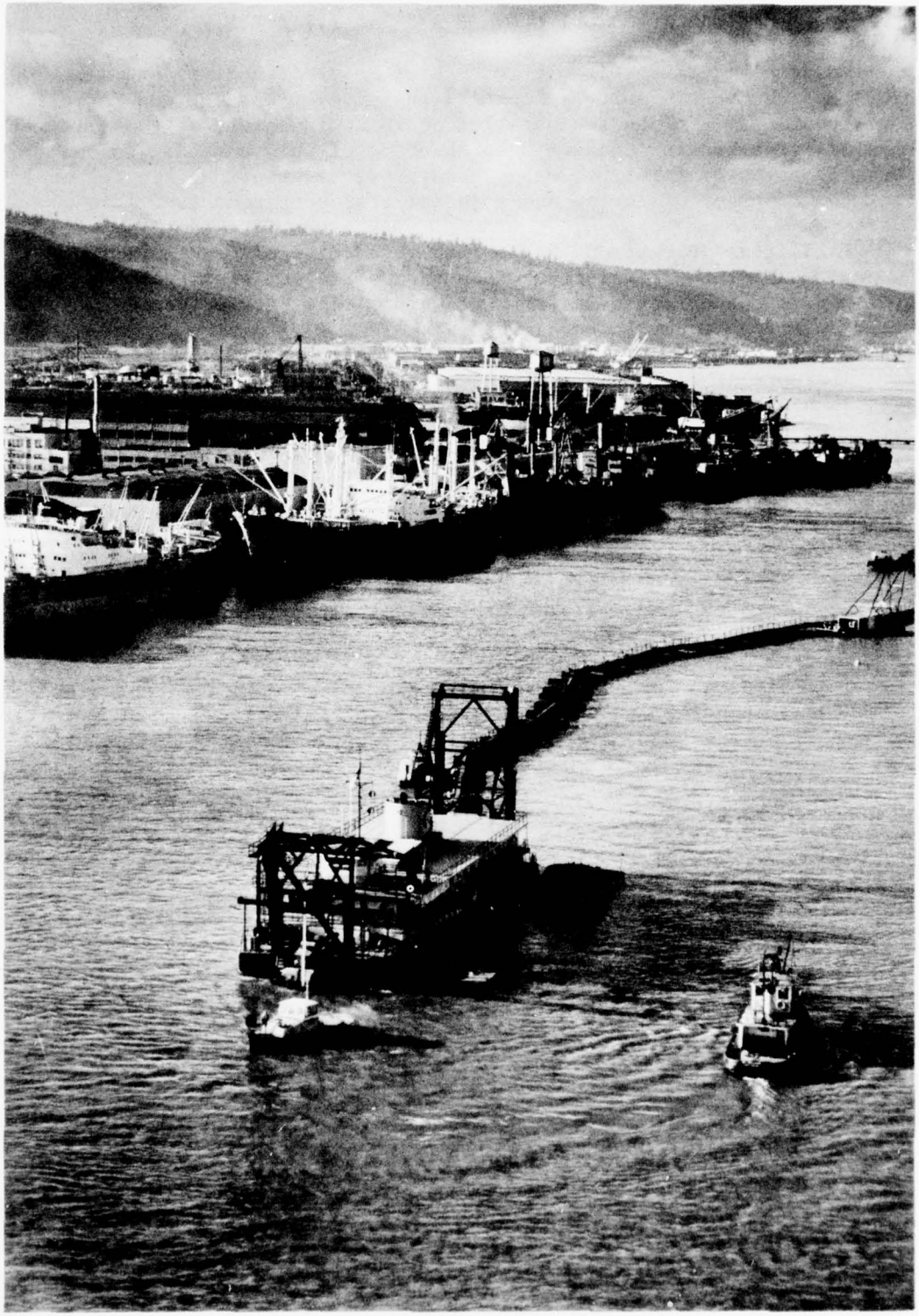


Photo II-1 The Port of Portland's dredge "Oregon" working in the harbor reach downstream from the Broadway Bridge. (Port of Portland Photo)

COMMERCIAL FACILITIES

Adjacent to the navigable reaches of Willamette River are some 100 piers and wharves to serve commercial shipping. The Portland Harbor reach contains 79 of these installations. An inventory of these facilities is presented in Addendum B at the back of this appendix, showing location, type of facility, owner, operator, description, special equipment for transfer of cargo, and adjacent transportation facilities.

Facilities in Portland Harbor are both privately and publicly owned. Much of the development, use, and administration of these facilities is concentrated in two commissions--the Port of Portland and the Commission of Public Docks.

The Port of Portland, a tax-levying body with commissioners appointed by the Governor of Oregon, has been active in developing navigation on Columbia and lower Willamette Rivers. It owns and operates ship-repair facilities at Swan Island, and develops land adjacent to Willamette River for industrial expansion. The Port also dredges and maintains the deep-draft channel between the Broadway and Ross Island Bridges, and assists the Corps of Engineers in other dredging work.

The Commission of Public Docks, an agency of the City of Portland, owns and operates three major commercial facilities in Portland Harbor--Terminals 1, 2, and 4.

Facilities on the Willamette upstream from Portland Harbor consist primarily of specialized piers, moorings, and log dumps. These are owned and operated by forest products industries and sand and gravel concerns. From its mouth to Harrisburg, the Willamette River also is used extensively for intransit log storage. Dolphins and piling have been placed along certain reaches of the river for temporarily tying up rafted logs before they are exported or towed to lumber and paper mills on both Columbia and Willamette Rivers.

During 1964, more than 578 million board-feet of logs were towed on Willamette River. Much of this traffic originated at dumps along the Columbia, but more than 200 million board-feet were dumped and rafted along the Willamette. The locks at Willamette Falls were used to transport 177 million board-feet of logs; virtually all of these were temporarily held in transit either upstream or downstream from the locks.

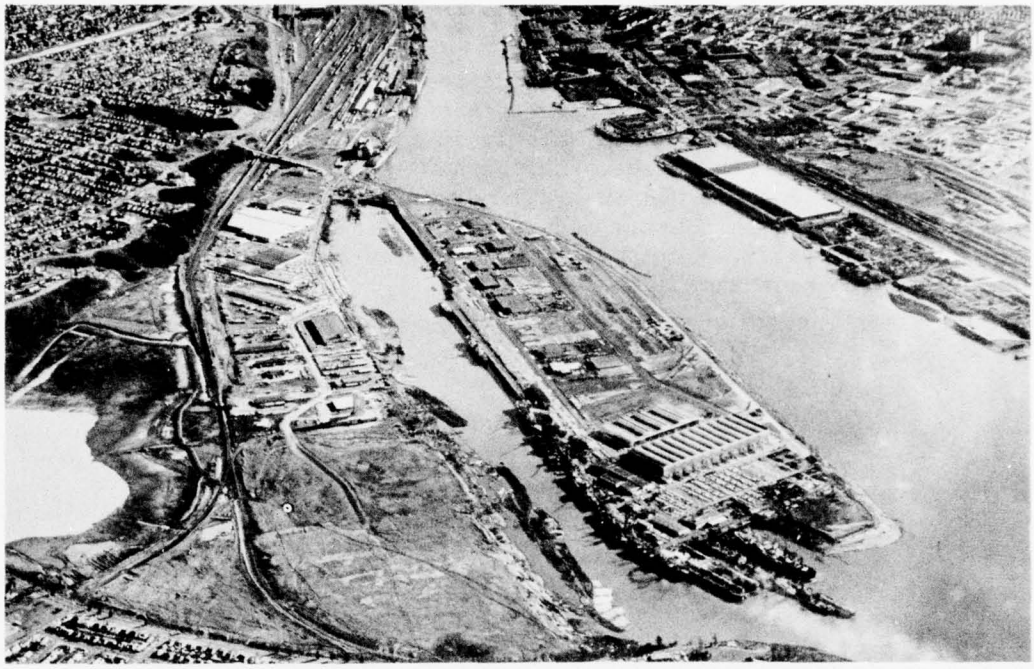


Photo II-2 Aerial view of Swan Island looking upstream in the harbor reach. Note ship in drydock in the right foreground. (Port of Portland Photo)

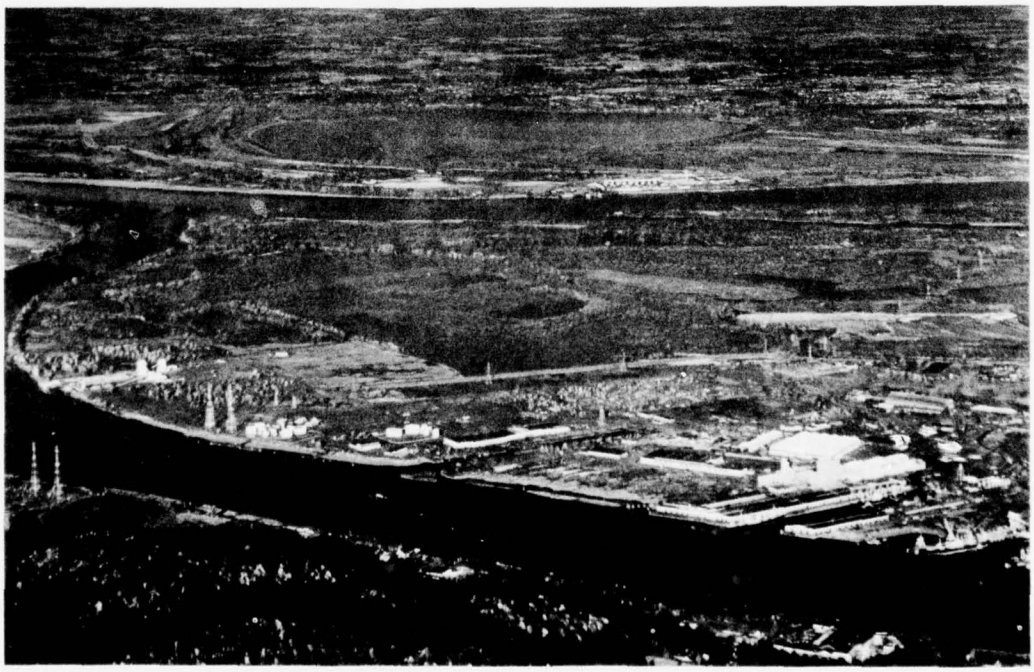


Photo II-3 Rivergate industrial area at the confluence of the Willamette and Columbia Rivers. (Port of Portland Photo)

NONCOMMERCIAL FACILITIES

Houseboats and recreation boating represent the principal noncommercial uses of Willamette River. About 500 houseboats are used for family residences in the basin, mostly in the Portland area; about 50 are in Columbia River upstream from Hayden Island, 130 in Oregon Slough, 290 between the Ross Island and Sellwood Bridges on the Willamette, and about 30 in Multnomah Channel and in the pond behind Willamette Falls. Boat ramps, moorages, and marinas to serve recreation boaters are distributed throughout the basin.

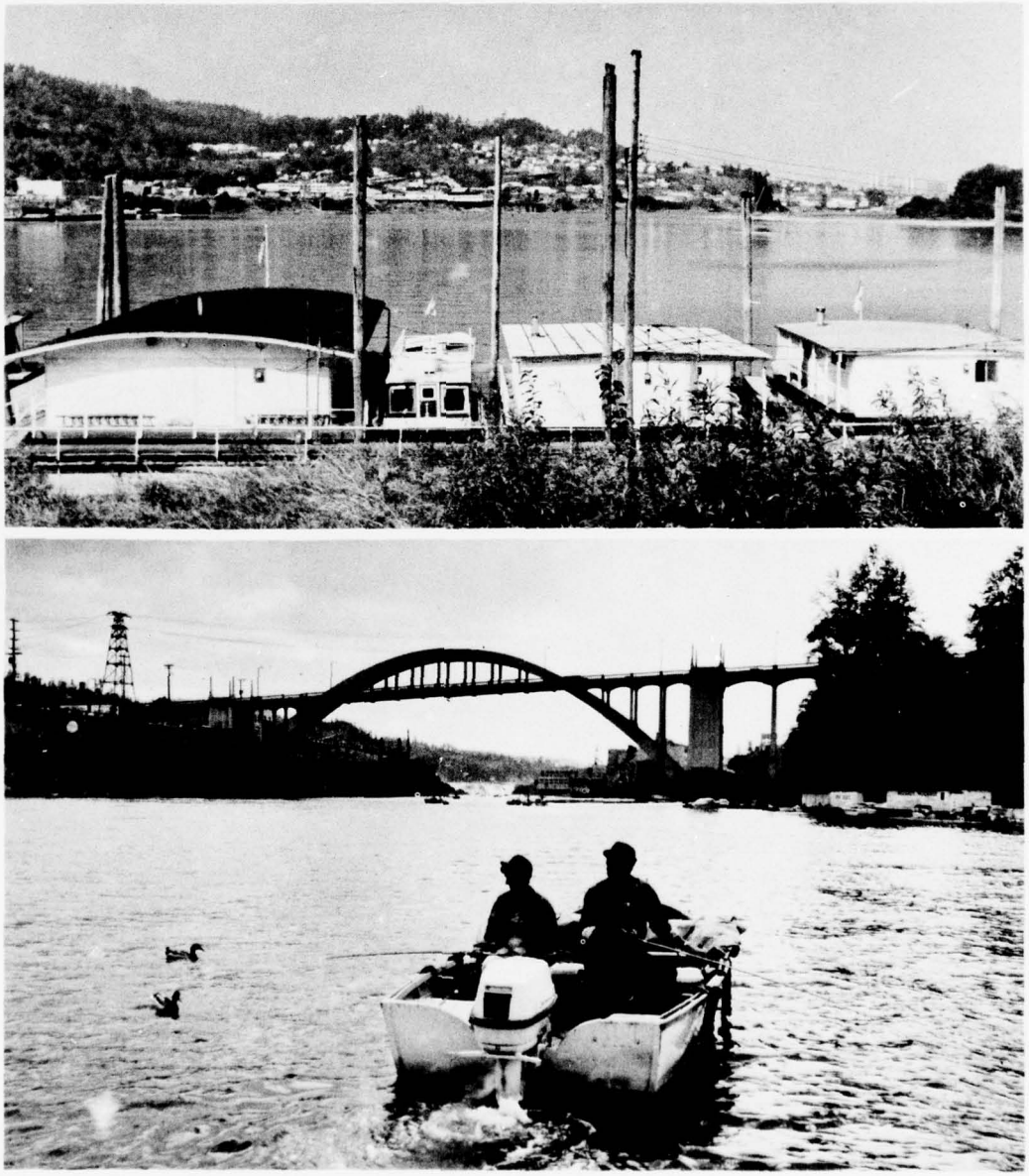


Photo II-4 Typical houseboats adjacent to Oaks Park just downstream from the Sellwood Bridge; two mallard drakes supervise salmon fishing at Oregon City. (OSHD Photo)

OTHER TRANSPORTATION

For certain bulk commodities, highway transport, railroads, and pipelines compete with navigation for business. Air freight lines move mostly nonbulk commodities. Location of rail lines, highways, and pipelines is shown on Map II-1.

RAILROAD CONNECTIONS AND YARD FACILITIES

Major railroads providing main-line service to the Portland port area and the Willamette Basin are Southern Pacific Company, Union Pacific Railroad, Northern Pacific Railway, Great Northern Railway, and Spokane, Portland and Seattle Railway (jointly owned by Great Northern and Northern Pacific Railways). Within the Portland port area, cars are transferred by the Northern Pacific Terminal Company of Oregon (jointly owned by Southern Pacific, Union Pacific, and Northern Pacific). Branch lines emanate to various points in the basin. In addition to regular trackage, the principal railroads provide yard capacity in the Portland area for about 11,450 cars. These yards and the approximate car capacities are listed in Table II-1.

Table II-1

Rail-yard facilities in Portland port area

Name of Carrier	Location	Car Capacity (Approximate)
Northern Pacific Terminal Company of Oregon	Guilds Lake Yard	1,700
	Terminal Depot Yard	200
Southern Pacific Company	Brooklyn Yard	1,300
	East Portland Yard	200
Union Pacific Railroad	Albina Yard	4,300
	Barnes Yard	1,300
	Kenton Yard	500
Northern Pacific Railway	Doane Street Yard	200
Spokane, Portland & Seattle Railway	Willbridge Yard	600
	Portland Yard	900
	East St. Johns	250

HIGHWAYS AND MOTOR CARRIERS

The Willamette Basin is served by an excellent highway net, with Interstate 5 traversing the full length of the basin and providing direct access to California and Washington distribution centers. Interstate 80N links the basin with the balance of the Continental United States to the east. At various points south of Portland, other Federal and State highways enter or cross the basin from east and west, thus providing additional connections to areas outside the basin. The highway network, combined with other transportation media, permits efficient distribution of goods.

More than 150 motor-freight firms serve the Willamette Basin. Some of these carriers are local while others are local representatives of large interstate trucking firms. The carriers efficiently distribute commodities which arrive in Portland via ship, barge, and raft, and bring agricultural and lumber products from elsewhere in the Pacific Northwest to the Portland area.

PIPELINES

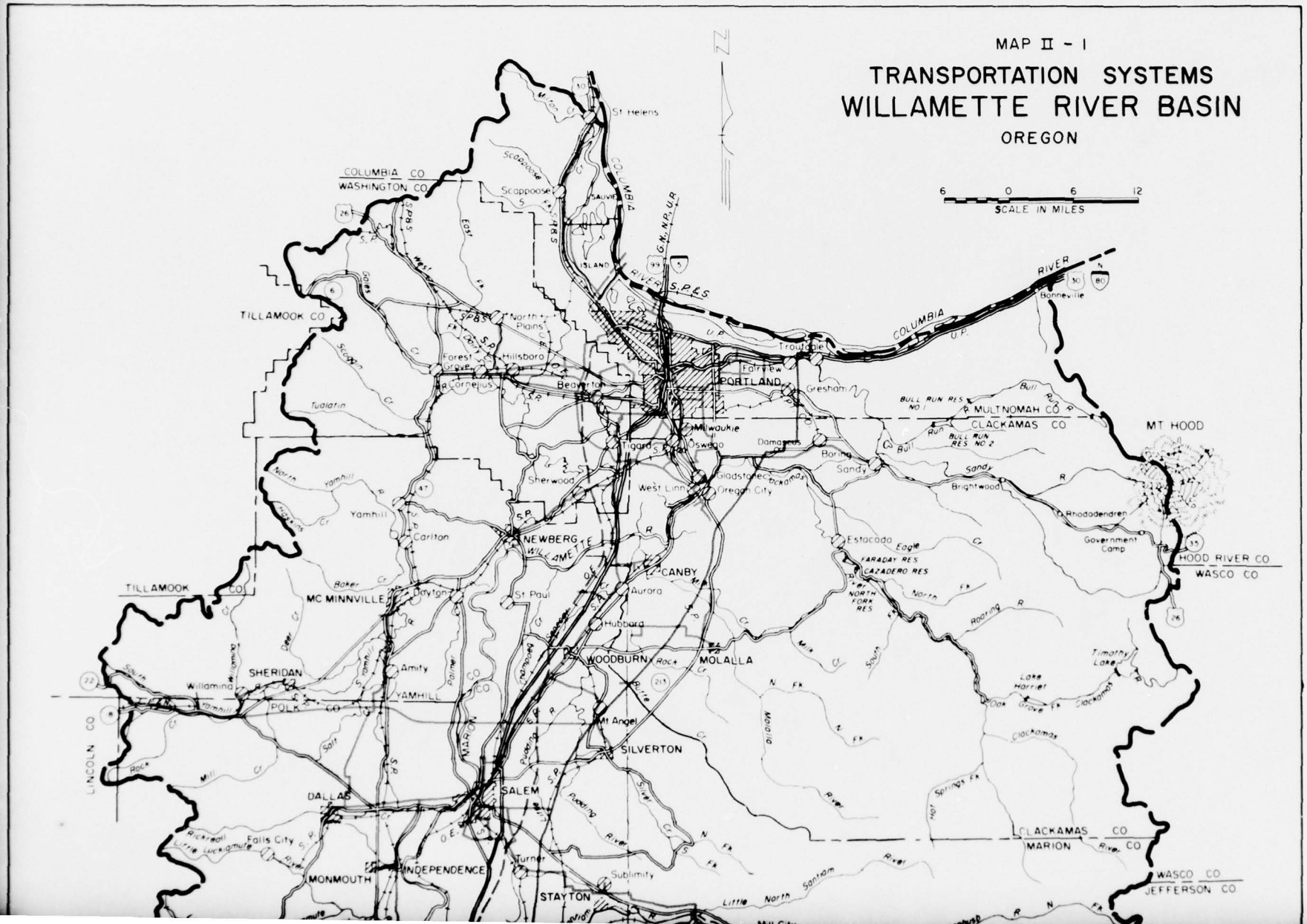
A majority of the basin's requirements for petroleum products are redistributed from the Portland area, which also serves as a storage and distribution center for supplying southwestern Washington, and north-central and northwestern Oregon. Petroleum products are shipped to the Portland area via deep-draft tankers, barges, and a pipeline. The Olympic Pipeline Company operates a 14-inch pipeline originating at refineries in the Puget Sound area, and terminating at tank farms in northwest Portland along the lower reaches of the Willamette River. The products are redistributed to Willamette Basin via pipeline, auto-freight, and rail. The Southern Pacific Pipeline Company operates an 8-inch pipeline from Portland to Eugene. This line transports gasoline and distillates, moving about 500,000 barrels per month. Residual fuel oils are moved by truck, railroad, and occasionally by barge.

Bulk natural gas is piped to the Pacific Northwest from the Southwest by the El Paso Natural Gas Company. It is delivered to the Northwest Natural Gas Company at approximately 20 points in Willamette Basin for retail distribution. The El Paso Natural Gas Company's main line comes down the Washington side of Columbia River, with a 20-inch lateral crossing Columbia River near Troutdale, and an 18-inch lateral crossing northwest of Portland. The 20-inch lateral continues south through Willamette Basin, stepping down at intervals to a 10-inch diameter at the southern limits of the basin.

AIRLINES

Air freight service is provided at Portland International Airport by 9 domestic and overseas airlines: Northwest Orient, Pan American, United, Western, Air West, Continental, Braniff, Eastern, and Flying Tiger. Several other firms provide agency service.

Salem, Corvallis, and Eugene are served by United Airlines and/or Air West. Charter service is also available from other airports, making all parts of the basin readily accessible.


MAP II - 1
TRANSPORTATION SYSTEMS
WILLAMETTE RIVER BASIN
OREGON
SCALE IN MILES
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JEFFERSON CO
MT HOOD
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St Helens
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Rainier
Clatskanie
Westport
Knappa
Astoria
Warrenton
Seaside
Cannon Beach
Nehalem
Manzanita
Rockaway
Tillamook
Bay City
Garibaldi
Wheeler
Nehalem
Mohler
Hebo
Cloverdale
Pacific City
Neskowin
Lincoln City
Otis
Gleneden Beach
Depoe Bay
Newport
Waldport
Yachats
Florence
Reedsport
Winchester Bay
Gardiner
Scottsburg
Elkton
Drain
Yoncalla
Sutherlin
Oakland
Roseburg
Winston
Myrtle Creek
Canyonville
Riddle
Glendale
Grants Pass
Cave Junction
Kerby
Selma
Galice
Agness
Port Orford
Gold Beach
Brookings
Harbor
Crescent City
Smith River
Hiouchi
Gasquet
Klamath
Requa
Orick
Trinidad
Arcata
Eureka
Fortuna
Ferndale
Rio Dell
Scotia
Garberville
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Phillipsville
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Laytonville
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Healdsburg
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Santa Rosa
Petaluma
Novato
San Rafael
Sausalito
Mill Valley
Tiburon
Belvedere
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El Cerrito
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Union City
Fremont
Newark
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San Jose
Los Gatos
Saratoga
Campbell
Cupertino
Sunnyvale
Santa Clara
Mountain View
Los Altos
Palo Alto
Menlo Park
Redwood City
San Mateo
Burlingame
San Francisco
Daly City
Pacifica
Half Moon Bay
Santa Cruz
Capitola
Aptos
Watsonville
Moss Landing
Castroville
Salinas
Gonzales
Greenfield
King City
Soledad
Chualar
Paraiso Springs
Jolon
Bradley
Parkfield
Cholame
Shandon
Paso Robles
Templeton
Atascadero
Santa Margarita
San Luis Obispo
Arroyo Grande
Nipomo
Guadalupe
Santa Maria
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Lompoc
Santa Barbara
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Oxnard
Port Hueneme
Camarillo
Moorpark
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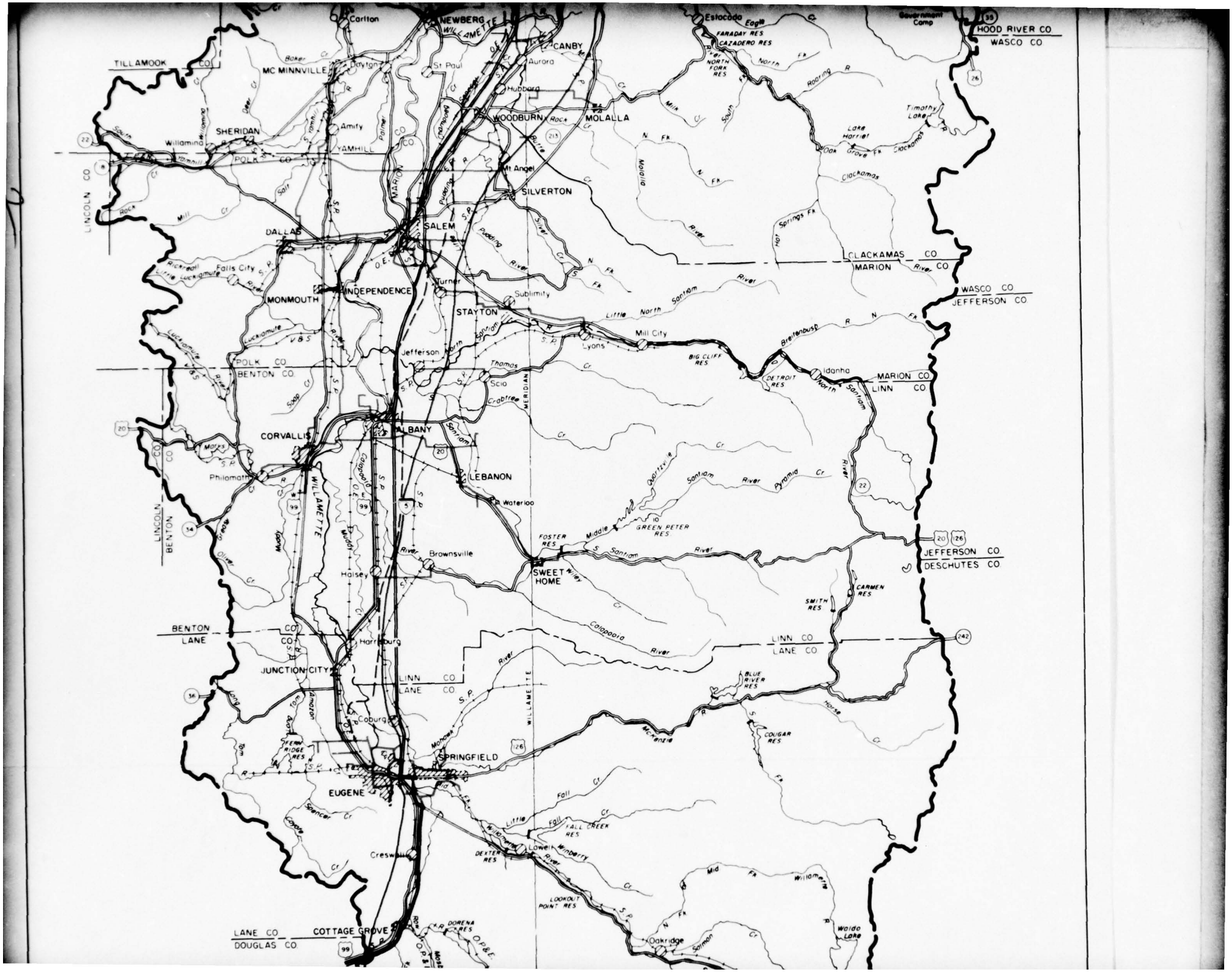
Chatsworth
Northridge
Van Nuys
Burbank
Glendale
Pasadena
Alhambra
San Gabriel
Monterey Park
Montebello
Whittier
La Habra
Fullerton
Anaheim
Orange
Santa Ana
Tustin
Irvine
Laguna Beach
Dana Point
San Clemente
Oceanside
Carlsbad
Encinitas
Solana Beach
Del Mar
La Jolla
San Diego
Chula Vista
National City
Coronado
Imperial Beach
Tijuana
Mexicali
Calexico
El Centro
Brawley
Holtville
Calipatria
Niland
Westmorland
Salton City
Indio
Coachella
Thermal
Mecca
Desert Center
Blythe
Needles
Barstow
Victorville
Hesperia
Apple Valley
Lucerne Valley
Yucca Valley
Twentynine Palms
Joshua Tree
Palm Springs
Cathedral City
Rancho Mirage
Palm Desert
Indian Wells
La Quinta
Bermuda Dunes


Carlton
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WASCO CO
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Baker
Dayton
St Paul
Aurora
Hubbard
FARADAY RES
CAZADERO RES
NORTH FORK RES
North Fk
Roaring R
WOODBURN
MOLALLA
Rock Cr
Mill Cr
South Fk
Timothy Lake
Lake Harriet
Oak Grove Fk
Clackamas
SHERIDAN
Willamina
YAMHILL
POLK CO
Mt Angel
SILVERTON
Pudding River
N Fk
Molalla
Clackamas
LINCOLN CO
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Rock Cr
Mill Cr
DALLAS
SALEM
Hot Springs Fk
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MARION CO
Richardson
Little Luckiamute
Falls City
Turner
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Little North Santiam River
WASCO CO
JEFFERSON CO
MONMOUTH
INDEPENDENCE
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Luckiamute
Mill City
Lyons
Breitenbush R
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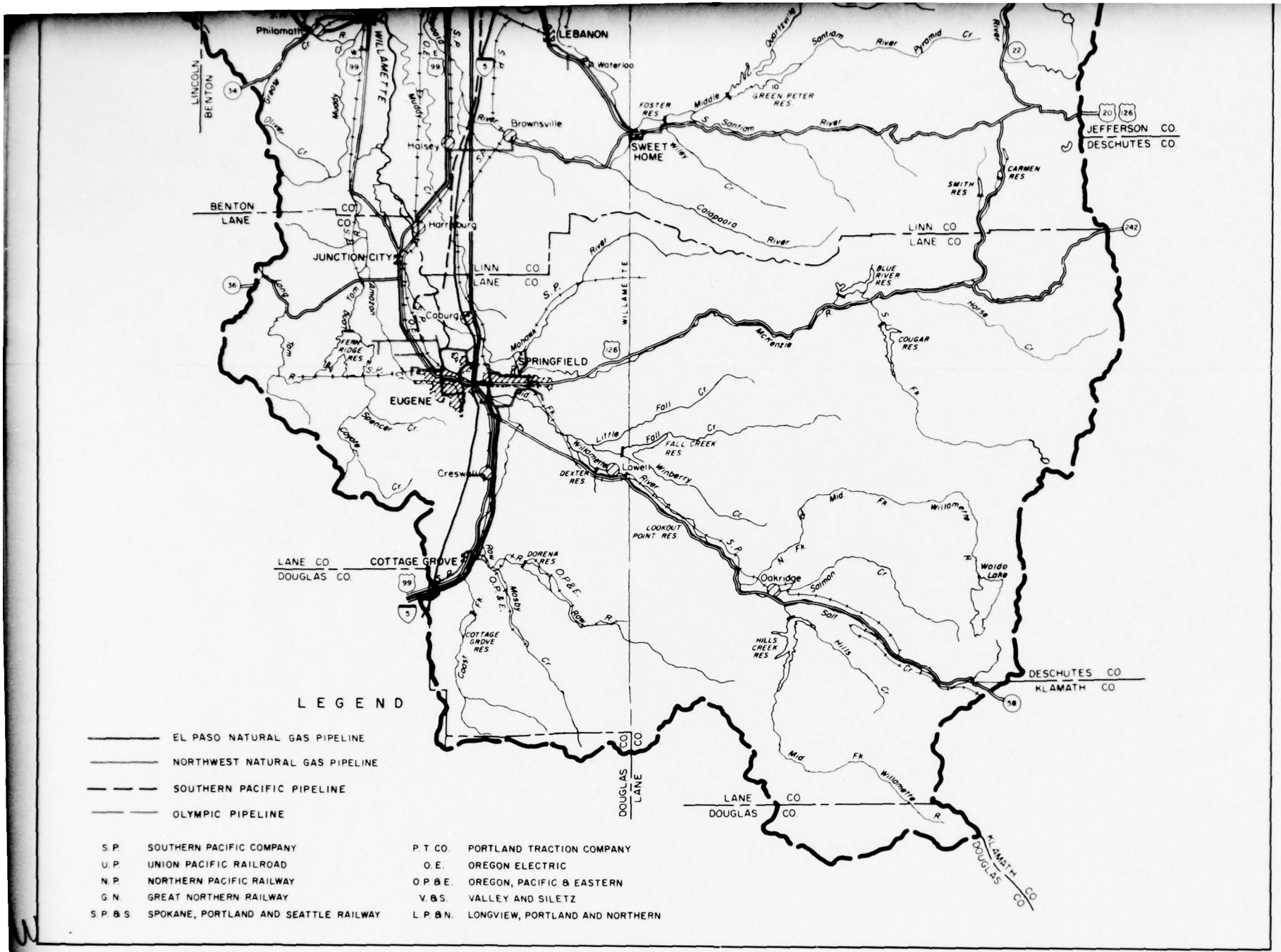
BENTON CO
Jefferson
Thomas Cr
Scio
Crabtree
MERIDIAN
BIG CLIFF RES
DETROIT RES
Idanha
MARION CO
LINN CO
North Santiam River
CORVALLIS
ALBANY
Soap Cr
Marys
Philomath
LEBANON
Waterloo
Quartzville
Pyramid Cr
Middle
GREEN PETER RES
FOSTER RES
Brownsville
Halsey
SWEET HOME
Wiley
JEFFERSON CO
DESCHUTES CO
CARMEN RES
SMITH RES
BENTON CO
LANE CO
Harrisburg
Calapooia River
LINN CO
LANE CO
JUNCTION CITY
Coburg
BLUE RIVER RES
COUGAR RES
McKenzie
Horse Cr
FERN RIDGE RES
SPRINGFIELD
EUGENE
Spencer Cr
Fall Cr
Little Fall Cr
FALL CREEK RES
Lowell
Winberry
DEXTER RES
Creswell
Mid Fk Willamette
LOOKOUT POINT RES
LANE CO
DOUGLAS CO
COTTAGE GROVE
DORENA RES
Oakridge
Salmon Cr
Waldo Lake


LEBANON
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Harrisburg
JUNCTION CITY
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SPRINGFIELD
EUGENE
Creswell
Lowell
COTTAGE GROVE
Oakridge
Quartzville
Santiam River
Pyramid Cr
GREEN PETER RES.
FOSTER RES
Middle Santiam River
JEFFERSON CO
DESCHUTES CO
CARMEN RES
SMITH RES
Calapooia River
LINN CO
LANE CO
BLUE RIVER RES
COUGAR RES
McKenzie
Horse Cr
Fall Cr
FALL CREEK RES
Little Fall Cr
Willamette River
DEXTER RES
LOOKOUT POINT RES
Mid Fk Willamette
Salt Cr
HILLS CREEK RES
DESCHUTES CO
KLAMATH CO
DORENA RES
COTTAGE GROVE RES
Mosby Cr
Coast Fk
Row R
O.P.&E.
Waldo Lake
Spencer Cr
Coast Cr
Fern Ridge Res
Long Tom R
Amazon Cr
Muddy Cr
Oliver Cr
Crabtree Cr
BENTON CO
LANE CO
LINCOLN CO
BENTON CO
DOUGLAS CO
LANE CO
KLAMATH CO
DOUGLAS CO
LEGEND
EL PASO NATURAL GAS PIPELINE
NORTHWEST NATURAL GAS PIPELINE
SOUTHERN PACIFIC PIPELINE
OLYMPIC PIPELINE
S.P. SOUTHERN PACIFIC COMPANY
U.P. UNION PACIFIC RAILROAD
N.P. NORTHERN PACIFIC RAILWAY
G.N. GREAT NORTHERN RAILWAY
S.P.&S. SPOKANE, PORTLAND AND SEATTLE RAILWAY
P.T.CO. PORTLAND TRACTION COMPANY
O.E. OREGON ELECTRIC
O.P.&E. OREGON, PACIFIC & EASTERN
V.&S. VALLEY AND SILETZ
L.P.&N. LONGVIEW, PORTLAND AND NORTHERN

P R O B L E M S

IMPROVEMENTS DESIRED

Requests and ideas for navigation improvements were obtained from public hearings in April 1963, at Eugene, Albany, McMinnville, and Oregon City. Participants stated that the following should be considered: (1) improve the channel between Corvallis and Eugene-Springfield to provide commercial navigation and recreational boating; (2) improve the existing channel to Corvallis; (3) improve and enlarge Willamette Falls Locks to at least an eight-foot depth; and (4) use control structures rather than storage releases to provide an eight-foot channel to Corvallis.

Economic reasons cited at the hearings included: (1) navigation development promotes economic growth; (2) river navigation is needed for establishing industries along the river; and (3) there is a need for economical water shipment of agricultural lime and petroleum products to be used in the Willamette Valley.

LIMITATIONS ON TRAFFIC

Limitations imposed by Willamette Falls Locks and the shallow channels between Oregon City and Harrisburg (presently the head of commercial navigation) restrict barge traffic and log rafts navigating Willamette River. Debris, snags, shoals, and lack of access between Harrisburg and Eugene-Springfield also prevent full use of the river by recreational boaters.

Willamette Falls Locks

Navigation problems related to Willamette Falls Locks stem principally from limited lock dimensions and length of lockage time. Barges and tugs presently in use on the Columbia and Snake Rivers cannot pass because the usable dimensions of each lock basin are only 37 by 175 feet and the controlling depth over the miter sill is only six feet. Therefore, the economies of using larger and fully loaded barges cannot be realized with the existing Willamette Falls Locks. Moreover, the downstream passages require 34 to 37 minutes and upstream passages 43 to 51 minutes, although the lockage time can be reduced by one-half for a continuous downstream run of several log rafts. During 1966, there were 7,985 lockages, or an average of about 22 per day. Congestion of the locks has been relieved by an operating schedule which the principal lock users have agreed to observe.

The practical capacity of the lock system is exceeded by the present traffic volume. Maintenance and operation costs are excessive in comparison with more modern facilities of similar lift heights. Many costly repairs and major restoration projects have been required to keep the locks operational and more will be required in increasing proportion as the facilities age into the projection period. As the initial construction of the locks was completed in 1873, the facilities

have far exceeded their expected life. The existing facilities are obsolete for modern barge service operations and in need of replacement.

Channels

No difficulty is experienced in navigating the river between Portland and Oregon City, but this is not the case in other reaches of the river. During periods of low water, log rafts move downstream with difficulty from log rollways located above Salem, and full loading of barge traffic is not possible. Also, it is difficult to maneuver barges and log rafts where the river channel is tortuous and narrow.

Authorized project depths of six feet between Willamette Falls and the mouth of the Santiam River, and five feet to Albany have not been realized. These depths were to be provided by increasing low-water flows by releases from upstream storage reservoirs supplemented by dredging and contraction works. Construction of the reservoir system is not completed, thus the storage releases are not available.

Wave Wash

Individuals and houseboat owners have complained about wave wash caused by larger boats and ships. Several years ago, the State Marine Board established a speed restriction on Oregon Slough; it is well posted with uniform waterway markers, and patrolled by the county sheriff. Houseboats on Multnomah Channel and on the Willamette River upstream from Oregon City are occasionally exposed to the wave wash of a commercial tugboat. However, most houseboats are located away from the general area of commercial traffic.

In general, slower ship speeds increase operating costs and make steerage difficult. The Governor of Oregon has asked the State Marine Board to determine if legislation will be needed to regulate waterfront and floating structures.

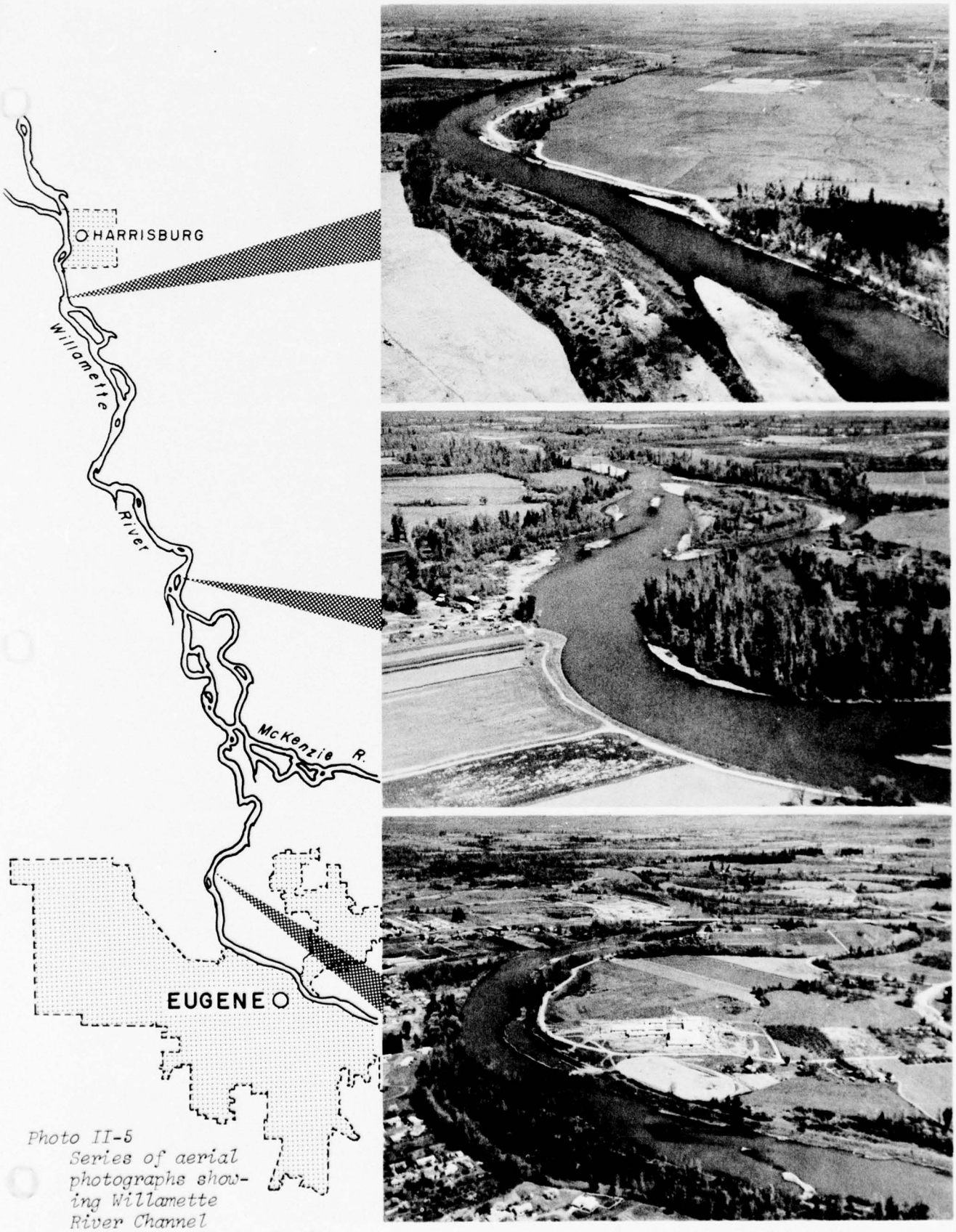
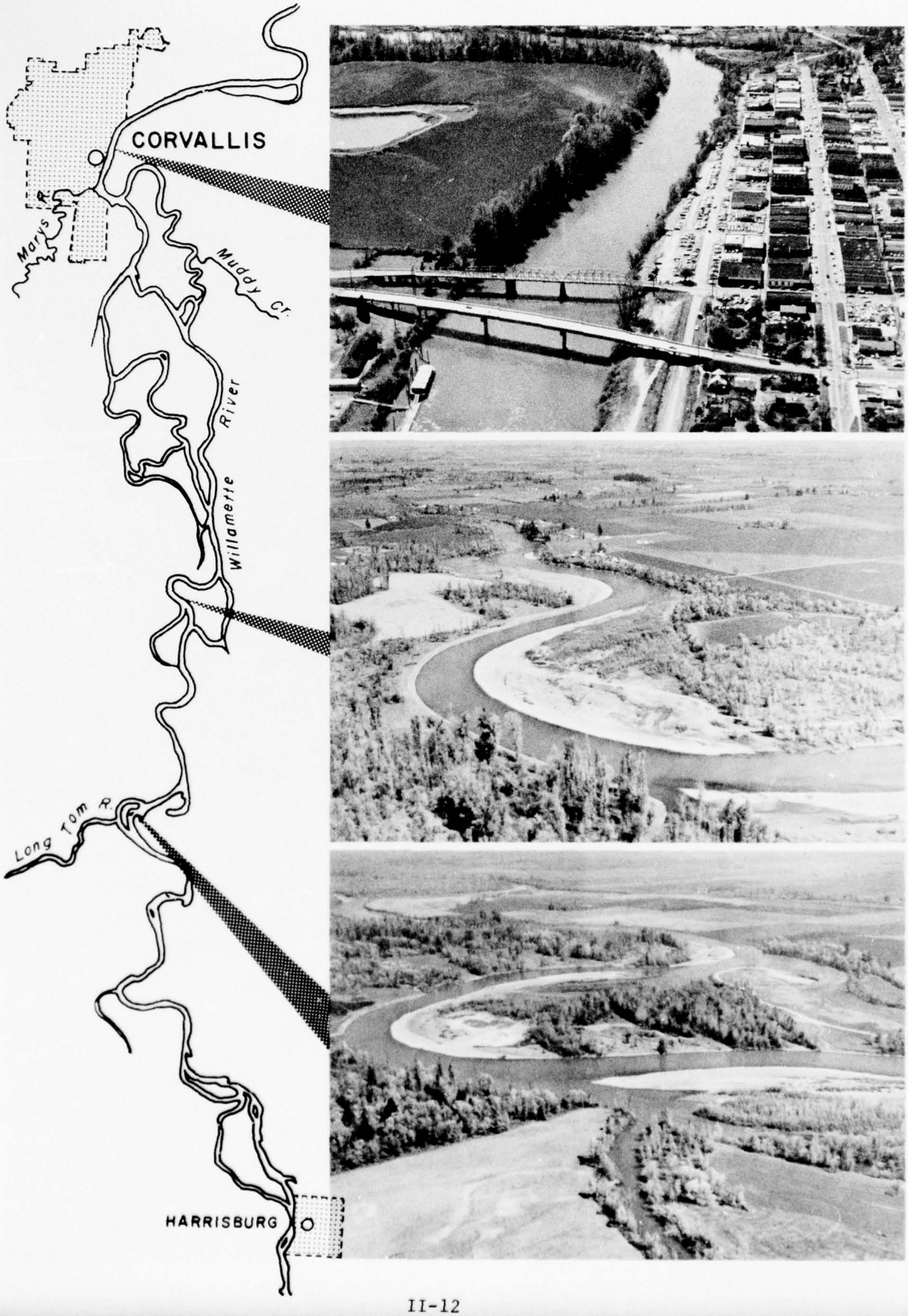


Photo II-5
Series of aerial photographs showing Willamette River Channel from Eugene to Portland. (OSHD Photo)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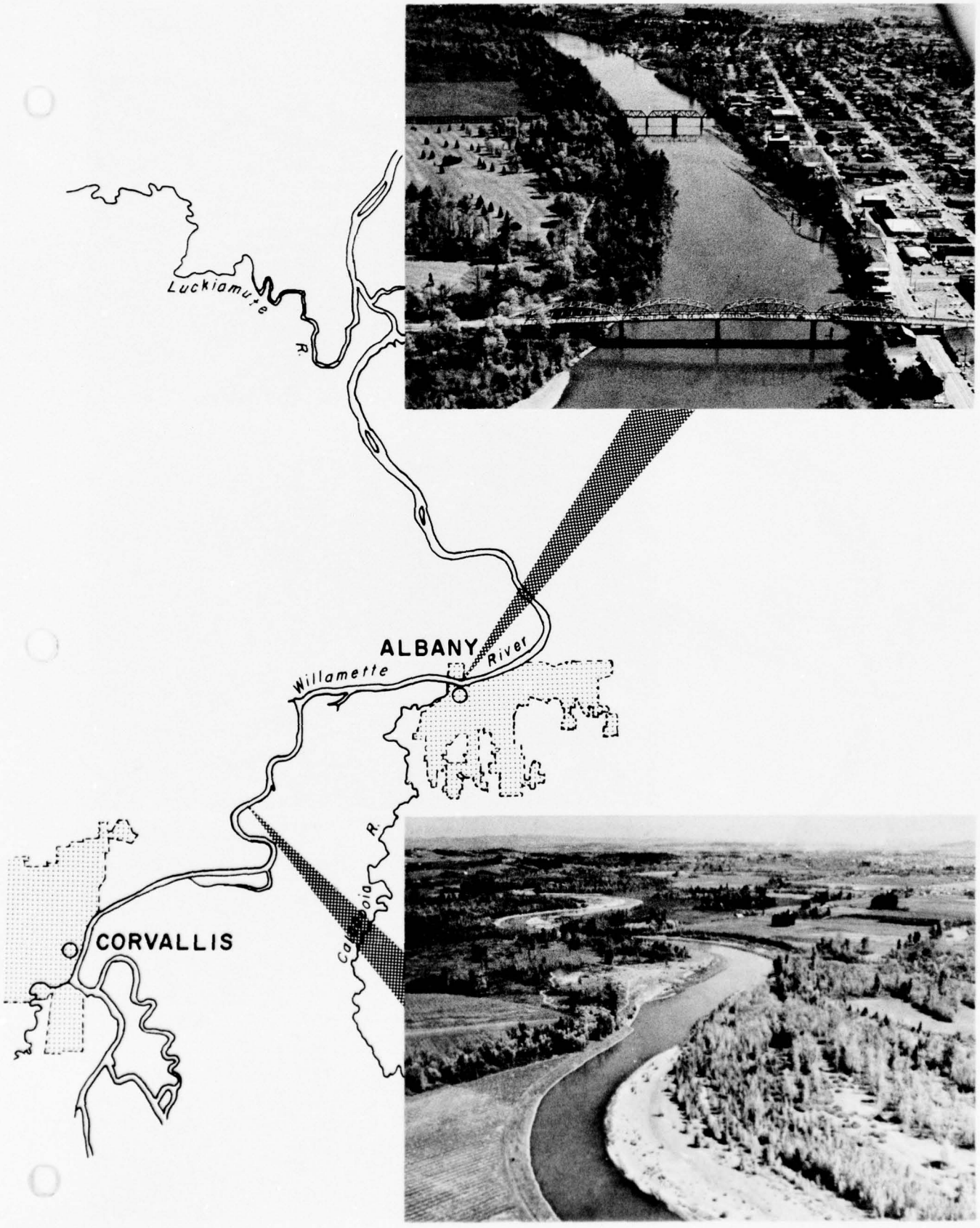
Marys R.
Muddy Cr.
Willamette River
Long Tom R.
HARRISBURG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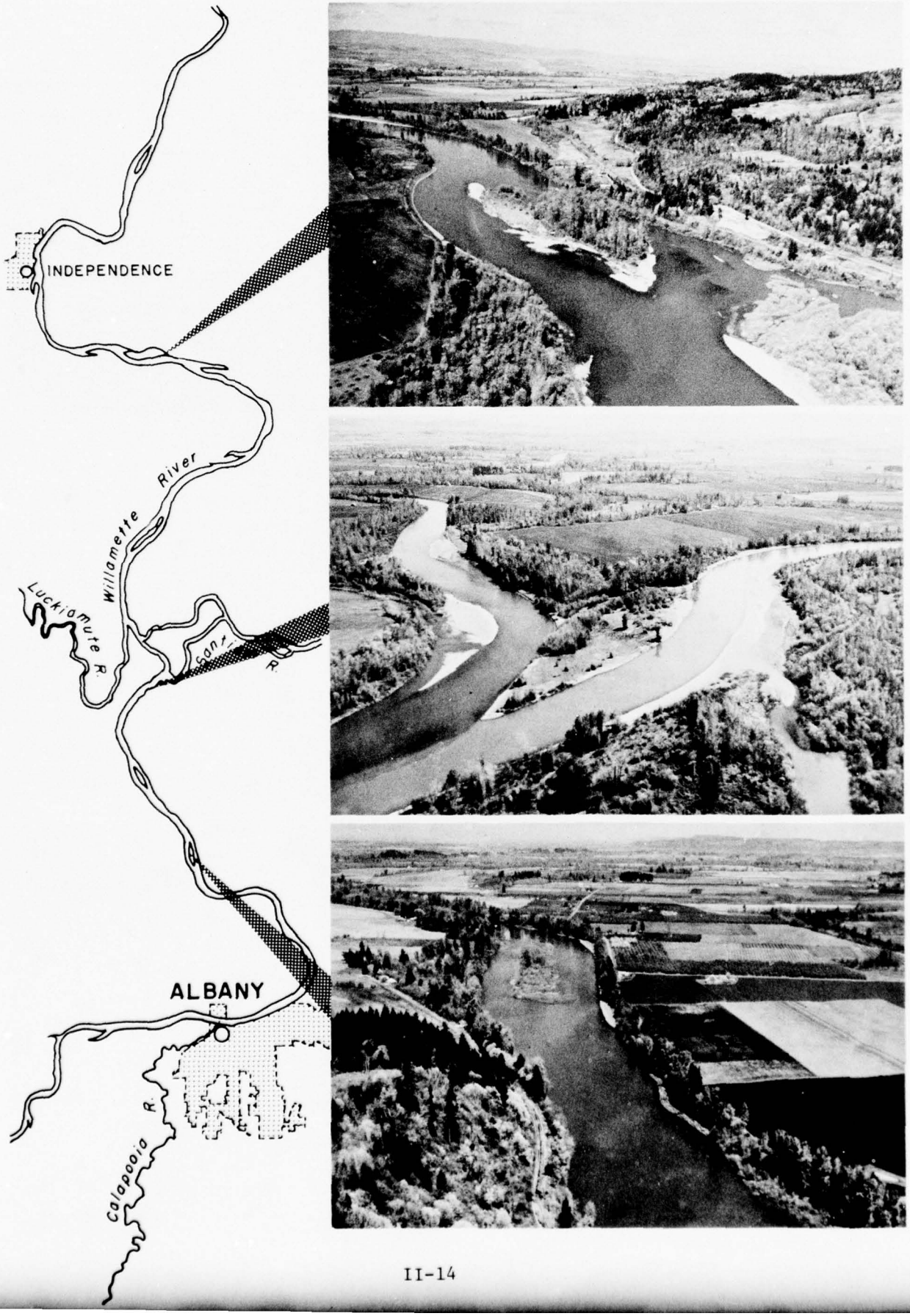
CORVALLIS
Calapooia R.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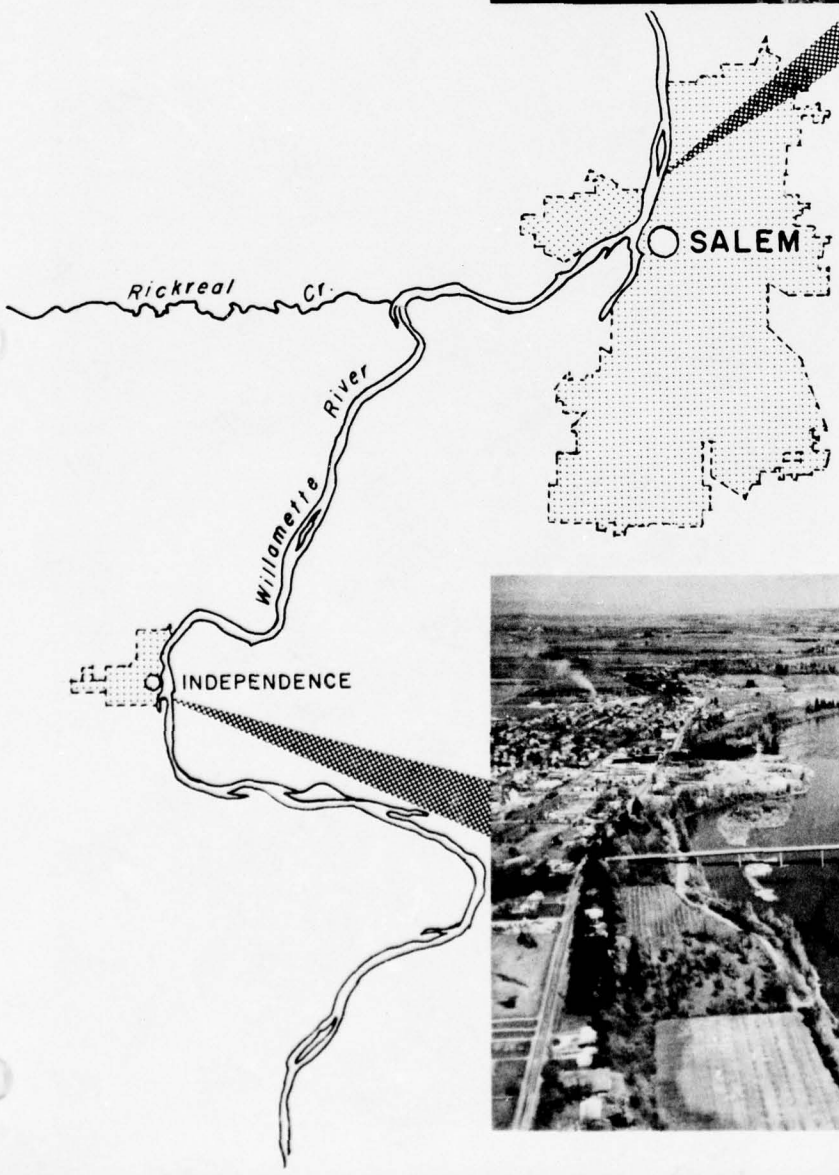
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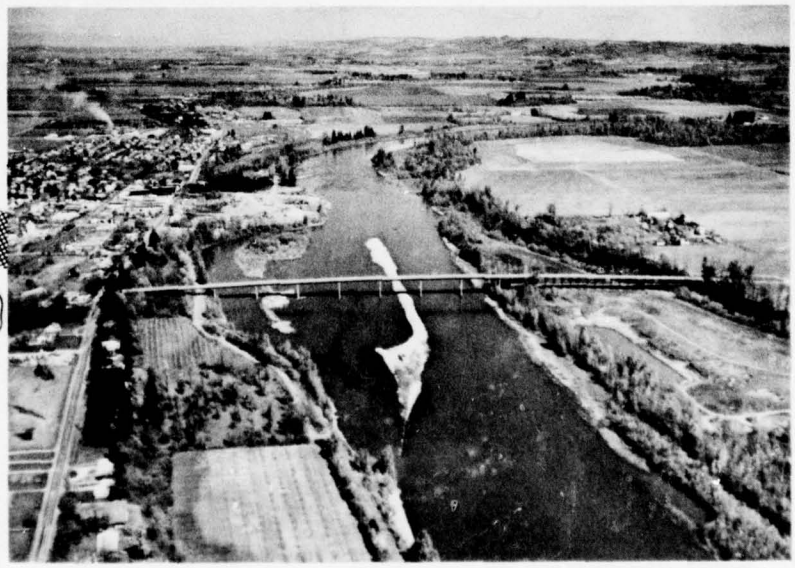
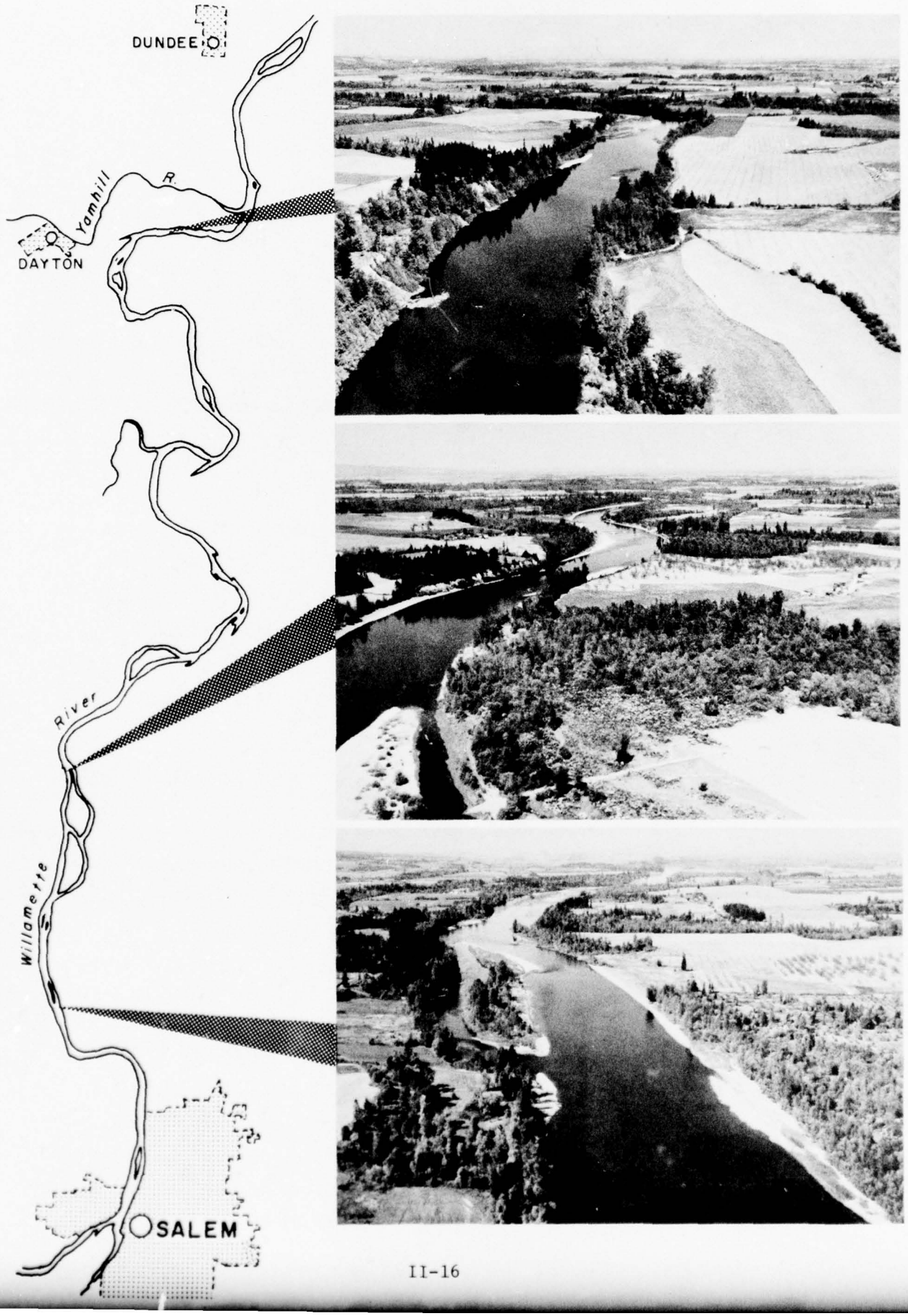
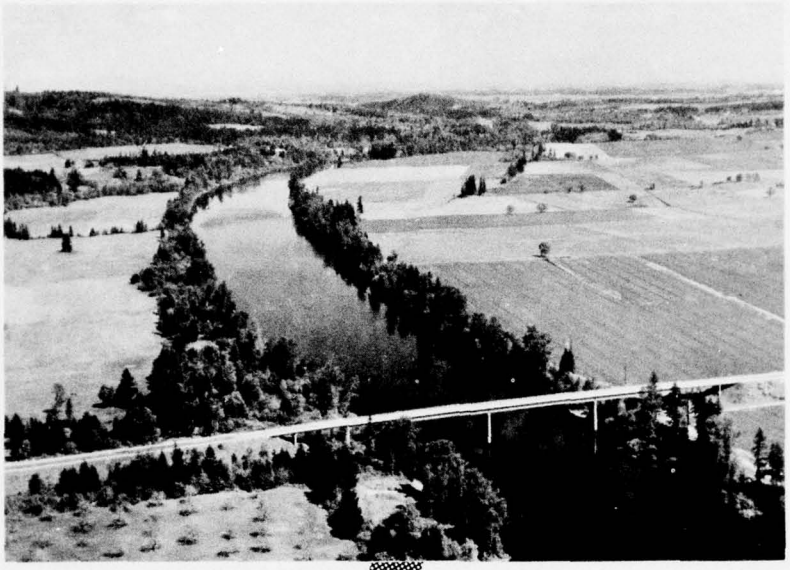
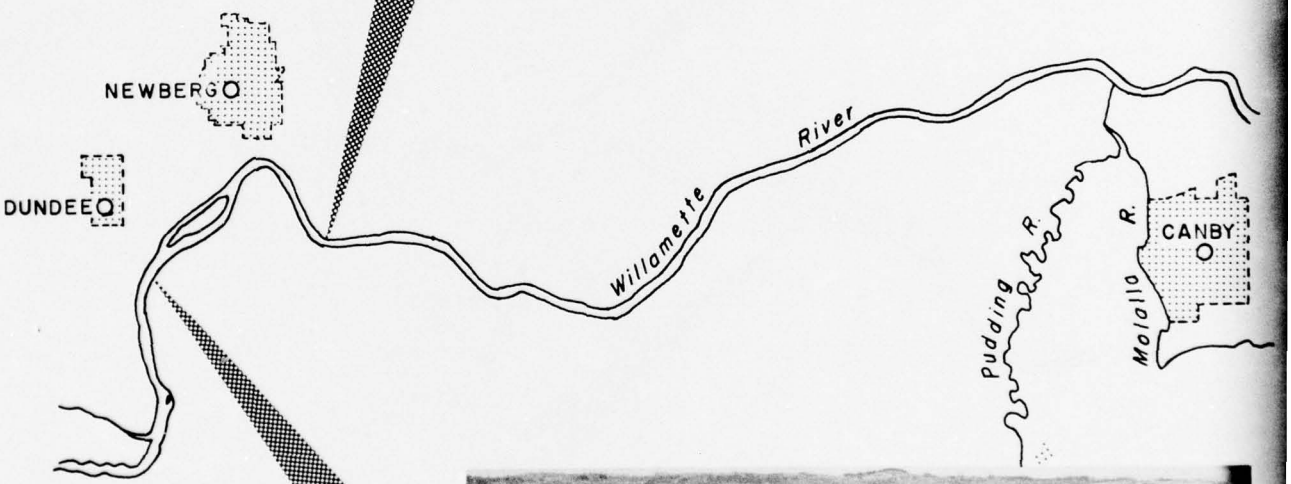
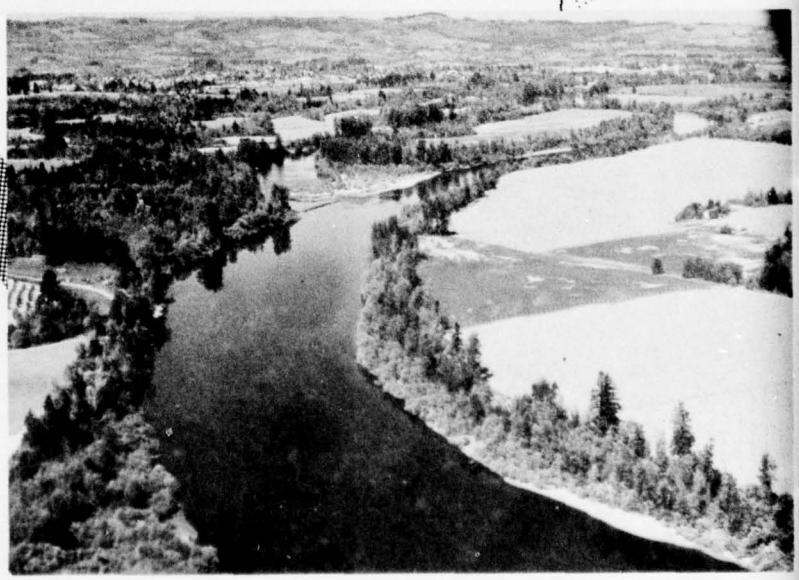
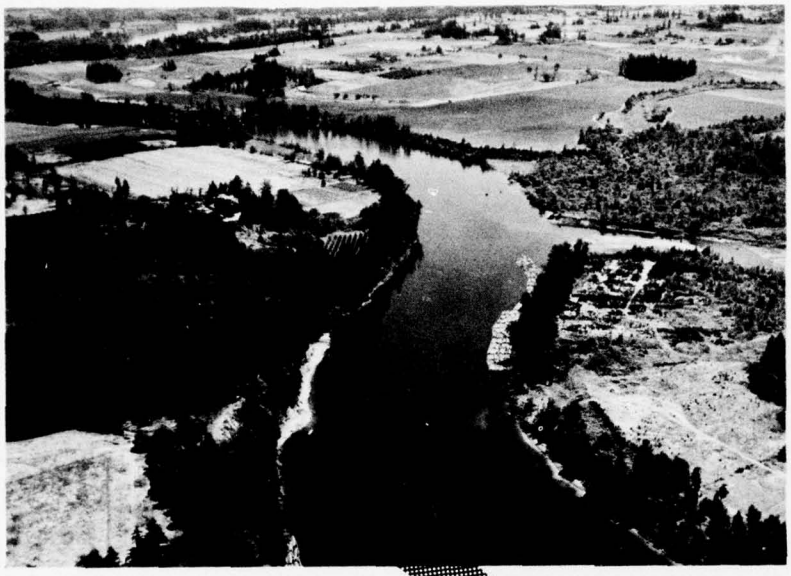


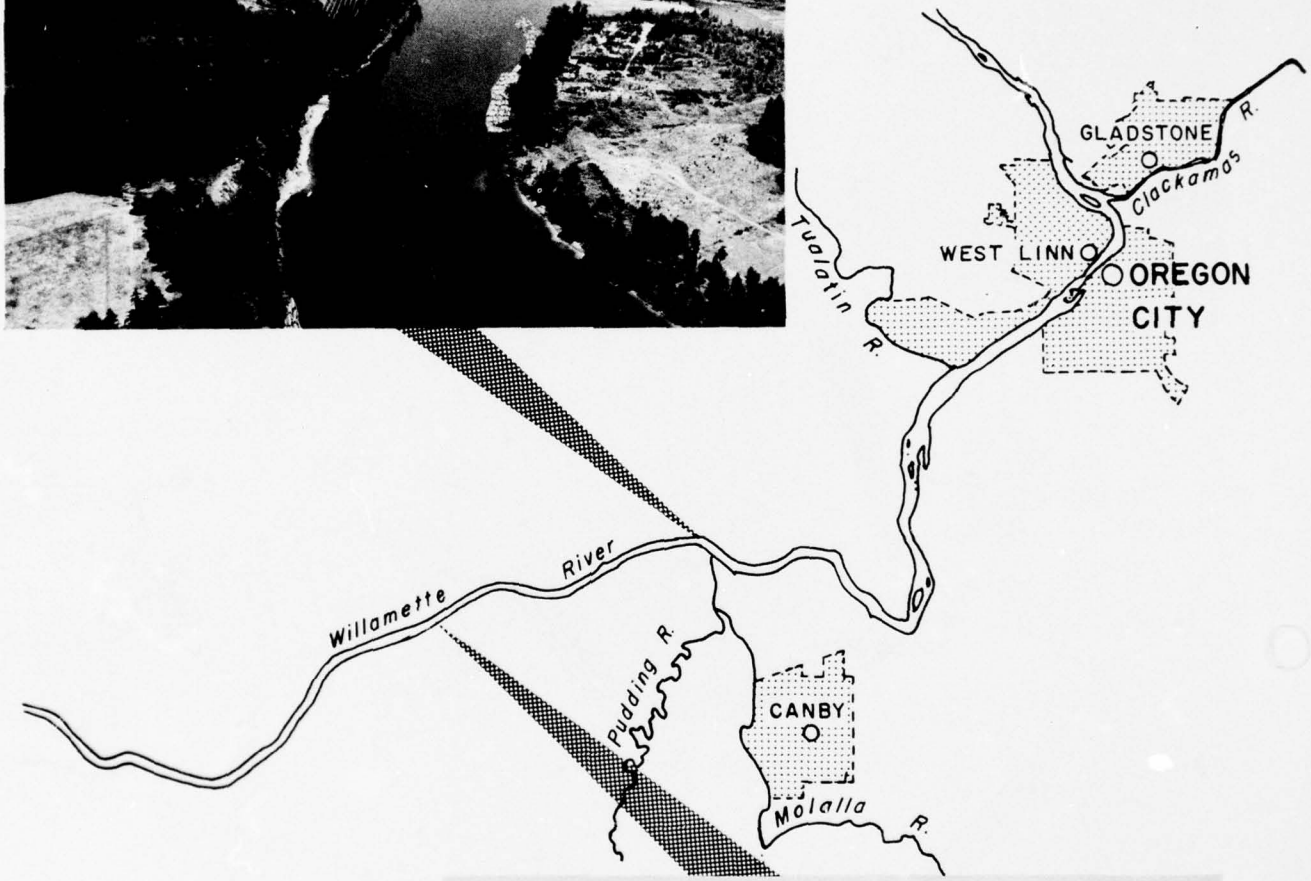

DUNDEE
Yamhill R.
DAYTON
River
Willamette
SALEM




NEWBERG
DUNDEE
Willamette River
Pudding R.
Molalla R.
CANBY






GLADSTONE
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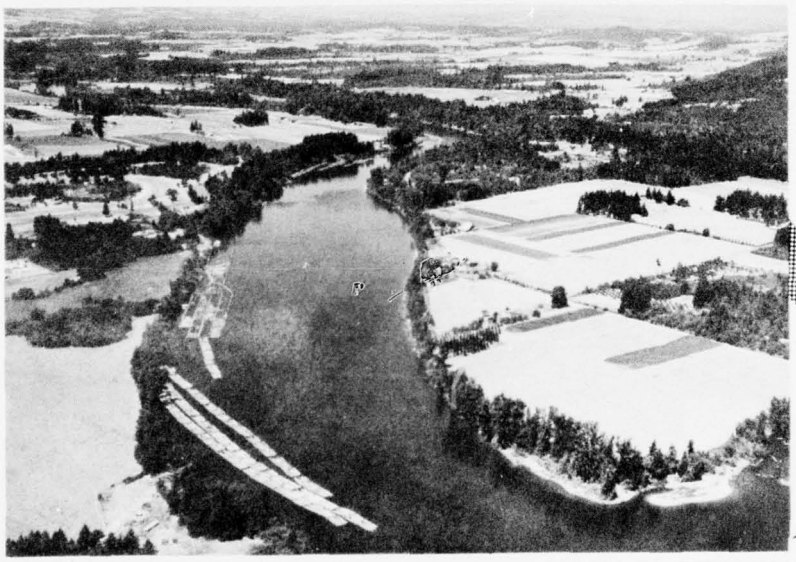
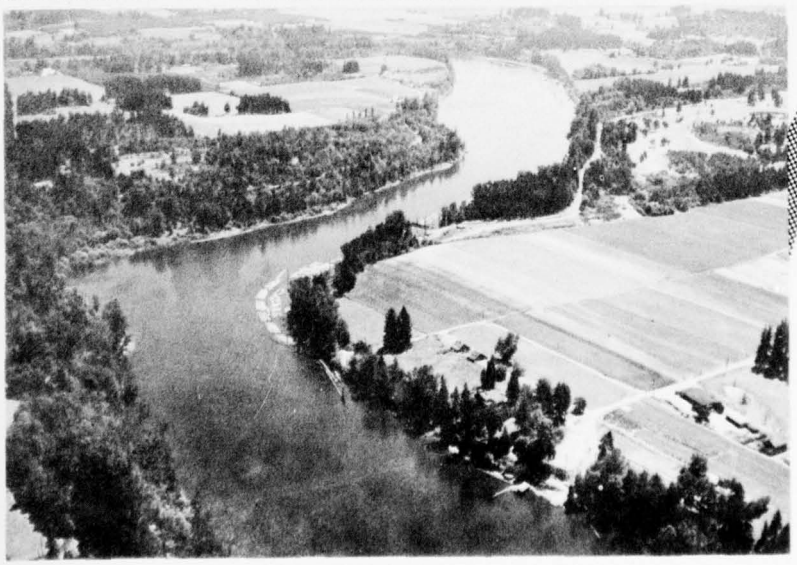
Willamette
River
Pudding R.
CANBY
Molalla
R.





LAKE
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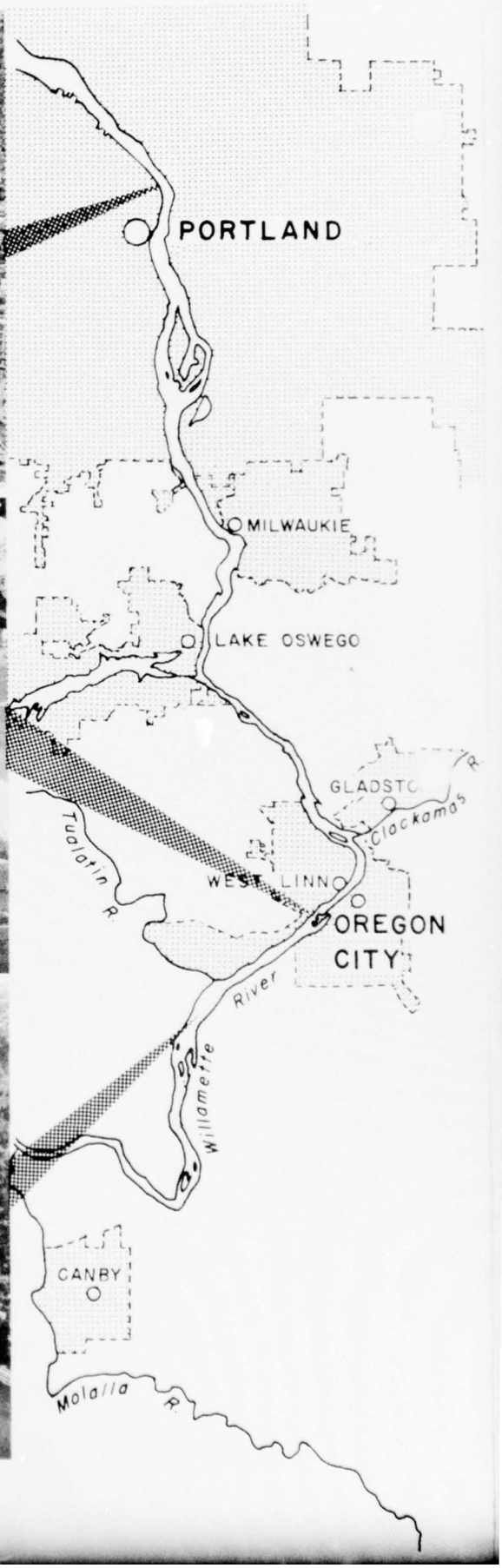
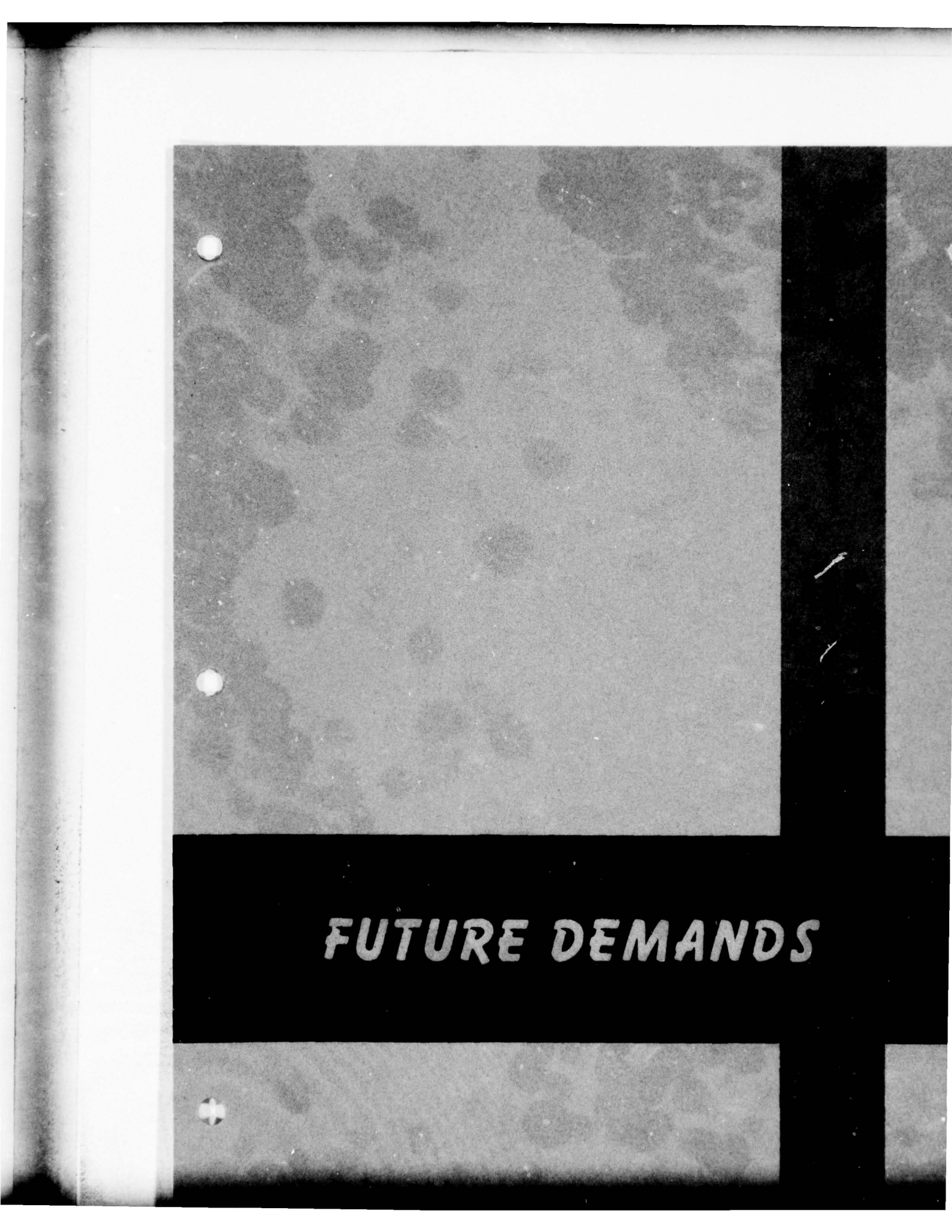
River
Willamette
CANBY
Molalla
R.


PORTLAND
MILWAUKIE
LAKE OSWEGO
GLADSTO
Clackamas R
Tualatin R
WEST LINN
OREGON CITY
Willamette River
CANBY
Molalla R


FUTURE DEMANDS

The goal for navigation, similar to the goal of all transportation, is to provide the most economical and efficient means of transporting commodities. Some commodities are more easily and economically transported by water than by any other means. To the extent that this is true, navigation can be used to reduce transportation costs.

Additional capacity will be needed through the navigable reach of Willamette River to handle prospective increases in potential waterborne commerce. Some traffic can be moved more economically by other transportation, but river navigation would be utilized to move that portion which is more economically movable by water. In the ocean-shipping channel, further deepening and widening will be needed as vessels become larger. In the shallow-draft channel (inland waterway), increased channel capacity and improvement of Willamette Falls Locks will be necessary to take full advantage of water transport.

Future navigation facility needs are based on dimensions of the tugs and barges used to move commodities such as rafted logs, petroleum products, sand and gravel, wood chips, lime, and fertilizer. Measures available to provide adequate channels (at low water) for these craft include increased flows, dredging, and channel constriction works.

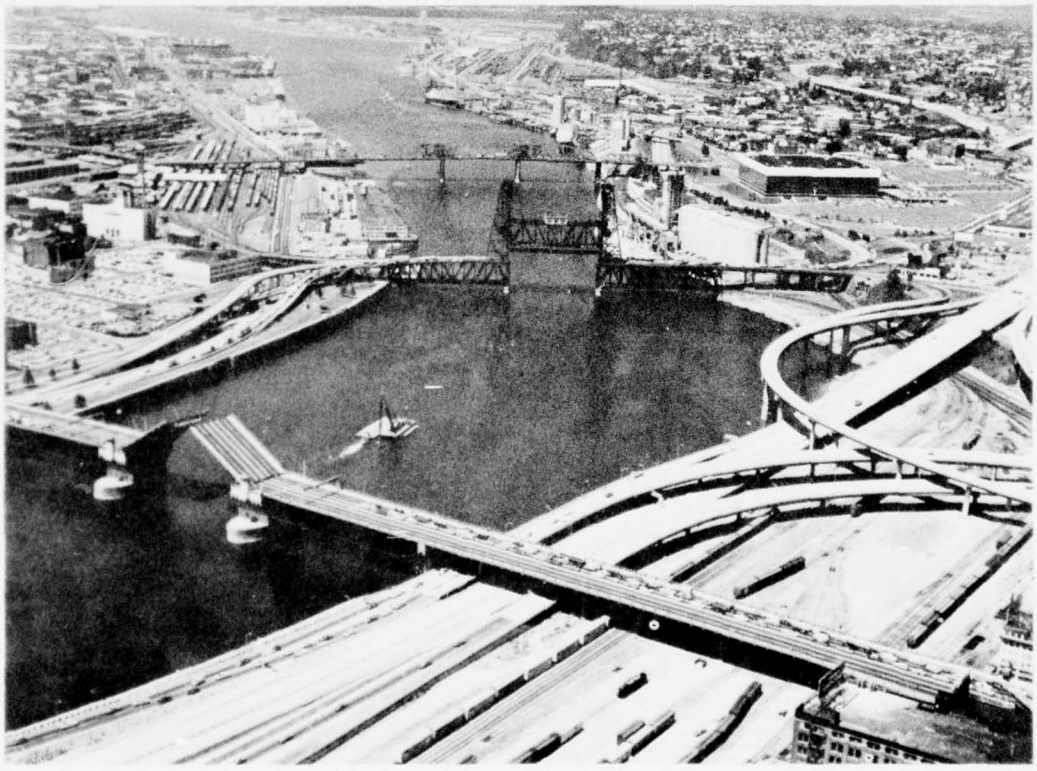


Photo III-1 The Portland Harbor is served by a system of railroads and freeways. (OSHD Photo)

PORTLAND HARBOR

The Port of Portland, which lies within the basin, is an important national and international port. A deep-draft channel project to increase the channel depth to 40 feet from the Pacific Ocean up the Columbia and Willamette Rivers to Portland is under construction.

The commerce handled through this port contributes substantially to the basin's economy. If present trends continue, commerce through the port will double by 1980 and quadruple by 2020. Expansion of port facilities will be required.

The trend in shipbuilding is toward larger, deeper-draft vessels, which will require deeper and wider channels. For this reason, periodic detailed navigation studies of the Columbia and Lower Willamette Rivers will be necessary. Such studies, although beyond the scope of this investigation, will be prerequisite to maintaining Portland's position in international maritime commerce.

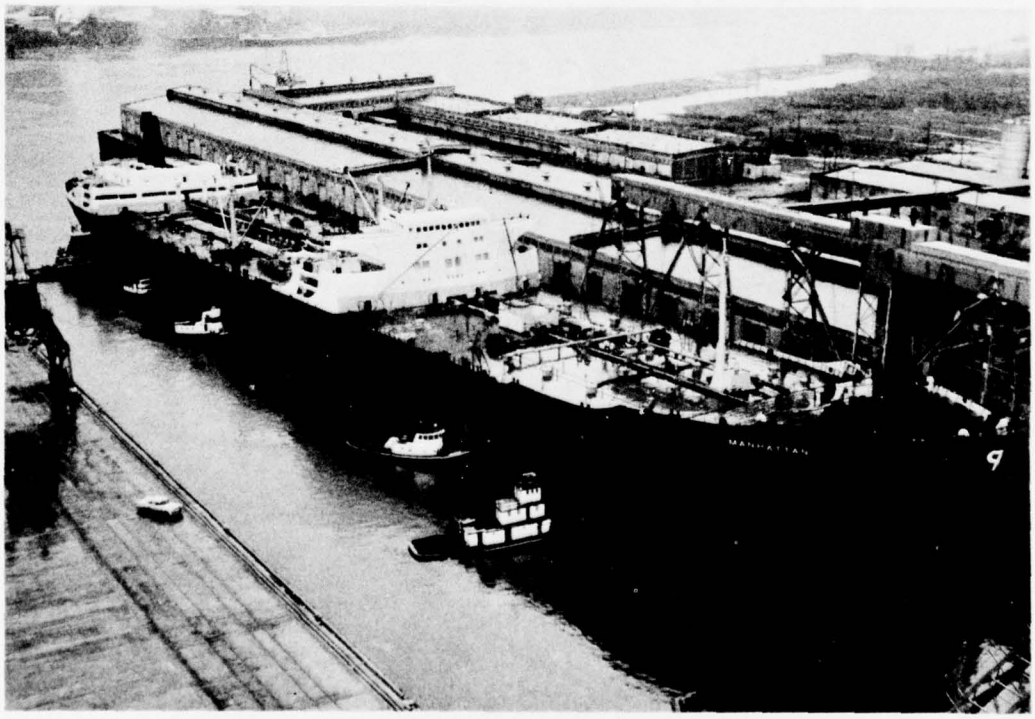


Photo III-2 The supertanker "Manhattan," largest commercial vessel under United States flag, being moored at a port facility. (Port of Portland Photo)

INLAND WATERWAY

The historical trend of commodity transportation in the area has been from river transport to rail, then to increased truck haul, and in recent years to a marked increase in air freight. The forces that brought about these changes were demands for more speed and flexibility of freight movement. Nowadays, much efficiency is realized by pick-up and delivery in a single conveyance vehicle, as exemplified by the "piggyback" freight system introduced by the rail and trucking industries. Inland water transport has been left with the task of transporting large-volume, low-unit-value materials whose origin and destination are near waterways, because it is economical only under these circumstances. In the Willamette Basin, water transport has become more important in the Lower Subarea, with its industrial complex, and less so in the Upper and Middle Subareas (see frontispiece map).

The future demand for water transport on the inland waterway depends primarily on the growth of certain industries using or producing bulk commodities in quantity. Future production and consumption of these commodities, then, largely constitute the potential waterborne commerce. Water would be used to transport these commodities when savings in shipping costs are in prospect. Barges transporting "piggyback" vehicles and other types of containerized cargo are expected to increase significantly on the Columbia and Willamette Rivers.

POTENTIAL WATERBORNE COMMERCE

The Willamette Basin's population is expected to nearly triple over the study period, from about 1.2 million in 1960 to about 3.6 million in 2020. This increase will take place primarily in and around the cities; all the larger cities are located along Willamette River. Production and consumption of some bulk commodities movable by water will increase concurrently. Detailed population projections for the years 1980, 2000, and 2020 are given in the Economic Base Appendix.

In 1960, the Lower Subarea had about 62 percent of the basin's population, the Middle Subarea 24 percent, and the Upper Subarea 14 percent. The population distribution is not expected to change materially between now and 2020.

Projections of the potential waterborne commerce in various bulk commodities follow. These are given by subarea, to identify reaches of the Willamette River. Aggregate potential waterborne commerce on the inland waterway for the years 1965, 1980, 2000, and 2020 is shown in Figure III-3 at the end of this subsection.

Forest Products

Forest-product manufacture is the leading industry in the basin. Lumber, plywood and paper mills produce for the national market. Logs from the basin's forests are consumed locally, transferred to mills on the Columbia River, or exported. Among the forest products, wood chip residues and rafted logs constitute potential waterborne commerce.

Wood Chips

Wood chips are a by-product of lumber and plywood mills. The greatest source of potential waterborne commerce is the movement of wood chips from these mills in the Upper and Middle Subareas to the pulp and paper mills in the Lower Subarea; at present, waterborne transport of wood chips is small. Future wood chip production in Upper and Middle Subareas is shown in Table III-1. These figures reflect average residues and the estimated future log consumption of sawmill and veneer plants.

Estimates in Appendix C - Economic Base show that 60 percent of the basin's pulp and paper production will occur in the Lower Subarea and along Columbia River. The potential waterborne wood chip tonnages, computed by converting units of wood chips to tons at a ratio of 1 to 1.75 and assuming that 35 to 40 percent of the chips produced would move by water to Lower Subarea plants, are shown in Table III-2.

Table III-1
Projected chip production, Upper and Middle Subareas, 1965-2020

Year	Types of Logs	Log Consumption millions of bd.-ft. Upper	Log Consumption millions of bd.-ft. Middle	Projected Wood Chip Production (units) Upper	Projected Wood Chip Production (units) Middle
1965	Sawlogs	1061	1023	584,000	568,000
	Veneer logs	862	1109	405,000	520,000
1980	Sawlogs	827	798	455,000	439,000
	Veneer logs	1089	1400	512,000	658,000
2000	Sawlogs	462	440	254,000	242,000
	Veneer logs	1068	1343	502,000	633,000
2020	Sawlogs	378	360	208,000	198,000
	Veneer logs	1068	1343	502,000	633,000

Table III-2
Potential waterborne wood chip movement from upper and Middle Subareas to Lower Subarea, 1980-2020

Year	Potential Waterborne Movement (short tons) Upper	Middle	Total
1980	580,000	658,000	1,238,000
2000	454,000	525,000	979,000
2020	426,000	498,000	924,000

Production capacity of pulp and paper mills located in the Lower Subarea and in the adjacent areas along the Columbia River is three times that of the Middle and Upper Subareas combined. The site advantages with reference to water supply, water transportation, waste disposal, and market access are expected to attract the major future expansion of this industry to Columbia River sites. Since much of the raw material for the pulp and paper industry of the region is in the vast timber stands of the Upper and Middle Subareas, it will continue to move to the Lower Subarea and adjacent areas in the form of wood chips. Primary processing of the timber into lumber and plywood products will continue to be of major proportions in the Upper and Middle Subareas. Chip residues are presently moved from the Upper and Middle Subareas by truck and rail transport. These alternative land modes are expected to retain a moderate share of the cargo volume.

Photo III-3 Wood chip barge in the vicinity of Lake Oswego. Chips are enroute to a plant on lower Columbia River. (USCE Photo)

Rafted Logs

At present the only significant commercial navigational use of the river above Willamette Falls is for moving log rafts. Logs are moved down to the Lower Subarea from as far upriver as Corvallis. In 1966, about 90 percent of the logs were designated for use by the paper and pulp plants of the Lower Subarea and along Columbia River. The following tabulation shows log movements for that year. The volume of logs originating at any one of these points is subject to extreme variation from year to year as the timber area harvested varies.

Originating Point	Log Tonnage
Corvallis	26,761
Albany	230
Salem	13,400
Yamhill River and Dundee	148,132
Canby	397,738
Total	586,261

Table III-3 and Figure III-1 show the projected log tonnages to be moved to the Lower Subarea in the years 1980, 2000, and 2020.

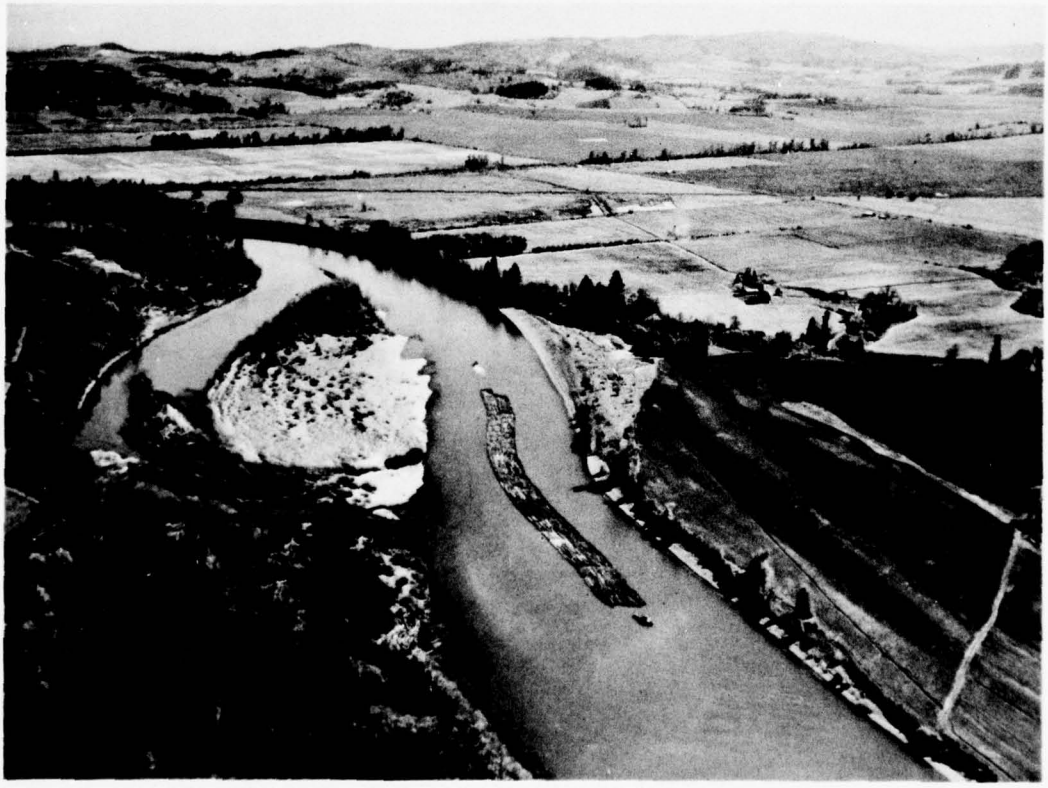


Photo III-4 Rafted logs moving in the vicinity of Independence. (OSHD Photo)

Table III-3

Projections of potential waterborne log movement to Lower Subarea, 1980-2020

Year	Potential Traffic - (short tons) 1/				
	Corvallis	Salem	Yamhill River	Canby	Total
1980	46,000	23,000	25,000	681,000	775,000
2000	58,000	29,000	32,000	850,000	968,000
2020	66,000	33,000	36,000	917,000	1,051,000

1/ *These tonnages are based on the projections of round-wood consumption contained in "Prospective Timber Supplies and Forest Industrial Development in the Willamette Basin," by the Pacific Northwest Forest and Range Experiment Station.*

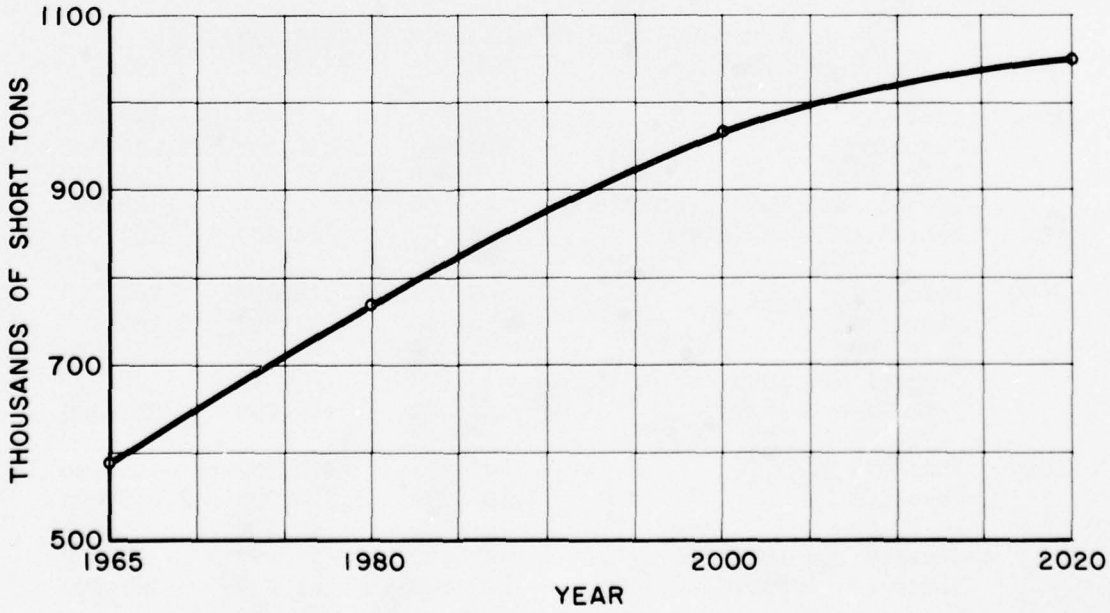


Figure III-1. Projected Potential Log Movement from Middle to Lower Subarea.

Petroleum Products

Petroleum products are another source of potential tonnage for Willamette River. Gasoline, fuel oils, asphalts, and lubricating oils and greases make up the major portion of the petroleum products considered potential waterborne commodities. At present, most of these products enter the basin area by pipeline from Puget Sound or through the Portland Harbor. The estimated consumption of gasoline, fuel oil, liquid petroleum (L.P.) gas, greases and lubricating oils, and petroleum asphalt in the Middle and Upper Subareas for 1980, 2000, and 2020, is shown in Table III-4 and Figure III-2.

Comparison of transportation rates shows that the existing pipeline into the basin can handle the potential traffic in fuel oil and gasoline as economically as the commodities could be handled by barge. However, there is potential waterborne commerce for L.P. gas, greases and lubricating oils, and petroleum asphalt.

Table III-4
Projected consumption of gasoline, fuel oil, L.P. gas, greases and lubricating oils, and petroleum asphalt in the Upper and Middle Subareas, 1980-2020

Year	Commodity	Projected Consumption (short tons) Upper	Middle	Total
1980	Fuel Oil	330,000	517,000	847,000
	Gasoline	413,000	640,000	1,053,000
	L. P. Gas	11,000	17,000	28,000
	Greases and Lubricating Oils	11,000	17,000	28,000
	Petroleum Asphalt	99,000	64,800	163,000
2000	Fuel Oil	366,000	522,000	888,000
	Gasoline	694,000	992,000	1,686,000
	L. P. Gas	12,000	17,000	29,000
	Greases and Lubricating Oils	15,000	21,000	36,000
	Petroleum Asphalt	142,000	100,000	242,000
2020	Fuel Oil	408,000	528,000	936,000
	Gasoline	1,185,000	1,530,000	2,715,000
	L. P. Gas	15,000	20,000	34,000
	Greases and Lubricating Oils	22,000	28,000	50,000
	Petroleum Asphalt	208,000	161,000	369,000

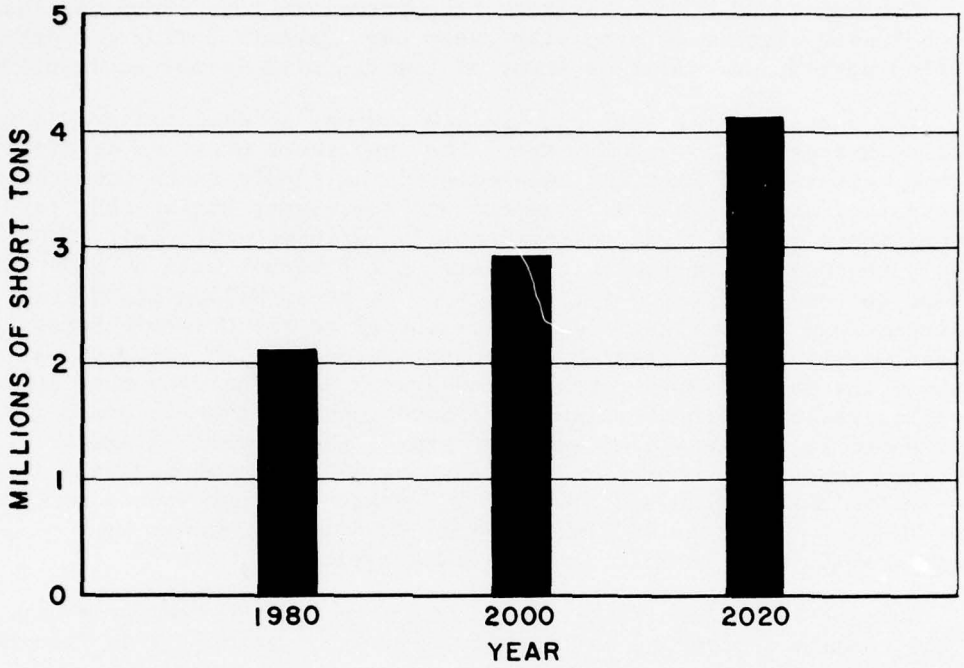


Figure III-2. Projected Consumption of Petroleum Products for the Upper and Middle Subareas, 1980-2020.

Sand and Gravel

Sand and gravel are well adapted to barge transport. Table III-5 shows the estimated consumption for three projection periods between 1965 and 2020. These projections are based on the estimated population and per capita consumption shown in the Economic Base Appendix.

Table III-5
Sand and gravel requirements, by Subarea, 1965-2020

Period	Sand and gravel requirements (Millions of short tons) Upper	Middle	Lower	Total
1965-1980	38.9	62.1	150.3	251.3
1980-2000	76.0	112.6	285.8	474.4
2000-2020	108.0	145.6	427.6	681.2

The Upper and Middle Subareas have gravel sources developed that are believed capable of supplying their requirements during the projection period, and water movement of the material is not anticipated.

The Portland area will require new sources of sand and gravel to satisfy its projected requirement. For many years quarries developed on the east side of Portland supplemented the supply taken from the Ross Island area. Urban development and subsequent zoning have converted these quarry sites to residential and industrial uses. To supply the demands of the Portland area, it probably will be necessary, before the end of the projection period, to go up Willamette River upstream from Willamette Falls or to sources on the Columbia River to obtain material. More economical sources closer to the area of use will satisfy the requirements for sand and gravel for about the next 30 years. Plant operators in the Portland area have revealed that they are quite interested in the source of sand and gravel just above Willamette Falls and they expect that zone to produce about 300,000 tons per year for use in the Lake Oswego and Oregon City areas. Further improvement of the inland waterway on Willamette River does not appear necessary to sustain waterborne traffic in sand and gravel.

Other mineral industries of the basin located upriver from Portland do not require or produce sufficient tonnages of materials to require water transport.

Agriculture

The river has not been used in recent years for transporting agricultural products. The many varieties of crops, varying harvest times, location of markets, and marketing methods do not make barge transport advantageous. The crops generally are hauled from the farm a short distance to one of the 375 processing or cleaning plants located in the basin. Those plants are located along rail sidings. In general, large inventories of processed produce are not allowed to build up, and in most cases the plants have facilities for storing only limited quantities. The produce is shipped as cars become available. Much of the produce is shipped east and south, so there would be no advantage to moving it down river.

Fertilizer and lime are import commodities used by the agricultural industry that may be considered potential tonnage. Trucks are now used to distribute fertilizer and lime from the warehousing point to the farm. Portland serves as a convenient point of distribution for Yamhill and Clackamas Counties, Salem for Marion and Polk Counties, Albany for Linn and Benton Counties, and Eugene for Lane County. Based upon the rate of increased usage during the period 1959 to 1964, the following potential tonnages are projected.

Table III-6
Projected potential tonnages of lime and fertilizer by river reaches for the years 1980, 2000, and 2020

(Short tons)

Reach	1980	2000	2020
Eugene - Albany	35,000	45,000	50,000
Albany - Salem	140,000	180,000	200,000
Salem - Portland	240,000	310,000	345,000

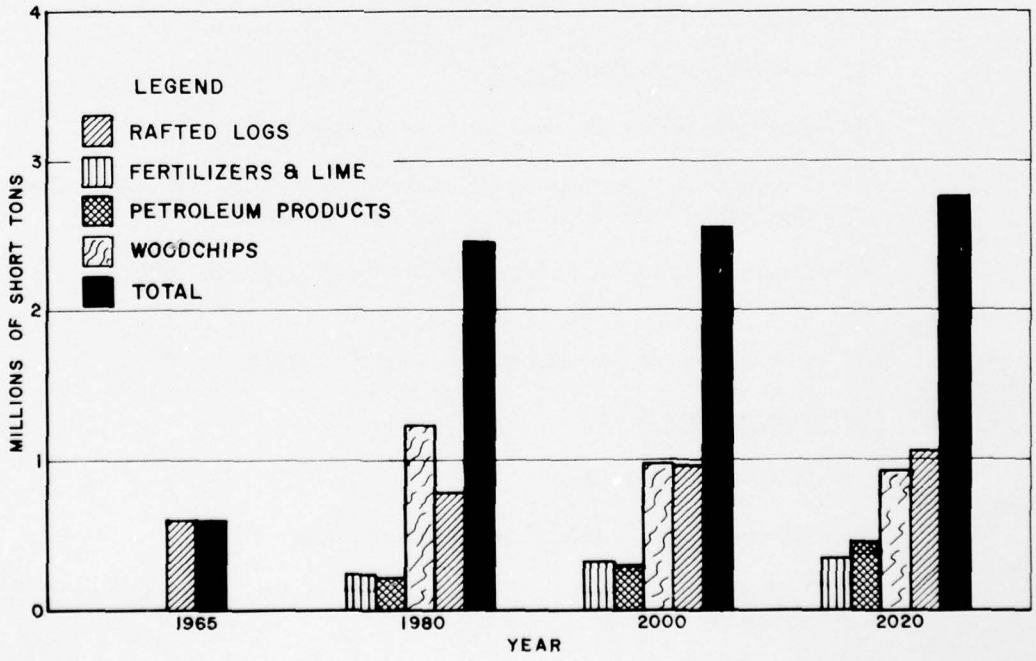


Figure III-3. Potential Waterborne Commerce - Willamette River upstream from Willamette Falls.

COMMERCIAL FACILITIES

Numerous terminal facilities will be needed if the river channel is improved to provide for navigation by tugs and barges. The requirements for facilities will vary with the commodity to be handled. The following facilities will be needed for the identified commodity:

(a) *Wood Chips*

(1) *Docking structures for tying up barges while loading and unloading*

(2) *Truck dumping equipment*

(3) *Area for stockpile*

(4) *Fast efficient equipment to transfer the chips to the barge at the upriver terminal and to transfer the chips from the barge to the stockpile at the destination*

(5) *Access roads to the upriver terminal for trucks hauling from the lumber and plywood mills*

(b) *Petroleum Products*

(1) *Docking structures*

(2) *Storage tanks at the upriver destination*

(3) *Piping and pumping equipment to transfer the fuel oils and gasolines from barge to tank storage*

(4) *Warehousing facilities for storing greases and lubricating oils*

(5) *Access roads to accommodate tank trucks*

(c) *Fertilizers and Lime*

(1) *Docking structures*

(2) *Warehousing facilities to store inventories*

(3) *Efficient equipment to unload barges and transfer the material to the warehouses*

(4) *Access roads for truck distribution from the warehouse to farm*

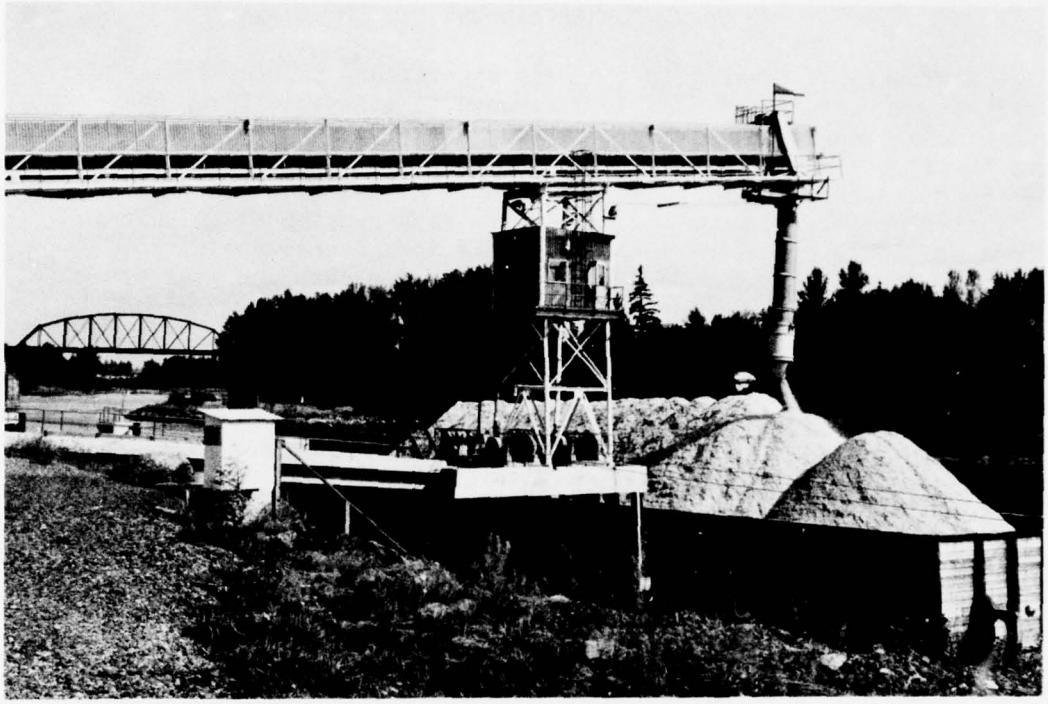


Photo III-5 Wood chip loading facility near Lake Oswego. (USCE Photo)

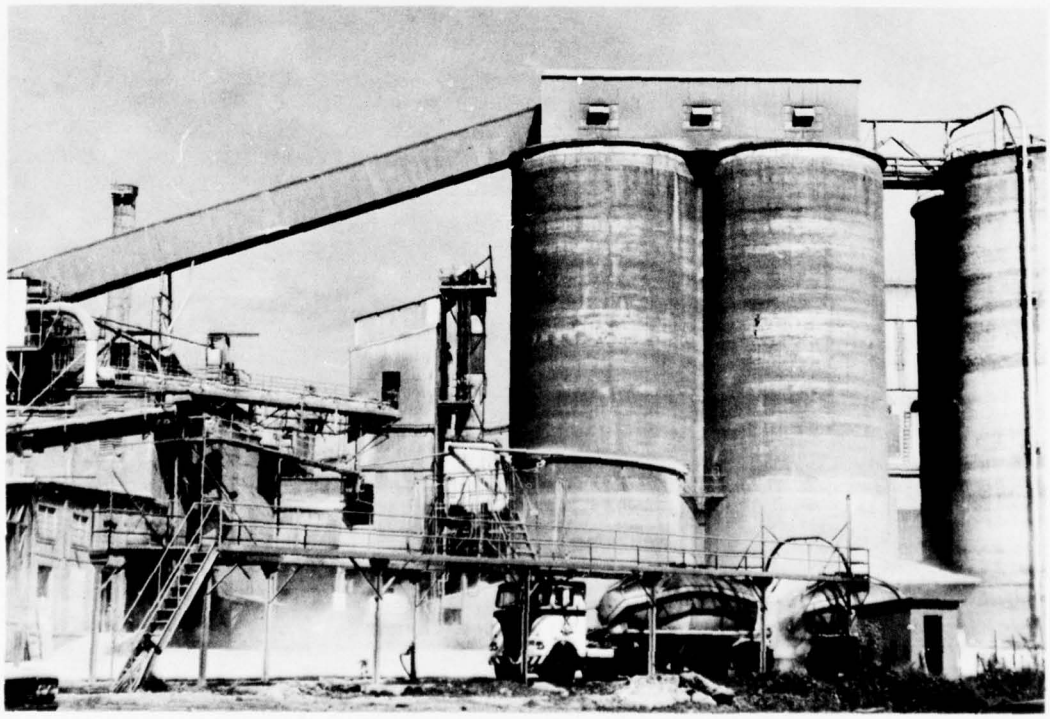


Photo III-6 Ash Grove Lime & Portland Cement Co., Rivergate Plant and docking structure. (USCE Photo)

NONCOMMERCIAL USE

Recreational boating is the only significant noncommercial navigational use of the basin's waterways. Willamette River has enormous potential for pleasure boating activity. In the past, growth of this activity has been hindered by lack of facilities for boats and boaters and by pollution. There is evidence now that the pollution will be reduced and that parks with camping areas, picnic areas, domestic water and sanitary facilities, access roads, good boat launching facilities and parking areas for cars and trailers will be provided.

EQUIPMENT

A large variety of tug and barge equipment is in current use below Willamette Falls. In past years, most of the barges were in a 500- to 1000-ton capacity class. In recent years the 3000-ton barges of Columbia River and coast trade have become common. When fully loaded, the older, smaller barges draw 6-8 feet of water. The new and larger vessels draw about 12 feet. A few barges of about 5000-ton capacity and 16- to 18-foot draft have entered service in the past year, and more vessels of this size are under construction.

Barges of 500- to 1000-ton capacity will be required for economical tug and barge service in the upper reaches of the river. These vessels vary in dimensions but will not exceed 50 feet in width and 200 feet in length and will draw 6-8 feet of water. Tugs presently in service will be adequate to handle these barges.

ECONOMICS OF NAVIGATION

Improving Willamette River to provide a channel for tug and barge service will require a large investment. Such an investment is reasonable if the savings in shipping cost of the estimated tonnages of anticipated waterborne commodities exceed the cost of the project. Savings in shipping cost is the difference between the cost of transporting the commodities by alternative means as compared to transporting by water after the project is completed. Project cost will vary with the choice of methods used to obtain the desired channel dimensions. Alternative methods available and their costs are examined in Part IV.

Potential transportation savings which could accrue to a navigation channel are presented in Table III-7. The following conditions underlie these estimates: (1) the projected potential tonnage of commodities which can be barged at a transportation saving would move by water; (2) the channel would accommodate barges of 500- to 1,000-ton capacity, with maximum dimensions of 50 feet wide by 200 feet long, drawing 6-8 feet fully loaded; and (3) Willamette Falls Locks would be expanded and improved to handle barges and tugs of these dimensions in a one-lift operation.

Table III-7

Potential annual savings - navigation channel from Portland to Eugene

Year	Commodity	Projected Potential Tonnage	Potential Transport Saving
1980	Wood Chips	1,238,000	
	Fertilizer & Lime	240,000	
	L. P. Gas	28,000	
	Greases and Lubricating Oils 1/	28,000	
	Petroleum Asphalts	163,000	
	Rafted Logs 2/	933,000	
	TOTALS	2,546,000	$2,600,000
2000	Wood Chips	979,000	
	Fertilizer & Lime	310,000	
	L. P. Gas	29,000	
	Greases and Lubricating Oils 1/	36,000	
	Petroleum Asphalts	242,000	
	Rafted Logs 2/	1,164,000	
	TOTALS	2,622,000	$2,500,000
2020	Wood Chips	924,000	
	Fertilizer & Lime	345,000	
	L. P. Gas	34,000	
	Greases and Lubricating Oils 1/	50,000	
	Petroleum Asphalts	369,000	
	Rafted Logs 2/	1,264,000	
	TOTALS	2,844,000	$2,800,000

1/ No savings in gasoline and fuel oil transport over existing pipeline

2/ Includes up-bound logs

Potential savings generally are the differences in the prevailing rates of the most competitive land haul mode of transportation and the projected waterway rate after channel improvement. Since the present channel dimensions are adequate most of the year for rafted logs, that commodity would not be benefited by increased channel dimensions; however, a transportation saving would be realized because of the reduction in time of transit at Willamette Falls Locks. The methodology used in determining potential savings is presented in Addendum C.

B

Photo III-7 Willamette Falls Locks, the scene of much activity. (USCE Photo)

ALTERNATIVE MEANS TO SATISFY DEMANDS

ALTERNATIVE MEANS TO SATISFY DEMAND

The commodities having potential for water movement into or out of Willamette Basin are currently being transported by other means. They will continue to move by those means if the river is not improved. However, there is a gross inefficiency in the present transport system. Substantial savings in transportation cost can be realized if the Willamette River is improved for inland navigation. The problems of obtaining navigable water differ markedly in three reaches of the river: (1) Willamette River mouth to Oregon City, (2) Willamette Falls Locks, and (3) Willamette Falls to Eugene.

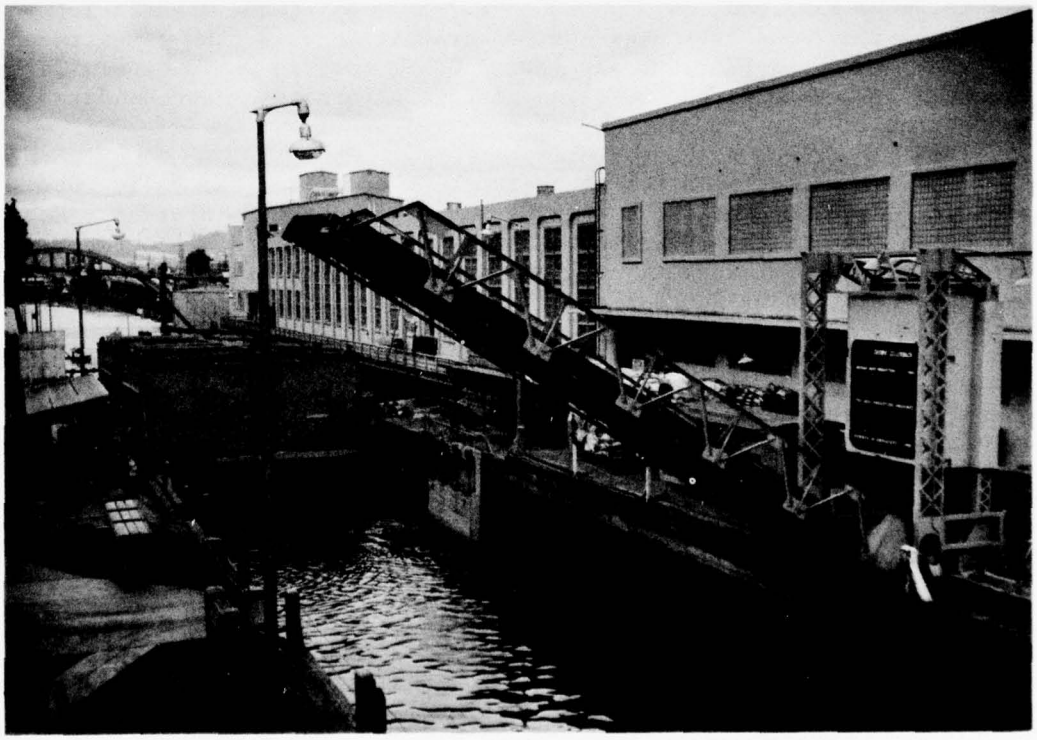


Photo IV-1 The narrow locks at Willamette Falls divide the river in two reaches. (USCE Photo)

WILLAMETTE RIVER REACHES

WILLAMETTE RIVER MOUTH TO OREGON CITY

The existing channel dimensions in this reach are adequate for the anticipated traffic. Between Lake Oswego and Oregon City, four bars will require periodic maintenance.

WILLAMETTE FALLS LOCKS

The existing locks are grossly inadequate for modern barge traffic. The locks have long been the greatest obstacle to development of modern water transport on the river upstream from Willamette Falls. Reconstruction of the existing locks or abandoning them and constructing a new lock is absolutely necessary for further development of navigation upstream from the locks. No economic alternative is available.

Overland portage around the locks was considered as an alternative. This by-pass method requires two transfers of all upbound and downbound cargoes plus about 2-3/4 miles of land transport. Cost of portage includes site preparation and investment in rehandling equipment for transfer of cargoes. Rafted logs upbound and downbound through the locks have averaged 618,900 tons during the past five years. The estimated cost of by-passing this volume of logs around the falls by land haul is $825,000 per year. Using the present locking facilities, the estimated cost of transit through this river reach has averaged about $247,000 per year. Other cargoes would be similarly affected. Therefore, the overland-portage alternative is considered impractical.

The authorized plan for reconstruction of Willamette Falls Locks provides adequate dimensions for the anticipated future traffic. Reconstruction cost is estimated to be about $13,600,000. A project to improve the upriver channel must accompany the lock reconstruction before a significant increase in river traffic can be expected.

The Willamette Falls Locks are in a congested industrial district, and reconstruction would affect utilities and riparian owners. The operations principally affected would be a paper mill owned by Crown-Zellerbach Paper Company, and a hydroelectric plant owned by the Portland General Electric Company. A bridge, fire and water mains, and electric power lines serving the paper company would have to be moved. The same items would need to be moved at the hydroelectric plant, but this would not interfere greatly with power generation.

Two pulp and paper mills near Willamette Falls depend heavily on the lock for movement of both logs and some finished paper output. The operation of these two plants would be difficult while the lock would be closed for reconstruction. Since there is limited storage

area on the river above the falls, logs could not be sufficiently stockpiled there to effectively offset the effects of the lock closure.

Some log-rafting operations would be severely affected by the lock closure during reconstruction, but the disruption could be lessened by constructing a log chute over the falls or mounting a crane to lift bundled logs over the falls. The cost of this temporary facility should be carried as a project expense.

WILLAMETTE FALLS TO EUGENE

The low-level dam at Willamette Falls creates a pool that extends upriver to Newberg. In this 24 miles, the channel dimensions are adequate. Between Newberg and Albany, the stream gradient is gentle enough for channel improvement by the open-channel method. This would require dredging to the desired depth and placing the excavated material where it would aid in stabilizing the river banks. An essential for open-channel development is a streamflow sufficient to permit navigation. On the Willamette River at Salem between 1942 and 1963, flows greater than 3,000 cfs have been maintained 99.6 percent of the time and greater than 6,000 cfs 83.7 percent of the time.

Since 1957, the available reservoir storage in Willamette Basin has more than doubled, and available authorizations provide for further increases. This additional storage will make it possible to maintain a minimum flow of 6,500 cfs in Willamette River downstream from the mouth of the Santiam and 5,000 cfs downstream from Albany in most years. A trapezoidal-shaped channel, 150 feet wide and eight feet deep with 4:1 slopes, will require a minimum flow of approximately 4,500 cfs; for a channel 120 feet wide, a minimum flow of 3,500 cfs is sufficient to fill a channel eight feet deep. Thus, there will be sufficient water for navigation.

Open channel development between Albany and Corvallis was considered. The slope of the river bed and the volume of available water are favorable; however, an economical evaluation of the incremental increase in channel length shows the increased project costs exceed benefits for this reach.

Between Corvallis and Eugene, the general gradient of the river is too steep to permit development by the open-channel method. Development by slack water is possible but not economical. Numerous low-level, long-crested dams with navigation locks would be required. The preliminary estimate of the first cost for this development exceeds $70,000,000. The annual cost for such development far exceeds the prospective benefits.

NAVIGATION IMPROVEMENT

Several plans for navigation improvements were studied. These plans consisted generally of reconstruction of Willamette Falls Locks and of improvement of the upstream channel for depths ranging to nine feet. For the various channel depths considered, construction costs ranged from $3 to $7 million. The determination of appropriate channel length, depth, and width is presented in Appendix M - Plan Formulation.

CONCLUSIONS

In the period since the Willamette Basin was first settled, commercial use of the river for movement of goods and people has fluctuated. For the early settlers, the river was a main artery of commerce; then it was replaced in its importance by the railroad and since has regained significance as a transportation route for logs and other bulk commodities.

At present there is sufficient volume of commerce in bulk commodities that are well adapted to water transport to warrant improvement of the river for navigation.

The improvement project considered most worthy would provide for replacement of Willamette Falls Locks with a larger, single-lift facility, and improvement of the channel between Oregon City and Albany.

An analysis of the comprehensive plan for water resources of the basin with regard to navigation is contained in Appendix M - Plan Formulation.

ADDENDA

Willamette River Bridges

ADDENDUM A

Bridges and utility crossings
Mouth through Eugene (Mile 185)

Miles above Mouth	Location	Owner	Type of Bridge	No. of Spans	Clear Width Normal to Channel (ft.)	Clear height of lowest point of superstructure (in feet) above Mean low Water	High Water	Year of Completion	Purpose
5.9	St. Johns	Multnomah County	Suspension	1	1,068	205	180	1931	Highway
6.9	St. Johns	Spokane, Portland & Seattle Railway	Swing	5	230	44	19	1910	Railroad
11.7	Broadway St.	Multnomah County	Bascule	3	251	90	65	1913	Highway
12.1	Glisan St. (Steel)	Southern Pacific Co. & Union Pacific Railroad	Vertical lift	3	205	26 71 161	1 46 136	1913	Railroad and Highway
12.4	Burnside St.	Multnomah County	Bascule	3	205	64	39	1926	Highway
12.8	Morrison St.	Multnomah County	Bascule	3	185	50	25	1905	Highway
13.1	Hawthorne Ave.	Multnomah County	Vertical lift	6	200	49	24	1911	Highway
13.5	Marquam	State of Oregon	Fixed	3	350	120	95	1967	Highway
14	Ross Island	Multnomah County	Fixed	5	330	90	95	1927	Highway
16.6	Sellwood	Multnomah County	Fixed	4	270	74	49	1927	Highway
20.0	Oswego	Southern Pacific Co.	Fixed	2	280	74.3	53.4	1910	Railroad
26.0	Oregon City	Oregon State Highway Commission	Fixed	1	181	E. Side 74.0 W. Side 83.5	E. Side 63.0 W. Side 72.5	1922	Highway
38.5	Wilsonville	Oregon State Highway Commission	Fixed	9	240	75	21	1954	Highway
38.8	Wilsonville	SP&S Railway Co.	Fixed	4	187	75	21	1907	Railroad
48.4	Newberg	Oregon State Highway Commission	Fixed	10	240	68	25	1958	Highway
50.0	Newberg	Oregon State Highway Commission	Fixed (Closed to highway traffic, permanently, 5 Aug 59)	5	105	88	36	1914	Highway
84.8	Salem (Union Street)	Southern Pacific Co.	Vertical lift	5	118	Closed 42.0 Raised 87.0	7 52	1913	Railroad
84.9	Salem (Marion St.)	Oregon State Highway Commission	Fixed	3	240	69.2	33	1953	Highway
85.0	Salem (Center St.)	Oregon State Highway Commission	Fixed	7	120	68.6	33.2	Original 1918 Reconstr. 1955	Highway
97.1	Independence	Oregon State Highway Commission	Fixed	10	90	68.0	36	1951	Highway
119.6	Albany	Southern Pacific Co.	Swing	4	110	40.0	15	Reconstr. 1922	Railroad
120.0	Albany	Oregon State Highway Commission	Fixed	4	195	54.0	23	1926	Highway
131.6	Corvallis (Harrison St)	Oregon State Highway Commission	Fixed	10	184	48.0	26	1965	Highway
131.7	Corvallis (Van Buren)	Benton County	Swing	4	102	35.0	8	1913	Highway
162.8	Harrisburg	Oregon State Highway Commission	Fixed	3	172	24.0	9.0	1925	Highway
164.2	Harrisburg	SP&S Railway Co.	Lift Fixed	5	190	25.0	9.0	Original 1918 Reconstr. 1961	Railroad
164.3	Harrisburg	Southern Pacific Co.	Swing Fixed	4	103	25.0	9.0	1885 1906 1/	Railroad
178.2	Eugene (Beltline)	Lane County	Fixed	5	180	16.3	7.1	1961	Highway
181.4	Eugene ("Q" St Interch.)	Oregon State Highway Commission	Fixed	11	133	25.8	8.0	Pending Constr.	Highway
182.2	Ferry St. - Eugene	Oregon State Highway Commission	Fixed	9	250	27.0	18.0	1947	Highway 2/
184.3	Eugene	Oregon State Highway Commission	Fixed	17	133	35.0	18.0	1961	Highway 2/
185.0	END OF FEDERAL PROJECT								
183.2	HEAD OF NAVIGATION - WILLAMETTE RIVER								

1/ Rebuilt

2/ No permit on file.

Willamette River -
Submarine Pipelines

Addendum A (cont'd)

River Mile	Type	Owner
7	Submerged Pipeline	Portland Gas and Coke Company
13.5	12" Gas	Portland Gas and Coke Company
16.3	12" Gas	Portland Gas and Coke Company
16.6	30" Water	City of Portland, Oregon
24.7	12" Gas	Northwest Natural Gas Company
39.2	8" Petroleum	Southern Pacific Pipelines, Inc.
76.0	10" Gas	Northwest Natural Gas Company
126.8	10" Gas	Northwest Natural Gas Company
164.4	6" Gas	Northwest Natural Gas Company
171.2	8" Petroleum	Southern Pacific Pipelines, Inc.
179.0	Sanitary Sewer	City of Eugene, Oregon
181.2	30" Water	Eugene Water and Electric Board

Willamette River -
Submarine Cables

River Mile	Type	Owner
3.5	Submerged power cable	Portland General Electric Company
7	Submerged power cable	Spokane, Portland and Seattle Railway
7	Submerged power cable	Pacific Power and Light Company
7	Submerged power cable	Northwestern Electric Company
11.5	Submerged power cable	Northwestern Electric Company
11.5	Submerged power cable	Pacific Power and Light Company
11.7	Submerged power cable	Northwestern Electric Company
15.0	Telephone	Pacific Telephone and Telegraph Co. (East Bank Willamette River to Hardtack Island)
16.6	Electric	Pacific Power and Light Company
20.1	Telephone	Pacific Telephone and Telegraph Company
25.[illegible]	Telephone	Pacific Telephone and Telegraph Company
37.75	Telephone	Pacific Telephone and Telegraph Company
76.5	Ferry Guide Cable	Mr. H. C. Wilcox

Willamette River -
Overhead Wires and Pipelines

Addendum A (cont'd)

River Mile	Vertical Clearance (Feet Above) Low Water	High Water	Type	Owner
3.5	230		Electric	Bonneville Power Administration
14.3	123	101	Electric	Pacific Power and Light Company
14.7	76	Side Channel	Electric	Ross Island Sand and Gravel
14.7	75	Side Channel	Bucket Cable	Ross Island Sand and Gravel
16.3	103		Electric	Portland General Electric Company
16.3	91		Electric	Portland General Electric Company
18.3	89	Side Channel	Electric	Southern Pacific Company
25.9	77		Electric	Portland General Electric Company
26.5	80	WFL 1/	Electric	Portland General Electric Company
26.5	97	WFL 1/	Electric	Crown Zellerbach Corporation
26.6	97	WFL 1/	Electric	Crown Zellerbach Corporation
26.6	72	WFL 1/	Pipeline Bridge	Crown Zellerbach Corporation
26.8	75	WFL 1/	Electric	Portland General Electric Company
26.8	125	WFL 1/	Electric - 73' Over Falls	Portland General Electric Company
30.0	123	105	Electric (Pool El. 52 MSL)	Bonneville Power Administration
30.0	131	-	Electric	Bonneville Power Administration
34.3	78	-	Electric	Portland General Electric Company
34.3	94	-	Electric (Incl. Sub. Cable)	Clackamas County
37.4	75	-	Stream Gage	USC and GS
38.7	88	-	Electric	Portland General Electric Company
38.8	93	-	Electric	Bonneville Power Administration
38.8	93	-	Electric	Bonneville Power Administration
39.4	99	-	Electric	Bonneville Power Administration
49.9	111	-	Electric	Portland General Electric Company
52.7	100	-	Electric	Portland General Electric Company
72.3	72	-	Electric	Portland General Electric Company
75.5	65)	(Same	Electric	(Side Channel
75.5	62)	(Poles	Telephone	Pacific Tel. & Tel. Co. (Windsor Island
78.0	86		Electric	Bonneville Power Administration
82.5	86		Electric	Salem Electric Company
84.6	75		Electric	Portland General Electric Company
86.8	86		Electric	Portland General Electric Company
87.2	84		Electric	Bonneville Power Administration
96.5	71	-	Telephone	Pacific Tel. and Tel. Co.
96.5	79	-	Electric	Pacific Power and Light Company
107.0	54	-	Ferry Cable	? (Unauthorized)
107.1	87	-	Electric	Pacific Power and Light Company
107.5	86	-	Electric	Pacific Power and Light Company
114.8	75	-	Electric	Bonneville Power Administration
117.4		-		
119.7	80	-	Electric	Southern Pacific Company
120.4	70	-	Electric	Pacific Power and Light Company
122.3	75	-	Electric	Bonneville Power Administration
122.4	75	-	Electric	Bonneville Power Administration
122.4	75	-	Electric	Bonneville Power Administration
124.3	75	-	Electric	Consumers Power, Inc.
127.0	75	-	Electric	Pacific Power and Light Company
132.1	75	-	Electric	Pacific Power and Light Company
132.1	70	-	Electric	Pacific Tel. and Tel. Co.
133.1	75	-	Electric	Pacific Power and Light Company
139.2	70	-	Electric	Pacific Power and Light Company
152.0	75	-	Electric	Consumers Power, Inc.
158.2	66	-	Electric	Consumers Power, Inc.
162.3	71	-	Electric	Pacific Power and Light Company
162.7	47	-	Telephone	Pacific Tel. and Tel. Co.
164.1	75	-	Telephone	Bonneville Power Administration
164.3	47	-	Telephone	Pacific Tel. and Tel. Co.
170.0	49	-	Telephone	Pacific Power and Light Company
171.2	24	-	Petroleum Pipeline	Southern Pacific Pipelines, Inc.
182.3	22	-	Electric	Pacific Tel. and Tel. Co.
184.1	38	-	Electric	Pacific Tel. and Tel. Co.
184.1	38	-	Electric	Eugene Wat. and Elec. Board
184.9	41	-	Electric	Eugene Wat. and Elec. Board

185.0 END OF FEDERAL PROJECT

1/ WFL - Willamette Falls Locks

ADDENDUM B

Commercial Facilities, Willamette River

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
R.B., approx. 3.0 mi.	Mooring-Ash Grove Lime and Portland Cement Co.,owner and operator	Limerock unloading facility Barge mooring Depth alongside at l.w.25 ft.	Adjustable hopper for clamshell unloading Crane with 80 ft. boom, 30 ton capacity at 35 f.. radius.	
R.B., 3.6 mi.	Wharf-Time Oil Co., owner and operator	Face 92 ft.,lower and upper side 24 ft. each. Depth alongside at l.w.32 ft. Load capacity 250 lbs. per sq. ft.	Two 8 in. and four 6 in. pipelines extend from wharf to 17 steel storage tanks in rear, total capacity 300,000 bbls. Pipelines also extend to Bell Oil Terminal Company's 7 steel storage tanks of 30,000 bbl. total capacity.	
L.B., 4.0 mi.	Wharf-Kingsley Lumber Co., owner and operator	Face 120 ft. Depth alongside at l.w. 15 ft. Load capacity per sq. ft. 250 lbs.	Conveyor system on trestle extends from lumber mill in rear to beyond face of wharf for loading barges with hogged fuel.	Plant trackage in rear connects with SP&S R.R.
L.B., 4.2 mi.	Wharf-Tidewater Oil Co., owner and operator	Face 400 ft., upper and lower sides 32 ft. Depth alongside at l.w. 32 ft. Load capacity per sq. ft. 500 lbs.	2 hosehandling mast and boom derricks One 12 in., six 10 in., one 8 in., three 6 in., eight 4 in. pipelines extend from wharf to 29 steel storage tanks of total capacity 479,200 lbs.	Plant trackage connects with SP&S R.R.
R.B., 4.3 mi.	Pier No.1,Municipal Terminal No.4-City of Portland owner, The Commission of Public Docks operator.	Face 1500 ft.,channel side 605 ft., head of slip 280 ft. Depth alongside at l.w. 36 ft. Load capacity per sq. ft. 1000 lbs. Two transit sheds, one 328 by 150; the other 1540 (average) by 180; 16 ft. inside height, total floor area for cargo 320,400 sq.ft.,load capacity per sq. ft. 1,000 lbs.	Grain gallery has 6 loading spouts and 2 pneumatic suction pipes. 2 locomotive cranes with 60 ft. booms of 25 ton capacity at 17 ft. radius. 2 truck cranes with 45 ft. booms of 10-ton capacity. Three 45-ton locomotives; 3 dock autos; portable belt conveyor; 9-ton freight elevator on channel side. One 8 in.pipeline extends from face of wharf to 8 steel molasses storage tanks of 41,500 bbls. capacity, 7 steel tallow storage tanks of 12,000 bbls. capacity. Grain elevator in rear has 7,314,852 bbls. capacity, operated by Cargill, Inc.	Surface track on apron, two platform-level tracks in rear of transit shed, two platform level tracks on north side of warehouse, connection with Union Pacific R.R.
R.B., 4.4 mi.	Pier No.2,Municipal Terminal No.4-City of Portland,owner; Matson Navigation Co., operator.	Face 1500 ft., channel side 246 ft. Depth alongside at l.w. 36 ft. Load capacity per sq.ft. 500 lbs. One transit shed, 690(average) by 166, 16 ft.height inside, 109,921 sq.ft.cargo floor area,load capacity per sq. ft. on apron 350 lbs., on fill 1,000 lbs. Open storage on pier totals 120,000 sq.ft.	Two traveling, full-portal gentry cranes, the first with 85 ft.boom with lift capacity of 50 tons at 45 ft.radius,the other with 100 ft.boom with lift capacity of 45 tons at 40 ft.radius. One 8 in.pipeline extends from face of wharf to join pipeline to tanks of Municipal Terminal No. 4, Pier No. 1. Fumigation cylinder in rear with capacity for 720 cu.ft. of cargo.	Two surface tracks on apron, four surface tracks 200 ft. from face (two of theseextend extend in rear of transit shed at platform level), connection with UP R.R.
R.B., 4.6 mi.	Pier No.4,Municipal Terminal No.4-City of Portland,owner; The Commission of Public Docks,operator.	Face 70 ft.,lower side 400 plus 100 ft., upper side 1220 ft. Depth alongside at l.w. face and upper side 36 ft.,lower side 36 to 20 ft. Load capacity per sq. ft.,outer 400 ft.,500 lbs.; inner 820 ft., 800 lbs.	Transit shed 120 by 70 ft.,height inside 20 ft.,floor area for cargo 8,236 sq.ft., load capacity per sq.ft.1000 to 800 lbs. One traveling unloading crane with 166 ft. boom and 13 ton grab bucket. Tower equipped with hopper from which materials flow by gravity to two 96 in. belt conveyors serving 2 weigh hoppers. Boom on tower extends beyond rear serving a 24,000 sq.ft. open bulk materials storage area. About 6.25 acres of additional open storage available.	Two surface tracks on apron under tower. One surface track along face. Connection with UP R.R.

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
L.B., 4.6 mi.	Linnton Terminals Wharf, SP&S R.R. owner; Linnton Plywood Assn., operator.	Face 720 ft.,lower and upper sides 15 ft. each. Depth alongside at l.w.31 ft.for face.	Rafted logs moored along timber pile mooring dolphins located along river bank above and below sides of wharf.	
R.B., 4.7 mi.	Pier No.5,Municipal Terminal No.4,Sulphur Wharf-City of Portland owner; The Commission of Public Docks, operator.	Face 900 plus 50 ft. Depth alongside at l.w. 35 ft. Load capacity per sq.ft. 500 lbs.	One fixed loading tower on wharf equipped with vessel-loading spout. Tower is served by 30 in.belt conveyor system from receiving hopper under rail track in rear and from 8 covered sulphur storage bins with capacity of 10,000 tons.	One surface track on apron. Connection with UP R.R.
R.B., 4.9 mi.	Pier No.5,Municipal Terminal No.4, Oil Wharf-City of Portland owner; The Commission of Public Docks, operator.	Face 50 ft.,lower side 15 ft.,upper side 15 ft. Depth alongside at l.w.35 ft.for face. Load Capacity per sq.ft. 500 lbs.	One hosehandling crane One 10 in.pipeline along lower walkway extends to UP R.R.'s 2 steel fuel oil storage tanks,total capacity 146,524 bbls. One 6 in.pipeline along lower walkway extends to Quaker State Oil Refining Co.'s 8 steel storage tanks, total capacity 16,904 bbls.	Connection with UP R.R.
L.B., 5.0 mi.	Wharf -Richfield Oil Co., owner and operator.	Face 200 plus 300 ft. Depth alongside at l.w. 32 ft. Load capacity per sq. ft. 500 lbs.	One 6 ton mast and boom derrick with three 25 ft. booms for handling hose. Three 10 in.,four 8 in.,and four 6 in.pipelines extend from wharves to 25 steel storage tanks, total capacity 630,039 bbls.	Plant trackage in rear connects with SP&S R.R.
L.B., 5.1 mi.	Wharf - Mobil Oil Co.,owner and operator.	Face 447 ft.,lower side 40 ft., upper side 40 ft. Depth alongside at l.w.30 ft.for face. Load capacity per sq.ft. 500 lbs.	Four hosehandling cranes Three 10 in., three 8 in., and two 4 in. pipelines extend from wharf to 18 steel storage tanks, total storage capacity 647,000 bbls.	Plant trackage in rear connects with SP&S R.R.
R.B., 5.7 mi.	Wharf-Ray Oslin, owner; Floating Marine Ways, operator	Face 110 ft.,lower and upper side 66 ft. Depth alongside at l.w. 30 ft. for face.	One 80 ton vertical boat lift. One 800 ton marine railway on north of wharf with rails extending to inside of building in rear.	
L.B., 6.0 mi.	Pier - General Construction Co., owner and operator.	Face 40 ft., lower side 108 ft., upper side 40 ft. Depth alongside at l.w.,face 18 ft., lower side 10 ft. Load capacity per sq. ft. 200 lbs.		SP&S R.R. serves plant trackage in rear.
R.B., 6.0 mi.	Wharf - Portland Lumber Mills, owner and operator	Face 316 plus 75 ft., lower side 30 plus 75 ft.,upper side 66 ft. Depth alongside at l.w. 30 ft.for face. Load capacity per sq.ft. 500 lbs.		UP R.R. serves plant trackage in rear.
L.B., approximately 6.2 mi.	Mooring Docks A & B, U.S. Government, owner; U.S.Army Corps of Engineers,operator.	Face 237 ft., lower side 36 plus 175 ft., upper side 250 ft. Depth alongside at l.w.20 ft. for face, lower and upper sides. Load capacity per sq. ft. 400 lbs.	One 50 ton stiff-leg derrick with 72 ft. boom located near lower end of Dock A. Mooring basin with numerous mooring piles on lower side provides additional berthing for floating equipment.	
L.B., 6.4 mi.	Wharf-Northwest Natural Gas Co., owner and operator	Mooring dolphins 750 ft. Depth alongside at l.w. 30 ft. Load capacity per sq.ft. 300 lbs.	Hosehandling crane located on 14 by 12 ft. platform at outer end of upper 6 ft. wide approach from shore. 24 in. belt conveyor. 10 in.pipeline extends from 14 by 12 ft. platform to steel storage tanks at plant in rear with total capacity 190,000 bbls.	Plant trackage connects with SP&S R.R.

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
R.B., 7.0 mi.	Wharf-McCormick & Baxter Creosoting Co.,owners and operators	Face 20 ft.,lower side and upper side 20 ft. each. Depth alongside at l.w. 36 ft. for face. Load capacity per sq.ft. 250 lbs.	One mast and boom derrick for handling hose. One 6 in.pipeline from wharf to one steel creosote storage tank capacity 730,000 gallons; one steel storage tank for pentachlerophenel capacity 235,000 gal.	Plant trackage in rear connects with UP R.R.
R.B., 7.3 mi.	Pier - Marine Repair Shop Pier-Willamette Tug and Barge Co.,owner and operator.	Face 30 ft., lower side 45 ft., upper side 45 ft. Depth alongside at l.w. 15 ft. for face.		Trackage in rear connects with UP R.R.
L.B., 7.4 mi.	Wharf-Pennsalt Chemical Corp., owner and operator	Face 200 ft.,lower side 40 ft.,upper side 40 ft. Depth alongside at l.w. 35 ft. for face. Load capacity per sq. ft. 500 lbs.	Two 5 cu.yd.salt-receiving hoppers travel on track along wharf face. Hoppers equipped with chutes for loading trucks on wharf. 54 in.wide belt conveyor system extends from plant in rear to a fixed salt-receiving hopper. 6 in.pipeline extends from wharf to 3 steel fuel oil storage tanks,total capacity 40,000 bbls;one 6 in.and one in. pipeline extend from plant to wharf. A 366 by 54 ft.concrete vessal permanently moored at lower wharf end.	Plant trackage in rear connects with SP&S R.R.
R.B., 7.5 mi.	Mooring-Columbia Tug Boat Co.,owner and operator.	Float 65 by 45 ft. Depth alongside at l w. 10 ft.		
R.B., 7.6 mi.	Lower Pier-Willamette Tug and Barge Co., owner and operator.	Face 46 ft., lower side 150 ft. Depth alongside face and lower side 18 ft. Load capacity per sq.ft.1,000 lbs.	One 25 ton revolving fixed tower crane equipped with 125 ft. boom and grab bucket used to unload materials from barges into a receiving hopper.	Plant trackage in rear connects with U.P.R.R.
R.B., 7.6 mi.	Upper Pier-Willamette Tug and Barge Co.,owner and operator.	Face 40 ft.,lower side 63 ft.,upper side 70 ft. Depth alongside at l.w.,face 18 ft., lower side 18 ft., upper side 18 ft. Load capacity per sq.ft.1,000 lbs.		Trackage in rear connects with UP R.R.
L.B., 7.7 mi.	Pier-Shell Oil Co., owner and operator	Face 40 ft.,lower side 248 plus 80, plus 176 plus 143 ft.,upper side 248 plus 80 plus 176 plus 143 ft. Depth alongside at l.w.35 ft.,lower and upper side 35 ft. Load capacity per sq. ft. 200 lbs.	Four mast and boom hosehandling derricks, each equipped with 5 booms. Three 12, four 10, five 6, and three 4 in.pipelines extend from pier to 114 steel storage tanks, total capacity 1,300,000 bbls.	Plant trackage in rear connects with SP&S R.R.

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
L.B., 7.7 mi.	Pier-Standard Oil Co.,owner and operator.	Face 40 ft.,lower and upper side 647 plus 275 ft. Depth alongside at l.w.face 35 ft., lower and upper side 35-28 ft. Load capacity per sq. ft. 500 lbs.	Two mast and boom hosehandling derricks each with 3 booms. One mast and boom hosehandling derrick with 4 booms. One 18, one 16, one 15, two 10, four 8, four 6, and two 4 in.pipelines extended from pier to 45 steel storage tanks with total capacity 1,200,000 bbls.	Plant trackage in rear connects with SP&S R.R.
L.B., 7.8 mi.	Pier-Union Oil Co., owner and operator.	Face 40 ft.,lower side 927 ft.,upper side 577 plus 350 ft. Depth alongside at l.w.face 35 ft., lower and upper sides 35-32 ft. Load capacity per sq. ft. 500 lbs.	Two mast and boom hosehandling derricks each with 4 booms. Two 12, four 10, two 8, five 6, and one 4 in. pipelines extend from pier to 31 steel storage tanks, total capacity 760,000 bbls.	Plant trackage in rear connects with SP&S R.R.
L.B., 8.0	Pier-Douglas Oil Co.of California, owner and operator.	Face 20 ft., lower and upper sides 20 ft. Depth alongside at l.w. face 19 ft.	One mast and boom derrick for handling hose. One 6 in. pipeline extends from platform to 8 steel storage tanks total capacity 34,000 bbls.	
R.B.,8.0 mi. Lower end of Swan Island	Pier C,Swan Island Ship Repair Yard-Port of Portland, owner and operator.	North side 1,093 ft., South side 1,093 ft., width 50 ft.& 32 ft. Drydock No.3,lift capacity 27,000 tons, moored south side. Drydock No.2,lift capacity 14,000 tons, moored adj.north side. Depth alongside at l.w. north side 32 ft.,south side 40 ft.-Load capacity 1,000 lbs.per sq.ft.	Two shipyard cranes each with 110 ft. boom with lifting capacity of 45 tons at 30 ft. radius travel along inner 720 ft. of pier. Served with air, water, steam, and electric power.	One surface rail track in center of pier, full length, connects to other trackage in Swan Island and to UP R.R. Albina Yard.
R.B., 8.0 mi., Lower end of Swan Island at entrance to Swan Island Lagoon.	Pier A, Swan Island Ship Repair Yard, Port of Portland, owner and operator	Pier, north side 850 ft., width 65 ft., south side 600 ft Dry Dock YFD-69, leased from Navy, with a lift capacity of 18,000 tons, moored along south side, 1-1/2 repair berths on north side. Depth alongside at l.w.30 ft. Load capacity 1,000 lbs. per sq. ft.	Six traveling whirley cranes, each with 110 ft. boom, 45 ton lifting capacity at 30 ft. radius, traveling length of repair berths and Pier A.	
R.B., 8.6 mi. South bank of Swan Island Lagoon	Wharf,Swan Island Ship Repair yard repair berths, Port of Portland, owner and operator	2,000 ft., 4 repair berths. Depth alongside at l.w. 30 ft. Load capacity 600 lbs. per sq.ft. 1,800 ft., 3-1/2 layup berths. Depth alongside at l.w. 15-20 ft. Load capacity-foot traffic	Six traveling whirley cranes each with 110 ft. boom, 45 ton lifting capacity at 30 ft.radius, traveling length of repair berths and Pier A. Served with air, water, steam, electricity necessary for repair of ships.	One mile track 50 ft. in rear of berth 4 connects to other trackage on Swan Island and to UP R.R. at Albina Yards.
L.B., 8.4 mi.	Mooring-Shaver Transportation Co.Mooring, owner and operator	Lower row 280 ft., upper row 400 ft. Depth alongside at l.w.lower row and upper row 10 ft.		
L.B., 8.5 mi.	Mooring-General Construction Co., owner and operator.	Face 20 ft.,lower and upper side 480 ft. Depth alongside at l.w. for face 18 ft., lower and upper side 18-0 ft. Load capacity per sq.ft. 200 lbs.		

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
L.B., 8.6 mi.	Pier-Gunderson Bros.Engineering Corp.,owner and operator	Face 40 ft.,lower and upper side 628 ft. Depth alongside at l.w. face 25 ft.,lower and upper side 25-0 ft.	One 100 ton marine railway located adjacent to west side of pier with rails extending to inside of building in rear. One 200 ton marine railway located 340 ft. east of pier with rails extending to inside of building in rear. Two shipbuilding and launching ways located east of pier. Additional berthing space available at two floating walkways located at upper and lower portion of plant's waterfront property.	Plant trackage in rear connects with SP&S R.R.
R.B., 8.7 mi. Swan Island Lagoon	Mooring-Sea Land of California,operator, Port of Portland; owner, Sea Land of California	Ramp 330 ft.	Power leveling device at end of ramp area. Transit shed in rear 140 by 70 ft.	
L.B., 8.7 mi. in slip	Barge Wharf-Texaco, Inc.,Barge Wharf, owner and operator	Face 55 ft.,outer end and inner end 25 ft. Depth alongside at l.w. for face 10 ft. Load capacity per sq. ft. 400 lbs.	One hosehandling crane. One 12, three 8, four 6, and three 4 in.pipelines extend from wharf to 39 steel storage tanks, total capacity 512,800 bbls.	
L.B., 8.7 mi.	Wharf-Texaco, Inc., owner and operator.	Face 400 ft.,lower and upper sides 40 ft. Depth alongside at l.w. 31 ft. for face. Load capacity per sq. ft. 400 lbs.	Two hosehandling cranes. One 12,three 8, four 6, and three 4 in.pipelines extend from wharf and connect with pipelines and storage tanks of Texaco, Inc. barge wharf located in slip, L.B., 8.7 mi. above mouth.	
L.B., 9.4 mi.	Wharf-Waterways Terminals Co., owner and operator.	Face 1,250 ft.,lower and upper sides 35 ft. Depth alongside at l.w. 15 ft. for face. Load capacity per sq.ft. 350 lbs.	One transit shed located about 140 ft. in rear and connected to wharf by two enclosed and two open approaches, 1974 by 475 ft.,height inside 24 ft., floor area for cargo 872,000 sq.ft.,load capacity per sq.ft. 1,000 lbs. One 15.5 and six 3.4 ton freight elevators located on face of wharf, elevators serve an automatic flat bed car rail system extending from wharf via 2 enclosed approaches to interior of transit shed.	Eight platform level tracks inside transit shed. Connection with SP&S R.R.
L.B., 9.6 mi.	Dock-Fireboat No.2 Dock, City of Portland, owner and operator.	Float 80 by 15 ft. Depth alongside at l.w. 20 ft.		
L.B.,9.8 mi.	Pier-Municipal Terminal No.2 Berths No.1,2, and 3, City of Portland, owner; Commission of Public Docks, operator	Face 575 ft.,lower and upper sides 680 ft. each. Depth alongside at l.w.for face 32 ft., lower side 32-22 ft., upper side 32-20 ft. Load capacity per sq.ft.for face 400 lbs., for lower and upper sides 500 lbs.	Three transit sheds. Shed Nos.1 and 3 are 408 by 150 ft. each, height inside 20 ft. each, floor area for cargo 58,702 sq.ft.each, load capacity per sq. ft. 500-1,000 lbs. Shed No. 2 is 504 by 120 ft., height inside 20 ft., floor area for cargo 59,192 sq.ft., load capacity per sq.ft. 400-500 lbs. One 10-ton marine cargo elevator located at lower end of face (Berth No. 2). Additional 60,406 sq.ft. of transit shed space available in 3-story building located on pier at rear of transit sheds. About 93,000 sq.ft.of open storage area located in inner portion of pier. An Additional 142,150 sq. ft. of open storage area is available at rear of adjacent Piers A and B and Dock No. 4	Two surface tracks on lower and upper apron. Two platform level tracks along rear of Shed No. 1 and 2. Platform-level tracks along rear of Shed No. 3. Connection with SP&S R.R.
L.B., 9.9 mi.	Pier-Municipal Terminal No.2, Pier A	Face 47 ft.,lower side 585 ft.,upper side 545 ft. Depth alongside at l.w. for face 24 ft., for lower and upper sides 24-0 ft.		Northern Pacific Terminal Co. and SP&S R.R.

Addendum B (Cont'd)

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
R.B., 10.0 mi.	Dock-General Ore, owner and operator.	Outer row 800 ft., inner row 320 ft. Depth alongside at l.w. 35 ft. for outer row.	Tower equipped with unloading system located on 120 by 40 ft.steel barge moored along inner row of dolphins. Bulk alumina unloaded from vessels in two 10 in.pipelines on tower and transferred from tower by a 16 in. line to a 140 ton capacity carloading hopper located on shore in rear.	Two surface tracks in rear under elevated hopper connects UP R.R.
L.B., 10.0 mi.	Pier-Municipal Terminal No.2, Pier B	Face 65 ft.,lower side 455 ft.,upper side 455 ft. Depth alongside at l.w. 20 ft.for face,lower and upper sides.		Northern Pacific Terminal Company and SP&S
L.B., 10.0 mi.	Dock-Municipal Terminal No.2, Dock No. 4	Slip side 545 ft., river side 325 ft. Depth alongside at l.w.slip side 12 ft., river side 20 ft.		Northern Pacific Terminal Co. and SP&S
L.B., 10.2 mi.	Outfitting Dock-Willamette Iron and Steel Co., owner and operator	Face 1,392 ft., ower side 28 plus 65 plus 28 ft., upper side 68 ft. Depth alongside at l.w. 20-30 ft. for face. Load capacity per sq.ft. 500 lbs.	Four traveling shipyard cranes, each with capacity of 37.5 tons at 25 ft. radius; two have 85 foot boom and two have 95 ft. booms, all with 7-1/2 ton ships. Three shipbuilding and launching ways located adjacent to lower end of wharf.	One surface track on wharf; connection with SP&S R.R.
R.B., 10.5 mi.	Dock-Union Pacific Dock, owner and operator	Face 41 plus 265 ft., upper side 138 ft. Depth alongside at l.w.30 ft.for face. Load capacity per sq.ft.500 lbs.	Transit Shed 295 by 119 ft.;inside height 16 ft., floor area for cargo 35,000 sq. ft. Load capacity per sq.ft. 500 lbs. 10 ton marine cargo elevator at upper end of face.	Two platform-level tracks in rear of transit shed. Connection with UP R.R.
R.B., 10.5 mi.	Wharf-Pacific Building Materials, UP R.R., owner; Pacific Building Materials,operator,	Face 28 ft.,lower side and upper side 40 ft. each. Depth alongside at l.w.20 ft.for face. Load capacity per sq.ft.500 lbs.	Truck ramp for dumping sand and gravel. 8 cu.yd.hopper on wharf. 30 in.belt conveyor from hopper to face of wharf.	UP R.R. tracks serve plant in rear.
L.B.,10.5 mi.	Dock-Municipal Terminal No.1, Berths No.7&8, City of Portland, owner; Commission of Public Docks, operator.	Face 1,100 ft. Depth alongside at l.w. 35 ft. Load capacity per sq. ft. on extension 600 lbs.;on fill, 1000 lbs.	Two transit sheds: Berth No.7 Shed-440 by 190 ft., height inside 20 ft.,floor area for cargo 79,500 sq.ft., load capacity per sq.ft. 600 and 1000 lbs. Berth No.8 Shed-340 by 190 ft.,height inside 20 ft., floor area for cargo 64,200 sq.ft.,load capacity per sq.ft.600 and 1,000 lbs. One 3-1/2 ton wagon crane-one 10-ton automotive crane. Additional 87,051 sq.ft. space for storage of cargo in transit in one-story 400 by 240 ft.building in rear of Berth No. 8 transit shed. Additional 175,000 sq.ft. of asphalt-surfaced open storage available in rear of sheds.	Two surface tracks on apron. Two platform level tracks at rear of transit shed. Connection with Northern Pacific Terminal Co.of Oregon and SP&S R.R.
R.B., 10.6 mi.	Wharf-Pacific Building Materials Receiving Wharf, UP R.R.,owner; Pacific Building Materials,operator.	Face 100 ft.,lower side 35 ft.,upper side 35 ft. Depth alongside at l.w.14 ft.for face. Load capacity per sq. ft. 600 lbs.	Stiff-leg derrick with 140 ft.boom and 5 cu.yd.clam-shell bucket. Open storage area in rear has capacity for 30,000 cu. yd. of sand and gravel.	UP R.R. serves plant in rear.
L.B., 10.6 mi.	Dock-Municipal Terminal No.1 Dock, Berth 6, City of Portland, owner;Commission of Public Docks, operator.	Face 510 plus 70 ft. Depth alongside at l.w.35 ft. Load capacity per sq.ft.600 lbs.on extension;1,000 lbs.on fill.	53,171 sq.ft.of space available for storage of cargo in transit in a 200 by 270 ft.building in rear. One transit shed 320 by 190 ft., height inside 20 ft., floor area for cargo 61,700 sq.ft.;load capacity per sq.ft.600 and 1,000 lbs.	Two surface tracks on apron. Two platform-level tracks at rear of transit shed. Connection with Northern Pacific Terminal Co.of Oregon and SP&S R.R.

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
R.B., 10.8 mi.	Dock-Albina Dock, Norpac shipping co., owner and operator.	Face 912 ft., lower side 60 ft., upper side 140 ft. Depth alongside at l.w. 33 ft. for face. Load capacity per sq.ft. 400 lbs.	Transit shed 615 by 120 ft., height inside 12 ft.; floor area for cargo 63,385 sq.ft.; load capacity per sq.ft. 400 lbs. 35-ton stiff-leg derrick with 100 ft. boom on open wharf at lower end. About 13,088 sq.ft. open storage available on lower portion of wharf.	8 platform-level tracks along rear of transit shed. Connection with UP R.R.
L.B., 10.9 mi. (average)	Pier and Dock-Municipal Terminal No. 1, Pier A, and Quay Dock, Bertha Nos. 1, 2, and 3, City of Portland, owner; Commission of Public Docks, operator.	Face Quay Dock 120 plus 1,164 ft. Face lower side Pier A 36 plus 464 ft. Depth alongside at l.w. 35 ft. for face and lower side. Load capacity per sq.ft. extension 500 lbs., fill 1000 lbs.	100 ton shear-leg derrick with 90 ft. boom equipped with 25 ton hoist. 10 ton marine cargo elevator located on face at lower end. ABout 83,350 sq.ft. of open storage area located at upper end of wharf. Warehouse No. 1 located in rear of transit shed Unit No. 1. Four transit sheds-Pier A 322 by 176 ft., Unit No. 1-505 by 177 ft., Unit No. 2-395 by 140 ft.; Unit No. 3, 259 by 200 ft.; height inside 16 ft.; floor area for cargo total 244,843 sq.ft.; load capacity per sq.ft. 500 and 1,000 lbs.	Two surface tracks on face; two surface tracks on lower apron; three platform level tracks in rear of Unit 1 shed; three platform level tracks in rear of Pier A shed; all tracks connect with Northern Pacific Co. of Oregon and SP&S R.R.
R.B., 11.1 mi.	Wharf-Municipal Paving Plant Wharf, City of Portland, owner and operator.	Face 185 ft. Depth alongside at l.w. 12 ft. for face. Load capacity per sq. ft. 500 lbs.	7-ton bridge crane with 65 ft. cantilevered boom, equipped with clamshell bucket.	UP R.R. tracks serve plant in rear.
R.B., 11.2 mi.	Dock-Albina Dock Berth No. 3-Luckenbach S.S.Co. Inc., owner; Norpac Shipping Co., Inc., operator.	Face 570 ft. Depth alongside at l.w. 33 ft. Load capacity per sq. ft. 300 lbs.	One transit shed, 550 by 265 ft., height inside 14 ft., floor area for cargo 145,750 sq.ft., load capacity per sq.ft. 300 lbs. 10-ton marine elevator on face at lower end of wharf.	UP R.R., two platform-level tracks in rear of transit shed.
L.B., 11.2 mi.	Wharf-Columbia Basin Terminals-SP&S R.R., owner and operator.	Face 1000 ft. Depth alongside at l. w. 31 ft.	One two-level transit shed 900 by 169 ft., ht. inside 10 ft. lower level, 15 ft. upper level, floor area for cargo 304,200 sq.ft., load capacity per sq.ft. 400 lbs. upper level, 1000 lbs. lower level. Two 6-ton marine cargo elevators.	SP&S R.R.; one platform-level track and 10 surface tracks, all located in rear of transit shed.
R.B., 11.3 mi.	Mooring-Star Sand Co., owner, Ross Island Sand and Gravel Co. and K.F. Jacobson & Co., Inc. operators.	Mooring piles 235 ft. Depth alongside at l.w. 14 ft.	50-ton, shipyard-type crane with 110 ft. boom, equipped with 4 cu.yd. clamshell bucket. About one acre of open storage area for sand and gravel in rear.	
R.B., 11.4 mi.	Wharf-Permanente Cement Co., owner and operator.	Face 100 ft., lower side 42 ft., upper side 21 ft. Depth alongside at l.w. 30 ft. for face. Load capacity per sq. ft. 500 lbs.	One derrick for handling hose. Two 10 in. cement-receiving pipelines extend from wharf to storage silos in rear of total capacity 90,000 bbls. One 6-in. airline serves wharf.	UP R.R. tracks serve plant in rear.
R.B., 11.4 mi.	Piers-Albina Engine and Machine Works, owner and operator.	Face 38 ft. each, lower sides and upper sides 300 ft. each. Depth alongside at l.w. 28 ft. for face. Load capacity per sq.ft. 500 lbs.	One 30 ton and one 25 ton traveling shipyard cranes with 40 ft. outreach each. Two shipbuilding and launching ways located between piers.	UP R.R. tracks serve plant in rear.
R.B., 11.4 mi.	Wharf-F.H. Peavey and Co., owner and operator.	Face 407 ft., lower and upper sides 10 ft. each. Depth alongside at l.w. 30 ft. for face. Load capacity per sq.ft. 300 lbs.	Elevated grain gallery with 2 vessel-loading spouts. One marine leg on wharf. Approach gallery with 42 in. belt conveyor extends from 935,000 bu. grain elevator in rear to grain gallery on wharf; marine leg connected to elevator by 36 in. belt conveyor at lower level.	2 surface tracks at rear of elevator serve car dumper. Connection with UP R.R.
L.B., 11.5 mi.	Wharves-Centennial Mills, owner and operator.	Face 400 ft. Depth alongside at l.w. 35 ft. Load capacity per sq.ft. 500 lbs. upper level.		Platform-level track in rear of flour mill connects with NP Terminal Co. of Oregon.

LOCATION	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
L.B., 11.8 mi.	Dock-Albers Milling Co,owners and operator.	Face 175 ft., Width 10 ft.	Grain elevator with 70,000 bu.capacity.	NP Terminal Co. connection at rear of plant.
L.B., 11.9 mi.	Ainsworth Dock-UP R.R.,owner; leased by Owens Illinois Glass Co.	Face 1800 ft. One transit shed 140 ft.by 18 ft.; load limit 600 lbs. per sq.ft.	3 marine elevators	Highway and UP R.R. tracks serve dock in rear.
R.B., 11.9 mi.	Barge Dock-Louis Dreyfus Corp.,owner and operator.	Face 18 ft.,lower side and upper side 35 ft. each. Depth alongside at l.w.30 ft.for face.	A-frame derrick on steel tower for handling marine leg. Trestle with 42 inch covered belt grain conveyor.	
R.B., 12.0 mi.	Wharf-Louis Dreyfus Corp.,Owner and operator.	Face 399 ft. Depth alongside at l.w.32 ft. Load capacity per sq.ft. 400 lbs.	Grain gallery with two 42 in.belt conveyors serving six vessel loading spouts and one marine leg. A transfer gallery with two 42 in. belt conveyors extending from 2 million bu.grain elevator in rear of shipping gallery along face of wharf.	2 surface tracks at rear of elevators. One surface track between wharf and elevator serves car dumper. Connection with UP R.R.
L.B., 12.1 mi.	Dock-Western Transportation Co.,owner and operator.	Face 110 ft. Depth alongside at l.w.10 ft. Load capacity per sq.ft. 750 lbs.	20 ton fixed revolving crane with 35 ft. boom.	
R.B., 13.1 mi.	Dock-Fireboat No.1,City of Portland,owner and operator.	Float 75 ft. by 8 ft. Depth alongside at l.w. 10 ft.		
L.B., 13.2 mi.	Small boat moorage and Harbor Patrol, Commission of Public Docks,owner; Harbor Patrol, Portland Police Dept., operator.	Mooring piles 400 ft. front(floating). Depth alongside at l.w. 5 ft.	2 floating ship barges for Harbor Patrol Ship repair.	
L.B., 13.3 mi.	Mooring and Log dump-Multnomah Plywood Corp., owner and operator.	Face at log dump 75 ft. Face at barker 16 ft., upper 30 ft.,lower 30 ft.	Stiff log at dump. Log elevator at barker.	S.Pacific Co. spur at west end of plant.
L.B., 13.4 mi.	Wharf-Pacific Power and Light Co., owner and operator.	Face 168 ft.,lower side 43 ft., upper side 80 ft. Depth alongside at l.w.10 ft. for face. Load capacity per sq. ft. 500 lbs.	10 ton derrick with 50 ft. boom and 2 chain conveyors systems from hoppers on wharf to boiler room or to storage in rear. One 8 in. pipeline extends from wharf to 2 underground fuel oil storage tanks of total capacity 12,989 bbls.	
R.B., 13.4 mi.	Wharf-Portland General Electric Co. Station L Wharf, owner and operator.	Face 68 ft.,lower and upper sides 30 ft. each. Load Cap.per sq.ft.500# Depth alongside at l.w. 26 ft.for face.	10 ton still-leg derrick with 40 ft. boom.	Plant trackage in rear connects with Portland Traction Co.
R.B., 13.6 mi.	Wharf-Portland General Electric Co.Station L Oil Wharf-owner and operator.	Face 30 ft.,lower and upper sides 16 ft each. Depth alongside at lw. 37 ft.for face.	One 12 in.pipeline with two 8 in. connections extend from wharf to one 96,000 bbl. fuel oil storage tank.	Plant trackage in rear connects with Portland Traction Co.
R.B., 13.7 mi.	Mooring-Knappton Towboat Co.,owner and operator.	Double fingered float-ing dock. 330 ft. face Depth at l.w. 23 ft.	Motorized winch activating supply elevator.	
L.B., 13.8 mi.	Wharf-Zidell Explorations,Inc., owner and operator (mooring also)	Face 1300 ft.,lower side 80 ft.,upper side 140 ft. Depth alongside at l.w. 30-28 ft,for face. Load capacity per sq.ft. 500 lbs.	Two traveling, revolving, shipyard cranes; one of 120 ft. boom, one of 110 ft. boom, each with 45 ton capacity at 45 ft. radius.	Surface track on wharf joins plant trackage in rear, connects with SP R.R.
R.B., 13.9 mi.	City Center Dock-Willamette Hi-Grade Concrete Co,,owner and operator.	Face 348 ft.,upper side 150 ft. Depth alongside at l.w.30 ft. for face. Load capacity per sq. ft. 500 lbs.	10 ton crawler crane with 80 ft. boom and clamshell bucket.	

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
R.B., 14.0 mi.	Wharf-Tait Sand and Gravel Co., owner and operator	Mooring piles 80 ft. Depth alongside at l.w. 7 ft.	One fixed revolving shipyard-type crane with 110 ft. boom and 3 cu.yd.clamshell bucket mounted on elevated platform;hopper serving a belt conveyor system.	
L.B., 14.3 mi.	Loading Pier-Pacific Building Materials, owner and operator	Face 35 ft.,lower and upper sides 135 ft. each. Depth alongside at l.w.20 ft. for face. Load capacity per sq.ft. 500 lbs.	Hopper on wharf served by 30 in. conveyor system or via truck ramp.	
L.B., 14.3 mi.	Receiving Pier-Pacific Building Materials,owner and operator.	Face 30 ft.,lower side 85 ft.,upper side 70 ft. Depth alongside at l.w.20 ft. for face. Load capacity per sq.ft. 500 lbs.	One fixed revolving crane with 120 ft. boom and 4 cu.yd. clamshell bucket serving 30 in. belt conveyor system.	
N.W. portion of Hardtack Island approx.14.5 mi.	Mooring-Ross Island Sand and Gravel Co.,owner and operator	Mooring piles 1200 ft. Depth alongside at l.w. 12 ft.	One fixed revolving crane on elevated platform with 80 ft. boom and 4 cu.yd.clamshell bucket serving hopper and 24 in.belt conveyor system. Aerial tramsway with 18 3/4 cu. yd. buckets from offshore tower on Hardtack Island to ready-mix concrete plant. Shipyard crane on Hardtack Island at prestressed concrete beam plant, 110 ft. boom, capacity 45 tons.	
L.B.,approx.15.3 mi.	Wharf-Capital Investment Co., owner and operator	Face 135 ft.,lower side 61 ft.,upper side 100 ft. Depth alongside at l.w.5 ft. for face. Load capacity per sq.ft. 500 lbs.	5 ton stiff-leg derrick with 60 ft. boom. Not used. Log dump-leased by B.P.John for their exclusive use.	Plant trackage in rear connects with SP R.R.
L.B., 15.7 mi.	Mooring-Portland Shipbuilding Co, owner and operator	Mooring piles 500 ft. Depth alongside at l.w. 5 ft.	10 ton locomotive crane with 40 ft. boom located in rear of building ways. 500 ton side-haul marine railway located in center of shipbuilding ways.	
R.B.,approx.18.6 mi.	Log Dump-Publishers Paper Co.,owner; Caffall Bros., lease and operator.	Face 60 ft. Solid cofferdam construction. Depth alongside 16 ft. at l.w.	Stiff leg log dumper.	Connection with SP R.R.
R.B., 18.7 mi.	Mooring Wharf-Milwaukie Sand & Gravel Co.,owner and operator-	Face 225 ft. Depth alongside at l.w. 15 ft.	Stiff leg crane with 2 yd. bucket, 80 ft. boom.	Connection with SP R.R.
L.B.,approx.21.0 mi.	Oregon Portland Cement Co.,owner and operator-Wharf	Face 77 ft. Depth alongside at l.w. 35 ft.	36 in.belt conveyor from face of wharf to plant in rear, capacity 645 tons per hr. 30 ton elevator at lower end of platform.	Plant trackage in rear connects with SP&S R.R.
L.B., 25.4 mi. immediately below locks.	Boom Walkway(floating)-Crown Zellerbach, owner and operator	Face 465 ft.	Mooring winch	
L.B. 26.5 mi.between river and Willamette Falls locks	Paper Mill Loading Dock(Wharf)-PGE Co., owner of land,U.S. Government leased bldg.owned by Crown Zellerbach,West Linn Div.	855 ft.loading dock face on lock basin. Concrete and wood decking. No special load limit. Six ft.deep over the miter sills at l.w.	Three hydraulic loading ramps. Bascule lift bridge(easement)on lock side. Power boom and sulphite liquor pipeline.	SP R.R.-on R.B. at Pulp, Oregon.
R.B., 28.6 mi.	Wharf-intransit-Crown Zellerbach, owner and operator	Face 70 ft.-finger dock to transit shed.	Marine Elevator. Berger overhead crane Power conveyor for unloading chips from rail to barge.	SP R.R. spur track
R.B.,approx.33.1 mi.	Log Dump-Weyerhaeuser Timber Co.,owner and operator.	50 ft.concrete face. Depth at l.w.6-9 ft.	A-frame log dumper. Electrically operated winch, capacity 30 tons.	Highway-private road
R.B., approx. 33.8 mi.	Log Dump-Crown Zellerbach,owner and operator.	50 ft. face. Depth at l.w.6-9 ft.	Berger overhead crane, electrically operated, 60 ton capacity. Concrete base supporting overhead crane.	Highway-private road.

LOCATION (Miles above mouth)	IDENTIFICATION	DESCRIPTION	SPECIAL EQUIPMENT	ADJACENT TRANSPORTATION FACILITIES
L.B., 39.7 mi.	Mooring-C.A.Young, owner land; Wilsonville Concrete Products lease and operator.	Face 50 ft. 3 mooring dolphins Depth at l.w.30 ft.	One floating clamshell crane, 90 ft. boom, 3 yd. capacity. One floating clamshell crane, 60 ft. boom, 2-1/2 yd.capacity bucket. Portable conveyor to crushing and grading hoppers.	Highway-private road
L.B., approx. 53.3 mi.	Log Dump-Crown Zellerbach, owner and operator.	50 ft. face-wooden dock approach. Depth at l.w.4-6 ft.	A-frame log dumper. Diesel operated winch,25 ton	Highway
R.B., 85.2 mi.	Log Dump-Boise Cascade Corp., Western Timber Div., owner and operator.	Face 50 ft. concrete, to booming area at river. Depth at l.w.5 ft.	Electrically operated winch. A-frame dumping boom, 30 ton capacity.	Oregon Electric R.R. track track at front of plant (SP&S R.R.)
R.B., 85.4 mi.	Mooring-Boise Cascade Co.,owner and operator.	Mooring Dolphins	Shipyard crane, 110 ft. boom. 6 in. oil boom, hoses and pipe for unloading from barges (not used during low water).	
R.B., 116.2 mi.	Mooring-Western Kraft Corp.,owner and operator.	Barge mooring dolphins	Pump on barge supplying water to plant.	SP R.R. at plant
R.B., 119.4 mi.	Log Dump & Booming Area-Land owned by Oregon Electric, Dump owned by G.P. Corp.,leased by Murphy Bros.Logging Co.	50 ft. face-log skids to water, protected by chain.	Stiff leg a-frame log dumper,diesel operated, capacity 50 ton	Oregon Elec.at rear of dump (not used)
L.B., 131.3 mi.	Log Dump-Pope and Talbot, owner and operator.	Face 60 ft.,log face, steel chain protected concrete footing. Depth at l.w.6 ft.	A-frame log dumper Electrically operated yarder winch,capacity 20 tons.	Highway
L.B., 132.5 mi.	Mooring-Corvallis Sand and Gravel, owner and operator.	Concrete footing at water's edge. Dolphin to secure gravel barge. Depth at l.w.10 ft.	Electrically driven belt conveyor.	Highway

A D D E N D U M C

This addendum presents a description of methods used to project potential cargo tonnages and to evaluate potential transportation savings.

Commodity	Projection Method
Wood chips	(a) Ref. #1 (see footnotes) furnishes projections of consumption of roundwood for lumber and wood products. (b) Ratios of 0.55 unit of chips per 1,000 fbm lumber and of 0.47 per 1,000 fbm veneer with weight of one ton per unit used to project tonnage of production. (c) Analysis of pulp and paper plant sizes and locations revealed about 2/3 of production takes place in lower Willamette River and Columbia River plants. Eighty-five percent of chip production takes place in Upper and Middle Subareas. Forty percent of Middle and Upper Subarea chip production is used locally or shipped to other markets leaving 60 percent potential source for lower Willamette River and Columbia River pulp and paper plants.
Rafted logs	A study of the past 10-year period of rafted log movements was made to determine origin of destination and type of operation utilizing the commodity. An estimate of the percent of the logs used by pulp and paper plants, sawmills and other uses was obtained from this study. Ref. #3 was used to obtain an index of projected increased or decreased consumption in the Lower Subarea in the years 1980, 2000, and 2020. Based on the past five years' average annual down-river log movements and the index of future consumption, a projection of log movements through the locks in 1980, 2000, and 2020 was computed. The projections assume that the distribution of sources of materials consumed will remain relatively static.
Fuel Oil	(a) Projection of consumption of fuel oils for the State of Oregon was obtained from Vol. 11, Part 11C of the Bonneville Power Administration's publication "Pacific Northwest Economic Base Study for Power Markets." (b) These projections were converted to a per capita consumption by use of population projections of Reference #1. Barrels were converted to tons by using a conversion factor of 0.1617 ton/bbl. Per capita consumption for the years 1980, 2000, and 2020, was computed at 1.18, 0.939, and 0.725 tons, respectively. (c) Based on the subarea population projections of Reference #1 and the computed per capita consumption, the projections of total consumption by subarea were developed.
Gasoline	(a) A projection of per capita consumption was obtained from Ref. #2. A specific gravity of 0.723 was used to convert volume measurement to weight measurement. Per capita consumption for the years 1980, 2000, and 2010, was computed at 1.462, 1.776, and 2.104 tons, respectively. (b) Based on the computed per capita consumption and the population projections of Ref. #1, the projections of total consumption by subareas were developed.

Commodity	Projection Method
L.P. Gas	(a) Per capita consumption was computed as per fuel oils. A conversion factor of 2.125×10^{-3} tons per gallon was used to convert volume to weight measurement.
	(b) Per capita consumption for the years 1980, 2000, and 2020, were computed at 18.04, 14.18, and 12.42 gallons, respectively.
	(c) Based on the computed per capita consumption and the population projections of Ref. #1, the projections of total consumption by subareas were developed.
Greases and Lubricating Oils	(a) Ref. #2 provided consumption data for the years 1951, 1960, and 1962, for the State of Oregon.
	(b) Using conversion factors of 294 lbs per barrel and 315 lbs per barrel for lubricating oils and greases, respectively, and State population figures for the year 1951 and 1962, a per capita consumption of 0.0389 ton per capita was computed.
	(c) The consumption projections by subarea for the years 1980, 2000, and 2020, were computed by use of the computed per capita consumption and the population projections of Ref. #1.
Petroleum Asphalt	(a) Ref. #2 provided data for computing per capita consumption for the State of Oregon for the years 1955, 1960, and 1962. This data showed a per capita consumption of 0.196 ton in 1960 with an increase of 0.015 ton per capita consumption per 10-year period.
	(b) Per capita consumption for the years 1980, 2000, and 2020, computed at 0.226, 0.256, and 0.286 tons, respectively.
	(c) Projections of consumption by subarea for the years 1980, 2000, and 2020, were computed by applying the per capita consumption computations to the population projections of Ref. #1.
Sand and Gravel	(a) Ref. #1 provided data relating the basin's sand, gravel, and stone production to population for the years 1940-64. By use of the function $Y = 10.51 + 17.28X$ from Ref. #1 and the population projections of Ref. #1, the sand, gravel, and stone requirements for the year 1980, 2000, and 2020 were computed.
	(b) The end-of-period year data was averaged for each interval and multiplied by the number of years in the time interval to project the gross sand, gravel, and stone requirements for the interval.

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Commodity	Projection Method
Fertilizer and Lime	Agricultural Census data on fertilizer and lime use were used to determine current level of commodity volume consumed and the data was plotted to determine the rate of change of commodity use. This data shows an average increase of about 3,000 tons per year of fertilizer and lime use in the areas that could be served by warehousing areas in Salem and Albany and 1,000 tons per year in the area served by Eugene as a distribution center. The rate of increase of commodity was assumed to continue at the present rate to 1980. A reduced rate of increased usage was assumed for the period 1980-2000 and further reduced in the period 2000-2020.

References numbered in projection methods:

Ref. #1. Appendix C, Willamette Basin Comprehensive Study

Ref. #2. Pacific Northwest Economic Base Study for Power Markets, Vol. 11C, Petroleum

Ref. #3. Prospective Timber Supplies and Forest Industrial Development in the Willamette River Basin

Method of Determination of Savings

1. In general, savings in transportation costs were determined by comparing estimated charges for transportation via the improved waterway with charges via other available routes or modes of transportation. Savings considered creditable to the improved waterway were computed as the difference between charges for transportation via the improved waterway and those for transportation via the most economical alternative route or mode of transport.

2. Basic rail, truck and pipeline rates were obtained from published tariffs; however, negotiated contract rates are permitted where movement of the cargoes are wholly within boundaries of the State and therefore the truck and rail published rates were adjusted to more nearly reflect current charges to shippers.

3. All waterway rates used for comparisons and analysis in determining benefits were constructed by estimating respective costs per ton for barge transportation of the various commodities expected to move over the proposed waterway, and by adjusting these costs to reflect a rate of charge which would include a reasonable profit. Barge costs were constructed by using hourly cost data, tow sizes, tow speeds, and other critieria considered to be representative of average operating costs and conditions applicable to the existing and improved waterway.

4. Cost computation for barge transportation on the improved waterway was based on a single barge tow consisting of a 50 by 200 foot barge with towboat of 800 horsepower. This is considered to reflect the typical equipment operation on the improved waterway.

5. Hourly costs for barges range from $2.00 per hour for open dry cargo barges to $8.50 for pressure type barges. Hourly operating costs for towboats in the 800 HP class average $30.00. These hourly rates were based on investment cost, depreciation, wages, fuel, maintenance and repair cost, supplies, subsistance, insurance and taxes.

6. Average tow speeds used in determining travel time on the waterway includes adjustment for locking time and effect of flow velocities and direction in relation to tug and barge movements.

7. The various commodities expected to move over the improved waterway would require several different types of barges and the payload in tons per vessel would depend mainly on the characteristics of the respective commodities. Unit cost projections include adjustments for the equipment and load variations.

8. Layover time for loading and unloading varies with the type of commodity involved and the type barge used. Loading and unloading time was applied to barges only. A turn-around time was applied to tugboat for allowance for pickup and docking of barges.

9. Applicable charges were applied for handling and transfer of commodities between barges and terminals, rail or truck for each such transfer of the cargo between origin and destination.

10. Rail switching charges were added to other transportation charges for waterway movement where the origination of commodity shipment was not at waterside.

11. Maximum port-to-port cost per ton occurs when a round trip movement is considered with no back haul. In such cases, the transportation cost per ton included the cost of barging the commodity to its destination plus the cost of returning the empty barge to the point of origin. A large back haul movement cannot occur unless a significant volume of commerce is available for movement between upriver and downriver ports and the commodities are adaptable to haul by the same type of barge equipment. About 10 percent of the expected commerce on the Willamette would lend itself to a back haul operation. In general, the characteristics of commodities, related barge type requirements, and origins and destinations of the expected barge commerce would permit little back haul movement of cargoes.

12. Computations of potential transportation savings in Part III were computed on the basis of water movement of all projected potential cargoes. Part IV savings projection assumed a portion of cargo movement would be borne by other transportation modes. The percent of total commodity shipment to be moved by water haul varied by commodity.