



Lower Columbia River Basin

The Lower Columbia River Basin comprises the western most portion of the Columbia-Snake Inland Waterway. Discovered by Capt. Robert Gray in 1792, the Columbia River has been a commercial waterway since the early 19th century. Fur traders of the Northwest Company, Astoria Pacific Fur Company, and the Hudson's Bay Company frequently used it. Oceangoing vessels sailed upriver to Vancouver, Washington, and to Portland and Oregon City, Oregon, via a tributary, the Willamette River. By mid-century, river steamers were plying sections of the Columbia upstream from Vancouver, but rapids blocked commerce into the interior.

Wagon portages were used at first, then railways, until Cascades Canal was constructed in 1896 by the U.S. Army Corps of Engineers. The old canal is now covered by waters of the lake backed up by Bonneville Dam. The Dalles-Celilo Canal was completed in 1915. It also is under water, flooded when The Dalles Dam was completed. When gold was discovered in Idaho in 1862, steamers began traveling from The Dalles, Oregon, to Lewiston, Idaho. They occasionally made trips beyond Lewiston on the Clearwater River to the Orofino mines. Before construction of Grand Coulee Dam, the upper Columbia was navigated in some seasons to Kettle Falls, Washington, 700 miles above the mouth. The Columbia-Snake Inland Waterway now extends from the Pacific

Ocean to Lewiston, Idaho, a distance of 465 miles.

The lower Columbia River extends from Bonneville Dam downstream 145 miles to its mouth. The entire reach is subject to tidal influence. The Lower Columbia River Basin includes all the lower Columbia River plus its tributaries downstream from the mouth of the Willamette River. The Willamette and Sandy rivers, which also enter the lower Columbia River, are discussed in the Willamette Basin chapter. The Cowlitz River, another major tributary, is discussed in the corresponding book for Washington.

The Lower Columbia River Basin includes part of the Portland metropolitan area and numerous small communities downstream. The remaining basin area is taken up by farms, forests, undeveloped rural areas, industrial developments, and ports along the river.

Many levees and revetments have been constructed by the Corps of Engineers to provide flood and erosion protection. Storage dams far upstream in both the Columbia and Willamette River basins substantially reduce flood flows along the lower Columbia. Historically, the largest floods have come during the spring, after the snowmelt in the Rocky Mountains. Floods almost as large have occurred in the winter, after heavy rainfall and rapid snowmelt in the Cascade Range and in certain tributary drainages of the Snake River.

During the December 1964 flood, about \$25 million in damages along the lower Columbia River in Oregon were prevented by dams upstream in the Willamette and Columbia River basins. Levees and revetments along the river prevented an additional \$23 million in damages. Damages prevented along the Washington side of the Columbia are not included in these totals.

Severe flooding occurred again during the winter of 1995-96, one of the wettest on record in the Pacific Northwest. Heavy rains in November and December brought flooding in Clackamas and Tillamook counties and several parts of Washington. Working with local, county, state, and federal agencies, the Corps provided technical advice and assistance. Heavy rains continued in January and February. As reservoirs reached capacity, Corps engineers began increasing releases at several projects, including Detroit, Applegate, Lost Creek, Willow Creek, Fern Ridge, and Lookout Point. Subtropical rains began in February and snowpacks that were 200 to 300 percent greater than normal began melting. The combination brought severe flooding to many parts of northern Oregon. River levels were comparable to those of the hundred-year flood of 1964, the largest flood event in Oregon since flood control reservoirs were built. Corps staff worked continuously to coordinate the operations of 60 dams throughout the Columbia River Basin and reduced releases to minimums on the 11 storage dams in the Willamette Basin. These actions helped keep the Willamette River below the top of the seawall in downtown Portland and prevented flooding. Severe flooding occurred in Lake Oswego, Oregon City, Tillamook, and Clatskanie in Oregon, and Kalama, Woodland and Cowlitz County in Washington. Flows began leveling off, the heavy rains abated and rivers began to recede in mid-February. Despite the extensive flooding, overall more than \$3.2 billion in flood damages were prevented throughout the region.

The lower Columbia River is used for navigation throughout its length. The navigation channel has been deepened to 40 feet to accommodate large ocean-going vessels. The 40-foot channel is maintained from the Portland area to the sea, and a 55-foot-deep entrance channel is maintained at the river's mouth. Upstream from Vancouver, a 17-foot-deep channel is maintained for river traffic to Bonneville Dam. Barges, log rafts, pleasure boats, and smaller ocean-going vessels use that part of the river. In addition to deep channels and turning basins maintained at Portland and Vancouver, there are many smaller harbor projects along the river.

The Portland District administers the Corps of Engineers projects in the Lower Columbia River Basin. In this chapter, flood control and navigation projects along the lower Columbia River are described. Upstream storage dams with influence on floodflows of the lower Columbia are described in the chapters for the Willamette, Middle Columbia, and Snake river basins.

Flood Damage Reduction Projects

Existing and Authorized Projects

Flood control works in the Lower Columbia River Basin have been constructed under authorities granted by Congress in the 1936 and 1950 Flood Control Acts. Both acts authorized construction of levees and improvements of existing projects. In addition, bank-protection works were authorized in the 1950 act.

Levees and Improvements to Existing Projects

Flood Control Act of 1936

The 1936 act authorized construction or rehabilitation of projects in 30 diking or drainage districts along the lower Columbia River in Oregon. The total federal cost for work done under that authority was about \$6.1 million. The cumulative benefits through 1996 amount to more than \$1.73 billion.

Costs and cumulative benefits through fiscal year 1999 for the 30 projects are listed in the following tabulation in downstream to upstream order. Costs are for original work. Benefits shown for five districts— Woodson, Midland, Rainier, Sauvie Island, and Multnomah 1— include those due to additional work authorized in 1950 as well as work done under the 1936 Act.

Location ¹	Drainage (Dr.D.) or Diking District (Dik.D)	Federal Cost	Cumulative Benefits
2	City of Warrenton ² Dik.D.#1	\$69,500	\$43,600,000
2	City of Warrenton ² Dik.D.#2	117,100	16,100,000
2	City of Warrenton ² Dik.D.#3	74,600	11,100,000
3	Clatsop County ³ Dik.D.#2 & 5	68,800	16,100,000
3,5	Clatsop County ³ Dik.D.#8,#11	158,400	3,300,000
4	Clatsop County ⁴ Dik.D.#9	248,800	9,400,000
4,5	Clatsop County ⁴ Dik.D.#13	66,900	200,000
4,5	Clatsop County Dik.D.#14	33,100	990,000
26	Clatsop County Dik.D.#10	25,800	730,000
27	Clatsop County ⁵ Dik.D.#12	18,800	170,000
28	Clatsop County Dr.D.#1	241,000	6,100,000
29	Clatsop County Dik.D.#7 (Blind Slough)	163,400	3,000,000

Location ¹	Drainage (Dr.D.) or Diking District (Dik.D)	Federal Cost	Cumulative Benefits
35	Clatsop County Dik.D.#6 ⁵ Dik.D.#15	133,800 40,700	1,100,000 1,840,000
45	Westland Dist. Improvement Co.	205,500	9,200,000
46	Woodson Dr.D.	32,800	5,900,000
47	Webb Dist. Improvement Co.	84,600	9,400,000
48	Marshland Dr.D.	39,500	16,700,000
49	Midland Dr.D.	77,700	20,500,000
50	Magruder Dr.D.	61,200	12,700,000
53	Beaver Dr.D.	274,600	125,300,000
65	Rainier Dr.D.	47,700	18,400,000
80	Deer Island Dr.D.	574,100	11,100,000
94	Scappoose Dr.D.	424,300	80,400,000
100	Sauvie Island Dr.D.	1,623,500	179,100,000
106	Peninsula Dr.D.#1	211,200	64,800,000
107	Peninsula Dr.D.#2	241,100	113,500,000
114	Multnomah County Dr.D.#1	610,700	762,900,000
120	Sandy Dr.D.	139,000	182,900,000
Totals		\$6,098,200	\$1,727,530,000

- 1 Locations are given in river miles upstream from the mouth of Columbia River; all footnoted locations are areas tributary to the Columbia between river miles nine and 18.
- 2 On Youngs Bay
- 3 On Lewis and Clark River
- 4 On Youngs River
- 5 Project no longer in federal program (benefits no longer accruing).

Flood Control Act of 1950

Improvements to existing levee projects were authorized in the Flood Control Act of 1950, supplementing and extending projects authorized in the 1936 act. Work under the 1950 authorization has been completed at the following district.

Woodson Drainage District

Construction began in 1963 and was completed the same year. The work included reinforcement of about 6,200 linear feet of existing levee, installation of toe drains, removal of a pump-discharge line, and construction of a new pumping plant. The total federal costs were \$162,500, not including local cooperation costs.

Drainage and Diking Districts

Proposed improvements, including modifications of existing levees and provision of drainage works, were not started because local cooperation requirements were not met.

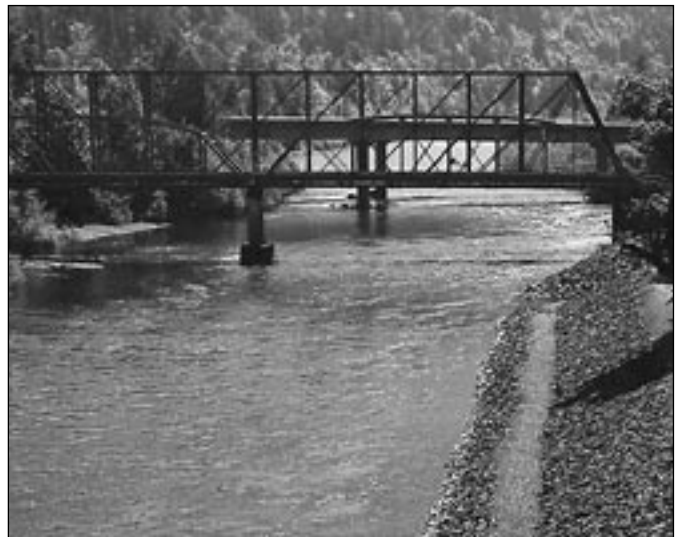
Other improvements to existing projects authorized in the 1950 Flood Control Act have been reclassified inactive or deferred because local cooperation or economic feasibility was lacking. Work has been authorized

at the following districts: Clatsop County Drainage District No. 1, Columbia Drainage District No. 1, John Drainage District, and Magruder Drainage District. Work authorized for the Sandy Drainage District was constructed in 1954 by that district at no cost to the federal government.

Work proposed for Clatskanie Drainage District and for Clatsop Diking Districts No. 4 and 6 has been deauthorized under the provisions of the 1974 Water Resources Development Act. Work proposed for Deer Island Drainage District has been deauthorized under the provisions of the 1986 Water Resources Development Act (PL 99-662).

Bank Protection Works

In addition to the levee work discussed earlier, the 1950 Flood Control Act authorized the construction of bank protection works, such as revetments, groins, and channel clearing along the lower Columbia River and its principal tributaries between Troutdale, Oregon, and the Pacific Ocean. The Lower Columbia River Basin Bank Protection program provides for study and construction of 224,000 linear feet of bank protection works at 96 locations along the lower Columbia River below river mile 125 and along principal tributaries in this reach to protect existing improvements such as levees and developed industrial lands from further erosion. Projects are accomplished at the request of non-federal sponsors who are willing and able to cost-share the implementation costs. Projects require congressional approval for construction.



The existing project is a unit of the general comprehensive plan for flood control, navigation, and other purposes in the Columbia River Basin. The Flood Control Act of 1950 requires that local interests furnish lands and rights-of-way; make necessary highway, highway bridge, and utility alterations; hold the United States free from damages; and maintain and oper-

ate completed works. Under Section 103 of the Water Resources Development Act of 1986, local interests also are required to make a cash contribution for construction at each site. Estimated costs for all requirements of local cooperation are \$2,000,000. Sponsors of improvements along the Columbia River include local ports and drainage and diking districts. Construction started in 1961 and is 88 percent complete. A total of 191,000 linear feet of bank protection work at 84 locations has been completed. Estimated total federal cost of the improvements is \$28,000,000 (1999). The federal cost through September 1999 is \$21,200,000. Through fiscal year 1999, flood damages prevented were \$31,700,000.

Navigation Development

Navigation development in the basin by the Portland District, U.S. Army Corps of Engineers, includes principal developments at the mouth of the Columbia River, the Columbia and Willamette rivers below Vancouver and Portland, and the Columbia River between Vancouver and The Dalles. Those projects provide water access from the ocean to upstream points in Oregon and Washington. Smaller channels from the Columbia River channel to several communities have been constructed under separate authorizations.

The three main projects and smaller projects are described below. Although the lower Willamette River and Multnomah Channel actually lie within the Willamette River Basin, they are included here due to their close relationship to navigation along the lower Columbia River. The project between Vancouver, Washington, and The Dalles, Oregon, which is partly in the Middle Columbia River Basin, is discussed here for the same reason.

Existing Projects

Columbia River at the Mouth, Oregon and Washington

This project provides a stabilized entrance channel across the Columbia River bar. In the early days, the bar

had a bad reputation with mariners. Its rapidly shifting sands grounded hundreds of vessels on treacherous shoals. Construction on this project started in the 1880s. The project as most recently modified in 1984 provides a one-half mile wide entrance channel 48 feet deep in the southern portion and 55 feet deep in the northernmost 2,000-foot width. The channel across the bar is secured by two converging stone jetties, which extend seaward from the Washington and Oregon shores. The entrance channel is five miles long, extending two miles seaward and three miles landward from the outer ends of the north and south jetties. The upstream end of the channel is stabilized by spur-jetty "A," which extends south perpendicular to the channel from Cape Disappointment, Washington. Three pile dikes near jetty "A" also help stabilize the channel.

The total costs through September 1999 from federal funds were \$198,438,600. Of that, \$24,913,700 was for construction, \$7,322,900 for jetty restoration, and \$166,202,000 for maintenance. Total waterborne traffic through the mouth of the Columbia River in 1999 was 38,970,000 tons. The average annual traffic for the five-year period 1995-1999 was 39,338,800 tons.

Recreation facilities have been jointly developed at Fort Stevens and Fort Canby state parks with the states of Oregon and Washington, respectively. Both of these state parks contain project lands leased by the states from the federal government.

Both parks are included on the National Register of Historic Places. Explorers Lewis and Clark first viewed the Pacific Ocean from these sites, and military facilities here are over 100 years old.

Columbia and Lower Willamette Rivers Below Vancouver and Portland

The project was first authorized in 1877, and the channel has been deepened at intervals since that time. The project authorization, as modified by Congress in 1962, covers 14.6 miles of Willamette River below Portland, Oregon, and 103.5 miles of Columbia River below Vancouver, Washington. Work on the authorized 40-foot-deep channel from Portland and Vancouver to the sea was complete in 1976. The Willamette River channel, from the Broadway Bridge (river mile 11.6) to the mouth (river mile 0), varies in width from 600 to 1,900 feet. On the Columbia River, the project provides for a channel 35 feet deep and 500 feet wide from the I-5 Interstate Bridge to the Burlington Northern Railroad bridge (river mile 106.5 to 105.5). The Columbia River channel for the four miles between the mouth of the Willamette River and the railroad bridge at Vancouver is being maintained to a 500-foot width until the need for a wider channel is demonstrated by traffic. The rest of the Columbia River from the railroad bridge to near the river's mouth (river mile 3) is 40 feet deep and 600 feet wide. Turning basins on the Columbia River are provided at Vancouver, Longview, and Astoria. The project





also includes 30- and 24-foot-deep auxiliary channels from the Columbia River channel at St. Helens (river mile 87) and Rainier (river mile 68), respectively.

Emergency dredging of a nine-mile reach of the Columbia River navigation channel was necessary after the May 18, 1980, eruption of Mount St. Helens, which clogged the river with more than 55 million cubic yards of volcanic material. At the mouth of the Cowlitz River near Longview, Washington, the silt-filled Columbia channel was only 15 feet deep. Within five days, Corps-owned dredges and the Port of Portland dredge, Oregon, under contract with the Corps, had cleared the channel to allow shallow-draft vessels to navigate on an intermittent basis. The \$44-million emergency excavation reopened the 40-foot-deep by 600-foot-wide navigation channel by November 1980.



In 1998, a \$787,000 contract was awarded to repair the Peninsula Drainage District #2 south levee which was damaged during the spring freshet. If the levee were to fail, the Portland International Airport and other highly valuable commercial industrial properties would have been jeopardized.

The total federal cost of the project through September 1999 was \$434,864,300. Of that total, \$28,349,300 was for construction and \$406,515,000 was for maintenance. In addition, \$666,000 was expended from contributed funds.

Current facilities along the Columbia River, with planned extensions, are considered adequate for existing commerce. At Portland, there are six Port of Portland terminals consisting of 43 berths equipped to handle general cargo, bulk cargo, lumber, automobiles, lift-on-lift-off and roll-on-roll-off containers, and bulkhead vessels. The Port of Portland owns and operates a major ship repair yard, which includes the west coast's largest, and the world's third largest, floating dry dock. Also available in the harbor area are privately operated facilities for receiving, storing, and unloading petroleum, wood chips, grain, logs, sand and gravel, cement, and steel products. At Vancouver, Washington, there are municipal facilities capable of berthing five ships simultaneously. Each berth is completely outfitted with mechanical and lift facilities for receiving and handling all types of cargo. The port has a low dock to handle roll-on-roll-off and side-port discharging vessels. The grain terminal has a storage capacity of 4,500,000 bushels. Port of Kalama has two berthing areas, one port-owned and one private. Port of Longview has a public terminal on the Columbia River and a privately owned grain elevator with a capacity of 6,900,000 bushels. This port also has a heavy-lift facility with a capacity of 600 tons. At Astoria, there is a terminal with facilities for receiving and handling all types of general cargo. At other locations between Portland and the Columbia River entrance, there are sufficient private facilities to accommodate river vessels and fishing craft. Waterborne traffic through the project in 1999 was 51,096,000 tons. The average annual traffic for the five-year period 1995-1999 was 52,948,400 tons.

Channel maintenance was heavily impacted by floods in the winter of 1995-96. A total of 9.6 million cubic yards of material was removed by dredges. In 1999, the easternmost 400 feet of the East Astoria Boat Basin North Breakwater was repaired with new steel sheetpile. Cost of the repair was about \$5.2 million.

A feasibility study for deepening the Columbia and Lower Willamette navigation channel is being conducted in cooperation with the Association of Lower Columbia River Ports.

Columbia River Between Vancouver and The Dalles

The project authorization provides for a channel 27 feet deep, 300 feet wide, and about 85 miles long between Vancouver, Washington, and The Dalles, Oregon. It also includes a channel 10 feet deep and 200 feet wide at the upstream entrance of Oregon Slough; a turning basin near Camas and Washougal, Washington; a 10-foot-deep boat basin at Hood River, with a 10-foot-deep connecting channel and a breakwater on the east side; a 10-foot barge channel to Bingen, Washington; and a small-boat harbor at The Dalles, including a breakwater and shear-boom-protected, eight-foot-deep basin.

From 1949 to 1957, the channel from Vancouver to The



Dalles was used commercially only for barge transportation and log towing. It was maintained to a 15-foot depth. Beginning in 1957, the project was deepened to the authorized 27-foot depth. The channel between Bonneville and The Dalles was completed in 1959. The channel between Vancouver and Bonneville was finished in 1960, except for some dredging and removal of submerged rock. The downstream entrance to the Bonneville lock was improved in 1961. At present, the channel is used only by tows and log rafts and is maintained to a 17-foot depth. Construction of a new navigation lock at Bonneville Dam was completed in 1993. This is described in more detail in the Middle Columbia Basin section.

Other work under the project authorization was completed in the early 1960s. The Hood River boat basin and the Camas-Washougal turning basin were constructed in 1962.

Barge-channel dredging and bank protection works near Bingen, Washington, were completed in 1963. A separate channel, 15 feet deep and 300 feet wide, under the fixed span on the I-5 Interstate Bridge between Vancouver and Portland, was completed in 1963, under authority of Section 107 of the 1960 Rivers and Harbors Act. That channel provides passage for smaller craft, decreasing the number of times the vertical-lift drawspan over the main channel must be raised. Also under Section 107, a small boat recreation channel 100 feet wide and six feet deep at South Channel Government Island was completed in 1985. A survey



study for a small-boat access channel to Mayer State Park, between Hood River and The Dalles, was completed in 1974. The study showed that due to redesign of the park and predicted higher pool elevations in Lake Bonneville, small boat access will be available without further construction.

The total project costs through September 1999 were \$21,182,900. Of that total, \$5,989,500 was for construction and \$15,193,400 was for maintenance.

At numerous locations along the entire waterway, there are facilities for transfer of logs to water from trucks, and public and private boat basins. Facilities are considered adequate for present commerce. At Vancouver, Washington, upstream of the Interstate Bridge at river mile 108.1 on the site of a former shipyard, there are numerous ship-building facilities equipped with railway and river moorage facilities. Also in this area are a paper-storage warehouse with barge slip, two boat-building businesses, and a storage dock with gantry crane. At Camas, Washington, about 13.5 miles upstream from Vancouver, there is a private wharf used for transfer of paper-mill supplies and paper to and from barges, and facilities for discharging bulk oils from barges. At Port of The Dalles (mile 44 above Bonneville), there is a municipal wharf 125 by 1,100 feet for use by tugs and barges.

There is a one-story timber and corrugated iron warehouse on this wharf. A private elevator with a capacity of 40,000 bushels and a public elevator of 1,113,800-bushel capacity for handling bulk grain to barges are also at The Dalles. The public elevator has rail, truck, and water connections. There is a port-owned rail connection about three-quarters of a mile below the municipal wharf where certain types of cargo may be handled between railroad cars and barges. Waterborne traffic in 1999 was 9,396,000 tons. From 1995-1999, the average annual traffic was 10,517,600 tons.

Skipanon Channel

The Skipanon River enters the Columbia River near Warrenton. The project provides for a 30-foot-deep, 200-foot-wide, 1.8-mile-long channel from the Columbia up the Skipanon to the railroad bridge at Warrenton; a 12-foot-deep mooring basin at Warrenton; and a seven-foot-deep, 40-foot-wide, 4,500-foot-long channel upstream from the railroad bridge, with greater log dumps and terminals. In recent years, however, the project has been maintained to a depth of 16 feet to accommodate traffic using the channel. The channel work and turning basin were completed in 1939. The small-boat mooring basin was completed in 1957 and fill stabilization work was completed in 1958. The total costs through September 1999 were \$4,423,745 of which \$280,900 was for construction and \$4,142,845 was for maintenance.

The city of Warrenton owns a wharf with a 300-foot frontage which is open to the public. One privately owned cannery wharf with a 300-foot frontage is used for unloading fish and handling fish nets. One privately owned boatyard has floats and moorage facilities for use by a maximum of 80 small boats. The small-boat

basin has facilities for numerous fishing and recreation craft. A privately owned lumber mill has a barge loading facility for chips and lumber. Facilities are considered adequate for existing commerce. Waterborne traffic through the channel totaled 58,000 tons in 1999. The average annual traffic for the five-year period 1995-1999 was 58,600 tons.

Multnomah Channel

Multnomah Channel, a 21-mile-long side channel of the Willamette River, connects the Willamette with the Columbia River. Sauvie Island lies between Multnomah Channel and the Columbia. The project provides for two 25-foot-deep ship channels and for removal of sunken logs throughout the waterway. The lower channel, 300 feet wide, extends 5,000 feet upstream from the Columbia River at St. Helens. The upper channel, 250 feet wide, extends 9,500 feet downstream from the Willamette River. Total costs through September 1999 were 437,700, all of which were for construction. Waterborne traffic through the channel in 1999 was 1,203,000 tons; average annual traffic for the five-year period 1995-1999 was 1,429,400 tons.

Oregon Slough

Oregon Slough is a side channel of the Columbia River in the North Portland-Vancouver area. The slough is parallel to and about one-half mile south of the Columbia River channel.

The project provides a 40-foot-deep by 400-foot-wide channel from the Columbia River to Oregon Slough (river mile 1.5) and a 20-foot-deep, 200-foot-wide channel from that point to Oregon Slough (river mile 3.8). The project was completed in 1913. Total federal costs through September 1999 were \$107,400— \$16,900 for construction and \$90,500 for maintenance. Waterborne traffic through the channel in 1999 was 3,717,000 tons. Average annual traffic for the period 1995-1999 was 3,389,600 tons.

A study to investigate the feasibility of providing a larger channel was completed in 1973. The study recommended increased channel dimensions to accommodate deep-draft vessels. Authorized by Congress in July 1976, the project was completed by local interests and no federal maintenance has yet been required.

Columbia River, Vancouver Deep Draft Anchorage, Washington

The deep draft anchorage is located on the Oregon side of the existing federally authorized 40-foot Columbia River channel, near Vancouver, Washington, between river miles 102 and 103. It includes the U.S. Coast Guard designed anchorage area near Hayden Island.

Safe anchoring in the Columbia River is dependent upon a combination of several factors: water and wind currents, tides, vessel size (overall length, draft,

and cargo volume), and the level of congestion in the anchoring area. The procedure being used was for the Columbia River pilots to decide where to anchor a vessel. At the recommendation of the pilots, the vessel either dropped one or two bow anchors. At the onset of anchoring, the vessel would be outside of the boundary of the 40-foot navigation channel. As wind conditions changed, the probability of a vessel tending to swing on its anchor increased. This then created a hazardous



condition for vessels navigating the main channel as they attempted to maneuver around anchored vessels that were partially in the channel.

Work was authorized under special continuing authority contained in Section 107 of the Rivers and Harbors Act of 1960, as amended, for navigation purposes. The project consists of two anchorage areas in the Columbia River by placement of two stern anchor buoys, one at each location. The downstream buoy, placed in the river 300 feet off the existing channel, is designated as a deep site for loaded or fully laden vessels. A second buoy, which is designated for light laden vessels or empty vessels, is placed 725 feet off the existing channel. The Ports of Portland and Vancouver signed Project Cooperation Agreements on January 3, 1994. The cost for preparation of the plans and specifications and for the construction of the project was \$376,791, of which \$282,593 was federal and \$94,198 was non-federal. The non-federal sponsors, Port of Portland and Port of Vancouver, provided \$53,698 and \$40,500, respectively. The contract for construction of the project was awarded in August 1994 and completed in September 1994.

Continuing Authority Projects

South Channel at Government Island

A small boat recreation channel, South Channel at Government Island was constructed in fiscal year 1985 at a federal cost of \$119,800.

Fox Creek Stream Restoration

Fox Creek is located at Rainier at river mile 67 across the Columbia River from Longview, Washington. From its mouth at the Columbia for approximately 650 feet upstream, Fox Creek was encased in a 72-inch corrugated metal pipe during a 1985 operation and maintenance dredging action and then buried by dredged material. Upstream access for anadromous fish including winter steelhead and coho salmon is effectively precluded except when creek flows are high. Erosion along the Columbia River shoreline at the mouth of Fox Creek has begun to destroy the outer segments of the pipe, making fish access even more difficult.

The local community has requested Corps assistance in restoring Fox Creek habitats and fish runs. A study conducted under Section 1135(b) of the Water Resources Development Act of 1986 recommends removal of the pipe and restoration of Fox Creek to a natural streambed, as well as placement of riparian plantings. Originally scheduled for construction in October 1997, the project is being reevaluated in light of other infrastructure improvements in the area being contemplated by the City of Rainier.

Multnomah Channel Improvements

Channel improvements in Multnomah Channel and Scappoose Bay requested by the Port of St. Helens were constructed under provisions of Section 107 of the 1960 Rivers and Harbors Act.

Improvements include a 2,950-foot channel extension at the downstream end of Multnomah Channel and a 7,080-foot channel branching from the new extension into Scappoose Bay. Both new channels are 10 feet deep. The work was accomplished in fiscal year 1984 at a total federal cost of \$419,600.

Trestle Bay Restoration

A 500-foot section of the Columbia River south jetty at river mile seven was lowered under Section 1135(b) of the Water Resources Development Act of 1986. This modification, which lowers the section to -5.6 mean sea level, allows fisheries resources access to 603 acres of intertidal habitat and increases nutrient availability for support populations of estuarine, marine, and anadromous fish stocks. It benefits an estimated 27 additional fish species previously not utilizing Trestle Bay, including chinook and sockeye salmon stocks which are federally listed as endangered species.

Construction was completed in September 1995, and post-construction monitoring continued through 1998.

Total cost for this modification, including all design and construction, is \$237,600, of which \$178,200 is federal and \$59,400 is non-federal. The project sponsor is the Oregon Parks and Recreation Department.

Westport, Oregon— Puget Island (Wahkiakum Ferry), Washington

The Wahkiakum Ferry route extends across the Columbia River at approximately river mile 43, between Westport, Oregon, and Puget Island, Washington. The project consists of a channel extending 1,900 feet from the Wahkiakum Ferry ramp at Puget Island to the existing federally authorized Columbia River Navigation Channel. This channel is nine feet deep (Columbia River Datum), 200 feet wide, and 900 feet long. The remaining length of the channel (1,000 feet) is naturally deep and extends to the Columbia River Navigation Channel. Operation and maintenance dredging is authorized for the full 1,900 feet.

Work was authorized under continuing authority contained in Section 107 of the Rivers and Harbors Act of 1960, as amended, for navigation purposes. This project established a federal channel to ensure safe and efficient operations associated with the existing Wahkiakum ferry. The cost for preparation of the plans and specifications and the construction of the project was \$215,853, of which \$194,268 was federal and \$21,585 cash was non-federal. Wahkiakum County, Washington, is the non-federal sponsor. The contract for the construction of the project was awarded on December 23, 1993, and completed on February 18, 1994.

Current and Recent Studies

Columbia River Channel Improvements

The seven ports on the lower Columbia River requested a study to evaluate the feasibility of deepening the existing channel that runs from the Pacific Ocean to Portland from its current depth of 40 feet to a possible maximum of 43 feet. The ports are Astoria, St. Helens, and Portland in Oregon and Longview, Kalama, Woodland, and Vancouver in Washington. The deeper channel would accommodate larger and more efficient vessels and reduce vessel delays that currently occur when ships must schedule their movements to coincide with high tides. The five-year feasibility study was initiated in 1994 and is expected to be completed in fiscal year 2000.

The project plan consists of deepening a segment of the Columbia and Willamette Rivers by three feet to 43 feet. The project begins at the mouth of the Columbia River and extends upstream to the vicinity of the Port of Vancouver, Washington (approximately river mile 105) and also includes the Lower Willamette River from its confluence with the Columbia River (river mile 101.5) upstream to the vicinity of downtown Portland (approx-

mately river mile 11). Project cost-sharing will include requirements for non-federal interests to pay 25 percent of the project cost during construction and an additional 10 percent to be repaid over a period not exceeding 30 years. Cost of construction is estimated at \$196 million.

In fiscal year 1996, effort focused on environmental, engineering, and economic concerns. Project representatives began fish and benthic sampling (relating to nutrients found on the ocean bottom and channel) and drafted two Environmental Impact Statements: one on the project itself and another dealing with dredged material management. Engineers used global positioning equipment to determine where ships actually travel in the channel, and economists developed commodity and fleet projections to calculate potential benefits of the project.

In 1999, the Final Integrated Feasibility Report for Channel Improvements and Environmental Impact Statement: Columbia and Lower Willamette River Federal Navigation Channel was released for public comment. The Chief of Engineers' Report was scheduled to be forwarded to Congress in fiscal year 2000 to request funding.

Peninsula Drainage District No. 1

Peninsula Drainage District No. 1 is located within the City of Portland in Multnomah County, along the Columbia River between river miles 105.6 and 106.5. The drainage district's flood-protective works did not provide dependable protection from major flood events of the Columbia River. The City of Portland Parks and Recreation Department requested Corps assistance in providing improvements to the existing flood protection system of Peninsula Drainage District No. 1 under Section 205 of the Flood Control Act of 1948, as amended.

A feasibility study was completed in September 1996. The study recommends a 100-year level of protection by reinforcing sections of the existing levee and modifying the existing pumping plant outlet pipe.

The project consisted of reinforcing the flood protective system in order to protect against the 100-year recurrence frequency flood event. This will be accomplished by reinforcing 2,000 feet of the landward side of the railroad embankment at the southwest corner of the drainage district and raising the outlet pipes of the pumping station to above-designed flood level of 28.7 feet. The railroad embankment will be reinforced by constructing a sand embankment structure against the landward slope of the railroad embankment having a 12-foot wide crown and one vertical to five horizontal side slopes. The catch point along a portion of this fill is in a golf course water hazard and the embankment will cover existing golf course tees. As a consequence, a 200-linear foot gabion retaining wall will confine the fill and allow construction of a flat bench so the tees can be re-established. The height of the retaining wall will vary from two to nine feet. Estimated cost for preparation of plans and specifi-

cations and construction of the project is \$1,484,000 of which \$1,113,000 is federal and \$371,000 is non-federal. Construction was completed in September 1998. In 1999, safety issues were addressed by adding a boat barrier to preclude access to the outlet.

Brookfield-Welch Island reach

Ship simulation models of the Brookfield-Welch Island reach in the Columbia River began in 1997 to determine whether conditions warranted changes to improve navigability for ships transiting through two turns in the channel at this location. The budget authorized \$400,000 for ship simulation to study the conditions; \$2 million is allocated to correct the turns if warranted. After inconclusive results, a second series of model runs and alternatives were conducted in fiscal year 1999.

Columbia Slough Ecological Study

The 1998 budget allocated \$150,000 to study potential restoration of the Columbia Slough ecosystem. The study will evaluate potential improvements to include flow management options and habitat restoration in the Columbia Slough corridor. The first phase of the plan will include completion of an addendum to the existing reconnaissance report, preparation of a project study plan, negotiation of a feasibility cost-sharing agreement to reflect 50 percent federal and 50 percent local sponsor participation, and initiation of the feasibility study. The City of Portland, Bureau of Environmental Services is the local sponsor. A Feasibility Cost Sharing Agreement for \$1,023,000 was signed in 1998 with the City of Portland to split costs equally between the two agencies.

For fiscal year 1999-2000, \$275,000 in federal funds were appropriated for study of modification of culverts, channels and habitat in Buffalo slough and Whitaker Slough, habitat restoration near MCDD Pump Station #4, and water transfer between the Columbia River and upper Columbia Slough by construction of a gated structure through the main flood control levee near MCDD Pump Station #4. Early study indicated that the gated structure through the main flood control levee would not prove feasible, due to a very limited environmental restoration improvements and to costs and maintenance issues for fish screens at the culverts. Other restoration alternatives were then considered in the feasibility study, including construction of wetland benches along the main Columbia Slough, and numerous riparian restoration sites near the slough corridor.

Lower Columbia River Basin

