

## Washington State

Washington is rich in snow-capped mountains, cool forests, surging rivers, golden deserts, and productive farmland. The state has about 300 miles of coastline on the Pacific Ocean and more than 2,000 miles of saltwater shoreline on Puget Sound, Hood Canal, the Strait of Juan de Fuca, and other waterways. The Evergreen State is divided north to south by the Cascade Mountains, which include three dormant volcanoes and an active Mount St. Helens. Mount Rainier, at 14,411 feet, is the state's highest peak. To the west are the Olympic Mountains and the Willapa Hills. To the east are the Okanogan Highlands, the western foothills of the Rocky Mountains, and the Blue Mountains, which extend south into Oregon. The mountains and the ocean give Washington two climates. Western Washington has mild summers and winters. The temperature seldom exceeds 85 degrees in the summer and rarely drops below freezing in the winter, except at higher elevations. Winter storms drop most of their moisture as they cross the Cascade Mountains. Eastern Washington (three-fifths of the state), therefore, has a drier climate, warmer in summer and cooler in winter than western Washington. Rainfall averages 40 inches per year, ranging from 150 inches in the Olympic rain forest to 15 inches on the east side of the Cascade Mountains. Precipitation runoff patterns fall into two general areas: the snowmelt runoff of the interior drainage and the rainfall runoff of the coastal drainage west of the Cascades. East of the Cascades the major runoff occurs during the snowmelt period from May through July. Streamflows gradually rise over a period of a month or more and usually reach peak discharge during June. Fluctuations in streamflows are mostly caused by variations in solar radiation and air temperatures. At times, rainfall adds significantly to the runoff. On streams west of the Cascades, precipitation from predominant winter storms usually falls as rain. Tributary streams carry the storm rains and water rapidly runs off. Most of the runoff from these areas comes in winter, but moderate streamflows continue through spring and early summer, fed by late snowmelt from high areas and ground water outflows. Dominating the interior region of the Pacific Northwest, the Columbia River runs through central Washington, then forms a border between Washington and Oregon. The river has one-third of the potential hydroelectric power in the United States. Grand Coulee Dam, constructed and operated by the Bureau of Reclamation, is the largest dam on the Columbia. The Corps constructed and operates five dams on the river - Bonneville, The Dalles, John Day, and McNary on the Washington-Oregon border, and Chief Joseph in north-central Washington. Additionally the Corps built and operates four dams on the Snake River, the Columbia's largest tributary. They are Ice Harbor, Lower Monumental, Little Goose, and Lower Granite, all in southeastern Washington. Public utility districts also have built and operate dams on the Columbia River in central Washington. These are Rock Island, Priest Rapids, Wanapum, Rocky Reach, and Wells Dams. This system of

Federal and public utility district dams provides electrical power, irrigation, flood control, water supplies for communities and industry, and channels and locks for navigation. Few environmental problems in the Pacific Northwest have proved more persistent than declining salmon populations. For more than a century, the Corps has been concerned with the fate of salmon in the Columbia River Basin. The Corps, with assistance of fish agencies, has developed adult fish passage facilities for its multi-purpose dams on the Columbia and Snake rivers. Listing of certain salmon species stocks under the ESA has accelerated focus on the dams and their impacts on salmon resulting in intensive efforts by the Corps and fish agencies to examine alternatives for improving dam operations to minimize impacts on salmon.

#### Removal of Navigational Hazards from Puget Sound and Its Tributary Waters

Seattle District operates the snagboat Puget to remove snags, deadhead logs, and other debris from bays, harbors, and waterways of Puget Sound, Lake Washington, and navigable portions of major rivers discharging into the Sound. Federal cost for this operation through September 1998 was \$25,680,796.

#### Flood Fighting Activities in Washington

Under the Emergency Advance Measures program, three communities were helped in the spring of 1999 when the high threat of flooding prompted cities, counties and a governor to ask for assistance. The projects in Lightning Creek, St. Maries and Milo Creek, Idaho, ranged from removing woody debris to prevent log jams at highway and railroad bridges, to reinforcing a crib wall with steel pilings, to running a 54-inch culvert down a Kellogg street. All of the projects were completed before the snowmelt started. Flooding in western Washington started just before Thanksgiving 1999. A coastal storm in Tokeland endangered a county road and marina, and a Corps team responded with bank protection. In another flood event, the rising waters in Pe Ell threatened the city's sewage treatment plant. Flood team members worked over the holiday weekend to save the day. After Washington's Congressman Brian Baird visited the area, he thanked the district and especially those who worked long hours and gave up their holiday to help in the flood fight. Flooding ramped up again in mid-December 1999, and floodfight assistance was provided in eastern Washington's Cle Elum along the Yakima River and in western Washington along the Humptulips where a levee breach took place. Flood team members also provided technical assistance and sandbags at four sites in western Washington.

#### Mount St. Helens Eruption

It was early morning on May 19, 1980, when a freighter, Hoegh Mascot, making its way slowly up the Columbia River, went aground in the middle of the 40-foot channel near Longview, WA. The incident was the first indication of the damage

gone to the Columbia River channel by the massive eruption of Mount St. Helens at 8:32 a.m. the previous day. Within minutes of being informed of the grounding, the Corps' Portland District dispatched a survey boat to the scene and ordered the hopper dredge Biddle, working at the mouth of the Columbia, to proceed upstream. The story of the May 18 eruption is well known - 1.3 cubic miles of the mountain top blown up. The massive floods of mud, ash, and debris that followed the eruption surged down the two forks of the Toutle River, down the Cowlitz, and into the Columbia, creating the shoal on which the Hoegh Mascot had gone aground. The 40-foot channel was blocked by an estimated 55 million cubic yards of mud and debris. The channel depth was reduced to 14 feet in spots for a distance of nine and a half miles. Within the first year after the eruption, about 24 million cubic yards of volcanic debris were removed from the Columbia River to restore the navigation channel and the river's hydraulic capacity. Since that time, an additional 25 million cubic yards have been removed as it continued to deposit in the river. The sediment-filled Cowlitz River created the probability of major flooding in the '80-'81 winter season at Castle Rock, Lexington, Kelso, and Longview, with a total population of about 45,000. Emergency flood control actions were begun to excavate the Cowlitz channel and to improve existing levees. Due to average rainfall and the emergency and continuing Corps actions, no major flooding has occurred on the Cowlitz River since the eruption. About 70 million cubic yards of sediment have been removed from the river. Work in intervening years included interim temporary structures on the North and South Fork Toutle rivers, excavation of sediment built up behind the structures, and sedimentation basins in the river.

#### Spirit Lake

The debris avalanche totally blocked the outlet of Spirit Lake, at the base of Mount St. Helens, to the North Fork Toutle River with a ridge of volcanic material up to 600 feet deep. A U.S. Forest Service Task Force reported that the natural dam barrier was unstable and an uncontrolled breach would release lake waters and cause flooding downstream. In response to a presidential emergency declaration and request from FEMA, the Corps developed an interim solution to stabilize the lake over the winter. Barge-mounted pumps operated from November 1982 to April 1985 pumping water from the lake through 3,450 feet of pipe across the debris "plug" to a concrete stilling basin, and from there to the North Fork of the Toutle River. To maintain a permanent safe level of Spirit Lake, an 11-foot-diameter, 8,460-foot-long tunnel was built to carry water through Harry's Ridge into South Coldwater Creek. Tunnel construction began in the summer of 1984 and was operational in May 1985. The lake was lowered by about 20 feet by that September.

#### Sediment Control Project

In May 1982, President Reagan directed the Corps to prepare a comprehensive

plan for long-term flood control and navigation maintenance. This preliminary study was completed in November 1983. The 1985 supplemental spending bill, signed Aug. 15, 1985, authorized the Corps to build a sediment retention structure on the North Fork Toutle River. A local cooperation agreement between the federal government and the sponsors was signed April 26, 1986. Construction of the Sediment Retention Structure (SRS) began in December 1986. A portion of the cofferdam was completed in time to begin trapping sediment before the winter of 1987-88. The entire structure was completed and dedicated in 1990. The SRS consists of an 1,800-foot-long embankment, rising 184 feet above the post-eruption streambed, with concrete outlet works and an unlined 125-foot spillway at one end. The project provides a permanent solution to potential flooding on the Cowlitz River from sedimentation problems created by the eruption of Mount St. Helens. The Kelso levee improvement and dredging in the Cowlitz River were accomplished during the summer of 1988. Local interests were responsible for provisions of all lands, easements, and rights-of-way for the sediment retention structure, dredging disposal areas, and levee improvements. Operations during fiscal year 1994 included fish and wildlife mitigation studies, real estate activities, preparation of as-built drawings, and routine operation and maintenance. Total Corps expenditure for Mount St. Helens work through September 1994 was about \$562 million.

Point of Contact: Nola Leyde    Phone: 206-764-6896    Email: Nola.R.Leyde@nws02.usace.army.mil