MOUNT ST. HELENS RECOVERY OPERATIONS

by

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Introduction

Following the catastrophic eruption of Mount St. Helens, Portland District, Corps of Engineers began perhaps the most unusual recovery operation in the history of the Corps. The purpose of this presentation is to portray, in general terms, the emergency situation that existed and the recovery measures implemented by Portland District.

The Eruption

Mount St. Helens, located in the southwest corner of the state of Washington, has been the most active volcano in the Cascade Range over the last several thousand years. Typically, periods of dormancy have rarely exceeded 200 years. In late March 1980, this picturesque mountain began exhibiting earthquakes and minor steam and ash ejections, signaling a new era of activity for the 123-year dormant volcano. Minor eruptions continued, becoming larger and larger as the weeks passed, resulting in a massive and explosive eruption on Sunday morning, 18 May 1980.

The eruption and blast disgorged an estimated four billion cubic yards (cy) of material, lowering the height of the mountain by more than 1,200 feet and forming a huge crater more than a mile in diameter. The damage, occurring in a 170-degree arc north of the mountain, devastated a 156-square-mile area. The hot gases and the force of the explosion completely destroyed all trees up to seven miles from the mountain, uprooting trees 12 miles out and destroyed other trees as far as 17 miles away.

As shown in figure 1, the blast and resultant mudflows seriously impacted the river basins of the Toutle, Cowlitz, and Columbia Rivers. The debris and mud avalanche left massive deposits in the Toutle River drainage. This deposit extends down the upper reach of the river for a distance of 17 river miles and is over 600 feet thick in places. Volume estimates of the debris avalanche vary from 2.5-3.5 billion cy.

Mudflows that followed carried material which deposited in the Toutle, Cowlitz, and Columbia Rivers. Approximately 50 million cy of sediment was deposited into 21 miles of the Cowlitz River from the mouth of the Toutle downstream, and approximately 45 million cy in the Columbia River near the mouth of the Cowlitz River.

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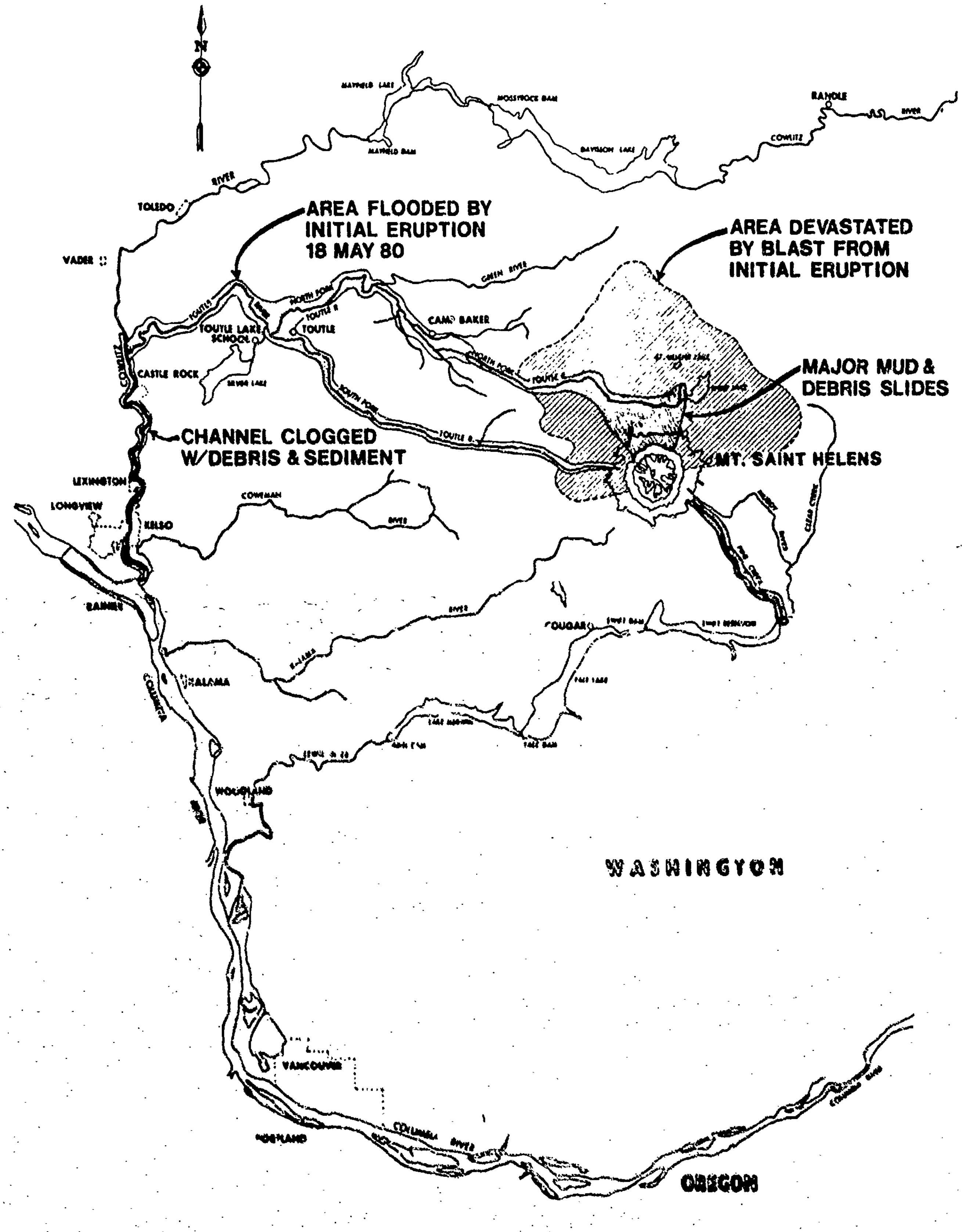

Figure 1 Areas Impacted by the Eruption

COLUMBIA RIVER

The Columbia River navigation channel, from the mouth to Portland, Oregon, is maintained at a 40-foot depth and 600-foot width. The day after the eruption, a vessel ran aground in the middle of this channel. As shown in figure 2, hydrographic surveys revealed a 9-1/2-mile shoal, which had reduced navigation depths to 15 feet. Approximately 14 million of the 45 million cy total infill deposited in the Columbia was in this navigation channel.

On 20 May, a plan for dredging was established (see figure 3) and the Hopper Dredge "Biddle" began work. In 5 days, the three hopper dredges assigned to this emergency had opened an emergency channel that permitted ship passage during high tide "windows" supervised by the U.S. Coast Guard. By 29 May, the channel had been expanded to 25 feet by 200 feet. On 14 June, the last ship of the 31 vessels trapped upstream of the shoal was able to proceed downriver with its cargo of grain. The 14 million cy of infill in the channel project limits were removed generally on schedule, and an unrestricted navigation channel was open to traffic by 30 November 1980. To date, approximately 26 million cy of sediment has been removed to restore and maintain the navigation channel to its pre-eruption state.

COWLITZ RIVER

The 21 miles of the Cowlitz River, from the mouth of the Toutle River downstream to the Columbia River, were impacted severely by the mudflows. Figure 4 illustrates the river profiles of the Cowlitz River before and after the eruption. As shown, natural channel capacities were virtually eliminated by the 50 million cy of infill. Before the ruption, a 76,000-cfs channel was in place. Figure 5 shows the probability of flooding; with even a normal water year, severe flooding would be expected.

Recovery efforts for the Cowlitz River centered around excavating this massive infill to restore its flood carrying capacity to the maximum extent practicable by 1 December 1980. Thirty-three million cubic yards of material was excavated by 1 December, with an addition 23 million cy removed in maintaining this channel, until work was terminated on 30 September 1981.

To remove this 56 million cy of sediment, an intensive and massive effort was required. During the height of operations, the following equipment was in operation: 23 pipeline dredges, 17 tower-type draglines, 52 draglines, 29 backhoes, and 226 hauler-loaders. A total of 4,400 acres were donated as disposal sites by the local landowners. Since an adequate channel would not be in place before the winter rains, flood control storage was obtained from Mossyrock Reservoir on the upper Cowlitz River for the 1980-81 winter.

In addition to the excavation work on the Cowlitz River, the feasibility of other flood protection measures was examined. The construction of levees at certain locations on the Cowlitz were found to be justified. To this end,

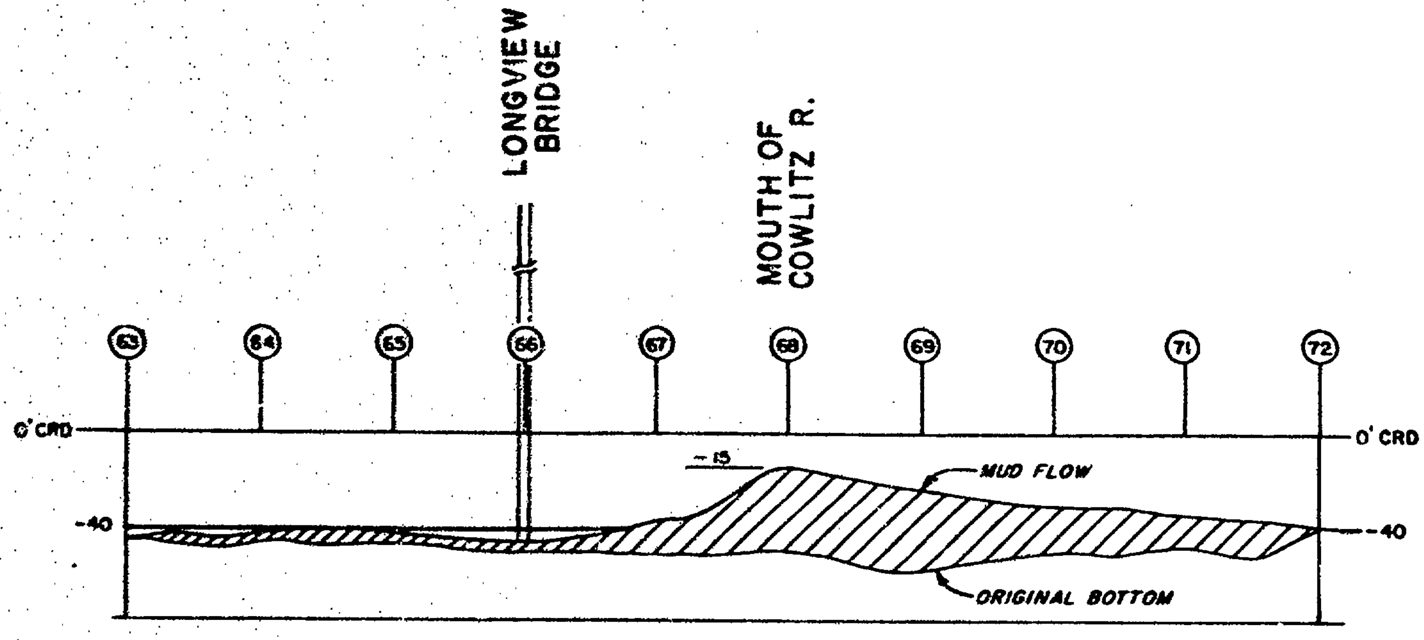

Figure 2

**COLUMBIA RIVER
LONGITUDINAL PROFILE
RM 63 -RM 72**

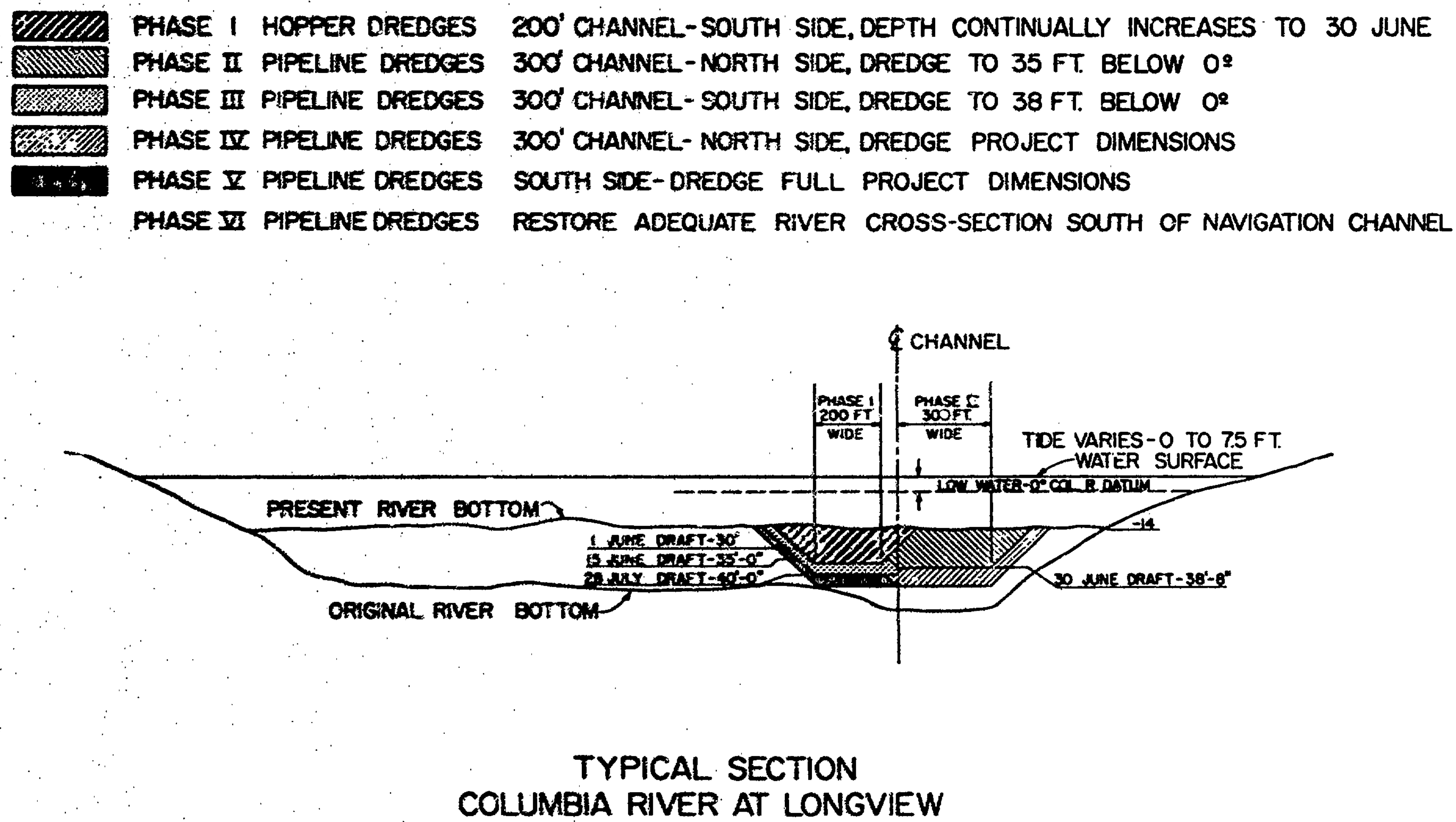

Figure 3 Dredging Plan for the Columbia River

levees providing 500-year flood protection were constructed along the Cowlitz River near the urban areas of Castle Rock, Lexington, Longview, and Kelso; 14,700 feet of existing levee were upgraded and 21,400 feet of new levee were constructed. Bank protection was provided in conjunction with the levees and to control river meandering.

TOUTLE RIVER

Measures implemented in the Toutle River drainage were primarily oriented toward reducing the quantity of sediment eventually depositing in the Cowlitz and Columbia Rivers. Tremendous quantities of sediment continued to erode from the upper watershed mud and avalanche deposits, with the eventual deposition in these lower rivers. Two major techniques were used to reduce this sedimentation: sediment stabilization basins and debris retention structures. The location of these structures is shown in figure 6.

In areas of natural deposition in the Toutle River drainage, eight sediment stabilization basins were excavated. During periods of heavy runoff, sediment was trapped in these basins, therby preventing further infill in the Cowlitz River. During the operation of these structures ending 30 September 1981, 7.5 million cy of sediment was excavated and placed in disposal areas.

Two debris retention structures were constructed: one on the north fork Toutle River and the other on the south fork Toutle River. The debris retention structures, or check dams, resemble earth-fill dams, but they are permeable; they were designed to hold back and impound sediment, which could then be excavated. The north fork structure is 6,000 feet long and 43 feet high, and has a sump capacity of 6 million cy. During the operation of this structure ending 30 September 1981, over 9 million cy of sediment have been removed. The south structure is 600 feet long and 20 feet high, and has a sump capacity of 600,000 cy. During the operation of this structure, approximately 2 million cy of material have been removed. In addition, a fish trap was constructed adjacent to the south fork debris retention structure to trap anadromous fish impeded by this structure.

The debris avalanche, besides contributing sediments, created another problem where recovery operations became necessary. The massive mudfill deposited in the upper 14 miles of the north fork valley had blocked a number of streams, creating ponds and lakes. To prevent catastrophic failure of the debris plugs creating certain of these impoundments, outlet channels were needed at four of the larger ponds. Structural measures were taken to reinforce the outlet channels at Coldwater Lake and South Castle Lake, the larger of these lakes.

Miscellaneous

Within the timeframe allowed for this presentation, it is impossible to detail the myriad of activities involved in these recovery operations. Normal planning and design had to be accomplished at an expedited rate. An example of this expedited schedule is the rate at which contracts were awarded. On

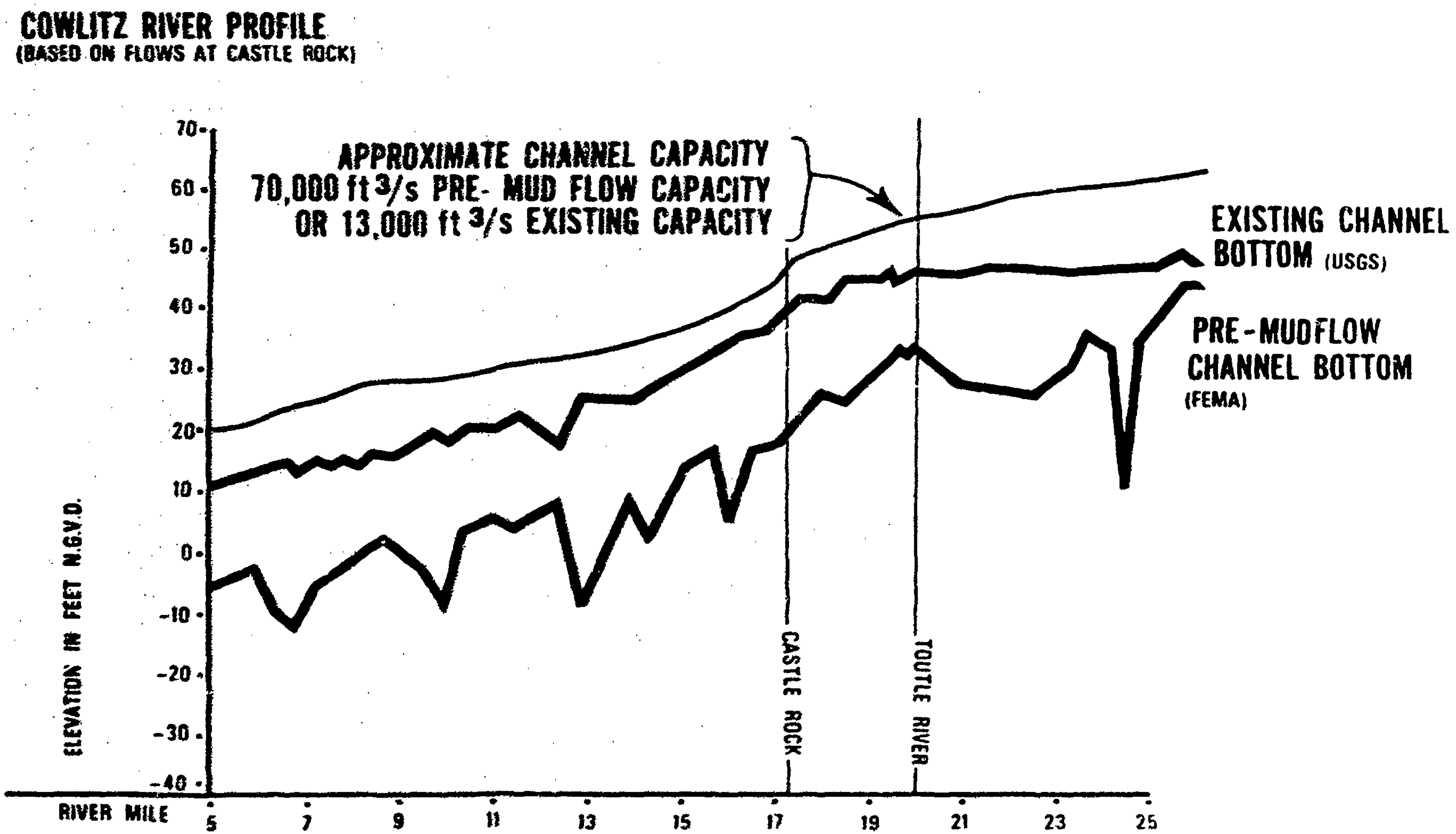

Figure 4 Impact of the Mudflows on the Cowlitz River

COWLITZ RIVER RUN OFF —
COWLITZ RIVER AT CASTLE ROCK

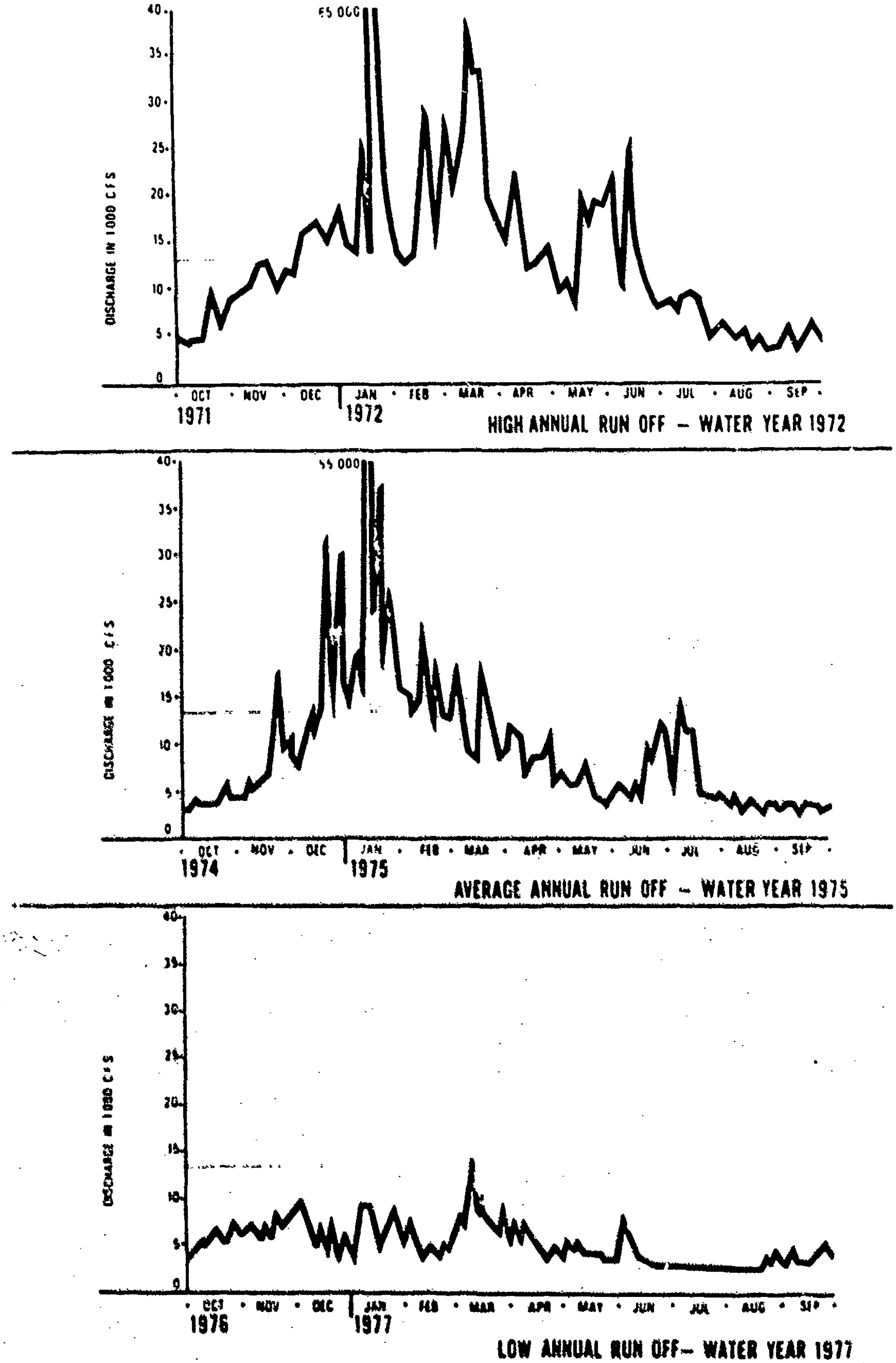

Figure 5 Potential for Flooding on the Cowlitz River

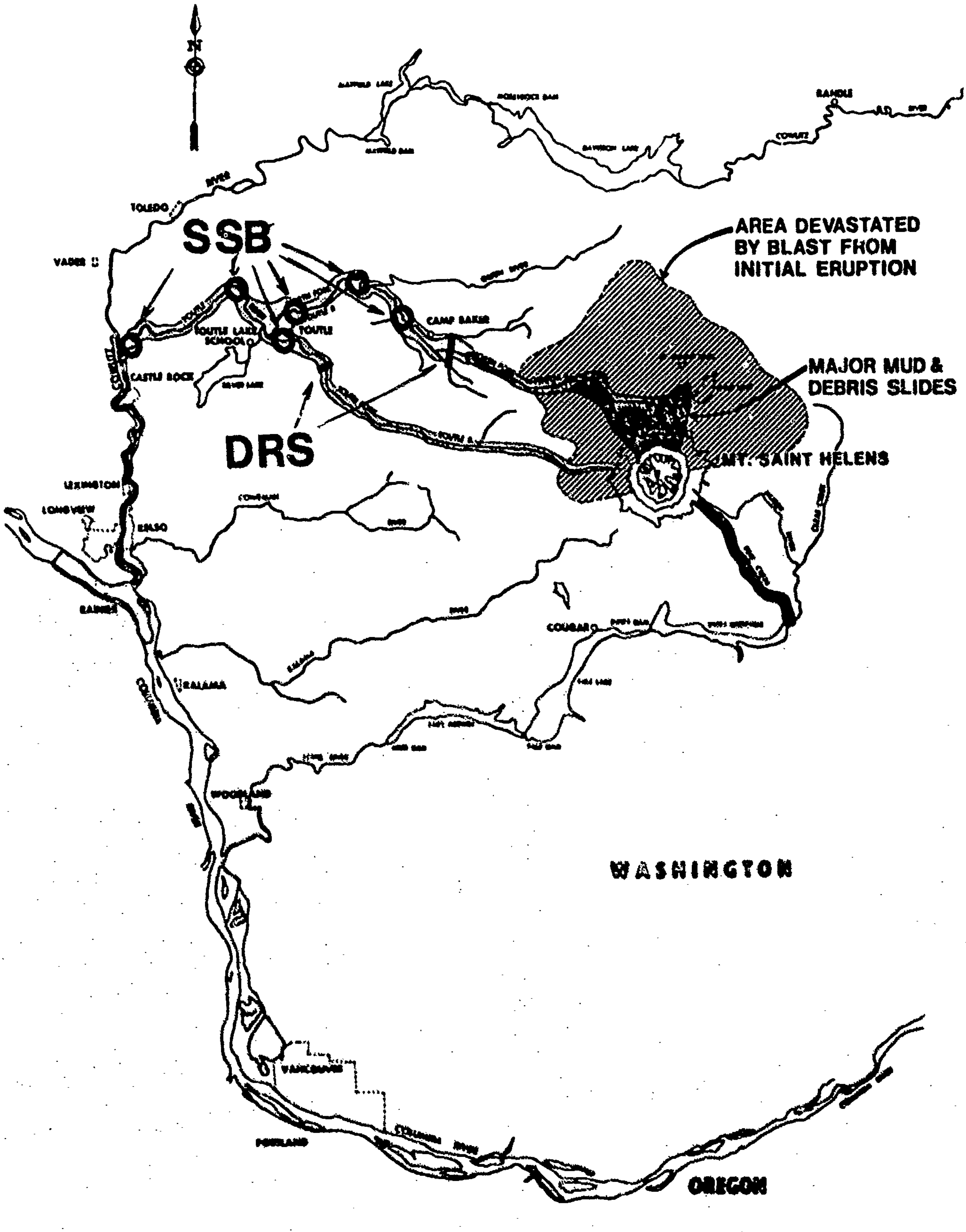

Figure 6 Location of Sediment Stabilization Basins (SSB) and Debris Retaining Structures (DRS)

30 June, over 500 contractors were called to notify them that a pre-bid meeting was to be held tomorrow, 1 July. The next day, 300 contractors from across the country were present for this pre-bid meeting.

Environmental coordination and evaluation occurred at the same rapid pace as the other activities. An environmental impact statement was prepared on an expedited schedule and an environmental taskforce comprised of Federal and State resource agencies was formed; this group met at frequent intervals to insure reasonable measures were taken during this operation to protect the environment.

Water quality evaluations were conducted in conjunction with other environmental assessment and monitoring activities. At first, the major water quality concern was to determine if the ash created any unusual water quality problem beyond the unusually high turbidity. Water quality evaluations continued to determine the effects of the debris retaining structures on the water quality of the Toutle River. But, perhaps the most unusual water quality investigations were associated with the newly formed lakes in the blast zone.

Water quality investigations of these Lahar lakes were conducted in conjunction with evaluations to provide outlet channels for these lakes. Earlier scientific reports indicated that water currently in these lakes was extremely poor in quality, and may be contaminated with pathogenic bacteria and chemical substances. Since a number of downstream communities rely on river water for their drinking water supplies, we commissioned followup water quality studies. In these studies, it was found that massive quantities of organic carbon, sulfur, and metals were loaded into the lakes. Heterotrophic microbial processes, stimulated both by elevated nutrient concentrations and temperature, rapidly consumed the available dissolved oxygen.

This concludes my presentation on Portland District, Mount St. Helens recovery operations. I hope this presentation provided an idea of the complex activities that were necessary in meeting this emergency.