FLOOD OF OCTOBER 1986 AT SEWARD, ALASKA

U.S.GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS REPORT 87-4278

Prepared in cooperation with the

STATE OF ALASKA:
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
DIVISION OF EMERGENCY SERVICES
FEDERAL HIGHWAY ADMINISTRATION
FEDERAL EMERGENCY MANAGEMENT AGENCY
KENAI PENINSULA BOROUGH

Cover photo: Cobbles and gravel deposits at Bridge 1389, Exit Glacier Road, October 13, 1986.

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by Stanley H. Jones and Chester Zenone

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Anchorage, Alaska
1988

DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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Denver, Colorado 80225

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CONVERSION FACTORS

For readers who may prefer to use metric (International System) units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit	by	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square foot (ft^2)	0.09294	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
foot per foot (ft/ft)	0.3048	meter per meter (m/m)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)/km^2$]

Other useful conversion factor for stream channel slope (or gradient):

Multiply	by	To obtain
foot per foot (ft/ft)	5,280	foot per mile (ft/mi)

Sea level:

In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929) -- a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

Stream names:

Stream names in parentheses on maps in this report either do not appear on U.S. Geological Survey maps, or indicate local usage.

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ABSTRACT

Broad areas along the lower Resurrection River and Salmon Creek as well as the surfaces of several adjacent alluvial fans in the Seward area were flooded as a result of the intensive rainstorm of October 9-11, 1986. Severe erosion took place through the steep gradient, mountain canyons and near the apex of the fans, while rock and debris were deposited on the distal parts of the fans. In Godwin, Lost, Box Canyon, Japanese, and Spruce Creek basins, and perhaps others, landslides or debris avalanches dammed the streams temporarily. Subsequent failure or overtopping of these dams led to "surge-release" flooding; peak discharge of such a flood at Spruce Creek was 13,600 cubic feet per second, four times as great as any previously known maximum discharge from the basin and 2.5 times as great as the runoff rate upstream from the debris dam.

Flood discharges were determined indirectly -- using the slope-area method -- at ten high-gradient reaches on nine streams. Computed peak discharge for several small basins were the largest since records began in 1963. The largest rainfall-runoff rate unaffected by surge-release was 1,020 cubic feet per second per square mile at Rudolph Creek, which has a drainage area of 1.00 square mile.

The 15.05 inches of rain that fell in one 24-hour period during the storm was assigned a recurrence interval of 100 years or greater. The length of the streamflow record available for most Seward area streams -- 25 years or less -- is inadequate to reliably define flood-frequency relations for recurrence intervals as great as 100 years. However, the slope-area determined discharge of Spruce Creek above the debris avalanche indicates a recurrence interval of 100 years or greater. In addition, conventional flood-frequency analysis techniques are not applicable to peak discharges that are affected by surge-release phenomena. Large, damaging floods have repeatedly caused major damage in the Seward area, and the potential for catastrophic, debris-laden floods is an ever-present threat to areas bordering the many steep mountain streams.

INTRODUCTION

During the period October 9-11, 1986 a large North Pacific storm system moved onshore over southcentral Alaska, where it caused record-setting rainfall that led to widespread, catastrophic flooding and landslides. One of the hardest-hit areas was the coastal community of Seward (fig. 1), which received more than 15 in. of precipitation in one 24-hour period. Broad areas along the Resurrection River and Salmon Creek at the head of Resurrection Bay were inundated (plate 1). The effects of the floodwaters were exacerbated by severe erosion and subsequent deposition of rock and debris along the channels of steep mountain streams. The high sediment discharge, combined with trees, brush and other debris, clogged channels at bridges

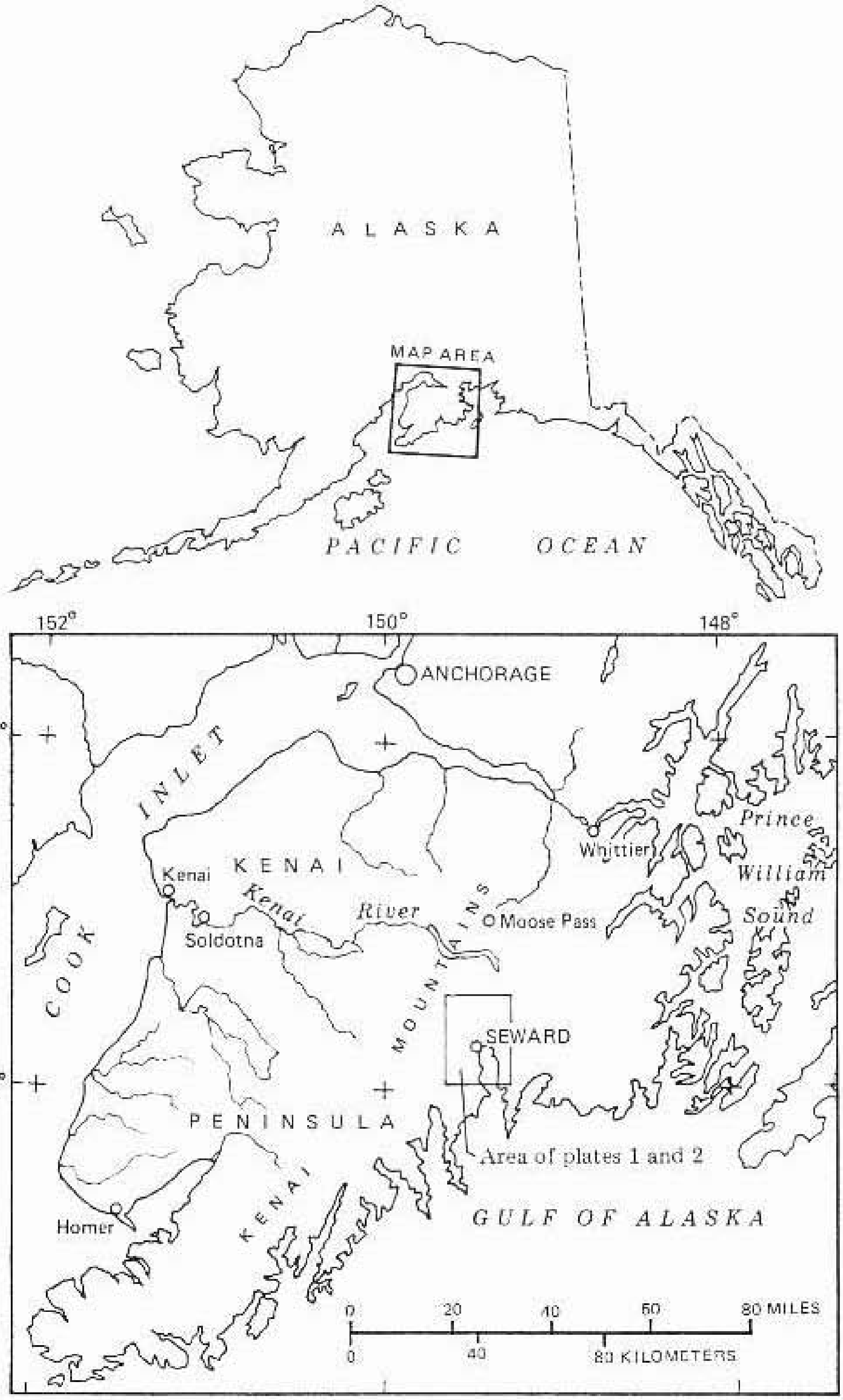

Figure 1.--Location of Seward area in southcentral Alaska.

and culverts, causing overtopping and erosion of bridge approaches and railroad and highway embankments; interruption of highway and rail transportation; and destruction and damage to businesses and residences.

The intense rainfall saturated steep slopes along the mountain streams, inducing landslides, avalanches, and debris flows that contributed material to debris-laden floods and in some instances temporarily dammed stream channels. The sudden failure of these debris dams resulted in mass movement of earth, rock, vegetation, and water. This surge-release flooding produced peak discharges substantially greater than any previously determined flood flows.

Flood data in this report were collected as part of a long-term cooperative program between the U.S. Geological Survey and the State of Alaska, Department of Transportation and Public Facilities (ADOT&PF), and the Federal Highway Administration (FHWA). Additional support for preparation of this report was furnished by the ADOT&PF, Alaska Division of Emergency Services, FHWA, and the Federal Emergency Management Agency (FEMA). The meteorological and rainfall analysis is based on information provided by Gerald Nibler of the National Weather Service.

Purpose and Scope

This report documents the floods of October 1986 at Seward and adjacent areas at the head of Resurrection Bay using information collected and observations made by the U.S. Geological Survey during and after the catastrophic event. Included are descriptions of the mass movement features and processes active in the steep mountainous terrain surrounding Seward, the floods and their effects in each of the affected drainage basins, and a discussion of the hydraulic and statistical analyses of the flood data. A flood inundation map, a discussion of and a map delineating flood-related hazards, and tabulations of hydrologic and hydraulic data on the October 1986 and earlier floods provide a technical basis on which to make flood-plain management decisions. Stream names in parentheses on maps either do not appear on U.S. Geological Survey maps, or indicate local usage.

Acknowledgments

The assistance, cooperation, and information provided by personnel of several agencies and local governments, including the Kenai Peninsula Borough and the City of Seward, are gratefully acknowledged. Helicopter support was provided by the Alaska Army National Guard. Darryl Schaefermeyer and Kerry Martin, City of Seward, and W.F. Barber, Alaska Department of Transportation and Public Facilities, provided valuable technical support and the aerial photographs used to map inundated areas. Finally, the authors thank the people of Seward for granting access to their property to make measurements and observations, and for sharing their knowledge of the present and past floods and flood damage in the area.

PHYSICAL SETTING AND CLIMATE

Seward lies at the head of Resurrection Bay, a deep fiord about 25 mi long on the north shore of the Gulf of Alaska (fig. 1). Near Seward, the bay is 2 to 3 mi wide and about 500 ft deep. The water is deep immediately offshore except at the