DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE HAWAII STATE DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF WATER AND LAND DEVELOPMENT

HYDROLOGIC INVESTIGATIONS
ATLAS HA-239

FLOODS IN THE KAHALUU AREA OAHU, HAWAII

This report presents hydrologic data concerning the extent, depth, and frequency of flooding that are useful in planning for economic development of flood plains in the Kahaluu area, Oahu. The data provide a technical basis for solving flood-plain problems and formulating regulations for land use and development that will reduce future flood damage.

The approximate areas inundated by the February 4 and May 2, 1965, floods in the Kahaluu area are outlined on a topographic map to portray the flood hazard graphically. Location of the Kahaluu area is shown in figure 1. The boundary of flooded areas was surveyed using floodmarks identified in the field immediately after the floods.

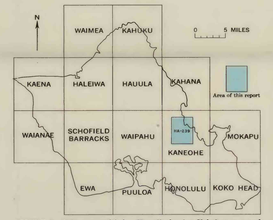

FIGURE 1.—*Index map of Oahu, Hawaii, showing Kahaluu area and 7½ minute quadrangles.*

The area inundated represents about 7 percent of the entire watersheds of Ahuimanu, Kahaluu, Waihee, and Kaalaea Streams. These four streams, ranging in length from 2½ to 3 miles, head at the crest of the Koolau Range at about the 2,500 foot elevation and descend to a common flood plain at about the 20-foot elevation.

Although peak discharges in the headwater reaches were generally higher on February 4, the inundated area was slightly greater on May 2 as a result of longer storm duration and larger volume of runoff. A flood of approximately the same magnitude and areal coverage occurred in November 1928, but no data are available to define the overflow boundary. The flood boundaries shown on the map are not necessarily those for the highest floods expected. They provide a record of historic fact that reflects channel conditions existing when the floods occurred. Planned protective works may reduce the area and frequency of flooding but might not eliminate all future flooding. Highway construction, housing developments, and other cultural changes may influence the area, pattern, and extent of inundation by future floods.

Cooperation and acknowledgment.—This report was prepared as part of a water-investigative program under cooperative agreement with the Hawaii State Department of Land and Natural Resources, Division of Water and Land Development. The cooperative program is administered on behalf of the State by the Board of Land and Natural Resources, Jim P. Ferry, Chairman and Member, and is directly coordinated by Robert T. Chuck, Manager-Chief Engineer and Chief Hydrographer, Division of Water and Land Development. Streamflow records at the gaging stations have been collected in cooperation with the State and the City and County of Honolulu.

Historical information was obtained from personal interviews with local residents.

Flood height.—The height of a flood at a gaging station usually is stated in terms of the gage height, or stage, which is the elevation of the water surface above a selected datum plane. Elevations shown on the map are in feet above mean sea level. Gage heights at gaging stations shown can be converted to elevation above mean sea level by adding the gage height to the appropriate gage datum as shown in the following table. The drainage area for each gage is listed in the table and the drainage divides are shown on the flood-inundation map.

Gaging station		Datum of gage above mean sea level (feet)	Drainage area (square miles)
No.	Site		
2825	Ahuimanu Stream near Kahaluu	19.37	2.16
2830	Kahaluu Stream near Heeia	357.52	.28
2836	South Fork Waihee Stream near Heeia	615.74	.03
2837	North Fork Waihee Stream near Heeia	639.00	.03
2838	Waihee Stream at altitude 260 feet near Heeia	259.28	.31
2840	Waihee Stream near Heeia	193.44	.93

Flood stage, the stage at which damage begins or threatens, is at elevation 28 feet (gage height, 8.6 feet) at the crest-stage gage on Ahuimanu Stream. The flood stage was exceeded once in 1963, once in 1964, and twice in 1965 during the period of record which began in April 1963.

Flood heights for all peaks equal to or greater than the flood stage of 361.5 feet (gage height, 4.0 feet) at the gaging station on Kahaluu Stream during the period of record (1937-65) are shown in figure 2. The irregular occurrence of floods is evident. There were 20 floods during the 29 years of record (January 1936 to June 1965). Six of these flood events occurred in 1 year and 13 in a 3-year period. No floods reached elevation 361.5 feet during the 14-year period 1944-57.

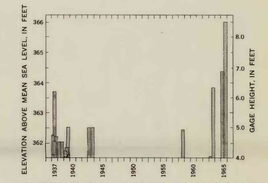

FIGURE 2.—*Floods above 361.5-foot elevation, 1937-65 Kahaluu Stream near Heeia (2830).*

Flood discharge.—The rate of discharge of a stream is the volume of flow that passes a particular site in a given period of time. Discharge rates usually are expressed in units of cubic feet per second (cfs) as in this report. To convert cubic feet per second to units of million gallons per day (mgd) multiply by 0.646. The maximum or peak discharge during a flood generally occurs at the time of the maximum height of the flood, but if the stream is affected by variable backwater, the maximum discharge may not coincide with maximum stage.

Flood frequency.—Frequency of flooding normally is derived from records of floods at gaging stations combined to define a regional flood-frequency relation. A flood-frequency relation based on the combined data of a group of gaging stations in a region having homogeneous flood characteristics is considered statistically more reliable than a flood-frequency relation defined from a single gaging-station record.

Regional flood-frequency relations have not yet been established for Hawaii. However, frequency of flooding at the gaging stations on Kahaluu Stream (2830) and Waihee Stream (2840) near Heeia and for the crest-stage gage on Ahuimanu Stream (2825) was derived from streamflow records at those stations combined with records for nearby stations. The general relation between frequency and discharge is shown in figures 3-5.

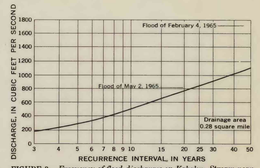

FIGURE 3.—*Frequency of flood discharges on Kahaluu Stream near Heeia.*

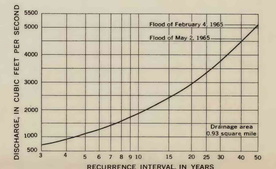

FIGURE 4.—*Frequency of flood discharges on Waihee Stream near Heeia.*

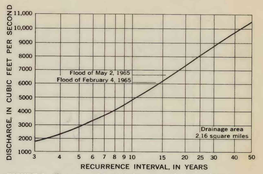

FIGURE 5.—*Frequency of flood discharges on Ahuimanu Stream near Kahaluu.*

The general relation between frequency and stage, shown in figure 6, is derived from the discharge-frequency relation and the stage-discharge relation, or rating curve, for the Ahuimanu gage.

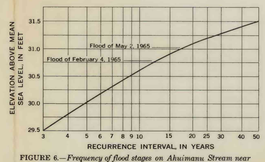

FIGURE 6.—*Frequency of flood stages on Ahuimanu Stream near Kahaluu.*

Recurrence intervals.—As applied to flood events, recurrence interval is the average number of years within which a given flood will be equaled or exceeded once. For floods greater than the 10-year flood, recurrence interval is virtually inversely related to the chance of a specific flood being equaled or exceeded in any one year. Thus a 20-year flood would have 1 chance in 20, or a 5-percent chance, of being equaled or exceeded in any year.

The general relation between recurrence interval and flood height at the crest-stage gage on Ahuimanu Stream is tabulated below.

Recurrence interval (years)	Elevations above mean sea level (feet)
50	31.52
30	31.32
20	31.12
15	30.92
10	30.67
7	30.32
5	30.02
4	29.77
3	29.47

It is emphasized that recurrence intervals are average figures—the average number of years that will elapse between floods equal to or greater than a given magnitude. The fact that a large flood occurred in February 1965 did not preclude the occurrence of a higher flood in May.

Flood elevations.—High-water marks in the major inundated area were flagged and surveyed immediately after the floods of February 4 and May 2, 1965. Representative elevations of the water surface are shown in figure 7. Elevations given were obtained from high-water marks on trees, posts, streambanks, and other surfaces and do not necessarily indicate the actual boundary of inundation. Flood areas shown on the map but not included in figure 7 were based on sketches of the flood boundaries made on the map and aerial photographs in the field.

The depth of flooding in the inundated area may not be the same in future floods because of variations in magnitude, duration, and timing of the individual stream discharges. The area subject to flooding would be approximately the same as that shown on the map for floods of similar magnitude under the same cultural conditions.

Additional data.—Other information pertaining to floods in the Kahaluu area can be obtained at the office of the U.S. Geological Survey, Honolulu, Hawaii, and from the following published reports:

Hoffard, S. H. and Vaudrey, W. C., 1964, An investigation of floods in Hawaii, Progress Report No. 8: U.S. Geol. Survey open-file report, 172 p.

Hoffard, S. H., 1965, Floods of December 1964 - February 1965 in Hawaii: Hawaii Div. of Water and Land Development, Dept. of Land and Natural Resources Report R26, 68 p.

Vaudrey, W. C., 1963, Floods of March - May 1963 in Hawaii: U.S. Geol. Survey open-file report, 65 p.

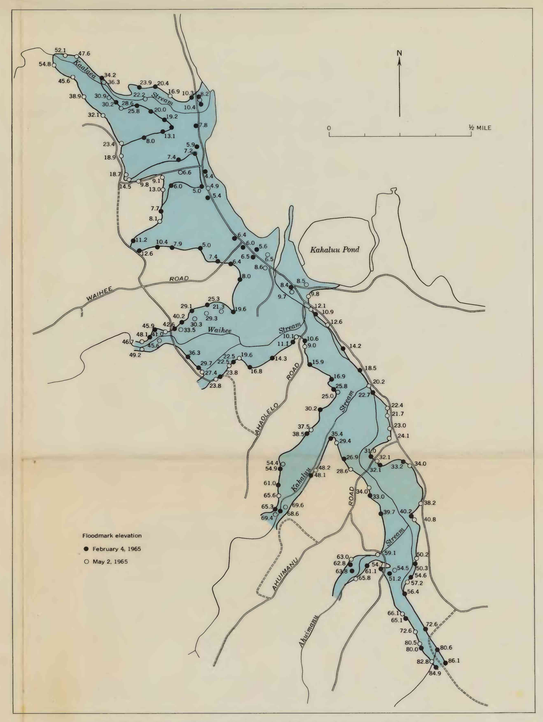

FIGURE 7.—*Outline of Kahaluu flood area showing floodmark elevations above mean sea level, in feet.*

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