DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

HYDROLOGIC INVESTIGATIONS
ATLAS HA-78

Photograph by Procter's Photographic Engineering Center
Aerial view looking northeast. Shows river floodwaters of December 22, 1955. Community of Arlynda Corners in foreground.

FLOODS NEAR FORTUNA, CALIFORNIA

The flood inundation map shows the approximate area inundated by the Eel River during the flood of December 22, 1955, from its mouth at the Pacific Ocean to a point about 18 river miles upstream. The flood of December 1955 is known to be the greatest since 1910 and is probably the greatest since the winter floods of 1861-62. Greater floods are possible but no attempt has been made to show their probable overflow limits.

The Eel River has a drainage area of 3,620 square miles at its mouth and it ranges in altitude from sea level to over 6,000 feet. In the upstream reaches the river is confined to a width of less than 1 mile, but in the vicinity of Alton it discharges onto a flood plain that attains a width of several miles at the river mouth.

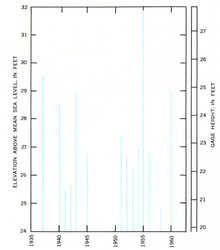

FIGURE 1.—*Annual floods above 24-foot elevation, 1937-61, Eel River at Fernbridge.*

The extent of the area inundated by the Eel River, in the reach of river covered by this map, is governed primarily by the magnitude of the floodflow. Other factors such as reduction in channel capacity caused at times by vegetative growth and changes in channel dimensions and alinement, height, location, and condition of levees, and encroachment on the flood plain also influence the extent of flooding. In the lower part of the reach near the Pacific Ocean, high tides may retard the floodflow and thereby increase the stage of floodwaters. Future protective works may reduce the frequency of flooding in the area but will not necessarily eliminate flooding. New highways and other cultural changes may also influence the inundation pattern of future floods.

Cooperation and acknowledgement.—The preparation of this flood inundation map was financed through a cooperative agreement between the California Department of Water Resources and the U.S. Geological Survey.

Information concerning flood elevations and overflow boundaries was furnished by the following agencies: California Division of Highways, U.S. Army Corps of Engineers, and U.S. Weather Bureau.

Flood elevation.—The elevation of a flood at gaging stations is usually stated in terms of the gage height or stage, which is the height of the water surface above a selected datum plane. Gage heights or stages at the gaging station on Eel River at Fernbridge (7⅛ miles upstream from the mouth) can be converted to elevations above mean sea level by adding 4.1 feet. For example, the maximum gage height on the Eel River at the river-stage gage at Fernbridge, during the flood of December 22, 1955, was 27.7 feet; therefore, the corresponding elevation above mean sea level was 31.8 feet. Elevations shown in this atlas are in feet above mean sea level, datum of 1929, supplementary adjustment of 1956.

The elevation and year of occurrence of each annual flood (greatest flood each year) that exceeded 24 feet at the U.S. Weather Bureau river-stage gage at Fernbridge are shown in figure 1. The 24-foot elevation was exceeded 14 times in 25 years of record (fig. 1). Although floods above elevation 24 feet occurred on the average of about 5 per decade, 4 were experienced in 1 decade whereas 8 occurred during the period 1951-60. The irregular occurrence of floods is evident.

Regulation and diversion.—Flow from the uppermost 288 square miles of the Eel River drainage area has been subject to regulation by Lake Pillsbury since 1921. However, the effect of reservoir storage on annual flood peaks is small because less than one-tenth of the total drainage above the reach of river covered by this map is subject to regulation. Some of the water from Lake Pillsbury is diverted through the Potter Valley powerhouse and out of the Eel River basin. The effect of this diversion on annual flood peaks from the more than 3,000 square miles of drainage area is negligible.

Flood frequency.—Frequency of flooding on the Eel River is derived from the regional frequency relation for northern California combined with the nearly continuous record of annual floods since 1911 at the Geological Survey gaging station at Scotia (located about 21 miles upstream from the mouth) and from the record for the U.S. Weather Bureau river-stage station at Fernbridge, operated since 1938. A limited amount of historical information also is available from other sources.

Recurrence interval.—As applied to flood events, recurrence interval is the number of years, on the average, within which a given flood elevation will be equaled or exceeded once. It is inversely related to the chance of a specific flood being equaled or exceeded in any one year. Thus a 25-year flood would have 1 chance in 25 of being equaled or exceeded in any one year or a 30-year flood would have 1 chance in 30 of being equaled or exceeded in any one year.

The relation between recurrence interval and flood elevation at the river-stage gage at Fernbridge is shown graphically in figure 2, and is tabulated below. Large errors may result if the flood-frequency curve is extrapolated beyond the limits shown.

FIGURE 2.—*Frequency of floods above elevation 25.5 feet on Eel River at Fernbridge.*

Recurrence interval (years)	Elevation of Eel River at Fernbridge (feet above mean sea level)
100	31.8
50	31.0
25	30.2
10	28.9
2	25.5

It is emphasized that recurrence intervals are average figures--the average number of years in which floods of specific elevation will be equaled or exceeded. Thus, on the Eel River, a flood that reaches a 31-foot elevation at the river-stage station at Fernbridge is said to have a recurrence interval of 50 years or a 1-in-50 chance of occurring in any one year. However, because of the erratic nature of flood occurrence, the 31-foot elevation may not be reached in a given 50-year period or it may be attained several times.

Flood profiles.—A profile of the water surface along the Eel River in the vicinity of Fortuna, constructed from marks left by the flood of December 22, 1955, is shown in figure 3, together with profiles of hypothetical floods with 2, 10, 25, and 50-year recurrence intervals. The flood of December 22, 1955, is considered to have a recurrence interval slightly in excess of 100 years. Profiles of the hypothetical floods shown are derived from stage-frequency relations at the gages at Scotia and Fernbridge and at intervening points. Upstream from Fernbridge, profiles of floods for other selected frequencies can be plotted on figure 3 by determining the flood elevation at Fernbridge from figure 2 and drawing the profile through this point, generally parallel to the profiles shown. Profiles for the hypothetical floods were not extended downstream below Fernbridge (river mile 7.5) because of uncertainties regarding distribution of flow in distributary channels, tide effects, and occurrences of levee breaks. Below Fernbridge the profile reflects conditions that existed at the time of the 1955 flood. A future flood of the same magnitude as that in 1955 at the gaging station at Scotia would not necessarily duplicate the profile shown in figure 3. Because of the extremely wide flood plain and the many channels and levees, the profile is not necessarily representative of flood elevations across the entire width of flood plain. Alterations in the creek channel or levee system may have a marked effect on the flood profiles downstream from Fernbridge.

The abrupt changes in the profiles at Fernbridge for the greater floods indicate the difference in water-surface elevations at the upstream and downstream sides of the bridge caused by constriction of the channel through the bridge structure.

The base line for the profiles is located generally along the centerline of the river. River miles measured upstream from the mouth of the Eel River, used for the profiles of figure 3, are marked along the river on the map.

The approximate depth of flooding at any point upstream from Fernbridge can be estimated by subtracting the ground elevation (shown by contours on the map) from the water-surface elevation indicated by the profiles of figure 3. The approximate ground elevation can be determined from information indicated by contours on the map although more accurate elevations can be obtained by leveling to nearby bench marks. The flood profile downstream from Fernbridge is not necessarily representative of the flood elevation across the entire width of the flood plain, and flood depths obtained from the map should be considered only approximate.

Tributaries.—The Van Duzen River flows into the Eel River at river mile 14.3 and is the only major tributary along the reach of river shown. Floods in the Eel River basin result from general storms of relatively moderate intensities which cover large areas so that floods with about the same recurrence intervals occur on both the Eel and Van Duzen Rivers during the same storm event.

The Van Duzen River drainage area is about one-eighth of the total Eel River basin drainage. Because this is a relatively small part of the total drainage area, and because of the difference in timing of flood peaks on the two rivers, the flow from the Van Duzen River has little effect on the elevation of major floods on the Eel River.

Areas inundated by overflows of small tributaries are not shown because few data regarding the extent of their flooding are available. These tributaries are so small in relation to the Eel River that they have little or no effect on Eel River flood elevations.

Additional data.—Other information pertaining to floods in the Eel River basin may be obtained at the office of the U.S. Geological Survey, Menlo Park, Calif., and from the following reports:

Hofmann, Walter, and Rantz, S. E., 1962, Floods of December 1955-January 1956 in the far Western States: U.S. Geol. Survey Water-Supply Paper, Part 1, 1650-A and Part 2, 1650-B.

U.S. Geological Survey, 1960, Compilation of records of surface waters of the United States through September 1950, pt. 11-A, Pacific slope basins in California except Central Valley: U.S. Geol. Survey Water-Supply Paper 1315-B.

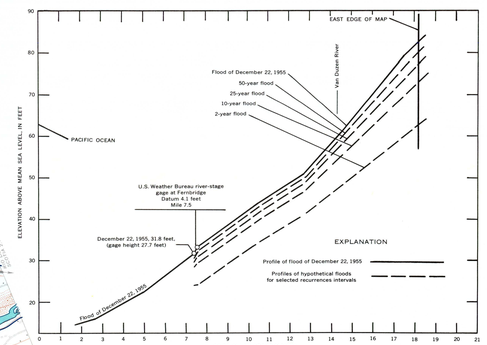

FIGURE 3.—*Profiles of floods on Eel River.*

EXPLANATION

Area flooded in December 1955

Boundary of 1955 flood

River miles measured upstream from mouth of Eel River (7)

SCALE 1:24 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVALS 10 AND 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
SHORELINE REPRESENTS APPROXIMATELY MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 4 FEET

APPROXIMATE MEAN DECLINATION, 1963

AREA OF THIS REPORT

EEL RIVER FLOODS
Major floods at the U.S. Weather Bureau river-stage gage on the Eel River at Fernbridge

Date of flood	Eel River at Fernbridge		
	Gage height (feet)	Elevation above mean sea level (feet)	Discharge (in cubic feet per second)
December 22, 1955	27.7	31.8	630,000
December 11, 1937	25.4	29.5	430,000
February 9, 1960	24.8	28.9	380,000

Base from U.S. Geological Survey topographic maps

FLOODS NEAR FORTUNA, CALIFORNIA

By

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1963

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—63078

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