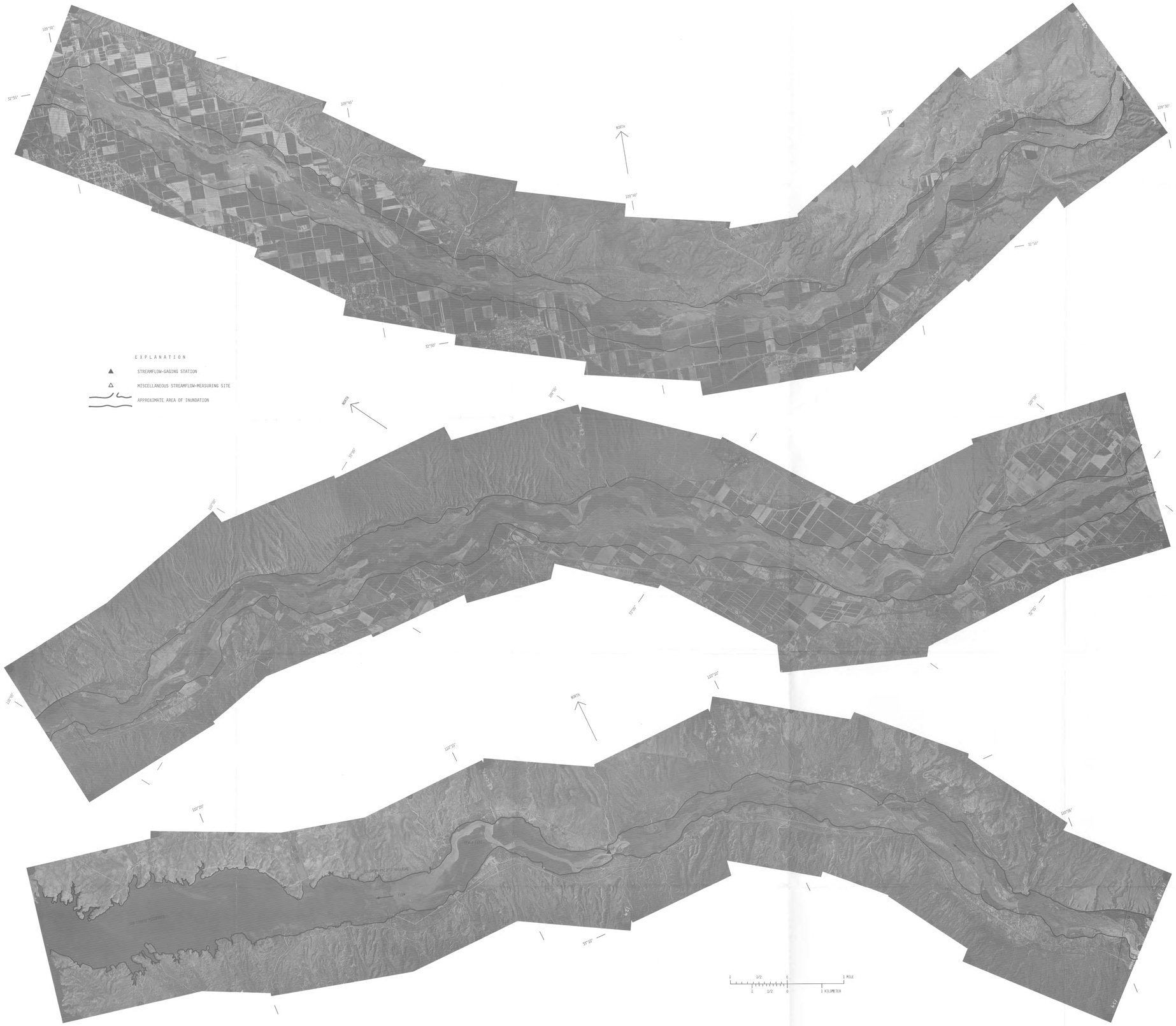
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U.S. ARMY CORPS OF ENGINEERS AND THE U.S. BUREAU OF RECLAMATION

WATER-RESOURCES INVESTIGATIONS REPORT 85-4225-A
SHEET 1 OF 3



INTRODUCTION

The flood of October 1983 on the Gila River from the head of Safford Valley to San Carlos Reservoir was the largest since at least 1906. From Winkelman to the mouth of the Salt River, the flood was the largest since at least 1928 when Coolidge Dam was completed. The flood was caused by heavy rainfall over southeastern Arizona and western New Mexico from September 28 through October 3. Total precipitation for the period was 11.2 in. at Blue River near Clifton, 6.2 in. at Safford, and 5.5 in. at Florence (National Environmental Satellite Data and Information Service, 1983).

The purpose of this report is to document an unusual flood on the Gila River by showing the inundated areas in selected reaches and by presenting information on runoff and flood frequency. The boundaries of the inundated areas will serve as an aid in estimating future flood risk. This investigation was made in cooperation with the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. This report is the first in a series of reports that will document the flood of October 1983 in southeastern Arizona.

The authors wish to acknowledge the cooperation and assistance of residents along the Gila River and of personnel of the following agencies and organizations: U.S. Soil Conservation Service, Gila River Indian Community, San Carlos Irrigation and Drainage District, Arizona State Land Department, Arizona Department of Transportation, Graham County Agricultural Extension Service, and Southern Pacific Transportation Company.

AREAS OF INUNDATION

Flood boundaries were delineated along three reaches of the Gila River: (1) from the head of Safford Valley to San Carlos Reservoir, (2) from Winkelman to Kelvin, and (3) from Ashurst-Hayden Dam to the confluence with the Salt River. (See fig. 1 and photomosaics.) In the intervening reaches, the flow generally was confined to narrow canyons.

Aerial photographs taken on October 7, 1983, were used to delineate the boundaries of the inundated areas along the Gila River. The boundaries were verified on the basis of other aerial photographs taken during and after the flood, interviews with local residents and other investigators, and onsite inspections. Several small islands of high ground within the boundaries may not have been inundated but are shown as inundated areas on the photomosaics because they could not be identified.

In reach 1 the Gila River emerged from the narrow canyon at the head of Safford Valley (fig. 2) and spread out over the flood plain. The inundated area of reach 1 was as much as 6,400 ft wide. Large areas of farmland were eroded, and ditches and crops were ruined as a result of the flooding. Hundreds of livestock were lost or drowned in the flood. Cotton crops in the flood plain that were not yet harvested were severely damaged or destroyed. Irrigation systems and wells were destroyed, and huge deposits of sediments were left on the flood plain. Agricultural damages in Graham County were estimated to be $14,533,400 (Federal Emergency Management Agency, 1983).

All the highway bridges that span the Gila River in reach 1 were impassable during the flood and about 300 residents were isolated on the north side of the Gila River. A 400-ft reach of the south approach to the U.S. Highway 70 bridge at Bylas was inundated, and erosion of the upstream side of the approach forced closure of the bridge for several days.

In reach 2 more than 500 residents were evacuated from their homes in lower Winkelman when floodwater from the San Pedro River entered the Gila River. Municipal wastewater-treatment plants were inundated in Winkelman and Hayden and protection dikes around water-treatment lagoons were breached at Kearny. High-water marks on the Southern Pacific Railroad bridge at Hayden indicated that floodwater was at least 23 ft deep in the Gila River. All the residents located in the flood plain in the community of Riverside (see photomosaic) were evacuated. Floodwater from the Gila River overtopped many of their homes (fig. 3). Downstream from Riverside at the Gila River at Kelvin gaging station (site 8), the floodwater was as much as 24 ft deep.

In reach 3 floodwater in the Gila River spread out over a broad area inundating desert and farmland and severely disrupting highway traffic. At U.S. Highway 89, (site 9, see photomosaic), the flow was confined to the bridge opening; however, at the State Highway 87 bridge (site 10, see photomosaic), both approaches were inundated. The south approaches of the north-bound and south-bound lane bridges on Interstate 10 were washed out (fig. 4). At the confluence of the Santa Cruz and Gila Rivers, residents of the village of Santa Cruz (see photomosaic) were isolated when floodwater from the rivers cut off access to the community. Downstream from the mouth of the Santa Cruz River, the inundated area was as much as 2 mi wide.

RUNOFF

The main source of runoff upstream from San Carlos Reservoir was the San Francisco River, which joins the Gila River 7 mi southwest of Clifton (fig. 2). The peak discharge at the San Francisco River at Clifton gaging station (site 1) was 90,000 ft³/s, which occurred at 0945 hours on October 2 (table 1). This discharge is the largest at this site since at least 1870. On the Gila River 6 mi upstream from the San Francisco River, the peak discharge was only 15,200 ft³/s. With the combined inflow of the San Francisco River, Eagle Creek (site 2), and Bonita Creek (site 3), the flood reached a peak discharge of 132,000 ft³/s at the Gila River at head of Safford Valley near Solomon gaging station (site 4) at the upstream end of reach 1. This discharge is the largest at the site since at least 1906. As the floodwater moved down Safford Valley, the flow spread out over the flood plain, which would normally result in a decreased peak discharge; however, tributary inflow increased the peak discharge of the Gila River to 150,000 ft³/s at the Gila River at Calva gaging station on October 3 (site 5, fig. 5). This is the largest discharge at this site since at least 1906. The flood runoff from reach 1 filled San Carlos Reservoir to capacity for the third time since Coolidge Dam (fig. 2) was completed in 1928. Inflow to the reservoir for the period September 28 to October 7 was about 450,000 acre-ft. Water began to flow over the spillway at 1330 hours on October 4; on October 6, spill and release from the reservoir reached a maximum discharge of 5,020 ft³/s.

The flood on the Gila River in reach 1 therefore was halted at Coolidge Dam; however, a large flood on the San Pedro River entered the Gila River at Winkelman at the upstream end of reach 2, which is 31 mi below Coolidge Dam. At Hayden (site 7), just downstream from the mouth of the San Pedro River, the peak discharge was 125,000 ft³/s on October 2. A small part of the discharge came from inflow to the Gila River between Coolidge Dam and Winkelman, but most of the discharge came from the San Pedro River. At the downstream end of reach 2 at the Gila River at Kelvin gaging station (site 8), the discharge increased from 8,400 ft³/s at 0100 hours on October 2 to a peak of 100,000 ft³/s at 1100 hours. The hydrograph was estimated on the basis of high-water marks and discharge measurements made after the peak (fig. 5). The peak discharge was the largest since 1916.

In reach 3 downstream from Ashurst-Hayden Dam—a low irrigation diversion dam—the peak discharge steadily decreased as the flow spread out over the broad flood plain. Tributary inflow was small with the exception of the Santa Cruz River. Peak discharges decreased from 61,000 ft³/s at Florence (site 9) to 46,000 ft³/s at Sacaton (site 10) and to 35,000 ft³/s at the Gila River near Laveen gaging station (site 11) just upstream from the mouth of the Santa Cruz River. The peak discharge occurred about 1400 hours on October 4 at the Gila River near Laveen gaging station. The peak discharge on the Santa Cruz River probably occurred a few hours earlier and was estimated to be 33,000 ft³/s. The combined peak discharge on the Gila River downstream from the confluence with the Santa Cruz River was estimated to be 65,000 ft³/s.

FLOOD FREQUENCY

The recurrence interval of a flood event is the average interval of time within which a given flood will be exceeded once. In terms of probability, the 100-year flood has one chance in 100 (1-percent probability) of being exceeded in any given year; thus, a 25-year flood would have one chance in 25 (4-percent probability) of being exceeded in *any* given year. Because the 25-year flood can occur in any year, or even in successive years, an inference that such a flood will occur at regular intervals is misleading. The length of record improves the reliability of the estimated recurrence interval of a particular flood.

Flood-frequency relations for the two Gila River gaging stations upstream from Coolidge Dam (fig. 6) show that the October 1983 flood had a recurrence interval of about 100 years. The relations are based on analyses of the annual maximum discharges, which includes the October 1983 discharge, using the log-Pearson Type III method (U.S. Water Resources Council, 1981). Downstream from Coolidge Dam—actually downstream from the San Pedro River and upstream from the Santa Cruz River—the recurrence interval for the flood was between 50 and 100 years. Recurrence intervals for the two Gila River gaging stations in this reach are based on discharges that represent inflow to the Gila River below Coolidge Dam.

SELECTED REFERENCES

Federal Emergency Management Agency, 1983, Flood hazard mitigation report: Federal Emergency Management Agency Report FEMA-691-DR-AZ, 41 p.

National Environmental Satellite Data and Information Service, 1983, Climatological data, Arizona, September 1983: National Oceanic and Atmospheric Administration, v. 87, no. 9, 29 p.

_____1983, Climatological data, Arizona, October 1983: National Oceanic and Atmospheric Administration, v. 87, no. 10, 28 p.

U.S. Water Resources Council, 1981, Guidelines for determining floodflow frequency: U.S. Water Resources Council Bulletin 17b, 181 p.

Figure 1.--Area of report.

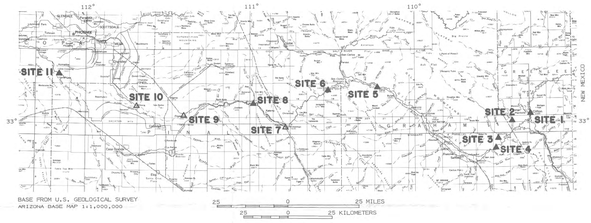


Figure 2.--Location of sites in the study area.

CONVERSION FACTORS

For readers who use metric units, conversion factors for terms used in this report are listed below:

Multiply	By	To obtain
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi²)	2.590	square kilometer (km²)
cubic foot per second (ft³/s)	0.02832	cubic meter per second (m³/s)

AERIAL PHOTOGRAPHS AND PHOTOMOSAICS
BY COOPER AERIAL SURVEYS.
PHOTOGRAPHS TAKEN OCTOBER 7, 1983

REACH 1—FROM THE HEAD OF SAFFORD VALLEY TO SAN CARLOS RESERVOIR

FLOOD OF OCTOBER 1983 IN SOUTHEASTERN ARIZONA—AREAS OF INUNDATION IN SELECTED REACHES ALONG THE GILA RIVER

BY

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