

FIGURE 1. — Damage to Bennett-Clarkson Hospital area in Rapid City.



FIGURE 2. — Damage to new automobiles stored on flood plain at East Boulevard in Rapid City.



FIGURE 4. — Damage to Canyon Lake dam in Rapid City.



FIGURE 3. — Damage to trailer homes at Campbell Street in Rapid City.

INTRODUCTION
Rapid City, the second largest city in South Dakota, is located at the eastern edge of the Black Hills about 9 miles downstream from Pactola Dam. It is bisected laterally by Rapid Creek and longitudinally by the eastern flank of the Black Hills. Canyon Lake, a small recreation reservoir having a surface area of 35 to 40 acres, is located near the west city limits on Rapid Creek.

The floods of June 9-10, 1972, covered a relatively small area of the eastern Hills, extending from Sturgis on the north to Hermosa on the south and on the west to Pactola Dam. The area is mountainous with very steep heavily wooded slopes. Channels are shallow and generally are confined in narrow, winding canyons.

The flood along Rapid Creek gained national attention because of damage to property and the loss of life in Rapid City. It has been called the greatest disaster in the history of South Dakota. The flood map and stage graphs show the results of analysis of data on the extent and frequency of the flood. These data provide a basis for making decisions concerning future development of the flood-prone area.

The deluge in the Black Hills west of Rapid City was the result of meteorological conditions consisting of a strong low-level easterly flow which forced moist unstable air uplope on the Hills. This strong and sustained orographic effect caused air to rise, cool, and release its moisture in thunderstorms. The high winds aloft prevented the thunderstorms from moving away from their area of formation (Elioy Balke, National Weather Service, written comm., 1972). Rainfall began the afternoon of June 9 and ended about midnight. Precipitation totals varied from 4 inches to more than 12 inches in the watershed between Pactola Dam and Rapid City. Fifteen inches of rainfall was measured at Nemo, about 8 miles north of Pactola Reservoir. Pactola Reservoir effectively stored all runoff originating upstream from Pactola Dam. All flow passing through the city originated in the 60 square miles of drainage area between Canyon Lake and Pactola Dam.

ACKNOWLEDGMENTS
This atlas was prepared under the direction of John E. Powell, district chief, in charge of water-resources investigations in South Dakota. The atlas was prepared to describe the floods of June 9-10, 1972, in the immediate vicinity of Rapid City as part of the U.S. Geological Survey program to document information in areas inundated by outstanding floods. Experienced personnel from five other States assisted with the field surveys.

THE FLOOD
The flood after the intense rainfall was short-lived. Overbank flow generally lasted less than 10 hours; however, the city sustained an unbelievable amount of damage in that short period (figs. 1, 2, 3). Stream velocities were high. Field surveys indicate that velocities as high as 25 feet per second were experienced (channel slope downstream from Canyon Lake exceeds 30 ft per mile). Tremendous quantities of debris and sediment were transported by the floodwaters. Buildings were torn from their foundations and became battering rams to dislodge other buildings. Trailer homes became boats and floated downstream to lodge in bridge openings. Stream channels and banks were severely eroded and sediment was transported downstream and deposited on the flood plain. The blocking of culvert and bridge openings caused additional submergence of the flood plain.

Flood damage to Rapid City has been estimated by the U.S. Army Corps of Engineers to be in excess of \$79,000,000. More than 1,335 homes and trailers were destroyed or were over 5,000 automobiles. The latest official count as of this writing (Oct. 1972) places the number of dead at 237 and the number of missing persons at eight. The dam creating Canyon Lake, a recreation reservoir of 35 to 40 acres surface area, was overtopped and partly destroyed (fig. 4). Failure of the dam, however, was not considered to have a major effect on the peak discharge (M. S. Petersen, written comm., 1972).

FLOOD DISCHARGE
Discharge is the rate of flow of a stream usually expressed in cubic feet per second (cfs). The peak stage (height of water) of 15.77 feet at the gaging station above Canyon Lake was 7.89 feet higher for the June 9-10, 1972, flood than the previous peak stage of record of May 23, 1952; the peak discharge of 31,200 cfs was 12 times that of the flood of May 23, 1952, the previous maximum peak discharge in 26 years of record.

The gaging station was inundated but not destroyed. Figure 5 is the stage graph for the station for June 9-10, 1972.

By way of comparison, a peak discharge of 2,220 cfs was measured in Claghorn Canyon for the flood of July 13, 1962. The two measurements were made at nearly the same site (Roetved and others, 1968).

FLOOD PROFILES
The extent of inundation from Rapid Creek in and around Rapid City is shown on the topographic base map. Inundation boundaries were identified from field inspection.

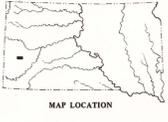
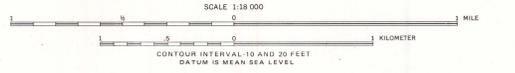
The high-water profile was determined by spirit leveling to high-water marks on both banks. The profile shown (fig. 6) is a composite drawn from three high-water marks. Stream miles used as a base for plotting the profile are actual stream miles measured along the low-water channel, the initial point being the mouth of Rapid Creek. Distances are marked along the channel at 1-mile intervals. Abrupt changes in the profile indicate the difference in water-surface elevation at the upstream and downstream side of bridges and road crossings.

FLOOD FREQUENCY
The relation of the 50-year flood to drainage area for the Rapid City region (fig. 7) is based on the flood frequency report by Patterson (1966). Also plotted in figure 7 are the peak discharges for the flood of June 9-10, 1972, at all points measured. These peaks exceed the 50-year discharge by several orders of magnitude but are less than maximum known floods from other regions as indicated by the enveloping curves of Matthai and Hoyt and Langbein. The true frequencies of these floods cannot be determined from present streamflow records, which are relatively short.

ADDITIONAL DATA
Additional information pertaining to floods in the Black Hills area can be obtained at the district office of the U.S. Geological Survey, Huron, South Dakota.

REFERENCES CITED
Hoyt, W. G., and Langbein, W. B., 1955, Floods: Princeton Univ. Press, p. 59, 60, 72-76.
Matthai, H. P., 1969, Floods of June 1965 in the South Platte River basin, Colorado: U.S. Geol. Survey Water-Supply Paper 1850-B, 64 p.
Patterson, J. L., 1966, Missouri River basin above Sioux City, Iowa, magnitude and frequency of floods: U.S. Geol. Survey Water-Supply Paper 1679, 471 p.
Roetved, J. O., and others, 1968, Summary of floods in the United States during 1962: U.S. Geol. Survey Water-Supply Paper 1820-E, 124 p.
Roetved, J. O., and others, 1970, Summary of floods in the United States during 1965: U.S. Geol. Survey Water-Supply Paper 1850-E, 110 p.
Photographs courtesy of Rapid City Journal.

Base from U.S. Geological Survey, Rapid City East and Rapid City West, 1:24,000, 1953. Photorevision as of 1971.



EXPLANATION
 Area flooded, June 9-10, 1972
 Boundary of flooded area
 River miles measured along stream channel upstream from mouth
 U.S. Geological Survey gaging station

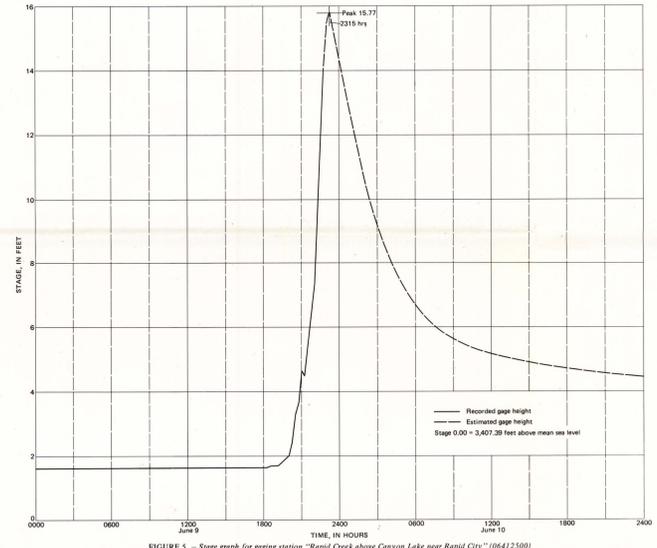


FIGURE 5. — Stage graph for gaging station "Rapid Creek above Canyon Lake near Rapid City" (06412500) for June 9-10, 1972.

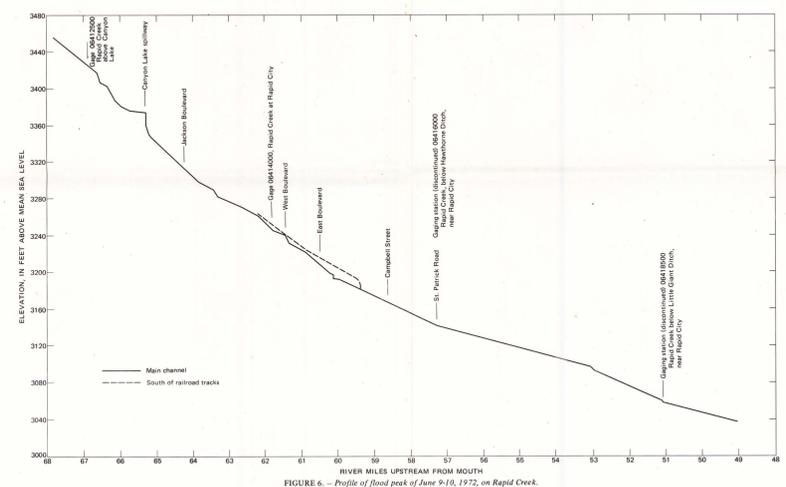


FIGURE 6. — Profile of flood peak of June 9-10, 1972, on Rapid Creek.

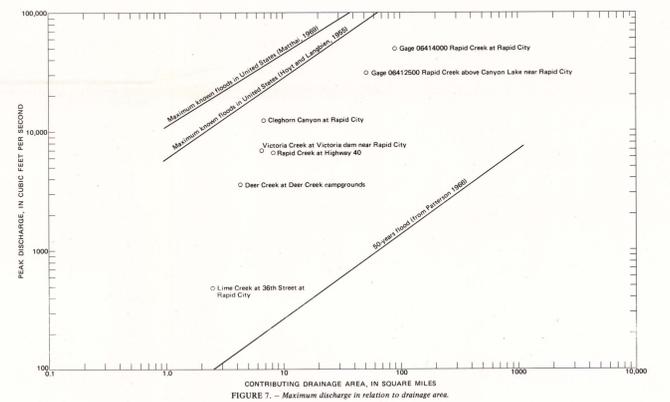


FIGURE 7. — Maximum discharge in relation to drainage area.

FLOOD OF JUNE 9-10, 1972, AT RAPID CITY, SOUTH DAKOTA
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1973