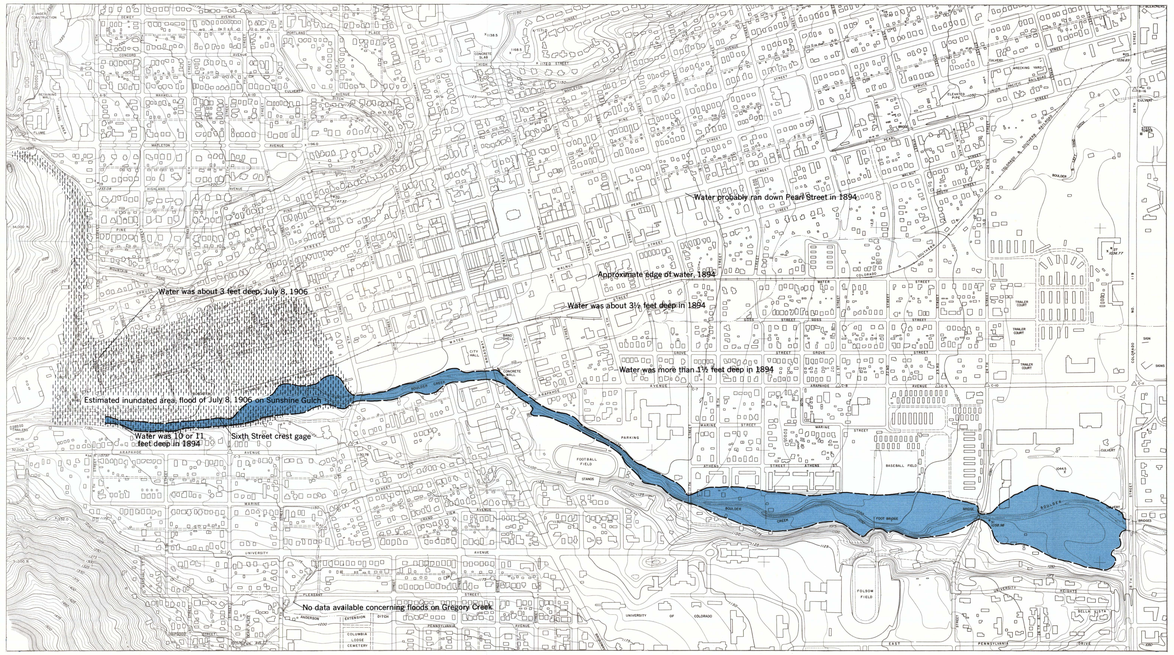
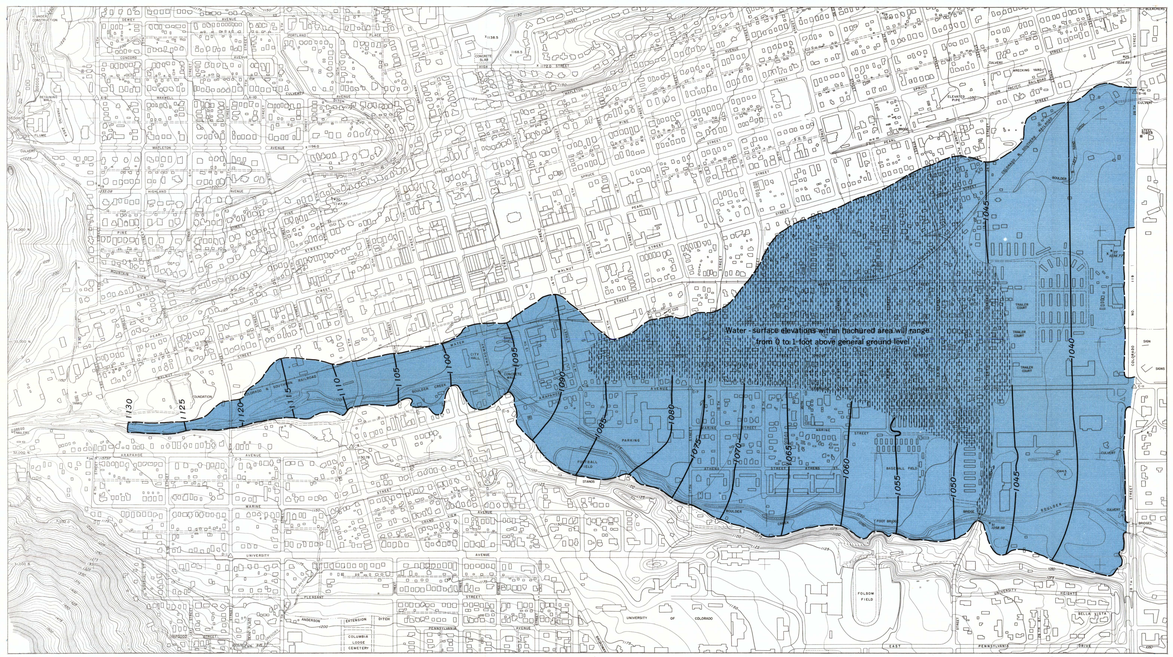


Topographic map furnished by City of Boulder, Colorado

FIGURE 4.—HISTORICAL FLOOD DATA AND ESTIMATED AREA INUNDATED BY HYPOTHETICAL 25-YEAR FLOOD ON BOULDER CREEK AT BOULDER, COLORADO

Topographic map furnished by City of Boulder, Colorado

FIGURE 6.—ESTIMATED AREA INUNDATED AND WATER-SURFACE CONTOUR LINES FOR HYPOTHETICAL 100-YEAR FLOOD ON BOULDER CREEK AT BOULDER, COLORADO



Topographic map furnished by City of Boulder, Colorado

FIGURE 5.—ESTIMATED AREA INUNDATED AND WATER-SURFACE CONTOUR LINES FOR HYPOTHETICAL 50-YEAR FLOOD ON BOULDER CREEK AT BOULDER, COLORADO

FREQUENCY AND EXTENT OF FLOOD INUNDATION ON BOULDER CREEK AT BOULDER, COLORADO

Introduction.—This atlas summarizes the results of an investigation of the flood flow characteristics of Boulder Creek and its tributaries in a selected area at Boulder, Colorado. Historical data for past floods are compiled, and hazards of future flooding are estimated. Computations of flood elevations, boundaries of inundated area, and velocities of flow are based on the condition of the creek valley and its constrictions existing in the fall of 1959. All elevations are referred to the datum, 4,248.0 feet above mean sea level, used by the city of Boulder. The Sixth Street crest-stage gage is located on the left (north) bank of the Boulder Creek channel, 100 feet upstream from the centerline of Sixth Street.

Flood History of Boulder Creek.—Outstanding floods occurred on Boulder Creek in May-June 1844, June 1864, May 1876, May 31-June 1, 1894, June 2, 1914, and June 6, 1921. The flood in 1894 probably was the greatest, although the flood in 1864 was comparable. The only data concerning elevations reached by past floods on Boulder Creek in the study area are those shown in figure 4 for the flood of 1894. Two floods in the period 1889–1959, those of 1894 and 1914, caused damage in Boulder. The flood of 1921, might have caused damage if present channel constrictions had existed at that time. Figure 1 shows the estimated elevations the floods of 1894, 1914, and 1921 would have reached at the Sixth Street crest-stage gage under present conditions of flood plain development. Six outstanding floods occurred during the period 1844–1959, an average of one flood every 19 years. However, during the period 1894–1959, three floods occurred at intervals of 20, 7, and 38 years, respectively (fig. 1). The erratic occurrence of floods is evident.

Elevation and frequency of floods.—Frequency of floods was computed from the combined record of flood peaks at seven gaging stations on Boulder Creek and on four other streams in the area. All five streams have similar characteristics; their sources are at the Continental Divide, and their drainage basins are subject to similar meteorological phenomena. The gaging stations are located near the base of the foothills of the Rocky Mountains. The period of record of annual peaks at the gaging stations ranges from 62 to 70 years, with certain historical information available for floods as early as 1844. Locations of the stations are shown in figure 2. The relation between flood elevation and recurrence interval at the Sixth Street crest-stage gage site under present conditions of channel constriction is shown in figure 3. It is emphasized that recurrence intervals are average figures—the average interval within which floods of a given magnitude will be equaled or exceeded once. Another way of comparing flood frequencies is in terms of their probabilities of occurrence (the reciprocals of their recurrence intervals). Thus, a flood with a recurrence interval of 50 years has a 2 percent chance, and a flood with a recurrence interval of 100 years has a 1 percent chance, of being equaled or exceeded in any given year. The recurrence interval of the 1894 flood is about 95 years; of the 1914 flood, about 40 years, and of the 1921 flood, about 23 years. The probabilities of these floods being equaled or exceeded in any given year are, respectively, about 1.0, 2.5, and 4.3 percent. The recurrence intervals of the hypothetical floods whose estimated areas of inundation are shown in figures 4–6 are 25, 50, and 100 years.

Flood depths.—Depth of flooding can be estimated for the hypothetical 50-year flood from figure 5 and for the hypothetical 100-year flood from figure 6 by computing the difference between the elevation of the water surface, shown by the heavy contour lines, and the elevation of the ground, shown by the light contour lines. Depths in the shaded areas shown on figure 5 and 6 will be within the ranges indicated.

Flood velocities.—Velocities probably will be in excess of 20 feet per second in the center of the main channel during both the 50- and 100-year hypothetical floods; on the other hand, there will be points on the overflow plain where the velocity may be zero. Mean velocities on the overflow plain to the left of the main channel near 6th and 9th Streets will be about 5 feet per second for the 50-year flood and about 6 feet per second for the 100-year flood. In the vicinity of the City Hall, these velocities are estimated as 7 and 10 feet per second respectively. Mean velocities in the overflow plain will decrease gradually downstream from the City Hall to less than 1 foot per second for both the 50- and 100-year floods in the area just upstream from 28th Street. It is emphasized that some point velocities probably will exceed mean velocities substantially. It is not possible to accurately predict what the velocity will be for a given flood at a given point in the channel.

Tributary streams.—Floods on Sunshine Gulch and Gregory Creek will inundate portions of the area shown on the maps. There are insufficient data to form a basis for dependable analysis of floods on small streams draining the foothills of the Rocky Mountains, but it is known that at least one flood, that of July 8, 1906, on Sunshine Gulch caused appreciable damage. An estimate of the area inundated by that flood is shown by the shaded portion of figure 4. The delineation of the area is the result of a very rough field estimate, and should not be considered final. No data are available concerning floods on Gregory Creek, although field inspection indicates that areas contiguous to the stream will be inundated by large floods.

Effect of alterations.—Changes in the regimen of Boulder Creek, either by substantial artificial regulation of flood peaks by storage and diversions or by alterations to the flood plain and main channel, will modify the results shown. In the past, regulation of flood peaks has been negligible, but there has been increasing encroachment on the flood plain. Areas of inundation, flood depths, and velocities in the overflow section will be increased if bridges become plugged with debris; if additional encroachment takes place on the flood plain; or if additional growth of trees and underbrush occurs along the main channel but will be reduced if the main channel is improved hydraulically, and there is no additional encroachment on the flood plain.

Additional data.—Other information concerning floods on Boulder Creek can be obtained at the office of the U. S. Geological Survey, Room 1227, Building 25, Denver Federal Center, Denver, Colorado, and from the following report:

U. S. Geological Survey, 1948, Floods in Colorado, U.S. Geol. Survey Water-Supply Paper 997.

Cooperation and acknowledgments.—The preparation of this atlas is a part of an investigation financed through a special cooperative agreement between the Geological Survey and Boulder County, Colorado.

The topographic base map used in figures 4–6 was furnished by the city of Boulder. Mr. Theodore Mikesell, Planning Director of the city of Boulder, furnished previous engineering reports concerning floods in Boulder.

The atlas was prepared by Clifford T. Jenkins, under the direction of Wallace T. Miller, District Engineer, Geological Survey. Mr. Eric Meyer assisted the author in the field investigations and computations.

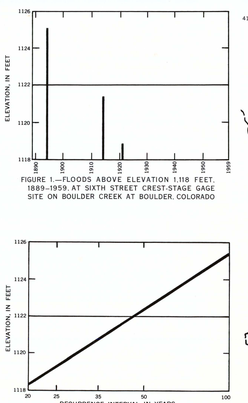
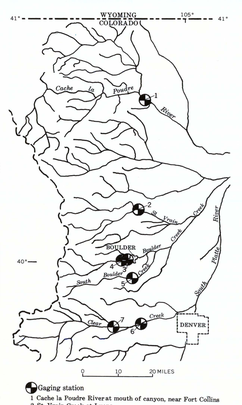


FIGURE 1.—FLOODS ABOVE ELEVATION 1,118 FEET, 1889–1959, AT SIXTH STREET CREST-STAGE GAGE SITE ON BOULDER CREEK AT BOULDER, COLORADO

FIGURE 3.—FREQUENCY OF FLOODS ABOVE ELEVATION 1,118 FEET AT SIXTH STREET CREST-STAGE GAGING SITE ON BOULDER CREEK AT BOULDER, COLORADO



Gaging station
1 Cache la Poudre River at mouth of canyon, near Fort Collins
2 St. Vrain Creek at Lyons
3 Boulder Creek near Boulder
4 Boulder Creek near Orodell
5 South Boulder Creek near Eldorado Springs
6 Clear Creek near Golden
7 Clear Creek at Forks Creek

FIGURE 2.—LOCATION OF GAGING STATIONS USED TO DETERMINE FREQUENCY OF FLOODS ON BOULDER CREEK AT BOULDER, COLORADO

EXPLANATION

Boundary of estimated area inundated by hypothetical floods, based on the condition of Boulder Creek Valley and its constrictions existing in the fall of 1959

1100
Estimated water-surface contours of hypothetical floods

APPROXIMATE MEAN DECLINATION, 1961

FLOODS AT BOULDER, COLORADO

SCALE 1:6000

500 0 500 1000 1500 2000 FEET

CONTOUR INTERVAL 5 FEET
ELEVATIONS SHOWN ARE REFERRED TO BOULDER CITY DATUM
TO CONVERT TO ELEVATIONS ABOVE MEAN SEA LEVEL, ADD 4248.0 FEET

1961

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