Paleoflood Research of South Boulder Creek Basin near Boulder, Colorado

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Abstract

The highly urbanized city of Boulder in Boulder Creek Basin is considered one of the most at-risk communities for flash flooding in Colorado. Boulder is located at the base of the Colorado Front Range foothills with its headwaters at the Continental Divide. South Boulder Creek (SBC) contributes substantially to the city's flood hazard. Four floodplain studies have been completed for SBC since 1969, producing varying flood-frequency estimates and, thus, large uncertainties in flood frequency (e.g., the 100-year flood varied from 122 to 223 m^3/s). In 2008, the City of Boulder completed a new floodplain study to better define flood hydrometeorology, flood frequency, and flood inundation for SBC. To complement the City of Boulder's study, paleoflood research was done along SBC and most tributaries from the headwaters to Eldorado Springs just south of Boulder, where urbanization and channel disturbance precludes paleoflood studies.

Paleoflood data using bouldery flood deposits and non-inundation surfaces were used to document maximum flood discharges, and relative age methods were used to date paleofloods that have occurred during the last 10,000 years. Hydraulic reevaluation and paleoflood data for the 1938 flood of record (209 m^3/s) at the SBC streamflow gaging station at Eldorado Springs (42.1 km^2) indicated the flood was overestimated by about 40 percent; the revised 1938 flood is 147 m^3/s. The expected moments algorithm was used with stream gage data (annual peaks and a mixed-population analysis of annual rainfall and snowmelt peaks) and paleoflood data to better define flood-frequency relations. The revised 100-year flood is 102 m^3/s. Analysis of paleoflood data also was used to define five distinct hydroclimatic regions for SBC. The most notable region extends from the base of the foothills west about 20 km (about 15 percent of the basin area) and is most prone to extreme flash flooding during storms. Snowmelt and low to moderate rainfall runoff regions define the remainder of the basin, and they contribute little to the largest floods. Paleoflood data also were used to define the footprint of the 1938 rainstorm; it is essentially the same as an independently reconstructed footprint of the 1938 rainstorm using historical rainfall data and meteorologic analysis. This cost-effective approach provided data on extreme floods critical to a better understanding of Boulder's flood risk and can be used in other regions.

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