Lahontan Reservoir Tributary No. 3 near Silver, Nevada

(Miscellaneous ungaged site near Silver Springs, Nevada;
USGS Nevada Water Science Center)

Review of peak discharge for flood of July 20, 1971

Location: This flood was located about 3 mi south of Silver Springs, Nev., at 39.3616 N and 119.2752 W.

Published peak discharge: The peak discharge for this site is 1,840 ft^3/s and was rated fair. The rating should be downgraded to estimate. A discharge of 1,680 ft^3/s (the original hand-calculated value) is published in Moosburner (1978).

Drainage area: The drainage area originally was estimated at 0.22 mi^2 by planimeter from the Churchill Butte quadrangle map, scale 1:24,000.

Data for storm causing flood: The storm is described by Patrick Glancy (USGS retired), as a high-intensity thunderstorm with more intense inner cells. Data on precipitation were not gathered as part of this review. A rain gage at nearby Lahontan Dam, 12 mi east of the slope-area measurement site, collected a little more than 1 in. of rain on July 19 and 0.37 in. on July 20, which probably do not reflect the rainfall amounts or storm intensities in the area. Lahotan Reservoir is on the flat valley floor at an elevation of less than 1,300 ft above sea level. Precipitation in the headwaters, at elevations greater than 1,600 ft, probably was greater than at Lahontan Dam. Historical photographs taken after the July 20, 1971, flood and during the 2003 review and described herein are provided in figures A100-A105.

Method of peak discharge determination: The peak discharge for this site was determined by a two-section slope-area measurement. Data for this calculation was collected on August 18, 1971.

The reach was selected because it is straight and is one of the few reaches where all flow was confined to one channel. The high-water profiles are uniform and well defined by an appropriate number of high-water marks although they were rated fair to poor in quality. The profiles are parallel to each other and to the channel slope. The cross sections were correctly located to minimize the effect of channel bends upstream and downstream of the reach. The slope-area measurement paperwork describes a channel bar at and upstream of section 1. Section 1 was located near the toe of this bar and was subdivided on the basis of shape. Section 2 did not require subdivision. The cross-sectional end elevations were picked from profile interpretation between high-water marks, but the marks are close enough together that getting marks on the cross section would not have increased the accuracy of the calculation. The 58-percent expansion decreases velocity from 30 to 15 ft/s, and Froude numbers ranged from 3.4 to 2.6 from section 1 to section 2, indicating supercritical flow.

The streambed is erodible and underlain by fractured bedrock that is exposed on the left bank at both cross sections. There was potential for a substantial amount of sediment to be transported through the reach but downcutting probably was limited by the bedrock. Channel sediment is mostly sand and gravel as much as about 1.5 in. diameter. Manning's "*n*" values were 0.035 and 0.037, respectively, for sections 1 and 2. The subsection at section 1 was assigned an "*n*" value of 0.044. Flow depths were in the range 3 to 4 ft, and the slope has a high gradient (a fall of 7.38 ft in 95 ft or a slope of 0.075 ft/ft).

Two errors were found in the original hand calculation. The total cross-sectional area was used as the area of the subsection for subdivided section 1. An extra digit was read from the calculator screen when computing conveyance for the same section. Win Hjalmarson (USGS Arizona Water Science Center) discovered the area error during his review of this indirect measurement in 1988. His recalculation, using a prior version of the USGS slope-area computation (SAC) program, yielded a discharge of 1,830 ft^3/s. Calculation using the current version of SAC produced the same discharge. The decrease in area did not explain the increase in discharge. A recheck of the hand calculation identified the conveyance error. The hand calculation agreed with the SAC results after the area and conveyance errors were corrected.

Possible sources of error: The most probable source of error is in selection of roughness coefficients for steep, movable-bed streams. The values used seem consistent with verified coefficients for streams that are less steep. The revised Froude numbers are high, ranging from 3.38 to 2.21, which appear unrealistically high. The drainage area is a possible source of error. Previous reviewers have questioned the location of the reach. Unit discharge is sensitive to basin size in drainages this small. The USGS Nevada Water Science Center used the GPS site-location data collected by the field-review team to remeasure the drainage area. The result was not significantly different from the original value. The excessive expansion and high Froude numbers also are a concern. Because of the "bar" at section 1, the conveyance did not vary uniformly between sections. The basin is highly erodible, so hyperconcentrated flows could have occurred.

Prior reviews suggest reducing the discharge for this flood to 700 ft^3/s on the basis of the assumption that movable-bed streams tend to adjust to critical flow. This change also would incorporate using the Jarrett (1984) equation to compute an effective "n-value" of about 0.14. This equation has not been verified for streams with movable beds or for slopes this steep. The opinion of the field-review team is that the relatively small part of the bed that could become mobile and the probable short duration of high flow make critical flow a questionable argument.

Recommendations for what could have been done differently: There is little that could have been done to improve this measurement. Some digging might have shed light on potential depths of scour. A more exact field location description would have been valuable. A more thorough review would have caught the two errors that were identified in this review. The sections are about 50 ft wide, the reach length between sections is 95 ft, so a third section could have been added to help assess the reliability of the peak discharge. Additionally, the extreme unit discharge warranted a return visit to try to find sites for indirect measurements in tributary or adjacent drainages to help validate the Lahontan Reservoir tributary no. 3 flood discharge.

Site visit and review: The site was visited on July 31, 2003, by John Costa (USGS Office of Surface Water), Patrick Glancy (USGS retired), Kerry Garcia (USGS Nevada Water Science Center), and Gary Gallino (USGS retired). The site was approximately located a week earlier by Kerry Garcia and Bob Burrows (USGS). This effort saved valuable field time. The original hubs and cross-section stakes were found, and a GPS reading of latitude and longitude were taken to positively locate the reach. These readings were used with the most recent topographic map to check the drainage area. The reach appears to have changed little when compared to photographs (stereo slides) taken shortly after the flood. Extensive side-hill erosion scars are evident in the upstream part of the basin and are visible in slides taken by Patrick Glancy documenting the original flood. The basin appears to have a history of erosion and high unit discharge. There is no evidence that this flood was a debris flow.

Recommendations: The original peak discharge of 1,680 ft^3/s should be updated to 1,840 ft^3/s and the rating should be downgraded to "estimate" because of the unrealistically high Froude numbers and excessive expansion. This value agrees with results from the corrected hand calculation and the prior SAC analysis.

Figure A100. View looking downstream of slope-area reach, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 1971.

Figure A101. View looking upstream at cross section 2, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 1971.

Figure A102. View looking upstream of slope-area reach, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 1971.

Figure A103. View looking downstream of slope-area reach, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 31, 2003.

Figure A104. View looking upstream toward cross section 2, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 31, 2003.

Figure A105. View looking upstream of slope-area reach, Lahontan Reservoir tributary no. 3 near Silver, Nevada, July 31, 2003.