Meyers Canyon near Mitchell, Oregon

(Miscellaneous ungaged site in the add John Day River basin,
USGS Oregon Water Science Center)

Review of peak discharge for flood of July 13, 1956

Location: The flood occurred about 4.1 mi northwest of Mitchell, Oreg., at 44.61995N and 120.19672W.

Published peak discharge: The published peak discharge for this flood is 54,500 ft^3/s and was rated fair.

Drainage area: The 12.7 mi^2 drainage basin is steep and sparsely vegetated. The soil is hydrophobic and easily eroded. The basin is about 6 mi long and 3.5 mi wide. The channel in the downstream part of the basin is deeply eroded into valley alluvium and forms a sinuous and deep (about 20–30 ft) canyon.

Data for storm causing flood: An intense convection storm produced excessive rainfall and caused severe flooding in tributaries to Bridge Creek near Mitchell, Oreg. Meyers Canyon, about 6 mi northwest of Mitchell, Oreg., was the hardest hit of these drainages. The storm reportedly centered over this basin and produced record runoff. There is continuing controversy among engineers and hydrologists who have studied this flood primarily because it is difficult to imagine that this extraordinary flood did not leave a geomorphic record in Bridge Creek. This may be because peak discharge only lasted a few minutes and the total volume of runoff was small; thus, the flood wave rapidly attenuated.

W.D. Wilkinson, an Oregon State College geology professor, was camped along Service Creek Road in the upstream part of Meyers Canyon basin during the flood. He reported rainfall starting about 4:30 p.m. on July 13, 1956, and increasing in intensity until about 5 p.m. The first flood crest passed his camp at about 5:15 p.m. and crested at about 7–8 ft. A second crest passed about 6:10 p.m. but was lower, about 4–5 ft. The storm was intense until about 6 p.m. and diminished until the rain stopped at 7 p.m. The most intense rainfall lasted only about 30 minutes (between 4:30 and 5 p.m.). Mr. Wilkinson observed sheet runoff at the base of the hills as deep as 2 in. Velocity of the 2.5-ft deep overbank flow near his camp was high enough to move his Travelall truck 500 ft downstream. There were no direct measurements of rainfall in the upstream part of the basin. Bucket surveys in Mitchell and at Girds Creek produced estimates in the 3.5- to 4-in. range; maximum rainfall amounts and intensities were likely greater but are unknown. Historical photographs taken after the flood of July 13, 1956, and photographs taken during the 2003 review and described herein are provided in figures A157–A171.

Method of peak discharge determination: A three-section slope-area measurement was made in a steep, narrow, gully 0.3 mi upstream of the mouth of Meyers Canyon. There was so much expansion between sections A and B that a three-section solution could not be obtained. The flow estimate is from a two-section slope-area measurement. The 30-ft deep gully appeared to have been overtopped leaving a line of good to fair high-water marks along the margin of the 400-ft wide valley floor. The left-bank marks were taken from the stiff stems of sagebrush that covered the left-bank overflow. High-water marks along the right bank primarily were fine debris on the ground at the gently sloping edge of the grassy overflow area. Marks along this bank are superelevated from a combination of an upstream breakout and a small rounded ridge perpendicular to the channel downstream.

The effect of the upstream breakout causes the major controversy surrounding this flow estimate. This "disagreement" has lasted for 50 years. The argument is that the high-water definition used for the slope-area computation does not represent the elevation of water in the main channel, and flow was small enough to be contained within the channel.

The channel is forced into an "S" configuration by projecting side ridges on each bank just upstream of the slope-area reach. The channel upstream of these side ridges is straighter and much larger in cross section. This reach of channel was not used for the slope-area measurement because no high-water marks could be found. Flow probably was contained in the channel, but the nearly vertical, unvegetated sidewalls did not trap any debris or erode enough to leave a peak-stage record. The right-bank breakout occurred just downstream of the S-shaped channel, and evidence is still visible. A breakout on the left bank that is not as obvious would have affected high-flow definition along that bank. Marks along the right bank are about 2.8 ft higher than those on the left bank at section A, about 5.5 ft higher at section B, and about 1.7 ft higher at section C. Some of this difference is attributed to channel curvature, but most may be caused by the upstream breakout. High-water slope along the right bank is almost flat between sections A and B. The high-water profiles from sections B to C are steep (more than 8 ft in about 220 ft) (slope = 0.036 ft/ft). Fall on the left bank in this reach is 6.75 ft, and fall along the right bank is 10.50 ft. The left-bank high-water marks define flow about 3 ft deep at the edge of the main channel at section B and about 3.5 ft deep at the channels edge at section C. If the high-water marks define a flow connected from valley margin to valley margin, there is sufficient area to carry the computed discharge at velocities less than 30 ft/s. Froude numbers ranged from 1.06 to 1.25, which are high but not unprecedented. Channel curvature and channel alignment made it difficult to locate the cross sections perpendicular to the flow.

Hydrologists from the Bureau of Reclamation have never agreed with the discharge computed from this slope-area measurement. Francis Hart and G.W. Kirkpatrick of the Bureau of Reclamation did a reconnaissance of the flood-affected area on August 13–14, 1956. They recorded few actual data but made several observations. They point out an area of erosion on the right rim of the channel between sections B and C caused by overbank return flow. They also assumed left-bank overflow returned to the main channel through a small draw between these two sections. This observation is not supported by the left-bank high-water marks nor do the right-bank marks support the theory that all or most of the right-bank overflow returned to the channel at the point defined by erosion on the channel rim. A Bureau of Reclamation report dated November 23, 1956, is included in the file and summarized these observations. It includes copies of photographs supporting the observations.

On August 9, 1956, Harry Hulsing (USGS) visited the site to review the assigned "*n*" values and made no comment about the possibility of the peak flow not being connected across the channel. Roughness coefficients were raised from 0.045 to 0.050 (increase of 11 percent) for the main channel to compensate for channel irregularities. This change reduced the computed discharge from 64,000 to 54,500 ft^3/s. He returned with G.L. Bodhaine (USGS) on October 22–23, 1956, in response to Mr. Hart's observations. They found no reason to discredit the results of the slope-area measurement. They were convinced that overbank flow was connected to flow in the main channel at the time of the peak discharge. During his first visit, Harry Hulsing investigated the upstream part of the basin and described a 2-mi stretch of the Service Creek Road as one long debris pile. He described all the side slopes as deeply gullied and commented that all the culverts were washed out, buried, or clogged with debris.

Bridge Creek runs through Mitchell and has a history of major flooding. Flow estimates in Bridge Creek at Mitchell and from a slope-area measurement about 10 mi downstream of the mouth of Meyers Canyon are both about 14,400 ft^3/s. The Bureau of Reclamation contends that flow in Bridge Creek downstream of Meyers Canyon should have been far greater if the discharge computed for this flood is correct. USGS noted that flow volume from Meyers Canyon was not great, and flow was attenuated along the Bridge Creek Valley. There is no comment on the timing of the two peak discharges.

The Bureau of Reclamation has studied this flood as part of a project for spillway design in Central Oregon. They mapped 1,600 ft of channel in the area of the slope-area reach and ran a step-backwater model through the downstream 300 ft to try to estimate maximum possible discharge. Their results are on the order of 17,700 ft^3/s, about one-third of the USGS estimate. Their study approach and results are published in Levish and Ostenaa (1996).

Possible sources of error: Application of a two-section slope-area computation introduces the possibility for significant error. If the high-water marks do not define a continuous water surface, the computation is invalid. This could have been confirmed by obtaining high-water marks on the sagebrush near the edge of the channel or on the overflow plain. This is a highly erodible basin, and flows could have been hyperconcentrated. Flows probably were multidimensional and could have been unstable. The cross sections do not appear to be perpendicular to the flow, so cross-sectional area may be incorrect. The estimated rainfall amounts do not seem to support the peak discharge estimated for this flood.

Recommendations of what could have been done differently: In 1956, not much could have been done differently. High-water marks could have been surveyed near the main channel to verify a continuous water surface. There may have been evidence on some stiff sagebrush that was recoverable. A cross section could have been surveyed across the larger channel upstream of the breakout to estimate if the peak discharge could be contained in that channel. Evidently there were no high-water marks indicating flow outside the channel and no recoverable marks in the channel.

Site visit and review: The site was visited on April 4–5, 2003, by John Costa (USGS Office of Surface Water), Bob Jarrett (USGS Office of Surface Water), Mike Nolan (USGS Regional Specialist), and Glenn Hess and Jim O'Conner (USGS Oregon Water Science Center), John England (Bureau of Reclamation), Joe Weber (Federal Emergency Management Agency), and Gary Gallino (USGS retired). The field-review team inspected flood remnants in the upstream part of the basin as well as the downstream reach. There were several buried trees near the mouth of the main canyon, and the mouths of tributary canyons provided evidence of extensive erosion, sediment transport, and deposition.

There was discussion of the benefits of using a two-dimensional model through the reach to try to simulate multidimensional flow. However, there is insufficient data, particularly water-surface elevations in the main channel, to justify the effort and improve the discharge. For future floods that have these types of unique hydraulic conditions, use of two-dimensional modeling and collection of appropriate site data should be encouraged. Evidence of the upstream breakout and the area of suspected return flow were inspected and discussed.

Recommendations: The original peak discharge of 54,500 ft^3/s should be accepted as published and the rating should be downgraded to "estimate."

The discharge estimate is so uncertain that its value should be viewed with great suspicion with respect to any determination of flood risk in other basins.

Figure A157. View looking downstream of slope-area reach, Meyers Canyon near Mitchell, Oregon, July 1956. Man standing at cross section B.

Figure A158. View of right-bank overflow, Meyers Canyon near Mitchell, Oregon, July 1956. Man standing at cross section B.

Figure A159. View looking downstream from above cross section B on right bank, Meyers Canyon near Mitchell, Oregon, July 1956.

Figure A160. View looking downstream of cross section B to cross section C, Meyers Canyon near Mitchell, Oregon, July 1956.

Figure A161. View looking upstream from downstream from cross section C, Meyers Canyon near Mitchell, Oregon, July 1956. Man standing at cross section C.

Figure A162. View looking upstream, Meyers Canyon near Mitchell, Oregon, July 1956. Man standing on right bank at cross section C.

Figure A163. View looking from right to left bank, Meyers Canyon near Mitchell, Oregon, July 1956. Man standing at cross section C.

Figure A164. View looking upstream to cross section B, Meyers Canyon near Mitchell, Oregon, July 1956.

Figure A165. View looking upstream toward slope-area reach, Meyers Canyon near Mitchell, Oregon, April 22, 2003.

Figure A166. View looking upstream from right-bank hillslope across to slope-area reach, Meyers Canyon near Mitchell, Oregon, April 21, 2003.

Figure A167. View looking downstream from area on right bank where flow likely broke out of canyon, Meyers Canyon near Mitchell, Oregon, April 21, 2003.

Figure A168. View from right bank looking across canyon toward possible return-flow gully that channeled flood-plain overflow back into canyon, Meyers Canyon near Mitchell, Oregon, April 21, 2003.

Figure A169. View looking downstream from left bank toward right bank and people standing in slope-area reach, Meyers Canyon near Mitchell, Oregon, April 21, 2003.

Figure A170. View looking downstream into main canyon toward slope-area reach, Meyers Canyon near Mitchell, Oregon, April 21, 2003.

Figure A171. Overland flow following rainfall in upstream part of Meyers Canyon Basin, Oregon, April 21, 2003. Almost no infiltration into fine-grained surficial material.