06759000 Bijou Creek near Wiggins, Colorado

(Discontinued gaging station, USGS Colorado Water Science Center)

Review of peak discharge for the flood of June 18, 1965

Location: This flood was located about 6.3 mi east of Wiggins, Colo., along the Interstate Highway 76 at 40.2547 N and 103.9667 W.

Published peak discharge: The published peak discharge was 466,000 ft^3/s, on June 18, 1965. The measurement was rated poor.

Drainage area: The drainage area of the original site for the streamflow-gaging station is 1,314 mi^2, which is 5.6 mi upstream of the location of the indirect discharge measurement for the June 18, 1965, flood. Drainage area at the indirect discharge measurement site is 1,500 mi^2.

Data for storm causing flood: The flood of 1965 was the result of a sequence of extreme rainfall that persisted for about 5 days along the Front Range of Colorado in the headwaters of South Platte River. Another large flood (stage of 15.9 ft) occurred at this site on June 15 according to the measurement summary. This sequence of rain resulted in large peak discharges in most of the northward-flowing tributaries of the South Platte River as well as producing devastating floods on the South Platte River upstream of Denver to the Colorado-Nebraska State line. Chatfield Dam was completed later to control floods on the South Platte River, primarily Plum Creek. The flooding is described by Matthai (1969) and is included in a report by Rostvedt and others (1970). Sediment deposits resulting from the flood were described by McKee and others (1967).

The June flooding in Colorado was front-page news in most area papers for several days preceding and following June 18, 1965. The Denver Post and Rocky Mountain News ran articles. Aerial photographs on the front page of the June 19 Fort Morgan Times and the Denver Post show the flooding on Bijou Creek at the former gaging station. The photographs provide graphic testimony about the size of this flood and the amount of embankment overtopped. Those photographs need to be seen to appreciate the scale of flooding. Historical photographs taken after the June 18, 1965, flood and during the 2003 review and described herein are provided in figures A82–A94.

A daily-discharge gaging station was operated at U.S. Highways 6 and 34 bridge (now I-76) just downstream of what is now the Burlington-Northern-Santa Fe (BNSF) railroad bridge from April 1, 1950, to September 30, 1956. The stream at the former gaging station is ephemeral, flowing only in response to thunderstorm activity and then only for a few days in most years. During the more than 6 years of record, flow never was recorded during October–April, and there were no periods when flow was recorded for more than 7 consecutive days. During the period of gaging, however, several large peaks were recorded as shown below:

Date	Discharge (ft^3/s)	Gage height (ft)
July 31, 1950	767	4.89
August 3, 1951	50,100	10.22
August 22, 1952	7,840	6.12
July 30, 1953	1,080	3.82
July 30, 1954	5,700	5.52
August 28, 1955	2,450	4.48
July 31, 1956	19,000	7.80

Method of peak discharge determination: The peak discharge is based on a three-section slope-area measurements made about 5.6 mi downstream of the site of the discontinued gaging station. Spread between the two subreach discharges computed for the measurement reach is only 16 percent. The channel width averages about 3,800 ft, and cross-section area averages about 30,000 ft^2 through the measurement reach. Fall in the reach is substantial (13.04 ft of fall over the 3,845-ft reach), but it is well defined by high-water marks. Agreement between the two profiles generally is good except on the right bank just upstream of section 2. Most right-bank fall in subreach 1–2 occurs in a single large fall just upstream of section 2. This fall probably relates to run-up as the main channel moves from the middle of the channel at section 1 to the right side of the channel at sections 2 and 3. However, the total fall in the reach could not be changed a great deal by any reasonable reinterpretation of the profiles. Matthai (1969) noted that the water-surface slope in the reach (0.0034) was comparable to the slope over a 2.3-mi reach of the channel from the Weldona Quadrangle (0.0033).

The cross sections were properly subdivided based on shape with each section broken into four subsections. Alpha was approximately 1.4 at all sections. The reach expands slightly from section 1 to 2 but contracts from section 2 to 3. However, the expansion is not a significant factor as there is only a 7-percent spread between computations for 0 and 100-percent energy recovery in the expanding reach. Velocities in the main channel are high, ranging from 21 ft/s at downstream section 3 to 26 ft/s at upstream section 1. Main channel Froude numbers of 1.34, 1.10, and 1.12 indicate upper regime and supercritical flow in all sections. The main channel carried about 40–45 percent of the flow.

As part of the 2003 review, the original computation was coded for the current USGS slope-area computation program (SAC). The SAC peak discharge (464,000 ft^3/s) confirms the original discharge.

According to the measurement summary, the June 18 peak discharge at this site may have been amplified by a release of water that ponded upstream of the BNSF railroad. The railroad embankment to the right of the railroad bridge failed. The measurement summary speculates that the failure could have been rapid and notes an earlier failure in 1935 that is discussed by Follansbee and Sawyer (1948, p. 71). However, newspaper accounts of the 1965 peak discharge talk about a large crest passing the community of Hoyt (about 20 mi upstream) in the early morning hours. The size of peaks from upstream tributaries, the amount of railroad embankment that was subjected to overflow (about 4,000 ft) relative to the fairly modest amount of embankment failure (hundreds of feet) suggest that the failure probably contributed little to the actual peak discharge. Aerial photographs on the front page of the June 19 Fort Morgan Times and the Denver Post need to be seen to appreciate the scale of flooding and the amount of embankment overtopped. The photographs show only a very few trees in the reach downstream of the railroad/Interstate crossing; in 2003, nearly mature cottonwood trees were scattered in this reach.

Possible sources of error: The most likely sources of error in the measurement are (1) the roughness values, (2) the assumption that the post-flood cross section represented the cross section at the time of the peak discharge, and (3) the possible effect of the railroad embankment failure. The roughness values were based on bed-material samples (median size 0.44 mm) and are consistent with verification data for high-gradient, sand-bed streams. Condition of the streambed during the peak is unknown, but Bijou Creek is known to transport large quantities of sand; significant scour could have occurred during the peak discharge relative to the post-flood channel. The effect on the peak of the embankment failure is believed to be small for the reasons noted in the previous paragraph.

Recommendations of what could have been done differently: The summary for this important indirect measurement has never been typed. Reviews are not included with the measurement summary. The writer knows that measurement of the 1965 floods in Colorado was done in assembly-line fashion, and all were reviewed. Those reviews, and the names of the reviewers, should have become a permanent part of the indirect measurement. The record of those reviews likely will not be found. A file of the newspaper coverage complete with photographs should be a part of the permanent record.

One thing that was done correctly was to document many peak discharges from the flood instead of just a few. The evidence of many extreme peak discharges is compelling corroboration for the individual peak discharges.

Site visit and review: The site was visited June 3, 2003, by John Costa (USGS Office of Surface Water), Joseph Capesius (USGS Colorado Water Science Center), John England (Bureau of Reclamation), Mark Smith (USGS Central Region), and Kenneth Wahl (USGS retired). The visit included stops at the BNSF railroad and Interstate Highway 76 crossing (the former gaging station) and the indirect measurement site about 6 mi downstream.

The reach used for the indirect measurement has changed little since 1965. Flood debris is still evident at places in the measurement reach, which has scattered cottonwood trees on the flood plain. The 1965 photographs show a sand bed in the main channel and the overflow sections. The sand is still present but has been overgrown with grass and small shrubs. Land-use changes upstream have produced a very slight base flow in the reach; as a result, the main channel now has pooled water, cattails, and reeds.

Recommendation: The original peak discharge of 466,000 ft^3/s should be accepted as published.

Photographic and geomorphic evidence leaves no doubt that this was a water flood. The indirect measurement was done correctly, and there is no evidence of error either in procedure or in interpretation.

For some reason, the measurement summary that is part of the indirect measurement has never been typed. The summary for this very unusual flood should be typed and properly archived. The aerial photographs from the Fort Morgan Times and the Denver Post should become a part of the permanent record of this indirect measurement.

Figure A82. View looking upstream from cross section 3, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A83. View looking downstream from 50 feet upstream of cross section 2, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A84. View looking downstream from 100 feet upstream of cross section 2, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A85. View looking downstream from 100 feet upstream of cross section 3, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A86. View looking downstream from 150 feet upstream of cross section 2, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A87. View looking downstream from 200 feet upstream of cross section 1, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A88. View looking downstream from 200 feet upstream of cross section 1 (different location than shown in figure A87), Bijou Creek near Wiggins, Colorado, June 1965.

Figure A89. View looking downstream from 200 feet upstream of cross section 2, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A90. View looking upstream from 200 feet downstream of cross section 1, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A91. View looking downstream from 150 feet upstream of cross section 1, Bijou Creek near Wiggins, Colorado, June 1965.

Figure A92. View looking north toward railroad wash-out, Bijou Creek near Wiggins, Colorado, June 3, 2003.

Figure A93. June 1965 flood debris in slope-area reach, Bijou Creek near Wiggins, Colorado, June 3, 2003.

Figure A94. Flood plain of Bijou Creek near Wiggins, Colorado, in slope-area reach, June 3, 2003.