

Matthai, 1951
U.S. Geological Survey internal paper
Paper includes American River peak discharge estimates for Jan. 1862
at Fair Oaks gage (USGS 11446500)

This paper was not published by USGS. Its history is described in the Charles Parrett document dated Dec. 31, 2009 and an email dated Aug. 31, 2016. These are available as the last four pages below. The work by Matthai was used by Parrett to recommend a revision to the official USGS estimate of the 1862 American River peak discharge.

1951	Matthai Howard F. Matthai, U.S. Geological Survey "Revision of Peak Discharge of American River at Fair Oaks, Calif., Mar. 25, 1928" (Dec. 14, 1951) Source: Armando R Robledo, Supervisory Hydrologist, U.S. Geological Survey, California Water Science Center Field Office, 8550 23rd Avenue, Sacramento, CA 95826
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Research by Gary Estes
California Extreme Precipitation Symposium (CEPSYM)
Feb. 2017

Revision of Peak Discharge
of
American River at Fair Oaks, Calif., Mar. 25, 1928

Abstract

In 1928 the U. S. G. S. published a peak discharge for March 25, 1928, of 182,000 cfs. based on a discharge measurement of 181,000 cfs. made by timing drift in a reach near the gage. In 1938 this figure was revised to 140,000 cfs. on the basis of the 1937 high-water studies and when the 1928 float measurement was discarded after consultation with the engineer of the Division of Water Resources, State of California, who made it.

In connection with the Corps of Engineers studies for Folsom Dam operation, it is to the best interest of all parties concerned to again revise the 1928 peak discharge on the basis of data subsequent to 1937 and especially the 1950 high-water studies. The revised figure is 163,000 cfs.

Ratings

The high-water rating for the Fair Oaks gage is unstable; however, it is the opinion of many engineers who have studied flood flows on the American River that the high-water rating at the Stockton and Coover Stone Stable just upstream from Folsom is permanent. Inflow between these two points is negligible during major flood peaks.

Crest stages at the Stone Stable have been observed since 1862 as listed below.

<u>Date</u>	<u>U. S. G. S. Elev.</u>	<u>Discharge at Fair Oaks</u>
1862, Jan. 10	183.0 - a, b/	
1907, Mar. 19	171.5 - b/	119,000 (140,000)
	171.8 - c/	
1925, Feb. 6	168.8 - c/	99,500
1928, Mar. 25	174.5 - c/	
	174.5 - d/	
	175.0 - e/	
1937, Dec. 11	170.5 - e/	114,000
	171.1 - e/	
1940, Feb. 28	167.0 - e/	69,100
1940, Mar. 30	168.0 - e/	89,200
1942, Jan. 27	164.3 - e/	83,200
1943, Jan. 21	172.9 - e/	136,000
1950, Nov. 19	174.3 - e/	163,000
1950, Nov. 21	175.5 - f/	180,000
	175.8 - e/	
1950, Dec. 4	173.2 - e/	136,000

a/ A Corps of Engineers report compiled in 1941, amended 1943, 1951.

b/ 1912 report of A. Given and C. E. Grunsky on "Flood Discharge of American River."

c/ A. M. Barton, Report of December 1929 to Trustees, American River Flood Control District.

d/ "Flood Discharge of American River, Mar. 25, 1928" by A. M. Wells (in files of State Division of Water Resources).

e/ Joseph W. Cross, Sacramento, California.

f/ Observation by F. A. Johnson and Harlowe Stafford, U. S. G. S., Sacramento, California, on 2-28-51.

A rating (see attached curves) for the Stone Stable was constructed using the elevations as listed above and the peak discharges at Fair Oaks. This method should give reliable results as major crests on the American River last about one hour, and the time interval from Folsom to Fair Oaks is about one hour.

All peak discharges except those for 1928, Feb. 1940, and Jan. 1942 plot very well on this rating. The 1907 peak was plotted as 119,000 cfs. as originally published.

Conclusions

Using this rating based on eight points, the 1928 peak discharge for Fair Oaks becomes 163,000 cfs. which should be much more reliable than either 140,000 or 182,000 cfs.

As the stage at the Stone Stable was 3.0 feet lower in 1907 than it was in 1928, the reference "flood of Mar. 19, 1907, reached a stage of 31.4 feet, present datum (discharge probably about same as that of Mar. 25, 1928)" should be deleted from the extremes paragraph.

An extension of the Stone Stable rating by logarithmic plotting to the stage of the 1862 flood gives a peak discharge for that flood of about 340,000 cfs.

Howard F. Matthal
12-14-51

American River - Folsom to Fair Oaks

Comparison of crest stages for major floods

Date of Flood	P. G. & E. Diversion Dam H.A.	Stockton & Cooper Stone Stable Elev. USGS	Folsom U.S.W.B. Gage	Fair Oaks USGS Gage
1862, Jan. 10		183.0 ^d / 183.0	53 ^e	39 ^e
1907, Mar. 19		171.5 ^b / 171.8 ^f	26.92 ^g / 26.92 ^g	31.42 ^g / 31.42 ^g
1925, Feb			26.92 ^g	
1928, Mar. 25	+0.7 ^h	170.55 ⁱ / 174.3 ^j / 174.5 ^k / 175.0	26.92 ^g / 26.92 ^g	31.45 ^g
1937, Dec. 11		170.5 ^l / 171.1 ^f	23.92 ^g	29.06 ^g
1950, Nov. 21	-0.6 ^h	175.5 ^k / 175.8	29.0	31.3
" 19		174.3		
Dec 4		173.2		
1943, Jan 21		172.9 ^f		

- a Top of extreme north abutment of dam,
- b From 1912 report of A. Givan and C. E. Grunsky on "Flood Discharge of American River".
- c W.S.P. 645, p.459,
- d Maximum recorded; may not be the peak.
- e Painted mark on wall inside old P.H. referred to present gage (Charles Hall, P.G.& E. Co., Folsom, Calif.
- f Observation reported by Charles Hall, P.G.& E. Co., Folsom, Calif.
- g A. Givan, Sacramento, Calif.
- h A. M. Barton, Report of December, 1929 to Trustees, American River Flood Control District.
- i From report on "Flood Discharge of American River, March 25, 1928" by A. M. Wells (in files of State Division of Water Resources)
- j Joseph W. Cross, Sacramento, Calif.
- k Observation by Fred Johnson and Harlowe Stafford, USGS, Sacramento, Calif., 2-28-51.
- l Top of drift as shown in photograph.

1940 Mar ✓
 Feb ✓
 1942 Jan

168.0 ✓
 167.0
~~167.8~~ 164.3

Folsom

Subject: Re: Looking for documents on peak discharge in American River in Jan. 1862
From: "O'Neil, Christine" <csoneil@usgs.gov>
Date: 9/1/2016 1:38 PM
To: <gary@cepsym.org>
CC: Christine O'Neil <csoneil@usgs.gov>

Good afternoon,

Attached is Chuck's documentation that he mentioned in email.

Thanks,
Chris

Chris O'Neil
Hydrologic Technician
USGS California Water Science Center

916-278-3164
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On Wed, Aug 31, 2016 at 2:38 PM, charles parrett <chuckparrett@yahoo.com> wrote:

Hi Gary,

Yes, retirement is nice, but I do miss working on flood hydrology. As to the USGS estimate of the 1862 flood, I had access to an old unpublished USGS paper that showed a partial rating curve for the old stone stable site near Folsom. As I recall, it showed peak flood elevations for the 1862, 1907, and a couple more early day floods on the American River. Discharges were available for the 1907 and the other early floods, but not for the 1862 flood. A rating curve shows flood elevations plotted against flood discharge, and at USGS gage locations typically there are many plotted points through which a smooth log-log curve can be drawn. For a flood whose peak elevation exceeds any other point on the rating curve (like the 1862 flood at the stone stable site) the plotted curve can usually be extended on a straight-line basis to provide an estimate of the discharge corresponding to the known flood elevation.

At this old site near Folsom, there were only a few measured elevations with known discharges, so I am calling it only a partial rating curve. I fit a straight line through the logs of the elevations and discharges and used that a basis for the estimated discharge for 1862. The documentation for my analysis is probably skimpy, I am afraid, but I recall that I left that information with Chris O'Neil at the Sacramento Water Science Center office. Chris was in charge of placing flood information into the USGS Peak Flow file, which is where you obtained the information about the estimated 1862 peak discharge and how it was estimated from the rating curve extension. Chris's phone number and email (I'm not sure whether she has retired yet or not) are 916-278-3164 and csoneil@usgs.gov. I am sending Chris a copy of this email to give her a heads-up about the info you are seeking. Good luck!

Chuck

From: Gary Estes <gary@cepsym.org>
To: Chuck Parrett <chuckparrett@yahoo.com>
Sent: Tuesday, August 30, 2016 12:48 PM
Subject: Looking for documents on peak discharge in American River in Jan. 1862

Chuck,

Hope this finds you enjoying retirement. I am working on collecting historic documents used to estimate the peak discharge on American River in Jan. 1862. I remember you worked at USGS on estimating the 1862 peak discharge from historic documents.

Can you help me locate the document identified on the USGS website as follows: "discharge, 318,000 ft³/s, estimated, from rating curve extended above 163,000 ft³/s"?

Where would I look for the "rating curve" at USGS?

I found at the National Archives in San Bruno a cross-section of the American River in the "Folsom canyon" beside the Folsom State Prison located at the Stockton and Coover stone stable foundation (unfortunately no longer there due to Folsom Dam construction). The cross-section shows the high water elevations for the 1862 and 1907 floods at the stone stable and "USGS datum" is noted on the drawing.

The document also had are two pictures of the high water marks from 1862 and 1907 flood events at the Stockton and Coover stone stable foundation. The pictures show high water elevations for 1862 and 1907 floods based on USGS elevation.

Also there is a picture looking from the stable foundation across the American River "showing the character of river bed."

This has been an interesting journey so far and more to discover.

Thank you for any help you can provide.

Gary

Gary Estes
Coordinator
California Extreme Precipitation Symposium (CEPSYM)
Ph. 530-889-9025

— Attachments: —

11446500 (1).pdf	213 KB
11446500 (2).pdf	503 KB

On December 14, 1951 Howard Matthai of the USGS wrote a 3-page summary of work documenting a revision of the 1928 peak discharge for the American River at Fair Oaks (attached). Matthai used data from several published reports to develop an 8-point rating curve for a site near Folsom termed the Stone Stable site. According to Matthai, this site is stable and can be reliably used to estimate discharge for the downstream Fair Oaks site for large floods. At the end of his summary on page 3, Matthai states that a logarithmic extension of the rating he drew for the Stone Stable site results in an estimated peak discharge for the 1862 peak (gage height at Stone Stable = 183.0 ft) of 340,000 cfs.

Although the original rating developed by Matthai is not available, I reconstructed a curve based on the data Matthai showed on page 2 of his summary report. I subtracted 104.3 ft from each gage height listed for the Stone Stable site. This was done to simply reduce the gage heights to reasonable values that would be indicative of a positive, but not unreasonably large PZF. Although Matthai stated that his rating was based on 8 points, the data on page 2 show 9 values of discharge and gage height. I presumed that he did not use one of the two discharge values of 136,000 cfs shown on page 2. The gage heights for the two discharges differed by 0.3 ft, and I retained only the lower gage height for this discharge.

For my reconstructed rating curve, the lowest discharge in 1942 clearly did not fit well with the remaining 8 points. I thus drew another curve without the 1942 peak and used both curves to calculate a plausible range for the 1862 peak discharge. Based on the two curves, I conclude that the 1862 peak was between 289,000 and 318,000 cfs. The best fit to the highest recorded peaks of

In their 1999 report titled Improving American River Flood Frequency Analyses, the National Research Council used an 1862 flood peak of 265,000 cfs obtained from the following reference:

Bossen, L.E., Discharge rating curves of the American River at Fair Oaks and at Folsom, August 1941 and February 1943.

I have not read the Bossen report, but most of the flood stage data used by Matthai is footnoted as being from "Corps of Engineers report compiled in 1941, amended in 1943, 1951". I believe the Corps report is the Bossen report.

Given that floods and flood frequency is a major concern on the American River, I recommend that the USGS provide as much information on flood magnitude as we can by providing our best estimate of the 1862 flood peak at Fair Oaks in the USGS Peak Flow File. I further recommend that we use the higher peak from my reconstructed curves (318,000 cfs) as our best value for this discharge and that it be coded as an estimate.

Charles Parrett
12/31/2009

American River at Fair Oaks (11446500)
Estimated 1862 Peak based on Rating
Curve Analysis by H. Matthal (12-14-1951)

