

Date: December 12, 1986

From: Robert D. O'Connor, Hydraulic Engineer

Subject: Flood Elevation Probability Study -- Lake Berryessa, Mid-Pacific Region, Sacramento, California

To: Chief, Water Resources Branch

As requested, in the September 29, 1986, memorandum to the Chief, Division of Planning and Technical Services, from the Regional Supervisor of Water and Power Resources Management, the study analyzing the probability of flooding within the surcharge zone (elevation 440 feet to 455 feet) of Lake Berryessa has been completed.

SUMMARY OF STUDY RESULTS

Shown in Table 1 and Table 2, respectively, are the computed probabilities and estimated recurrences of flood water reaching and surpassing the lake elevations within the surcharge zone specified in the memorandum. Computed probabilities beyond a 100-year recurrence are not considered to be reliable, therefore, only confidence limits are presented. There is a 90 % probability of a specific event occurring somewhere in the interval between the confidence limits.

The probability curve shown on Plate 1 was developed for use in assessing the risk of development within the surcharge zone for elevations other than those specified in the memorandum.

FREQUENCY ANALYSIS

The frequency floods derived for Lake Berryessa were developed using USGS stream gage records at "Putah Creek near Winters", station # 11454000, for water years 1931 through 1956, and Bureau of Reclamation computed inflows to Lake Berryessa, for water years 1957 through 1986. The Putah Creek flows near Winters were assumed to be representative of the flows at Monticello damsite for water years 1931 through 1956.

The above records were analyzed to determine the relative frequency of the highest mean daily flows greater than 2,660 ft³/s for the following number of consecutive days, 1,2,3,...,20 or more. The flow of 2,660 ft³/s is the discharge capacity of Monticello Dam at elevation 440 feet. It was assumed that mean daily inflows less than this could be released without increasing the water surface elevation of Berryessa Reservoir. This analysis determined that 90 percent of all consecutive mean daily inflows greater than 2660 ft³/s for water years 1931 through 1986 were of 7 days duration or less.

An annual frequency analysis was performed on the highest consecutive 1- day, 3-day, 5-day, and 7-day flows for the period of record.

Frequency Flood Derivation

The 1984 flood study for Lake Berryessa provided the frequency flood peak discharges which were used in conjunction with the computed 1 day, 3-day, 5-day, and 7-day frequency flows to derive the symmetrical synthetic 100-year, 50-year, 25-year, 10-year, and 5-year frequency floods for Lake Berryessa shown on Plate 2. All the frequency floods developed for this study have a duration of 7 days. Time-discharge values for the above frequency floods are presented in Table 3.

RESERVOIR ROUTING

The above frequency floods were routed through Berryessa Reservoir and the maximum water surface elevations reached during the floods were used to develop the probability curve shown on Plate 1. The routing of the 1984 Probable Maximum Flood through the reservoir produced a water surface elevation of 463.7 feet, or 7.7 feet above the crest of the dam. Monticello

Dam was assumed not to fail and discharge over the top of the dam was treated as flow over a broad crested weir. The 463.7 foot elevation was assumed to be the maximum reservoir elevation that could be reached during a flood.

All frequency floods routed in this study were started at lake elevation 440 feet which is the top of active conservation pool and the recommended elevation to begin routing all floods. The initial elevation of 440 feet, which is a conservative estimate of the reservoir water surface elevation at the start of a flood, is also the crest elevation of the uncontrolled glory hole spillway.

PROBABILITY CURVE

The maximum reservoir water surface elevations reached when routing the 100, 50, 25, 10, and 5-year frequency floods through Berryessa Reservoir were plotted on Arithmetic Probability paper and a probability curve was drawn through the respective points. The probability curve was then extended below the 5-year return period to the point where it intersects water surface elevation 440 feet by linear extrapolation.

The upper and lower confidence limits between the 5-year and 200-year floods, as shown on Plate 1, were defined by developing the 5-year and 200-year floods at the upper and lower confidence limits and routing the four floods through the reservoir. The upper confidence limit curve was more clearly defined by developing the 50-year upper confidence limit flood and routing it through the reservoir.

In order to extend the upper and lower confidence limits beyond the 200 year flood the the 1984 Probable Maximum Flood was routed through the reservoir and the maximum water surface elevation reached was used to define the maximum elevation. A line was drawn between the upper confidence limit at the 200-year flood and elevation 463.7 feet at the 10,000 year return period (0.01 percent probability). The same process was repeated extending the lower confidence limit to elevation 463.7 feet at the 1,000,000 year return period (0.0001 percent probability). The method described to the extend the confidence limits beyond

the 200-year flood is recommended by the Engineering and Research Center for use in developing peak discharge probability curves and was assumed to be applicable to this study.

In order to define the portion of the upper and lower confidence curves below the 5-year return period the following method was used. At the point where the probability curve intersects water surface elevation 440 feet, the upper and lower confidence limits were assumed to be plus or minus 0.5 feet above and below the computed curve. The confidence limit curves were then assumed to be linear between these two points and the 5 year return period upper and lower confidence limits.

The probability curve developed in this study and shown on Plate 1 can be used to assess the risk of development within Lake Berryessa's surcharge zone (elevation 440 feet to 455 feet) for elevations other than those specified in the September 29, 1986 memorandum.

Noted :

Chief, Water Resources Branch

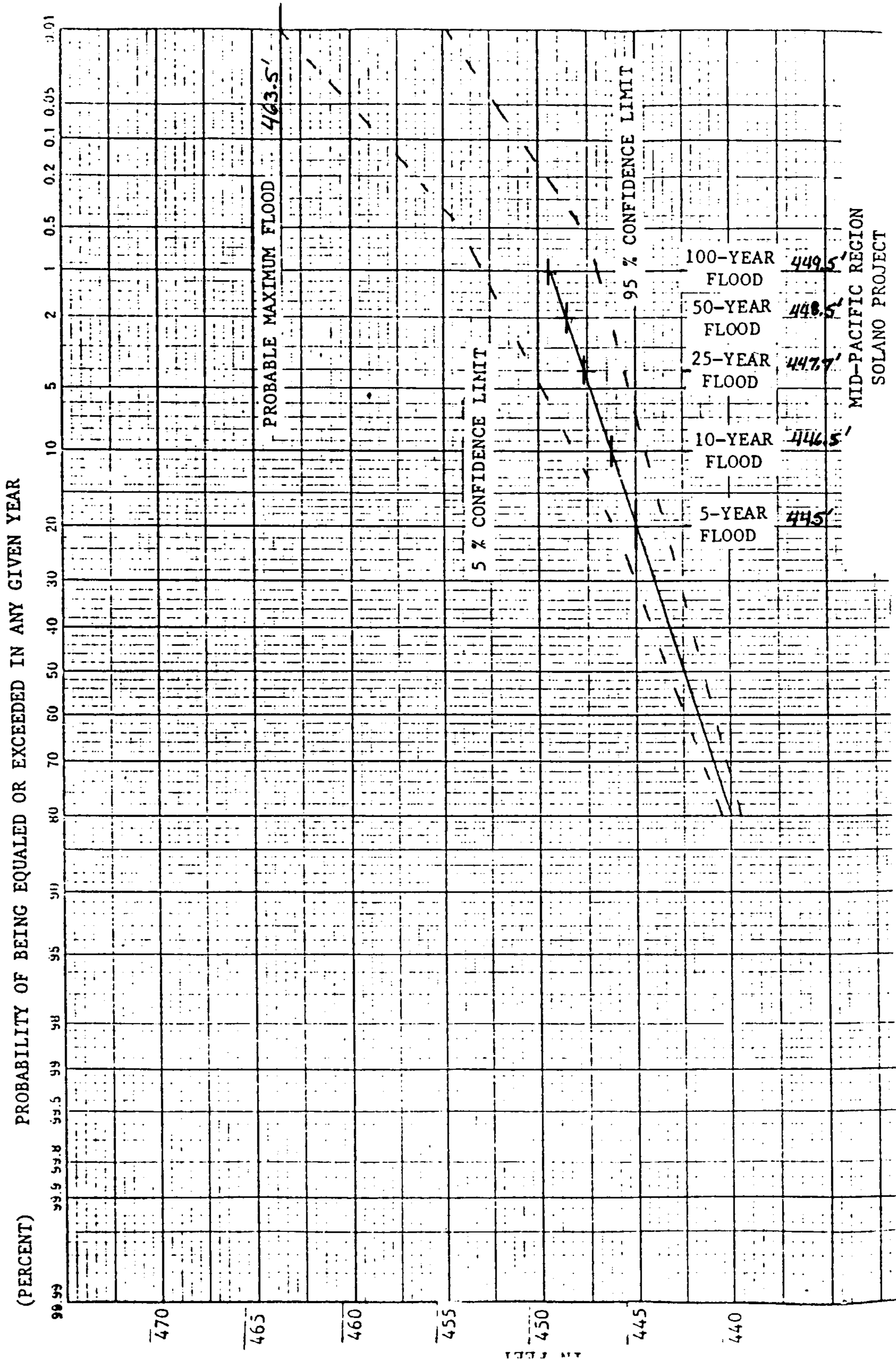


Table 1

Flood Probability Study
for
Lake Berryessa
December 1986

Probability of being Equaled
or Exceeded in any Given Year

Surcharge Zone Elevation (feet)	5 % Confidence Limit (percent)	Computed Probability (percent)	95 % Confidence Limit (percent)	
456	0.24	n/r	0.006 *	Crest of dam
455	0.35	n/r	0.009 *	Top of surcharge zone
454	0.50	n/r	0.016	
452	1.34	n/r	0.05	
450	4.60	n/r	0.20	
448	11.00	2.90	0.42	
445	30.00	20.00	6.70	
440	83.00	80.00	71.00	Top of active conservation and bottom of surcharge zone

* --- estimated from extension of 95 % confidence limit on Plate 1
n/r - not reliable

Table 2
Flood Probability Study
for
Lake Berryessa
December 1986

Probability of being Equaled
or Exceeded in any Given Year

Surcharge Zone Elevation (feet)	Recurrence Interval at the 5 % Confidence Limit (years)	Recurrence at the Computed Probability (years)	Recurrence Interval at the 95 % Confidence Limit (years)	
456	417	n/r	16,667 *	Crest of dam
455	286	n/r	11,111 *	Top of surcharge zone
454	200	n/r	6250	
452	75	n/r	2000	
450	21	n/r	500	
448	9.1	35	238	
445	3.3	5.0	15	
440	1.2	1.3	1.4	Top of active conservation and bottom of surcharge zone

* --- estimated from extension of 95 % confidence limit on Plate 1
n/r - not reliable