US Army Corps
of Engineers
Hydrologic Engineering Center

Stochastic Modeling of Extreme Floods on the American River at Folsom Dam

Appendix A - Seasonality Analysis of Extreme Storms for the American River Watershed

September 2005

RD-48A

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14. ABSTRACT
This report presents the results of the application of a stochastic flood model to develop flood-frequency relationships for the American River at Folsom Dam. Flood-frequency relationships are presented for flood characteristics of peak discharge, maximum 24-hour discharge, maximum 72-hour discharge, maximum reservoir release, runoff volume, and maximum reservoir level.

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Stochastic, Precipitation, Frequency Analysis, Frequency Curve, Exceedance Probability, Temperature, Snow, Wind, Volume, Folsom, American, Corps of Engineers, MGS

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SEASONALITY ANALYSIS OF EXTREME STORMS
FOR THE AMERICAN RIVER WATERSHED
November 23, 1999

PRECIPITATION STUDY REGION
Regional analysis techniques were used in analyzing the characteristics of extreme precipitation for the American River watershed. Using this approach, extreme storm data were assembled from all locations that were climatologically similar to the American River watershed. This included assembling precipitation annual maxima series data for the 24-hour, 72-hour, and 10-day durations from all stations on the west face of the Sierra Mountains and stations immediately adjacent to the Sierras between latitude 36°30′N and 41°00′N. Data were collected from NCDC and California Department of Water Resources electronic files. This totaled 215 stations and approximately 9,600 station-years of record for each duration and included about 20 stations with records that began at the turn-of-the-century.

SEASONALITY OVERVIEW
Information on the seasonality of extreme storms will be used in the computer simulations of extreme floods to select the date of occurrence of the extreme storm for a given simulation. The basic concept is that the seasonality characteristics of extraordinary storms will be the same as the seasonality of the most extreme storms in the historical record.

Separate seasonality analyses were conducted for extreme storms at the 24-hour and 72-hour durations. Extreme storms were taken to be those storms that exceeded a 10-year event for the specified duration. Ideally, the threshold for extreme storms should be set at as rare a frequency level as possible to best replicate the seasonality characteristics of the extraordinary storms to be simulated. A second goal is to have a sample set sufficiently large to minimize estimation errors arising from sampling variability. The 10-year recurrence interval threshold was selected in order to balance these two goals.

ANALYSIS PROCEDURE
The seasonality analysis for the 24-hour and 72-hour durations proceeded as follows:

- An annual maxima series dataset was assembled for each station using a climatic-year basis (October- September) that included the precipitation total and the date of storm occurrence.

- Events were identified at each station that exceeded a 10-year threshold using a non-parametric approach/plotting position formula. For example, with 40 years of record at a given station, the four largest events would be selected.

- A dataset was assembled comprised of the extreme storm dates, precipitation amounts, and stations where the storms occurred.

- Storm dates were identified where the extreme storm threshold was exceeded at 3 or more stations. This was done to assure that only storms with broad areal coverage would be considered.

- A frequency histogram was computed on a twice-monthly basis to depict the monthly distribution of extreme storms.

- A probability-plot was developed using numeric storm dates. It was determined that the seasonality data could be well described by a Normal distribution and a Normal distribution was fitted to the seasonality data.
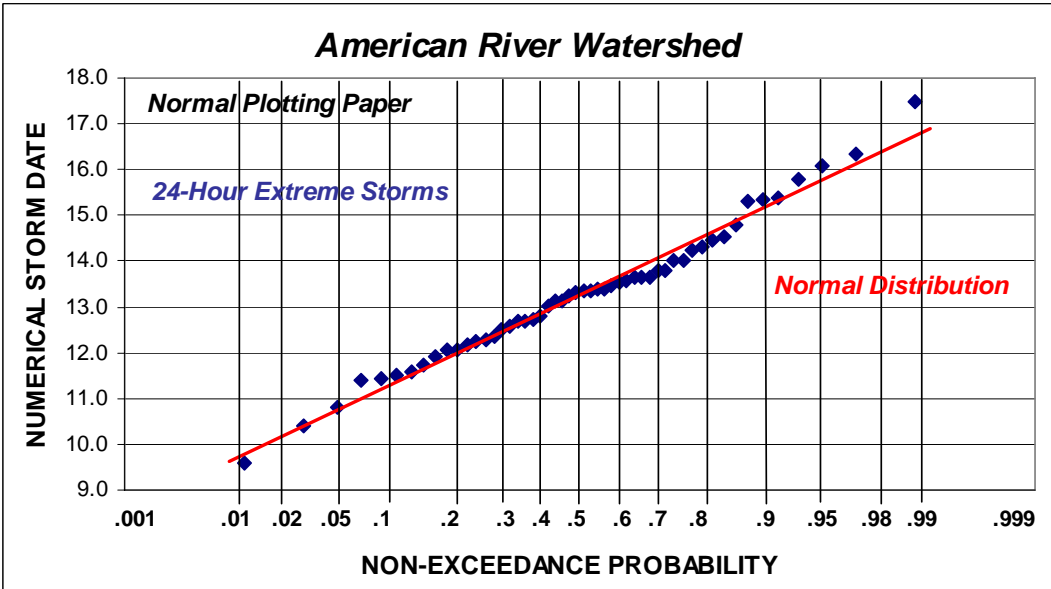

Figure A-1 – Probability-Plot of Numeric Date of Occurrence of Extreme Storms at the 24-Hour Duration for the American River watershed
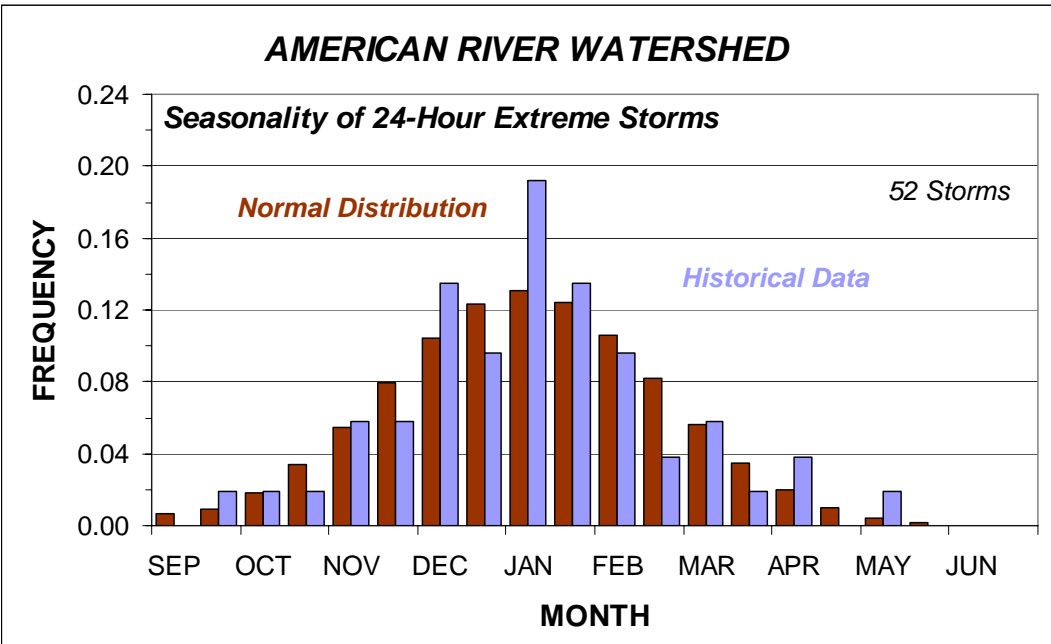

Figure A-2 – Frequency Histograms of Dates of Occurrence of Extreme Storms at the 24-Hour Duration for the American River watershed
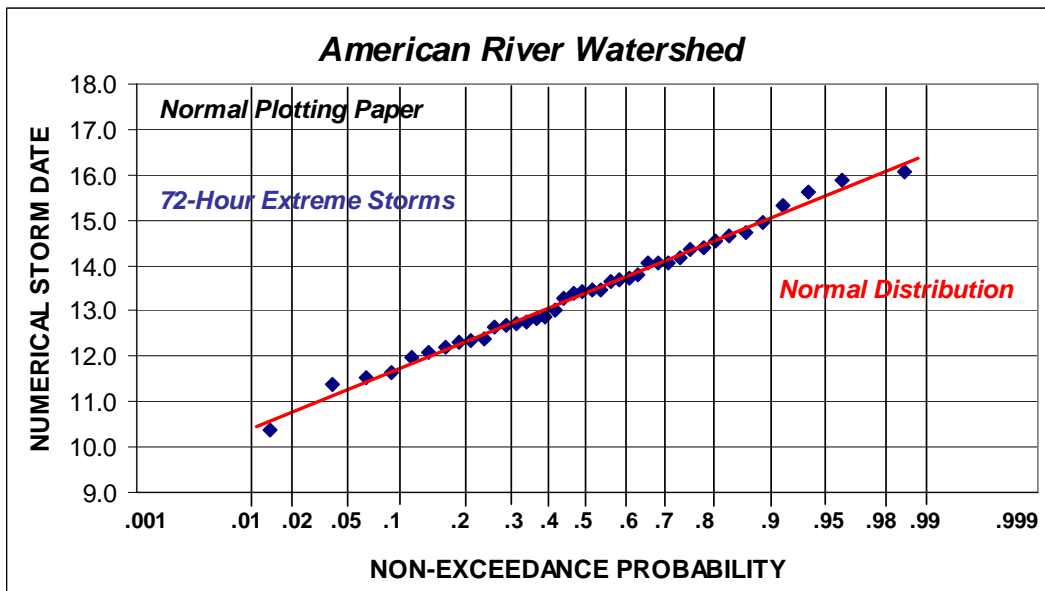
Figure A-3 – Probability-Plot of Numeric Date of Occurrence of Extreme Storms
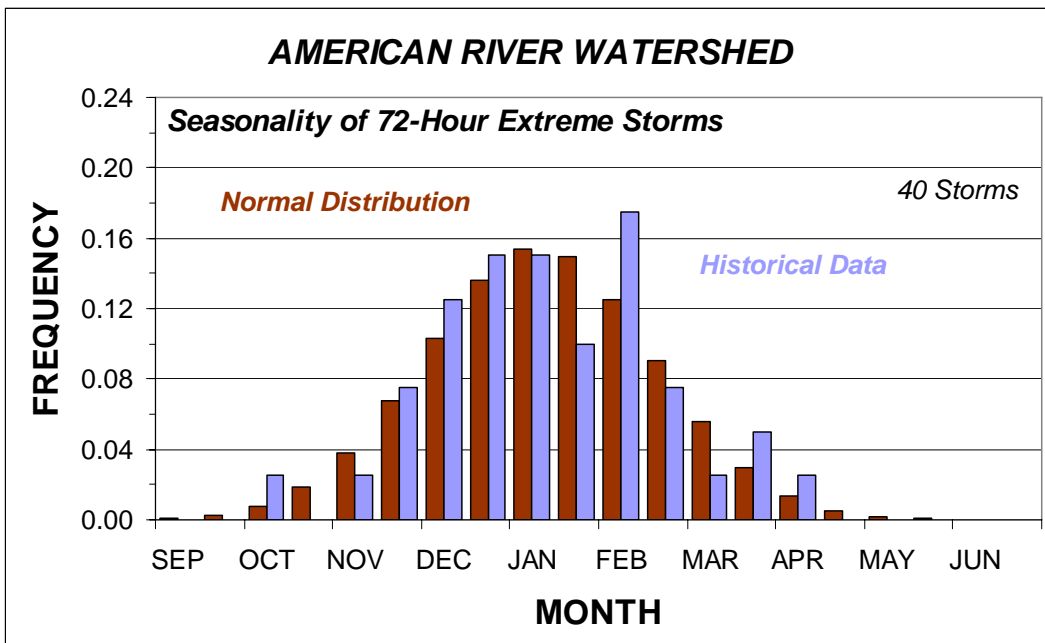at the 72-Hour Duration for the American River watershed

Figure A-4 – Frequency Histograms of Dates of Occurrence of Extreme Storms
at the 72-Hour Duration for the American River watershed