Some Ideas on Estimating the Reasonably Foreseeable Flood

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BIOGRAPHICAL SKETCH

Mr. Roos is Chief Hydrologist (part time) with the California Department of Water Resources in its Division of Flood Management located in Sacramento. He had 43 years of experience as a water engineer with DWR when he retired from full time service in July 2000.

He continues to work part time as a retired annuitant providing advice on flood forecasting, hydrology, water supply and snowmelt forecasting and staff meteorology. Related topics include floods and droughts, global warming, weather modification, and participation in elements of the California Water Plan update (Bulletin 160). For years he has been attempting to track climate change issues as well, especially as they relate to water supply in California.

Prior to retirement, he oversaw work on flood forecasting, hydrology, water supply and snowmelt forecasting, staff meteorology, and related subjects. As Chief Hydrologist, he also provided (and continues to provide) advice on drought, floods, global warming, and weather modification and tries to keep abreast of ongoing water and flood planning studies.

Mr. Roos received a B.S. in Civil Engineering from San Jose State University in 1957 and has been employed by the Department of Water Resources since then. His career began with a series of studies on channels, levees, proposed water transfer works, and water quality in the Sacramento-San Joaquin River Delta. From 1965 through 1978, he worked on various water planning studies and reservoir system operation studies, and evaluated water requirements, supplies, and potential water system developments in the Department's Division of Planning.

In 1979, he began his current assignment in the Division of Flood Management, primarily on flood and water supply forecasting. He was one of the authors of several editions of DWR Bulletin 160, the Department's main water planning document. During the past 10 years, he has had opportunity to share expertise in Israel, northern India, Nigeria, and China.

ABSTRACT

We have heard a lot about statistical processes and risk. I think we need a simpler method to explain to folks what we are trying to accomplish in flood protection and then in measuring how well our designed systems are working. I would propose that we go back to an earlier concept, the standard project flood (SPF), which is modeled after recent events, which have been measured in the region. I am not sure we should call it that, because the Corps' definition of the SPF is too close to that of the probably maximum flood (PMF). So maybe we call it the Maximum Regional Storm, MRS, or simply the Reasonably Foreseeable Flood, RFS. How would we estimate such a flood? For major rivers it would be transposing the largest measured event in the region.

Some Ideas on Estimating the Reasonably Foreseeable Flood

by

Maurice Roos

We have heard a lot about statistical processes and risk. These have their value, especially for economic studies. But I think we need a simpler method to explain to folks what we are trying to accomplish in flood protection and then in measuring how well our designed systems are working.

I would propose that we go back to an earlier concept, the standard project flood (SPF), which is modeled after events, preferably fairly recent, which have been measured in the region. I am not sure we should call it that, because the Corps' definition of the SPF is too close to that of the probably maximum flood (PMF), to wit: "the most severe combination of meteorological and hydrological conditions considered reasonably characteristic of a geographic region." Listen to the definition of probable maximum flood: "the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a region."

Another reason to steer away from the term is that most folks will think of SPF as sunscreen, that is a sun protection factor. So maybe we call it the Maximum Regional Storm, MRS, or simply the Reasonably Foreseeable Flood, RFS. It would be based on something that happened, without some of the adjustments which tend to make the SPF more severe than historical events. Again, the idea would be a simple transposition of the largest observed storm on a watershed in the region. If we want to add an additional safety factor, of say 20 percent, that too can be done. Then folks can relate better, I think, to something more tangible and within their experience. I am not averse to using the standard project flood, but think that the fewer adjustments we make to a historical event would leave less doubts in the mind of the public.

The same concept would apply for the design flood profile. This would relate to high water marks along the levee or bank or at bridge crossings. When the next large flood comes we can all see how well it followed the profile. Significant mismatches may mean the channel capacity is not there, too much vegetation growth is constricting the flow, the river has cut off or added an oxbow bend, or perhaps the channel has incised itself and has more capacity than designed. A defined freeboard, whether it be the customary 3 feet or something else, is part of the design. Then if we don't see that being maintained during a flood, we know something is wrong. We all know that there will always be some risk of failure even for flows or stages within design parameters, but at least the flood plane is a line on the ground which all of us can see. Indirectly, emergency agencies or their advisors are going to set some line or stage level anyway for evacuation.

How would we estimate such a flood? For major rivers it would be transposing the largest measured event in the region, such as somewhere in the Sacramento River basin, to the watershed of interest. The same approach could apply to smaller watersheds, although we will have to shift to rainfall-runoff models on ungaged streams. Some thought would be needed on defining a region with reasonable similarity of flood threat. Obviously, the Sierra front could be one such region, the Coast range might be another, the South Coast another fairly homogeneous region and the southern deserts should probably be a region. There probably will be differences between windward and leeward sides.

It may be possible to use the CNRFC orographic model to give guidance where rainfall-runoff models are used. This would apply for the major general storm floods. I don't think the orographic model would be the right tool, however, for the local floods from relatively small drainage areas, such as the Roseville Cirby/Dry Creek flood in January 1995 from a cloud train focusing on a relative small drainage area. There we would have to rely on depth-duration data. It would not be too hard to add a factor for increased storm intensity for global warming, whether for a small stream or large river with this approach. The problem is we do not now know what a reasonable increment would be; 10 percent would be a suggested minimum.

Another point to consider is how to allow room for differing degrees of protection based on the consequences of flood. Two feet is more an inconvenience and a big mess to clean up, whereas 10 to 20 feet is life threatening.

I think there is still a place for flood frequency analysis to determine the degree of protection. FEMA needs it for flood insurance. A frequency rating or comparison may also be a good tool to help in transposing storms from one river basin to another.