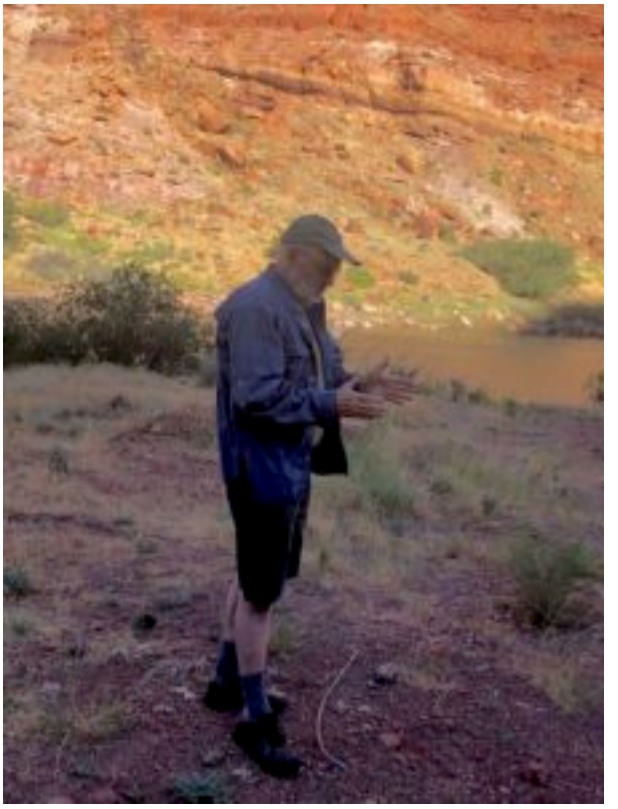
Floods on the Colorado: If It Has Happened in the Past, It Can Happen

Posted by on

By Eric Kuhn



The University of Arizona's Vic Baker on paleofloods of the Colorado River. Photo by Eric Kuhn

Last week I had the pleasure of exploring the banks the Colorado River near Moab, Utah with two of our most accomplished river scientists, Jack Schmidt (Utah State) and Vic Baker (U of Arizona), and hear a presentation by Dr. Baker on the science of studying past floods on the Colorado River system. When a flood occurs, the river leaves evidence of the flood by depositing materials that are carried by the river high on the banks of the river or in caves adjacent to the river. His basic message is "if it has happened in the past, it can happen," therefore, if we can use the evidence nature has provided to estimate the peak discharge of past floods, we can use that

knowledge to be better prepared for future floods.

With the recent focus by the basin's water management agencies on drought contingency plans, flooding has been given little attention. In fact, there are now only very few of us around who were actively involved in river operations during the last major flooding event on the river; the high flows of 1983 and '84. By now the story of 1983 is well known. The large runoff caused by a wet winter and spring combined with higher than normal carry-over storage in Lake Powell caught the Bureau of Reclamation by surprise. The resulting inflow quickly filled the reservoir and far exceeded the capacity of Glen Canyon Dam's power plants and outlet tubes (44,000 cfs) requiring a large amount of water to be released through the emergency spillways. Cavitating flow through the spillways caused considerable damage carving out a small building-sized hole in soft sandstone that surrounds the dam. Further damage was avoided by the installation of 8' plywood panels on the top of the dam (they were quickly replaced by steel panels). In theory, the emergency spillways have now been repaired and redesigned to reduce cavitation (and successfully tested with a short duration high flow), but clearly the reoccurrence of a large uncontrolled spill at a dam anchored in relatively soft sandstone (Glen Canyon) is an event we want to avoid.

The remarkable aspect of the 1983 and '84 high flows is just

how unremarkable and modest the peak flow levels were. The inflow to Lake Powell peaked at about 116,000 cfs in '83 and 125,000 cfs in '84. Before Glen Canyon Dam the largest peak flow we've experienced and documented at Lee's Ferry is about 250,000 cfs in 1884, twice the peak flow of 1984. We know 1884 was a very big year based on newspaper reports and the diaries of settlers, but the flow estimate is somewhat crude. It was made based on the memory of one of the ferry employees whose cat became stranded in a tree by the flood and had to be rescued. Based on Dr. Baker's science, even this 250,000 cfs flow at Lee's Ferry is far from the largest flow that has happened in the past 2000 years. Based the field work of Baker and his students, evidence of flood flows on the Colorado River just upstream of Moab, Utah and the nearby Green River point to a flow as high as 300,000 cfs (each). The estimated past peak flow at Lee's Ferry is about 500,000 cfs, four timed the 1984 peak!

But wait you say, don't we believe that climate change is reducing, not increasing, the natural flow at Lee's Ferry? The answer is yes, the best available science suggests that the long-term average annual natural flow at Lee's Ferry is likely declining. That does not mean, however, that future large flood flows will be less. In fact, because a warmer atmosphere can hold more moisture, science points to the possibility of much larger future peak flows. I can envision an above average runoff year (like 2011 or 2019) that makes a

reasonable dent in the filling of Lake Powell (enough that because of our concern with drought, the Upper Basin would want to keep every drop of it in storage) followed by a super-wet year. Perhaps a year where the track of a series of warm and very moist atmospheric rivers comes in off the Pacific through Southern California with the bullseye on the Colorado and Utah Rockies for an extended period of time. The resulting runoff peaks with an inflow to Lake Powell of over 400,000 cfs and a total volume of near 50 million acre-feet (the climate models suggest it's possible). The potential impacts of such an event could be very serious. Even if Lake Powell was only half full, such flows would quickly fill the available vacant space, then possibly exceed the capacity of Glen Canyon Dam's emergency spillways and over-top the dam. In theory, the dam might survive an over-topping event, but remember how a little imperfection in the service spillway at Oroville Dam resulted in huge damage to the structure (because of the immense erosive power of high velocity water).

Ultimately the flood waters would work their way down through the Grand Canyon, scouring the canyon and causing major environmental damage, into Lake Mead and the Lower Basin main stem reservoirs. The highest flows would be dampened by the lower river facilities, but still high enough to potentially cause major damage to communities along the river From the Mojave-Parker strip to Mexico. This stretch has

seen considerable growth, but no high flows since the mid-1980s. In the worst-case scenario, the flooding impacts might cause a dam failure. The results of which would be catastrophic. I'm not predicting such an event will happen any time soon. I'm only suggesting that with the dominant focus on managing the impacts of aridification, we would also be derelict for not considering and being prepared for future large high-flow events. Given the uncertainties of climate change, the basin's water agencies would be wise to fund additional studies on the high-flow side of hydrograph while they continue their plans to live with reduced average flows.