



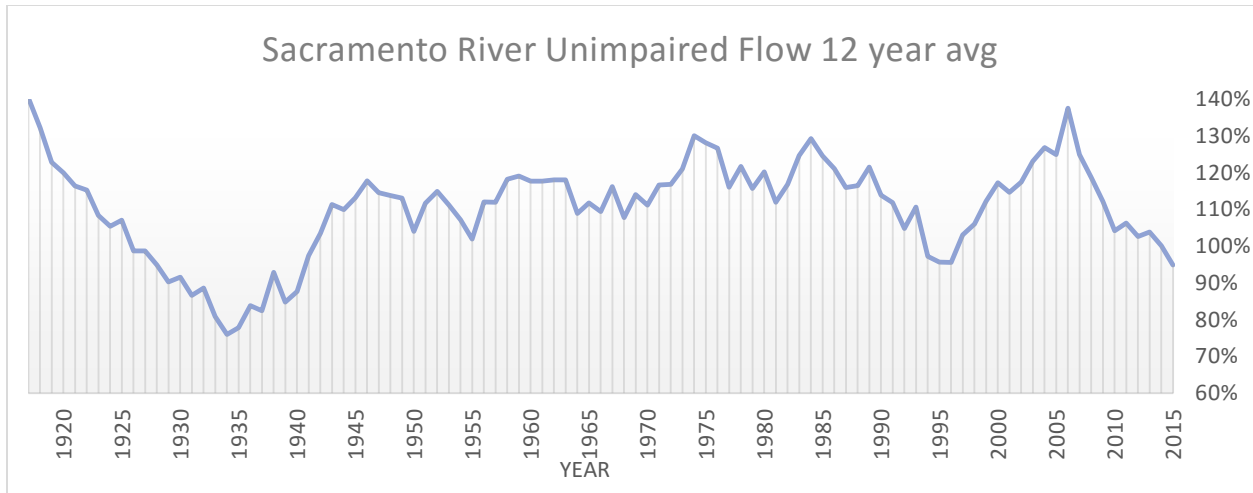
Deirdre Des Jardins
145 Beel Dr
Santa Cruz, CA 95060
(831) 423-6857
ddj@cah2oresearch.com

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State Water Resources Control Board
1001 I Street
Sacramento, California 95814

Observations from the historical record

Much has been said about the recent drought being the “new normal,” but it may just be a return to the old normal. When we look at long term average runoff, California is not in a long term drought, just drying out from an unusually wet period in the late 1990s and early 2000s. The graph below shows the 12 year running average of unimpaired flows on the Sacramento River as a percentage of the median flow for the historical record, 1906-2015. The 12 year average flow declines from a peak of 127% of median in 2006, to about 95% of median in 2015.



12 year running average, reconstructed Sacramento 4 River Index of Unimpaired flow for 1906-2015 (as % of median)

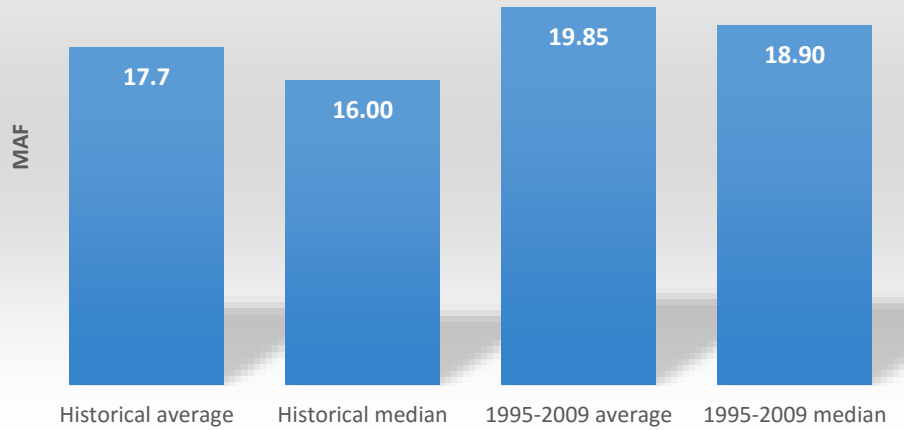
Source: Department of Water Resources, California Data Exchange Center,¹

Many water agencies based their 2010 UWMPs on average water supply for the previous 10-15 years. As the chart below shows, from 1995 to 2009, the average unimpaired flow on the Sacramento River was 19.85 million acre feet, 124% of the median of 16 million acre feet for the historical record (1906-2005). The “shortage” from returning to close to median flows is about 19%. The perceived “shortage” may be exacerbated by using average flows, which are significantly higher than median flows, due to a few unusually wet years. The median flows from 1995 to 2009 were 5% below the average flows. The historical period median is 11% below average flows.

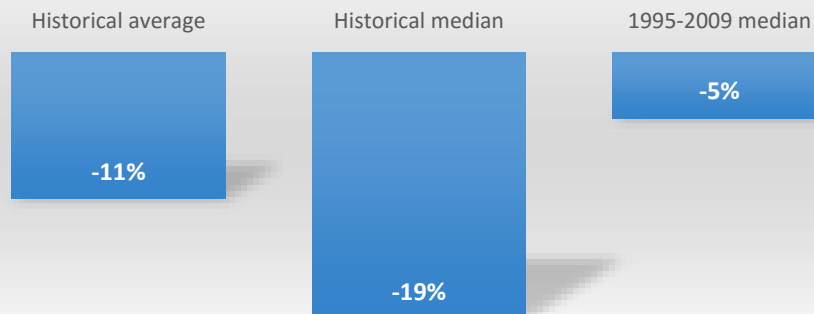
When compared with estimates of unimpaired flows reconstructed from the tree ring record, median historical flows are about 6% below the reconstructed pre-1905 average, reflecting the extremely dry period in the 1920s and 1930s.

¹ Available at <http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST>. Accessed on May 15, 2016.

Sacramento River Unimpaired Flows



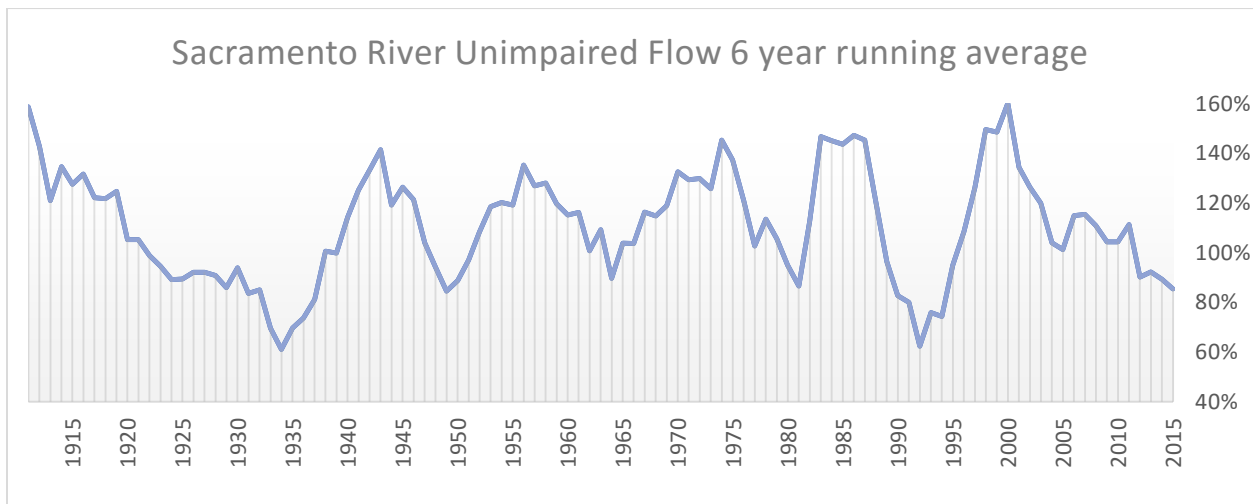
Sacramento River Unimpaired Flow % reduction from 1995-2009 average



A study by Sarah Null and Josh Viers found that greenhouse gas emissions could increase the frequency of dry and critically dry years², so it would be prudent for water agencies to plan for the historical period median flows to be the normal for annual water supply. For the Sacramento River, this means a water supply derived from a permanent reduction of 19% over average flows from 1995 to 2009. While these calculations are for a single watershed, there are likely similar reductions for watersheds across the state.

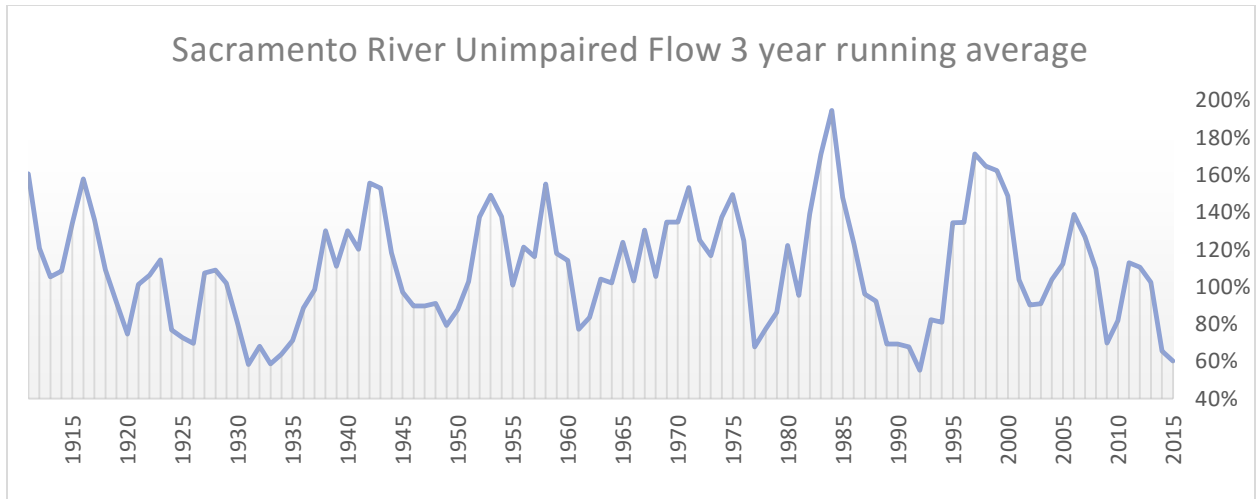
Shorter term effects

Runoff in California is extremely variable. Looking at a 6 year average shows the variability in water supply. The 6 year average declined to 85% of the historical median flow in 2015, and it is unclear when it is going to recover.



A 3 year running average shows even more variability.

² Sarah Null and Josh Viers, Water and Energy Sector Vulnerability to Climate Warming in the Sierra Nevada: Water Year Classification in Non-Stationary Climates, July 31, 2012. Available at <http://www.energy.ca.gov/2012publications/CEC-500-2012-015/CEC-500-2012-015.pdf>



When looking at multiyear average flows, it is unclear that the current dry period has ended. In the Sacramento River watershed, water agencies should plan for a continuation of the six year average reduction of 15% over historical median flows. In other regions, water agencies should calculate the reduction for their watershed.

Recommendations

1. When estimating annual surface water deliveries, median rather than average values should be used, to avoid overestimation due to a few wet years. For estimated deliveries to multi-year carryover storage, averages can be used, but should be based on the entire historical period.
2. When looking at water supply, water agencies should use the historical record for their watershed, and plan for a permanent reduction over average flows in the 1995-2009. The State Water Board regulations should reflect this permanent reduction.
3. When looking at six year averages, the current dry period is not over. Water agencies should plan for an ongoing continuation of the reduction in the six year average flow. The State Water Board regulations should reflect this reduction.
4. Water agencies should also be able to meet greater reductions for three year periods.