## March 2, 2016

## Climate Change and Potential Effects on

 California Water Operations

Placer Oqunty Water

## The Issues

- Observed Data
- Historical Perspective
- Northern California Watersheds
- Future Climate Scenarios
- Interior's Modeling Scenarios
- Reservoir Management
- The Bay-Delta
- Adaptation Strategies


## Data



Figure 2-3 Changes in Air Temperature Over About the Past 400,000 Years
Explanation: Graph depicts changes in air temperature as evidenced by isotopic analysis of ice cores obtained at the Russian Vostok station in central east Antarctica. For additional explanation visit:
http://cdiac.esd.ornl.gov/trends/temp/vostok/jouz_tem.htm.
Source: United Nation's Environment Programme Global Resource Information Database - Arendal website at http://www.grida.no/climate/vital/02.htm.
"The Global sea level rose by about 120 m during the several millennia that followed the end of the last ice age (approximately 21,000 years ago), and stabilized between 3,000 and 2,000 years ago." IPCC AR4



Figure 2-27 Graph of Annual Average Relative Sea Level and the 19-Year Running Average Sea Level at the San Francisco Tide Gauge
b) Total Water Year Runoff Volume (October-September)


Figure 2-14 Unimpaired Runoff Volume for Four Sacramento Valley Rivers*
*Based on the flows of four rivers in the Sacramento Valley; Sacramento River at Bend Bridge (near Red Bluff), Feather River into Lake Oroville, Yuba River at Smartville, and American River below Folsom Lake. $(\mathrm{taf})=$ thousand acre feet.

## Sacramento River Runoff <br> April - July Runoff in percent of Water Year Runoff



Source: DWR, 2011

## Blue Canyon, CA - Air Temperature



## Forecasts

## USBR Basin Study Modeling Assumptions

Relationship Between Changes in Mean Annual Temperature and Precipitation
Scenarios - 10 NN Method
Representative gridcell at American River Basin (Example)


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Annual Folsom Unimpaired Inflow (FUI) (WY1902 - WY2014)


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## USBR Basin Study Results - Sea Level Rise Projections



## Basin Study Results - Delta Salinity Projections





## BDCP Results - Folsom Dry in 10\% of years with Climate Change

Folsom Reservoir Carryover Storage


## Adaptations

(a.k.a. finally some good news)

## We've Been Here Before



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## We Can Adapt

- Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

Upstream actions:

- More rain and less snow demand more upstream storage.
- Upstream reservoir operations require higher end of year carry-over storage targets, and smarter flood control operations.
- Much broader utilization of conjunctive use of groundwater and surface water.


## We Can Adapt

- Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.

In the Delta:

- A saltier Delta requires modified Delta conveyance to move fresh water around brackish water.
- Compressed winter runoff pattern requires large diversion capacity when water is available in the system.
- Delta requirements must recognize drought and climate reality, or we kill the tributaries trying to keep the Delta fresh.


## We Can Adapt

- Preparing for present-day droughts and preparing for a warming climate involve the same adaptations.


## South of the Delta:

- Increased storage south-of-Delta to take advantage of diversions when available.
- Stabilize groundwater levels in the San Joaquin Valley so conjunctive use opportunities are available in dry years for multiple uses.
- Broader utilization of desalination, recycled and groundwater resources, combined with imports to stabilize supplies.


