Forecast Informed Reservoir Operations
- An Opportunity to Improve the Resiliency of our Water Supply

Western States Water Council
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www.sonomacountywater.org
Russian River System

Dual Purpose Facilities
- Flood Protection (ACOE)
- Water Supply (SCWA)
- Rainfall dominated watershed
- Eel River Diversions
- Highly regulated river system

Lake Sonoma (Warm Springs Dam)
Flood Control Pool: 136,000 AF
Water Supply Pool: 245,000 AF

Lake Mendocino (Coyote Valley Dam)
Flood Control Pool: 48,100 AF
Water Supply Pool: 68,400 AF (Min)
Lake Mendocino Does Not Function As A Reliable Water Supply Facility

Some Reasons For Inadequate Water Supply Reliability:

- Relatively small storage capacity
- Relatively unproductive watershed
- Reduced inflow from Potter Valley Project (Eel River)
- Highly variable precipitation patterns
  - Almost 50% rainfall from atmospheric rivers
- Future growth & climate change will likely further reduce reliability
Who Relies On Water Supply From Lake Mendocino?

**Municipal Uses:**
- Direct river diversions & groundwater recharged by Russian River
- Sonoma County Water Agency (regional system)

**Agriculture Uses:**
- Vineyards, orchards, row crops

**Environmental & Ecosystem Uses:**
- Three ESA-listed salmonid species

**Recreation & Tourism Uses:**
- Lake Mendocino high use recreation facility
- Tourism associated with Russian River significant to regional economy
Atmospheric Rivers: Our Extreme Weather Events

Composite Dec 11, 2014

Total Precipitable Water (mm)

Source: CIMSS
Atmospheric Rivers Drive Droughts & Floods

Hopland Composite

Large storms account for 84% of the variance of total precipitation

From M. Dettinger
Hydrograph - Russian River at Hacienda Bridge, Guerneville California

Discharge, cubic meters per second

Date


2,500
2,000
1,500
1,000
500
0
ARs & Russian River floods

- **ALL 7 major floods of Russian River since 1997 have been atmospheric rivers** *(Ralph et al., GRL, 2006)*

On a longer time scale, **among all 39 “declared” floods of the Russian River (39 cases with > 50,000 cfs) from 1948-2011... 87% were caused by ARs**

Ralph et al., GRL, 2006
Cumulative Potter Valley Project Diversions

A Declining Trend
Reduced Potter Valley Project Diversions

Average Potter Valley Project Diversions

Lake Mendocino Guide Curve
Lake Mendocino Reliability Study

Modeling Study: 8 Scenarios Evaluated

- Current Water Supply Reliability
  - Current Eel River Diversions
  - No Eel River Diversions
- Projected 2045 Water Demand: High & Low
- Potential Climate Change Impacts: Dry & Wet
Lake Mendocino Minimum Annual Storage Distribution

Scenario #1: Modeled Data (1910 - 2013) with Current Operations of PVP, 2015 Projected Demands, and Modeled Historical Climate
Scenario #2: Modeled Data (1910 - 2013) with No Operations of PVP, 2015 Projected Demands, and Modeled Historical Climate
Scenario #3: Modeled Data (1910 - 2013) with Current Operations of PVP, 2045 Projected Low Demands, and Modeled Historical Climate
Scenario #4: Modeled Data (1910 - 2013) with Current Operations of PVP, 2045 Projected High Demands, and Modeled Historical Climate
Observed Historical Data (1984 - 2006)
Lake Mendocino Minimum Annual Storage Distribution

Scenario #1: Modeled Data (1910 - 2013) with Current Operations of PVP, 2015 Projected Demands, and Modeled Historical Climate
Scenario #4: Modeled Data (1910 - 2013) with Current Operations of PVP, 2045 Projected High Demands, and Modeled Historical Climate
Scenario #5: Modeled Data (2001 - 2099) with Current Operations of PVP, 2045 Projected Low Demands, and Modeled Dry Climate
Scenario #6: Modeled Data (2001 - 2099) with Current Operations of PVP, 2045 Projected High Demands, and Modeled Dry Climate
Scenario #7: Modeled Data (2001 - 2099) with Current Operations of PVP, 2045 Projected Low Demands, and Modeled Wet Climate
Scenario #8: Modeled Data (2001 - 2099) with Current Operations of PVP, 2045 Projected High Demands, and Modeled Wet Climate
Several Initiatives To Improve Water Supply Reliability

- Raise Coyote Valley Dam
- Integrated water management & conservation
- Modification of the hydrologic index
- **Forecast Improved Reservoir Operations (FIRO)**
Lake Mendocino Water Years 2012 - 2014

Can we save some of this water?

Atmospheric River Events

To avoid this
Lake Mendocino FIRO Demonstration Project - A Collaborative Effort

Broad coalition of federal, state, & regional agencies comprised of scientists & water managers

Steering Committee:
Federal: NOAA (OAR, NWS, NMFS), USGS, Army Corps of Engineers, & Bureau of Reclamation
State: California Department of Water Resources & Scripps Center for Western Weather & Water Extremes
Regional: Sonoma County Water Agency

Partnerships: NOAA Habitat Blueprint
Integrated Water Resource Sciences & Services
Possible Operational Improvements: Forecast Informed Operations

Incorporate current forecast skill into operations for periods when no storm events are predicted (near-term)

Reservoir operations consider watershed conditions (near-term)

- SCWA/NOAA/USGS install soil moisture & rain gages above reservoirs
- Develop correlations between rainfall-soil moisture-reservoir inflow

Forecast skill for atmospheric river events (long-term)

- Predict landfall & intensity of storms
- CalWater-2 and other research
Lake Mendocino
FIRO Demonstration Project

Goal of initial phase is to answer the following question:
Is FIRO currently viable as an operational strategy to improve water supply and environmental conditions without impairing flood protection?

If answer is yes, then next step is to answer the following:
What decision support system & tools need to be employed to operationalize FIRO?

If answer is no, then next step is to address the following:
What research needs to be conducted to improve science & technology to meet the needs of water managers?
Viability Evaluation
Is FIRO currently viable strategy to improve water supply and environmental conditions without impairing flood protection?

YES – FIRO is a viable strategy
(Note: some FIRO strategies may be currently viable while others are not)

NO – FIRO is NOT currently a viable strategy to improve reservoir operations

What Improvements in scientific knowledge & decision tools need to occur so that FIRO is viable and can meet the needs of water managers?

Science & Technical Programs
- Data collection & monitoring (watershed, hydrometric)
- Weather Forecasting
  - QPI
  - QPE
  - ARs
- Decision support model
- Data interoperability

How can FIRO become incorporated into reservoir operations?
- Process
- Decision support tools/model
Demonstration Project Status

Complete Work Plan
- Early Summer 2015

In-person Steering Committee Mtg
- July 2015

“Bookend” Model Studies
- Baseline and perfect forecast
- Current condition assessments
- Fall 2015

Preliminary feasibility/viability study
- Winter 2016
Modeling Shows FIRO Potential for Water Supply Benefits
Challenges

Coordination between (and within) multiple agencies

Operationalizing research products & new technology into reservoir management decisions

Who accepts risks? What is tolerable risk?

Take the long-term view but demonstrate short-term improvements

Manage expectations: “No silver bullets”