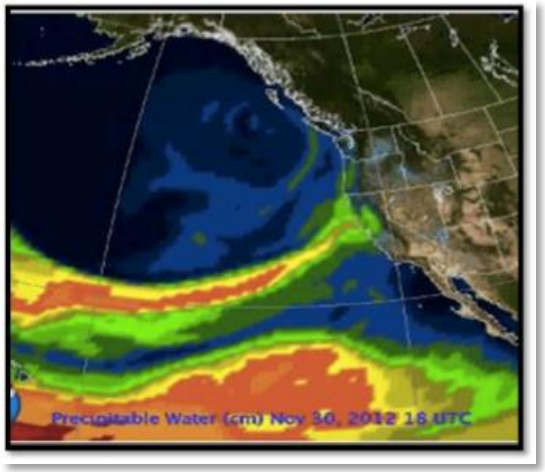
Forecast Informed Reservoir Operations - Lake Mendocino Demonstration Project



Improving S2S Precipitation Forecasting - WSWC
May 16, 2018
San Diego, CA

Jay Jasperse, P.E.
Chief Engineer
Sonoma County Water Agency

SONOMA COUNTY WATER AGENCY

Overview

- Background & Motivation for Project
- Forecast Informed Reservoir Operations (FIRO) Project Team
- Project Status
  - Process
  - Results of Preliminary Viability Analysis
  - Results of Virtual Operations – 2016/2017
  - Decision Support System & Planned Operations
- Summary

Russian River Reservoirs

Dual Purpose Facilities

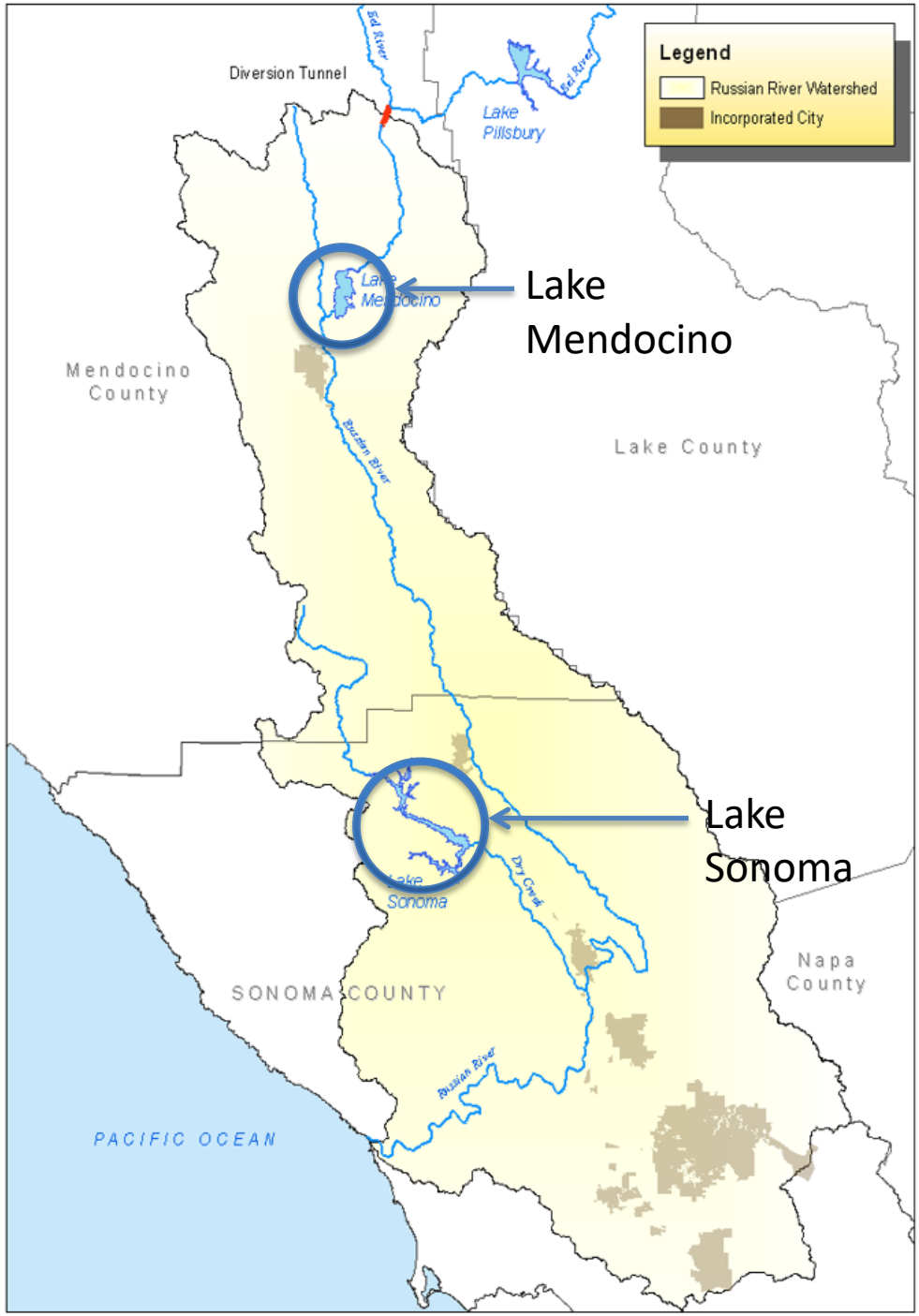
- Flood Management (ACOE)
- Water Supply (SCWA)
- Operations Dictated by Storage Levels Relative to "Rule Curve"

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
(Nov. 1 – March 1)



Lake Mendocino Provides Several Regional Benefits

Flood Protection

Potable Water Supply

- Cities & communities along the Russian River
- Other urban areas in Sonoma & Marin Counties via SCWA's transmission system

Agriculture

- Multi-billion dollar agricultural industry, most notably wine grapes

Ecosystem Services

- Fisheries & sensitive habitat
- Groundwater recharge – groundwater dependent ecosystems

Tourism & Recreation

- "Wine country"
- Boating, fishing, swimming, camping, etc.

The Issue: Lake Mendocino's Water Supply Is Not Reliable

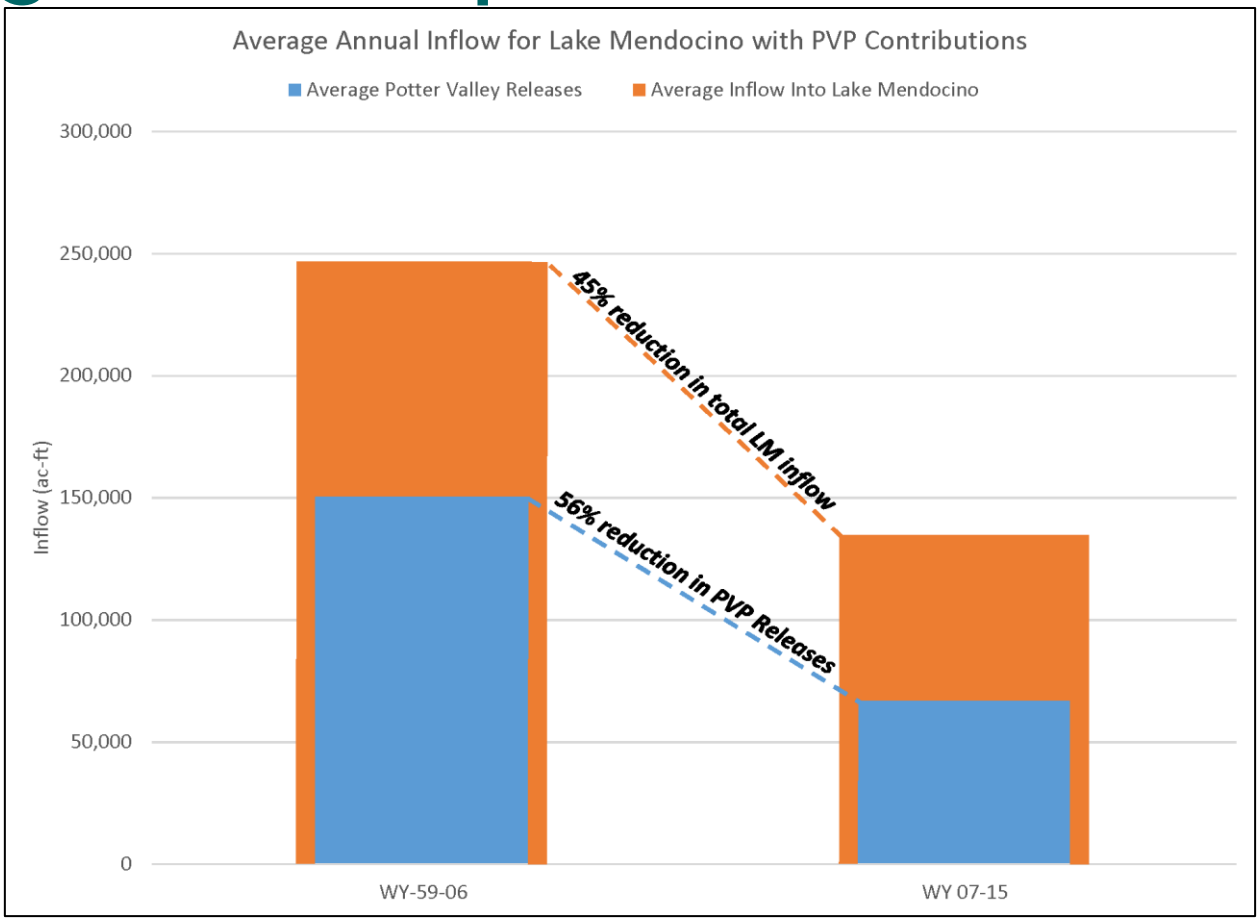
Some Reasons For Low Water Supply Reliability:

- Reduced inflow (56%) from the Eel River (via Potter Valley Project) results in an overall decrease of ~45% of total inflow
- Highly variable precipitation patterns
  - Almost 50% rainfall from atmospheric rivers
- Future growth & climate change will likely further reduce reliability

Coyote Valley Dam & Lake Mendocino

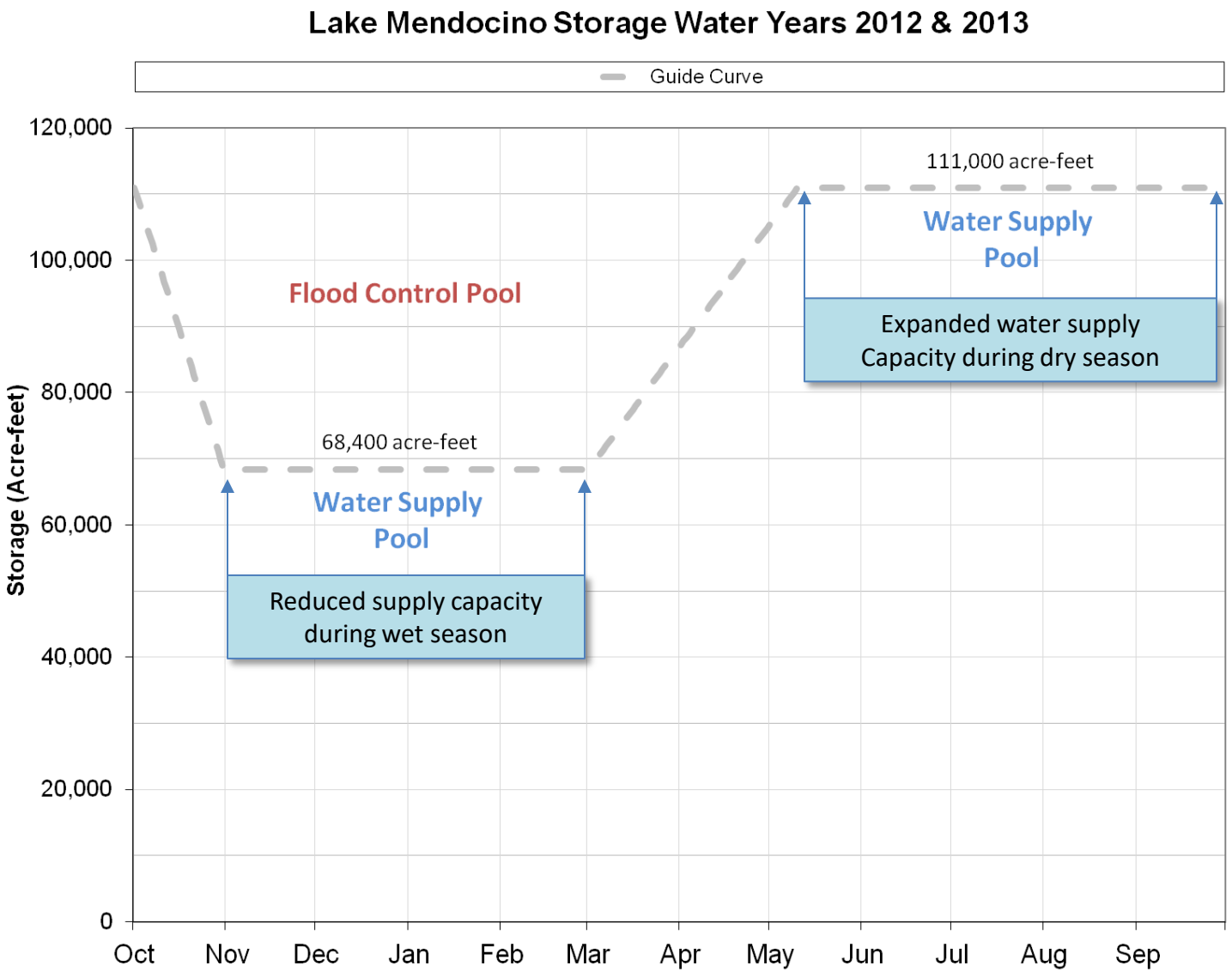
- **Upper Russian River Watershed**
- **Coyote Valley Dam**
  - Constructed by the Army Corps of Engineers in 1959
  - USACE: Flood Control
  - SCWA: Water supply
- **Watershed Area: 105 mi^2**
- **Max Water Supply: 111,000 acre-feet**
- **Potter Valley Project – PG&E**
  - Imports water from the Eel River to the East Fork Russian River

Reduced Potter Valley Inflows - Significant Impact to Lk Mendocino

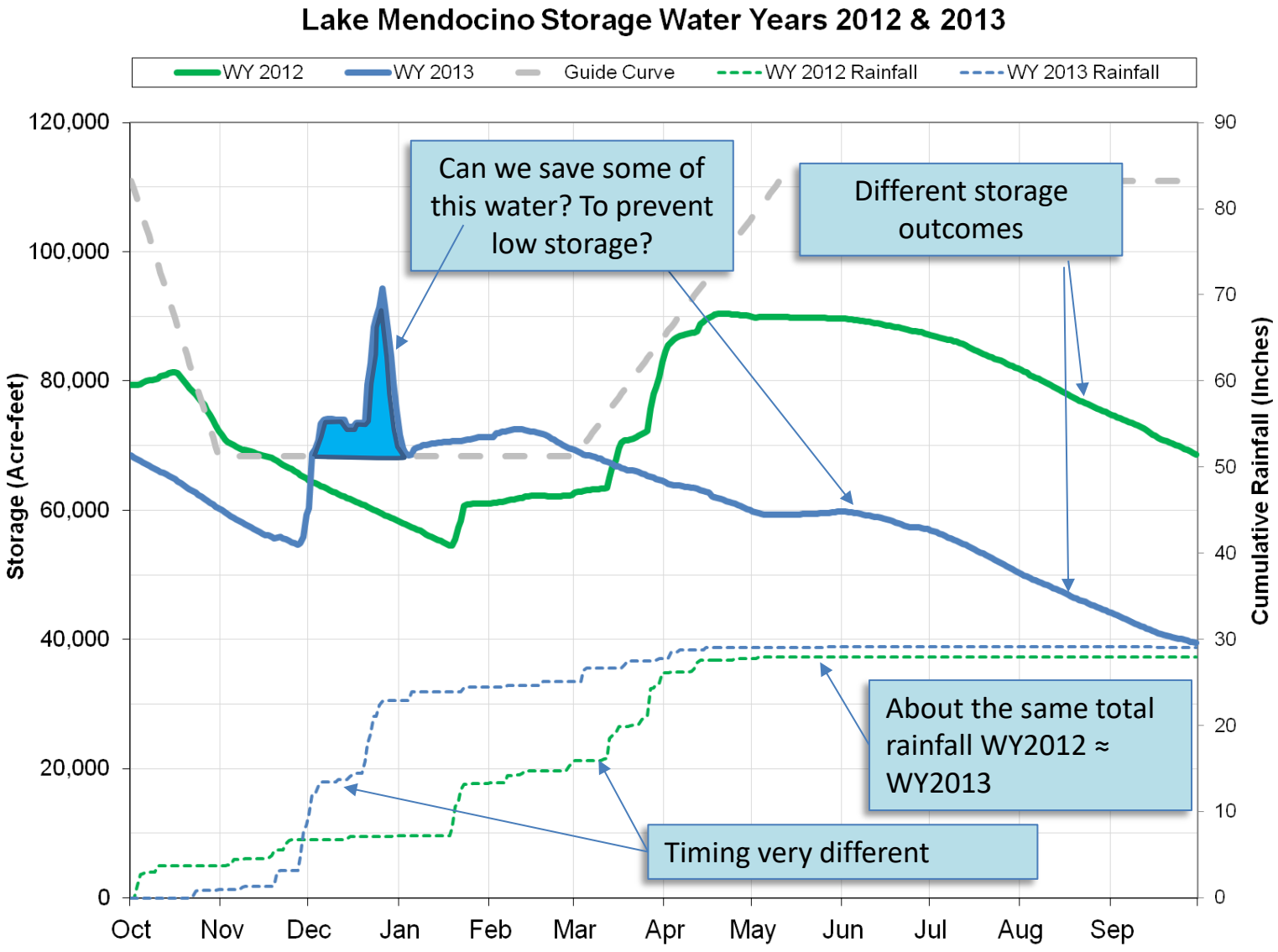


- **2004 FERC License Amendment implemented in Fall 2006**
  - Significant reductions in Eel River imports through the PVP
  - Water supply reliability challenges in Lake Mendocino

Lake Mendocino Guide Curve



Lake Mendocino Guide Curve



Lake Mendocino FIRO Steering Committee – A Collaborative Effort

- **Co-Chairs**
  - Jay Jasperse – Sonoma County Water Agency
  - F. Martin Ralph – UCSD / SIO / CW3E
- **Members**
  - Michael Anderson – California DWR
  - Levi Brekke – USBR
  - Nick Malasavage – USACE / SPN
  - Michael Dettinger – USGS
  - Joe Forbis – USACE / SPK
  - Alan Haynes – NOAA / NWS
  - Patrick Rutten – NOAA / NMFS
  - Cary Talbot – USACE / ERDC
  - Robert Webb – NOAA / OAR

Project Partners

Lake Mendocino FIRO Timeline

First FIRO workshop August 2014

Steering Committee formed June 2014

Second FIRO workshop July 2015

Draft work plan developed June 2015

Third FIRO workshop June 2016

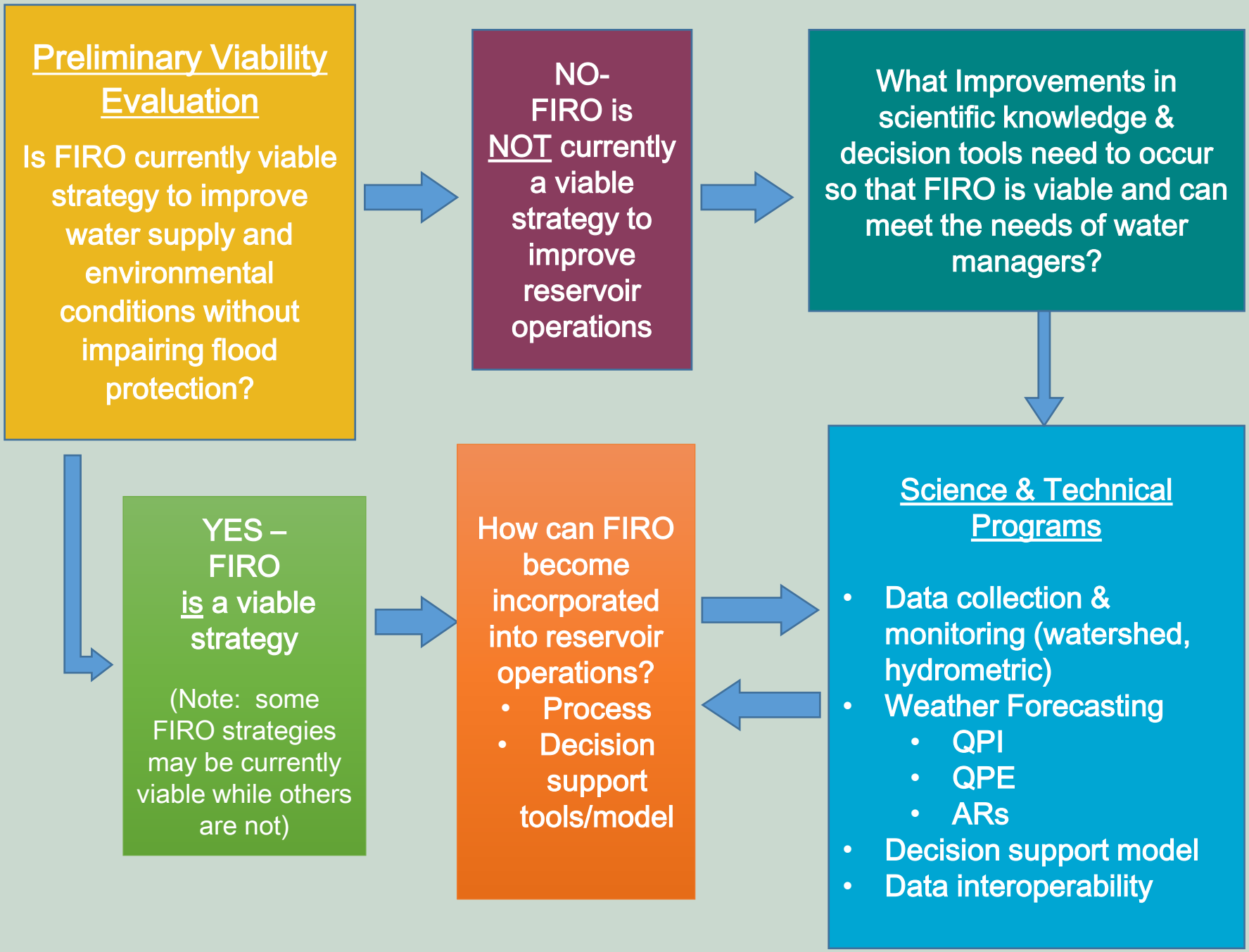
Work plan finalized September 2015

Draft PVA released December 2016

PVA review complete May 2017

PVA finalized July 2017

Fourth FIRO workshop August 2017

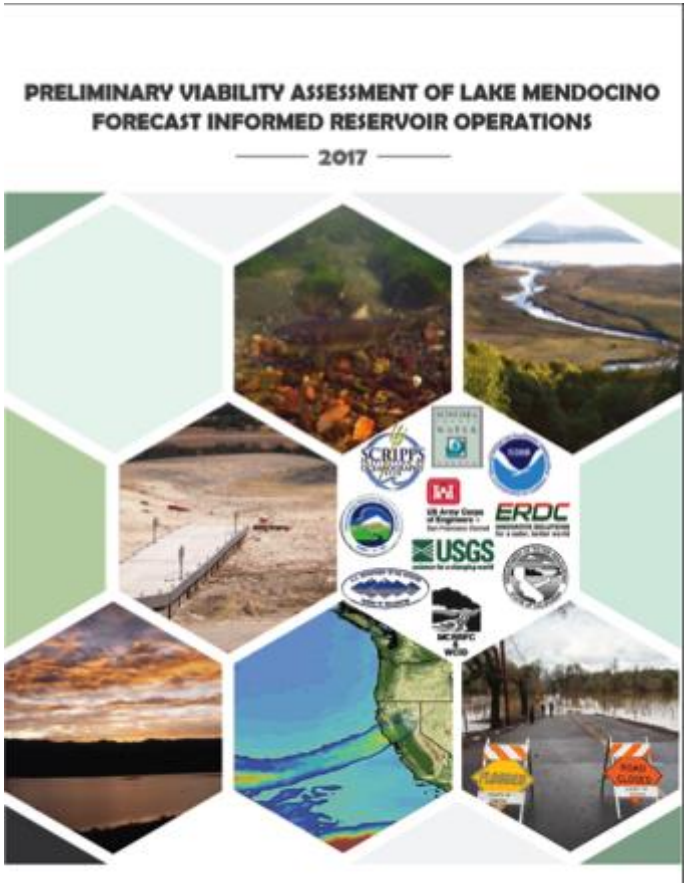

Preliminary Viability Evaluation
Is FIRO currently viable strategy to improve water supply and environmental conditions without impairing flood protection?
NO- FIRO is NOT currently a viable strategy to improve reservoir operations
What Improvements in scientific knowledge & decision tools need to occur so that FIRO is viable and can meet the needs of water managers?
YES – FIRO is a viable strategy
(Note: some FIRO strategies may be currently viable while others are not)
How can FIRO become incorporated into reservoir operations?
• Process
• Decision support tools/model
Science & Technical Programs
• Data collection & monitoring (watershed, hydrometric)
• Weather Forecasting
• QPI
• QPE
• ARs
• Decision support model
• Data interoperability

Lake Mendocino FIRO
Preliminary Viability Assessment - 2017

SCWA – Development and evaluation of a reservoir model that leverages streamflow forecast skill

USACE HEC – Evaluation of multiple reservoir management rule-sets/schemes in the HEC-WAT framework

Scripps CW3E – AR analysis, monitoring enhancements, and quantified forecast skill requirements



Lake Mendocino FIRO PVA Findings

1. Elements of FIRO are currently viable, and can improve reliability in meeting water management objectives and ecosystem conditions without impairing flood protection

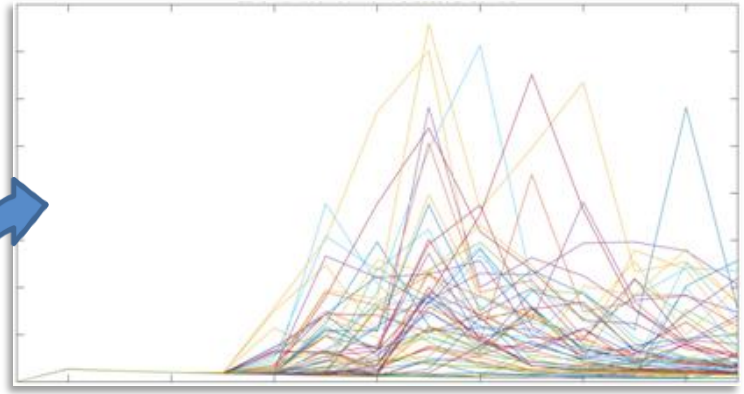
2. Major deviation requests should be developed and submitted to USACE for consideration for winter 2017/18 and beyond

3. Additional improvements in forecast skill have the potential to further enhance reservoir operations

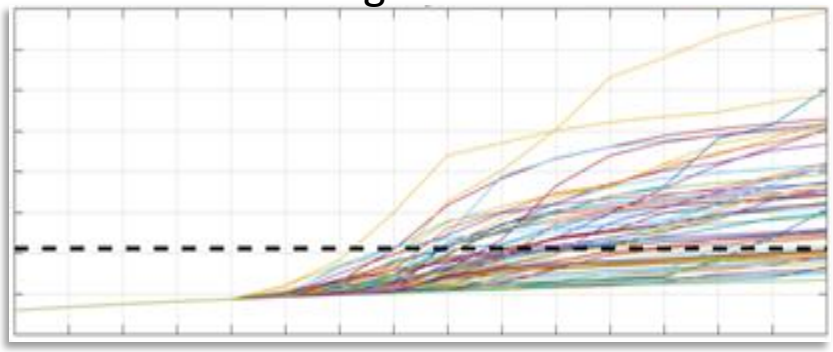
4. Research into integrated hydrometeorological modeling and monitoring with incorporation into decision support systems is required to realize the full potential of FIRO including for enhanced reliability in meeting water management objectives, flood mitigation, and ecosystem services

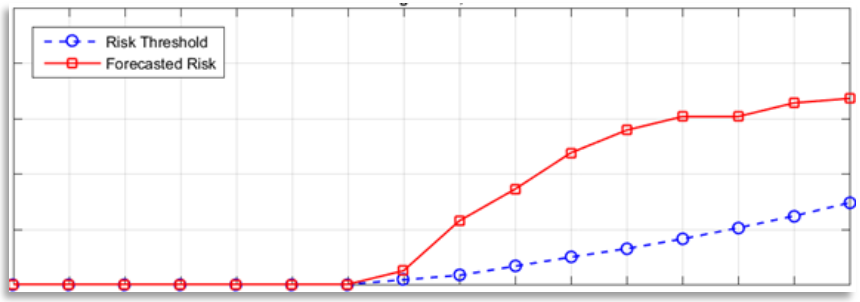
Ensemble Forecast Operations (EFO) Modeling Overview

CNRFC Ensemble Flow Forecast



Storage Forecast



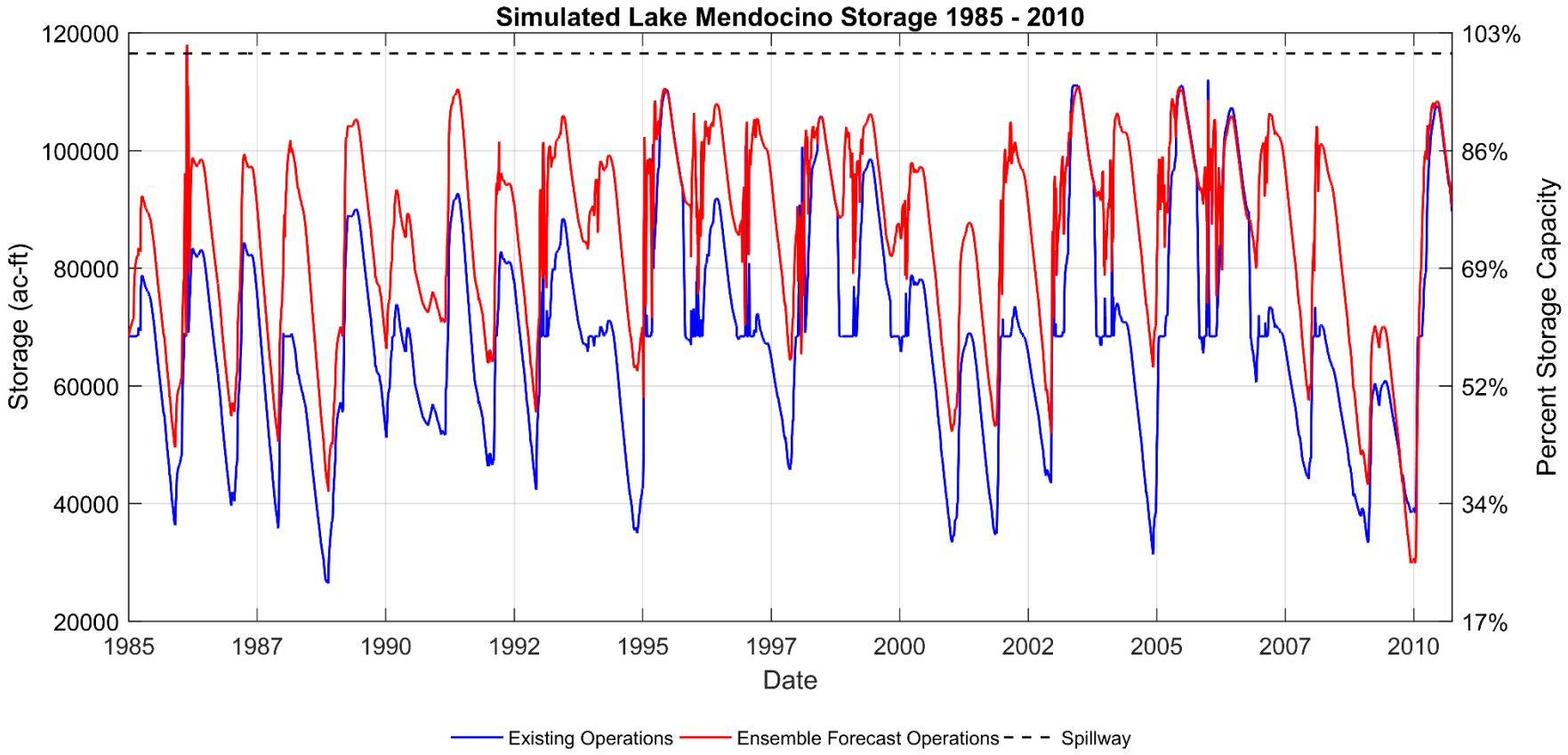


Flood Risk Analysis

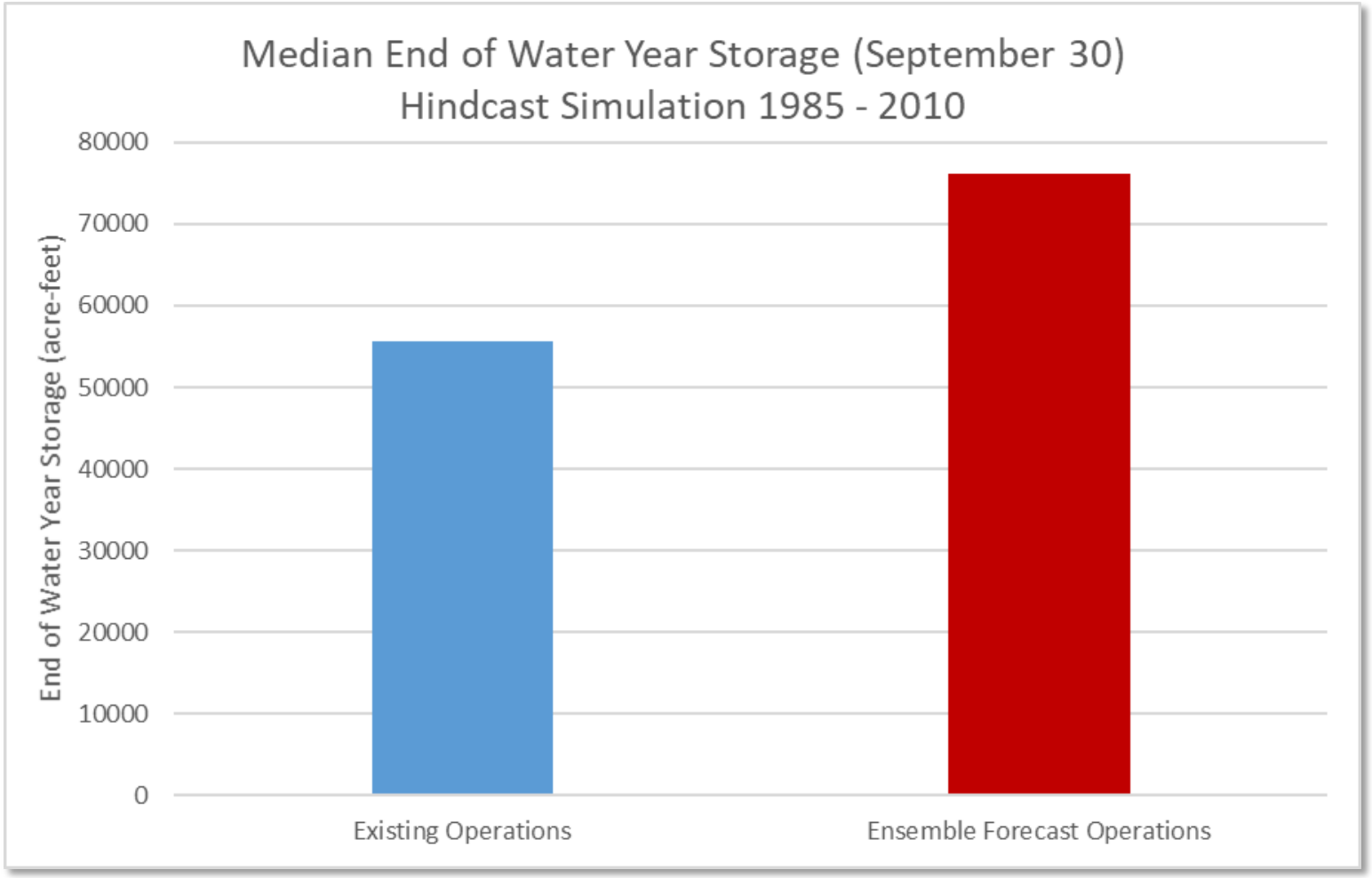
Flood Release

Process repeated each time step

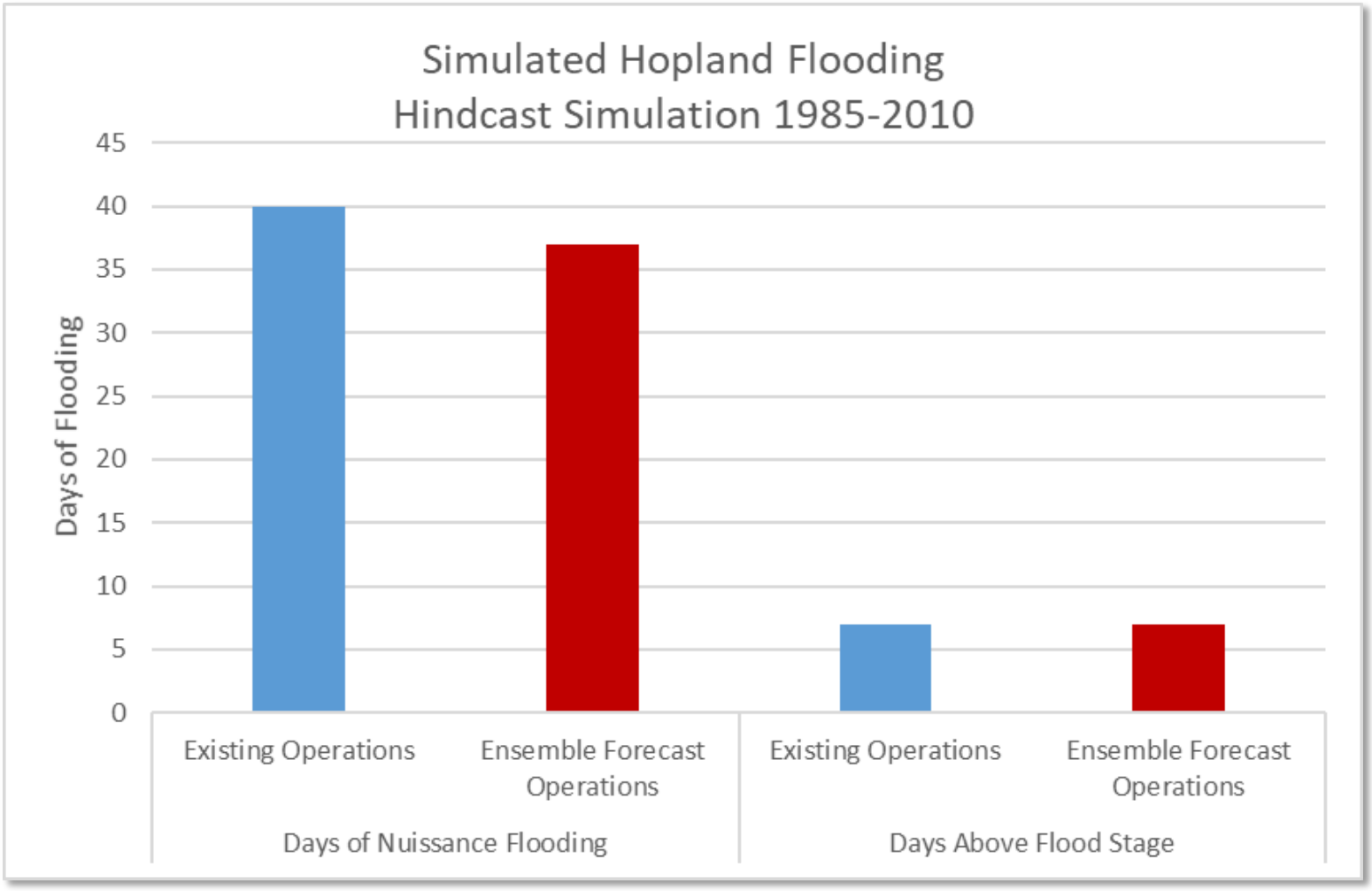
Lake Mendocino Storage Hindcast Simulation 1985-2010



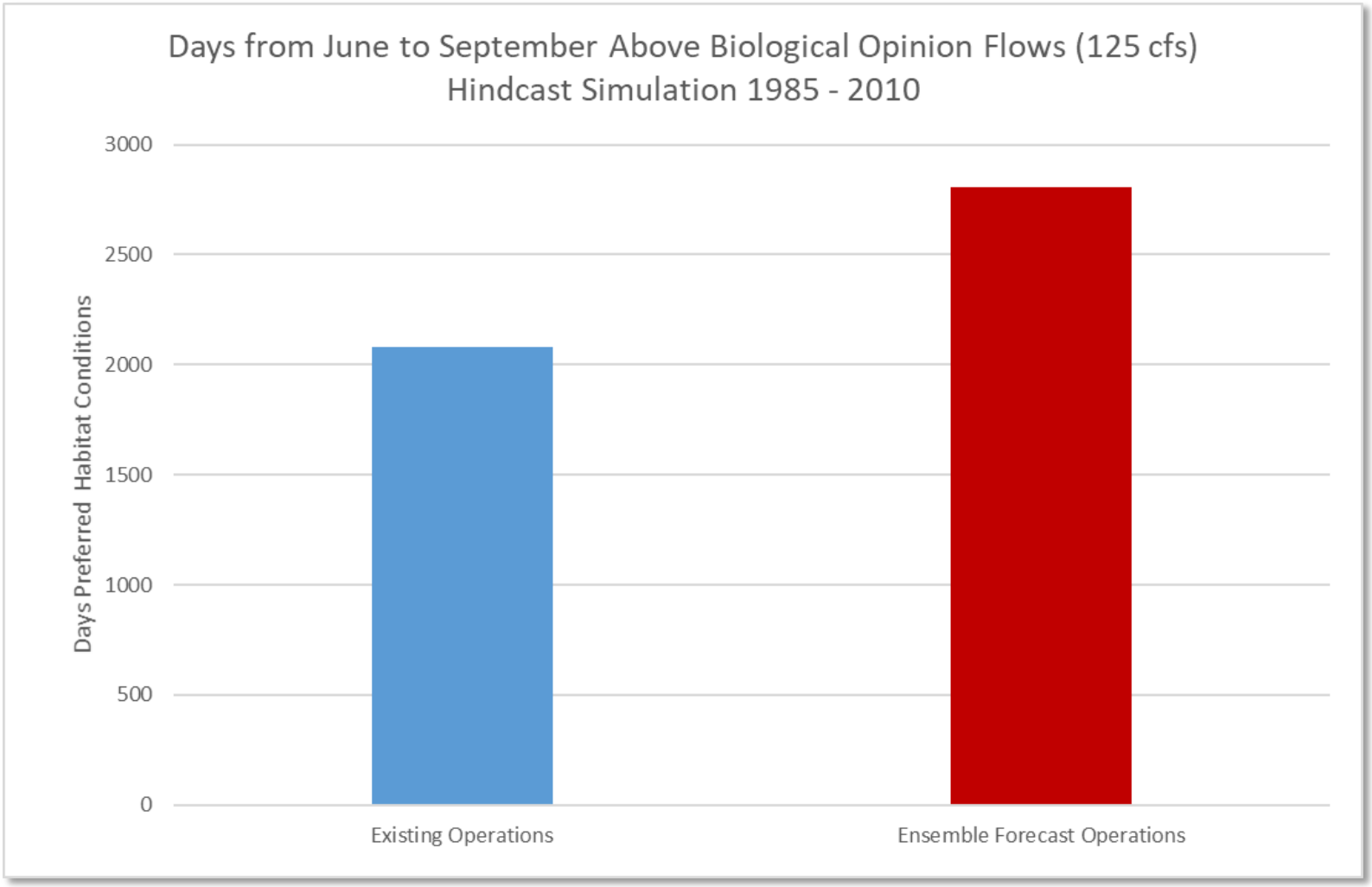
Increased Water Supply
Hindcast Simulation 1985-2010



No Increased Flood Risk
Hindcast Simulation 1985-2010



Improved Habitat Conditions Hindcast Simulation 1985-2010



2017 Virtual FIRO Operations

Actual Operations - In compliance with rule curve

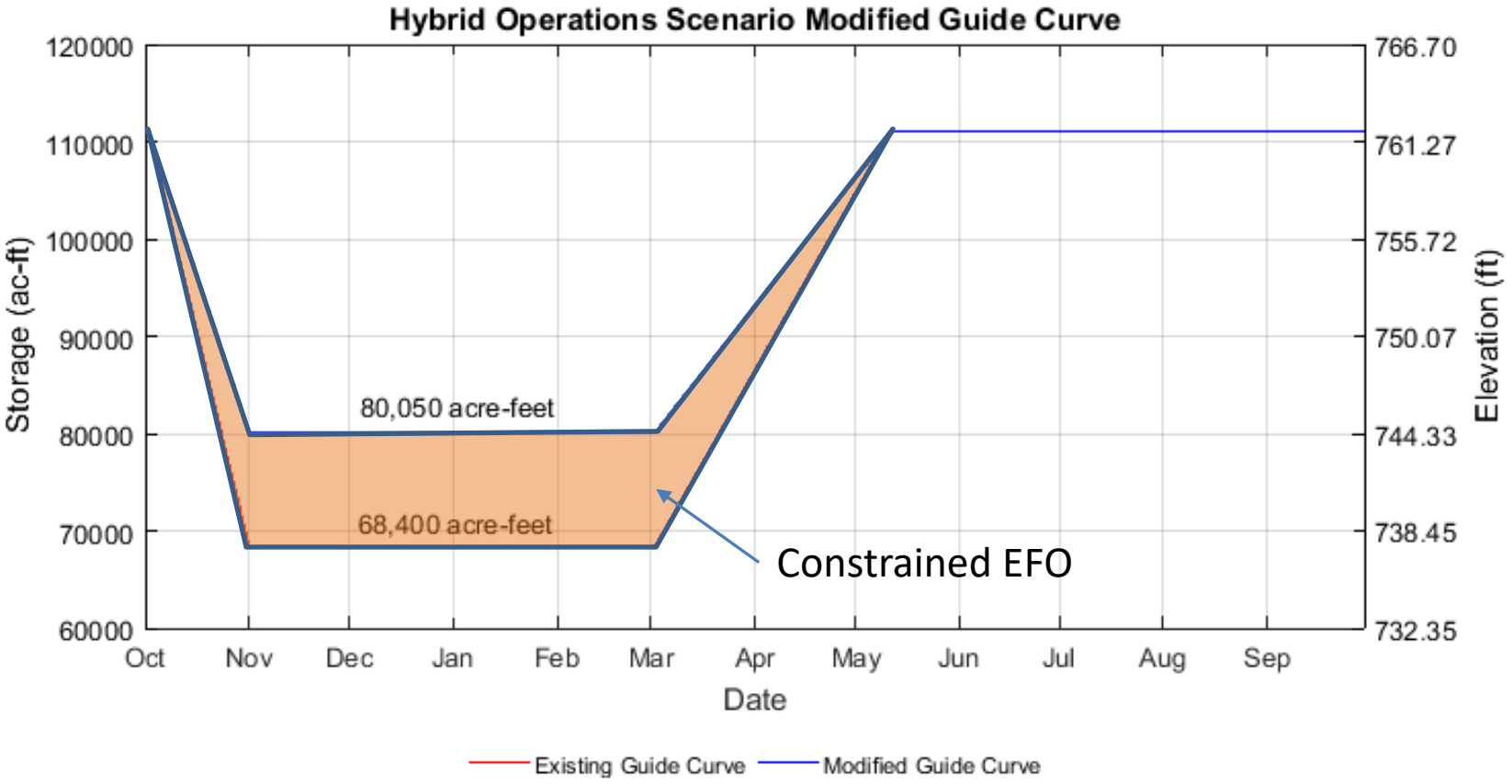
Virtual Ensemble Forecast Operations

- No Rule Curve
- Operations by FIRO based on 60-member ensemble forecasts of reservoir inflows from CNRFC (NWS)

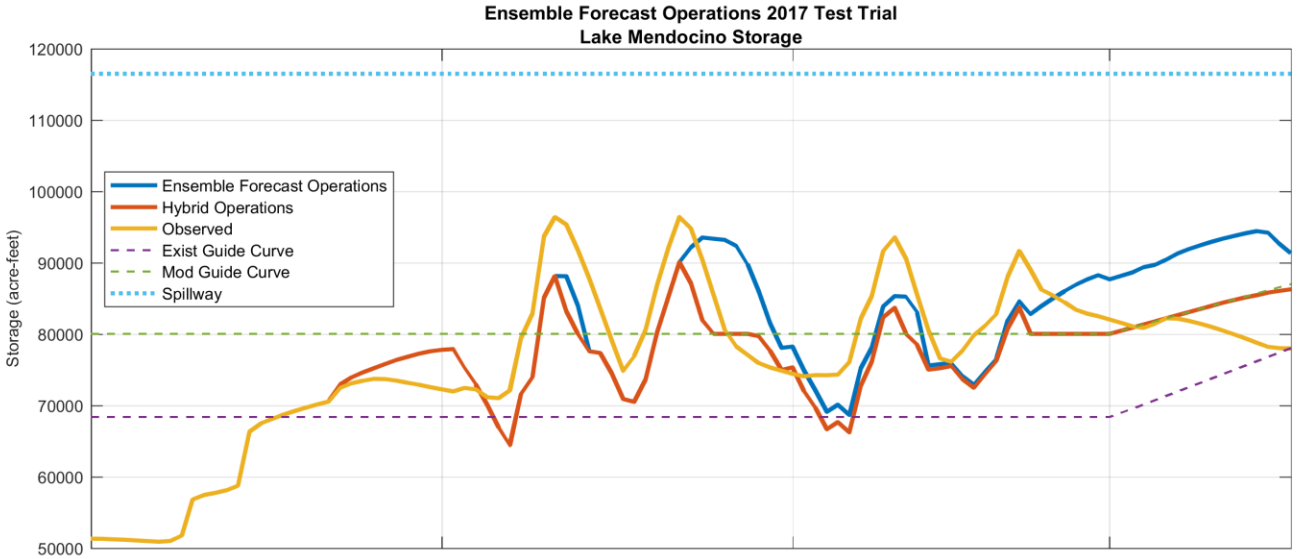
Virtual Hybrid Operations

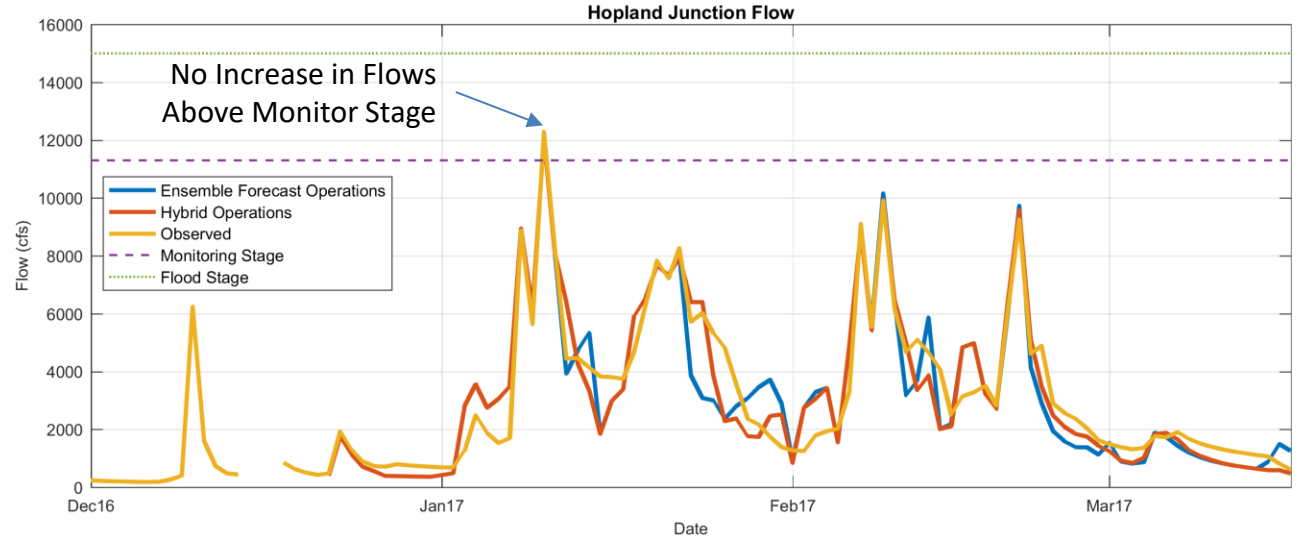
- Combination of Rule Curve & FIRO
- Zone or band of storage which is operated by FIRO using ensemble forecasts are used to inform operations
- When storage outside of FIRO zone/band, operations by rule curve

Virtual Hybrid Operations Scenario

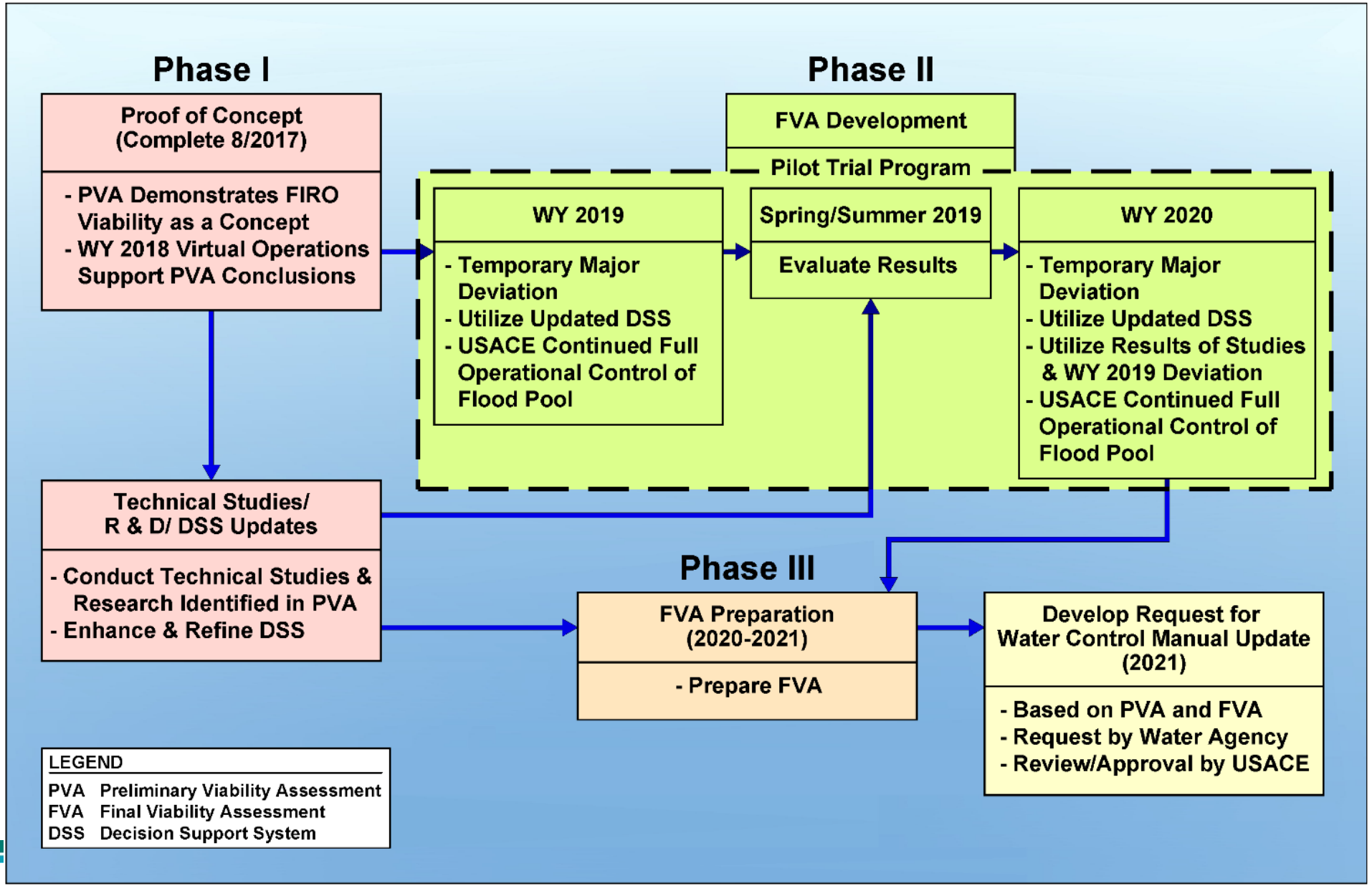


2017 FIRO Virtual Test Trial





Roadmap to Final Viability Assessment



Objectives:
Lake Mendocino FIRO Decision Support System

1. Supports decision making by USACE San Francisco District operators related to CVD releases

2. Provides a learning environment for both operations and research

Decision Support System Attributes

- Resides on California Data Exchange Center (CDEC)
- Access to real time data
- Access to current ensemble forecasts from CNRFC
- Uses SCWA EFO Model (Hybrid Option)
- Uses HEC ResSim
- Provides Operator with release options
  - Standard Water Control Manual
  - SCWA EFO Hybrid
  - User selected
- Selected release pattern pushed to CNRFC operations
- Accessible by USACE and full FIRO team (read only)

Status of Decision Support System

- DWR agreed to host RR DSS as a new instance of the FCO program on CDEC
- SCWA procured/delivered computer server
- CDEC has initial version running
- SCWA model enhancements (hourly, 4x/day)
- Training scheduled for Oct 2018
- In use to support Major Deviation Oct 2018

Summary

- Water management operations must respond to highly variable weather (precipitation) conditions mainly caused by atmospheric rivers (or lack thereof)
- Many reservoirs operate using rules several decades old & based on limited hydrological data
- Increasing requirements & stresses imposed on reservoir operations (e.g., water supply, flood management, environmental, & recreation)
- Lake Mendocino demonstration project employs technical/scientific innovation utilizing collaborative multi-agency partnership

SONOMA COUNTY WATER AGENCY

Summary

- FIRO shows promise for improved reservoir water supply & in-stream flows without compromising flood management
- Potential for improved flood management should be investigated
- FIRO has potential to build resiliency & defer/avoid expensive capital projects
- Incremental implementation (version 1, version 2, etc.) with continual improvements as technical & scientific advances are incorporated

SONOMA COUNTY WATER AGENCY