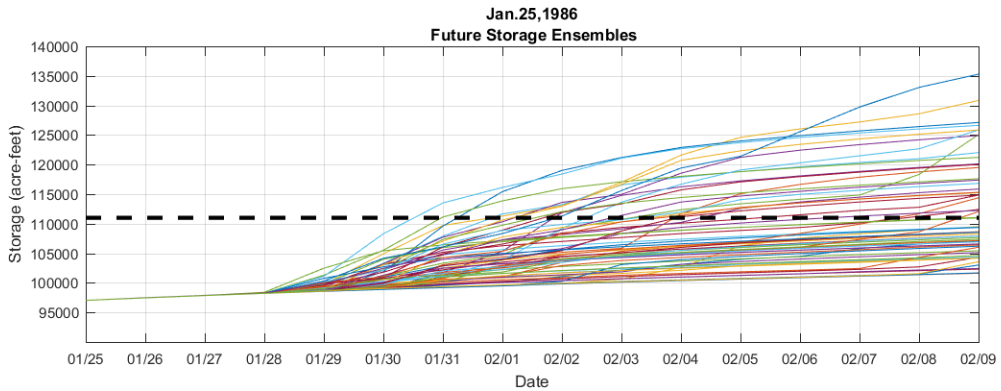
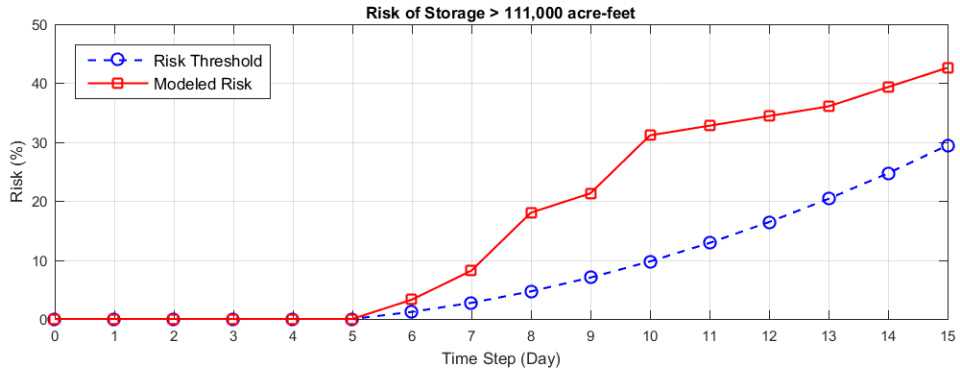
FIRO Viability Assessment
SCWA Analysis
Preliminary Results





Chris Delaney

John Mendoza

June 27, 2016

SONOMA COUNTY WATER AGENCY

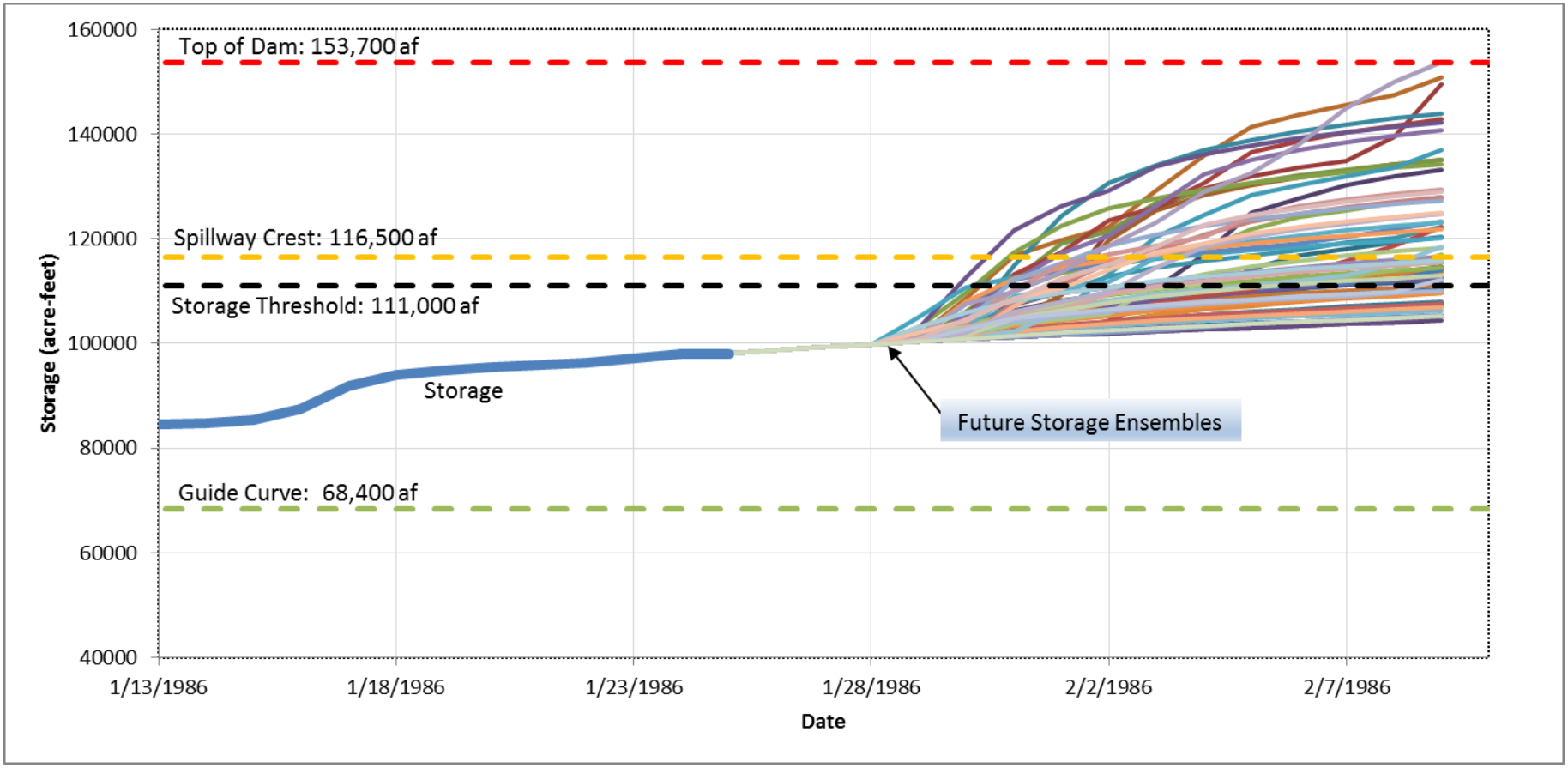
FIRO Viability Assessment
Sonoma County Water Agency

- **Water Agency Interests**
  - Can FIRO improve water supply reliability?
    - Environmental
    - Municipal
    - Agricultural

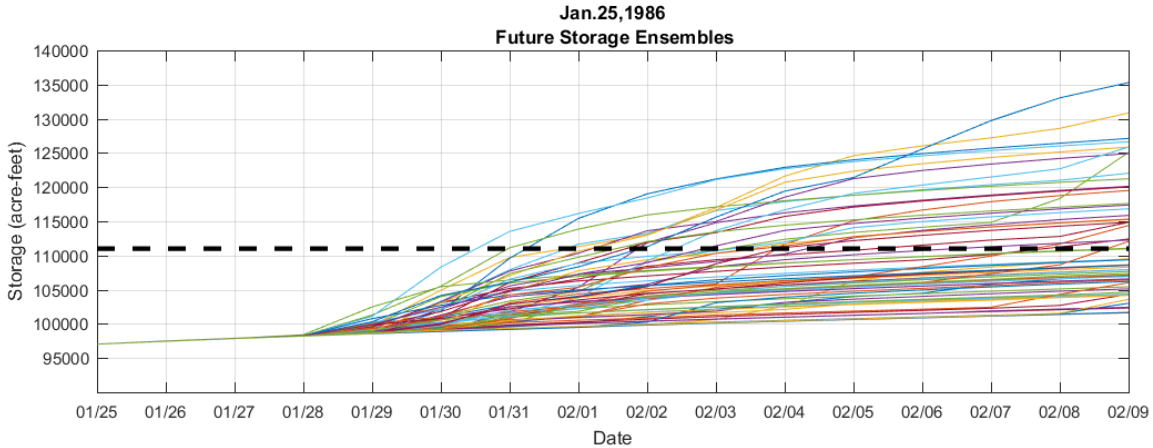
- **Water Agency Perspective**
  - Regional understanding of water supply system
    - Quantify system losses
    - Current system reliability
    - Observational experience & regulatory compliance

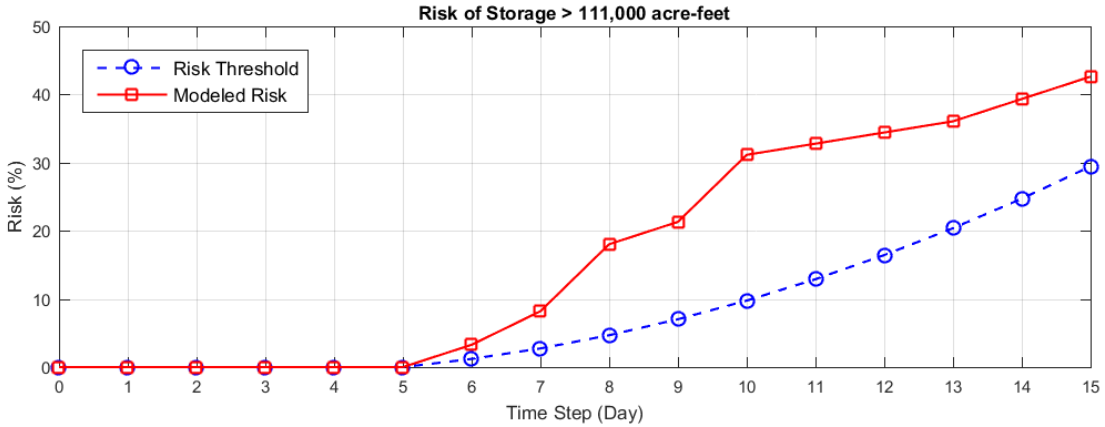
- **Analysis of Risk Based Alternative**
  - Non-guide curve approach
  - Hybrid: Risk based and guide curve approach

Reservoir Stage Forecast from CNRFC Flow Forecast



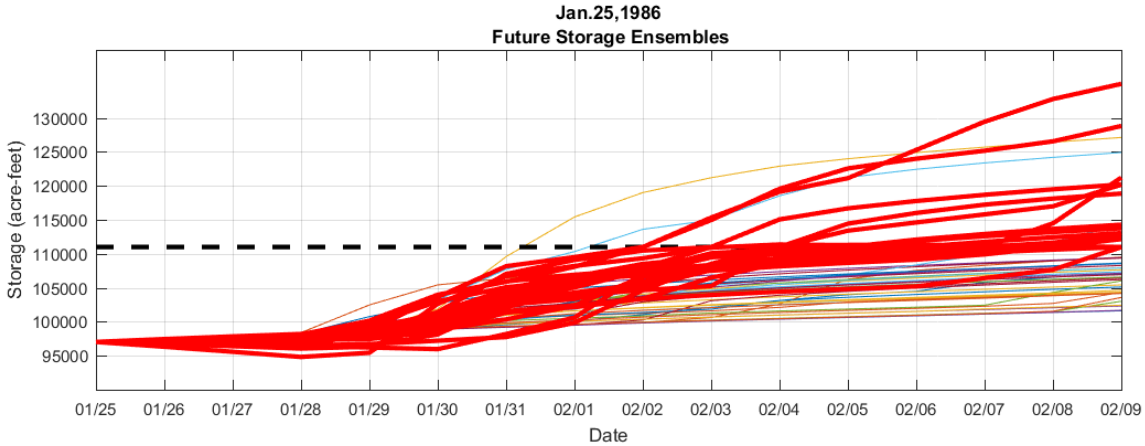
Risk Based Approach

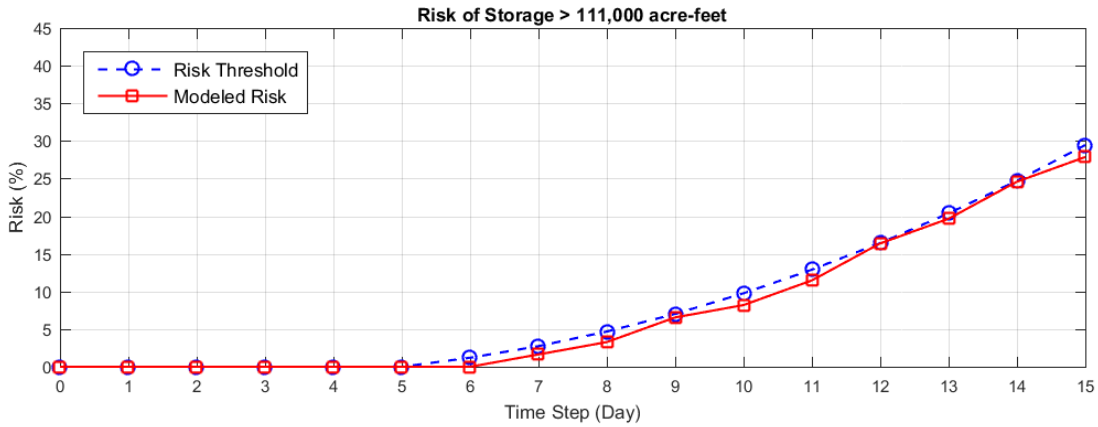




- **Future risk/ probability that storage exceeds a storage threshold**
  - 111,000 acre-feet – current maximum conservation storage

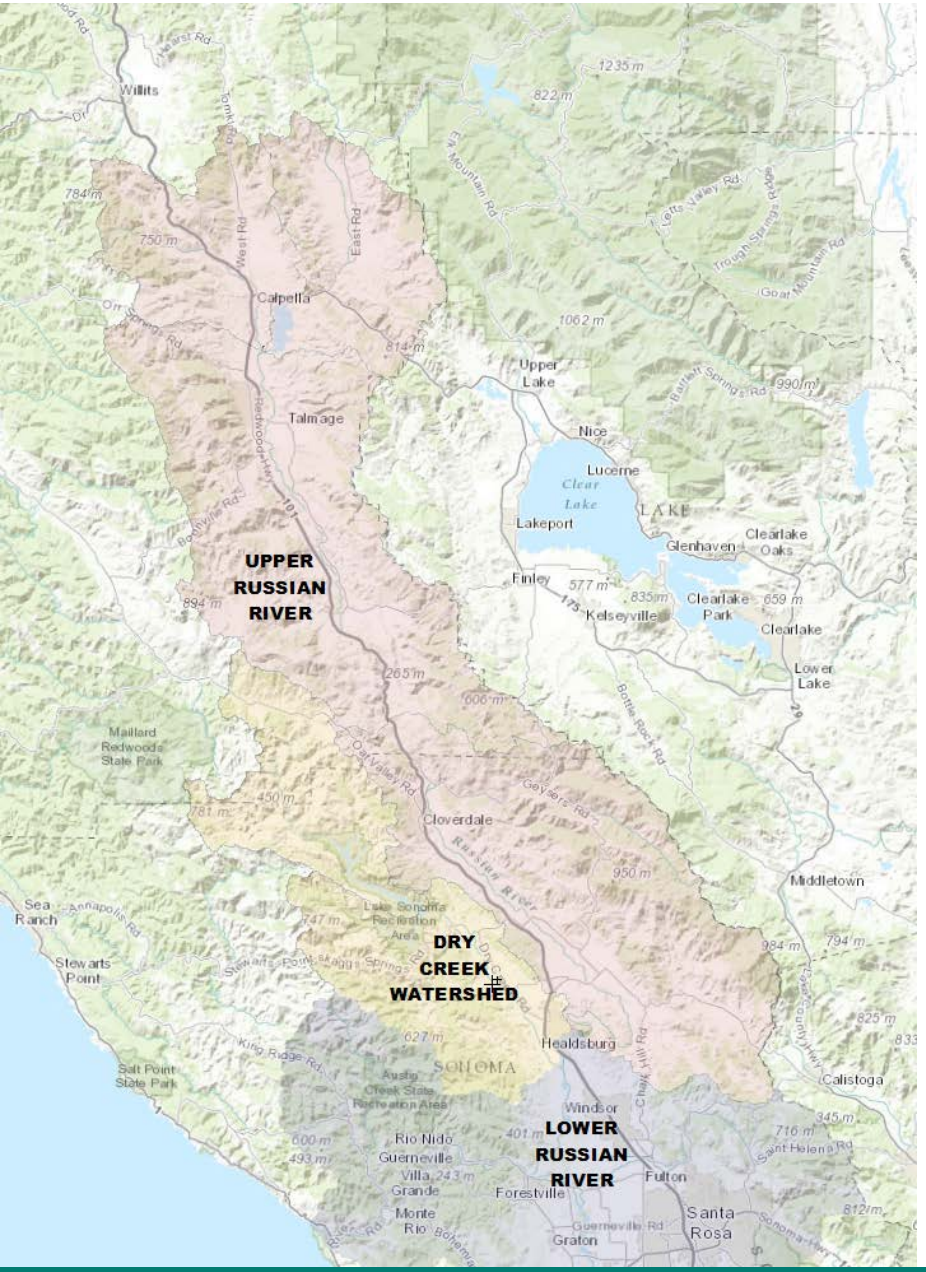
Risk Based Approach

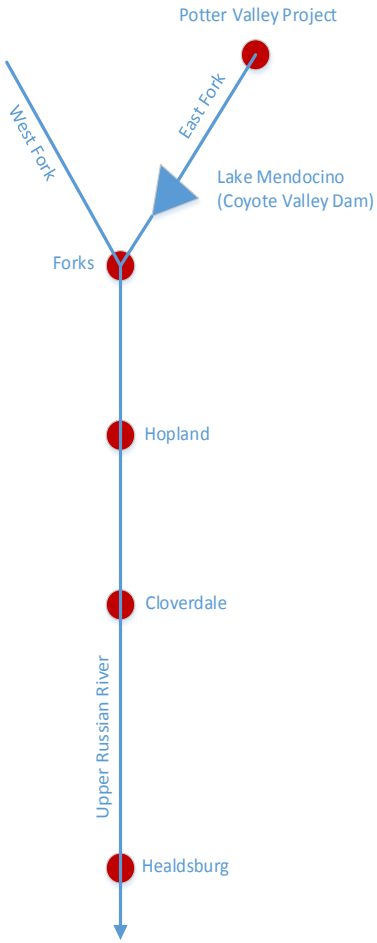




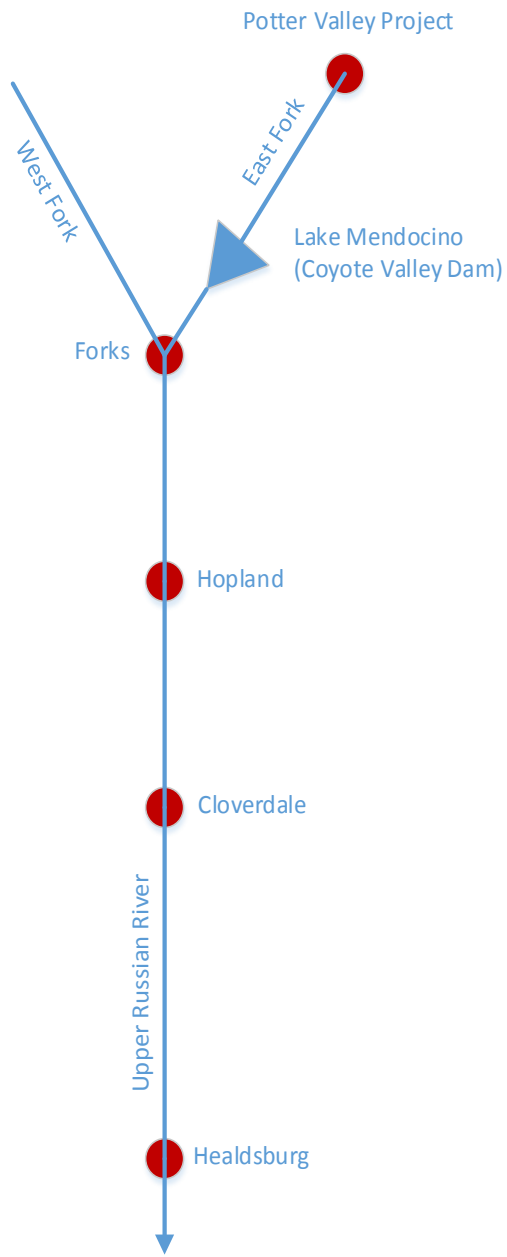
- **Future risk evaluated against risk tolerance threshold**
  - Release calculated to bring all future levels of estimated risk below the risk tolerance threshold

Model Setup





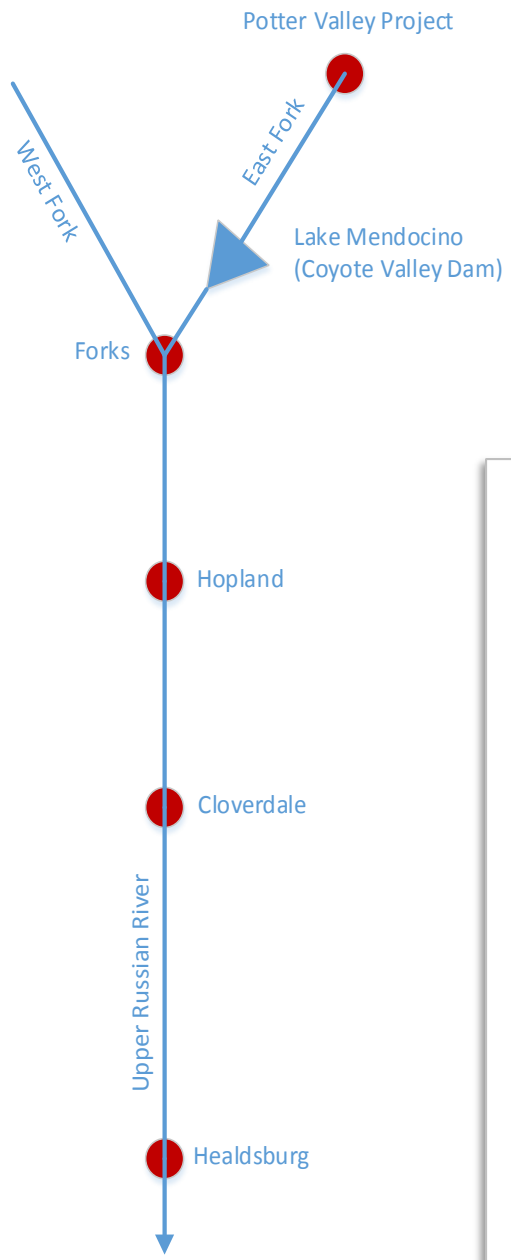
- **Water balance model**
  - Potter Valley Project to the USGS Gage at Healdsburg
  - Daily time step



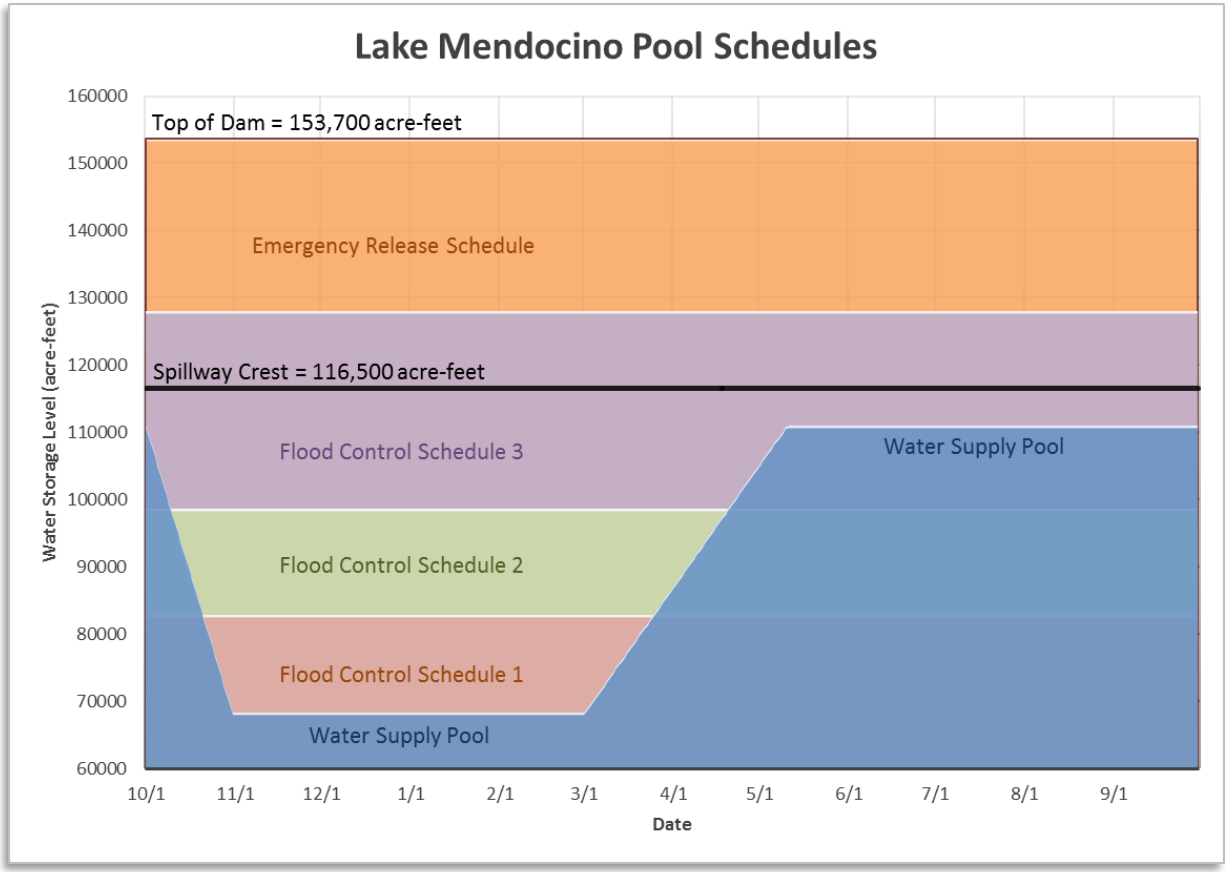
Model Setup

- **Model Gains**
  - Potter Valley Project Imports:
    - Eel River Model 1985-2010
    - Simulate current operations
  - Unimpaired Flows:
    - CNRFC observed daily flows 1985-2010
      - Lake Mendocino
      - West Fork of Russian River
      - Hopland
      - Cloverdale
      - Healdsburg
- **Model Losses**
  - Compliance Releases:
    - Decision 1610 Hydrologic Index
    - Biological Opinion TUC Minimum Flows
  - Reach Losses:
    - 2 Year Types
      1. Wet Year
      2. Dry Year

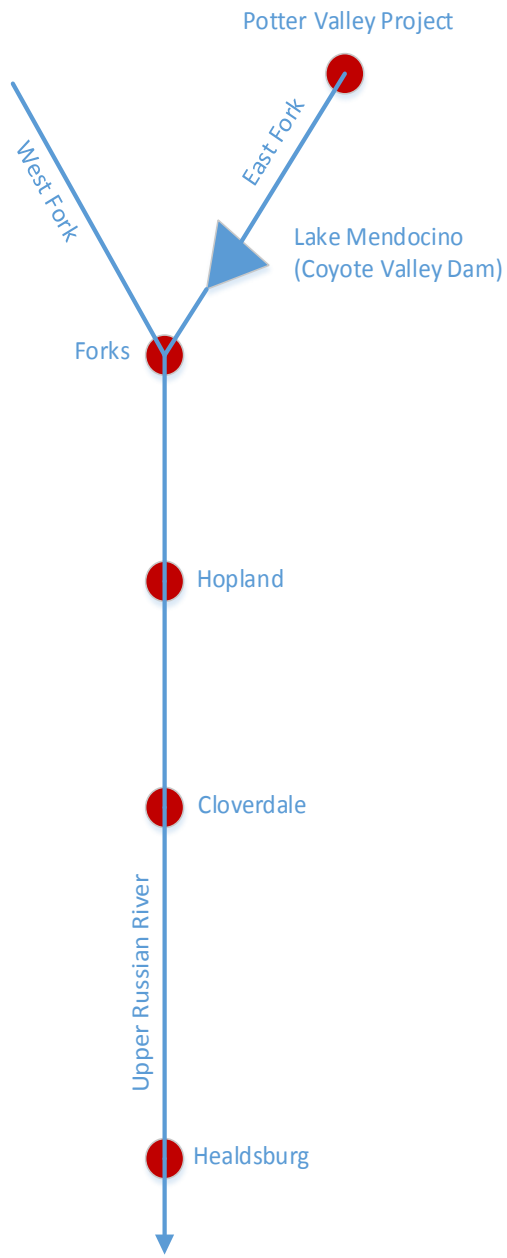
Model Setup



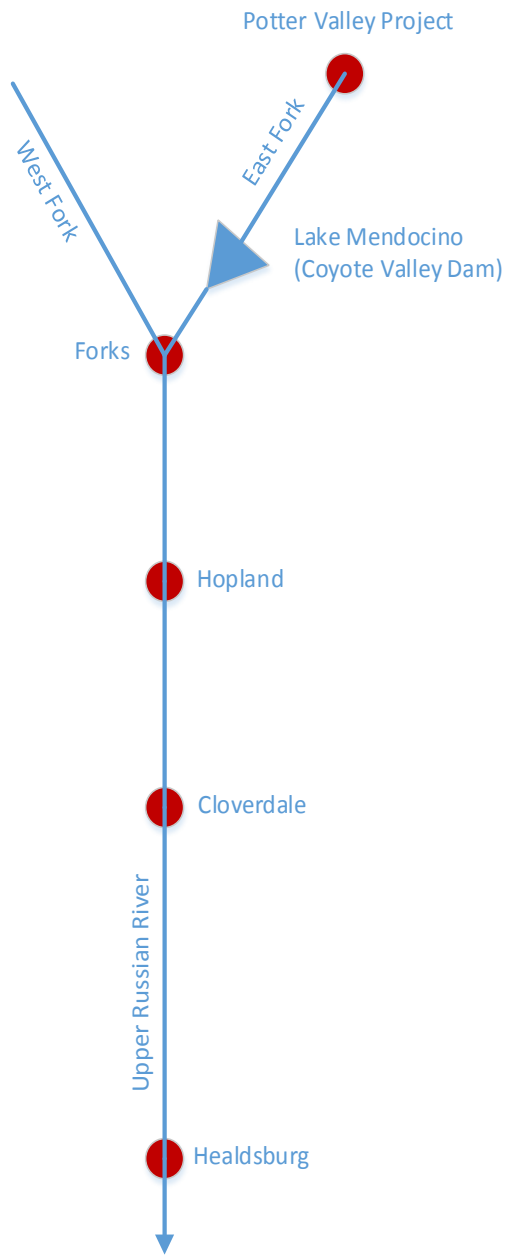
- **Flood Operations**
  - Max release constraints of Water Control Manual
  - No flood releases when:
    - Flows at West Fork RR > 2,500 cfs or
    - Flows at RR at Hopland > 8,000 cfs



Model Setup



- **Flow Forecast**
  - CNRFC Hindcast
    - 61 member ensemble
    - Based on GEFS and CFSv2 reforecasts
    - 1985 to 2010
    - Daily average flows out to 15 days
      - Lake Mendocino
      - West Fork
      - Hopland



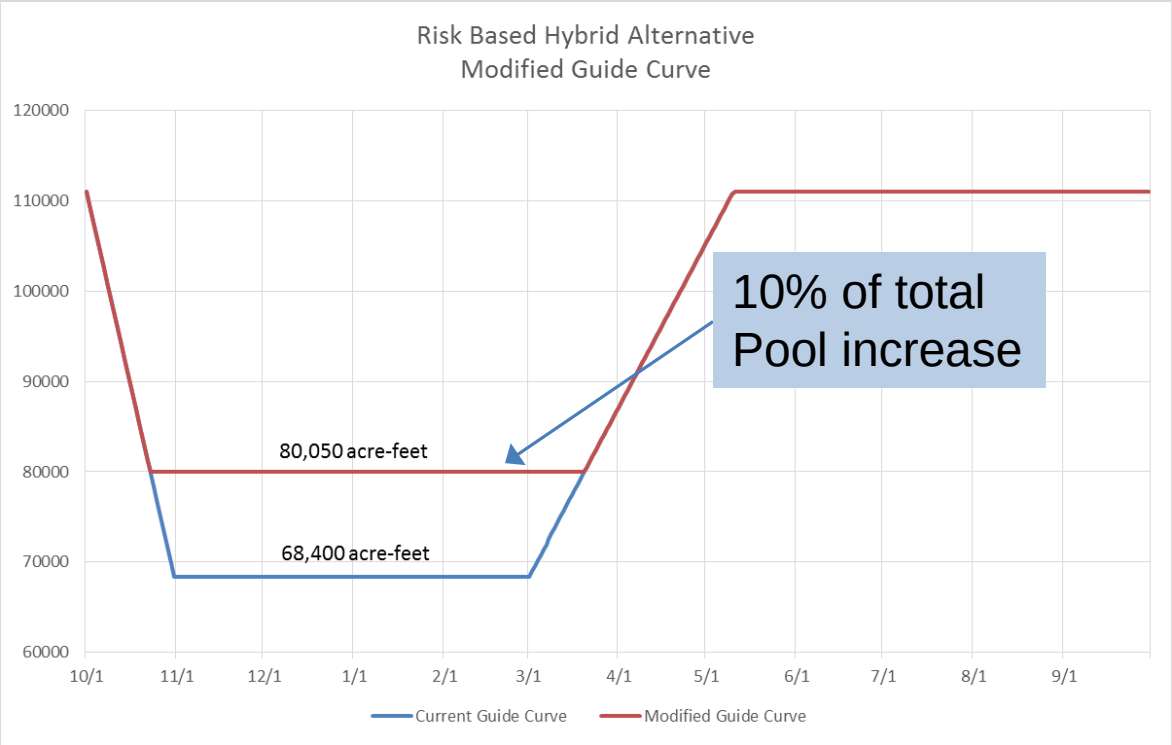
Model Scenarios

1. **Current Operations (Baseline)**
   - Water Control Manual Guide Curve
2. **Perfect Forecast (Perfect FIRO)**
   - 15-day Observed Flows
3. **Risk Based**
   - Full pool utilization for risk based operations
4. **Hybrid**
   - Risk Based with Modified Guide Curve

❖ **Analysis Metrics**

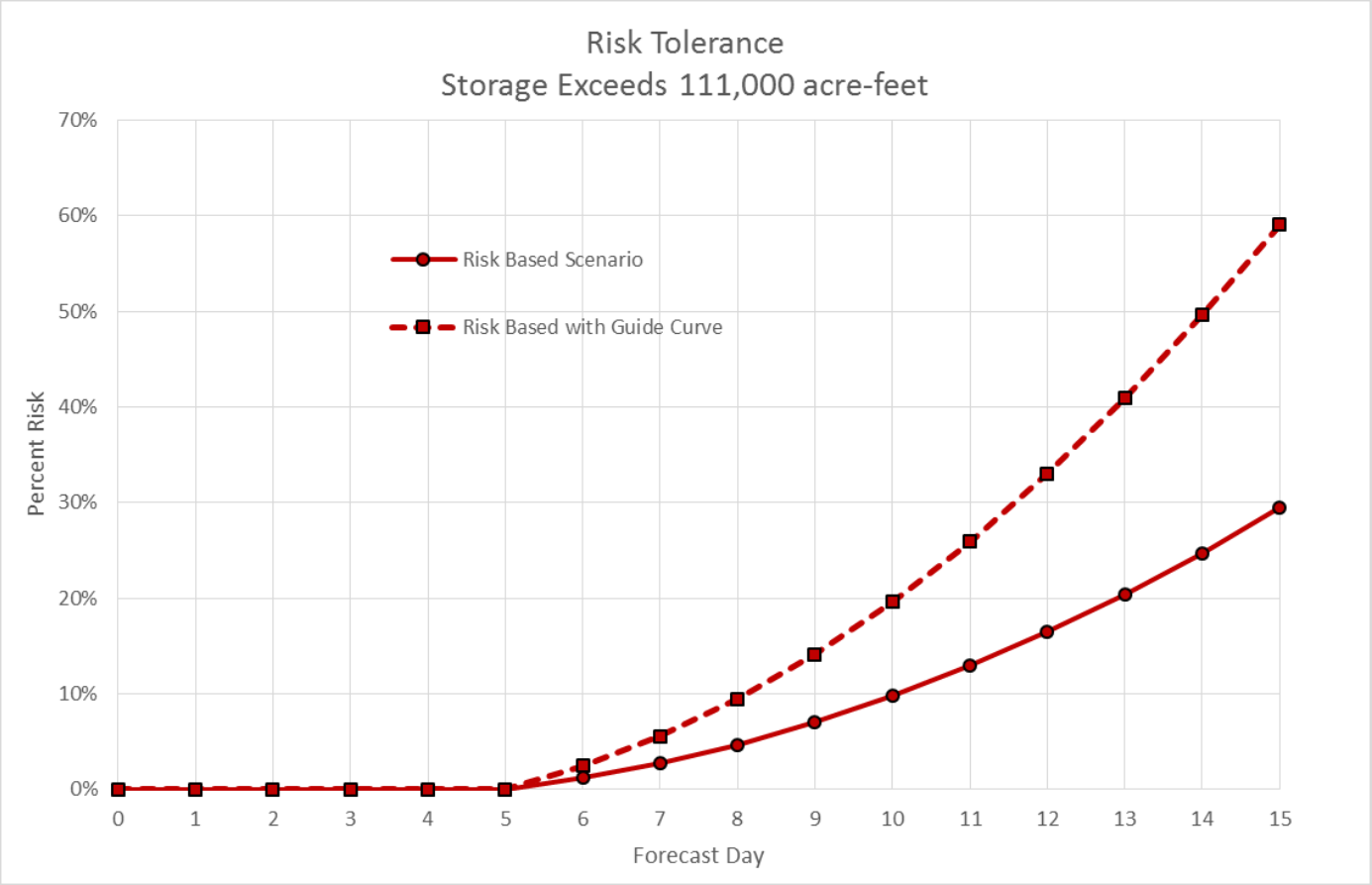
- Water Supply Reliability
  - Reservoir Storage
  - Available Water
    - End of WY storage + WY demand
- Flows at Hopland
  - Increased frequency of flows > 8,000 cfs
- "Happy Fish"
  - Downstream flow reliability

Hybrid Scenario
Risk Based w/ Modified Guide Curve

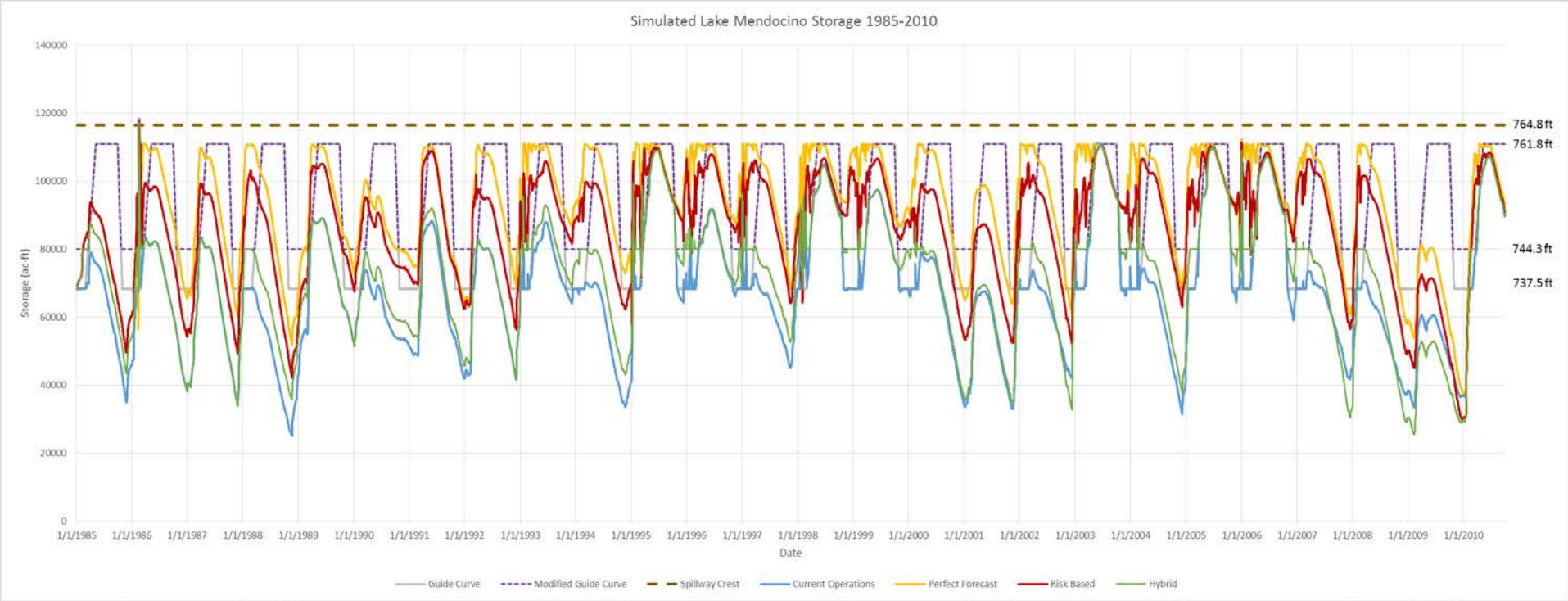


- **If Storage > Guide Curve**
  - Estimate Flood Release per Guide Curve Operations
- **All Storage Levels**
  - Estimate Flood Release per Risk Based Operations
- **Flood Release = Max**
  - Risk Based or Guide Curve

Risk Tolerance



Modeling Results
Lake Mendocino Storage

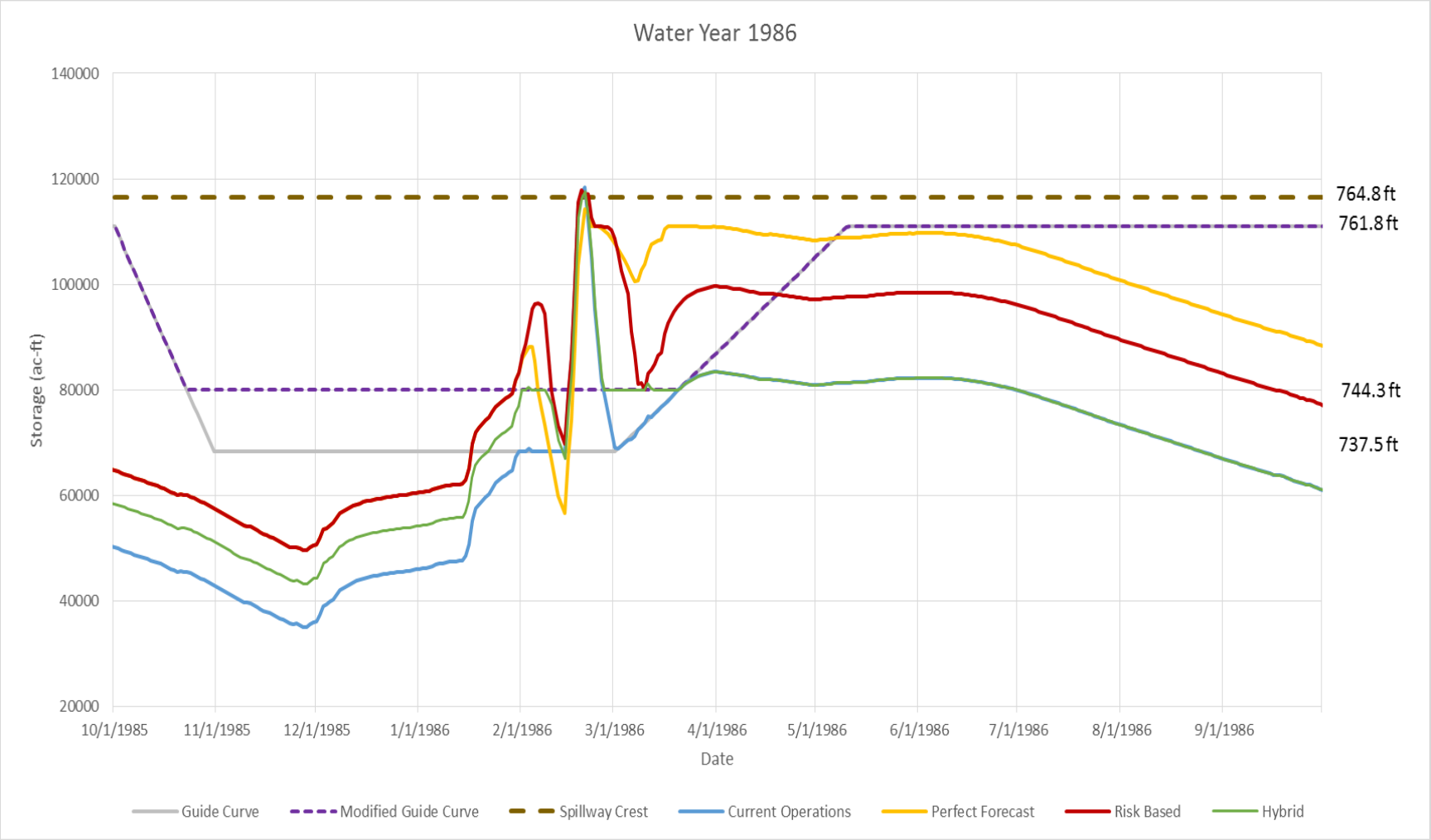


- **Risk Based Alternative**
  - Increased storage levels for all years of simulation
- **Hybrid Alternative**
  - Increased storage levels for most years

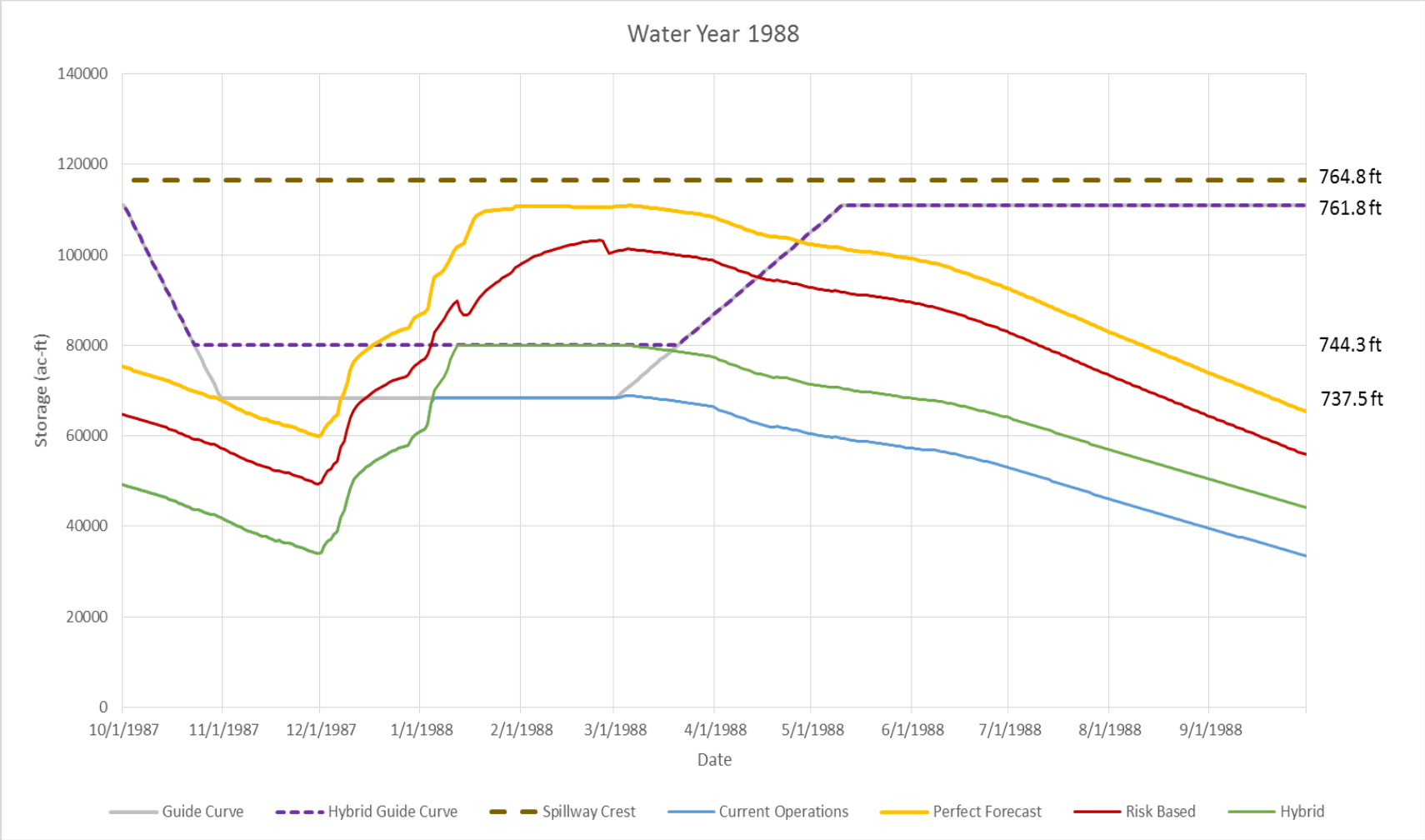
Modeling Results

1986 Lake Mendocino

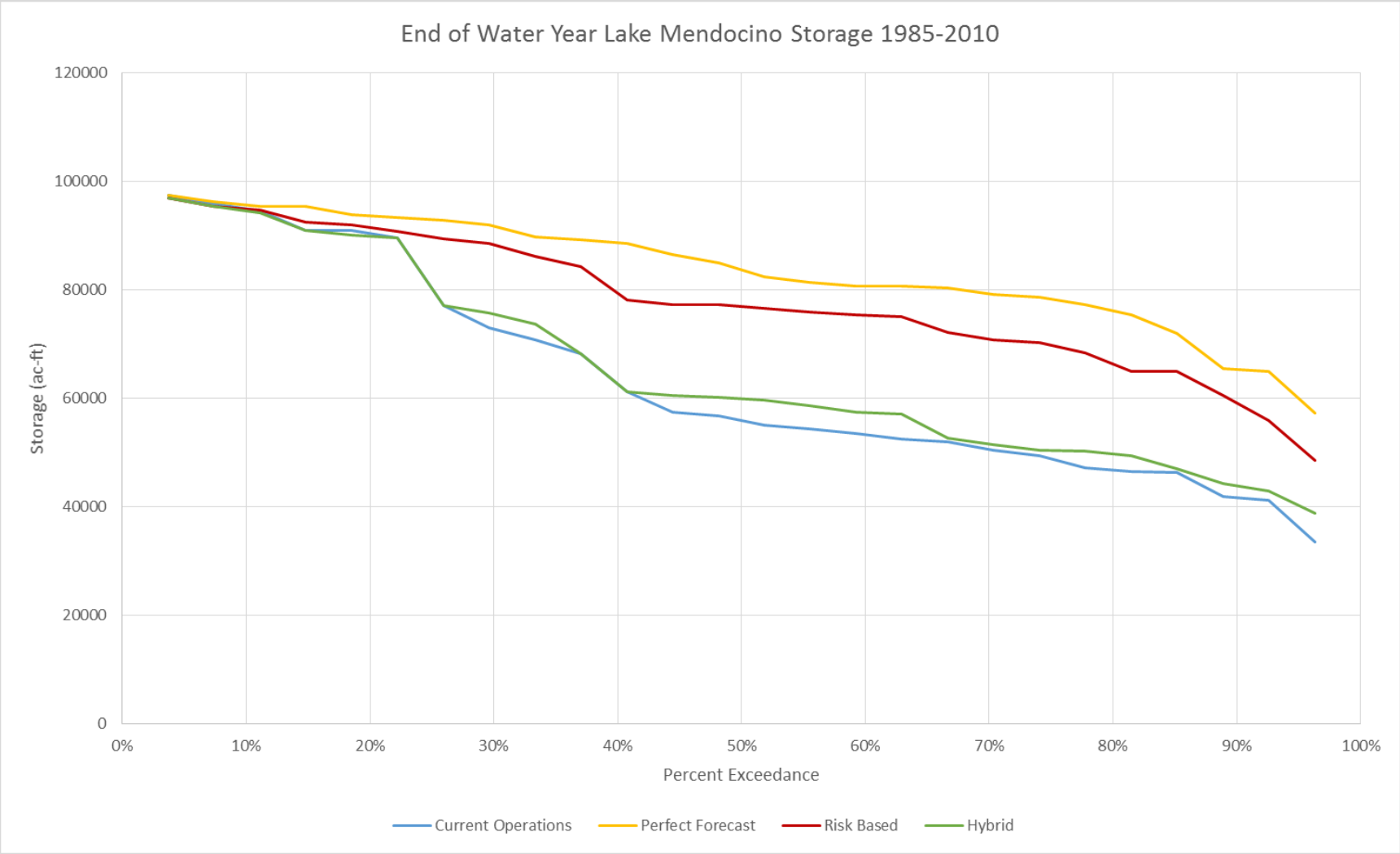
Largest Flood Event in the Simulation Period



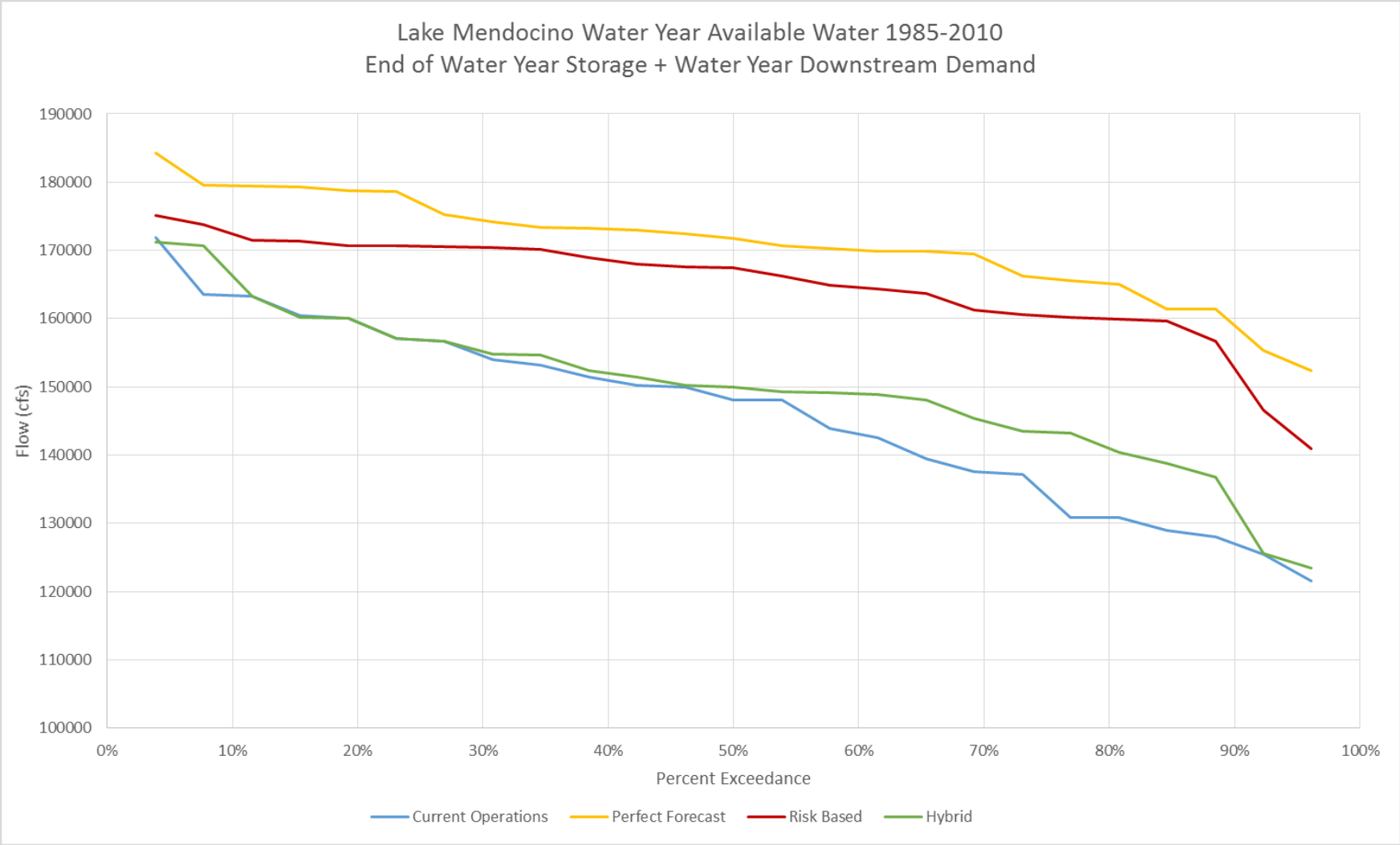
Modeling Results
1988 Lake Mendocino
Dry Spring Year



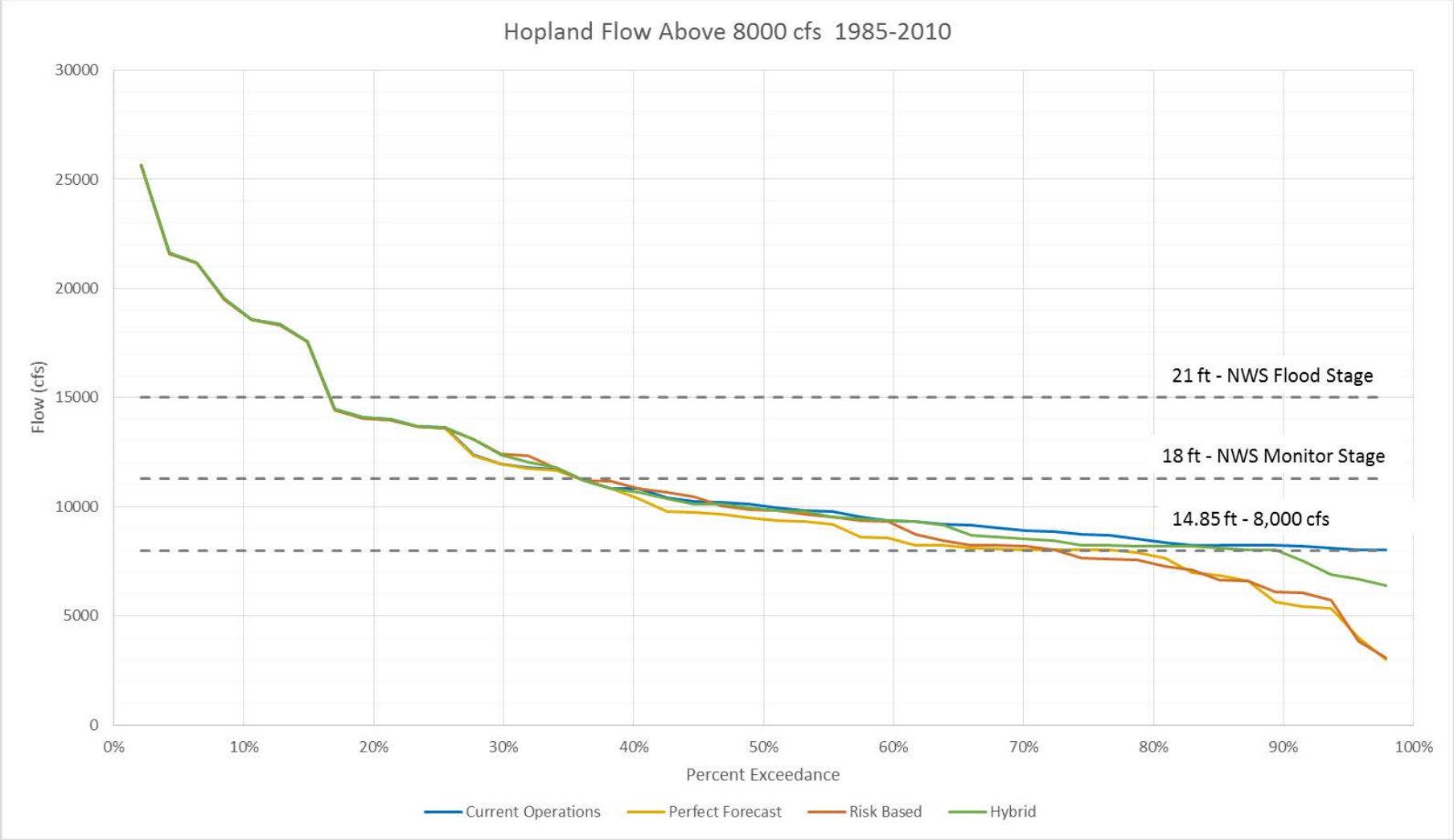
Modeling Results
Lake Mendocino End of Water Storage



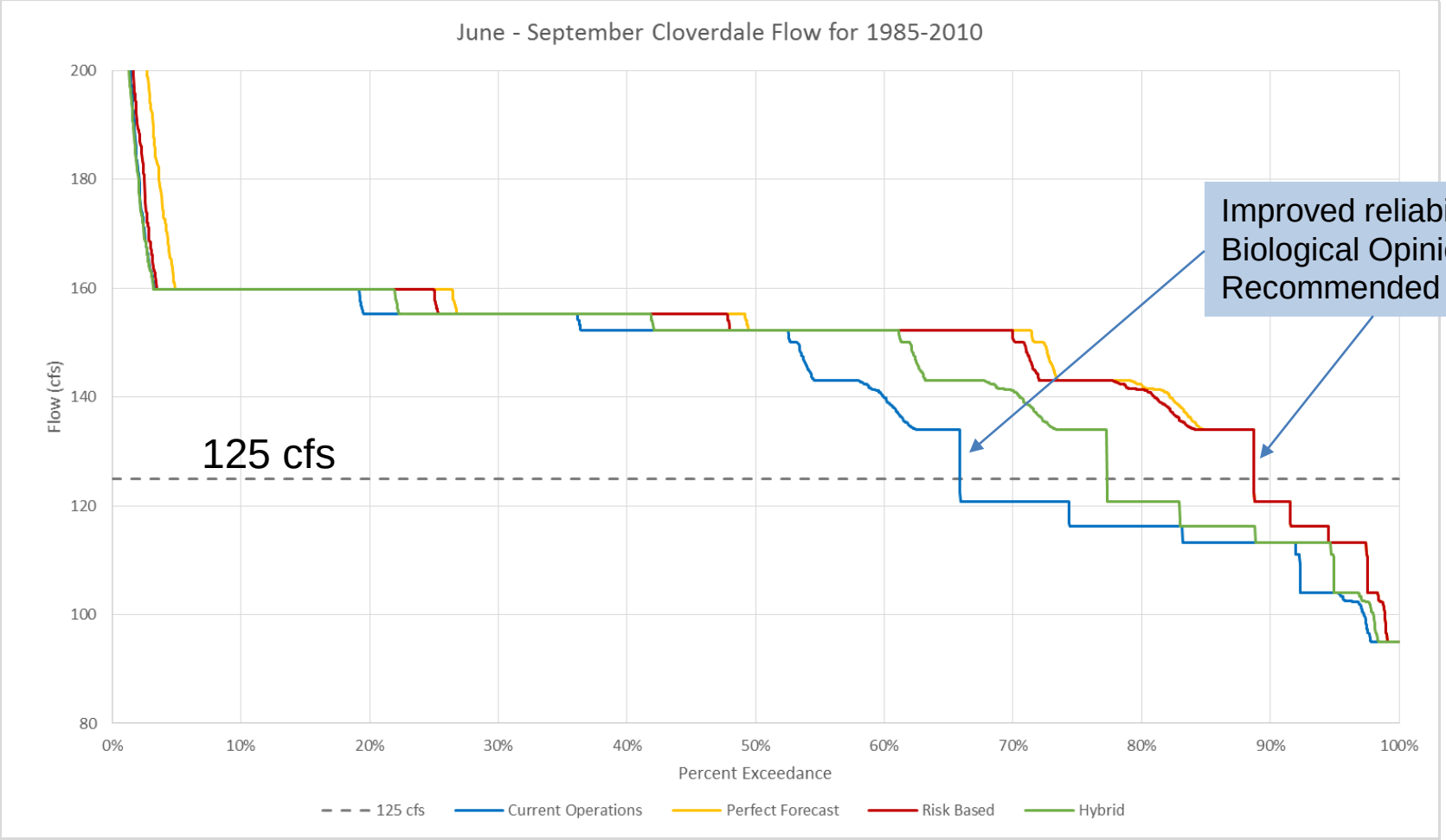
Modeling Results
Lake Mendocino Water Year Available Water



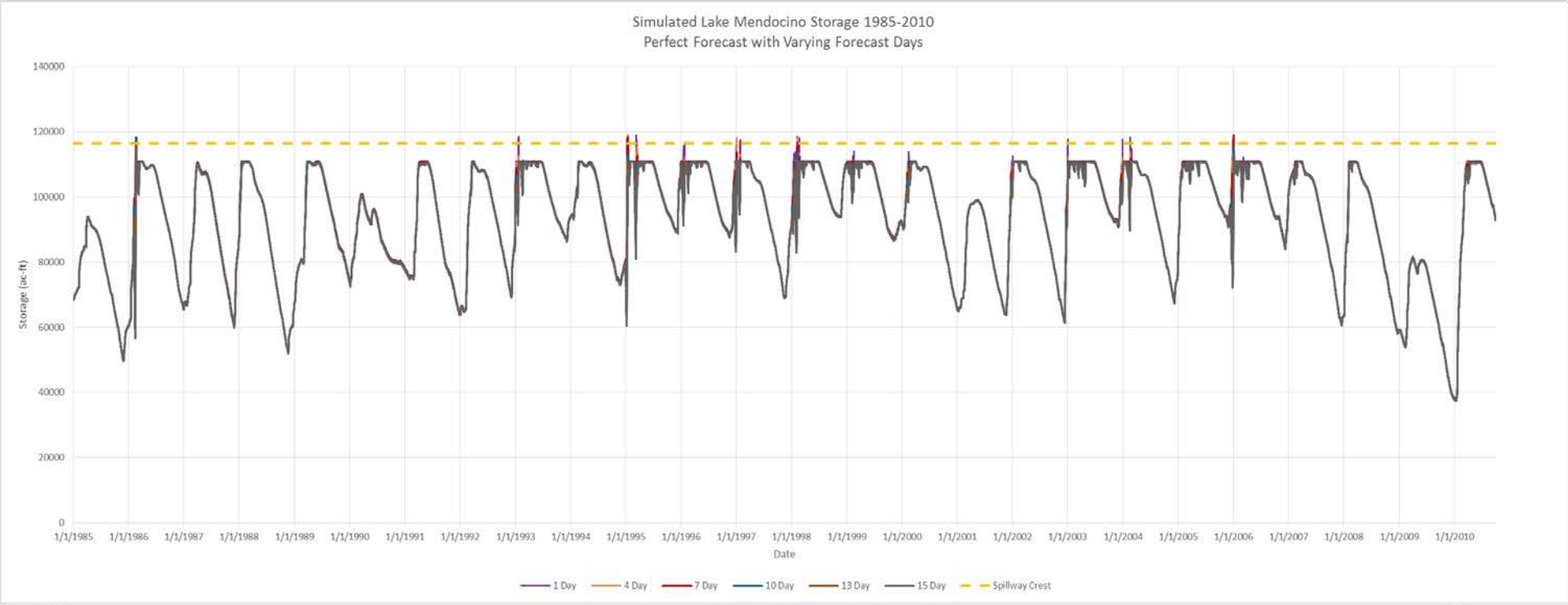
Modeling Results
Hopland Flows



Modeling Results
Happy Fish
June to September Cloverdale Flows

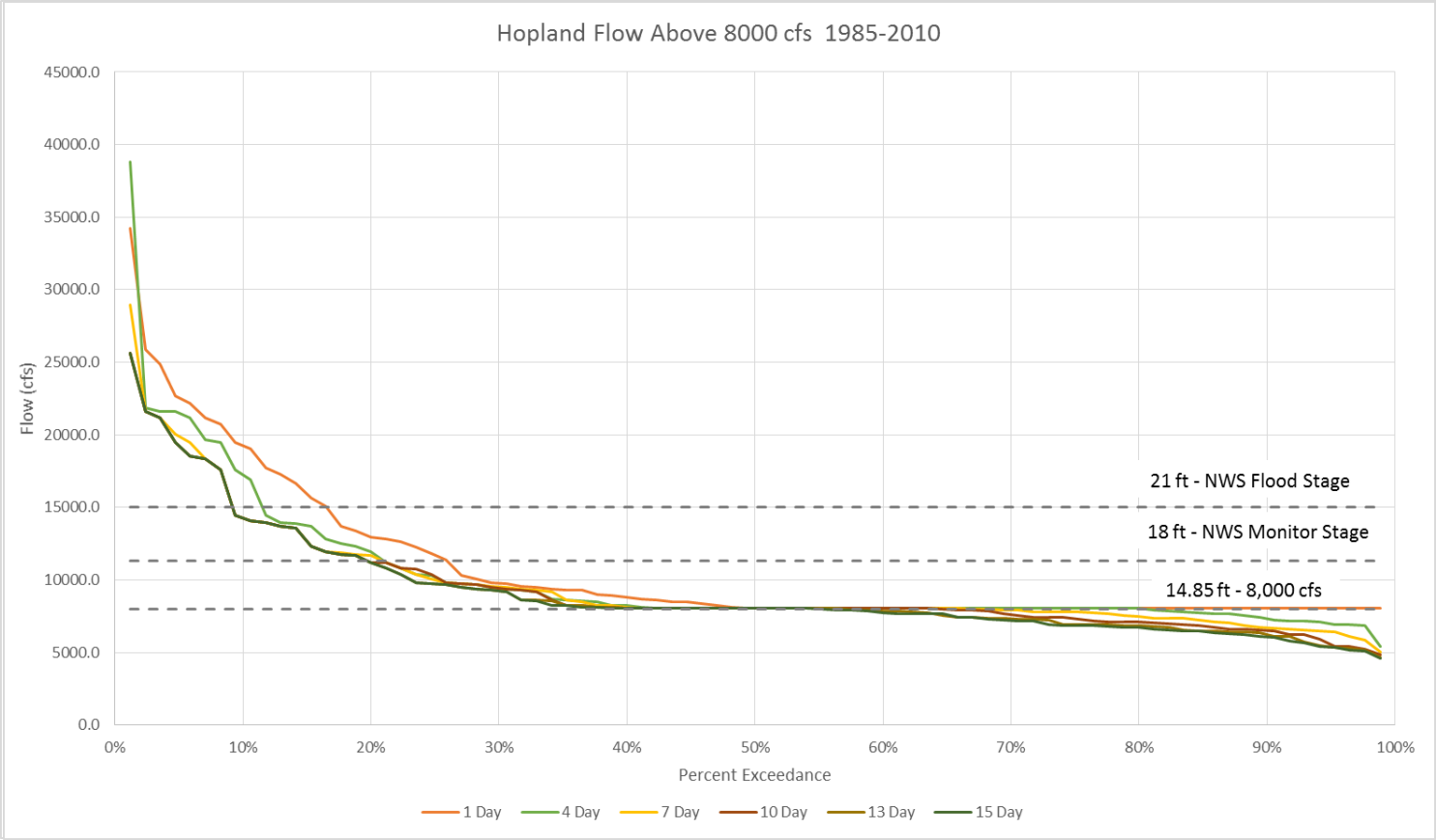


Sensitivity Analysis
Perfect Forecast
Varying Forecast Days

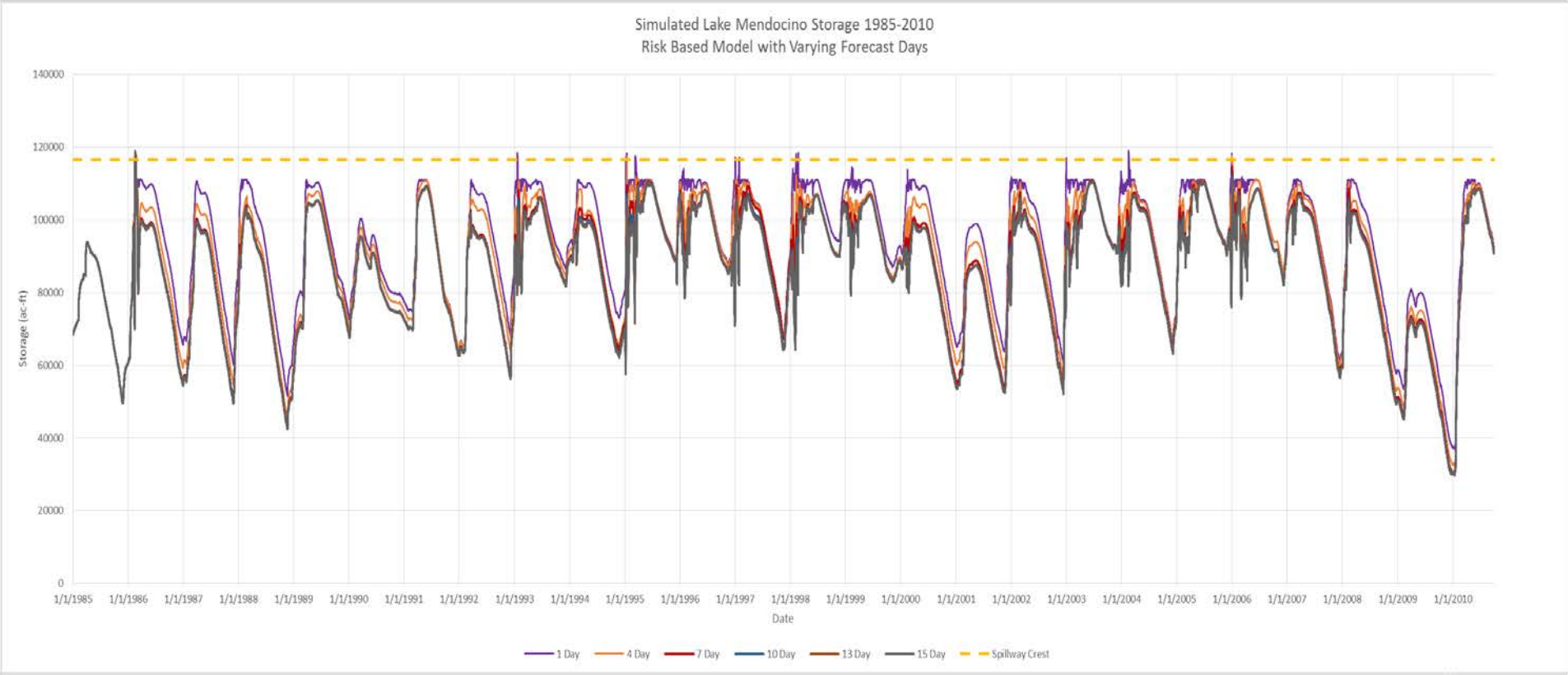


- **No impact to storage reliability with decreasing forecast days**

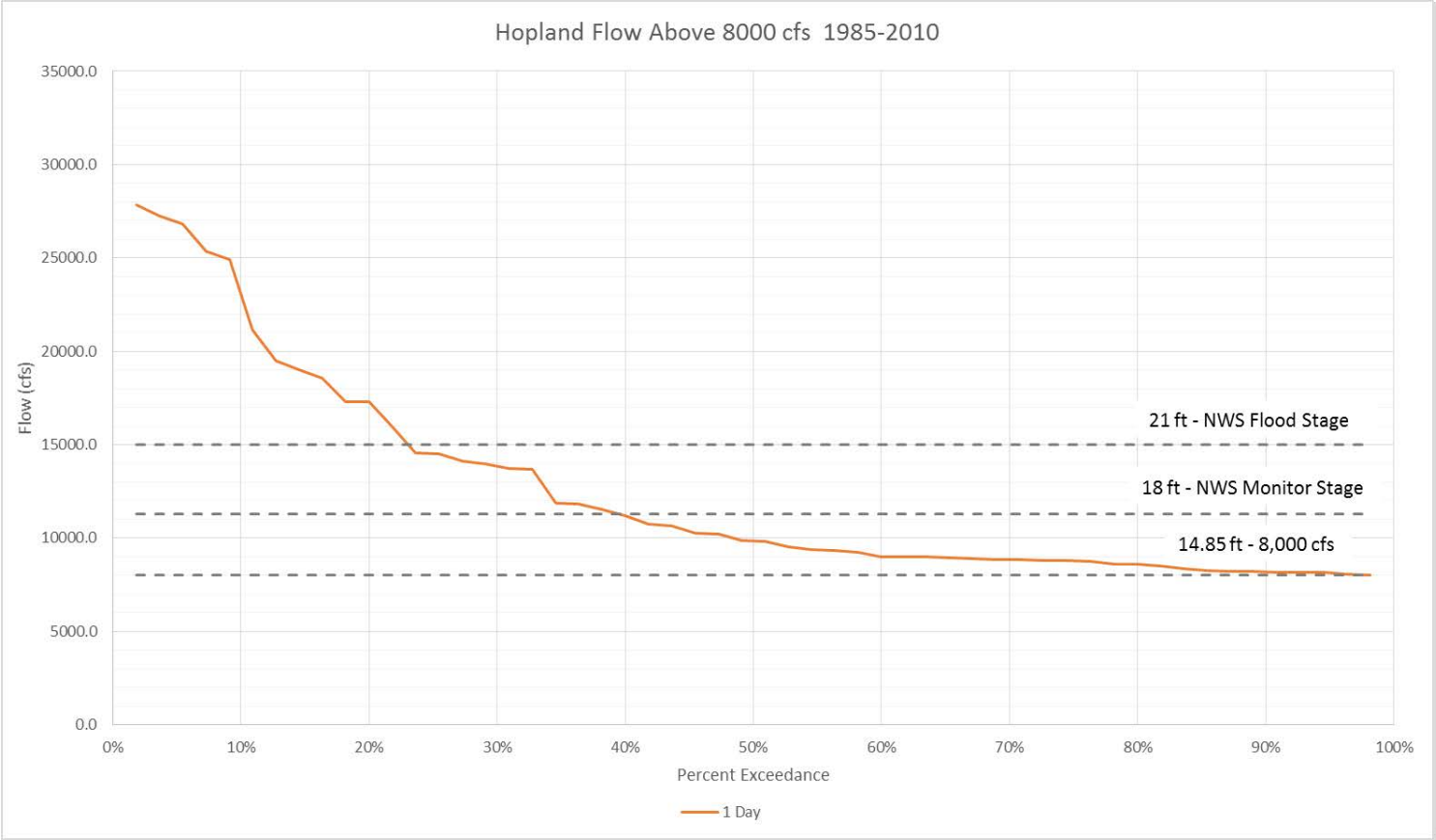
Sensitivity Analysis
Perfect Forecast
Varying Forecast Days



Sensitivity Analysis
Ensemble Hindcast
Varying Forecast Days



Sensitivity Analysis
Ensemble Hindcast
Varying Forecast Days



Summary of Key Findings

- **Risk Based Scenario: Full pool utilization**
  - Significant improvement in annual available water
  - Increased flow reliability for environmental needs
  - No significant increase in downstream flows above 8,000 cfs

- **Hybrid Scenario: Risk Based with Modified Guide Curve**
  - Modest improvement in annual available water
  - Increased flow reliability for environmental needs
  - No significant increase in downstream flows above 8,000 cfs

Model Limitations

- **Limited historical period of evaluation 1985-2010**
  - **Does not include the flood event of record: 1964**
  - **Does not include any significant droughts: 1976-1977 or 2013-2015**
- **Daily time step**
  - **Flow peaks and storage peaks occur at a sub-daily time step**
- **Risk tolerance thresholds have not been fully optimized**
  - **Thresholds were derived through an iterative approach**

Topics for Discussion

- **Potential Future Alternatives – Post Viability Assessment**
  - Multiple risk curves for different storage levels
  - Weighting ensemble members using information not available to the ensemble forecasting system (AR Tool, Obs. Soil Moisture)
- **Hopland Flows**
  - 8,000 cfs flow ceiling could limit FIRO alternatives
  - Is the 8,000 cfs ceiling still an accurate constraint?
  - Are there alternatives for increasing this ceiling?
- **Potential Areas of Future Work**
  - Optimize risk tolerance threshold
  - Evaluate expanding CNRFC flow hindcast/ reforecast to 2015
  - Develop synthetic flood events (e.g. Lake Folsom methodology)
  - Water Quality Model
    - Evaluate for potential benefit of increased cold water pool
- **Forecast days for Viability Assessment**
  - 13-days to 15-days
    - Perfect forecast sensitivity analysis demonstrated a benefit
    - Hindcast sensitivity analysis demonstrated no impact
  - 10-days – Hindcast sensitivity analysis demonstrated no benefit to using forecast beyond 10-days

Schedule

7/15/16 – Finalize Modeling

8/15/16 – Draft Report

9/16/16 – Comments back from reviewers

10/28/16 – Final Report