

Operated by the San Francisco Public Utilities Commission

Forecast Informed Reservoir Operations

April 4, 2019
C. Graham – Chief Hydrologist
Hetch Hetchy Water and Power
Water Enterprise

Services of the San Francisco Public Utilities Commission

Motivation for Revisiting Operations

- Risk to downstream facilities
- Increased operational scrutiny
- Increased weather variability



Cherry Lake - 1955



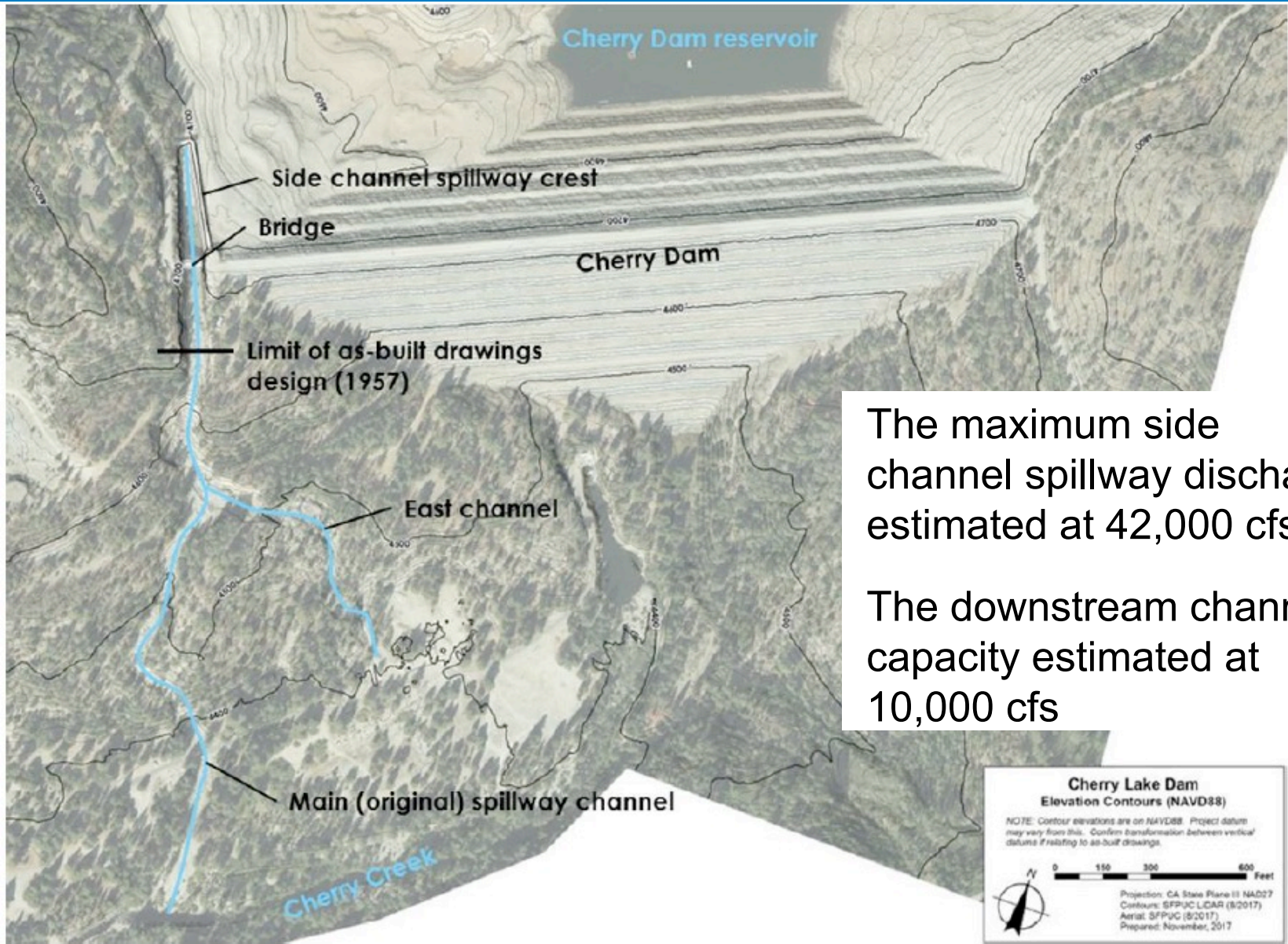
Cherry Spillway



Spillway channel



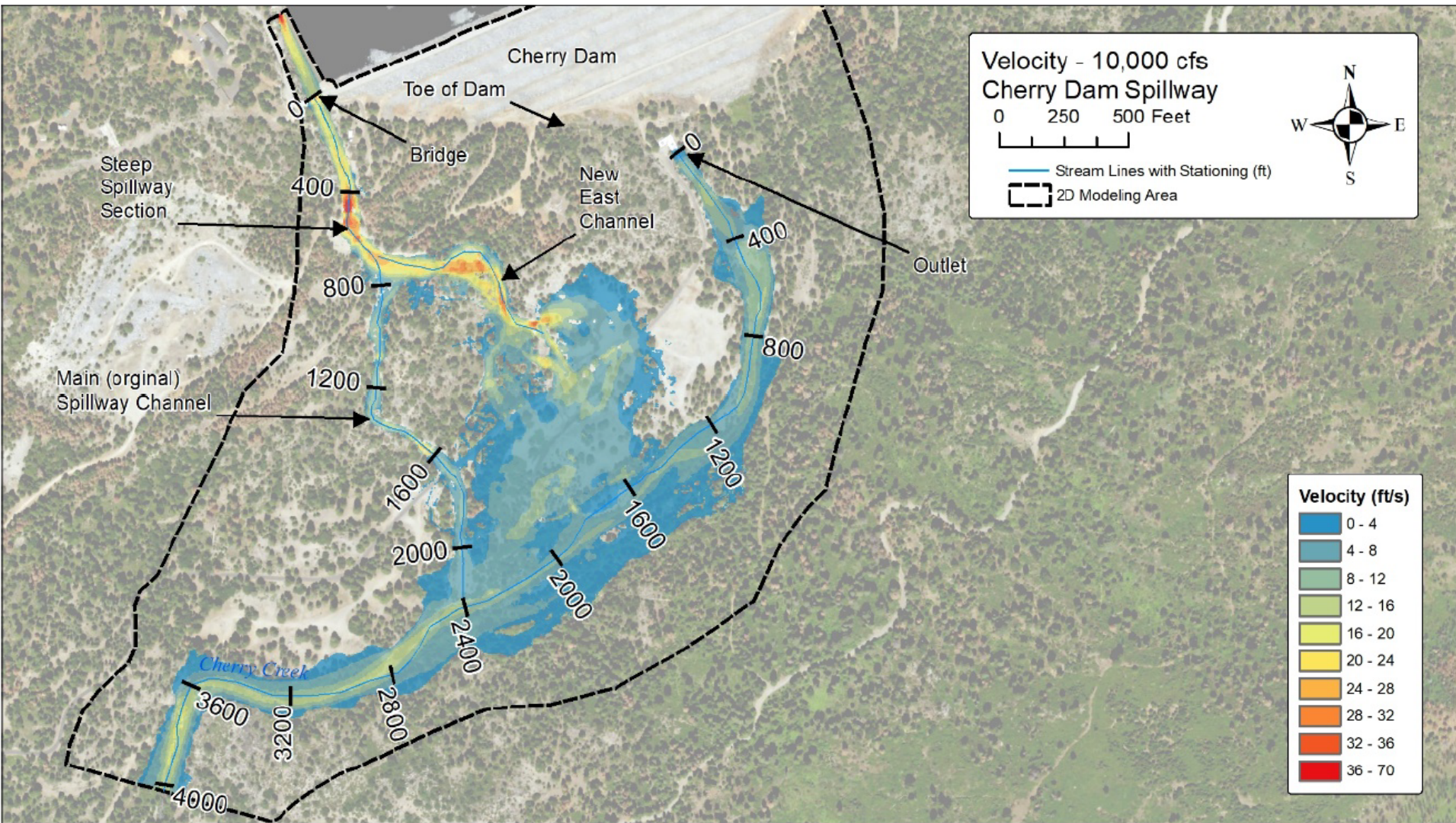
Assessment Results



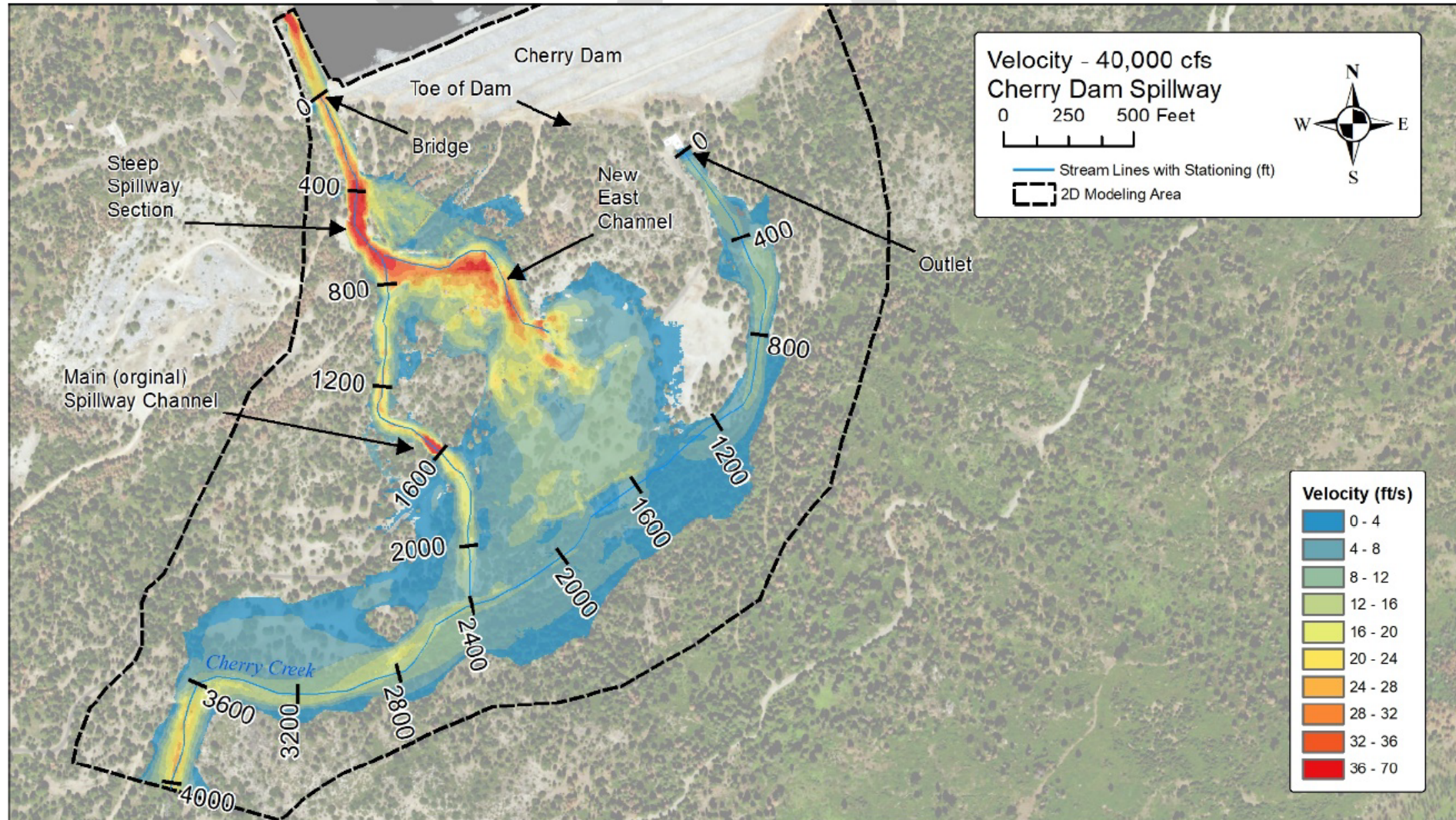
The maximum side channel spillway discharge estimated at 42,000 cfs

The downstream channel capacity estimated at 10,000 cfs

2D modeling: 10,000 cfs velocities



2D modeling: 40,000 cfs velocities



Problem: Spillway capacity alone does not accommodate large storm events

Proposed Solution:

Forecasted Informed Reservoir Operations

7 Day forecast with flood days 8-10, executed daily

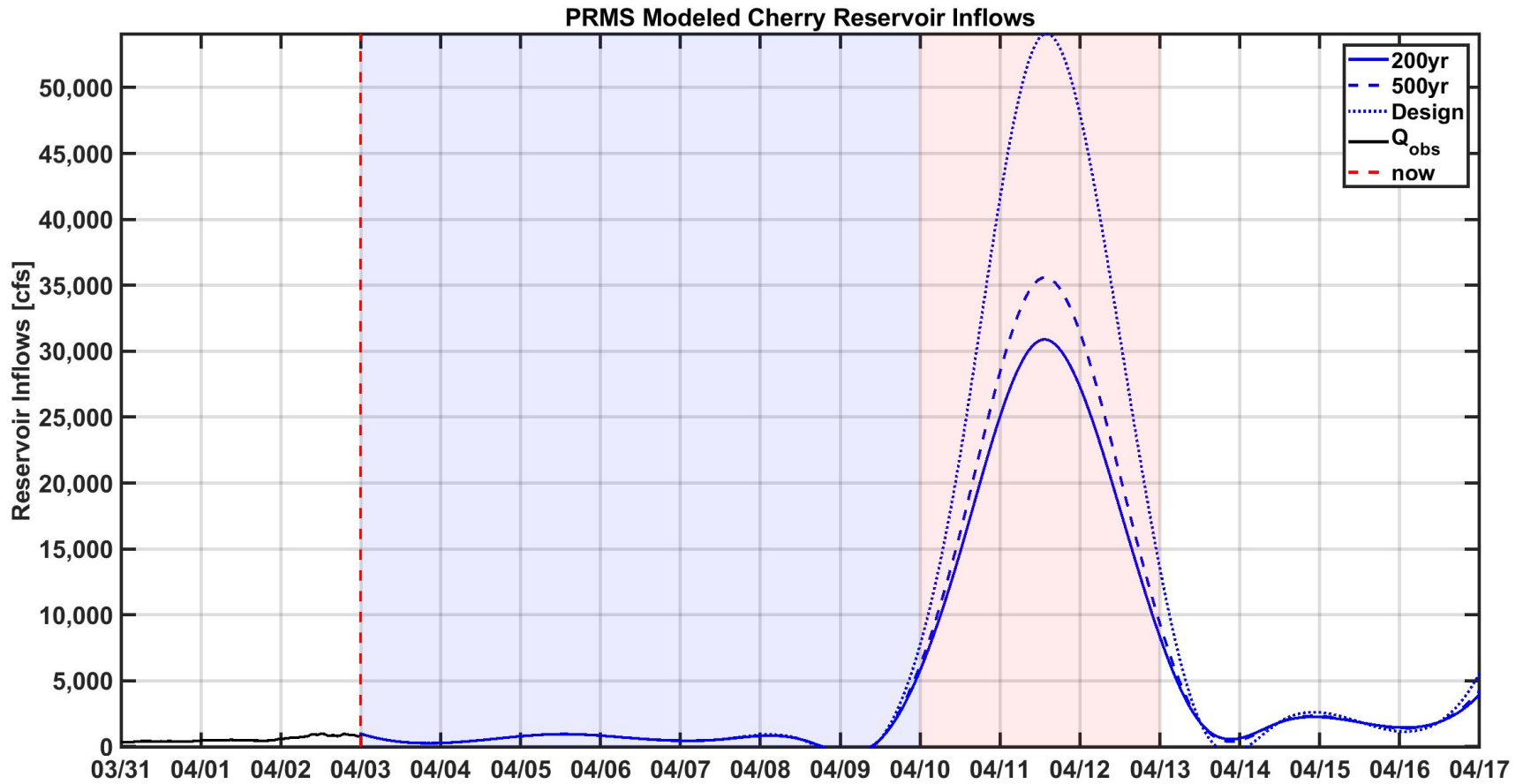
Operate to accommodate defined flood event

Limit spill to acceptable level

Assume facility operations

- 200 year return = 0 cfs
 - Uncommon event, no possible impact
- 500 year return < 10,000 cfs
 - Rare event, manageable impact
- Design Storm < 42,000 cfs
 - Maximum event, no damage to dam, at spillway capacity

Return Period Storms run through Hydrologic Model (PRMS)

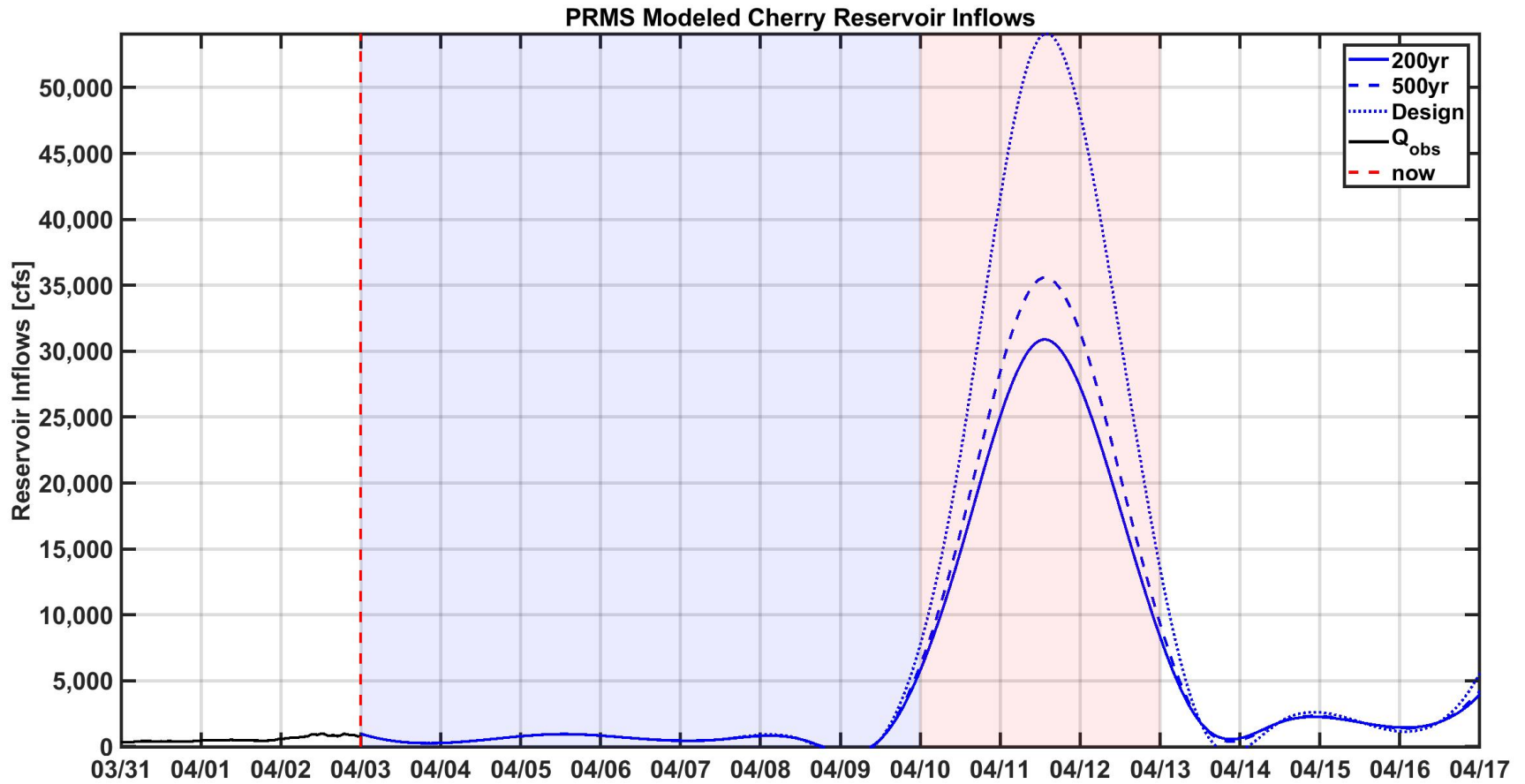


System Response to Large Event

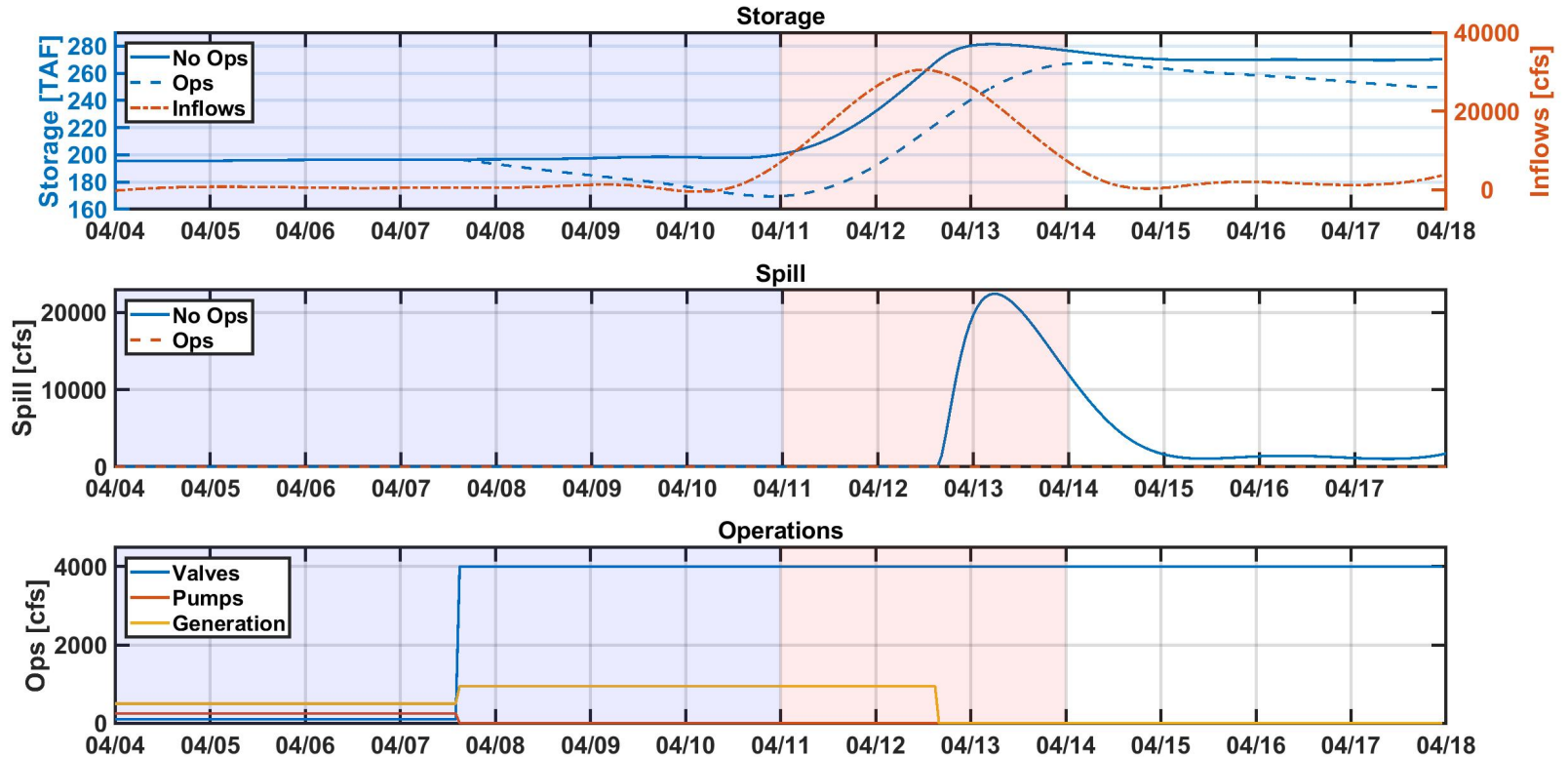


Valves – 4400 cfs
Power – 950 cfs
Pumps – 200 cfs

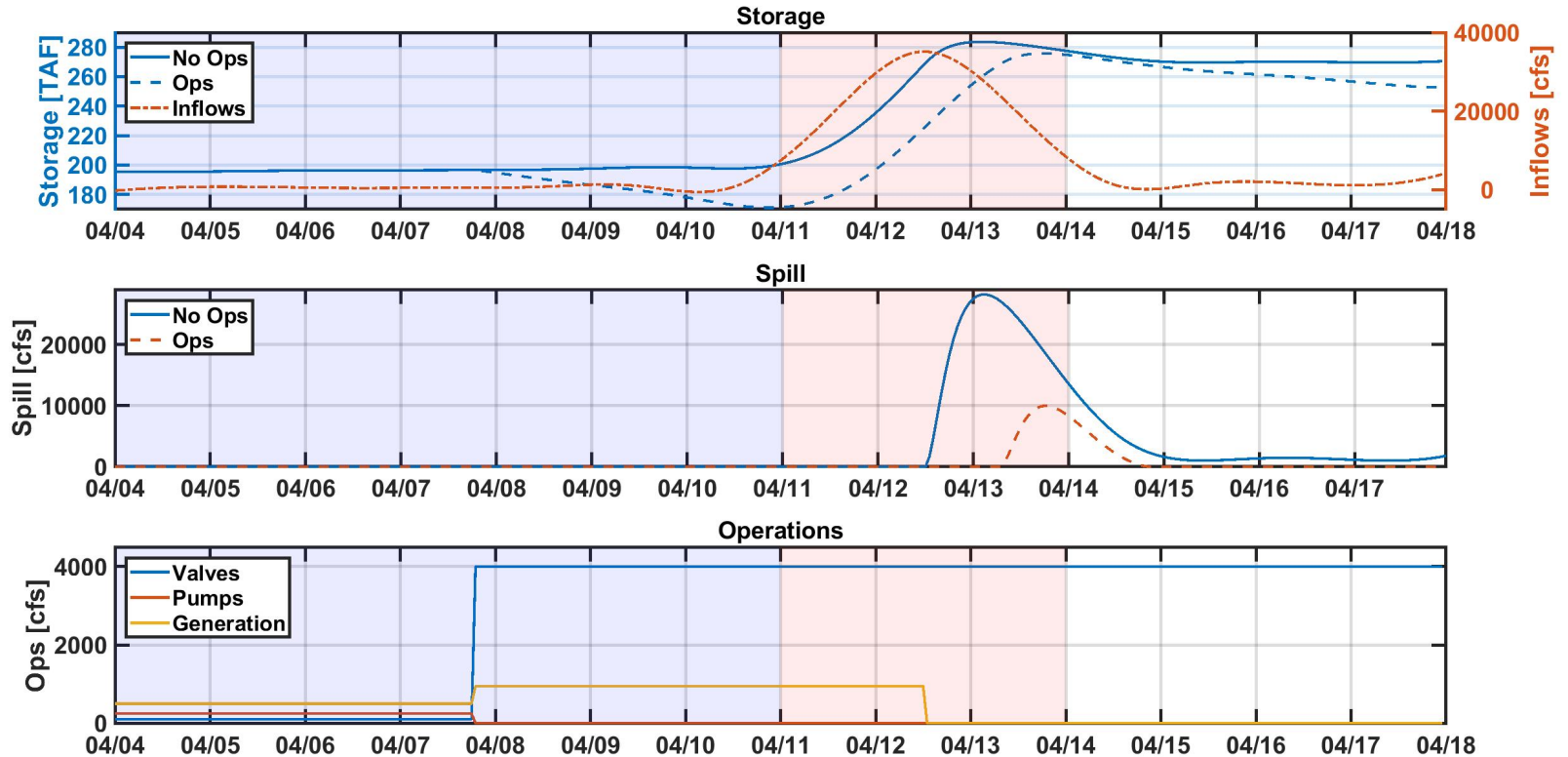
Return Period Storms run through Hydrologic Model (PRMS)



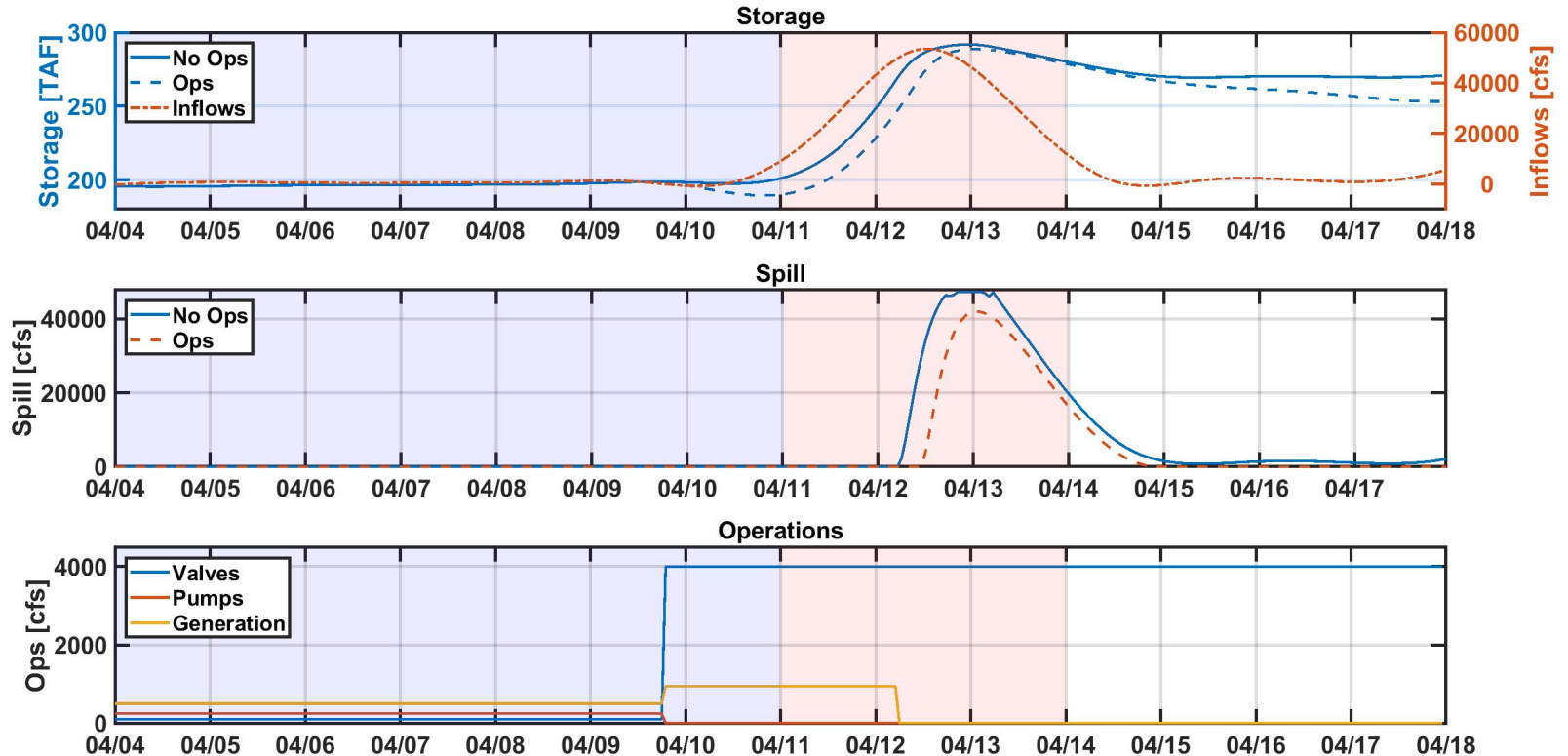
200 Year Return – no spill



500 Year Return – 10,000 cfs spill



Design Storm – 42,000 cfs spill



Cherry Lake FIRO – Implications to Operations

- Reservoir kept lower throughout the fall and winter
- Increased power generation during summer and fall
- Reduced generation and spill during spring runoff



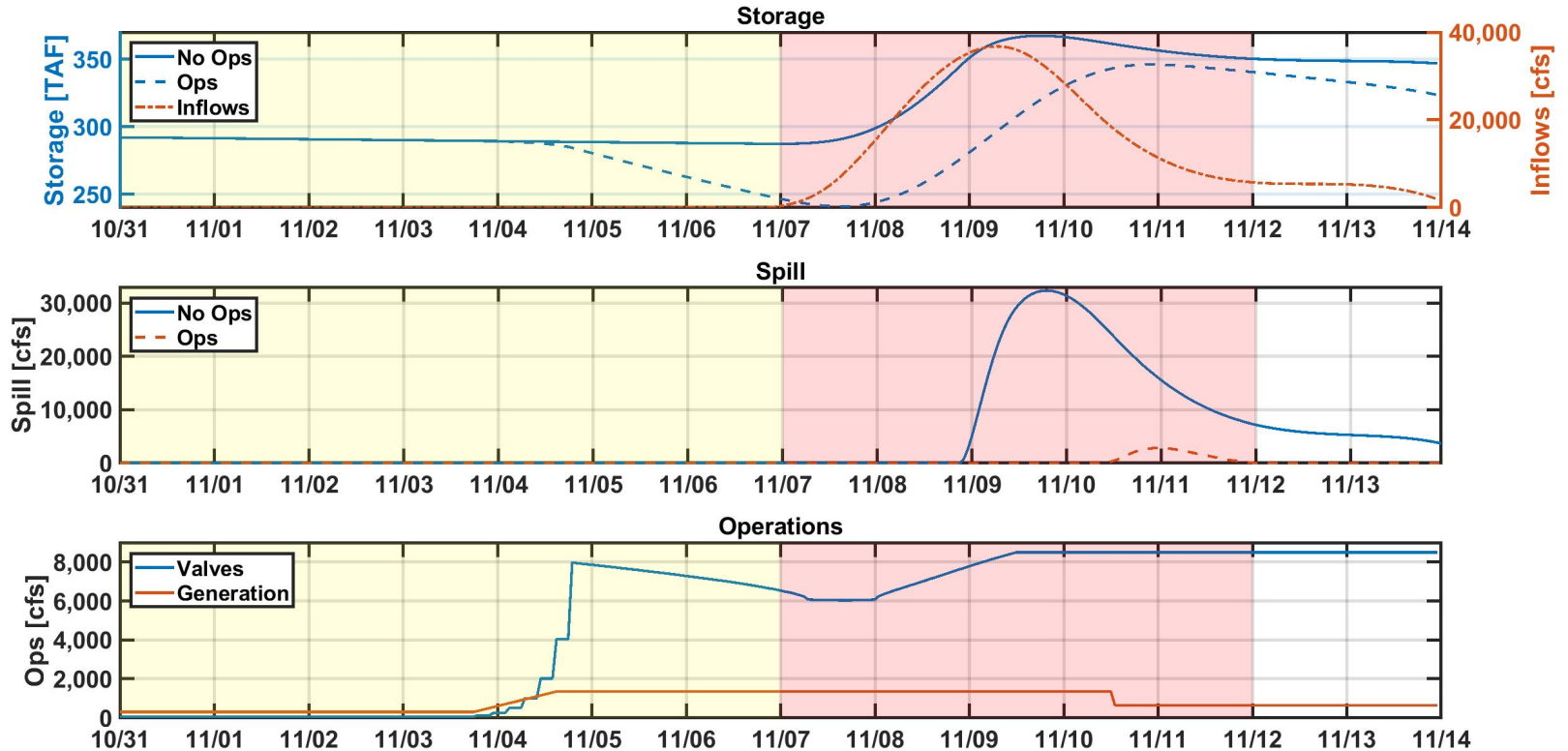


O'Shaughnessy Dam Hetch Hetchy Reservoir

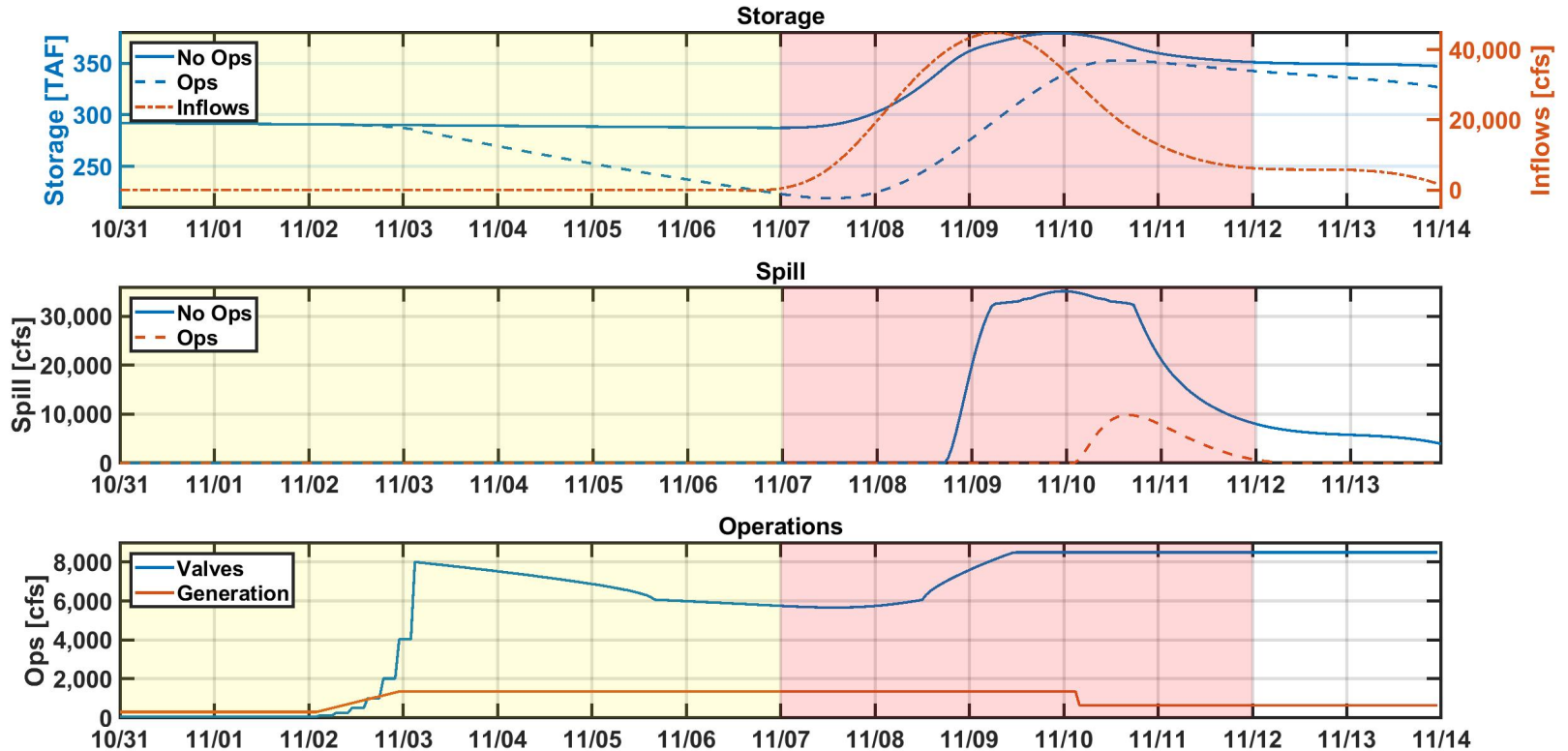
- No concerns about Spillway
 - Pure Granite
 - Designed to spill every year
- No concerns about bedrock under dam
 - Pure Granite
- Overtopping Dam
 - 32,000 cfs exceeds spillway capacity
 - No structural concerns
- Flooding downstream
 - HHWP facilities
 - Early Intake
 - Don Pedro

- Critical Flows
 - 3,000 cfs – Base of Spillway wets Diversion Tunnel
 - 10,000 cfs – Kirkwood Powerhouse Operations Impacted
 - 15,000 cfs – Early Intake Bridge under water
 - 32,000 cfs – Spillway overtops
 - 50,000 cfs – seems like a lot
 - 100,000 cfs – seems like a real lot

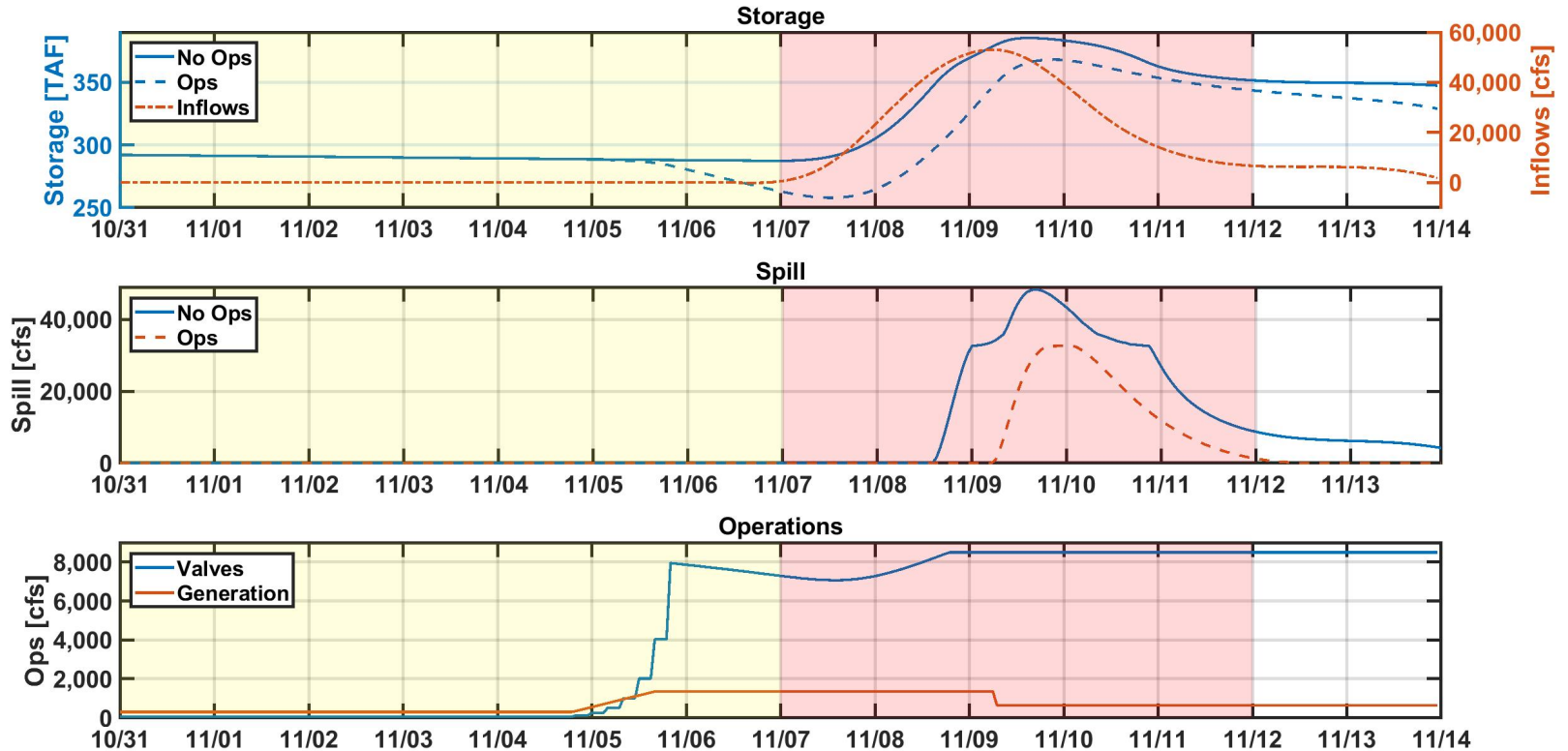
25 Year Storm, 3,000 cfs



50 year storm, 10,000 cfs



100 year storm, 32,000 cfs



Hetch Hetchy FIRO – Implications to Operations

- Likely have normal operations through summer and early fall
- Maintain Reservoir at lower level once snow is on the ground
- More power generation earlier
- Less spring spill, more early spring controlled valve releases