Unique Features

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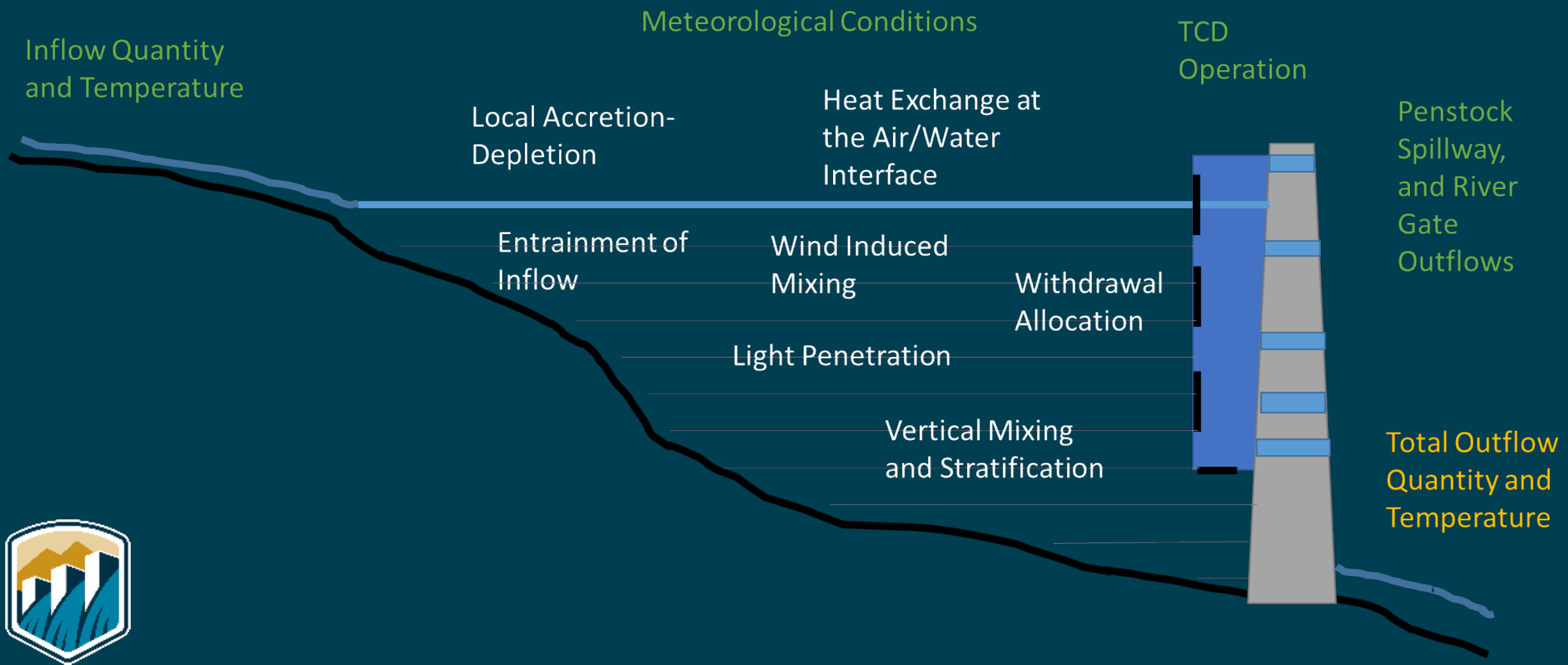
Unique Features Highlights

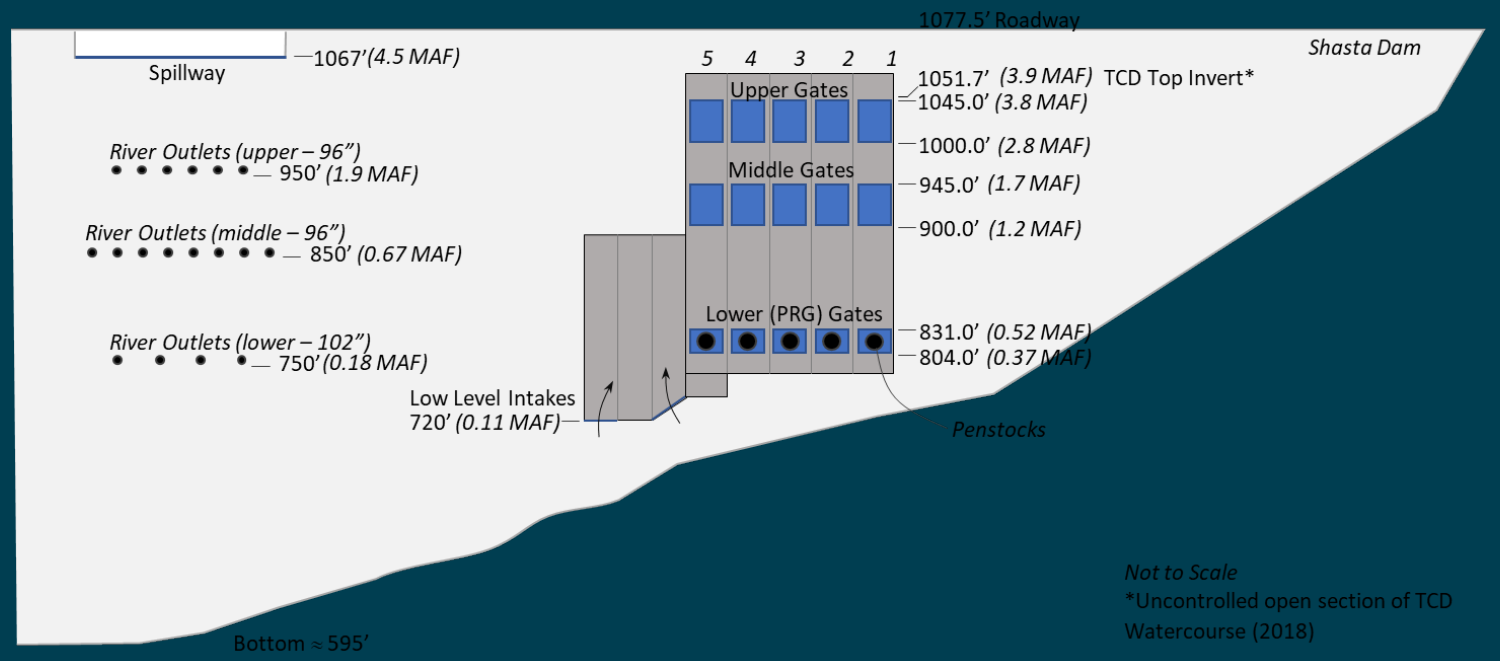
- Shasta
  - Temperature Control Device
- Lewiston
  - Temperature Control Curtain
- Whiskeytown
  - Temperature Control Curtains
- Folsom Dam
  - Temperature Shutters
- Old Melones Dam
  - Submerged Dam

Thermal Mechanisms influencing Shasta



Shasta Temperature Control

- TCD located off of centerline
- Multiple withdrawal positions
- Three dimensional flows not fully described
- Parameterize 1D/2D model to describe temperature dynamics



Shasta TCD Implementation
principally equivalent implementations in W2 and ResSim

CE-QUAL-W2

- Model blends to temperature requirements
- Three point sinks per gate
  - Top, middle, bottom of gate
- Four point sinks for side gates
- Minimum flow fractions assigned to each point sink
- Six additional line sinks for leakage
- Leakage up to 20% of flow
- Outlets effectively at dam centerline

ResSim

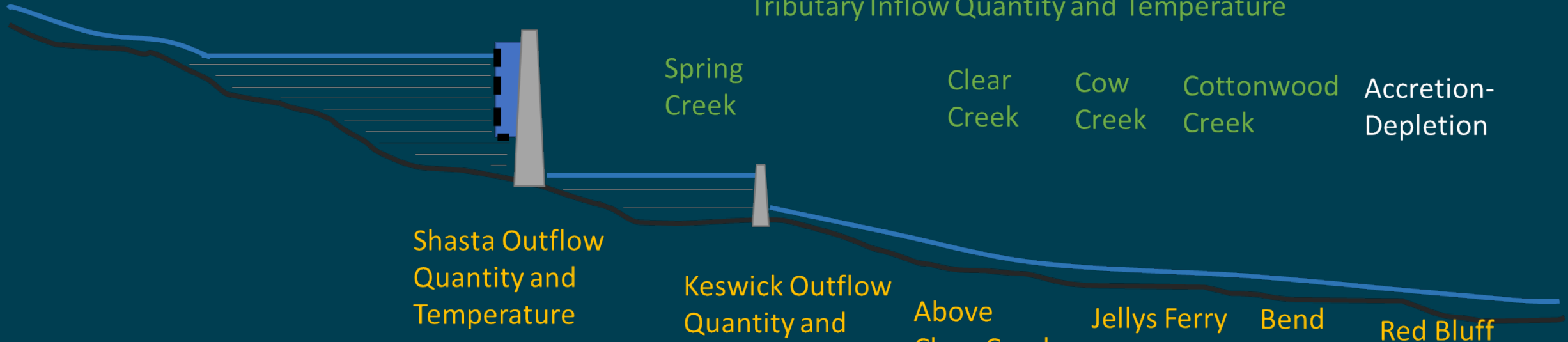
- Model blends to temperature requirements
- Three point sinks per gate
  - Top, middle, bottom of gate
- Four point sinks for side gates
- Minimum flow fractions dynamically managed
- Six additional point sinks for leakage
- Leakage up to 20% of the flow
- Outlets effectively at the main body of the reservoir

Shasta-Keswick-Upper Sacramento River

Meteorological Conditions

Inflow Quantity and Temperature

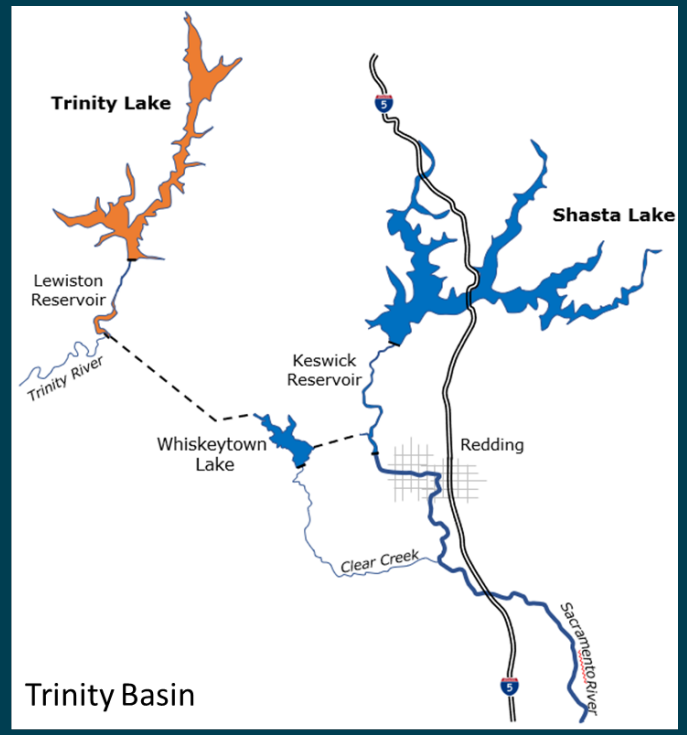
Tributary Inflow Quantity and Temperature



Sacramento River Temperature Monitoring Locations

Lewiston

- Lewiston Lake
  - Temperature Control Curtain
  - Clear Creek Diversion



Google Maps

Lewiston Implementation

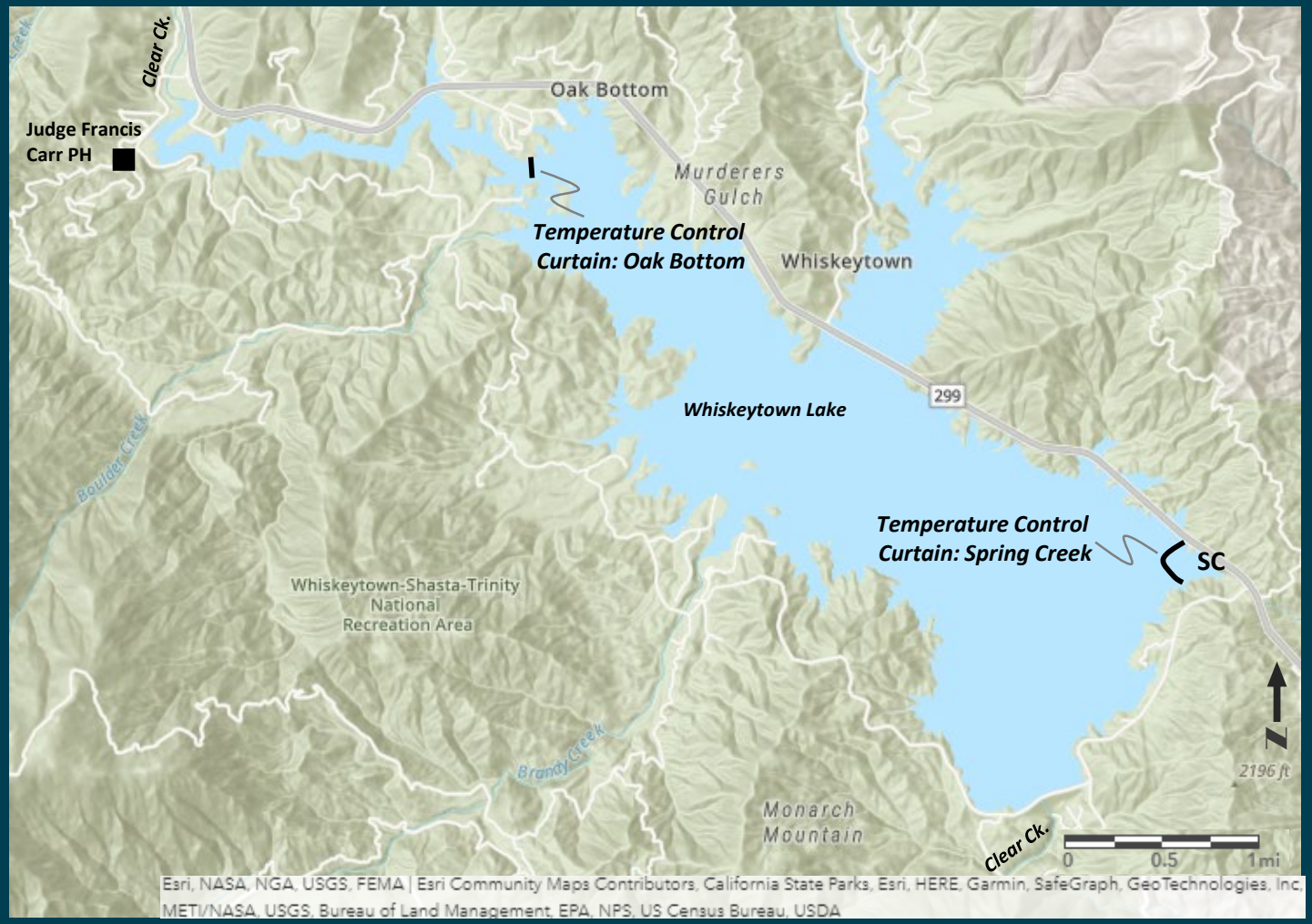
CE-QUAL-W2

- Upstream Curtain– Floating skimmer weir
  - No flow condition across the upper layers between segments
- Hatchery Curtain – Not explicitly represented
  - Fixed bottom withdrawal reproduces curtain behavior
- Diversion – Point sink at fixed elevation

ResSim

- Upstream Curtain considered in calibration of withdrawal envelop for reservoir outlets
- Hatchery Curtain – Not explicitly represented
  - Fixed bottom withdrawal reproduces curtain behavior
- Diversion – Point sink at fixed elevation

Whiskeytown Curtains



- Temperature Control Curtains
  - Oak Bottom
  - Spring Creek

Whiskeytown Implementation

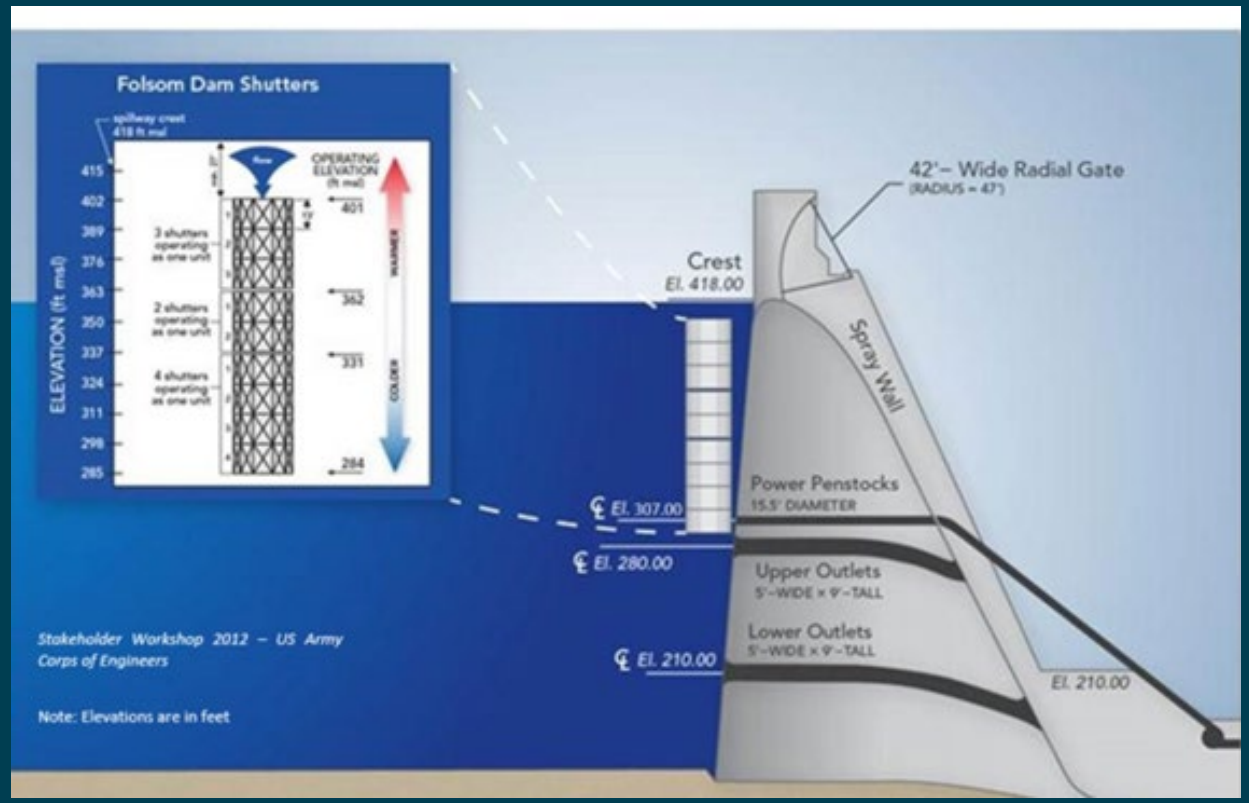
CE-QUAL-W2

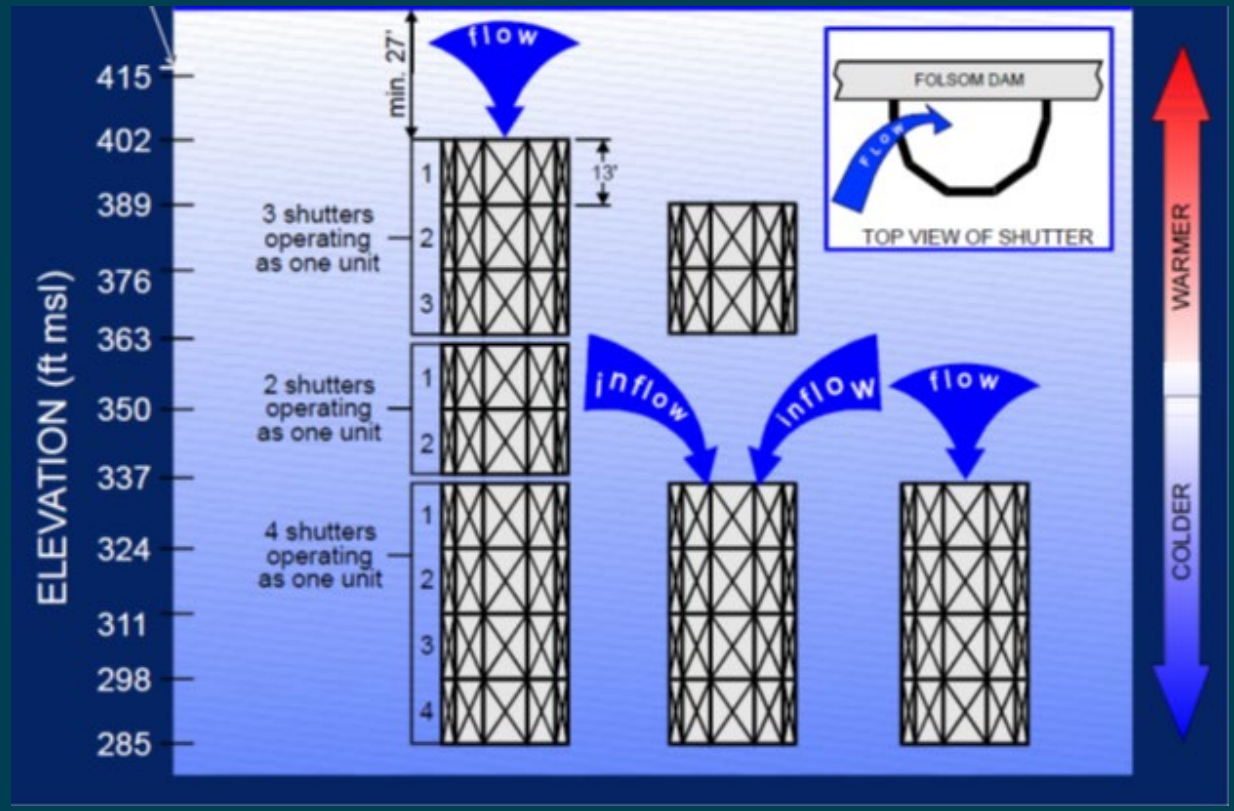
- Oak Bottom – Floating skimmer weir
  - No flow condition across the upper layers between segments
- Spring Creek – Floating skimmer weir
  - No flow condition across the upper layers between segments

ResSim

- Oak Bottom
  - Uses normal entrainment algorithm, no adjustment was found necessary during calibration to represent the impact of the Oak Bottom curtain
- Spring Creek
  - The depth of the Spring Creek tunnel inlet is similar to the Spring Creek Curtain bottom depth and the resulting withdrawal envelop provided a representative approximation of release temperatures

Folsom Dam Temperature Shutters





Folsom Temperature Shutters Implementation

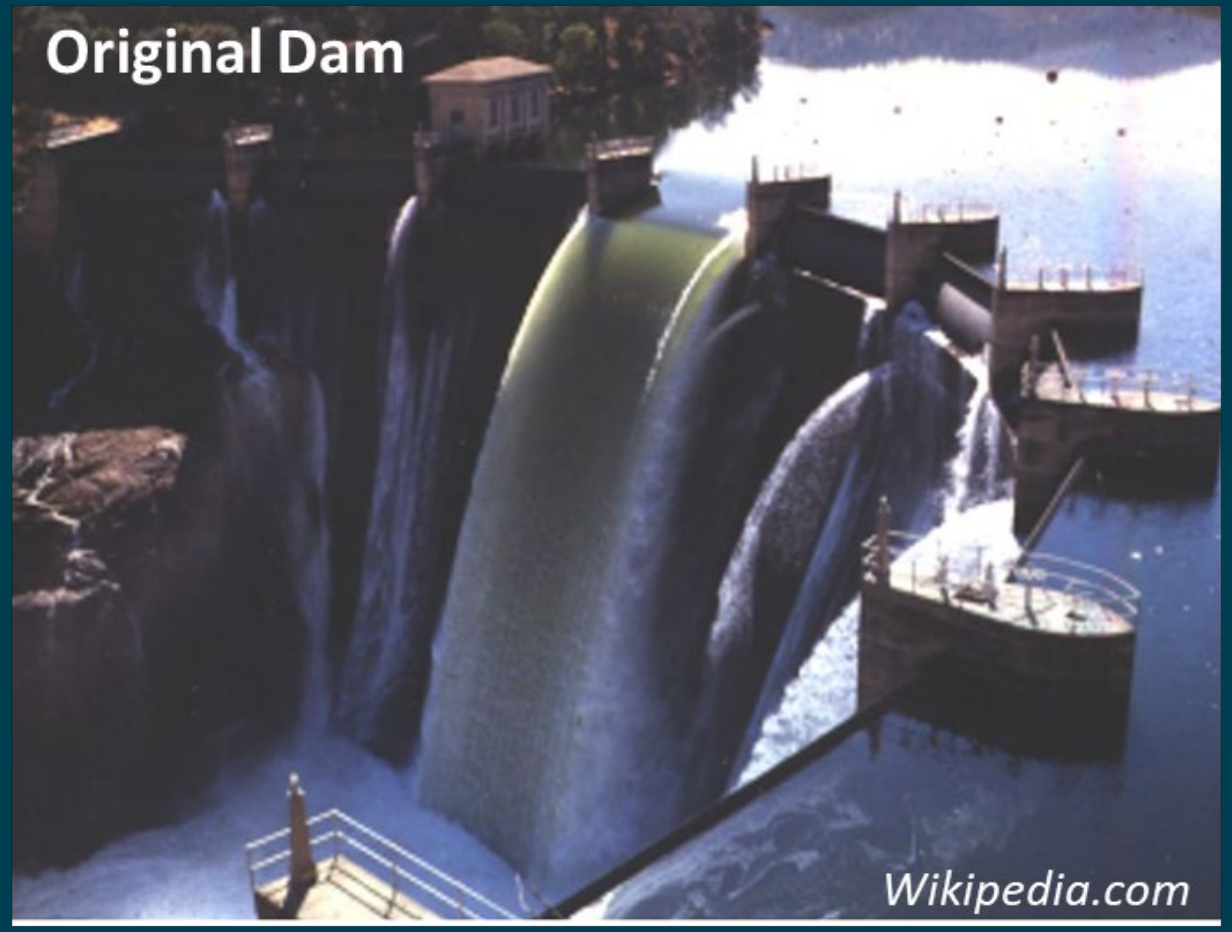
CE-QUAL-W2

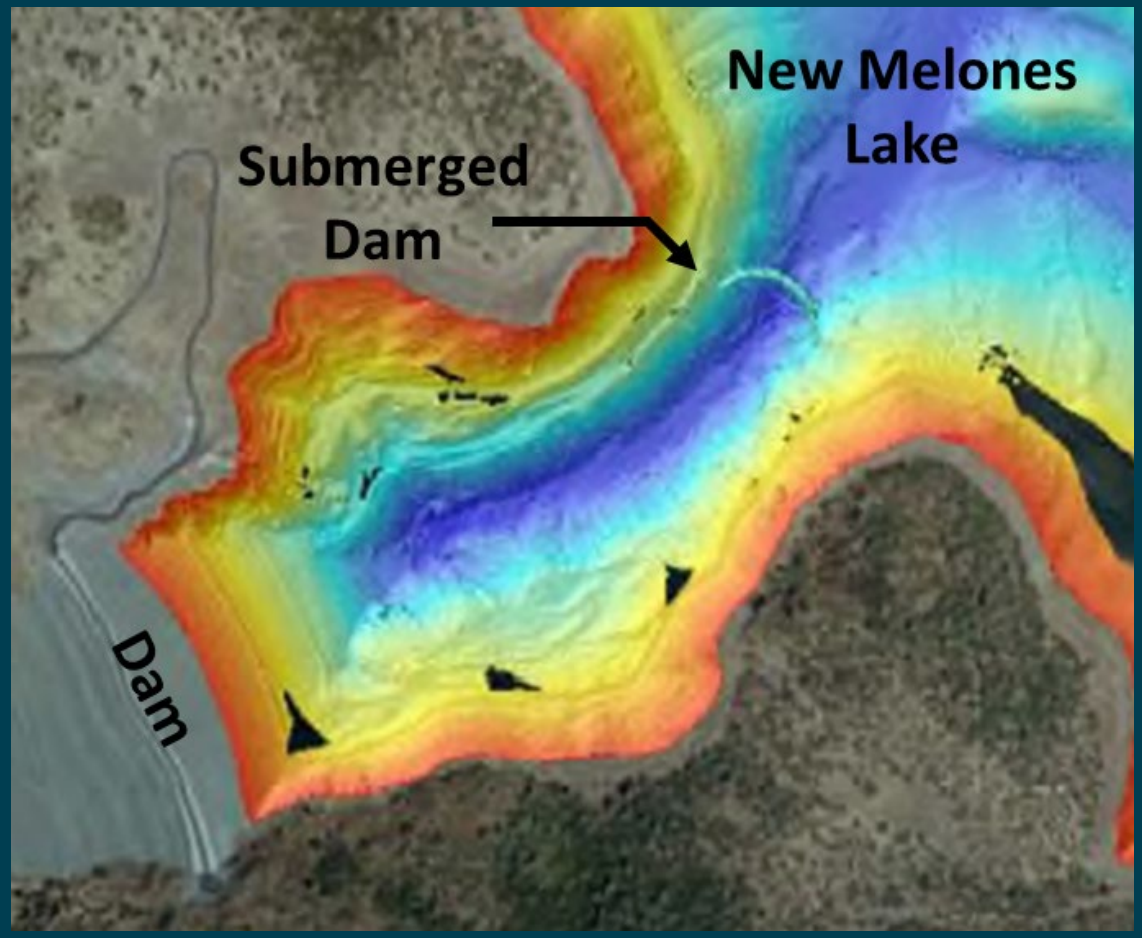
- One point sink per shutter
  - Located at 8.9 feet above lowest available elevation to approximate flow centerline
- Leakage varied with shutter configuration
- Cold water bypass enabled to meet downstream temperatures
- Iterative target temperature control

ResSim

- One point sink per shutter
  - Maintains same elevations as CE-QUAL-W2
- Leakage varied with shutter configuration
- Cold water bypass enabled to meet downstream temperatures
- Downstream target temperature control (Watt Bridge)

New Melones


Original Dam
Wikipedia.com


New Melones
Lake
Submerged
Dam
Dam

New Melones Implementation: Submerged Dam

CE-QUAL-W2

- The submerged dam within New Melones Lake is represented as an internal weir in the CE-QUAL-W2 model. The weir acts as a barrier and represents a no flow condition across the layers between segments.

ResSim

- Influence of the Old Melones Dam upstream of the New Melones Dam is represented by restricting the withdrawal envelop of the New Melones Dam outlets to not draw water below the height of the old dam

Unique Features Summary

- Each facility presents a unique geometry and operations logic
- Represented as physically accurate as allowed by the model limitations
- Future data can help to refine current assumptions

Photo credit: John Hannon, Reclamation

Lunch Break