RECLAMATION
Managing Water in the West

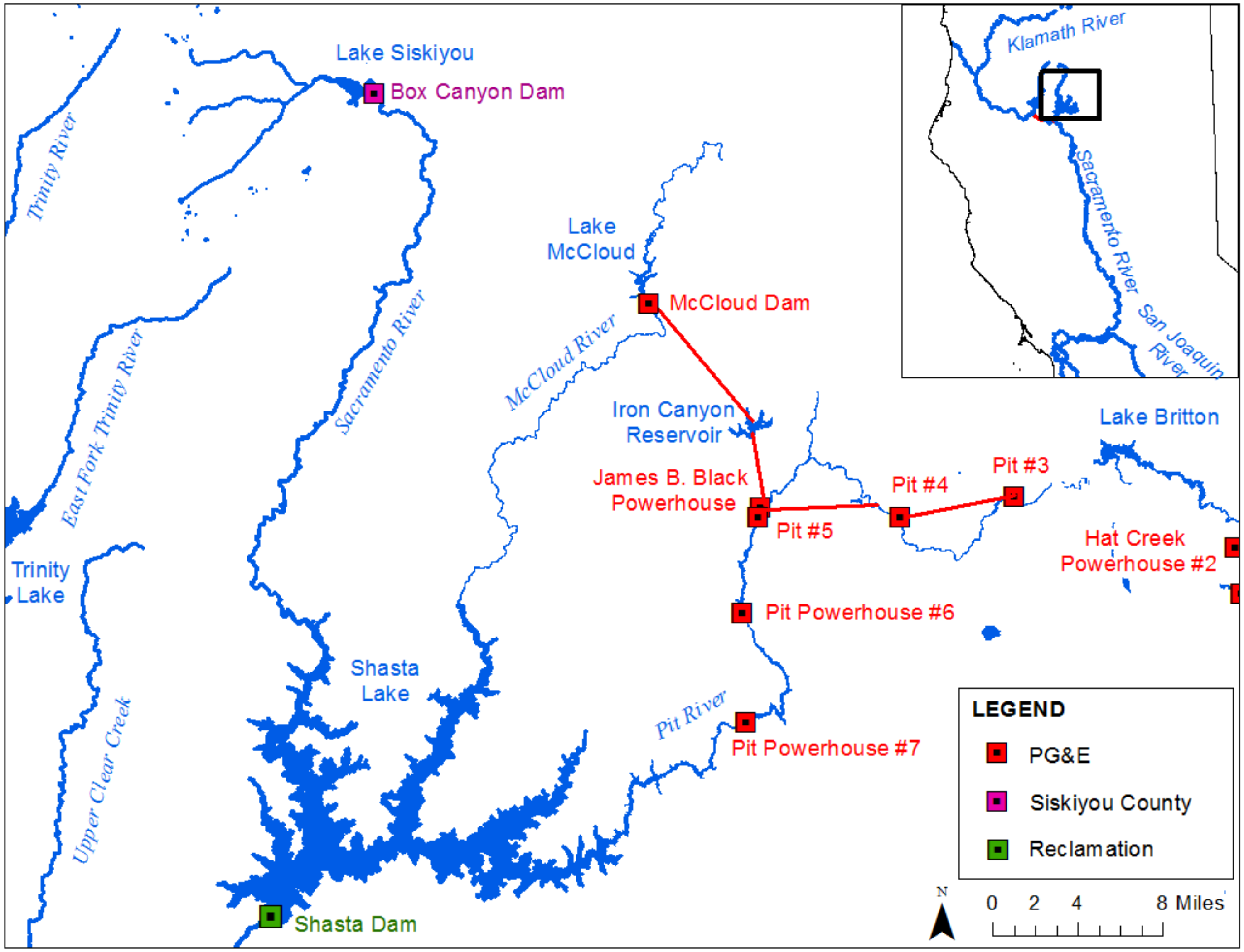
Sacramento Brainstorming Workshop

May 23, 2018

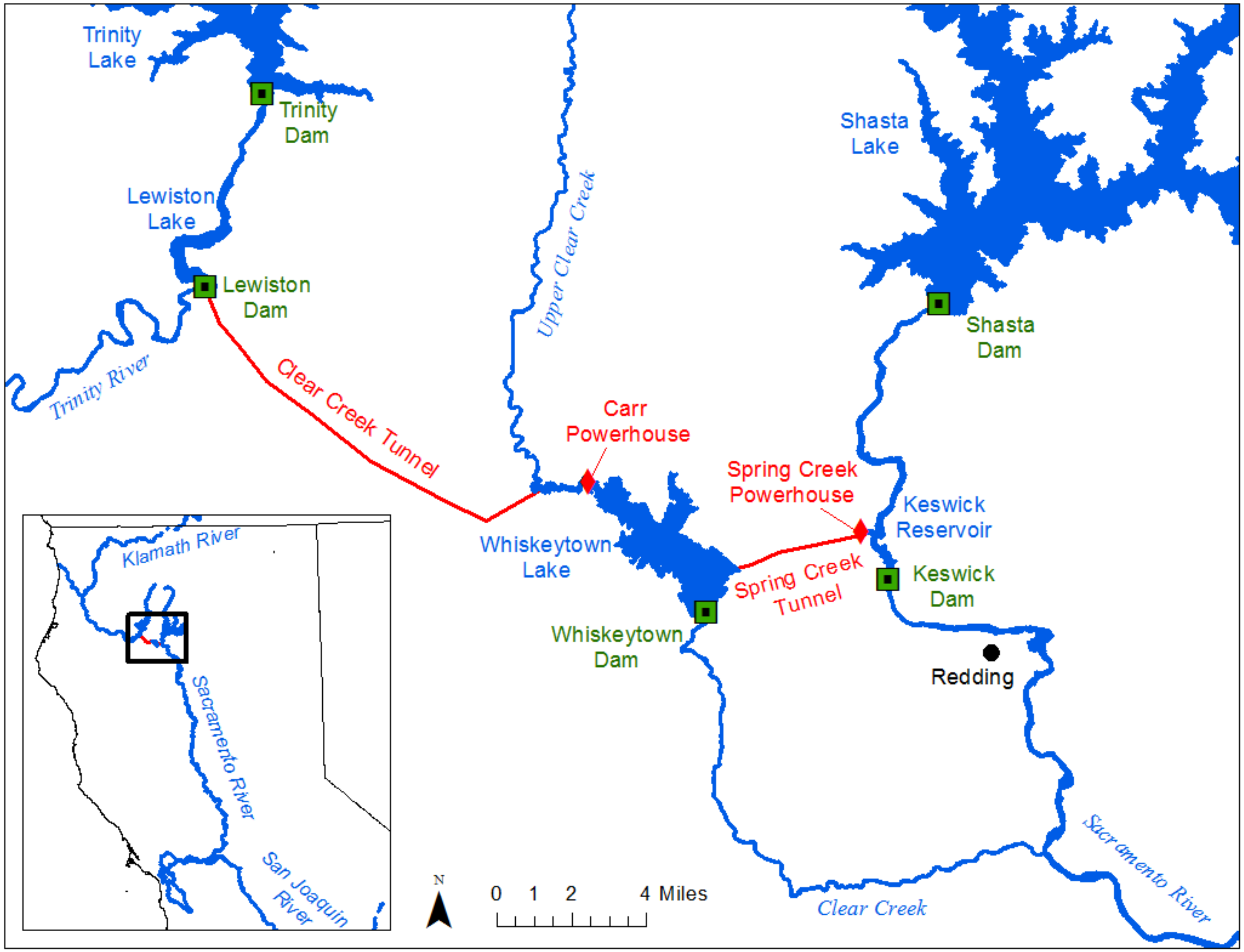
Shasta Dam

- 4.5 Million Acre-Feet
- 676 MW generating capacity
- Largest reservoir in California
- Irrigation water supply, municipal and industrial (M&I) water supply, flood control, hydropower generation, fish and wildlife conservation, and navigation

Upper Sacramento River

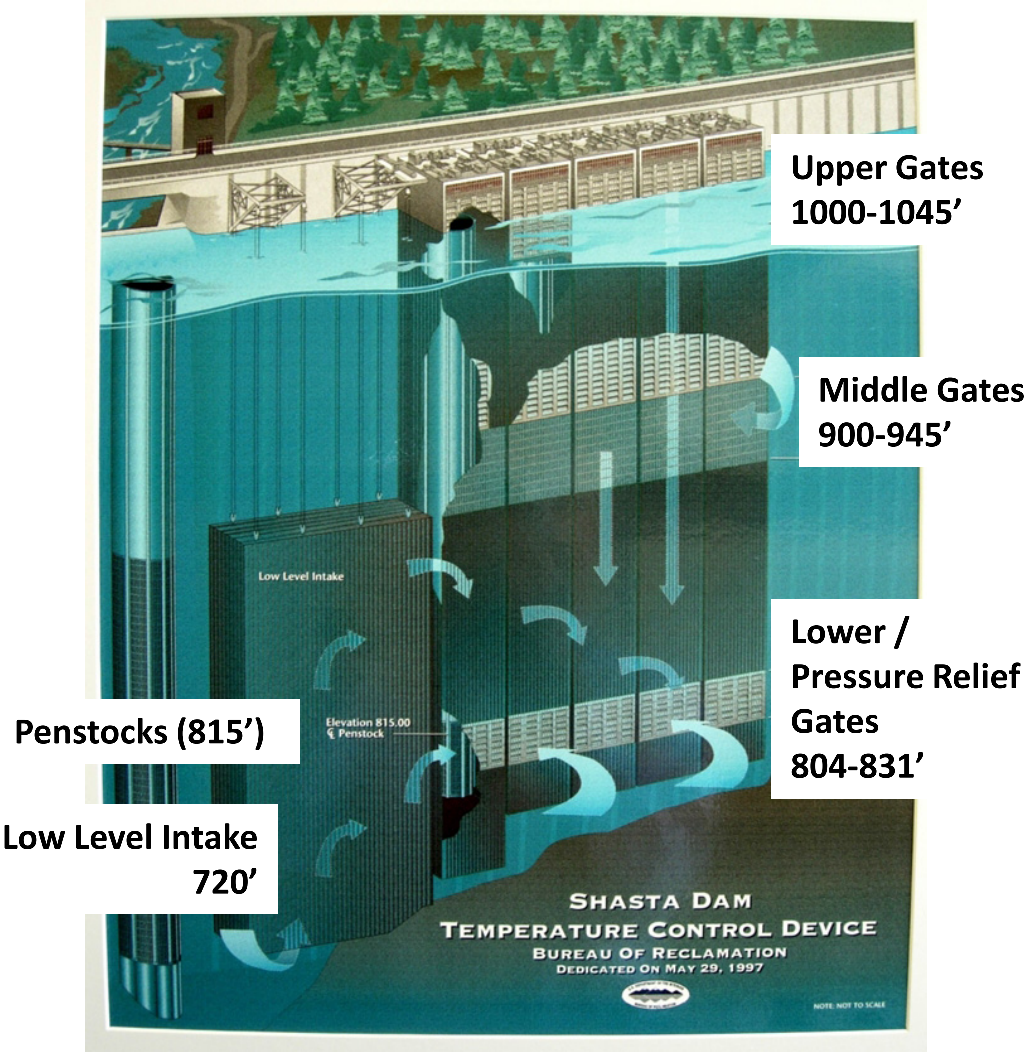


Sacramento / Trinity System



Shasta Dam Temperature Shutters

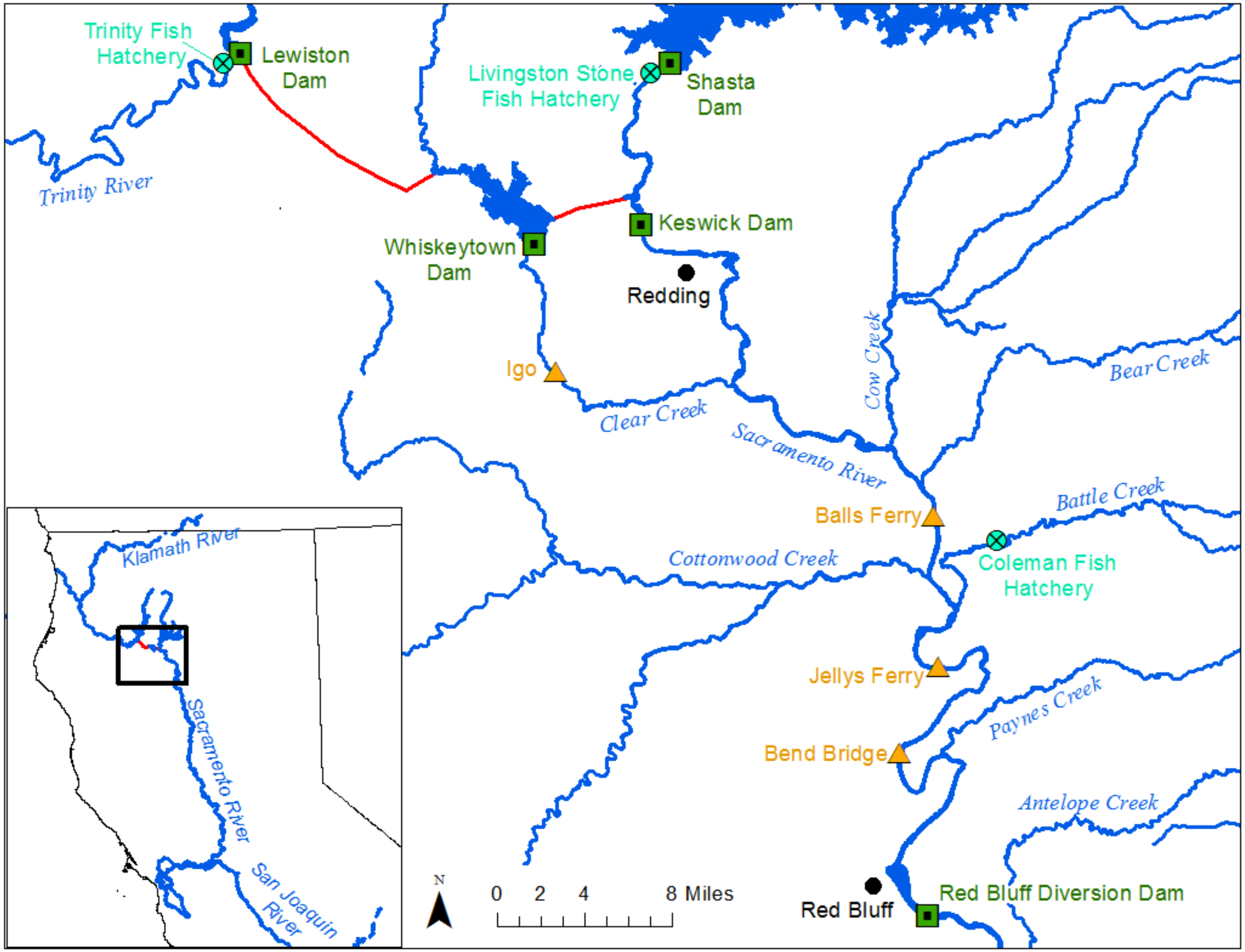
- Constructed 1997
- Selective withdrawal to powerplant penstocks
- Water from all gates is mixed in the TCD
- If reservoir is high enough in early spring to access upper gates = better temperature control
- Transitioning to side gate (low level intake) early drains cold water pool



Temperature Considerations

- Flows from Trinity via Spring Creek Tunnel
- Residence Time in Keswick Reservoir
- 90-5 SWRCB Temperature Management Process
  - 56 degrees at Red Bluff
  - Sacramento River Temperature Task Group
- Winter and Spring Flows
- Tributary inflows
- Meterology
- Hydrology uncertainty
- Time of Year

Sacramento River to Red Bluff

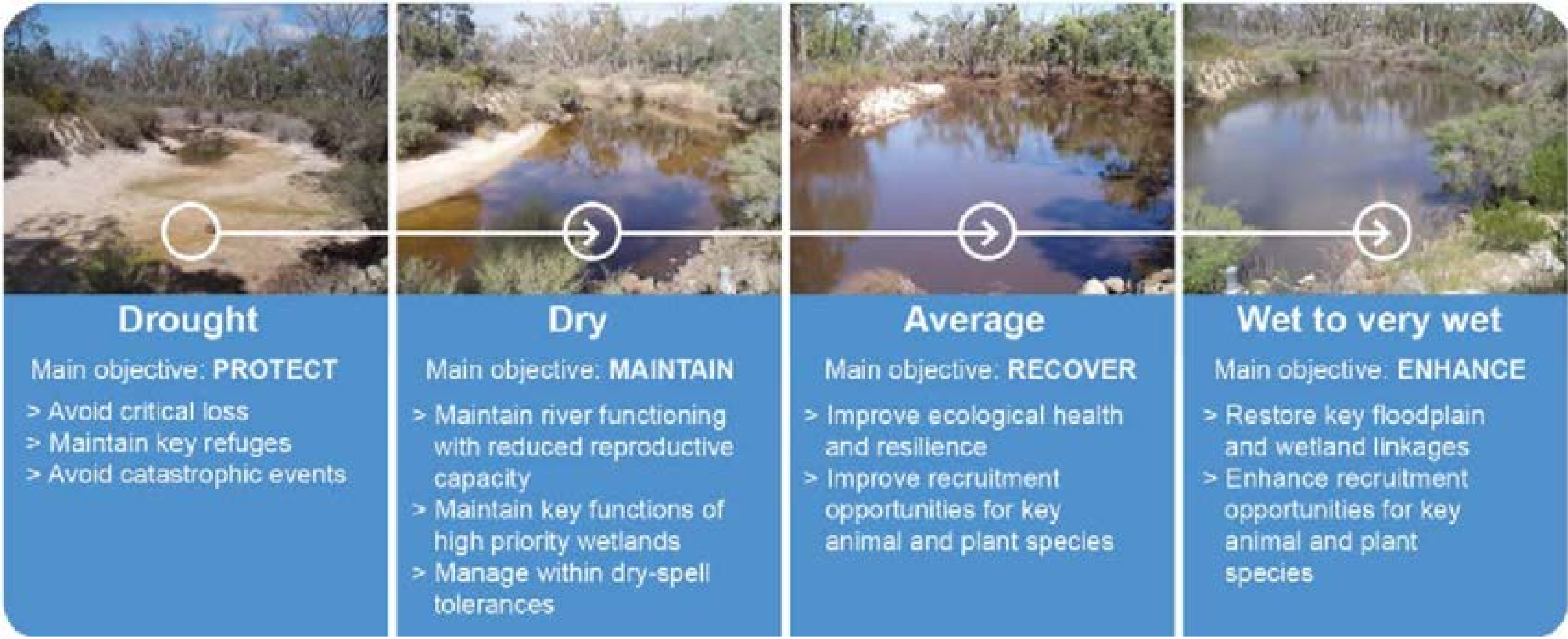


Operational Constraints

- Water Right Order 90-5
- Wilkins Slough Navigational Target
- Bend Bridge - 100,000 cubic feet per second
- Sacramento River Temperatures
- Fall-run Redd Dewatering

- 79,000 cfs normal release from Shasta

Environmental Watering



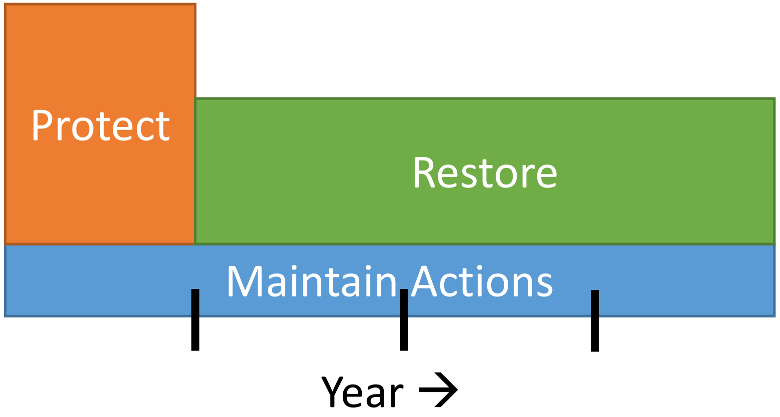
Source: Mount et. al., 2016 from the Murray-Darling Basin in Australia

Environmental Watering for California

- Protect: Predict adverse conditions and implement standard contingency plans to address potential extinction risks to fish populations.
- Restore: Promote production of sufficient numbers of juveniles per adult to enable the rebuilding of fish populations.
- Maintain: Operate water projects to support adult returns.

Environmental Watering for California

- Protect
  - Ex: Drought Contingency Plans for Temperature
- Restore
  - Non-flow and/or flow actions to increase the number of juveniles per adult
  - Ex: Increase rearing habitat
  - Ex: Reduce predation, invasives
  - Ex: Improve water quality
- Maintain
  - Minimum actions in all years
  - Ex: Flows for passage

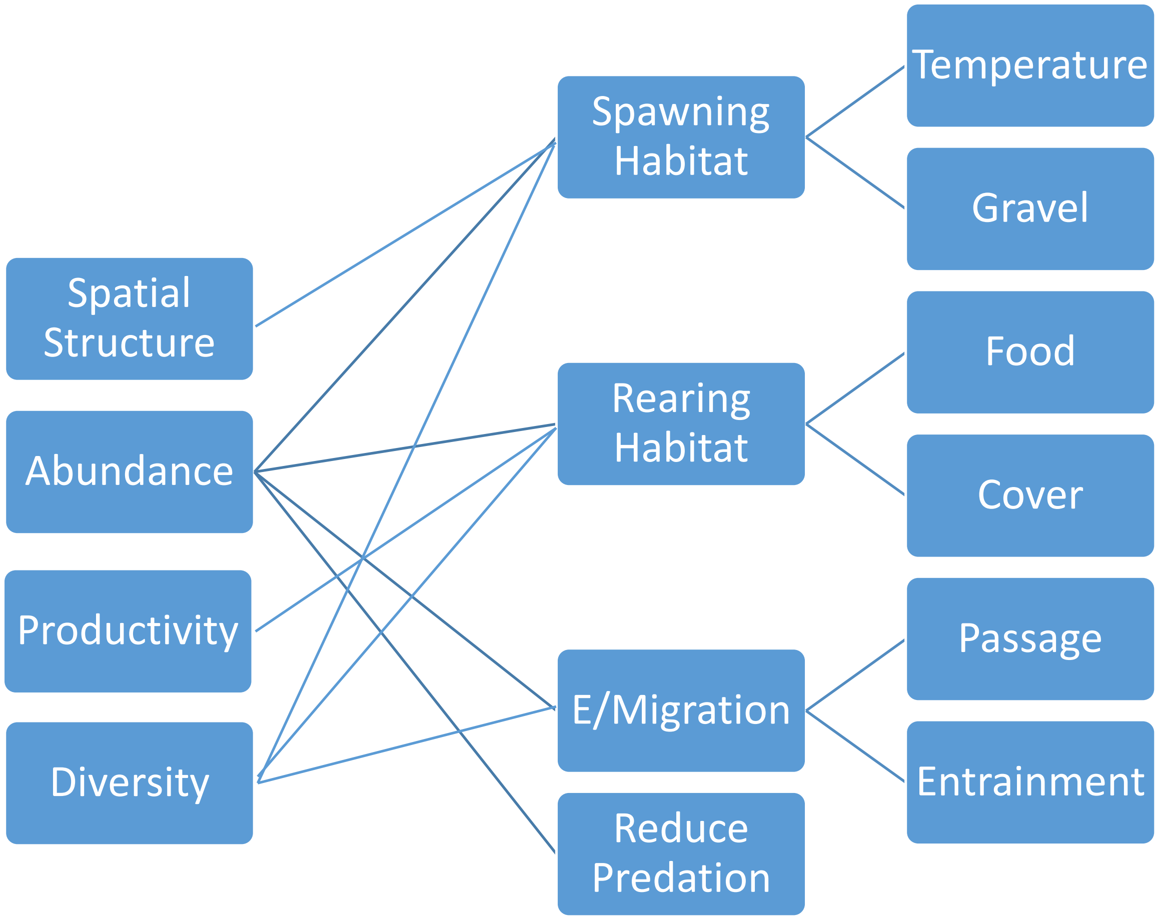


Biological Objectives for ROC on LTO

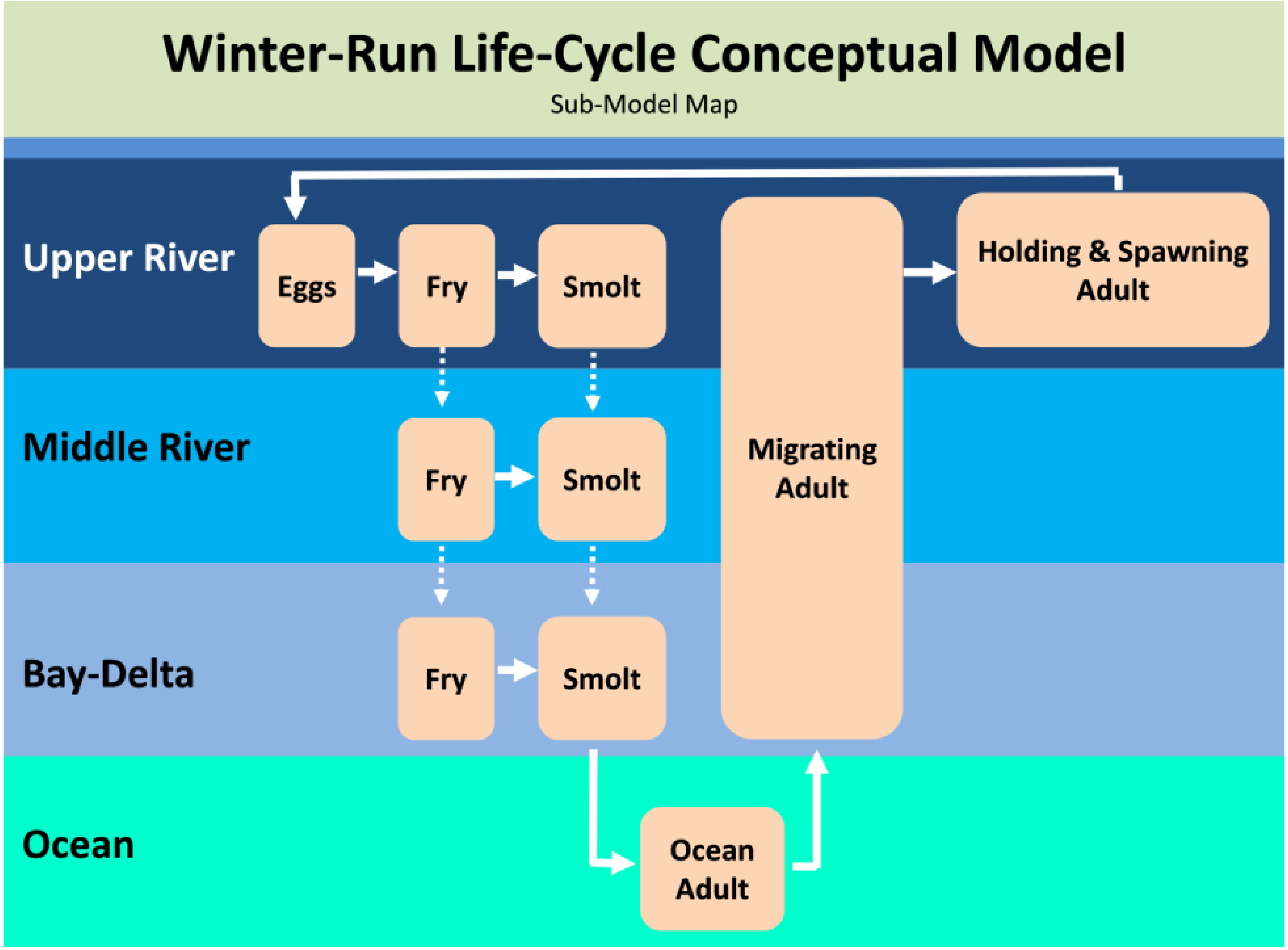
Viability Parameter	Description
Abundance / Resilience	Avoid rapid decreases in cohort replacement rate, and increase in 3-year running average cohort replacement rate, controlled for hydrology
Productivity / Resilience	Increase number of juveniles exiting the Delta per adult spawner, controlled for hydrology
Spatial Structure / Redundancy	Increased number of river systems in which the species is observed;
Diversity / Redundancy & Representation	Increase number of rearing / spawning / holding locations, controlled for hydrology

Source: Viable Salmonid Population Report

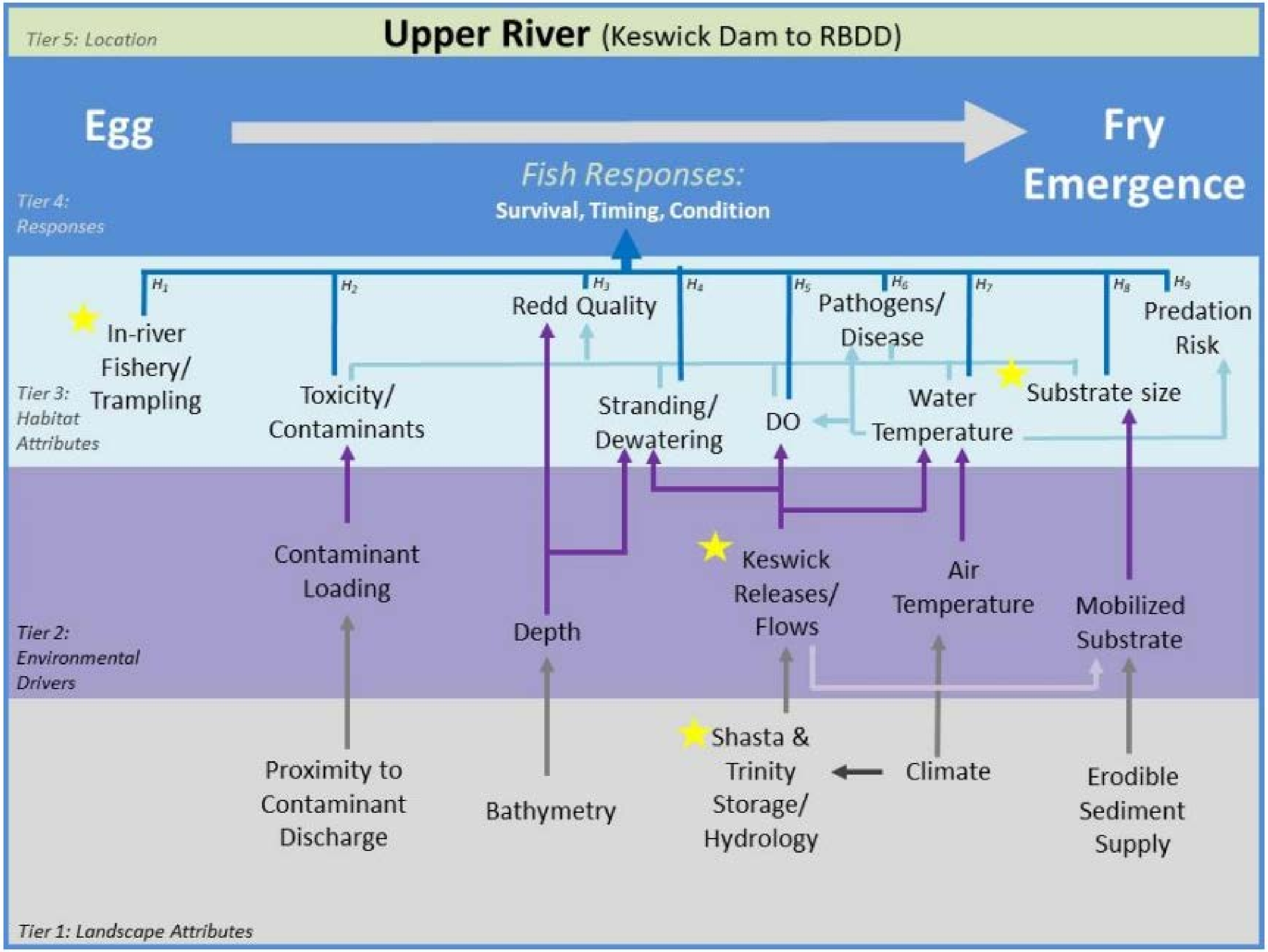
Biological Objectives



SAIL Conceptual Models



Spawning / Emergence Habitat



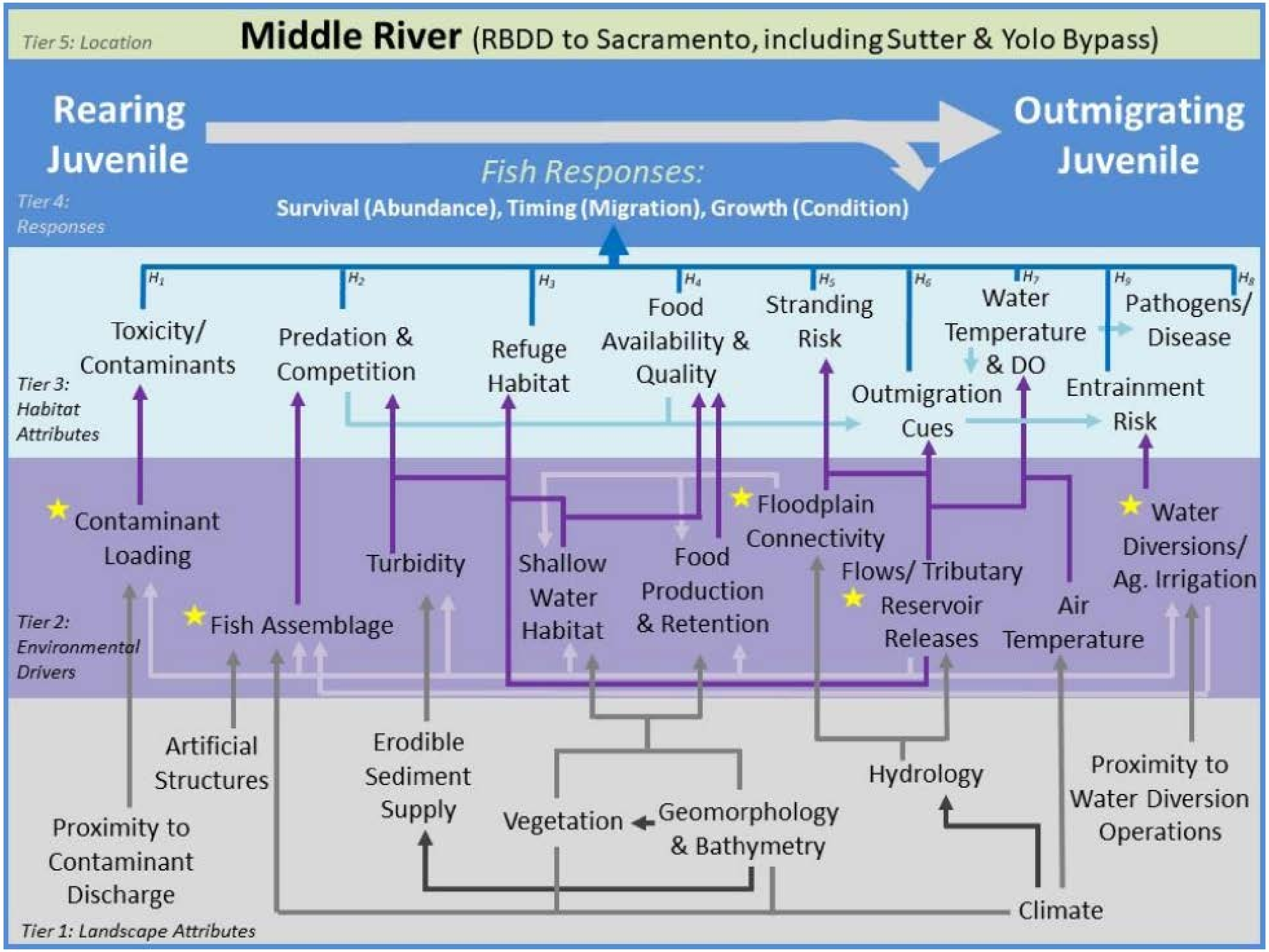
Egg to Fry Emergence

- "The survival of eggs into emerging fry depends largely on the quality of the redd and the quantity of gravel of appropriate sizes (H3, H8). Redd quality is affected by gravel size and composition, flow, temperature, dissolved oxygen (DO), contaminants, sedimentation, and pathogens and diseases." (SAIL, 2017)

SCIENTIFIC FRAMEWORK FOR ASSESSING FACTORS INFLUENCING ENDANGERED SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON (*Oncorhynchus tshawytscha*) ACROSS THE LIFE CYCLE

Sean Windell, Patricia L. Brandes, J. Louise Conrad, John W. Ferguson, Pascale A.L. Goertler, Brett N. Harvey, Joseph Heublein, Joshua A. Israel, Daniel W. Kratville, Joseph E. Kirsch, Russell W. Perry, Joseph Pisciotto, William R. Poytress, Kevin Reece, Brycen G. Swart, and Rachel C. Johnson

Rearing Habitat



Rearing Juvenile to Outmigrating Juvenile

- The foremost factor affecting migration, growth, and survival of SRWRC fry is habitat (e.g., substrate, water quality, water temperature, water velocity, shelter, and food; Williams 2006, Williams 2010). (SAIL, 2017 – Upper Sacramento River)
- Piscivore and avian predation (H2) is probably the most common proximate cause of juvenile mortality in the Middle Sacramento River. (SAIL, 2017)