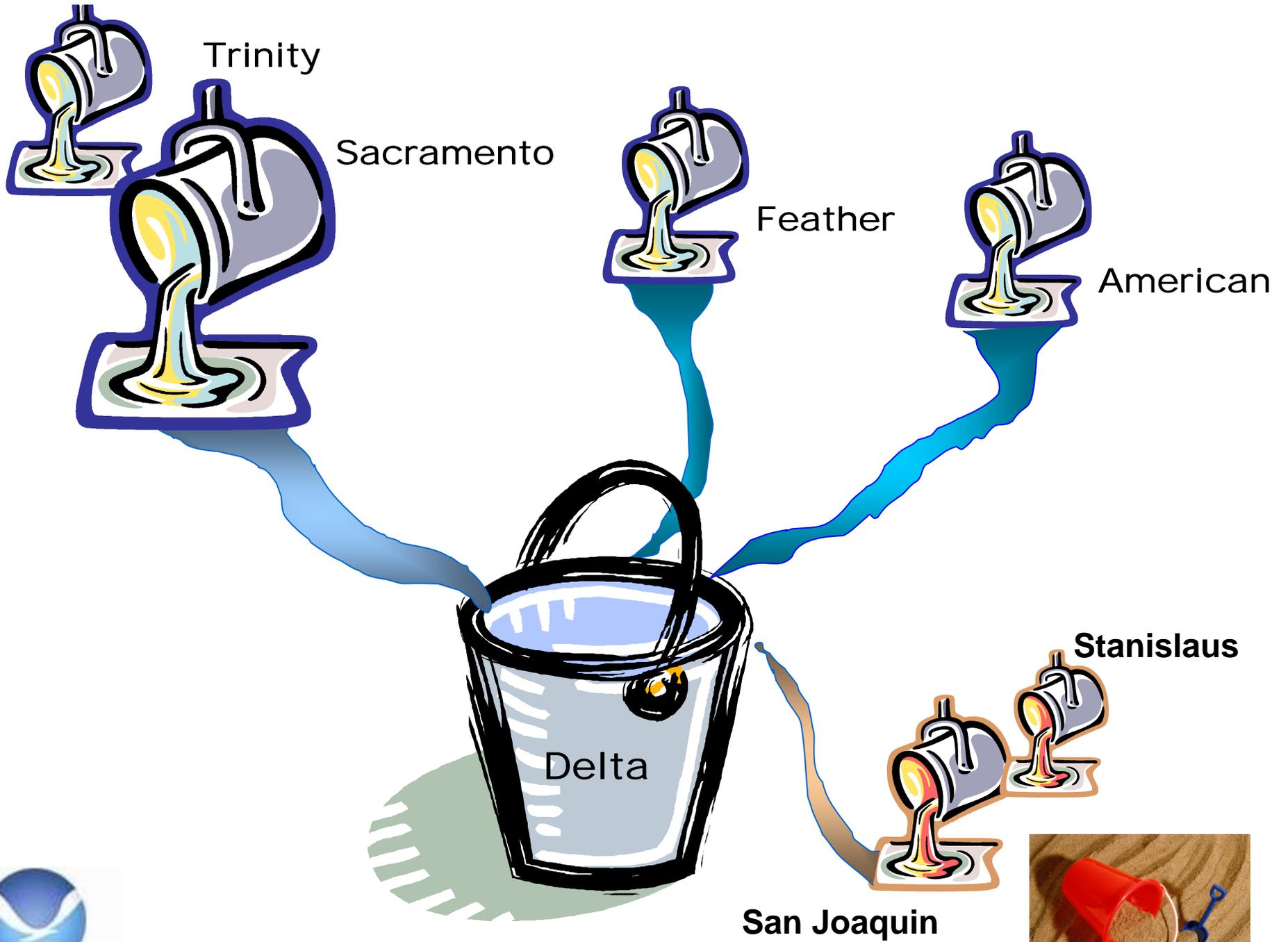


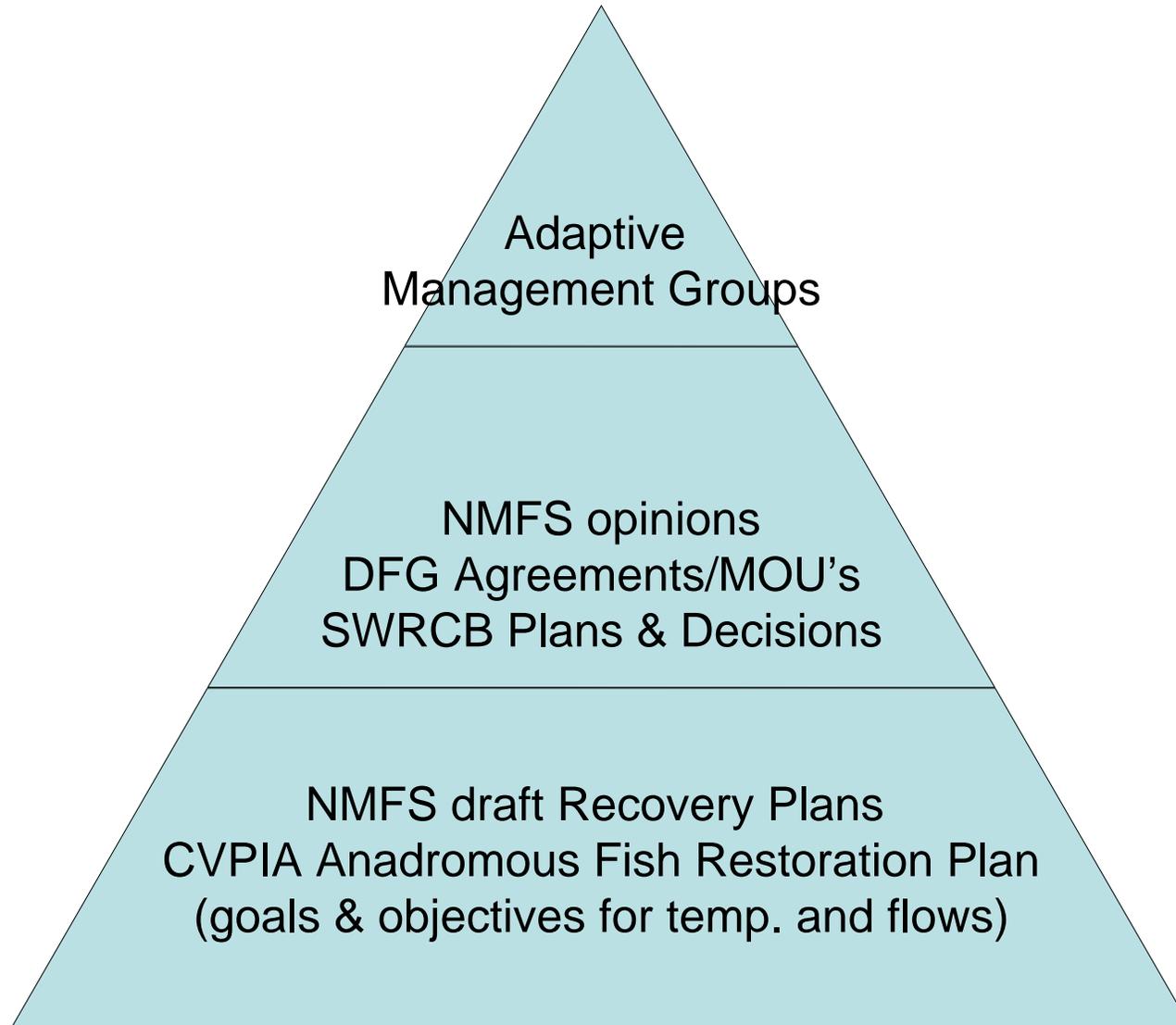
Temperature Criteria & Management in the Central Valley



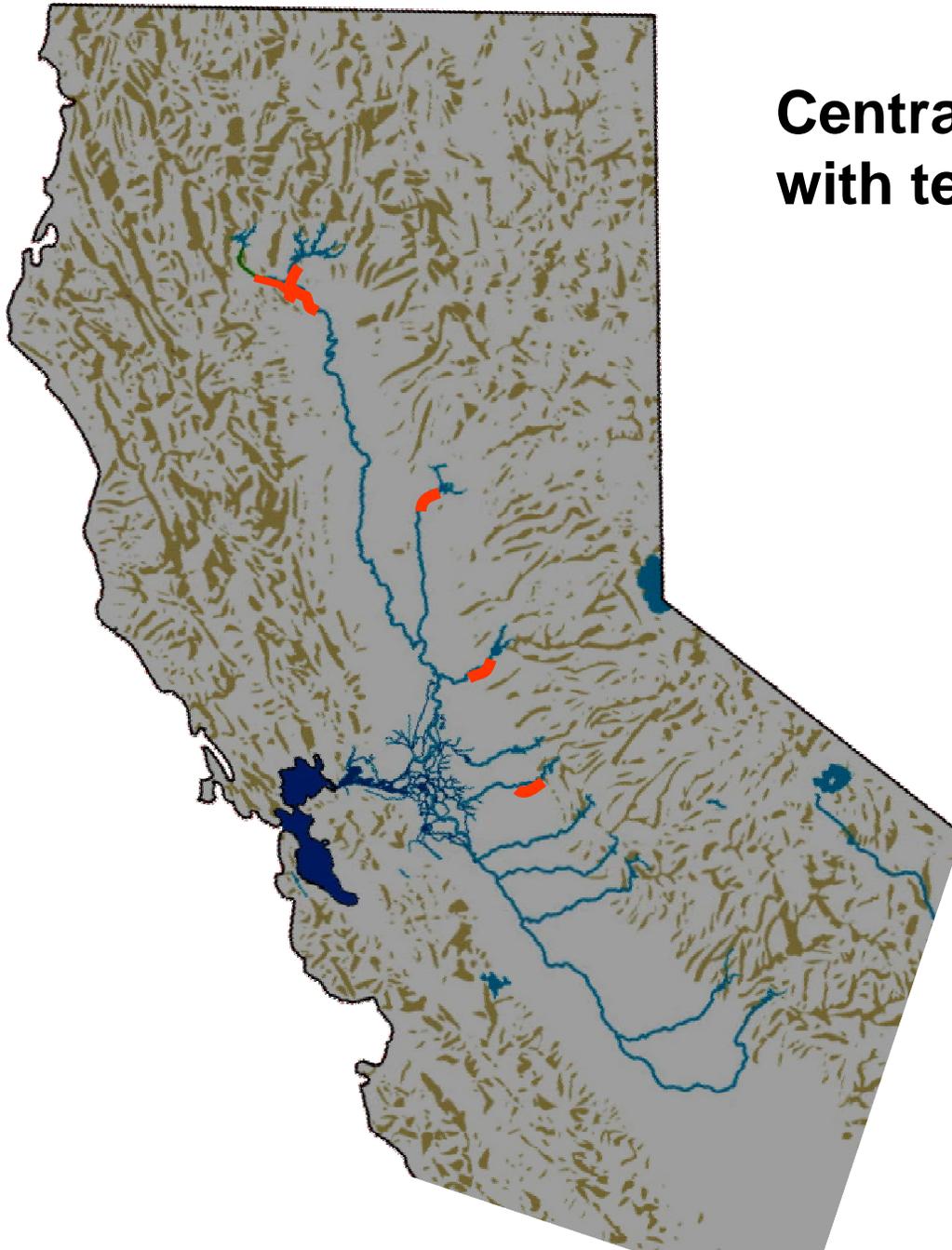
Bruce Oppenheim
Southwest Region
Protected Resource Division



Temperature Management



Central Valley streams with temperature control



NMFS-SWR

NMFS Approach

- Protect life-stage needs of ESA listed species
- Winter-run egg, incubation, and fry
- Spring-run egg, incubation, fry and adult holding
- Steelhead over-summering period
- Green sturgeon consistent with salmonids



Trinity River Objectives

- July 1 to Sept 14, 60 F at Douglas City
- Sept 15 to Oct. 1, 56 F at Douglas City (SWRCB 90-5 requirement)
- Oct. 1 to Dec 31, 56 F to confluence with the North Fork



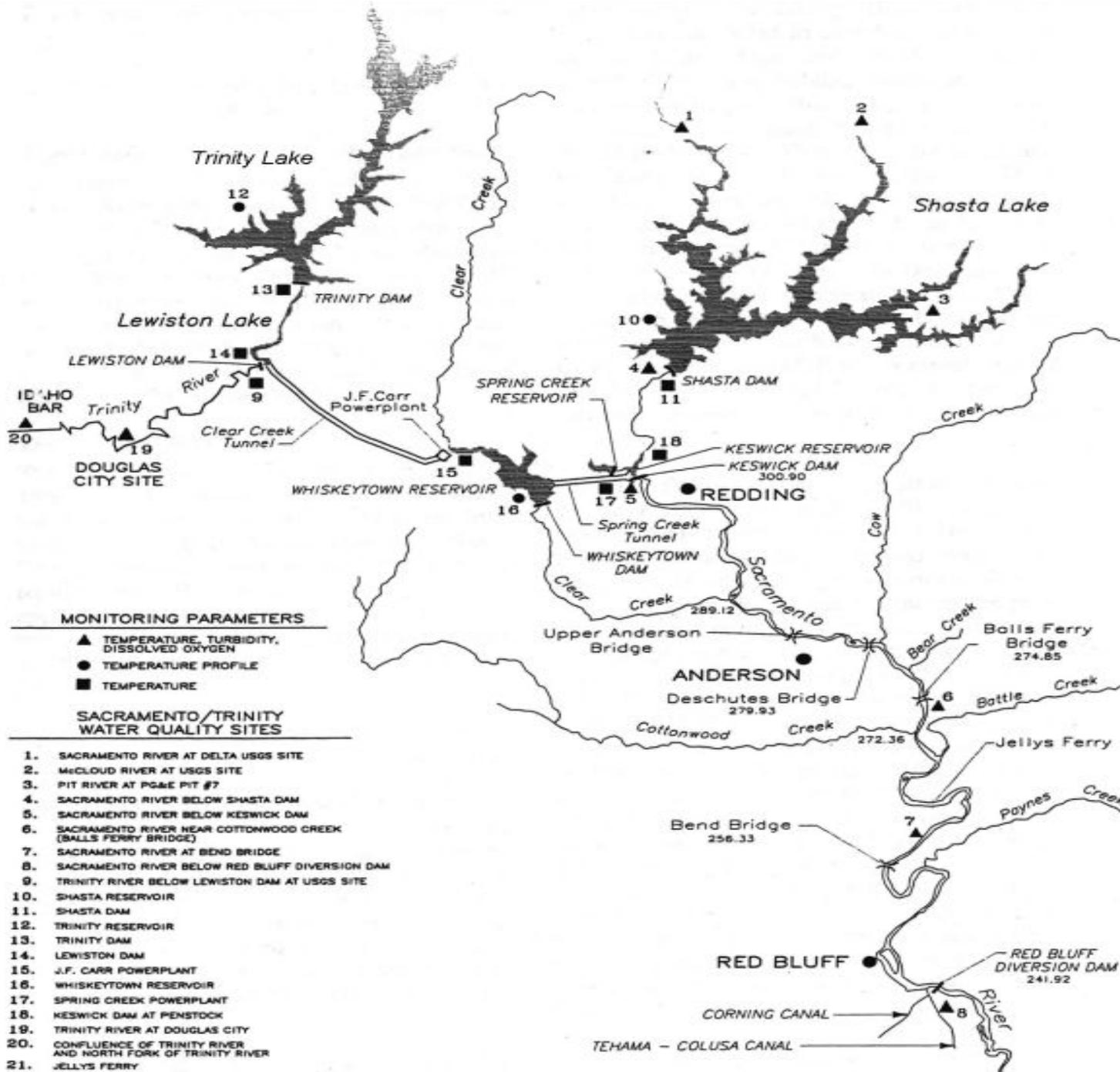
Approach to Trinity River Mgt

- Implement the Trinity ROD flows, beneficial impacts to listed coho salmon
- > flows, < temps April to July
- Temp. effects on winter-run due to reliance on cold water from Trinity would have to be managed with Shasta releases
- Less storage in Shasta = less cold water available in summer to Sacramento River

Sacramento River Temperature Criteria

- 56 F target between Balls Ferry and Bend Bridge, April 15 – Sept. 30
- 60 F from Oct 1 – Oct 31
- Not to exceed > 0.5 F for 3 days (1993 winter-run opinion)
- 1.9 million acre feet end-of-September target in Shasta for following year.
- Use of conservative forecast (90%) starting in February





Sacramento-Trinity Water Temperature Compliance Points (with river miles)

OCAP 2004 BA

MONITORING PARAMETERS

- ▲ TEMPERATURE, TURBIDITY, DISSOLVED OXYGEN
- TEMPERATURE PROFILE
- TEMPERATURE

SACRAMENTO/TRINITY WATER QUALITY SITES

1. SACRAMENTO RIVER AT DELTA USGS SITE
2. McCloud RIVER AT USGS SITE
3. PIT RIVER AT PG&E PIT #7
4. SACRAMENTO RIVER BELOW SHASTA DAM
5. SACRAMENTO RIVER BELOW KESWICK DAM
6. SACRAMENTO RIVER NEAR COTTONWOOD CREEK (BALLS FERRY BRIDGE)
7. SACRAMENTO RIVER AT BEND BRIDGE
8. SACRAMENTO RIVER BELOW RED BLUFF DIVERSION DAM
9. TRINITY RIVER BELOW LEWISTON DAM AT USGS SITE
10. SHASTA RESERVOIR
11. SHASTA DAM
12. TRINITY RESERVOIR
13. TRINITY DAM
14. LEWISTON DAM
15. J.F. CARR POWERPLANT
16. WHISKEYTOWN RESERVOIR
17. SPRING CREEK POWERPLANT
18. KESWICK DAM AT PENSTOCK
19. TRINITY RIVER AT DOUGLAS CITY
20. CONFLUENCE OF TRINITY RIVER AND NORTH FORK OF TRINITY RIVER
21. JELLYS FERRY

Upper Sacramento River Temperature Control History

Water Year	Oct. 1 Shasta Storage (TAF)	April 30 Shasta Storage (TAF)	Starting Compliance Point	Month	Action	Change in Compliance Point
1987-1996					Use of low-level outlets, power costs	
1992					CVPIA passed, construct TCD	
1993	1683	4263	Bend Bridge			
1994	3102	3534	Jelly's Ferry			
1995	2102	4165	Bend Bridge	July	Conserve cold water	Jelly's Ferry
1996	3136	4308	Bend Bridge	April	Exceed 56 °F 4/26	
				May	Exceed 56 °F 5/27	
				July	Conserve cold water	Jelly's Ferry
				August	Conserve cold water	Ball's Ferry
				Sept	Transition to stable min flow for fall-run salmon by Oct 15	Clear Creek
1997*	3089	3937	Bend Bridge	May	Exceed 56 °F at Bend 3 days	
				July	Exceed 56 °F at Bend 4 days	
				Sept	Conserve cold water	Jelly's Ferry
				Sept	Exceed 56 °F at Jelly's 8/29 to 9/13	
				Oct	Exceed 56 °F at Jelly's 9/20-9/30	
1998	2308	4061	Bend Bridge	June	Exceed 56 °F at Bend 3 days	
				June	Exceed 56 °F at Bend 4 days	
				Sept	temp exceed 56 since Sep 12	Jelly's Ferry
1999	3441	4256	Bend Bridge	August	Exceed 56 °F at Bend 4 days	
2000	3327	4153	Bend Bridge	June	Exceed 56 °F at Bend 3 days	
				July	Conserve cold water	Jelly's Ferry
				August	Conserve cold water	Ball's Ferry
				Oct	Exceed 56 °F at Balls 3 days	
2001	2985	4020	Jelly's Ferry	July	Exceed 56.5 °F at Jelly's 2 days	
				August	Exceed 56 °F at Jelly's 8/28/2001 to 9/1/2001 and 9/15/2001 to 9/30/2001	
				Sept		
2002	2200	4297	Jelly's Ferry	May	Exceed 56 °F at Jelly's 5/18/2003	
2003	2558	4537	Bend Bridge	May	Exceed 56 °F at Bend 5/14/2003	
				Aug. 6		Jellys Ferry
				Aug. 8		Balls Ferry
				Aug. 28	Conserve cold water	
2004	3159	4060	Bend Bridge	May 7.	Exceed 56 °F at Bend	Jellys Ferry
				May 27.		Balls Ferry
2005	2183	4207	Balls Ferry	May 8.		Jellys Ferry
				Aug. 5		Balls Ferry
2006	3035	4057	Balls Ferry	May 1.		Bend Bridge
2007	3205	3901	Balls Ferry	May 7.		Jellys Ferry
				June 8.		Balls Ferry
2008	1879					

Above Normal & Wet
Below Normal & Dry
Critical

*First year that the TCD was used



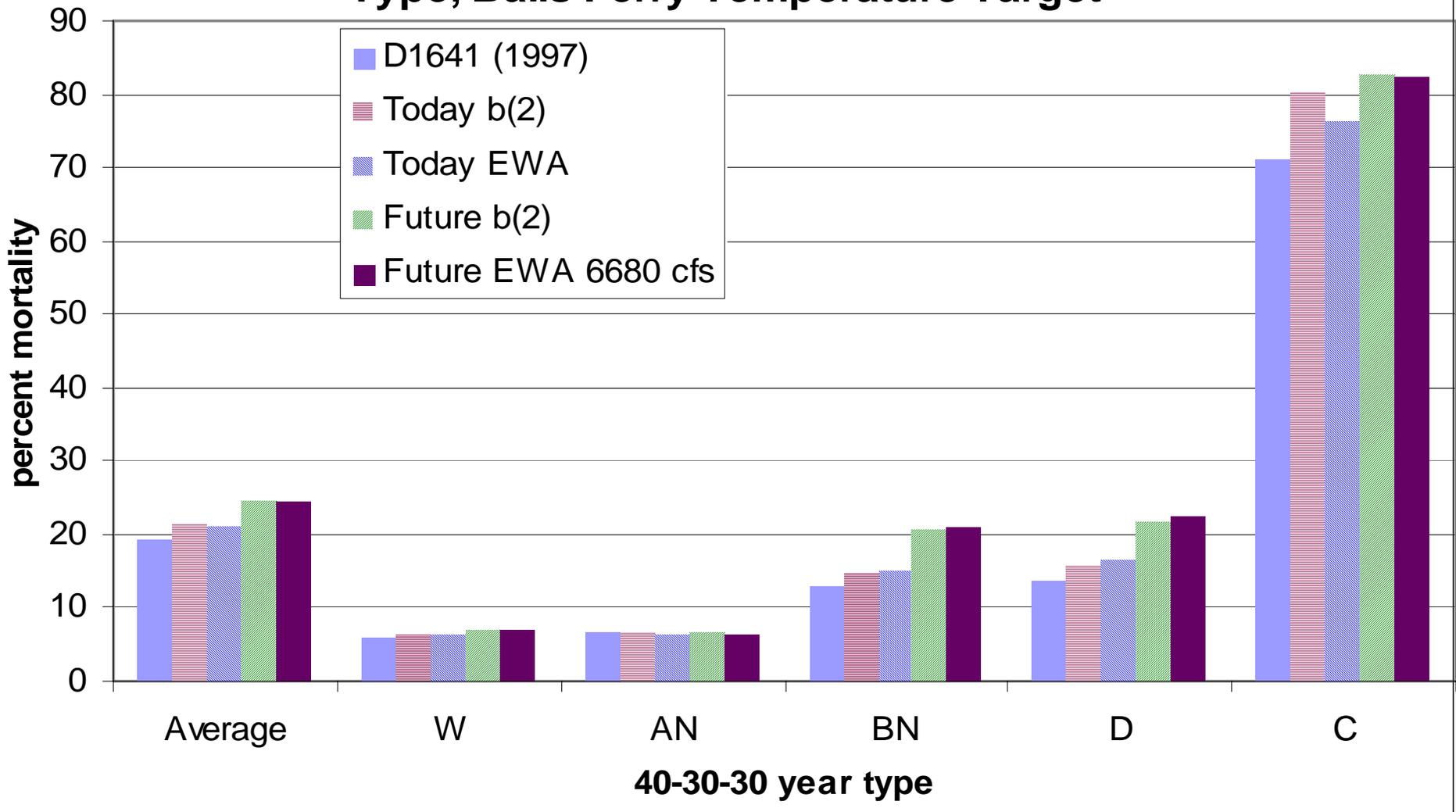
Trends in Shasta Lake

- 2.0 degree C warming in last 50 years
- Cold water pool statistically associated with air temps
- Continued warming of spring air temps could markedly reduce cold water avail.
- All cold water accumulates by mid April giving operators 4 months to plan!

(Souce: Nickel, Brett and Jassby 2001)



Sacramento River Spring Run Chinook Mortality by Year Type, Balls Ferry Temperature Target



Process & Strategy

- Sac. River Temp.Task Group
- Decisions based on cold water pool, spawning distribution, abundance
- Protect 90% of run 90% time
- Based on timing, life-stage, species present (April – Sept), risk mgt.
- Conserve early, get fish to move above limit of control



Juvenile Chinook above ACID

> 50% of winter-run spawn above Anderson-Cottonwood Irrigation Dam



Spring-run mainstem population

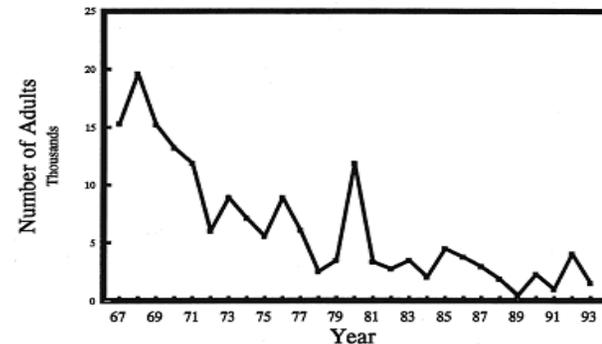
- Mainstem population probably extinct through introgression with fall-run Chinook
- 1982 – 23,156 spawned above RBDD
- 2006 - 0 ?
- Overlap in temperature control season, run out of cold water by September (spawning period)

Source: R.Reavis, 1986, DFG, Admin. Report No. 84-10

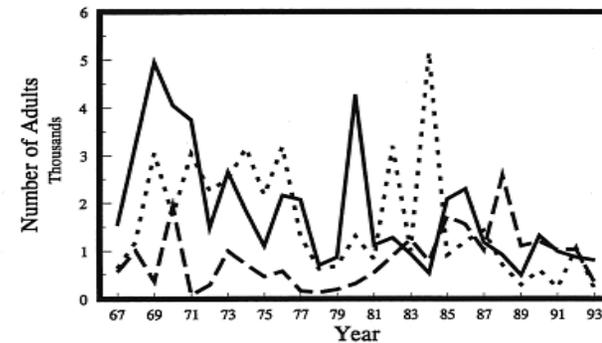


Central Valley steelhead

- Temp control has changed populations below dams to resident form
- Not enough high elevation habitat to support over summering
- Hatchery production has replaced natural stocks
- Spatial structure fragmented, dams have reduced core populations



Adjusted adult steelhead counts at Red Bluff Diversion Dam on the Sacramento River, 1967-1993.



COLEMAN NATIONAL FISH HATCHERY
Does not include steelhead less than 22.5 inches in length
FEATHER RIVER HATCHERY
NIMBUS FISH HATCHERY

Adult steelhead counts at Coleman, Feather River, and Nimbus fish hatcheries, 1967-1993.



Feather River

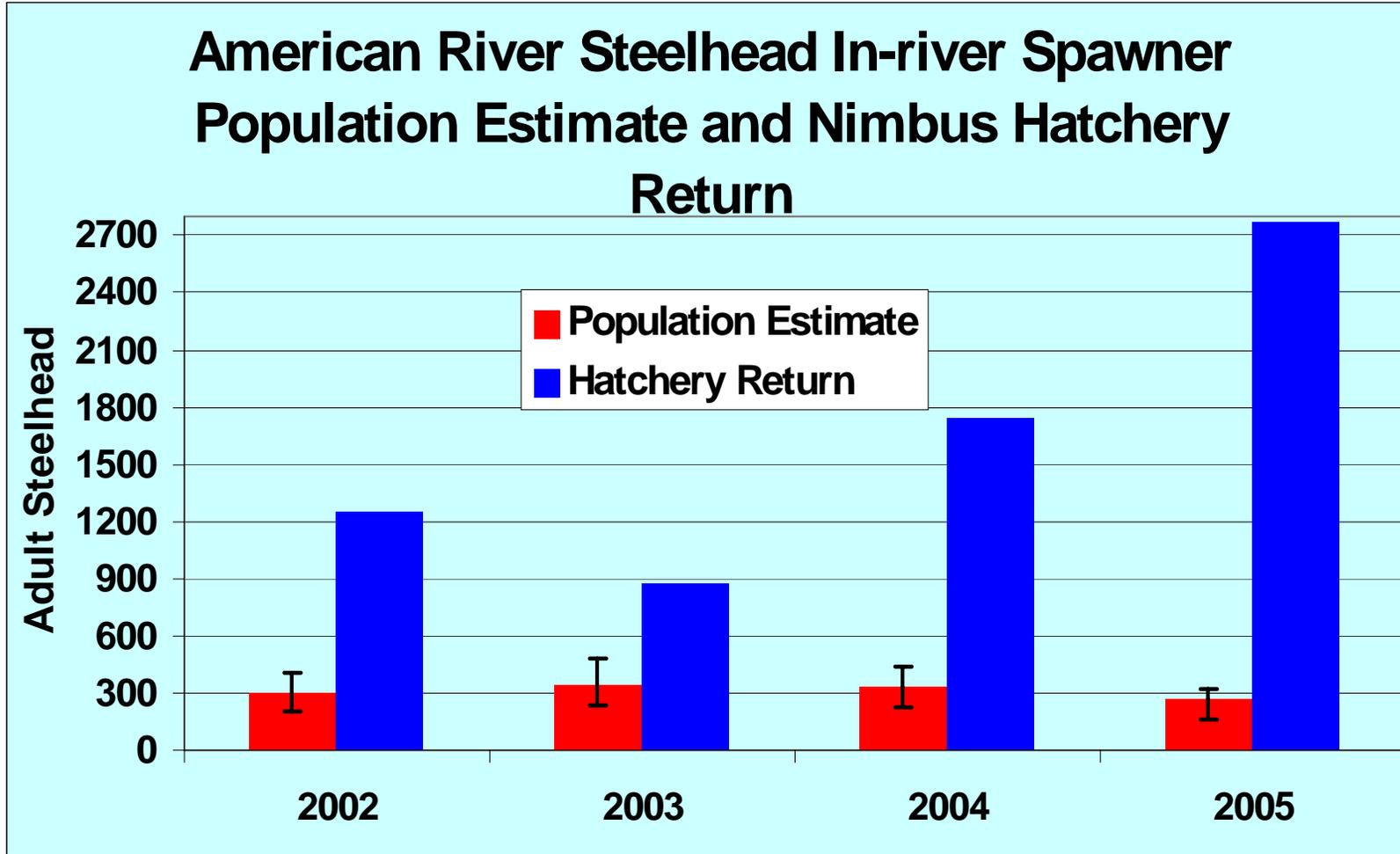
- 65F from Fish Barrier Dam to Robinson's Riffle June 1 – Sept. 30
- Goal: protect over-summering steelhead and early returning salmon
- Thermolito Afterbay warming effect on mainstem, only 5 miles of Low Flow Channel controllable



American River

- 68F target at Watt Ave., recognizes 65 F can not be achieved due to physical constraints
- Goal: balance summer-time life history needs of steelhead with fall-run Chinook spawning
- Steelhead pop. stable but dependant on Nimbus Hatchery





Source: John Hannon, USBR, American R. Steelhead Spawning Reports, 2001-2005



Steelhead Distribution

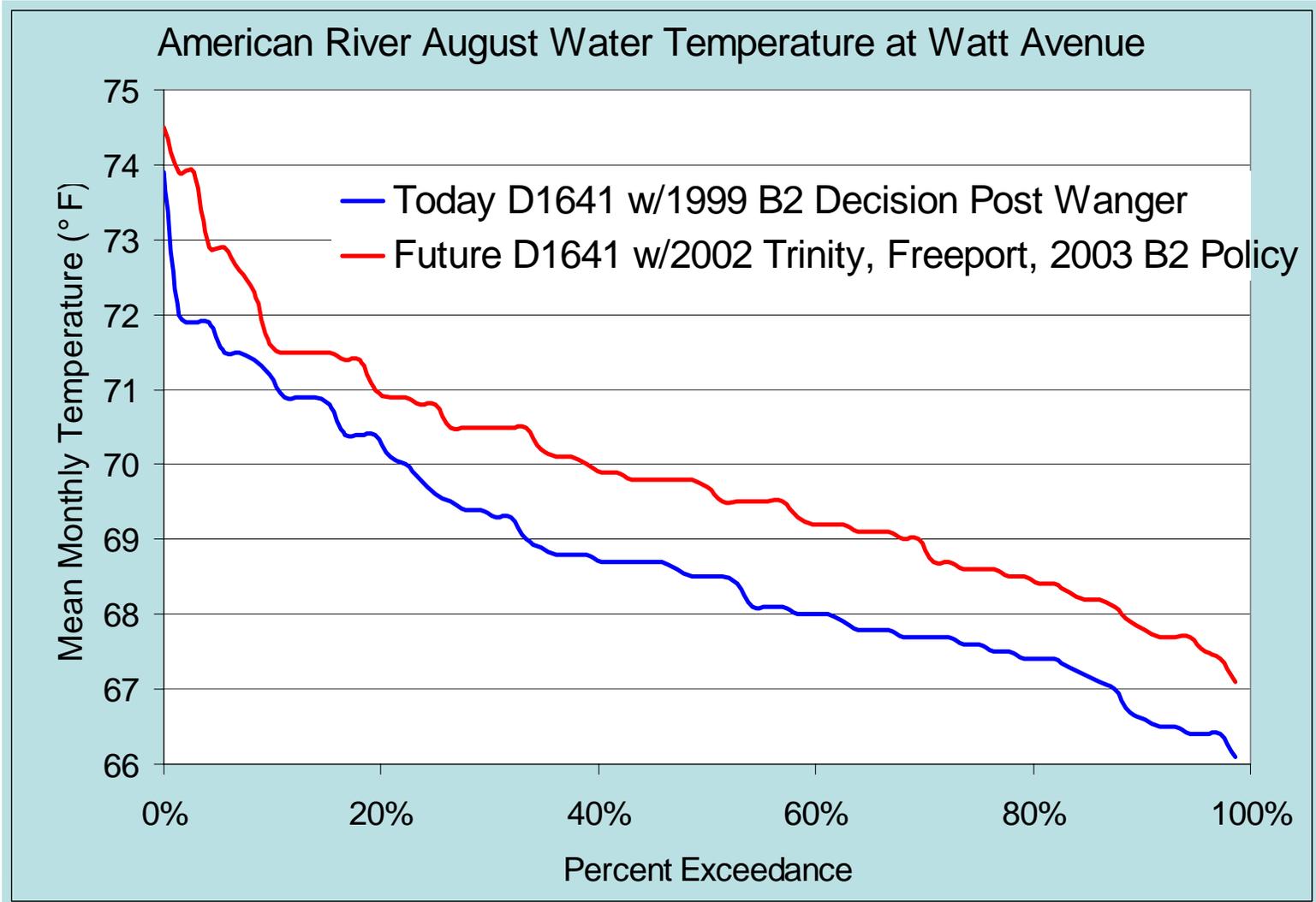
American River Steelhead redd distribution

Reach	Miles	Total 2002-2005	Average Redds/mile	Total %
Above weir				
Nimbus to Sunrise bridge	2.86	243	28	35%
Sunrise to Ancil Hoffman	4.73	125	11	18%
Ancil Hoffman to Goethe bike bridge	1.89	57	12	8%
Arden Rapids (Goethe bridge) to Watt bridge	4.1	113	9	16%
Watt to Fairbairn water intake	2.02	5	2	1%
Fairbairn to H Street bridge	0.75	0	0	0%
H Street bridge to Paradise Beach	1.09	14	6	2%
Paradise Beach to 16th st	3.49	0	0	0%
16th st to Sacramento River	2.01	0	0	0%
Total	22.94	699	8	100%



Most spawning occurs above Watt Ave

Predicted Water Temperatures in 2004



American R. Process & Strategy

- Similar to Sac. R, Ops Group provides input based on limited cold water pool
- 700 TAF May storage target in Folsom
- Temp. Control Plan approved by May 1
- 3 shutter pulls/year and blending temps
- Reserve cold water for summer, if we can't do better than 68 F, save last for Fall-run



Stanislaus River

- 65 F criteria at Orange Blossom Road from June 1 – Nov 30
- Goal: protect over-summering steelhead
- 25 miles of suitable habitat below Goodwin
- No TCD, only knob is $>$ flows
- Coordination with DFG, FWS (D-1641, CVPIA, New Melones Interim Plan of Operations)



Clear Creek

- 60 F at Igo from June 1 - Sept 15, protects over-summering steelhead & holding spring-run adults
- 56 F at Igo from Sept 15 – Oct 31 spring-run spawning
- No TCD, only > flows
- Steelhead & spring-run pop. > due to Saeltzer Dam removal
- Temps > due to less Trinity R water moving thru Whiskeytown Reservoir



San Joaquin River Strategy

- Tributary releases during VAMP (April 15 to May 15) provide cooler water for juvenile steelhead & salmon
- Unofficial 70 F cutoff (in Delta) for VAMP actions

San Joaquin River Spring-run Re-introduction

- 150 miles upstream in July & August
- August mean 79 F, max/min 83/ 73F
- September mean 77 F, max/min 83/ 73F
(1875 Report of the Commissioners of Fisheries)

- August mean 79 F, max/min 85/74F
- September mean 72 F, max/min 78/ 67F
(2005 CDEC data Hwy 99 Bridge near Fresno)