**From:** Milligan, Ronald [mailto:rmilligan@usbr.gov]
**Sent:** Friday, June 26, 2015 3:01 PM
**To:** Howard, Tom
**Cc:** Ren_Lohoefener@fws.gov; Garwin.Yip@noaa.gov; Messer, Dean@DWR; Castleberry, Dan@fws; Rabin, Larry@fws.gov; Wilcox, Carl@Wildlife; Stein, Russell@DWR; Kim_S_Turner@fws.gov; Leahigh, John@DWR; Bonham, Chuck@Wildlife; Murillo, D@USBR; William Stelle; Candice M A Davidson; pfujitani@usbr.gov; Cowin, Mark@DWR; ekiteck@usbr.gov; twashburn@usbr.gov; Shane Hunt; Fry, Susan@USBR; Idlof, Patti@usbr.gov; PABLO ARROYAVE; Grober, Les@Waterboards; Riddle, Diane@Waterboards
**Subject:** Re: Continued Drought Response Measures under FWS BiOp

Tom,

Please find attached the Revised Sacramento River Temperature Plan that Reclamation has submitted to the National Marine Fisheries Service as part of our ongoing Drought Contingency Planning to protect winter-run Chinook salmon, as outlined in the 2009 Biological Opinion. Also find attached additional biological fishery information associated with the proposed revised Sacramento River operations, and additional summary temperature model output used to inform the revised temperature management strategies.

This revised plan is consistent with the June 16 "Key Components" discussed last week amongst the agencies, and that was publically announced last week. Reclamation now requests your approval of the attached plan as required by your communications suspending the previous plan and by State Board Order 90-5. In the interim, we continue to conduct temperature management actions consistent with proposed plan and in close coordination with the Federal and State fishery agencies, and State Board staff.

We appreciate the hard work by your staff in assisting us in crafting a new plan, and in working through this difficult water year.

Ron Milligan
CVP Operations Manager
US Bureau of Reclamation

**Attachment 1**

**Revised Sacramento River Water Temperature Management Plan**
**June 2015**

In May 2015, the U.S. Bureau of Reclamation (Reclamation) prepared a Sacramento River Temperature Management Plan for Water Year 2015 pursuant to the National Marine Fisheries Service (NMFS) 2009 Biological Opinion, and the State Water Resources Control Board (State Water Board) Order 90-5. Subsequent to approval of that plan, ongoing reservoir temperature monitoring at Shasta Lake have indicated reservoir water temperatures higher than expected based on the data used to develop the May Plan. These increased lake temperatures are significant enough that a revised plan is warranted to best manage the limited cold-water resource at Shasta Lake.

Reclamation, in coordination with NMFS, the U.S. Fish and Wildlife Service (USFWS), the California Department of Water Resources (DWR), the California Department of Fish and Wildlife (CDFW), and the State Water Board, has modified the previous Shasta Temperature Management Plan to better utilize the current cold-water resource and manage the seasonal temperature risks to winter-run Chinook salmon. This document outlines the components of that plan, including revised base schedule of releases at Keswick Dam, an adjusted temperature targeting strategy, additional real-time temperature management, additional fishery monitoring, and commitment to a review of modeling tools.

## A. Shasta Temperature Management Plan Objectives

- Fishery objectives:
    - Attain river temperatures of 57°F at the CCR gage location, not to exceed 58°F unless going above is needed to conserve cold water pool based on real-time temperature management team guidance. This team will follow a rigorous real-time management process (see below) that carefully tracks river temperatures, air temperatures, and biological metrics to ensure that water releases are made to optimize the limited cold water pool resources throughout the season.
    - The team will also monitor in real-time temperatures near the Highway 44 bridge to assess what temperatures the majority of redds are actually exposed to (assuming spawning will be at or upstream of the Highway 44 bridge).
    - Monthly adjustments to the base operations that meet the above temperature objective and delays last TCD side gate operation until mid-October (target October 15$^{th}$).

- Minimize the potential for fall-run Chinook redd dewatering in October and November due to flow reductions.

- Retain integrated system operations and flexibility for local solutions:
    - Meet modified Delta objectives (outflow and salinity) as requested in the current TUCP for Water Year 2015 operations.
    - Work to manage south of Delta exports to achieve San Joaquin Valley refuge management objectives based on allocations and delivery timing.
    - Commit to working with Sacramento River Settlement contractors and other river diverters in real-time to minimize water supply impacts.
    - Minimize effects to any non-CVP water users (e.g., State Water Project, Feather River service area contractors, or other system operators).
    - Release accumulated transfer water from Shasta Reservoir in October through November 15 whenever ambient air temperatures recede and river temperatures are suitable. This volume of water is incorporated into the current forecasted operations.
    - Reshape and augment project releases in late October, November, and December (consistent with fall-run Chinook needs) in order to facilitate waster exchanges and meet critical needs South of Delta. This volume is not currently included in our CVP operations forecast, and would be in addition to releases identified. The overall volume of water used to augment the current schedule would range up to 150,000 acre-feet.
    - Flexibly implement the Coordinated Operations Agreement in order to achieve overall system goals.

B. **Shasta Temperature Management Plan Base Operations**

- Establish 7,250 cubic feet per second (cfs) as a base flow from Keswick Dam in June and July.
- Modeled Keswick releases in other months that achieve the above objectives are: August: 7,250 cfs; September: 6,500 cfs; October: 5,000 cfs. These are subject to adjustment by the Real-Time Operations Team based on performance of the plan in June and July.

Attachment 1a includes estimated temperatures under the plan for both the 50% and 10% exceedance forecasts of meteorology provided by the National Weather Service in May. Attachment 1a also includes the latest operational forecast using the proposed Keswick releases noted above.

C. **Shasta Temperature Management Plan Real-time Management**

The criteria described above are guidelines for base operations--actual operations will be decided using a real-time monitoring and decision making process that includes representatives from the relevant Federal and State agencies. This decision making process may yield adjustments to base operations depending on real-time conditions including real-time river temperatures, resulting cold water pool volumes, and observed spawning timing and location.

Reclamation will convene the real time real-time monitoring and decision making group at least weekly, and more frequently if necessary inform decisions about temperature operations. The State and Fereral agencies also acknowledge the expertise of local water districts and irrigation districts to operate their systems in partnership with the agencies to optimize results and minimize impacts. The agencies expect to work closely during real-time operations with such districts.

Decisions on real-time adjustments to base operations will be made using the following principles:

- Attaining temperatures as close to 57°F as possible at the CCR gate, while monitoring in real-time temperatures near the Highway 44 bridge (SAC gage) to assess what temperatures the majority of redds are actually exposed to (assuming spawning will be at or upstream of the Highway 44 bridge).

- Based on projected temperatures, and if it appears that they will exceed 58°F at CCR, Reclamation will call a meeting to determine what actions are most advisable given salmon life-stage and projected ability to withstand additional adverse effects of temperatures. Actions which could be implemented include: TCD gate changes, bypassing power and other operational adjustments, allowing short-term exceedances above 58°F at CCR as long as night-time temperatures are low, and possibly increasing Keswick releases above 7,250 cfs. Releases above the base flow have a negative cumulative effect on thermal mass, cold water and possible timing of side gate operations, and therefore require careful consideration.

- Because overall seasonal temperature management, and most importantly the timing of future side gate operations, appears very sensitive to managing through heat waves, additional consideration will be given to optimal procedures for longer heat spells which are most likely to occur in July or early August.

- If air temperatures are cooler, and 57°F is attainable at the CCR location, real-time adjustments may be made to reduce Keswick releases at times below 7,250 cfs in order to conserve thermal mass and cold water for later in the season, as long as 58°F at CCR is not exceeded.

- CDFW will monitor observed redd locations, particularly the most downstream redd and redds at risk of being dewatered and report results on a weekly basis. While this is not a comprehensive survey due to redds that are in deep water above Highway 44, it will provide a general distribution of redds. It will also provide a way of tracking the duration and peak of spawning which will inform temperature management decisions.

- NMFS will track temperature exposures and report on cumulative estimated mortalities on at least a bi-weekly basis. NMFS is also in the process of deploying new automated temperature fiber optic cables behind Shasta Dam and within Keswick Reservoir.

**D. Additional Monitoring Commitments:**

- Reclamation and NMFS will deploy new automated temperature fiber optic cables in Shasta Lake and within Keswick Reservoir to help inform management decisions.

- Reclamation will monitor temperatures near the Highway 44 Bridge (SAC gage) to assess what temperatures the majority of winter-run redds are actually exposed.

- The agencies will monitor weather conditions and forecasts, and adjust releases and TCD gate operations accordingly. For example:

    - The River Assessment for Forecasting Temperature (RAFT) model will be used to better anticipate the need for management actions and help predict effectiveness of different real-time operations options.

    - Seasonal temperature management appears to be very sensitive to short-term heat-storms, so the agencies will devise optimal procedures for longer heat spells (most likely to occur in July).

    - If air temperatures from June through August are substantially below what was forecast, there may be additional opportunities to increase releases in September and October for other purposes, while still meeting temperature objectives.

- CDFW will monitor observed redd locations, particularly the downstream distribution of redds, throughout the temperature management season, and those redds at potential risk of being dewatered as flows are ramped down in the fall.

- The agencies will meet as often as needed to share and review information, and/or make real-time decisions or adjustments, but no less than weekly.

**E. Commitment to advance new peer reviewed temperature model review**

- NMFS and Reclamation will co-chair a new model review technical working group that will identify limitations with the existing modeling tools and will make recommendation about short-term fixes to the current tools or defer changes to new model development efforts.

- In addition, Reclamation and NMFS-Southwest Fisheries Science Center are working on a multiyear effort to develop a Temperature Decision Support Tool that includes a reservoir temperature model coupled with the existing River Assessment for Forecasting Temperature (RAFT) model[1] that forecasts downstream river temperatures using real-time meteorological conditions. This model may have some applicability for forecasting water temperatures resulting from differing operational choices.

- Future efforts will incorporate NOAA Climate Prediction Center forecasts, NOAA National Weather Service assistance, and a broader range of meteorology as input to future model runs, rather than the median projections used in 2014 and prior years.

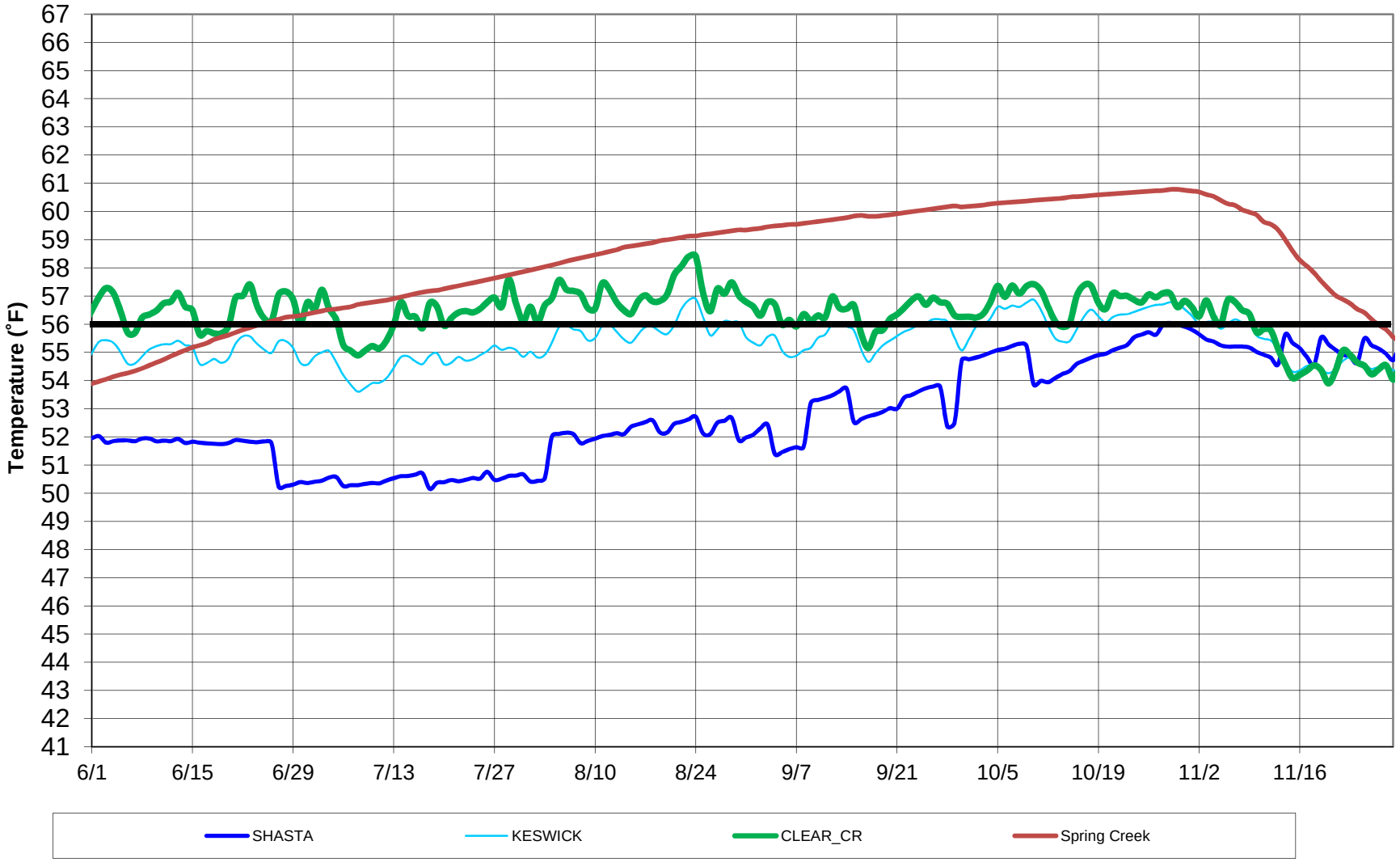
- The agencies will develop a plan for independent peer review of these models and tools.

- Through all of these steps, the agencies can and will improve on temperature management from here forward to more accurately project TCD operations and downstream river temperatures to manage potential effects on listed and special status species.

[1] http://oceanview.pfeg.noaa.gov/RAFT/stream.html

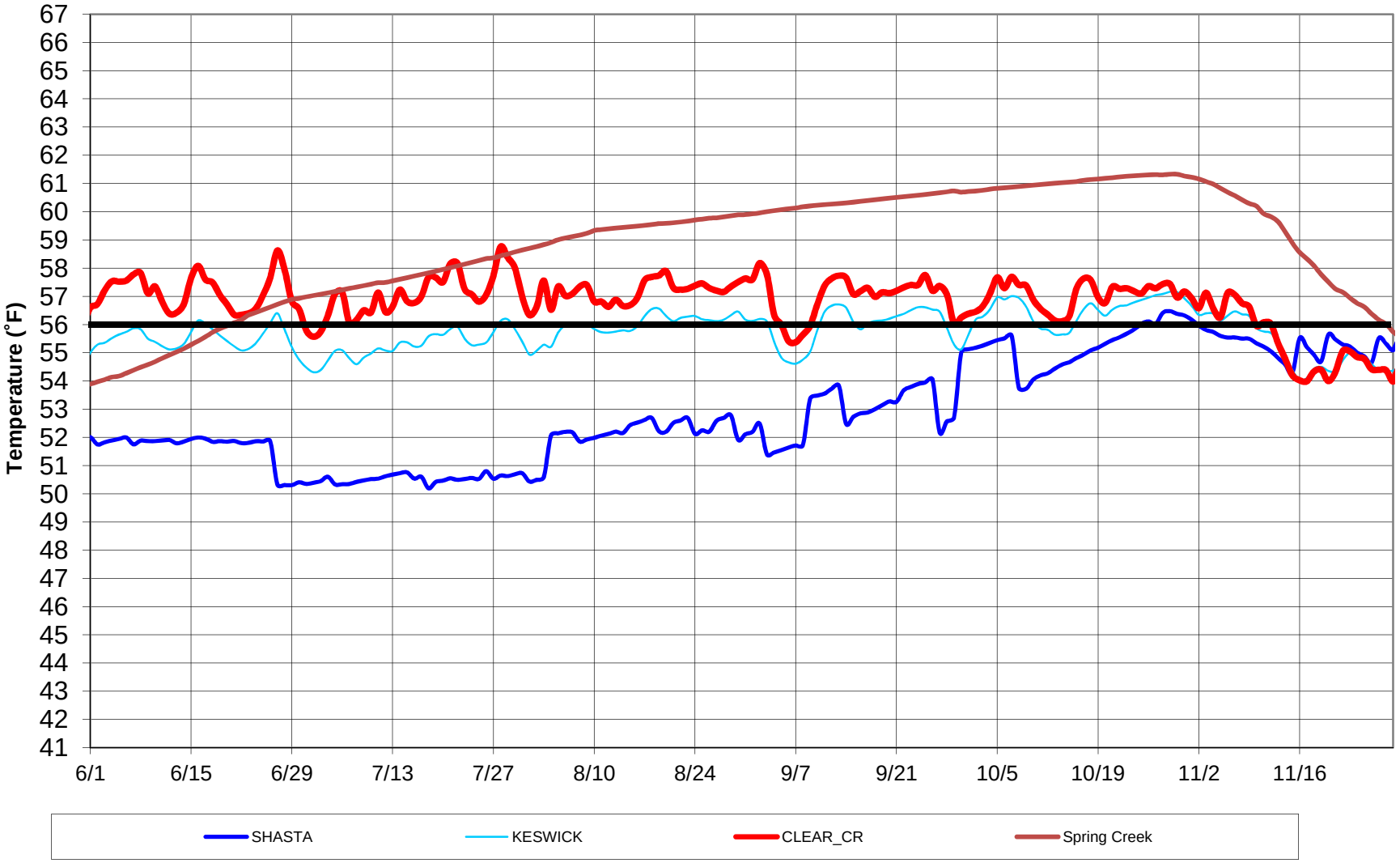
| | Kes 7250 50% L3MTO 57 degree at CCR | Kes 7250 10% L3MTO 57 degree at CCR | WY 2014 Actual Data |
|---|---|---|---|
| Flows June, July and Aug | 7250 | 7250 | 8900, 9100,7700 |
| Sept and Oct Keswick flows | 6500, 5000 | 6500, 5000 | 5600, 4500 |
| Nov and Dec | 4000 | 4000 | 4200, 3300 |
| First Side Gate Used | July 7 | July 6 | Aug 7 |
| Primary Reliance of Side Gate | Oct 11 | Oct 9 | Aug 26 |
| | | | |
| End of August Volume < 54 degree | 444 TAF | 444 TAF | 315 TAF |
| End of August Volume < 52 degree | 349 TAF | 344 TAF | 278 TAF |
| End of August Volume < 50 degree | 229 TAF | 225 TAF | 241 TAF |
| End of September Volume < 54 degree | 207 TAF | 207 TAF | 108 TAF |
| End of September Volume < 52 degree | 204 TAF | 200 TAF | 97 TAF |
| End of September Volume < 50 degree | 74 TAF | 74 TAF | 72 TAF |

**Sacramento River Modeled Temperature**
**2015 May 90%-Water Ops Outlook - 50% L3MTO (May)**
**Approximately 57 degree at CCR - Kes at 7,250 cfs**




6/25/2015

**Sacramento River Modeled Temperature**
**2015 May 90%-Water Ops Outlook - 10% L3MTO (May)**
**Approximately 57 degree at CCR - Kes at 7,250 cfs**




6/25/2015

**Estimated CVP Operations Jun 90% Exceedance - 7250 cfs Keswick Jun, Jul, Aug**
**Revised Sacramento River Temperature Plan**

## Storages

### Federal End of the Month Storage/Elevation (TAF/Feet)

| | | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|
| **Trinity** | **1024** | **870** | **745** | **620** | **530** | **499** | **467** | **451** |
| | Elev. | 2240 | 2224 | 2205 | 2190 | 2185 | 2178 | 2175 |
| **Whiskeytown** | **239** | **238** | **238** | **238** | **230** | **206** | **206** | **206** |
| | Elev. | 1209 | 1209 | 1209 | 1207 | 1199 | 1199 | 1199 |
| **Shasta** | **2404** | **2196** | **1943** | **1687** | **1460** | **1379** | **1388** | **1413** |
| | Elev. | 968 | 954 | 938 | 923 | 917 | 917 | 919 |
| **Folsom** | **535** | **433** | **238** | **136** | **120** | **126** | **139** | **161** |
| | Elev. | 408 | 375 | 349 | 343 | 345 | 350 | 357 |
| **New Melones** | **453** | **388** | **323** | **265** | **238** | **216** | **211** | **206** |
| | Elev. | 832 | 815 | 798 | 789 | 781 | 780 | 778 |
| **San Luis** | **305** | **220** | **100** | **24** | **1** | **20** | **11** | **99** |
| | Elev. | 443 | 410 | 380 | 367 | 367 | 383 | 413 |
| **Total** | | 4345 | 3587 | 2970 | 2579 | 2446 | 2421 | 2535 |

### State End of the Month Reservoir Storage (TAF)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Oroville** | **1565** | **1346** | **1115** | **954** | **911** | **901** | **793** | **738** |
| | Elev. | 712 | 681 | 657 | 650 | 648 | 630 | 620 |
| **San Luis** | **786** | **679** | **502** | **351** | **283** | **266** | **382** | **534** |
| **Total San Luis (TAF)** | **1091** | **900** | **602** | **374** | **284** | **286** | **393** | **633** |

## Monthly River Releases (TAF/cfs)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Trinity** | TAF | 47 | 28 | 28 | 27 | 23 | 18 | 18 |
| | cfs | **783** | **450** | **450** | **450** | **373** | **300** | **300** |
| **Clear Creek** | TAF | 9 | 7 | 5 | 9 | 11 | 10 | 11 |
| | cfs | **150** | **120** | **85** | **150** | **175** | **175** | **175** |
| **Sacramento** | TAF | 431 | 446 | 446 | 387 | 307 | 238 | 246 |
| | cfs | **7250** | **7250** | **7250** | **6500** | **5000** | **4000** | **4000** |
| **American** | TAF | 134 | 222 | 126 | 30 | 31 | 30 | 31 |
| | cfs | **2250** | **3615** | **2043** | **501** | **500** | **504** | **501** |
| **Stanislaus** | TAF | 9 | 9 | 9 | 9 | 35 | 12 | 13 |
| | cfs | **150** | **150** | **150** | **150** | **577** | **200** | **206** |
| **Feather** | TAF | 142 | 160 | 101 | 57 | 58 | 57 | 58 |
| | cfs | **2387** | **2600** | **1650** | **950** | **950** | **950** | **950** |

## Trinity Diversions (TAF)

| | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|
| **Carr PP** | 116 | 98 | 97 | 62 | 15 | 28 | 19 |
| **Spring Crk. PP** | **110** | **90** | **90** | **60** | **30** | **19** | **12** |

## Delta Summary (TAF)

| | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|
| **Total Export** | 59 | 30 | 38 | 141 | 196 | 161 | 277 |
| **Old/Middle River Std.** | | | | | | | |
| **Old/Middle R. calc.** | -1,215 | -832 | -937 | -2,276 | -2,531 | -2,330 | -3,721 |
| **Computed DOI** | 4001 | 3000 | 3000 | 3009 | 4197 | 5093 | 4994 |
| **Excess Outflow** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **% Export/Inflow** | 10% | 5% | 7% | 27% | 35% | 31% | 47% |
| **% Export/Inflow std.** | 35% | 65% | 65% | 65% | 65% | 65% | 65% |

## Hydrology

| | Trinity | | Shasta | | Folsom | New Melones |
|---|---|---|---|---|---|---|
| **Water Year Inflow (TAF)** | 877 | | 3,468 | | 864 | 314 |
| Year to Date + Forecasted % of mean | 73% | | 63% | | 32% | 30% |

6/25/2015