UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

FEB 2 7 2015

Mr. Ron Milligan
Operations Manager, Central Valley Project
U.S. Bureau of Reclamation
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Dear Mr. Milligan:

Thank you for the opportunity to review the U.S. Bureau of Reclamation's (Reclamation) initial February forecast and water supply allocation for water year 2015. Your February 20, 2015, letter and enclosures included 90 and 50 percent exceedence forecasts, water temperature modeling, and this year's initial water supply allocations. This information is reviewed prior to the first water supply allocation of the year for purposes of compliance with reasonable and prudent alternative (RPA) Action I.2.3 (page 23 of the 2009 RPA with 2011 amendments[1]) in NOAA's National Marine Fisheries Service's (NMFS) biological opinion (issued June 4, 2009) on the long-term operations of the Central Valley Project (CVP) and State Water Project (SWP, CVP/SWP Opinion). The objective of using the February 90 percent exceedence forecast is to use the most conservative forecast as early as possible to protect the cold water pool in Shasta Reservoir so that suitable spawning habitat can be maintained in the Sacramento River during the summer and fall seasons for federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*).

NMFS has reviewed Reclamation's preliminary CVP operations forecasts and corresponding water temperature model runs (enclosure 1) for the Sacramento River, based on the latest reservoir profiles, inflows, and snow surveys. The forecast is based on estimated runoff within the Sacramento River basin as of February 1, 2015. The Sacramento River Valley Index is classified as a Critical water year type, with the forecasted inflow into Shasta Reservoir at 3.31 million acre-feet (MAF) under a 90 percent exceedence forecast, and 4.45 MAF under a 50 percent exceedence forecast. The projected end-of-September (EOS) carryover storage in Shasta Reservoir is forecasted to range between 1.32 MAF in the 90 percent exceedence forecast and 1.95 MAF in the 50 percent exceedence forecast. The resulting water temperature model run based on the 90 percent forecast indicates that a Clear Creek temperature compliance point may be possible through September, with several exceedances, but not achievable throughout the winter-run and spring-run Chinook salmon spawning and incubation period (*i.e.*, May 15 through October 31). Based on the projected EOS storage in Shasta Reservoir below 1.9 MAF and

---

1 http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf

temperature model runs in the 90 percent exceedance forecast, NMFS agrees with Reclamation that RPA Action I.2.3.C should be implemented this year.

The CVP/SWP Opinion, RPA Action I.2.3.C requires that a contingency plan be developed by March 1st. Reclamation and the California Department of Water Resources (DWR) have already taken initial steps by submitting a Temporary Urgency Change (TUC) Petition to the State Water Resources Control Board (SWRCB) on January 23, 2015. The TUC Petition allows for flexibility in water project operations by modifying certain water quality standards required in Water Rights Decision 1641. The TUC Petition provided in the basis for a project description that Reclamation submitted to NMFS on January 27, 2015, as an interim contingency plan. In a January 29, 2015, response letter[2], NMFS concurred that the interim contingency plan, as proposed, was consistent with RPA Action 1.2.3.C and meets the specified criteria for a drought contingency plan.

Reclamation's initial water supply allocations based on the 90 percent exceedence forecast include the following: 0 percent to North of Delta (NOD) agricultural water service contractors, 75 percent to NOD refuges, 75 percent to Water Rights Settlement Contractors, 40-75 percent to Water Rights Exchange Contractors, 0 percent to South of Delta (SOD) agricultural contractors, and 75 percent to SOD refuges. Pursuant to RPA Action I.2.2.B, and in order to balance the need to conserve storage for temperature requirements this summer with water quality requirements in the Delta, Keswick releases were reduced to the minimum allowed [3,250 cubic feet second (cfs)] for most of the time period from December through February.

In light of the high mortality (95%) associated with water temperatures observed in 2014 for juvenile winter-run Chinook salmon that spawned in upper Sacramento River, it is critically important to improve the accuracy of water temperature forecasting, and specifically Reclamation's temperature model. Also at issue is the performance of the Temperature Control Device when Shasta storage levels reach the lowest outlets. A consistent recommendation from the independent review panels pursuant to the annual reviews of the CVP/SWP Opinion has been to calibrate temperature forecasts to reduce uncertainty. Therefore, the model needs to be recalibrated to accurately reflect operations during drought year conditions. NMFS is committed to providing assistance in temperature modeling as described in the CVP/SWP Drought Contingency Biological Monitoring Plan for WY 2015[3].

It is also important to conserve storage in Shasta Reservoir, and specifically the cold water pool, in order to provide for the needs of winter-run eggs and alevin throughout the temperature management season. On February 23, 2015, staff from Reclamation and NMFS met to discuss the forecasts and temperature model results, likelihood of meeting the Clear Creek temperature compliance point, and concerns regarding the temperature model. Based on NMFS' request, Reclamation agreed to provide an additional 90% exceedance forecast and subsequent temperature model run that includes the following considerations: (1) limiting flows at Wilkins Slough to no more than 3,800 cfs; (2) delayed depletions by Sacramento Settlement Contractors for their spring flood up; and (3) incorporation of potential changes that Reclamation and DWR

---

[2] http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/20140131_nmfs_contingency_plan_response_letter_with_enclosures.pdf

[3] http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf

will likely request from the SWRCB for April through July in a TUC Petition. On February 25, 2015, Reclamation provided results from the additional 90% exceedance forecast and temperature model run (enclosure 2). The temperature model run indicates that a temperature compliance point at Clear Creek may be achievable throughout the temperature management season (until October 31), with limited exceedances (in duration and magnitude). However, these modeling results should be interpreted with caution due to previous experience of the model significantly underestimating actual conditions.

In consideration of the concerns associated with Reclamation's temperature model, NMFS and Reclamation are making a commitment to co-lead a new technical team to improve Reclamation's ability to accurately forecast water temperatures in the upper Sacramento River. Reclamation and NMFS developed an initial strategy for this team to improve current temperature analysis (enclosure 3). The team will recommend changes in modeling and interpretation of model results in the short-term (this year) and also recommend an approach for longer-term changes (next year and beyond). Additional temperature modeling and monitoring may be necessary this year to better forecast water temperatures and protect winter-run eggs and alevin.

As you know, the SWRCB's February 3, 2015, Order requires Reclamation to submit a temperature management plan to the Sacramento River Temperature Task Group (SRTTG) for review no later than March 15, 2015, with updates as necessary to reflect changing conditions. NMFS expects the draft temperature management plan, along with updated 50% and 90% exceedance forecasts and temperature model runs, to be submitted to NMFS for concurrence. The Order also requires Reclamation to meet weekly with the SRTTG to discuss operations and options for reducing or avoiding redd dewatering, stranding and temperature impacts to winter-run Chinook salmon. NMFS expects updates of these discussions through technical team notes, which were lacking in water year 2014. As a reminder, the RPA, section 11.2.1.1 states that, "Brief notes of each meeting shall be recorded, including issues considered, recommendations made, and key information on which recommendations were based. Meeting notes shall be distributed to members within two days of the meeting."

NMFS concurs with Reclamation's draft February forecast and initial water supply allocations, based on the following consideration and provisions:

- This concurrence is limited to the February 90% exceedance forecast as it pertains to Shasta operations pursuant to RPA Action I.2.3.C. NMFS acknowledges concerns with operations of Folsom and New Melones reservoirs that will need to be addressed with Reclamation.
- Reclamation will update these forecasts with revised hydrology, temperature modeling, and interpretation of temperature modeling by Mid-March (a coordinated submittal to NMFS and the SWRCB is encouraged). Specifically, NMFS is interested in developing an upper and lower bound Keswick release schedule for the 90% and 50% exceedances similar to the April 2014 Drought Operations Plan, with the goal of extending temperature control throughout the season.
- Reclamation will continue to work with the Sacramento Settlement Contractors to re-schedule water and delay their spring flood up depletions from the Sacramento River.

- Reclamation will relax the Wilkins Slough navigation criteria to at most 3,800 cfs. NMFS may be interested in further relaxations of Wilkins Slough in order to support conservative Keswick release schedules.
- Reclamation (and DWR) will issue a TUC Petition, as appropriate, to the SWRCB to relax some of the D-1641 Delta requirements for April and beyond in order to conserve storage in Shasta Reservoir.
- Reclamation will co-lead with NMFS a new temperature modeling workgroup and will make needed investments in forecasting and temperature modelling in order to improve predictability of February forecasts.
- In consideration of the temperature modeling concerns in 2014, and potential water temperature issues in 2015 in the upper Sacramento River, NMFS incorporates by reference the winter-run contingency plan, provided as Attachment G of Reclamation's and DWR's drought operations Plan, issued on April 8, 2014[4].
- The Executive Director of the SWRCB issued a TUC Petition Order on February 3, 2015[5]. Terms and conditions provided within the Order include requirements pursuant to SWRCB Order WR 90-5, including: hindcast temperature modeling for 2014; a 2015 temperature management plan for the Sacramento River for the 2015 winter-run Chinook salmon spawning and rearing period to be submitted to the SRTTG for review no later than March 15, 2015; and weekly meetings of the SRTTG to discuss operations and options for reducing or avoiding redd dewatering, stranding and temperature impacts to winter-run Chinook salmon. NMFS reiterates these requirements, including our expectation that the temperature management plan be submitted to NMFS for concurrence, and expects that the results from these efforts will better inform Shasta operations and broodyear 2015 winter-run throughout the temperature management season.
- Notes from SRTTG meetings shall be taken, distributed to the SRTTG for review and comment within 2 days following each meeting, and subsequently finalized.

Thank you for the recent discussions with your staff in meeting the initial 2015 February forecast requirements in the CVP/SWP Opinion. I look forward to further communication between our agencies to fully meet the requirements provided in RPA Action I.2.3.C of the CVP/SWP Opinion. If you have any questions regarding this letter, please feel free to contact me, or have your staff contact Mr. Bruce Oppenheim at (916) 930-3603, or via e-mail at bruce.oppenheim@noaa.gov.

Sincerely,

Maria C. Rea

Maria C. Rea
Assistant Regional Administrator
California Central Valley Area Office

[4] http://www.water.ca.gov/waterconditions/docs/2014-Operations-Plan.pdf
[5] http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order020315.pdf

Enclosures:

1: February 20, 2015, 50 and 90 percent operations forecasts and preliminary temperature analysis
2. February 25, 2015, 90 percent operations forecast and preliminary temperature analysis
3. Strategy to Improve Current Temperature Analysis Capabilities

cc: Copy to file – ARN 151422SWR2006SA00268
Seth Naman, NMFS, Arcata, California
Sue Fry, Reclamation, Bay-Delta Office, 801 I St., Suite 140, Sacramento, California 95814
Scott Ligare, SWRCB, 1001 I St, Sacramento, California 95814
Chad Dibble, CDFW, Water Branch, 830 S St., Sacramento, California 95811
John Lealigh, CDWR, 3310 El Camino Ave, Sacramento, California 95821-9000
Roger Guinee, Craig Anderson, USFWS, 650 Capitol Mall, Suite 5-100, Sacramento, California 95814

90%

Storages

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

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	874	1112	1177	1178	1017	908	806	702	642	611	578	562	570
	Elev.	2267	2274	2274	2257	2244	2232	2217	2209	2204	2198	2196	2197
Whiskeytown	205	206	206	238	238	238	238	238	230	206	206	206	206
	Elev.	1199	1199	1209	1209	1209	1209	1209	1207	1199	1199	1199	1199
Shasta	2001	2671	2856	2746	2471	2169	1766	1471	1324	1299	1345	1416	1537
	Elev.	993	1001	996	983	967	943	923	912	911	914	919	928
Folsom	448	542	559	554	549	465	293	224	192	182	177	181	196
	Elev.	422	424	423	423	412	386	373	365	362	361	362	366
New Melones	563	600	559	488	385	299	206	119	63	49	54	61	63
	Elev.	878	870	855	831	808	778	741	707	696	700	706	707
San Luis	347	372	392	366	313	219	103	23	72	163	196	324	505
	Elev.	479	475	459	439	414	387	366	369	388	411	443	473
Total		5502	5750	5570	4973	4297	3412	2777	2523	2510	2556	2750	3076

State End of the Month Reservoir Storage (TAF)

Oroville	1444	1740	1828	1761	1633	1408	1176	1012	971	964	871	865	943
	Elev.	757	766	759	745	720	690	666	660	659	643	642	655
San Luis	756	900	839	702	555	423	323	255	227	271	420	578	721
Total San Luis (TAF)	1103	1272	1231	1068	868	642	426	278	299	434	617	902	1225

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	32	180	47	28	28	27	23	18	18	18
	cfs	300	300	540	2,924	783	450	450	450	373	300	300	300
Clear Creek	TAF	10	11	9	9	9	7	5	9	11	10	11	11
	cfs	175	175	150	150	150	120	85	150	175	175	175	175
Sacramento	TAF	180	200	350	454	506	589	479	297	251	202	200	200
	cfs	3250	3250	5881	7383	8500	9579	7800	5000	4077	3394	3250	3250
American	TAF	50	49	52	49	98	182	87	48	49	48	50	49
	cfs	900	800	868	800	1645	2964	1418	802	800	800	807	800
Stanislaus	TAF	14	25	30	29	16	19	14	9	35	15	13	18
	cfs	255	403	503	465	270	316	232	153	573	260	205	295
Feather	TAF	53	49	131	49	116	141	108	77	55	54	55	55
	cfs	950	800	2200	800	1950	2300	1750	1300	900	900	900	900

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	2	0	34	18	77	78	77	32	15	28	19	6
Spring Crk. PP	3	9	8	15	70	70	70	30	30	19	12	3

Delta Summary (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy	50	75	45	61	46	45	45	133	146	65	148	200
USBR Banks	0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa	7	7	11.4	11.4	11.4	9.9	10.6	11.4	7	8.4	9.2	9.2
Total USBR	57	82	56	73	57	55	56	144	153	73	157	209
State Export	225	75	18	15	35	45	45	30	75	165	181	200
Total Export	282	157	74	88	92	100	101	174	228	238	338	409
COA Balance	0	0	-22	-22	-64	-55	-48	-38	-38	-38	-39	-39
Old/Middle River Std.												
Old/Middle R. calc.	-4,070	-2,060	-924	-1,216	-1,536	-1,575	-1,636	-2,635	-2,939	-3,302	-4,492	-5,319
Computed DOI	9527	4604	7396	4425	4001	4002	2993	3009	2993	3496	3497	5482
Excess Outflow	2431	602	0	423	0	0	0	0	0	0	0	1985
% Export/Inflow	36%	35%	11%	17%	16%	15%	18%	32%	44%	48%	60%	58%
% Export/Inflow std.	45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	894		3,792		856		248	
Year to Date + Forecasted % of mean	74%		68%		31%		23%	

50% Forecast

Storages

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

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	874	1117	1279	1373	1220	1028	873	751	636	585	579	617	682
	Elev.	2268	2284	2292	2278	2258	2240	2224	2208	2199	2198	2205	2214
Whiskeytown	205	206	206	238	238	238	238	238	230	230	225	206	206
	Elev.	1199	1199	1209	1209	1209	1209	1209	1207	1207	1205	1199	1199
Shasta	2001	2703	3129	3296	3208	2843	2423	2085	1954	1912	1961	2164	2577
	Elev.	994	1013	1020	1017	1001	980	962	955	952	955	967	988
Folsom	448	564	673	704	759	639	450	340	299	298	314	349	424
	Elev.	424	437	440	445	433	410	394	387	387	390	395	406
New Melones	563	600	613	588	532	466	384	308	258	249	269	296	327
	Elev.	878	880	876	864	850	831	810	795	793	799	807	816
San Luis	347	392	512	427	268	141	55	64	135	285	496	657	815
	Elev.	473	483	457	420	385	352	340	353	395	441	472	501
Total		5581	6413	6625	6225	5355	4422	3785	3512	3559	3843	4289	5029

State End of the Month Reservoir Storage (TAF)

Oroville	1444	1790	2055	2185	2083	1891	1677	1515	1447	1412	1393	1458	1715
	Elev.	762	788	800	790	772	750	732	724	720	718	726	754
San Luis	756	825	805	617	426	264	142	73	67	198	391	542	700
Total San Luis (TAF)	1103	1217	1317	1044	694	405	198	136	202	482	887	1200	1514

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	32	258	126	68	28	27	23	18	18	18
	cfs	300	300	540	4,189	2,120	1,102	450	450	373	300	300	300
Clear Creek	TAF	10	11	10	11	9	7	7	9	12	12	11	11
	cfs	175	175	175	175	150	120	120	150	200	200	175	175
Sacramento	TAF	180	200	268	430	666	679	584	369	307	268	200	200
	cfs	3250	3250	4500	7000	11200	11041	9500	6200	5000	4500	3250	3250
American	TAF	50	111	153	98	195	246	170	101	77	74	77	77
	cfs	900	1800	2567	1600	3273	4000	2762	1690	1250	1250	1250	1250
Stanislaus	TAF	14	25	30	29	16	19	14	9	35	15	13	18
	cfs	255	403	503	465	270	316	232	153	573	260	205	295
Feather	TAF	53	58	57	58	89	127	123	89	58	57	58	61
	cfs	950	950	950	950	1500	2070	2000	1500	950	950	950	1000

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	1	3	42	31	93	97	98	91	40	19	1	1
Spring Crk. PP	35	30	23	35	90	90	90	90	30	19	25	25

Delta Summary (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy	60	220	48	49	145	231	278	270	282	270	200	200
USBR Banks	0	0	0	0	11	11	11	0	0	0	0	0
Contra Costa	7	6.35	11.35	11.35	9.9	10.55	11.35	12	8.4	9.2	9.15	7
Total USBR	67	226	59	61	166	253	300	282	290	279	209	207
State Export	200	170	42	43	65	68	74	80	189	235	200	200
Total Export	267	396	101	104	231	321	374	362	479	514	409	407
COA Balance	0	0	-19	-19	-8	1	0	0	0	0	0	0
Old/Middle R. std.												
Old/Middle R. calc.	-3,651	-4,795	-1,265	-1,276	-3,238	-4,243	-4,984	-4,972	-5,934	-6,697	-5,198	-5,131
Computed DOI	23737	18122	10977	7841	7094	4002	2993	3009	3009	3816	9337	13030
Excess Outflow	16641	11013	0	732	0	0	0	0	16	319	5840	9533
% Export/Inflow	17%	26%	11%	14%	27%	38%	47%	51%	63%	65%	41%	35%
% Export/Inflow std.	45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

	Trinity	Shasta	Folsom	New Melones
Water Year Inflow (TAF)	1226	4,547	1,479	513
Year to Date + Forecasted % of mean	101%	82%	54%	49%

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

February 20, 2015

Upper Sacramento River – February 2015 Preliminary Temperature Analysis

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. Operation is based on the February 2015 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90 and50% exceedances.
2. The profiles used for Shasta, Trinity and Whiskeytown were taken on February 3, February 4, and February 3, respectively.
3. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge is not available beyond 5 days. Model input side flows (Cottonwood Cr & Bend Bridge local flow w/o Cottonwood Cr) were selected from the historical record, and are consistent with the forecast exceedance frequency. During spring, the relatively warm creek flows can be a significant percentage of the flows at Bend Bridge.
4. Although mean daily flows and releases are temperature model inputs, they are based on the mean monthly values from the operation outlooks. Mean daily flow patterns are user defined.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period.
6. Meteorological inputs were derived from a database of 86 years of meteorological data (1920-2005). The meteorological inputs in the model represent "Average" meteorological conditions.
7. Meteorology, as well as flow volume and pattern, significantly influences reservoir inflow temperatures and downstream tributary temperatures; and consequently, the development of the cold-water pool during winter and early spring.

Enclosure 1

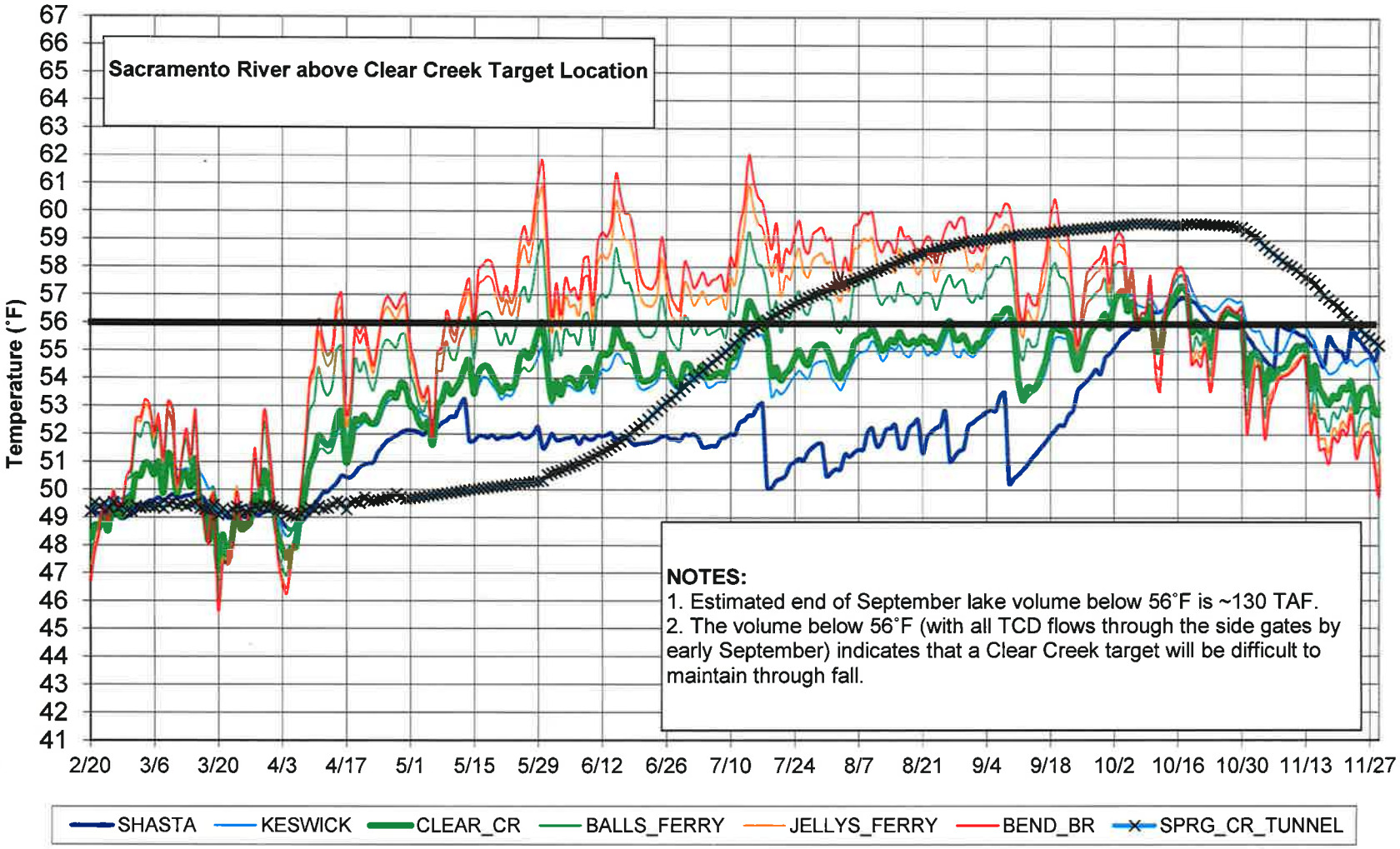
Temperature Analysis Results:

Note that for all exceedances, Lake Shasta storage is too low to utilize the upper gates of the TCD. This TCD limitation, along with the relatively small cold-water pool volume, significantly impacts temperature management.

90%-Exceedance:
A temperature target location at Clear Creek is possible through mid-August or early September (Figure 1). By September, the TCD intake level will be through the side gates. Shasta Dam release temperature is expected to exceed 56˚F by mid-August, nearing 62˚F by mid-September.

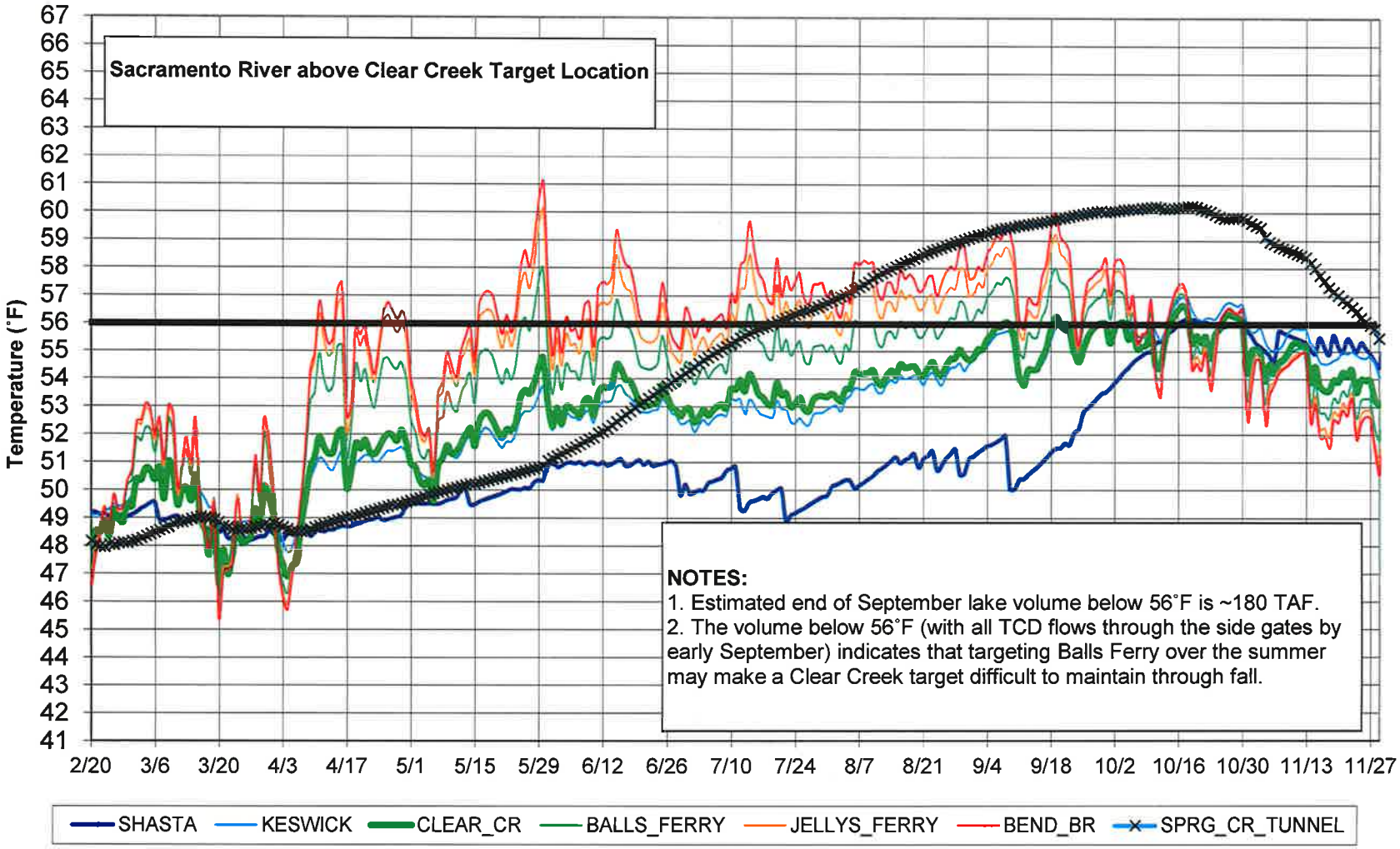
50%-Exceedance:
A temperature target location at Clear Creek is possible through the temperature season (Figure 2). By September, the TCD intake will be through the side gates. Early summer operation to a Balls Ferry target may be possible but it would be at the risk of exceeding compliance at Clear Creek in the fall. Shasta Dam release temperature is expected to exceed 56˚F by early October.

Sacramento River Modeled Temperature
2015 February 90%-Exceedance Outlook



Enclosure 1

Sacramento River Modeled Temperature
2015 February 50%-Exceedance Outlook



Enclosure 1

2015 February 90%

(With Modified Outflow Objective, WLK and SRSC April diversions)

Storages

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

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Trinity	**874**	**1112**	**1177**	**1178**	**1017**	**908**	**806**	**702**	**642**	**611**	**578**	**562**	**570**
	Elev.	2267	2274	2274	2257	2244	2232	2217	2209	2204	2198	2196	2197
Whiskeytown	**205**	**206**	**206**	**238**	**238**	**238**	**238**	**238**	**230**	**206**	**206**	**206**	**206**
	Elev.	1199	1199	1209	1209	1209	1209	1209	1207	1199	1199	1199	1199
Shasta	**2001**	**2671**	**2856**	**2758**	**2496**	**2205**	**1815**	**1538**	**1418**	**1393**	**1438**	**1509**	**1630**
	Elev.	993	1001	997	984	969	946	928	920	918	921	926	934
Folsom	**448**	**542**	**559**	**558**	**552**	**432**	**295**	**234**	**201**	**191**	**186**	**191**	**205**
	Elev.	422	424	424	423	408	386	374	367	365	363	365	368
New Melones	**563**	**600**	**559**	**488**	**385**	**299**	**206**	**119**	**63**	**49**	**54**	**61**	**63**
	Elev.	878	870	855	831	808	778	741	707	696	700	706	707
San Luis	**347**	**372**	**392**	**366**	**295**	**184**	**54**	**-41**	**-19**	**72**	**105**	**233**	**414**
	Elev.	479	475	459	438	411	381	355	354	376	401	434	466
Total		5502	5750	5586	4982	4266	3413	2790	2535	2522	2568	2762	3087

State End of the Month Reservoir Storage (TAF)

Oroville	**1444**	**1740**	**1828**	**1845**	**1716**	**1491**	**1259**	**1083**	**1041**	**1034**	**940**	**934**	**1013**
	Elev.	757	766	768	754	729	701	677	670	669	655	654	666
San Luis	**756**	**900**	**839**	**702**	**558**	**426**	**326**	**258**	**230**	**275**	**424**	**581**	**724**
Total San Luis (TAF)	**1103**	**1272**	**1231**	**1068**	**853**	**611**	**380**	**217**	**211**	**347**	**529**	**814**	**1138**

Monthly River Releases (TAF/cfs)

Trinity	TAF	17	18	32	180	47	28	28	27	23	18	18	18
	cfs	**300**	**300**	**540**	**2,924**	**783**	**450**	**450**	**450**	**373**	**300**	**300**	**300**
Clear Creek	TAF	10	11	9	9	9	7	5	9	11	10	11	11
	cfs	**175**	**175**	**150**	**150**	**150**	**120**	**85**	**150**	**175**	**175**	**175**	**175**
Sacramento	TAF	180	200	338	442	494	577	460	271	251	202	200	200
	cfs	**3250**	**3250**	**5681**	**7183**	**8296**	**9379**	**7485**	**4549**	**4077**	**3394**	**3250**	**3250**
American	TAF	50	49	48	50	134	148	79	48	49	48	50	49
	cfs	**900**	**800**	**800**	**813**	**2252**	**2415**	**1289**	**800**	**800**	**800**	**807**	**800**
Stanislaus	TAF	14	25	30	29	16	19	14	9	35	15	13	18
	cfs	**255**	**403**	**503**	**465**	**270**	**316**	**232**	**153**	**573**	**260**	**205**	**295**
Feather	TAF	53	49	48	49	116	141	120	77	55	54	55	55
	cfs	**950**	**800**	**800**	**800**	**1950**	**2300**	**1950**	**1300**	**900**	**900**	**900**	**900**

Trinity Diversions (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Carr PP	2	0	34	18	77	78	77	32	15	28	19	6
Spring Crk. PP	**3**	**9**	**8**	**15**	**70**	**70**	**70**	**30**	**30**	**19**	**12**	**3**

Delta Summary (TAF)

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Tracy	50	75	45	43	30	30	30	106	146	65	148	200
USBR Banks	0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa	7	7	11.4	11.4	11.4	9.9	10.6	11.4	7	8.4	9.2	9.2
Total USBR	57	82	56	54	41	40	41	117	153	73	157	209
State Export	225	75	18	18	35	45	45	30	75	165	181	200
Total Export	282	157	74	73	76	85	86	147	228	238	338	409
COA Balance	0	0	0	-25	-57	-56	-62	-52	-52	-52	-52	-52
Old/Middle River Std.												
Old/Middle R. calc.	-4,070	-2,060	-924	-1,024	-1,329	-1,387	-1,448	-2,285	-2,939	-3,302	-4,492	-5,319
Computed DOI	9527	4604	6909	4002	4001	3497	2993	3009	2993	3496	3497	5482
Excess Outflow	2431	602	2908	0	0	0	0	0	0	0	0	1985
% Export/Inflow	36%	35%	11%	15%	13%	14%	15%	29%	44%	48%	60%	58%
% Export/Inflow std.	45%	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%

Hydrology

		Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)		894		3,792		856		248	
Year to Date + Forecasted	% of mean	74%		68%		31%		23%	

February 25, 2015

Upper Sacramento River – February 2015 Preliminary Temperature Analysis
(with Modified Outflow Objective, WLK & SRSC April diversions)

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

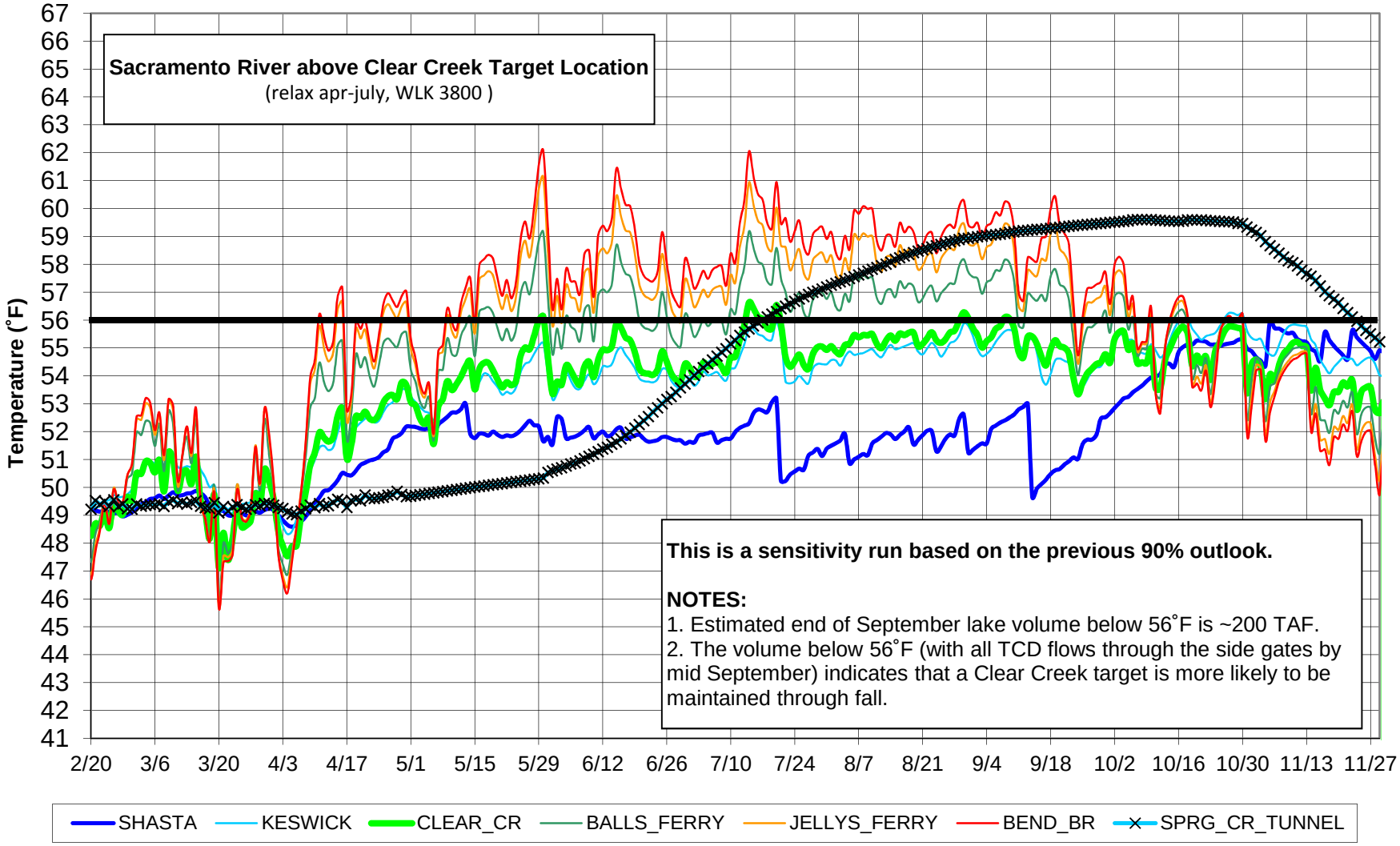
1. Operation is based on the February 2015 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) This is a sensitivity run based on the previous 90% outlook with modified outflow objectives, WLK and SRSC April diversions.
2. The profiles used for Shasta, Trinity and Whiskeytown were taken on February 3, February 4, and February 3, respectively.
3. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge is not available beyond 5 days. Model input side flows (Cottonwood Cr & Bend Bridge local flow w/o Cottonwood Cr) were selected from the historical record, and are consistent with the forecast exceedance frequency. During spring, the relatively warm creek flows can be a significant percentage of the flows at Bend Bridge.
4. Although mean daily flows and releases are temperature model inputs, they are based on the mean monthly values from the operation outlooks. Mean daily flow patterns are user defined.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period.
6. Meteorological inputs were derived from a database of 86 years of meteorological data (1920-2005). The meteorological inputs in the model represent "Average" meteorological conditions.
7. Meteorology, as well as flow volume and pattern, significantly influences reservoir inflow temperatures and downstream tributary temperatures; and consequently, the development of the cold-water pool during winter and early spring.

Temperature Analysis Results:

Note that for all exceedances, Lake Shasta storage is too low to utilize the upper gates of the TCD. This TCD limitation, along with the relatively small cold-water pool volume, significantly impacts temperature management.

90%-Exceedance:
A temperature target location at Clear Creek appears to be maintainable through the fall. By mid September, the TCD release will be through the side gates.

Sacramento River Modeled Temperature
2015 February 90%-Exceedance Outlook
(With Modified Outflow Objective, WLK & SRSC April diversions)



Enclosure 3

Strategy to Improve Current Temperature Analysis Capabilities:

Background: The ability to model water temperatures is critically important in managing one of the key stressors in the early life-history of ESA-listed salmonids, such as winter-run and spring-run Chinook salmon. Improving the current temperature modeling capability will enable managers to make key decisions on whether a species is in jeopardy, how much mortality is predicted in any one year, and what steps should be taken to avoid the loss of a year's cohort. Thus, both the U.S. Bureau of Reclamation and NOAA's National Marine Fisheries Service (NMFS) need reliable temperature forecasts before and during the temperature control season to make decisions on the in-river risk of water temperatures to ESA-listed juvenile salmonids. For example, the level of risk of a temperature-related disaster (such as running out of cold water) informs the broodstock operations at Livingstone Stone National Fish Hatchery. Specifically, an accurate temperature forecast can be used to plan for drought-relevant measures such as the initiation of an emergency captive broodstock program. Due to problems encountered in forecasting water temperatures in 2014, the Interagency 2015 Drought Strategy, and specifically the Central Valley Project and State Water Project Drought Contingency Biological Monitoring Plan[1], called for improving the tools used to plan and evaluate water project operations. In addition, the independent review panels pursuant to the annual reviews of the NMFS 2009 biological opinion recommended recalibrating the temperature forecast models to reduce uncertainty.

Strategy: The following approach is intended to guide improvements in the existing Sacramento River Water Quality Management Model (SRWQM) and guide further development of a Temperature Decision Support Tool in progress between Reclamation and NMFS-Southwest Fisheries Science Center (SWFSC). Reclamation-Central Valley Operations (CVO), Reclamation-Bay-Delta Office, and NMFS will convene a group of internal experts (*e.g.*, fluid mechanics/engineers, operators, biologists, hydro-climatologists, and temperature modelers) who are familiar with the operations of the Central Valley Project, hydraulic characteristics of the Temperature Control Device (TCD), and the SRWQM. The goal of this group is to assist Reclamation-CVO to document the inputs to the SRWQM, and describe which of these parameters may result in forecasted inaccuracies for the limited cold water resources available to meet monthly temperature compliance locations in the upper Sacramento River from May 15 through October 31. This goal would be achieved through evaluation of the SRWQM by Reclamation-CVO using different inputs (operating assumptions) identified by the internal technical group. The expectation is that the work can be completed this spring to inform this summer's (June-September) Temperature Management Plan required by the State Water Quality Control Board Water Rights Decision 90-5.

Potential steps in this collaborative effort include:

1. Convene internal technical group
2. Meet with NMFS and reclamation managers to verify scope, resources and timing.
3. Document temperature model inputs
4. Evaluate sensitivity of model inputs (*e.g.*, test different assumptions)

[1] http://ca.gov/drought/pdf/DCP-2015-Monitoring-Plan_12-12-14.pdf

5. Diagnose inputs that result in the greatest variation in forecasts (*e.g.*, project operations, TCD characteristics, historical depletion rates, compliance locations)
6. Recalibrate and validate model
7. Report findings to Reclamation and NMFS management

These steps should be immediately pursued to improve the use of this tool for water year 2015. If these improvements are not possible by June 1, 2015[2], then at a minimum, the degree of uncertainty will be reported to Reclamation and NMFS management.

Reclamation and NMFS will review longer-term changes that may be needed in decision support tools in order to better model operational scenarios and resulting temperatures in February. Reclamation and NMFS-SWFSC 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[3] that successfully forecasts downstream river temperatures using real-time meteorological conditions. This model may have some applicability for forecasting water temperatures resulting from differing operational plans, and will incorporate peer reviews and iterative technical workshops to inform its development and implementation in the future.

[2] June 1, 2015, fits the requirement of the State Water Resources Control Board In its February 3, Order at http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/tucp/2015/tucp_order020315.pdf
[3] http://oceanview.pfeg.noaa.gov/RAFT/stream.html