From: Milligan, Ronald [mailto:rmilligan@usbr.gov]
Sent: Friday, April 15, 2016 7:48 AM
To: Rea, Maria@NOAA; Kaylee Allen
Cc: Wilcox, Carl@Wildlife; Garwin.Yip@noaa.gov; Erin_Gleason@fws.gov; Leahigh, John@DWR; Dibble, Chad@Wildlife; Biggs, Charlotte@DWR; Stein, Russell@DWR; Kim_S_Turner@fws.gov; Barbara.Byrne@noaa.gov; ekiteck@usbr.gov; Thomas Patton; Jeffrey Rieker; Riddle, Diane@Waterboards; Satkowski, Rich@Waterboards
Subject: Request for Concurrence - March 2016 TUCP and consistency with the Biological Opinions

Maria and Kaylee (and Garwin and Kim),

Thank you and your staffs for your cooperative efforts to assist Reclamation with our ongoing drought operations. As you are aware, Reclamation has recently filed a Temporary Urgency Change Petition (TUCP) with the SWRCB to request modifications to the "San Joaquin River at Vernalis" flow objectives for this spring. A copy of the TUCP is attached. The purpose of the petition is to conserve storage in New Melones Reservoir while still providing critical spring flows for out-migrating salmonids.

(Please also note that Reclamation is in the process of modifying our TUCP to the SWRCB to withdraw our request to modify the Dissolved Oxygen objective for this summer.)

The drought conditions in the San Joaquin River basin have continued well into the spring of 2016, which has limited San Joaquin River flows at Vernalis and into the Sacramento-San Joaquin Delta. Reclamation has worked with the Stanislaus basin water districts to augment the currently scheduled Stanislaus River Appendix 2(e) flow releases with an additional 75,000 af during the pulse flow period this April and May. Unfortunately, these Stanislaus River flows will not be enough to meet the required D-1641 flow objectives given drought conditions and the minimal releases this year on the Tuolumne and Merced Rivers. The table below summarizes Reclamation's proposed Vernalis flows relative to the flows called for by D-1641 this year.

Dates	Proposed Flows (cfs)	D-1641 Objective (cfs)
April 1 – 14	1,000	2,280
April 15 – May 15	3,100	4,880
May 16 - May 31	750	2,280
June 1 -30	500	2,280

The D-1641 objectives are well above the flows forecasted this year despite the significant augmentation of flow from the Stanislaus River. Without approval of the requested TUCP, an additional release of approximately 192 taf would be required from storage in April and May, with an additional volume of 107 taf in June. Given the continued low reservoir storage at New Melones, this additional release would result in a very low lake level by September - lower than the lake level last year, impacting river temperatures this summer and limiting the ability to meet 2(e) flows into next the fall and 2017.

Our last estimate of end-of September storage at New Melones is 415 taf assuming the TUCP and 90% exceedance hydrology. A release of an additional 192 taf from New Melones (the April – May volume) would

take that storage down to 223 taf. By comparison, the end-of September storage in 2015 was 267 taf. An additional release of 107 taf in June would take the reservoir down to 116 taf.

Since the termination of the San Joaquin River Agreement and VAMP, the operators on the Tuolumne and the Merced are not compelled to augment spring flows beyond their current FERC requirements, which are minimal this spring after several critically dry years.

Given the lack of options, Reclamation believes that the TUCP reasonably balances the use of the limited New Melones supplies to provide fishery flows on the San Joaquin River this spring while maintaining storage to protect Stanislaus river temperatures and river flows later this year and next. This approach is similar to the dry-year operations envisioned by Reclamation when we prepared the Biological Opinion in 2008.

Based on our review of the record, the proposed flows appear to be within the range of Vernalis flows and Stanislaus releases evaluated during the 2008/2009 consultations, and the range of effects are within those previously analyzed. Reclamation believes that the operations to the TUCP this spring, in conjunction with the ongoing implementation of RPA actions from both Biological Opinions, will not adversely jeopardize any of the listed species, or result in adverse modification of critical habitat.

As outlined above, we believe that implementation of the TUCP this year is consistent with the Biological Opinions. To facilitate the SWRCB's review of Reclamation's TUCP, I am asking for your concurrence with our conclusion. Again, thank you for your continued assistance. If you have any questions, or need further clarification, please let me know.

Ron

TEMPORARY URGENCY CHANGE PETITION TO CERTAIN

U.S. BUREAU OF RECLAMATION PERMIT TERMS AND CONDITIONS

Permits for the Central Valley Project

Application Numbers: 14858A

Permit Numbers: 16597

I. Requested Changes

Due to the unprecedented dry conditions of 2014 and 2015, reservoir storage in the San Joaquin River Basin and New Melones is particularly low. These reservoir storage deficiencies, combined with the continued dry conditions, especially in the Stanislaus River basin, faced by California in this current water year, compel the U.S. Bureau of Reclamation (Reclamation) to request modification of certain San Joaquin River flow objectives contained in Water Rights Decision 1641 (D-1641), and modification of certain permit conditions (identified below) related to dissolved oxygen in the Stanislaus River.

This Petition sets forth specific requests for adjustment in flow requirements at Vernalis during the pulse flow period for April and May and adjustment for base, or "shoulder" flow requirements during April through June. Reclamation also proposes modification of permit conditions for dissolved oxygen on the Stanislaus River. The requested modifications were developed consistent with the findings of the January 2016 Central Valley Project and State Water Project Drought Contingency Plan, as updated, (2016 DCP), Governor Brown's January 2014 Emergency Proclamation, the December 2014 Emergency Proclamation, and other gubernatorial and state action addressing the drought.

Reclamation has actively collaborated with the State Water Board throughout this drought to ensure that the scarce water resources at New Melones Reservoir and the San Joaquin River Basin are managed appropriately over this multi-year drought, and the State Water Board has supported these efforts by approving prior Temporary Urgency Change Petitions. These proposed modifications similarly represent necessary compromises toward meeting the goals of D-1641[1] and the 2009 Coordinated Long-Term Operation of the Central Valley Project and State Water Project Biological Opinion issued by the National Marine Fisheries Service (2009

[1] Reclamation reserves and reiterates its past position often communicated to the Board that the issues with the Vernalis minimum instream flow requirements reveal issues with the implementation strategy, rather than Reclamation compliance issues. Reclamation is hopeful that the current Sacramento-San Joaquin River- San Francisco Bay Delta basin planning process will achieve a more reliable implementation of the Vernalis minimum instream flow requirements.

BiOp), while still recognizing the lingering effects from the unprecedented critically dry years of 2014, 2015, and 2016.

The requested modifications in this petition will not have any cascading direct or indirect impacts with respect to other Delta objectives.

A. Modification of San Joaquin River April-May Pulse Flows and Base Flows from April through June

D-1641 requires minimum monthly average flows on the San Joaquin River at Airport Way Bridge, Vernalis from February through June and additional pulse flows in April and May. Reclamation hereby petitions the State Water Board to adopt temporary modifications to the Vernalis base flow for April through June and the pulse flow requirements for April and May.

Reclamation will meet the critical-year March base flow requirement. However, for April through June, Reclamation proposes a base flow requirement of 1,000 cfs April 1-April 15, 2016, and May 15-May 31, 2016. Given the continued dry conditions in the San Joaquin Basin, Reclamation proposes a 500 cfs base flow for the month of June.

For the April-May pulse flow period, Reclamation proposes a modification to the D-1641 Vernalis flow criteria of a dry year (4,880 cfs) criteria. Reclamation proposes that the Stanislaus River flows specified in Appendix 2(E) of the 2009 BiOp be met. In addition, Reclamation has requested that Oakdale Irrigation District and South San Joaquin Irrigation District concur with release of 75,000 acre feet (af) of water during the April-May period to supplement Reclamation's releases from New Melones Reservoir storage to the Stanislaus River. The combined release will create a total flow on the Stanislaus River during the pulse flow period of approximately 2,000 cfs for 31 days. These flows combined with release from the Tuolumne and Merced River and South San Joaquin River accretions will create the overall pulse flow at Vernalis. In total, based on current projections and the proposed releases, the combined pulse flow rate at Vernalis would likely reach flow levels between 3,000 to 3,200 cfs[2].

Reclamation proposes that the Vernalis pulse flow requirement be temporarily adjusted to these levels. Without the proposed change, an additional release of approximately 116,000 acre-feet of stored water would be required to meet the D-1641 flow pulse flow objective of 4,880 cfs. If this release was made exclusively from stored water at New Melones Reservoir, flows on the Stanislaus River would be near 4,000 cfs for this period.

The proposed modifications are prudent and necessary because of the extraordinarily dry conditions of the past several years in combination with low reservoir storage and the competing demands on water supply for fish and wildlife protection, salinity control, carryover

[2] *See* Attached Hydrologic Flow Analysis (Attachment 1)

storage, and water supply needs. The temporary adjustments of flow requirements will conserve reservoir storage levels and help deal with the persistently dry conditions facing California, and provide sufficient carryover into water year 2017 to help meet the 2009 BiOp Appendix 2(E) flows and other fishery requirements.

B. Modification of the Ripon Dissolved Oxygen Requirement

Reclamation also requests that the State Water Board modify Permits 16597 to temporarily change the requirements of the dissolved oxygen objective identified in Reclamation's permits (condition 19). Condition 19 requires, in part, that Reclamation release water stored in New Melones Reservoir to meet the currently applicable dissolved oxygen objectives in the Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins. Reclamation is requesting that this requirement be relaxed from 7.0 mg/l to 5.0 mg/l through October 1, 2016. This same proposal was made last year to conserve stored water. Given the projected river conditions downstream of Oakdale this summer, there is a low possibility that O'mykiss will be in the lower river due to elevated water temperatures[3].

This proposed change will allow Reclamation to operate New Melones Reservoir to best meet some degree of all its permit terms and requirements of the 2009 BiOp, in coordination with the local water districts, fishery agencies and the State Water Board. Given the low reservoir storage levels, Reclamation will not be able to meet the dissolved oxygen objective and still reliably retain enough water for the October pulse flow, the targeted carryover storage, and fishery needs later in the year if conditions remain dry.

C. Application of a 1:1 Combined Export Ratio

Reclamation is not requesting any changes to D-1641 related to export rates – the following discussion is provided for information purposes only.

Through footnote 18 of Table 3, D-1641 provides that the maximum export rate during spring pulse flow shall be 1,500 cfs or 100% of the 3-day running average of San Joaquin River flow at Vernalis, whichever is greater. The 2009 BiOp also specifies certain conditions that allow for a 1:1 export/import ratio: if the previous two years plus current year of San Joaquin Valley "60-20-20" Water Year Hydrologic Classification and Indicator as defined in D-1641 is 6 or less and the New Melones Index is less than 1 million acre feet (MAF), then exports shall be limited to a 1:1 ratio with San Joaquin River inflow as measured at Vernalis, as shown in the following 2009 BiOp excerpt:

[3] *See* Attached Water Temperature Analysis (Attachment 2)

Exception procedure for multiple dry years: If the previous 2 years plus current year of San Joaquin Valley "60-20-20" Water Year Hydrologic Classification and Indicator as defined in D-1641 and provided in following table, is 6 or less, AND the New Melones Index is less than 1 MAF, exports shall be limited to a 1:1 ratio with San Joaquin River inflow, as measured at Vernalis.

San Joaquin Valley Classification	Indicator
Critically dry	1
Dry	2
Below normal	3
Above normal	4
Wet	5

In this current situation, the 2014 and 2015 San Joaquin Basin "60-20-20" Indicators were both critically dry, and the 2016 forecast most likely ranges between dry and below normal. Similarly, given the extremely low storage at New Melones Reservoir and current forecasts, the New Melones Index slightly more than 1 MAF. As a result, the combined Water Year Hydrologic Classifications and Indicators are very close to meeting the exception provided in the 2009 BiOp.

These conditions are consistent with the 1:1 export rate outlined in D-1641 and they are extremely close to meeting the 2009 BiOp exception as well. In addition, the supplemental 75,000 af river release will greatly improve outmigration conditions this spring for fall-run Chinook salmon and steelhead trout. Given the dry conditions in the Basin and low reservoir storage levels, combined with Reclamation's diligence in facilitating an additional 75,000 af of water for release, Reclamation is requesting flexibility from NMFS in implementing this specific export limit action found in the 2009 BiOp. The cumulative environmental effects are currently being evaluated by Reclamation and NMFS. We believe this combined export rate reflects an appropriate balance between competing beneficial needs in light of the drought.

Basis to Authorize the Requested Modifications

California Water Code section 1435 provides that the State Water Board may grant a temporary change order for any permittee or licensee where the State Water Board finds the following: (1) the permittee has an urgent need for the proposed change; (2) the proposed change may be made without injury to any other lawful user of water; (3) the proposed change can be made without unreasonably affecting fish, wildlife, or other instream beneficial uses; and (4) the proposed change is in the public interest. The law also requires consultation with representatives of the Department of Fish and Wildlife. Given current conditions, all of the requirements necessary to support this temporary urgency change petition have been met.

A. Reclamation Has an Urgent Need for the Changes

California has just ended four consecutive years of below-average rainfall and snowpack in the Central Valley. WY 2015 was the eighth of nine years with below-average runoff. This extended drought has produced chronic and significant challenges in the San Joaquin River Basin, especially the Stanislaus River basin, including shortages to municipal and industrial, environmental, agricultural, and wildlife refuge water supplies and historically low groundwater levels. The cumulative effects of these sustained dry conditions in the San Joaquin River Basin are demonstrated in reduced natural runoff for streamflow, limited surface water storage in reservoirs, increased groundwater pumping, and significant effects to fish and wildlife populations.

Perhaps the most critical environmental factor necessitating these proposed modifications is the fact that dry conditions in 2014 and 2015 have resulted in exceptionally low reservoir storages, which create near-impossible challenges for Reclamation to deliver critical water supplies, provide adequate cold water for instream fisheries resources, and comply with all D-1641 objectives. As of March 28, the New Melones Reservoir held 611 taf, which is over 800 taf short of the average storage amount (42% average), and only 50 taf more than this time last year. Based on forecasts incorporating the requested modifications and improved runoff in the Stanislaus River, Reclamation projects that it may be able to attain an end of month storage in September (EOMSS) amounting to 415 TAF, which is more than the 267 TAF EOMSS in 2015. However, these storage levels at New Melones are still very low. Even with the requested modifications, recovery in the San Joaquin River Basin will be a slow process, and a closely coordinated effort with local water districts will again be needed through the year to effectively manage limited supplies. Under the current circumstances, Reclamation believes the most prudent course of action is to conserve storage in upstream reservoirs until significant improvement of that storage is realized.

If the requested modifications to D-1641 Table 3 and dissolved oxygen are granted, Reclamation forecasts additional conservation of stored water in upstream reservoirs. Upstream supplies can provide the water necessary to protect fish and wildlife, Delta water quality, and water supply moving into Water Year 2017, including the Appendix 2(E) fall attraction flow required in the 2009 BiOp. However, without a modification to the Vernalis and dissolved oxygen requirements, Reclamation could be obligated to increase releases from upstream storage to meet Vernalis flows of up to 4,880 cfs (amounting to approximately 116 TAF in the pulse flow releases alone) and additional releases to meet dissolved oxygen objectives (up to 6 taf per month from June to October)**.** These estimated impacts to reservoir storage significantly decrease the likelihood that adequate reserves will be available to meet multiple regulatory requirements in the fall of 2016 and beyond.

B. There Will Be No Impact to Other Legal Users of Water

Other legal users of water should not be injured by this action. Delta water quality objectives, protective of municipal/industrial and agricultural uses, remain in place. Reclamation anticipates that these changes will not affect the natural and abandoned flows within the San Joaquin River. The requested changes to D-1641 will reduce Reclamation's anticipated releases of stored water to augment natural and abandoned flow to satisfy regulatory requirements, but these releases would not be flows available for downstream diverters. If the State Water Board approves the requested changes that result in a reduction in the release of stored water, such a reduction would not result in a loss of supply to other legal water users. These flows are intended for the instream benefit of fish and would not be available for appropriation by others.

C. The Changes Will Not Result in Unreasonable Impacts to Fish and Wildlife or Other Instream Uses

Extreme drought conditions inevitably stress aquatic resources of the San Francisco estuary and its watershed. Dry or below normal conditions during winter and spring are expected to adversely affect spawning and rearing conditions for Longfin and Delta Smelt, and migration conditions for winter-run Chinook salmon, spring-run Chinook salmon, steelhead trout, and southern distinct population segment of North American green sturgeon. However, Reclamation has worked with fishery agencies, local interests and the State Water Board to best manage the very limited storage volumes to protect the fishery in the Stanislaus River. Reclamation will maintain releases supporting the Stanislaus River flow schedule contained in 2009 BiOp.

Reclamation will continue to work with the resource agencies to ensure these releases are timed to achieve the highest fishery benefits. In addition, this year the Head of Old River Barrier has been installed and will be functional during the pulse flow period. These efforts will assist in moving O'mykiss and fall-run Chinook salmon smolts from the San Joaquin River and through the Delta.

D. The Changes Serve the Public Interest

The public interest is best served by maintaining sustainable water diversions and water quality necessary for the protection of critical water supplies. The requested changes are in the public interest because they reserve critical water supplies for use during times when they are more beneficial to the Stanislaus River fishery and serve multiple beneficial uses, while not creating an unreasonable effect on other legal users of water, fish and wildlife, or the environment.

Reclamation Has Exercised Due Diligence

Since December 2013, state and federal agencies that supply water, regulate water quality, and protect fish and wildlife have worked closely together to cope with persistent drought. Reclamation, California Department of Water Resources, California Department of Fish and Wildlife, the State Water Board, U.S. Fish and Wildlife Service, and NMFS have closely coordinated Central Valley Project and State Water Project water operations to manage reservoir water resources through both innovative and real-time efforts, including through drought operations planning and weekly Real-time Drought Operations Management Team Meetings. This cooperative environment has allowed the State and Federal Agencies to collectively provide the necessary information to the State Water Board to support its evaluation of Reclamation's previous and future requests for modifications to operational standards required under D-1641.

The January 2016 Drought Contingency Plan and subsequent monthly updates, along with current conditions and future projections, demonstrate the urgent need to seek the modifications proposed above. The information supportive of this petition has been developed through extensive collaborative agency efforts to examine and determine the narrow and focused changes necessary to address the immediate problem and develop potential future refinements that are dependent upon the evolving hydrology.

75 TAF supplement to 2E pulse flow during April and May; 10 TAF to SEWD from OID/SSJID; same upstream operation

90% Forecast – Alt

Version 2 - 75 Sup 2E Pulse | 10 SEWD

Stanislaus River - 2016 Year - 90% UF - 926,000 TAF Inflow

3-20-2016	Upstream Stanislaus				Tulloch Operation					Goodwin Operation						New Melones			
	Stanislaus Unimpaired	Upstr Storage	Upstr Regulation	NM Inflow	Tulloch Local	Tulloch Evap	Tulloch Storage	Tulloch Storage Trgt	Tulloch Release	Goodwin OID/SSJID	Goodwin CVP	Info 2E (cfs)	Fish Require	Fish Req - CFS	River Release	NM Release	NM Net Evap	NM Storage	NM Elev (FT)
Beginning		136					54.684	54.684										267	798
Oct 2015	14	110	25	40	-3.281	0.401	54.015	54.015	31.587	5.1		577	26.5	430	26.5	34.6	1.2	271	799
Nov	19	108	3	22	-3.600	0.169	54.289	54.289	21.497	0.3		200	21.2	357	21.2	25.5	0.5	267	798
Dec	45	100	8	53	4.330	0.091	55.812	55.812	12.716	0.0		200	12.7	207	12.7	10.0	0.3	310	811
Jan 2016	76	89	11	87	9.593	0.186	56.608	56.608	12.611	0.0		213	12.6	205	12.6	4.0	0.6	393	832
Feb	86	101	-12	74	2.079	0.196	54.567	54.567	12.532	0.9		214	11.6	202	11.6	8.6	0.8	458	848
Mar	241	160	-59	182	11.000	0.200	58.000	58.000	29.500	16.7		200	12.8	208	12.8	22.1	0.9	617	880
Apr - 1	83	199	-39	44	0.200	0.250	58.000	58.000	40.554	35.0		200	5.6	200	5.6	40.6	1.2	619	881
Apr - 2	135	258	-59	76	0.200	0.350	61.000	61.000	101.544	41.0		688	60.5	1908	60.5	104.7	1.2	589	875
May - 1	126	304	-46	80	0.200	0.350	64.000	64.000	92.838	37.0		657	55.8	1877	55.8	96.0	1.2	571	872
May - 2	93	332	-28	65	0.200	0.400	65.000	65.000	41.760	37.0		150	4.8	150	4.8	43.0	1.2	592	876
Jun	100	350	-18	82	0.400	1.000	66.000	66.000	90.925	79.0	3.0	150	8.9	150	8.9	92.5	2.0	580	873
Jul	20	330	20	40	0.400	1.000	66.000	66.000	110.225	97.0	4.0	150	9.2	150	9.2	110.8	2.0	507	859
Aug	8	294	36	44	0.400	0.950	65.000	65.000	100.225	88.0	3.0	150	9.2	150	9.2	99.8	2.0	449	846
Sep	3	260	34	37	0.400	0.700	62.000	62.000	71.925	63.0		150	8.9	150	8.9	69.2	1.5	415	838
Oct				20	0.400	0.500	57.020	57.000	35.505	0.0		577	35.5	577	35.5	30.6	1.0	404	835
Nov				20	0.400	0.200	55.000	55.000	11.901	0.0		200	11.9	200	11.9	9.7	1.0	413	837
Dec				20	1.000	0.200	56.000	56.000	12.298	0.0		200	12.3	200	12.3	12.5	0.5	420	839
	Approx			Approx	Approx					Approx			Approx		Approx		Approx		
WY 2016	1,050			926	23	NMI =				500	10		260		260		17		
NMI:	1,107					Formula =												1,000 acre-feet unless noted	

75% Forecast – Alt

Version 2 - 75 Sup 2E Pulse | 10 SEWD

Stanislaus River - 2016 Year - 75% UF - 996,000 TAF Inflow

3-20-2016	Upstream Stanislaus				Tulloch Operation				Goodwin Operation						New Melones			
	Stanislaus Unimpaired	Upstr Storage	Upstr Regulation	NM Inflow	Tulloch Local	Tulloch Evap	Tulloch Storage	Tulloch Release	Goodwin OID/SSJID	Goodwin CVP	Info 2E (cfs)	Fish Require	Fish Req - CFS	River Release	NM Release	NM Net Evap	NM Storage	NM Elev (FT)
Beginning		136					54.684										267	798
Oct 2015	14	110	25	40	-3.281	0.401	54.015	31.587	5.1		577	26.5	430	26.5	34.6	1.2	271	799
Nov	19	108	3	22	-3.600	0.169	54.289	21.497	0.3		200	21.2	357	21.2	25.5	0.5	267	798
Dec	45	100	8	53	4.330	0.091	55.812	12.716	0.0		200	12.7	207	12.7	10.0	0.3	310	811
Jan 2016	76	89	11	87	9.593	0.186	56.608	12.611	0.0		213	12.6	205	12.6	4.0	0.6	393	832
Feb	86	101	-12	74	2.079	0.196	54.567	12.532	0.9		214	11.6	202	11.6	8.6	0.8	458	848
Mar	241	160	-59	182	11.000	0.200	58.000	29.500	16.7		200	12.8	208	12.8	22.1	0.9	617	880
Apr - 1	86	201	-42	44	0.200	0.250	58.000	40.554	35.0		200	5.6	200	5.6	40.6	1.2	619	881
Apr - 2	139	260	-59	80	0.200	0.350	61.000	101.544	41.0		688	60.5	1908	60.5	104.7	1.2	594	876
May - 1	144	309	-49	95	0.200	0.350	64.000	92.838	37.0		657	55.8	1877	55.8	96.0	1.2	591	876
May - 2	106	334	-25	81	0.200	0.400	65.000	41.760	37.0		150	4.8	150	4.8	43.0	1.2	628	883
Jun	125	350	-15	110	0.400	1.000	66.000	90.925	79.0	3.0	150	8.9	150	8.9	92.5	2.0	643	885
Jul	25	331	19	44	0.400	1.000	66.000	110.225	97.0	4.0	150	9.2	150	9.2	110.8	2.0	574	872
Aug	9	294	37	46	0.400	0.950	65.000	100.225	88.0	3.0	150	9.2	150	9.2	99.8	2.0	518	861
Sep	4	260	34	38	0.400	0.700	62.000	71.925	63.0		150	8.9	150	8.9	69.2	1.5	485	854
Oct				20	0.400	0.500	57.020	35.505	0.0		577	35.5	577	35.5	30.6	1.0	474	851
Nov				20	0.400	0.200	55.000	11.901	0.0		200	11.9	200	11.9	9.7	1.0	483	853
Dec				20	1.000	0.200	56.000	12.298	0.0		200	12.3	200	12.3	12.5	0.5	490	855
	Approx			Approx	Approx				Approx			Approx		Approx		Approx		
WY 2016	1,120			996	23	NMI =			500	10		260		260		17		
NMI:	1,177					Formula =											1,000 acre-feet unless noted	

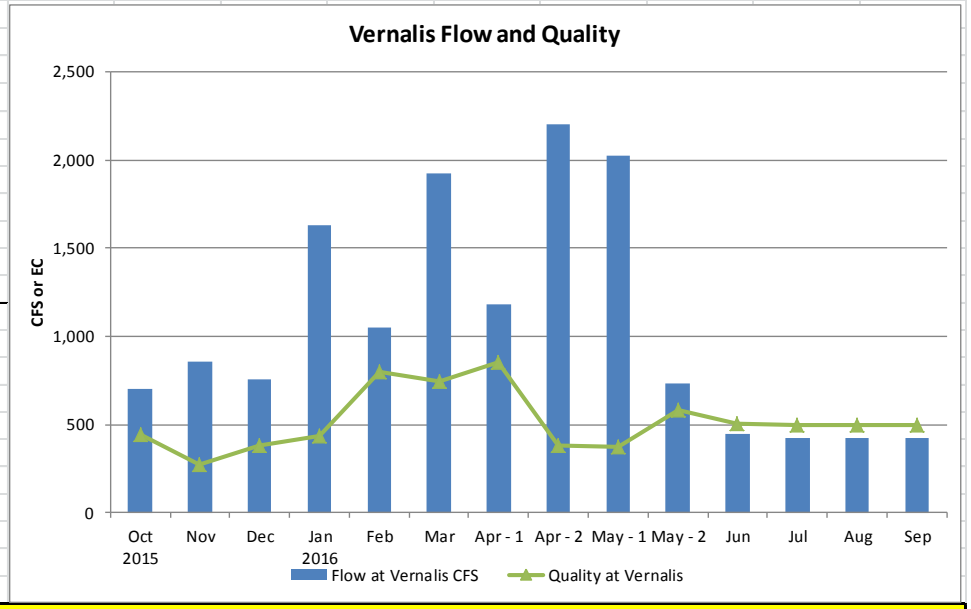
50% Forecast – Alt

Version 2 - 75 Sup 2E Pulse | 10 SEWD

Stanislaus River - 2016 Year - 50% UF - 1076,000 TAF Inflow

3-20-2016	Upstream Stanislaus				Tulloch Operation				Goodwin Operation						New Melones			
	Stanislaus Unimpaired	Upstr Storage	Upstr Regulation	NM Inflow	Tulloch Local	Tulloch Evap	Tulloch Storage	Tulloch Release	Goodwin OID/SSJID	Goodwin CVP	Info 2E (cfs)	Fish Require	Fish Req - CFS	River Release	NM Release	NM Net Evap	NM Storage	NM Elev (FT)
Beginning		136					54.684										267	798
Oct 2015	14	110	25	40	-3.281	0.401	54.015	31.587	5.1		577	26.5	430	26.5	34.6	1.2	271	799
Nov	19	108	3	22	-3.600	0.169	54.289	21.497	0.3		200	21.2	357	21.2	25.5	0.5	267	798
Dec	45	100	8	53	4.330	0.091	55.812	12.716	0.0		200	12.7	207	12.7	10.0	0.3	310	811
Jan 2016	76	89	11	87	9.593	0.186	56.608	12.611	0.0		213	12.6	205	12.6	4.0	0.6	393	832
Feb	86	101	-12	74	2.079	0.196	54.567	12.532	0.9		214	11.6	202	11.6	8.6	0.8	458	848
Mar	243	161	-60	183	11.000	0.200	58.000	29.500	16.7		200	12.8	208	12.8	22.1	0.9	617	881
Apr - 1	108	213	-52	56	0.200	0.250	58.000	40.554	35.0		200	5.6	200	5.6	40.6	1.2	632	883
Apr - 2	132	267	-54	78	0.200	0.350	61.000	101.544	41.0		688	60.5	1908	60.5	104.7	1.2	604	878
May - 1	160	322	-54	106	0.200	0.350	64.000	92.838	37.0		657	55.8	1877	55.8	96.0	1.2	612	880
May - 2	120	350	-29	91	0.200	0.400	65.000	41.760	37.0		150	4.8	150	4.8	43.0	1.2	659	888
Jun	150	351	-1	149	0.400	1.000	66.000	90.925	79.0	3.0	150	8.9	150	8.9	92.5	2.0	714	898
Jul	30	333	18	48	0.400	1.000	66.000	110.225	97.0	4.0	150	9.2	150	9.2	110.8	2.0	649	887
Aug	11	296	37	48	0.400	0.950	65.000	100.225	88.0	3.0	150	9.2	150	9.2	99.8	2.0	595	876
Sep	5	260	36	41	0.400	0.700	62.000	71.925	63.0		150	8.9	150	8.9	69.2	1.5	566	871
Oct				20	0.400	0.500	57.020	35.505	0.0		577	35.5	577	35.5	30.6	1.0	554	868
Nov				20	0.400	0.200	55.000	11.901	0.0		200	11.9	200	11.9	9.7	1.0	563	870
Dec				20	1.000	0.200	56.000	12.298	0.0		200	12.3	200	12.3	12.5	0.5	570	872
	Approx			Approx	Approx				Approx			Approx		Approx		Approx		
WY 2016	1,200			1,076	23	NMI =			500	10		260		260		17		
NMI:	1,257					Formula =											1,000 acre-feet unless noted	

3-20-2016	SJR River - 90% Exceedence							
	TAF Merced CRS	TAF Tuolumne La Grange	TAF Stanislaus Goodwin	TAF Combined Tributaries	CFS Combined Tributaries	CFS SJR A/D Vernalis	CFS SJR Vernalis	FYI Vernalis Req - est
Oct 2015	16	9	26	52	838	-133	706	
Nov	14	10	21	45	761	97	858	
Dec	13	10	13	35	577	183	760	
Jan 2016	21	10	13	44	721	911	1,631	
Feb	12	10	12	33	600	453	1,053	602020 D
Mar	24	10	13	47	767	1,155	1,922	X2 West
Apr - 1	7	5	6	17	630	550	1,180	2280
Apr - 2	8	24	22	54	1,702	500	2,202	4880
May - 1	6	23	20	48	1,621	400	2,021	4880
May - 2	6	6	5	17	530	200	730	2280
Jun	6	6	9	21	350	100	450	2280
Jul	5	6	9	20	325	100	425	
Aug	5	6	9	20	325	100	425	
Sep	4	6	9	19	325	100	425	
Oct								
Nov								
Dec								



3-20-2016	SJR River								Generally 90% Exceedence Forecast						All values in 1,000 acre-feet unless otherwise noted		
	TAF Merced CRS	TAF Tuolumne La Grange	TAF Total U/S Maze	CFS U/S Maze	CFS A/D Maze	CFS Maze Flow	EC Maze	EC-Load Maze Flow	TAF Stanislaus Goodwin	TAF A/D GDW - Stan	TAF Stanislaus Mouth	CFS Stanislaus Mouth	EC Stanislaus Mouth	EC-Load Stanislaus Mouth	Flow at Vernalis CFS	EC at Vernalis	TAF Vernalis
Oct 2015	16	9	25	408	13	421	670	282,051	26	-9	18	285	100	28,469	706	440	43
Nov	14	10	24	404	221	625	342	213,863	21	-7	14	233	100	23,260	858	276	51
Dec	13	10	23	370	-10	360	687	247,475	13	12	25	399	100	39,938	760	378	47
Jan 2016	21	10	32	516	507	1,023	635	649,403	13	25	37	609	100	60,870	1,631	435	100
Feb	12	10	22	390	363	753	1,077	811,182	12	5	17	300	100	29,967	1,053	799	58
Mar	24	10	34	559	1090	1,649	850	1,401,683	13	4	17	273	100	27,322	1,922	743	118
Apr - 1	7	5	12	430	550	980	1,000	980,057	6	0	6	200	120	24,000	1,180	851	33
Apr - 2	8	24	32	1,014	500	1,514	500	756,995	22	0	22	688	120	82,560	2,202	381	70
May - 1	6	23	29	964	400	1,364	500	682,002	20	0	20	657	120	78,840	2,021	376	60
May - 2	6	6	12	380	200	580	700	405,989	5	0	5	150	120	18,000	730	581	23
Jun	6	6	12	200	100	300	700	209,994	9	0	9	150	120	17,998	450	507	27
Jul	5	6	11	175	100	275	700	192,513	9	0	9	150	120	18,003	425	495	26
Aug	5	6	11	175	100	275	700	192,513	9	0	9	150	120	18,003	425	495	26
Sep	4	6	10	175	100	275	700	192,494	9	0	9	150	120	17,998	425	495	25
Oct																	
Nov																	
Dec																	
WY	147	141	288						185	29	215						708

Stanislaus Temperature Modeling
2016 Proposed Operations
Water Allocation Schedule – March 20, 2016

General:

The objective of this work is to assess, using the HEC-5Q Model, the expected temperature conditions at discrete points along the Stanislaus River, given the most recent projections of inflow to New Melones Reservoir, proposed instream flow requirements and various alternatives for OID/SSJID/SEWD diversions from March 20, 2016 through December 31, 2016.

Tasks:

1. Set up the model to run a year with observed and synthesized data similar to the 2015 analysis:
   a. Extend the meteorological inputs (April 2015 thru present). Use last year's (2015) conditions going forward.
   b. Extend the hydrologic inputs through present based on available data.
   c. Consider two alternatives for New Melones Unimpaired Flow (UF) conditions in the water year 2016:
      - Based on the 90% forecast (New Melones inflow ~ 926 TAF)
      - Based on the 75% forecast (New Melones inflow ~ 996 TAF).
   d. Disaggregate the estimated monthly New Melones inflow to daily using inflow records for similar monthly inflows (monthly data provided in Figure 1 & 2 below).
   e. Disaggregate the estimated monthly diversion and Goodwin flows incorporating pulse flow when appropriate (monthly data provided in Figure 1 & 2 below).
   f. Prime the model by setting New Melones and Tulloch to the November 2015 temperature profiles and to the most recent profiles taken in March 2016 (see Task 2).
2. Conduct field measurements for New Melones and Tulloch temperature profiles on March 9, 2016.
3. Incorporate representation of Tulloch's third unit in the model (based on specifications provided by Tri-Dam).
4. Perform model validation by running the model from Jan 1, 2015 to March 8, 2016 and comparing computed temperatures with observed.
5. Perform model simulation, assuming no hydro bypass at New Melones, for the two alternatives by running the model from March 8 to December 31, 2016. Compute the thermal regime downriver.
6. Analyze the results in terms of the expected temperatures (7DADM) at the specified locations along the Stanislaus River from day 1 of the simulation to end-of-year 2016.
7. Prepare a short summary report containing: methodology, assumptions, model verification and results.

System Operation - Projected Hydrology and Assumed Demands						
Based on March 20, 2016 - 90% Forecast						
Beginning	**NM Inflow**	**Goodwin OID/SSJID**	**Goodwin SEWD**	**Total Diversion**	**Goodwin To River**	**Goodwin To River**
	TAF	**TAF**	**TAF**	**TAF**	**CFS**	**TAF**
1-Mar-16	182.0	16.7		16.7	208	12.8
1-Apr-16	44.0	35.0		35.0	200	5.6
15-Apr-16	76.0	41.0		41.0	1908	60.6
1-May-16	80.0	37.0		37.0	1877	55.8
16-May-16	65.0	37.0		37.0	150	4.8
1-Jun-16	82.0	79.0	3.0	82.0	150	8.9
1-Jul-16	40.0	97.0	4.0	101.0	150	9.2
1-Aug-16	44.0	88.0	3.0	91.0	150	9.2
1-Sep-16	37.0	63.0		63.0	150	8.9
1-Oct-16	20.0	0.0		0.0	577	35.5
1-Nov-16	20.0	0.0		0.0	200	11.9
1-Dec-16	20.0	0.0		0.0	200	12.3
Total (Mar-Sep)	650.0	493.7	10.0	503.7		175.8

Figure 1: New Melones Inflow, Diversion and Release Schedule – 90% UF

System Operation - Projected Hydrology and Assumed Demands						
Based on March 20, 2016 - 75% Forecast						
Beginning	**NM Inflow**	**Goodwin OID/SSJID**	**Goodwin SEWD**	**Total Diversion**	**Goodwin To River**	**Goodwin To River**
	TAF	**TAF**	**TAF**	**TAF**	**CFS**	**TAF**
1-Mar-16	182.0	16.7		16.7	208	12.8
1-Apr-16	44.0	35.0		35.0	200	5.6
15-Apr-16	80.0	41.0		41.0	1908	60.6
1-May-16	95.0	37.0		37.0	1877	55.8
16-May-16	81.0	37.0		37.0	150	4.8
1-Jun-16	110.0	79.0	3.0	82.0	150	8.9
1-Jul-16	44.0	97.0	4.0	101.0	150	9.2
1-Aug-16	46.0	88.0	3.0	91.0	150	9.2
1-Sep-16	38.0	63.0		63.0	150	8.9
1-Oct-16	20.0	0.0		0.0	577	35.5
1-Nov-16	20.0	0.0		0.0	200	11.9
1-Dec-16	20.0	0.0		0.0	200	12.3
Total (Mar-Sep)	720.0	493.7	10.0	503.7		175.8

Figure 2: New Melones Inflow, Diversion and Release Schedule – 75% UF

Modeling, Analysis and Findings

1. Model Validation

Model validation was conducted by simulating the operation of the Stanislaus River System with actual hydrological and meteorological data from January 1, 2015 through March 8, 2016 and then comparing computed temperature downriver with observed. It should be emphasized that the HEC-5Q was not recalibrated for the purpose of this study but rather validated. In other words, none of the parameters used in the computation process as currently exist in the model have been modified.

The first measure of validation is how well the model replicates the thermal structure in New Melones and Tulloch in comparison with the most recent temperature profiles taken for these reservoirs.

Temperature profiles for Tulloch and New Melones were taken in May, June and October of 2015. However, in order to ensure that the model starts with the most recent and most accurate thermal structure in the reservoirs when projecting temperatures forward in time, additional profiles were taken on March 9, 2016.

A comparison between the computed and observed temperature profiles in New Melones and Tulloch is shown in Figure 3 and Figure 4 below.

The figures show a good match between computed and observed temperatures, thus concluding that the model performed to par as well as was primed properly for this study.

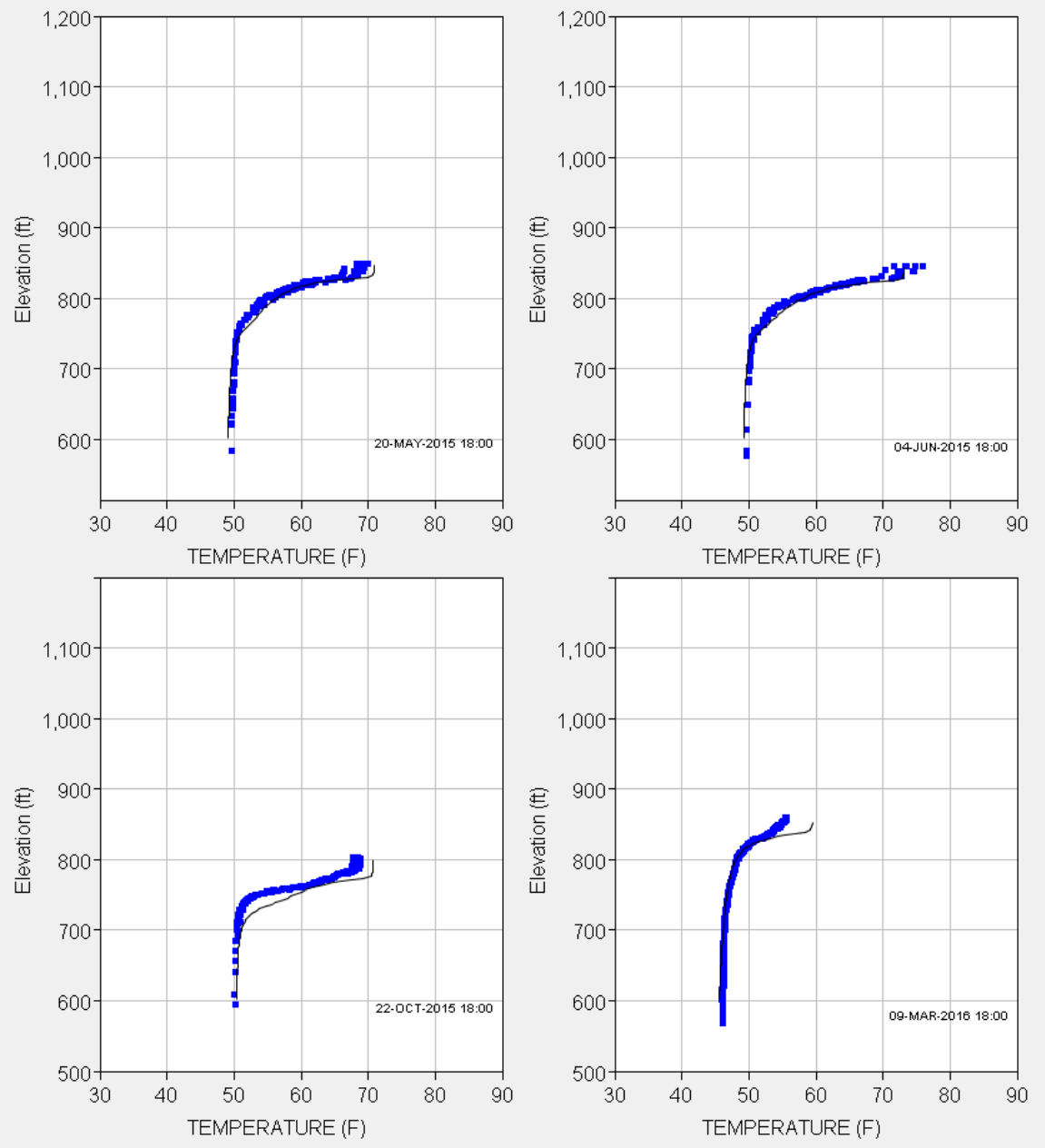


Figure 3: Temperature Profile in New Melones. Computed (line) vs. Observed (squares).

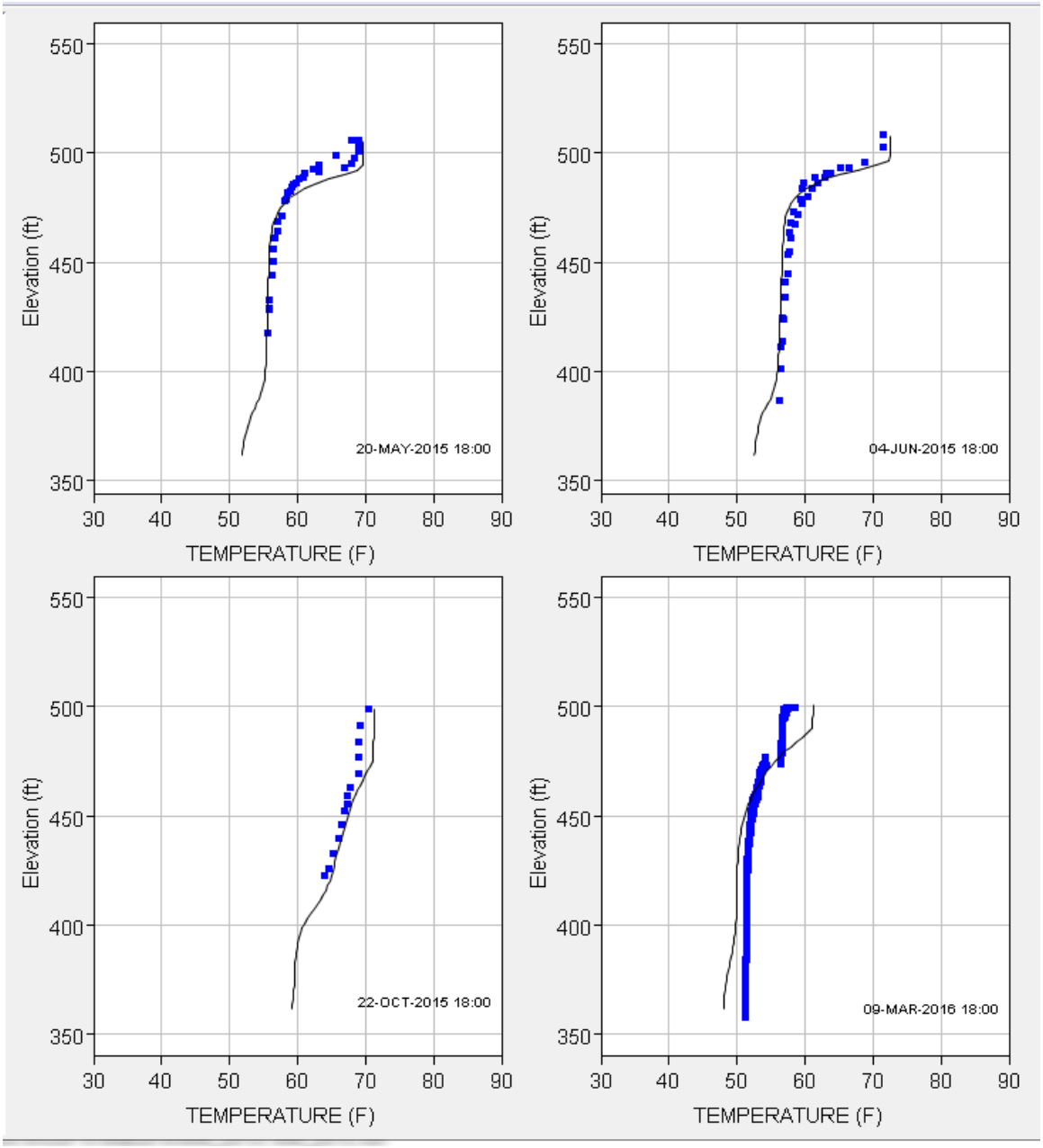


Figure 4: Temperature Profile in Tulloch. Computed (line) vs. Observed (squares).

The second measure of validation is how well the model was able to compute temperature condition downriver for the same time period (i.e., January 1, 2015 to March 8, 2016).

The results are shown in the following three plots, for three locations:

- Goodwin Pool below Tulloch Power Plant
- Below Goodwin Dam
- Below Hwy 120 Bridge (Oakdale)

Here again, the results demonstrate a good match between computed and observed.

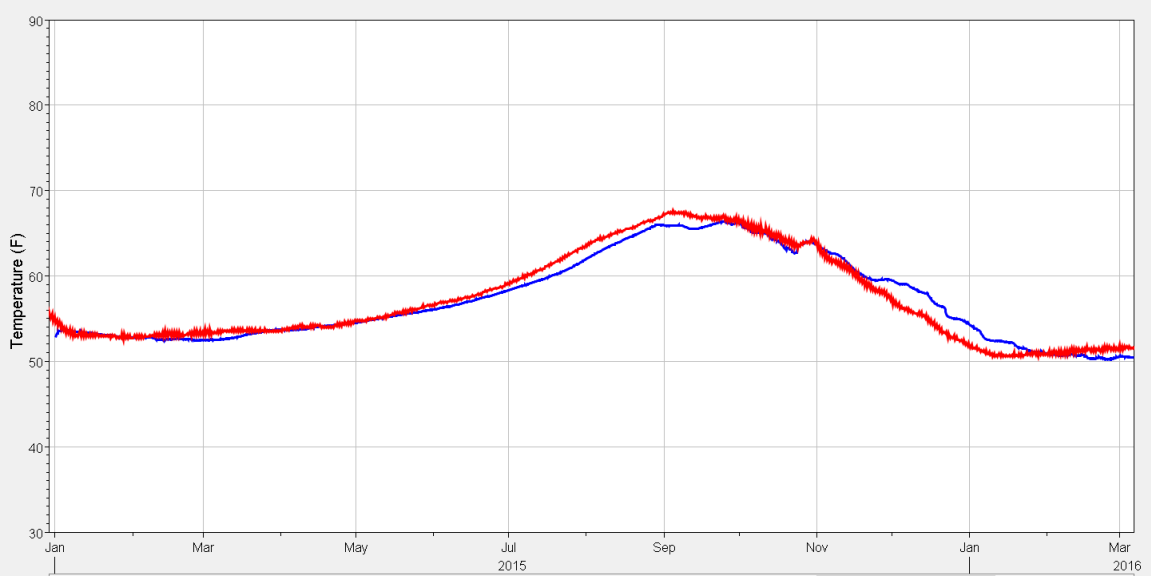


Figure 5: Computed (blue) vs. Observed (red) below Tulloch Power Plant

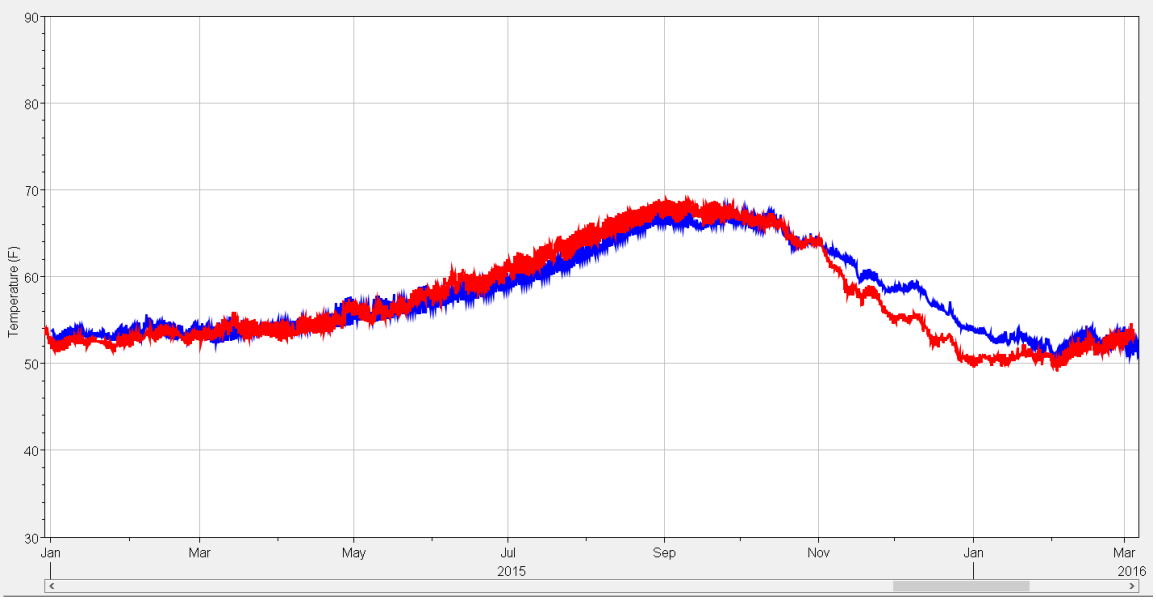


Figure 6: Computed (blue) vs. Observed (red) below Goodwin Dam

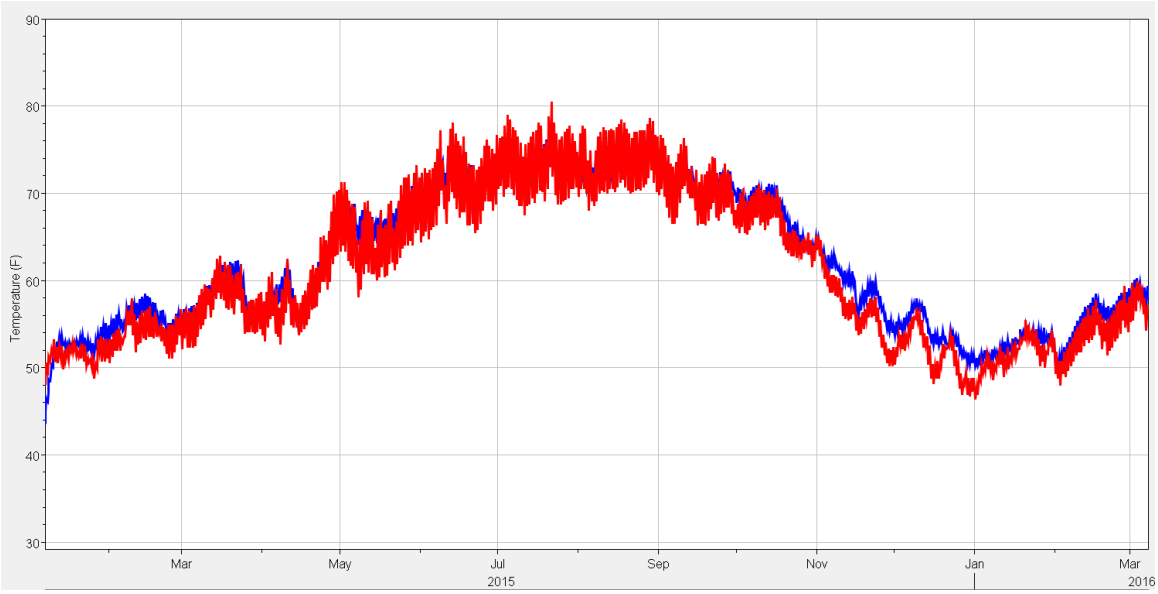


Figure 7: Computed (blue) vs. Observed (red) below Hwy 120 Bridge (Oakdale)

2. Hydrological and Meteorological Data used for Simulation

The pattern of inflow to New Melones for the remainder of this year was based on the pattern of inflow that was observed in 2010. The justification for that is the fact that the level of snowpack that was present in January and February of 2010 and the resulting inflow to New Melones, appear to be similar to the current conditions, as shown in Figure 9 and Figure 9 below. The volume of the inflow in a daily basis was then scaled down to match the monthly estimates for 2016, as specified in Figure 1 and Figure 2 above.

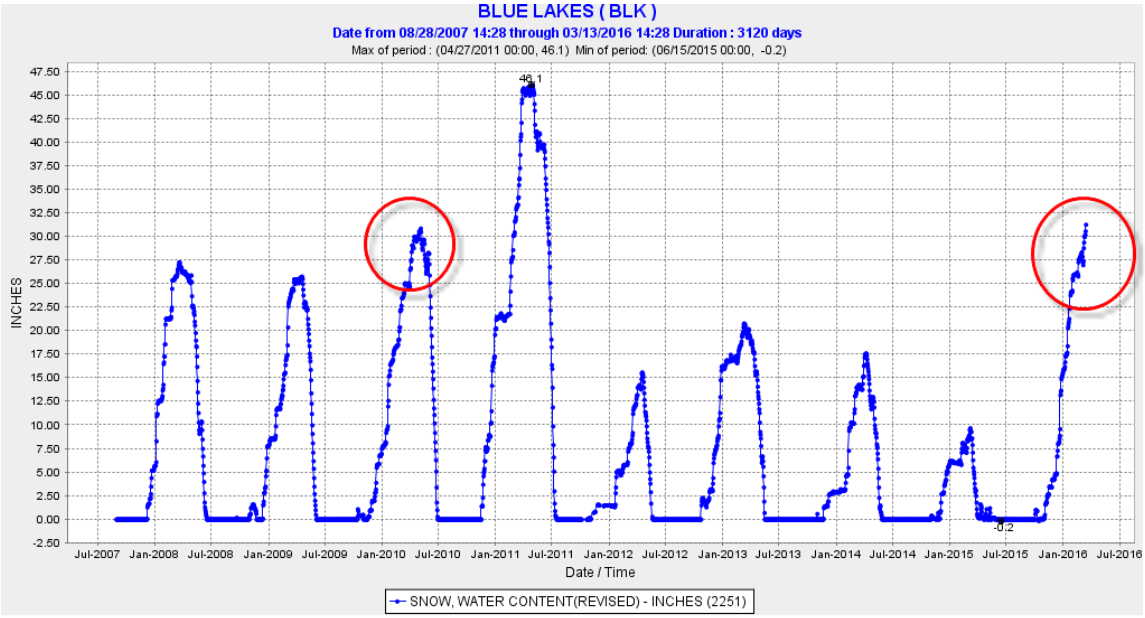


Figure 8: Snowpack in 2016 Similar to 2010

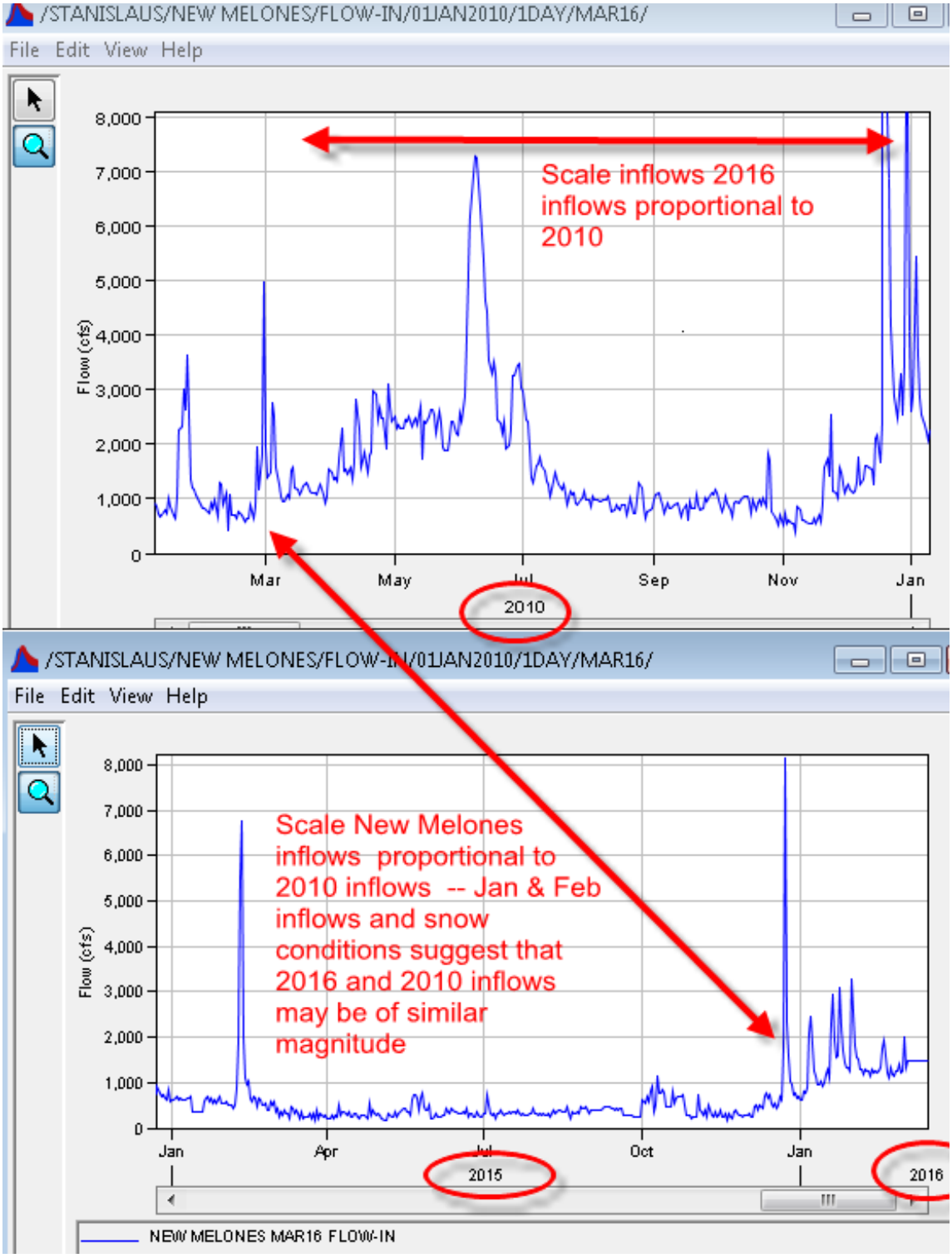


Figure 9: Pattering of New Melones Inflow in 2016 Based on 2010 Data

The meteorological data used (from March 9 to December 31) was based on the hourly data over the similar period in 2015.

It should be noted that another alternative for meteorological data was considered. This was the average meteorology for the past 5 years. Since the difference between the effect of the

two meteorological conditions on downriver temperatures was minimal, the 2015 meteorology was selected for this study.

3. Projected New Melones Storage

The projected New Melones end-of-month (EOM) storage as simulated with the model for the 90% UF and 75% UF is shown in the table and figure below.

	90% UF	75% UF
EOM	TAF	TAF
Feb-16	459	459
Mar-16	617	617
Apr-16	586	590
May-16	588	623
Jun-16	574	637
Jul-16	499	565
Aug-16	439	506
Sep-16	404	472
Oct-16	393	461
Nov-16	399	468
Dec-16	407	475

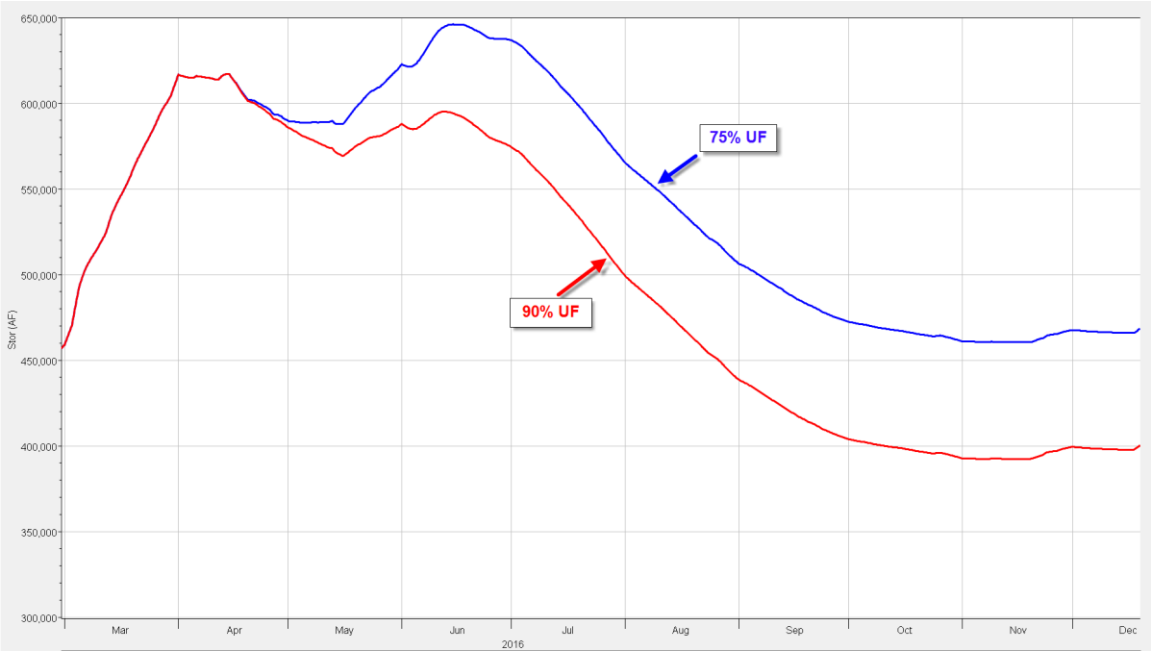


Figure 10 – New Melones Projected Storage

4. Projected Downriver Temperature Response

The projected downriver temperature is provided for six discrete points along the Stanislaus River:

1) **Below Goodwin Dam**
2) **Knights Ferry**
3) **Orange Blossom Bridge**
4) **Highway 120 Bridge (Oakdale)**
5) **Ripon Gage (Highway 99)**
6) **Above the confluence with the San Joaquin River**

The results are presented in two ways for the two alternatives (UF75 and UF90):

A. Graphical form (provided below) - showing the daily maximum temperatures.

B. Excel File: ***Stanislaus7DADM-March-20-2016_Study.xlsx*** (attached) - showing the 7-Days Average of Daily Maximums (7DADM).

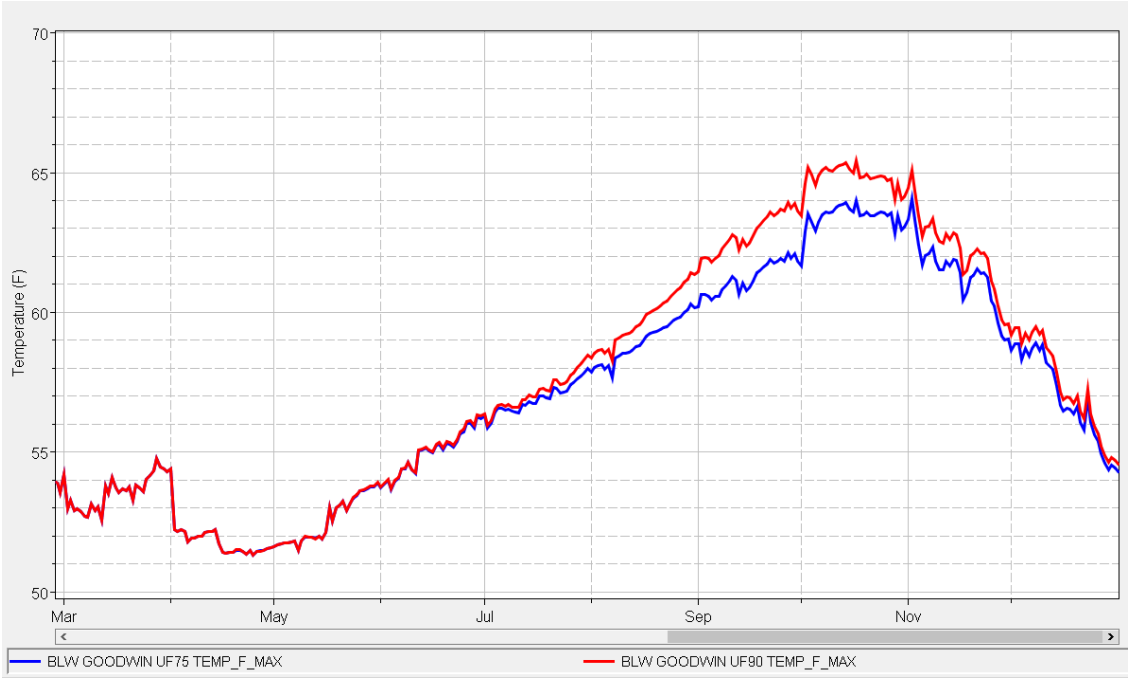


Figure 11 : Maximum Daily Temperatures below Goodwin Dam

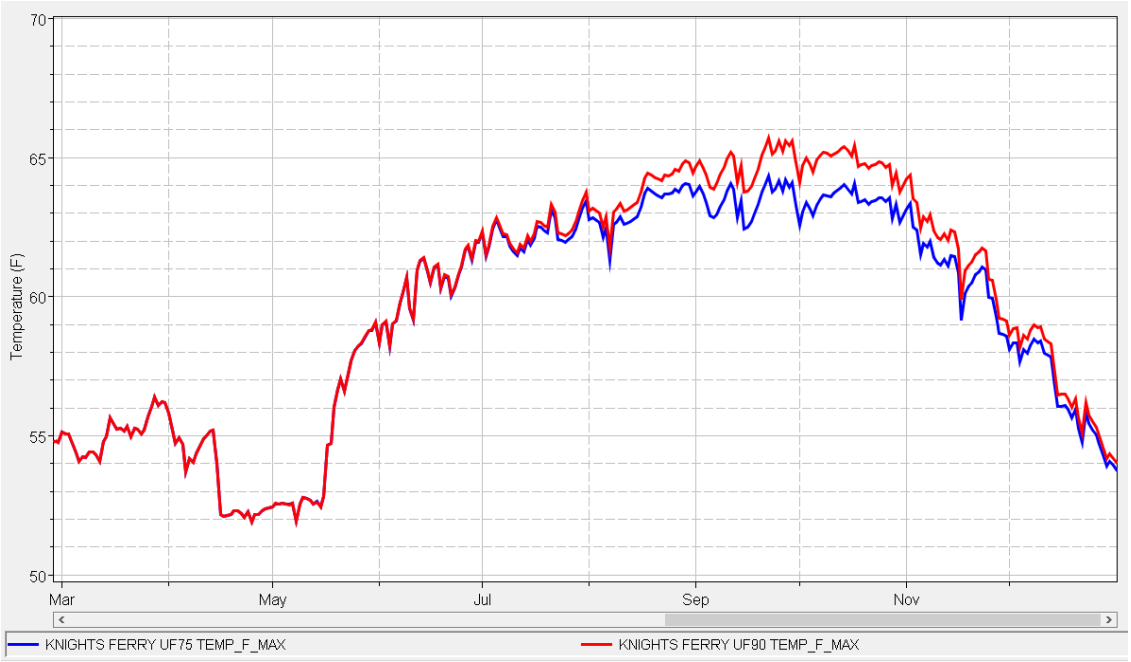


Figure 12 : Maximum Daily Temperatures at Knights Ferry

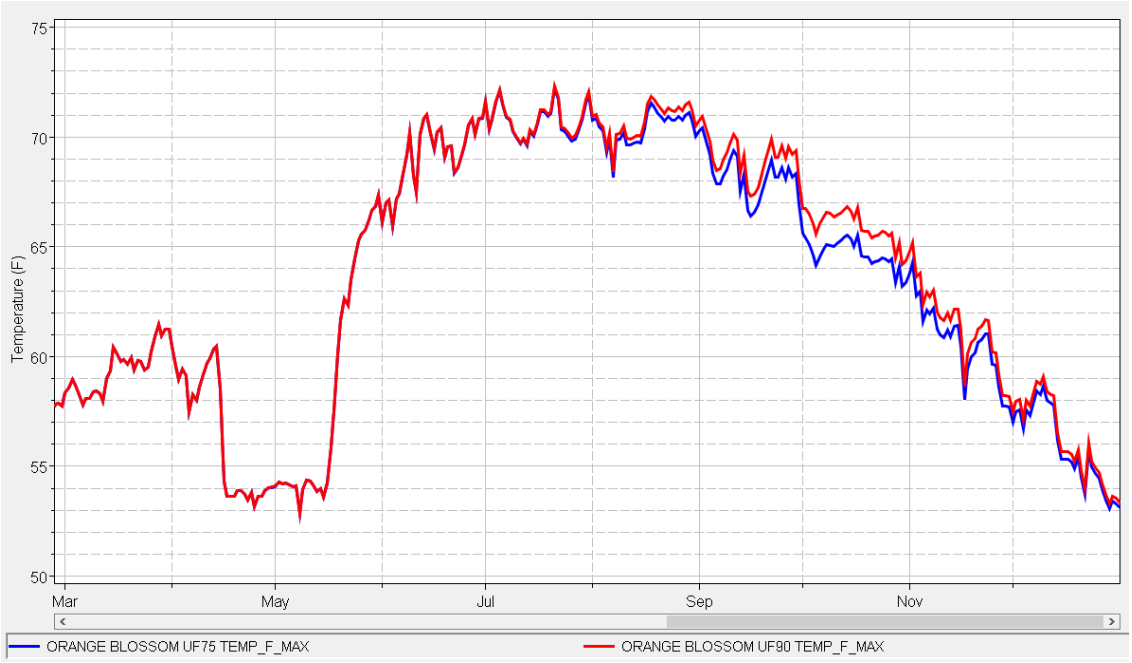


Figure 13 : Maximum Daily Temperatures at Orange Blossom Bridge

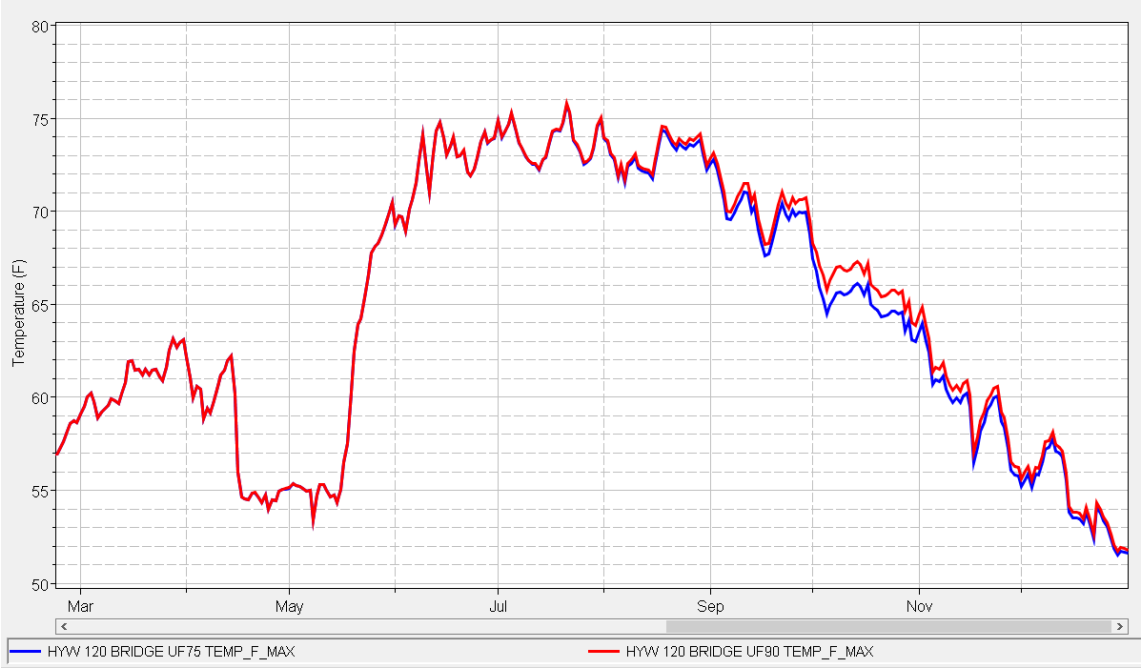


Figure 14 : Maximum Daily Temperatures below Highway 120 Bridge (Oakdale)

Figure 15 : Maximum Daily Temperatures at Ripon Gage (Highway 99)

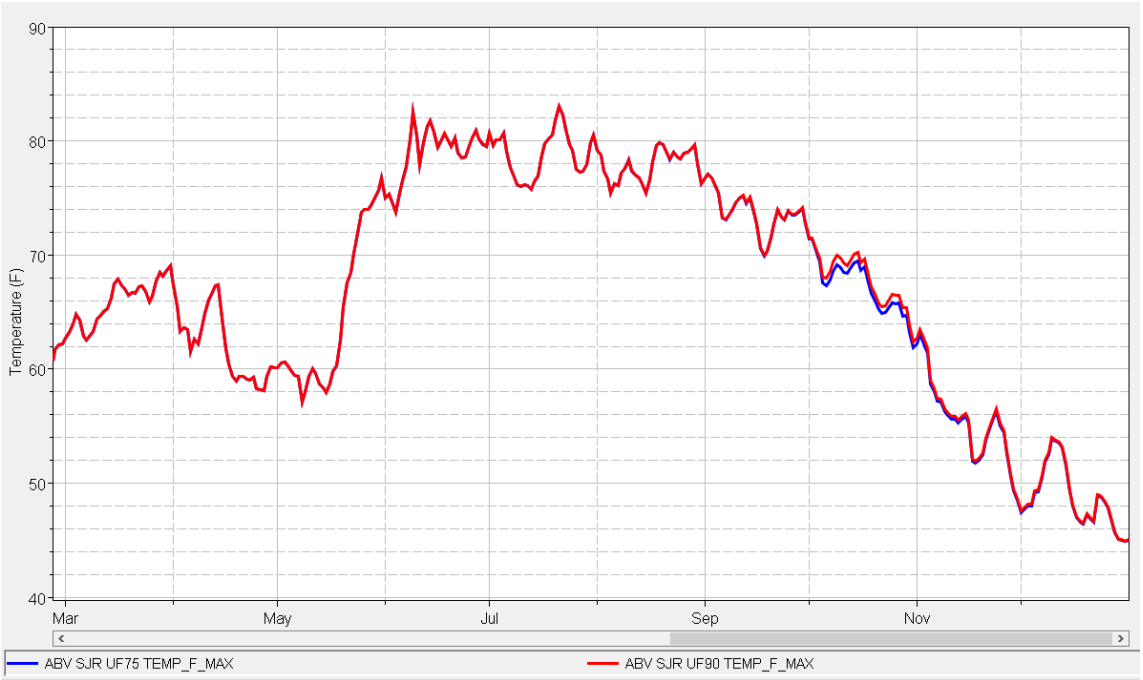


Figure 16 : Maximum Daily Temperatures above the Confluence with the San Joaquin River

5. Relationship between New Melones Storage and Below Goodwin Temperatures

The recent drought and the precipitous decline in New Melones storage provide us with a unique opportunity to gain insight of the relationship between New Melones storage and the temperature below Goodwin Dam.

It should be noted that this is just a crude assessment as the temperature is greatly influenced by the thermal structure of the reservoir which depends on depletion of cold/warm water from the reservoir resulting from preceding operation strategies.

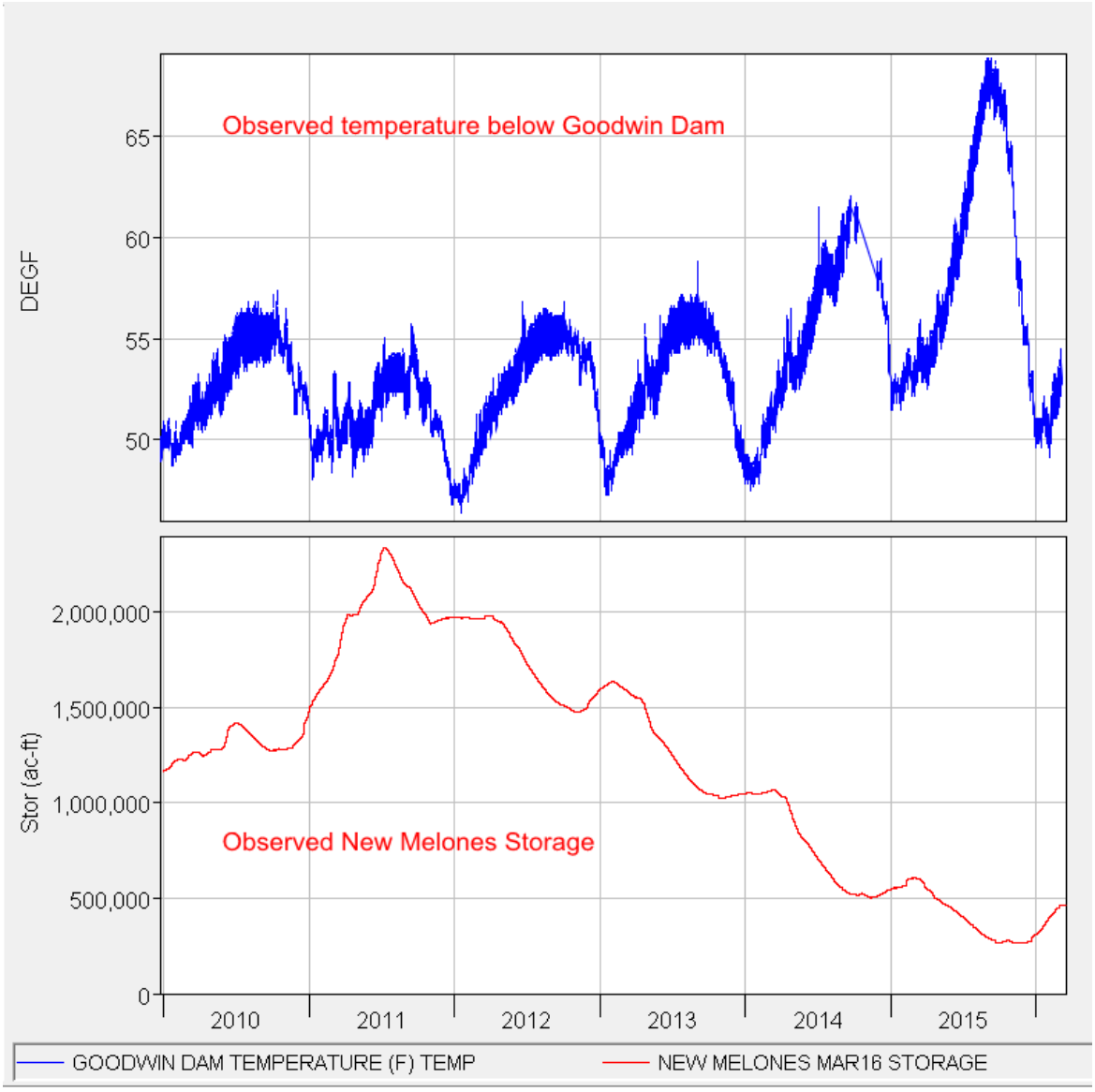


Figure 17 : Goodwin Observed Temperatures vs. New Melones Storage