Sacramento River Temperature Task Group Meeting

March 27, 2014

Conference Line: 877-718-6527
Pass code: 1954134

Agenda

1. Introductions

2. Fishery update

3. Hydrology & Operations update
    a. Daily CVP Water Supply Report ***
    b. Drought outlook graph***
    c. Snow water content***
    d. March 90% and 50% forecasts ***

4. Discussion of recent temperature model runs
    a. Temperature studies packet ***

5. Next meeting

***handouts

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. BUREAU OF RECLAMATION-CENTRAL VALLEY PROJECT-CALIFORNIA

DAILY CVP WATER SUPPLY REPORT

MARCH 25, 2014

RUN DATE: March 26, 2014

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2013	WY 2014	15 YR MEDIAN
TRINITY	LEWISTON	320	289	300
SACRAMENTO	KESWICK	4,047	3,077	4,047
FEATHER	OROVILLE (SWP)	2,300	800	1,750
AMERICAN	NIMBUS	1,300	541	1,748
STANISLAUS	GOODWIN	208	428	454
SAN JOAQUIN	FRIANT	649	141	250

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2013	WY 2014	% OF 15 YR AVG
TRINITY	2,448	1,816	2,051	1,293	71
SHASTA	4,552	3,598	3,743	2,086	58
OROVILLE (SWP)	3,538	2,424	2,939	1,627	67
FOLSOM	977	614	584	409	67
NEW MELONES	2,420	1,640	1,560	1,048	64
FED. SAN LUIS	966	838	776	470	56
MILLERTON	520	374	321	169	45
TOT. N. CVP	11,360	8,506	8,714	5,306	62

ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2014	DRIEST WY 1977	WETTEST WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	208	73	1,162	532	39
SHASTA	1,415	1,351	6,574	2,971	48
FOLSOM	422	189	3,355	1,075	39
NEW MELONES	170	0	1,089	371	46
MILLERTON	64	107	1,529	411	16

ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

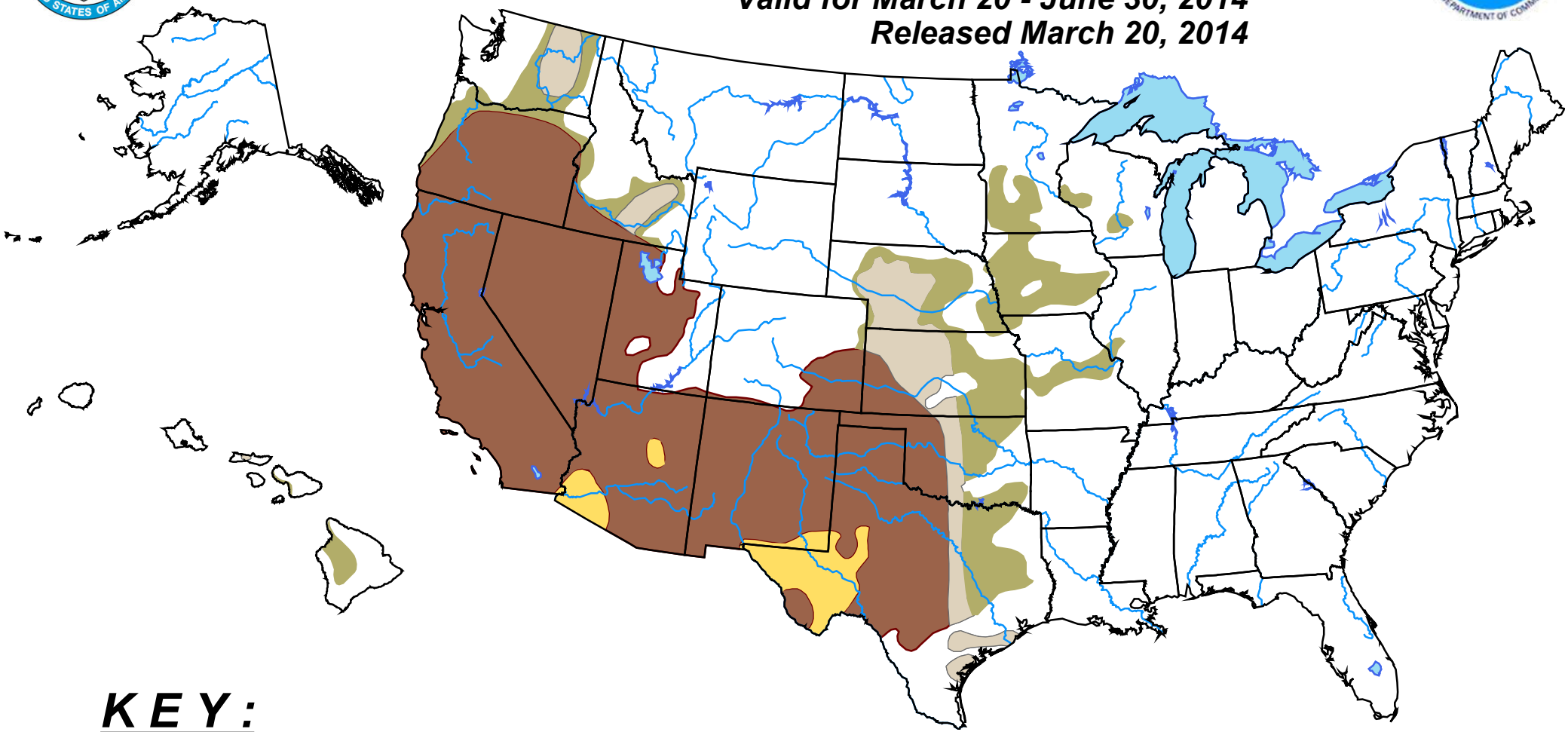
RESERVOIR	CURRENT WY 2014	DRIEST WY 1977	WETTEST WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	12.81	8.94	47.73	26.43 (52)	48	0.00
SACRAMENTO AT SHASTA DAM	22.12	10.78	96.82	51.03 (57)	43	0.00
AMERICAN AT BLUE CANYON	30.80	15.20	91.33	53.38 (39)	58	0.28
STANISLAUS AT NEW MELONES	10.01	0.00	41.10	22.18 (36)	45	0.00
SAN JOAQUIN AT HUNTINGTON LK	10.60	10.50	72.30	33.77 (39)	31	0.00

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for March 20 - June 30, 2014

Released March 20, 2014



KEY:

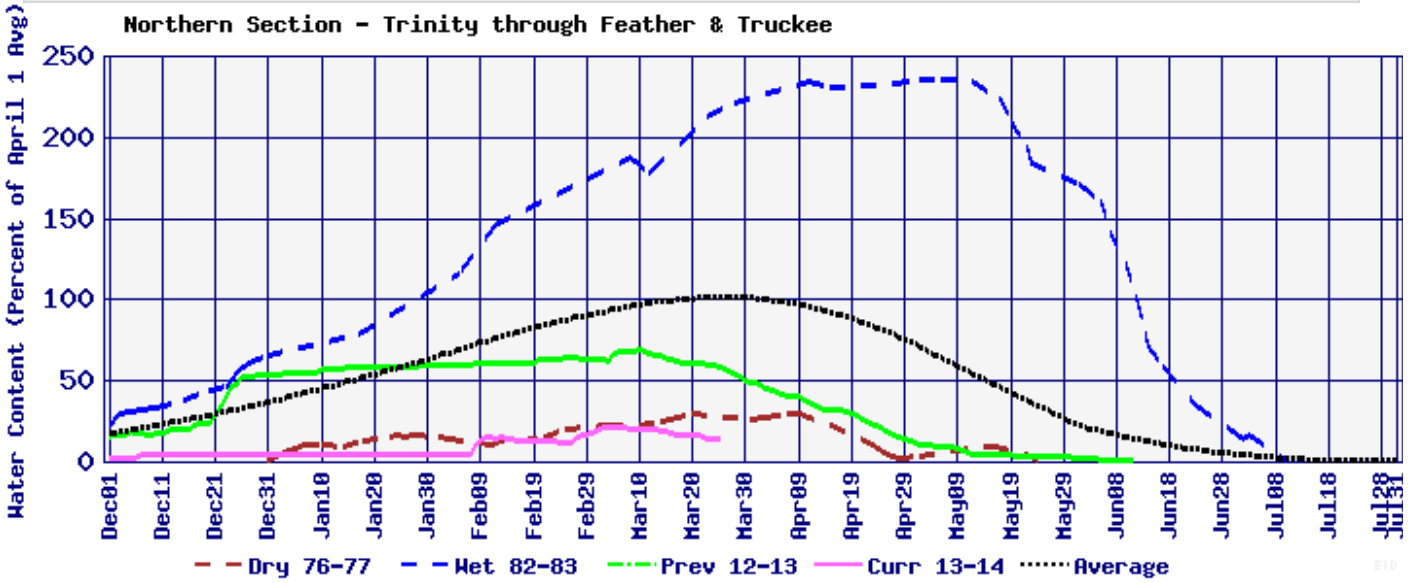
- **Drought persists or intensifies**
- **Drought remains but improves**
- **Drought removal likely**
- **Drought development likely**

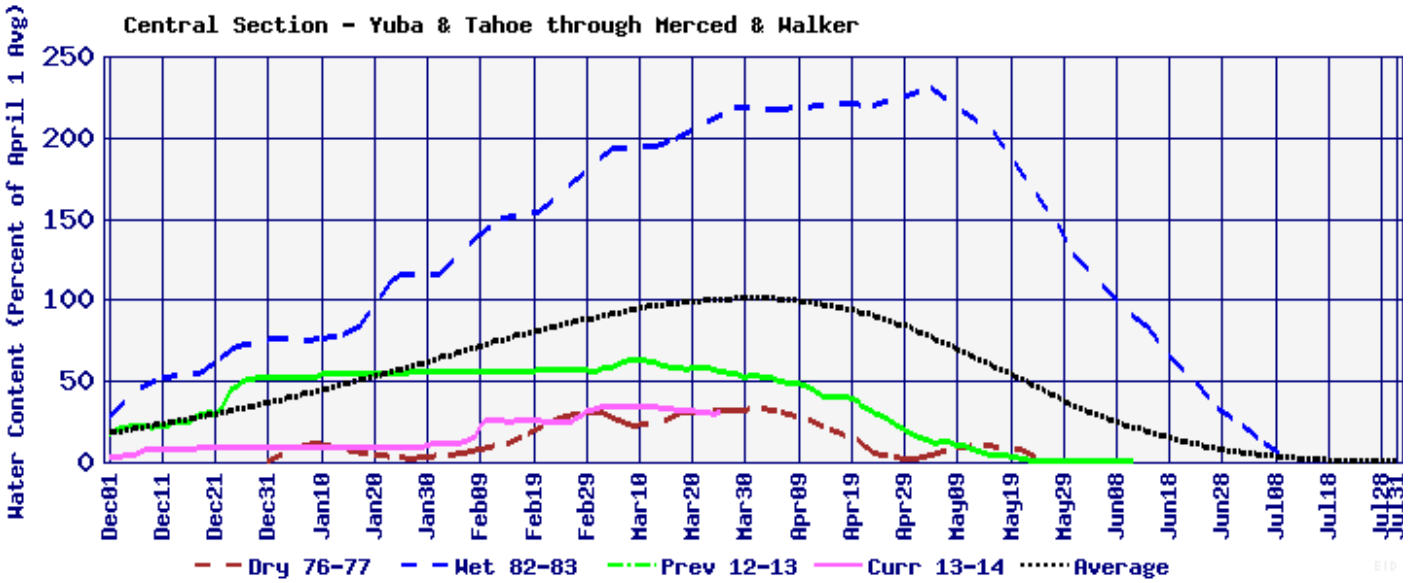
Author: Anthony Artusa, Climate Prediction Center, NOAA
http://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.html

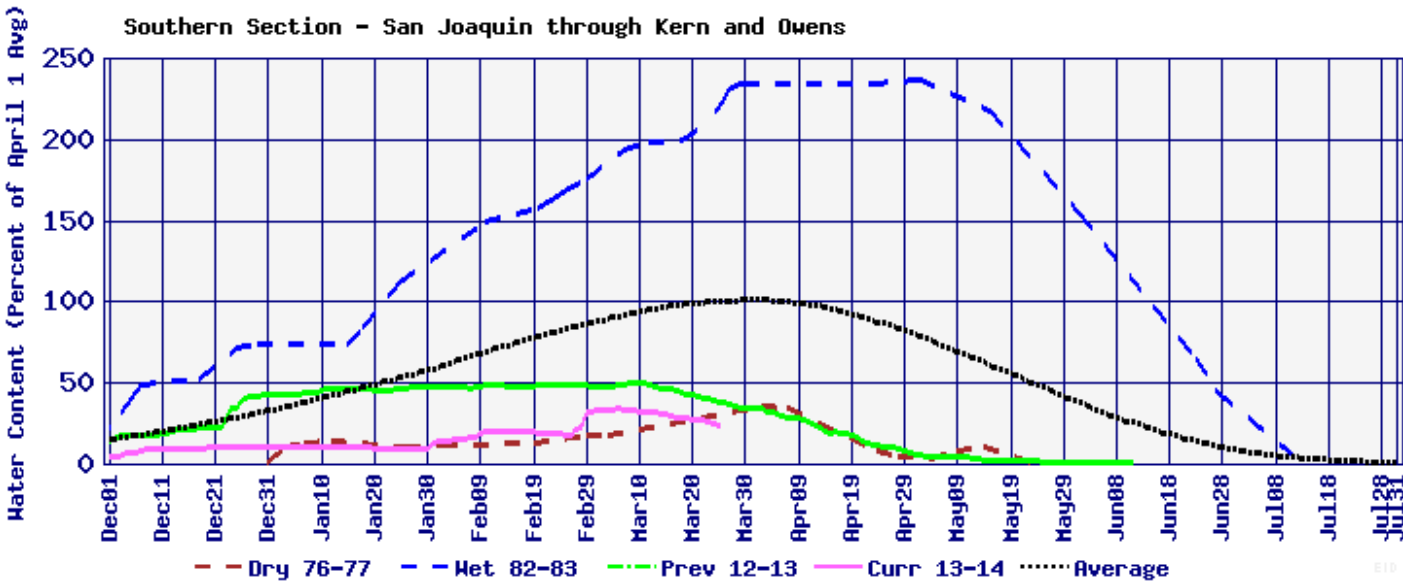
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance. Use caution for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity).
For weekly drought updates, see the latest U.S. Drought Monitor.
NOTE: The tan area areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period although drought will remain.
The Green areas imply drought removal by the end of the period (D0 or none)

California Snow Water Content

PERCENT OF APRIL 1 AVERAGE, MARCH 26, 2014







Storages

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

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	**1187**	**1374**	**1264**	**1075**	**912**	**760**	**605**	**455**	**399**	**394**	**391**	**392**	**1098**
	Elev.	2292	2282	2263	2245	2225	2203	2176	2165	2164	2163	2163	2266
Whiskeytown	**206**	**206**	**238**	**238**	**238**	**238**	**238**	**230**	**230**	**201**	**182**	**186**	**206**
	Elev.	1199	1209	1209	1209	1209	1209	1207	1207	1197	1190	1192	1199
Shasta	**1773**	**2053**	**1891**	**1663**	**1335**	**963**	**717**	**662**	**608**	**626**	**702**	**825**	**1028**
	Elev.	960	951	936	913	882	856	850	843	845	854	868	888
Folsom	**305**	**422**	**440**	**447**	**430**	**405**	**390**	**373**	**378**	**387**	**409**	**439**	**513**
	Elev.	406	409	410	407	404	402	399	400	401	404	409	418
New Melones	**1060**	**1064**	**994**	**894**	**789**	**672**	**559**	**474**	**454**	**459**	**464**	**469**	**566**
	Elev.	951	942	927	911	891	870	852	847	849	850	851	871
San Luis	**369**	**444**	**397**	**313**	**210**	**88**	**39**	**137**	**300**	**433**	**591**	**764**	**771**
	Elev.	442	432	414	398	375	360	375	418	449	481	509	531
Total		5563	5224	4631	3914	3126	2548	2332	2369	2500	2739	3075	4182

State End of the Month Reservoir Storage (TAF)

Oroville	**1407**	**1434**	**1446**	**1318**	**1129**	**990**	**880**	**864**	**846**	**763**	**707**	**694**	**733**
	Elev.	723	724	708	683	663	645	642	639	624	614	611	619
San Luis	**307**	**451**	**405**	**323**	**300**	**249**	**206**	**198**	**371**	**525**	**700**	**852**	**1105**
Total San Luis (TAF)	**676**	**895**	**802**	**636**	**511**	**337**	**245**	**336**	**671**	**959**	**1290**	**1616**	**1876**

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	36	92	47	28	28	27	23	18	18	18	17
	cfs	**300**	**600**	**1,498**	**783**	**450**	**450**	**450**	**373**	**300**	**300**	**300**	**300**
Clear Creek	TAF	12	12	12	9	7	5	9	12	12	12	12	11
	cfs	**200**	**200**	**200**	**150**	**120**	**85**	**150**	**200**	**200**	**200**	**200**	**200**
Sacramento	TAF	200	470	510	589	627	483	294	281	230	200	200	180
	cfs	**3250**	**7900**	**8300**	**9900**	**10200**	**7860**	**4945**	**4573**	**3874**	**3250**	**3250**	**3250**
American	TAF	34	30	38	31	37	34	30	31	30	31	31	28
	cfs	**550**	**500**	**621**	**529**	**599**	**550**	**508**	**500**	**506**	**500**	**500**	**500**
Stanislaus	TAF	23	29	25	34	26	21	14	35	12	12	13	12
	cfs	**368**	**480**	**410**	**564**	**425**	**346**	**240**	**577**	**200**	**200**	**213**	**214**
Feather	TAF	49	48	51	65	49	49	48	49	48	49	49	44
	cfs	**800**	**800**	**822**	**1100**	**800**	**800**	**800**	**800**	**800**	**800**	**800**	**800**

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	1	149	126	127	128	127	122	41	0	6	13	-344
Spring Crk. PP	**8**	**120**	**120**	**120**	**120**	**120**	**120**	**30**	**19**	**17**	**4**	**5**

Delta Summary (TAF)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy		153	45	46	45	45	80	172	209	158	175	190	46
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		7	6.4	6.4	6.4	4.9	5.6	6.4	7	8.4	9.2	9.2	7
Total USBR		160	51	53	51	50	86	178	216	166	184	199	53
State Export		153	45	31	50	5	10	30	180	156	175	200	300
Total Export		313	96	83	101	55	96	208	396	322	359	399	353
COA Balance		0	0	0	0	19	19	34	65	30	30	30	30
Old/Middle River Std.													
Old/Middle R. calc.		-4,052	-1,218	-1,075	-1,429	-874	-1,441	-2,937	-4,771	-4,204	-4,538	-5,033	-4,822
Computed DOI		9224	4841	4002	2505	2505	2505	2505	2505	3496	4116	5384	4809
Excess Outflow		33	840	0	0	0	0	0	0	0	618	878	810
% Export/Inflow		32%	18%	16%	19%	11%	23%	45%	71%	61%	64%	56%	57%
% Export/Inflow std.		35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	433		2,367		727		275	
Year to Date + Forecasted % of mean	36%		43%		27%		26%	

Storages

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

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	**1187**	**1382**	**1416**	**1271**	**1084**	**907**	**725**	**546**	**522**	**519**	**551**	**614**	**725**
	Elev.	2293	2296	2283	2264	2244	2221	2193	2189	2188	2194	2204	2221
Whiskeytown	**206**	**206**	**238**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**
	Elev.	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199
Shasta	**1773**	**2105**	**1977**	**1819**	**1599**	**1346**	**1141**	**1081**	**1102**	**1217**	**1406**	**1819**	**2388**
	Elev.	963	956	946	932	914	898	893	894	904	919	946	979
Folsom	**305**	**435**	**521**	**533**	**440**	**355**	**304**	**255**	**279**	**318**	**378**	**453**	**575**
	Elev.	408	419	421	409	396	388	379	383	390	400	410	426
New Melones	**1060**	**1070**	**1028**	**949**	**855**	**760**	**665**	**597**	**586**	**606**	**631**	**666**	**732**
	Elev.	952	946	935	921	906	890	877	875	879	884	890	902
San Luis	**369**	**470**	**417**	**307**	**164**	**88**	**159**	**309**	**445**	**602**	**853**	**1022**	**1092**
	Elev.	448	435	414	392	371	373	391	417	451	495	522	534
Total		5667	5597	5116	4380	3694	3232	3027	3140	3468	4025	4780	5718

State End of the Month Reservoir Storage (TAF)

Oroville	**1407**	**1496**	**1562**	**1449**	**1240**	**1064**	**964**	**940**	**970**	**979**	**1069**	**1288**	**1684**
	Elev.	730	738	724	698	674	659	655	660	661	674	705	751
San Luis	**307**	**478**	**410**	**329**	**295**	**225**	**163**	**145**	**221**	**384**	**598**	**750**	**825**
Total San Luis (TAF)	**676**	**948**	**828**	**637**	**459**	**313**	**323**	**454**	**666**	**987**	**1450**	**1773**	**1917**

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	36	92	47	28	28	27	28	18	18	18	17
	cfs	**300**	**600**	**1,498**	**783**	**450**	**450**	**450**	**450**	**300**	**300**	**300**	**300**
Clear Creek	TAF	12	11	12	12	5	5	9	12	13	12	12	11
	cfs	**200**	**190**	**190**	**200**	**85**	**85**	**150**	**200**	**225**	**200**	**200**	**200**
Sacramento	TAF	200	461	530	550	562	505	357	246	193	200	200	194
	cfs	**3250**	**7750**	**8615**	**9250**	**9149**	**8214**	**6000**	**4000**	**3250**	**3250**	**3250**	**3500**
American	TAF	37	59	97	145	125	92	87	52	51	52	77	139
	cfs	**600**	**1000**	**1571**	**2437**	**2035**	**1504**	**1455**	**850**	**850**	**850**	**1250**	**2500**
Stanislaus	TAF	15	29	25	32	22	23	14	35	12	12	13	12
	cfs	**243**	**480**	**410**	**536**	**364**	**368**	**240**	**577**	**200**	**200**	**213**	**214**
Feather	TAF	49	48	68	94	137	108	65	58	57	58	58	53
	cfs	**800**	**800**	**1100**	**1575**	**2225**	**1750**	**1100**	**950**	**950**	**950**	**950**	**950**

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	10	50	117	156	155	156	154	8	17	7	3	2
Spring Crk. PP	**35**	**30**	**120**	**150**	**150**	**150**	**145**	**30**	**10**	**10**	**25**	**35**

Delta Summary (TAF)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy		185	45	46	64	70	189	280	227	200	282	200	125
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		6.35	6.35	6.35	4.9	5.55	6.35	7	8.4	9.2	9.15	7	7
Total USBR		191	51	52	69	76	195	287	235	209	291	207	132
State Export		185	30	46	71	30	29	45	183	208	300	200	125
Total Export		376	81	99	140	106	224	332	418	417	591	407	257
COA Balance		0	0	0	0	-1	4	5	5	5	5	5	5
Old/Middle R. std.													
Old/Middle R. calc.		-4,404	-746	-923	-1,804	-1,463	-2,964	-4,454	-5,000	-5,242	-7,260	-4,875	-2,575
Computed DOI		12444	8539	6198	4001	4002	2993	3009	3367	4270	6182	13046	22297
Excess Outflow		2294	151	2196	0	0	0	0	374	773	2684	8540	10896
% Export/Inflow		31%	11%	15%	22%	18%	40%	54%	63%	63%	64%	34%	17%
% Export/Inflow std.		35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	544		2,732		1,017		413	
Year to Date + Forecasted % of mean	45%		49%		37%		39%	

March 25, 2014

Upper Sacramento River – March 2014 Preliminary Temperature Analysis

Summary of Temperature Target Results by Month

Initial Target Location	JUN	JUL	AUG	SEP	OCT
90%-Exceedance Outlook (Figure 1)					
Sac. R. above Clear Creek (CCR)	**CCR**	**CCR**	**Keswick ~** 56˚F to 62˚F		
50%-Exceedance Outlook (Figure 4)					
Sac. R. above Clear Creek (CCR)	**CCR**	**CCR**	**CCR**	**CCR**	**Kwk~**56˚F

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. Operation is based on the March 2014 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90% and 50% exceedances.
2. The profiles used for Shasta, Trinity and Whiskeytown were taken on March 12, March 18, and March 12, 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 is possible through about mid-August (Figure 1). By early August, the TCD intake level will be through the side gates. Shasta Dam release temperature is expected to exceed 56˚F by late August, nearing 62˚F by mid-September.

Figure 2 shows temperature results for Clear Creek at Igo.

Figure 3 includes results for the Trinity River at Lewiston Dam. The dashed lines are the 2009 mean daily temperatures at selected locations. **NOTE**: There are no releases through the auxiliary outlet works (AOW) in this analysis.

50%-Exceedance:
A temperature target location at Clear Creek is possible through September (Figure 4). By September, the TCD intake will be through the side gates. Shasta Dam release temperature is expected to approach 56˚F by mid-October.

Figure 5 shows temperature results for Clear Creek at Igo.

Figure 6 includes results for the Trinity River at Lewiston Dam. The dashed lines are the 2009 mean daily temperatures at selected locations. **NOTE**: There are no releases through the auxiliary outlet works (AOW) in this analysis.

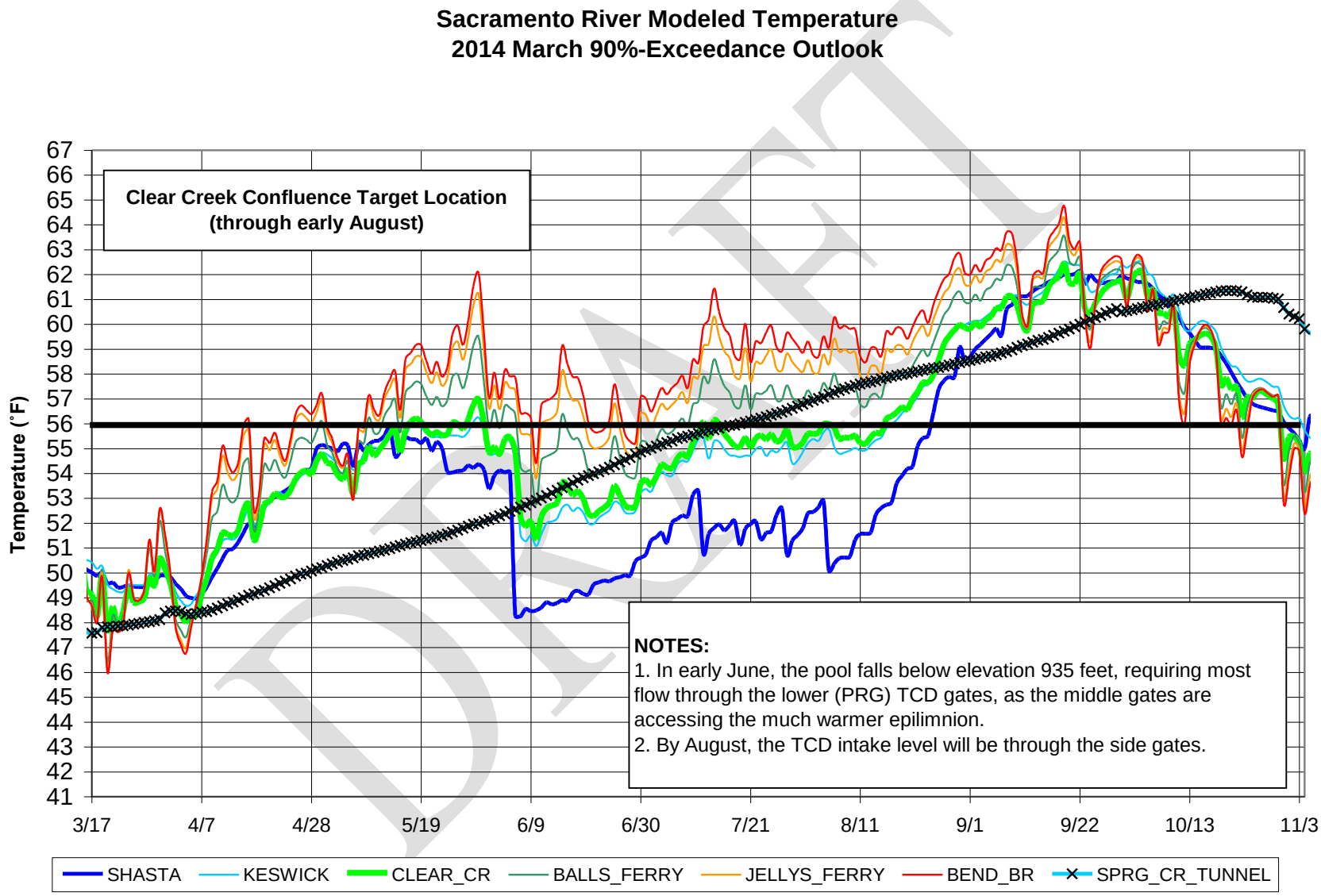

Sacramento River Modeled Temperature
2014 March 90%-Exceedance Outlook
Clear Creek Confluence Target Location
(through early August)
Temperature (°F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
3/17
4/7
4/28
5/19
6/9
6/30
7/21
8/11
9/1
9/22
10/13
11/3
NOTES:
1. In early June, the pool falls below elevation 935 feet, requiring most flow through the lower (PRG) TCD gates, as the middle gates are accessing the much warmer epilimnion.
2. By August, the TCD intake level will be through the side gates.
SHASTA
KESWICK
CLEAR_CR
BALLS_FERRY
JELLYS_FERRY
BEND_BR
SPRG_CR_TUNNEL

Figure 1

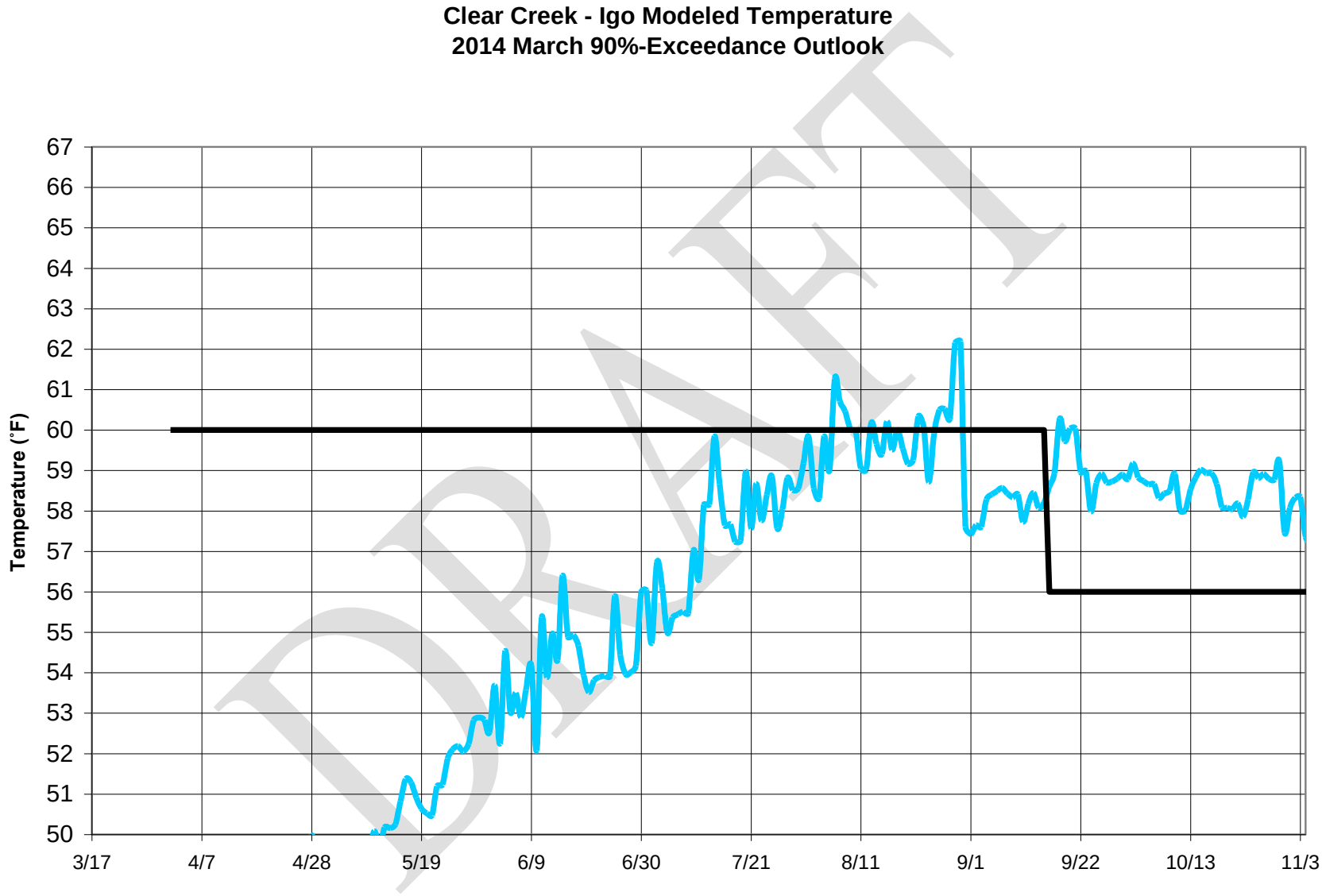


Figure 2

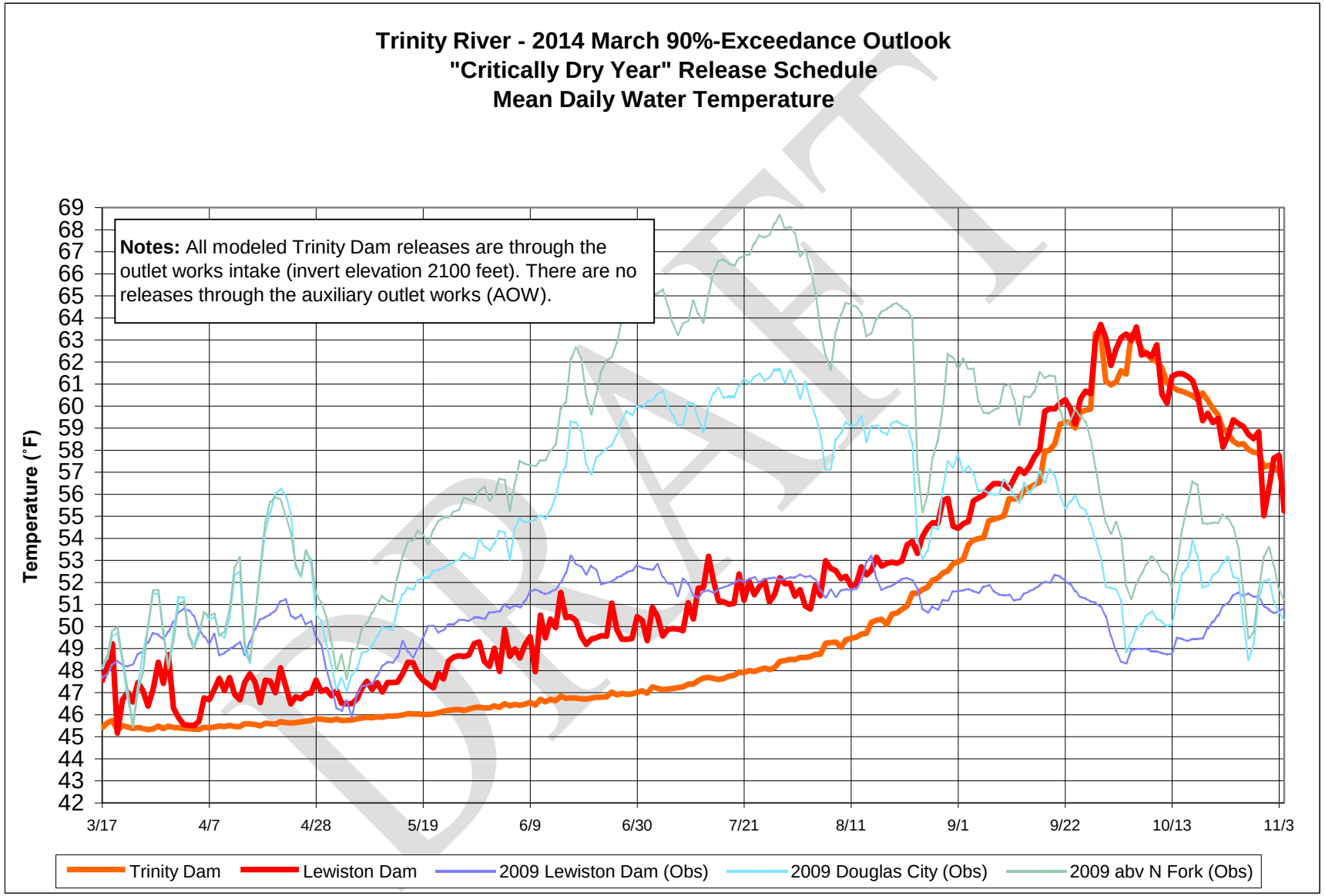

Trinity River - 2014 March 90%-Exceedance Outlook
"Critically Dry Year" Release Schedule
Mean Daily Water Temperature
Notes: All modeled Trinity Dam releases are through the outlet works intake (invert elevation 2100 feet). There are no releases through the auxiliary outlet works (AOW).
Temperature (˚F)
69
68
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
3/17
4/7
4/28
5/19
6/9
6/30
7/21
8/11
9/1
9/22
10/13
11/3
Trinity Dam
Lewiston Dam
2009 Lewiston Dam (Obs)
2009 Douglas City (Obs)
2009 abv N Fork (Obs)

Figure 3

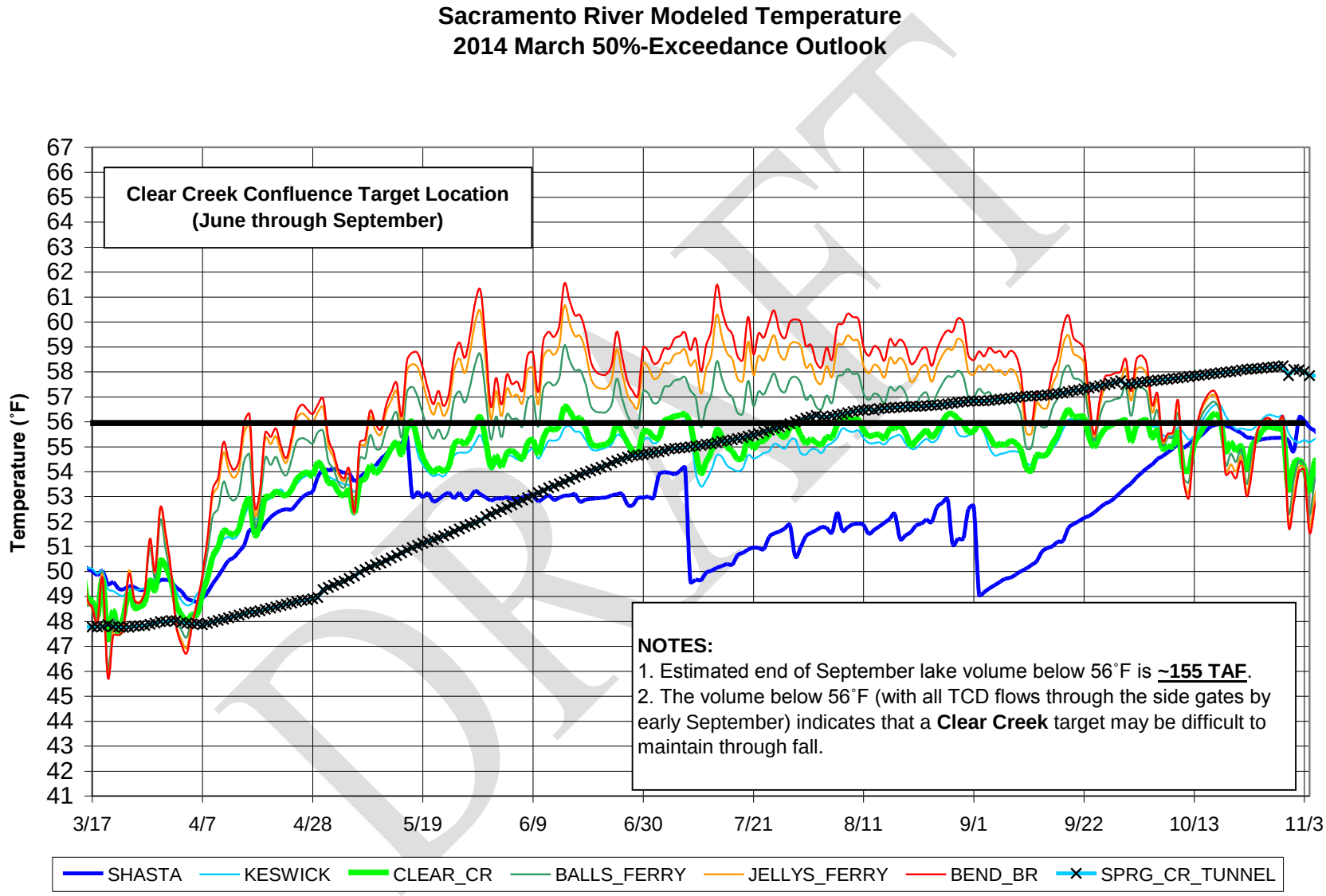

Sacramento River Modeled Temperature
2014 March 50%-Exceedance Outlook
Clear Creek Confluence Target Location
(June through September)
Temperature (˚F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
41
3/17
4/7
4/28
5/19
6/9
6/30
7/21
8/11
9/1
9/22
10/13
11/3
NOTES:
1. Estimated end of September lake volume below 56˚F is ~155 TAF.
2. The volume below 56˚F (with all TCD flows through the side gates by early September) indicates that a Clear Creek target may be difficult to maintain through fall.
SHASTA
KESWICK
CLEAR_CR
BALLS_FERRY
JELLYS_FERRY
BEND_BR
SPRG_CR_TUNNEL

Figure 4

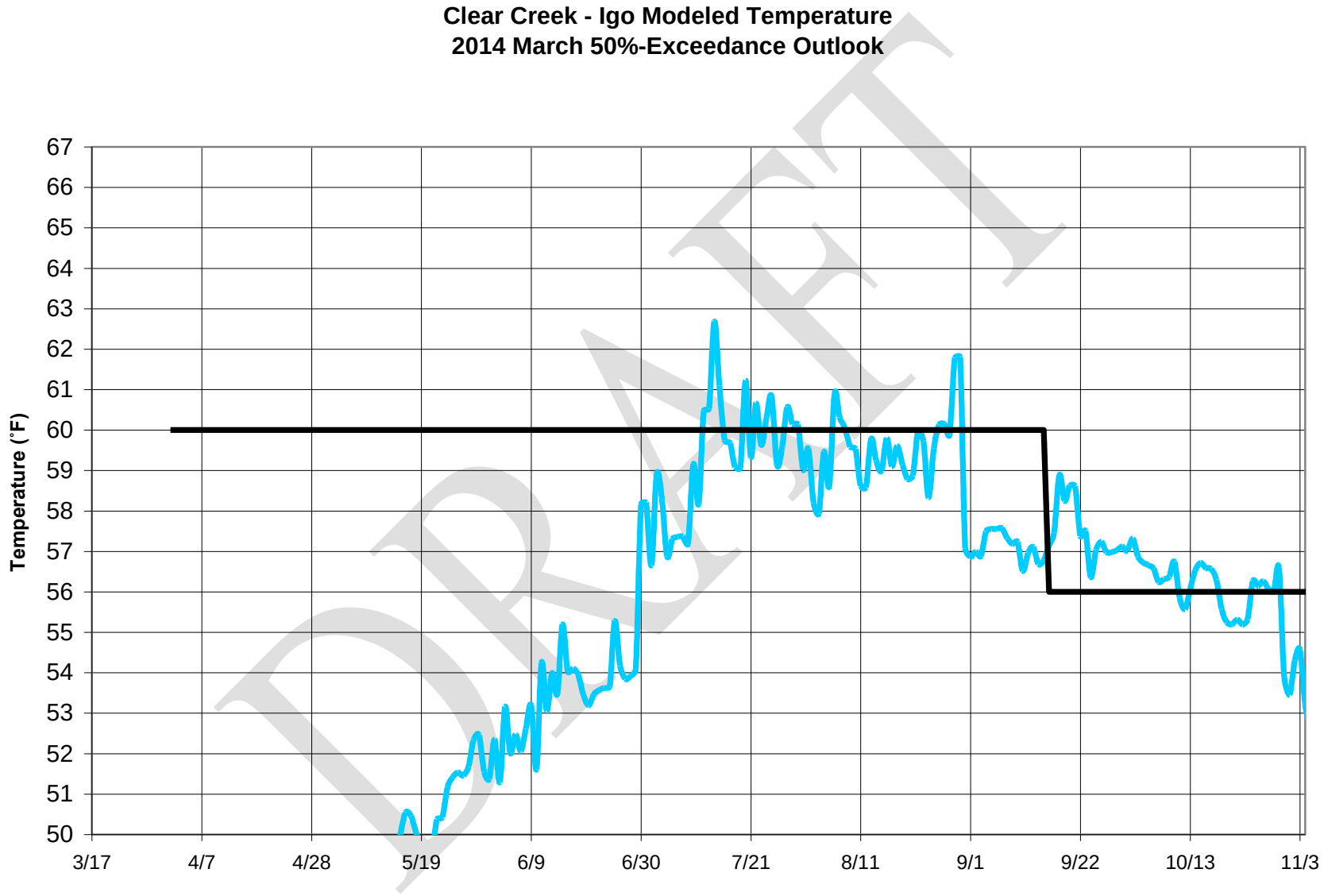

Clear Creek - Igo Modeled Temperature
2014 March 50%-Exceedance Outlook
Temperature (˚F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
3/17
4/7
4/28
5/19
6/9
6/30
7/21
8/11
9/1
9/22
10/13
11/3
DRAFT

Figure 5

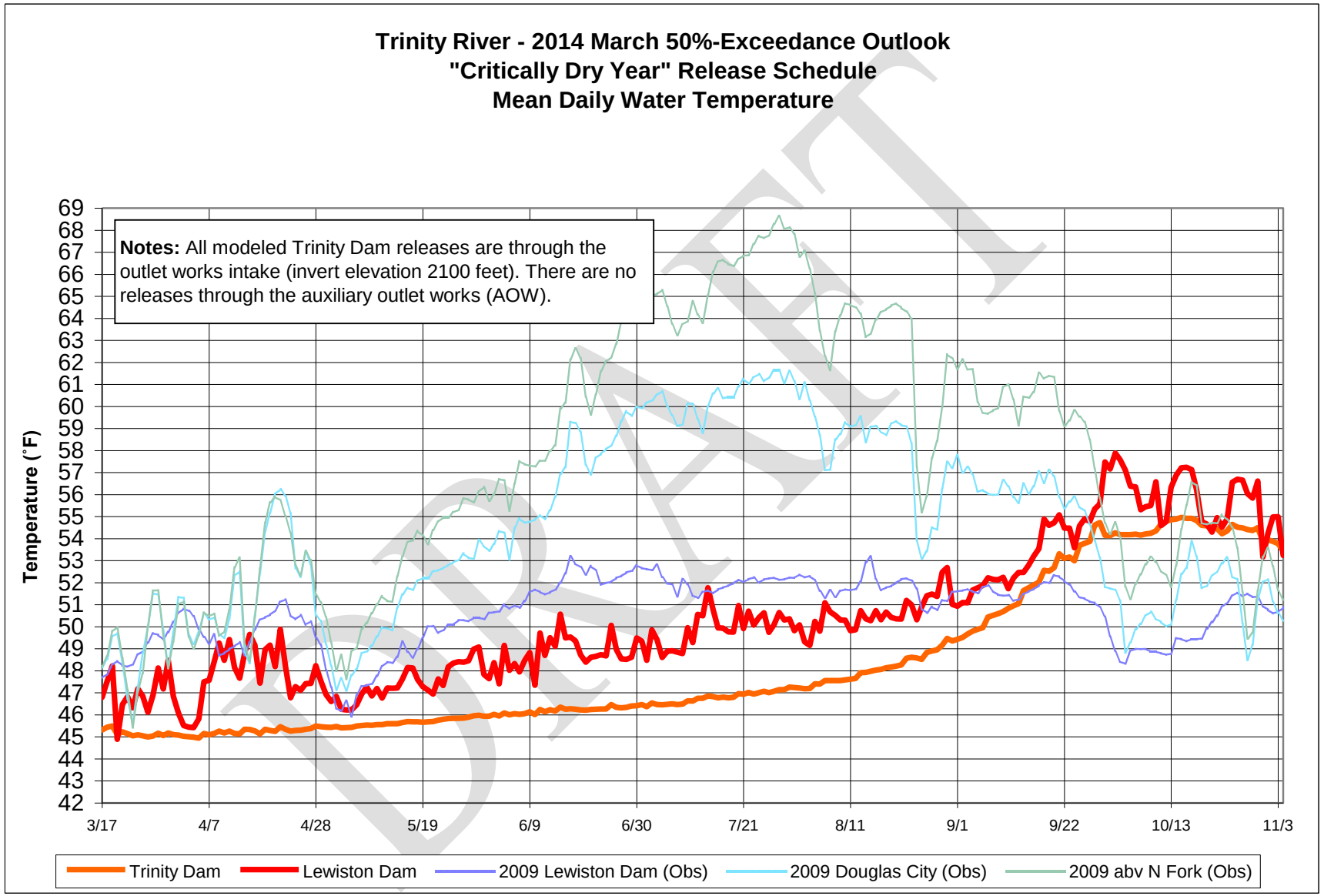
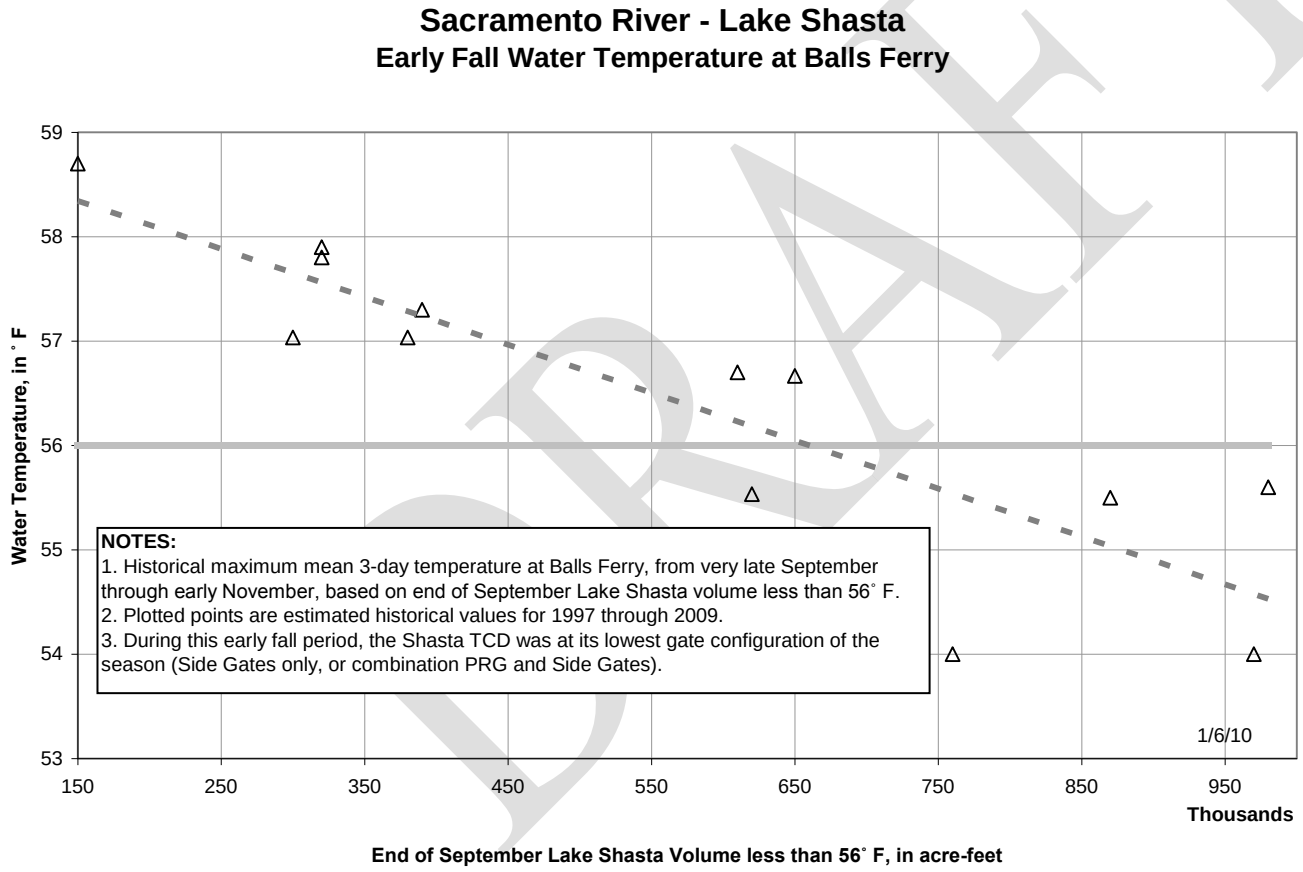

Trinity River - 2014 March 50%-Exceedance Outlook
"Critically Dry Year" Release Schedule
Mean Daily Water Temperature
Notes: All modeled Trinity Dam releases are through the outlet works intake (invert elevation 2100 feet). There are no releases through the auxiliary outlet works (AOW).
Temperature (˚F)
69
68
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
43
42
3/17
4/7
4/28
5/19
6/9
6/30
7/21
8/11
9/1
9/22
10/13
11/3
Trinity Dam
Lewiston Dam
2009 Lewiston Dam (Obs)
2009 Douglas City (Obs)
2009 abv N Fork (Obs)

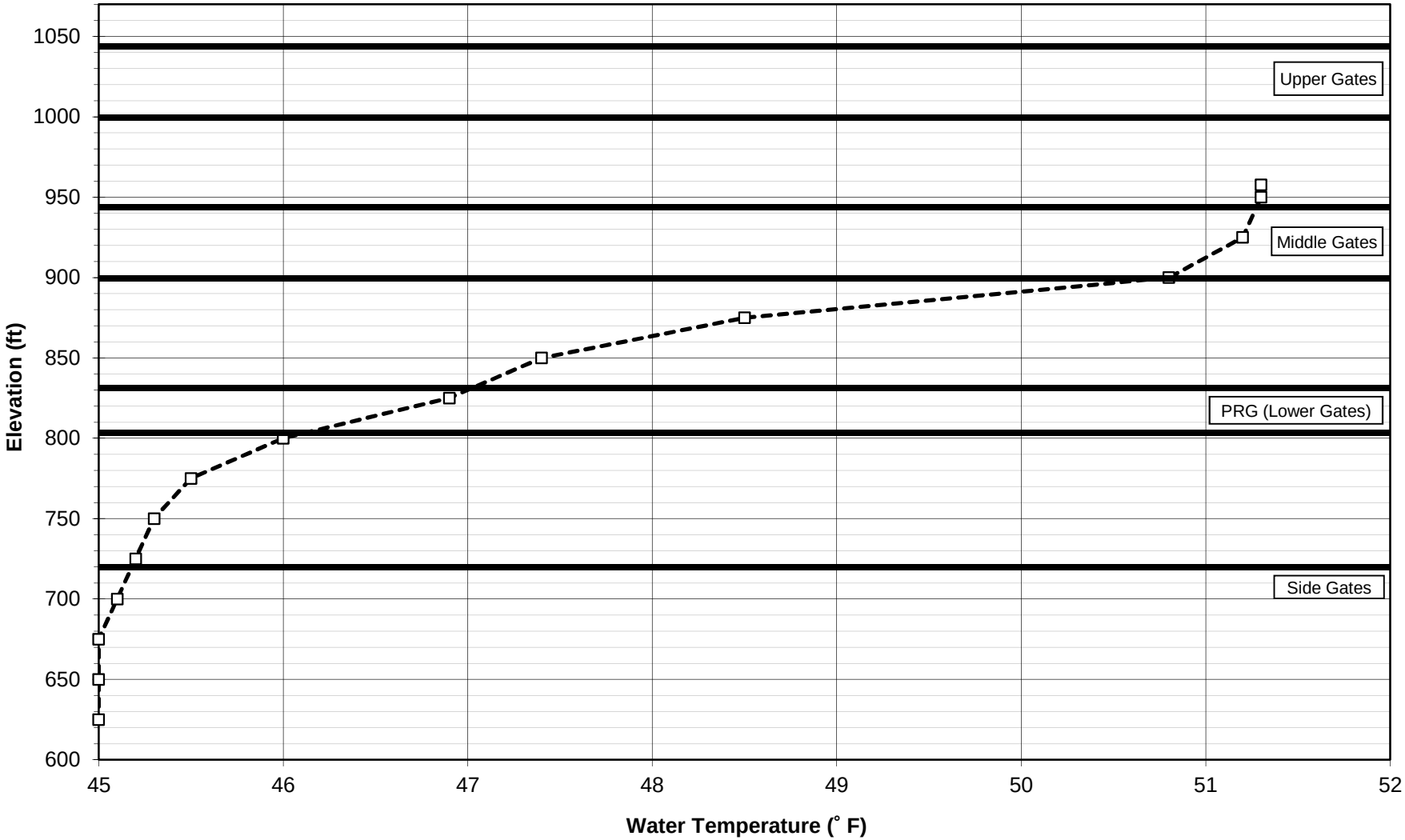
Figure 6

Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well from late September through fall. One factor is that the modeled release temperatures are cooler than has historically been achieved when all release is through the side gates (lowest gates), especially when there's a large temperature gradient between the pressure relief gates (PRG) and the side gates.
2. Based on historical records, the end-of-September Lake Shasta volume below 56˚F is a reasonable indicator of fall water temperature in the river reach to Balls Ferry.
3. For river temperatures not to exceed 56 ˚F downstream to Balls Ferry, the end-of-September lake volume less than 56˚F should be greater than about 650 TAF, see figure below:



Lake Shasta Temperature Profile - 3/12/14



Trinity Lake Temperature Profile - 3/18/14