RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

March 22, 2018

Conference Line: 877-718-6527

Participant code: 1954134

Agenda

- Introductions
- Meeting Purpose and Overview
- Fishery update
- Hydrology & Operations update (information is available on web-pages)
    - Daily Operation
    - Summary
    - 8-Station Index and Snow Water Content March 2018
    - Operations Outlook
    - Mean Daily Water Temperatures
    - Redding 10-Day Forecasted Air Temperatures
    - Sac River Gage temp plot and air temp plot
    - Lake Shasta Isothermobath Plot
    - Lake Shasta Isotherm Statistics Plots
    - Lake Shasta Current TCD Configuration
    - Trinity Lake Isothermobath Plot
- Temperature Studies
    - March 90% Runoff Exceedance and 10% Meteorology
    - March 90% Runoff Exceedance and 50% Meteorology
    - March 50% Runoff Exceedance and 10% Meteorology
    - March 50% Runoff Exceedance and 50% Meteorology
- Updates
- Next Meeting : April 26, 2018 1:00 pm – 3:00 pm, Location TBD

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

DAILY CVP WATER SUPPLY REPORT

MARCH 20, 2018

RUN DATE: March 21, 2018

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2017	WY 2018	15 YR MEDIAN
TRINITY	LEWISTON	313	304	303
SACRAMENTO	KESWICK	7,697	3,043	3,792
FEATHER	OROVILLE (SWP)	46,100	1,050	1,350
AMERICAN	NIMBUS	5,786	1,761	1,761
STANISLAUS	GOODWIN	1,009	200	303
SAN JOAQUIN	FRIANT	7,972	300	242

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2017	WY 2018	% OF 15 YR AVG
TRINITY	2,448	1,698	2,047	1,817	107
SHASTA	4,552	3,437	3,581	3,619	105
FOLSOM	977	589	482	651	110
NEW MELONES	2,420	1,491	1,726	1,937	130
FED. SAN LUIS	966	751	963	839	112
TOTAL NORTH CVP	11,363	7,965	8,799	8,863	111
MILLERTON	520	330	234	345	104
OROVILLE (SWP)	3,538	2,359	2,810	1,648	70

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

RESERVOIR	CURRENT WY 2018	DRIEST WY 1977	WETTEST WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	236	69	1,121	546	43
SHASTA	1,740	1,306	6,265	2,914	60
FOLSOM	924	184	3,200	1,249	74
NEW MELONES	291	0	1,041	414	70
MILLERTON	371	105	1,455	432	86

ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

RESERVOIR	CURRENT WY 2018	DRIEST WY 1977	WETTEST WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	14.13	8.67	45.38	25.77 (56)	55	0.00
SACRAMENTO AT SHASTA DAM	30.11	9.78	90.94	49.75 (61)	61	0.00
AMERICAN AT BLUE CANYON	46.85	14.16	86.13	52.91 (43)	89	0.60
STANISLAUS AT NEW MELONES	15.63	0.00	37.90	21.75 (40)	72	0.00
SAN JOAQUIN AT HUNTINGTON LK	19.33	9.50	68.50	32.48 (43)	60	0.00

Upper Sacramento River Summary Conditions – March (On-going):

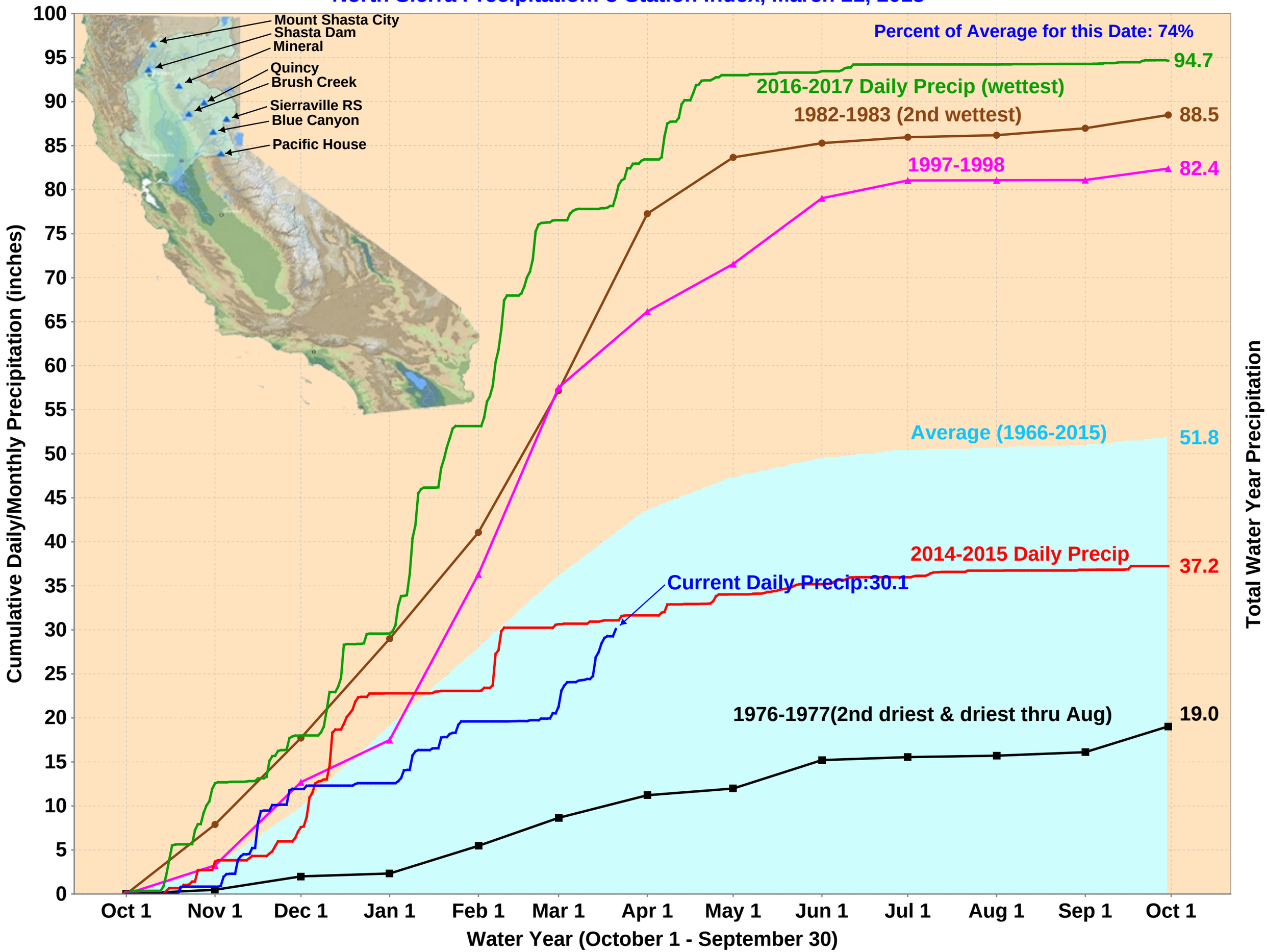
Storage/Release Management Conditions:

- Very low risk of increased releases for flood control management: no increased releases anticipated in late March or early April.
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) are below normal chances of precipitation, longer term forecasts (three-month outlook: April - June) suggest below normal chances for precipitation
- The six day projection indicates Shasta Lake watershed to receive 5+ inches of precipitation in the most favorable locations (Mar 21- Mar 27)
- The 8-Station Index precipitation total to date is poised to cross over the 2014-2015 year trend and Snow Water Content to date is 42% for the Northern California Region; expect these values to change as we head into this week's storm event
- Releases reduced to minimum, 3,250 cfs, for storage conservation
- Actual runoff in March is wetter than the March 1 forecasted estimates. March 1 Operational Outlooks have diminished value as a result of current storm events, expect updates with the April 1 forecast information.

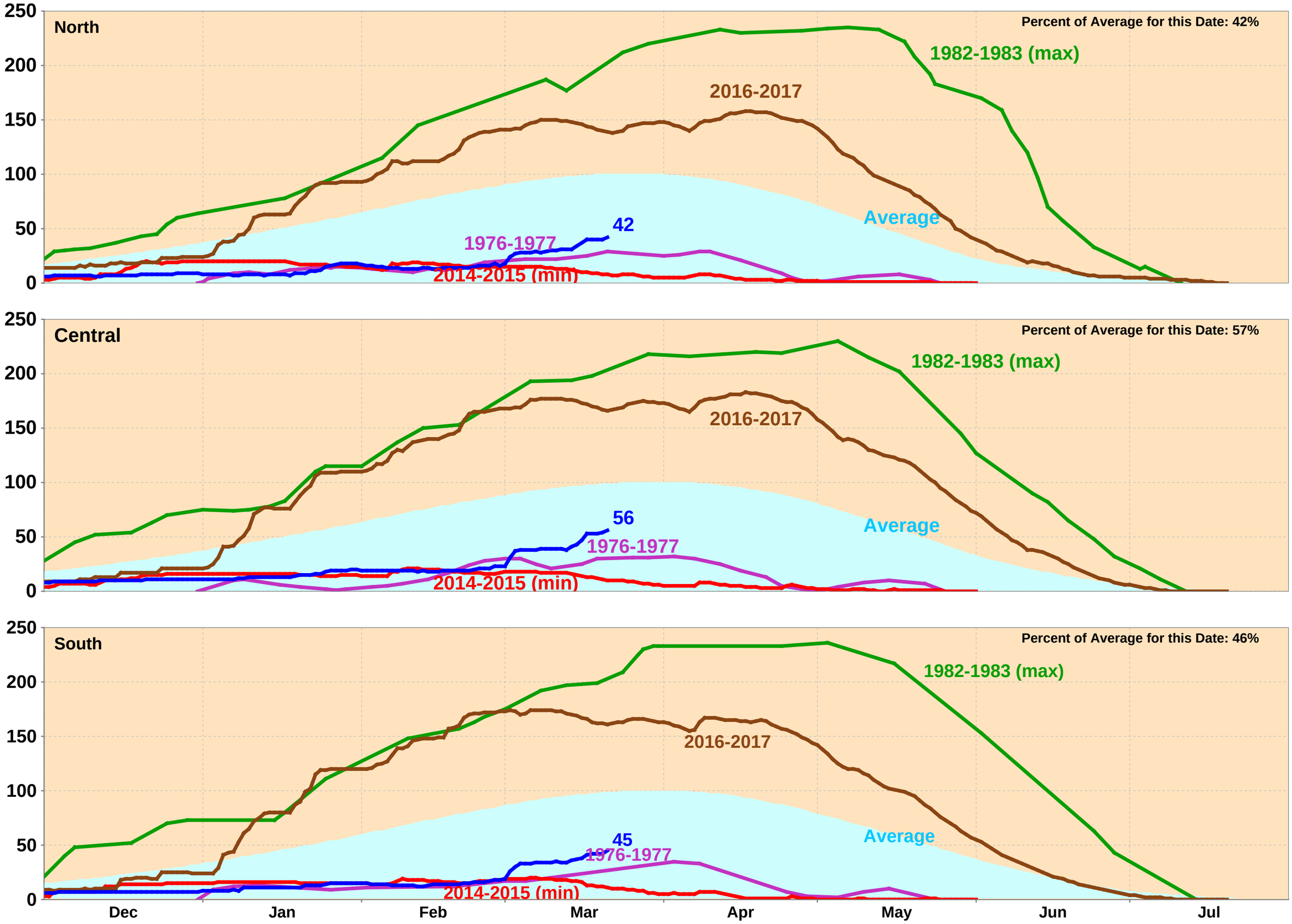
Temperature Management:

- No active temperature management
- Releases made from Upper and Middle Gates to conserve cold water pool
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) are above temperatures; longer term forecasts (three-month outlook April - June) suggest above normal temperature.
- Temperature Model results created using March 1 have diminished value as a result of current storm events, expect updates with the April 1 forecast information.

North Sierra Precipitation: 8-Station Index, March 21, 2018



California Snow Water Content, March 21, 2018, Percent of April 1 Average



Statewide Percent of April 1: 49%

Statewide Percent of Average for Date: 50%

INFORMATION BELOW HAS DIMINISHED VALUE AS A RESULT OF MARCH STORM EVENTS

DRAFT March 2018

90% Runoff Exceedance Outlook:

Inflow based on the DWR March 2018 B120, 90% Historical Inflows Oct and future months

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

		Mar	Apr	May	Jun	Jul	Aug
Shasta	3414	3729	3689	3525	3156	2637	2201
Elev.		1038	1036	1030	1015	991	969

Monthly River Releases (cfs)

Sacramento	3250	7500	8500	11000	12500	10000
Clear Creek	200	218	216	288	150	150

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug
Carr Power Plant	23	100	112	135	130	71
Spring Creek PP	30	70	105	120	120	60

50% Runoff Exceedance Outlook:

Inflow based on the DWR March 2018 B120, 50% Historical Inflows Oct and future months

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

		Mar	Apr	May	Jun	Jul	Aug
Shasta	3414	3869	3903	3808	3408	2860	2483
Elev.		1043	1044	1041	1025	1001	983

Monthly River Releases (cfs)

Sacramento	3250	7250	7500	11500	13000	10000
Clear Creek	200	218	216	288	150	150

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug
Carr Power Plant	35	36	24	71	84	85
Spring Creek PP	60	15	25	60	75	75

Please note:

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.

CVP operational forecasts or outlooks consider general system-wide dynamics and do not necessarily address specific watershed/tributary details.

CVP releases represent monthly averages.

CVP operations are updated monthly as new hydrology information is made available December through May.

Northern CVP Water Temperature Report

March - 2018

Page	Description
1	- Mean Daily Water Temperature, Release Flow Rates and Air Temperatures with Monthly Averages
2	- Redding 10-Day Forecasted Air Temperatures
3	- Sacramento River Mean Daily Water Temperature, Air Temperature and 10-Day Forecasted Air Temperature Plot
	- Water Temperature Measuring Station Details
	- Temperature Control Point Details
4	- Lake Shasta Isothermalbaths Plot
5	- Daily Maximum and 7DADM
x	- TCD Configuration (External Link)

All Data in this Report is Preliminary and Subject to Change

DATE	Mean Daily Water Temperatures (°F)													Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR	BSF[2]	JLF	BND	RDB	IGO	LWS	-----[3]	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Feb	50.8	50.0	48.9	50.1	50.1	50.3	50.1	49.9	50.0	50.1	47.4	44.6	-	3267	19	3500	51.2	48.0	51.2	39.3
03/01	49.7	49.0	47.9	49.0	48.8	49.0	**48.8**	48.5	48.6	48.3	? 46.2	43.6	-	3198	14	3141	47.0	48.5	48.3	37.2
03/02	49.9	48.8	48.2	48.9	48.6	48.6	**48.1**	48.2	48.3	48.6	45.4	43.5	-	3019	14	3114	↓ 41.5	41.3	42.6	33.7
03/03	49.5	48.8	47.8	48.8	48.8	48.9	**48.4**	48.2	48.3	48.5	46.0	43.7	-	2729	14	3115	43.0	42.1	42.8	34.5
03/04	49.5	48.9	47.8	48.7	48.6	49.0	**48.8**	48.8	48.8	49.0	46.4	44.2	-	3010	14	3114	45.0	42.5	43.3	37.5
03/05	50.0	49.0	47.7	48.8	48.8	49.2	**48.6**	48.7	48.9	49.4	46.3	44.3	-	3101	14	3117	46.0	42.8	46.2	40.5
03/06	50.1	49.0	47.6	49.0	49.2	49.8	**49.6**	49.7	49.8	49.9	46.9	44.4	-	3138	14	3116	51.0	46.9	50.6	42.6
03/07	49.6	48.9	47.8	49.3	49.4	49.8	**50.5**	50.8	51.1	51.1	47.1	44.9	-	3018	14	3115	54.5	52.0	54.5	45.3
03/08	49.8	48.9	48.2	49.5	49.7	? 50.5	**51.3**	51.9	52.1	52.2	48.1	45.7	-	3006	14	3114	56.5	54.6	55.6	45.7
03/09	49.9	48.8	47.7	49.7	49.8	50.5	**51.2**	51.7	51.9	52.5	47.7	46.0	-	3149	27	3114	55.0	51.2	52.8	47.6
03/10	50.0	48.9	47.6	49.8	50.2	50.9	**51.7**	52.0	52.2	52.7	47.9	46.3	-	3115	14	3115	57.0	51.8	54.3	48.0
03/11	49.5	48.9	47.3	49.8	50.1	51.0	**52.1**	52.8	52.9	53.5	47.8	? 46.4	-	2680	287	3134	55.5	52.8	55.2	48.8
03/12	49.5	48.8	47.6	49.9	50.0	50.6	**52.2**	53.2	53.6	54.2	47.4	46.3	-	2975	34	3144	55.0	55.1	56.5	47.4
03/13	49.2 ?	48.8	47.6	49.6	49.8	50.7	**52.5**	53.4	53.8	54.6	48.4	47.0	-	2922	22	3138	53.5	56.8	56.8	49.5
03/14	49.5 ?	48.9	47.0	49.6	49.7	50.1	**50.4**	50.8	51.2	52.5	47.4	47.6	-	971	411	3245	48.5	47.2	48.7	42.1
03/15	49.5	48.6	47.2	49.3	49.0	49.2	**48.8**	49.1	49.3	49.7	46.4	46.2	-	2575	552	3163	44.0	43.8	44.8	34.8
03/16	49.3	48.8	47.3	48.9	49.0	49.4	**48.1**	48.1	48.0	48.6	46.8	47.2	-	2406	423	3095	48.0	45.4	46.2	38.1
03/17	49.4	48.9	47.3	48.8	49.1	49.7	**49.1**	49.4	49.4	49.4	46.9	47.7	-	2050	259	3094	47.0	45.0	45.3	39.8
03/18	49.3	48.8	47.8	48.7	49.0	49.7	**49.9**	50.2	50.3	50.4	47.1	47.7	-	3084	32	3094	48.0	47.0	47.0	41.4
03/19	49.3	48.7	47.8	49.2	49.5	50.2	**50.7**	51.0	51.1	51.5	47.7	47.8	-	2782	14	3094	51.0	48.8	51.5	44.8
03/20	49.4	48.8	47.7	49.6	49.4	49.9	**50.9**	51.5	51.7	52.0	47.3	47.4	-	3134	47	3043	52.0	49.8	50.9	42.5
03/21																				
03/22																				
03/23																				
03/24																				
03/25																				
03/26																				
03/27																				
03/28																				
03/29																				
03/30																				
03/31																				
Mar	49.6	48.9	47.6	49.2	49.3	49.8	50.1	50.4	50.6	50.9	47.1	45.9	-	2803	112	3121	50.0	48.3	49.7	42.1
												Total CFS		56062	2234	62419				
												Total AF		111197	4431	123806				

Legend

- ? = 1-9 hours of data missing (Average includes estimations)
- ! = 10 or more hours of data missing (Average not calculated)
- # = Station out of service
- ↑ = Record high air temperature
- ↓ = Record low air temperature
- = Monthly Averages

Notes

[1] Temperatures are weighted averages based on individual penstock flow and temperature
Highlighted cells in the TCD column indicate a TCD change was made on that day

[2] Current control point (see page 3 for more details)

[3] Column not used this month

DATE	Redding (RDD) Daily Air Temperatures (°F)																																			
	Actual			Forecasted																																
	Previous Day			Current Day			1 Day			2 Days			3 Days			4 Days			5 Days			6 Days			7 Days			8 Days			9 Days			10 Days		
	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg	↓	↑	Avg
03/01	31	51	41.0	46	53	49.5	31	48	39.5	34	50	42.0	29	52	40.5	29	56	42.5	31	63	47.0	34	60	47.0	47	62	54.5	47	60	53.5	48	65	56.5	42	68	55.0
03/02	38	56	47.0	31	48	39.5	33	50	41.5	32	53	42.5	30	59	44.5	32	62	47.0	35	57	46.0	38	59	48.5	46	67	56.5	46	68	57.0	44	71	57.5	46	69	57.5
03/03	**31**	52	41.5	37	48	42.5	32	51	41.5	31	60	45.5	32	64	48.0	36	64	50.0	44	59	51.5	44	60	52.0	46	60	53.0	44	62	53.0	45	62	53.5	45	61	53.0
03/04	37	49	43.0	38	52	45.0	31	58	44.5	34	66	50.0	39	63	51.0	44	58	51.0	44	59	51.5	39	62	50.5	42	64	53.0	46	64	55.0	49	60	54.5	45	61	53.0
03/05	37	53	45.0	30	63	46.5	33	68	50.5	38	64	51.0	44	59	51.5	44	61	52.5	42	62	52.0	42	63	52.5	47	58	52.5	44	60	52.0	46	66	56.0	44	70	57.0
03/06	29	63	46.0	34	69	51.5	38	65	51.5	44	61	52.5	42	62	52.0	40	62	51.0	43	60	51.5	42	60	51.0	46	56	51.0	42	59	50.5	40	63	51.5	43	62	52.5
03/07	33	69	51.0	42	67	54.5	44	60	52.0	42	60	51.0	40	66	53.0	42	66	54.0	44	65	54.5	45	58	51.5	39	60	49.5	41	63	52.0	43	66	54.5	43	63	53.0
03/08	41	68	54.5	51	63	57.0	46	64	55.0	44	66	55.0	44	67	55.5	44	67	55.5	46	63	54.5	44	57	50.5	45	58	51.5	42	61	51.5	42	63	52.5	43	67	55.0
03/09	49	64	56.5	45	64	54.5	45	67	56.0	45	67	56.0	49	64	56.5	46	61	53.5	43	57	50.0	40	57	48.5	40	61	50.5	46	65	55.5	41	64	52.5	43	64	53.5
03/10	45	65	55.0	46	69	57.5	42	73	57.5	47	66	56.5	49	61	55.0	39	54	46.5	38	55	46.5	37	58	47.5	41	61	51.0	43	61	52.0	43	65	54.0	43	68	55.5
03/11	45	69	57.0	40	73	56.5	46	67	56.5	49	60	54.5	41	56	48.5	41	53	47.0	38	57	47.5	36	59	47.5	41	66	53.5	44	66	55.0	40	64	52.0	42	66	54.0
03/12	38	73	55.5	41	66	53.5	51	58	54.5	38	54	46.0	37	53	45.0	37	56	46.5	35	61	48.0	37	62	49.5	42	67	54.5	47	64	55.5	45	64	54.5	43	67	55.0
03/13	41	69	55.0	48	60	54.0	40	54	47.0	35	51	43.0	36	53	44.5	34	56	45.0	35	58	46.5	35	61	48.0	42	65	53.5	45	69	57.0	47	71	59.0	46	68	57.0
03/14	46	61	53.5	44	56	50.0	36	50	43.0	36	54	45.0	33	56	44.5	35	57	46.0	35	61	48.0	38	59	48.5	45	66	55.5	49	66	57.5	46	67	56.5	41	71	56.0
03/15	42	55	48.5	41	49	45.0	36	53	44.5	33	56	44.5	34	57	45.5	35	61	48.0	38	60	49.0	41	59	50.0	43	63	53.0	46	67	56.5	45	70	57.5	47	73	60.0
03/16	41	47	44.0	41	52	46.5	34	55	44.5	34	58	46.0	35	61	48.0	37	63	50.0	39	59	49.0	42	59	50.5	41	58	49.5	39	65	52.0	44	70	57.0	45	76	60.5
03/17	39	57	48.0	38	55	46.5	34	58	46.0	35	65	50.0	37	59	48.0	44	58	51.0	43	56	49.5	36	57	46.5	45	59	52.0	40	64	52.0	43	69	56.0	44	73	58.5
03/18	37	57	47.0	38	59	48.5	36	65	50.5	40	58	49.0	44	60	52.0	45	53	49.0	35	55	45.0	35	59	47.0	40	62	51.0	46	70	58.0	48	75	61.5	50	78	64.0
03/19	37	59	48.0	37	65	51.0	40	61	50.5	44	61	52.5	43	56	49.5	36	52	44.0	35	55	45.0	35	59	47.0	41	65	53.0	48	74	61.0	50	76	63.0	47	71	59.0
03/20	36	66	51.0	48	63	55.5	45	61	53.0	47	59	53.0	34	52	43.0	34	54	44.0	33	60	46.5	36	64	50.0	44	70	57.0	52	80	66.0	52	78	65.0	50	77	63.5
03/21	48	56	52.0	49	60	54.5	47	60	53.5	36	53	44.5	36	53	44.5	34	57	45.5	31	64	47.5	36	71	53.5	45	74	59.5	51	79	65.0	51	77	64.0	50	76	63.0
03/22																																				
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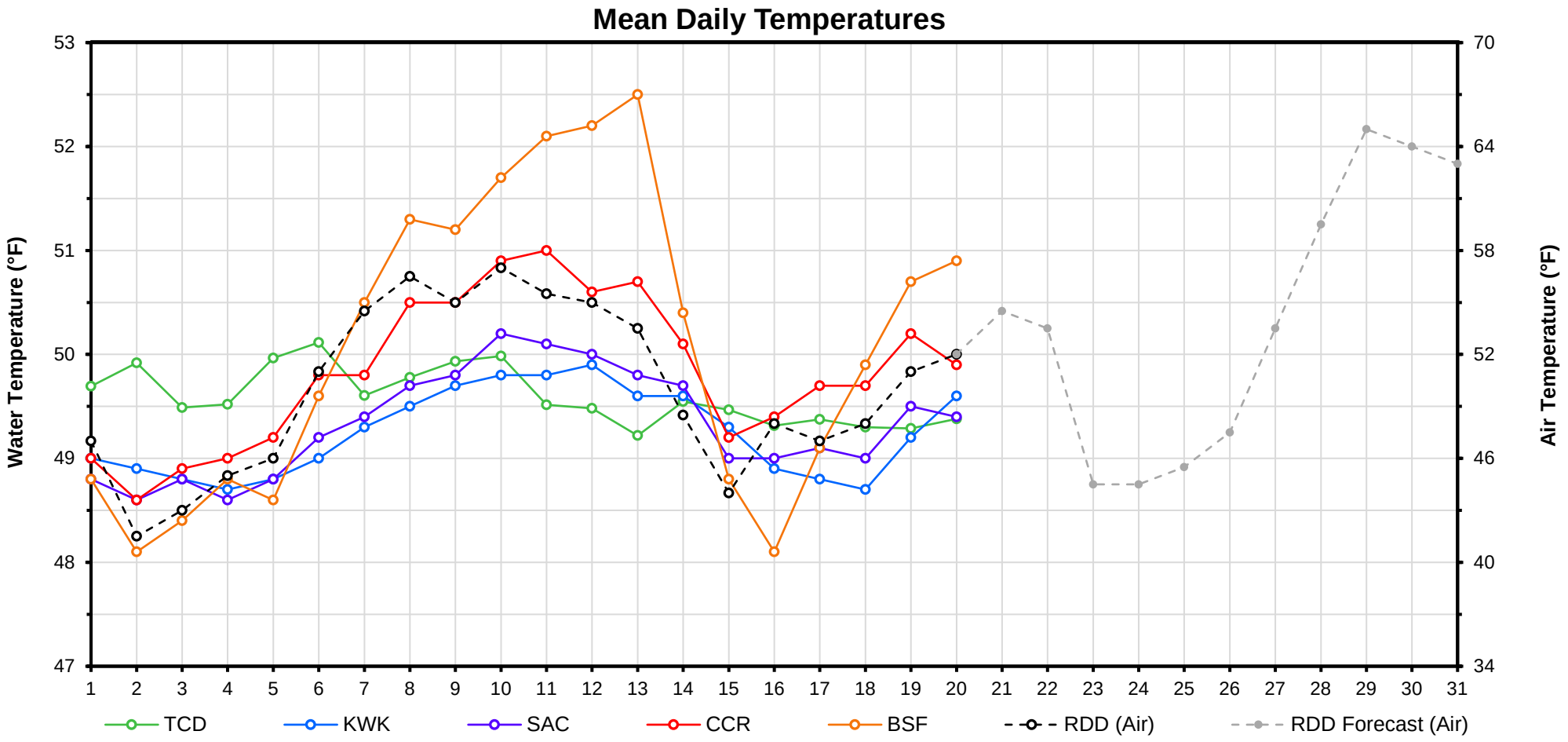
03/28																																				
03/29																																				
03/30																																				
03/31																																				

Web Links

10-Day Min/Max Forecast
Previous Days Min/Max Actuals

Legend

NR = Forecasted temperatures not recorded
100 = Previous day actual temperatures in red and bolded indicate a record temperature for that date



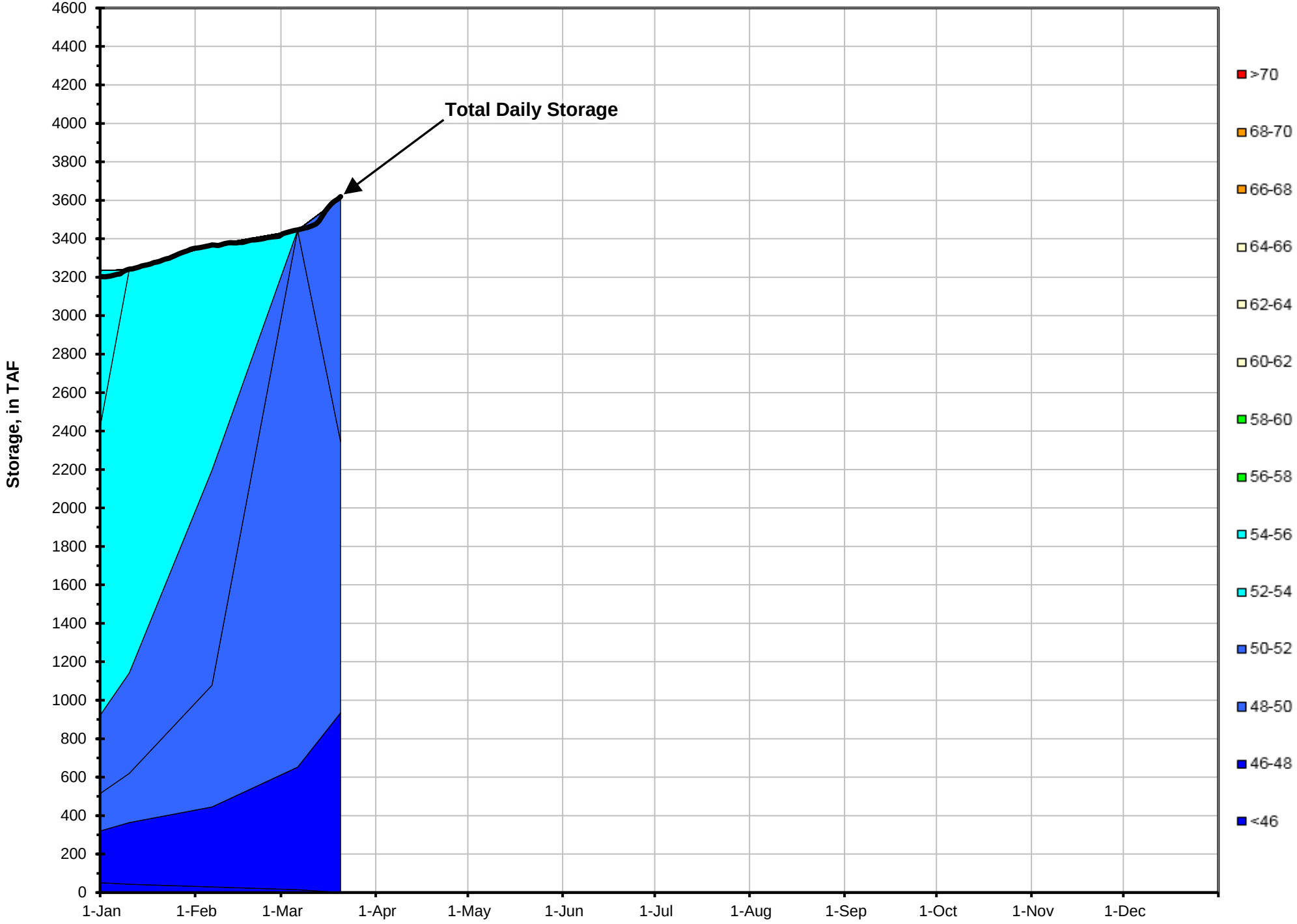
Station Details			
Code	Body of Water	Location[1]	CDEC Link
TCD	N/A	Shasta Power Plant	N/A
SHD	Sacramento River	0.3 miles downstream of Shasta Power Plant	Click Here
SPP	N/A	Spring Creek Power Plant	N/A
KWK	Sacramento River	0.8 miles downstream of Keswick Dam	Click Here
SAC	Sacramento River	4.8 miles downstream of Keswick Dam	Click Here
CCR	Sacramento River	9.7 miles downstream of Keswick Dam	Click Here
BSF	Sacramento River	25 miles downstream of Keswick Dam	Click Here
JLF	Sacramento River	34 miles downstream of Keswick Dam	Click Here
BND	Sacramento River	41 miles downstream of Keswick Dam	Click Here
RDB	Sacramento River	58 miles downstream of Keswick Dam	Click Here
IGO	Clear Creek	7.3 miles downstream of Whiskeytown Dam	Click Here
LWS	Trinity River	1.1 miles downstream of Lewiston Dam	Click Here
DGC[2]	Trinity River	19 miles downstream of Lewiston Dam	Click Here
NFH[3]	Trinity River	38 miles downstream of Lewiston Dam	Click Here

Temperature Control Point		
Point	Temp. (°F)	Date Range
BSF	56.0	06/01/17 - Current

Notes

[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

Lake Shasta Isothermalbaths - 2018
(Water Temperature, in °F)

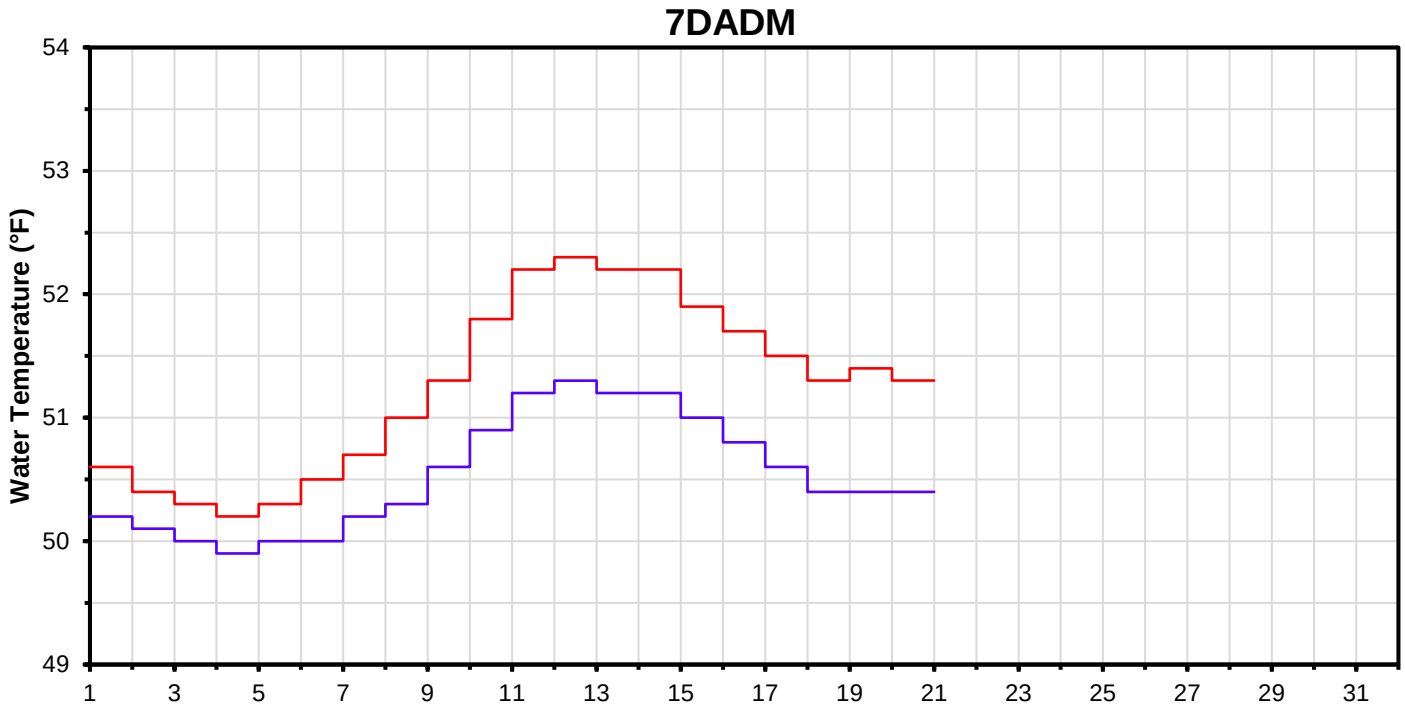


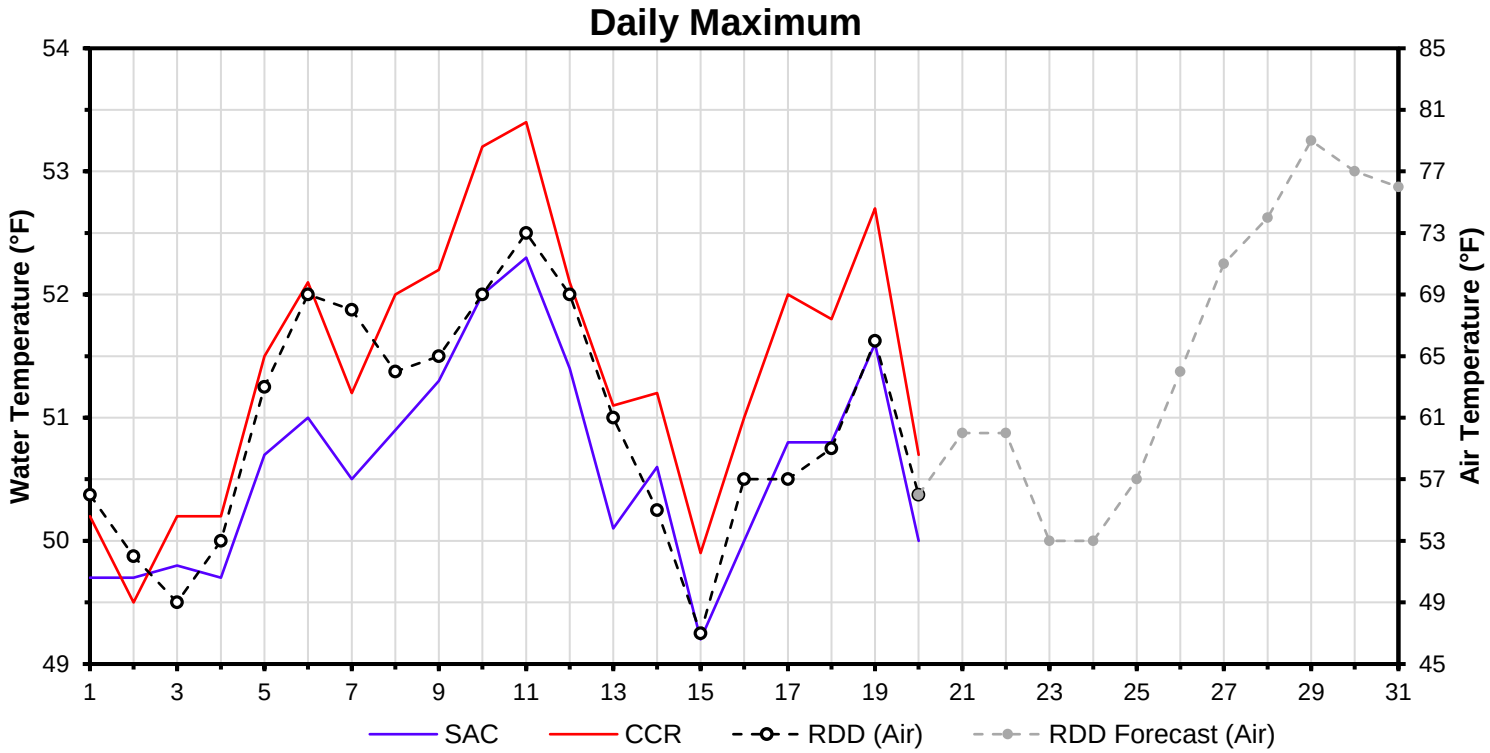
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
03/01	49.7	50.2	50.2	50.6	48.8
03/02	49.7	49.5	50.1	50.4	48.1
03/03	49.8	50.2	50.0	50.3	48.4
03/04	49.7	50.2	49.9	50.2	48.8
03/05	50.7	51.5	50.0	50.3	48.6
03/06	51.0	52.1	50.0	50.5	49.6
03/07	50.5	51.2	50.2	50.7	50.5
03/08	50.9	52.0	50.3	51.0	51.3
03/09	51.3	52.2	50.6	51.3	51.2
03/10	52.0	53.2	50.9	51.8	51.7
03/11	52.3	53.4	51.2	52.2	52.1
03/12	51.4	52.1	51.3	52.3	52.2
03/13	50.1	51.1	51.2	52.2	52.5
03/14	50.6	51.2	51.2	52.2	50.4
03/15	49.2	49.9	51.0	51.9	48.8
03/16	50.0	51.0	50.8	51.7	48.1
03/17	50.8	52.0	50.6	51.5	49.1
03/18	50.8	51.8	50.4	51.3	49.9
03/19	51.6	52.7	50.4	51.4	50.7
03/20	50.0	50.7	50.4	51.3	50.9
03/21					
03/22					
03/23					
03/24					
03/25					
03/26					
03/27					
03/28					
03/29					
03/30					
03/31					

Notes

[1] 7DADM = 7-Day Average Daily Maximum

[2] DAT = Daily Average Temperature



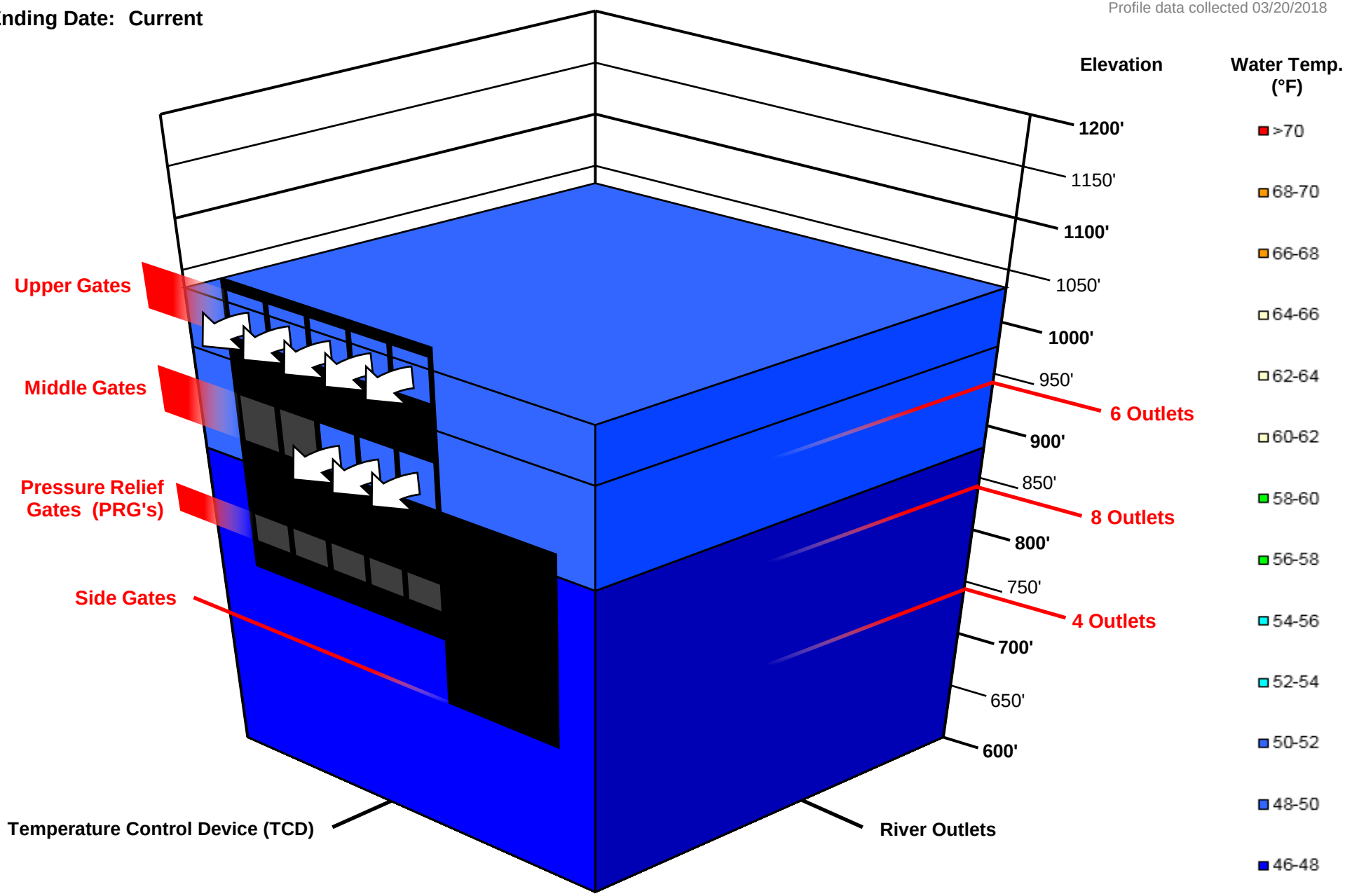


Shasta TCD Configuration

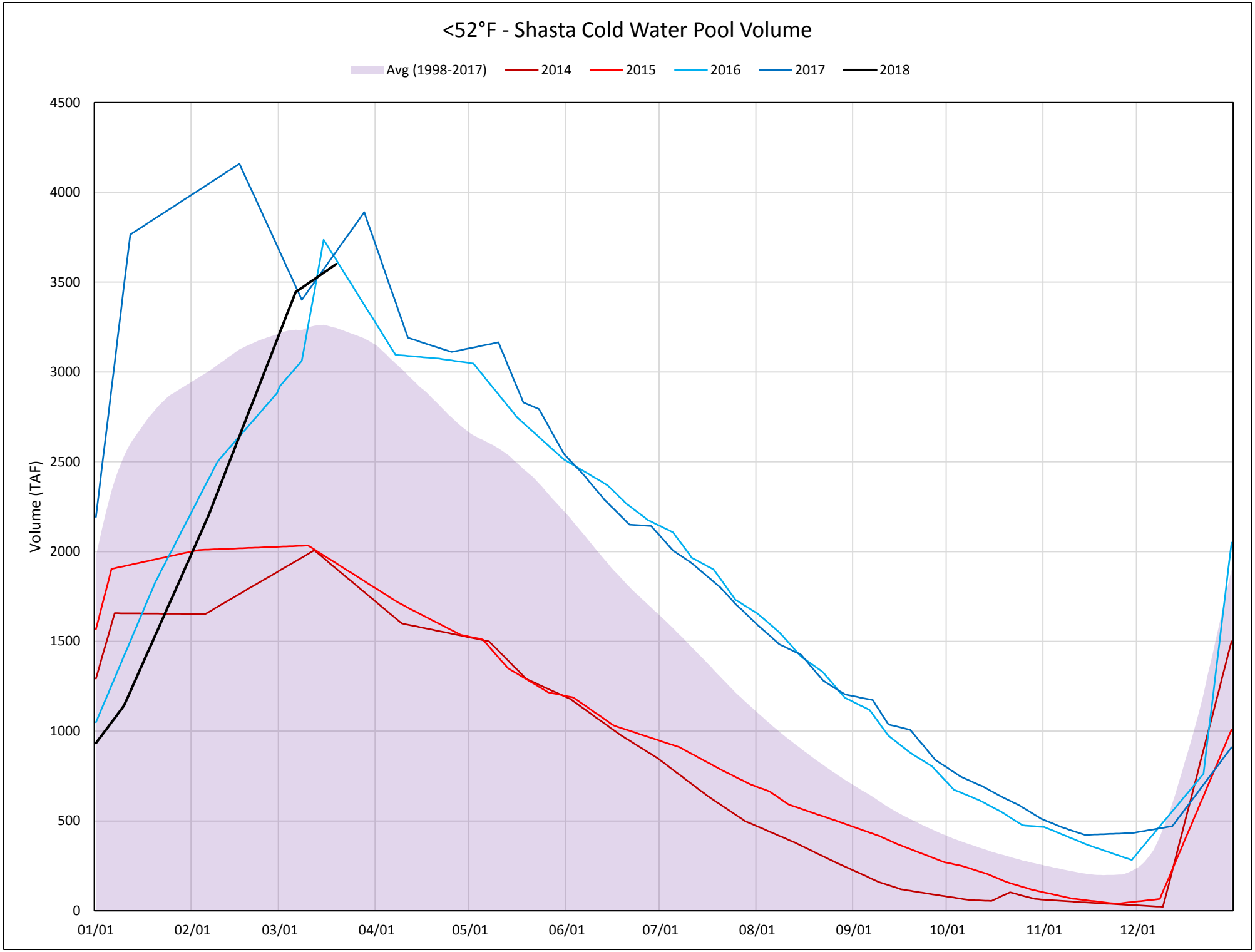
Starting Date: 02/08/2018

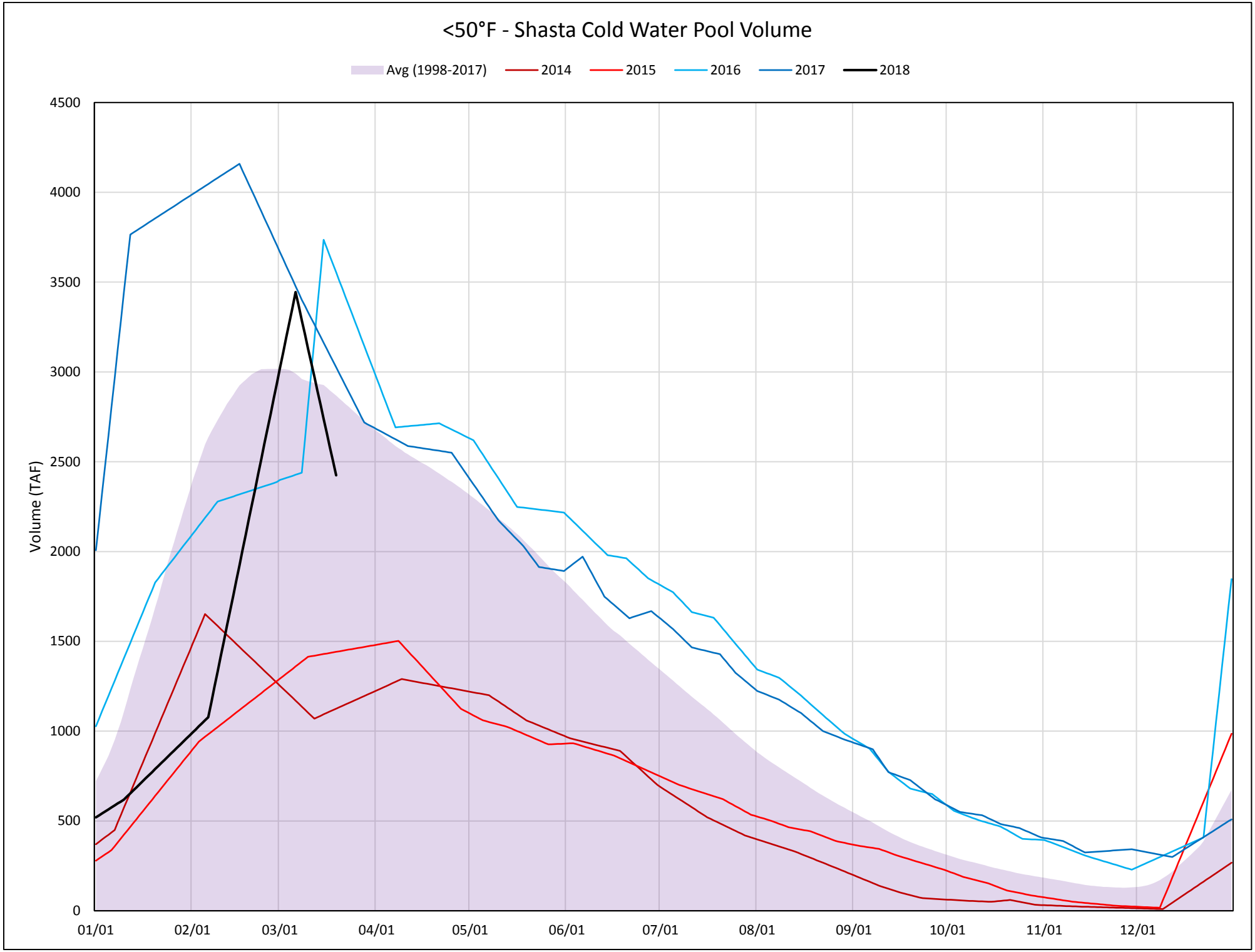
Ending Date: Current

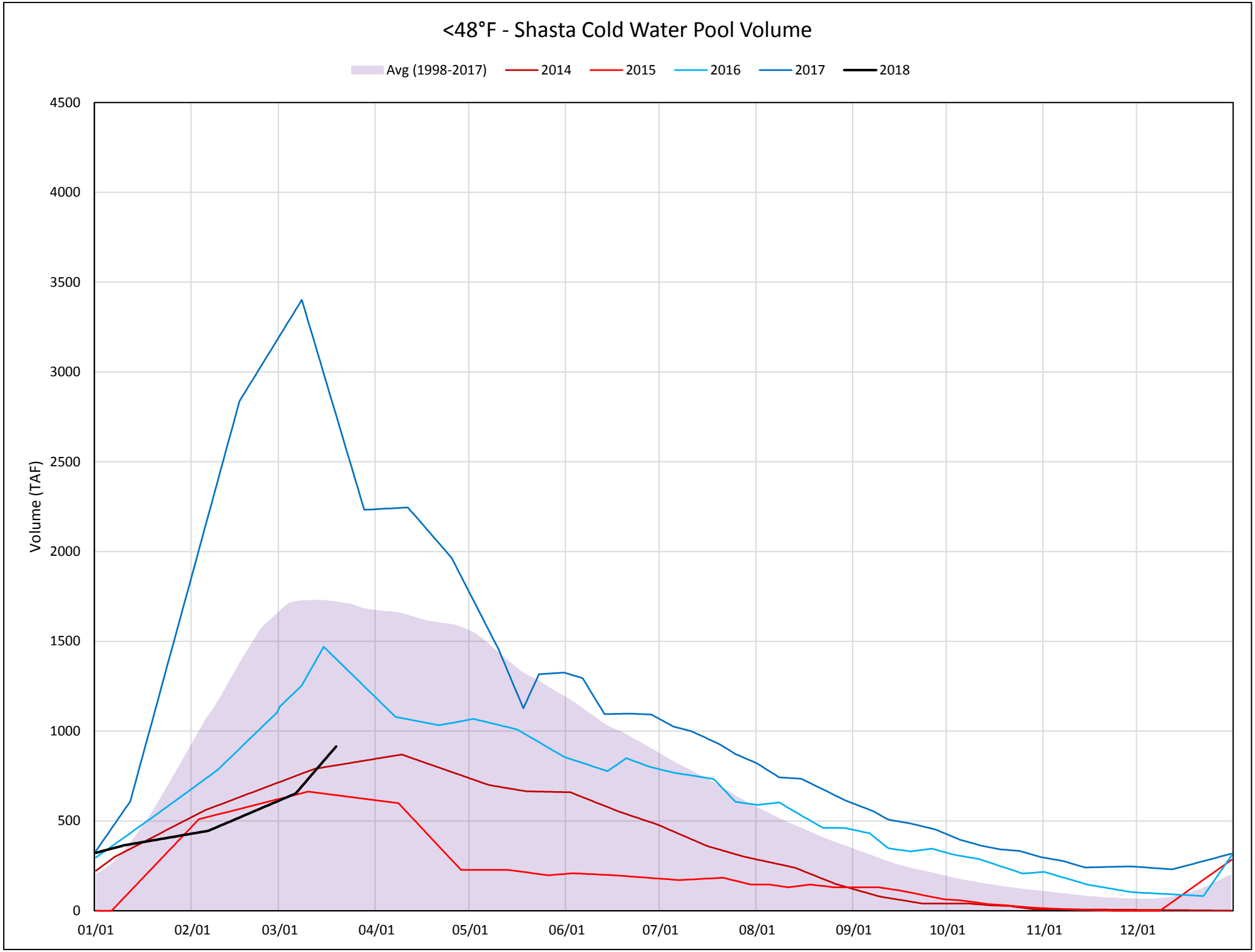
Profile data collected 03/20/2018

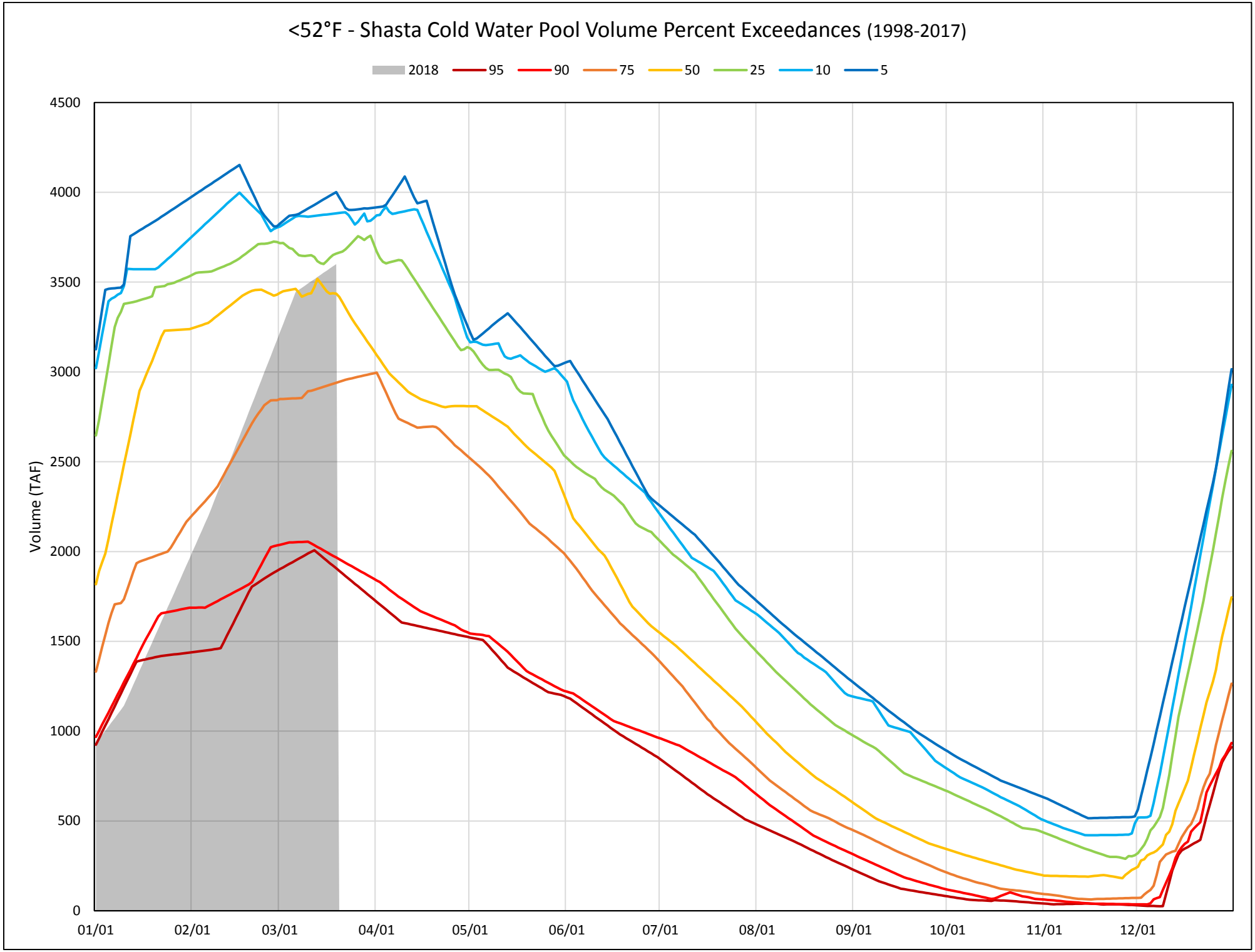


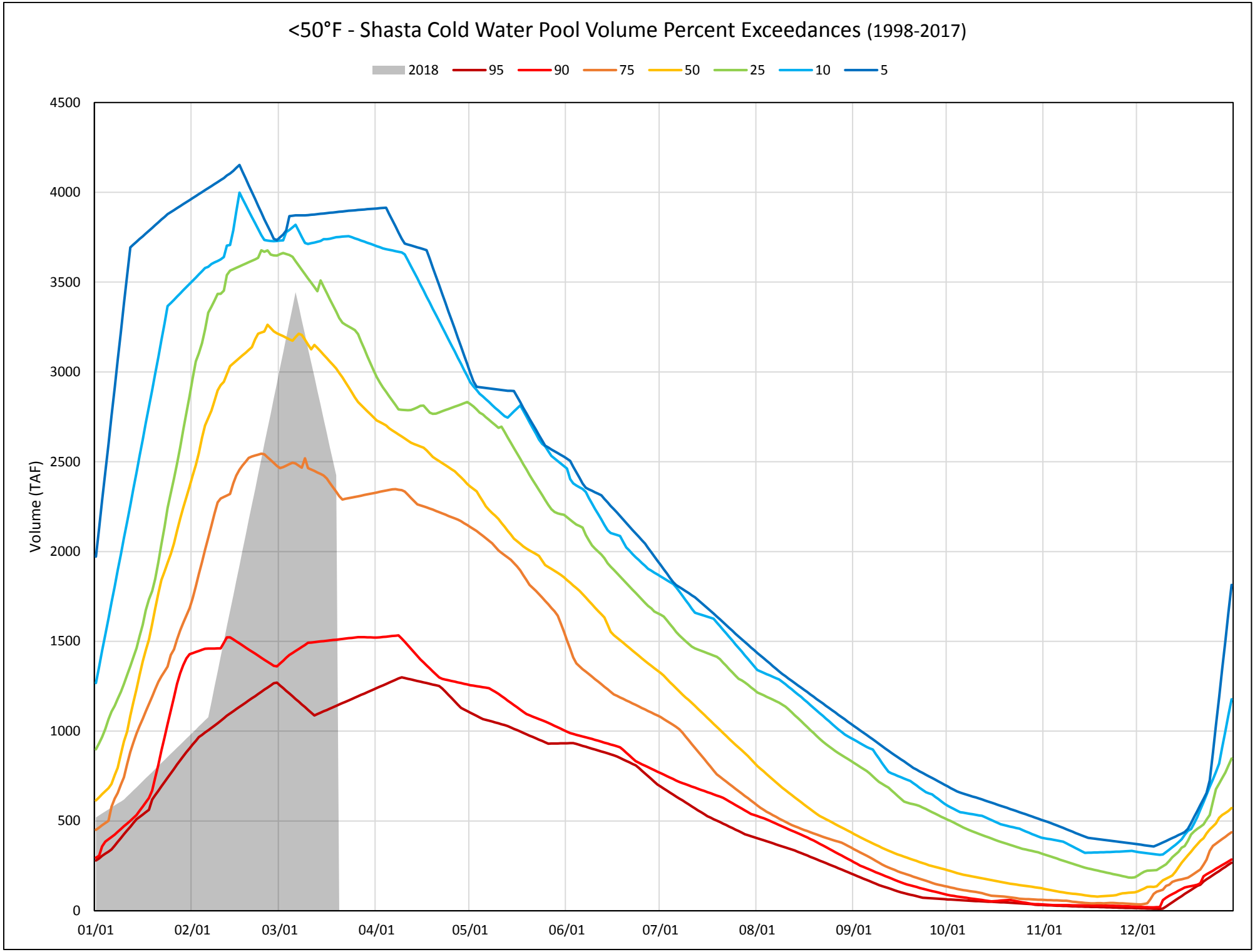
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

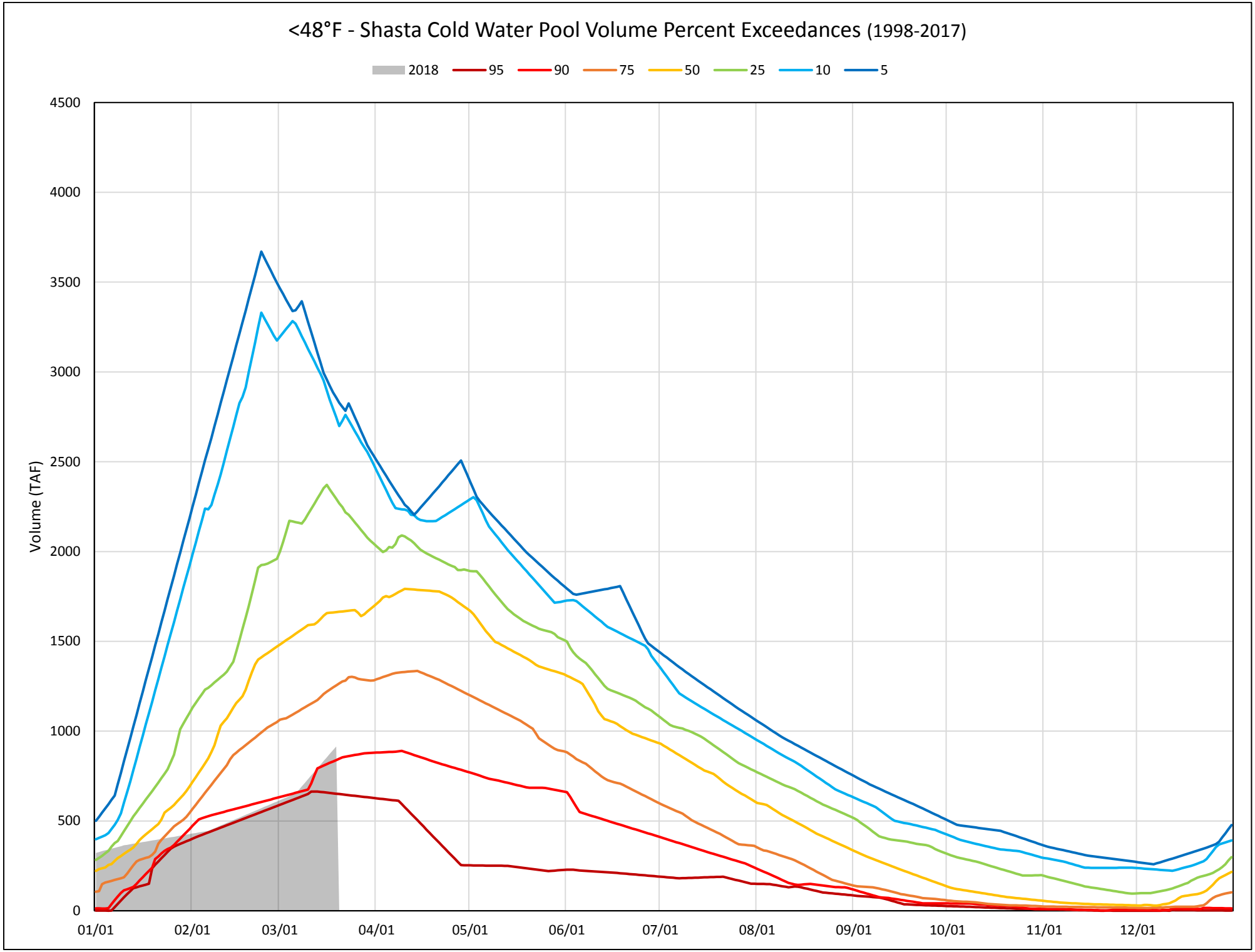

<52°F - Shasta Cold Water Pool Volume
Avg (1998-2017)
2014
2015
2016
2017
2018
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

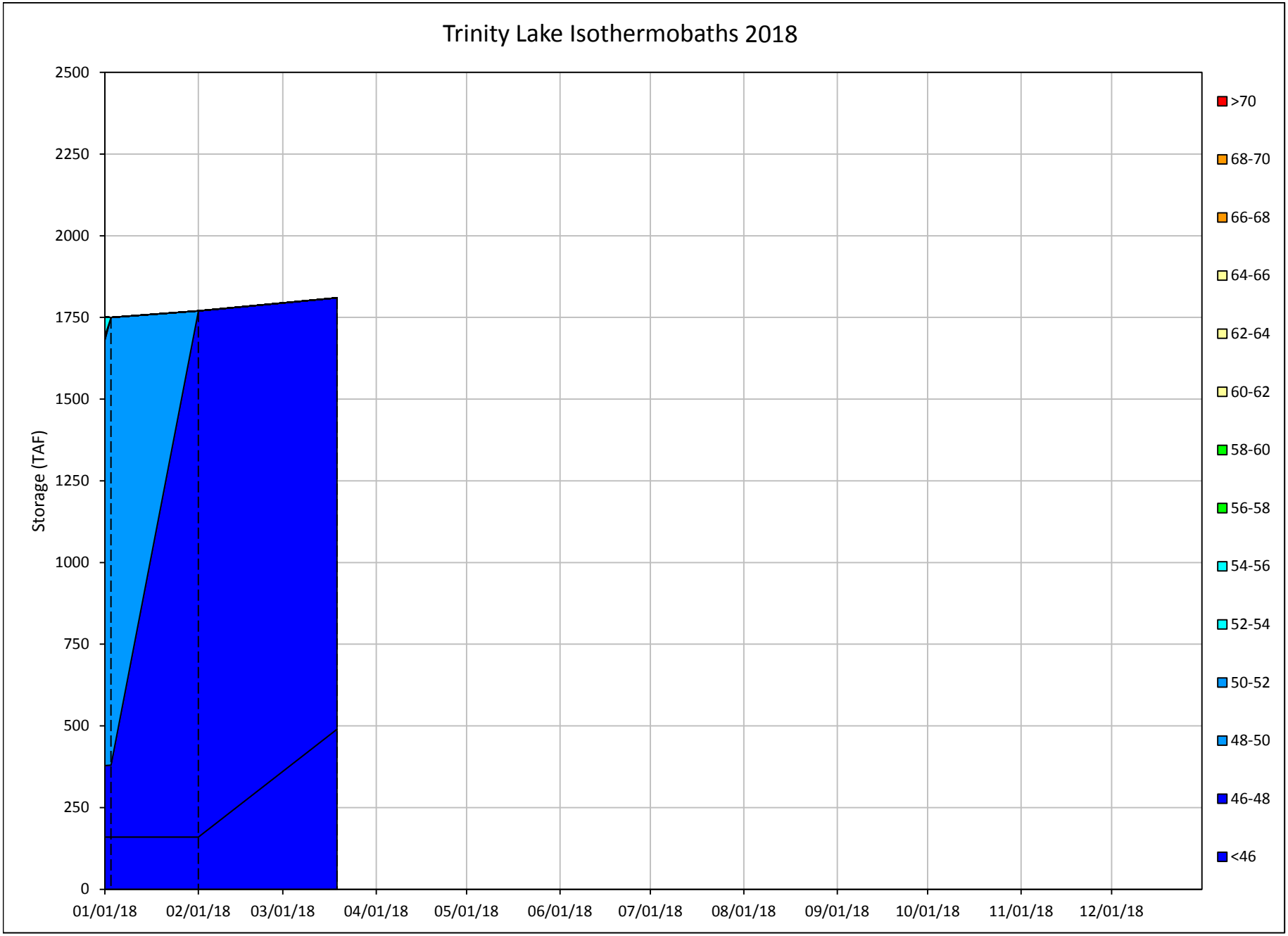

<50°F - Shasta Cold Water Pool Volume
Avg (1998-2017)
2014
2015
2016
2017
2018
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


<48°F - Shasta Cold Water Pool Volume
Avg (1998-2017)
2014
2015
2016
2017
2018
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


<52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2017)
2018
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


<50°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2017)
2018
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


<48°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2017)
2018
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


Trinity Lake Isothermobaths 2018
Storage (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
01/01/18
02/01/18
03/01/18
04/01/18
05/01/18
06/01/18
07/01/18
08/01/18
09/01/18
10/01/18
11/01/18
12/01/18
>70
68-70
66-68
64-66
62-64
60-62
58-60
56-58
54-56
52-54
50-52
48-50
46-48
<46

INFORMATION BELOW HAS DIMINSHED VALUE AS A RESULT OF MARCH STORM EVENTS

March 16, 2018

Upper Sacramento River – March 2018 Preliminary Temperature Analysis

Summary of Temperature Results by Month (Monthly Average Temperature °F)

Initial Compliance Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
March 90%-Exceedance Outlook – 10% Historical Meteorology							
Keswick Dam KWK	52.8	53.5	52.5	53.3	53.4	NA	NA
Sac. R. abv Clear Creek CCR	53.3	54.2	53.1	53.8	53.9	NA	NA
Balls Ferry BSF	56.2	58.0	56.0	55.9	55.9	58.2	58.2
March 90%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	52.6	53.2	52.1	53.3	53.1	NA	NA
Sac. R. abv Clear Creek CCR	53.0	53.8	52.7	53.7	53.6	NA	NA
Balls Ferry BSF	55.6	57.3	55.5	55.6	55.5	58.1	58.1
March 50%-Exceedance Outlook – 10% Historical Meteorology							
Keswick Dam KWK	53.1	52.8	52.6	53.2	53.5	NA	NA
Sac. R. abv Clear Creek CCR	53.6	53.7	53.2	53.7	54.0	NA	NA
Balls Ferry BSF	56.5	58.0	56.0	55.7	56.0	57.0	57.0
March 50%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	53.0	53.3	52.8	53.4	53.6	NA	NA
Sac. R. abv Clear Creek CCR	53.4	54.0	53.3	53.8	54.0	NA	NA
Balls Ferry BSF	55.9	57.8	55.9	55.6	55.9	57.9	57.9

* The HEC5Q model output is displayed above for the months April through August. Based on past analysis, the temperature model does not perform well in late September and October. 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. For the months of September and October estimated temperatures are provided based on the Fall Temperature Index (graphic below). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance at Balls Ferry for the early fall months.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on March 6, due to inclement weather conditions Trinity will not be measured until 3/19/2018 – a simulated value of 3/1/2018 is used instead, and March 7, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The March 2018 temperature profile does not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring. The concern this year is assuming over or under estimations with variable hydrologic and meteorologic conditions and not capturing the stratification with sufficient detail to project.
2. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge are not available beyond 5 days. Creek flows developed from the historical record that most closely reflects current conditions were used for all model runs. The resulting low creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the March 2017 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for both the 90% and 50% runoff exceedance studies.
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 and are generalized representations. It is important to note that these outlooks do not suggest a certain actual future outcome, but rather the statistical likelihood of an event occurring, including, but not limited to, projected storage and releases. Thus, the outlooks do not provide exact end of month storages or flow rates but general projections that will likely fall within the range of uncertainty based on the different hydrologic runoff conditions between the 90% and 50% runoff exceedance hydrology.
5. Cottonwood Creek flows, Keswick to Bend Bridge local flows, and ACID diversions are mean daily synthesized flows based on the available historical record for a 1922-2002 study period. Inflows were adjusted to a 95% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 10% and 50% patterned after like months on a 6-hour timestep. Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology.
7. Meteorology, as well as the 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.
8. Modified model coefficients more closely represent actual Keswick Dam temperatures. As a result, temperature predictions downstream of Keswick Dam are likely to be warmer than actual. Model re-calibrations efforts are underway.

Model Run Date March 16, 2018

<u>Temperature Analysis Results</u>:

Modeling runs explore Sacramento River compliance performance above Clear Creek confluence and Balls Ferry locations by varying hydrology and meteorology. The temperature results for the Sacramento River between Keswick Dam and Balls Ferry are shown in Figures 1 through 4. The relationship between end-of-September lake volume below 56°F and a Balls Ferry compliance through fall is based on the Figure 5.

Model Run	**End of September Cold Water Pool <56°F (TAF)**	**First Side Gate**	**Full Side Gates**
90% Hydro, 10% Met	173	7/27	8/26
90% Hydro, 50% Met	210	8/2	8/27
50% Hydro, 10% Met	437	7/29	8/18
50% Hydro, 50% Met	245	8/9	9/1

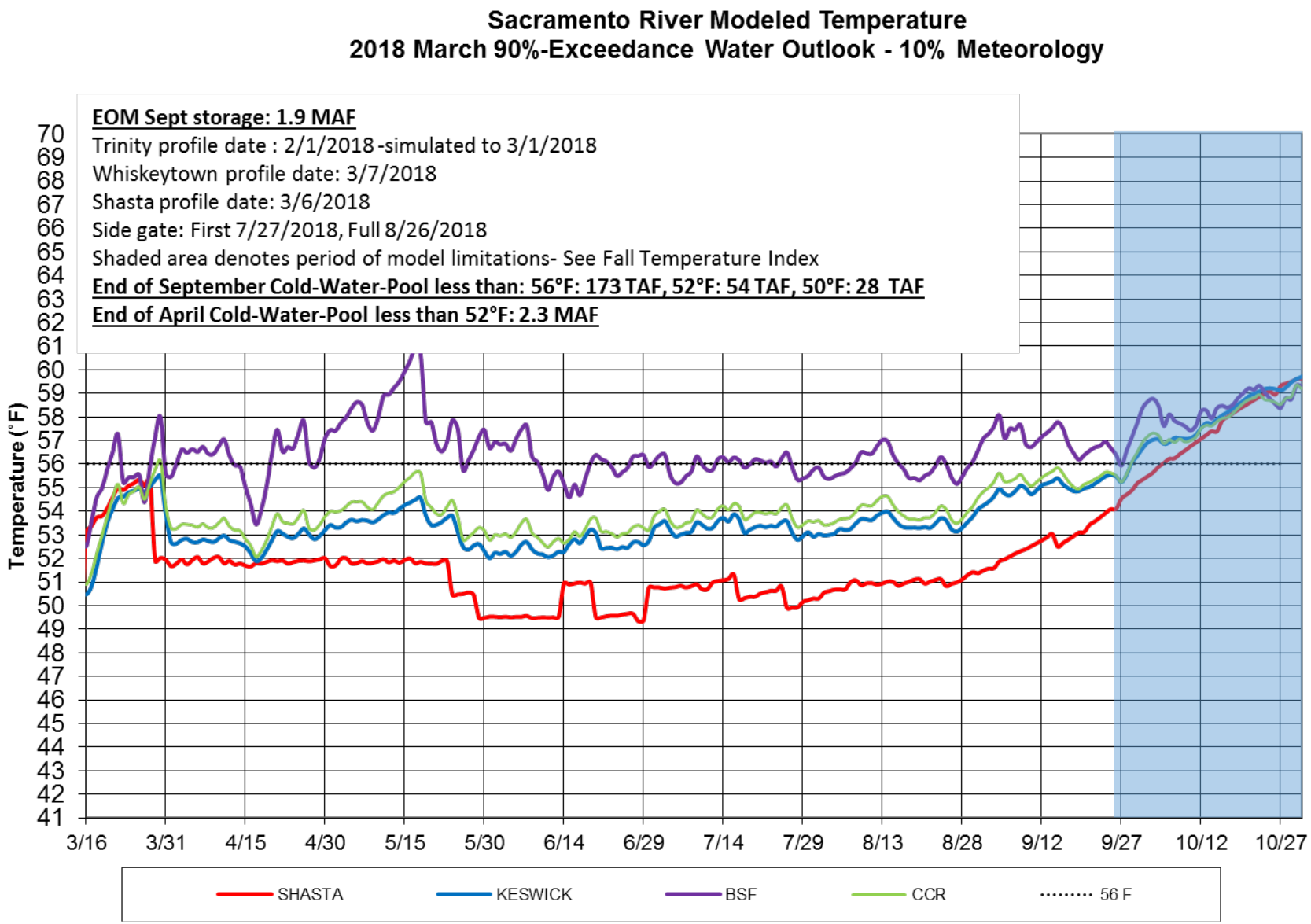

Sacramento River Modeled Temperature
2018 March 90%-Exceedance Water Outlook - 10% Meteorology
EOM Sept storage: 1.9 MAF
Trinity profile date : 2/1/2018 -simulated to 3/1/2018
Whiskeytown profile date: 3/7/2018
Shasta profile date: 3/6/2018
Side gate: First 7/27/2018, Full 8/26/2018
Shaded area denotes period of model limitations- See Fall Temperature Index
End of September Cold-Water-Pool less than: 56°F: 173 TAF, 52°F: 54 TAF, 50°F: 28 TAF
End of April Cold-Water-Pool less than 52°F: 2.3 MAF
Temperature (°F)
70
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
41
3/16
3/31
4/15
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
SHASTA
KESWICK
BSF
CCR
56 F

Figure 1

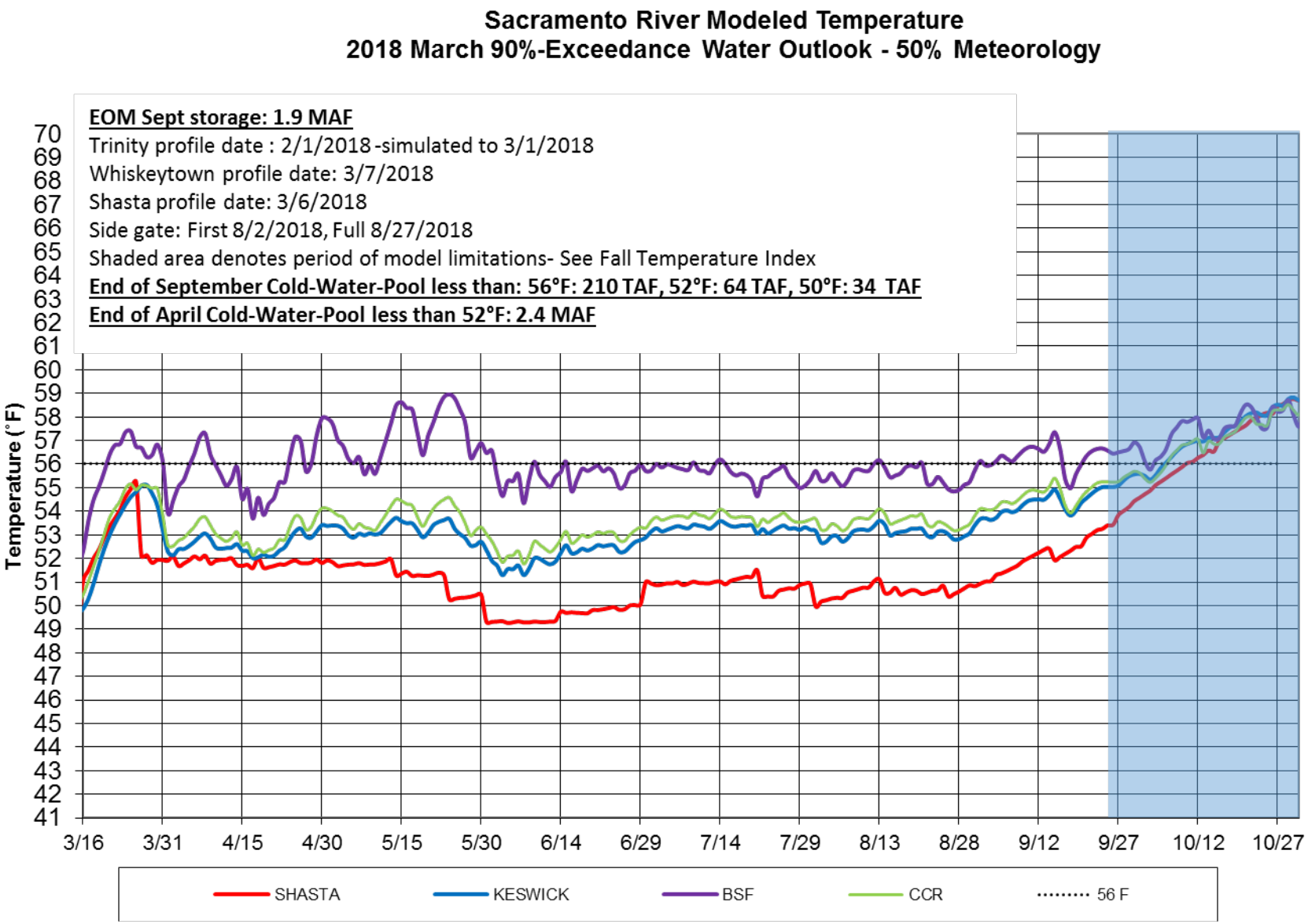

Sacramento River Modeled Temperature
2018 March 90%-Exceedance Water Outlook - 50% Meteorology
EOM Sept storage: 1.9 MAF
Trinity profile date : 2/1/2018 -simulated to 3/1/2018
Whiskeytown profile date: 3/7/2018
Shasta profile date: 3/6/2018
Side gate: First 8/2/2018, Full 8/27/2018
Shaded area denotes period of model limitations- See Fall Temperature Index
End of September Cold-Water-Pool less than: 56°F: 210 TAF, 52°F: 64 TAF, 50°F: 34 TAF
End of April Cold-Water-Pool less than 52°F: 2.4 MAF
Temperature (°F)
70
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
41
3/16
3/31
4/15
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
SHASTA
KESWICK
BSF
CCR
56 F

Figure 2

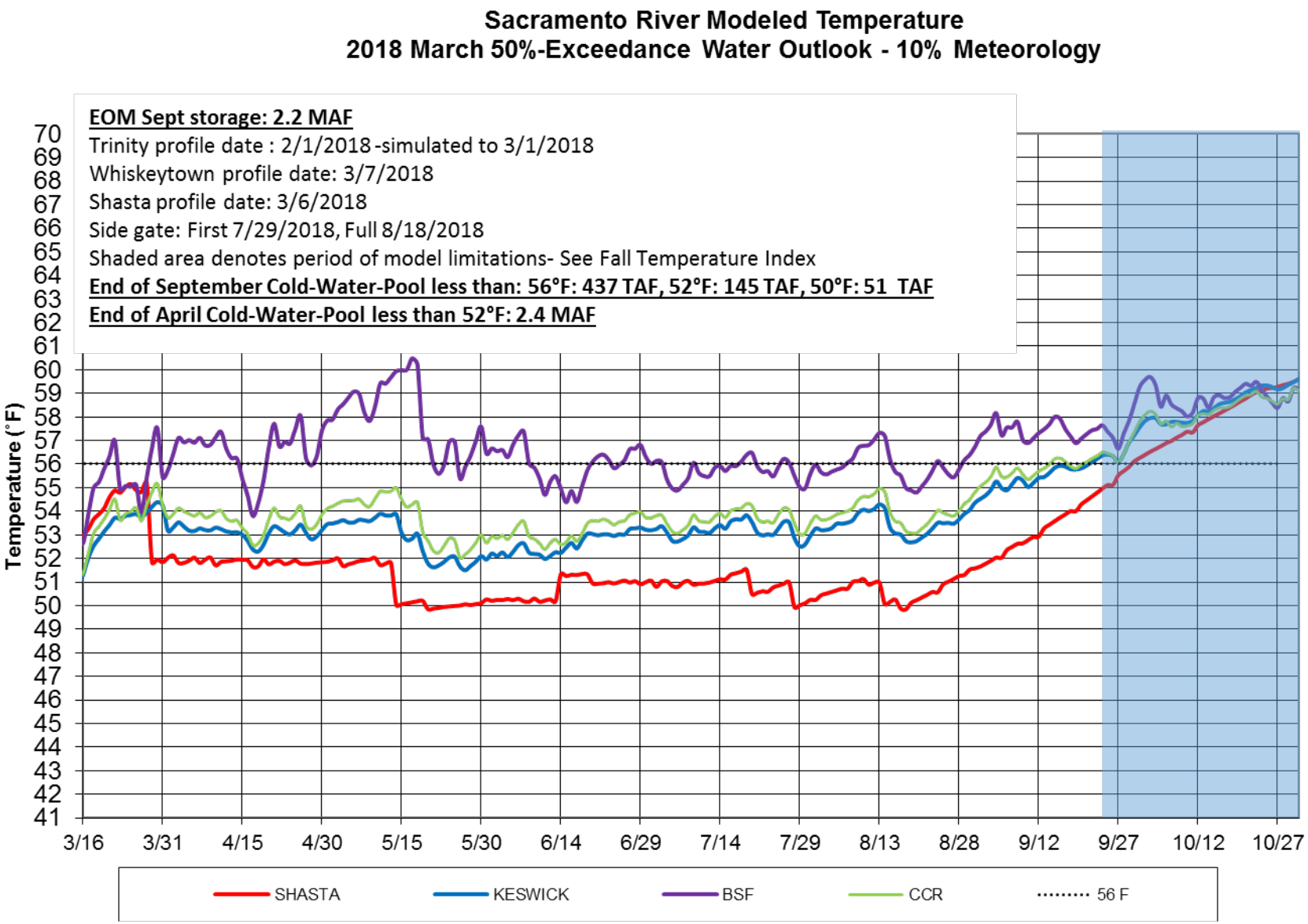

Sacramento River Modeled Temperature
2018 March 50%-Exceedance Water Outlook - 10% Meteorology
EOM Sept storage: 2.2 MAF
Trinity profile date : 2/1/2018 -simulated to 3/1/2018
Whiskeytown profile date: 3/7/2018
Shasta profile date: 3/6/2018
Side gate: First 7/29/2018, Full 8/18/2018
Shaded area denotes period of model limitations- See Fall Temperature Index
End of September Cold-Water-Pool less than: 56°F: 437 TAF, 52°F: 145 TAF, 50°F: 51 TAF
End of April Cold-Water-Pool less than 52°F: 2.4 MAF
Temperature (°F)
70
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
41
3/16
3/31
4/15
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
SHASTA
KESWICK
BSF
CCR
56 F

Figure 3

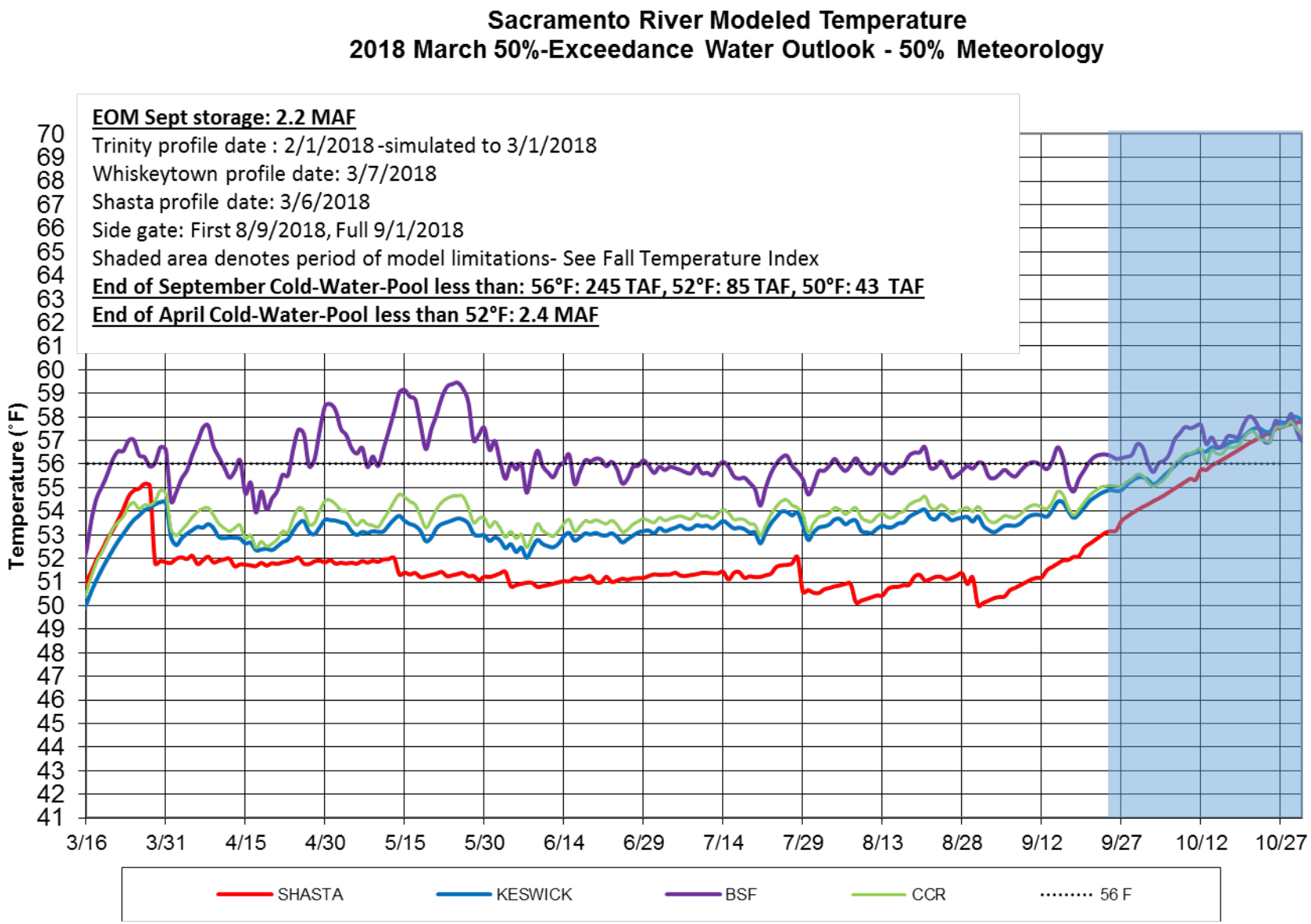
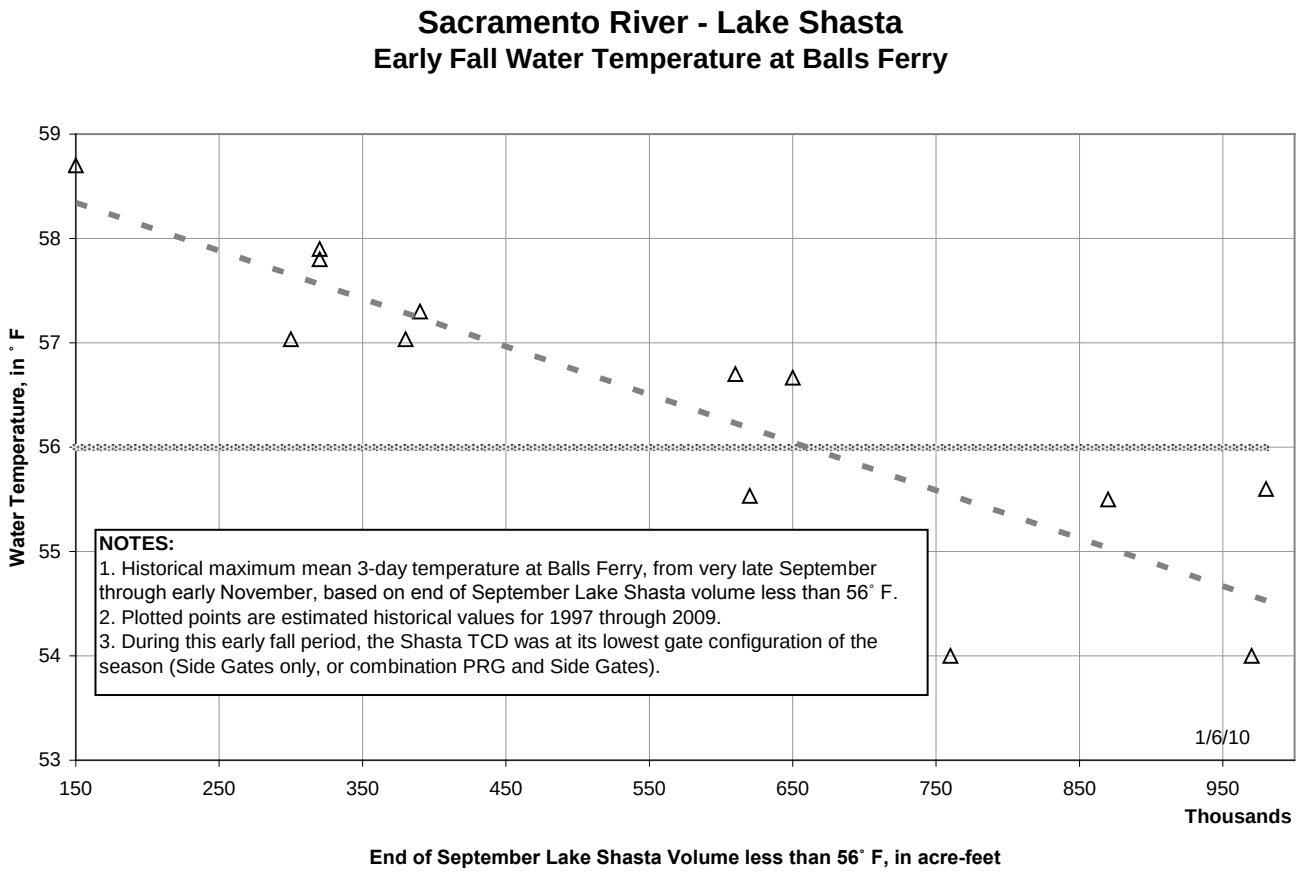
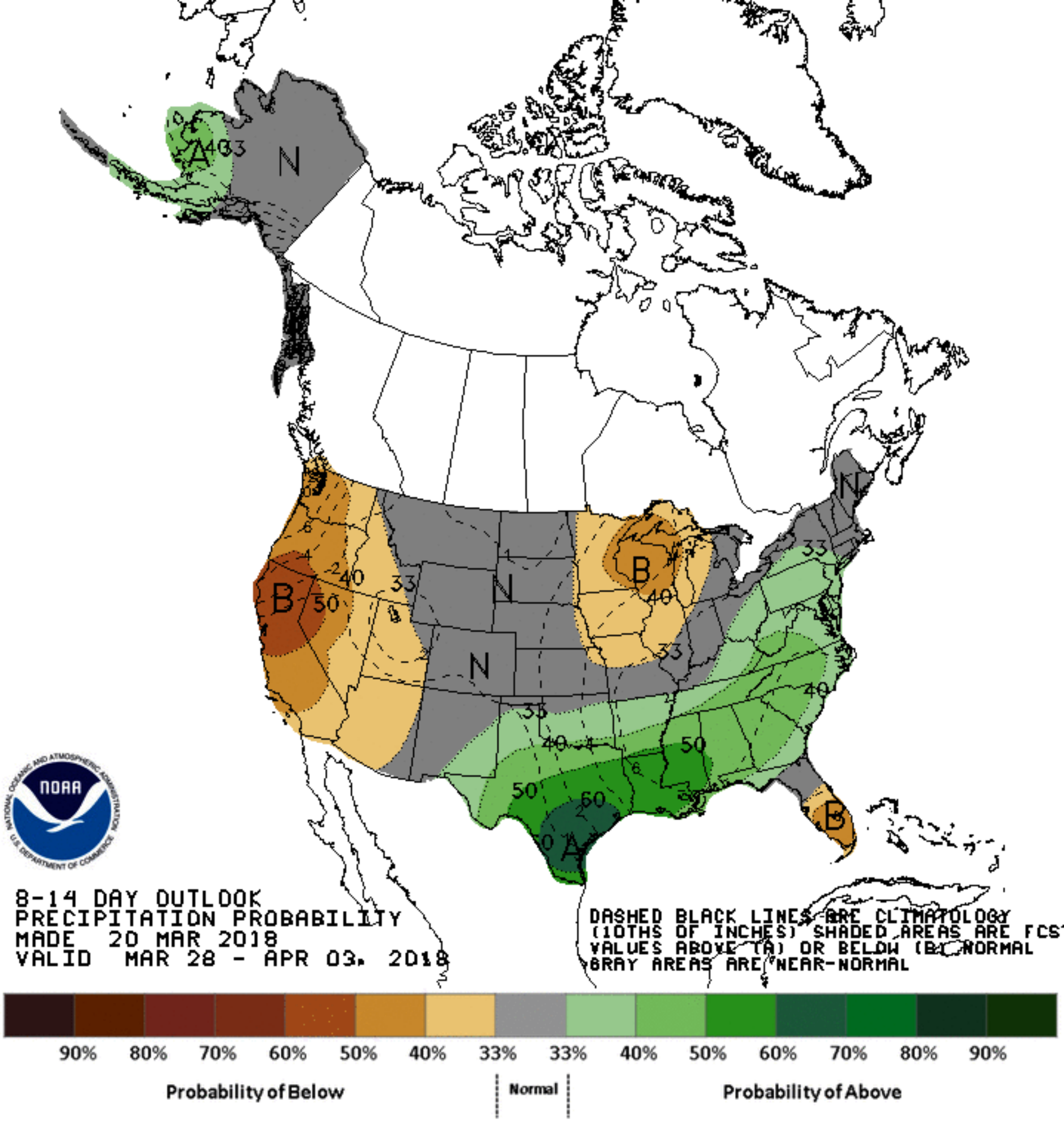

Sacramento River Modeled Temperature
2018 March 50%-Exceedance Water Outlook - 50% Meteorology
EOM Sept storage: 2.2 MAF
Trinity profile date : 2/1/2018 -simulated to 3/1/2018
Whiskeytown profile date: 3/7/2018
Shasta profile date: 3/6/2018
Side gate: First 8/9/2018, Full 9/1/2018
Shaded area denotes period of model limitations- See Fall Temperature Index
End of September Cold-Water-Pool less than: 56°F: 245 TAF, 52°F: 85 TAF, 50°F: 43 TAF
End of April Cold-Water-Pool less than 52°F: 2.4 MAF
Temperature (°F)
70
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
41
3/16
3/31
4/15
4/30
5/15
5/30
6/14
6/29
7/14
7/29
8/13
8/28
9/12
9/27
10/12
10/27
SHASTA
KESWICK
BSF
CCR
56 F

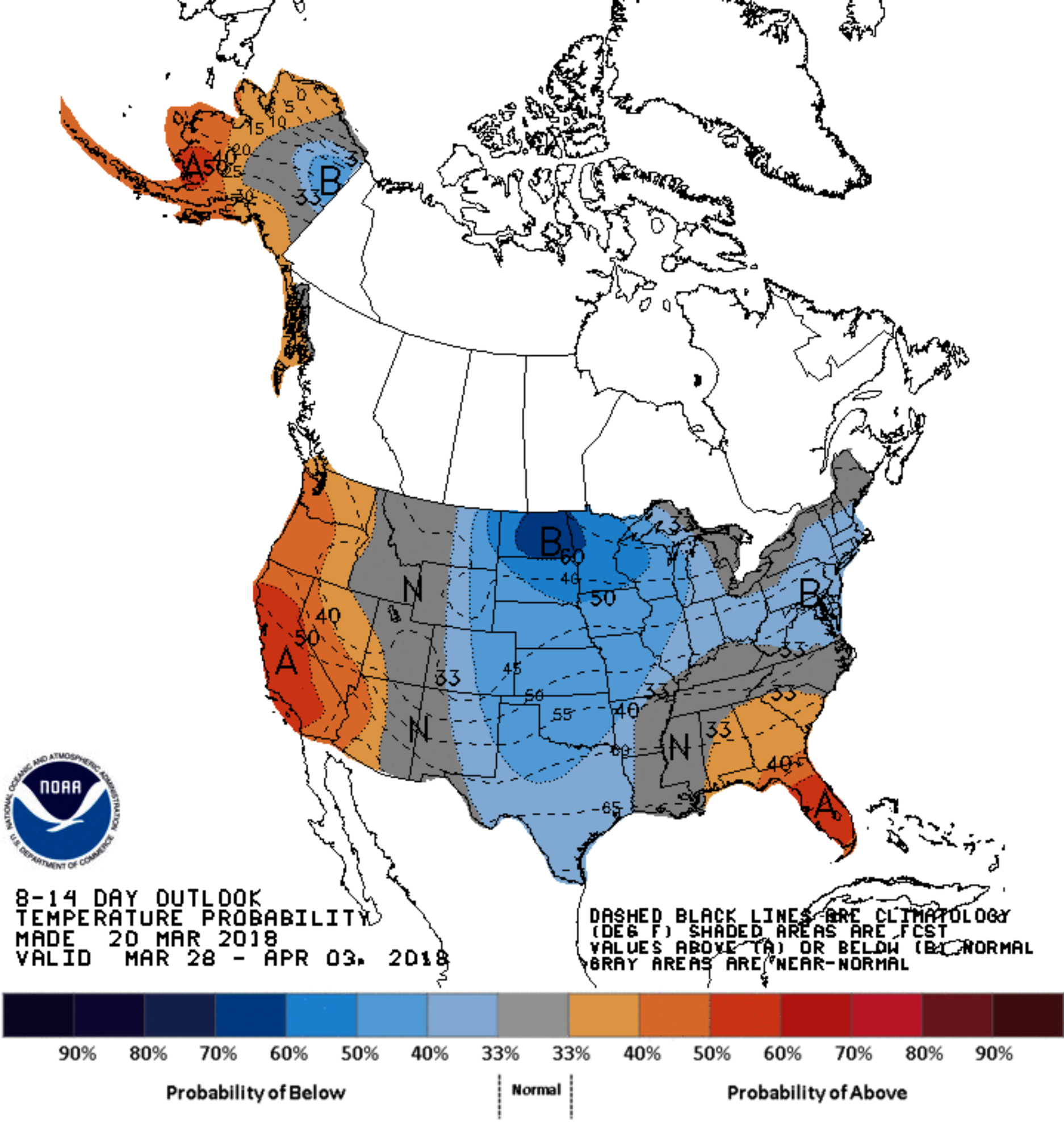
Figure 4

Figure 5 Model Performance and Fall Temperature Index:

1. Based on past analyses, the temperature model does not perform well in late September and October. 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 good 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 600 TAF, see chart below:




8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 20 MAR 2018
VALID MAR 28 - APR 03, 2018
DASHED BLACK LINES ARE CLIMATOLOGY
(10THS OF INCHES) SHADED AREAS ARE FCST
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%
Probability of Below
Normal
Probability of Above


8-14 DAY OUTLOOK
TEMPERATURE PROBABILITY
MADE 20 MAR 2018
VALID MAR 28 - APR 03, 2018
DASHED BLACK LINES ARE CLIMATOLOGY
(DEG F) SHADED AREAS ARE FCST
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%
Probability of Below
Normal
Probability of Above