RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

June 27, 2019 | 1:00 pm – 3:00 pm

Location: Northern California Area Office Shasta Dam

Shasta Dam Blvd, Redding, CA

Conference Line: 877-417-6209

Participant code: 1593030

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
    - 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
    - Whiskeytown Lake Isothermobath Plot
- Temperature Studies
    - 90% Runoff Exceedance: 25% and 50% L3MTO Meteorology
    - Cold Water Pool Tracking
- Updates
- Next Meeting: July 25, 2019 – USFWS: Red Bluff Fish and Wildlife Office, 10950 Tyler Rd, Red Bluff, CA 96080

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

DAILY CVP WATER SUPPLY REPORT

JUNE 25, 2019

RUN DATE: June 26, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	486	1,942	1,942
SACRAMENTO	KESWICK	12,156	9,990	12,148
FEATHER	OROVILLE (SWP)	4,500	1,800	3,500
AMERICAN	NIMBUS	3,321	4,874	3,910
STANISLAUS	GOODWIN	428	2,503	439
SAN JOAQUIN	FRIANT	425	1,003	351

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2018	WY 2019	% OF 15 YR AVG
TRINITY	2,448	1,802	1,791	2,338	130
SHASTA	4,552	3,558	3,705	4,399	124
FOLSOM	977	782	866	932	119
NEW MELONES	2,420	1,564	1,914	2,229	143
FED. SAN LUIS	966	472	553	725	154
TOTAL NORTH CVP	11,363	8,178	8,829	10,623	130
MILLERTON	520	422	465	500	118
OROVILLE (SWP)	3,538	2,647	2,282	3,474	131

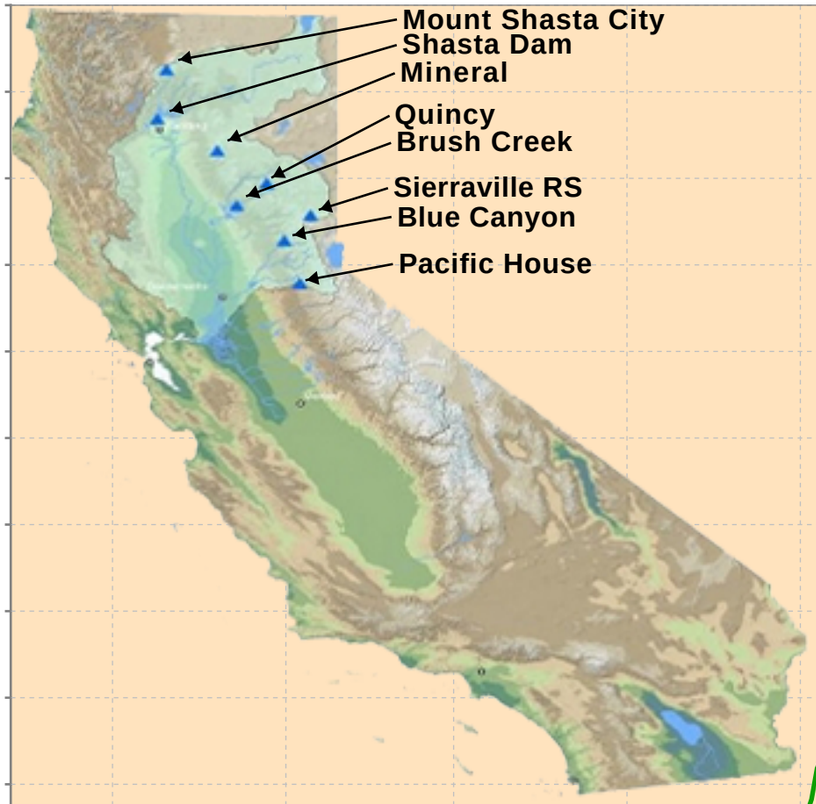
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	1,568	189	2,481	1,155	136
SHASTA	6,467	1,986	9,756	4,697	138
FOLSOM	3,559	296	5,673	2,482	143
NEW MELONES	1,457	----	2,262	947	154
MILLERTON	1,999	183	3,416	1,324	151

ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	36.87	13.69	54.65	31.23 (57)	118	0.00
SACRAMENTO AT SHASTA DAM	87.96	17.27	112.33	60.97 (62)	144	0.00
AMERICAN AT BLUE CANYON	90.61	15.64	103.88	66.16 (44)	137	0.00
STANISLAUS AT NEW MELONES	42.23	----	45.33	27.27 (41)	155	0.00
SAN JOAQUIN AT HUNTINGTON LK	57.32	17.20	81.40	41.17 (44)	139	0.00

Northern Sierra Precipitation: 8-Station Index, June 26, 2019



Percent of Average for this Date: 136%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

68.4

Average (1966-2015) 51.8

2017-2018 Daily Precip 41.0

2014-2015 Daily Precip 37.2

1976-1977(2nd driest & driest thru Aug) 19.0

Cumulative Daily/Monthly Precipitation (inches)

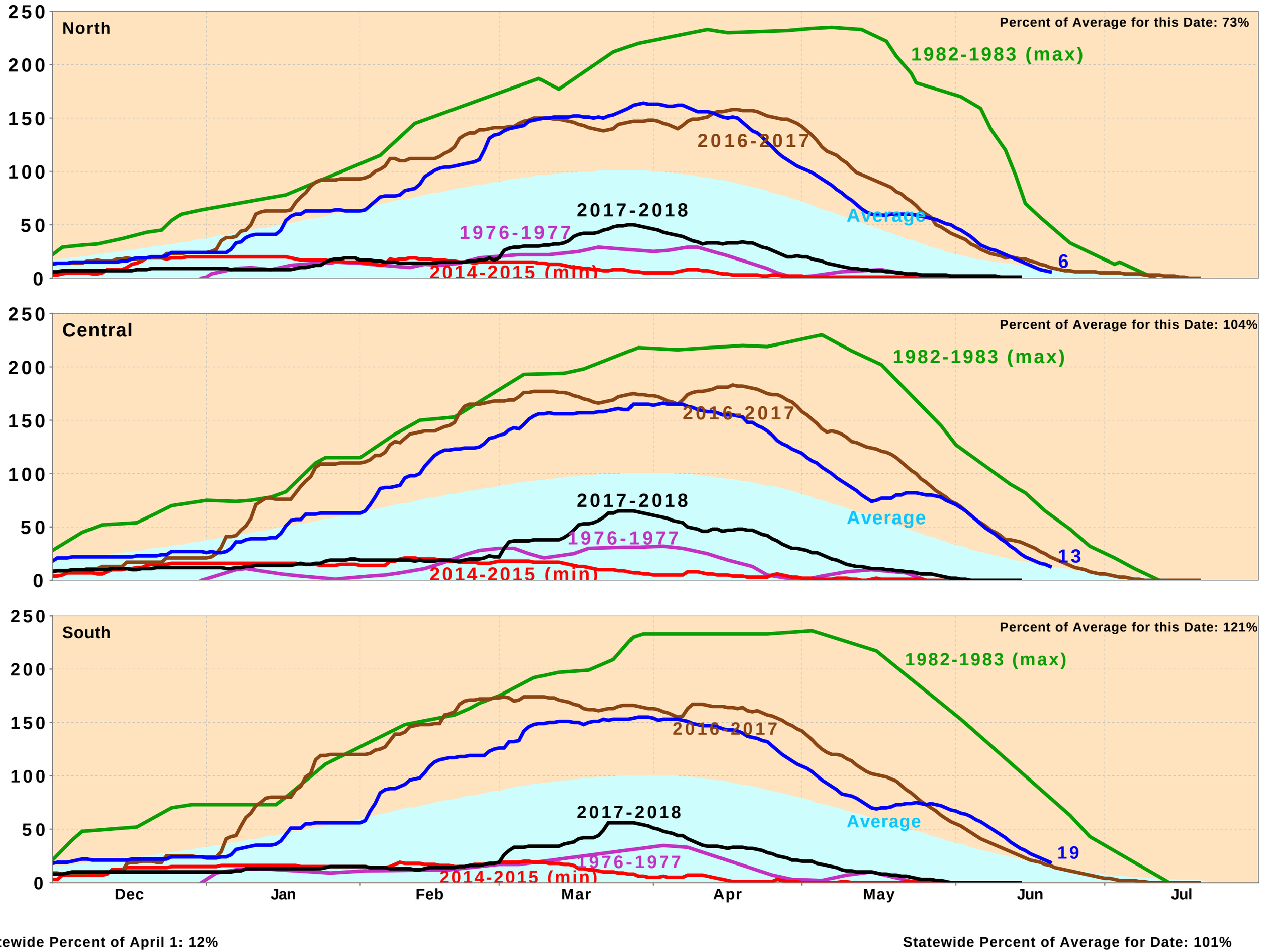
Total Water Year Precipitation

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

Oct 1 Nov 1 Dec 1 Jan 1 Feb 1 Mar 1 Apr 1 May 1 Jun 1 Jul 1 Aug 1 Sep 1 Oct 1

Water Year (October 1 - September 30)

California Snow Water Content, June 20, 2019, Percent of April 1 Average



Statewide Percent of April 1: 12%

Statewide Percent of Average for Date: 101%

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Meteorological projections: Shorter term forecasts (8-14 day) suggest above normal chances of precipitation
- Longer term forecasts (one-month outlook) suggest equal chances of above normal or below normal precipitation
- Current release from Keswick Dam: 10,000 cfs, and to 11,000 cfs on June 29th
- Keswick Dam release is expected to increase in July

Temperature Management:

- Temperature management: Active management in June
- Selective withdrawal: Releases – 3 Upper and 2 Middle TCD gates
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest warming to above normal temperatures
- Longer term forecasts (one-month outlook) suggest above normal chances of warmer temperatures

Resources:

- Excellent link for short term precipitation forecasts, overlay with burn areas, debris flow potential, etc: https://www.cnrfc.noaa.gov/
- Comprehensive Upper Sacramento fishery information: https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx

CVP Northern System Operation Outlooks

DRAFT June 2019

90% Runoff Exceedance Outlook:

Inflow based on DWR B120 90%; Historical Inflows Oct and future months

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

		Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shasta	4477	4370	3887	3318	2979	2836	2805	2859
Elev.		1061	1044	1021	1007	1000	999	1001

Monthly River Releases (cfs)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento	10500	12000	13000	9500	7250	5000	4500
Clear Creek	288	150	150	150	200	200	200

Trinity Diversions (TAF)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Carr Power Plant	134	100	61	55	68	26	12
Spring Creek PP	120	90	50	45	90	20	12

50% Runoff Exceedance Outlook:

Inflow based on DWR B120 50%; Historical Inflows Oct and future months

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

		Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shasta	4477	4370	3991	3455	3147	3040	2999	3082
Elev.		1061	1047	1027	1014	1009	1008	1011

Monthly River Releases (cfs)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento	10500	11500	13000	9500	7000	6000	5000
Clear Creek	288	150	150	150	200	200	200

Trinity Diversions (TAF)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Carr Power Plant	130	99	60	54	68	25	9
Spring Creek PP	120	90	50.3	45	90	20	12

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.

Estimated CVP Operations 90% Exceedance

Storages

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

		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trinity	**2393**	**2287**	**2140**	**2036**	**1931**	**1848**	**1824**	**1834**	**1865**	**1950**	**2027**	**2138**	**2129**
	Elev.	2360	2350	2343	2336	2330	2328	2329	2331	2337	2343	2350	2350
Whiskeytown	**239**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**
	Elev.	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209
Shasta	**4477**	**4370**	**3887**	**3318**	**2979**	**2836**	**2805**	**2859**	**3009**	**3314**	**3744**	**3887**	**3760**
	Elev.	1061	1044	1021	1007	1000	999	1001	1008	1021	1038	1044	1039
Folsom	**935**	**923**	**811**	**671**	**573**	**454**	**374**	**313**	**314**	**376**	**524**	**663**	**811**
	Elev.	461	451	436	425	411	399	389	390	399	420	435	451
New Melones	**2047**	**2122**	**2066**	**1969**	**1900**	**1851**	**1856**	**1864**	**1868**	**1875**	**1809**	**1792**	**1732**
	Elev.	1063	1058	1049	1043	1038	1039	1040	1040	1041	1034	1033	1027
San Luis	**742**	**650**	**374**	**207**	**204**	**107**	**209**	**415**	**561**	**646**	**762**	**604**	**340**
	Elev.	482	459	445	458	438	452	479	500	510	526	493	446
Total		10590	9516	8439	7825	7302	7275	7491	7823	8366	9072	9321	9009

Monthly River Releases (TAF/cfs)

Trinity	TAF	133	66	53	52	23	18	18	18	17	18	32	180
	cfs	**2,235**	**1,073**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**540**	**2,924**
Clear Creek	TAF	17	9	9	9	12	12	12	12	11	12	13	13
	cfs	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**200**	**200**	**200**	**218**	**216**
Sacramento	TAF	625	738	799	565	446	297	277	246	222	246	357	523
	cfs	**10500**	**12000**	**13000**	**9500**	**7250**	**5000**	**4500**	**4000**	**4000**	**4000**	**6000**	**8500**
American	TAF	535	221	239	191	154	119	123	111	100	92	144	92
	cfs	**9000**	**3600**	**3888**	**3217**	**2502**	**2005**	**2000**	**1800**	**1800**	**1500**	**2417**	**1500**
Stanislaus	TAF	65	49	49	48	52	18	18	22	20	101	42	96
	cfs	**1100**	**800**	**800**	**800**	**842**	**300**	**300**	**358**	**364**	**1648**	**700**	**1555**

Trinity Diversions (TAF)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Carr PP	134	100	61	55	68	26	12	3	2	35	32	12
Spring Crk. PP	**120**	**90**	**50**	**45**	**90**	**20**	**12**	**10**	**20**	**50**	**10**	**10**

Delta Summary (TAF)

		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Tracy		225	268	268	242	63	186	270	220	200	258	54	55
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7
Total USBR		235	279	281	256	80	204	288	234	214	271	66	68
COA Balance		0	0	0	0	0	0	0	0	0	0	-1	-1
Vernalis	TAF	595	140	141	137	99	66	81	85	90	181	101	176
Vernalis	cfs	10009	2280	2297	2296	1606	1107	1325	1383	1625	2950	1700	2856
Old/Middle River Std.													
Old/Middle R. calc.		-3,655	-8,571	-8,358	-8,539	-2,933	-5,546	-6,611	-4,903	-5,045	-5,033	-1,144	-619
Computed DOI		25954	9191	11794	13280	12282	5850	6946	11891	11545	13941	9497	9874
Excess Outflow		13364	1188	0	0	0	0	2440	5889	144	2538	0	2765
% Export/Inflow		25%	46%	42%	42%	21%	50%	54%	36%	37%	34%	12%	12%
% Export/Inflow std.		35%	65%	65%	65%	65%	65%	65%	65%	45%	35%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1634		7,107		4,015		1604	
Year to Date + Forecasted % of mean	135%		128%		148%		152%	

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Estimated CVP Operations 50% Exceedance

Storages

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

		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Trinity	**2393**	**2311**	**2185**	**2077**	**1972**	**1890**	**1877**	**1907**	**1971**	**2081**	**2165**	**2310**	**2255**
	Elev.	2362	2353	2346	2339	2333	2332	2334	2339	2346	2352	2361	2358
Whiskeytown	**239**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**
	Elev.	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209
Shasta	**4477**	**4370**	**3991**	**3455**	**3147**	**3040**	**2999**	**3082**	**3319**	**3637**	**4020**	**4282**	**4389**
	Elev.	1061	1047	1027	1014	1009	1008	1011	1021	1034	1048	1058	1061
Folsom	**935**	**923**	**818**	**681**	**578**	**530**	**501**	**490**	**518**	**557**	**622**	**776**	**929**
	Elev.	461	451	437	426	420	417	415	419	424	431	447	462
New Melones	**2047**	**2117**	**2112**	**2031**	**1971**	**1926**	**1937**	**1955**	**1979**	**2025**	**2002**	**1993**	**2038**
	Elev.	1063	1062	1055	1050	1046	1047	1048	1050	1055	1052	1052	1056
San Luis	**742**	**663**	**384**	**224**	**239**	**232**	**414**	**612**	**776**	**894**	**1016**	**863**	**607**
	Elev.	482	457	444	457	440	464	490	514	526	540	509	465
Total		10622	9728	8705	8145	7825	7934	8251	8768	9400	10031	10462	10455

Monthly River Releases (TAF/cfs)

Trinity	TAF	133	66	53	52	23	18	18	18	17	18	28	258
	cfs	**2,235**	**1,073**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**477**	**4,189**
Clear Creek	TAF	17	9	9	9	12	12	12	15	11	12	13	13
	cfs	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**240**	**200**	**200**	**218**	**216**
Sacramento	TAF	625	707	799	565	430	357	307	369	444	492	357	369
	cfs	**10500**	**11500**	**13000**	**9500**	**7000**	**6000**	**5000**	**6000**	**8000**	**8000**	**6000**	**6000**
American	TAF	535	246	246	208	123	119	123	123	222	246	268	307
	cfs	**9000**	**4000**	**4000**	**3500**	**2000**	**2000**	**2000**	**2000**	**4000**	**4000**	**4500**	**5000**
Stanislaus	TAF	107	61	49	48	52	18	18	22	20	93	83	96
	cfs	**1800**	**1000**	**800**	**800**	**842**	**300**	**300**	**358**	**364**	**1521**	**1400**	**1555**

Trinity Diversions (TAF)

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Carr PP	130	99	60	54	68	25	9	0	2	45	31	9
Spring Crk. PP	**120**	**90**	**50.3**	**45**	**90**	**20**	**12**	**20**	**35**	**70**	**10**	**10**

Delta Summary (TAF)

		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Tracy		225	265	275	260	150	264	260	235	230	260	54	55
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7
Total USBR		235	276	288	274	167	282	278	249	244	273	66	68
COA Balance		0	0	0	0	0	0	0	0	0	0	0	0
Vernalis	TAF	637	152	141	137	125	105	109	127	150	223	161	219
Vernalis	cfs	10709	2480	2297	2296	2029	1762	1780	2066	2706	3636	2701	3556
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-3,340	-8,444	-8,672	-8,604	-3,194	-6,688	-6,532	-4,971	-4,975	-4,374	-694	-304
Computed DOI		25887	8069	11810	13296	12379	7110	10232	17927	26349	27557	17969	12851
Excess Outflow		13296	65	16	17	16	17	5726	11924	14948	16153	8472	5742
% Export/Inflow		25%	48%	43%	42%	23%	52%	45%	28%	21%	20%	7%	9%
% Export/Inflow std.		35%	65%	65%	65%	65%	65%	65%	65%	45%	35%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1668		7,245		4,069		1710	
Year to Date + Forecasted % of mean	138%		131%		149%		162%	

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Northern CVP Water Temperature Report

June - 2019

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[4]	LWS	-----[3]			Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
May	51.4		50.6		50.8		51.8	52.5	53.1	55.1	56.9	58.0	58.1	54.2	47.7	-			6954	731	8074	66.0	63.6	64.4	-
06/01		50.9	#	-		52.0	51.5	52.1	52.6	**54.9**	57.0	57.6	58.4	59.0	47.8	-			9511	3063	13003	80.5	77.1	79.1	-
06/02	?	51.0	#	-		52.3	51.7	52.2	52.8	**55.1**	57.3	57.9	58.8	59.3	48.1	-			8915	3355	12996	80.5	75.8	75.9	-
06/03		51.0	#	-		52.5	51.8	52.3	52.8	**55.1**	57.4	58.1	59.1	59.3	48.4	-			9117	3612	12929	82.0	79.7	79.0	-
06/04		51.1	#	-		52.6	51.9	52.4	53.0	**55.4**	57.6	58.3	59.2	59.2	48.4	-			9045	3305	12894	83.5	80.9	80.4	-
06/05		51.1	#	-		52.8	52.0	52.5	53.1	**55.3**	57.5	58.2	59.1	59.5	48.3	-			9818	3583	12902	82.5	77.5	79.6	-
06/06	?	51.1	#	-	?	52.8	52.0	52.3	52.8	**54.7**	56.7	57.4	58.4	57.2	48.1	-			9053	3324	12858	72.0	70.2	74.4	-
06/07		51.1	#	-		52.7	51.7	52.1	52.5	**54.2**	55.7	56.2	56.8	56.1	47.2	-			9114	3332	12897	67.5	65.0	66.7	-
06/08		51.0	#	-		52.5	51.8	52.2	52.6	**54.2**	55.5	56.1	56.5	56.2	47.3	-			8754	3286	12897	73.5	70.6	72.3	-
06/09		51.2	#	-		52.2	51.8	52.2	52.7	**54.5**	56.0	56.5	57.1	57.1	47.6	-			8950	3211	12895	81.5	73.6	76.6	-
06/10		51.2	#	-		52.1	51.9	52.3	52.8	**54.7**	56.5	57.0	57.8	58.0	47.9	-			8776	3251	12727	80.5	78.3	78.9	-
06/11		51.3	#	-		52.0	51.9	52.5	53.0	**55.2**	57.1	57.8	58.5	58.7	48.1	-			7982	2836	11575	84.0	79.3	80.5	-
06/12		51.2	#	-		52.1	52.0	52.5	52.9	**55.1**	57.3	58.1	59.0	59.0	48.1	-			7838	3172	10134	83.5	78.3	80.3	-
06/13		51.0	#	-		52.2	52.0	52.6	53.3	**55.7**	57.8	58.4	59.1	59.1	48.2	-			5983	3315	10070	83.0	79.3	80.3	-
06/14		51.0	#	-		52.1	52.0	52.7	53.4	**56.1**	58.4	59.2	60.2	59.4	48.3	-			7322	1583	10069	82.5	78.8	76.9	-
06/15		51.3	#	-		52.1	51.8	52.5	53.1	**55.8**	58.2	59.1	60.2	59.7	48.6	-			8032	1574	9999	81.0	75.5	74.1	-
06/16		50.6	#	-		52.2	51.8	52.5	53.1	**55.6**	57.9	58.7	59.7	59.6	48.8	-			7801	1593	9999	83.5	77.6	75.7	-
06/17		50.3	#	-		52.5	51.4	52.3	53.0	**55.9**	58.5	59.3	60.6	59.8	49.1	-			8853	1435	10000	87.0	84.2	84.1	-
06/18		50.3	#	-		52.4	51.3	52.1	52.8	**55.6**	58.1	59.0	60.5	59.7	49.1	-			7979	1213	9993	93.0	85.8	85.6	-
06/19		50.3	#	-		52.5	51.2	52.0	52.6	**55.4**	57.8	58.8	60.2	59.5	49.0	-			7566	1832	9996	92.0	86.3	84.7	-
06/20		50.6	#	-		52.6	51.2	51.9	52.4	**54.9**	57.2	58.2	59.5	58.5	49.8	-			8197	1350	9948	81.0	79.1	80.3	-
06/21		50.7	#	-	!	-	51.2	51.8	52.3	**54.4**	56.3	57.1	58.1	57.5	49.2	-			9090	1379	9988	77.0	75.0	76.3	-
06/22		50.8	#	-	#	-	51.4	52.0	52.7	**55.0**	56.8	57.5	58.4	55.8	49.1	-			8355	1262	9988	84.0	79.5	80.5	-
06/23		51.0	#	-	#	-	51.5	52.1	52.8	**55.1**	57.1	57.9	59.0	56.9	49.3	-			8603	1224	9992	84.0	79.8	80.4	-
06/24		51.0	#	-	#	-	51.7	52.3	52.9	**55.2**	57.3	58.1	59.1	57.6	49.0	-			7922	1180	9988	85.0	77.1	78.9	-
06/25		50.9	#	-	#	-	51.6	52.1	52.7	**54.8**	56.8	57.7	58.9	57.7	49.3	-			8363	1379	9990	77.5	73.0	77.1	-
06/26																									
06/27																									
06/28																									
06/29																									
06/30																									
-																									
Jun	50.9		-		52.4		51.7	52.3	52.8	55.1	57.2	57.9	58.9	58.4	48.5	-			8438	2386	11229	81.7	77.5	78.3	-
																	Total CFS		210939	59649	280727				
																	Total AF		418389	118311	556811				

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			
06/01	57	93	75.0	65	94	79.5	65	92	78.5	65	95	80.0	65	96	80.5	65	94	79.5	61	86	73.5	55	83	69.0	58	86	72.0	60	94	77.0	62	95	78.5	65	95	80.0			
06/02	64	97	80.5	66	94	80.0	65	97	81.0	65	98	81.5	63	95	79.0	59	83	71.0	54	82	68.0	55	87	71.0	65	99	82.0	65	99	82.0	65	95	80.0	65	96	80.5			
06/03	66	95	80.5	68	96	82.0	64	98	81.0	66	95	80.5	61	84	72.5	53	81	67.0	53	87	70.0	58	93	75.5	64	98	81.0	64	99	81.5	65	97	81.0	65	97	81.0			
06/04	67	97	82.0	67	99	83.0	64	98	81.0	61	85	73.0	52	78	65.0	51	84	67.5	56	92	74.0	61	97	79.0	63	101	82.0	65	102	83.5	67	98	82.5	67	97	82.0			
06/05	67	100	83.5	70	100	85.0	60	86	73.0	51	79	65.0	52	86	69.0	58	94	76.0	61	99	80.0	64	103	83.5	68	102	85.0	67	98	82.5	65	94	79.5	64	95	79.5			
06/06	68	97	82.5	62	84	73.0	51	80	65.5	52	88	70.0	60	97	78.5	63	102	82.5	66	104	85.0	68	102	85.0	69	98	83.5	66	97	81.5	65	92	78.5	65	94	79.5			
06/07	59	85	72.0	57	78	67.5	53	87	70.0	60	97	78.5	63	103	83.0	66	106	86.0	68	101	84.5	66	100	83.0	69	99	84.0	67	99	83.0	68	98	83.0	67	98	82.5			
06/08	57	78	67.5	61	87	74.0	60	97	78.5	63	104	83.5	67	107	87.0	69	100	84.5	68	98	83.0	66	98	82.0	68	100	84.0	68	99	83.5	67	95	81.0	66	94	80.0			
06/09	60	87	73.5	70	97	83.5	63	104	83.5	67	107	87.0	69	102	85.5	68	97	82.5	68	98	83.0	66	98	82.0	69	102	85.5	69	99	84.0	66	98	82.0	68	98	83.0			
06/10	67	96	81.5	60	102	81.0	67	105	86.0	69	101	85.0	69	99	84.0	68	99	83.5	67	99	83.0	67	100	83.5	67	100	83.5	66	95	80.5	66	93	79.5	66	95	80.5			
06/11	59	102	80.5	67	104	85.5	69	100	84.5	69	100	84.5	69	100	84.5	68	100	84.0	67	100	83.5	68	101	84.5	70	100	85.0	66	92	79.0	65	95	80.0	65	95	80.0			
06/12	63	105	84.0	72	102	87.0	66	100	83.0	66	98	82.0	67	100	83.5	68	103	85.5	69	102	85.5	69	100	84.5	69	99	84.0	65	94	79.5	60	88	74.0	62	95	78.5			
06/13	70	97	83.5	66	98	82.0	66	96	81.0	66	98	82.0	66	102	84.0	68	104	86.0	69	105	87.0	67	102	84.5	67	101	84.0	66	101	83.5	66	97	81.5	65	95	80.0			
06/14	65	101	83.0	69	97	83.0	66	95	80.5	65	101	83.0	68	105	86.5	70	106	88.0	68	103	85.5	66	99	82.5	67	101	84.0	67	98	82.5	66	94	80.0	66	98	82.0			
06/15	67	98	82.5	68	94	81.0	65	100	82.5	67	103	85.0	71	106	88.5	68	104	86.0	67	99	83.0	63	97	80.0	65	97	81.0	65	95	80.0	64	92	78.0	63	94	78.5			
06/16	68	94	81.0	67	99	83.0	69	104	86.5	71	106	88.5	69	105	87.0	67	100	83.5	64	97	80.5	64	97	80.5	64	90	77.0	63	93	78.0	65	92	78.5	63	92	77.5			
06/17	67	100	83.5	70	104	87.0	73	105	89.0	67	103	85.0	66	97	81.5	62	95	78.5	63	97	80.0	62	94	78.0	63	91	77.0	62	89	75.5	64	92	78.0	65	95	80.0			
06/18	69	105	87.0	81	105	93.0	68	101	84.5	64	93	78.5	60	90	75.0	62	97	79.5	62	95	78.5	60	91	75.5	64	90	77.0	62	91	76.5	67	95	81.0	65	96	80.5			
06/19	81	105	93.0	80	101	90.5	65	92	78.5	60	87	73.5	62	96	79.0	63	96	79.5	61	92	76.5	59	87	73.0	60	89	74.5	60	90	75.0	63	91	77.0	62	94	78.0			
06/20	80	104	92.0	73	90	81.5	64	88	76.0	64	94	79.0	63	95	79.0	62	93	77.5	60	86	73.0	57	85	71.0	59	89	74.0	62	93	77.5	64	95	79.5	65	97	81.0			
06/21	71	91	81.0	65	89	77.0	63	96	79.5	63	98	80.5	62	93	77.5	60	87	73.5	56	85	70.5	55	87	71.0	60	89	74.5	62	94	78.0	64	91	77.5	63	91	77.0			
06/22	65	89	77.0	72	94	83.0	64	99	81.5	64	95	79.5	61	89	75.0	57	85	71.0	55	86	70.5	57	90	73.5	62	93	77.5	63	98	80.5	67	96	81.5	67	97	82.0			
06/23	72	96	84.0	70	99	84.5	65	93	79.0	63	88	75.5	57	82	69.5	53	83	68.0	56	88	72.0	59	92	75.5	63	94	78.5	64	95	79.5	65	93	79.0	65	96	80.5			
06/24	69	99	84.0	74	94	84.0	63	89	76.0	59	81	70.0	54	80	67.0	55	87	71.0	57	90	73.5	60	94	77.0	64	96	80.0	66	99	82.5	67	95	81.0	66	95	80.5			
06/25	73	97	85.0	65	91	78.0	59	83	71.0	55	80	67.5	54	85	69.5	58	90	74.0	59	93	76.0	62	96	79.0	65	99	82.0	66	97	81.5	67	96	81.5	66	98	82.0			
06/26	64	91	77.5	59	83	71.0	54	79	66.5	55	85	70.0	57	89	73.0	60	88	74.0	62	93	77.5	64	96	80.0	66	97	81.5	66	97	81.5	66	95	80.5	66	98	82.0			
06/27																																							
06/28																																							
06/29																																							
06/30																																							
-																																							

Web Links

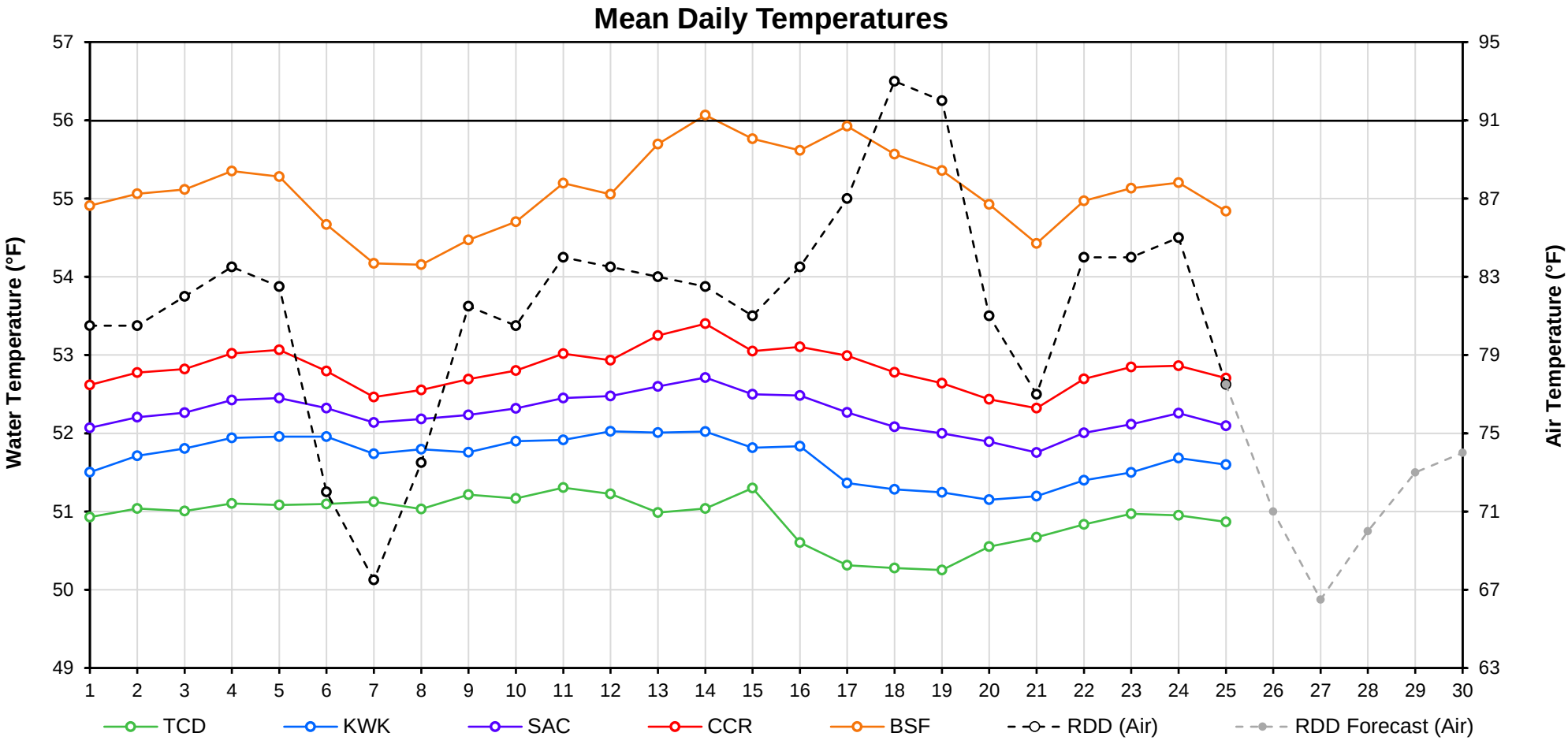
[10-Day Min/Max Forecast]

[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)	Begin Date
BSF	**56.0**	**05/25/2018**

Notes

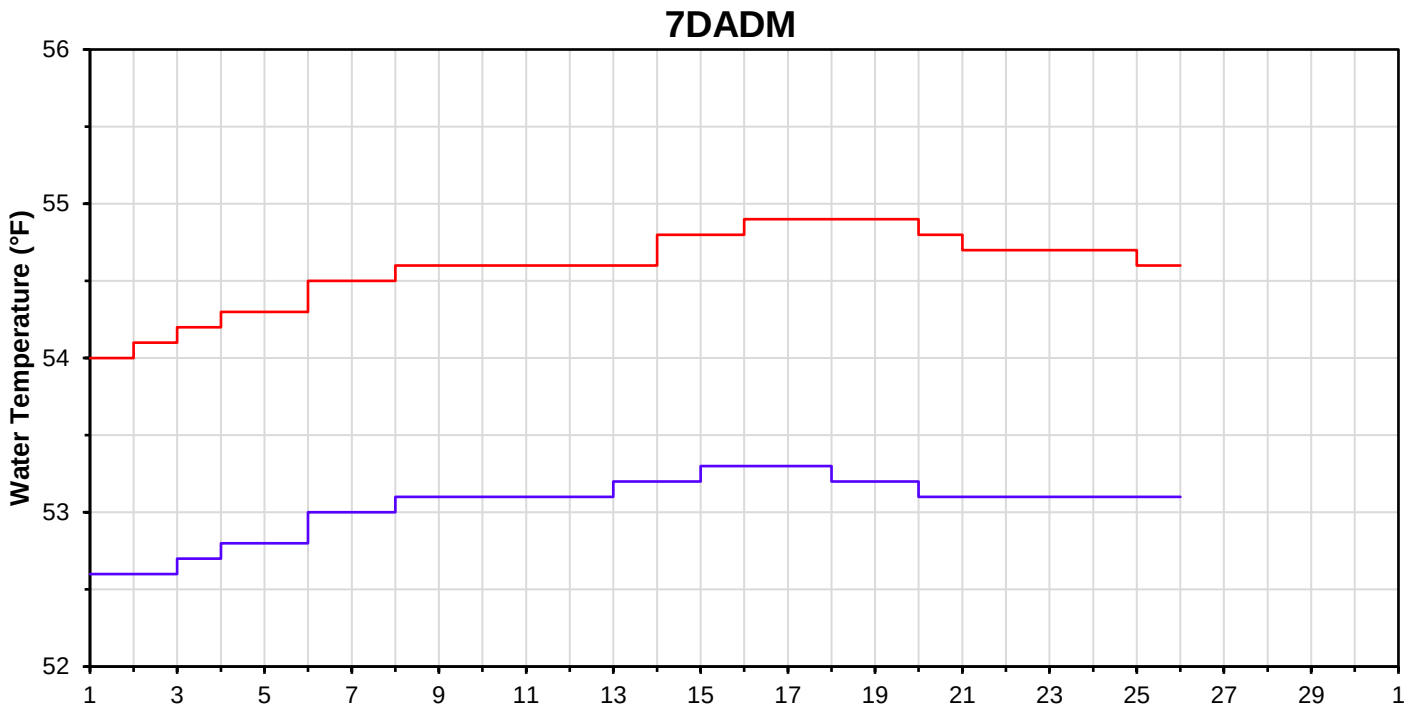
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

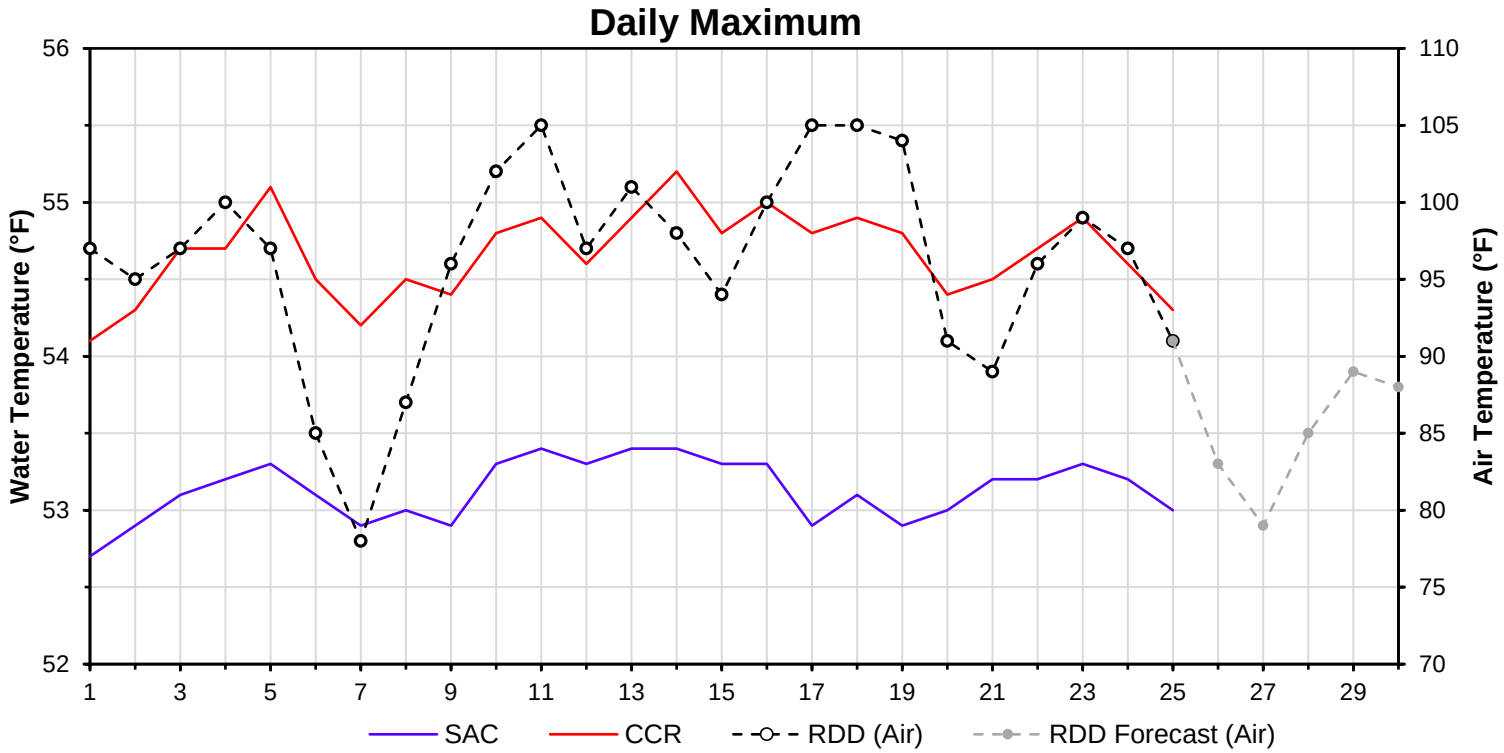
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
06/01	52.7	54.1	52.6	54.0	54.9
06/02	52.9	54.3	52.6	54.1	55.1
06/03	53.1	54.7	52.7	54.2	55.1
06/04	53.2	54.7	52.8	54.3	55.4
06/05	53.3	55.1	52.8	54.3	55.3
06/06	53.1	54.5	53.0	54.5	54.7
06/07	52.9	54.2	53.0	54.5	54.2
06/08	53.0	54.5	53.1	54.6	54.2
06/09	52.9	54.4	53.1	54.6	54.5
06/10	53.3	54.8	53.1	54.6	54.7
06/11	53.4	54.9	53.1	54.6	55.2
06/12	53.3	54.6	53.1	54.6	55.1
06/13	53.4	54.9	53.2	54.6	55.7
06/14	53.4	55.2	53.2	54.8	56.1
06/15	53.3	54.8	53.3	54.8	55.8
06/16	53.3	55.0	53.3	54.9	55.6
06/17	52.9	54.8	53.3	54.9	55.9
06/18	53.1	54.9	53.2	54.9	55.6
06/19	52.9	54.8	53.2	54.9	55.4
06/20	53.0	54.4	53.1	54.8	54.9
06/21	53.2	54.5	53.1	54.7	54.4
06/22	53.2	54.7	53.1	54.7	55.0
06/23	53.3	54.9	53.1	54.7	55.1
06/24	53.2	54.6	53.1	54.7	55.2
06/25	53.0	54.3	53.1	54.6	54.8
06/26					
06/27					
06/28					
06/29					
06/30					
-					

Notes

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

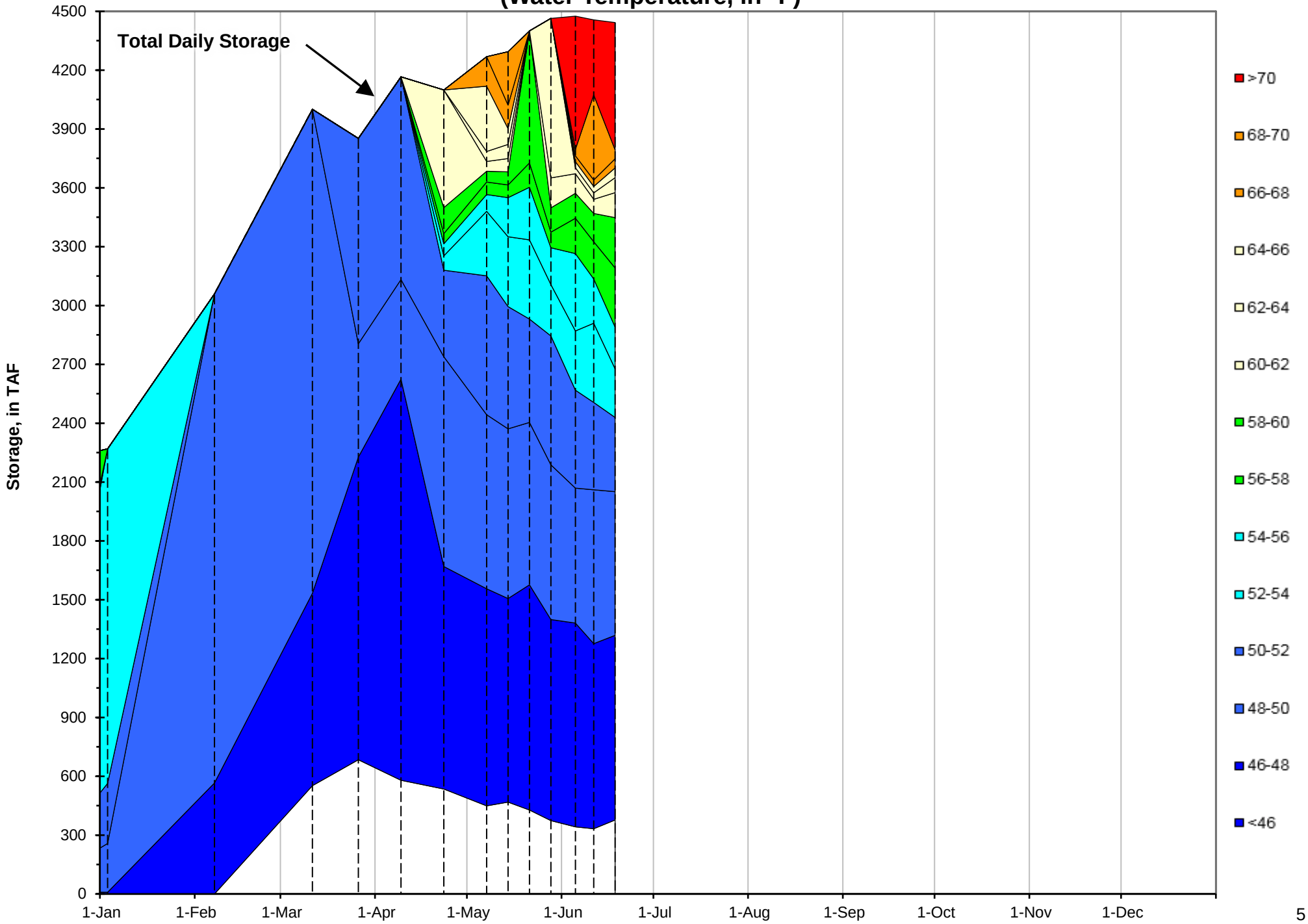
[2] DAT = Daily Average Temperature





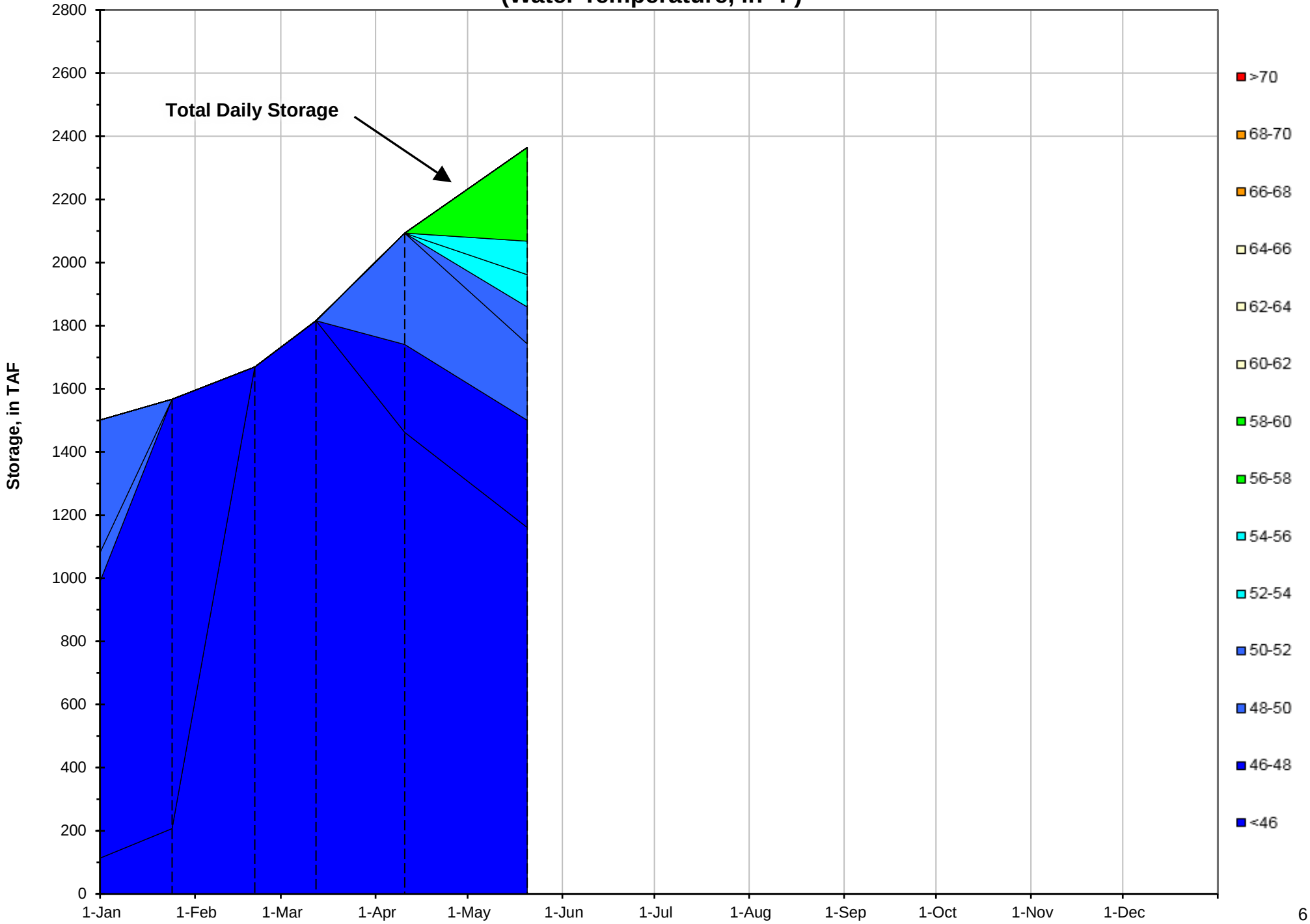
Latest Profile Date: 06/18/2019

Shasta Lake Isothermobaths - 2019
(Water Temperature, in °F)



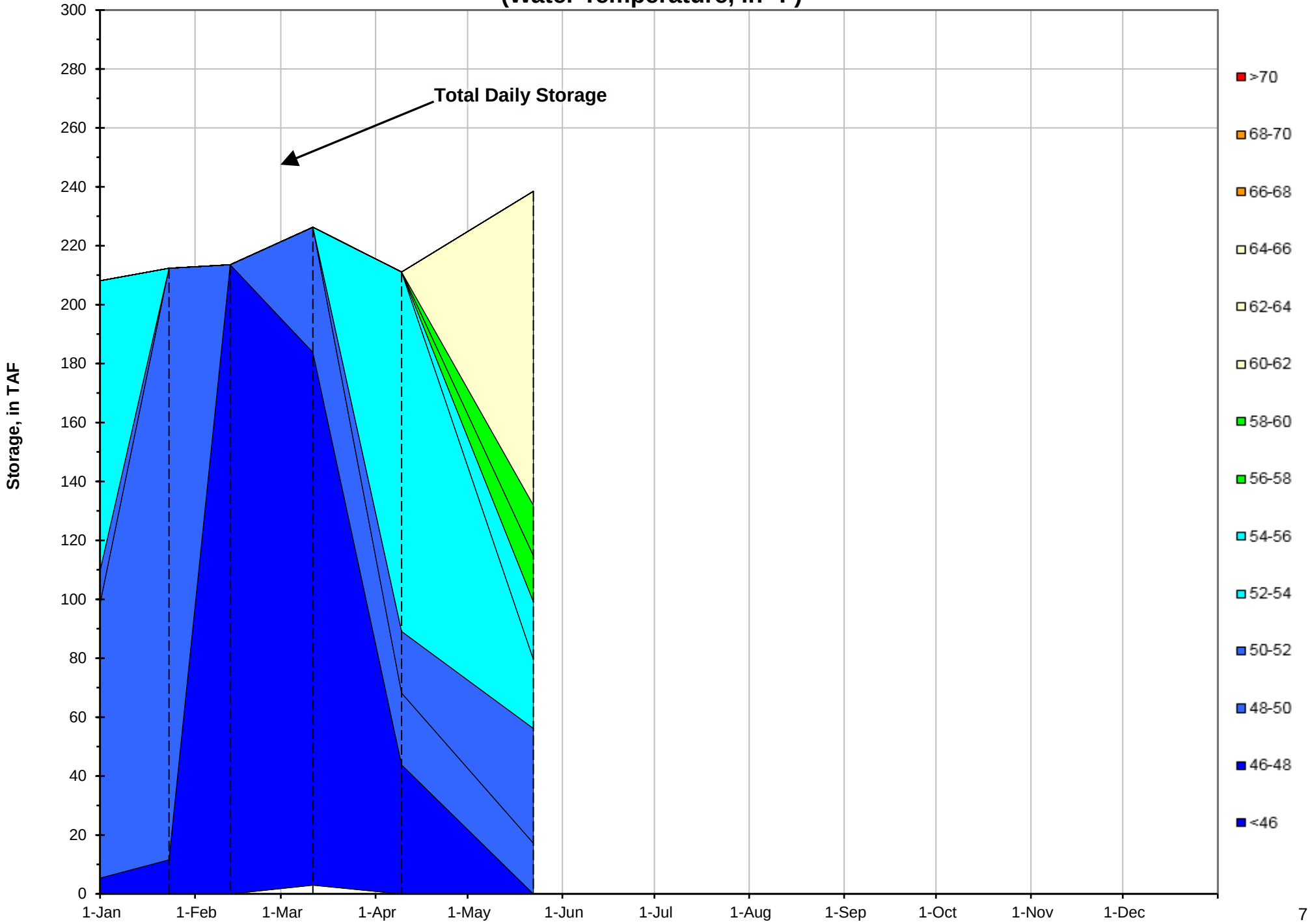
Latest Profile Date: 05/20/2019

Trinity Lake Isothermobaths - 2019
(Water Temperature, in °F)



Latest Profile Date: 05/22/2019

Whiskeytown Lake Isothermobaths - 2019
(Water Temperature, in °F)

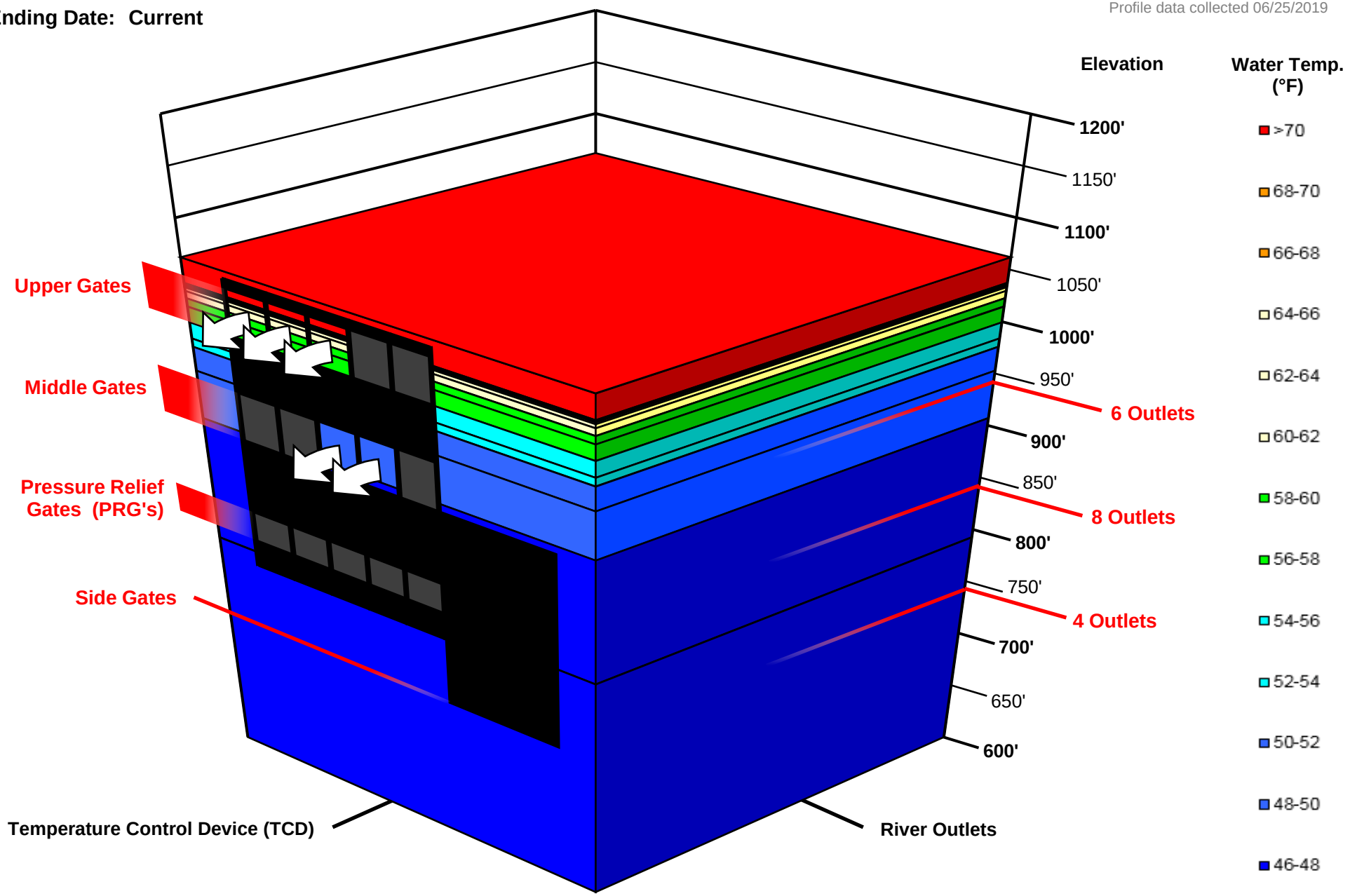


Shasta TCD Configuration

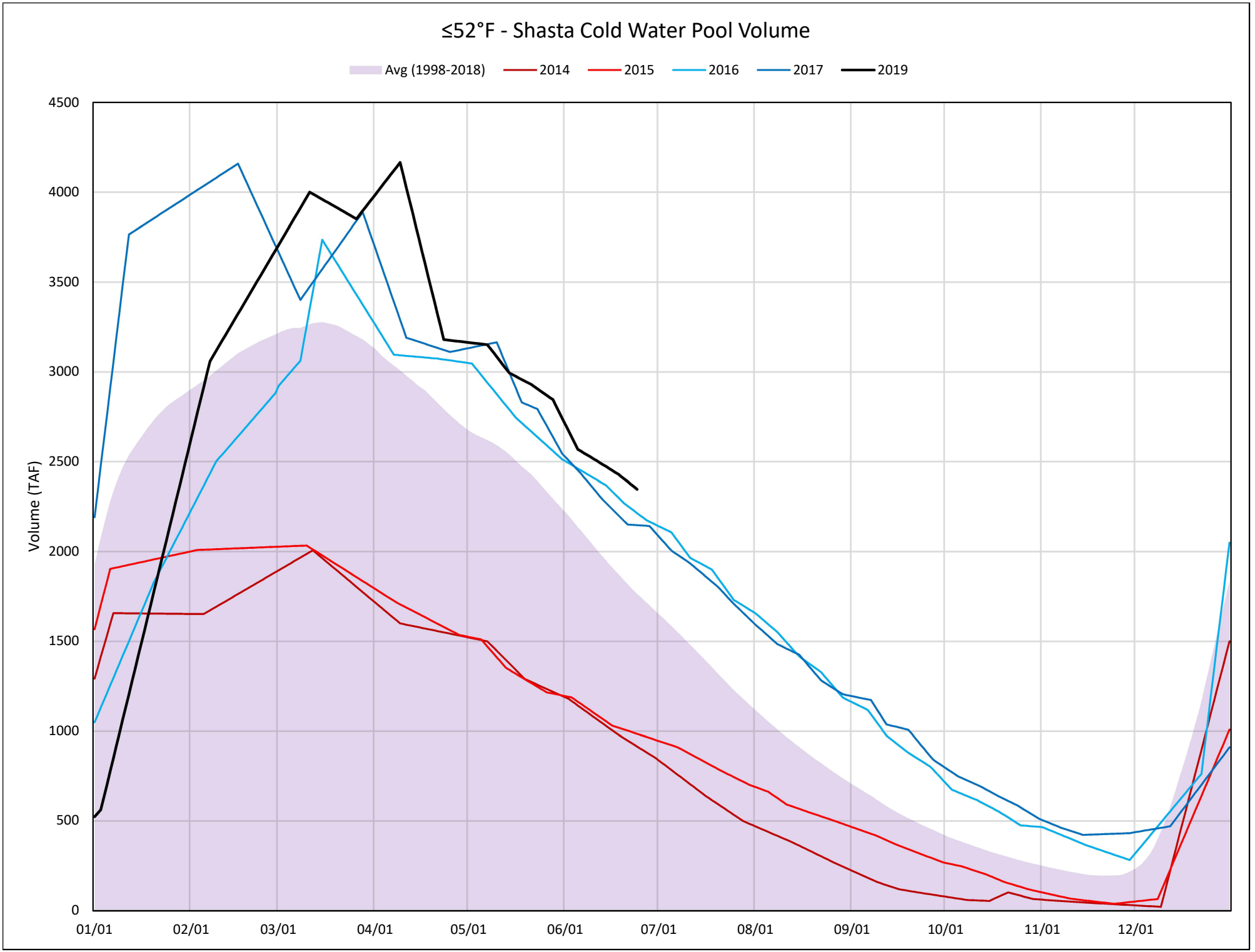
Starting Date: 06/20/2019

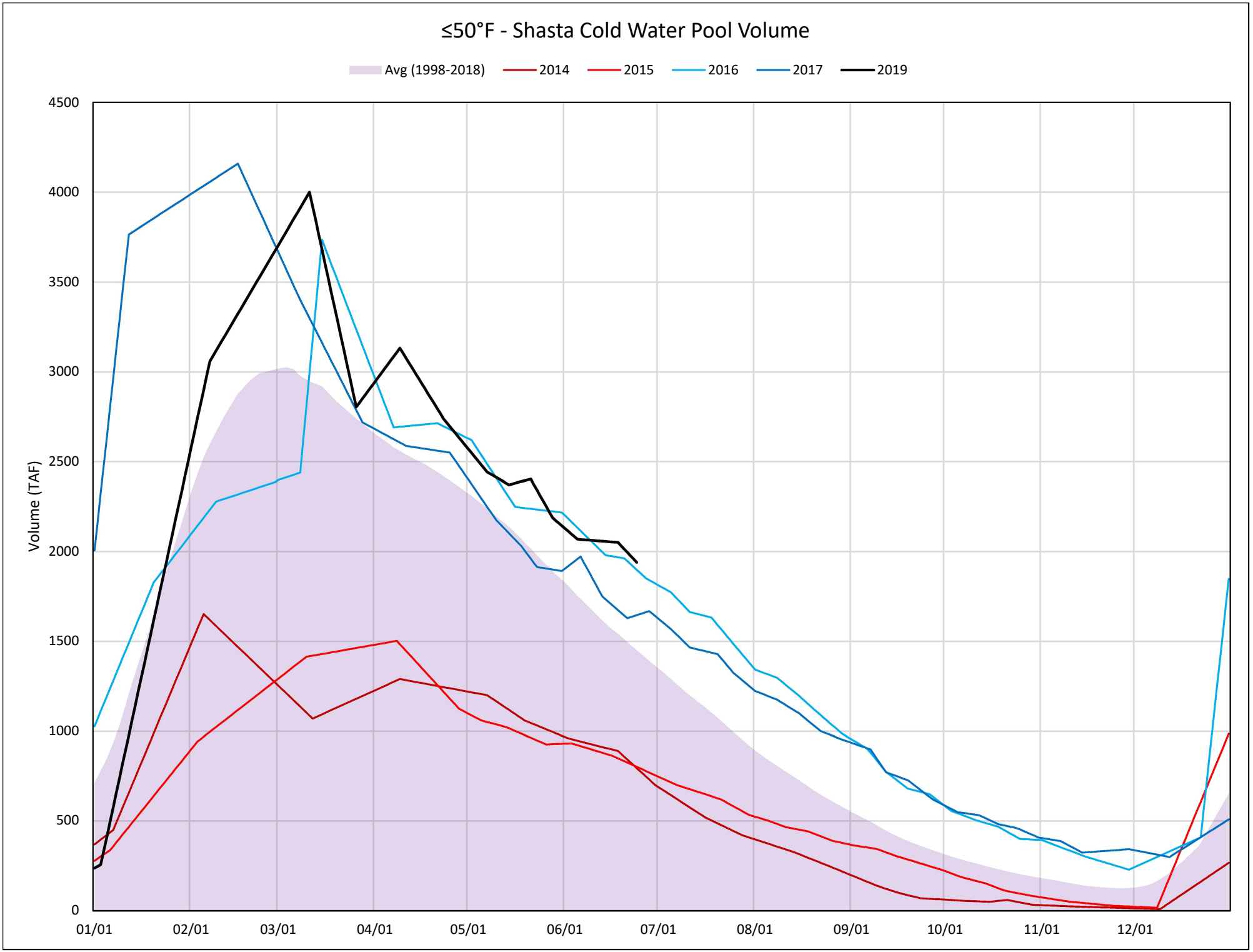
Ending Date: Current

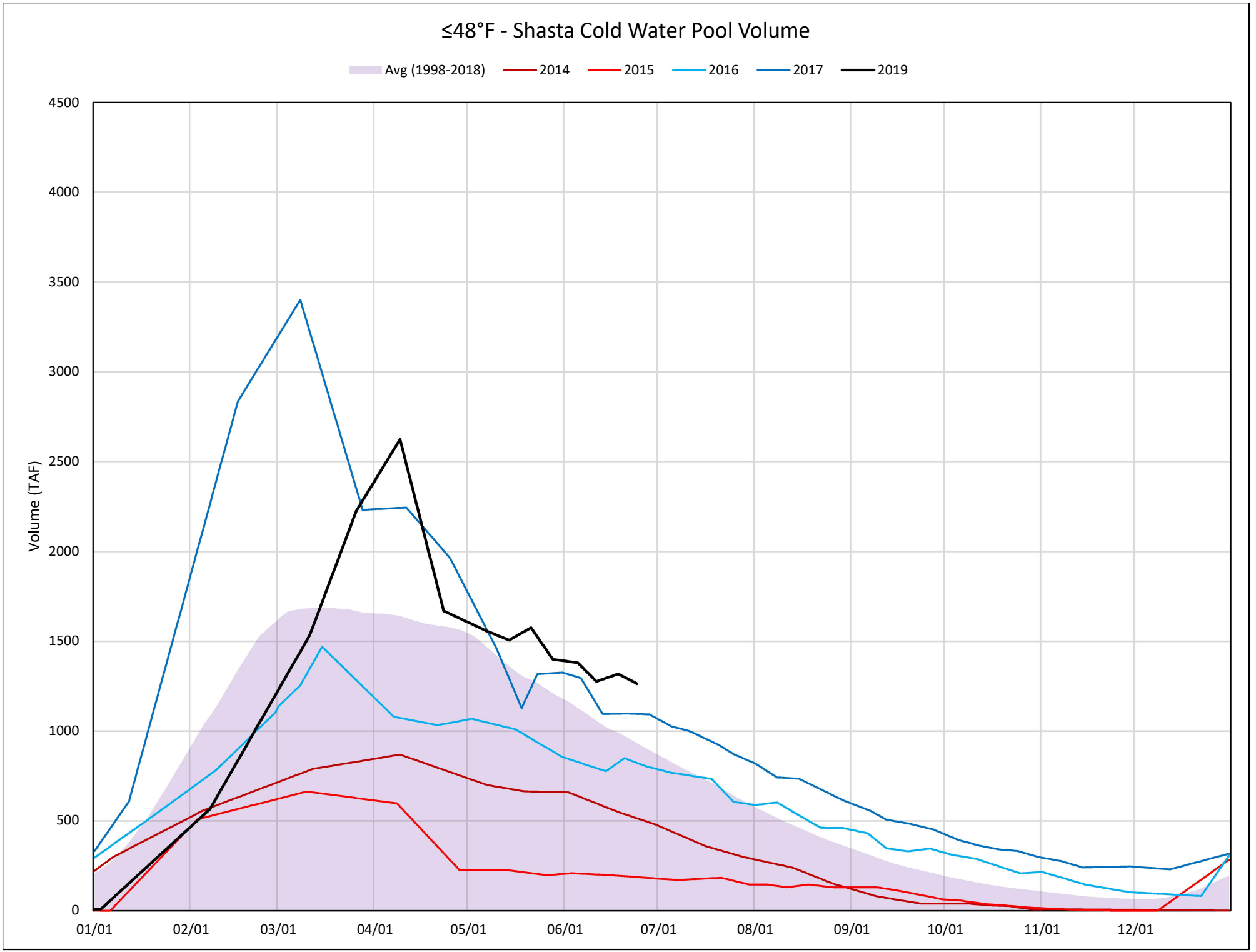
Profile data collected 06/25/2019

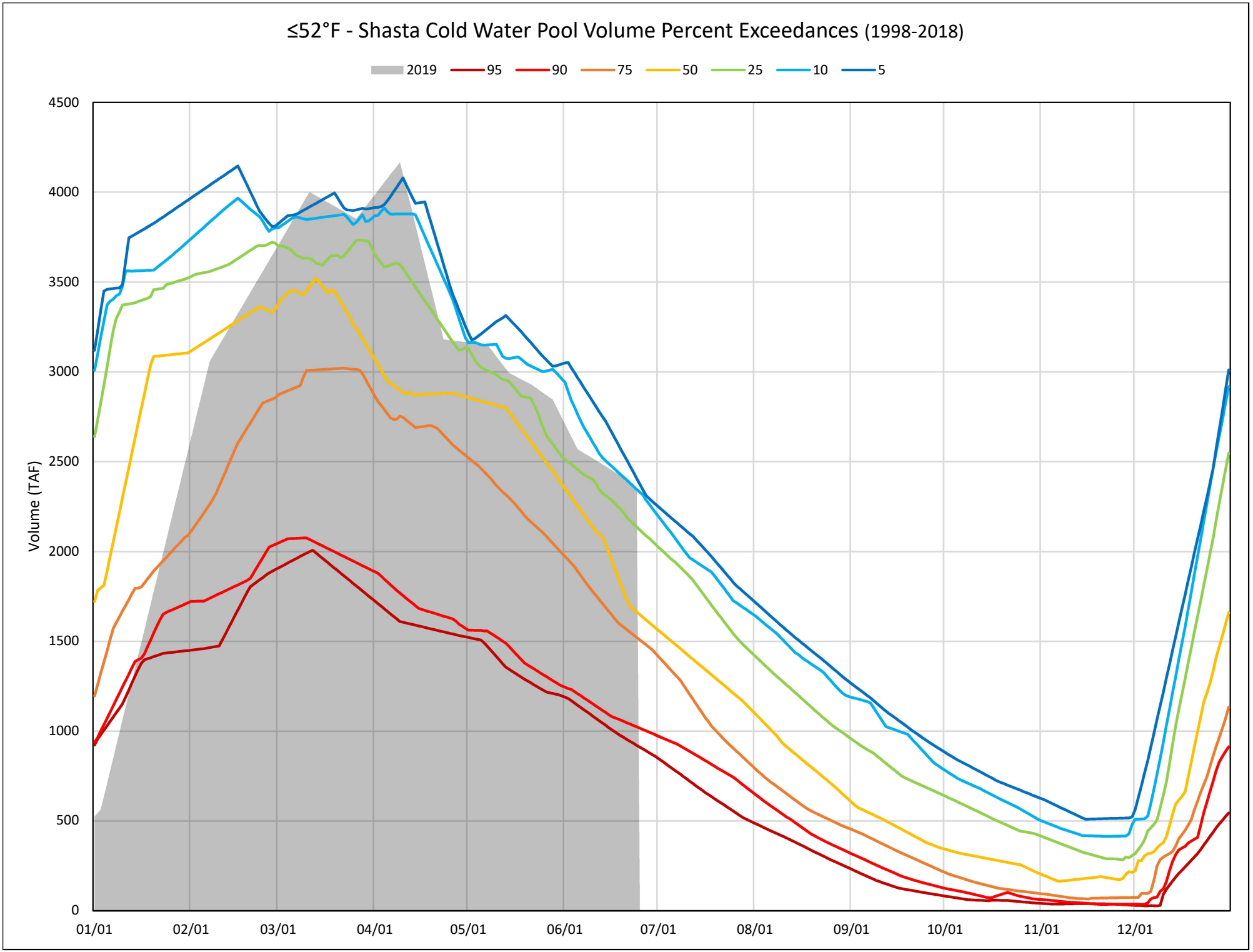


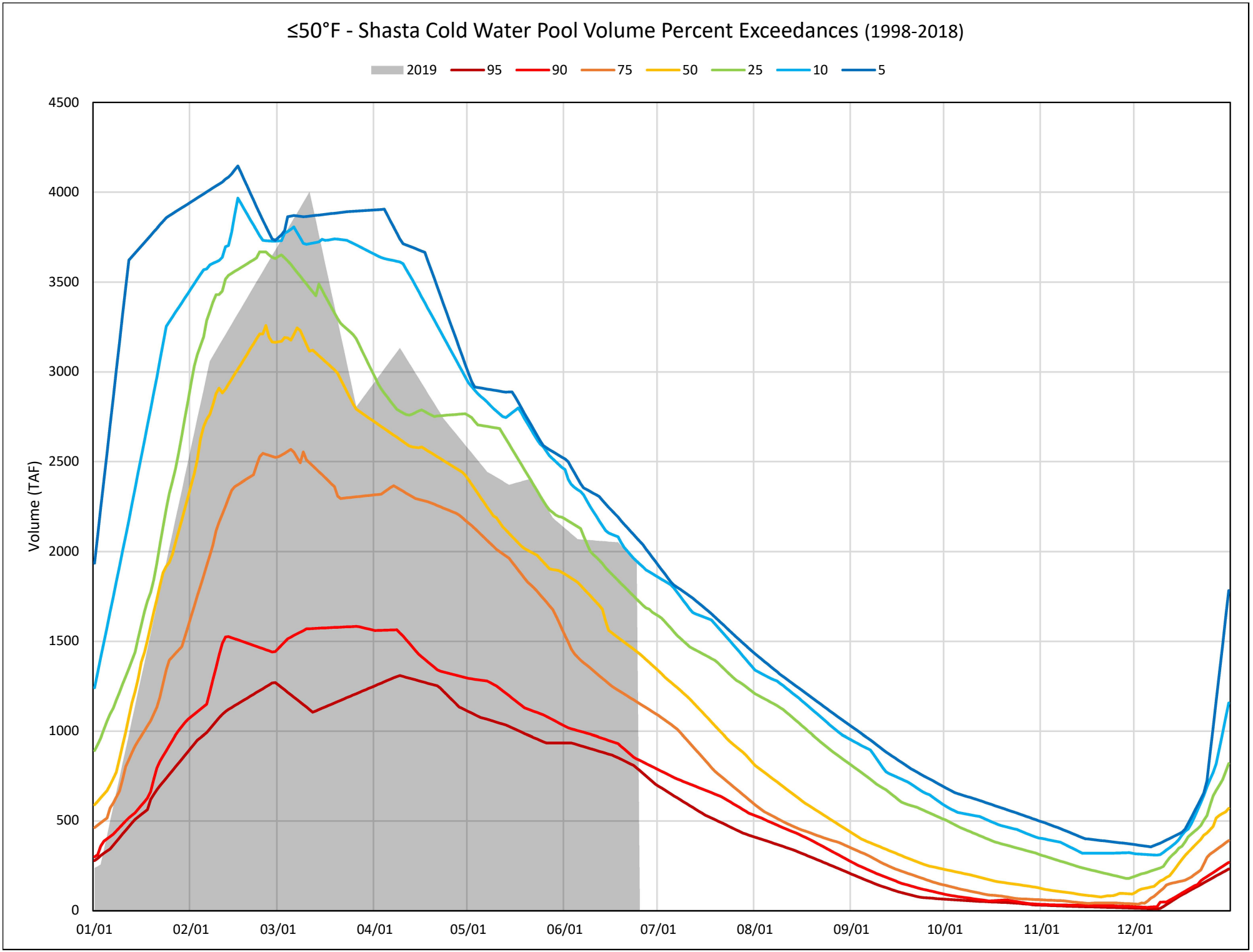
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

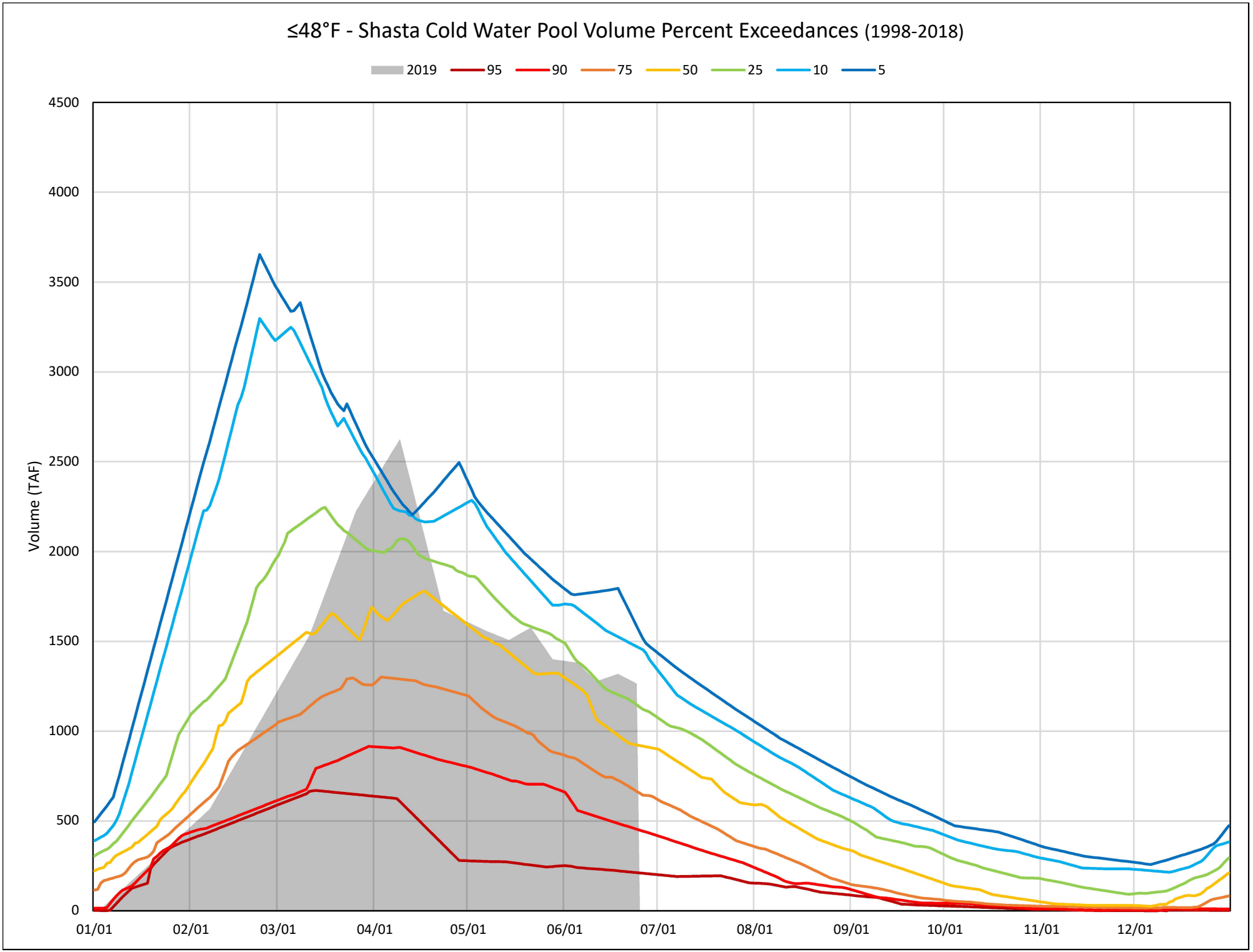

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤50°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
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 (1998-2018)
2014
2015
2016
2017
2019
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

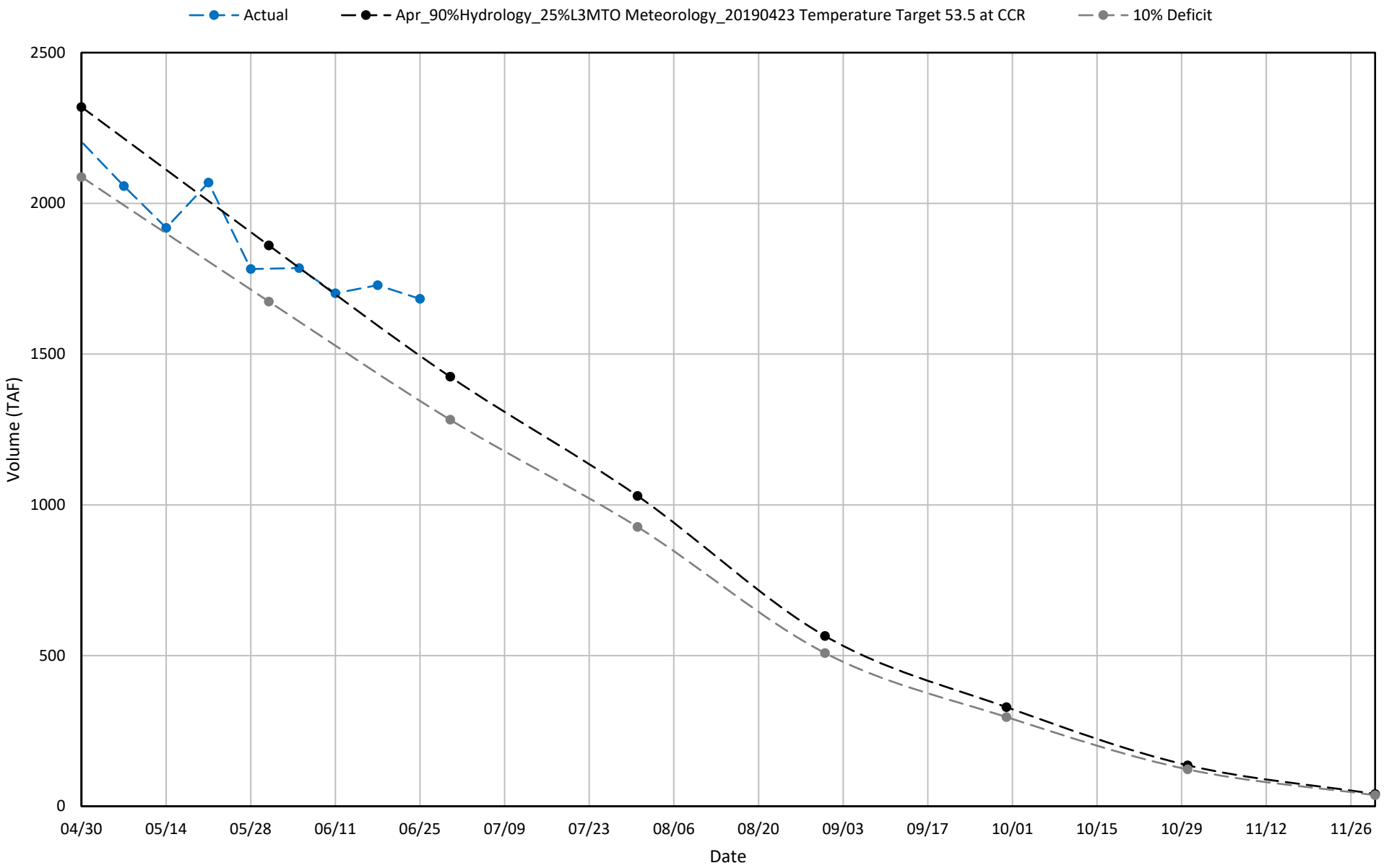

≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤50°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
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 (1998-2018)
2019
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

Printed: 2019.06.26

2019 Shasta Cold Water Pool Volume ≤49°F



June 26, 2019

Upper Sacramento River – June 2019 Preliminary Temperature Analysis

June Model Run: Only the most conservative hydrology set (90% Runoff Exceedance) is used in June as the hydrology information has converged and water year 2019 runoff volumes are nearly identical (CNRFC 50% and 90% runoff water year volume estimates differ by only 20 TAF – 50% 7250 TAF and 90% 7230 TAF)

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

Location (°F DAT)	JUN	JUL	AUG	SEP*	OCT*
May 90%-Exceedance Outlook – 25% L3MTO Meteorology					
Keswick Dam KWK	52.6	52.6	52.5	See Figures 1 and 3	See Figures 1 and 3
Sac. R. abv Clear Creek CCR	53.1	53.2	52.8	See Figures 1 and 4	See Figures 1 and 4
Balls Ferry BSF	55.6	55.3	54.2	See Figures 1 and 5	See Figures 1 and 5
May 90%-Exceedance Outlook – 50% L3MTO Meteorology					
Keswick Dam KWK	52.8	52.8	52.8	See Figures 2 and 3	See Figures 2 and 3
Sac. R. abv Clear Creek CCR	53.3	53.3	53.2	See Figures 2 and 4	See Figures 2 and 4

Location (°F DAT)	JUN	JUL	AUG	SEP*	OCT*
Balls Ferry BSF	55.7	55.2	54.6	See Figures 2 and 5	See Figures 2 and 5

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 25% Met	1,062	10/15	Not used
90% Hydro, 50% Met	1,062	10/18	Not used

Model Run Date June 26, 2019

* 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, ranges in possible outcomes are illustrated with the Fall Temperature Index (graphics above Figures 5-7). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months. Estimated temperatures for September and October may fall into a range indicated within the Fall Temperature Index (graphical chart), illustrating historical performance. However, this range should be viewed as an element of uncertainty based on past performance, not a simulation or projection of temperature management operations or results.

Temperature Analysis Results:

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 downstream Sacramento River compliance location through fall is based on the Figures 5-7.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on May 26, May 24, and May 24, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The temperature profiles prior to May do not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring (i.e. end of April). The concern this year is assuming over or under estimations with variable hydrologic and meteorological conditions and not capturing the stratification with sufficient detail to project into the future with confidence.
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 creek flows cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the June 2019 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances, with minor modifications to accommodate for flood management. Trinity Lake inflows are updated with the CNRFC 90% runoff exceedance for the 90% and DWR Bulletin 120 for the 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. Side-flows were adjusted to a 25% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature exceedance at 25% and 50% patterned after like months on a 6-hour time-step (for months prior to April). Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use local three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are used beginning in April.
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, which is still uncertain prior to the end of April.

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.
9. The model is specifically being applied to generate the most accurate results at the Sacramento River above Clear Creek confluence location.

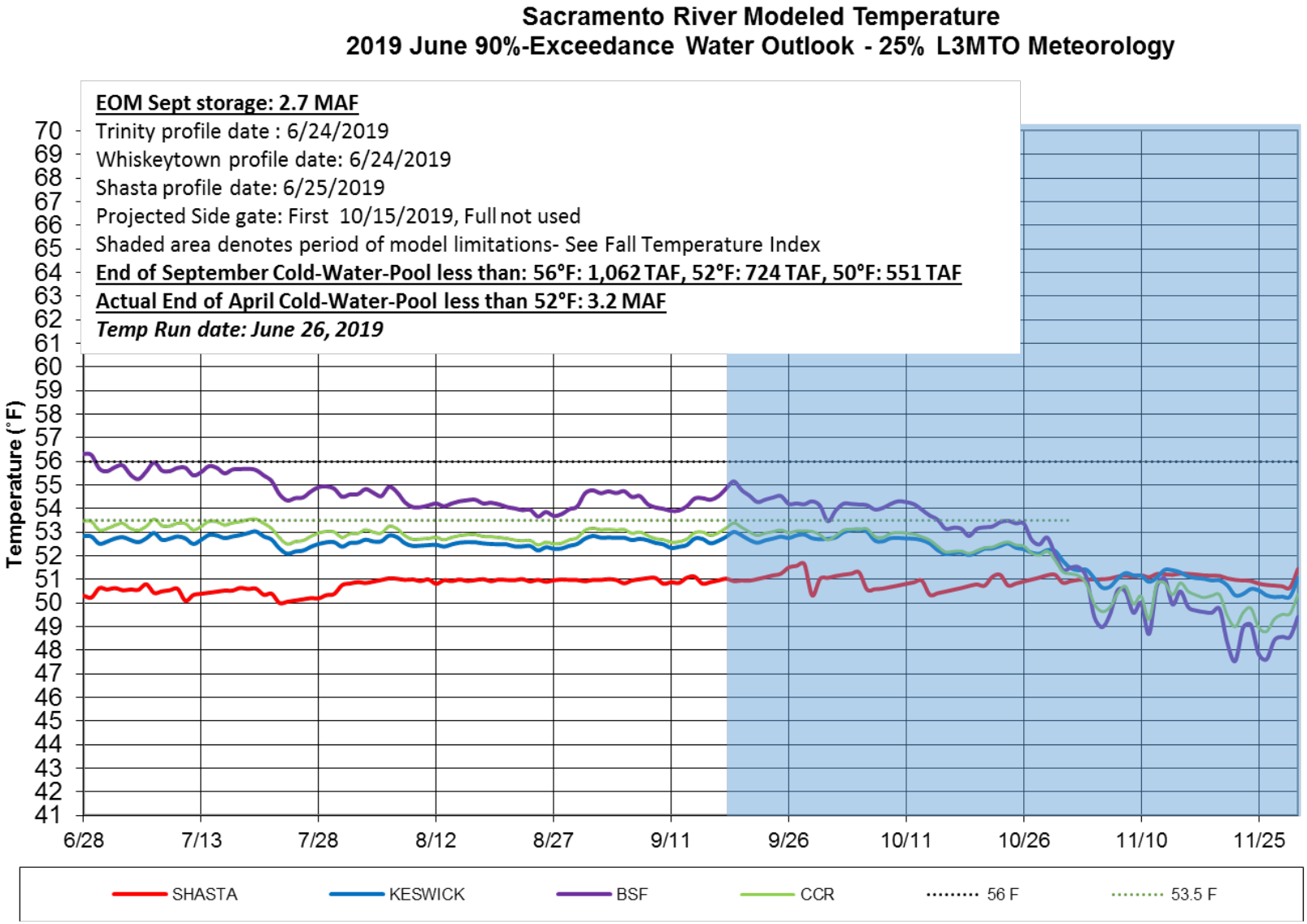


Figure 1. June 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology.

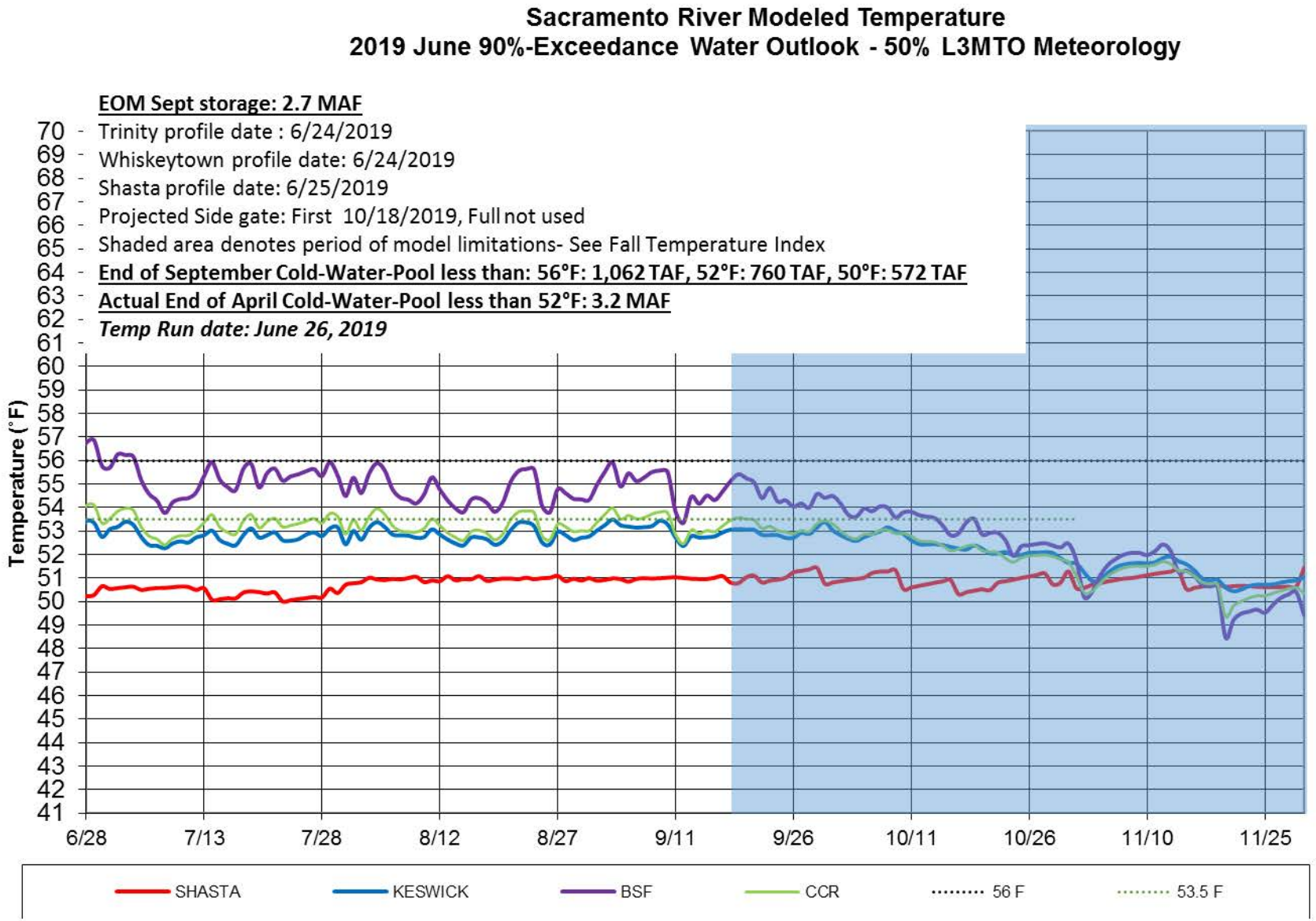


Figure 2. June 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% L3MTO meteorology.

Figures 3-5 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. Based on these records and estimates, the charts below illustrates a range of uncertainty in the expected river temperatures based on the end-of-September lake volume less than 56˚F.

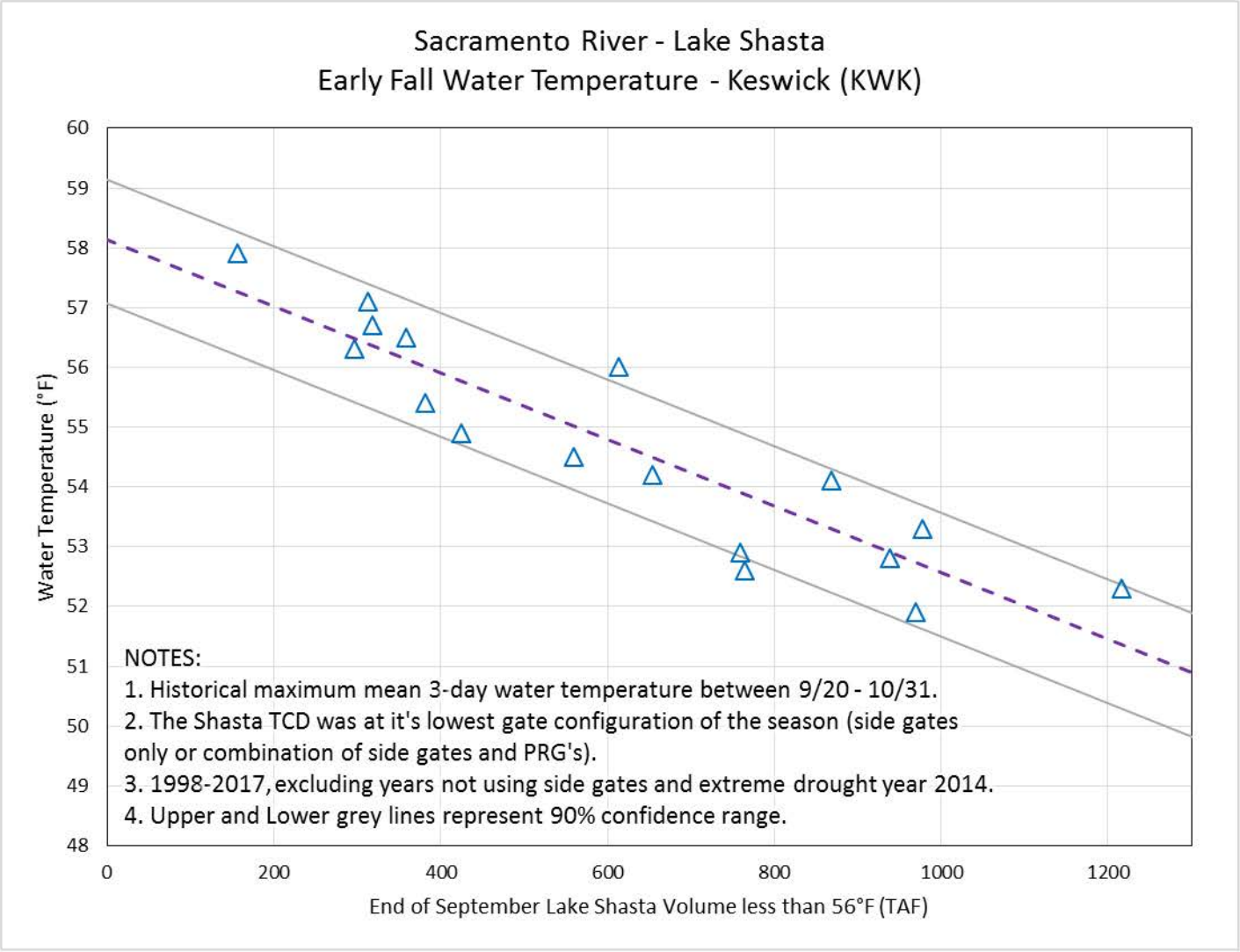


Figure 3. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

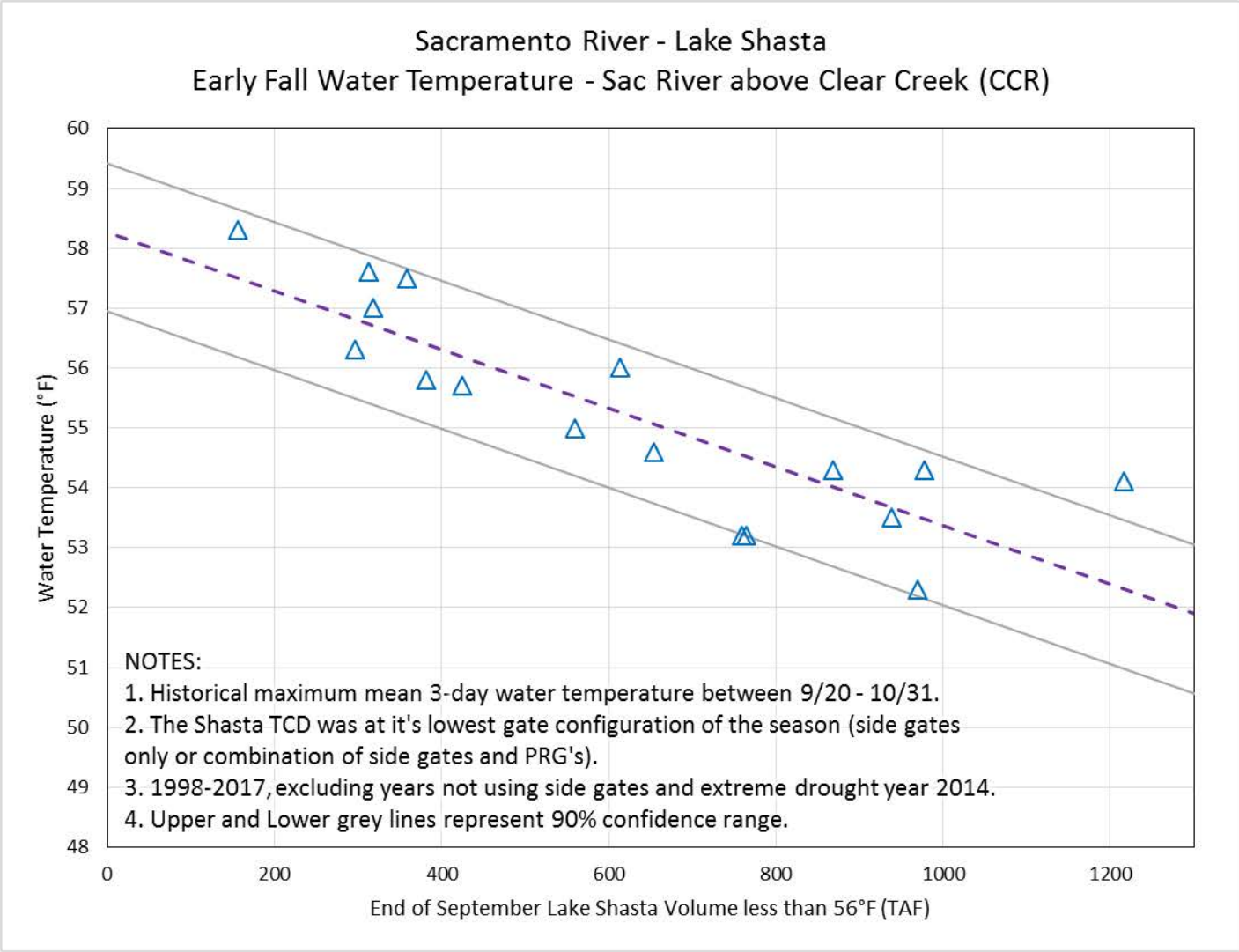


Figure 4. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

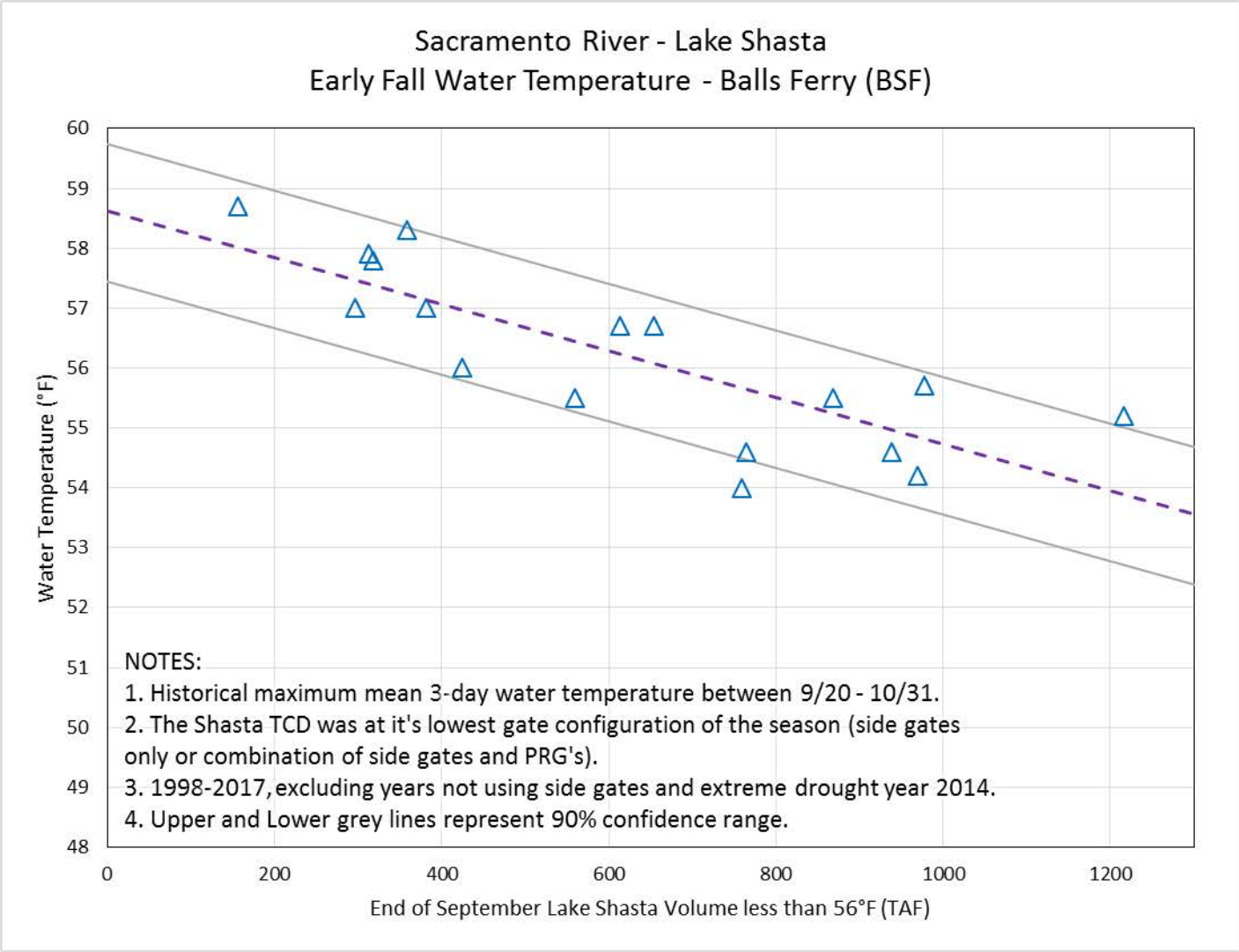
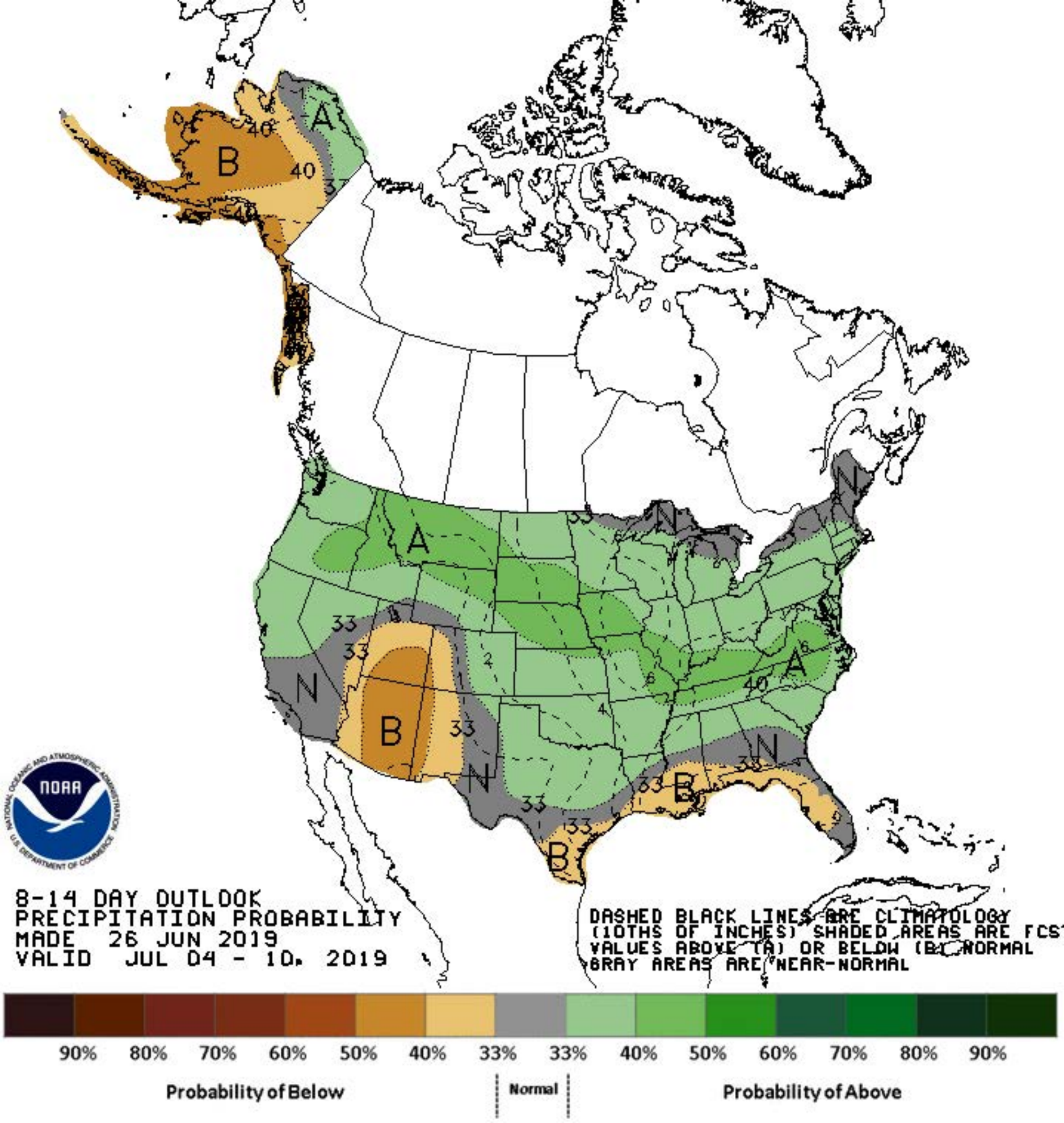
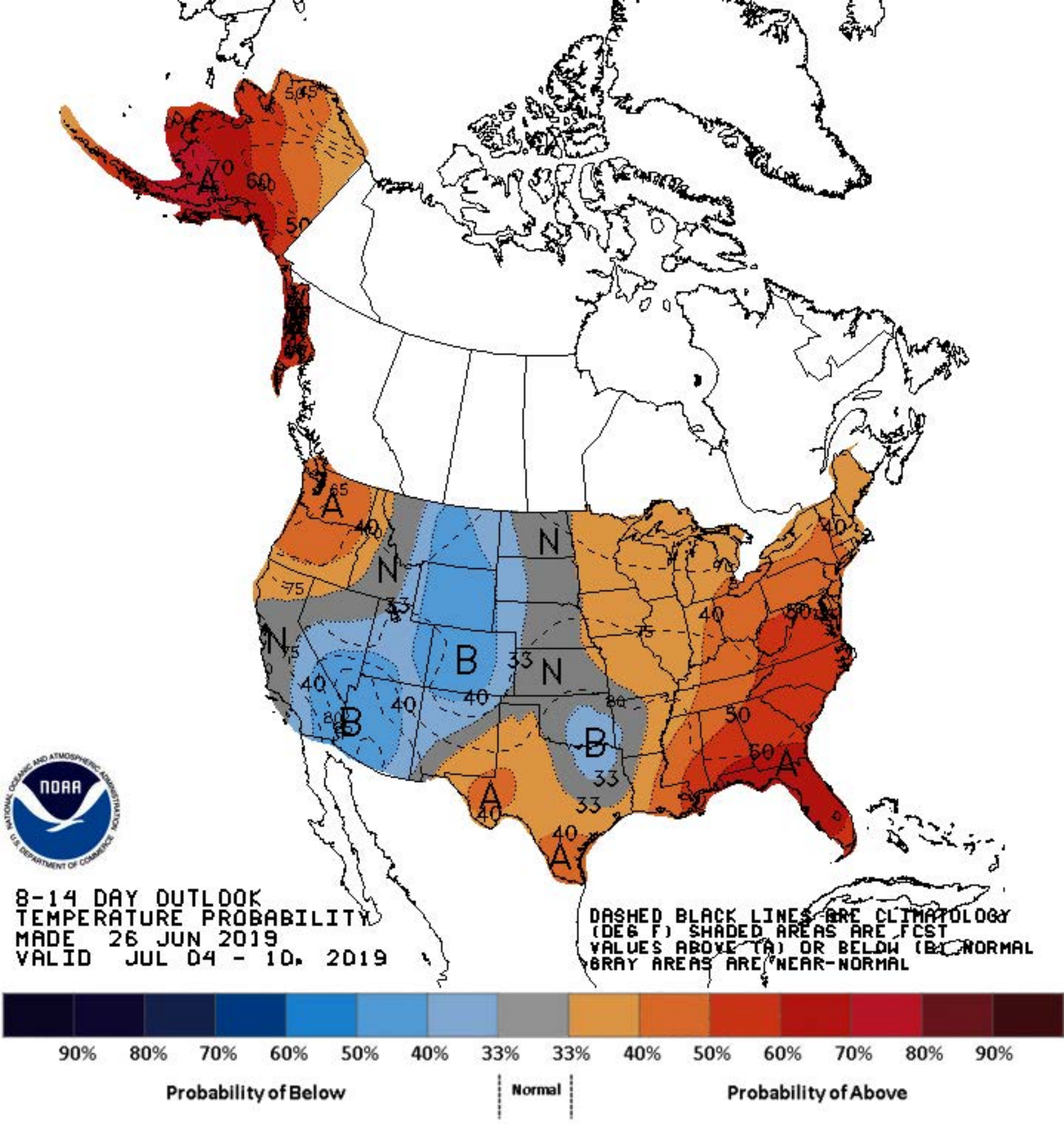


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.


8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 26 JUN 2019
VALID JUL 04 - 10, 2019
DASHED BLACK LINES ARE CLIMATOLOGY
(10THS OF INCHES) SHADED AREAS ARE FCS
VALUES ABOVE (A) OR BELOW (B) NORMAL
GRAY AREAS ARE NEAR-NORMAL
NOAA
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 26 JUN 2019
VALID JUL 04 - 10, 2019
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