RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

August 22, 2019 | 1:00 pm – 3:00 pm

Location: NMFS Office, 650 Capitol Mall , Suite 5-100 – Delta Conference Room, Sacramento, 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: September 26, 2019 – Joint Operations Center – Room 302, 3310 El Camino Ave, Sacramento

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

DAILY CVP WATER SUPPLY REPORT

AUGUST 20, 2019

RUN DATE: August 21, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	800	451	456
SACRAMENTO	KESWICK	9,412	11,101	10,000
FEATHER	OROVILLE (SWP)	6,000	7,500	5,500
AMERICAN	NIMBUS	2,896	3,367	2,528
STANISLAUS	GOODWIN	301	500	261
SAN JOAQUIN	FRIANT	456	419	348

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	1,587	1,599	2,147	135
SHASTA	4,552	2,814	2,826	3,774	134
FOLSOM	977	559	524	782	140
NEW MELONES	2,420	1,442	1,844	2,067	143
FED. SAN LUIS	966	274	325	497	182
TOTAL NORTH CVP	11,363	6,676	7,118	9,267	139
MILLERTON	520	317	294	435	137
OROVILLE (SWP)	3,538	2,075	1,710	2,795	135

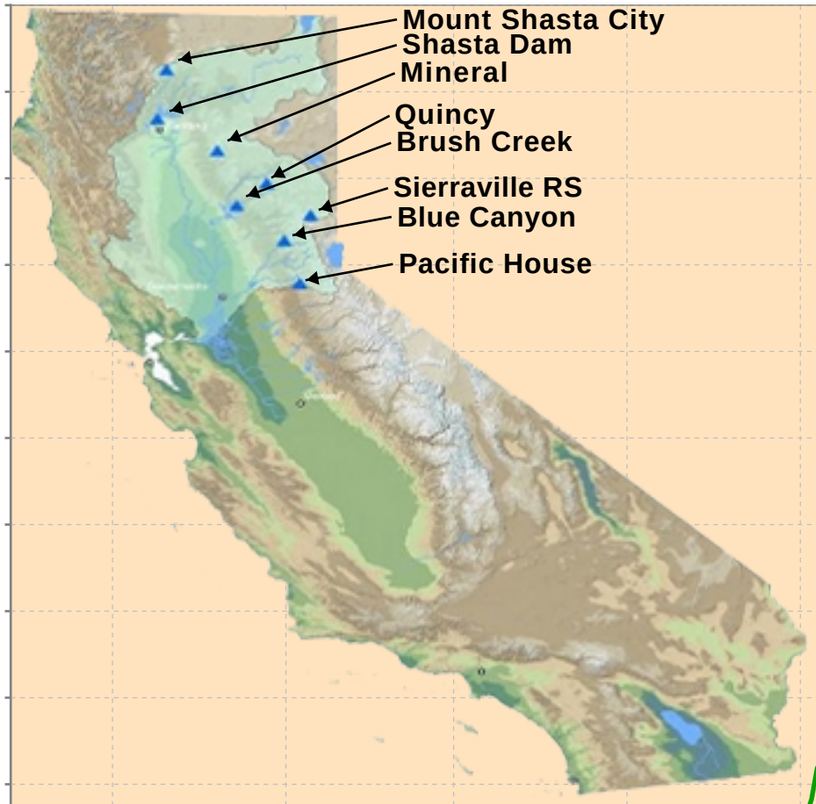
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	1,616	203	2,838	1,216	133
SHASTA	6,906	2,328	10,405	5,083	136
FOLSOM	3,885	321	6,335	2,703	144
NEW MELONES	1,650	----	2,673	1,078	153
MILLERTON	2,498	309	4,424	1,661	150

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	37.27	13.76	55.46	31.69 (57)	118	0.00
SACRAMENTO AT SHASTA DAM	88.74	17.28	112.64	61.72 (62)	144	0.00
AMERICAN AT BLUE CANYON	90.62	15.70	103.88	66.61 (44)	136	0.00
STANISLAUS AT NEW MELONES	42.23	----	45.73	27.47 (41)	154	0.00
SAN JOAQUIN AT HUNTINGTON LK	57.56	17.50	82.90	41.75 (44)	138	0.00

Northern Sierra Precipitation: 8-Station Index, August 21, 2019



Percent of Average for this Date: 135%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

68.7

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)

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Meteorological projections: Shorter term forecasts (8-14 day) suggest 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: 11,000 cfs, Releases will reduce to 10,500 cfs 8/22/19
- Keswick Dam release is expected to decrease in September
- Discussions on-going addressing USFWS BiOp RPA Action 4
- Planning for Fall Sacramento River release reduction discussions in September: Balancing tradeoffs between winter-run, fall-run, in-stream demands, and storage conservation.

Temperature Management:

- Temperature management: Active management
- Selective withdrawal: Releases – 4 Middle and 2 PRG 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 August 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)

		Aug	Sep	Oct	Nov	Dec	Jan	Feb
Shasta	4024	3617	3351	3148	3058	3111	3261	3607
Elev.		1033	1023	1014	1010	1013	1019	1033

Monthly River Releases (cfs)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Sacramento	11000	8500	7500	6000	4500	4000	3250
Clear Creek	150	150	200	200	200	200	200

Trinity Diversions (TAF)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr Power Plant	102	70	23	26	12	3	2
Spring Creek PP	90	60	45	20	12	10	20

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)

		Aug	Sep	Oct	Nov	Dec	Jan	Feb
Shasta	4024	3650	3416	3202	3162	3244	3543	3860
Elev.		1035	1025	1016	1015	1018	1030	1043

Monthly River Releases (cfs)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Sacramento	11000	8500	8000	6000	5000	5000	8000
Clear Creek	150	150	200	200	200	240	200

Trinity Diversions (TAF)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr Power Plant	101	69	23	25	9	0	2
Spring Creek PP	90	60	45	20	12	20	35

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)

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Trinity	**2210**	**2064**	**1944**	**1906**	**1882**	**1892**	**1923**	**2008**	**2085**	**2195**	**2186**	**2082**	**1929**
	Elev.	2345	2337	2334	2333	2333	2336	2342	2347	2354	2353	2347	2336
Whiskeytown	**236**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**	**238**
	Elev.	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209	1209
Shasta	**4024**	**3617**	**3351**	**3148**	**3058**	**3111**	**3261**	**3607**	**4083**	**4250**	**4215**	**4053**	**3666**
	Elev.	1033	1023	1014	1010	1013	1019	1033	1051	1057	1055	1050	1035
Folsom	**838**	**722**	**658**	**534**	**423**	**361**	**362**	**423**	**571**	**764**	**912**	**918**	**770**
	Elev.	442	435	421	406	397	397	406	425	446	460	461	446
New Melones	**2142**	**2030**	**1961**	**1912**	**1918**	**1925**	**1929**	**1936**	**1870**	**1853**	**1792**	**1707**	**1536**
	Elev.	1055	1049	1044	1045	1045	1046	1046	1040	1039	1033	1025	1007
San Luis	**581**	**398**	**412**	**520**	**675**	**871**	**967**	**966**	**966**	**802**	**538**	**446**	**166**
	Elev.	469	472	466	483	504	524	530	543	512	468	444	414
Total		9070	8564	8225	8161	8366	8648	9146	9781	10102	9881	9445	8305

Monthly River Releases (TAF/cfs)

Trinity	TAF	53	52	23	18	18	18	17	18	32	180	47	66
	cfs	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**540**	**2,924**	**783**	**1,073**
Clear Creek	TAF	9	9	12	12	12	12	11	12	13	13	17	9
	cfs	**150**	**150**	**200**	**200**	**200**	**200**	**200**	**200**	**218**	**216**	**288**	**150**
Sacramento	TAF	676	506	461	357	277	246	180	200	332	430	535	676
	cfs	**11000**	**8500**	**7500**	**6000**	**4500**	**4000**	**3250**	**3250**	**5586**	**7000**	**9000**	**11000**
American	TAF	215	157	158	151	123	111	101	92	89	92	89	231
	cfs	**3500**	**2639**	**2577**	**2534**	**2004**	**1800**	**1817**	**1500**	**1500**	**1500**	**1500**	**3751**
Stanislaus	TAF	61	48	52	18	18	22	20	101	42	96	56	98
	cfs	**1000**	**800**	**842**	**300**	**300**	**358**	**364**	**1648**	**700**	**1555**	**940**	**1600**

Trinity Diversions (TAF)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Carr PP	102	70	23	26	12	3	2	35	32	12	132	99
Spring Crk. PP	**90**	**60**	**45**	**20**	**12**	**10**	**20**	**50**	**10**	**10**	**120**	**90**

Delta Summary (TAF)

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Tracy		253	258	268	240	260	170	114	142	48	55	225	263
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7	9.8	11.1
Total USBR		266	272	285	258	278	184	128	155	60	68	235	274
COA Balance		46	179	113	121	93	93	107	107	107	107	107	86
Vernalis	TAF	153	137	99	66	81	85	90	181	101	176	141	189
Vernalis	cfs	2497	2296	1606	1107	1325	1383	1625	2950	1700	2856	2369	3080
Old/Middle River Std.													
Old/Middle R. calc.		-6,678	-7,155	-4,562	-6,025	-6,073	-4,778	-4,588	-4,595	-1,144	-619	-5,670	-7,585
Computed DOI		10346	7564	7808	5715	4506	12054	11400	13762	11162	8378	11178	8004
Excess Outflow		0	0	0	0	0	6051	0	2359	1664	1269	3715	0
% Export/Inflow		39%	48%	38%	53%	62%	35%	35%	33%	11%	13%	35%	47%
% Export/Inflow std.		65%	65%	65%	65%	65%	65%	45%	35%	35%	35%	35%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1640		7,166		4,029		1698	
Year to Date + Forecasted % of mean	136%		129%		148%		161%	

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Estimated CVP Operations 50% Exceedance

Storages

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

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Trinity	**2210**	**2060**	**1940**	**1904**	**1891**	**1921**	**1985**	**2095**	**2179**	**2323**	**2269**	**2106**	**1958**
	Elev.	2345	2337	2334	2333	2335	2340	2347	2353	2362	2359	2348	2338
Whiskeytown	**236**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**	**238**
	Elev.	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209	1209
Shasta	**4024**	**3650**	**3416**	**3202**	**3162**	**3244**	**3543**	**3860**	**4120**	**4382**	**4366**	**4174**	**3796**
	Elev.	1035	1025	1016	1015	1018	1030	1043	1052	1061	1061	1054	1040
Folsom	**838**	**731**	**677**	**599**	**540**	**528**	**557**	**624**	**750**	**898**	**958**	**906**	**802**
	Elev.	443	437	428	421	420	423	431	444	459	464	460	450
New Melones	**2142**	**2046**	**1986**	**1942**	**1952**	**1970**	**1994**	**2040**	**2017**	**2009**	**2053**	**2027**	**1871**
	Elev.	1056	1051	1047	1048	1050	1052	1056	1054	1053	1057	1055	1040
San Luis	**581**	**398**	**414**	**519**	**694**	**895**	**961**	**961**	**959**	**801**	**527**	**282**	**19**
	Elev.	469	472	471	489	507	530	546	546	515	470	426	384
Total		9124	8671	8371	8445	8764	9245	9786	10231	10651	10410	9734	8685

Monthly River Releases (TAF/cfs)

Trinity	TAF	53	52	23	18	18	18	17	18	28	258	126	66
	cfs	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**477**	**4,189**	**2,120**	**1,073**
Clear Creek	TAF	9	9	12	12	12	15	11	12	13	13	17	9
	cfs	**150**	**150**	**200**	**200**	**200**	**240**	**200**	**200**	**218**	**216**	**288**	**150**
Sacramento	TAF	676	506	492	357	307	307	444	615	357	492	595	676
	cfs	**11000**	**8500**	**8000**	**6000**	**5000**	**5000**	**8000**	**10000**	**6000**	**8000**	**10000**	**11000**
American	TAF	215	160	152	149	123	123	194	184	274	400	268	215
	cfs	**3503**	**2690**	**2481**	**2500**	**2000**	**2000**	**3500**	**3000**	**4600**	**6500**	**4500**	**3500**
Stanislaus	TAF	61	48	52	18	18	22	20	93	83	96	56	98
	cfs	**1000**	**800**	**842**	**300**	**300**	**358**	**364**	**1521**	**1400**	**1555**	**940**	**1600**

Trinity Diversions (TAF)

	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Carr PP	101	69	23	25	9	0	2	45	31	9	131	99
Spring Crk. PP	**90**	**60**	**45**	**20**	**12**	**20**	**35**	**70**	**10**	**10**	**120**	**90**

Delta Summary (TAF)

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Tracy		253	260	265	260	265	140	115	140	54	55	205	255
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7	9.8	11.1
Total USBR		266	274	282	278	283	154	129	153	66	68	215	266
State Export		310	324	135	182	180	270	330	112	36	37	205	310
COA Balance		94	220	217	217	217	217	217	217	217	217	217	217
Vernalis	TAF	153	137	130	105	109	127	244	330	161	219	130	189
Vernalis	cfs	2497	2296	2111	1762	1780	2066	4399	5376	2701	3556	2184	3080
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-6,678	-7,297	-4,861	-5,756	-5,592	-4,971	-4,976	-1,486	-694	-304	-5,041	-6,420
Computed DOI		10688	7615	8459	8304	11420	16918	27808	34129	20323	18610	9161	9207
Excess Outflow		0	0	0	2589	6914	10915	16407	22725	10825	11501	1698	1204
% Export/Inflow		39%	49%	39%	45%	38%	29%	23%	11%	7%	7%	36%	41%
% Export/Inflow std.		65%	65%	65%	65%	65%	65%	45%	35%	35%	35%	35%	65%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1634		7,231		4,051		1714	
Year to Date + Forecasted % of mean	135%		131%		149%		162%	

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Northern CVP Water Temperature Report

August - 2019

DATE	Mean Daily Water Temperatures (°F)															Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR	APR[4]	BSF[2]	JLF	BND	RDB	IGO	LWS	-----[3]		Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Jul	51.1	50.4	54.3	51.8	52.5	53.0	-	55.1	56.9	57.7	58.9	58.9	50.5	-		9218	1240	10873	82.4	78.2	78.3	-
08/01	50.6	50.2	55.1	51.2	52.1	52.7	-	**54.7**	56.4	57.2	58.4	58.2	52.3	-		9927	912	10887	81.0	76.1	76.3	-
08/02	50.7	? 50.3	55.1	51.4	52.2	52.6	-	! -	56.1	56.9	58.2	58.4	52.1	-		9494	1491	10903	83.5	-	79.0	-
08/03	50.7	50.2	55.4	51.4	52.1	52.9	-	# -	56.4	57.3	58.5	58.8	52.7	-		9633	997	10890	87.0	-	80.2	-
08/04	50.8	50.3	55.5	51.5	52.3	52.9	-	# -	56.6	57.4	58.7	58.8	52.5	-		8756	963	10926	85.5	-	80.1	-
08/05	50.8	50.3	55.5	51.7	52.3	52.6	-	! -	56.0	56.8	58.1	57.6	52.1	-		9049	1269	10927	82.0	-	77.5	-
08/06	50.9	# -	55.5	51.9	52.5	53.0	-	**54.6**	56.1	56.8	57.9	58.2	! -	-		9660	1125	10831	86.0	79.1	81.2	-
08/07	50.9	# -	55.6	51.8	52.5	52.9	53.8	**54.7**	56.3	57.0	58.1	? 58.2	! -	-		9105	1422	10881	83.0	77.5	77.3	-
08/08	51.3	! -	55.6	51.8	52.6	53.1	54.0	**54.8**	56.3	57.0	58.1	58.2	? 53.3	-		9655	1257	10998	78.0	73.2	72.5	-
08/09	50.9	50.1	55.7	51.9	52.4	52.7	53.5	**54.2**	55.7	56.5	57.7	? 57.3	? 52.8	-		9799	1478	11107	72.5	70.8	69.5	-
08/10	50.8	? 49.9	55.9	51.6	52.2	52.5	53.3	**54.1**	55.4	? 56.0	56.7	56.9	53.0	-		9168	1529	11068	70.0	67.5	70.2	-
08/11	50.7	49.9	55.9	51.3	52.1	52.5	53.4	**54.2**	55.5	56.0	56.7	57.8	53.1	-		9453	1282	11088	75.0	70.4	73.1	-
08/12	51.0	50.2	55.9	51.6	52.3	52.8	53.7	**54.5**	55.9	56.6	57.5	58.4	52.7	-		9315	1237	11093	82.5	76.3	75.8	-
08/13	50.7	49.9	56.0	51.8	52.5	52.9	53.8	**54.7**	56.2	56.9	57.9	58.4	52.6	-		9396	1142	11091	84.0	78.5	78.9	-
08/14	50.6	49.7	56.1	51.6	? 52.5	53.1	54.0	**54.8**	56.4	57.1	58.2	58.8	52.9	-		9488	1098	11092	87.0	82.0	81.7	-
08/15	50.6	49.6	56.2	51.6	52.4	53.1	53.9	**54.8**	56.4	57.1	58.4	59.1	53.2	-		9504	1014	11087	89.0	83.4	85.4	-
08/16	50.7	49.9	56.3	51.5	52.4	53.0	53.9	**54.8**	56.5	57.3	58.5	59.0	! -	-		9661	934	11090	94.0	84.0	85.3	-
08/17	50.7	50.0	56.3	51.6	52.3	53.0	53.8	**54.5**	56.2	? 56.9	58.2	58.8	! -	-		9746	969	11080	86.5	80.2	79.8	-
08/18	50.9	50.1	56.2	51.7	52.6	53.1	53.8	**54.6**	56.1	56.8	58.0	58.4	! -	-		9215	1180	11099	80.0	74.8	73.2	-
08/19	50.6	49.9	56.3	51.9	52.5	53.1	53.8	**54.5**	55.9	56.6	57.7	58.1	52.4	-		9447	1308	11011	78.0	72.8	72.7	-
08/20	50.4	49.3	56.4	52.0	52.7	53.2	53.9	**54.6**	56.0	56.6	57.6	58.9	52.6	-		9261	1441	11101	78.5	73.0	72.7	-
08/21																						
08/22																						
08/23																						
08/24																						
08/25																						
08/26																						
08/27																						
08/28																						
08/29																						
08/30																						
08/31																						
Aug	50.8	50.0	55.8	51.6	52.4	52.9	53.8	54.6	56.1	56.8	58.0	58.3	52.7	-		9437	1202	11013	82.2	76.2	77.1	-
															Total CFS	188732	24048	220250				
															Total AF	374342	47698	436857				

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
[4] APR = Airport Road. This is a virtual site interpolated linearly between CCR and BSF based on distance.

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
08/01	65	100	82.5	64	98	81.0	62	100	81.0	64	103	83.5	65	103	84.0	66	103	84.5	65	100	82.5	63	96	79.5	63	93	78.0	62	95	78.5	65	96	80.5	65	99	82.0
08/02	64	98	81.0	68	99	83.5	64	104	84.0	66	102	84.0	66	102	84.0	67	101	84.0	63	95	79.0	60	93	76.5	62	92	77.0	64	97	80.5	66	98	82.0	64	98	81.0
08/03	66	101	83.5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
08/04	70	104	87.0	70	101	85.5	65	102	83.5	66	101	83.5	62	96	79.0	59	93	76.0	59	92	75.5	59	94	76.5	65	96	80.5	65	101	83.0	68	101	84.5	66	101	83.5
08/05	70	101	85.5	65	103	84.0	67	101	84.0	64	97	80.5	61	94	77.5	61	90	75.5	58	90	74.0	60	97	78.5	65	101	83.0	67	103	85.0	67	99	83.0	65	97	81.0
08/06	64	100	82.0	71	100	85.5	63	97	80.0	61	93	77.0	60	87	73.5	59	85	72.0	58	95	76.5	61	101	81.0	67	103	85.0	67	103	85.0	67	99	83.0	65	98	81.5
08/07	70	102	86.0	67	100	83.5	61	94	77.5	61	88	74.5	58	82	70.0	59	95	77.0	62	101	81.5	64	102	83.0	67	103	85.0	67	100	83.5	67	97	82.0	62	95	78.5
08/08	66	100	83.0	65	96	80.5	63	90	76.5	57	83	70.0	59	95	77.0	62	100	81.0	63	101	82.0	64	100	82.0	67	102	84.5	67	103	85.0	68	98	83.0	64	96	80.0
08/09	64	92	78.0	66	86	76.0	57	81	69.0	58	93	75.5	64	98	81.0	65	99	82.0	62	96	79.0	60	92	76.0	63	98	80.5	65	101	83.0	66	99	82.5	64	96	80.0
08/10	60	85	72.5	61	80	70.5	55	92	73.5	59	97	78.0	62	98	80.0	62	97	79.5	61	93	77.0	60	94	77.0	63	96	79.5	63	96	79.5	65	98	81.5	64	97	80.5
08/11	61	79	70.0	60	93	76.5	59	97	78.0	61	99	80.0	64	100	82.0	63	95	79.0	61	94	77.5	61	91	76.0	63	97	80.0	65	100	82.5	67	100	83.5	66	100	83.0
08/12	59	91	75.0	66	98	82.0	63	100	81.5	65	104	84.5	67	102	84.5	64	95	79.5	60	91	75.5	59	93	76.0	65	99	82.0	68	103	85.5	68	100	84.0	65	95	80.0
08/13	66	99	82.5	68	102	85.0	66	106	86.0	69	107	88.0	68	101	84.5	64	94	79.0	60	92	76.0	60	97	78.5	65	100	82.5	65	99	82.0	65	95	80.0	64	94	79.0
08/14	67	101	84.0	68	106	87.0	70	108	89.0	70	104	87.0	66	99	82.5	63	95	79.0	61	96	78.5	63	99	81.0	64	101	82.5	67	100	83.5	67	97	82.0	64	95	79.5
08/15	67	107	87.0	71	108	89.5	69	104	86.5	67	101	84.0	63	94	78.5	61	95	78.0	62	100	81.0	64	102	83.0	66	98	82.0	65	96	80.5	66	95	80.5	64	95	79.5
08/16	69	109	89.0	83	106	94.5	67	102	84.5	62	94	78.0	61	96	78.5	63	99	81.0	64	102	83.0	65	101	83.0	67	98	82.5	67	97	82.0	65	98	81.5	64	95	79.5
08/17	82	106	94.0	72	100	86.0	63	94	78.5	60	95	77.5	62	100	81.0	64	104	84.0	66	102	84.0	67	100	83.5	67	99	83.0	65	101	83.0	67	100	83.5	65	99	82.0
08/18	72	101	86.5	65	93	79.0	60	93	76.5	61	97	79.0	63	103	83.0	66	104	85.0	66	101	83.5	66	100	83.0	67	103	85.0	67	104	85.5	67	98	82.5	63	97	80.0
08/19	65	95	80.0	53	95	74.0	61	97	79.0	63	101	82.0	67	104	85.5	67	103	85.0	67	102	84.5	66	104	85.0	64	100	82.0	63	103	83.0	65	99	82.0	65	99	82.0
08/20	62	94	78.0	62	95	78.5	63	98	80.5	66	101	83.5	67	103	85.0	68	103	85.5	67	103	85.0	67	105	86.0	66	103	84.5	68	102	85.0	66	98	82.0	65	97	81.0
08/21	62	95	78.5	67	99	83.0	66	102	84.0	65	104	84.5	68	103	85.5	66	103	84.5	67	104	85.5	68	106	87.0	69	104	86.5	69	103	86.0	68	100	84.0	64	98	81.0
08/22																																				
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08/30																																				
08/31																																				

Web Links

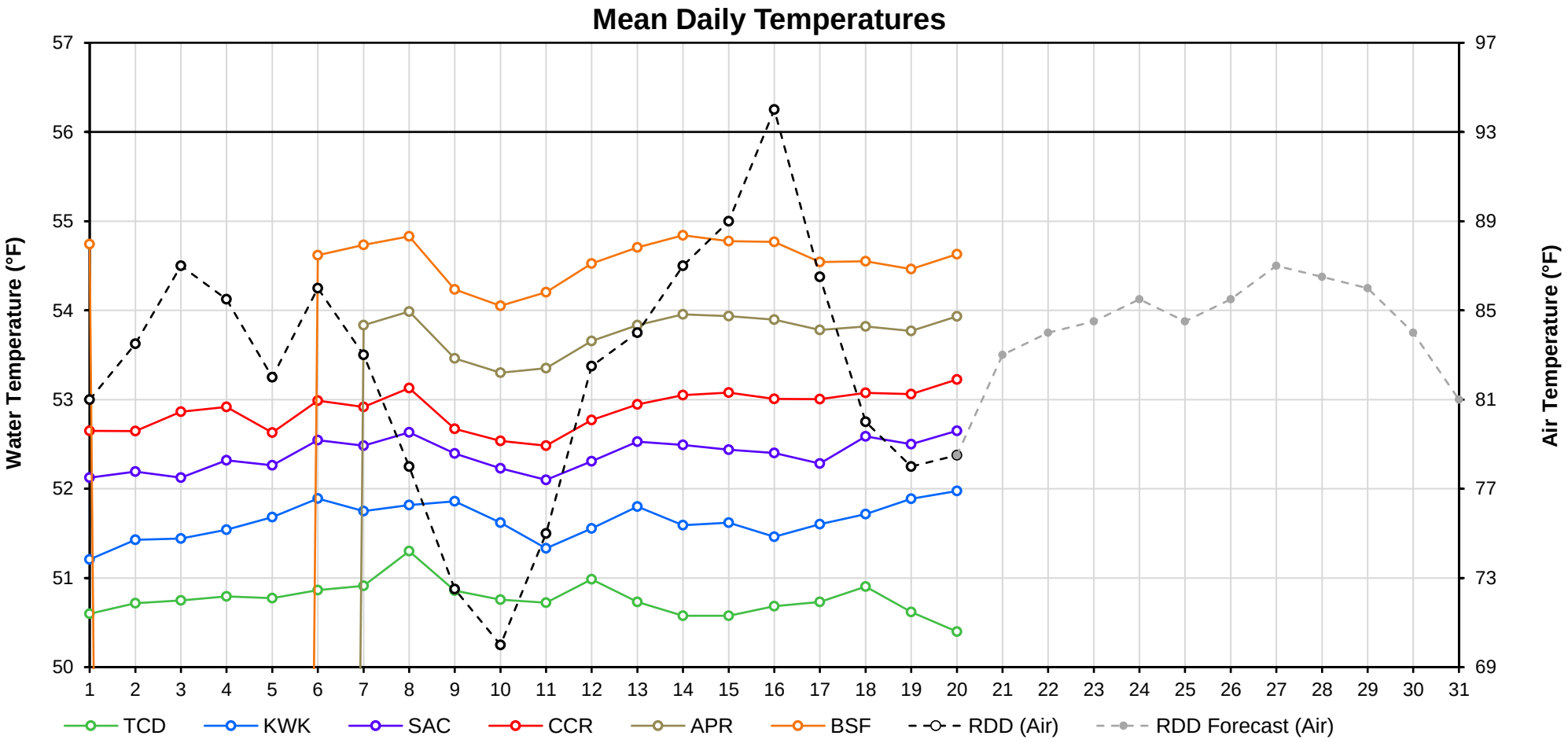
10-Day Min/Max Forecast

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)	Begin Date
BSF	**56.0**	**5/25/2018**

Notes

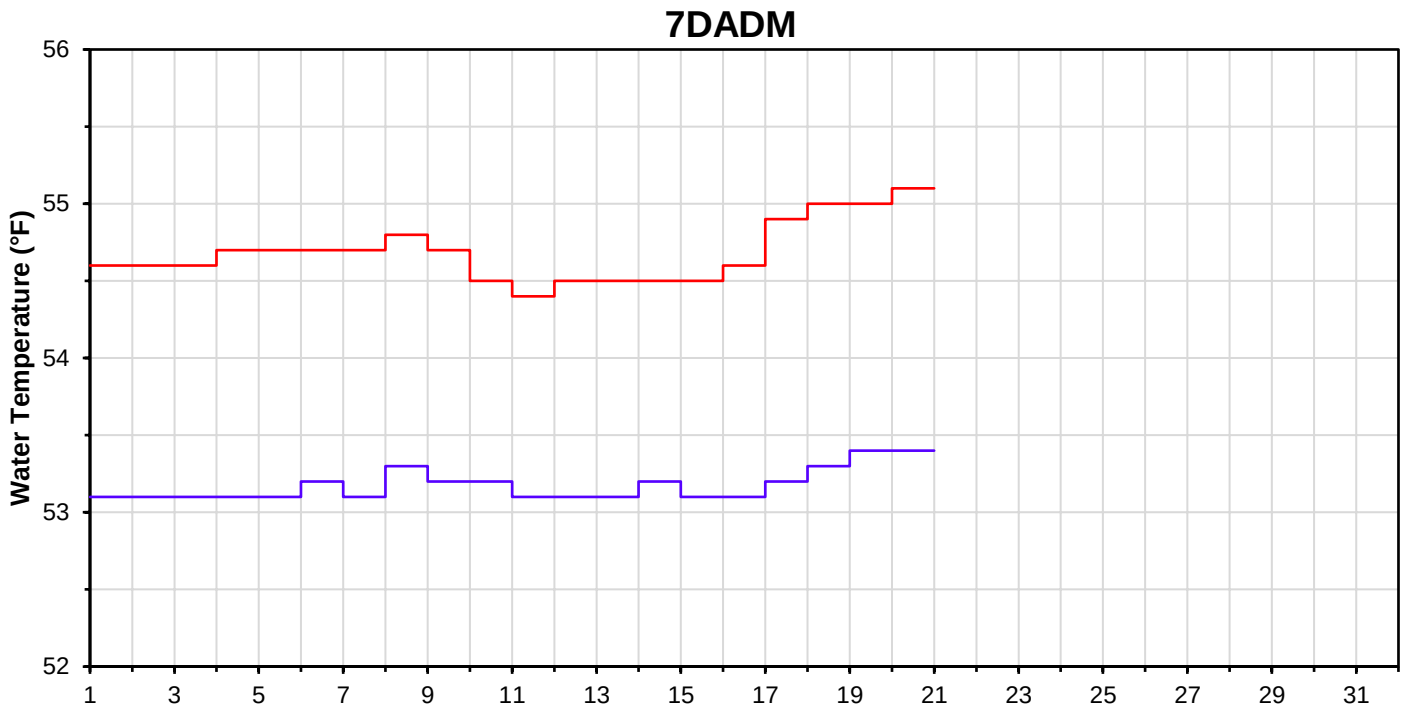
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

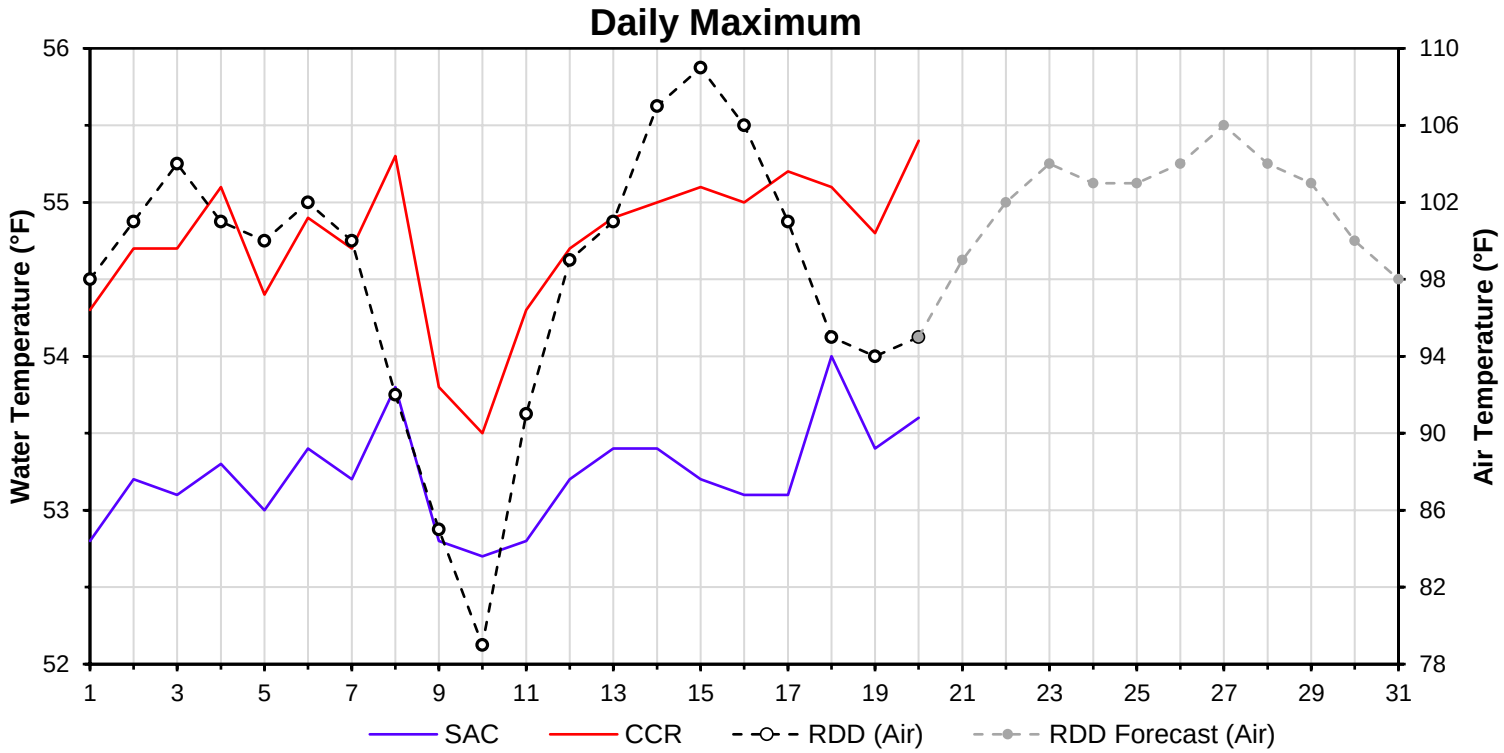
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
08/01	52.8	54.3	53.1	54.6	54.7
08/02	53.2	54.7	53.1	54.6	-
08/03	53.1	54.7	53.1	54.6	-
08/04	53.3	55.1	53.1	54.7	-
08/05	53.0	54.4	53.1	54.7	-
08/06	53.4	54.9	53.2	54.7	54.6
08/07	53.2	54.7	53.1	54.7	54.7
08/08	53.8	55.3	53.3	54.8	54.8
08/09	52.8	53.8	53.2	54.7	54.2
08/10	52.7	53.5	53.2	54.5	54.1
08/11	52.8	54.3	53.1	54.4	54.2
08/12	53.2	54.7	53.1	54.5	54.5
08/13	53.4	54.9	53.1	54.5	54.7
08/14	53.4	55.0	53.2	54.5	54.8
08/15	53.2	55.1	53.1	54.5	54.8
08/16	53.1	55.0	53.1	54.6	54.8
08/17	53.1	55.2	53.2	54.9	54.5
08/18	54.0	55.1	53.3	55.0	54.6
08/19	53.4	54.8	53.4	55.0	54.5
08/20	53.6	55.4	53.4	55.1	54.6
08/21					
08/22					
08/23					
08/24					
08/25					
08/26					
08/27					
08/28					
08/29					
08/30					
08/31					

Notes

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

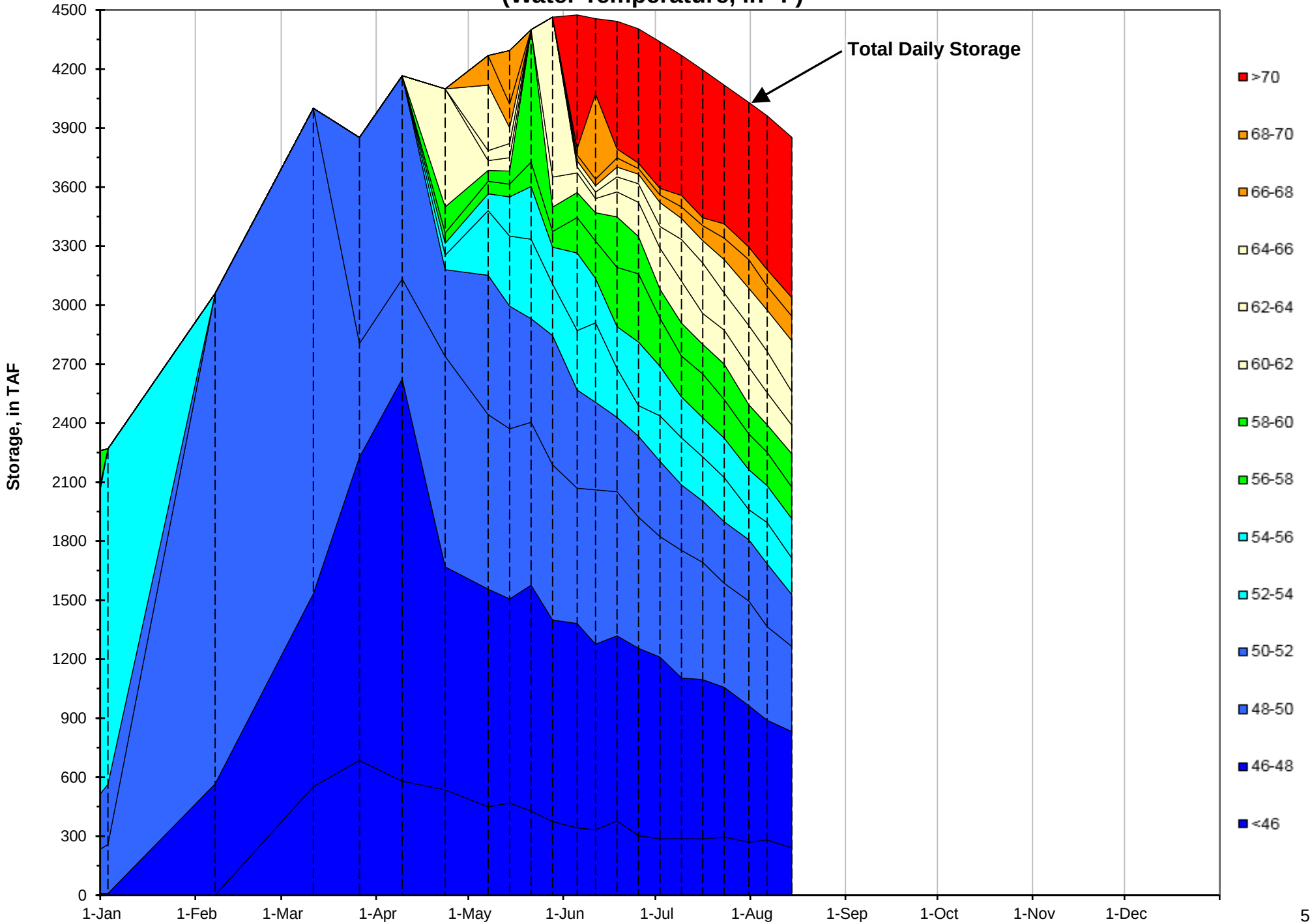
[2] DAT = Daily Average Temperature





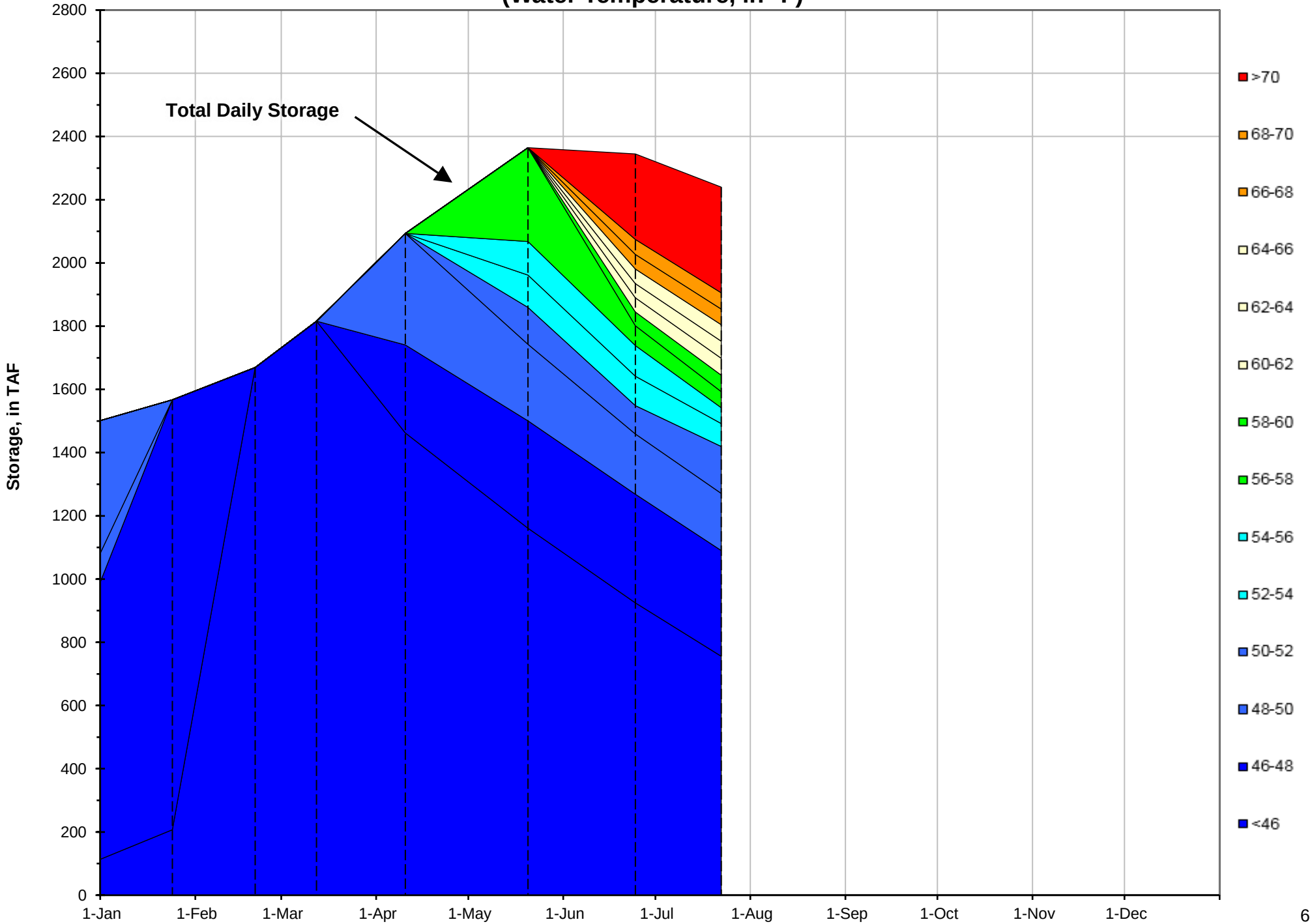
Latest Profile Date: 08/14/2019

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



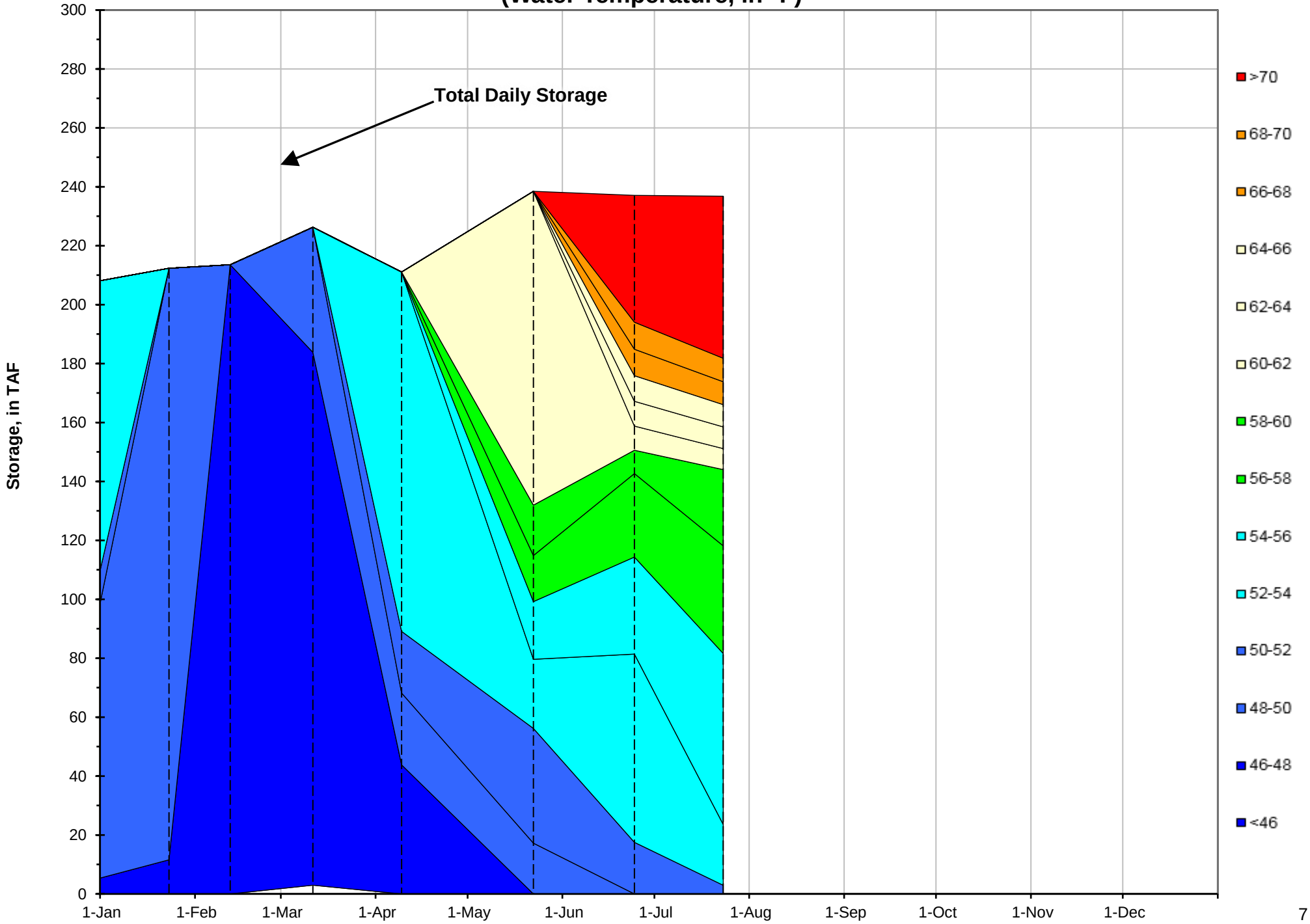
Latest Profile Date: 07/22/2019

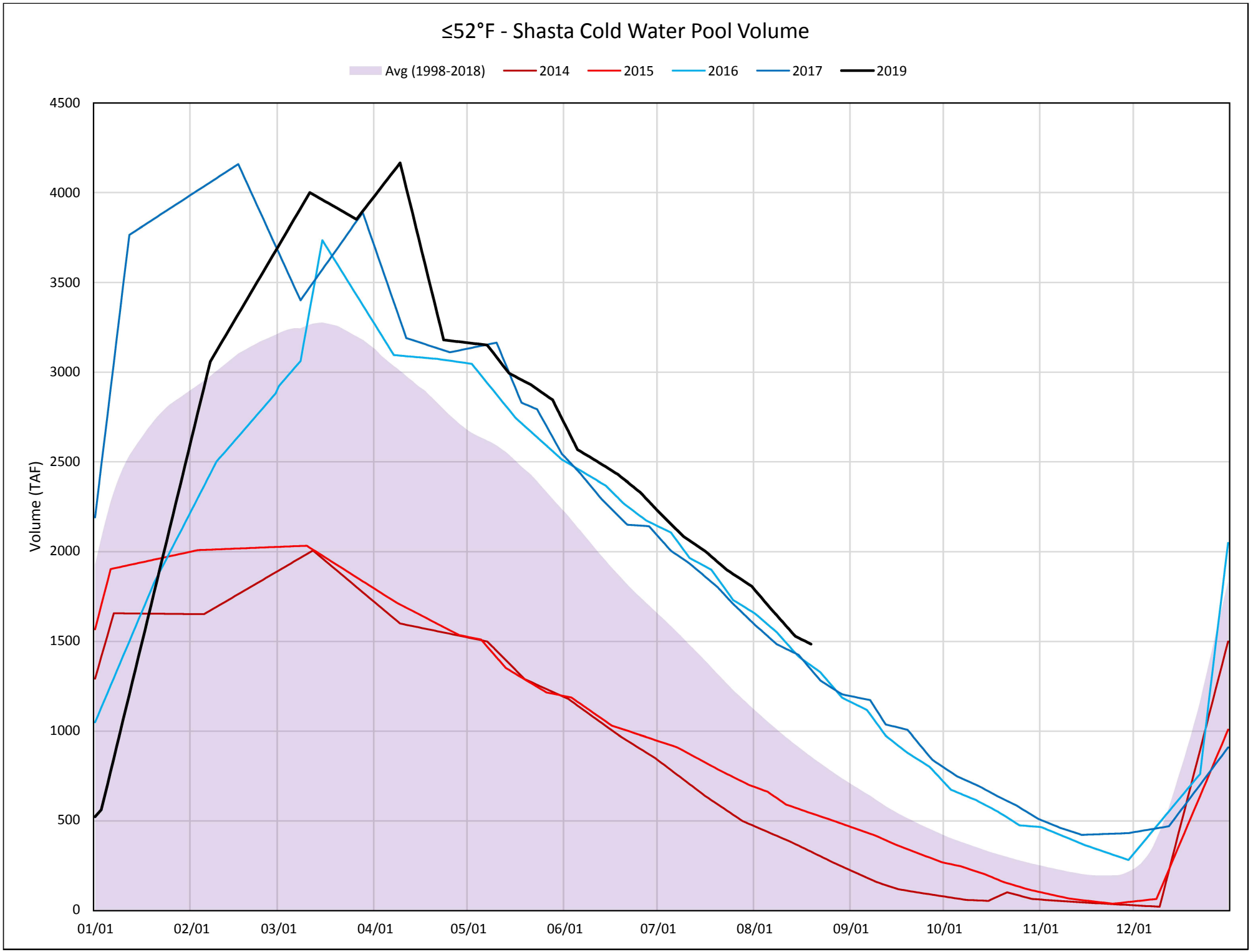
Trinity Lake Isothermobaths - 2019
(Water Temperature, in °F)

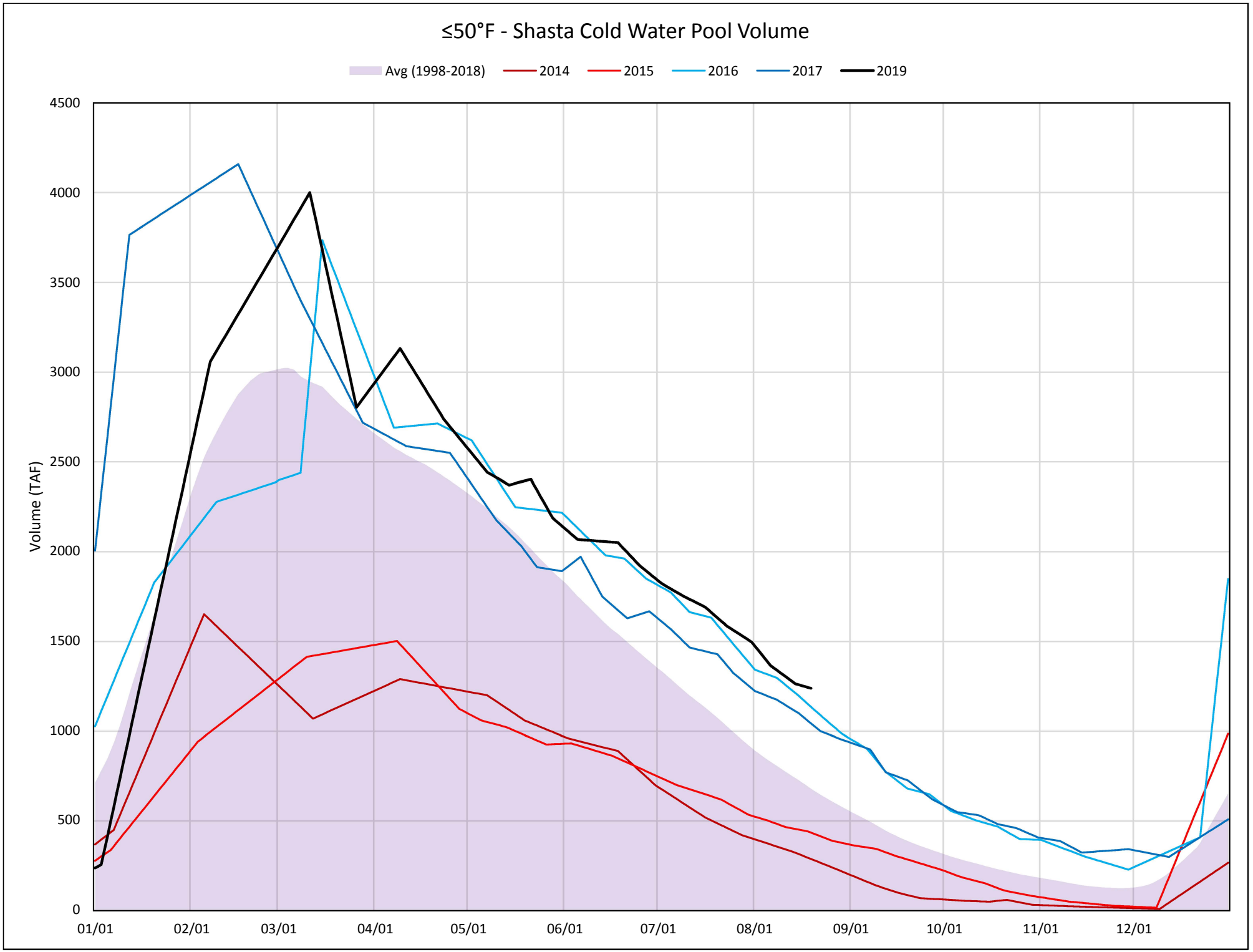


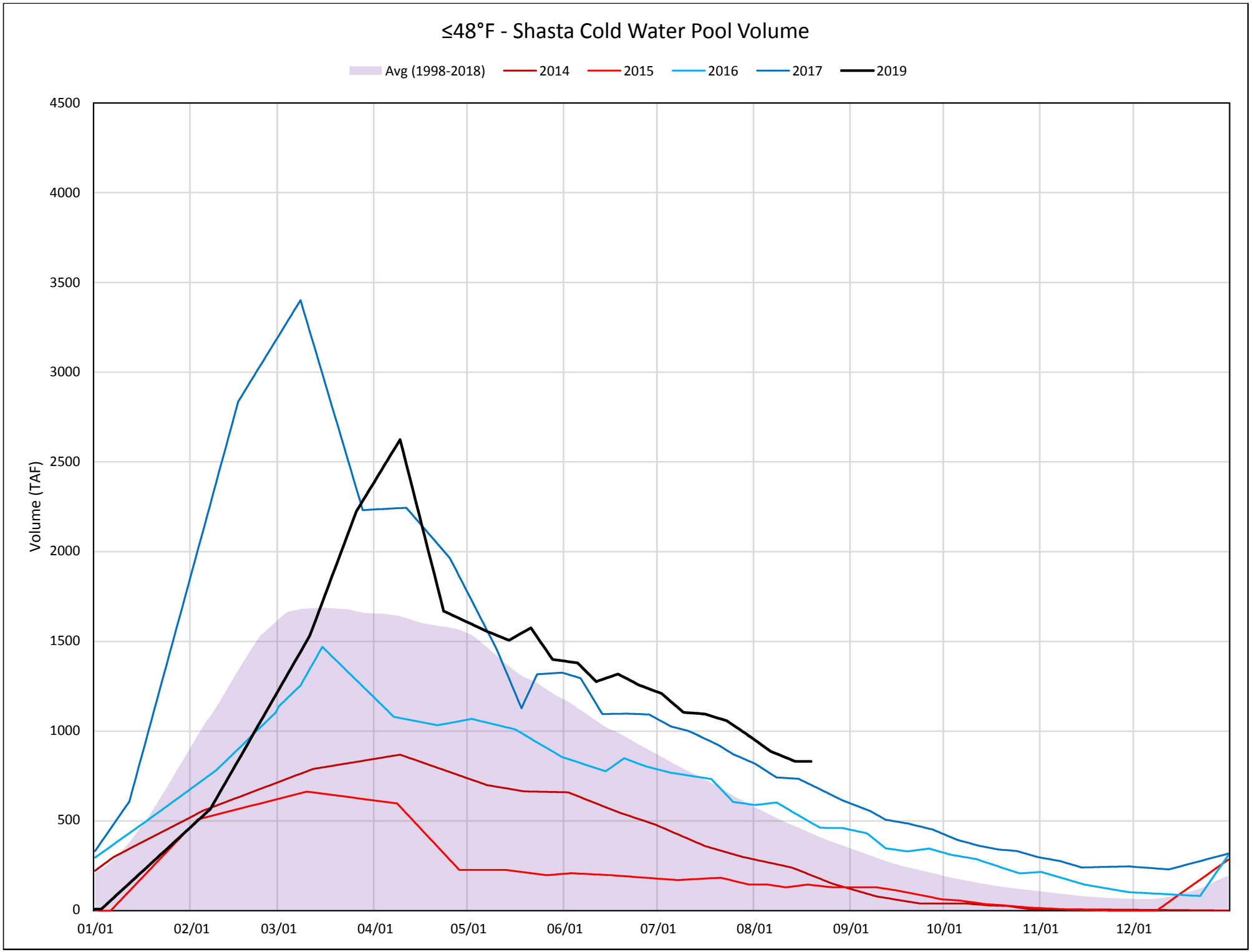
Latest Profile Date: 07/23/2019

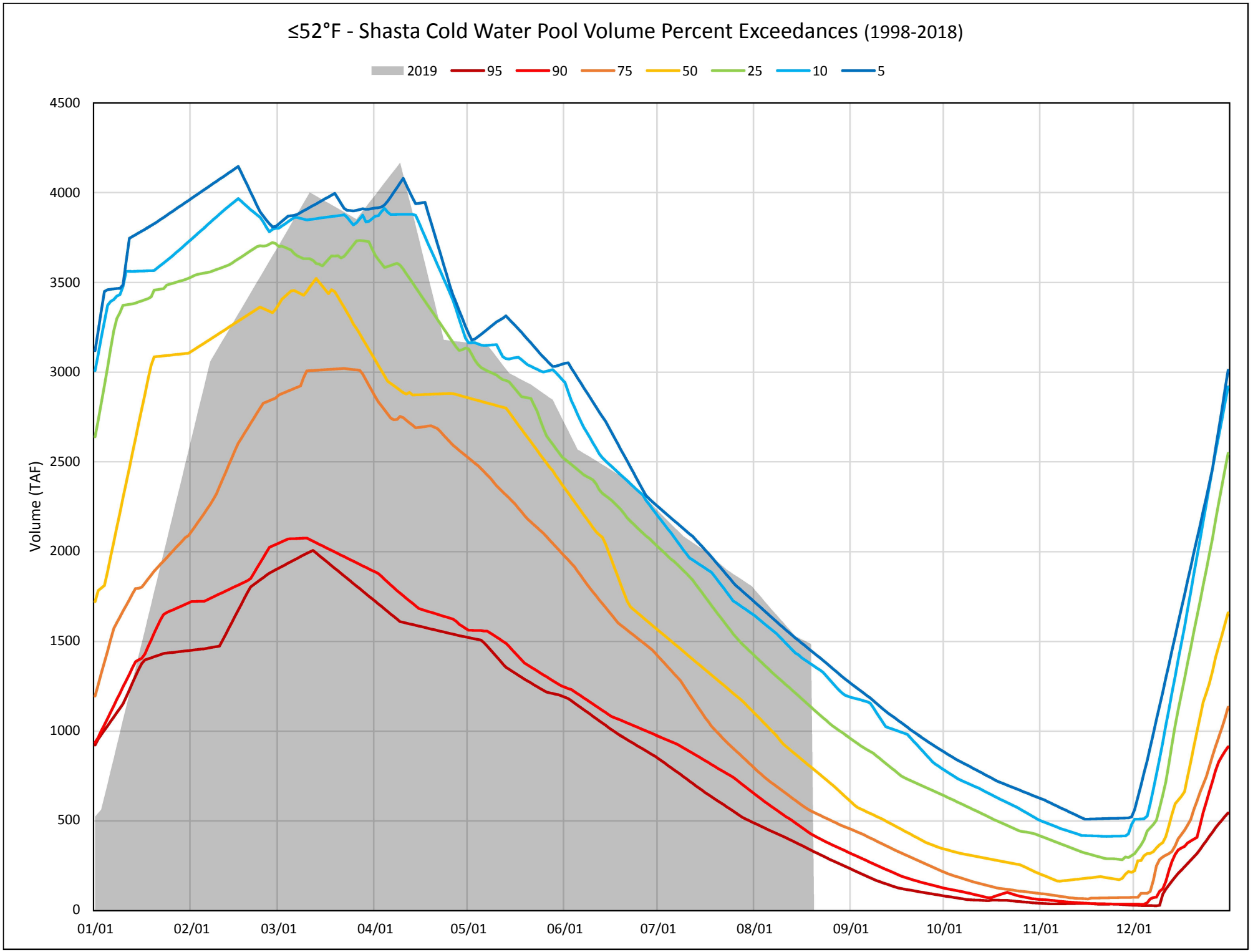
Whiskeytown Lake Isothermobaths - 2019
(Water Temperature, in °F)

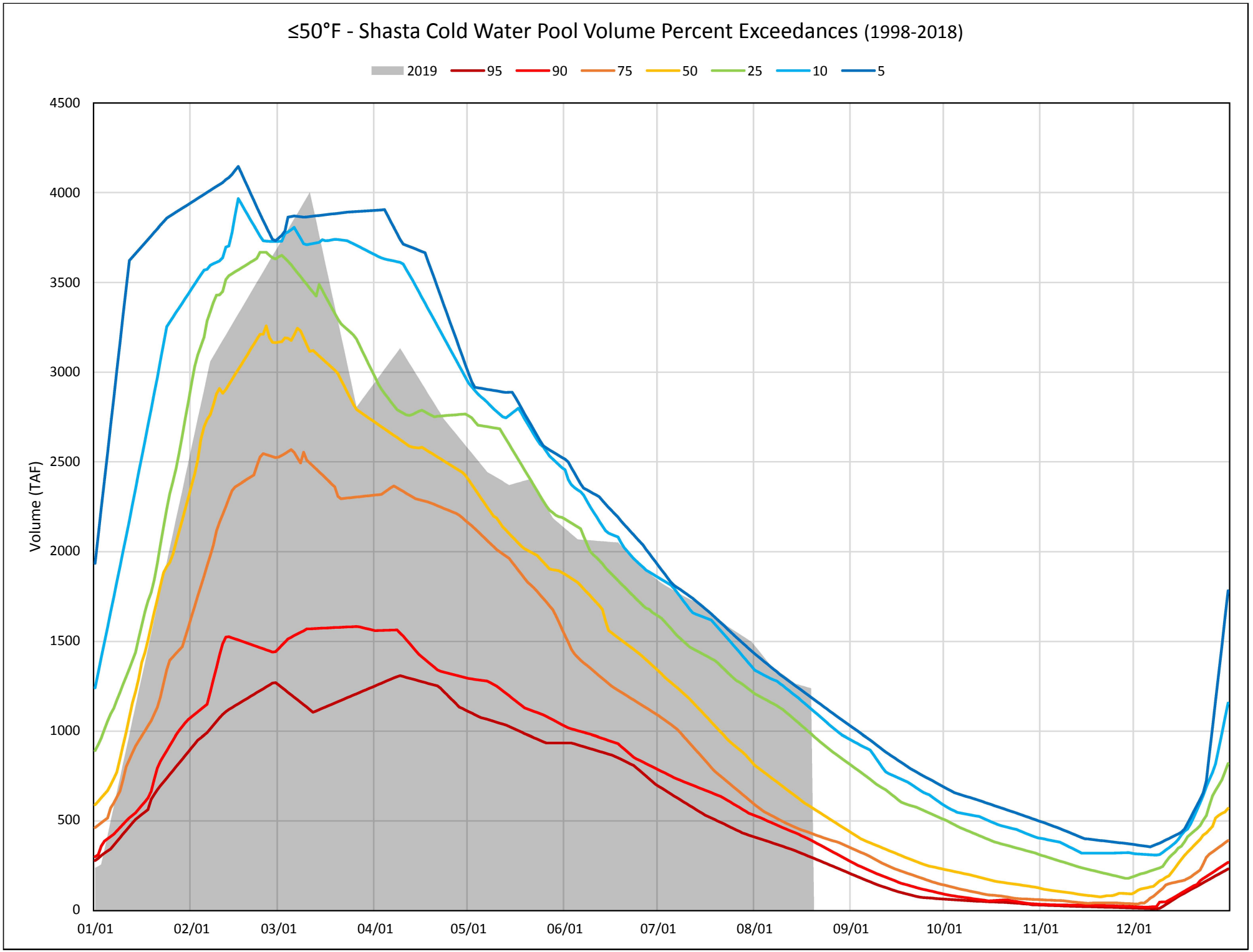


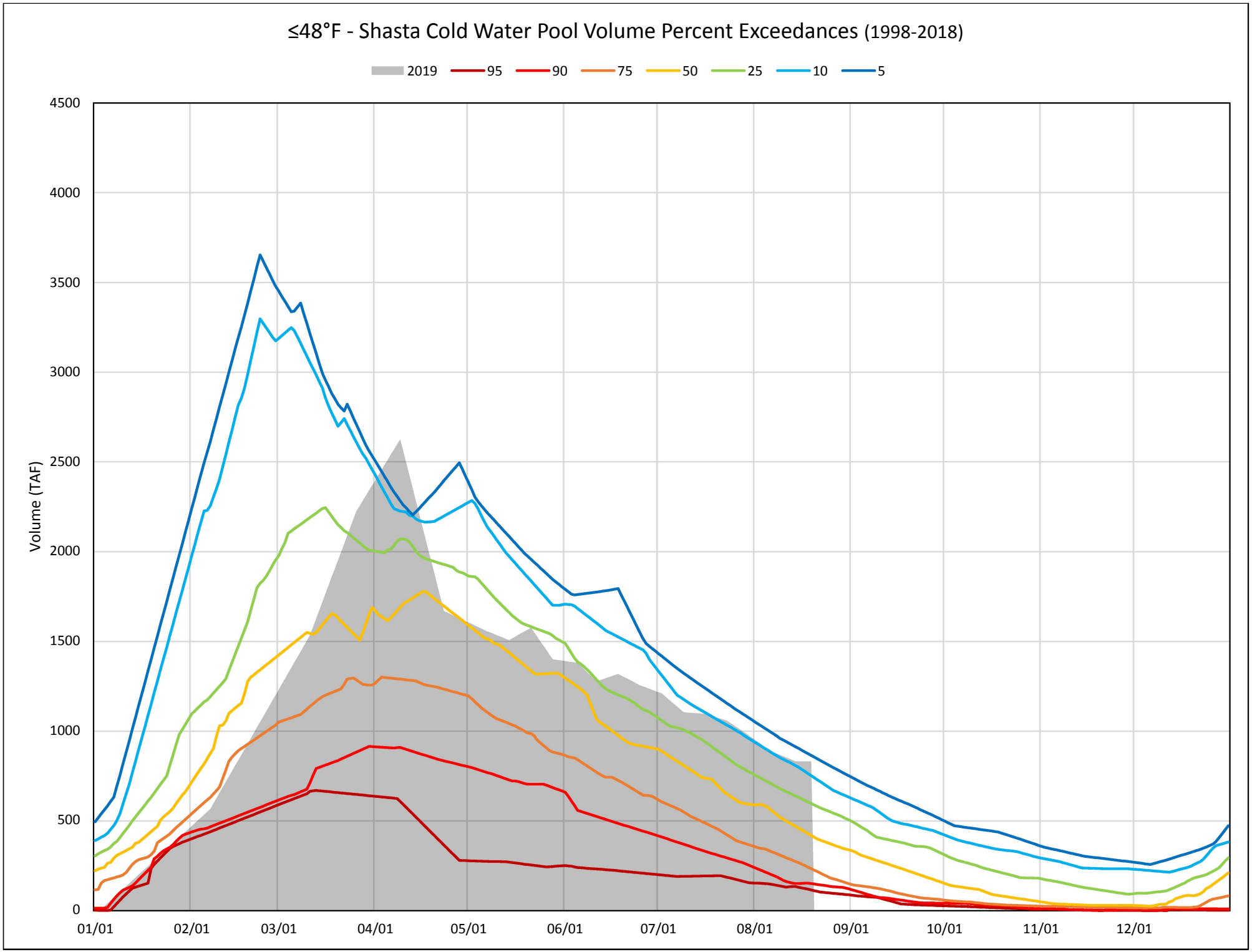

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤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

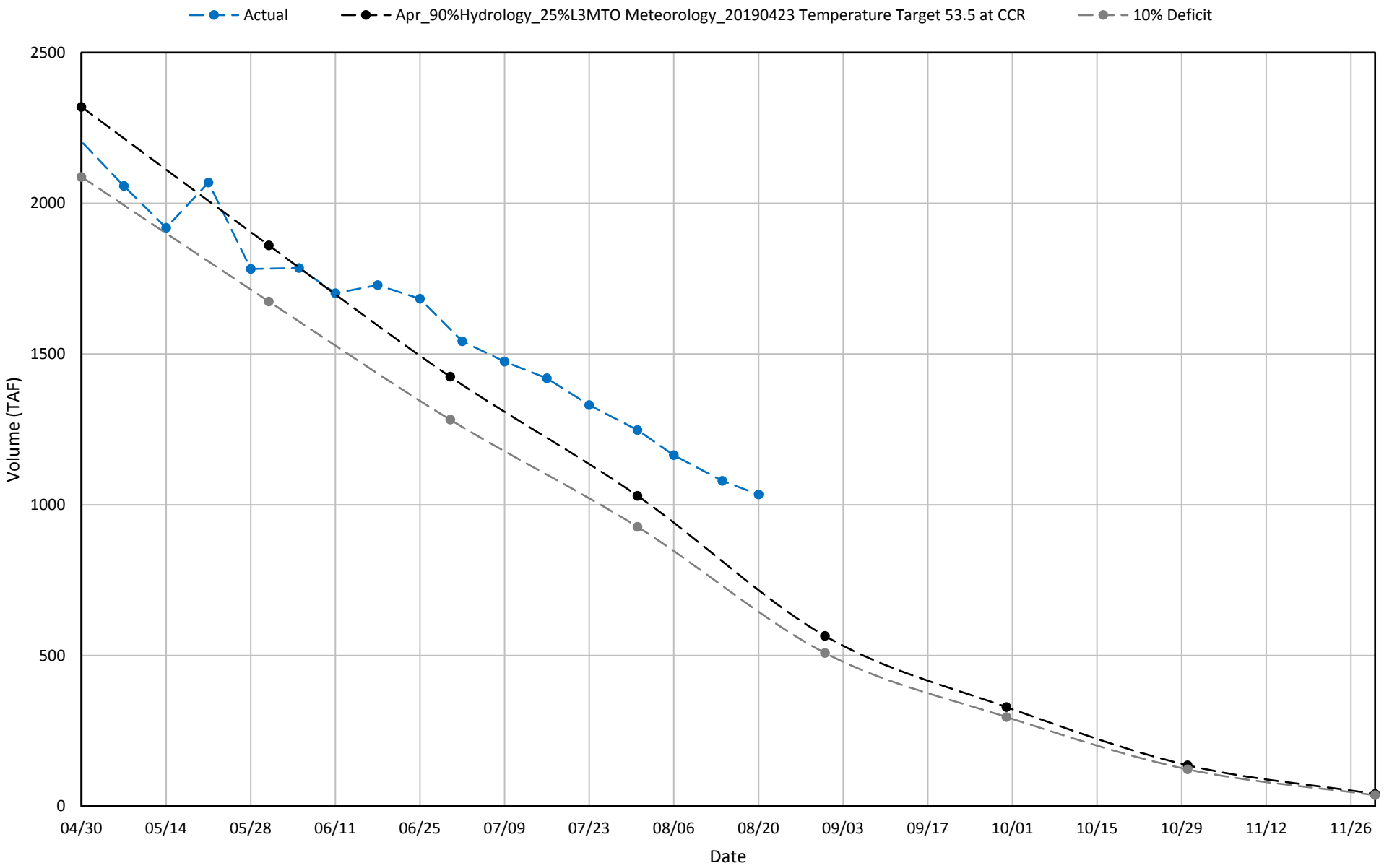

≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤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: 2019.08.20

2019 Shasta Cold Water Pool Volume ≤49°F



August 24, 2019

Upper Sacramento River – August 2019 Preliminary Temperature Analysis

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

Location (°F DAT)	AUG	SEP*	OCT*
August 90%-Exceedance Outlook – 25% L3MTO Meteorology			
Keswick Dam KWK	52.8	52.8	52.4
Sac. R. abv Clear Creek CCR	53.0	53.1	52.4
Airport Road	53.5	53.5	52.7
Balls Ferry BSF	54.5	54.5	53.3
August 90%-Exceedance Outlook – 50% L3MTO Meteorology			
Keswick Dam KWK	52.7	52.5	52.3
Sac. R. abv Clear Creek CCR	53.0	52.9	52.3
Airport Road	53.5	53.4	52.6
Balls Ferry BSF	54.4	54.5	53.1

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 25% Met	1,291	11/20	NA
90% Hydro, 50% Met	1,253	11/12	NA

Model Run Date August 21, 2019

* The HEC5Q model output is displayed 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 3-5). 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 2. 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 3-5.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on August 20, August 19, and August 16, 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 August 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. The Operation Outlook assumes a modified USFWS BiOp RPA Action 4 to approximately 80 km. Discussions are on-going and actual

conditions may vary.
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.

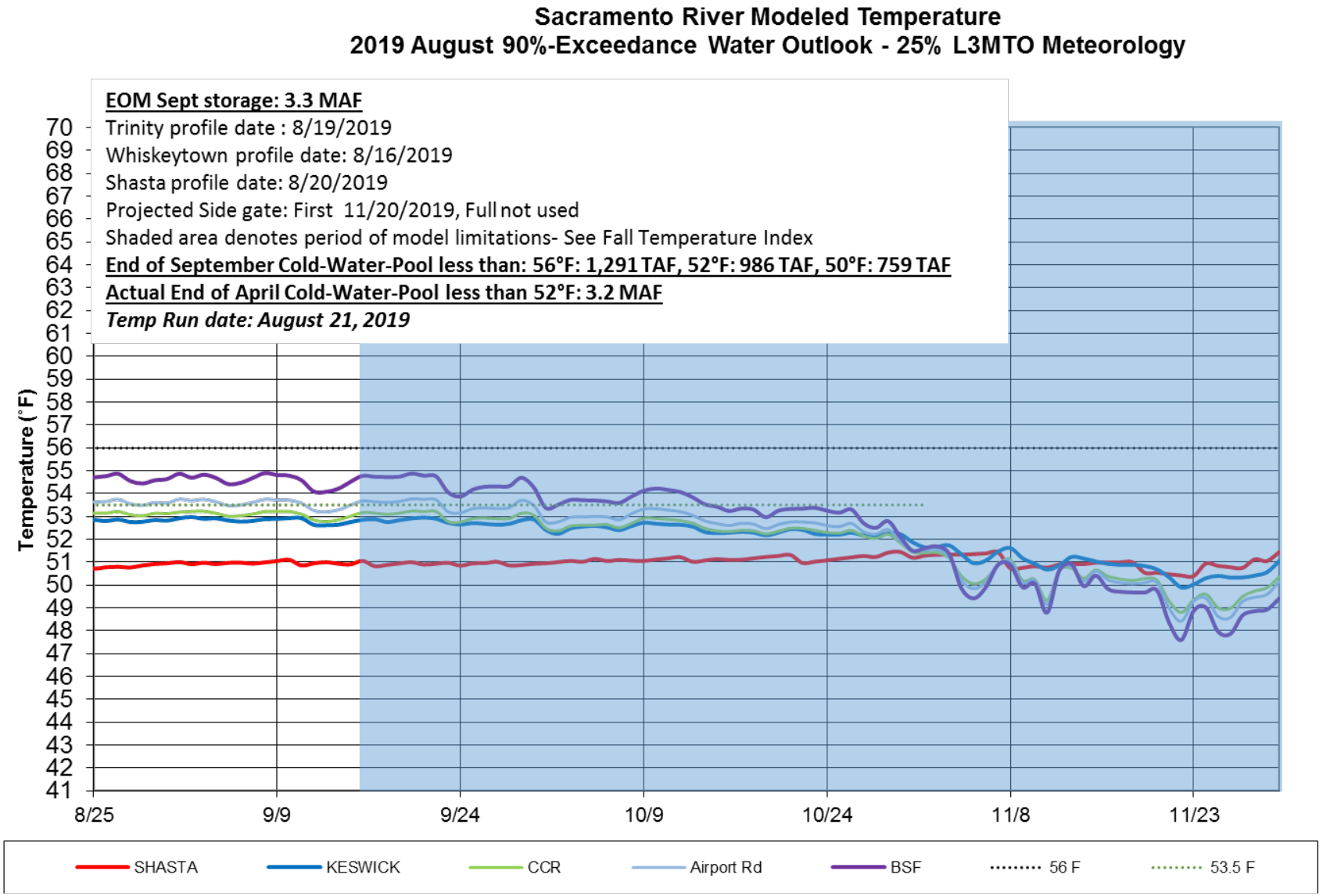


Figure 1. August 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology.

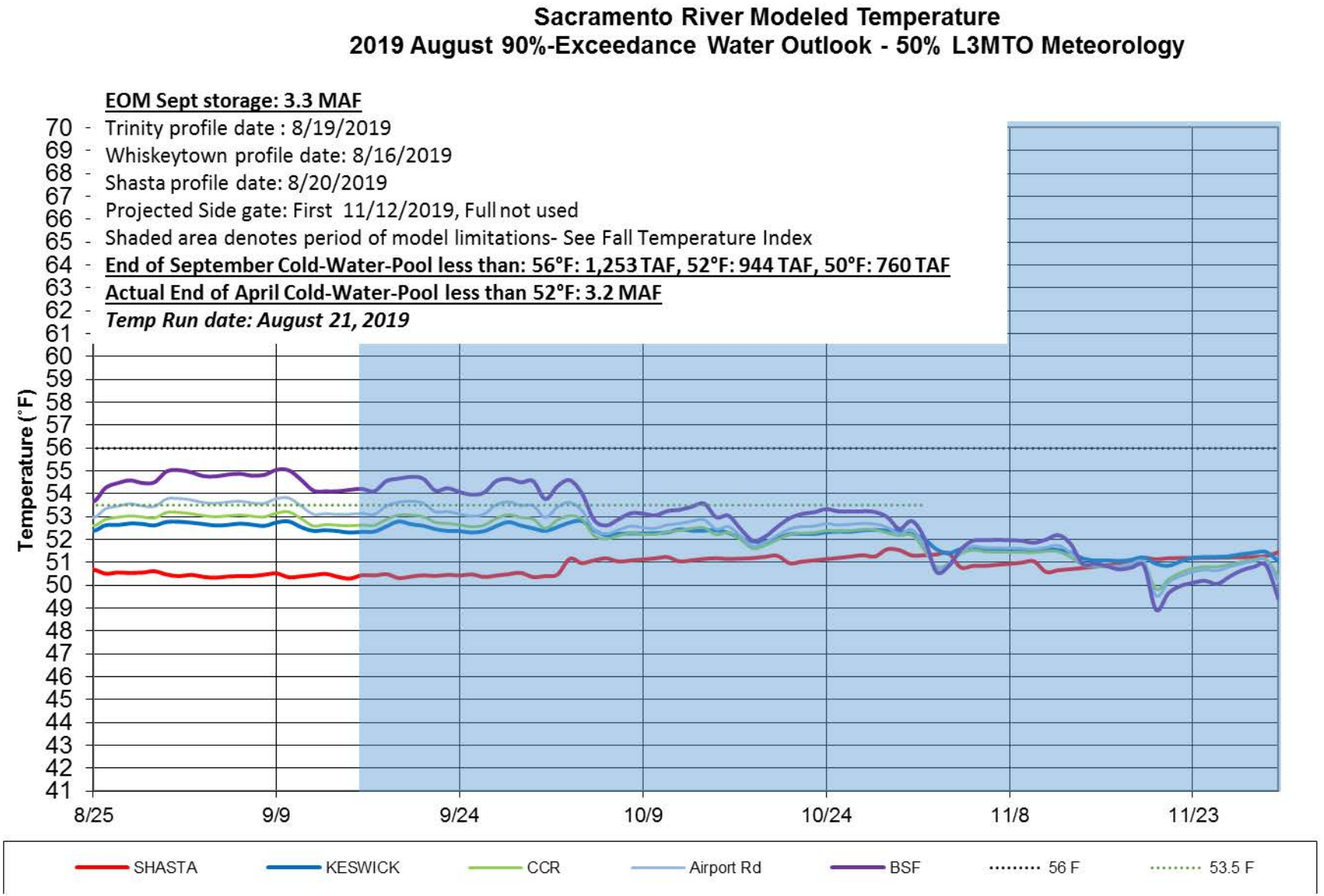


Figure 2. August 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% L3MTO meteorology.

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.

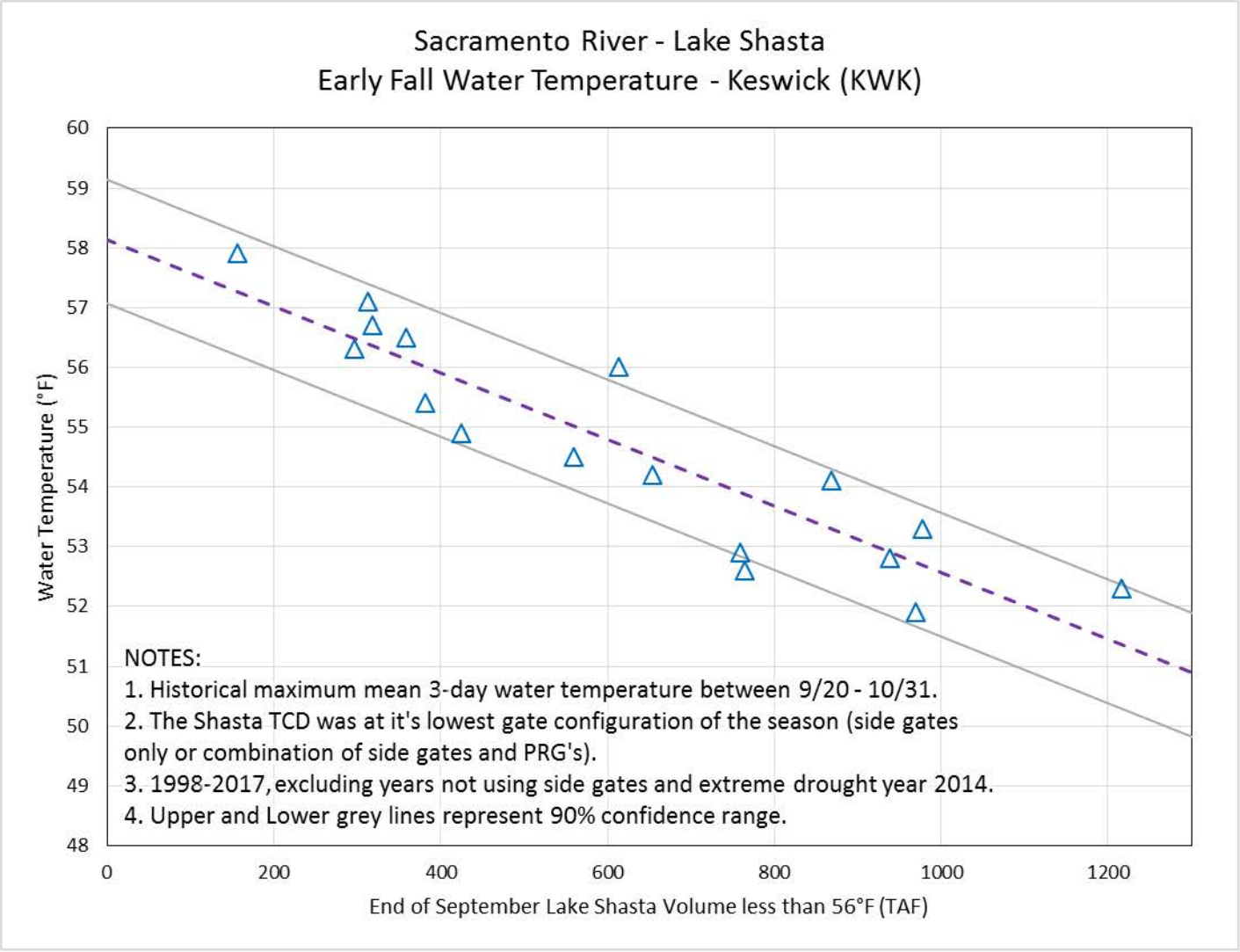


Figure 3. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

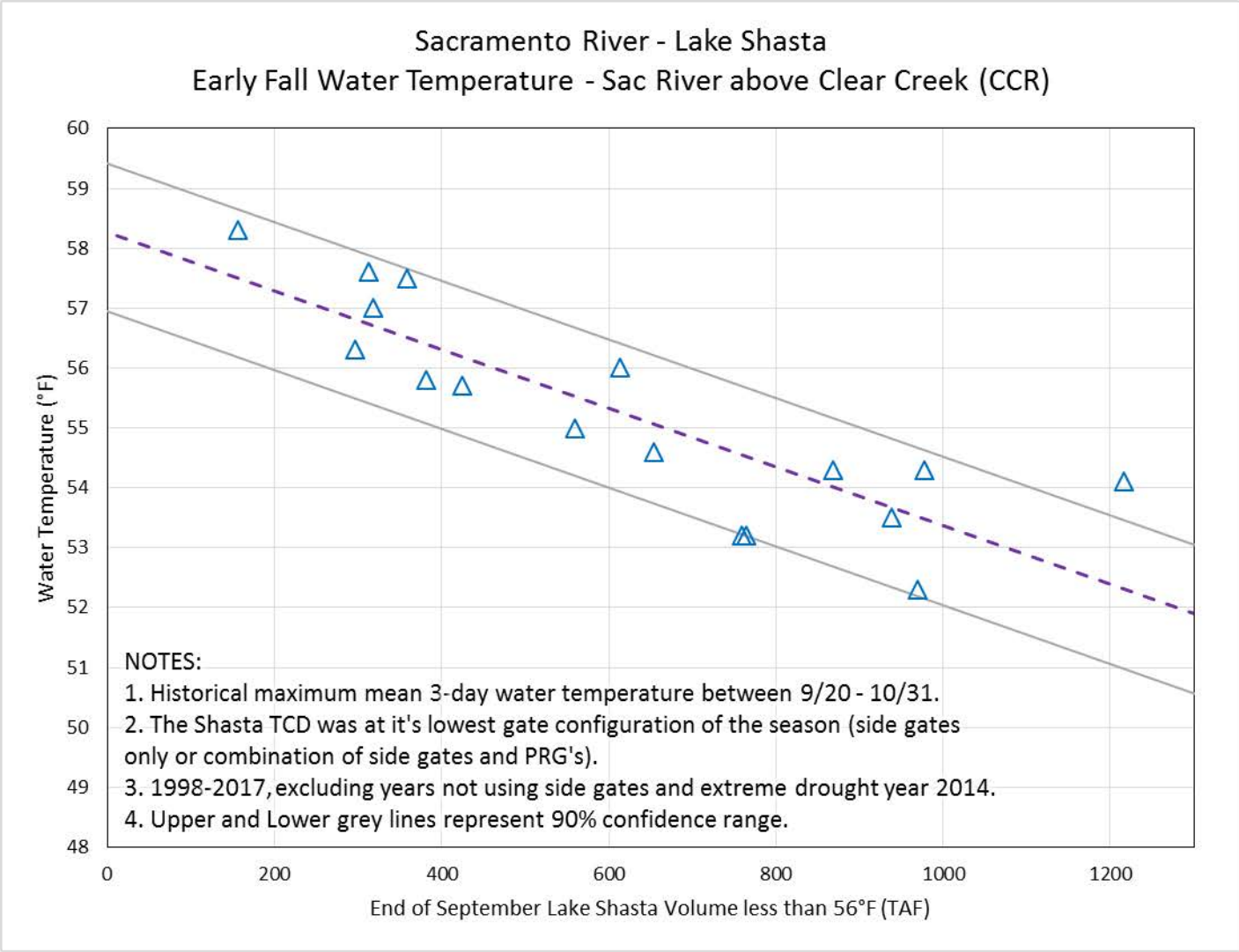


Figure 4. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

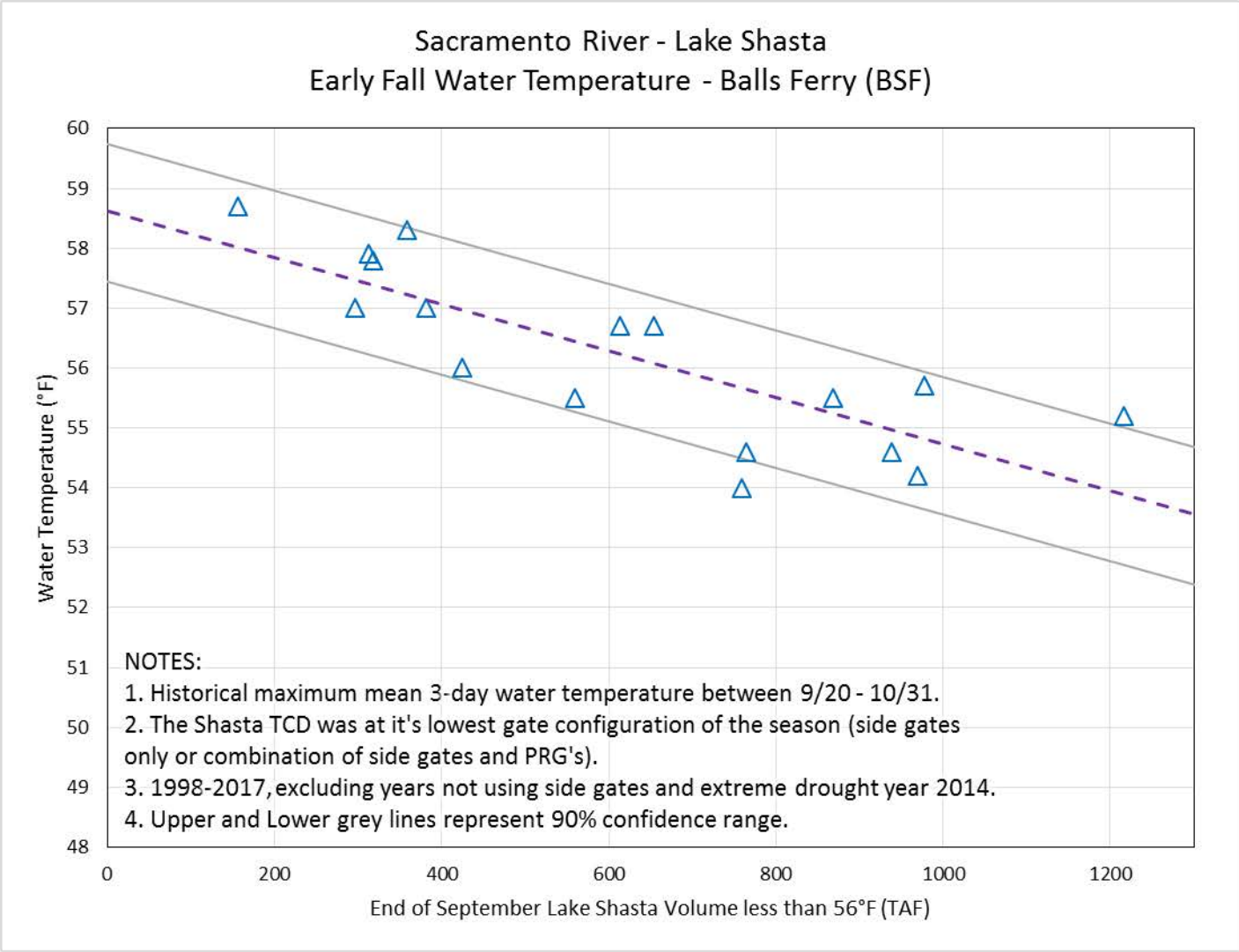
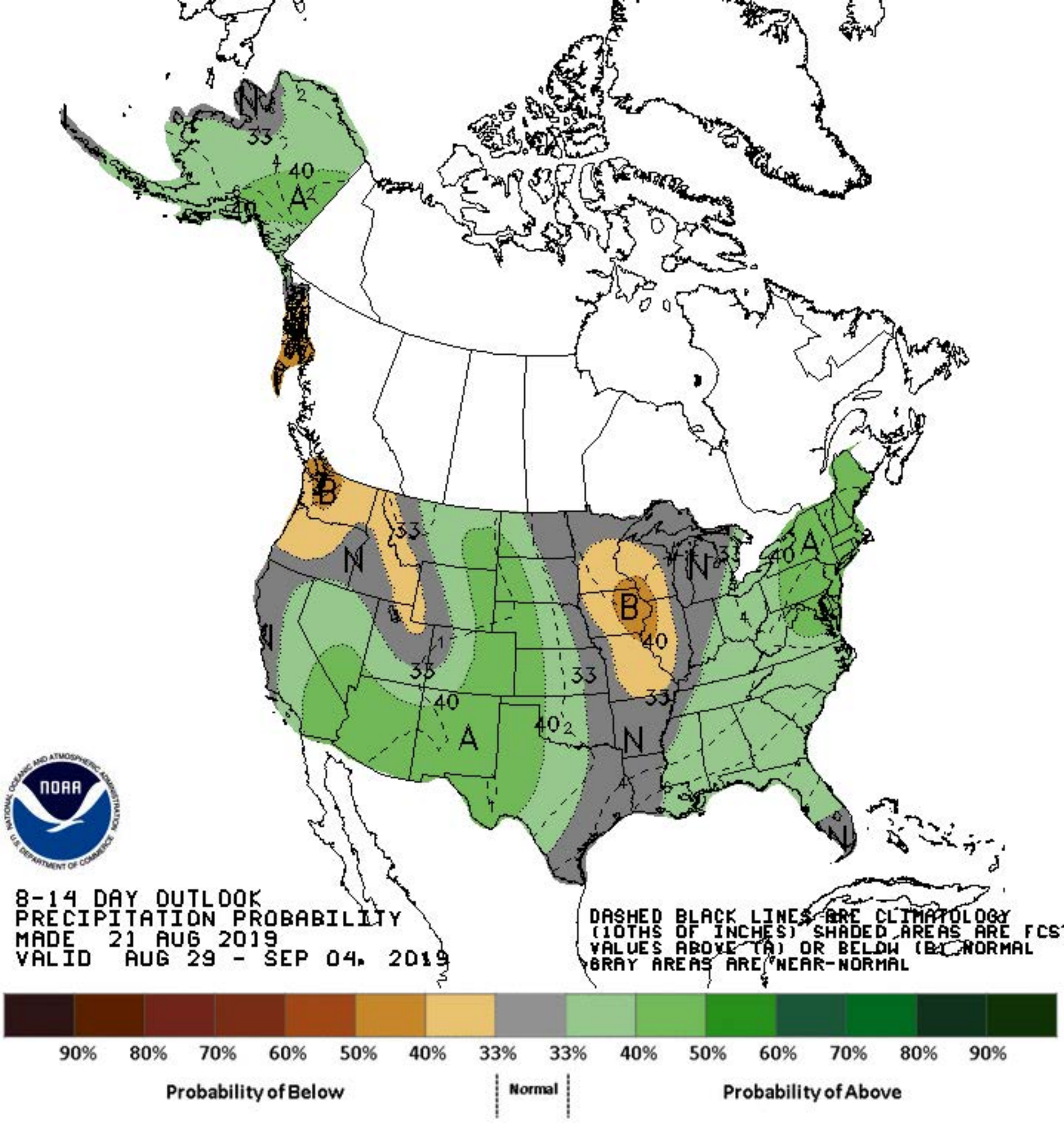
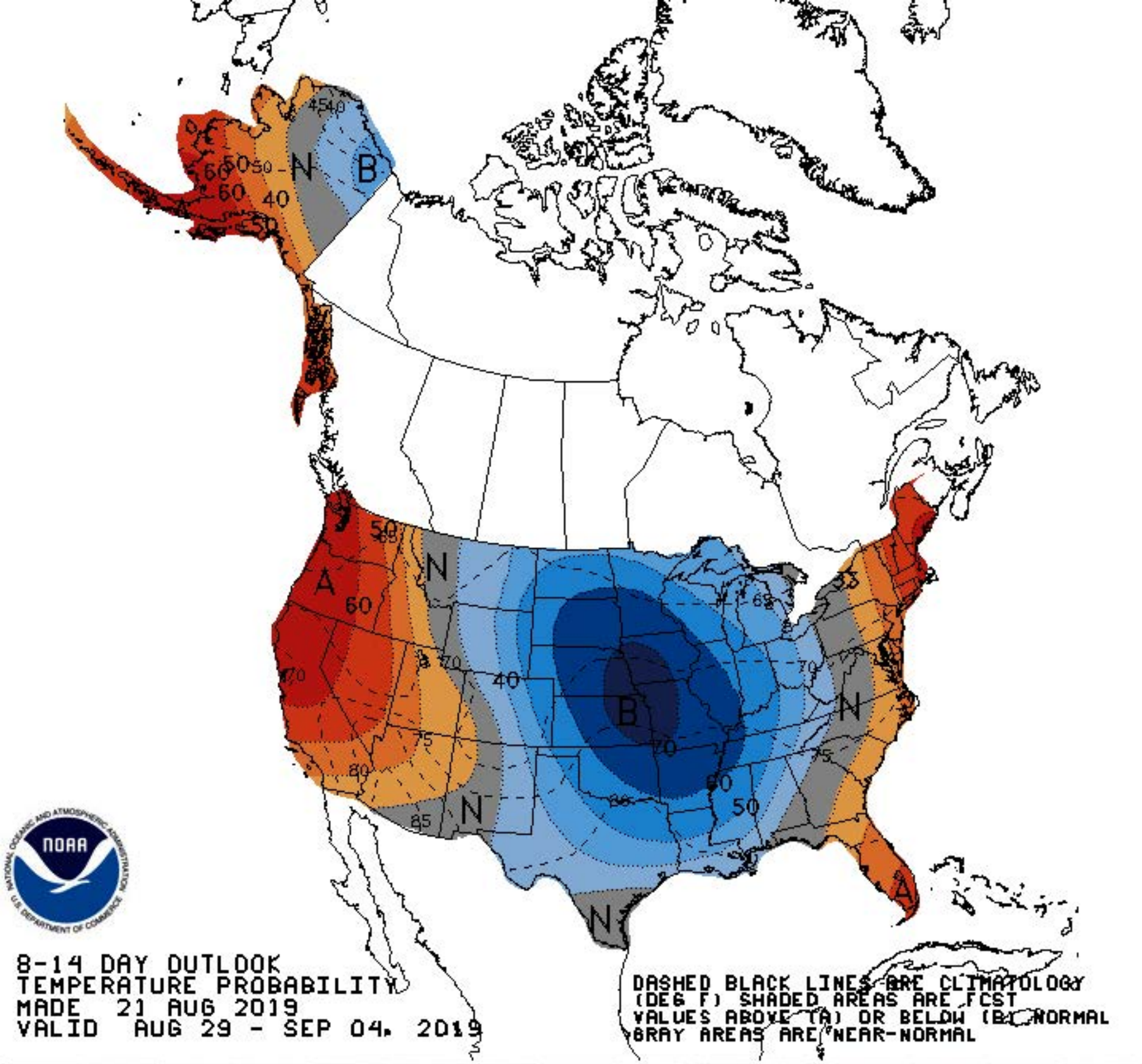


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.


8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 21 AUG 2019
VALID AUG 29 - SEP 04, 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
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 21 AUG 2019
VALID AUG 29 - SEP 04, 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