RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

March 28, 2018 | 1:00 pm – 3:00 pm

Location JOC – Joint Operations Center, 3310 El Camino Ave, Sacramento CA 95821

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: 50% and 30% Historical Meteorology
    - 50% Runoff Exceedance: 50% and 30% Historical Meteorology
    - Cold Water Pool Tracking
- Updates
- Next Meeting: April 25, 2019

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

DAILY CVP WATER SUPPLY REPORT

MARCH 26, 2019

RUN DATE: March 27, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	301	312	301
SACRAMENTO	KESWICK	3,090	10,151	3,804
FEATHER	OROVILLE (SWP)	1,050	11,400	1,750
AMERICAN	NIMBUS	9,741	4,810	1,745
STANISLAUS	GOODWIN	204	4,511	452
SAN JOAQUIN	FRIANT	300	3,001	300

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	1,710	1,834	1,897	111
SHASTA	4,552	3,526	3,805	3,865	110
FOLSOM	977	626	834	692	111
NEW MELONES	2,420	1,540	2,001	2,015	131
FED. SAN LUIS	966	756	860	966	128
TOTAL NORTH CVP	11,363	8,158	9,334	9,435	116
MILLERTON	520	338	396	373	111
OROVILLE (SWP)	3,538	2,397	2,013	2,748	115

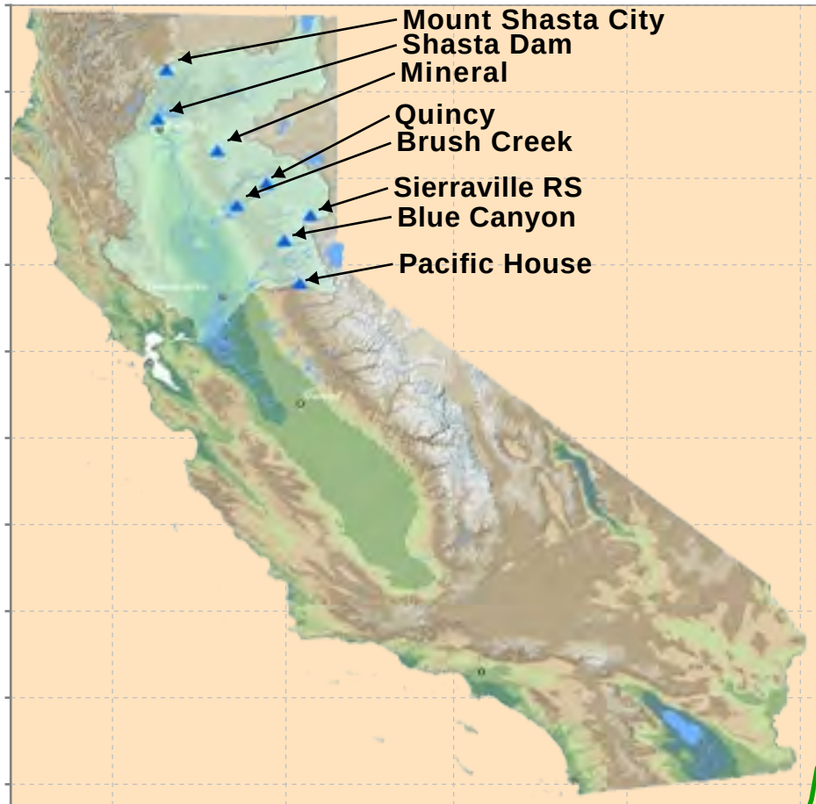
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	565	74	1,170	570	99
SHASTA	3,803	1,357	6,629	3,080	123
FOLSOM	1,777	190	3,385	1,394	127
NEW MELONES	592	----	1,097	460	129
MILLERTON	616	107	1,542	479	129

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	31.57	8.94	47.73	26.65 (57)	118	0.37
SACRAMENTO AT SHASTA DAM	67.81	10.78	96.82	51.87 (62)	131	1.18
AMERICAN AT BLUE CANYON	74.31	15.20	91.49	55.66 (44)	134	0.29
STANISLAUS AT NEW MELONES	36.36	----	41.11	23.11 (41)	157	0.00
SAN JOAQUIN AT HUNTINGTON LK	47.01	10.50	72.30	34.27 (44)	137	0.16

Northern Sierra Precipitation: 8-Station Index, March 27, 2019



Percent of Average for this Date: 132%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

55.9

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)

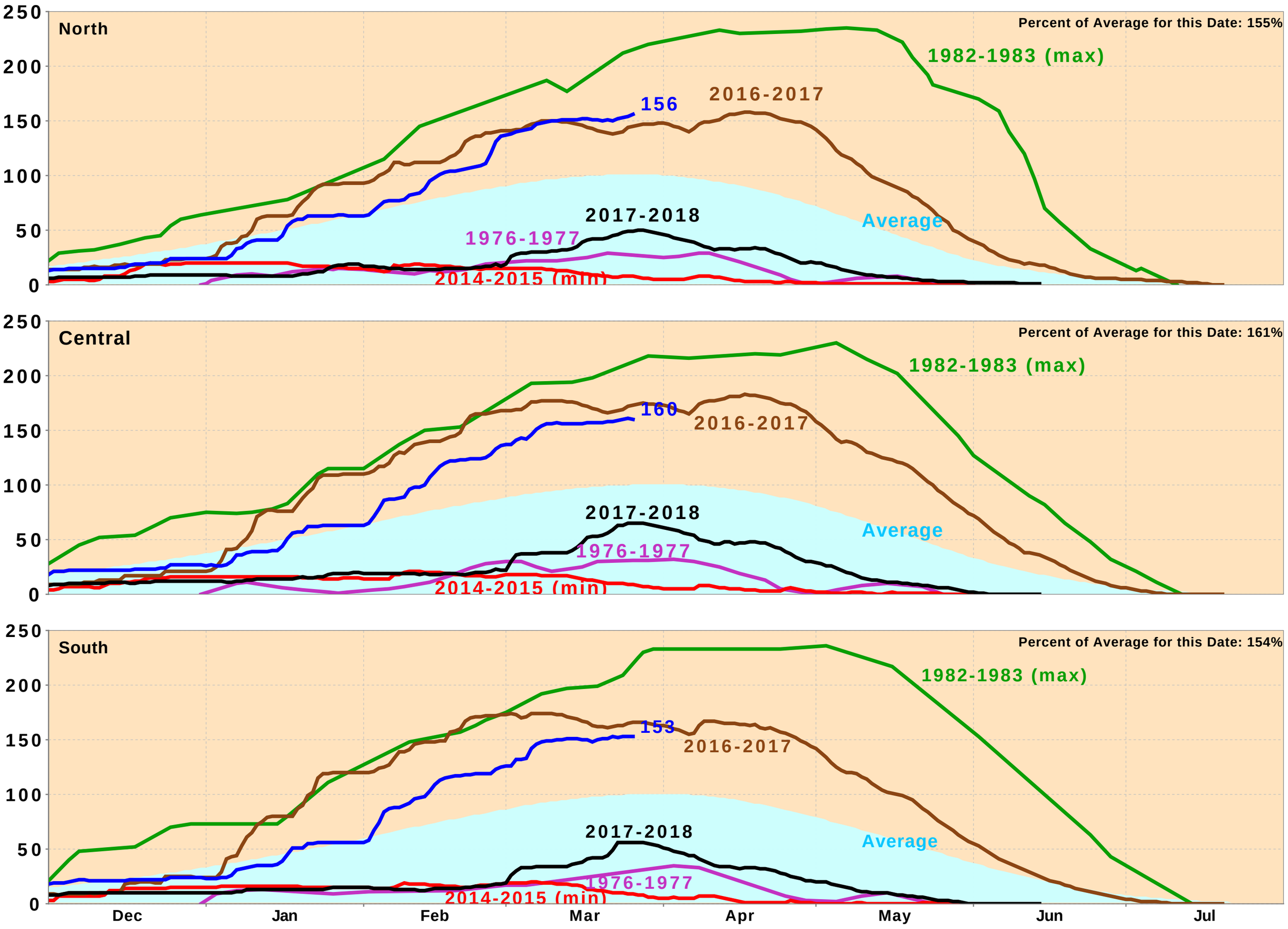
Total Water Year Precipitation

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, March 26, 2019, Percent of April 1 Average



Statewide Percent of April 1: 157%

Statewide Percent of Average for Date: 157%

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Meteorological projections: Shorter term forecasts (8-14 day) suggest increased chances of precipitation
- Longer term forecasts (one-month outlook) suggest equal chances of above or below precipitation
- Current Lake Shasta encroachment into the USACE flood space: 18%, encroachment is expected to increase in the short term in response to current storm events. Shasta spring refill has begun under the USACE flood control diagram.
- Current release from Keswick Dam: 15,000 cfs for Shasta flood space management
- Operation Release measurement from Keswick Dam facility (KWK on CDEC) due to flow meter installation
- Tentatively planning mid-April release reductions for ACID flashboard installation, gravel injection/in-river habitat management/other in-river work

Temperature Management:

- Temperature management: Active management has concluded for the season. Seasonal cooling is controlling water temperatures.
- Selective withdrawal: Releases are made from Upper Gates – rebuilding cold water pool reserves
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest above normal temperatures
- Longer term forecasts (one-month outlook) suggest equal chances of above or below normal 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 March 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)

		Mar	Apr	May	Jun	Jul	Aug	Sep
Shasta	3948	3963	4350	4398	4127	3683	3378	3194
Elev.		1046	1060	1062	1052	1036	1024	1016

Monthly River Releases (cfs)

	Mar	Apr	May	Jun	Jul	Aug	Sep
Sacramento	20000	5500	7200	10500	12000	9200	7000
Clear Creek	200	218	216	288	150	150	150

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep
Carr Power Plant	2	55	17	75	100	101	70
Spring Creek PP	50	25	10	60	90	90	60

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)

		Mar	Apr	May	Jun	Jul	Aug	Sep
Shasta	3948	3899	4382	4542	4365	3986	3672	3397
Elev.		1044	1061	1067	1061	1047	1035	1025

Monthly River Releases (cfs)

	Mar	Apr	May	Jun	Jul	Aug	Sep
Sacramento	23000	7000	8000	10000	11500	10000	9500
Clear Creek	200	218	216	288	150	150	150

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep
Carr Power Plant	4	51	1	71	99	100	89
Spring Creek PP	70	30	2	60	90	90	80

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)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	**1739**	**1867**	**1945**	**1989**	**1959**	**1821**	**1669**	**1540**	**1508**	**1489**	**1499**	**1531**	**1616**
	Elev.	2332	2337	2340	2338	2328	2317	2306	2304	2302	2303	2306	2313
Whiskeytown	**247**	**206**	**238**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**
	Elev.	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199
Shasta	**3948**	**3963**	**4350**	**4398**	**4127**	**3683**	**3378**	**3194**	**3019**	**2929**	**2982**	**3133**	**3438**
	Elev.	1046	1060	1062	1052	1036	1024	1016	1009	1005	1007	1014	1026
Folsom	**598**	**738**	**878**	**964**	**952**	**787**	**643**	**560**	**460**	**381**	**319**	**320**	**382**
	Elev.	443	457	465	464	448	433	424	411	400	390	391	400
New Melones	**2005**	**1875**	**1845**	**1873**	**1885**	**1818**	**1749**	**1709**	**1663**	**1674**	**1688**	**1700**	**1644**
	Elev.	1041	1038	1041	1042	1035	1029	1025	1020	1021	1023	1024	1018
San Luis	**921**	**966**	**823**	**587**	**425**	**225**	**75**	**86**	**210**	**287**	**504**	**664**	**796**
	Elev.	543	517	478	449	411	382	380	386	395	434	460	478
Total		9615	10080	10049	9586	8572	7750	7327	7064	6965	7198	7553	8081

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	32	258	126	68	53	52	23	18	18	18	17
	cfs	**300**	**540**	**4,189**	**2,120**	**1,102**	**857**	**870**	**373**	**300**	**300**	**300**	**300**
Clear Creek	TAF	12	13	13	17	9	9	9	12	12	12	12	11
	cfs	**200**	**218**	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**200**	**200**
Sacramento	TAF	1229	327	443	625	738	566	416	428	352	277	246	222
	cfs	**20000**	**5500**	**7200**	**10500**	**12000**	**9200**	**7000**	**6955**	**5909**	**4500**	**4000**	**4000**
American	TAF	430	238	314	238	258	234	169	135	119	123	111	100
	cfs	**7000**	**4000**	**5100**	**4000**	**4200**	**3811**	**2849**	**2202**	**2000**	**2000**	**1800**	**1800**
Stanislaus	TAF	277	83	92	56	18	18	18	49	12	12	14	83
	cfs	**4500**	**1400**	**1500**	**940**	**300**	**300**	**300**	**797**	**200**	**200**	**232**	**1500**

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	2	55	17	75	100	101	70	18	21	12	3	2
Spring Crk. PP	**50**	**25**	**10**	**60**	**90**	**90**	**60**	**40**	**15**	**12**	**10**	**20**

Delta Summary (TAF)

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy		199	54	55	255	268	240	259	270	150	270	220	230
USBR Banks		0	0	0	0	24	24	24	0	0	0	0	0
Contra Costa		12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0
Total USBR		212	66	68	265	303	277	297	287	168	288	234	244
COA Balance		0	0	0	0	0	0	0	9	9	9	9	9
Old/Middle River Std.													
Old/Middle R. calc.		-239	581	-110	-5,221	-6,207	-6,340	-6,565	-5,058	-4,258	-6,656	-4,959	-4,950
Computed DOI		80214	29030	20952	11145	8004	5694	7094	7109	7682	6849	11778	12139
Excess Outflow		66517	7531	9549	1748	0	0	0	0	588	2342	5775	738
% Export/Inflow		7%	5%	6%	34%	39%	46%	46%	42%	37%	54%	36%	38%
% Export/Inflow std.		35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1259		5,962		3,167		1264	
Year to Date + Forecasted % of mean	104%		108%		116%		120%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

3/14/2019

Estimated CVP Operations 50% Exceedance

Storages

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

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity	**1739**	**1904**	**2065**	**2079**	**2029**	**1891**	**1744**	**1606**	**1580**	**1567**	**1594**	**1658**	**1769**
	Elev.	2334	2345	2346	2343	2333	2322	2312	2310	2309	2311	2316	2324
Whiskeytown	**247**	**206**	**238**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**
	Elev.	1199	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199
Shasta	**3948**	**3899**	**4382**	**4542**	**4365**	**3986**	**3672**	**3397**	**3235**	**3254**	**3339**	**3638**	**3955**
	Elev.	1044	1061	1067	1061	1047	1035	1025	1018	1019	1022	1034	1046
Folsom	**598**	**725**	**875**	**964**	**961**	**855**	**748**	**605**	**496**	**466**	**455**	**483**	**495**
	Elev.	442	457	465	465	455	444	429	416	412	411	414	416
New Melones	**2005**	**1871**	**1877**	**1953**	**2026**	**2001**	**1945**	**1908**	**1864**	**1874**	**1892**	**1916**	**1962**
	Elev.	1040	1041	1048	1055	1052	1047	1044	1040	1041	1042	1045	1049
San Luis	**921**	**972**	**865**	**647**	**489**	**290**	**170**	**49**	**47**	**29**	**237**	**411**	**554**
	Elev.	544	521	486	471	463	451	426	414	407	446	472	497
Total		9576	10301	10424	10108	9263	8516	7803	7427	7396	7722	8312	8940

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	28	258	126	68	53	52	23	18	18	18	17
	cfs	**300**	**477**	**4,189**	**2,120**	**1,102**	**857**	**870**	**373**	**300**	**300**	**300**	**300**
Clear Creek	TAF	12	13	13	17	9	9	9	12	12	12	15	11
	cfs	**200**	**218**	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**240**	**200**
Sacramento	TAF	1414	416	492	595	707	615	565	430	297	307	307	444
	cfs	**23000**	**7000**	**8000**	**10000**	**11500**	**10000**	**9500**	**7000**	**5000**	**5000**	**5000**	**8000**
American	TAF	492	387	461	357	248	215	250	184	119	123	123	250
	cfs	**8000**	**6500**	**7500**	**6000**	**4030**	**3500**	**4200**	**3000**	**2003**	**2000**	**2000**	**4500**
Stanislaus	TAF	277	97	120	65	26	25	24	52	18	18	22	20
	cfs	**4500**	**1633**	**1958**	**1100**	**429**	**400**	**400**	**842**	**300**	**300**	**358**	**364**

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	4	51	1	71	99	100	89	13	25	12	0	2
Spring Crk. PP	**70**	**30**	**2**	**60**	**90**	**90**	**80**	**35**	**20**	**15**	**20**	**35**

Delta Summary (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	200	89	74	259	270	270	128	145	55	260	235	240
USBR Banks	0	0	0	0	24	24	24	0	0	0	0	0
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0
Total USBR	213	102	86	269	305	307	166	162	73	278	249	254
COA Balance	0	0	0	0	73	73	70	70	70	70	70	70
Old/Middle River Std.												
Old/Middle R. calc.	136	1,881	1,094	-5,996	-8,583	-6,975	-3,172	-2,606	-2,041	-6,532	-4,971	-5,045
Computed DOI	95993	48781	33982	17314	8004	6377	16019	12266	11397	10183	16918	30707
Excess Outflow	82296	23735	13388	6051	0	2375	0	862	0	5677	10915	19307
% Export/Inflow	7%	5%	5%	30%	48%	47%	18%	20%	17%	45%	29%	21%
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1317		6,592		3,741		1512	
Year to Date + Forecasted % of mean	109%		119%		137%		143%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
CVP operational forecasts or outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details.
CVP releases or export values represent monthly averages.
CVP Operations are updated monthly as new hydrology information is made available December through May.

3/14/2019

Northern CVP Water Temperature Report

March - 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		LWS		-----[3]		Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Feb	49.4		48.7		47.0		48.2	47.5	48.2	47.0		46.9	-		47.0		45.9		42.5		-		2055	925	3991	44.9	44.6	45.5	-
03/01		48.2		47.4		45.9	47.5	47.6	47.8	**48.2**		48.4	#	-		48.9	!	-	#	-		-	14422	3585	25767		47.5	47.1	47.4	-
03/02		48.4		47.5		45.9	47.5	47.7	47.9	**48.3**		48.6	#	-		48.7	?	47.6	#	-		-	14279	3521	28819		52.5	50.0	50.0	-
03/03		48.5		47.6		46.0	47.7	47.9	48.1	**48.8**		49.3	#	-		49.5	?	48.5	#	-		-	15147	3771	30696		53.5	51.6	52.2	-
03/04		48.5		47.5		46.2	47.7	47.9	48.1	**48.8**		49.3	#	-		49.8	?	48.3	#	-		-	15165	3431	30839		53.5	51.3	51.5	-
03/05		48.7		47.6		46.1	47.6	47.8	47.9	**48.3**		48.5	#	-		49.0	?	47.4	#	-		-	15206	3837	30875		49.0	48.5	48.7	-
03/06		48.6		47.4		46.1	47.8	48.4	48.3	**49.3**		49.5		49.9		49.6	?	49.5	#	-		-	15374	1713	30073		54.5	54.7	54.5	-
03/07		48.6		47.8		46.2	47.7	48.0	48.0	**49.1**		49.5		50.0		50.1	?	49.1	#	-		-	14534	2429	36980		49.5	50.0	51.2	-
03/08		48.3		47.9		46.3	47.5	47.7	47.9	**48.5**		48.8		49.3		49.2	!	-	#	-		-	14305	3628	41654		48.0	46.8	46.9	-
03/09		48.0		47.4		46.6	47.4	47.5	47.7	**47.8**		47.9		48.4		48.4		46.3	#	-		-	13513	3230	40467		43.0	43.2	44.6	-
03/10		48.3		47.5		46.4	47.6	47.8	48.0	**48.3**		48.2		48.6	?	48.4		47.3	#	-		-	13906	2632	40265		51.0	48.3	49.7	-
03/11	?	48.6	?	47.7		46.6	47.8	48.0	48.2	**48.6**		48.7		49.2		49.3		47.8	#	-		-	14252	1725	40176		56.5	52.6	53.0	-
03/12	?	48.6	#	-		46.8	47.9	48.1	48.3	**48.7**		49.0		49.4		49.6		48.0	#	-		-	15449	1486	39653		52.5	49.8	52.2	-
03/13	!	-	#	-		47.2	47.9	48.1	48.3	**48.5**		48.7		49.1		49.2		47.0	#	-		-	15217	1634	39824		48.0	47.6	50.2	-
03/14	!	-	#	-	?	47.2	48.0	48.1	48.3	**48.5**		48.6		49.1		49.2		47.3	#	-		-	15193	1606	39207		54.5	50.5	52.1	-
03/15	?	48.7	#	-	?	47.0	48.2	48.3	48.5	**48.8**		49.0		49.4		49.6		47.9	#	-		-	15240	1639	33658		53.5	50.6	52.6	-
03/16	?	48.8	#	-	?	46.9	48.2	48.4	48.7	**49.1**		49.4		49.9		50.1		48.2	#	-		-	15293	1427	29031		54.0	52.8	55.2	-
03/17	!	-	#	-	?	46.9	48.2	48.4	48.7	**49.3**		49.8		50.2		50.5		48.8	#	-		-	15019	1530	24238		58.5	55.1	57.1	-
03/18	#	-	#	-	?	46.9	48.3	48.5	48.8	**49.6**		50.2		50.7		51.0		49.0	#	-		-	15217	1610	20769		58.0	56.5	59.5	-
03/19	!	-	#	-	?	47.0	48.3	48.6	48.9	**49.6**		50.3		50.8		51.1		49.0	!	-		-	15286	1995	17706		60.5	56.7	59.3	-
03/20		49.2	#	-	?	46.9	48.4	48.7	48.9	**49.8**		50.5		51.0		50.9	?	49.0		47.6		-	13822	439	14954		56.0	53.1	53.9	-
03/21		49.3	#	-		46.9	48.2	48.6	49.0	**50.1**		50.8		51.2		51.1		49.3		48.1		-	10616	607	12734		55.5	53.8	55.0	-
03/22		49.9	#	-		47.0	48.4	48.6	48.9	**49.6**		50.2		50.8		50.8		48.3		46.8		-	8603	1538	10934		48.0	47.6	48.0	-
03/23		50.3	#	-		47.0	48.4	49.0	49.1	**50.3**		50.5		50.8		50.4		49.6		48.2		-	8652	1011	10023		54.0	51.5	52.1	-
03/24		50.5	#	-		47.2	48.7	49.1	49.4	**50.5**		51.1		51.5		51.5		49.3		48.5		-	8948	444	10188		51.0	50.3	51.6	-
03/25		49.6	#	-		47.1	48.8	49.1	49.0	**49.9**		50.4		51.0		50.9		48.5		47.5		-	9061	606	10037		50.0	49.7	50.8	-
03/26		49.7	#	-	?	47.2	48.5	48.9	49.1	**50.4**		50.6		51.1		50.9		49.2		49.1		-	8730	567	10151		53.0	52.8	54.3	-
03/27																													
03/28																													
03/29																													
03/30																													
03/31																													
Mar	48.9		47.6		46.7		48.0	48.3	48.4	49.1		49.4	50.1		49.9		48.3		48.0		-	13479	1986	26912		52.5	50.9	52.1	-
																			Total CFS			350449	51641	699718				
																			Total AF			695101	102428	1387862				

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	40	55	47.5	41	55	48.0	41	59	50.0	41	59	50.0	43	58	50.5	44	58	51.0	46	57	51.5	43	56	49.5	36	60	48.0	37	64	50.5	41	66	53.5	43	70	56.5			
03/02	40	55	47.5	45	56	50.5	44	58	51.0	43	59	51.0	42	58	50.0	47	56	51.5	45	54	49.5	39	54	46.5	39	61	50.0	44	66	55.0	42	67	54.5	44	65	54.5			
03/03	45	60	52.5	49	59	54.0	44	59	51.5	42	58	50.0	46	56	51.0	44	55	49.5	40	54	47.0	38	53	45.5	39	62	50.5	42	66	54.0	44	64	54.0	45	68	56.5			
03/04	49	58	53.5	49	58	53.5	43	55	49.0	47	56	51.5	46	54	50.0	39	55	47.0	38	54	46.0	40	56	48.0	43	63	53.0	42	62	52.0	42	65	53.5	43	66	54.5			
03/05	49	58	53.5	47	53	50.0	48	56	52.0	45	54	49.5	40	55	47.5	38	53	45.5	39	57	48.0	39	60	49.5	39	64	51.5	46	68	57.0	43	69	56.0	45	72	58.5			
03/06	47	51	49.0	50	57	53.5	44	53	48.5	40	54	47.0	38	52	45.0	38	59	48.5	39	62	50.5	42	58	50.0	41	60	50.5	44	68	56.0	43	68	55.5	44	68	56.0			
03/07	50	59	54.5	47	52	49.5	38	53	45.5	39	51	45.0	36	57	46.5	38	63	50.5	42	59	50.5	39	58	48.5	39	63	51.0	42	65	53.5	45	68	56.5	44	68	56.0			
03/08	47	52	49.5	43	53	48.0	40	49	44.5	38	56	47.0	38	60	49.0	43	56	49.5	38	58	48.0	38	60	49.0	41	65	53.0	43	69	56.0	46	72	59.0	45	71	58.0			
03/09	42	54	48.0	40	49	44.5	39	57	48.0	38	63	50.5	42	56	49.0	38	59	48.5	37	61	49.0	40	61	50.5	43	69	56.0	44	70	57.0	49	69	59.0	46	70	58.0			
03/10	40	46	43.0	42	57	49.5	39	65	52.0	41	58	49.5	37	60	48.5	39	66	52.5	41	66	53.5	43	65	54.0	45	72	58.5	45	74	59.5	48	74	61.0	45	75	60.0			
03/11	42	60	51.0	47	65	56.0	41	60	50.5	37	61	49.0	39	63	51.0	41	67	54.0	44	68	56.0	46	71	58.5	45	72	58.5	46	67	56.5	47	69	58.0	47	65	56.0			
03/12	44	69	56.5	41	61	51.0	38	61	49.5	40	61	50.5	41	68	54.5	45	69	57.0	47	72	59.5	48	72	60.0	46	68	57.0	47	66	56.5	47	65	56.0	45	72	58.5			
03/13	41	64	52.5	35	61	48.0	40	65	52.5	43	69	56.0	44	69	56.5	47	72	59.5	47	72	59.5	50	66	58.0	46	73	59.5	47	67	57.0	50	67	58.5	46	69	57.5			
03/14	33	63	48.0	42	67	54.5	42	70	56.0	44	71	57.5	47	75	61.0	49	74	61.5	50	70	60.0	50	68	59.0	50	66	58.0	48	65	56.5	48	66	57.0	45	70	57.5			
03/15	39	70	54.5	36	70	53.0	43	71	57.0	47	75	61.0	48	74	61.0	50	70	60.0	50	67	58.5	50	64	57.0	48	63	55.5	47	66	56.5	45	71	58.0	47	72	59.5			
03/16	34	73	53.5	38	72	55.0	45	74	59.5	47	74	60.5	51	71	61.0	51	66	58.5	49	67	58.0	50	61	55.5	47	65	56.0	44	70	57.0	46	71	58.5	45	71	58.0			
03/17	35	73	54.0	44	75	59.5	46	74	60.0	50	73	61.5	52	62	57.0	50	65	57.5	49	61	55.0	48	62	55.0	43	64	53.5	45	64	54.5	48	66	57.0	44	72	58.0			
03/18	43	74	58.5	42	75	58.5	51	74	62.5	51	60	55.5	47	66	56.5	49	59	54.0	47	63	55.0	44	65	54.5	46	64	55.0	44	70	57.0	48	71	59.5	45	73	59.0			
03/19	40	76	58.0	50	74	62.0	50	61	55.5	47	65	56.0	48	59	53.5	46	64	55.0	43	68	55.5	47	63	55.0	46	63	54.5	47	62	54.5	46	67	56.5	46	67	56.5			
03/20	49	72	60.5	51	60	55.5	46	64	55.0	47	62	54.5	44	63	53.5	42	67	54.5	46	60	53.0	47	62	54.5	44	61	52.5	44	66	55.0	46	68	57.0	45	71	58.0			
03/21	49	63	56.0	47	64	55.5	46	54	50.0	45	60	52.5	42	65	53.5	46	60	53.0	47	61	54.0	46	60	53.0	41	64	52.5	45	71	58.0	47	71	59.0	46	67	56.5			
03/22	46	65	55.5	45	53	49.0	45	61	53.0	43	64	53.5	45	59	52.0	45	60	52.5	46	58	52.0	43	61	52.0	43	68	55.5	46	75	60.5	49	71	60.0	45	67	56.0			
03/23	44	52	48.0	48	61	54.5	40	65	52.5	46	58	52.0	44	60	52.0	45	56	50.5	44	59	51.5	42	66	54.0	40	68	54.0	47	72	59.5	47	67	57.0	47	68	57.5			
03/24	48	60	54.0	40	65	52.5	46	56	51.0	43	59	51.0	45	57	51.0	44	58	51.0	42	65	53.5	43	68	55.5	45	66	55.5	48	73	60.5	50	77	63.5	49	73	61.0			
03/25	39	63	51.0	42	54	48.0	44	60	52.0	47	58	52.5	45	58	51.5	42	65	53.5	44	69	56.5	46	66	56.0	47	70	58.5	50	74	62.0	52	73	62.5	48	72	60.0			
03/26	47	53	50.0	46	60	53.0	48	60	54.0	45	56	50.5	43	65	54.0	44	69	56.5	47	70	58.5	49	68	58.5	47	72	59.5	50	75	62.5	50	76	63.0	48	73	60.5			
03/27	46	60	53.0	47	60	53.5	45	56	50.5	43	64	53.5	42	71	56.5	46	72	59.0	50	68	59.0	48	69	58.5	48	75	61.5	52	71	61.5	53	68	60.5	49	69	59.0			
03/28																																							
03/29																																							
03/30																																							
03/31																																							

Web Links

10-Day Min/Max Forecast

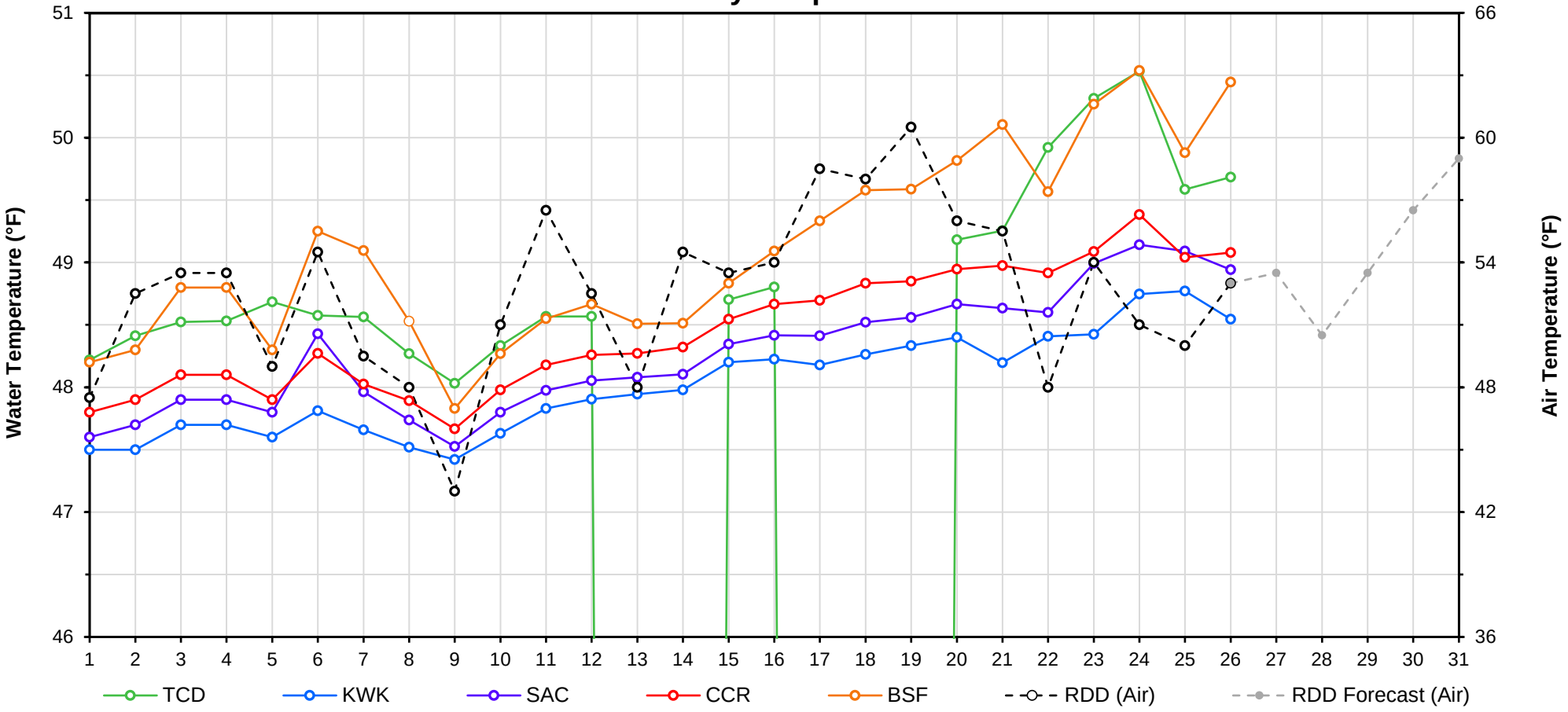
Previous Days Min/Max Actuals

Legend

NR = Forecasted temperatures not recorded

100 = Previous day actual temperatures in red and bolded indicate a record temperature for that date

Mean Daily Temperatures



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

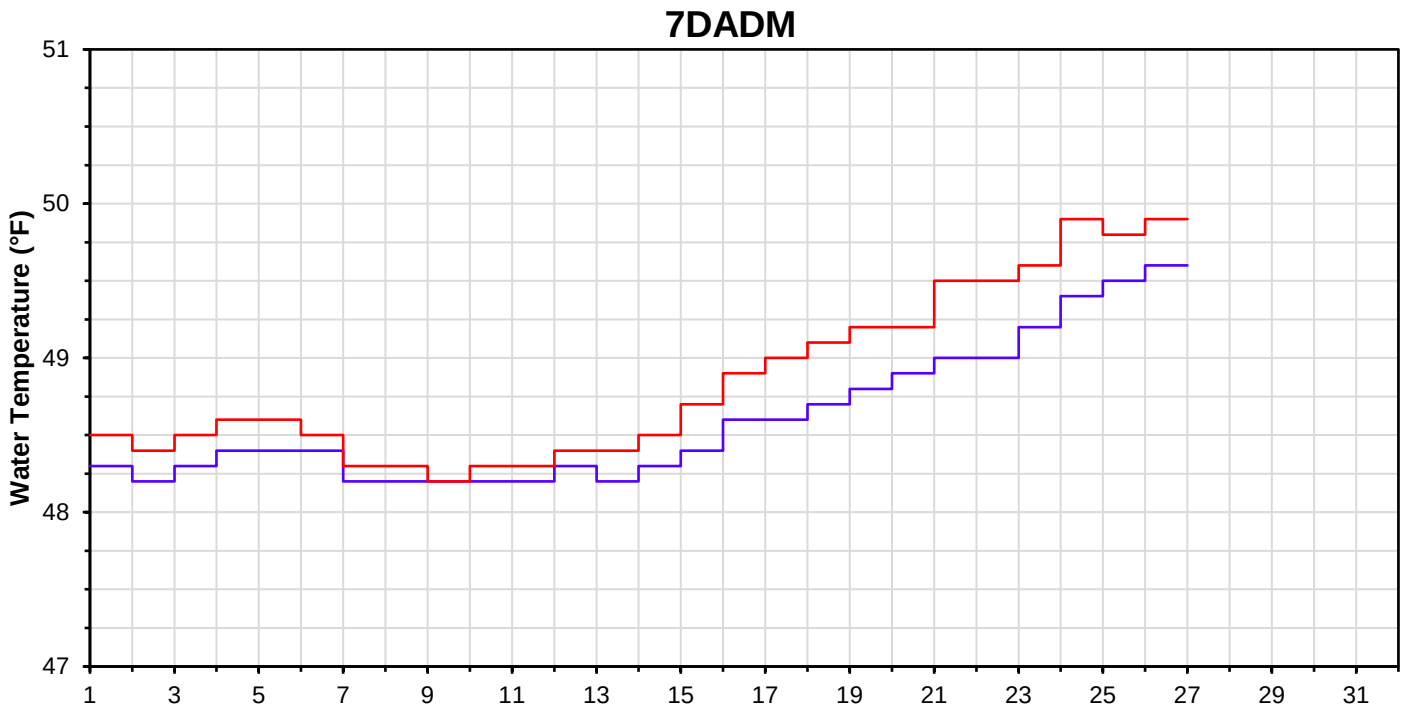
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

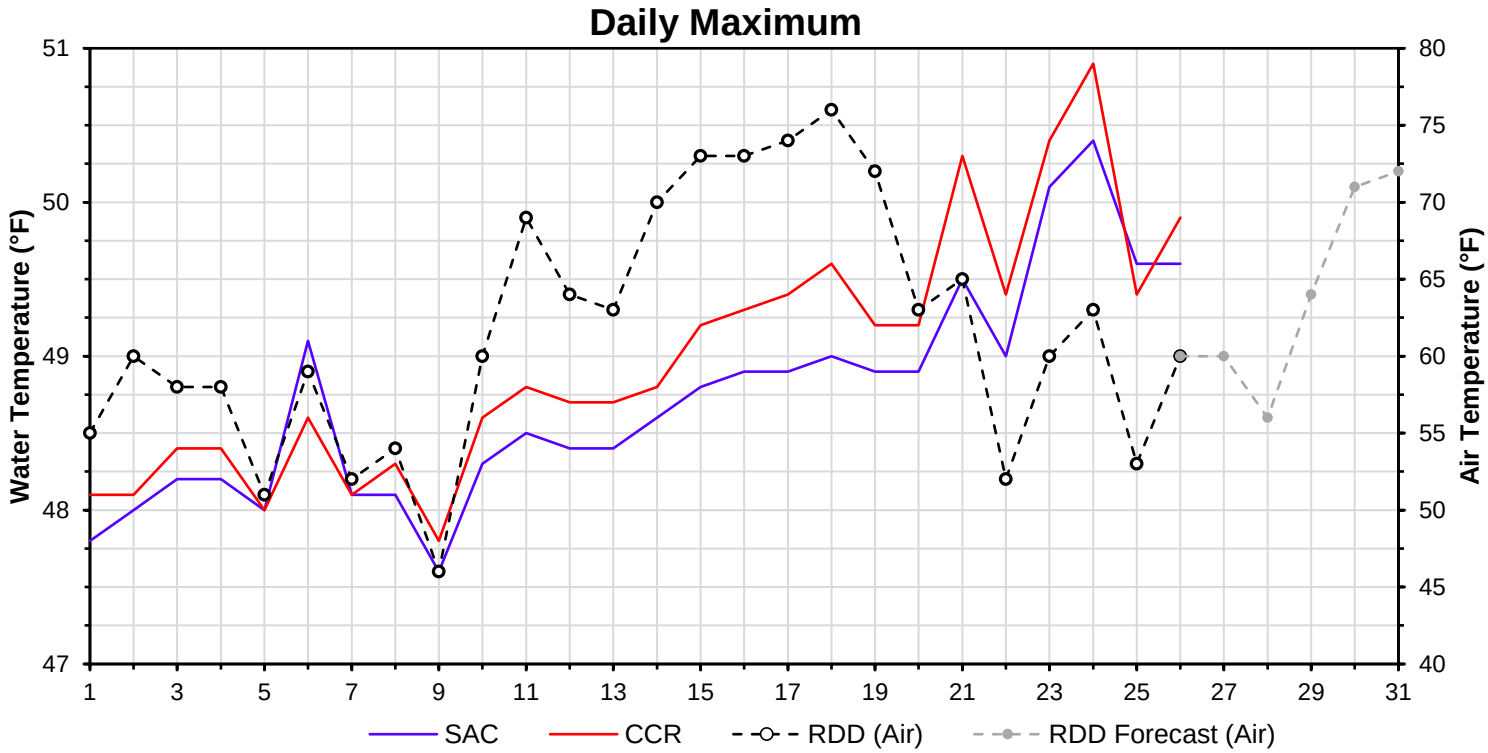
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
03/01	47.8	48.1	48.3	48.5	48.2
03/02	48.0	48.1	48.2	48.4	48.3
03/03	48.2	48.4	48.3	48.5	48.8
03/04	48.2	48.4	48.4	48.6	48.8
03/05	48.0	48.0	48.4	48.6	48.3
03/06	49.1	48.6	48.4	48.5	49.3
03/07	48.1	48.1	48.2	48.3	49.1
03/08	48.1	48.3	48.2	48.3	48.5
03/09	47.6	47.8	48.2	48.2	47.8
03/10	48.3	48.6	48.2	48.3	48.3
03/11	48.5	48.8	48.2	48.3	48.6
03/12	48.4	48.7	48.3	48.4	48.7
03/13	48.4	48.7	48.2	48.4	48.5
03/14	48.6	48.8	48.3	48.5	48.5
03/15	48.8	49.2	48.4	48.7	48.8
03/16	48.9	49.3	48.6	48.9	49.1
03/17	48.9	49.4	48.6	49.0	49.3
03/18	49.0	49.6	48.7	49.1	49.6
03/19	48.9	49.2	48.8	49.2	49.6
03/20	48.9	49.2	48.9	49.2	49.8
03/21	49.5	50.3	49.0	49.5	50.1
03/22	49.0	49.4	49.0	49.5	49.6
03/23	50.1	50.4	49.2	49.6	50.3
03/24	50.4	50.9	49.4	49.9	50.5
03/25	49.6	49.4	49.5	49.8	49.9
03/26	49.6	49.9	49.6	49.9	50.4
03/27					
03/28					
03/29					
03/30					
03/31					

Notes

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

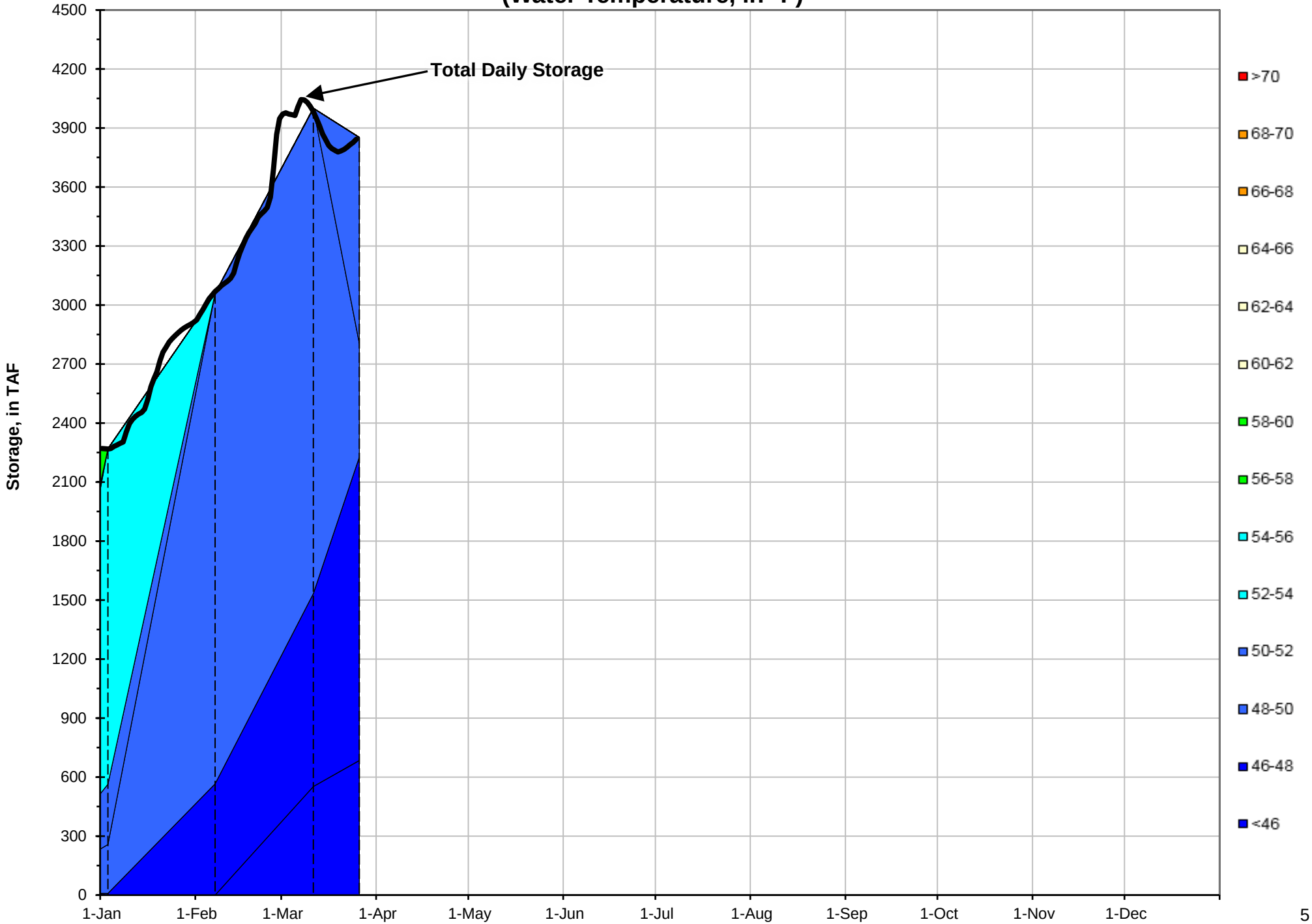
[2] DAT = Daily Average Temperature





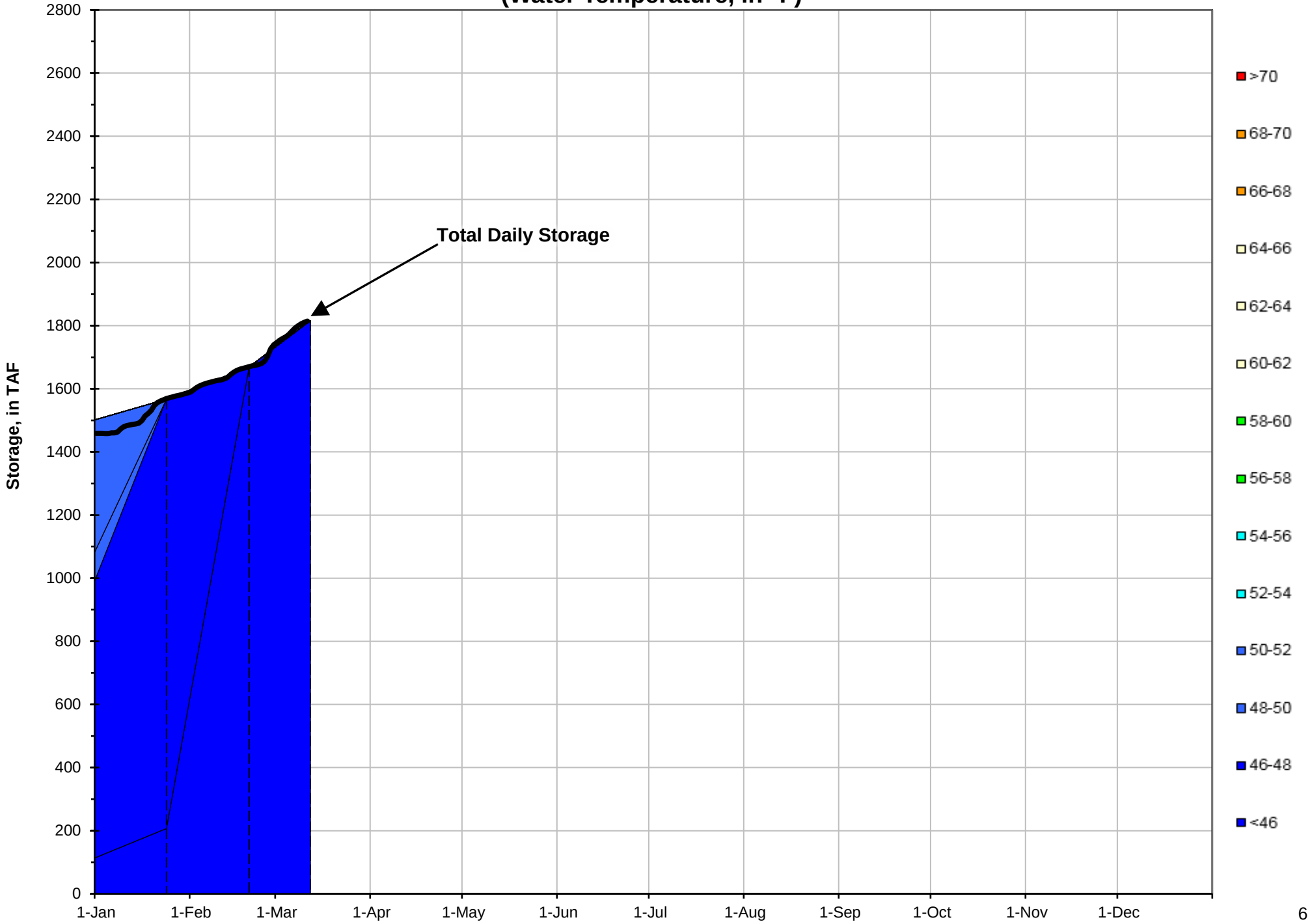
Latest Profile Date: 03/26/2019

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



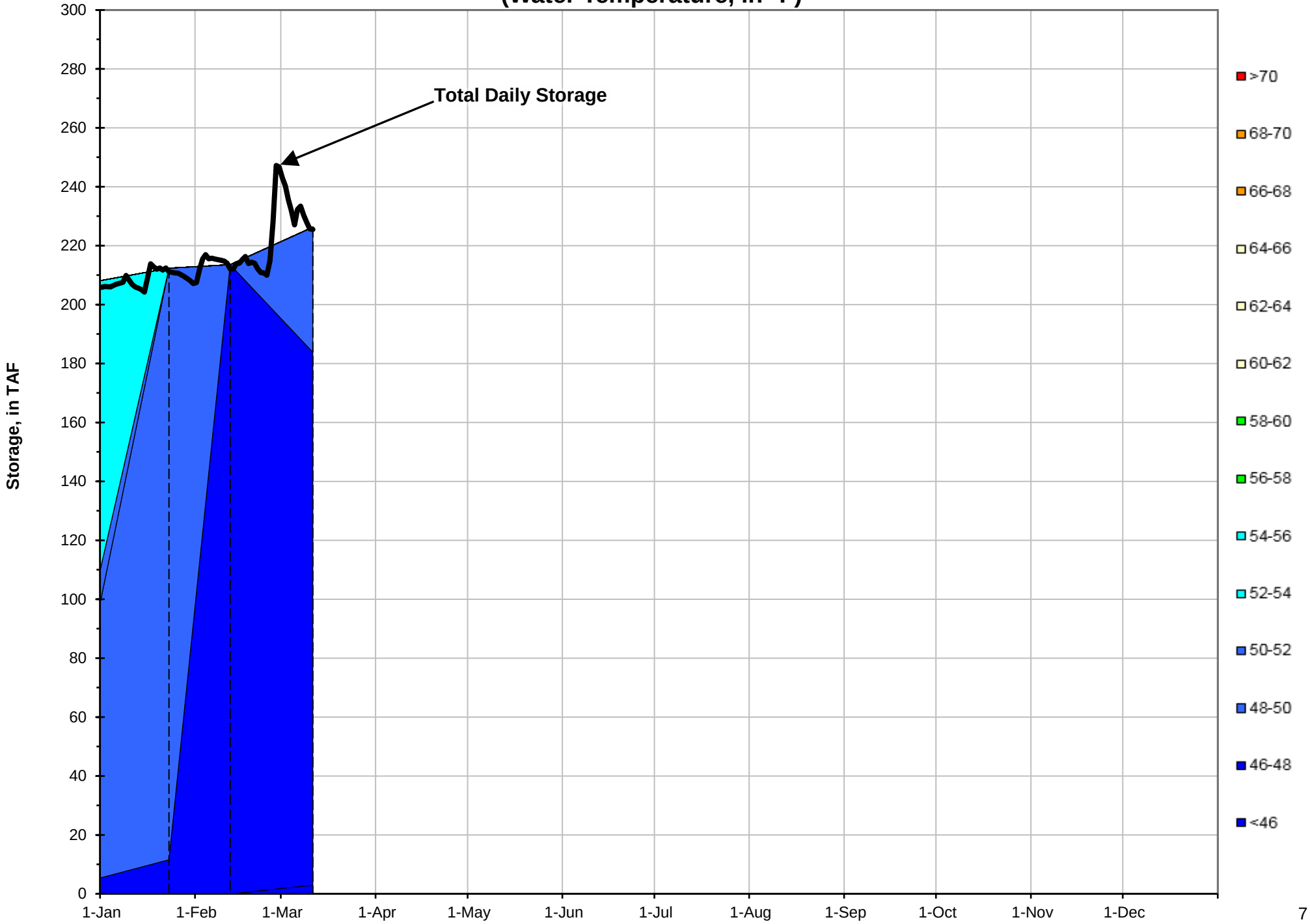
Latest Profile Date: 03/12/2019

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



Latest Profile Date: 03/11/2019

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

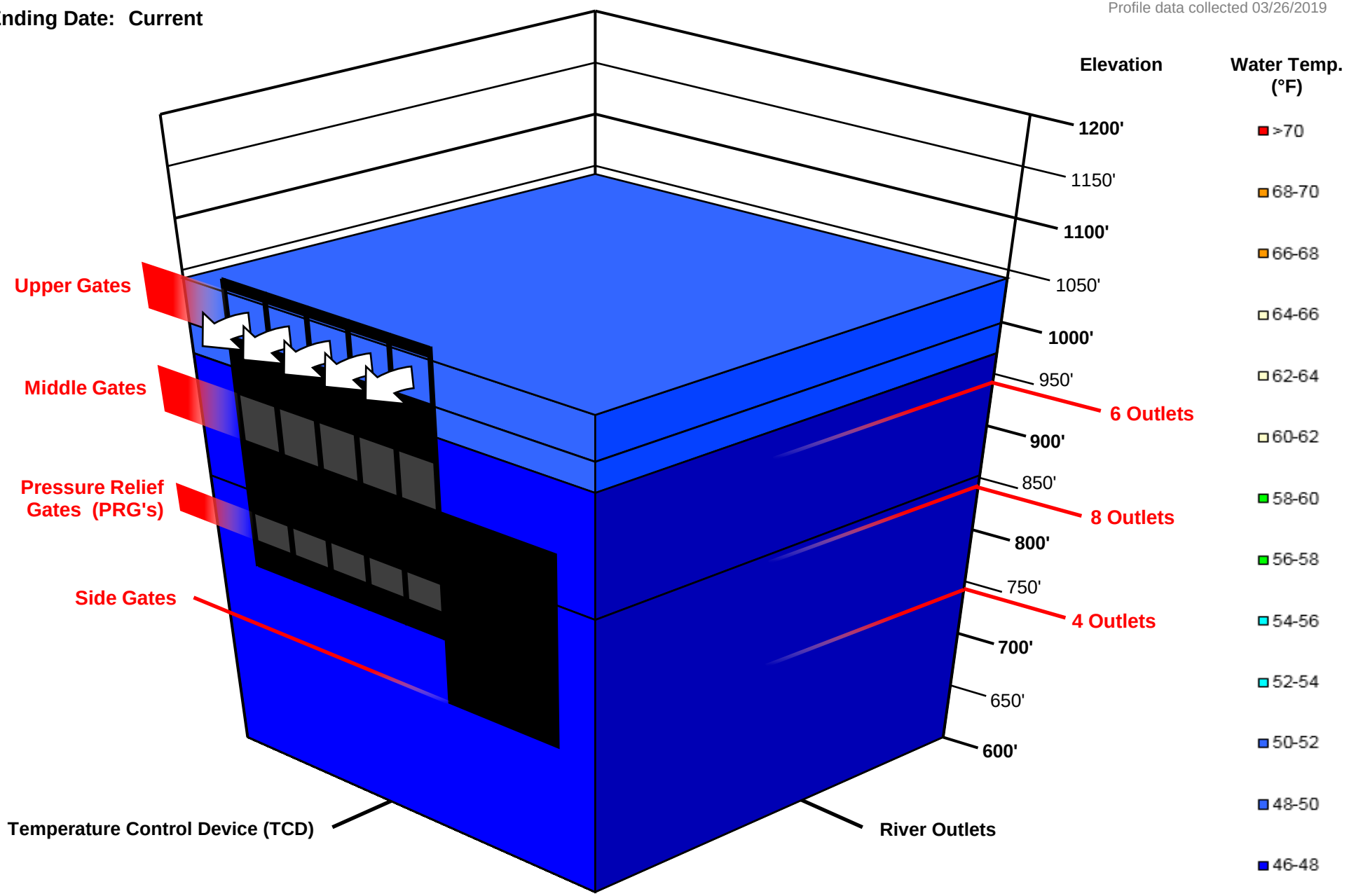


Shasta TCD Configuration

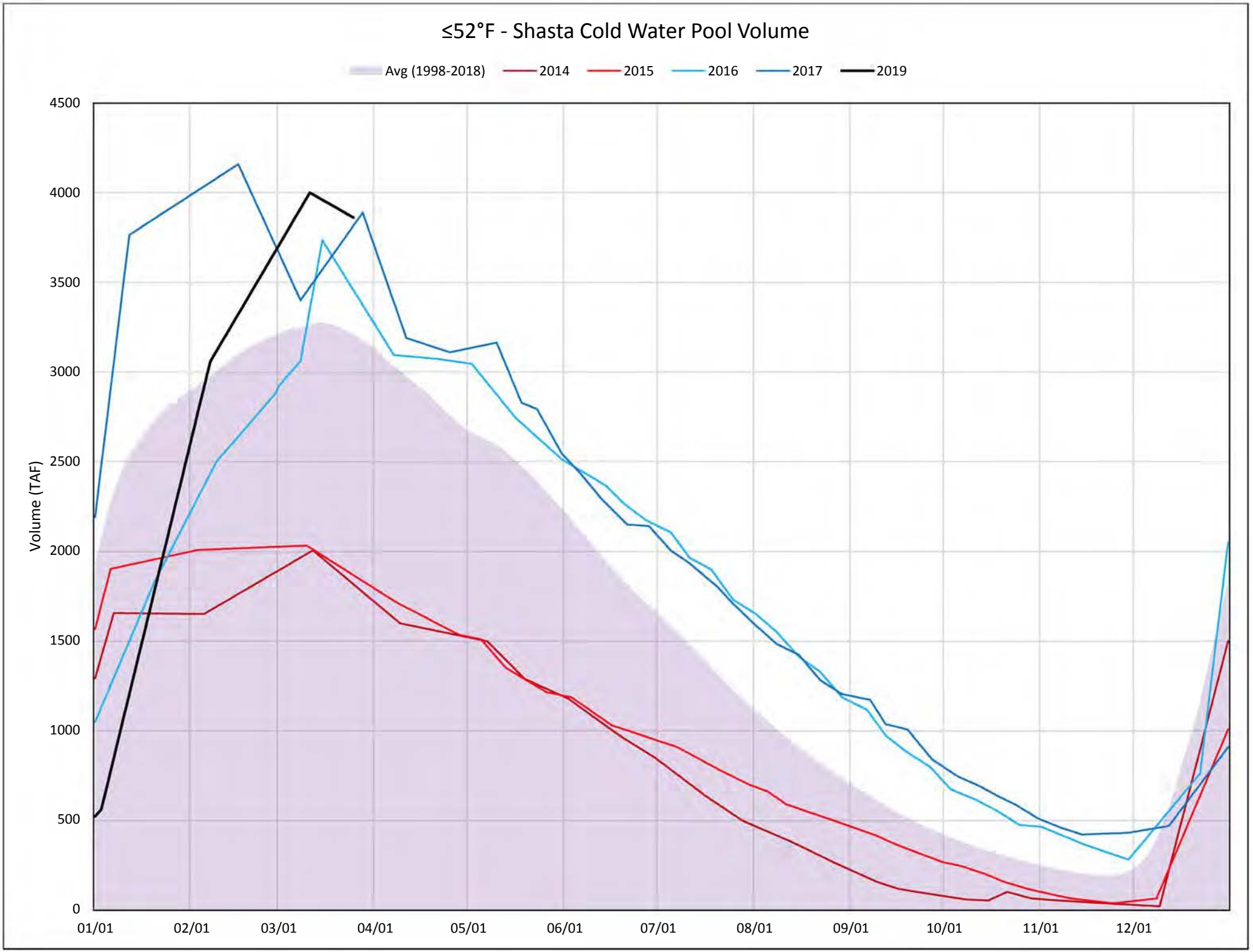
Starting Date: 03/18/2019

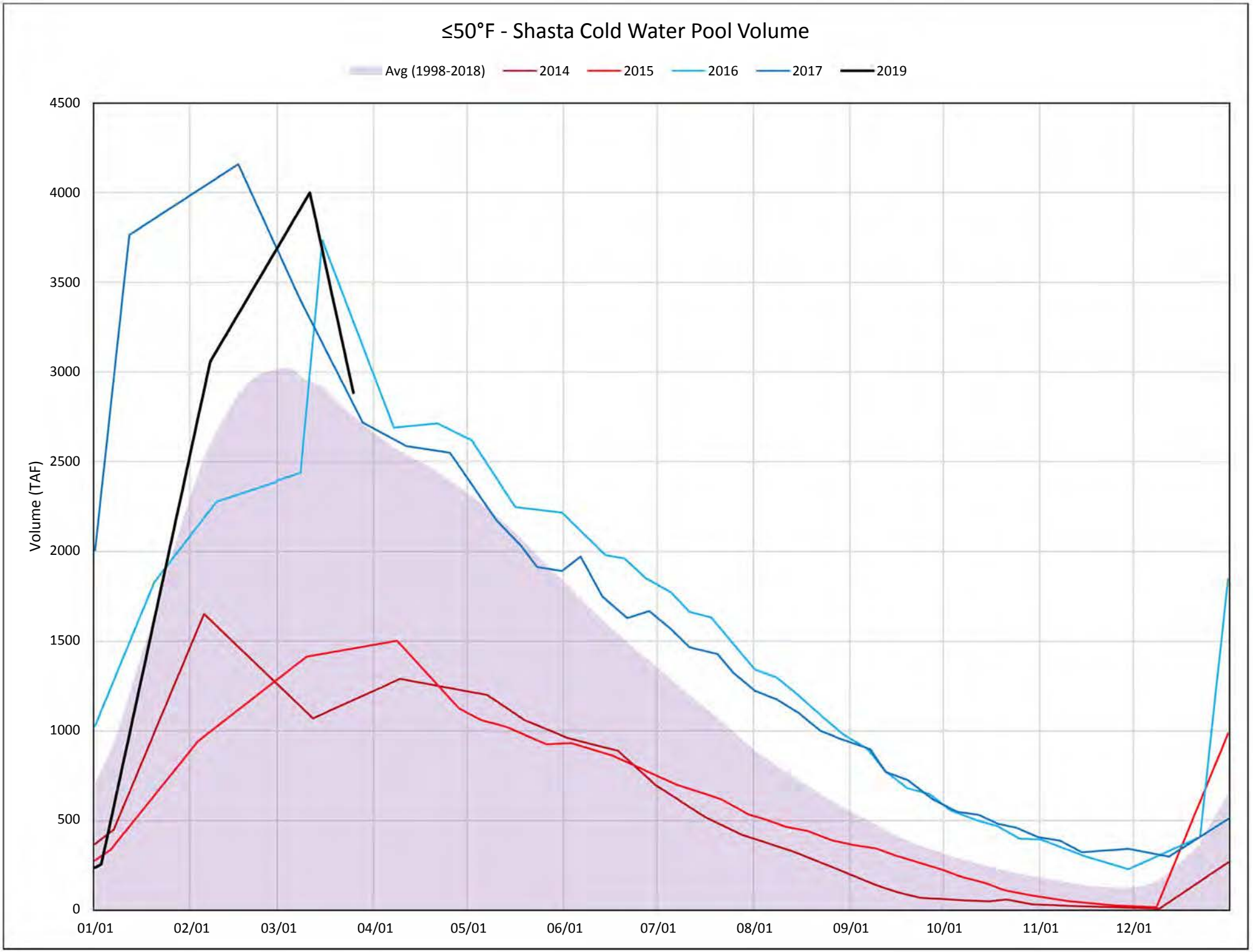
Ending Date: Current

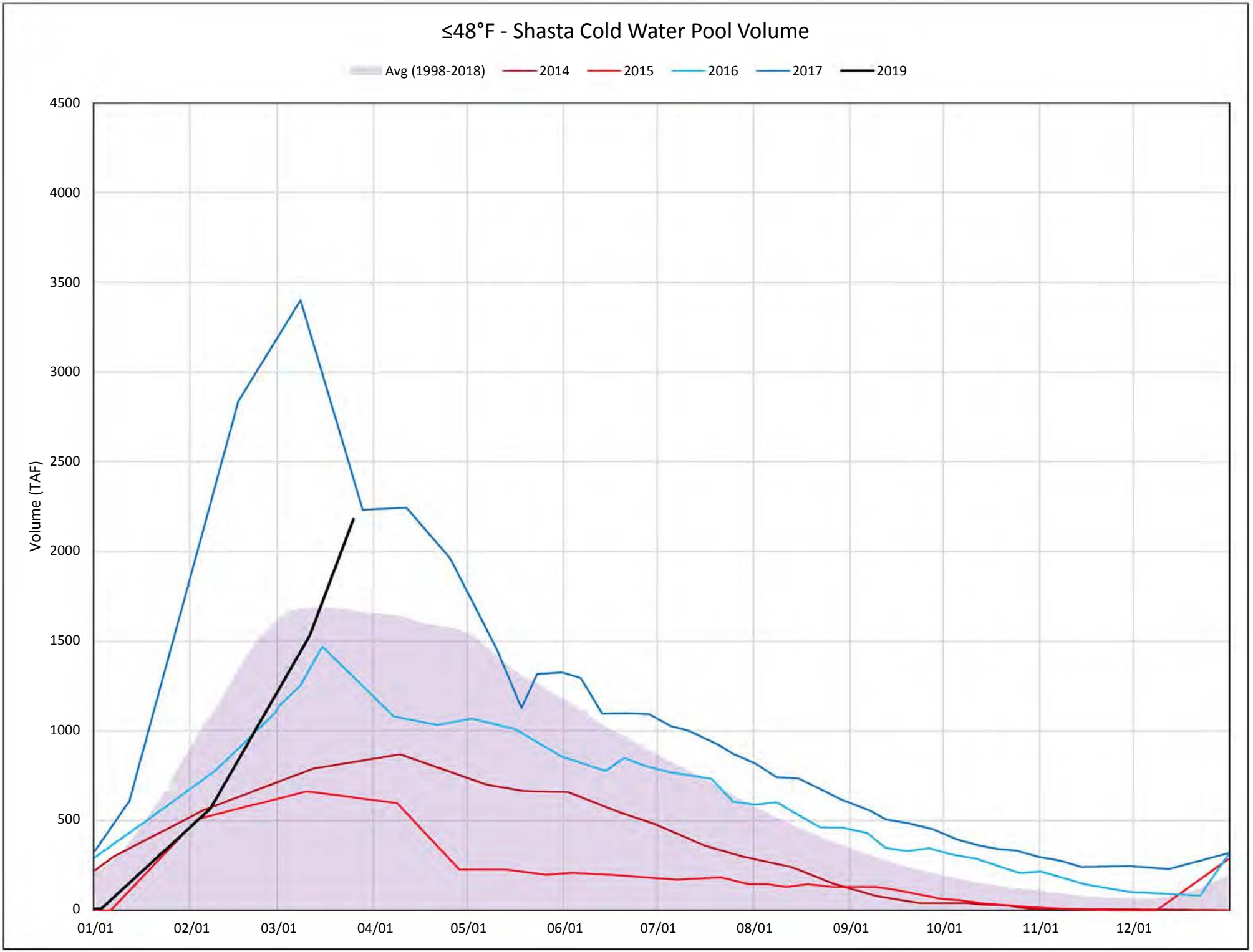
Profile data collected 03/26/2019

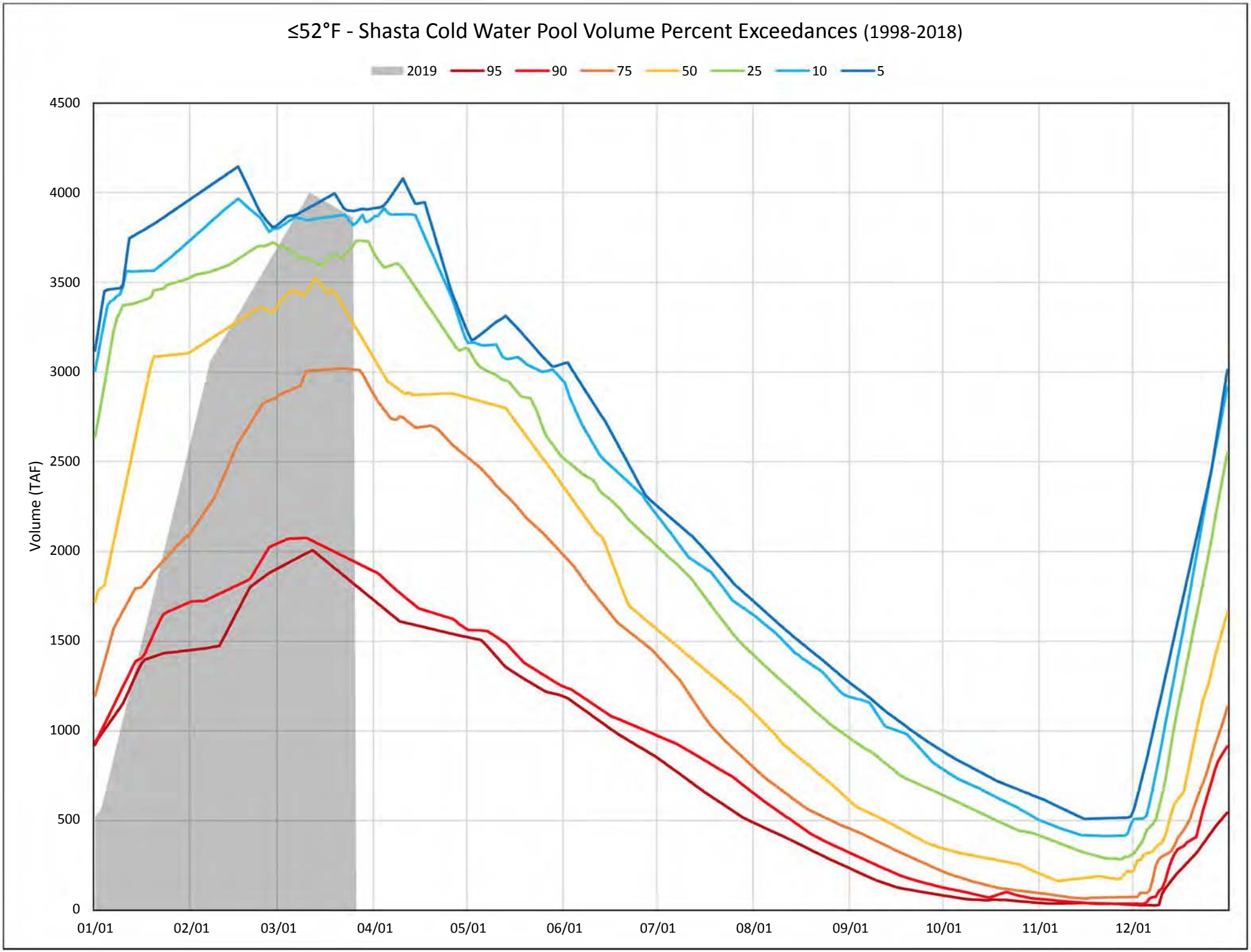


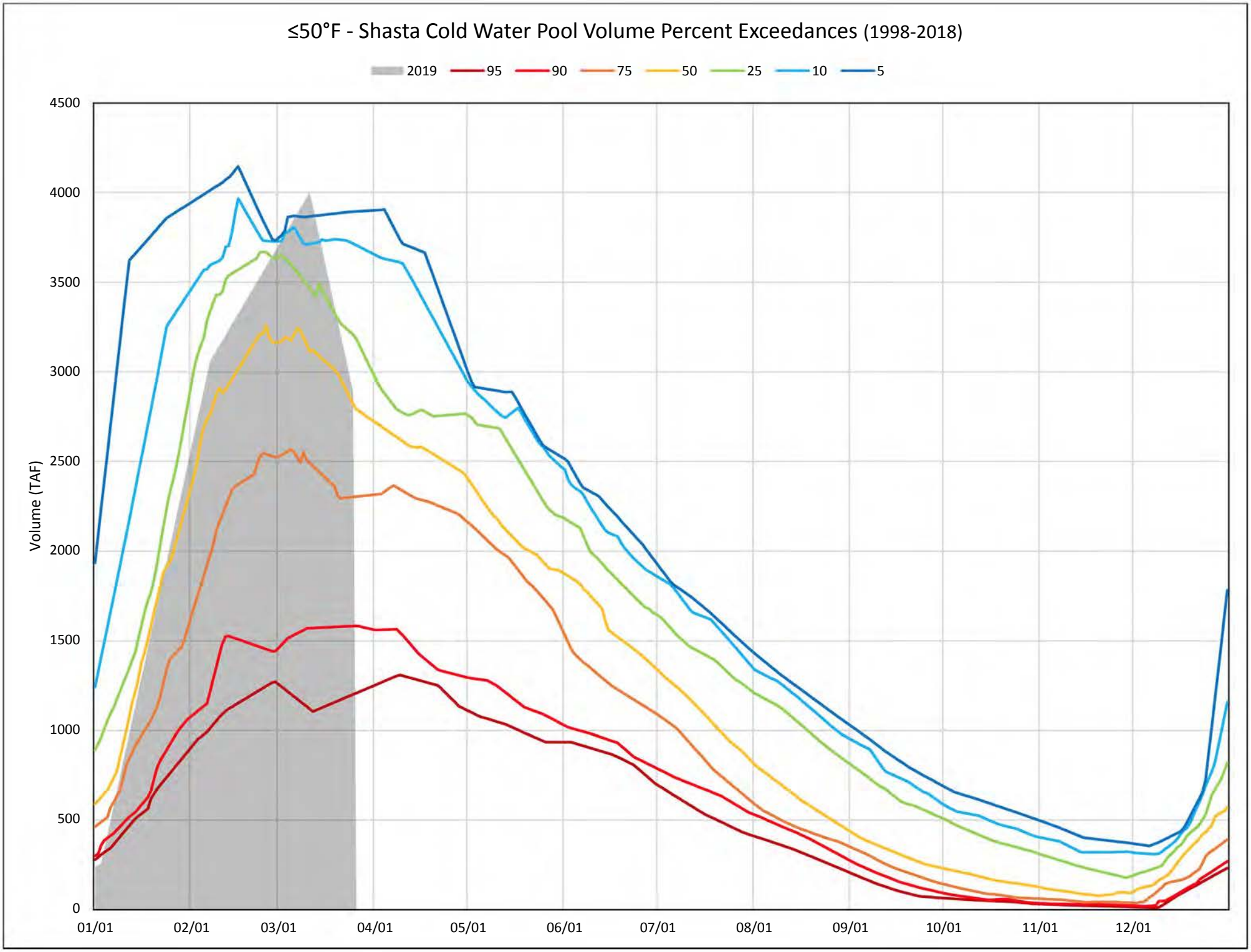
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

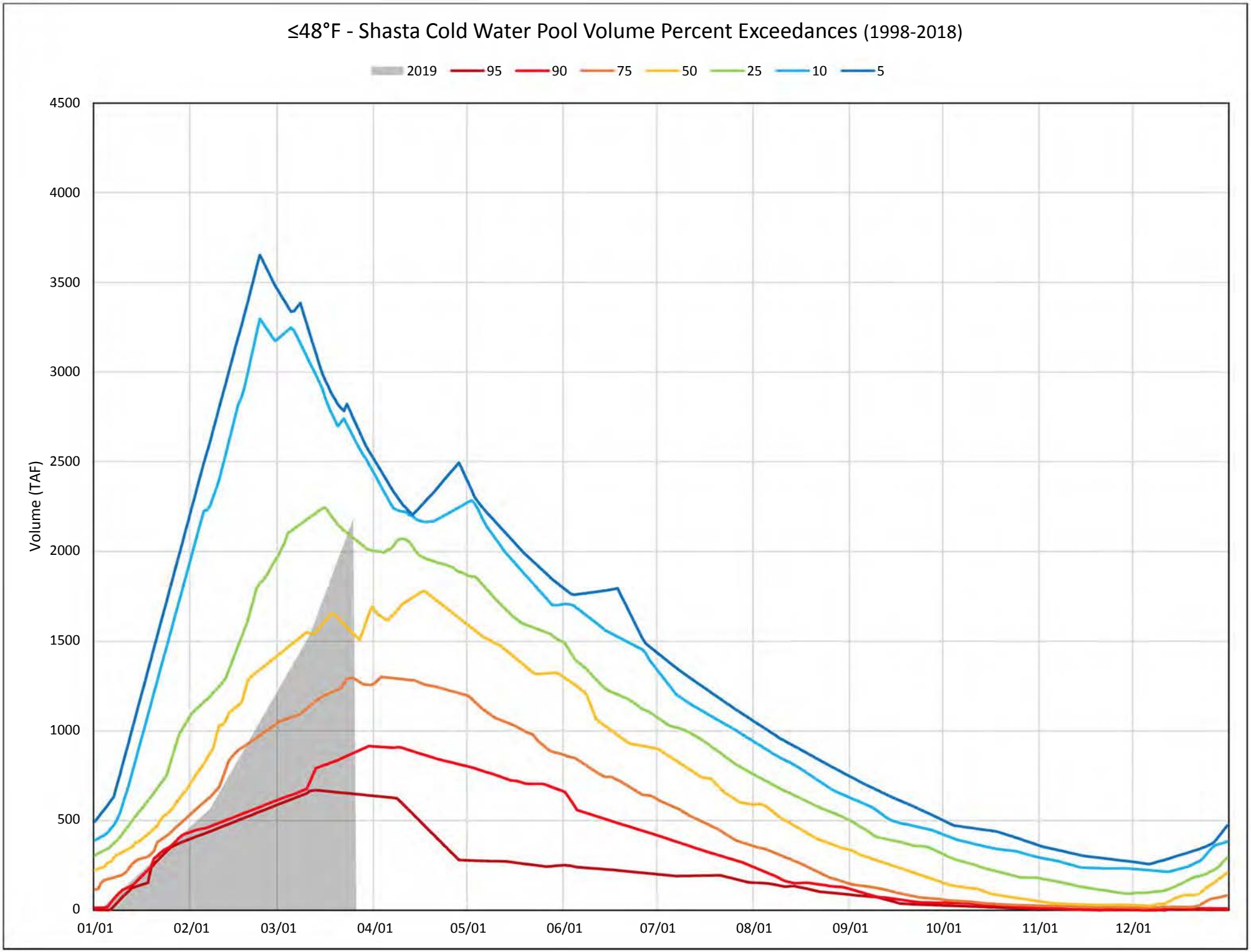

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤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

March 27, 2019

Upper Sacramento River – March 2019 Preliminary Temperature Analysis

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

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
March 90%-Exceedance Outlook – 30% Historical Meteorology							
Keswick Dam KWK	52.7	52.4	52.0	52.7	52.8	See Figures 1 and 5	See Figures 1 and 5
Sac. R. abv Clear Creek CCR	53.3	53.2	52.7	53.3	53.4	See Figures 1 and 6	See Figures 1 and 6
Balls Ferry BSF	56.4	57.6	55.7	55.5	55.5	See Figures 1 and 7	See Figures 1 and 7
March 90%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	52.6	52.3	51.8	52.4	52.6	See Figures 2 and 5	See Figures 2 and 5
Sac. R. abv Clear Creek CCR	53.2	53.1	52.4	52.9	53.2	See Figures 2 and 6	See Figures 2 and 6
Balls Ferry BSF	56.2	57.2	55.3	54.9	55.3	See Figures 2 and 7	See Figures 2 and 7

Location (°F DAT)	APR	MAY	JUN	JUL	AUG	SEP*	OCT*
March 50%-Exceedance Outlook – 30% Historical Meteorology							
Keswick Dam KWK	52.3	52.2	51.9	53.0	53.0	See Figures 3 and 5	See Figures 3 and 5
Sac. R. abv Clear Creek CCR	52.8	53.0	52.6	53.5	53.5	See Figures 3 and 6	See Figures 3 and 6
Balls Ferry BSF	55.4	57.0	55.8	55.8	55.4	See Figures 3 and 7	See Figures 3 and 7
March 50%-Exceedance Outlook – 50% Historical Meteorology							
Keswick Dam KWK	52.3	52.1	51.7	52.6	52.9	See Figures 4 and 5	See Figures 4 and 5
Sac. R. abv Clear Creek CCR	52.7	52.8	52.3	53.1	53.4	See Figures 4 and 6	See Figures 4 and 6
Balls Ferry BSF	55.3	56.6	55.4	55.2	55.3	See Figures 4 and 7	See Figures 4 and 7

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate	Full Side Gates
90% Hydro, 30% Met	975	10/2	11/15
90% Hydro, 50% Met	975	10/2	11/16
50% Hydro, 30% Met	815	9/27	11/12
50% Hydro, 50% Met	824	9/27	11/14

Model Run Date March 27, 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 March 26, March 12, and March 11, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The March 2019 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 (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 March 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 30% and 50% patterned after like months on a 6-hour time-step. Assumed inflows temperature remain static inputs and do not vary with the assumed meteorology. Tools to use long-term three-month-temperature outlooks, driven by the NOAA NWS Climate Prediction Center (CPC) are available beginning April, prior to April historical meteorology is used.
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, 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.

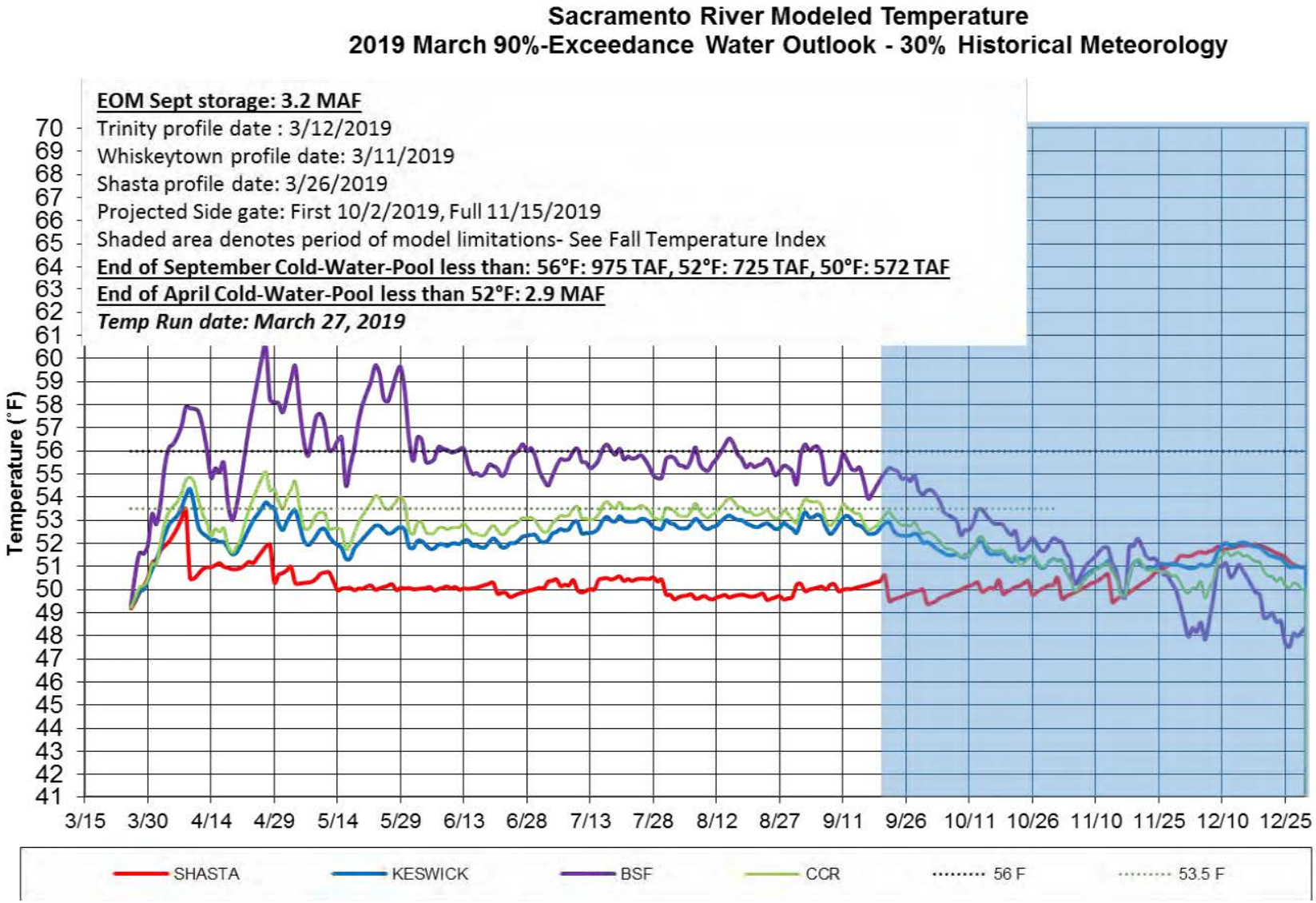


Figure 1. March 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 30% historical meteorology.

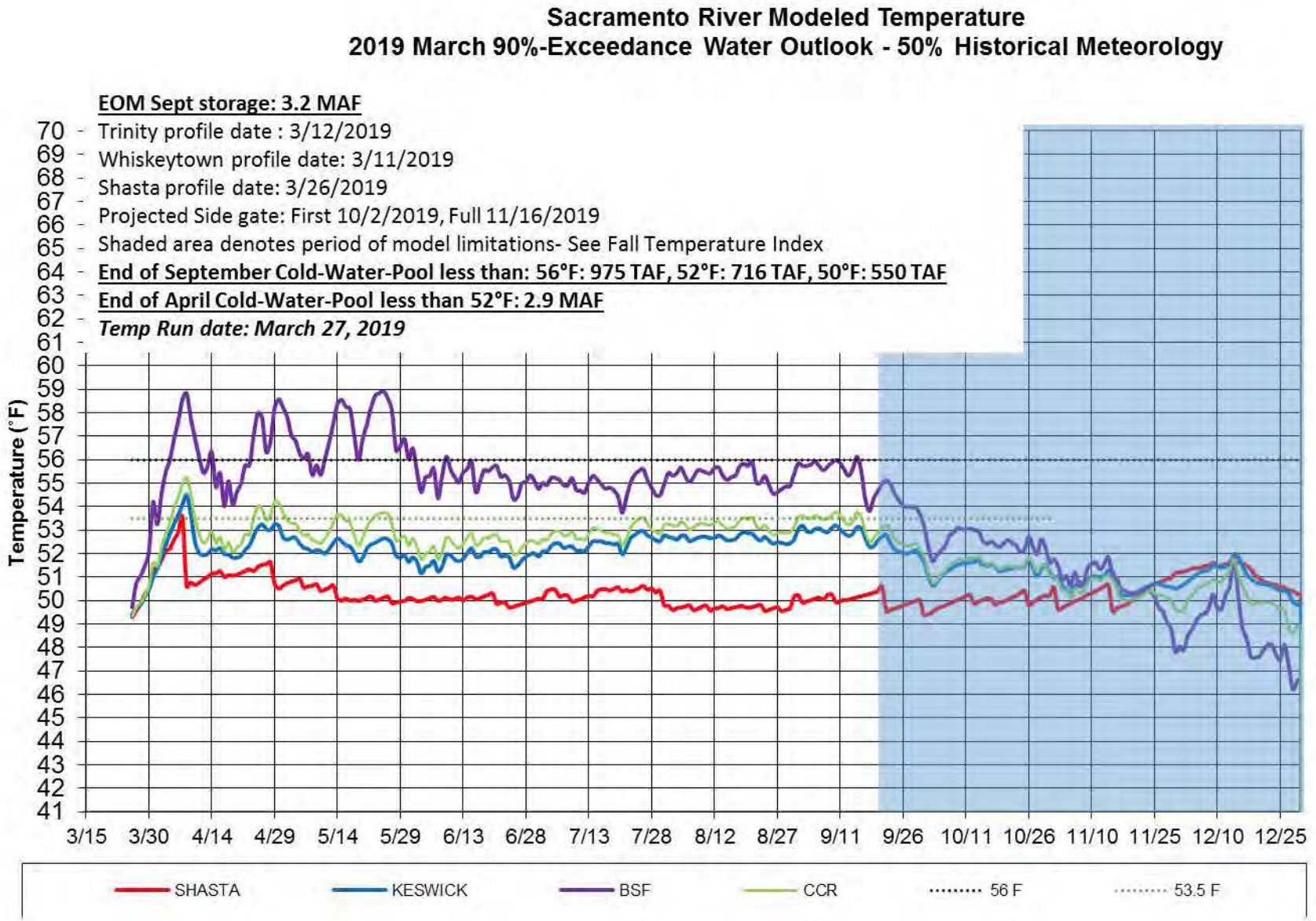


Figure 2. March 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% historical meteorology.

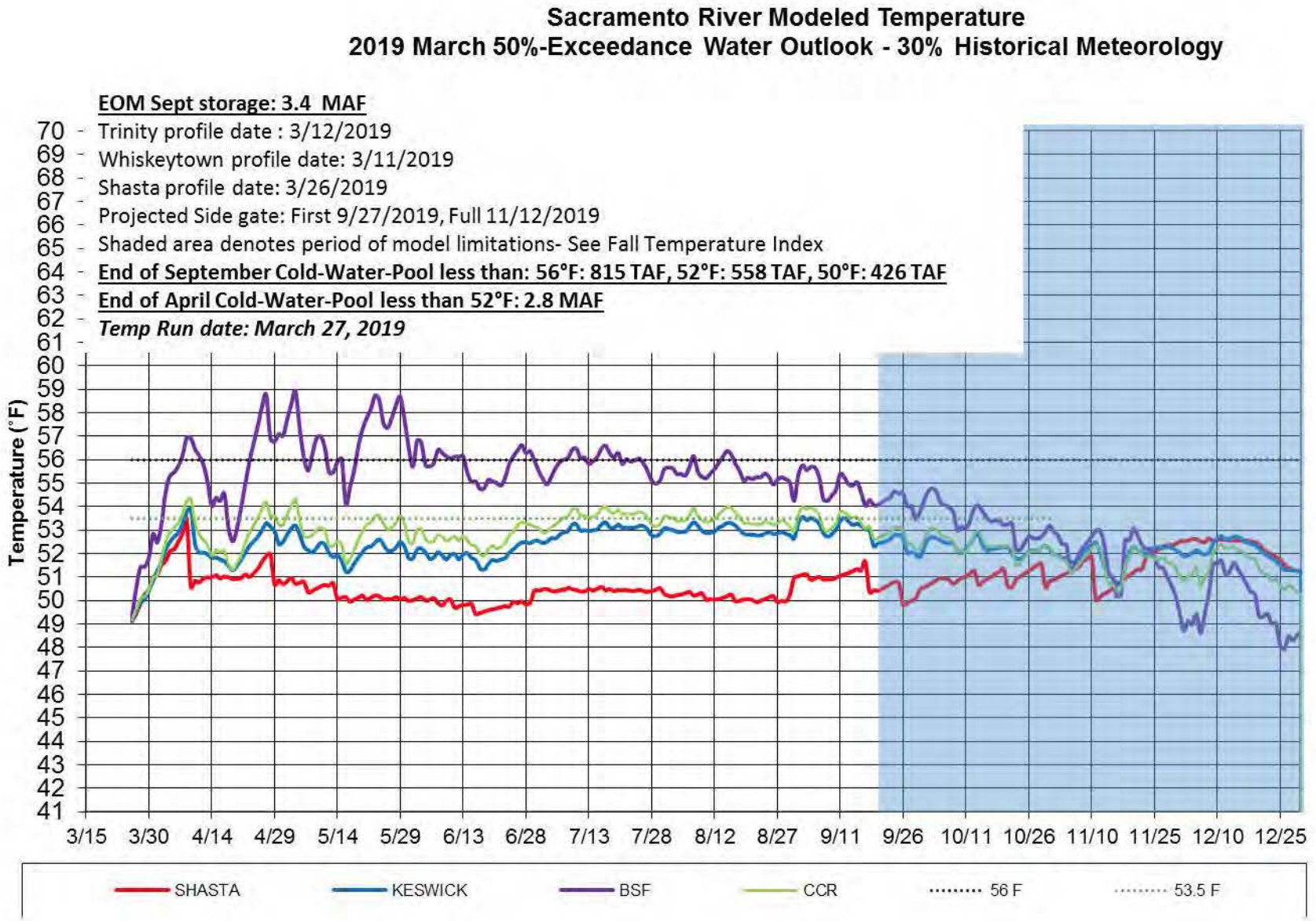


Figure 3. March 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 30% historical meteorology.

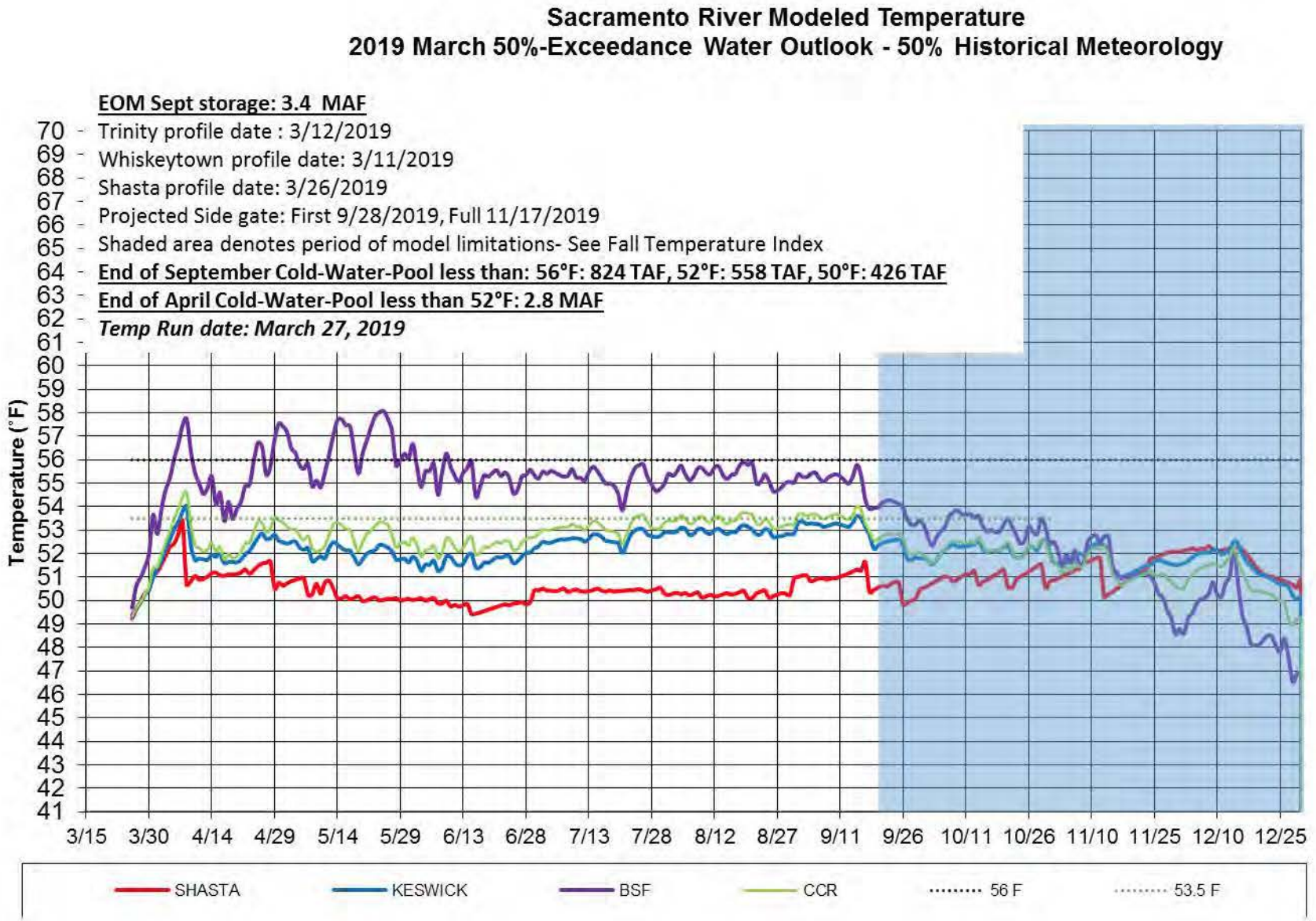


Figure 4. March 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 50% historical meteorology

Figure 5-7 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.

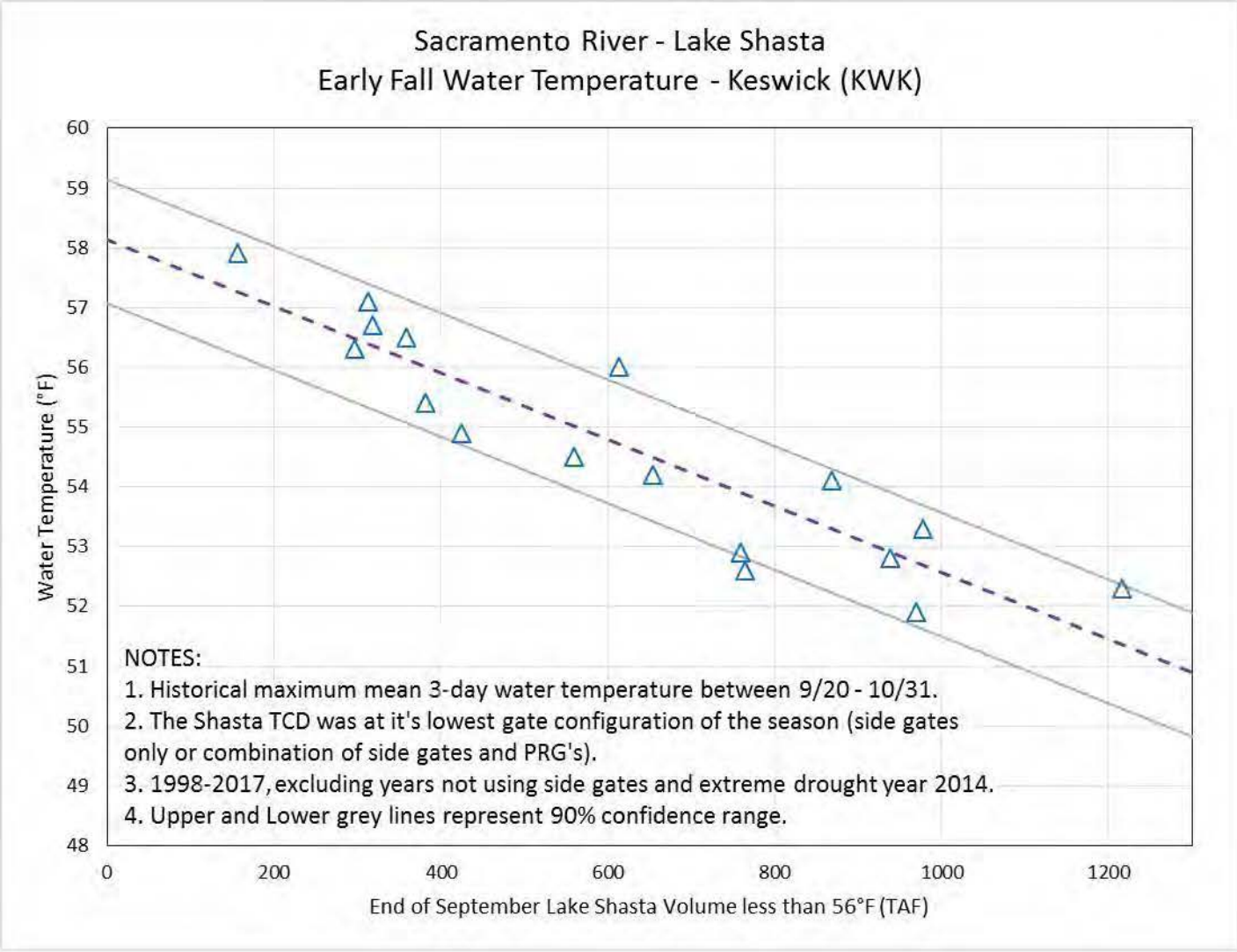


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

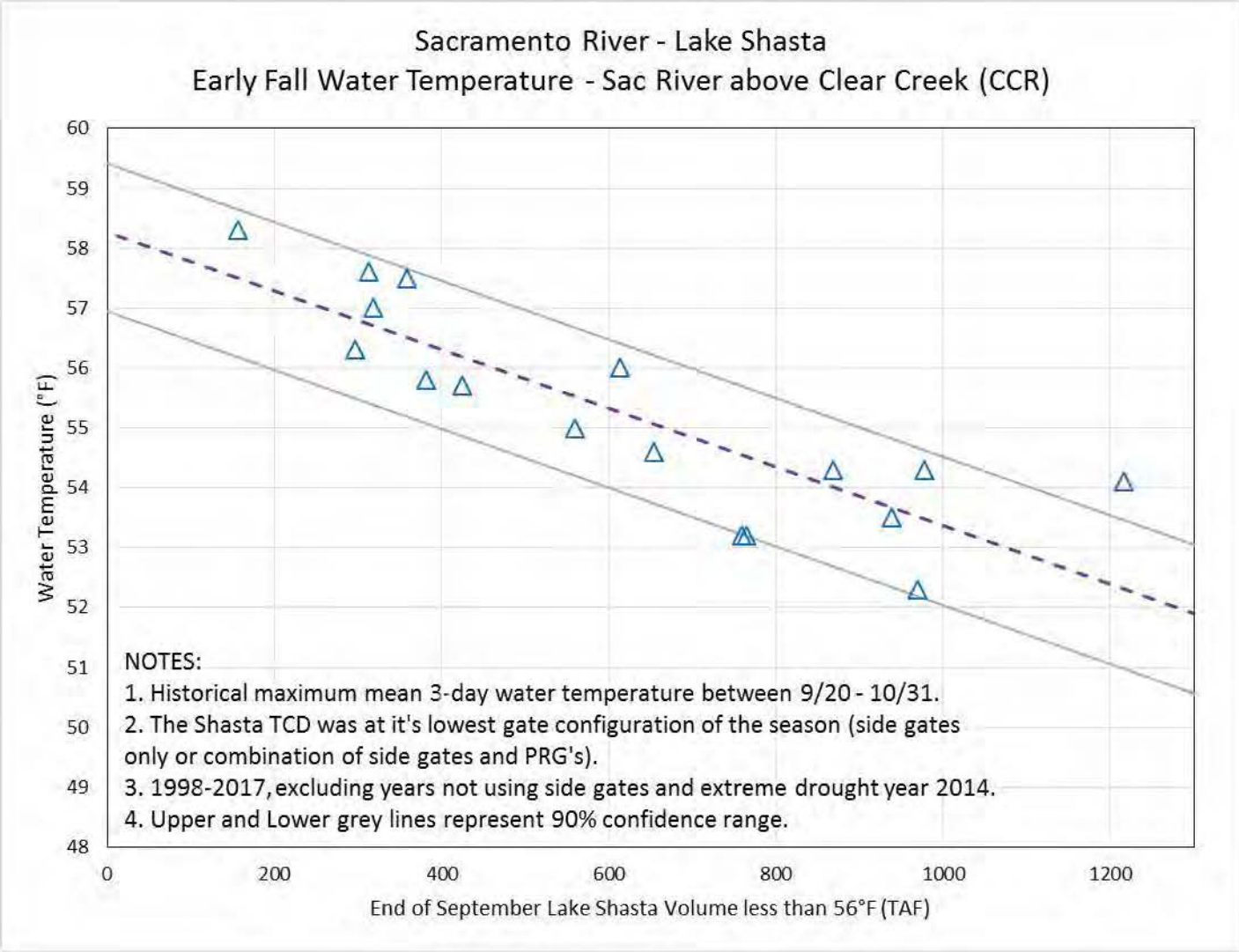


Figure 6. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

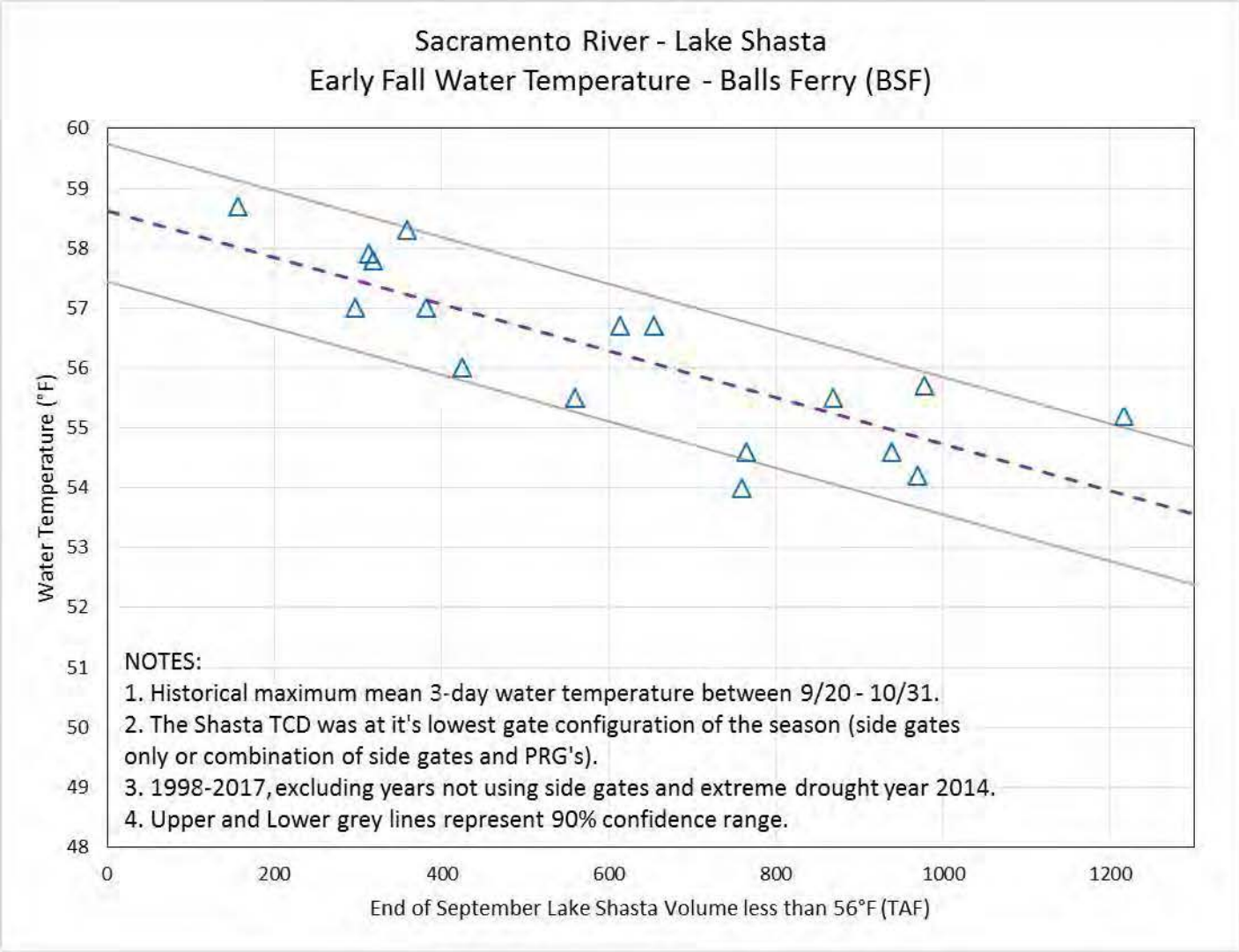
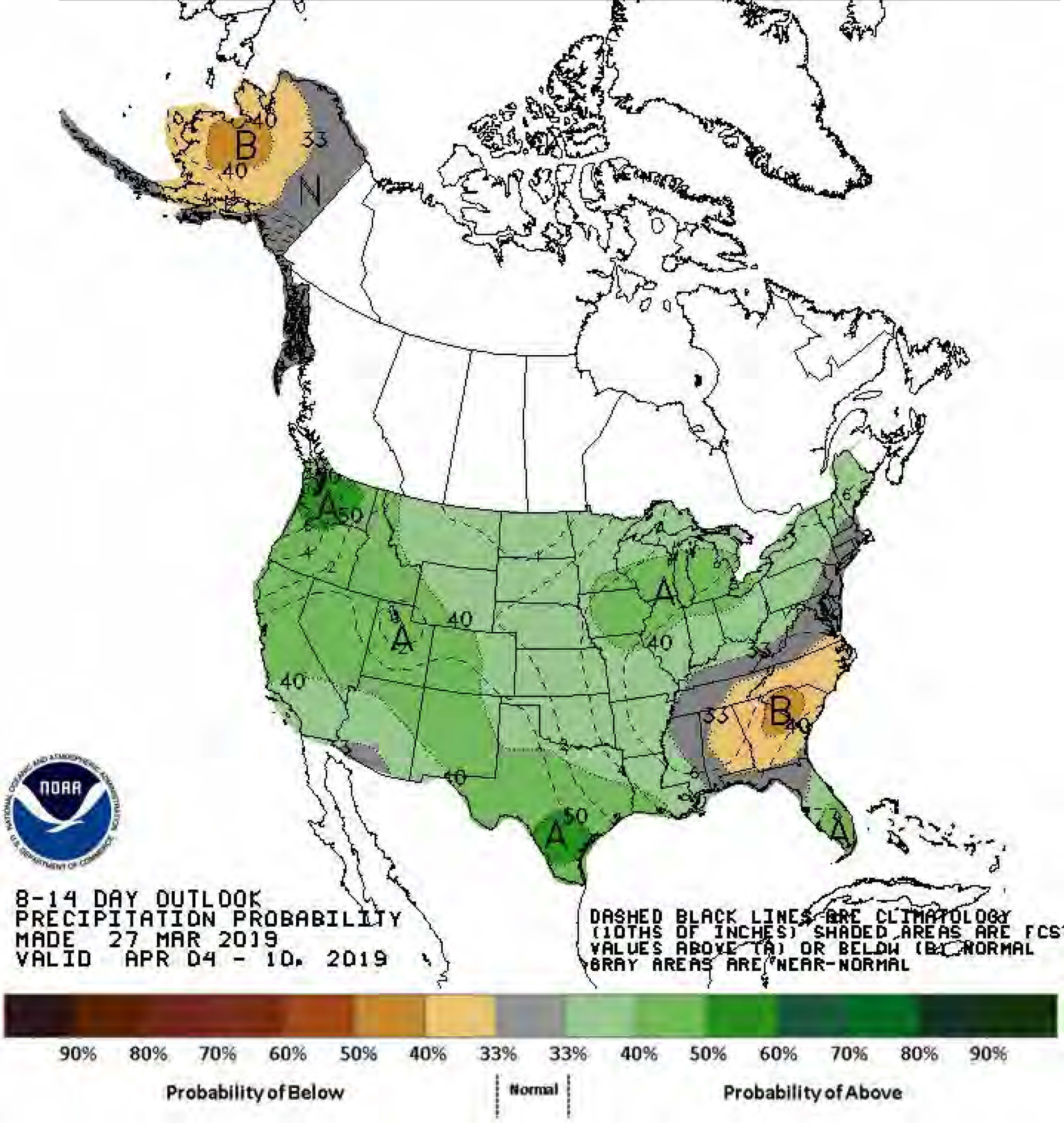
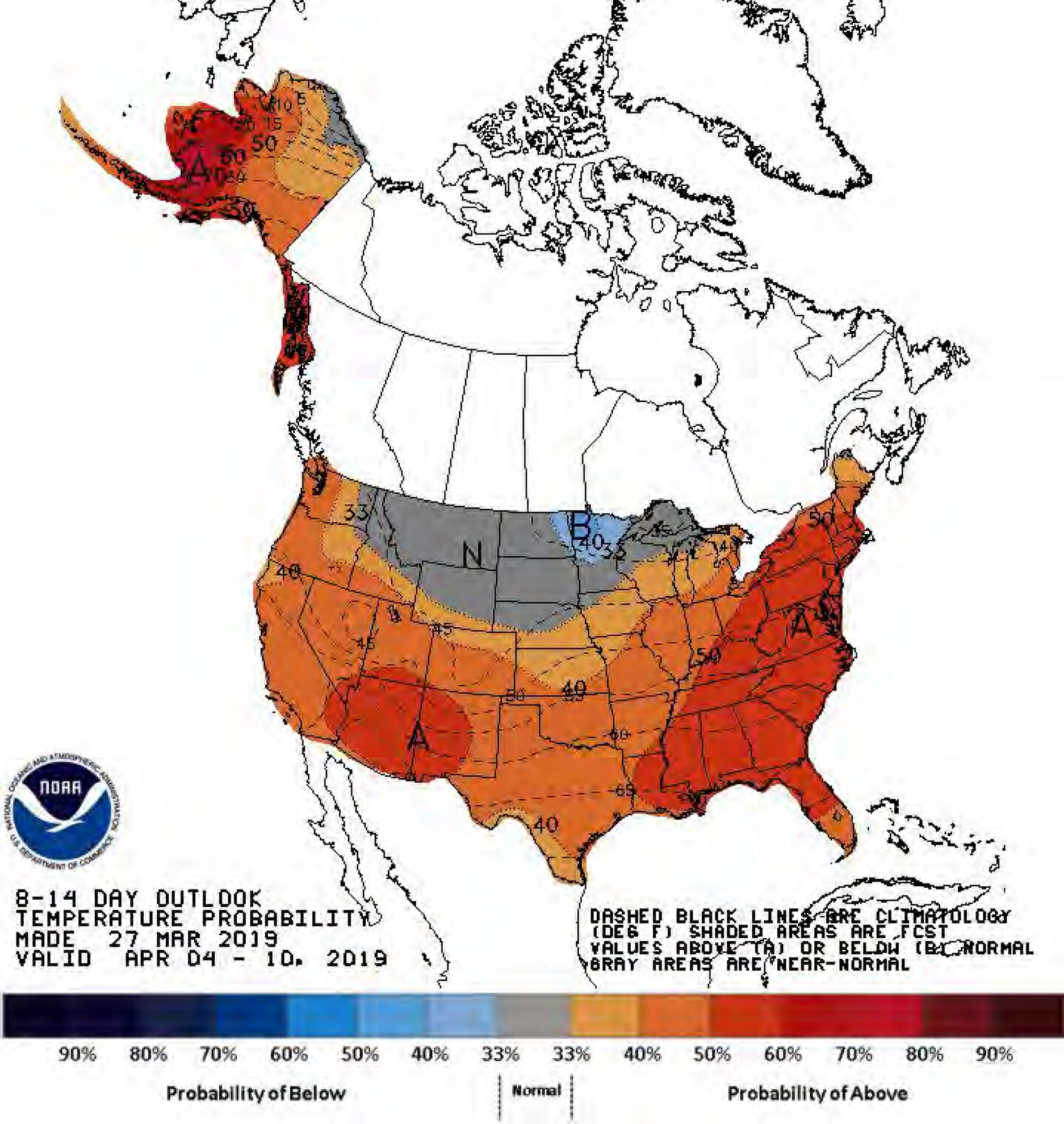


Figure 7. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.


B
40
33
N
A
50
A
40
A
40
40
A
40
B
33
40
A
50
A
8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 27 MAR 2019
VALID APR 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
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 27 MAR 2019
VALID APR 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

Precipitation Forecast

Today through Friday

.10 .25 .50 1 1.50 2 3 4 6 8 10 15 20 30

Eureka
0.50-1.00"

Weaverville
0.50-1.00"

Redding
1.00-2.00"

Susanville
0.25-0.50"

Chico
0.50-1.00"

Grass Valley
1.00-2.00"

Ukiah
0.50-1.00"

South Lake Tahoe
0.50-1.00"

Santa Rosa
0.50-1.00"

Sacramento
0.25-0.50"

Stockton
0.25-0.50"

Sonora
1.00-2.00"

San Francisco
0.25-0.50"

Modesto
0.25-0.50"

Yosemite
2.00-3.00"

Issued: March 27, 2019