RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Sacramento River Temperature Task Group Meeting

May 23, 2019 | 1:00 pm – 3:00 pm

Location: California State Water Resources Control Board Offices

1001 I Street, Sacramento, CA 95814 - Room 1510 15th Floor

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
    - 50% Runoff Exceedance: 25% and 50% L3MTO Meteorology
    - Cold Water Pool Tracking
- Updates
- Next Meeting: June 27, 2019 – Shasta Dam Tour and Meeting at Northern California Area Office: Shasta Office

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

DAILY CVP WATER SUPPLY REPORT

MAY 21, 2019

RUN DATE: May 22, 2019

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2018	WY 2019	15 YR MEDIAN
TRINITY	LEWISTON	1,602	3,622	3,622
SACRAMENTO	KESWICK	9,472	7,974	9,472
FEATHER	OROVILLE (SWP)	2,050	9,000	2,050
AMERICAN	NIMBUS	1,771	9,482	3,001
STANISLAUS	GOODWIN	3,009	2,007	1,116
SAN JOAQUIN	FRIANT	385	2,512	451

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	1,861	1,906	2,367	127
SHASTA	4,552	3,821	4,041	4,406	115
FOLSOM	977	810	950	927	114
NEW MELONES	2,420	1,540	1,996	2,005	130
FED. SAN LUIS	966	645	733	750	116
TOTAL NORTH CVP	11,363	8,677	9,626	10,455	120
MILLERTON	520	362	456	449	124
OROVILLE (SWP)	3,538	2,736	2,447	3,397	124

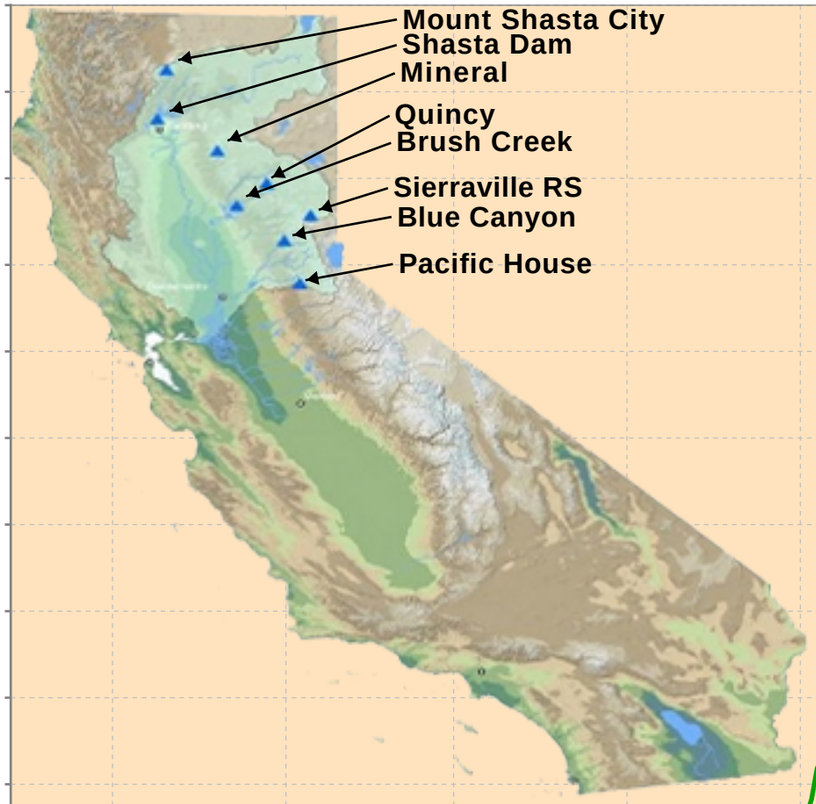
ACCUMULATED INFLOW FOR WATER YEAR TO DATE IN THOUSANDS OF ACRE-FEET

RESERVOIR	CURRENT WY 2019	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	1,317	148	1,729	982	134
SHASTA	5,889	1,742	8,865	4,296	137
FOLSOM	2,912	257	4,693	2,160	135
NEW MELONES	1,056	----	1,497	753	140
MILLERTON	1,318	125	2,195	920	143

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	36.40	12.30	54.59	30.27 (57)	120	0.03
SACRAMENTO AT SHASTA DAM	87.42	15.35	112.07	59.37 (62)	147	0.71
AMERICAN AT BLUE CANYON	86.54	15.64	103.28	64.61 (44)	134	1.26
STANISLAUS AT NEW MELONES	40.84	----	45.33	26.71 (41)	153	0.08
SAN JOAQUIN AT HUNTINGTON LK	55.45	15.70	80.80	40.24 (44)	138	0.00

Northern Sierra Precipitation: 8-Station Index, May 22, 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

66.4

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, May 22, 2019, Percent of April 1 Average

Statewide Percent of April 1: 73%

Statewide Percent of Average for Date: 159%

Upper Sacramento River Summary Conditions – May (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 storage: 97% capacity as of midnight 5/22/19
- Shasta Lake is in a spring refill condition under the USACE flood control diagram
- Current release from Keswick Dam: 8,000 cfs

Temperature Management:

- Temperature management: Active management in May
- Selective withdrawal: Releases - all Upper TCD gates and one Middle TCD gate are open
- 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 May 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)

		May	Jun	Jul	Aug	Sep	Oct	Nov
Shasta	4223	4296	3950	3468	2962	2624	2482	2451
Elev.		1058	1046	1027	1006	990	983	982

Monthly River Releases (cfs)

	May	Jun	Jul	Aug	Sep	Oct	Nov
Sacramento	8500	10500	12000	12000	9500	7250	5000
Clear Creek	216	288	150	150	150	200	200

Trinity Diversions (TAF)

	May	Jun	Jul	Aug	Sep	Oct	Nov
Carr Power Plant	24	45	100	61	55	68	26
Spring Creek PP	10	30	90	50	45	90	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)

		May	Jun	Jul	Aug	Sep	Oct	Nov
Shasta	4223	4376	4164	3786	3245	2938	2831	2790
Elev.		1061	1054	1040	1018	1005	1000	998

Monthly River Releases (cfs)

	May	Jun	Jul	Aug	Sep	Oct	Nov
Sacramento	8500	10000	11500	13000	9500	7000	6000
Clear Creek	216	288	150	150	150	200	200

Trinity Diversions (TAF)

	May	Jun	Jul	Aug	Sep	Oct	Nov
Carr Power Plant	16	41	99	55	54	68	25
Spring Creek PP	10	30	90	45	45	90	20

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
70% Ag 95% MI

Storages

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

		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Trinity	**2240**	**2342**	**2325**	**2177**	**2074**	**1968**	**1885**	**1861**	**1871**	**1903**	**1988**	**2065**	**2071**
	Elev.	2363	2362	2353	2346	2339	2333	2331	2332	2334	2340	2345	2346
Whiskeytown	**231**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**
	Elev.	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209
Shasta	**4223**	**4296**	**3950**	**3468**	**2962**	**2624**	**2482**	**2451**	**2505**	**2656**	**2961**	**3390**	**3534**
	Elev.	1058	1046	1027	1006	990	983	982	984	992	1006	1024	1030
Folsom	**887**	**904**	**926**	**814**	**666**	**544**	**426**	**346**	**285**	**286**	**348**	**496**	**635**
	Elev.	459	461	451	436	422	407	395	384	385	395	416	432
New Melones	**1921**	**1960**	**1991**	**1927**	**1855**	**1810**	**1761**	**1766**	**1774**	**1778**	**1785**	**1719**	**1702**
	Elev.	1049	1051	1046	1039	1035	1030	1030	1031	1032	1032	1026	1024
San Luis	**882**	**641**	**494**	**246**	**102**	**105**	**12**	**118**	**327**	**478**	**567**	**689**	**548**
	Elev.	481	454	435	427	442	428	443	476	498	508	525	496
Total		10380	9924	8871	7896	7289	6771	6748	6967	7306	7853	8564	8728

Monthly River Releases (TAF/cfs)

Trinity	TAF	197	133	66	53	52	23	18	18	18	17	18	136
	cfs	**3,204**	**2,235**	**1,073**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**2,286**
Clear Creek	TAF	13	17	9	9	9	12	12	12	12	11	12	13
	cfs	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**200**	**200**	**200**	**218**
Sacramento	TAF	523	625	738	738	565	446	297	277	246	222	246	357
	cfs	**8500**	**10500**	**12000**	**12000**	**9500**	**7250**	**5000**	**4500**	**4000**	**4000**	**4000**	**6000**
American	TAF	523	238	221	248	214	154	119	123	111	100	92	144
	cfs	**8500**	**4000**	**3600**	**4031**	**3603**	**2502**	**2005**	**2000**	**1800**	**1800**	**1500**	**2417**
Stanislaus	TAF	123	65	26	25	24	52	18	18	22	20	101	42
	cfs	**2001**	**1100**	**429**	**400**	**400**	**842**	**300**	**300**	**358**	**364**	**1648**	**700**

Trinity Diversions (TAF)

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Carr PP	24	45	100	61	55	68	26	12	3	2	35	32
Spring Crk. PP	**10**	**30**	**90**	**50**	**45**	**90**	**20**	**12**	**10**	**20**	**50**	**10**

Delta Summary (TAF)

		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Tracy		87	255	268	268	242	63	187	270	220	200	258	54
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7
Total USBR		99	265	279	281	256	80	205	288	234	214	271	66
COA Balance		0	0	0	0	0	0	0	0	0	0	0	-2
Vernalis	TAF	457	158	117	117	113	99	66	81	85	90	181	101
Vernalis	cfs	7437	2663	1909	1897	1896	1606	1107	1325	1383	1625	2950	1700
Old/Middle River Std.													
Old/Middle R. calc.		945	-5,408	-8,387	-8,313	-8,176	-2,933	-5,546	-6,611	-4,903	-5,045	-5,033	-1,144
Computed DOI		36422	12943	8394	10004	13011	12282	5850	6946	11891	11545	13941	9497
Excess Outflow		8361	2975	390	0	0	0	0	2440	5889	144	2538	0
% Export/Inflow		5%	32%	47%	44%	41%	21%	50%	54%	36%	37%	34%	12%
% Export/Inflow std.		35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1611		6,865		3,733		1496	
Year to Date + Forecasted % of mean	133%		124%		137%		142%	

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5/22/2019

Estimated CVP Operations 50% Exceedance
70% Ag 95% MI

Storages

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

		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Trinity	**2240**	**2380**	**2387**	**2260**	**2157**	**2052**	**1970**	**1957**	**1984**	**2048**	**2158**	**2242**	**2386**
	Elev.	2366	2366	2358	2352	2344	2339	2338	2340	2344	2352	2357	2366
Whiskeytown	**231**	**238**	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**
	Elev.	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209
Shasta	**4223**	**4376**	**4164**	**3786**	**3245**	**2938**	**2831**	**2790**	**2876**	**3175**	**3493**	**3907**	**4229**
	Elev.	1061	1054	1040	1018	1005	1000	998	1002	1015	1028	1044	1056
Folsom	**887**	**913**	**907**	**833**	**726**	**625**	**577**	**547**	**536**	**580**	**675**	**831**	**985**
	Elev.	460	460	453	442	431	426	422	421	426	437	452	467
New Melones	**1921**	**1992**	**2070**	**2047**	**1990**	**1954**	**1910**	**1920**	**1938**	**1962**	**2008**	**1985**	**1976**
	Elev.	1052	1058	1056	1051	1048	1044	1045	1047	1049	1053	1051	1050
San Luis	**882**	**652**	**454**	**205**	**59**	**62**	**55**	**229**	**428**	**593**	**712**	**836**	**694**
	Elev.	484	456	441	423	439	428	454	487	511	523	537	510
Total		10550	10219	9369	8416	7868	7548	7650	7968	8563	9251	10006	10508

Monthly River Releases (TAF/cfs)

Trinity	TAF	197	133	66	53	52	23	18	18	18	17	18	28
	cfs	**3,204**	**2,235**	**1,073**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**477**
Clear Creek	TAF	13	17	9	9	9	12	12	12	15	11	12	13
	cfs	**216**	**288**	**150**	**150**	**150**	**200**	**200**	**200**	**240**	**200**	**200**	**218**
Sacramento	TAF	523	595	707	799	565	430	357	307	307	444	461	297
	cfs	**8500**	**10000**	**11500**	**13000**	**9500**	**7000**	**6000**	**5000**	**5000**	**8000**	**7500**	**5000**
American	TAF	523	357	215	215	207	123	119	123	108	167	154	268
	cfs	**8500**	**6000**	**3500**	**3500**	**3478**	**2000**	**2000**	**2000**	**1750**	**3000**	**2500**	**4500**
Stanislaus	TAF	123	65	26	25	24	52	18	18	22	20	93	83
	cfs	**2001**	**1100**	**429**	**400**	**400**	**842**	**300**	**300**	**358**	**364**	**1521**	**1400**

Trinity Diversions (TAF)

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Carr PP	16	41	99	55	54	68	25	12	0	2	45	31
Spring Crk. PP	**10**	**30**	**90**	**45**	**45**	**90**	**20**	**15**	**20**	**35**	**70**	**10**

Delta Summary (TAF)

		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Tracy		100	258	268	268	243	149	255	260	235	230	260	54
USBR Banks		0	0	0	0	0	0	0	0	0	0	0	0
Contra Costa		12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7
Total USBR		113	268	279	281	257	166	273	278	249	244	273	66
COA Balance		0	0	0	0	0	0	0	0	0	0	0	0
Vernalis	TAF	670	258	117	117	113	125	105	109	127	150	223	161
Vernalis	cfs	10898	4344	1909	1897	1896	2029	1762	1780	2066	2706	3636	2701
Old/Middle River Std.													
Old/Middle R. calc.	cfs	2,049	-5,337	-8,738	-7,298	-8,241	-3,194	-6,649	-6,532	-4,971	-4,975	-4,374	-694
Computed DOI		42783	19264	8443	12884	13280	12379	7110	10183	16674	25358	25556	16961
Excess Outflow		14722	6673	439	1090	0	16	17	5677	10671	13958	14153	7463
% Export/Inflow		6%	28%	47%	36%	40%	23%	52%	45%	29%	22%	21%	8%
% Export/Inflow std.		35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	1675		7,188		3,887		1617	
Year to Date + Forecasted % of mean	139%		130%		143%		153%	

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Northern CVP Water Temperature Report

May - 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
Apr	50.8	-	49.0	50.3	50.8	50.9	52.7	53.8	54.2	54.7	52.9	49.4	-	14123	783	20556	64.0	62.2	63.5	-
05/01	52.3	# -	50.0	52.6	53.5	54.2	**56.3**	57.6	58.2	59.0	53.6	46.6	-	4986	282	5450	60.5	59.0	61.5	-
05/02	52.1	# -	50.5	52.9	53.6	54.1	**56.0**	57.5	58.1	58.9	53.4	46.7	-	4636	94	5438	63.5	61.5	62.8	-
05/03	51.9	# -	50.3	53.0	53.8	54.4	**56.6**	58.2	58.7	59.4	53.5	47.2	-	5902	84	6233	65.5	62.8	64.6	-
05/04	51.9	# -	50.3	52.7	53.3	53.9	**56.1**	57.9	58.6	59.4	53.5	47.2	-	6917	97	7847	68.0	64.6	65.8	-
05/05	52.4	# -	50.4	52.4	53.1	53.7	**55.9**	57.7	58.3	59.1	53.7	47.5	-	8218	106	7997	67.5	64.5	64.5	-
05/06	52.1	# -	49.9	52.7	53.3	53.8	**56.0**	57.8	58.3	59.1	53.9	47.8	-	7706	253	8014	64.0	62.4	62.1	-
05/07	52.0	# -	50.2	52.6	53.3	53.9	**56.2**	58.1	58.7	59.4	54.1	48.0	-	7271	171	7999	67.0	63.9	63.1	-
05/08	51.7	# -	50.5	52.8	? 53.5	54.2	**56.3**	58.3	? 59.0	59.7	54.2	48.3	-	7323	95	8037	73.0	70.0	70.4	-
05/09	51.2	# -	50.4	52.4	53.2	53.9	**56.4**	58.6	59.5	60.2	54.4	48.3	-	7767	104	8028	74.5	71.7	73.1	-
05/10	51.1	# -	50.5	51.8	52.7	53.3	**55.8**	58.0	58.8	59.7	54.4	48.3	-	7798	103	7983	75.0	71.0	72.1	-
05/11	51.0	# -	50.6	51.4	52.3	53.0	**55.5**	57.7	58.6	59.3	54.5	48.3	-	8192	95	8044	72.0	69.6	70.3	-
05/12	51.0	# -	50.3	51.5	52.4	53.1	**55.4**	57.7	58.5	59.3	54.3	48.2	-	7385	147	7999	72.5	69.3	70.1	-
05/13	51.0	# -	50.2	51.4	52.1	52.7	**55.2**	57.6	58.6	59.4	53.7	48.3	-	7122	362	7997	71.5	67.3	68.0	-
05/14	50.9	# -	50.4	51.6	52.2	52.6	**54.4**	56.4	57.4	58.0	53.7	48.2	-	6302	1182	7718	66.0	63.5	65.7	-
05/15	51.3	# -	50.2	51.0	51.6	51.8	**53.5**	55.4	56.3	56.6	53.6	47.7	-	7105	436	8054	61.0	60.0	59.5	-
05/16	51.8	# -	50.2	50.9	51.3	51.6	**52.9**	54.2	? 54.9	55.1	53.8	47.2	-	6292	1114	8219	58.0	55.9	56.6	-
05/17	52.6	# -	50.5	51.3	51.7	52.0	**53.1**	54.3	# -	54.7	53.6	47.2	-	5380	2723	7968	59.0	56.9	57.6	-
05/18	52.0	# -	50.5	51.5	51.6	51.7	**52.6**	53.8	# -	54.5	53.5	47.2	-	5529	1766	7981	53.0	51.5	51.8	-
05/19	52.5	# -	50.7	52.0	52.7	53.0	**53.9**	54.4	# -	53.9	53.6	46.2	-	5979	1178	7972	55.5	53.5	53.4	-
05/20	52.1	# -	50.8	52.2	52.6	52.9	**54.7**	55.9	# -	56.5	? 53.4	46.3	-	5387	1372	7976	60.0	57.8	57.4	-
05/21	51.7	# -	51.0	52.5	53.0	53.2	**54.2**	55.4	# -	56.3	53.5	46.8	-	7326	270	7974	56.0	56.5	56.4	-
05/22																				
05/23																				
05/24																				
05/25																				
05/26																				
05/27																				
05/28																				
05/29																				
05/30																				
05/31																				
May	51.7	-	50.4	52.1	52.7	53.2	55.1	56.8	58.2	58.0	53.8	47.5	-	6692	573	7663	64.9	62.5	63.2	-
												Total CFS		140523	12034	160928				
												Total AF		278722	23869	319194				

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] IGO thermistor reported as insulated by sand as evident by hourly data starting 05/01.
Low confidence in daily averages. Data may be removed if deemed grossly unrepresentative.

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	↓	↑	Avg
05/01	49	74	61.5	43	78	60.5	50	81	65.5	53	85	69.0	55	86	70.5	56	79	67.5	55	81	68.0	56	86	71.0	59	87	73.0	58	90	74.0	57	85	71.0	57	84	70.5
05/02	43	78	60.5	45	81	63.0	53	83	68.0	54	84	69.0	56	82	69.0	55	80	67.5	54	87	70.5	59	89	74.0	60	88	74.0	57	90	73.5	58	89	73.5	59	89	74.0
05/03	45	82	63.5	48	83	65.5	51	85	68.0	54	84	69.0	54	80	67.0	56	87	71.5	58	89	73.5	60	90	75.0	60	87	73.5	59	89	74.0	57	88	72.5	59	86	72.5
05/04	47	84	65.5	50	86	68.0	55	85	70.0	54	81	67.5	56	87	71.5	58	90	74.0	61	91	76.0	59	91	75.0	58	86	72.0	56	83	69.5	58	82	70.0	58	85	71.5
05/05	50	86	68.0	51	83	67.0	55	79	67.0	56	84	70.0	57	89	73.0	60	90	75.0	59	93	76.0	59	91	75.0	61	90	75.5	59	89	74.0	57	83	70.0	54	84	69.0
05/06	50	85	67.5	51	81	66.0	55	85	70.0	57	91	74.0	60	91	75.5	59	93	76.0	58	93	75.5	60	91	75.5	61	87	74.0	57	85	71.0	55	80	67.5	54	83	68.5
05/07	50	78	64.0	53	85	69.0	56	91	73.5	62	90	76.0	59	92	75.5	58	93	75.5	58	91	74.5	59	89	74.0	59	90	74.5	58	90	74.0	59	89	74.0	57	85	71.0
05/08	52	82	67.0	56	90	73.0	62	90	76.0	60	91	75.5	57	91	74.0	59	90	74.5	59	88	73.5	58	84	71.0	54	75	64.5	53	72	62.5	53	76	64.5	55	81	68.0
05/09	53	93	73.0	57	90	73.5	59	91	75.0	56	90	73.0	59	89	74.0	59	88	73.5	57	83	70.0	55	80	67.5	50	75	62.5	50	73	61.5	51	81	66.0	54	80	67.0
05/10	57	92	74.5	57	92	74.5	57	91	74.0	59	90	74.5	58	88	73.0	57	85	71.0	56	80	68.0	55	76	65.5	54	82	68.0	54	83	68.5	54	85	69.5	56	84	70.0
05/11	57	93	75.0	55	91	73.0	58	90	74.0	58	88	73.0	57	85	71.0	56	78	67.0	54	73	63.5	52	77	64.5	53	82	67.5	53	81	67.0	54	79	66.5	54	83	68.5
05/12	55	89	72.0	57	88	72.5	57	87	72.0	56	79	67.5	56	72	64.0	53	69	61.0	50	73	61.5	50	75	62.5	52	72	62.0	51	76	63.5	53	77	65.0	53	83	68.0
05/13	57	88	72.5	62	84	73.0	56	76	66.0	55	69	62.0	52	67	59.5	50	70	60.0	48	70	59.0	48	72	60.0	48	74	61.0	52	72	62.0	53	76	64.5	54	81	67.5
05/14	61	82	71.5	61	76	68.5	55	67	61.0	52	63	57.5	47	68	57.5	49	64	56.5	47	67	57.0	46	68	57.0	50	79	64.5	59	80	69.5	55	83	69.0	60	89	74.5
05/15	57	75	66.0	61	65	63.0	51	63	57.0	48	70	59.0	50	62	56.0	48	67	57.5	44	69	56.5	47	73	60.0	49	78	63.5	57	83	70.0	58	86	72.0	61	90	75.5
05/16	57	65	61.0	53	59	56.0	47	67	57.0	50	60	55.0	48	66	57.0	46	70	58.0	48	71	59.5	46	73	59.5	49	75	62.0	53	80	66.5	55	82	68.5	56	86	71.0
05/17	52	64	58.0	51	67	59.0	50	59	54.5	46	60	53.0	44	63	53.5	48	69	58.5	47	77	62.0	51	78	64.5	61	91	76.0	59	85	72.0	57	87	72.0	59	90	74.5
05/18	51	67	59.0	50	59	54.5	46	63	54.5	44	68	56.0	46	67	56.5	47	75	61.0	52	79	65.5	53	82	67.5	59	89	74.0	59	90	74.5	60	91	75.5	62	91	76.5
05/19	49	57	53.0	48	63	55.5	44	69	56.5	47	65	56.0	45	75	60.0	50	77	63.5	52	79	65.5	54	78	66.0	57	83	70.0	57	85	71.0	59	87	73.0	61	89	75.0
05/20	48	63	55.5	51	68	59.5	48	63	55.5	46	76	61.0	52	78	65.0	53	78	65.5	54	76	65.0	54	79	66.5	57	83	70.0	59	83	71.0	57	81	69.0	58	85	71.5
05/21	51	69	60.0	51	63	57.0	46	77	61.5	53	80	66.5	53	80	66.5	54	74	64.0	52	74	63.0	54	77	65.5	58	88	73.0	61	89	75.0	61	88	74.5	62	90	76.0
05/22	51	61	56.0	47	78	62.5	55	83	69.0	55	78	66.5	55	72	63.5	52	73	62.5	54	76	65.0	55	83	69.0	61	91	76.0	61	91	76.0	61	93	77.0	63	93	78.0
05/23																																						
05/24																																						
05/25																																						
05/26																																						
05/27																																						
05/28																																						
05/29																																						
05/30																																						
05/31																																						

Web Links

10-Day Min/Max Forecast

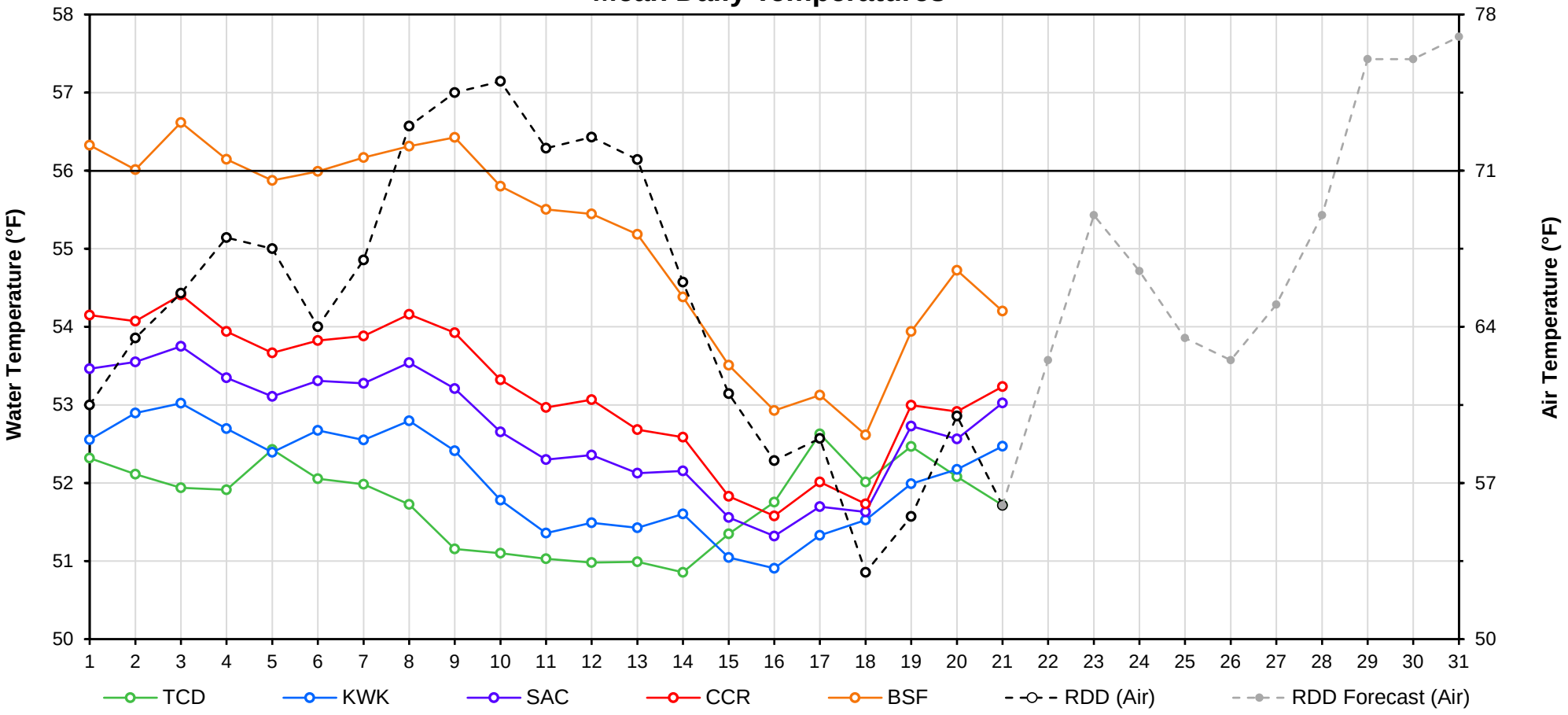
Previous Days Min/Max Actuals

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

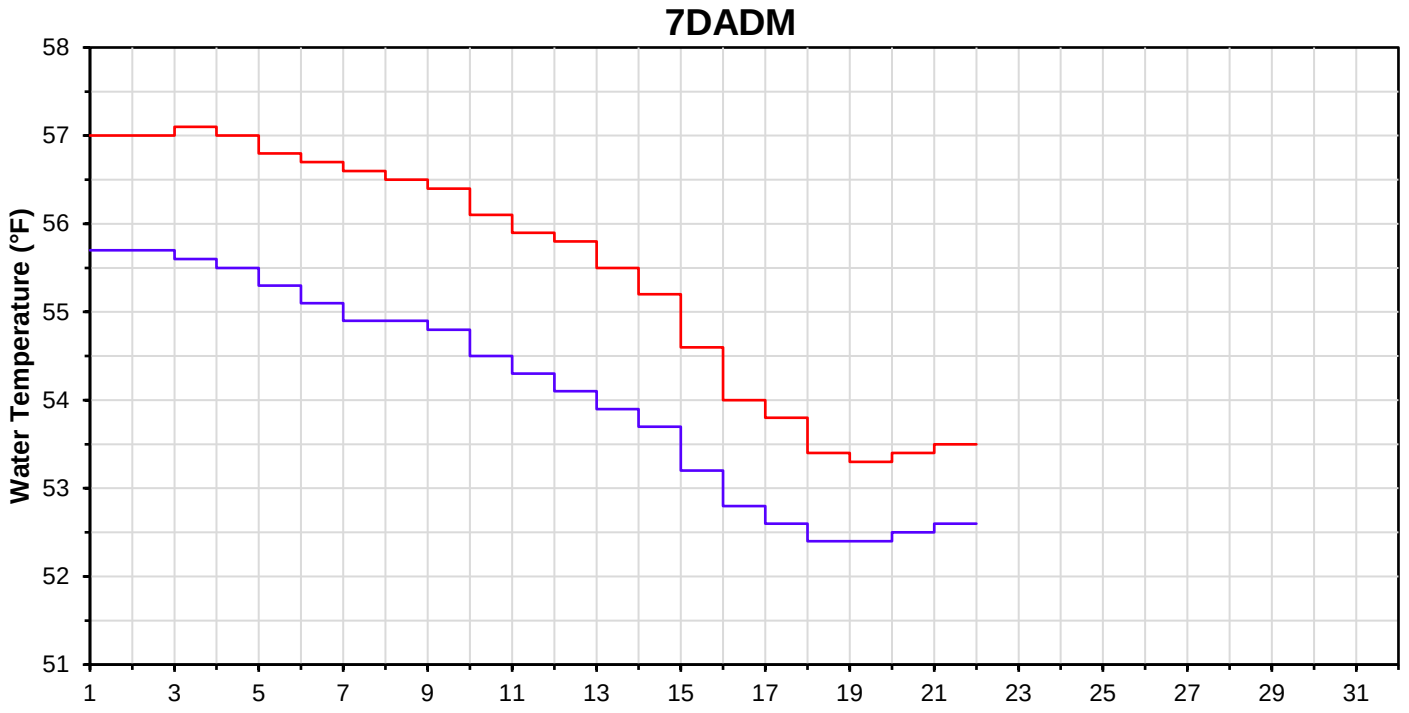
[1] Distances are approximate
[2] DGC is only reported in September
[3] NFH is only reported in October, November and December

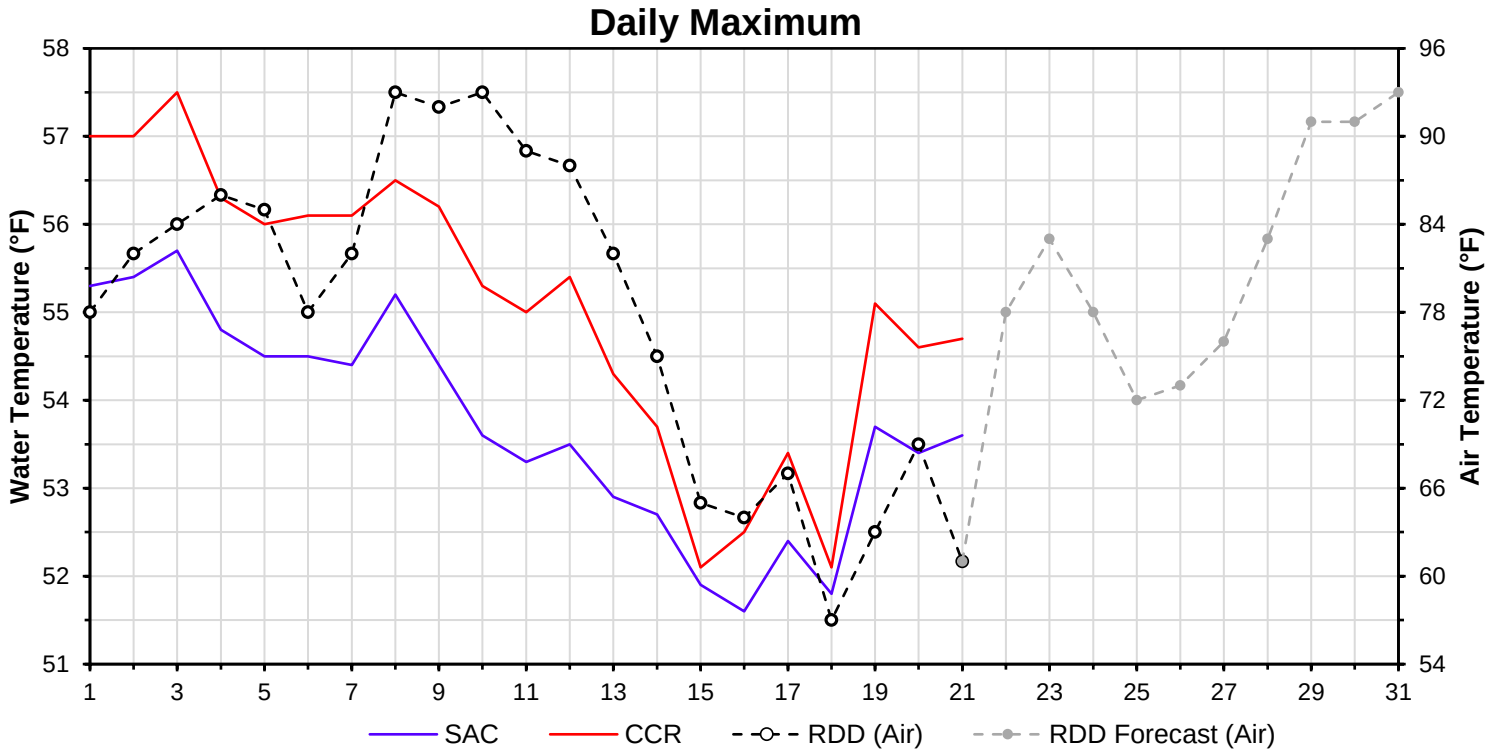
DATE	Daily Max		7DADM[1]		DAT[2]
	SAC	CCR	SAC	CCR	BSF
05/01	55.3	57.0	55.7	57.0	56.3
05/02	55.4	57.0	55.7	57.0	56.0
05/03	55.7	57.5	55.6	57.1	56.6
05/04	54.8	56.3	55.5	57.0	56.1
05/05	54.5	56.0	55.3	56.8	55.9
05/06	54.5	56.1	55.1	56.7	56.0
05/07	54.4	56.1	54.9	56.6	56.2
05/08	55.2	56.5	54.9	56.5	56.3
05/09	54.4	56.2	54.8	56.4	56.4
05/10	53.6	55.3	54.5	56.1	55.8
05/11	53.3	55.0	54.3	55.9	55.5
05/12	53.5	55.4	54.1	55.8	55.4
05/13	52.9	54.3	53.9	55.5	55.2
05/14	52.7	53.7	53.7	55.2	54.4
05/15	51.9	52.1	53.2	54.6	53.5
05/16	51.6	52.5	52.8	54.0	52.9
05/17	52.4	53.4	52.6	53.8	53.1
05/18	51.8	52.1	52.4	53.4	52.6
05/19	53.7	55.1	52.4	53.3	53.9
05/20	53.4	54.6	52.5	53.4	54.7
05/21	53.6	54.7	52.6	53.5	54.2
05/22					
05/23					
05/24					
05/25					
05/26					
05/27					
05/28					
05/29					
05/30					
05/31					

Notes

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

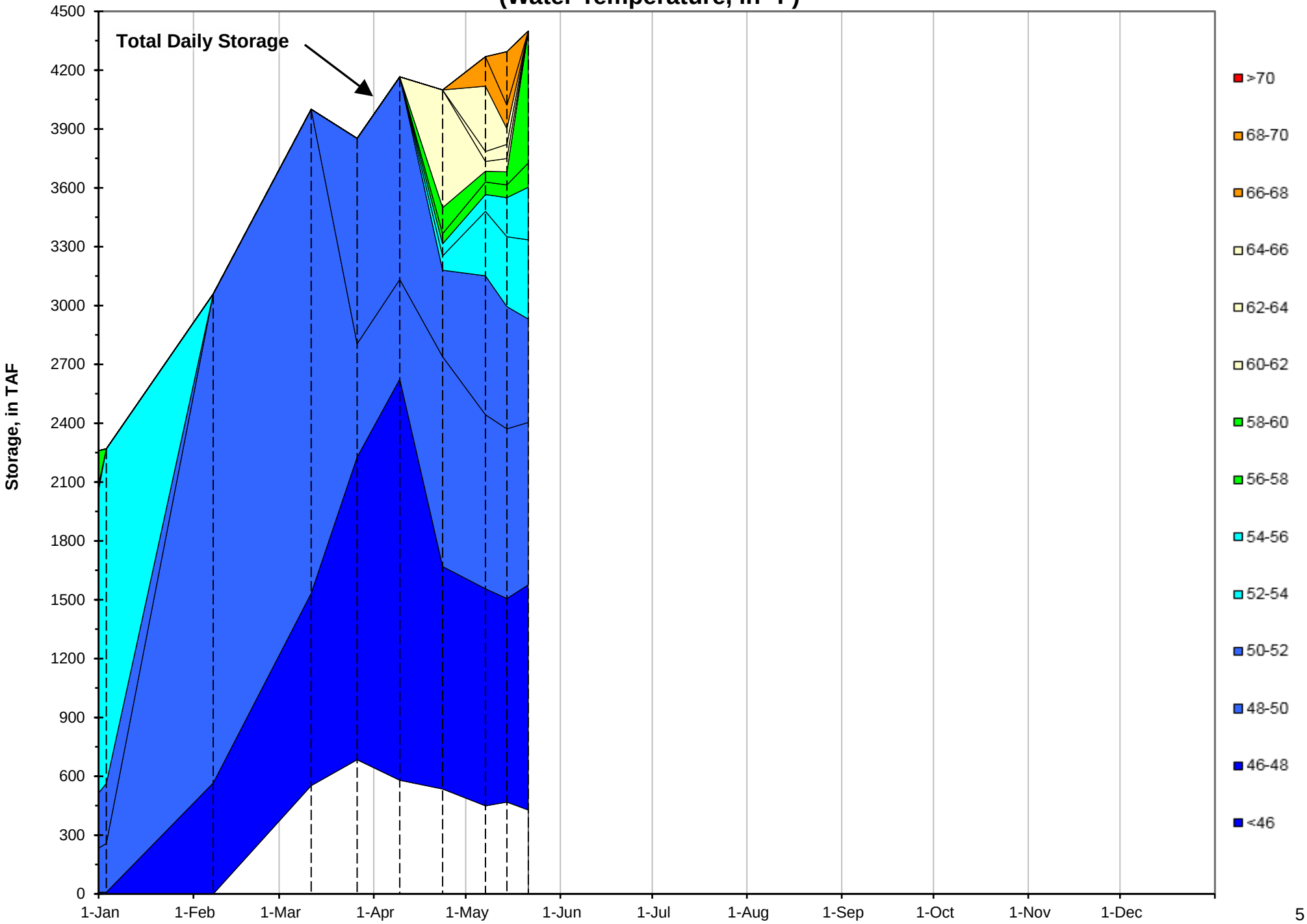
[2] DAT = Daily Average Temperature





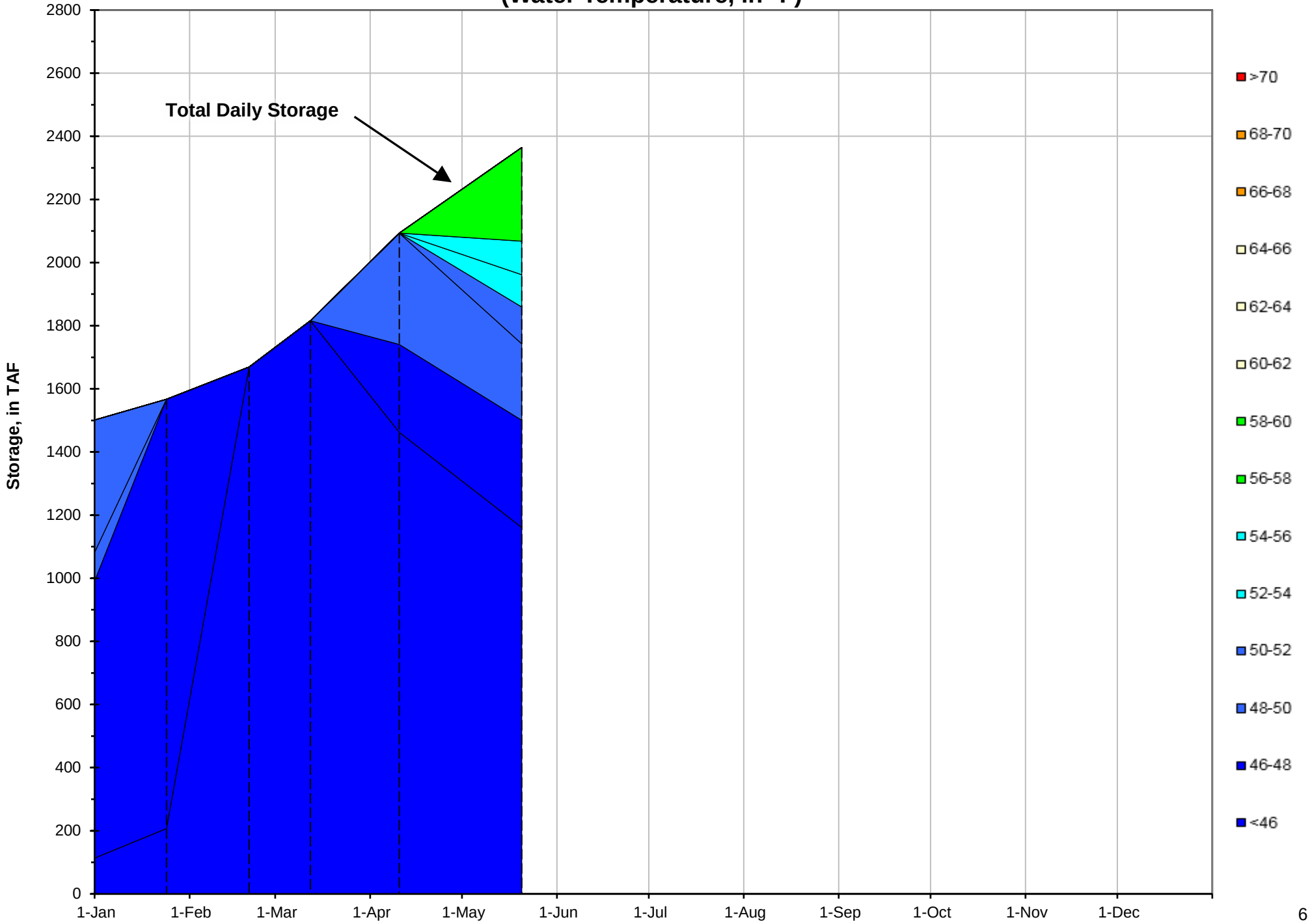
Latest Profile Date: 05/21/2019

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



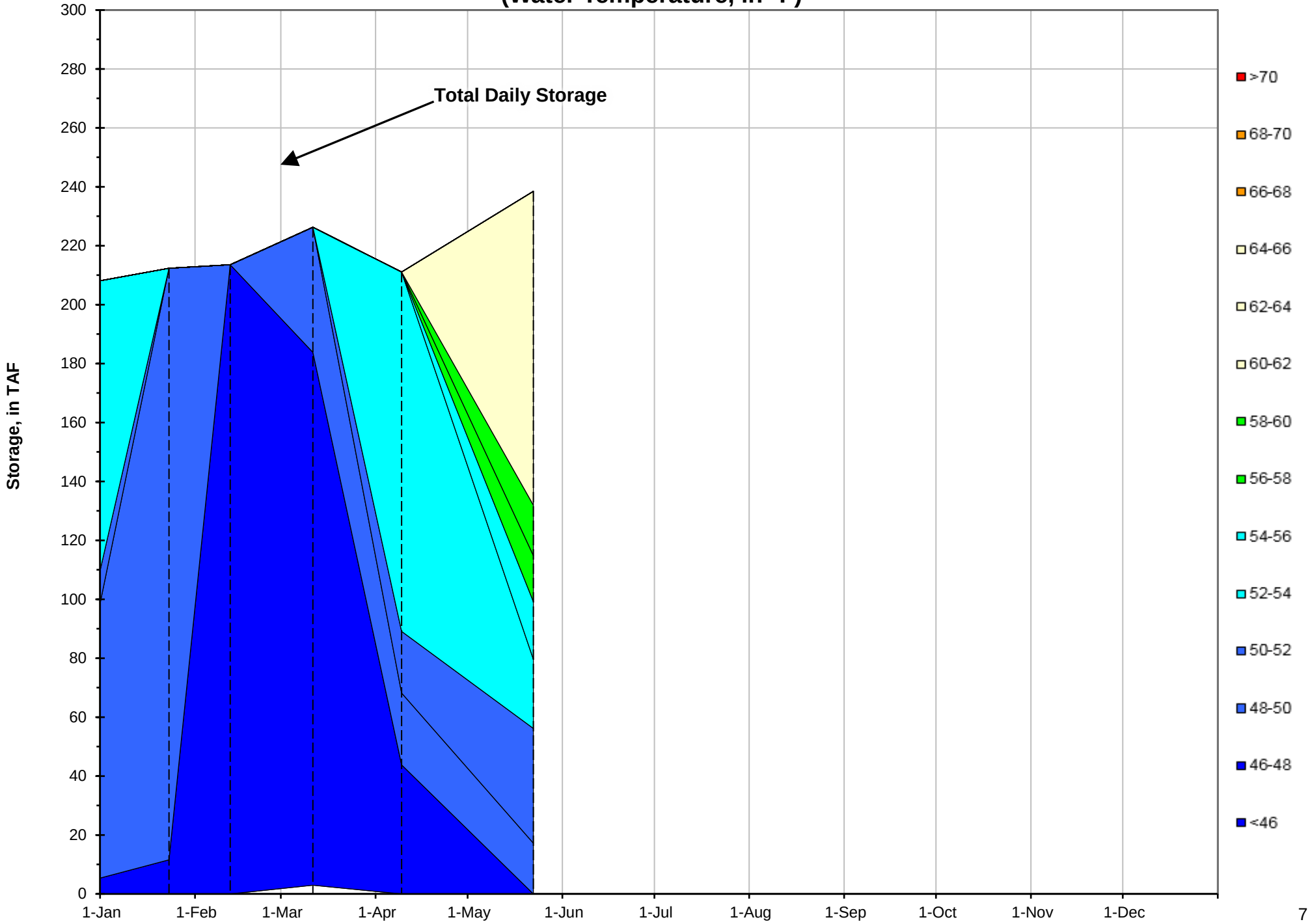
Latest Profile Date: 05/20/2019

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



Latest Profile Date: 05/22/2019

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

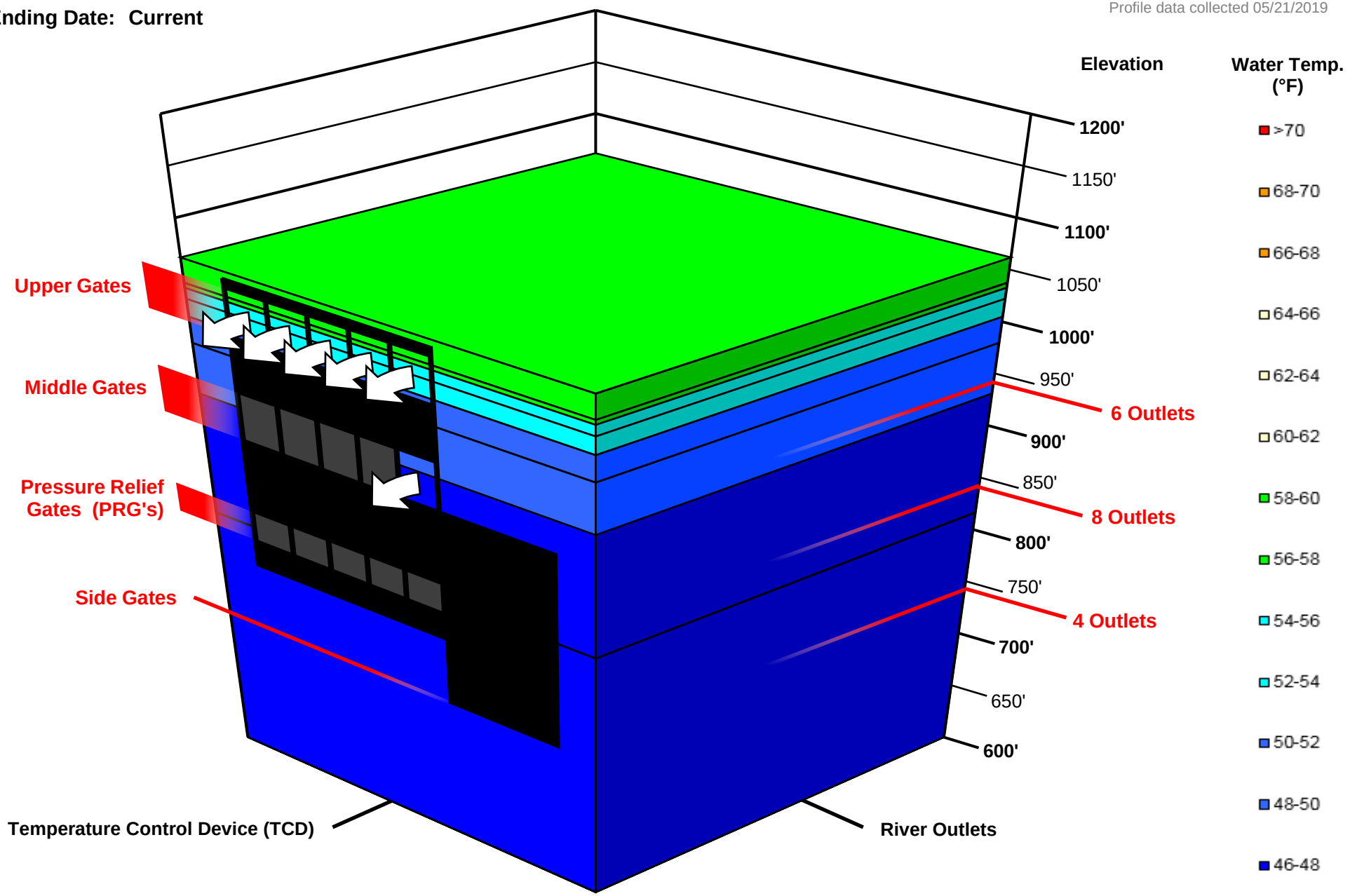


Shasta TCD Configuration

Starting Date: 05/21/2019

Ending Date: Current

Profile data collected 05/21/2019



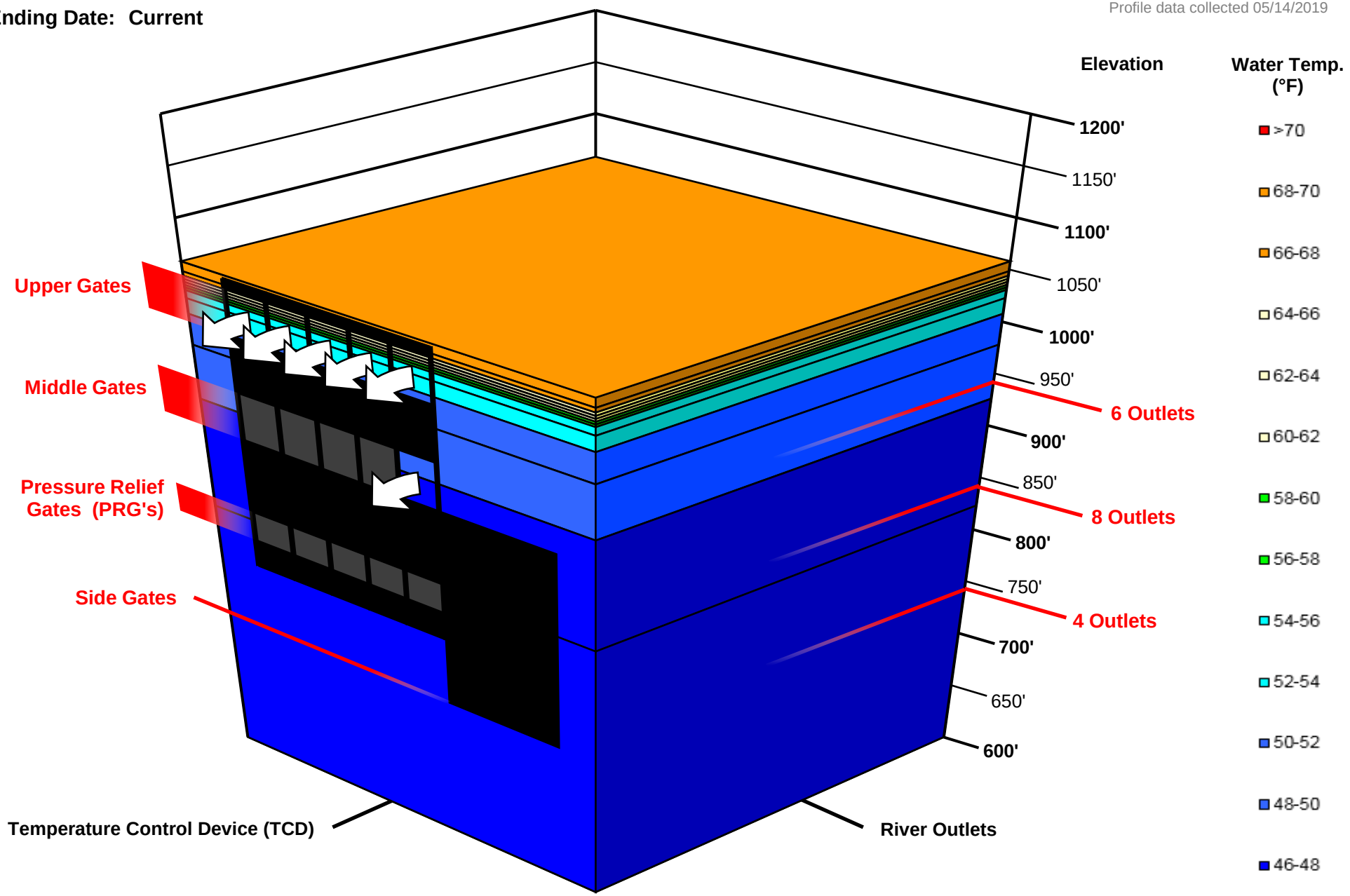
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

Shasta TCD Configuration

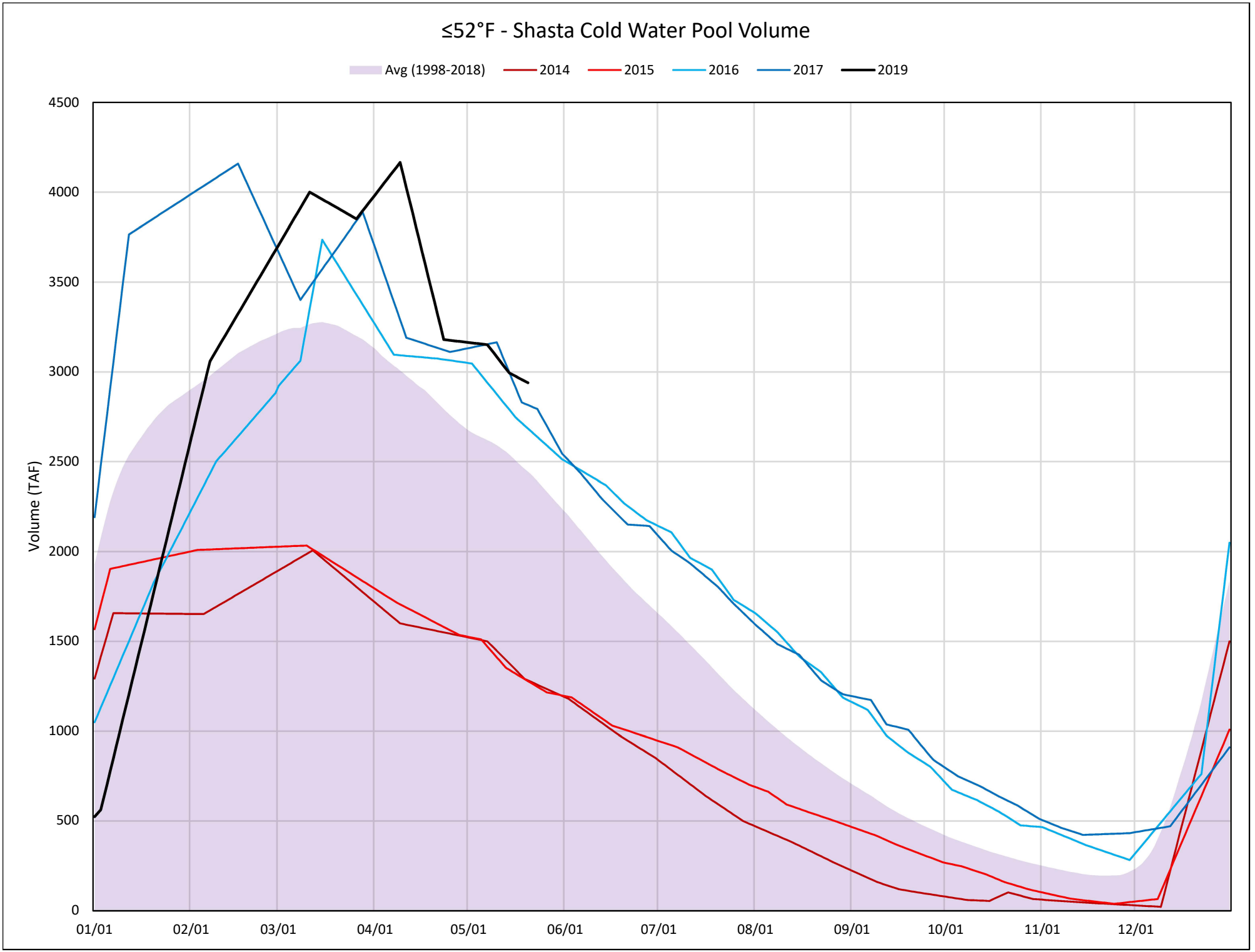
Starting Date: 05/21/2019

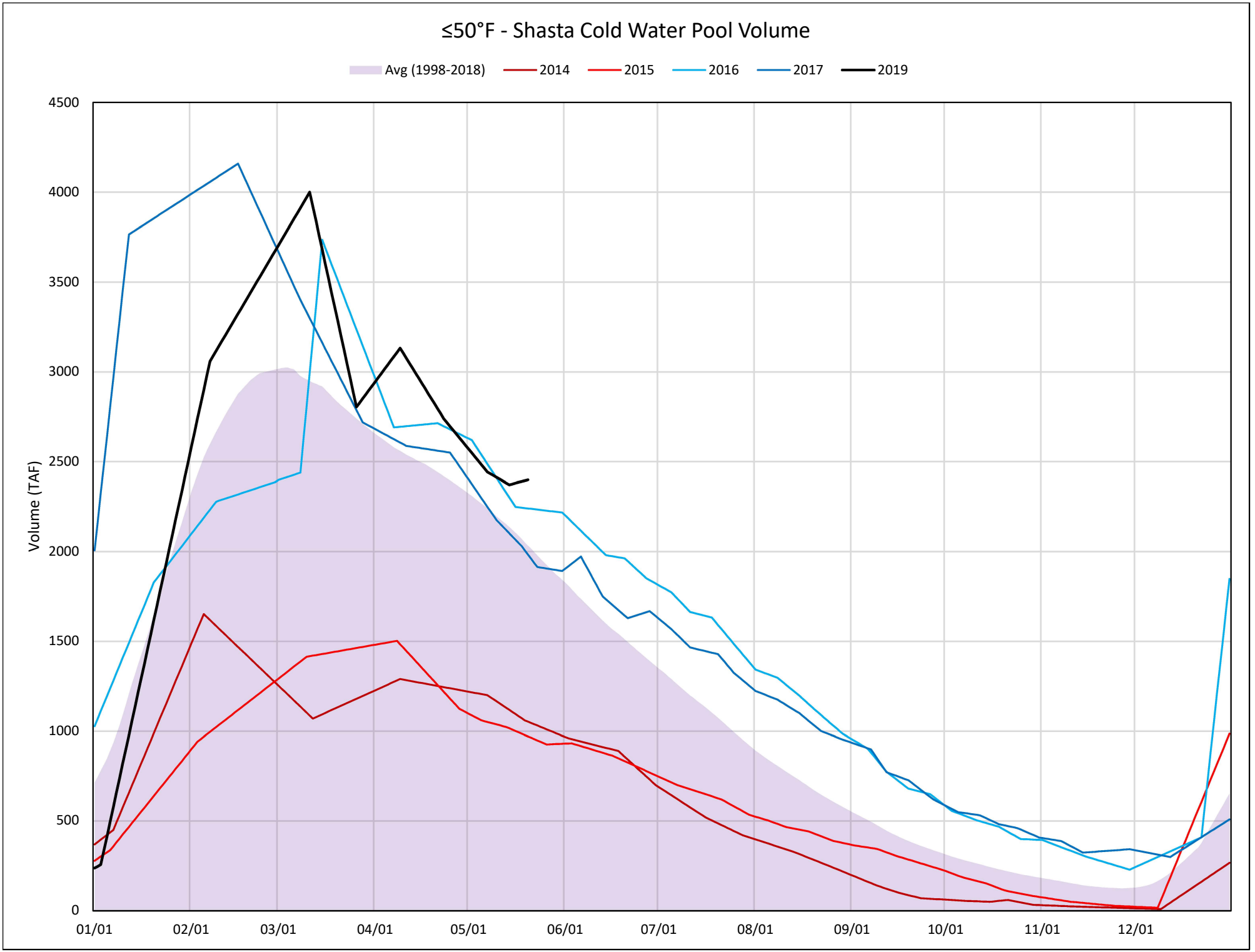
Ending Date: Current

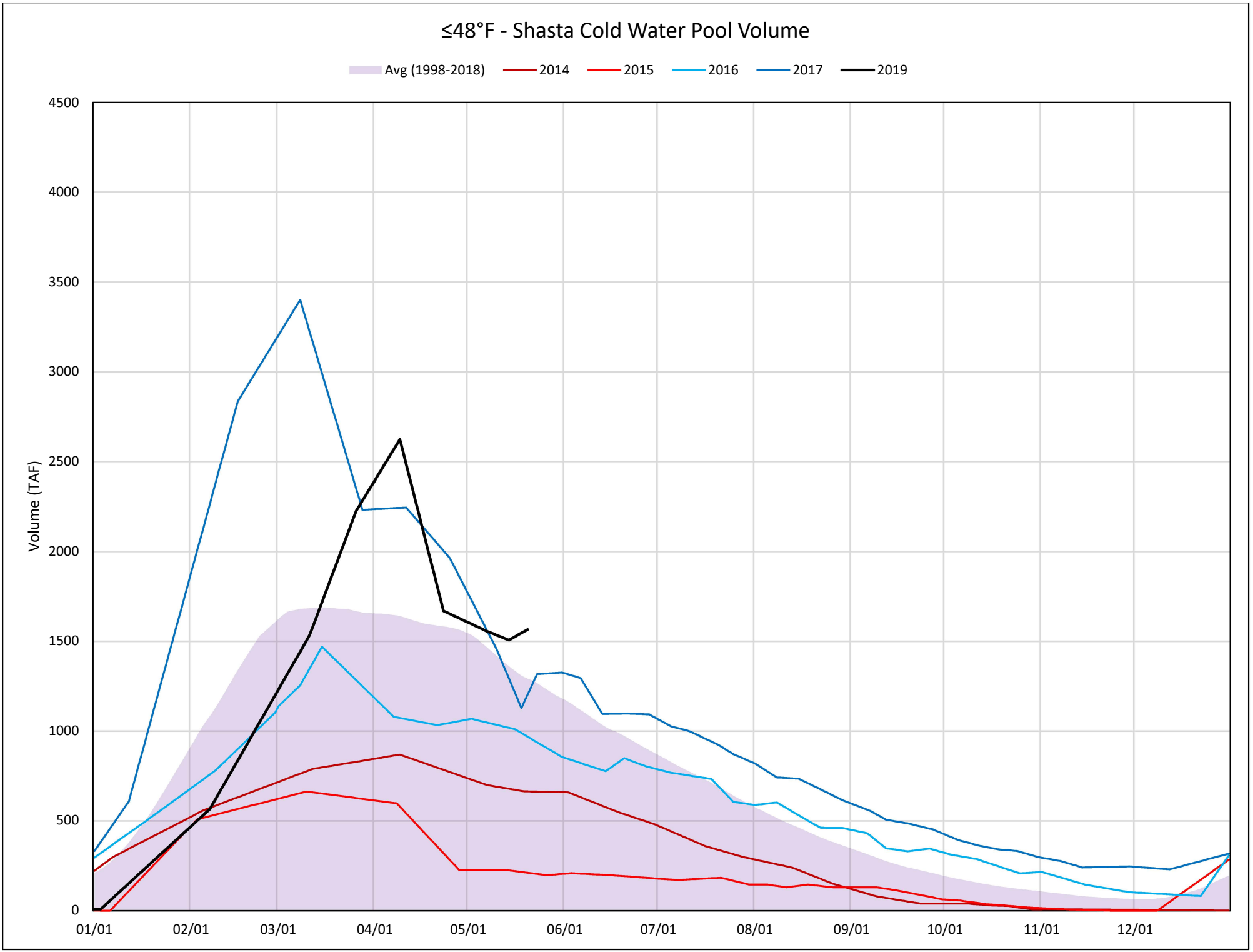
Profile data collected 05/14/2019

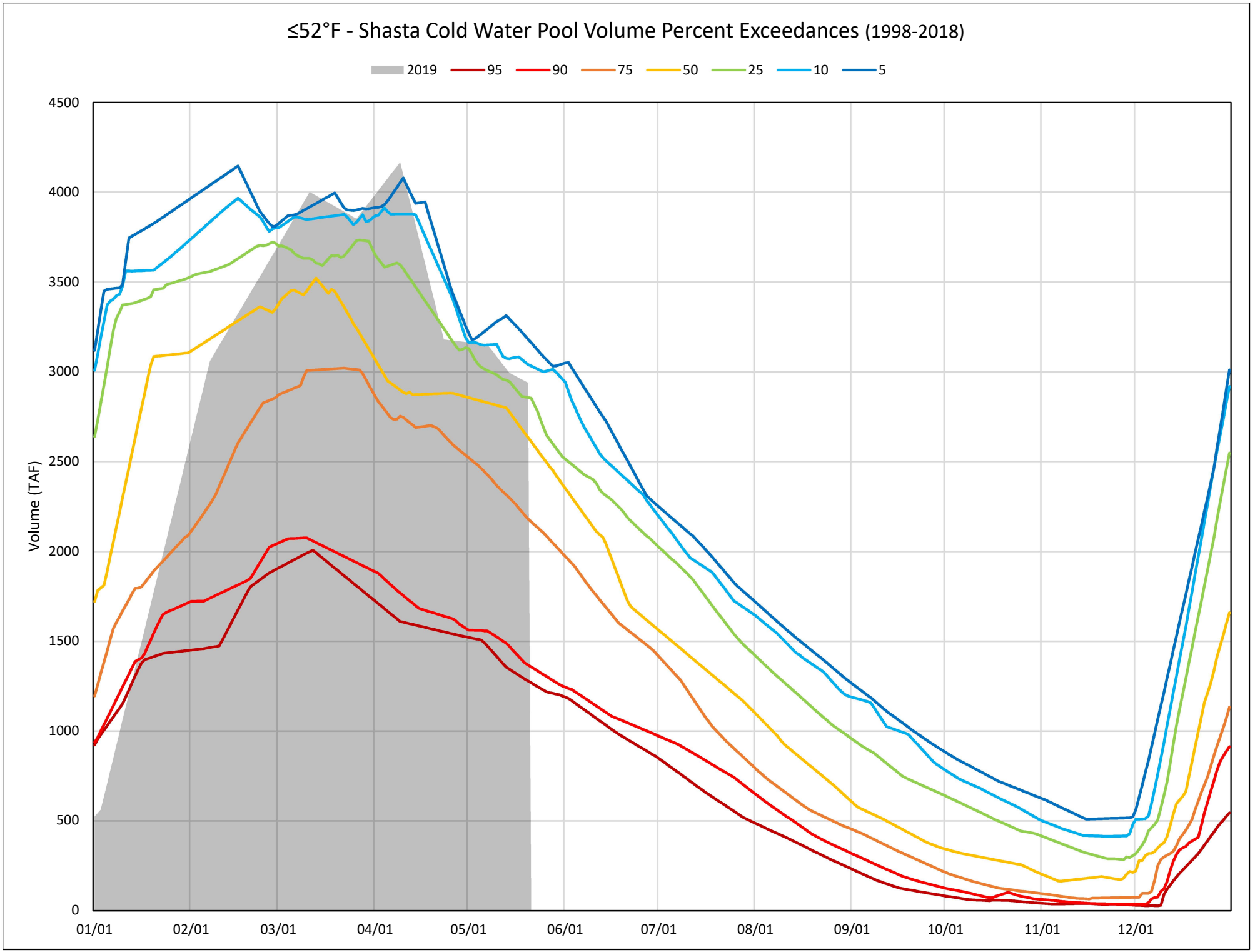


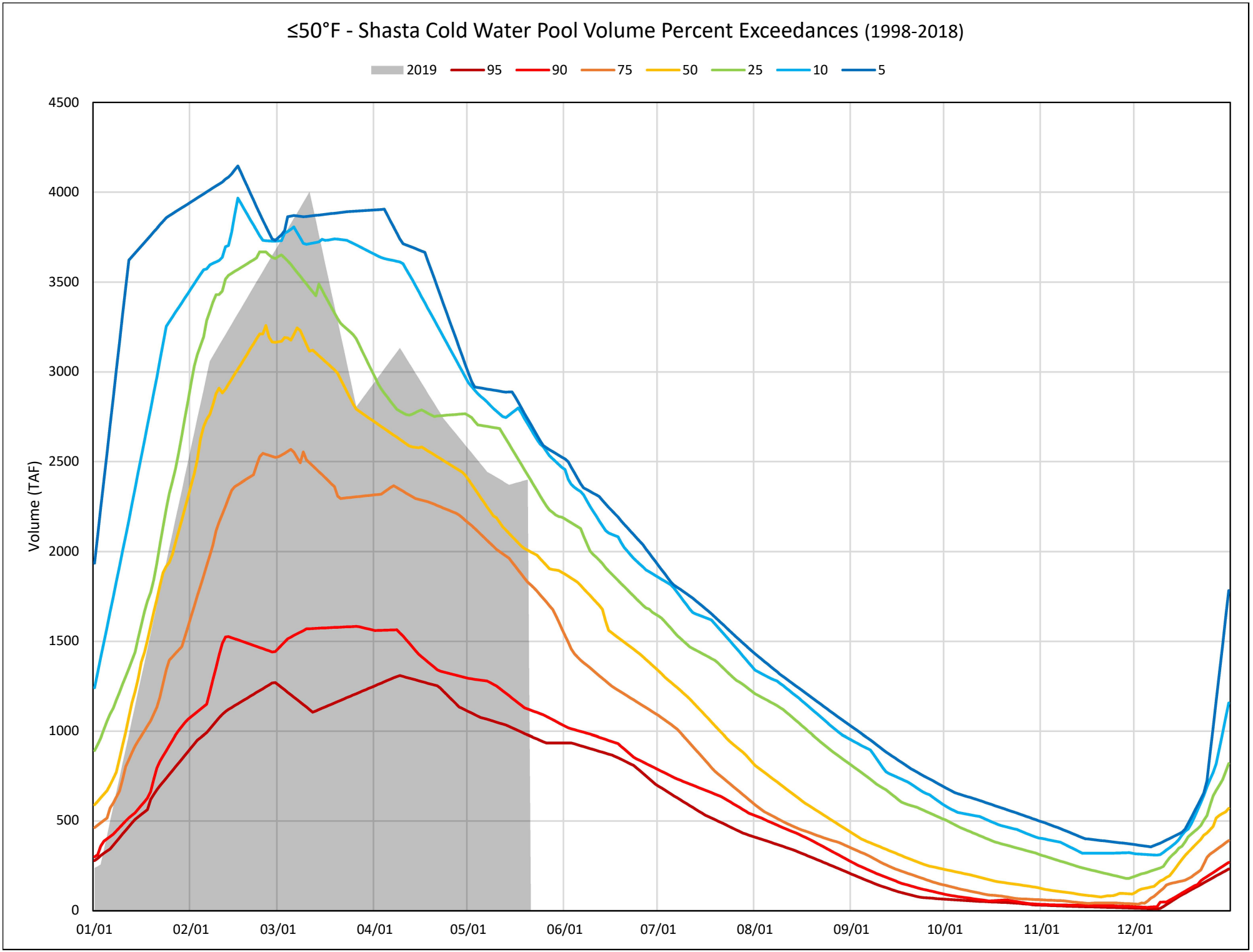
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

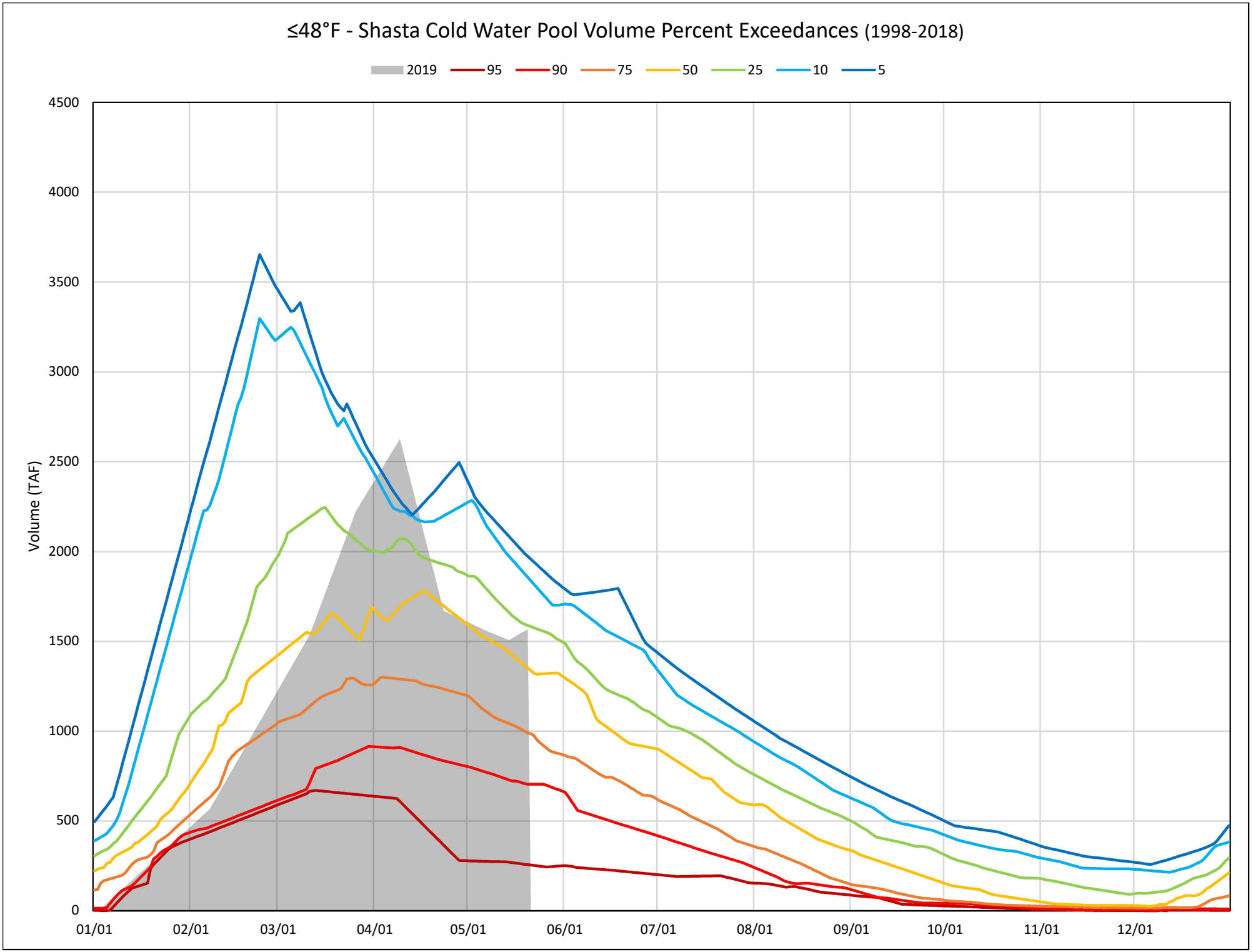

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2018)
2014
2015
2016
2017
2019
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤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

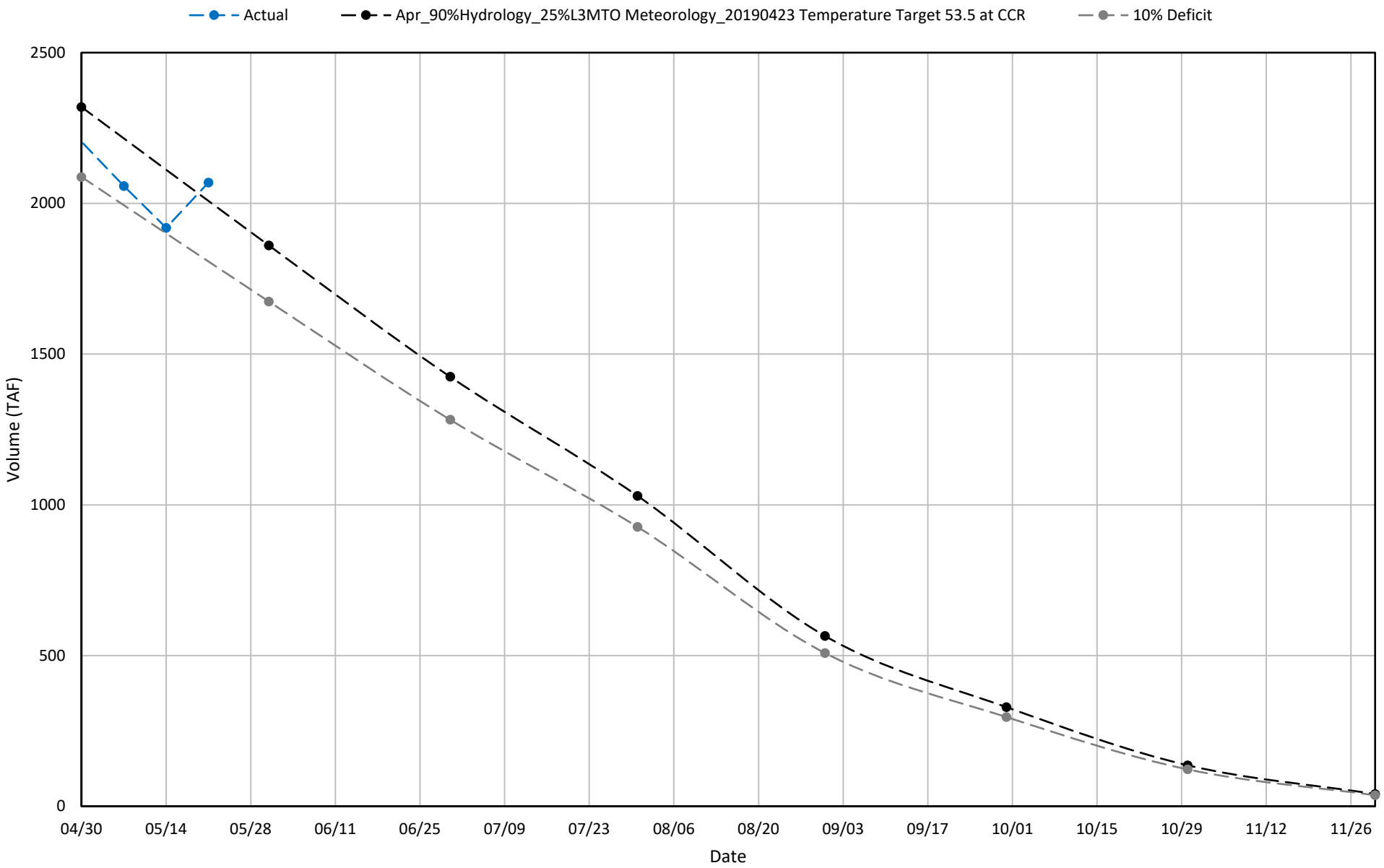

≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2018)
2019
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤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: 2019.05.22

2019 Shasta Cold Water Pool Volume ≤49°F



May 22, 2019

Upper Sacramento River – May 2019 Preliminary Temperature Analysis

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

Location (°F DAT)	MAY	JUN	JUL	AUG	SEP*	OCT*
May 90%-Exceedance Outlook – 25% L3MTO Meteorology						
Keswick Dam KWK	51.4	52.0	53.0	52.5	See Figures 1 and 5	See Figures 1 and 5
Sac. R. abv Clear Creek CCR	52.4	52.7	53.5	52.9	See Figures 1 and 6	See Figures 1 and 6
Balls Ferry BSF	57.0	56.0	55.8	54.5	See Figures 1 and 7	See Figures 1 and 7
May 90%-Exceedance Outlook – 50% L3MTO Meteorology						
Keswick Dam KWK	52.0	52.1	52.9	52.9	See Figures 2 and 5	See Figures 2 and 5
Sac. R. abv Clear Creek CCR	52.6	52.5	53.5	53.3	See Figures 2 and 6	See Figures 2 and 6
Balls Ferry BSF	56.0	54.8	55.7	55.1	See Figures 2 and 7	See Figures 2 and 7

Location (°F DAT)	MAY	JUN	JUL	AUG	SEP*	OCT*
May 50%-Exceedance Outlook – 25% L3MTO Meteorology						
Keswick Dam KWK	51.4	51.7	52.9	52.7	See Figures 3 and 5	See Figures 3 and 5
Sac. R. abv Clear Creek CCR	52.4	52.4	53.5	53.0	See Figures 3 and 6	See Figures 3 and 6
Balls Ferry BSF	57.0	55.9	55.8	54.5	See Figures 3 and 7	See Figures 3 and 7
May 50%-Exceedance Outlook – 50% L3MTO Meteorology						
Keswick Dam KWK	51.4	51.5	52.9	52.4	See Figures 4 and 5	See Figures 4 and 5
Sac. R. abv Clear Creek CCR	52.4	52.3	53.4	52.7	See Figures 4 and 6	See Figures 4 and 6
Balls Ferry BSF	57.0	55.8	55.8	54.2	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, 25% Met	954	10/5	Not used
90% Hydro, 50% Met	1008	10/14	Not used
50% Hydro, 25% Met	954	10/6	Not used
50% Hydro, 50% Met	923	10/2	Not used

Model Run Date May 22, 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 21, May 20, and May 22, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The May 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 May 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.

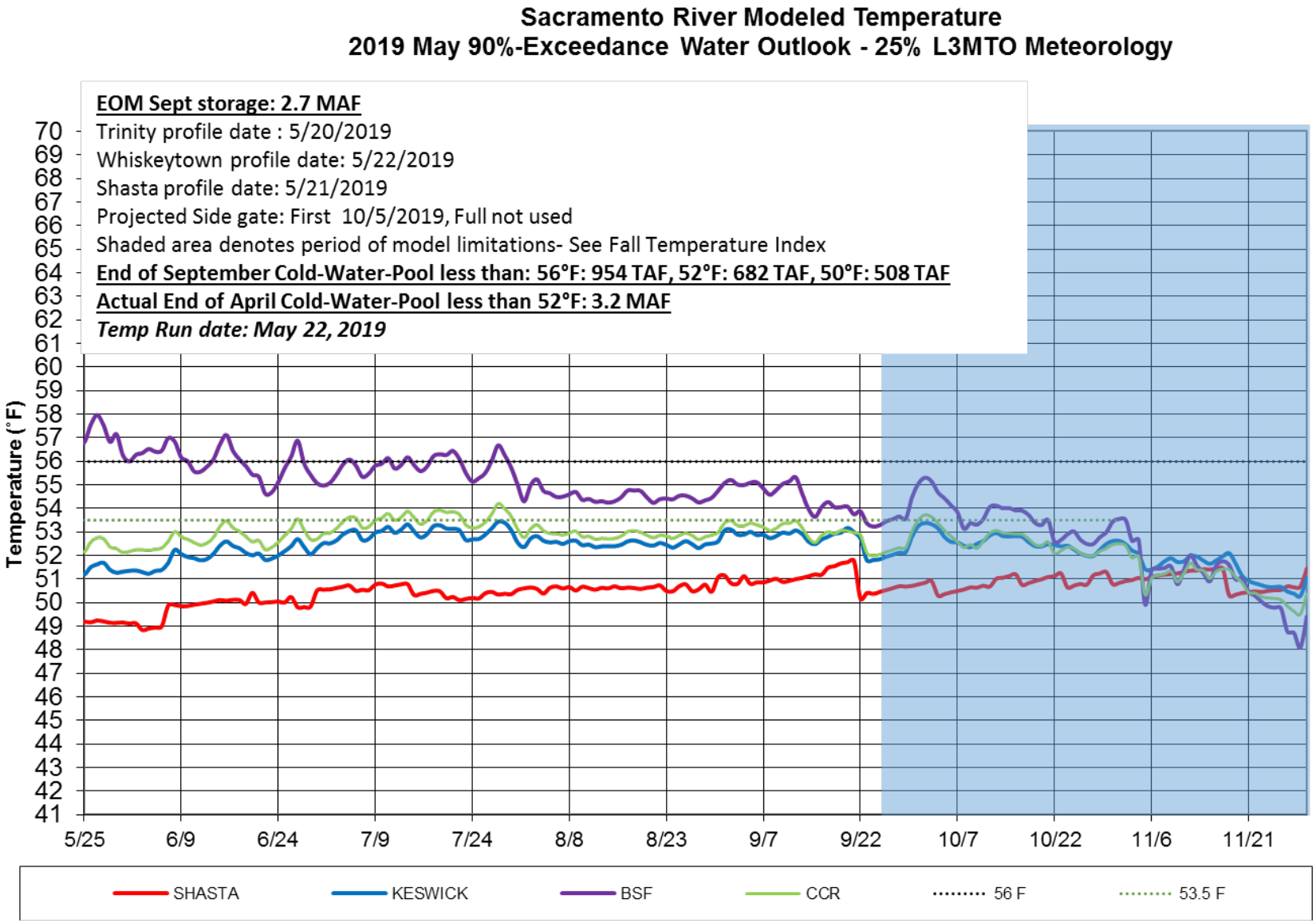


Figure 1. May 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology.

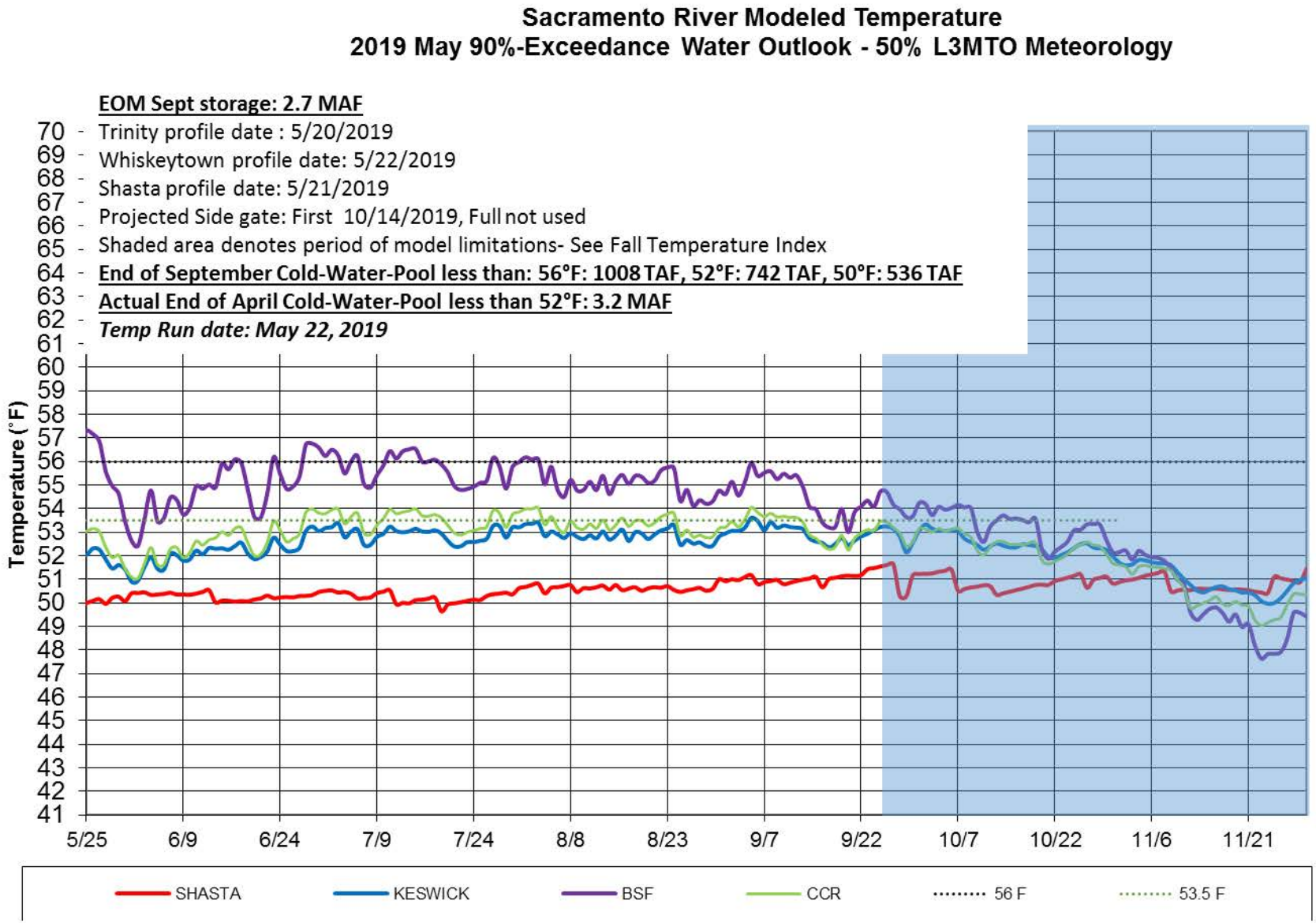


Figure 2. May 2019 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 50% L3MTO meteorology.

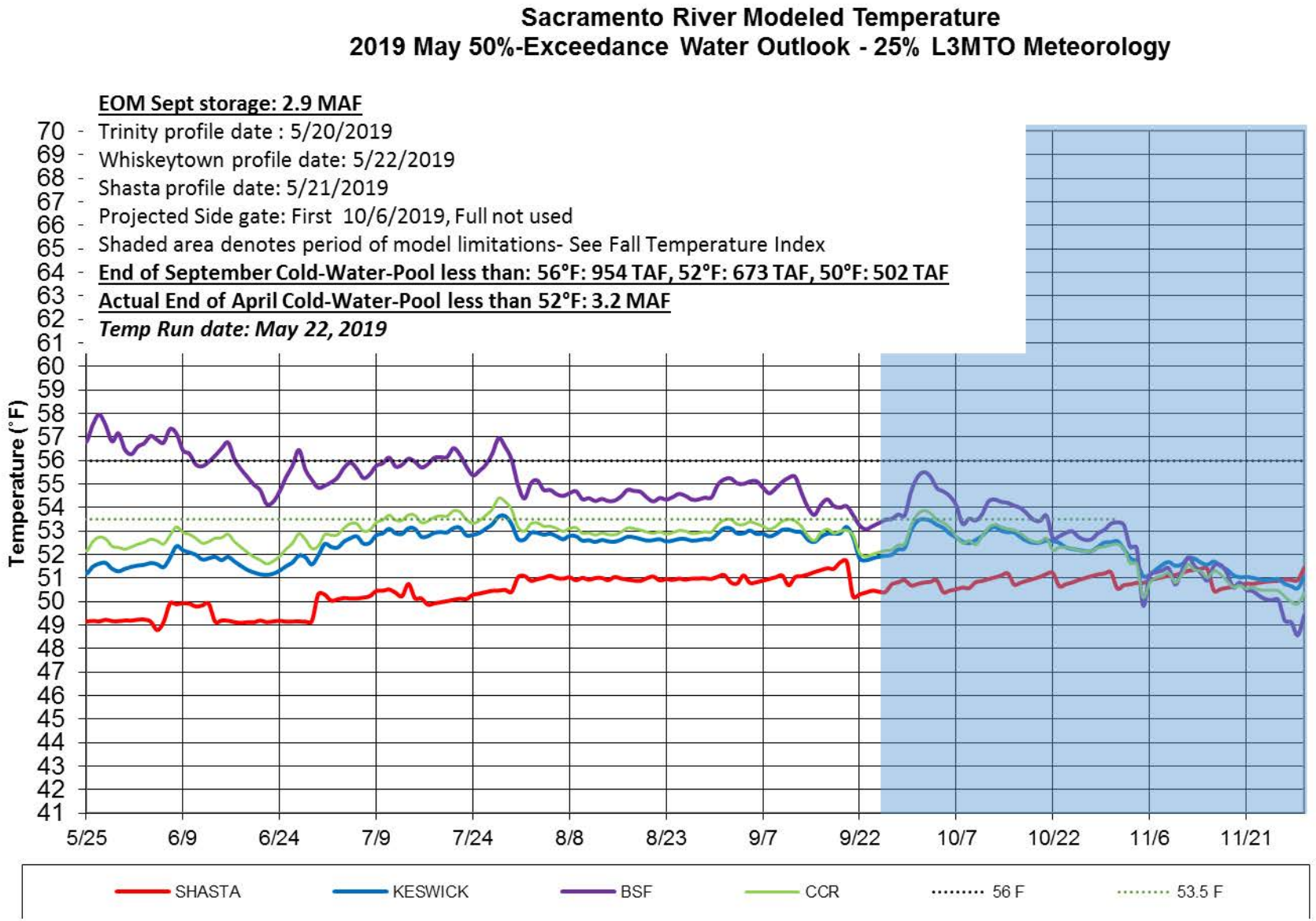


Figure 3. May 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 25% L3MTO meteorology.

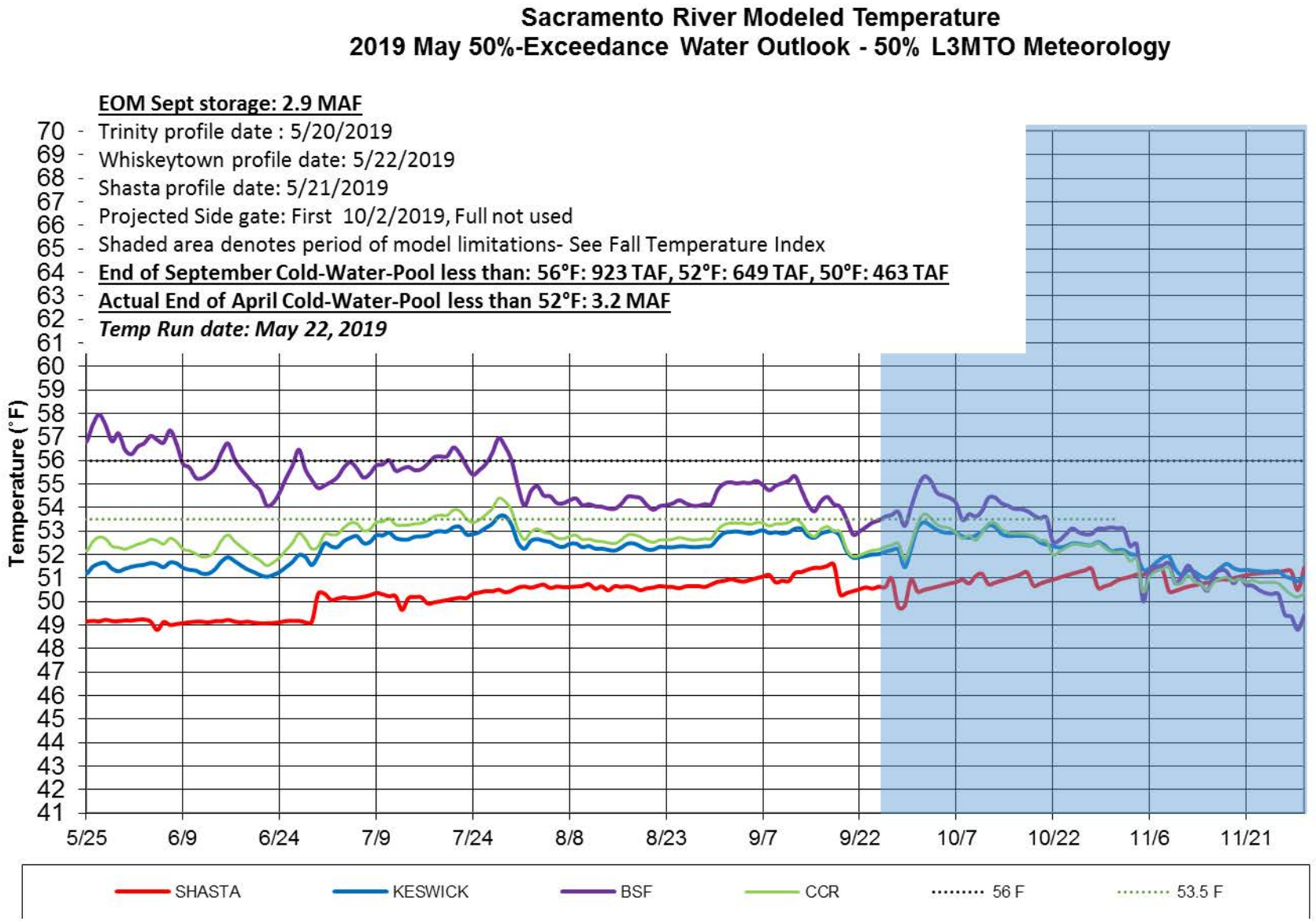


Figure 4. May 2019 simulated Sacramento River temperatures 50% runoff exceedance hydrology and 50% L3MTO meteorology

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.

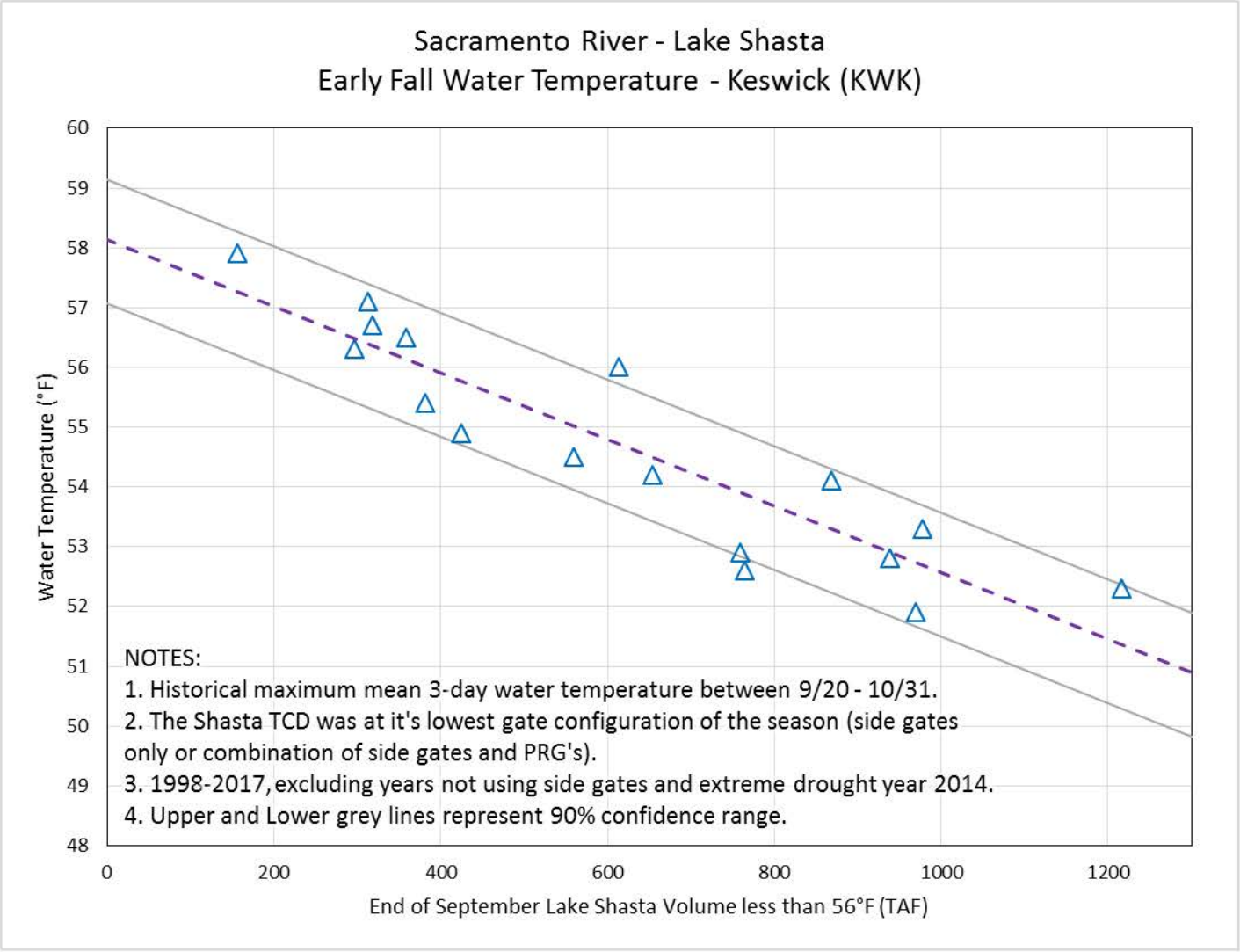


Figure 5. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

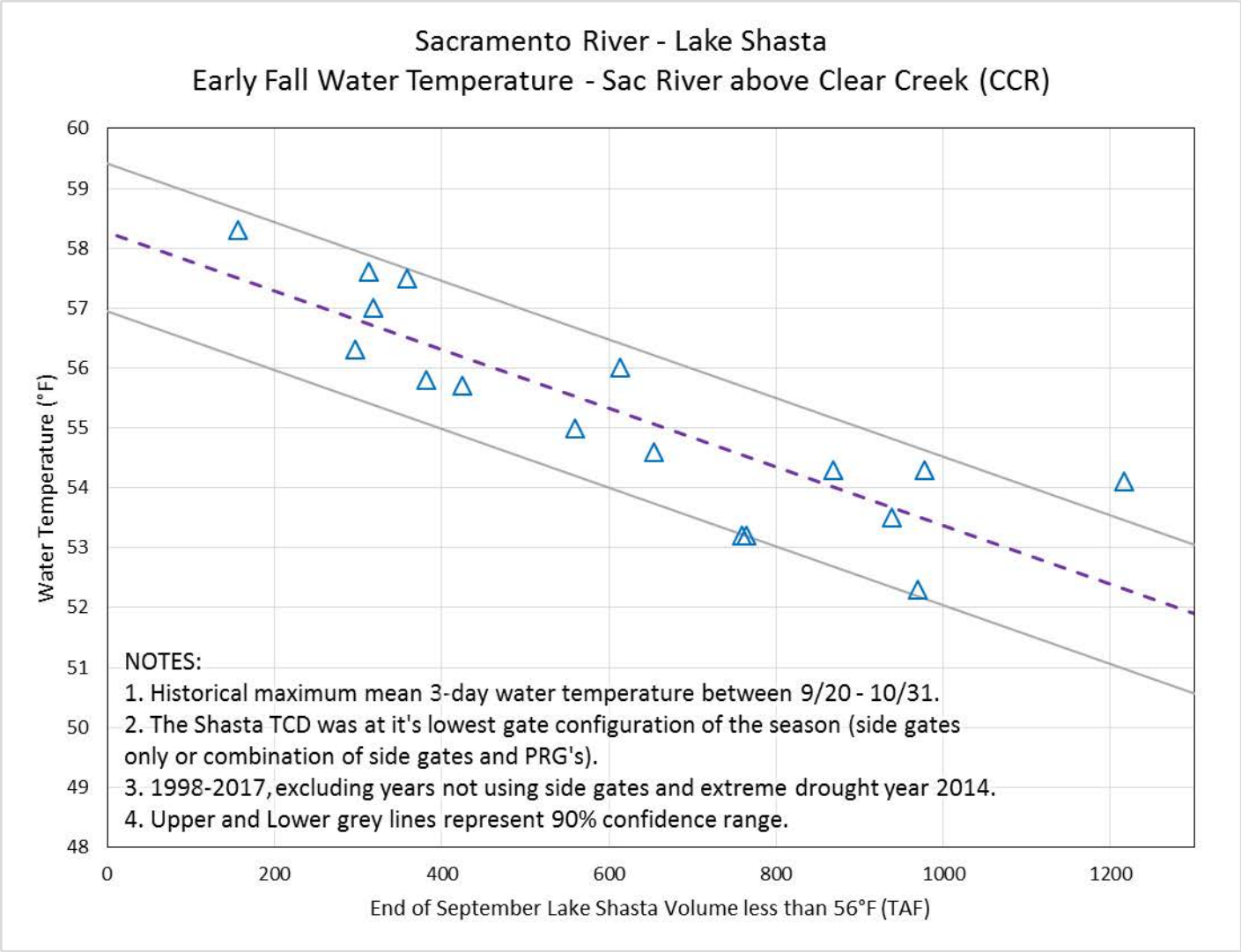


Figure 6. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

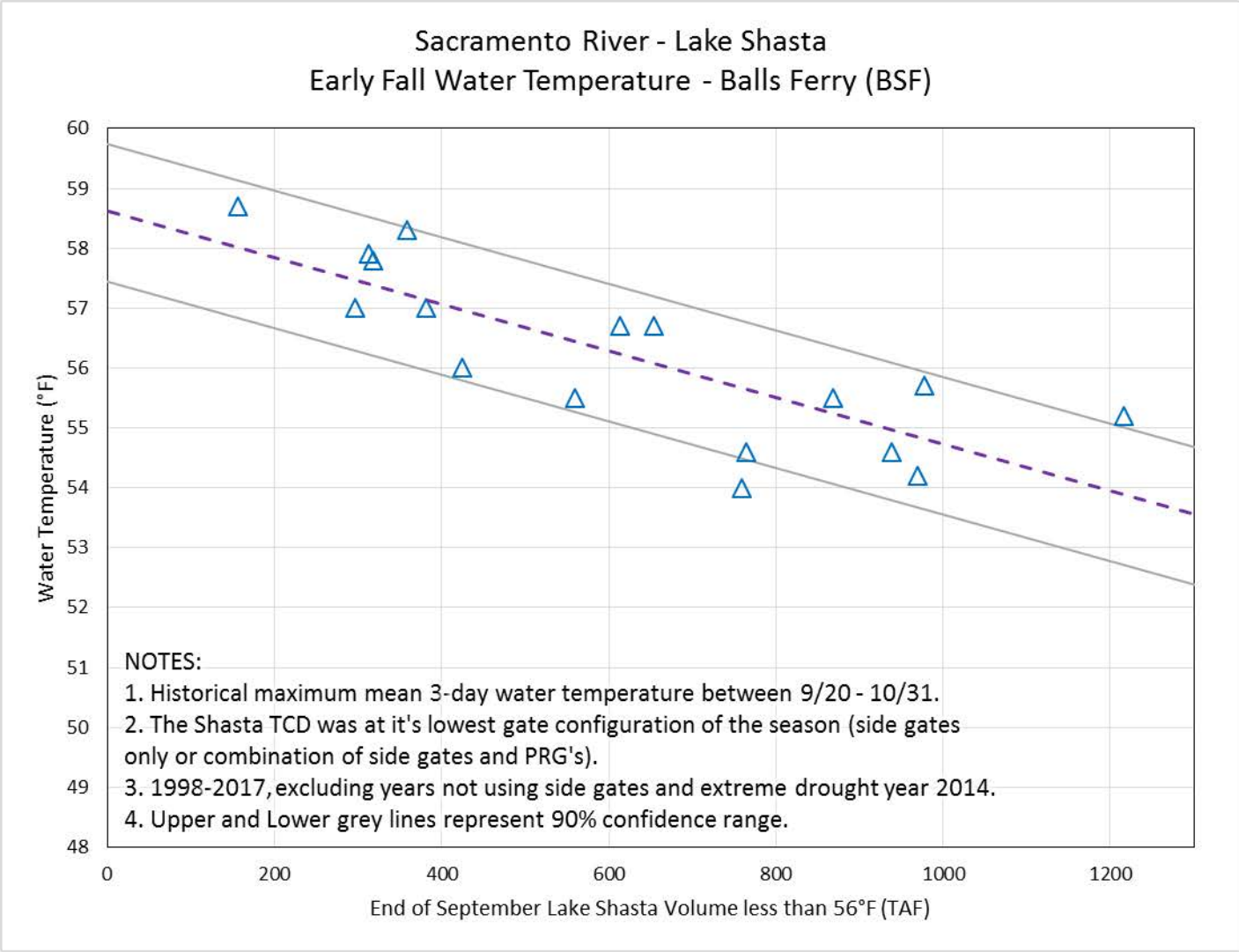
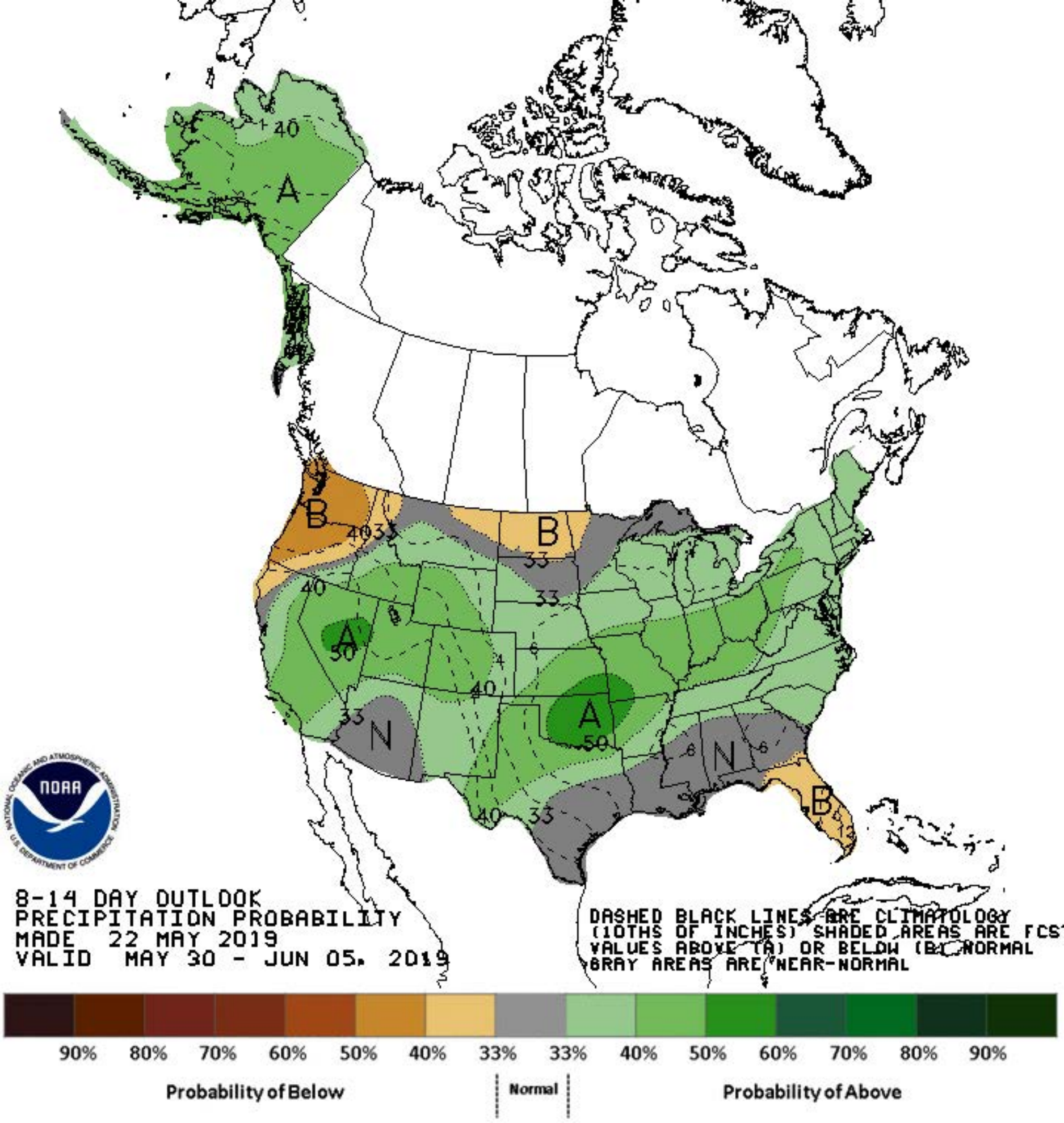


Figure 7. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.

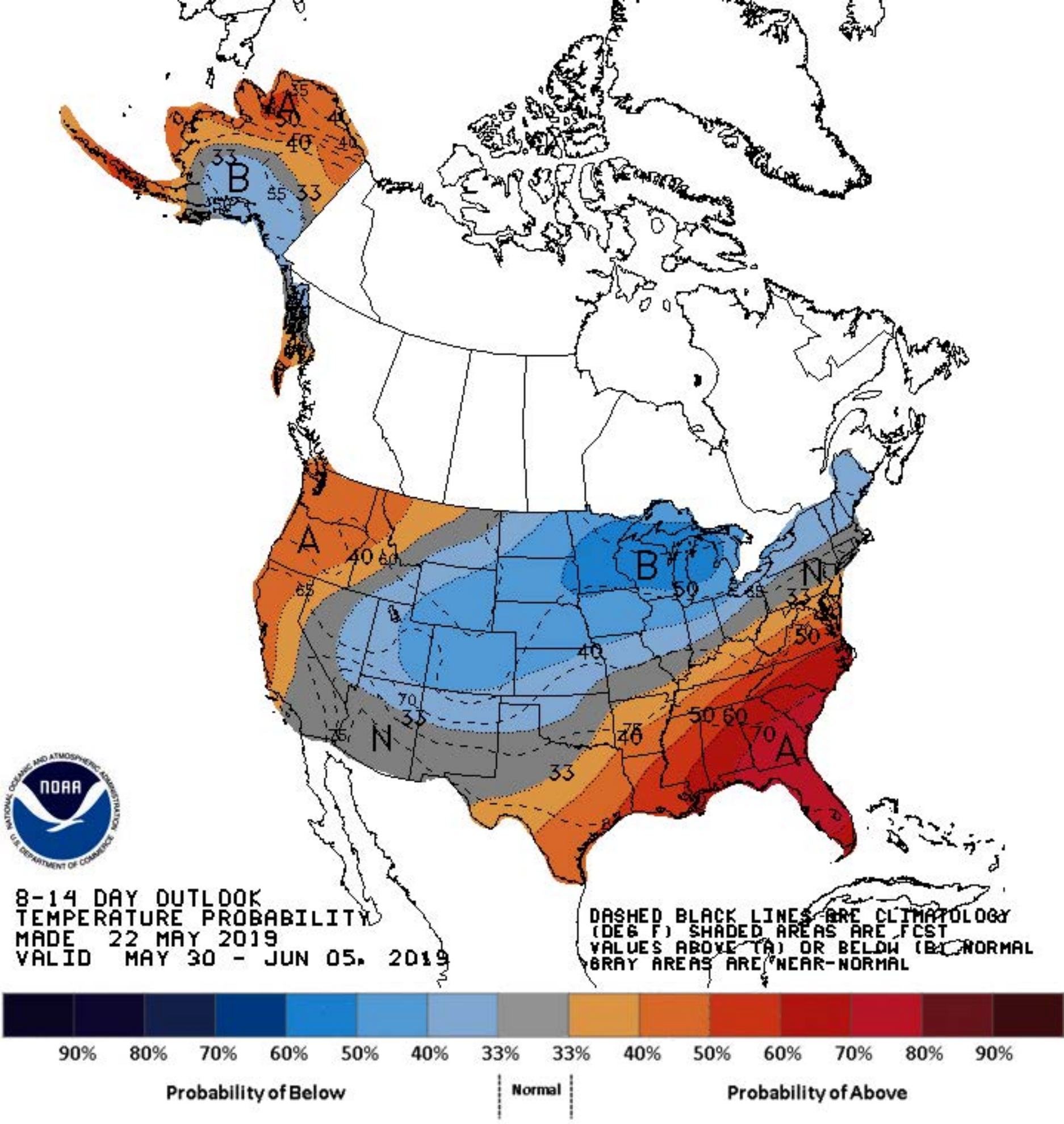


8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 22 MAY 2019
VALID MAY 30 - JUN 05, 2019

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 22 MAY 2019
VALID MAY 30 - JUN 05, 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