BUREAU OF RECLAMATION

Sacramento River Temperature Task Group

Thursday, July 23, 2020 1:00 pm – 3:00 pm

Conference Call:

+1(623)4049000

Meeting ID: 1497574502# (US West)

Join from PC, Mac, Linux, iOS or Android: https://meetings.ringcentral.com/j/1497574502

Agenda

1:00 pm	Introductions
1:10 pm	Purpose and Objective
1:12 pm	Prior Action Items
1:17 pm	Communications
1:20 pm	Long Term Operations Implementation - Update
1:25 pm	River Fish Monitoring: carcass surveys, redd counts, stranding and dewatering surveys and sampling at rotary screw traps
1:35 pm	Fish Distribution/Forecasts: Estimated percentage of the population upstream of Red Bluff Diversion Dam for steelhead, winter-run and spring-run Chinook salmon, steelhead update and Livingston Stone Hatchery.
1:45 pm	Recommendations: Agencies provide feedback and information to Reclamation regarding fish monitoring/operations
1:50 pm	Hydrology Update
1:55 pm	Operations Update and Forecasts
2:00 pm	Storage/Release Management Conditions
2:05 pm	Temperature Management
2:15 pm	Temperature Dependent Mortality

2:25 pm Recommendations: Agencies provide feedback and information to Reclamation regarding temperature management operations

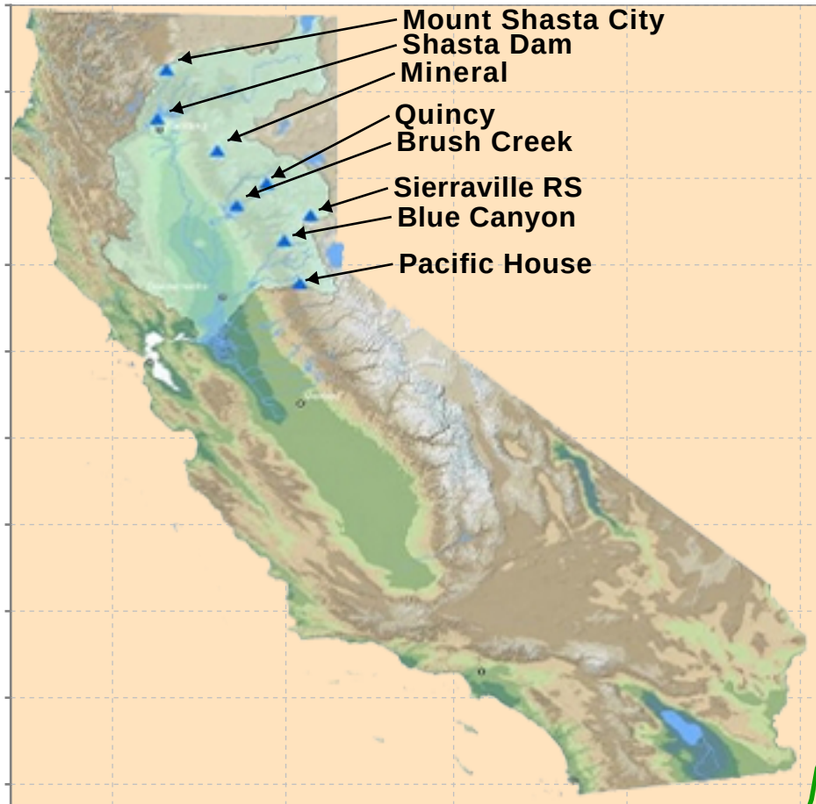
2:45 pm Seasonal Topics

2:50 pm Discussion

2:55 pm Review Action Items

2:59 pm Next Meeting Scheduling

Northern Sierra Precipitation: 8-Station Index, July 22, 2020



Percent of Average for this Date: 63%

2016-2017 Daily Precip (wettest) 94.7

1982-1983 (2nd wettest) 88.5

1997-1998 82.4

2018-2019 Daily Precip 70.7

Average (1966-2015) 51.8

2017-2018 Daily Precip 41.0

2014-2015 Daily Precip 37.2

Current: 31.7

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)

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

DAILY CVP WATER SUPPLY REPORT

JULY 21, 2020

RUN DATE: July 22, 2020

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2019	WY 2020	15 YR MEDIAN
TRINITY	LEWISTON	795	464	500
SACRAMENTO	KESWICK	10,890	12,461	12,461
FEATHER	OROVILLE (SWP)	6,000	3,000	4,500
AMERICAN	NIMBUS	3,333	3,993	3,847
STANISLAUS	GOODWIN	803	205	318
SAN JOAQUIN	FRIANT	374	426	350

STORAGE IN MAJOR RESERVOIRS IN THOUSANDS OF ACRE-FEET

RESERVOIR	CAPACITY	15 YR AVG	WY 2019	WY 2020	% OF 15 YR AVG
TRINITY	2,448	1,674	2,242	1,672	100
SHASTA	4,552	3,142	4,133	2,819	90
FOLSOM	977	658	860	595	90
NEW MELONES	2,420	1,498	2,182	1,665	111
FED. SAN LUIS	966	328	635	222	68
TOTAL NORTH CVP	11,363	7,299	10,052	6,973	96
MILLERTON	520	382	505	302	79
OROVILLE (SWP)	3,538	2,300	3,256	1,959	85

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

RESERVOIR	CURRENT WY 2020	WY 1977	WY 1983	15 YR AVG	% OF 15 YR AVG
TRINITY	453	194	2,731	1,139	40
SHASTA	2,896	2,138	10,109	4,744	61
FOLSOM	1,315	299	6,123	2,493	53
NEW MELONES	558	----	2,568	966	58
MILLERTON	771	246	4,067	1,414	55

ACCUMULATED PRECIPITATION FOR WATER YEAR TO DATE IN INCHES

RESERVOIR	CURRENT WY 2020	WY 1977	WY 1983	AVG (N YRS)	% OF AVG	LAST 24 HRS
TRINITY AT FISH HATCHERY	19.31	13.70	55.19	31.30 (58)	62	0.00
SACRAMENTO AT SHASTA DAM	34.51	17.28	112.58	61.02 (63)	57	0.00
AMERICAN AT BLUE CANYON	39.50	15.70	103.88	65.78 (45)	60	0.00
STANISLAUS AT NEW MELONES	22.35	----	45.33	27.24 (42)	82	0.00
SAN JOAQUIN AT HUNTINGTON LK	28.25	17.20	81.40	41.20 (45)	69	0.00

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Shorter term forecasts (8-14 day) suggest near normal chance of precipitation
- Longer term forecasts (one-month outlook) suggest equal chance of precipitation
- Observed Shasta inflow for July is tracking slightly above the 90% inflow exceedance probability estimate for the month
- Releases from Keswick Dam: Thursday, June 23 and Friday, July 24 releases are decreasing from 12,000 cfs to 11,500 cfs for storage conservation
- Long-term conservative (inflow hydrology) projections suggest improved end of September Shasta storage volumes due to increased hydrology estimates in June/July

Temperature Management:

- Temperature management: Active draw on cold water pool for temperature management
- Selective withdrawal: Using cold-water-pool reserves. Two Middle TCD gates are open and three PRGs are open
- Reclamation continues to actively look for opportunities to conserve cold water pool using operational refinements
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest above normal temperatures
- Longer term forecasts (one month outlook) suggest 30%-40%o probability of above normal temperatures

Resources:

- Reclamation Bay Delta website: https://www.usbr.gov/mp/bdo/lto/index.html
- Reclamation SRTTG website: https://www.usbr.gov/mp/bdo/sacramento-river-temperature-task-group.html
- LTO Proposed Action: https://www.usbr.gov/mp/bdo/docs/ba-chapter-4-proposed-action.pdf
- 2019 Biological Opinions: https://www.usbr.gov/mp/bdo/lto/biop.html
- California Nevada River Forecast Center: short term precipitation forecasts, overlay with burn areas, debris flow potential, etc: https://www.cnrfc.noaa.gov/
- CDFW Upper Sacramento fishery information: https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx
- SacPAS: Central Valley Prediction & Assessment of Salmon: http://www.cbr.washington.edu/sacramento/
- DWR Bulletin 120 Forecast Updates: http://cdec.water.ca.gov/b120up.html

CVP Northern System Operation Outlooks: Draft July 2020

90% Runoff Exceedance Outlook

End of Month Storage/Elevation	Jul	Aug	Sep	Oct	Nov	Dec
Shasta Volume (TAF)	2613	2242	2082	1984	1971	2023
Shasta Elevation (Feet)	990	971	962	956	956	959

Monthly Average River Release	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento (CFS)	12500	9750	6500	5500	4373	3557
Clear Creek (CFS)	150	150	150	200	200	200

Trinity Diversions	Jul	Aug	Sep	Oct	Nov	Dec
Carr Power Plant (TAF)	100	101	100	24	30	21
Spring Creek PP (TAF)	90	90	90	45	20	12

50% Runoff Exceedance Outlook

End of Month Storage/Elevation	Jul	Aug	Sep	Oct	Nov	Dec
Shasta Volume (TAF)	2638	2309	2166	2108	2182	2373
Shasta Elevation (Feet)	991	974	967	963	968	978

Monthly Average River Release	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento (CFS)	12500	9350	6500	5500	4000	3250
Clear Creek (CFS)	150	150	150	200	200	200

Trinity Diversions	Jul	Aug	Sep	Oct	Nov	Dec
Carr Power Plant (TAF)	99	100	99	23	20	9
Spring Creek PP (TAF)	90	90	90	45	15	12

Notes: Inflow is based on the DWR B120 90% or 50% inflow exceedance Outlook; Historical inflows are used in the month of October and future months.

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)

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Trinity	**1753**	**1624**	**1469**	**1313**	**1272**	**1236**	**1219**	**1217**	**1244**	**1304**	**1360**	**1388**	**1294**
	Elev.	2313	2301	2287	2283	2280	2278	2278	2280	2286	2291	2294	2285
Whiskeytown	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**
	Elev.	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209
Shasta	**3147**	**2613**	**2242**	**2082**	**1984**	**1971**	**2023**	**2150**	**2343**	**2654**	**2695**	**2480**	**2120**
	Elev.	990	971	962	956	956	959	966	976	992	994	983	964
Folsom	**717**	**537**	**378**	**297**	**293**	**293**	**303**	**316**	**342**	**426**	**527**	**608**	**591**
	Elev.	421	400	387	386	386	388	390	394	407	420	429	427
New Melones	**1716**	**1630**	**1559**	**1515**	**1474**	**1476**	**1480**	**1483**	**1482**	**1481**	**1444**	**1355**	**1265**
	Elev.	1017	1009	1005	1000	1001	1001	1001	1001	1001	997	987	977
San Luis	**275**	**233**	**248**	**328**	**330**	**372**	**408**	**600**	**574**	**529**	**450**	**310**	**91**
	Elev.	442	428	429	423	437	456	483	470	460	447	426	383
Total		6875	6133	5774	5560	5555	5637	5971	6192	6600	6713	6379	5600

Monthly River Releases (TAF/cfs)

Trinity	TAF	28	53	52	23	18	18	18	17	18	36	92	47
	cfs	**450**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**600**	**1,498**	**783**
Clear Creek	TAF	9	9	9	12	12	12	12	11	17	12	16	11
	cfs	**150**	**150**	**150**	**200**	**200**	**200**	**200**	**200**	**275**	**200**	**265**	**190**
Sacramento	TAF	768	599	387	338	260	219	200	194	215	416	559	678
	cfs	**12500**	**9750**	**6500**	**5500**	**4373**	**3557**	**3250**	**3500**	**3500**	**7000**	**9100**	**11400**
American	TAF	228	215	126	44	43	44	49	77	88	106	92	89
	cfs	**3706**	**3502**	**2116**	**710**	**720**	**710**	**800**	**1394**	**1433**	**1776**	**1500**	**1500**
Stanislaus	TAF	12	12	12	39	12	12	13	12	12	27	55	12
	cfs	**200**	**200**	**200**	**635**	**200**	**200**	**219**	**221**	**200**	**460**	**887**	**200**

Trinity Diversions (TAF)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Carr PP	100	101	100	24	30	21	15	10	7	44	25	99
Spring Crk. PP	**90**	**90**	**90**	**45**	**20**	**12**	**10**	**10**	**10**	**15**	**15**	**90**

Delta Summary (TAF)

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Tracy		260	265	255	132	99	72	230	45	50	48	49	50
USBR Banks		9	9	9	0	0	0	0	0	0	0	0	0
Contra Costa		15.0	12.1	9.5	7.9	6.3	5.5	6.8	8.0	8.1	8.0	12.0	14.0
Total USBR		284	286	274	140	105	77	237	53	58	56	61	64
COA Balance		38	39	54	23	0	0	0	-24	-78	-58	-58	-25
Vernalis	TAF	45	40	46	108	83	83	92	82	82	105	135	43
Vernalis	cfs	737	655	772	1758	1393	1355	1504	1482	1339	1767	2194	721
Old/Middle River Std.													
Old/Middle R. calc.		-4,605	-4,142	-4,172	-1,990	-3,151	-3,143	-5,008	-1,019	-1,341	-1,054	-908	-1,845
Computed DOI		4994	4636	4118	4994	5009	6003	6165	11400	11403	9497	7255	7800
Excess Outflow		0	0	0	0	0	0	1659	0	0	0	390	0
% Export/Inflow		37%	36%	42%	29%	41%	40%	55%	11%	13%	12%	14%	14%
% Export/Inflow std.		65%	65%	65%	65%	65%	65%	65%	45%	35%	35%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	462		3,236		1,462		639	
Year to Date + Forecasted % of mean	38%		58%		54%		60%	

CVP actual operations do not follow any forecasted operation or outlook; actual operations are based on real-time conditions.
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7/15/2020

Estimated CVP Operations 50% Exceedance

Storages

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

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Trinity	**1753**	**1626**	**1472**	**1318**	**1283**	**1275**	**1306**	**1370**	**1481**	**1609**	**1724**	**1588**	**1463**
	Elev.	2313	2301	2287	2284	2283	2286	2292	2302	2312	2321	2310	2300
Whiskeytown	**238**	**238**	**238**	**238**	**206**	**206**	**206**	**206**	**206**	**206**	**238**	**238**	**238**
	Elev.	1209	1209	1209	1199	1199	1199	1199	1199	1199	1209	1209	1209
Shasta	**3147**	**2638**	**2309**	**2166**	**2108**	**2182**	**2373**	**2770**	**3351**	**3906**	**4211**	**4208**	**3903**
	Elev.	991	974	967	963	968	978	997	1023	1044	1055	1055	1044
Folsom	**717**	**536**	**443**	**411**	**394**	**395**	**414**	**489**	**556**	**744**	**868**	**928**	**906**
	Elev.	421	409	405	402	402	405	415	423	444	456	462	460
New Melones	**1716**	**1641**	**1574**	**1533**	**1502**	**1519**	**1543**	**1575**	**1629**	**1688**	**1671**	**1752**	**1762**
	Elev.	1018	1011	1007	1003	1005	1008	1011	1017	1023	1021	1029	1030
San Luis	**275**	**222**	**216**	**287**	**416**	**574**	**785**	**966**	**966**	**966**	**887**	**735**	**662**
	Elev.	451	442	444	463	489	524	543	543	543	532	514	505
Total		6901	6251	5954	5909	6151	6626	7376	8189	9118	9599	9449	8933

Monthly River Releases (TAF/cfs)

Trinity	TAF	28	53	52	23	18	18	18	17	18	36	258	126
	cfs	**450**	**857**	**870**	**373**	**300**	**300**	**300**	**300**	**300**	**600**	**4,189**	**2,120**
Clear Creek	TAF	9	9	9	12	12	12	25	11	12	12	16	11
	cfs	**150**	**150**	**150**	**200**	**200**	**200**	**400**	**200**	**200**	**200**	**265**	**190**
Sacramento	TAF	768	575	387	338	238	200	200	180	277	339	559	678
	cfs	**12500**	**9350**	**6500**	**5500**	**4000**	**3250**	**3250**	**3250**	**4500**	**5700**	**9100**	**11400**
American	TAF	240	154	91	92	89	92	77	194	123	297	400	238
	cfs	**3903**	**2500**	**1530**	**1500**	**1502**	**1500**	**1250**	**3500**	**2000**	**5000**	**6500**	**4000**
Stanislaus	TAF	12	12	12	39	12	12	14	13	12	91	55	22
	cfs	**200**	**200**	**200**	**635**	**200**	**200**	**226**	**229**	**200**	**1536**	**887**	**363**

Trinity Diversions (TAF)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Carr PP	99	100	99	23	20	9	0	2	1	55	92	95
Spring Crk. PP	**90**	**90**	**90**	**45**	**15**	**12**	**10**	**35**	**26**	**35**	**90**	**90**

Delta Summary (TAF)

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Tracy		265	265	260	262	217	250	223	76	100	54	57	210
USBR Banks		11	11	11	0	0	0	0	0	0	0	0	0
Contra Costa		11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	12.7	12.7	9.8
Total USBR		287	289	285	279	235	268	237	90	113	66	70	220
COA Balance		105	88	65	47	0	0	0	0	0	0	0	0
Vernalis	TAF	51	49	54	108	83	83	93	112	57	169	113	69
Vernalis	cfs	834	802	906	1758	1393	1355	1511	2012	932	2843	1833	1153
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-5,928	-4,810	-4,557	-5,170	-5,301	-6,097	-4,607	-2,888	-2,948	-630	-1,104	-4,858
Computed DOI		4994	4652	4186	4994	5009	7825	14331	23017	21636	17785	12640	8388
Excess Outflow		0	0	0	0	0	1822	8329	11617	10232	8287	4831	941
% Export/Inflow		44%	40%	44%	50%	53%	49%	30%	15%	14%	7%	10%	35%
% Export/Inflow std.		65%	65%	65%	65%	65%	65%	65%	45%	35%	35%	35%	35%

Hydrology

	Trinity		Shasta		Folsom		New Melones	
Water Year Inflow (TAF)	464		3,296		1,509		657	
Year to Date + Forecasted % of mean	38%		60%		55%		62%	

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7/20/2020

BUREAU OF RECLAMATION

CVP July 2020 90% Exceedance Operations Outlook Information

General Information:

Central Valley Project (CVP) reservoir operations are re-assessed monthly for a one-year period into the future at varied hydrologic conditions on a monthly time-step. Because future watershed hydrology is not known with certainty, estimates for inflow are typically updated using a spread of likely outcomes. These values can range anywhere from 1 percent to 99 percent runoff exceedance probabilities by using meteorological or historical precipitation and snow trends. The CVP commonly uses a 90 percent and 50 percent runoff exceedance probability hydrology. The 90 percent runoff exceedance probability hydrology suggests a conservative, or relatively "dry" condition in which it's expected that in any particular year, nine out of ten years the conditions for the year will be "wetter" than presented. Similarly, the 50 percent hydrology suggest a less conservative, or relatively "wet" condition in which it's expected that in any particular year, equal chances or five out of ten years will be "wetter" or "drier" than presented. The designation to view the former a "dry" outlook and the latter a "wet" one can be somewhat misleading. For the months of October and November, there is typically little to no data (snowpack), and the inflow hydrology set which is used is derived from a long term average of historic data. In that case, the 90% is dry and 50% is the median of historic data, which is slightly drier than the long term average due to the skew produced by a few very large events. Once National Weather Service (NWS) and California Department of Water Resources (DWR) forecasts become available (usually December through May), the hydrology switches from long term averages to more specific projections pertaining to the current water year. It is derived from monthly snowpack measurements and statistical runoff curves and is published at several probability levels for the current year. It is important to note that for these hydrology sets, a 90% is not necessarily dry, nor is the 50% (median) necessarily anywhere close to the long term average. They are simply runoff projections based upon probabilities. For example, in a parched year with poor snowpack, the 50% (median) runoff forecast might be very dry by any standard, and conversely, in a year high runoff and large snowpack, the 90% (drier) forecast could be very wet. In summary, for the December through May outlooks, the 90% can be viewed as "drier" (but not necessarily dry) and the 50% (median) as "wetter" but not necessarily wet. Generally, the differences between the NWS/DWR 90% and 50% runoff forecasts diminish as the water year progresses and more information becomes available. In December, with little of the annual snowpack in place there are usually very large differences between the 90% and 50% runoff forecasts. By April or May, much (if not all) of the snowpack has accumulated, and the 90% and 50% runoff forecasts typically have relatively small differences between them.

The assumed uncertain hydrology sets are used to simulate, including, but not limited to, projected storage, releases, exports, and features of the Sacramento and San Joaquin Delta performance. These estimates serve as useful operational guides for both CVP and DWR State Water Project (SWP) operations to jointly manage the system according to shared coordination framework (Coordinated Operations Agreement) for various conditions. This coordinated effort ensures that DWR and Reclamation supply required quantity and quality of water in the Delta to support agricultural, environmental, and water quality goals according to water right permit conditions (D-1641). The CVP system balances available resources to meet regulatory obligations, environmental requirements, senior water right holders, and CVP service contracts including agricultural, municipal and industrial, and wildlife refuge water delivery demands. Reclamation considers the factors that go into the outlooks to guide export opportunities and capabilities. Central Valley Operation staff combine their institutional knowledge and experience, and optimize reservoir and export operations given the system, regulatory, and environmental constraints which are applicable in the current water year. The final step in the analysis process is to select an allocation and demand set which fully utilizes San Luis storage by drawing the reservoir down to absolute minimums in late summer. Per requirements, the 90% outlook is used to determine allocations, and the 50% outlook is provided for informational purposes.

These operation outlooks do not suggest a certain actual future outcome, but rather the statistical likelihood of projected outcomes and represent levels of CVP operational risk. Thus, the outlooks do not provide exact or anticipated end-of-month storages, flow rates, but general projections that would be expected if actual conditions matched this uncertain future hydrology. However, actual operations are generally expected to fall within the bracketed 90 percent and 50 percent hydrology projections. Outlooks represent general system-wide dynamics and do not necessarily address specific watershed/tributary details and releases and export values are represented as monthly averages. Actual operations are based on real-time conditions.

Inputs:

- Reservoir Inflow Hydrology: Final Issue of the Bulletin 120 Water Supply Forecast Update June 10, 2020, DWR
- Sacramento Valley Accretion Depletion Hydrology: Sacramento River at Freeport forecast for June 2020, DWR. Per personal communication with DWR, values were adjusted conservatively due to late season toolset limitations.
- Operations: Personal communication with DWR, SWP Operations

Assumptions:

- Reservoir inflows are adjusted to date of forecasting to approximate actual conditions
- SWRCB D1641 permit conditions for outflow and salinity requirements are met for compliance
- Coordinated Operations Agreement (COA) classification: Dry – CVP 65% Sharing responsibility for meeting Sacramento Valley inbasin use with storage withdrawals during balanced water conditions
- Delta salinity/outflow requirements control through August 15 at Emmaton/Jersey Point, Delta Outflow approximately 4,000 to 5,000 cfs

- Delta controls: Anticipated water quality goals at Emmaton/Jersey Point through mid-August, then water quality goals for Rock Slough for the remainder of dry season
- Sacramento River water year type classification for requirements: Dry
- San Joaquin River water year type classification for requirements: Dry
- Stanislaus River classification for minimum release: Dry
- American River classification for minimum release: based on forecasted inflows to Folsom reservoir
- Trinity River Record of Decision (ROD) water year type classification: Critically Dry
- Sacramento River Settlement Contractors allocation classification: Shasta Non-Critical 100%
- North of Delta Water Service Contractor allocation for agriculture: 50%
- North of Delta Municipal and Industrial allocation: 75%
- North of Delta Refuge allocation: 100%
- American River Water Rights allocation: 100%
- South of Delta Water Rights allocation: 100%
- South of Delta Water Service Contractor allocation for agriculture: 20%
- CVP South of Delta Municipal and Industrial allocation: 70%
- South of Delta Refuge allocation: 100%
- Feather River Service Area allocation: 100%

Notes:

- A Shasta Non-Critical determination was made June 8, 2020 based on DWR Bulletin 120 Forecast Update June 2, 2020.
- Based on the COA and year classification, the CVP is responsible for 65% of water released from storage to meet all inbasin uses (entitlements) in the Sacramento River watershed under balanced conditions (SWP is responsible for 35%). To determine the magnitude of this responsibility, DWR estimates the Sacramento River watershed inbasin use by applying a mass balance calculation over the entire basin. This is because specific or individual diversion and return flows from the Sacramento River are not metered or measured and an aggregate based on historical information is used instead. Historical water gains (returns or accretion) and uses (diverted, losses or depleted) out of the Sacramento River watershed contain water year type associated patterns. This outlook contains an updated accretion/depletion calculation. The Shasta Non-Critical assumption is imbedded within this mass balance calculation and captures a 100% allocation to the Sacramento River Settlement Contractors (SRSC).
- Sacramento River accretion/depletion assumptions have been crossed checked with diversion estimates from the SRSC. Per personal communication with the SRSC, year 2020 summer (June through September) diversion patterns are similar between the 100% and 75% allocations due to the late season determination. Discussions are on-going to adjust an increase in SRSC demand in October for rice decomposition.
- South of Delta Water Rights and Refuge allocations are assumed to be 100%.
- The North of Delta water service contractor's allocation for agriculture (50%) was set by provisions of the WIIN Act, Section 4005 (e)(1)(A)(iv), which states that allocations shall be

not less than 50% of the contract quantity in a Dry year preceded by a Below Normal, Above Normal or Wet year.

Northern CVP Water Temperature Report

July - 2020

BUREAU OF RECLAMATION

All Data in this Report is Preliminary and Subject to Change

DATE	Mean Daily Water Temperatures (°F)													Mean Daily Release (CFS)			Mean Daily Air Temperatures (°F)			
	TCD[1]	SHD	SPP[1]	KWK	SAC	CCR	BSF[2]	JLF	BND	RDB	IGO	LWS	-----	Shasta Generation	Spring Creek P.P.	Keswick Total	RDD	BSF	RDB	LWS
Jun	51.3	50.5	52.8	51.9	52.4	53.1	54.8	56.1	56.9	57.9	56.4	51.5	-	9680	1497	11443	78.3	75.1	76.0	-
07/01	51.8	51.1	53.9	52.3	52.6	53.3	**54.7**	55.9	56.7	57.6	57.8	53.5	-	10503	1528	12478	80.0	77.1	77.3	-
07/02	51.7	51.1	54.0	52.6	52.9	53.6	**55.0**	56.2	57.0	57.9	57.8	54.0	-	10416	1387	12434	83.5	76.4	77.1	-
07/03	51.9	51.2	54.0	52.6	53.0	53.6	**55.1**	56.3	57.1	58.1	57.8	54.2	-	10356	1583	12458	77.0	73.8	73.8	-
07/04	52.0	51.5	54.1	52.7	53.0	53.7	**55.1**	56.2	57.0	58.0	57.8	54.4	-	10719	1372	12462	81.0	77.6	77.5	-
07/05	52.1	51.4	54.1	52.9	53.3	53.9	**55.3**	56.5	57.2	58.1	57.9	54.3	-	10691	1581	12446	81.0	78.3	80.3	-
07/06	51.7	51.1	54.2	52.9	53.3	53.9	**55.4**	56.6	57.3	58.3	58.0	53.7	-	9934	1646	12407	79.5	75.3	78.7	-
07/07	51.9	51.1	54.3	52.6	53.0	53.6	**55.2**	56.4	57.2	58.2	57.7	53.6	-	11412	1358	12361	78.0	75.6	76.0	-
07/08	52.0	51.2	54.4	52.7	53.0	53.6	**55.1**	56.3	57.1	58.1	58.4	53.5	-	10658	1111	12372	85.5	79.3	79.3	-
07/09	52.0	51.2	54.4	52.9	53.2	53.6	**55.3**	56.5	57.3	58.3	58.4	53.7	-	10630	1586	12313	82.5	79.6	80.0	-
07/10	52.2	51.4	54.5	52.9	53.3	53.8	**55.4**	56.6	57.4	58.5	58.5	53.8	-	10504	1624	12388	84.5	79.5	81.2	-
07/11	52.1	51.3	54.7	53.1	53.5	54.1	**55.7**	56.8	57.6	58.6	58.6	53.8	-	10458	1669	12330	85.0	80.2	81.4	-
07/12	51.9	51.0	54.7	53.1	53.5	54.0	**55.7**	56.9	57.8	58.8	58.5	53.2	-	9872	1736	12359	84.5	80.6	82.5	-
07/13	52.2	51.3	54.8	52.9	53.4	53.9	**55.6**	56.9	57.7	58.8	59.1	53.3	-	10979	1483	12356	85.5	80.3	81.0	-
07/14	52.4	51.4	54.8	53.1	53.5	54.0	**55.6**	56.9	57.7	58.8	58.6	53.7	-	10395	1466	12419	86.0	81.4	80.0	-
07/15	52.5	51.6	54.9	53.2	53.6	54.2	**55.9**	57.1	58.0	59.1	58.8	53.7	-	10712	1245	12393	90.0	84.3	83.0	-
07/16	52.0	51.2	55.0	53.3	53.7	54.4	**56.1**	57.4	58.3	59.4	59.1	53.6	-	11064	1046	12365	86.0	81.0	79.8	-
07/17	51.9	50.8	55.0	53.0	53.5	54.1	**55.9**	57.3	58.2	59.4	59.2	53.9	-	10863	1419	12381	85.5	80.5	79.8	-
07/18	52.0	51.0	55.1	52.9	53.3	53.7	**55.5**	56.7	57.7	59.0	58.9	54.1	-	10383	1461	12404	86.0	81.7	81.2	-
07/19	51.9	50.9	55.2	53.0	53.4	54.0	**55.6**	56.7	57.6	58.6	59.0	53.9	-	10482	1798	12415	88.5	83.5	83.6	-
07/20	51.9	50.9	55.2	53.0	53.4	54.0	**55.8**	57.0	57.9	59.1	59.3	53.8	-	10226	1643	12475	87.0	80.9	79.1	-
07/21	52.1	51.1	55.3	52.9	53.4	53.9	**55.6**	56.8	57.7	59.0	59.3	53.9	-	10405	1525	12461	85.5	79.6	78.4	-
07/22																				
07/23																				
07/24																				
07/25																				
07/26																				
07/27																				
07/28																				
07/29																				
07/30																				
07/31																				
Jul	52.0	51.2	54.6	52.9	53.3	53.9	55.5	56.7	57.5	58.6	58.5	53.8	-	10555	1489	12404	83.9	79.3	79.6	-
													Total CFS	221662	31267	260477				
													Total AF	439658	62017	516646				

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
07/01	64	94	79.0	66	96	81.0	62	96	79.0	62	95	78.5	62	97	79.5	63	98	80.5	63	98	80.5	63	97	80.0	66	92	79.0	64	94	79.0	66	95	80.5	64	95	79.5
07/02	64	96	80.0	73	97	85.0	62	95	78.5	62	98	80.0	62	97	79.5	61	97	79.0	62	95	78.5	62	95	78.5	65	96	80.5	65	94	79.5	65	94	79.5	66	98	82.0
07/03	71	96	83.5	63	94	78.5	61	96	78.5	61	98	79.5	61	96	78.5	61	94	77.5	61	94	77.5	62	94	78.0	63	92	77.5	66	96	81.0	67	95	81.0	66	96	81.0
07/04	62	92	77.0	65	97	81.0	61	97	79.0	61	95	78.0	60	94	77.0	61	96	78.5	62	94	78.0	61	97	79.0	66	96	81.0	67	95	81.0	67	95	81.0	66	95	80.5
07/05	64	98	81.0	62	99	80.5	61	97	79.0	61	95	78.0	63	98	80.5	64	96	80.0	63	98	80.5	64	101	82.5	65	95	80.0	64	90	77.0	64	92	78.0	65	94	79.5
07/06	62	100	81.0	63	97	80.0	59	96	77.5	62	99	80.5	64	98	81.0	63	100	81.5	64	102	83.0	65	103	84.0	67	97	82.0	66	97	81.5	66	94	80.0	65	96	80.5
07/07	62	97	79.5	60	97	78.5	64	100	82.0	64	100	82.0	63	100	81.5	65	102	83.5	64	102	83.0	65	102	83.5	68	101	84.5	69	100	84.5	70	99	84.5	68	100	84.0
07/08	59	97	78.0	73	100	86.5	64	100	82.0	64	101	82.5	64	102	83.0	64	102	83.0	66	102	84.0	66	103	84.5	73	105	89.0	71	102	86.5	70	98	84.0	67	98	82.5
07/09	73	98	85.5	68	100	84.0	64	102	83.0	65	103	84.0	65	105	85.0	67	105	86.0	69	105	87.0	69	104	86.5	71	102	86.5	69	101	85.0	70	99	84.5	67	100	83.5
07/10	65	100	82.5	67	102	84.5	65	104	84.5	65	104	84.5	68	105	86.5	69	107	88.0	70	108	89.0	69	101	85.0	70	101	85.5	69	101	85.0	70	99	84.5	67	98	82.5
07/11	67	102	84.5	68	104	86.0	65	104	84.5	68	104	86.0	69	107	88.0	70	109	89.5	70	105	87.5	69	103	86.0	71	102	86.5	69	101	85.0	69	99	84.0	66	98	82.0
07/12	66	104	85.0	66	105	85.5	68	103	85.5	67	106	86.5	69	109	89.0	70	105	87.5	69	104	86.5	69	104	86.5	71	103	87.0	69	102	85.5	69	97	83.0	65	96	80.5
07/13	65	104	84.5	77	104	90.5	67	106	86.5	69	109	89.0	70	104	87.0	70	102	86.0	68	104	86.0	68	105	86.5	67	100	83.5	66	100	83.0	68	98	83.0	66	98	82.0
07/14	69	102	85.5	69	104	86.5	67	110	88.5	69	104	86.5	69	102	85.5	68	104	86.0	67	104	85.5	68	104	86.0	68	102	85.0	67	100	83.5	69	98	83.5	67	100	83.5
07/15	68	104	86.0	69	110	89.5	69	106	87.5	69	102	85.5	68	105	86.5	68	106	87.0	68	106	87.0	68	105	86.5	71	106	88.5	70	105	87.5	71	101	86.0	68	100	84.0
07/16	69	111	90.0	70	106	88.0	69	102	85.5	67	104	85.5	69	106	87.5	70	107	88.5	69	104	86.5	67	101	84.0	66	97	81.5	65	94	79.5	66	94	80.0	64	96	80.0
07/17	69	103	86.0	71	101	86.0	67	104	85.5	69	106	87.5	68	105	86.5	68	105	86.5	67	101	84.0	64	100	82.0	66	99	82.5	66	100	83.0	68	98	83.0	66	98	82.0
07/18	71	100	85.5	70	104	87.0	68	106	87.0	68	105	86.5	67	103	85.0	66	99	82.5	64	98	81.0	65	100	82.5	67	98	82.5	66	101	83.5	67	99	83.0	66	99	82.5
07/19	69	103	86.0	71	106	88.5	68	106	87.0	68	104	86.0	65	101	83.0	65	100	82.5	66	101	83.5	66	102	84.0	67	102	84.5	68	101	84.5	70	100	85.0	66	98	82.0
07/20	70	107	88.5	73	105	89.0	68	104	86.0	67	99	83.0	65	98	81.5	65	99	82.0	64	99	81.5	64	101	82.5	67	100	83.5	67	102	84.5	69	100	84.5	66	98	82.0
07/21	72	102	87.0	71	102	86.5	66	99	82.5	64	96	80.0	65	99	82.0	64	100	82.0	65	104	84.5	68	106	87.0	71	107	89.0	70	103	86.5	70	100	85.0	66	100	83.0
07/22	71	100	85.5	71	98	84.5	65	97	81.0	65	100	82.5	64	101	82.5	66	104	85.0	67	104	85.5	68	103	85.5	66	97	81.5	65	93	79.0	66	95	80.5	65	97	81.0
07/23																																					
07/24																																					
07/25																																					
07/26																																					
07/27																																					
07/28																																					
07/29																																					
07/30																																					
07/31																																					

Web Links

[10-Day Min/Max Forecast]

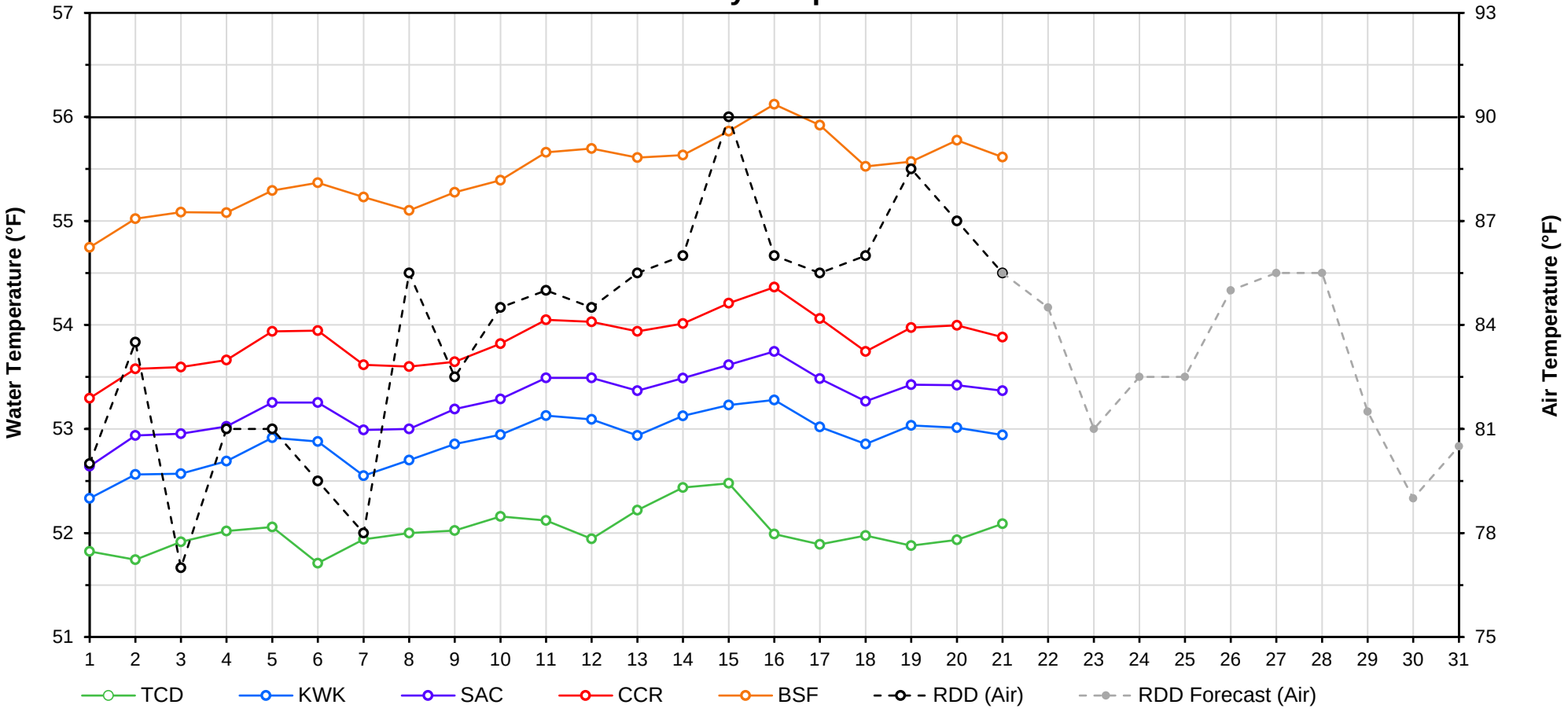
[Previous Days Min/Max Actuals]

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

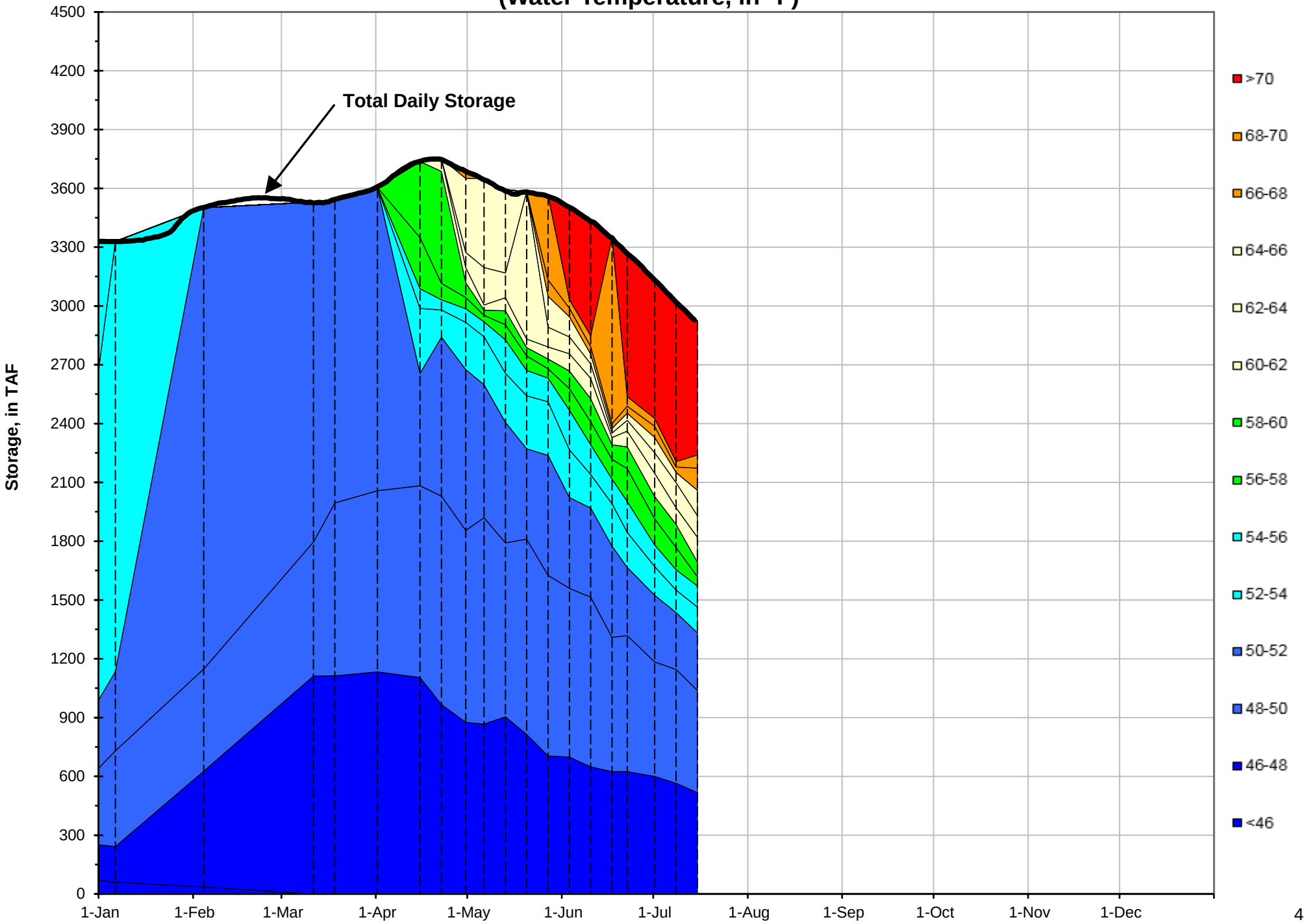
Temperature Control Point		
Point	Temp. (°F)	Begin Date
BSF	**56.0**	**5/15/2019**

Notes

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

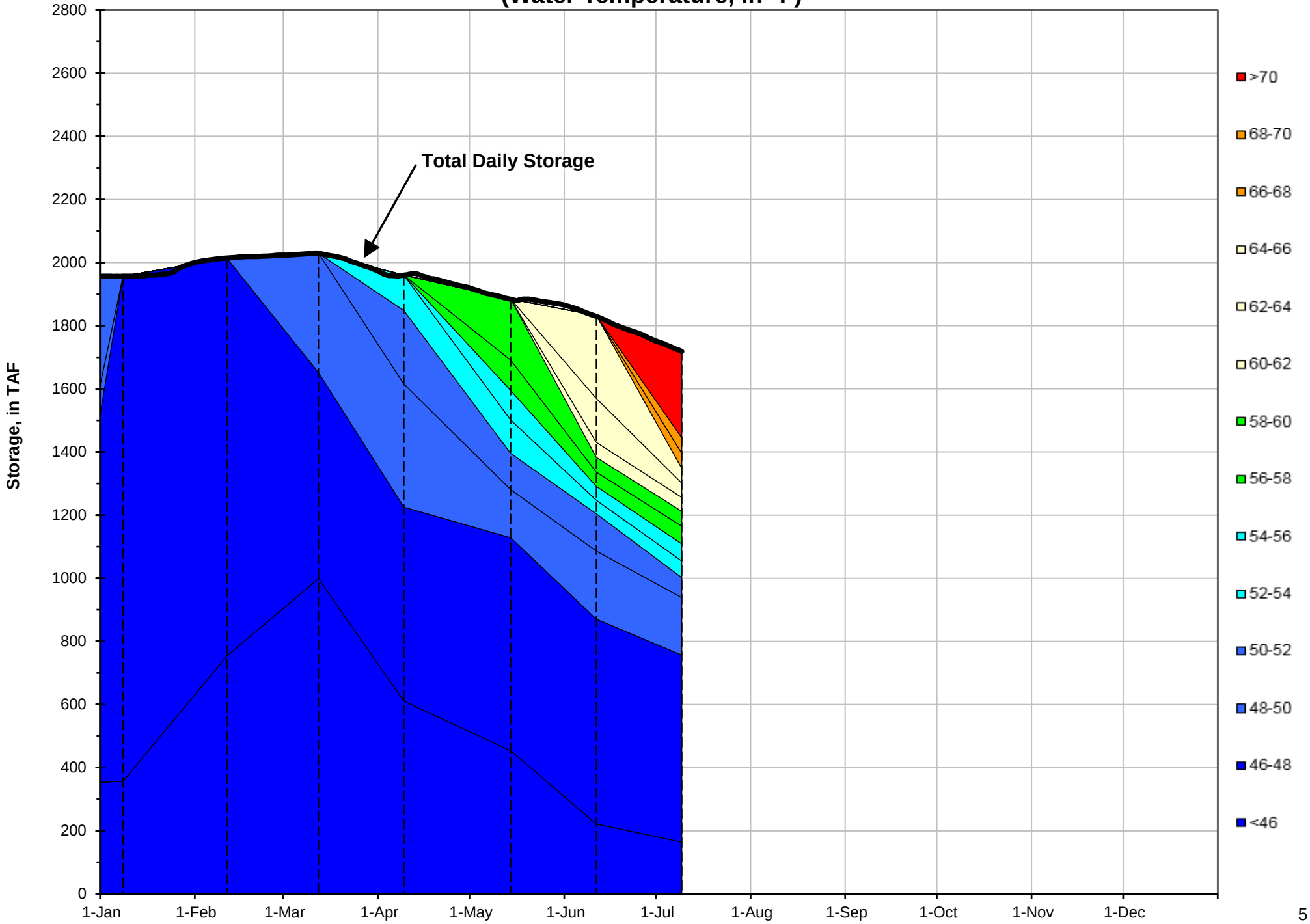
Latest Profile Date: 07/15/2020

Shasta Lake Isothermobaths - 2020
(Water Temperature, in °F)



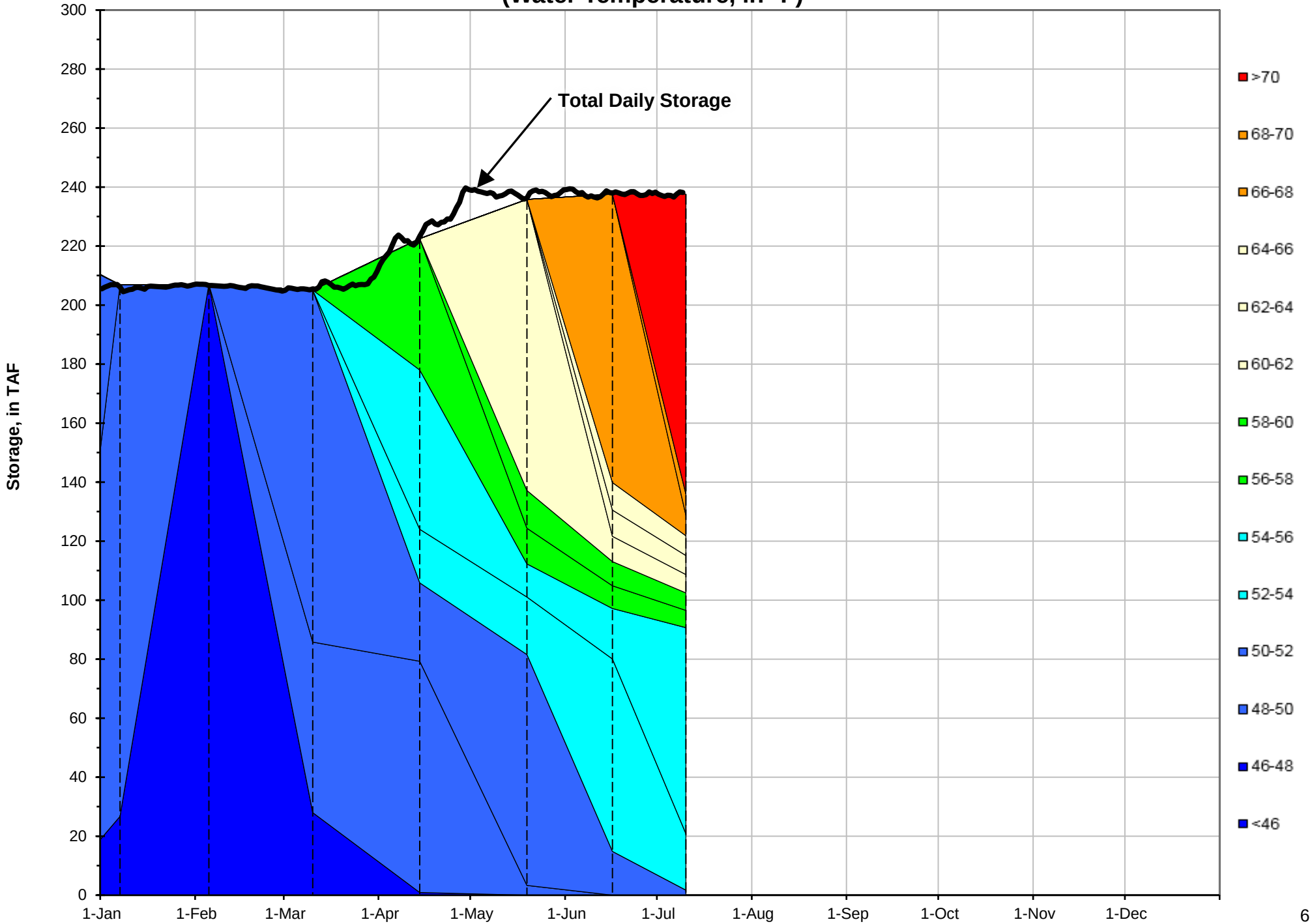
Latest Profile Date: 07/09/2020

Trinity Lake Isothermobaths - 2020
(Water Temperature, in °F)



Latest Profile Date: 07/10/2020

Whiskeytown Lake Isothermobaths - 2020
(Water Temperature, in °F)

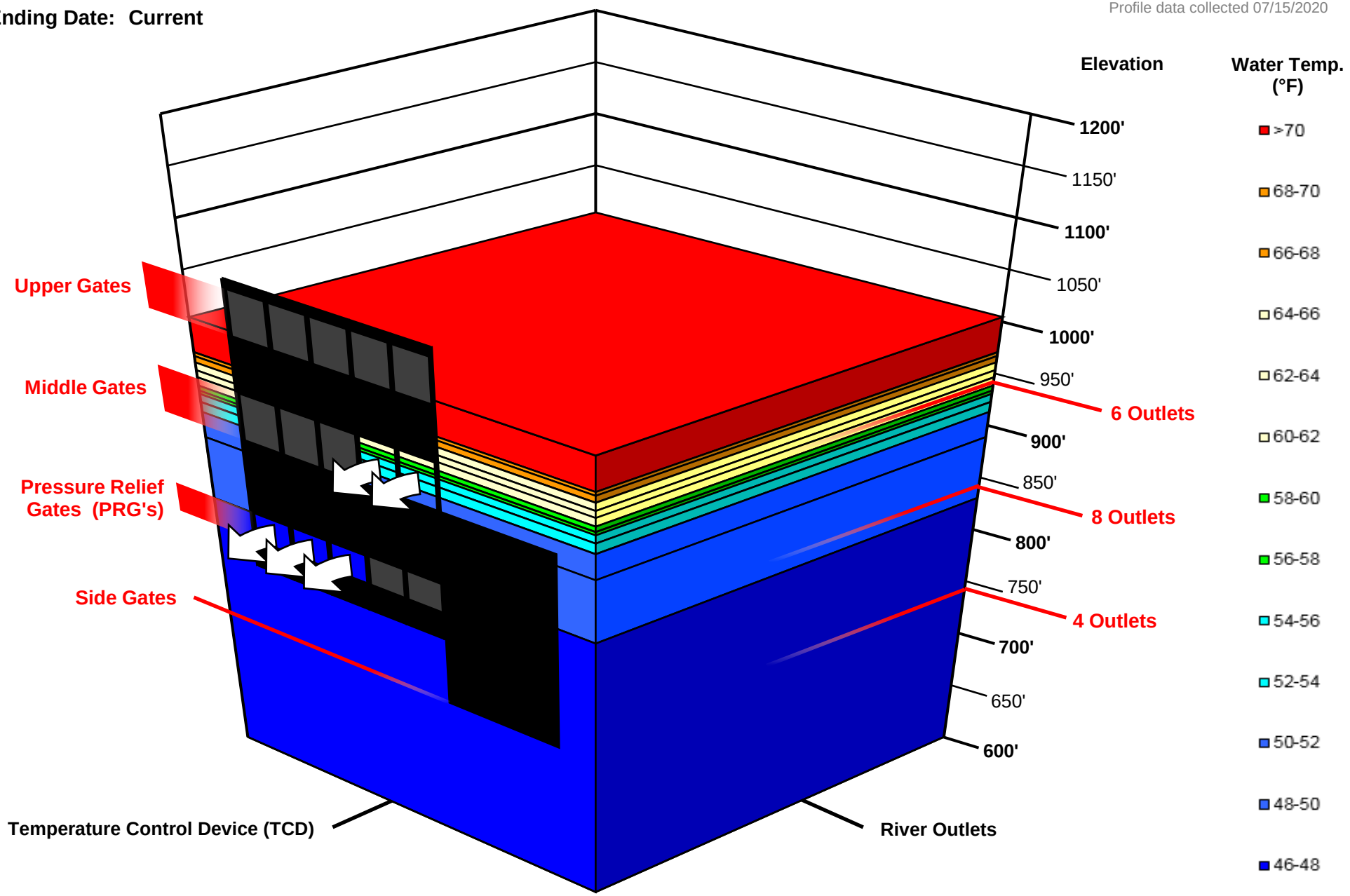


Shasta TCD Configuration

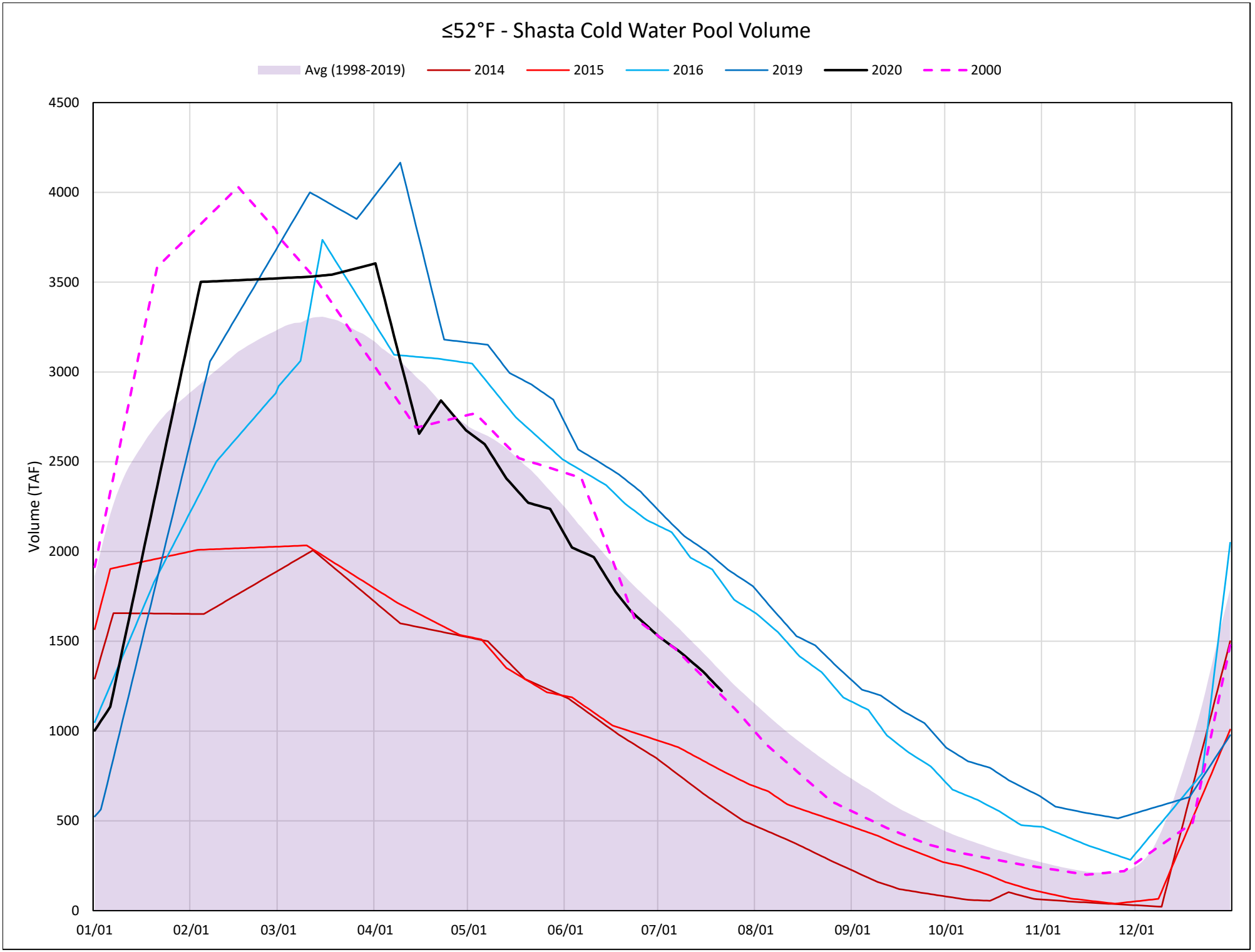
Starting Date: 7/20/2020

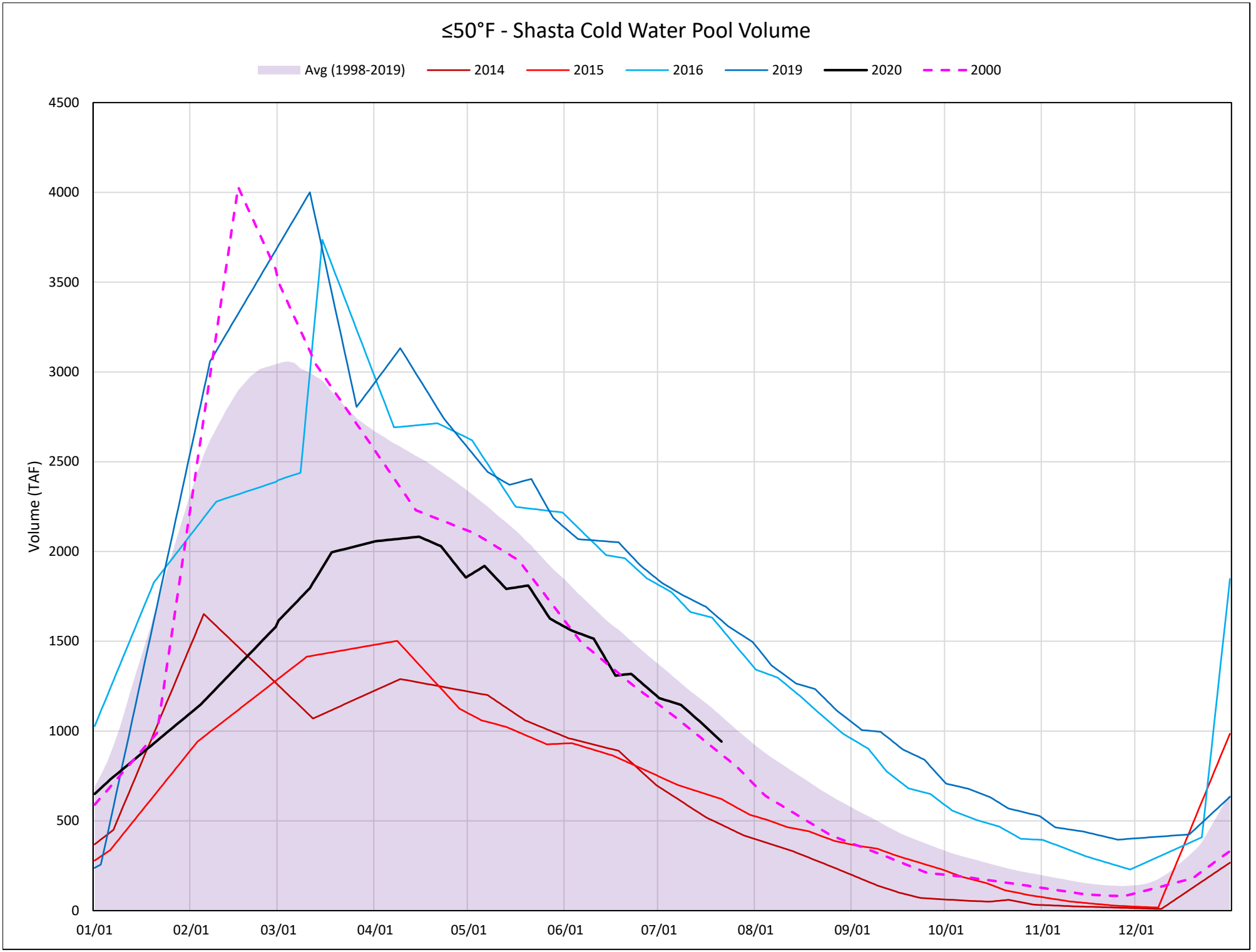
Ending Date: Current

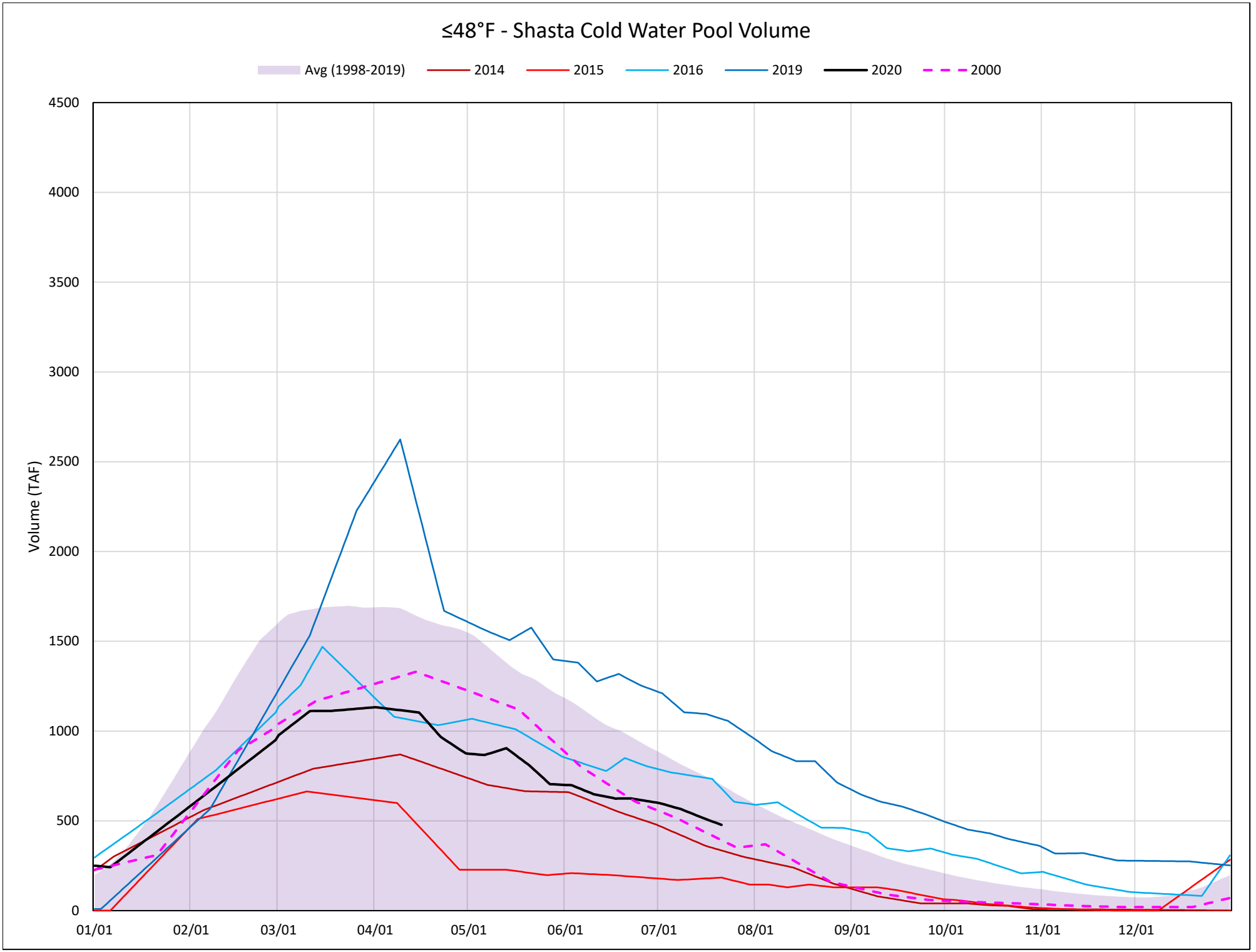
Profile data collected 07/15/2020

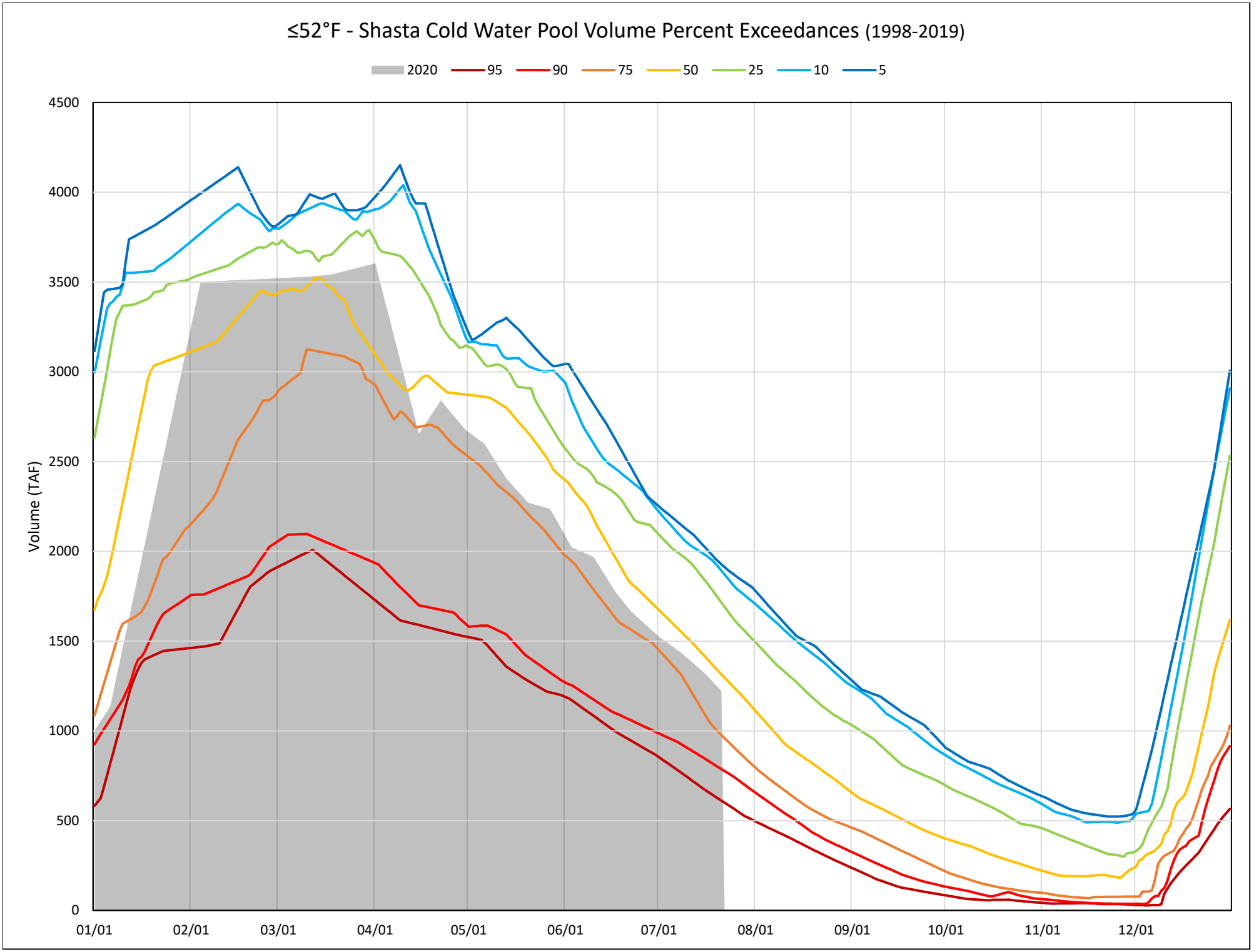


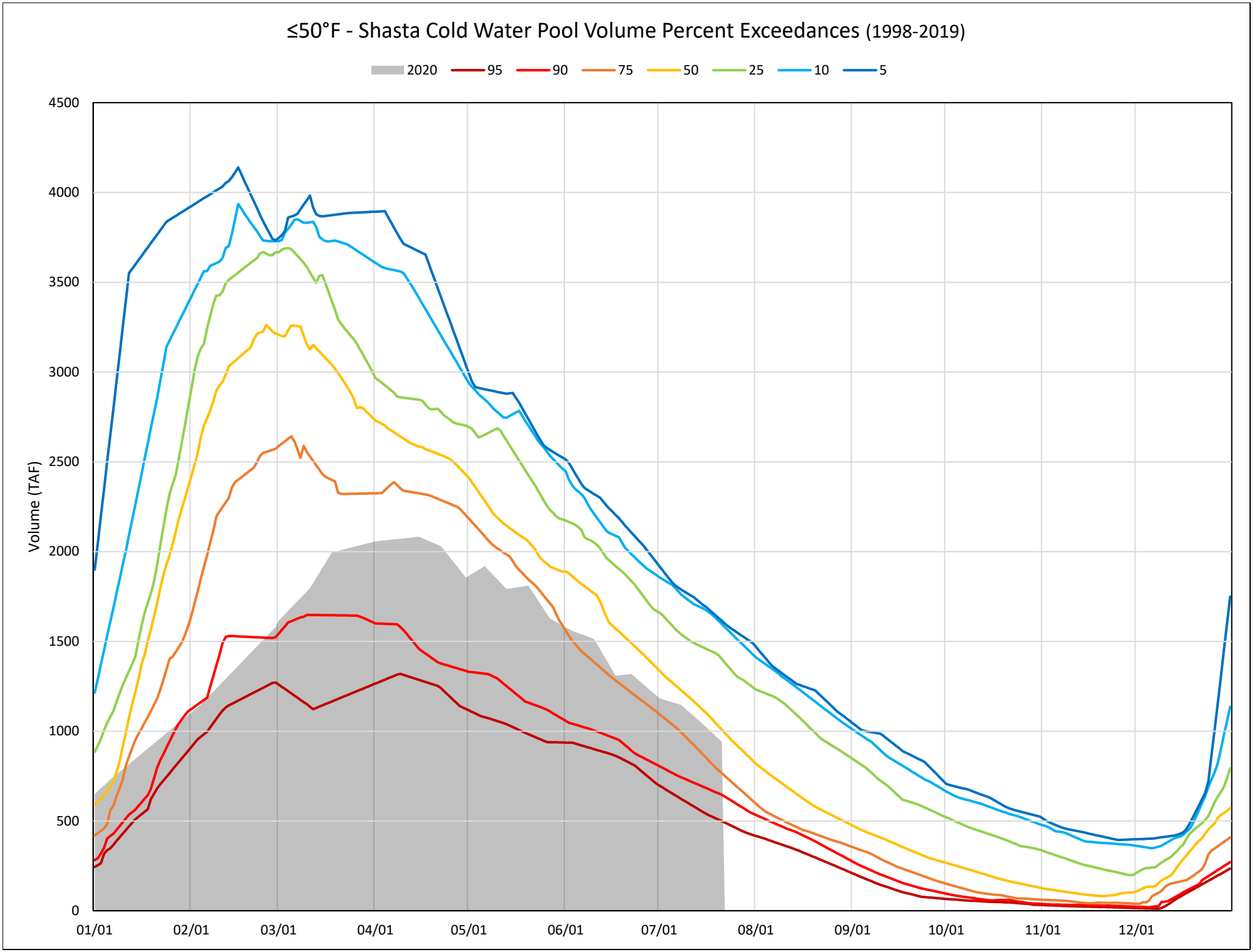
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

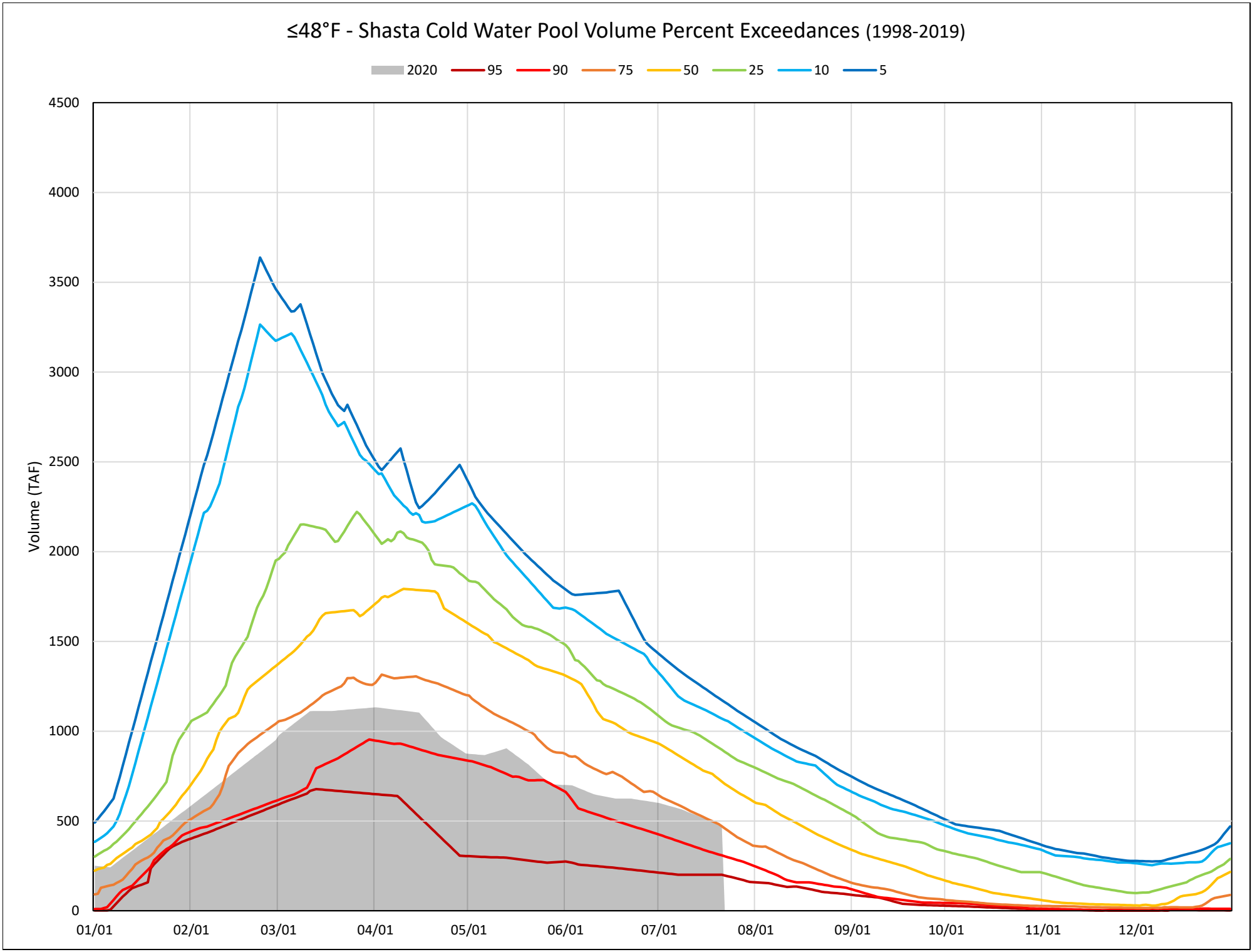

≤52°F - Shasta Cold Water Pool Volume
Avg (1998-2019)
2014
2015
2016
2019
2020
2000
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤50°F - Shasta Cold Water Pool Volume
Avg (1998-2019)
2014
2015
2016
2019
2020
2000
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 (1998-2019)
2014
2015
2016
2019
2020
2000
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

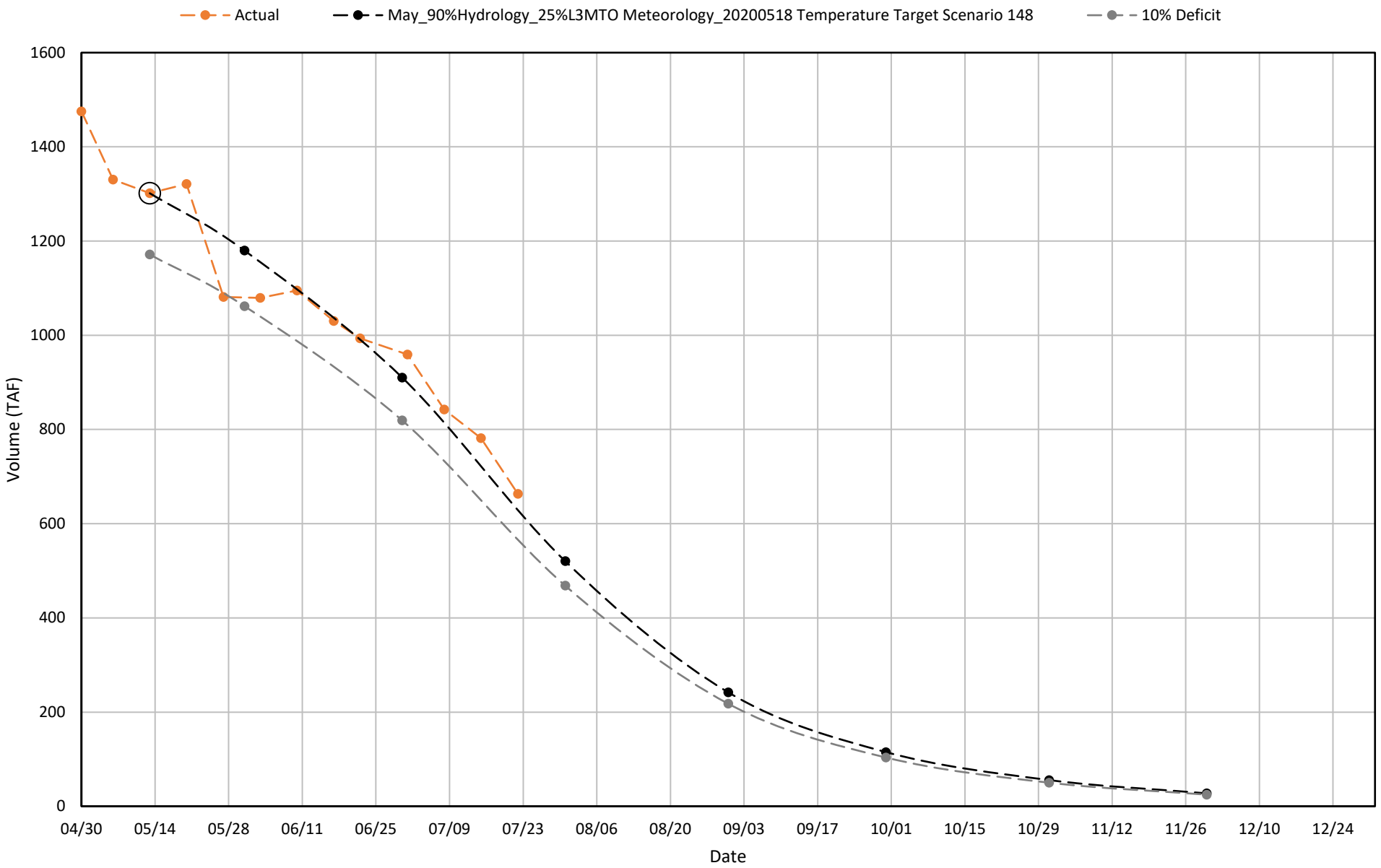

≤52°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

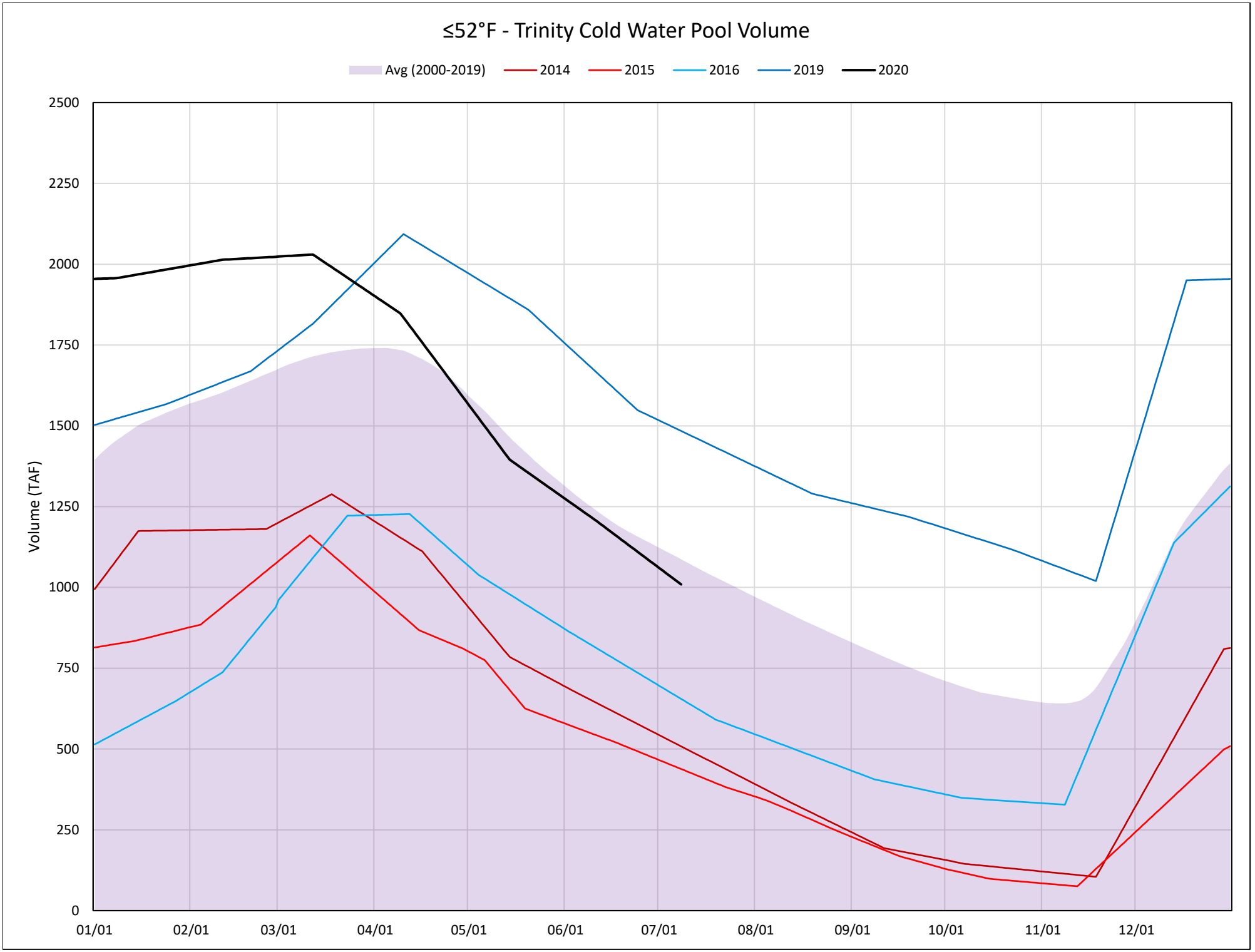

≤50°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

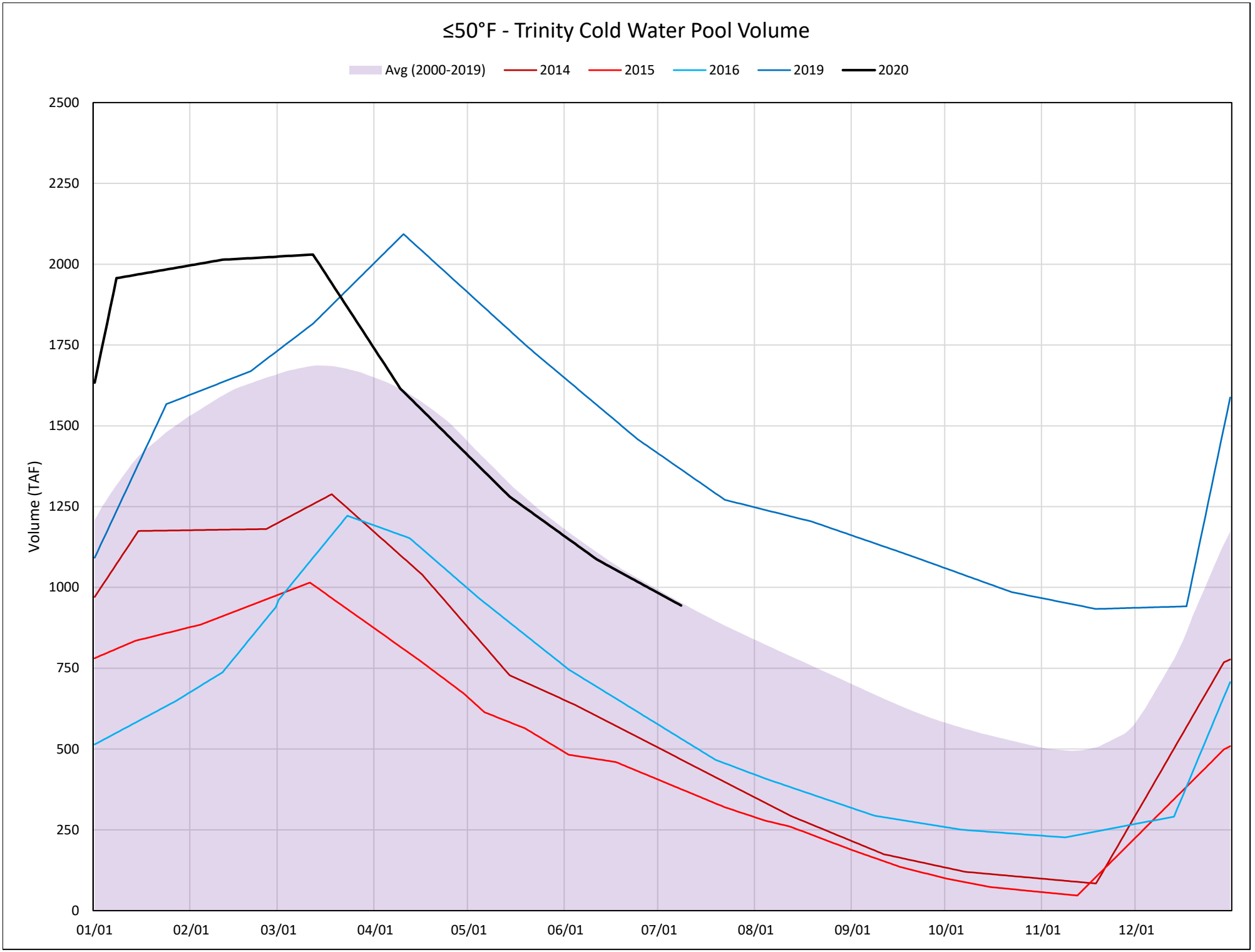

≤48°F - Shasta Cold Water Pool Volume Percent Exceedances (1998-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

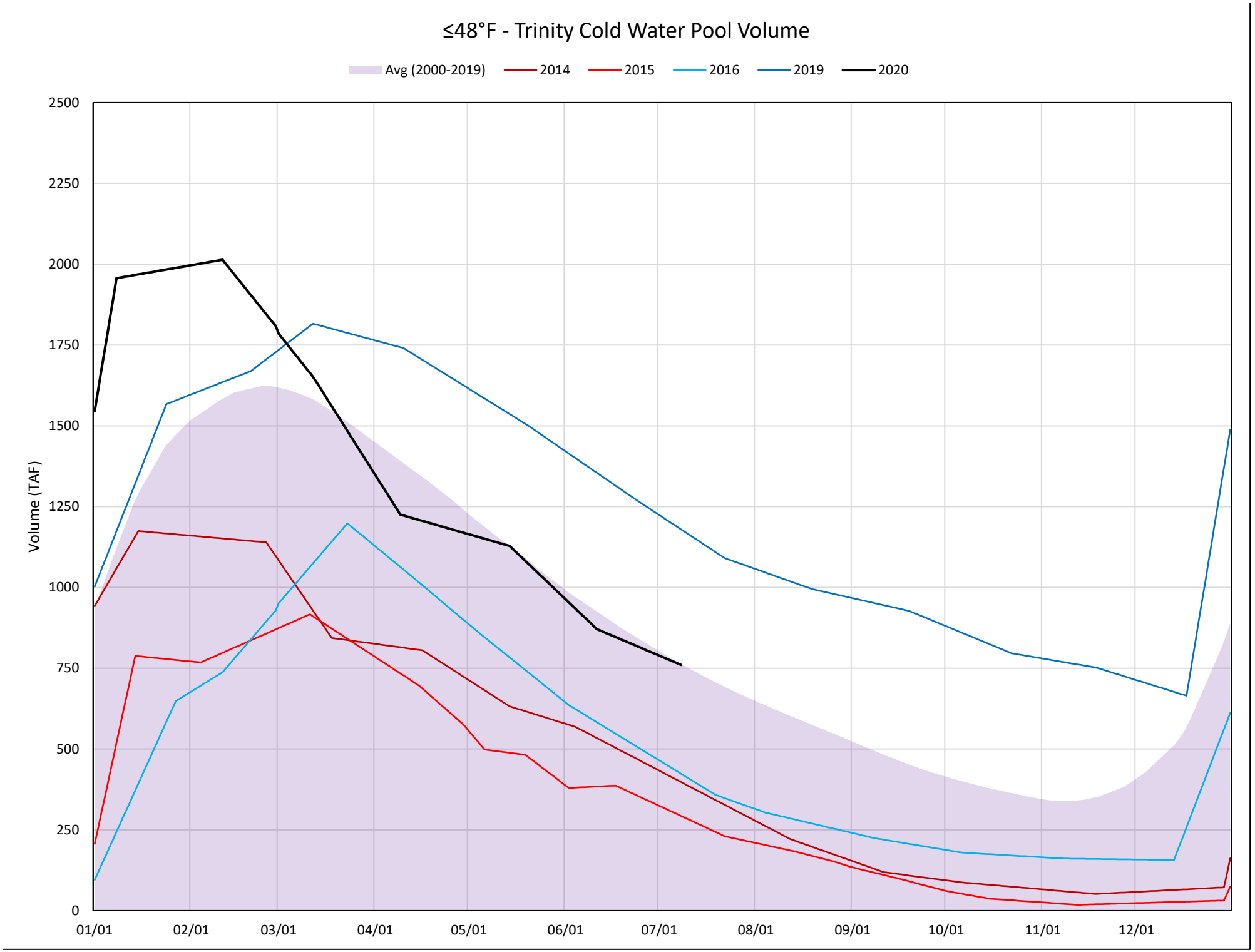
Printed: 2020.07.22

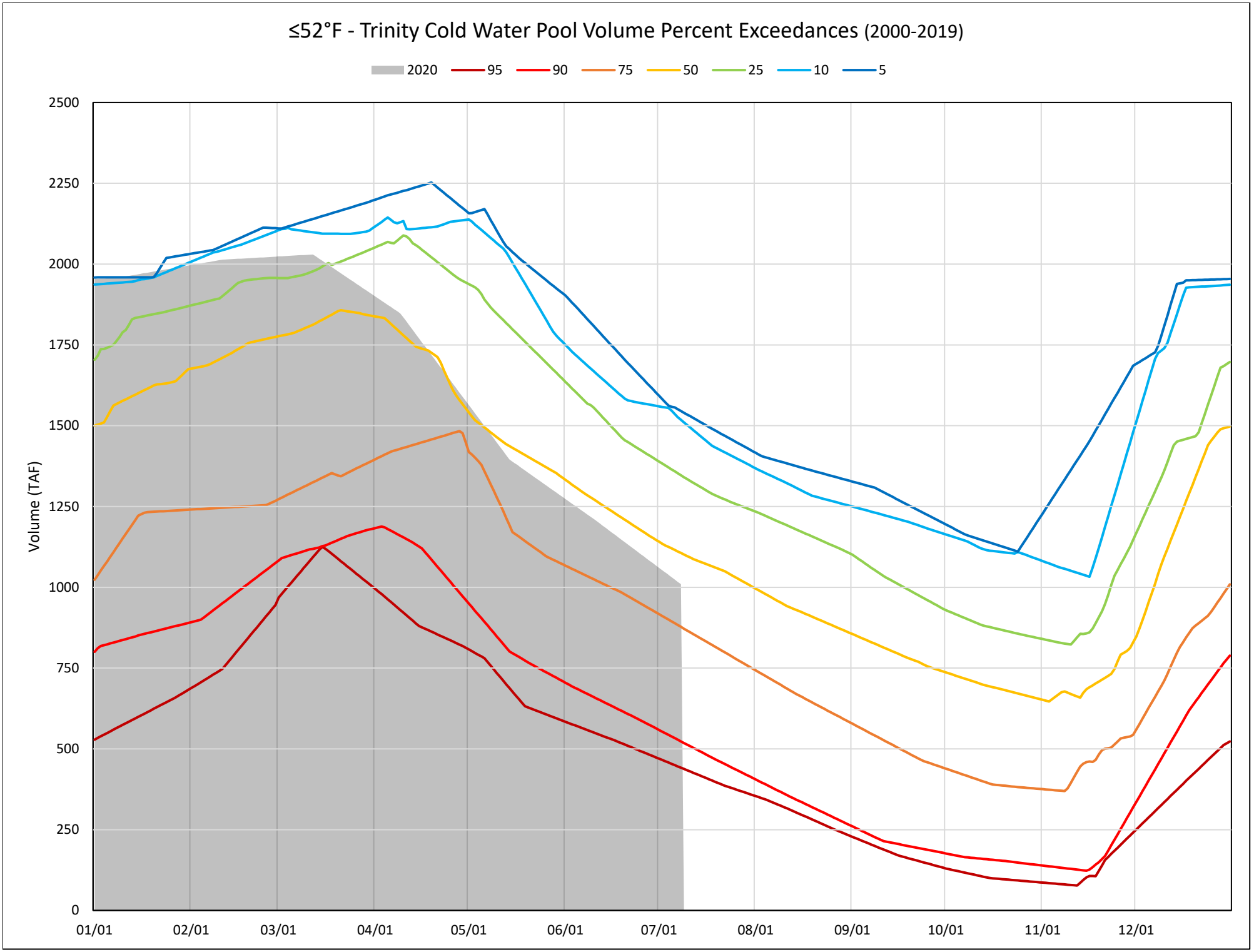
2020 Shasta Cold Water Pool Volume ≤49°F

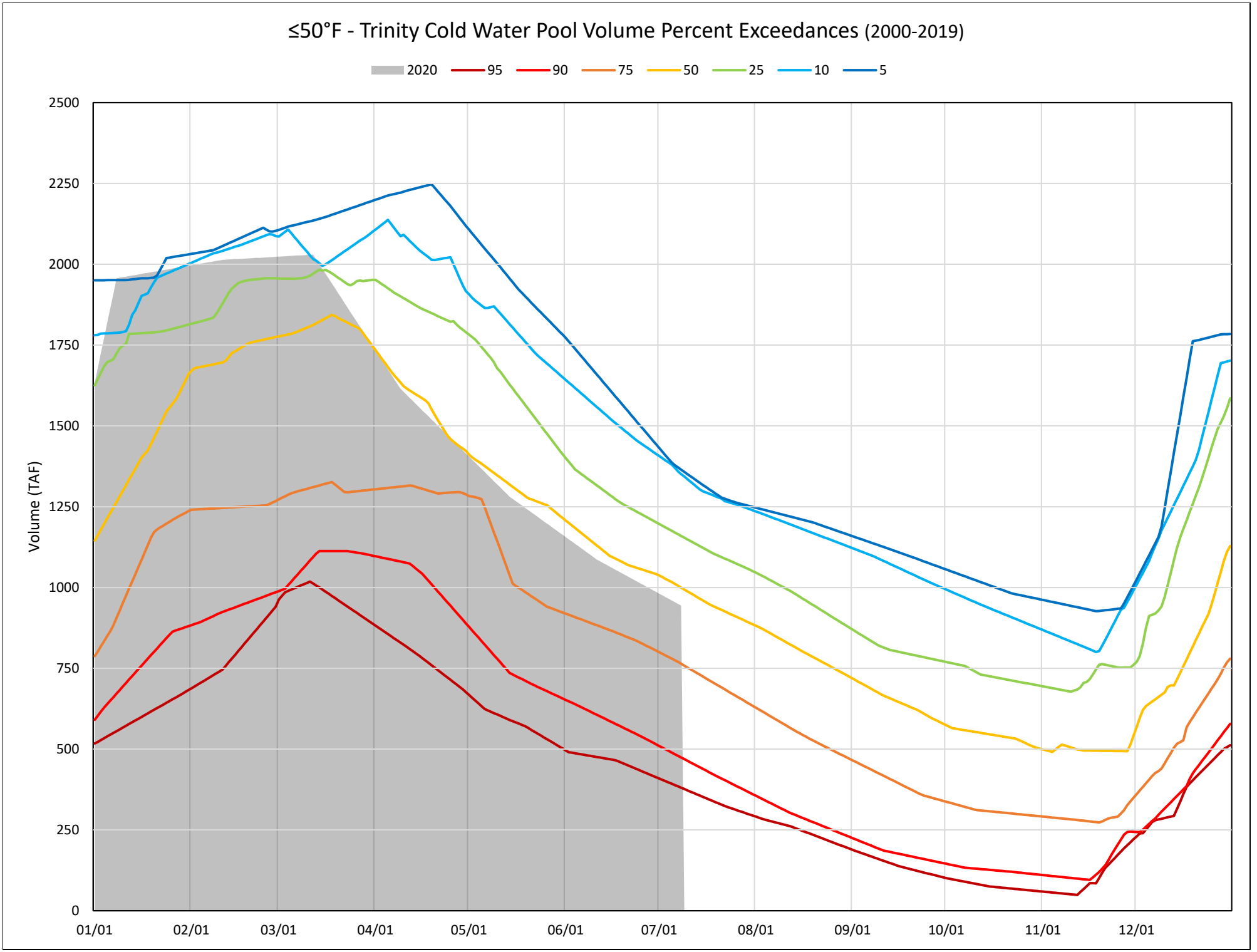


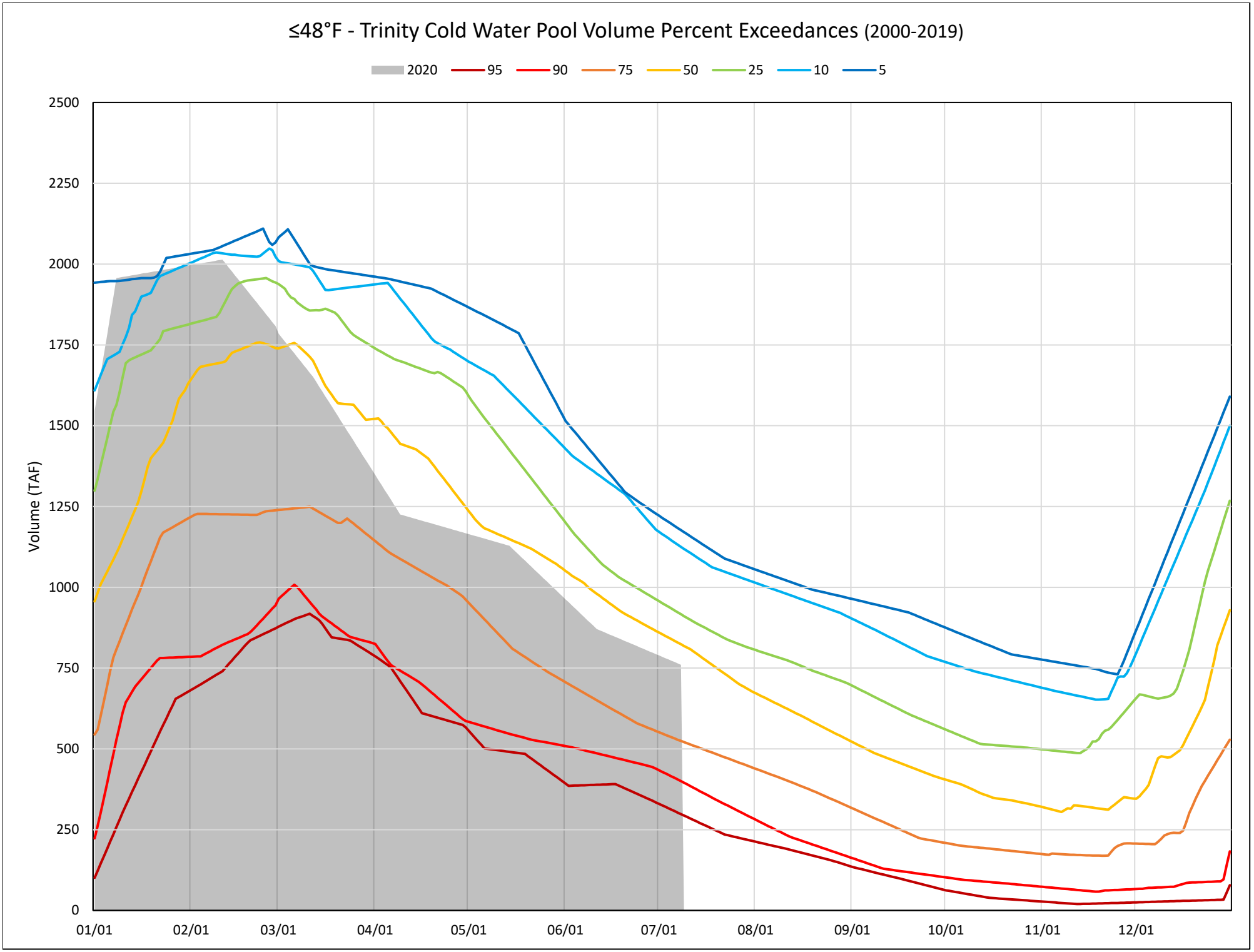

≤52°F - Trinity Cold Water Pool Volume
Avg (2000-2019)
2014
2015
2016
2019
2020
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

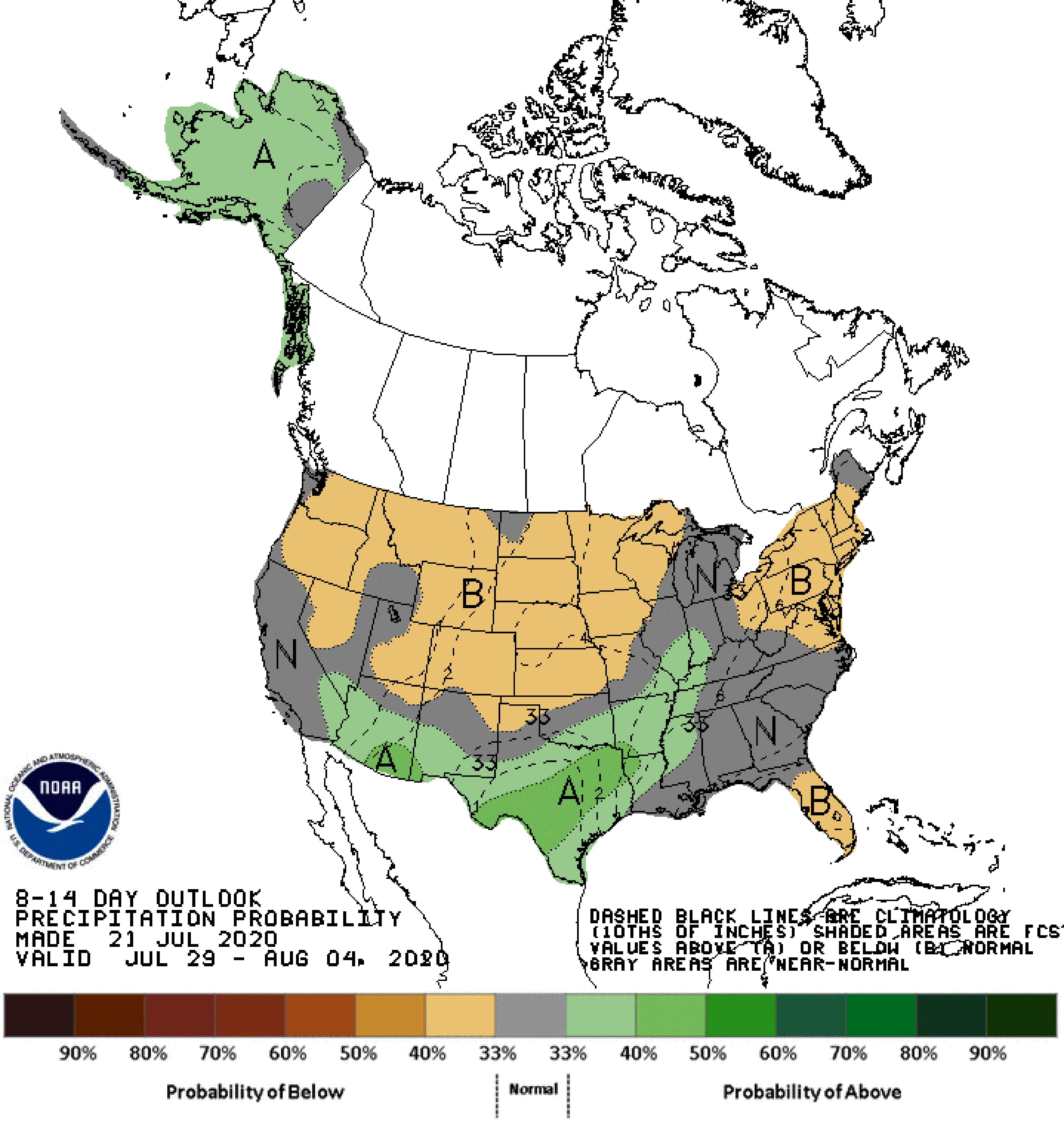

≤50°F - Trinity Cold Water Pool Volume
Avg (2000-2019)
2014
2015
2016
2019
2020
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01

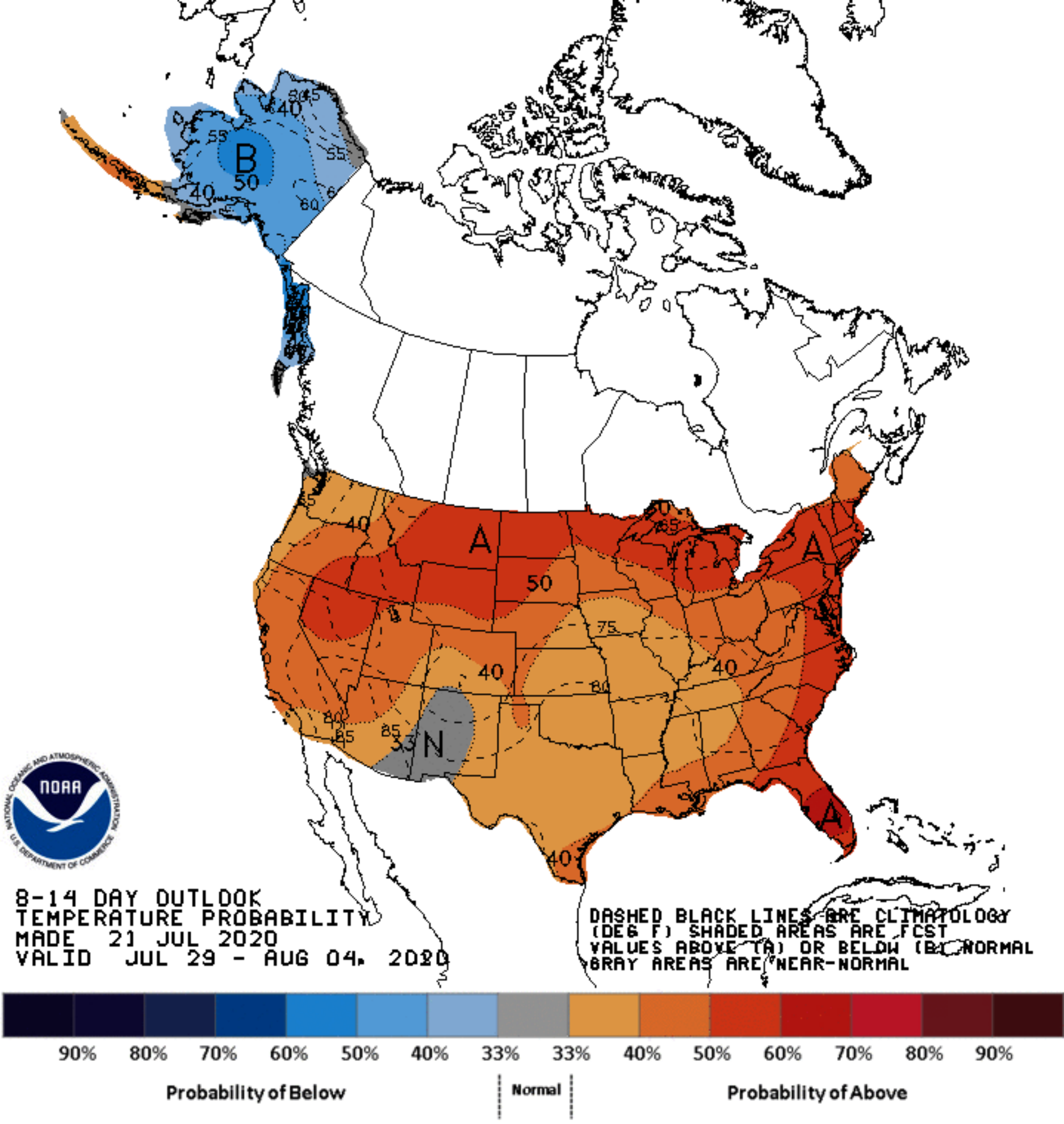

≤48°F - Trinity Cold Water Pool Volume
Avg (2000-2019)
2014
2015
2016
2019
2020
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
01/01
02/01
03/01
04/01
05/01
06/01
07/01
08/01
09/01
10/01
11/01
12/01


≤52°F - Trinity Cold Water Pool Volume Percent Exceedances (2000-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
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 - Trinity Cold Water Pool Volume Percent Exceedances (2000-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
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 - Trinity Cold Water Pool Volume Percent Exceedances (2000-2019)
2020
95
90
75
50
25
10
5
Volume (TAF)
2500
2250
2000
1750
1500
1250
1000
750
500
250
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


NOAA
8-14 DAY OUTLOOK
PRECIPITATION PROBABILITY
MADE 21 JUL 2020
VALID JUL 29 - AUG 04, 2020
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 JUL 2020
VALID JUL 29 - AUG 04, 2020
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

July 21, 2020

Upper Sacramento River – July 2020 Preliminary Temperature Analysis

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

Model Run	Location	Jul	Aug	Sep*	Oct*
90% Hydro. - 25% L3MTO Met. Scenario 148 – Delay Side Gate Use	Keswick Dam KWK	53.5	53.3	See Fig. 7	See Fig. 7
	Sac. R. abv Clear Creek CCR	53.9	53.7	See Fig. 8	See Fig. 8
	Airport Road	54.4	54.3	n/a	n/a
	Balls Ferry BSF	55.3	55.2	See Fig. 9	See Fig. 9
90% Hydro. - 25% L3MTO Met. Scenario 148 – Extend 53.5°F in August	Keswick Dam KWK	53.5	53.1	See Fig. 7	See Fig. 7
	Sac. R. abv Clear Creek CCR	53.9	53.5	See Fig. 8	See Fig. 8
	Airport Road	54.4	54.1	n/a	n/a
	Balls Ferry BSF	55.3	55.0	See Fig. 9	See Fig. 9
90% Hydro. - 25% L3MTO Met. Scenario 148 – Extend 54°F in September	Keswick Dam KWK	53.5	53.3	See Fig. 7	See Fig. 7
	Sac. R. abv Clear Creek CCR	53.9	53.7	See Fig. 8	See Fig. 8
	Airport Road	54.4	54.3	n/a	n/a
	Balls Ferry BSF	55.3	55.2	See Fig. 9	See Fig. 9

Summary of Shasta Lake Cold Water Pool and TCD Operation

Model Run	End of September Cold Water Pool <56°F (TAF)	First Side Gate Use (Date)	Full Side Gate Use (Date)
90% Hydro. - 25% L3MTO Met. Scenario 148 – Delay Side Gate Use	500	8/21	10/30
90% Hydro. - 25% L3MTO Met. Scenario 148 – Extend 53.5°F in August	495	8/15	10/30
90% Hydro. - 25% L3MTO Met. Scenario 148 – Extend 54°F in September	482	8/21	9/23

Model Run Date July 17, 2020

* 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 7-9). 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 Shasta tailbay temperature targets. The temperature results for the Sacramento River between Keswick Dam and Balls Ferry and the Trinity River are shown in Figures 1-6. 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 7-9.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on July 15, July 9, and July 10, respectively. Initial temperature profiles are adjusted and noted at Whiskeytown and Trinity using simulated results if the length of time between monitoring is large. 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 can cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the June 2020 Operation Outlooks (monthly flows, reservoir release, and end-of-month reservoir storage) for the 90%- and 50%-exceedances (when available), with minor modifications to accommodate for within month real-time operations (e.g. flood operations, underestimated system demands/requirements, etc.). After September, historical information is used for inflow. 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 representation of the State and Federal regulatory environment under NMFS and FWS 2019 Biological Opinions.
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 95% historical exceedance for both the 90% and 50% runoff exceedance studies.
6. Meteorological inputs represent historical (1985 – 2017) monthly mean equilibrium temperature non-exceedance at 25% and 50% (when available) 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 (L3MTO), 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 (CCR).

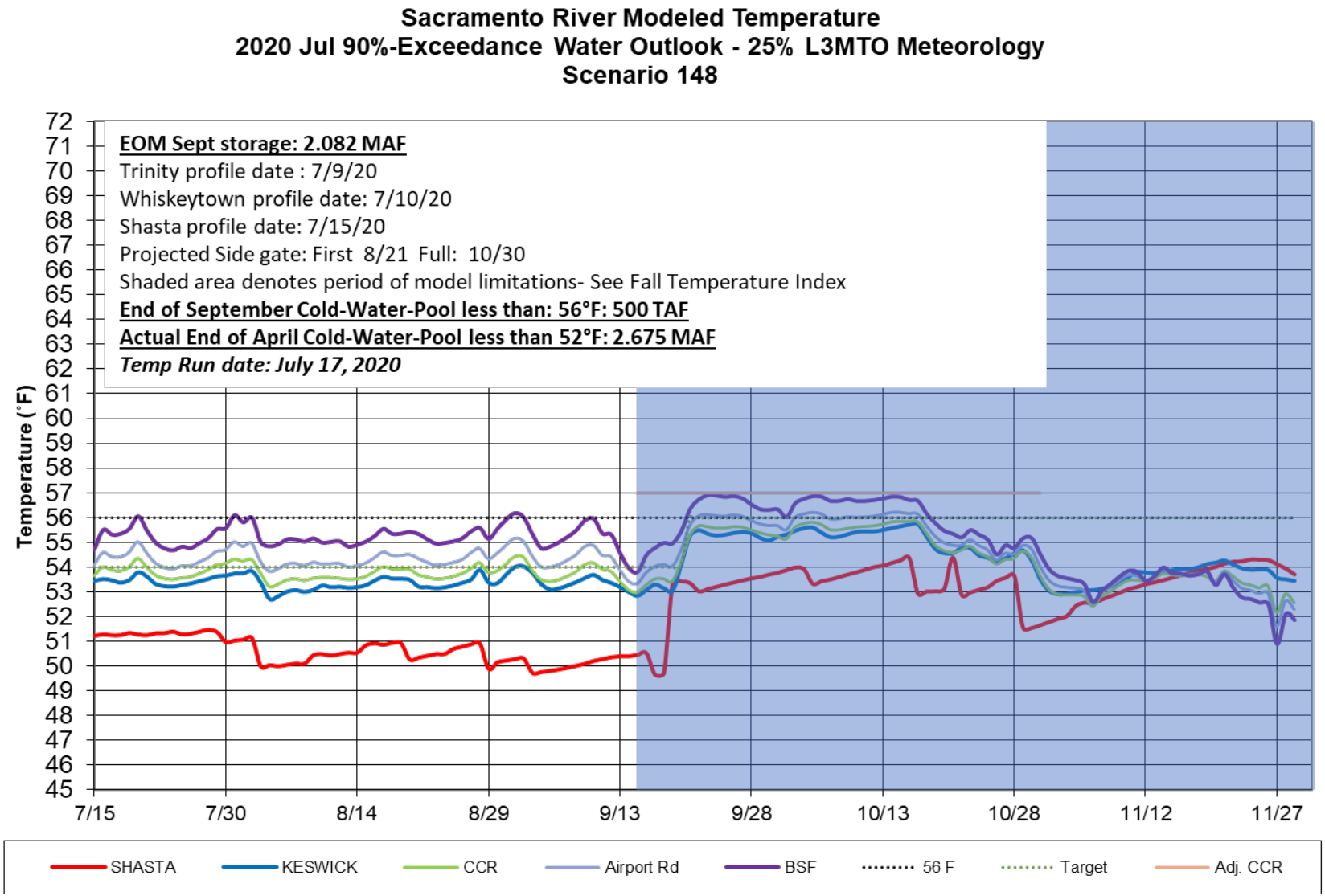


Figure 1. July 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology delaying the side gate use in August.

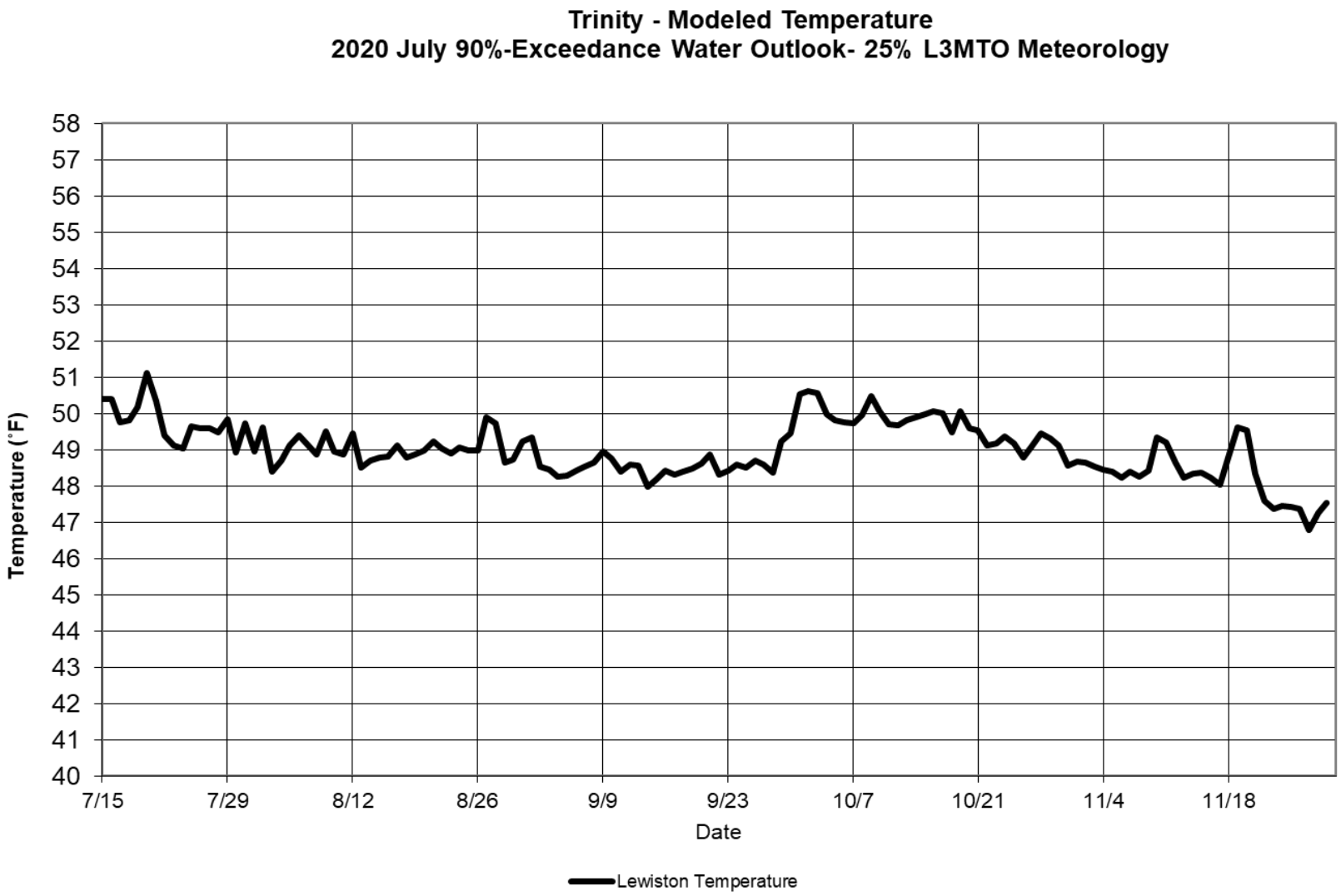


Figure 2. July 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology delaying the side gate use in August.

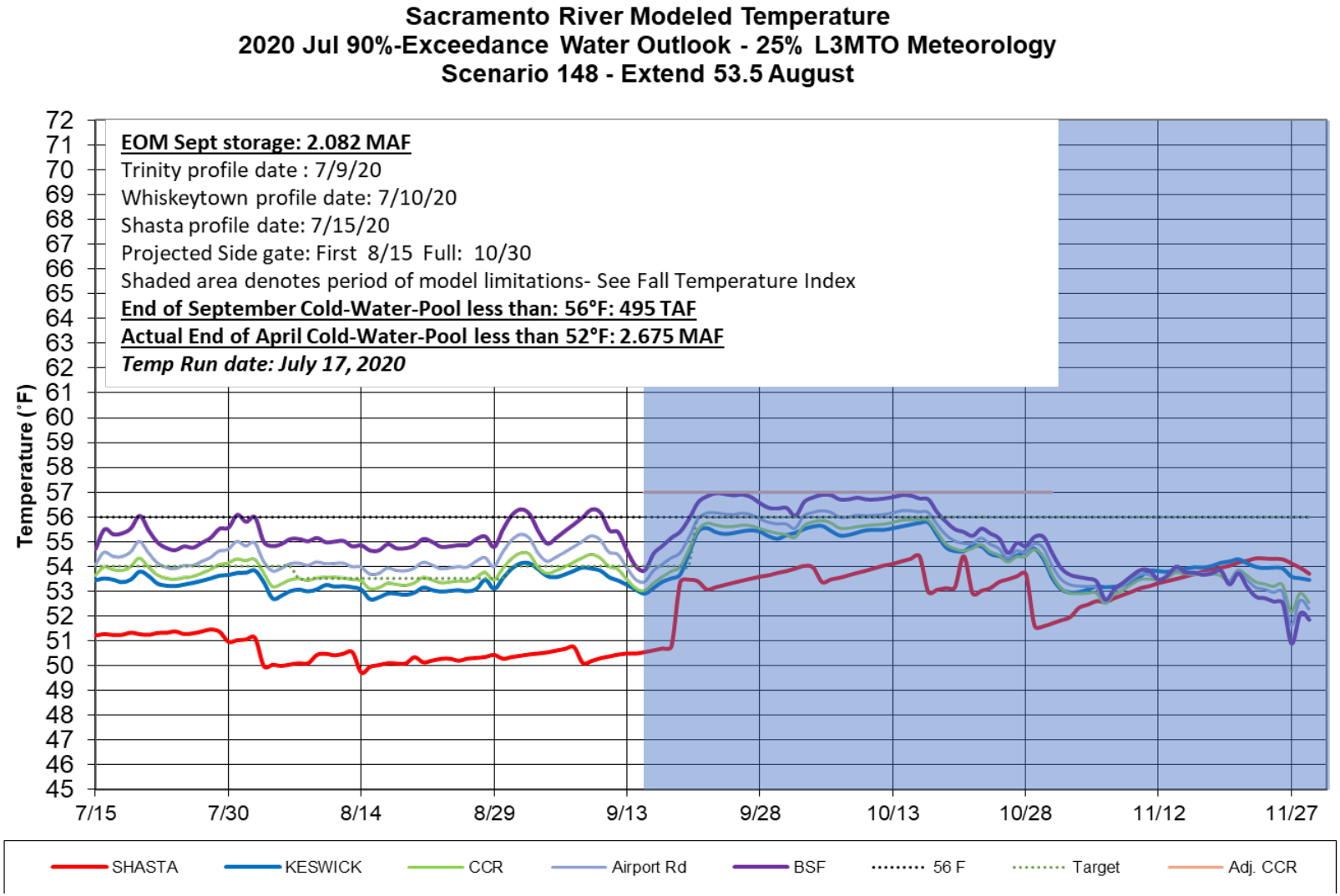


Figure 3. July 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology Extending 53.5 at CCR in August.

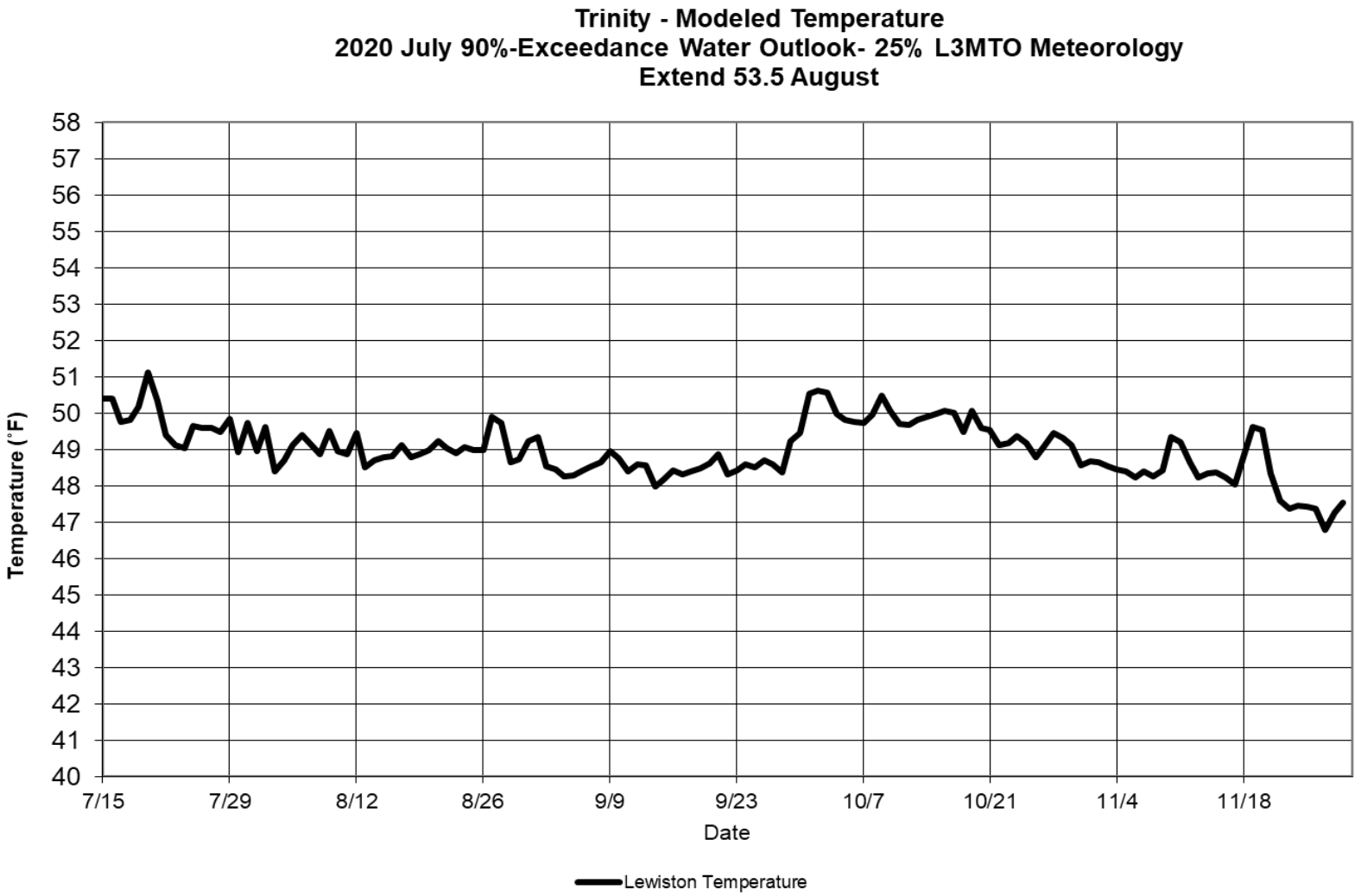


Figure 4. July 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology Extending 53.5 at CCR in August.

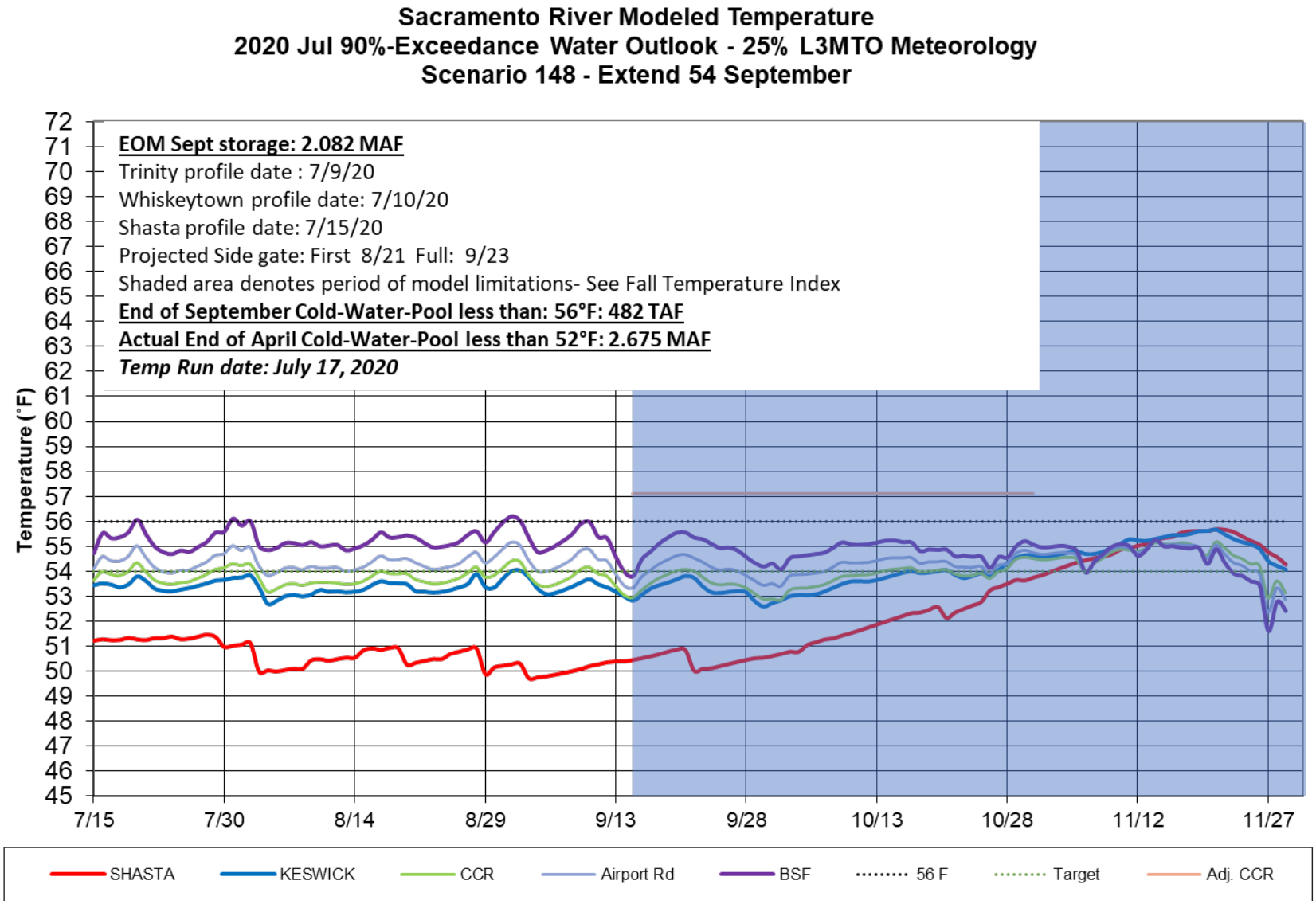


Figure 5. July 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology Extending 54 at CCR in September.

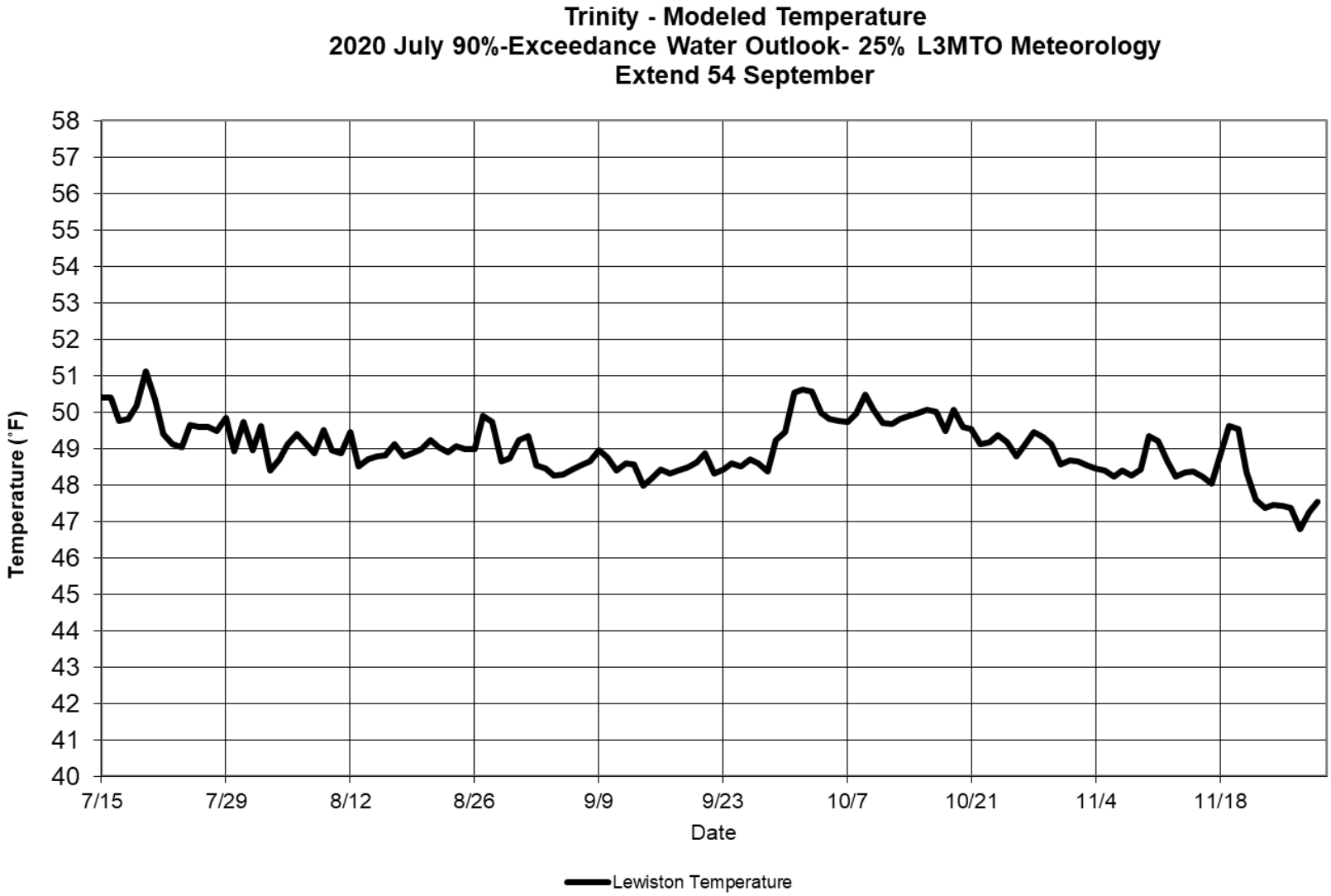


Figure 6. July 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% L3MTO meteorology Extending 54 at CCR in September.

Figures 7-9 <u>Model Performance and Fall Temperature Index</u>:

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

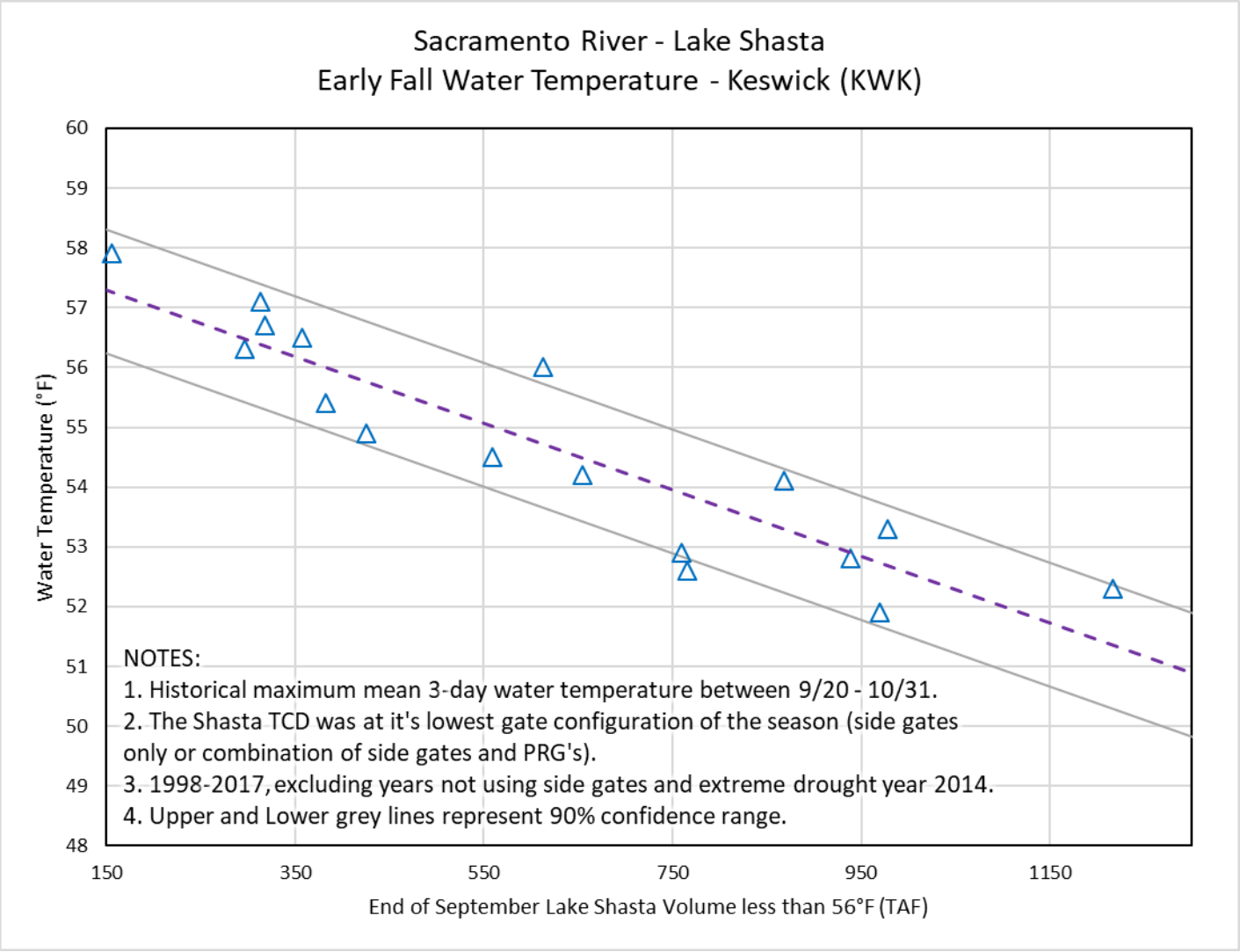


Figure 7. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

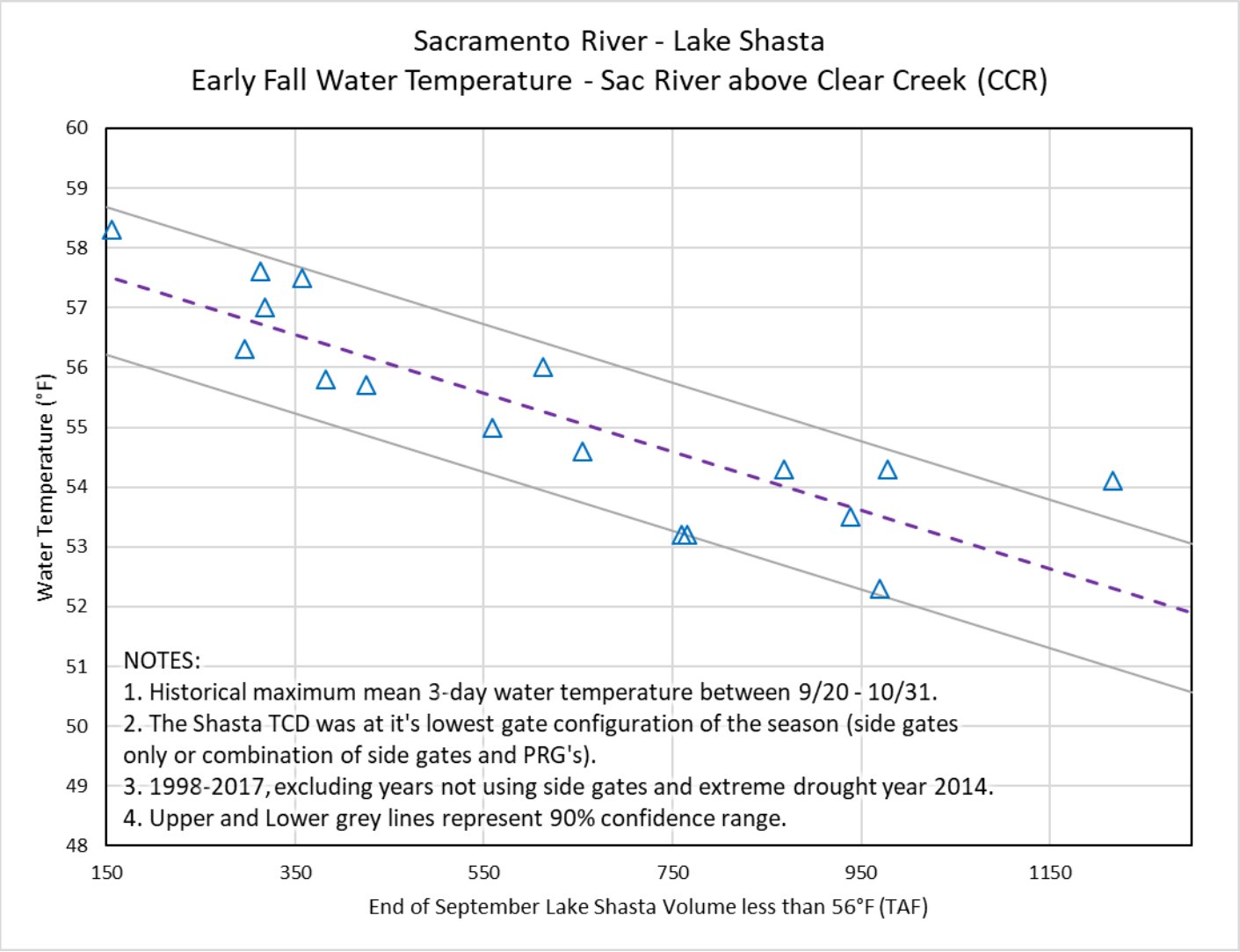


Figure 8. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

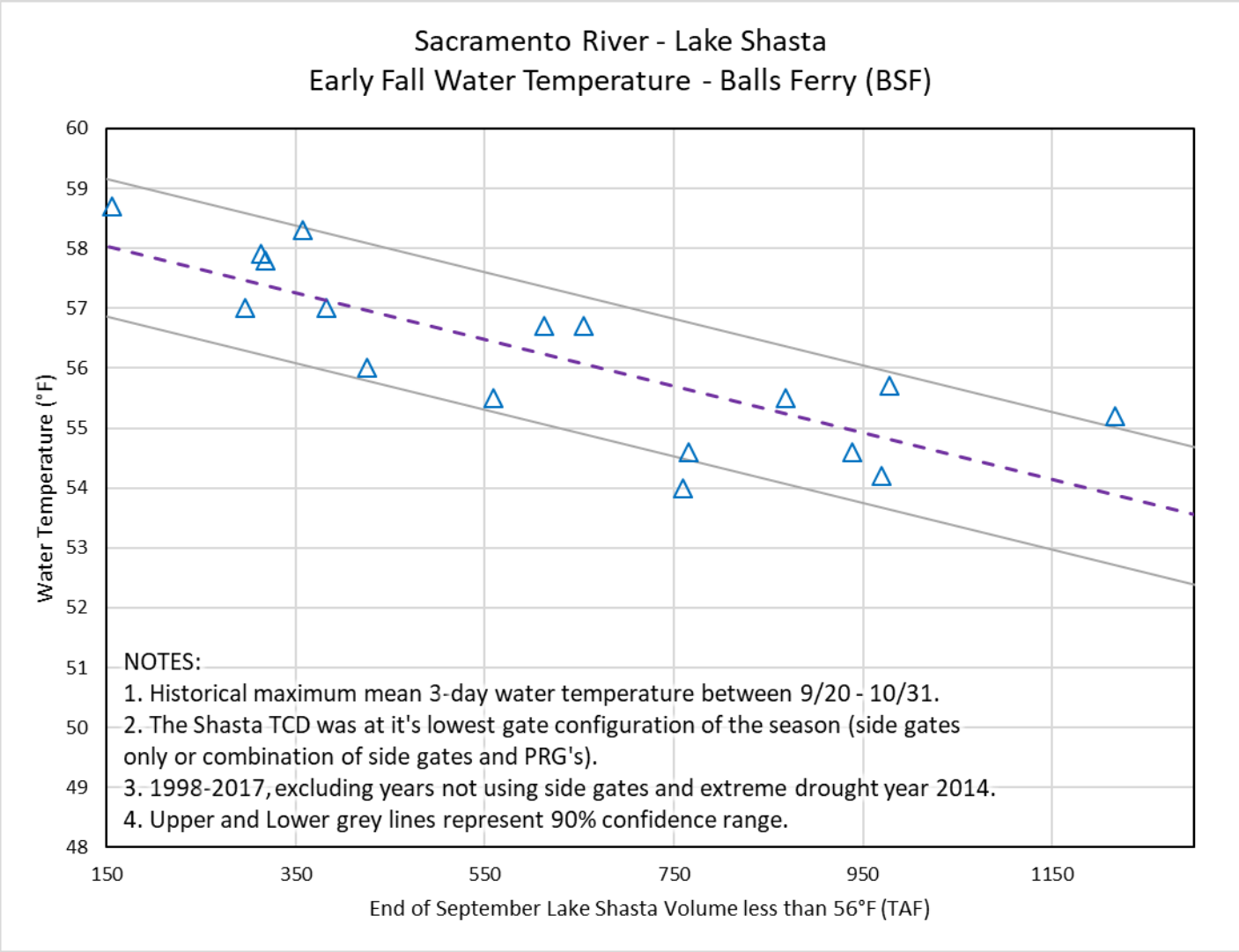


Figure 9. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.

Summary Document for temperature-dependent egg mortality

Prepared by U.S. Bureau of Reclamation, Bay-Delta Office on July 22, 2020

Below are biological results from the temperature management scenarios run July 20, 2020. These estimates are from the same planning model used in the Temperature Tier Selection Protocol this spring and summer and used in the May 20 Temperature Management Plan.

Spatially-explicit daily average Sacramento River water temperatures forecasts from the HEC-5Q model results are used as inputs to generate temperature-dependent egg mortality estimates between July 16 and September 14. Between May 12 and July 15, historical temperature data is used to capture actual observed temperature during the early temperature management period. For this period, historical temperatures on the Sacramento River at Shasta Dam, Keswick Dam, above Clear Creek, Balls Ferry, Jelly's Ferry, and Bend Bridge are interpolated to estimate temperatures at river miles where simulated redds were located. Between September 15 and October 31, daily temperatures at the simulated redds' river miles are estimated based on a relationship between cold water pool volume less than 56 degrees F at the end of September in Shasta Lake and water temperatures above Clear Creek derived by Central Valley Operations. Reclamation thinks this relationship is more reliable in that time period than outputs from the HEC-5Q model. The 90% confidence interval value from this analysis was used as a conservative estimate. The average difference between the simulated temperatures above Clear Creek and the simulated temperatures at the redds' river miles during this period are used to adjust above Clear Creek estimated temperatures for each river mile. Temperature-dependent egg mortality estimates are calculated by modeling a redd's lifetime based on the days required to cross a known cumulative degree-day threshold and estimating mortality as an increasing function of temperature past a temperature threshold. Two models were used: 1. Martin et al (2017)[1] for stage independent modeling whereby a single temperature threshold is used from spawning and incubation through emergence; and 2. Anderson et al. (2018)[2] for stage dependent modeling for targeting different temperatures before, during, and after the most sensitive stages during egg incubation. The methods are applied to a set of simulated redds representative of redd construction timing and location from 2007-2014 and the results summarized on a seasonal level for comparison.

Further information about the model's assumptions and methods are described in Reclamation's Final EIS for the Reinitiation of Consultation on the Coordinated LTO of the CVP and SWP: Appendix F- Modeling.

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[1] Martin B.T. et al. (2017). Phenomenological vs. biophysical models of thermal stress in aquatic eggs. Ecology Letters 10:50-59.

[2] Anderson, J. (2018). Using river temperature to optimize fish incubation metabolism and survival: a case for mechanistic models. ResearchGate Preprint. 10.1101/257154.

Table 1: Estimated temperature dependent egg mortality using observed and HEC-5Q interpolated temperature model output and 2007-2014 spatial and temporal redd distribution.

Scenario	Stage Dependent Egg Mortality (%)	Stage Independent Egg Mortality (%)
Scenario 148 – Delay Side Gate Use	17.9	25.8
Scenario 148 – Extend 53.5°F in August	14.6	26.8
Scenario 148 – Extend 54°F in September	17.9	26.0

Summary Document for Shasta/Keswick Operational Scenarios
Prepared by the Southwest Fisheries Science Center on July 22nd, 2020

Below are results comparing three USBR scenarios ran July 21st 2020. Scenarios have the same hydrology (Input 90% exceedance) and air temperature (25% exceedance of L3MTO) inputs. Inputs from scenarios are used to generate daily average Sacramento River water temperatures using the RAFT model and associated temperature-dependent egg mortality and survival estimates using the NMFS stage-independent temperature mortality model (Martin et al. 2017) for the 2020 temperature management season.

Further details of modeling methods are at: https://oceanview.pfeg.noaa.gov/CVTEMP/

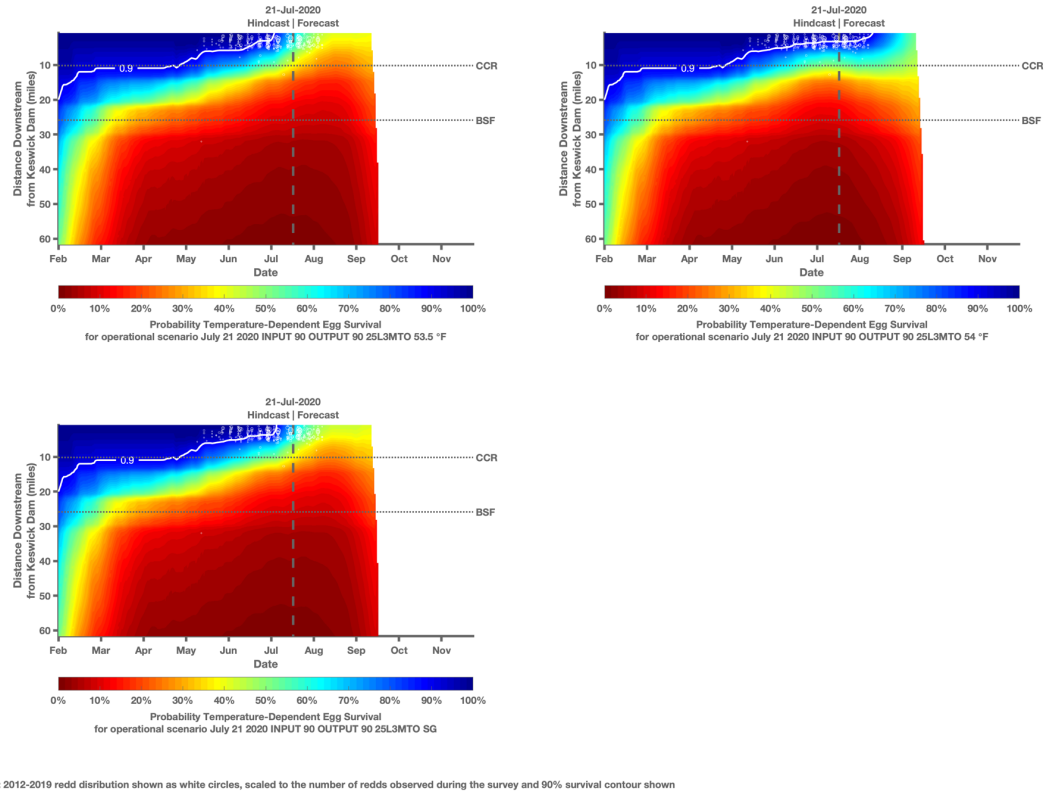

Figure1: Estimated temperature-dependent egg survival produced by the NMFS stage-independent temperature mortality model under the three July 21st 2020 scenarios. 2012-2019 redd distributions are used for all plots.

Table 1: Estimated temperature-dependent egg mortality under different scenarios assuming a 2012-2019 spatial and temporal redd distribution using output from RAFT model.

Scenario	MODEL	Mean (%)	Median (%)	Lower (%)	Upper (%)
JULY_21_2020_INPUT_90_OUTPUT_90_25L3MTO **Scenario 53.5 °F**	RAFT	30.0	27.7	0.2	67.6
JULY_21_2020_INPUT_90_OUTPUT_90_25L3MTO **Scenario 54 °F**	RAFT	20.0	13.8	0.1	64.8
JULY_21_2020_INPUT_90_OUTPUT_90_25L3MTO **Scenario SG**	RAFT	29.4	26.2	0.2	67.9

Reference: Martin, B. T., Pike, A., John, S. N., Hamda, N., Roberts, J., Lindley, S. T. and Danner, E. M. (2017), Phenomenological vs. biophysical models of thermal stress in aquatic eggs. Ecology Letters 20: 50–59. doi:10.1111/ele.12705