



— BUREAU OF —
RECLAMATION

Sacramento River Temperature Task Group

Thursday, April 23, 2020 1:00 pm – 3:00 pm **Conference Call:**

Join from PC, Mac, Linux, iOS or Android: <https://meetings.ringcentral.com/j/5306224350>

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Meeting ID: 530 622 4350

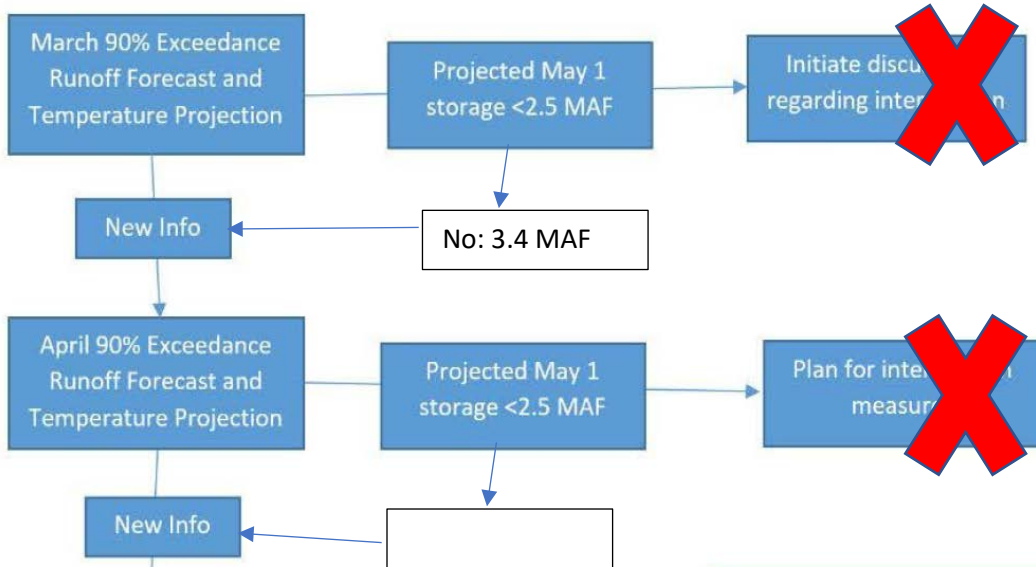
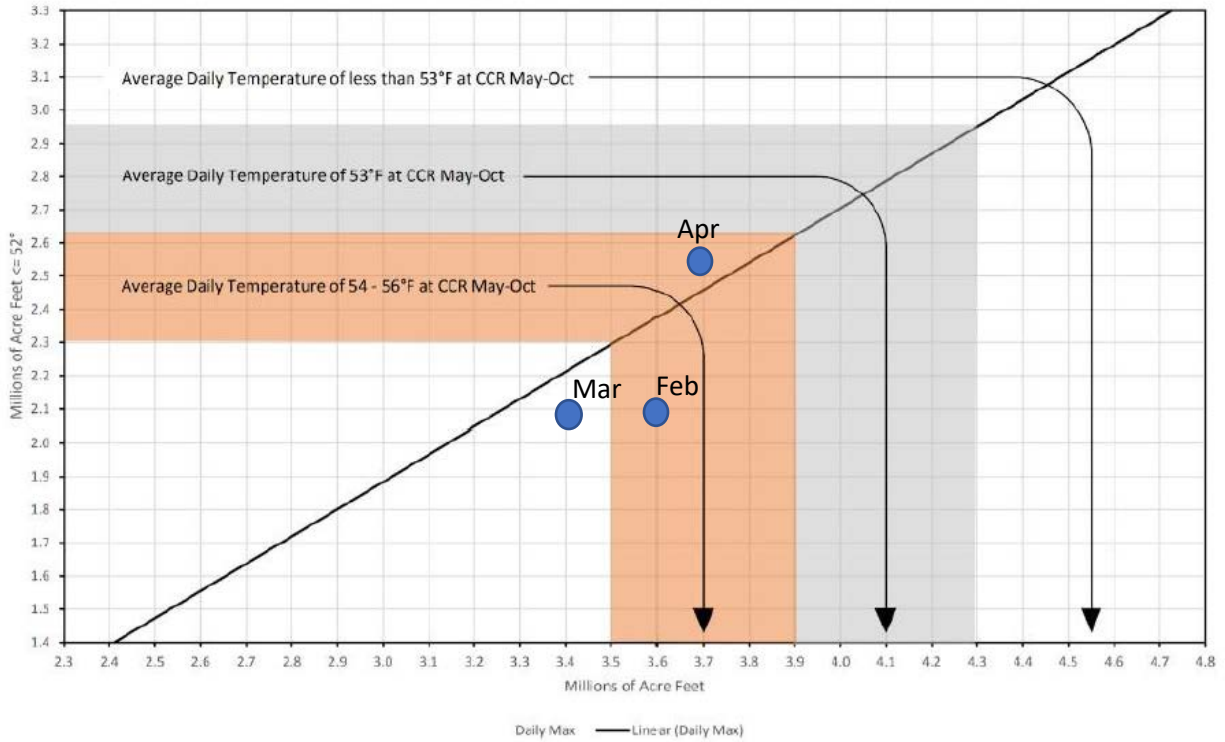
International numbers available: <https://meetings.ringcentral.com/teleconference>

Agenda

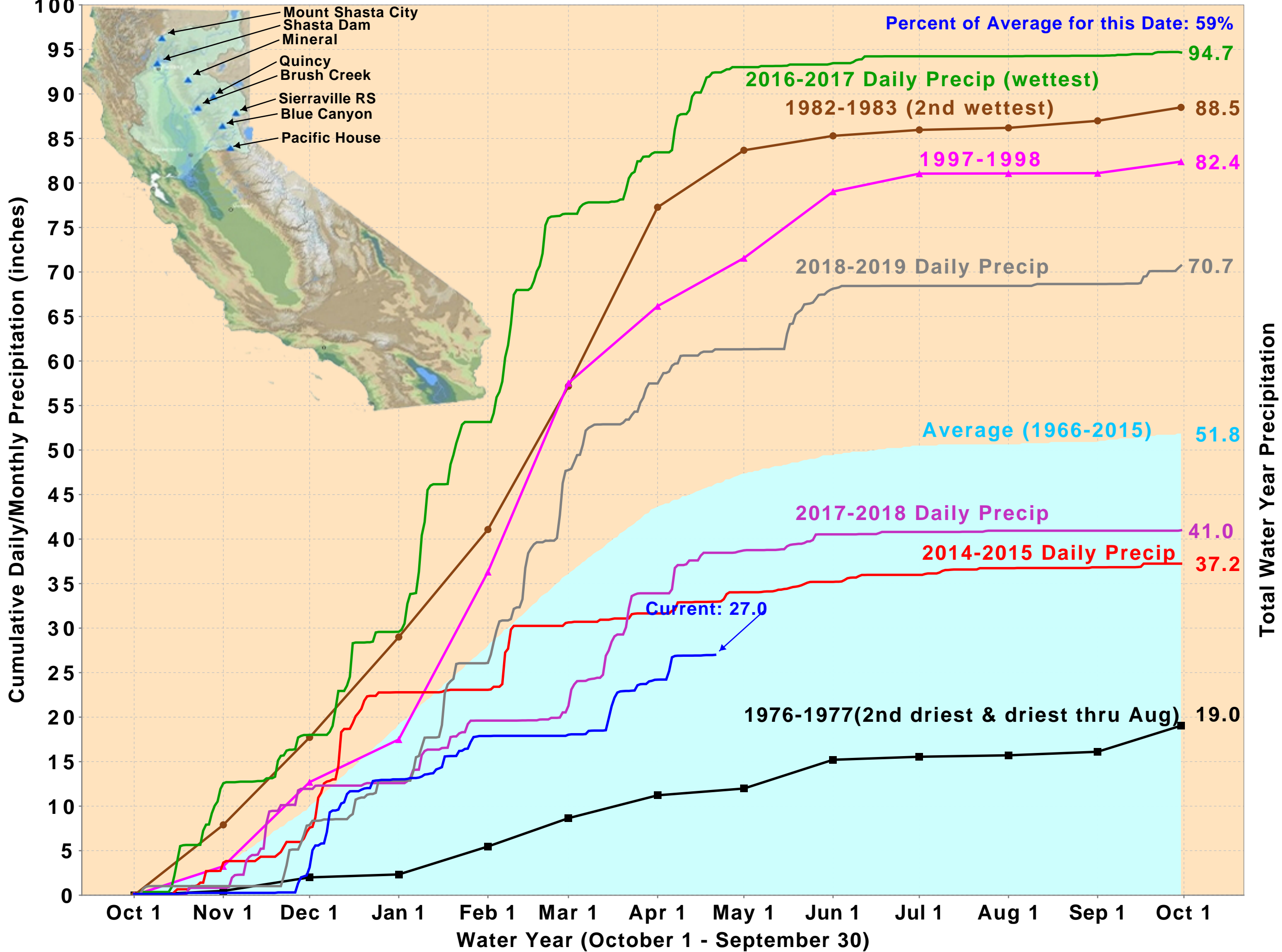
1. Introductions
2. Purpose and Objective
3. Prior Action Items
4. 2020 Meeting Logistics
5. Communications between SWRCB and Reclamation
6. Long Term Operations Implementation - Update
7. Hydrology Update
8. Operations Update and Forecasts
 - a. Storage/Release Management Conditions
 - b. Temperature Management
 - c. Temperature Dependent Mortality
9. River Fish Monitoring: carcass surveys, redd counts, stranding and dewatering surveys and sampling at rotary screw traps
10. 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.
11. Seasonal Topics
 - a. Spring Pulse Flows

12. Discussion
13. Review Action Items
14. Next Meeting Scheduling

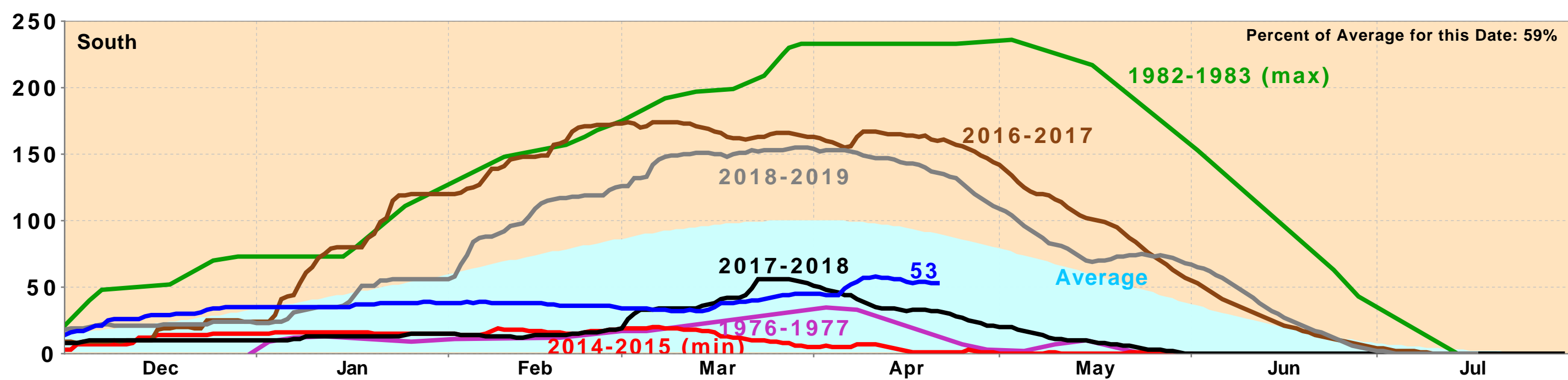
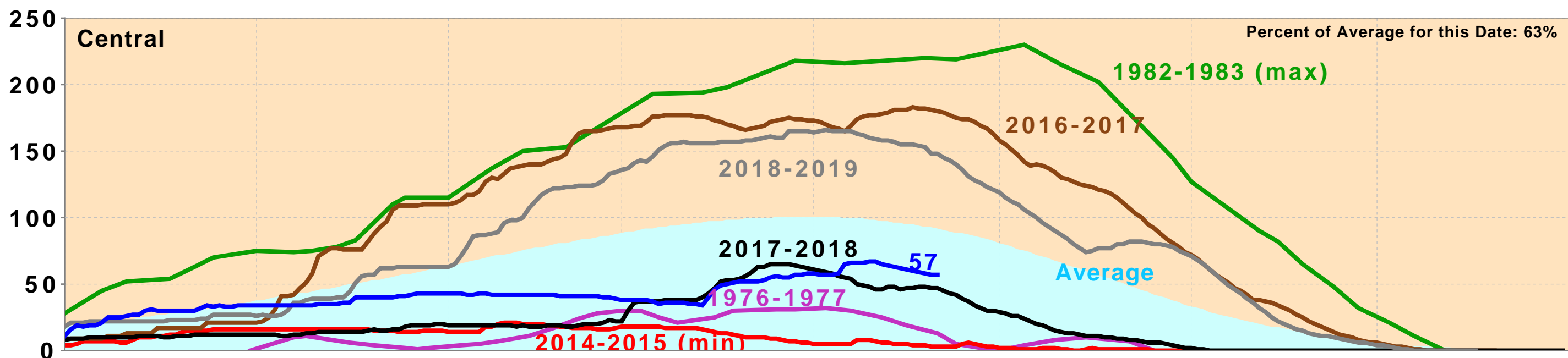
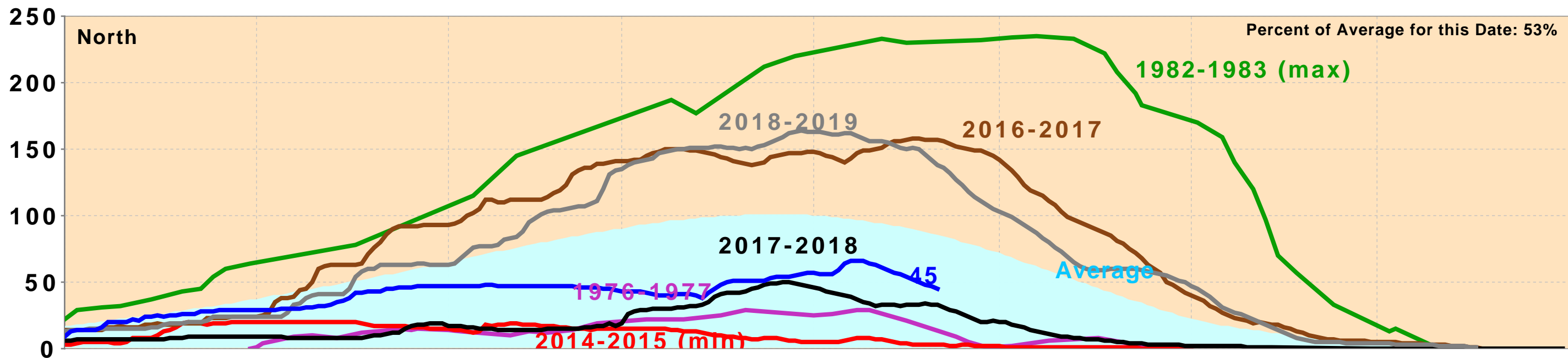
Shasta Storage Vs 52°F or less Storage on May 1st
with CCR Average Daily Maximum for May through October



Northern Sierra Precipitation: 8-Station Index, April 21, 2020



California Snow Water Content, April 21, 2020, Percent of April 1 Average



Statewide Percent of April 1: 52%

Statewide Percent of Average for Date: 58%

DAILY CVP WATER SUPPLY REPORT

APRIL 21, 2020

RUN DATE: April 22, 2020

RESERVOIR RELEASES IN CUBIC FEET/SECOND

RESERVOIR	DAM	WY 2019	WY 2020	15 YR MEDIAN
TRINITY	LEWISTON	2,806	585	322
SACRAMENTO	KESWICK	11,159	7,466	5,921
FEATHER	OROVILLE (SWP)	9,000	0	1,700
AMERICAN	NIMBUS	6,939	1,468	2,028
STANISLAUS	GOODWIN	4,006	426	1,503
SAN JOAQUIN	FRIANT	509	0	502

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	1,843	2,163	1,943	105
SHASTA	4,552	3,740	4,082	3,750	100
FOLSOM	977	708	829	642	91
NEW MELONES	2,420	1,570	1,933	1,908	121
FED. SAN LUIS	966	721	930	584	81
TOTAL NORTH CVP	11,363	8,581	9,937	8,827	103
MILLERTON	520	290	278	0	0
OROVILLE (SWP)	3,538	2,446	3,119	0	0

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	290	103	1,390	719	40
SHASTA	2,164	1,537	7,780	3,685	59
FOLSOM	868	218	3,949	1,715	51
NEW MELONES	363	---	1,247	565	64
MILLERTON	372	116	1,836	595	62

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	15.95	9.27	50.99	28.64 (58)	56	0.00
SACRAMENTO AT SHASTA DAM	28.59	11.04	104.29	56.21 (63)	51	0.00
AMERICAN AT BLUE CANYON	34.44	15.64	96.22	60.24 (45)	57	0.00
STANISLAUS AT NEW MELONES	21.20	---	42.10	25.26 (42)	84	0.00
SAN JOAQUIN AT HUNTINGTON LK	26.34	11.50	75.30	37.66 (45)	70	0.00

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

Storage/Release Management Conditions:

- Reservoir Inflow Uncertainty: Shorter term forecasts (8-14 day) suggest a below normal chance of precipitation
- Longer term forecasts (three-month outlook) suggest below normal chance of precipitation
- Dry pattern break in April: actual inflows are tracing better than the 75% inflow exceedance probability estimates for the month
- Current release from Keswick Dam: Current release (Wednesday April 22) of 8,300 cfs, Thursday April 23, increasing to 9,100 cfs, and Friday April 24, increasing to 9,500 cfs for downstream diversion demands
- “Early April Moderate Storm Event Coordinated Operation”: During poorer hydrologic years Reclamation is looking to take advantage of opportunities as they present themselves to garner incremental benefits. Reclamation coordinated a Keswick release reduction during a moderate storm event: flows were reduced from 5,000 cfs to 4,500 cfs for 8 days (4/6 – 4/14), precipitation was 1.92 in, Shasta lake elevation increased from 1035 ft to 1038 ft, and Shasta storage volume increased over 71 TAF for the same time period. (Also see temperature management below). Thank you to those who participated.
- Long-term conservative (inflow hydrology) projections suggest lower Shasta storage volumes. Estimated peak storage will likely occur in April rather than May due to poor inflow.

Temperature Management:

- Temperature management: Inactive draw on cold water pool
- Selective withdrawal: Rebuilding cold-water-pool reserves. All Upper TCD gates open as of 4/7. This affords greater flexibility (reservation of cold water pool) for temperature management later in the season.
- Meteorological Uncertainty: Shorter term forecasts (8-14 day) suggest above normal temperatures
- Longer term forecasts (three-month outlook) suggest above normal temperatures

Resources:

- Reclamation Bay Delta website: <https://www.usbr.gov/mp/bdo/lto/index.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>
- 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>

- SacPAS: Central Valley Prediction & Assessment of Salmon: <http://www.cbr.washington.edu/sacramento/>
- Bulletin 120 Forecast Updates: <http://cdec.water.ca.gov/b120up.html>

CVP Northern System Operation Outlooks: Draft April 2020

90% Runoff Exceedance Outlook

End of Month Storage/Elevation	Apr	May	Jun	Jul	Aug	Sep
Shasta Volume (TAF)	3674	3483	3025	2489	2110	1944
Shasta Elevation (Feet)	1035	1028	1009	984	964	954

Monthly Average River Release	Apr	May	Jun	Jul	Aug	Sep
Sacramento (CFS)	7000	8500	12000	12500	9750	6500
Clear Creek (CFS)	200	265	200	150	150	150

Trinity Diversions	Apr	May	Jun	Jul	Aug	Sep
Carr Power Plant (TAF)	114	100	100	100	101	100
Spring Creek PP (TAF)	90	90	90	90	90	90

50% Runoff Exceedance Outlook

End of Month Storage/Elevation	Apr	May	Jun	Jul	Aug	Sep
Shasta Volume (TAF)	3674	3578	3169	2688	2364	2231
Shasta Elevation (Feet)	1035	1032	1015	993	977	970

Monthly Average River Release	Apr	May	Jun	Jul	Aug	Sep
Sacramento (CFS)	7000	8500	12000	12100	9350	6500
Clear Creek (CFS)	200	380	150	150	150	150

Trinity Diversions	Apr	May	Jun	Jul	Aug	Sep
Carr Power Plant (TAF)	105	99	93	99	100	99
Spring Creek PP (TAF)	90	90	90	90	90	90

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)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Trinity		1975	1835	1710	1584	1429	1275	1234	1198	1180	1178	1206	1216
	Elev.	2336	2329	2320	2310	2297	2283	2279	2276	2274	2274	2277	2278
Whiskeytown		211	238	238	238	238	238	206	206	206	206	206	206
	Elev.	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199
Shasta		3600	3674	3483	3025	2489	2110	1944	1846	1870	1926	2038	2231
	Elev.	1035	1028	1009	984	964	954	948	950	953	959	970	989
Folsom		476	635	642	598	467	349	311	307	308	320	335	367
	Elev.	432	433	428	412	395	389	388	389	390	393	398	411
New Melones		1892	1844	1791	1707	1621	1551	1509	1472	1474	1477	1481	1479
	Elev.	1038	1033	1024	1016	1009	1004	1000	1000	1001	1001	1001	1001
San Luis		344	349	235	90	45	69	150	220	224	310	516	494
	Elev.	479	464	439	422	419	428	439	453	479	505	493	481
Total		8672	8224	7368	6444	5746	5427	5284	5280	5419	5754	5984	6396

Monthly River Releases (TAF/cfs)

Trinity	TAF	36	92	47	28	53	52	23	18	18	18	17	18
	cfs	600	1,498	783	450	857	870	373	300	300	300	300	300
Clear Creek	TAF	12	16	12	9	9	9	12	12	12	12	11	17
	cfs	200	265	200	150	150	150	200	200	200	200	200	275
Sacramento	TAF	416	523	714	768	599	387	338	223	215	215	194	215
	cfs	7000	8500	12000	12500	9750	6500	5500	3750	3500	3500	3500	3500
American	TAF	89	111	107	184	177	91	44	42	44	49	73	83
	cfs	1500	1800	1800	3000	2882	1528	723	710	715	800	1310	1357
Stanislaus	TAF	37	15	9	9	9	9	35	12	12	13	12	12
	cfs	620	245	150	150	150	150	577	200	200	213	214	200

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carr PP	114	100	100	100	101	100	24	30	21	15	10	57
Spring Crk. PP	90	90	90	90	90	90	45	20	12	10	10	60

Delta Summary (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Tracy	115	66	110	231	265	255	196	58	120	240	45	50	
USBR Banks	0	0	0	4	4	4	0	0	0	0	0	0	
Contra Costa	3.8	4.2	5.1	5.6	5.5	4.2	4.2	3.8	3.8	3.8	3.0	3.4	
Total USBR	119	70	115	241	275	263	200	62	124	244	48	53	
COA Balance	11	11	8	0	0	18	0	0	0	0	-25	-80	
Vernalis	TAF	115	95	40	42	37	43	104	83	83	92	82	
Vernalis	cfs	1927	1552	671	687	605	722	1700	1393	1355	1498	1339	
Old/Middle River Std.													
Old/Middle R. calc.		-1,826	-1,322	-2,231	-3,808	-4,696	-4,630	-3,586	-2,795	-3,999	-4,974	-952	-1,282
Computed DOI		10304	7808	7447	4994	3497	3009	4002	4505	4506	6458	11400	11403
Excess Outflow		2505	0	0	0	0	0	0	0	0	1952	0	0
% Export/Inflow		19%	16%	19%	33%	43%	50%	47%	41%	54%	54%	11%	13%
% Export/Inflow std.		35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted	490	3,165	1,321	589
% of mean	41%	57%	49%	56%

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CVP releases or export values represent monthly averages.

CVP Operations are updated monthly as new hydrology information is made available December through May.

Estimated CVP Operations 50% Exceedance

Storages

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

		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Trinity		1975	1876	1756	1631	1476	1324	1289	1276	1306	1361	1472	1596
	Elev.	2338	2332	2323	2314	2301	2288	2285	2283	2286	2291	2301	2311
Whiskeytown		211	238	238	238	238	238	206	206	206	206	206	206
	Elev.	1209	1209	1209	1209	1209	1209	1199	1199	1199	1199	1199	1199
Shasta		3600	3674	3578	3169	2688	2364	2231	2172	2252	2427	2818	3358
	Elev.	1035	1032	1015	993	977	970	967	971	981	1000	1023	1044
Folsom		476	630	696	623	465	369	335	321	321	341	400	537
	Elev.	432	439	431	412	398	393	391	391	394	403	421	442
New Melones		1892	1854	1839	1790	1712	1646	1607	1580	1597	1620	1654	1708
	Elev.	1039	1037	1033	1025	1018	1014	1012	1013	1016	1019	1025	1030
San Luis		344	326	184	82	31	25	97	229	371	587	805	966
	Elev.	473	456	434	415	406	412	439	471	509	530	540	543
Total		8685	8411	7659	6765	6118	5832	5797	6022	6487	7244	8210	9157

Monthly River Releases (TAF/cfs)

Trinity	TAF	36	92	47	28	53	52	23	18	18	18	17	18
	cfs	600	1,498	783	450	857	870	373	300	300	300	300	300
Clear Creek	TAF	12	23	9	9	9	9	12	12	12	25	11	12
	cfs	200	380	150	150	150	150	200	200	200	400	200	200
Sacramento	TAF	416	523	714	744	575	387	338	238	215	215	222	295
	cfs	7000	8500	12000	12100	9350	6500	5500	4000	3500	3500	4000	4800
American	TAF	89	130	164	220	159	95	89	90	92	92	125	123
	cfs	1500	2113	2750	3573	2583	1605	1451	1518	1500	1500	2250	2000
Stanislaus	TAF	37	15	9	9	9	9	35	12	12	13	12	12
	cfs	622	245	150	150	150	150	577	200	200	213	214	200

Trinity Diversions (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Carr PP	105	99	93	99	100	99	23	25	9	10	2	5
Spring Crk. PP	90	90	90	90	90	90	45	20	12	19.8	35	30

Delta Summary (TAF)

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Tracy	115	66	181	267	265	260	265	201	255	260	200	136	
USBR Banks	0	0	0	11	11	11	0	0	0	0	0	0	
Contra Costa	12.7	12.7	9.8	11.1	12.7	14.0	16.8	18.4	18.3	14.0	14.0	12.7	
Total USBR	128	79	191	289	289	285	282	219	273	274	214	149	
Total Export COA Balance	11	12	17	17	17	20	20	0	0	0	0	0	
Vernalis	115	95	56	48	46	51	104	83	83	92	111	57	
Vernalis	1929	1552	940	784	752	856	1700	1393	1355	1498	1997	932	
Old/Middle River Std.													
Old/Middle R. calc.	cfs	-1,940	-1,428	-2,895	-4,096	-4,507	-4,903	-5,885	-5,702	-6,598	-4,901	-4,975	-3,887
Computed DOI	14423	7808	7447	4994	3497	3009	4002	4505	7418	14445	19811	20725	
Excess Outflow	6623	0	0	0	0	0	0	0	2912	8443	8411	9321	
% Export/Inflow	15%	16%	24%	34%	42%	51%	57%	57%	52%	31%	25%	18%	
% Export/Inflow std.	35%	35%	35%	65%	65%	65%	65%	65%	65%	65%	45%	35%	

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted	520	3,405	1,482	688
% of mean	43%	61%	54%	65%

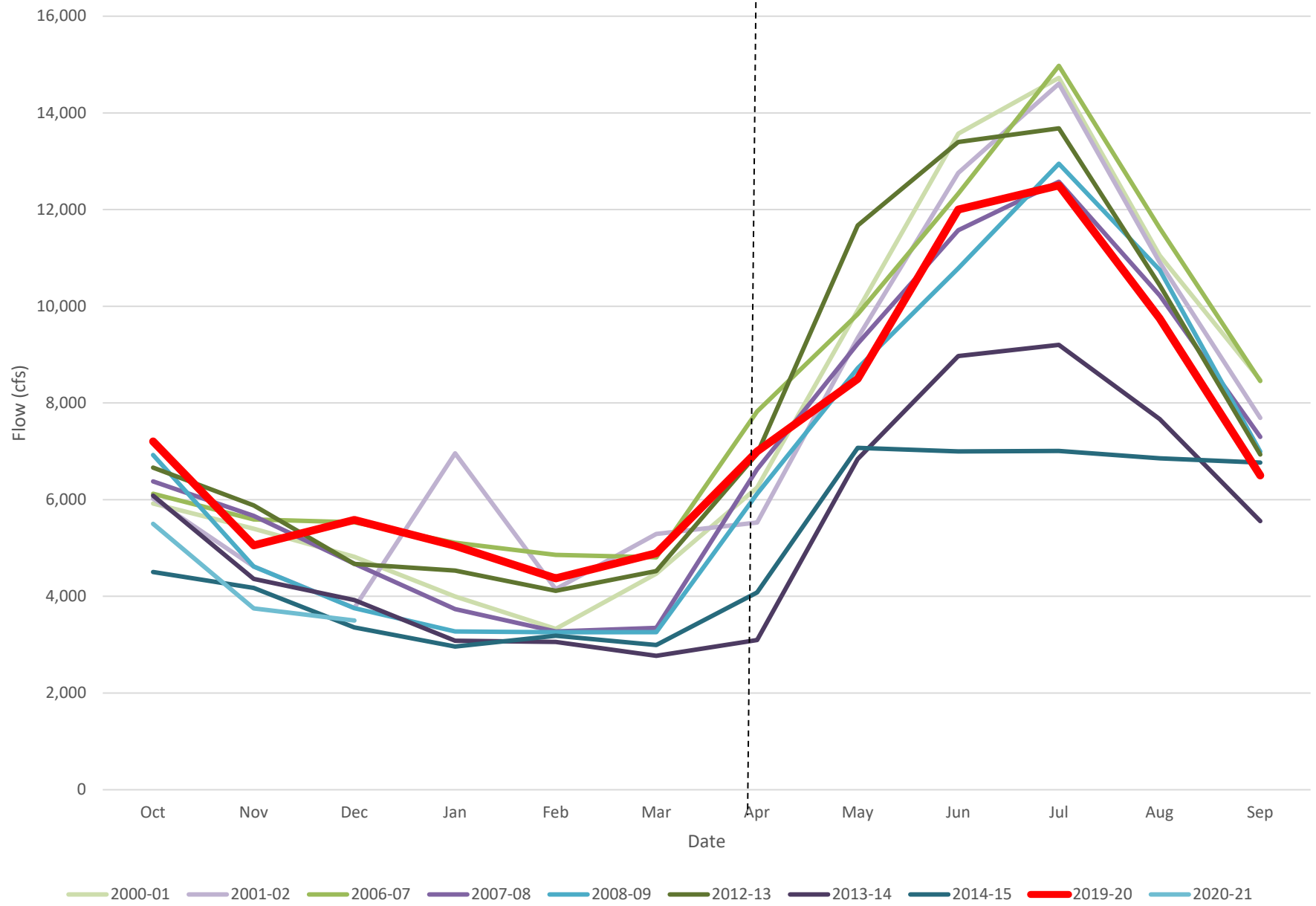
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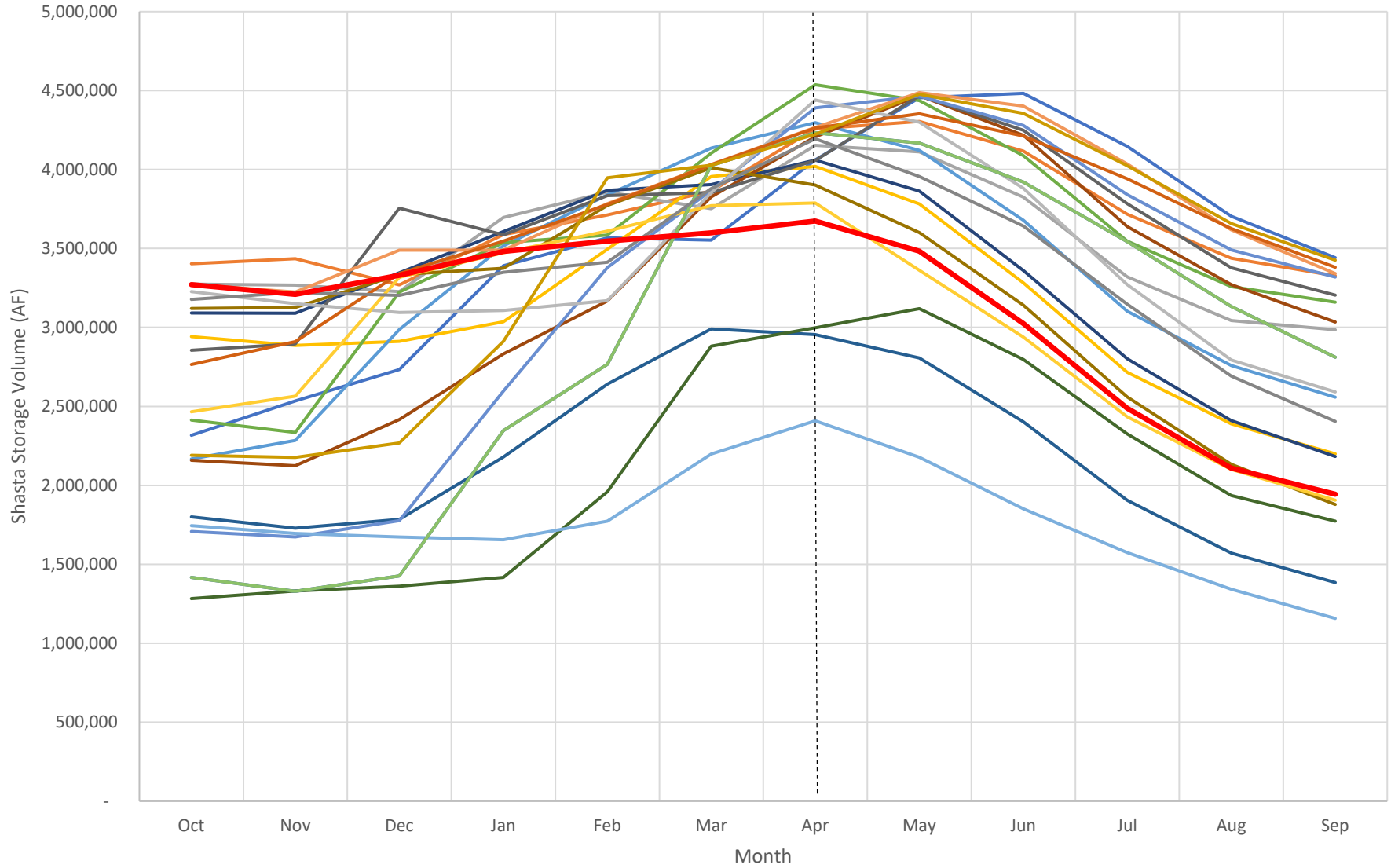
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Keswick Historical Monthly Average Release and WY2020 April 90% Operations Outlook

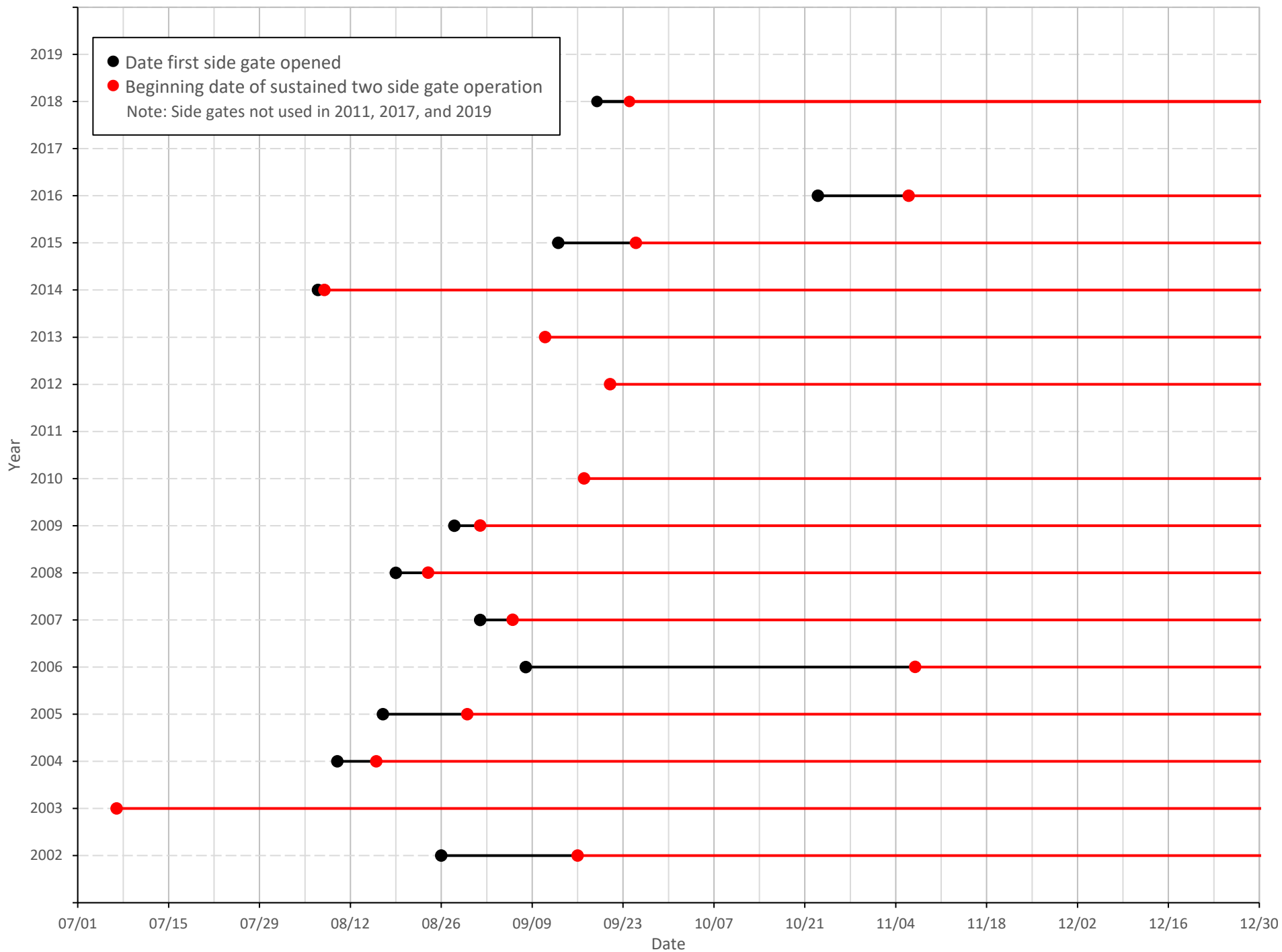


Historical Shasta Storage (1998 - 2020) and WY2020 90% Operation Outlook



- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020

Historic TCD Side Gate Opening Date (2002-2019)



Northern CVP Water Temperature Report

April - 2020

Page	Description
1	- Mean Daily Water Temperature, Release Flow Rates and Air Temperatures with Monthly Averages
2	- Redding 10-Day Forecasted Air Temperatures
3	- Sacramento River Mean Daily Water Temperature, Air Temperature and 10-Day Forecasted Air Temperature Plot - Water Temperature Measuring Station Details - Temperature Control Point Details
4	- Shasta Lake Isothermobaths Plot
5	- Trinity Lake Isothermobaths Plot
6	- Whiskeytown Lake Isothermobaths Plot
x	- TCD Configuration (External Link)



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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
Mar	49.4	48.7	48.7	49.2	49.6	50.0	50.6	51.3	51.6	51.9	49.0	47.6	-	3693	969	4891	53.2	51.7	53.3	-
04/01	49.2	48.6	49.6	49.2	49.9	50.3	51.5	52.5	53.0	53.6	50.3	47.9	-	3219	1644	4949	50.5	49.9	52.6	-
04/02	# - ?	49.1	49.5	49.4	50.1	50.6	51.4	52.2	52.5	53.0	50.3	47.8	-	2731	1907	4958	53.0	52.2	53.5	-
04/03	# -	48.7	49.5	49.3	50.1	50.7	51.7	52.5	52.9	53.4	50.5	47.8	-	2795	1880	4956	50.5	50.7	52.9	-
04/04	# - ?	48.5	49.1	49.3	49.5	49.5	50.2	51.2	51.8	52.5	49.0	46.3	-	3249	1909	4961	46.0	45.3	47.1	-
04/05	# -	48.6	48.9	49.1	49.6	49.8	50.1	50.5	50.5	50.6	49.2	46.7	-	2635	1800	4958	51.0	51.8	51.4	-
04/06	# -	48.8	49.1	49.0	49.9	50.5	51.3	51.9	52.0	52.1	50.3	47.1	-	3127	1813	4794	54.0	51.3	52.1	-
04/07	# -	49.4	48.9	49.2	50.1	50.7	52.3	53.3	53.6	54.0	50.9	48.2	-	2592	1814	4610	54.5	53.5	54.9	-
04/08	! -	50.4	48.8	49.9	50.8	51.6	53.5	54.6	55.0	55.4	52.0	49.0	-	2496	1900	4493	66.5	61.0	62.1	-
04/09	50.8	50.5	48.6	49.8	50.6	51.3	53.6	55.1	55.8	56.2	50.8	49.7	-	2708	1830	4500	53.5	54.7	54.7	-
04/10	50.4	50.0	48.6	50.2	51.3	52.2	54.1	55.2	55.7	56.5	52.4	51.0	-	1952	1834	4478	63.0	61.9	63.2	-
04/11	51.0	49.9	48.8	50.5	51.6	52.7	55.3	56.8	57.4	58.1	52.6	51.4	-	2342	1944	4483	62.5	61.5	62.0	-
04/12	51.5 ?	51.1	48.7	51.1	52.0	53.0	55.7	57.5	58.3	59.3	52.7	51.7	-	1911	1819	4478	65.5	65.1	66.0	-
04/13	51.5 ?	50.6	48.8	51.3	52.1	52.9	55.1	56.5	57.1	58.2	51.5	50.8	-	3172	1368	4472	62.0	58.3	61.5	-
04/14	51.6 !	-	48.9	50.9	51.9	52.8	54.7	55.9	56.4	57.4	51.5	49.8	-	3075	1797	4982	60.0	58.3	61.9	-
04/15	51.8 ?	51.1	49.0	51.0	51.8	52.7	54.7	56.0	56.6	57.6	51.9	49.5	-	3328	1883	5466	64.5	62.3	62.5	-
04/16	52.5 ?	51.6 ?	49.0	51.5	52.3	53.2	55.0	56.4	56.9	57.8	52.3	49.7	-	3497	1866	5501	68.0	63.6	64.6	-
04/17	52.1 !	-	49.0	51.4	52.3	53.2	55.2	56.6	57.1	58.0	52.1	49.0	-	3712	1888	5888	68.5	61.9	64.3	-
04/18	51.8 !	- ?	49.0	51.6	52.1	52.7	54.4	55.7	56.4	57.6	51.8	49.0	-	3914	1850	6246	59.0	58.3	58.4	-
04/19	52.2	51.6	49.2	51.5	52.3	53.0	54.5	55.6	56.0	56.7	52.1	48.9	-	5252	1928	6676	59.5	59.4	59.5	-
04/20	52.5	51.6	49.2	51.4	52.0	52.5	54.1	55.3	55.7	56.7	51.8	49.6	-	4901	1933	6969	59.0	56.3	57.4	-
04/21	52.8 ?	52.3	49.4	51.8	52.5	53.1	54.6	55.6	55.9	56.5	52.4	49.9	-	5127	1917	7466	63.0	60.9	62.1	-
04/22																				
04/23																				
04/24																				
04/25																				
04/26																				
04/27																				
04/28																				
04/29																				
04/30																				
-																				
Apr	51.6	50.1	49.0	50.4	51.2	51.9	53.5	54.6	55.1	55.8	51.4	49.1	-	3225	1834	5252	58.8	57.1	58.3	-

Total CFS	67735	38524	110284
Total AF	134350	76411	218744

Legend

Notes

- ? = 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

- 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

D A T E	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	
04/01	49	69	59.0	38	63	50.5	35	66	50.5	37	66	51.5	42	58	50.0	42	56	49.0	38	60	49.0	38	69	53.5	47	73	60.0	48	78	63.0	49	79	64.0	51	77	64.0	
04/02	38	63	50.5	40	64	52.0	37	66	51.5	40	55	47.5	44	55	49.5	38	60	49.0	38	68	53.0	42	75	58.5	52	77	64.5	49	83	66.0	49	79	64.0	48	72	60.0	
04/03	40	66	53.0	36	65	50.5	41	55	48.0	44	55	49.5	40	59	49.5	38	67	52.5	41	73	57.0	44	70	57.0	47	74	60.5	45	78	61.5	46	73	59.5	46	71	58.5	
04/04	35	66	50.5	42	53	47.5	43	57	50.0	39	61	50.0	39	68	53.5	42	76	59.0	45	78	61.5	48	77	62.5	52	81	66.5	51	79	65.0	50	78	64.0	50	75	62.5	
04/05	41	51	46.0	49	57	53.0	40	62	51.0	40	72	56.0	44	80	62.0	45	81	63.0	49	80	64.5	46	81	63.5	55	81	68.0	53	82	67.5	50	80	65.0	52	75	63.5	
04/06	45	57	51.0	45	62	53.5	41	71	56.0	45	81	63.0	47	80	63.5	49	79	64.0	49	81	65.0	50	80	65.0	56	83	69.5	53	84	68.5	52	80	66.0	52	77	64.5	
04/07	44	64	54.0	41	72	56.5	45	82	63.5	47	78	62.5	50	78	64.0	48	83	65.5	50	80	65.0	48	78	63.0	53	83	68.0	52	86	69.0	53	82	67.5	52	76	64.0	
04/08	41	68	54.5	49	81	65.0	48	76	62.0	49	78	63.5	48	81	64.5	48	78	63.0	47	78	62.5	46	80	63.0	53	82	67.5	52	79	65.5	52	76	64.0	49	72	60.5	
04/09	48	85	66.5	45	71	58.0	49	76	62.5	49	80	64.5	49	78	63.5	47	78	62.5	46	80	63.0	47	80	63.5	53	83	68.0	53	84	68.5	53	82	67.5	53	80	66.5	
04/10	44	63	53.5	51	77	64.0	49	79	64.0	48	78	63.0	47	80	63.5	46	82	64.0	48	83	65.5	50	82	66.0	52	73	62.5	48	72	60.0	49	76	62.5	52	78	65.0	
04/11	51	75	63.0	49	81	65.0	49	77	63.0	46	75	60.5	44	81	62.5	47	80	63.5	50	76	63.0	48	73	60.5	48	71	59.5	48	75	61.5	51	78	64.5	53	79	66.0	
04/12	49	76	62.5	57	77	67.0	47	75	61.0	44	79	61.5	48	83	65.5	51	76	63.5	48	78	63.0	49	73	61.0	51	74	62.5	49	73	61.0	51	77	64.0	53	80	66.5	
04/13	53	78	65.5	50	75	62.5	44	79	61.5	48	82	65.0	51	81	66.0	50	80	65.0	51	73	62.0	50	70	60.0	51	71	61.0	48	74	61.0	50	75	62.5	51	78	64.5	
04/14	48	76	62.0	43	80	61.5	49	81	65.0	52	79	65.5	46	79	62.5	48	74	61.0	49	71	60.0	49	69	59.0	49	75	62.0	49	75	62.0	52	82	67.0	50	76	63.0	
04/15	41	79	60.0	48	82	65.0	53	79	66.0	48	80	64.0	49	74	61.5	48	71	59.5	49	66	57.5	49	74	61.5	51	80	65.5	51	84	67.5	51	82	66.5	51	80	65.5	
04/16	47	82	64.5	56	79	67.5	49	78	63.5	49	73	61.0	49	74	61.5	49	73	61.0	48	79	63.5	51	77	64.0	53	83	68.0	51	79	65.0	49	81	65.0	53	82	67.5	
04/17	56	80	68.0	60	79	69.5	48	73	60.5	47	72	59.5	47	72	59.5	47	78	62.5	50	77	63.5	50	79	64.5	52	80	66.0	52	83	67.5	52	82	67.0	53	77	65.0	
04/18	58	79	68.5	51	74	62.5	46	72	59.0	47	72	59.5	46	79	62.5	49	79	64.0	52	82	67.0	51	83	67.0	52	84	68.0	55	85	70.0	54	84	69.0	57	85	71.0	
04/19	50	68	59.0	53	70	61.5	47	73	60.0	47	80	63.5	50	74	62.0	52	82	67.0	53	85	69.0	53	88	70.5	53	84	68.5	53	85	69.0	55	86	70.5	57	86	71.5	
04/20	50	69	59.5	47	73	60.0	46	81	63.5	51	80	65.5	53	83	68.0	53	86	69.5	56	87	71.5	53	84	68.5	49	81	65.0	51	84	67.5	54	88	71.0	56	82	69.0	
04/21	47	71	59.0	46	80	63.0	49	79	64.0	51	82	66.5	52	86	69.0	55	87	71.0	53	83	68.0	52	84	68.0	53	85	69.0	55	89	72.0	55	89	72.0	58	87	72.5	
04/22	45	81	63.0	50	76	63.0	51	81	66.0	52	86	69.0	55	86	70.5	53	86	69.5	52	86	69.0	56	93	74.5	59	91	75.0	59	90	74.5	58	84	71.0	54	78	66.0	
04/23																																					
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04/25																																					
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04/29																																					
04/30																																					
-																																					

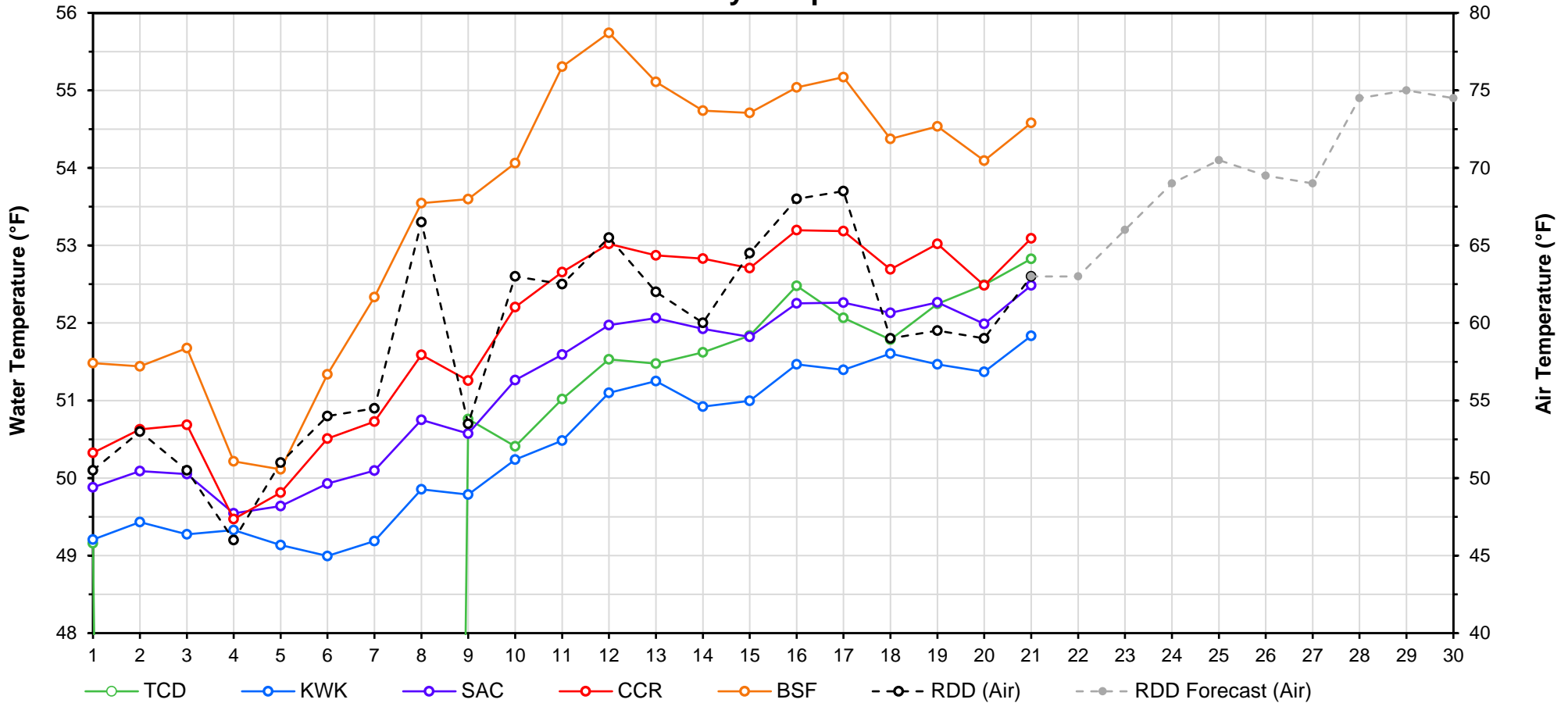
Web Links

- [10-Day Min/Max Forecast](#)
- [Previous Days Min/Max Actuals](#)

Legend

- NR = Forecasted temperatures not recorded
- 100** = Previous day actual temperatures in red and bolded indicate a record temperature for that date

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	5/25/2018

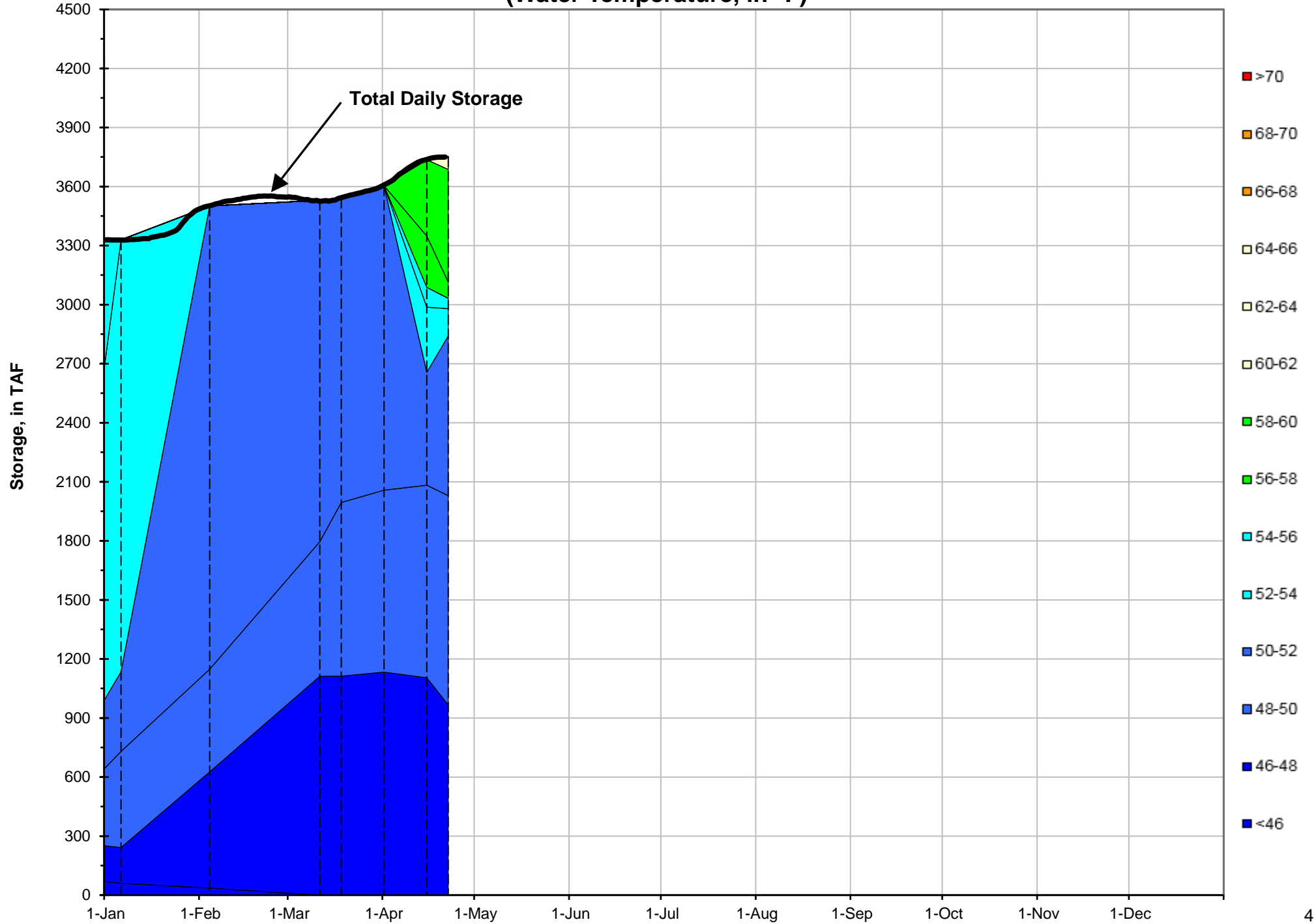
Notes

¹ Distances are approximate

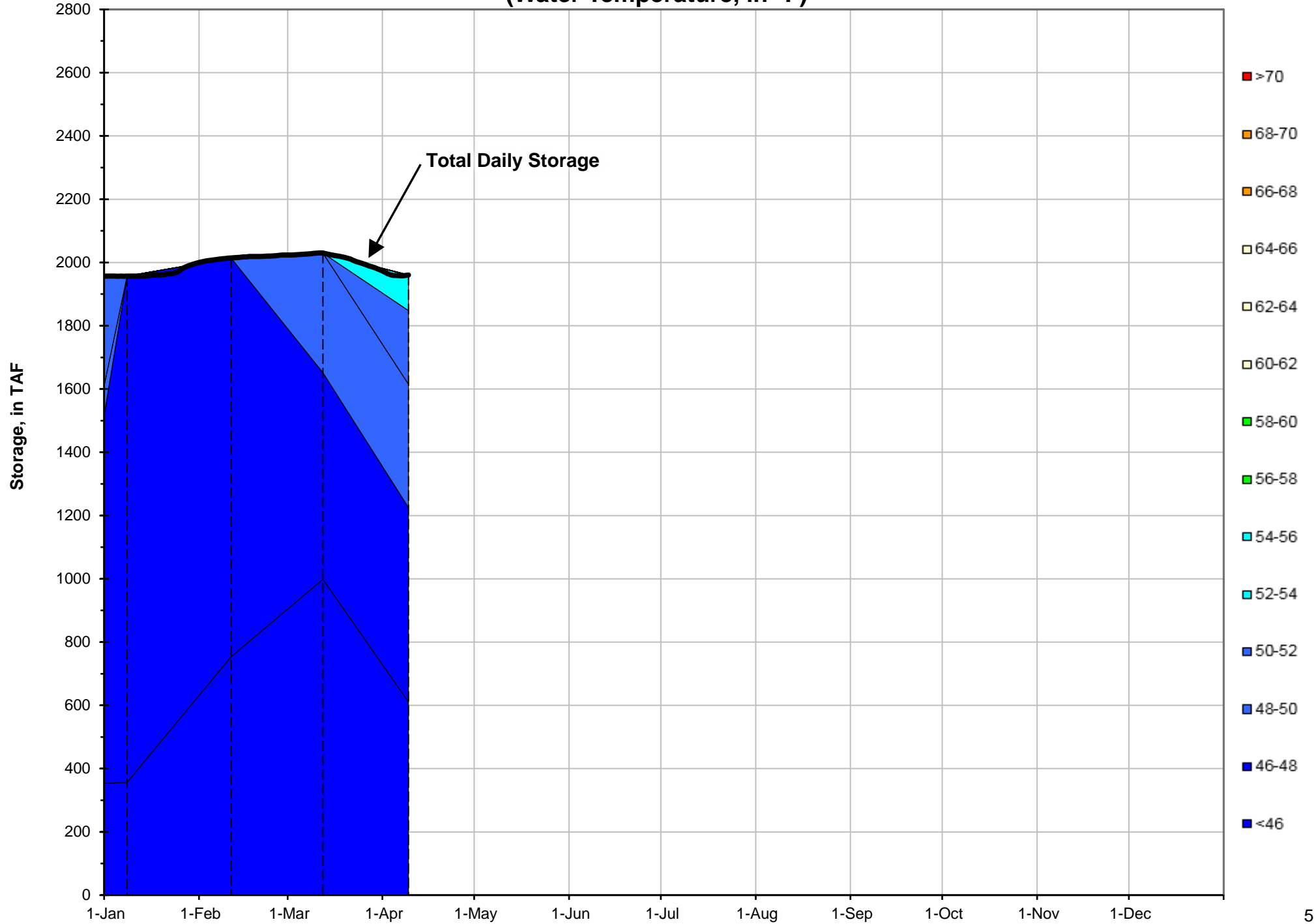
² DGC is only reported in September

³ NFH is only reported in October, November and December

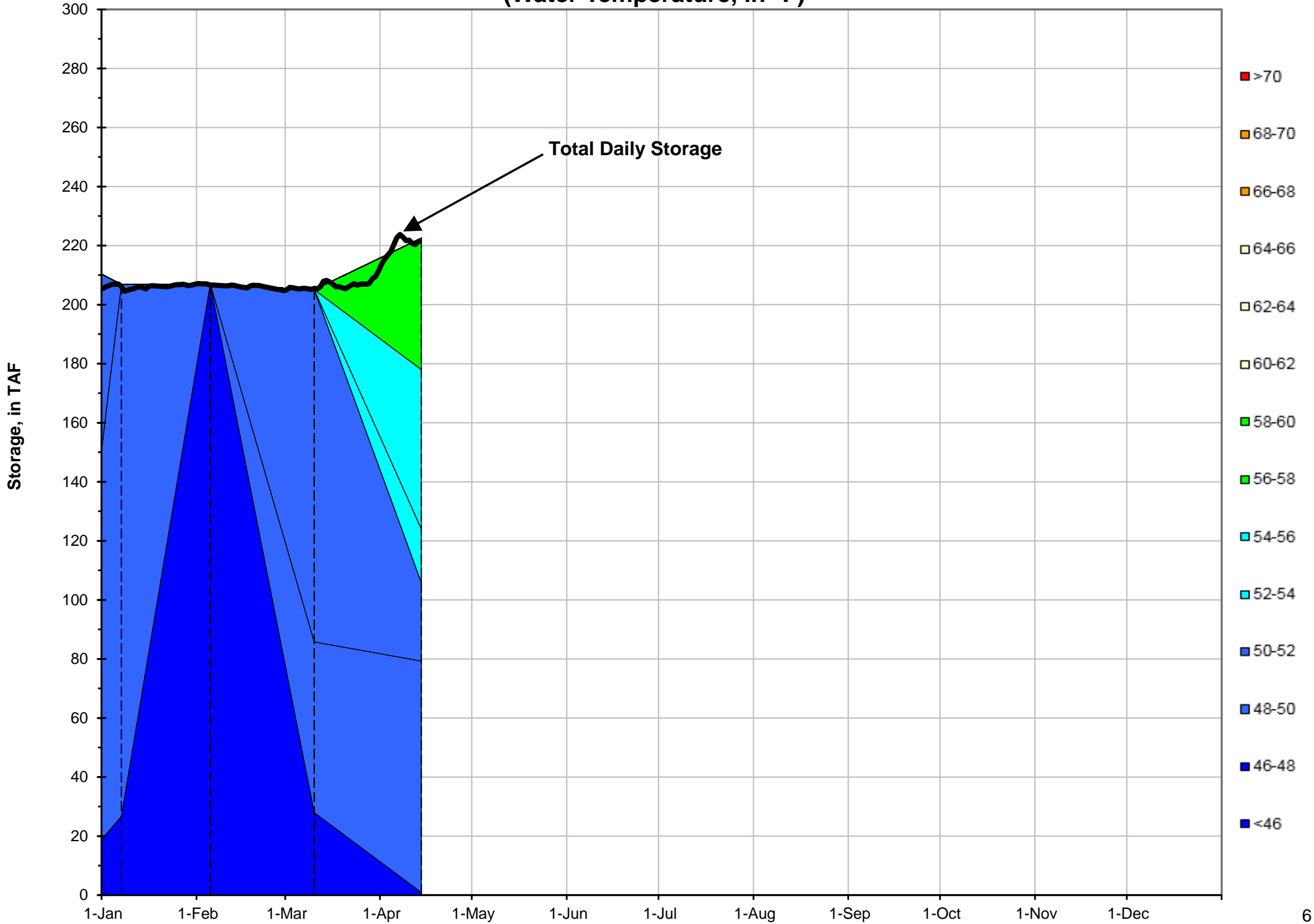
Shasta Lake Isothermobaths - 2020 (Water Temperature, in °F)



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



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

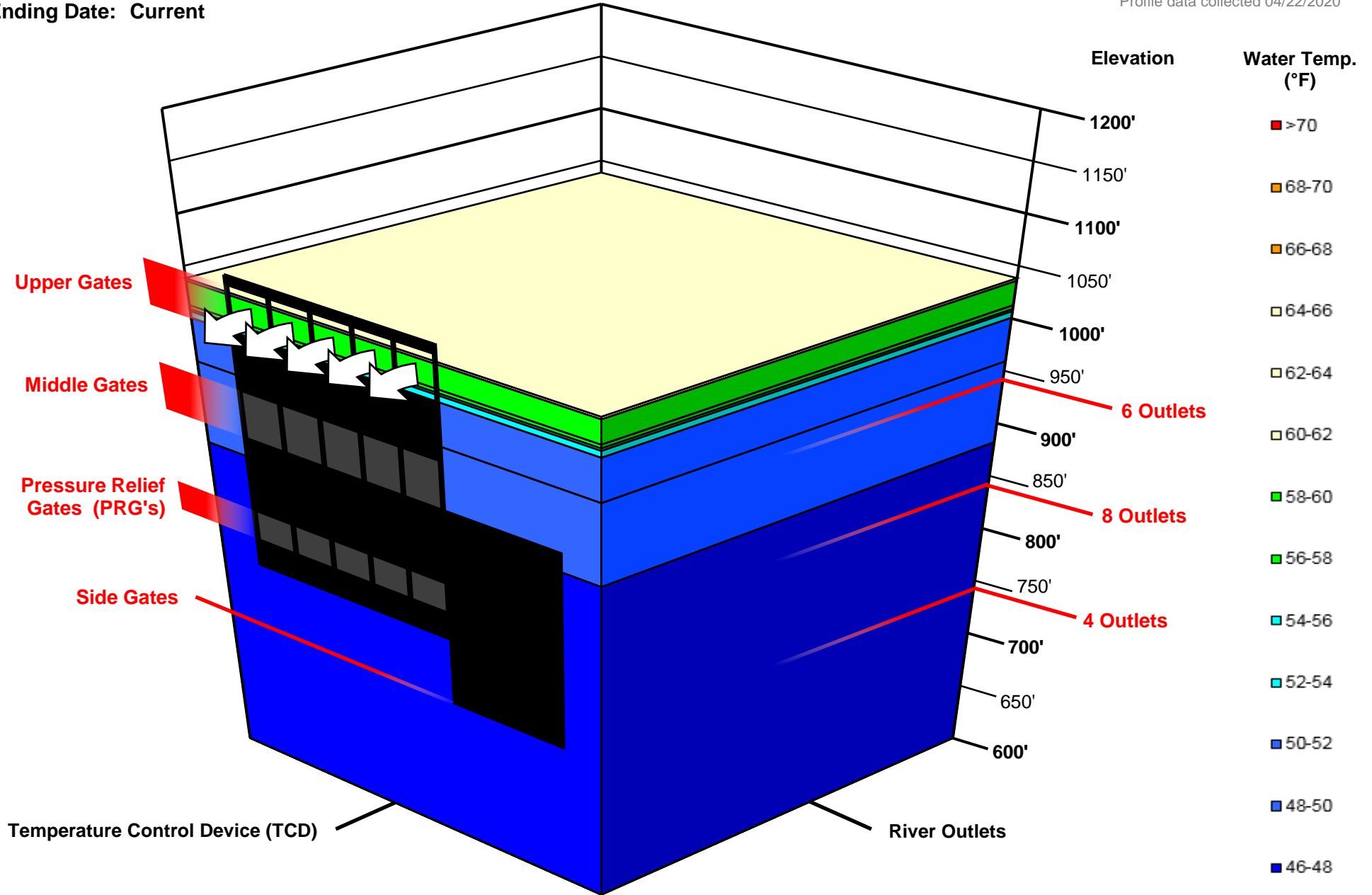


Shasta TCD Configuration

Starting Date: 4/7/2020

Ending Date: Current

Profile data collected 04/22/2020



Temperature Control Device (TCD)

River Outlets

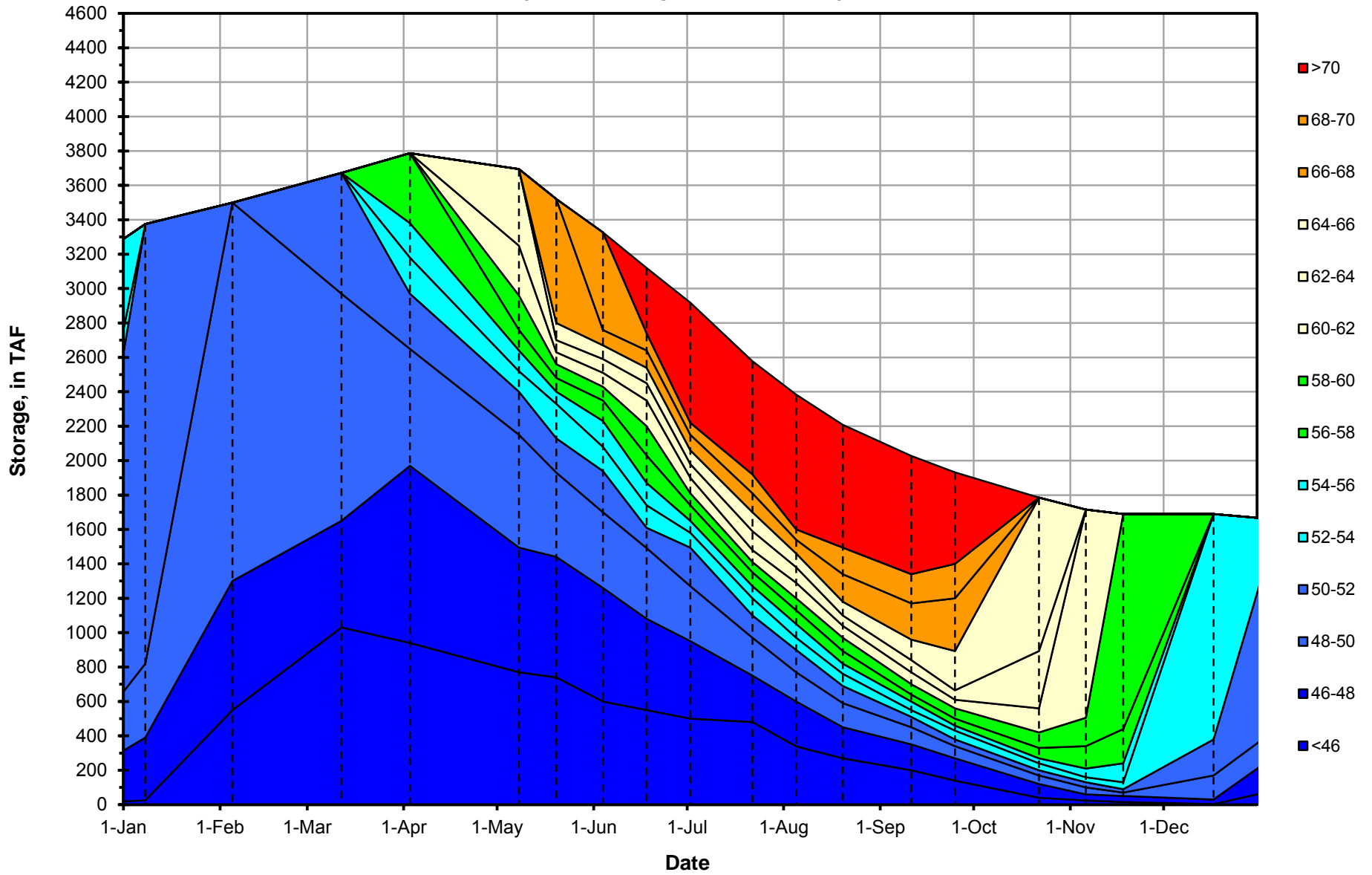
Arrows indicate open Gate or Outlet (i.e. Water flowing from this location)

CCR

Daily Avg		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Tot.	Valid ¹	172	177	177	177	177	177	176	177	177	174	177	177	177	177	177	177	176	177
	%	(97.2)	(100)	(100)	(100)	(100)	(100)	(99.4)	(100)	(100)	(98.3)	(100)	(100)	(100)	(100)	(100)	(100)	(99.4)	(100)
Exceedance Count / °F	52.0	97	61	124	135	145	112	138	133	89	135	154	152	93	98	135	172	176	177
	%	(56.4)	(34.5)	(70.1)	(76.3)	(81.9)	(63.3)	(78.4)	(75.1)	(50.3)	(77.6)	(87)	(85.9)	(52.5)	(55.4)	(76.3)	(97.2)	(100)	(100)
	52.5	65	9	116	119	105	101	131	103	37	130	151	144	65	56	82	165	176	177
	%	(37.8)	(5.1)	(65.5)	(67.2)	(59.3)	(57.1)	(74.4)	(58.2)	(20.9)	(74.7)	(85.3)	(81.4)	(36.7)	(31.6)	(46.3)	(93.2)	(100)	(100)
	53.0	45		79	92	63	83	96	89	9	119	149	140	32	27	31	154	173	177
	%	(26.2)		(44.6)	(52)	(35.6)	(46.9)	(54.5)	(50.3)	(5.1)	(68.4)	(84.2)	(79.1)	(18.1)	(15.3)	(17.5)	(87)	(98.3)	(100)
	53.5	33		53	56	24	65	72	82		96	145	133	8	4	3	129	172	177
	%	(19.2)		(29.9)	(31.6)	(13.6)	(36.7)	(40.9)	(46.3)		(55.2)	(81.9)	(75.1)	(4.5)	(2.3)	(1.7)	(72.9)	(97.7)	(100)
	54.0	14		30	48	10	29	62	67		66	132	118	6	2	1	98	172	177
	%	(8.1)		(16.9)	(27.1)	(5.6)	(16.4)	(35.2)	(37.9)		(37.9)	(74.6)	(66.7)	(3.4)	(1.1)	(0.6)	(55.4)	(97.7)	(100)
	54.5	1		2	41	2		58	39		44	111	97	2	1	1	56	167	176
	%	(0.6)		(1.1)	(23.2)	(1.1)		(33)	(22)		(25.3)	(62.7)	(54.8)	(1.1)	(0.6)	(0.6)	(31.6)	(94.9)	(99.4)
	55.0				29	2		50	30		25	82	50				20	161	170
	%				(16.4)	(1.1)		(28.4)	(16.9)		(14.4)	(46.3)	(28.2)				(11.3)	(91.5)	(96)
	55.5				12			42	16		15	56	33				7	134	162
%				(6.8)			(23.9)	(9)		(8.6)	(31.6)	(18.6)				(4)	(76.1)	(91.5)	
56.0				1			29	2		7	45	21					90	143	
%				(0.6)			(16.5)	(1.1)		(4)	(25.4)	(11.9)					(51.1)	(80.8)	
56.5							19			2	40	16					67	114	
%							(10.8)			(1.1)	(22.6)	(9)					(38.1)	(64.4)	
57.0							1				35	9					53	77	
%							(0.6)				(19.8)	(5.1)					(30.1)	(43.5)	
57.5											30	3					51	28	
%											(16.9)	(1.7)					(29)	(15.8)	
58.0											8						47	7	
%											(4.5)						(26.7)	(4)	

¹ A daily average is only calculated if 14 or more hours of data were collected that day.

Lake Shasta Isothermobaths - 2013 (Water Temperature, in °F)



April 22, 2020

Upper Sacramento River – April 2020 Preliminary Temperature Analysis

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

Model Run	Location	Apr	May	Jun	Jul	Aug	Sep*	Oct*
90% Hydrology 25% Historical Meteorology Targeting CCR Scenario 148	Keswick Dam KWK	53.6	54.1	52.7	53.2	53.2	See Fig. 9	See Fig. 9
	Sac. R. abv Clear Creek CCR	53.6	54.4	53.1	53.7	53.7	See Fig. 10	See Fig. 10
	Airport Road	53.8	54.8	53.6	54.3	54.4	n/a	n/a
	Balls Ferry BSF	54.7	56.0	54.6	55.3	55.4	See Fig. 11	See Fig. 11
90% Hydrology 25% Historical Meteorology Targeting CCR Scenario 23	Keswick Dam KWK	53.6	53.3	52.7	53.2	53.2	See Fig. 9	See Fig. 9
	Sac. R. abv Clear Creek CCR	53.6	53.6	53.1	53.7	53.7	See Fig. 10	See Fig. 10
	Airport Road	53.8	54.1	53.6	54.3	54.4	n/a	n/a
	Balls Ferry BSF	54.7	55.3	54.6	55.3	55.4	See Fig. 11	See Fig. 11
90% Hydrology 25% Historical Meteorology Targeting CCR Scenario 144	Keswick Dam KWK	53.6	53.7	52.7	53.2	53.3	See Fig. 9	See Fig. 9
	Sac. R. abv Clear Creek CCR	53.6	54.0	53.1	53.7	53.7	See Fig. 10	See Fig. 10
	Airport Road	53.8	54.5	53.6	54.3	54.4	n/a	n/a
	Balls Ferry BSF	54.7	55.7	54.6	55.3	55.4	See Fig. 11	See Fig. 11
90% Hydrology 25% Historical Meteorology Targeting CCR Scenario 145	Keswick Dam KWK	53.6	54.1	52.7	53.2	53.3	See Fig. 9	See Fig. 9
	Sac. R. abv Clear Creek CCR	53.6	54.4	53.1	53.6	53.7	See Fig. 10	See Fig. 10
	Airport Road	53.8	54.8	53.6	54.3	54.4	n/a	n/a
	Balls Ferry BSF	54.7	56.0	54.6	55.3	55.4	See Fig. 11	See Fig. 11

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% Hist. Met. CCR Scenario 148	495	8/10	10/30
90% Hydro. - 25% Hist. Met. CCR Scenario 23	462	8/9	9/30
90% Hydro. - 25% Hist. Met. CCR Scenario 144	468	8/10	10/24
90% Hydro. - 25% Hist. Met. CCR Scenario 145	480	8/10	10/28

Model Run Date April 22, 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 6-8). This relationship is an end of September Lake Shasta Volume less than 56°F and likely downstream temperature performance for the early fall months. Estimated temperatures for September and October may fall into a range indicated within the Fall Temperature Index (graphical chart), illustrating historical performance. However, this range should be viewed as an element of uncertainty based on past performance, not a simulation or projection of temperature management operations or results.

Temperature Analysis Results:

Modeling runs explore Sacramento River compliance performance above Clear Creek confluence and Balls Ferry locations by varying hydrology and meteorology. The temperature results for the Sacramento River between Keswick Dam and Balls Ferry are shown in Figures 1 through 2. The relationship between end-of-September lake volume below 56°F and a downstream Sacramento River compliance location through fall is based on the Figures 3-5. Runs targeting temperature above Clear Creek confluence and at Balls Ferry target locations attempt to meet the April 15 – May 15 temperature target of 56°F at Balls Ferry.

Temperature Model Inputs, Assumptions, Limitations and Uncertainty:

1. The latest available profiles for Shasta, Trinity, and Whiskeytown were taken on April 15, April 9, and April 14, respectively. Model results are sensitive to initial reservoir temperature conditions and the model performs best under highly stratified conditions. The temperature profiles prior to May do not yet exhibit conditions for ideal model computations (still nearly isothermal conditions). The model performs well after the reservoir stratifies, typically in late spring (i.e. end of April). The concern this year is assuming over or under estimations with variable hydrologic and meteorological conditions and not capturing the stratification with sufficient detail to project into the future with confidence.
2. Guidance on forecasted flows from the creeks (e.g., Cow, Cottonwood, Battle, etc.) between Keswick Dam and Bend Bridge are not available beyond 5 days. Creek flows developed from the historical record that most closely reflects current conditions were used for all model runs. The resulting creek flows can cause significant additional warming in the upper Sacramento River during spring.
3. Operation is based on the April 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 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).

**Sacramento River Modeled Temperature
2020 April 90%-Exceedance Water Outlook - 25% L3MTO Meteorology
Scenario 148**

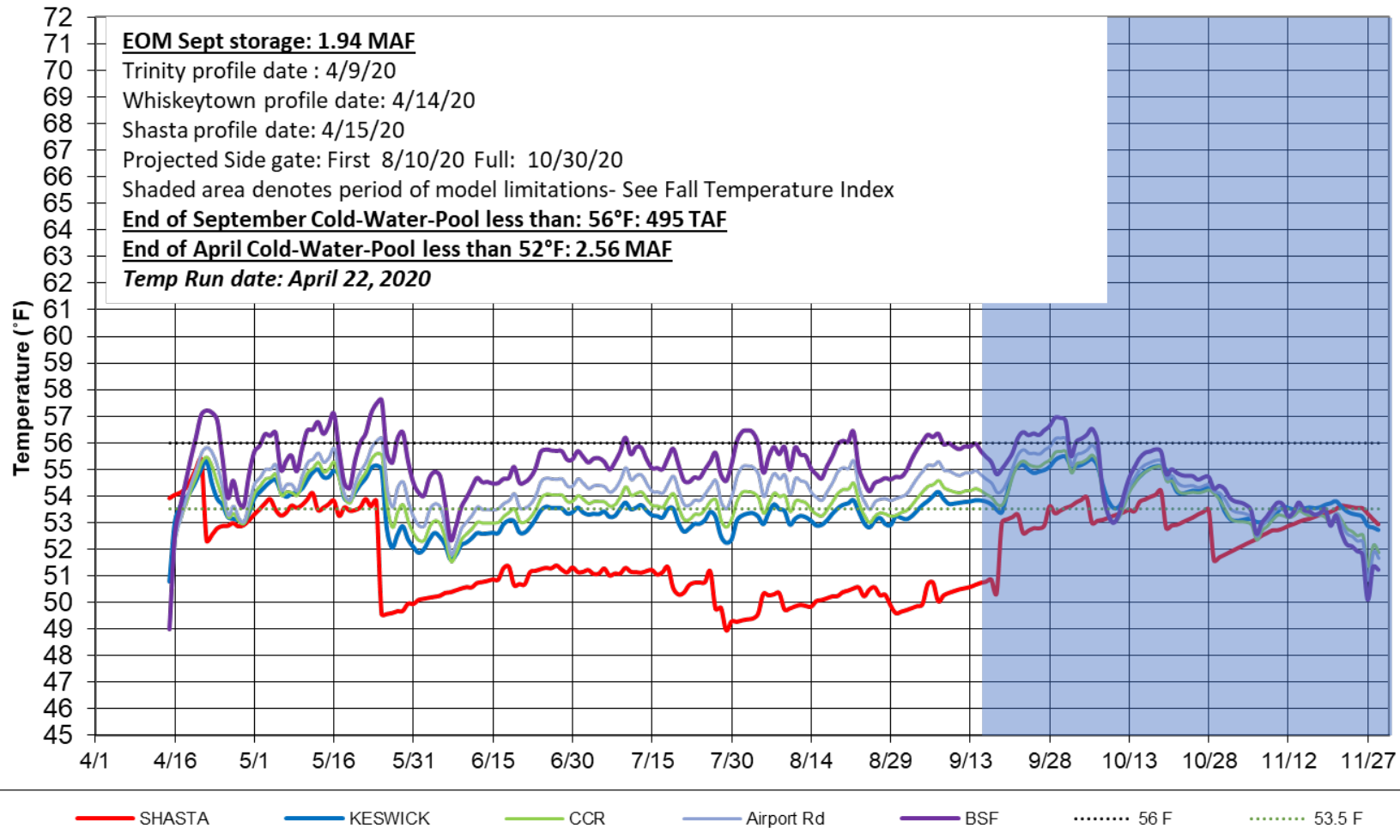


Figure 1. April 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% historical meteorology targeting CCR.

Trinity - Modeled Temperature
2020 April 90%-Exceedance Water Outlook- 25% L3MTO Meteorology Scenario 148

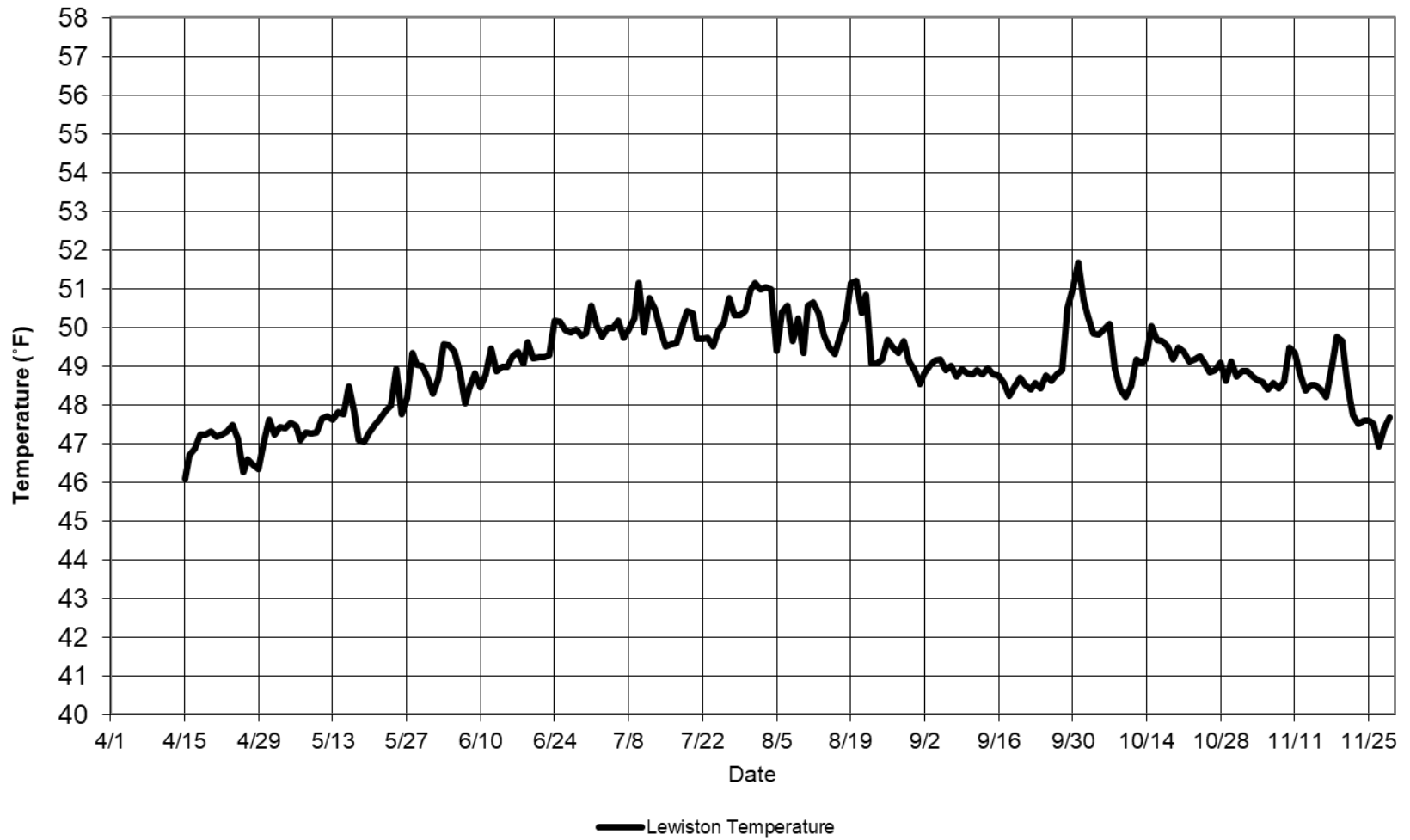


Figure 2. April 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% historical meteorology

**Sacramento River Modeled Temperature
2020 April 90%-Exceedance Water Outlook - 25% L3MTO Meteorology
Scenario 23**

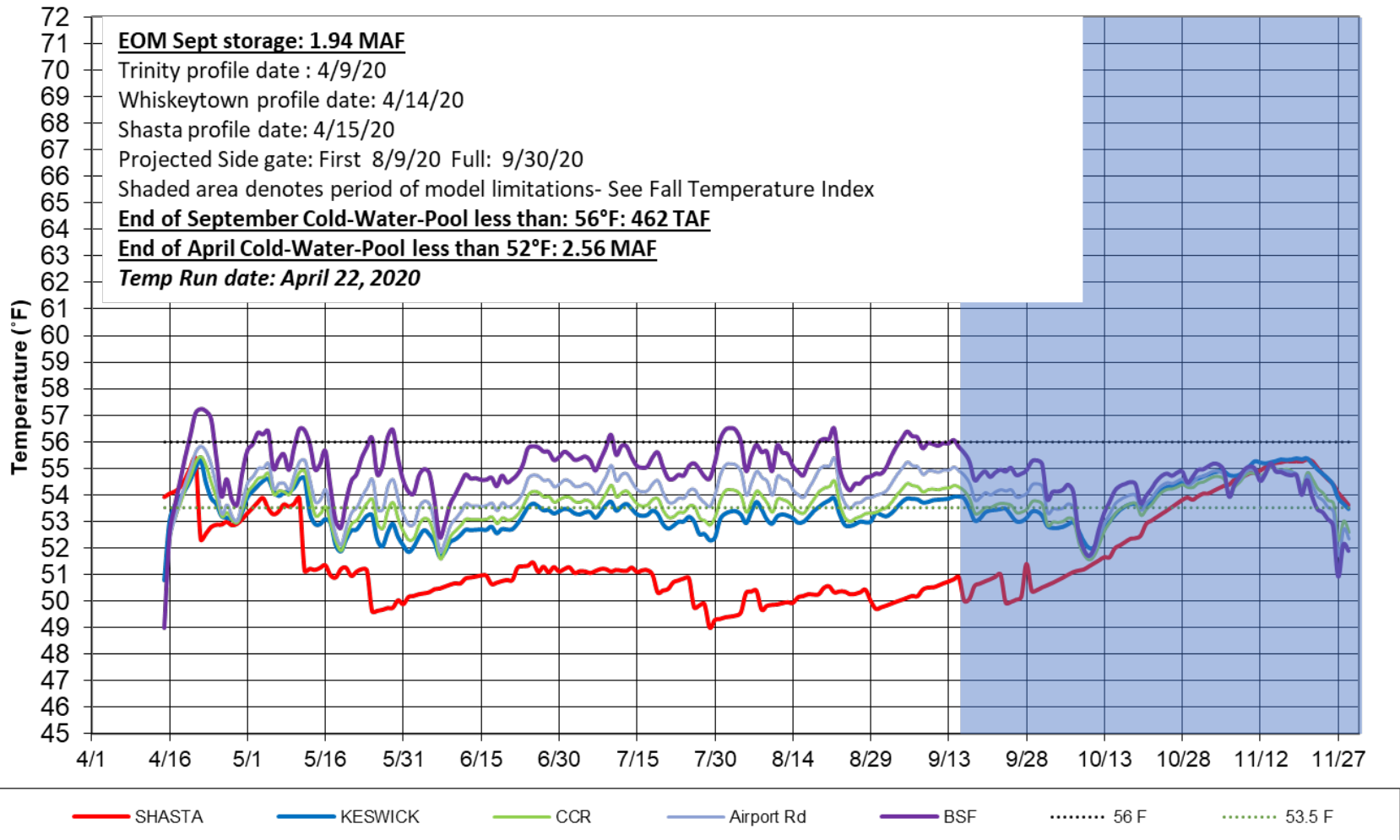


Figure 3. April 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% historical meteorology targeting CCR.

Trinity - Modeled Temperature
2020 April 90%-Exceedance Water Outlook- 25% L3MTO Meteorology Scenario 23

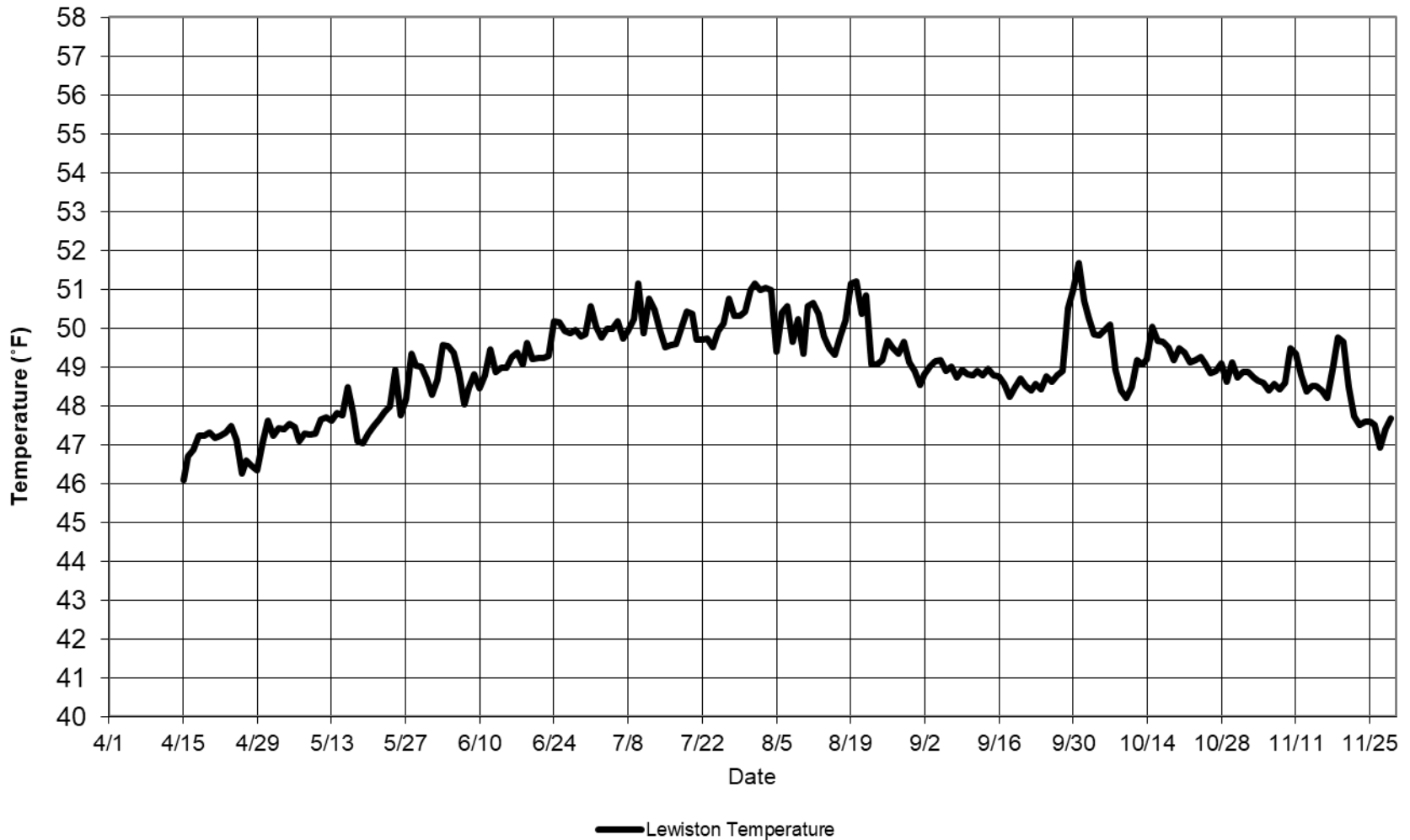


Figure 4. April 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% historical meteorology

**Sacramento River Modeled Temperature
2020 April 90%-Exceedance Water Outlook - 25% L3MTO Meteorology
Scenario 144**

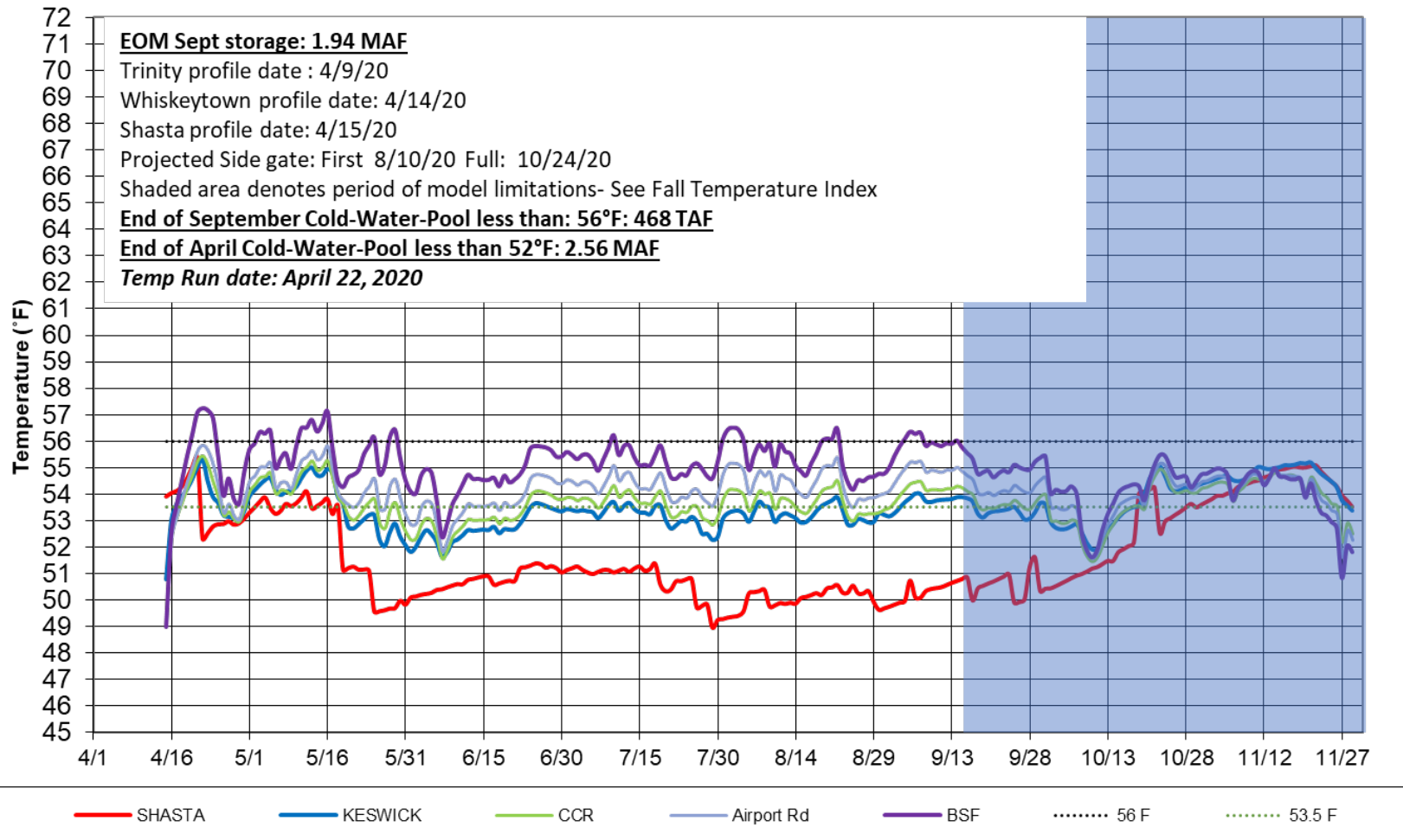


Figure 5. April 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% historical meteorology targeting CCR.

Trinity - Modeled Temperature
2020 April 90%-Exceedance Water Outlook- 25% L3MTO Meteorology
Scenario 144

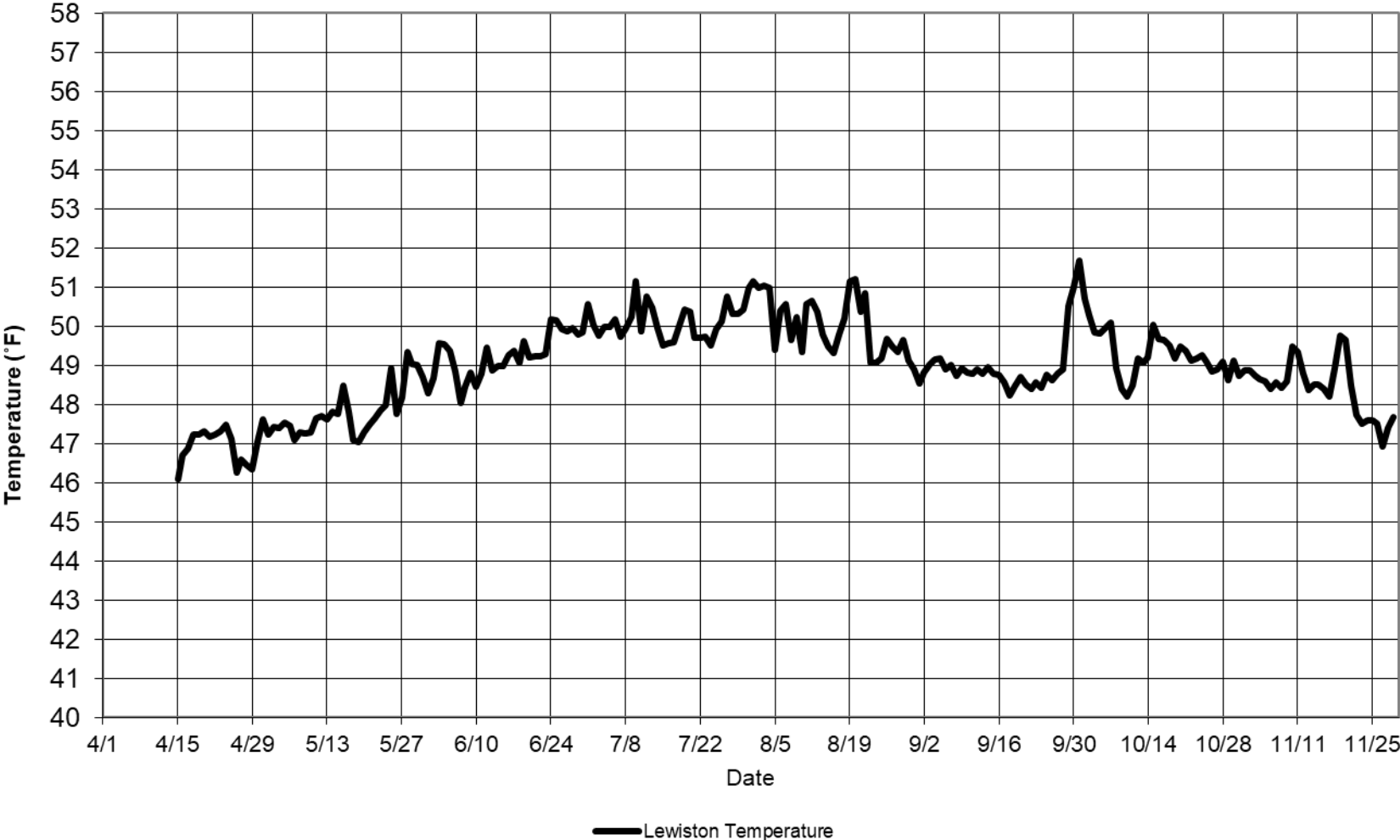


Figure 6. April 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% historical meteorology

**Sacramento River Modeled Temperature
2020 April 90%-Exceedance Water Outlook - 25% L3MTO Meteorology
Scenario 145**

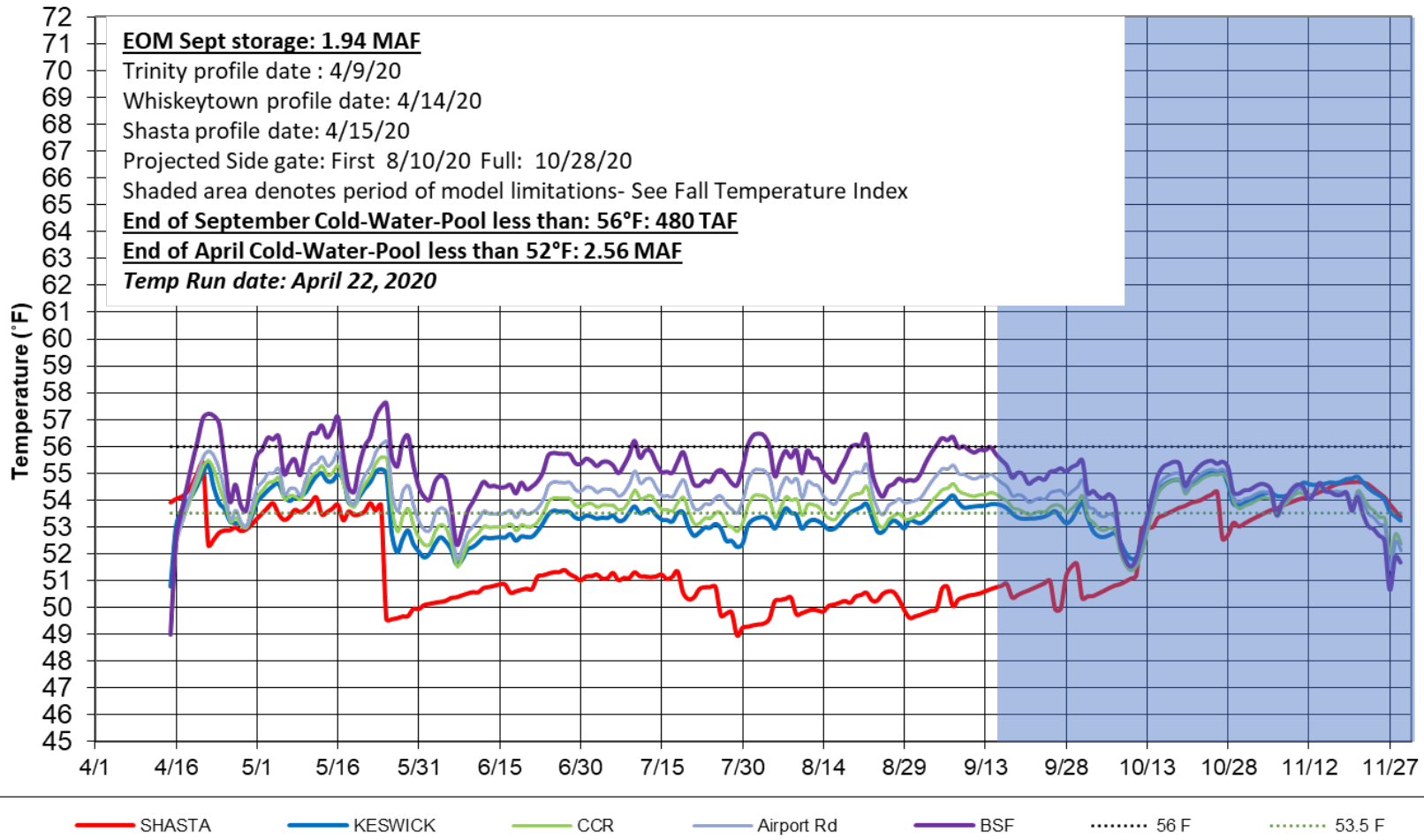


Figure 7. April 2020 simulated Sacramento River temperatures 90% runoff exceedance hydrology and 25% historical meteorology targeting CCR.

Trinity - Modeled Temperature
2020 April 90%-Exceedance Water Outlook- 25% L3MTO Meteorology
Scenario 145

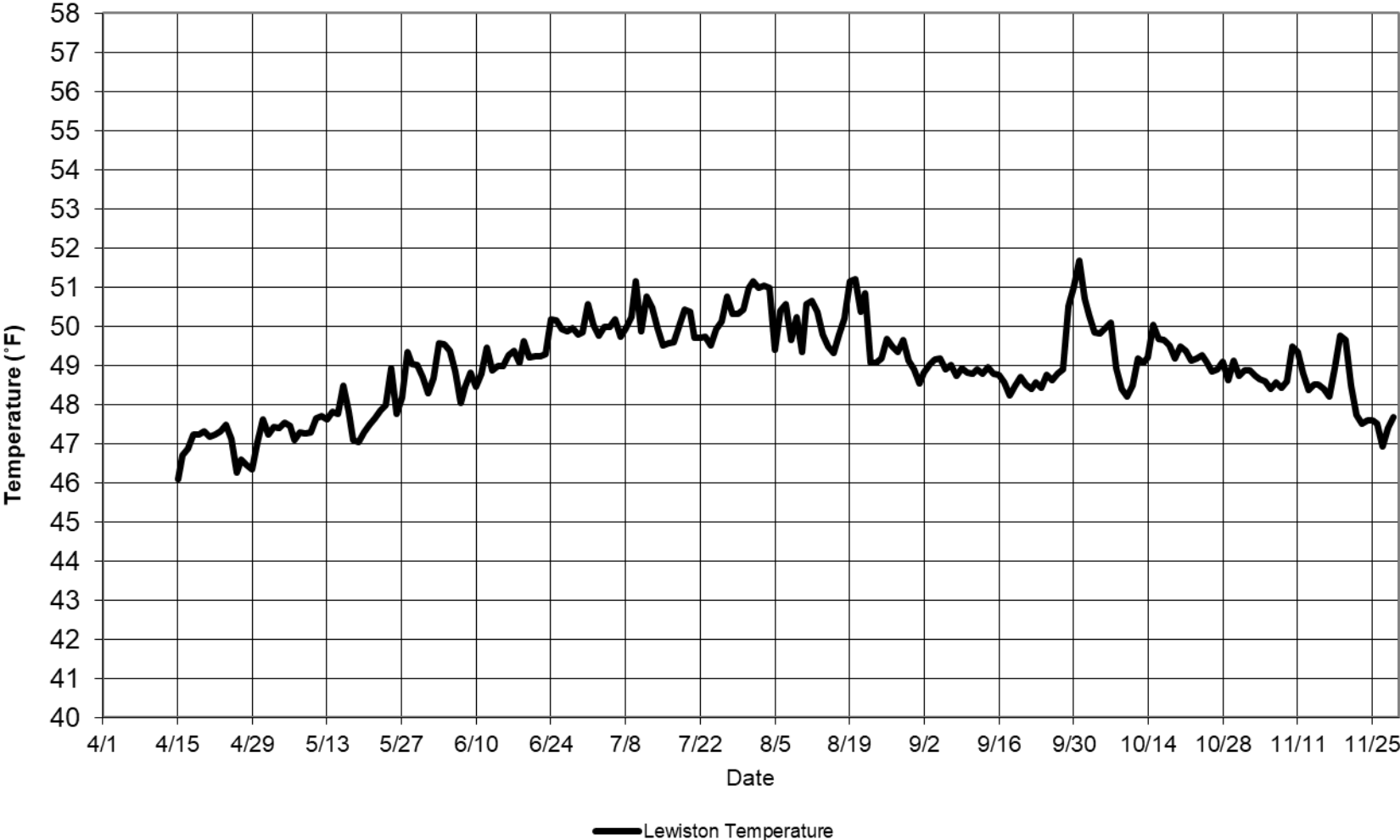


Figure 8. April 2020 simulated Trinity River temperatures 90% runoff exceedance hydrology and 25% historical meteorology

Figures 9-11 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 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.

Sacramento River - Lake Shasta
 Early Fall Water Temperature - Keswick (KWK)

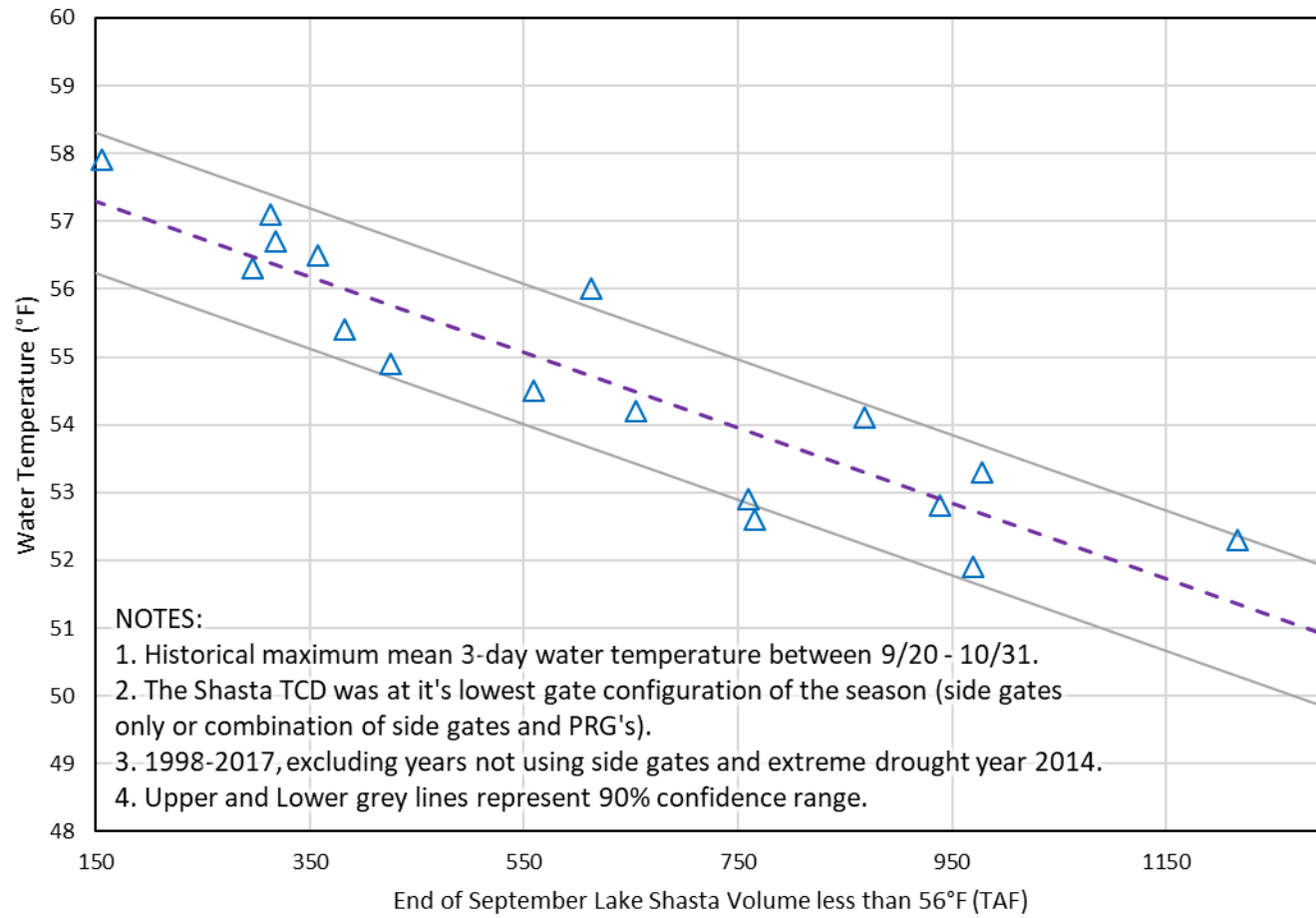


Figure 9. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Keswick water temperature.

Sacramento River - Lake Shasta
 Early Fall Water Temperature - Sac River above Clear Creek (CCR)

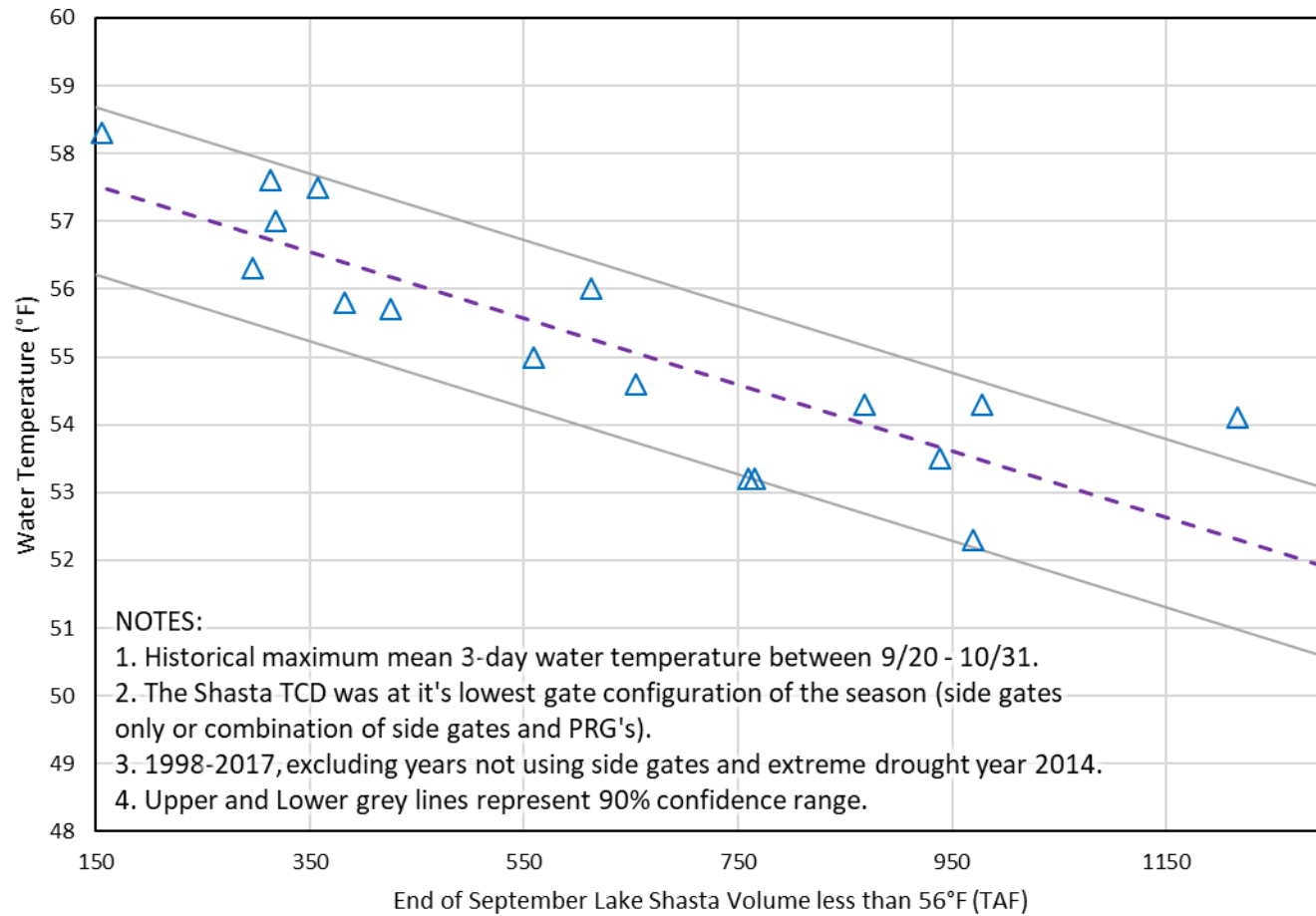


Figure 10. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Sacramento River above Clear Creek confluence water temperature.

Sacramento River - Lake Shasta
 Early Fall Water Temperature - Balls Ferry (BSF)

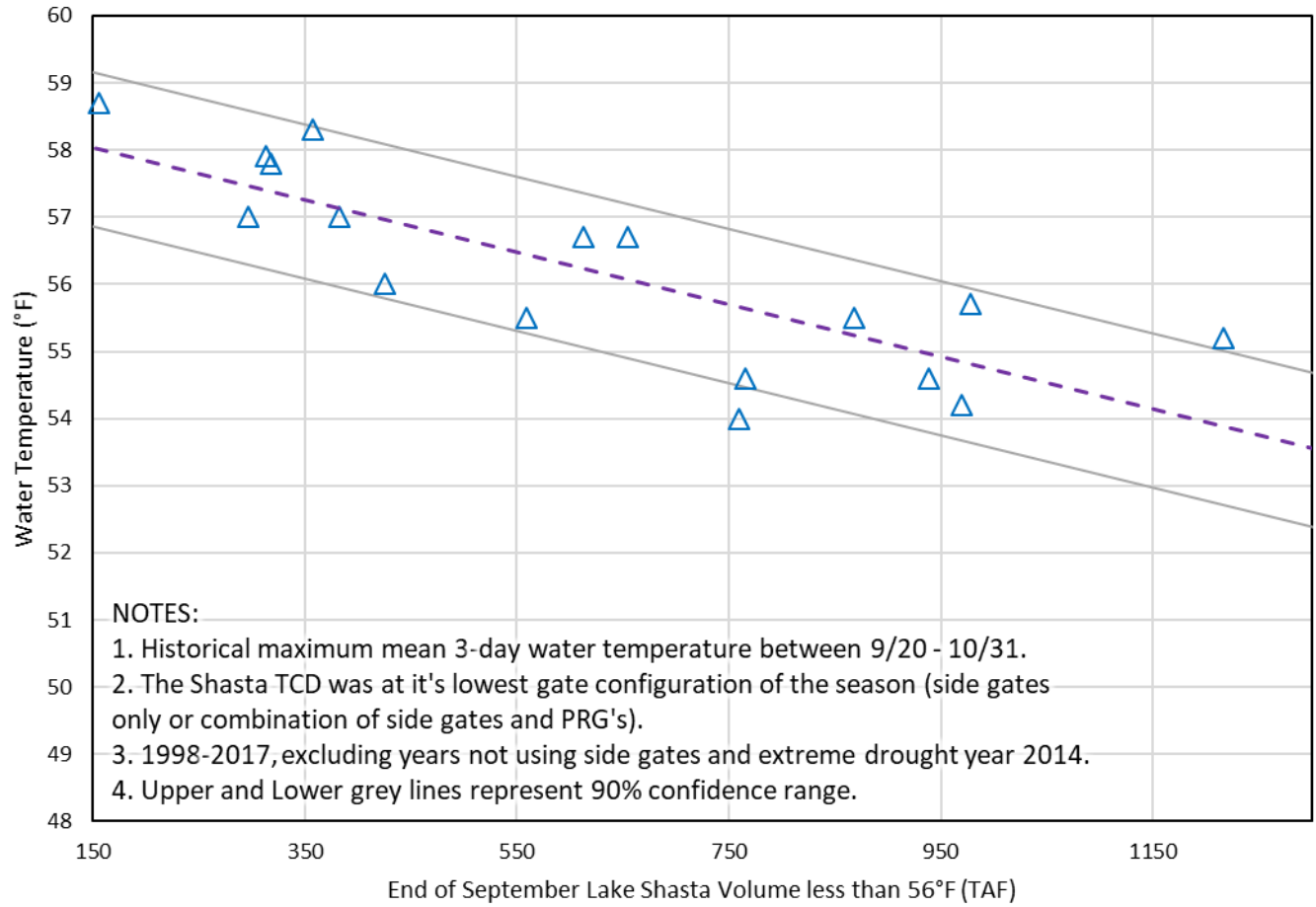
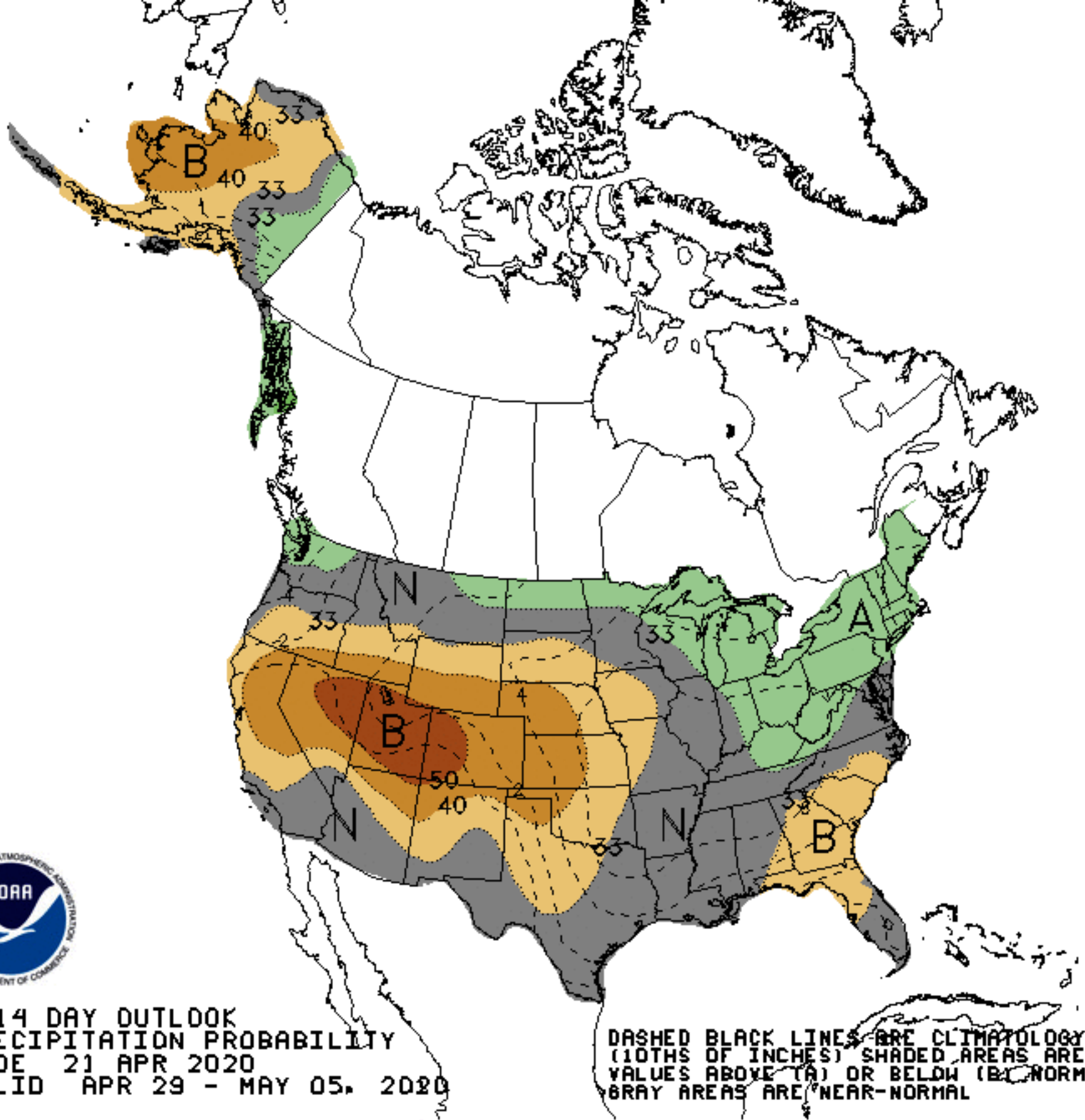
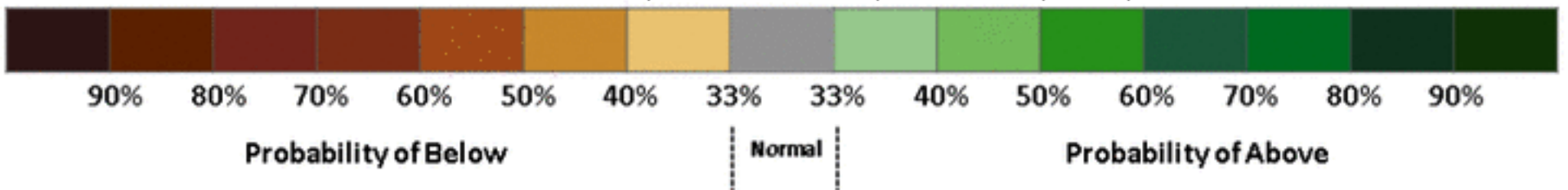


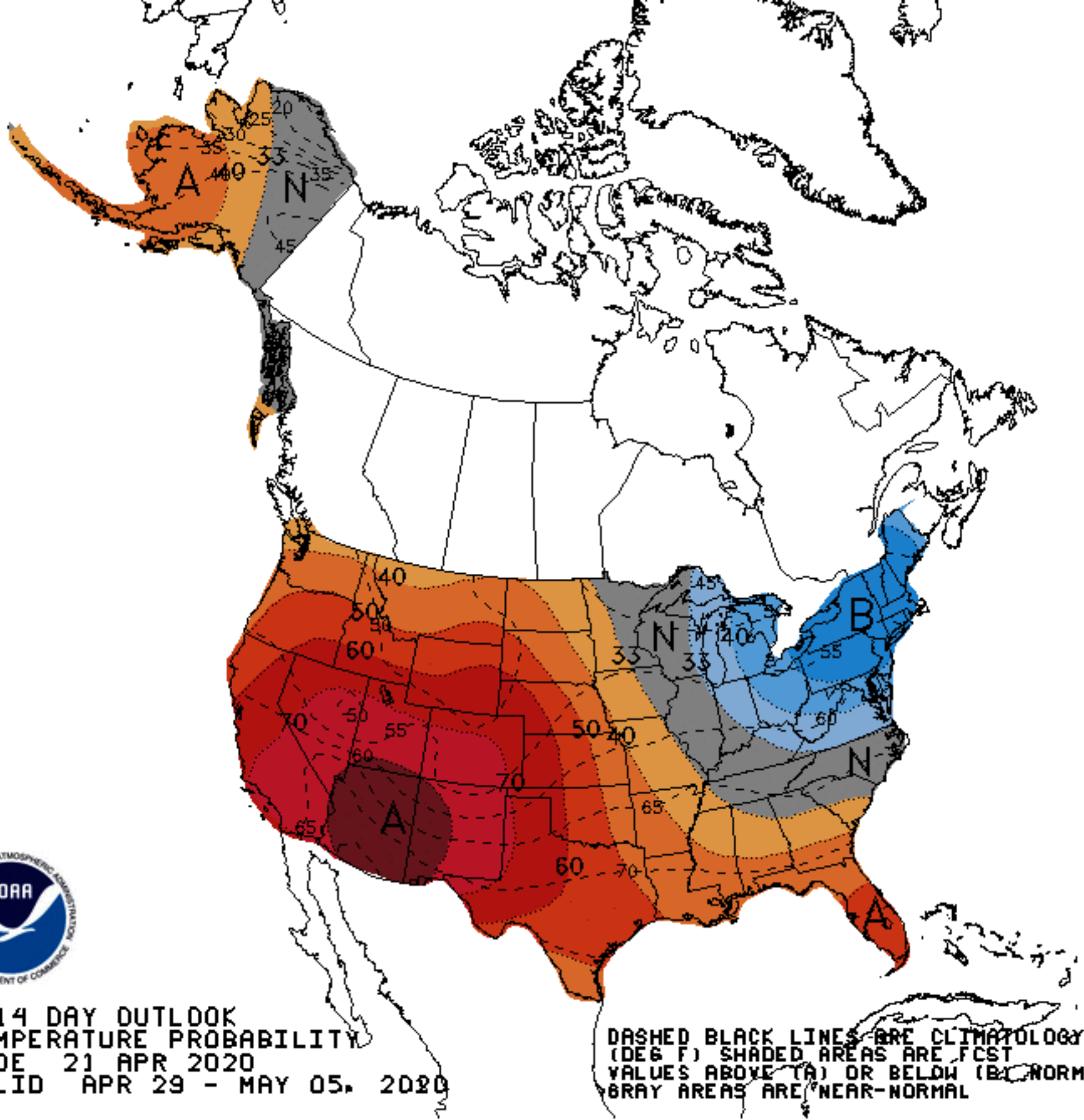
Figure 11. Historical relationship between Lake Shasta cold-water-pool characteristics and early fall Balls Ferry water temperature.



8-14 DAY OUTLOOK
 PRECIPITATION PROBABILITY
 MADE 21 APR 2020
 VALID APR 29 - MAY 05, 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





8-14 DAY OUTLOOK
 TEMPERATURE PROBABILITY
 MADE 21 APR 2020
 VALID APR 29 - MAY 05, 2020

DASHED BLACK LINES ARE CLIMATOLOGY (DEG F) SHADED AREAS ARE FCST VALUES ABOVE (A) OR BELOW (B) NORMAL GRAY AREAS ARE NEAR-NORMAL

