



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

March 21, 2017

Mr. Ron Milligan
Operations Manager, Central Valley Project
U.S. Bureau of Reclamation
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Re: Transmittal of March 2011 Reservoir Operations Forecast Per RPA 1.2.3

Dear Mr. Milligan:

Thank you for the opportunity to review the U.S. Bureau of Reclamation's (Reclamation) March forecast and water supply allocations for water year 2017. Your March 17, 2017, letter included the results of the 90 and 50 percent exceedance Central Valley Project (CVP) reservoir operations forecasts, water temperature modeling, and this year's initial water supply allocations. For purposes of compliance with the reasonable and prudent alternative (RPA) Action I.2.3, described in NOAA's National Marine Fisheries Service's (NMFS) April 7, 2011, amendment of the 2009 RPA¹, NMFS' concurrence is required prior to the initial water supply allocation of the year. The objective is to use a conservative forecast as early as possible to protect the cold water pool in Shasta Reservoir so that suitable spawning and egg/alevin incubation habitat can be maintained in the Sacramento River during the summer and fall season for federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*).

As noted in your March 17, 2017, letter, water year 2017 has been one of the wettest water years on record for the CVP, and Reclamation's approach to CVP water supply allocation determinations has deviated this year from historical practices. In a February 23, 2017 email, NMFS concurred with Reclamation's determination of allocations to CVP contractors that take water directly from Folsom, New Melones, and Millerton reservoirs and decision that allocations to portions of the CVP more directly affected by Shasta Dam operations would be deferred until March forecasts were available in order to ensure updated runoff forecasts could be used to project Sacramento River temperature management operations. In addition, NMFS concurred with Reclamation's determination that the runoff and operations projections for the San Joaquin River, duration of time that San Luis Reservoir is not needed to meet south of Delta water supply demands, and other operational considerations south of the Delta, are not influenced by Shasta Dam operations, but will all significantly influence the ultimate South of Delta allocations.

¹http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf



The March 2017 CVP reservoir operations forecast is based on estimated runoff within the Sacramento River basin as of March 8, 2017. The estimated annual inflow into Shasta Reservoir is 8.60 million acre-feet (MAF) (160% of mean) in the 90 percent exceedance forecast and 9.62 MAF (174% of mean) in the 50 percent exceedance forecast. The projected storage in Shasta Reservoir is forecast to be at 4.25 MAF at the end of May 2017 and 2.90 MAF at the end of September in the 90 percent exceedance forecast, and the projected storage in Shasta Reservoir is forecast to be at 4.42 MAF at the end of May 2017 and 3.18 MAF at the end of September in the 50 percent exceedance forecast. The following table provides Reclamation's initial water supply allocations based on the 90 percent exceedance forecast:

March 90% Exceedance Municipal & Industrial (M&I) Water Service Contracts and Agricultural Water Service Contracts				
	North of Delta M&I	North of Delta Agricultural	South of Delta M&I	South of Delta Agricultural
Allocation	100%	100%	90%	65%

NMFS understands that the proposed monthly average Keswick release schedule:

- includes consideration of flows necessary to implement RPA Action 4, Estuarine Habitat During Fall (commonly referred to as fall X2) in the U.S. Fish and Wildlife Service's December 15, 2008, biological opinion on the proposed coordinated operations of the CVP and State Water Project².
- does not include flows that may be requested to implement the North Delta Food Web Adaptive Management Project, as part of the Delta Smelt Resiliency Strategy³. However, based on its implementation in 2016, the flows for the project were on the order of 400 cfs, and were within the Keswick release schedule in the Sacramento River final temperature management plan⁴.

NMFS has reviewed Reclamation's March 2017 CVP reservoir operations 90 percent and 50 percent exceedance forecasts (enclosure 1), quantity and quality of the Shasta cold water pool at the beginning of March and forecasted end of May compared with historically similar years (enclosure 2), Shasta Reservoir end of April storage potential for meeting compliance point target of 56°F (enclosure 3), and corresponding water temperature model runs (enclosure 4). In addition, the NMFS-Southwest Fisheries Science Center utilized the Keswick release and temperature data from the March CVP reservoir operations 90 percent and 50 percent exceedance forecasts as input into its River Assessment for Forecasting Temperature (RAFT) and temperature-dependent mortality models (enclosure 5).

²https://www.fws.gov/sfbaydelta/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf

³<http://resources.ca.gov/docs/Delta-Smelt-Resiliency-Strategy-FINAL070816.pdf>

⁴http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/bureau_of_reclamation_s_sacramento_river_temperature_management_plan_-_june_27_2016.pdf
http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_concurrence_on_the_bureau_of_reclamation_s_sacramento_river_temperature_management_plan-june_28_2016.pdf

The resulting water temperature model runs based on the 90 percent exceedance hydrological forecast and average historic meteorological conditions indicate that a Keswick Dam release daily average temperature of 52°F can be maintained through the entire temperature management season (*i.e.*, May 15 through October 31) and should be adequate to obtain a 53°F daily average temperature at CCR⁵ [which is comparable and a surrogate for the 55°F 7-day average of daily maximum (7DADM) temperatures at CCR] as well as a target of 56°F daily average temperature (DAT) between Balls Ferry and Jellys Ferry and will be achievable throughout the winter-run and spring-run Chinook salmon spawning and incubation period. Based on the projected end-of-September storage in Shasta Reservoir of at least 2.2 MAF and temperature model runs meeting a Balls Ferry temperature compliance point, Reclamation and NMFS agree that RPA Action I.2.3.A should be implemented this year. The following table provides the results from the temperature-dependent mortality model.

March 2017 Hydrological Exceedance Forecast	Percent Temperature-Dependent Mortality		
	Mean	Median	95% Confidence Interval
90%	1.83%	0.08%	0.05 – 19.17%
50%	1.69%	0.01%	0.05 – 16.02%

In reviewing the Keswick release schedules, NMFS is concerned about the potential for winter-run Chinook salmon redd dewatering prior to complete fry emergence in the fall, and also fall-run Chinook salmon redd dewatering in the late fall and into the winter. NMFS will work with Reclamation to adjust the Keswick release schedule in the coming months in order to minimize the potential for winter-run Chinook salmon redd dewatering until complete emergence, and also to stabilize flows for fall-run Chinook salmon spawning and egg incubation.

In summary, NMFS concurs with Reclamation's forecasts based on March 8, 2017, hydrologic conditions, and initial water supply allocations, that RPA Action I.2.3.A should be implemented this year, and that a 55°F 7DADM temperature will be attainable at CCR. In addition, NMFS will work with Reclamation to adjust the Keswick release schedules in order to minimize the potential for winter-run and fall-run Chinook salmon redd dewatering. Our concurrence is based on Reclamation implementing the following monthly average Keswick release schedule (in cubic feet per second):

Exceedance	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
90%	17,000	6,000	8,500	10,000	12,000	10,500	8,500	7,000
50%	20,000	8,500	9,500	10,000	12,000	11,000	10,000	9,000

Should Reclamation need to change the release schedule, NMFS expects close coordination between our agencies to ensure that the habitat needs (*i.e.*, cold water, stable flows) of winter-run Chinook salmon continue to be met. In addition, NMFS requests to work with Reclamation on real-time management during the temperature management season. It will be critically important this year to target a 55°F 7DADM temperature at CCR (or most downstream winter-run redd) as the compliance criterion and location.

⁵ Sacramento River above Clear Creek (CCR) (river mile 292) California Data Exchange Center gauge station

Thank you for the recent discussions with your staff in meeting the requirements in RPA Action I.2.3. As you know, on January 19, 2017⁶, NMFS issued to Reclamation a draft proposed 2017 RPA amendment, focused on Shasta RPA Action Suite I.2. As part of the amendment process, Reclamation agreed⁷ to implement a pilot program for Shasta Reservoir temperature management in water year 2017 to make Keswick releases to maintain a temperature compliance point not in excess of: (1) 58.0°F DAT at Jellys Ferry as a surrogate temperature target of 61.0°F 7DADM from March 1 through May 15, and (2) 53.0°F DAT at CCR or to the downstream-most winter-run redd, as a surrogate temperature target of 55.0°F 7DADM, from the start of winter-run spawning, based on CDFW aerial redd or carcass surveys, through 100 percent winter-run emergence. I look forward to further communication between our agencies as we work on the annual Temperature Management Plan pursuant to RPA Action I.2.4 and the pilot program pursuant to the draft proposed 2017 RPA amendment.

NMFS also looks forward to working with Reclamation on the upcoming stakeholder engagement meetings to discuss the details of the proposed amendment to the Shasta RPA. We expect this dialogue with stakeholders will provide helpful context to supplement our ongoing conversations about how to manage Shasta resources for water supply and species over the long-term. If you have any questions regarding this letter, please feel free to contact me, or have your staff contact Mr. Brycen Swart at (916) 930-3712, or via e-mail at brycen.swart@noaa.gov.

Sincerely,



Maria C. Rea
Assistant Regional Administrator

Enclosures:

1. 90 and 50 percent exceedance forecasts (2 pages)
2. Shasta Reservoir cold water storage in the March 8, 2017, model run and forecasted end of May vs. historic data (2 pages)
3. Shasta Reservoir end of April storage potential for meeting compliance point target of 56°F
4. 90 and 50 percent exceedance temperature model runs (2 pages)
5. RAFT and temperature-dependent mortality model results for the 90 and 50 percent exceedance forecasts

cc: California Central Valley Office
Division Chron File: 151422SWR2006SA00268

⁶http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_s_draft_proposed_2017_rpa_amendment_-_january_19_2017.pdf

⁷http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/reclamation_s_response_to_nmfs_s_draft_proposed_2017_rpa_amendment_-_january_25_2017.pdf

Electronic copy only:

- Mr. Paul Souza, Regional Director, Pacific Southwest Region, U.S. Fish and Wildlife Service, 2800 Cottage Way, Sacramento, California 95825
- Ms. Kaylee Allen, Field Supervisor, Bay Delta Fish and Wildlife Office, U.S. Fish and Wildlife Service, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814
- Mr. Chuck Bonham, Director, California Department of Fish and Wildlife, 1416 Ninth Street, Sacramento, California 95814
- Mr. William Croyle, Acting Director, California Department of Water Resources, 1416 Ninth Street, Sacramento, California 95814
- Ms. Cindy Messer, Chief Deputy Director, California Department of Water Resources, 1416 Ninth Street, Sacramento, California 95814
- Mr. John Leahigh, Operations Control Office, California Department of Water Resources, 3310 El Camino Ave, Suite 300, Sacramento, California 95821
- Mr. Pablo Arroyave, Acting Regional Director, Mid-Pacific Region, Bureau of Reclamation, 2800 Cottage Way, Sacramento, California 95825
- Ms. Michelle Banonis, Area Manager, Bay-Delta Office, Bureau of Reclamation, 801 I Street, Suite 140, Sacramento, California 95814
- Mr. Tom Howard, Executive Director, State Water Resources Control Board, 1001 I St, Sacramento, California 95814

Enclosure 1

Estimated CVP Operations Mar 2017 90% Exceedance

Storages

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

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity		1922	2007	2111	2127	1992	1846	1722	1606	1574			
	Elev.	2341	2349	2350	2340	2330	2321	2312	2309				
Whiskeytown		224	206	238	238	238	238	230	206				
	Elev.	1199	1209	1209	1209	1209	1209	1207	1199				
Shasta		3779	3804	4225	4248	4026	3577	3169	2903	2716			
	Elev.	1040	1056	1057	1049	1032	1015	1003	995				
Folsom		404	580	759	966	944	784	647	539	415			
	Elev.	426	445	465	463	448	434	421	405				
New Melones		1578	1668	1712	1875	1990	1973	1919	1876	1846			
	Elev.	1021	1025	1041	1051	1050	1045	1041	1038				
San Luis		923	966	938	828	624	323	133	113	71			
	Elev.	543	534	510	480	446	424	417	404				
Total		9231	9984	10282	9814	8741	7827	7268	6829				

State End of the Month Reservoir Storage (TAF)

Oroville	Elev.	
San Luis		
Total San Luis (TAF)		

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	32	260	150	68	28	27	23
	cfs	300	540	4,225	2,526	1,102	450	450	373
Clear Creek	TAF	11	13	13	9	7	5	9	14
	cfs	175	218	216	150	120	85	150	225
Sacramento	TAF	1045	357	523	595	738	645	506	430
	cfs	17000	6000	8500	10000	12000	10500	8500	7000
American	TAF	492	357	400	387	307	246	215	159
	cfs	8000	6000	6500	6500	5000	4000	3618	2588
Stanislaus	TAF	61	83	96	56	18	18	18	49
	cfs	1000	1400	1555	940	300	300	300	797
Feather	TAF								
	cfs								

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	34	38	37	67	98	97	92	17				
Spring Crk. PP	60	8	30	60	90	90	90	30				

Delta Summary (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	128	104	98	262	271	272	267	95				
USBR Banks	0	0	0	0	0	0	0	33				
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8				
Total USBR	141	117	111	272	282	285	281	145				
State Export												
Total Export												
COA Balance	0	0	0	0	0	0	-15	-16				
Old/Middle River Std.												
Old/Middle R. calc.	6,339	2,807	2,527	-3,388	-8,333	-8,358	-6,706	-4,244				
Computed DOI	72048	39233	33706	18558	8182	7109	11397	11403				
Excess Outflow	42848	16776	12184	4875	179	114	0	0				
% Export/Inflow	5%	8%	8%	28%	46%	49%	38%	30%				
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%				

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted % of mean	1850 153%	8,859 160%	6,865 252%	2417 229%

Estimated CVP Operations Mar 50% Exceedance

Storages

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

		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Trinity		1922	2055	2223	2289	2197	2076	1928	1814	1785			
	Elev.	2345	2356	2360	2354	2346	2336	2328	2326				
Whiskeytown		224	206	238	238	238	238	230	206				
	Elev.	1199	1209	1209	1209	1209	1209	1207	1199				
Shasta		3779	3854	4308	4420	4213	3809	3468	3178	2949			
	Elev.	1042	1059	1063	1055	1041	1027	1015	1005				
Folsom		404	618	739	957	945	889	698	574	451			
	Elev.	430	443	464	463	458	439	425	410				
New Melones		1578	1711	1763	1939	2135	2166	2109	2062	1961			
	Elev.	1025	1030	1047	1064	1067	1062	1058	1049				
San Luis		923	966	1057	958	774	387	133	79	215			
	Elev.	543	536	518	502	463	436	420	417				
Total		9411	10327	10800	10502	9565	8574	7937	7567				

State End of the Month Reservoir Storage (TAF)

Oroville	
San Luis	
Total San Luis (TAF)	

Monthly River Releases (TAF/cfs)

Trinity	TAF	18	46	248	275	68	28	27	23
	cfs	300	767	4,032	4,617	1,102	450	450	373
Clear Creek	TAF	11	13	13	9	7	7	9	12
	cfs	175	218	216	150	120	120	150	200
Sacramento	TAF	1229	506	584	595	738	676	595	492
	cfs	20000	8500	9500	10000	12000	11000	10000	8000
American	TAF	492	506	523	565	307	307	238	198
	cfs	8000	8500	8500	9500	5000	5000	4000	3219
Stanislaus	TAF	74	97	120	65	26	25	24	123
	cfs	1200	1633	1958	1100	429	400	400	2000
Feather	TAF								
	cfs								

Trinity Diversions (TAF)

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Carr PP	66	51	9	13	97	128	91	16				
Spring Crk. PP	110	30	10	10	90	120	90	30				

Delta Summary (TAF)

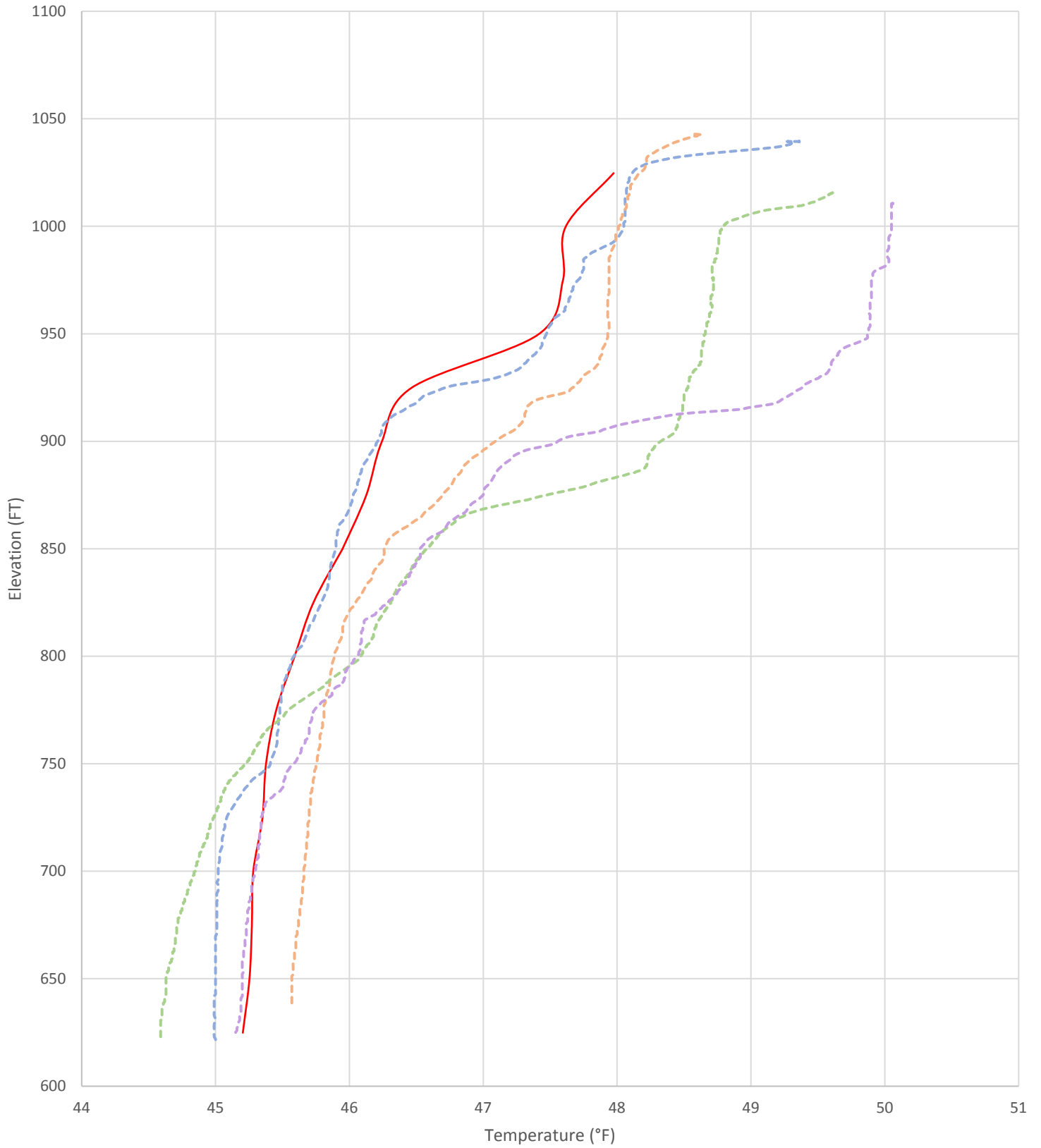
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Tracy	132	253	154	262	270	273	265	270				
USBR Banks	0	0	0	0	0	0	0	44				
Contra Costa	12.7	12.7	12.7	9.8	11.1	12.7	14.0	16.8				
Total USBR	145	266	166	272	281	286	279	331				
State Export												
Total Export												
COA Balance	0	0	0	0	0	0	0	13				
Old/Middle River Std.												
Old/Middle R. calc.	6,379	6,044	4,608	-4,205	-7,227	-8,085	-5,723	-4,744				
Computed DOI	85029	72382	52755	30543	10509	10395	11800	11403				
Excess Outflow	55829	46142	26255	10220	2505	390	403	0				
% Export/Inflow	4%	6%	8%	24%	43%	44%	35%	35%				
% Export/Inflow std.	35%	35%	35%	35%	65%	65%	65%	65%				

Hydrology

Water Year Inflow (TAF)	Trinity	Shasta	Folsom	New Melones
Year to Date + Forecasted % of mean	2179 180%	9,619 174%	7,434 273%	2687 254%

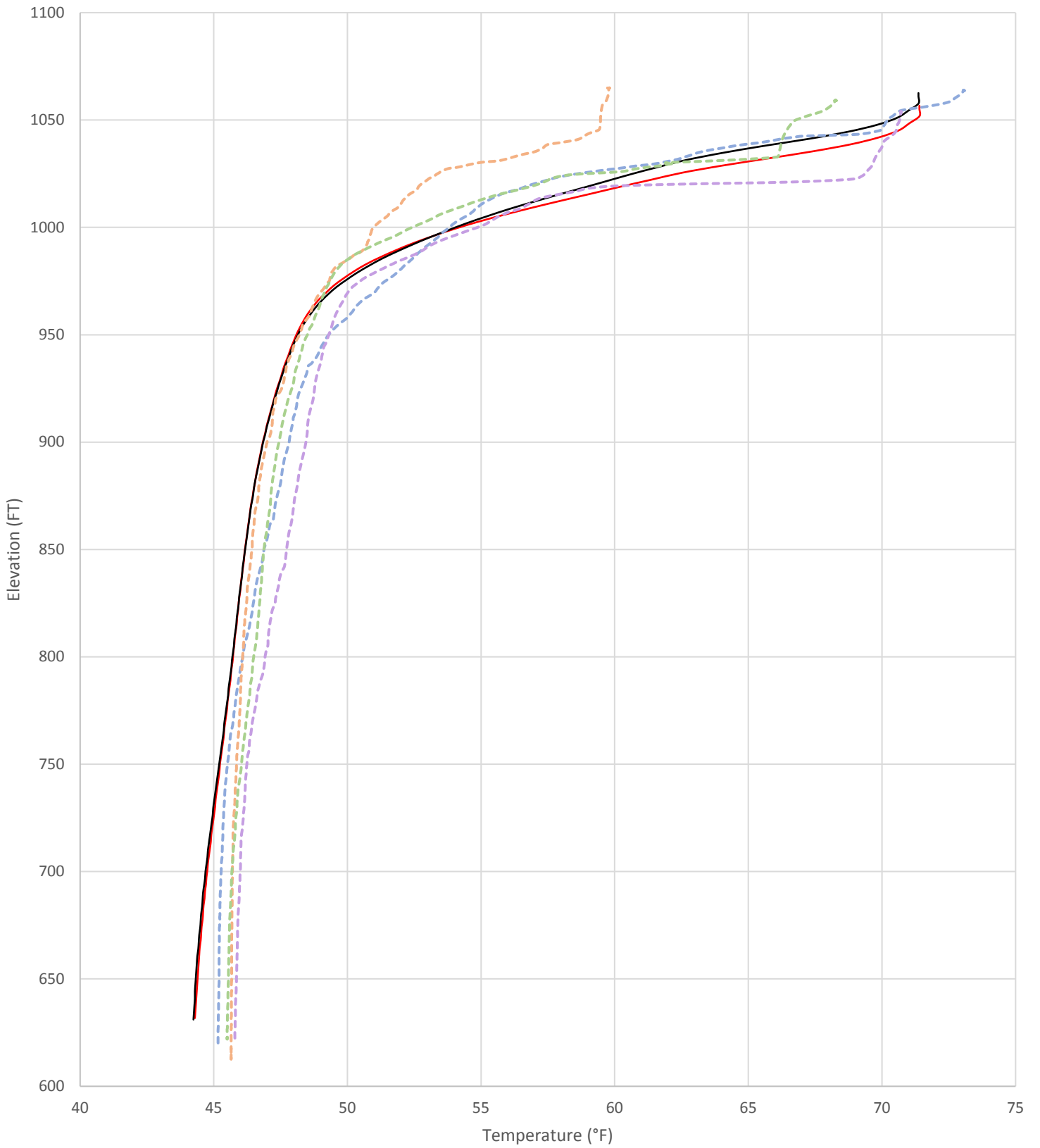
Enclosure 2

March 2017 vs Historic Shasta Temperature Profiles



— 3/8/2017 - - - 3/23/2006 - - - 3/4/2011 - - - 3/8/2012 - - - 3/8/2016

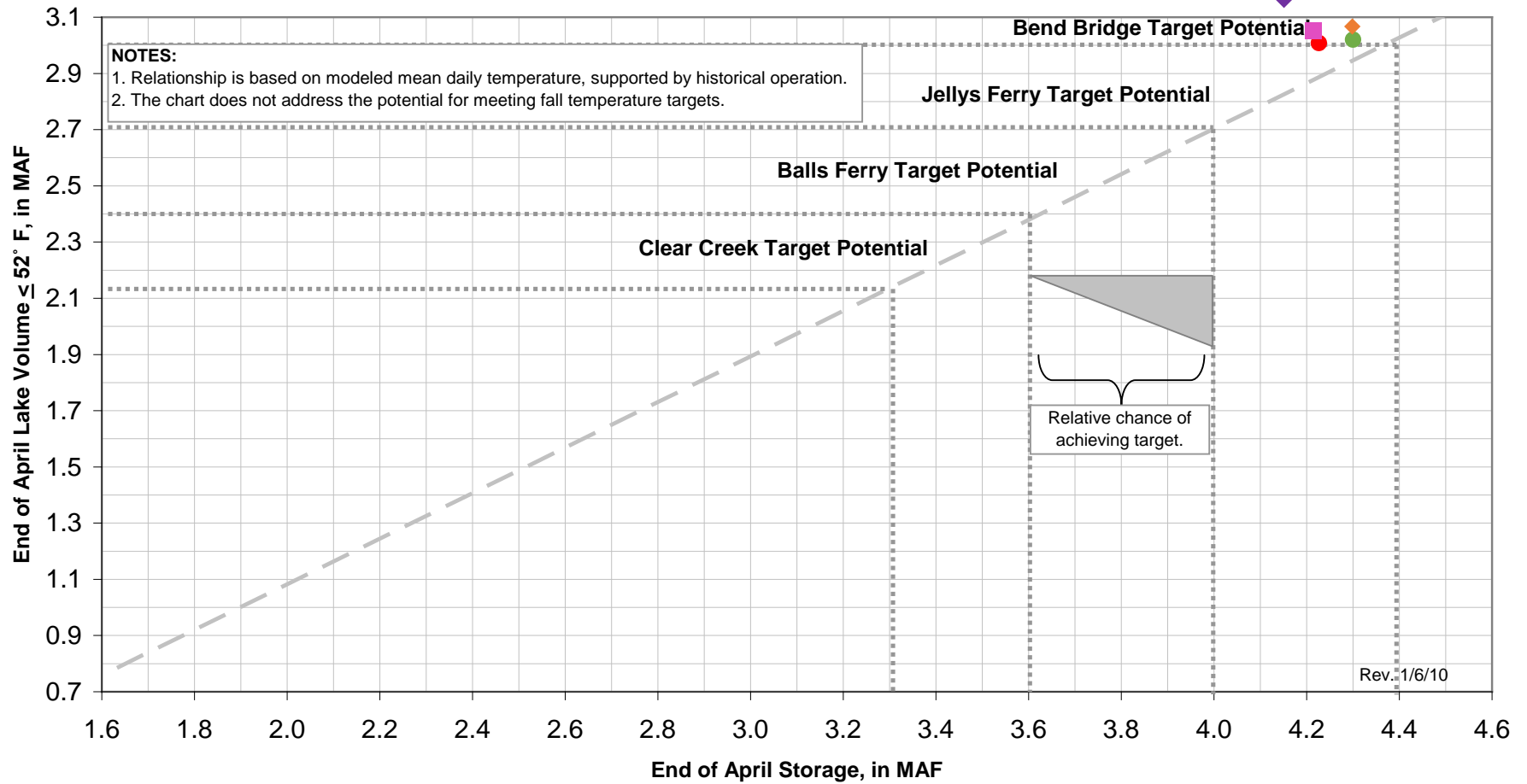
March 2017 Forecasted End of May vs Historic Shasta Temperature Profiles



— 5/30/2017 (90%) — 5/30/2017 (50%) - - - 6/5/2006 - - - 6/2/2011 - - - 5/29/2012 - - - 5/31/2016

Enclosure 3

Lake Shasta End of April Storage Potential for Meeting Compliance Point Target of 56° F (Apr-Sep)



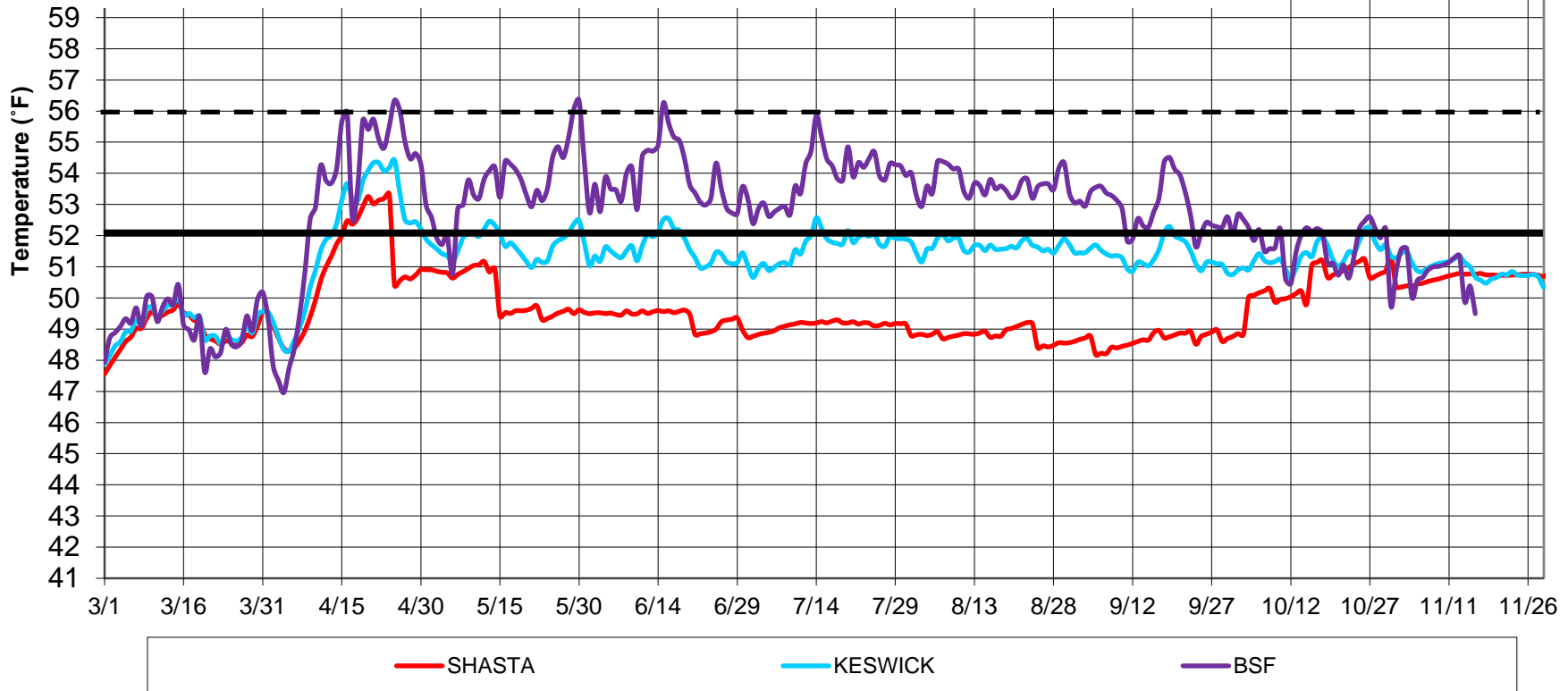
● 2017 (90%)
 ● 2017 (50%)
 ◆ 2006
 ◆ 2011
 ■ 2012
 ■ 2016

Enclosure 4

**Sacramento River Modeled Temperature
 2017 Mar 90%-Exceedance Water Outlook - Average Historical Meteorology
 Approximately 52 degree at Keswick**

67 Kes Releases: April at 6,000, May at 8,500, June at 10,000, July at 12,000, Aug at 10,500, Sept at 8,500,
 66 Oct at 7,000, and Nov at 4,500
 65 **EOM April storage: 4.2 MAF & EOM Sept storage: 2.9 MAF**
 64 Trinity profile date : 3/16/2017
 63 Whiskeytown profile date: 3/9/2017
 62 Shasta profile date: 3/8/2017
 61 One Side gate: Sep 10, Full Side gates not used

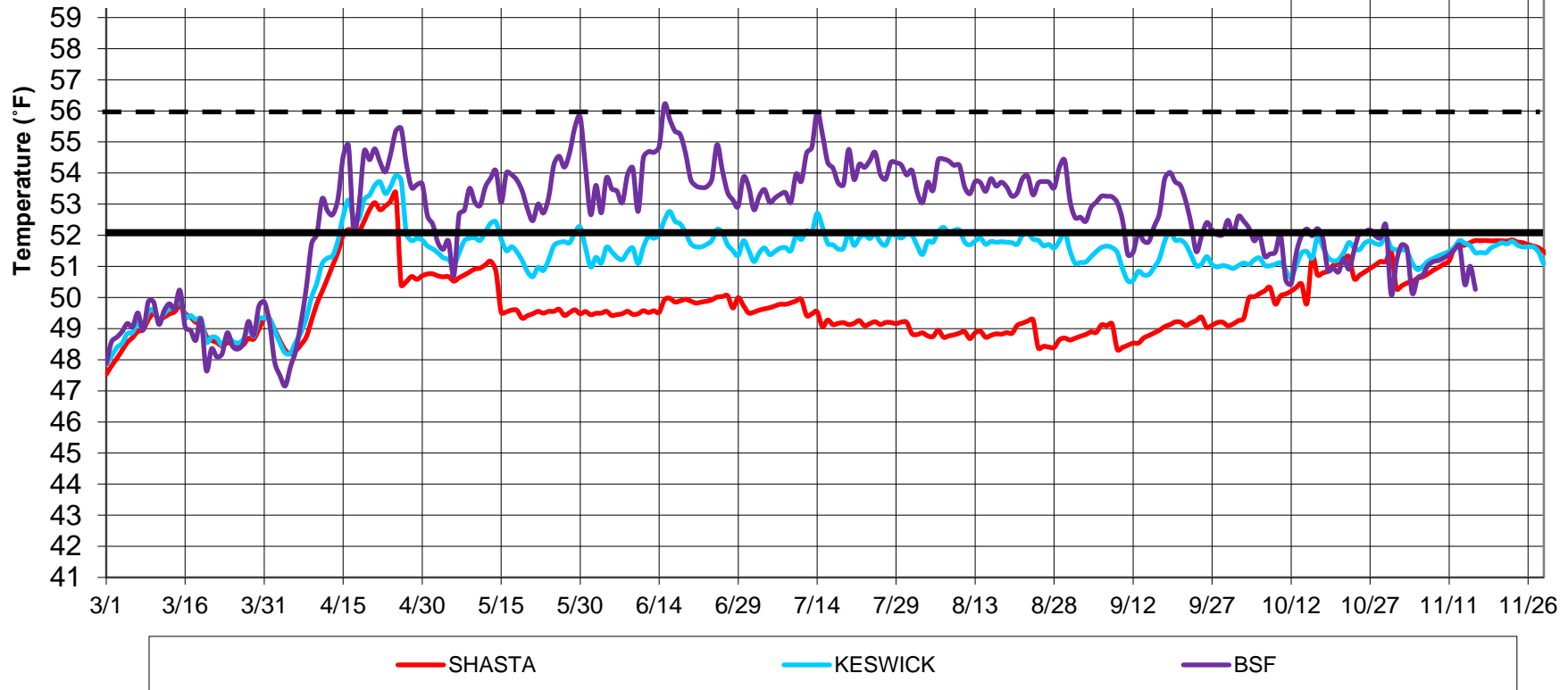
Temp Run date: March 16, 2017



**Sacramento River Modeled Temperature
2017 Mar 50%-Exceedance Water Outlook - Average Historical Meteorology
Approximately 52 degree at Keswick**

67 Kes Releases: April at 8,500, May at 9,500, June at 10,000, July at 12,000, Aug at 11,000, Sept at 10,000,
66 Oct at 8,000, and Nov at 5,500
65 **EOM April storage: 4.3 MAF & EOM Sept storage: 3.2 MAF**
64 Trinity profile date : 3/16/2017
63 Whiskeytown profile date: 3/9/2017
62 Shasta profile date: 3/8/2017
61 One Side gate: Sept 10, Full Side gates not engaged

Temp Run date: March 16, 2017

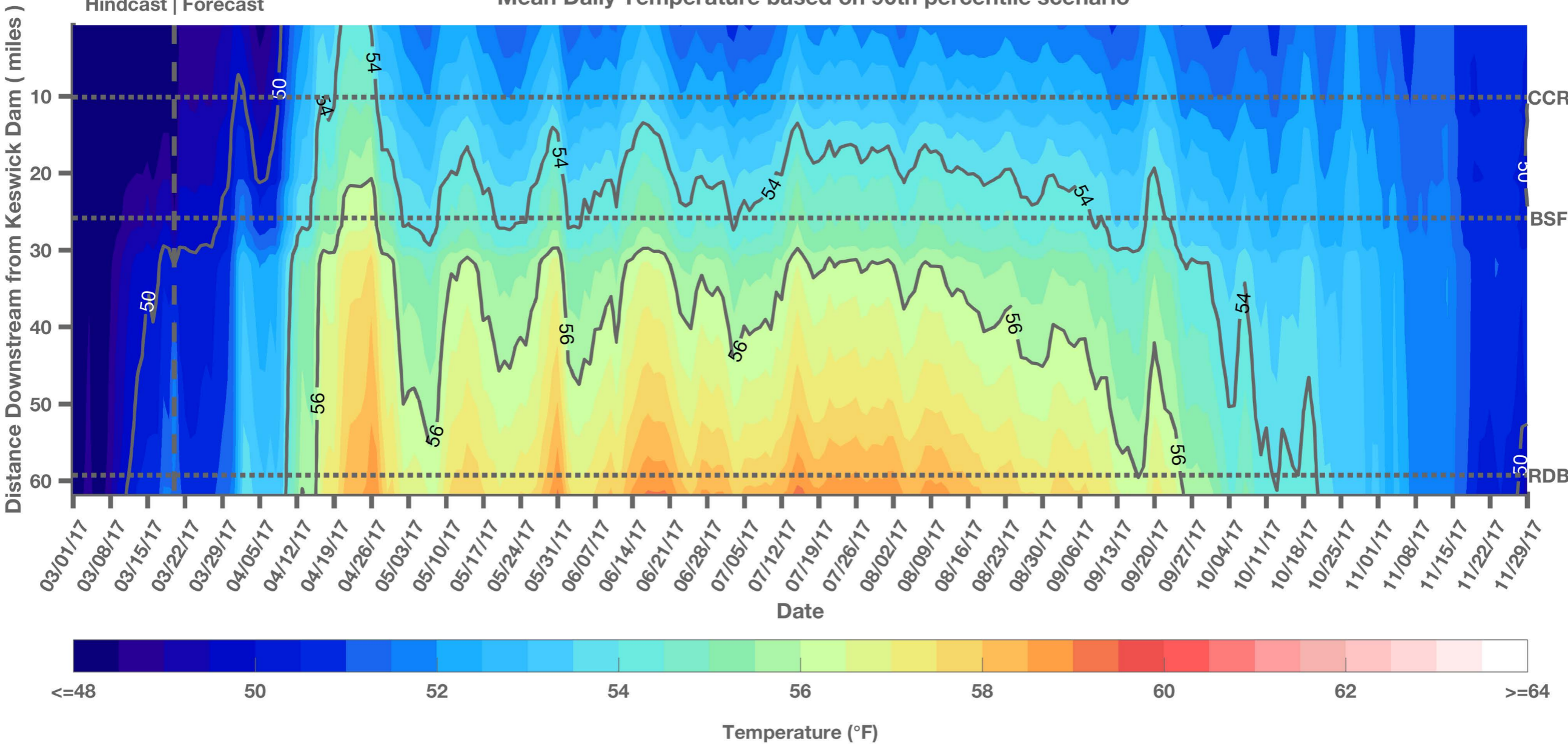


Enclosure 5

20-Mar-2017

Hindcast | Forecast

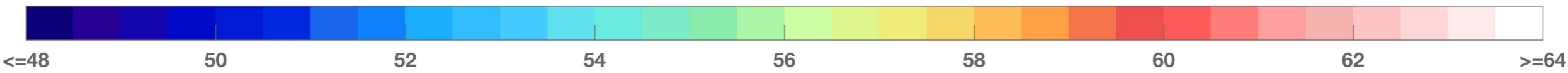
Mean Daily Temperature based on 90th percentile scenario



Distance Downstream from Keswick Dam (miles)

03/01/17 03/08/17 03/15/17 03/22/17 03/29/17 04/05/17 04/12/17 04/19/17 04/26/17 05/03/17 05/10/17 05/17/17 05/24/17 05/31/17 06/07/17 06/14/17 06/21/17 06/28/17 07/05/17 07/12/17 07/19/17 07/26/17 08/02/17 08/09/17 08/16/17 08/23/17 08/30/17 09/06/17 09/13/17 09/20/17 09/27/17 10/04/17 10/11/17 10/18/17 10/25/17 11/01/17 11/08/17 11/15/17 11/22/17 11/29/17

Date



<=48 50 52 54 56 58 60 62 >=64

Temperature (°F)

CCR

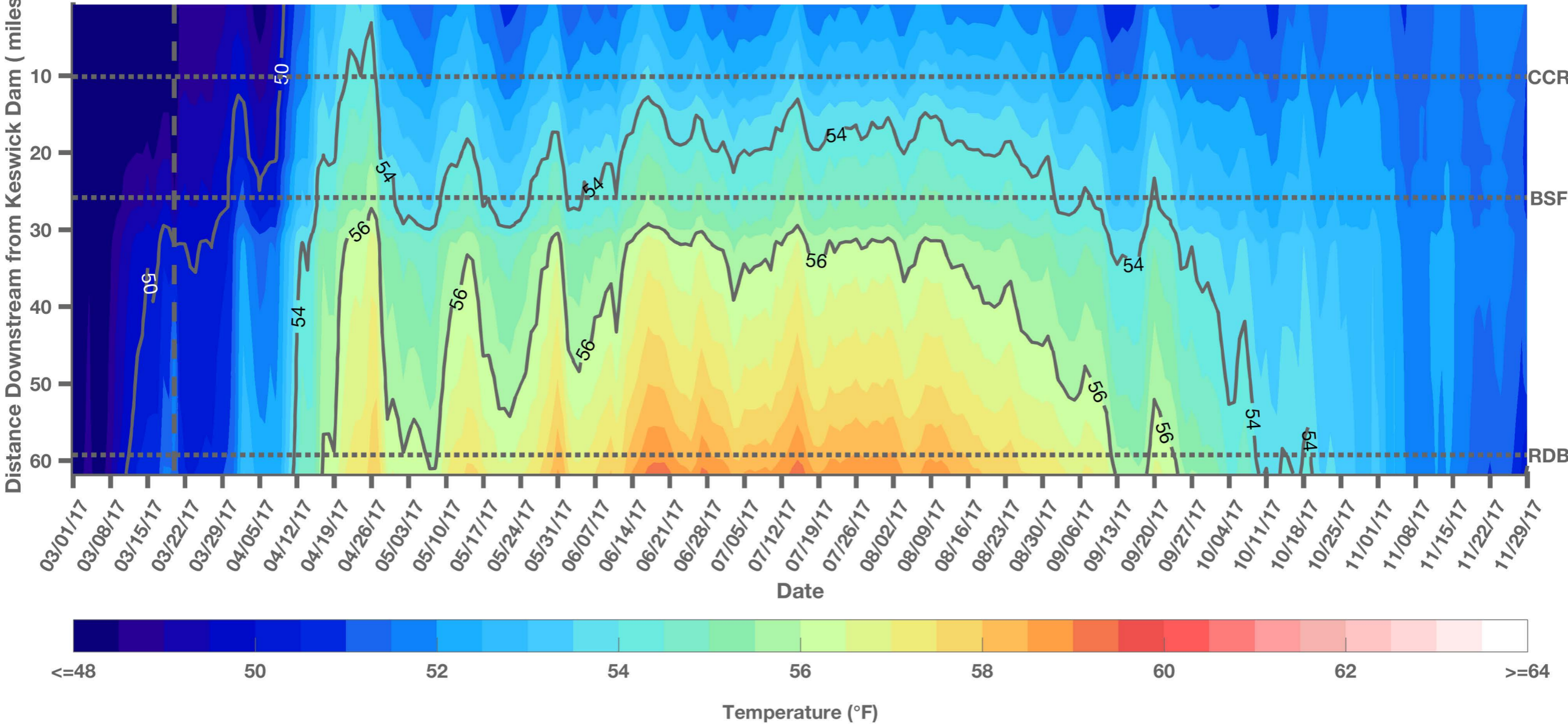
BSF

RDB

20-Mar-2017

Hindcast | Forecast

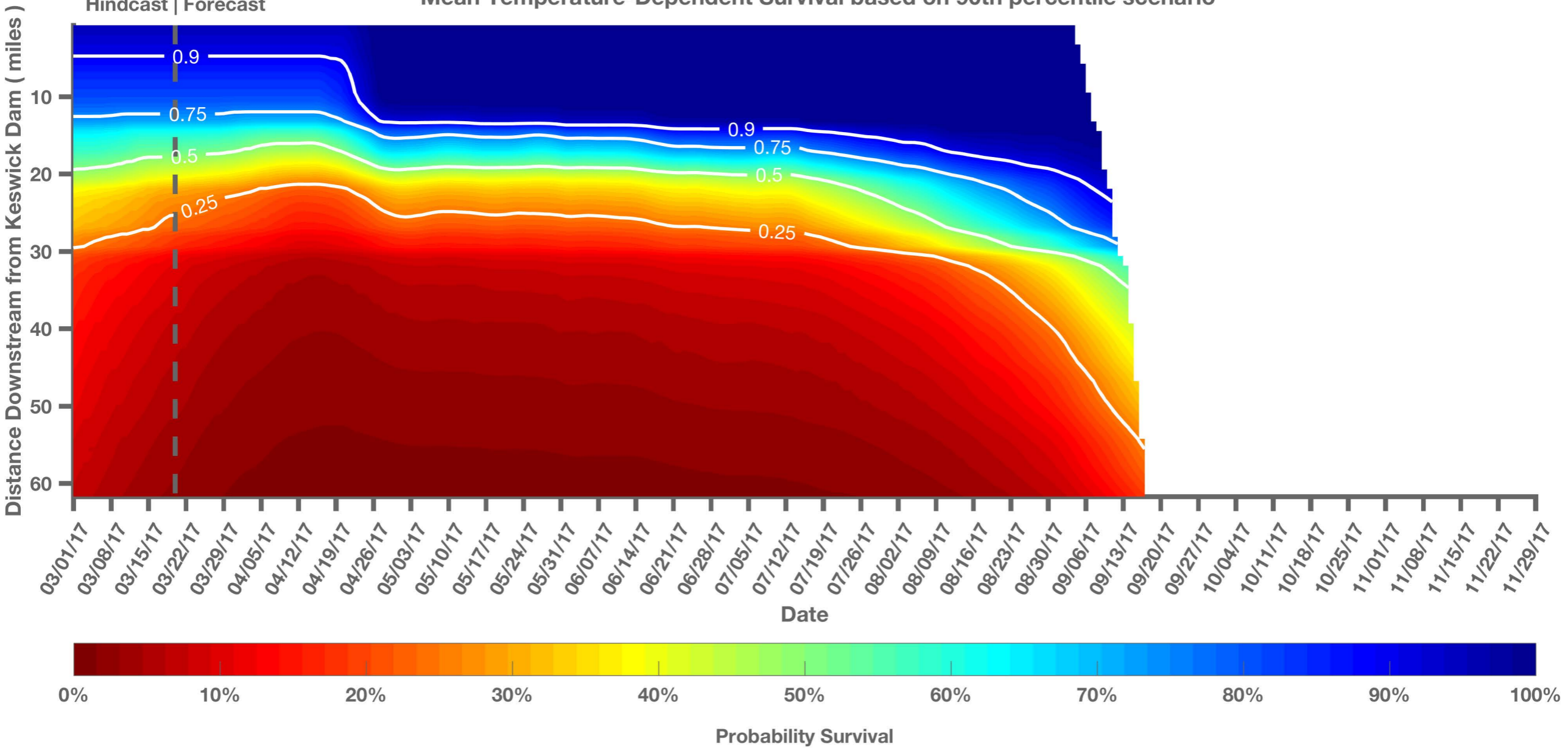
Mean Daily Temperature based on 50th percentile scenario



20-Mar-2017

Hindcast | Forecast

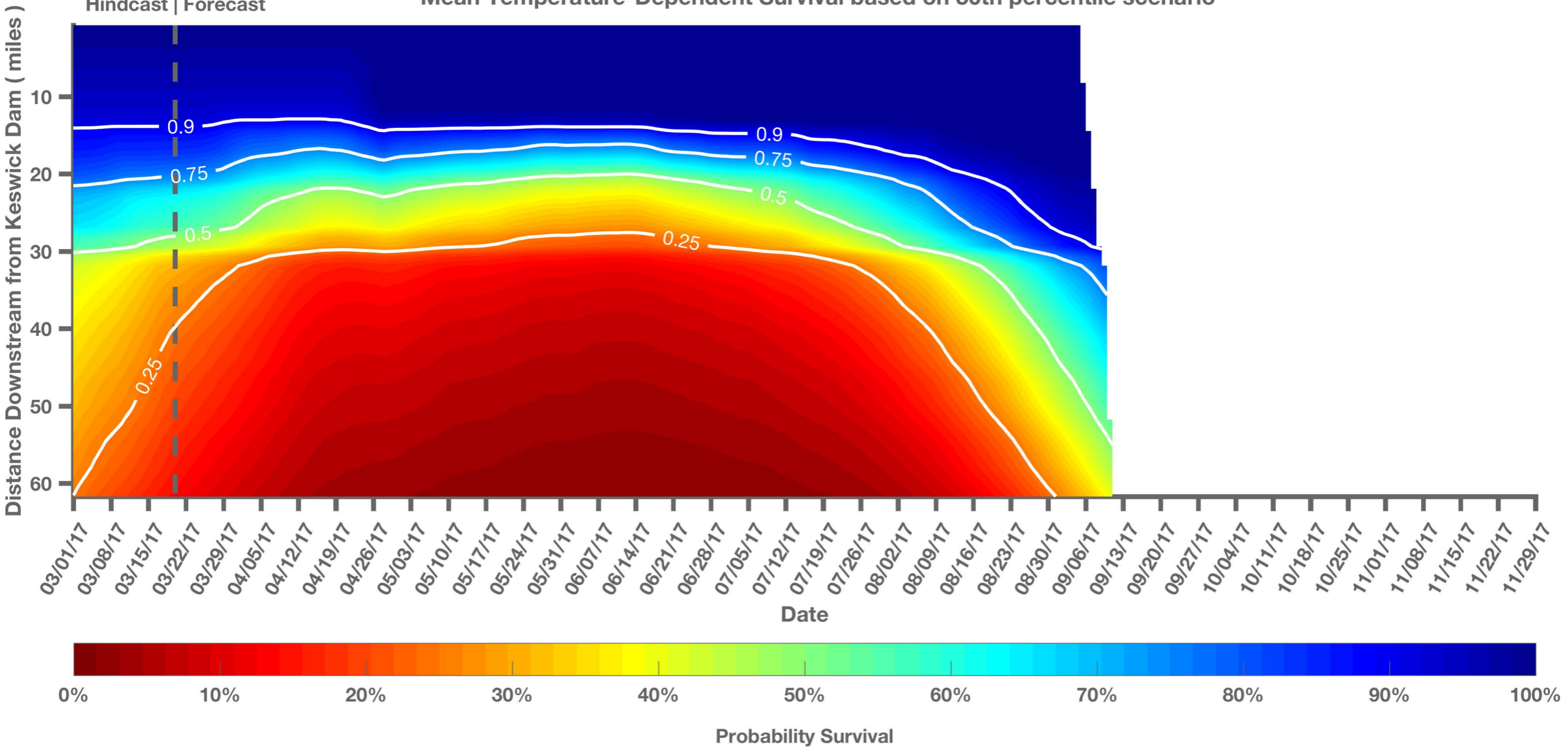
Mean Temperature-Dependent Survival based on 90th percentile scenario



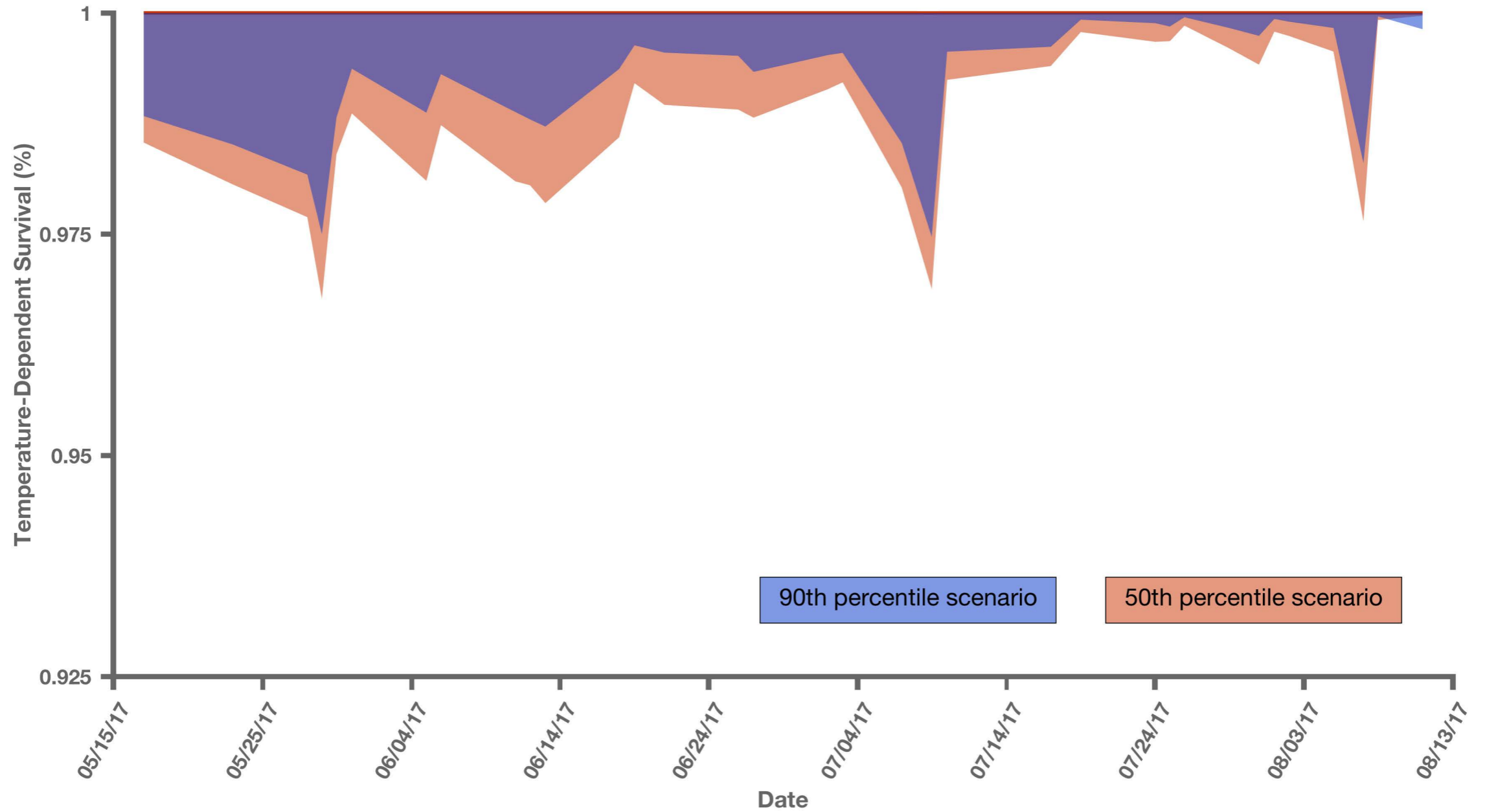
20-Mar-2017

Hindcast | Forecast

Mean Temperature-Dependent Survival based on 50th percentile scenario



Range of Temperature-Dependent Survival based on 2012-2015 Redd Data



Percent Temperature-dependent Mortality

Run

Mean Median 2.5 - 97.5 Percentiles

Scenario_50_Percentile

1.83 0.08 0.047 - 19.17

Scenario_90_Percentile

1.69 0.079 0.049 - 16.02