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Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

April 12, 2023

Background

This briefing is being provided consistent with the provision in Attachment B - Section 1.1 of the LTEMP ROD which states:

“Annually, Reclamation will develop a hydrograph based on the characteristics above. Reclamation will seek consensus on the annual hydrograph through monthly operational coordination calls with governmental entities, and regular meetings of the GCDAMP Technical Working Group (TWG) and AMWG.

Reclamation will conduct monthly Glen Canyon Dam operational coordination meetings or calls with the DOI bureaus (USGS, NPS, FWS, and BIA), WAPA, and representatives from the Basin States and UCRC. The purpose of these meetings or calls is for the participants to share and seek information on Glen Canyon Dam operations. One liaison from each Basin State and from the UCRC may participate in the monthly operational coordination meetings or calls.”

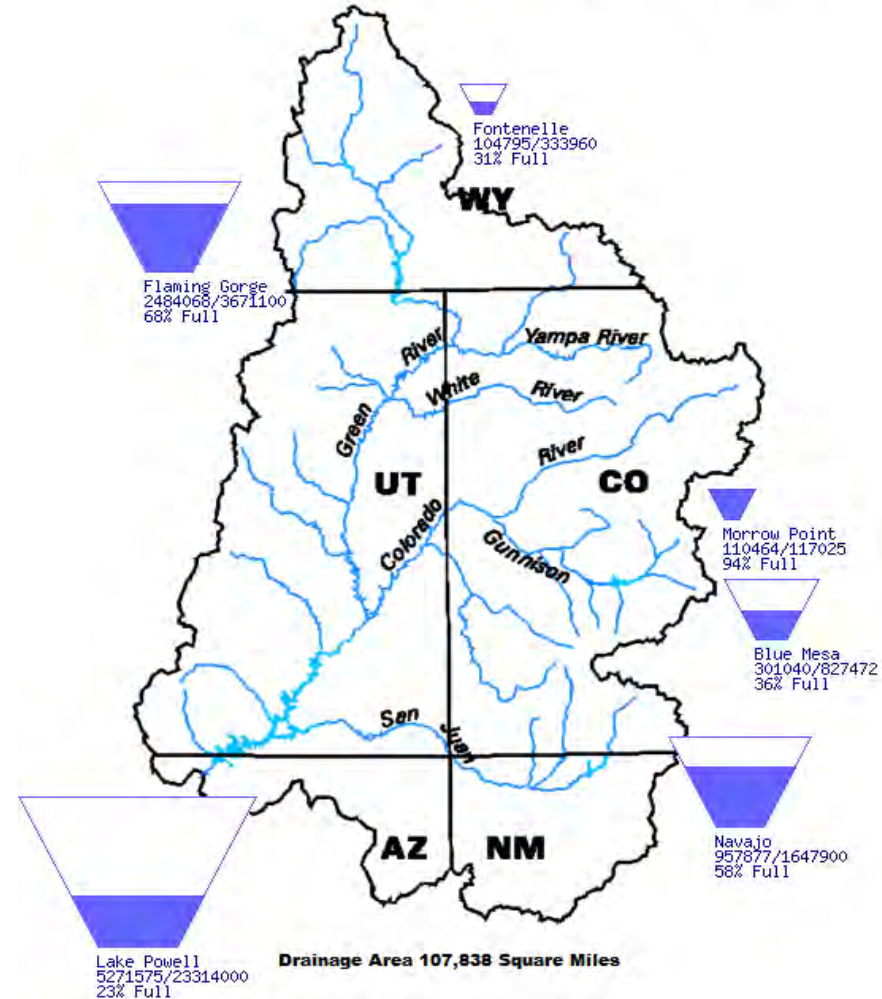


Upper Basin Storage (as of April 10, 2023)

Data Current as of:
04/10/2023

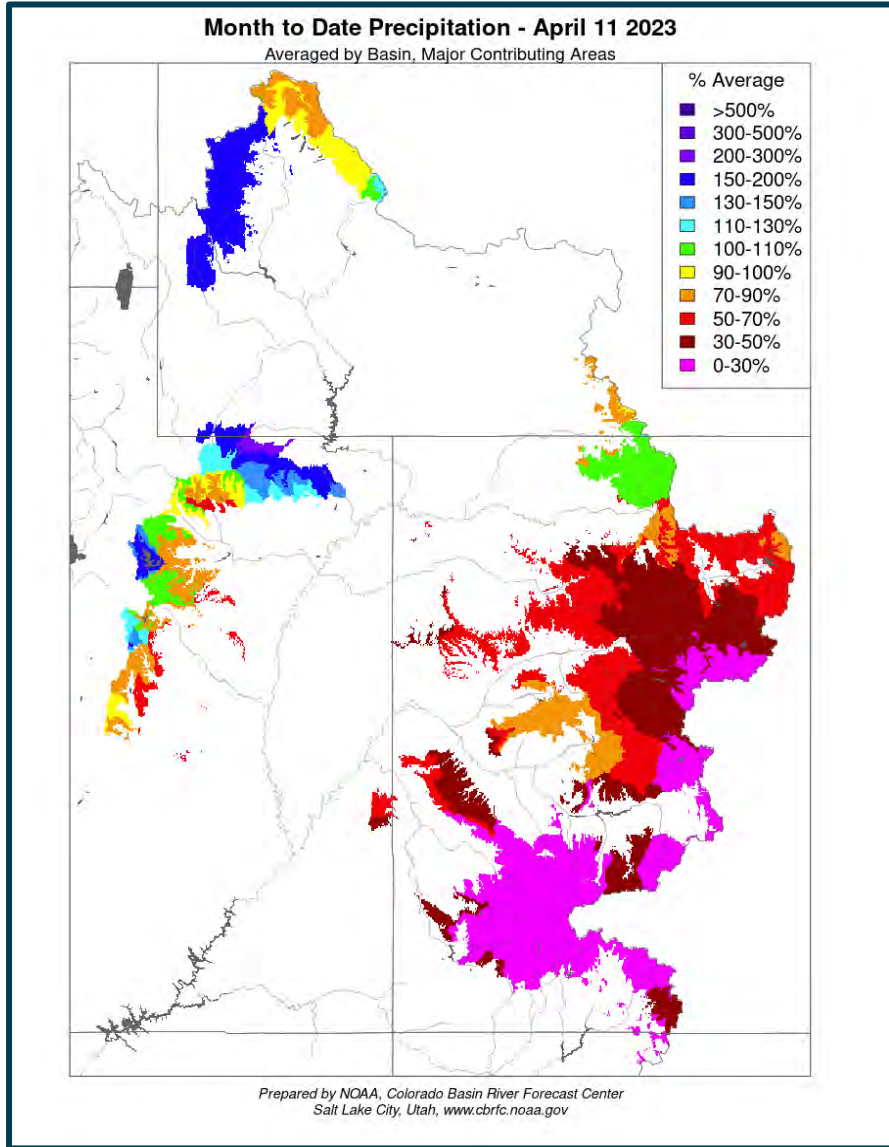
Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	31	0.10	0.33	6,468.04
Flaming Gorge	68	2.48	3.67	6,006.77
Blue Mesa	37	0.30	0.83	7,448.48
Navajo	58	0.96	1.65	6,029.83
Lake Powell	23	5.27	23.31	3,520.18
UC System Storage	31	9.25	29.79	
Total System Storage	32	18.97	58.48	

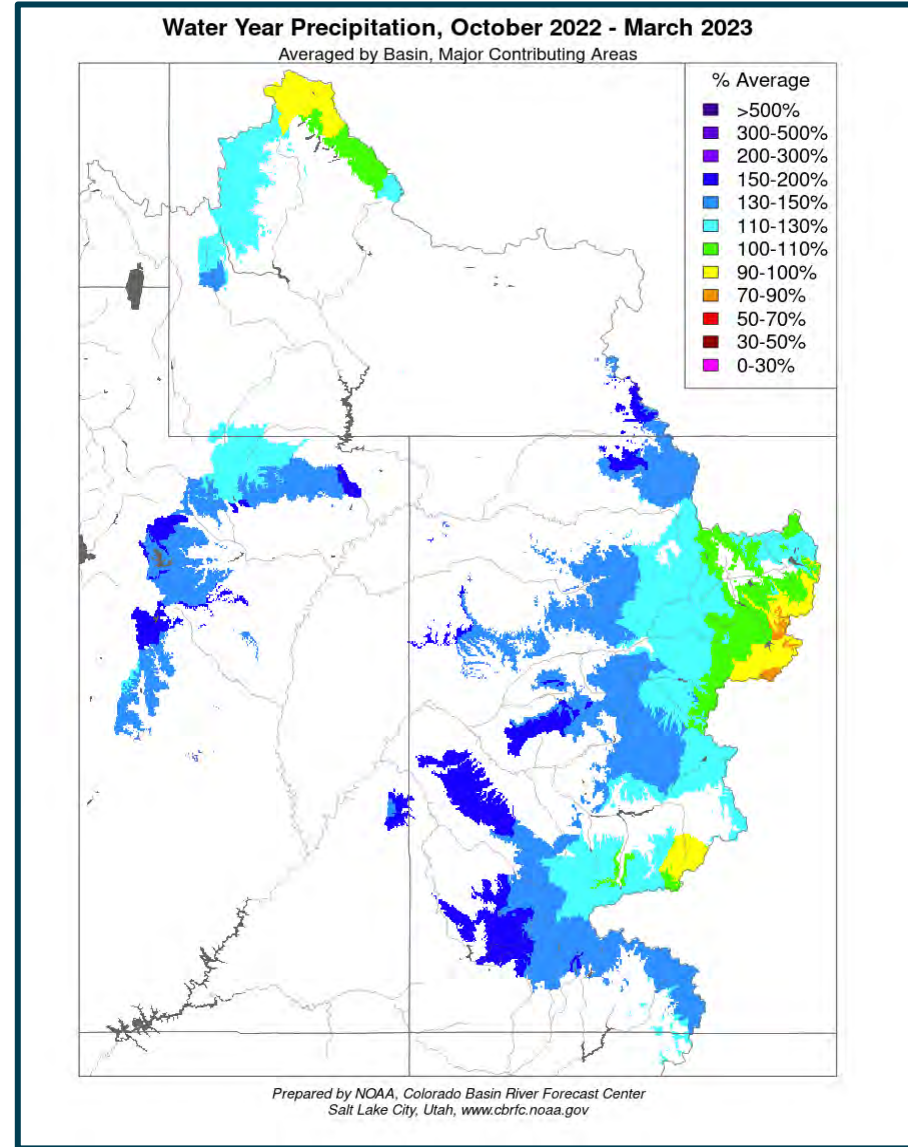


April Month and March WY Precipitation

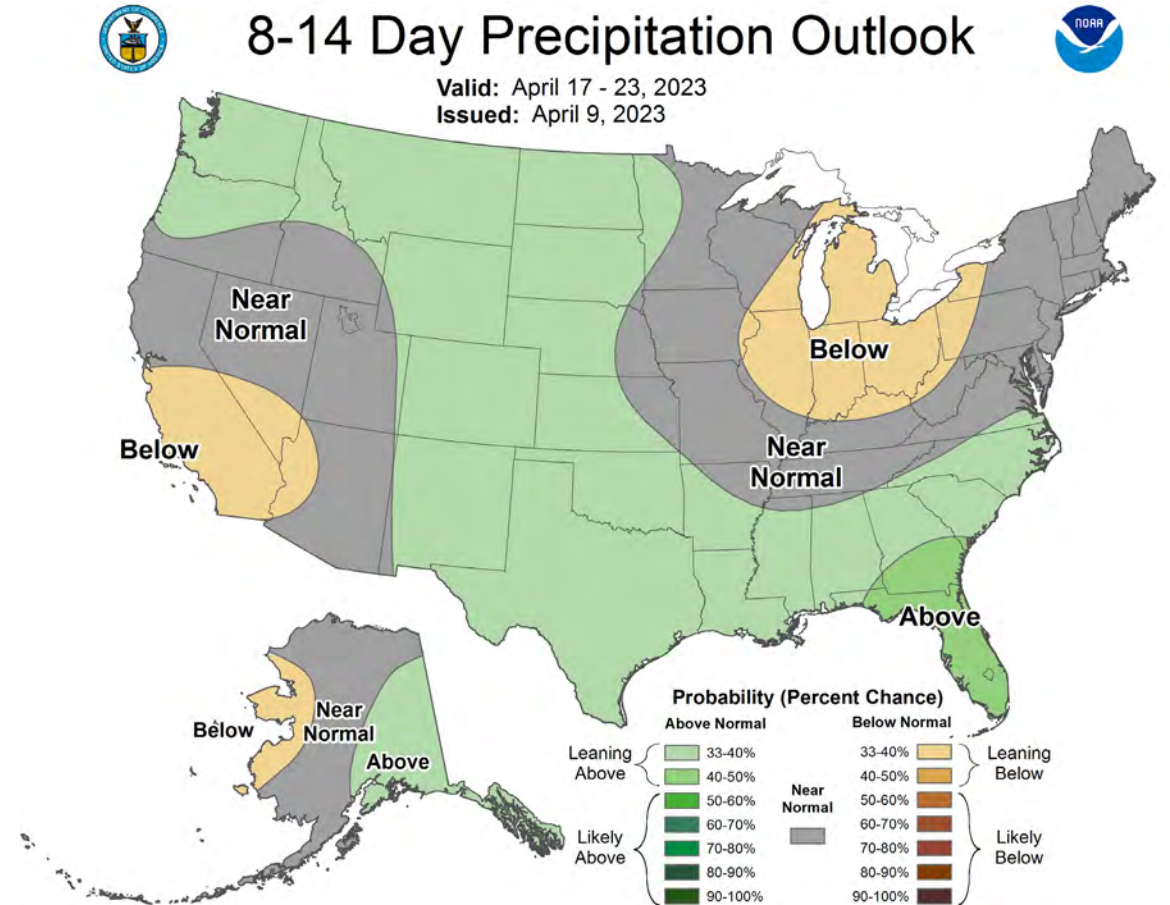
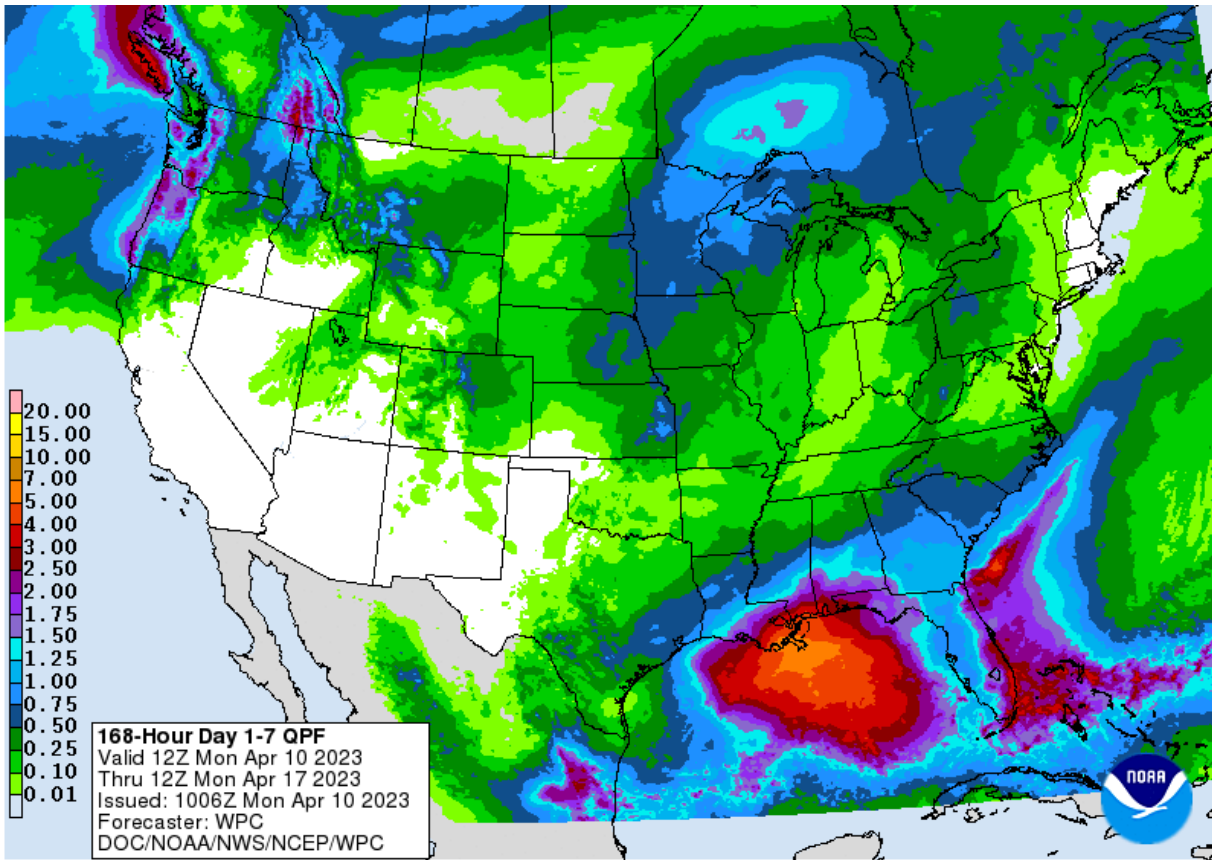
Month to Date Precipitation



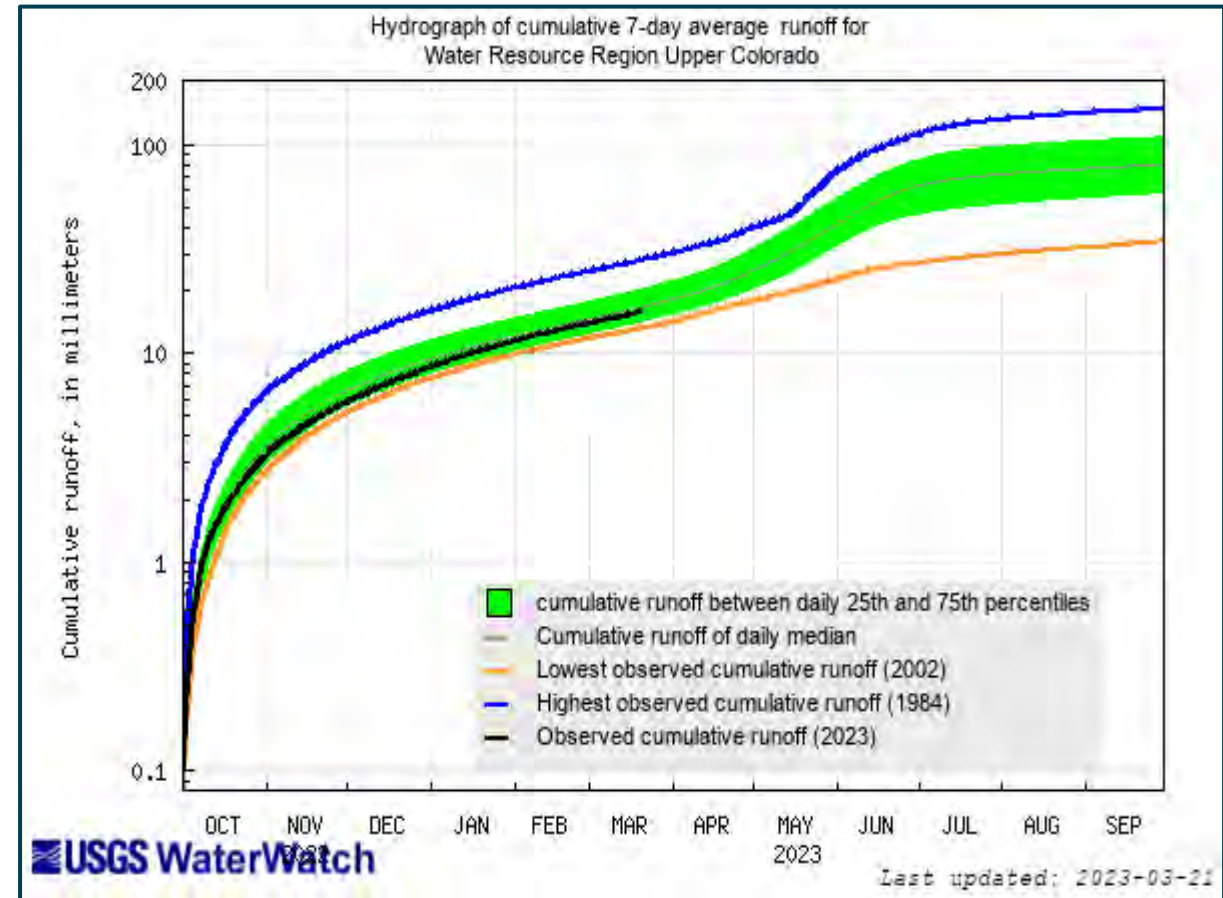
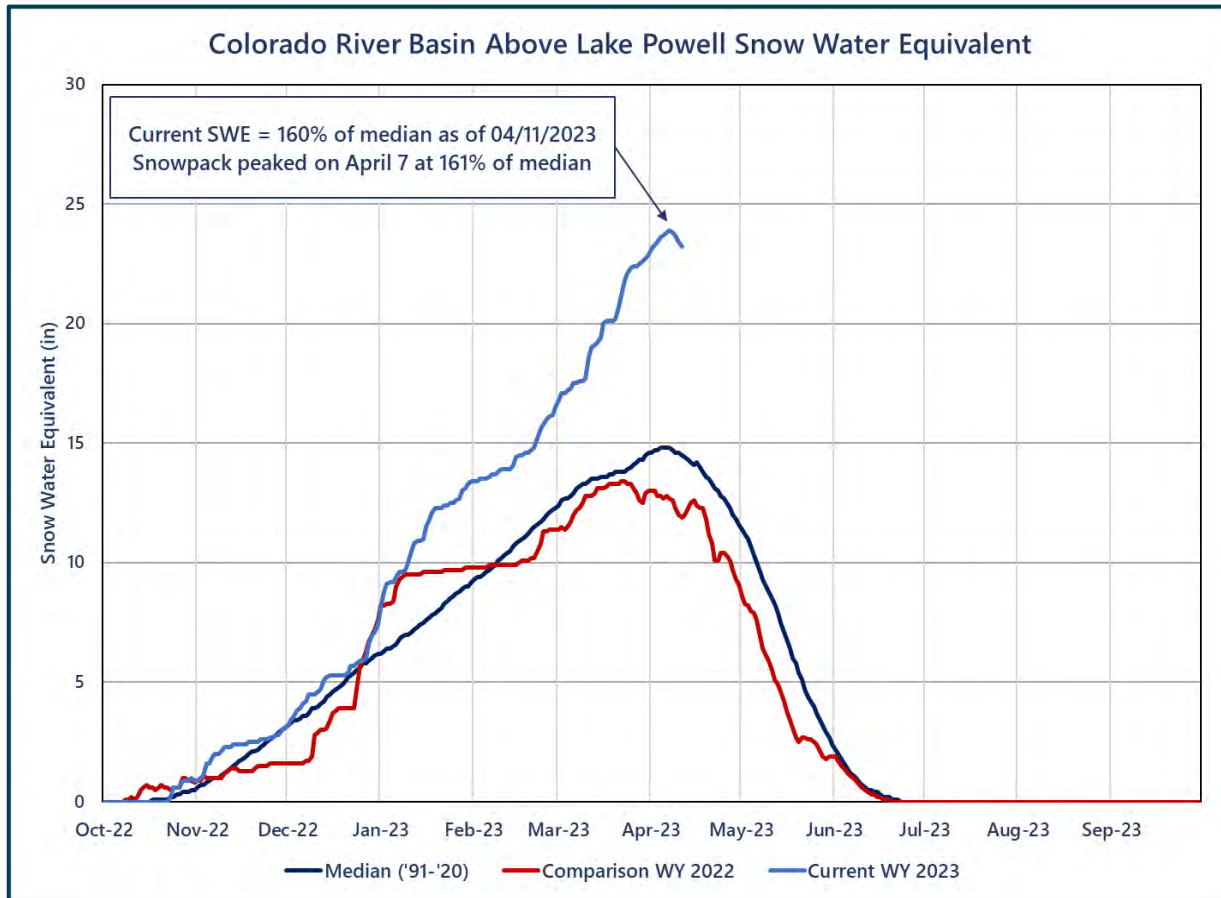
WY Precipitation



Climate Prediction Center Short-Term Precipitation Forecast



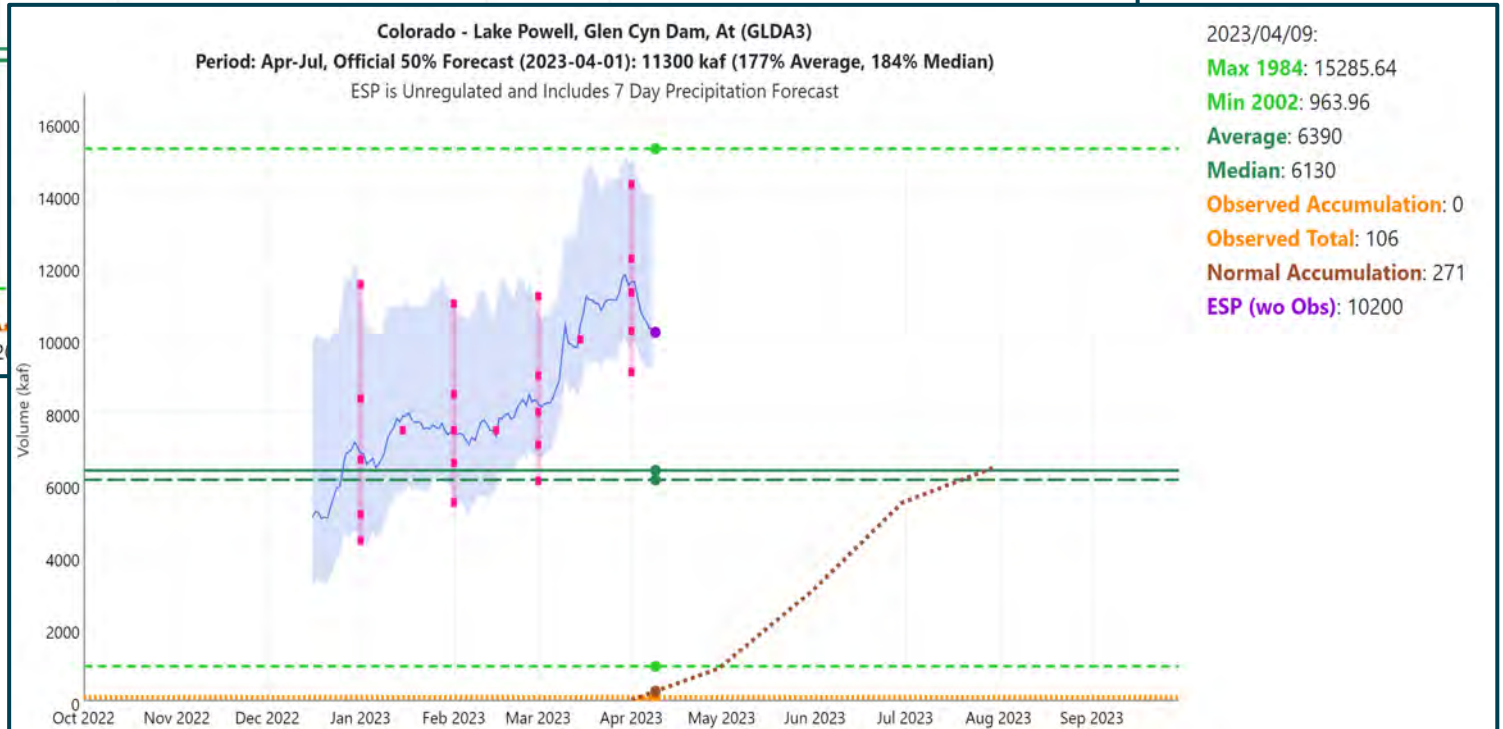
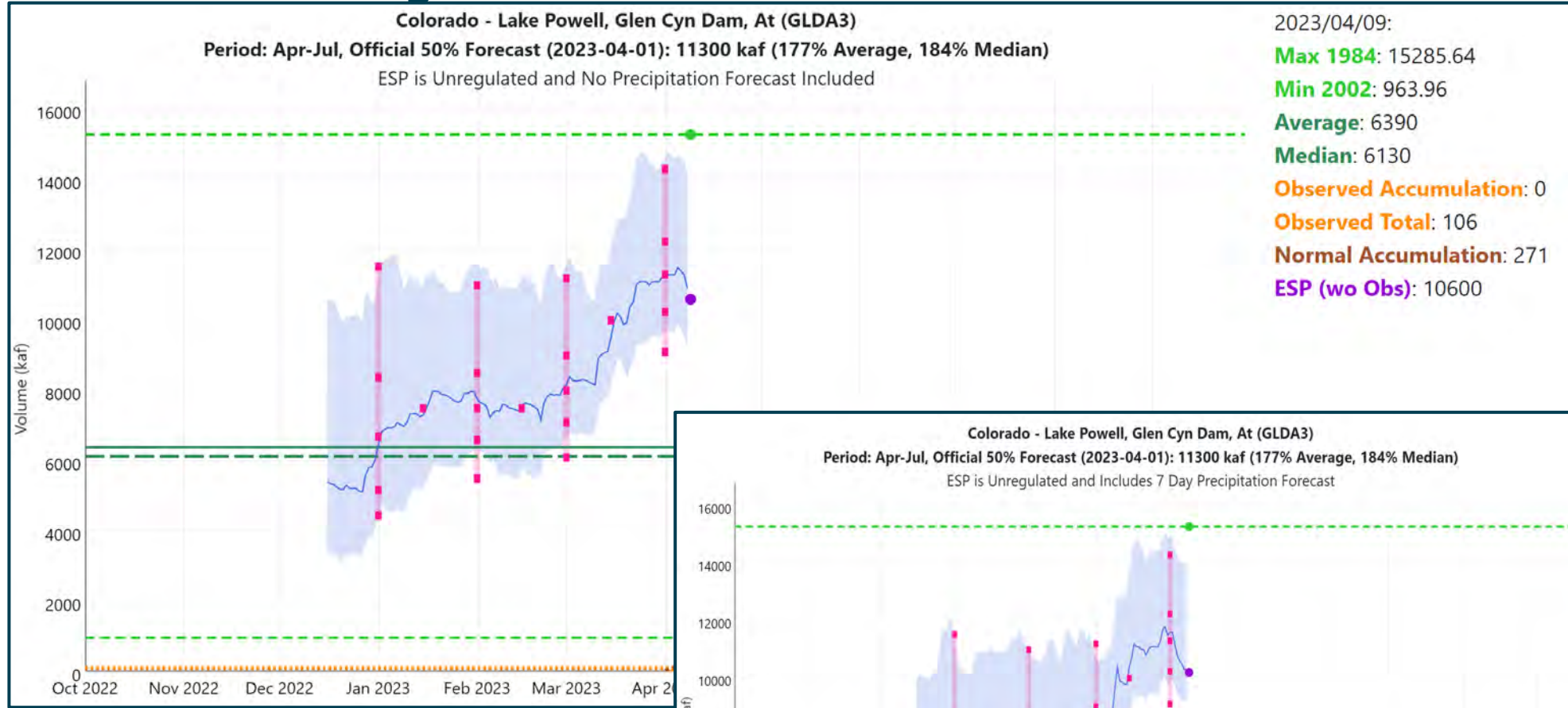
Upper Colorado SWE and Observed Inflows



Available online at: https://waterwatch.usgs.gov/index.php?id=wwdur_cumrunoff



Glen Canyon Raw ESP Forecast Trends



Most Probable April Forecast Water Year 2023

April – July 2023
Forecasted Unregulated Inflow
as of April 5, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	800	109
Flaming Gorge	1,200	124
Blue Mesa	850	134
Navajo	945	150
Powell	11,300	177

Water Year 2023
Unregulated Inflow Forecast
as of April 5, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	1,095	102
Flaming Gorge	1,548	110
Blue Mesa	1,101	122
Navajo	1,195	131
Powell	14,472	151

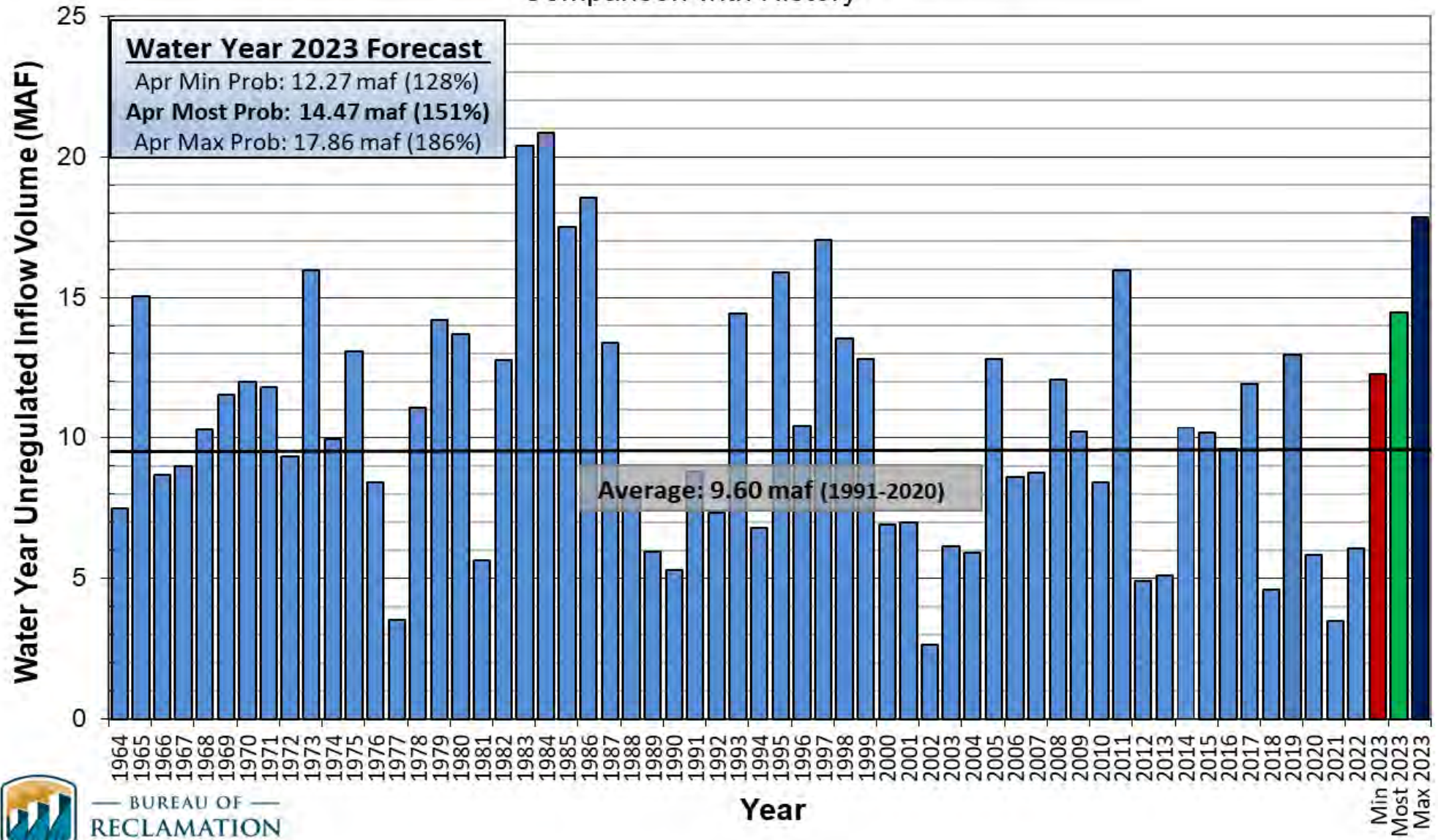
¹Averages are based on the 1991 through 2020 period of record.



Lake Powell Unregulated Inflow

Water Year 2023 Forecast (issued April 5)

Comparison with History



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Upper Colorado Basin

Hydrology and Operations
Projections Based on January
and March 2023 24-Month
Study



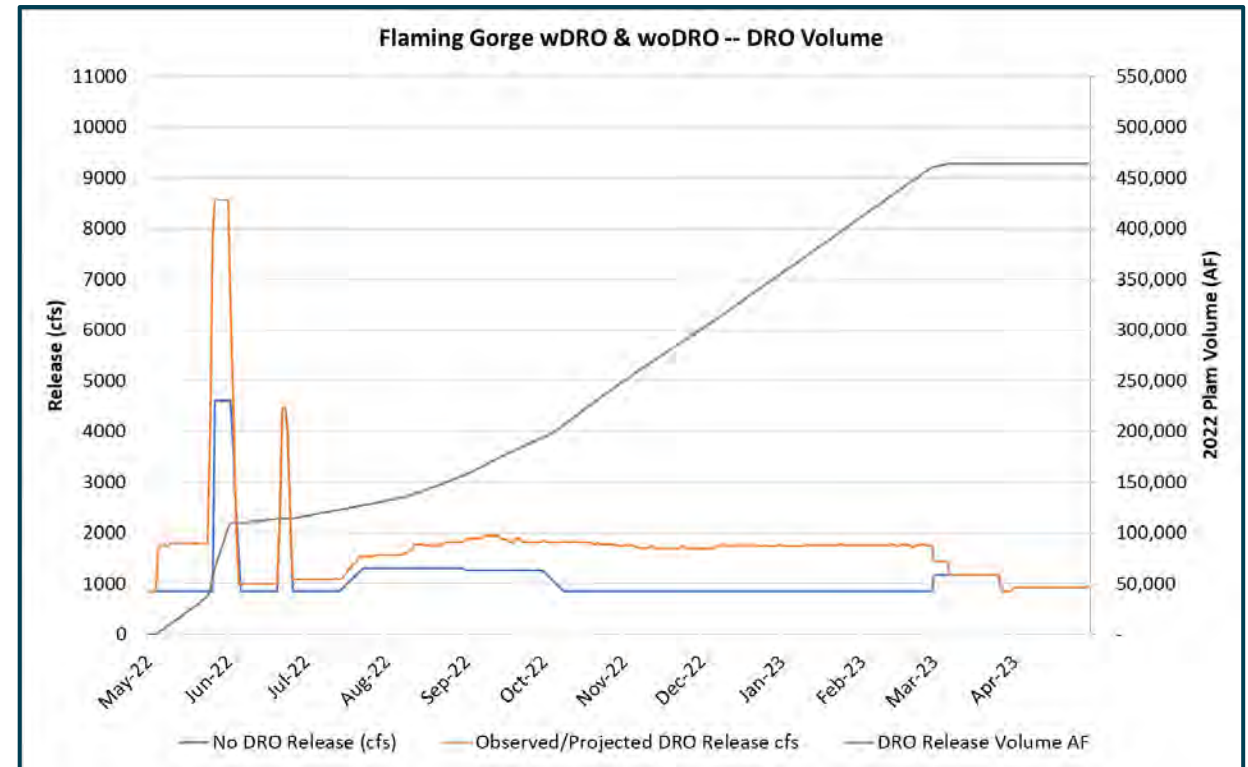
Drought Response Operations Agreement (DROA)

Flaming Gorge 2022 Plan Daily Releases

DROA Volumes Released¹

Reservoir	2021 DROA Volume (kaf)	2022 DROA Volume (kaf)	Total DROA Volume (kaf)
Flaming Gorge	125	463	588
Blue Mesa	36	0	36
Navajo	0	0	0
Volume in Powell	161	463	624

¹DROA operational year is from May through April.



Flaming Gorge DROA final volume = 463 kaf



Upper Basin Reservoir Operations in Water Year 2023

- Lake Powell will be operated consistent with the 2007 Interim Guidelines, the Upper Basin Drought Response Operations Agreement and Upper Basin Records of Decision
- Lake Powell's projected end of calendar year (CY) 2022 "tier determination" elevation in the August 2022 24-Month Study determines Lake Powell's operating tier in CY 2023
 - Lake Powell will operate in the Lower Elevation Balancing Tier where Lake Powell and Lake Mead will balance contents with Glen Canyon Dam release volumes no less than 7.0 maf and no more than 9.5 maf
- Consistent with the provisions of the 2007 Interim Guidelines, and to preserve the benefits to Glen Canyon Dam facilities from 2022 Operations into 2023 and 2024, Reclamation will consult with the Basin States on monthly and annual operations. Reclamation will also ensure all appropriate consultation with Basin Tribes, the Republic of Mexico, other federal agencies, water users and non-governmental organizations with respect to implementation of these monthly and annual operations.
 - The Glen Canyon Dam annual release has initially been set to 7.00 maf, and in April 2023 Reclamation will evaluate hydrologic conditions to determine if balancing releases may be appropriate under the conditions established in the 2007 Interim Guidelines;
 - Balancing releases will be limited (with a minimum of 7.00 maf) to protect Lake Powell from declining below elevation 3,525 feet at the end of December 2023;
 - Balancing releases will take into account operational neutrality of the 0.480 maf that was retained in Lake Powell under the May 2022 action1. Any Lake Powell balancing release volume will be calculated as if the 0.480 maf had been delivered to Lake Mead in WY 2022; and
 - The modeling approach for WY 2023 will apply to 2024.



Most Probable March Forecast Water Year 2023

April – July 2023
Forecasted Unregulated Inflow
as of March 3, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	620	84
Flaming Gorge	880	91
Blue Mesa	665	105
Navajo	735	117
Powell	8,000	125

Water Year 2023
Unregulated Inflow Forecast
as of March 3, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	916	85
Flaming Gorge	1,264	90
Blue Mesa	904	100
Navajo	953	105
Powell	10,869	113

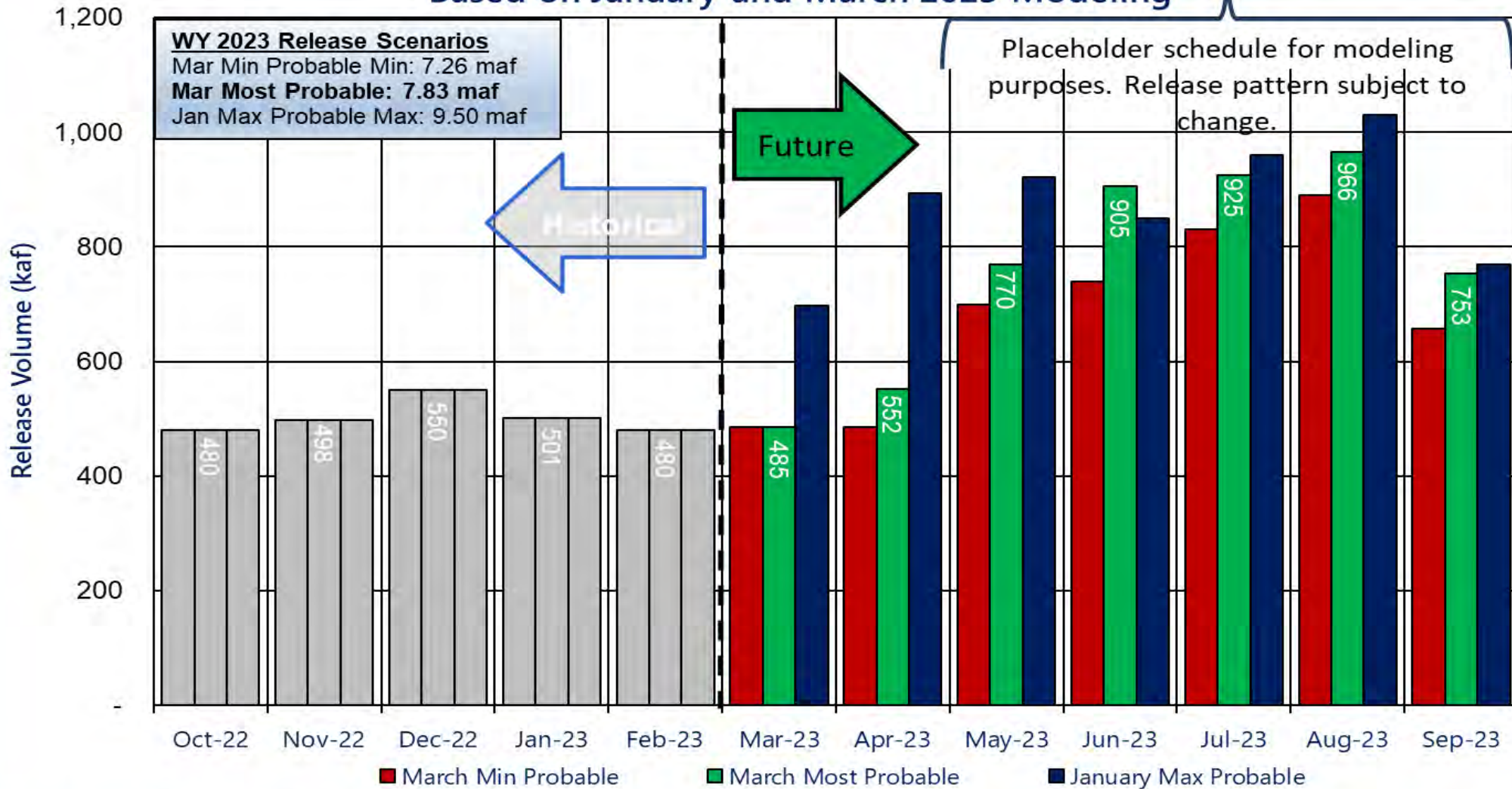
¹Averages are based on the 1991 through 2020 period of record.



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on January and March 2023 Modeling



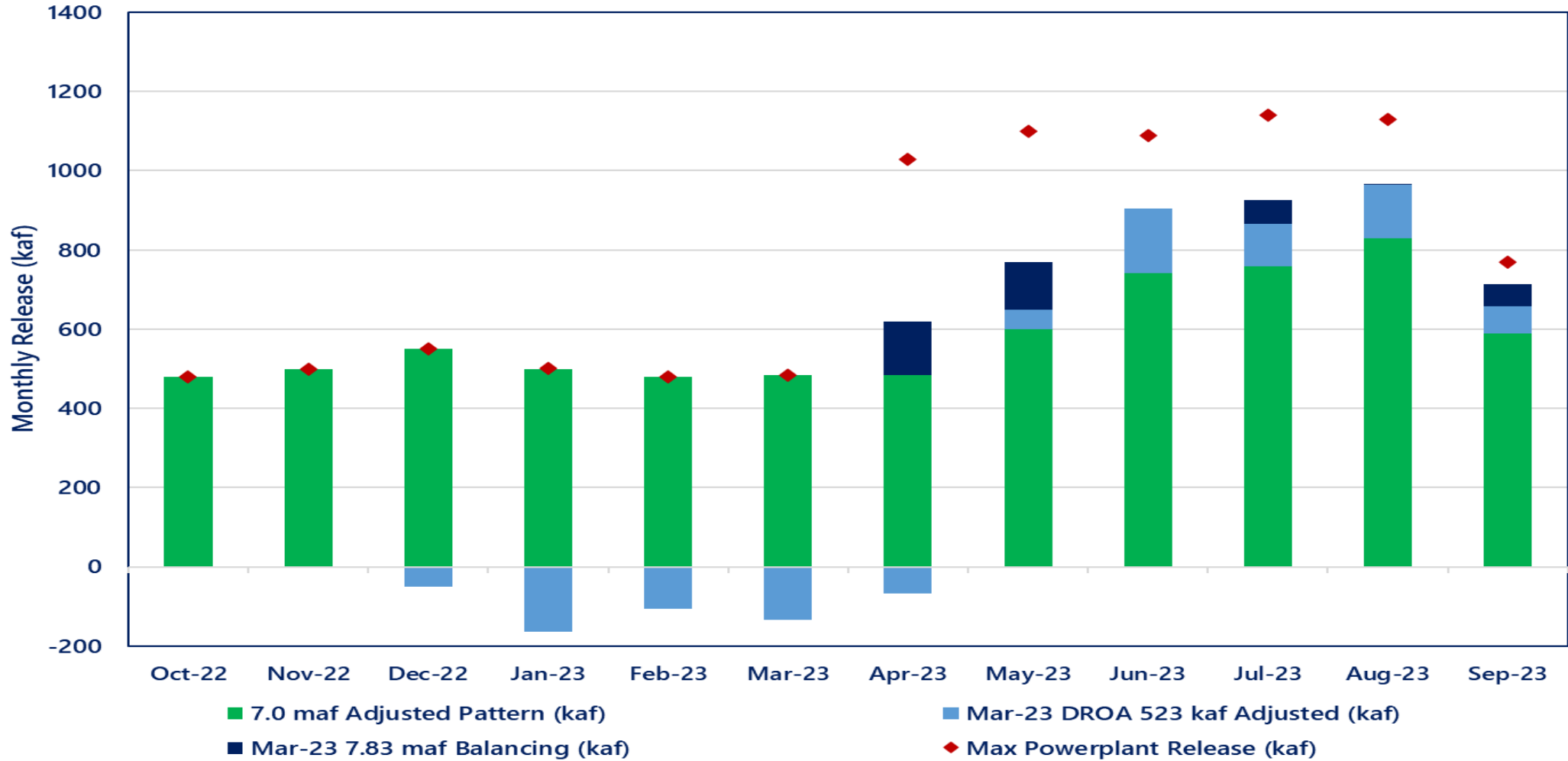
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WY2023 March 24MS Official

All scenarios are for discussion purposes to assist Reclamation in the GCD decision-making process.

Lake Powell Monthly Release Volume Distribution for WY2023 7.0 maf
Adjusted DROA Release of 523 kaf and Balancing Release of 825 kaf

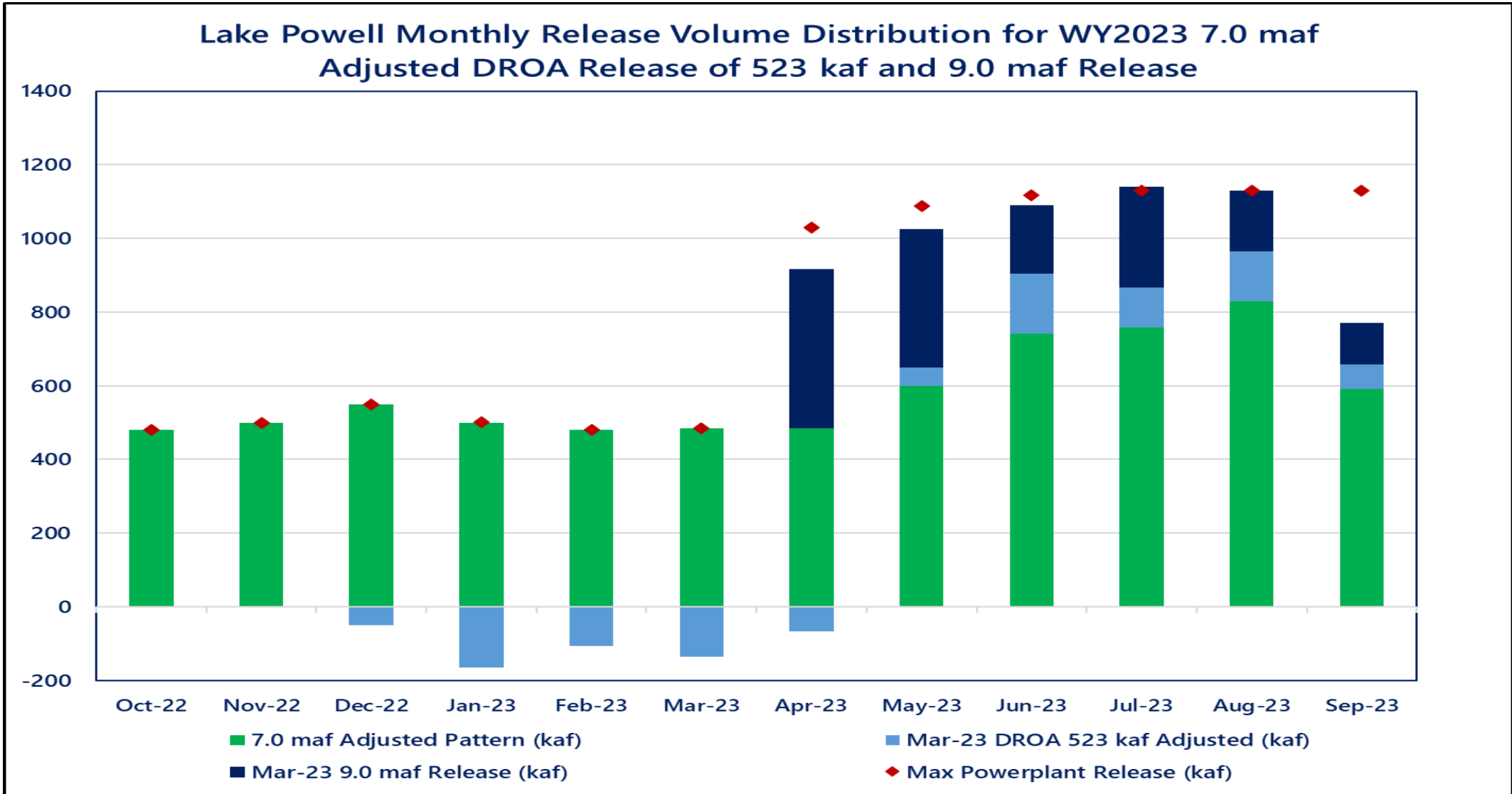


	WY2023	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Total
Max Powerplant Release (kaf)		480	498	550	501	480	485	1,030	1,100	1,090	1,140	1,130	770	
7.0 maf LTEMP Pattern (kaf)		480	500	600	664	587	620	552	550	577	652	696	522	7,000
Mar23 24MS Official 7.83 maf Pattern (kaf)		480	498	550	501	480	485	552	770	905	925	966	713	7,825



WY2023 Potential GCD Release of 9.0 maf

All scenarios are for discussion purposes to assist Reclamation in the GCD decision-making process.



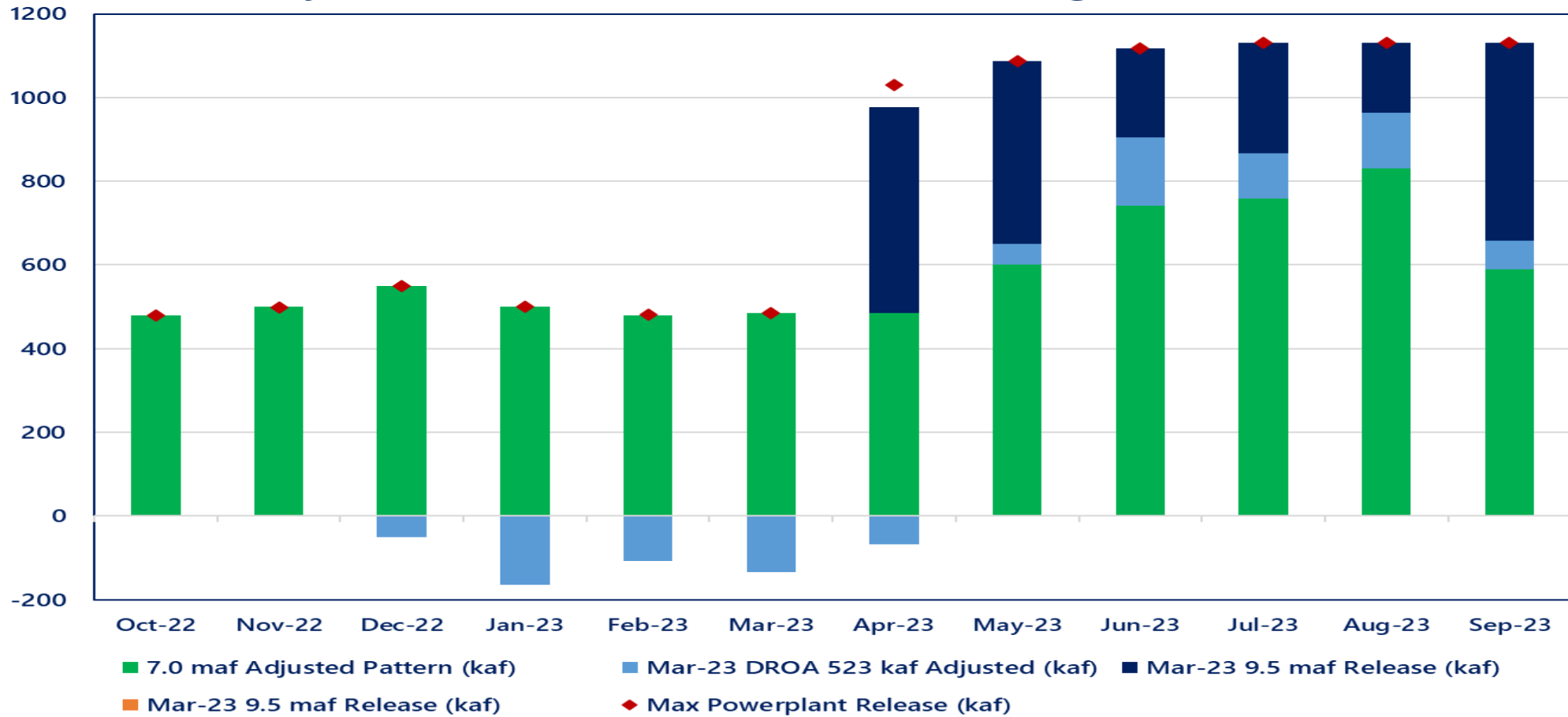
	WY2023	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Total
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7.0 maf LTEMP Pattern (kaf)		480	500	600	664	587	620	552	550	577	652	696	522	7,000
Mar23 24MS Official 7.83 maf Pattern (kaf)		480	498	550	501	480	485	552	770	905	925	966	713	7,825
Mar-23 9.0 maf Pattern (kaf)		480	498	550	501	480	485	700	750	905	1,000	1,030	757	8,136



WY2023 Potential GCD Release of 9.5 maf

All scenarios are for discussion purposes to assist Reclamation in the GCD decision-making process.

Lake Powell Monthly Release Volume Distribution for WY2023 7.0 maf
Adjusted DROA Release of 523 kaf, and Balancing Release of 9.5 maf

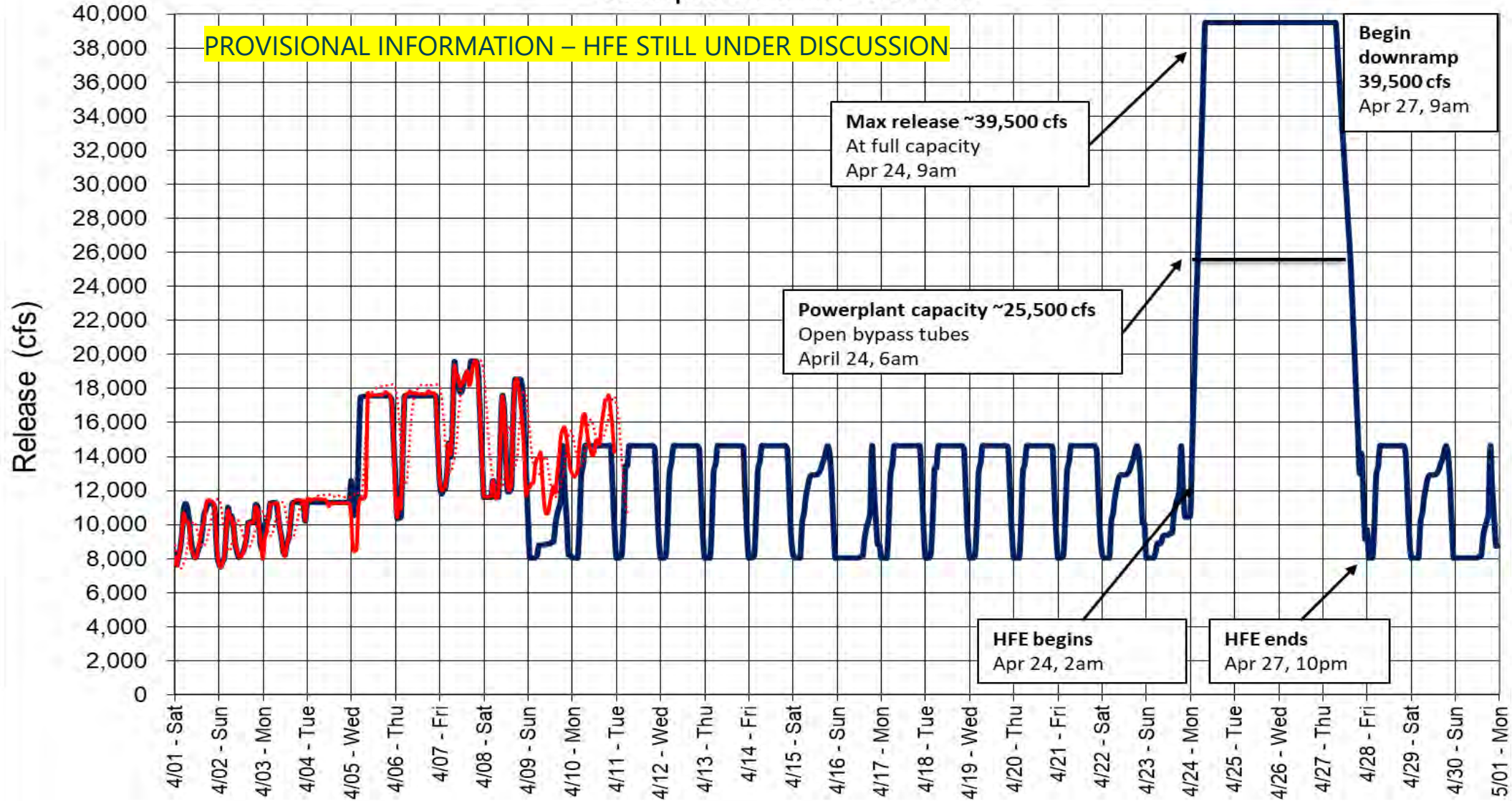


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7.0 maf LTEMP Pattern (kaf)		480	500	600	664	587	620	552	550	577	652	696	522	7,000
Mar23 24MS Official 7.83 maf Pattern (kaf)		480	498	550	501	480	485	552	770	905	925	966	713	7,825
Mar-23 9.0 maf Pattern (kaf)		480	498	550	501	480	485	700	750	905	1,000	1,030	757	8,136
Mar-23 9.5 maf Pattern (kaf)		480	498	550	501	480	485	700	900	990	1,000	1,050	752	8,386



Glen Canyon Dam Hourly Release Pattern April 2023

Compare HFE Patterns



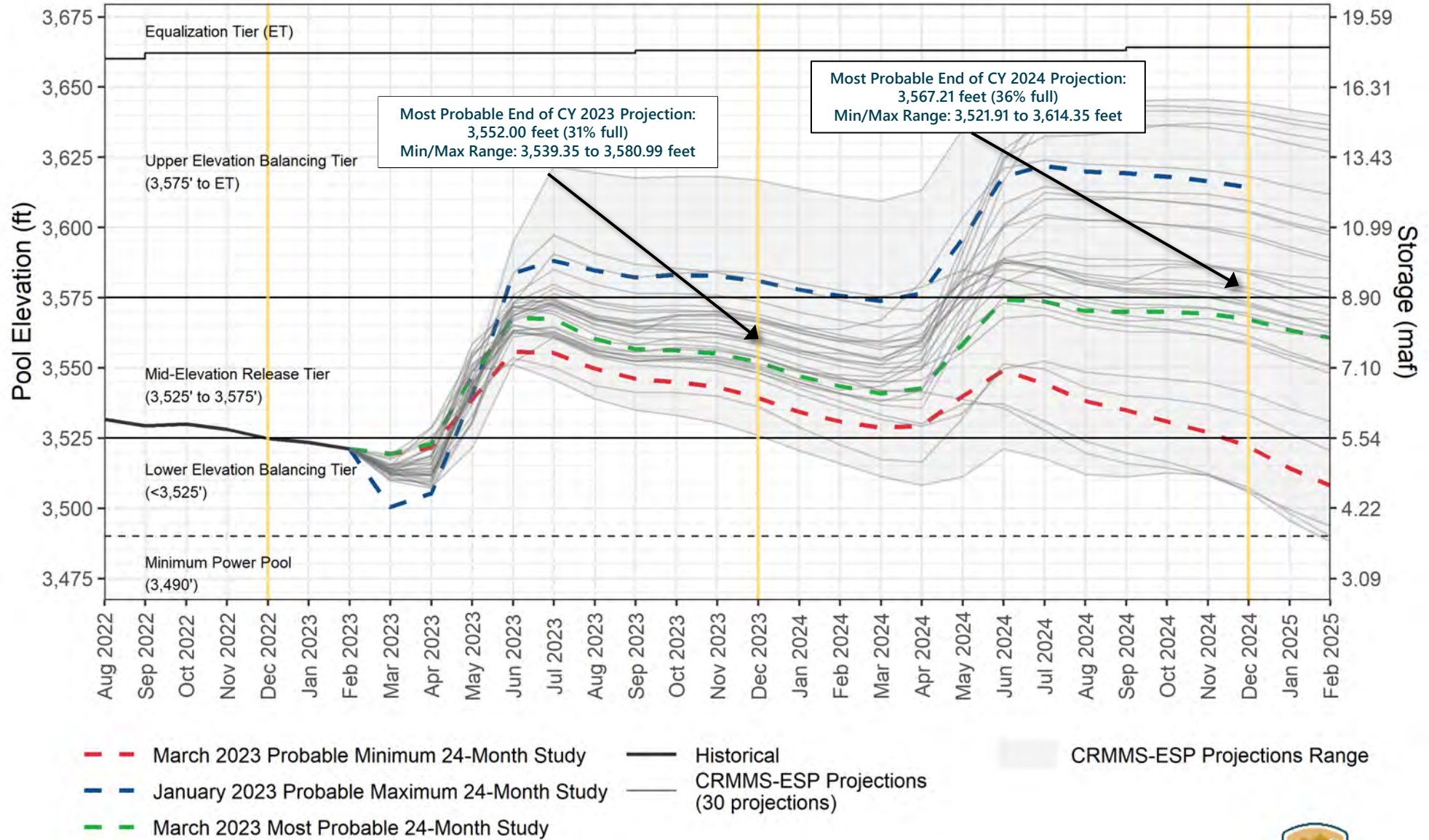
Reclamation Operational Modeling Model Comparison

	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir Operations	Operations input manually	Rule-driven operations	
Probabilistic or Deterministic	Deterministic – single hydrologic trace	Deterministic OR Probabilistic 30 (or more) hydrologic traces	Probabilistic – 100+ traces
Time Horizon (years)	1 - 2	1 - 5	1 - 50
Upper Basin Inflow	Unregulated forecast, 1 trace	Unregulated ESP forecast, 30 traces	Natural flow; historical, paleo, or climate change hydrology
Upper Basin Demands	Implicit, in unregulated inflow forecast		Explicit, 2016 UCRC assumptions
Lower Basin Demands	Official approved or operational		Developed with LB users



Lake Powell End-of-Month Elevations¹

CRMMS Projections from January and March 2023

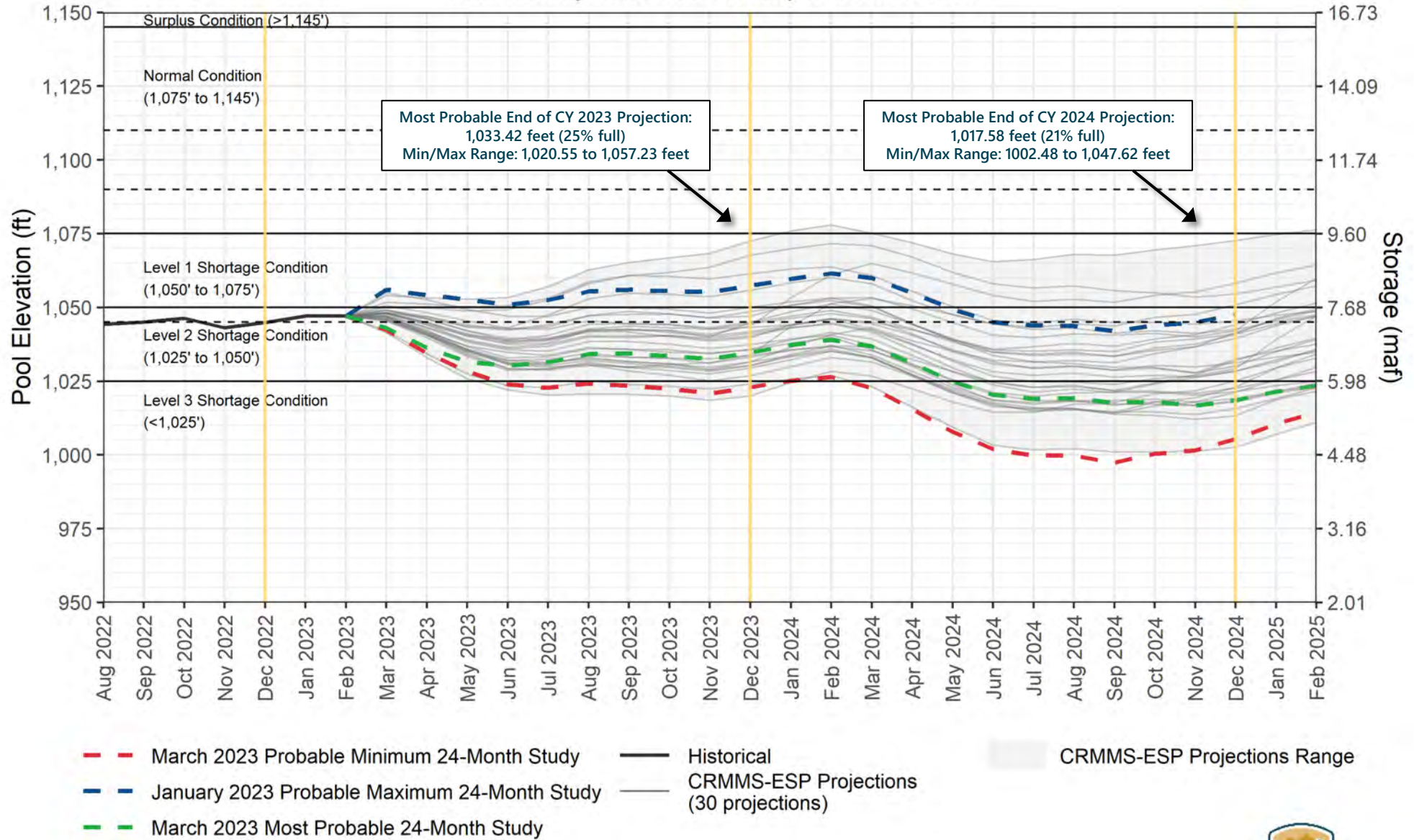


¹ Projected Lake Powell end-of-month physical elevations from the latest CRMMS-ESP and 24-Month Study inflow scenarios.



Lake Mead End-of-Month Elevations¹

CRMMS Projections from January and March 2023



¹ Projected Lake Mead end-of-month physical elevations from the latest CRMMS-ESP and 24-Month Study inflow scenarios.

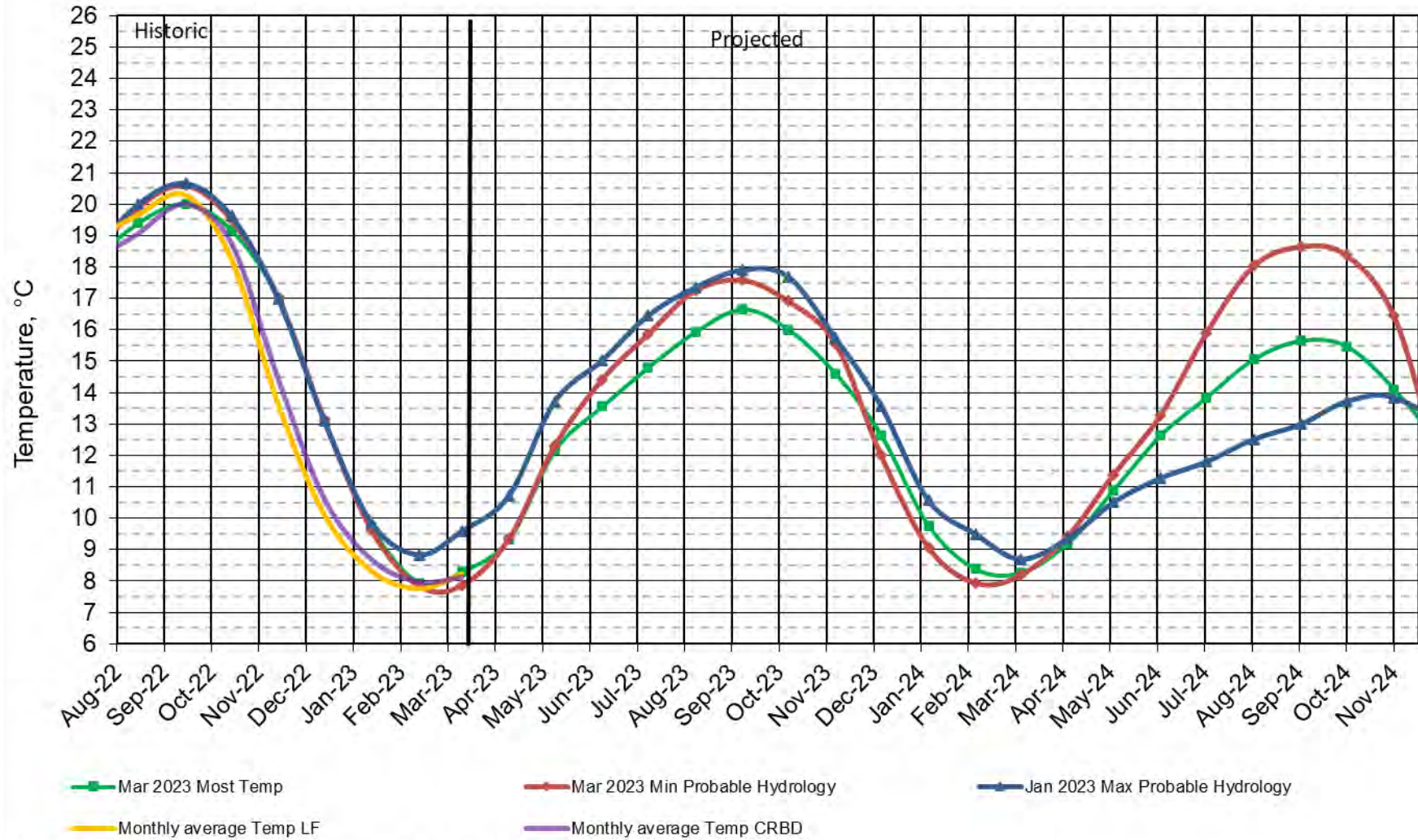


Water Quality



Lake Powell Release Temperature

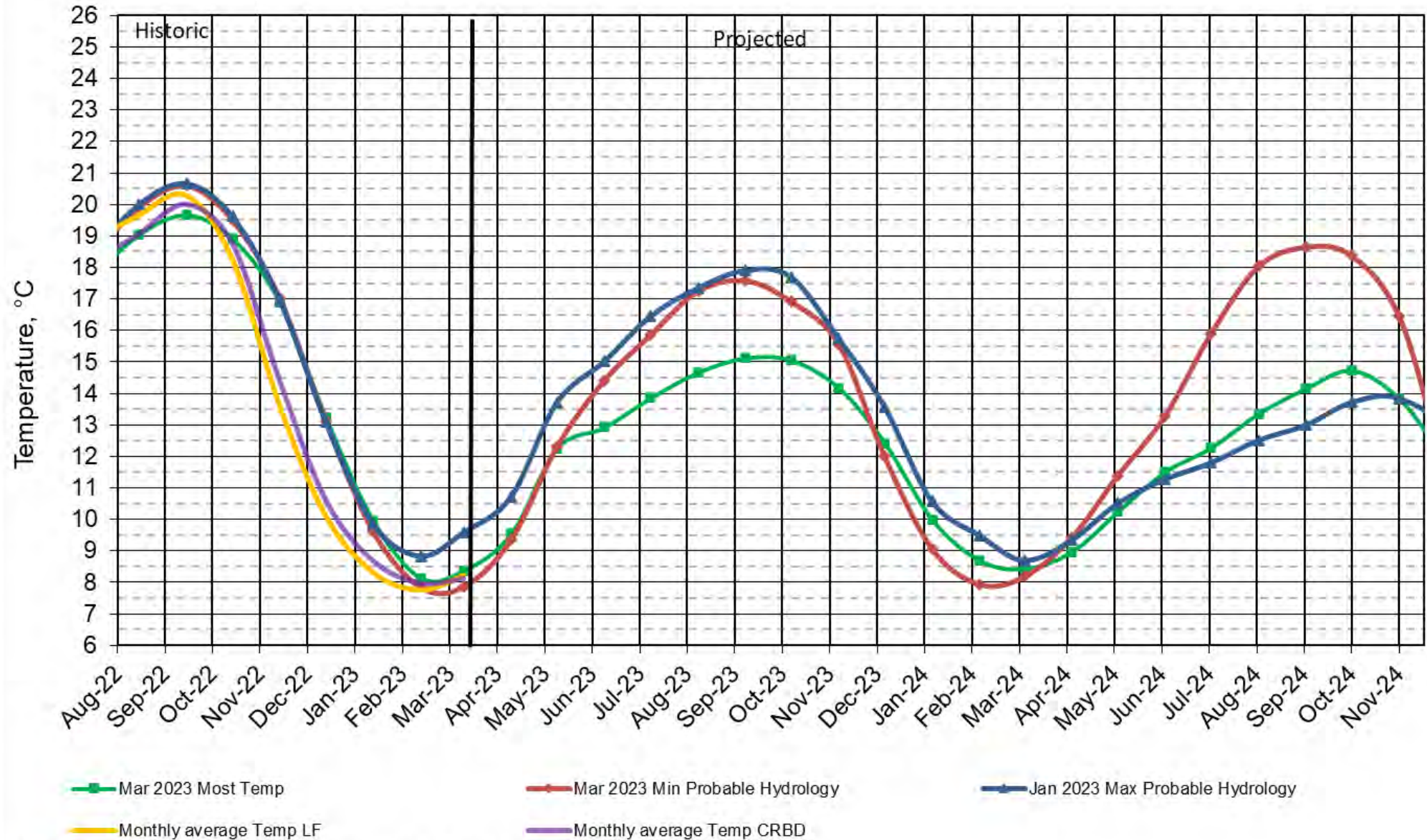
Projected Temperature based on March 2023 Forecast 7.823 maf



#Projection start date is based on initial conditions (March 2021)

Lake Powell Release Temperature

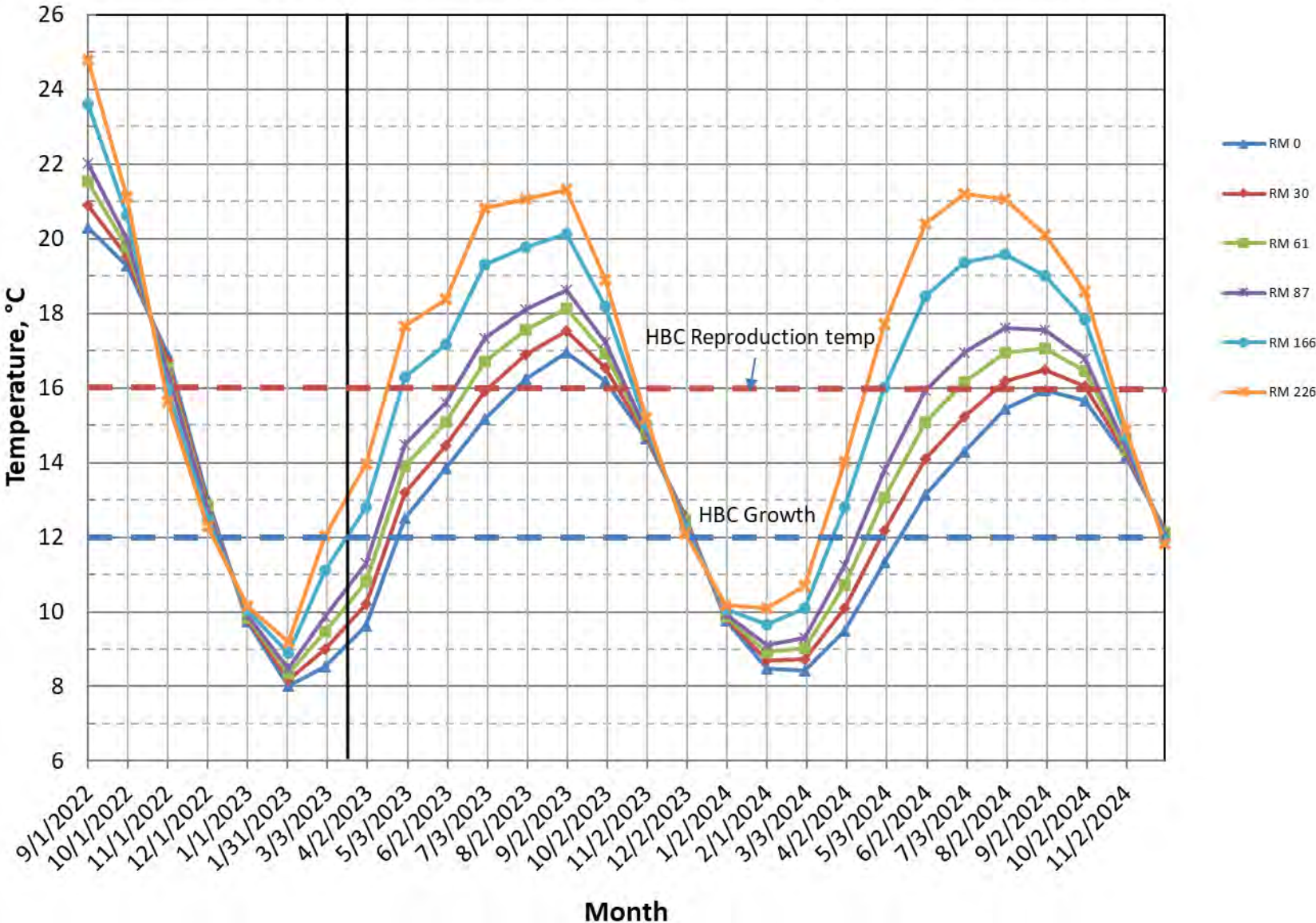
Projected Temperature based on March 2023 Forecast; 9 maf



#Projection start date is based on initial conditions (March 2021)

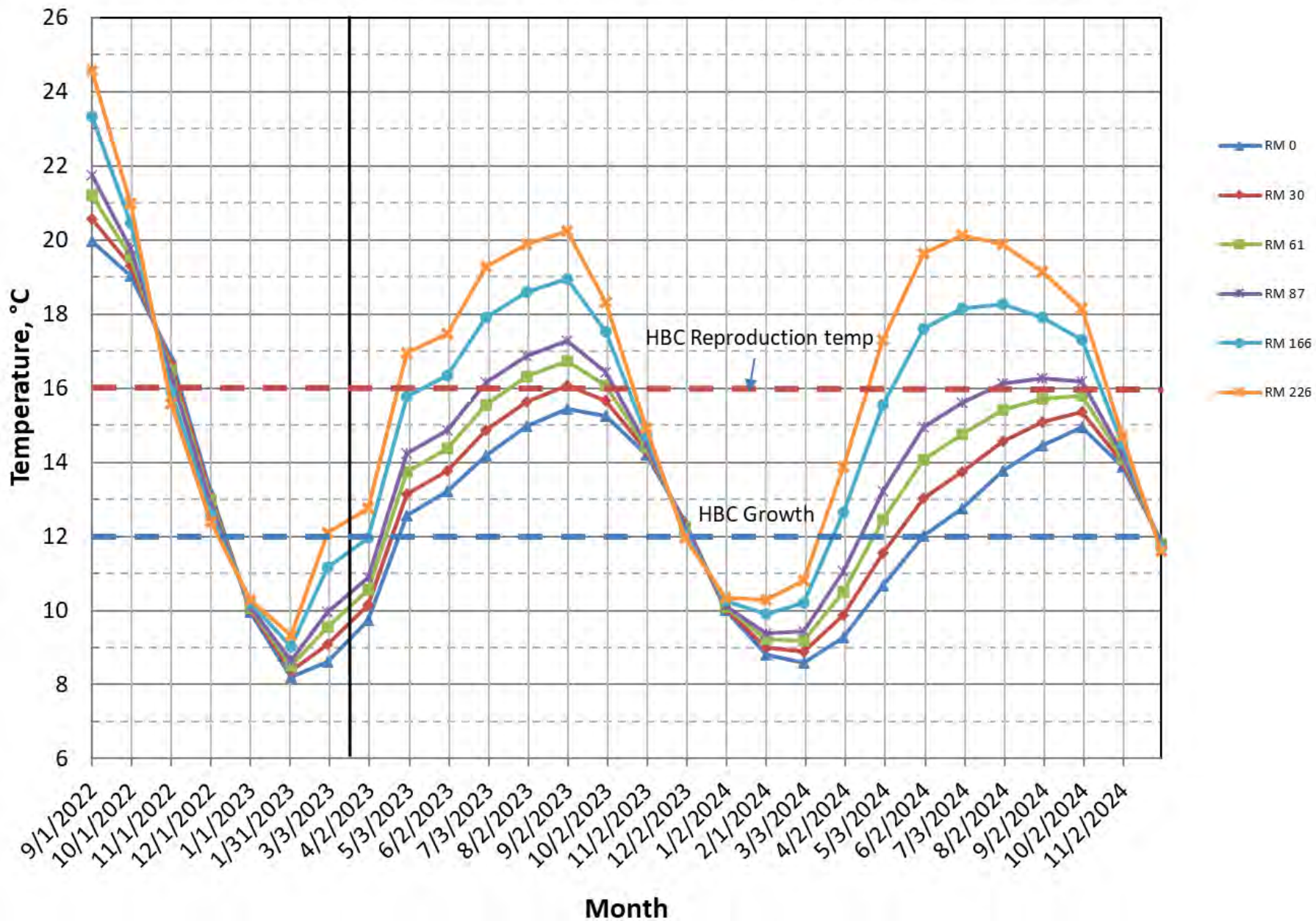
Colorado River, Grand Canyon Water Temperatures

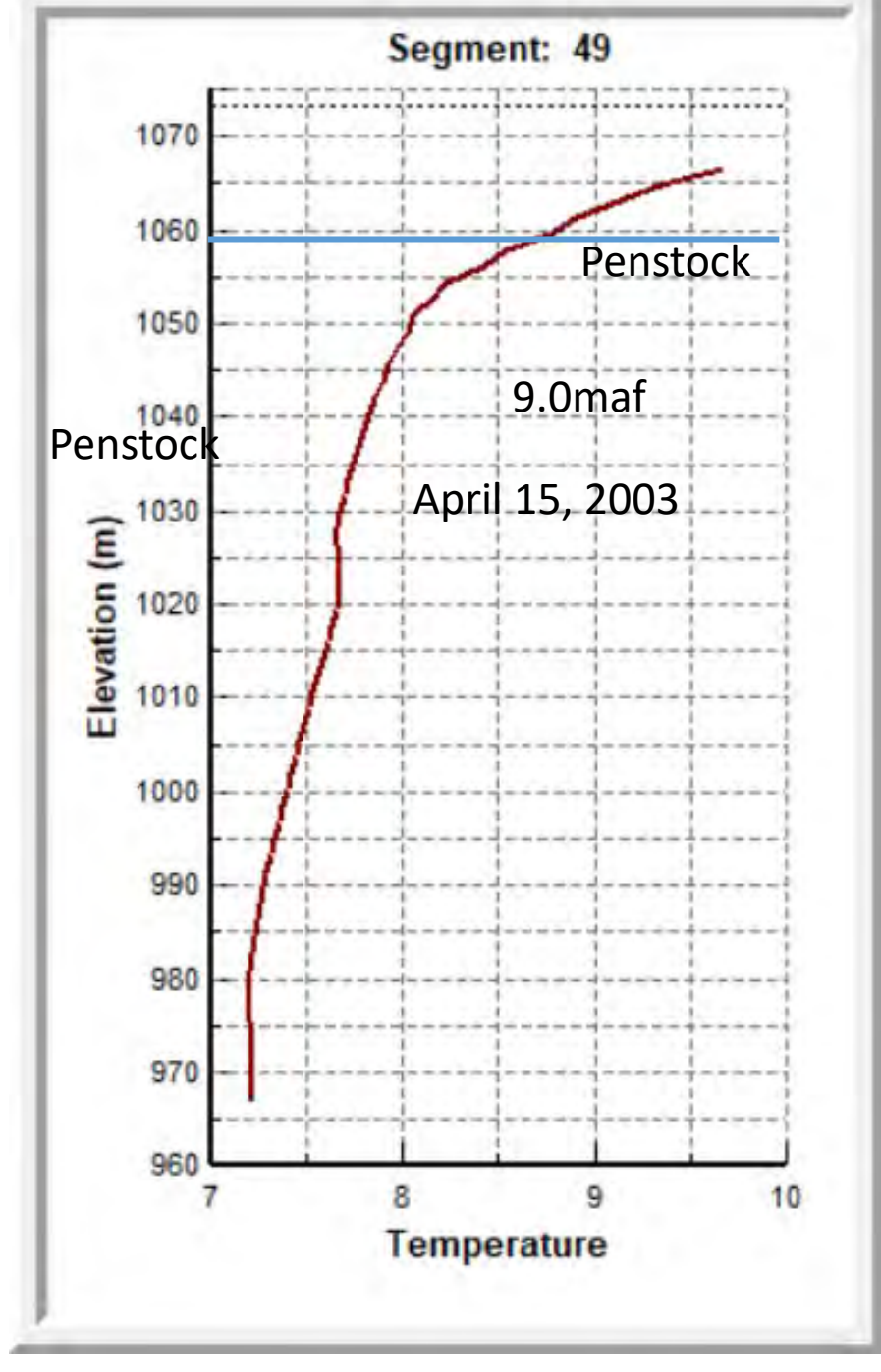
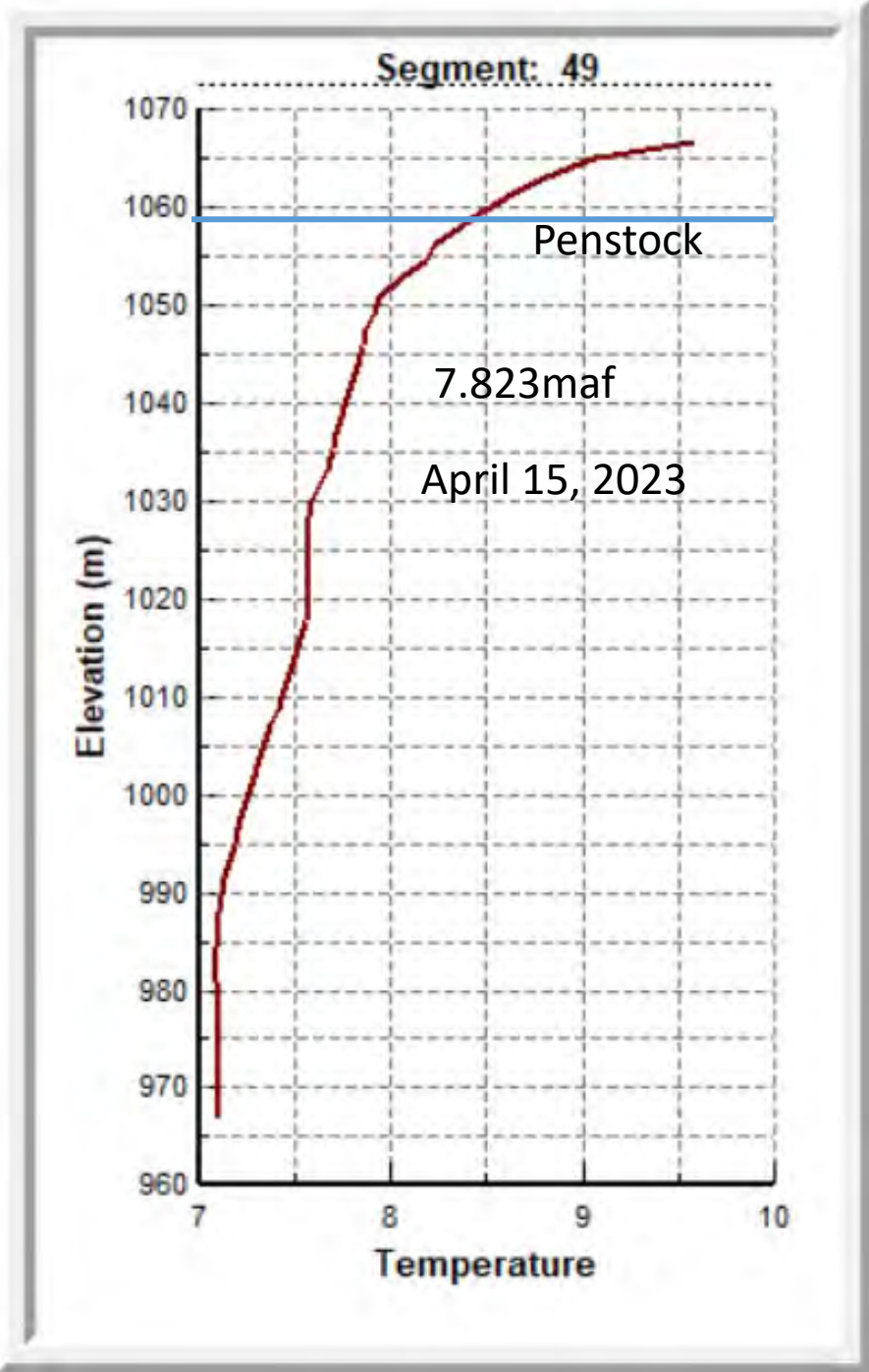
Projections based on March 2023, Most Probable Hydrology 7.823maf

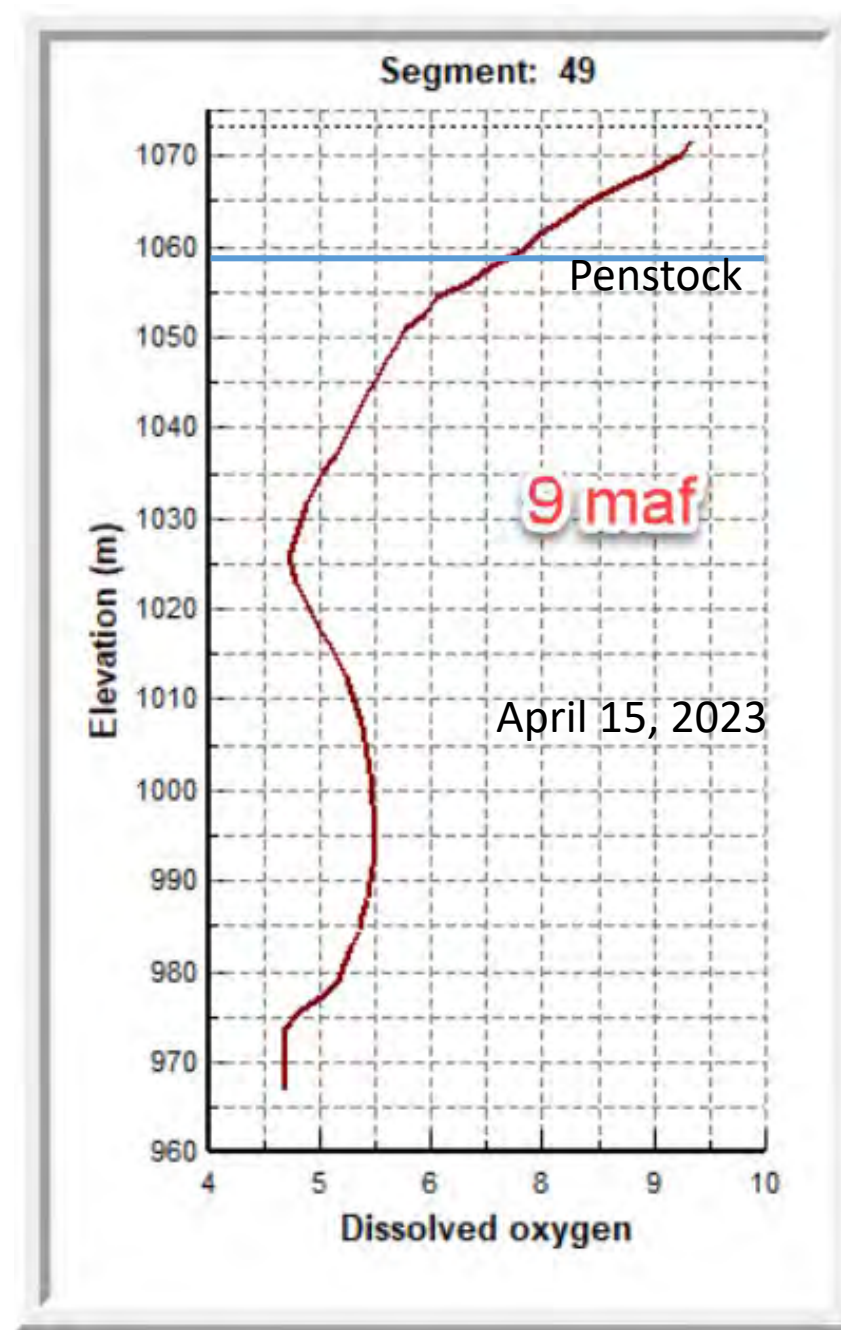
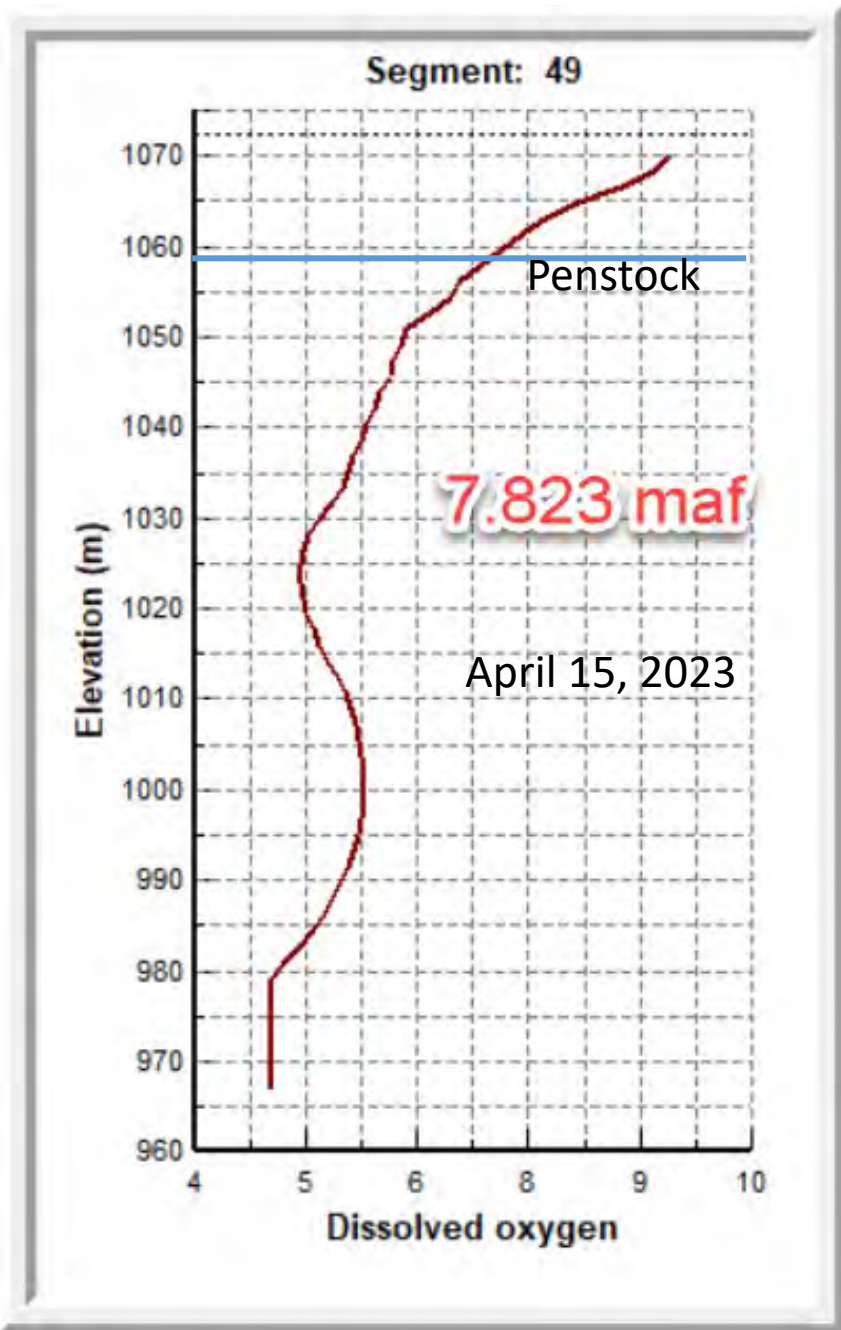


Colorado River, Grand Canyon Water Temperatures

Projections based on March 2023, Most Probable Hydrology; 9 maf





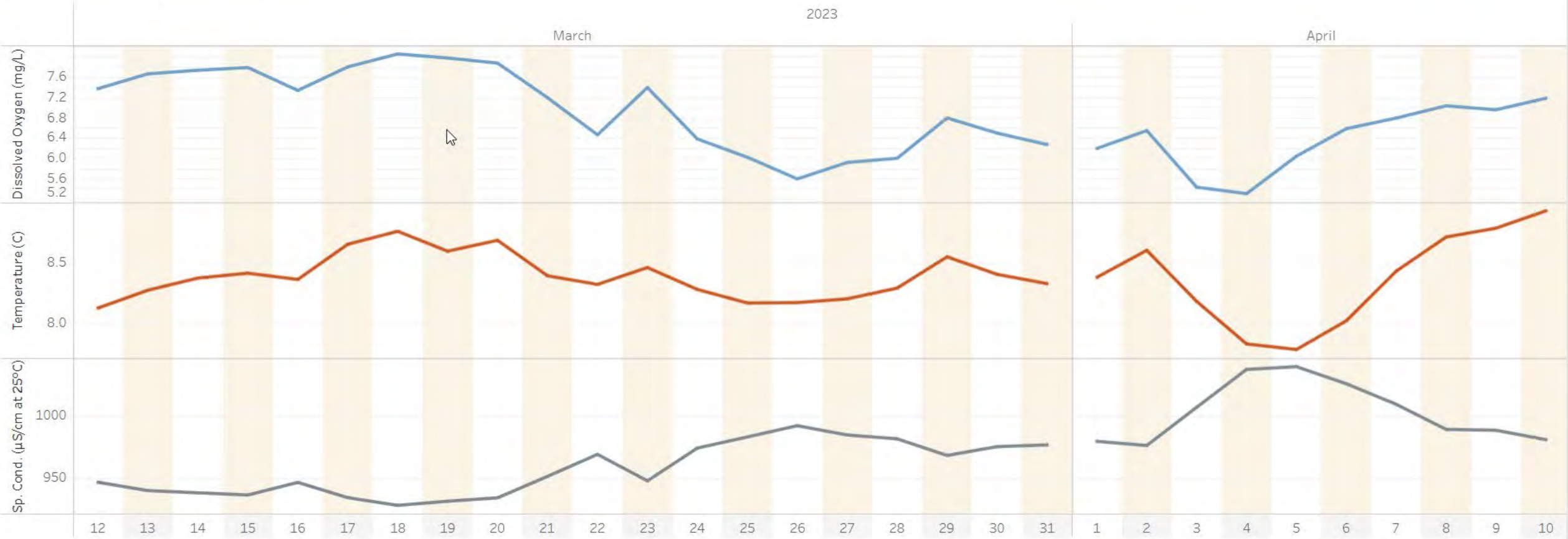


Daily Water Quality Data at Glen Canyon Dam

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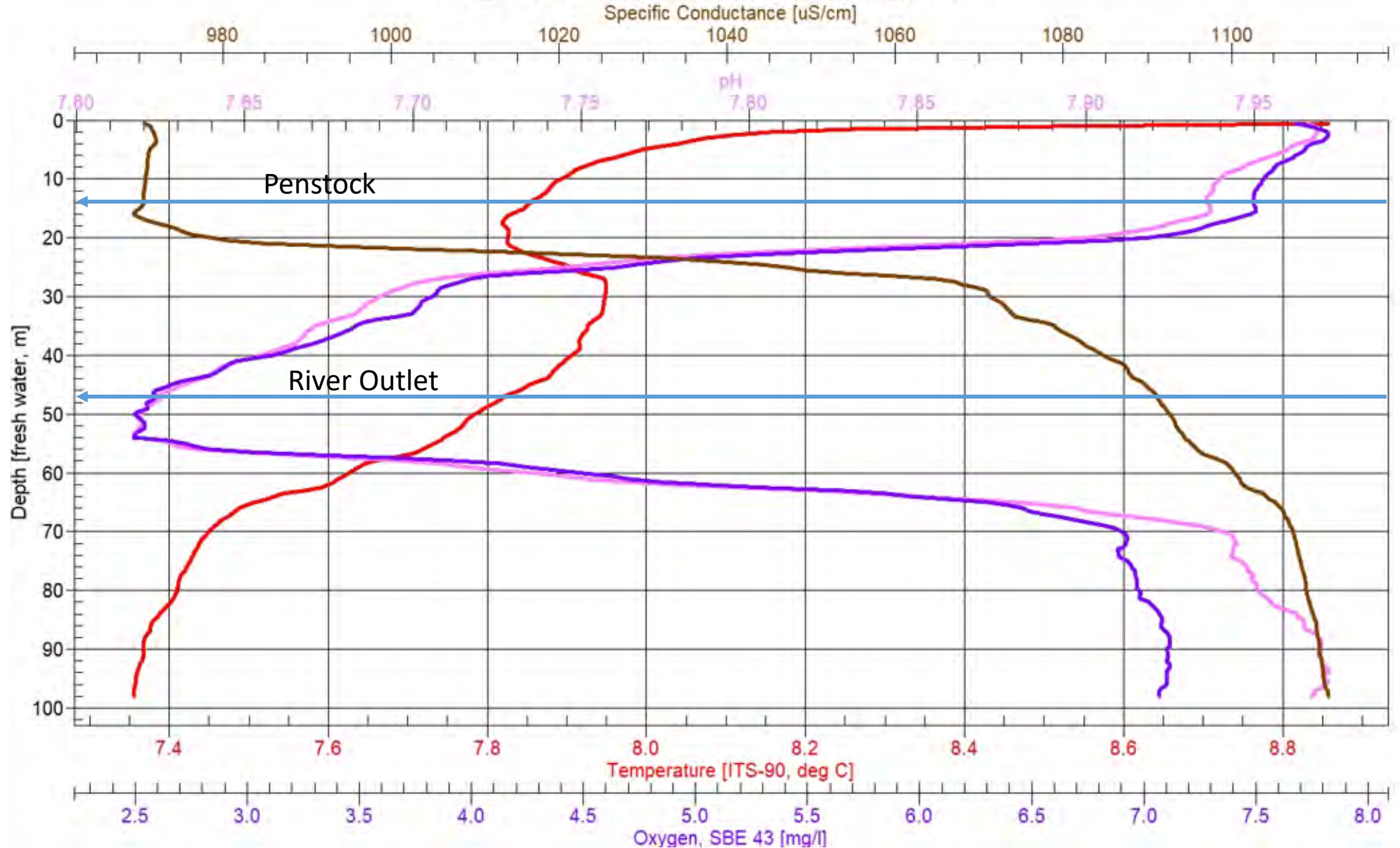


Daily Dissolved Oxygen & Temperature Values

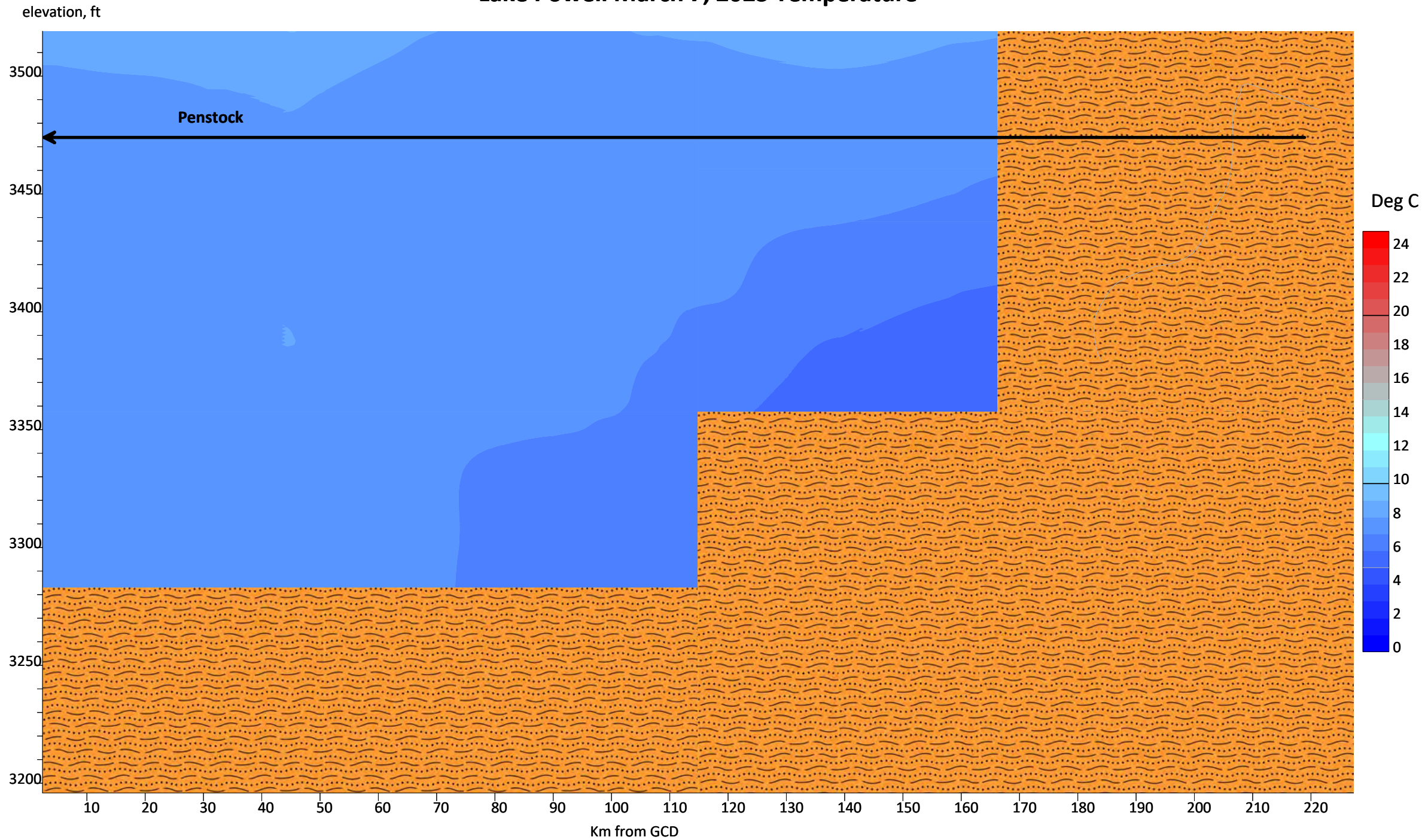


The trends of daily average Dissolved Oxygen, Temperature and Specific Conductance shown for the past 30 days.

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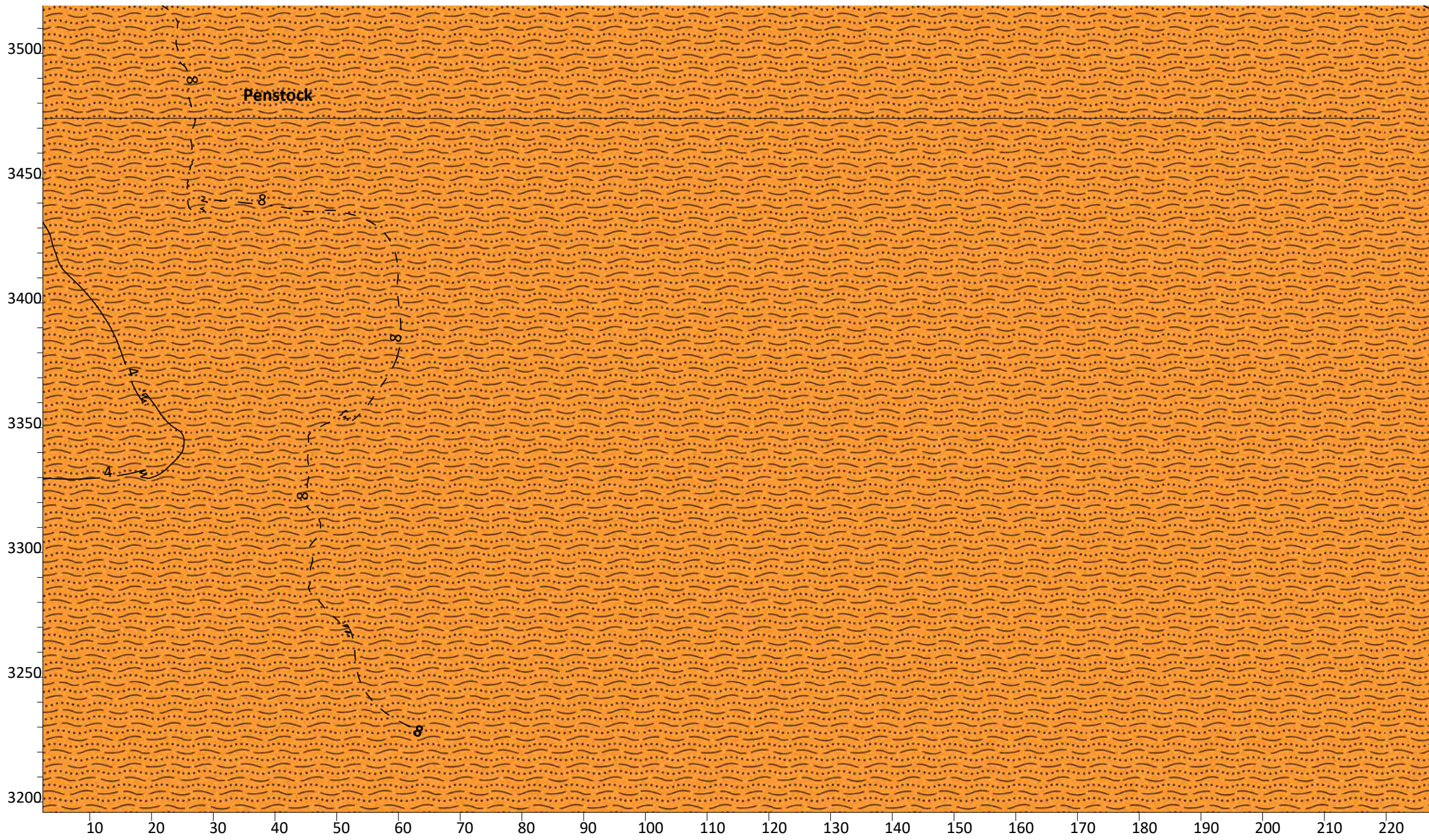


Lake Powell March 7, 2023 Temperature

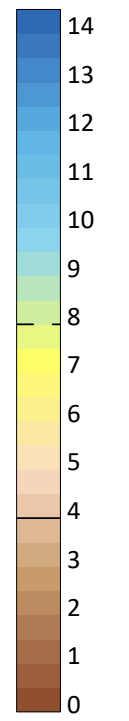


Lake Powell March 7, 2023 Dissolved Oxygen

elevation, ft

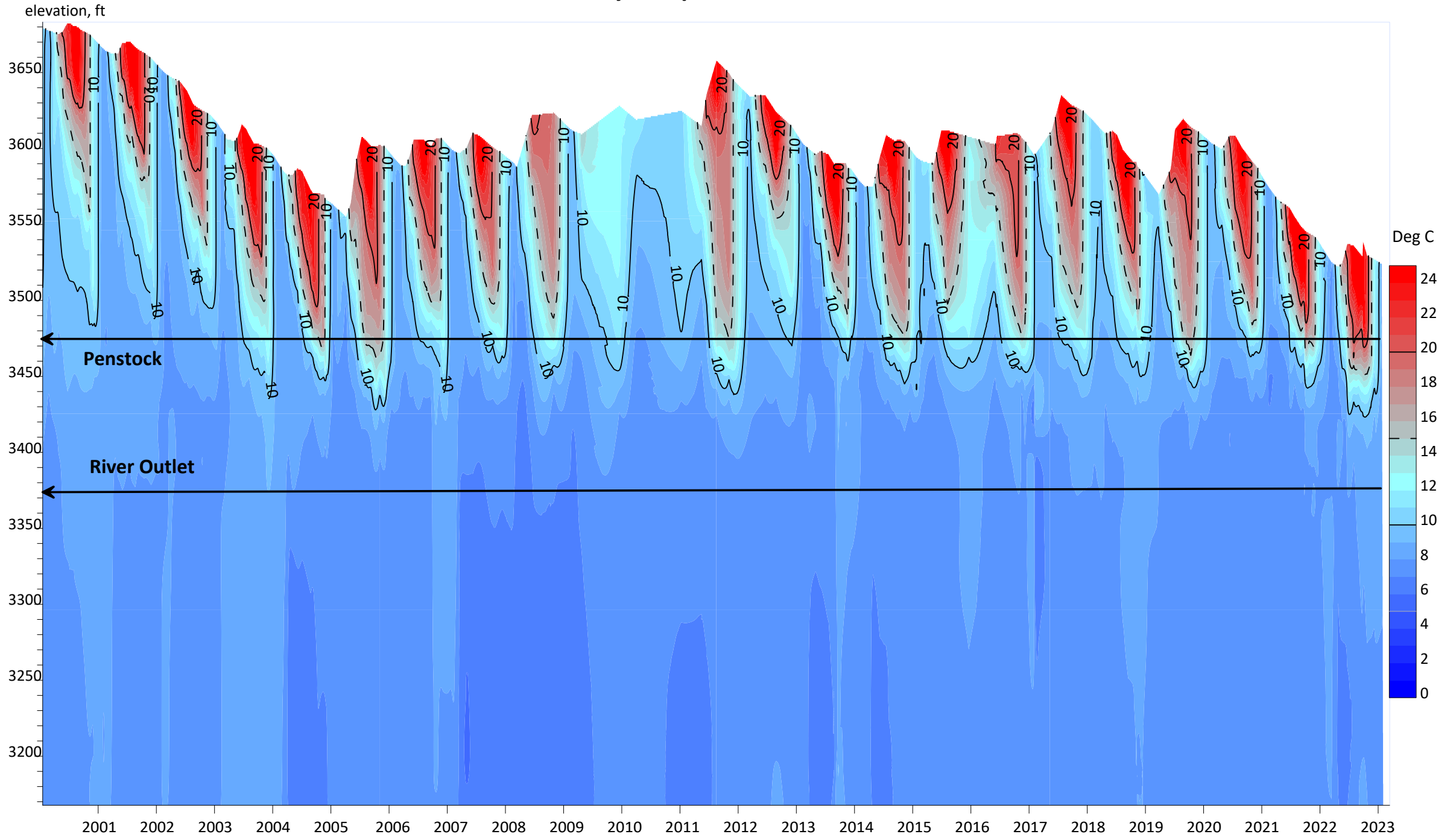


mg/L



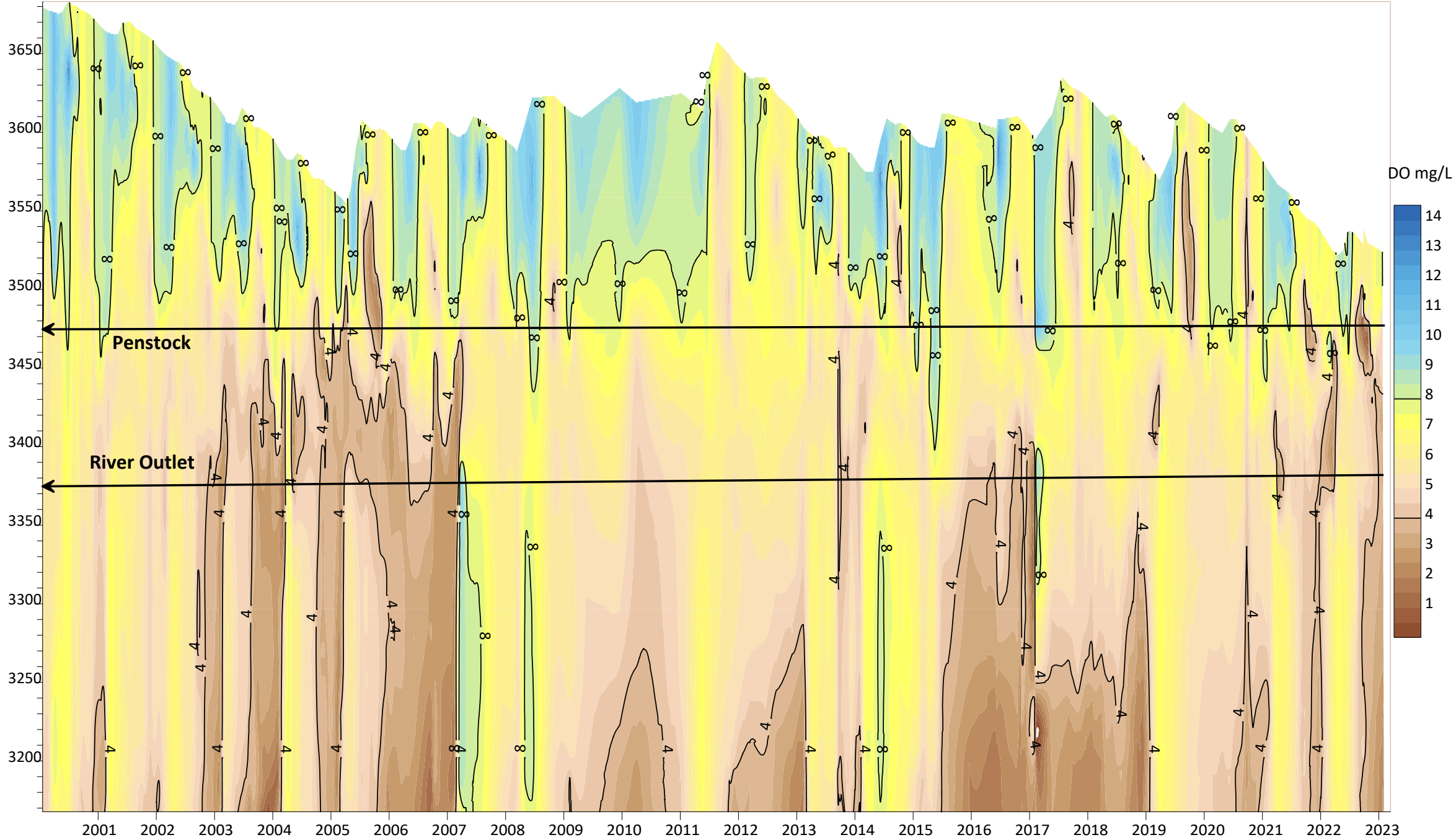
Km from GCD

Lake Powell Forebay Temperature Jan 2000 - March 2023



Lake Powell Forebay Dissolved Oxygen Jan 2000 - March 2023

elevation, ft



Questions?



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