



— BUREAU OF —  
RECLAMATION

# Glen Canyon Monthly Operations Call

## Basin Hydrology and Operations

July 19, 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.”

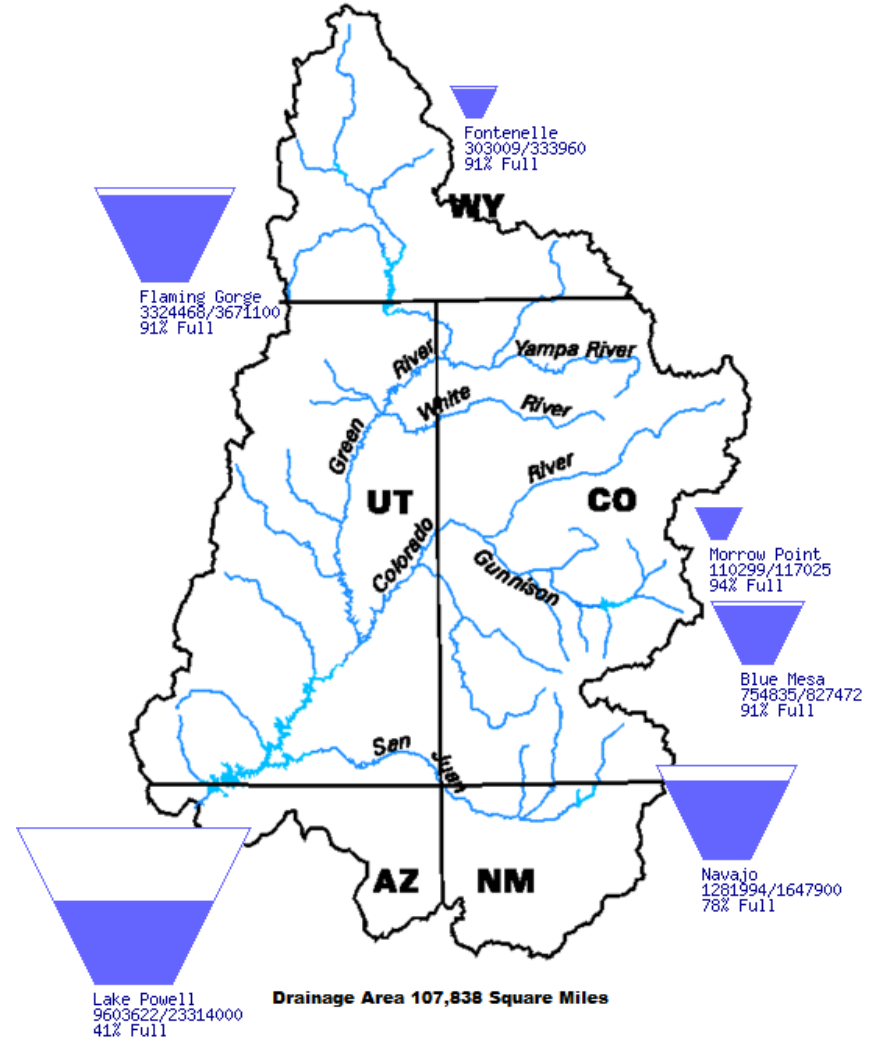


# Upper Basin Storage (as of July 18, 2023)

Data Current as of:  
07/17/2023

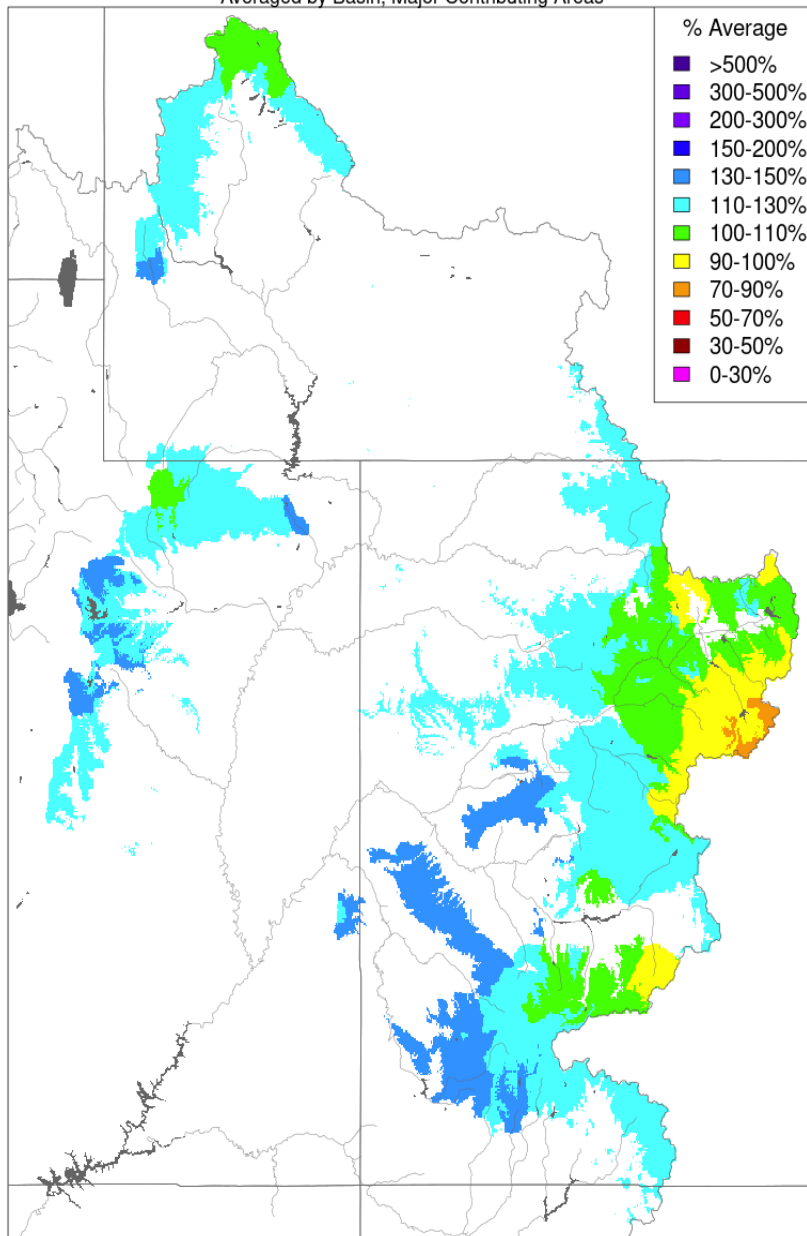
## Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	91	0.30	0.33	6,501.98
Flaming Gorge	91	3.32	3.67	6,031.53
Blue Mesa	91	0.75	0.83	7,511.30
Navajo	78	1.28	1.65	6,059.17
Lake Powell	41	9.60	23.31	3,583.83
UC System Storage	51	15.40	29.93	
System Storage	44	26.01	58.48	



### Water Year Precipitation, October 2022 - June 2023

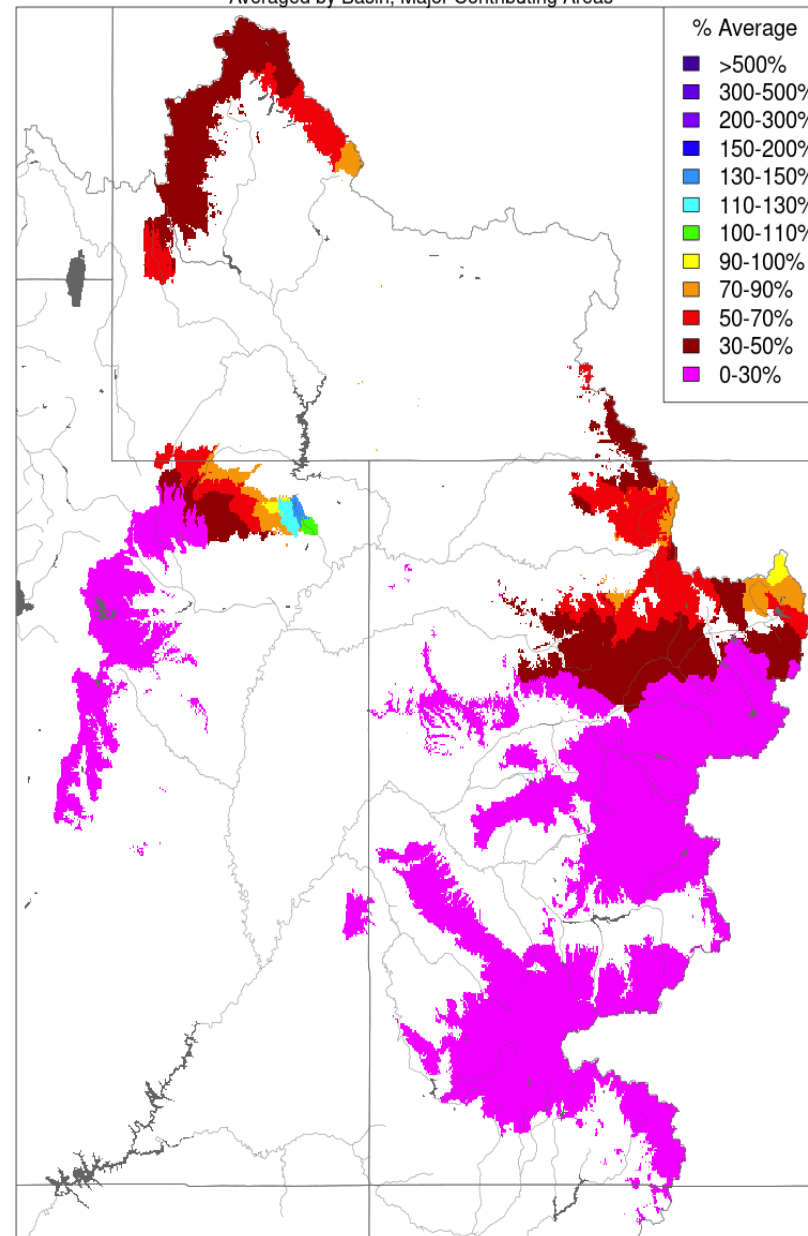
Averaged by Basin, Major Contributing Areas



Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

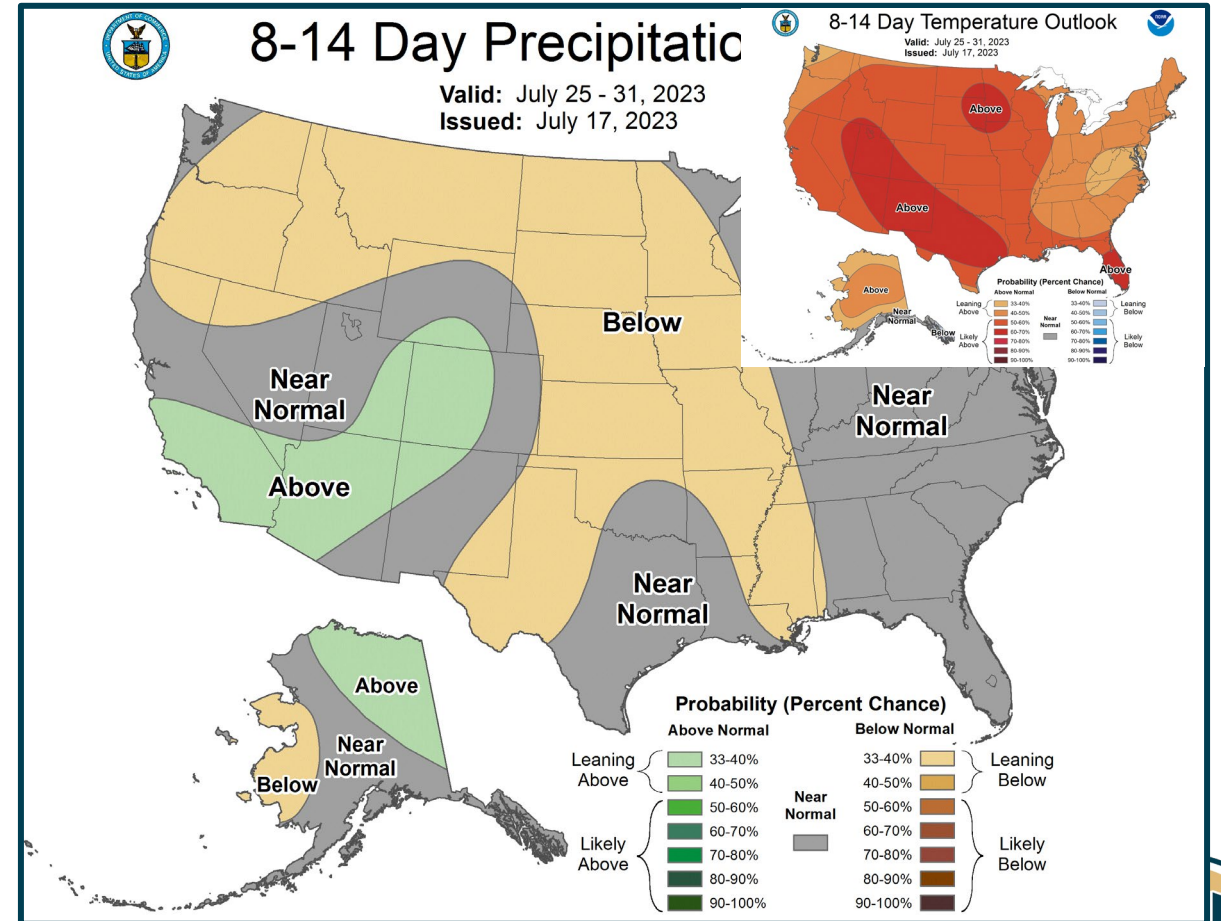
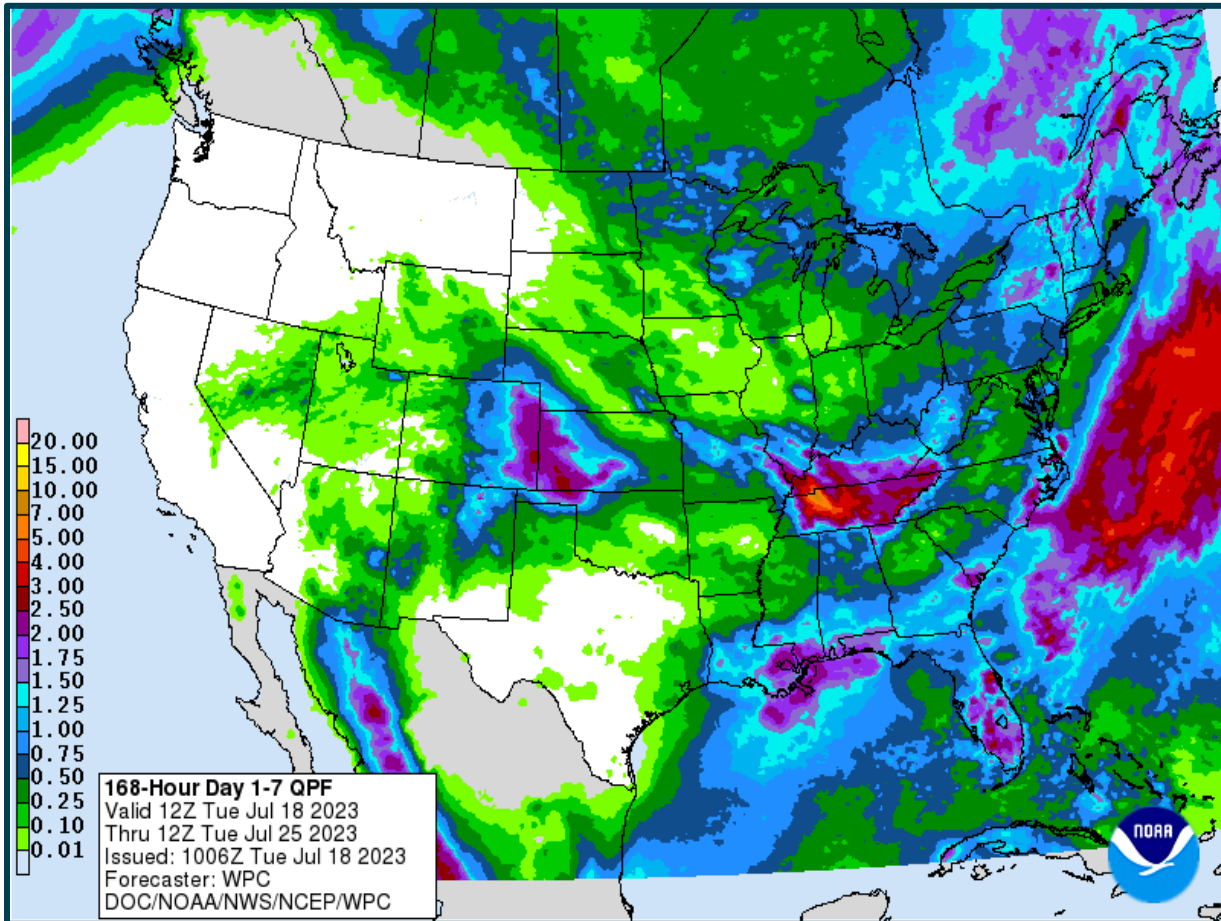
### Month to Date Precipitation - July 18 2023

Averaged by Basin, Major Contributing Areas

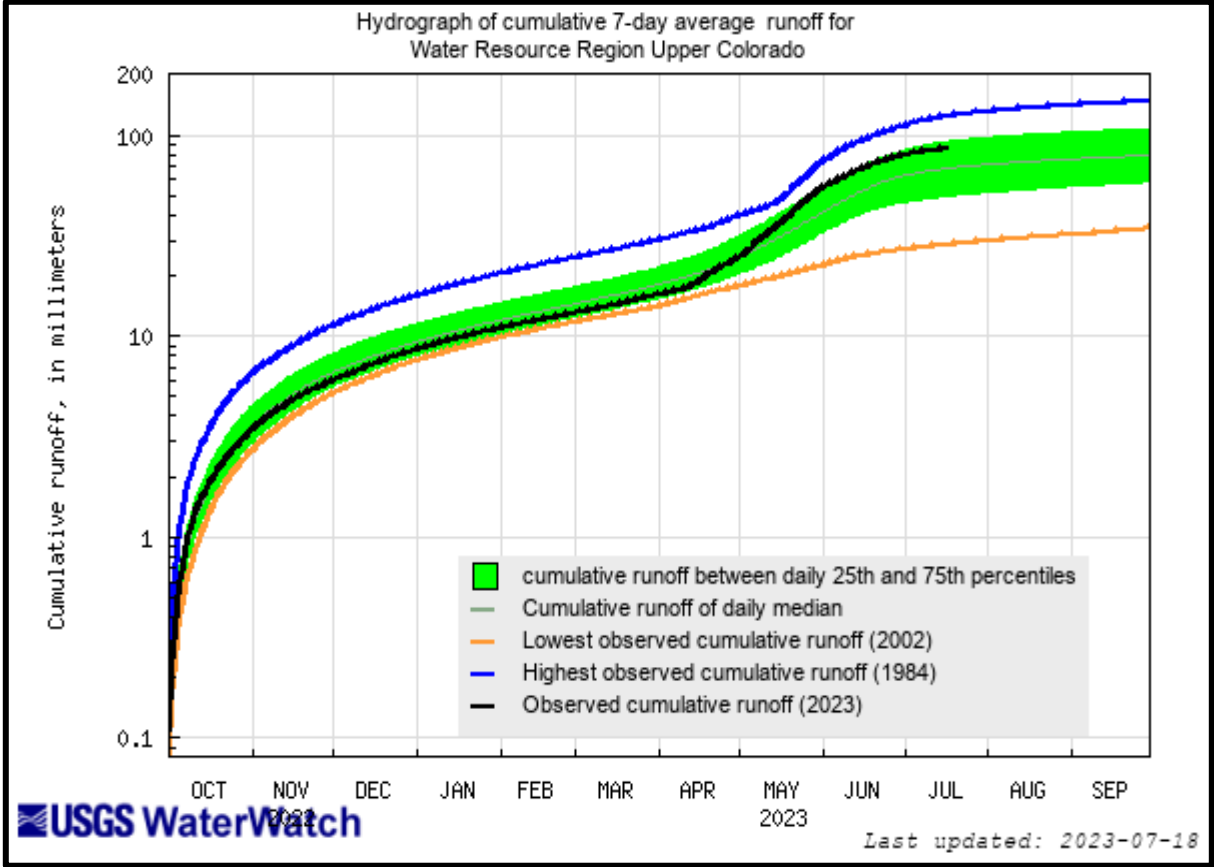
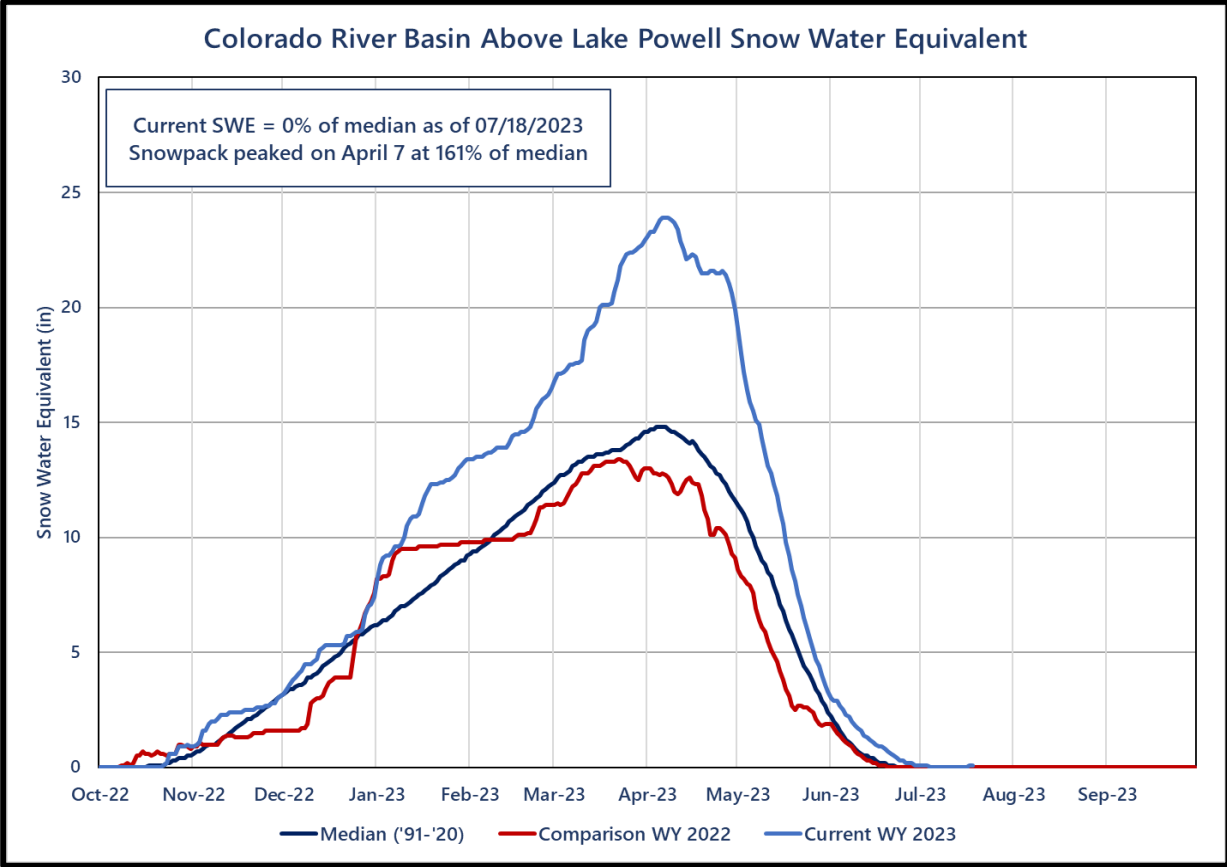


Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

# Weather Prediction Center and Climate Prediction Center Precipitation Forecasts



# Upper Colorado SWE and Observed Inflows



Available online at: [https://waterwatch.usgs.gov/index.php?id=wwdur\\_cumrunoff](https://waterwatch.usgs.gov/index.php?id=wwdur_cumrunoff)





# Most Probable July Forecast Water Year 2023

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

Reservoir	Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	965	131
Flaming Gorge	1,460	151
Blue Mesa	845	133
Navajo	1,035	164
Powell	10,800	169

Midmonth Powell 10,700 kaf (167%)

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

Reservoir	Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	1,260	117
Flaming Gorge	1,810	128
Blue Mesa	1,099	122
Navajo	1,278	140
Powell	14,001	146

Midmonth Powell 13,900 kaf (145%)

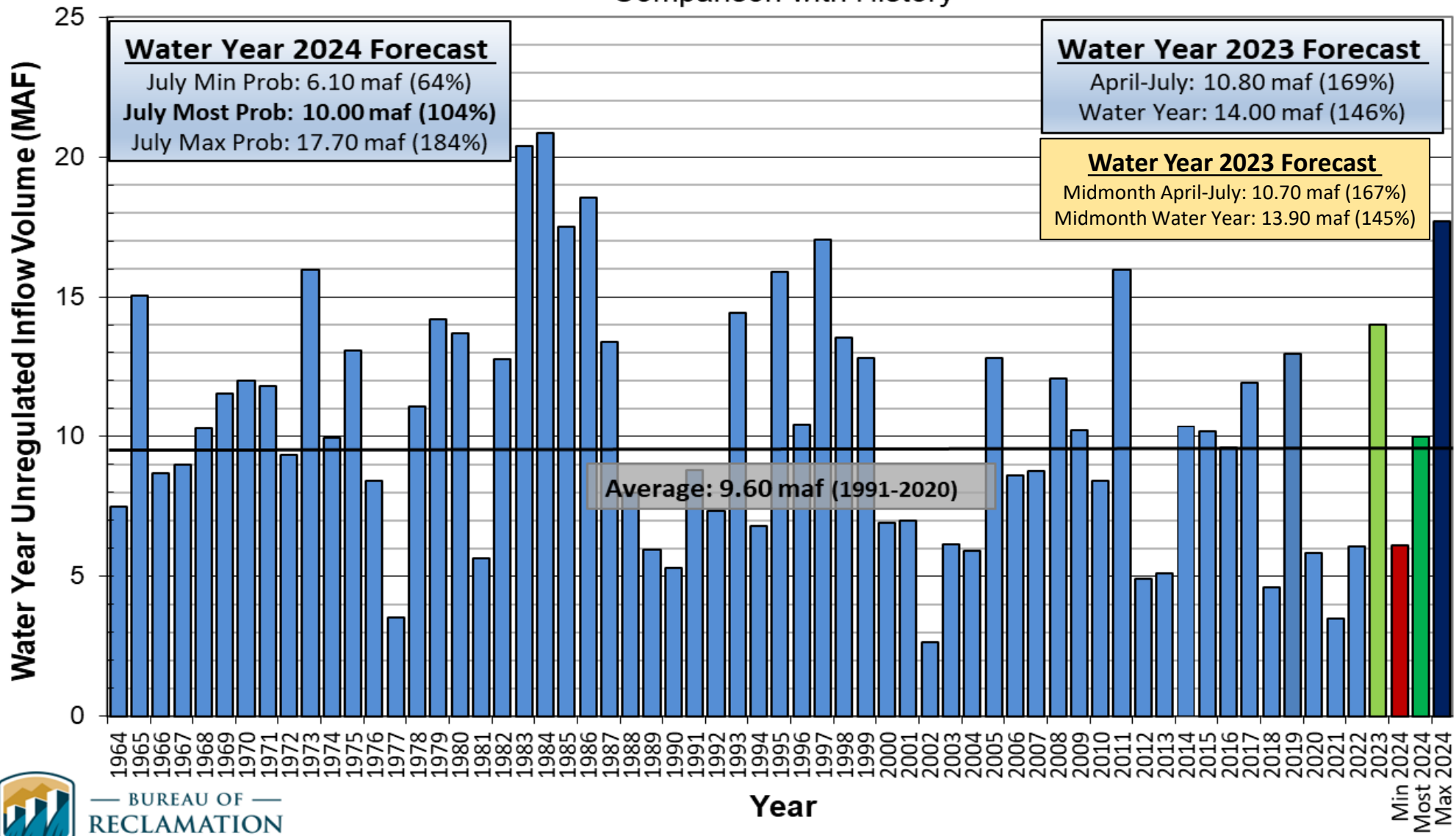
<sup>1</sup>Averages are based on the 1991 through 2020 period of record.



# Lake Powell Unregulated Inflow

## Water Year 2023 and 2024 Forecast (issued July 3)

### Comparison with History







# Upper Colorado Basin

Hydrology and Operations  
Projections Based on April  
and July 2023 24-Month  
Study



# Upper Basin Reservoir Operations in Water Year 2023

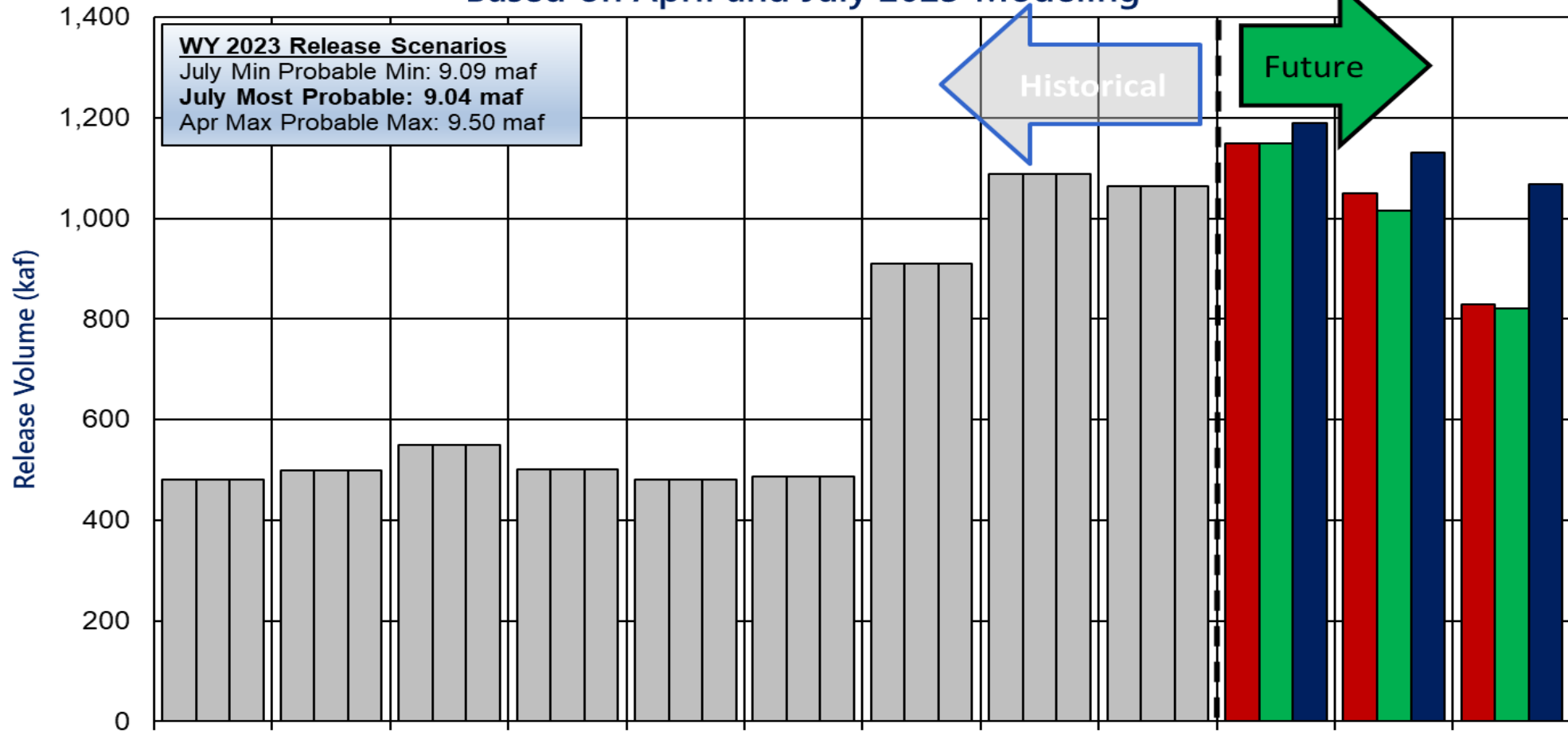
- Lake Powell will be operated consistent with the 2007 Interim Guidelines, the Upper Basin Drought Response Operations Agreement and Upper Basin Records of Decision
- Lake Powell's projected end of calendar year (CY) 2022 "tier determination" elevation in the August 2022 24-Month Study determined Lake Powell's operating tier in water year (WY) 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 was initially set to 7.00 maf
  - In April 2023, Reclamation evaluated hydrologic conditions and determined balancing releases are 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. Lake Powell will release between 7.0 MAF and 9.5 MAF in WY 2023
  - Reclamation has removed the operational neutrality of the 0.480 maf that was retained in Lake Powell under the May 2022 action, such that balancing releases are based on the physical storage of Lake Powell and Lake Mead



# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2023

### Based on April and July 2023 Modeling



	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
	10/1/2022	11/1/2022	12/1/2022	1/1/2023	2/1/2023	3/1/2023	4/1/2023	5/1/2023	6/1/2023	7/1/2023	8/1/2023	9/1/2023
■ July Min Probable	480,052	498,343	549,827	500,751	480,408	486,044	909,310	1,088,254	1,063,574	1,150,000	1,050,000	828,700
■ July Most Probable	480,052	498,343	549,827	500,751	480,408	486,044	909,310	1,088,254	1,063,574	1,150,000	1,015,000	820,360
■ April Max Probable	480,052	498,343	549,827	500,751	480,408	486,044	909,310	1,088,254	1,063,574	1,190,000	1,130,000	1,068,705

■ July Min Probable      ■ July Most Probable      ■ April Max Probable

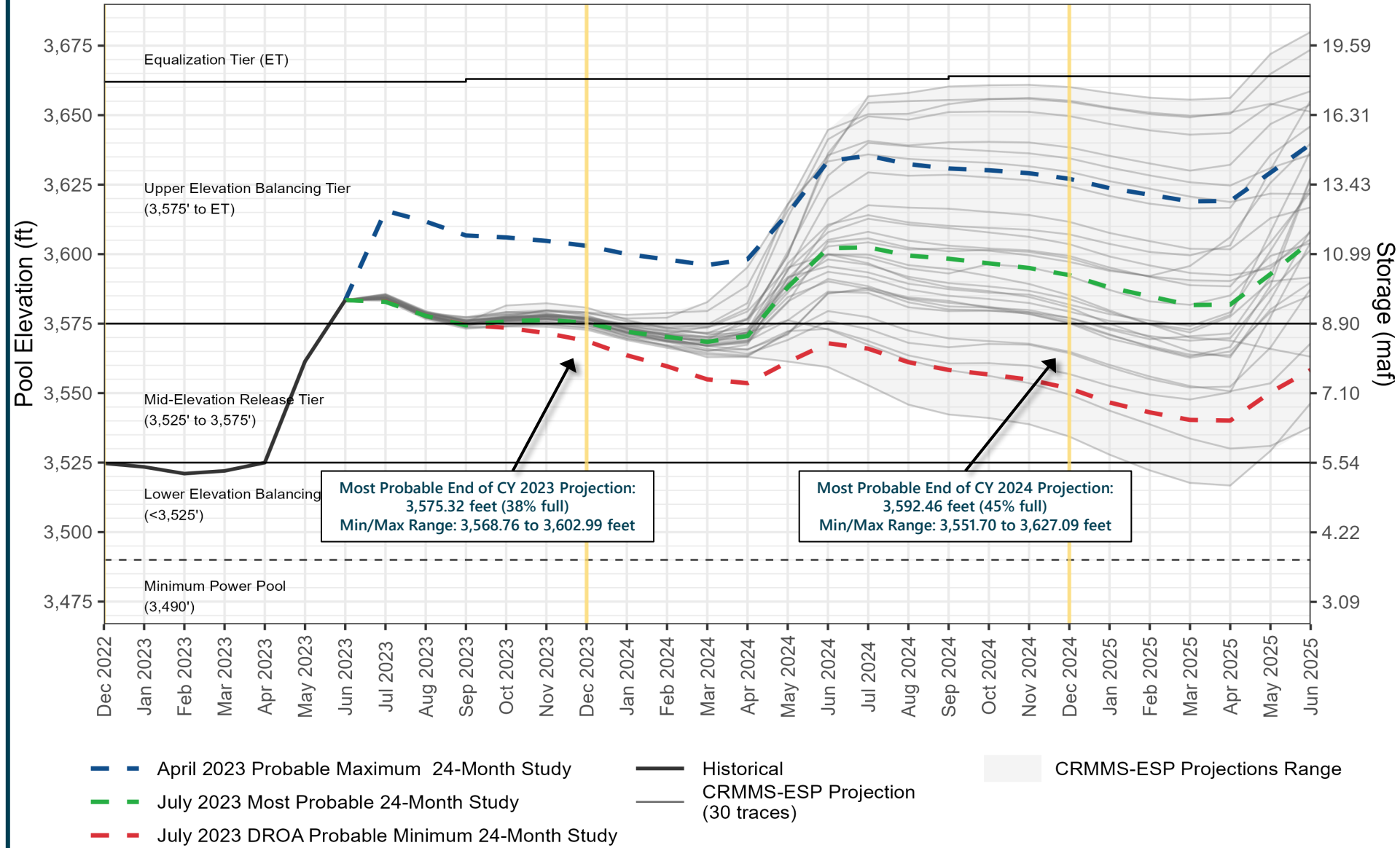


# Reclamation Operational Modeling Model Comparison

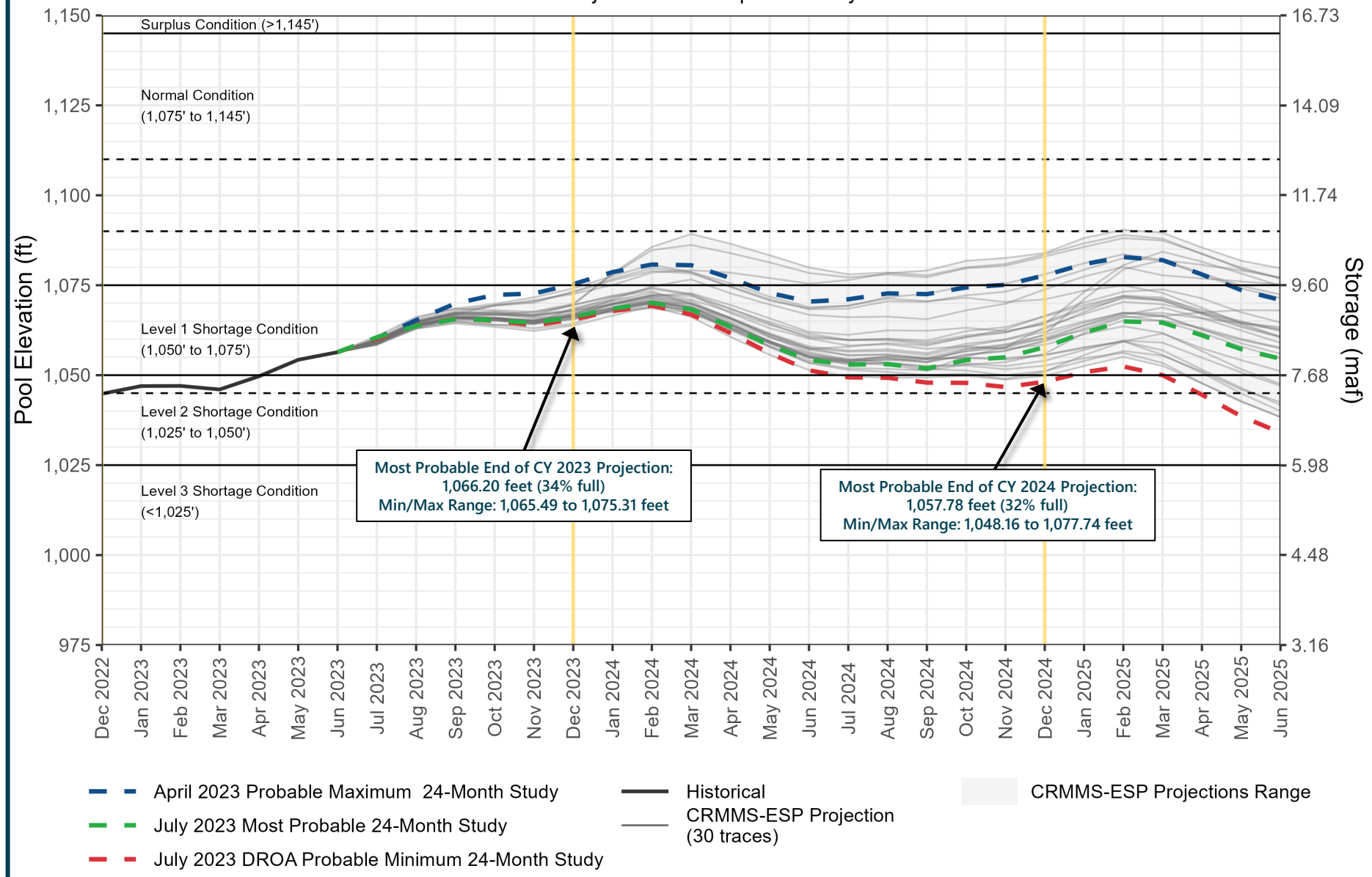
	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir 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 Elevations CRMMS Projections from April and July 2023



## Lake Mead End-of-Month Elevations CRMMS Projections from April and July 2023







# Upper Colorado Basin

## Hydropower Maintenance



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2023

Unit Number	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	6	6	6	6	6	6	8	6	6	6	6	6
Capacity (cfs)	18,200	18,150	18,050	18,000	17,919	17,900	24,500	19,100	19,900	19,800	19,700	19,600
Capacity (kaf/month)	1,120	1,080	1,110	1,110	970	1,090	1,030	1,170	1,180	1,220	1,210	1,160
Max (kaf) <sup>1</sup>	480	498	549	980	870	698	910	1,088	1,064	1,190	1,130	1,069
Most (kaf) <sup>1</sup>	480	498	549	501	480	485	910	1,088	1,064	1,150	1,015	820
Min (kaf) <sup>1</sup>	480	498	549	501	480	485	910	840	1,064	1,150	1,050	829
										(updated 07-18-2023)		

JUL MOST<sup>2</sup>  
 JUL MOST  
 9.50 maf  
 9.04 maf  
 9.09 maf

1 Projected release, based on April 2023 24MS for the maximum probable and the July 2023 24MS for the minimum and most probable inflow projections and 24-Month Study model runs.  
 2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.



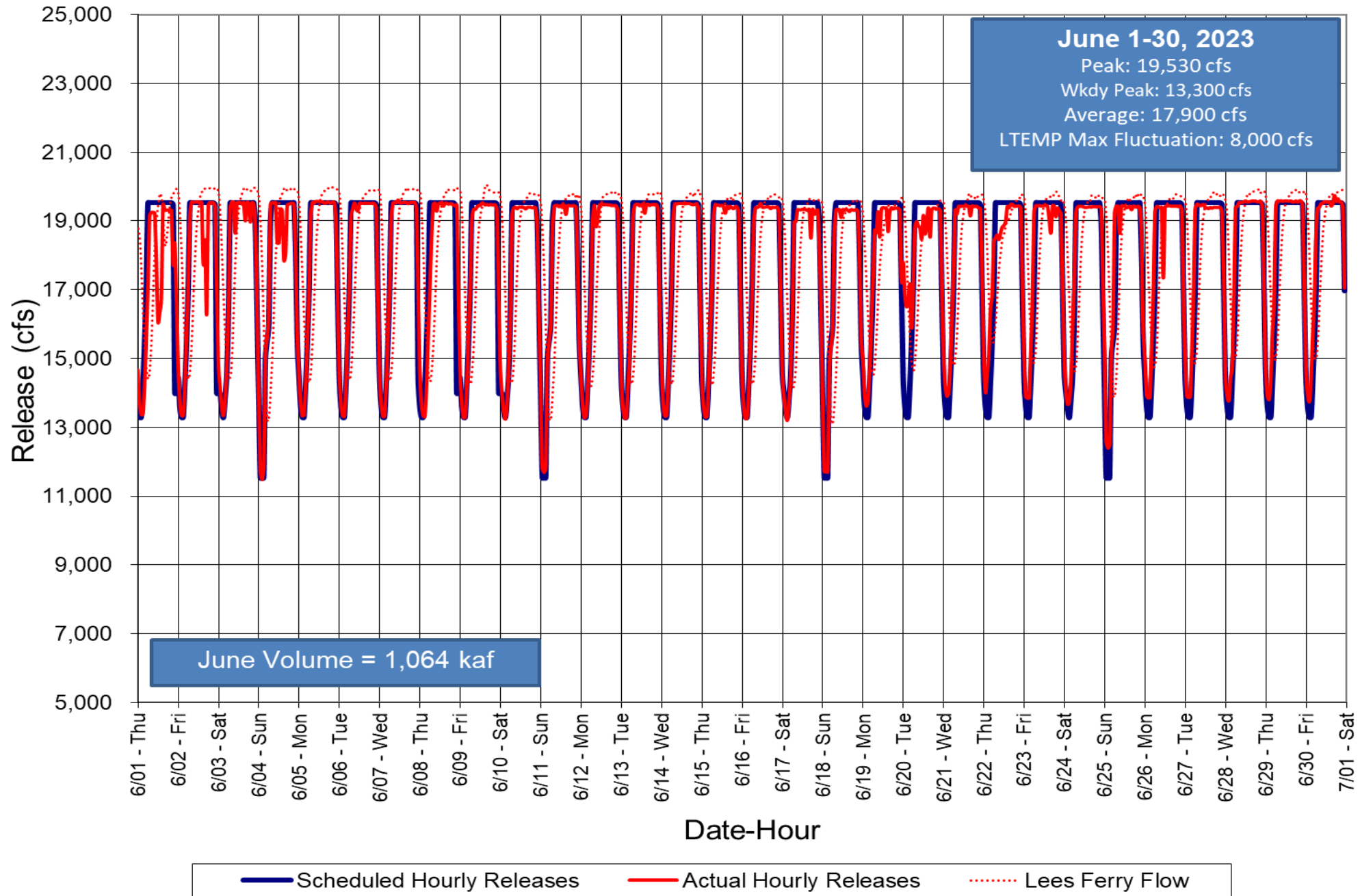
# Glen Canyon Dam Power Plant Unit Outage Schedule for 2024

Unit Number	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Jul 2024	Aug 2024	Sep 2024	
1	[Outage]							[Outage]					
2	[Outage]												
3	[Outage]												
4	[Outage]												
5						[Outage]							
6						[Outage]							
7								[Outage]					
8								[Outage]					
Units Available	4	4	6	6	4	6	5	5	8	8	8	8	
Capacity (cfs)	12,400	12,400	19,600	19,500	12,300	19,400	15,850	16,250	27,700	27,700	27,550	27,550	JUL MOST <sup>2</sup>
Capacity (kaf/month)	780	1,040	1,200	1,200	1,000	1,190	1,020	1,250	1,650	1,700	1,700	1,640	JUL MOST
Max (kaf) <sup>1</sup>	643	642	715	857	758	801	713	710	745	842	900	674	9.00 maf
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
Min (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
													(updated 07-18-2023)

1 Projected release, based on April 2023 24MS for the maximum probable and July 2023 24MS for the minimum and most probable inflow projections and 24-Month Study model runs.  
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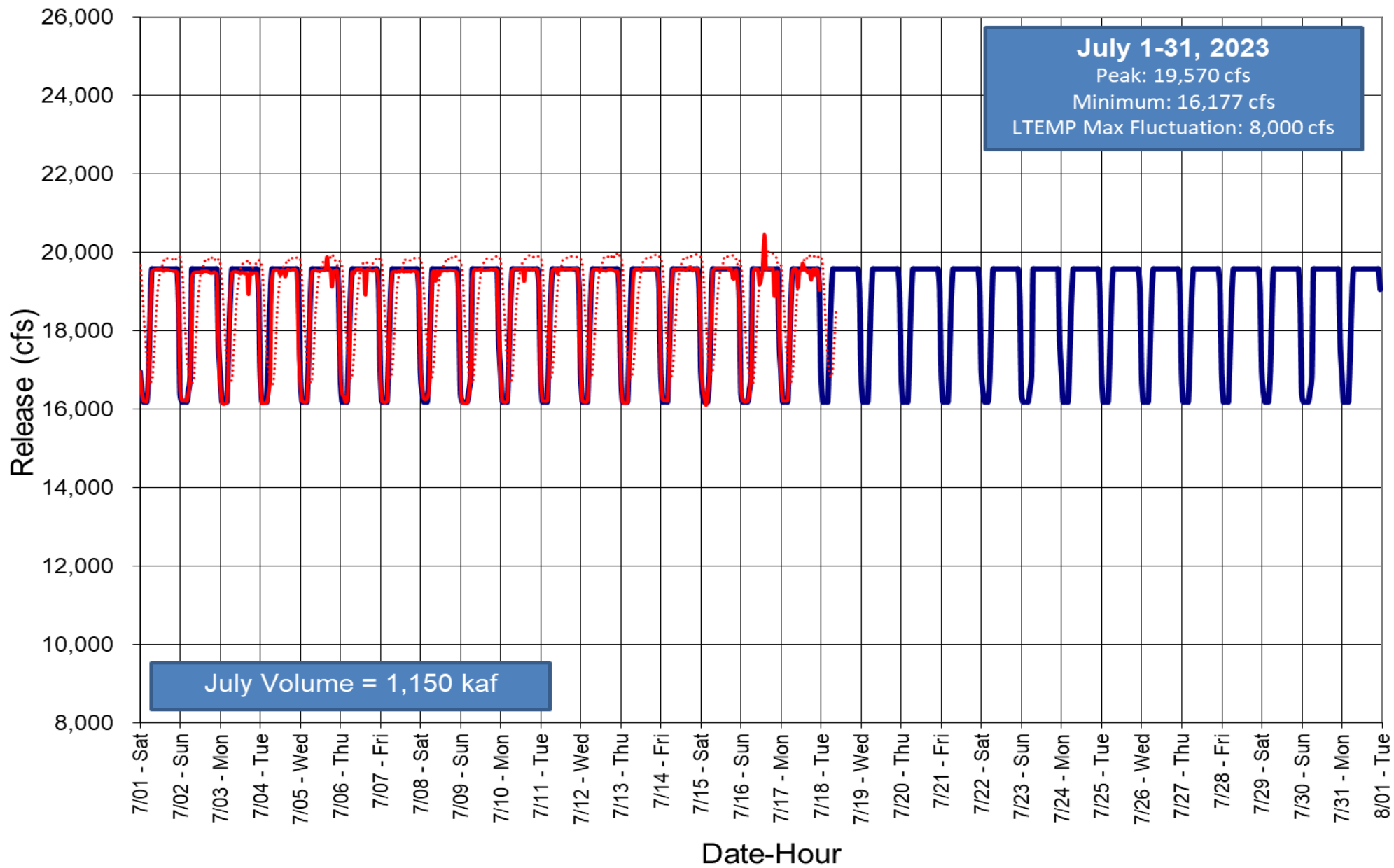


# Glen Canyon Dam Hourly Release Pattern June 2023





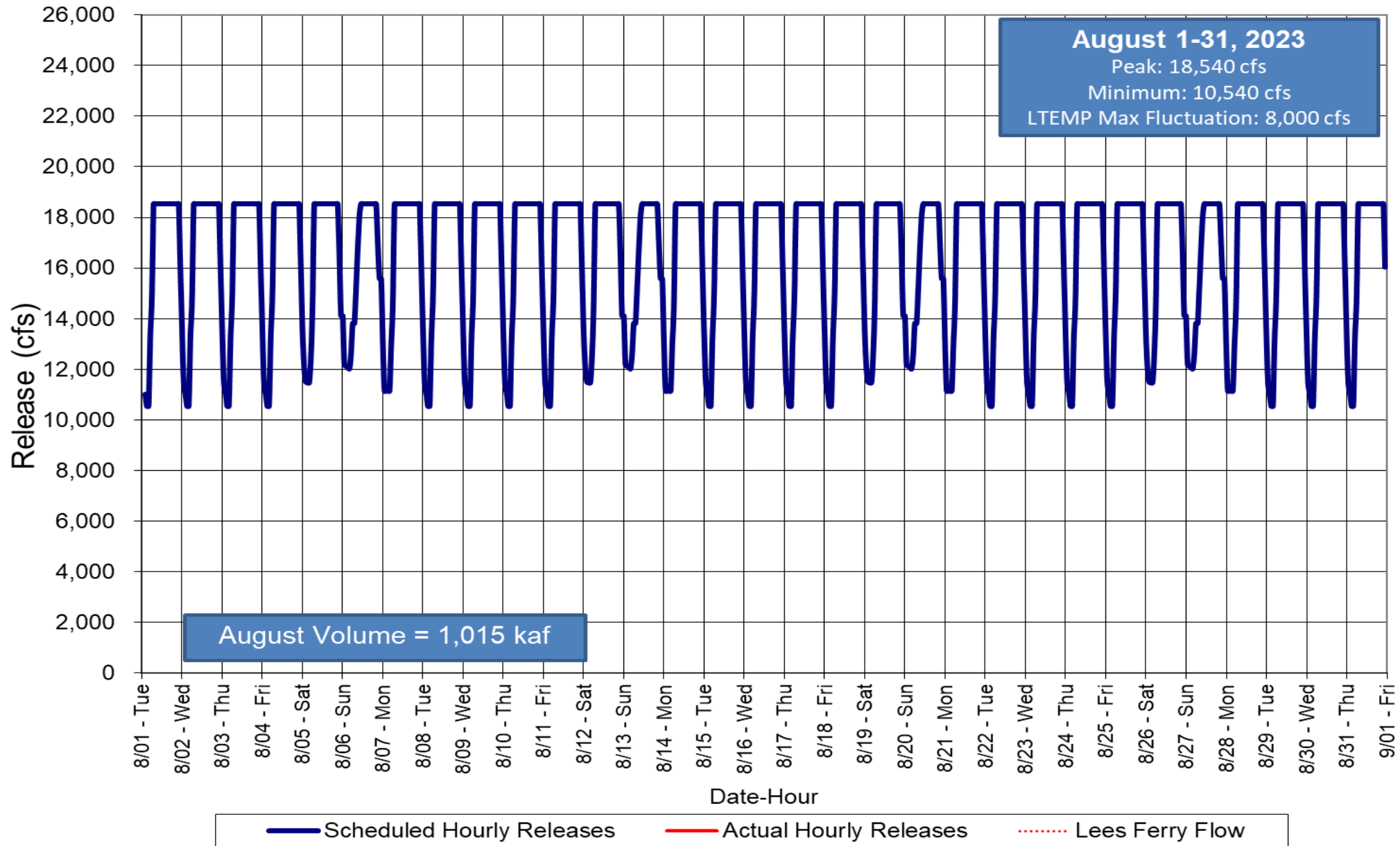
# Glen Canyon Dam Hourly Release Pattern July 2023



— Scheduled Hourly Releases    
 — Actual Hourly Releases    
 ⋯ Lees Ferry Flow



# Glen Canyon Dam Hourly Release Pattern August 2023



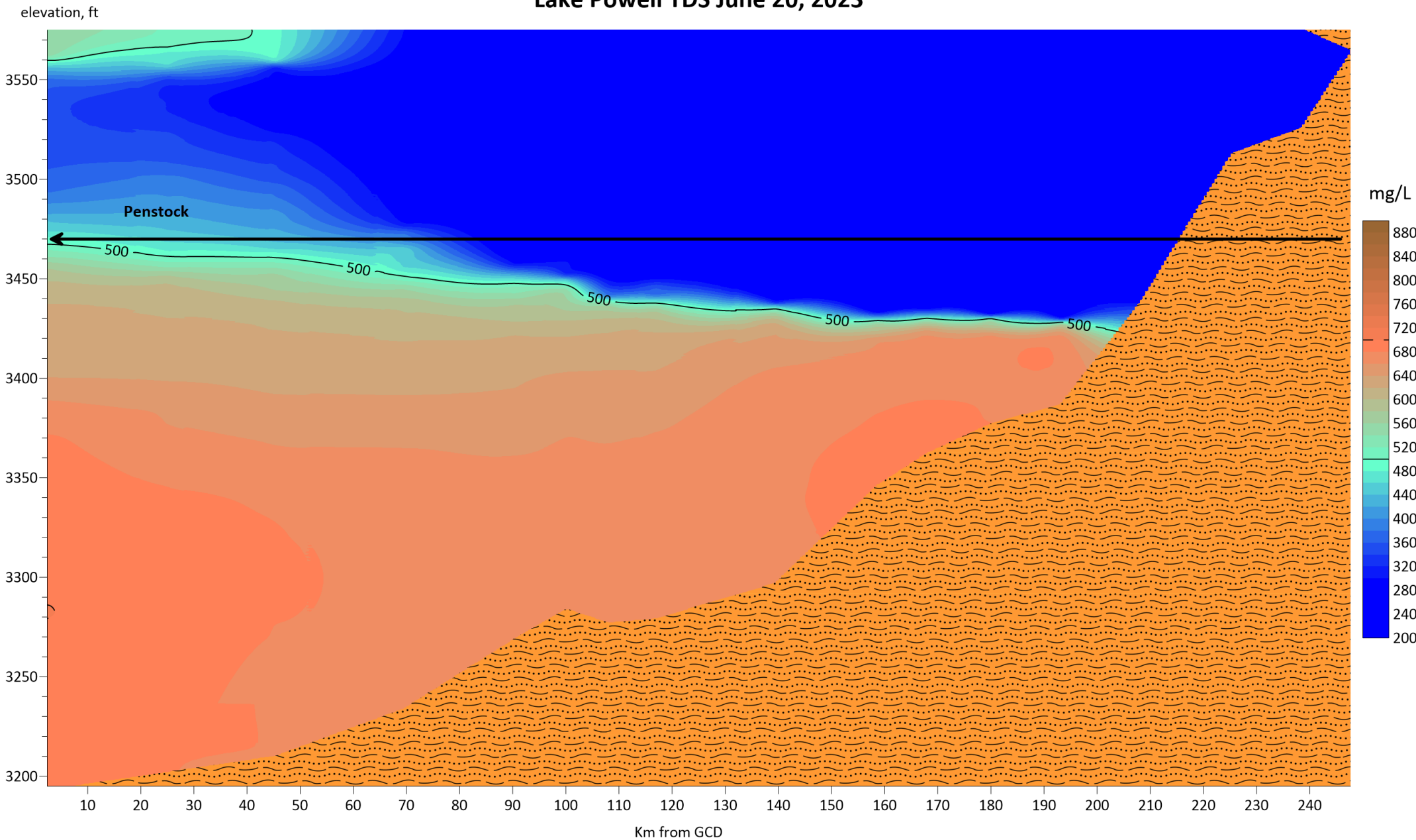


# Water Quality



# Lake Powell TDS June 20, 2023

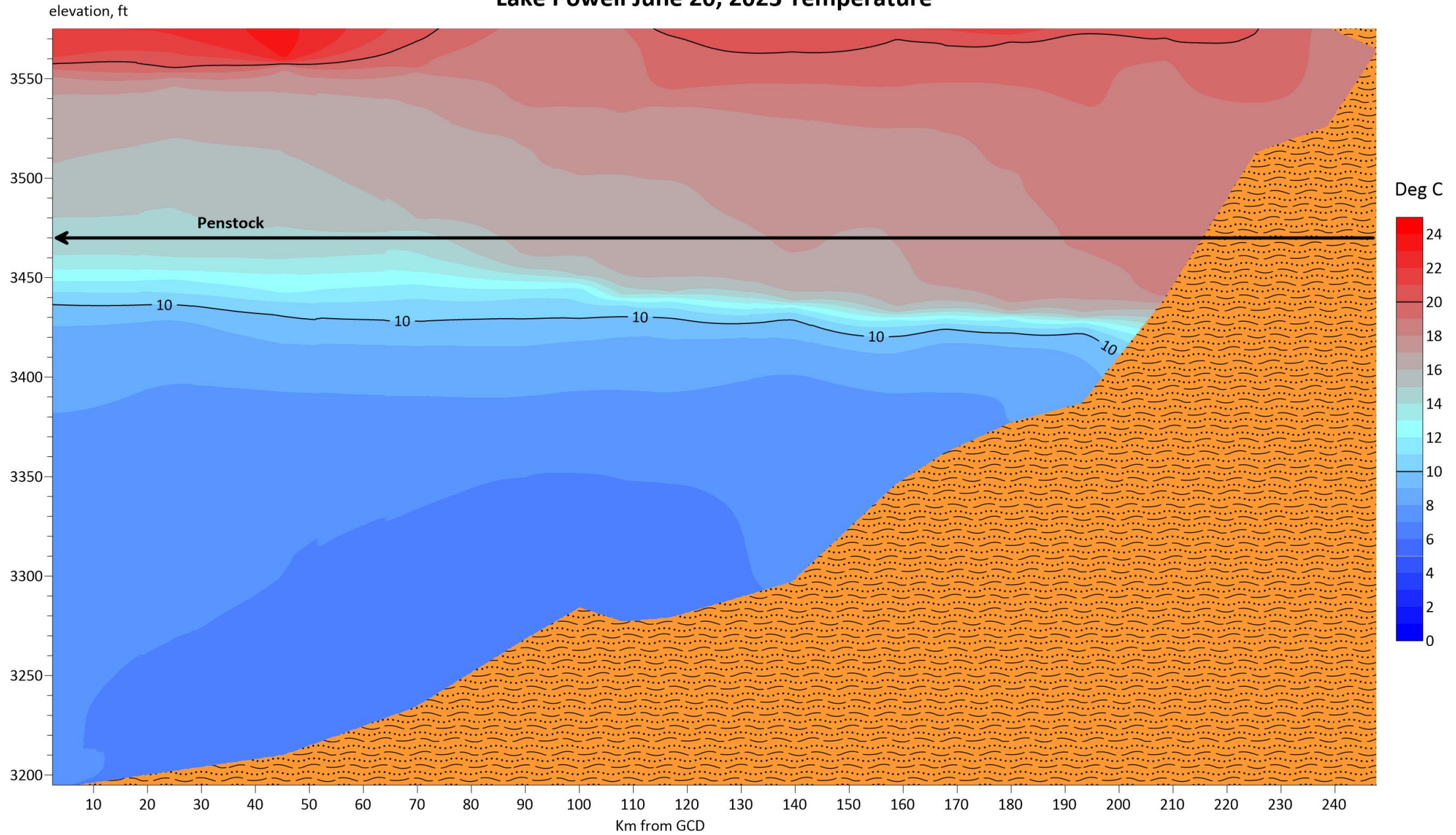
480 mg/L at penstock





# Lake Powell June 20, 2023 Temperature

15° at  
penstock

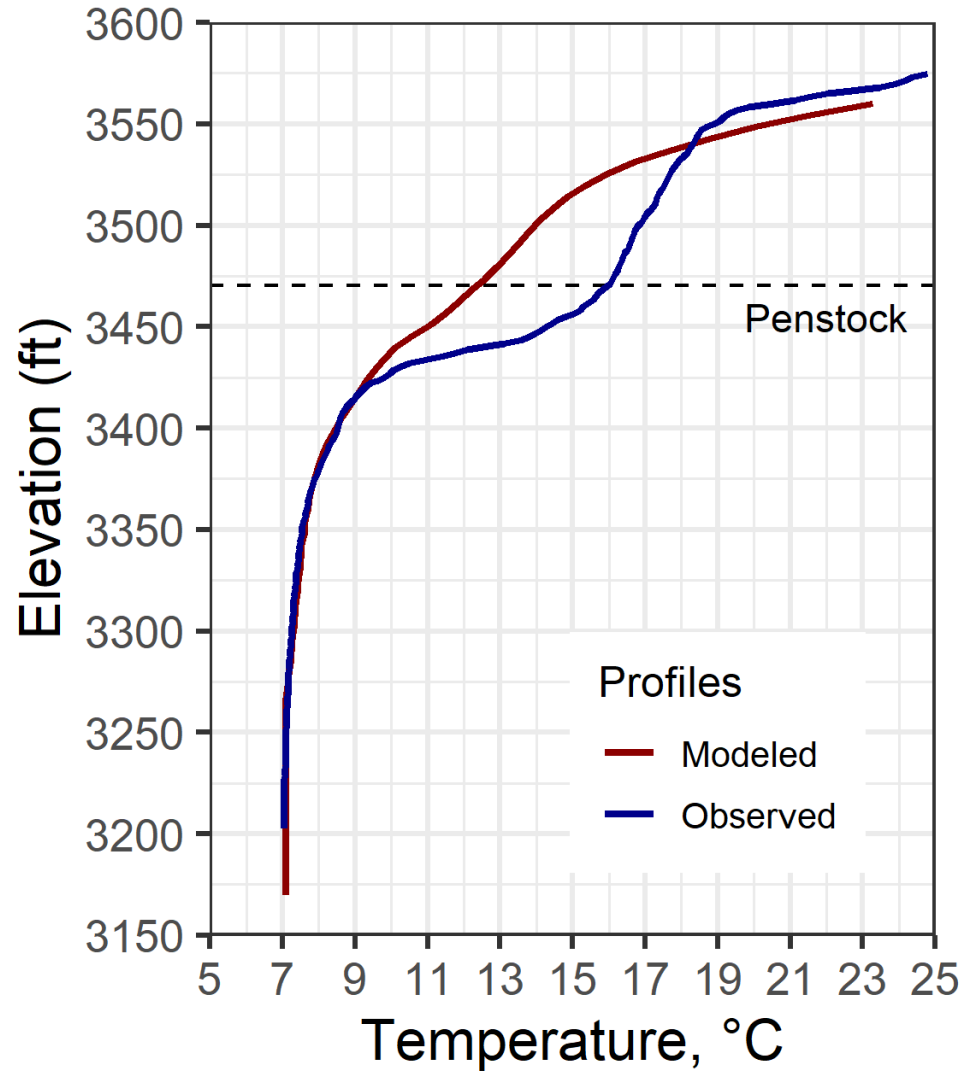






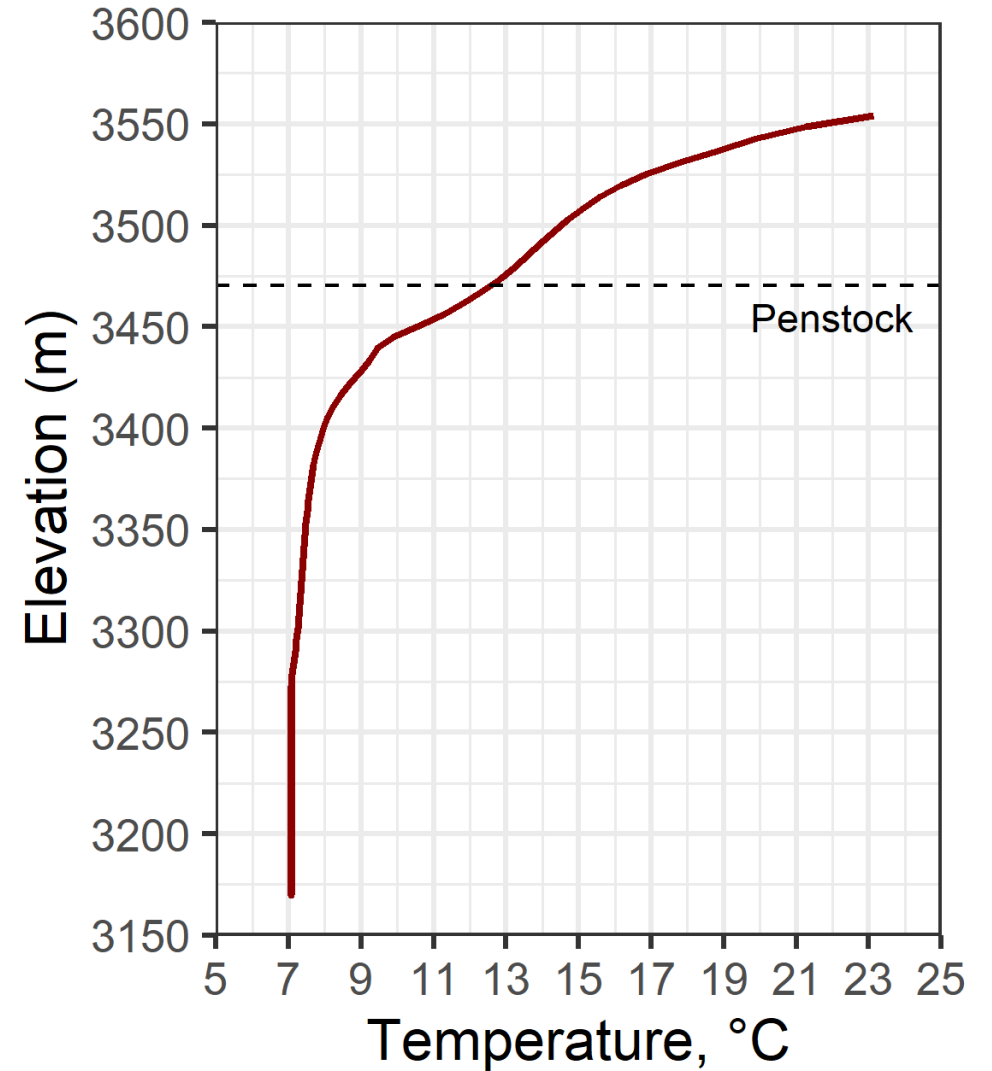
# Latest Profile Comparison

July 12, 2023



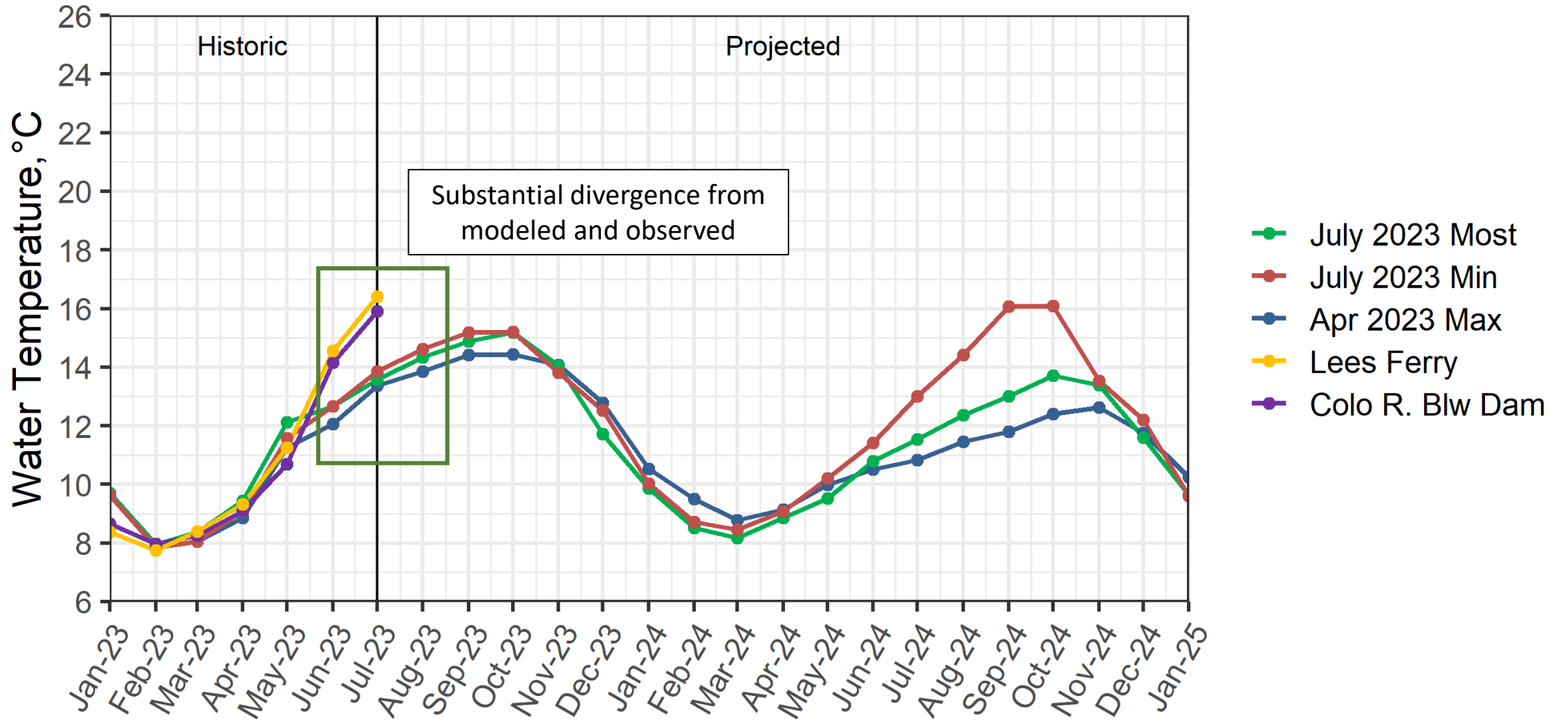
# Powell Forebay

July 18, 2023



# Lake Powell Release Temperature

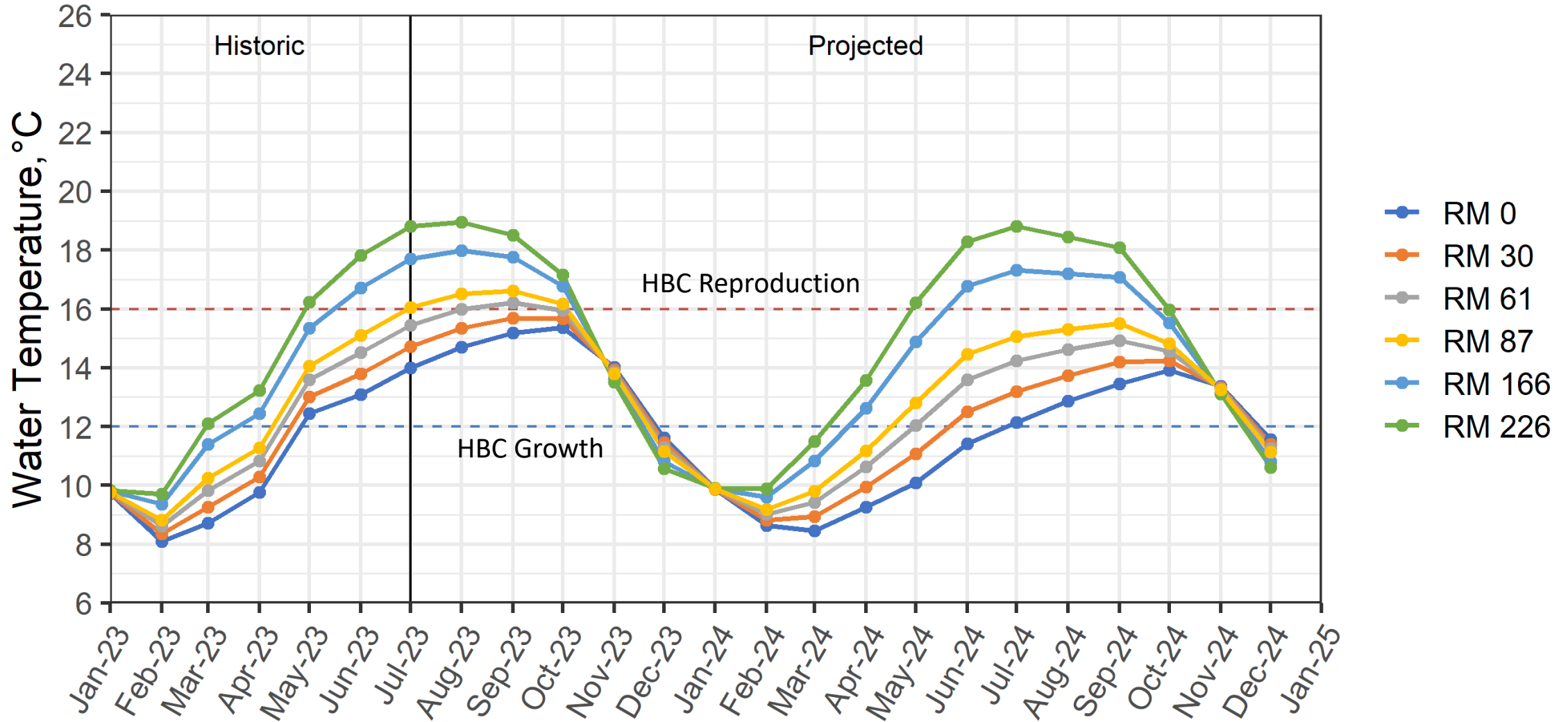
Projected Temperature based on July 2023 Forecast





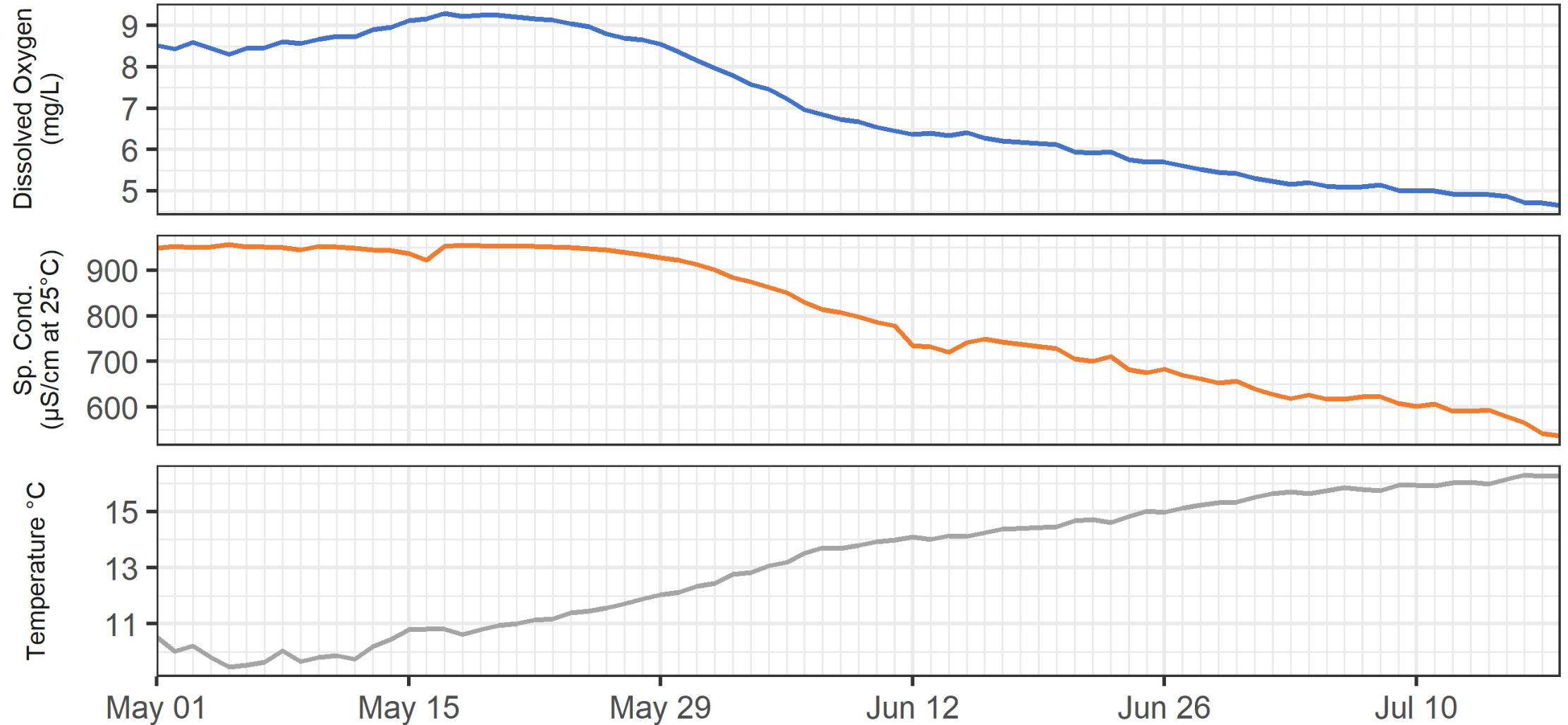
# Colorado River Grand Canyon Water Temperature

## Projected Temperature based on July 2023 Forecast

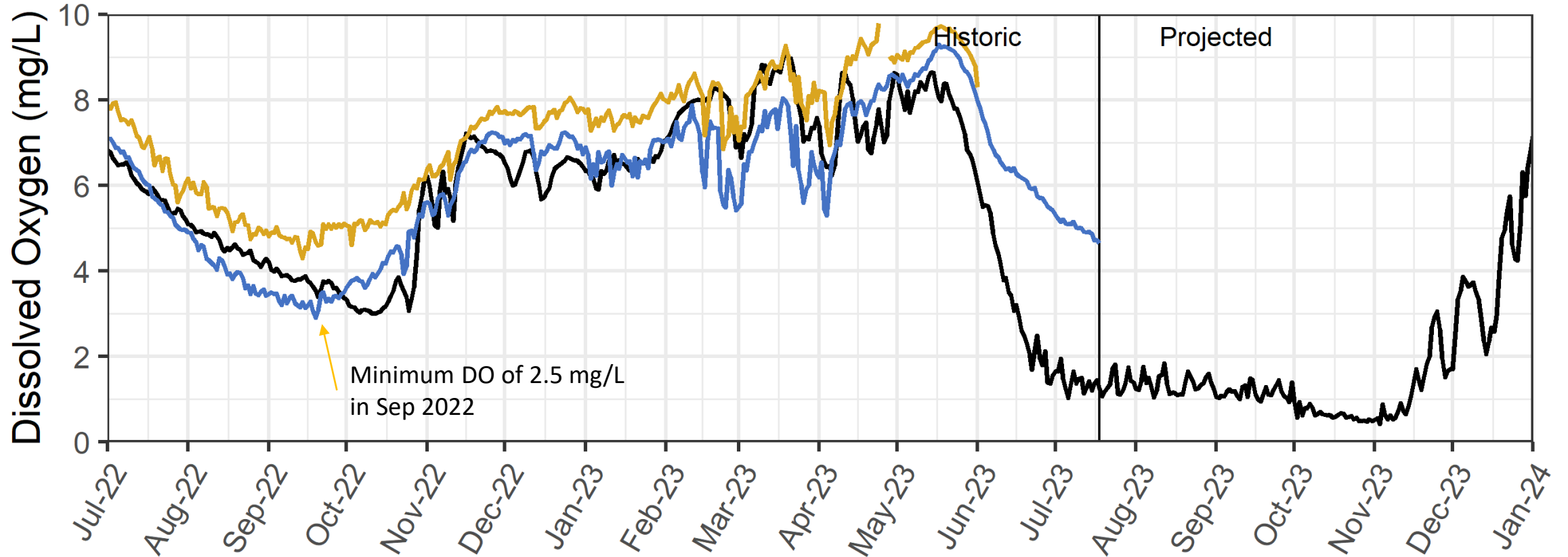


# Observed Water Quality at Glen Canyon Dam

These data are preliminary or provisional and subject to revision



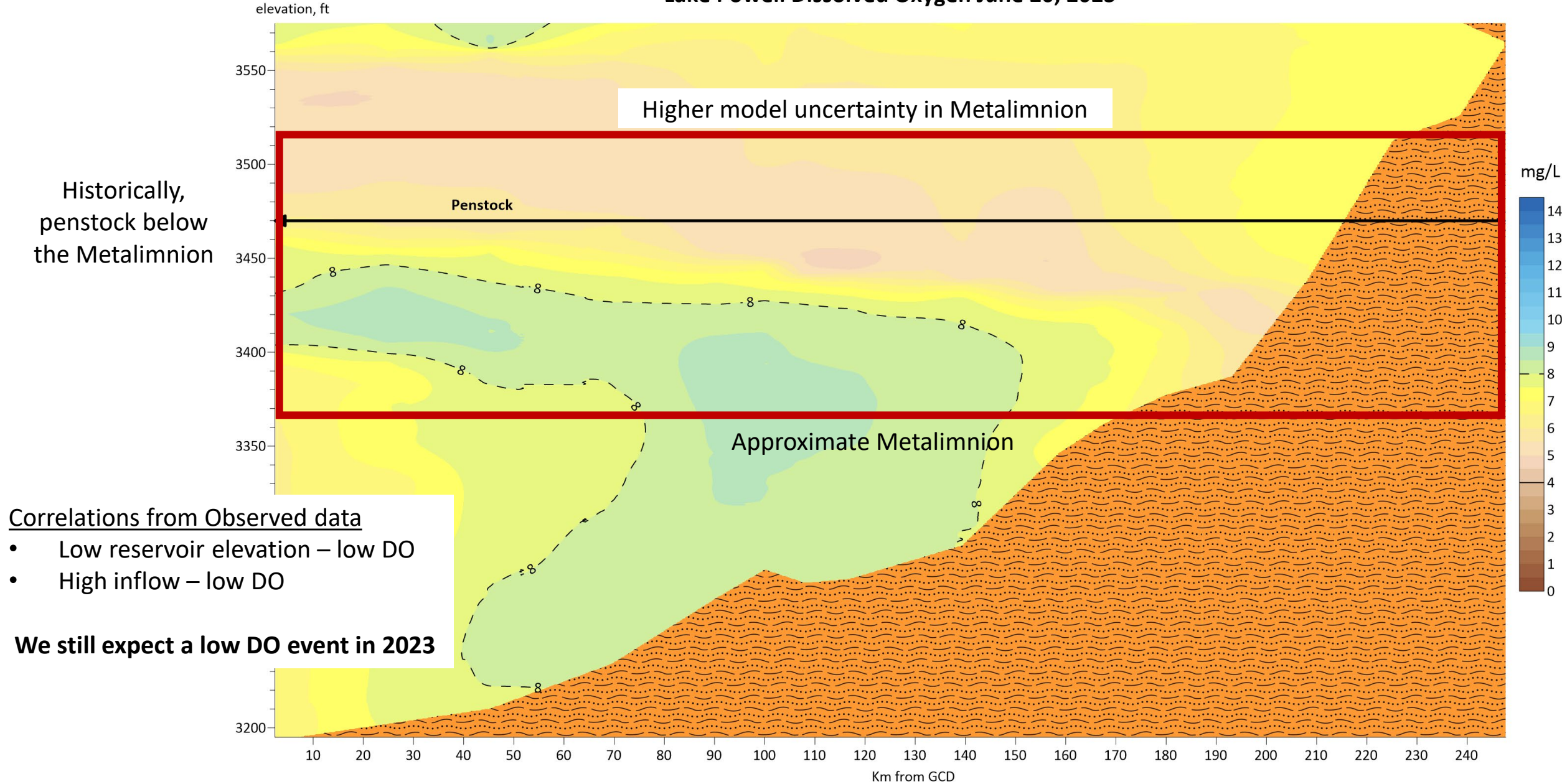
# Dissolved Oxygen at Glen Canyon Dam



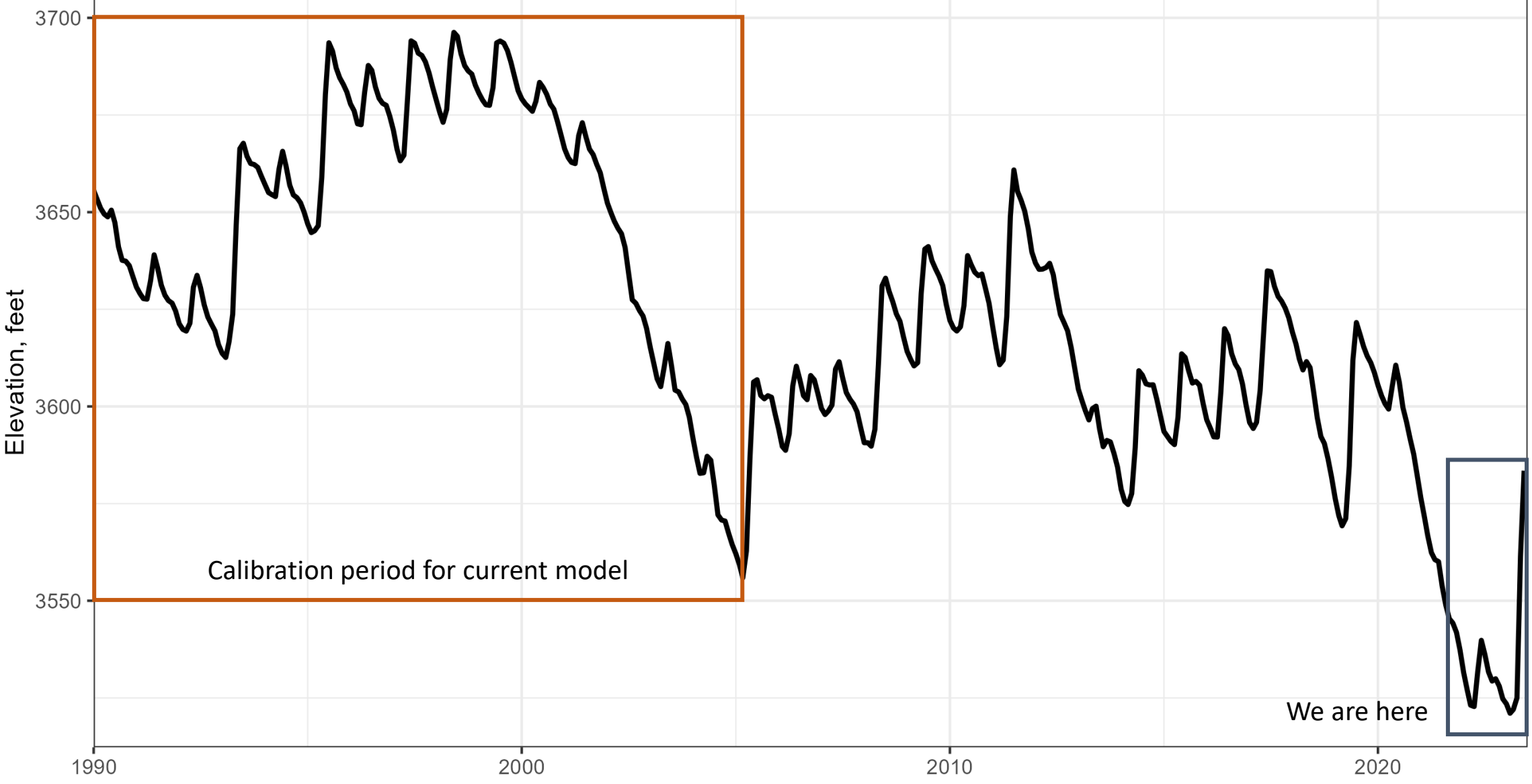
- Modeled using July 2023 24-Month Most Probable Hydrology
- Observed at Glen Canyon Dam
- Observed at Lees Ferry

# Understanding CE-QUAL results vs observed

## Lake Powell Dissolved Oxygen June 20, 2023



Lake Powell Reservoir Elevation 1990-2023





# Questions?



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