



— BUREAU OF —  
RECLAMATION

# Glen Canyon Monthly Operations Call

## Basin Hydrology and Operations

July 20, 2022

# 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.”

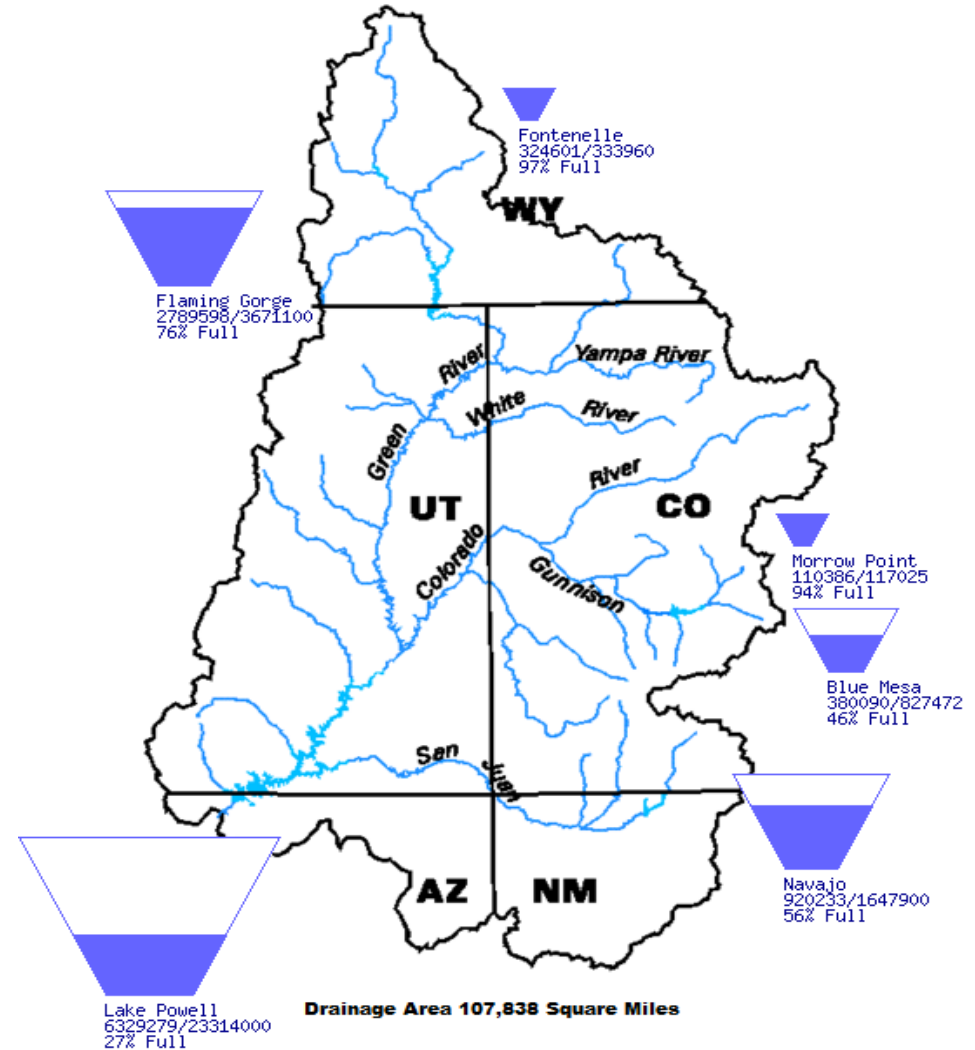


# Upper Basin Storage (as of July 18, 2022)

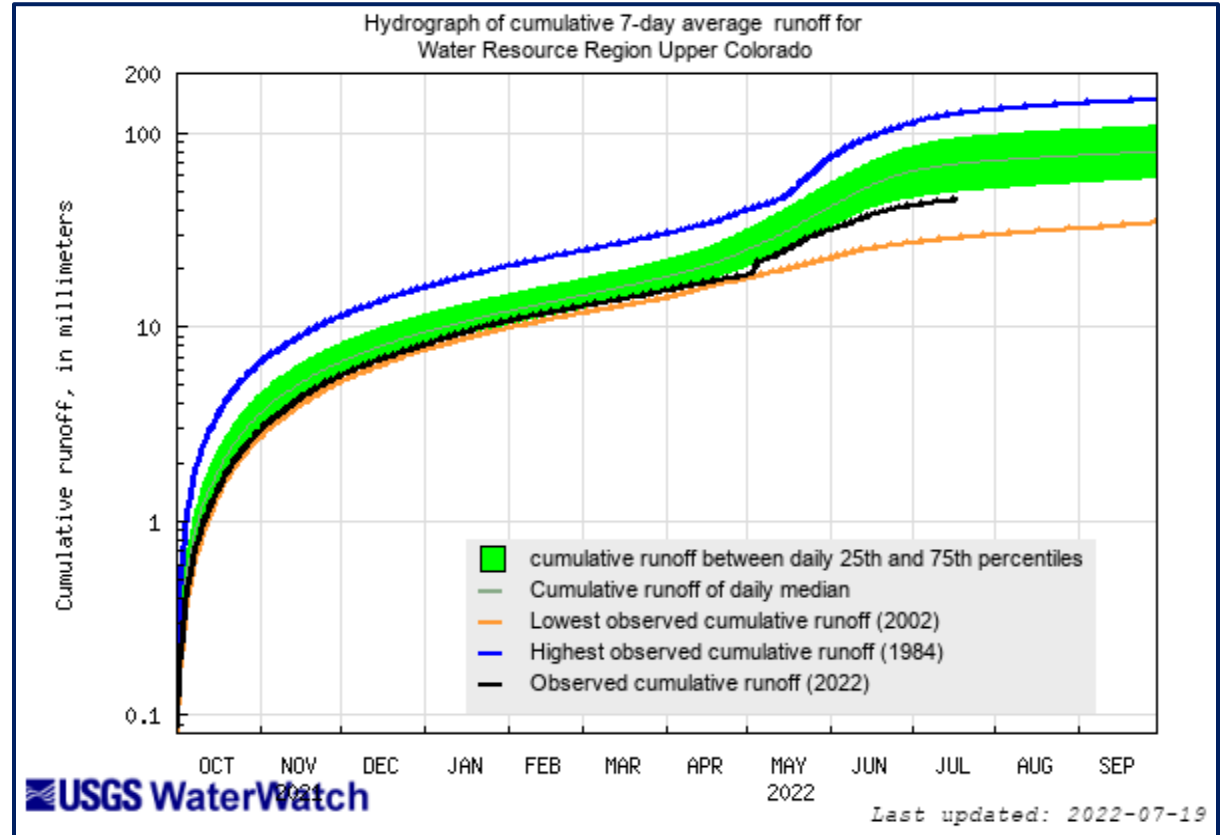
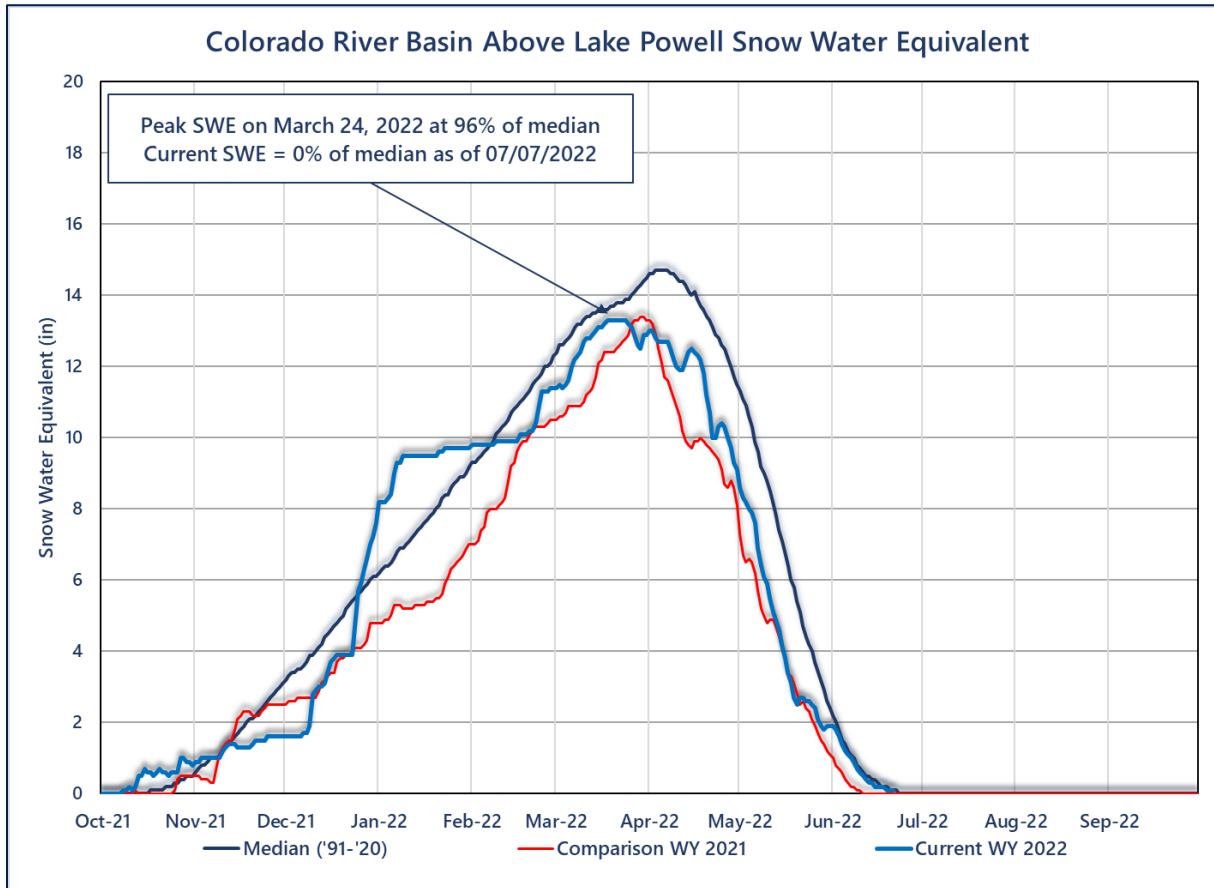
Data Current as of:  
07/18/2022

## Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	97	0.32	0.33	6,504.80
Flaming Gorge	76	2.79	3.67	6,016.39
Blue Mesa	46	0.38	0.83	7,462.09
Navajo	57	0.92	1.65	6,025.89
Lake Powell	27	6.33	23.31	3,538.09
UC System Storage	36	10.87	29.93	



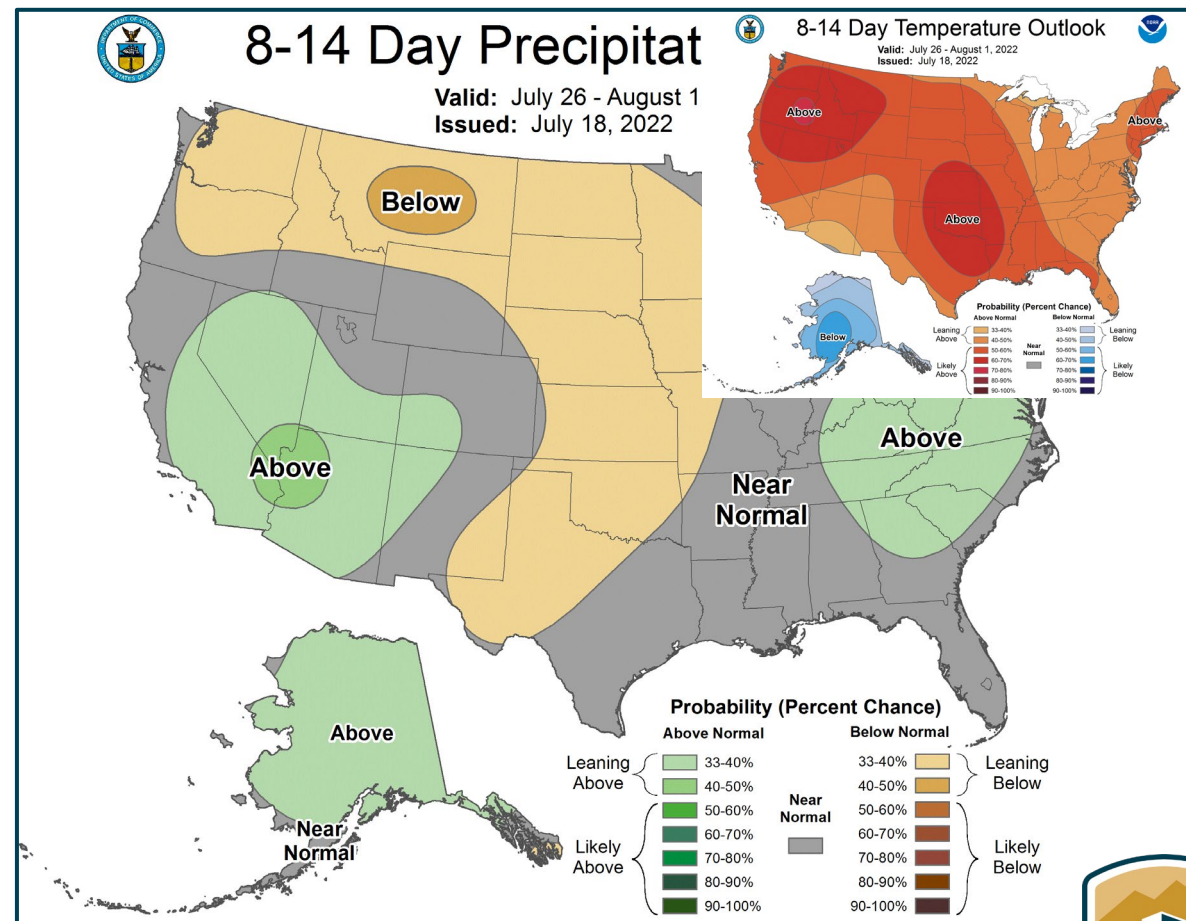
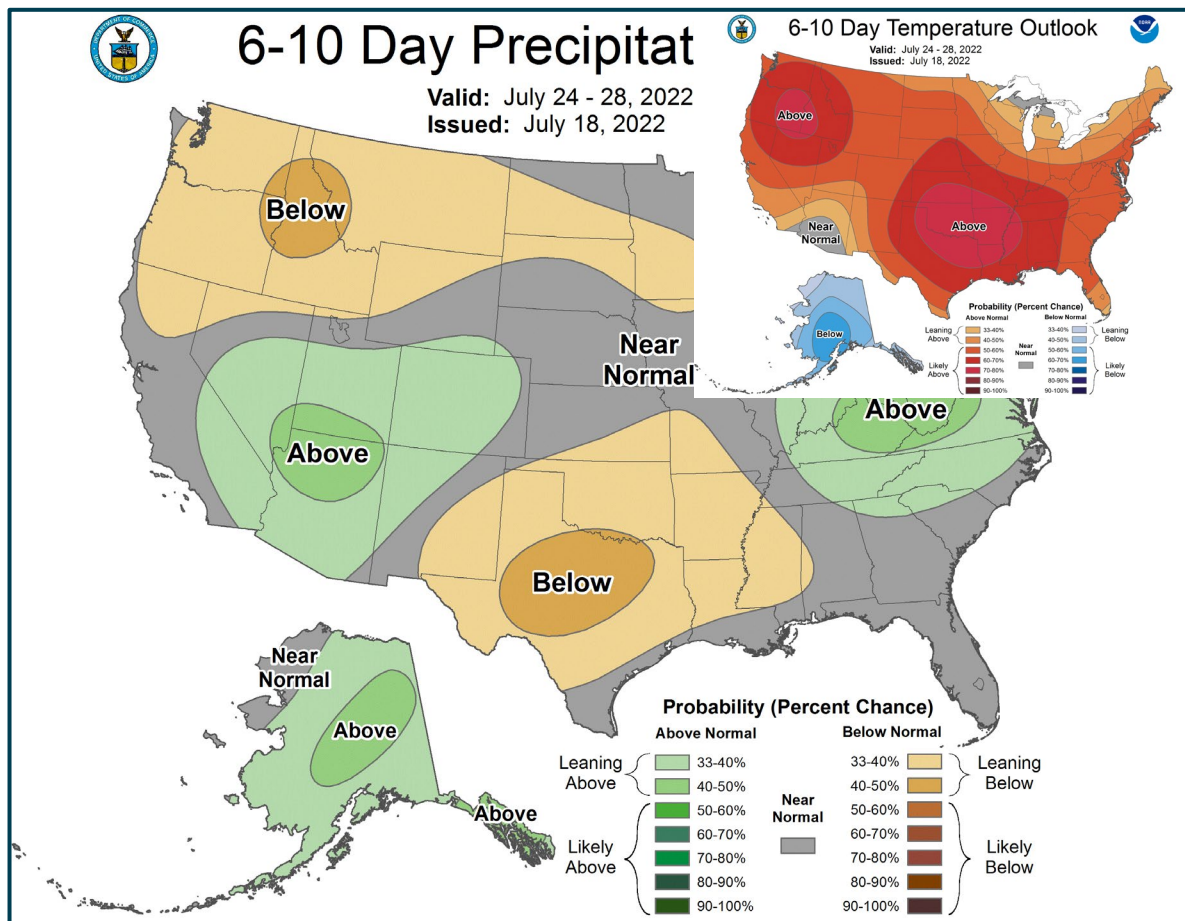
# Upper Colorado SWE and Observed Inflows



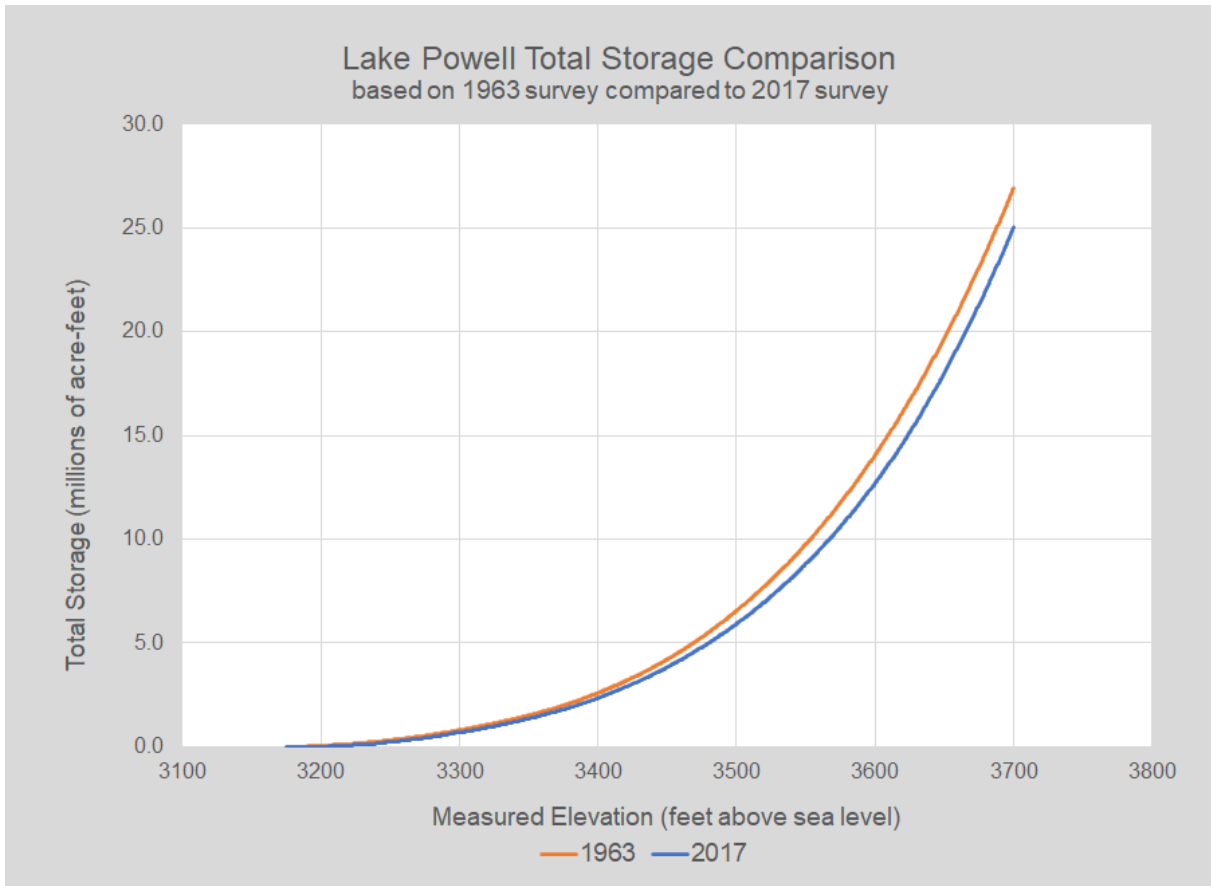
<https://waterwatch.usgs.gov/index.php>



# NOAA Precipitation Outlook Comparison



# 2017 Powell Elevation-Volume Relationship



- Reduced Reservoir Storage

Elevation (ft)	New 2017 Table Storage (kaf)	Old 1986 Table Storage (kaf)	Change in Volume (kaf)	% Change
3,700	23,314	24,322	-1,008	-4%
3,666	18,361	19,291	-930	-5%
3,575	8,901	9,517	-616	-6%
3,539.78	6,435	6,878	-443	-6%
3,525	5,545	5,927	-382	-6%
3,490	3,743	3,997	-254	-6%

- *Powell is a "Skinnier Bucket"*

# Bathymetric Sensitivity Analysis Summary

- The bathymetry change results in less Powell storage, where change in volume varies by elevation
- Generally, forecasting higher Powell and lower Mead elevation and storage
  - Except by 2026 where increased Powell storage results in higher balancing releases
- Bathymetry change effects differ for balancing verse tier determination.
  - Balancing and storage – reduced balancing releases from Powell due to less storage
  - Tier determination and lake elevations – move through tiers more quickly, less storage loss/gain required to change tiers
- Powell benefits from the 2022 Actions remain with the bathymetry update



# Most Probable July Forecast Water Year 2022

April – July 2022  
Forecasted Unregulated Inflow  
as of July 5, 2022

Reservoir	Unregulated Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	450	61
Flaming Gorge	540	56
Blue Mesa	425	67
Navajo	355	56
Powell	3,600	56

Mid-Month Forecast<sup>2</sup> = 3,690 kaf (58%)

Water Year 2022  
Forecasted Unregulated Inflow  
as of July 5, 2022

Reservoir	Unregulated Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	730	68
Flaming Gorge	878	62
Blue Mesa	634	70
Navajo	514	56
Powell	5,736	60

Mid-Month Forecast<sup>2</sup> = 5,826 kaf (61%)

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

<sup>2</sup>Mid-Month Forecast dated July 18, 2022

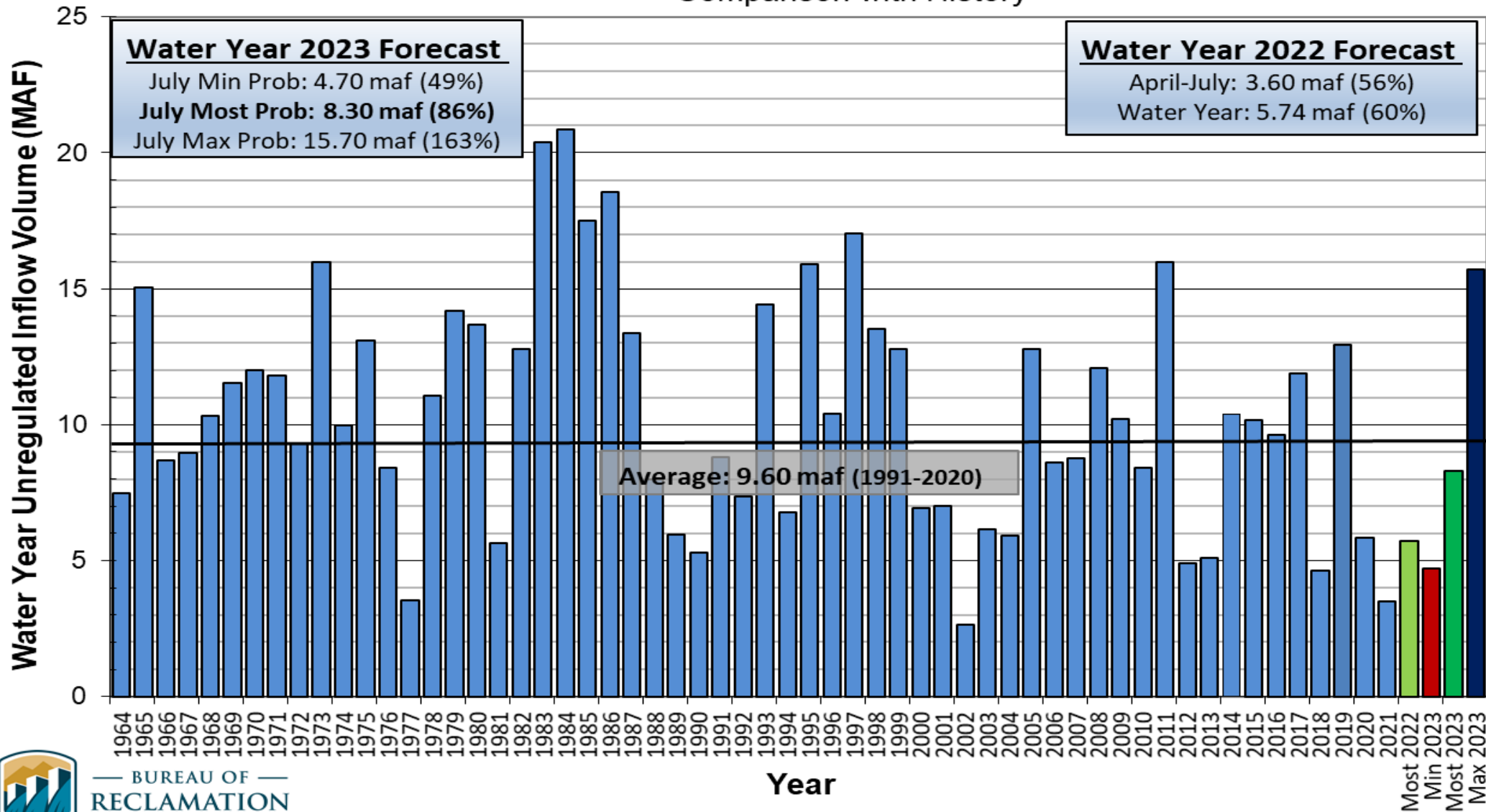




# Lake Powell Unregulated Inflow

## Water Year 2022 and 2023 Forecast *(issued July 5)*

### Comparison with History



BUREAU OF RECLAMATION





# Upper Colorado Basin

Projected Operations  
for Water Years 2022  
and 2023 Based on and  
July 2022 Modeling



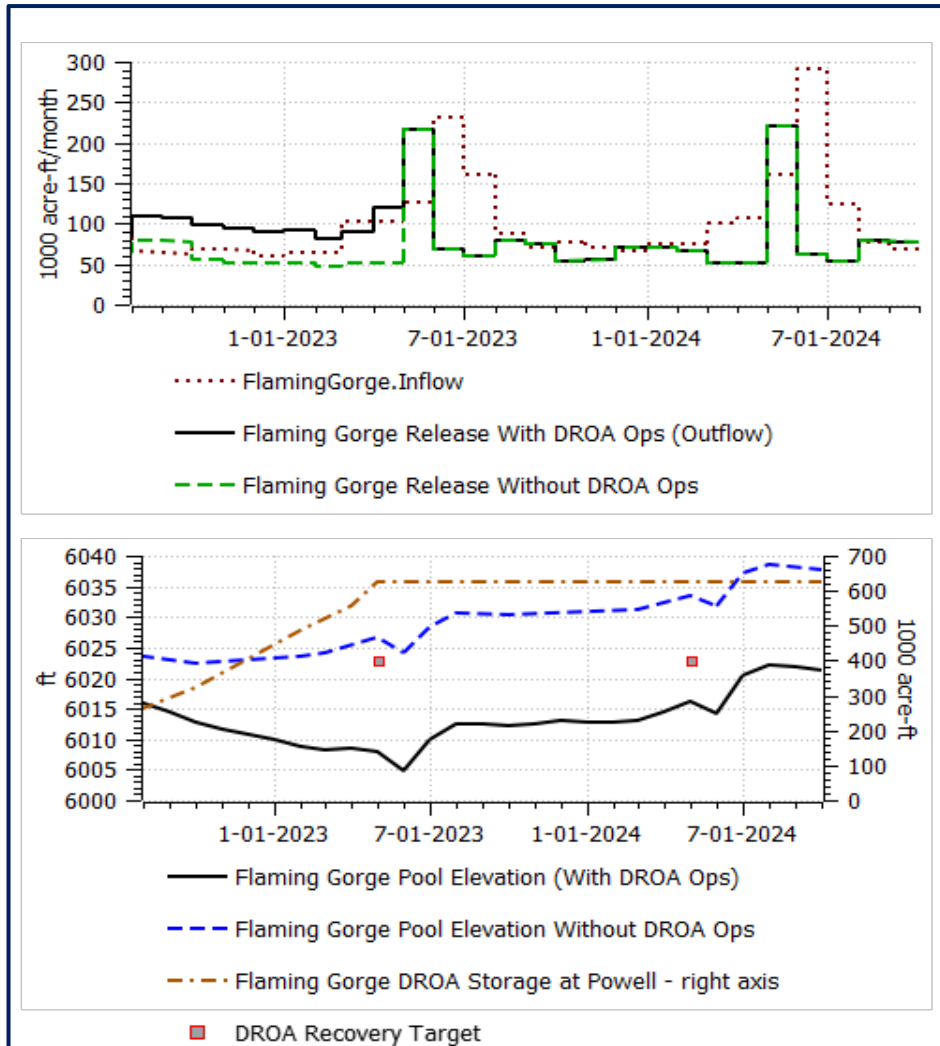
# Upper Basin Drought Response Actions

- The Bureau of Reclamation announced on May 3, 2022, two separate urgent drought response actions that will help prop up Lake Powell by nearly 1 million acre-feet (maf) of water over the next 12 months (May 2022 through April 2023). To protect Lake Powell, more water will flow into the lake from upstream reservoirs and less water will be released downstream:
  - Under a Drought Contingency Plan adopted in 2022, approximately 500 thousand acre-feet (kaf) of water will come from Flaming Gorge Reservoir, located approximately 455 river miles upstream of Lake Powell (2022 Plan).
    - For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220429-2022DroughtResponseOperationsPlan-ApprovalMemo-508-DOI.pdf>.
  - Another 480 kaf will be left in Lake Powell by reducing Glen Canyon Dam's annual release volume from 7.48 maf to 7.00 maf (GC Operational Adjustment), in accordance with Sections 6 and 7.D of the 2007 Interim Guidelines.
    - For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf>

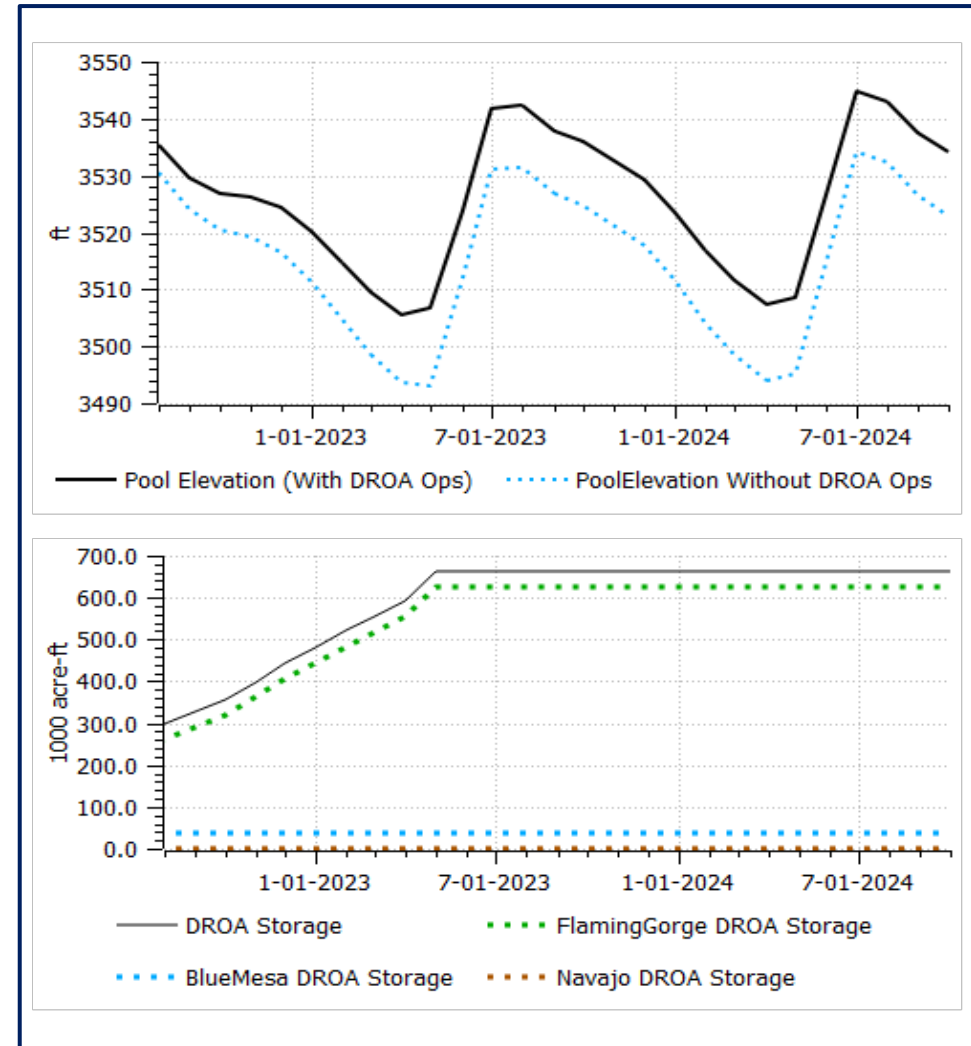


# July 2022 24MS 2022 Plan Operations

## Flaming Gorge Operations

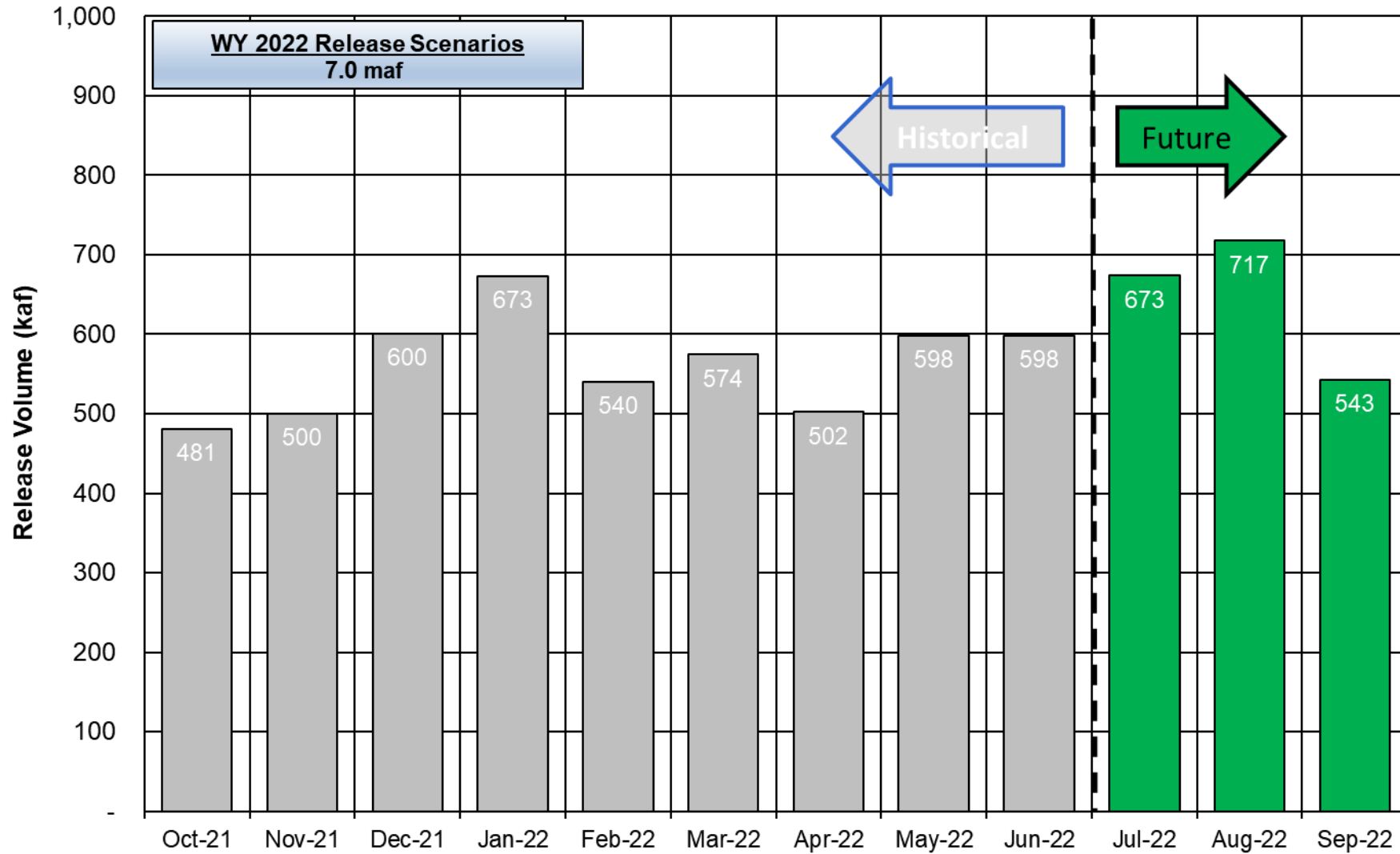


## Lake Powell Operations



# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2022



BUREAU OF RECLAMATION

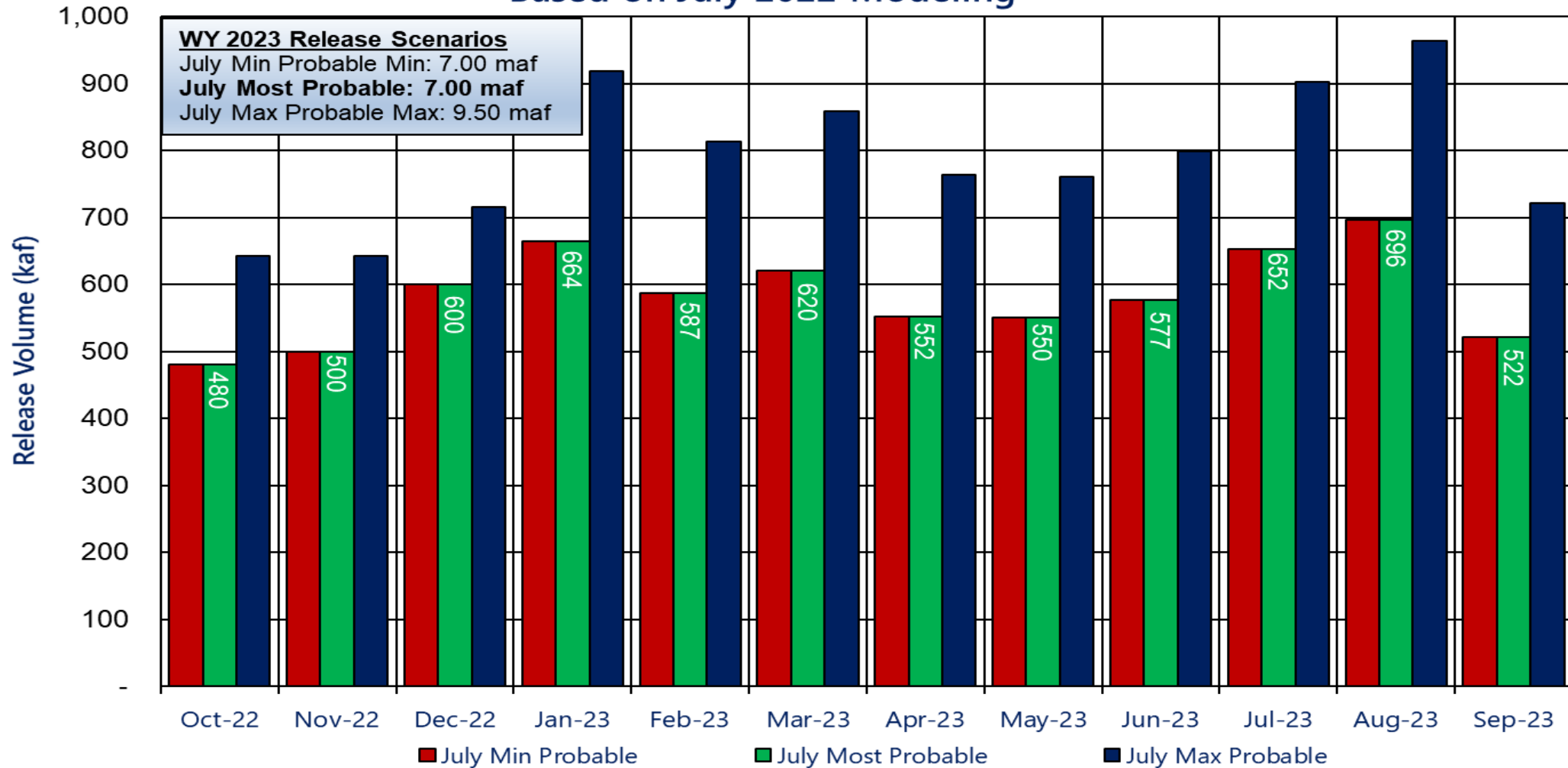
The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2023

### Based on July 2022 Modeling



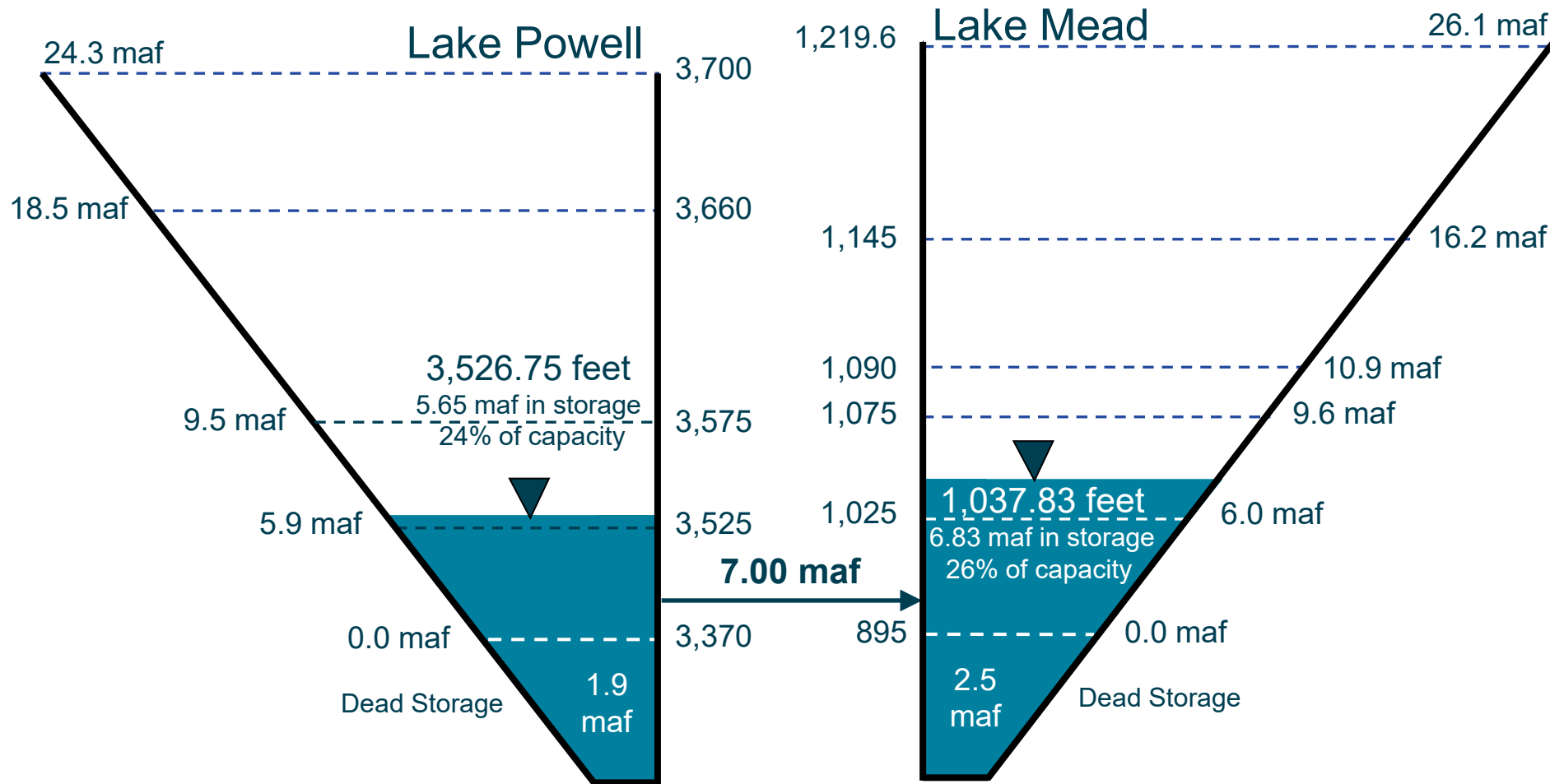
The operating determination for upcoming years will be based on a projected “tier” elevation in the August 2022 24-Month Study. Based on July 2022 24-Month Study modeling, Lake Powell’s operating condition for water year 2023 is projected to be within the Lower Elevation Balancing Tier. The Department of Interior and Reclamation will work with the Basin States to determine the manner in which to operate Glen Canyon Dam to ensure the benefits of the drought actions are preserved.



# End of Water Year 2022 Projections

## July 2022 24-Month Study Most Probable Inflow Scenario<sup>1, 2</sup>

Based on a Lake Powell Unregulated Inflow Forecast of 5.74 maf (60% of average)



Not to Scale

<sup>1</sup> WY 2022 unregulated inflow into Lake Powell is based on the CBRFC forecast dated 6/3/22.

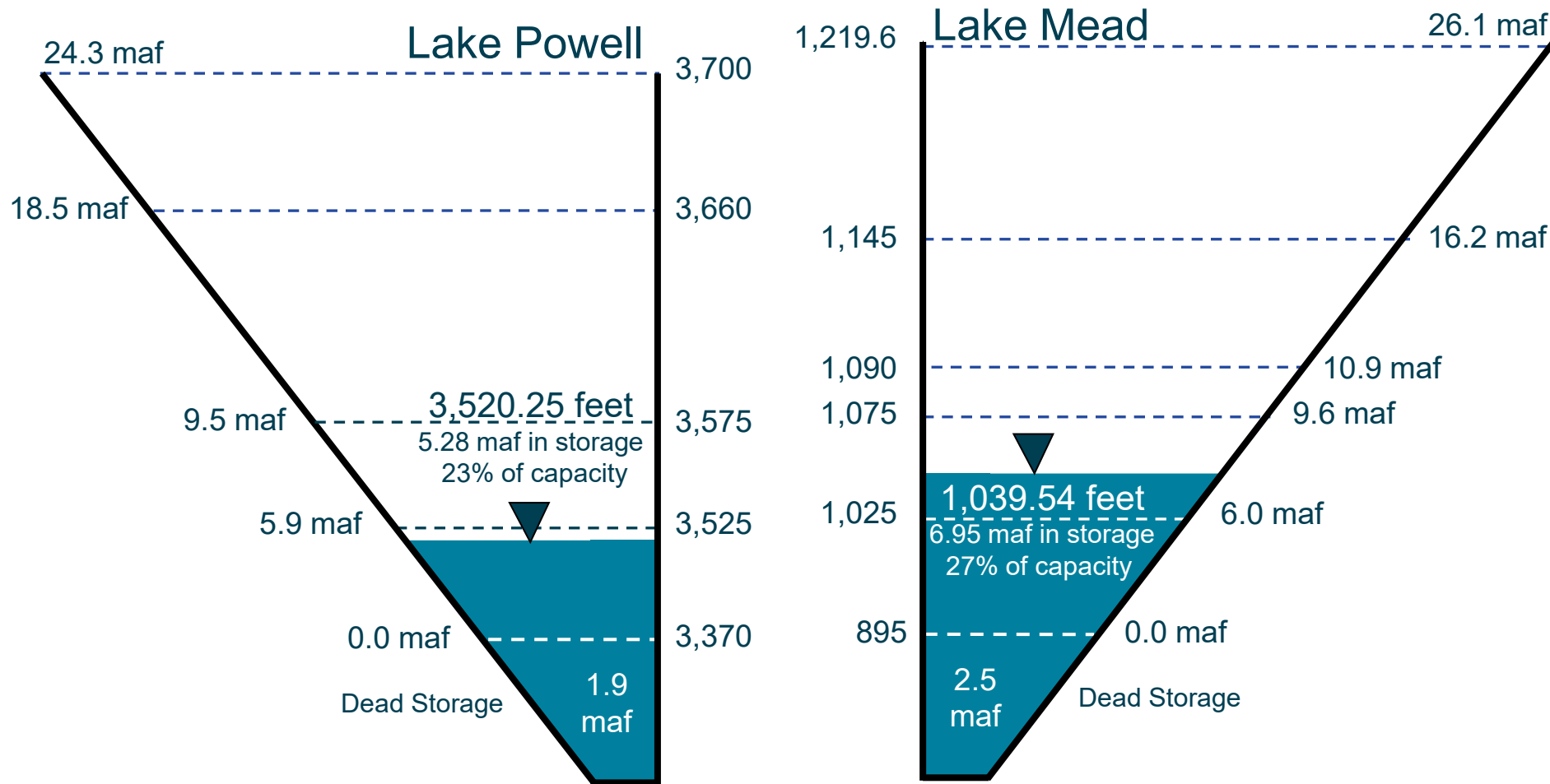
<sup>2</sup> The teacup diagram displays projected "physical" elevations and storages for Lake Powell and Lake Mead.



# End of Calendar Year 2022 Projections

July 2022 24-Month Study Most Probable Inflow Scenario<sup>1, 2</sup>

*Based on a Lake Powell release of 7.00 maf in WY 2022 and 7.05 maf in WY 2023*



Not to Scale

<sup>1</sup> WY 2022 & WY 2023 unregulated inflow into Lake Powell is based on the CBRFC forecast dated 6/3/22.

<sup>2</sup> The teacup diagram displays projected “physical” elevations and storages for Lake Powell and Lake Mead. The operating determinations for upcoming years, however, will be determined by projected “effective” elevations. Based on June 2022 24-Month Study modeling, the effective elevations for end of calendar year 2022 for Lake Powell is 3,511.37 feet and 1,045.95 feet for Lake Mead.



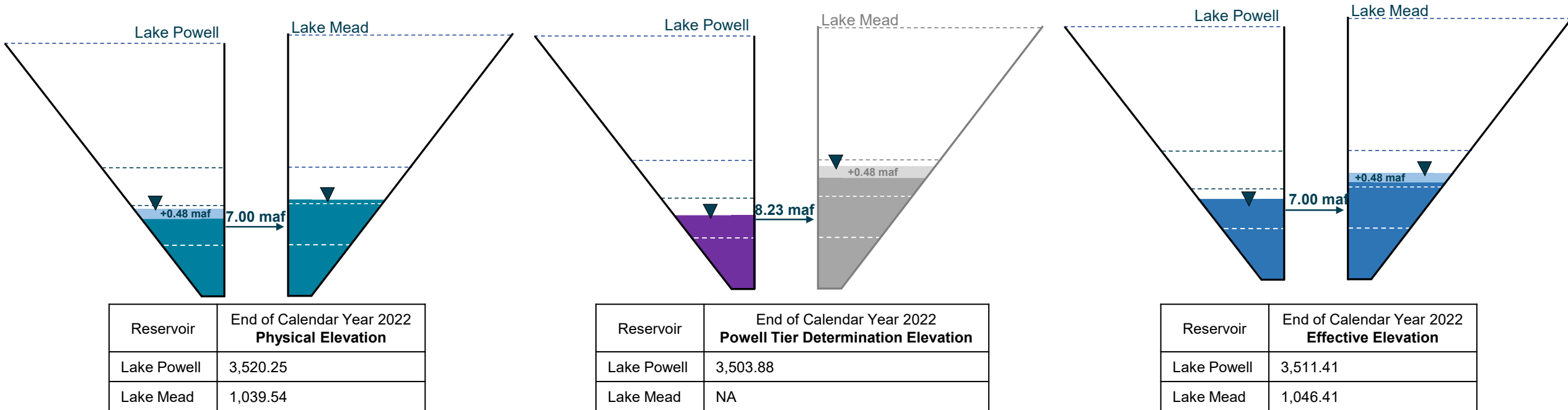


# End of Calendar Year 2022 Lake Powell and Lake Mead Elevations Based on July 2022 24-Month Study<sup>1,2,3</sup>

**Physical Elevations:** Real-time or projected elevations based on a 7.00 maf release from Lake Powell in WY 2022 and 7.00 maf in WY 2023.

**Powell Tier Determination:** Projected elevation “as if” the additional 0.48 maf were released from Powell in WY 2022 and with an 8.23 maf WY 2023 Powell release.

**Effective Elevation & Mead Operating Condition Determination:** Projected elevation “as if” the additional 0.48 maf were released from Powell in WY 2022, with an adjusted WY 2023 Powell release of 7.00 maf.



<sup>1</sup> For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf>.

<sup>2</sup> Both the Powell Tier Determination and Effective Elevations are “as if” the additional 0.48 maf were released from Powell in WY 2022. Powell’s Tier Determination elevation is used to set the WY 2023 operating tier. For Mead, the Effective Elevation is used to set the CY 2023 operating condition. The Department of Interior and Reclamation will work to determine the

<sup>23</sup> manner in which to operate Glen Canyon Dam to ensure the benefits of these actions are preserved.

<sup>3</sup> Images are **not** to scale.

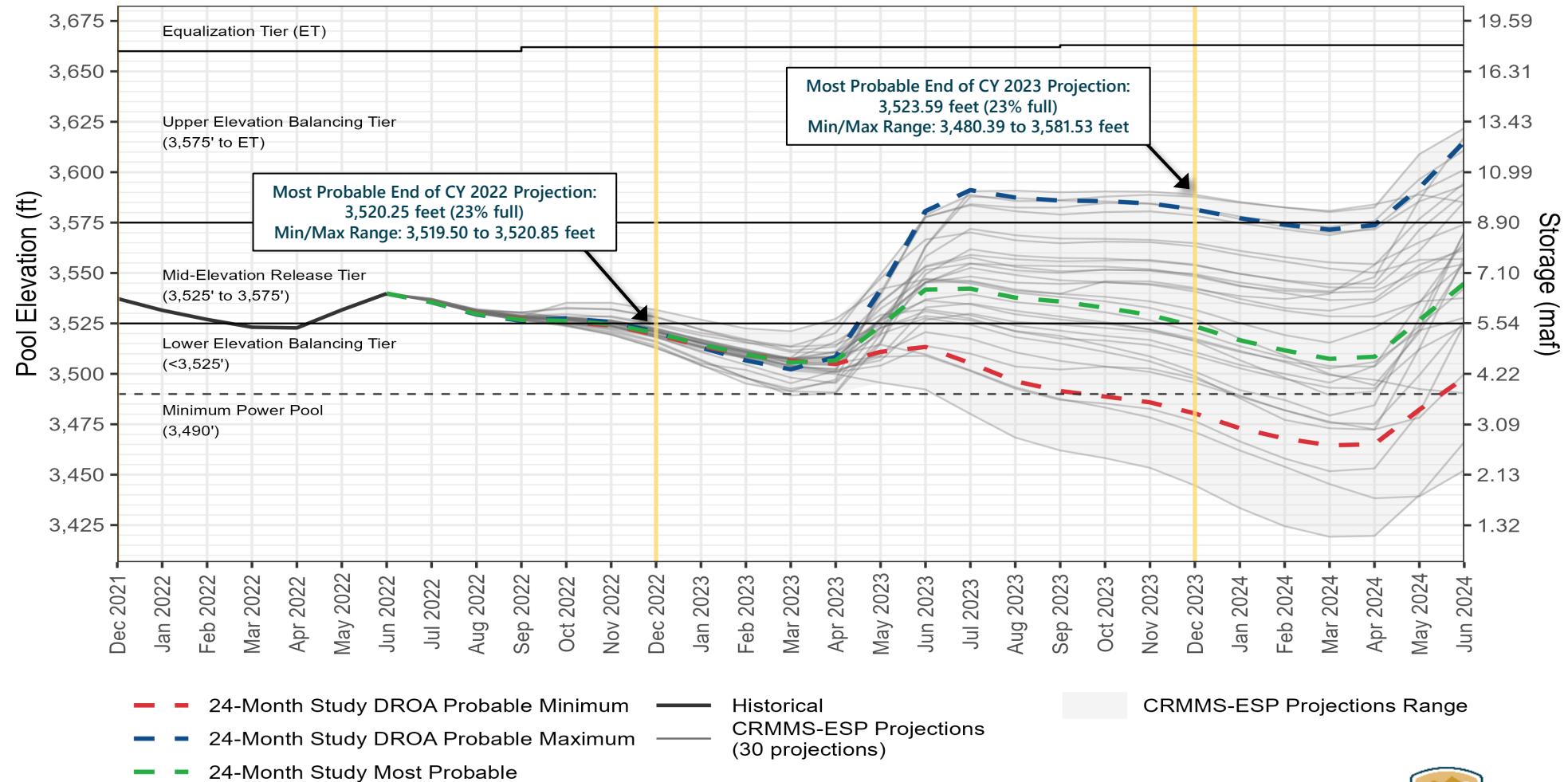


# Reclamation Operational Modeling Model Comparison

	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<sup>1</sup> CRMMS Projections from July 2022

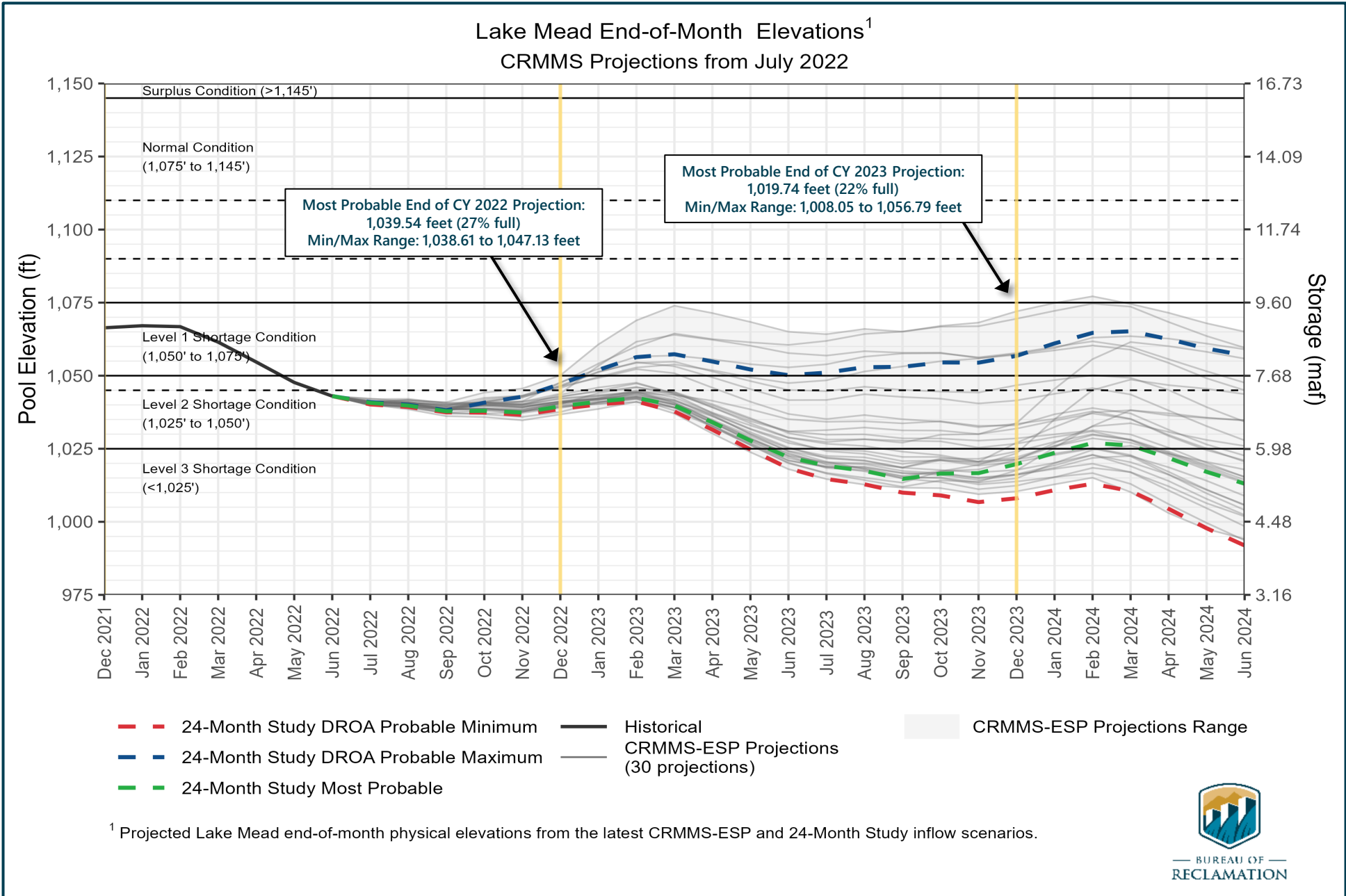


<sup>1</sup> Projected Lake Powell end-of-month physical elevations from the latest CRMMS-ESP and 24-Month Study inflow scenarios.



BUREAU OF RECLAMATION

The chart above displays projected “physical” elevations for Lake Powell. The operating determination for upcoming years, however, will be based on a projected “tier” elevation in the August 2022 24-Month Study. Based on July 2022 24-Month Study modeling, Lake Powell’s operating condition for water year 2023 is projected to be within the Lower Elevation Balancing Tier. The Department of Interior and Reclamation will work to determine the manner in which to operate Glen Canyon Dam to ensure the benefits of the drought actions are preserved.



The chart above displays projected “physical” elevations for Lake Mead. The operating determination for upcoming years, however, will be based on a projected “effective” elevation in the August 2022 24-Month Study. Based on July 2022 24-Month Study modeling, Lake Mead’s operating condition for calendar year 2023 is projected to be within the 1,045 – 1,050 elevation band.



# Upper Colorado Basin

## Hydropower Maintenance



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2022

Unit Number	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	
1					■								
2													
3													
4													
5							■						
6							■						
7	■												
8	■												
Units Available	6	6	6	6	5	4	6	6	6	6	6	6	
Capacity (cfs)	18,700	18,600	11,700	18,700	14,800	11,300	17,900	14,900	18,500	18,400	18,200	18,100	JUL MOST <sup>2</sup>
Capacity (kaf/month)	1,150	1,110	1,110	1,160	810	980	1,000	1,050	1,110	1,130	1,120	1,080	JUL MOST
Max (kaf) <sup>1</sup>	481	500	600	673	540	575	502	598	598	673	717	543	7.0 maf
Most (kaf) <sup>1</sup>	481	500	600	673	540	575	502	598	598	673	717	543	7.0 maf
Min (kaf) <sup>1</sup>	481	500	600	673	540	575	502	598	598	673	717	542	7.0 maf
										(updated 07-19-2022)			

1 Projected release, based on July 2022 minimum, most and maximum 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 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	5	6	6	6	6	6	6	6	6	6	6	4
Capacity (cfs)	14,750	18,000	17,890	17,690	17,500	17,360	17,390	18,000	18,600	18,620	18,480	11,620
Capacity (kaf/month)	940	1,070	1,100	1,090	950	990	1,020	1,100	1,100	1,140	1,130	750
Max (kaf) <sup>1</sup>	643	642	715	919	813	858	764	761	798	902	963	722
Most (kaf) <sup>1</sup>	480	500	600	664	587	620	552	550	577	652	696	522
Min (kaf) <sup>1</sup>	480	500	600	664	587	620	552	550	577	652	696	522

JUL MOST<sup>2</sup>

JUL MOST

9.5 maf

7.0 maf

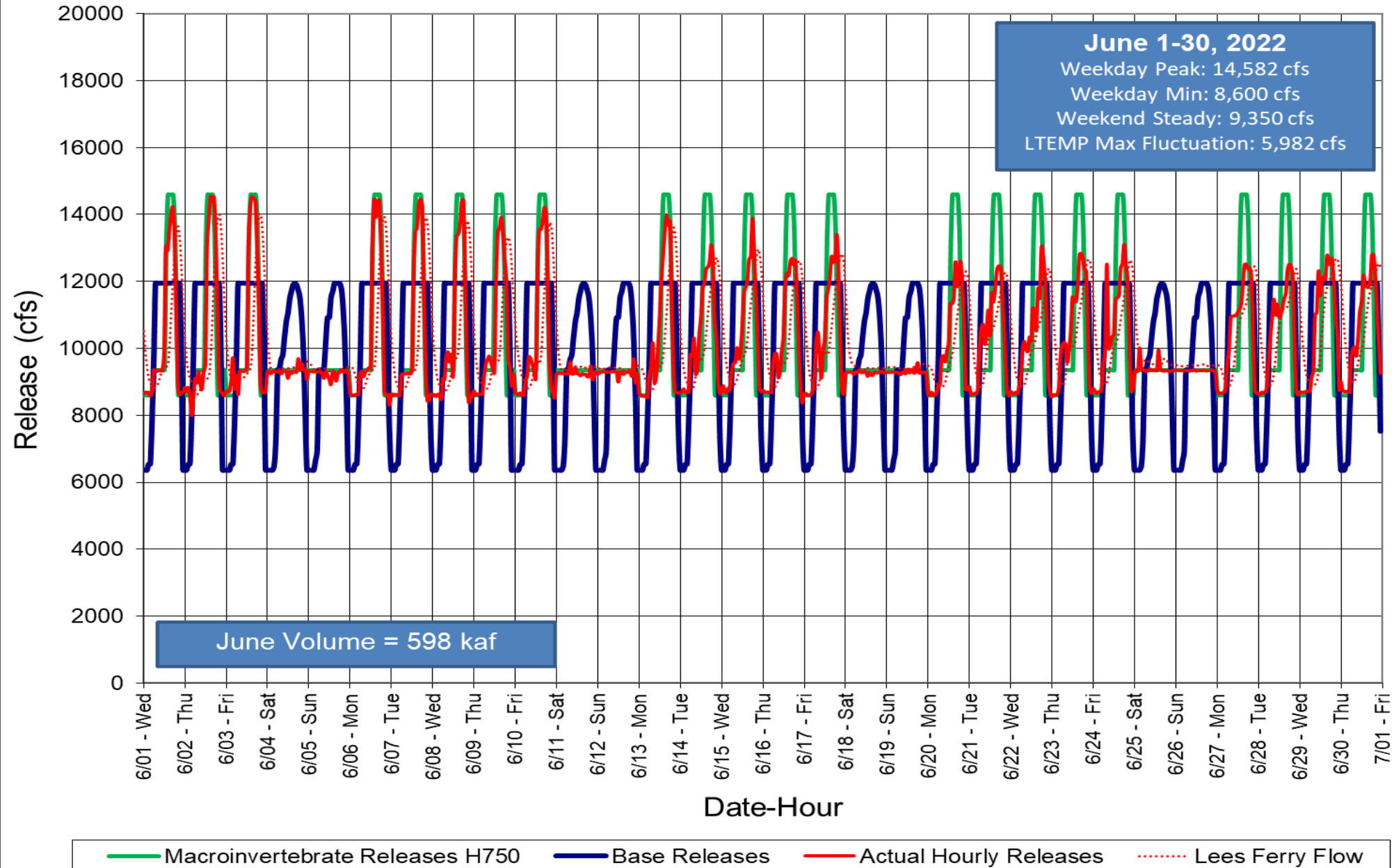
7.0 maf

(updated 07-19-2022)



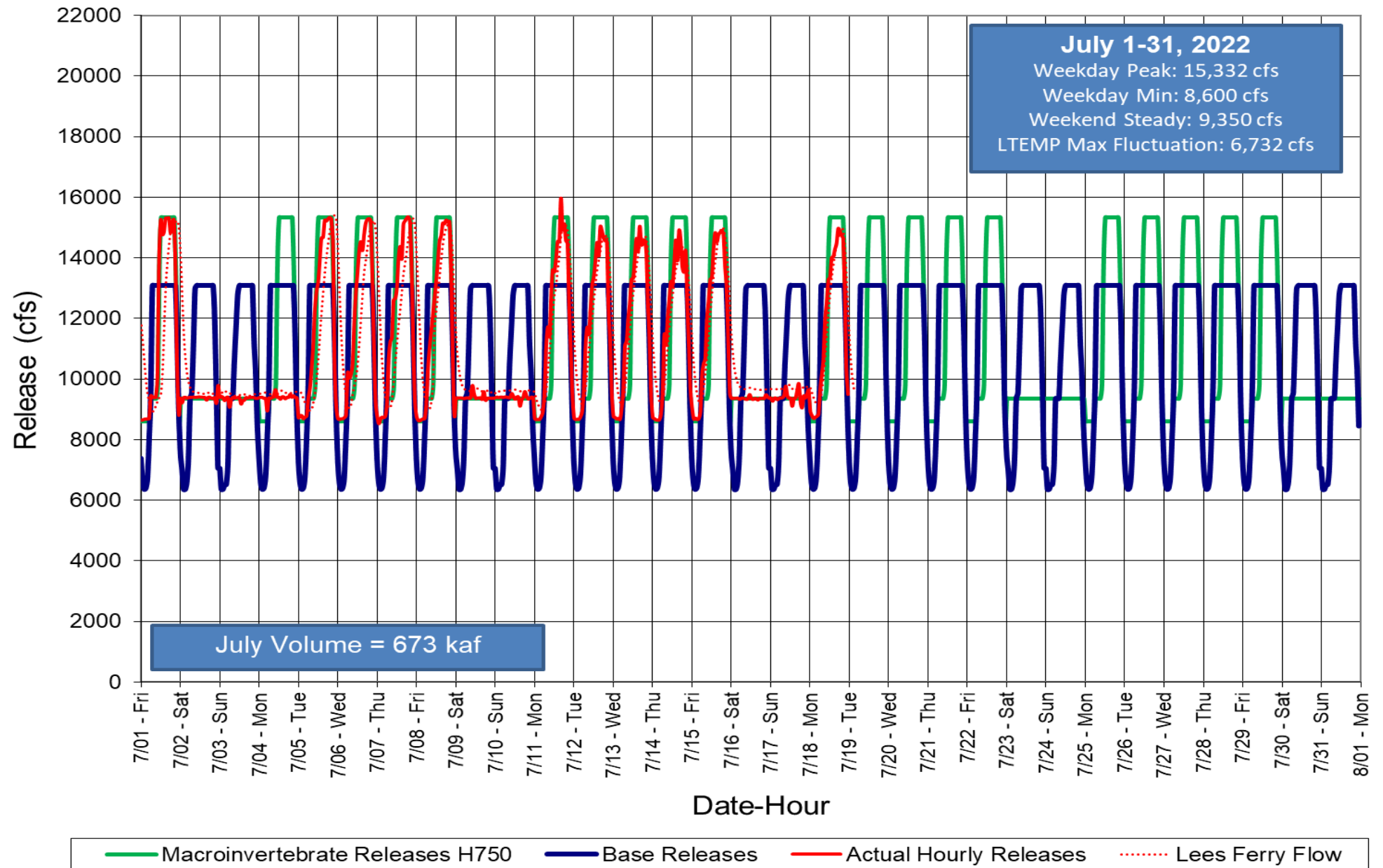
1 Projected release, based on July 2022 minimum, most and maximum probable Inflow Projections and 24-Month Study model runs.  
 2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.

# Glen Canyon Dam Hourly Release Pattern June 2022

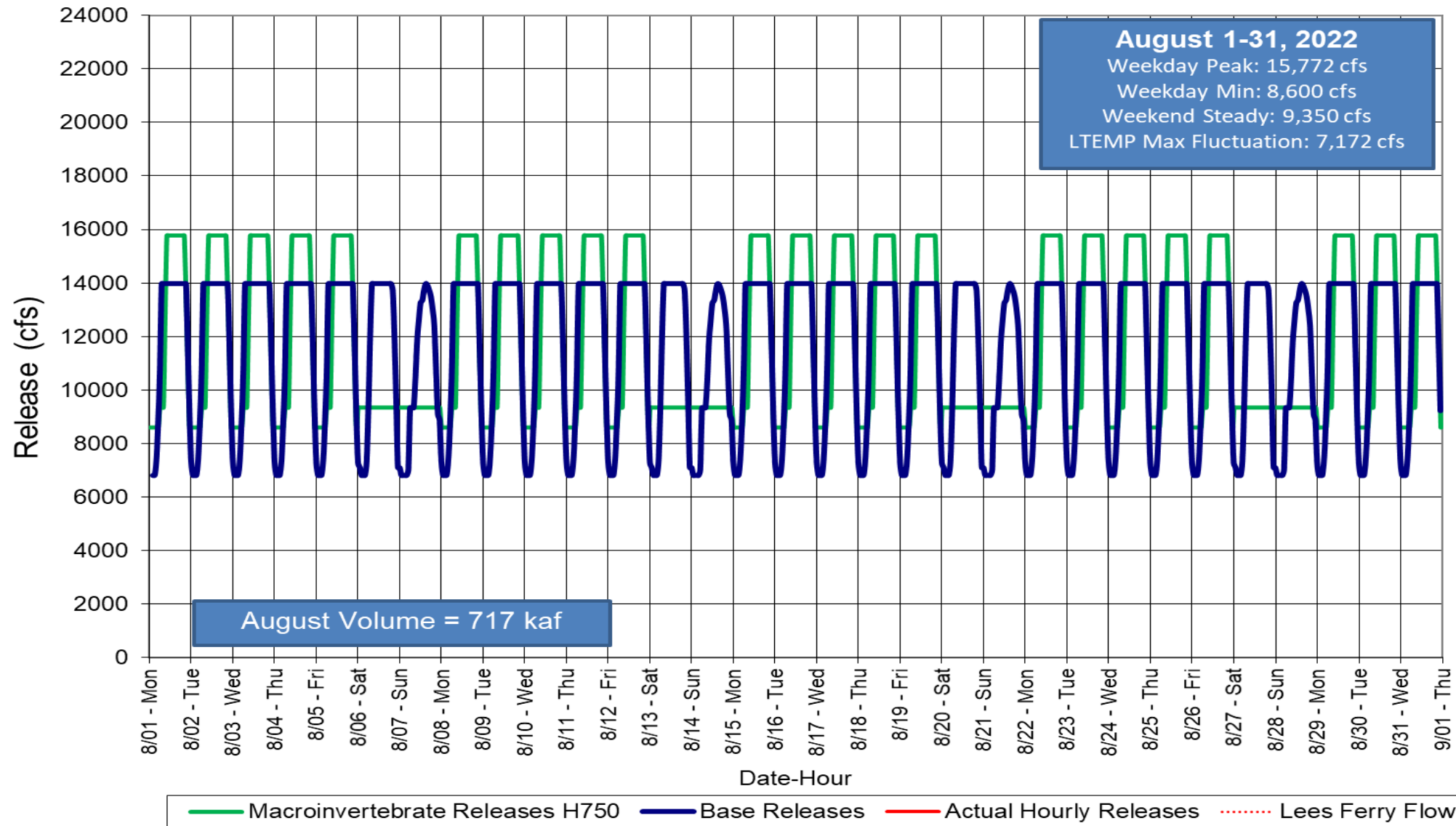




# Glen Canyon Dam Hourly Release Pattern July 2022



# Glen Canyon Dam Hourly Release Pattern August 2022

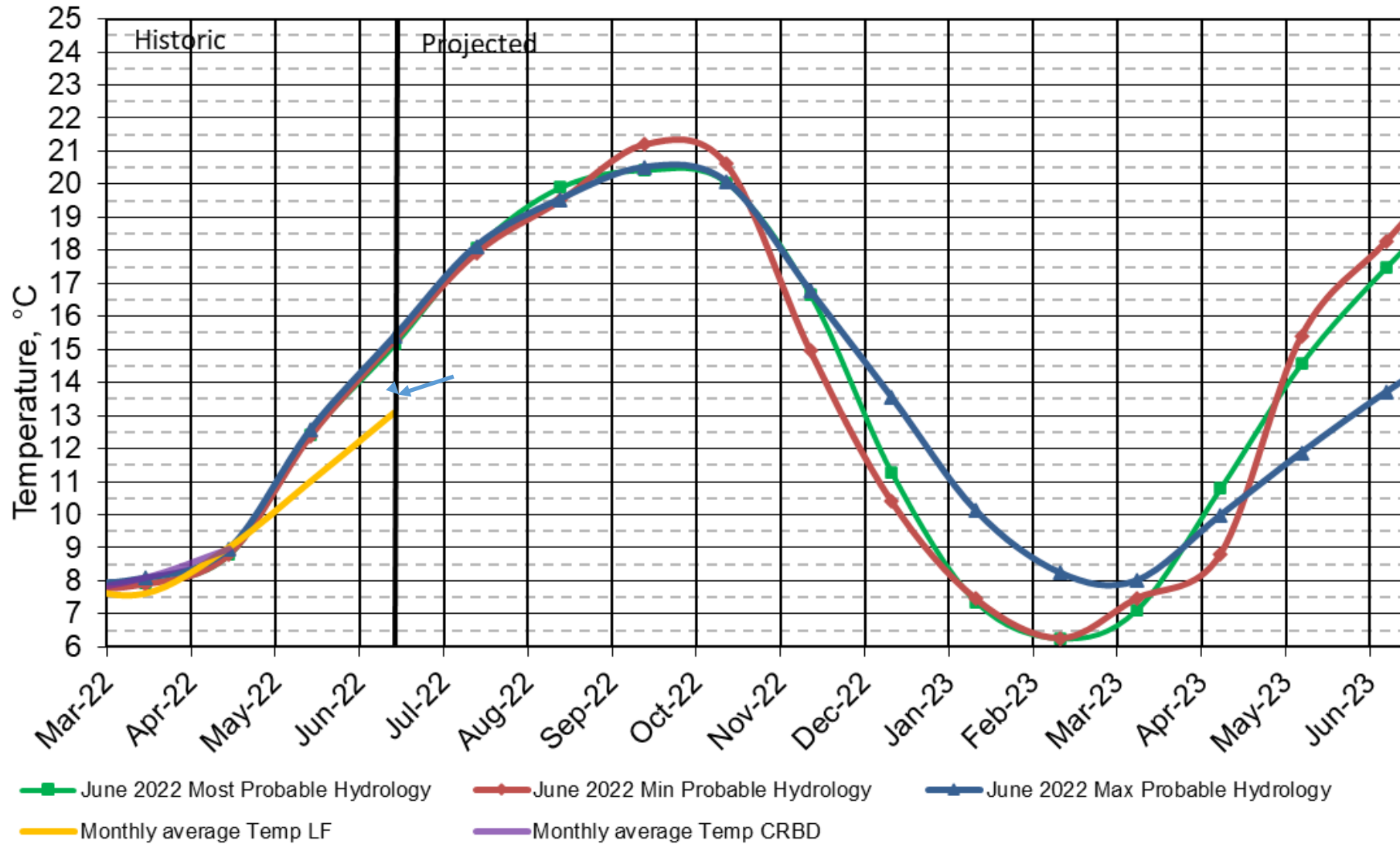


# Water Quality



## Lake Powell Release Temperature

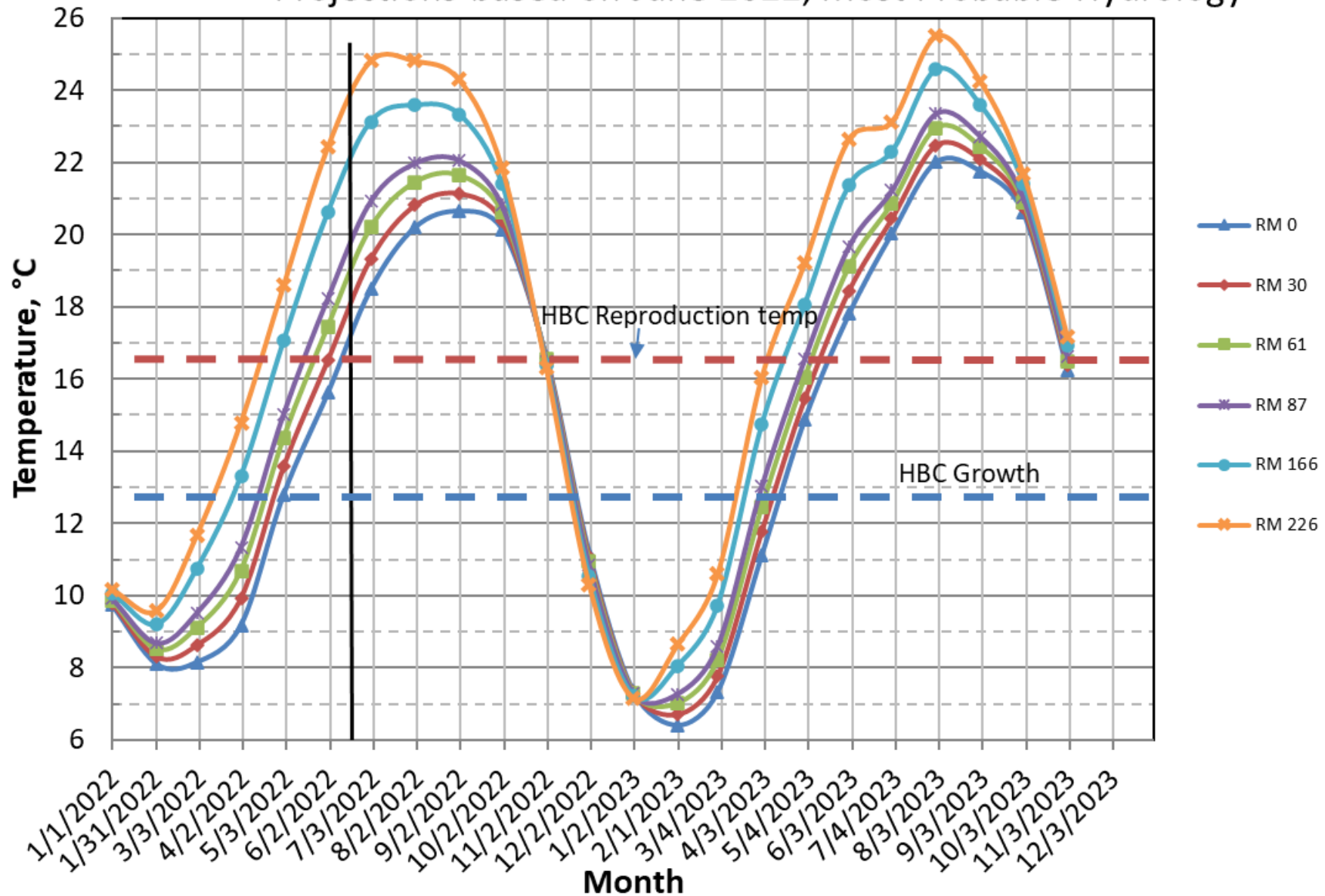
### Projected Temperature based on June 2022 Forecast



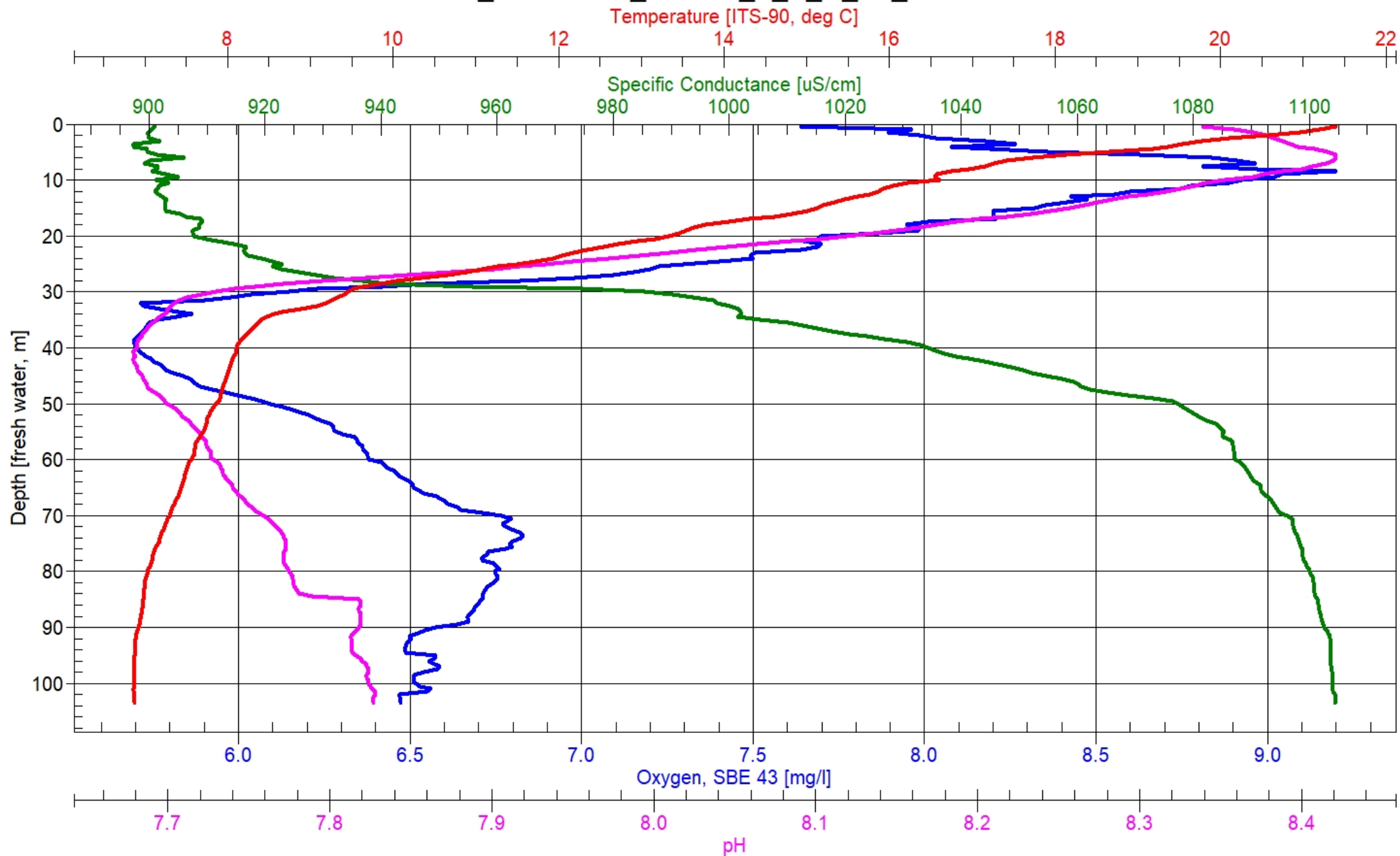
#Projection start date is based on initial conditions (March 2021)

# Colorado River, Grand Canyon Water Temperatures

## Projections based on June 2022, Most Probable Hydrology



# 01\_LPCR0024\_220613\_F\_A\_D\_LE\_bin.cnv



# Questions?



— BUREAU OF —  
RECLAMATION