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Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

July 20, 2021

Background

This briefing is being provided consistent with the provision in 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.”

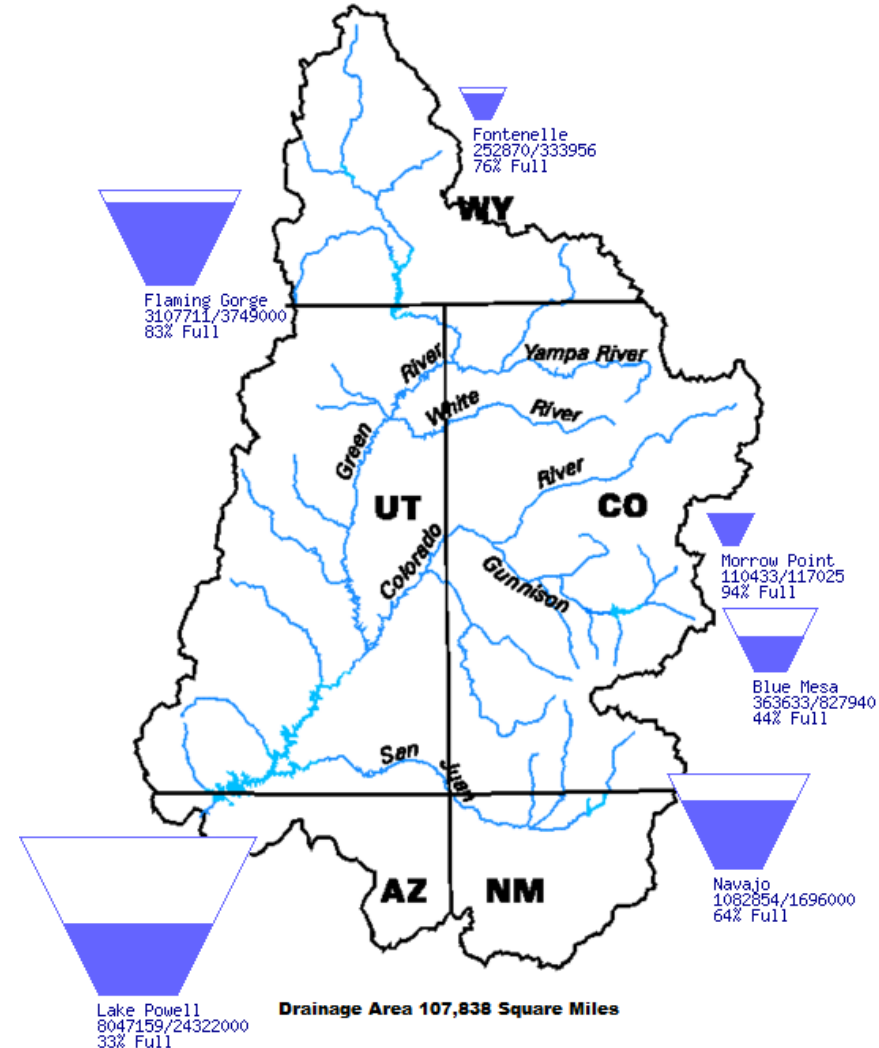


Upper Basin Storage (as of July 19, 2021)

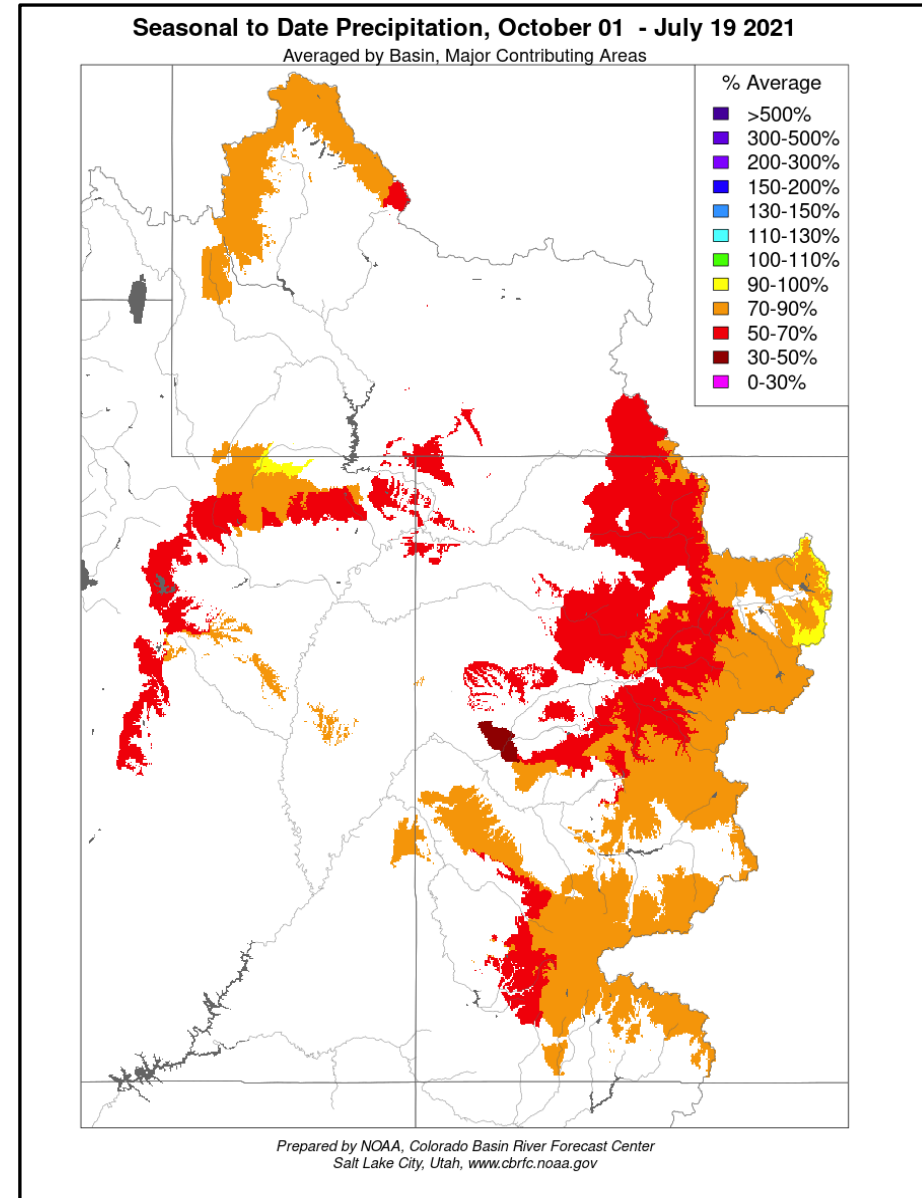
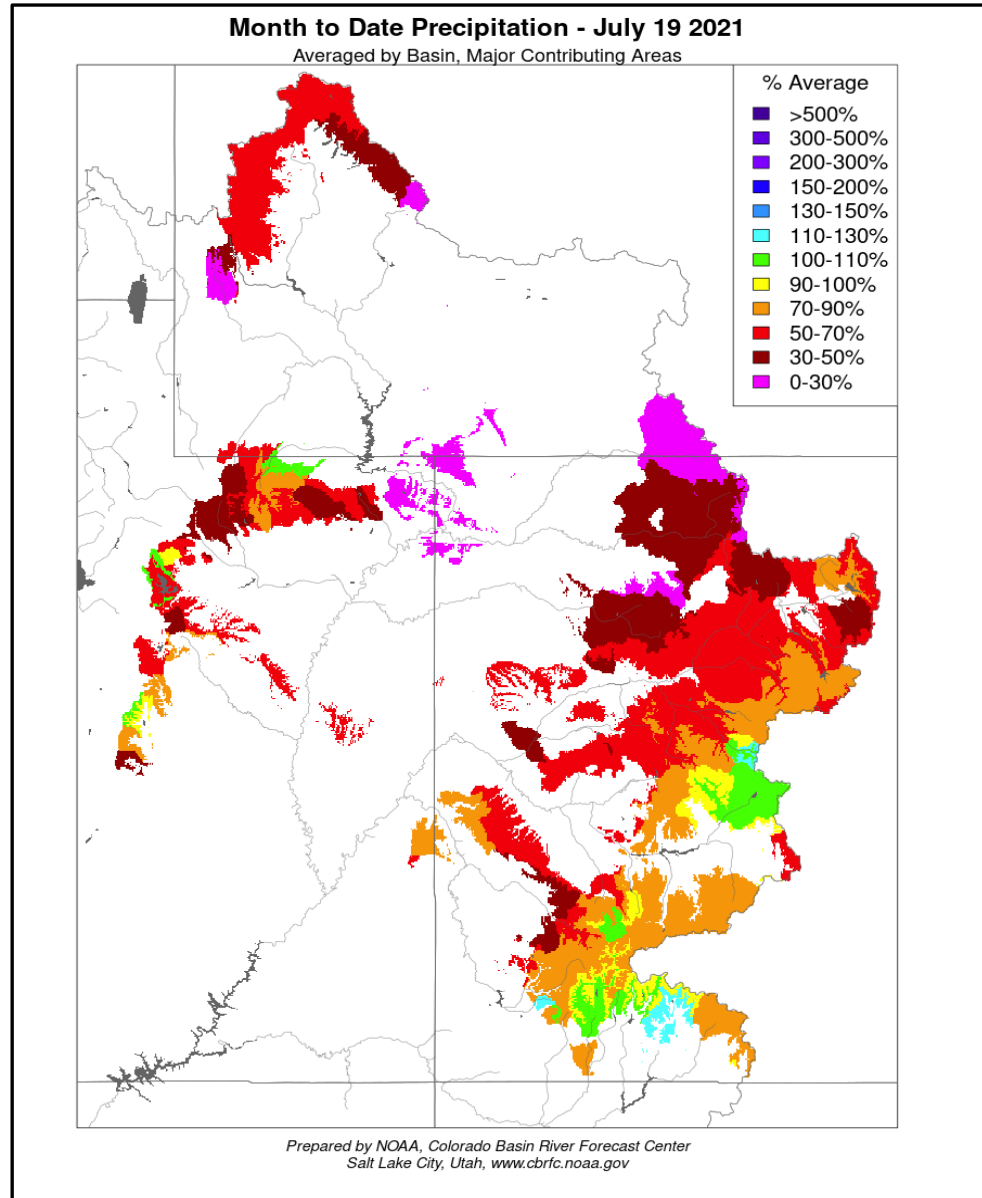
Data Current as of:
07/18/2021

Upper Colorado River Drainage Basin

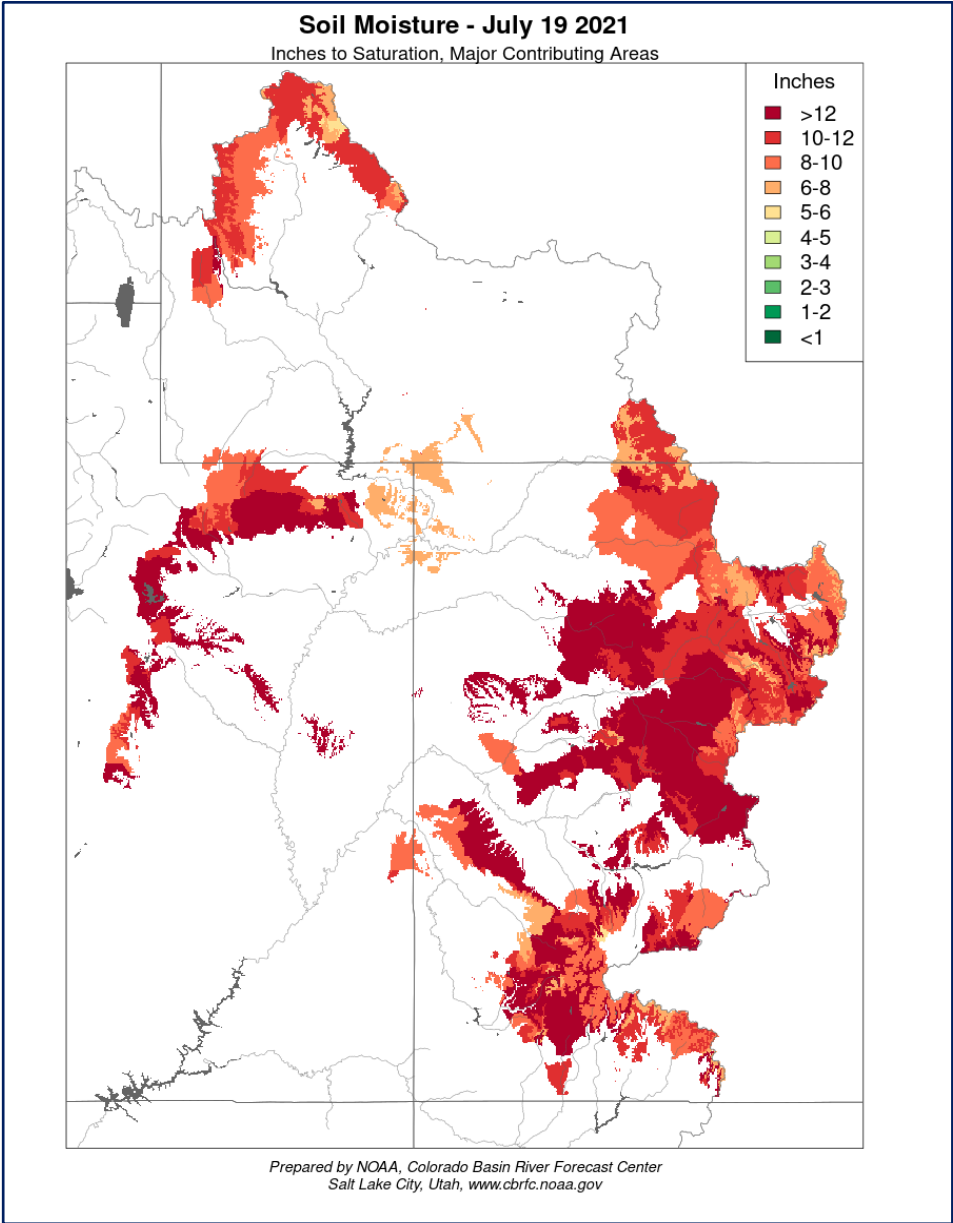
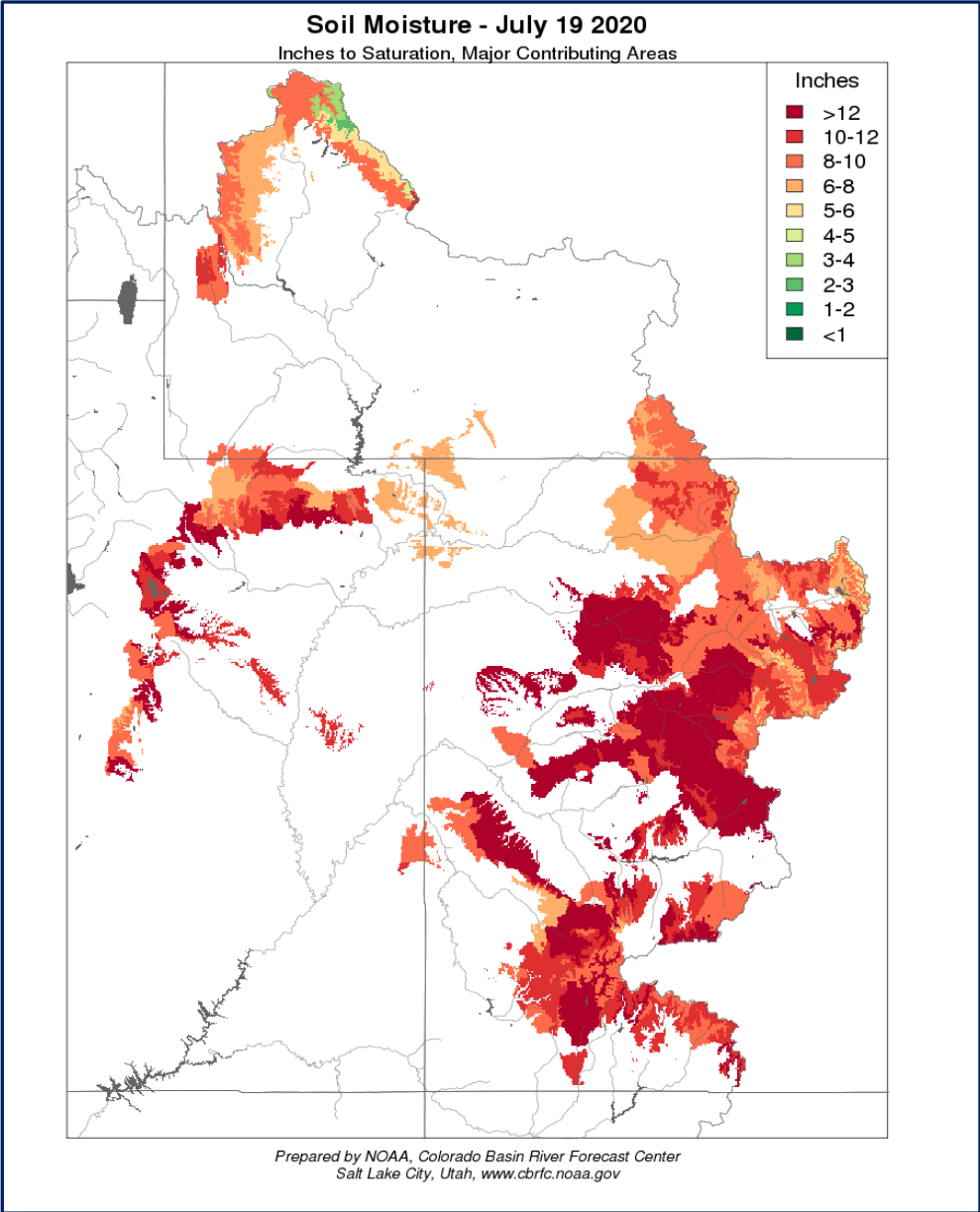
Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	76	0.25	0.33	6,495.06
Flaming Gorge	83	3.11	3.75	6,023.57
Blue Mesa	44	0.36	0.83	7,459.08
Navajo	64	1.08	1.70	6,037.03
Lake Powell	33	8.02	24.32	3,556.00
UC System Storage	42	12.95	31.09	



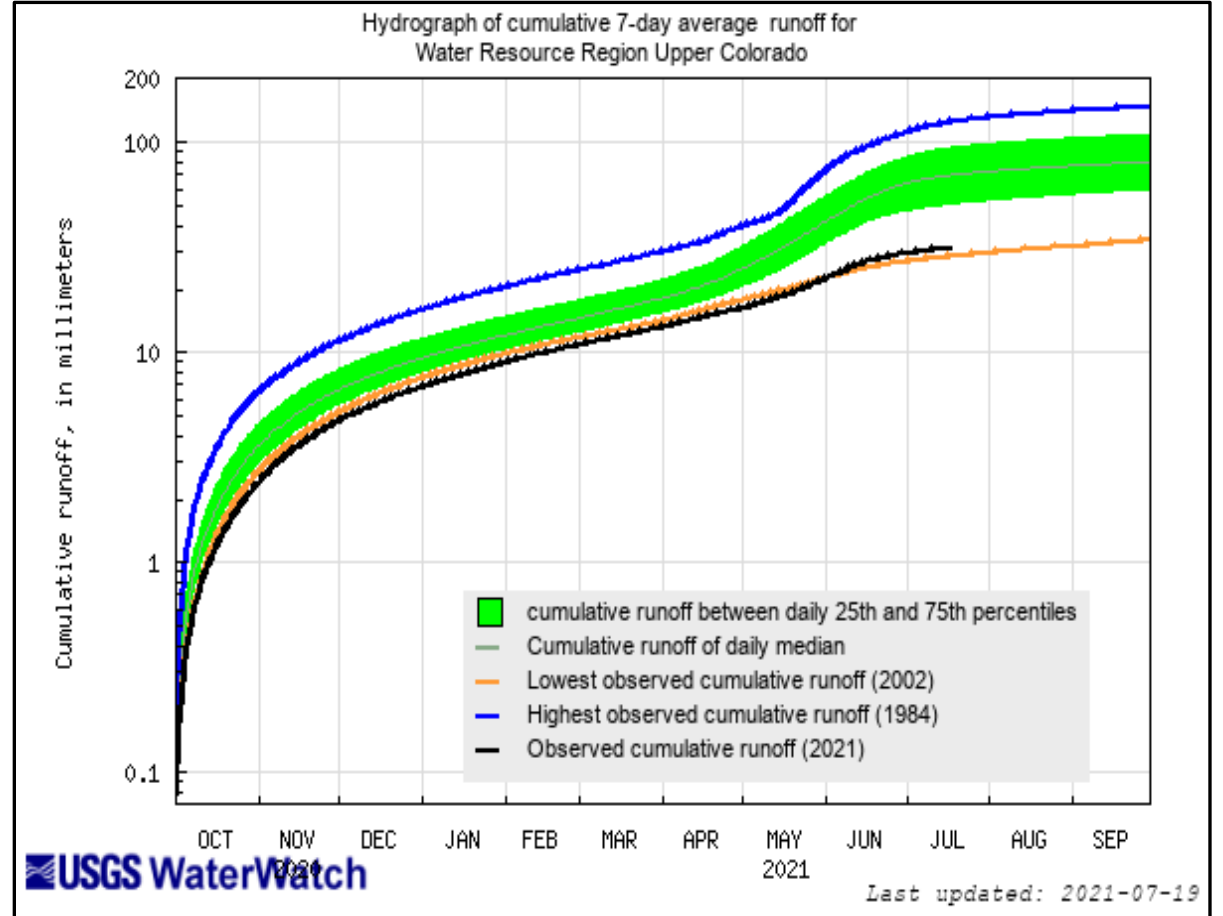
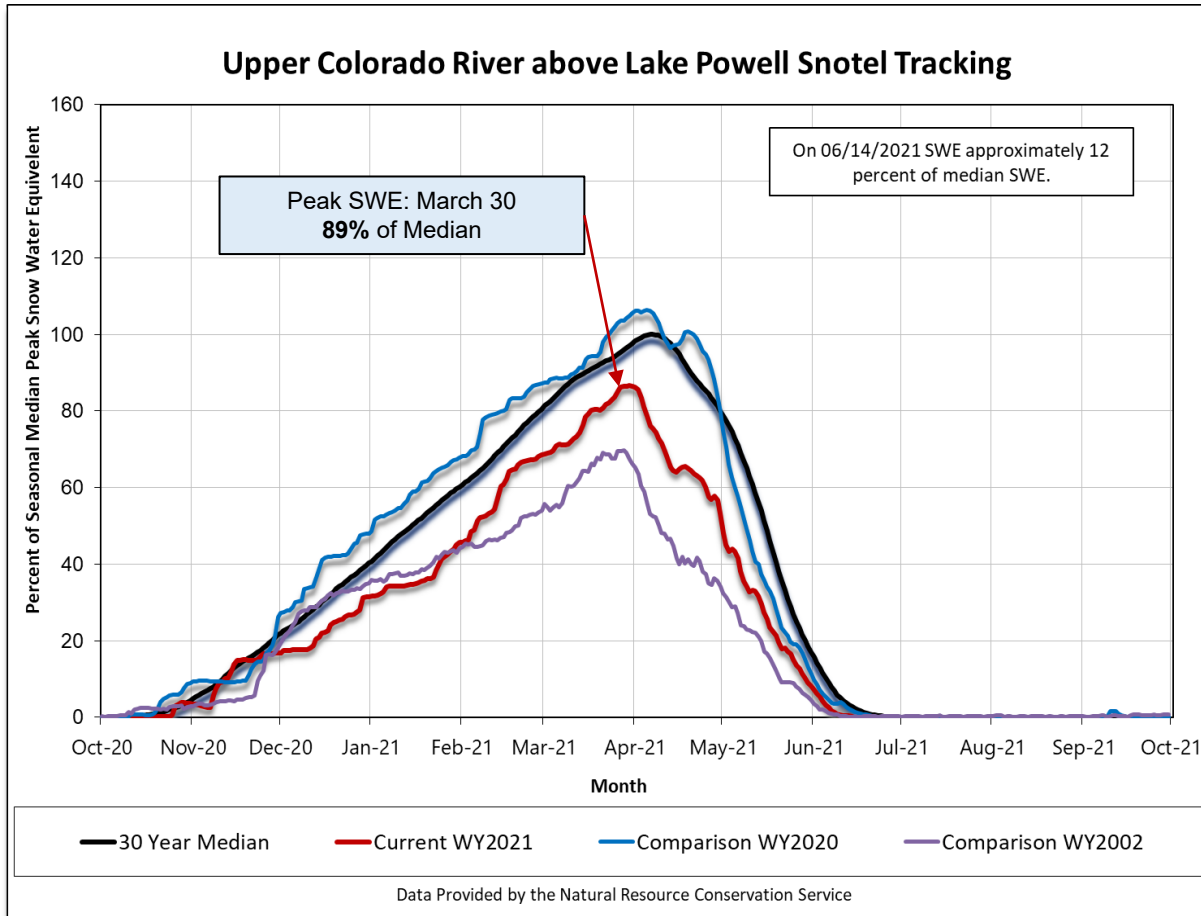
Precipitation: July and Seasonal



Soil Moisture Comparison: July 2020 and 2021



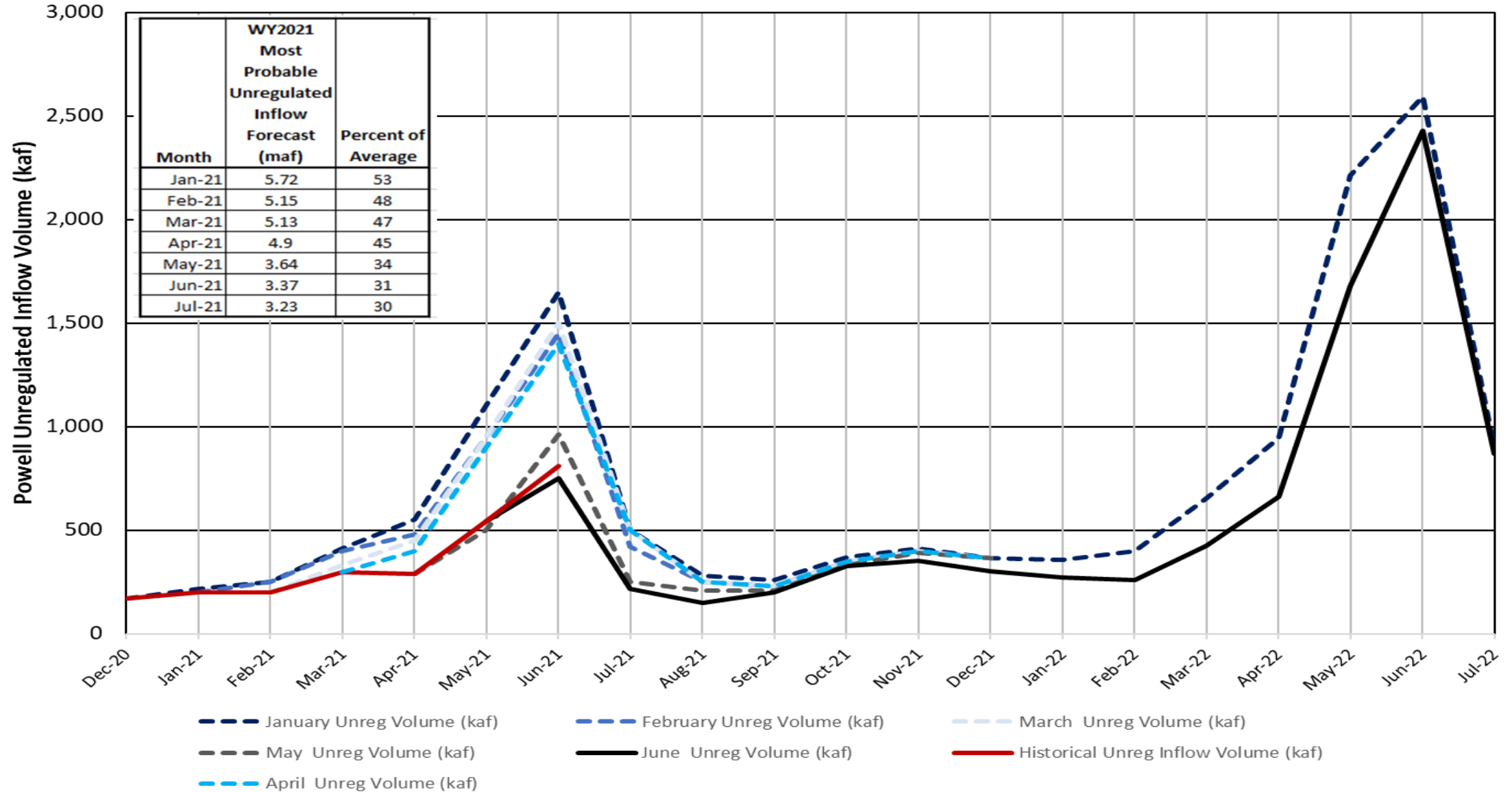
Current SWE and Observed UC Runoff



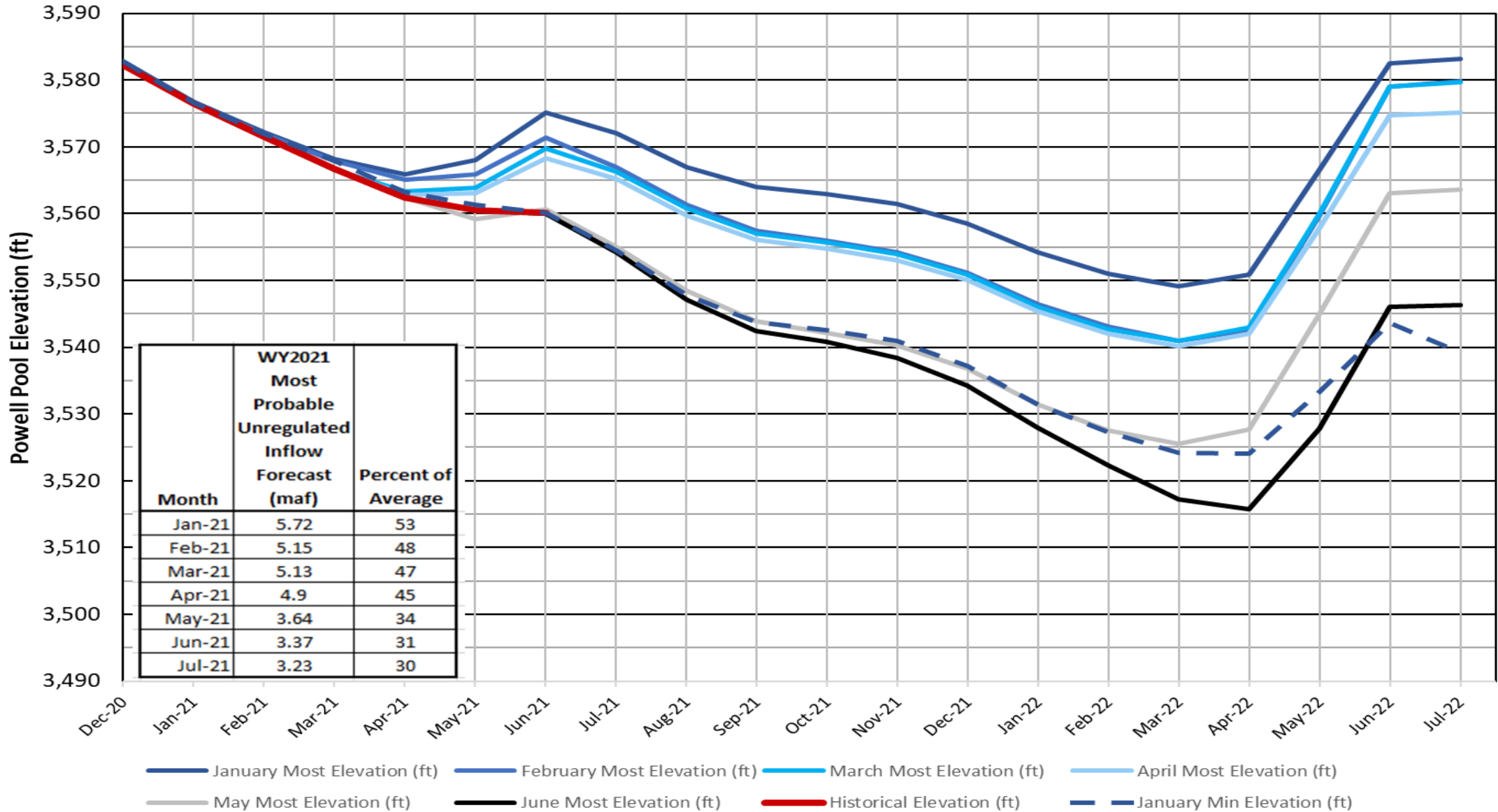
Available online at: https://waterwatch.usgs.gov/index.php?id=wwdur_cumrunoff



Lake Powell 24-Month Study Most Probable Unregulated Inflow Projections from January through June 2021



Lake Powell 24-Month Study Most Probable Elevation Projections January through June 2021



Most Probable July Final Spring Forecast and WY 2021 Forecast

April – July 2021
Forecasted Unregulated Inflow
as of July 1, 2021

Reservoir	Unregulated Inflow (kaf) ¹	Percent of Average ²
Fontenelle	307	42
Flaming Gorge	350	36
Blue Mesa	305	45
Navajo	364	50
Powell	1,746	24

Water Year 2021
Forecasted Unregulated Inflow
as of July 1, 2021

Reservoir	Unregulated Inflow (kaf)	Percent of Average ¹
Fontenelle	538	50
Flaming Gorge	617	42
Blue Mesa	500	52
Navajo	489	45
Powell	3,228	30

Powell forecast decreased 140 kaf from June to July and 2.5 maf from Jan through July

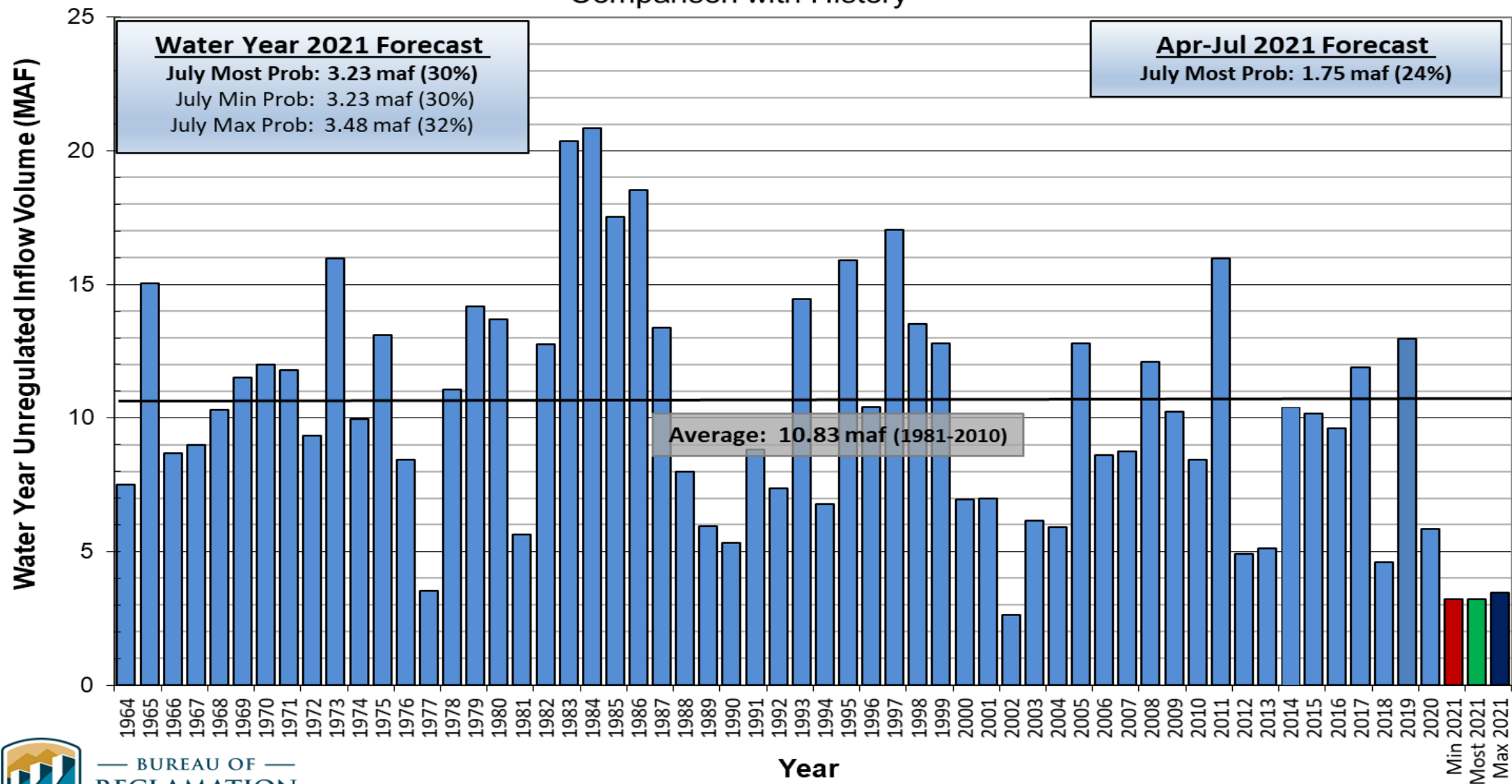
9 ¹ April-July includes observed volumes for April and May.
² Percent of average based on the period of record from 1981-2010.



Lake Powell Unregulated Inflow

Water Year 2021 Forecast (issued July 1)

Comparison with History



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Most and Minimum Probable WY2022 Forecast

**MOST Water Year 2022
Forecasted Unregulated Inflow¹
as of July 1, 2021**

Reservoir	Unregulated Inflow (kaf)	Percent of Average ²
Flaming Gorge	1,100	76
Blue Mesa	795	83
Navajo	830	77
Powell	8,130	75

**MINIMUM Water Year 2022
Forecasted Unregulated Inflow¹
as of July 1, 2021**

Reservoir	Unregulated Inflow (kaf)	Percent of Average ²
Flaming Gorge	815	56
Blue Mesa	620	65
Navajo	650	60
Powell	6,300	58

¹ WY2022 forecasted unregulated inflow is calculated from the CBRFC water year volumes with median for most probable, 75% exceedance for minimum probable and 25% exceedance for maximum probable.

² Percent of average based on the period of record from 1981-2010.





Upper Colorado Basin

**Projected Operations
for Water Year 2021
Based on June 2021
Modeling**



Drought Response Operations Agreement (DROA)

- Formal notification that the January 2021 Minimum Probable 24 Month Study (24-MS) run projected Powell to fall below 3,525 feet in 2022 was provided pursuant to the DROA.
 - February through July Minimum Probable 24-MS continued to indicate elevations below 3,525 feet in 2022.
 - Operating under enhanced monitoring and coordination under the DROA.
 - Operating with monthly analysis of min/most/max with the parties specified in the DROA.
- The UCRC announced on May 20, 2021, that the parties are beginning the process of developing a drought response operations plan in accordance with the DROA.
- The June and July most probable 24-Month Study elevation projects Lake Powell reaching below 3,525 feet as early as February 2022



Upper Basin DROA Initial Unit Additional Releases Beginning in July 2021

DROA Releases for the July 24MS Model Run

	Jul	Aug	Sep	Oct	Nov	Dec	
	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	Sum
Flaming Gorge	13	42	43	27	0	0	125
Blue Mesa	0	14	18	4	0	0	36
Navajo	0	0	0	0	10	10	20
Sum:	13	56	61	31	10	10	181

Total Anticipated Releases with Additional DROA Volumes Included

		Jul	Aug	Sep	Oct	Nov	Dec
		(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
Flaming Gorge	Max Release	1450	1700	1700	1450		
	Min Release	1250	1500	1500	1250		
Blue Mesa	Max Whitewater		1500	1500	1500		
	Min Whitewater		1000	1000	1000		
Navajo	Max Release					600	600
	Min Release					300	300



Lake Powell & Lake Mead Operational Table

Projected Tiers for Water/Calendar Year 2022¹
based on July 24-Month Study

Lake Powell			Lake Mead		
Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) ¹	Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) ¹
3,700	Equalization Tier Equalize, avoid spills or release 8.23 maf	24.3	1,220	Flood Control Surplus or Quantified Surplus Condition Deliver > 7.5 maf	25.9
3,636 - 3,666 (2008-2026)	Upper Elevation Balancing Tier² Release 8.23 maf; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf	15.5 - 19.3 (2008-2026)	1,200 (approx.) ²	Domestic Surplus or ICS Surplus Condition Deliver > 7.5 maf	22.9 (approx.) ²
3,575			1,145	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	15.9
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,105	Shortage Condition Deliver 7.167 ⁴ maf	11.9
			1,075		1,064.84 ft
	3,534.65 ft		1,050	Jan 1, 2022 Projection	7.5
3,525	Jan 1, 2022 Projection	5.9	1,025	Shortage Condition Deliver 7.083 ⁵ maf	5.8
3,490	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	4.0	1,000	Shortage Condition Deliver 7.0 ⁶ maf Further measures may be undertaken ⁷	4.3
3,370		0	895		0

Diagram not to scale

¹ Acronym for million acre-feet

² This elevation is shown as approximate as it is determined each year by considering several factors including Lake Powell and Lake Mead storage, projected Upper Basin and Lower Basin demands, and an assumed inflow.

³ Subject to April adjustments which may result in a release according to the Equalization Tier

⁴ Of which 2.48 maf is apportioned to Arizona, 4.4 maf to California, and 0.287 maf to Nevada

⁵ Of which 2.40 maf is apportioned to Arizona, 4.4 maf to California, and 0.283 maf to Nevada

⁶ Of which 2.32 maf is apportioned to Arizona, 4.4 maf to California, and 0.280 maf to Nevada

⁷ Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division States and Mexico is likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with the Basin States, may result in the undertaking of further measures, consistent with applicable Federal law.



Lake Powell WY 2022 Operating Tier Scenarios

Based on July 2021 24-Month Study Inflow Scenarios

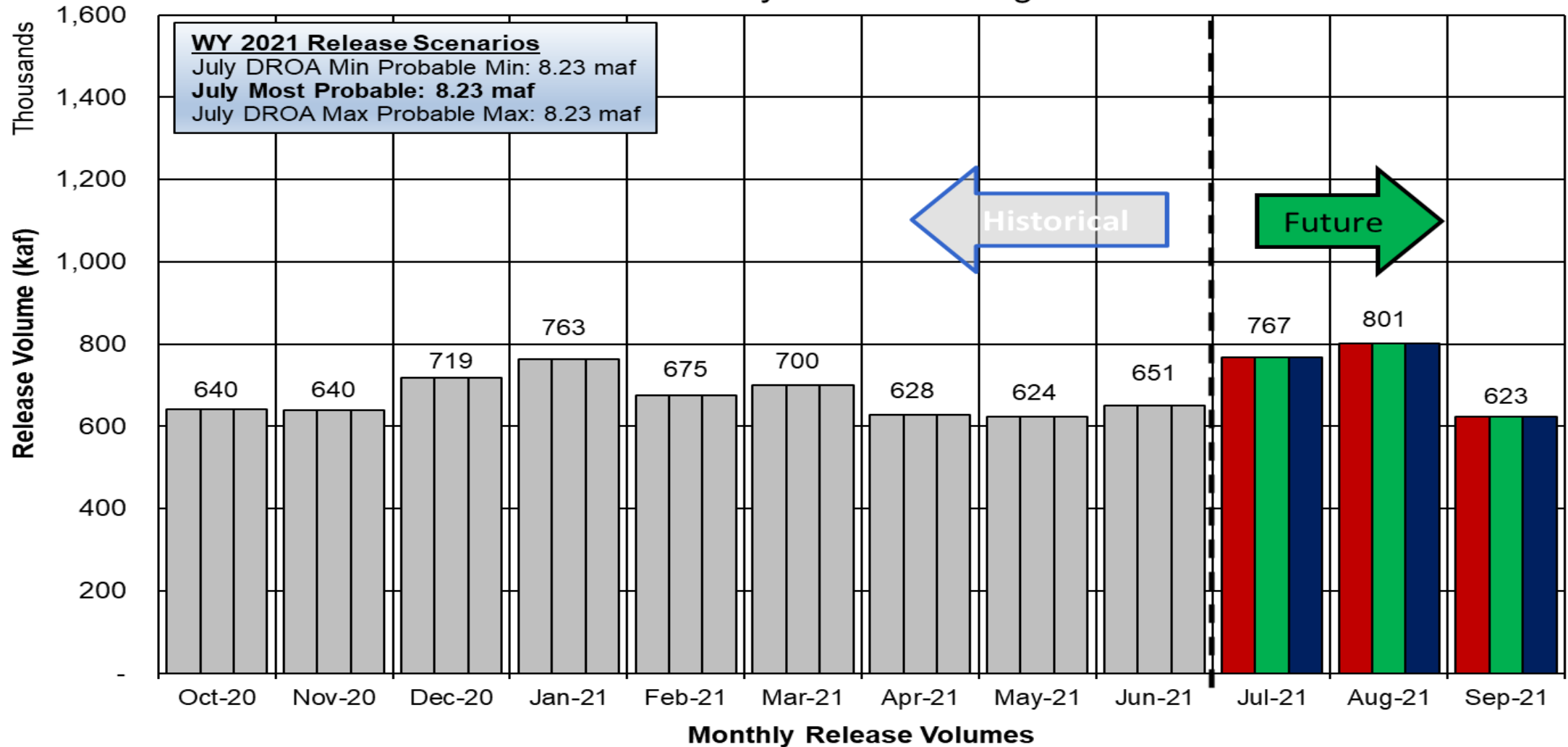
Inflow Scenario	Operating Tier/ Release Volume
July DROA* Minimum Probable	Mid-Elevation Release 7.48 maf
July Most Probable	Mid-Elevation Release 7.48 maf
July DROA* Maximum Probable	Mid-Elevation Release 7.48 maf

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



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2021
Based on July 2021 Modeling

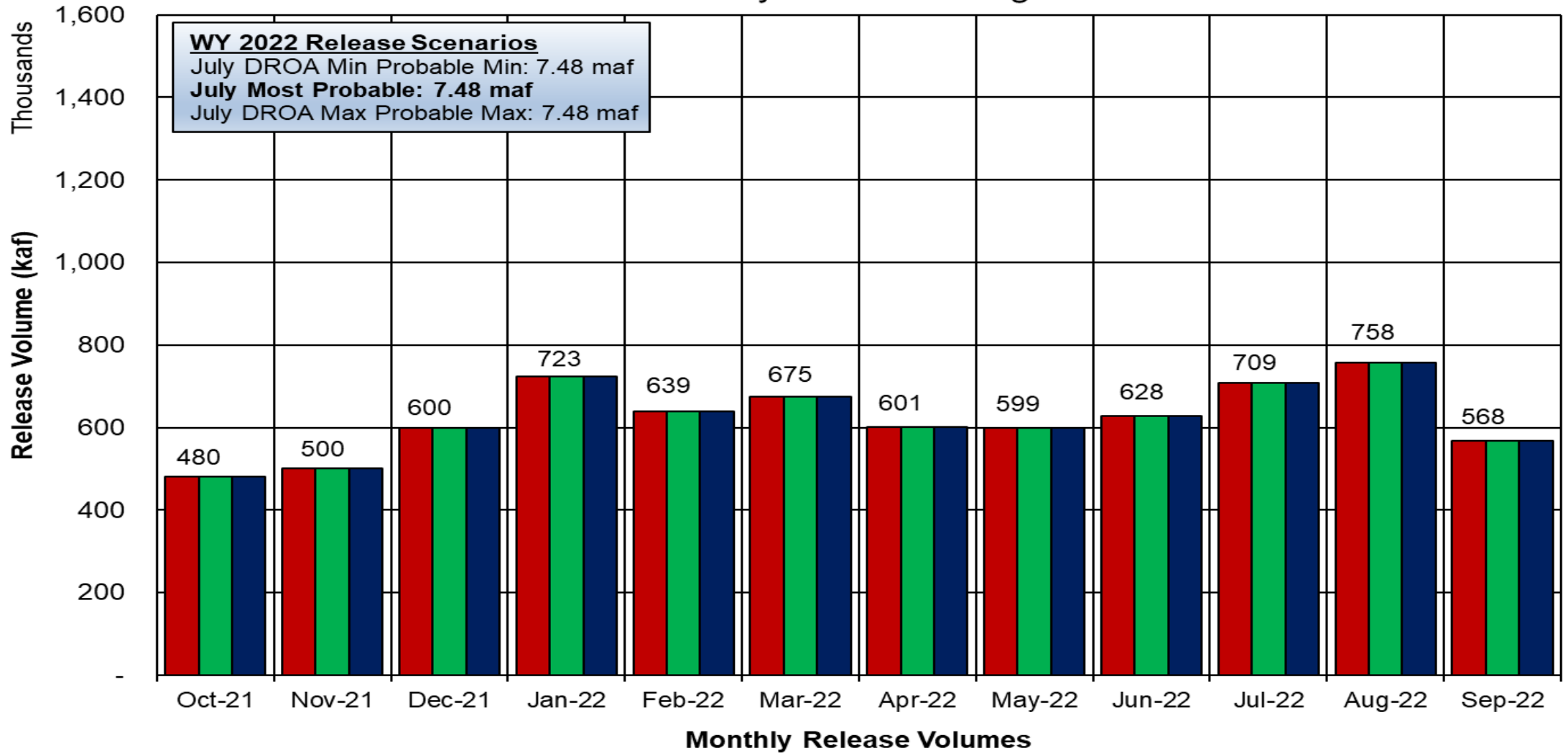


■ July DROA Min Probable
 ■ July Most Probable
 ■ July DROA Max Probable
 The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>

Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on July 2021 Modeling

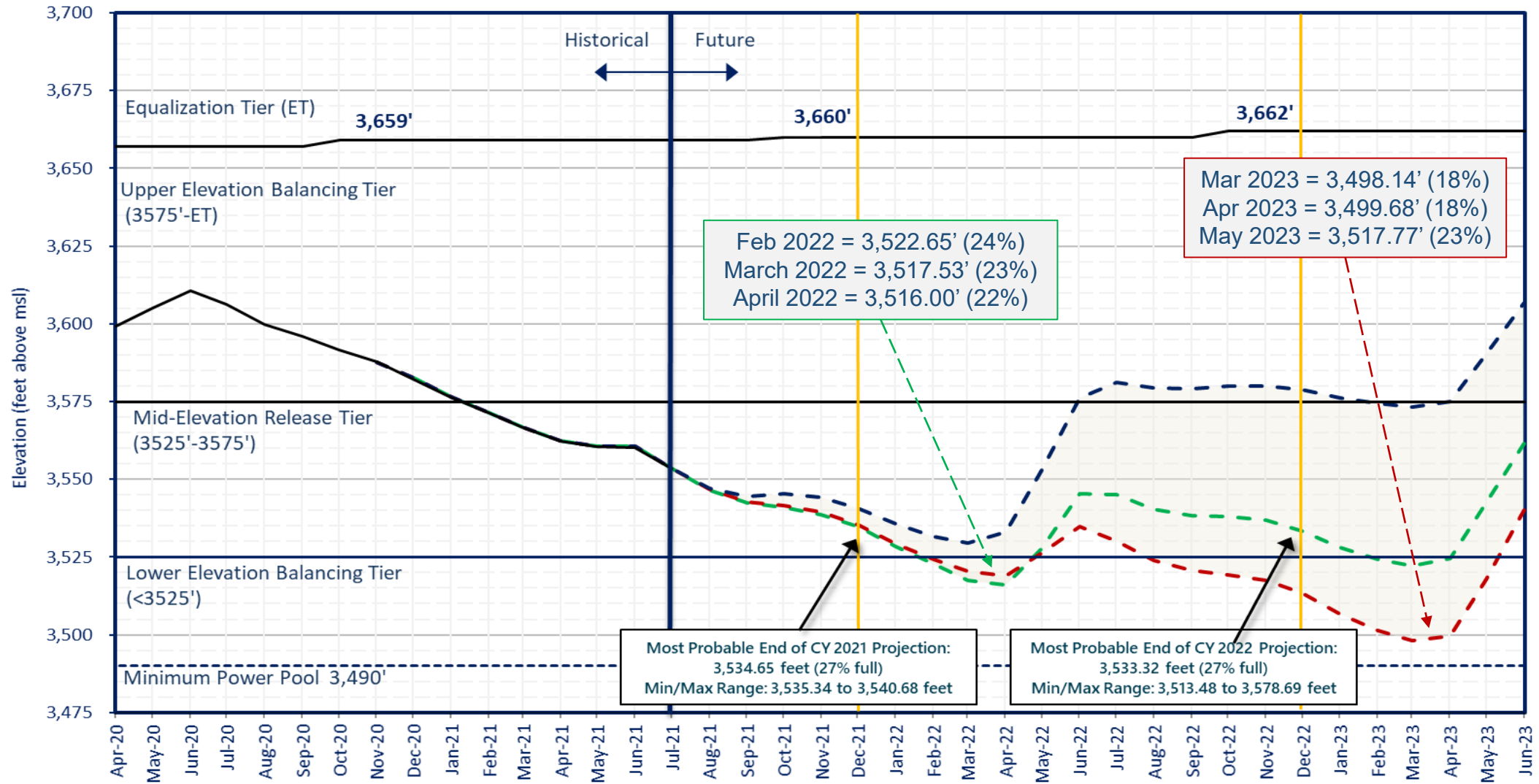


■ July DROA Min Probable
 ■ July Most Probable
 ■ July DROA Max Probable

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

Lake Powell End of Month Elevations

Projections from the July 2021 24-Month Study Inflow Scenarios



- July 2021 Most Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- - - July 2021 DROA* Minimum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- - - July 2021 DROA* Maximum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- Historical Elevations

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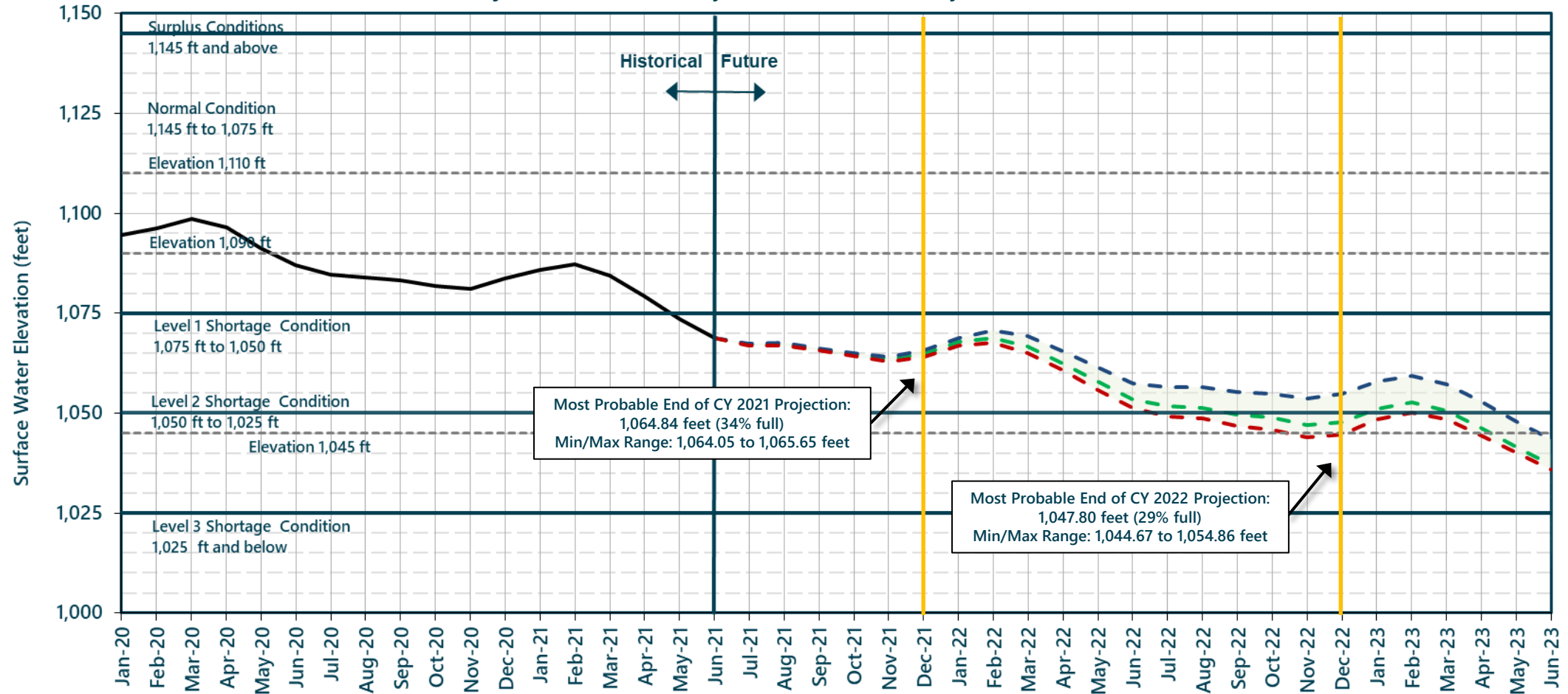


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Lake Mead End of Month Elevations

Projections from the July 2021 24-Month Study Inflow Scenarios



— Historical Elevations

— July 2021 Most Probable Inflow with a Lake Powell release of 8.23 maf in WY 2021 and 7.48 maf in WY 2022

— July 2021 DROA Maximum Probable Inflow with a Lake Powell release of 8.23 maf in WY 2021 and 7.48 maf in WY 2022

— July 2021 DROA Minimum Probable Inflow with a Lake Powell release of 8.23 maf in WY 2021 and 7.48 maf in WY 2022

*The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.





Upper Colorado Basin

Hydropower Maintenance and Hourly Scheduling



Glen Canyon Dam Power Plant Unit Outage Schedule for 2021

Unit Number	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	
1	[Outage]												[Outage]
2	[Outage]												[Outage]
3	[Outage]											[Outage]	
4	[Outage]											[Outage]	
5		[Outage]						[Outage]					
6		[Outage]											
7	[Outage]						[Outage]						
8							[Outage]						
Units Available	5	4	6	6	6	4	4	5	6	6	6	4	
Capacity (cfs)	16,400	16,400/ 12,200	19,800	19,600	19,500	19,400 (20,150) ⁴	19,200	15,700	19,200	19,000	18,800	11,800	JUL MOST ³
Capacity (kaf/month)	1,040	1,140	1,250	1,220	1,080	1,540	1,140	1,050	1,140	1,170	1,150	990	JUL MOST
Max (kaf) ²	640	640	719	763	675	700	628	624	651	767	801	623	8.23
Most (kaf) ¹	640	640	719	763	675	700	628	624	651	767	801	623	8.23
Min (kaf) ²	640	640	719	763	675	700	628	624	651	767	801	623	8.23
										(updated 07-19-2021)			

1 Projected release, based on July 2021 Most Probable Inflow Projections and 24-Month Study model runs.
 2 Projected release, based on July 2021 DROA Min and Max Probable Inflow Projections and 24-Month Study model runs. The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>.
 3 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.
 4 Increased capacity available from shifting contingency reserves for Spring Disturbance Flow.



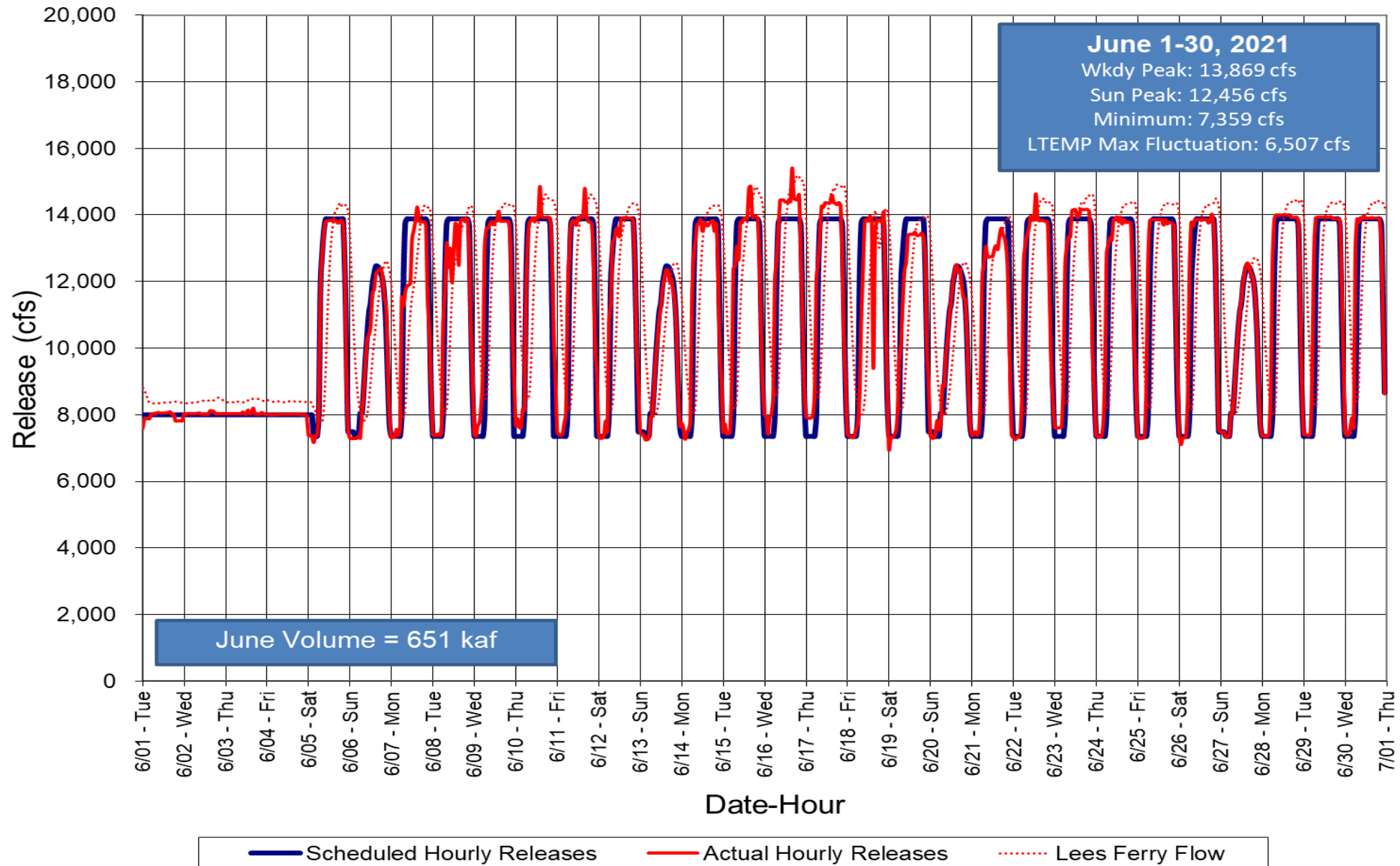
Glen Canyon Dam Power Plant Unit Outage Schedule for 2022

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	4	5	5	4	4	6	6	5	6	6	8	6	
Capacity (cfs)	11,700	15,100	15,000	11,500	11,300	17,800	17,700	14,800	18,700	18,700	25,400	18,500	JUL MOST ³
Capacity (kaf/month)	940	990	1,080	1,100	890	1,090	1,050	940	1,110	1,180	1,560	1,150	JUL MOST
Max (kaf) ²	480	500	600	723	639	675	601	599	628	709	758	588	7.48
Most (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	588	7.48
Min (kaf) ²	480	500	600	723	639	675	601	599	628	709	758	588	7.48
													(updated 07-19-2021)

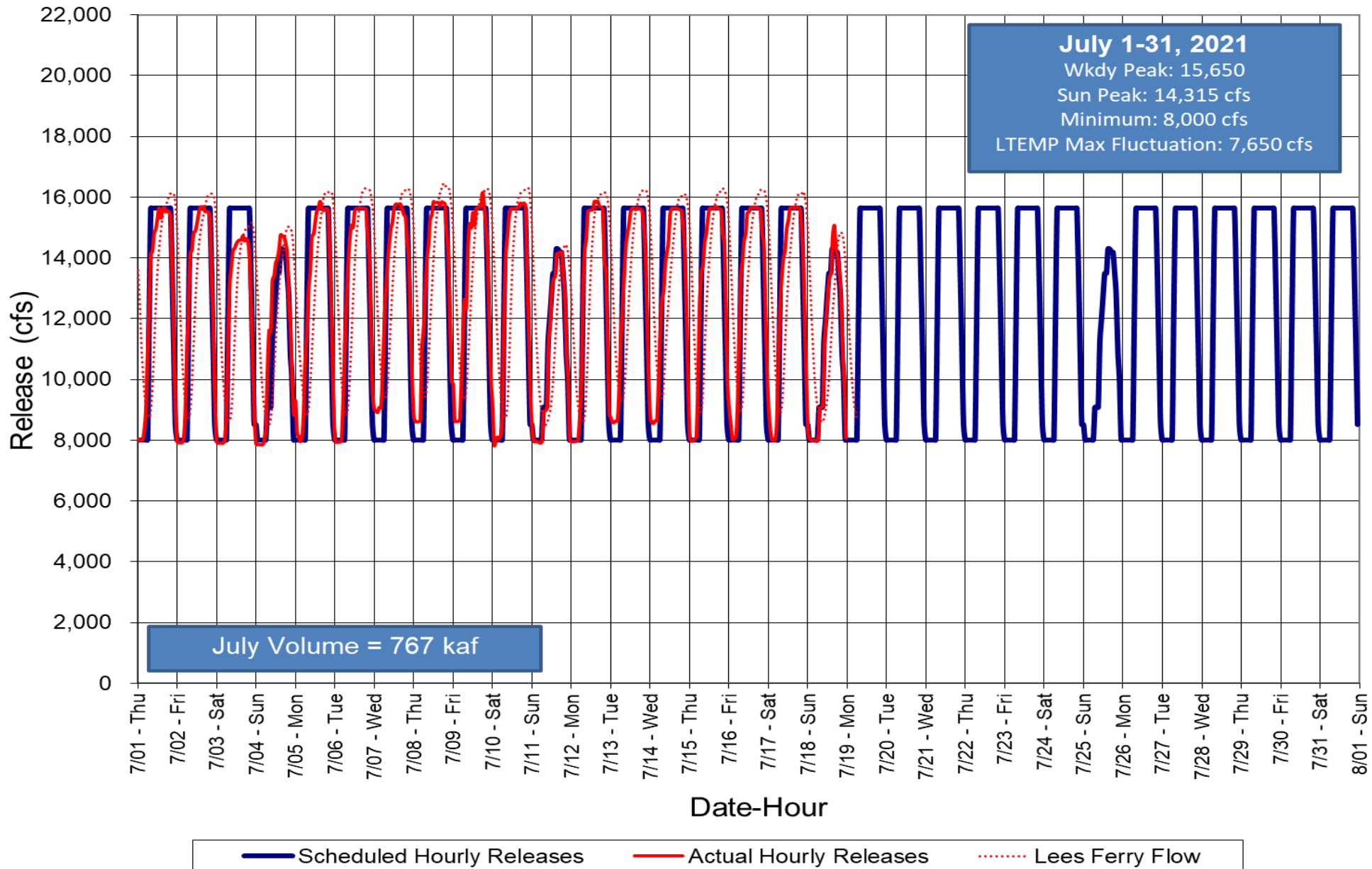
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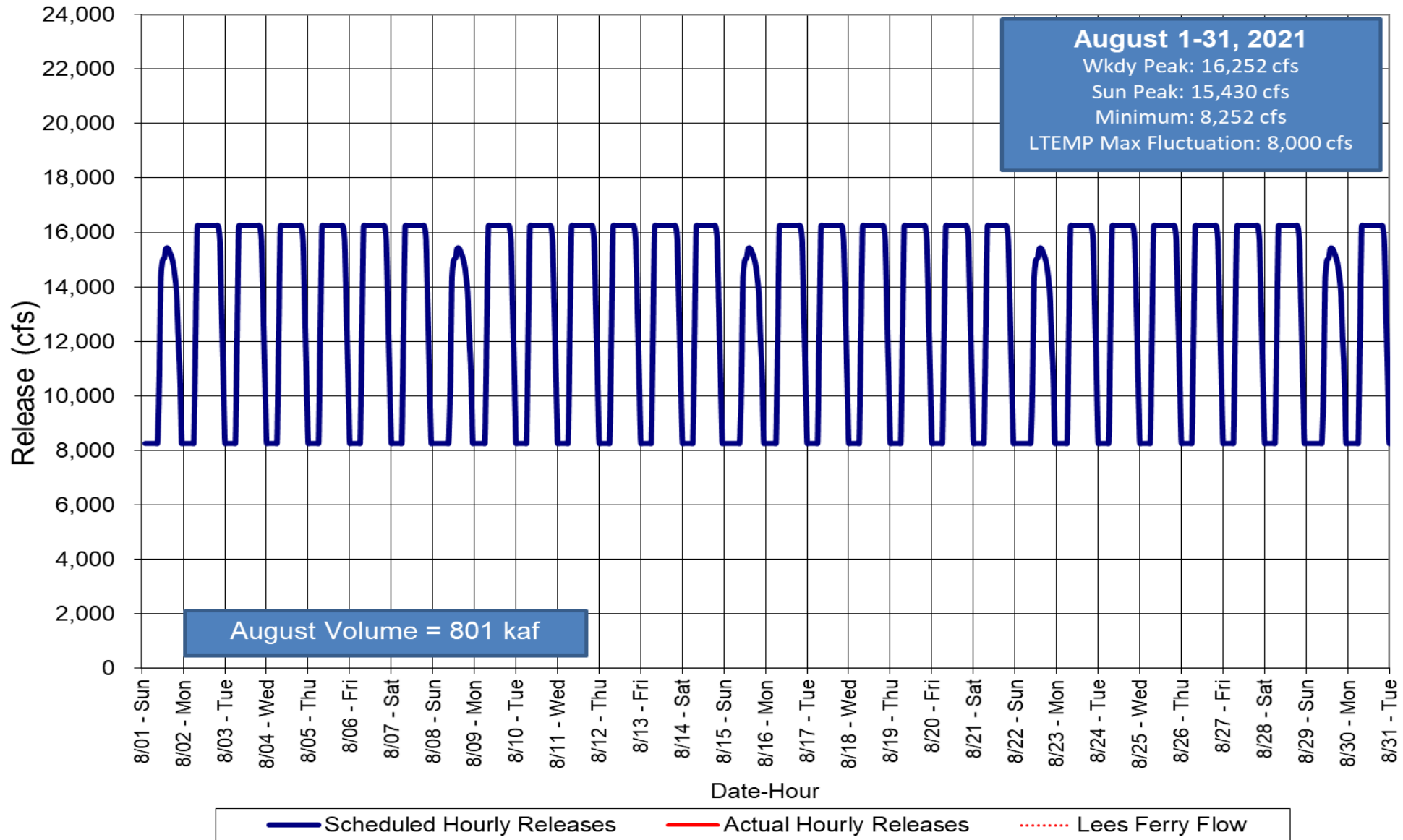
Glen Canyon Dam Hourly Release Pattern June 2021



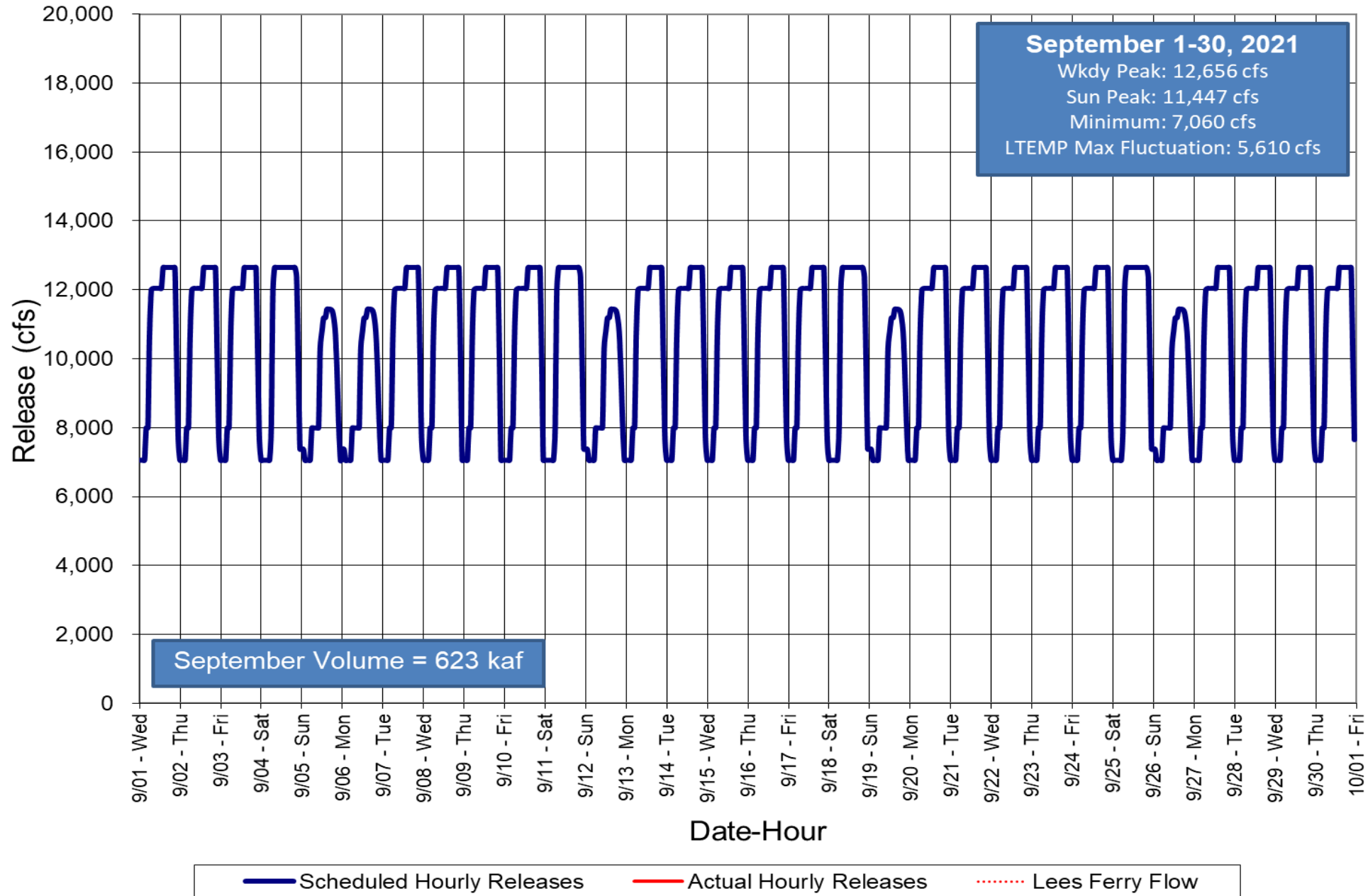
Glen Canyon Dam Hourly Release Pattern July 2021



Glen Canyon Dam Hourly Release Pattern August 2021



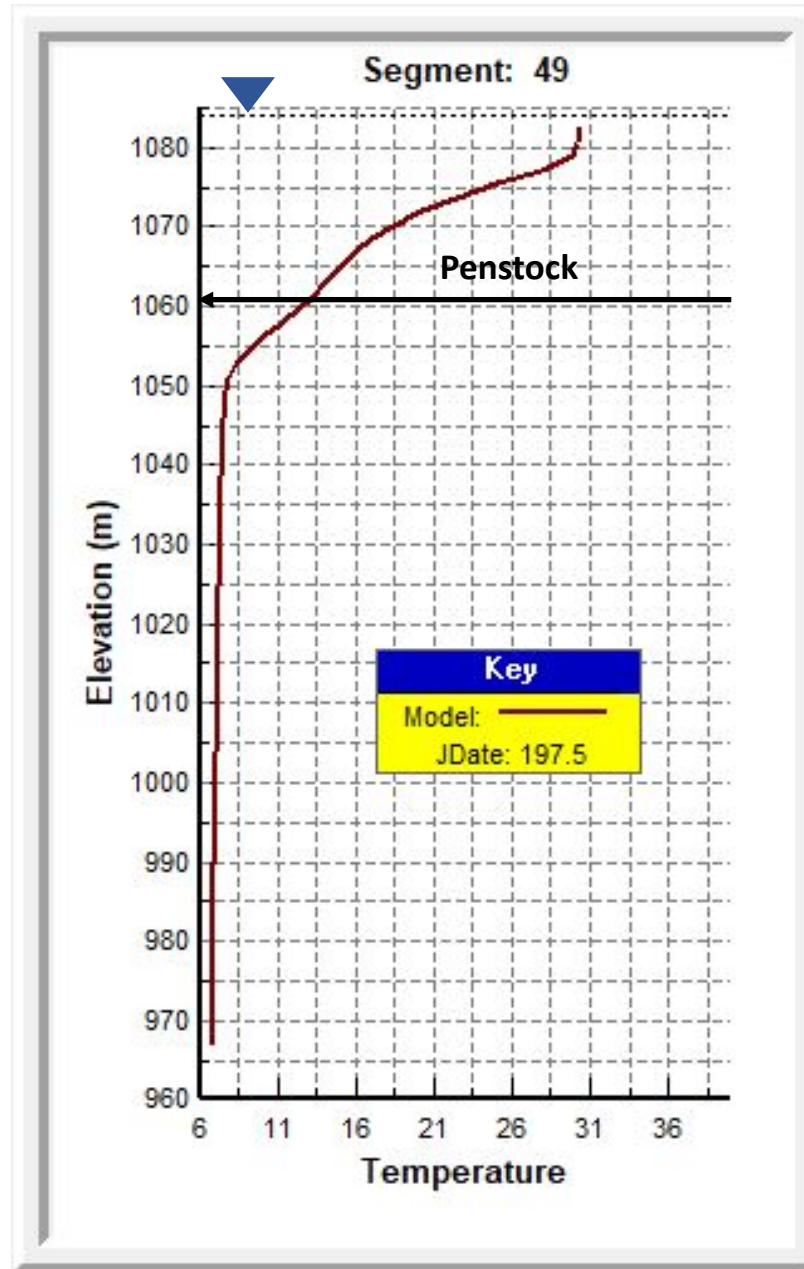
Glen Canyon Dam Hourly Release Pattern September 2021



Water Quality

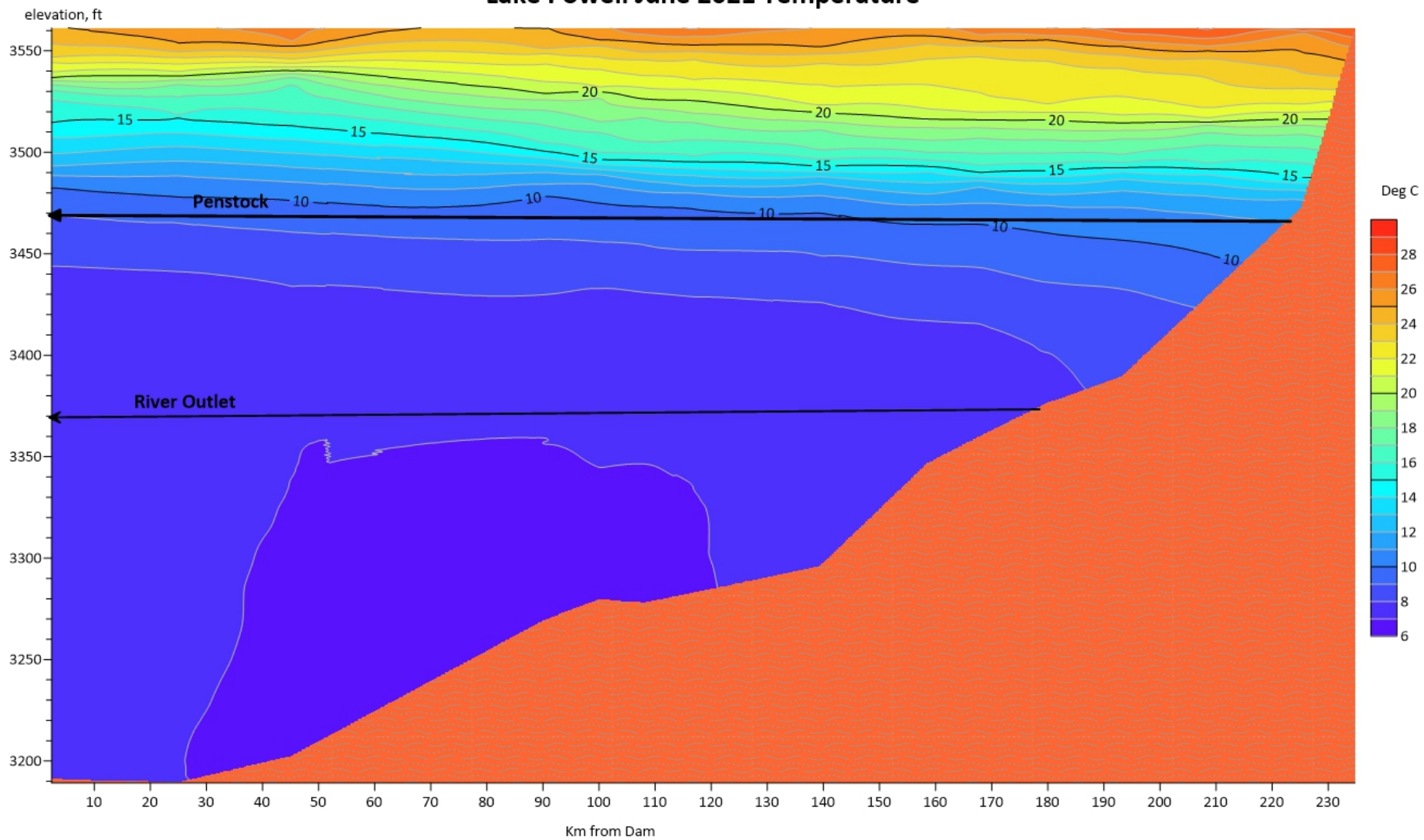


Temperature Profile of Lake Powell near Glen Canyon Dam
7/16/2021



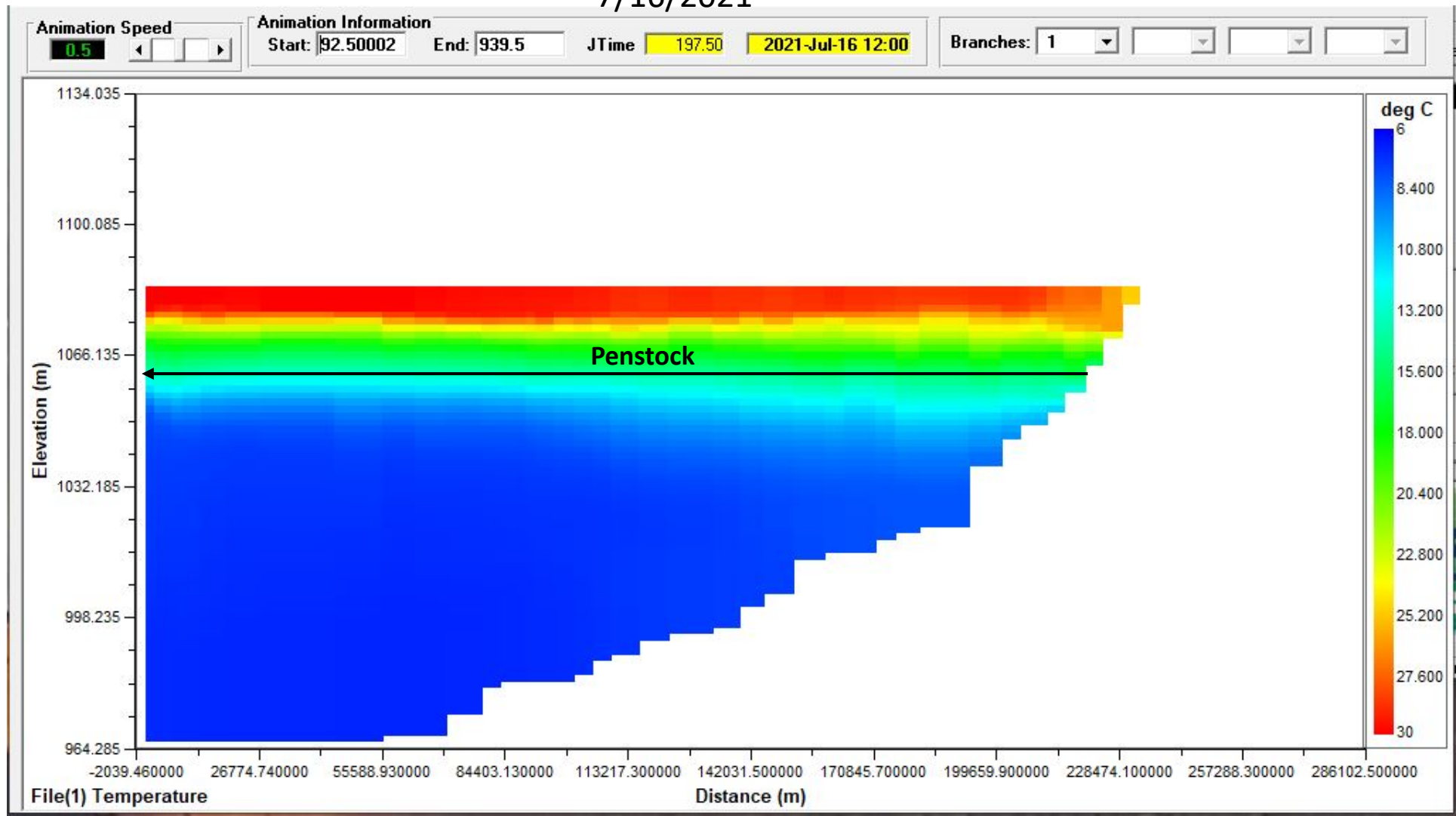
Cross Sectional Temperature Profile of Lake Powell

Lake Powell June 2021 Temperature

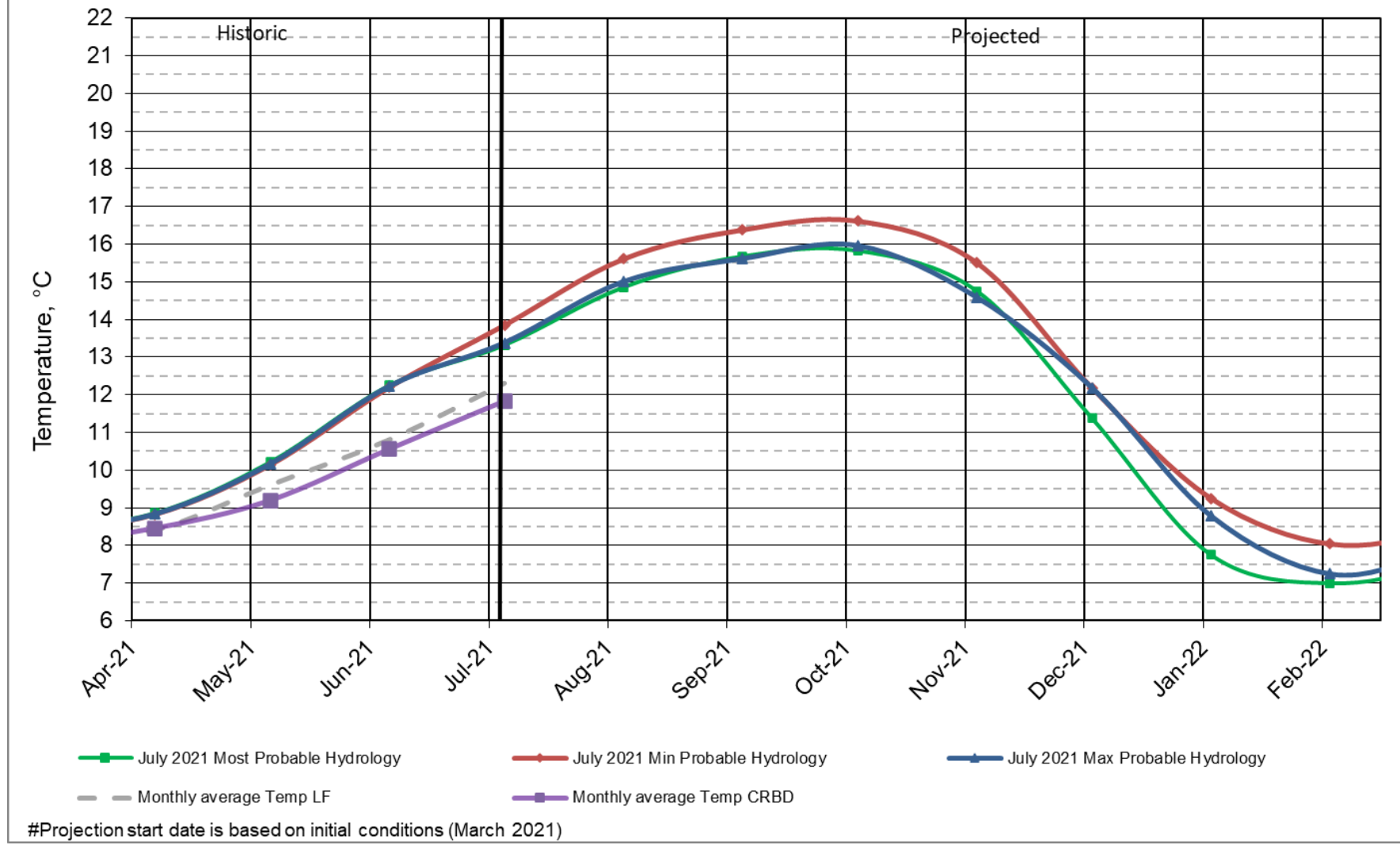


Cross Sectional Temperature Profile of Lake Powell

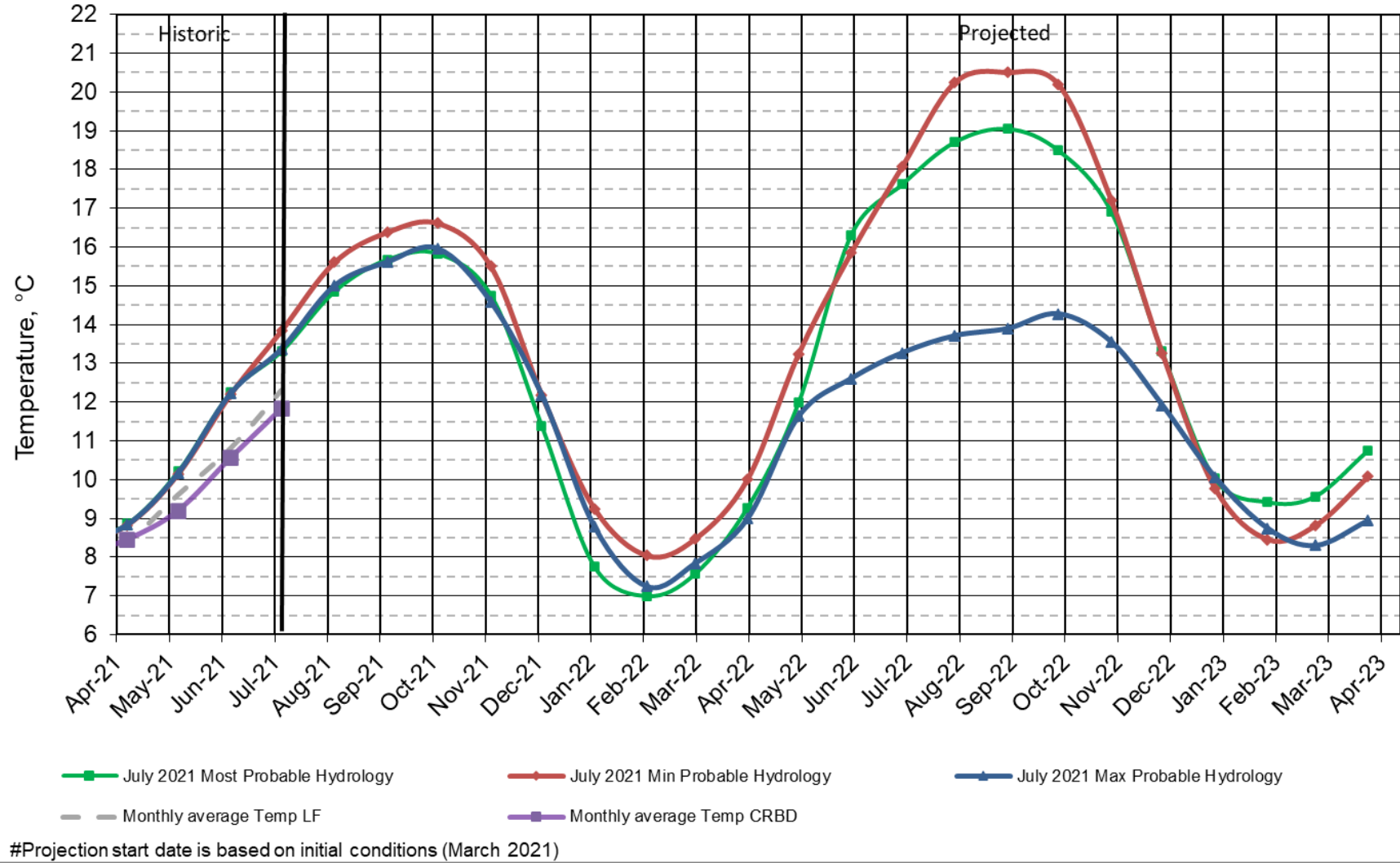
7/16/2021



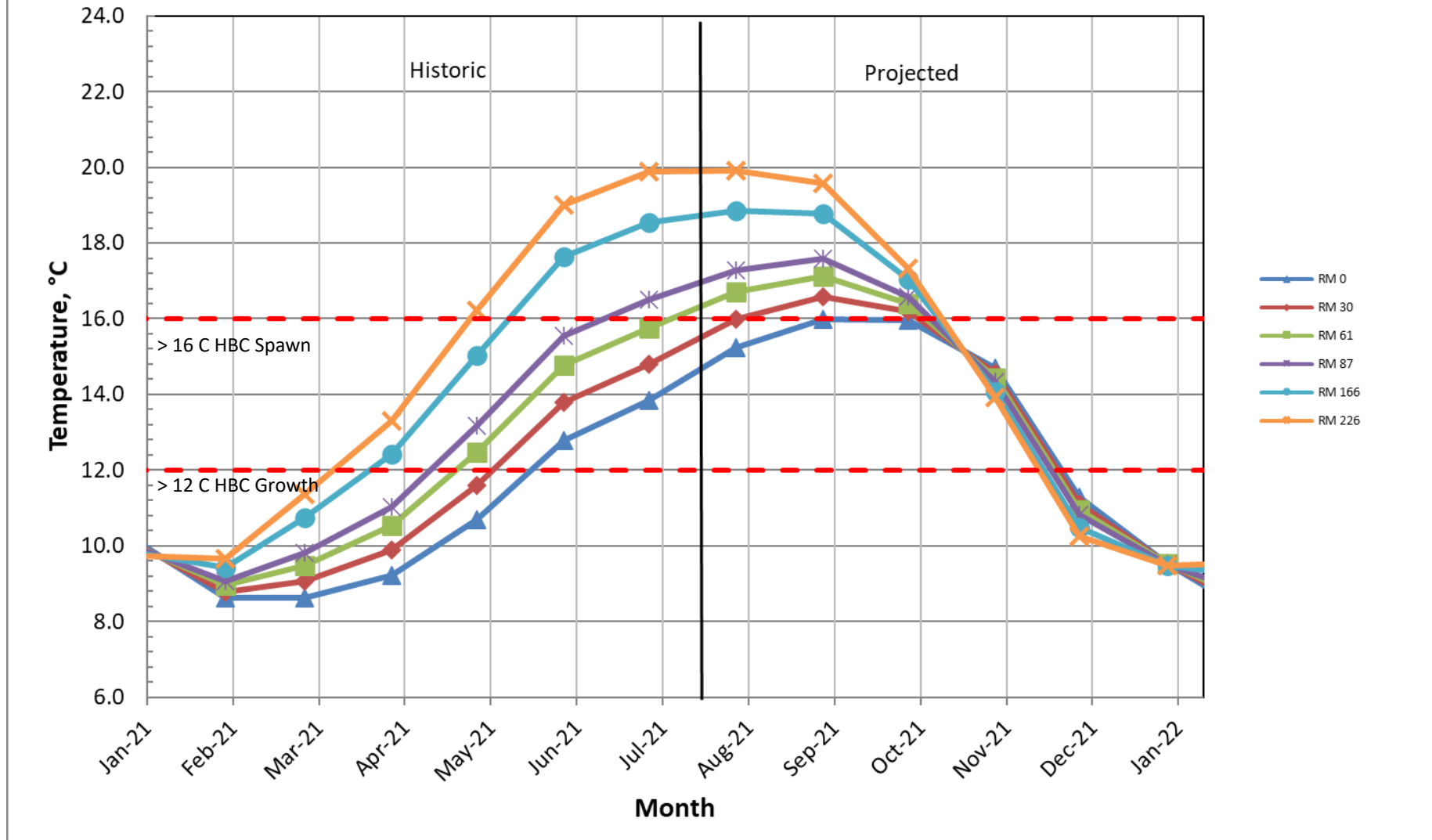
Lake Powell Release Temperature Projected Temperature based on July 2021 Forecast



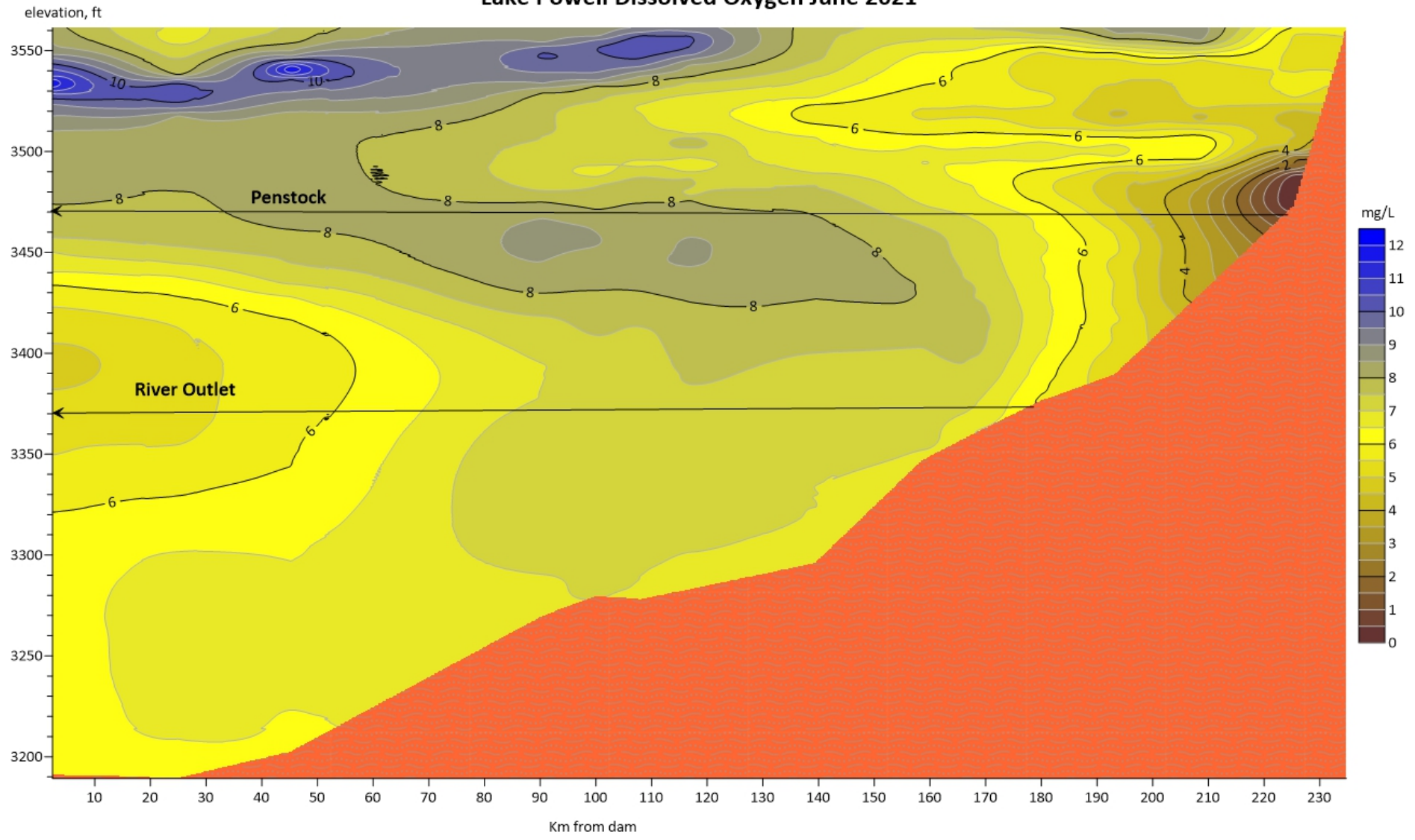
Lake Powell Release Temperature Projected Temperature based on July 2021 Forecast



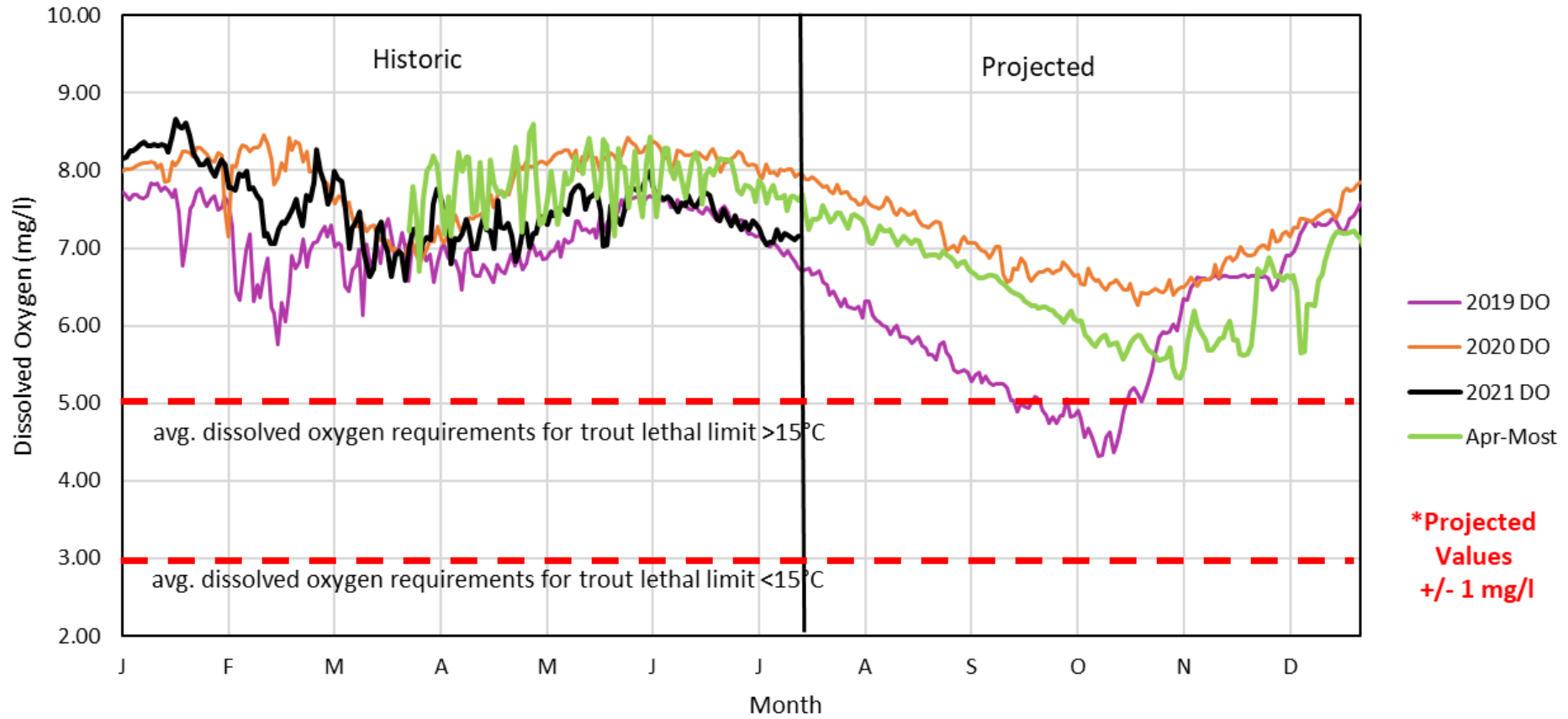
Colorado River, Grand Canyon Water Temperatures
Projections based on July 2021, Most Probable Hydrology (Dibble 2020)



Lake Powell Dissolved Oxygen June 2021



DO Concentration at Glen Canyon Dam years 2019, 2020, and 2021



Questions?



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