



— BUREAU OF —
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Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

November 23, 2021

Background

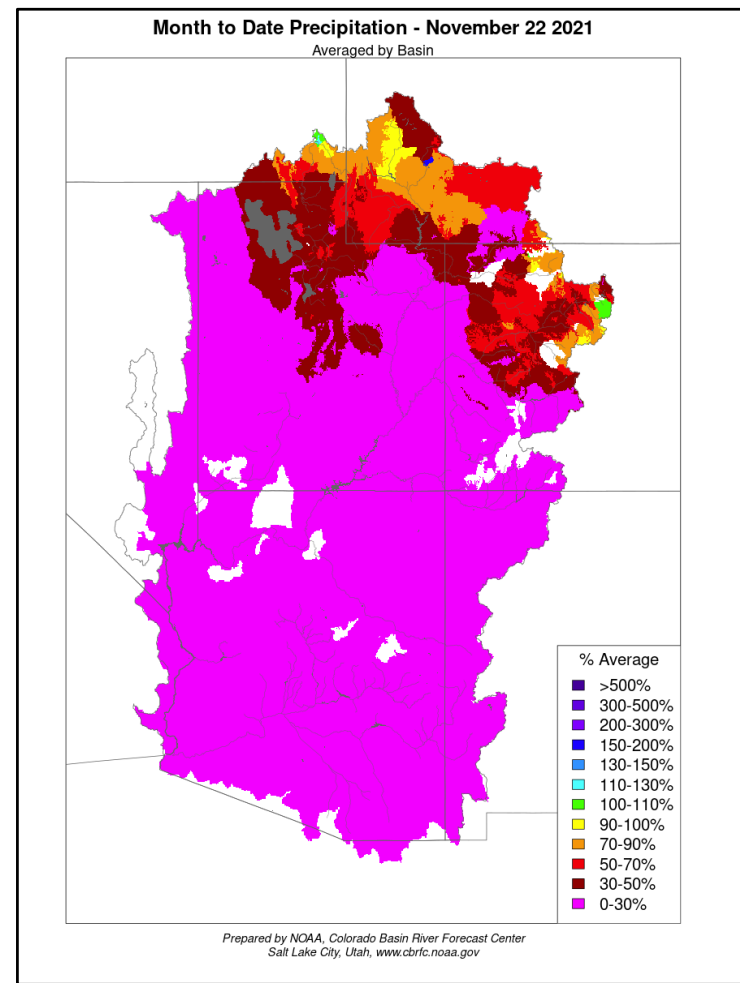
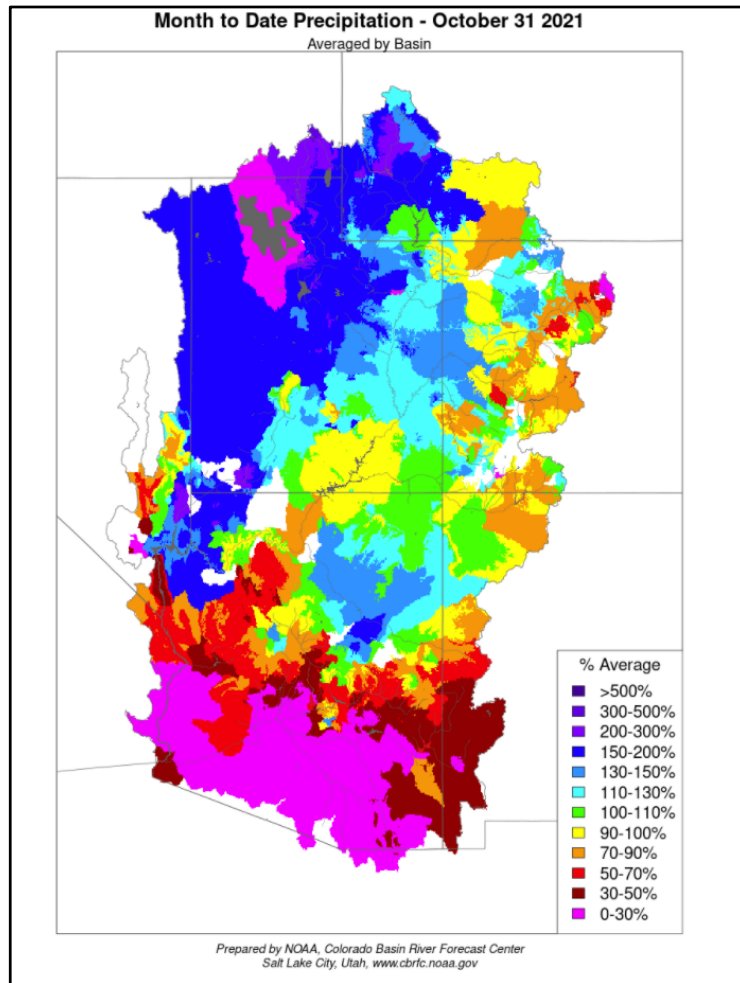
This briefing is being provided consistent with the provision in Section 1.1 of the LTEMP ROD which states:

“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.”

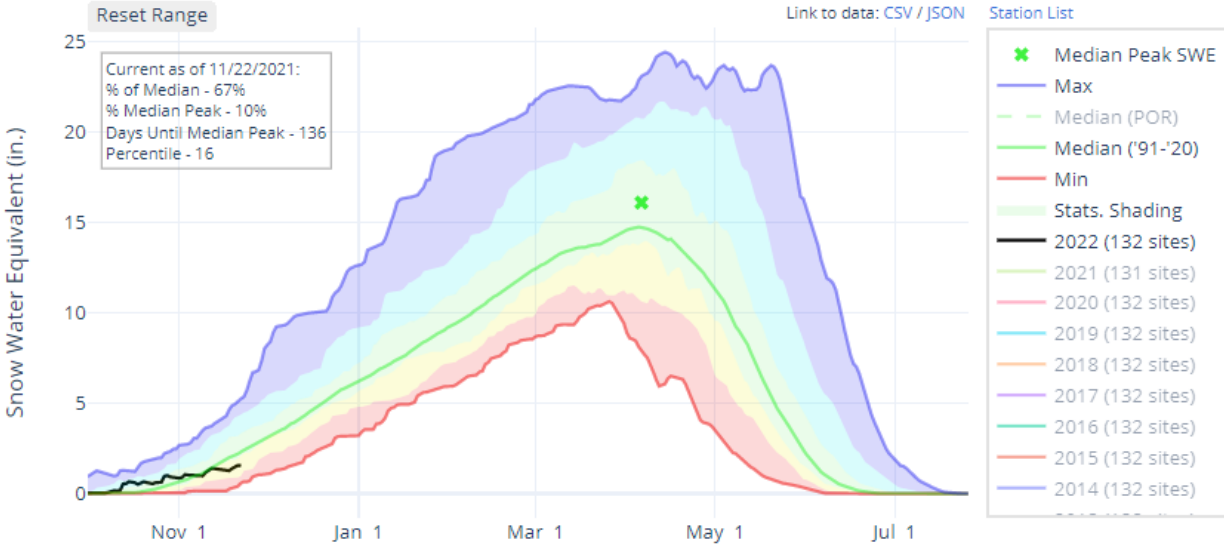


2022 Precipitation: October and November



Current SWE

SNOW WATER EQUIVALENT IN UPPER COLORADO REGION

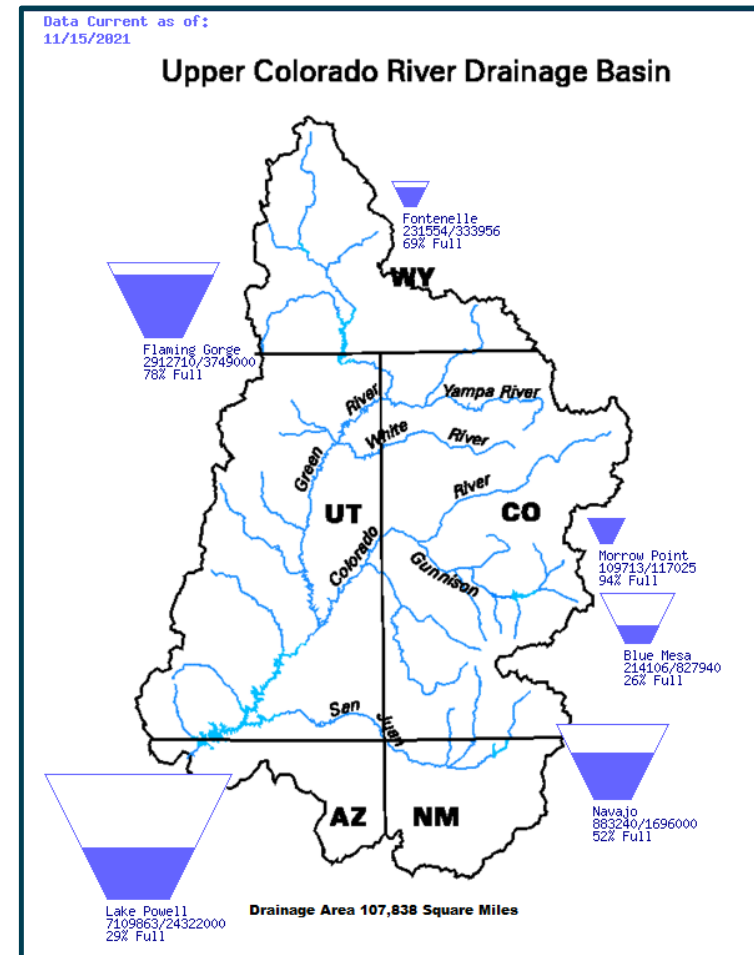


Available online at: <https://www.nrcs.usda.gov/>



Upper Basin Storage (as of November 22, 2021)

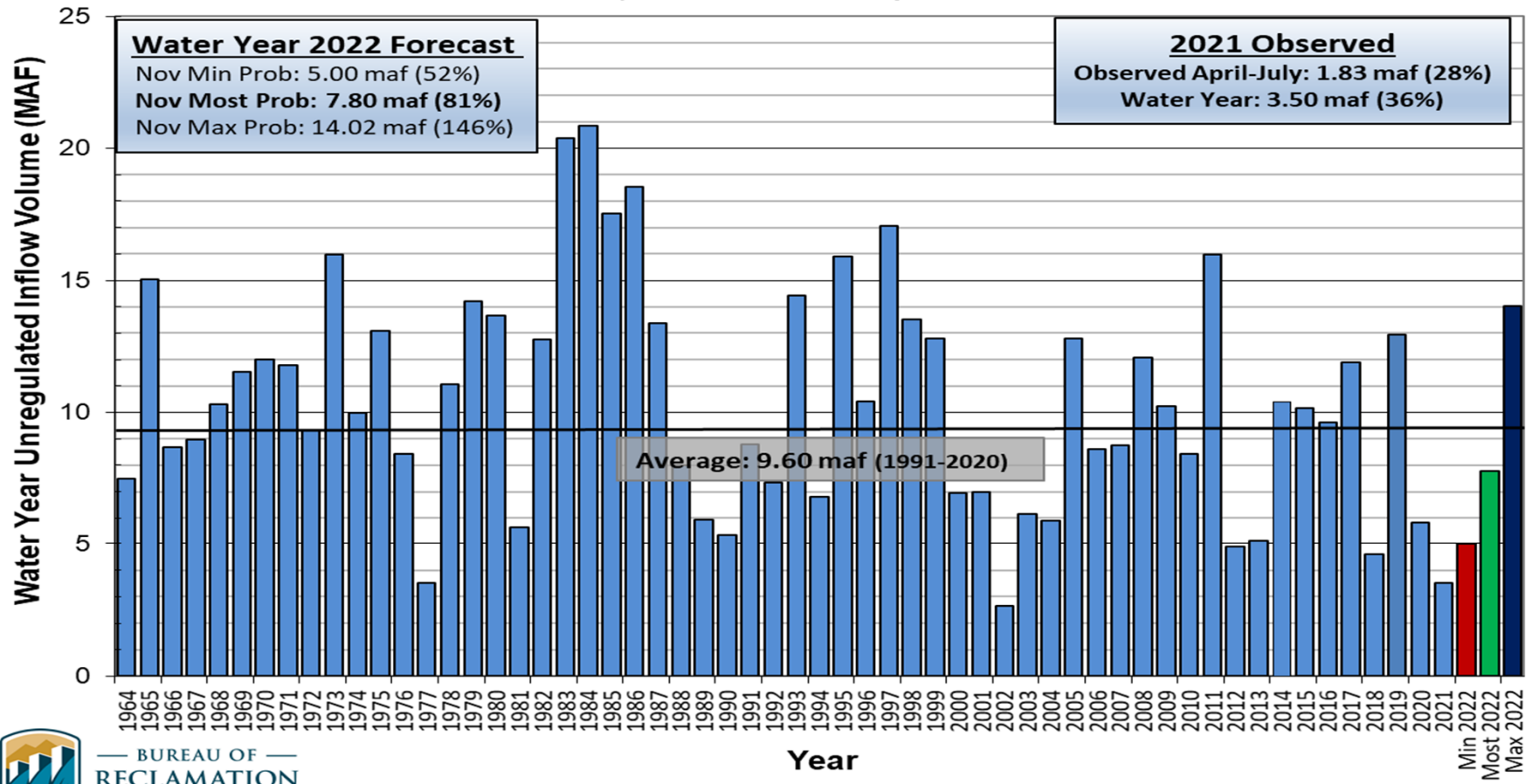
Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	70	0.23	0.33	6,491.67
Flaming Gorge	78	2.91	3.75	6,018.13
Blue Mesa	26	0.22	0.83	7,431.28
Navajo	52	0.88	1.70	6,021.68
Lake Powell	29	7.07	24.32	3,542.69
UC System Storage	37	11.32	30.93	



Lake Powell Unregulated Inflow

Water Year 2022 Forecast *(issued November 3)*

Comparison with History



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Most Probable October Forecast Water Year 2022

Water Year 2022
Forecasted Unregulated Inflow
as of November 1, 2021

Reservoir	Unregulated Inflow (kaf)	1991-2020 Percent of Avg
Fontenelle	905	84
Flaming Gorge	1,180	84
Blue Mesa	755	84
Navajo	680	75
Powell	7,792	81

April – July 2022
Forecasted Unregulated Inflow
as of November 1, 2021

Reservoir	Unregulated Inflow (kaf)	1991-2020 Percent of Avg
Fontenelle	625	85
Flaming Gorge	810	84
Blue Mesa	545	86
Navajo	490	78
Powell	5,270	82





Upper Colorado Basin

**Projected Operations
for Water Year 2022
Based on November
2021 Modeling**



Upper Basin DROA Initial Unit Drought Response Releases that started in July 2021

- July WY2021 forecast decreased 140 kaf from the June forecast
- Continued drought conditions exacerbated already parched soil moisture conditions
- WY2022 most probable forecast decreased 1.84 maf (17%)
 - May forecast 9.97 maf (92% avg)
 - July forecast 8.13 maf (75% avg)
- Prospects of future monsoon events unknown

DROA Releases for the July 24MS Model Run

	Jul	Aug	Sep	Oct	Nov	Dec	Sum
	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	
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

DROA Releases for the November 24MS Model Run

	Jul	Aug	Sep	Oct	Nov	Dec	Sum
	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	
Flaming Gorge	12	45	44	24	0	0	125
Blue Mesa	0	17	16	3	0	0	36
Navajo	0	0	0	0	0	20	20
Sum:	12	62	60	27	0	20	181



Lake Powell & Lake Mead Operational Table

Operating Determinations for Water Year/Calendar Year 2022

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 Tier ² 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		11.9
	3,535.40 ft		1,075	1,065.85 ft	9.4
3,525	Jan 1, 2022 Projection	5.9	1,050	Shortage Condition Deliver 7.167 ³ maf	7.5
	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	4.0	1,025	Shortage Condition Deliver 7.083 ³ maf	5.8
3,490			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.

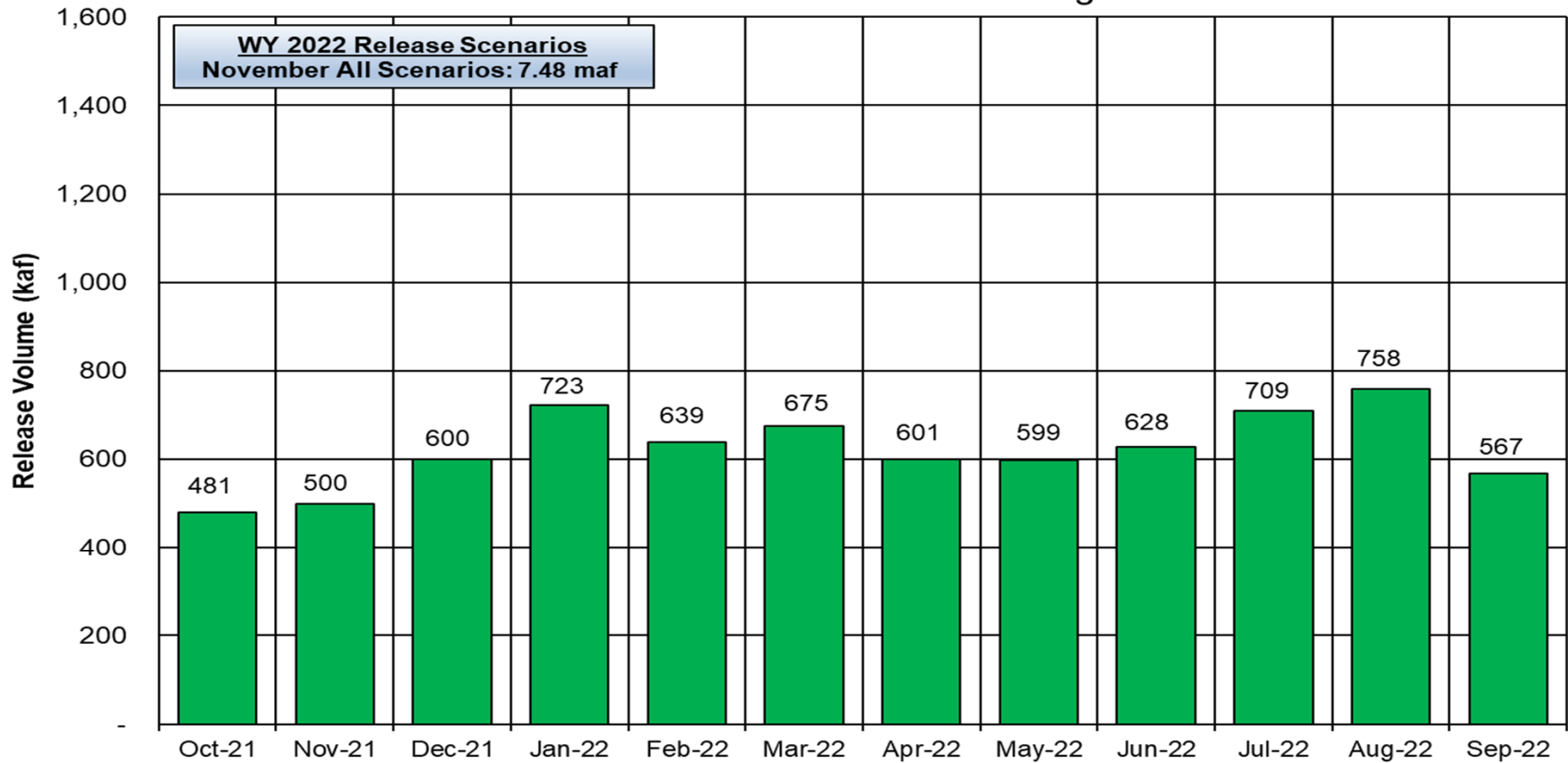
¹ Lake Powell and Lake Mead operating determinations are based on August 2021 24-Month Study projections consistent with the 2007 Interim Guidelines and 2019 Drought Contingency Plans. These determinations will be documented in the 2022 Annual Operating Plan for Colorado River Reservoirs.



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on November 2021 Modeling



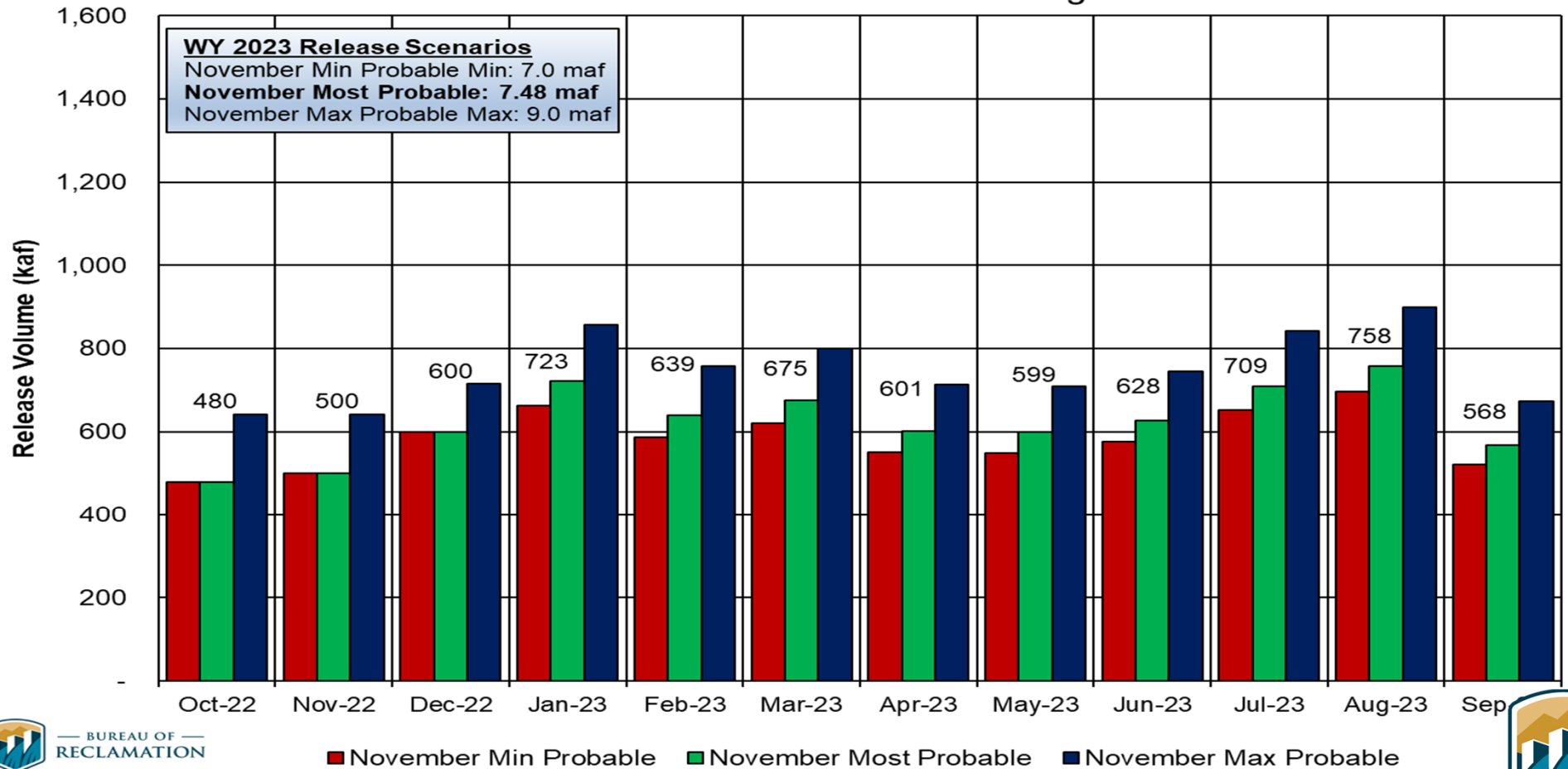
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The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023
Based on November 2021 Modeling



■ November Min Probable ■ November Most Probable ■ November Max Probable



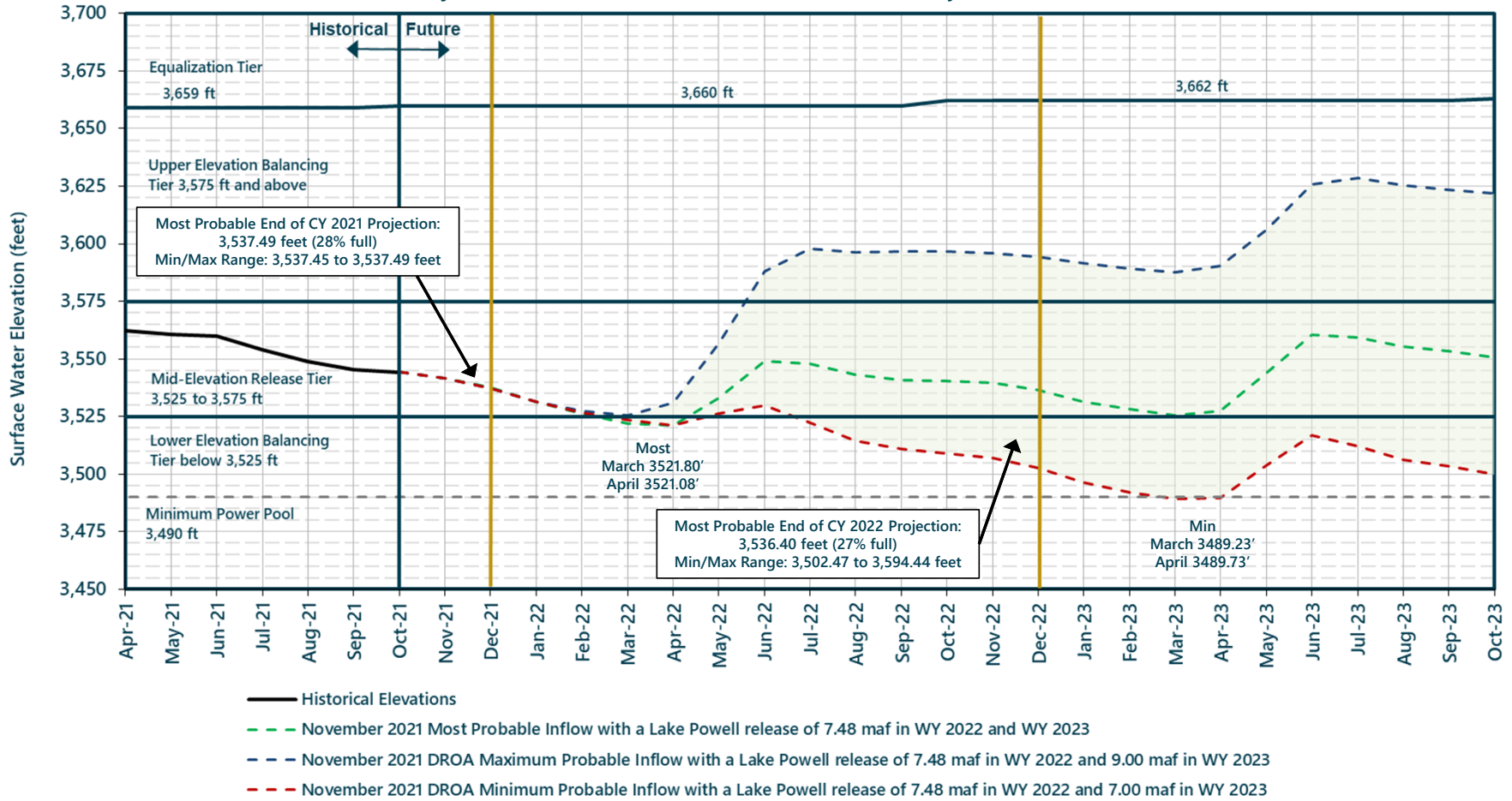
Reclamation Operational Modeling Model Comparison

	<i>Colorado River Mid-term Modeling System (CRMMS)</i>		<i>CRSS</i>
	<i>24-Month Study Mode (Manual Mode)</i>	<i>Ensemble Mode (Rule-based Mode)</i>	
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 35 (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, 35 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

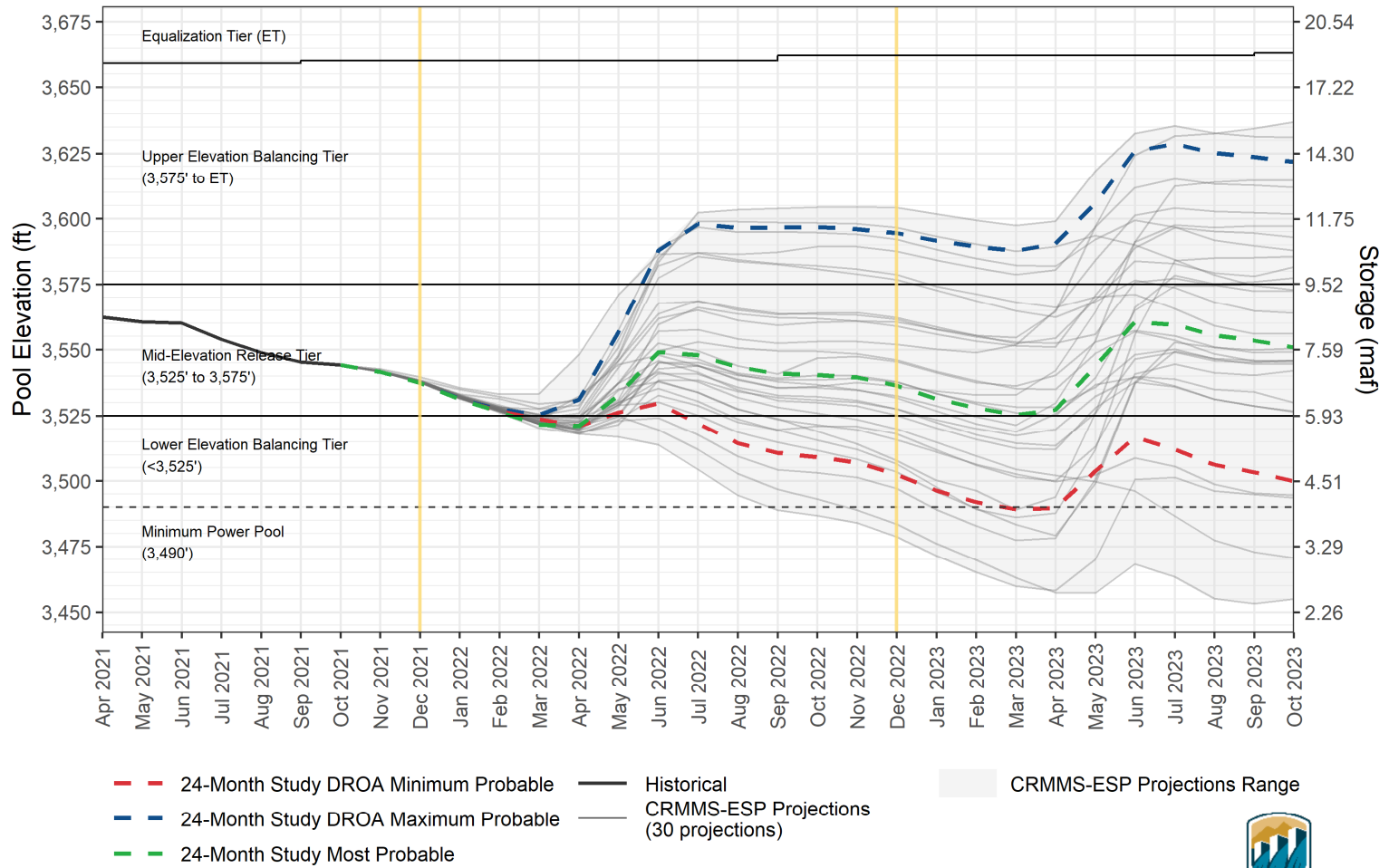
Projections from the November 2021 24-Month Study Inflow Scenarios



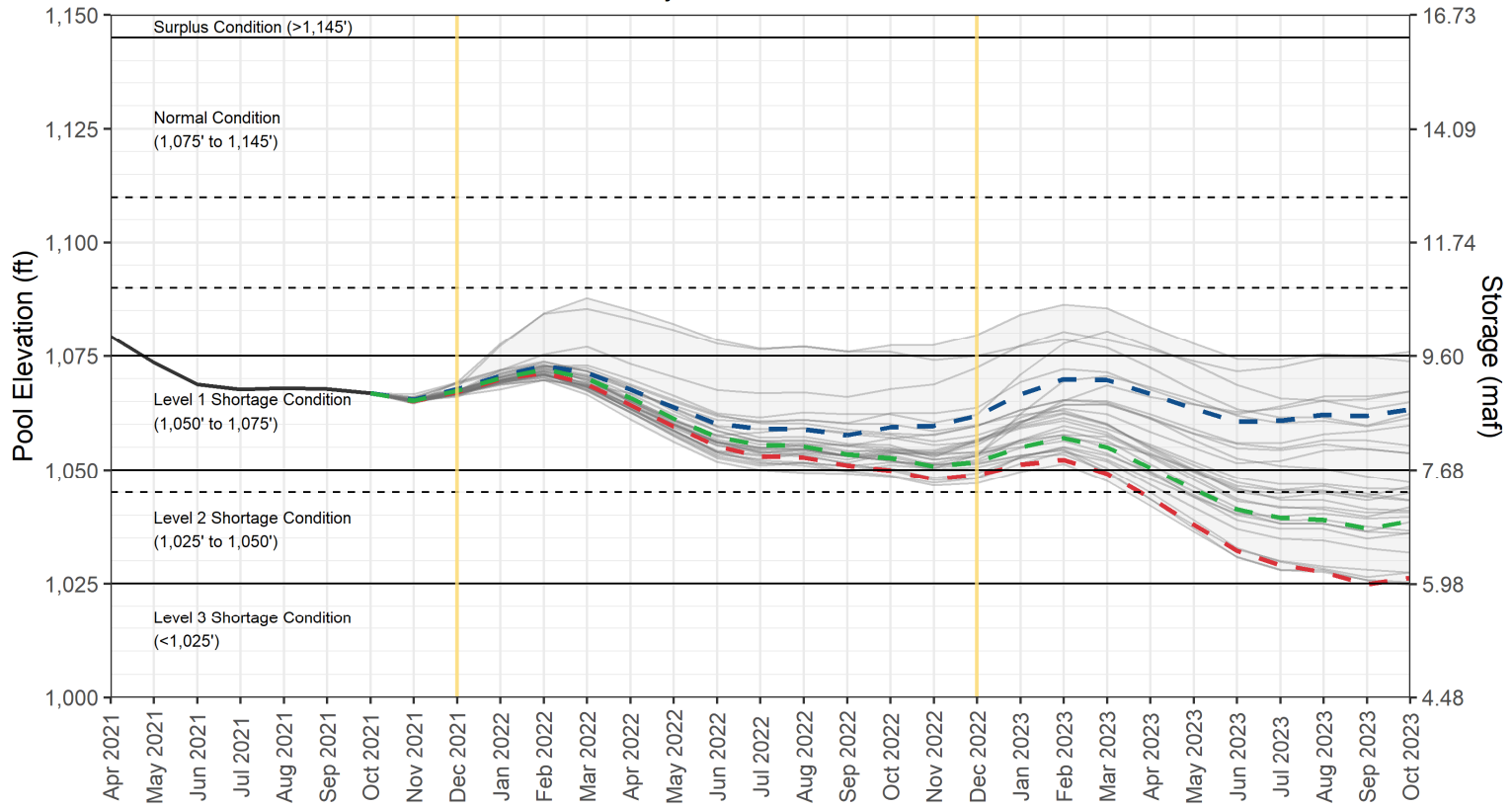
The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.



Lake Powell End-of-Month Elevations CRMMS Projections from November 2021



Lake Mead End-of-Month Elevations CRMMS Projections from November 2021



- - - 24-Month Study DROA Minimum Probable
- - - 24-Month Study DROA Maximum Probable
- - - 24-Month Study Most Probable
- Historical
- CRMMS-ESP Projections (30 projections)
- CRMMS-ESP Projections Range





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	5	6	7	8	6	7	8	7	8	8	8	6
Capacity (cfs)	15,100	18,500	18,400	18,300	11,400	18,100	24,800	22,100	26,200	26,200	26,000	19,000
Capacity (kaf/month)	960	1,100	1,430	1,510	940	1,300	1,480	1,390	1,560	1,610	1,600	1,200
Max (kaf) ¹	643	642	715	857	758	801	713	710	745	842	900	674
Most (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	568
Min (kaf) ¹	480	500	600	664	587	620	552	550	577	652	696	522

NOV MOST²

NOV MOST

9.0 maf

7.48 maf

7.0 maf

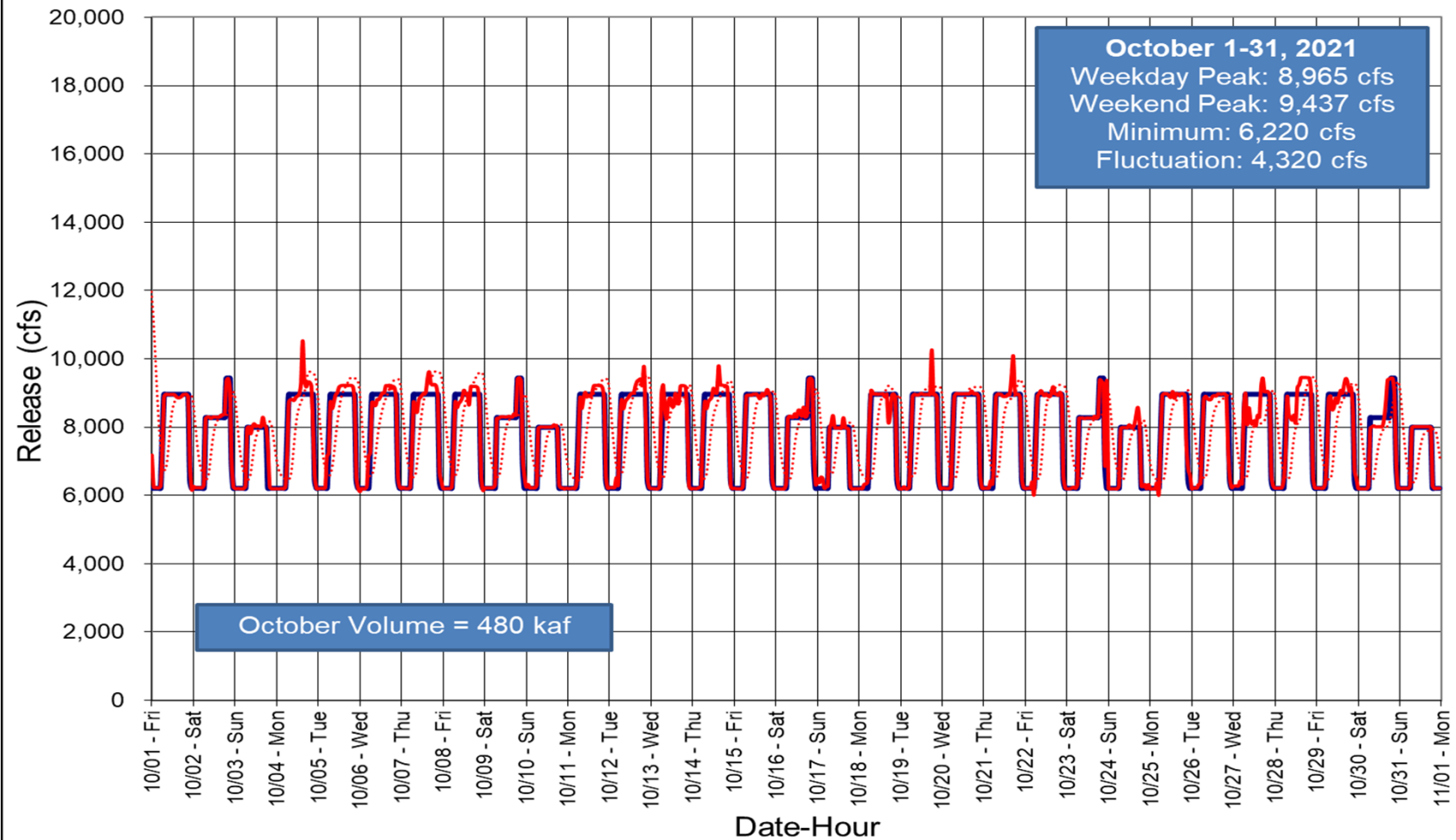
(updated 11-10-2021)

1 Projected release, based on November 2021 minimum, most and maximum probable Inflow Projections and 24-Month Study model runs.

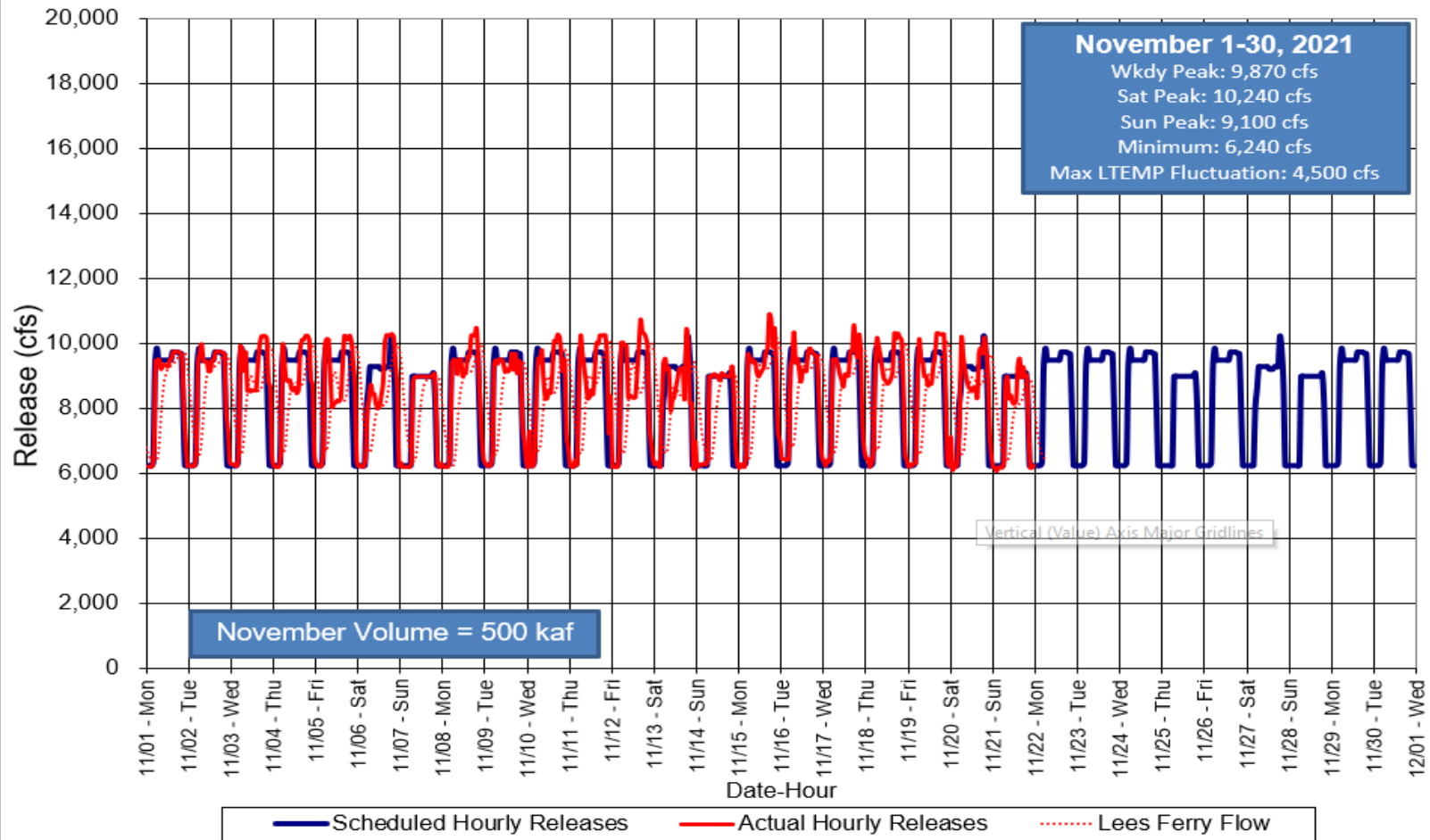
2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.



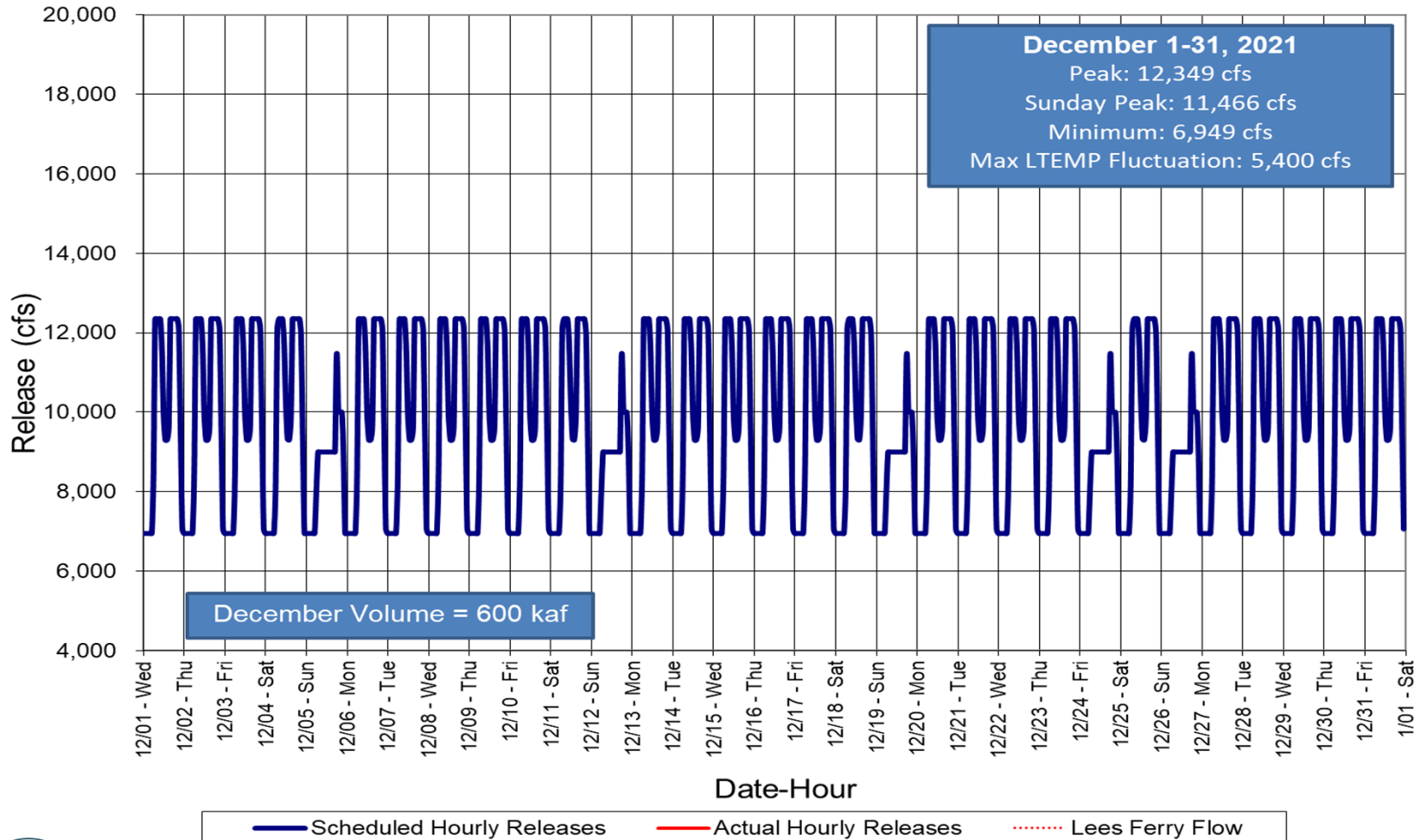
Glen Canyon Dam Hourly Release Pattern October 2021



Glen Canyon Dam Hourly Release Pattern November 2021



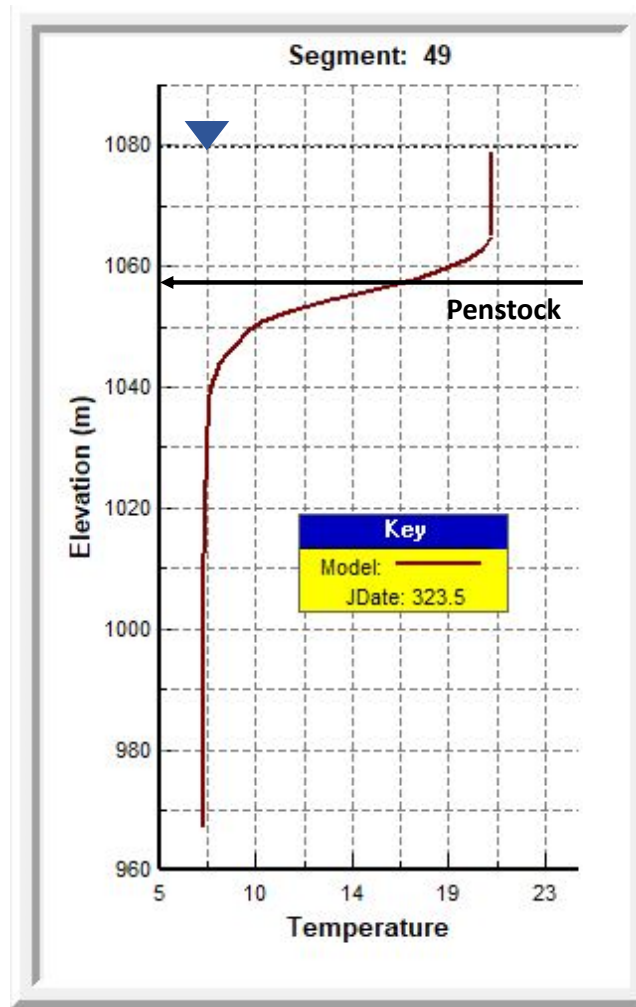
Glen Canyon Dam Hourly Release Pattern December 2021



Water Quality

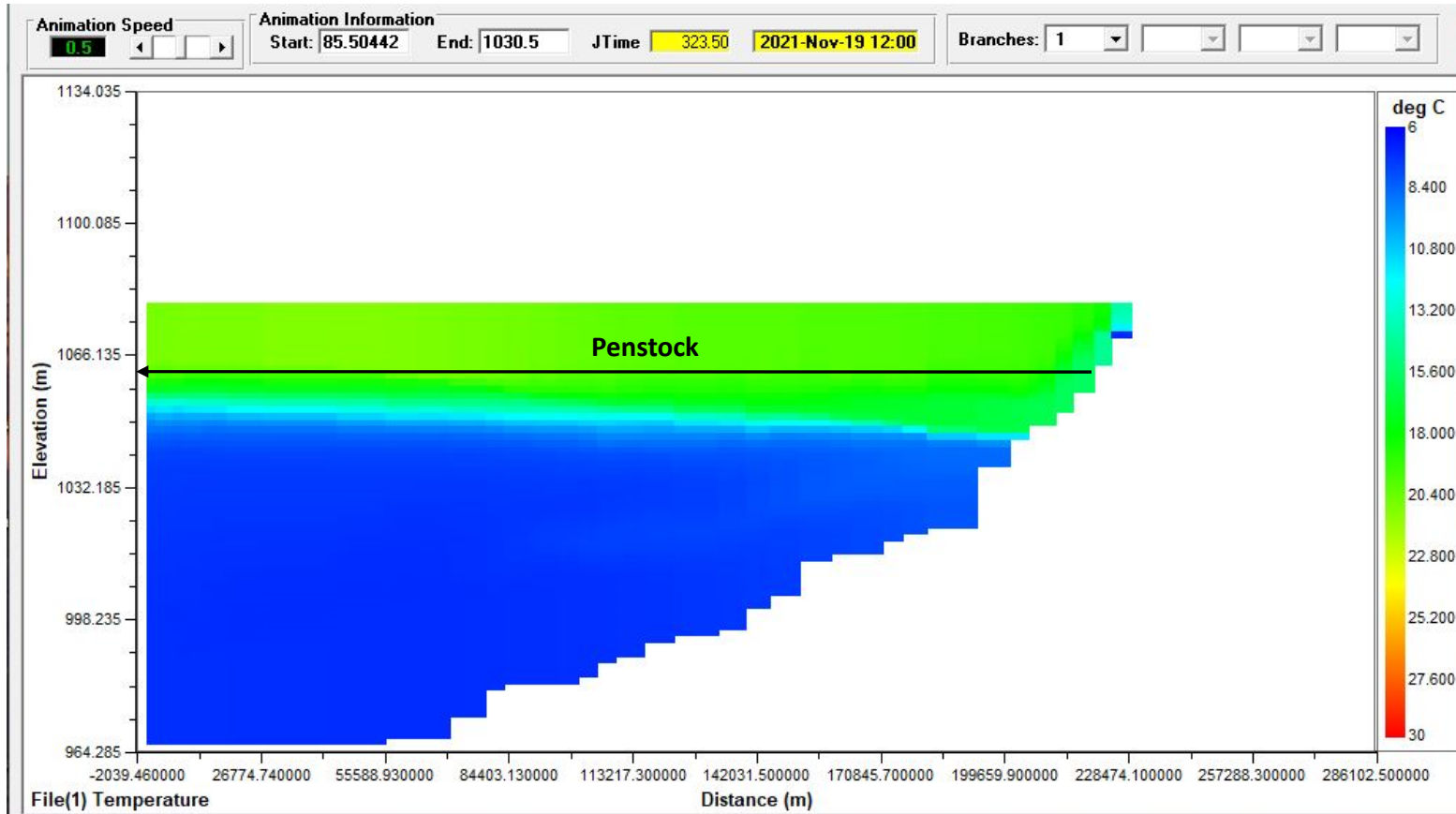


Temperature Profile of Lake Powell near Glen Canyon Dam
11/19/2021

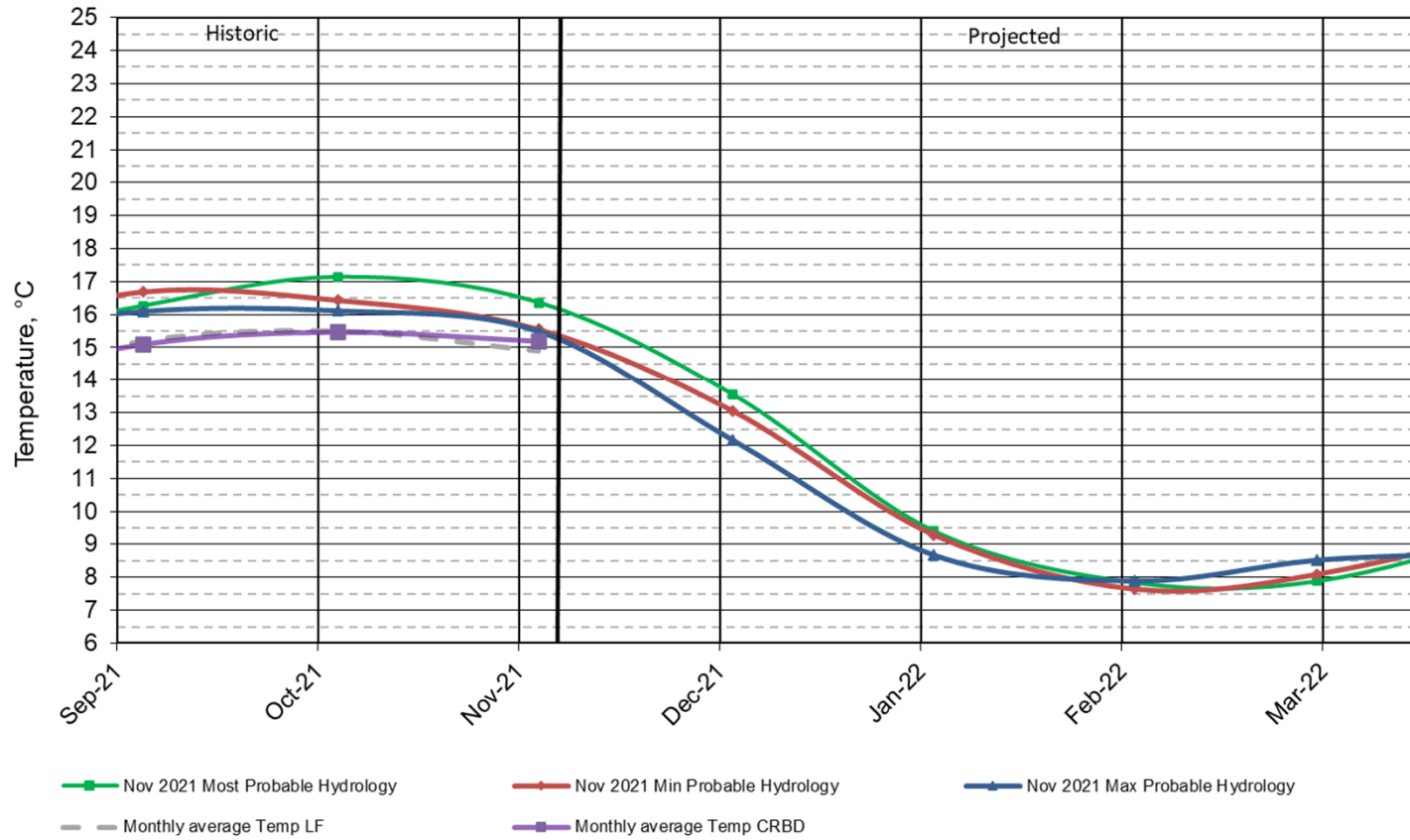


Cross Sectional Temperature Profile of Lake Powell

11/19/2021

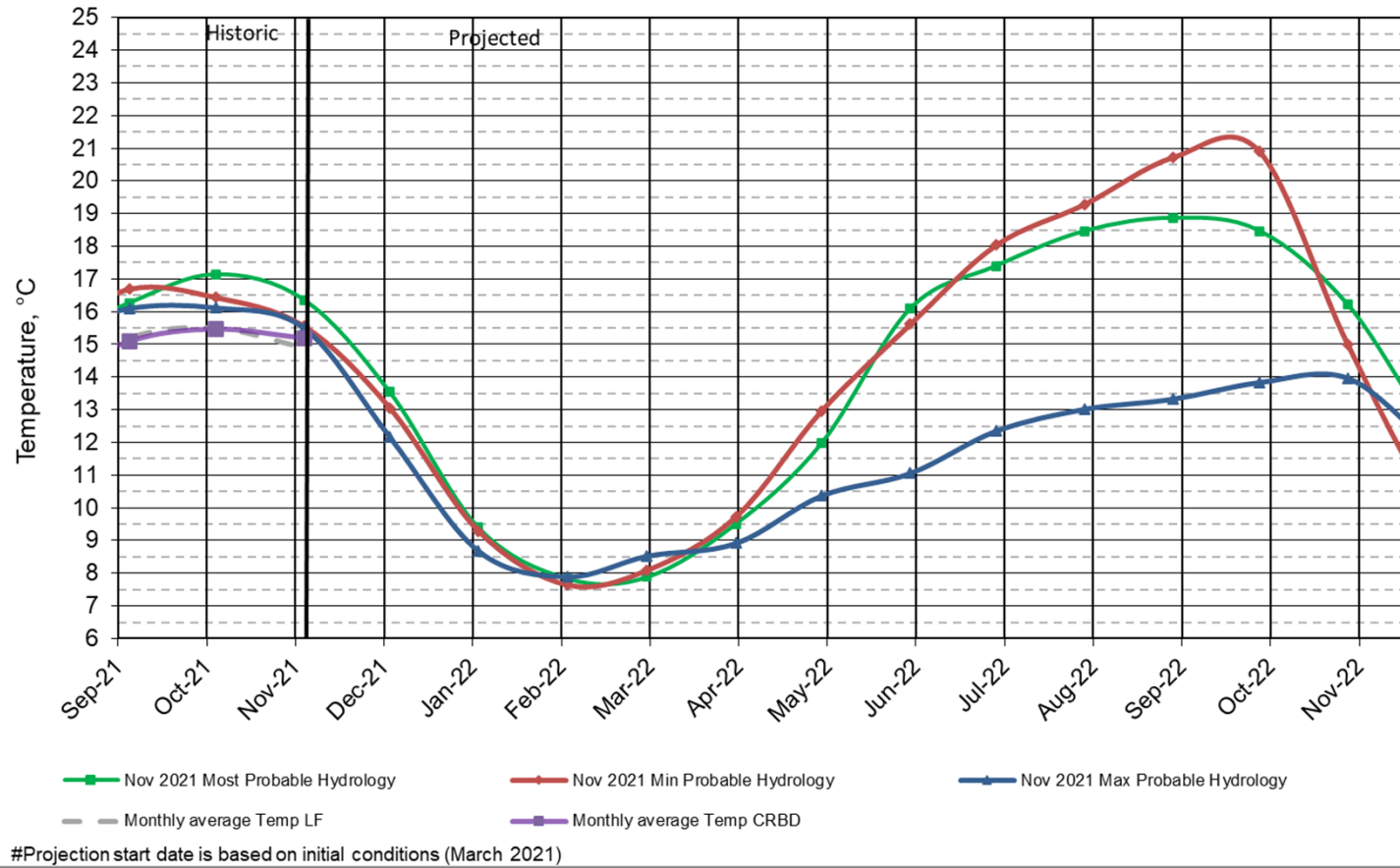


Lake Powell Release Temperature
 Projected Temperature based on Nov 2021 Forecast

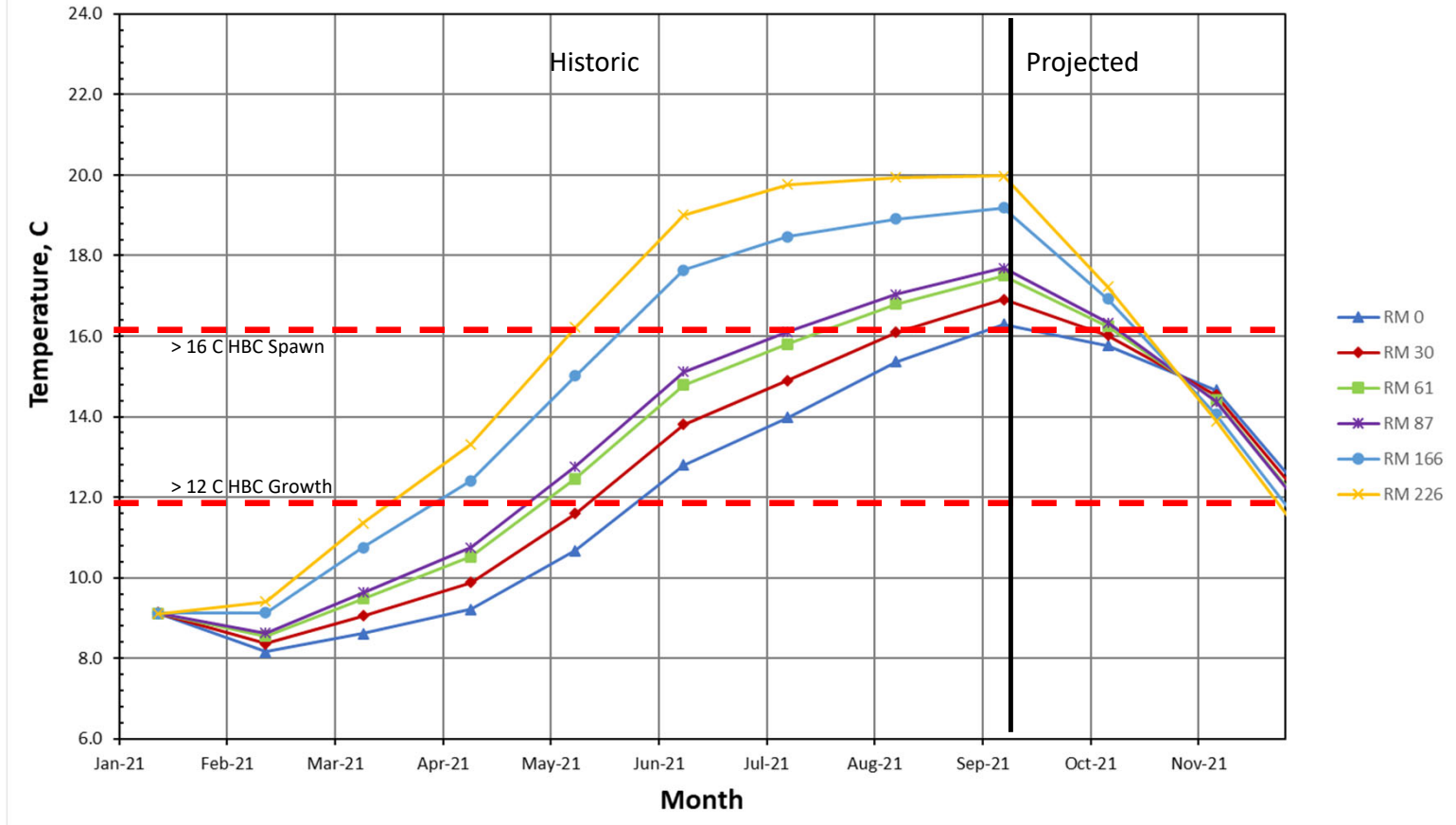


#Projection start date is based on initial conditions (March 2021)

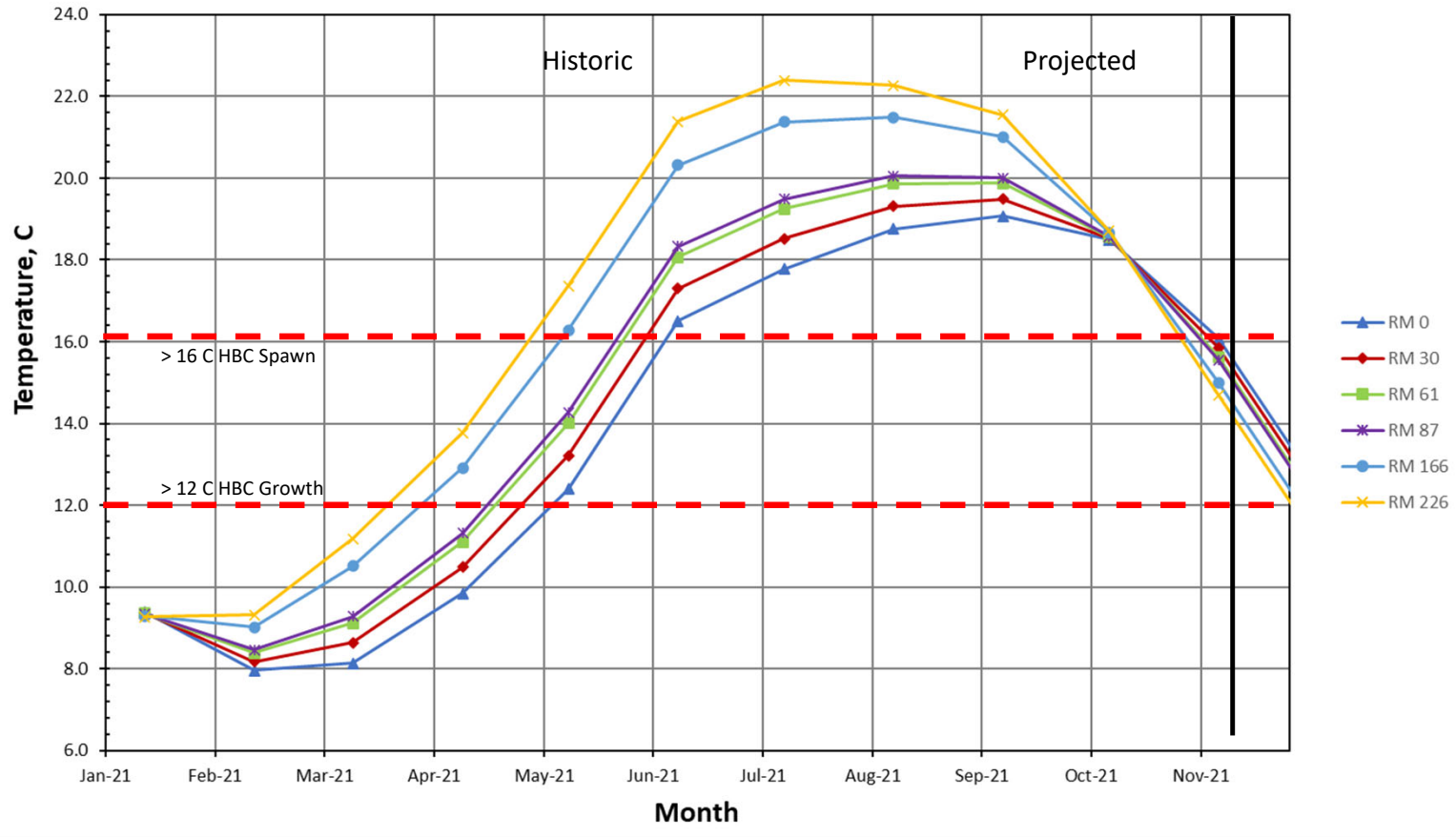
Lake Powell Release Temperature Projected Temperature based on Nov 2021 Forecast

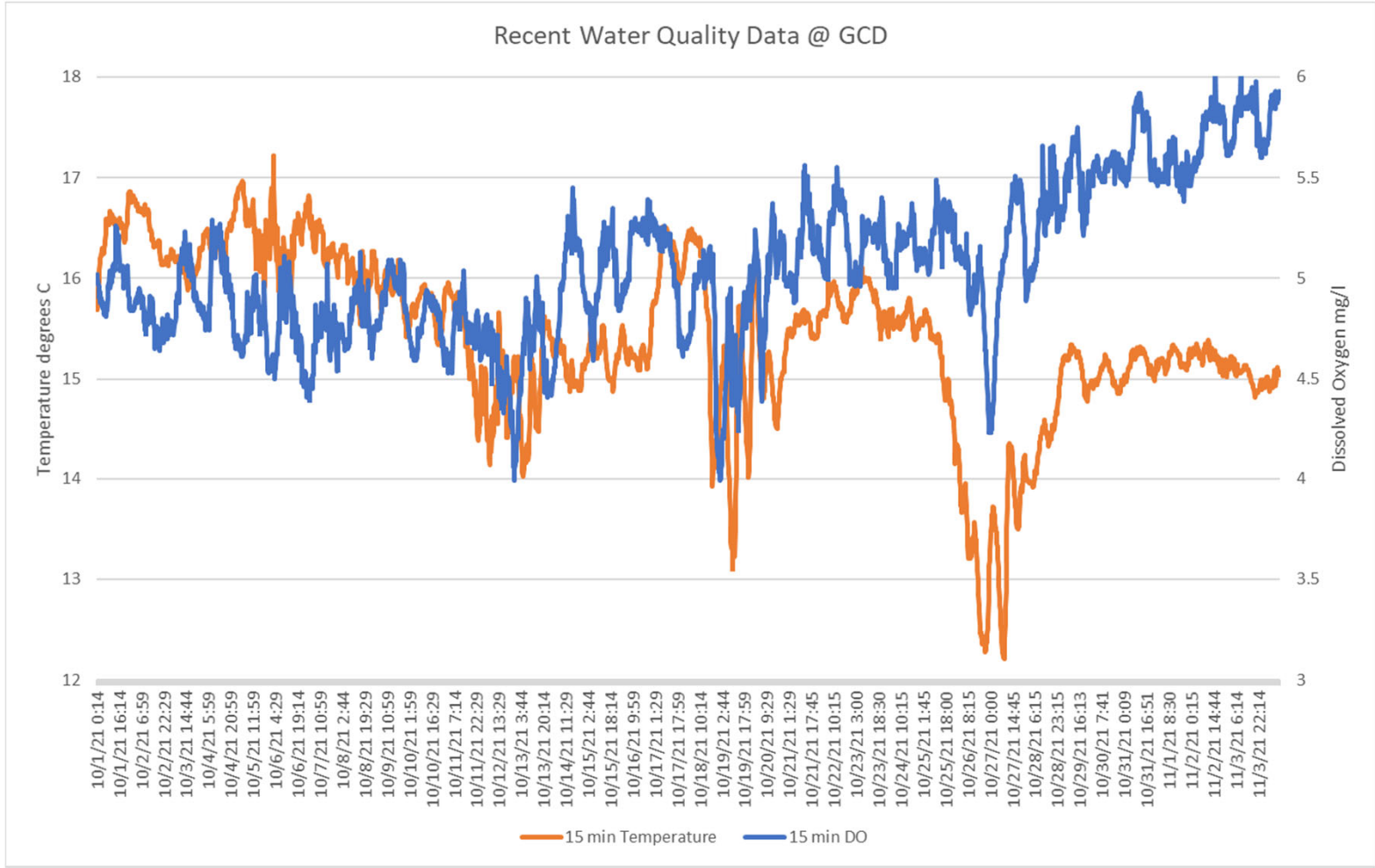


Colorado River, Grand Canyon Water Temperatures
 Projections based on August 2021, Most Probable Hydrology (Dibble 2020)



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





Questions?



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