



— BUREAU OF —
RECLAMATION

Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

August 22, 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.”

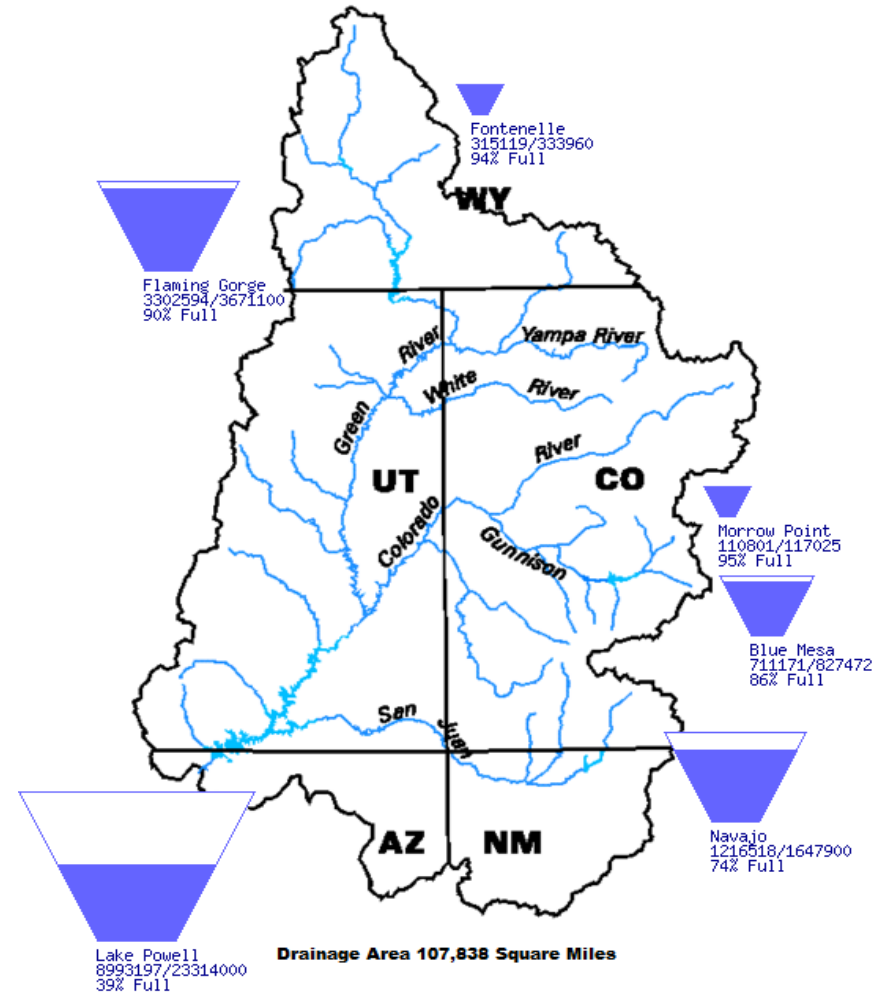


Upper Basin Storage (as of August 20, 2023)

Data Current as of:
08/20/2023

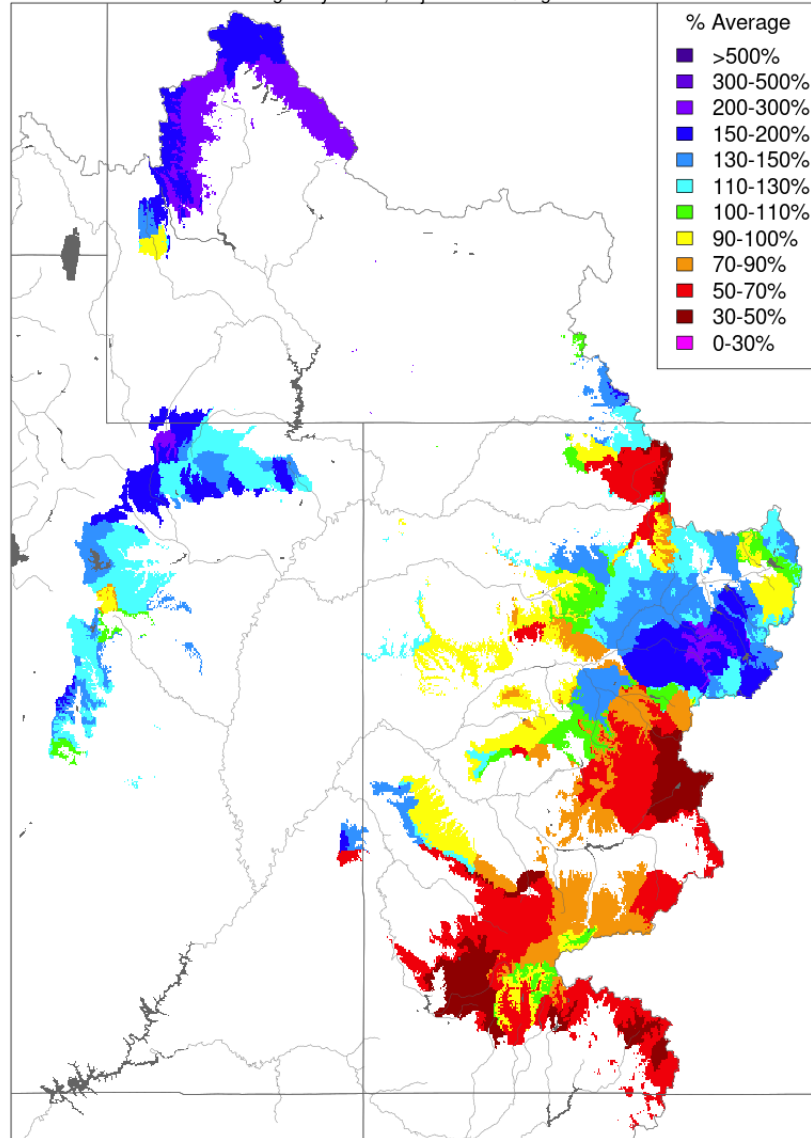
Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	94	0.32	0.33	6,503.57
Flaming Gorge	90	3.30	3.67	6,030.97
Blue Mesa	86	0.71	0.83	7,506.28
Navajo	74	1.22	1.65	6,053.85
Lake Powell	39	8.99	23.31	3,576.19
UC System Storage	49	14.67	29.93	
System Storage	44	25.70	58.48	

Upper Colorado River Drainage Basin



Month to Date Precipitation - August 21 2023

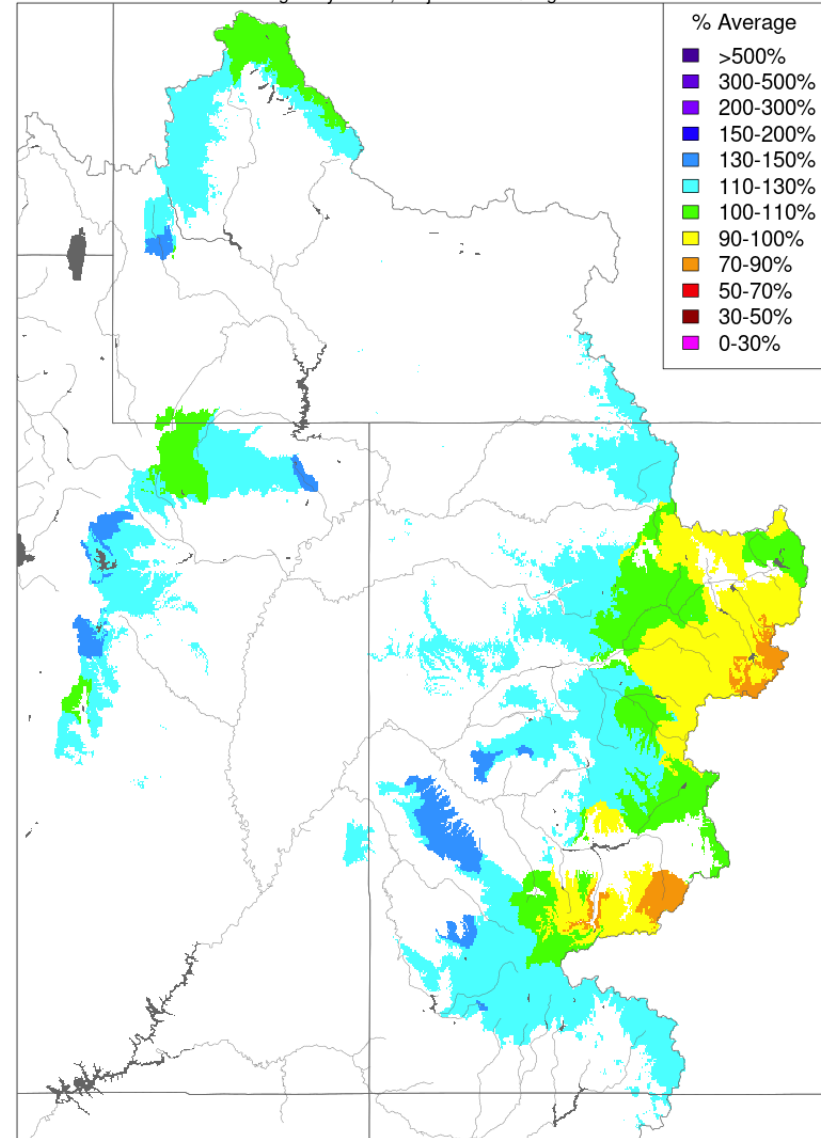
Averaged by Basin, Major Contributing Areas



Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov

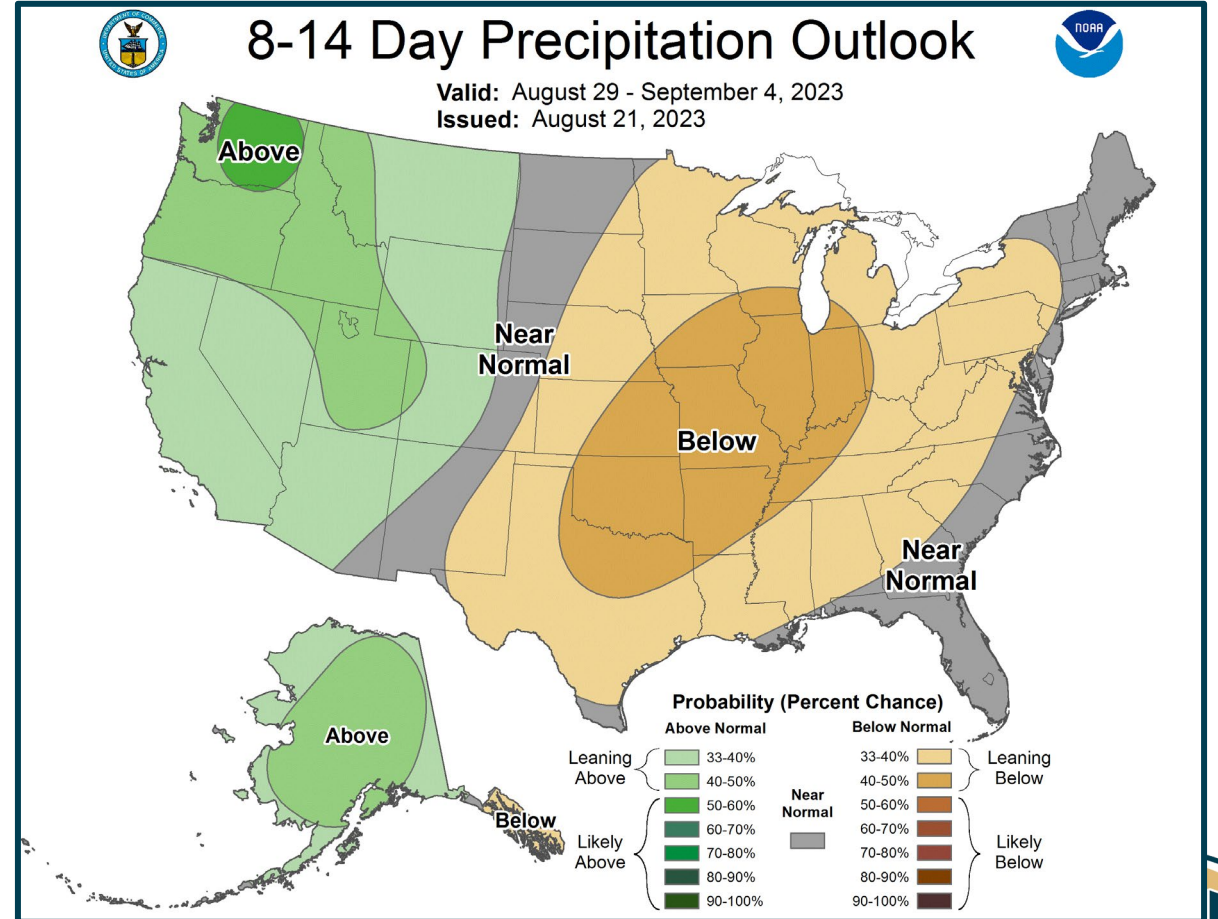
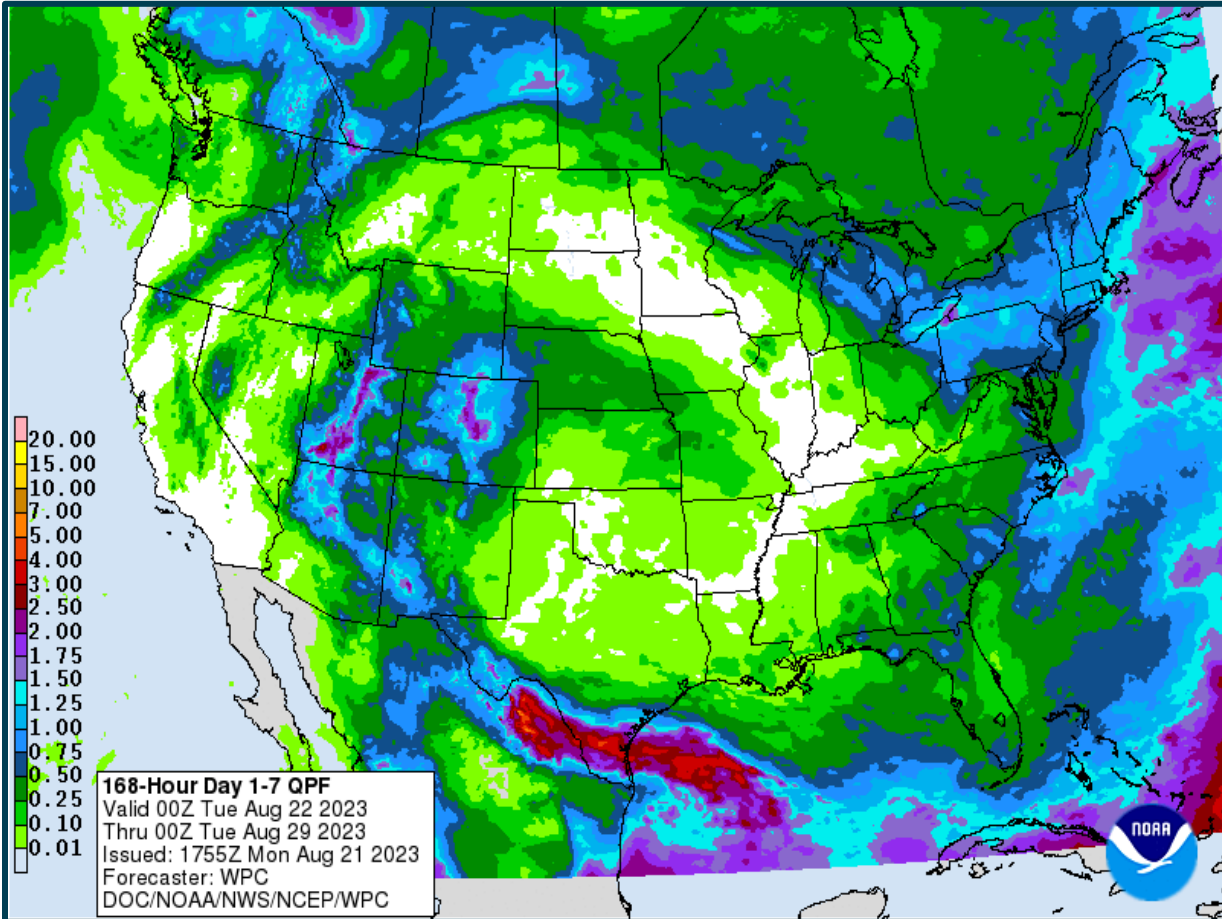
Water Year Precipitation, October 2022 - July 2023

Averaged by Basin, Major Contributing Areas

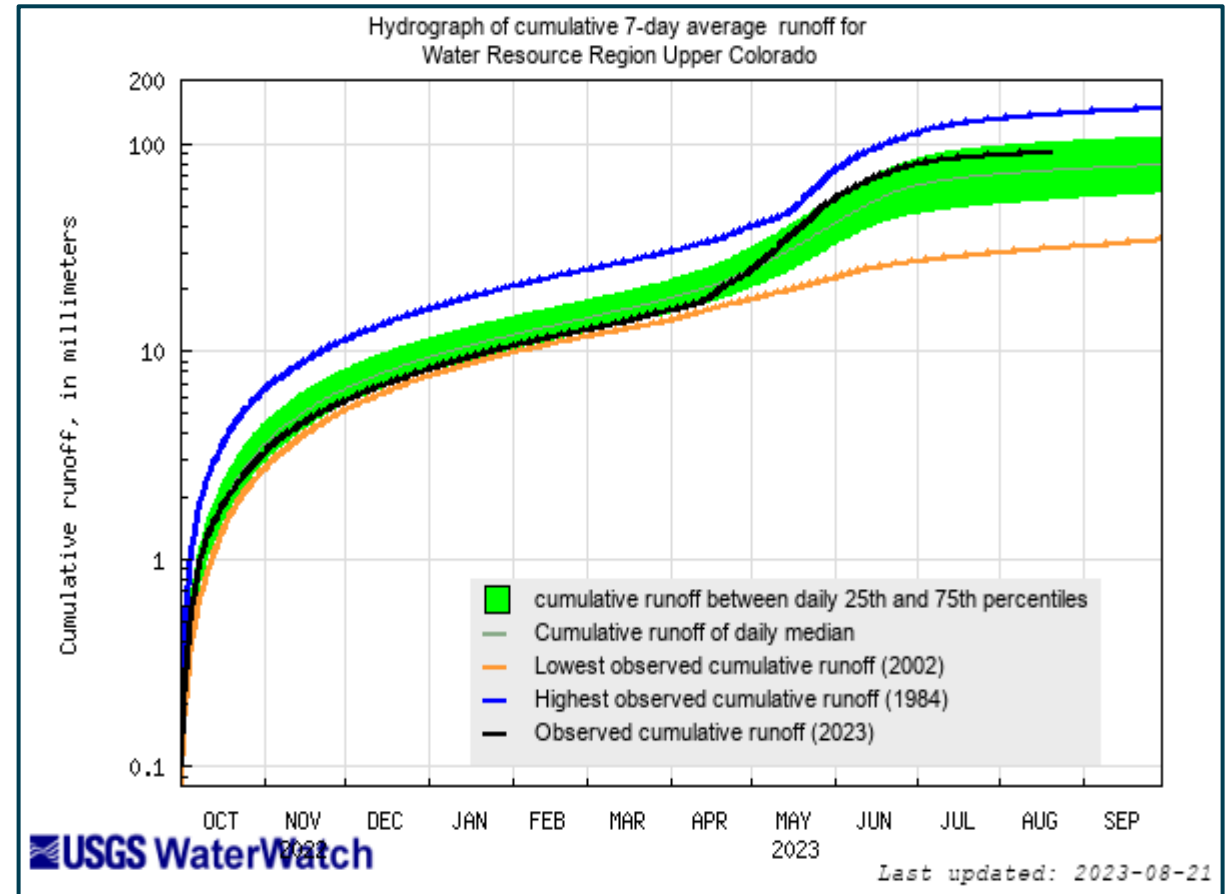
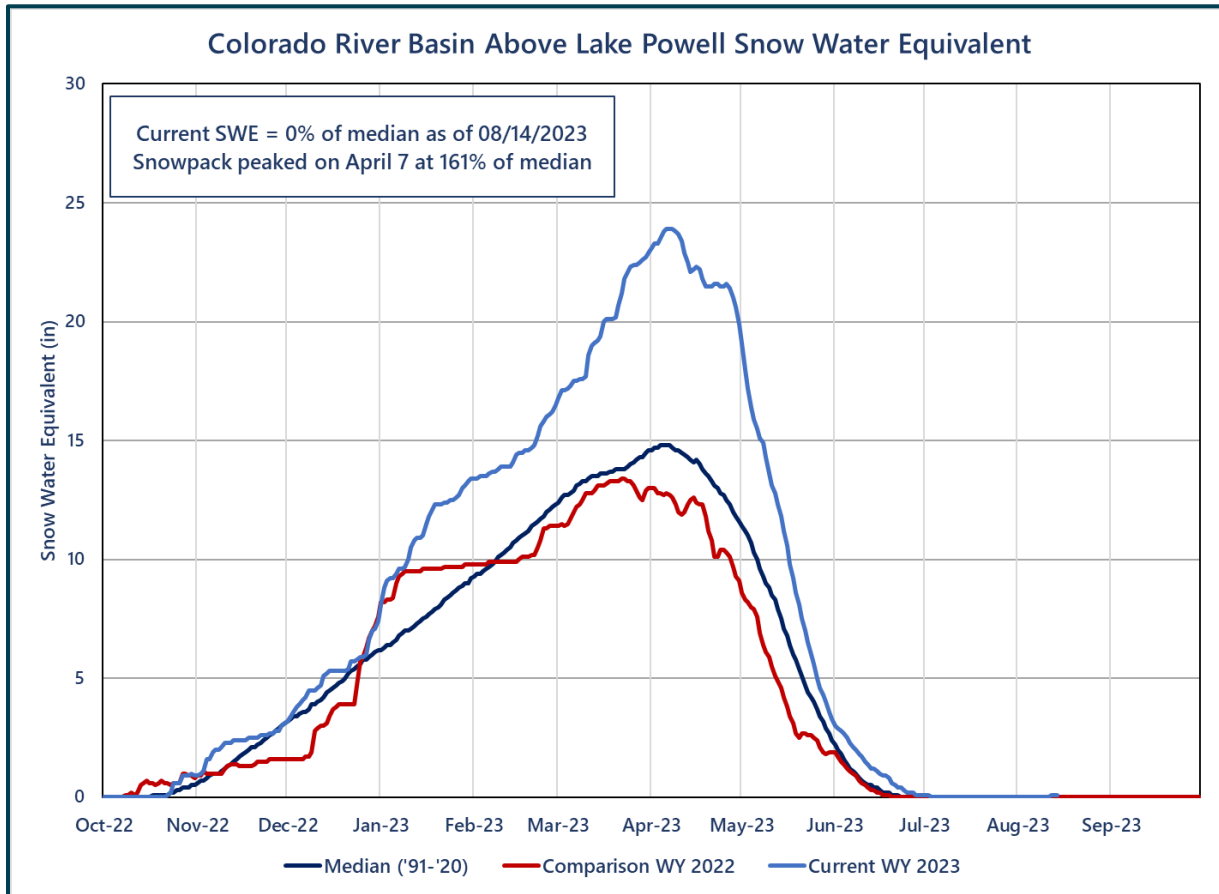


Prepared by NOAA, Colorado Basin River Forecast Center
Salt Lake City, Utah, www.cbrfc.noaa.gov

Weather Prediction Center and Climate Prediction Center Precipitation Forecasts



Upper Colorado SWE and Observed Inflows



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



Most Probable August Preliminary Observed and Forecast Water Year 2023

April – July 2023
Preliminary Observed
Unregulated Inflow
as of August 1, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	951	129
Flaming Gorge	1,457	151
Blue Mesa	833	131
Navajo	1,028	163
Powell	10,619	166

Water Year 2023
Unregulated Inflow Forecast
as of August 1, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	1,251	116
Flaming Gorge	1,810	128
Blue Mesa	1,083	120
Navajo	1,265	139
Powell	13,750	143

Midmonth Powell 13,720 kaf (143%)

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



Most Probable August Forecast Water Year 2024

April – July 2024
Forecasted Unregulated Inflow
as of August 1, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	690	94
Flaming Gorge	920	95
Blue Mesa	620	97
Navajo	577	92
Powell	6,420	100

Water Year 2024
Unregulated Inflow Forecast
as of August 1, 2023

Reservoir	Inflow (kaf)	Percent of Avg ¹
Fontenelle	1,030	96
Flaming Gorge	1,380	98
Blue Mesa	895	99
Navajo	845	93
Powell	10,000	104

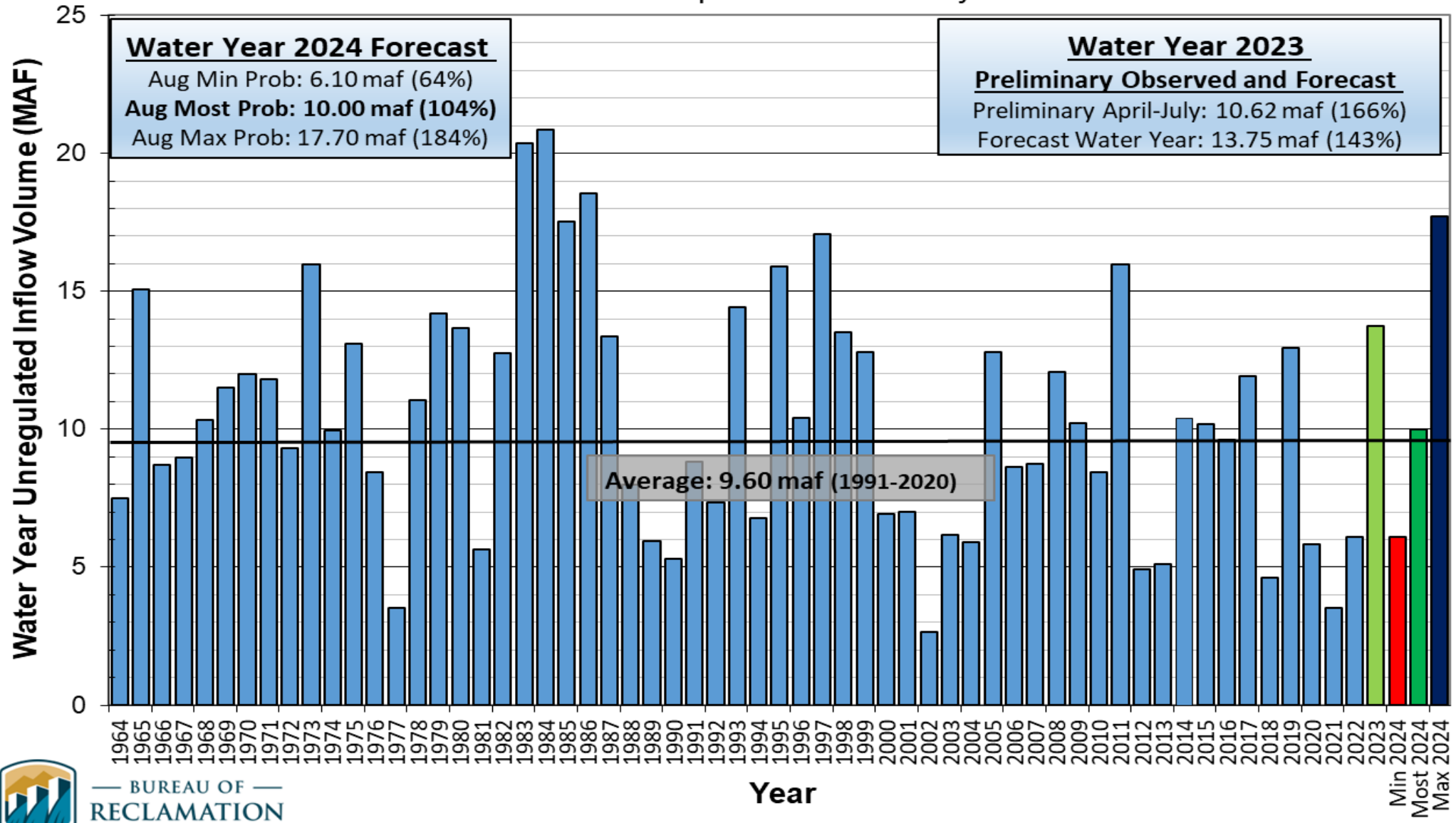
¹Averages are based on the 1991 through 2020 period of record.



Lake Powell Unregulated Inflow

Water Year 2023 and 2024 Forecast *(issued August 1)*

Comparison with History





Upper Colorado Basin

Hydrology and Operations
Projections Based on August
2023 24-Month Study



Upper Basin Reservoir Operations

Water Years 2023 and 2024

- 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 water year (WY) 2023 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
- Lake Powell WY 2024 will operate in the Mid-Elevation Release Tier where Lake Powell will release 7.48 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.



Lake Powell & Lake Mead Operational Table

Lake Powell Operational Tier Determination Run (aka "Exhibit Run") with an 8.23 maf Release¹

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 Tier³ 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
3,525	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,105	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	11.9
			1,075	Shortage Condition Deliver 7.167 ⁴ maf	9.4
3,490	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	5.9	1,050	Shortage Condition Deliver 7.083 ⁵ maf	7.5
3,490			1,025	Shortage Condition Deliver 7.0 ⁶ maf Further measures may be undertaken ⁷	5.8
3,370		0	1,000		4.3
			895		0

3,568.57 ft
Jan 1, 2024
Projection

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

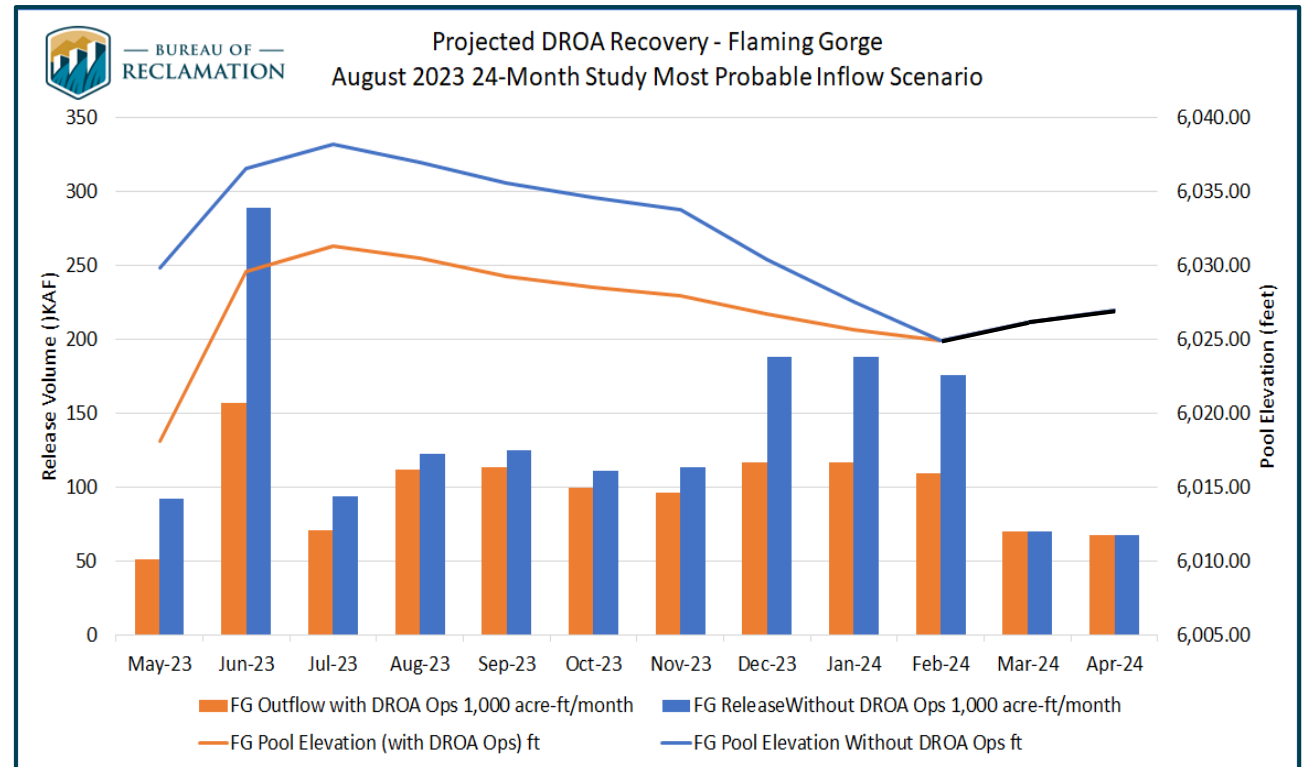
⁷ Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division States and Mexico is likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with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



Drought Response Operations Agreement (DROA)

Completed DROA Volumes^{1,2}

Reservoir	2021 DROA Volume (kaf)	2022 DROA Volume (kaf)	2023 DROA Volume (kaf) ⁴	Total DROA Volume (kaf)
Flaming Gorge	125	328 ³	-193	260
Blue Mesa	36	0	0	36
Navajo	0	0	0	0
Total DROA Volume (kaf)	161	328	-193	296



¹DROA operational year is from May through April.

²Positive values indicate Drought Response Operations Releases and negative values indicate Drought Response Operations Recovery

³ 463 kaf of DROA releases prior to DROA release suspension on March 6, 2023.

-135 kaf of DROA recovery from March 7, 2023 through April 30, 2023

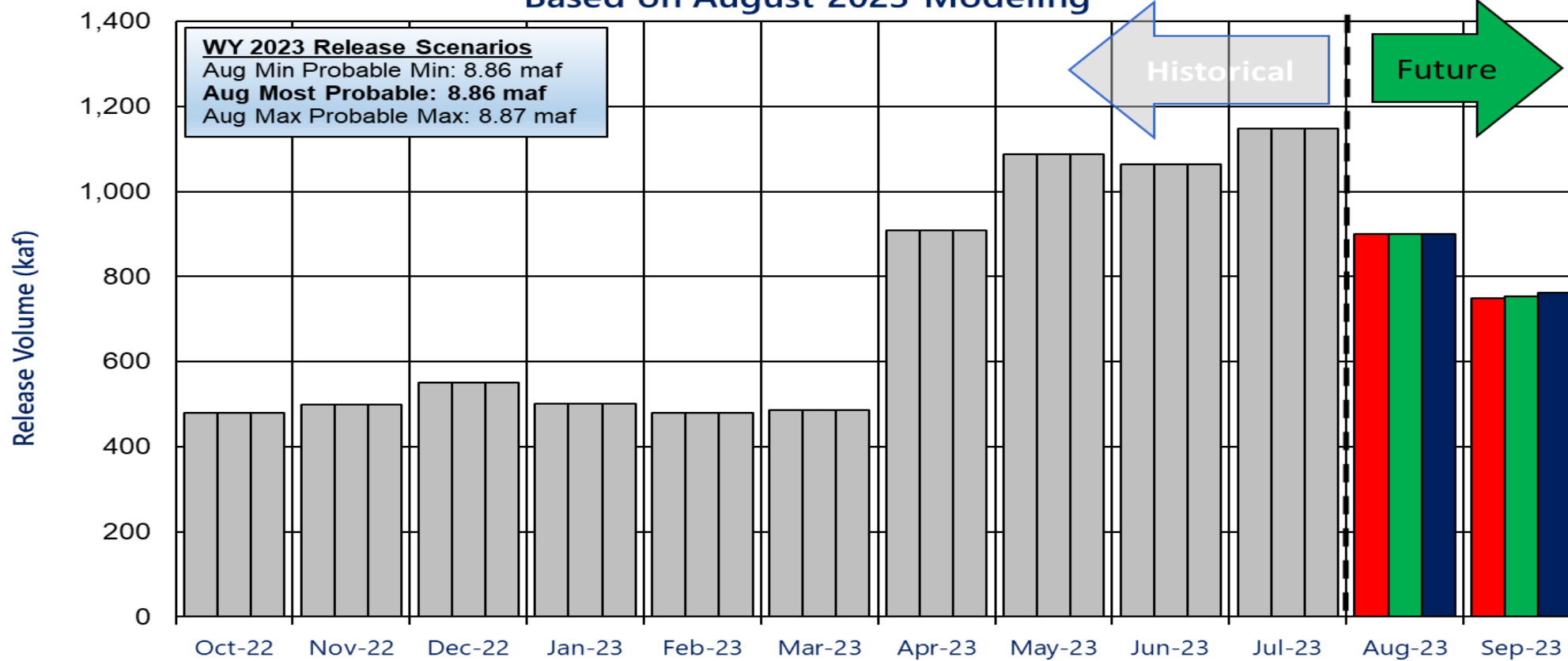
⁴DROA recovery through June 2023



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on August 2023 Modeling



	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
■ August Min Probable	480.052	498.343	549.767	500.681	480.408	486.044	909.310	1,088.254	1,063.574	1,149.012	900.000	750.075
■ August Most Probable	480.052	498.343	549.767	500.681	480.408	486.044	909.310	1,088.254	1,063.574	1,149.012	900.000	753.025
■ August Max Probable	480.052	498.343	549.767	500.681	480.408	486.044	909.310	1,088.254	1,063.574	1,149.012	900.000	761.938

■ August Min Probable ■ August Most Probable ■ August Max Probable

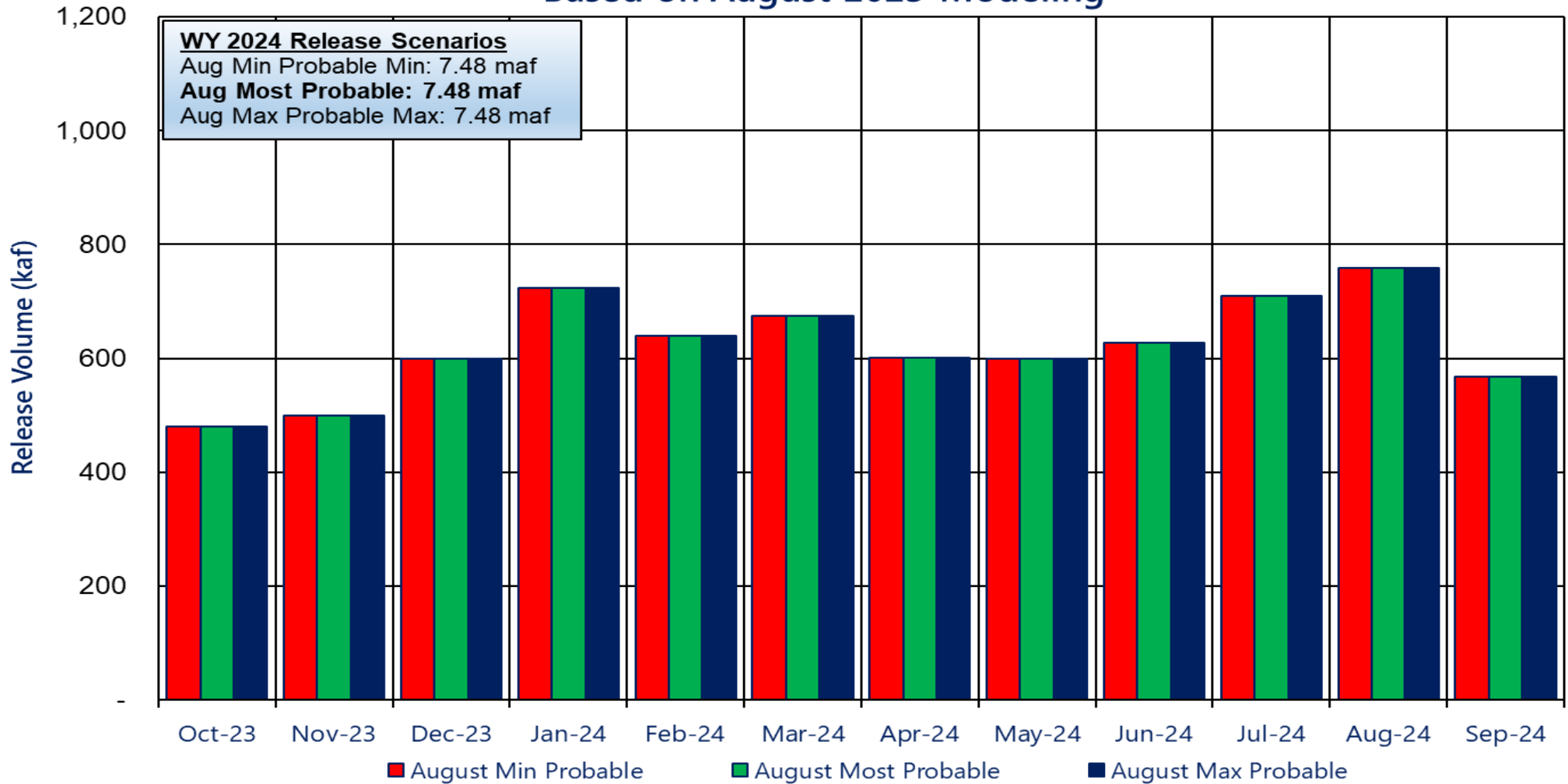
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Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2024

Based on August 2023 Modeling



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.

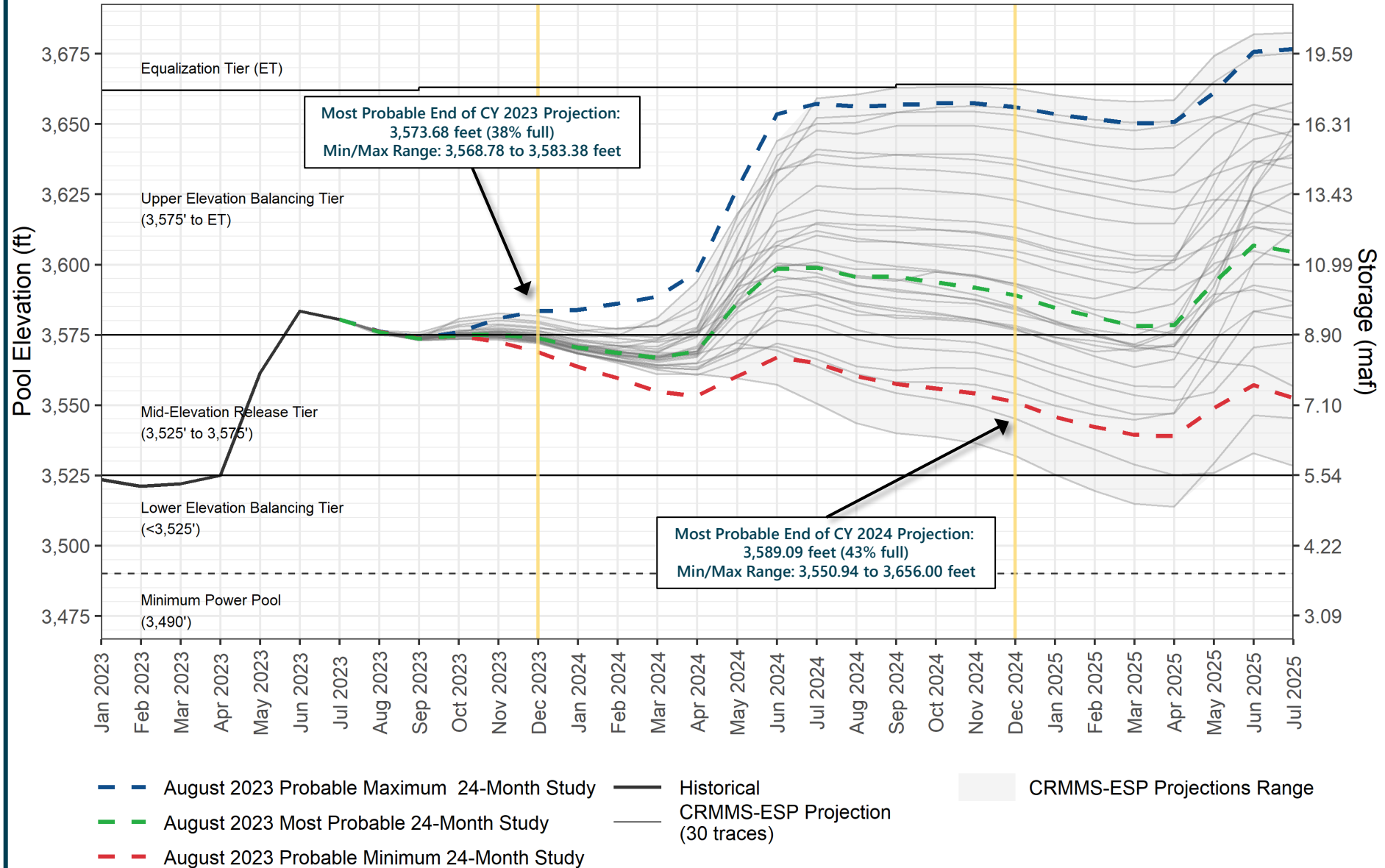


Reclamation Operational Modeling Model Comparison

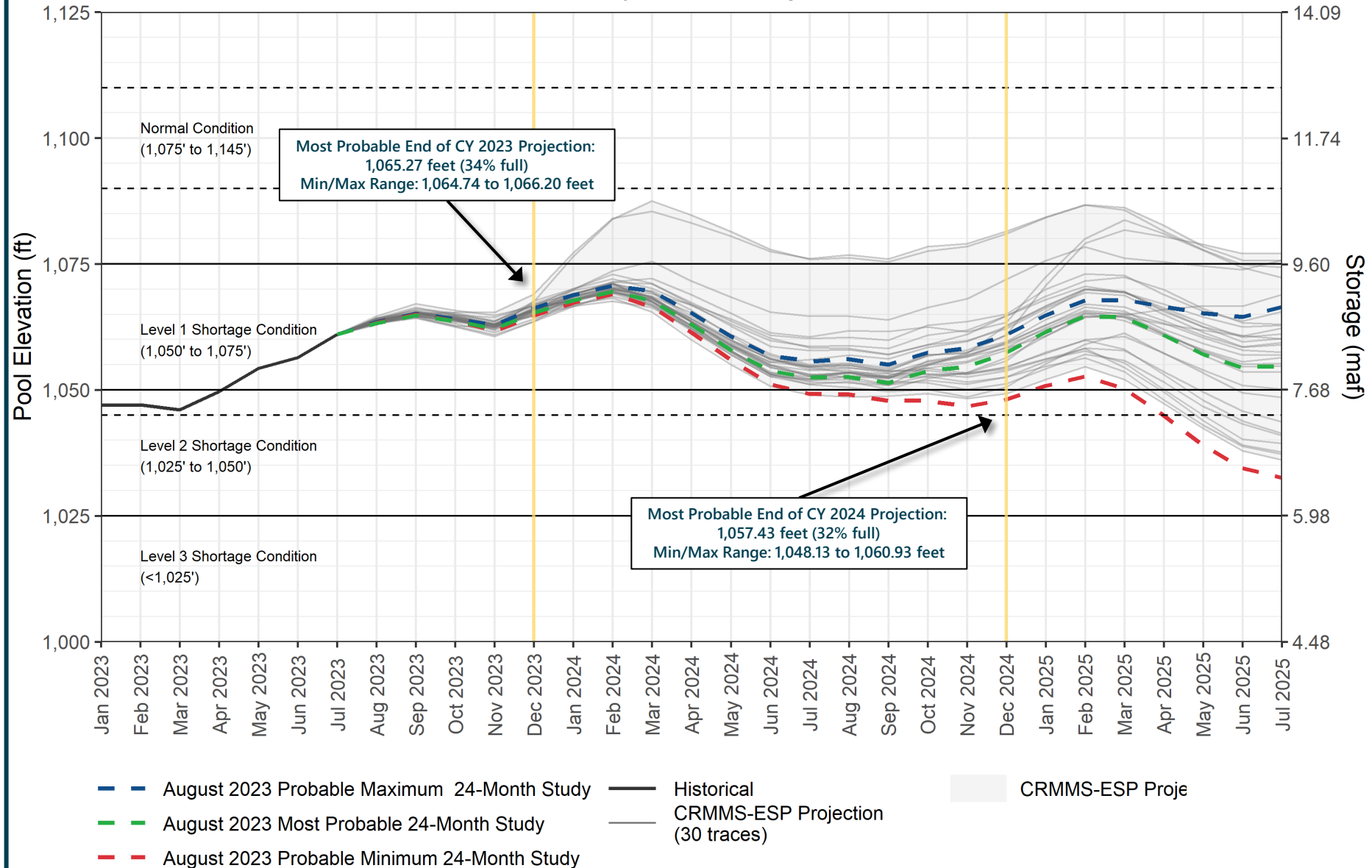
	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir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



Lake Mead End-of-Month Elevations CRMMS Projections from August 2023





Upper Colorado Basin

Hydropower Maintenance



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	■	■						■				
2	■	■										
3	■	■	■	■	■	■	■					
4	■	■	■	■	■	■	■					
5						■	■					
6						■	■					
7								■	■			
8								■	■			
Units Available	4	4	6	6	4	6	5	5	8	8	8	8
Capacity (cfs)	12,400	12,400	19,500	19,500	12,300	19,400	15,900	16,200	27,600	27,600	27,500	27,500
Capacity (kaf/month)	780	1,040	1,200	1,200	1,000	1,190	1,020	1,240	1,640	1,690	1,690	1,630
Max (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	568
Most (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	568
Min (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	568

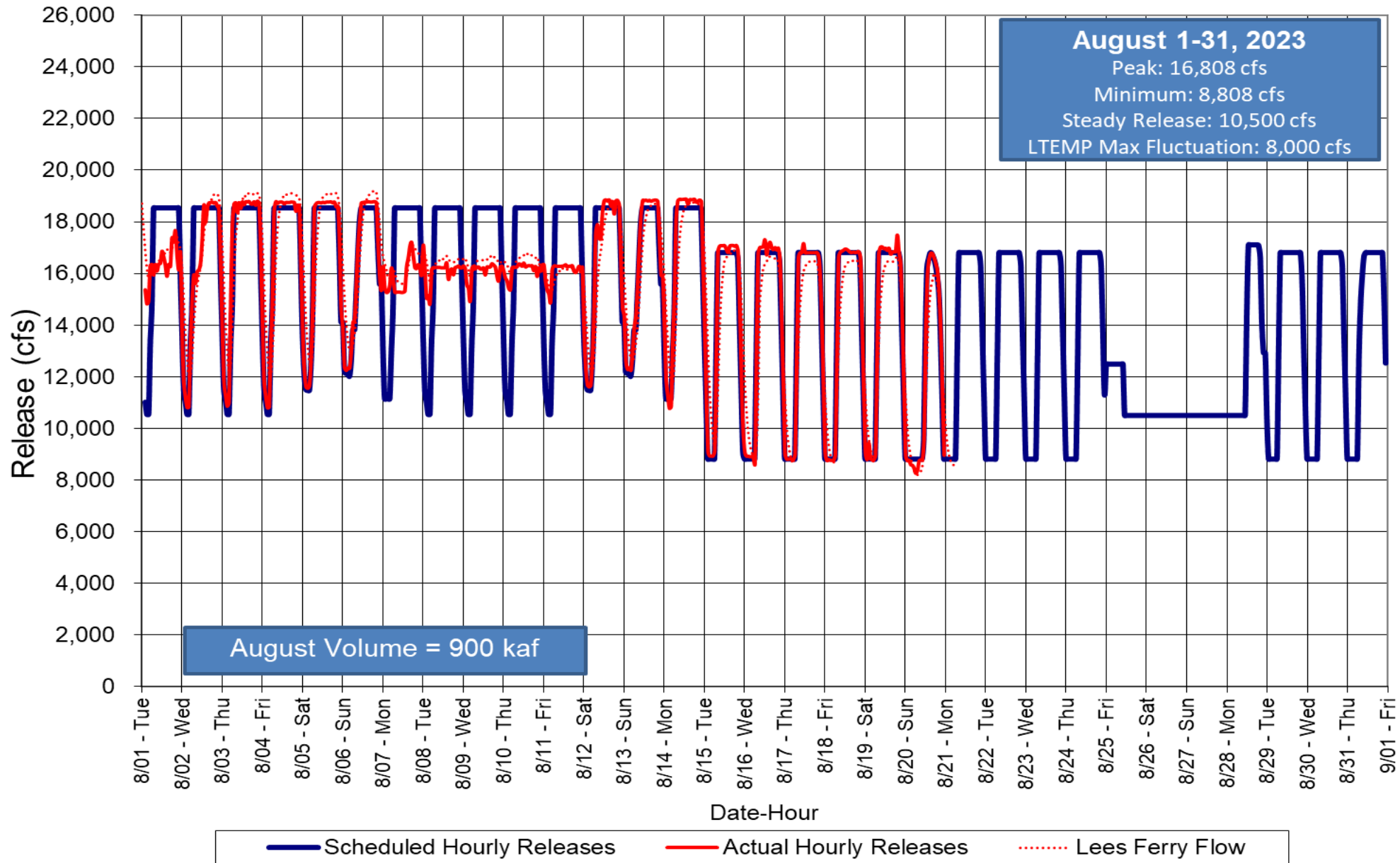
AUG MOST²
 AUG MOST
 7.48 maf
 7.48 maf
 7.48 maf

(updated 08-21-2023)

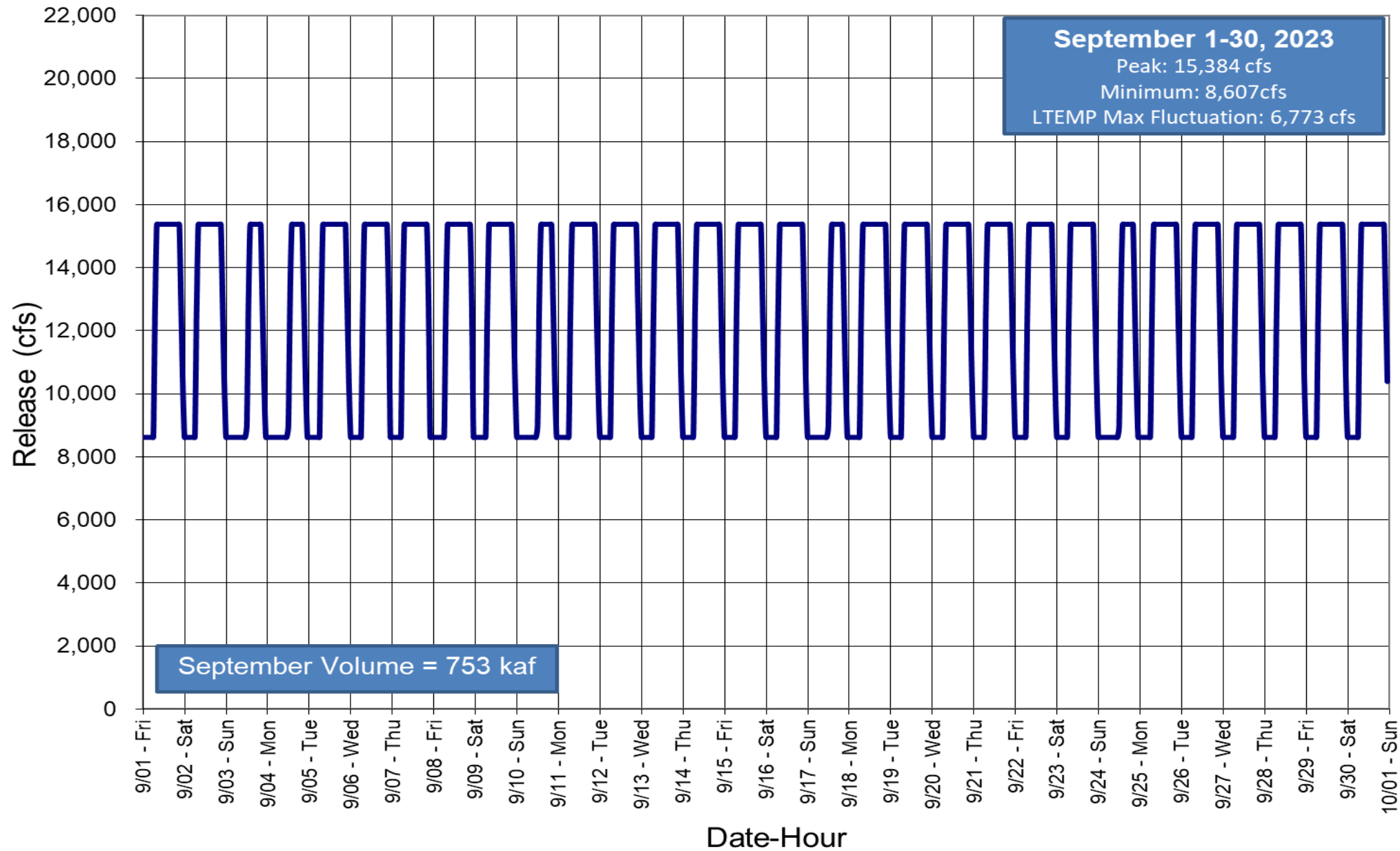
1 Projected release, based on August 2023 24MS for the maximum, minimum and most probable inflow projections and 24-Month Study model runs.
 2 Dependent upon availability to shift contingency regulation, which will increase capacity by 30-40MW (3%) at current efficiency.



Glen Canyon Dam Hourly Release Pattern August 2023



Glen Canyon Dam Hourly Release Pattern September 2023



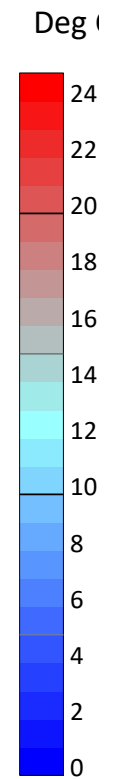
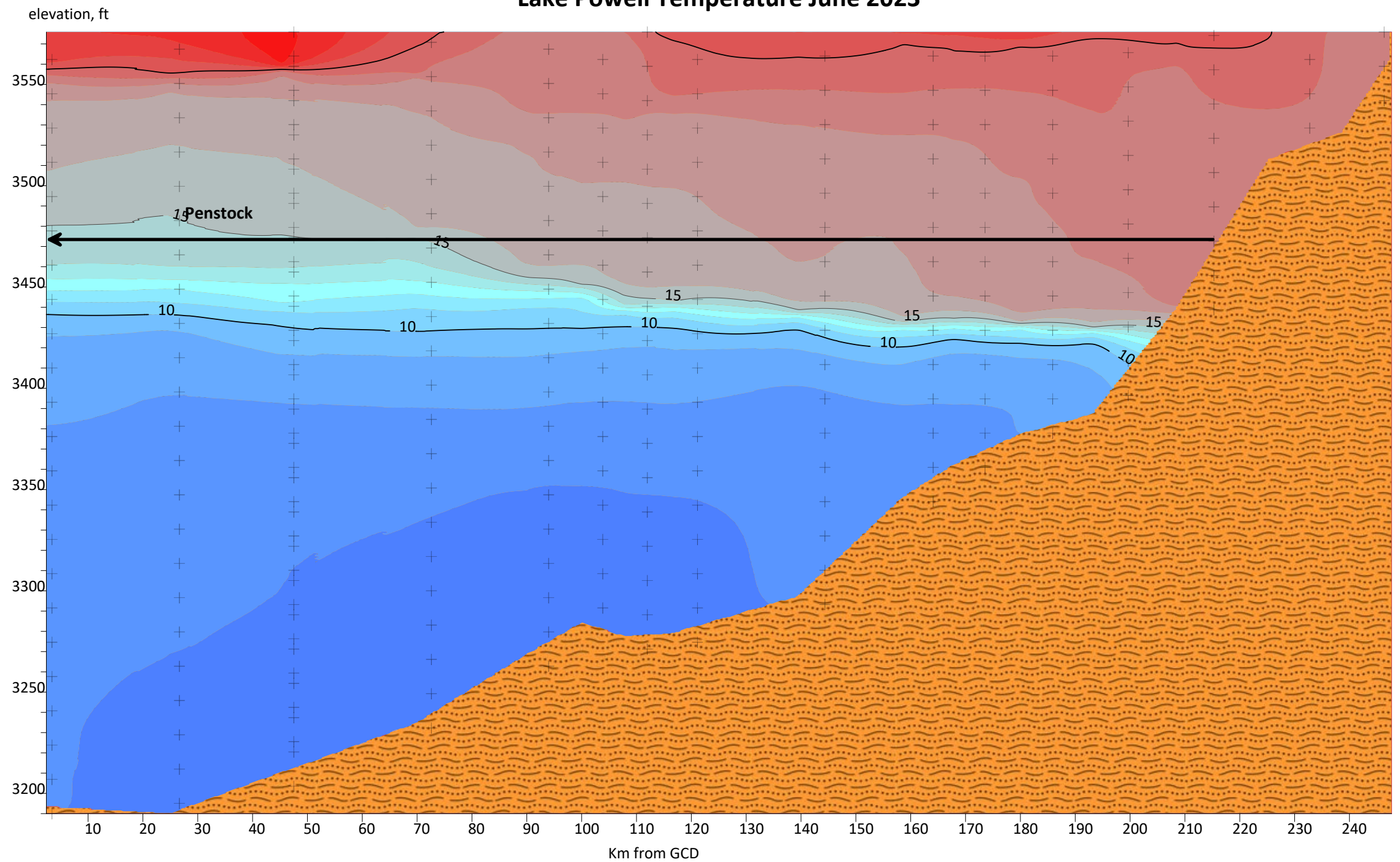
— Scheduled Hourly Releases — Actual Hourly Releases Lees Ferry Flow



Water Quality

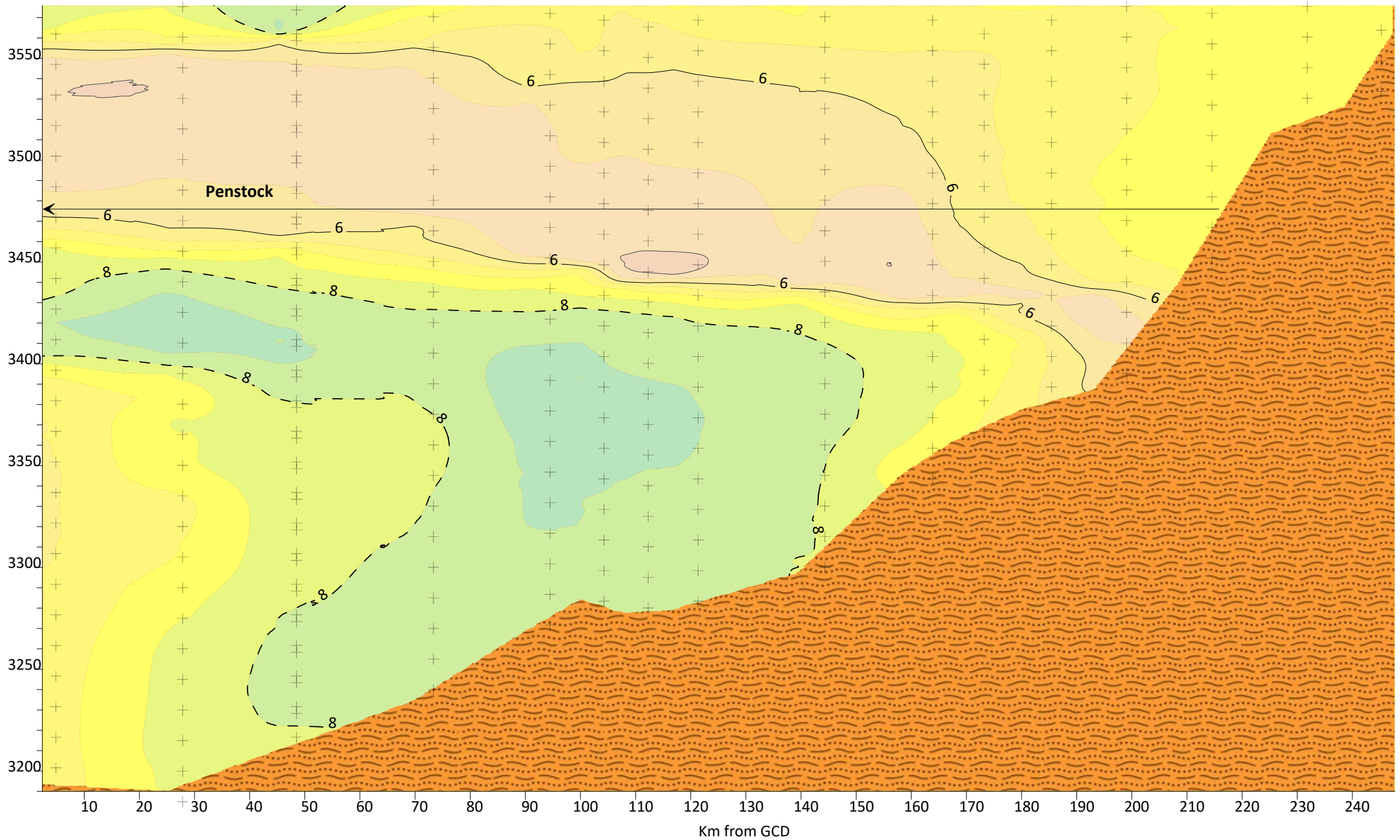


Lake Powell Temperature June 2023



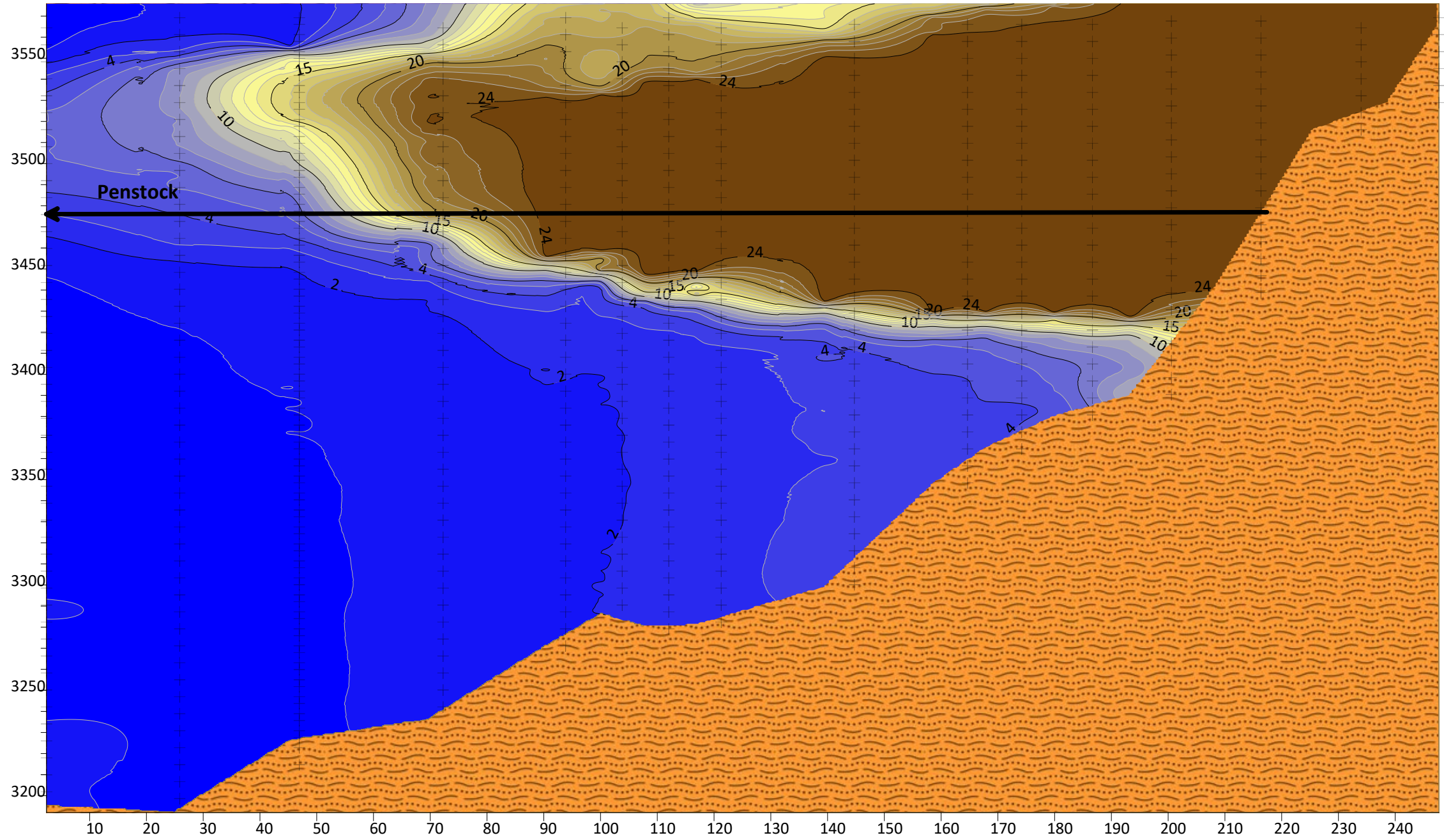
Lake Powell Dissolved Oxygen June 2023

elevation, ft

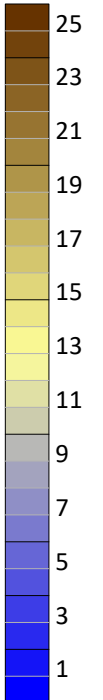


Lake Powell Turbidity, June 2023

elevation, ft



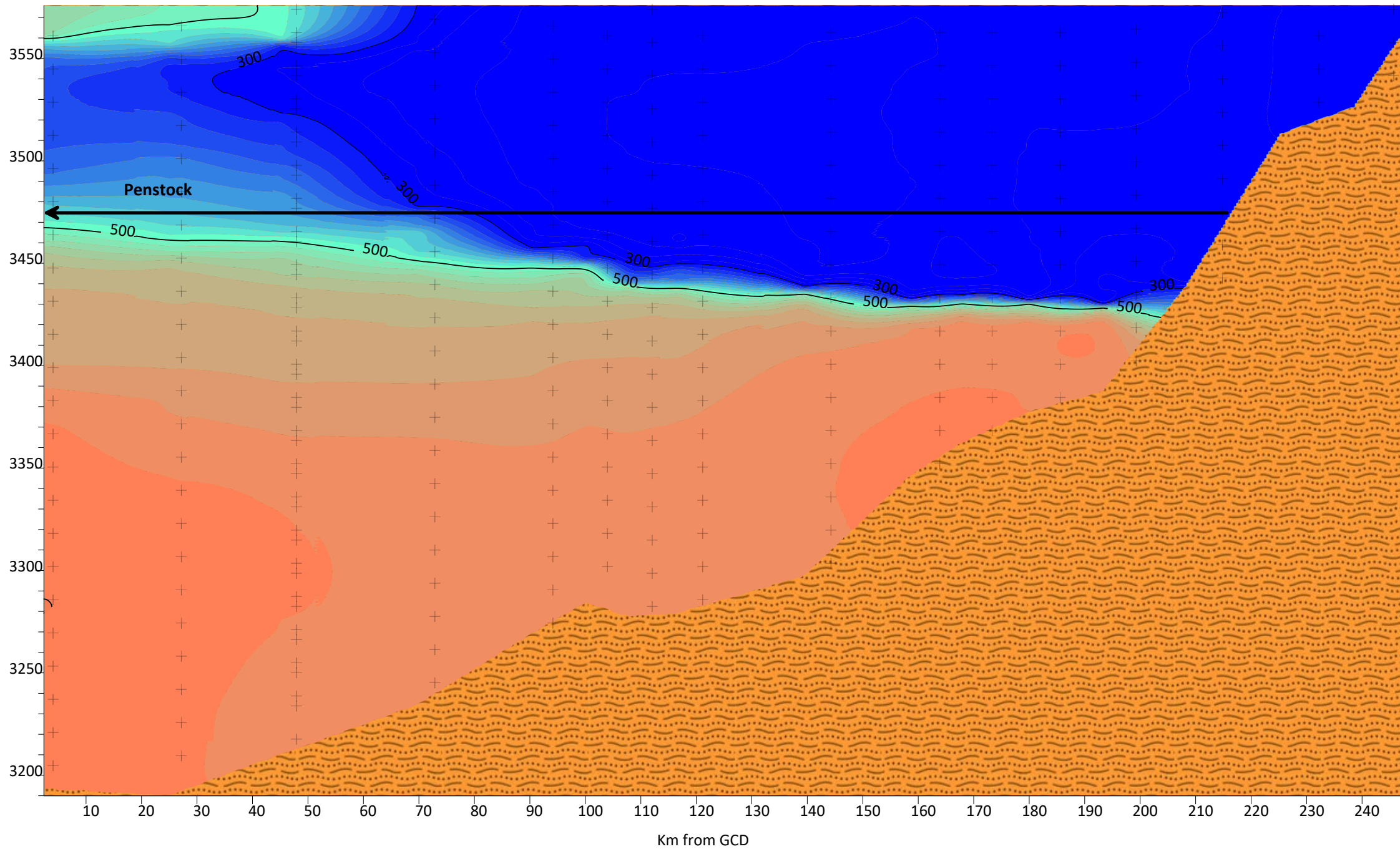
NTU



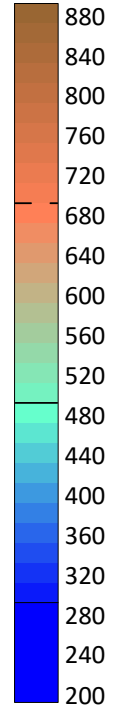
Km from Dam

Lake Powell TDS June 2023

elevation, ft

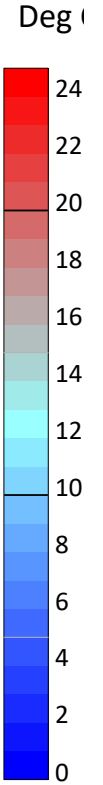
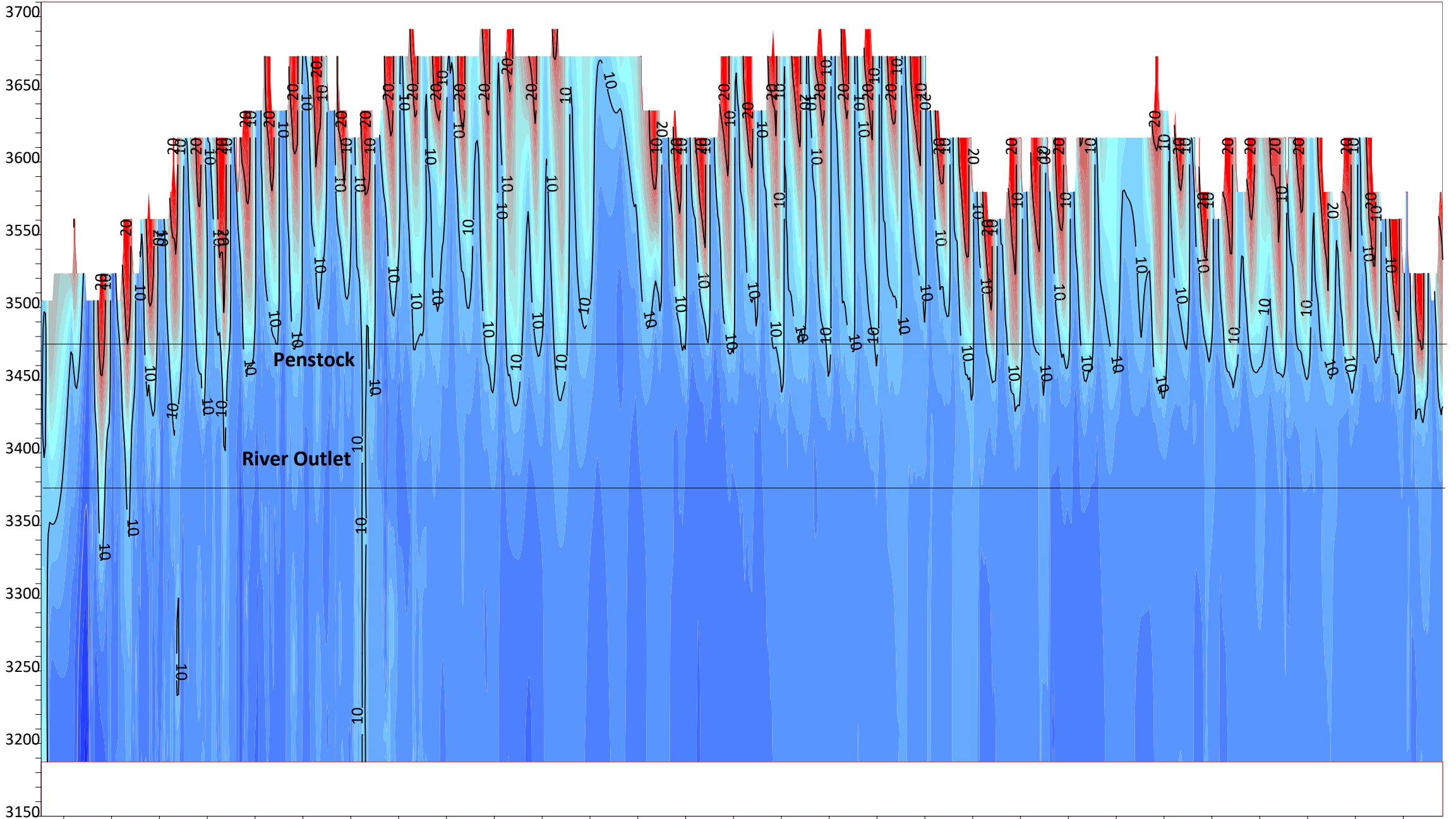


mg/L



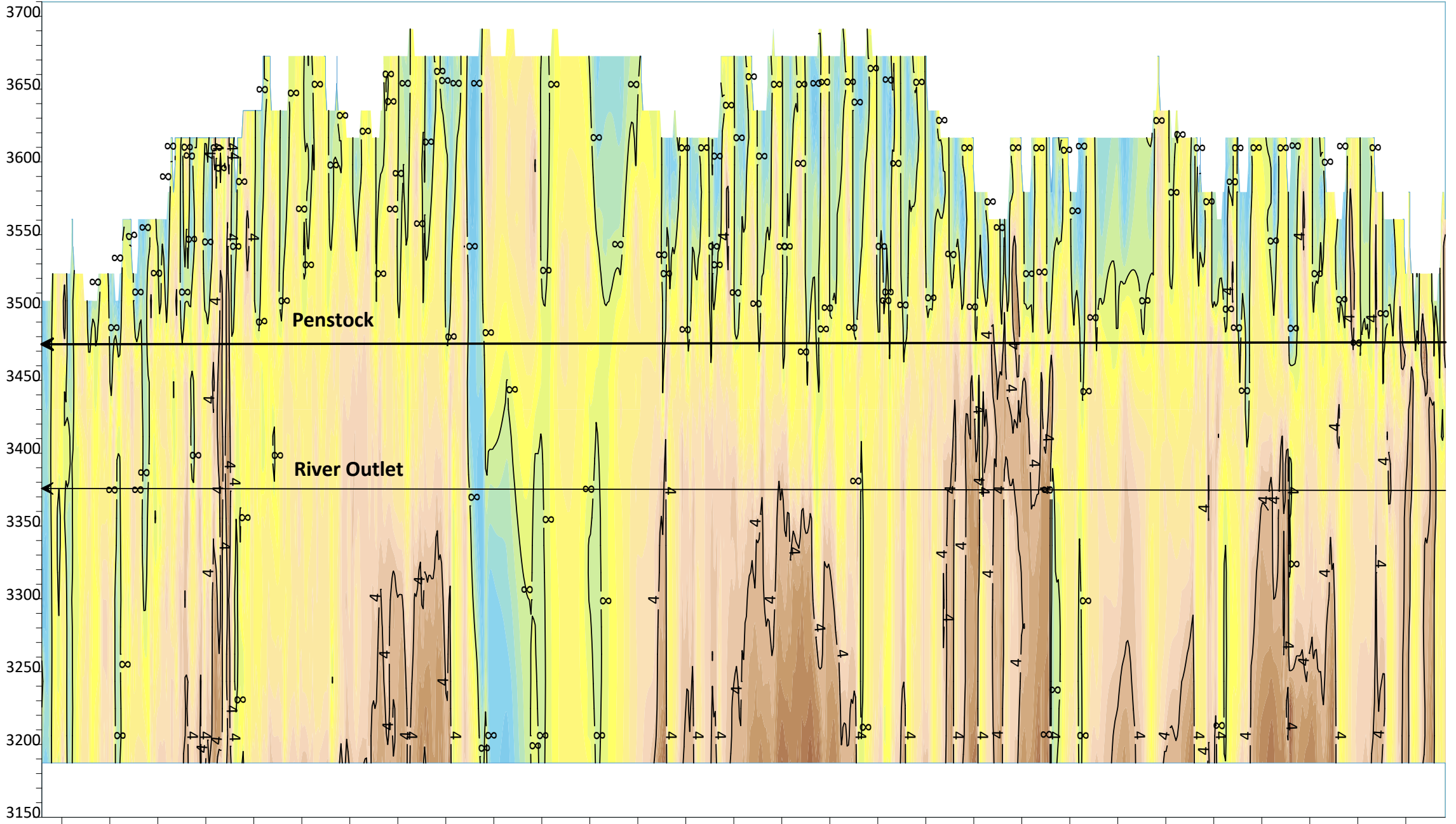
Lake Powell Forebay Temperature, Jan 1965 - Aug 2023

elevation, ft

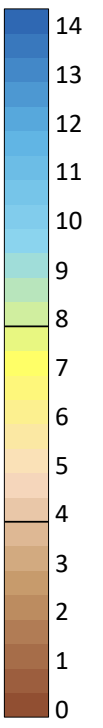


Lake Powell Forebay Dissolved Oxygen, Jan 1965 - Aug 2023

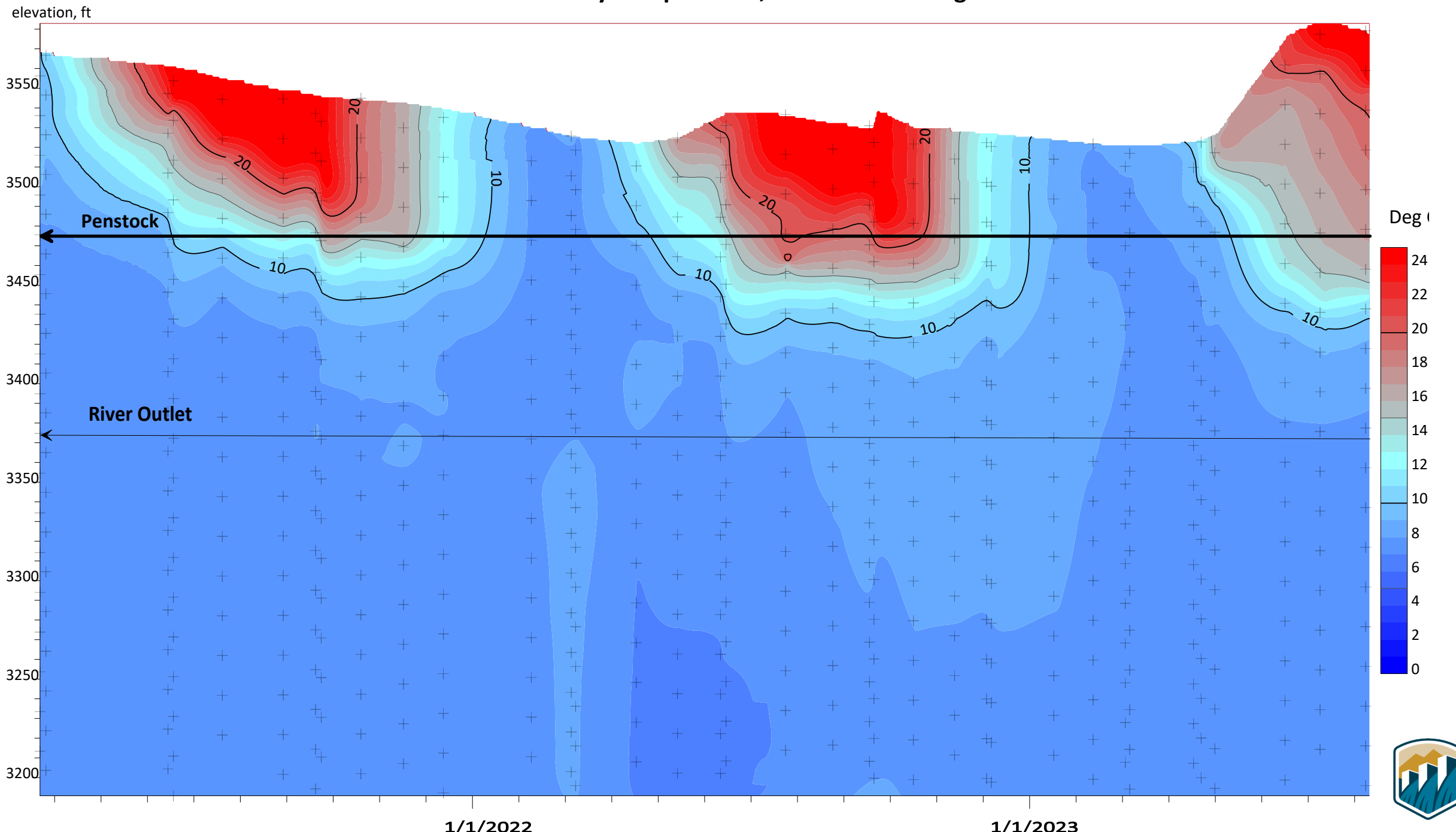
elevation, ft



mg/

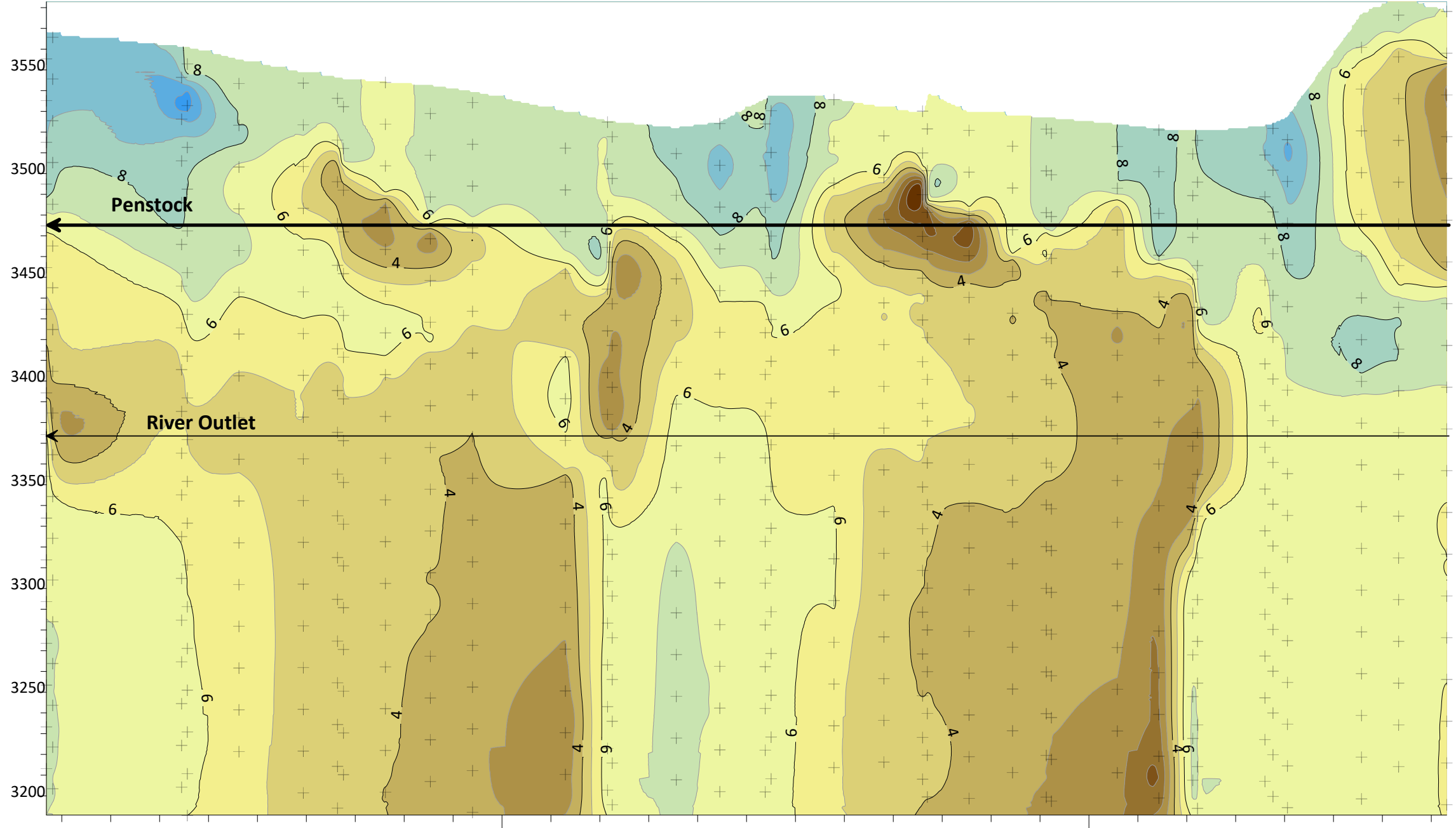


Lake Powell Forebay Temperature, March 2021 - Aug 2023

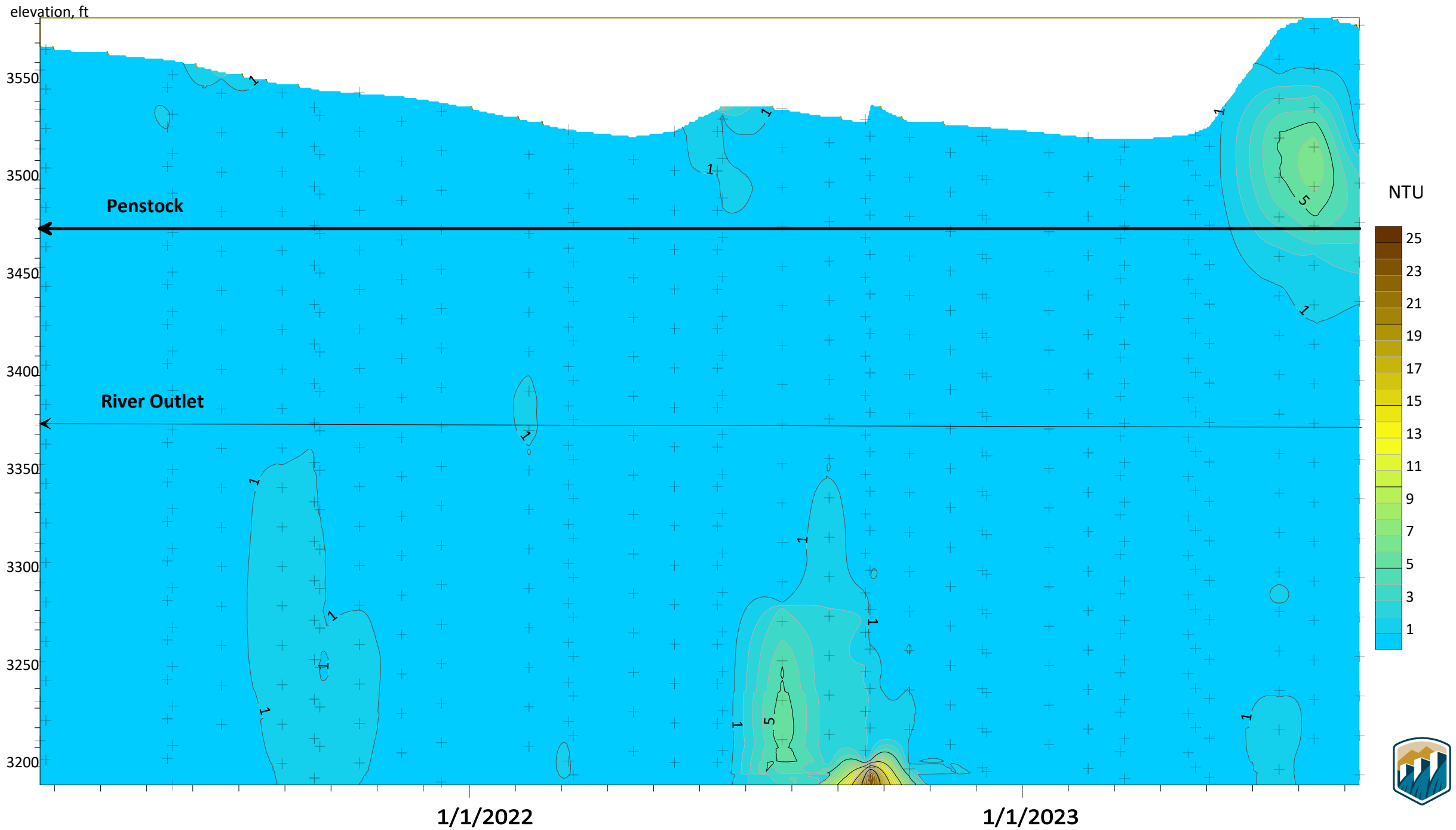


Lake Powell Forebay, Dissolved Oxygen, March 2021 - Aug 2023

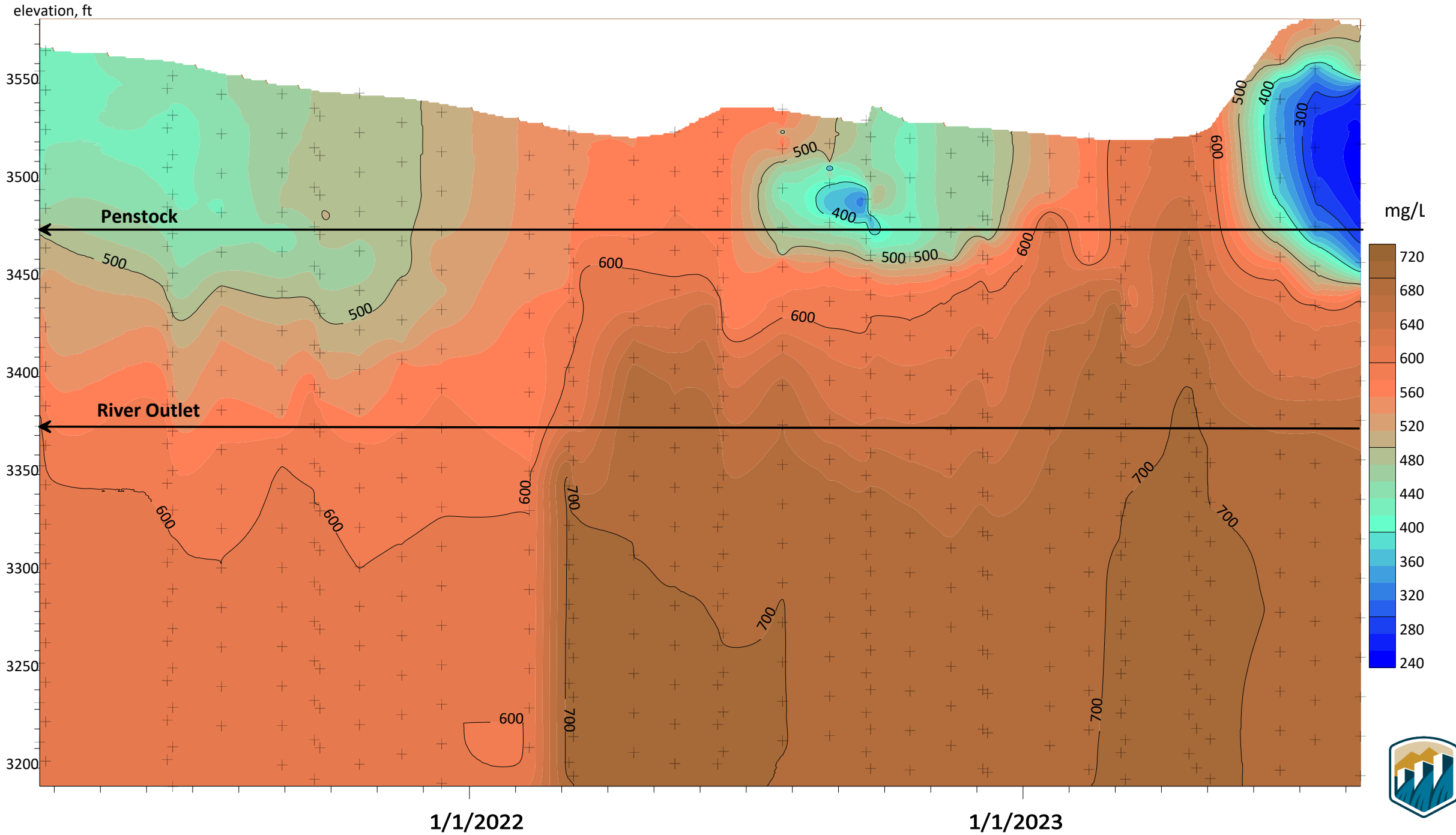
elevation, ft



Lake Powell Forebay, Turbidity, March 2021 - Aug 2023



Lake Powell Forebay, TDS, March 2021 - Aug 2023

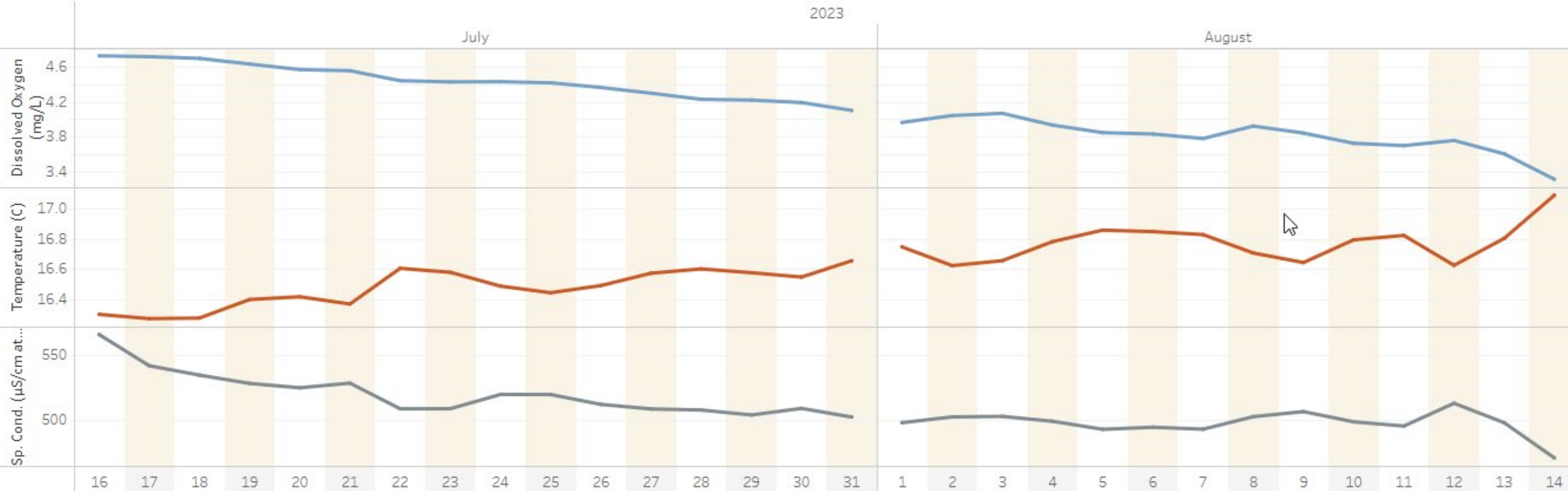


Daily Water Quality Data at Glen Canyon Dam

[Download PDF](#)

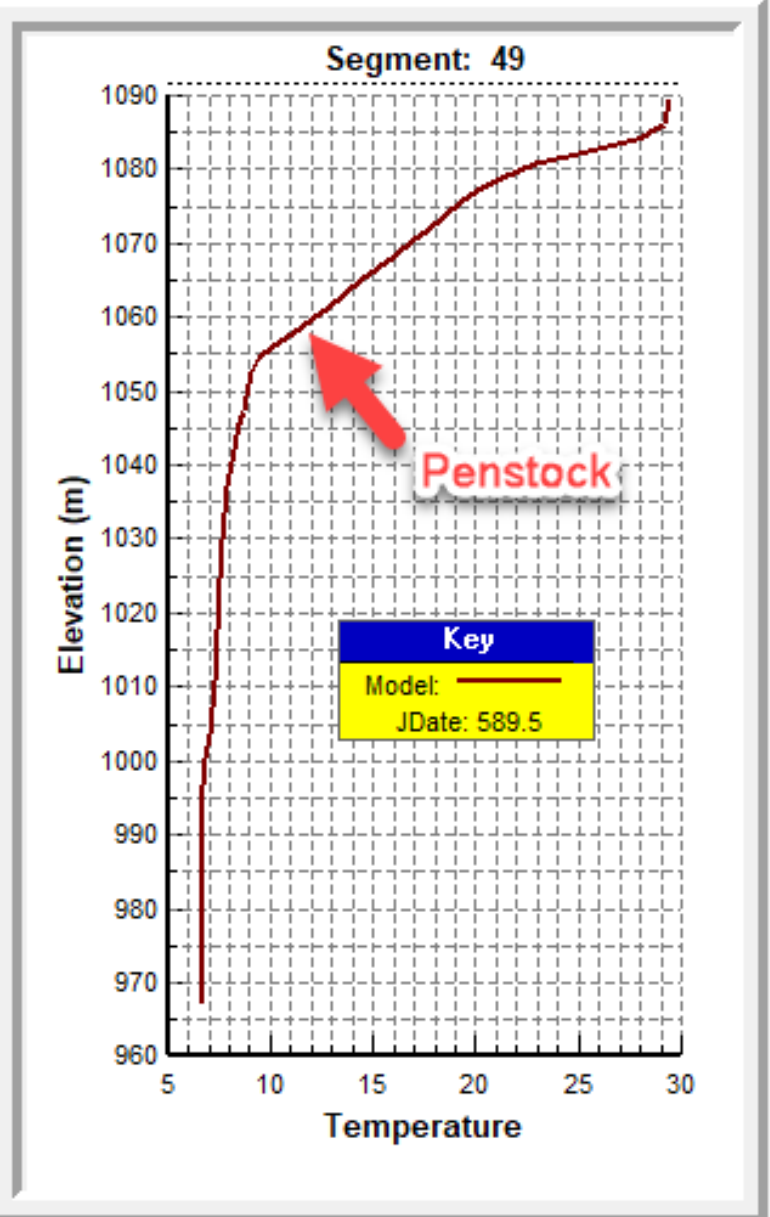


Daily Dissolved Oxygen & Temperature Values



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





Profiling Selections

WB	BR	US	DS	SEG
1	1	2	49	#48
1	2	52	57	#6
1	3	60	73	#14
1	4	76	100	#25

Segment: 49

Parameter List

- Horizontal Velocity
- Vertical Velocity
- Temperature
- TDS
- Phosphate

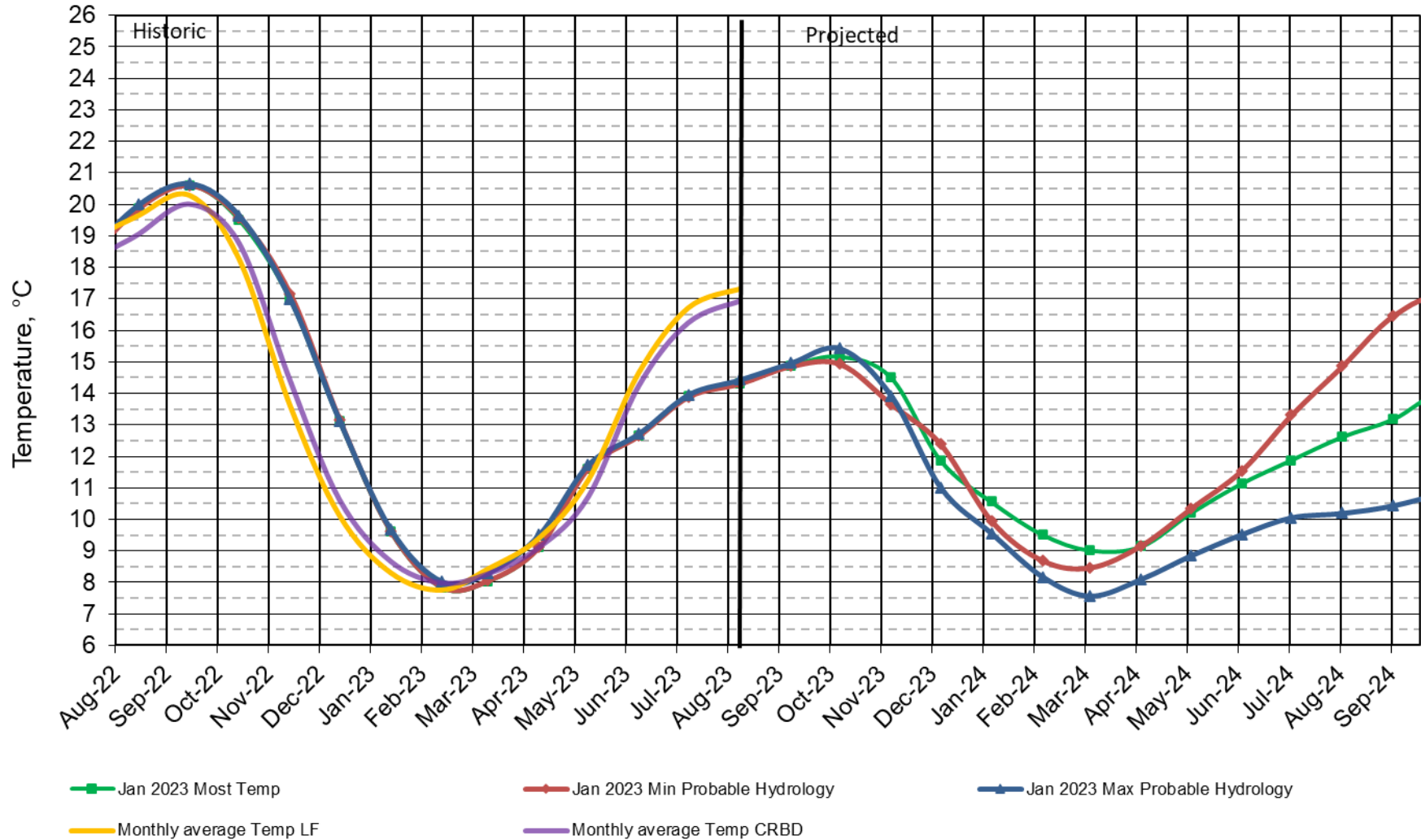
Time Steps

- 547.500
- 554.500
- 561.500
- 568.500
- 575.500
- 582.500
- 589.500



Lake Powell Release Temperature

Projected Temperature based on August 2023 Forecast



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

Questions?



— BUREAU OF —
RECLAMATION