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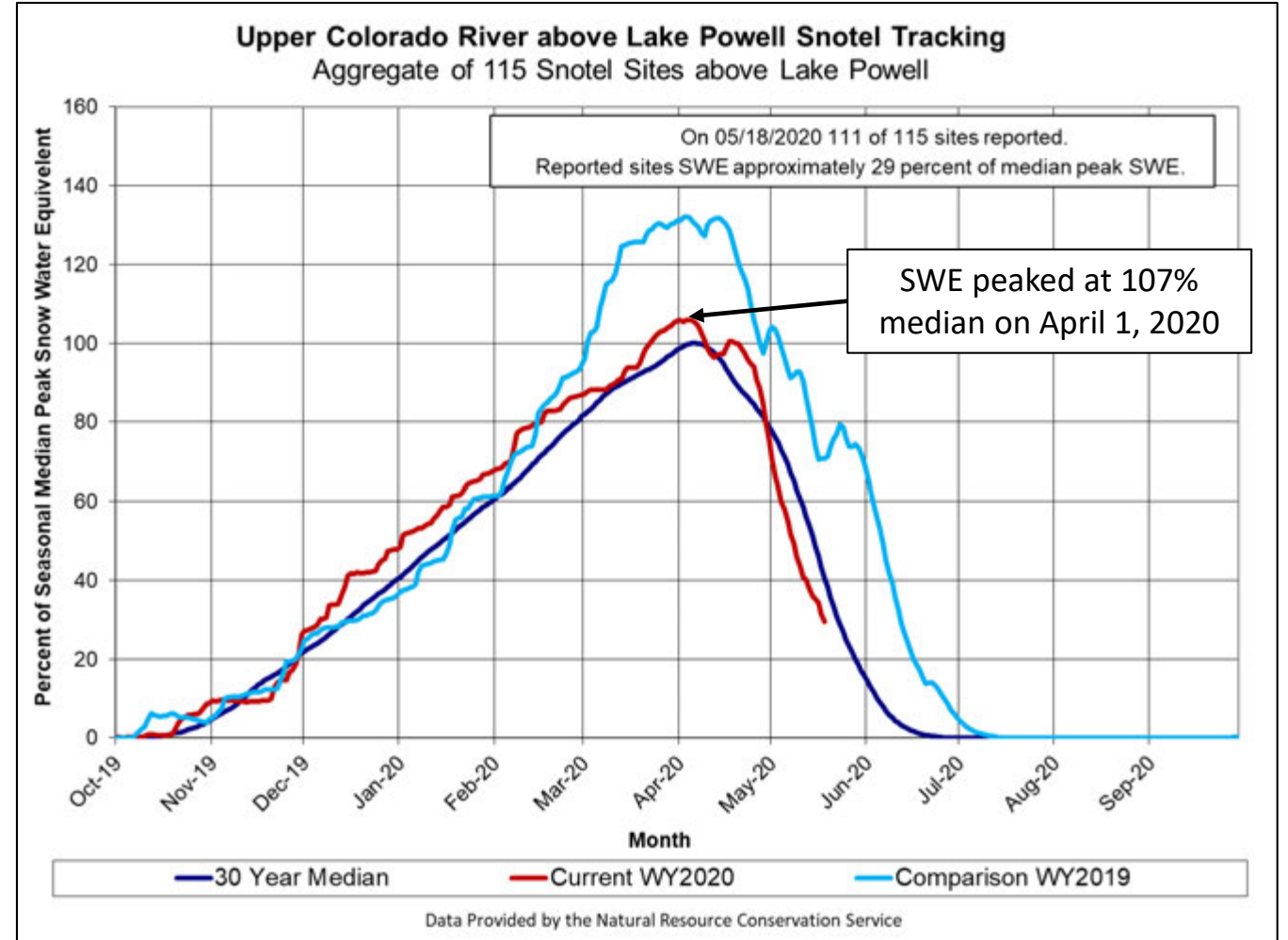
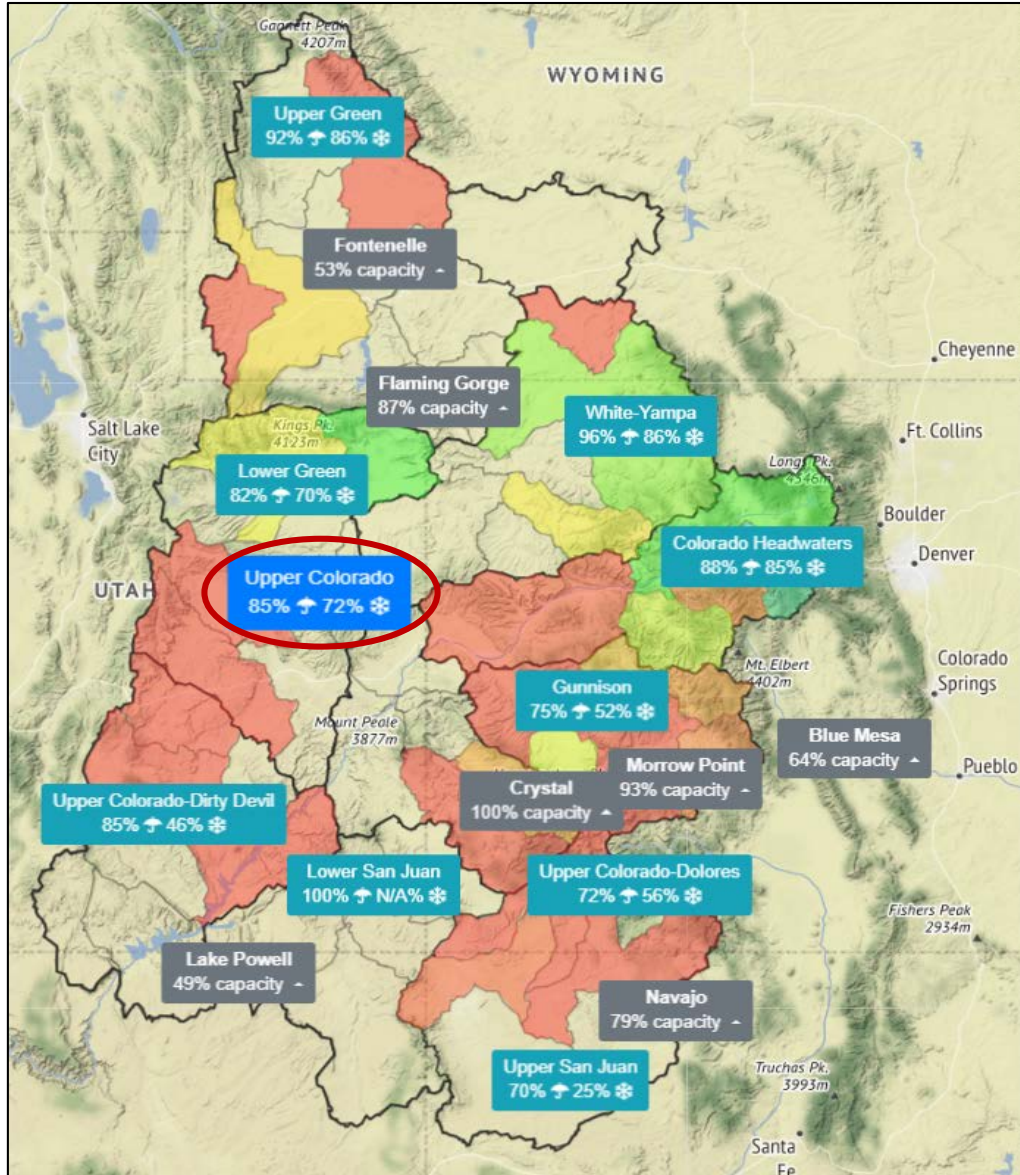
AMWG Hydrology, Operations and Reservoir Release

May 20, 2020

Heather E. Patno

Hydraulic Engineer

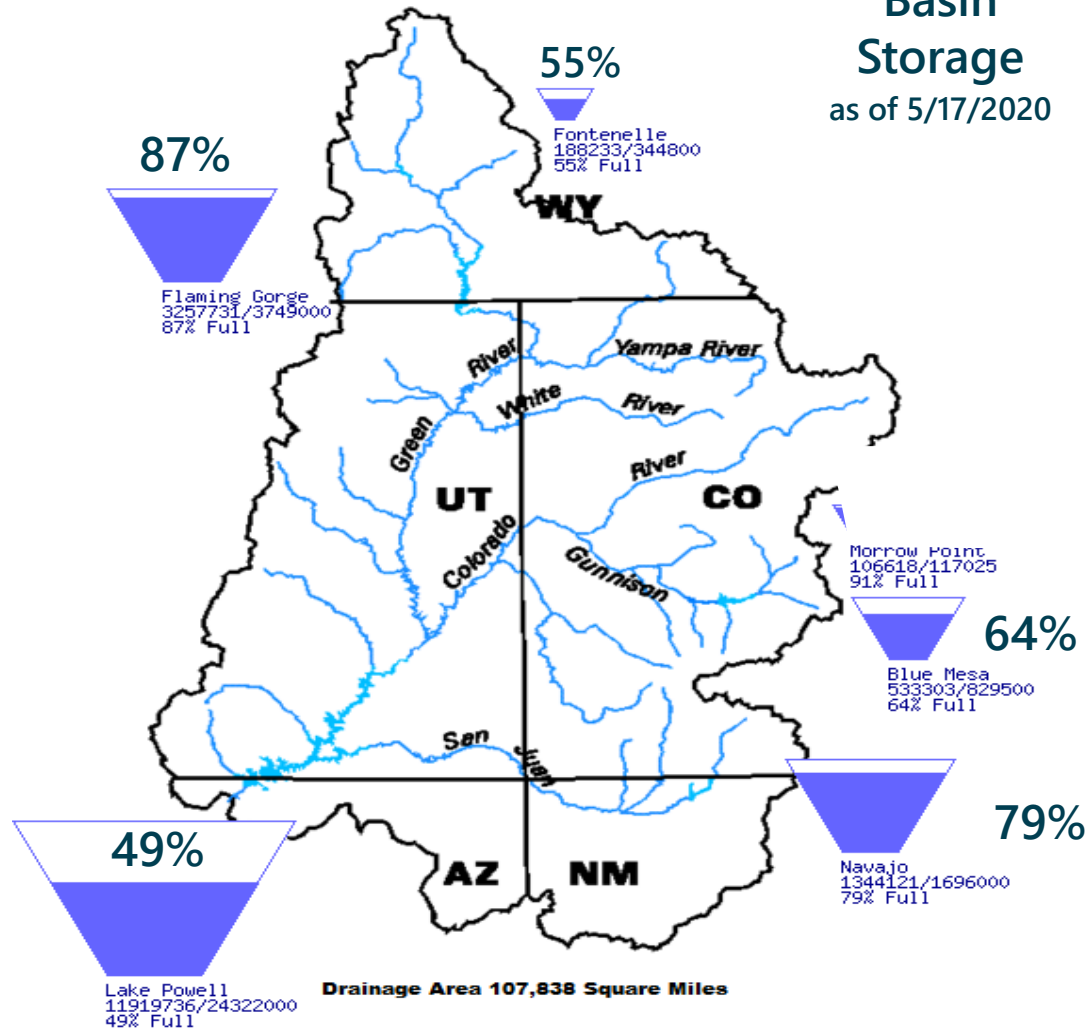
Snow Conditions



Upper Basin Storage

Data Current as of:
05/17/2020

Upper Colorado River Drainage Basin Basin Storage as of 5/17/2020



2020 April – July Unregulated Inflow Forecast

as of May 18, 2020

Reservoir	Forecast (kaf)	Percent of Average ¹
Fontenelle	640	88
Flaming Gorge	820	84
Blue Mesa	395	59
Navajo	365	50
Powell	4,400	61

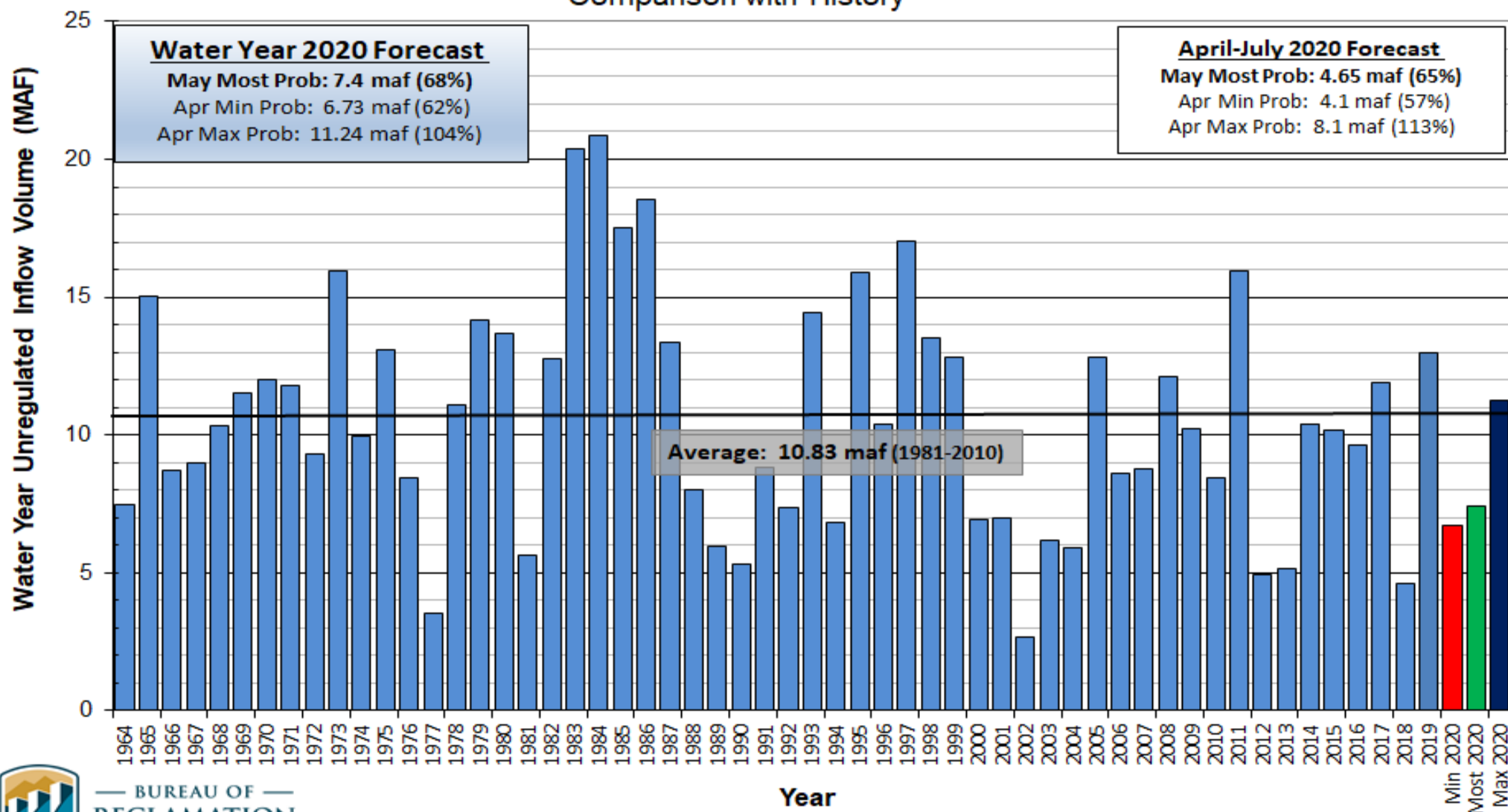
¹ Percent of average based on the period of record from 1981-2010.



Lake Powell Unregulated Inflow

Water Year 2020 Forecast (issued May 4)

Comparison with History



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Timing of Operational Decisions

- August 24-Month Study projections of January 1 elevations sets the operating tiers for Lake Powell and Lake Mead
- When Lake Powell is in Upper Elevation Balancing Tier, April 24-Month Study projections of September 30 elevations may result in an adjustment to Powell's operations



B. Upper Elevation Balancing Tier

1. In Water Years when the projected January 1 Lake Powell elevation is below the elevation stated in the Lake Powell Equalization Elevation Table and at or above 3,575 feet, the Secretary shall release 8.23 maf from Lake Powell if the projected January 1 Lake Mead elevation is at or above 1,075 feet.
2. If the projected January 1 Lake Powell elevation is below the elevation stated in the Lake Powell Equalization Elevation Table and at or above 3,575 feet and the projected January 1 Lake Mead elevation is below 1,075 feet, the Secretary shall balance the contents of Lake Mead and Lake Powell, but shall release not more than 9.0 maf and not less than 7.0 maf from Lake Powell in the Water Year.
3. When operating in the Upper Elevation Balancing Tier, if the April 24-Month Study projects the September 30 Lake Powell elevation to be greater than the elevation in the Lake Powell Equalization Elevation Table, the Equalization Tier will govern the operation of Lake Powell for the remainder of the Water Year (through September).
4. When operating under Section 6.B.1, if the April 24-Month Study projects the September 30 Lake Mead elevation to be below 1,075 feet and the September 30 Lake Powell elevation to be at or above 3,575 feet, the Secretary shall balance the contents of Lake Mead and Lake Powell, but shall release not more than 9.0 maf and not less than 8.23 maf from Lake Powell in the Water Year.
5. When Lake Powell is projected to be operating under Section 6.B.2. and more than 8.23 maf is projected to be released from Lake Powell during the upcoming Water Year, the Secretary shall recalculate the August 24-Month Study projection of the January 1 Lake Mead elevation to include releases above 8.23 maf that are scheduled to be released from Lake Powell during the months of October, November, and December of the upcoming Water Year, for the purposes of determining Normal or Shortage conditions pursuant to Sections 2.A. or 2.D. of these Guidelines.

**August
Determination**

**April
Determination**



Lake Powell & Lake Mead Operational Table

Operational Tiers for Water/Calendar Year 2020¹

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)	3,618.56 ft Upper Elevation Balancing Tier ³ 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
			1,145	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	15.9
	Jan 1, 2020 projection		1,105		11.9
3,575	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,089.40 ft Jan 1, 2020 projection	Shortage Condition Deliver 7.167 ⁴ maf	9.4
3,525	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	5.9	1,075	Shortage Condition Deliver 7.083 ⁵ maf	7.5
3,490			1,050		5.8
3,370		0	1,025	Shortage Condition Deliver 7.0 ⁶ maf Further measures may be undertaken ⁷	4.3
			1,000		
			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

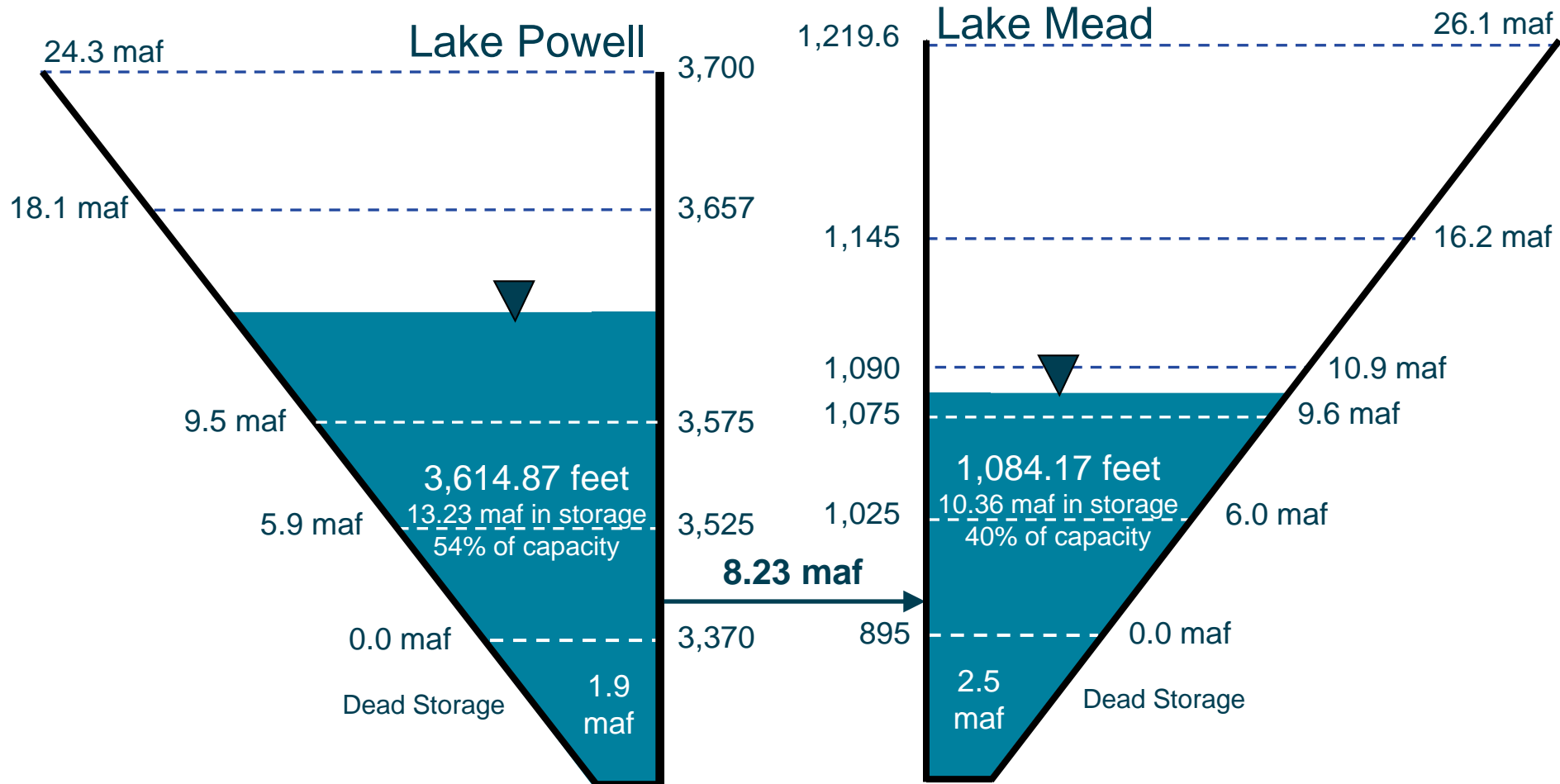
⁷ Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division States and Mexico is likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with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



End of Water Year 2020 Projections

April 2020 24-Month Study Most Probable Inflow Scenario¹

Projected Lake Powell Unregulated Inflow = 8.42 maf (78% of average)



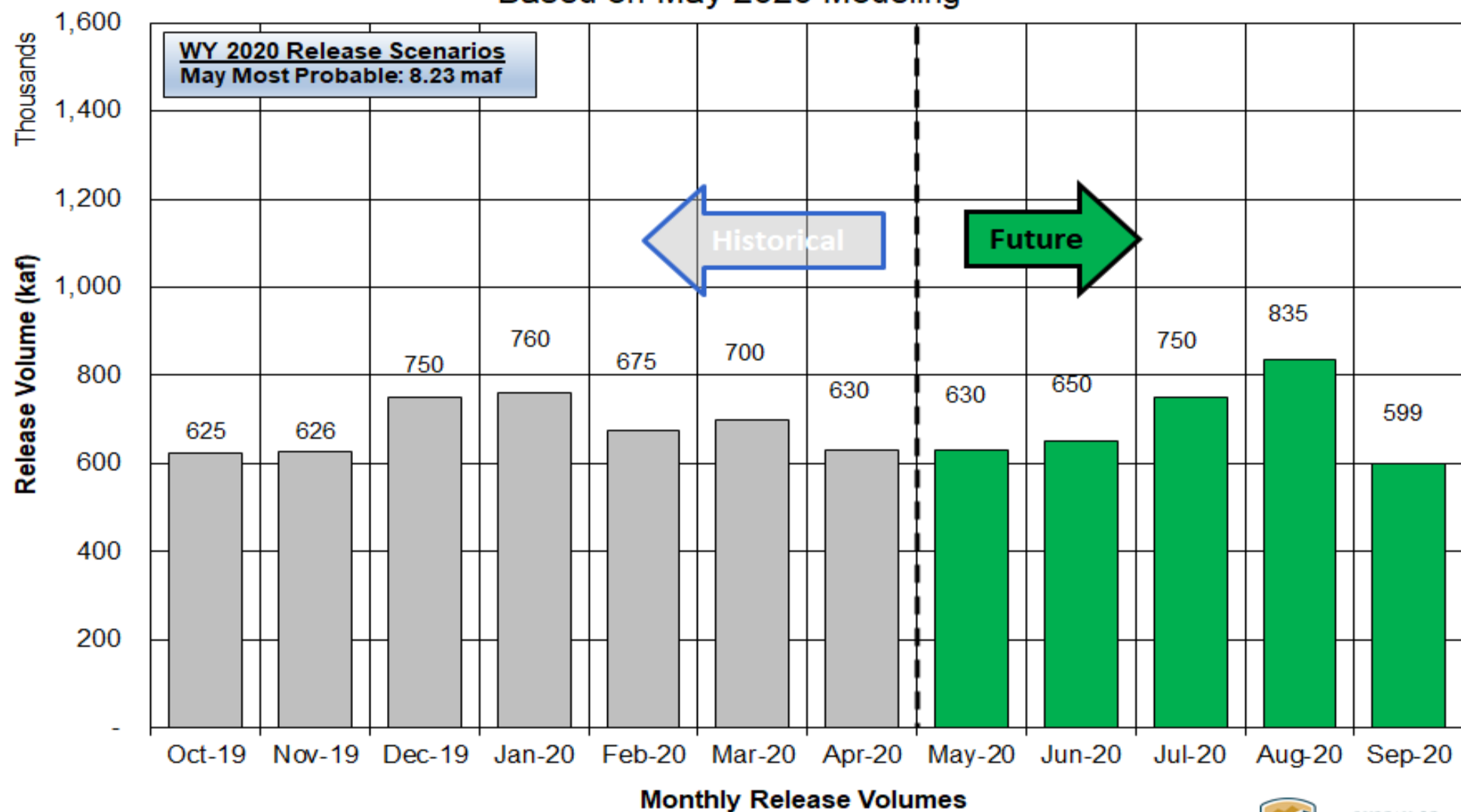
Not to Scale



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2020

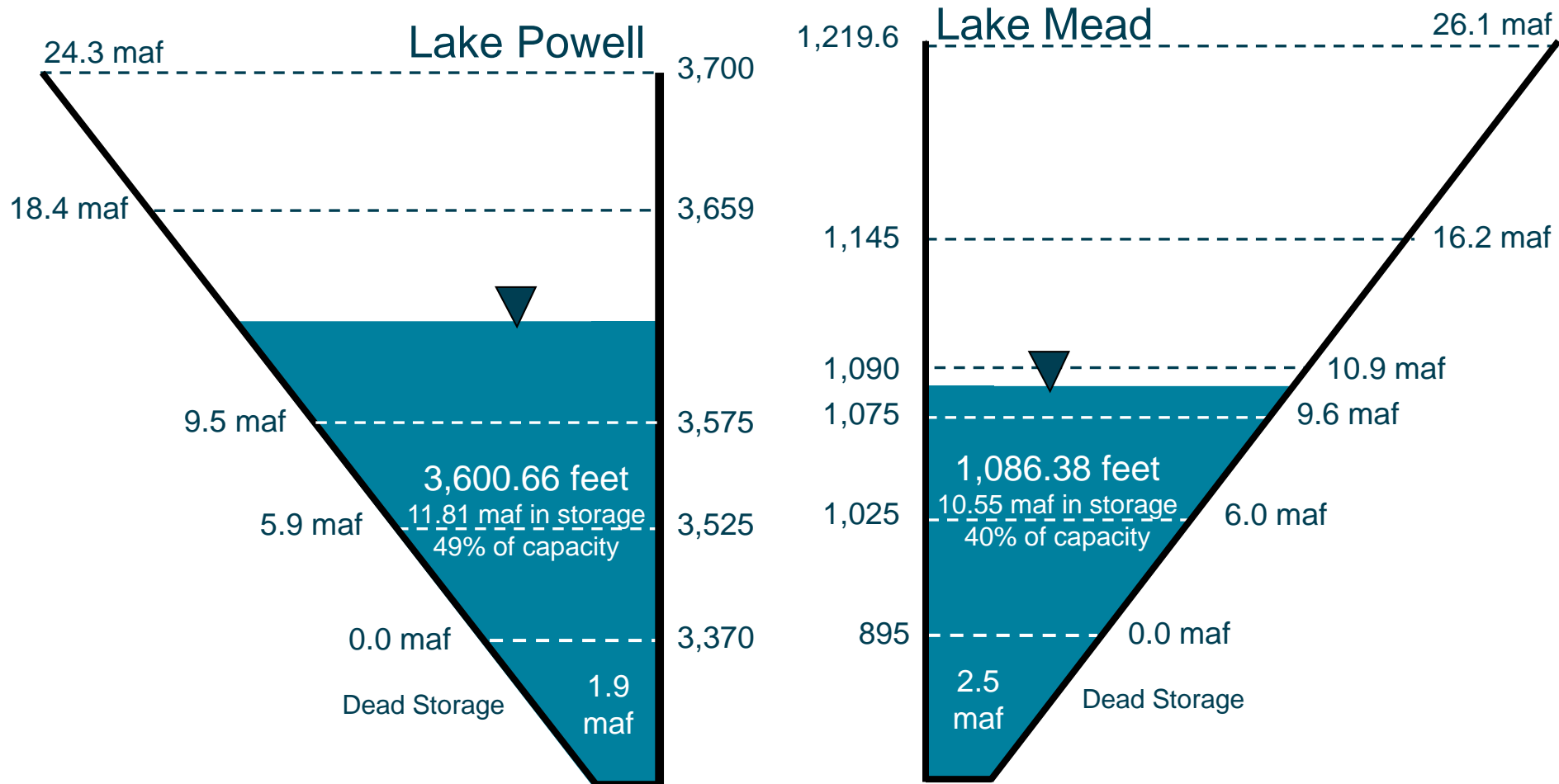
Based on May 2020 Modeling



End of Calendar Year 2020 Projections

May 2020 24-Month Study Most Probable Inflow Scenario¹

Based on a Lake Powell release of 8.23 maf in WY 2020 & 9.00 maf in WY 2021



Not to Scale



Lake Powell 2021 Operating Tier Scenarios

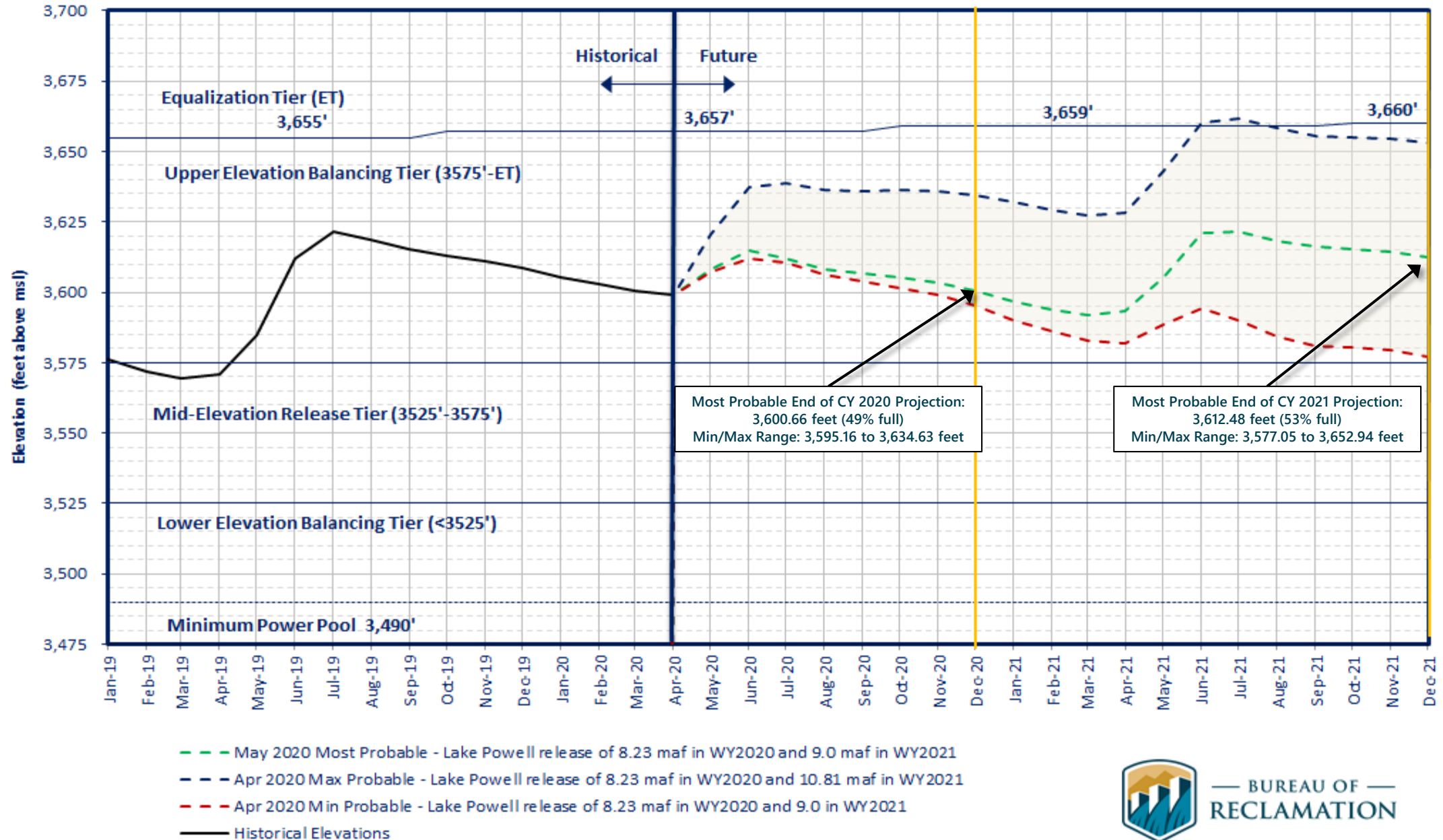
Based on April and May 2020 24-Month Study

Inflow Scenario	Operating Tier/ Release Volume
April Minimum Probable	Upper Elevation Balancing 9.00 maf
May Most Probable	Upper Elevation Balancing 9.00 maf
April Maximum Probable	Equalization 10.81 maf



Lake Powell End of Month Elevations

Historic and Projected based on April and May 2020 24-Month Study Inflow Scenarios

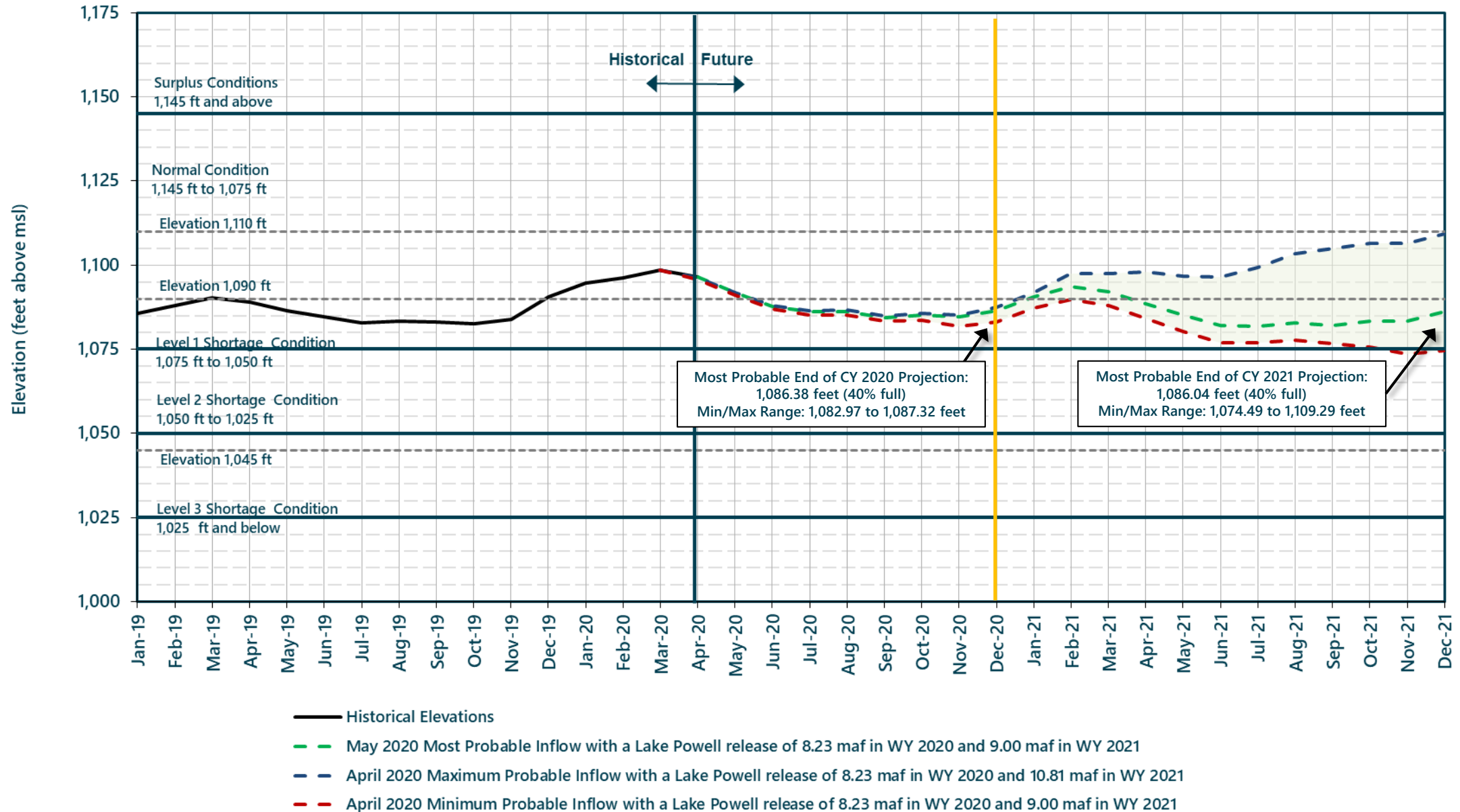


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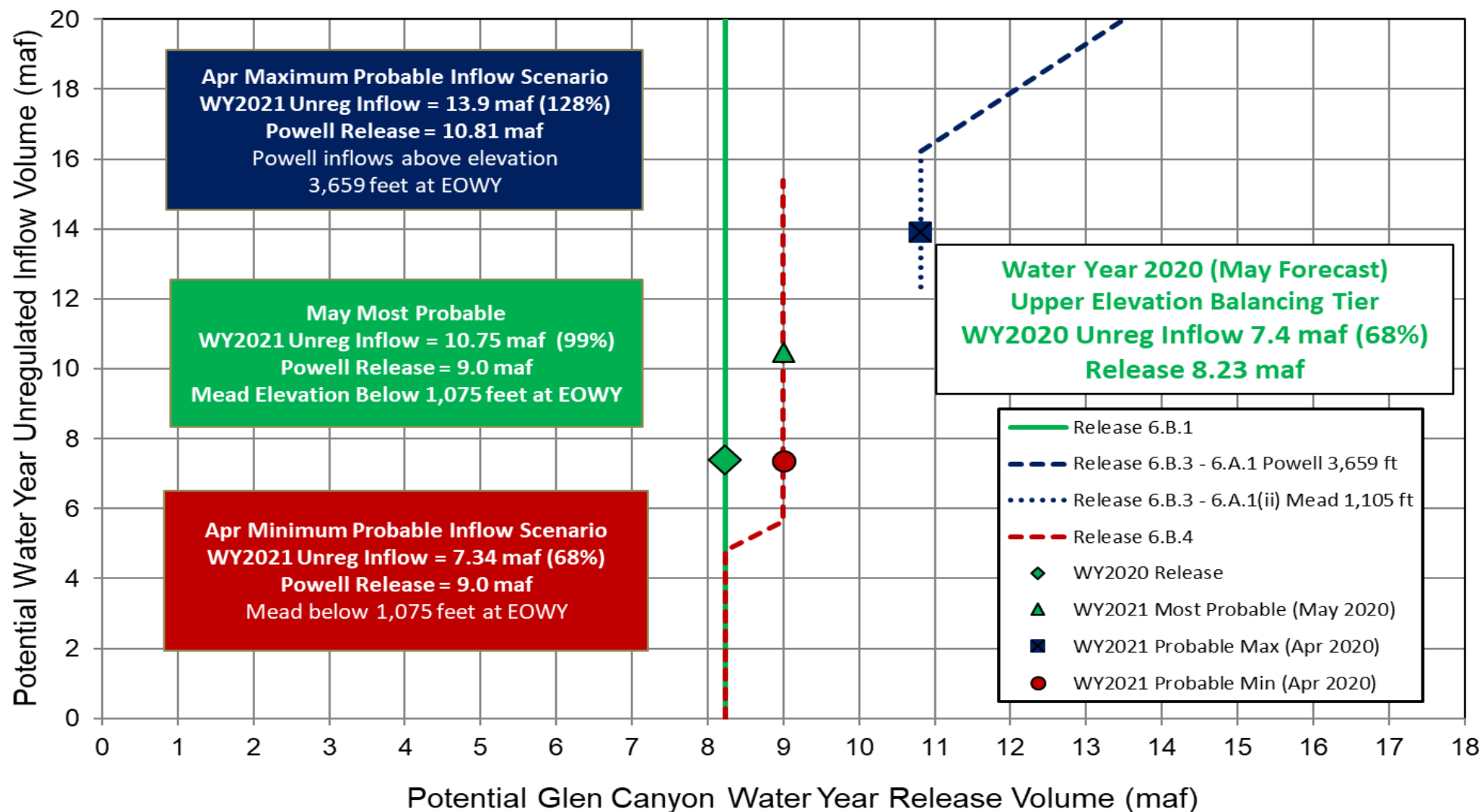
Lake Mead End of Month Elevations

Projections from the May 2020 24-Month Study Inflow Scenarios



Lake Powell Release Scenarios under Section 6.B

Water Year 2020 and 2021 Release Volume as a Function of Upper Elevation Balancing Tier
based on April and May 2020 24-Month Study Conditions



Glen Canyon Power Plant Planned Unit Outage Schedule for Water Year 2020

Unit Number	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	5	6	6	6	6	5	6	6	6	6	6	6
Capacity (cfs)	16,800	20,500	20,400	20,400	20,300	16,500	20,200	20,400	20,600	20,500	20,400	20,400
Capacity (kaf/month)	1,060	1,160	1,420	1,250	1,180	1,100	1,210	1,300	1,390	1,300	1,290	1,250
Max (kaf) ¹	625	625	750	760	675	700	630	630	650	750	835	599
Most (kaf) ²	625	625	750	760	675	700	630	630	650	750	835	599
Min (kaf) ¹	625	625	750	760	675	700	630	630	650	750	835	599
(updated 05-13-2020)												

- 1 Projected release, based on May 2020 MOST Probable Inflow Projections and 24-Month Study model runs
- 2 Projected release, based on April 2020 Min and Max Probable Inflow Projections and 24-Month Study model runs
- 3 *Dependent upon availability to shift regulation and reserves



Glen Canyon Power Plant Planned Unit Outage Schedule for Water Year 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												
2												
3												
4												
5												
6												
7												
8												
Units Available	6	6	6	6	6	6	6	6	6	6	6	6
Capacity (cfs)	20,300	20,300	20,200	20,100	20,100	20,000	20,000	20,300	20,700	20,700	20,700	20,600
Capacity (kaf/month)	1,310	1,270	1,290	1,290	1,160	1,310	1,240	1,300	1,280	1,360	1,350	1,310
Max (kaf) ¹	640	640	720	860	970	920	1,030	910	960	1,110	1,170	877
Most (kaf) ²	640	640	720	860	750	800	710	710	750	850	900	670
Min (kaf) ¹	640	640	720	860	750	800	710	710	750	850	900	670
(updated 05-13-2020)												

1 Projected release, based on May 2020 Most Probable Inflow Projections and 24-Month Study model runs

2 Projected release, based on April 2020 Min and Max Probable Inflow Projections and 24-Month Study model runs

3 *Dependent upon availability to shift regulation and reserves

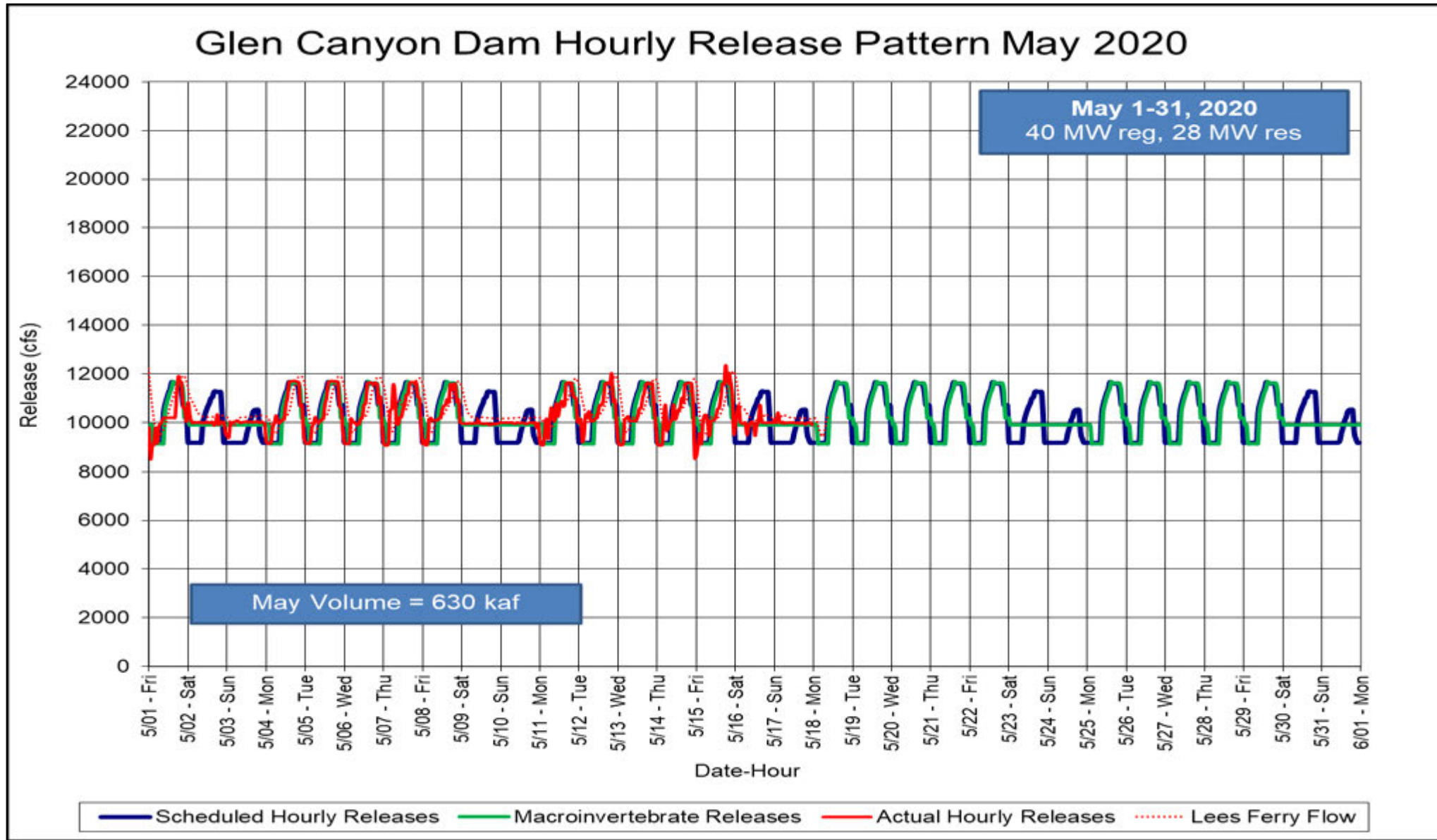


Bug Flow Hydrograph

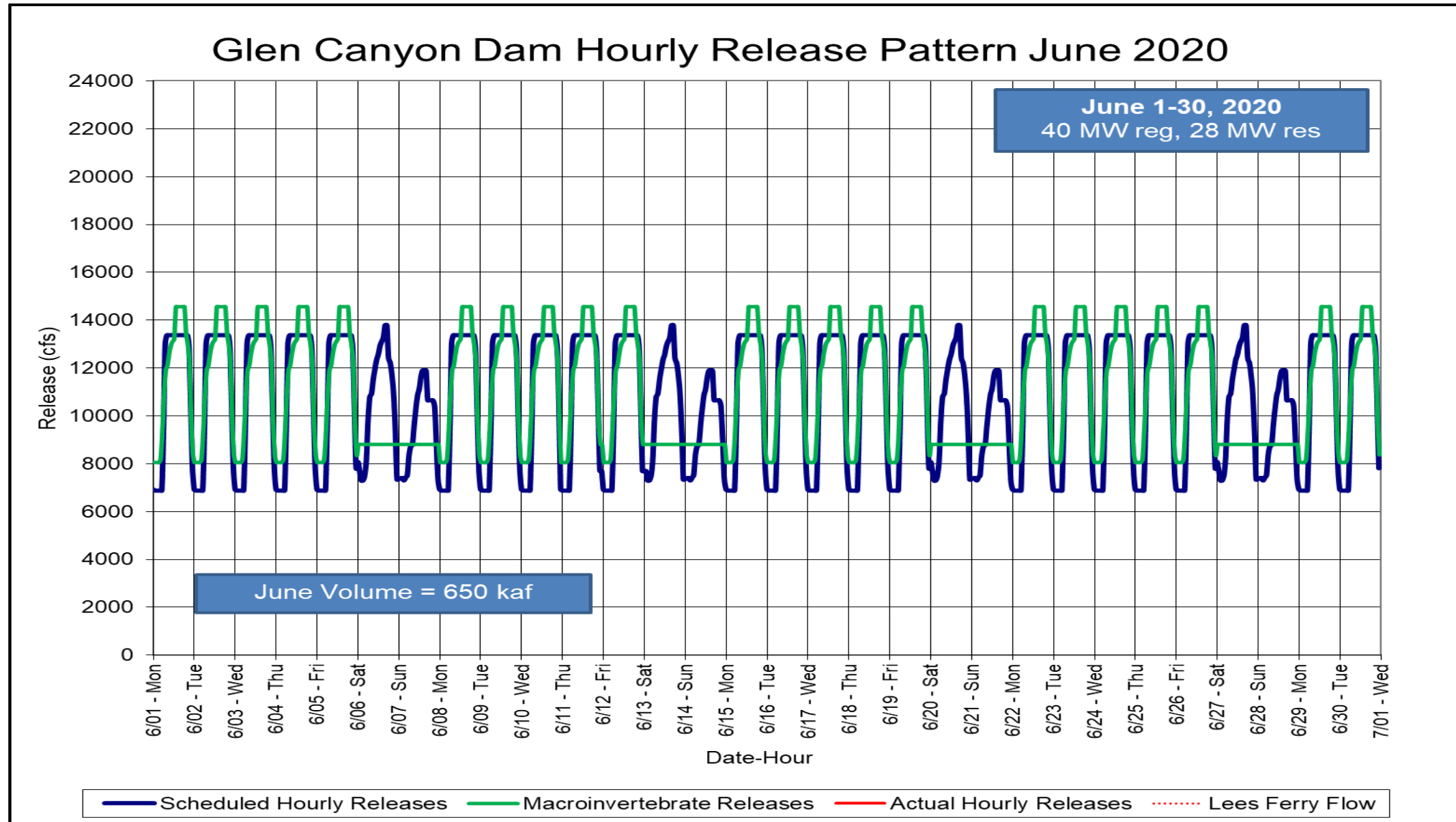
- Hydrograph characteristics:
 - Implement May 1 through August 31, 2020
 - Steady weekend lows, fluctuating weekday releases
 - Weekend lows 750 cfs higher than weekday lows
 - Weekly, monthly, and annual release volumes do not change
 - Hydropower reserves, regulation and emergency criteria remain in effect

Month	Release Volume (af)	Maximum Daily Fluctuation (cfs)	Weekday Maximum (cfs)	Weekday Minimum (cfs)	Weekend Release (cfs)
May	630,000	2,525	11,665	9,135	9,890
June	650,000	6,500	14,565	8,065	8,815
July	750,000	7,500	16,030	8,530	9,280
August	835,000	8,000	17,880	9,880	10,630

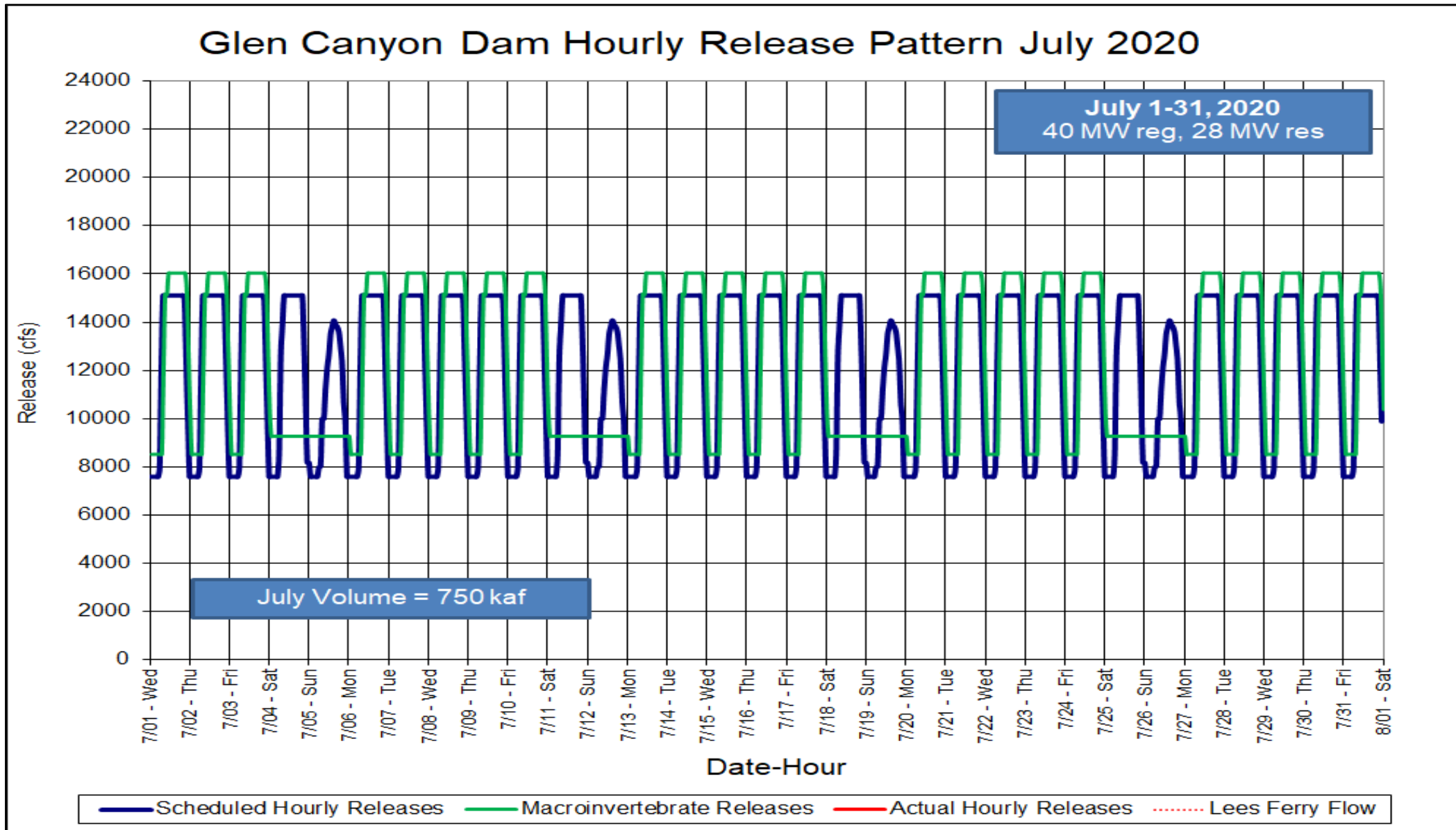
May 2020 Hourly Releases



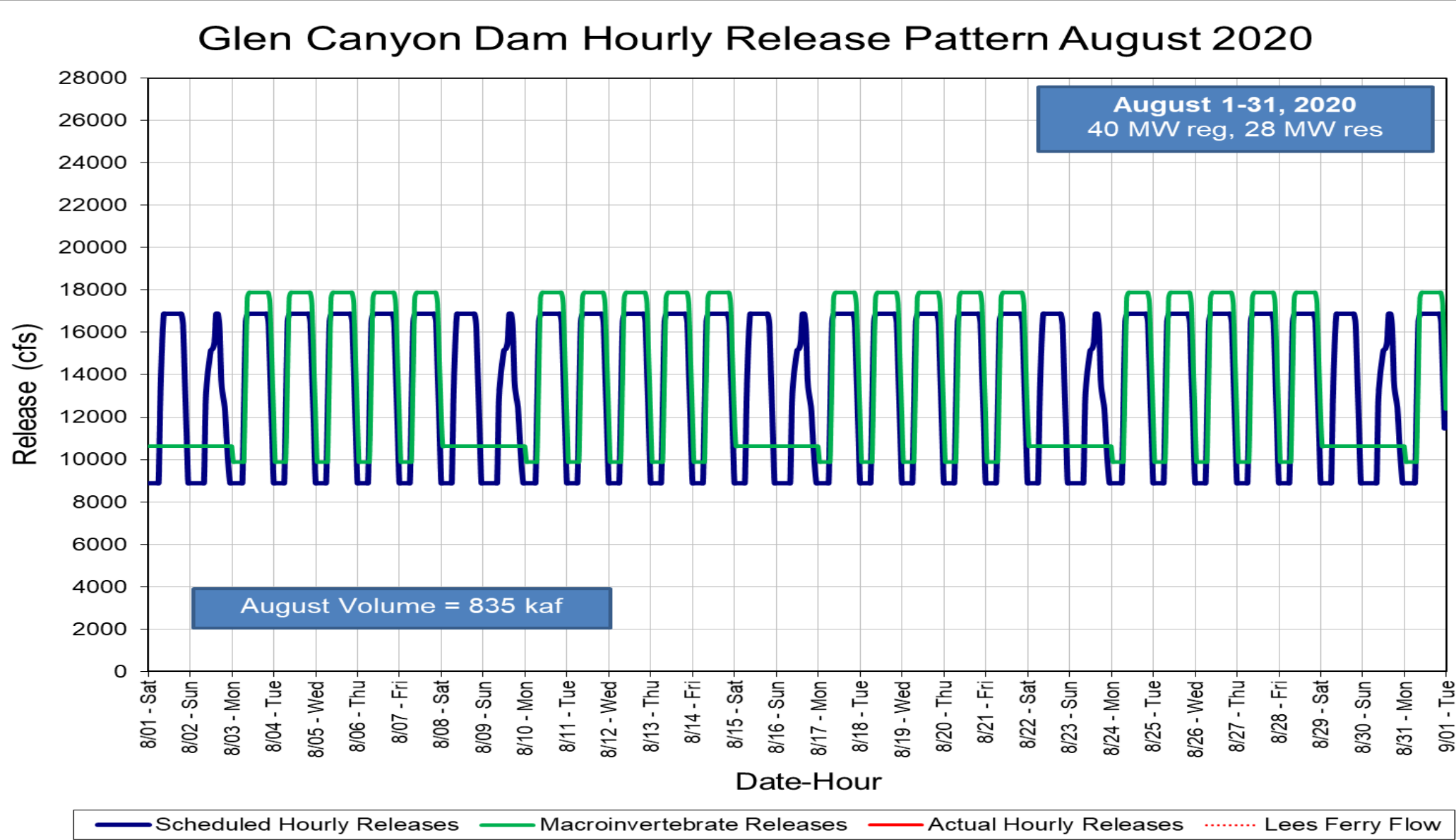
June 2020 Hourly Releases



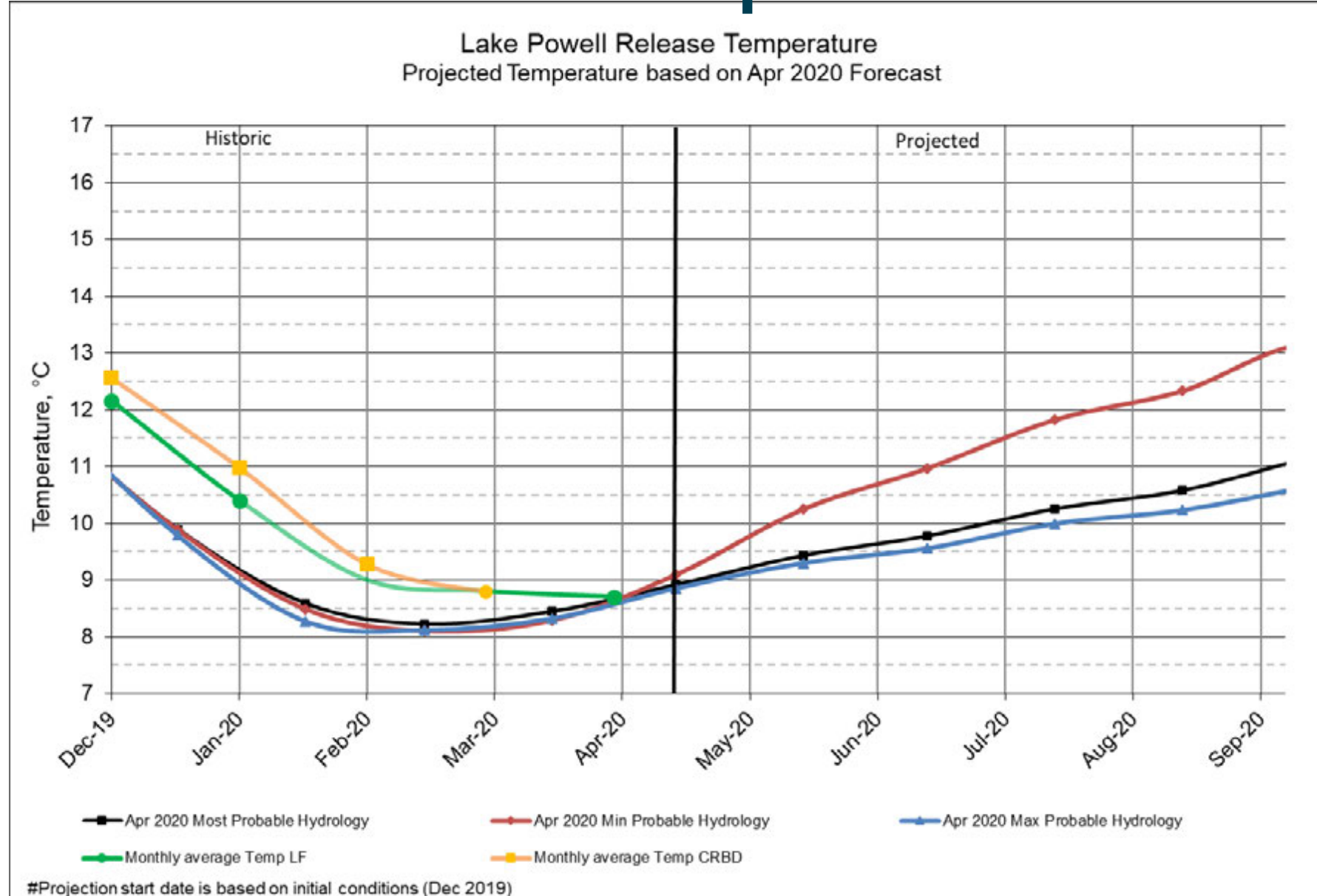
July 2020 Hourly Releases



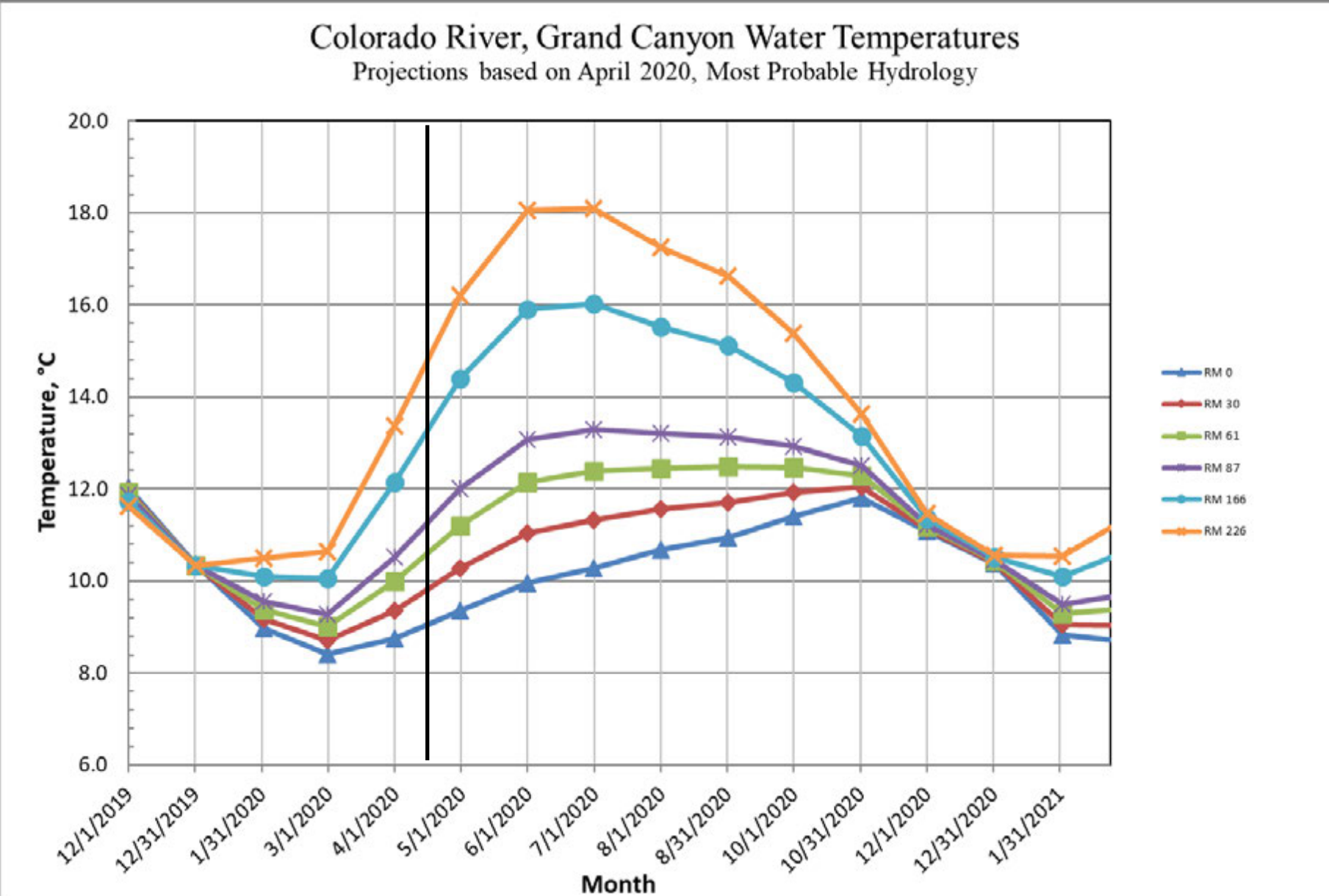
August 2020 Hourly Releases



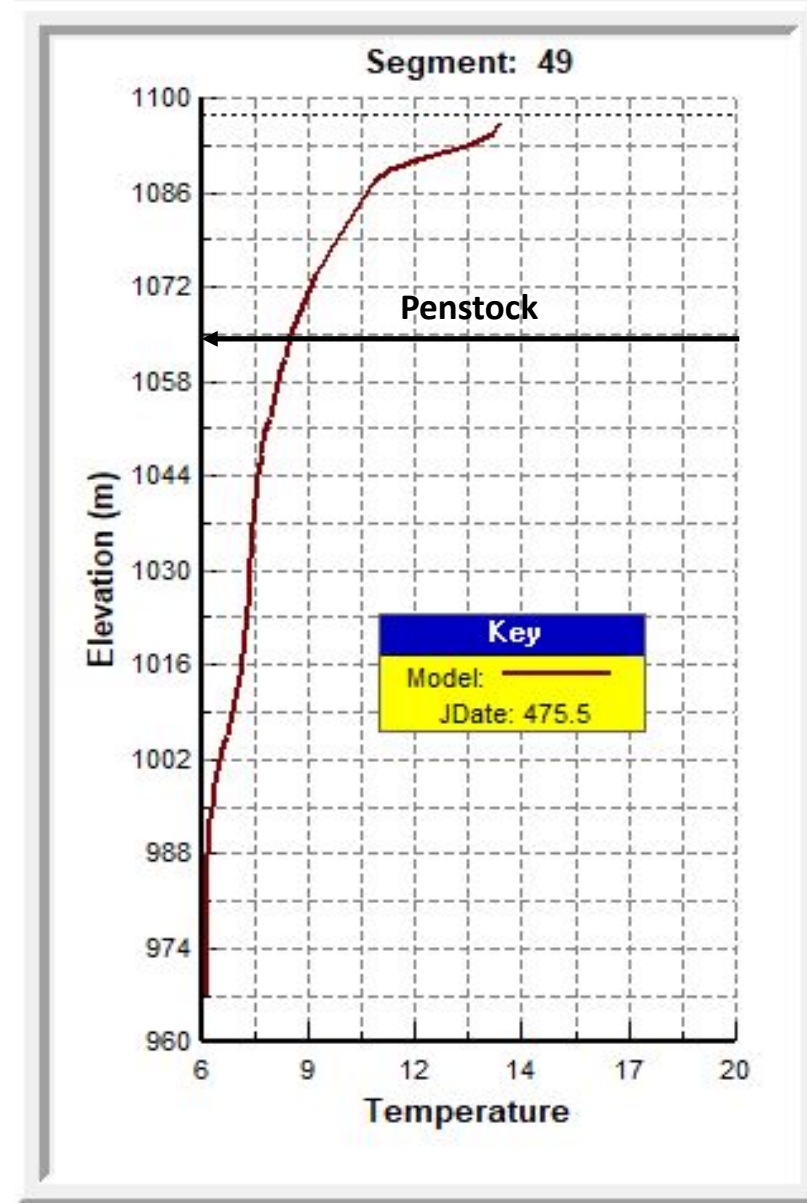
Lake Powell Release Temperature



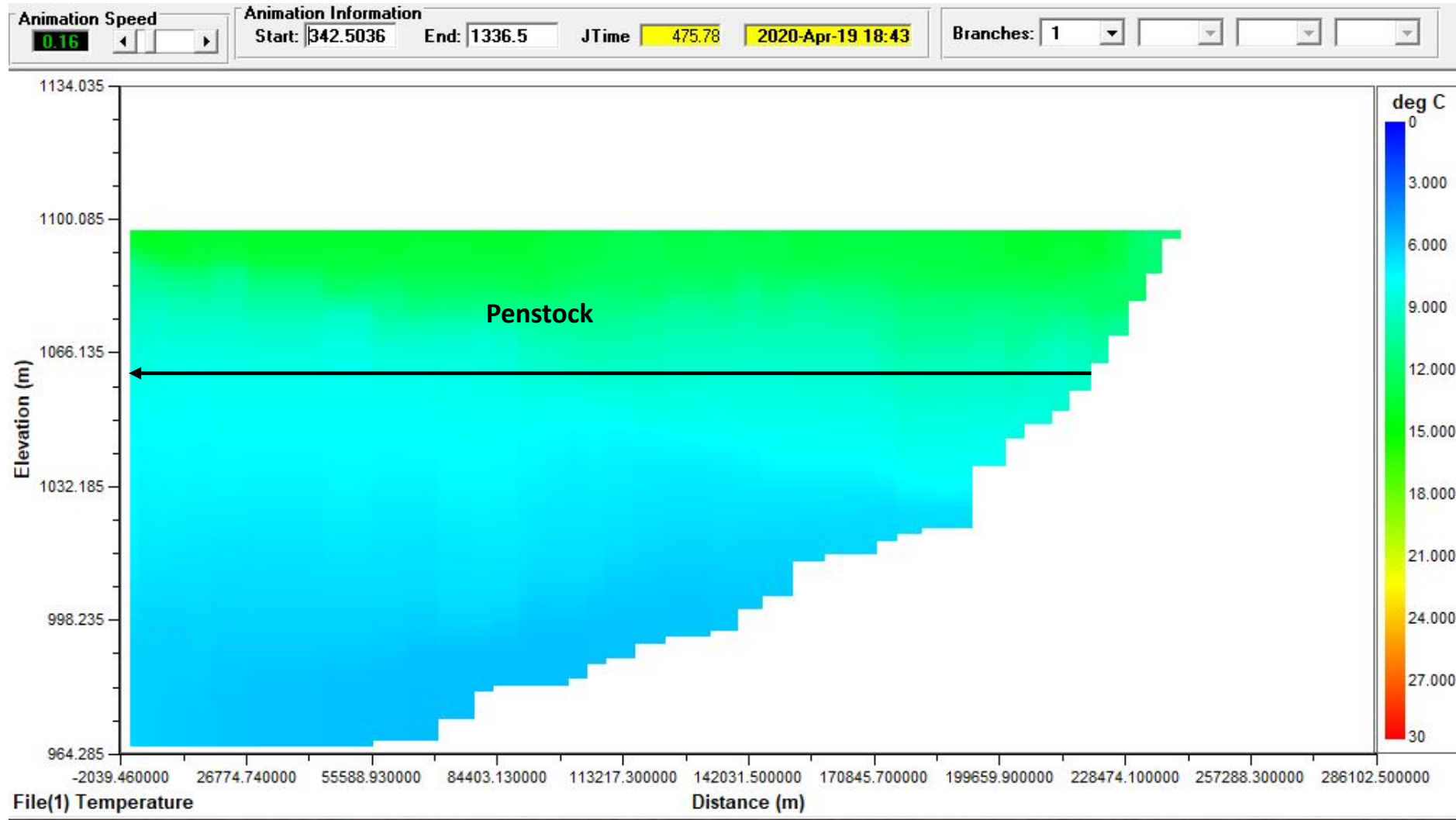
Grand Canyon Water Temperatures



Powell Profile Temperature



Powell Reservoir Profile Temperatures



Questions

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