BUREAU OF RECLAMATION

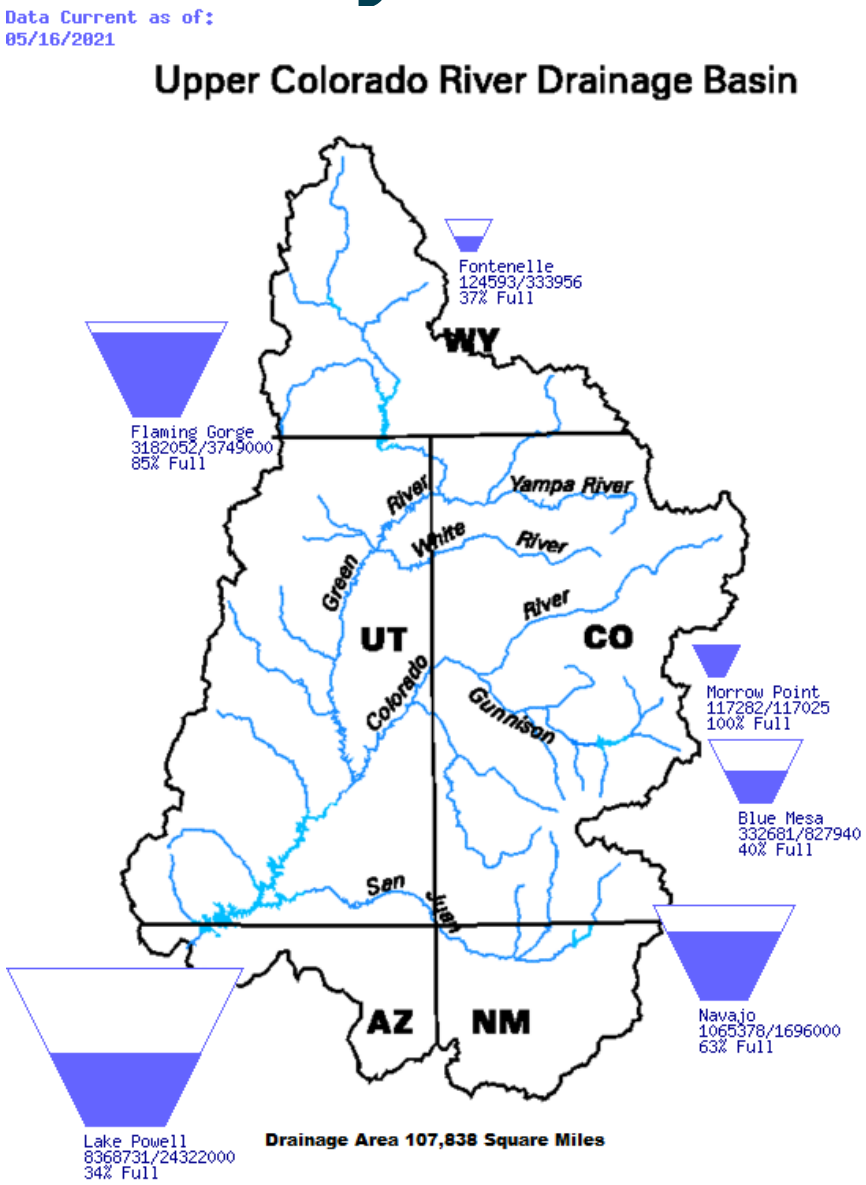
GCDAMP Adaptive Management Work Group

Basin Hydrology and Operations

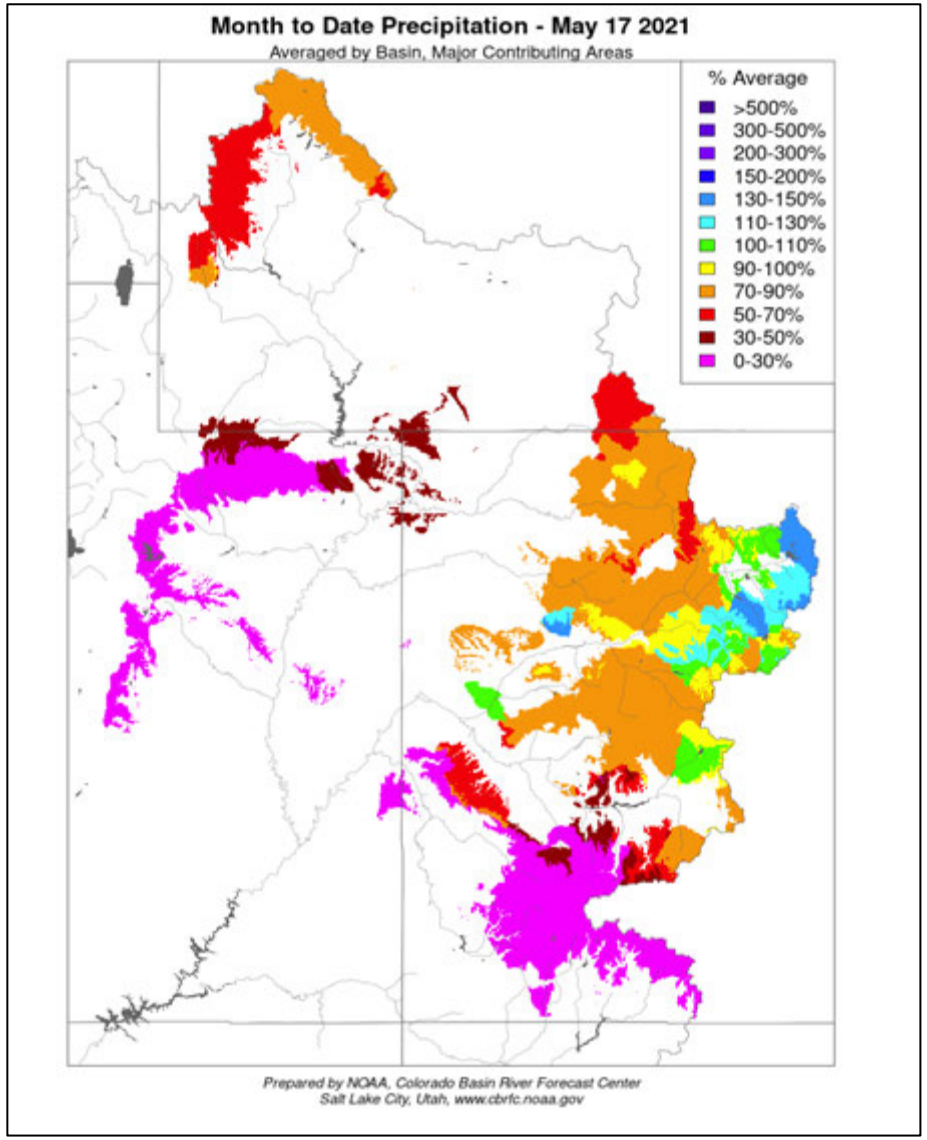
May 19, 2021

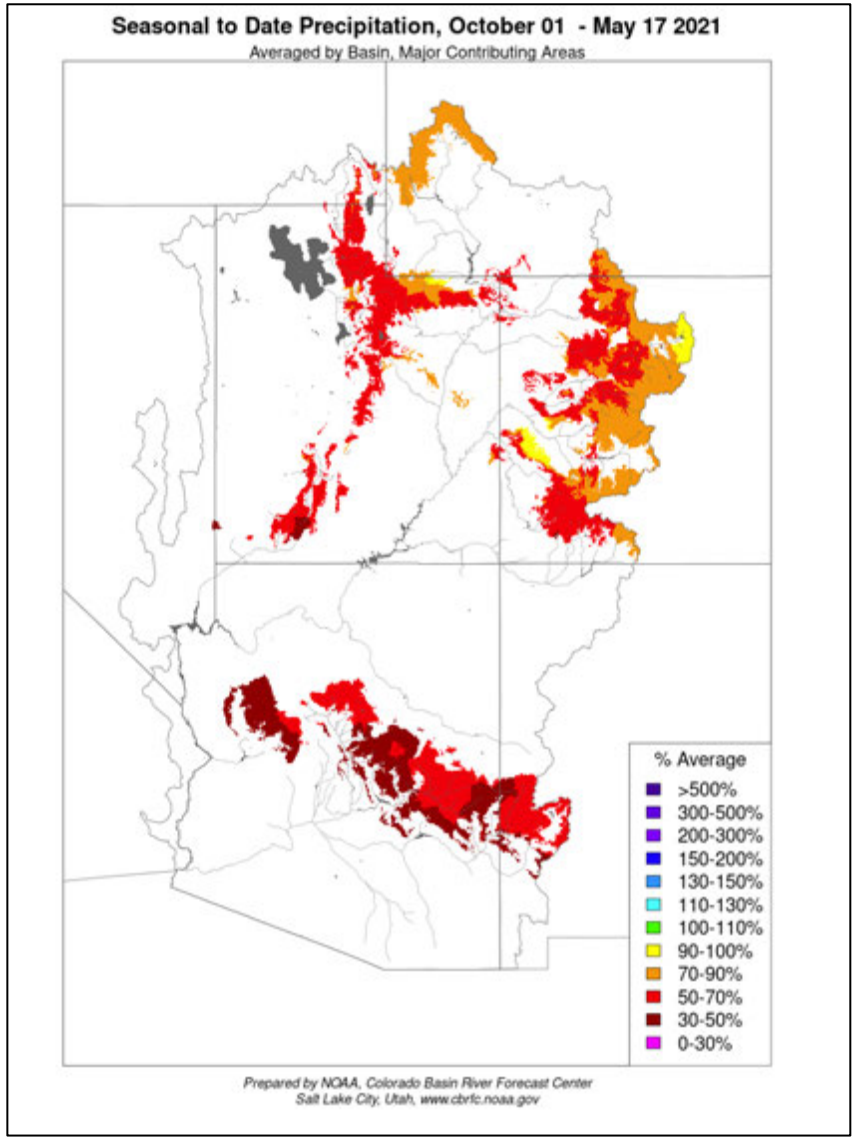
Upper Basin Storage (as of May 17, 2021)

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	37	.125	.334	6,472.89
Flaming Gorge	85	3.18	3.75	6,025.59
Blue Mesa	40	0.333	.828	7,454.17
Navajo	63	1.07	1.70	6,035.54
Lake Powell	34	8.37	24.32	3,560.60
UC System Storage	42	13.21	31.09	

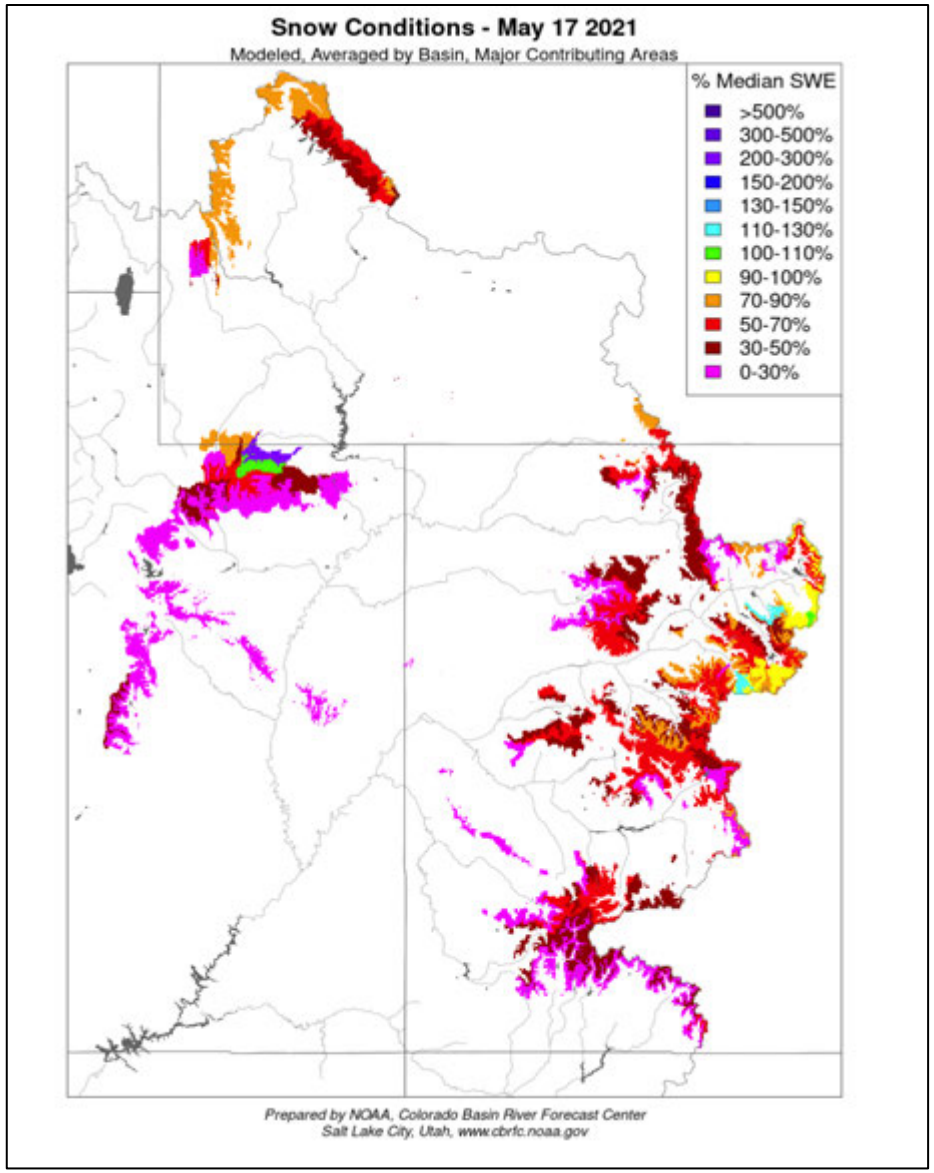


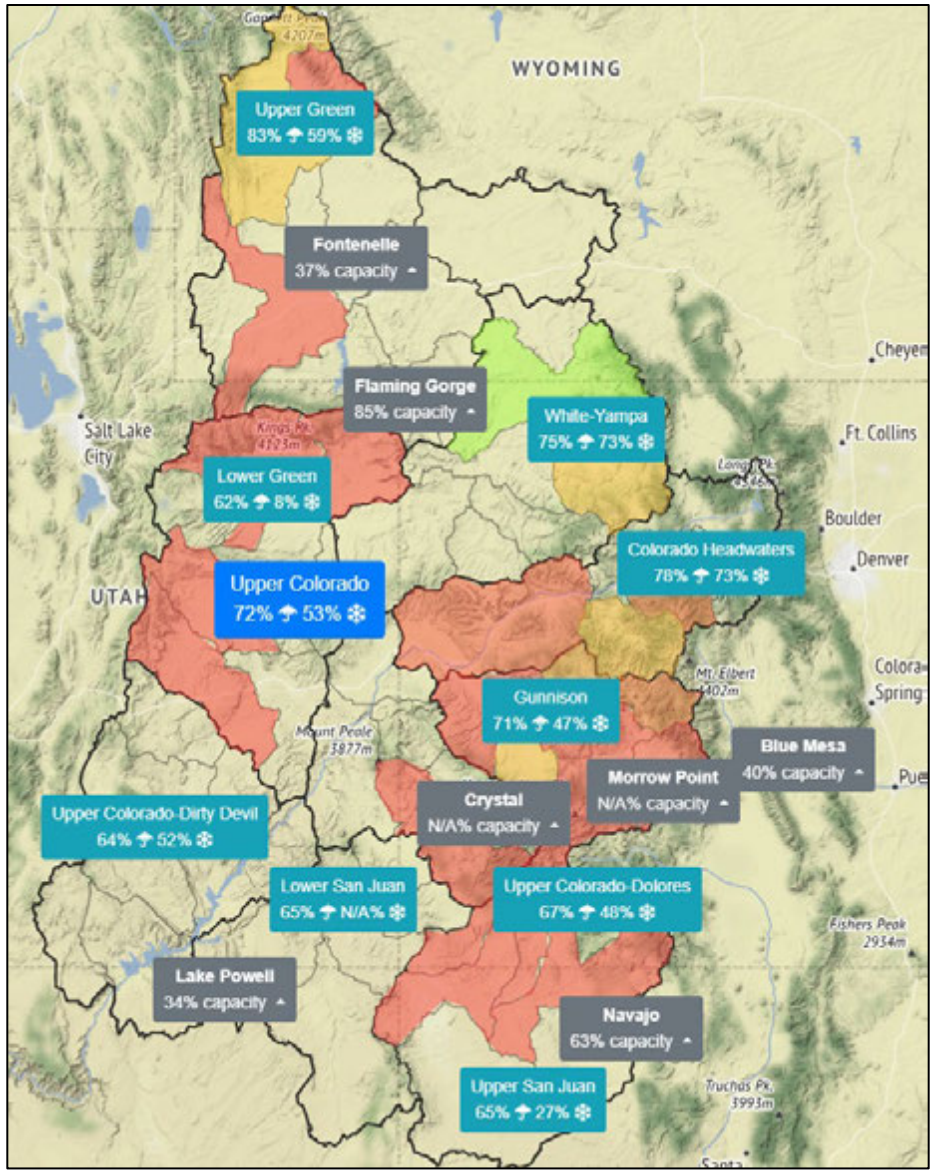
Seasonal and Monthly Precipitation



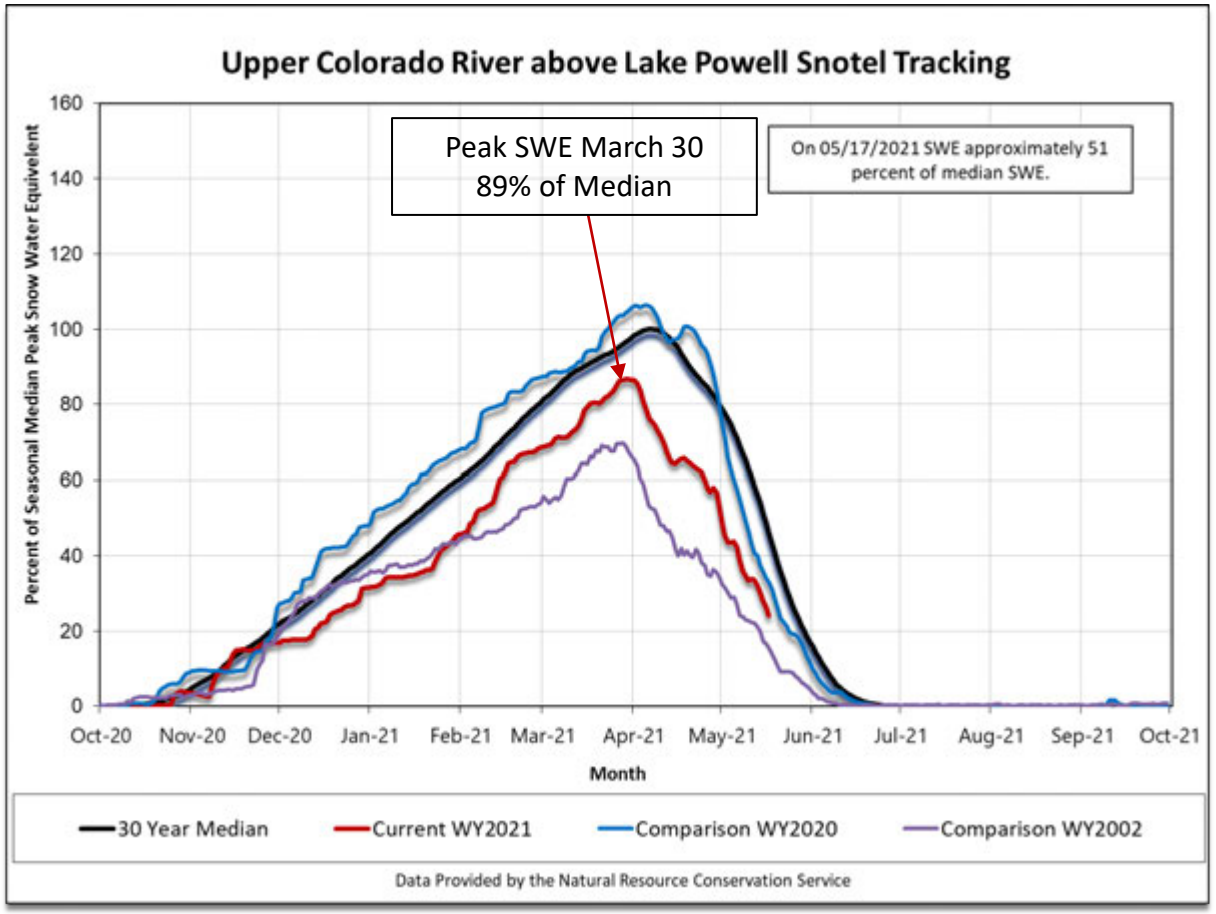


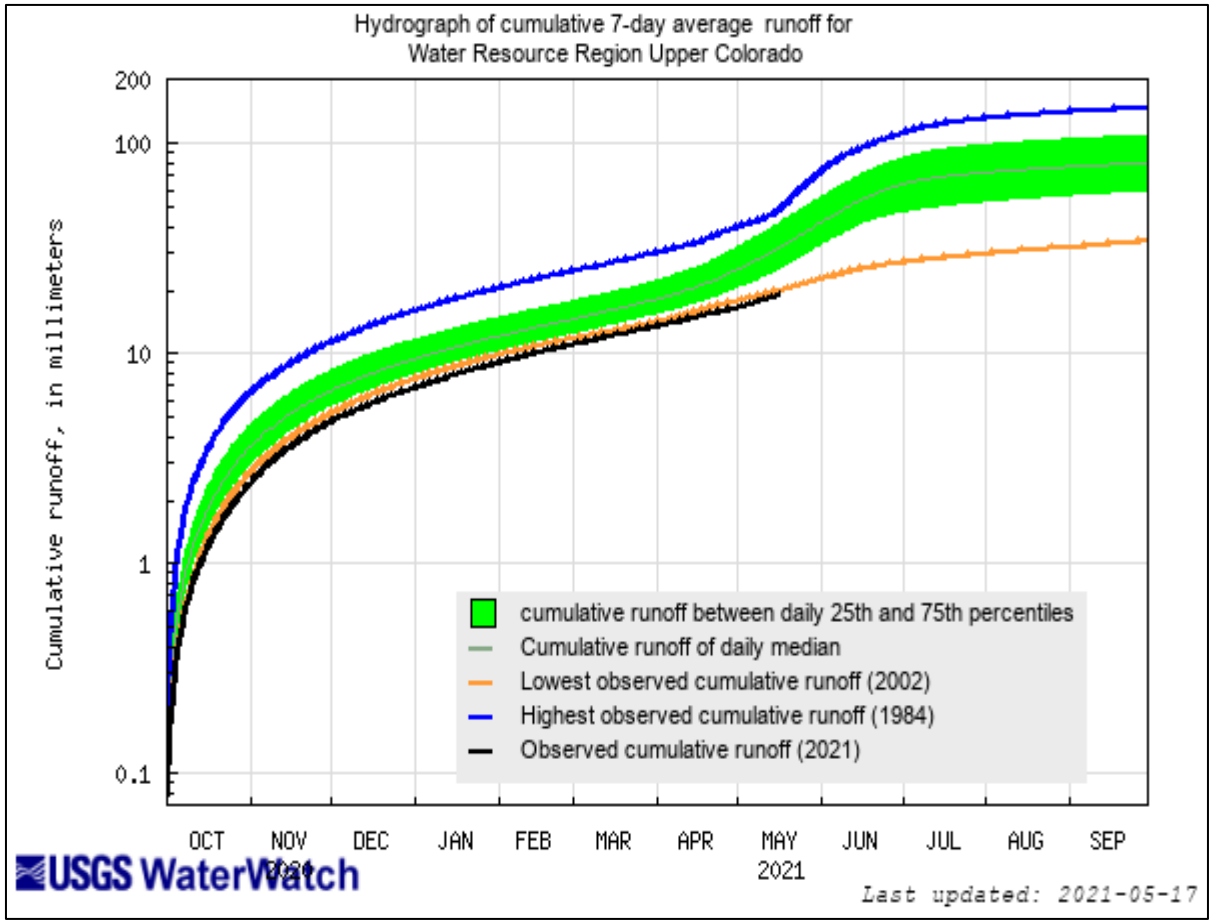
Seasonal Snow Conditions and Basin SWE





Current SWE and February WY2021 Forecast





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

Most Probable May Midmonth Spring and WY 2021 Forecast

April – July 2021 Forecasted Unregulated Inflow

as of May 17, 2021

Reservoir	Unregulated Inflow (kaf)	Difference from May FF (kaf)	Percent of Average[1]
Fontenelle	380	-35	48
Flaming Gorge	450	-55	40
Blue Mesa	340	NA	50
Navajo	325	-15	42
Powell	1,850	-150	26

Water Year 2021 Forecasted Unregulated Inflow

as of May 17, 2021

Reservoir	Unregulated Inflow (kaf)	Percent of Average[1]
Fontenelle	695	55
Flaming Gorge	591	48
Blue Mesa	540	57
Navajo	448	42
Powell	3,487	32

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

Most Probable May Final Spring Forecast and WY 2021 Forecast

April – July 2021 Forecasted Unregulated Inflow

as of May 4, 2021

Reservoir	Unregulated Inflow (kaf)	Difference from April (kaf)	Percent of Average[1]
Fontenelle	380	-50	52
Flaming Gorge	450	-80	46
Blue Mesa	340	-100	50
Navajo	325	-70	44
Powell	2,000	-1200	28

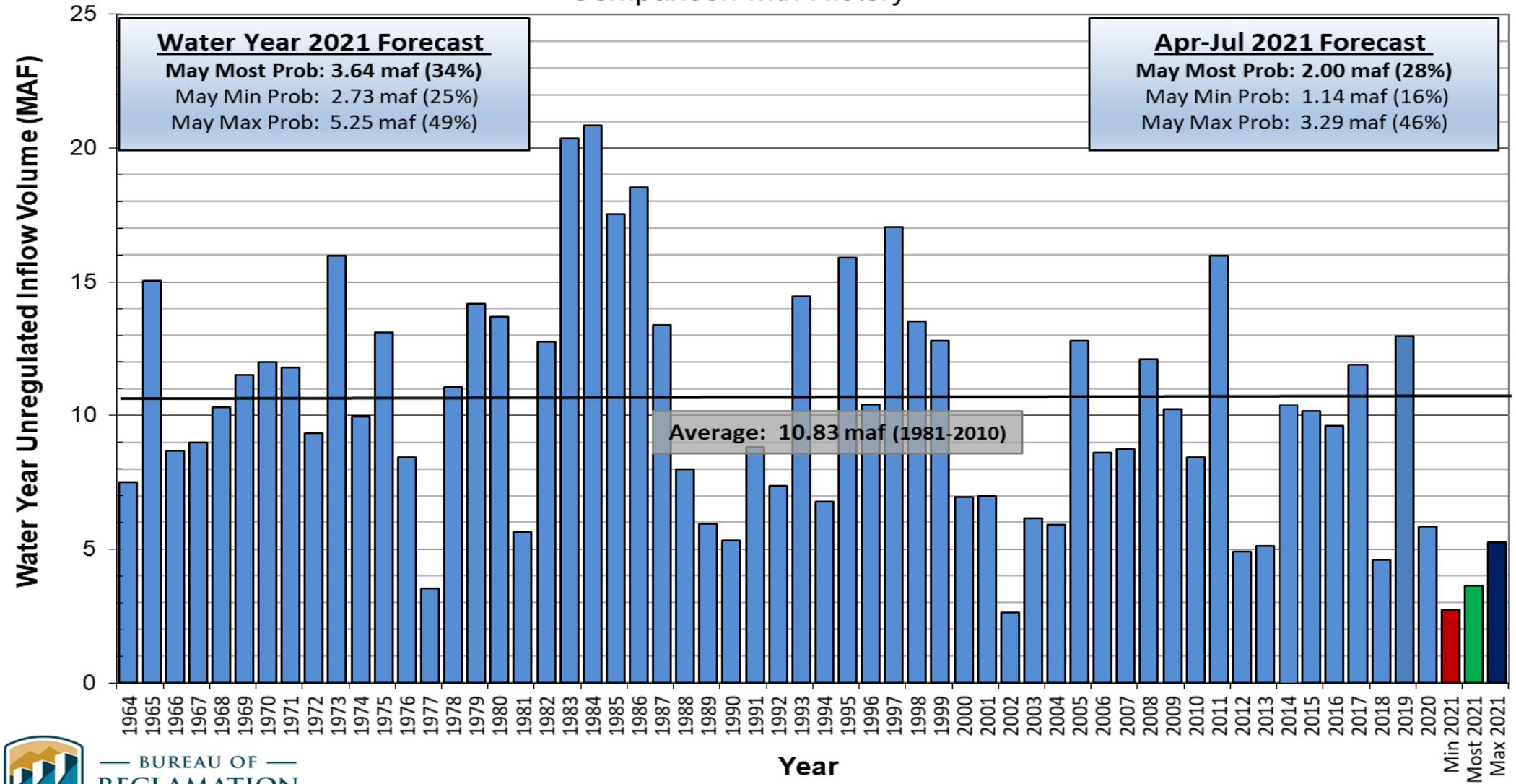
Water Year 2021 Forecasted Unregulated Inflow

as of May 5, 2021

Reservoir	Unregulated Inflow (kaf)	Difference from April (kaf)	Percent of Average[1]
Fontenelle	630	-61	58
Flaming Gorge	744	-90	51
Blue Mesa	540	-104	57
Navajo	440	-74	41
Powell	3,636	-1,261	34

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

Lake Powell Unregulated Inflow
Water Year 2021 Forecast *(issued May 5)*
Comparison with History



BUREAU OF RECLAMATION

Upper Colorado Basin

Projected Operations for Water Year 2021 Based on May 2021 Modeling

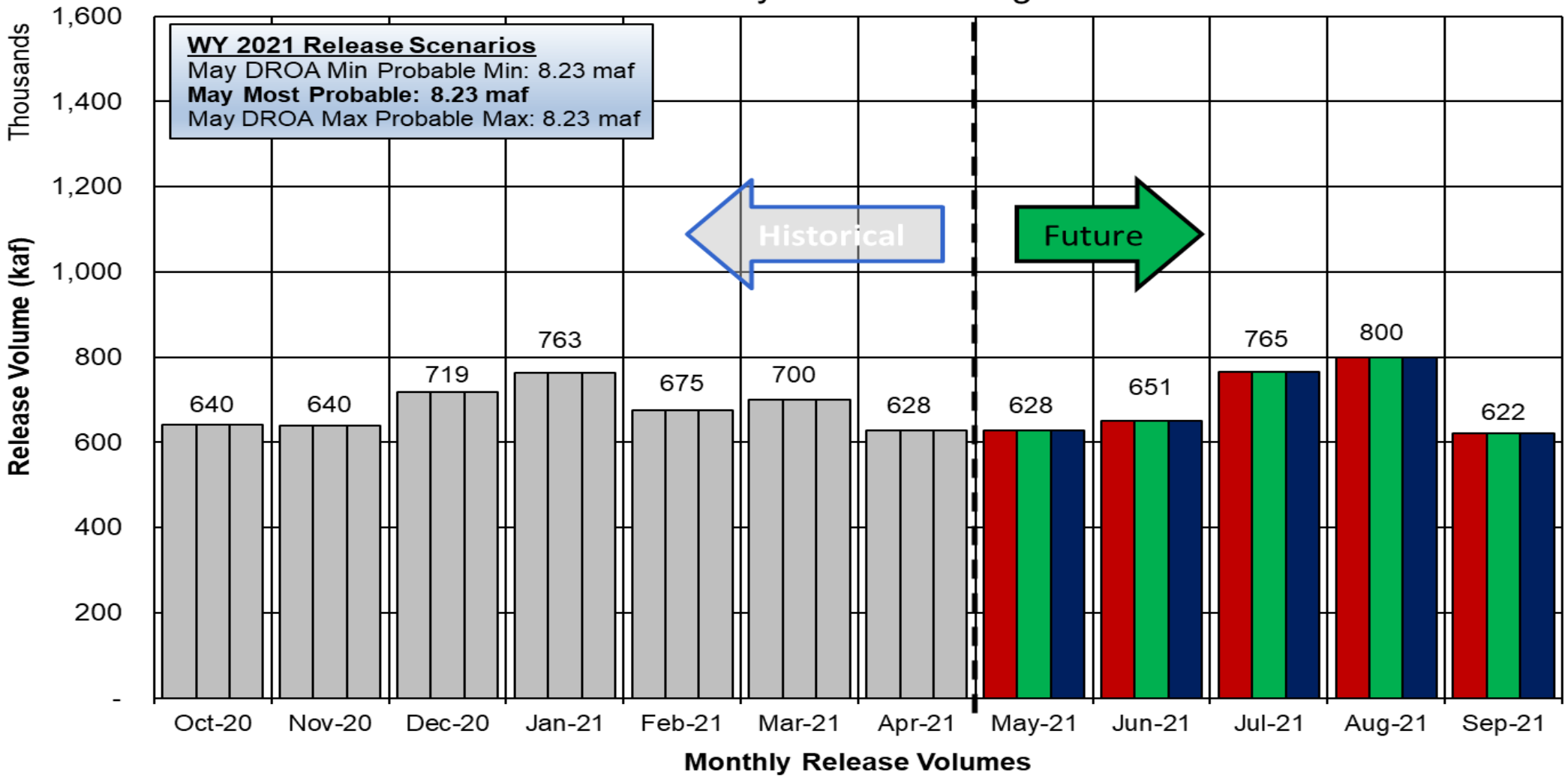
Drought Response Operations Agreement (DROA)

- 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 May Minimum Probable 24-MS continued to indicate elevations below 3,525 feet in 2022.
- These minimum projections *do not* initiate immediate operational changes to Reclamation facilities.
- These minimum projections *do* initiate enhanced monitoring and coordination under the DROA.
- These minimum projections *do* initiate monthly analysis of min/most/max with the parties specified in the DROA.
- The DROA enhanced monitoring and coordination will continue until either:
  - (i) The minimum probable projected elevation remains above 3,525 feet for 24 months; or
  - (ii) the process moves to the next step when the Most Probable 24-MS projects Powell elevations below 3,525 feet and a specific Drought Response Operations Plan is developed.

Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2021

Based on May 2021 Modeling



BUREAU OF RECLAMATION

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

Lake Powell WY 2022 Operating Tier Scenarios

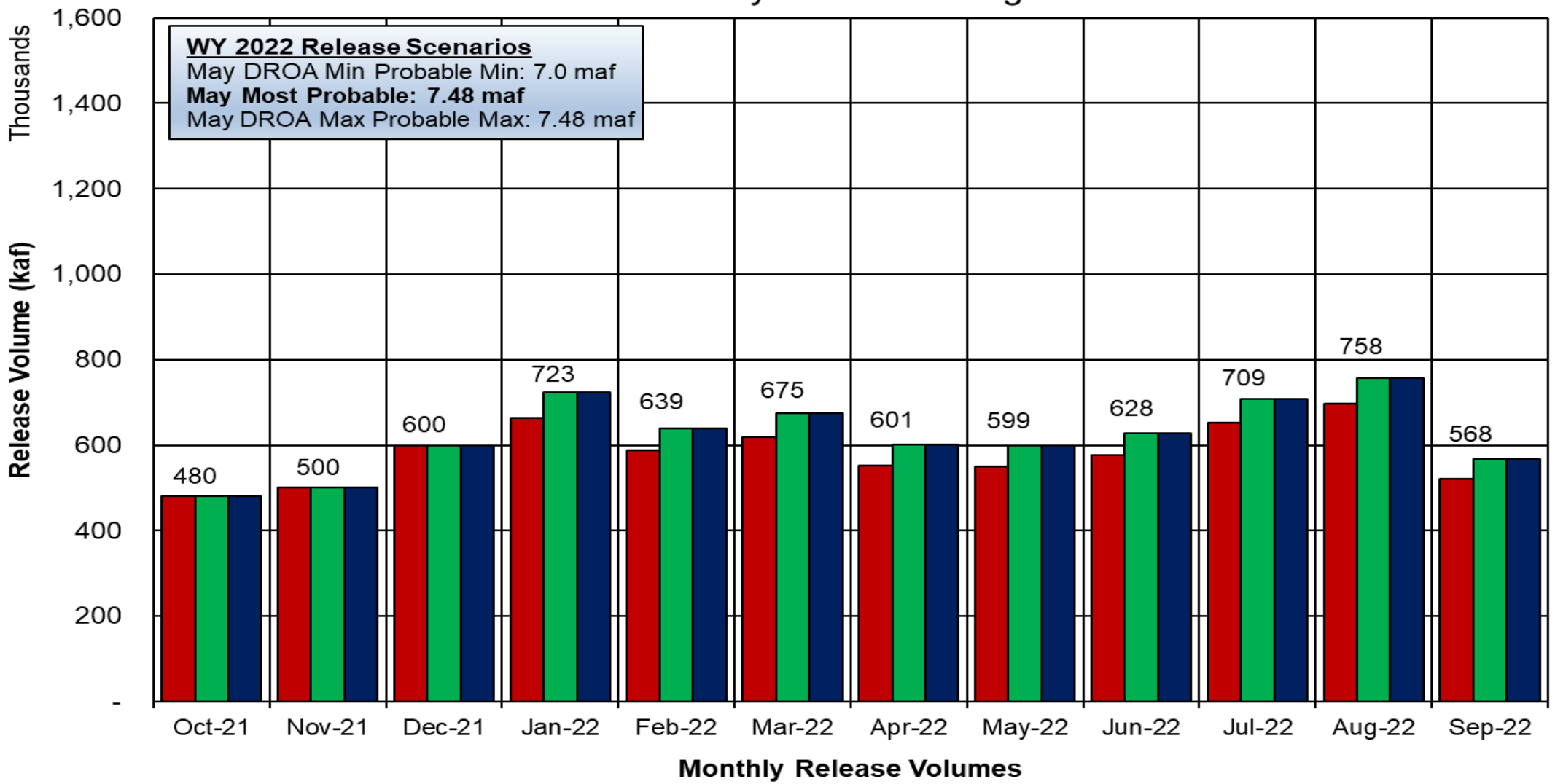
Based on May 2021 24-Month Study Inflow Scenarios

Inflow Scenario	Operating Tier/ Release Volume
May DROA* Minimum Probable	Lower Elevation Balancing 7.00 maf
May Most Probable	Mid-Elevation Release 7.48 maf
May 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 2022
Based on May 2021 Modeling

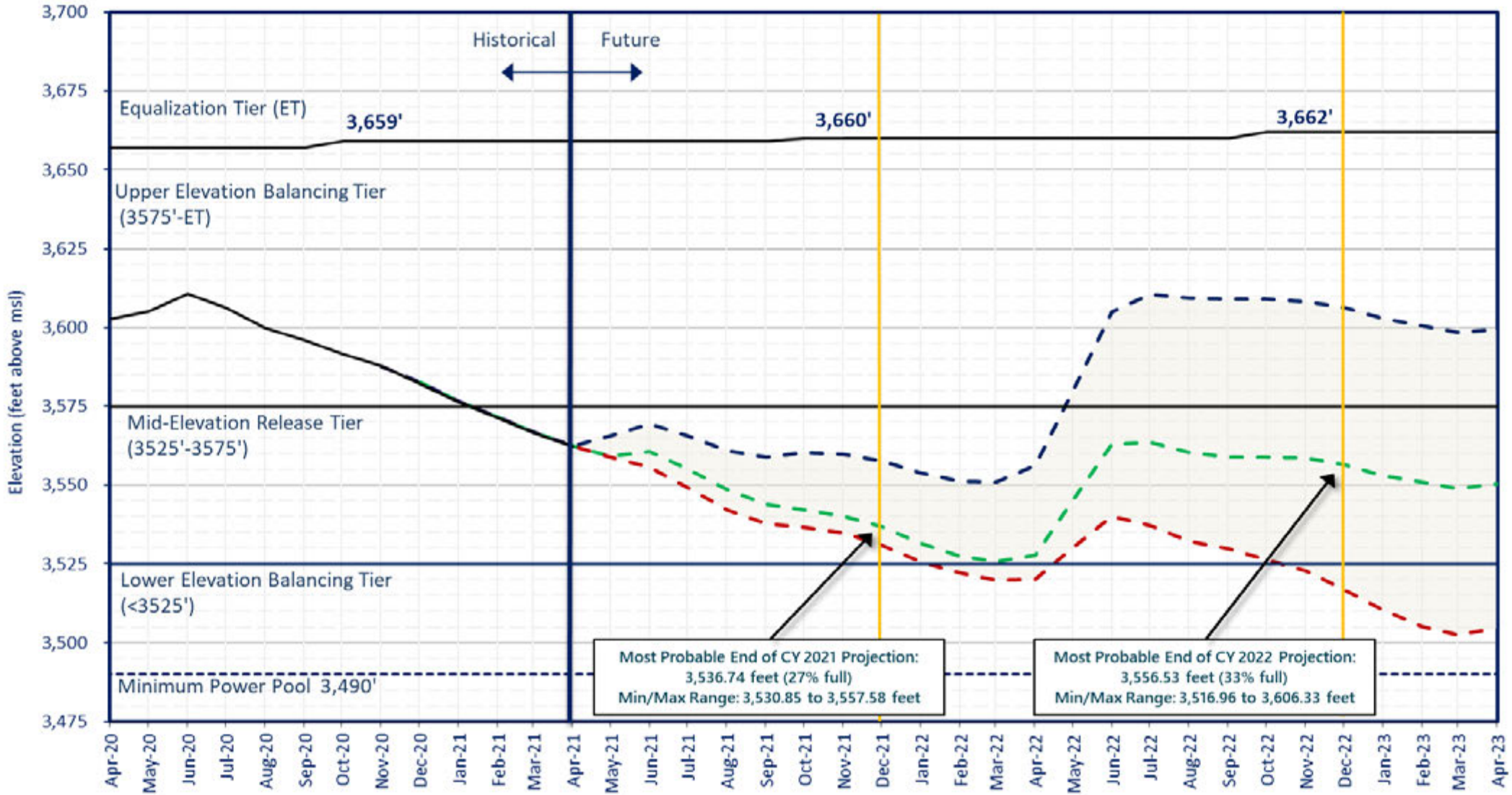


BUREAU OF RECLAMATION

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 May 2021 24-Month Study Inflow Scenarios



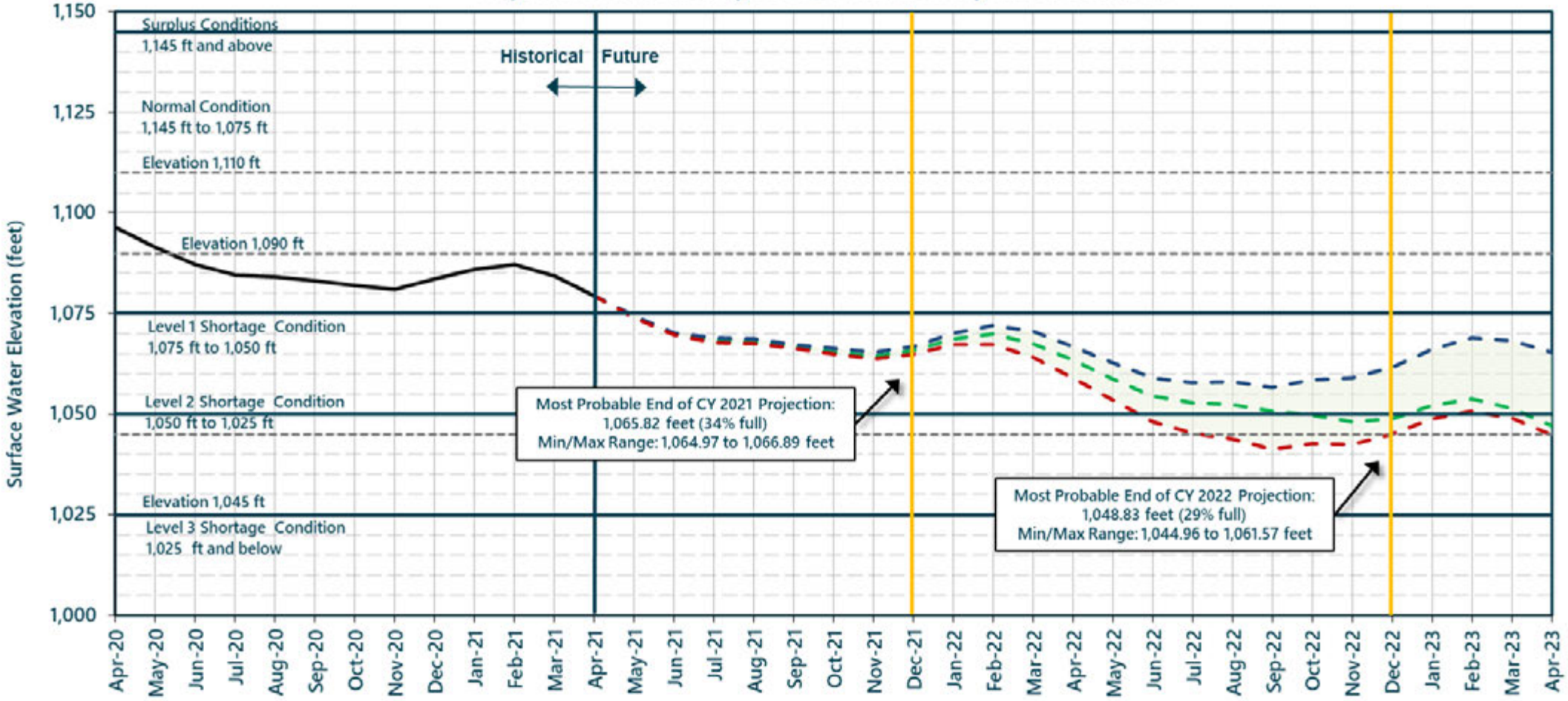
— BUREAU OF —
RECLAMATION

- May 2021 Most Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- May 2021 DROA* Minimum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.0 maf in WY2022
- May 2021 DROA* Maximum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- Historical Elevations

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

Lake Mead End of Month Elevations

Projections from the May 2021 24-Month Study Inflow Scenarios



Historical Elevations

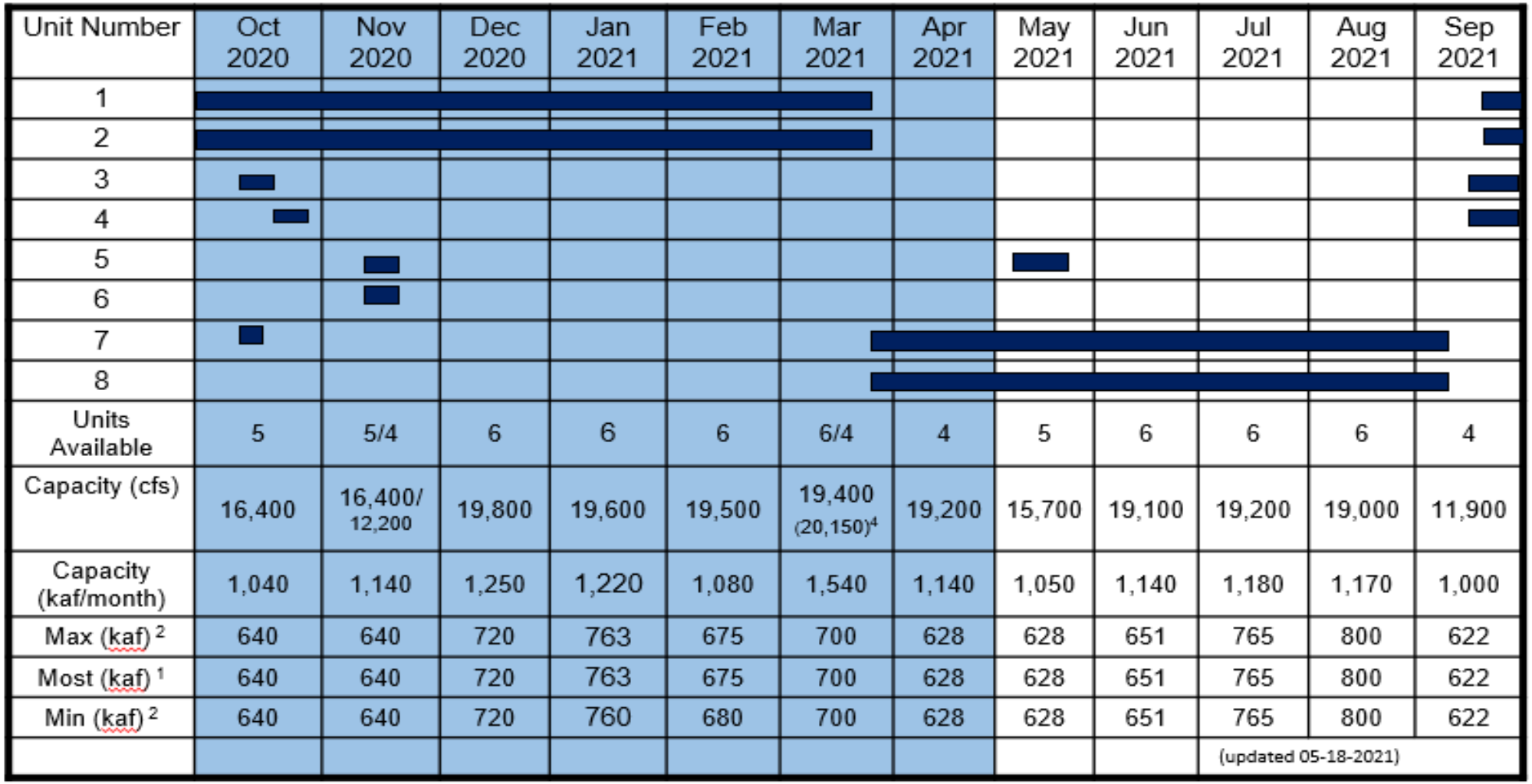
May 2021 Most Probable Inflow with a Lake Powell release of 8.23 maf in WY 2021 and 7.48 maf in WY 2022

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

May 2021 DROA* Minimum Probable Inflow with a Lake Powell release of 8.23 maf in WY 2021 and 7.00 maf in WY 2022

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

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													
2													
3													
4													
5													
6													
7													
8													
Units Available	5	5/4	6	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	19,100	19,200	19,000	11,900	MAY MOST[3]
Capacity (kaf/month)	1,040	1,140	1,250	1,220	1,080	1,540	1,140	1,050	1,140	1,180	1,170	1,000	MAY MOST
Max (kaf)[2]	640	640	720	763	675	700	628	628	651	765	800	622	8.23
Most (kaf)[1]	640	640	720	763	675	700	628	628	651	765	800	622	8.23
Min (kaf)[2]	640	640	720	760	680	700	628	628	651	765	800	622	8.23
										(updated 05-18-2021)			

1 Projected release, based on May 2021 Most Probable Inflow Projections and 24-Month Study model runs.

2 Projected release, based on May 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

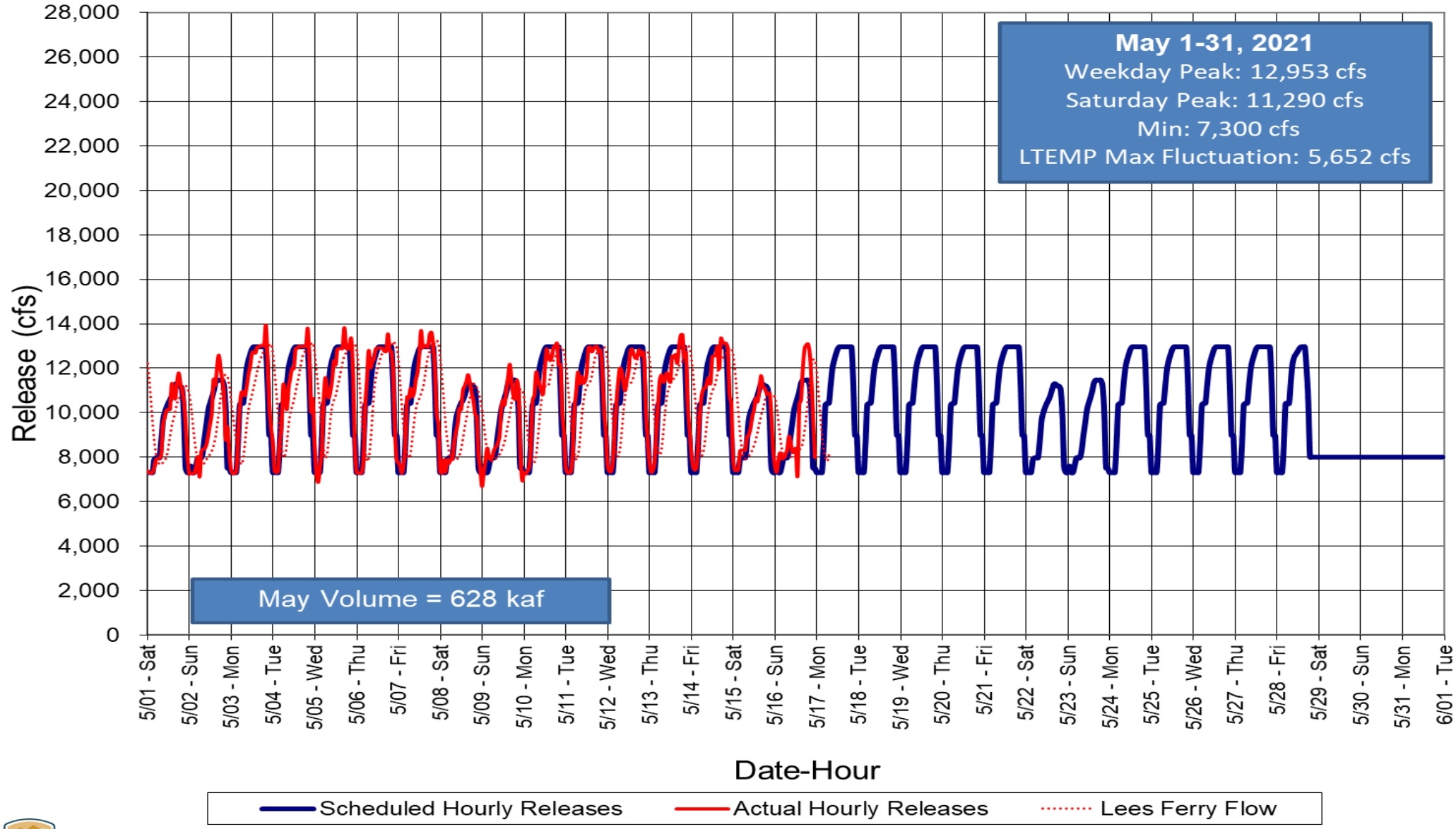
Unit Number	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	
1													
2													
3													
4													
5													
6													
7													
8													
Units Available	4/6	6/5	5/6	6/4	4	6	6	5	6	6	8	6	
Capacity (cfs)	11,800	15,200	15,100	11,600	11,500	18,100	18,100	14,800	18,700	19,200	26,300	19,200	MAY MOST[3]
Capacity (kaf/month)	940	1,000	1,070	1,120	710	1,110	1,070	940	1,110	1,210	1,620	1,200	MAY MOST
Max (kaf)[2]	480	500	600	723	639	675	601	599	628	709	758	568	7.48
Most (kaf)[1]	480	500	600	723	639	675	601	599	628	709	758	568	7.48
Min (kaf)[2]	480	500	600	664	587	620	552	550	577	652	696	522	7.0
										(updated 05-18-2021)			

1 Projected release, based on May 2021 Most Probable Inflow Projections and 24-Month Study model runs.

2 Projected release, based on May 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.

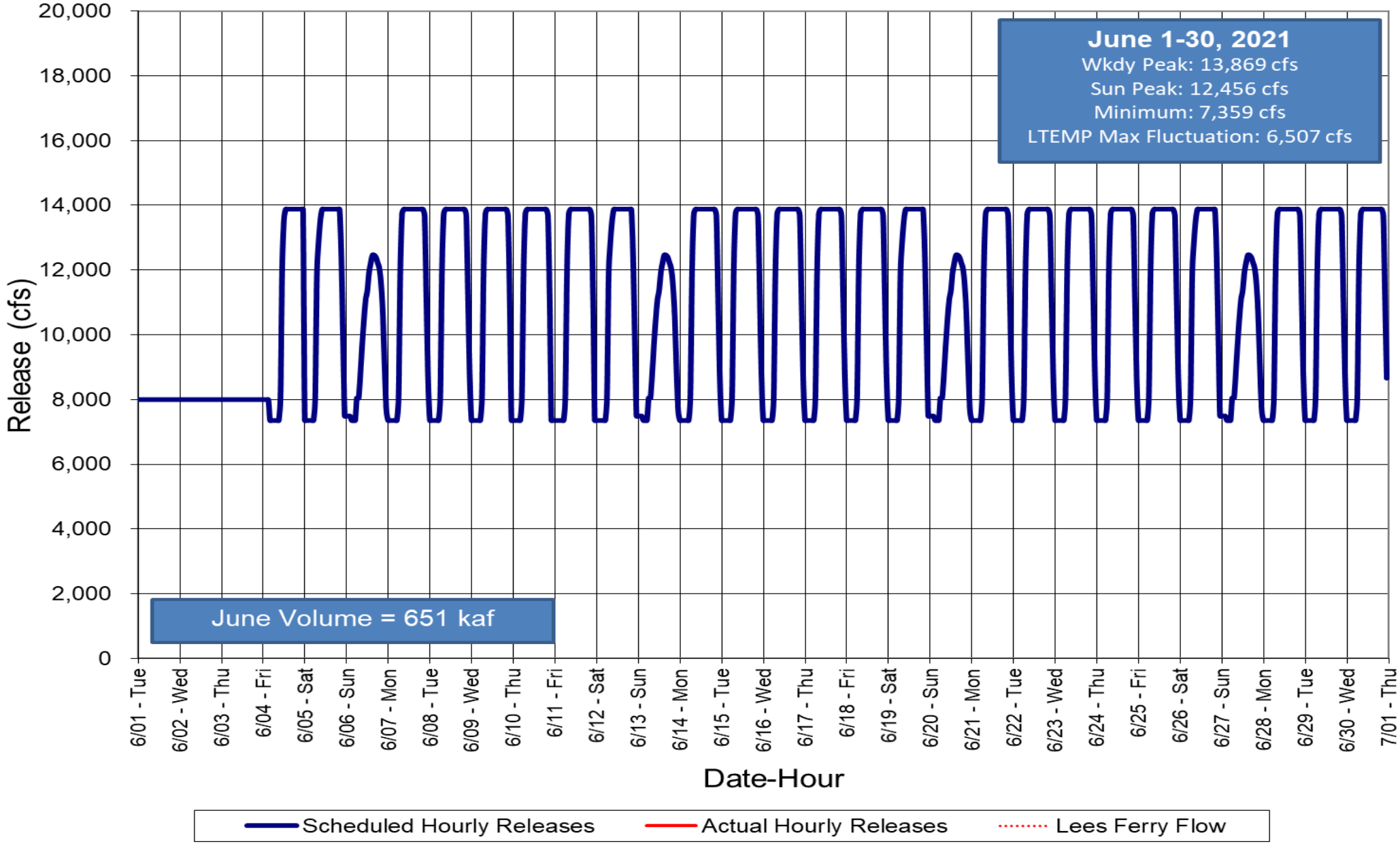
3 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.

Glen Canyon Dam Hourly Release Pattern May 2021



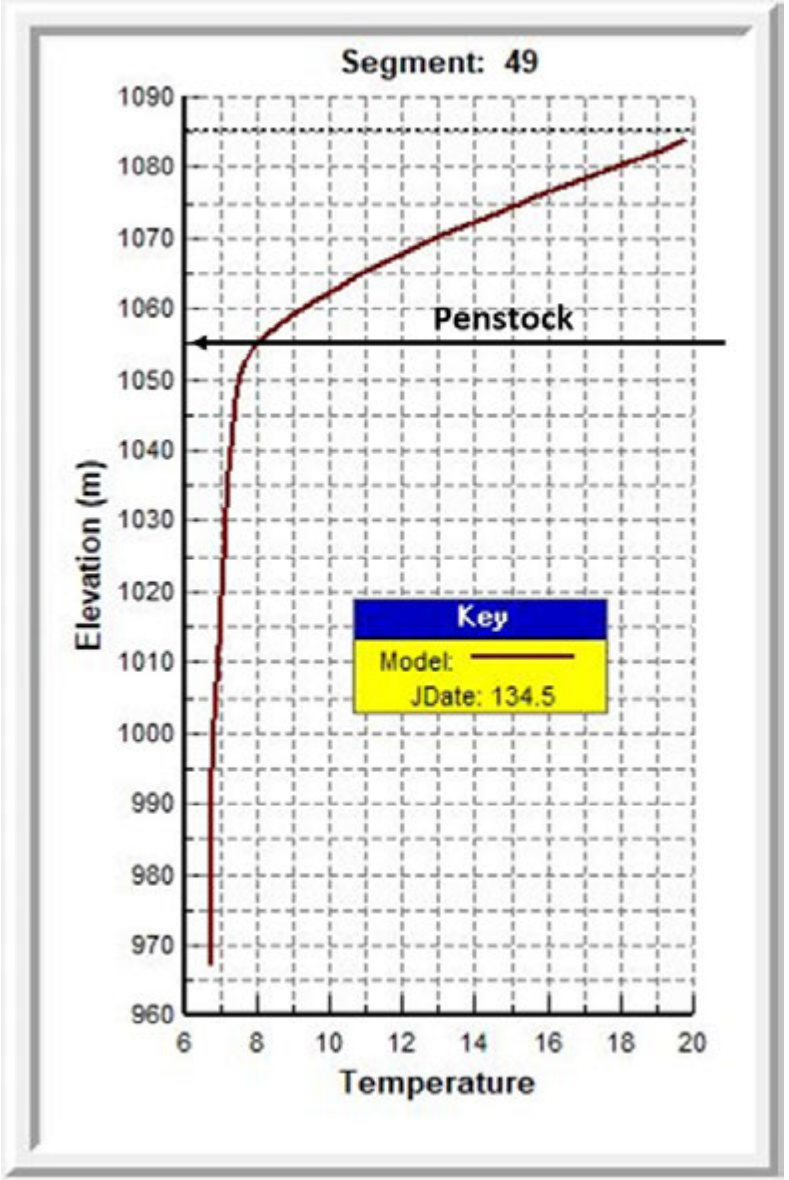
BUREAU OF RECLAMATION

Glen Canyon Dam Hourly Release Pattern June 2021



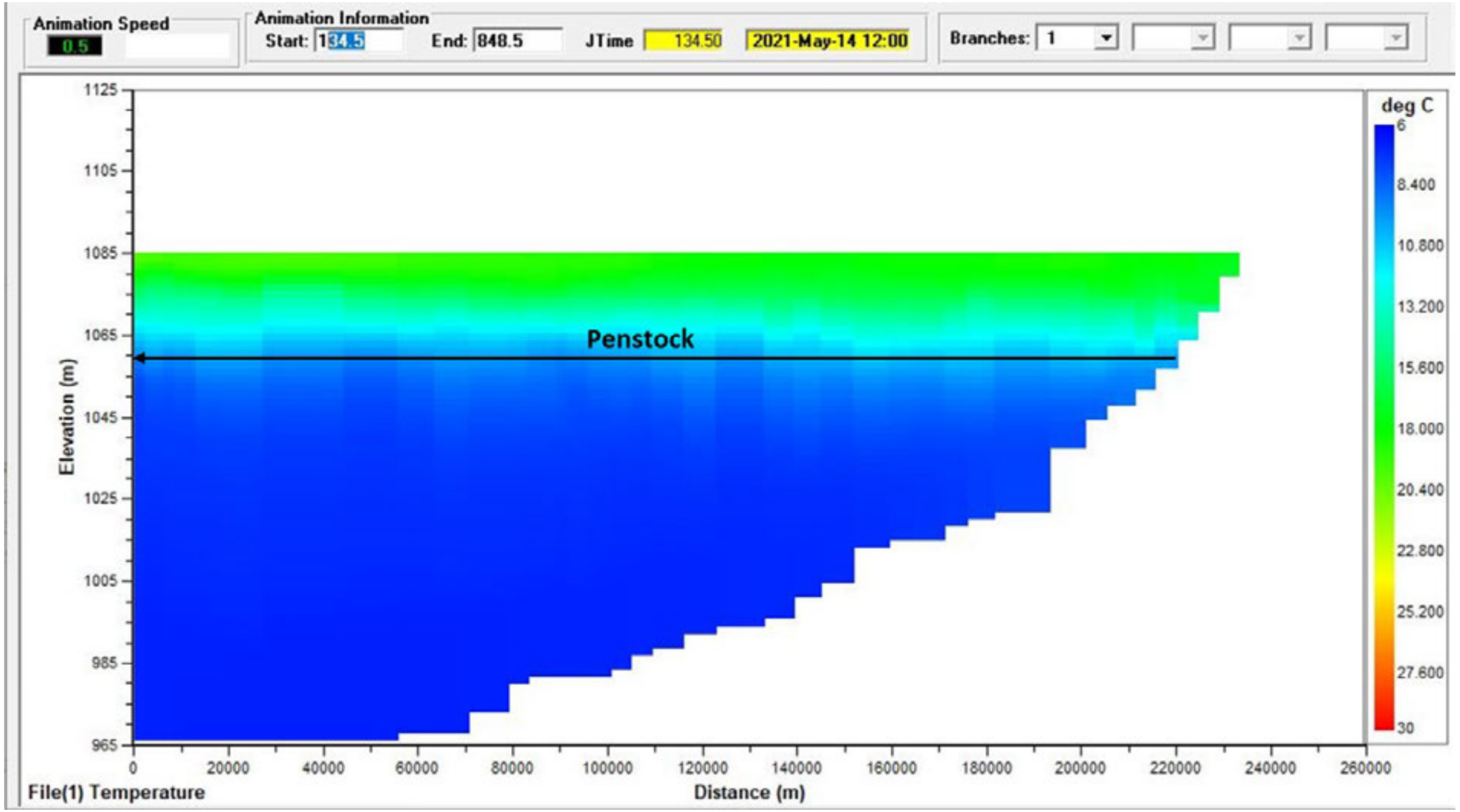
Water Quality

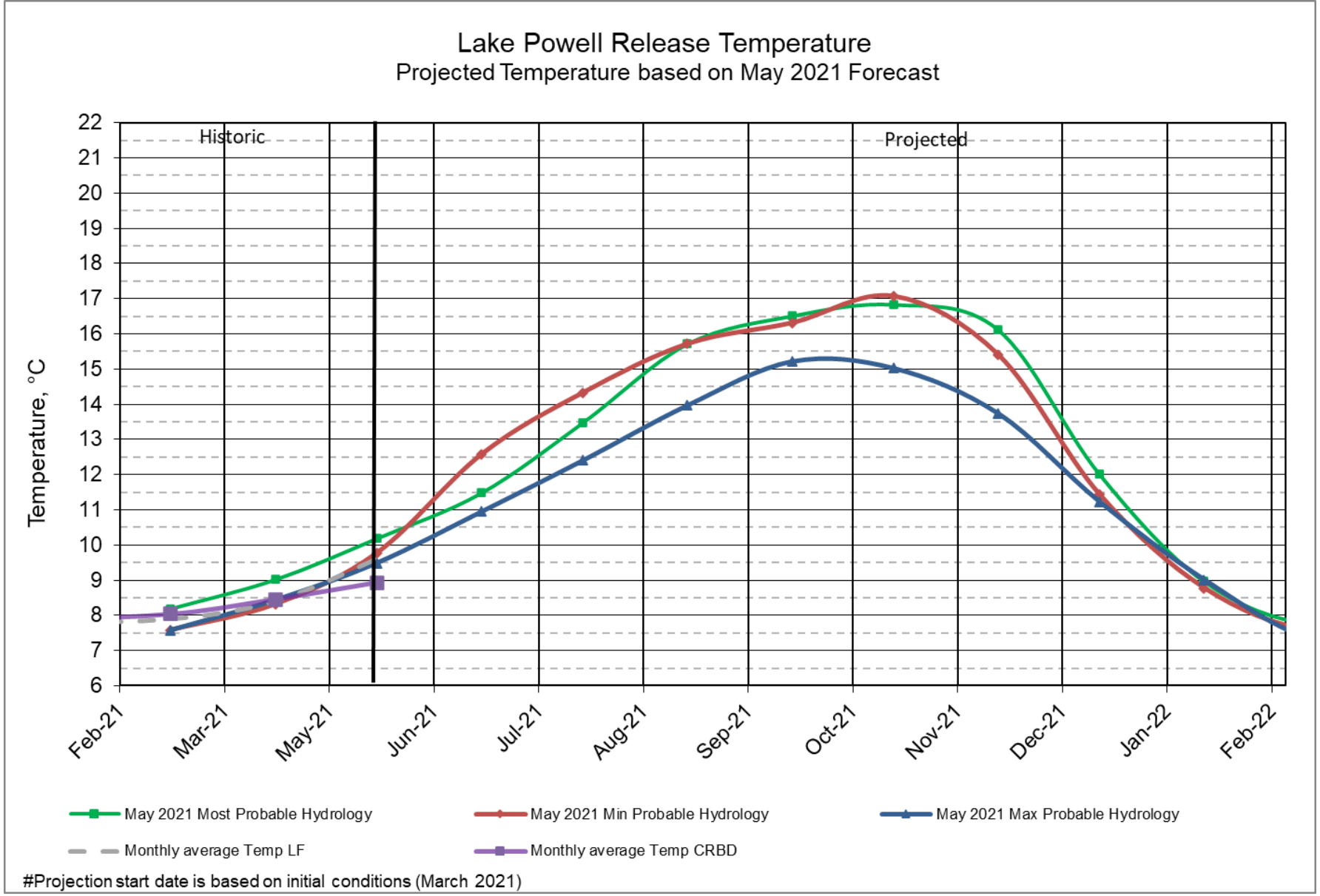
Temperature Profile of Lake Powell near Glen Canyon Dam
5/14/2021

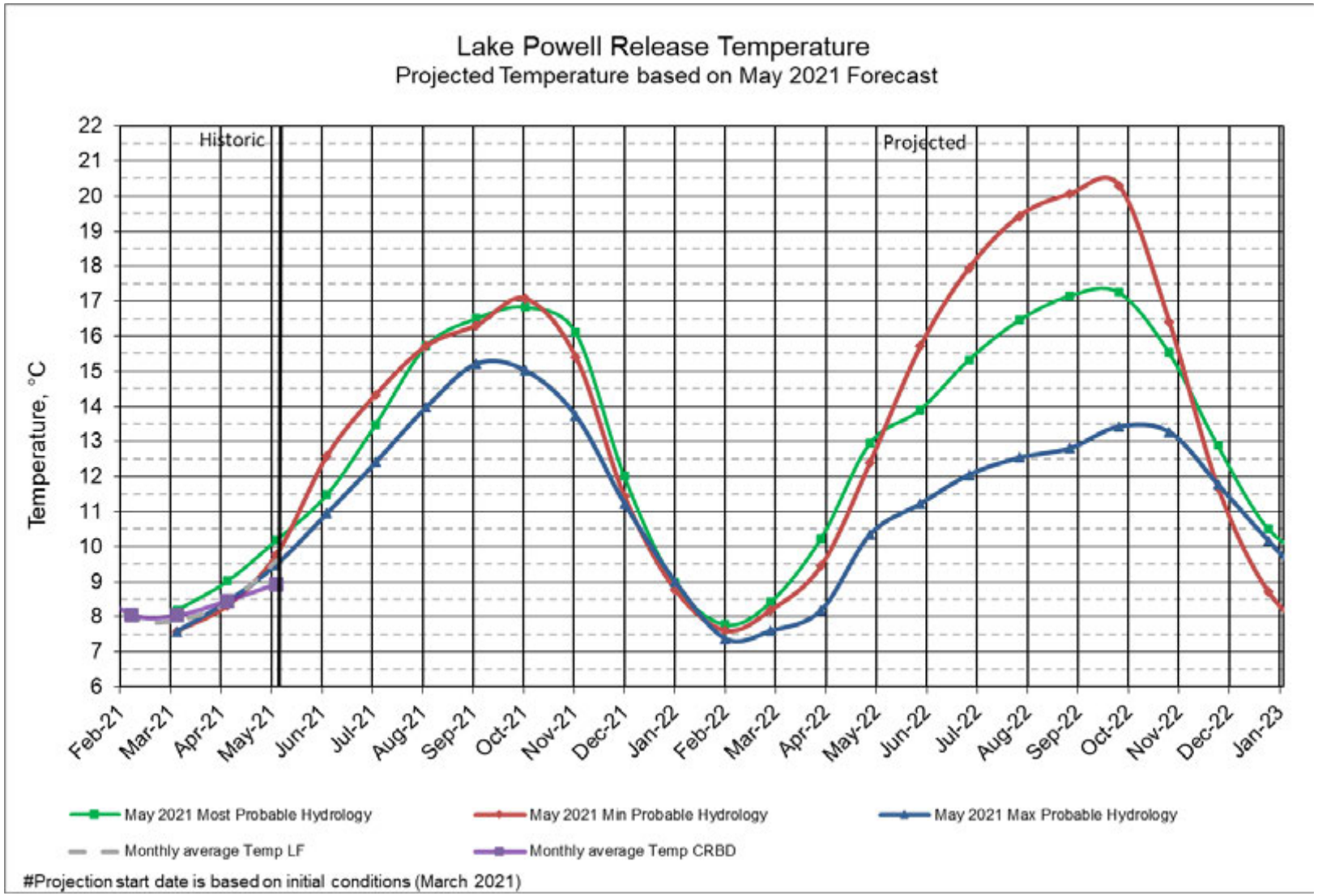


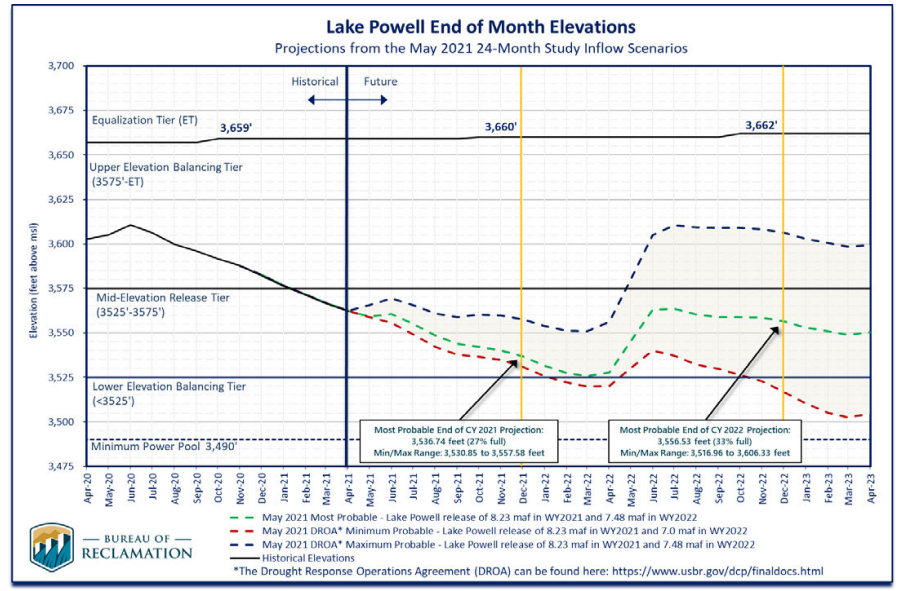
Cross Sectional Temperature Profile of Lake Powell

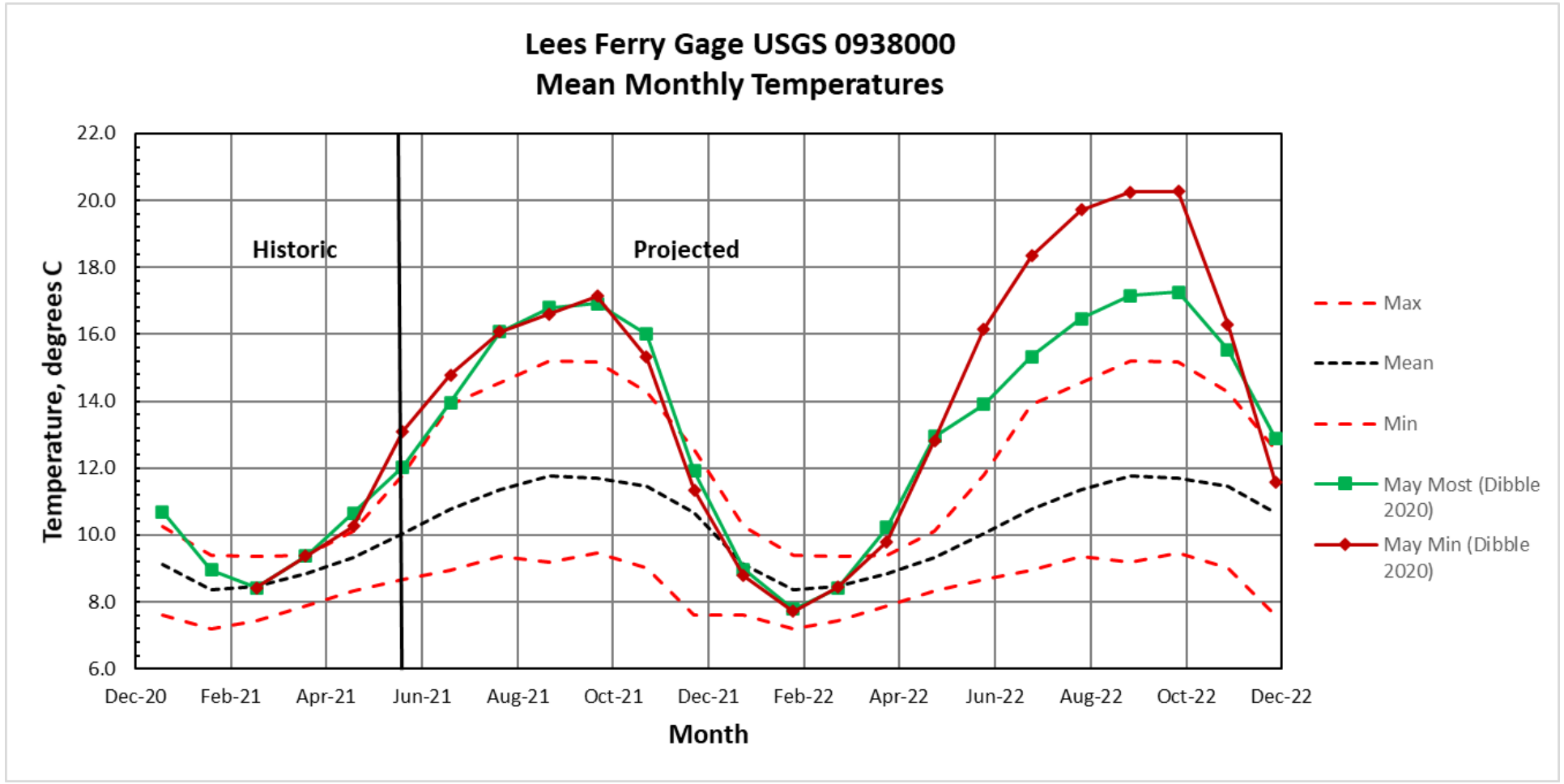
5/14/2021

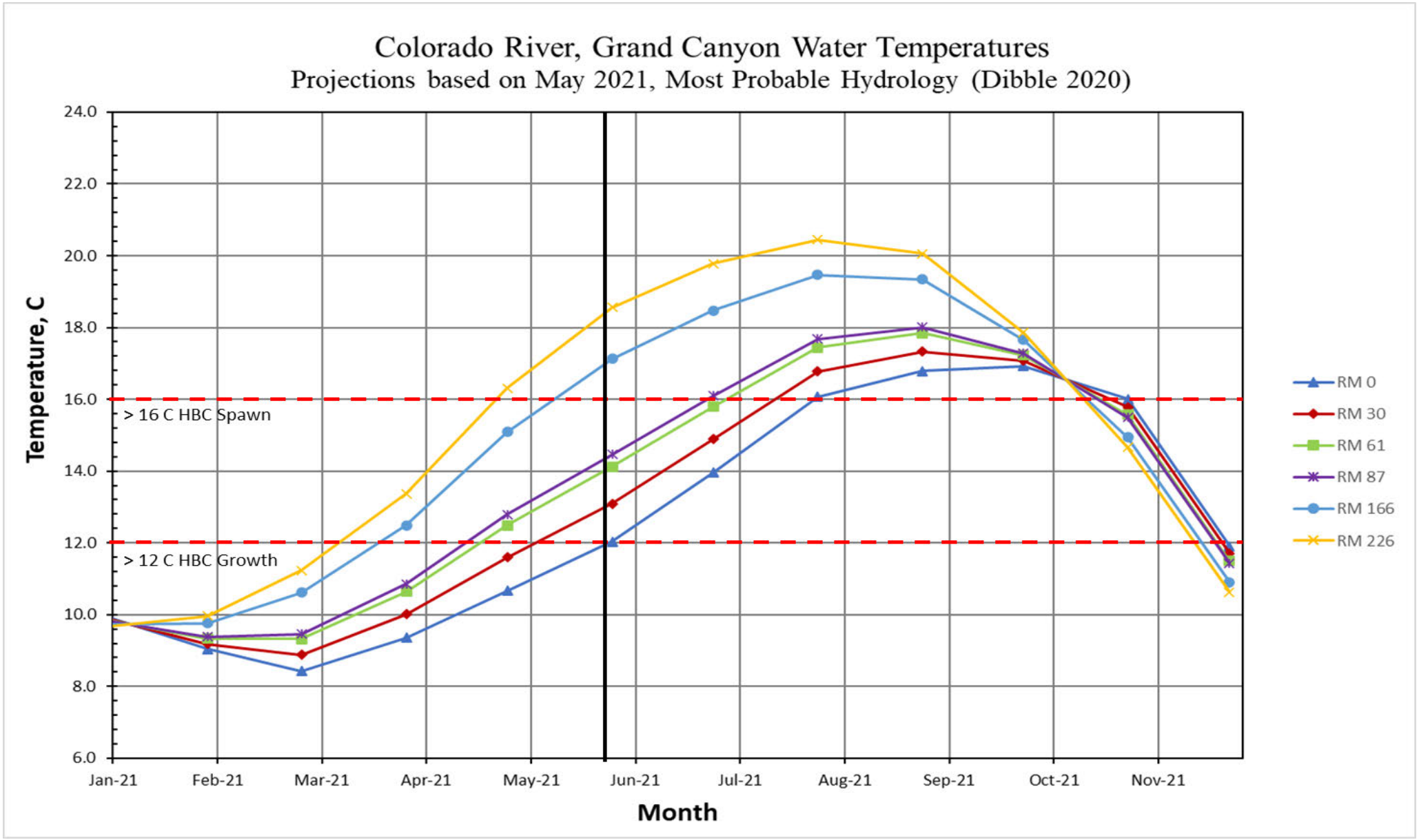


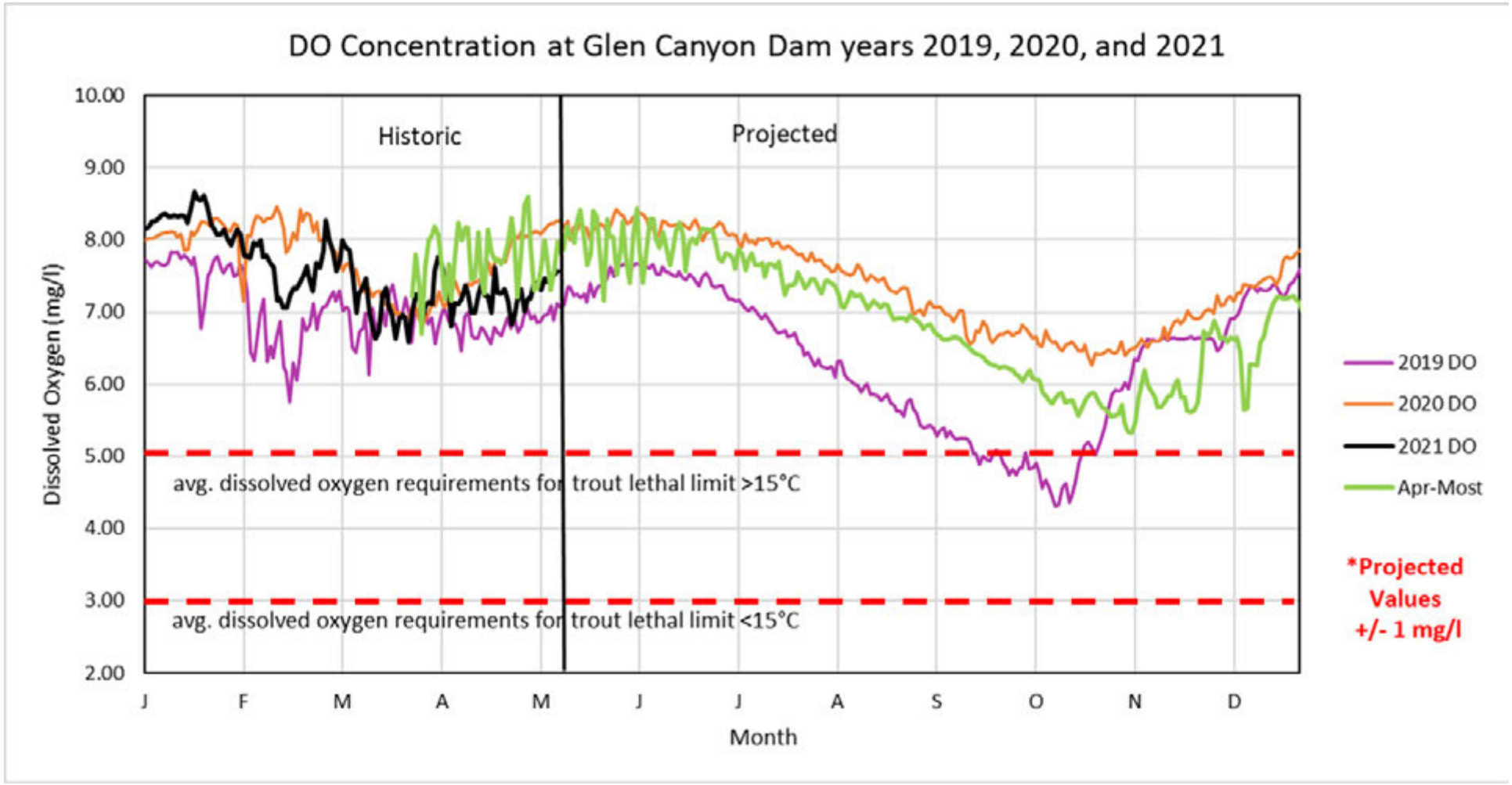

Lake Powell Release Temperature
Projected Temperature based on May 2021 Forecast
Historic
Projected
Temperature, °C
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
Feb-21
Mar-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
May 2021 Most Probable Hydrology
May 2021 Min Probable Hydrology
May 2021 Max Probable Hydrology
Monthly average Temp LF
Monthly average Temp CRBD
#Projection start date is based on initial conditions (March 2021)


Lake Powell Release Temperature
Projected Temperature based on May 2021 Forecast
Historic
Projected
Temperature, °C
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22
Apr-22
May-22
Jun-22
Jul-22
Aug-22
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
May 2021 Most Probable Hydrology
May 2021 Min Probable Hydrology
May 2021 Max Probable Hydrology
Monthly average Temp LF
Monthly average Temp CRBD
#Projection start date is based on initial conditions (March 2021)


Lake Powell End of Month Elevations
Projections from the May 2021 24-Month Study Inflow Scenarios
Historical
Future
Equalization Tier (ET)
3,659'
3,660'
3,662'
Upper Elevation Balancing Tier
(3575'-ET)
Mid-Elevation Release Tier
(3525'-3575')
Lower Elevation Balancing Tier
(<3525')
Minimum Power Pool 3,490'
Elevation (feet above msl)
3,700
3,675
3,650
3,625
3,600
3,575
3,550
3,525
3,500
3,475
Most Probable End of CY 2021 Projection:
3,536.74 feet (27% full)
Min/Max Range: 3,530.85 to 3,557.58 feet
Most Probable End of CY 2022 Projection:
3,556.53 feet (33% full)
Min/Max Range: 3,516.96 to 3,606.33 feet
BUREAU OF RECLAMATION
May 2021 Most Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
May 2021 DROA* Minimum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.0 maf in WY2022
May 2021 DROA* Maximum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
Historical Elevations
*The Drought Response Operations Agreement (DROA) can be found here: https://www.usbr.gov/dcp/finaldocs.html


Lees Ferry Gage USGS 0938000
Mean Monthly Temperatures
Temperature, degrees C
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
Historic
Projected
Dec-20
Feb-21
Apr-21
Jun-21
Aug-21
Oct-21
Dec-21
Feb-22
Apr-22
Jun-22
Aug-22
Oct-22
Dec-22
Month
Max
Mean
Min
May Most (Dibble 2020)
May Min (Dibble 2020)


Colorado River, Grand Canyon Water Temperatures
Projections based on May 2021, Most Probable Hydrology (Dibble 2020)
Temperature, C
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
> 16 C HBC Spawn
> 12 C HBC Growth
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Month
RM 0
RM 30
RM 61
RM 87
RM 166
RM 226


DO Concentration at Glen Canyon Dam years 2019, 2020, and 2021
Historic
Projected
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
Dissolved Oxygen (mg/l)
avg. dissolved oxygen requirements for trout lethal limit >15°C
avg. dissolved oxygen requirements for trout lethal limit <15°C
J
F
M
A
M
J
J
A
S
O
N
D
Month
2019 DO
2020 DO
2021 DO
Apr-Most
*Projected Values +/- 1 mg/l

Questions/Discussion

BUREAU OF RECLAMATION