

RECLAMATION

Managing Water in the West

Basin Hydrology, Reservoir Operations

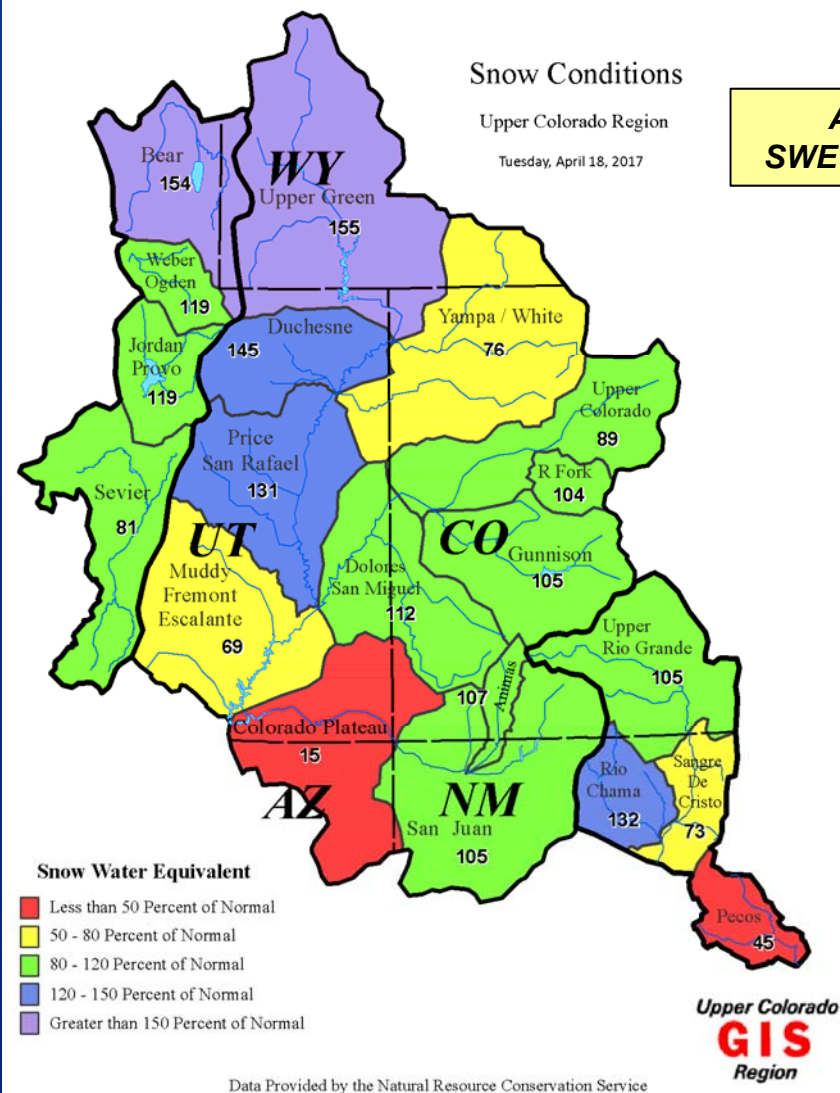
Glen Canyon Technical Work Group

April 20-21, 2016



U.S. Department of the Interior
Bureau of Reclamation

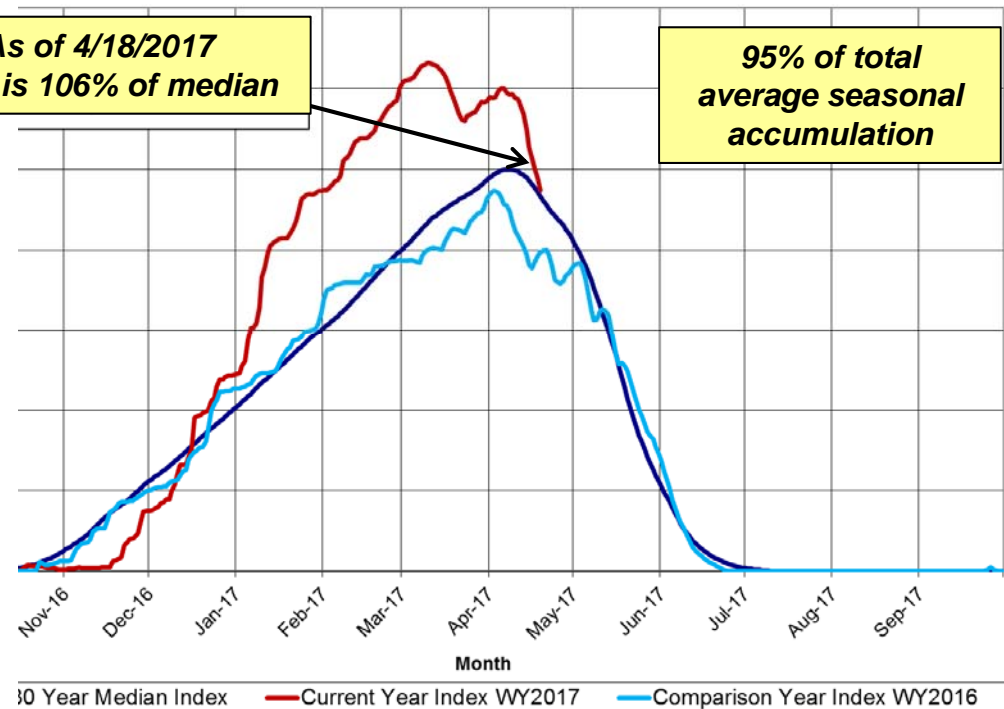
Snow Conditions



Upper Colorado River Basin Snotel Tracking
Aggregate of 116 Snotel Sites above Lake Powell

**As of 4/18/2017
SWE is 106% of median**

**95% of total
average seasonal
accumulation**



Data Provided by the Natural Resource Conservation Service

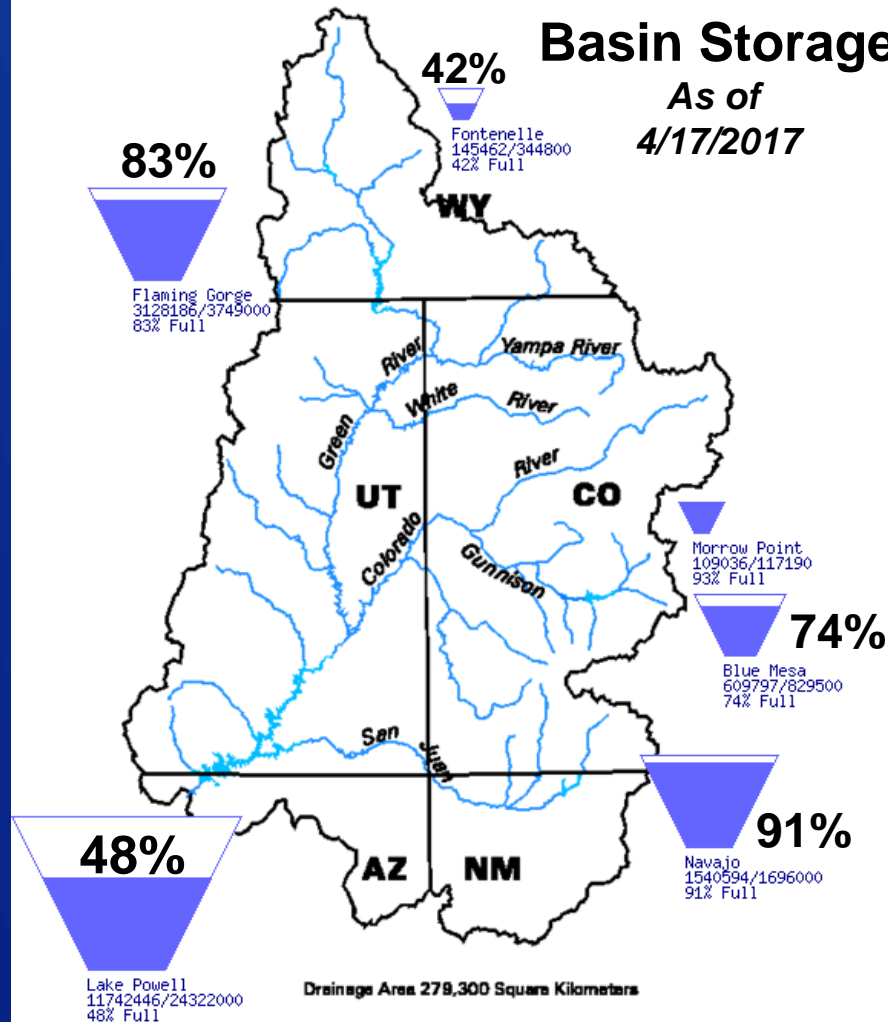
Upper Basin Storage

Data Current as of:
04/17/2017

Upper Colorado River Drainage Basin

Basin Storage

As of
4/17/2017



http://www.usbr.gov/uc/water/basin/tc_cr.html

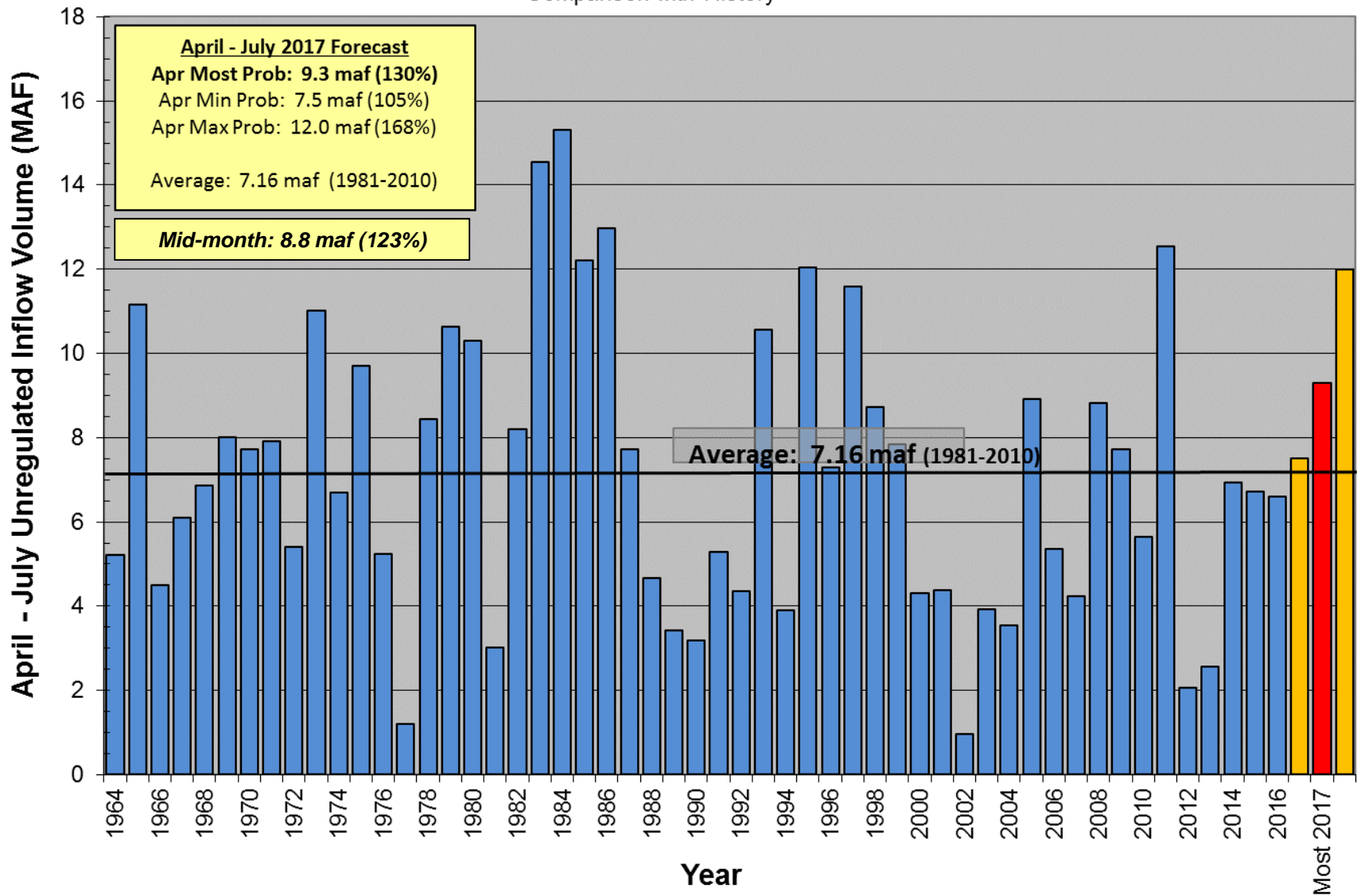
2017 April to July Inflow Forecast Issued April 4, 2017

Reservoir	A-J Forecast (KAF)	Percent of Average ¹
Fontenelle	1,680	232%
Flaming Gorge	2,260	231%
Blue Mesa	930	138%
Navajo	760	103%
Powell	9,300	130%

¹ percent of average based on period 1981-2010.

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Lake Powell Unregulated Inflow
April - July 2017 Forecast
Issued April 1st
 Comparison with History



* Water Year 2017 forecast: 13.47 maf (124%)

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Lake Powell 2017 Operating Tier

Upper Elevation Balancing

- Tier was set in August 2016
 - Start with 8.23 maf release
- Use April 24-Month Study projections of end of water year storage to potentially adjust
 1. Stay with 8.23 maf
 2. Balancing: 8.23 - 9.0 maf
 3. Equalization: > 8.23 maf

Lake Powell		
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
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)
3,575	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5
3,525	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	5.9
3,490		4.0
3,370		0

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**August
determination**

**April
determination**

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.

Water Year 2017 Operations: April 2017 24-Month Study Upper Elevation Balancing

April 2017 24-Month Study EXHIBIT run

SCT Powell.sct (24month_APR17_8.23_Exhibit_Run.mdl.gz)

File Edit Slots Aggregation View Config DMI Run Scripts Diagnostics Go To

Series Slots

Edit Series Slot List

Scalar Slots

Other Slots

Object Grid

Timestep	Day	Powell Unreg Inflow 1,000 acre-ft/month	Powell Outflow 1,000 acre-ft/mor	Powell Pool Elevation ft	Mead Pool Elevation ft
4/30/16	Sat	813.93	665.22	3,592.12	1,076.13
5/31/16	Tue	2,294.36	700.24	3,603.87	1,073.80
6/30/16	Thu	2,907.14	799.93	3,620.01	1,071.64
7/31/16	Sun	594.51	950.23	3,618.22	1,072.75
8/31/16	Wed	253.34	899.57	3,613.55	1,075.17
9/30/16	Fri	280.81	698.89	3,610.93	1,075.23
10/31/16	Mon	381.00	600.53	3,609.48	1,076.34
11/30/16	Wed	382.75	750.41	3,605.81	1,076.55
12/31/16	Sat	300.42	898.34	3,600.49	1,080.82
1/31/17	Tue	359.01	880.30	3,595.86	1,086.08
2/28/17	Tue	555.29	710.69	3,594.33	1,089.78
3/31/17	Fri	1,109.53	720.21	3,595.91	1,088.26
4/30/17	Sun	1,600.00	600.00	3,604.11	1,084.09
5/31/17	Wed	3,000.00	600.00	3,625.41	1,080.23
6/30/17	Fri	3,350.00	600.00	3,644.54	1,076.83
7/31/17	Mon	1,350.00	600.00	3,647.98	1,074.40
8/31/17	Thu	630.00	669.53	3,647.58	1,074.06
9/30/17	Sat	450.00	600.00	3,646.82	1,072.07
10/31/17	Tue	547.21	640.00	3,646.28	1,072.48
11/30/17	Thu	489.06	640.00	3,645.53	1,071.08
12/31/17	Sun	362.53	720.00	3,644.19	1,071.09
1/31/18	Wed	361.18	1,260.00	3,638.20	1,078.23
2/28/18	Wed	392.99	1,100.00	3,633.22	1,083.81
3/31/18	Sat	665.38	1,170.00	3,628.87	1,085.56
4/30/18	Mon	1,055.51	1,040.00	3,627.74	1,085.35
5/31/18	Thu	2,342.99	1,040.00	3,636.82	1,086.19
6/30/18	Sat	2,666.05	1,080.00	3,646.31	1,087.45
7/31/18	Tue	1,090.84	1,230.00	3,643.96	1,091.75
8/31/18	Fri	499.88	1,310.00	3,637.99	1,098.00
9/30/18	Sun	408.21	981.00	3,634.00	1,101.71

Powell.Outflow -- Volume: 8.23000 [1,000,000 acre-ft]

12 values: Sum 8,230.00 -- Ave 685.83 -- Med 635.03 -- Min 600.00 -- Max 898.34 -- Range 298.

With an 8.23maf release pattern for WY2017, September 30, 2017 projected elevations are:

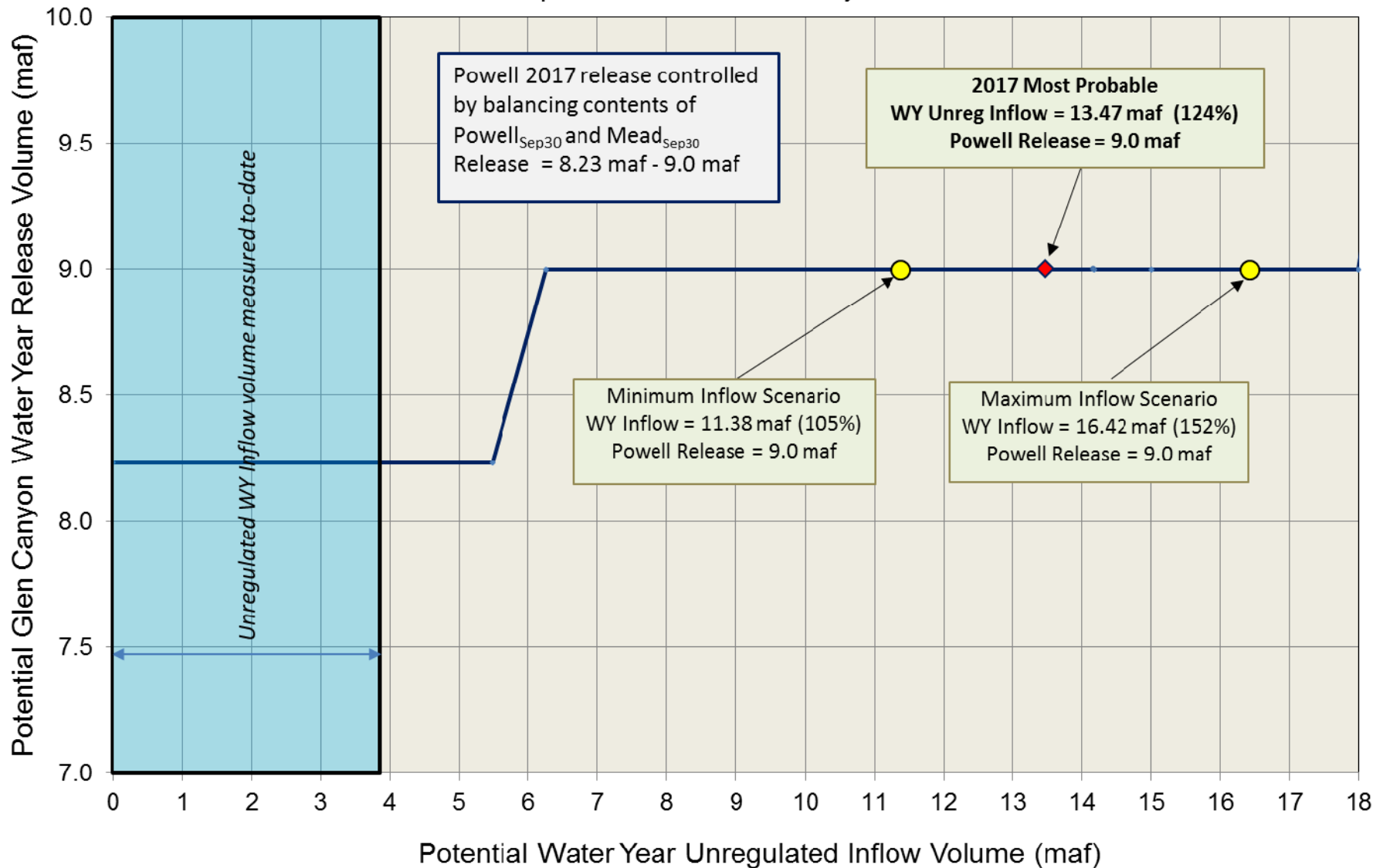
Powell: 3646.82 (i.e, above 3575 ft)
Mead: 1072.07 (i.e, below 1075 ft)

Therefore, Powell's April adjustment is to Balancing, with releases not more than 9.0 maf and not less than 8.23 maf in the Water Year.

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Potential Lake Powell Release Scenarios

Water Year 2017 Release Volume as a Function of Unregulated Inflow Volume
based on April 2017 24-Month Study Conditions

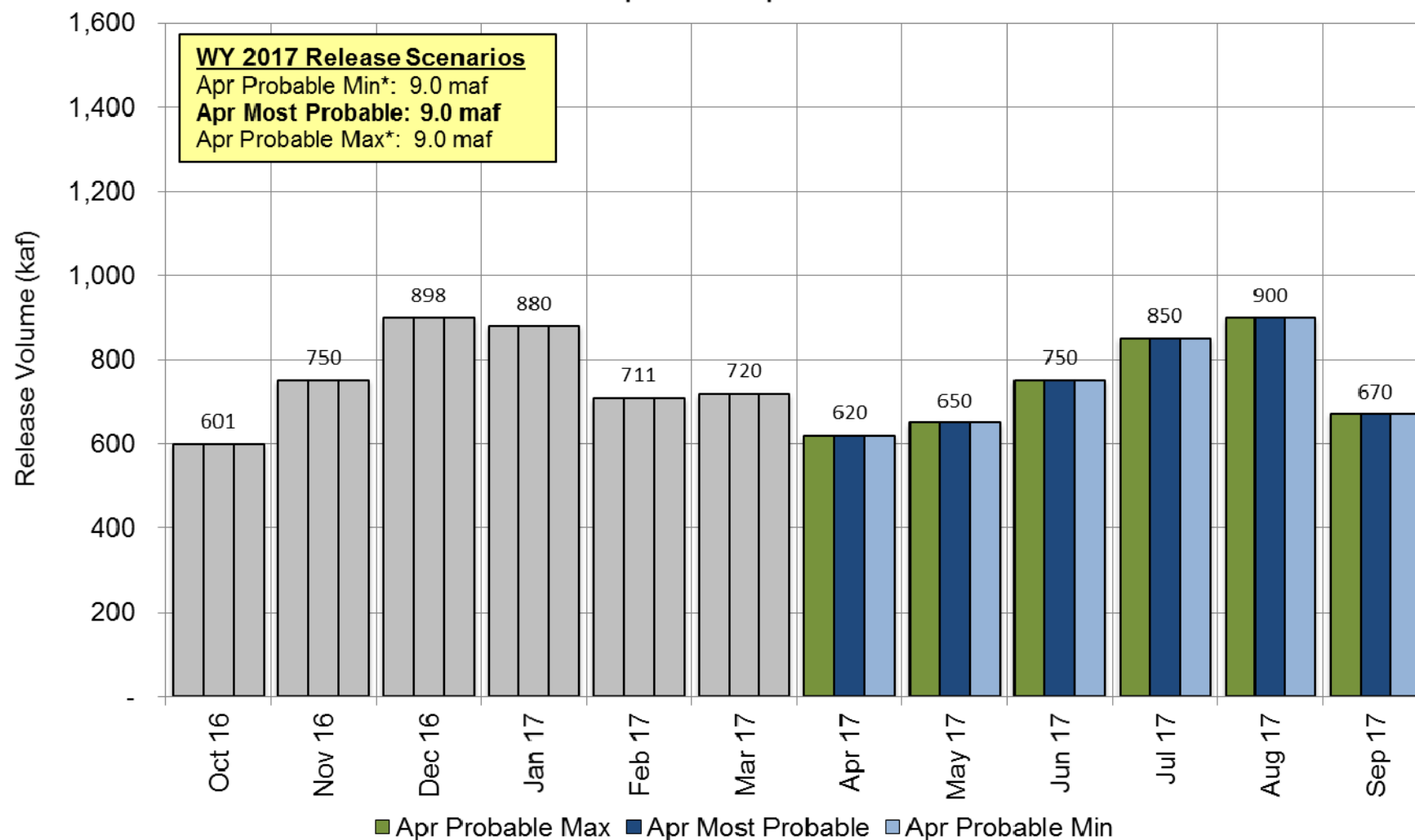


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Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2017

Updated April 2017

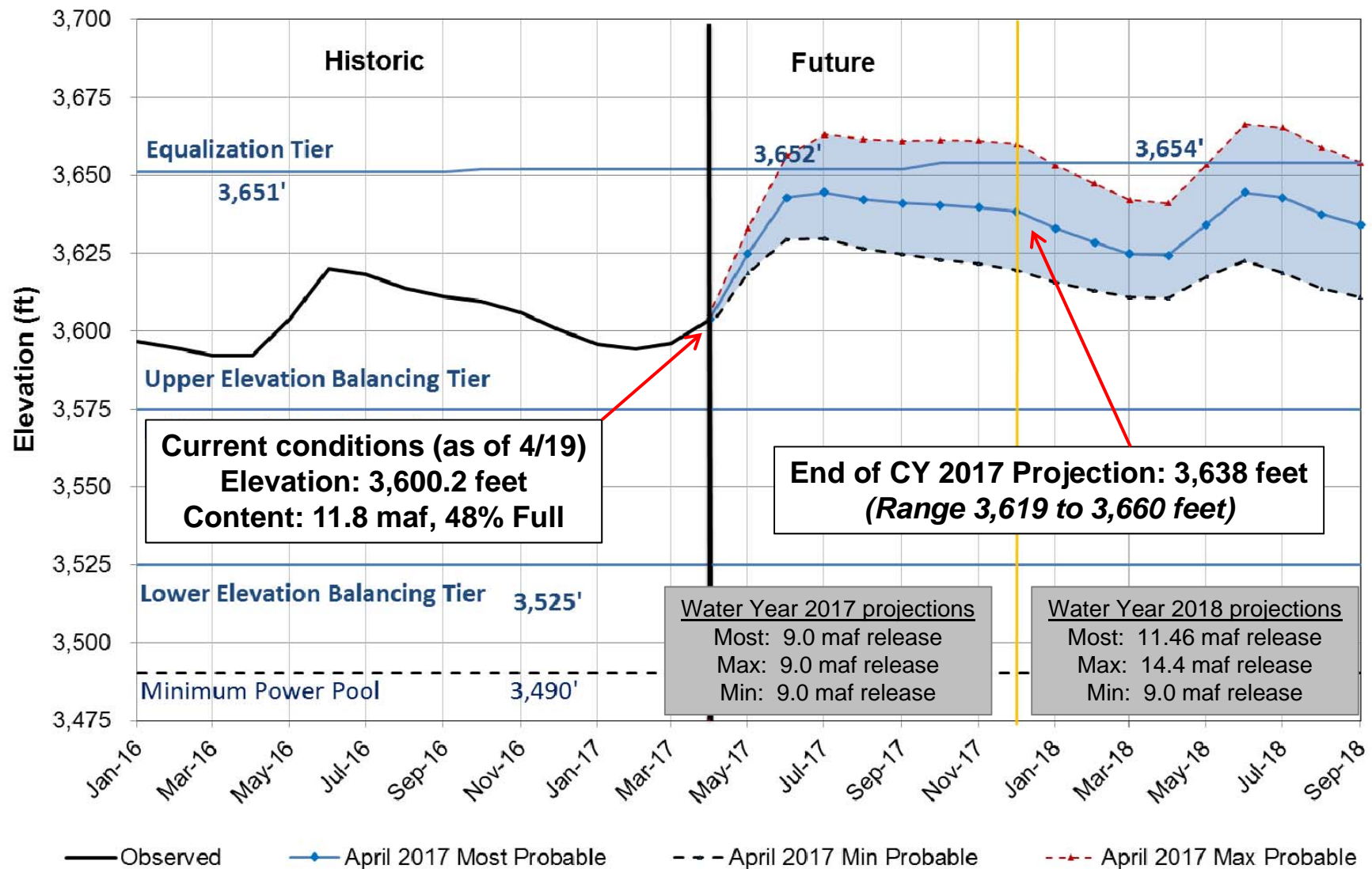


* Probable Min and Max annual release volume is based on January Min and Max inflow forecasts

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Lake Powell End of Month Elevations

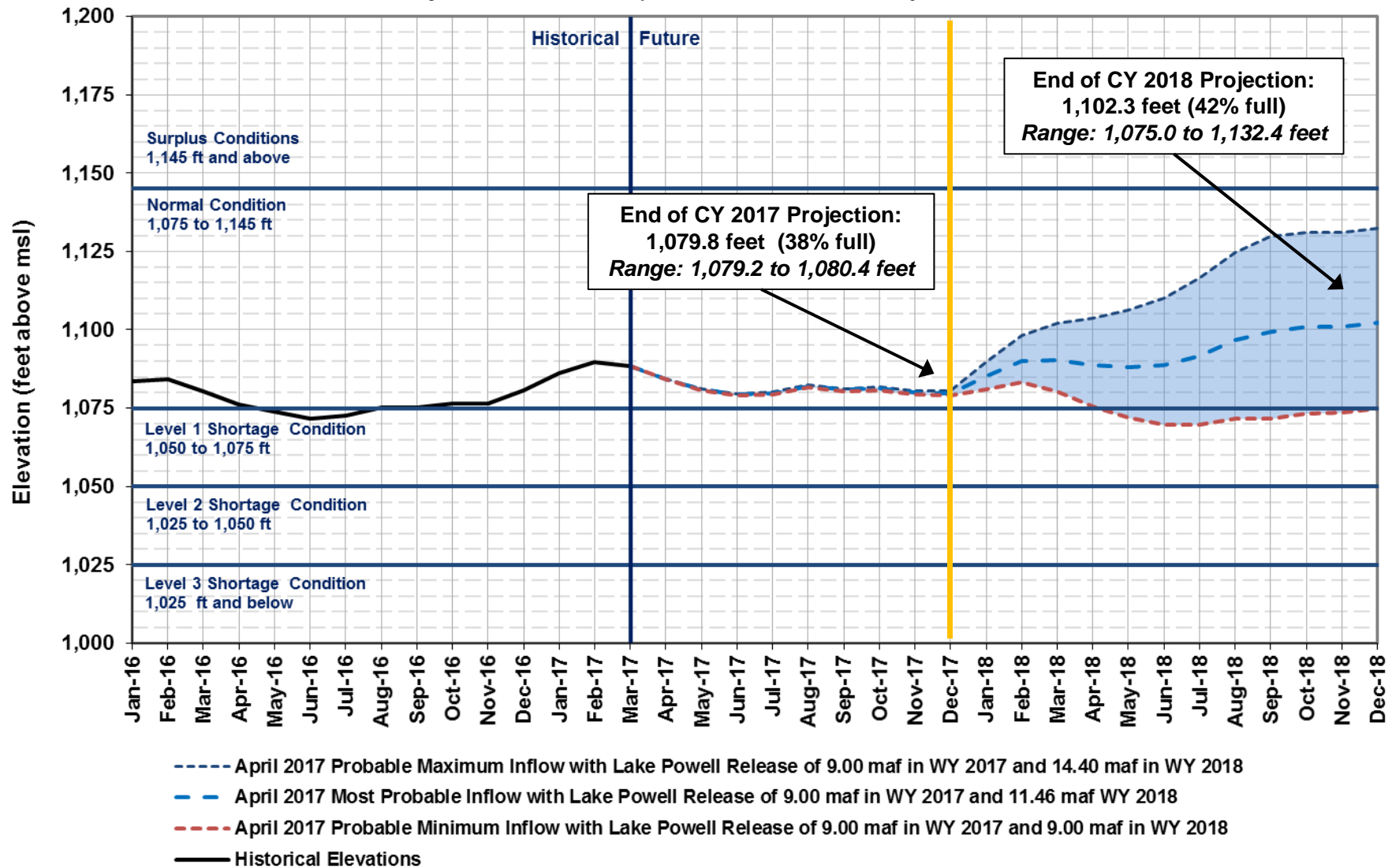
Historic and Projected based on April 2017 Modeling



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Lake Mead End of Month Elevations

Projections from the April 2017 24-Month Study Inflow Scenarios



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Glen Canyon Power Plant Planned Unit Outage Schedule for Water Year 2017

Unit Number	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	6	6	6	6	5	5	6	7	7	7	7	6
Capacity (cfs)	21,000	21,000	19,700	19,750	16,100	15,900	19,600	23,400	23,400	23,400	23,400	19,600
Capacity (kaf/month)	1,310	1,280	1,180	1,270	920	1,070	1,250	1,400	1,390	1,440	1,450	1,200
Max (kaf) ¹	601	750	898	880	711	720	620	650	750	850	900	670
Most (kaf) ²	601	750	898	880	711	720	620	650	750	850	900	670
Min (kaf) ¹	601	750	898	880	711	720	620	650	750	850	900	670

9.0

9.0

9.0

(updated 4-17-2017)

¹ Projected release, based on Apr 2017 Min and Max Probable Inflow Projections and 24-Month Study model runs

² Projected release, based on Apr 2017 Most Probable Inflow Projections and 24-Month Study model runs

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Reservoir Operations for Water Year 2018

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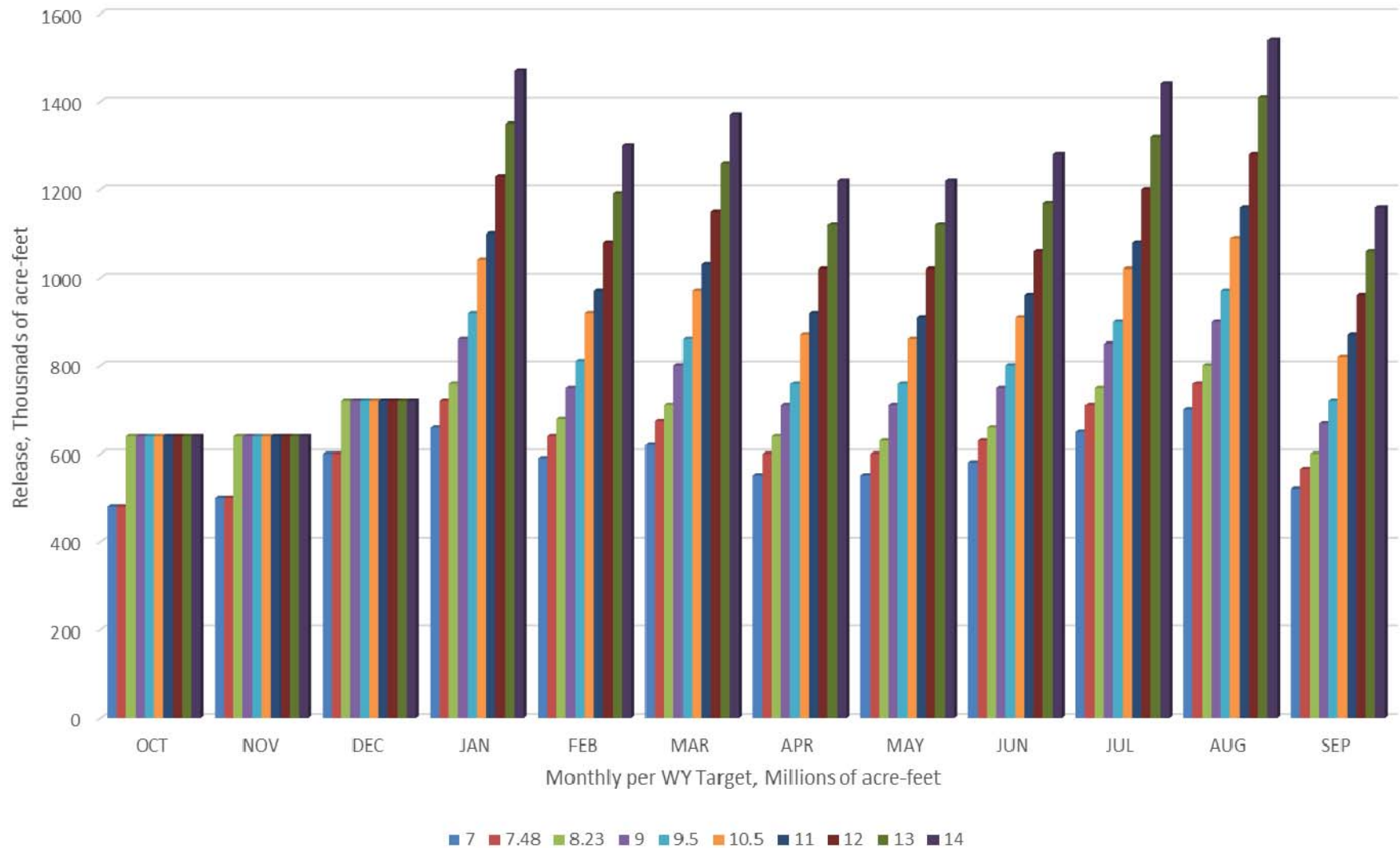
2018 Projected Release Scenarios

Based on April 2017 24-Month Study Inflow Scenarios

Powell Inflow Scenario	WY 2018 Release Projection
Probable Minimum	Upper Elevation Balancing Tier w/ Projected April shift to Balancing 9.0 maf release
Most Probable	Upper Elevation Balancing Tier w/ Projected April shift to Equalization 11.5 maf release
Probable Maximum	Equalization Tier 14.4 maf release

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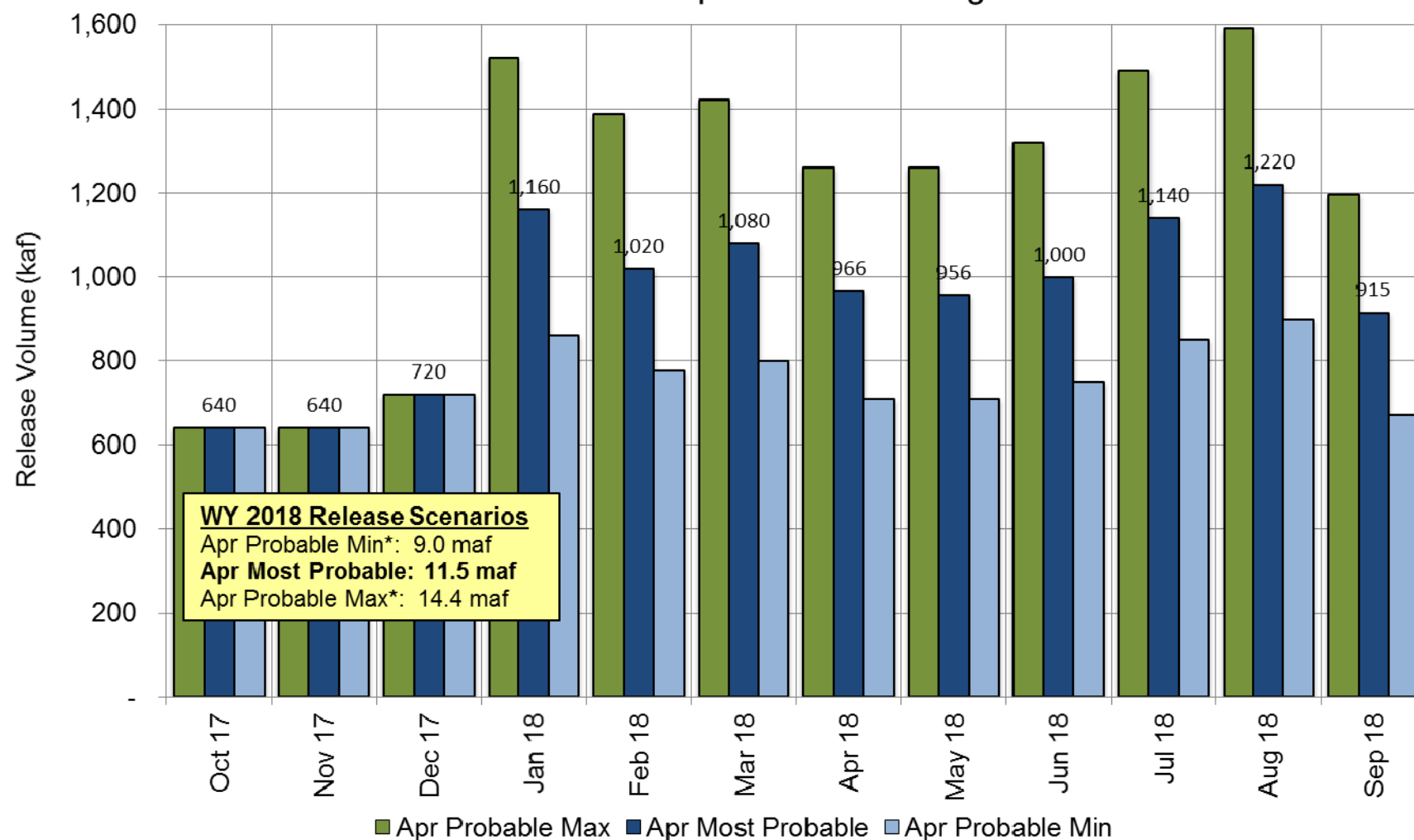
LTEMP Monthly Release Volumes



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2018

Based on April 2017 modeling



* Probable Min and Max annual release volume is based on January Min and Max inflow forecasts

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Glen Canyon Power Plant Planned Unit Outage Schedule for Water Year 2018

Unit Number	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018
1		Possible HFE										
2												
3												
4												
5												
6												
7												
8												
Units Available	5	7	7	7	5	5	5	6/8	8	8	8	7
Capacity (cfs)	16,100	23,400	23,400	23,400	16,200	16,000	16,000	27,000	27,000	27,000	27,000	23,500
Capacity (kaf/month)	1,060	1,390	1,440	1,290	920	980	1,040	1,520	1,610	1,660	1,660	1,470
Max (kaf) ¹	640	640	720	1,520	1,340	1,420	1,260	1,260	1,320	1,490	1,590	1,197
Most (kaf) ²	640	640	720	1,160	1,020	1,080	966	956	1,000	1,140	1,220	915
Min (kaf) ¹	640	640	720	860	750	800	710	710	750	850	900	670

14.40

11.48

9.0

(updated 4-17-2017)

¹ Projected release, based on Apr 2017 Min and Max Probable Inflow Projections and 24-Month Study model runs

² Projected release, based on Apr 2017 Most Probable Inflow Projections and 24-Month Study model runs

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Questions?

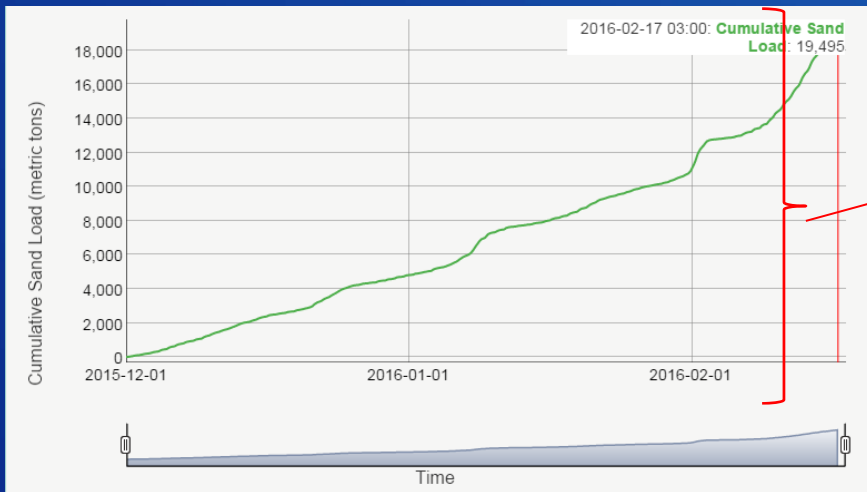
Paul Davidson
801-524-3642

PDavidson@usbr.gov

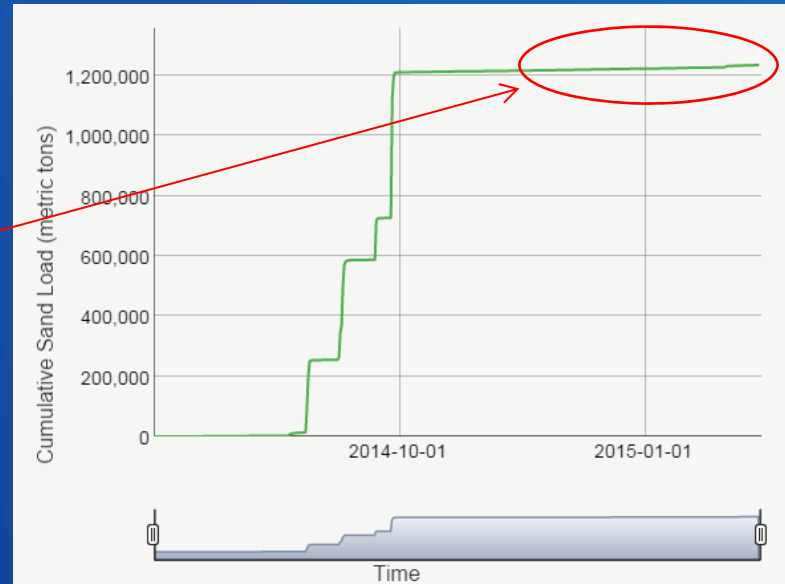
Hydraulic Engineer, Glen Canyon
Reclamation, Upper Colorado Region
Resource Management Division
Water Resources Group

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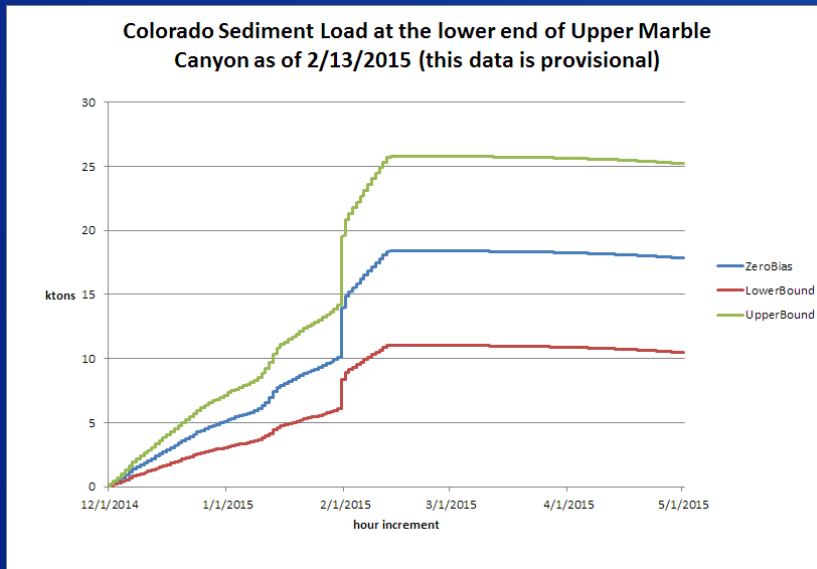
Sediment Conditions *As of 2-13-2015*



Paria Sand Load Dec 1 though Feb 13



Paria Sand Load July 1 though Feb 13



Sediment Model Results

As of 2-13-2015

Have: ~18 ktons

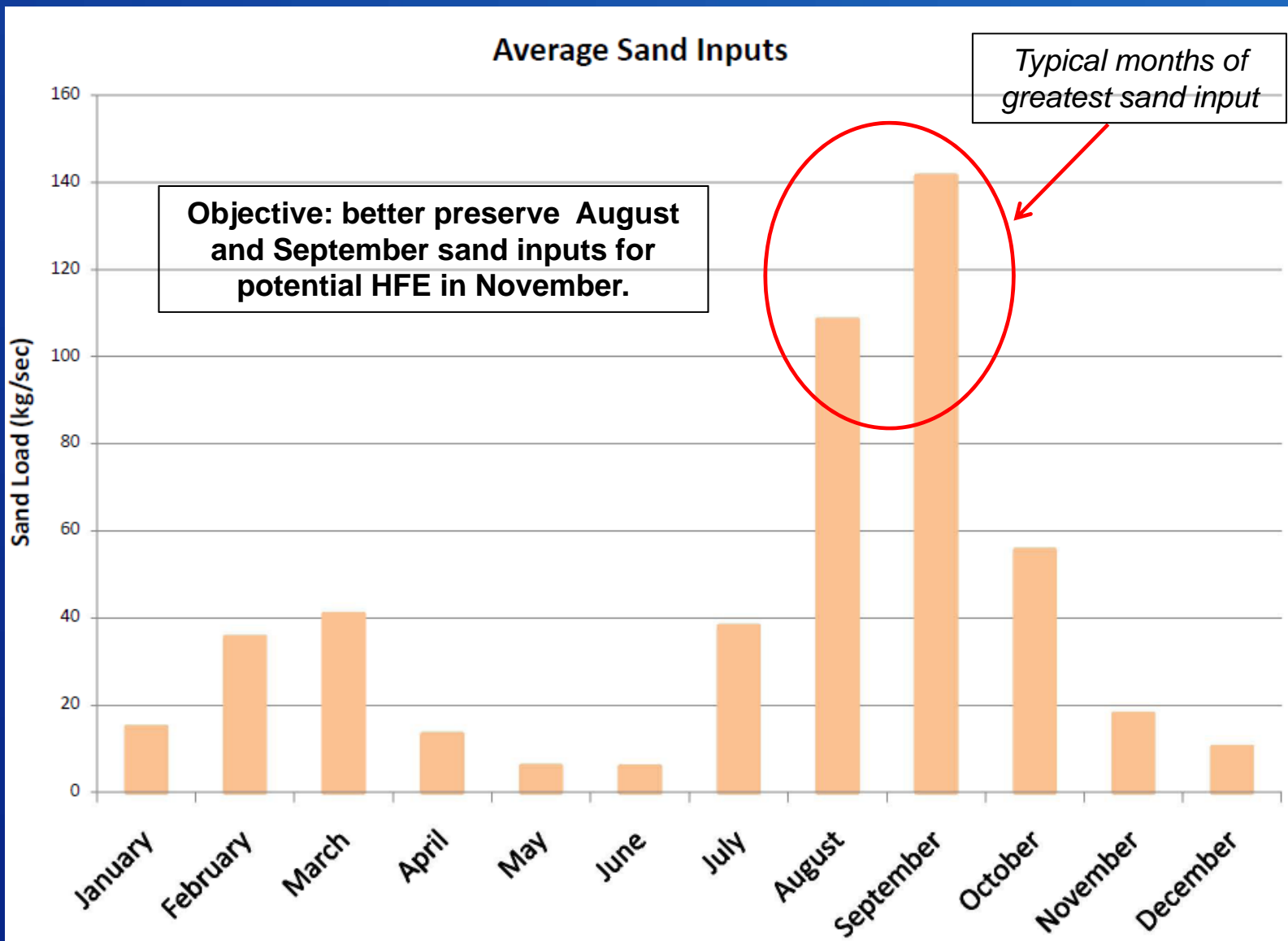
Need: several hundred ktons
(for the smallest HFE)

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If we end up with a 8.23 maf release instead of 9.0 maf, we will need to reduce the remaining months by 770kaf

	Typical pattern (9.0 maf)	Proposed 2016 Hydrograph (9.0 maf)	Possible monthlies after maintenence considerations and discussions with Western (maintaining 2016 Hydrograph)				96 hr HFE 8.23 maf	spring HFE 8.23
			9.0 maf	96 hr HFE 9.0 maf	spring HFE 9.0	8.23 maf		
October	600	600	600	600	600	600	600	600
November	600	600	600	770	600	600	770	600
December	800	900	900	900	900	900	900	900
January	800	900	900	900	900	900	900	900
February	650	700	700	665	700	700	665	700
March	650	650	650	615	650	650	615	650
April	600	600	600	600	770	540	540	710
May	650	700	700	600	600	540	500	500
June	800	800	800	800	800	600	600	500
July	1000	950	950	950	950	800	800	800
August	1050	900	900	900	900	800	800	800
September	800	700	700	700	630	600	540	570
	9000	9000	9000	9000	9000	8230	8230	8230

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