

Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
May 27, 2014

Agenda Item

Basin Hydrology and Operations

Action Requested

✓ Information item only.

Presenter

Katrina Grantz, Hydraulic Engineer, Bureau of Reclamation, Upper Colorado Region

Previous Action Taken

N/A

Relevant Science

N/A

Background Information

The presentation is intended to provide pertinent information to AMWG members on current water supply and forecasted hydrologic conditions within the Upper Colorado River Basin. The presentation will focus on projected reservoir conditions and operations at Lake Powell/Glen Canyon Dam for the remainder of water year 2014 and provide a general outlook for 2015.

The presentation will cover the implementation of the *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations of Lake Powell and Lake Mead*, the planned releases from Lake Powell in water year 2014 and the range of potential releases in water year 2015. Such information is provided to assist the AMWG in developing recommendations to the Secretary on the operation of Glen Canyon Dam for water years 2014 and 2015.

Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
May 27, 2014

Agenda Item

Development of Water Year 2015 Hydrograph

Action Requested

✓ This is an information item.

Presenter

Katrina Grantz, Hydraulic Engineer, Upper Colorado Region, Bureau of Reclamation

Previous Action Taken

✓ By AMWG:

At the August 2013 AMWG meeting, the following motion was passed:

AMWG recommends to the Secretary of the Interior his approval of the DOI-DOE Proposed Hydrograph for Water Year 2014 as follows:

- **Annual Release Volumes** will be determined in compliance with the 2007 Interim Guidelines (in consultation with the Basin States as appropriate).
- **Monthly Release Volumes** are anticipated to shift depending upon: (1) the Annual Release Volume, and (2) the magnitude of a potential High Flow Experiment in the fall of 2013.
- Monthly Release Volumes may vary within the targets identified below. Any remaining monthly operational flexibility will be used for existing power production operations under the Modified Low Fluctuating Flow (MLFF) alternative selected by the 1996 ROD and contained in the 1995 FEIS and in compliance with all applicable NEPA compliance documents (HFE EA, NNFC EA, 2007 IG).
- **Release objective for June 2014** is 600 kaf to 650 kaf.
- **Release objective for August 2014** is 800 kaf.
- **Release objective for September and October 2014** is 600 kaf to 630 kaf (or less).
- **Monthly Release Volumes** will generally strive to maintain 600 kaf levels in the spring/fall timeframe and 800 kaf in December/January and July/August timeframe.

- Additionally, the Bureau of Reclamation will continue to apply best professional judgment in conducting actual operations and in response to changing conditions throughout the water year. Such efforts will continue to be undertaken in coordination with the DOI/DOE agencies, and after consultation with the Basin States as appropriate, to consider changing conditions and adjust projected operations at Glen Canyon Dam in a manner consistent with the objectives of these parameters as stated above and pursuant to the Law of the River.

Relevant Science

N/A

Background Information

The presentation will include a brief review of the 2014 hydrograph development and an overview of the ongoing 2015 hydrograph development process.

In cooperation with the other federal agencies, Reclamation is continuing the development of Interior's recommendation for the 2015 Hydrograph. This recommendation will be based upon the scenarios analyzed for the 2014 Hydrograph. Reclamation will review the analyses with the TWG and Interior will provide a recommendation for the AMWG's consideration later this year.

RECLAMATION

Managing Water in the West

Basin Hydrology, Operations and 2015 Hydrograph

Adaptive Management Work Group
May 27, 2014



U.S. Department of the Interior
Bureau of Reclamation

Katrina A. Grantz, PhD
Hydraulic Engineer, Glen Canyon Dam
Bureau of Reclamation

- **Upper Colorado River Basin Hydrology**
- **Glen Canyon Dam Operations**
(WY 2014 and 2015)

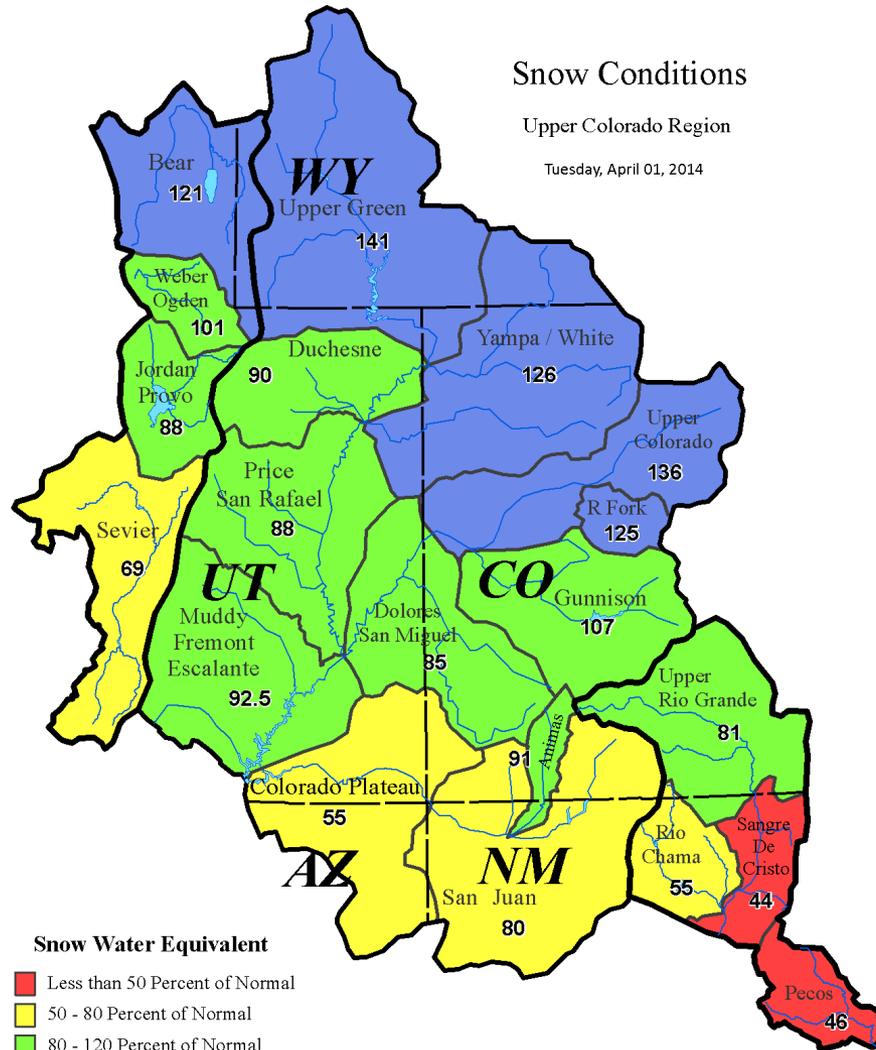


RECLAMATION

Snow Conditions

Upper Colorado Region

Tuesday, April 01, 2014



Snow Water Equivalent

- Less than 50 Percent of Normal
- 50 - 80 Percent of Normal
- 80 - 120 Percent of Normal
- 120 - 150 Percent of Normal
- Greater than 150 Percent of Normal

Upper Colorado
GIS
Region

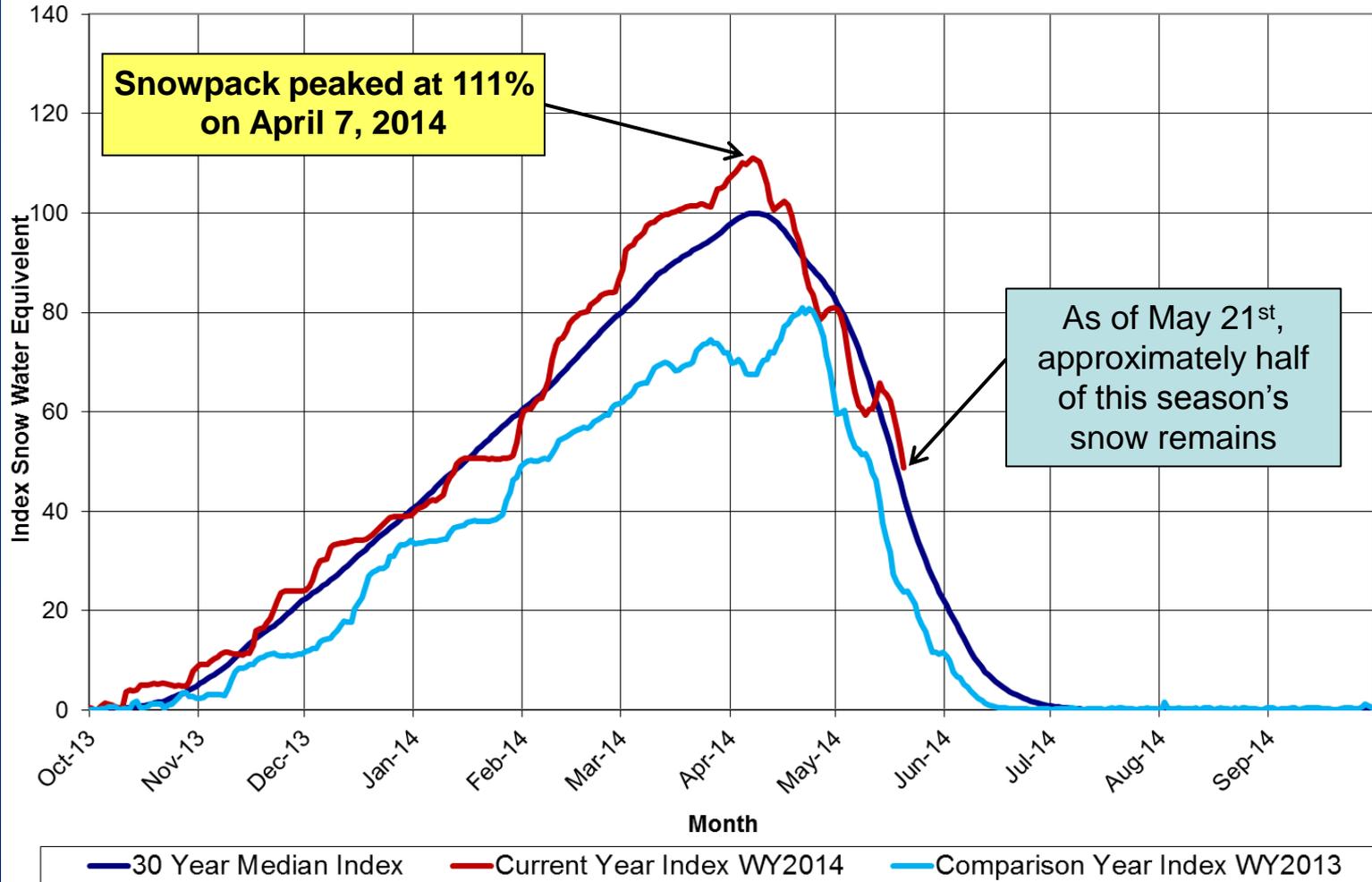
Data Provided by the Natural Resource Conservation Service

Upper Basin Snowpack on April 1, 2014

RECLAMATION

Upper Basin Hydrology

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



Data Provided by the Natural Resource Conservation Service

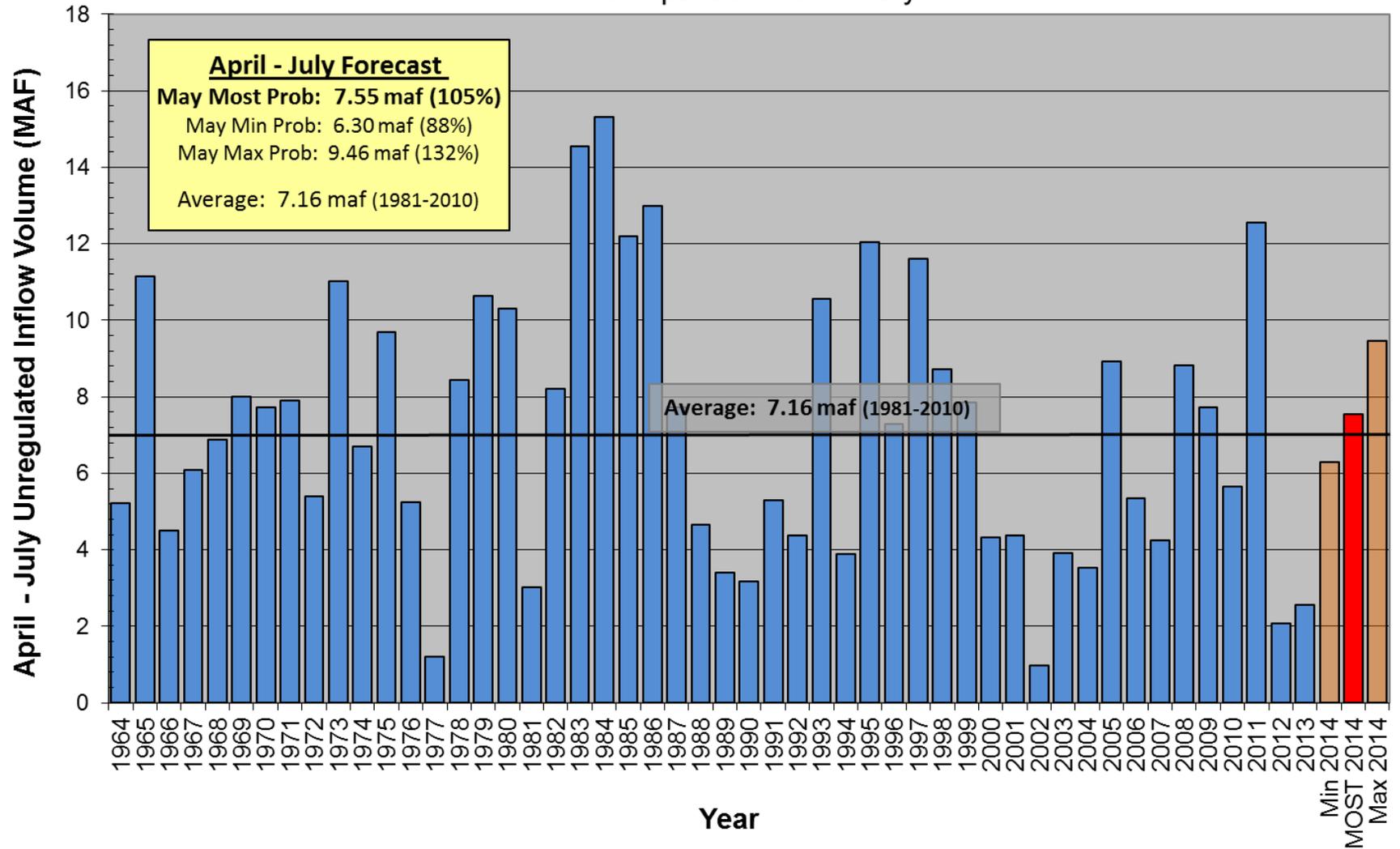
http://www.usbr.gov/uc/water/notice/Graphs/Upper_Colorado.html

RECLAMATION

Lake Powell Unregulated Inflow

Apr - Jul 2014 Forecast *(issued May 2)*

Comparison with History



WY2014 Operations under Interim Guidelines

determined in August 2013 24-Month Study

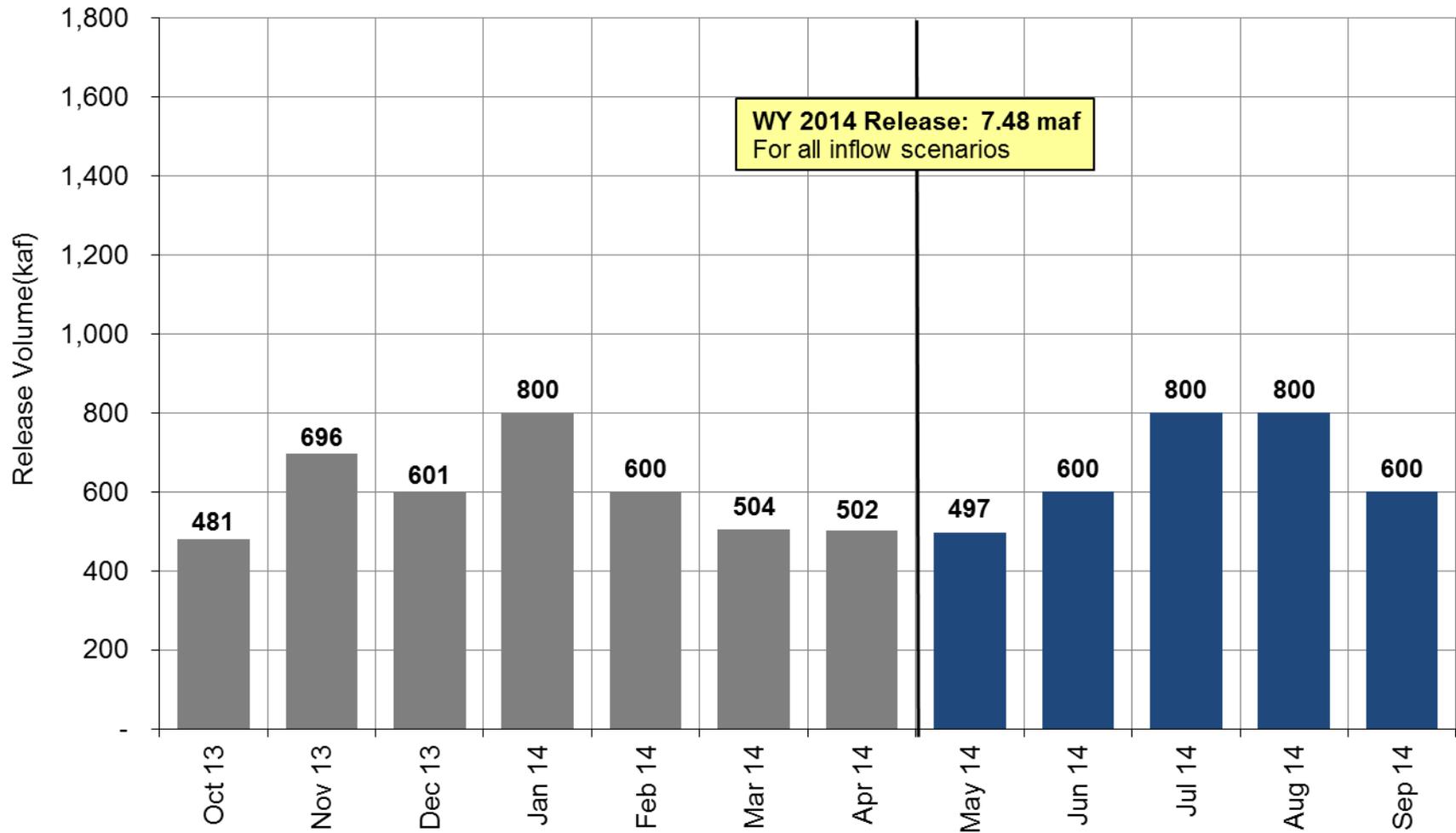
Scenario	Operational Tier	Annual Release Volume
Minimum Probable	Mid-Elevation Release	7.48 maf
Most Probable	Mid-Elevation Release	7.48 maf
Maximum Probable	Mid-Elevation Release	7.48 maf

* Note that in the Mid-Elevation Release Tier, there is no provision for an April adjustment to the operating tier.

Projected Lake Powell Monthly Release Volume Distribution

May 2014 Release Projections

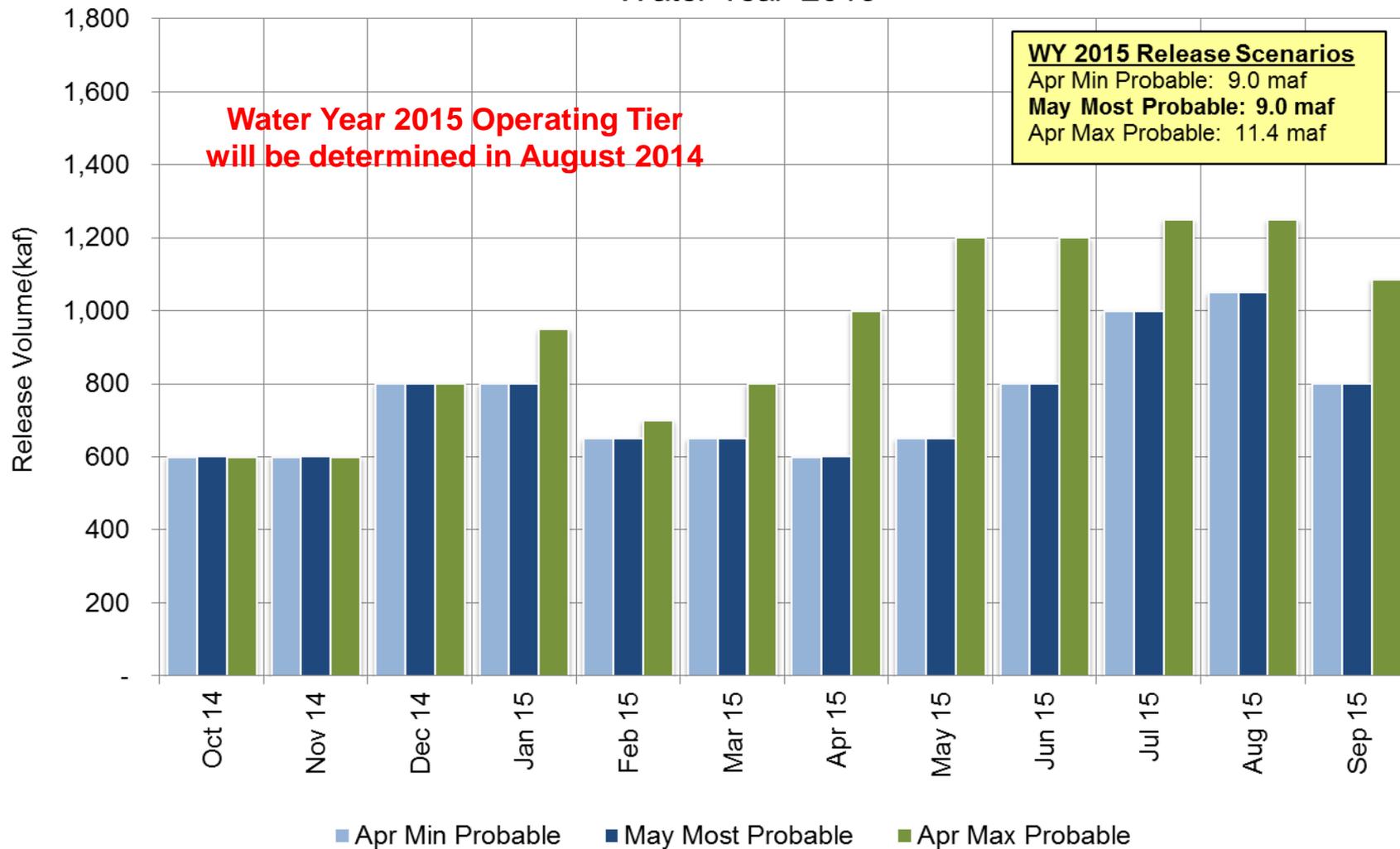
Water Year 2014



Projected Lake Powell Monthly Release Volume Distribution

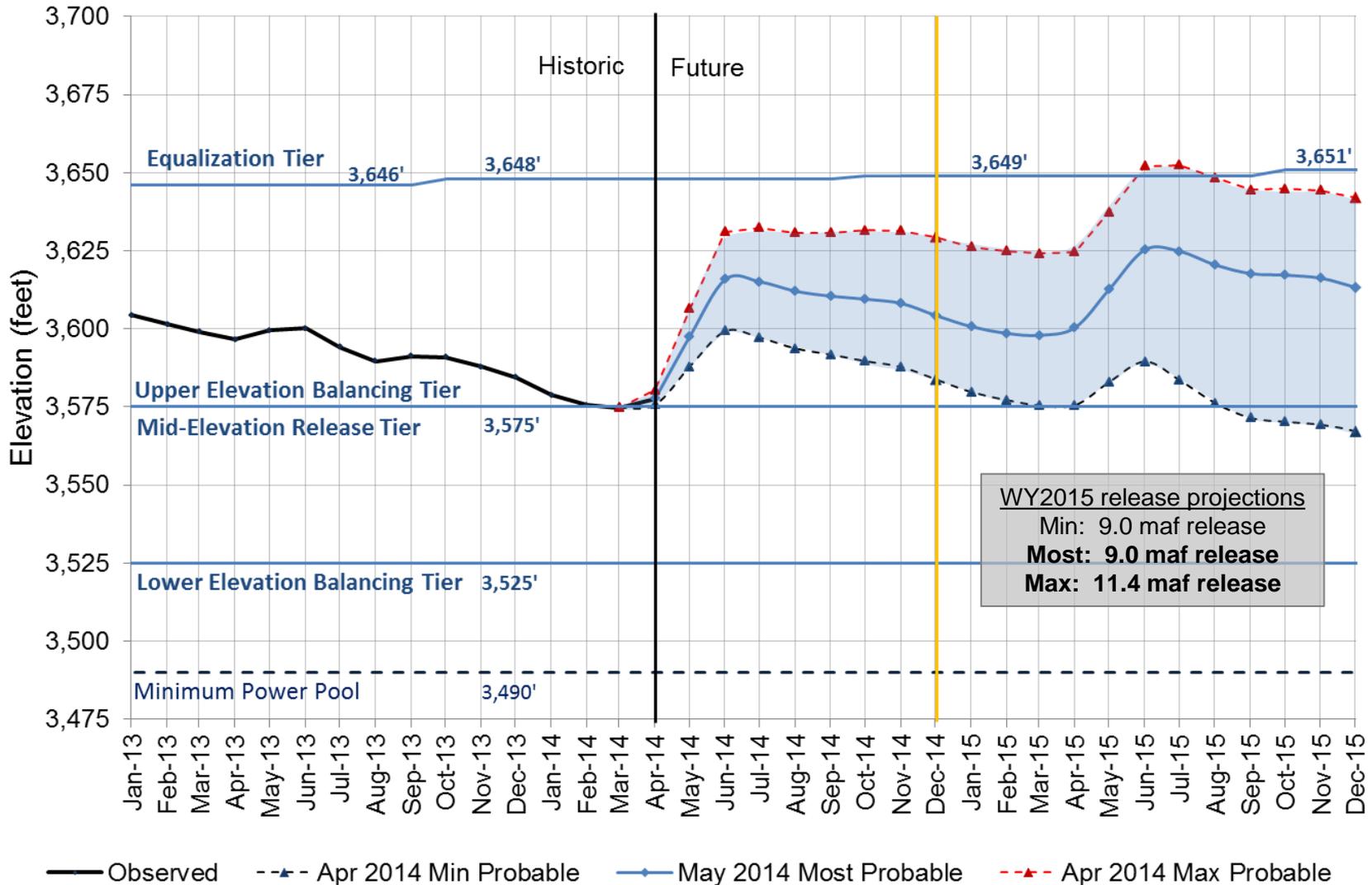
April and May 2014 Projected Release Scenarios

Water Year 2015



Lake Powell End of Month Elevations

Historic and projected based on April and May modeling



Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2014

Unit Number	Oct 2013	Nov 2013	Dec 2013	Jan 2014	Feb 2014	Mar 2014	Apr 2014	May 2014	Jun 2014	Jul 2014	Aug 2014	Sep 2014
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	5	6 5	6	6	5 4	4 6	6	5 6	6	6	6	4 5
Capacity (cfs)	14,200	20,000 14,300	18,000	17,900	13,600 10,300	10,300 16,600	16,600	13,800 17,000	17,000	17,000	17,000	10,400 13,800
Capacity (kaf/month)	900	1040	1120	1100	750	850	950	950	1010	1050	1050	710
Max (kaf) ¹	--	--	--	--	--	--	--	497	600	800	800	600
Most (kaf) ²	481	696	601	800	600	504	502	497	600	800	800	600
Min (kaf) ¹	--	--	--	--	--	--	--	497	600	800	800	600

7.48

¹ Projected release, based on April 2014 Min and Max Probable Inflow Projections and 24-Month Study model runs

² Projected release, based on May 2014 Most Probable Inflow Projections and 24-Month Study model runs

(updated 5-19-2014)



Glen Canyon Power Plant Provisional Unit Outage Schedule for Water Year 2015

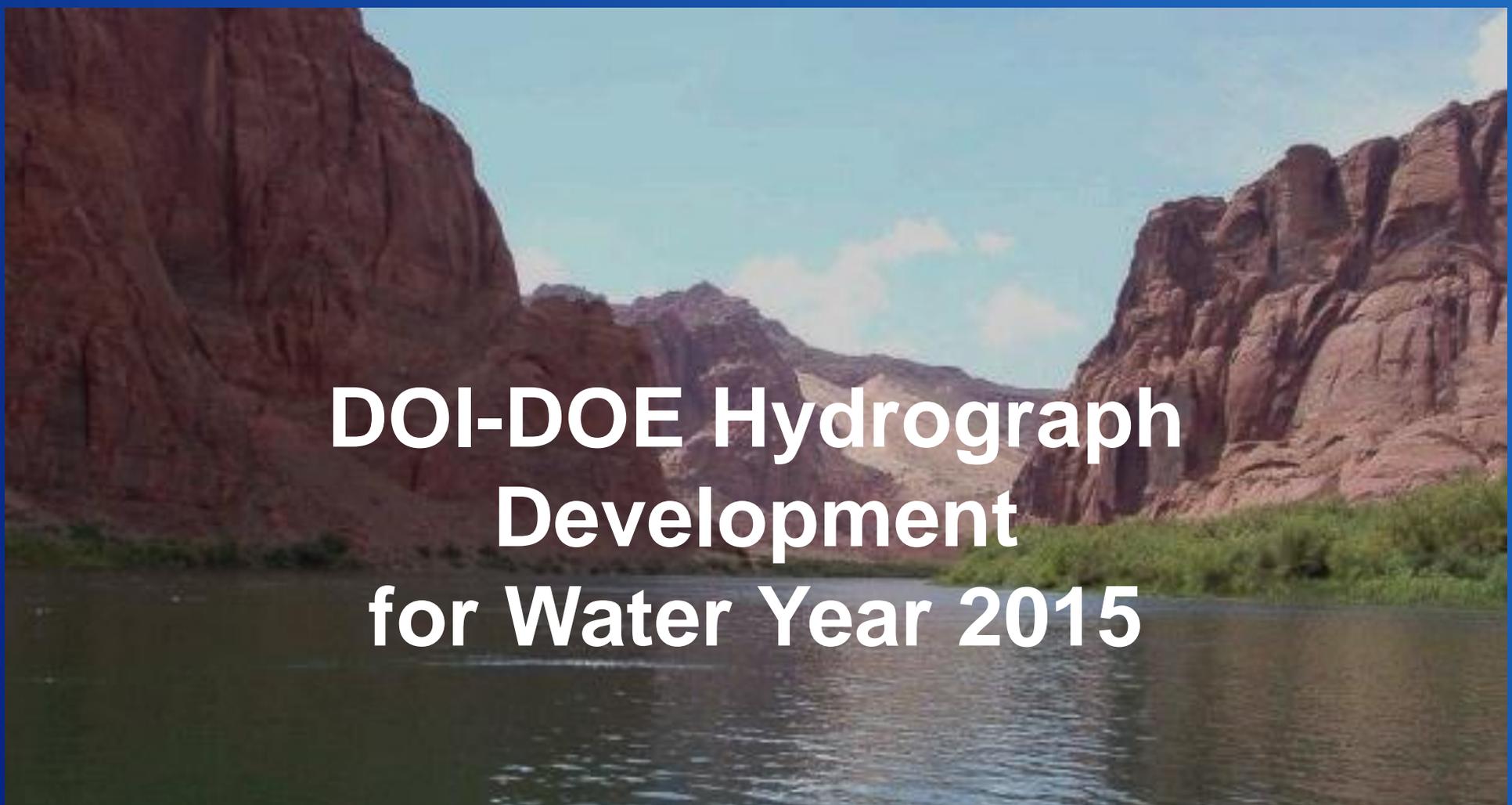
Unit Number	Oct 2014	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	
1													
2													
3													
4													
5													
6													
7													
8													
Units Available	5	7	6	6	4	4 6	6	6 5	6	6	6	6	
Capacity (cfs)	13,800	20,600	17,200	17,200	10,700	10,400 17,200	17,200	17,200 13,600	17,200	17,200	17,200	17,400	
Capacity (kaf/month)	870	1180	1060	1060	630	880	1020	930	1020	1060	1130	1120	
Max (kaf) ¹	600	600	800	950	700	800	1000	1200	1200	1250	1250	1086	11.4
Most (kaf) ²	600	600	800	800	650	650	600	650	800	1000	1050	800	9.0
Min (kaf) ¹	600	600	800	800	650	650	600	650	800	1000	1050	800	9.0

¹ Projected release, based on April 2014 Min and Max Probable Inflow Projections and 24-Month Study model runs

² Projected release, based on May 2014 Most Probable Inflow Projections and 24-Month Study model runs

(updated 5-19-2014)

RECLAMATION



**DOI-DOE Hydrograph
Development
for Water Year 2015**

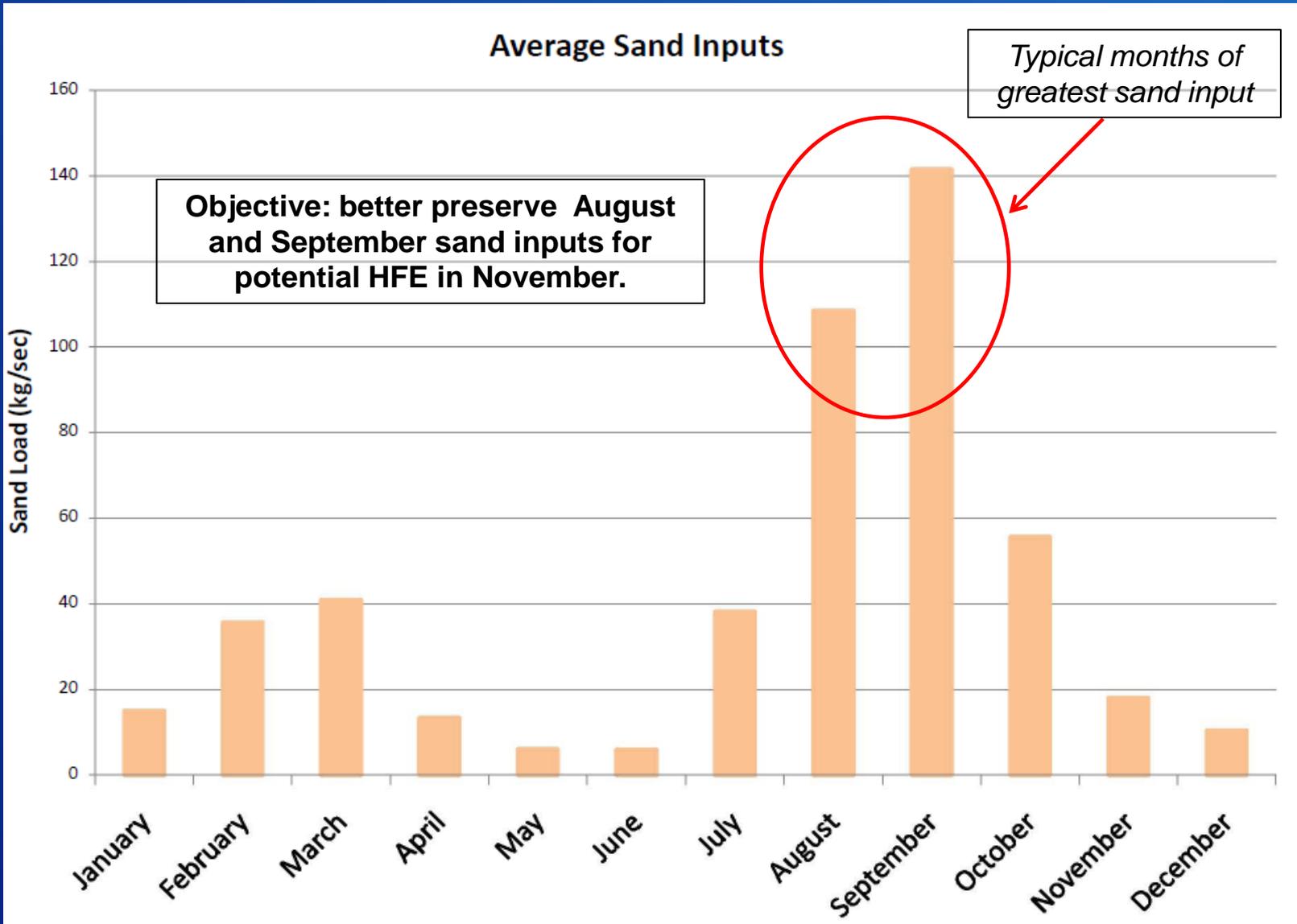
RECLAMATION

2015 Hydrograph Development

- Start 2012, 2013, and 2014 hydrograph
 - “Targeted Approach”
- Consider operating experiences and input
- Continue to work within existing environmental compliance

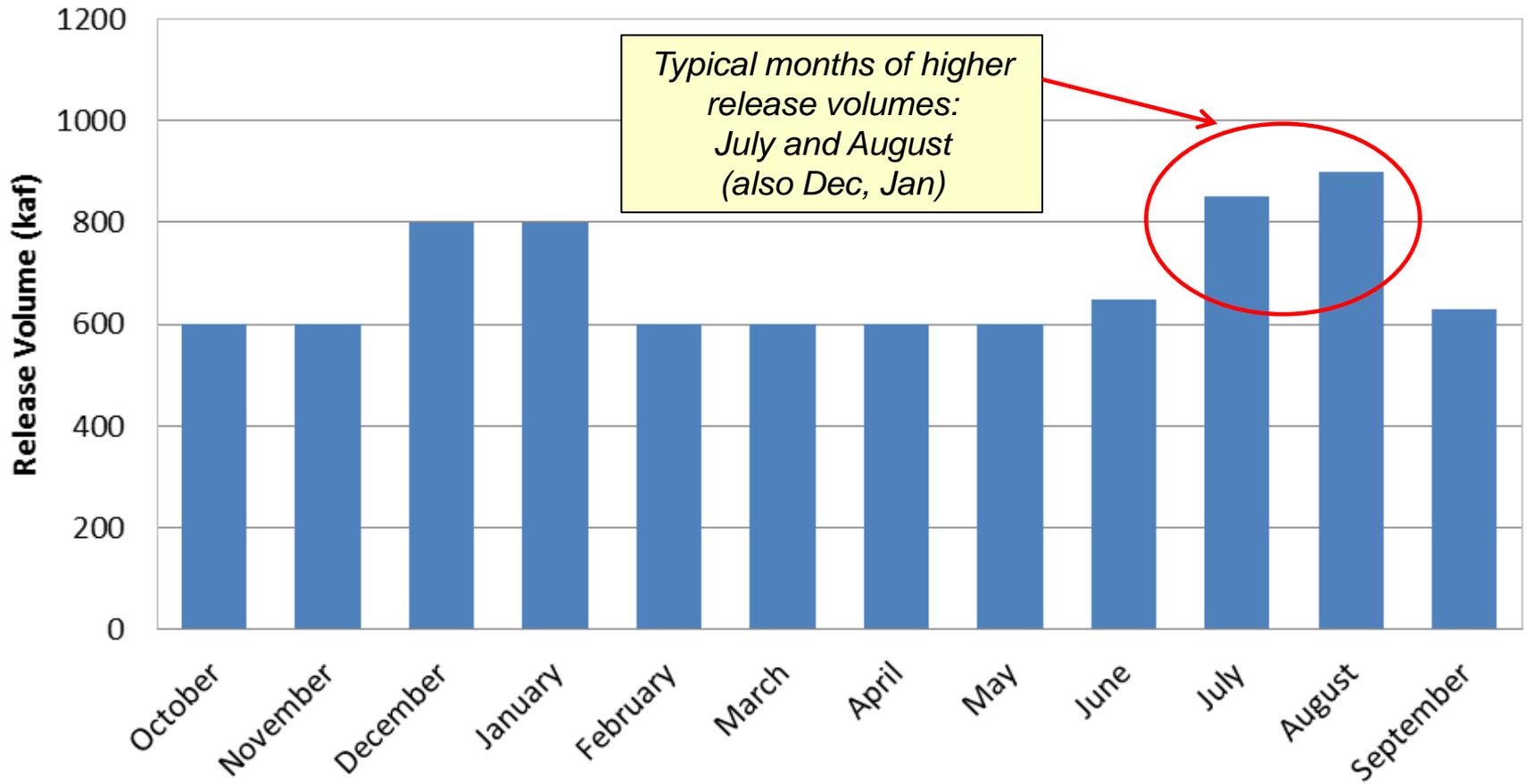
2015 Hydrograph Concepts

- Objective: retain sand inputs high in the system in anticipation of a potential HFE in fall 2015
- Target lower August through October releases
- Avoid shifting “extra” water to June (which cools temperatures at the mouth of the LCR)
- Move water from August to other equal value months for hydropower (Dec/Jan)



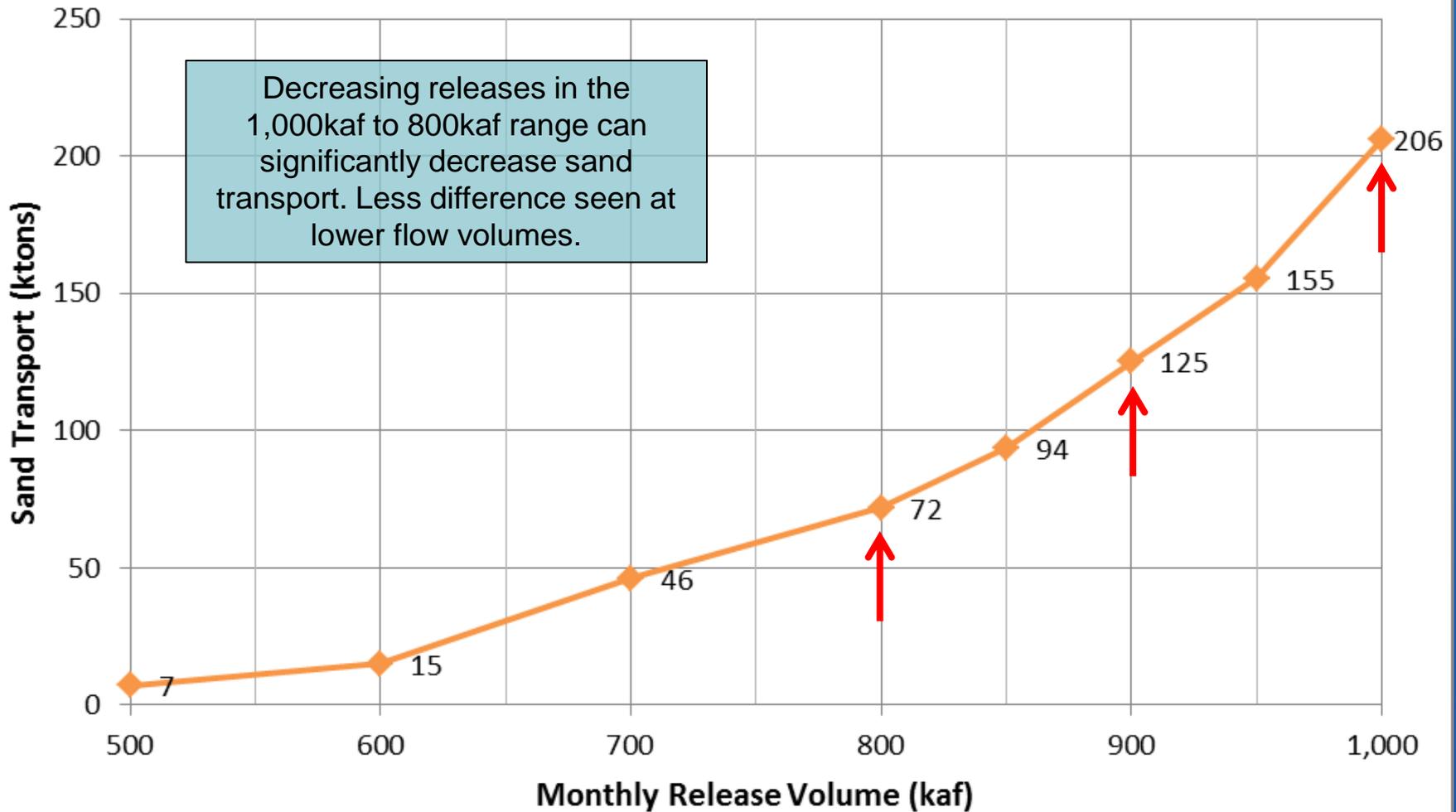
Typical Annual Release Pattern

8.23 maf year



Sand Budget Model - Marble Canyon Reach

(based on Dec-2013 initial conditions)



Temperature Considerations

- Last year FWS suggested we look at ways to improve temperatures at the mouth of the LCR early in the season (June)
- LCR temperatures were found to drop by about 0.5 deg C as releases are increased from 600 to 800 kaf
- Avoid shifting “extra” water into June

2015 Targeted Release Volumes

- August releases targeting 800kaf, and adjusted to account for hydrologic uncertainty:
 - January: August target is greater of 800 kaf or 10% remaining annual release volume.
 - February: August target is greater of 800 kaf or 10% remaining annual release volume.
 - March: August target is greater of 800 kaf or 12% remaining annual release volume.
 - April: August target is greater of 800 kaf or 15% remaining annual release volume.
 - May: August target is greater of 800 kaf or 20% remaining annual release volume.
 - June: August target is greater of 800 kaf or 25% remaining annual release volume.
 - July: August target is greater of 800 kaf or 40% remaining annual release volume.
 - August: Release volume established as 100% of remaining annual release volume (release could be less than 800 kaf in some cases).
- September releases would adjusted to the forecast as follows:
 - 600 kaf/month for annual releases below 9.0 maf
 - 700 kaf/month for annual release from 9.0 maf up to 10.0 maf
 - 800 kaf/month for annual release from 10.0 maf up to 11.0 maf
 - 900 kaf/month for annual release from 11.0 maf up to 12.0 maf
 - Up to powerplant capacity for high equalization releases

NOTE: Propose same release targets and language as 2013 hydrograph (last time GCD was in Upper Elevation Balancing Tier)

2015 Projected Annual Release

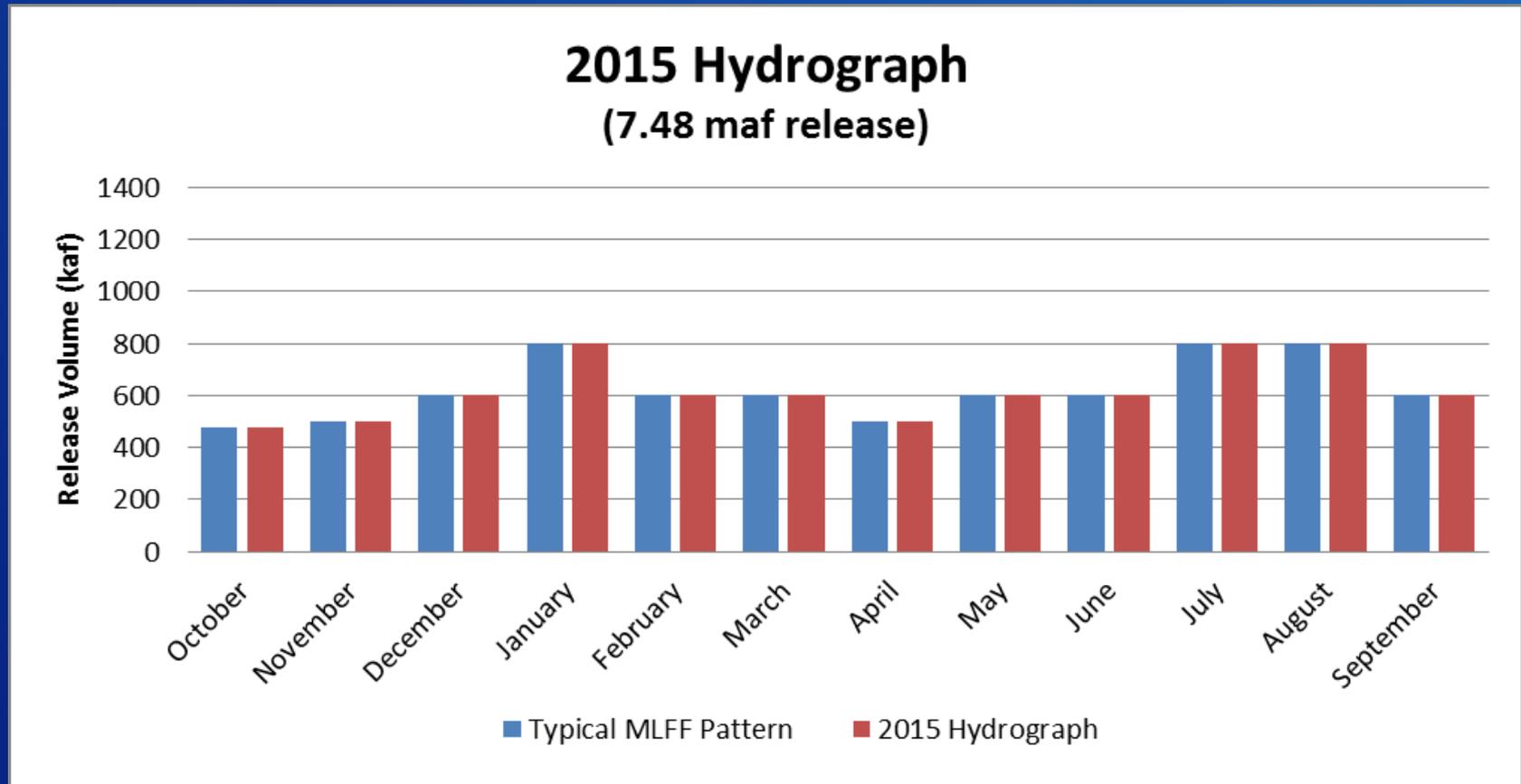
(Based on April and May 2014 modeling)

- **Min probable:** 9.0 maf release
(Upper Elevation Balancing, with 9.0 release, but 8.23 or 7.48 are still possible if observed 2014 runoff is significantly less than forecasted)
- **Most probable:** 9.0 maf release
(Upper Elevation Balancing, with 9.0 release)
- **Max probable:** ~11 maf release
(Upper Elevation Balancing, with April adjustment to equalization)
- GCD Operating Tier will be determined in August
- If Upper Elevation Balancing Tier, potential for April adjustment to equalization.

2015 Possible Hydrograph

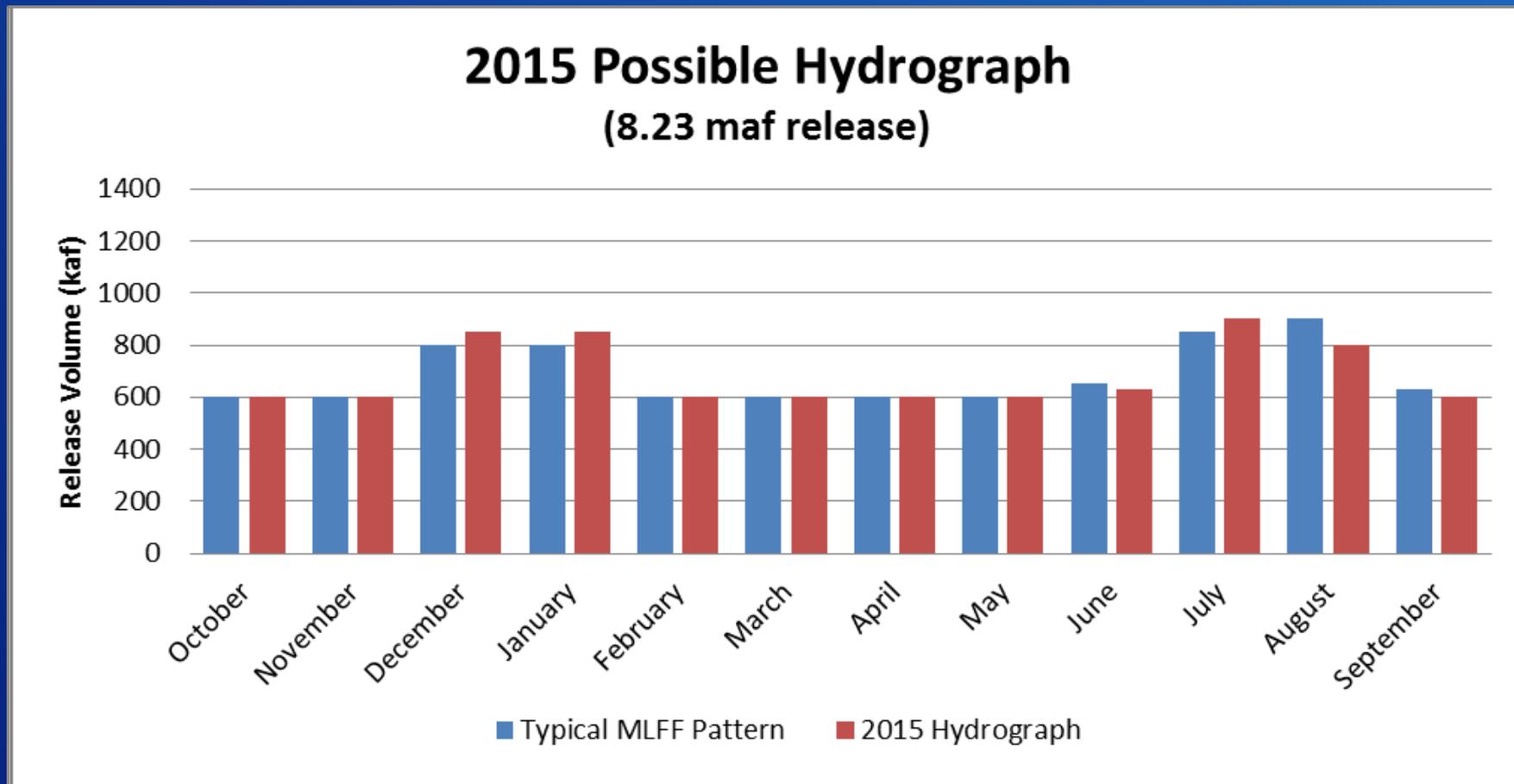
7.48 maf release

- Flows are already low – no difference from typical MLFF



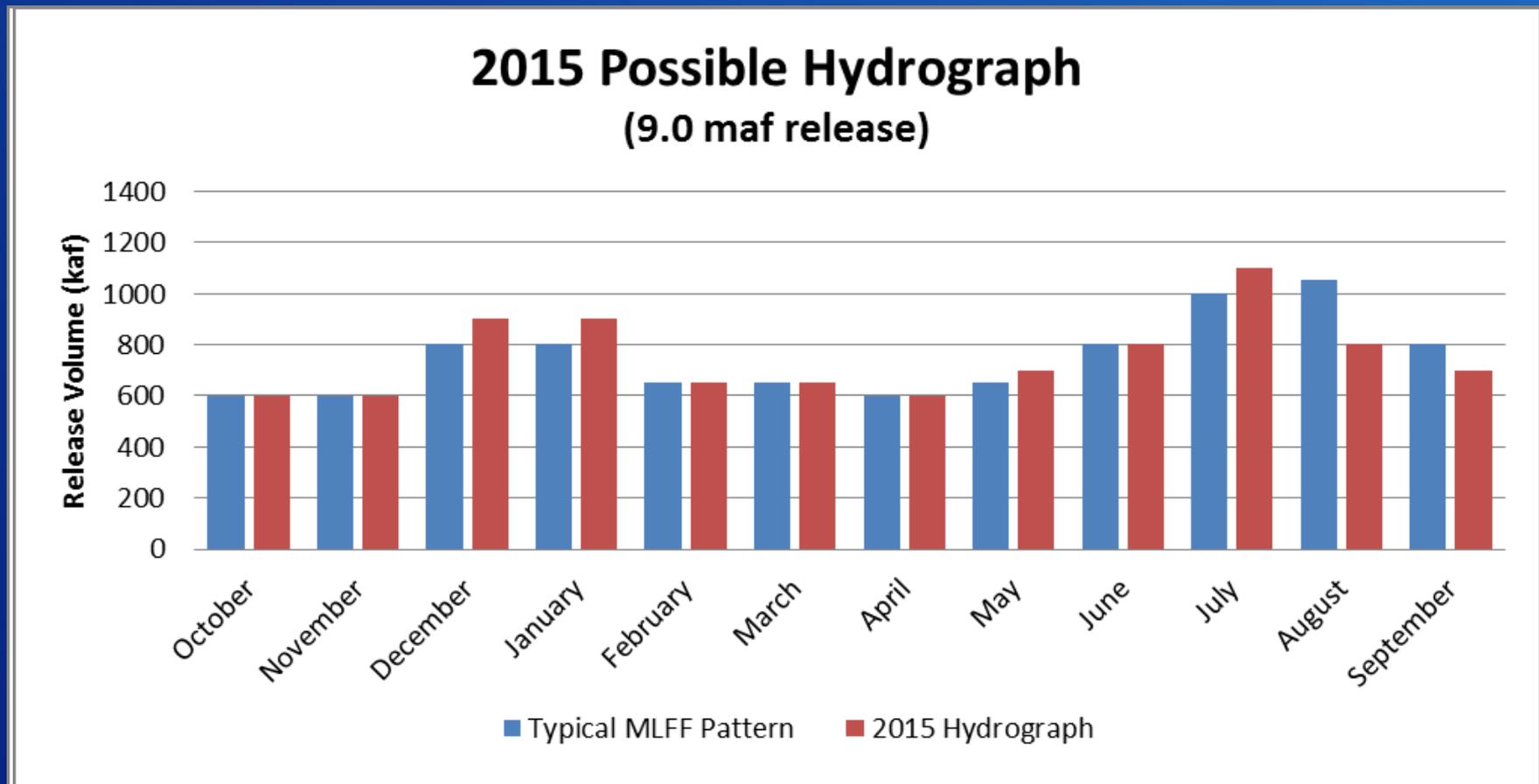
2015 Possible Hydrograph

8.23 maf release



2015 Possible Hydrograph

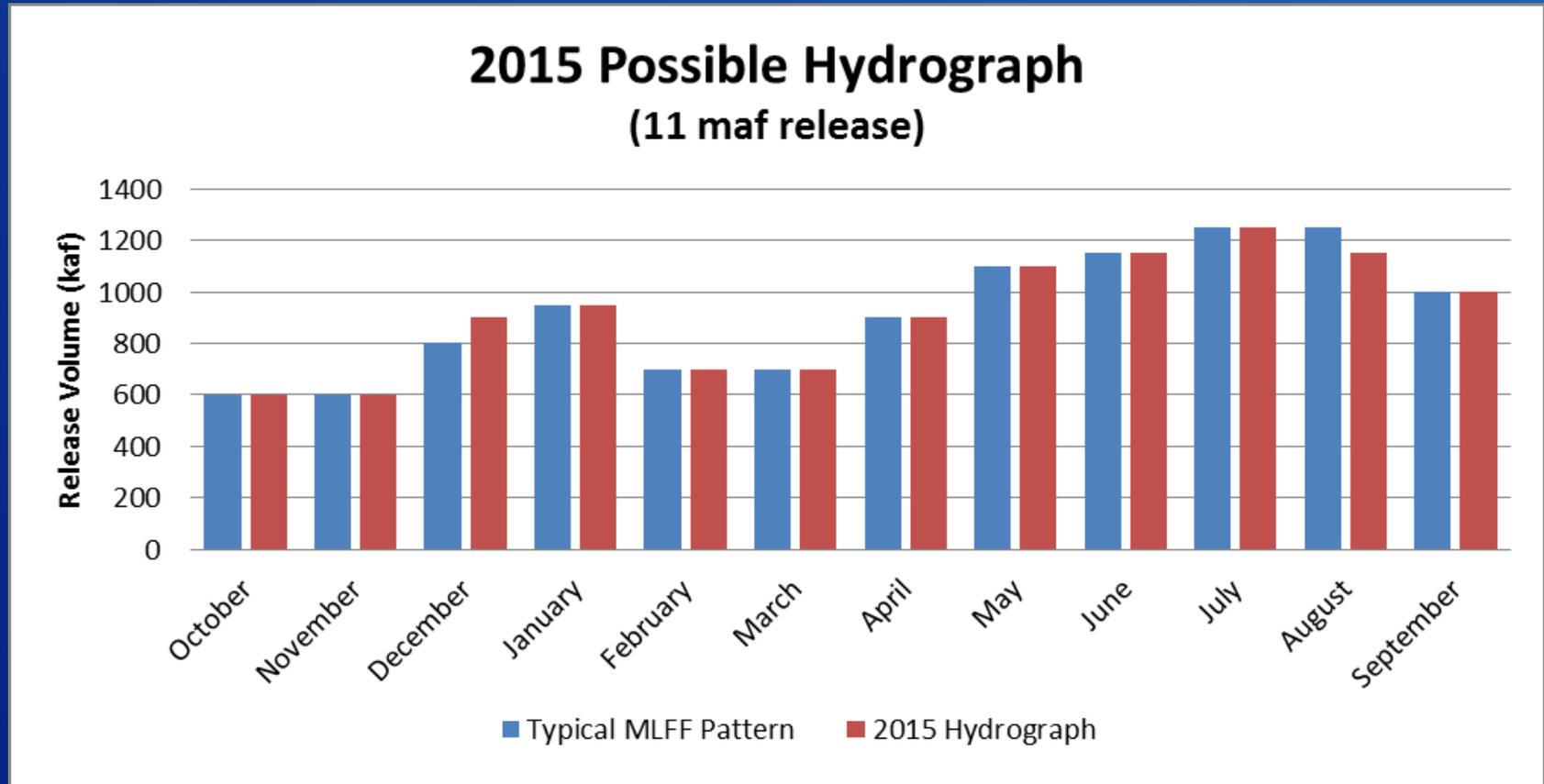
9.0 maf release



2015 Possible Hydrograph

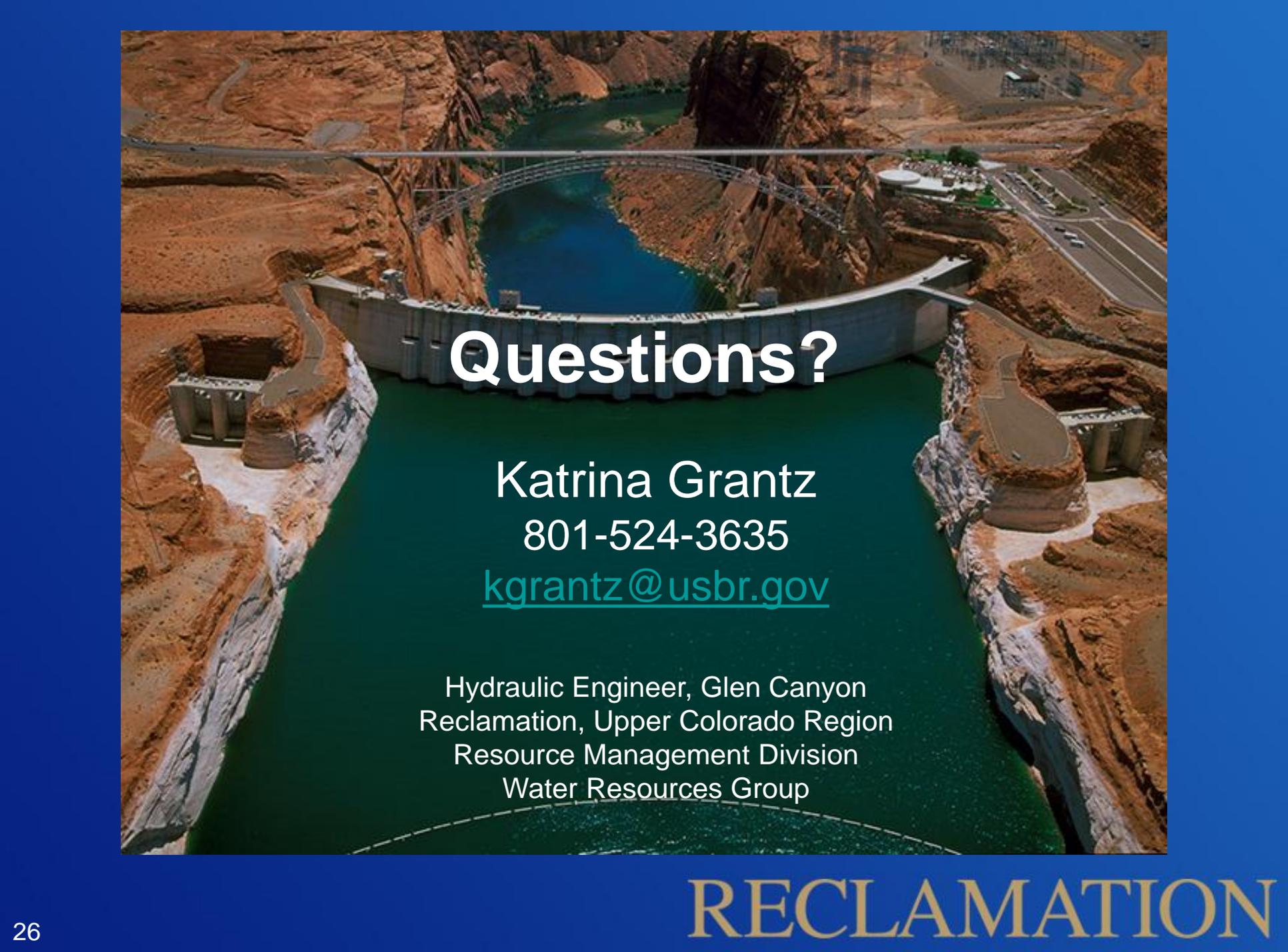
11 maf release

- Lots of water to move: limited flexibility, minimal difference in sand retention or temperature



2015 Hydrograph Next Steps

- Continue to coordinate with DOI-DOE Agencies
- No additional modeling is proposed
 - We have already analyzed the range of annual release volumes in past years:
 - Projected hydropower impacts: GTMax
 - Projected sediment retention: Sand Budget model
 - Projected temperature Impacts
- Present to TWG in June 2014 for review
- If acceptable, TWG will move to AMWG for recommendation to Secretary at August 2014 AMWG meeting.



Questions?

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Resource Management Division
Water Resources Group

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