Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 19-20, 2014

Agenda Item

Basin Hydrology, Operations, and 2015 Hydrograph

Action Requested

Information only

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 DOIIDOE 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 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 provisional outlook for water years 2015 and 2016.

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* and the forecast for annual releases from Lake Powell 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 year 2015.

The presentation will include a brief review of the 2014 hydrograph development and an overview of the upcoming 2015 hydrograph development process. In cooperation with the other federal agencies, Reclamation is beginning its development of Interior's recommendation for the 2015 Hydrograph. This recommendation will be based upon the scenarios analyzed for the 2014 Hydrograph and any new ideas that may become known through our discussions. 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

February 19-20, 2014

U.S. Department of the Interior
Bureau of Reclamation

Lake Powell & Lake Mead

Operational Diagrams for 2014 (projected in Aug 2013)

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 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)
3,575	3,573.69	9.5
	Projection of 1/1/14 [1] **Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	
3,525		5.9
3,490	**Lower Elevation Balancing Tier** Balance contents with a min/max release of 7.0 and 9.5 maf	4.0
3,370		0

Lake Mead

Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf)[1]
1,220	**Flood Control Surplus or Quantified Surplus Condition** Deliver > 7.5 maf	25.9
1,200 (approx.)[2]	**Domestic Surplus or ICS Surplus Condition** Deliver > 7.5 maf	22.9 (approx.)[2]
1,145		15.9
1,105	1,103.08 **Normal or ICS Surplus Condition** Deliver ≥ 7.5 maf	11.9
1,075	Projection of 1/1/14 **Shortage Condition** Deliver 7.167[4] maf	9.4
1,050	**Shortage Condition** Deliver 7.083[5] maf	7.5
1,025		5.8
1,000	**Shortage Condition** Deliver 7.0[6] maf Further measures may be undertaken[7]	4.3
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.

[1] Lake Powell's projected elevation is based on an 8.23 maf annual release pattern from in water year 2014.

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WY2014 Operations under Interim Guidelines

determined in August 2013 24-Month Study

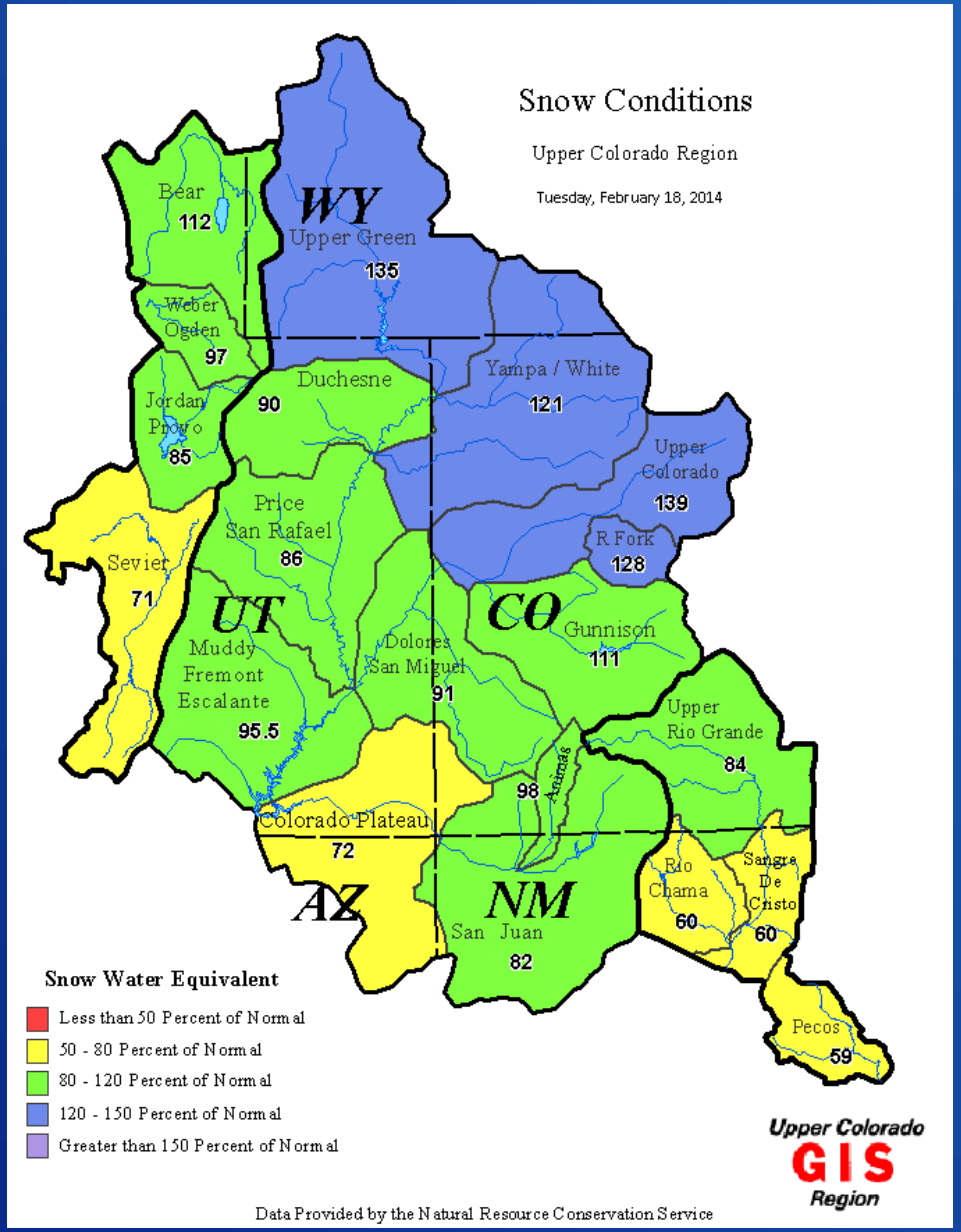
Scenario	Operational Tier	Annual Release Volume
Minimum Probable	Mid-Elevation Release	7.48 maf
Most Probable	Mid-Elevation Release	7.48 maf
Maximum Probable	Mid-Elevation Release	7.48 maf

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

RECLAMATION

Upper Basin Snowpack

as of 2/18/2014



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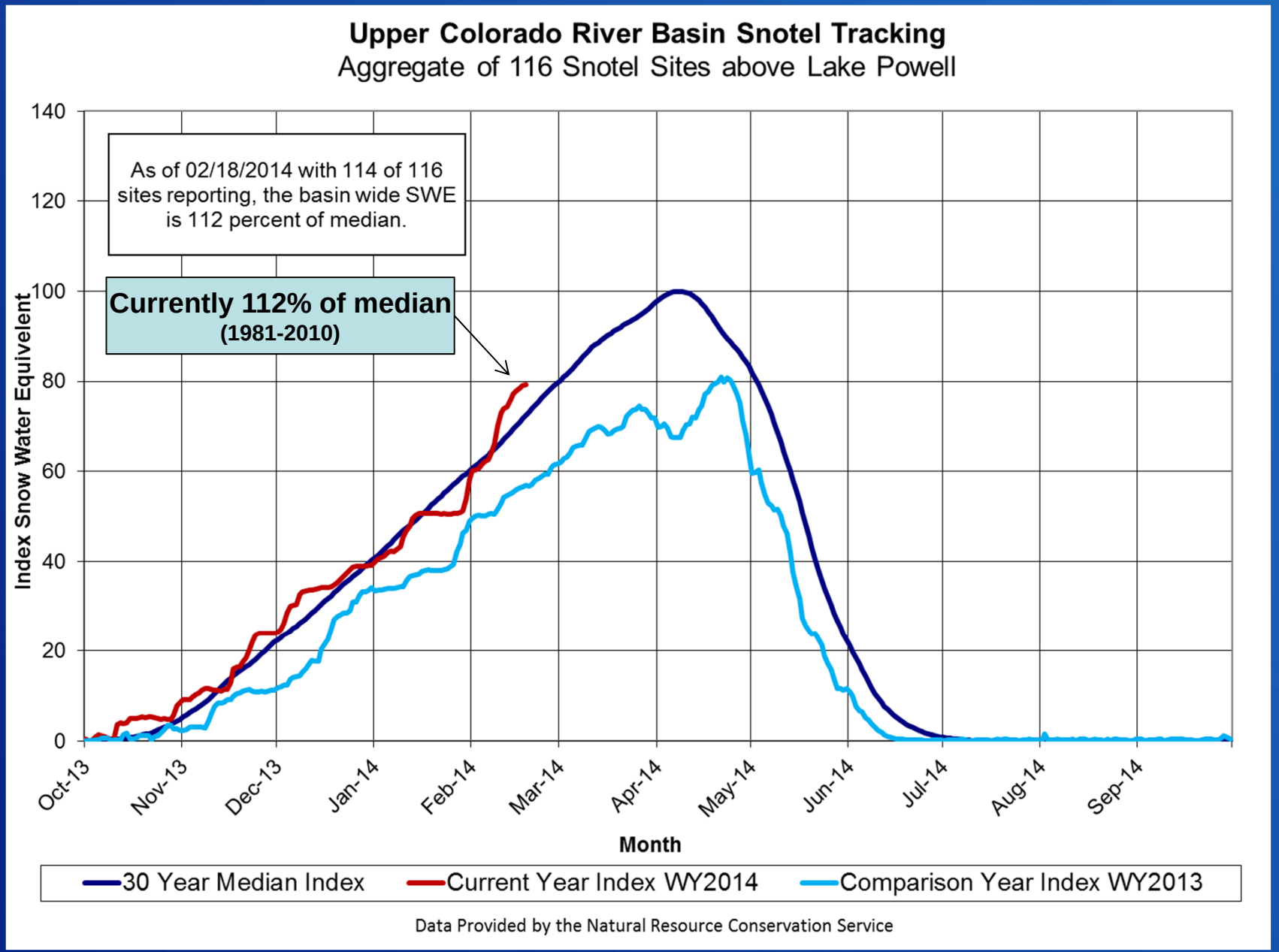
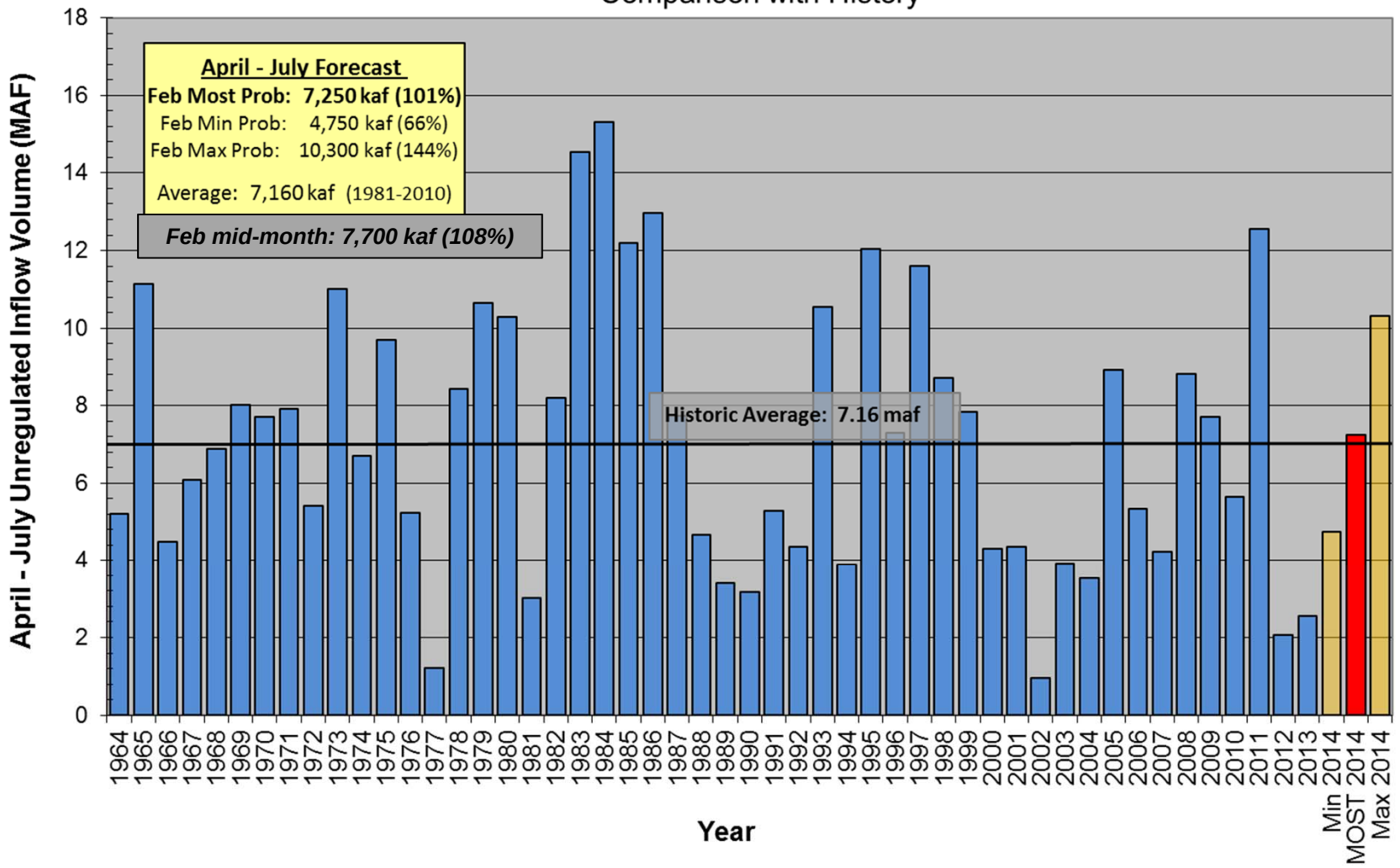


RECLAMATION

Lake Powell Unregulated Inflow

Apr - Jul 2014 Forecast *(issued Feb 4)*

Comparison with History



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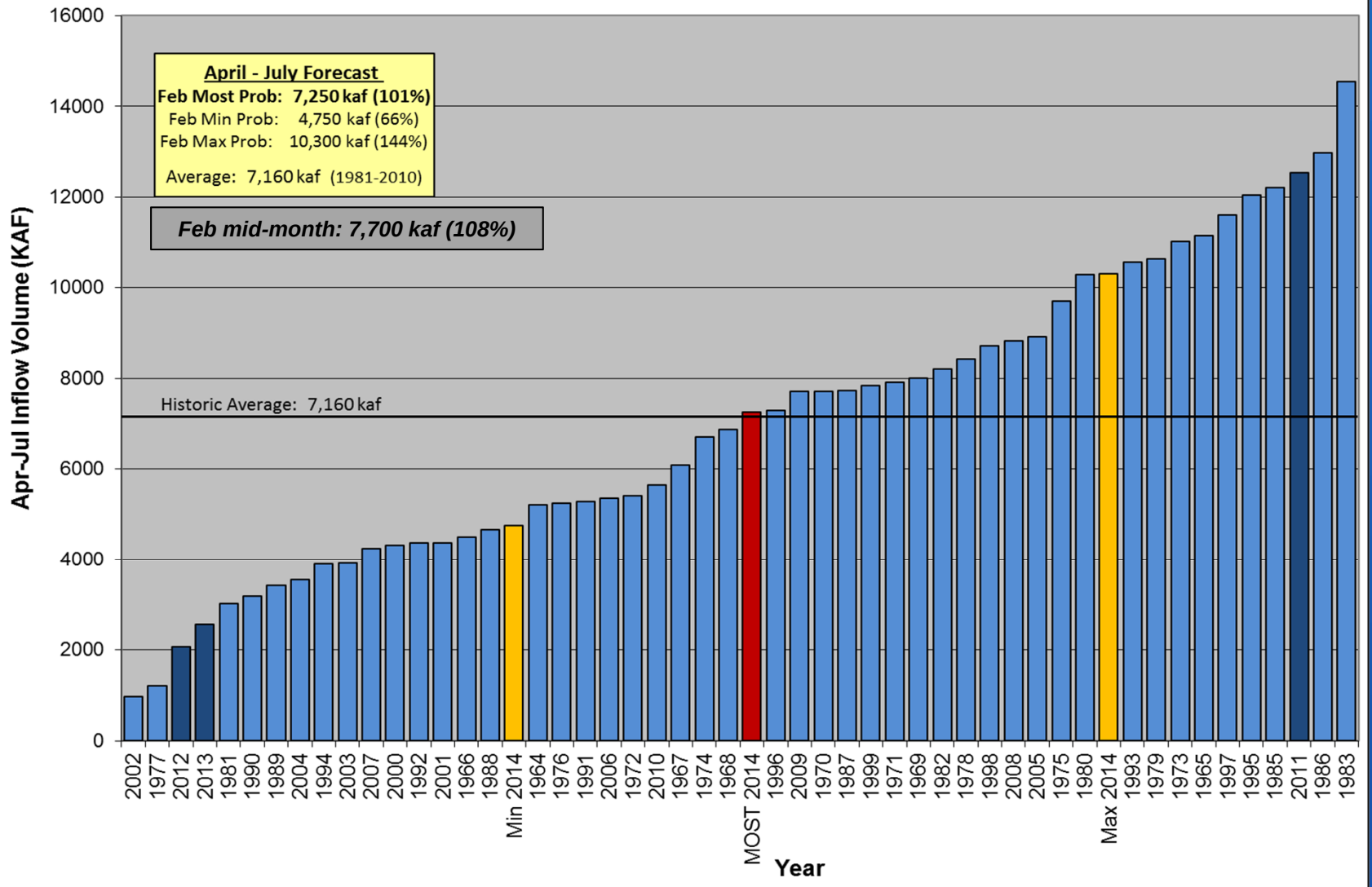
Powell Unregulated Inflow

Apr-Jul 2014 Forecast (Feb 4)

Comparison with History



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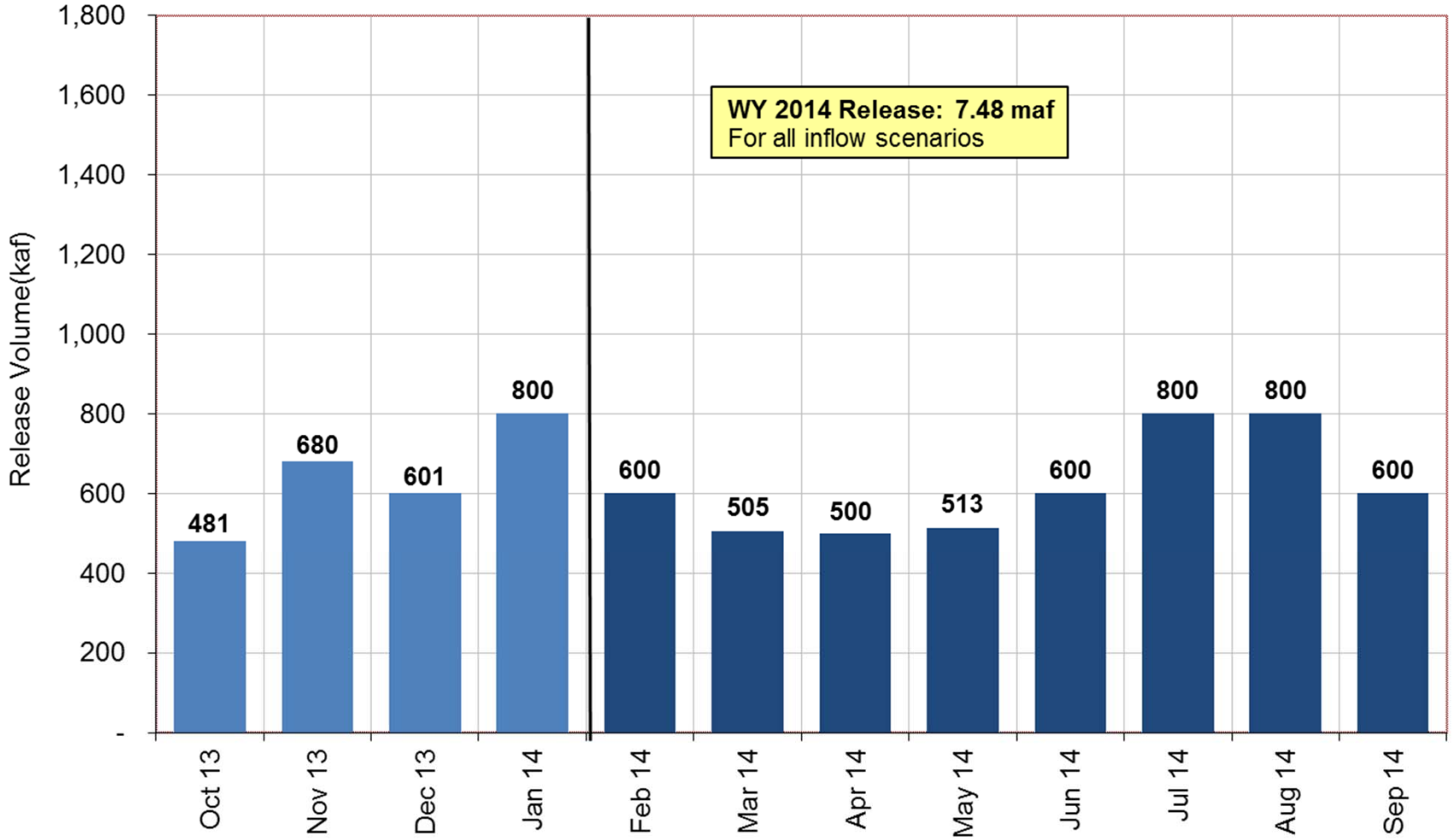
Projected Lake Powell Monthly Release Volume Distribution

February 2014 Release Projections

Water Year 2014



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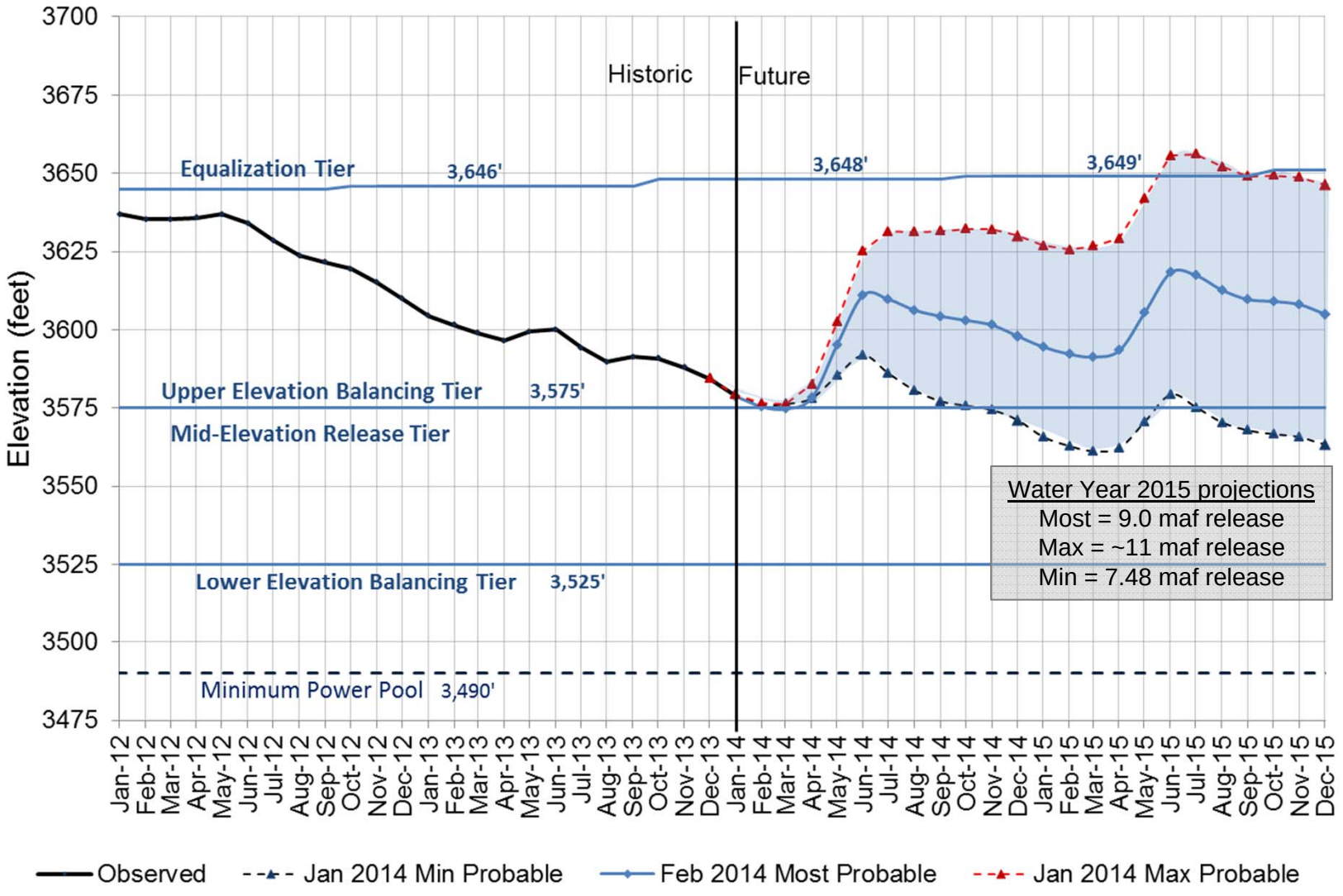
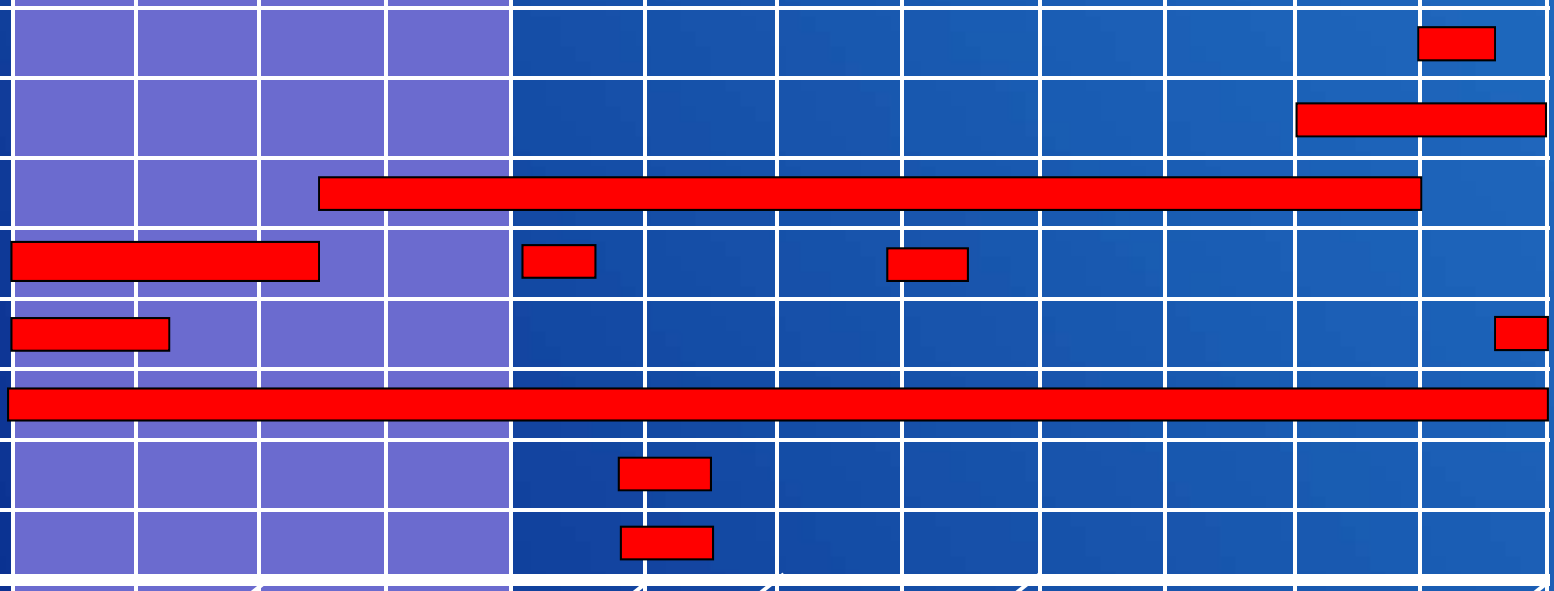
Lake Powell End of Month Elevations
Historic and Projected based on February modeling



RECLAMATION

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
Units Available	5	6 / 5	6	6	5 / 4	4 / 6	6	5 / 6	6	6	5	4 / 5
Capacity (cfs)	14,200	20,000 / 14,300	18,000	17,900	13,600 / 10,300	10,300 / 16,600	16,600	13,600 / 16,600	16,600	16,600	13,200	10,100 / 13,700
Capacity (kaf/month)	900	1040	1120	1100	750	850	970	930	990	1020	840	680
Max (kaf) [1]	--	--	--	--	600	505	500	513	600	800	800	600
Most (kaf) [1]	481	680	601	800	600	505	500	513	600	800	800	600
Min (kaf) [1]	--	--	--	--	600	505	500	513	600	800	800	600

7.48

1 **Projected release, based on Feb 2014 Inflow Projections and 24-Month Study model runs**

(updated 2-18-2014)

RECLAMATION

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	6	6	6	4 / 6	6 / 4	5	5	5	6	7	6 / 5	
Capacity (cfs)	13,800	**16,800**	**16,800**	**16,800**	**10,600** / **16,800**	**16,800** / **10,200**	13,700	13,700	13,700	**17,100**	**20,500**	**17,100** / **13,900**	
Capacity (kaf/month)	860	1000	1040	1040	700	830	810	840	820	1050	1210	970	
Max (kaf) [1]	600	600	800	950	700	700	900	1100	1150	1250	1250	955	**11.0**
Most (kaf) [2]	600	600	800	800	650	650	600	650	800	1000	1050	800	**9.0**
Min (kaf) [1]	480	500	600	800	600	600	500	600	600	800	800	600	**7.48**

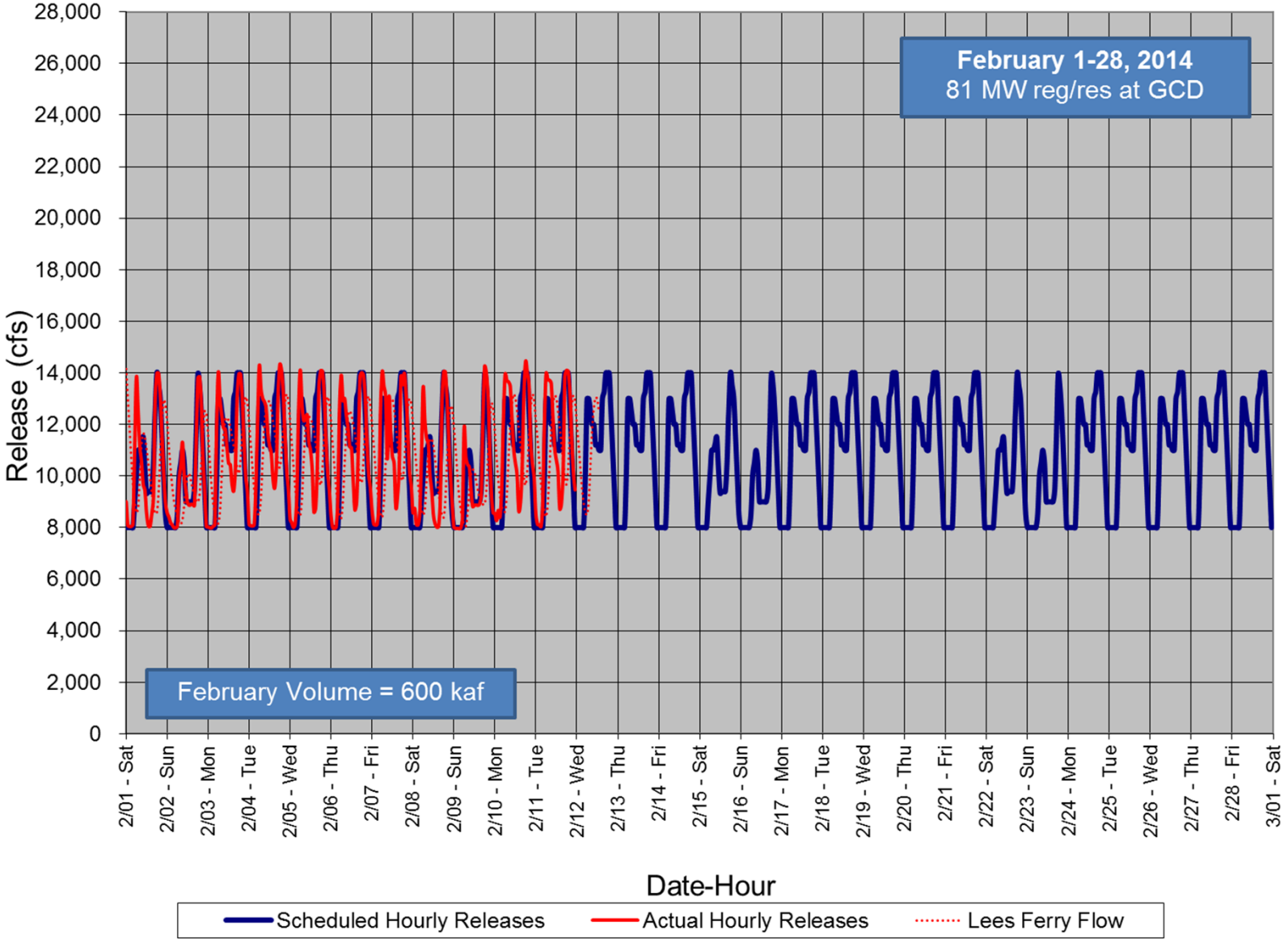
(updated 2-18-2014)

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

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

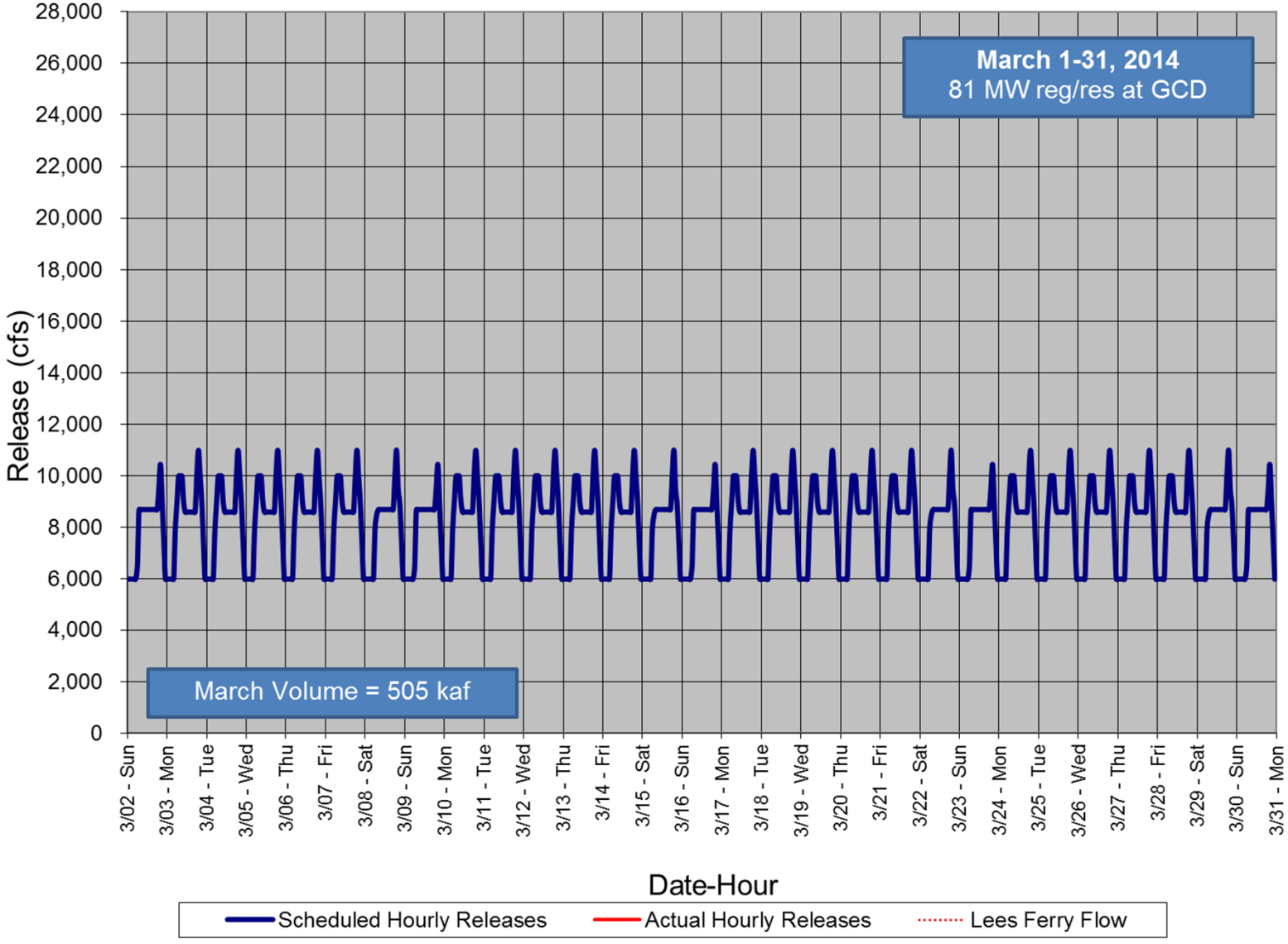
RECLAMATION

Glen Canyon Dam Hourly Release Pattern FEB 2014



RECLAMATION

Glen Canyon Dam Hourly Release Pattern MAR 2014



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DOI-DOE Hydrograph Development for 2015

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2015 Hydrograph Concepts

- Objective– retain sand inputs high in the system in anticipation of a potential HFE

- Continue to 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)

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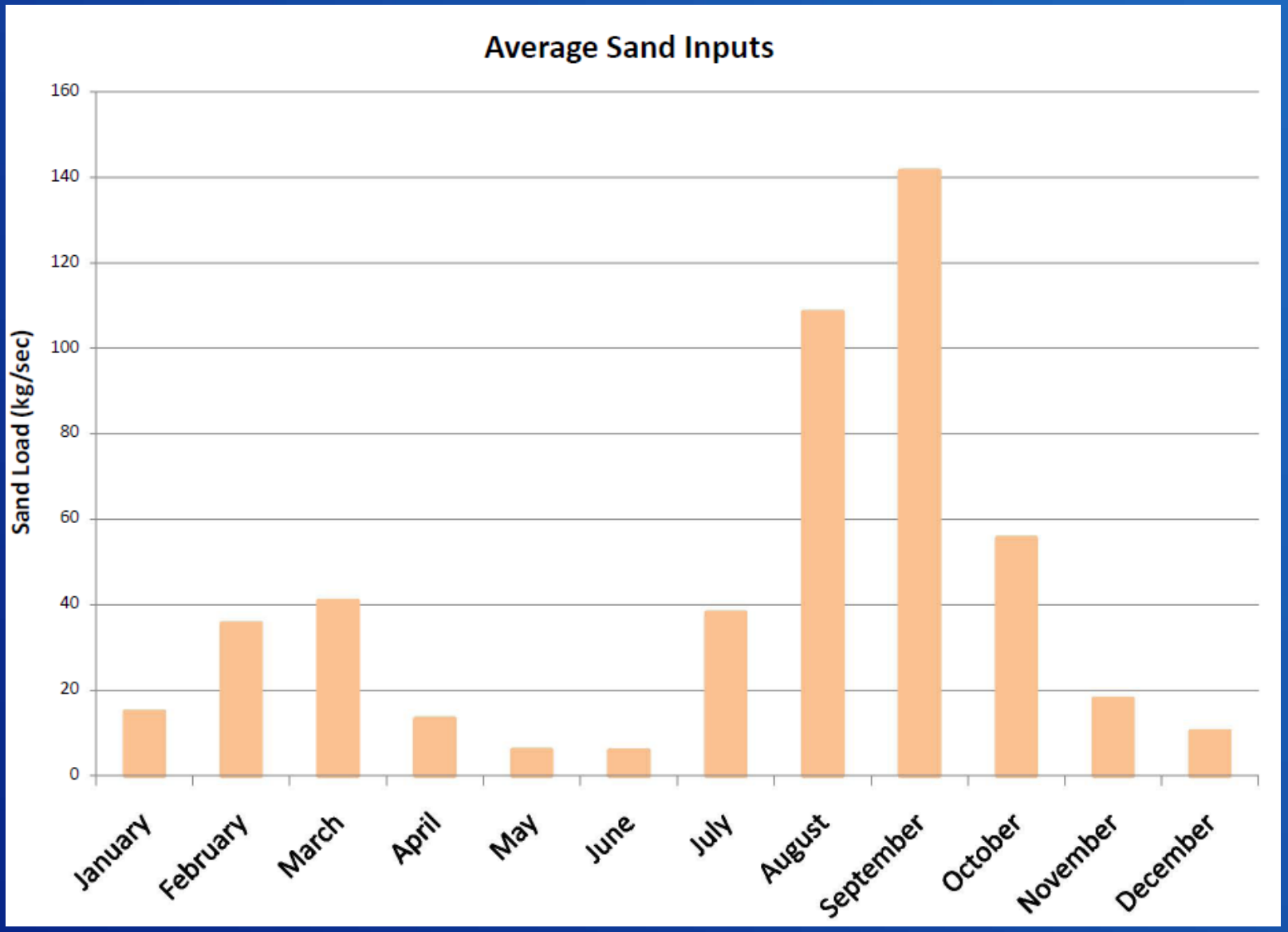

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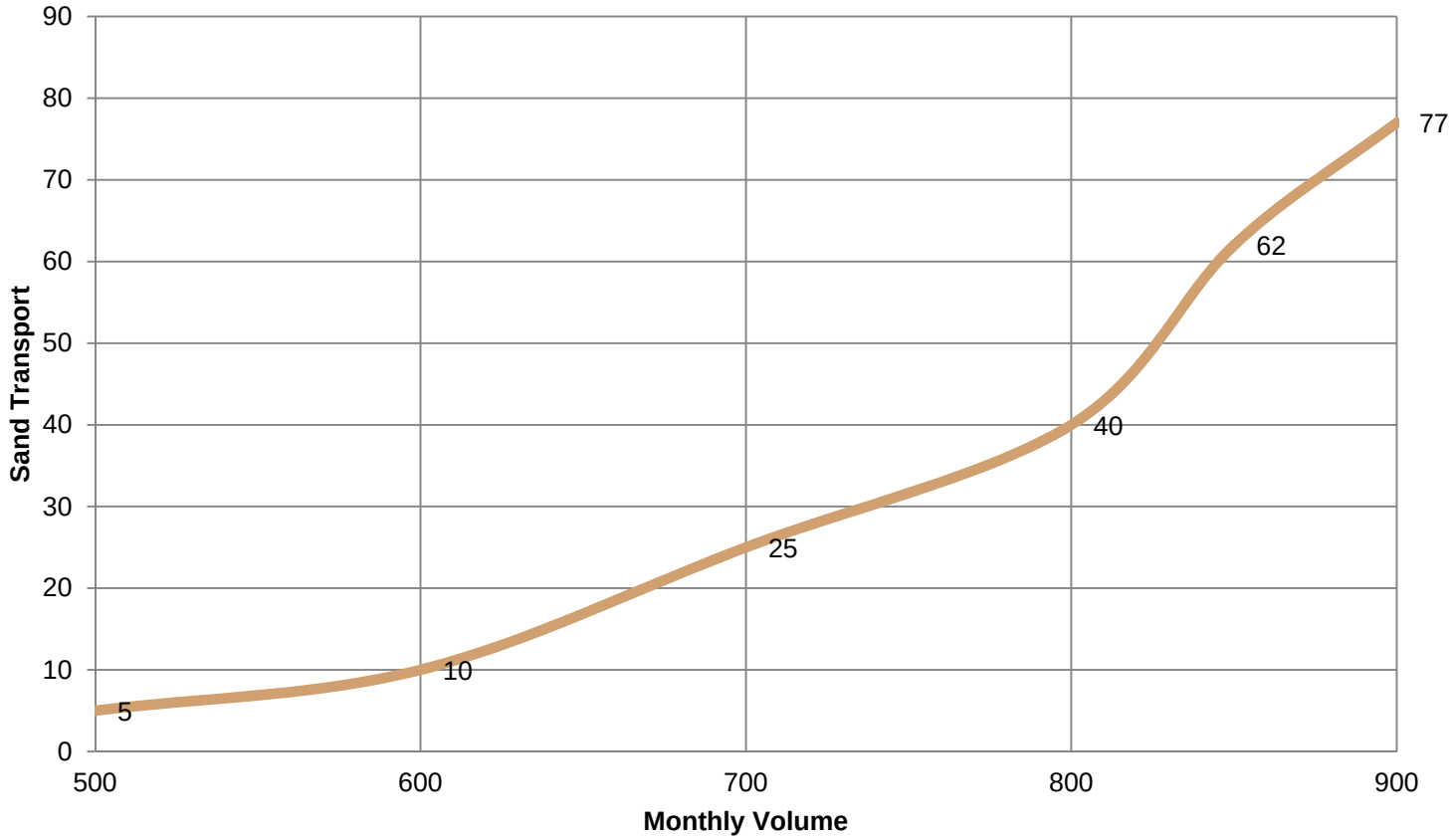
Sand Transport Model

(based on median inputs)



Note: Median to Mean July-Nov Inputs range from 630 to 946 ktons
Based on 2013 initial conditions; sand transport values may be slightly higher in 2014 (due to

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2014 Hydrograph language

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- **Release objective for August is 800 kaf.**
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2015 Projected Annual Release

(Based on January and February 2014 modeling)

- **Min probable**: 7.48 maf release

  (less likely with improved hydrology)
- **Most probable**: 9.0 maf release

  (Upper Elevation Balancing, between 8.23 and 9.0 maf)
- **Max probable**: ~11maf release

  (with April adjustment to equalization)

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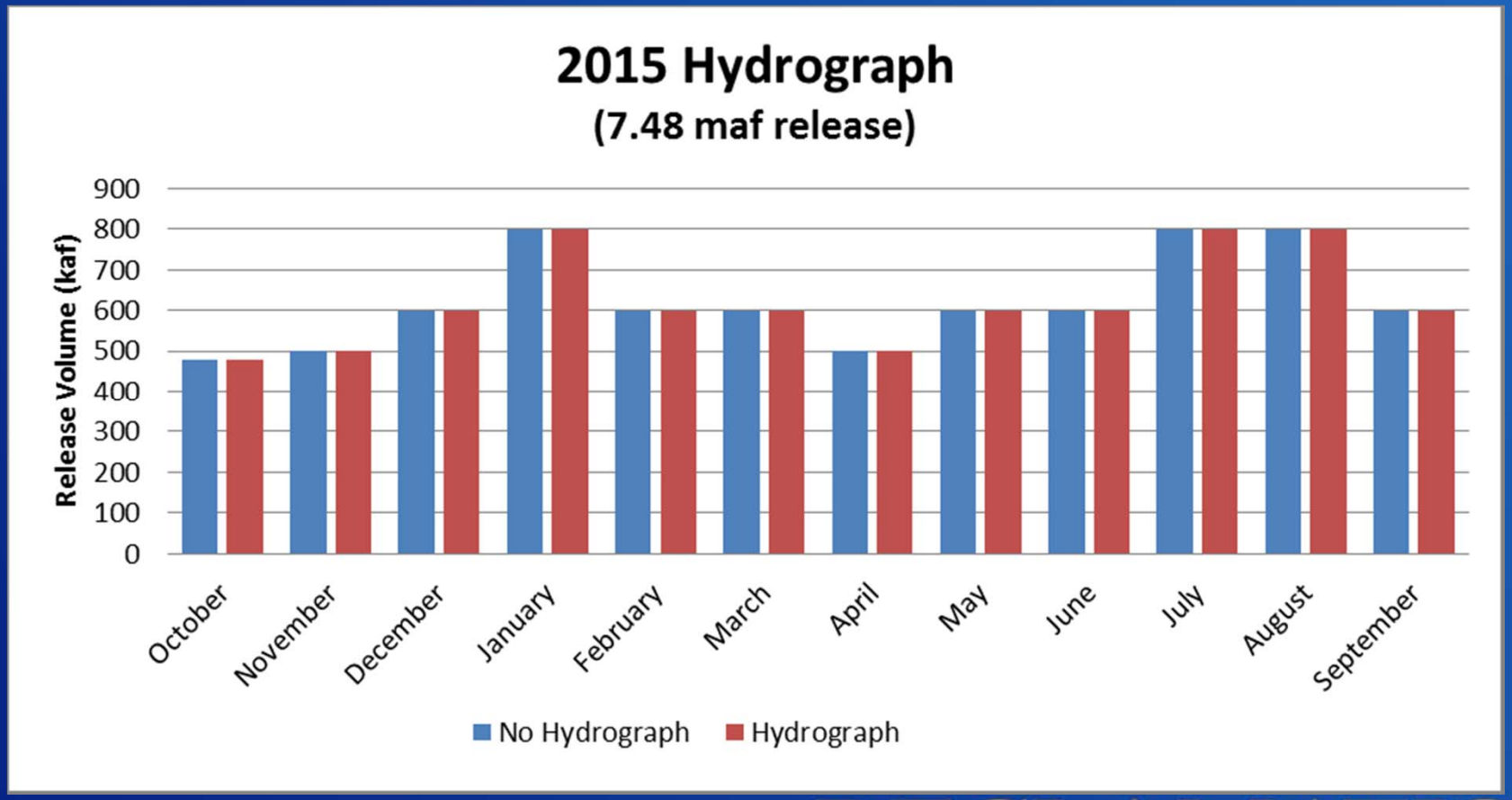
2015 Possible Hydrograph
7.48 maf release

- **Flows are already low – no difference from typical MLFF**



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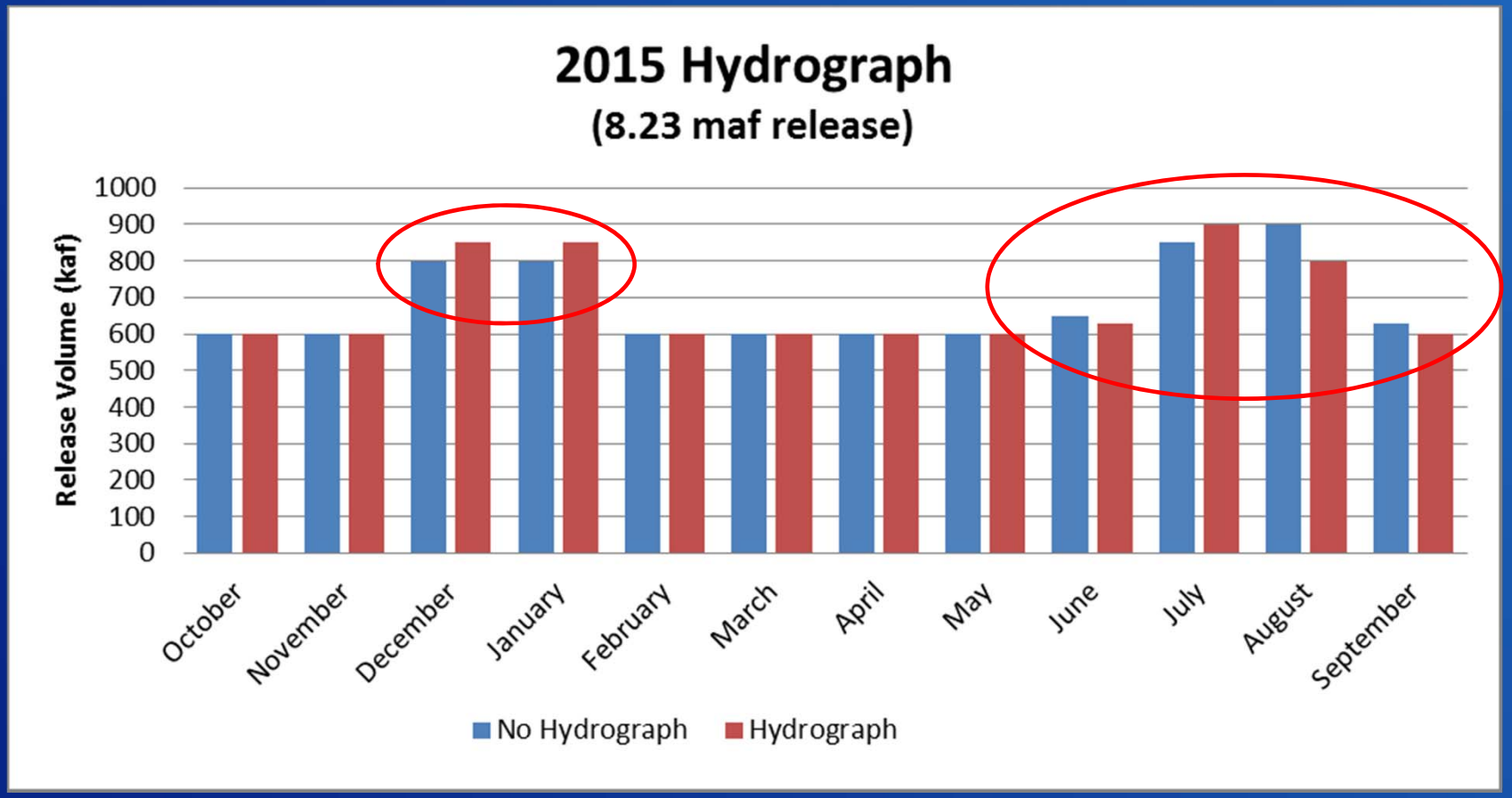
2015 Possible Hydrograph
8.23 maf release



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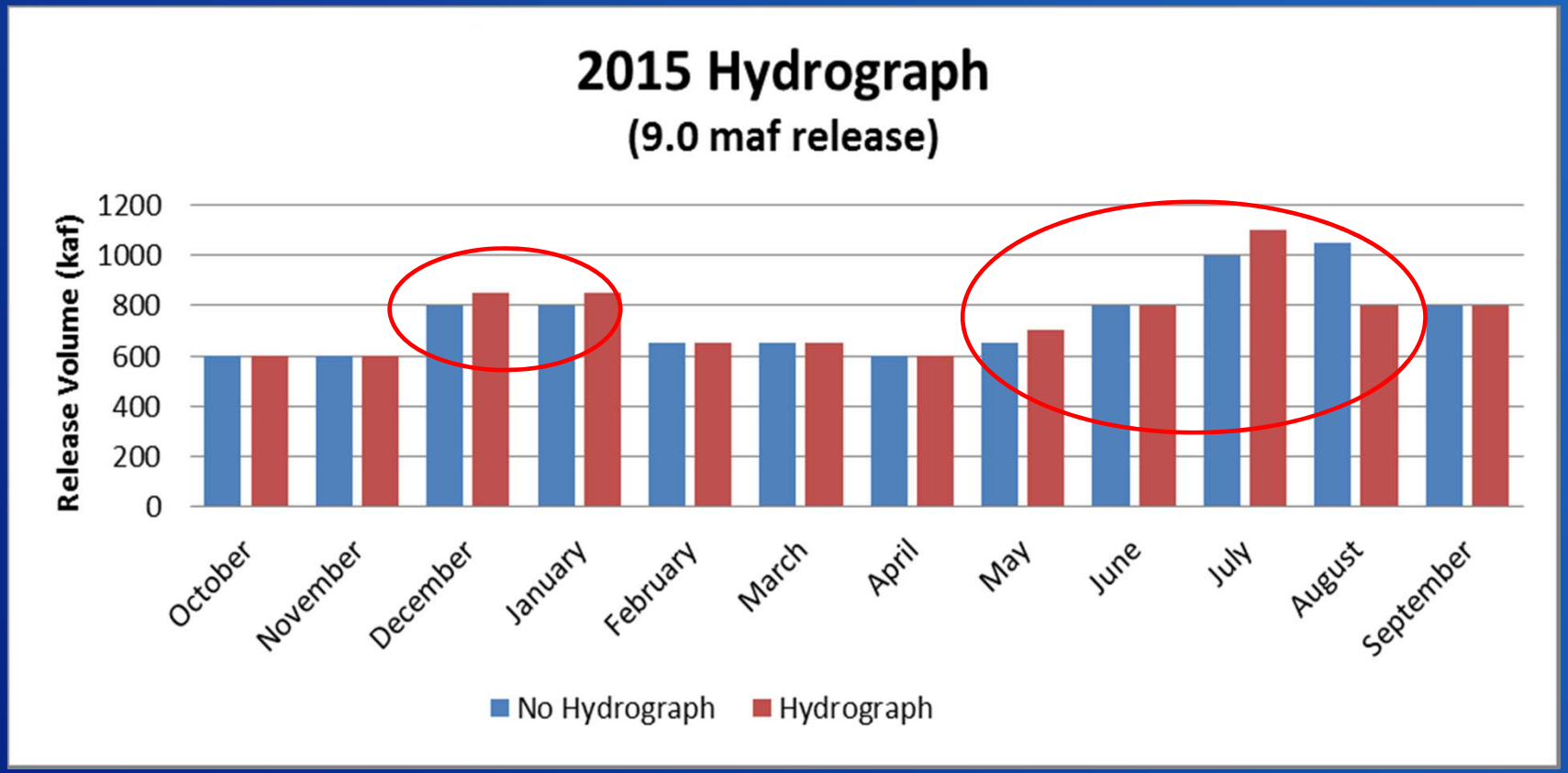
2015 Possible Hydrograph
9.0 maf release



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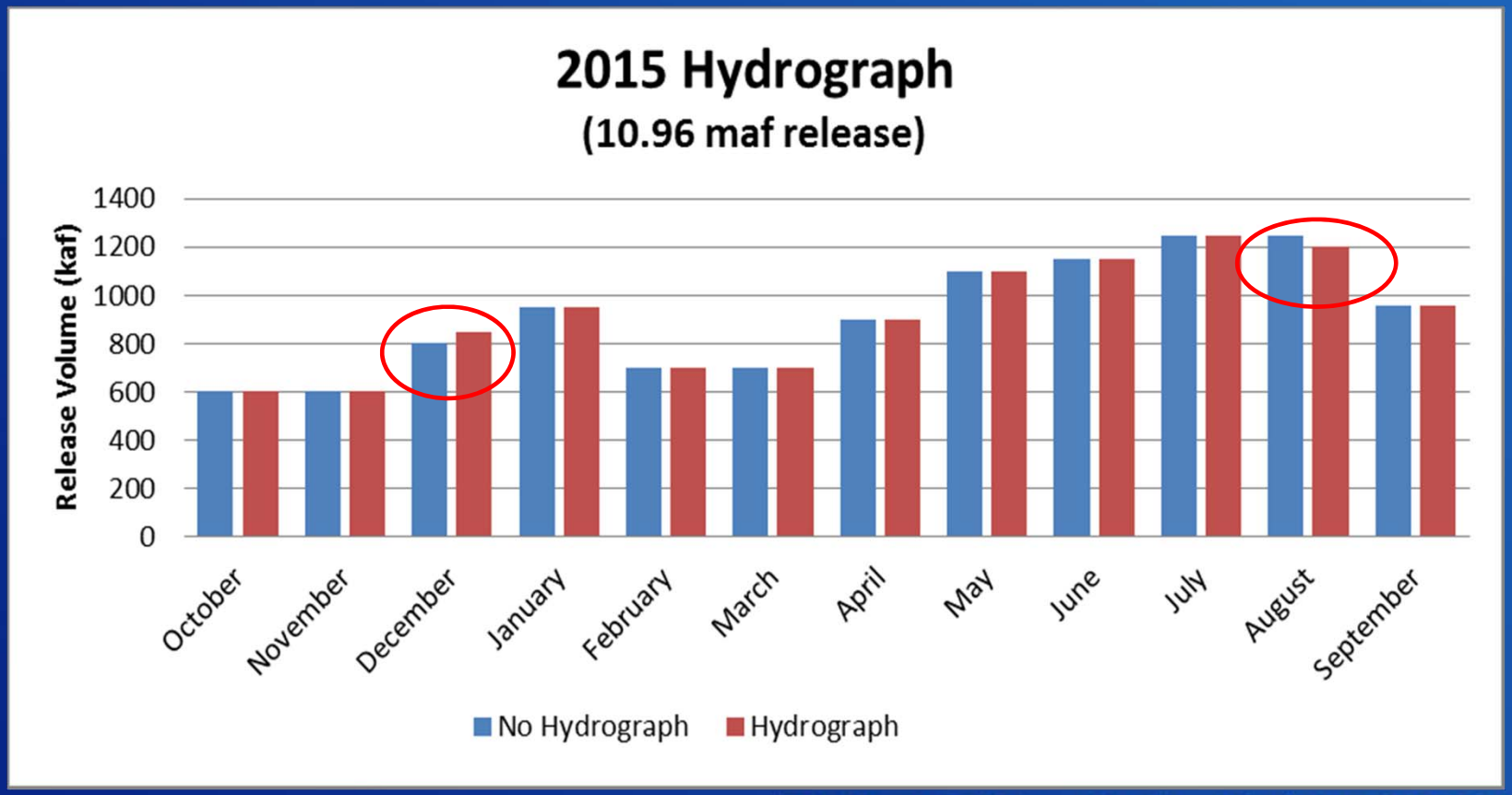
2015 Possible Hydrograph
10.95 maf release

- Lots of water to move: limited flexibility, minimal difference



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2015 Hydrograph Next Steps

- Continue to coordinate with DOI-DOE Agencies
- Analyze impacts of hydrgraph release scenarios:
  - Hydropower Impacts: GTMax
  - Sediment retention: Sand Budget model
  - Temperature Impacts
- Present to TWG in June

RECLAMATION

Questions?

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

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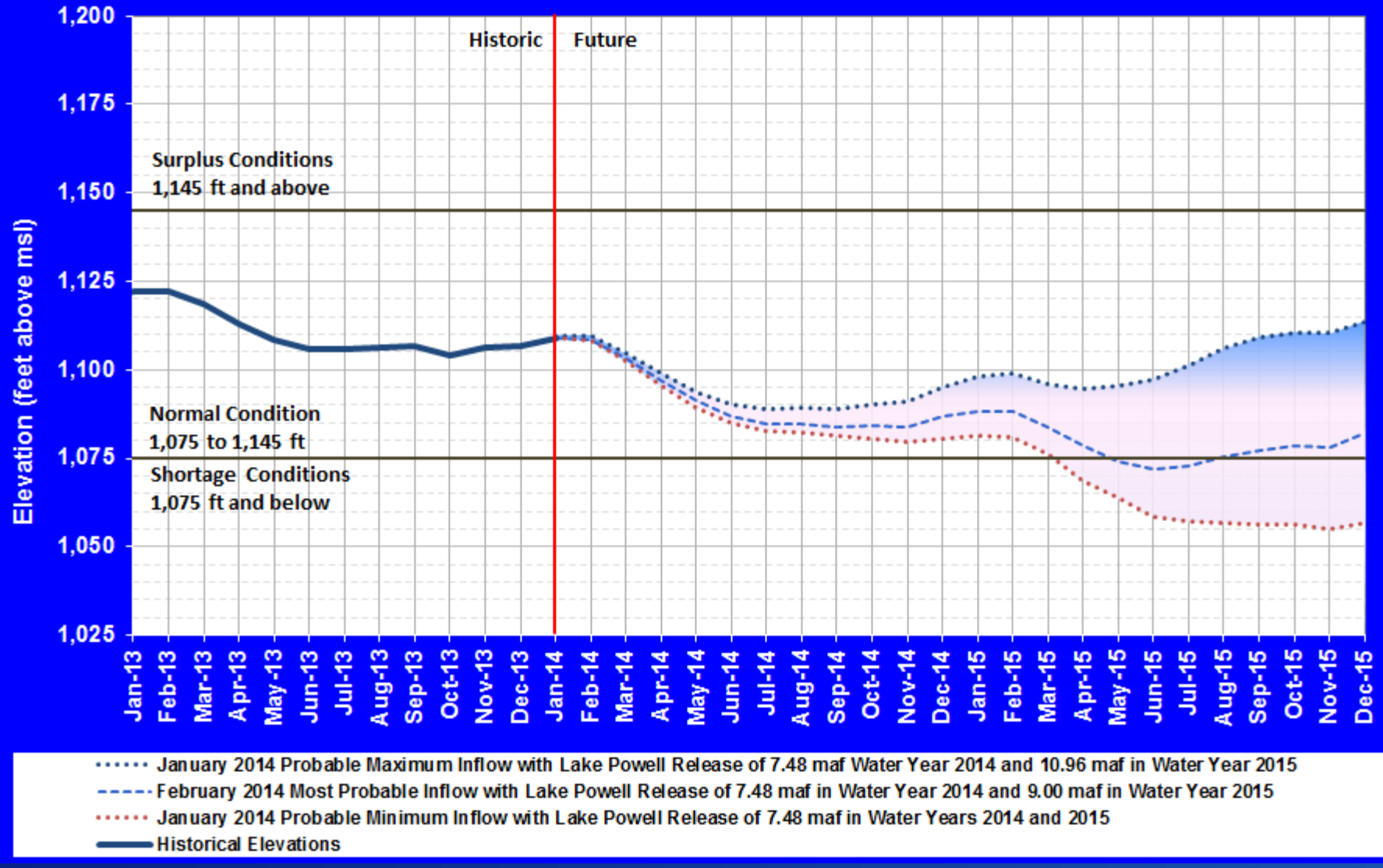
Lake Mead End of Month Elevations

Projections from January and February 2014 24-Month Study Inflow Scenarios



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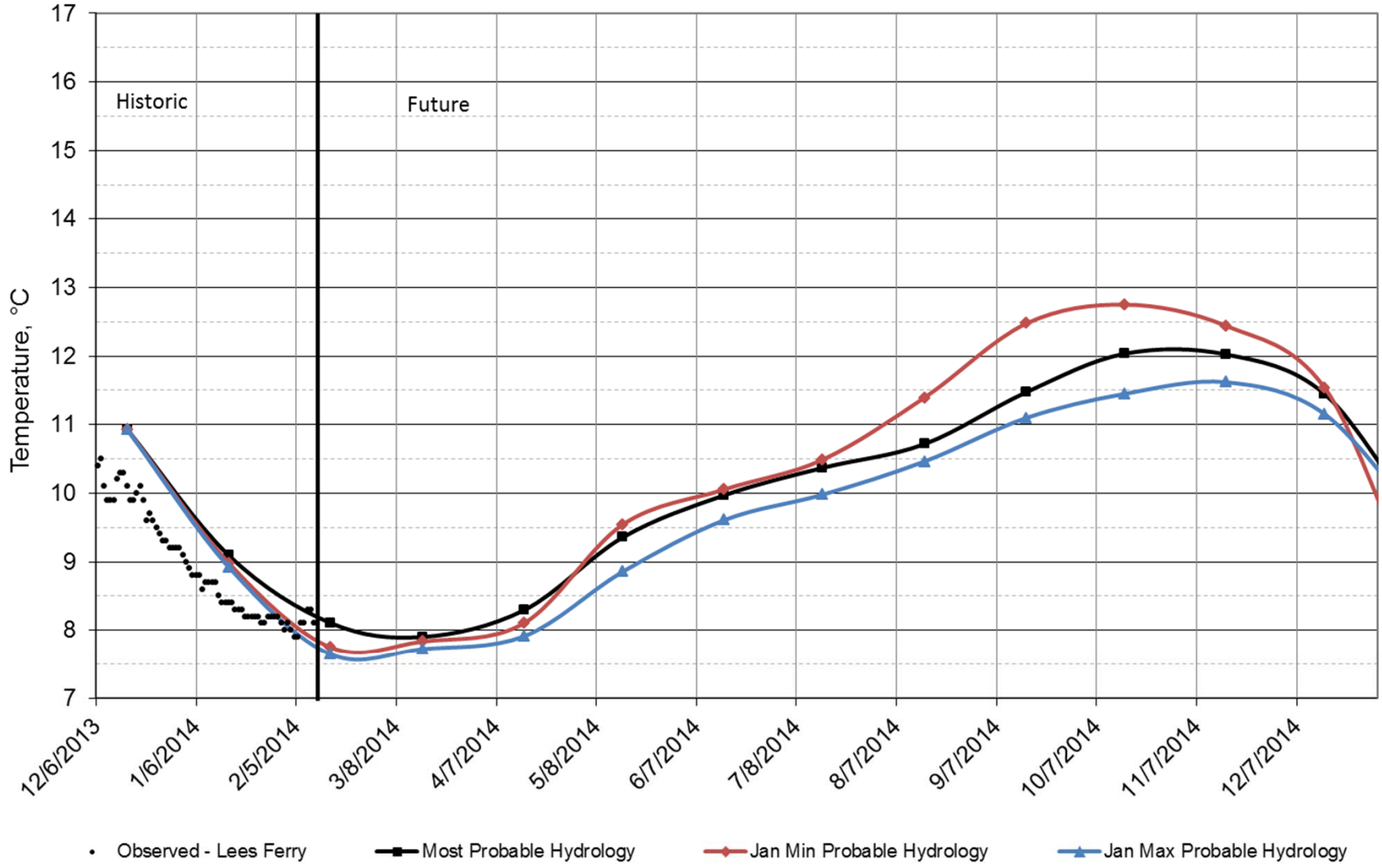
Lake Powell Release Temperature

2014 Projected Temperature based on February 2014 Forecast



#Projection start date is based on initial conditions (December 2013)

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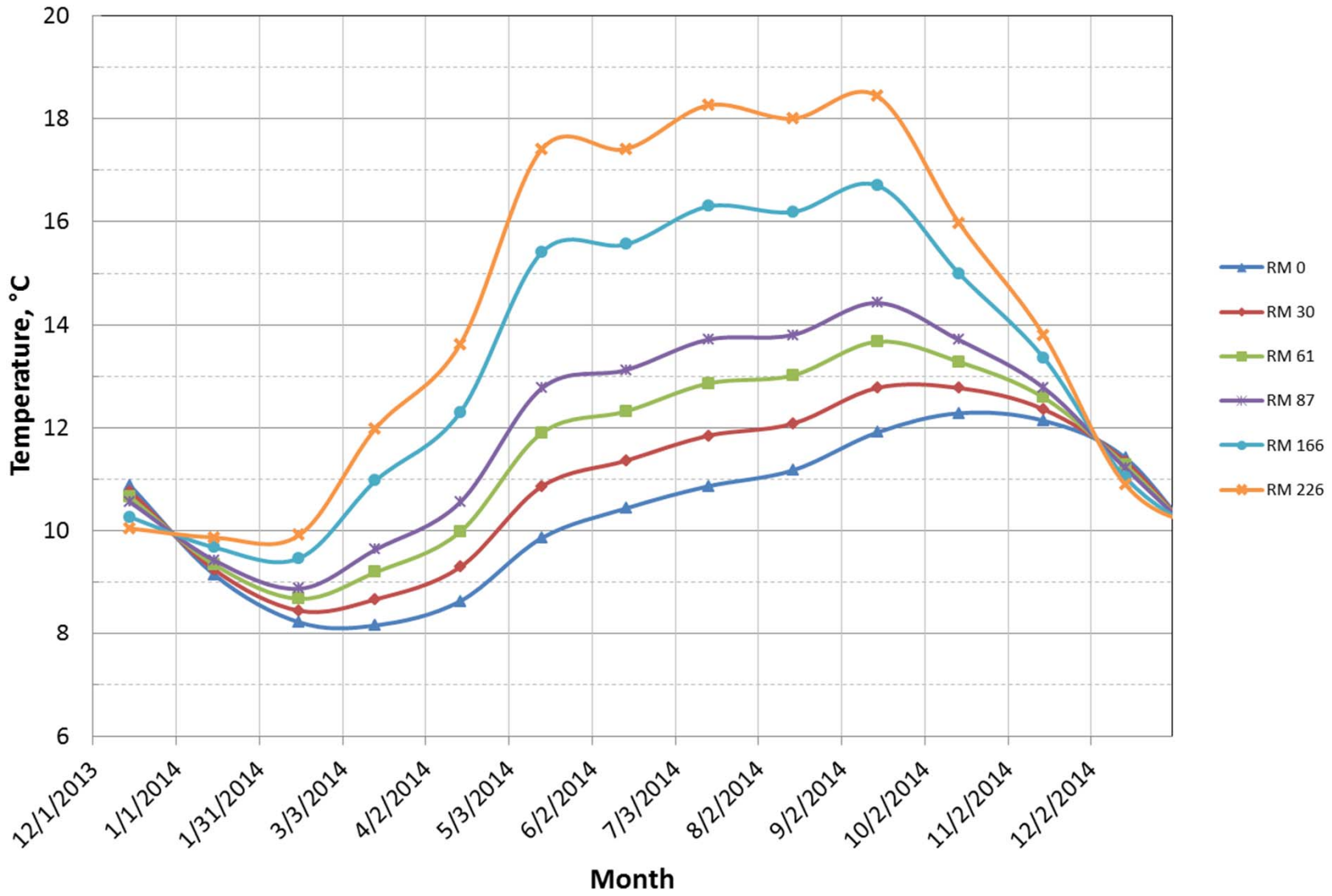
Colorado River, Grand Canyon Water Temperatures

Projections based on February 2014, Most Probable Hydrology



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