

# Colorado River Drought Response and System Sustainability

Tom McCann  
Chuck Cullom  
June 5, 2014



YOUR WATER. YOUR FUTURE.

# Colorado River System Storage

**Total System Capacity  
60 MAF**

**Lake Mead - 26 MAF**



**Lake Powell - 24 MAF**



# Colorado River System Storage

87% Full  
(21.3 MAF)

1/1/2000

43% Full  
(10.4 MAF)

5/27/2014

**Lake Powell**

91% Full  
(25 MAF)

1/1/2000

41% Full  
(10.8 MAF)

5/27/2014

**Lake Mead**

**Storage Depletion**

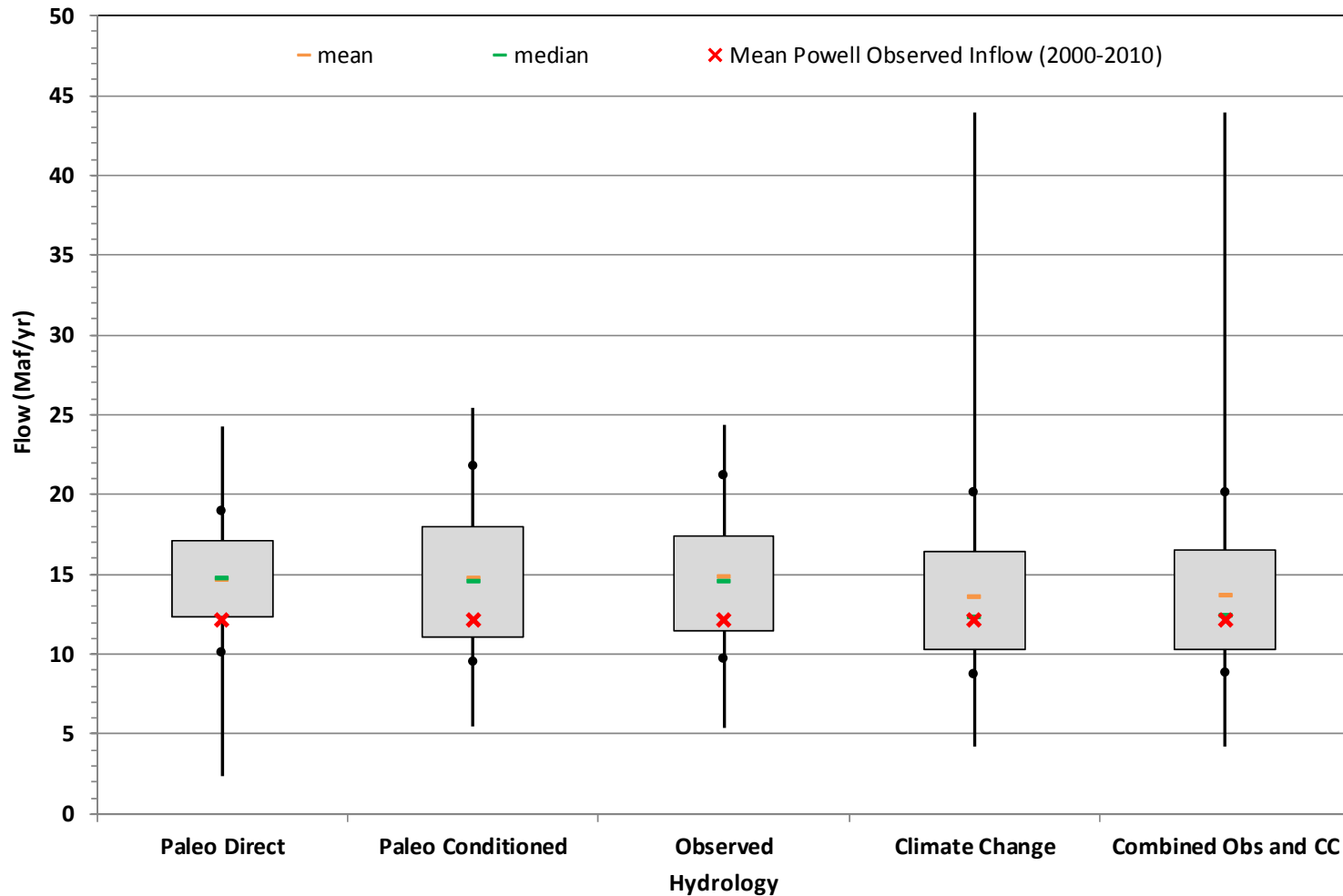
**Powell - 10.9 MAF**

**Mead - 14.2 MAF**

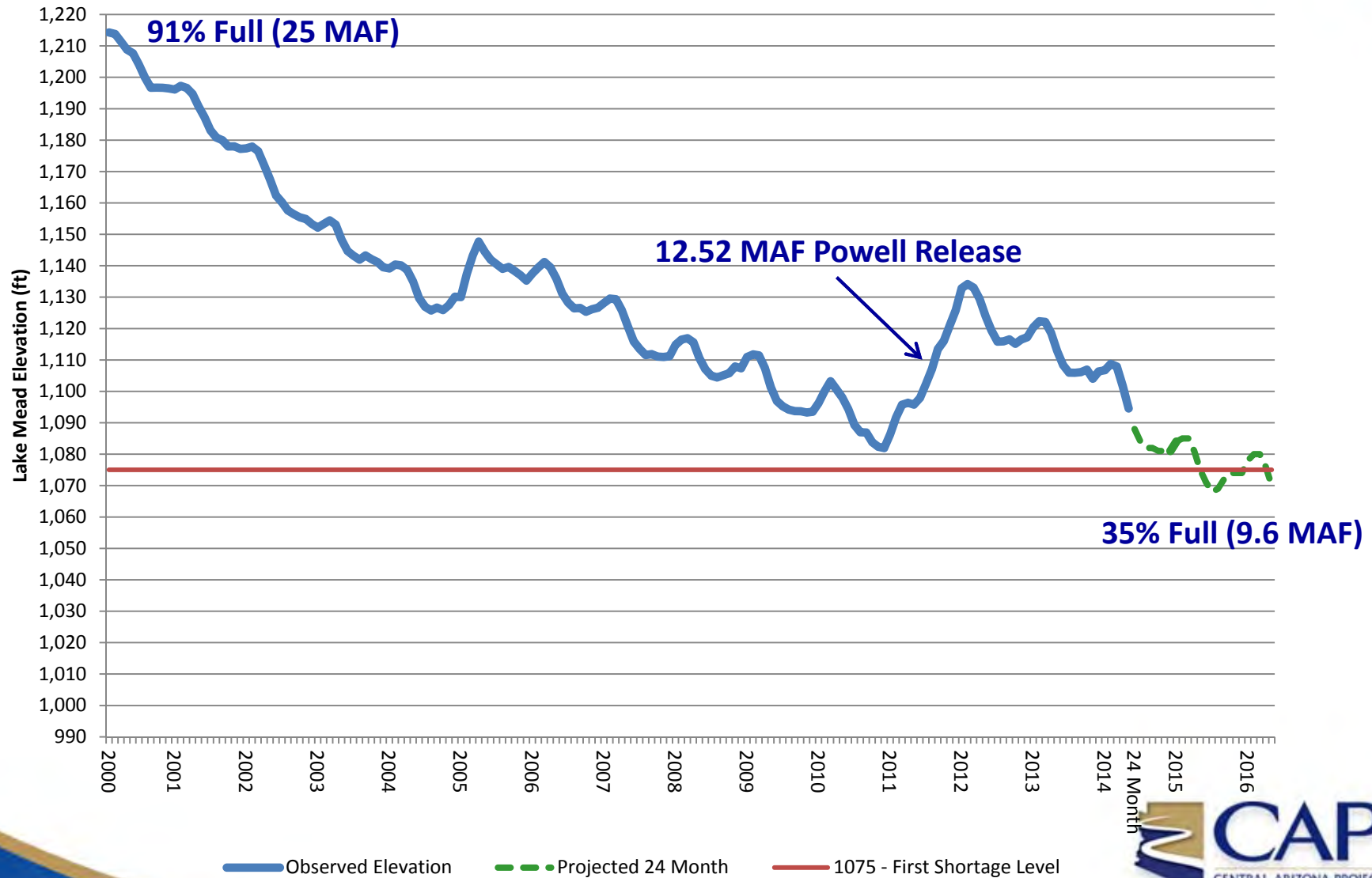
**Total = 25.1 MAF**

# The Current Drought in Perspective

Annual (CY) Lees Ferry Flow



# Lake Mead Since 2000



## Interim Guidelines (2007)

- Basin States agreement in 2006 on conjunctive management of Lakes Powell and Mead and shortage sharing in the Lower Basin



- Adopted by Secretary in 2007
- Effective through water year 2026
- Renegotiation to start by 2020

## 2007 Guidelines

---

- Lower Basin apportionments are reduced when Lake Mead falls below specified elevations:

<u>Elevation</u>	<u>Reduction</u>
1075'	333,000 AF
1050'	417,000 AF
1025'	500,000 AF

- If Lake Mead is projected to fall below elevation 1000, the Secretary will consult with Basin States to discuss further measures

# Shortage Sharing

- Arizona and Nevada share Lower Basin shortages under the 2007 Guidelines
- Mexico voluntarily agreed in Minute 319 to accept reductions in its deliveries at the same elevations

Lake Mead Elevation	Arizona Reduction	Nevada Reduction	Mexico Reduction
1075'	320,000 AF	13,000 AF	50,000 AF
1050'	400,000 AF	17,000 AF	70,000 AF
1025'	480,000 AF	20,000 AF	125,000 AF

- No reductions to California under 2007 Guidelines

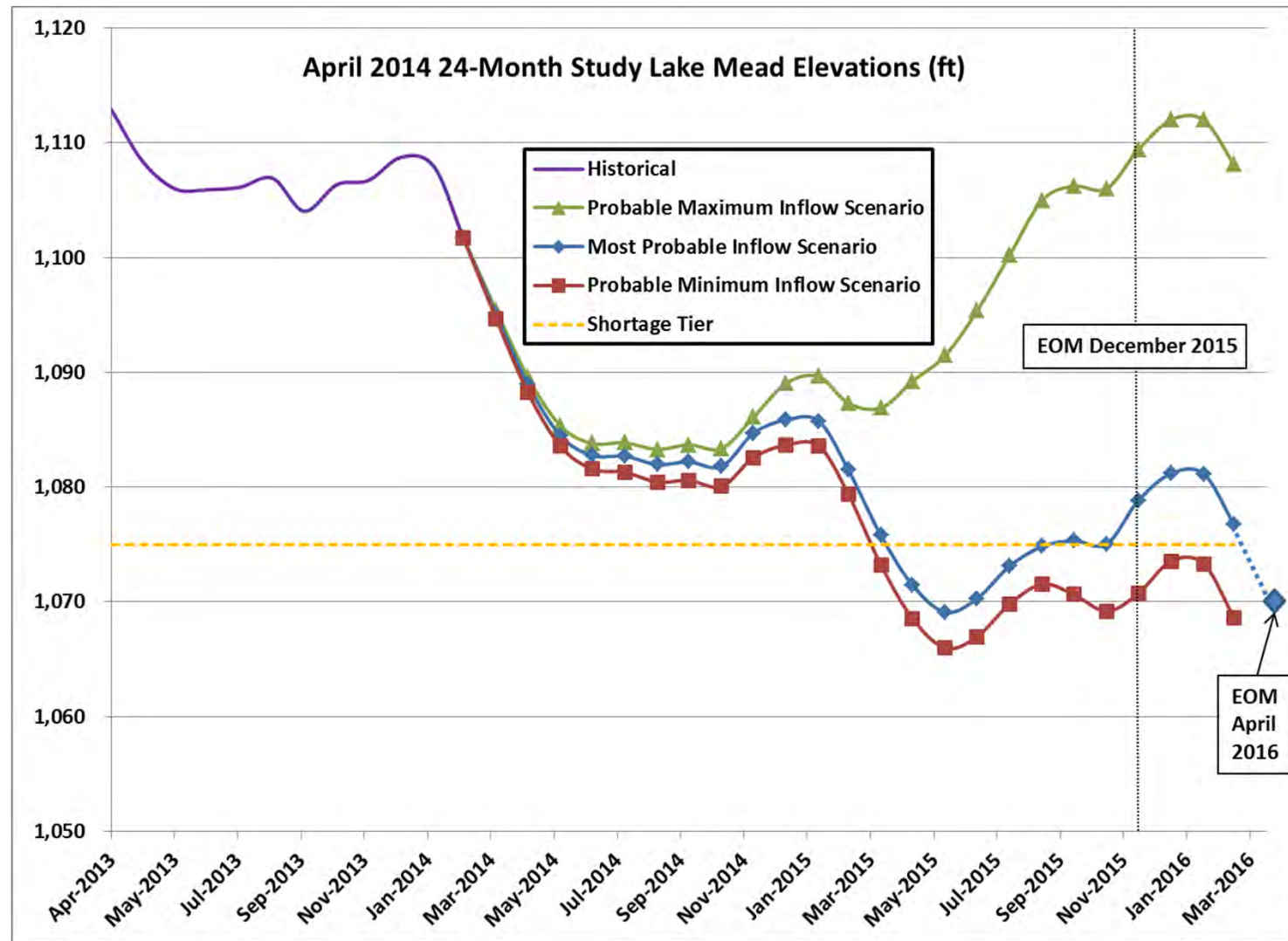


# Shortage Impacts Under Guidelines

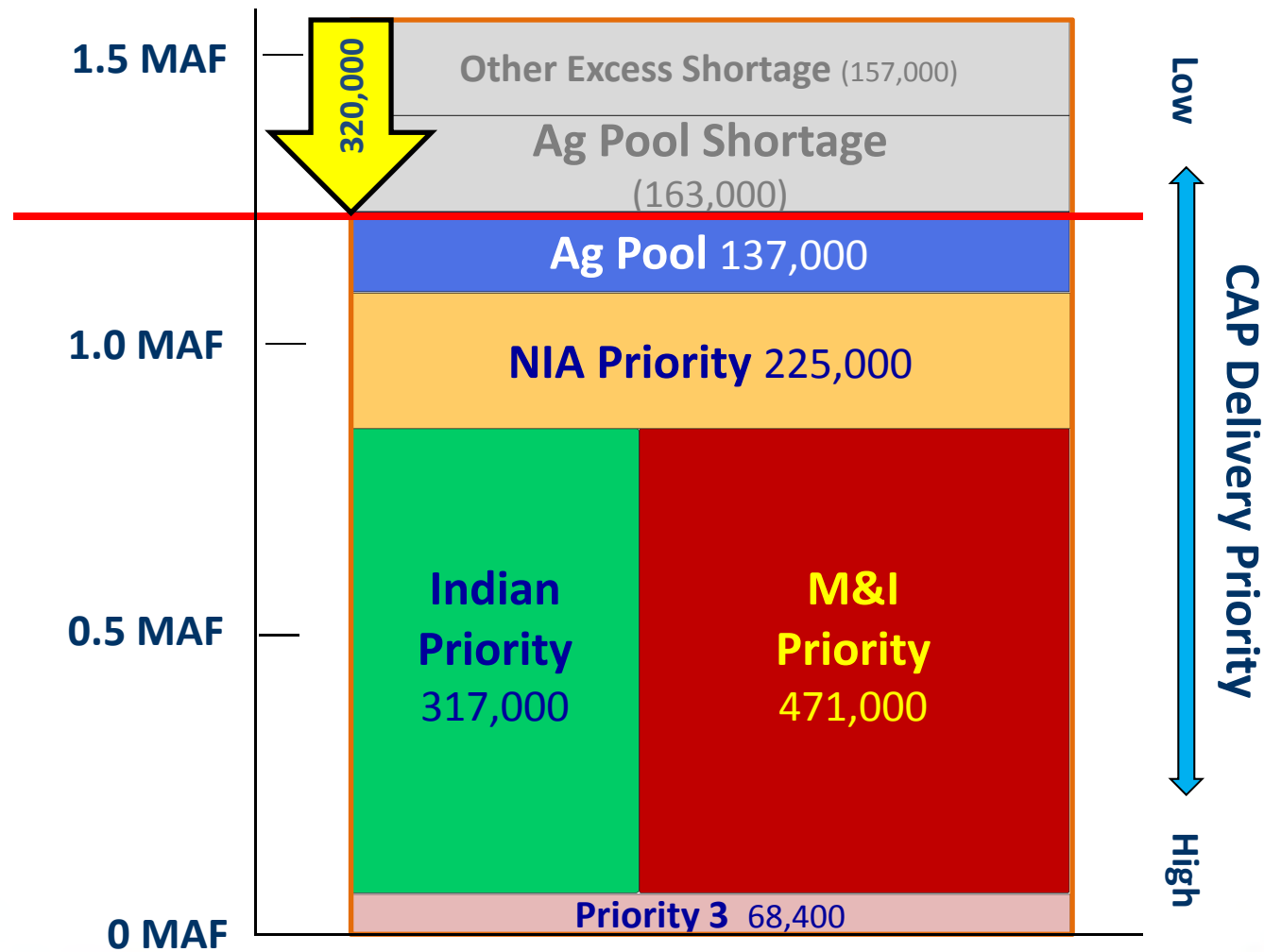
---

- No water for AWBA and other excess users
- Significant impacts to Ag Settlement Pool
  - Reduced under early shortages
  - Eliminated when shortage deepens and long-term CAP uses grow
- Some impact to NIA priority deliveries in deeper shortages as long-term CAP uses grow
- **No anticipated impact to CAP M&I or Indian priority**
- Possible recovery for on-river M&I or Indian NIA

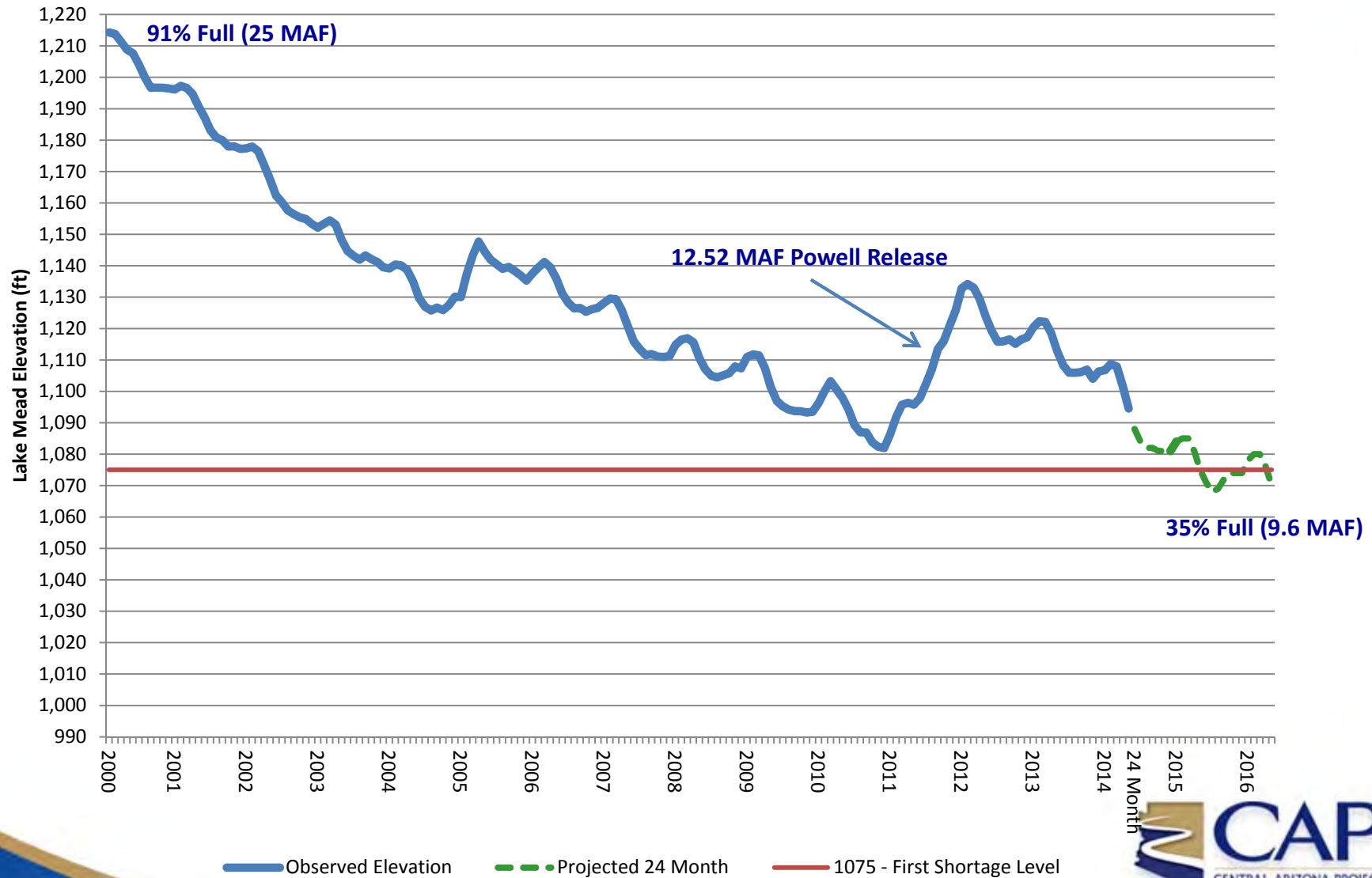
# Near-Term Outlook



# 2017 Level 1 Shortage



# Lake Mead Since 2000





# Water Budget at Lake Mead

- Inflow = 9.0 maf  
(release from Powell + side inflows)
- Outflow = - 9.6 maf  
(AZ, CA, NV, and Mexico delivery  
+ downstream regulation and gains/losses)
- Mead evaporation losses = - 0.6 maf
- Balance = - 1.2 maf

Given basic apportionments in the Lower Basin, the allotment to Mexico, and an 8.23 maf release from Lake Powell, Lake Mead storage declines about 12 feet each year

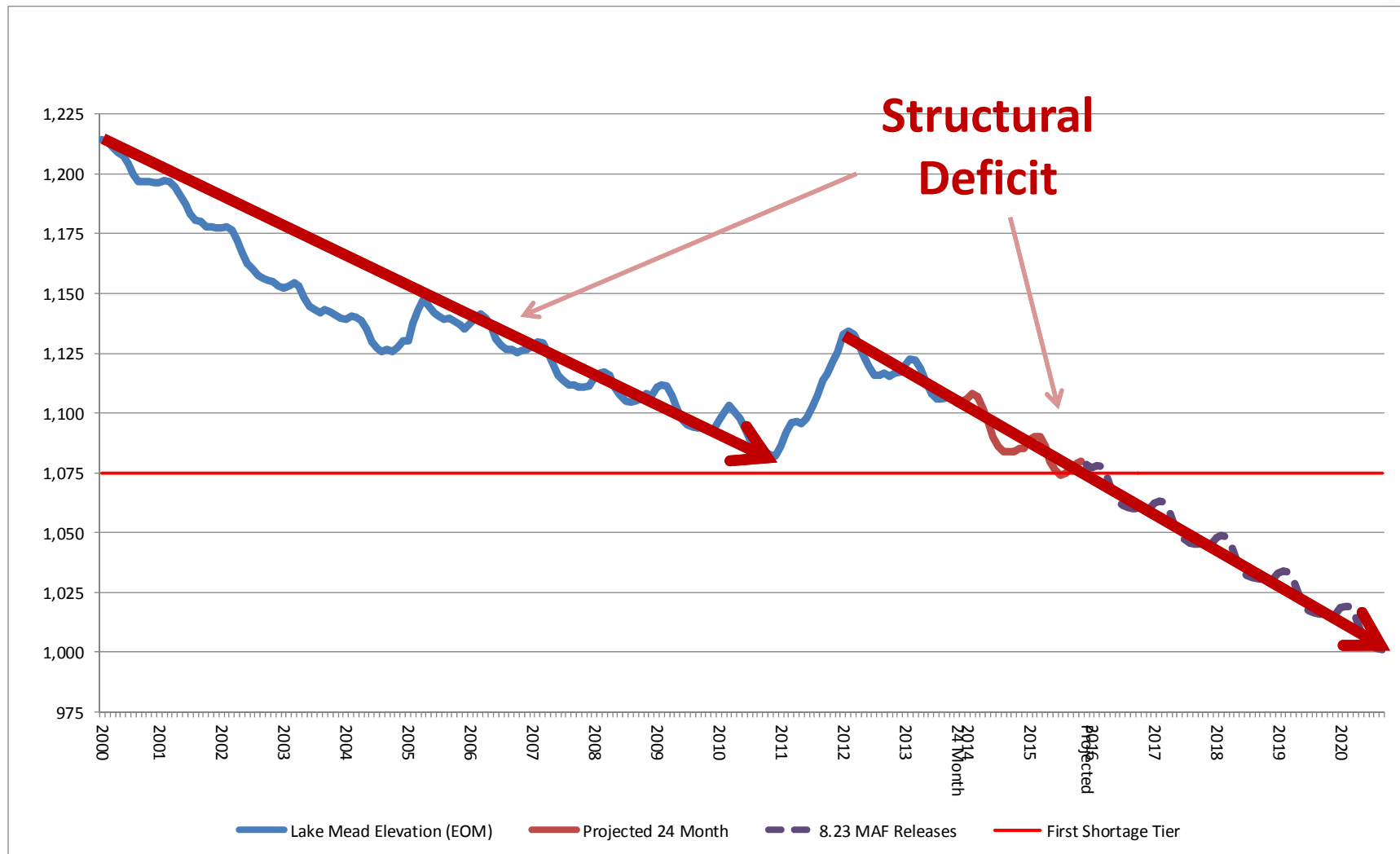
RECLAMATION

# Impact of Structural Deficit

---

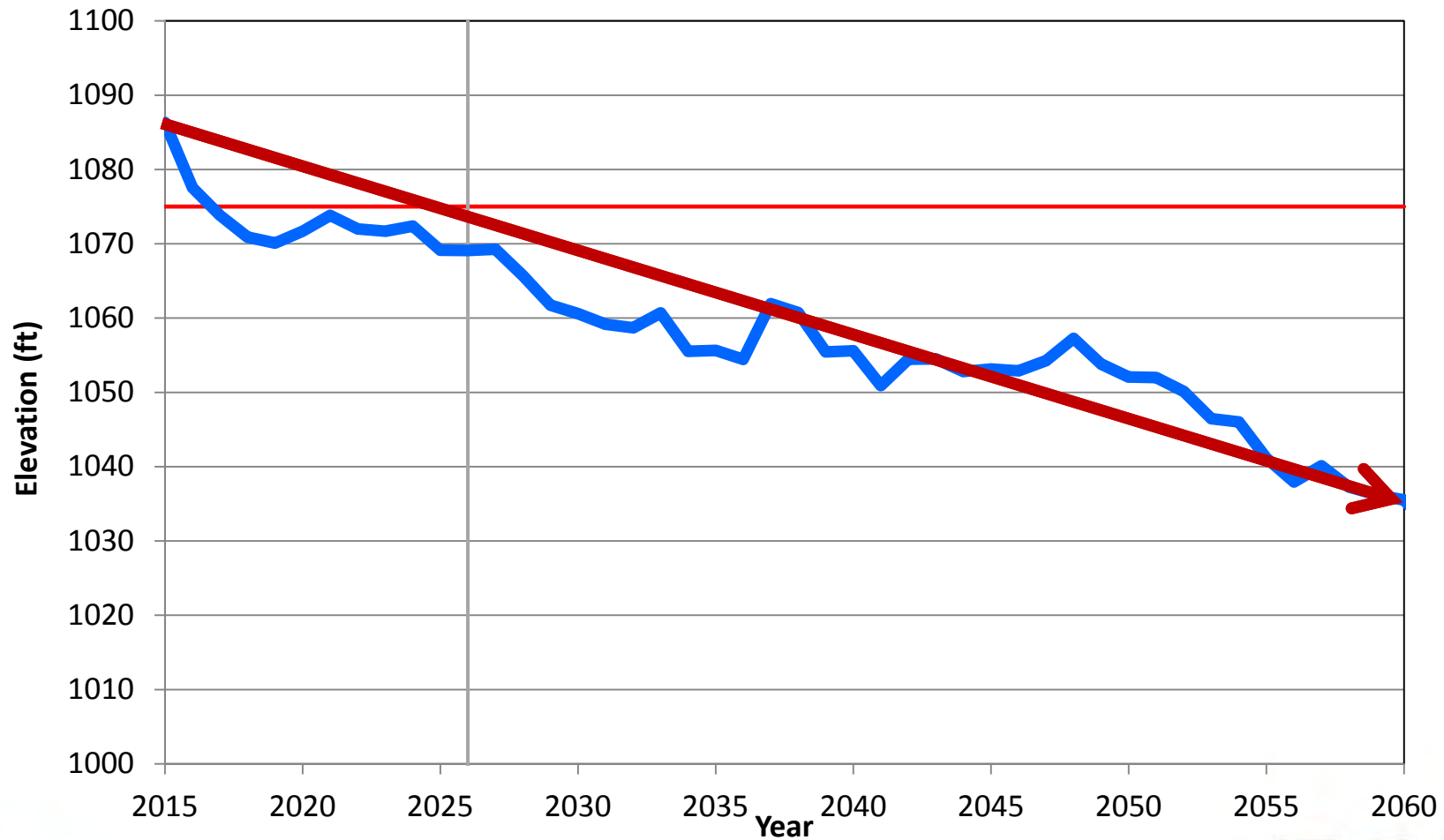
- Results in a decline of 12+ feet in Lake Mead every year when releases from Powell are “normal” (8.23 MAF)
- Undermines effectiveness of the 2007 Guidelines
- Drives Lower Basin to shortage
- CAP forced to bear obligations of others
  - Evaporation and other system losses
  - Lower Basin’s half of Mexican Treaty obligation
  - US failure to operate YDP

# Near-Term Outlook



# Longer-Term Outlook

Median Lake Mead January Elevation (Baseline CRSS Run)





# Risk to All Colorado River Users

---

- Without equalization or corrective action, Lake Mead will fall below elevation 1000 in 5-8 years
- If Lake Mead is below elevation 1000:
  - Impacts SNWA ability to withdraw water
  - Less than 4.5 MAF left in storage in Lake Mead
  - Reduced power generation and efficiency at Hoover Dam, potential cavitation or vibration damage
- **What will the Secretary of the Interior do?**

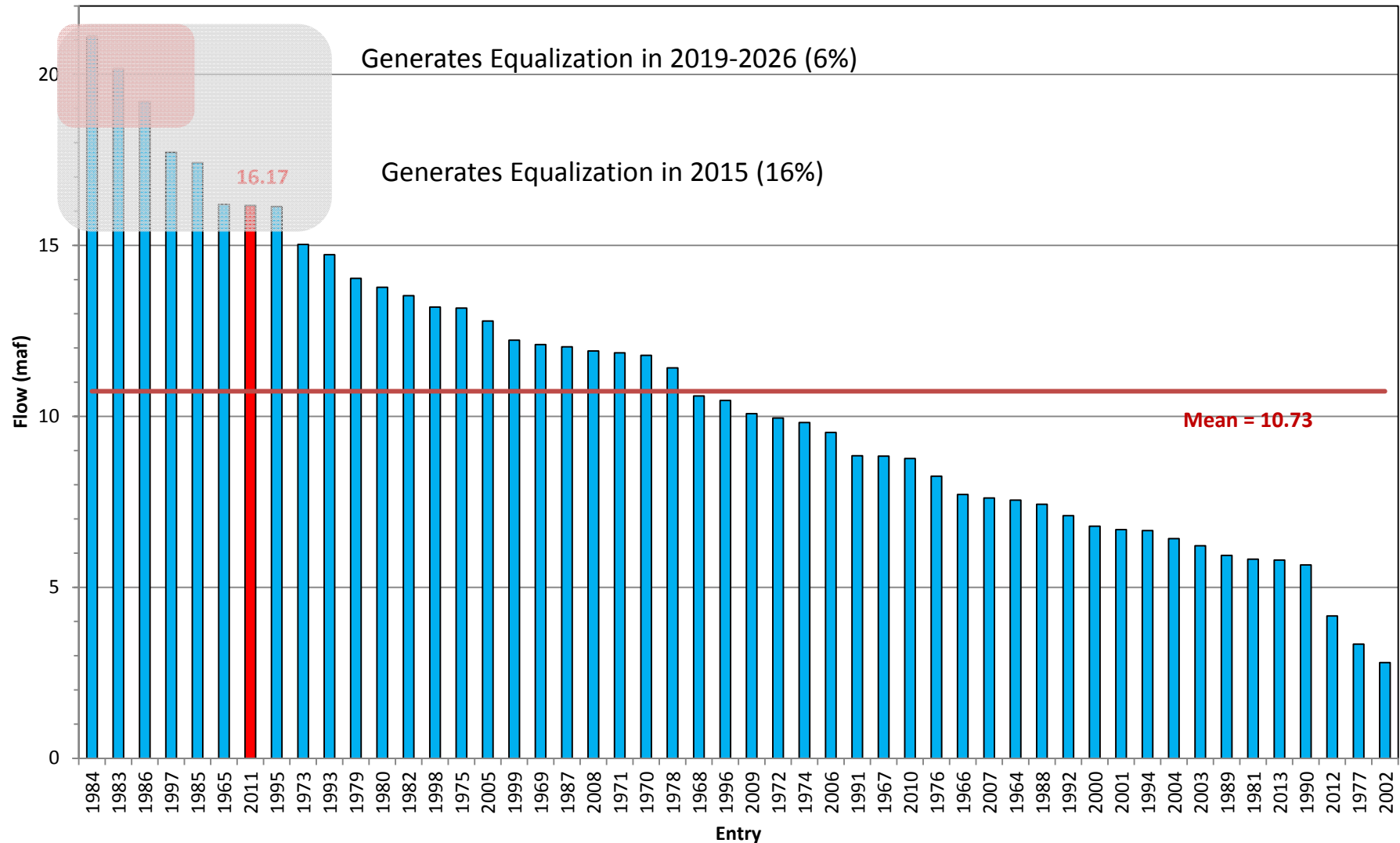
# Chances for Equalization

---

- Equalization trigger under the 2007 Guidelines goes up every year
  - For 2015, requires 17 MAF in storage in Lake Powell
  - By 2019, almost 18 MAF
  - By 2026, more than 19 MAF
- Current storage in Lake Powell is 10.8 MAF
- Powell inflow required for equalization in 2015:
  - 6.2 MAF (storage increase) + 9.0 MAF (release to Lower Basin) = **15.2 MAF**

# Powell Inflows (1964 – 2013)

## Lake Powell Unregulated Inflow





# Percent of Traces with Event or System Condition

## Results from April 2014 CRSS<sup>1,2,3</sup> (values in percent)

	Event or System Condition	2015	2016	2017	2018	2019
<b>Upper Basin – Lake Powell</b>	<b>Equalization Tier</b>	0	25	25	27	30
	<i>Equalization – annual release &gt; 8.23 maf</i>	9	25	25	27	29
	<i>Equalization – annual release = 8.23 maf</i>	0	0	0	0	1
	<b>Upper Elevation Balancing Tier</b>	91	60	55	54	46
	<i>Upper Elevation Balancing – annual release &gt; 8.23 maf</i>	55	46	43	41	33
	<i>Upper Elevation Balancing – annual release = 8.23 maf</i>	36	14	11	10	12
	<i>Upper Elevation Balancing – annual release &lt; 8.23 maf</i>	0	0	1	3	1
	<b>Mid-Elevation Release Tier</b>	0	15	19	11	15
	<i>Mid-Elevation Release – annual release = 8.23 maf</i>	0	0	0	1	3
	<i>Mid-Elevation Release – annual release = 7.48 maf</i>	0	15	19	10	12
	<b>Lower Elevation Balancing Tier</b>	0	0	1	8	9
<b>Lower Basin – Lake Mead</b>	<b>Shortage Condition – any amount (Mead ≤ 1,075 ft)</b>	0	23	51	62	58
	<i>Shortage – 1<sup>st</sup> level (Mead ≤ 1,075 and ≥ 1,050)</i>	0	23	43	45	36
	<i>Shortage – 2<sup>nd</sup> level (Mead &lt; 1,050 and ≥ 1,025)</i>	0	0	8	14	14
	<i>Shortage – 3<sup>rd</sup> level (Mead &lt; 1,025)</i>	0	0	0	3	8
	<b>Surplus Condition – any amount (Mead ≥ 1,145 ft)</b>	0	0	6	9	17
	<i>Surplus – Flood Control</i>	0	0	0	2	2
	<b>Normal or ICS Surplus Condition</b>	100	77	43	29	25

<sup>1</sup> Reservoir initial conditions based on the most probable April 24-month Study projected levels for December 31, 2014.

<sup>2</sup> Hydrologic inflow traces based on resampling of the observed natural flow record from 1906-2010.

<sup>3</sup> Percentages shown may not be representative of the full range of future possibilities that could occur with different modeling assumptions.

# RECLAMATION



## When Lake Mead is at 1,000 ft . . .

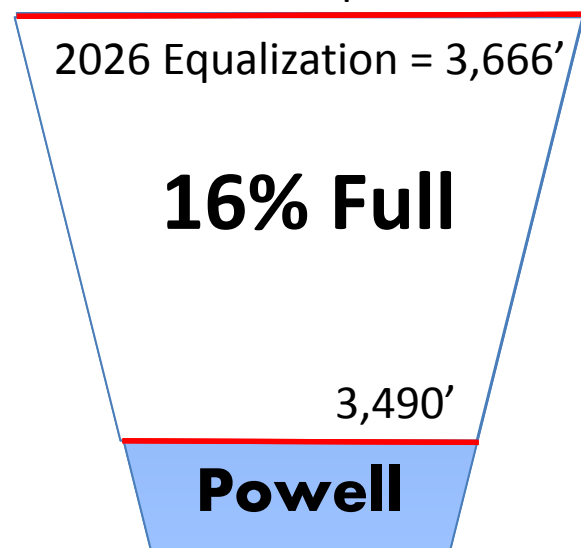
- **Lake Mead live storage = 4.48 MAF**
  - 1 ft is approximately 55 kaf of storage
- **Lake Powell**
  - Lake Powell is < 3,490 ft about 75% of the time
  - Lake Powell is < 3,525 ft about 84% of the time
  - Lake Powell storage at 3,490 and 3,525 ft is 4.00 and 5.93 MAF, respectively
  - Median release is 8.23 MAF, 10<sup>th</sup> percentile release is 7.3 MAF

Note: Analysis done using Observed hydrology

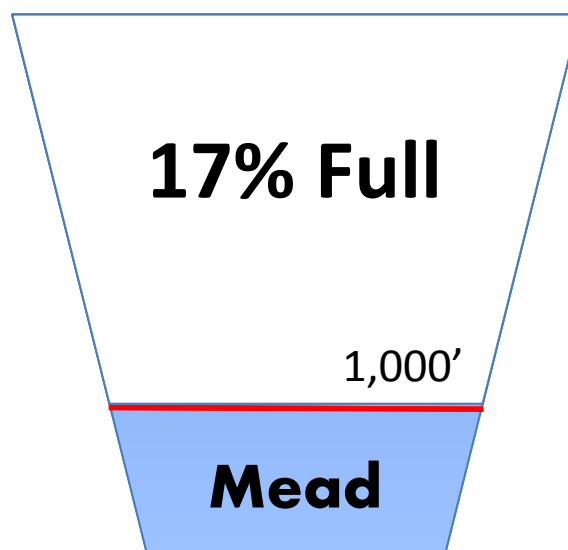
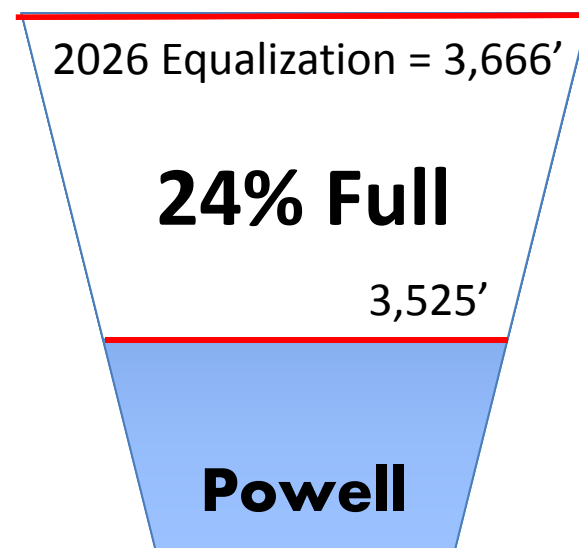
RECLAMATION

# When Mead is at Elevation 1000

Volume to reach equalization = **24.3MAF**



Volume to reach equalization = **19.4MAF**



# Lake Mead Elevation Response After Falling Below 1,000 ft by 2026

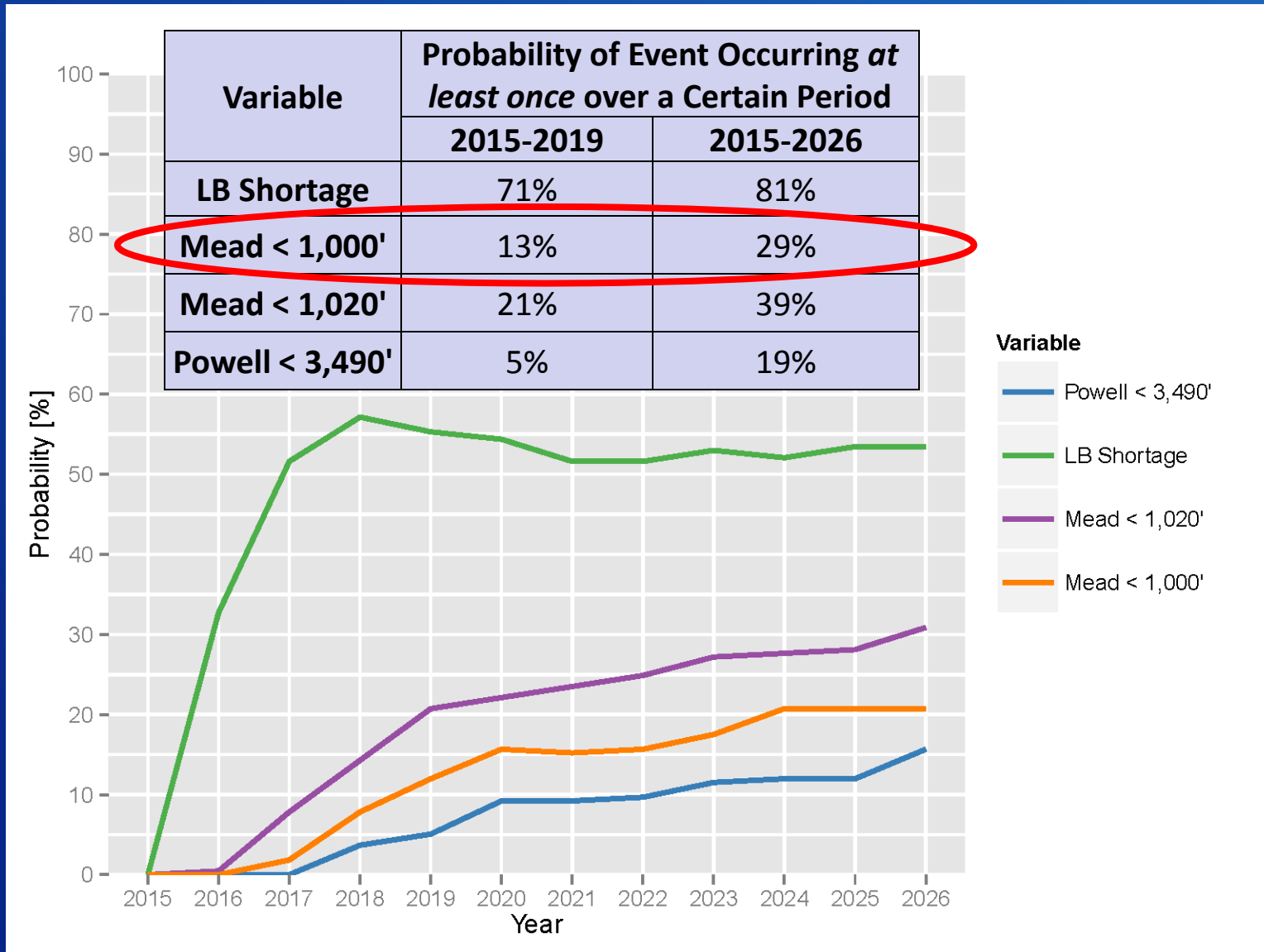
Hydrology	Average Years to Reach Threshold Elevation		
	1,025 ft	1,050 ft	1,075 ft
Observed	7.1	14.3	15.2
Climate Change	10.8	12.5	14.6
Combined	9.5	13.2	14.9

Hydrology	Number/Percent of Futures Below 1,000 ft by 2026	Number of Futures <b>Not</b> Reaching Threshold Elevation by 2060		
		1,025 ft	1,050 ft	1,075 ft
Observed	18/105 = 17%	0	5	6
Climate Change	46/112 = 41%	14	24	31
Combined	64/217 = <b>29%</b>	14	29	37

RECLAMATION

# Current Projections

## Combined Hydrology (Observed and Climate Change)



\* Projected using April 2014 CRSS

RECLAMATION



# What will the Secretary Do?

---

## Option 1

Allow Lake Mead to continue falling below elevation 1000, potentially to dead pool

## Option 2

Take emergency action to protect elevation 1000

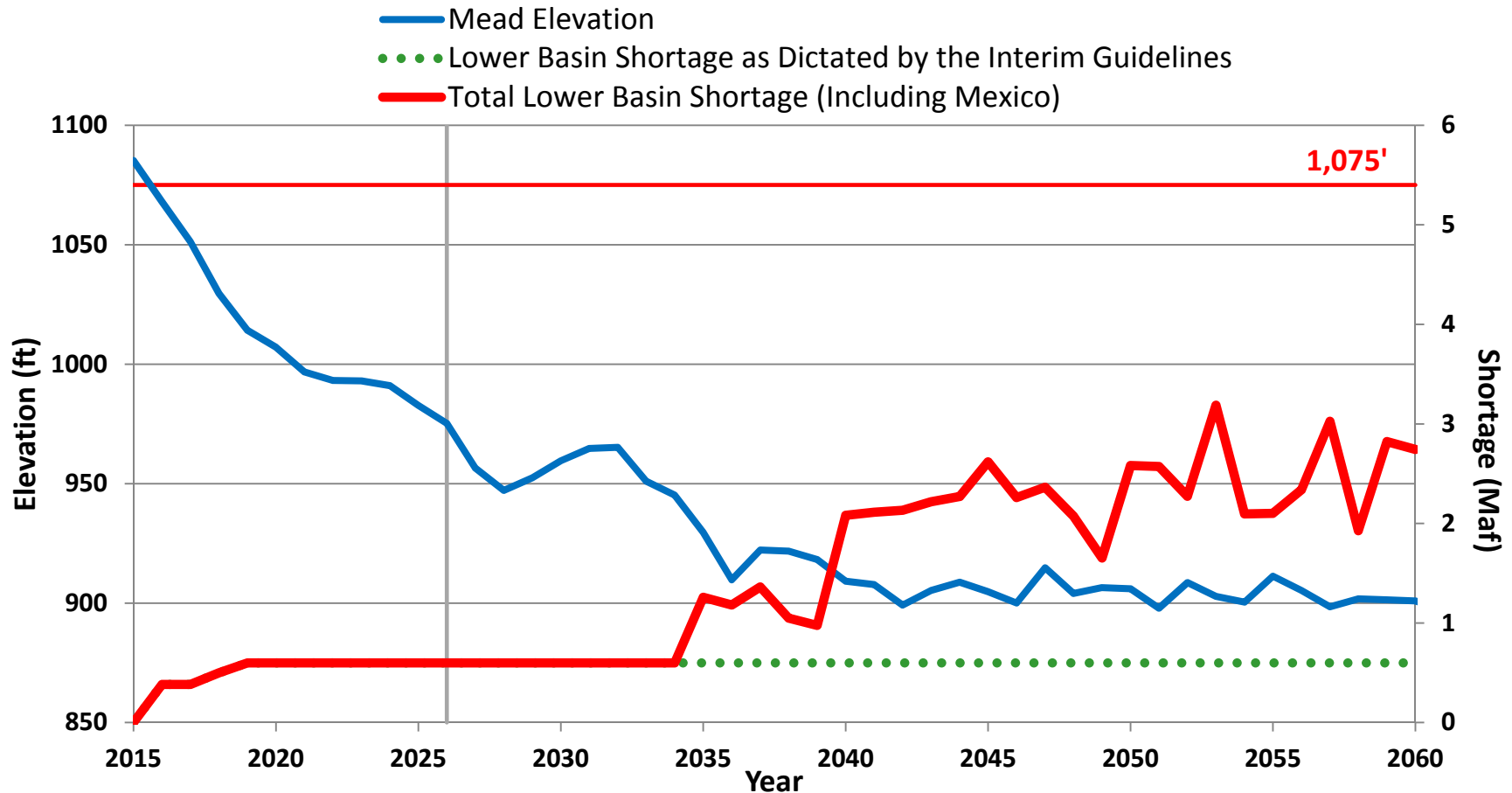
# Option 1 – Allow Lake Mead to Fall

---

- Secretary continues making all scheduled deliveries until there is insufficient water available
- When orders exceed available supply, Secretary follows Law of the River priority system
  - CAP and post-1968 users reduced first
  - Pre-1968, non-PPR users reduced next
  - PPRs and federal reserved rights reduced last
- When Lake Mead reaches dead pool, deliveries are limited to run of the river—i.e., annual inflow

# Option 1 – Allow Lake Mead to Fall

## Baseline: 10th Percentile



# Option 1 - Consequences

---

- Southern Nevada may be unable to withdraw any water below elevation 1000
- Diversions for CAP M&I and Indian users are reduced to zero, along with on-river P4 users
- Mead reaches dead pool in at least 10% of traces, forcing additional reductions of 1 MAF or more
- Hoover powerplant capacity is reduced from installed rating of 2079 MW to:
  - 1046 MW at elevation 1000
  - 696 MW at elevation 950

## Option 2 – Protect Elevation 1000

---

- Secretary intervenes to protect level of Lake Mead, reducing Lower Basin diversions as needed
- Secretary applies discretion in determining who gets water, regardless of priority, e.g.:
  - Nevada allotted 230 KAF to meet health and safety needs
  - CAP allotted 950 KAF to meet core municipal needs and U.S. tribal responsibilities
  - Other uses reduced as necessary



# Protection Volume Analysis

*Volumes<sup>1</sup> needed to “absolutely protect” Lake Mead elevations 1,000’ and 1,020’ through 2026*

Hydrology	Lake Mead Elevation 1,020’			Lake Mead Elevation 1,000’		
	Maximum in any year (MAF)	First Year that Maximum Occurs	Average through 2026 (MAF)	Maximum in any year (MAF)	First Year that Maximum Occurs	Average through 2026 (MAF)
Observed	2.1	2019	0.74	1.9	2019	0.49
Climate Change	6.1	2025	1.7	6.0	2025	1.8
Combined	6.1	2025	1.5	6.0	2025	1.6

<sup>1</sup>Volumes are in addition to Shortages per the 2007 Interim Guidelines

RECLAMATION

## Option 2 - Consequences

---

- Secretarial discretion has replaced the Law of the River
- Diversions by users other than SNWA and CAP are reduced by 2 to 6 MAF
  - Primary reductions to agricultural users
  - Additional reductions to Mexico lead to increased international tension

# Proactive Alternative

---

- Based on principal that all Colorado River water and power users share risk
- Structural deficit must be reduced by 600-900 KAF per year to “bend the curve”
- Potential components:
  - Target volume (e.g., 600 KAF)
  - Funding mechanism (\$100M+ per year)
  - Joint system conservation/augmentation projects
  - States backstop if joint projects do not meet target
  - U.S. action to reduce system losses (100-200 KAF)

# Potential Cost of Proactive Plan

---

- Annual CAP diversions reduced
  - Impacts CAP Excess Water, potentially NIA
  - Increased fixed OM&R rates for all CAP customers
- Annual funding for conservation/augmentation projects (\$20M+)
- For comparison purposes, \$20M per year might be sufficient to generate
  - 10,000 AF from ocean desalination
  - 65,000 AF from brackish desalination

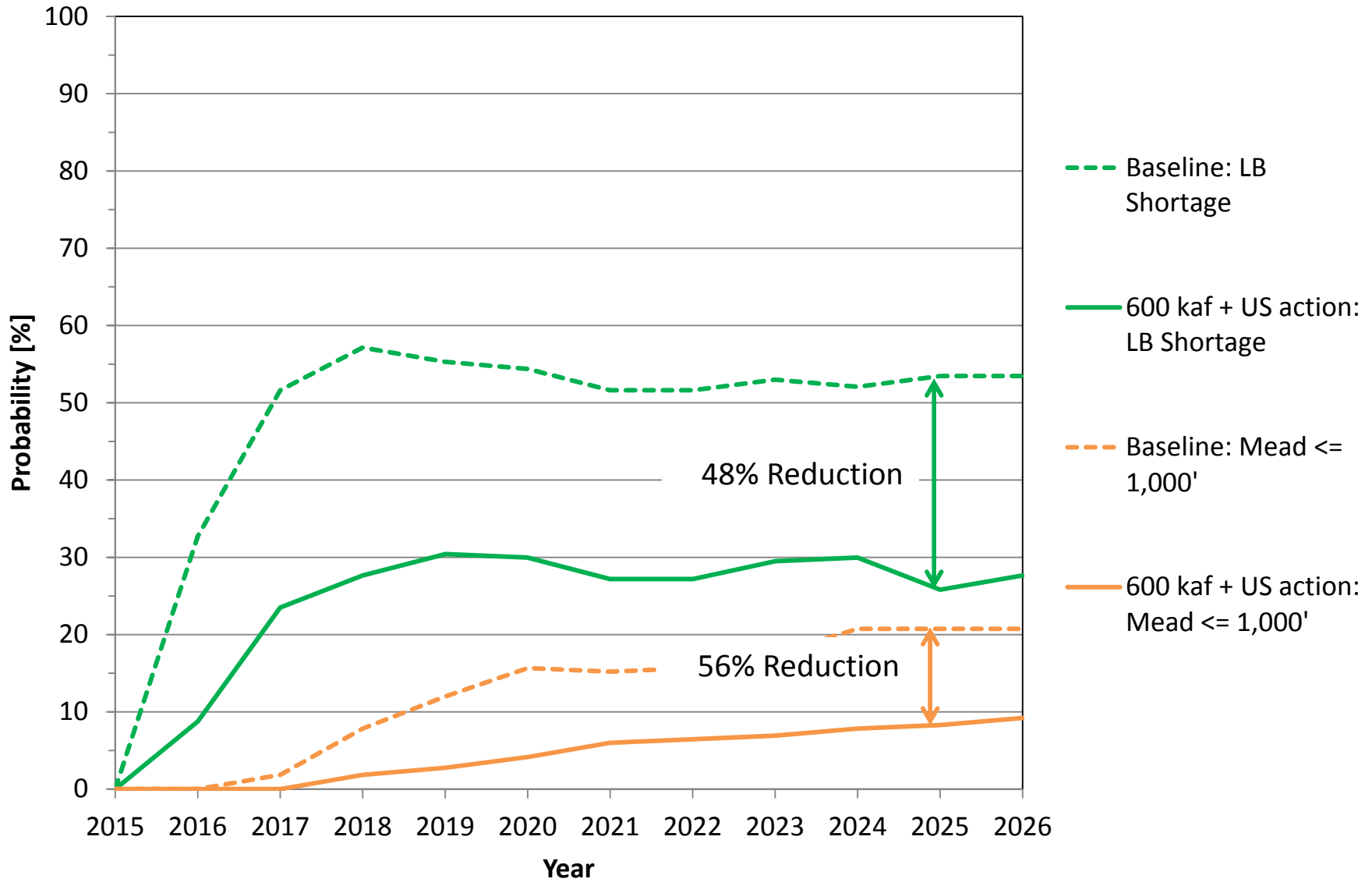
# Benefits of Proactive Plan

---

- Preserves the Law of the River
- Provides greater certainty and predictability to all water and power users
- Reduces probability of Mead falling below elevation 1000 by 2026 from 29% to 12%
- Reduces likelihood of non-hydrologic supply reductions to CAP
- Increases chances of success when new operating guidelines are negotiated with Upper Basin in 2020
- Reduces likelihood of protracted litigation



# Benefits of Proactive Plan



# Current Status

---

- CAP and ADWR are working with Basin States and Reclamation to prepare a “Drought Response and Sustainability Plan”
- Ongoing efforts
  - Expand weather modification and tamarisk removal
  - System conservation pilot agreement
  - Long-term augmentation studies
- Basin States report to Secretary of the Interior anticipated in July

# Questions?



YOUR WATER. YOUR FUTURE.