RECLAMATION

Managing Water in the West

Colorado River Management under Uncertainty

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WRRC Annual Meeting
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U.S. Department of the Interior
Bureau of Reclamation

Colorado River Management under Uncertainty

- Overview of Colorado River Basin
- Decision-making under Uncertainty
  - Interim Guidelines for the Operation of Lake Powell and Lake Mead
- Future Needs and Directions

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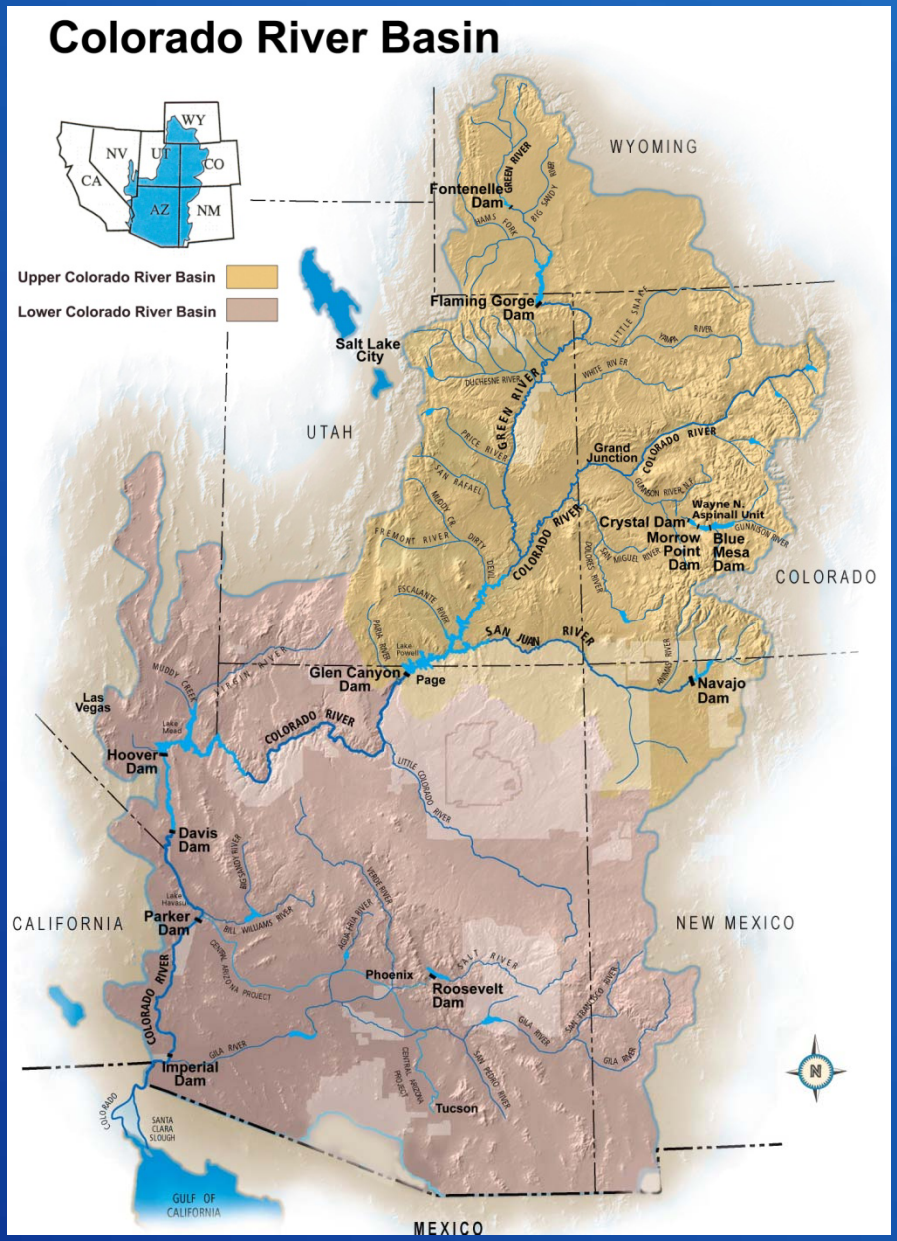
Colorado River Basin Hydrology

- 16.5 million acre-feet (maf) allocated annually
- 13 to 14.5 maf of consumptive use annually
- 60 maf of storage
- 15.1 maf average annual “natural” inflow into Lake Powell over past 100 years
- Inflows are highly variable year-to-year



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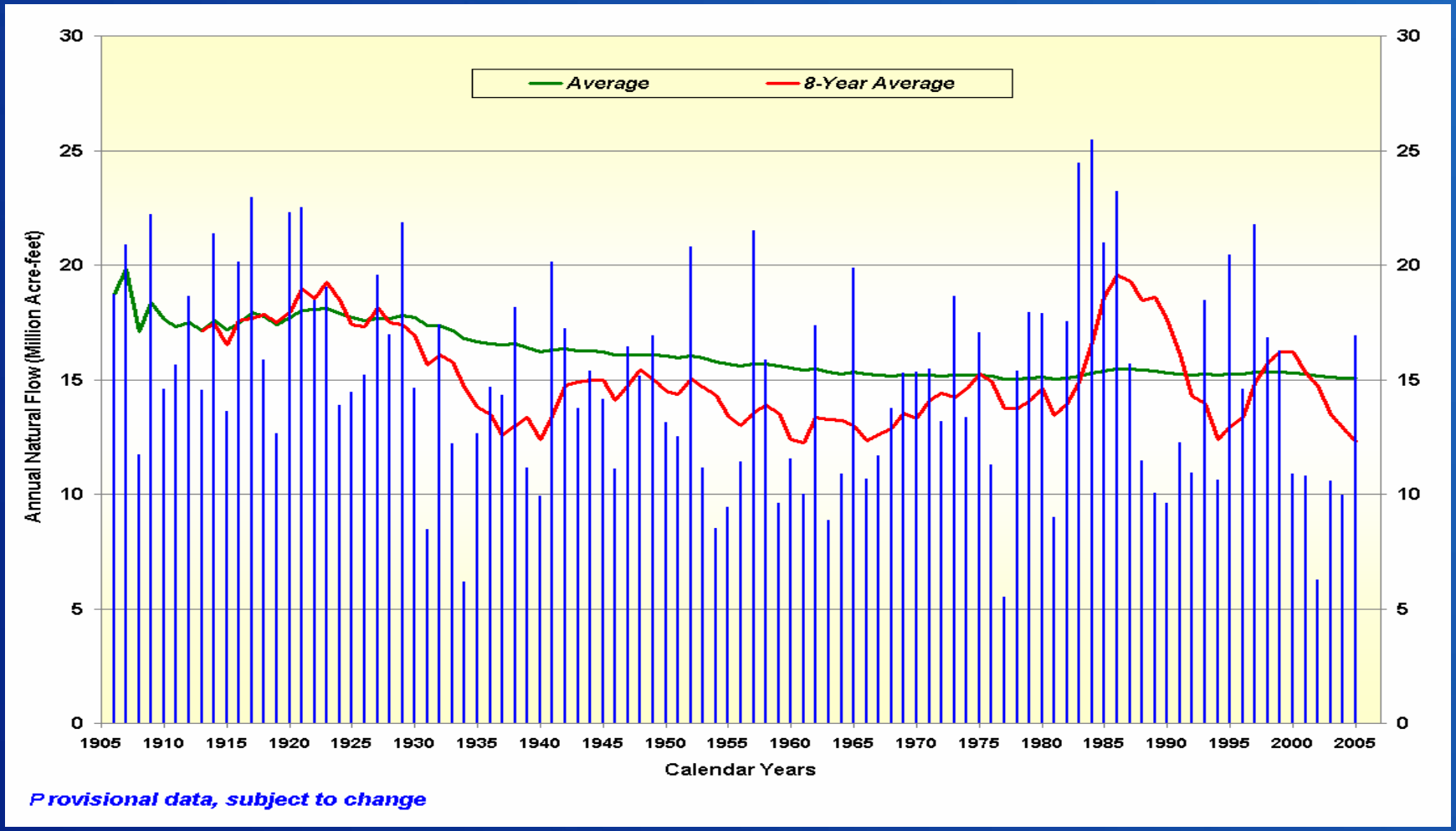
Natural Flow
Colorado River at Lees Ferry Gaging Station, Arizona
Calendar Year 1906 to 2005



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Colorado River Basin Storage
(as of June 15, 2008)

Current Storage	Percent Full	MAF	Elevation (Feet)
Lake Powell	58%	14.14	3623
Lake Mead	46%	12.03	1106
Total System Storage	57%*	33.77	NA

*Total system storage was 33.81 maf or 57% this time last year

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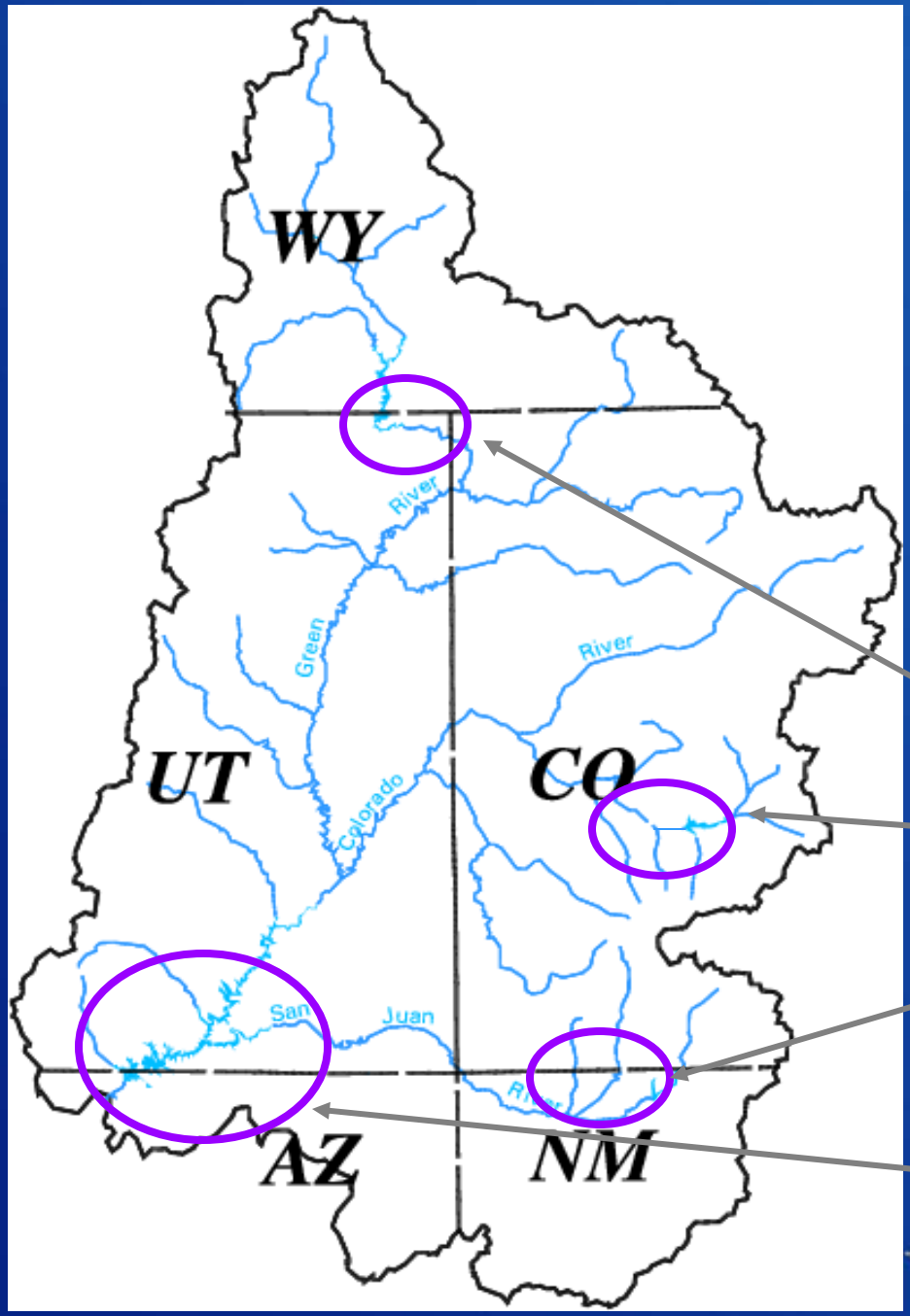

2008 Upper Colorado Projected Apr–Jul Inflow

(mid-month June forecast)

Flaming Gorge – 66%

Blue Mesa – 156%

Navajo – 127%

Lake Powell – 113%

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State of the System (1999-2008)

WY	Unregulated inflow into Powell % of Average	Powell and Mead Storage, maf	Powell and Mead % Capacity
1999	109	47.59	95
2000	62	43.38	86
2001	59	39.01	78
2002	25	31.56	63
2003	52	27.73	55
2004	49	23.11	46
2005	104	27.24	54
2006	72	25.80	51
2007	68	24.43	49
*2008	106	27.38	55

*Based on June 24 Month Study and June mid-month inflow forecast

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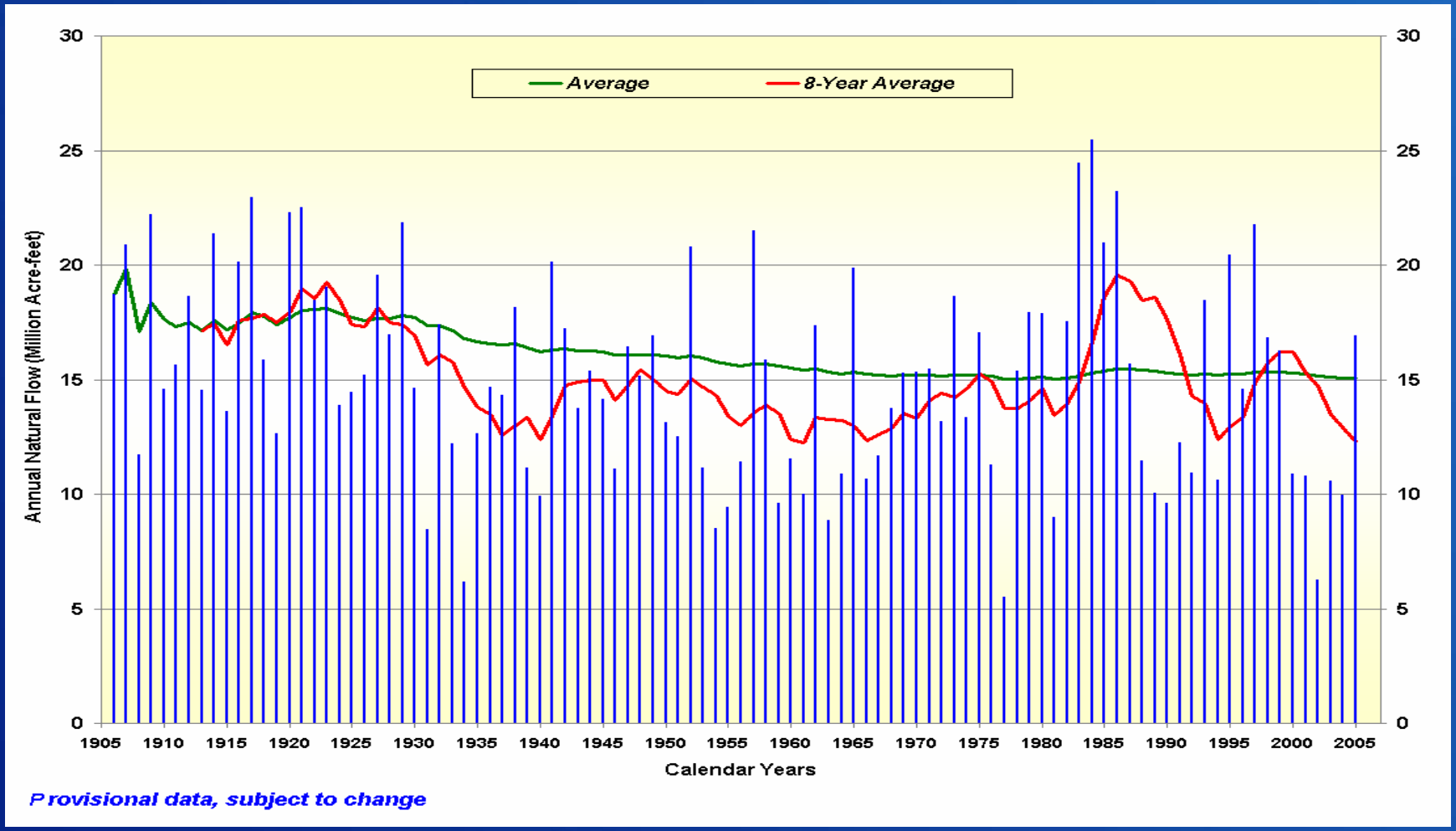

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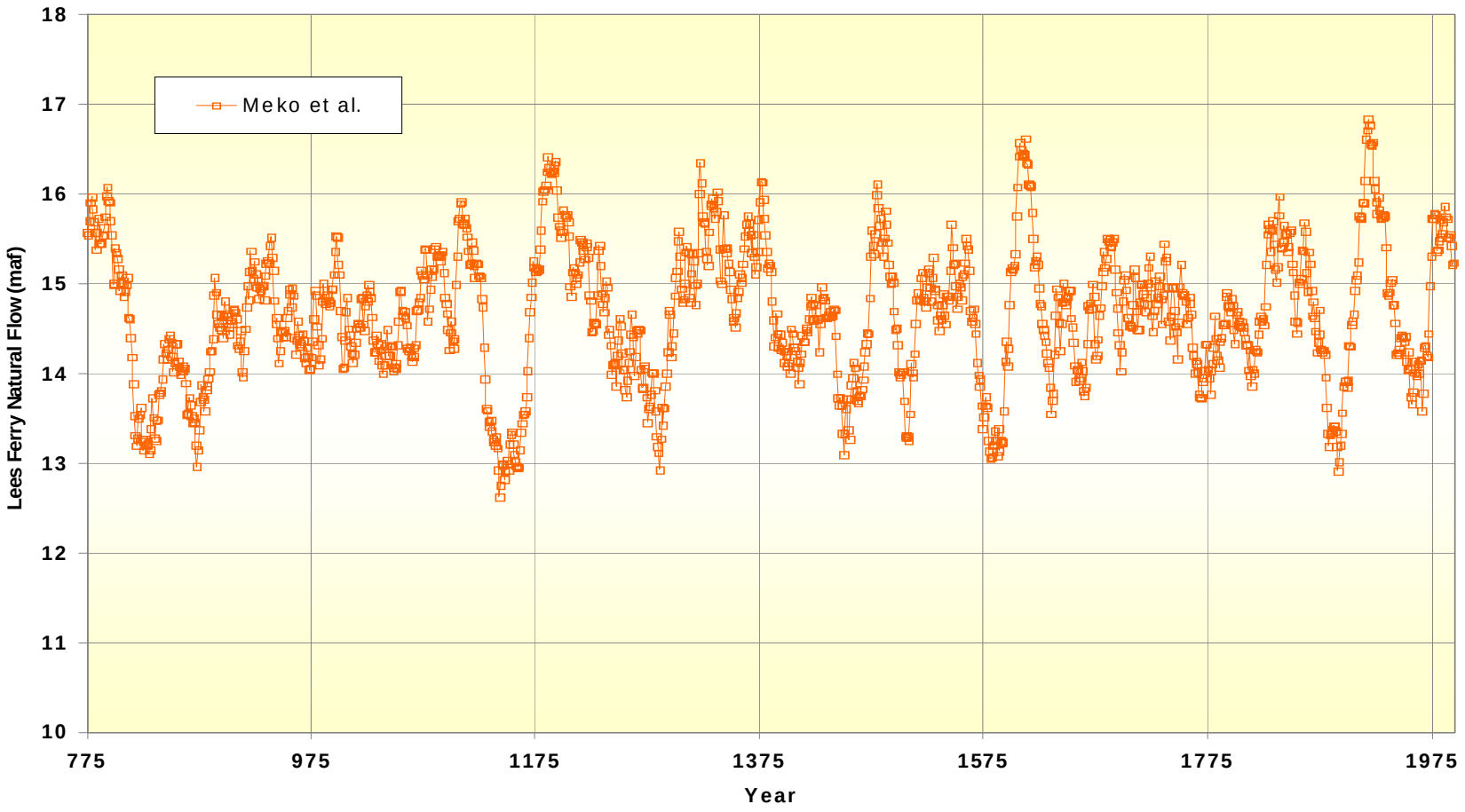
Annual Natural Flow at Lees Ferry
Tree-ring Reconstruction (Meko et al., 2007)
25-Year Running Mean



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Interim Guidelines for the Operation of Lake Powell and Lake Mead

- Specifies a coordinated operation for the full operating range of Lake Powell and Lake Mead in order to better balance the water supply between the two basins
- Encourages more efficient and flexible use of Colorado River water in the Lower Basin by providing a “market-driven” mechanism for water conservation and transfers
- Implements a strategy for shortages in the Lower Basin, including a provision for additional shortages if warranted
- In place for an interim period (through 2026) to gain valuable operational experience

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Lake Powell & Lake Mead Operational Diagrams

Lake Powell Elevation (feet)	Lake Powell Operational Tiers	Lake Powell Storage (maf)
3,700	**Equalization Tier** Equalize, Avoid Spills or Release 8.23 maf	24.3
3,636 - 3,666 (2008-2026)		15.5 - 19.3 (2008-2026)
3,595	**Upper Elevation Balancing Tier**[1] Release 8.23 maf; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf	11.3
3,575		9.5
3,560	**Mid-Elevation Release Tier** Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	8.3
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)	Lake Mead	Lake Mead Storage (maf)
1,220	**Flood Control or 70R Surplus**	25.9
1,200		22.9
	Domestic Surplus	
1,145		15.9
	Normal Operations	
1,125		13.9
1,100		11.5
1,075		9.4
	Shortage 333 kaf[2]	
1,050		7.5
	Shortage 417kaf[2]	
1,025		5.8
	Shortage 500 kaf[2] **and Consultation**[3]	
1,000		4.3
895		0

[1] Subject to April adjustments that may result in balancing releases or releases according to the Equalization Tier.

[2] These are amounts of shortage (i.e., reduced deliveries in the United States).

[3] If Lake Mead falls below elevation 1,025 ft msl, the Department will initiate efforts to develop additional guidelines for shortages at lower Lake Mead elevations.

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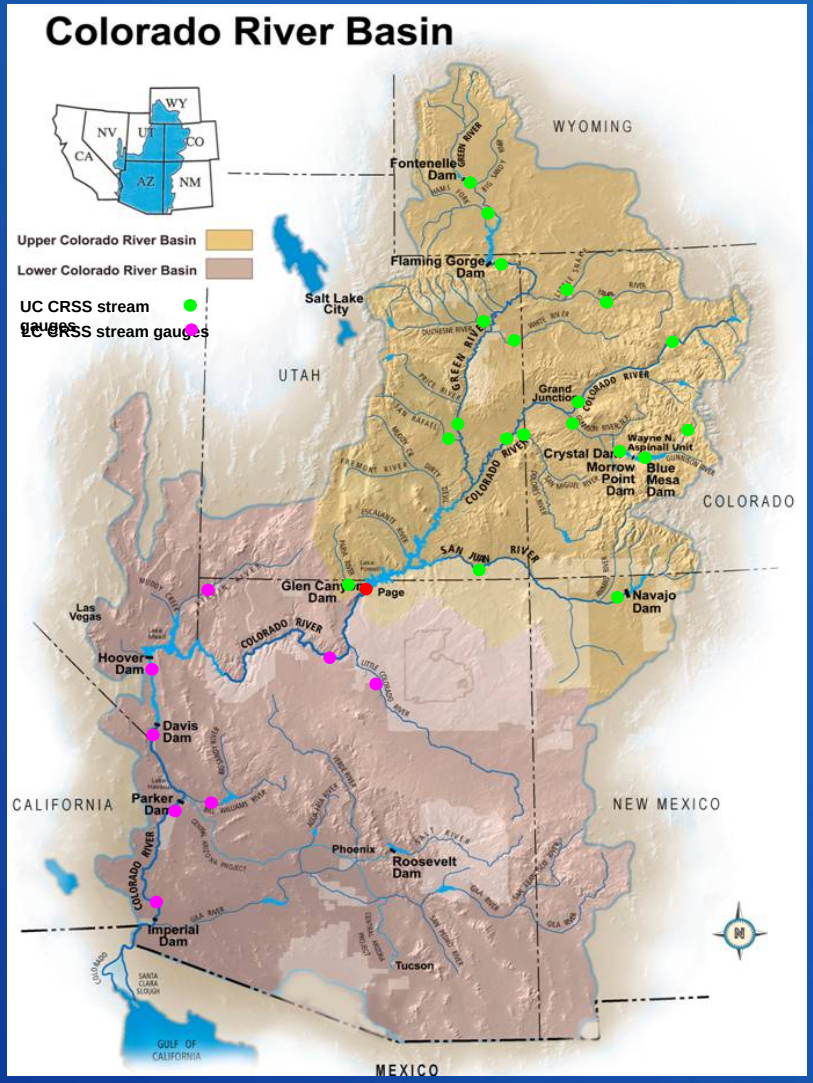
Decision-making Under Uncertainty
Interim Guidelines

- Multi-faceted research and development program begun in 2004
- Formation of work group of climate scientists to inform our EIS process – report published in EIS (Appendix U) and will be made available stand-alone
- Risk due to increasing climate variability analyzed in the EIS leading to this decision



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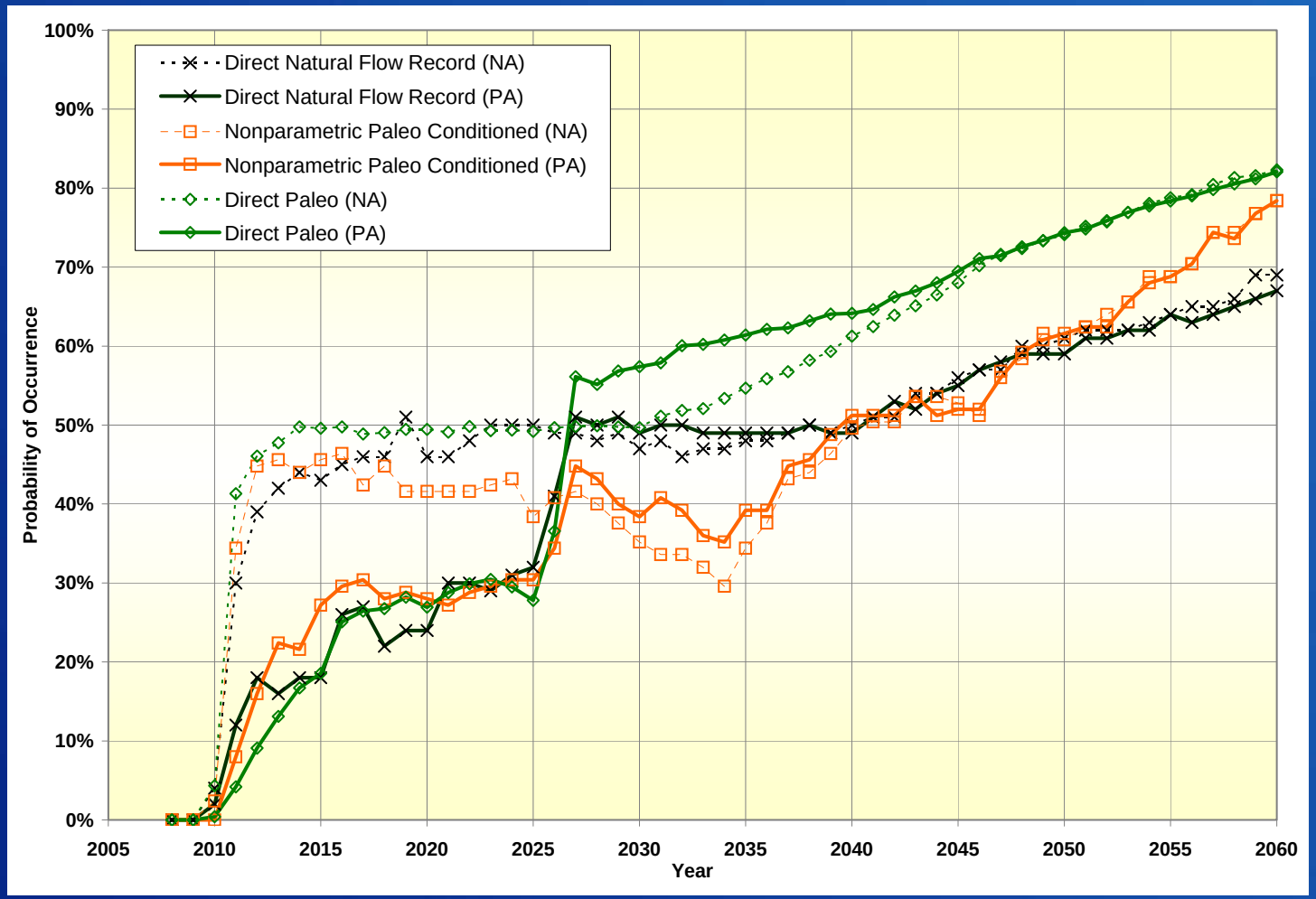
Probability of Lower Basin Shortages
Comparison of Future Inflow Methodologies



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Major Conclusions from Colorado River Climate Technical Work Group

- Methodologies likely dependent upon time horizon of the decision
  - Climate variability potentially more important in the 10 to 20 year time frame than climate change
- For the 10 to 20 year time frame
  - “Condition” flows at Lee’s Ferry based on projections of climate indicators (i.e., AMO, PDO)
- For the 20+ year time frame
  - Model climate scenarios to generate temperature and precipitation on global scale
  - “Downscale” information to regional scale to drive runoff models

Decision-making Under Uncertainty
Next Steps

- Continued Research and Development
- The bottom line
  - **B**etter quantification of uncertainties and improved understanding of risks
  - Better decision-making under uncertainty

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THE UNIVERSITY OF ARIZONA.

Water Resources Research Center
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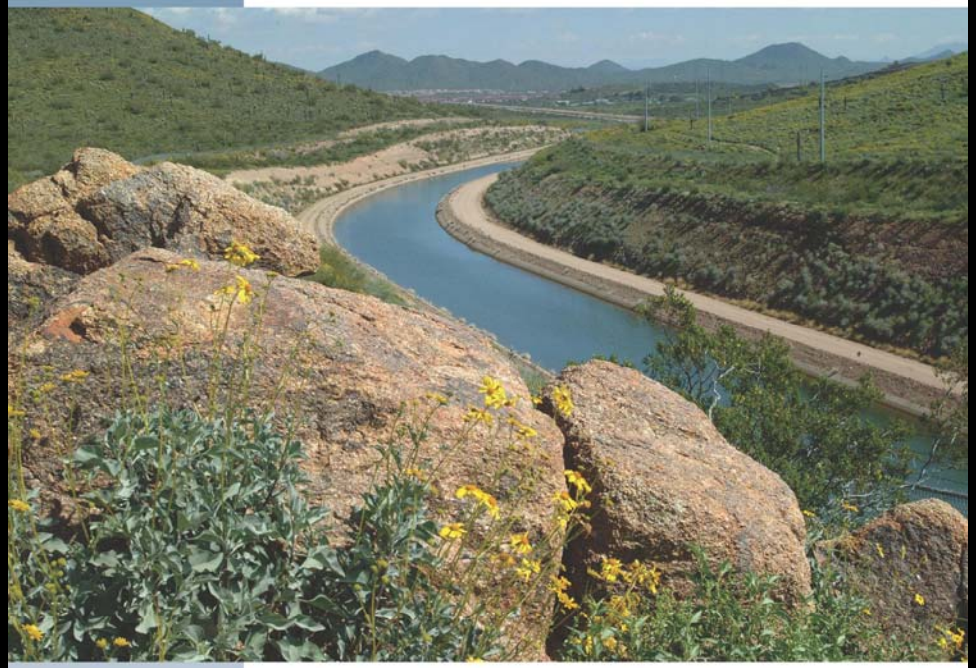

The Importance of the Colorado River to Arizona's Future

June 24, 2008
Phoenix, Arizona

Water Resources Research Center
The University of Arizona

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