

# DROUGHT CONTINGENCY PLANNING AND COLORADO RIVER RISK STUDY

AN OVERVIEW AND STATUS REPORT FOR THE  
COLORADO RIVER DISTRICT BOARD OF DIRECTORS

OCTOBER 17, 2017





# OUTLINE

## Drought Contingency Planning (DCP)

1. Background
2. Contingency Planning Process 2013-Present

## Colorado River Risk Study

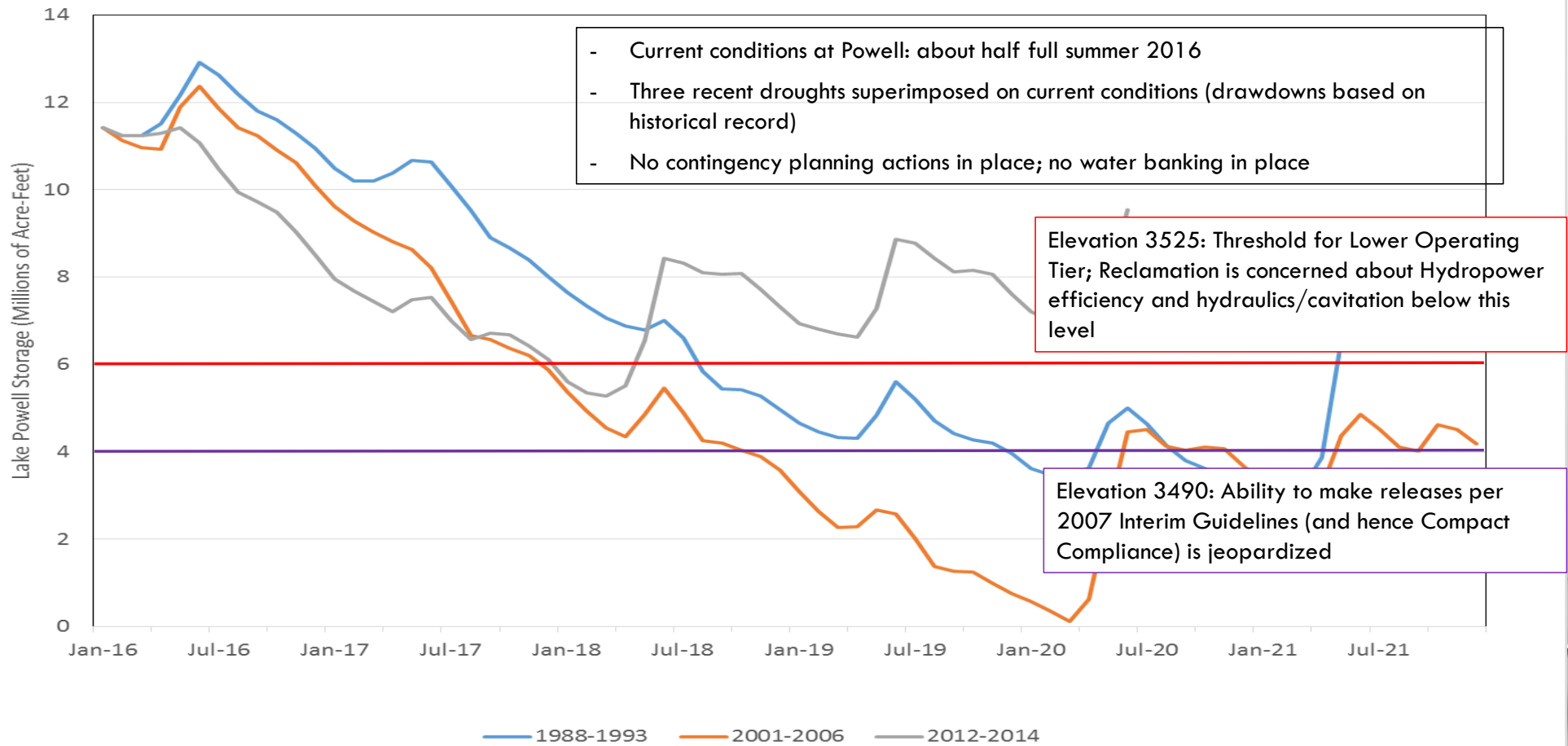
1. Background
2. Link to DCP
3. Work to Date

## What's Next?




# What if drought periods of past 25 years repeated?

## Recent Droughts - Powell Drawdowns



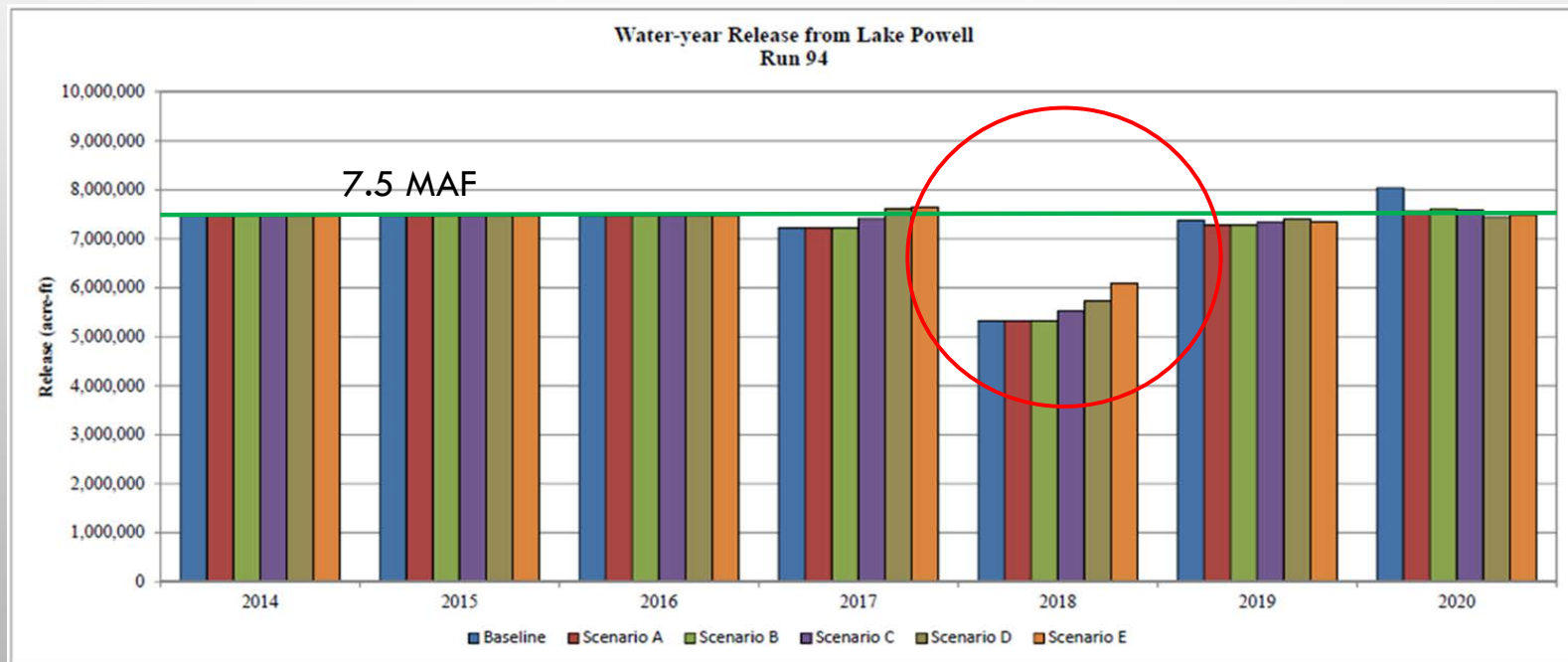


## BACKGROUND AND CATALYST FOR DCP AND RISK STUDY

- July 2013: Secretary Jewell asks basin states “if 2000 – 2013” drought conditions continue, are you prepared: ANSWER – NO!
  - Fall 2013: SNWA and Reclamation analysis for Lower Basin States illustrate possibility of critical storage levels in Mead and Powell and potential for a compact “hole”.
  - Upper Basin and Lower Basin begin coordinated, but independent development of contingency plans.
  - Dec 2014 Joint West Slope BRT Meeting, Request was made for additional studies.
  - Colorado’s Water Plan: Take actions that will minimize risk of compact curtailment actions (pt. 4 of Seven Point Framework)
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## WHAT ARE “CRITICAL ELEVATIONS” AT POWELL?

- If Lake Powell drops below el. 3525' on January 1, 2007 Guideline operations are in the Lower Balancing Tier – This can lead to an **increase** in releases
- Minimum elevation for turbine intakes is el. 3490', but Reclamation will be concerned about air entrainment and generation efficiency at ~el. 3525'



# UPPER BASIN DROUGHT CONTINGENCY PLANNING

## Upper Basin Objective:

Identify actions that can reduce the risk of either losing power production at Powell or lose ability to meet our compact obligations

## Three Component Solution:

1. Coordinated Drought Operations of initial CRSP Reservoirs (Powell, Flaming Gorge, Aspinall , Navajo)
  - First line of defense against critical Powell elevations
2. Demand Management
  - System Conservation Pilot Project
  - Water Bank Work Group
3. Cloud Seeding

# UPPER BASIN DCP DROUGHT OPERATIONS DETAILS

- Initial Storage Units of CRSP (Powell, Flaming Gorge, Aspinall, Navajo)
- If August 24-month forecast indicates January 1 Powell elevation will be below the trigger elevation (3525'), implement Drought Operations
- 1<sup>st</sup> option: modify timing of Powell Releases
- 2<sup>nd</sup> option: Utilize Flaming Gorge, Aspinall, Navajo
- Move water from those CRSP units to Powell
  - Implement at all three upper CRSP reservoirs simultaneously
    - Does not mean all three can necessarily contribute.
    - Constraints of Contracted water, Records of Decision, Hydrology
  - Operations covered by current Records of Decision (NO reconsultation)
- Formal agreement between Reclamation and States is in the works.

# LOWER BASIN DCP (AND MEXICO)

- Lower Basin reductions based on Mead elevations, and are in addition to 2007 Interim Guidelines' Shortage Criteria
- Lower Basin conservation begins at elevation 1090' (200 kaf), which is higher than the current IG shortage criteria threshold
- Could result in as much as 1.2 maf of Lower Basin conservation if Mead is forecast to drop below 1020'
- Agreement valid through 2026 (if approved)
- Minute 323 – U.S. / Mexico Treaty
  - MX participation in shortage sharing pro-rata with 07 Guidelines
  - MX will participate in DCP if and when LB States approve and implement



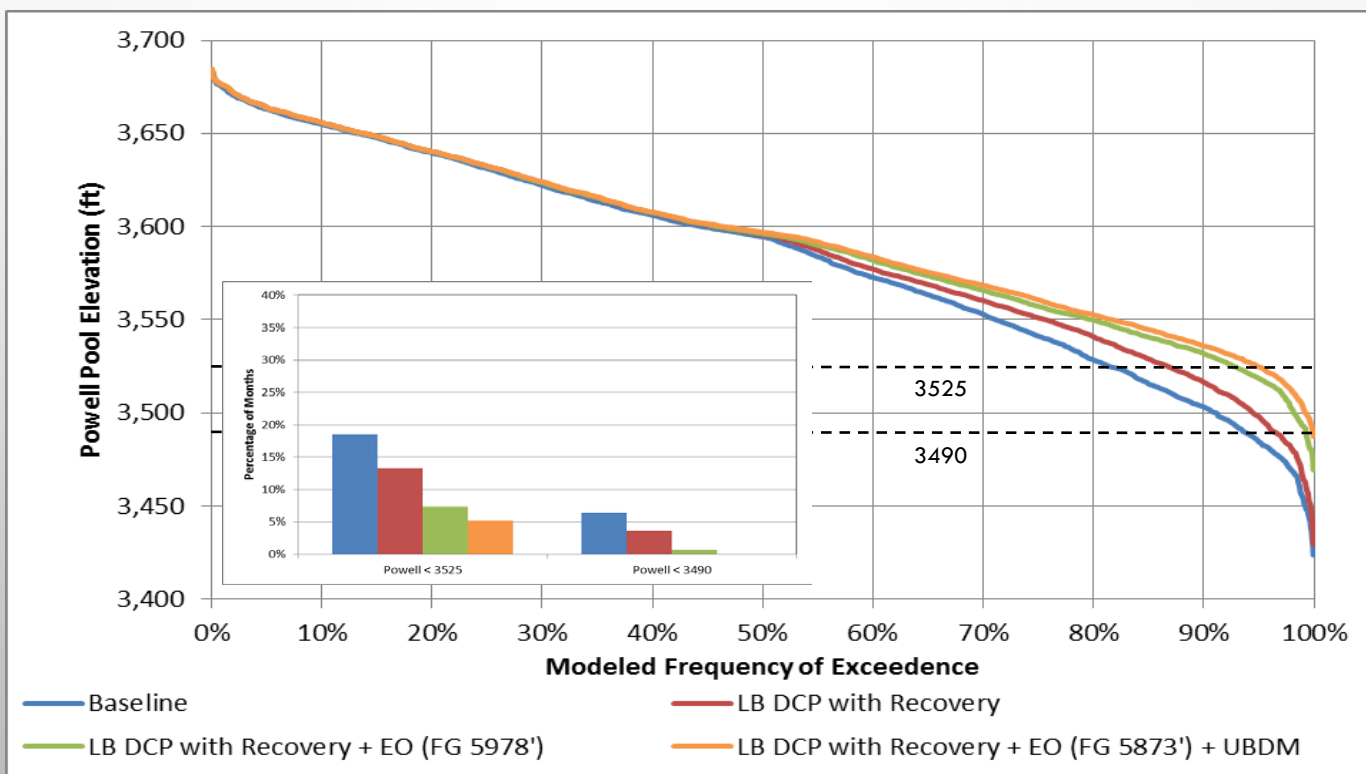
# LOWER BASIN DCP CONSERVATION SCHEDULE

Lake Mead Elevation	AZ (2007)	AZ (Plan)	AZ Total	NV (2007)	NV (Plan)	NV Total	CA (2007)	CA (Plan)	CA Total	USBR	Mexico Minute 319*	Total
1,090-1,075	0	192,000	192,000	0	8,000	8,000	0	0	0	100,000	0	300,000
1,075-1,050	320,000	192,000	512,000	13,000	8,000	21,000	0	0	0	100,000	50,000	683,000
1,050-1,045	400,000	192,000	592,000	17,000	8,000	25,000	0	0	0	100,000	70,000	787,000
1,045-1,040	400,000	240,000	640,000	17,000	10,000	27,000	0	200,000	200,000	100,000	70,000	1,037,000
1,040-1,035	400,000	240,000	640,000	17,000	10,000	27,000	0	250,000	250,000	100,000	70,000	1,087,000
1,035-1,030	400,000	240,000	640,000	17,000	10,000	27,000	0	300,000	300,000	100,000	70,000	1,137,000
1,030-1,025	400,000	240,000	640,000	17,000	10,000	27,000	0	350,000	350,000	100,000	70,000	1,187,000
<1,025	480,000	240,000	720,000	20,000	10,000	30,000	0	350,000	350,000	100,000	125,000	1,325,000

# DCP OUTCOMES


Powell and Mead are operationally coupled through the '07 Guidelines

Neither Basin can completely mitigate its own risk: The best solutions require participation by both Upper and Lower Basins.





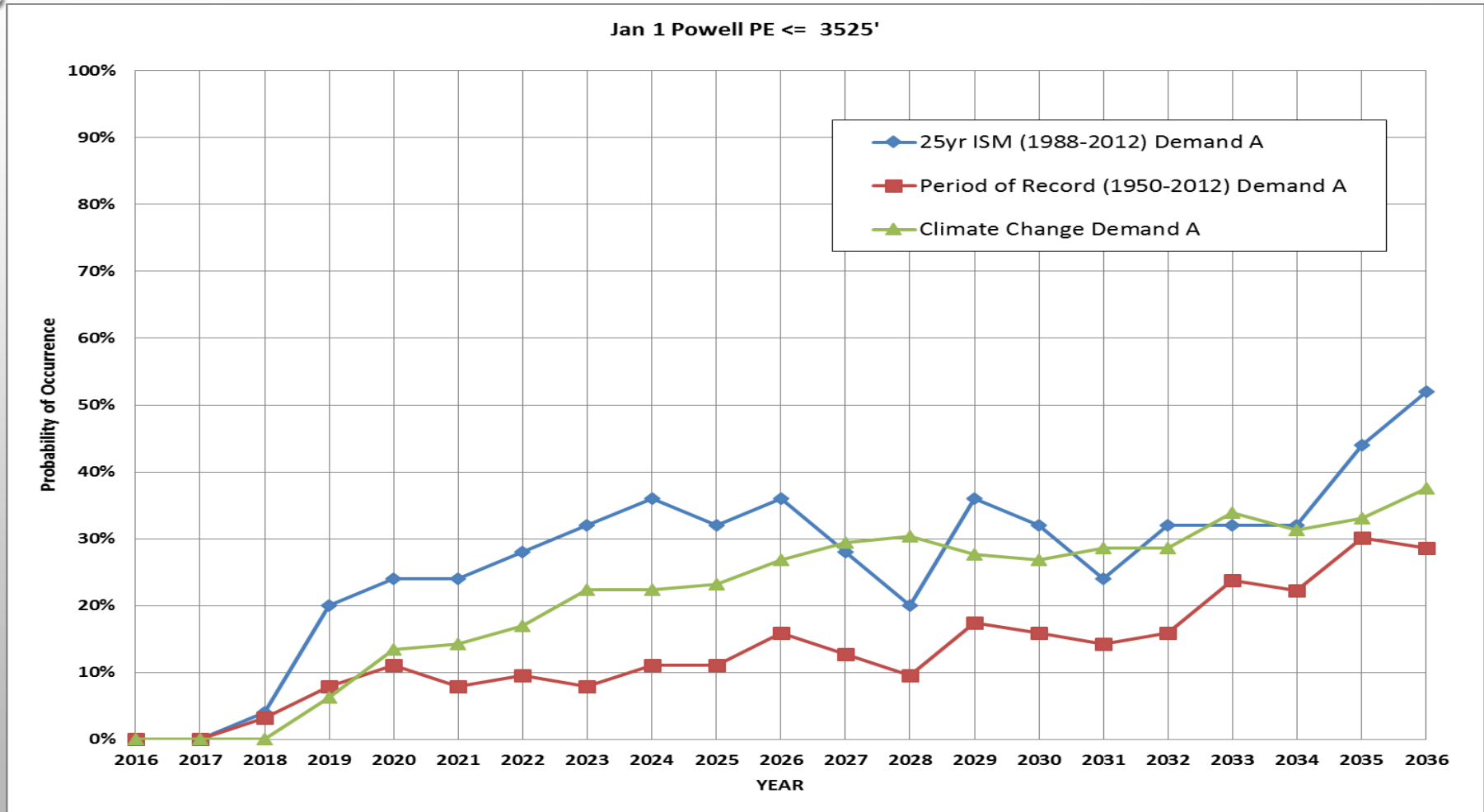
# COLORADO RIVER RISK STUDY

- Originated from joint West Slope BRT discussions and reflection on DCP process
  - Funding via Colorado River District, Southwestern Water, W.S. BRTs (CWCB)
  - Colorado's Water Plan: Take actions that will minimize risk of compact curtailment actions (pt. 4 of Seven Point Framework)
  - Phase I completed Fall 2016
  - Phase II ongoing (completion est. Spring 2018)
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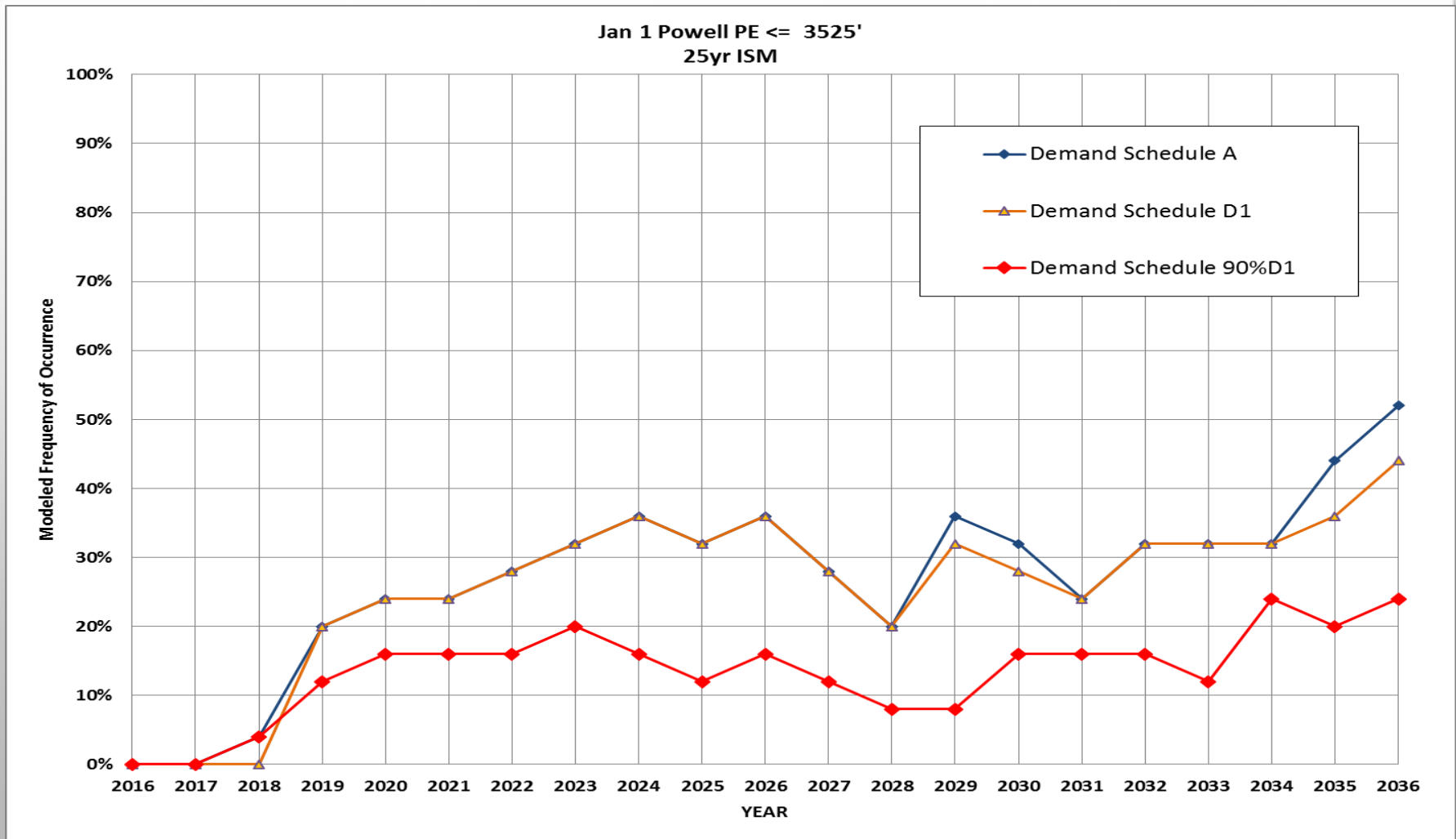
# WEST SLOPE BRT STUDY – PHASE I

- Questions to answer in Phase I:
  - What are magnitude and duration of Powell shortages below elevation 3525'?
  - How much of the above shortages can be met by contributions from Drought Operations of CRSP reservoirs? (A: up to about 2 MAF)
  - How much consumptive use reduction (“demand management”) would be needed by Upper Basin states - AFTER use of stored CRSP water - in order to maintain Powell pool elevations?
  - What are possible implications to Colorado River water users? What is range of volumes that Colorado might need to conserve? (Colorado’s apportionment under the 1948 Upper Basin Compact is 51.75%, but we’re currently using about 56-58% of UB total)
- Use CRSS Model to address these “What If” questions...

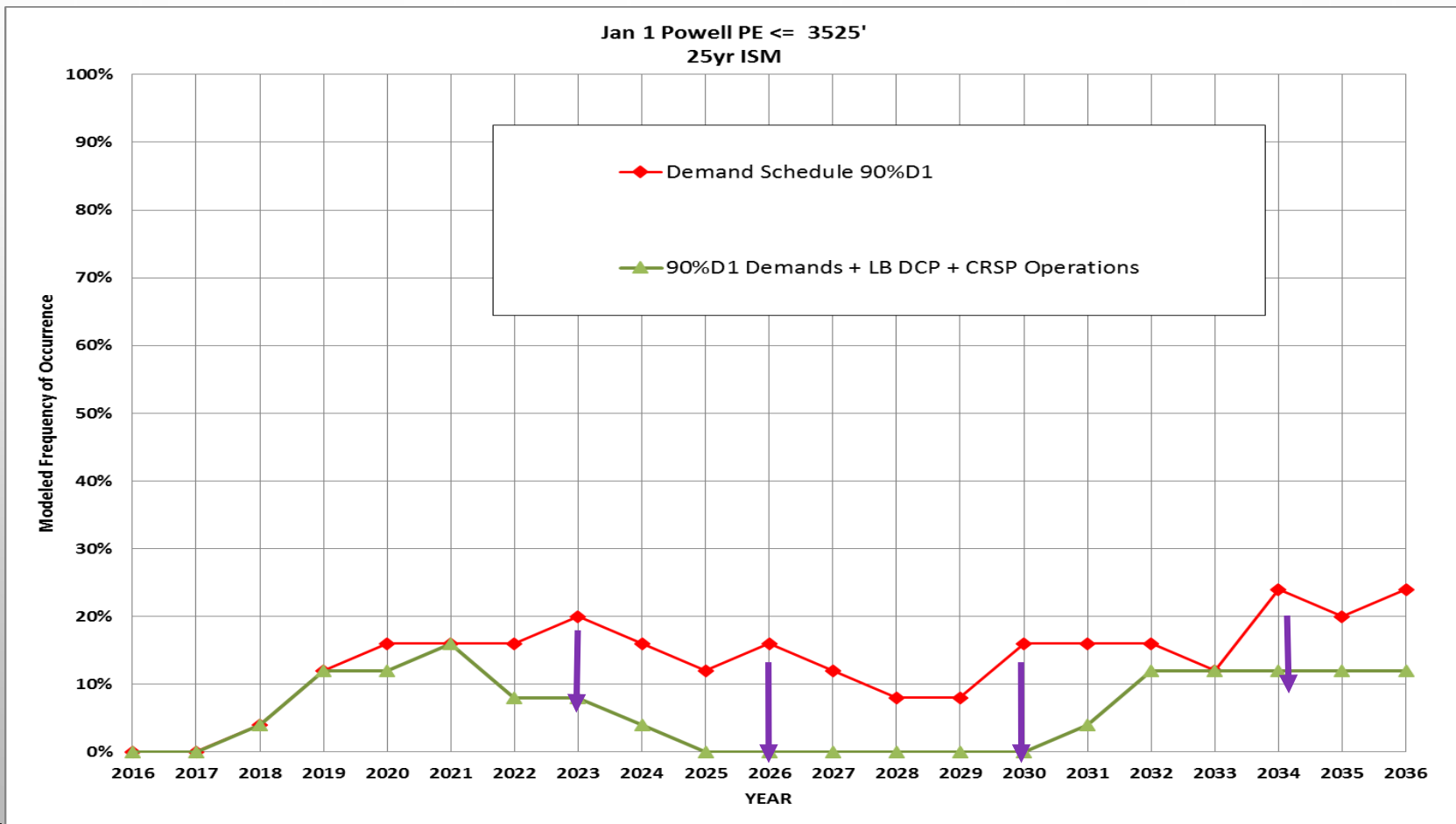
# EXAMPLE : HYDROLOGIC SENSITIVITY



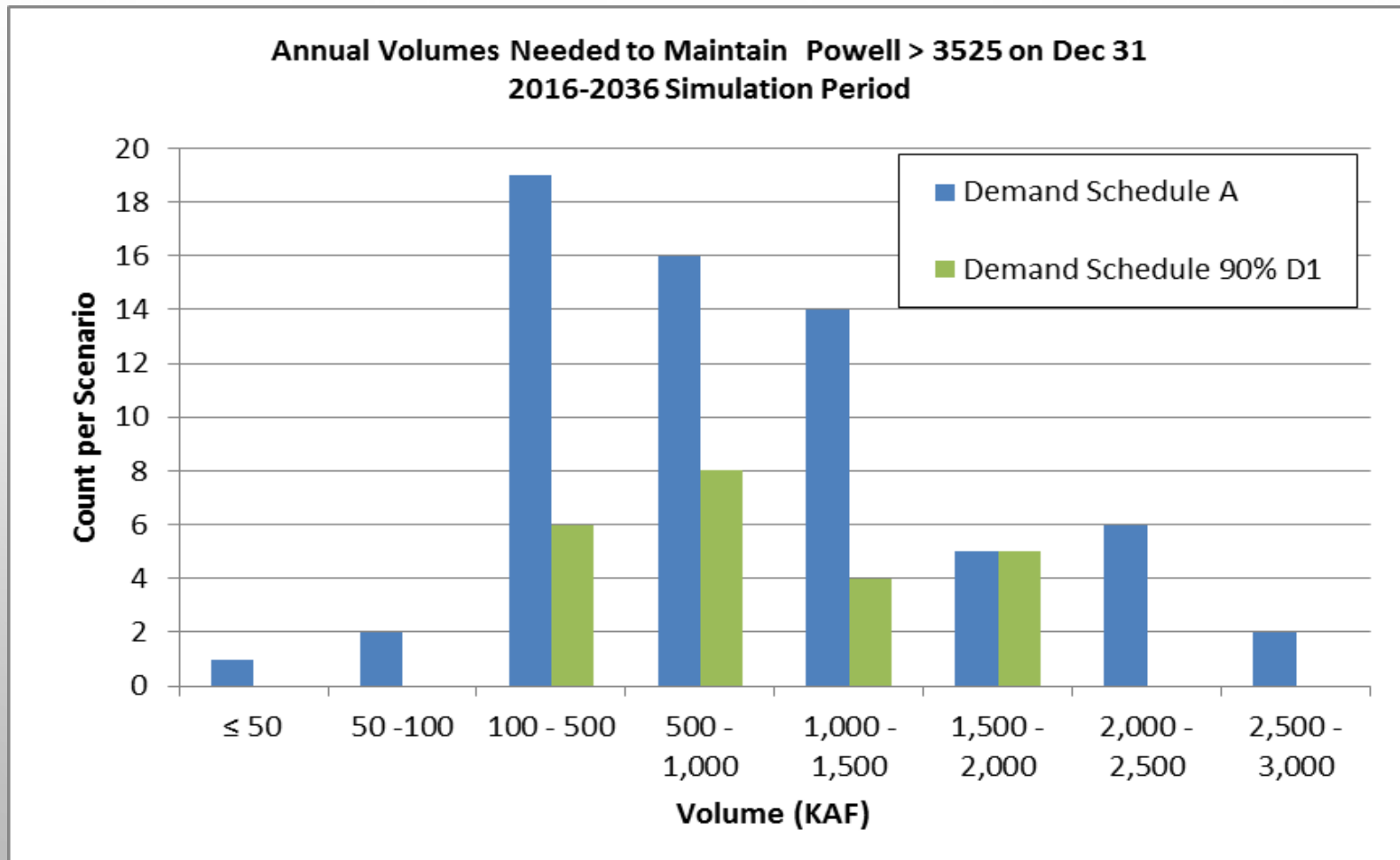
# EXAMPLE : DEMAND SENSITIVITY



# CRSP DROUGHT OPERATIONS AND LOWER BASIN CONSERVATION REDUCES THE RISK, BUT DOES NOT ELIMINATE IT



# WHAT WOULD IT TAKE TO COMPLETELY ELIMINATE RISK?





# WEST SLOPE BRT STUDY – PHASE II

## Phase II Scope of Work:

- Task 1: CRSS “Infilling” - additional model runs and completion of CRSS modeling report
  - Water Banking
  - Paleo Hydrology
  - Sensitivity Analysis (Storage Conditions, Demands)
- Task 2: StateMod investigations
  - Investigate use of StateMod for addressing water use, storage, and demand management questions
  - Look at coupling of StateMod / CRSS and

## PHASE II STATEMOD WORK

- *“Evaluate the utility of using StateMod in addressing questions related to voluntary demand management. Understand capabilities and limitations”*
  - a) Use of non-federal reservoirs to bank conserved water. Timing and magnitude of availability
  - b) “Allocation” of demand management (who/when/where)
  - c) Shepherding questions arising from a) and b)
  - d) Representation of storage and delivery for TBDs
  - e) Coupling with CRSS
- Scheduling: This task is in progress (10/2017).

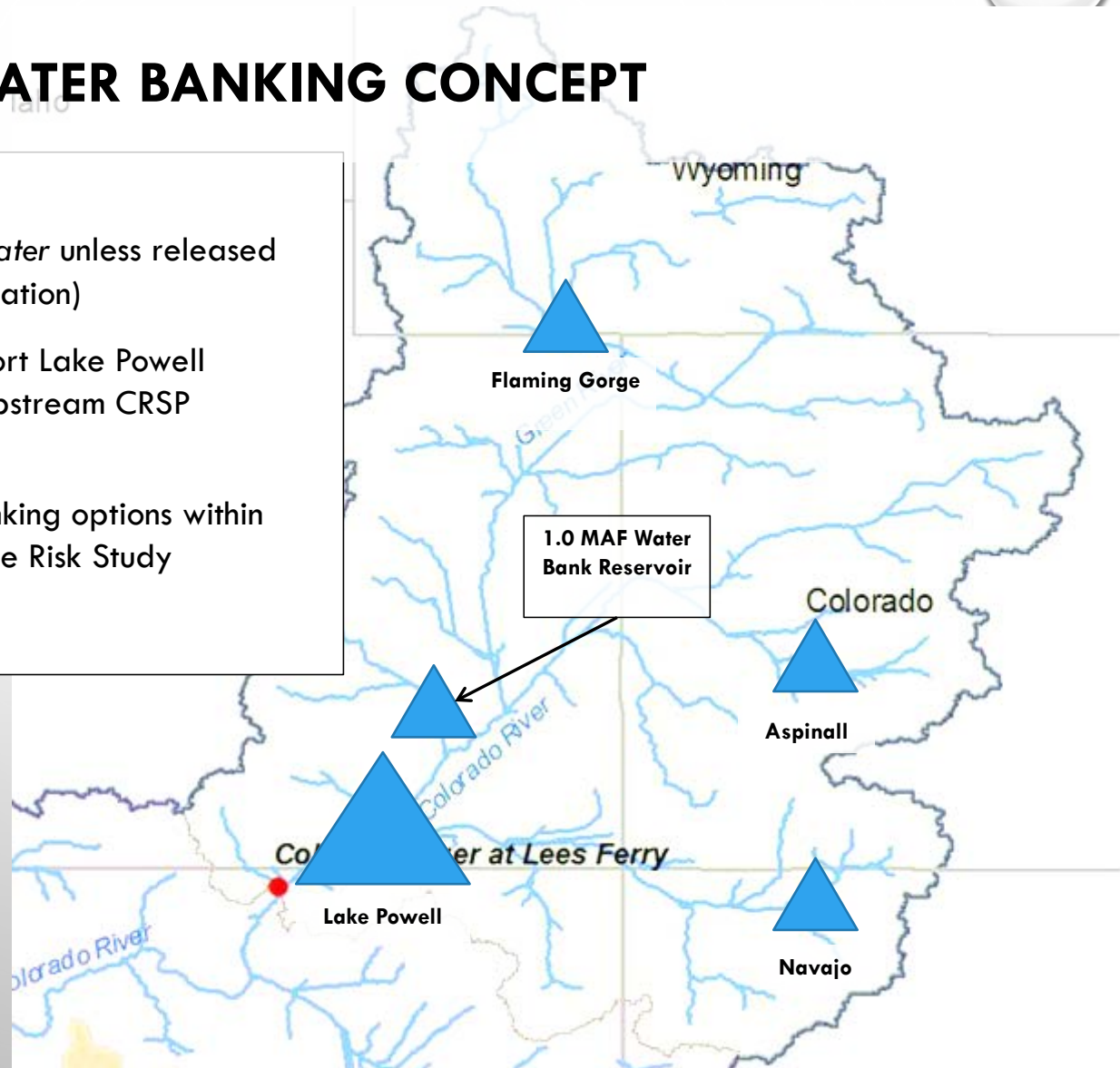
# STATEMOD EXAMPLE

- Targeted reductions in Consumptive Use
- How much yield at State Line?

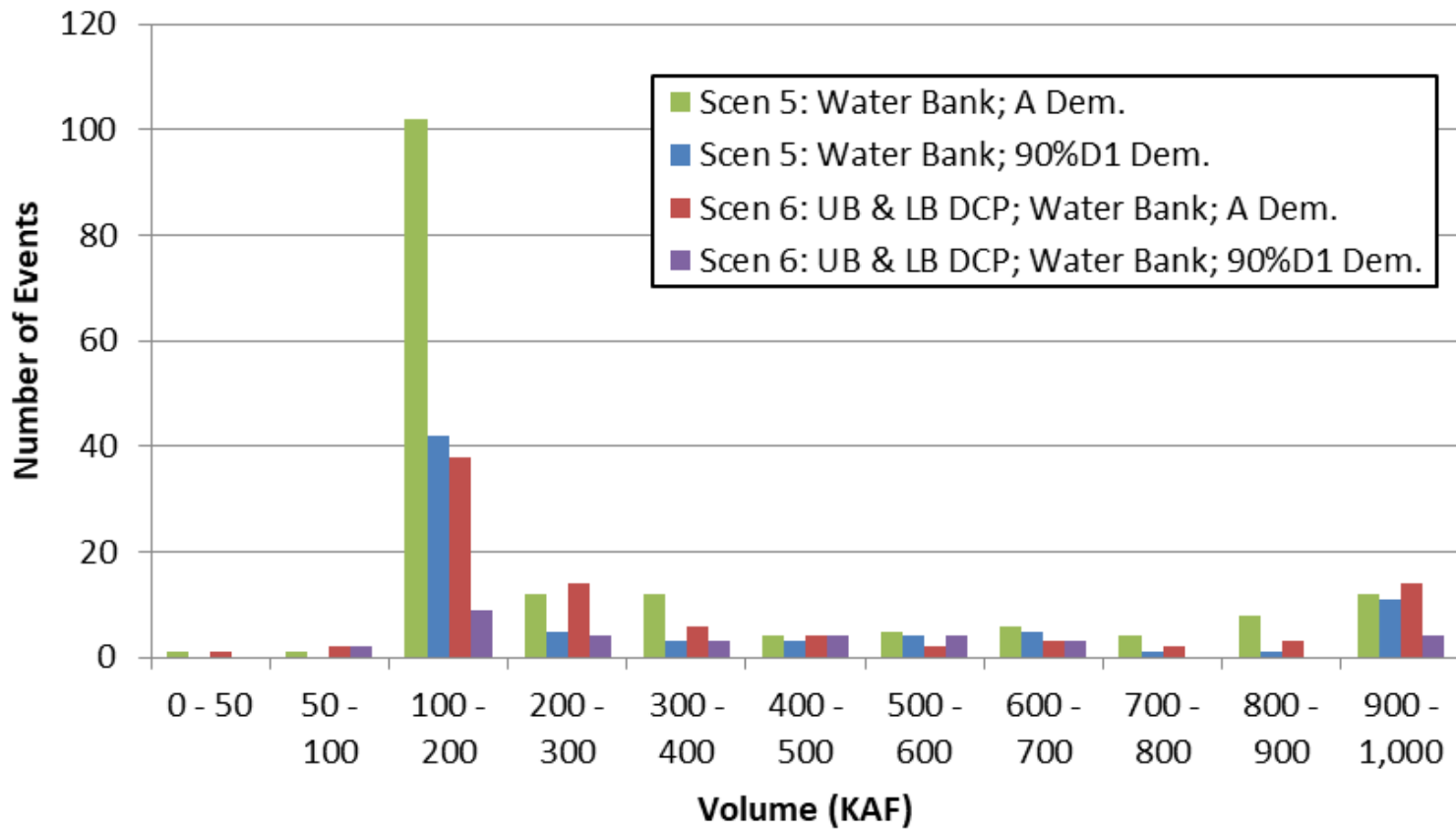
Demand Management Yield by Basin	5%			15%		
	Target CU	Outflow	Efficiency	Target CU	Outflow	Efficiency
Yampa	9,434	8,774	93%	28,322	27,189	96%
White	2,832	2,917	103%	8,514	8,940	105%
Upper Colorado	49,852	42,873	86%	150,226	133,701	89%
Gunnison	26,450	20,631	78%	79,328	64,256	81%
San Juan & Dolores	22,271	14,476	65%	66,823	49,449	74%

# WATER BANKING CONCEPT

- Conserved CU is stored in the Bank
- Banked water does not become *system water* unless released from the Bank. (i.e., not subject to equalization)
- Water Bank releases water only to support Lake Powell elevation, after Drought Operations of upstream CRSP Reservoirs.
- We are looking at Colorado-specific banking options within StateMod model as part of Phase II of the Risk Study



### Annual Volumes Release from Bank Storage 2016-2036 Simulation Period - Stress Test Hydrology



# WATER BANK OUTCOMES

Stress Test Hydrology (1988-2012)	Count of Bank Release Years	Count of Release Years that did not fill to 3525'	Shortage 3525 after Bank Release (AF)
Scen 5: Water Bank; A Dem.	127	113	2,035,526
Scen 5: Water Bank; 90%D1 Dem.	61	50	1,570,560
Scen 6: UB & LB DCP; Water Bank; A Dem.	62	46	1,270,984
Scen 6: UB & LB DCP; Water Bank; 90%D1 Dem.	26	13	607,293

## Effectiveness of water bank?

- Needs to be an add-on to Drought Contingency Plan
- Does not always keep Powell above 3525, but..
- Can increase minimum Powell elevation by ~15-20 ft. (e.g. 3481.2 to 3497.6 in Scenario 6 above)
- UB States need to control “if and when” of banked water releases

# THE BIG PICTURE

- Hydrology, Demands and Future Development levels matter, the higher the consumptive use in the UB the higher the risk to existing users.
- The most successful DCP requires joint participation by both Upper and Lower Basins. Additional measures in the UB may be necessary to eliminate risk.
- Contingency Planning is essential; CRSP reservoir drought operations reduces the risk, but in more severe droughts (e.g., 1988-1993 & 2001-2005), demand management would be necessary.
- Some of the volumes we are seeing in the model are very large and may not be feasible, need to consider the “trade-offs” and alternative strategies
- Demand Management combined with a Water Bank:
  - Could limit the Annual impact to CU by spreading Conservation over many years
  - Would provide greater control over conserved water (a “must have” condition)



END



# PHASE II CRSS WORK

## Additional Model Scenarios / Assumptions

- Water Bank concept: Assume different levels of pre-emptive banking with a “non-equalized” storage pool at Powell. Questions: amount/timing/usage (e.g., maintain 3525 vs Compact deficit avoidance)
  - Example: 100kaf per year, until needed or  $WB = 1.0maf$ ; Increase to 200kaf if drought operations are initiated.
- Hydrology: Request to use PaleoHydrology ala Basin Study, and compare with Stress Period, Period of Record, and CMIP-3 Climate Change results
- Sensitivity of Powell/Mead to hydrologic and demand variability

## PHASE II CRSS WORK (CONT)

### Additional Model Scenarios / Assumptions

- Continue evaluating risk sensitivity to demands. Scenarios A, 90%D1, Other ???
- Sensitivity of risk time horizon to initial conditions (e.g., Powell projection for January 2018 is ~35 ft higher than initial conditions for Phase I Risk Study runs)
- Interim Guidelines vs 602a beyond 2026?
- Drought Contingency Plan Changes?

Scheduling: Scenario definition and model setup is happening now, will continue through summer.