DROUGHT CONTINGENCY PLANNING AND COLORADO RIVER PLAN STUDY-DRAFT

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?



<u> 1988-1993</u> <u> 2001-2006</u> <u> 2012-2014</u>

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)

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:

- 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
- 1st option: modify timing of Powell Releases
- 2nd option: Utilize Flaming Gorge, Aspinall, Navajo
- Move water from those CRSP units to Powell
 - Implement at all three upper CRSP reservoirs simultaneously
 - <u>Does not mean all three can necessarily contribute.</u>
 - 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 <u>in addition</u> 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 | 200000 | 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 | 250000 | 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 | 300000 | 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 | 350000 | 100,000 | 70,000 | 1,187,000 |
| <1,025 | 480,000 | 240,000 | 720,000 | 20,000 | 10,000 | 30,000 | 0 | 350,000 | 350000 | 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)

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

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



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WHAT WOULD IT TAKE TO COMPLETELY ELIMINATE RISK?



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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?

| Domand Management | | 5% | | 15% | | |
|--------------------|----------------------|---------|------------|-----------|---------|------------|
| Yield by Basin | Target CU | Outflow | Efficiency | Target CU | Outflow | Efficiency |
| Yampa | 9 <mark>,43</mark> 4 | 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

Co

olorado Rive

Lake Powell

voming

Colorado

Aspinal

Navajo

Flaming Gorge

er at Lees Ferry

1.0 MAF Water

Bank Reservoir

- 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



Preliminary results, not for distribution

WATER BANK OUTCOMES

| Stress Test Hydrology (1988-2012) | Count of Bank | Count of Release Years | Shortage 3525 after |
|---|---------------|----------------------------|---------------------|
| | Release Years | that did not fill to 3525' | 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)



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.