CRSS Scenario Assumptions

CRRIM was built to operate on outputs from the Colorado River Simulation System model (CRSS). Hydros Consulting completed the default CRSS scenarios included in this version of CRRIM, which as noted in the System Conservation Analysis were focused on assessing the viability of a basin-wide system conservation program, and modeled the use of an "early-and-often" system conservation effort (which layered on top of the DCP triggers in the Lower Basin, and operated whenever Powell was less than 70% full in the Upper Basin). An overview of the current CRSS scenarios is outlined in Table 1 below and the assumptions are detailed below.

Table 1: CRSS Run Overview Table

	90% D1 + Stress Test Hydrology	Scenario A + Stress Test Hydrology	90% D1 + CMIP-3 Hydrology	Scenario A + CMIP-3 Hydrology
Baseline Condition: LB DCP + UB Drought Ops + Minute 323	**RUN 4b**	**RUN 17b**	**RUN 9b**	**RUN 11b**
System Conservation – No UB Bank: SC/DM + LB DCP + UB Drought Ops + Minute 323	**RUN 8d**	**RUN 18d**	**RUN 10d**	**RUN 12d**
System Conservation – UB Bank: SC/DM + UB Water Bank + LB DCP + UB Drought Ops + Minute 323	**RUN 15c**	**RUN 19c**	**RUN 14c**	**RUN 16c**

Baseline Condition: LB DCP + UB Drought Ops + Minute 323 (Runs 4b/9b/11b/17b)

Overarching Assumptions

- Initial Conditions: Jan 1, 2020 Forecasts from the Aug 2019 24 Month Study.
- Model Run Duration: Stress Test 2020-2047; CMIP-3 2020-2060
- Assume that the Interim Guidelines are in place for the duration of the simulation.
    - Lower Basin Interim Guideline Shortages in the model become demand reductions for the following users:
        - Arizona: CAPdiversionAG, CAPdiversionMandI, CAPdiversionTribal, CAPdiversionEnergy, CAPdiversionFWR, CAPdiversionMinerals
        - Nevada: SNWPDiversion
- Minute 319 Mexico shortages are in place for the duration of the simulation.
- Minute 323 in place for duration of the simulation.

Lower Basin Drought Contingency Plan Assumptions

- DCP contribution volumes per Table 1. Contributions occur in 2019-2026.
    - For modeling purposes, the contributions are made by the following users in CRSS
        - Contributions for Arizona are made by Wellton-Mohawk IDD
        - Contributions for Nevada are made by SNWA
        - Contributions for California are split between IID (60%) and MWD (40%)
    - Contributions are assumed to continue below 1,025 ft. No additional reductions are modeled.
    - If there is space in a state's ICS account, DCP contributions are assumed to be DCP-ICS, otherwise, it is system water
- DCP ICS accounting
    - When the cumulative total DCP contributions reaches 3.35 maf, the following logic is implemented:
        - DCP contributions assumed to continue.
        - For modeling simplicity, DCP contributions above a cumulative total of 3.35 maf are not tracked individually by state.
            - The year and frequency of exceeding 3.35 maf is reported; the volume above 3.35 maf is also reported
        - DCP ICS assessment will be 10% in the second year after recovery (e.g. if recovery is possible in 2020 and 2021, the end of 2021 balance will be diminished by 10%) if a 10% assessment has not already been applied to the ICS credits, e.g., if EC-ICS is converted to DCP ICS a 10% assessment has already been applied
        - DCP ICS assumed to remain in the event of a Flood Control Surplus
    - DCP ICS Recovery
        - CA & NV recover DCP according to EC ICS logic
        - AZ does not recover DCP ICS
- EC ICS activity
    - Follows modeling assumptions of CRSS v 4.0.1, based on Interim Guidelines

- Actions by the United States are modeled as a reduction in the bypass flow to the Cienega de Santa Clara in Mexico. The assumed bypass flows are 115 kafy (1990-2016 average). This volume is reduced by the following amounts:
    - 2019-2020: 33 kaf
    - 2021-2022: 66 kaf
    - 2023-2026: 100 kaf
- Demand/depletion reductions in Mead count towards IG/equalization with Powell.
- Mexico WSCP
    - WSCP savings volumes per Minute 323
    - No recovery of WSCP savings

Table 1:

Lower Basin Interim Guidelines and Drought Contingency Plan Reductions									
Lake Mead Elevation (ft msl)	2007 Interim Guideline Shortages (KAF)		DCP Voluntary Reductions (KAF)			Combined Reductions (KAF)			
	Arizona	Nevada	Arizona	Nevada	California	Arizona	Nevada	California	Lower Basin States Total
Above 1090	0	0	0	0	0	0	0	0	0
1090 - 1075	0	0	192	8	0	192	8	0	200
1075 - 1050	320	13	192	8	0	512	21	0	533
1050 - 1045	400	17	192	8	0	592	25	0	617
1045 - 1040	400	17	240	10	200	640	27	200	867
1040 - 1035	400	17	240	10	250	640	27	250	917
1035 - 1030	400	17	240	10	300	640	27	300	967
1030 - 1025	400	17	240	10	350	640	27	350	1017
Below 1025	480	20	240	10	350	720	30	350	1100

Upper Basin Drought Operations Assumptions

- Reclamation Drought Operations (DO) turn on when Powell pool elevation is forecasted (in April or August) to have a Jan 1 deficit (<3525').
- Flaming Gorge - Minimum release pool elevation is at the emergency level (5,873') assuming waiver of its Record of Decision (ROD). This emergency draw down is 17’ below what the USBR models as the minimum power pool at 5890’ and 107’ below the ROD draw down at 5980’.
- Navajo - Adjusting peak releases based on a DO set end of water year pool elevation.
- Blue Mesa - Uses a DO rule curve.

System Conservation/Demand Management (SC/DM): SC/DM + LB DCP + UB Drought Ops + Minute 323 (Runs 8d/10d/12d/18d)

Includes Overarching + Lower Basin DCP + Upper Basin Drought Operations assumptions outlined in above sections

System Conservation/Demand Management (SC/DM) Assumptions

- SC/DM is done in addition to Interim Guideline demand reductions, DCP reductions, and UB Drought Operations.
- SC/DM will be triggered based on Jan 1 reservoir elevations every year of the model run.
- Annual volume will be distributed uniformly over a 12-month period when triggered.
- Upper Basin SC/DM
    - Distribute SC/DM volumes (Table 2) to different reservoir locations proportional to entitlement in the Upper Basin (see Table 3).
    - In the model, water is injected into each reservoir *instead* of reducing demands.
    - No shepherding to Powell.
    - No separate storage account in Lake Powell.
    - System water counts towards IG/equalization with Mead.
    - Table 3 distribution percentages are calculated from water user depletion requested slots in the model and avg annual values from 2018-2042 per the Basin Study scenarios.
- Lower Basin SC/DM
    - SC/DM volumes and their trigger elevations are in Table 2.
    - Demand/depletion reductions are made to Imperial Irrigation District to avoid double counting the water in Mead's power (no Mead injections).
    - Demand/depletion reductions in Mead count towards IG/equalization with Powell.

Table 2: UB and LB demand management with trigger elevations

Run	Mead Elev	Lower Basin SC (KAF)	Powel Elev	Upper Basin SC (KAF)
Run 8d Intervene early, lower basin ramp down	1090-1075	300	3648.47 (70% of live capacity) – bottom	200
	1075-1045	200		
	1045-bottom	0		

Table 3: UB geographic distribution proportional to estimated entitlement

	Powell	Aspinall	Fontenelle	Flaming Gorge
Wyoming	--	--	5%	6%
Colorado	51%	2%	--	--
Utah	22%	--	--	--
New Mexico	14%	--	--	--

UB Storage Account: UB Storage Account + SC/DM + LB DCP + UB Drought Ops + Minute 323 (Runs 14c/15c/16c/19c)

Includes Overarching + Lower Basin DCP + Upper Basin Drought Operations + System Conservation/Demand Management (SC/DM) assumptions outlined in above sections

Upper Basin Storage Account Assumptions

- Total storage account capacity is 1 MAF.
- Water is introduced to the system in the geographic distribution defined in Table 3, and in the amount of the specified demand management reductions.
    - The same amount is removed from the equalized account in Powell and placed in the non-equalized account at Powell.
    - If max capacity is reached, then SC/DM water becomes system water in each of the reservoirs.
    - There is a potential timing disconnect with this method, which is unlikely to have an impact outside of a single year, and is a noted simplifying assumption of this method.
- The storage account is modeled using a separate reservoir object, and post-processing calculations adjust simulated pool elevation and hydropower generation for Powell.
    - This method allows the coordinated operation of Powell and Mead to proceed based upon equalized storage only, while maintaining physical benefits to pool elevation and hydropower production in the results.
    - Banked water is also exempt from Drought Operation trigger level determination.
- Water bank releases are made at the end of the calendar year so that Jan 1 Powell will be 3525'.
- This method reflects what has recently been done in the Risk Study and other modeling work.
- A 5% evaporation end of calendar year charge to the full balance in the storage account is applied.