TECHNICAL MEMORANDUM

To: URGWOM Steering Committee
From: URGWOM Technical Team
Subject: Rio Grande Compact Rules-Assumptions for Use in Planning Model

The Upper Rio Grande Basin Water Operations Review (Review) and Environmental Impact Statement (EIS) is a comprehensive system-wide review of the water operations activities that are conducted under existing authorities and state laws. The Review process includes developing and evaluating water operation alternatives. The Upper Rio Grande Water Operation Model (URGWOM) is being developed to evaluate these alternatives and URGWOM must appropriately simulate the system rules and constraints. One of the important sets of rules is provided by the Rio Grande Compact between the states of Colorado, New Mexico and Texas. The following paragraphs summarize the need and the assumptions required to implement certain Rio Grande Compact rules in the URGWOM planning model.

URGWOM uses a rule based language to simulate system regulations and constraints that is based on *if … then* statements (rules statements). The rules have been developed for the operations of all the major reservoirs on the Rio Grande (and tributaries) from the Colorado-New Mexico Border to Caballo Dam. Modeling of Elephant Butte and Caballo Dams would be for flood control operations only. Important parts of these rules are constraints that may be imposed on one or more upstream reservoirs as a result of storage conditions at Elephant Butte and Caballo Reservoirs. For example, under Article VII of the Rio Grande Compact, the storage in reservoirs constructed after 1929 in Colorado and New Mexico is not allowed to increase if the usable water in project storage is less than 400,000 acre feet. To apply this rule, the planning model should be able to compute the usable water and credit water in project storage.

Currently, the rules in the water operations model use the total storage in Elephant Butte and Caballo reservoirs to limit upstream storage, assuming that Elephant Butte releases are known. For a water operations model this is satisfactory, because the release from Elephant Butte for a short period (up to one year) can be reasonably estimated and input into the model. But for a planning model run (20-25 years), the releases cannot be reliably estimated for such a long period of time. Also, the current rules for the planning model do not provide an evaluation of how alternative analyses may affect the Rio Grande Compact deliveries over a long period. Determination of these effects is one of the objectives of the Review and EIS. Therefore, the URGWOM technical team will implement a simplified method of accounting storage and release and accrued debits and credits. Following are the assumptions for the planning model rules incorporating this simplified accounting method.

Colorado:

URGWOM does not model the basin above Lobatos; therefore, the difference between Colorado's "actual" annual delivery and its "scheduled" annual delivery at the New Mexico stateline (Lobatos gage) will be an amount requested by the Colorado Engineer Advisor. Each annual credit or debit will be input to the model as requested by Colorado.

New Mexico:

On January 1, the Rio Grande Compact schedules will be applied to determine the New Mexico annual delivery status. The model will calculate the accrued debit or credit status by adding the annual credit or debit to the previous year's accrued status.

i. The model will determine the Otowi Index Supply each calendar year based on the modeled flow at the Otowi gage corrected for the operation of reservoirs between

Lobatos and Otowi constructed after 1929 and any San Juan-Chama Project water at the Otowi gage determined by the accounting model.

ii. The Elephant Butte Effective Supply will be determined each calendar year by utilizing the flow below Elephant Butte Dam (see discussion below) plus the net gain/loss in storage in Elephant Butte Reservoir. The net gain/loss in storage in the reservoir will be based on routed inflow to the reservoir as computed by the model.

Elephant Butte Reservoir:

i. The model will contain a variable value slot for a minimum pool at Elephant Butte Reservoir. This value will vary between zero and 50,000 acre-feet. The rules will not allow the pool to go below this level.

ii. On January 1, any credit water in storage in Elephant Butte Reservoir along with the minimum pool (if any) and any San Juan-Chama Project water in storage will be subtracted from the total storage in Elephant Butte and Caballo to determine the usable water in project storage.

iii. On March 1 of each year, URGWOM will estimate the amount of usable water in storage in Elephant Butte and Caballo Reservoirs and the forecasted volume above Cochiti that will reach Elephant Butte to estimate the amount of usable water available for the year. If the usable water in project storage is equal to or greater than 790,000 ac-ft, then 790,000 ac-ft will be released that year (a set schedule will be developed for daily releases). If there is less than 790,000 ac-ft of usable water in project storage predicted, then the release schedule will be reduced proportionately.

iv. If the water surface elevation of Elephant Butte Reservoir exceeds the prudent flood space criteria (50,000 ac-ft vacant from April through September and 25,000 ac-ft from October through March), the flood operation rules will govern the releases.

v. There will be no special consideration given to release for power generation.

Caballo:

i. It is possible to drain Caballo (no minimum pool); storage levels may be minimized to reduce evaporation loss.

ii. Flood control rules will set the releases when storage is in flood control space.

iii. A linear relation will be developed between Caballo and Elephant Butte releases during the irrigation season and a minimum, or zero, release during non-irrigation season will be set for Caballo Dam. Also computed will be the Caballo release based on 790,000 acre-feet distributed based on historic proportions during the irrigation season.

A previous draft of this Technical Memorandum was circulated to the Rio Grande Compact Commission Engineer Advisors for their review and comment. A representative of the New Mexico Engineer Advisor participated in the development of this Technical Memorandum. The Texas Engineer Advisor commented to ensure that the model used a total annual release from project storage of 790,000 acre-feet. The comments of the Colorado Engineer Advisor addressed matters related to the assumptions regarding Colorado annual credit and debit status, the existence of a minimum pool in Elephant Butte Reservoir, the optimization of the operation of Caballo Reservoir to minimize evaporation loss and the method of computing New Mexico debits and credits. The comments of the Engineer Advisors were addressed and incorporated in this Technical Memorandum on Rio Grande Compact Rules –Assumptions for Use in Planning Model.

TECHNICAL MEMORANDUM

To: URGWOM Steering Committee
From: URGWOM Technical Team
Subject: Proposed Method of Computation of Schedule of Release from Project Storage for Use in URGWOM Planning Model

This Memorandum summarizes proposed procedures for computing releases of water from Elephant Butte and Caballo Reservoirs for use in the URGWOM Planning Model. In general, the Planning Model will use a release from Project Storage (Caballo Reservoir) of 790,000 acre-feet per annum. See Technical Memorandum on Rio Grande Compact Rules – Assumptions for Use in Planning Model.

The historic average mean daily flow of the Rio Grande below Caballo Dam and the Rio Grande below Elephant Butte Dam were computed for the 1975-2000 period. These values are summarized in the following table. The record of release of water into the Bonita Ditch, which diverts directly from Caballo Dam, is not included in the record of the flow of the Rio Grande below Caballo Dam. Water diverted by the Bonita Ditch is accounted as part of the release of usable water from Project Storage

Station	Average Mean Daily Flow (cfs-days)	(acre-feet)
Rio Grande below Elephant Butte Dam	383,338	760,350
Rio Grande below Caballo Dam	379,890	753,500
Difference	3,448	6,850

For the purposes of this exercise, it is assumed that the difference in the average annual streamflow (6,850 acre-feet) represents losses between Elephant Butte Dam and Caballo Reservoir and the historic evaporation loss from Caballo Reservoir.

The Caballo Reservoir release (release from Project Storage) for use in the Planning Model is computed as follows:

1. Releases during the non-irrigation season (October 15-January 15) are set equal to zero. This reduces the historic average mean daily flow below Caballo Dam to 736,050 acre-feet.

2. The annual release is increased from 736,050 acre-feet to 790,000 acre-feet by increasing each daily flow (during the irrigation season) in proportion to the amount that each day's flow bears to the total annual flow.

The release from Elephant Butte Dam for use in the Planning Model is computed as follows:

1. The historic mean daily flow of the Rio Grande below Elephant Butte Dam is increased from 760,350 acre-feet to 796,900. The historic daily flows are increased in proportion to the amount that each day's flow bears to the total annual flow. The Elephant Butte release is increased above 790,000 acre-feet to provide water to offset losses between Elephant Butte Dam and Caballo Reservoir and evaporation losses from Caballo Reservoir.

This release schedule will be used each year except that an adjustment (proportional reduction) will be made when the projected inflow and storage content is not adequate to meet the 790,000 acre-foot demand. A hydrograph of the daily release schedule to be used in the Planning Model is attached.

Schedule of Daily Releases from Project Storage for Use in Planning Model