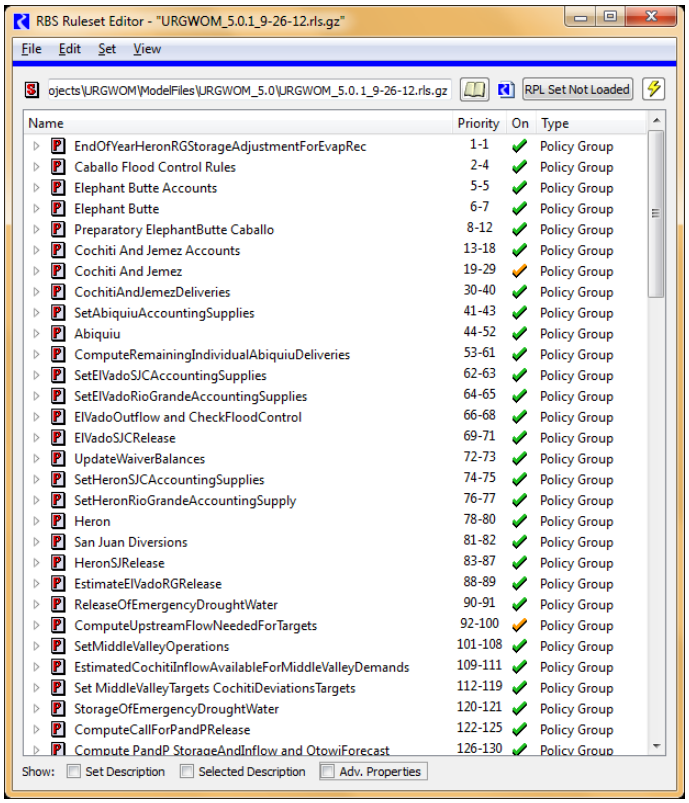
RiverWare Ruleset Documentation

Version 5.0.2_9-12-13

Upper Rio Grande Water Operations Model (URGWOM)



prepared by

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TABLE OF CONTENTS

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Contractor, Tomas Stockton, provided significant support with the review of all the RiverWare rule policy language (RPL) and the review of operations in the basin. Other members of the URGWOM Technical Team must also be acknowledged for their contributions and help with the review of the URGWOM rules and development of this document including Nabil Shafike with the New Mexico Interstate Stream Commission (ISC); Mike Roark with the United States Geological Survey (USGS); Amy Louise with the Corps; Brian Westfall, contractor to the Bureau of Indian Affairs (BIA); Bill Miller, contractor to the Corps; Carolyn Donnelly, Ed Kandl, and Michelle Estrada-Lopez with Reclamation; and Jesse Roach with Sandia National Laboratories. Several members of the URGWOM Technical Team in past years must also be credited for all their extraordinary work to develop and enhance the original URGWOM ruleset including Mark Yuska (previously with Reclamation), April Fitzner, and Don Gallegos with the Corps along with Dave Wilkins (previously with USGS).

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EXECUTIVE SUMMARY

A RiverWare model for the Upper Rio Grande in New Mexico was developed with the RiverWare software application. Rulebased simulations are completed with the Upper Rio Grande Water Operations Model (URGWOM) using a RiverWare ruleset that represents policy for operating the facilities in the basin. The ruleset includes code in the RiverWare rule policy language for computing key demands, diversions, and releases from dams based on all the policy factors. The releases from the dams along the Rio Chama and Rio Grande are set for each day in the daily timestep model based on the policy coded in the ruleset. The ruleset has been under development for several years with involvement from an interagency Technical Team and contractors.

This report was prepared to provide documentation of the URGWOM RiverWare ruleset and provide new RiverWare users with a document that can be referenced when working with the ruleset. Background information on key policy controls are presented to prepare users for working with the model and to also summarize the key aspects of the policy as coded in the RiverWare ruleset. The key policy controls that are specifically discussed are the San Juan-Chama Project; flood control operations; the Rio Grande Compact; diversions for the Middle Rio Grande Conservancy District (and the six Middle Rio Grande pueblos), the Albuquerque Bernalillo County Water Utility Authority, and from the Rio Chama; downstream target flows; and recreational interests. Separate discussions of priorities at each of the following dams are also presented: Heron, El Vado, Abiquiu, Cochiti, Jemez, Elephant Butte, and Caballo.

Discussion on several different aspects of operations or proposed actions that can be simulated with URGWOM is presented including relinquished Compact credits and storage of Emergency Drought water, pumping from the Low Flow Conveyance Channel to the river, and Cochiti deviations. Background information is presented on letter water deliveries by contractors to payback the river for depletions in the basin, leases of San Juan-Chama Project water by the U.S. Bureau of Reclamation, and waivers issued to contractors to allow allocated San Juan-Chama Project water to be stored at Heron Reservoir into the year following the year of the allocation.

This report does not serve as documentation of RiverWare or the functionalities of the software, but some aspects of RiverWare are discussed that are used abundantly for the URGWOM application and may need to be specifically understood by new users before working with the ruleset.

All the individual rules in the current URGWOM RiverWare Ruleset version 5.0.2 (2013) are discussed separately in Appendix B, and a flowchart for overall policy as represented in the ruleset is presented in Appendix A. The appendix with discussion for individual rules makes up a significant portion of this report and was specifically prepared such that model users would have a reference when working with the RiverWare rule policy language. The discussion in this report could also be referenced as a means to complete an initial review of the policy coded in URGWOM.

I. Introduction

The Upper Rio Grande Water Operations Model (URGWOM) is a daily timestep computational model developed through an interagency effort to simulate processes and operations of facilities in the Rio Grande Basin in New Mexico. A single model file is maintained and used for multiple applications including model runs for long-term planning studies, simulations with forecasted inflows for preparing Annual Operating Plans (AOP), and daily simulations for updating the actual status of accounts with up-to-date data. A separate URGWOM ruleset is used for all rulebased simulations including model runs for planning studies and to prepare AOPs. Modeling for planning studies is used to evaluate subsequent long-term impacts of a proposed action on various indicators including deliveries to water users, river flows, interstate Compact deliveries and Compact status, and the overall water budget. AOP modeling is completed as rulebased simulations to forecast operations, deliveries, and resulting flows through the end of a calendar year with forecasted inflows computed with forecast calculations. The Accounting Model application is used to complete model runs, without rules, up to the current date using actual data to simulate the status of accounts for different water users.

This report provides documentation of the policy for Rio Grande operations in New Mexico as coded in the URGWOM ruleset. This document serves as a reference for URGWOM users working with the RiverWare ruleset and also provides a means to review the policy as coded in the model. The version number for this document matches the version number for the corresponding ruleset file. Refer to the URGWOM Quality Control Plan for more information on the protocol for model versioning.

A brief review of RiverWare rules is initially presented followed by a discussion of the policy factors affecting Rio Grande operations. A general description of the key controls that affect operations is presented. San Juan-Chama project diversions and paper accounting for San Juan-Chama Project water, the interstate Rio Grande Compact, policy for flood operations, diversions by water users including Middle Rio Grande Conservancy District (MRGCD) and the six Middle Rio Grande pueblos, target flows to comply with the Biological Opinion on Rio Grande water operations (Service, 2003) and the Endangered Species Act (ESA) of 1973, and recreational interests are key driving forces that ultimately affect the outflow from each dam along the river. URGWOM is also set up to model several potential flow tools for meeting water needs in the basin such as relinquished Compact credits and subsequent allocations for storage of Emergency Drought water at El Vado Reservoir and pumping from the Low Flow Conveyance Channel (LFCC) to the river. A general discussion of these factors is presented to summarize the key aspects that affect policy and prepare model users for working with URGWOM. The priorities for operating each of the major dams are then discussed separately.

While this report does not serve as documentation of the RiverWare software, some particular aspects of the software are discussed in this report. A specific understanding of

these topics may be important before new users begin working with the URGWOM ruleset.

A more detailed summary for each individual rule is presented with a brief explanation of the assignments made with each rule, a discussion of the execution constraints, and a summary of the rule logic. A flow chart for policy is also presented that depicts the general overall rule logic. All the rules in the current ruleset are discussed in this report. The level of detail for the summaries varies depending on the complexity of the rule, and discussion may not be repeated for rules that contain identical logic.

1.1. URGWOM Ruleset

The URGWOM model was developed with the RiverWare software application developed at the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) at the University of Colorado at Boulder. The model is a daily timestep model for simulating operations of facilities along the Rio Grande (and Rio Chama) within New Mexico including Heron, El Vado, Abiquiu, Cochiti, Jemez, Elephant Butte, and Caballo Dams. Diversions at numerous locations along the Rio Chama and Rio Grande are simulated along with drain and canal flows in the Middle Valley between Cochiti Dam and Elephant Butte Reservoir. Refer to Figure 1.1 for a map of the Rio Grande basin in New Mexico.

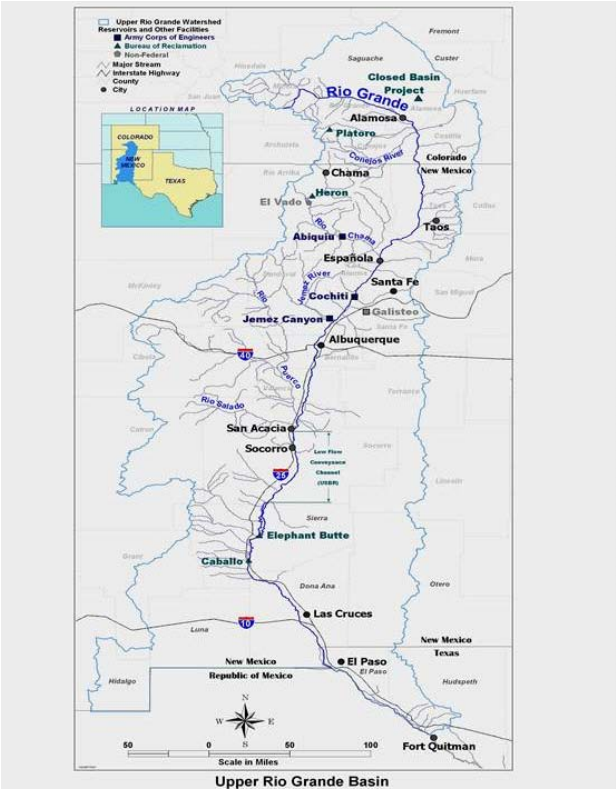

Figure 1.1. Map of the Rio Grande Basin (courtesy of the Upper Rio Grande Water Operations Review)

URGWOM has been under development for many years and changes are always being made to enhance the model. This report focuses solely on the ruleset portion of the model which contains code for completing daily timestep rulebased simulations. The ruleset includes a series of rules coded in the RiverWare rule policy language (RPL) using the graphical rules editor in RiverWare. The series of rules represents the policy for operating the facilities throughout the basin in New Mexico and ultimately setting the daily outflows from each dam.

The rules are sorted in 46 different policy groups (Refer to Figure 1.2). Assignments for the different parameters as completed with each rule are based on the priority for the rule. For example, setting an outflow based on flood control policy will have a higher priority than a delivery to water users. The rules are listed based on priority and are executed, or fired, in reverse order. In addition to the priority of the policy, the rules set outflows from the dams from upstream to downstream. Please refer to documentation on RiverWare for more details on rulebased simulations.

For URGWOM version 5.0.2, there are 180 rules coded which represent the policy in the basin for such objectives as setting diversions, recording paper water transfers, meeting downstream target flows, adhering to flood control operations criteria, all to ultimately determine the daily outflow from each dam in the basin. (Note that a few old rules are turned off but still included in the ruleset. Rules that are turned off and do not execute are noted with a red X in the ruleset. Such rules are usually under development or older rules that have been turned off but retained as new rules are tested. As new rules are deemed appropriate, the older rules or temporary rules that were turned off are deleted.)

The URGWOM ruleset is configured to allow for regular simulations to be completed with the Accounting Model followed by continued rulebased simulation for AOP modeling or planning runs. Such combined Accounting Model runs with rulebased simulations allow for the latest Accounting Model run to be used to provide actual initial conditions and such that the year-to-date conditions can be included as part of the first year in rulebased simulations. Projected conditions can then be easily modeled with the latest Accounting Model while using the policy reflected in the URGWOM ruleset and an assumed hydrology or using forecasted inflows for the future. The setup entails the use of Execution Constraints for almost every rule in the URGWOM ruleset that check whether the current timestep is greater than or equal to the rulebased simulation start timestep, which is input by the user as the first date after the Accounting Model run period. Using this approach, the objects in URGWOM will dispatch using actual year-to-date data for the Accounting Model portion of such a combined run, and the rules will set operations for the continued rulebased simulation portion of the run. Refer to the URGWOM user manual (Boroughs, 2013) for more details on the setup for such combined runs.

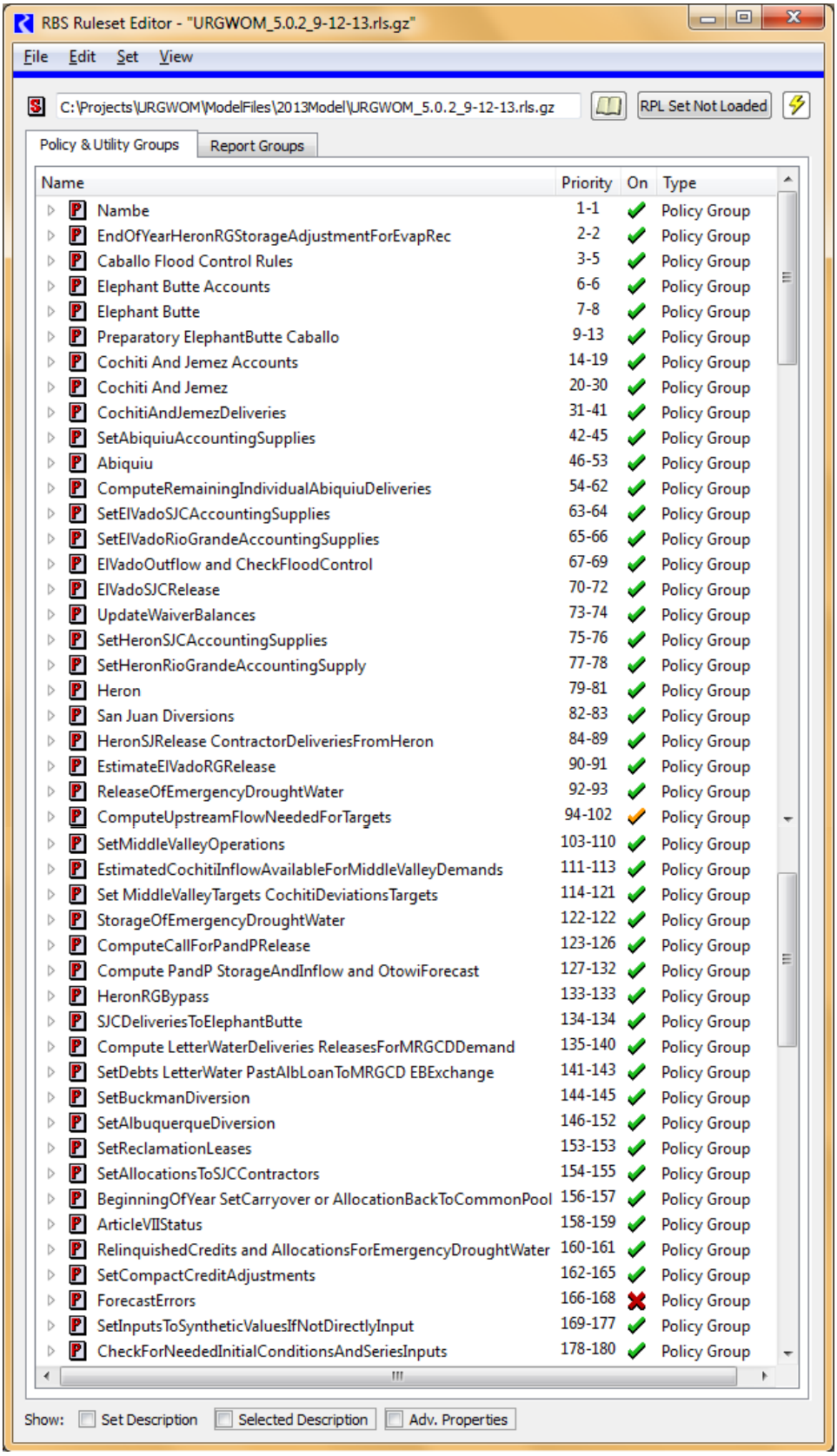

Figure 1.2. Screen Capture of the Names for All Policy Groups in the URGWOM Ruleset

II. Synopses of Policy Controls

The key driving forces that affect the policy for operating the facilities in the Rio Grande basin within New Mexico are the following: the trans-basin diversion of water from the San Juan River to the Rio Chama and paper accounting for San Juan water versus native Rio Grande water, flood control operations, the interstate Compact, diversions by the Middle Rio Grande Conservancy District (MRGCD) and other water users including the six Middle Rio Grande pueblos, releases to meet downstream target flows to comply with the 2003 BO, and operations for recreational interests. Operations are significantly complicated by the separate accounting for San Juan-Chama Project water versus native Rio Grande water. Note that throughout this document, there are numerous references to Rio Grande water versus San Juan-Chama Project water or Rio Grande releases versus San Juan-Chama releases. These terms are used to refer to the two different colors of water in the system: native Rio Grande water that originates within the basin versus San Juan water that is diverted to the Rio Grande basin from the San Juan basin through the San Juan-Chama Project facilities. Also, the discussion in this Section of the report often refers the reader to the discussions for the individual rules in Appendix B for more detailed information.

2.1. San Juan-Chama Project

The San Juan-Chama Project was authorized by Congress in 1962 and allows for the trans-basin diversion of water from the San Juan River to the Rio Grande basin. The project is part of the Colorado River Storage Project to allow for New Mexico to utilize its 11.25% share of the Colorado River water as stipulated in the Upper Colorado River Compact (1948).

Water is diverted based on the capacity restrictions of the diversion facilities while assuring minimum bypass flows in the San Juan tributaries (Refer to Table 2.1). There is a maximum diversion volume allowed in any year and over any 10-year period. The water is conveyed to Azotea Creek in the Rio Grande basin and flows into Heron Reservoir which is on Willow Creek. The fixed firm yield that is allocated to the different contractors for various purposes is 96,200 acre-ft. Refer to Table 2.2 for the allocations for contractors.

Table 2.1. Minimum Bypasses at the San Juan Basin Diversions (cfs)

MONTH	RIO BLANCO (Blanco Diversion)	LITTLE NAVAJO RIVER (Little Oso Diversion)	NAVAJO RIVER (Oso Diversion)
January	15	4	30
February	15	4	34
March	20	4	37
April	20	4	37
May	40	27	88
June	20	27	55
July	20	27	55
August	20	27	55
September	20	27	55
October	20	4	37
November	20	4	37
December	15	4	37

Table 2.2. Allocations to Contractors for San Juan-Chama Project Water in URGWOM (HeronData.SanJuanContractorAllocations)

Contractor	Allocation (acre-ft)
Albuquerque	48,200
MRGCD	20,900
Jicarilla	6500
Santa Fe City	5230
Santa Fe County	375
Cochiti Rec Pool	5000
Los Alamos	1200
PVID	1030
Espanola	1000
Belen	500
Bernalillo	400
Town of Taos	400
Los Lunas	400
Red River	60
Taos Ski Valley	15
OHKAY Owingeh	2000
El Prado	40
Town of Taos Settlement	366
Taos Pueblo	2215
Uncontracted	369
TOTAL ALLOCATION:	96,200

The San Juan Diversions at the Blanco, Little Oso, and Oso diversions are computed in URGWOM with consideration for the total annual limit (270,000 acre-ft/year), limited diversion for a decade (1,350,000 acre-ft/10 years), or the available space at Heron Reservoir. The annual and 10-year diversion limits are input to the SanJuanChamaRules data object. If the diversion is limited based on one of these criteria, a different algorithm may be used to compute each diversion if the total diversion will be less than 150 cfs. Otherwise and if the diversions are not input, the diversions are set based on the input diversion capacities of 520 cfs for the Blanco diversion, 650 cfs for the Oso Diversion, and 150 cfs for the Little Oso diversion and with consideration for the minimum bypasses presented in Table 2.1. The capacities are input in the Max Diversion table slots for the corresponding diversion objects, and the minimum bypasses are input to the reach objects for the San Juan tributaries. Refer to the discussion for the San Juan Diversions rule for more information on how the San Juan diversions are computed in the model.

Figure 2.1. Photo of Little Oso Diversion (courtesy of Reclamation)

Figure 2.2. Photo of the Oso Diversion (courtesy of Reclamation)

San Juan water is allocated to contractors on January 1 of each year if water is available. The contracted allocations (Refer to Table 2.2) are input to the SanJuanContractorAllocations table slot in the HeronData data object. If the storage in the federal pool at Heron Reservoir is greater than the total allocation for all contractors, the full allocation is then made to all the contractors.

Otherwise, the contractors receive a portion of the common pool for San Juan-Chama Project water based on the ratio of their contracted allocation to the sum of the contracted allocations for all the contractors. Additional allocations up to the contracted total allocation are made in the same manner on a subsequent date (e.g. July 1) if full allocations could not be made on January 1. Refer to the discussion for the SetSanJuanContractorAllocations and SetAdditionalSanJuanContractorAllocations IfNeeded rules for more details on how these allocations are made in the model.

Within the model, separate accounting is included to track San Juan-Chama Project water versus native Rio Grande water throughout the system as San Juan-Chama Project water is delivered to contractors or to storage accounts. Storage of San Juan-Chama Project water is only authorized at Heron Reservoir, so native Rio Grande water is required to be bypassed and therefore is not to be stored. The contractors do not have dedicated storage space at Heron Reservoir, so if contractors have not called for their water by December 31, they lose their allocation and it remains in Heron Reservoir as part of the project supply, or the common pool (i.e. there is no carryover of annual allocations). The Bureau of Reclamation (Reclamation) may issue waivers to allow for contractors to store water in Heron Reservoir until as late as September 30th of the following year. This has been allowed because of the resulting ecological benefits and the benefits to Reclamation from the added operational flexibility. San Juan-Chama Project water will not be released from Heron Reservoir if it is spilling or it has full ice coverage as determined with the HeronSJReleaseRestrictions rule.

Contractors for San Juan-Chama Project water may cause depletions in the basin and then use allocated San Juan-Chama Project water to pay back the river. Actual paybacks are determined by the Office of the State Engineer using the groundwater models (depletions are generally caused by groundwater pumping) or other tools, and the deliveries are requested through letters from the Office of the State Engineer to Reclamation, hence the name "letter water deliveries." Within URGWOM, the Exchanges Manager in RiverWare is used to establish debts for contractors to deliver water to pay back MRGCD as a paper water transfer at El Vado Reservoir, deliver the water from Abiquiu Reservoir as needed to contribute to meeting the MRGCD demand, or deliver the water from Abiquiu Reservoir to Elephant Butte during the winter to pay back the Compact depending on the model inputs. Separate accounting supplies are set up for the different payback options for each contractor.

San Juan-Chama Project water may be released from Heron Dam to fill downstream allocated storage space. Any water released from Heron Reservoir to storage space at Abiquiu Reservoir is simply passed through El Vado Reservoir. MRGCD will store San Juan-Chama Project water at El Vado Reservoir in the space available above the storage of native Rio Grande water. MRGCD may also allow for other contractors to use extra space at El Vado Reservoir where the water is temporarily stored up to an estimated amount that can be evacuated before the next runoff. MRGCD will keep their San Juan-Chama Project water in storage at El Vado Reservoir and deliver the water to meet the irrigation demand in the Middle Valley after all native supplies have been exhausted.

Some contractors have contracts to store San Juan-Chama Project water at Abiquiu Reservoir up to a pool elevation of 6220 ft with the majority of the space allocated to the Albuquerque Bernalillo County Water Utility Authority (Albuquerque). The actual allocated storage space decreases due to sediment accumulation. Albuquerque will store water until it is needed to meet the demand at their surface water diversion or for letter water deliveries. Deliveries of San Juan-Chama Project water from Abiquiu Reservoir are simply passed through at Cochiti Lake except for the San Juan-Chama Project water delivered to maintain the 1200 acre recreation pool at Cochiti Lake.

2.2. Flood Control Operations

All the reservoirs are operated to comply with flood operations criteria and downstream channel capacities as possible. If the pool elevation at a reservoir exceeds a designated threshold, releases will be adjusted accordingly. If there is an unregulated spill, the releases will be reduced as possible per flood control policy to comply with the downstream channel capacities. Releases will also be adjusted to comply with stepped release restrictions as possible. The computed outflows include consideration for restrictions due to the physical constraints of the outlet works.

At Heron Reservoir, the change in the pool elevation over one day is restricted to be no greater than 1.0 ft (Refer to the discussion for the HeronCheckDeltaStorage rule for more details). At El Vado Reservoir, if the pool elevation exceeds the maximum allowable elevation of 6901.0 ft, the outflow will be set to the release required to reduce the pool elevation down to that maximum allowable elevation or the maximum possible release through the outlet works if that maximum possible outflow is lower (Refer to the discussion for the ElVadoFloodControl rule for more information). As a higher priority, the release will be restricted to be no greater than the downstream channel capacity of 5000 cfs (Refer to the write-up for the ElVadoChannelCapacity Rule in the ElVado policy group).

Figure 2.3. Photo of El Vado Dam (courtesy of Reclamation)

At Abiquiu Reservoir, water will be "pre-evacuated" before April 30 if the forecasted inflow will increase the pool elevations at El Vado Reservoir and/or Abiquiu Reservoir over either of the corresponding maximum allowable elevations by a certain threshold. The pre-evacuation release is set to the average required release to evacuate the forecasted inflow before August 1. The stepped release restrictions as captured by the AbiquiuSteppedRelease rule and the downstream channel capacities of 1800 cfs below the dam, 3000 cfs at Chamita, and 10,000 cfs at Otowi as checked with the AbiquiuChannelCapacityRestrictions rule are higher priority. As an even higher priority, a maintenance outflow can be input to override normal operations (Such a maintenance flow would likely only be used to simulate a unique situation). If there is an unregulated spill at Abiquiu Reservoir, the releases will be reduced as possible to comply with the downstream channel capacities. The policy for Abiquiu Reservoir includes an additional stipulation that allows for water that was stored under flood operations to be carried over until after the irrigation season starting on July 1 and after the flow at Otowi drops below 1500 cfs. That carryover storage is then released from November 1 through March 31 based on the current inputs, but these dates can be changed.

Flood control operations at Cochiti Dam and Jemez Canyon Dam involve consideration for the combination of the outflows from each dam. The releases are adjusted based on the ratio of the available space at each reservoir to the total available space in both reservoirs in order to comply with the channel capacity at Central, currently input as 7000 cfs, and San Marcial, currently input as 5000 cfs (Refer to the CentralChannelCapacityRule, SanMarcialChannelCapacityRule, JemezSanMarcialChannelCapacity, and CochitiChannelCapacityRestricions rules). The channel capacity at San Marcial is lower due to the current constraint at the railroad bridge. Stepped release restrictions at both Cochiti Dam and Jemez Canyon Dam as captured by the CochitiSteppedRelease rule are higher priority. If necessary, releases will be adjusted to balance operations as stipulated in the water control manuals for each facility using the CochitiWCMBalancedRelease rule. If there is an unregulated spill at Cochiti Dam, the release through the gates will be reduced to comply with the downstream channel capacity as possible using the CochitiFloodControl rule.

At Elephant Butte Dam, if necessary, the release will be increased to reduce the pool elevation down to the corresponding winter or summer "prudent" elevation. That release is restricted to be no greater than the downstream channel capacity of 5000 cfs. The prudent pool elevation is based on having 50,000 acre-ft of space available below the top of the conservation pool from March through October (summer) and 25,000 acre-ft of space vacant from November through February (winter) (Refer to the discussion for the ElephantButteOutflowRestrictions rule).

At Caballo Dam, the release will be set to the maximum outflow if the pool elevation exceeds the maximum elevation of 4182.0 ft. Below that maximum elevation, the release will be set to the appropriate value in the flood release table if that lookup value will reduce the pool elevation below the threshold flood pool elevation of 4172.45 ft, or the inflow will be bypassed if that inflow is greater than the outflow required to reduce the pool elevation below that flood pool elevation (Refer to the write-up for the CaballoFloodControlReleaseBasedOnFORD rule). As a lower priority policy, the release from Caballo Dam will be reduced as possible to comply with the downstream channel capacity of 11,000 cfs at El Paso as coded for the CaballoOutflowRestrictions rule.

2.3. Rio Grande Compact

Equations are coded into expression series slots in the RioGrandeCompact data object (and RioGrandeCompactMonthly data object) in the model for completing New Mexico calculations for the Rio Grande Compact (States of New Mexico, Colorado, and Texas, 1938). The calculations involve determining the native Rio Grande flow at Otowi excluding San Juan-Chama Project water. The Otowi Index Supply is computed and the corresponding scheduled delivery to Elephant Butte Reservoir is determined (Refer to the flowchart in Figure 2.4 for the steps for this calculation with reference to each expression series slot in the model). The actual delivery to Elephant Butte Reservoir is also computed, and a flowchart for the calculation is displayed in Figure 2.5. An annual net adjustment to the Compact credit is calculated as the difference between the Elephant

Butte Effective Supply and the scheduled delivery to Elephant Butte Reservoir. The annual net adjustment is applied at the end of each calendar year to the running Compact credit. Evaporation losses are applied to a Compact credit during the year (but not a Compact debt).

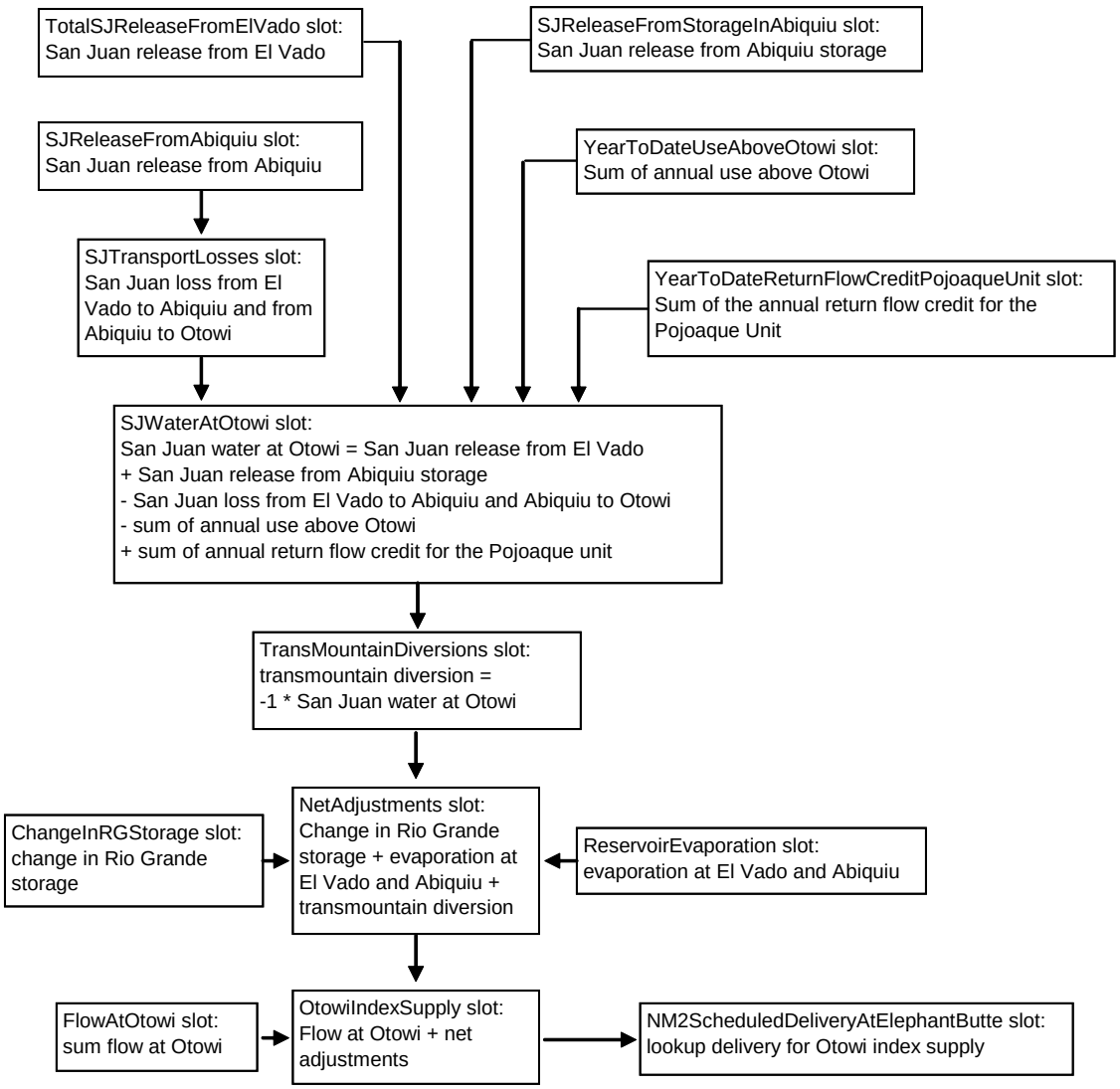

Figure 2.4. Flowchart for New Mexico Rio Grande Compact Calculations – Compute Otowi Index Supply and Scheduled Delivery at Elephant Butte Reservoir

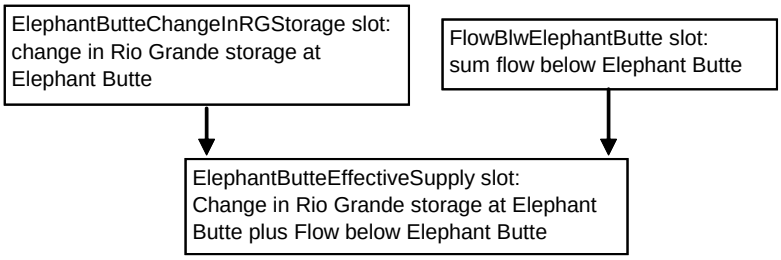

Figure 2.5. Flowchart for New Mexico Rio Grande Compact Calculations – Compute Elephant Butte Effective Supply

2.3.1. Article VII of the Rio Grande Compact

Under Article VII of the Rio Grande Compact (States of New Mexico, Colorado, and Texas, 1938), it is stipulated that native Rio Grande water cannot be stored in post-1929 reservoirs when the usable storage is less than 400,000 acre-ft. This does not include the Prior and Paramount (P&P) storage for the six Middle Rio Grande pueblos as discussed in Section 2.4.3. The usable storage is computed with the ComputeUsableStorage rule and includes the total storage at Elephant Butte Reservoir and Caballo Reservoir minus credit water stored at Elephant Butte Reservoir, as of December 31, and any San Juan-Chama Project water as tracked in the accounting. The usable storage is also updated for any relinquished Compact credits as discussed in the next section. For each timestep in the model, a switch is set with the SetCompactArticleVIISwitch rule to identify whether the stipulations of Article VII of the Compact are in effect for that day. That switch is then referenced throughout the ruleset. Article VII status affects storage of native Rio Grande water at El Vado Reservoir.

2.3.2. Relinquished Credits and Emergency Drought Water

Agreements have been made in the past where Compact credits are relinquished and allocations are made for storage of native Rio Grande water at El Vado Reservoir as Emergency Drought water when stipulations of Article VII of the Compact are in effect. Policy is coded to simulate relinquished Compact credits and the subsequent storage of Emergency Drought water. If this aspect of policy is modeled, the assumption is that Compact credits will be relinquished annually on an input date each year if the Compact credit exceeds an input threshold to reduce the credit to an input target credit after a relinquishment (SetRelinquishedCompactCredits rule). The magnitude of a relinquishment can also be input. Allocations for subsequent storage of Emergency Drought water at El Vado Reservoir are set in the UpdateEmergencyDroughtStorage Allocations rule based on input fractions (summing to one) of the relinquished credit for each of three purposes: MRGCD, ESA, and municipalities.

Inflows of native Rio Grande water to El Vado Reservoir when Article VII is in effect are then stored to separate accounts for Emergency Drought water after any P&P storage

requirement is met first (Refer to Section 2.4.3 for more information on P&P storage). Storage accumulates in the Emergency Drought accounts with the actual inflow of native Rio Grande water. The allocation for storage of Emergency Drought water for municipalities is tracked but is not currently used since exact policy for how such water would be used by municipalities has not been defined. MRGCD water is used to meet their diversion demand, and ESA water is used to meet target flows in the Middle Valley.

If needed, storage of Emergency Drought water could potentially be modeled as reregulation storage at Abiquiu and/or Cochiti Reservoirs using the RioGrandeConservation accounts at these reservoirs as this operation has occurred in the past.

2.4. Diversions

Diversions are set in the model for numerous diversions on the Rio Chama, the four main MRGCD diversions, the Albuquerque surface water diversion, and the Buckman Direct Diversion.

2.4.1. Rio Chama Diversions/Acequias

There are five aggregate diversion site objects in the model that represent diversions from the Rio Chama. The Scull and Monastery diversions are included together above Abiquiu Reservoir. The diversion requested for each individual diversion is input to the RioChamaDiversionData object and referenced with the SetRioChamaDiversionAnd DepletionRequested rule. The depletion requested is also set with the same rule based on the input fractional return flow in the RioChamaDiversionData object. The input fractional return flow is currently set to 0.5 for all the Rio Chama diversions for all months. Other diversions are located below Abiquiu Dam, and the diversion and depletion requested values for each are set in the same manner. The Chili diversion, the Chamita and Hernandez diversions, and the Salazar diversion are subtracted at three separate locations further downstream. Note that there will be no storage of water at El Vado Reservoir if it would deprive these downstream acequias of water. A minimum outflow is also maintained at El Vado Dam during the irrigation season to assure water is delivered to the acequias. This minimum outflow is bypassed at Abiquiu Dam.

2.4.2. MRGCD Diversions

Diversions by MRGCD at Cochiti, Angostura, Isleta, and San Acacia are set with the SetMiddleRioGrandeDiversionRequested rule based on input diversion requested values in the MRGCD data object or synthetic diversion schedules if diversion series are not input. Diversions from Cochiti Lake to the Sili and Eastside Main canals are subtracted in the model immediately below Cochiti Dam. Diversions at Angostura to the Atrisco Feeder and Albuquerque Main Canal are subtracted using the AngosturaDiversions

aggregate diversion site object. The input diversions to the Belen High Line Canal and Peralta Main Canal along with the Cacique Acequia, Chical Acequia, and Chical Lateral are subtracted at the Isleta diversion. The requested diversions to the Low Flow Conveyance Channel at the San Acacia diversion dam are also input to the MRGCD data object. Diversions to the Socorro main canal are set with consideration for flows from the Unit 7 drain.

Releases from upstream storage for the MRGCD diversions are set with reference to a single demand at Cochiti Lake. The demand curve reflects the use of return flows at downstream diversions. Native Rio Grande water in storage at El Vado Reservoir will be released to meet the demand as needed if water is available. Any available Emergency Drought water will be used thereafter, and MRGCD San Juan-Chama Project water will be used after all native supplies have been exhausted.

2.4.3. Six Middle Rio Grande Pueblos

There are six pueblos in the Middle Valley: Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. Reservoir operations may entail releasing water if the supply is insufficient to irrigate the 8,847 acres of irrigated land at the pueblos. The Indian irrigation season runs from March 1 to November 15. Irrigated acreage for the pueblos is not distinguished from MRGCD land in URGWOM and diversions to the pueblos are included with MRGCD diversions; however, the storage and release of Prior and Paramount (P&P) water for the pueblos to assure the P&P demand is met is tracked separately in URGWOM.

An initial P&P storage requirement is computed on March 1 (and updated on April 1 and May 1) with the ComputePandPStorageRequirement rule to set the storage required to meet the demand for the remainder of the irrigation season. The storage requirement includes additional storage needed for any dead storage (or unavailable storage below the outlet works) at El Vado Dam. The P&P storage requirement is computed based on the approach implemented by the Bureau of Indian Affairs (BIA).

The storage requirement is computed as an estimated storage required to meet a monthly demand for the remainder of the year minus the estimated flow that will be available for the remainder of the year as computed with reference to an Otowi forecast volume. A release is made from P&P storage at El Vado if the flow from the mainstem, based on the modeled flow at Embudo, would not meet the demand for the pueblos. This release is made independently of the available supply for MRGCD. The needed release is computed with the rules in the ComputeCallForPandPRelease policy group.

2.4.3.1. Increased Angostura Diversions

When MRGCD is in a shortage situation which is indicated when the MRGCD Demand at Cochiti cannot be met with the river flow or the available water in storage for MRGCD, diversions at Angostura are then increased from the regular diversion requested

values to the total canal capacity of 400 cfs. This adjustment is completed with the ResetAngosturaDiversionForShortageOps rule. These increased diversions assure water is delivered to the pueblos and reflect adjustments in MRGCD operations during shortage situations such that the limited supply is used most efficiently.

2.4.4. Albuquerque Diversion

The Albuquerque diversion is set up as a water user object in the model, and the diversion requested is computed with rules in the SetAlbuquerqueDiversion policy group. The diversions are generally set to double the full demand for Albuquerque San Juan-Chama Project water as input to the AlbuquerqueDiversions data object, with a 50 percent return flow credit for the native water that is diverted, unless it is determined that the diversion should be curtailed or cut off per the diversion permit. If diversions are subject to curtailment, diversions may still be met with additional San Juan-Chama Project water if a switch is set in the model. Also, if San Juan-Chama Project water cannot be delivered because of flood control operations at Abiquiu, diversions may be met with additional Rio Grande water to be paid back later with an exchange for San Juan-Chama Project water at Elephant Butte Reservoir if another switch is set.

Releases of Albuquerque's San Juan-Chama Project water are generally set to provide 65 cfs with loss rates applied. The loss rate is based on the San Juan-Chama loss rate of 1.23 percent from Abiquiu to Cochiti and monthly loss rates from Cochiti to the diversion. A threshold of 135 cfs for native Rio Grande flow is input for curtailing the diversions per the permit and 70 cfs is input as the threshold for native Rio Grande flow for cutting off the diversions.

Coded policy also includes a check against preemptive cutoff criteria where a preemptive cutoff is implemented before actual permit restrictions would result in curtailed diversions or also during high flows. The preemptive cutoff represents the assumption that Albuquerque would switch to groundwater during low flows before curtailment per the permit would occur or during high flows when it may be unsafe or impractical to operate the diversion dam or when flood control operations at Abiquiu or Cochiti might prevent Albuquerque from receiving a delivery of their allocated San Juan-Chama Project water. The high flow thresholds for a preemptive diversion cutoff are set to 1800 cfs out of Abiquiu or 4500 cfs out of Cochiti. The threshold low flow for a preemptive cutoff is 200 cfs and diversions will not restart until at least two weeks after any preemptive cutoff criterion is not satisfied and the flow at Central is greater than 250 cfs.

Wastewater returns from Albuquerque are set as an input based on historical data and are not affected by a cutoff to the surface water diversions as actual wastewater returns are not dependent on whether surface water or groundwater is being used to provide drinking water. Assumed returns range from approximately 77.5 cfs to 83.4 cfs (slightly more than half the diversion).

2.4.5. Buckman Direct Diversion

The Buckman Direct Diversion is modeled with a water user object for the diversion below the Otowi stream gage. Diversions are modeled based on an assumed average rate for the future for Santa Fe City and Santa Fe County to use their allocations of San Juan-Chama Project water, and an average rate for diversion for native Rio Grande water is included based on water rights that may be in place for each. Portions of Rio Grande water diverted for the mixing operation at the diversion are also included for each, and return flow fraction is computed for the immediate return of this portion of the diversion. Criteria for the curtailment or cutoff of the diversions of native Rio Grande water are modeled. The diversions and fraction return rate are set with the rules in the SetBuckmanDiversion policy group.

2.5. Downstream Target Flows

Releases of supplemental water for targets are made in the model with consideration of the physical losses as represented by all the different methods in the model. The physical model was calibrated with reference to results from a simulation for historical operations versus historical gage data. Supplemental water consists of leased San Juan-Chama Project water or Emergency Drought water stored at El Vado Reservoir that is specifically designated for targets.

Targets are input to a table and established for hydrology year types: dry, average, or wet. Targets in the table may be adjusted based on an input adjustment factor. A step down in targets after the continuous flow requirement is included in the current target table, and additional step downs at Isleta, San Acacia, and San Marcial may be implemented for discretionary operations as discussed further in Section 2.5.3. Targets are identified at each timestep using the MinCentralTarget and MinIsletaSanAcaciaSanMarcialFlow Targets rules. The Central targets may be modified to provide recruitment or overbank flows as part of Cochiti deviations.

2.5.1. Hydrology Year Type

The year classification for setting targets in the model is set using the Hydrology Year Type rule based on a March through July forecasted flow volume at Otowi calculated with reference to input inflows. This approach essentially matches the actual approach of referencing the runoff forecast. The year will be classified as dry or wet if the forecasted flow volume is less than 80% of the average Otowi flow volume or greater than 120% of average, respectively. The determined year classification on May 1 is maintained for the remainder of a calendar year. A year is classified as dry regardless of the forecast if the stipulations of Article VII of the Compact are in effect, but since the year classification is set for the remainder of the year on May 1st, the year classification will not change if the Article VII status changes after May 1st.

2.5.2. Adjustment Factor

An adjustment factor is included in URGWOM to increase targets by a percentage (i.e. a target of 100 cfs will increase to 125 cfs with a 25% adjustment factor). A 25% adjustment factor is currently applied to targets because the model can set releases from Abiquiu to hit targets in the Middle Valley with much better precision than can be done in actual operations. Uncertainty about conveyance losses, MRGCD returns, local inflows, etc. combined with the travel time from Abiquiu Dam to target locations and other physical operational constraints prevent actual releases from being adjusted with such precision, so an adjustment factor is applied to targets in the model such that modeled supplemental water releases more accurately reflect actual release volumes.

2.5.3. Discretionary Operations

URGWOM is set up to simulate discretionary operations as part of the 2003 BO which entail using supplemental water to manage the recession after the runoff and control the rate of drying after river rewetting for minnow salvage. Coded policy for representing discretionary operations entails implementing a 30-day step down in targets at the end of the runoff and 7-day step downs in targets thereafter following each river rewetting event. Magnitudes for the initial flow for the step downs in targets are set to 50, 100, and 50 cfs for initial targets at Isleta, San Acacia, and San Marcial with targets decreasing to zero in five steps for the initial 30-day step down and 7 steps for the subsequent 7-day step downs. Switches are included in the model such that the two separate implementations of step downs in targets can be turned on/off.

2.5.4. Supplemental Water Needed For Targets

Daily needed releases from Abiquiu Dam to meet targets at Central, Isleta, San Acacia, and San Marcial are computed in the model using hypothetical simulations, or separate side simulations in RiverWare used to iterate and solve for the upstream flow needed to meet a target at a downstream location. Needed releases are determined for the downstream targets. The separate side simulations include consideration for all MRGCD diversions and estimated returns and any diversions by Albuquerque. Four instances of hypothetical simulation are completed for each target location with the rules that include ComputeMinCochitiReleaseFor… in the rule name and the highest needed flow at Cochiti is determined with the ComputeMinCochitiReleaseForAllMiddleValleyTargets rule. The determined minimum flow is a *total flow* needed for targets that includes water needed for MRGCD and Albuquerque diversions. Another instance of hypothetical simulation is completed for the segment of the model from Abiquiu Dam to Cochiti Lake to determine the total flow needed from Abiquiu Reservoir as determined in the ComputeTotalFlowNeededAtAbiquiuForAllMiddleValleyTargets rule.

The amount of supplemental water needed from Abiquiu is computed by subtracting the release of native Rio Grande water, letter water deliveries, any release of MRGCD San

Juan-Chama Project water, the release of Albuquerque's San Juan-Chama Project water for the surface water diversion, and deliveries to the Buckman Direct Diversion from the determined total flow needed at Abiquiu for targets. The resulting amount of supplemental water needed varies daily based on the estimated physical losses, but the needed release of supplemental water is not adjusted until the supplemental water needed based on the physical losses has changed by more than 50 cfs and will not be adjusted twice within three days. The computational approach for adjusting the releases is configured such that the volume for the release of supplemental water approximately matches the volume of supplemental water needed based on the hypothetical simulations. Refer to Figure 2.6 for a flow chart that depicts the series of steps for setting a release of supplemental water from Abiquiu Reservoir starting with the targets at the four target locations.

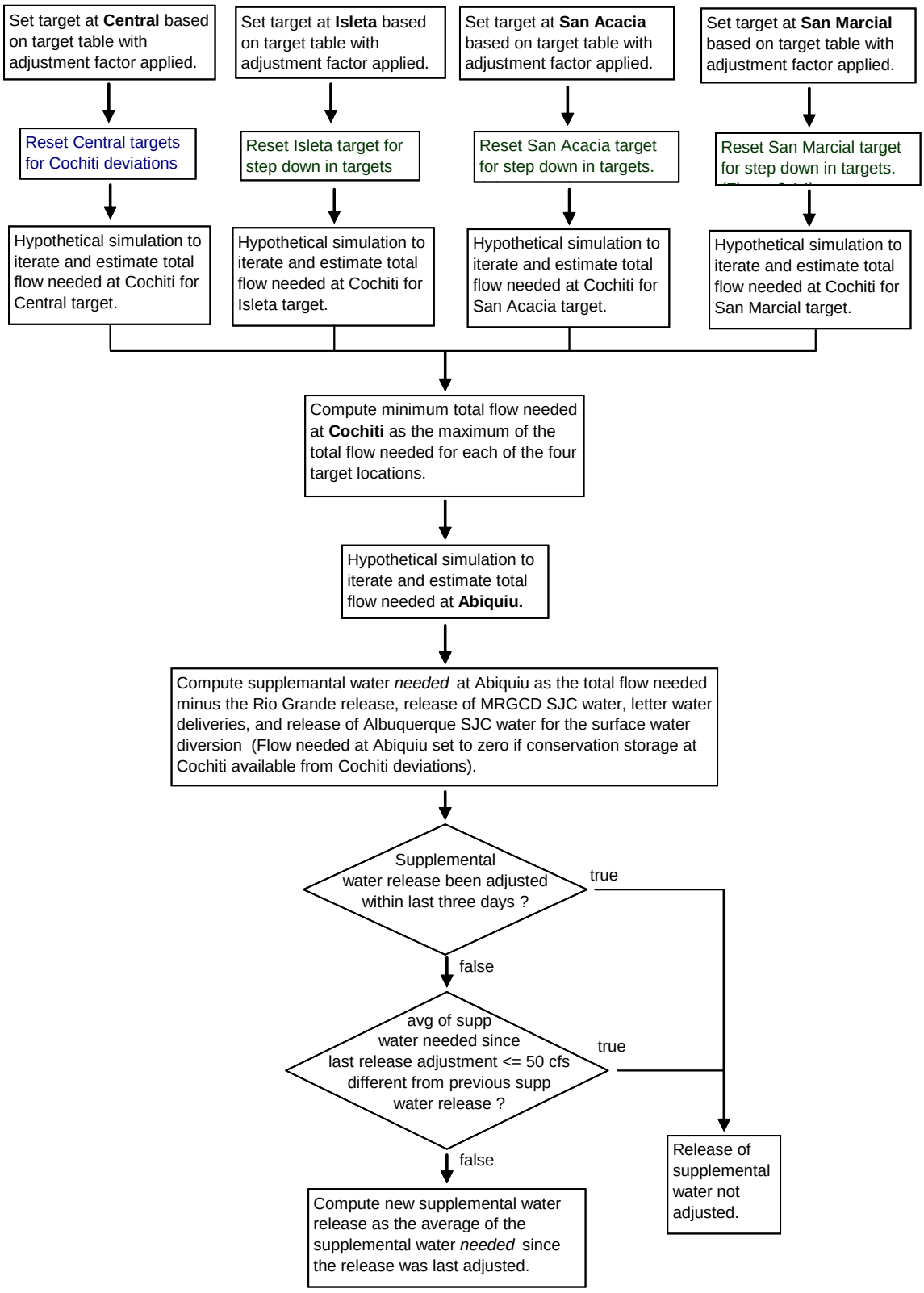

Figure 2.6. Flow Chart for Logic to Set Release of Supplemental Water from Abiquiu

2.5.5. Shorted Diversions

If MRGCD is in a shortage situation and does not have the supply to meet their full demand, it is possible that full MRGCD requested diversions would not be met. Requested diversions may then be shorted in the model in such a shortage situation to prevent the diversion of released supplemental water that is specifically designated for meeting target flows. These adjustments are implemented in a simulation with rules in the SetMiddleValleyOperations policy group by completing additional side simulations to iterate and solve for what the diversions would be without supplemental water, and requested diversions at the main MRGCD diversions are reset from the full requested diversions to the determined shorted diversion. This assumption is currently only applied if there are downstream targets. If there are no downstream targets, it is assumed that any supplemental water still in the river is available for diversion. For example, if supplemental water is released to meet a target flow at Central, diversions may be shorted at Cochiti or Angostura if MRGCD would not have received their full requested diversion at those locations without supplemental water, but if there were no targets below Central, remaining supplemental water in the river at Isleta may be diverted at the Isleta diversion during a shortage situation.

2.5.6. Pumping from the Low Flow Conveyance Channel

URGWOM is set up to model pumping of flows from the Low Flow Conveyance Channel (LFCC) to the river to prevent river drying. Refer to Figure 2.7 for a picture of pumps used to pump from the LFCC. Diversions at the Neil Cupp site, North Boundary of the Bosque del Apache National Wildlife Refuge, and South Boundary are simulated (Pumping at the Fort Craig site was determined to be inconsequential to URGWOM simulation results and is not included). Water that seeps into the Low Flow Conveyance Channel is pumped to the river where pumping begins based on specific river flow triggers. Different triggers could be established as a function of the year classification for setting targets; although, the threshold low San Acacia flow triggers for initiating pumping at each site are the same in the current model regardless of the year type. Different values can be set up for the winter of wet years.

After pumping has initiated at a site, pumping will continue for a minimum of one week and until the flow at San Acacia has exceeded 150 cfs. Pumping will cease for the year at each site after input dates for each site. It is assumed in the current model that pumps at the Neil Cupp site and North Boundary would not be used after June 30th. This aspect of operations can be turned off fairly easily by setting the date to shut off pumping at each site to January 1st.

Figure 2.7. Low Flow Conveyance Channel Pumps

2.6. Recreation

There are two key recreation factors that affect policy in the basin. A portion of the San Juan water is used to maintain a permanent recreation pool of 1200 acres at Cochiti Lake, and a rafting release from El Vado Dam may be modeled. The annual allocation of San Juan-Chama Project water for the Cochiti Rec Pool is 5000 acre-ft, and the water is delivered to maintain a content of 49,370 acre-ft plus any sediment accumulation at Cochiti Lake which corresponds to a reservoir surface area of approximately 1200 acres. A switch is included in the model to neglect the modeled sedimentation and target a total storage of 49,370 acre-ft or allow for the water need to reduce with modeled sedimentation and only target the 1200 acre surface area.

The model is also set up to move contractor San Juan-Chama Project water from Heron Reservoir to Abiquiu Reservoir in a manner to provide rafting flows below El Vado Dam based on an input rafting flow schedule. Actual operations entail moving contractor San Juan-Chama Project, as possible, on weekends starting Memorial Day weekend or by the July 4th holiday through Labor Day weekend to provide rafting flows. Rafting releases are modeled in URGWOM by moving contractor San Juan-Chama Project water from Heron Reservoir to Abiquiu Reservoir as needed to augment flows below El Vado Dam and meet rafting flow targets. This policy is only modeled if switches are set for a contractor to move the water to provide the rafting flows.

III. Priorities for Rule Execution

The rules in the URGWOM ruleset execute, or fire, in reverse order from the lowest priority rule to the highest priority rule (Rule 1) and are sorted from upstream to downstream for setting reservoir releases. The lowest priority rules in the SetInputsToSyntheticValuesIfNotDirectlyInput policy group are used to check inputs if switches are set by the model user. The switches would be set such that the rules do not fire after all needed inputs are set and confirmed (Refer to Figure 1.2 for a list of all the policy groups). Next, several needed inputs will be set to assumed or synthetic projected values if values are not input. Several initialization steps are completed with the rules to identify the state of the system (e.g. Article VII status, hydrology year type, etc.) and numerous demands, diversions, and individual deliveries are set or computed to be referenced when setting the outflow from each dam. The model contains a data object called ComputedDeliveries with all the initial computed deliveries referenced for setting the initial reservoir outflows and for setting the final deliveries as possible with the final set total outflow.

For each dam, there are essentially three steps to arrive at a final outflow and final value for individual deliveries. The initial deliveries are computed for individual contractor deliveries of San Juan-Chama Project water and for releases of native Rio Grande water. An initial total outflow is determined and then checked against physical and legal constraints where outflows can then be altered if not within the normal range of operations, either due to high flows (flood control operations) or low flows (minimum releases). Flood control operations tend to have the highest priority (i.e. lower rule number) because of safety and damage considerations. The outflow is set with consideration for flood control operation criteria if reservoir pool elevations exceed specific thresholds. The outflow will be restricted to comply with downstream channel capacities as possible, and stepped release restrictions may also be a priority. The computed total outflow will also be checked to assure it exceeds a designated minimum outflow. The determined final outflow is always checked to assure the release is legitimate based on the outlet works for the dam. If there is an unregulated spill, the total release is adjusted as much as possible by using the regulated outflow through the gates at the dam. Given the reservoir pool elevation, the outflow may also be restricted based on the rating curve for the outlet works.

After the final total outflow has been set, a final reconciled outflow of Rio Grande and San Juan-Chama Project water is computed and used to identify the final values for individual deliveries and accounting supplies are set. (For most cases, the initial deliveries can be made with no adjustments needed for flood control operations or the physical constraints of the system). Refer to Appendix A for a flowchart of the overall policy and a depiction of the procedure used to ultimately set the reservoir outflows and individual deliveries at each timestep.

3.1. Heron Dam

Releases of Rio Grande and San Juan-Chama Project water from Heron Dam under normal operations are computed with the ComputeHeronRGRelease and the ComputeHeronSJRelease Rules, respectively, and a predetermined total outflow is set to the sum with the HeronOutflow Rule. Rio Grande water is effectively bypassed, but operations actually entail making releases during the runoff and evacuating Rio Grande water during other periods after storage accumulates which is replicated with the rules in URGWOM.

Figure 3.1. Photo of Heron Reservoir

San Juan-Chama Project water is released from Heron Reservoir to fill downstream allocated storage space for contractors or to meet other contractor demands. If the ice coverage at Heron Reservoir is equal to a value of 1.0 (i.e. 100% ice coverage) as input to the HeronData data object, the release of San Juan-Chama Project water is reset to zero. The ice coverage is included as part of the CurrentSurfaceAreaPanAndIce evaporation method within RiverWare. Also, if the elevation at Heron Dam is greater than the Maximum elevation of 7186.1 ft and Heron Dam must spill, the release of San Juan water is reset to zero. Refer to the discussion for the HeronSJReleaseRestrictions Rule for more details on coding for these two criteria. Flood operation criteria are checked with the HeronCheckDeltaStorage Rule, and the final outflow of Rio Grande water is reconciled with the SetHeronRGAccount Rule. If the total release exceeds the predetermined release of Rio Grande water, the Rio Grande outflow is reconciled to equal that lower total outflow. If the total release exceeds the sum of the predetermined release of Rio Grande and San Juan water, the Rio Grande outflow is reconciled to include that additional outflow.


Figure 3.2. Photo of Heron Dam
(courtesy of Reclamation)

3.2. El Vado Dam

For El Vado Dam, the predetermined release of Rio Grande and San Juan water is computed with the EstimateElVadoRGRelease and ComputeElVadoSJRelease Rules, respectively, and a predetermined total outflow is set to the sum of the two with the ElVadoOutflow Rule with consideration for a computed minimum release. MRGCD San Juan-Chama Project water is stored at El Vado Reservoir as space is available with the storage of native Rio Grande water. Native Rio Grande water is stored, as *not* needed to meet downstream demands, if the stipulations of Article VII of the Rio Grande Compact are not in effect. Otherwise, all native Rio Grande water is bypassed if not needed for

P&P storage or Emergency Drought storage. Flood operations and the downstream channel capacities are checked with the ElVadoFloodControl and ElVadoChannel Capacity Rules, respectively, and the final outflow of Rio Grande water is reconciled with the SetElVadoRGAccounts Rule.

Figure 3.3. Photo of the Outlet Works at El Vado Dam

3.3. Abiquiu Dam

Predetermined releases of Rio Grande and San Juan water from Abiquiu Dam are computed with the ComputeAbiquiuRGRelease and ComputeAbiquiuSJRelease Rules, respectively. The subsequent total outflow is set as the sum of the two. Rio Grande water is bypassed at Abiquiu Dam unless storage is required for flood control operations or is being modeled as proposed conservation storage. Releases of San Juan-Chama Project water include bypassed inflows and releases from storage for contractors to meet downstream demands including the Albuquerque surface water diversions and Buckman Direct Diversion. The predetermined total outflow is checked against a 25 cfs minimum outflow. The minimum required flow for the Rio Chama acequias during the irrigation season is maintained with the minimum flow out of El Vado Dam which is bypassed at Abiquiu Dam.

Any water stored for flood control operations may be locked in as carryover storage at Abiquiu Reservoir between July and October if 212,000 acre-ft of space is available at Cochiti Lake and the flow at Otowi drops below 1500 cfs before the stored water can be evacuated. That carryover storage is then released from November through March (or

other periods for the release of carryover storage can be defined). If it is determined that water needs to be pre-evacuated at Abiquiu Reservoir in anticipation of large forecasted inflows, the outflow from Abiquiu Dam is reset based on a computed pre-evacuation flow which includes consideration for the downstream channel capacity and stepped release restrictions (Refer to the AbiquiuPreEvacuation Rule). The stepped release and downstream channel capacity restrictions are checked with the AbiquiuSteppedRelease and AbiquiuChannelCapacityRestrictions Rules, respectively. For Abiquiu Dam, a maintenance flow may be input. Flood operations criteria are checked with the AbiquiuFloodControl Rule, and the final outflow of Rio Grande water is reconciled with the SetAbiquiuRioGrandeAccountingSupply Rule.

Figure 3.4. Photo of the Outlet Works at Abiquiu Dam

3.4. Cochiti and Jemez Canyon Dams

Releases from Cochiti and Jemez Canyon Dams are essentially computed together. The predetermined releases of Rio Grande and San Juan-Chama Project water for both dams are computed with the rules in the CochitiAndJemezDeliveries policy group. The total outflow from Cochiti Dam is set to bypass all inflows except for any inflows to potentially be transferred to conservation storage or any deliveries to the Cochiti Rec Pool plus also considering whether storage should be locked in at Cochiti Lake until after the irrigation season (Refer to the discussion for the CochitiOutflow rule).

The channel capacities at Central and San Marcial are checked with the CochitiChannel CapacityRestrictions rule with specific consideration for the combination of the flows

from both Cochiti and Jemez Canyon Dams. Stepped release restrictions at Cochiti Dam are checked with CochitiSteppedRelease Rule, and the rule for balanced operations of Cochiti and Jemez Canyon Dams as identified in the water control manuals for each dam are checked with the CochitiWCMBalancedRelease Rule. Flood operations criteria are checked with the CochitiFloodControl Rule, and the final outflow of Rio Grande water is reconciled with the SetCochitiRGAccount Rule. Inflows to Jemez Reservoir are bypassed.

3.4.1. Cochiti Deviations

Cochiti deviations are authorized through 2013 where the U.S. Army Corps of Engineers (Corps) may temporarily store native Rio Grande water to be released at the time of the peak and augment flows to provide recruitment flows in the Middle Valley (Corps, 2009). Specific criteria are coded for identifying whether the runoff is sufficient to enact Cochiti deviations to provide recruitment flows (or overbank flows) for the benefit of species listed under the Endangered Species Act but the runoff is insufficient for providing the needed hydrograph by just bypassing inflows at Cochiti Lake. Operations entail providing overbank flows if conditions support providing the higher flows. This aspect of policy can be set to expire based on an input year as the last year that Cochiti deviations are authorized – currently set to 2013.

Deviations will be implemented to provide recruitment flows if the March through July Otowi flow forecast is between 50% and 80% of average and the projected peak inflow to Cochiti Lake during the recruitment or overbank season is between 1800 and 5000 cfs or the March through July forecast is greater than 80% of average but the projected peak inflow is less than 3500 cfs. The projected peak inflow to Cochiti is estimated during an URGWOM simulation based on input inflows. Deviations will be implemented to provide overbank flows if the Otowi forecast is between 80% and 120% of average and the projected peak inflow to Cochiti is between 3500 and 10,000 cfs or the Otowi forecast is between 50% and 80% of average but the projected peak inflow is greater than 5000 cfs.

The date to start storage at Cochiti Lake for deviations can be input to URGWOM, but if no preset date is input in the current model, the date to begin storage is set to 24 days before the projected date of the peak inflow to Cochiti Lake. Target flows to provide recruitment or overbank flows are input as 30-day target hydrographs. If deviations are implemented, targets at Central are reset such that day five in the appropriate target hydrograph matches the date of the projected peak inflow to Cochiti Lake (Refer to the ResetCentralTargetForCochitiDeviations and SetConservationSpaceAtCochiti rule).

Water in reregulation storage for Cochiti deviations is released as needed for targets where the needed release reflects the adjusted targets at Central to provide either recruitment or overbank flows. Remaining water in reregulation storage will then be evacuated by the end of a deviations period which lasts for 45 days as currently input (ComputeCochitiRGConservationRelease rule). Water will begin to be evacuated 15

days before the end of the Cochiti deviations period at a constant rate if that constant rate is greater than the flow needed to meet targets. When the reregulation storage drops below 3000 acre-ft, targets are adjusted back to the original Central targets with the EndTargetsForOverbankOrRecruitment rule. This adjustment is needed to prevent other sources for supplemental water (i.e. leased San Juan-Chama Project water or Emergency Drought water) from being used to meet the recruitment or overbank targets.

3.5. Elephant Butte and Caballo Dams

Releases from Elephant Butte and Caballo Dams are initially set with ElephantButteOutflow and CaballoOutflow Rules based on an input full demand schedule and a computed percentage where the percentage reflects the portion of the full demand that can be provided based on the water in storage and the forecasted runoff. Downstream channel capacities are checked along with criteria for maintaining flood storage space.

IV. Other Topics

Descriptions of RiverWare and rulebased simulation are not provided in this report. New users of RiverWare or URGWOM are encouraged to attend the Simulation, Rulebased Simulation, and Accounting training courses held by CADSWES. The online help documentation should also be reviewed. There are a few particular aspects of RiverWare that are specifically discussed here to prepare new users for working with the URGWOM ruleset.

4.1. User-defined vs. Predefined Functions

Within RiverWare, there are numerous predefined functions. Several of these predefined functions are used in the URGWOM ruleset, but this document does not include descriptions of these predefined functions in RiverWare. Discussions of these functions are presented in the RiverWare online help. Logic for many of the user-defined functions is discussed in this document within the rule logic write-ups for each rule. Most of the functions used in the URGWOM ruleset are user-defined functions that were specifically created using the RiverWare rule policy language (RPL) by the URGWOM developers. The user-defined functions are grouped in separate utility groups.

4.2. Accounting

The accounting functionality within RiverWare is a major component of URGWOM. Separate accounts are set up to track the use and movement of San Juan-Chama Project water for individual contractors versus native Rio Grande water. The status of individual accounts is key for setting reservoir releases and identifying how and which demands will be met. The system has storage accounts at each reservoir with passthrough accounts between the reservoirs for all the different potential deliveries. Accounting supplies are used to set the deliveries or transfers between accounts. Refer to the RiverWare Accounting View in URGWOM for the accounting layout that also serves as an excellent visual aid for depicting the different aspects of policy.

4.2.1. Supplies

The primary role of the rules in setting the accounting is to set the accounting supplies for the deliveries from accounts or transfers between accounts at each timestep. A transfer may be from one account to another account to payback a debt or to deliver water from one location to another location. Note that the accounting supplies are also set in URGWOM at each reservoir for passthrough accounts. Passthrough accounts on the reservoirs can have storage that may result if the physical or legal constraints at the dam prevent an immediate passthrough. The nomenclature for supply names are based on the

following format: *ContractorName-Origin-ContractorName-Destination*. For example, the supply with a name of *MRGCDAbiquiuToReclamationAbiquiu* is the name for the supply to transfer water from the MRGCD account at Abiquiu Reservoir to Reclamation's account at Abiquiu Reservoir.

4.2.2. Exchanges

An Exchanges Manager is used in RiverWare to track debts between one contractor for San Juan-Chama Project water and another or a contractor's debt to payback the Rio Grande account for depletions. The exchanges are established to maintain a record of the debt, since that debt may not be paid back at the same timestep that the debt is established. The exchange essentially represents a follow-up demand on a source for San Juan-Chama Project water such as a reservoir storage account. The Exchanges Manager is a separate tracking system for monitoring the loans and the demand for a payback. Each timestep, supplies are set to pay back the debts based on input priorities for the use of San Juan-Chama Project water and the availability of San Juan-Chama Project water stored in and released from the source storage account.

The primary use of exchanges in URGWOM is to establish debts for contractor letter water deliveries to pay back MRGCD and the Compact based on input letter water delivery volumes in the LetterWaterDeliveryData data object for each contractor. These debts are set each timestep using the rules in the SetDebts LetterWater PastAlbLoan ToMRGCD EBExchange policy group.

4.3. Other RiverWare Features

Within the rules, slots may be checked to see if a value is a NaN, which stands for Not-a-Number. Slots will be populated with NaNs until values are input or assignments are made during the rulebased simulation. If a value is a NaN, no assignment has been made yet for the identified timestep. If the value is not a NaN, an assignment has already been made, and this is checked as an Execution Constraint for some rules to prevent assignments from being attempted again. This is done such that the simulation will be completed more efficiently. It is also important to understand that a simulation begins at the start timestep, but the timestep before the start timestep is the initial timestep which may contain many key input values that are needed at the start timestep.

Several subbasins are identified in URGWOM. Subbasins are automatically created in RiverWare but may also be established as user-defined subbasins. The subbasins are lists of objects in the model that can then be referenced by the rules. Multiple assignments can be made with one rule for identical slots in all the objects within a subbasin. The subbasins are also referenced for the hypothetical simulations to identify the portion of the system to be modeled as part of the hypothetical simulation. The predefined HypTargetSimWithStatus function is referenced several times in the URGWOM ruleset to complete hypothetical simulations as side calculations with all the objects in an

identified subbasin. Refer to the RiverWare documentation for more information on subbasins. The subbasins in URGWOM can be viewed by clicking on the Edit Subbasins label in the Workspace menu.

V. Conclusions

Documentation of the RiverWare rules in the URGWOM ruleset version 5.0.2 (2013) was prepared to serve as a reference for URGWOM users. This report provides summaries of key aspects of the policy coded in URGWOM including the impact of San Juan-Chama Project water on operations in the basin, stipulations for flood control operations, Compact calculations, diversions to acequias, MRGCD, Albuquerque, and the six pueblos, releases to meet downstream target flows, and recreational interests. The priorities at each dam along the Rio Chama and Rio Grande are summarized. Aspects of RiverWare that are used abundantly in the ruleset and that are key to understanding the policy as coded in URGWOM are discussed. Discussions for each individual rule and an overall flowchart of policy for the ruleset are included in the Appendix to serve as a reference for URGWOM users. This report could also be used to complete an initial review of the policy as coded in URGWOM.

REFERENCES

Boroughs, Craig. 2013. User Manual for the Upper Rio Grande Water Operations Model (URGWOM). Report to the URGWOM Technical Team. Albuquerque, New Mexico.

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Upper Colorado River Compact. 1948. States of New Mexico, Colorado, Utah, Arizona, and Wyoming.

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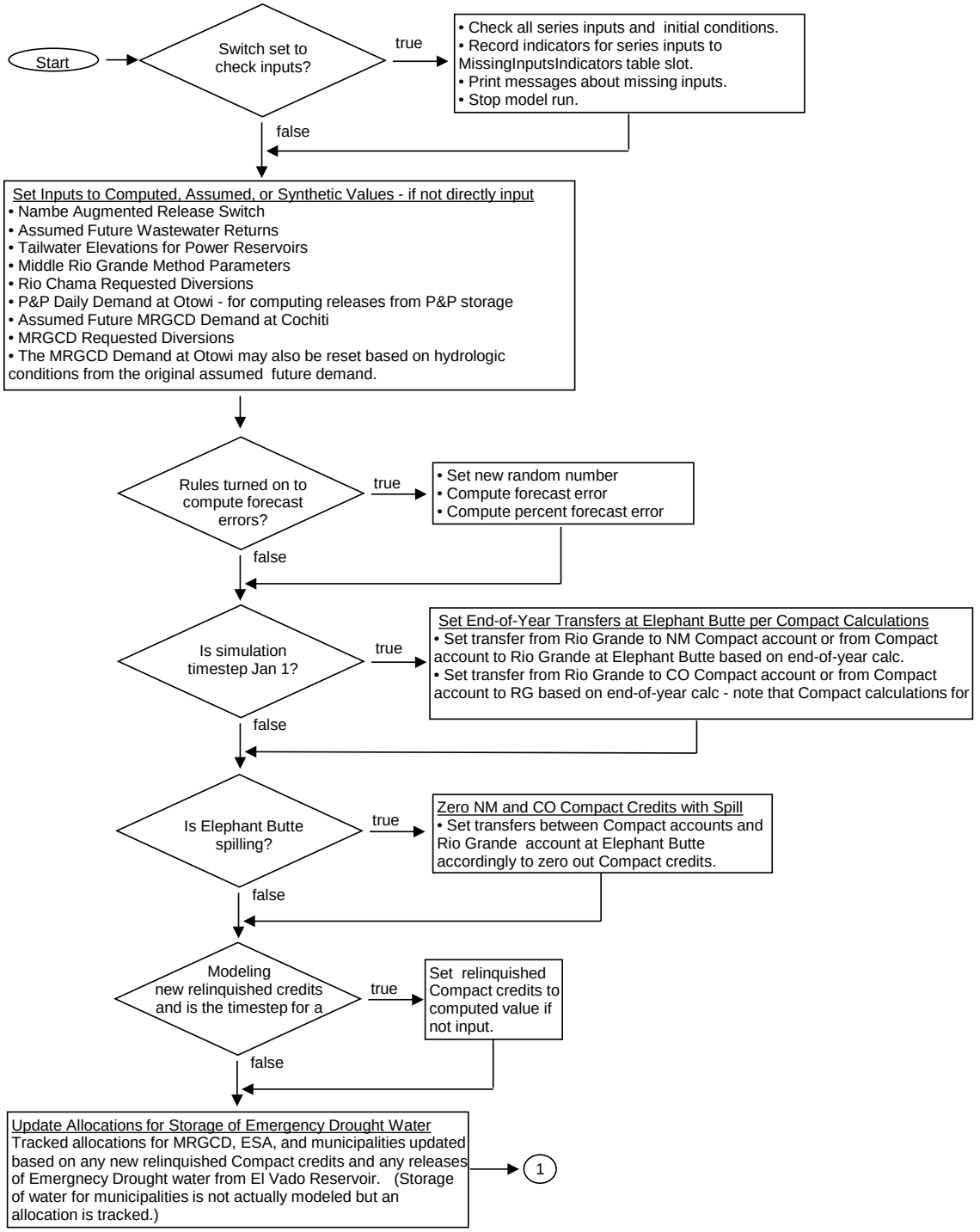
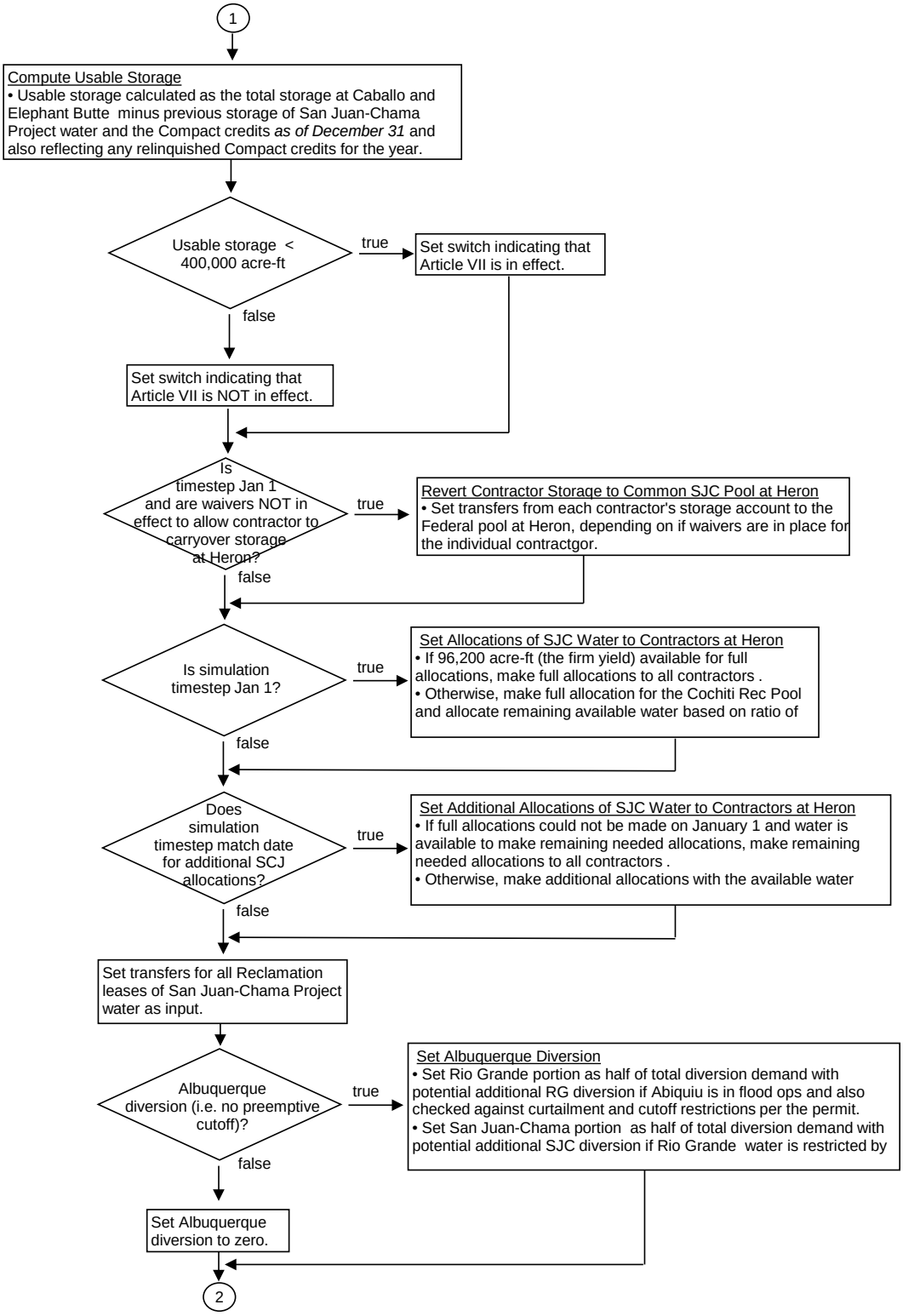
U.S. Army Corps of Engineers (Corps). 2009. Final Environmental Assessment and Finding of No Significant Impact for a Temporary Deviation in the Operation of Cochiti Lake and Jemez Canyon Dam, Sandoval County, New Mexico.

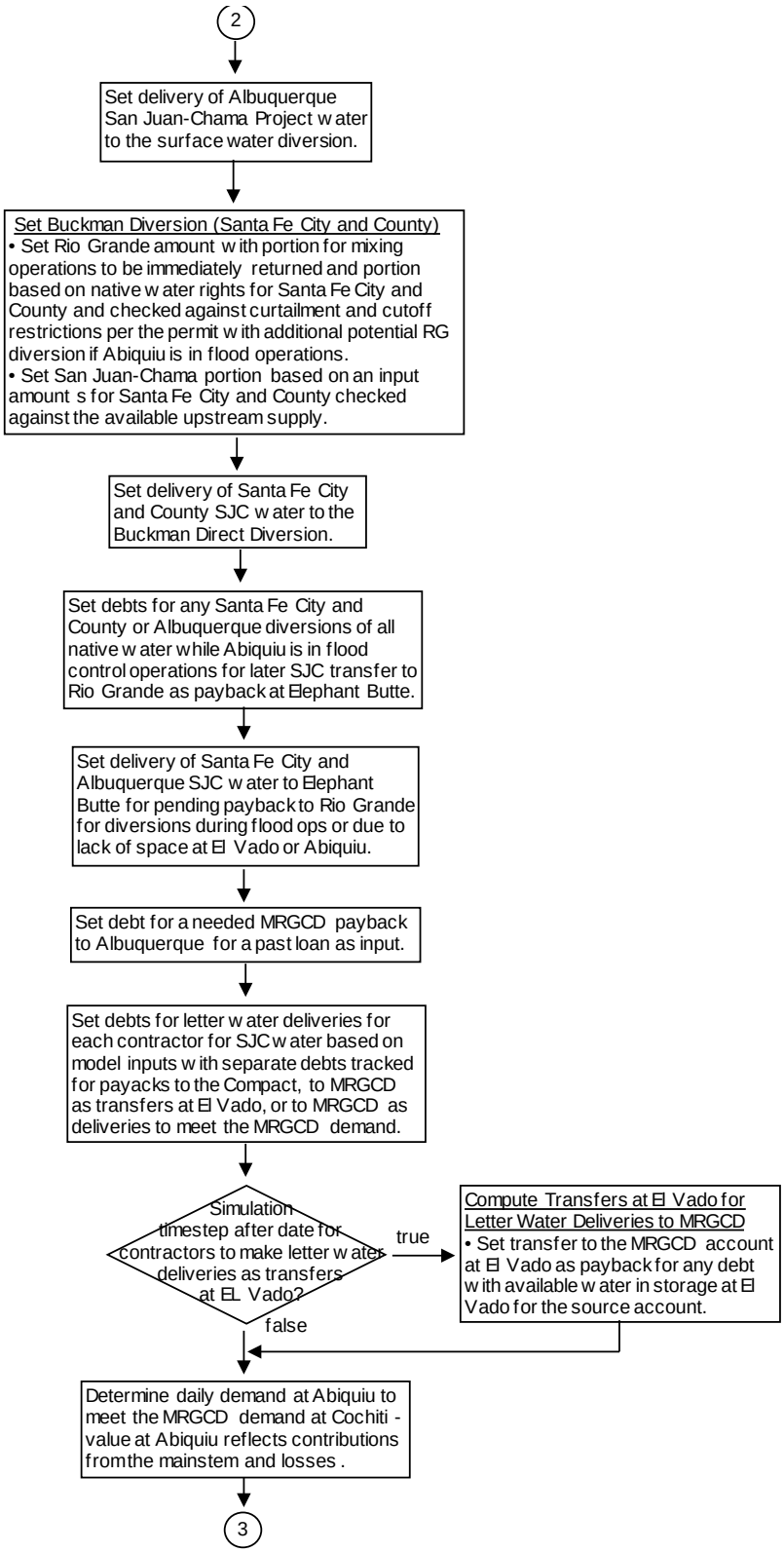
U.S. Fish and Wildlife Service (Service). 2003. Biological and Conference Opinions on the Effects of Actions Associated With the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Non-Federal Actions on the Middle Rio Grande, New Mexico. Albuquerque, New Mexico.

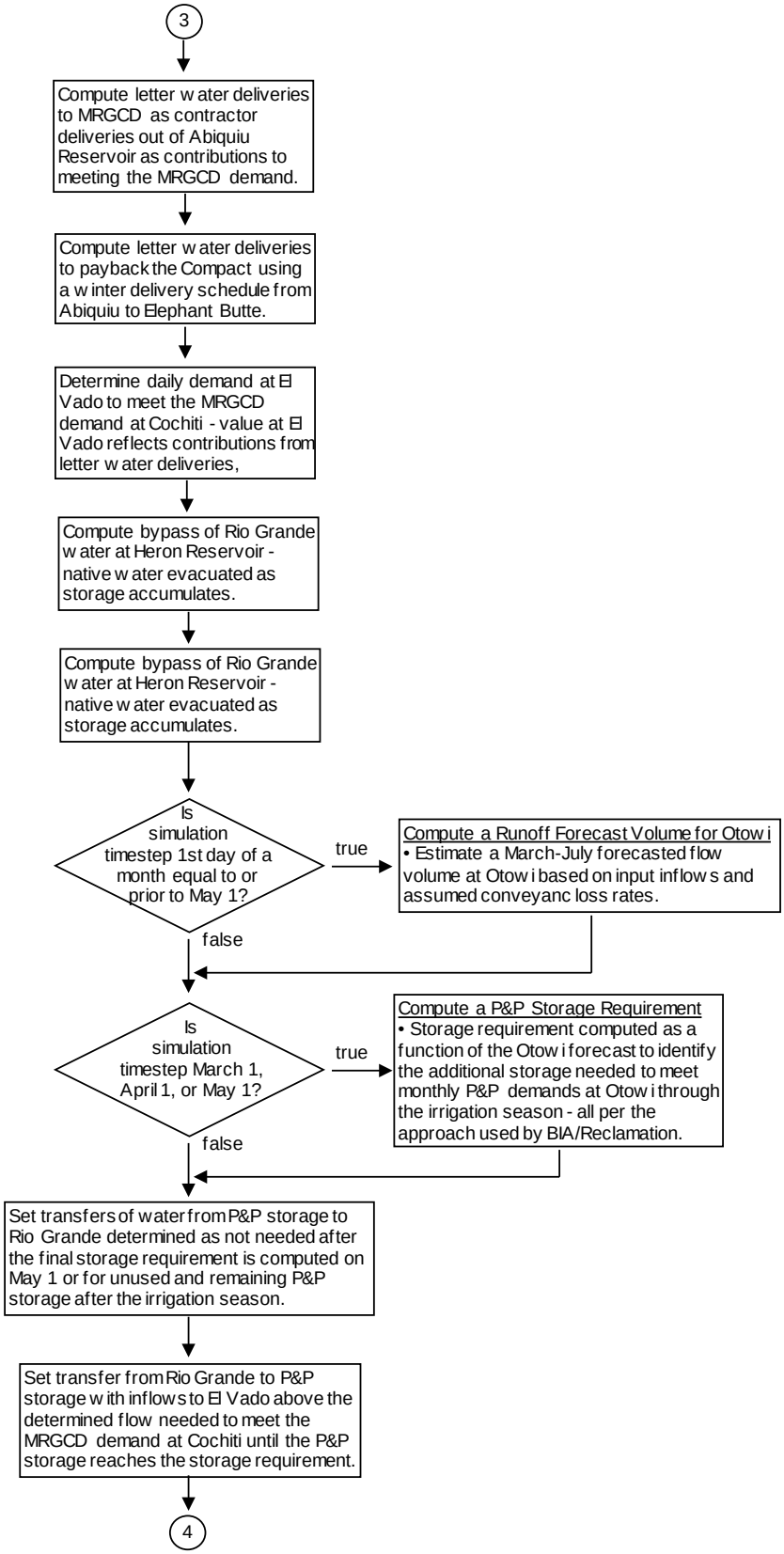
A. Flowchart for Overall Policy

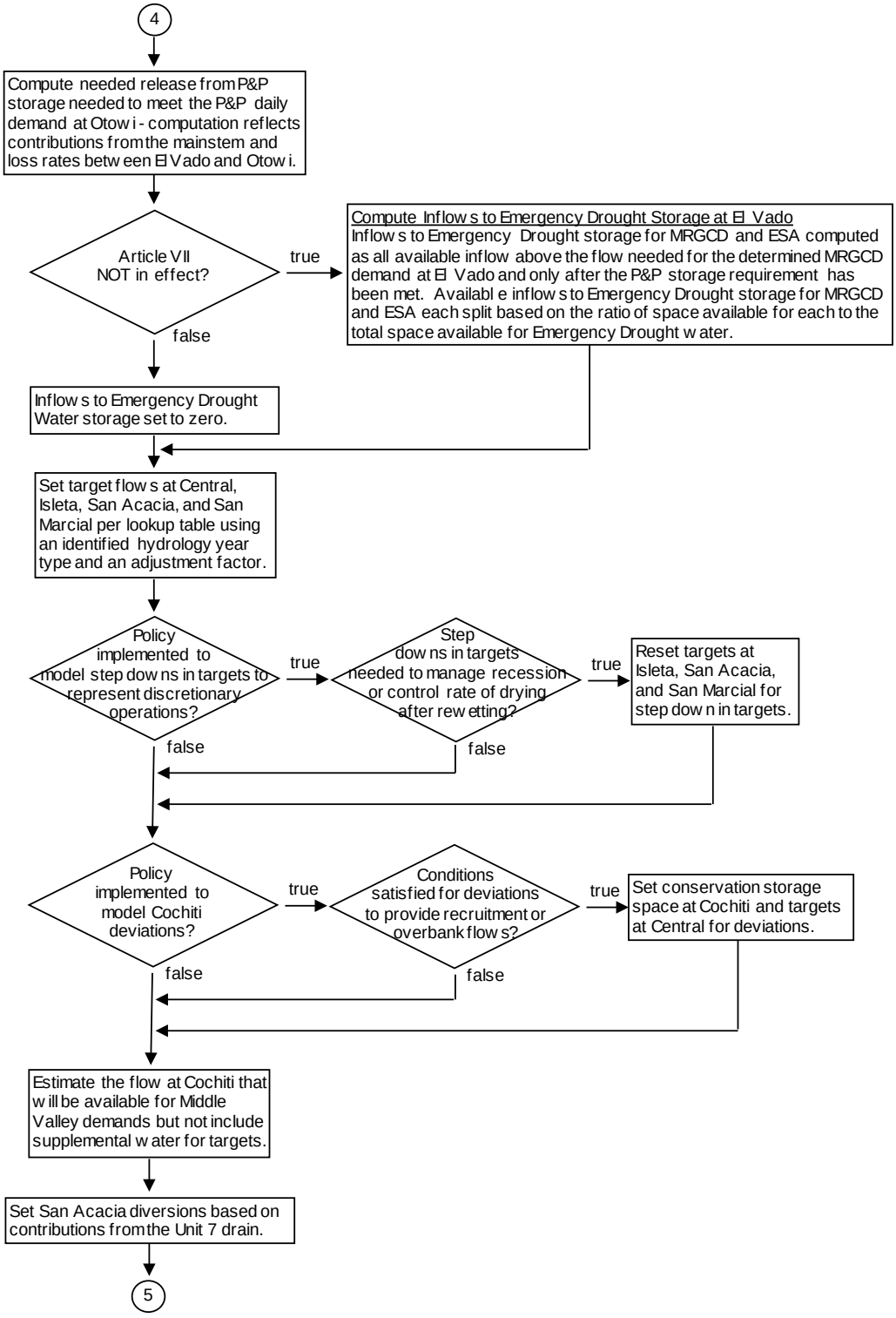
All steps completed daily unless noted differently in flowchart

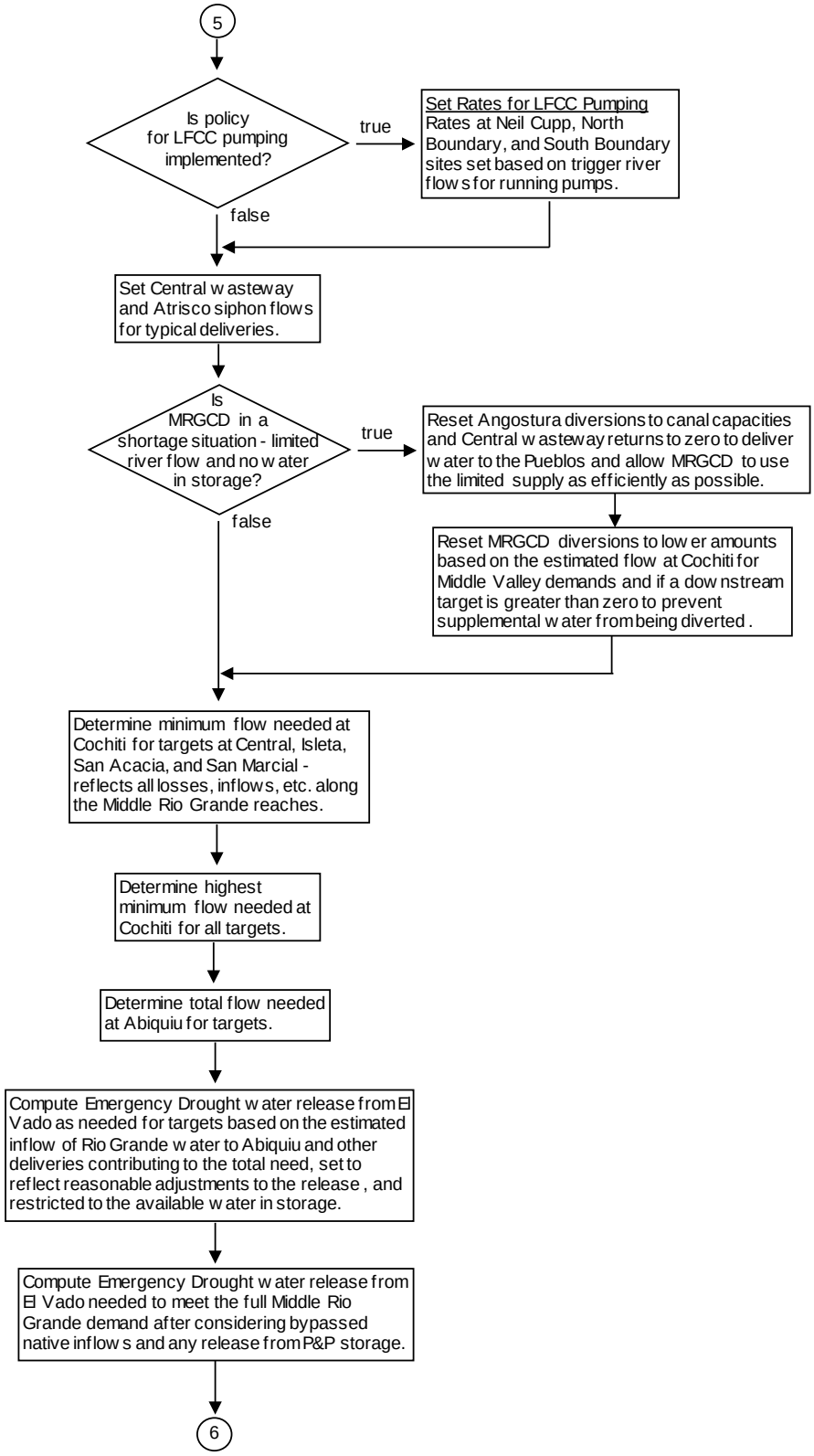


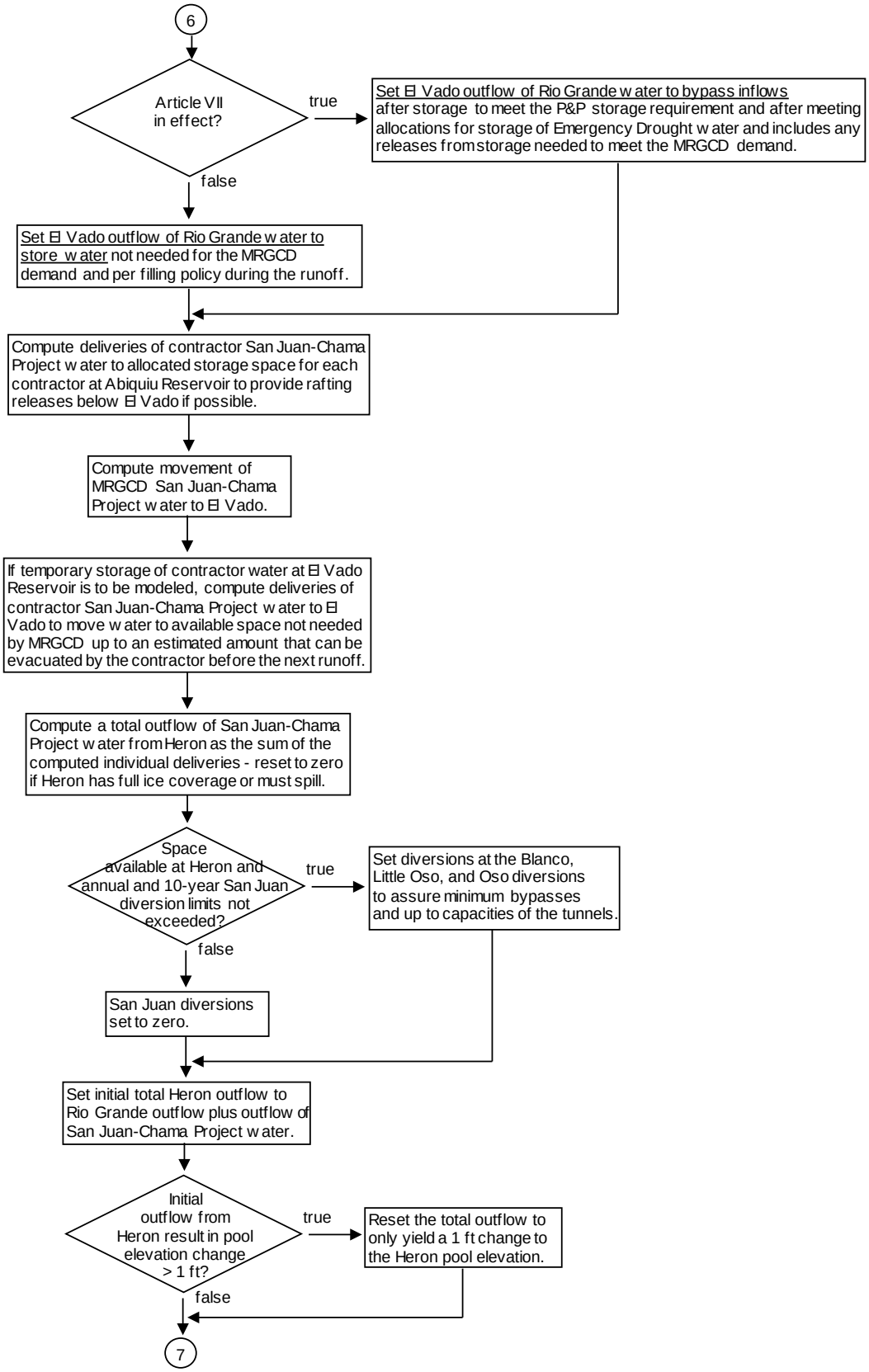

1
Compute Usable Storage
• Usable storage calculated as the total storage at Caballo and Elephant Butte minus previous storage of San Juan-Chama Project water and the Compact credits *as of December 31* and also reflecting any relinquished Compact credits for the year.
Usable storage < 400,000 acre-ft
true
Set switch indicating that Article VII is in effect.
false
Set switch indicating that Article VII is NOT in effect.
Is timestep Jan 1 and are waivers NOT in effect to allow contractor to carryover storage at Heron?
true
Revert Contractor Storage to Common SJC Pool at Heron
• Set transfers from each contractor's storage account to the Federal pool at Heron, depending on if waivers are in place for the individual contractgor.
false
Is simulation timestep Jan 1?
true
Set Allocations of SJC Water to Contractors at Heron
• If 96,200 acre-ft (the firm yield) available for full allocations, make full allocations to all contractors .
• Otherwise, make full allocation for the Cochiti Rec Pool and allocate remaining available water based on ratio of
false
Does simulation timestep match date for additional SCJ allocations?
true
Set Additional Allocations of SJC Water to Contractors at Heron
• If full allocations could not be made on January 1 and water is available to make remaining needed allocations, make remaining needed allocations to all contractors .
• Otherwise, make additional allocations with the available water
false
Set transfers for all Reclamation leases of San Juan-Chama Project water as input.
Albuquerque diversion (i.e. no preemptive cutoff)?
true
Set Albuquerque Diversion
• Set Rio Grande portion as half of total diversion demand with potential additional RG diversion if Abiquiu is in flood ops and also checked against curtailment and cutoff restrictions per the permit.
• Set San Juan-Chama portion as half of total diversion demand with potential additional SJC diversion if Rio Grande water is restricted by
false
Set Albuquerque diversion to zero.
2

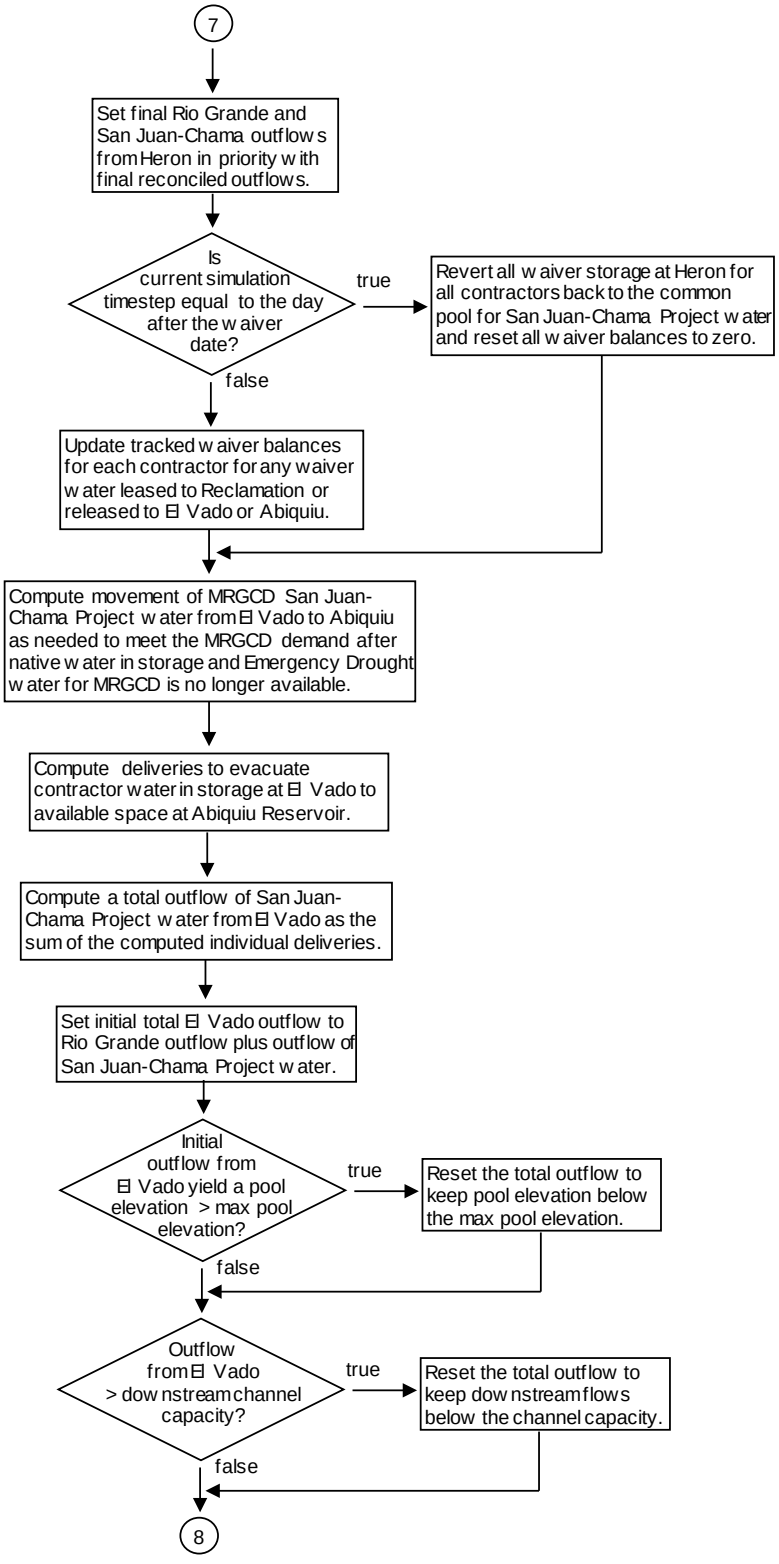

2
Set delivery of Albuquerque San Juan-Chama Project water to the surface water diversion.
Set Buckman Diversion (Santa Fe City and County)
• Set Rio Grande amount with portion for mixing operations to be immediately returned and portion based on native water rights for Santa Fe City and County and checked against curtailment and cutoff restrictions per the permit with additional potential RG diversion if Abiquiu is in flood operations.
• Set San Juan-Chama portion based on an input amounts for Santa Fe City and County checked against the available upstream supply.
Set delivery of Santa Fe City and County SJC water to the Buckman Direct Diversion.
Set debts for any Santa Fe City and County or Albuquerque diversions of all native water while Abiquiu is in flood control operations for later SJC transfer to Rio Grande as payback at Elephant Butte.
Set delivery of Santa Fe City and Albuquerque SJC water to Elephant Butte for pending payback to Rio Grande for diversions during flood ops or due to lack of space at El Vado or Abiquiu.
Set debt for a needed MRGCD payback to Albuquerque for a past loan as input.
Set debts for letter water deliveries for each contractor for SJC water based on model inputs with separate debts tracked for payacks to the Compact, to MRGCD as transfers at El Vado, or to MRGCD as deliveries to meet the MRGCD demand.
Simulation timestep after date for contractors to make letter water deliveries as transfers at EL Vado?
true
Compute Transfers at El Vado for Letter Water Deliveries to MRGCD
• Set transfer to the MRGCD account at El Vado as payback for any debt with available water in storage at El Vado for the source account.
false
Determine daily demand at Abiquiu to meet the MRGCD demand at Cochiti - value at Abiquiu reflects contributions from the mainstem and losses.
3

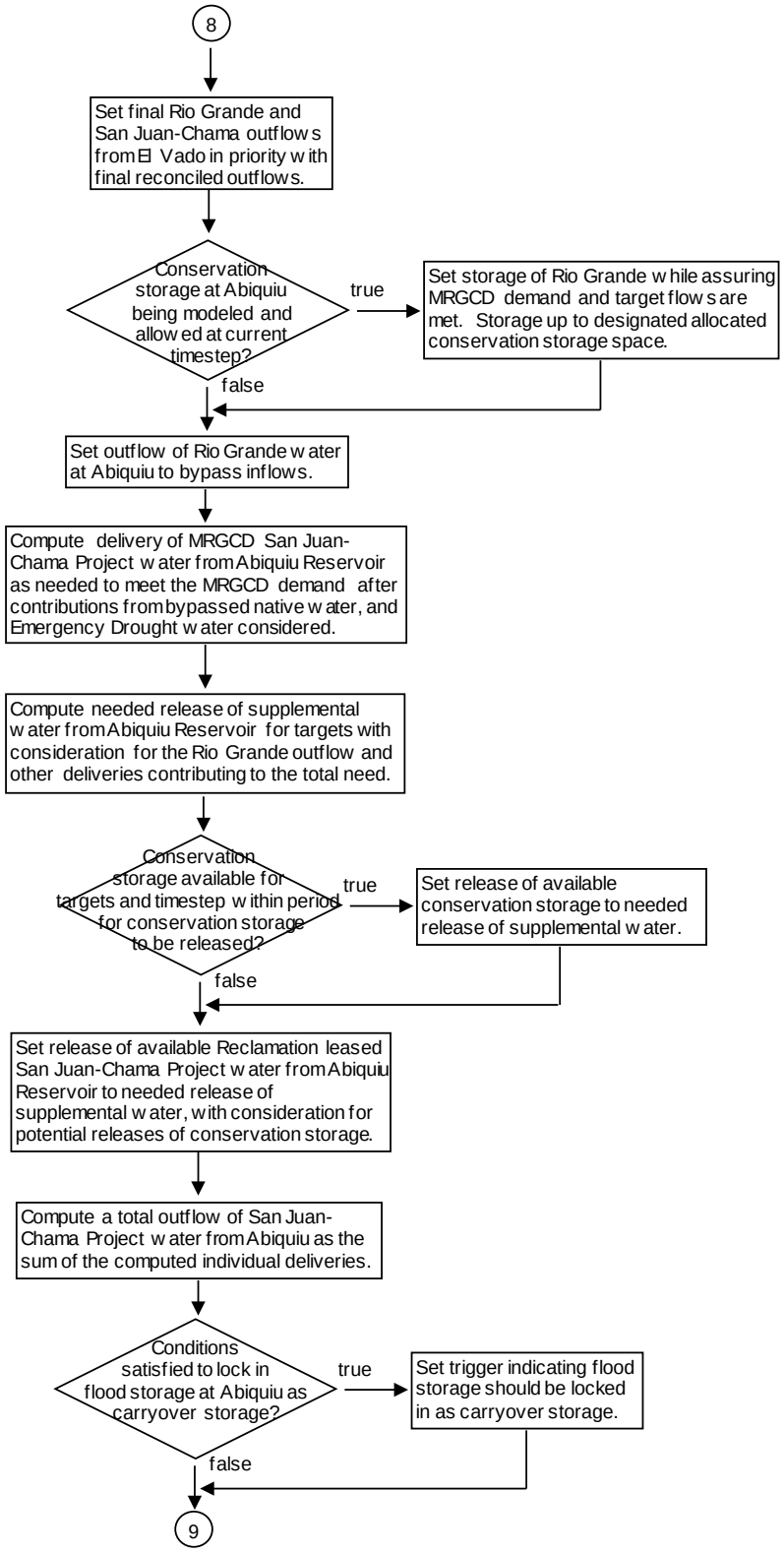

3
Compute letter water deliveries to MRGCD as contractor deliveries out of Abiquiu Reservoir as contributions to meeting the MRGCD demand.
Compute letter water deliveries to payback the Compact using a winter delivery schedule from Abiquiu to Elephant Butte.
Determine daily demand at El Vado to meet the MRGCD demand at Cochiti - value at El Vado reflects contributions from letter water deliveries,
Compute bypass of Rio Grande water at Heron Reservoir - native water evacuated as storage accumulates.
Compute bypass of Rio Grande water at Heron Reservoir - native water evacuated as storage accumulates.
Is simulation timestep 1st day of a month equal to or prior to May 1?
true
Compute a Runoff Forecast Volume for Otowi
• Estimate a March-July forecasted flow volume at Otowi based on input inflows and assumed conveyanc loss rates.
false
Is simulation timestep March 1, April 1, or May 1?
true
Compute a P&P Storage Requirement
• Storage requirement computed as a function of the Otowi forecast to identify the additional storage needed to meet monthly P&P demands at Otowi through the irrigation season - all per the approach used by BIA/Reclamation.
false
Set transfers of water from P&P storage to Rio Grande determined as not needed after the final storage requirement is computed on May 1 or for unused and remaining P&P storage after the irrigation season.
Set transfer from Rio Grande to P&P storage with inflows to El Vado above the determined flow needed to meet the MRGCD demand at Cochiti until the P&P storage reaches the storage requirement.
4

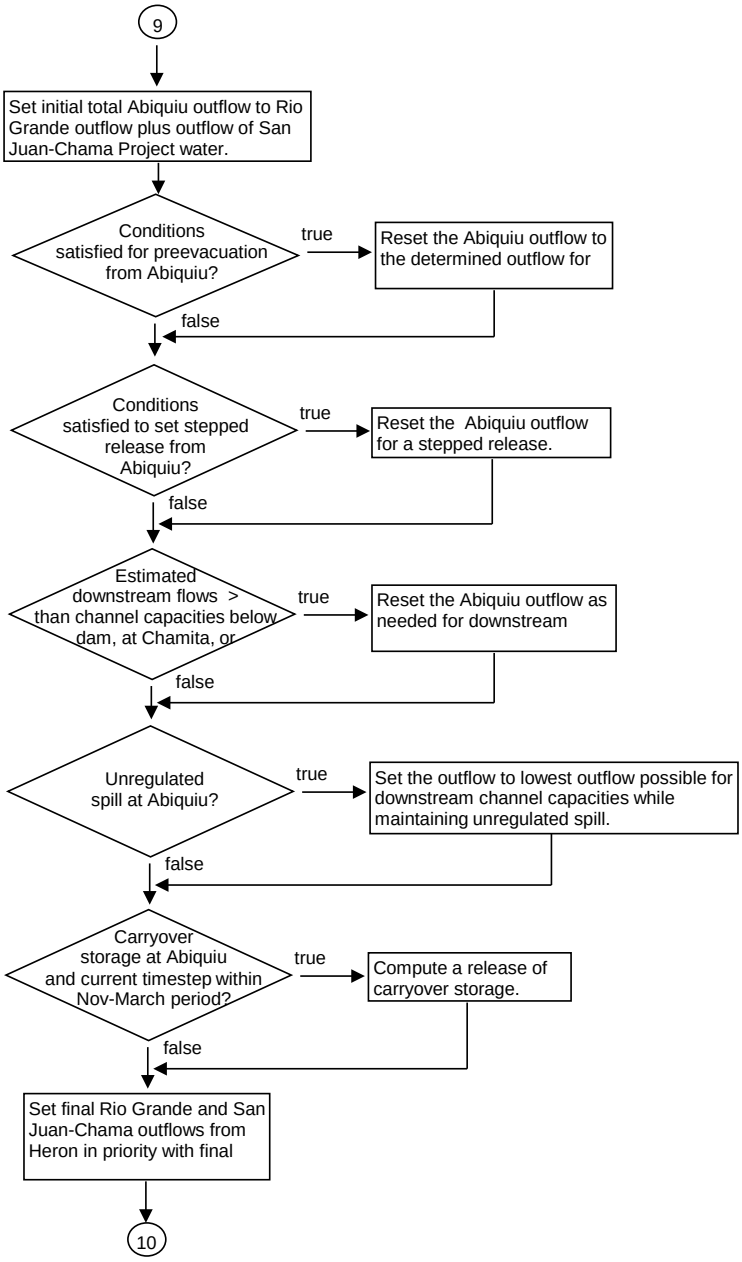

4
Compute needed release from P&P storage needed to meet the P&P daily demand at Otowi - computation reflects contributions from the mainstem and loss rates between El Vado and Otowi.
Article VII NOT in effect?
true
false
Compute Inflows to Emergency Drought Storage at El Vado
Inflows to Emergency Drought storage for MRGCD and ESA computed as all available inflow above the flow needed for the determined MRGCD demand at El Vado and only after the P&P storage requirement has been met. Available inflows to Emergency Drought storage for MRGCD and ESA each split based on the ratio of space available for each to the total space available for Emergency Drought water.
Inflows to Emergency Drought Water storage set to zero.
Set target flows at Central, Isleta, San Acacia, and San Marcial per lookup table using an identified hydrology year type and an adjustment factor.
Policy implemented to model step downs in targets to represent discretionary operations?
true
false
Step downs in targets needed to manage recession or control rate of drying after rewetting?
true
false
Reset targets at Isleta, San Acacia, and San Marcial for step down in targets.
Policy implemented to model Cochiti deviations?
true
false
Conditions satisfied for deviations to provide recruitment or overbank flows?
true
false
Set conservation storage space at Cochiti and targets at Central for deviations.
Estimate the flow at Cochiti that will be available for Middle Valley demands but not include supplemental water for targets.
Set San Acacia diversions based on contributions from the Unit 7 drain.
5

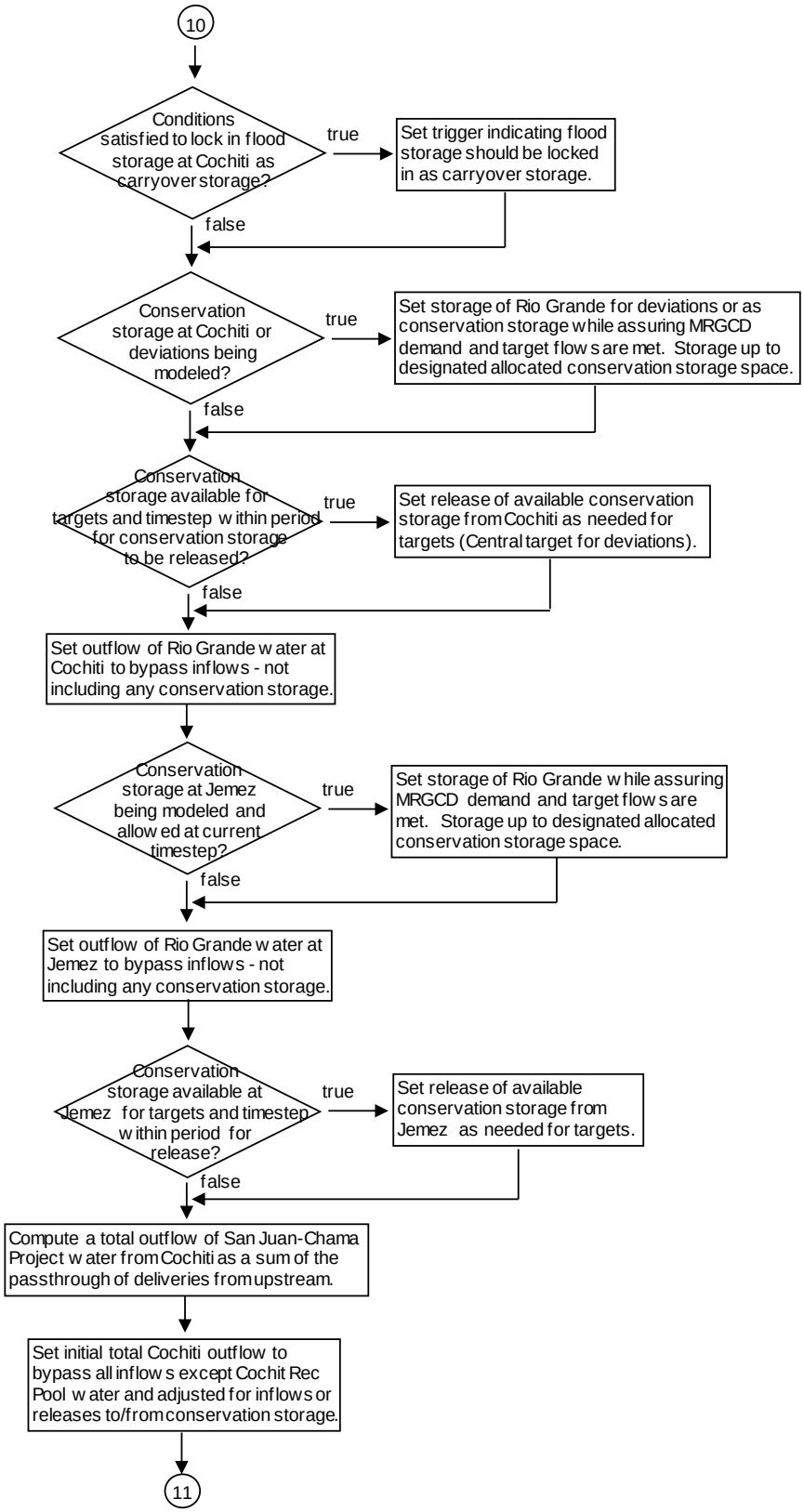

5
Is policy for LFCC pumping implemented?
true
Set Rates for LFCC Pumping
Rates at Neil Cupp, North Boundary, and South Boundary sites set based on trigger river flows for running pumps.
false
Set Central wasteway and Atrisco siphon flows for typical deliveries.
Is MRGCD in a shortage situation - limited river flow and no water in storage?
true
Reset Angostura diversions to canal capacities and Central wasteway returns to zero to deliver water to the Pueblos and allow MRGCD to use the limited supply as efficiently as possible.
false
Reset MRGCD diversions to lower amounts based on the estimated flow at Cochiti for Middle Valley demands and if a downstream target is greater than zero to prevent supplemental water from being diverted.
Determine minimum flow needed at Cochiti for targets at Central, Isleta, San Acacia, and San Marcial - reflects all losses, inflows, etc. along the Middle Rio Grande reaches.
Determine highest minimum flow needed at Cochiti for all targets.
Determine total flow needed at Abiquiu for targets.
Compute Emergency Drought water release from El Vado as needed for targets based on the estimated inflow of Rio Grande water to Abiquiu and other deliveries contributing to the total need, set to reflect reasonable adjustments to the release, and restricted to the available water in storage.
Compute Emergency Drought water release from El Vado needed to meet the full Middle Rio Grande demand after considering bypassed native inflows and any release from P&P storage.
6

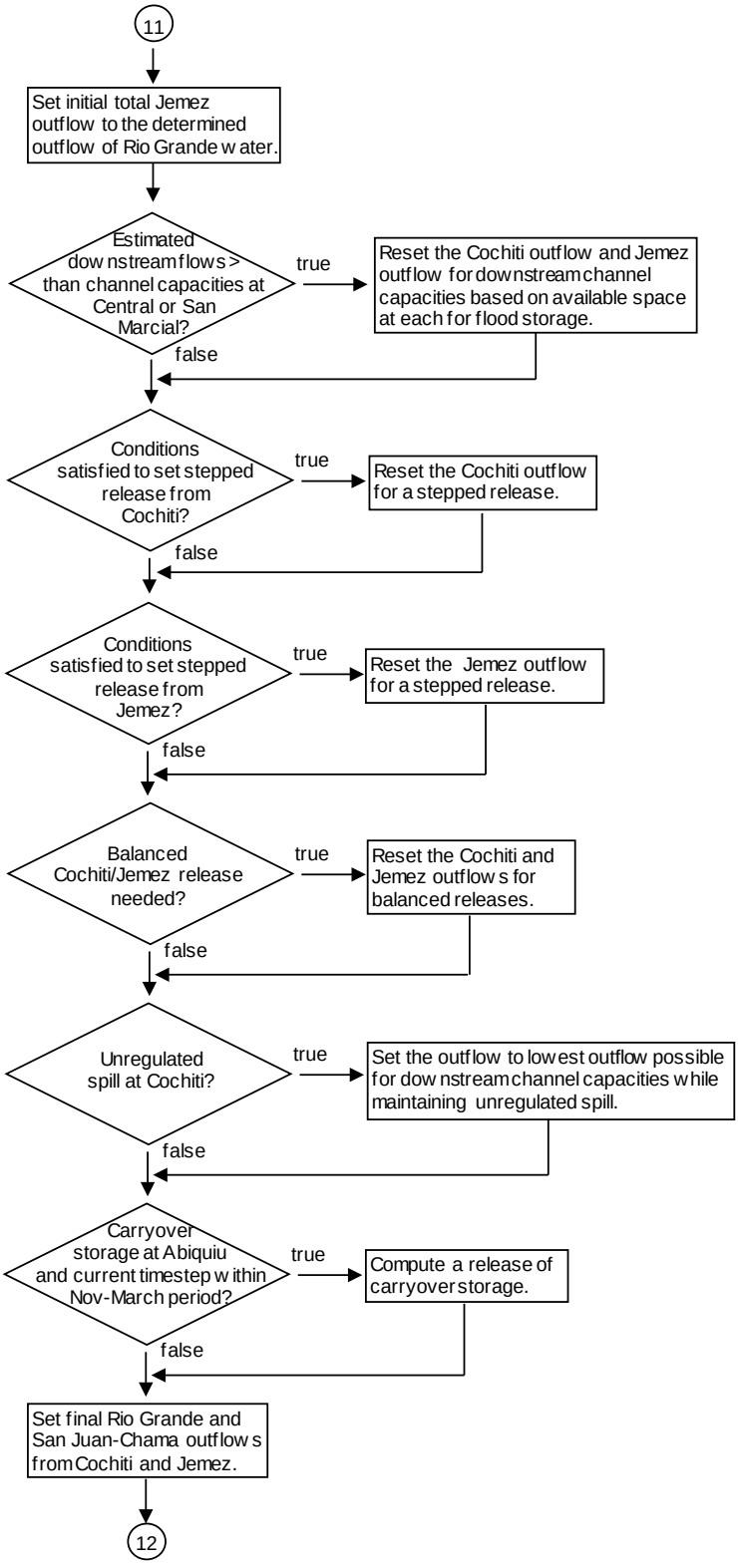

6
Article VII in effect?
true
Set El Vado outflow of Rio Grande water to bypass inflows after storage to meet the P&P storage requirement and after meeting allocations for storage of Emergency Drought water and includes any releases from storage needed to meet the MRGCD demand.
false
Set El Vado outflow of Rio Grande water to store water not needed for the MRGCD demand and per filling policy during the runoff.
Compute deliveries of contractor San Juan-Chama Project water to allocated storage space for each contractor at Abiquiu Reservoir to provide rafting releases below El Vado if possible.
Compute movement of MRGCD San Juan-Chama Project water to El Vado.
If temporary storage of contractor water at El Vado Reservoir is to be modeled, compute deliveries of contractor San Juan-Chama Project water to El Vado to move water to available space not needed by MRGCD up to an estimated amount that can be evacuated by the contractor before the next runoff.
Compute a total outflow of San Juan-Chama Project water from Heron as the sum of the computed individual deliveries - reset to zero if Heron has full ice coverage or must spill.
Space available at Heron and annual and 10-year San Juan diversion limits not exceeded?
true
Set diversions at the Blanco, Little Oso, and Oso diversions to assure minimum bypasses and up to capacities of the tunnels.
false
San Juan diversions set to zero.
Set initial total Heron outflow to Rio Grande outflow plus outflow of San Juan-Chama Project water.
Initial outflow from Heron result in pool elevation change > 1 ft?
true
Reset the total outflow to only yield a 1 ft change to the Heron pool elevation.
false
7

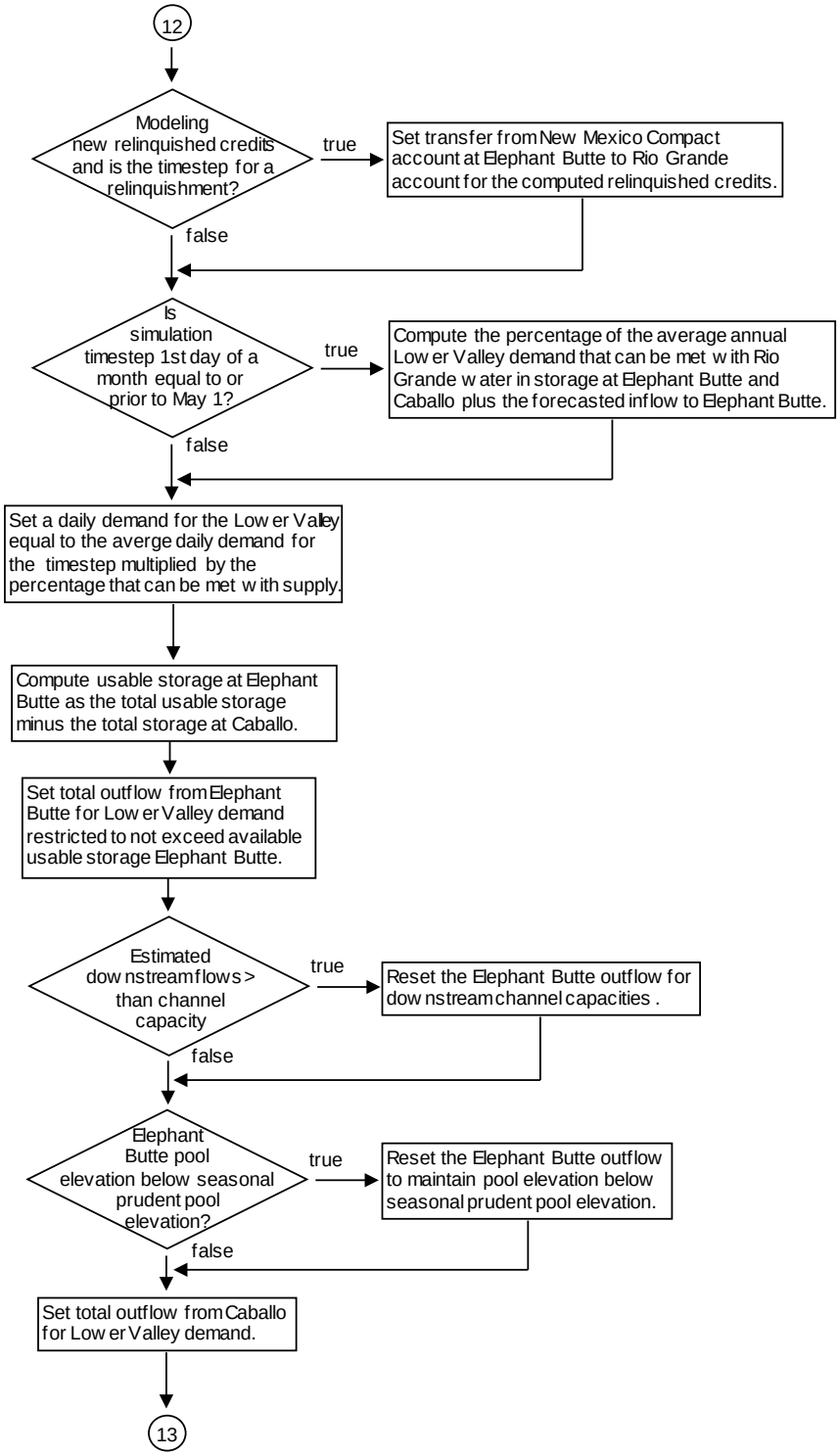

7
Set final Rio Grande and San Juan-Chama outflows from Heron in priority with final reconciled outflows.
Is current simulation timestep equal to the day after the waiver date?
true
Revert all waiver storage at Heron for all contractors back to the common pool for San Juan-Chama Project water and reset all waiver balances to zero.
false
Update tracked waiver balances for each contractor for any waiver water leased to Reclamation or released to El Vado or Abiquiu.
Compute movement of MRGCD San Juan-Chama Project water from El Vado to Abiquiu as needed to meet the MRGCD demand after native water in storage and Emergency Drought water for MRGCD is no longer available.
Compute deliveries to evacuate contractor water in storage at El Vado to available space at Abiquiu Reservoir.
Compute a total outflow of San Juan-Chama Project water from El Vado as the sum of the computed individual deliveries.
Set initial total El Vado outflow to Rio Grande outflow plus outflow of San Juan-Chama Project water.
Initial outflow from El Vado yield a pool elevation > max pool elevation?
true
Reset the total outflow to keep pool elevation below the max pool elevation.
false
Outflow from El Vado > downstream channel capacity?
true
Reset the total outflow to keep downstream flows below the channel capacity.
false
8

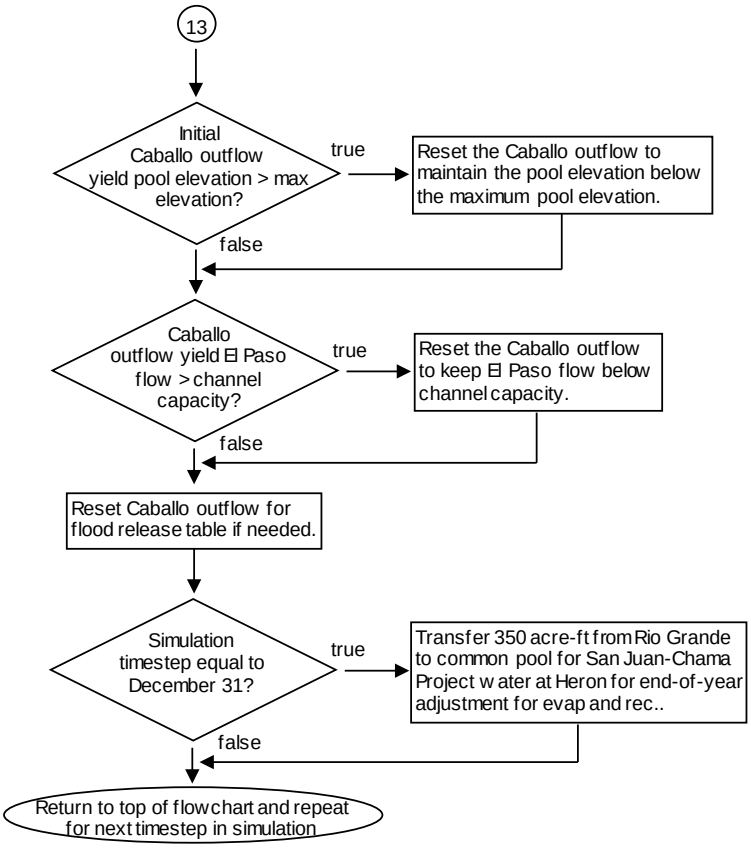

8
Set final Rio Grande and San Juan-Chama outflows from El Vado in priority with final reconciled outflows.
Conservation storage at Abiquiu being modeled and allowed at current timestep?
true
Set storage of Rio Grande while assuring MRGCD demand and target flows are met. Storage up to designated allocated conservation storage space.
false
Set outflow of Rio Grande water at Abiquiu to bypass inflows.
Compute delivery of MRGCD San Juan-Chama Project water from Abiquiu Reservoir as needed to meet the MRGCD demand after contributions from bypassed native water, and Emergency Drought water considered.
Compute needed release of supplemental water from Abiquiu Reservoir for targets with consideration for the Rio Grande outflow and other deliveries contributing to the total need.
Conservation storage available for targets and timestep within period for conservation storage to be released?
true
Set release of available conservation storage to needed release of supplemental water.
false
Set release of available Reclamation leased San Juan-Chama Project water from Abiquiu Reservoir to needed release of supplemental water, with consideration for potential releases of conservation storage.
Compute a total outflow of San Juan-Chama Project water from Abiquiu as the sum of the computed individual deliveries.
Conditions satisfied to lock in flood storage at Abiquiu as carryover storage?
true
Set trigger indicating flood storage should be locked in as carryover storage.
false
9


9
Set initial total Abiquiu outflow to Rio Grande outflow plus outflow of San Juan-Chama Project water.
Conditions satisfied for preevacuation from Abiquiu?
true
Reset the Abiquiu outflow to the determined outflow for
false
Conditions satisfied to set stepped release from Abiquiu?
true
Reset the Abiquiu outflow for a stepped release.
false
Estimated downstream flows > than channel capacities below dam, at Chamita, or
true
Reset the Abiquiu outflow as needed for downstream
false
Unregulated spill at Abiquiu?
true
Set the outflow to lowest outflow possible for downstream channel capacities while maintaining unregulated spill.
false
Carryover storage at Abiquiu and current timestep within Nov-March period?
true
Compute a release of carryover storage.
false
Set final Rio Grande and San Juan-Chama outflows from Heron in priority with final
10


10
Conditions satisfied to lock in flood storage at Cochiti as carryover storage?
true
Set trigger indicating flood storage should be locked in as carryover storage.
false
Conservation storage at Cochiti or deviations being modeled?
true
Set storage of Rio Grande for deviations or as conservation storage while assuring MRGCD demand and target flows are met. Storage up to designated allocated conservation storage space.
false
Conservation storage available for targets and timestep within period for conservation storage to be released?
true
Set release of available conservation storage from Cochiti as needed for targets (Central target for deviations).
false
Set outflow of Rio Grande water at Cochiti to bypass inflows - not including any conservation storage.
Conservation storage at Jemez being modeled and allowed at current timestep?
true
Set storage of Rio Grande while assuring MRGCD demand and target flows are met. Storage up to designated allocated conservation storage space.
false
Set outflow of Rio Grande water at Jemez to bypass inflows - not including any conservation storage.
Conservation storage available at Jemez for targets and timestep within period for release?
true
Set release of available conservation storage from Jemez as needed for targets.
false
Compute a total outflow of San Juan-Chama Project water from Cochiti as a sum of the passthrough of deliveries from upstream.
Set initial total Cochiti outflow to bypass all inflows except Cochit Rec Pool water and adjusted for inflows or releases to/from conservation storage.
11


11
Set initial total Jemez outflow to the determined outflow of Rio Grande water.
Estimated downstream flows > than channel capacities at Central or San Marcial?
true
Reset the Cochiti outflow and Jemez outflow for downstream channel capacities based on available space at each for flood storage.
false
Conditions satisfied to set stepped release from Cochiti?
true
Reset the Cochiti outflow for a stepped release.
false
Conditions satisfied to set stepped release from Jemez?
true
Reset the Jemez outflow for a stepped release.
false
Balanced Cochiti/Jemez release needed?
true
Reset the Cochiti and Jemez outflows for balanced releases.
false
Unregulated spill at Cochiti?
true
Set the outflow to lowest outflow possible for downstream channel capacities while maintaining unregulated spill.
false
Carryover storage at Abiquiu and current timestep within Nov-March period?
true
Compute a release of carryover storage.
false
Set final Rio Grande and San Juan-Chama outflows from Cochiti and Jemez.
12


12
Modeling new relinquished credits and is the timestep for a relinquishment?
true
Set transfer from New Mexico Compact account at Elephant Butte to Rio Grande account for the computed relinquished credits.
false
Is simulation timestep 1st day of a month equal to or prior to May 1?
true
Compute the percentage of the average annual Lower Valley demand that can be met with Rio Grande water in storage at Elephant Butte and Caballo plus the forecasted inflow to Elephant Butte.
false
Set a daily demand for the Lower Valley equal to the averge daily demand for the timestep multiplied by the percentage that can be met with supply.
Compute usable storage at Elephant Butte as the total usable storage minus the total storage at Caballo.
Set total outflow from Elephant Butte for Lower Valley demand restricted to not exceed available usable storage Elephant Butte.
Estimated downstream flows > than channel capacity
true
Reset the Elephant Butte outflow for downstream channel capacities .
false
Elephant Butte pool elevation below seasonal prudent pool elevation?
true
Reset the Elephant Butte outflow to maintain pool elevation below seasonal prudent pool elevation.
false
Set total outflow from Caballo for Lower Valley demand.
13


13
Initial Caballo outflow yield pool elevation > max elevation?
true
Reset the Caballo outflow to maintain the pool elevation below the maximum pool elevation.
false
Caballo outflow yield El Paso flow > channel capacity?
true
Reset the Caballo outflow to keep El Paso flow below channel capacity.
false
Reset Caballo outflow for flood release table if needed.
Simulation timestep equal to December 31?
true
Transfer 350 acre-ft from Rio Grande to common pool for San Juan-Chama Project water at Heron for end-of-year adjustment for evap and rec..
false
Return to top of flowchart and repeat for next timestep in simulation

B. Individual Rules

All of the individual rules in the URGWOM ruleset are discussed separately and are grouped based on policy group (Refer to Figure 1.2). There are 44 separate Sections in this appendix for the 46 different policy groups. The rules fire in reverse order within URGWOM, so the discussion of the rules begins with the last rule in each policy group and the last policy group in the ruleset. The discussion for each rule typically includes an Explanation, notes on the Execution Constraints, and a write-up on the Rule Logic. Screen captures of the RiverWare rule policy language are included for a few cases. The level of detail of the discussion depends on the complexity of the rule. For the more complex rules, some of the finer details of the logic will still need to be referenced in the electronic ruleset file.

B.1. Check for Needed Initial Conditions and Series Inputs

This policy group includes rules for checking inputs for all required series and initial conditions. Switches in the IndicatorForWhetherToCheckModelInput table slot in the MissingInputsIndicators data object must be set to 1 if the rules are to be used to check inputs. Note that the simulation will stop if a switch is set and after needed inputs are checked, so the switches should be set to 0 after all required slots have been confirmed as having inputs. Also, the rules must be selected in the Diagnostics Manager for rulebased simulation and the box must be checked in the Diagnostics Manager to view Print Statements. If any needed initial conditions or series inputs are missing, messages will be posted in the Diagnostics Output window. For series, separate series slots in the MissingInputsIndicators data object are used to record which individual dates in each series that data may be missing that can be used by a model user to identify an exact date in a series that an input may be missing. Note that different rules are included in the Initialization rules for checking inputs for Accounting Model runs completed without the URGWOM ruleset. These rules also check the switches to set check for required inputs for Accounting Model runs.

B.1.1. Check and PrintMessagesIfMissingInitialConditions

Explanation: Numerous IF THEN statements are used in this rule to check for required initial conditions. If needed values are missing, messages are posted to the Diagnostics Output window noting the missing initial conditions.

Rule Execution: The rule executes at the Start Timestep if the switch is set to check inputs as indicated by a value of 1.0 in the CheckInitialConditions(1=Yes,0=No) column of the IndicatorForWhetherToCheckModelInputs table slot in the MissingInputsIndicators data object and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully predefined function.

Rule Logic: This rule first uses FOR DO statements to create lists of each reservoir in the model and each storage account at each reservoir, and then uses IF THEN statements to check whether each storage account at each reservoir has an input value for the Storage and Accrual slots for the timestep prior to the Start Timestep. The user-defined AbortMessage#InitialValues function is used to print that the needed value is missing with the slot name included in the message text. An IF THEN statement is then used to check whether the total reservoir storage values have been input for the same timestep. Separate IF THEN statements are used to check that the Incidental Content and Accumulated Perm Sediment values have been input for Abiquiu, Cochiti, and Jemez reservoir objects and that the Carryover Content and RGCarryOverLeft values have been input for Abiquiu and Cochiti objects. Outflow inputs are checked for each reservoir with the check at Elephant Butte for two initial timesteps and the check at Caballo for eight initial timesteps.

Initial waiver balances in the Waivers data object are checked if the start timestep is not January 1st (If the start timestep is January 1st, the waiver balances are set to the December 31 account storage at Heron Reservoir for each contractor and thus initial balances do not need to be input.) A FOR DO loop is used to create a list of slots that must have an initial flow value, and an IF THEN statement is used to check for the required flow input for each slot. Inflows must be input for two initial timesteps for the CerroToTaos reach object. A FOR DO loop is used to create a list of all groundwater storage objects, and IF THEN statements are used to check for required initial groundwater storage and elevation values.

Annual San Juan-Chama Project diversion values are needed for checking the 10-year limit to the diversion amount in the rules, so these values are checked next. If the Start Timestep is not January 1st, year-to-date San Juan-Chama diversions are needed to check against the annual diversion limit, so the values back to January 1st are checked in this rule. The last check is to assure the Otowi Forecast for the previous year is input to the annual PandP.OtowiForecast slot for December 31 of the previous year.

B.1.2. CheckNeededSeriesInputs

Explanation: This rule is used to check that series slots have required inputs. If a value is missing, a value of 1 is input for the same date in the companion series slot in the MissingInputsIndicators data object. Otherwise, a value of 0 is recorded to the companion slot. These companion slots then allow for a model user to easily identify exact locations of missing data and the values are also checked in the PrintMessagesIfMissingSeriesInputs rule for printing messages about missing data. This rule may be turned off after all required inputs have been checked.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the switch is set to check inputs as indicated by a value of 1.0 in the

CheckSeriesInputs(1=Yes,0=No) column of the IndicatorForWhetherToCheckModelInputs table slot in the MissingInputsIndicators data object and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create the list of all timesteps for a model run period for checking inputs. The first internal FOR DO loop creates a list of reservoirs in the model, and IF THEN ELSE statements are used to check inputs for the Precipitation Rate and Surface Ice Coverage series slots and record values of 1 if an input is missing to the companion slot in the MissingInputsIndicators data object or 0 if a value is input. Even though the Nambe object is not linked, inputs must be set such that object can solve as part of the entire model. Required inflows to the Nambe object are checked. Inputs for the Pan Evaporation series are checked for the full calendar year for Elephant Butte and Caballo objects, and for April 1 through October 31 for the remaining reservoirs (Pan Evaporation values are not used for the winter for the upper reservoirs when the pans are historically often frozen). Inputs for the Max Air Temperature and Min Air Temperature series slots are checked for the upper reservoirs for the winter months (for computing reservoir evaporation at these times when pans would be frozen).

A second internal FOR DO loop is used to create a list of all local inflow reach objects and an IF THEN ELSE statement is used to record values of 1 to the companion series slots in the MissingInputsIndicators data object if an input is missing for the Local Inflow series slot on the local inflow reach object. A FOR DO loop is used to create a list of all stream gage objects that must have input values for the Gage Inflow series slots. An IF THEN ELSE statement is used to record values of 1 to the companion series slots in the MissingInputsIndicators data object. FOR DO loops are subsequently used to create list of river groundwater objects, river evaporation reach objects, and all groundwater objects, and within each FOR DO loop, IF THEN ELSE statements are used to check inputs for the ET Rate, Pan Evaporation, or Deep Aquifer Elevation series slots, respectively, and record a values of 1 to the companion series slots in the MissingInputsIndicators data object when a value is missing. Finally, all water user objects used for each irrigated area are checked to assure values are input for the Irrigated Area, Evapotranspiration Rate, Minimum Efficiency, and Fraction GW Return Flow.

B.1.3. PrintMessagesIfMissingSeriesInputs

Explanation: This rule checks all values recorded to the series slots in the MissingInputsIndicator data object to identify if any required inputs for model series slots are missing (Refer to the CheckNeededSeriesInputs rule for how values are set to the slots in the MissingInputsIndicator data object), and messages are posted to the Diagnostic Output window if inputs are missing. Note that the simulation will stop if the switch is set by the model user to check all required series inputs, so the switch should be turned off after all inputs have been checked.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the switch is set to check inputs as indicated by a value of 1.0 in the CheckSeriesInputs(1=Yes,0=No) column of the IndicatorForWhetherToCheckModelInputs table slot in the MissingInputsIndicators data object and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used with the predefined GetSeriesSlots function to create the list of all slots in the MissingInputsIndicators data object as strings. Missing inputs are checked by evaluating whether the sum of values for each series slot in the MissingInputsIndicators data objects is greater than 0.1, which would indicate at least one value is 1, as checked with the predefined SumSlotSkipNaN function. The user-defined AbortMessageEntireSeries function is used to print a message to the Diagnostics Output window with the slot name included in the message. A STOP RUN statement is used to stop the simulation after this rule has fired.

B.2. SetInputsToSyntheticValuesIfNotDirectlyInput

This policy group includes rules for setting inputs and model parameters with rules, when possible and when values are not already directly input, to an assumed or synthetic schedule that is generally appropriate for planning or AOP model runs. These rules significantly simplify data management and the DMIs for importing data needed for rulebased simulations.

B.2.1. SetNambeAugmentedReleaseSwitch

Explanation: Even though the Nambe object is not linked to the rest of the system in URGWOM, the object is included such that the single master model file will meet the needs for Accounting Model runs. Inputs must be set such that the Nambe object will solve for rulebased simulations, so this rule is used to set the Augmented Release Switch series slot to zero for the entire run just so the full rulebased simulation can complete.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to scroll through each date in the rulebased simulation period and set the value for the Augmented Release Switch series slot in the Nambe data object to zero if the value was a NaN.

B.2.2. SetProjectedWastewaterReturns

Explanation: Wastewater return flows are included in URGWOM, and while historical data are used for calibration runs, synthetic assumed future returns are used for rulebased simulations for future scenarios. This rule is used to set projected returns for rulebased simulations if values were not directly input.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps for the rulebased simulation. A separate FOR DO loop is used to create a list of the wastewater returns in the model as set up in the WastewaterReturns subbasin. An IF THEN ELSE statement is used to set the return in the model for each timestep to the values in the corresponding column in the WastewaterDate periodic slot in the SyntheticData data object. Refer to Figure B.1 for a screen capture of the RPL for this rule.

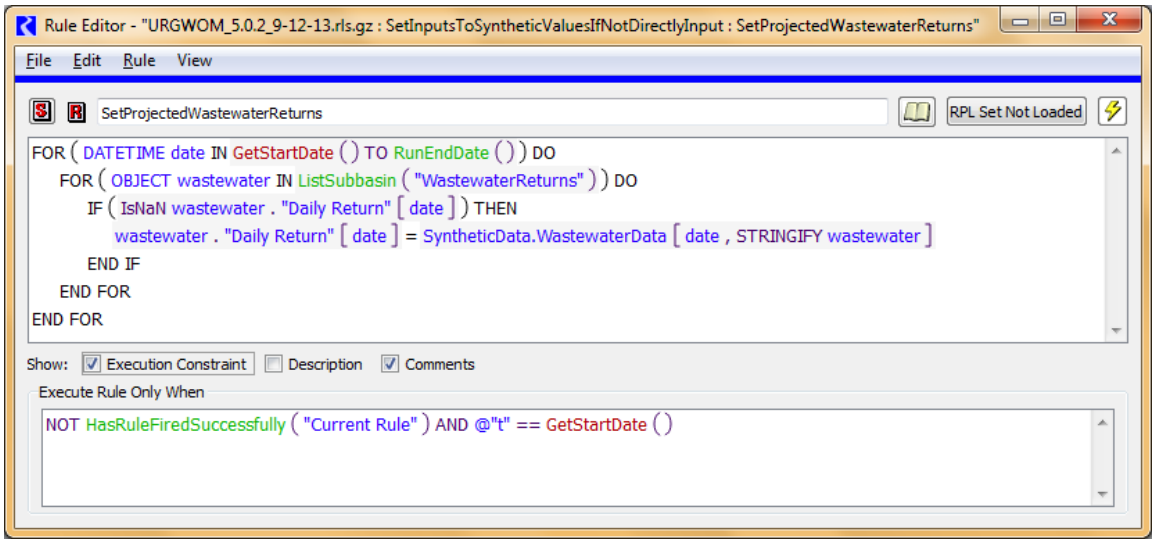


Figure B.1. Rule Policy Language for SetProjectedWastewaterReturns Rule

B.2.3. SetTailwaterForPowerReservoirs

Explanation: The El Vado, Abiquiu, and Elephant Butte level power reservoir objects in URGWOM are set up to compute the power generation with the turbines at each of these three reservoirs. A required input as part of this setup is the tailwater elevation at the

reservoir. Synthetic tailwater values are set with this rule if values were not directly input.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the rulebased simulation. A separate FOR DO loop is used to create a list of the three level power reservoir objects in the model as included in the PowerReservoir subbasin. The Tailwater Elevation slot values on each reservoir object are then set to the values in the corresponding column in the Tailwater periodic slot in the SyntheticData data object if the target Tailwater Elevation slot value is a NaN.

B.2.4. SetMiddleRioGrandeMethodParameters

Explanation: If the values are currently NaN in the model file for the full rulebased simulation period for the groundwater return rate for water not consumed by crops, maximum canal seepage rates, the percent of available flow in the system returned to the river at wasteways and outfalls, fractional returns for MRGCD diversions, flows at the top of drains in URGWOM, or the fractional return for the Albuquerque diversion, the values are set to standard method values with this rule.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the rulebased simulation. A separate FOR DO loop is used to identify every Percent of Available To Divert for wasteway returns that must be input as included in the MiddleRioGrandeWasteways subbasin and set the values to the values in the corresponding column in the Wasteway periodic slot in the SyntheticData data object if a target slot value is a NaN. A separate FOR DO loop is used to identify the Fractional Return Flow slots for all the water users in the MiddleRioGrandeDiversions subbasin. The slot values are set to zero if a target slot value is a NaN. A FOR DO loop is used to identify all the canal seepage objects included in the CanalSeepageObjects subbasin. The slot values are set to the values in the corresponding column in the CanalMaximumSeepage periodic slot in the SyntheticData data object if a target slot value is a NaN. A separate FOR DO loop is used to identify all the inflow slots for the top of drains as represented in URGWOM idenfied with the user-defined ListSlotsTopOfDrains function. The slot values are set to zero if a target slot value is a

NaN. Values for the Fractional Return Flow on the AlbuquerqueWaterUser object are set to 0.5 for all timesteps if the values are NaN. (Note that the return flow from the AlbuquerqueWaterUser object are not linked in the model. The actual returns are input to a separate linked data object, so the values for the Fractional Return Flow on the AlbuquerqueWaterUser object do not affect the model results but values are required for the RiverWare object to solve). A Fractional Return Flow is set to zero on the CanalDiv water user object on the SanAcaciaDiversions aggregate diversion site object with a separate assignment because the MiddleRioGrandeDiversions subbasin does not include this water user such that the subbasin meets the needs for other uses.

B.2.5. SetRioChamaDiversionAndDepletionRequested

Explanation: This rule sets the diversions for the Rio Chama diversions for the full rulebased simulation period. If values are not input for the series slots that corresponds to each canal, synthetic values for a calendar year are used for the full rulebased simulation period. The rule allows for the diversions to also be scaled for a portion of each calendar year (This scale factor has been set to zero to reflect no adjustment for a nil date range, January 1 to January 1, for all the most recent applications). The depletion requested for each canal is set based on the fractional return flows set up in a table for each individual diversion.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the rulebased simulation. A separate FOR DO loop is used to create a list of all the individual canals at the diversions as set up in the RioChamaAcequias subbasin in URGWOM. Values for the Diversion Requested series slots for each canal are set to the values in the corresponding column in the RioChamaDiversions periodic slot in the SyntheticData data object. Values for the Depletion Requested series slots are set to the same referenced diversion rates but multiplied by the values for the corresponding canal in the RioChamaFractionalReturnFlows periodic slot in the SyntheticData data object.

B.2.6. SetPandPDemandAtOtowi

Explanation: The approach for determining releases needed for meeting P&P demands as implemented by the BIA includes references to a daily series for the P&P demand at Otowi for a calendar year. This rule sets values for the series for the full simulation period to those values for a calendar year as set up in the PandP data object. This approach simplifies data management.

Rule Execution: The rule executes at the start timestep and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully predefined function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the simulation. An IF THEN statement is used to set the value in the DailyDemandForCallCalc series slot for each date to the value for the corresponding date in the DailyDemandForCallCalcPeriodic periodic slot if a value was not already input to the source series slot as checked with reference to the predefined IsInput function.

B.2.7. SetInitialMRGCDDemandAtCochiti

Explanation: This rule sets an initial value for the MRGCD demand at Cochiti that drives releases from storage for providing the total flow needed for irrigation in the Middle Valley for MRGCD and the six Middle Rio Grande pueblos. If a series is not directly input, synthetic values are assumed. Note that a separate series slot is used for values that may be directly input such that the set demand can still be adjusted by the higher priority ResetMRGCDDemandAtCochitiForHydrologicConditions rule if the conditions in that rule are satisfied.

Rule Execution: The rule executes at the start timestep and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully predefined function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the simulation. An IF THEN ELSE statement is used to set the value in the DemandAtCochiti series slot in the MRGCD data object to the value for the corresponding date in the SyntheticDemandAtCochiti periodic slot in the same data object if values were not directly input to the DirectInputDemandAtCochiti series slot as checked with reference to the predefined IsInput function.

B.2.8. ResetMRGCDDemandAtCochitiForHydrologicConditions

Explanation: This rule allows for the MRGCD demand to be adjusted during a simulation based on hydrologic conditions and is set up to conserve water in storage if the supply has dropped below an input threshold after a threshold date by changing the demand to zero (i.e. it may be set up to not conserve water until after a later date in the irrigation season). The supply is computed as available native water in storage at El Vado Reservoir, including Emergency Drought water for MRGCD, and San Juan-Chama Project water for MRGCD at Heron, El Vado, and Abiquiu Reservoirs and also any letter water deliveries made at the previous timestep to pay back MRGCD. The rule checks if the demand was reset to zero at a previous timestep, and if so, the demand will then be maintained at zero for the remainder of the irrigation season.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the

ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If the current timestep is greater than or equal to March 1 of the current year and before October 31 of the current year (i.e. within the irrigation season), the input amount of storage to conserve as input to the StorageToConserve periodic slot in the MRGCD data object is greater than 0.1, and the supply for MRGCD as checked with the user-defined MRGCDSupply function is greater than the the storage to conserve or the value for the DemandAtCochiti at the current timestep has already been set to zero. Refer to Figure B.2 for a screen capture of the RPL for this rule.

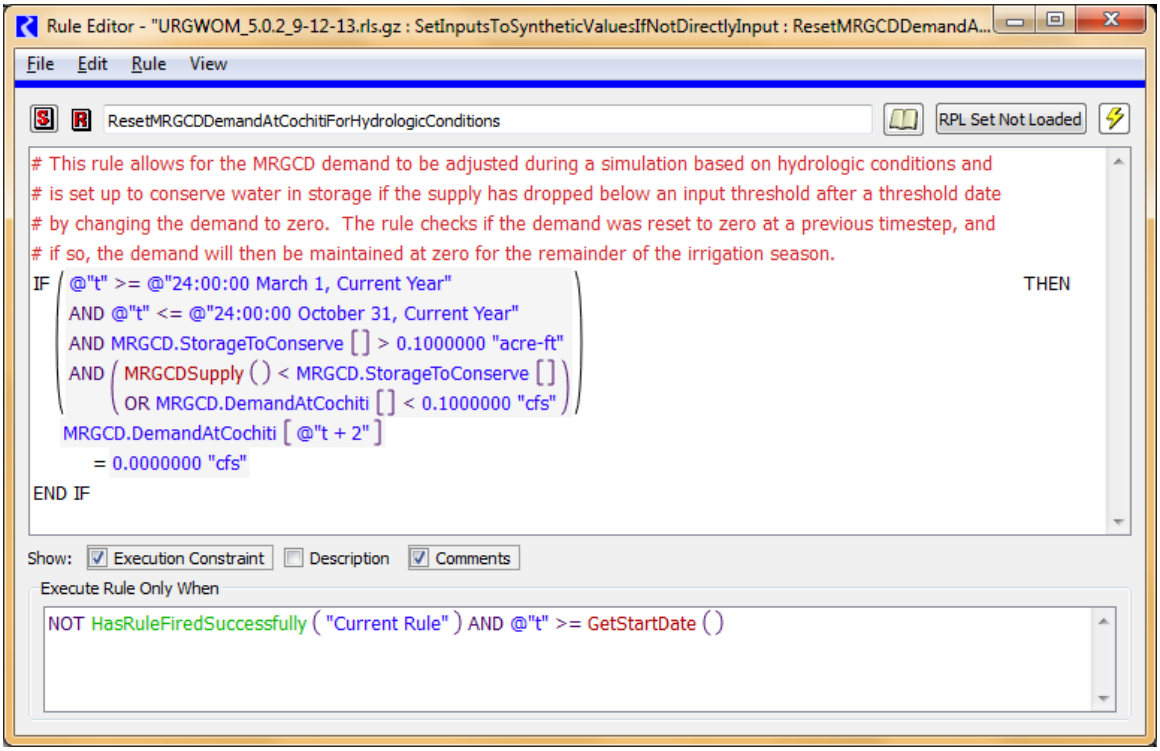


Figure B.2. Rule Policy Language for ResetMRGCDDemandAtCochitiForHydrologic Conditions Rule

B.2.9. SetMiddleRioGrandeDiversionRequested

Explanation: This rule sets the initial requested diversions for the MRGCD diversions for the full simulation period (except to the Socorro Main Canal which is set with a separate rule with reference to the flow in the Unit 7 drain). If values are not input for the series slots that corresponds to each canal, synthetic values for a calendar year are used for the full simulation period. The rule allows for the diversions to also be scaled for a portion of each calendar year (This scale factor has been set to zero to reflect no adjustment for essentially a nil date range, January 1 to January 1, for all the most recent applications). Note that the set diversion amounts may be adjusted with higher priority rules to prevent

supplemental water for Biological Opinion flow targets from being diverted or to increase diversions at Angostura if MRGCD is in a shortage situation.

Rule Execution: The rule executes at the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An outside FOR DO statement is used to create a list of all the timesteps in the rulebased simulation. A separate FOR DO loop is used to create a list of all the individual canals at the diversions as set up in the MiddleRioGrandeDiversions subbasin, which does NOT include the CanalDiv on the SanAcaciaDiversions object. Values for the Diversion Requested and Depletion Requested series slots for each canal are set to the result from the GetMRGCDDiversionRequested user-defined function. The function references the input value in the series slot for the corresponding canal in the MRGCD data object if a value is input; otherwise, the value in the corresponding column in the SyntheticDiversions periodic slot is referenced for setting the canal diversion. Also, the input date range and scale adjustment in the ScaleDiversions table slot in the MRGCD data object are referenced for potentially adjusting the diversions.

B.3. Forecast Errors

The rules in this policy group are used to compute a percent forecast error for each month with reference to estimated inflows to El Vado Reservoir. If the rules are turned on, the computed forecast error is then used to incorporate uncertainty in forecasted flows within a simulation. The computed forecast error, not to exceed input maximums, is referenced in other rules including the calculation of a forecasted Otowi flow volume. These rules have been turned off for recent URGWOM applications.

B.3.1. RewindRandomFile

Explanation: This rule rewinds the random number file. The seed for the random number generator is constant so that simulations can be regenerated if needed. Refer to the discussion of the predefined ResetRanDev function in the RiverWare online help for further discussion of the random number generator.

Rule Execution: This rule executes at the start timestep.

Rule Logic: The function is imbedded in a Print statement, so note that it will not execute if the diagnostics are turned off.

B.3.2. CalculatedForecastError

Explanation: This rule computes a forecast error using a random number generator. The forecast error is then used to compute a percent forecast error.

Rule Execution: If the current timestep is the first day of a month and the forecast error for the end of the current month is a NaN as set to the ForecastError time series slot in the ForecastData data object, the rule fires.

Rule Logic: The ComputeForecastError function in the ComputedForecastError utility group is used to compute the forecast error using different methods depending on the month (Refer to Figure B.3 for a screen capture of the RiverWare Rule Policy language for this user-defined function). Up to May, the error is computed as a function of input coefficients, the estimated inflow to El Vado Reservoir, the previous forecast error, and a random number. The forecast error in June is set to half the forecast error for May, and the forecast error in July is set to a quarter of the forecast error for June. During the remaining months, it is set to zero. Within the rule, the results from the ComputeForecastError function are then checked against input maximum forecast errors for each month for El Vado Reservoir with consideration for the sign of the error. If the maximum is exceeded, the forecast error is reset to the maximum with consideration for the sign.

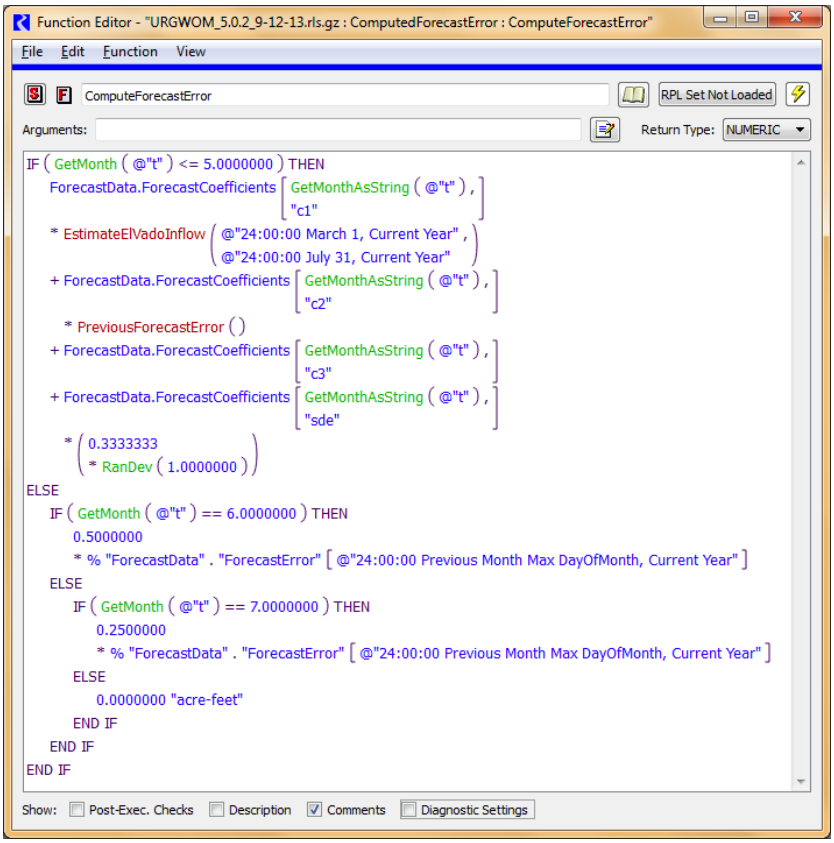


Figure B.3. Rule Policy Language for the ComputeForecastError function used in the CalculatedForecastError Rule

B.3.3. ForecastErrorPercent

Explanation: This rule computes a percent forecast error from the forecast error calculated with the CalculatedForecastError Rule. The percent forecast error is used later when forecasting river flows at Otowi or inflows to Abiquiu Reservoir.

Rule Execution: If the current timestep is the first day of a month and if the percent forecast error for the end of the current month is a NaN as entered in the PercentForecastError time series slot in the ForecastData data object, the rule fires. The second criterion ensures that the rule only fires once per timestep.

Rule Logic: The percent forecast error is computed differently depending on the month. Through July, the percent forecast error is the lesser of the forecast error divided by the estimated inflow to El Vado Reservoir and the input maximum percent forecast error with consideration for the sign. If the estimated inflow to El Vado Reservoir is zero, the percent forecast error is set to 0.10. During other months, if it is the first year of the simulation, the percent forecast error is set to 0.04, and if it is not the first year of the simulation, the percent forecast error is set to the lesser of 0.1 or the computed percent forecast error for July of the current year. Refer to Figure B.4 for a screen capture of the RPL for this rule.

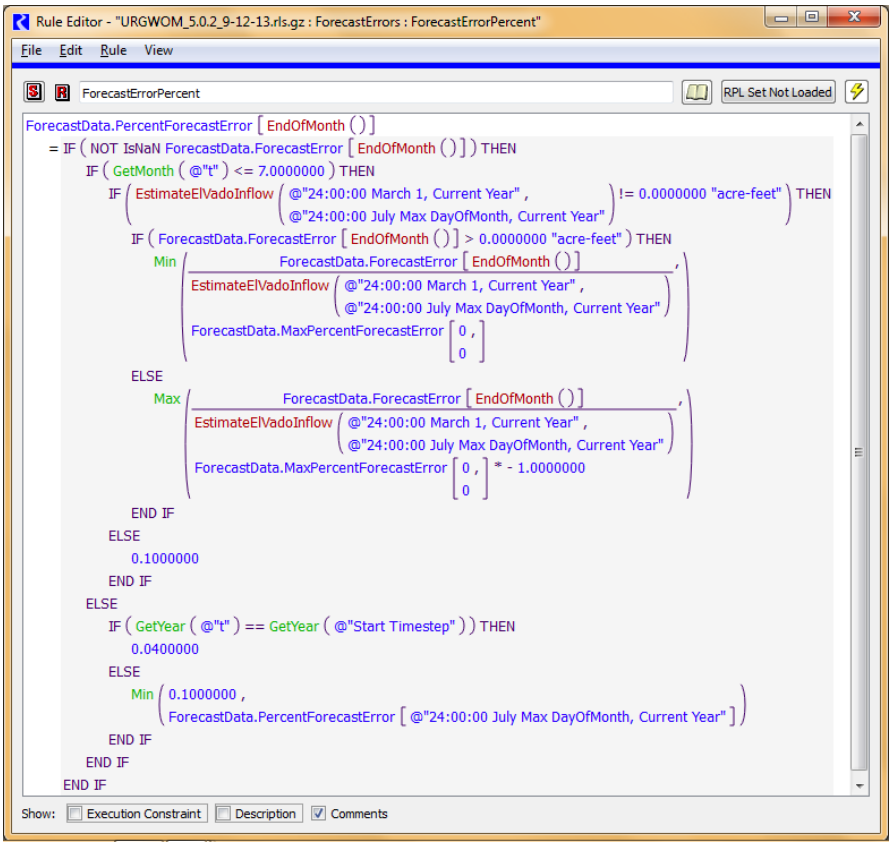


Figure B.4. Rule Policy Language for the ForecastErrorPercent Rule

B.4. SetCompactCreditsAdjustments

New Mexico Compact calculations are completed in URGWOM with expression series slots. If needed, average values may be set with the first rule in this policy group for the Use above Otowi and the Pojoaque Return Flow Credit as referenced for the Compact calculations. Rules in this policy group are also used to adjust the amounts in the New Mexico and Colorado Credit accounts at Elephant Butte Reservoir based on the end-of-year Compact calculations. Note that the Colorado credit/deficit values under the Rio Grande Compact are not actually being input or computed in all the recent applications. A rule is also included to zero out the Compact credits if Elephant Butte spills.

B.4.1. SetAvgNambeFallsDataForRGCompactCalcs

Explanation: At the start of the simulation, average values are set to the UseAboveOtowi and ReturnFlowCreditPojoaqueUnit slots in the RioGrandeCompact data object if values are not input. Values for these two series slots are needed for Rio Grande Compact calculations completed with expression series slots in that same data object. The average values are in the UseAboveOtowiPeriodic and the ReturnFlowCreditPojoaqueUnitPeriodic periodic slots in the RioGrandeCompact data object.

If the Otowi gage flow is input for January 1 through the initialization timestep, assignments are made for each timestep from January 1 through the finish timestep. If the Otowi gage flow is not input from January 1 up to the initialization timestep, average values are only set for the start timestep through the finish timestep. This check for inputs to the Otowi stream gage object for January 1 through the initialization timestep is used to assess whether values have been input to complete Compact calculations for the current year in which case the UseAboveOtowiPeriodic and ReturnFlowCreditPojoaqueUnit values would also be needed back to January 1.

Warning messages are displayed in the diagnostic output window during the run if average values are used. A separate warning message is displayed if Otowi gage data were not input back to January 1 and the start timestep is after January 1.

Rule Execution: The rule executes at the simulation start timestep if there are any NaNs entered in the UseAboveOtowi and ReturnFlowCreditPojoaqueUnit time series slots in the RioGrandeCompact data object.

Rule Logic: The assignments to the UseAboveOtowi and ReturnFlowCreditPojoaqueUnit slots are completed with FOR loops. An IF THEN ELSE statement is used to have the assignments made for January 1 of the current year through the finish timestep if values are input to the Otowi stream gage object for January 1 through the initialization timestep. Otherwise, the assignments are made from the start timestep through the finish

timestep. Print statements are used to note that average values were used and if Otowi gage data were not input for January 1 through the start timestep as needed to complete Compact calculations for the current year. Refer to Figure B.5 for a screen capture of the rule policy language from the RiverWare ruleset.

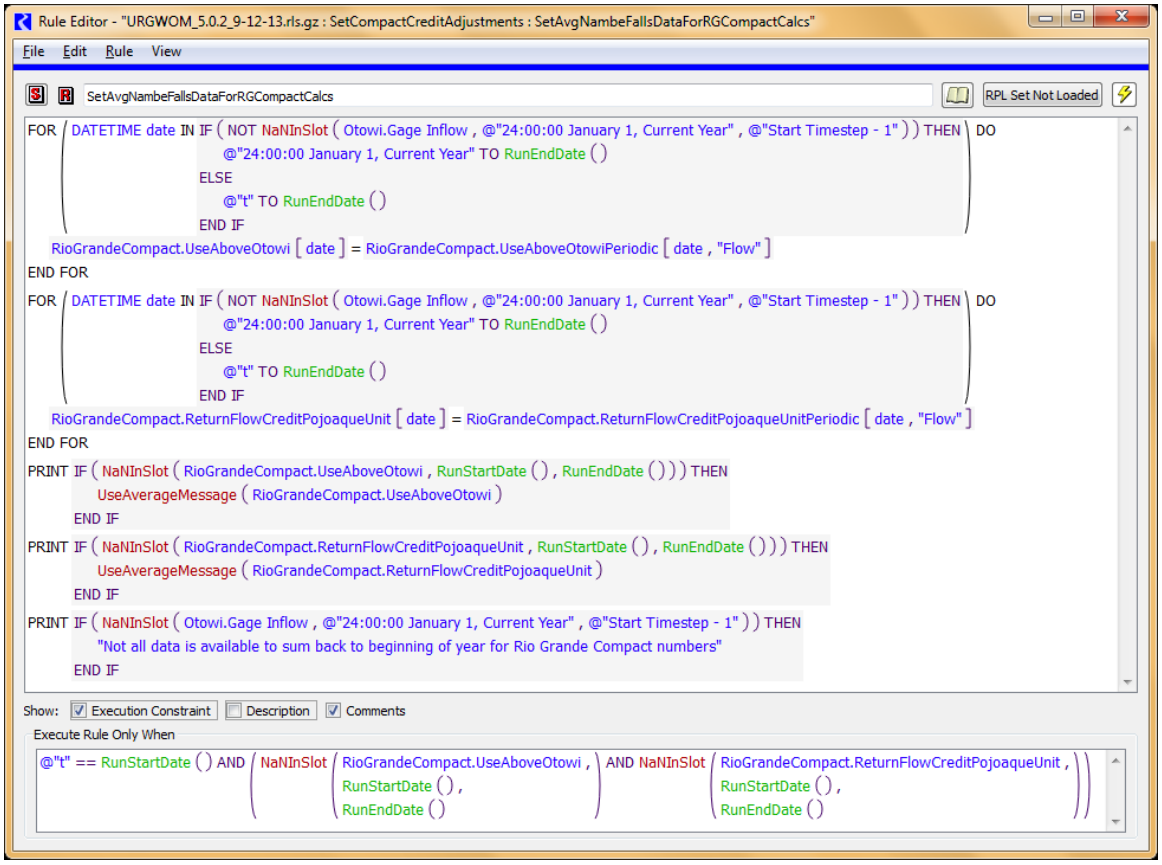


Figure B.5. Rule Policy Language for SetAvgNambeFallsDataForRGCompactCalcs Rule

B.4.2. SetNewMexicoCreditAdjustment

Explanation: This rule makes the annual transfer from the Rio Grande account to the NMCredit account at Elephant Butte Reservoir (or from the NMCredit account to the Rio Grande account) to reflect the annual Compact adjustment as computed with the NMCreditAdj expression series slot in the RioGrandeCompact data object. The December 31st adjustment is made on January 1st of each year (after the first year of simulation).

Rule Execution: The rule executes if the current timestep is greater than the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the EBUnfilledCredit in the RioGrandeCompact data object for the previous timestep is greater than or equal to zero. (Note that the check against the December 31st timestep to

make the annual adjustment is completed within the rule as opposed to within the execution constraint. The transfer is set to zero for all other timesteps.)

Rule Logic: Two assignments are made with this rule to set the accounting supplies for 1) the transfer from the RioGrande account to the NMCredit account at Elephant Butte Reservoir and 2) the transfer from the NMCredit account to the Rio Grande account. IF THEN ELSE statements are used to assign values if the previous timestep was December 31st and depending on whether the value for the NMCreditAdj slot in the RioGrandeCompact data object is positive or negative. The transfer from the Rio Grande account to the NMCredit account is set to the adjustment if the value is positivie; otherwise, the supply is set to zero (i.e. a Compact *credit* for the year results in a transfer from the Rio Grande account to the Compact credit account). The transfer from the NMCredit account to the RioGrande account is set to the magnitude of the adjustment if the NMCreditAdj value is less than zero; otherwise, that supply is set to zero (i.e. a Compact *deficit* for the year results in a transfer from the Compact credit account to the Rio Grande account).

B.4.3. SetColoradoCreditAdjustment

Explanation: This rule sets the supply for an annual transfer of water from the Colorado credit account to the Rio Grande storage account at Elephant Butte Reservoir.

Rule Execution: The rule executes if the current timestep is greater than the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the supply at Elephant Butte Reservoir to transfer water from the Rio Grande account to the COCredit account is a NaN. (Note that the check against the December 31st timestep to make the annual adjustment is completed within the rule as opposed to within the execution constraint. The transfer is set to zero for all other timesteps.)

Rule Logic: Two assignments are made with this rule to set the accounting supplies for 1) the transfer from the RioGrande account to the COCredit account at Elephant Butte Reservoir and 2) the transfer from the COCredit account to the Rio Grande account. IF THEN ELSE statements are used to assign values if the previous timestep was December 31st and depending on whether the value for the COCreditDebit slot in the RioGrandeCompact data object is positive or negative. The transfer from the Rio Grande account to the COCredit account is set to the adjustment if the value is positivie; otherwise, the supply is set to zero (i.e. a Compact *credit* for the year results in a transfer from the Rio Grande account to the Compact credit account). The transfer from the COCredit account to the RioGrande account is set to the magnitude of the adjustment if the COCreditDebit value is less than zero; otherwise, that supply is set to zero (i.e. a Compact *deficit* for the year results in a transfer from the Compact credit account to the Rio Grande account).

B.4.4. Zero NM CO Credits

Explanation: If a spill is occurring at Elephant Butte Reservoir, this rule zeroes out the New Mexico and Colorado Compact credits at Elephant Butte Reservoir.

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the ElephantButteSpillSwitch time series slot in the RioGrandeCompact data object for the previous timestep is equal 1.0.

The ElephantButteSpillSwitch is an expression series slot that sets the switch to 1.0 if the EBUnfilledCredit expression series slot value is negative. After the switch has been set to 1.0, the value is maintained for the remainder of the calendar year. The EBUnfilledCredit slot in the RioGrandeCompact data object is computed as the Elephant Butte Reservoir capacity at the top of conservation minus an input reserve capacity minus the water in storage with any Compact credit (or San Juan-Chama Project water) subtracted. A negative value indicates that storage of native Rio Grande water at Elephant Butte Reservoir has exceeded the limit to indicate a spill.

Rule Logic: Four assignment statements are included for the accounting supplies to make transfer water from the Compact credit account to the Rio Grande account and the Rio Grande account to the Compact credit account for both the New Mexico credit and Colorado credit accounts as needed to zero out the credit accounts. IF THEN ELSE statements are used to identify whether the cumulative credit, or account storage, is positive or negative affecting which supply must be used to zero out the credit.

B.5. RelinquishedCredits and AllocationsForEmergencyDroughtWater

The rules in this policy group are used to compute relinquished Compact credits and set allocations for subsequent storage of Emergency Drought water at El Vado Reservoir. This potential policy can be turned on or off with a switch in the model.

B.5.1. SetRelinquishedCompactCredits

Explanation: This rule records an amount of relinquished Compact credits. If a switch has been set by the model user, Compact credits will be relinquished on an input date for the relinquishment to occur. If a threshold Compact credit is exceeded, Compact credits will be relinquished to reduce the credit to a target lower Compact credit.

Rule Execution: This rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the RelinquishedNMCredits series slot in the RelinquishedCreditsEmergencyDroughtWater data object is a NaN for the current timestep.

Rule Logic: The value for the RelinquishedNMCredits series slot in the RelinquishedCreditsEmergencyDroughtWater data object is set using two IF THEN ELSE statements. If relinquished credits are to be modeled based on an input value greater than 0.1 in the the TriggerModelRelinquishedCredits scalar slot as checked with the ModelRelinquishedCredits user-defined function and the current timestep matches the date for relinquishments as input to the DateOfRelinquishment column of the RelinquishedCreditsTriggers table slot, a relinquishment volume will be computed; otherwise, the value is set to zero. If the Compact credits as of December 31 of the previous year as checked with the CreditWater user-defined function is less than the value input to the ThresholdForRelinquishment column of the RelinquishedCreditsTriggers table slot, the relinquishment value is set to zero. Otherwise, the value is set to the amount of the Compact credit as of December 31 minus the value input to the CreditAfterRelinquishment column of the RelinquishedCreditsTriggers table slot.

B.5.2. UpdateEmergencyDroughtStorageAllocations

Explanation: This rule includes three assignment statements to track the allocations for storage of Emergency Drought water for MRGCD, ESA, and use by municipalities where the allocations are increased for a proportion of any relinquished Compact credits. Note that the allocations include water still in storage and the allocations do not decrease until the water is released from storage. Also, the allocations for municipalities are tracked but URGWOM is not set up to model the storage or use of this water for municipalities.

Rule Execution: This rule executes if any of the values in the MRGCDDroughtAllocation, SupplementalESAAllocation, or MunicipalitiesAllocation series slots are NaN for the current timestep.

Rule Logic: Values for the MRGCDDroughtAllocation and SupplementalESAAllocation series slots in the RelinquishedCreditsEmergencyDroughtWater data object are set with reference to the user-defined UpdatedAllocationForEmergencyDroughtWaterStorage function. The computation with the function starts with the allocation at the previous timestep. If the current timestep is the Start Timestep and an initial allocation was not input, the initial allocation is set to the initial storage for the corresponding Emergency Drought Water account. The allocation is then updated based on the previous gain/loss for the corresponding account and to reflect any new allocation based on the amount of the relinquished Compact credit at the current timestep (which will often be zero unless a relinquishment occurred at the current timestep) multiplied by the proportion of that

relinquishment to be allocated for the corresponding account as input to the ProportionsForNewEmergencyDroughtAllocations table slot. The allocation is then reduced based on any release of water from the allocated storage at the previous timestep as identified by the value for the relevant accounting supply (i.e. the allocation as tracked in URGWOM is not reduced when the water is stored but is reduced when the water is released). A separate similar calculation is completed within the rule for tracking the allocation for municipalities, but with no check against gain/loss or release for the account since there is no account or storage or release to reference for municipalities. The allocation for municipalities is tracked but not used in URGWOM.

B.6. ArticleVIIStatus

The rules in this policy group are used to compute the usable storage at Elephant Butte and Caballo Reservoir and set a switch that designates whether the stipulations or Article VII of the Compact are in effect.

B.6.1. ComputeUsableStorage

Explanation: This rule computes the "usable storage" to be referenced by the SetCompactArticleVIISwitch rule when identifying whether the stipulations of Article VII of the Compact are in effect. Usable storage is computed as the total storage at Elephant Butte and Caballo Reservoirs minus any credit water for New Mexico and Colorado and minus San Juan-Chama Project water including water in the Albuquerque, Santa Fe City, Reclamation, and Combined accounts. Note that the storage in the Compact credit accounts is only subtracted if the account storage is positive and based on the credit amount as of December 31st of the previous year (i.e. any tracked Compact *debt* as negative account storage is not considered in the calculation and any year-to-date evaporative losses to the Compact accounts is not subtracted). Also, the usable storage is immediately adjusted for any relinquished credit (i.e. the transfer of water from the NMCredit account to Rio Grande storage as a result of relinquished credits. The result is recorded to a series slot that can be reviewed from any simulation.

Rule Execution: If the value in the UsableStorage time series slot in the RioGrandeCompact data object is a NaN for the current timestep, the rule fires.

Rule Logic: The value for the UsableStorage time series slot in the RioGrandeCompact data object for the current timestep is set to the value for the Storage at Elephant Butte Reservoir at the previous timestep minus the storage in the NMCredit and COCredit storage accounts at Elephant Butte Reservoir on December 31st of the previous year or the initial timestep, if the corresponding Compact credit account storage on that date is greater than 0.0 acre-ft as assured with the predefined Max function. Also, any relinquished credit in the RelinquishedNMCredits series slot in the RelinquishedCreditsEmergencyDroughtWater data object is added if the current timestep is after the relinquishment date as identified with the user-defined RelinquishmentDate

function. Any San Juan-Chama Project storage at the previous timestep is subtracted as computed with reference to the Albuquerque, SantaFeCity, Combined, and Reclamation storage accounts at the previous timestep. The value for the storage at Caballo Reservoir at the previous timestep is also added. Refer to Figure B.6 for a screen capture of the rule.

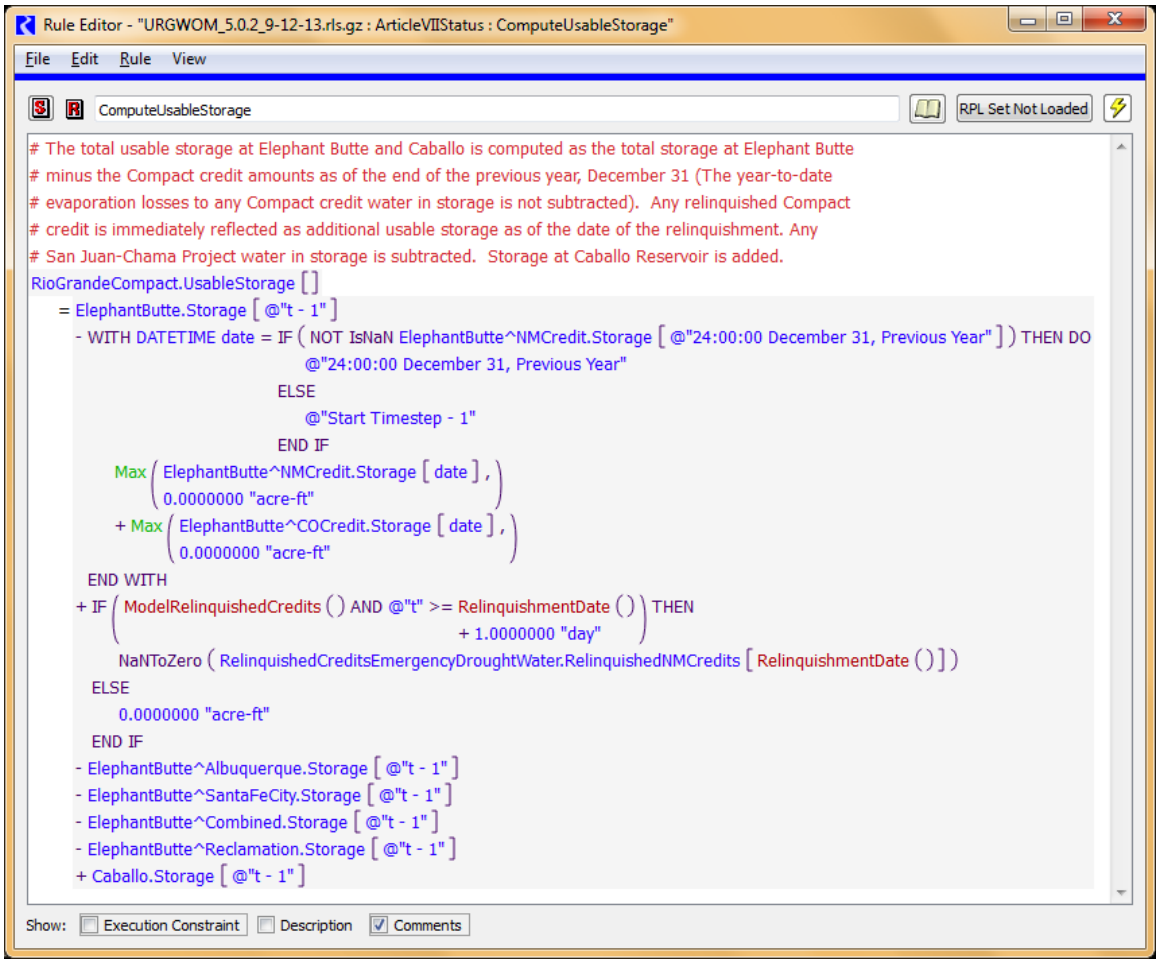


Figure B.6. Rule Policy Language for the ComputeUsableStorage Rule

B.6.2. SetCompactArticleVIISwitch

Explanation: This rule sets a switch that identifies whether the policy stipulated in Article VII of the Rio Grande Compact applies which depends on whether the usable storage as determined with the CompactVIIUsableStorage Rule is less than a minimum storage of 400,000 acre-ft.

Rule Execution: If the value in the ArticleVIISwitch time series slot in the RioGrandeCompact data object is a NaN for the current timestep, the rule fires.

Rule Logic: If the value for the UsableStorage time series slot in the RioGrandeCompact data object for the previous timestep is less than the minimum storage input to the MinUsableStorageToAvoidArticleVIIRestrictions table slot in the RioGrandeCompact data object (400,000 acre-ft), the value for the switch is set to 1.0. Otherwise, the value is set to zero. The result is recorded to the ArticleVIISwitch time series slot in the RioGrandeCompact data object for the current timestep. The input minimum storage is referenced with the user-defined CompactMinStorage function. An identical assignment statement is included to be applied at the Start Timestep for specifically setting the value for the Initial Timestep if a value was not input.

B.7. BeginningOfYear SetCarryover or AllocationBackToCommonPool

San Juan-Chama Project water allocated to contractors at Heron Reservoir must be moved out of Heron Reservoir before December 31 unless waivers are issued allowing the contractor to store the water into the following year. The rules in this policy group are used to either set the carryover for the contractor accounts at Heron if waivers are issued or revert the remaining water in storage back to the common pool for San Juan-Chama Project water if the water is not moved by the end of the year. (Note that the account methods on other reservoirs are already set to always carryover account storage to the following year.)

B.7.1. SetCarryoverForContractorWaiverWater

Explanation: On January 1 during a simulation, the Carry Over slot on all the San Juan-Chama storage accounts is set for each contractor to carryover storage into the subsequent year if waivers have been granted for that contractor.

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the current timestep is January 1.

Rule Logic: A FOR DO statement is used to create a list of all the storage accounts for San Juan-Chama contractors at Heron Reservoir as strings which allows for a single assignment statement to then be efficiently used to set the Carry Over account slot for each of those storage accounts at Heron Reservoir. An IF THEN ELSE statement is used to set the Carry Over if waivers are in effect as input to the corresponding column for the contractor in the WaiverGranted table slot in the Waivers data object by year within the simulation. Cochiti Rec Pool water will always carry over. The amount of the Carry Over is set to the storage at the previous timestep (December 31) for the account not to exceed the annual allocation for the contractor. There is no annual allocation limit to

Reclamation or Cochiti Rec Pool water that may be carried over. If waivers are not in effect for the contractor, the Carry Over is set to zero.

B.7.2. SetCommonPoolAllocationFromContractorWaterNotUsedAndLost

Explanation: On January 1 during a simulation, some contractor water may be lost if it is not moved by the end of the calendar year. If waivers are not in effect for those contractors, the water is reverted back to the common pool for San Juan-Chama Project water and this rule sets the resulting allocation to the FederalSanJuan storage account at Heron Reservoir on January 1st.

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the current timestep is January 1.

Rule Logic: A FOR DO statement is used to create a list of all the storage accounts for San Juan-Chama contractors at Heron Reservoir as strings. An IF THEN ELSE statement is then used to loop through the accounts and identify the contractors that have not been granted waivers as input to the corresponding column for the contractor in the WaiverGranted table slot in the Waivers data object by year within the simulation and as checked with the WaiversAreInEffect user-defined function. A WITH statement is used within the loop to sum the amount of storage that will revert back to the FederalSanJuan account as then assigned to the Begin Year Allocation slot on the FederalSanJuan storage account at Heron Reservoir.

B.8. SetAllocationsToSJCContractors

Inflows of San Juan-Chama Project water through the Azotea tunnel to Heron Reservoir is tracked in a common pool account called FederalSanJuan in URGWOM. That water is then allocated to the contractors for San Juan-Chama Project water each year. An initial allocation is made on January 1st with an additional allocation made after the runoff if needed to potential allocate more water to each contractor up to the max allocation for a year and the total firm yield for all contractors. The two rules in the policy group are used to make the allocations on January 1 and again on an input follow-up date (e.g. July 1) if necessary. Note that the Cochiti Rec Pool gets a full allocation regardless of the available water in storage and thus will not be shorted if necessary for other contractors.

B.8.1. SetSanJuanContractorAllocations

Explanation: This rule is used to allocate available water in the federal pool at Heron Reservoir to contractors for San Juan-Chama Project water on January 1 of each year. A full allocation is first made to the Cochiti Rec Pool account. Allocations are then made proportionally, using the remaining supply, to each contractor up to the full annual allocation for the contractor.

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the current timestep is January 1 and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The first assignment statement sets the Begin Year Allocaton slot for the CochitiRecPool storage account at Heron Reservoir to the annual allocation as input to the corresponding row in the SanJuanContractorAllocations table slot in the HeronData data object but not to exceed the available water in the FederalSanJuan account as checked using the predefined Min function.

A FOR DO loop is used to create a list of all the other contractors for San Juan-Chama Project water as strings such that the Begin Year Allocation slots for each storage account can be set efficiently. The slots are each set with reference to the the user-defined Compute1JanSanJuanContractorAllocations function. The function contains an IF THEN ELSE statement for identifying the allocation. If the total storage in the FederalSanJuan account at the previous timestep is greater than the sum of the allocations for all contractors as checked with reference to the predefined SumTableColumn function, the full allocation is made. Otherwise, the allocations are set to annual allocation multiplied by the ratio of the available supply, minus the full allocation to the Cochiti Rec Pool, to the total firm yield subtracting the Rec Pool allocation. Refer to Figure B.7 for a screen capture of the RiverWare rule policy language for this function.

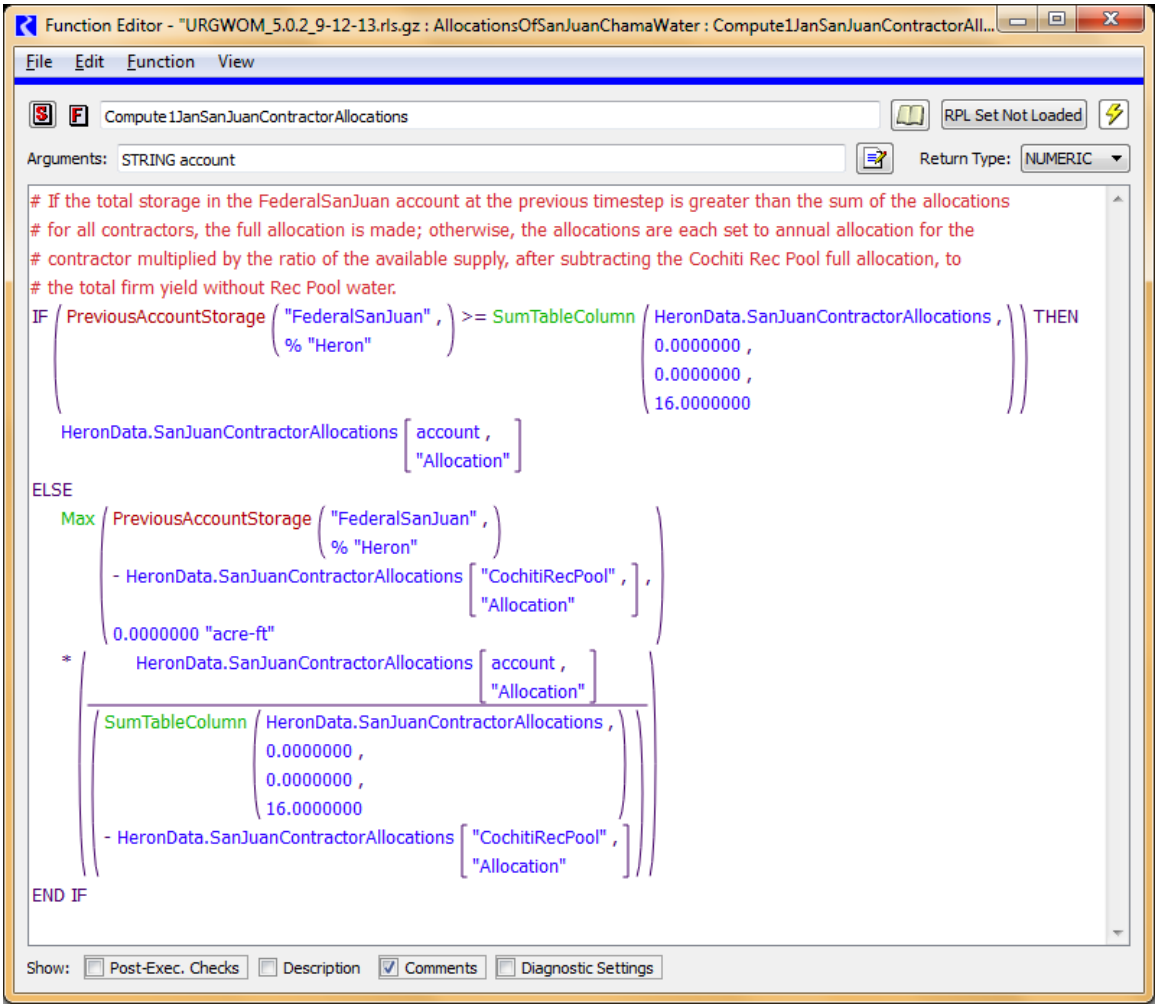


Figure B.7. Rule Policy Language for the Compute1JanSanJuanContractorAllocations Function used in the SetSanJuanContractorAllocations Rule

B.8.2. SetAdditionalSanJuanContractorAllocationsIfNeeded

Explanation: This rule is used to allocate water in the federal pool at Heron Reservoir to contractors for San Juan-Chama Project water at a follow-up date after January 1st if needed to allocate more water up to the annual allocation. Additional allocations would be made if the full allocations for the year could not be made on January 1st due to a limited supply in the common pool for San Juan-Chama Project water at Heron Reservoir. Additional allocations are made on a date input by the model user (e.g. July 1st such that additional water is allocated after the runoff and after the additional inflows for the year from the Azotea tunnel have reach heron Reservoir).

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the current timestep

matches the timestep input to the DateForAdditionalSJCAllocations table slot in the HeronData data object as checked with reference to the DateForAdditionalSJCAllocations user-defined function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The first assignment statement sets the accounting supply to transfer water from the FederalSanJuan account to the Cochiti Rec Pool account to the annual allocation for the CochitiRecPool account as input to the corresponding row in the SanJuanContractorAllocations table slot in the HeronData data object minus the Accrual for the Cochiti Rec Pool account for the year. The assignment is set to not exceed the available water in the FederalSanJuan account as checked using the predefined Min function and not be less than zero as checked with the predefined Max function.

A FOR DO loop is used to create a list of all the other contractors for San Juan-Chama Project water as strings such that each accounting supply for the transfer from the FederalSanJuan account to each contractor storage account can be set efficiently. The slots are each set with reference to the ComputeAdditionalSanJuanContractorAllocations user-defined function. This function references the user-defined 1JanSanJuanAllocations function to sum the allocations made on January 1st for all contractors. If that amount is less than the sum of all annual allocations as computed with the predefined SumTableColumn function and the additional water available in the FederalSanJuan account at the previous timestep is greater than 10 acre-ft, additional allocations are made. Otherwise, the additional allocations are all set to zero.

An internal IF THEN ELSE statement is used to check the sum of allocations made on January 1st plus the available water in the FederalSanJuan account against the total firm yield as computed with reference to the predefined SumTableColumn function. If enough water is available, the function result is the full allocation minus the Accrual for the contractor at the previous timestep (The Accrual is equal to the Begin Year Allocation with no other inflows to the account for the year). Otherwise, the available water in the FederalSanJuan account is distributed proportionately to each contractor based on the ratio of the annual allocation for the contractor to the total firm yield.

B.9. SetReclamationLeases

Reclamation leases of San Juan-Chama Project water are modeled as transfers from accounts for contractors for San Juan-Chama Project water to Reclamation storage accounts. URGWOM is set up to model potential transfers from each account at each reservoir once a year. Leases of waiver water at Heron Reservoir are tracked separately from leases of current year allocations such that Reclamation water at Heron Reservoir can be appropriately treated as waiver water or current year allocation water. The rule in this policy group sets all the transfers for the current timestep based on the model user inputs for leases.

B.9.1. SetAllLeases

Explanation: This rule is used to set all the accounting supplies for transfers from storage accounts for contractors for San Juan-Chama Project water to the Reclamation storage accounts for all leases as input by a model user. Transfer amounts are set to zero for all dates other than the input date for lease transfers to occur.

Rule Execution: The rule executes if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to create a list of the three Rio Chama reservoirs where accounting transfers may occur from Reclamation leases, and an internal FOR DO loop is used to create a list of strings with the potential sources for lease water as San Juan-Chama storage accounts. Accounting supplies for the transfers from the source contractor account to the Reclamation account at each reservoir are set with reference to an IF THEN ELSE statement. If the current timestep matches the date for a transfer to occur as input to the corresponding column in the table slot for the source contractor in the LeaseData data object, the supply is set to the amount input for the current simulation year to the corresponding table slot in the LeaseData data object.

The lease amounts are restricted to not exceed the available water in storage for the source account with reference to the predefined Min function and to not be less than zero using the predefined Max function.

B.10. SetAlbuquerqueDiversion

Diversions by Albuquerque are set with the rules in the policy group. The rules include a check for a preemptive cutoff where Albuquerque would switch to groundwater before curtailment and cutoff restrictions under the permit go into effect, flood control operations at Abiquiu Dam prevent the delivery of San Juan-Chama Project water, or high flows out of Cochiti Dam prevent safe operation of the diversion structure. Note that the model user can set switches in the model to allow for diversions of all native water to occur while Abiquiu is in flood control operations with a debt tracked to be paid back later with San Juan-Chama Project water, and another switch is included that would allow for all San Juan-Chama Project water to be diverted when native flows are too low such that full diversions can continue.

B.10.1. SetPreemptiveAlbuquerqueCutoffSwitch

Explanation: This rule sets a switch to identify whether conditions are satisfied for a preemptive cutoff of Albuquerque surface water diversions (Albuquerque would switch

to groundwater to meet their demand). Preemptive cutoff criteria include a low river flow at which Albuquerque would shutdown before the permit criteria result in a curtailment to diversions, a high Cochiti outflow at which operating the diversion would be unsafe and impractical, and an Abiquiu high outflow at which Abiquiu operations are being conducted for flood control operations and Albuquerque's San Juan-Chama Project water would not be released. Note that the model user can set switches to allow for diversions to continue when Abiquiu is in flood control operations with all Rio Grande water or for diversions to continue with a curtailment or cutoff of native water with additional San Juan-Chama Project water used.

Rule Execution: This rule fires if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN statement is used to check if the switch has been directly input. If not, the value for the PreemptiveCutoffSwitch series slot for the current timestep in the AlbuquerqueDiversions data object is set to 1.0 if the criteria in the PreemptiveCutoffAlbuquerqueDiversion function are satisfied. Otherwise, the value is set to 0.0.

The PreemptiveCutoffAlbuquerqueDiversion function includes a check to see if the value in the TriggerUseAllSJCIfNeeded table slot in the AlbuquerqueDiversions data object is NOT equal to 1.0 and if the Gage Outflow on the Central stream gage object at the previous timestep is less than the input value for the ThresholdCentralFlowForAlbPreemptiveCutoff scalar slot or the value of the TriggerModelElephantButteExchange table slot in the AlbuquerqueDiversions data object is equal to 1.0 and the Outflow from the Abiquiu level power reservoir object is greater than or equal to the input value in the ThresholdHighAbiquiuOutflowForAlbPreemptiveCutoff scalar slot or the Outflow from the Cochiti object is greater than the input to the ThresholdHighCochitiOutflowForAlbPreemptiveCutoff scalar slot on the AlbuquerqueDiversions data object. Refer to Figure B.8 for a screen capture of the RPL for this function.

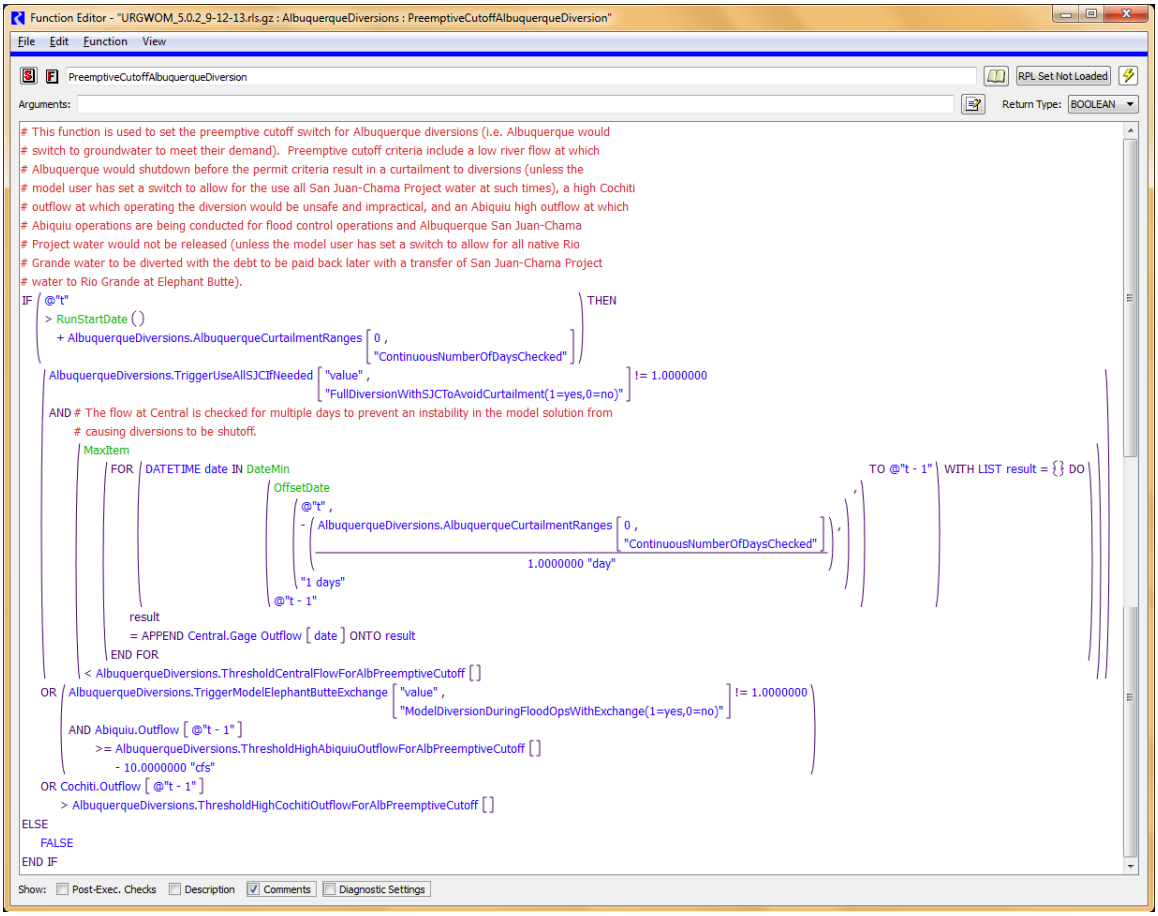


Figure B.8. Rule Policy Language for the PreemptiveCutoffAlbuquerqueDiversion Function

B.10.2. ComputeAlbuquerqueRGDiversionPerPermit

Explanation: This rule records a Albuquerque diversion amount for native Rio Grande water based on the permit that reflects any potential curtailment or cutoff to diversions as a function of river flows. This value reflects the native portion of the total diversion.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the ComputedCurtailedOrCutoffRGDiversion series slot in the AlbuquerqueDiversions data object for the current timestep is set based on the flow of native Rio Grande water in the river as checked over a number of days to prevent fluctuations in modeled flow from affecting operations. If the river flow is less than the value in the StartCurtailment column of the AlbuquerqueCurtailmentRanges table slot in the AlbuquerqueDiversions data object and greater than the value in the Cutoff column of

the AlbuquerqueCurtailmentRanges table slot, the value is set to the Albuquerque demand for San Juan-Chama Project water minus the difference in the StartCurtailment value and the RioGrande flow at AlamedaBridge. Elseif the flow is less than the value in the Cutoff column of the AlbuquerqueCurtailmentRanges table slot, the Rio Grande diversion value is set to zero. Otherwise, the value is set to match the AlbuquerqueSJCDemand.

B.10.3. RecordAlbuquerqueSJCDiversion

Explanation: This rule sets an initial value for the diversion of San Juan-Chama Project water at the Albuquerque surface water diversion. The amount is generally set to a standard demand (e.g. 65 cfs) but may be set to zero if the preemptive cutoff switch has been set or Abiquiu is in flood control operations where San Juan-Chama Project water cannot be delivered to the diversion. This rule includes checks to assure Albuquerque San Juan-Chama Project water is available to deliver to meet the computed demand.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the AlbuquerqueSJCdiversion series slot in the AlbuquerqueDiversions data object is set with reference to three IF THEN ELSE statements. The diversion is set to zero if it is before the startup date for the diversion, the preemptive cutoff switch at the current timestep is equal to 1, or the preemptive cutoff switch has been 1 for the last two weeks as checked with reference to the user-defined PreemptiveCutoffAlbuquerqueDiversionsWithinLastTwoWeeks function. If the value in the TriggerModelElephantButteExchange table slot in the AlbuquerqueDiversions data object is equal to 1.0 and the Abiquiu outflow is greater than the value in the ThresholdHighAbiquiuOutflowforAlbPreemptiveCutoff slot, the San Juan-Chama diversion is set to zero. A WITH DO statement is used to record the amount of San Juan-Chama Project water available for diversion. If the value in the TriggerUseAllSJCIfNeeded table slot in the AlbuquerqueDiversions data object is equal to 1.0, the San Juan-Chama diversion is set to twice the demand computed with reference to the user-defined AlbuquerqueSJCDemand function minus the value in the ComputedCurtailedOrCutoffRGDiversion slot. Otherwise the diversion is set to the demand. The final assignment is set with a check against the available water that is also adjusted for the San Juan-Chama loss rates from Abiquiu to the surface water diversion.

B.10.4. RecordAlbuquerqueRGDiversion

Explanation: This rule sets an initial value for the native Rio Grande water to be diverted at the Albuquerque surface water diversion. The amount is generally set to half the

diversion as allowed for the return flow credit. If the preemptive cutoff switch has been set, the Rio Grande diversion is set to zero. The amount will be set to the total diversion, or twice the typical San Juan-Chama Project diversion, if the model user has set a switch to allow for all native diversion during Abiquiu flood control operations with a debt to be paid back later.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the AlbuquerqueRGDiversion series slot in the AlbuquerqueDiversions data object is set with reference to IF THEN ELSE statements. The diversion is set to zero if it is before the startup date for the diversion, the preemptive cutoff switch at the current timestep is equal to 1, or the preemptive cutoff switch has been 1 for the last two weeks as checked with reference to the user-defined PreemptiveCutoffAlbuquerqueDiversionsWithinLastTwoWeeks function. If the value in the ComputedCurtailedOrCutoffRGDiversion series slot for the current timestep is less than the Albuquerque demand, the AlbuquerqueRGDiversion slot value is set to the ComputedCurtailedOrCutoffRGDiversion series slot value. If the value in the TriggerModelElephantButteExchange table slot in the AlbuquerqueDiversions data object is equal to 1.0 and it is not the start timestep, the value is set to twice the demand for San Juan-Chama Project water as determined with reference to the user-defined AlbuquerqueSJCDemand function minus the accounting supply slot value for the delivery of San Juan-Chama Project water from Abiquiu at the previous timestep adjusted for San Juan-Chama Losses to the diversion. Otherwise the slot is set the Albuqueque demand with the result restricted to not exceed the available supply for Albuquerque at Abiquiu Reservoir.

B.10.5. SetAlbuquerqueDiversion

Explanation: This rule sets the total Albuquerque diversion as the sum of the initial computed diversion of native Rio Grande water and the final amount of San Juan-Chama Project water delivered to the diversion. The diversion is set for the next timestep also such that a value will be in place as needed for hypothetical simulation to solve through the Middle Rio Grande portion of the model.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to make assignments for the current timestep and the next timetep. The value for the Diversion Requested series slot on the AlbuquerqueWaterUser water user object is set to the sum of the accounting supply slot value at the previous timestep for the delivery of San Juan-Chama Project water from Abiquiu adjusted for San Juan-Chama Losses to the diversion and the AlbuquerqueRGDiversion slot value on the AlbuquerqueDiversions data object for the current timestep. The Depletion Requested slot is set in the same manner where a value is required for rulebased simulations.

B.10.6. ComputeAbiquiuSJCDeliveriesToAlbuquerqueDiversion

Explanation: This rule sets an initial computed delivery of San Juan-Chama Project water from Abiquiu Reservoir to the Albuquerque surface water diversion to be referenced when setting the total Abiquiu outflow and for setting the accounting supply for the delivery. The diversion supply is also set in this rule based on the delivery made at the previous timestep, which can be done here due to the modeled 1-day lag between Abiquiu and the surface water diversion.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value was not input, the AlbuquerqueDeliveryToSurfaceWater diversion slot on the ComputedDeliveries data object is set to the value in the AlbuquerqueSJCDiversion slot on the AlbuquerqueDiversions data object adjusted for the San Juan-Chama loss rates between Abiquiu and the diversion.

The diversion accounting supply to the water user object is also set with reference to the separate accounting supply set at the previous timestep for the delivery to the diversion and as adjusted for the San Juan-Chama loss rates to the diversion. Diversions are not set at the start timestep since information is not available in the model to set the diversion.

B.10.7. SetMinBypassAtAngosturaForAlbuquerqueSJC

Explanation: This rule sets a minimum bypass at the Angostura diversion to assure any San Juan-Chama Project water for the Albuquerque diversion does not get diverted at Angostura.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO statement is used to make the assignment into the future as required to allow for hypothetical simulation to solve. The value for the Minimum Diversion Bypass on the BlwSanFelipeDiversionsReach reach object is set to the accounting supply slot value at the previous timestep for the delivery of San Juan-Chama Project water from Abiquiu adjusted for San Juan-Chama Losses to the diversion.

B.11. SetBuckmanDiversion

Diversions by the City of Santa Fe and County of Santa Fe at the Buckman Direct Diversion are set with the rules in this policy group. Current coded policy is based on an average diversion rate over time that reflect usage of their allocated San Juan-Chama Project water and allows for diversions of native water too based on any water rights in place for native water. Water diverted and immediately returned as required for their mixing operation at the diversion are included.

B.11.1. SetBuckmanDirectDiversion

Explanation: This rule sets the diversion for the BuckmanDirectDiversion water user object for both the City of Santa Fe and County of Santa Fe diversions of San Juan-Chama Project water and native Rio Grande water based on the native rights that may be in place. The diversion is set to an amount of San Juan-Chama Project water than can be delivered (or the full request for the City of Santa Fe if an exchange for San Juan-Chama Project water at Elephant Butte is to be modeled), native water used for the mixing operation at the diversion that is immediately returned, and native water based on input water rights with checks for curtailment or cutoff restrictions per the permit. A fractional return is computed for the native water that is diverted for the mixing operation and immediately returned. The diversion accounting supplies are also set in this rule based on the final deliveries from Abiquiu Reservoir as set at the previous timestep.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO statement is used to set diversions in the future as required for hypothetical simulation in the model runs. Three assignment statements are included in the FOR DO loop. Values for the Diversion Requested and Depletion Requested slots on the BuckmanDirectDiversion water user object are both set to the result from the user-defined ComputeBuckmanDiversion function. A WITH DO statement is used in this function to check the river flow over a number of days such that fluctuations in the

modeled river flow do not impact operations with the checks against curtailment and cutoff thresholds. If the current timestep is not the Start Timestep and is greater than or equal to the input startup date, a diversion is computed. Otherwise, the diversion is set to zero. The diversion is computed in separate sections for the San Juan-Chama Project water for the City of Santa Fe, San Juan-Chama Project water for the County of Santa Fe, native water diverted for the mixing operation, and native water diverted set based on the input amount per water rights and with checks against the curtailment and cutoff thresholds.

Within the rule, the Fractional Return Flow slot on the BuckmanDirectDiversion water user object is set with reference to the user-defined ComputeBuckmanFractionalReturn function which computes the value as the ratio of the amount of native water for mixing for both the Santa Fe City and Santa Fe County portions divided by the total diversion computed with the ComputeBuckmanDiversion function.

Two diversion supplies are also set in the rule for the Santa Fe City and Santa Fe County diversions and are set to the amount delivered from Abiquiu Reservoir at the previous timestep with adjustments for the San Juan-Chama loss rates from Abiquiu to Otowi.

B.11.2. ComputeDeliveriesToBuckmanDirectDiversion

Explanation: This rule records deliveries of City of Santa Fe and Santa Fe County water for the Buckman Direct Diversion. These recorded amounts are then referenced when setting the total outflow from Abiquiu Reservoir and for setting the accounting supplies for the final deliveries after the total Abiquiu outflow has been set.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Two assignment statements are included in this rule that each have the same format. If a value is not input, the series slots in the ComputedDeliveries data object for the delivery of SantaFeCity and SantaFeCounty water are set. If the current timestep is greater than the diversion startup date, the delivery is computed. Otherwise, the value is set to zero. Within the BuckmanSanJuanChamaPortion user-defined function, a diversion amount is determined if the Abiquiu outflow is less than the value in the ThresholdAbiquiuOutflowCutoffSJC slot on the Buckman data object; otherwise, the delivery is zero. The requested delivery is identified as the corresponding average diversion amount for the corresponding water user in the DiversionPortions table slot in the Buckman data object. Within the rule, the delivery is then adjusted in the rule for the San Juan-Chama loss rate from Abiquiu to Otowi and also reduced if needed for the available flow at Abiquiu Reservoir for the corresponding water user.

B.12. SetDebts LetterWater PastAlbLoanToMRGCD EBExchange

URGWOM is set up to allow surface water diversions to continue for Albuquerque and the city of Santa Fe during flood control operations when their San Juan-Chama Project water cannot be delivered. A debt is tracked for each during these times to be paid back later with a transfer at Elephant Butte Reservoir.

Contractors for San Juan-Chama Project water may cause depletions in the basin due to groundwater pumping or some other water use and then pay back the river for the impacts with deliveries of San Juan-Chama Project water from storage. Debts caused by groundwater pumping or such other water uses are not modeled in URGWOM and thus must be input by the model user. The inputs also include a split for the amount of the payback that should go to MRGCD and the portion that should be paid back to the Compact deliveries. The payback to MRGCD may occur as a transfer to the MRGCD San Juan-Chama account at El Vado Reservoir or a release to contribute to meeting the MRGCD irrigation demand. The pay back to the Compact is set as a delivery in the winter to Elephant Butte Reservoir after irrigation diversions have ceased.

This policy group also contains a rule to allow for model users to set up an MRGCD debt to payback ABCWUA for a past loan. The debt is tracked in RiverWare until paid back with the delivery from MRGCD's San Juan-Chama account at El Vado Reservoir to the Albuquerque account at Abiquiu Reservoir.

B.12.1. SetDebtForDiversionsDuringFloodOps

Explanation: This rule sets the exchange borrow supply for the debts incurred by the Albuquerque or the City of Santa Fe as a result of diverting water at their surface water diversions while Abiquiu Dam is in flood control operations and San Juan-Chama Project water is not being delivered. The debt for Albuquerque is set to half the Rio Grande diversion due to the return flow credit for the other half of the diversion. The Santa Fe debt is set to the amount taken that would have otherwise been San Juan-Chama Project water.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Two assignment statements are included in this rule. The first assignment statement sets the borrow supply for the Albuquerque debt equal to half the resulting Rio Grande diversion if the value in the TriggerModelElephantButteExchange table slot is equal to 1 and the value in the Outflow slot on the Abiquiu reservoir level power object at the previous timestep is greater than or equal to the value in the ThresholdHighAbiquiuOutflowForAlbPreemptiveCutoff table slot in the

AlbuquerqueDiversions data object. Otherwise, that borrow supply is set to zero. The second assignment statement sets the borrow supply for the City of Santa Fe debt to the amount of San Juan-Chama Project water that would have otherwise been diverted minus any potential delivery of San Juan-Chama Project water, which should be zero during flood ops, if the value in the TriggerModelElephantButteExchangesSantaFeCity table slot in the Buckman data object is equal to 1 and the previous Abiuiu outflow is greater than the value in the ThresholdAbiquiuOutflowCutoffSJC slot in the Buckman data object.

B.12.2. SetDebtForPastAlbuquerqueLoanToMRGCD

Explanation: This rule sets the exchange Borrow slot for any input debt from a past loan by Albuquerque to MRGCD. The debt is then tracked and paid back as MRGCD makes deliveries of their San Juan-Chama Project water at El Vado Reservoir to the Albuquerque account at Abiquiu Reservoir.

Rule Execution: This rule fires if the current timestep equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function or greater than the rulebased simulation start timestep and equal to January 1 and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The Borrow slot on the MRGCDPaybackToAlbuquerqueEX exchange is set to the input amount in the VolumeForPayback column in the for current year of simulation in the PaybackScheduleForPastAlbuquerqueLoanToMRGCD table slot. The volume is converted to a flow with the predefined VolumeToFlow function.

B.12.3. SetLetterWaterPaybacksDebts

Explanation: This rule sets the exchange Borrow slots for all the exchanges set up to track the debts for contactors for San Juan-Chama Project water to be paid back with letter water deliveries. Each contractor has three exchanges for tracking a debt to be paid back as a transfer to the MRGCD account at El Vado Reservoir, a release from Abiquiu Reservoir to contribute to the MRGCD irrigation demand, and to be released from Abiquiu Reservoir to pay back the Compact. The Borrow slots are set based on model user inputs for the total debt, the portions to be paid back to MRGCD versus the Compact, and which means to use to pay back MRGCD.

Rule Execution: This rule fires if the current timestep equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function or greater than the rulebased simulation start timestep and equal to January 1 and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to create a list of contractor account names with potential letter water deliveries. Effectively, three assignment statements are then included in the loop to set three Borrow slots for three exchanges set up in RiverWare for each contractor. The Borrow slot for the payback to the Compact is set to the amount in the TotalPaybackVolume column for the current simulation year in the table slot for the contractor in the LetterWaterDeliveryData data object multiplied by the value in the RatioToCompact column in the same table slot. If the value in the PaybackMRGCDwithTransferAtElVado(1=yes,0=no) column in the same table slot for the current year is 1.0, the Borrow slot for the payback to MRGCD as a transfer at El Vado is then set to the amount in the TotalPaybackVolume column for the current simulation year multiplied by the quantity of 1.0 minus the value in the RatioToCompact column in the same table slot and the Borrow slot for the payback to MRGCD out of Abiquiu Reservoir is set to zero. If the switch is not set to 1.0, the Borrow slot for the payback to MRGCD as a transfer at El Vado is set to zero and the Borrow slot for the payback to MRGCD out of Abiquiu Reservoir is set to the amount in the TotalPaybackVolume column for the current simulation year multiplied by the quantity of 1.0 minus the value in the RatioToCompact column in the same table slot.

B.13. Compute LetterWaterDeliveries ReleasesForMRGCDDemand

The rules in the policy group are used to compute letter water delivery amounts for paybacks to MRGCD as transfers at El Vado, deliveries to payback MRGCD by contributing to the MRGCD demand at Cochiti, and deliveries to Elephant Butte to payback the Compact. Rules are also used to identify the MRGCD demand at Abiquiu and El Vado for eventually later identifying the needed release from storage for MRGCD. These rules are all included together because the releases MRGCD demand for identify releases from storage is reduced for any letter water deliveries from Abiquiu already computed that contribute to the demand.

B.13.1. ComputeLetterWaterPaybackToMRGCDatElVado

Explanation: This rule records computed transfers for contractors to make letter water deliveries to MRGCD as transfers from account storage at El Vado Reservoir to the MRGCD San Juan-Chama account at El Vado. The deliveries are set to zero unless the switch has been set to make paybacks as transfers at El VAdo and the date is on or after the input date to make such a transfer. The recorded value is set to the tracked debt with a check against the available supply for the source contractor.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to create a list of the accounts that may have a payback to MRGCD at El Vado pending. The strings allow for all the assignments to then be made with one assignment statement within the loop. If a value is not already input to the corresponding series in the ComputedLetterWater data object, the value is set to the result of the ComputeLetterWaterPaybackToMRGCDasTransferAtElVado function. Within this function, if the value for the current simulation year in the PaybackMRGCDwithTransferAtElVado(1=yes,0=no) column in the table slot for the corresponding account in the LetterWaterDeliveryDate data object is equal to 1 and the date is greater than or equal to the date in the DateToCompleteTransferAtElVado column in the same table slot, a payback amount is computed; otherwise, the value is set to zero. The computed amount is set to mimimum of the payback debt as identified with the predefined GetPaybackDebt function or the the available supply.

B.13.2. ComputeAbiquiuMRGCDDemand

Explanation: This rule uses hypothetical simulation to determine the required release from Abiquiu Dam to meet the MRGCD demand at Cochiti Lake. A computed value is determined first and then a final value is set with the SetAbiquiuMRGCDDemand rule. The separate steps are included to potentially allow for some alternate approaches to be used in regards to better matching the needed flow at Abiquiu. The final set value is then referenced later to determine the release needed from El Vado Reservoir and to ultimately set any potential releases from storage to meet the MRGCD demand. If the demand at Cochiti is zero, the demand at Abiquiu is set to zero without a call to hypothetical simulation.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value in the ComputedMRGCDDemand series slot in the AbiquiuData data object is a NaN for the next timestep.

Rule Logic: If the value in the DemandAtCochiti series slot in the MRGCD data object at timestep t+2 is greater than 0.1 cfs, the value for the ComputedMRGCDDemand time series slot in the AbiquiuData data object for the next timestep is set using the user-defined AbiquiuComputedMRGCDDemand function. Otherwise, the slot value is set to 0.0 cfs. The AbiquiuComputedMRGCDDemand function uses the predefined HypTargetSimWithStatus function to determine the required outflow from Abiquiu Dam (or the value for the Gage Inflow time series slot for the BlwAbiquiu stream gage object) to meet a target inflow to Cochiti Lake (or a value for the Outflow time series slot in the OtowiToCochitiLocalInflow reach object) equal to the value for the DemandAtCochiti series slot in the MRGCD data object. The function completes the hypothetical

simulation for all the objects in the BelowAbiquiu subbasin and uses the input minimum and maximum outflows from Abiquiu Dam of 0 and 1800 cfs, respectively (the channel capacity below Abiquiu Dam is 1800 cfs) as the bounds for the solution procedure. A tolerance of 2 cfs is allowed for the target flow.

B.13.3. SetAbiquiuMRGCDDemand

Explanation: This rule sets the MRGCD demand for the next timestep based on the computed demand. This separate rule allows for an adjustment to the computed demand to be implemented to potentially better match the need at Abiquiu Dam. With the adjustment in URGWOM to use a one-day physical lage that matches the one-day accounting lag between Abiquiu and Cochiti, this additional rule may not be needed any more.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the MRGCDDemand in the AbiquiuData data object is a NaN for the next timestep.

Rule Logic: The value for the MRGCDDemand slot in the AbiquiuData data object for the next timestep is set to the ComputedMRGCDDemand slot value for the next timestep. For the rulebased simulation start timestep, the value is also set for the current timestep.

B.13.4. ComputeLetterWaterPaybackToMRGCDOutOfAbiquiu

Explanation: This rule records computed letter water deliveries set to contribute to meeting the MRGCD demand at Cochiti. The contributions to the demand are split evenly between contractors that need to make deliveries limited to the remaining payback debt for each contractor or the available supply at Abiquiu for the source contractor. If any contractors cannot make their portion of an evenly split delivery, other contractors will delivery more if possible.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used in the rule to make assignments with reference to the user-defined ComputeLetterWaterPaybacksToMRGCDOutOfAbiquiu function which returns a list of slot names, at index 0, and corresponding resulting deliveries for each, at index 1, in the list.

Within the function, an outer WITH DO statement is used to create a list of accounts that may have a letter water payback to MRGCD out of Abiquiu Reservoir. Another WITH DO statement is used to identify the available total payback to MRGCD that could be made at the current timestep as the minimimum of the tracked debt with a check against the available supply for the contractor. A third WITH DO statement is used to create a list of the account names and determined release where the total need to meet the MRGCD demand is split evenly between the number of source contractors restricted for each to the total available payback. A final WITH DO loop is used in the function to create the list of the target slot names for recording the potential letter water delivery and the determined magnitude of the letter water delivery.

B.13.5. ComputeLetterWaterPaybacksToCompact

Explanation: The daily letter water deliveries to pay back the Compact are recorded with this rule for each contractor based on the total payback amount for the year for the contractor, the portion to be paid back to the Compact, and the unit delivery schedule for the paybacks to the Compact. Note that deliveries are restricted to the available water in storage at Abiquiu for the contractor, and if water is not available, the payback is NOT adjusted later to make up for the discrepancy, but this should be avoided with water moved from Heron to Abiquiu and made available for the paybacks as needed.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used in the rule to make assignments for each of the series slots fore each contractor in the ComputedLetterWater data object for contractor letter water deliveries to pay back the Compact. The amounts are set to the value for the current timestep in the UnitDeliveryScheduleForPaybackToCompact periodic slot in the LetterWaterDeliveryData data object multiplied by the value in the RatioToCompact column for the current simulation year in the table slot for the corresponding contractor in the same data object multiplied by the value in the TotalPaybackVolume column in the same table slot. The result is checked against the available supply at Abiquiu for the source contractor.

B.13.6. SetElVadoMRGCDDemand

Explanation: The MRGCD demand at El Vado for determining needed releases from storage is computed with this rule. The amount is determined using hypothetical simulation between El Vado and Abiquiu for meeting the MRGCD demand at Abiquiu after subtracting off contributions from any letter water deliveries out of Abiquiu to the MRGCD demand.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the MRGCD demand series slot in the ElVadoData data object for the current timestep is a NaN.

Rule Logic: An IF THEN ELSE statement is used to check the result of the GetAbiquiuMRGCDDemand user-defined function which computes the MRGCD demand at Abiquiu as the value in the MRGCDDemand slot in the AbiquiuData data object minus the sum of the recorded letter water deliveries out of Abiquiu to pay back MRGCD in the ComputedLetterWater data object. If that function result is greater than 0.1 cfs, the user-defined ComputeElVadoMRGCDDemand function uses the predefined HypTargetSimWithStatus function to determine the required outflow from El Vado Dam (or the value for the Gage Inflow time series slot for the BlwElVado stream gage object) to meet a target inflow to Abiquiu Reservoir (or a value for the Outflow time series slot in the ElVadoToAbiquiuLocalInflow reach object) equal to the result of the GetAbiquiuMRGCDDemand function for the next timestep. The hypothetical simulation is completed for all the objects in the BelowElVado subbasin and uses the input minimum and maximum outflows from El Vado Dam of 0 and 5000 cfs, respectively, as bounds for the solution procedure. A tolerance of 2 cfs is allowed for the target flow.

B.14. SJCDeliveriesToElephantButte

URGWOM is set up to allow surface water diversions to continue for Albuquerque and the city of Santa Fe during flood control operations when their San Juan-Chama Project water cannot be delivered. The rule in this policy group is used to set the deliveries to Elephant Butte to payback any accrued debt or to be delivered for temporary storage when upstream space is not available.

B.14.1. ComputeContractorDeliveriesToElephantButte

Explanation: This rule records values for Albuquerque and Santa Fe City deliveries to Elephant Butte if there is no space at El Vado or Abiquiu to ultimately avoid losing allocated water at Heron Reservoir or to assure enough water is available for the contractor at Elephant Butte to pay back a debt accrued due to surface water diversions of all native water during flood control operations.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function rule and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set the corresponding slots for Albuquerque and Santa Fe City in the ComputedDeliveries data object for deliveries to Elephant Butte if values are not input. An internal IF THEN ELSE statement is used to check if the value in the TemporaryStorageAtElephantButteAllowed(1=yes,0=no) column in the DeliverySettings table slot for the corresponding contractor is equal to 1.0. If not, the slot is set to 0.0. If so, the slot is set using the user-defined SJCDeliveryAbiquiuToElephantButte function which sets the delivery to move water at the same determined rate to evacuate water from Heron Reservoir such that it will not be lost or to deliver water to Elephant Butte Reservoir for a pending debt payback.

B.15. HeronRGBypass

The rule in this policy group is used to compute the release of native Rio Grande water from Heron Reservoir. Space at Heron Reservoir is designated for San Juan-Chama Project water and the native inflow from Willow Creek is bypassed, but operations actually entail evacuating native water periodically as storage starts to accumulate. This is the realistic approach that is represented in the ruleset as it is not practical for damtenders to bypass the exact inflow every day.

B.15.1. ComputeHeronRGRelease

Explanation: This rule computes an outflow of Rio Grande water from Heron Dam. The referenced function sets the outflow with three parts. Any unregulated outflow is included, and a separate calculation is included for targeting an end-of-year storage of 350 acre-ft such that the native storage will be zero to start the next calendar year after the end-of-year 350 acre-ft accounting adjustment for impacts of Rio Grande water on evaporation. The third part of the calculation is the primary component that sets the release to evacuate Rio Grande water after a threshold amount of Rio Grande storage has been exceeded to then reduce the storage to a lower storage over an input number of days.

Rule Execution: This rule fires if the value in the RGOutflow series slot in the HeronData data object for the current timestep is a NaN and the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function.

Rule Logic: This rule references the HeronRGOutflow function. The function first includes any unregulated spill that must be included in the Rio Grande outflow as checked with the predefined ElevationToUnregulatedSpill function and set based on the reservoir rating table. Second, if the current timestep is after the date in the DateToBeginEvacuatingWaterTo350ForEndOfYearAdjustment column of the RioGrandeBypassComputationParameters function, a release is determined to evacuate any excess storage over 350 acre-ft by the end of the year such that the end-of-year 350

acre-ft accounting adjustment will return the Rio Grande storage to zero to begin the next year. The primary aspect of the computation includes a check to see if the storage of native water is greater than the value in the ThresholdRGStorageToInitiateBypass column in the RioGrandeBypassComputationParameters table slot or the outflow from Rio Grande storage was greater than zero at the previous timestep and the Rio Grande storage is still greater than the value in the TargetMinimumRGStorage column in the RioGrandeBypassComputationParameters table slot. If those conditions are satisfied, a release is computed. The release is computed to evacuate the difference in the previous storage and the target storage plus the average projected inflow of additional native water over an input number of days. The predefined Floor function is used to restrict releases to only adjust by the increment input to the IncrementalAdjustmentToFlowForEvacuatingWater column in the RioGrandeBypassComputationParameters. The computed release is restricted to not exceed the available Rio Grande water in storage plus the inflow for the current day. The function also contains post-execution constraints to assure the maximum outflow is set as required based on the rating tables.

B.16. Compute PandP StorageAndInflow and OtowiForecast

The rules in this policy group are used to compute the P&P storage requirement and set the inflow of native water to P&P storage. The approach matches the actual approach used by the BIA and Reclamation with an Otowi forecast computed in URGWOM based on input inflows. The rules allow for P&P water to be stored prior to March 1 if model parameters are set accordingly.

B.16.1. ComputeOtowiForecast

Explanation: This rule is used to compute a forecasted flow at Otowi for the period from March through July. The Otowi forecast is used later to identify the type of year when setting flow targets and is also referenced as the forecast in the model computation for the P&P storage requirement. Note that an Otowi forecast is determined based on set model inputs.

Rule Execution: This rule fires if the current timestep equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function or greater than the rulebased simulation start timestep and before May 1 or the first day of a month on or before May 1 of the current year.

Rule Logic: If the value in the OtowiForecast time series slot in the PandP data object for December 31 of the current year is not input, an IF THEN ELSE statement is used to see if the finish timestep is before July 31 of the current year, indicating that inflow inputs would not be available in the model run to compute an Otowi forecast volume, and if the forecast for AOP modeling is not a NaN. If those unique conditions are satisfied,

probably only for a short-term run, the Otowi forecast directly input for AOP modeling is used. Otherwise, the December 31 OtowiForecast series slot value is set to the computed volume from the user-defined RouteRioGrandeToOtowi function multiplied by a factor or 1.0 or the PercentForecastError (Refer to the ForecastErrorPercent Rule) if the PerrcentForecastError is not a NaN.

The RouteRioGrandeToOtowi function references several other functions in the OtowiForecastFromInputs utility group. All of these functions use the predefined SumFlowsToVolumeSkipNaN function to compute the volume of flow from a particular source that would be expected at Otowi for the period from March 1 through July 31. Each of these functions considers input average percent losses for the forecast period for the appropriate separate designated reaches from the location of the inflow to Otowi. The user-defined AverageForecastPeriodLoss function is used to reference the percent losses, as a function of a reach identifier, which are input to the AverageForecastPeriodLosses table slot in the ForecastData data object.

B.16.2. ComputePandPStorageRequirement

Explanation: This rule computes a P&P storage requirement at El Vado Reservoir on March 1, April 1, May 1, and also on the rulebased simulation start timestep if it is after March 1. The storage requirement is calculated based on the procedures actually used by the BIA in coordination with Reclamation as the amount of water that would be needed to meet the P&P Demand in the Middle Valley during the irrigation season with consideration for natural flows from the mainstem. Note that the resulting calculated storage requirement may be reset if the model user has also input a minimum storage requirement.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The CalculatedStorageRequirement series slot in the PandP data object for the current timestep is set with two IF THEN ELSE statements. If the current timestep is prior to March 1st or after October 31st, the value is set to 0 acre-ft. If the current timestep is March 1, April 1, May 1, or the start timestep and after March 1, the storage requirement is set to a sum of the monthly needs for the remainder of the year plus the dead storage at El Vado Reservoir. The dead storage is determined using the user-defined DeadStorage function based on the highest reservoir stage with zero outflow in the Max Release table for the ElVado storage reservoir object which is converted to a storage using the predefined ElevationToStorage function. On other dates between March 1 and October 31, the storage requirement at the current timestep is set the storage requirement at the previous timestep.

The user-defined ComputeMonthlyIndianStorageReq function is used to create a list of the monthly Indian storage requirements that are summed with the user-defined SumList function. The ComputeMonthlyIndianStorageReq function computes the requirement as the maximum of zero or the value in the MonthlyDemandsForStorageRequirementCalc table slot for the corresponding month minus the result from the ElVadoUsableFlow function all divided by the value in the ElVadoToOtowiEfficiencyForStorageRequirementCalc table slot in the PandP data object. The ElVadoUsableFlow function multiplies the result from the user-defined ComputeSupplyAtOtowi function by the corresponding input value in the UsableFlowFactor table slot in the PandP data object referenced using the user-defined LookupUsableFlowFactor function.

B.16.2.1. ComputeSupplyAtOtowi

Function Logic: The ComputeSupplyAtOtowi function computes the Otowi supply as a function of the month. The value is set to the input value in the LowRecordLateSummer table slot in the PandP data object for corresponding month plus the result from the ElVadoRunoffLeft function multiplied by the value in the MonthPercent table slot in the PandP data object for the current month referenced with the user-defined GetMonthPercent function.

If the month is March, the result from the ElVadoRunoffLeft function is set to the value in the OtowiForecast series slot in the PandP data object for the current year (Refer to the ComputeOtowiForecast Rule) referenced using the InputElVadoForecast function multiplied by the value in the ForecastFactors table slot in the ElVadoData data object for the corresponding month referenced using the user-defined ElVadoForecastFactor function. If the month is a month between April and July (inclusive), the result from the user-defined RealizedOtowiForecast function is subtracted from the result from the InputElVadoForecast function before multiplying by the result from the ElVadoForecastFactor.

B.16.3. ResetPandPStorageRequirementToMinIfInputAndHigher

Explanation: URGWOM is set up such that a model user can override a computed P&P storage requirement to assure the storage requirement is greater than or equal to a user input minimum. This flexibility is particularly valuable for AOP modeling where a exact storage requirement may already be known that should be used as a minimum as an override to a potentially lower computed value computed in URGWOM. The separate final storage requirement is recorded and then used for setting P&P storage.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The FinalStorageRequirement series slot in the PandP data object for the current timestep is set to the maximum of the CalculatedStorageRequirement series slot value or the value in the InputMinPandPStorageRequirement scalar slot in the PandP data object as checked with the predefined Max function. An outer IF THEN ELSE statement is used to check if the date is before March 1 or after October 30 when the storage requirement is set to zero.

B.16.4. TallyPandPWaterStoredInArticleVII

Explanation: This rule records a tally of the P&P water stored while Article VII is in effect. This tally is then referenced when determining whether unused P&P water each year should be evacuated from El Vado Reservoir or transferred to Rio Grande storage at El Vado. The tally adds water stored while Article VII was in effect, subtracts water then evacuated at the end of the year that was stored while Article VII was in effect, and subtracts releases in excess of the amount needed to meet the P&P demand between May and October, which is water not needed and being evacuated as water stored while Article VII was in effect.

Rule Execution: This rule fires if the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value in the SumPandPWaterStoredWhileInArticleVII series slot for the current timestep is set with an IF THEN ELSE statement. If the current timestep is January 1 or the start timestep and a value is not input, the previous value is set to the previous storage in the PandP account if the ArticleVII switch value is 1.0 or 0 if not. If a previous value for the tally is input, that value is used.

For subsequent timesteps, the tally is set to the previous value in the SumPandPWaterStoredWhileInArticleVII plus the inflow, as the value of the transfer supply converted to a volume, at the previous timestep if the ArticleVII switch is 1.0 minus the any release from the PandP account out of El Vado Reservoir, based on the corresponding supply, if the date is between the dates to evacuate PandP water at the end of the year, and minus any release made between May and October that is above the release needed to meet the PandP demand at Otowi (i.e. this excess releases is P&P water not needed and being evacuated as water stored while Article VII was in effect).

B.16.5. UnneededPandPWaterTransferredBackToRioGrande

Explanation: This rule sets the transfer of unused P&P water to the Rio Grande account at El Vado Reservoir. Note that any water stored while Article VII was in effect will be evacuated before excess water stored while Article VII was not in effect is transferred to

the Rio Grande account. Water may be transferred to the Rio Grande account at the end of the year or during the irrigation season if the P&P storage exceeds the final storage requirement.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If the current timestep is after the date in the EvacuationStartDate column of the ParametersToEvacuatePandPWaterStoredInArticleVII table slot in the PandP data object, and the value in the SumPandPWaterStoredWhileInArticleVII series slot is less than 0.01 acre-ft, the accounting supply for the transfer from the PandP account to the Rio Grande account is set to the previous storage in the PandP account at El Vado Reservoir. If the current timestep is between May 1 and October 30 and the tally of water stored while Article VII is in effect is less than 0.01 acre-ft and the value for the Accrual to the PandP account plus water potentially stored early is greater than the storage requirement, and the previous PandP account storage is greater than the storage requirement, the accounting supply is set to the previous storage minus the storage requirement. The latter check allows for water to be moved out of the PandP account if the storage requirement on May 1 decreases from an earlier computed requirement. If those conditions are not satisfied, the accounting supply is set to 0.0 cfs. Refer to Figure B.9 for screen capture of the rule policy language for the PandPTransferToRioGrande function.

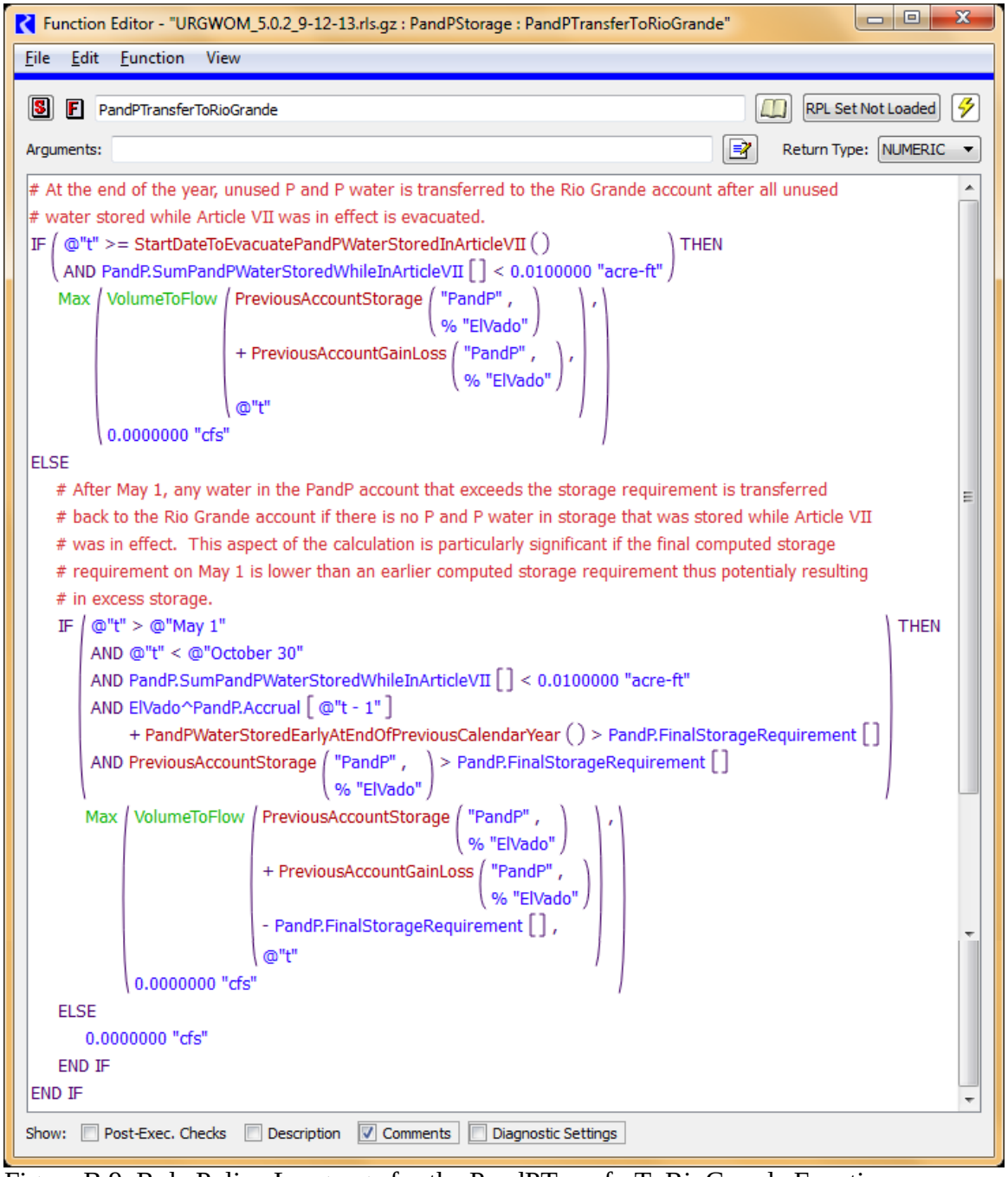


Figure B.9. Rule Policy Language for the PandPTransferToRioGrande Function

B.16.6. SetInflowToPandPStorage

Explanation: This rule sets the transfer from Rio Grande storage to P&P storage at El Vado Reservoir for storing inflows for meeting the P&P storage requirement regardless of whether Article VII of the Compact is in effect. Daily inflows are stored as needed up until the storage requirement is met with available inflows above the minimum El Vado release and above the amount needed for the total Middle Rio Grande irrigation demand.

Note that the referenced storage requirement allows for water to be stored up to the minimum possible requirement prior to March 1 if parameters are set accordingly in the model.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the accounting supply to transfer water from the RioGrande account account to the PandP account at El Vado for the current timestep is a NaN.

Rule Logic: The accounting supply for the transfer of water from the RioGrande account account to the PandP account at El Vado for the current timestep is set using the user-defined InflowToPandPStorage function. The function computes the value as the minimum of the current Rio Grande inflow minus the maximum of the MRGCDDemand slot value in the ElVadoData data object or the minimum Rio Grande outflow identified with the user-defined MinRGOutflow function. If the Rio Grande storage is negative, the available flow for storage is reduced to allow for the Rio Grande account to return to zero storage. The inflow is also restricted to the result from the user-defined ComputePandPStorageSpace function.

The ComputePandPStorageSpace function computes the space with an IF THEN ELSE statement. If the current timestep is prior to March 1 and after the date in the DateToBeginStorageForPandP table slot in the PandP data object as checked with the user-defined StoreEarlyForPandP function, the space is computed as a computed minimum storage requirement, evaluated with the user-defined MinimumPandPStorageRequirement function, minus the storage in the PandP account at the previous timestep plus the cumulative of the Gain Loss values for the account since storage began. When storage is not beginning early, the space is computed as the value in the FinalStorageRequirement slot in the PandP data object for the current timestep minus the previous Accrual to the account minus any water stored early during the previous calendar year as determined with the user-defined PandPWaterStoredEarlyAtEndOfPreviousCalendarYear.

B.17. ComputeCallForPandPRelease

The rules in this policy group incrementally complete the computations for ultimately computing the call for releases from P&P storage at El Vado Reservoir. The rules are configured to record the steps in the computation such that the incremental calculations can be reviewed from any model run. The call effectively represents the amount of additional water that needs to be released from El Vado Dam to meet a daily demand schedule after considering inflows from the mainstem and native flows above El Vado Reservoir.

B.17.1. ComputeFlowFromMainstemForPandPCallCalc

Explanation: This rule records a value for the flow from the mainstem realized at Otowi for identifying the potential additional water needed to meet the daily P&P irrigation demand at Otowi.

Rule Execution: If the value for the NaturalFlowFromMainstemForCallCalc in the PandP data object for the current timestep is a NaN, the rule fires.

Rule Logic: The value for the NaturalFlowFromMainstemForCallCalc in the PandP data object for the current timestep is set the minimum of the Gage Outflow on the Embudo stream gage object at the previous timestep adjusted based on the Variable GainLoss Coef values for the previous timestep on the EmbudoToConfluence and ConfluenceToOtowi reach objects or the Gage Outflow on the Otowi stream gage object at the previous timestep. That resulting flow is then adjusted based on the appropriate value in the UsableFlowFactorsForCallCalc table slot it the PandP data object. Note that for the model run start timestep, flows are not available to complete the calculation, so the flow at Embudo is used for this first timestep to start the simulation.

B.17.2. RioChamaNaturalFlowNeedForPandPOtowi

Explanation: This rule records a value for the flow needed from the Rio Chama in addition to the flow provided from the mainstem as needed to meet the daily P&P irrigation demand at Otowi.

Rule Execution: If the value for the RioChamaNaturalFlowNeedOtowi in the PandP data object for the next timestep is a NaN, the rule fires.

Rule Logic: The value for the RioChamaNaturalFlowNeedOtowi in the PandP data object for the next timestep is set with an IF THEN ELSE statement. If the current timestep is between March 1 and November 15 as checked with the user-defined PandPIrrigationSeason function, the next timestep is less than or equal to the Finish Timestep, and the value in the DailyDemandForCallCalc series slot for the next timestep is greater than the value in the NaturalFlowFromMainstemForCallCalc series slot in the PandP data object for the current timestep, a computation is completed. Otherwise, the value is set to 0.0 cfs. The calculation is set as the quantity of the DailyDemandForCallCalc slot value at the next timestep minus the NaturalFlowFromMainstemForCallCalc series slot value for the current timestep multiplied by the appropriate value from the UsableFlowFactorsForCallCalc table slot in the PandP data object as identified with IF THEN ELSE statements.

B.17.3. RioChamaNaturalFlowNeedForPandPElVado

Explanation: This rule records a value for the flow needed at El Vado in addition to the flow provided from the mainstem as needed to meet the daily P&P irrigation demand at Otowi. Model loss coefficients for the reaches between El Vado and Otowi from the previous timestep are used to identify the flow needed at El Vado from the flow needed at Otowi.

Rule Execution: If the value for the RioChamaNaturalFlowNeedElVado in the PandP data object for the next timestep is a NaN, the rule fires.

Rule Logic: The value for the RioChamaNaturalFlowNeedElVado in the PandP data object for the current timestep is set to the value in the RioChamaNaturalFlowNeedOtowi series slot for the next timestep divided by the delivery efficiency from the confluence to Otowi computed as 1.0 plus the previous Variable GainLoss Coef slot value in the ConfluenceToOtowi reach object divided by the delivery efficiency from Abiquiu Dam to Chamita computed as 1.0 plus the previous Variable GainLoss Coef slot value in the BlwAbiquiuToChamita reach object divided by the delivery efficiency from the El Vado Dam to Abiquiu Reservoir computed as 1.0 plus the previous Variable GainLoss Coef slot value in the BlwElVadoToAbvAbiquiu reach object. At the start timestep, the result is set to 0.0 cfs to get the simulation started.

B.17.4. ComputeCallForPandPReleaseElVado

Explanation: This rule sets a call for releases of P&P water from storage. The primary purpose of the rule is to set the release as needed to meet the P&P demand at Otowi, but releases are also set to evacuate unused P&P storage that was stored while Article VII was in effect.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and if the value for the PandPReleaseFromElVado series slot in the ComputedDeliveries data object for the next timestep is a NaN.

Rule Logic: If the current timestep is after the date in the EvacuationStartDate column of the ParametersToEvacuatePandPWaterStoredInArticleVII table slot in the PandP data object and before the date in the EvacuationEndDate column, a release is set to the maximum of the rate to evacuate all the water over the evacuation period or the input value in the TypicalMinimumReleaseRate column of the ParametersToEvacuatePandPWaterStoredInArticleVII table slot in the PandP data object.

The release is restricted to not exceed the value in the SumPandPWaterStoredWhileInArticleVII series slot in the PandP data object.

Otherwise, if the current timestep is between May 1 and October 30 and the tally of water stored while Article VII is in effect is greater than 0 acre-ft and the value for the Accrual to the PandP account plus water potentially stored early is greater than the storage requirement, and the previous PandP account storage is greater than the storage requirement, the release is set to value in the TypicalMinimumReleaseRate column of the ParametersToEvacuatePandPWaterStoredInArticleVII table slot in the PandP data object not to exceed the amount of water in the PandP storage account. Else, the release is set to the difference in the value in the RioChamaNaturalFlowNeedElVado series slot minus the value in the Local Inflow series slot in the ElVadoLocalInflow reach object nto to exceed the available storage in the PandP storage account.

B.18. StorageOfEmergencyDroughtWater

The rule in this policy group is used to set the acconting supplies for transferring Rio Grande water to Emergency Drought water accounts based on tracked allocations for storage. Inflows above the amount needed for P&P storage and the amount needed to meet the MRGCD demand are stored when Article VII is in effect. Storage of Emergency Drought water is split between MRGCD and ESA based on the available space for each.

B.18.1. SetInflowToEmergencyDroughtWaterAccounts

Explanation: This rule computes the transfer of native Rio Grande inflows to Emergency Drought water storage for MRGCD and ESA. Available inflows not needed for P&P storage and also above the amount needed for meeting the MRGCD demand are stored as Emergency Drought water when Article VII is in effect. Storage of available inflows are split between Emergency Drought water storage for MRGCD and ESA based on the ratio of the available space for the individual use to the total space for both MRGCD and ESA Emergency Drought water where the space reflects the remaining unfilled allocation for storage of Emergency Drought water.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and as identified with the user-defined GetStartDate function and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A WITH DO loop is used to define the inflow to El Vado Reservoir potentially available for Emergency Drought Water storage using the InflowAvailableForStorageAsEmergencyDroughtWaterAtElVado function. The flow available for storage is computed as the estimated Rio Grande inflow minus any required

inflow to P&P storage and minus the amount needed to meet the MRGCD Demand at El Vado. The RioGrandeElVadoToMRGCDDroughtElVado.Supply and RioGrandeElVadoToSupplementalESA.Supply slots to transfer native inflows to Emergency Drought Water storage are set with this rule. The rule contains an IF THEN ELSE statement to identify whether Article VII is in effect, there is space for Emergency Drought water storage for the corresponding Emergency Drought Water account, and the current timestep is in the user defined season for filling Emergency Drought Water storage. If those conditions are not satisfied, the inflow to Emergency Drought Water storage for the account is set to 0.0 cfs. Otherwise, the calculation is set to the computed available inflow for Emergency Drought Water storage multiplied by the ratio of the available space for the account to the total available space for both ESA and MRGCD Emergency Drought Water storage.

B.19. SetMiddleValleyTargetFlows CochitiDeviationsTargets

The rules in this policy group are used to set Middle Rio Grande target flows per the 2003 Biological Opinion for ESA operations. Rules are used to set targets based on a lookup table, and the targets may then be reset to include step downs in targets to represent the use of supplemental water for discretionary operations or to higher targets at Central for Cochiti deviations.

B.19.1. Hydrology Year Type

Explanation: This rule is used to set a trigger for the current timestep to 1, 2, or 3 to identify whether the year is classified as Dry, Normal, or Wet, respectively. The result is used later when downstream target flows are determined. These year classifications are established as needed for defining flow targets per the Biological Opinion. Note that the year classification is checked at the first day of each month through May 1st, and the year classification as of May 1st is maintained for the remainder of the calendar year.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the value for the HydrologyYearType series slot in the MiddleValleyTargets data object is a NaN for the current timestep.

Rule Logic: The HydrologyYearType time series slot in the MiddleValleyTargets data object is set using IF THEN ELSE statements. If the current timestep is the Start Timestep or the first day of a month on or before May 1, the following criteria are checked for potentially adjusting the hydrology year type. Otherwise, the same established year classification from the previous timestep is maintained.

If the stipulations in Article VII of the Compact apply, the value is set to 1.0 to identify that it is a Dry year. Otherwise, the OtowiForecast for the current year computed with

the ComputeOtowiForecast Rule is checked against the input AverageOtowiForecast in the PandP data object multiplied by the corresponding forecast factor entered in the ForecastFactorsForHydYearType table slot in the MiddleValleyTargets data object. If the forecast is less than or equal to the average forecast times the Dry forecast factor, the value for the HydrologyYearType slot is set to 1.0 to identify that it is a Dry year. If the Otowi forecast is greater than the average forecast times the Wet forecast factor, the value is set to 3.0 to identify that it is a Wet year. If none of the preceding criteria applies, the value is set to 2.0 to identify that is a Normal year.

B.19.2. SetMinTargetsAtStart

Explanation: This rule is used to identify the downstream target flows at Central, Isleta, San Acacia, and San Marcial at the Start Timestep based on the hydrology year type and with consideration for the input adjustment factor.

Rule Execution: This rule fires if the current timestep is equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to record the downstream targets flows for four time series slots in the MiddleValleyTargets data object: MinTargetForCentral, MinTargetForIsleta, MinTargetForSanMarcial, and MinTargetForSanAcacia. An internal FOR DO loop is used to make assignments for each slot for the current timestep through the current timestep plus one day (i.e. the approximate travel time from Abiquiu Dam to Cochiti Lake) plus the travel time from Cochiti Dam to the corresponding target location as input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object.

The user-defined MinTargetFlow function is used to compute the target flow as a function of the date, hydrology year type, and target flow adjustment factor. The target flows for each location based on the date and hydrology year type are input to the MinTargetFlows periodic slot in the MiddleValleyTargets data object, and the target flow adjustment factor for each target location and each month is input to the MinTargetFlowsSafetyFactor periodic slot in the MiddleValleyTargets data object. An identical calculation is completed to also assign the values to series slots that end in "TargetNoOtowiCutoff" in the MiddleValleyTargets data object for each target location (The side calculations are completed to track what targets would be if targets are set to zero as part of simulated proposed action to not use targets after a year-to-date threshold flow volume at Otowi is reached).

B.19.3. MinIsletaSanAcaciaSanMarcialFlowTargets

Explanation: This rule is used to set the downstream flow targets at Isleta, San Acacia, and San Marcial based on the hydrology year type and with consideration for the input adjustment factor. (The target for Central is set separately to prevent priority conflicts with the potential alternate policy for resetting Central targets for recruitment or overbank flows as a result of Cochiti deviations.) Targets are actually set into the future based on the travel time from Abiquiu Dam to the target location. Targets are set to zero after the year-to-date Otowi flow volume has exceeded the input threshold volume for conserving supplemental leased San Juan-Chama Project water and if there is no Emergency Drought water available (i.e. there is no storage in the SupplementalESA account at El Vado Reservoir). Policy for this proposed action of conserving supplemental leased San Juan-Chama Project in wetter years may be turned off by inputting a very high threshold Otowi flow volume.

Rule Execution: This rule executes if the value in the MinTargetForSanMarcial series slot in the Middle Valley Demands data object is a NaN for the timestep equal to t+1 plus the result from the user-defined ApproximateNumDaysDownstream function for San Marcial.

Rule Logic: A FOR DO loop is used to record the downstream flow targets for the timestep equal to the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to the target location for the following three time series slots in the MiddleValleyTargets data object: MinTargetForIsleta, MinTargetForSanAcacia, and MinTargetForSanMarcial. If the year-to-date modeled flow volume in the Gage Outflow series slot for the Otowi stream gage object is less than the input value in the ThresholdOtowiVolumeHoldLeaseWater scalar slot in the MiddleValleyTargets data object or the storage in the SupplementalESA account at El Vado Reservoir at the previous timestep is greater than zero, the target is determined with reference to the user-defined MinTargetFlow function as a function of the date, hydrology year type, and target flow adjustment factor. The target flows for each location, based on date and hydrology year type, are input to the MinTargetFlows periodic slot in the MiddleValleyTargets data object, and the target flow adjustment factor for each target location and each month is input to the MinTargetFlowsSafetyFactor periodic slot in the MiddleValleyTargets data object. If the condition is not satisfied, the target is set to zero.

An outer IF THEN ELSE statement is included such that the year-to-date Otowi flow volume is not checked if the current timestep is the Start Timestep or January 1. An additional assignment statement is also included to record what the targets would be if the values were not reset to zero after the year-to-date Otowi flow volume exceeds the threshold volume. These assignments are made to three series slots for the target locations that end with “TargetNoOtowiCutoff” in the MiddleValleyTargets data object.

B.19.4. MinCentralFlow Target

Explanation: This rule is used to set the downstream flow target at Central based on the hydrology year type and with consideration for the input adjustment factor. (The target for Central is set separately to prevent conflicts with the potential alternate policy for resetting Central targets for recruitment or overbank flows as a result of Cochiti deviations.) The target is actually set into the future based on the travel time from Abiquiu Dam to Central. The target may be set to zero after the year-to-date Otowi flow volume has exceeded the input threshold volume for conserving supplemental leased San Juan-Chama Project water and if there is no Emergency Drought water available (i.e. there is no storage in the SupplementalESA account at El Vado Reservoir). Policy for this proposed action of conserving supplemental leased San Juan-Chama Project in wetter years may be turned off by inputting a very high threshold Otowi flow volume. Note that the rule for resetting the Central targets for Cochiti deviations is higher priority and targets will be subsequently be changed for deviations if deviations are implemented.

Rule Execution: This rule executes if the value in the MinTargetForCentral series slot in the MiddleValleyTargets data object is a NaN for the timestep equal to t+1 plus the result from the user-defined ApproximateNumDaysDownstream function for Central.

Rule Logic: The downstream flow target for the MinTargetForCentral time series slot in the MiddleValleyTargets data object is set for the timestep equal to the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to Central. If the year-to-date modeled flow volume in the Gage Outflow series slot for the Otowi stream gage object is less than the input value in the ThresholdOtowiVolumeHoldLeaseWater scalar slot in the MiddleValleyTargets data object or the storage in the SupplementalESA account at El Vado Reservoir at the previous timestep is greater than zero, the target is determined with reference to the user-defined MinTargetFlow function as a function of the date, hydrology year type, and target flow adjustment factor. The target flow, based on the date and hydrology year type, is input to the MinTargetFlows periodic slot in the MiddleValleyTargets data object, and the target flow adjustment factor for each target location and each month is input to the MinTargetFlowsSafetyFactor periodic slot in the MiddleValleyTargets data object. If the condition is not satisfied, the target is set to zero.

An outer IF THEN ELSE statement is included such that the year-to-date Otowi flow volume is not checked if the current timestep is the Start Timestep or January 1. An additional assignment statement is also included to record what the targets would be if the values were not reset to zero after the year-to-date Otowi flow volume exceeds the threshold volume. This assignment is made to the SideCalcCentralTargetNoOtowiCutoff series slot in the MiddleValleyTargets data object.

B.19.5. ResetIsletaSanAcaciaSanMarcialTargetsForStepDown

Explanation: Targets may be reset in URGWOM for discretionary operations as conducted under the Biological Opinion (Service, 2003) which entail using supplemental water to manage the recession after the runoff and control the rate of drying after river rewetting for minnow salvage. Policy for representing discretionary operations entails implementing a longer step down in targets at the end of the runoff and shorter step downs in targets thereafter following each river rewetting event. Note that a step down in targets as needed after the continuous flow requirement if the runoff ends before the continuous flow requirement is over would be represented separately and would need to be included in the input target table.

This rule resets the targets for a 30-day step down to manage recession at the first occurrence of river drying. The definition of drying and the shape of the step down in targets are set based on input threshold flows and target values. Any input adjustment factor is applied to the computed step down in targets. Targets are not set for discretionary operations if the threshold year-to-date Otowi flow volume for conserving leased San Juan-Chama Project water has been exceeded and there is no Emergency Drought water. The logic used in this rule for potentially resetting the targets originally set with the MinIsletaSanAcaciaSanMarcialFlowTargets rule is depicted by the flowchart in Figure B.10.

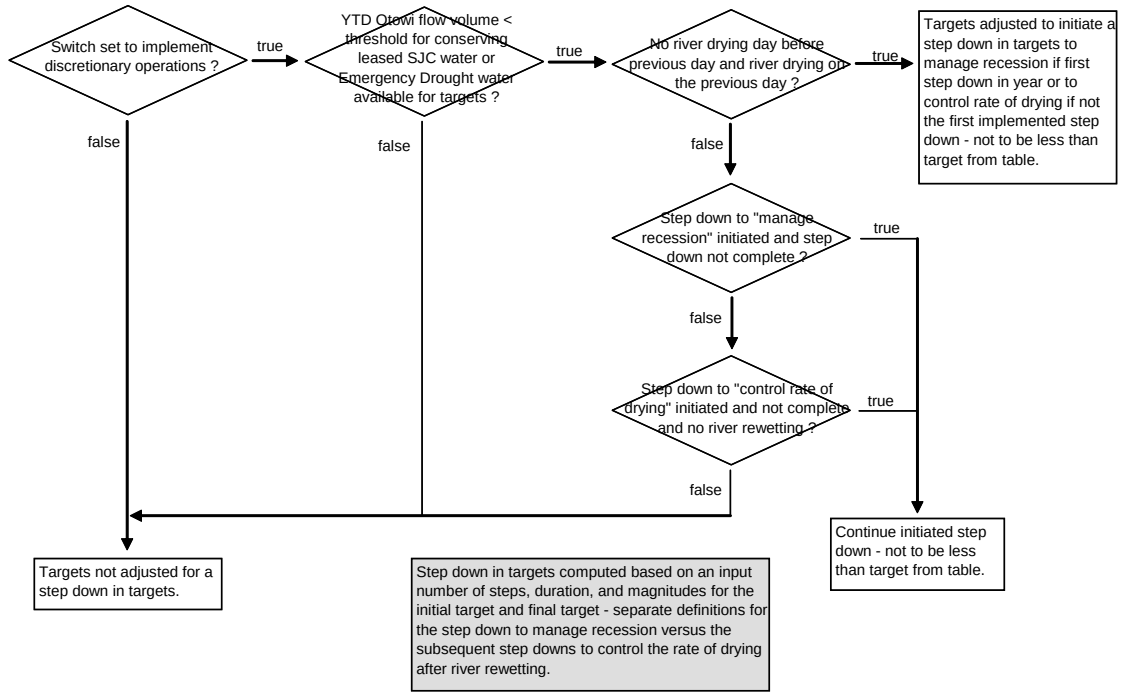


Figure B.10. Flow Chart Depicting Logic for Establishing Step Downs in Targets

Rule Execution: This rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function and a switch is set to implement the operation based on an input value greater than zero in the TriggerImplementStepDownInTargets scalar slot in the MiddleValleyTargets data object and river drying has initiated as checked with the user-defined TimeToStartStepDownInTargets function or an initiated step down in targets needs to continue as checked with the TimeToContinueStepDownInTargets function.

Rule Logic: A FOR DO loop is used to reset the downstream flow targets for the timestep equal to the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to the target location for the following three time series slots in the MiddleValleyTargets data object: MinTargerForIsleta, MinTargetForSanAcacia, and MinTargetForSanMarcial. If the year-to-date modeled flow volume in the Gage Outflow series slot for the Otowi stream gage object is less than the input value in the ThresholdOtowiVolumeHoldLeaseWater scalar slot in the MiddleValleyTargets data object or the storage in the SupplementalESA account at El Vado Reservoir at the previous timestep is greater than zero, the target is computed using the user-defined ComptueTargetInStepDown function based on the input values for the final target in the step down, initial target in the step down, number of steps, and duration of the step down. The adjustment factor is then applied to the computed target. If the condition is not satisfied, the target is set to the original table value with reference to the user-defined MinTargetFlow function.

An outer IF THEN ELSE statement is included such that the year-to-date Otowi flow volume is not checked if the current timestep is the Start Timestep or January 1. An additional assignment statement is also included using similar logic except without the check against the year-to-date Otowi flow volume to record what the targets would be if the values were not reset to zero after the year-to-date Otowi flow volume exceeds the threshold volume. These assignments are made to three time series slots for the target locations that end with "TargetNoOtowiCutoff" in the MiddleValleyTargets data object. Also, another assignment statement is included to set the value in the StepDownImplementedCounter series slot in the MiddleValleyTargets data object to track the number of timesteps since the step down was implemented as needed for computing the target during the step down period.

B.19.6. RecordPeakInflowAndDateForDeviationsRules

Explanation: This rule records a date and magnitude for the estimated peak inflow to Cochiti Lake. The values are then referenced later when setting operations for Cochiti deviations to target storage before the peak with releases of temporary storage then made to augment the peak flow for better providing recruitment or overbank flows in the Middle Rio Grande for ESA interests.

Rule Execution: This rule executes if the current timetep is equal to the date before the beginning of the Cochiti deviations period as identified with the RecruitmentOrOverbankSeasonStartDate function or the start timestep if later in the year as checked with the predefined DateMax function or on the rulebased simulation start timestep if later. The estimated date and magnitude of the Cochiti peak inflow is recorded once a year.

Rule Logic: Two assignment statements are included in this rule that each contain an IF THEN statement to make assignments if values are not input as checked with the predefined IsInput function. Values for the EstimatedPeakInflow and EstimatedPeakInflowDate annual timestep slots are set to the two resulting values from using the user-defined CochitiMaxInflowAndDateList function which creates a two item list with the magnitude of the flow and the date for the maximum inflow between two input dates. A WITH DO loop is used in the CochitiMaxInflowAndDate function to create a list of estimated flows for each date between the the two input dates defined with the user-defined RecruitmentOrOverbankSeasonStartDate and RecruitmentOrOverbankSeasonEndDate functions. Future inflows are estimated based on input inflows to the model and are computed with consideration for the restriction to flows past Abiquiu to the channel capacity below Abiquiu Dam. A final list is created with the maximum flow and corresponding date. Refer to Figure B.11 for a screen capture of the CochitiMaxInflowAndDate function.

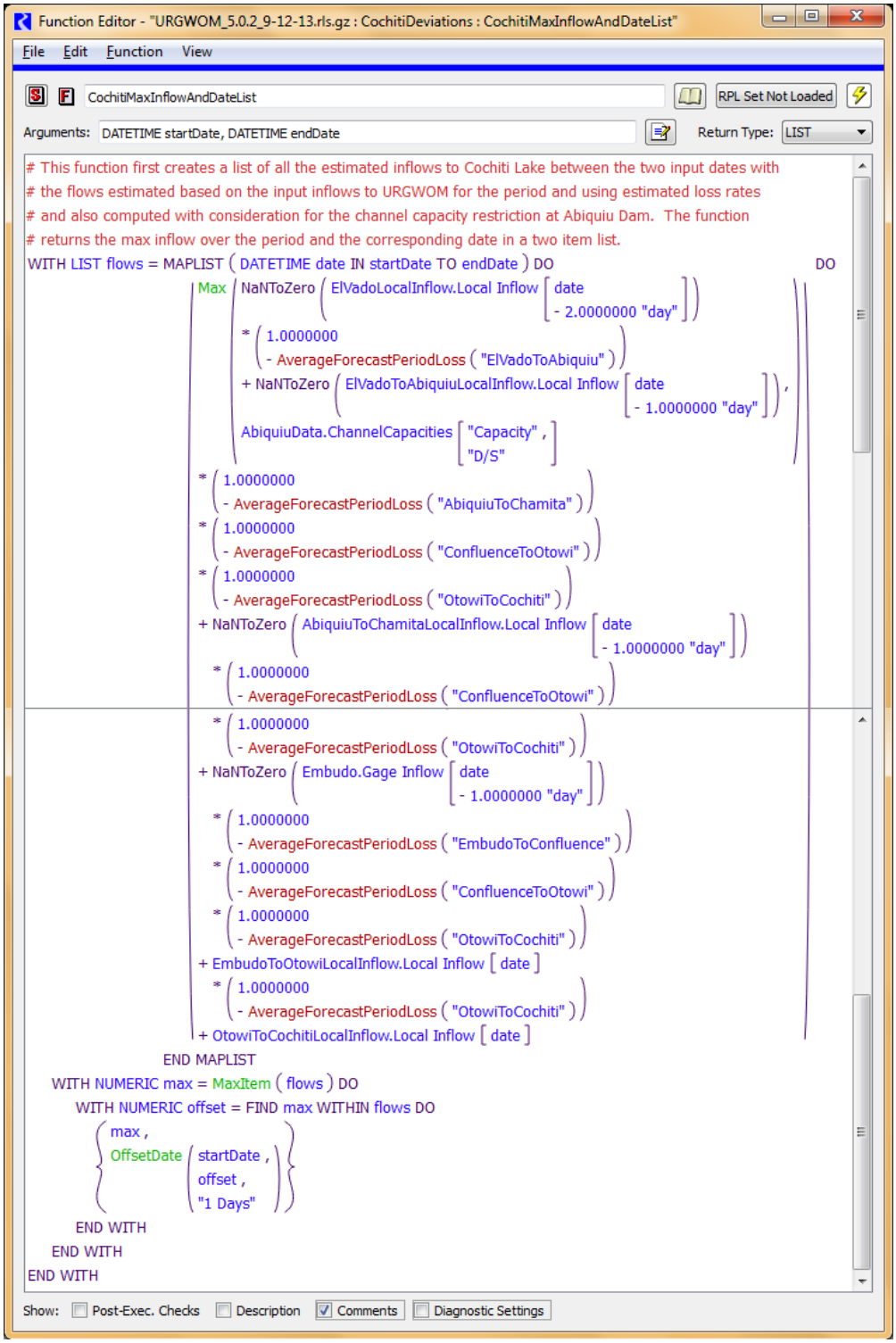


Figure B.11. Rule Policy Language for the CochitiMaxInflowAndDateList Function

B.19.7. ResetCentralTargetForCochitiDeviations and SetConservationSpaceAtCochiti

Explanation: This rule is used to reset the downstream flow targets at Central to provide either a "recruitment" hydrograph or an "overbank" hydrograph if Cochiti deviations are implemented. The targets for the entire hydrograph are set on the determined date, or input date, to begin storage at Cochiti Lake for deviations. The computed date is based on an input number of days prior to the estimated date of the peak inflow to Cochiti. The available conservation space at Cochiti is also then set for the corresponding operation based on a lookup table if a value was not input. If deviations are not being modeled, the amount of conservation space is set to a separate input amount – which may likely be zero. Deviations are not implemented if the current timestep is after the last year that deviations are implemented as input. The rule also includes assignments to a trigger slot to record which operation was conducted.

Rule Execution: The rule files if the rule has not fired successfully yet as checked with reference to the user-defined HasRuleFiredSuccessfully function, the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the value in the ModelDeviations(1=yes,0=no) column of the ModelUserControlTrigger table slot in the CochitiDeviations data object equals 1.0, and the current timestep is before the date input to the LastYearCochitiDeviationsAuthorized table slot. In addition to those conditions, a check is included to check if the switch is set to use an input date for Cochiti deviations as checked with the UsePresetDayForCochitiDeviationsStorage function. If so, the current timestep is checked to see if it is equal to the value in the PresetDayForCochitiDeviationsStorage table slot in the CochitiDeviations data object; otherwise, the current timestep is checked to see if it is equal to the value in the EstimatedPeakInflowDate annual timestep slot offset by the value in the DaysOfCochitiDeviationsStorageBeforePeak scalar slot.

Rule Logic: The rule contains an IF THEN ELSE statement to check whether conditions are satisfied to reset targets for recruitment or for overbank flows. Two assignment statements are included after conditions are checked to reset Central targets for the corresponding operation and to set an amount of conservation space available at Cochiti Lake for deviations operations.

The following conditons are checked first. If the Otowi forecast is within the range for conducting deviations to provide *overbank* flows as checked with the user-defined IsOverbankForecastRange function and the projected peak inflow to Cochiti is within the range for conducting deviations to provide *overbank* flows as input to the EnvironmentalMinMaxPeakFlows table slot in the CochitiDeviations data object or the Otowi forecast is within the range for conducting deviations to provide *recruitment* flows but the projected peak inflow to Cochiti is within the range for conducting deviations to provide *overbank* flows as input to the EnvironmentalMinMaxPeakFlows table slot, operations are set to provide overbank flows. If the Otowi forecast is within the range for

conducting deviations to provide *recruitment* flows as checked with the user-defined IsRecruitmentForecastRange function and the projected peak inflow to Cochiti is within the range for conducting deviations to provide *recruitment* flows as input to the EnvironmentalMinMaxPeakFlows table slot in the CochitiDeviations data object or the Otowi forecast is within the range for conducting deviations to provide *overbank* flows but the projected peak inflow to Cochiti is less than the minimum for conducting deviations to provide *overbank* flows as input to the EnvironmentalMinMaxPeakFlows table slot, operations are conducted to provide recruitment flows.

For each condition, A FOR DO loop is then used to set the MinTargetForCentral series slot in the MiddleValleyTargets data object for the list of dates and corresponding targets for the operation as created with the user-defined EnvironmentalMinRelease function. The EnvironmentalMinRelease function identifies the list of targets to provide flows for the corresponding operation, overbank or recruitment, from the EnvironmentalTargets table slot in the MiddleValleyTargets data object.

Another IF THEN ELSE statement is used for each condition to set the value for the ComputedRGConservationSpaceAvailable annual time series slot in the CochitiDeviations data object if a value was not input. The allowable conservation space is set using the predefined TableLookup function with reference to the Otowi forecast as a percent of average and referencing the column for the corresponding operation, overbank or recruitment, in the RGConservationSpaceTable in the CochitiDeviations data object. If conditions for deviations are not satisfied, the slot value is set to the input value to the FullTimeRGConservationSpaceAvailableNotRelevantToDeviations table slot in the CochitiDeviations data object.

A trigger is also set for each condition to the ModeledDeviationsIndicator1forRecrutimentOr2forOverbank slot to record which operations was modeled.

B.19.8. EndTargetsForOverbankOrRecruitment

Explanation: This rule is used to reset targets at Central set for Cochiti deviations back to the original table targets if conservation storage at Cochiti Lake drops below a threshold low volume. This adjustment is required to prevent supplemental leased San Juan-Chama Project water or Emergency Drought water from being used to provide recruitment or overbank flows after conservation storage is no longer available from Cochiti deviations.

Rule Execution: This rule executes if a value has been set in the MinTargetForCentral series slot in the MiddleValleyTargets data object for the timestep equal to the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to Central and that value is greater than the value set with reference to the original target table and the storage in the RioGrandeConservation

account at Cochiti Lake at the previous timestep is less than the input value in the LowStorageToEndDeviationsTargets scalar slot in the CochitiDeviations data object.

Rule Logic: A FOR DO loop is used to record the downstream flow target for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the timestep equal to the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to Central. If the year-to-date modeled flow volume in the Gage Outflow series slot for the Otowi stream gage object is less than the input value in the ThresholdOtowiVolumeHoldLeaseWater scalar slot in the MiddleValleyTargets data object or the storage in the SupplementalESA account at El Vado Reservoir at the previous timestep is greater than zero, the target is determined with reference to the user-defined MinTargetFlow function as a function of the date, hydrology year type, and target flow adjustment factor. The target flow, based on the date and hydrology year type, is input to the MinTargetFlows periodic slot in the MiddleValleyTargets data object, and the target flow adjustment factor for each target location and each month is input to the MinTargetFlowsSafetyFactor periodic slot in the MiddleValleyTargets data object. If the condition is not satisfied, the target is set to zero.

An outer IF THEN ELSE statement is included such that the year-to-date Otowi flow volume is not checked if the current timestep is the Start Timestep or January 1. An additional assignment statement is also included to record what the target would be if the values were not reset to zero after the year-to-date Otowi flow volume exceeds the threshold volume. This assignment is made to the SideCalcCentralTargetNoOtowiCutoff series slot in the MiddleValleyTargets data object.

This rule also contains an additional assignment statement to set the value for the CochitiRGConservationSpaceAvailable slot back to the input value to the FullTimeRGConservationSpaceAvailableNotRelevantToDeviations table slot.

B.20. EstimatedCochitiInflowAvailableForMiddleValleyDemands

The rules in this policy group are used to develop an estimated inflow to Cochiti Lake available for Middle Rio Grande demands. The calculation is completed in separate steps with the results recorded to series slots that allows for model users to compare the estimates to the resulting modeled flows for each step. The inflow to Cochiti is then used to reset MRGCD diversions if needed for that flow to prevent supplemental water for targets from being diverted.

B.20.1. EstimateElVadoRGOutflow

Explanation: This rule estimates the outflow from El Vado Dam that will be available for meeting the MRGCD demand plus any additional inflows that are bypassed if Article VII is in effect. The computation includes bypassed inflows, any release of P&P water, and any release from available storage to meet the MRGCD demand.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the EstimatedElVadoRGOutflow series slot in the MRGCD data object for the current timestep is set to the result of the ComputeEstimateElVadoRGOutflow function. That function computes an initial potential outflow as the MRGCD demand at El Vado *restricted if needed* to the available bypassed inflow plus available water in storage released to meet the demand. Bypassed inflows are set to the value for the Local Inflow series slot on the ElVadoLocalInflow reach object for the current timestep minus the three accounting supplies for transferring inflow to the PandP, MRGCDDrought, and SupplementalESA accounts. Water available in storage to also contribute to meet the demand is equal to the previous storage in the Rio Grande account plus all pending transfers to the MRGCD San Juan-Chama account at the current timestep plus any water transferred from the PandP account back to the RioGrande account plus all Emergency Drought water in storage for MRGCD. Any pending release from the PandP account is also included.

If Article VII is in effect as checked with the user-defined ArticleVIIInEffect function, the resulting initial potential outflow for meeting the MRGCD demand is increased to include all bypassed inflows and any release form PandP storage.

B.20.2. EstimateAbiquiuRGInflow

Explanation: This rule estimates the inflow to Abiquiu Reservoir based on the estimated outflow from El Vado Dam.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the EstimatedAbiquiuRGInflow series slot for the next timestep is set using the user-defined RouteElVadoRGOutflowToAbiquiu function which references the predefined HypSim function to complete hypothetical simulation for the reach from El Vado to Abiquiu with an upstream flow equal to the value in the EstimatedElVadoRGOutflow series slot in the MRGCD data object.

B.20.3. EstimateCochitiInflowAvailableForMiddleValleyDemands

Explanation: This rule estimates an inflow to Cochiti Lake available to meet the Middle Valley demands based on the estimated inflow to Abiquiu for the MRGCD demand plus any releases of San Juan-Chama Project water from storage at Abiquiu for the Buckman Direct Diversion, the Albuquerque diversion, as additional water released from storage for the MRGCD demand, or as letter water deliveries to payback MRGCD (Letter water to pay back the Compact is not included with amount available for Middle Valley demands).

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object for the next timestep is set to the result of the RouteAbiquiuFlowToCochitiForMiddleValleyDemands function which references the predefined HypSim function to complete hypothetical simulation for the reach from El Vado to Abiquiu with an upstream flow equal to the result of the EstimatedAbiquiuOutflowForMiddleValleyDemands function. That function for estimating the Abiquiu outflow computes an initial potential outflow as the value in the EstimatedAbiquiuRGInflow series slot for the current timestep plus the values in the SantaFeCityDeliveryToBuckmanDiversion and SantaFeCountyDeliveryToBuckmanDiversion series slots in the ComputedDeliveries data object plus a sum of any pending letter water deliveries released from storage at Abiquiu Reservoir to pay back MRGCD. That initial outflow is then adjusted if needed to include additional releases from storage to meet the MRGCD demand if needed with a check of the initial computed outflow against the MRGCDDemand series slot in the AbiquiuData data object. The value for any release from storage for the Albuquerque diversion in the AlbuquerqueDeliveryToSurfaceWaterDiversion series slot in the ComputedDeliveries data object is also included after checking the MRGCD demand since these diversions are not included in the MRGCD demand.

B.21. SetMiddleValleyOperations

The rules in this policy group are used set the Middle Valley operations which include the operations of the LFCC pumps along with the flows through the Atrisco siphon and the returns at the Central wasteway. Diversions at Angostura may be increased during shortage operations such that the limited supply of water is delivered to the Belen Division as efficiently as possible. Diversions may also be reset lower if necessary to prevent supplemental water for targets from being diverted when there is a shortage.

Potential shorted diversions are set separately as the policy at each diversion is dependent on whether there are any target flows below the diversion.

B.21.1. SanAcaciaSocorroMainCanalDiversionRequest

Explanation: This rule sets the diversion requested to the Socorro Main Canal at the San Acacia diversion based on an input diversion schedule minus the contributions from the Unit 7 drain in the MRGCD system. Flows from the Unit 7 drain contribute toward meeting the need at the Socorro main canal, and diversions from the river are curtailed accordingly. The diversion requested values for San Acacia are set separately from the Cochiti, Angostura, and Isleta diversions due to the unique dependency at San Acacia on the Unit 7 through flow.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN ELSE statement is used to set the diversion requested value for multiple timesteps as needed at the Start Timestep, and then ultimately if a value is not input, the value for the Diversion Requested series slot is set for the CanalDiv water user on the SanAcaciaDiversions aggregate diversion site object for the current timestep plus one day (i.e. the approximate travel time from Abiquiu Dam to Cochiti Lake) plus the travel time from Cochiti Dam to San Marcial as input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object. (The assignment is set into the future as needed for the hypothetical simulation to estimate flows needed for targets.) The diversion is set to the result of the user-defined GetMRGCDDiversionRequested function minus the value in the Total Outflow series slot for the previous timestep in the DrainUnit7Return aggregate distribution canal object. The associated value for the Depletion Requested series slot for the CanalDiv water user on the SanAcaciaDiversions aggregate diversion site object is set to zero.

B.21.2. LFCCPumpingRequested

Explanation: This rule sets the pumping rates from the LFCC at the Neil Cupp, North Boundary of the Bosque del Apache National Wildlife Refuge, and South Boundary sites. Policy is coded for pumping water from the LFCC to the river to manage recession after the runoff or to prevent river drying. Water that seeps into the LFCC is pumped to the river where pumping begins based on input river flow triggers. After pumping has initiated at a site, pumping will continue for a minimum of one week and until a threshold flow at San Acacia has been exceeded. Pumping will cease for the year at each site after the specific dates input for each site.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Two FOR DO loops are used to set the value for the Diversion Request series slots for the Neil Cupp, North Boundary, and South Boundary diversion objects from the current timestep through the current timestep plus one day (i.e. the approximate travel time from Abiquiu Dam to Cochiti Lake) plus the travel time from Cochiti Dam to San Marcial as input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object. (The assignment is set into the future as needed for the hypothetical simulation to estimate flows needed for targets.)

The user-defined LFCCPumping function is referenced for setting the Diversion Request values to represent the pumping at each site. A series of IF THEN ELSE statements are included to check the conditions for setting the diversion. If the current timestep is after the Start Timestep and switches have been set by the model user to set a pumping rate for the corresponding site and the current date is before the input date to shutdown pumping for that site for the year as input to the DateToShutDownForYear table slot in the LFCCPumpingTriggers data object and as checked with the user-defined BeforeDateToShutDownLFCCPumpsForYear function, a pumping rate is set. Otherwise, the pumping rate is set to zero.

If the hydrology year type as checked with the user-defined HydrologyYearType function (reference the discussion for the Hydrology Year Type rule) is Dry and the flow at San Acacia is less than the input trigger flow to start pumping at that site as input to the Dry table slot in the LFCCPumpingTriggers data object, the function result is set to the value for the PumpingRate for that site in that same table slot. A similar check is then completed if the hydrology year type is Normal. If the hydrology year type is Wet and the current timestep is within the "winter target season" for wet targets as checked with the user-defined IsWetSanMarcialWinterTargetSeason function and the flow at San Acacia is less than the input trigger to start pumping at that site for wet years, the function result is set to value for the WinterPumpingRate in the Wet table slot in the LFCCPumping triggers data object. Alternatively, if the hydrology year type is Wet and the current timestep is NOT within the winter target season for wet targets and the flow at San Acacia is less than the input trigger to start pumping at that site for wet years, the function result is set to value for the SummerPumpingRate in the Wet table slot in the LFCCPumping triggers data object.

If pumping occurred at the previous timestep for the site as checked with the user-defined LFCCPumpingOnPreviousDay function and pumping has not continued for at least a week as checked with NOT LFCCPumpingForAtLeastAWeek function or the flow at San Acacia has not exceeded the trigger flow within the past week to shutdown pumping as checked with the SATriggerForLFCCPumpingShutdownExceededAWeek function, the

function result is set to the previous pumping rate (i.e. the previous set pumping rate is maintained).

B.21.3. MRGCDWastewayCalcs

Explanation: This rule sets the MRGCD returns to the river through key wasteways and flows through siphons as represented in the URGWOM layout. Flows through some wasteway objects in URGWOM are simply set with the RiverWare method to use a percentage of the available flow, but some returns or siphon flows are set with this rule based on general policy as identified by the URGWOM Tech Team. Note that it may be important for the policy implemented with this rule to match the policy used for the Middle Valley calibration. Flows through the Central Wasteway and Atrisco siphon are set along with returns at the Peralta wasteways, the return from Atrisco Drain outfall, and the flow through the Corrales siphon.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set the Diversion Request on the objects for each wasteway or siphon for the current timestep plus one day (i.e. the approximate travel time from Abiquiu Dam to Cochiti Lake) plus the travel time from Cochiti Dam to San Marcial as input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object. (The assignment is set into the future as needed for the hypothetical simulation to estimate flows needed for targets.)

The Diversion Request slot value is set on the CentralWasteway and AtriscoSyphon objects with IF THEN ELSE statements. During the irrigation season (March 1 – October 31), the flow through the Central wasteway is set to the flow at that location in the MRGCD system, represented by the Outflow value from the AngosturaEastSideAgDepletionsCanal object, minus 180 cfs. During the non-irrigation season, all flow in the system is returned through the wasteway. During the irrigation season, the flow diverted through the Atrisco siphon is set to 120 cfs if the Outflow value from the CentralEastSideLag reach object is greater than or equal to 180 cfs. Alternatively, the flow through the siphon is set to the flow in the system * 0.67 during the irrigation season. During the non-irrigation season, no flow is diverted through the Atrisco siphon. An IF THEN ELSE statement is used to set the Diversion Request slot on the CorralesSyphon object to an input typical value during the irrigation season or zero in the non-irrigation season. An IF THEN ELSE statement is used to set the Diversion Request for the IsletaToBernardoArea3WasteWayDiversion object to return the available flow while maintain a target flow MRGCD's system for the San Juan Main Canal during the irrigation season. All flow is returned at the object during the non-irrigation season. An IF THEN ELSE statement is used to set the Diversion Request slot

on the AtriscoDrainOutfall object to return available flow while maintaining a target throughflow to the Belen Diversion in the irrigation season and returning all flow in the non-irrigation season.

B.21.4. ResetAngosturaDiversionForShortageOps

Explanation: This rule increases the requested diversion values for the Angostura diversion when MRGCD is in a shortage situation (i.e. no water in storage and the inflow to Cochiti is less than the MRGCD demand) and operations are being conducted to assure delivery of P&P water to the six Middle Valley pueblos. In actual operations, diversions are also increased so MRGCD can then use the limited supply as efficiently as possible. Flows to the Central wasteway and Atrisco siphon are also reset accordingly to zero and 120 cfs, respectively, for shortage operations within this rule.

Rule Execution: The rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the user-defined TimeToIncreaseAngosturaDiversions function is evaluated as TRUE. That latter function checks to see if the value in the TriggerIncreaseAngosturaDiversionsForPandPOps table slot in the MRGCD data object is 1 (i.e. a switch has been set by the model user to implement operations to increase Angostura diversions when MRGCD is in a shortage situation) and if the current timestep is greater than or equal to March 1st and less than or equal to October 31st (i.e. the diversion is being reset only within the irrigation season) and the MRGCD supply as computed with the user-defined MRGCDSupply function is less than the value for the DemandAtCochiti series slot in the MRGCD data object and the inflow to Cochiti is less than the MRGCD demand plus a buffer amount input to the MRGCDData.CochitiInflowBuffer scalar slot.

Rule Logic: Two assignment statements are included to reset the Diversion Requested values for the current timestep plus one timestep (the approximate travel time from Abiquiu Dam to Cochiti) plus the travel time from Cochiti to San Marcial. Values are reset for the AlbMainCanal and AtriscoFeeder water users on the AngosturaDiversions aggregate diversion site object to the maximum canal capacities as input to the MaxCapacityAtAngosturaAlbMainCanal and MaxCapacityAtAngosturaAtriscoFeeder scalar slots on the MRGCD data object. Flows to the Central wasteway (CentralWasteway.Diversion Request) and the Atrisco siphon (AtriscoSyphon.Diversion Request) are also reset in this rule to 0.0 cfs and 120 cfs, respectively for shortage operations to effectively represent deliverying 120 cfs through the Atrisco siphon during such opeartions and all remaining flow down the Albuquerque drain with any excess to be delivered as efficiently as possible to the Belen Division.

B.21.5. ResetCochitiDivToPreventDiversionOfSuppWater

Explanation: This rule resets the diversions at Cochiti to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated flow at Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted.

Rule Execution: This rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function, the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the minimum target at Central, Isleta, San Acacia, or San Marcial is greater than 0.0 cfs as checked with references to the user-defined MinTargetFlowForLocation function, the inflow to Cochiti available for Middle Valley demands is not very large indicated if the value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object for the current timestep is less than 2.5 times the value in the SyntheticDemandAtCochiti periodic slot in the MRGCD data object for the current timestep or less than 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the current timestep, and supplemental water is available to meet targets checked if the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu is greater than zero. (The latter two checks are included to minimize the amount of hypothetical simulation invoked during a simulation with this rule.)

Rule Logic: A user-defined function called ListWaterUsersShortedDiversionsCochiti is used to create a list of four lists with the name of the canal at the Cochiti diversion, the timestep, and determined diversion without supplemental water. The user-defined HypSimSolveShortedCochitiDiversion function is used to call the predefined HypSim function to execute hypothetical simulation and solve for the determined diversions without supplementeal water at the next timestep with the upstream flow set to the values in the EstimatedCochitiInflowAvailableForMiddleValley. Within the rule, assignment statements are included to set the Diversion Requested and Depletion Requested slots for each canal for each timestep to the resulting diversion from the hypothetical simulation.

B.21.6. ResetAngosturaToPreventDiversionOfSuppWater

Explanation: This rule resets the diversions at Angostura to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted.

Rule Execution: This rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully

function, the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the minimum target at Central, Isleta, San Acacia, or San Marcial is greater than 0.0 cfs as checked with references to the user-defined MinTargetFlowForLocation function, the inflow to Cochiti available for Middle Valley demands is not very large indicated if the value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object for the current timestep is less than 2.5 times the value in the SyntheticDemandAtCochiti periodic slot in the MRGCD data object for the current timestep or less than 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the current timestep, and supplemental water is available to meet targets checked if the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu is greater than zero. (The latter two checks are included to minimize the amount of hypothetical simulation invoked during a simulation with this rule.)

Rule Logic: A user-defined function called ListWaterUsersShortedDiversionsAngostura is used to create a list of four lists with the name of the canal at the Angostura diversion, the timestep, and determined diversion without supplemental water. The user-defined HypSimSolveShortedAngosturaDiversion function is used to call the predefined HypSim function to execute hypothetical simulation and solve for the determined diversions without supplementeal water for the next timestep with the upstream flow set to the values in the EstimatedCochitiInflowAvailableForMiddleValley. Within the rule, assignment statements are included to set the Diversion Requested and Depletion Requested slots for each canal for each timestep to the resulting diversion from the hypothetical simulation.

B.21.7. ResetIsletaToPreventDiversionOfSuppWater

Explanation: This rule resets the diversions at Isleta to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted. (Note that the Execution Constraints for this rule are not dependent on the target at Central. The rule only fires if a downstream target is greater than zero which means that remaining supplemental water could be diverted at Isleta if there are no downstream targets.)

Rule Execution: This rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function, the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the minimum target at Isleta, San Acacia, or San Marcial is greater than 0.0 cfs as checked with references to the user-defined MinTargetFlowForLocation function, the inflow to Cochiti available for Middle

Valley demands is not very large indicated if the value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object for the current timestep is less than 2.5 times the value in the SyntheticDemandAtCochiti periodic slot in the MRGCD data object for the current timestep or less than 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the current timestep, and supplemental water is available to meet targets checked if the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu is greater than zero. (The latter two checks are included to minimize the amount of hypothetical simulation invoked during a simulation with this rule.)

Rule Logic: A user-defined function called ListWaterUsersShortedDiversionsIsleta is used to create a list of 15 lists with the name of the canal at the Isleta diversion, the timestep, and determined diversion without supplemental water. The user-defined HypSimSolveShortedIsletaDiversion function is used to call the predefined HypSim function to execute hypothetical simulation and solve for the determined diversions without supplementeal water at timestep t+2 with the upstream flow set to the values in the EstimatedCochitiInflowAvailableForMiddleValley. It is also assumed that inflows to Jemez will be bypassed. Within the rule, assignment statements are included to set the Diversion Requested and Depletion Requested slots for each canal for each timestep to the resulting diversion from the hypothetical simulation.

B.21.8. ResetSanAcaciaToPreventDiversionOfSuppWater

Explanation: This rule resets the diversions at San Acacia to a lower amount if needed to assure supplemental water needed for targets is not diverted. The estimated inflow to Cochiti for Middle Valley demands is used to identify whether the diversions should be shorted. (Note that the Execution Constraints for this rule are not dependent on the target at Central or Isleta. The rule only fires if a downstream target is greater than zero which means that remaining supplemental water could be diverted at San Acacia if there are no downstream targets.)

Rule Execution: This rule fires if the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function, the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the minimum target at San Acacia or San Marcial is greater than 0.0 cfs as checked with references to the user-defined MinTargetFlowForLocation function, the inflow to Cochiti available for Middle Valley demands is not very large indicated if the value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object for the current timestep is less than 2.5 times the value in the SyntheticDemandAtCochiti periodic slot in the MRGCD data object for the current timestep or less than 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data

object for the current timestep, and supplemental water is available to meet targets checked if the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu is greater than zero. (The latter two checks are included to minimize the amount of hypothetical simulation invoked during a simulation with this rule.)

Rule Logic: A user-defined function called ListWaterUsersShortedDiversionsSanAcacia is used to create a list of four lists with the name of the canal at the San Acacia diversion, the timestep, and determined diversion without supplemental water. The user-defined HypSimSolveShortedSanAcaciaDiversion function is used to call the predefined HypSim function to execute hypothetical simulation and solve for the determined diversions without supplementeal water for timestep t+3 with the upstream flow set to the values in the EstimatedCochitiInflowAvailableForMiddleValley. Within the rule, assignment statements are included to set the Diversion Requested and Depletion Requested slots for each canal for each timestep to the resulting diversion from the hypothetical simulation.

B.22. ComputeUpstreamFlowNeededForTargets

The rules in this policy group are used to determine the flow needed at Cochiti for the Middle Rio Grande target flows and ultimately the amount of supplemental water needed from Abiquiu and El Vado Reservoirs. A need for Emergency Drought water from El Vado is estimated and a final needed release is determined such that releases are not adjusted every day to better reflect actual operations.

B.22.1. AlternateCalcOfMinCochitiReleases TEST

Explanation: This rule was set up to TEST alternate simplified means for identify the flow needed at Cochiti Dam for downstream targets from the more computationally intensive hypothetical simulation. The approach will not be used unless a switch is set by the model user to use the alternate approach.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function and the value in the TriggerUseAlternateApproachToEstimateFlowNeededAtCochitiForTargets table slot in the MiddleValleyTargets data object is equal to 1.0.

Rule Logic: Values for the MinReleaseForCentral, MinReleaseForIsleta, MinReleaseForSanAcacia, and MinReleaseForSanMarcial series slots in the MiddleValleyTargets data object would be set with this rule as a function of the target at

the corresponding location and the major inflows and outflows (that are known or could be estimated) between Cochiti Dam and the target location and a coefficient.

B.22.2. ComputeMinCochitiReleaseForCentralTarget

Explanation: This rule uses hypothetical simulation to determine the minimum total outflow from Cochiti Dam needed to meet the determined target flow at Central. The value for the next timestep is computed as needed to eventually determine the flow needed at Abiquiu at the current timestep. Inflows to Jemez Reservoir are assumed to be bypassed at Jemez Canyon Dam.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object, the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function, the value in the TriggerUseAlternateApproachToEstimateFlowNeededAtCochitiForTargets table slot in the MiddleValleyTargets data object is equal to 1.0, and the recorded value to the MinTargetForCentral series slot in the MiddleValleyTargets data object is greater than zero for the timestep equal to the next timestep plus the number of timesteps for the release to reach Central from Cochiti Dam. The travel time is set based on the travel time input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object and referenced with the user-defined ApproximateNumDaysDownstream function. The execution constraints also check that the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu and the Rio Grande Conservation accounts at Cochiti and Jemez is greater than zero. Also, the EstimatedCochitiInflowAvailableForMiddleValley series slot value for the current timestep is checked to assure it is less than 2.5 times the value in the SyntheticDemandAtCochiti periodic slot in the MRGCD data object for the current timestep or 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the current timestep. (The latter two checks are included to minimize the amount of hypothetical simulation started with this rule.)

Rule Logic: The value for the MinReleaseForCentral time series slot in the MiddleValleyDemands data object for the next timestep is set using the user-defined ReleaseToMeetMinFlowAtCentral function which uses the predefined HypTargetSimWithStatus function to determine the required outflow from Cochiti (or the value for the Inflow time series slot for the BlwCochitiDiversionsReach reach object) to meet a target flow at Central (or the Gage Outflow time series slot in the Central stream gage object) at the timestep equal to the next timestep plus the number of timesteps for the release to reach Central from Cochiti Dam. The next timestep and travel time are set as function arguments within the rule where the travel time is input to the ApproxNoOfDaysDS table slot in the MiddleValleyTargets data object and referenced with the user-defined ApproximateNumDaysDownstream function.

The function completes the hypothetical simulation for all the objects in the BlwCochitiToCentralTarget subbasin and uses the minimum outflow and maximum outflow from Cochiti Dam as the bounds for the solution procedure as input to the MinRelease periodic slot and ReservoirData table slot, respectively, in the CochitiData data object and referenced with the user-defined MinOutflow and MaxOutflow functions, respectively. A tolerance of 0.25 cfs is allowed for the target flow. The inflow from the Rio Jemez is set to the inflow to Jemez Reservoir with the user-defined JemezInflowInputs function.

B.22.3. ComputeMinCochitiReleaseForIsletaTarget

Explanation: This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at Isleta (Refer to Section A.22.2 for more details).

B.22.4. ComputeMinCochitiReleaseForSanAcaciaTarget

Explanation: This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at San Acacia (Refer to Section A.22.2 for more details).

B.22.5. ComputeMinCochitiReleaseForSanMarcialTarget

Explanation: This rule is essentially the exact same as the ComputeMinCochitiReleaseForCentralTarget rule except the minimum release is being determined for the target flow at San Marcial (Refer to Section A.22.2 for more details).

B.22.6. ComputeMinCochitiReleaseForAllMiddleValleyTargets

Explanation: This rule determines the maximum value from the four computed minimum releases from Cochiti Dam needed to meet the target flows at Central, Isleta, San Acacia, and San Marcial. The resulting maximum total flow needed for targets in the Middle Valley is then referenced later to identify the amount of supplemental water needed from Abiquiu Reservoir (or Cochiti Deviations). Values are set for the next timestep. Indicators are also set to identify which targets are critical and driving the release of supplemental water.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired yet as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with the predefined IsInput function, the MinReleaseNeededAtCochiti time series slot in the MiddleValleyTargets data object for the next timestep is set using the user-defined ComputeCochitiMinimumFlow function. The ComputeCochitiMinimumFlow function uses the predefined MaxItem function to determine the maximum value from the minimum releases to meet the target flows at Central, Isleta, San Acacia, and San Marcial. A second assignment statement is used to set the same slot value for the current timestep if it is the current timestep equals the start timestep.

This rule also includes four separate assignment statements that record values of 1 or 0 to the CentralDrivingTargetIndicator, IsletaDrivingTargetIndicator, SanAcaciaDrivingTargetIndicator, and SanMarcialDrivingTargetIndicator series slots in the MiddleValleyTargets data object. If the value for the minimum release for the corresponding target is greater than 0.1 cfs and the difference in the final mimimum release from Cochiti for all targets and the minimum release for the corresponding target is less than 0.1 cfs (i.e. the values are the same) and supplemental water was released, the corresponding slot value is set to 1.0 to indicate that the corresponding target is critical and driving the release of supplemental water for the current timestep. Otherwise, the slot value is set to 0.

B.22.7. AbiquiuTotalFlowToMeetTarget

Explanation: This rule uses hypothetical simulation to determine the total release from Abiquiu Dam required to meet the computed minimum flow needed at Cochiti Lake for all the Middle Valley targets. The flow needed at Abiquiu is set to zero if the flow needed at Cochiti is not greater than zero, there is no supplemental water available in storage, or the estimated inflow to Cochiti Lake is high.

Rule Execution: If the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the value for the TotalFlowNeededAtAbiquiuForTargets time series slot in the MiddleValleyTargets data object for the current timestep is a NaN, the rule fires.

Rule Logic: An IF THEN ELSE statement is used to see if the value for the MinReleaseNeededAtCochiti in the MiddleValleyTargets data object is greater than zero, and if the sum of the storage in the Reclamation account at Heron, the Reclamation and Supplemental ESA accounts at El Vado, the Reclamation and Rio Grande Conservation accounts at Abiquiu and the Rio Grande Conservation account at Cochiti is greater than zero, and if the value for the EstimatedCochitiInflowAvailableForMiddleValley series slot in the MRGCD data object is less than 2.5 times the value in the SyntheticDemandAtCochiti time series slot in the MRGCD data object for the current timestep or 2.0 times the value for the MinTargetForCentral time series slot in the MiddleValleyTargets data object for the current timestep. If so, the

TotalFlowNeededAtAbiquiuForTargets time series slot in the AbiquiuData data object for the current timestep is set with the user-defined AbiquiuMinFlowsDemand function. Otherwise the assignment is set to 0.0 cfs.

The AbiquiuMinFlowsDemand function uses the predefined HypTargetSimWithStatus function to determine the required outflow from Abiquiu Dam (or the value for the Gage Inflow time series slot for the BlwAbiquiu stream gage object) to meet a target inflow to Cochiti Lake (or a value for the Outflow time series slot in the OtowiToCochitiLocalInflow reach object) equal to the value for the MinReleaseNeededAtCochiti time series slot in the MiddleValleyTargets data object for the next timestep. The function completes the hypothetical simulation for all the objects in the BelowAbiquiu subbasin and uses the input minimum and maximum outflows from Abiquiu Dam of 0 and 1800 cfs, respectively (the channel capacity below Abiquiu Dam is 1800 cfs) as bounds for the solution. A tolerance of 5 cfs is allowed for the target flow.

B.22.8. ComputeEmergencyDroughtWaterNeededFromElVadoForTargets

Explanation: The amount of Emergency Drought water needed from El Vado for targets must be estimated before the Rio Grande bypass at Abiquiu is known. This rule is used to estimate the amount of Emergency Drought water needed as the total release needed for targets minus the *estimated* Rio Grande inflow and minus San Juan-Chama Project deliveries to the Buckman Direct Diversion, the Albuquerque diversion, deliveries to Elephant Butte, letter water deliveries to payback the Compact, letter water deliveries to payback MRGCD, and releases from MRGCD storage at Abiquiu. The calculation is complicated by the potential conservation storage at Abiquiu that may be modeled. The amount needed at Abiquiu is adjusted by the last loss coefficient betwen El Vado and Abiquiu to estimate the amount needed at El Vado.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the NeededEmergencyDroughtWaterFromElVado series slot in the MiddleValleyTargets data object is set with this rule as the result for the user-defined EmergencyDroughtWaterForTargetsNeededAtAbiquiu function adjusted with reference to the Variable Gain Loss slot value in the BlwElVadoToAbvAbiquiu reach object for the previous timestep. The function computes the need at Abiquiu using an initial value equal to the TotalFlowNeededAtAbiquiuForTargets series slot minus the values in the AlbuquerqueDeliveryToSurfaceWaterDiversion,
SantaFeCityDeliveryToBuckmanDiversion,
SantaFeCountyDeliveryToBuckmanDiversion,
AlbuquerqueDeliveryAbiquiuToElephantButte, and

SantaFeCityAbiquiuToElephantButte slots in the ComputedDeliveries data object minus the value in the EstimateAbiquiuRGInflow series slot in the MRGCD data object for the current timestep. The flow needed is also reduced by the letter water deliveries to payback MRGCD, letter water deliveries to payback the Compact, any release of available MRGCD San Juan-Chama water at Abiquiu to meet the MRGCD demand.

If the previous storage in the RioGrandeConservation account at Abiquiu is greater than that initial demand and the current timestep is between the dates to release conservation storage from Abiquiu referenced with the user-defined GetStartAbiquiuRGConsReleaseDate and GetEndAbiquiuRGConsReleaseDate functions or the previous storage in the RioGrandeConservation account at Jemez is greater than the initial demand and the current timestep is between the dates to release conservation storage from Jemez referenced with the user-defined GetStartJemezRGConsReleaseDate and GetEndJemezRGConsReleaseDate functions, the function result is set to 0.0. Otherwise, the function result is the initial demand.

B.22.9. SetNeededEmergencyDroughtWaterReleaseFromElVadoForTargets

Explanation: This rule sets a final value for the needed minimum release of Emergency Drought water from El Vado for targets with reference to the computed need. The actual release is not adjusted unless a specific threshold change in the need is exceeded and the release of supplemental water is not adjusted until after an input minimum of days since the last adjustment. The calculations are included to better represent actual operations that do not entail adjusting the release each day by a few cfs in attempt to exactly meet a target flow.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the value for the NeededEmergencyDroughtWaterReleaseFromElVado time series slot in the MiddleValleyTargets data object for the current timestep is a NaN.

Rule Logic: An IF THEN ELSE statemeint is included to first check if the current timestep is the start timestep for rulebased simulation. If so, the value for the NeededEmergencyDroughtWaterReleaseFromElVado time series slot in the MiddleValleyTargets data object for the current timestep is set to the value in the NeededEmergencyDroughtWaterFromElVado time series slot for the current timestep rounded to the nearest 10 cfs. A separate assignment is included to reset a counter for the number of days since an adjustment was made to the release of supplemental water.

Otherwise, another IF THEN ELSE statement is included to check if the previous counter value in the CountSinceEmergencyDroughtWaterReleaseAdjusted time series slot is greater than or equal to the value in the MinDaysBeforeSupplementalWaterReleaseAdjusted scalar slot in the

MiddleValeyTargets data object and the average demand over that period minus the previous value for the NeededEmergencyDroughtWaterReleaseFromElVado time series slot exceeds the value for the ChangeBeforeSupplementalWaterReleaseAdjusted scalar slot in the MiddleValleyTargets data object or the previous value in the CountSinceEmergencyDroughtWaterReleaseAdjusted time series slot in the MiddleValleyTargets data object is greater than or equal to the value in the MaxDaysWithNoSupplementalWaterReleaseAdjustment scalar slot. If the condition is satisfied, the value for the NeededEmergencyDroughtWaterReleaseFromElVado slot is set to the average of the NeededEmergencyDroughtWaterFromElVado slot values since the last adjustment was made. Otherwise, the previous value for the NeededEmergencyDroughtWaterReleaseFromElVado slot is maintained. A counter is also set if the value in the NeededEmergencyDroughtWaterReleaseFromElVado slot is adjusted.

B.23. ReleaseOfEmergencyDroughtWater

The rules in this policy group are used to compute releases of Emergency Drought water as contributions to meeting the MRGCD demand and deliveries to meet target flows in the Middle Rio Grande with checks against the available supply and checks against input limited annual release volumes.

B.23.1. ComputeSupplementalESARelease

Explanation: This rule computes a daily release of Emergency Drought water from El Vado Reservoir for ESA needs as the determined need restricted to not exceed the input daily maximum, the maximum release volume for a year, or the available Emergency Drought water supply for ESA at El Vado Reservoir.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the SupplementalESAReleaseFromElVadoForTargets time series slot in the ComputedDeliveries data object for the current timestep is a NaN.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the value for the SupplementalESAReleaseFromElVadoForTargets time series slot in the ComputedDeliveries data object for the current timestep is set to the result of the SupplementalESAReleaseFromElVado function. This function uses a WITH DO loop to sum the year-to-date releases with reference to the SupplementalESAElVadoToRioGrandeBlwElVado supply slot values from January 1 to the previous timestep. An IF THEN ELSE statement is used to identify if the current timestep is within the input dates for releases as checked with the user-defined ESAReleaseSeason function. If not, the function result is 0.0 cfs. Otherwise, the release is computed with reference to the user-defined MinList function to the minimum of the

value in the NeededEmergencyDroughtWaterReleaseFromElVado series slot in the MiddleValleyTargets data object for the current timestep or the available storage at the previous timestep in the SupplementalESA account at El Vado with any transfer to the account at the current timestep or the value in the MaxESARelease table slot in the RelinquishedCreditsEmergencyDroughtWater data object or the difference in the value in the MaxSupplementalESAAnnualRelease row of the RelinquishedNMCreditAllocations table slot in the RelinquishedCreditsEmergencyDroughtWater data object and the sum of the year-to-date releases.

B.23.2. ComputeMRGCDDroughtRelease

Explanation: This rule computes a daily release of Emergency Drought water from El Vado Reservoir for MRGCD to meet the remaining need for the MRGCD demand above native inflows that are bypassed at El Vado and any release of P&P water. Emergency Drought water is used before Rio Grande project water in storage and before MRGCD's San Juan-Chama Project water.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the MRGCDDroughtReleaseFromElVado time series slot in the ComputedDeliveries data object for the current timestep is a NaN.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the value for the MRGCDDroughtReleaseFromElVado time series slot in the ComputedDeliveries data object for the current timestep is set to the result of the MRGCDDroughtReleaseFromElVado function. This function uses a WITH DO loop to sum the year-to-date releases with reference to the MRGCDDroughtElVadoToRioGrandeBlwElVado supply slot values from January 1 to the previous timestep. The result is set with reference to the predefined MinItem function to the MRGCD demand at El Vado minus the P&P releases determined with the ElVadoMRGCDDemand function minus the current Rio Grande inflow available to bypass computed as the Rio Grande inflow minus the transfers into the MRGCDDrought, SupplementalESA, and PandP accounts. If the Rio Grande storage is negative, the inflow is also adjusted to allow for the Rio Grande storage to return to zero. The MinItem function also checkes the available storage at the previous timestep in the MRGCDDrought account at El Vado with any transfer to the account at the current timestep and the difference in the value in the MaxMRGCDDroughtAnnualRelease row of the RelinquishedNMCreditAllocations table slot in the RelinquishedCreditsEmergencyDroughtWater data object and the sum of the year-to-date releases. Refer to Figure B.12 for a screen capture of the RPL for the MRGCDDroughtReleaseFromElVado function.

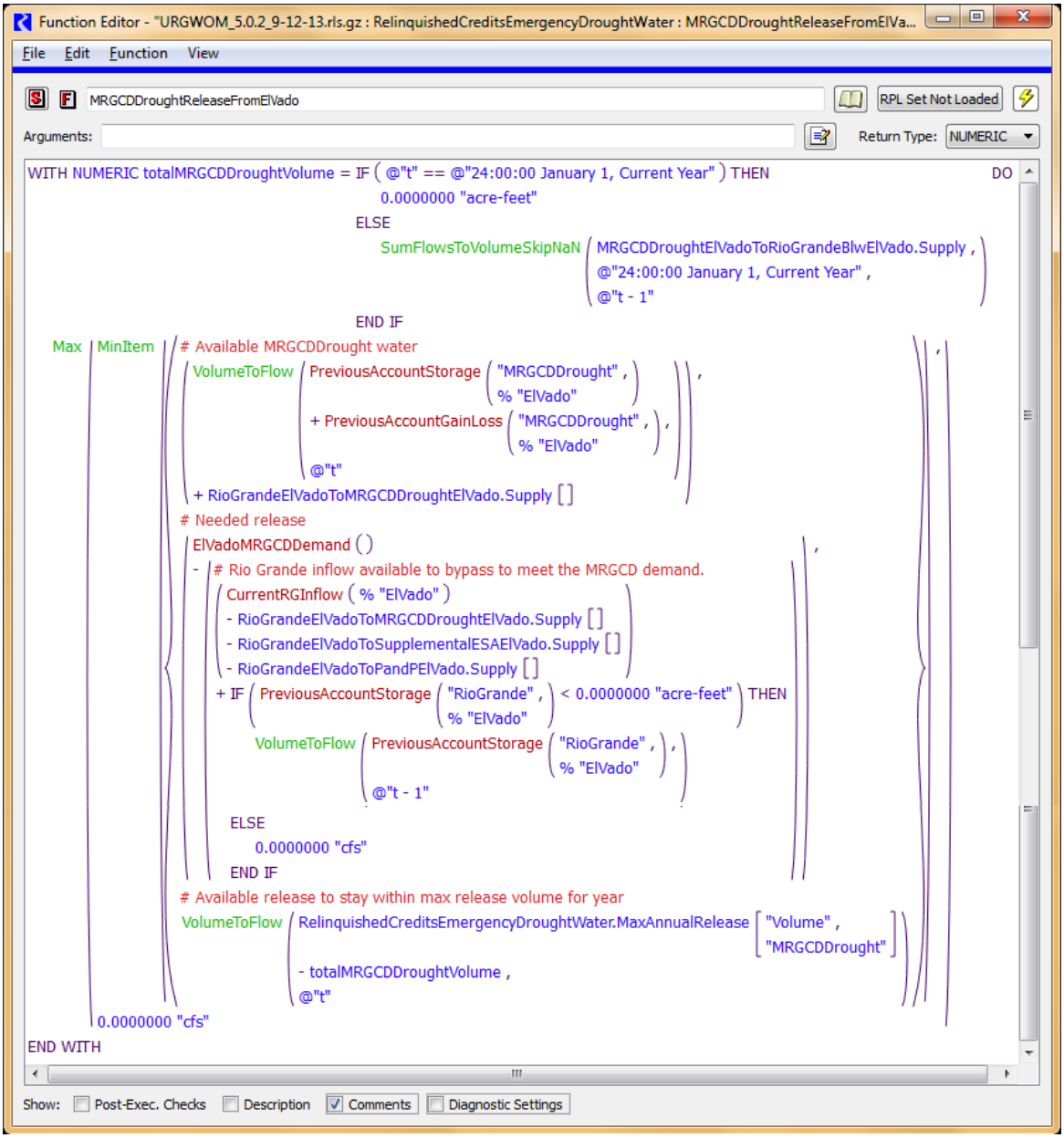


Figure B.12. Rule Policy Language for MRGCDDroughtReleaseFromElVado Function

B.24. EstimateElVadoRGRelease

The rules in the policy group record an estimated magnitude and date for the peak inflow to El Vado Reservoir and compute the release of Rio Grande water from El Vado. The magnitude and date of the peak are referenced for policy for filling El Vado Reservoir if Article VII is not in effect. If Article VII is in effect, inflows are bypassed. Native water will also be released from storage as available and as needed to meet the MRGCD

demand with consideration for contributions from P&P releases and deliveries of MRGCD Emergency Drought water.

B.24.1. RecordEstimatedElVadoPeakInflowAndDate

Explanation: This rule records a date and magnitude for the estimated peak inflow to El Vado Reservoir for each year in a model run. The values are then referenced later when setting the release of native water from El Vado Reservoir during filling if Article VII of the Compact is not in effect.

Rule Execution: This rule executes if the current timetep is equal to March 1 or the rule based simulation start timestep if that rulebased simulation timestep is after March 1.

Rule Logic: Two assignment statements are included in this rule. Values for the EstimatedPeakInflow and EstimatedPeakInflowDate slots for December 31 of the current year are set to the two resulting values from using the user-defined ElVadoMaxInflowAndDateList function which creates a two item list with the magnitude of the peak inflow and the date for the maximum inflow between March 1 and July 31. A WITH DO loop is used in the ElVadoMaxInflowAndDateList function to create a list of estimated flows for each date between the the two input dates of March 1 and July 31. Future inflows are estimated based on input inflows to AzoteaWillow confluence object and the Local Inflow slot of the ElVadoLocalInflow reach object. A final list is created with the maximum flow and corresponding date.

B.24.2. EstimateElVadoRGRelease

Explanation: This rule computes a daily release of Rio Grande water from El Vado Reservoir. If Article VII is in effect, inflows are bypassed as not needed for P&P storage and storage to meet Emergency Drought Water allocations for MRGCD and ESA. Inflows will also be stored if needed to offset a negative storage. If Article VII is not in effect, the outflow is set to the computed amount for filling. The outflow from the Rio Grande account is checked to assure the MRGCD demand is met with releases from available storage if needed and against the Minimum Rio Grande outflow for ultimately assuring Rio Chama acequia diversions demands are met. The total outflow of native water includes any computed release of P&P water or Emergency Drought water for MRGCD or ESA.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGOutflow series slot in the ElVadoData data object for the current timestep is a NaN.

Rule Logic: The value for the RGOutflow series slot in the ElVadoData data object for the current timestep is set using the ElVadoRGRelease function. The predefined MaxItem function is first used to identify the maximum of 1) the release of native water set as a function of Article VII status, 2) the release needed to meet the MRGCD demand, and 3) the minimum Rio Grande outflow. 1) An IF THEN ELSE statement is used to check the user-defined ArticleVIIinEffect function. If Article VII is in effect, the bypassed inflow is set to the result from the CurrentRGInflow function minus the accounting supplies for transfers to the MRGCDDrought, SupplementalESA, and PandP accounts. The bypassed inflow is also adjusted if the previous Rio Grande storage is negative to allow for the Rio Grande storage to return to zero. If Article VII is not in effect, the release is set to the result of the user-defined ElVadoOutflowForFilling function (That function mimics a calibrated procedure developed by Warren Sharp that was tested extensively by Warren in an Excel file (20100608_PotentialElVadoOps2010.xls) and was refined to serve as a guide for how El Vado Reservoir could be filled to best assure the reservoir is filled with available inflows while minimizing the chance that the downstream channel capacity is exceeded). 2) The release needed to meet the MRGCD demand is set to the value in the MRGCDDemand series slot in the ElVadoData data object for the current timestep minus the value in the PandPReleaseFromElVado series slot in the ComputedDeliveries data object as checked with the user-defined ElVadoMRGCDDemand function minus the value in the MRGCDDroughtReleaseFromElVado series slot in the ComputedDeliveries data object for the current timestep checked against the previous storage in the RioGrande account at ElVado using the predefined Min function. 3) The minimum Rio Grande outflow from El Vado is checked with the MinRGOutflow function. Values in the PandPReleaseFromElVado, MRGCDroughtReleaseFromElVado, and SupplementalESAReleaseFromElVadoForTargets series slots in the ComputedDeliveries data object are then added to compute the total Rio Grande outflow.

B.25. HeronSJRelease

The rules in this policy group are used to compute deliveries of San Juan-Chama Project water from Heron Reservoir to El Vado Reservoir, Abiquiu Reservoir, or the Cochiti Recreation Pool. Deliveries to Abiquiu may be scheduled to provide rafting releases below El Vado Dam.

B.25.1. RecordComputedRaftingSchedule

Explanation: If a specific rafting schedule has not been input by the model users, this rule records a typical schedule for rafting releases below El Vado Dam based on input values in a periodic slot and with reference to user set dates for a rafting season.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN statement is used to check to see if the ComputedRaftingSchedule series slot in the ElVadoData data object for the current timestep is not input. If not, and IF THEN ELSE statement is then used to see if the current timestep is within the rafting season dates set in the RaftingSeasonDates table slot in the El Vado Data data object as referenced with the user-defined RaftingSeasonStartDate and RaftingSeasonEndDate functions. If so, the ComputedRaftingSchedule series slot value for the current timestep is set to the value in the RaftingSchedule periodic slot in the same data object. Otherwise, the rafting schedule slot value is set to zero.

B.25.2. RecordPotentialRaftingReleases

Explanation: This rule records a potential delivery from Heron Reservoir to Abiquiu Reservoir for individual contractors to provide rafting flows below El Vado Dam. The determined delivery may be set when the final computed delivery is set with consideration for other factors.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set the potential rafting release slot value for each contractor in the ComputedDeliveries data object for the current timestep based on the list of slot names, at index 0, and determined releases, at index 1, identified with the user-defined PotentialRaftingReleasesFromHeron function.

Within the function, an outer WITH DO loop is used to create a list of accounts that move water to provide a rafting release. An inner WITH DO statement is used to identify the available water at Heron for delivery at the current timestep for each contractor as the minimum of the previous storage for the account minus water to be retained at Heron as waiver water for the account determined with the user-defined CurrentYearAllocatiounToBeRetainedAsWaiverWater function minus the amount of contractor water to be retained for a pending lease to Reclamation identified with the user-defined HeronStorageToBeLeased function checked against the available supply for the contractor. Final releases are set to split the delivery between all accounts to meet the target rafing flow computed with the RequestedRaftingRelease function.

B.25.3. ComputeHeronSJCDeliveryToCochitiRecPool

Explanation: This rule computes a delivery of Cochiti Rec Pool water from Heron to Cochiti Lake. Deliveries may be set under multiple conditions to assure an input minimum storage is maintained or water is moved out of Heron by the end of the year, as a rafting release, or over a typical delivery period restricted to not exeed the target content at Cochiti Lake. Note that the target content at Cochiti Lake may be set by the model user to an input Cochiti surface area or an input storage with different results due to the impacts of modeled sedimentation at Cochiti Lake.

Rule Execution: The rule fires if the value for the CochitiRecPoolDeliveryHeronToCochiti series slot in the ComputedDeliveries data object for the current timestep is a NaN and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the CochitiRecPoolDeliveryHeronToCochiti series slot in the ComputedDeliveries data object for the current timestep is not input as checked with the predefined IsInput function, a value is computed with the user-defined SJCDeliveryFromHeronToCochitiRecPool function. Within the function IF THEN ELSE statements are used to check conditions for computing an outflow. If the previous storage in the CochitiRecPool account at Cochiti is less than the value in the MinDownstreamStorageTriggerImmediateDelivery column and CochitiRecPool row of the DeliverySetting table slot in the ComputedDeliveries data object, a release is computed as the rate input to the TypicalDeliveryFromHeron column of the same table slot restricted if needed to the previous CochitiRecPool account storage at Heron. Otherwise, if the total amount of water to be moved out of Heron Reservoir as computed with the user-defined TotalWaterToBeMovedOutOfHeron function is greater than 0 acre-ft and the current timestep is greater than or equal to the offset date equal to December 31st minus the value in the DaysBeforeTargetDateToStartMovingWater column and CochitiRecPool row of the DeliverySettings table slot and less than or equal to December 31st, a release is computed with the TypicalSJCDeliveryFromHeron function. That function sets the computed release to the maximum of the input value in the TypicalDeliveryFromHeron column or the average delivery to evacuate the TotalWaterToBeMovedOutOfHeron over the number days to move water before Decmeber 31st. Otherwise, if the value in the RaftingReleaseTrigger(1=Raft,0=NoRaft) column and CochitiRecPool row of the DeliverySettings table slot equals 1.0 and the current timestep is prior to the end of the rafting season identified with the user-defined RaftingSeasonEndDate function, the release is set to the value in the PotentialCochitiRecPoolRaftingRelease series slot in the ComputedDeliveries data object. Otherwise, if the current timestep is between the dates in the TypicalDeliveryStartDate and TypicalDeliveryEndDate columns for the CochitiRecPool row in the DeliverySettings table slot, the release is computed with the TypicalSJCDeliveryFromHeron function over the period within those two dates.

The predefined Min function is used to restrict the determined release to the amount of water needed at Cochiti with reference to the storage in the CochitiRecPool account at Cochiti at the previous timestep. If the value for the SwitchForCochitiRecPoolTargetContent scalar slot is equal to 1.0, the Cochiti storage associated with the value in the AuthorizedSurfaceAcres column of the PoolLevels table slot in the CochitiData data object is targeted; otherwise, the storage input to the Content of Permanent Pool column of the Permanent Sediment Content table is targeted.

B.25.4. ComputeHeronSJCDeliveriesToAbiquiu

Explanation: This rule computes deliveries for contractor San Juan-Chama Project water from Heron Reservoir to allocated storage space at Abiquiu Reservoir. Deliveries may be set under multiple conditions to assure an input minimum storage is maintained at Abiquiu Lake or water is moved out of Heron by the waiver date, by the end of the year, as a rafting release, or over a typical delivery period while restricted to not exeed the available allocated storage space at Abiquiu Reservoir.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set computed deliveries from Heron to Abiquiu for each contractor to slots in the ComputedDeliveries data object. If the corresponding slot value for the current timestep is not input as checked with the predefined IsInput function, and the available space at Abiquiu for the contractor as checked with the user-defined AvailableAccountStorage function is greater than a percentage of the maximum storage or a delivery has already begun indicated by the previous value for the assignment slot greater than 0.0 cfs or the previous account storage is less than the value in the MinDownstreamStorageTriggerImmediateDelivery column for the account in the DeliverySetting table slot in the ComputedDeliveries data object, a delivery is computed with the user-defined SJCDeliveryFromHeronToAbiquiu function.

Within the function, separate WITH DO loops are used to define different potential releases that may be made. If the previous storage for the corresponding account at Abiquiu is less than the value in the MinDownstreamStorageTriggerImmediateDelivery column for the account in the DeliverySettings table slot, a release rate is computed as the rate input to the TypicalDeliveryFromHeron column of the same table slot restricted if needed to the previous account storage at Heron. If the total amount of water to be moved out of Heron Reservoir by the waiver date as computed with the user-defined WaiverWaterToBeMovedOutOfHeron function is greater than 0 acre-ft and the current timestep is greater than or equal to the offset date equal to waiver date as referenced with the user-defined WaiverDate function minus the value in the

DaysBeforeTargetDateToStartMovingWater column for the corresponding account in the DeliverySettings table slot and less than or equal to waiver date, a waiver release rate is computed with the TypicalSJCDeliveryFromHeron function. That function sets the computed release to the maximum of the input value in the TypicalDeliveryFromHeron column or the average delivery to evacuate the WaiverWaterToBeMovedOutOfHeron over the number days to move water before the waiver date. If the total amount of water to be moved out of Heron Reservoir as computed with the user-defined TotalWaterToBeMovedOutOfHeron function is greater than 0 acre-ft and the current timestep is greater than or equal to the offset date equal to December 31st minus the value in the DaysBeforeTargetDateToStartMovingWater column for the corresponding account in the DeliverySettings table slot and less than or equal to December 31st, an end-of-year release is computed with the TypicalSJCDeliveryFromHeron function. If the current timestep is between the dates in the TypicalDeliveryStartDate and TypicalDeliveryEndDate columns for the corresponding account in the DeliverySettings table slot, the a typical release rate is computed with the TypicalSJCDeliveryFromHeron function over the period within those two dates. The final determined release rate for the account is set to the maximum of the potential release rates and includes a check against the potential rafting release. Note that the maximum of all the potential release rates may be zero.

The predefined Min function is used to restrict the determined release to the available space at Abiquiu for the contractor determined with the user-defined AvailableAccountStorage function.

B.25.5. ComputeHeronSJCDeliveriesToElVado

Explanation: Deliveries of contractor San Juan-Chama Project water from Heron Reservoir to El Vado Reservoir are set with this rule. MRGCD water is moved to fill available space, and other contractor water may be temporarily stored at El Vado if allowed based on model user inputs. Water for other contractors is moved as space is available at El Vado Reservoir and up to an estimated amount that can be evacuated before the next runoff.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set computed deliveries from Heron to El Vado Reservoir for each contractor to slots in the ComputedDeliveries data object. If the corresponding slot value for the current timestep is not input as checked with the predefined IsInput function, a delivery is computed with the user-defined SJCDeliveryFromHeronToElVado function.

Within the function, the delivery is computed in separate steps. If the account is MRGCD, a delivery for MRGCD is computed using the user-defined MRGCDDeliveryToElVado function that sets the MRGCD delivery to move water over an input period or to maintain a minimum account storage at El Vado if needed and as possible. If the account is not Reclamation, a needed delivery to assure water is available at El Vado for a pending lease to Reclamation or letter water transfer to MRTGCD is added as computed with the WaterNeededForPendingLeaseToReclamationAndOrLetterWaterTransferToMRGCD atElVado function. The computation includes additional water moved to avoid being lost at Heron Reservoir. For contractors other than MRGCD, the amount moved is restricted to an estimated amount that can be evacuated from El Vado before the next runoff as computed within the ProjectedElVadoTempStorageThatCanBeEvacuated function. The resulting computed delivery is restricted to the available account storage at Heron Reservoir at the previous timestep or the available space at El Vado after computed as all space while assuring space is available for MRGCD. Refer to Figure B.13 for a screen capture of the RPL for the SJCDeliveryFromHeronToElVado Function.

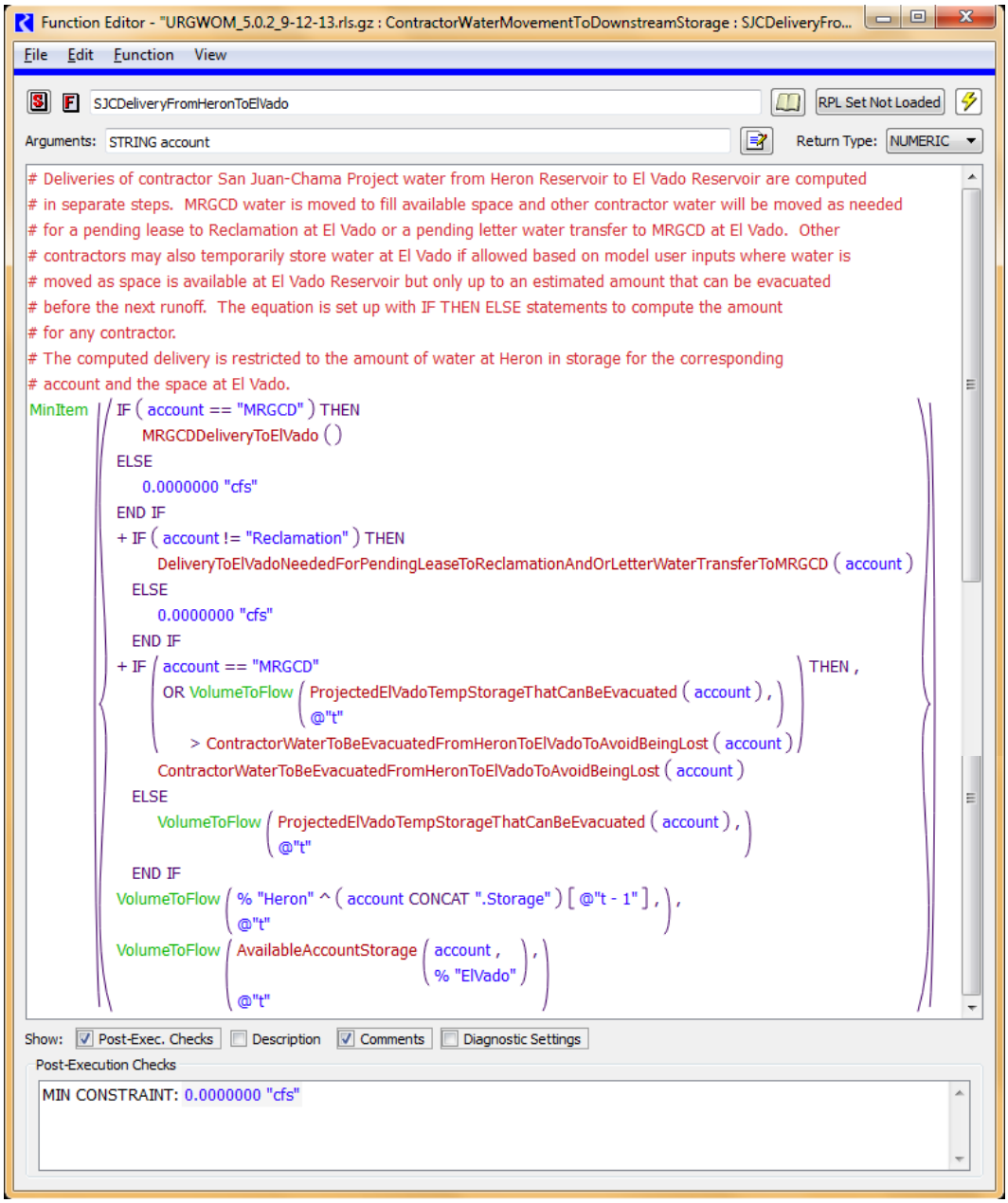


Figure B.13. Rule Policy Language for the SJCDeliveryFromHeronToElVado Function

B.25.6. ComputeHeronSJRelease

Explanation: A total outflow of San Juan-Chama Project water from Heron Reservoir is computed as a sum of all the computed individual deliveries.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the SJOutflow series slot in the HeronData data object for the current timestep is computed as an addition of all the computed individual deliveries in the series slots in the ComputedDeliveries data object. The predefined Max function is used to assure the release is enough to provide the value in the MinRelease periodic slot in the HeronData data object and the predefined Min function is used to restrict the total release to an input value to the MaximumSJOutflow periodic slot in the HeronData data object.

B.26. San Juan Diversions

The rules in this policy group are used for setting the San Juan diversions with consideration for the available flow in the tributaries to the San Juan River, all diversion and tunnel capacities, and legal constraints for the Project diversions. Diversions result in modeled flows into Heron Reservoir via the Azotea tunnel. The diversions are computed at this location in priority such that the space in Heron Reservoir can be assessed.

B.26.1. ComputeAnnualSJDiversion

Explanation: On January 1 of each year, this rule sums the annual diversion of San Juan water over the previous year. The values are then referenced when 10-year restrictions on San Juan-Chama Project diversions.

Rule Execution: If the current timestep is January 1 and not the Start Timestep and the value for the AnnualDiversion annual time series slot in the SanJuanChamaDiversions data object for December 31 of the previous year is a NaN, the rule fires.

Rule Logic: The value for the AnnualDiversion time series slot in the SanJuanChamaDiversions data object for the previous timestep is set to the summation of the values in the Total time series slot in the SanJuanChamaDiversions data object for the January 1 of the previous year, or the start timestep if it is later, through the previous timestep. The predefined SumSlotOverTime function is used to complete the summation and the predefined FlowToVolume function is used to convert the flows to a volume.

B.26.2. San Juan Diversions

Explanation: The San Juan Diversions at the Blanco, Little Oso, and Oso diversions are determined with this rule. If an input maintenance switch is checked for a diversion, an input diversion will be referenced for the corresponding diversion. Diversions will be

limited if necessary based on the annual limit, limited diversion for a decade, or the available space at Heron Reservoir. If the Project diversion is limited, separate calculations are used to determine the diversions. Otherwise, the diversions are set to the input diversion capacity. These rules capture detailed aspects of diversion and tunnel capacities that may ultimately affect the total Project diversion volume to Heron Reservoir via the Azotea tunnel.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: A FOR DO loop is used to set the Diversion Request values for the current timestep for all the diversions in the San Juan Diversions subbasin. An exterior IF THEN ELSE statement is used to identify whether the maintenance switch is on for the diversion as identified with the user-defined IsMaintenanceSwitchOn function. If so, the Diversion Request is set to the input value in the MaintenanceFlow table slot for the data object for the corresponding diversion. An interior IF THEN ELSE statement is used to identify whether the diversion is limited based on the annual diversion limit, decade diversion limit, or the space in Heron Reservoir using the user-defined DiversionIsLimited function in the SanJuanDiversions utility group. If not, the Diversion Request is set to the input value in the Max Diversion table slot for the corresponding diversion. If so, the limited remaining diversion for the year, decade, or based on the available space in Heron Reservoir is converted to a flow rate for one timestep and compared to the value in the SmallDivThreshold table slot in the SanJuanChamaRule data object. If the threshold is not exceeded, the Diversion Request is set with the user-defined SmallDivCalc function in the SanJuanDiversions utility group. Otherwise, the value is set using the user-defined LargeDivCalc function in the SanJuanDiversions utility group.

This rule also includes two additional assignment statements to set the values in the Diversion Request time series slots in the OsoTunnelInlet and AzoteaTunnelInlet diversion objects to the value in the Max Diversion table slot for the corresponding diversion as referenced using the user-defined Capacity function in the SanJuanDiversions utility group. Refer to Figures B.14 for a flowchart that depicts the logic used for setting the diversions.

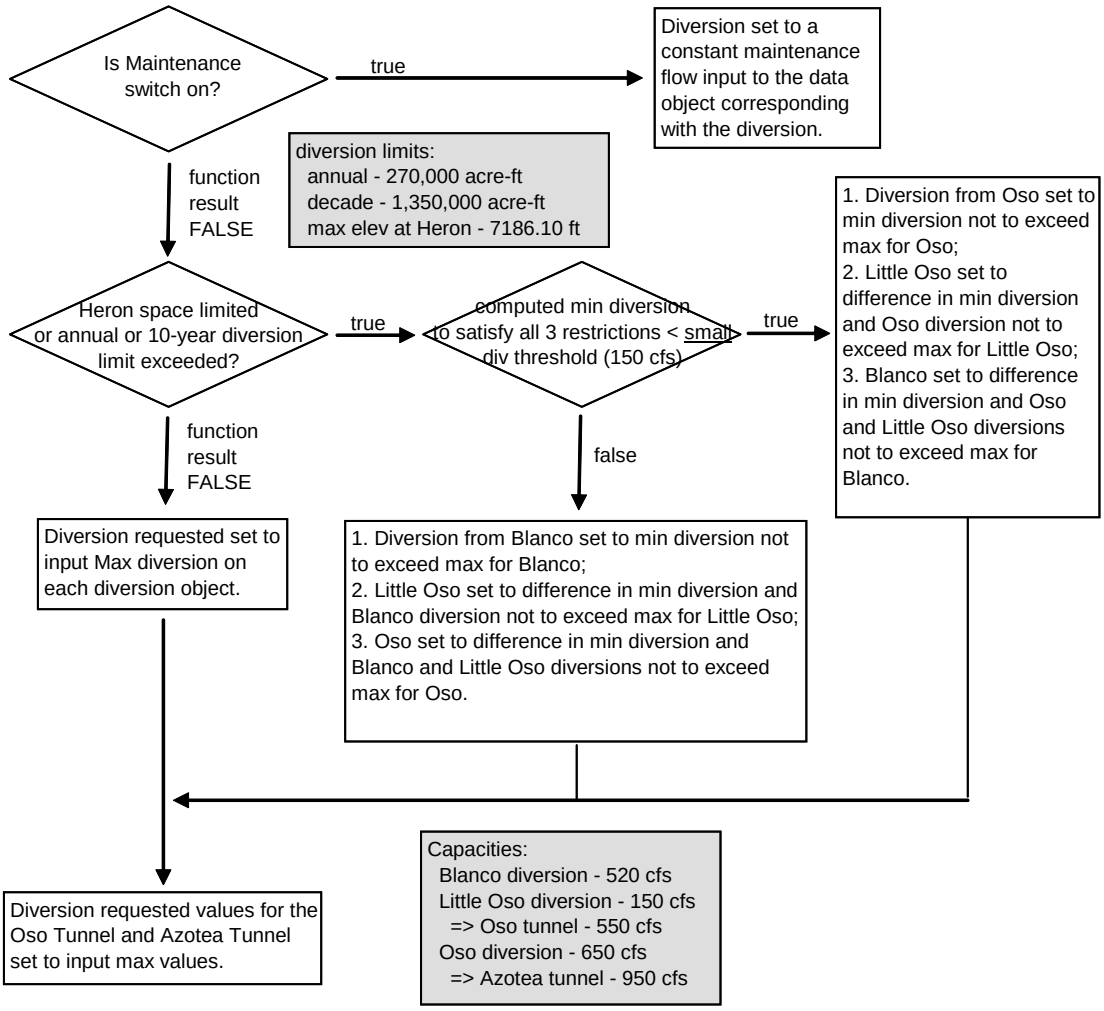


Figure B.14. Flow Chart Depicting Logic for Setting San Juan Diversions

B.27. Heron

The rules in this policy group are used to ultimately determine the total outflow from Heron Dam and include checks against the reservoir ice coverage, whether the reservoir is spilling, and the maximum daily pool elevation change of one foot.

B.27.1. HeronSJReleaseRestrictions

Explanation: This rule checks to see if Heron Reservoir has full ice coverage or if it must spill. If so, the release of San Juan-Chama Project water is reset to 0.0 cfs. The ice coverage is computed as part of the CurrentSurfaceAreaPanAndIce evaporation method.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired successfully for the current timestep as determined with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: This rule contains an IF THEN statement to set the value of the SJOutflow time series slot in the HeronData data object for the current timestep to 0.0 cfs if the result from either the user-defined HeronHasFullIceCover or HeronMustSpill functions is TRUE. The former function checks to see if the input value in the Surface Ice Coverage time series slot in the Heron storage reservoir object for the current timestep is greater than or equal to the value in the IceCoverageThreshold table slot in the HeronData data object. The latter function first computes the storage of water above the maximum pool elevation as the value for the Storage time series slot in the Heron storage reservoir object for the previous timestep minus the maximum storage that corresponds to the MaxElevation input in the ReservoirData table slot in the HeronData data object. If that value plus the value in the Inflow time series slot in the Heron storage reservoir object minus the value in the Inflow1 time series slot in the AzoteaWillow confluence object is greater than the maximum outflow as determined using the predefined GetMaxOutflowGivenHW function, the result for the function is TRUE.

B.27.2. HeronOutflow

Explanation: Unless a total outflow for Heron Dam has been input for the current timestep, the value is set to the sum of the separate initial computed values for the release of native Rio Grande water and the release of San Juan-Chama Project water if the resulting total release is physically legitimate with consideration for the outlet works. If not, the release is reset to reflect the restriction of the Heron Dam outlet works.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the Heron storage reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the HeronData data object for the current timestep as referenced using the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the Heron storage reservoir object for the current timestep is set to that TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the Outflow is set to the sum of the RGOutflow and SJOutflow for Heron Dam checked with the user-defined CheckThisResPhysicalConstraints function (Section B.27.2.1).

B.27.2.1. CheckThisResPhysicalConstraints

Explanation: This function checks a predetermined outflow against the physical constraints of the outlet works for a dam. First, if there would be an unregulated spill, the outflow is reset to that spill if it is greater than the predetermined outflow. Otherwise, the predetermined outflow is checked to assure it does not exceed the maximum outflow that can be released through the outlet works or the release that would reduce the storage down to the invert level of the outlet works (or the level corresponding to a maximum release of 0.0 cfs).

Function Logic: This function includes a WITH DO loop to determine the minimum spill for the current reservoir situation using the predefined GetMinSpillGivenInflowRelease function. An IF THEN ELSE statement is used to see if the predetermined outflow is less than the determined minimum spill. If so, the outflow is reset to the minimum spill. If not, the function result is set to the minimum of the predetermined outflow or the result from the user-defined ComputeMaxOutflow function which references the predefined GetMaxOutflowGivenInflow function or the result from the user-defined ComputeOutflowAtGivenStorage function which references the predefined SolveOutflow function to solve for the outflow that would reduce the storage down to the elevation corresponding with 0 cfs in the Max Release table in the storage reservoir object.

B.27.3. HeronCheckDeltaStorage

Explanation: If the change to the pool elevation, resulting from the initial set outflow for the current timestep, is greater than the limited change of 1 ft, the outflow is reset to restrict the change to the pool elevation to the input value of 1 ft.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the change in the pool elevation as determined with the user-defined ComputeDeltaPoolElevWOAbs function is greater than the value input to the maxDeltaPoolElev table slot in the HeronData data object and if the value in either the RGOutflow or the SJOutflow time series slot in the HeronData data object for the current timestep is greater than zero.

Rule Logic: This rule references the user-defined HeronLimitDeltaStorage function to compute the outflow corresponding to a decrease in the pool elevation equal to the input value in the maxDeltaPoolElev table slot in the HeronData data object. The predefined ElevationToStorage and VolumeToFlow functions are referenced in this function. The value in the Outflow time series slot in the Heron storage reservoir object is then set to the result after it is checked with the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1 for more information on this function). This rule also includes a PRINT statement to print a comment to the Diagnostics Output window that

the change in storage was limited and PRINT statements are activiated in the Diagnostics Manager.

B.28. SetHeronRioGrandeAccountingSupply

The rules in this policy group are used to set the accounting supply for the final determined outflow of Rio Grande water from Heron Reservoir. Another rule is included to assure that supply got set. If the supply does not get set, a simulation will stop and allows the model user to identify the problem from that location in the simulation (The problem may not be directly related to the computation of the Rio Grande outflow).

B.28.1. SetHeronRGAccount

Explanation: This rule sets the supply for the release from Rio Grande account at Heron Reservoir based on the determined outflow. If the Rio Grande outflow is greater than the Heron outflow, the supply is set to the Heron outflow. If the Heron outflow is greater than the sum of the Rio Grande and San Juan outflow, the reconciled release is set to the Heron outflow minus the San Juan outflow, or the minimum Rio Grande outflow if it is higher. Otherwise, the supply is set to the Rio Grande outflow.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeHeronToRioGrandeHeronSeepage supply slot for the current timnestep is a NaN.

Rule Logic: The value for the RioGrandeHeronToRioGrandeHeronSeepage supply slot for the current timnestep is set with this rule to the result from the user-defined ReconcileRGOutflow function. For Heron, this ReconcileRGOutflow function includes an IF THEN ELSE statement to see if the value for the RGOutflow time series slot in the HeronData data object for the current timestep as referenced using the user-defined RGOutflow function is greater than the value in the Outflow time series slot in the Heron storage reservoir object. If so, the function result is set to that Outflow for the Heron storage reservoir object. Otherwise, a second IF THEN ELSE statement is used to see if the value for that Outflow is greater than the sum of the values in the RGOutflow and SJOutflow time series slots in the HeronData data object. If so, the function result is set to the maximum of either the minimum Rio Grande outflow (0.0 cfs for Heron Dam) or the difference between the value in the Outflow time series slot in the Heron storage reservoir object and the value in the SJOutflow time series slot in the HeronData data Object. If not, the function result is set to the value in the RGOutflow time series slot in the HeronData data object for the current timestep.

B.28.2. CheckHeronRGOutflow

Explanation: This rule aborts the simulation if the supply for the release of Rio Grande wbater from the account at Heron Reservoir was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the RioGrandeHeronToRioGrandeHeronSeepage supply slot for the current timestep is a NaN, the STOP_RUN command is used to stop the simulation, and the PRINT statement is used to print a comment to the Diagnostics Output window that the run stopped because the account slot value was not set.

B.29. SetHeronSJCAccountingSupplies

The rules in this policy group are used to set all the accounting supplies for deliveries of San Juan-Chama Project water from Heron Reservoir. Supplies are all set to the intial computed values for the deliveries unless some operational constraint resulted in the total outflow from not being fully met. Supplies are then set to the initial values in priority based on the order of the supplies listed in the function referenced for making the assignments. For deliveries through the single combined passthrough account, additional supplies are set to move the water back out of the downstream combined passthrough account to the corresponding contractor's storage account.

B.29.1. SetHeronSJCAccountingSupplies

Explanation: This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from Heron Reservoir.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN statement is used first in the rule to identify if the final reconciled outflow of San Juan-Chama Project water determined with the user-defined

ReconcileSJOutflow function is less than the previous determined outflow. If so, Print statements are used to print statements to the Diagnostics Output window that the full initial computed outflow could not be met, if Print statements are enable in the Diagnostics Manager. A FOR DO statement is then used in the rule to set all the accounting supplies from a list of all supply slot names, at index 0, and the final determined deliveries, at index 1, as created with the user-defined HeronPrioritizedSJCSuppliesAndValuesReconciliationCheck function. That function contains a list of all the accounting supplies from Heron Reservoir for deliveries of San Juan-Chama Project water and a corresponding list of all the initial computed deliveries recorded to the ComputedDeliveries data object. A WHILE DO loop is then used in the function to loop through each supply *in the order listed* and set the deliveries while checking the cumulative release set within the function with each final determined delivery against the final total outflow of San Juan-Chama Project water. If the final total outflow of San Juan-Chama Project water, which is an input to the function, is less than the sum of the intial computed deliveries, deliveries included at the bottom of the listed supplies will be shorted in order from bottom up as needed.

B.29.2. SetTransfersAtElVadoForDeliveriesViaCombinedAccount

Explanation: This rule sets the accounting supplies to transfer water back out of the Combined storage account at El Vado for contractor water moved from Heron to El Vado with the CombinedHeronToCombinedElVado passthrough accounts. This approach is used for the twelve contractors other than MRGCD, Albuquerque, Santa Fe City, Santa Fe County, and Cochiti Rec Pool.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Twelve assignment statements are included in this rule to set the accounting supplies for transfers from the Combined storage accout at El Vado to contractor storage accounts at El Vado based on any delivery from Heron to El Vado for the corresponding contractor as moved in the combined passthrough accounts to El Vado. The assignments are simple one-to-one assignments since there is no San Juan-Chama loss or lag between Heron and El Vado.

B.30. UpdateWaiverBalances

The rules in this policy group are used to track the balances of contractor waiver water in storage at Heron Reservoir. Waiver balances are zeroed out the day after the waiver date with any remaining waiver water in storage transferred to the FederalSanJuan account at

Heron. Waiver balances are updated throughout the year for any leases of waiver water to Reclamation and for waiver water moved to El Vado or Abiquiu Reservoir.

B.30.1. ZeroWaivers

Explanation: On the input waiver date (e.g. September 30th), accounting supplies are set to transfer remaining contractor waiver water still in storage at Heron Reservoir to the common pool for San Juan-Chama Project water. The separate tracked waiver balances for each contractor are also reset to zero.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the current timestep is equal to the date input to the WaiverDate table slot in the Waivers data object plus one day.

Rule Logic: A FOR DO loop is used to make two assignments for each of the strings in the list of contractors for San Juan-Chama Project water. The accounting supply for the transfer of San Juan-Chama project water for each contractor to the FederalSanJuan account at Heron Reservoir is set to the minimum of the value for the contractor waiver balance tracked in corresponding series slots in the Waivers data object and as referenced with the user-defined PreviousWaiverBalance function or the previous account storage for the contractor. The value for the waiver balance series slot for the contractor is also set to 0.0 acre-ft. Refer to Figure B.15 for a screen capture of the RPL for this rule.

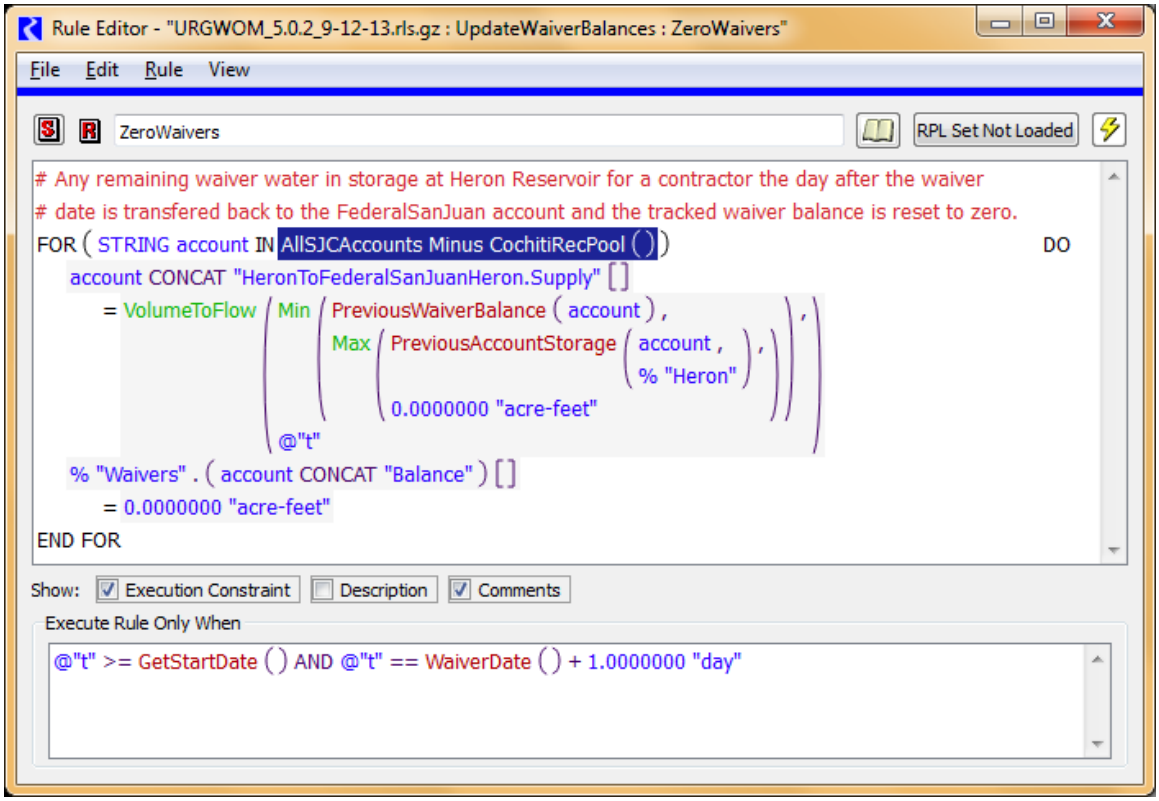


Figure B.15. Rule Policy Language for the ZeroWaivers Rule

B.30.2. UpdateContractorWaiverBalances

Explanation: The waiver balance for each contractor is tracked as the previous waiver balance minus any waiver water leased to Reclamation and minus any water moved to El Vado or Abiquiu. A Reclamation balance is also tracked that is increased with leases.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function and if the current timestep is NOT equal to the date input to the WaiverDate table slot in the Waivers data object plus one day.

Rule Logic: A FOR DO loop is used to set the waiver balance slot for each contractor for San Juan-Chama Project water in the Waivers data object. IF THEN ELSE statements are used to check three conditions for setting the waiver balance slot. 1) If the current timestep is January 1 and waivers are in effect for the contractor as checked with the user-defined WaiversAreInEffect function, the waiver balance slot is set to the previous account storage at Heron. Throughout the rest of the year, 2) for all accounts other than the Reclamation account, the waiver balance is set to the previous waiver balance minus any waiver water leased to Reclamation as checked with reference to the corresponding accounting supply and minus any water moved to El Vado or Abiquiu also as checked

with reference to the corresponding account supply for the account. 3) For Reclamation, the waiver balance is set to the previous balance PLUS any waiver water leased to Reclamation minus any delivery of Reclamation water to El Vado or Abiquiu as checked with reference to the corresponding accounting supply.

B.31. ElVadoSJCRelease

The rules in this policy group are used to compute deliveries of San Juan-Chama Project water from El Vado Reservoir and compute an initial total outflow of San Juan-Chama Project water from El Vado Reservoir.

B.31.1. ComputeElVadoSJCDeliveriesToAbiquiu

Explanation: This rule computes deliveries for San Juan-Chama Project water from El Vado to Abiquiu. MRGCD water is moved to assure water is available as needed at Abiquiu Reservoir to meet the MRGCD demand, and water for other contractors is evacuated from El Vado Reservoir prior to the runoff based on input dates to move the water. Deliveries are also computed for the passthrough of contractor water being moved from Heron to Abiquiu Reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Twenty-three assignment statements are included in the rule to compute deliveries for San Juan-Chama Project water from El Vado Reservoir. For the first assignment statement, the MRGCDDeliveryElVadoToAbiquiu series slot in the ComputedDeliveries data object for the current timestep is set with the user-defined ComputeElVadoMRGCDSJRelease function. Within that function, if the MRGCD demand at Abiquiu as determined with the user-defined AbiquiuMRGCDDemand function is greater than 0.0 cfs or the current timestep is in the irrigation season and the available space at Abiquiu for MRGCD San Juan-Chama Project water as computed with the user-defined AvailableAccountStorage function is greater than half the allocated storage space for the MRGCD account and the previous storage in the Rio Grande and MRGCDDrought accounts is less than twice the MRGCD demand at Cochiti, MRGCD San Juan-Chama Project water is moved to Abiquiu. Otherwise, the delivery is set to 0.0 cfs. A delivery of MRGCD water to Abiquiu is set to fill the available space at Abiquiu plus meet the current MRGCD demand at El Vado with consideration for any contributions from the MRGCDDrought account and any release of RioGrande water from El Vado. The release is restricted to the available MRGCD storage at El Vado.

The next sixteen assignment statements set deliveries for moving contractor water to Abiquiu – for contractors other than MRGCD – using the user-defined SJCDeliveryFromElVadoToAbiquiu function. Within that function, if the account storage at El Vado is greater than zero and the current timestep is within the period to evacuate contractor water from El Vado based on the values input to the DateToFullyEvacuateTemporaryStorageAtElVado and DaysBeforeTargetDateToStartMovingWater columns for the corresponding account in the DeliverySettings table slot in the ComputedDeliveries data object, a delivery rate is set to the maximum of the same typical delivery rate used to move water out of Heron or the average rate to evacuate all the storage out of El Vado over the delivery period. The result is checked against the available space for the corresponding account at Abiquiu Reservoir with reference to the user-defined AvailableAccountStorage function.

The remaining six assignment statements set the passthrough amounts for water being moved from Heron to Abiquiu through El Vado Reservoir.

B.31.2. ComputeDeliveryForMRGCDPaybackToAlbuquerque

Explanation: This rule computes a delivery of MRGCD San Juan-Chama Project water from El Vado Reservoir to the Albuquerque account at Abiquiu based on inputs that reflect the debt for a past loan.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the value for the MRGCDPaybackToAlbuquerqueElVadoToAbiquiu series slot in the ComputedDeliveries data object for the current timestep is set with an IF THEN ELSE statement. If the current timestep is within the period between the dates input to the DeliveryStartDate and DeliveryEndDate columns of the PaybackScheduleForPastAlbuquerqueLoanToMRGCD table slot in the ComputedDeliveries data object, the delivery is set to the maximum of the rate input to the MinimumDeliveryRate column of the same table slot or the rate to deliver the amount in the VolumeForPayback column of that slot over the delivery period. The computed delivery is restricted to the amount of the remaining debt to be paid back and the available MRGCD water at El Vado Reservoir.

B.31.3. ComputeElVadoSJRelease

Explanation: A total outflow of San Juan-Chama Project water from El Vado Reservoir is computed as a sum of all the computed individual deliveries.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value of the SJOutflow series slot in the ElVadoData data object for the current timestep is a NaN.

Rule Logic: The value for the SJOutflow series slot in the ElVadoData data object for the current timestep is computed as an addition of all the computed individual deliveries in the series slots in the ComputedDeliveries data object.

B.32. ElVadoOutflow and CheckFloodControl

The rules in this policy group are used to compute an initial total outflow from El Vado Reservoir and check the outflow against the maximum pool elevation and downstream channel capacity.

B.32.1. ElVadoOutflow

Explanation: Unless a total outflow for El Vado Dam has been input for the current timestep, the value is set to the sum of the predetermined outflows of Rio Grande and San Juan-Chama Project water, checked against the minimum outflow. That total release is checked to see if it is physically legitimate based on the El Vado Dam outlet works, and if not, the release is reset to reflect the restriction for the outlet works.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the ElVado storage reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the ElVadoData data object for the current timestep as referenced with the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the ElVado storage reservoir object for the current timestep is set to that input TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the Outflow is set using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1) with the sum of the RGOutflow and SJOutflow slot values in the ElVadoData data object the predetermined outflow, or the minimum outflow if it is larger as determined using the user-defined MinOutflow function.

B.32.2. ElVadoFloodControl

Explanation: If the pool elevation at El Vado Reservoir is higher than the input maximum, the outflow is set to the release required to reduce the pool elevation to that maximum pool elevation or the maximum release from the outlet works if that outflow is lower. A check is also included to assure the minimum release is exceeded.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Pool Elevation time series slot in the ElVado storage reservoir object for the current timestep is greater than the value in the MaxAllowableElevation periodic slot in the ElVadoData data object for the previous timestep and if this rule has not already fired for the current timestep as checked against the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the Outflow time series slot in the ElVado storage reservoir object for the current timestep is set to the minimum of the result from the user-defined ComputeMaxOutflow function which references the predefined GetMaxOutflowGivenInflow function or the outflow required to reduce the pool elevation to the value in the MaxAllowableElevation periodic slot in the ElVadoData data object for the previous timestep as computed using the predefined SolveOutflow function. That result is checked to assure it exceeds the minimum outflow from El Vado Dam as determined with the user-defined MinOutflow function.

B.32.3. ElVadoChannelCapacity

Explanation: This rule adjusts the outflow from El Vado Dam to comply with the input downstream channel capacity if the predetermined outflow exceeds that capacity. Note that this rule fires after the ElVadoFloodControl rule, so the reservoir level will rise above the maximum pool elevation if required to keep downstream flows less than the channel capacity.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the current set value in the Outflow time series slot in the ElVado reservoir object for the current timestep is greater than the maxRelease in the ReservoirData table slot in the ElVadoData data object as referenced using the user-defined MaxOutflow function and if this rule has not already fired for the current timestep as checked with a reference against the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the Outflow time series slot in the ElVado storage reservoir object is set to the maxRelease identified with the user-defined MaxOutflow function.

B.33. SetElVadoRioGrandeAccountingSupplies

The rules in this policy group are used to set the final accounting supplies for the outflow of Rio Grande water from El Vado Reservoir and for the deliveries from P&P storage and Emergency Drought storage for MRGCD and ESA. An additional rule is included to assure the accounting supply for the outflow from the Rio Grande account gets set and stops the simulation if the supply did not get set.

B.33.1. SetAllRioGrandeAccountingSupplies

Explanation: Accounting supplies for the outflow of Rio Grande water from El Vado are set for the release from the PandP, SupplementalESA, MRGCDDrought, and RioGrande accounts. The supplies are set one-by-one with consideration for the previously set supplies restricted to a total reconciled Rio Grande outflow. If initial computed deliveries cannot all be made with the final reconcile Rio Grande outflow, water is moved based in priority based on the order of the assignment statements. If a higher outflow is set due to flood control operations, the additional outflow will be included with the Rio Grande account outflow set last.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeElVadoToRioGrandeBlwElVado.Supply slot for the current timestep is a NaN.

Rule Logic: Four assignment statements are used to set the four accounting supplies for the outflow of Rio Grande water from El Vado. The supply slot for the outflow from the PandP account is set to the minimum of the initial corresponding computed delivery in the ComputedDeliveries data object and the reconciled Rio Grande outflow. The supply slot for the outflow from the SupplementalESA account is set to the minimum of the initial corresponding computed delivery in the ComputedDeliveries data object and the reconciled Rio Grande outflow minus the delivery from the PandP account. The supply slot for the outflow from the MRGCDDrought account is set to the minimum of the initial corresponding computed delivery in the ComputedDeliveries data object and the reconciled Rio Grande outflow minus the delivery from the PandP account minus the delivery from the SupplementalESA account. The supply slot for the outflow from the RioGrande account is set to the reconciled Rio Grande outflow minus the delivery from the PandP account minus the delivery from the SupplementalESA account minus the delivery from the MRGCDDrought account.

B.33.2. CheckElVadoRGOutflow

Explanation: Aborts the simulation if the accounting supply for the release of Rio Grande water from the account at El Vado Reservoir was not set. This rule helps with debugging

because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely due to some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the RioGrandeElVadoToRioGrandeBlwElVado.Supply is a NaN, the STOP_RUN command is used to stop the simulation, and the PRINT statement is used to print a comment to the Diagnostics Output window that the run stopped because the account slot value was not set.

B.34. SetElVadoSJCAccountingSupplies

The rules in this policy group are used to set the accounting supplies for the final deliveries of San Juan-Chama Project water from El Vado Reservoir and to transfer water conveyed in the combined passthrough accounts back to individual contractor storage accounts at Abiquiu Reservoir.

B.34.1. SetElVadoSJCAccountingSupplies

Explanation: This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from El Vado Reservoir. Accounting supplies are also set for the transfers from contractor storage accounts to the MRGCD account for letter water deliveries completed as a payback to MRGCD.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Fifteen assignment statements are first included for setting the accounting supplies for transfers from contractor storage accounts to the MRGCD account at El Vado based on the computed amounts in the corresponding series slots in the ComputedDeliveries data object.

An IF THEN statement is then used to identify if the final reconciled outflow of San Juan-Chama Project water determined with the user-defined ReconcileSJOutflow function is less than the previous determined outflow. If so, Print statements are used to

print statements to the Diagnostics Output window that the full initial computed outflow could not be met, if Print statements are enable in the Diagnostics Manager.

A FOR DO statement is then used in the rule to set all the accounting supplies from a list of all supply slot names, at index 0, and the final determined deliveries, at index 1, as created with the user-defined ElVadoPrioritizedSJCSuppliesAndValuesReconciliationCheck function. That function contains a list of all the accounting supplies from El Vado Reservoir for deliveries of San Juan-Chama Project water and a corresponding list of all the initial computed deliveries recorded to the ComputedDeliveries data object. A WHILE DO loop is then used in the function to loop through each supply *in the order listed* and set the deliveries while checking the cumulative release set so far within the function against the final total outflow of San Juan-Chama Project water. If the final total outflow of San Juan-Chama Project water, which is an input to the function, is less than the sum of the intial computed deliveries, deliveries included at the bottom of the listed supplies will be shorted in order from bottom up as needed.

B.34.2. SetTransfersAtAbiquiuForDeliveriesViaCombinedAccount

Explanation: This rule sets the accounting supplies to transfer water back out of the Combined storage account at Abiquiu for contractor water moved from Heron to Abiquiu and from El Vado to Abiquiu with the CombinedHeronToCombinedAbiquiu and CombinedElVadoToCombinedAbiquiu passthrough accounts, respectively. This approach is used for the twelve contractors other than MRGCD, Albuquerque, Santa Fe City, Santa Fe County, and Cochiti Rec Pool.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Twelve assignment statements are included in this rule to set the accounting supplies for transfers from the Combined storage accout at Abiquiu to contractor storage accounts at Abiquiu based on any deliveries from Heron to Abiquiu and El Vado to Abiquiu for the corresponding contractor as moved in the combined passthrough accounts to Abiquiu. The assignments are set to the upstream accounting supplies for the deliveries at the previous timestep (per the one day travel time to Abiquiu) and adjusted for the San Juan-Chama loss rate from El Vado to Abiquiu as input to the Losses table slot in the SanJuanChamaRules data object and identified with the user-defined SJCLoss function.

B.35. ComputeRemainingIndividualAbiquiuDeliveries

The rules in this policy group are used to compute a potential inflow to conservation storage at Abiquiu Reservoir, an outflow of Rio Grande water, and deliveries of contractor San Juan-Chama Project water from Abiquiu Reservoir for MRGCD and targets. A total outflow of San Juan-Chama Project water from Abiquiu Reservoir is computed.

B.35.1. SetInflowToRGConservationStorageAtAbiquiu

Explanation: This rule sets an inflow to Rio Grande conservation storage at Abiquiu if conservation space has been set and inflows are available for conservation storage.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeAbiquiuToRioGrandeConservationAbiquiu.Supply slot for the current timestep is a NaN.

Rule Logic: The RioGrandeAbiquiuToRioGrandeConservationAbiquiu.Supply slot for the current timestep is set to minimum of the result from the user-defined ComputeRGConsInflow function and the maximum inflow input to the MaxRGConservationInflow table slot in the AbiquiuData data object as identified with the user-defined MaxRGConservationInflow function. Within the ComputeRGConsInflow function, an IF THEN ELSE statement is used to check whether an inflow to conservation storage should be computed with the IsRGConservationAllowed function. If not, the function result is 0.0 cfs. If so, the inflow available for conservation storage is computed as the available native inflow determined with the user-defined RioGrandeInflowWithPreviousRGGainLoss function plus the value in the Incidental Content slot for the corresponding reservoir object at the previous timestep or any storage adjustment and determined carryover release amount for the reservoir minus a minimum reservoir outflow determined with the user-defined MinimumRioGrandeOutflowBeforeTransferToConservationStorage function which assures Middle Valley demands are met. The resulting inflow to conservation storage is restricted to the available space determined as the minimum of the results from the user-defined EasementSpaceAvailableAsFlow and RGConsSpaceAvailableAsFlow functions. Refer to Figure B.16 for a screen capture of the RPL for the ComputeRGConsInflow function.

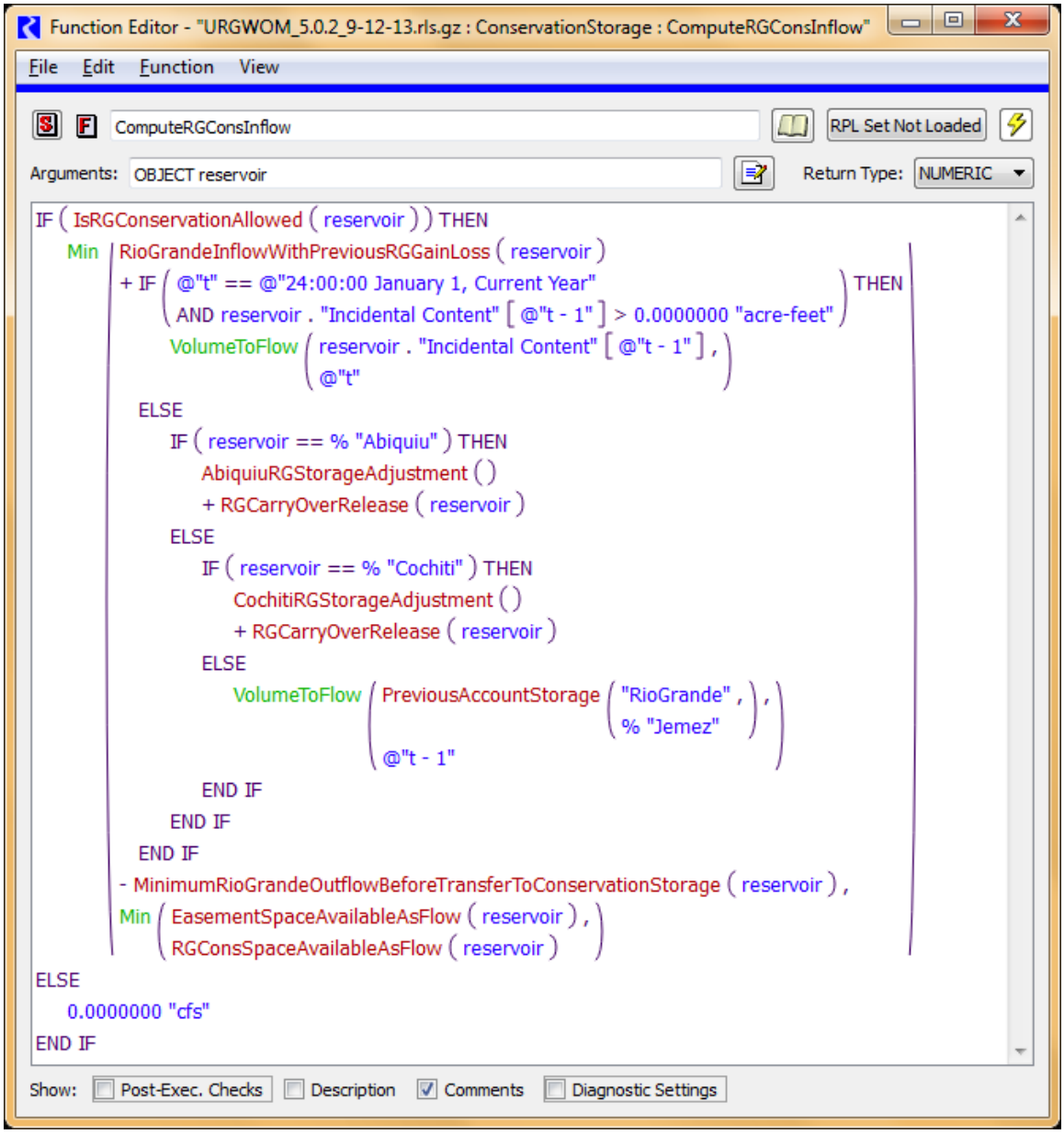


Figure B.16. Rule Policy Language for the ComputeRGConsInflow Function

B.35.2. ComputeAbiquiuRGRelease

Explanation: This rule computes the preliminary value for the release of Rio Grande water from Abiquiu Dam. The release is set to bypass inflows with any needed release from storage or adjustment from any potential storage during flood control operations and any potential non-irrigation season release of carrover storage from the irrigation season. The outflow is reduced for any inflow to conservation storage at Abiquiu Reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the

RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGOutflow time series slot in the AbiquiuData data object for the current timestep is a NaN.

Rule Logic: The value for the RGOutflow series slot in the AbiquiuData data object for the current timestep is set to the result of the user-defined AbiquiuMinRGOutflow function minus the RioGrandeAbiquiuToRioGrandeConservationAbiquiu.Supply slot value for the current timestep. The AbiquiuMinRGOutflow function computes the minimum outflow equal to the current Rio Grande inflow as determined with the user-defined CurrentRGInflow function plus the value for the Gain Loss for the Rio Grande Account at Abiquiu Reservoir for the previous timestep plus the result from the user-defined AbiquiuRGStorageAdjustment function plus the result from the RGCarryOverRelease function. The predefined Max function is used to restrict the result from this function to a minimum of the value of the MinRGOutflow function.

B.35.3. ComputeAbiquiuPassthroughToCochitiRecPool

Explanation: This rule computes the passthrough at Abiquiu of CochitiRecPool account water being delivered from Heron to Cochiti.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the CochitiRecPoolPassthroughAtAbiquiu series slot in the ComputedDeliveries data object for the current timestep is set to the accounting supply out of Heron Reservoir for the delivery of Cochiti Rec Pool water to Cochiti for the previous timestep (per the one day lag to Abiquiu) adjusted for the San Juan-Chama loss rate from El Vado to Abiquiu as input to the Losses table slot in the SanJuanChamaRules data object and as referenced with the user-defined SJCLoss function. The passthrough is also adjusted for any storage in the passthrough account at Abiquiu Reservoir.

B.35.4. ComputeMRGCDSJCDeliveryToMiddleRioGrande

Explanation: This rule computes a delivery of MRGCD San Juan-Chama Project from Abiquiu to meet the MRGCD demand if the storage of Rio Grande water and Emergency Drought water at El Vado Reservoir has dropped below a low threshold storage.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the MRGCDSJCDeliveryToMiddleRioGrande series slot in the ComputedDeliveries data object for the current timestep is computed if the previous account storage for the RioGrande and MRGCDDrought accounts at El Vado is less than twice the MRGCD demand at Cochiti. The delivery is computed as the MRGCD demand at Abiquiu identified with reference to the AbiquiuMRGCDDemand function minus the Rio Grande outflow from Abiquiu and minus the sum of all the letter water deliveries from Abiquiu to payback MRGCD. The computed amount is restricted to the available MRGCD storage at Abiquiu Reservoir.

B.35.5. ComputeNeededSupplementalWaterFromAbiquiu

Explanation: This rule computes the needed amount of supplemental water for targets as the total amount of water needed minus other deliveries for diversions and as letter water deliveries that will contribute towards the total need for targets.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the NeededSupplementalWaterFromAbiquiu series slot in the MiddleValleyTargets data object for the current timestep is a NaN.

Rule Logic: The value for the NeededSupplementalWaterFromAbiquiu series slot in the MiddleValleyTargets data object for the current timestep is set to the value for the TotalFlowNeededAtAbiquiuForTargets series slot for the current timestep minus the values in the AlbuquerqueDeliveryToSurfaceWaterDiversion, MRGCDSJCDeliveryToMiddleRioGrandeFromAbiquiu, SantaFeCityDeliveryToBuckmanDiversion, AlbuquerqueDeliveryAbiquiuToElephantButte, and SantaFeCityDeliveryAbiquiuToElephantButte series slots in the ComputedDeliveries data object for the current timestep. All computed letter water deliveries to payback MRGCD and to payback the Compact are also subtracted. The need for supplemental water is reset to zero if there is Emergency Drought water available for ESA at El Vado or conservation storage at Cochiti or Jemez Reservoir.

B.35.6. SetNeededSupplementalWaterReleaseFromAbiquiu

Explanation: This rule sets a final value for a needed release of supplemental water from Abiquiu Reservoir. The actual release is not adjusted unless a specific threshold change in the need is exceeded and the release of supplemental water is not adjusted until after an input minimum of days since the last adjustment. These calculations are included to

better represent actual operations that do not entail adjusting the release each day by a few cfs in attempt to exactly meet a target flow.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the NeededSupplementalWaterReleaseFromAbiquiu time series slot in the MiddleValleyTargets data object for the current timestep is a NaN.

Rule Logic: An IF THEN ELSE statement is included to first check if the current timestep is the start timestep for rulebased simulation. If so, the value for the NeededSupplementalWaterReleaseFromAbiquiu time series slot in the MiddleValleyTargets data object for the current timestep is set to the value in the NeededSupplementalWaterFromAbiquiu time series slot for the current timestep rounded to the nearest 10 cfs. A separate assignment is included to reset a counter for the number of days since an adjustment was made to the release of supplemental water.

Otherwise, another IF THEN ELSE statement is included to check if the previous counter value in the CountSinceSupplementalWaterReleaseAdjusted time series slot is greater than or equal to the value in the MinDaysBeforeSupplementalWaterReleaseAdjusted scalar slot in the MiddleValeyTargets data object and the average demand over that period minus the previous value for the NeededSupplementalWaterReleaseFromAbiquiu time series slot exceeds the value for the ChangeBeforeSupplementalWaterReleaseAdjusted scalar slot in the MiddleValleyTargets data object or the previous value in the CountSinceSupplementalWaterReleaseAdjusted time series slot in the MiddleValleyTargets data object is greater than or equal to the value in the MaxDaysWithNoSupplementalWaterReleaseAdjustment scalar slot. If the condition is satisfied, the value for the NeededSupplementalWaterReleaseFromAbiquiu slot is set to the average of the NeededSupplementalWaterReleaseFromAbiquiu slot values since the last adjustment was made. Otherwise, the previous value for the NeededSupplementalWaterReleaseFromAbiquiu slot is maintained. A counter is also set if the value in the NeededSupplementalWaterReleaseFromAbiquiu slot is adjusted.

B.35.7. ComputeAbiquiuRGConservationRelease

Explanation: This rule computes a release of available conservation storage at Abiquiu to meet target flows. If the current timestep is within the period to make a release from conservation storage at Abiquiu, available conservation storage is released as the maximum of the amount needed for targets or an average flow to evacuate the water over an input delivery period.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the RGConservationReleaseFromAbiquiu series slot in the ComputedDeliveries data object for the current timestep is computed if the current timestep is within the period for a release based on the dates input to the RGConservationReleaseDays table slot in the AbiquiuData data object. For other periods, the release is set to 0.0 cfs. The computed release is set to the maximum of the value in the NeededSupplementalWaterReleaseFromAbiquiu series slot in the MiddleValleyTargets data object for the current timestep or the constant release to evacuate the storage over an input delivery period as computed with the user-defined ComputeConstantAbiquiuRGConservationRelease function. The computed release is restricted with the predefined MinItem function to the available conservation storage at Abiquiu Reservoir and the value in the MaxESARelease periodic slot in the AbiquiuData data object.

B.35.8. ComputeAbiquiuReleaseOfReclamationLeasedWater

Explanation: This rule computes a release of leased San Juan-Chama Project water from Abiquiu Reservoir for targets based on the computed need for supplemental water minus any potential contribution from conservation storage releases.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the ReclamationReleaseFromAbiquiuForTargets series slot in the ComputedDeliveries data object for the current timestep is computed as the value in the NeededSupplementalWaterReleaseFromAbiquiu series slot in the MiddleValleyTargets data object for the current timestep minus the value for the RGConservationReleaseFromAbiquiu series slot in the ComputedDeliveries data object for the current timetep. The computed release is restricted with the predefined MinItem function to the storage in the Reclamation account at Abiquiu Reservoir and the value in the MaxESARelease periodic slot in the AbiquiuData data object.

B.35.9. ComputeAbiquiuSJRelease

Explanation: A total outflow of San Juan-Chama Project water from Abiquiu Reservoir is computed as a sum of all the computed individual deliveries.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the SJOutflow series slot in the AbiquiuData data object for the current timestep is a NaN.

Rule Logic: The value for the SJOutflow series slot in the Abiquiu data object for the current timestep is computed as an addition of all the computed individual deliveries in the series slots in the ComputedDeliveries data object. The result is restricted to not exceed the value input to the MaximumSJOutflow periodic slot in the AbiquiuData data object.

B.36. Abiquiu

The rules in this policy group are used to determine the total outflow from Abiquiu Dam with consideration for minimum flows, pre-evacuation releases, stepped release restrictions, downstream channel capacity restrictions, prescribed maintenance flows, and flood control operations.

B.36.1. AbiquiuLockedIn

Explanation: This rule is used to set a trigger indicating that storage during flood control operations should be locked in as carryover storage at Abiquiu Reservoir until after the irrigation season per flood control operations. Between July and October, if the storage is greater than the input minimum storage for carryover and the flow at Embudo plus the local inflows above Abiquiu Reservoir are less than an input flow to lock in water as carryover storage, the trigger is set. The water is then released during the non-irrigation season. This rule effectively assures any water stored during flood control operations is delivered to Elephant Butte for the Compact if the flows subsequently decrease to where it would otherwise be diverted in the Middle Valley.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: This rule includes two assignment statements. First, the user-defined LockinCarryOverLookAhead function is used to set the value for the Locked In time series slot in the Abiquiu level power reservoir object if it is a NaN for the current timestep plus the number of timesteps input to the LookAhead table slot in the FloodCarryOverData data object as determined using the user-defined LookAhead function (hereinafter referred to as the look ahead timestep). The assignment serves as a trigger to identify whether storage should be locked in at Abiquiu Reservoir.

Within the LockinCarryOverLookAhead function, the user-defined IfLockinCarryOverLookAhead function is used to see if it is time to lock in storage. This function checks first to see if the look ahead date is between July and October (inclusive) as determined with the user-defined FloodCarryOverSeasonLookAhead function and if the value for the Local Inflow time series slot in the ElVadoLocalInflow reach object plus the value for the Gage Inflow time series slot in the Embudo stream gage object at the look ahead timestep as computed using the user-defined OtowiLookAhead function is less than the input value in the MinLockinFlow table slot in the FloodCarryOverData data object. Second, this function checks to see if the look ahead date is between July 3rd and the end of October (inclusive) and the value for the LockedIn time series slot for any day in this period is equal to 1.0.

An additional check is then included within the LockinCarryOverLookAhead function to see if the result from the user-defined EstimatedRGStorageLookAhead function is greater than the value for the MinRGCarryOverStorage table slot in the AbiquiuData data object as referenced using the user-defined MinRGCarryOverStorage function. The EstimatedRGStorageLookAhead function estimates the storage of Rio Grande water at the look ahead date based on the storage at the previous timestep referenced using the PreviousRGStorage function and the estimated inflow and outflow till the look ahead date as referenced using the user-defined EstimatedRGInflowLookAhead and the EstimatedRGOutflowLookAhead functions. The volume of outflow, till the look ahead date, is assumed to be equal to 3.5 times the Rio Grande outflow at the previous timestep. The estimated inflow is computed using the user-defined EstimatedAbiquiuInflowLookAhead function as the maximum of either the volume of the Rio Grande outflow from El Vado Dam plus the volume of the Local Inflow time series slot in the ElVadoToAbiquiuLocalInflow reach object or the volume of the Local Inflow time series slot in the ElVadoLocalInflow reach object plus the volume of the Local Inflow time series slot in the ElVadoToAbiquiuLocalInflow reach object till the look ahead dated. That estimated inflow volume is then multiplied by 0.95 and multiplied by the value for the PercentForecastError time series slot in the ForecastData data object for the end of the current month if it is not a NaN.

If those criteria are all satisfied, an interior IF THEN ELSE statement is included in the LockinCarryOverLookAhead function to see if the value for the Locked In time series slot for the timestep before the look ahead timestep is equal to 1.0. If so the function result is 1.0. Otherwise, if the result from the user-defined CochitiFloodSpaceAvailable function is greater than the value in the MinimumFloodSpaceForFloodCarryOver table slot in the CochitiData data object as determined with the user-defined IfCochitiFloodSpaceAvailable function, the function result is 1.0. Otherwise, the function result is 0.0.

A second assignment statement is included in the rule to set the value for the Locked In time series slot for the current timestep using the user-defined LockinCarryOver function. The logic in this function is the same as for the look ahead timestep except values for the

current timestep are used instead of estimated values for the look ahead timestep and the check against the available flood space at Cochiti Lake is not included.

B.36.2. Abiquiu Outflow

Explanation: Unless a total outflow for Abiquiu Dam has been input for the current timestep, the value for the outflow is set to the determined Rio Grande release plus the release of San Juan-Chama Project water. The resulting total release is checked to see if it is physically legitimate based on the outlet works, and if not, the release is reset to reflect the restriction of the outlet works. Note that a minimum flow for the Rio Chama acequias is set at El Vado Dam and would be bypassed at Abiquiu Dam. Separate minimum flows are also set by the user for Abiquiu Dam.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is a NaN.

Rule Logic: The user-defined InitialAbiquiuOutflow function is used to compute the total outflow from Abiquiu Dam. This function contains an exterior IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the AbiquiuData data object for the current timestep as referenced using the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is set to that input TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the result is set to the sum of the values for the SJOutflow and RGOutflow time series slots in the AbiquiuData data object for the current timestep as referenced with the user-defined SJOutflow and RGOutflow functions plus any release from conservation storage, with that sum restricted to the value in the MinRelease periodic slot in the AbiquiuData data object for the current timestep as referenced using the MinOutflow function. Within the rule, the result for the Outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.36.3. AbiquiuPreEvacuation

Explanation: If water needs to be pre-evacuated at Abiquiu Reservoir in anticipation of forecasted inflows, the outflow from Abiquiu Dam is reset based on a computed pre-evacuation flow which includes consideration for the downstream channel capacity and stepped release restrictions. It is very rare that criteria would be satisfied for such a pre-evacuation operation. If water is pre-evacuated from Abiquiu Dam, the Rio Grande account storage may go negative, signifying a debt by the Rio Grande account to all other

accounts at the reservoir. That debt is effectively paid back as Rio Grande water is recaptured after the pre-evacuation operation.

Rule Execution: The rule fires if the result from the user-defined IsPreEvacuationRequired function is TRUE AND the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function. The IsPreEvacuationRequired function checks to see if the current timestep is between December 31 plus the number of days entered to the PreEvacJulianDay column of the PreEvacuationData table slot in the AbiquiuData data object and April 30 (inclusive) as determined with the user-defined IsPreEvacuationSeason function. The IsPreEvacuationRequired function also checks to see if the forecasted volume of inflows to Abiquiu Reservoir minus the space remaining to the maximum elevation at El Vado Reservoir minus the space remaining to the AllowableStorageElevation entered to the PreEvacuationData table slot as computed with the user-defined AbiquiuRemainingForecastVolume function is greater than or equal to the input value in the MinPreEvacStorage column in the PreEvacuationData table slot.

Rule Logic: If the execution constraints are satisfied, the value in the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is reset to the result from the user-defined DeterminePreEvacFlow function. The user-defined ComputePreEvacFlow function is referenced to compute the pre evacuation flow rate as the average flow required to evacuate the result from the AbiquiuRemainingForecastVolume function over the period from the current timestep to August 1. Within the DeterminePreEvacFlow function, the result is checked against the input downstream (D/S) value in the ChannelCapacities table slot and input value for the MaxThreshold, MaxStepFactor, and MaxThreshold in the SteppedReleaseData table slot in the AbiquiuData data object. The result from the DeterminePreEvacFlow function is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1). Refer to Figure B.17 for a flowchart that depicts how preevacuation releases are set.

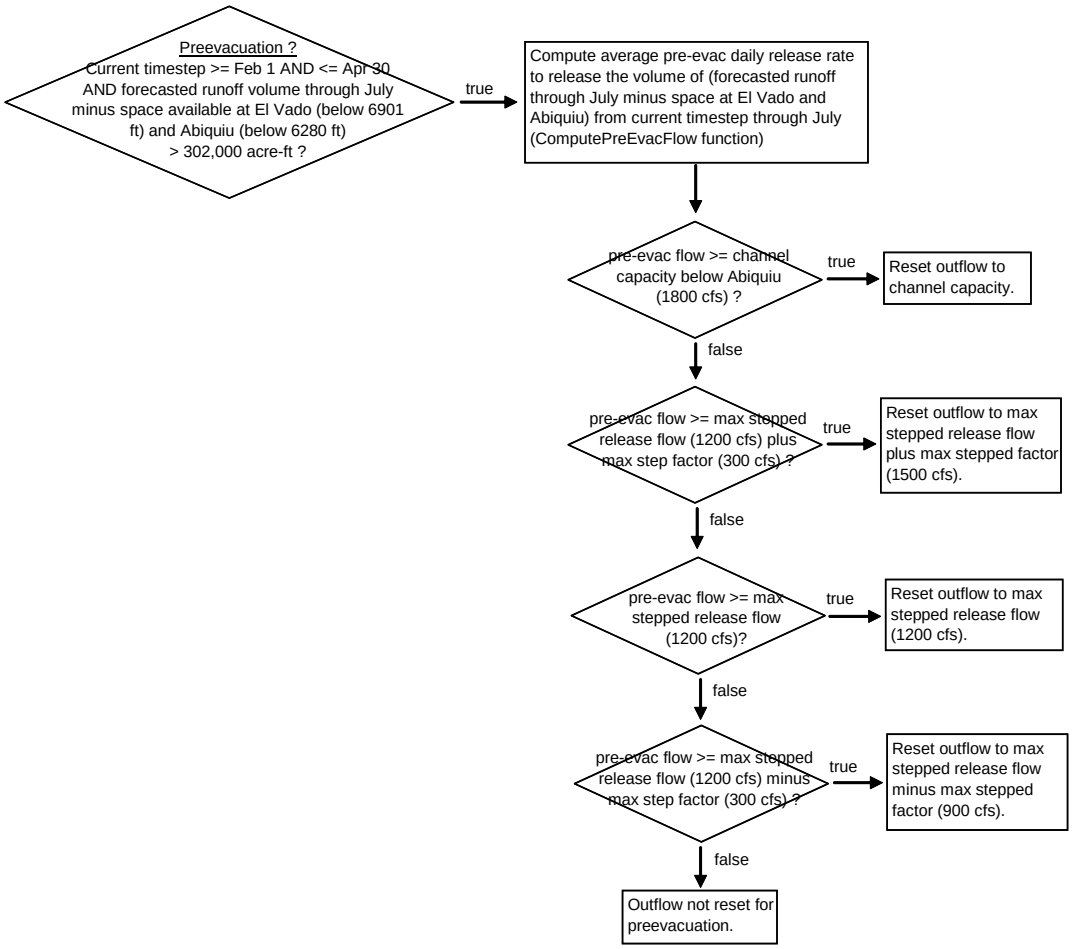


Figure B.17. Flow Chart with Logic for Setting Abiquiu Preevacuation Releases

B.36.4. AbiquiuSteppedRelease

Explanation: Per flood control operations, the total outflow from Abiquiu Dam may be reset if the release needs to be stepped. This rule determines whether a stepped release is required, and if so, computes the release based on a stepped release approach. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative. Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over.

Rule Execution: The rule fires if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the result from the user-defined SteppedReleaseIsNeeded function is TRUE. The

SteppedReleaseIsNeeded function includes three separate functions to check the change to the outflow as computed using the user-defined ComputeDeltaOutflow function against different criteria.

Rule Logic: If the execution constraints are satisfied, the value in the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is reset using an IF THEN ELSE statement. If the model user has input a value of 1.0 to the RestrictSteppedReleasesToAvailableNativeSupply(1=Yes,0=No) column in the SteppedReleaseData table slot on the AbiquiuData data object and the result from the DetermineSteppedRelease function indicates a higher release than the value computed with the user-defined MaximumAvailableToPreventNegativeRioGrandeStorage function, the result from that latter MaximumAvailableToPreventNegativeRioGrandeStorage function is used. Otherwise, the release is reset to the result from the user-defined DetermineSteppedRelease function.

The DetermineSteppedRelease function includes an exterior IF THEN ELSE statement to see if the outflow from Abiquiu Dam is increasing as determined using the user-defined OutflowIsIncreasing function. If so, the outflow is calculated with the user-defined ComputeOutflowIncrSteppedRelease function. If not, the outflow is computed using the user-defined ComputeOutflowDecrSteppedRelease function unless it is determined that the release should be shutoff.

Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.36.5. AbiquiuChannelCapacityRestrictions

Explanation: This rule resets the outflow from Abiquiu Dam if necessary maintain a downstream flow that is less than the downstream channel capacity restrictions below the dam (1800 cfs), at Chamita (3000 cfs), and at Otowi (10,000 cfs) with consideration for downstream local inflows.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function.

Rule Logic: This rule includes an IF THEN ELSE statement to see if the value for the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is greater than the maximum release to comply with downstream channel capacities at Otowi and Chamita as determined with the user-defined AbiquiuReleaseForChannelCapacity function. This function references input values in the ChannelCapacities table slot in the AbiquiuData data object along with the flow at

Otowi and local inflows between Embudo and Otowi and local inflows between Abiquiu Dam and Chamita to determine the maximum release. The value for the Outflow slot is reset if needed to comply with the downstream channel capacities. The result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.36.6. AbiquiuTemporaryFlowsForMaintenance

Explanation: This rule resets the outflow from Abiquiu Dam to the input maintenance flow if the maintenance switch is set.

Rule Execution: The rule fires if the value for the MaintenanceSwitch periodic slot in the AbiquiuData data object is equal to 1.0 as determined with the user-defined IsMaintenanceSwitchOn function and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function.

Rule Logic: If the execution constraints are satisfied, the value for the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is reset to the input value in the MaintenanceFlow table slot in the AbiquiuData data object as referenced with the user-defined MaintenanceFlow function.

B.36.7. AbiquiuFloodControl

Explanation: If there is an unregulated spill, per flood control operations, this rule resets the outflow from Abiquiu Dam to either the downstream channel capacity or the unregulated spill if it is higher.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function and the value for the Unregulated Spill time series slot in the Abiquiu level power reservoir object is greater than zero as determined with the user-defined ReservoirIsSpillingUnreg function.

Rule Logic: If the execution constraints are satisfied, the value for the Outflow time series slot in the Abiquiu level power reservoir object for the current timestep is reset to the result from the AbiquiuFCOutflow function. This function includes an IF THEN ELSE statement to see if the result from the user-defined UnregulatedSpillWhenNoConduitFlow function, which references the predefined GetMinSpillGivenInflowRelease function, is less than the value for the downstream

channel capacity in the ChannelCapacities table slot in the AbiquiuData data object. If so, the outflow is set to that input downstream channel capacity. If not, the release is set to the result from the UnregulatedSpillWhenNoConduitFlow function.

Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.36.8. AbiquiuRGCarryOver

Explanation: This rule records the value for any release of carryover storage (during the period from November through March) and updates the recorded value for the carrover storage remaining. Carryover storage results from storage during flood control operations that is not evacuated before flows decrease below a set threshold.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGCarryOverRelease time series slot in the AbiquiuData data object for the current timestep is a NaN and the current timestep is between November and March (inclusive) as determined with the user-defined FloodCarryOverReleaseSeason function.

Rule Logic: The rule includes an IF THEN ELSE statement to see if the current timestep is January 1 and if the result from the user-defined IsRGConservationAllowed function is TRUE. If not, the value for the RGCarryOverRelease time series slot in the AbiquiuData data object for the current timestep is set to the result from the user-defined RGCarryOverRelease function. If so, an interior IF THEN ELSE statement is used to see if the value for the RGCarryOverLeft time series slot in the AbiquiuData data object for the previous timestep is greater than the result from the user-defined ComputeAbiquiuRGConsInflow function converted to a volume using the predefined FlowToVolume function. If so, the value for the RGCarryOverRelease time series slot for the current timestep is set to the result from the user-defined RGCarryOverRelease function. If not, the value for the RGCarryOverRelease slot is set to 0.0 cfs.

This rule includes an additional assignment statement to set the value for the RGCarryOverLeft time series slot in the AbiquiuData data object for the current timestep to the result from the user-defined RGCarryOverLeft function.

B.37. SetAbiquiuAccountingSupplies

The rules in this policy group are used to set the accounting supplies for the release from conservation storage, the Rio Grande outflow, and releases of San Juan-Chama Project water from Abiquiu Reservoir.

B.37.1. SetAbiquiuRioGrandeAccountingSupply

Explanation: This rule sets the accounting supplies for the outflows from the Rio Grande and Rio Grande Conservation accounts at Abiquiu Reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeAbiquiuToRioGrandeBlwAbiquiu.Supply slot for the current timestep is a NaN.

Rule Logic: Two assignment statements are included in this rule. The value for the RioGrandeConservationAbiquiuToRioGrandeBlwAbiquiu.Supply slot for the current timstep is set to the minimum of the value in the RGConservationReleaseFromAbiquiu series slot in the ComputedDeliveries data object for the current timestep or the result from the user-defined ReconcileRGOutflow function. For the second assignment statement, the value for the RioGrandeAbiquiuToRioGrandeBlwAbiquiu.Supply slot for the current timestep is set to the result from the user-defined ReconcileRGOutflow function minus the value in the RGConservationReleaseFromAbiquiu series slot restricted to not be less than zero.

B.37.2. CheckAbiquiuRGOutflow

Explanation: Aborts the simulation if the accounting supply for the release of Rio Grande water from the account at Abiquiu Reservoir was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely due to some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the RioGrandeAbiquiuToRioGrandeBlwAbiquiu.Supply is a NaN, the STOP_RUN command is used to stop the simulation, and the PRINT statement is used to print a comment to the Diagnostics Output window that the run stopped because the account slot value was not set.

B.37.3. SetAbiquiuSJCAccountingSupplies

Explanation: This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from Abiquiu Reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN statement is used first in the rule to identify if the final reconciled outflow of San Juan-Chama Project water determined with the user-defined ReconcileSJOutflow function is less than the previous determined outflow. If so, Print statements are used to print statements to the Diagnostics Output window that the full initial computed outflow could not be met, if Print statements are enable in the Diagnostics Manager. A FOR DO statement is then used in the rule to set all the accounting supplies from a list of all supply slot names, at index 0, and the final determined deliveries, at index 1, as created with the user-defined AbiquiuPrioritizedSJCSuppliesAndValuesReconciliationCheck function. That function contains a list of all the accounting supplies from Abiquiu Reservoir for deliveries of San Juan-Chama Project water and a corresponding list of all the initial computed deliveries recorded to the ComputedDeliveries data object. A WHILE DO loop is then used in the function to loop through each supply *in the order listed* and set the deliveries while checking the cumulative release set so far within the function against the final total outflow of San Juan-Chama Project water. If the final total outflow of San Juan-Chama Project water, which is an input to the function, is less than the sum of the intial computed deliveries, deliveries included at the bottom of the listed supplies will be shorted in order from bottom up as needed.

B.37.4. SetTransfersAtElephantButteForDeliveriesViaCombinedAccount

Explanation: For Albuquerque and Santa Fe City water that may have been delivered from Abiquiu Reservoir to Elephant Butte, the water is conveyed through a single thread of passthrough accounts through the Middle Rio Grande portion of URGWOM. The water is then transferred back to the contractor's storage account at Elephant Butte using this rule. The transfer is set to the release minus San Juan-Chama losses between Abiquiu Dam and Elephant Butte Reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Two assignment statements are included in this rule to set the CombinedElephantButteToAlbuquerqueElephantButte and CombinedElephantButteToSantaFeCityElephantButte transfer supplies to the value for the corresponding accounting supplies out of Abiquiu Reservoir for the Albuquerque and Santa Fe City deliveries to Elephant Butte multiplied by the San Juan-Chama loss rates. The user-defined SJCLoss function is used to identify the loss rate from Abiquiu to Cochiti. The loss rate for the delivery between Cochiti and Elephant Butte is actually computed with a user-defined accounting method, but the calculation is simplified here because the determined loss rate in the simulation, with consideration for the applied lags, can be referenced. The loss method for San Juan-Chama deliveries to Elephant Butte is applied on the SanFelipeToCentralSeepageArea2 reach object.

B.38. CochitiAndJemezDeliveries

The rules in this policy group are used to determine whether storage at Cochiti Lake and Jemez Reservoir should be locked in as carryover storage per flood control operations, compute potential inflows to conservation storage, and compute the Rio Grande and San Juan releases from each reservoir.

B.38.1. Cochiti and Jemez LockedIn

Explanation: This rule is used to set a trigger indicating that storage should be locked in at Cochiti Lake as carryover storage until after the irrigation season per flood control operations. The trigger is also set for Jemez in this rule to zero if not input.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: This rule includes three assignment statements. The functions referenced for these assignments are the same as those used for determining locked in storage at Abiquiu Reservoir. Refer to the discussion for the AbiquiuLockedIn rule for more information on the logic used in this rule. The LockedIn slot value for Jemez is set to 0.0 if a value is a NaN.

B.38.2. SetCochitiRGConservationAccountInflow

Explanation: This rule sets the accounting supply to transfer Rio Grande inflows to Cochiti Lake to conservation storage based on the defined space available for storage for deviations operations. Conservation storage may occur based on an input value for

available space or a computed value as part of Cochiti Deviations policy. Note that conservation space for both reasons can be modeled.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the RioGrandeCochitiToRioGrandeConservationCochiti.Supply slot value for the current timestep is a NaN.

Rule Logic: The RioGrandeCochitiToRioGrandeConservationCochiti.Supply slot value for the current timestep is set with an IF THEN ELSE statement. If the value in the FullTimeRGConservationSpaceAvailableNotRelevantToDeviations table slot in the CochitiData data object is greater than zero or the value in the ComputedRGConservationSpaceAvailable slot for the current timestep is greater than zero and the current timestep is within the period for deviations storage, the value is set as the minimum of the result from the user-defined ComputeRGConsInflow function and the maximum inflow input to the MaxRGConservationInflow table slot in the AbiquiuData data object as identified with the user-defined MaxRGConservationInflow function. Within the ComputeRGConsInflow function, an IF THEN ELSE statement is used to check whether an inflow to conservation storage should be computed with the IsRGConservationAllowed function. If not, the function result is 0.0 cfs. If so, the inflow available for conservation storage is computed as the available native inflow determined with the user-defined RioGrandeInflowWithPreviousRGGainLoss function plus the value in the Incidental Content slot for the corresponding reservoir object at the previous timestep or any storage adjustment and determined carryover release amount for the reservoir minus a minimum reservoir outflow determined with the user-defined MinimumRioGrandeOutflowBeforeTransferToConservationStorage function which assures Middle Valley demands are met. The resulting inflow to conservation storage is restricted to the available space determined as the minimum of the results from the user-defined EasementSpaceAvailableAsFlow and RGConsSpaceAvailableAsFlow functions.

B.38.3. TallyCochitiRGConservationStorageInArticleVII

Explanation: This rule sets a slot to track the amount of water stored as conservation storage at Cochiti Lake while Article VII is in effect. This may happen during Cochiti deviations where any unused amount stored while in Article VII must be evacuated while other water stored during deviations may be retained if conservation space is still established after the deviations policy.

Rule Execution: This rule fires if it has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the SumConservationStorageWhileInArticleVII series slot for the current timestep is set to 0 if the current timestep is the start timestep or January 1. Otherwise, the value is set to the slot value at the previous timestep plus the value for the

accounting supply for the transfer to the RioGrandeConservation account at Cochiti if the ArticleVII switch is equal to 1.0 and minus the value for the outflow from the RioGrandeConservation account at Cochiti. Refer to Figure B.18 for a screen capture of the RPL for this rule.

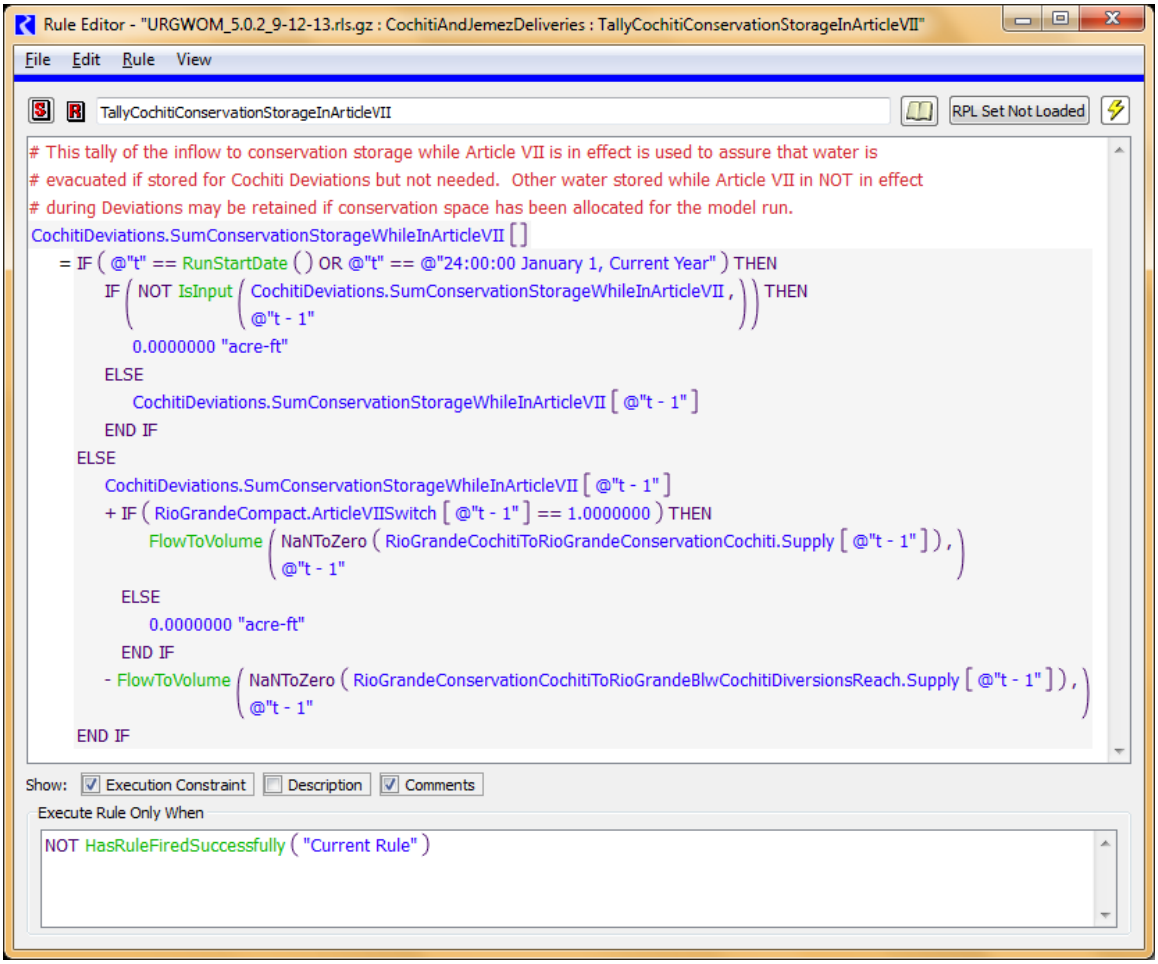


Figure B.18. Rule Policy Language for the TallyCochitiConservationStorageInArticleVII Rule

B.38.4. ComputeCochitiRGRelease

Explanation: This rule computes the preliminary value for the release of Rio Grande water at Cochiti Dam. The release is set to bypass inflows with any needed release from storage or adjustment from any potential storage during flood control operations and any potential non-irrigation season release of carrover storage from the irrigation season.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

if the value for the RGOutflow time series slot in the CochitiData data object for the current timestep is a NaN.

Rule Logic: the value for the RGOutflow time series slot in the CochitiData data object for the current timestep is set to the result from the user-defined CurrentRGInflow function plus the value for the Gain Loss for the Rio Grande account for the previous timestep as determined with the user-defined PreviousAccountGainLoss function plus the result from the user-defined CochitiRGStorageAdjustment function plus the result from the user-defined RGCarryOverRelease function and minus the value for the accounting supply for the current timestep for the transfer from the Rio Grande account into the RioGrandeConservation account. The result is restricted using the predefined Max function to assure it is at least equal to the input value in the MinRGOutflow periodic slot in the CochitiData data object as referenced with the user-defined MinRGOutflow function. The result is also checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

The CurrentRGInflow function computes the Rio Grande inflow to Cochiti Lake as the value for the Inflow time series slot in the Cochiti storage reservoir object for the current timestep minus the sum of all the San Juan-Chama supplies into Cochiti as defined with the user-defined AllSJSuppliesIntoCochiti function. Within the RGCarryOverRelease function, if the criteria for a carry over release are NOT satisfied, the value is set to 0.0 cfs. Otherwise, the value in the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is referenced. If that value is a NaN, the function then references the user-defined ConstantRGCarryOverRelease function.

B.38.5. ComputeCochitiRGConservationRelease

Explanation: This rule computes a release of native Rio Grande water in conservation storage at Cochiti Lake from Cochiti Deviations or based on an input amount of conservation storage space. For Deviations, releases are set to provide recruitment or overbank flows depending on which operation is targeted based on established criteria. Releases are set to provide a peak release at the same time as the peak inflow. Releases may also be set to assure water is evacuated from conservation storage by the end of an input Deviations period. Any water that may be stored based on an input amount of conservation storage space will be released as needed for targets before water from upstream sources is used (e.g. Emergency Drought water for ESA or Reclamation leased San Juan-Chama Project water). Water stored for Deviations not needed for targets is evacuated at the end of the deviations period down to an input amount of regular conservation space or if it was stored while Article VII was in effect.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and

if the value for the RGConservationRelease time series slot for the current timestep is a NaN.

Rule Logic: A preliminary release from conservation storage at Cochiti Lake is computed using a WITH DO statement as the value in the MinReleaseNeededAtCochiti series slot in the MiddleValleyTargets data object for the current timestep minus the bypassed inflow at the current timestep estimated as the outflow of San Juan-Chama Project water plus the value in the RGOutflow series slot in the CochitiData data object for the current timestep. That release is also restricted to the available storage in the RioGrandeConservation account at Cochiti and the input value in the MaxESARelease periodic slot in the CochitiDeviations table slot. An IF THEN ELSE statement is used to also determine if conservation storage should be evacuated. If the previous storage in the RioGrandeConservation account is greater than the input value to the FullTimeRGConservationSpaceAvailableNotRelevantToDeviations table slot or the value in the SumConservationStorageWhileInArticleVII series slot for the current timestep and the current timestep is within 15 days of the end of the Cochiti Deviations period, the release is then set to the maximum of the preliminary value computed as needed for targets or the amount needed to evacuate the excess water by the end of the deviations period as computed with the user-defined ReleaseToEvacuateDeviationsRGConservationStorage function. Otherwise, the release is set to the amount needed for targets not to be less than 0.0.

B.38.6. SetJemezSJRelease

Explanation: The San Juan release from Jemez Canyon Dam is set to zero.

Rule Execution: If the value for the SJOutflow time series slot in the JemezData data object for the current timestep is a NaN, the rule fires.

Rule Logic: The value for the SJOutflow time series slot in the JemezData data object for the current timestep is set to 0.0 cfs.

B.38.7. SetJemezRGConservationAccountInflow

Explanation: This rule sets an inflow to Rio Grande conservation storage at Jemez if conservation space has been set and inflows are available for conservation storage.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeJemezToRioGrandeConservationJemez.Supply slot for the current timestep is a NaN.

Rule Logic: The RioGrandeJemezToRioGrandeConservationJemez.Supply slot for the current timestep is set to minimum of the result from the user-defined ComputeRGConsInflow function and the maximum inflow input to the MaxRGConservationInflow table slot in the JemezData data object as identified with the user-defined MaxRGConservationInflow function. Within the ComputeRGConsInflow function, an IF THEN ELSE statement is used to check whether an inflow to conservation storage should be computed with the IsRGConservationAllowed function. If not, the function result is 0.0 cfs. If so, the inflow available for conservation storage is computed as the available native inflow determined with the user-defined RioGrandeInflowWithPreviousRGGainLoss function plus the value in the Incidental Content slot for the corresponding reservoir object at the previous timestep minus a minimum reservoir outflow determined with the user-defined MinimumRioGrandeOutflowBeforeTransferToConservationStorage function which assures Middle Valley demands are met. The resulting inflow to conservation storage is restricted to the available space determined as the minimum of the results from the user-defined EasementSpaceAvailableAsFlow and RGConsSpaceAvailableAsFlow functions.

B.38.8. SetJemezRGRelease

Explanation: This rule computes an initial value for the release of Rio Grande water at Jemez Canyon Dam as the sum of the inflow to the reservoir plus the amount of water in the Rio Grande storage account at Jemez Reservoir. If the amount of water in the storage account is negative, the outflow is set to the inflow multiplied by an input percentage such that the Rio Grande storage will return toward zero. The bypassed inflow is reduced for any transfer to conservation storage at Jemez Reservoir. The reference to storage includes consideration for modeled sedimentation.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGOutflow time series slot in the JemezData data object for the current timestep is a NaN.

Rule Logic: The value for the RGOutflow time series slot in the JemezData data object for the current timestep is set to the result from the user-defined JemezRGOutflow function minus the value for the accounting supply for any transfer to conservation storage at Jemez Reservoir. An IF THEN ELSE statement in the JemezRGOutflow function is used to see if the value for the inflow is less than or equal to zero and if the value for the previous account storage is less than or equal to zero. If so, the function result is set to 0.0 cfs. Otherwise, a second IF THEN ELSE statement is used to see if the current inflow is greater than zero and the previous account storage is less than zero. If so, the result is set to the value for the inflow multiplied by the value in the PercentRGReleaseWhenNegRGStorage table slot in the JemezData data object. Otherwise, the result is set to the inflow plus the previous account storage. The references to the previou storage are adjusted for modeled sedimentation.

B.38.9. ComputeJemezRGConservationRelease

Explanation: This rule computes a release of available conservation storage at Jemez to meet target flows. If the current timestep is within the period to make a release from conservation storage at Jemez, available conservation storage is released as the maximum of the amount needed for targets or an average flow to evacuate the water over an input delivery period. Note that the release of any available conservation storage for targets is not implemented until the conservation storage at Cochiti is used.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGConservationReleaseFromJemez series slot in the JemezData data object for the current timestep is a NaN.

Rule Logic: If a value is not input as checked with reference to the predefined IsInput function, the RGConservationReleaseFromJemez series slot in the ComputedDeliveries data object for the current timestep is computed if the current timestep is within the period for a release based on the dates input to the RGConservationReleaseDays table slot in the JemezData data object. For other periods, the release is set to 0.0 cfs. The computed release is set to zero if the previous storage in the RioGrandeConservation account at Cochiti is greater than 10 acre-ft or otherwise the value is set to the MinReleaseNeededAtCochiti minus the bypassed inflow at Cochiti. The predefined Max function is used to increase the release to the constant release to evacuate the storage over the input delivery period, if that release rate is higher, as computed with the user-defined ComputeConstantAbiquiuRGConservationRelease function. The computed release is restricted with the predefined MinItem function to the available conservation storage at Jemez Reservoir and the value in the MaxESARelease periodic slot in the JemezData data object.

B.38.10. ComputeCochitiSJCPassthroughsToMRG

Explanation: This rule computes the passthroughs at Cochiti Lake for San Juan-Chama Project water being delivered to the Albuquerque surface water diversion, MRGCD diversions, Reclamation leased San Juan-Chama Project water for targets, or contractor deliveries to Elephant Butte.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: Four assignment statements are included in this rule for computing the Cochiti passthroughs for the corresponding series slots on the ComputedDeliveries data object. If values are not input as checked with the predefined IsInput function, values for each passthrough delivery are set to the corresponding accounting supply out of Abiquiu at the previous timestep (per the one day lag from Abiquiu to Cochiti) adjusted for the San Juan-Chama loss rate from Abiquiu to Cochiti as input to the Losses table slot in the SanJuanChamaRules data object and identified with the user-defined SJCLoss function. The computed deliveries are adjusted for any potential storage on the passthrough accounts at Cochiti.

B.38.11. ComputeCochitiSJRelease

Explanation: This rule computes an initial value for the release of San Juan-Chama Project water from Cochiti Dam which is essentially a passthrough of all San Juan-Chama Project water except for Cochiti rec pool water.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the SJOutflow time series slot in the CochitiData data object for the current timestep is a NaN.

Rule Logic: The value for the SJOutflow time series slot on the CochitiData data object for the current timestep is computed as an addition of all the computed individual deliveries out of Cochiti in the corresponding series slots in the ComputedDeliveries data object.

B.39. CochitiAndJemezDeliveries

The rules in this policy group are used to determine the total outflow from Cochiti Dam and Jemez Canyon Dam with consideration for downstream target flows, downstream channel capacities, stepped release restrictions, and flood control operations. Policy for balanced operations between Cochiti Dam and Jemez Canyon Dam for flood control operations is also checked.

B.39.1. Cochiti Outflow

Explanation: Unless a total outflow for Cochiti Dam has been input for the current timestep, the value is set to bypass all inflows minus any potential transfers to conservation storage and not including water being delivered to the Cochiti Rec Pool and with any needed adjustment for incidental content and any winter release of carryover storage added.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the Cochiti storage reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the CochitiData data object for the current timestep as referenced using the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the Cochiti storage reservoir object for the current timestep is set to that input TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the value for the Outflow slot is set to the result from the user-defined InitialCochitiOutflow function which sets the outflow to the sum of the computed Rio Grande outflow in the RGOutflow series slot on the CochitiData data object and the total San Juan-Chama outflow in the SJOutflow series slot on the CochitiData data object plus the computed release from conservation storage in the RGConservationRelease series slot in the CochitiDeviations data object. The predefined Max function is used to assure the minimum Rio Grande outflow is maintatined.

Within the rule, the result for the Outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.39.2. JemezOutflow

Explanation: Unless a total outflow for Jemez Canyon Dam has been input for the current timestep, the value is set to the sum of the predetermined Rio Grande and San Juan-Chama outflows and including any release from conservation storagte. The resulting total release is checked to see if it is physically legitimate based on the outlet works, and if not, the release is reset to reflect the restriction for the given outlet works.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the Jemez storage reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an exterior IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the JemezData data object for the current timestep as referenced with the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the Jemez storage reservoir object for the current timestep is set to that input TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the outflow is set to the value in the RGOutflow series slot on the JemezData data object for the current timestep

plus the value in the SJOutflow series slot on the same data object for the current timestep plus the value for the RGConservationReleaseFromJemez series slot on the ComputedDeliveries data object for the current timestep.

Within the rule, the result for the Outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.39.3. CentralChannelCapacityRule

Explanation: This rule uses hypothetical simulation to determine the release from Cochiti Dam to meet the input channel capacity at Central.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the MaxReleaseForCentralChannelCap time series slot in the CochitiData data object for the current timestep is a NaN and if the EstimatedCochitiInflowAvailableForMiddleValley slot value is greater than half of either the channel capacity at Central or at San Marcial.

Rule Logic: The value for the MaxReleaseForCentralChannelCap time series slot in the CochitiData data object for the current timestep is set to the result from the user-defined CochitiReleaseForCentralChannelCapacity function. This function uses the predefined HypTargetSimWithStatus function to determine the required outflow from Cochiti Dam (or the value for the Inflow time series slot for the BlwCochitiDiversionsReach reach object) to yield the channel capacity at Central (or the Gage Inflow time series slot in the Central stream gage object) at the next timestep equal to the input value in the CentralChannelCapacity periodic slot in the CochitiData data object. The function completes the hypothetical simulation for all the objects in the BlwCochitiToCentralTarget subbasin, and for the input bounds for the hypothetical simulation, the lower bound is set to the channel capacity minus 1000 cfs or the minimum outflow and the upper bound is set to the maximum outflow from Cochiti Dam as input to the maxRelease column of the ReservoirData table slot in the CochitiData data object. The tolerance is input to the CentralChannelCapacity periodic slot in the CochitiData data object. The release from Jemez Canyon Dam (or the value for the Gage Inflow time series slot in the BlwJemez stream gage object) is assumed to equal the Inflow to Jemez as identified with the user-defined JemezInflowInputs function.

B.39.4. SanMarcialChannelCapacityRule

Explanation: This rule uses hypothetical simulation to determine the release from Cochiti Dam to meet the input channel capacity at San Marcial or the maximum computed inflow

to Elephant Butte to prevent an Elephant Butte release greater than the channel capacity below Elephant Butte.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the MaxReleaseForSanMarcialChannelCap time series slot in the CochitiData data object for the current timestep is a NaN and if the EstimatedCochitiInflowAvailableForMiddleValley slot value is greater than half of either the channel capacity at Central or at San Marcial.

Rule Logic: The value for the MaxReleaseForSanMarcialChannelCap time series slot in the CochitiData data object for the current timestep is set to the result from the user-defined CochitiReleaseForSanMarcialChannelCapacity function. This function uses the predefined HypTargetSimWithStatus function to determine the required outflow from Cochiti Dam (or the value for the Inflow time series slot for the BlwCochitiDiversionsReach reach object) to yield the minimum of the channel capacity at San Marcial (or the Gage Inflow time series slot in the SanMarcialFloodway stream gage object) at the timestep after the next timestep equal to the input value in the SanMarcialChannelCapacity periodic slot in the CochitiData data object or the inflow to Elephant Butte to keep the Elephant Butte outflow below the channel capacity below Elephant Butte as identified with the predefined SolveInflow function. The CochitiReleaseForSanMarcialChannelCapacity function completes the hypothetical simulation for all the objects in the BlwCochitiToSanMarcialTarget subbasin, and for the input bounds for the hypothetical simulation, the lower bound is set to the channel capacity minus 1000 cfs or the minimum outflow and the upper bound is set to the maximum outflow from Cochiti Dam as input to the maxRelease column of the ReservoirData table slot in the CochitiData data object. The tolerance is input to the SanMarcialChannelCapacity periodic slot in the CochitiData data object. The release from Jemez Canyon Dam (or the value for the Gage Inflow time series slot in the BlwJemez stream gage object) is assumed to equal the Inflow to Jemez as identified with the user-defined JemezInflowInputs function.

B.39.5. JemezSanMarcialChannelCapacity

Explanation: This rule simply sets the value for the MaxReleaseForSanMarcialChannelCap time series slot in the JemezData data object for the current timestep equal to the value in the MaxReleaseForSanMarcialChannelCap time series slot in the CochitiData data object for the current timestep.

B.39.6. CochitiChannelCapacityRestrictions

Explanation: This rule resets the outflow from Cochiti Dam and Jemez Canyon Dam to comply with the downstream channel capacities at Central and San Marcial if necessary.

An indicator slot value is also set to identify for the model user which downstream channel capacity is controlling the release: 1 – Central, 2 – San Marcial, 3 – below Elephant Butte.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function and if the EstimatedCochitiInflowAvailableForMiddleValley slot value is greater than half of either the channel capacity at Central or at San Marcial and if the sum of the values in the Outflow time series slots in the Cochiti and Jemez storage reservoir objects is greater than the minimum of the values for the MaxReleaseForCentralChannelCap and MaxReleaseForSanMarcialChannelCap time series slots in the CochitiData data object as determined with the user-defined CochitiReleaseForChannelCapacity function.

Rule Logic: If the execution constraints are satisfied, three assignments are made in this rule. The value for the Outflow time series slot in the Cochiti storage reservoir object is set to the minimum of the values for the MaxReleaseForCentralChannelCap and MaxReleaseForSanMarcialChannelCap time series slots in the CochitiData data object as determined with the user-defined CochitiReleaseForChannelCapacity function minus the result for the user-defined JemezFloodRelease function.

For the second assignment, the value for the Outflow time series slot in the Jemez storage reservoir object is set to the result for the user-defined JemezFloodRelease function. This function sets the Jemez release equal to the result from the user-defined CochitiReleaseForChannelCapacity function multiplied by the storage space at Jemez Reservoir as determined with the user-defined AvailableStorage function divided by the total storage space at both Jemez Reservoir and Cochiti Lake. The predefined Min function is used to assure the release is no greater than the value in the Inflow time series slot at Jemez Reservoir plus the storage in the Rio Grande account at Jemez Reservoir at the previous timestep as determined with the user-defined PreviousAccountStorage function and converted to a flow using the predefined VolumeToFlow function.

For both of the previous assignments, the result for the Outflow is checked against the physical restrictions of the outlet works for the corresponding dam using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

For the third assignment statement, the value in the ChannelCapacityOpsFlag series slot in the CochitiData data object is set to 1.0 if the max release for Central is less than the max release for San Marcial, and 2 if channel capacity at San Marcial is less than the inflow to Elephant Butte to keep the Elephant Butte outflow below the channel capacity below Elephant Butte. Otherwise, the value is set to 3.

B.39.7. CochitiSteppedRelease

Explanation: The outflow from Cochiti Dam may be reset to assure increasing or decreasing releases are stepped if needed. This rule determines whether stepped releases are required, and if so, computes the release for Cochiti. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative. Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over.

Rule Execution: The rule fires if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function and if the current timestep is greater than the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the result from the user-defined SteppedReleaseIsNeeded function is TRUE. The SteppedReleaseIsNeeded function includes three separate functions to check the change to the outflow as computed using the user-defined ComputeDeltaOutflow function against different criteria. Also, the rule only fires when the Central target flow is not increasing to assure stepped release policy does not conflict with operations for Cochiti Deviations.

Rule Logic: If the execution constraints are satisfied, the value in the Outflow time series slot in the Cochiti storage reservoir object for the current timestep is reset using an IF THEN ELSE statement. If the model user has input a value of 1.0 to the RestrictSteppedReleasesToAvailableNativeSupply(1=Yes,0=No) column in the SteppedReleaseData table slot on the CochitiData data object and the result from the DetermineSteppedRelease function indicates a higher release than the value computed with the user-defined MaximumAvailableToPreventNegativeRioGrandeStorage function, the result from that latter MaximumAvailableToPreventNegativeRioGrandeStorage function is used. Otherwise, the release is reset to the result from the user-defined DetermineSteppedRelease function.

The DetermineSteppedRelease function includes an exterior IF THEN ELSE statement to see if the outflow from Cochiti Dam is increasing as determined using the user-defined OutflowIsIncreasing function. If so, the outflow is calculated with the user-defined ComputeOutflowIncrSteppedRelease function. If not, the outflow is computed using the user-defined ComputeOutflowDecrSteppedRelease function unless it is determined that the release should be shutoff.

The resulting outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.39.8. JemezSteppedRelease

Explanation: The outflow from Jemez Canyon Dam may be reset to assure increasing or decreasing releases are stepped if needed. This rule determines whether stepped releases are required, and if so, computes the release for Jemez. The rule references a switch that may be set by the model user to prevent stepped release policy from causing the Rio Grande account storage to go negative. Rio Grande storage may go negative if there is not enough native water in storage to maintain higher releases for a step down in releases. For such cases, the negative Rio Grande storage effectively represents a debt by the Rio Grande account to all other accounts that is paid back when native Rio Grande storage is recaptured after stepped releases over.

Rule Execution: The rule fires if the rule has not fired as checked against the predefined HasRuleFiredSuccessfully function and if the current timestep is greater than the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the result from the user-defined SteppedReleaseIsNeeded function is TRUE. The SteppedReleaseIsNeeded function includes three separate functions to check the change to the outflow as computed using the user-defined ComputeDeltaOutflow function against different criteria.

Rule Logic: If the execution constraints are satisfied, the value in the Outflow time series slot in the Jemez storage reservoir object for the current timestep is reset using an IF THEN ELSE statement. If the model user has input a value of 1.0 to the RestrictSteppedReleasesToAvailableNativeSupply(1=Yes,0=No) column in the SteppedReleaseData table slot on the JemezData data object and the result from the DetermineSteppedRelease function indicates a higher release than the value computed with the user-defined MaximumAvailableToPreventNegativeRioGrandeStorage function, the result from that latter MaximumAvailableToPreventNegativeRioGrandeStorage function is used. Otherwise, the release is reset to the result from the user-defined DetermineSteppedRelease function.

The DetermineSteppedRelease function includes an exterior IF THEN ELSE statement to see if the outflow from Jemez Canyon Dam is increasing as determined using the user-defined OutflowIsIncreasing function. If so, the outflow is calculated with the user-defined ComputeOutflowIncrSteppedRelease function. If not, the outflow is computed using the user-defined ComputeOutflowDecrSteppedRelease function unless it is determined that the release should be shutoff.

The resulting outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.39.9. CochitiWCMBalancedRelease

Explanation: This rule resets the outflow from Cochiti Dam and Jemez Canyon Dam as necessary to balance operations and the available flood storage space at each reservoir as stipulated in the water control manuals for each dam.

Rule Execution: This rule fires if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function and and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value in the Outflow time series slots in the Cochiti storage reservoir object minus the result from the user-defined CochitiBalancedOperation function is greater than 10 cfs or if the value in the Outflow time series slots in the Jemez storage reservoir object minus the result from the user-defined JemezBalancedOperation function is greater than 10 cfs and if the result from the user-defined IfCochitiJemezBalancedOperation function is TRUE.

Rule Logic: If the execution constraints are satisfied, two assignments are completed with this rule. The value for the Outflow time series slot in the Cochiti storage reservoir object is set to the result from the user-defined CochitiBalancedOperation function. Within this function, an IF THEN ELSE statement is used to see if the result from the user-defined CochitiJemezStorageDifferentialRatio function is less than zero. The result from this function is the ratio of the currently available flood storage space to the total available flood storage space at Cochiti Lake minus the ratio of the currently available flood storage space to the total available flood storage space at Jemez Reservoir. So, if that value is less than zero (the ratio at Cochiti Lake is less than the ratio at Jemez Reservoir), the outflow is increased using that ratio. Otherwise, the outflow is decreased based on the adjustment made to the release from Jemez Canyon Dam. For the second assignment, the user-defined JemezBalanceOperation function is used to set the value for the Outflow time series slot in the Jemez storage reservoir object. The same ratio is checked again, and the outflow is adjusted similarly.

For both of the previous assignments, the result for the Outflow is checked against the physical restrictions of the outlet works for the corresponding dam using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1). Refer to Figures B.19 through A.21 for flowcharts that depict the logic used for balanced operations.

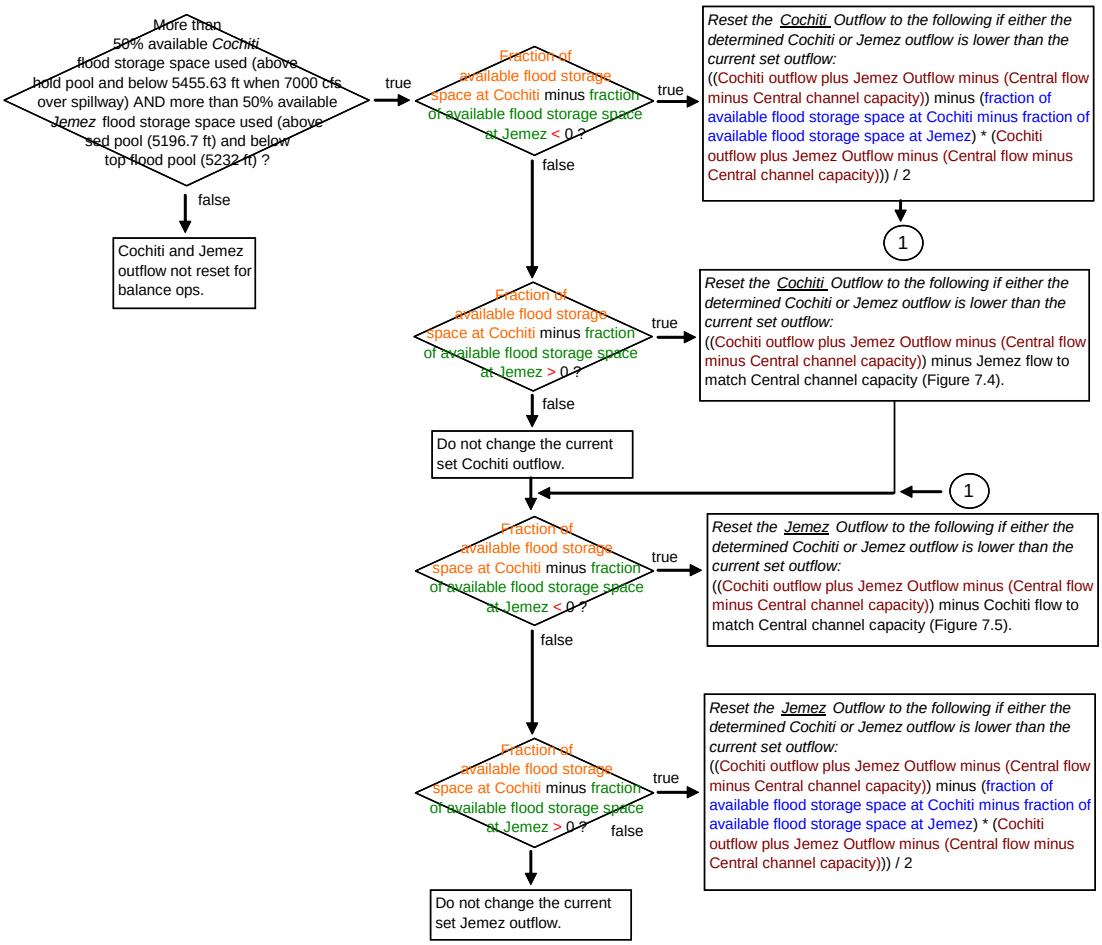


Figure B.19. Flow Chart with Logic for Setting Cochiti and Jemez Balanced Operations

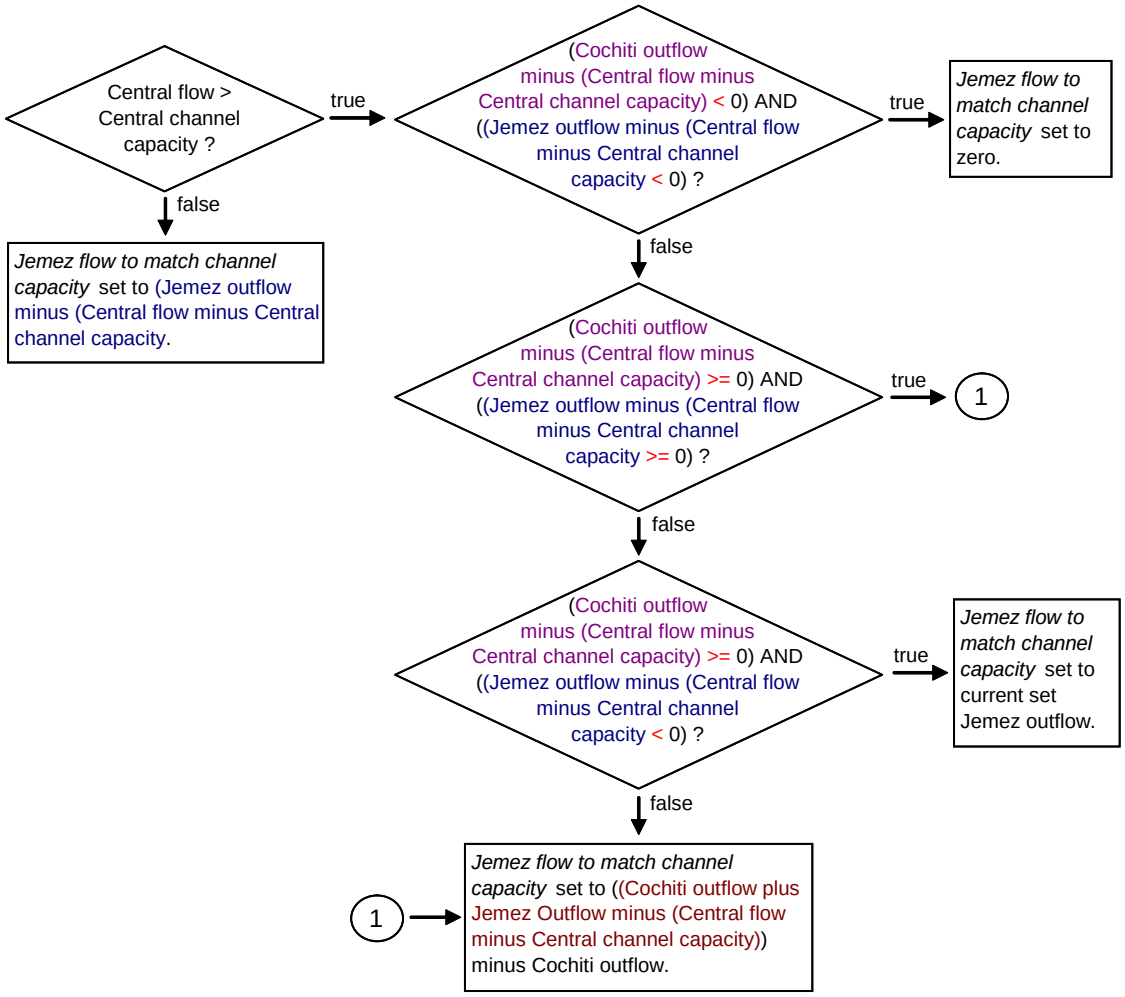


Figure B.20. Flow Chart for Setting Jemez Flow for Channel Capacity – Balanced Ops

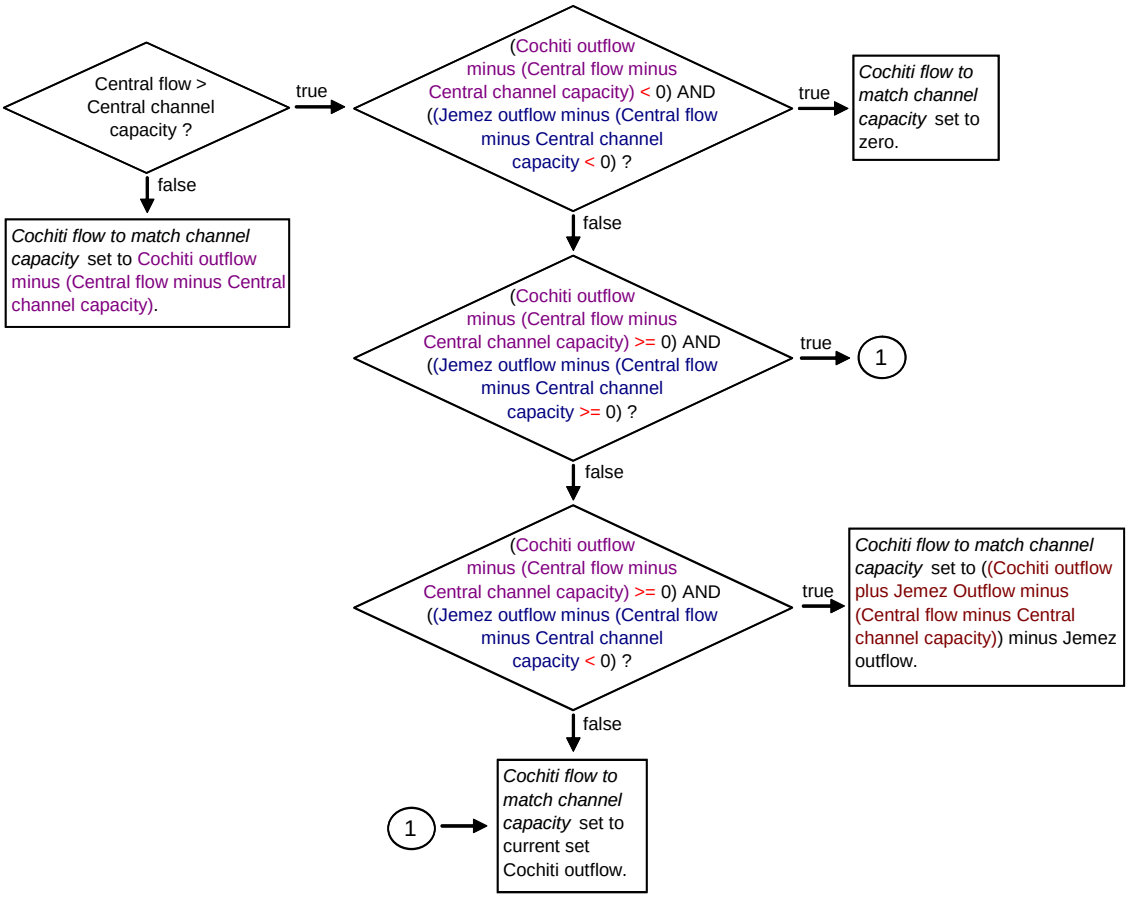


Figure B.21. Flow Chart for Setting Cochiti Flow for Channel Capacity – Balanced Ops

B.39.10. CochitiFloodControl

Explanation: If there is an unregulated spill, per flood control operations, this rule resets the outflow from Cochiti Dam to match the channel capacity at Central if necessary and as possible while maintaining the unregulated spill portion of the outflow.

Rule Execution: This rule fires if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function and and if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Unregulated Spill time series slot in the Cochiti storage reservoir object is greater than zero as determined with the user-defined ReservoirIsSpillingUnreg function.

Rule Logic: If the execution constraints are satisfied, the value for the Outflow time series slot in the Cochiti storage reservoir object for the current timestep is reset to the result from the CochitiFCOutflow function. This function includes an IF THEN ELSE statement to see if the value for the Unregulated Spill time series slot in the Cochiti

storage reservoir object for the current timestep is less than the channel capacity at Cochiti as input in the ChannelCapacities table slot in the CochitiData data object and referenced with the user-defined ChannelCapacity function. If not, the function result is set equal to the value in the Outflow time series slot in the Cochiti storage reservoir object for the current timestep (i.e. the outflow is not changed). If so, the function result is then computed using the user-defined CochitiFlowToMatchCentralChannelCapacity function.

The CochitiFlowToMatchCentralChannelCapacity function computes the outflow to match the input channel capacity, if necessary, based on the value in the Gage Inflow time series slot in the Central stream gage object for the current timestep. An exterior IF THEN ELSE statement is used to see if the value in the Gage Inflow time series slot is greater than the channel capacity. If not, the outflow at the current timestep is adjusted based on that difference to match the channel capacity. If so, a second IF THEN ELSE statement is used to see if the computed release to match the channel capacity is less than zero as identified with the user-defined IsReleaseToMatchChannelCapacity<0 function. If so, the release is set to the value input to the Minimum column in the ChannelCapacities table slot in the CochitiData data object as referenced using the user-defined ChannelCapacity function. Otherwise, a third IF THEN ELSE statement is used to see if the computed release to match the channel capacity is greater than zero as identified with the IsReleaseToMatchChannelCapacity>0 function. If so, the outflow is set to the Outflow time series slot in the Cochiti storage reservoir object for the current timestep (i.e. the outflow is not changed). The last IF THEN ELSE statement identifies whether the outflow from just Jemez Canyon Dam to match the target is less than zero, and then the outflow from Cochiti Dam is adjusted accordingly.

Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.39.11. CochitiRGCarryOver

Explanation: This rule sets a value for the release of carry over storage and sets the remaining carry over content. Flood water may be carried over until after the irrigation season. This rule computes the subsequent release and remaining carry over storage.

Rule Execution: The rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is a NaN.

Rule Logic: The value for the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is set to the result from the user-defined RGCarryOverRelease function. This function includes an exterior IF THEN ELSE

statement to see if it is the carry over release season (November through March) as determined using the user-defined FloodCarryOverReleaseSeason function and if the value for the Storage in the Rio Grande account is greater than zero and if the value for the Locked In time series slot in the Cochiti storage reservoir object is equal to zero. If not, the carry over release is set to 0.0 cfs. If so, a second IF THEN ELSE statement is used to see if the result from the user-defined IfRGCarryOverRelease function is true. This function checks to see if the value for the RGCarryOverLeft time series slot in the CochitiData data object is greater than zero or the value for the Storage in the Rio Grande account at Cochiti Lake is greater than the value in the MinRGCarryOverStorage table slot in the CochitiData data object or the value in the Carryover Content time series slot in the Cochiti storage reservoir object for October 31 of the current year is greater than zero. If not, the carry over release is set to 0.0 cfs. If so, the carry over release is set to the value in the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep unless it is a NaN. Then, the value is set to the result from the user-defined ConstantRGCarryOverRelease function.

The rule includes a second assignment statement to set the value for the RGCarryOverLeft time series slot in the CochitiData data object for the current timestep to the result from the user-defined RGCarryOverLeft function. Within this function, an exterior IF THEN ELSE statement is used to see if the results from the RGCarryOverIsNaNBoolean function and the user-defined ConstantCOReleaseBoolean function are true. The former checks to see if the result from the FloodCarryOverReleaseSeason function is true and if the Storage in the Rio Grande account at the previous timestep is greater than zero and if the result from the IfRGCarryOverRelease function is true and if the value for the RGCarryOverRelease time series slot in the CochitiData data object for the current timestep is a NaN. The latter checks some of the same criteria and also to see if the value for the Locked In time series slot in the Abiquiu level power reservoir object is equal to 0.0. If those criteria are satisfied, a second IF THEN ELSE statement checks again to see if the Storage in the Rio Grande account at the previous timestep is greater than zero. If not, the function result is 0.0 acre-ft. A third IF THEN ELSE statement is then used to see if the value for the RGCarryOverLeft time series slot in the CochitiData data object for the previous timestep is greater than zero. If not, the carry over left is set to the previous Storage in the Rio Grande account minus the volume of the RGCarryOverRelease. A fourth IF THEN ELSE statement is used to see if the result from the user-defined IsRGConservationAllowed function is true. If not, the carry over left is the value in the RGCarryOverLeft time series slot in the CochitiData data object for the previous timestep minus the RGCarryOverRelease. If so, the result is the value for the RGCarryOverLeft minus the result from the user-defined ComputeAbiquiuRGConsInflow function minus the RGCarryOverRelease. If the exterior IF THEN ELSE is NOT satisfied, a second IF THEN ELSE statement is used to see if the results from the RGCarryOverNOTNaNBoolean function and the ConstantCOReleaseBoolean functions are true. If so, the Storage in the Rio Grande account is checked again to see if it is greater than zero and then, the result is the previous Storage in the Rio Grande account minus the RGCarryOverRelease. If not, an IF THEN ELSE statement is used to see if the value for the RGCarryOverRelease is a NaN. If so, the result from the user-defined

ComputeIsNaNRGCarryOverLeft function is checked to see if it is less than or equal to zero or the RGCarryOverRelease is equal to zero. If so, the result is 0.0 acre-ft. If not, the function result is the result from the user-defined ComputeIsNaNRGCarryOverLeft function. Otherwise, a last IF THEN ELSE statement is used to see if the ComputeNOTIsNaNRGCarryOverLeft function is less than or equal to zero or the RGCarryOverRelease is greater than or equal to the Storage in the Rio Grande account. If so, the result is 0.0 acre-ft. If not, the carry over left is set to the result from the user-defined ComputeNOTIsNaNRGCarryOverLeft function.

B.40. Cochiti and Jemez Accounts

The rules in this policy group are used to set the accounting supplies for the final outflow of Rio Grande water from Cochiti and Jemez Dams and for the deliveries of San Juan-Chamna Project water through Cochiti Dam.

B.40.1. SetCochitiRGAccount

Explanation: This rule sets the accounting supplies for the release from conservation storage at Cochiti Lake and for the final outflow of Rio Grande water from Cochiti Dam. The outflow of Rio Grande water is set to the total outflow minus the outflow of San Juan-Chama Project water and minus the release from conservation storage. The outflow of Rio Grande water is checked against the mimimum outflow.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeCochitiToRioGrandeBlwCochitiDiversionsReach accounting supply for the current timestep is a NaN.

Rule Logic: The value for the RioGrandeConservationCochitiToRioGrandeBlwCochitiDiversionsReach accounting supply for the current timestep is set to the minimum of the value in the RGConservationRelease series slot in the CochitiDeviations data object for the current timestep or the result from the user-defined ReconcileRGOutflow function. For Cochiti Lake, the ReconcileRGOutflow function result is set equal to the value in the Outflow time series slot in the Cochiti storage reservoir object for the current timestep minus the value in the SJOutflow time series slot in the CochitiData data object for the current timestep as identified with the user-defined SJOutflow function. The predefined Max function is used to restrict the result to be no less than the value in the MinRGOutflow periodic slot in the CochitiData data object as referenced with the user-defined MinRGOutflow function. A second assignment statement is used to set the RioGrandeCochitiToRioGrandeBlwCochitiDiversionsReach.Supply slot for the current timestep equal to the result from the ReconcileRGOutflow function minus the value in the RGConservationRelease series slot.

B.40.2. CheckCochitiRGOutflow

Explanation: Aborts the simulation if the supply for the release of Rio Grande water from the Rio Grande account at Cochiti Lake was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing input can be identified by backtracking in the calculations from the point in the simulation that the run aborted. NOTE THAT the problem is likely not directly related to the computation of the Rio Grande outflow but most likely due to some earlier aspect of the rules solution. This rule just forces the run to go ahead and stop, so the problem can be fixed.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the RioGrandeCochitiToRioGrandeBlwCochitiDiversionsReach.Supply slot for the current timestep is is a NaN, the STOP_RUN command is used to stop the simulation, and the PRINT statement is used to print a comment to the Diagnostics Output window that the run stopped because the account slot value was not set.

B.40.3. SetCochitiSJCAccountingSupplies

Explanation: This rule sets all the accounting supplies for deliveries of San Juan-Chama Project water from Cochiti Lake.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: An IF THEN statement is used first in the rule to identify if the final reconciled outflow of San Juan-Chama Project water determined with the user-defined ReconcileSJOutflow function is less than the previous determined outflow. If so, Print statements are used to print statements to the Diagnostics Output window that the full initial computed outflow could not be met, if Print statements are enable in the Diagnostics Manager. A FOR DO statement is then used in the rule to set all the accounting supplies from a list of all supply slot names, at index 0, and the final determined deliveries, at index 1, as created with the user-defined CochitiPrioritizedSJCSuppliesAndValuesReconciliationCheck function. That function contains a list of all the accounting supplies from Cochiti Lake for deliveries of San Juan-Chama Project water and a corresponding list of all the initial computed deliveries

recorded to the ComputedDeliveries data object. A WHILE DO loop is then used in the function to loop through each supply *in the order listed* and set the deliveries while checking the cumulative release set so far within the function against the final total outflow of San Juan-Chama Project water. If the final total outflow of San Juan-Chama Project water, which is an input to the function, is less than the sum of the intial computed deliveries, deliveries included at the bottom of the listed supplies will be shorted in order from bottom up as needed.

B.40.4. SetJemezRGAccountingSupply

Explanation: This rule sets the accounting supplies for the release from conservation storage at Jemez Reservoir and for the final outflow of Rio Grande water from Jemez Canyon Dam.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the RioGrandeJemezToRioGrandeBlwJemez accounting supply for the current timestep is a NaN.

Rule Logic: The value for the RioGrandeConservationJemezToRioGrandeBlwJemez accounting supply for the current timestep is set to the minimum of the value in the RGConservationReleaseFromJemez series slot in the ComputedDeliveries data object for the current timestep or the result from the user-defined ReconcileRGOutflow function. A second assignment statement is used to set the RioGrandeJemezToRioGrandeBlwJemez.Supply slot for the current timestep equal to the result from the ReconcileRGOutflow function minus the value in the RGConservationReleaseFromJemez series slot.

B.40.5. CheckJemezRGOutflow

Explanation: Aborts the simulation if the supply for the release of Rio Grande water from the Rio Grande account at Jemez Reservoir was not set. This rule helps with debugging because a simulation will stop if the Rio Grande supply was not set and the problem and any missing inputs can be identified by backtracking in the calculations from the point in the simulation that the run aborted.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object.

Rule Logic: If the value for the RioGrandeJemezToRioGrandeBlwJemez.Supply slot for the current timestep is a NaN, the STOP_RUN command is used to stop the simulation,

and the PRINT statement is used to print a comment to the Diagnostics Output window that the run stopped because the account slot value was not set.

B.40.6. ReconciledRGandSJReleases

Explanation: This rule records results for the reconciled Rio Grande and San Juan outflow from Heron, El Vado, Abiquiu, and Cochiti Dams to the data object for each reservoir.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the ReconciledRGOutflow time series slot in the AbiquiuData data object for the current timestep is a NaN.

Rule Logic: Two FOR DO statements are used to set the ReconciledRGOutflow series slots and the ReconciledSJOutflow series slots in the HeronData, ElVadoData, AbiquiuData, and CochitiData data objects for the current timestep. The values are computed with the user-defined ReconcileRGOutflow and ReconcileSJOutflow functions. Different equations are used in the ReconcileRGOutflow function depending on the reservoir. For the user-defined ReconcileSJOutflow function, the result is the value for the Outflow time series slot in the corresponding reservoir object for the current timestep minus the result from the ReconcileRGOutflow function for the corresponding reservoir object.

B.41. Preparatory ElephantButte Caballo

The rules in this policy group are used to set the transfer of Compact credit water to the Rio Grande account that may result from relinquished credits and determine the percentage of the full demand out of Elephant Butte Dam that can be met and then used for setting releases from Elephant Butte and Caballo Dams.

B.41.1. SetEBAccountingSupplyForRelinquishment

Explanation: This rule sets the accounting supply for the transfer from the New Mexico Compact credit account at Elephant Butte Reservoir to the Rio Grande account based on any relinquished credits that are input or calculated.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the switch is set to model relinquished credits as checked with reference to the user-defined ModelRelinquishedCredits function and if the current timestep is equal to the

input date for a relinquishment as checked with reference to the user-defined RelinquishmentDate function and if the value for the RelinquishedNMCredits time series slot in the RelinquishedCreditsEmergencyDroughtWater data object for the current timestep is greater than zero.

Rule Logic: The NMCreditElephantButteToRioGrandeElephantButte accounting supply for the current timestep is set to the value in the RelinquishedNMCredits slot in the RelinquishedCreditsEmergencyDroughtWater data object for the current timestep, converted to a flow with the predefined VolumeToFlow function, plus the value for Transfers Out for the NMCredit account at Elephant Butte Reservoir for the current timestep.

B.41.2. PercentageOfFullLowerValleyDemandThatCanBeMet

Explanation: This rule computes the percentage of the average annual demand below Elephant Butte that can be met with the available supply in storage and the forecasted inflow. Releases from Elephent Butte and Caballo dam are then set with reference to this computed percentage.

Rule Execution: This rule fires if the current timestep is equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object or the current timestep is greater than or equal to that rulebased simulation start timestep and it is the first day of a month as determined with the user-defined IsFirstDayOfMonth function and the current timestep is in May or earlier.

Rule Logic: The value for the DownstreamDemandPercentage time series slot in the ElephantButteData data object for the timestep at the end of the current month is set to the Storage in the Rio Grande account at Elephant Butte Reservoir at the previous timestep as identified with the user-defined PreviousAccountStorage function plus the value in the Storage time series slot in the Caballo storage reservoir object at the previous timestep as identified with the user-defined PreviousStorage function plus the quantity of the value in the OtowiForecast time series slot in the PandP data object for December 31 of the current year unless it is a NaN, then the value in the AverageOtowiForecast scalar slot in the PandP data object, multiplied by the quantity of 1.0 minus the value in the ForecastLossPercentage table slot in the ElephantButteData data object all divided by the sum of the values in the AverageDemand periodic slot in the ElephantButteData data object for the current year as summed using the user-defined SumPeriodicSlot function. The result is restricted to be no greater than 1.0 using the predefined Min function. Refer to Figure B.22 for a screen capture of the RPL for this rule.

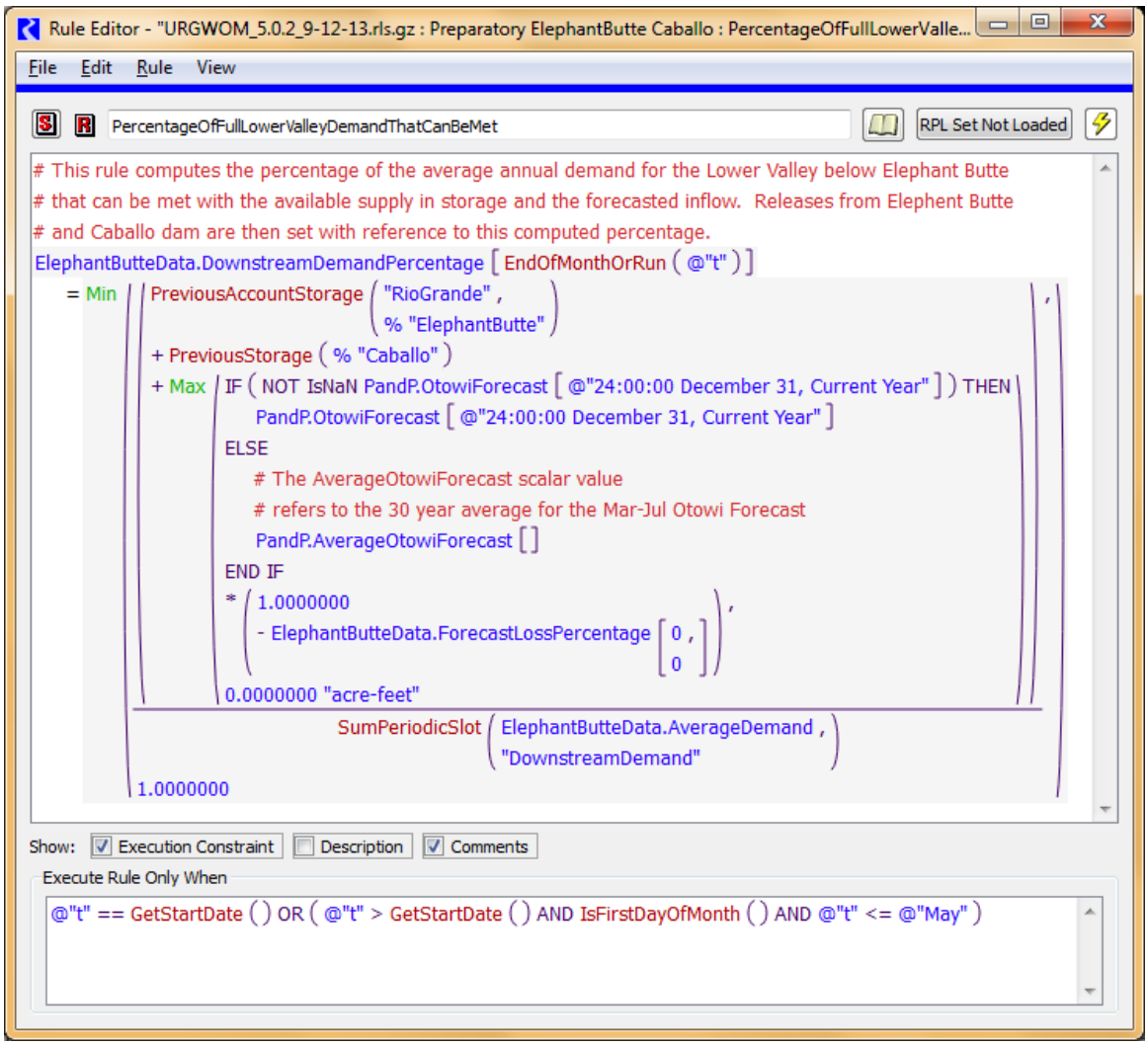


Figure B.22. Rule Policy Language for the PercentageOfFullLowerValleyDemandThat CanBeMet Rule

B.41.3. SetLowerValleyDemandFromElephantButte

Explanation: This rule computes the demand downstream from Elephant Butte Dam based on the computed downstream demand percentage and input average demand. The average demand is met as possible with the available supply or reduced based on the ratio of the available supply to the average annual demand.

Rule Execution: This rule fires if the current timestep is equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object or the current timestep is greater than or equal to that rulebased simulation start timestep and it is the first day of a month as determined with the user-defined IsFirstDayOfMonth function and the current timestep is in May or earlier.

Rule Logic: A FOR DO loop is used to set the values in the DownstreamDemand time series slot in the ElephantButteData data object for the current timestep to December 31 of the current year or the finish timestep if it is earlier. The values are set to the value in the AverageDemand periodic slot in the ElephantButteData data object for each corresponding date multiplied by the value in the DownstreamDemandPercentage time series slot in the ElephantButteData data object for the timestep at the end of the current month.

B.41.4. ComputeElephantButteUsableStorage

Explanation: This rule computes the usable storage at Elephant Butte as the total usable storage minus the storage at Caballo Reservoir. This recorded usable storage at Elephant Butte is valuable to reference against restricted releases from Elephant Butte.

Rule Execution: This rule fires if it has not fired yet as determined with a reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The value for the UsableStorageAtElephantButte series slot on the ElephantButteData data object for the current timestep is set to the value for the UsableStorage series slot on the RioGrandeCompact data object minus the total storage at Caballo at the previous timestep.

B.41.5. SetLowerValleyDemandFromCaballo

Explanation: This rule computes the demand downstream from Caballo Dam using the same equation used for Elephant Butte Dam except the different average demand values input to the CaballoData data object are referenced and the results are recorded to the CaballoData data object.

B.42. Elephant Butte

The rules in this policy group are used to determine the outflow from Elephant Butte Dam with consideration for the downstream demand, the release to return to the prudent storage level, and downstream channel capacity.

B.42.1. ElephantButteOutflow

Explanation: Unless a total outflow for Elephant Butte Dam has been input for the current timestep, the value is set to the computed downstream demand if the previous storage at Elephant Butte Reservoir is greater than the available usable storage. The resulting total release is checked to see if it is physically legitimate based on the outlet works, and if not, the release is reset to reflect the restriction for the given outlet works.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the ElephantButte level power reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the ElephantButteData data object for the current timestep as referenced using the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot on the ElephantButte level power reservoir object for the current timestep is set to that input TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the outflow is set to the minimum of the value in the UsableStorageAtElephantButte series slot in the ElephantButteData data object or the value in the DownstreamDemand time series slot in the ElephantButteData data object for the current timestep as referenced using the user-defined DownstreamDemands function. The result for the Outflow is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.42.2. ElephantButteOutflowRestrictions

Explanation: This rule resets the outflow from Elephant Butte Dam if needed to maintain the storage below the prudent pool elevation.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: The rule contains an IF THEN statement to see if the value for the Outflow time series slot in the ElephantButte level power reservoir object minus the result from the user-defined ElephantButteComputedMaxOutflow function is greater than 10 cfs or the result from the user-defined EBPrudentRelease function is greater than the value in the DownstreamDemand time series slot in the ElephantButteData data object for the current timestep as referenced using the user-defined DownstreamDemands function. IF those criteria are satisfied, the value for the Outflow time series slot in the ElephantButte level power reservoir object is reset to the result from the ElephantButteComputedMaxOutflow function. This function sets the outflow to the minimum of the channel capacity as input to the ChannelCapacities table slot in the ElephantButteData data object and referenced using the user-defined ChannelCapacity function which is referenced in the user-defined ElephantButteReleaseForDSChannelCapacity function or the result from the EBPrudentRelease function or the result from the EBReleaseForCaballo function.

The EBPrudentRelease function includes an IF THEN ELSE statement to see if it is NOT the irrigation season as determined using the user-defined NonIrrigationSeason function and if the expected elevation at Elephant Butte Reservoir for the current inflow as determined with predefined StorageToElevation function within the user-defined StorageToElevationBasedOnCurrentInflow function is greater than the storage space between the top of the conservation pool as input to the PoolLevels table slot in the ElephantButteData data object and the WINTER value (25,000 acre-ft) input to the PrudentAvailableStorage table slot in the ElephantButteData data object. If those criteria are satisfied, the function result is set to the outflow required to reduce the pool elevation below the WINTER prudent storage level as computed with the user-defined OutflowToGetBelowPrudentPool function and restricted to be no less than the value in the DownstreamDemand time series slot in the ElephantButteData data object for the current timestep as referenced using the user-defined DownstreamDemands function. Otherwise, if it is the irrigation season (March 1 through October 31) as determined with the user-defined IrrigationSeason function and if the expected elevation at Elephant Butte Reservoir for the current inflow is greater than the storage space between the top of conservation pool and the SUMMER value (50,000 acre-ft) in the PrudentAvailableStorage table slot in the ElephantButteData data object. If not, the function result is set to the value in the Outflow time series slot in the ElephantButte level power reservoir object for the current timestep. If so, the function result is set to the outflow to reduce the pool elevation below the SUMMER prudent storage level as computed with the user-defined OutflowToGetBelowPrudentPool function and restricted to be no less than the value in the DownstreamDemand time series slot in the ElephantButteData data object for the current timestep.

Several criteria are checked in the EBReleaseForCaballo function, and depending on whether the criteria are satisfied, the result is set to either be 0.0 cfs or the channel capacity as input to the ChannelCapacities table slot in the ElephantButteData data object.

B.43. Elephant Butte Accounts

The rule in this policy group sets the supply for the release of Rio Grande water and any transfers from contractors for San Juan-Chama Project water to Rio Grande as paybacks for debts.

B.43.1. SetElephantButteAccounts

Explanation: The value for the supply to transfer water from the Rio Grande account downstream is set to the outflow from Elephant Butte Dam, and transfers to the Rio Grande account from contractor storage for San Juan-Chama Project water are set as paybacks for debts.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function.

Rule Logic: This rule includes three assignment statements. The value for the RioGrandeElephantButteToRioGrandeBlwElephantButte.Supply is set to the value in the Outflow time series slot in the ElephantButte level power reservoir object for the current timestep. Assignment statements are included to set the accounting supplies for the transfers from the Albuquerque account and from the Santa Fe City account to the Rio Grande account. IF THEN ELSE statements are used for each assignment to check if the current timestep is equal to the date in the DateForTransferToRioGrandeAtElephantButteForPayback column of the DeliverySettings table slot in the ComputedDeliveries data object for the corresponding account. If so, the accounting supply is set to the corresponding payback debt as identified with the predefined GetPaybackDebt function and restricted to the previous storage for the source account.

B.44. Caballo Flood Control Rules

The rules in this policy group are used to set the initial outflow from Caballo Dam and then check the outflow against flood control criteria, the downstream channel capacity, and the physical constraints of the outlet works.

B.44.1. CaballoOutflow

Explanation: Unless a total outflow for Caballo Dam has been input for the current timestep, the value is set to the computed downstream demand or the outflow to drop below the flood pool elevation. The resulting total release is checked to see if it is physically legitimate based on the outlet works, and if not, the release is reset to reflect the restriction for the given outlet works.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the Outflow time series slot in the Caballo storage reservoir object for the current timestep is a NaN.

Rule Logic: This rule contains an IF THEN ELSE statement to see if the value in the TotalOutflowDirectlyInputToOverrideRules time series slot in the CaballoData data object for the current timestep as referenced using the user-defined TotalOutflow function is a NaN. If not, the value for the Outflow time series slot in the Caballo storage reservoir object for the current timestep is set to that input

TotalOutflowDirectlyInputToOverrideRules value. Otherwise, the value for the Outflow slot is set to the maximum of two values: 1) the value in the DownstreamDemand time series slot in the CaballoData data object for the current timestep as referenced using the user-defined DownstreamDemands function or 2) The outflow to drop below the flood pool elevation as determined with the user-defined OutflowToGetBelowFloodPool function which references the predefined SolveOutflow function is the other value.

Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.44.2. CaballoOutflowRestrictions

Explanation: This rule resets the outflow from Caballo Dam to comply with the downstream channel capacity at El Paso if necessary. The resulting total release is checked to see if it is physically legitimate based on the outlet works, and if not, the release is reset to reflect the restriction for the given outlet works.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the rule has not already fired for the current timestep as checked with reference to the predefined HasRuleFiredSuccessfully function and if the value for the Outflow time series slot in the Caballo storage reservoir object for the current timestep minus the result from the user-defined CaballoChannelCapacity function is greater than zero.

Rule Logic: If the execution constraints are satisfied, the value for the Outflow time series slot in the Caballo storage reservoir object for the current timestep is set to the result from the user-defined CaballoChannelCapacity function. This function uses the predefined HypTargetSimWithStatus function to determine the outflow from Caballo Dam (or the value for the Gage Inflow time series slot in the BlwCaballo stream gage object) to meet a target flow at El Paso (or the Gage Inflow time series slot in the ElPaso stream gage object) at the timestep equal to the current timestep plus the number of timesteps input to the ApproxNoOfDaysDS table slot in the CaballoData data object. The target is the channel capacity at ElPaso as input to the ChannelCapacities table slot in the CaballoData data object. The function completes the hypothetical simulation for all the objects in the BlwCaballoToElPaso subbasin and considers a check against a minimum solution range of 0.0 cfs and a maximum of 20000 cfs. The tolerance is equal to the input value in the ChannelCapacities table slot in the CaballoData data object.

Within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.44.3. CaballoFloodControlReleaseBasedOnFORD

Explanation: This rule is used to reset the outflow from Caballo Dam if a flood release is required to reduce the elevation below the flood pool elevation.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and if the value for the FloodRelease time series slot in the CaballoData data object for the current timestep is a NaN and if the value for the Outflow time series slot in the Caballo storage reservoir object is NOT a NaN and if the result from the user-defined IsFloodReleaseRequired function is true. That function checks to see if the anticipated elevation as determined with the predefined StorageToElevation function and with the current inflow and predetermined outflow is greater than the BottomOfFlood elevation in the PoolLevels table slot in the CaballoData data object.

Rule Logic: If the execution constraints are satisfied, this rule includes two assignment statements. The value in the Outflow time series slot in the Caballo storage reservoir object for the current timestep and the value in the FloodRelease time series slot in the CaballoData data object are both set to the result from the user-defined CaballoFloodReleaseBasedOnFORD function. This function includes an IF THEN ELSE statement to see if the anticipated elevation based on the current inflow and predetermined outflow as computed with the user-defined StorageToElevationBasedOnCurrentInflow function which references the predefined StorageToElevation function is greater than the Max elevation in the PoolLevels table slot in the CaballoData data object. If so, the outflow is set to the result from the user-defined ComputeMaxOutflow function which references the predefined GetMaxOutflowGivenInflow function. Otherwise, the function result is set to the maximum of the result from the user-defined ComputeCaballoFloodReleaseBasedOnFORD function or the value in the DownstreamDemand time series slot in the CaballoData data object for the current timestep as referenced with the user-defined DownstreamDemands function.

The ComputeCaballoFloodReleaseBasedOnFORD function checks to see if the pool elevation in the Caballo storage reservoir object at the previous timestep is greater than the BottomOfFlood elevation in the PoolLevels table slot in the CaballoData data object and if the value in the Outflow time series slot in the Caballo storage reservoir object at the previous timestep is equal to 5000 cfs, the downstream channel capacity, and if the value in the Inflow time series slot in the Caballo storage reservoir object for the current timestep is less than or equal to the previous inflow plus 1000 cfs. If those criteria are satisfied, the function result is set to the previous outflow. If not, a second IF THEN ELSE statement is used to see if the result from the IsFloodReleaseRequired function is true given the current inflow and an outflow looked up in the FloodReleaseTable table slot in the CaballoData data object. If so, the function result is set to that value looked up in the FloodReleaseTable. If not, the function result is set to the minimum of the current

inflow, the value from the FloodReleaseTable, or the result from the user-defined OutflowToGetBelowFloodPool function.

For both assignments within the rule, the result is checked against the physical restrictions of the outlet works using the user-defined CheckThisResPhysicalConstraints function (Refer to Section B.27.2.1).

B.45. EndOfYearHeronRGStorageAdjustmentForEvapRec

The rule in this policy group is used for the end-of-year accounting adjustment at Heron Reservoir to offset for impacts of Rio Grande water in storage on losses to the San Juan-Chama Project water.

B.45.1. HeronRioGrandeAdjustment

Explanation: On January 1 of each year of simulation, this rule sets the supply for the previous timestep to transfer 350 acre-ft from the Rio Grande account to the Federal San Juan account at Lake Heron to offset for recreation and loss impacts due to storage of Rio Grande water on the supply of San Juan-Chama Project water.

Rule Execution: This rule fires if the current timestep is greater than or equal to the beginning timestep for rulebased simulation as input by the model user to the RulebasedSimulationStartDate scalar slot in the ModelRunTypeTriggers data object and the current timestep is January 1.

Rule Logic: The value for the RioGrandHeronToFederalSanJuanHeron.Supply slot for the previous timestep is set to the flow corresponding to transferring a volume of 350 acre-ft over one day as computed with the predefined VolumeToFlow function.

B.46. Nambe

A Nambe reservoir object is included for rulebased simulations in the single URGWOM file used for all applications because the object is needed for Accounting Model runs. The object is not linked and is thus irrelevant for rulebased simulations but the object must contain inputs for the simulation to complete. The rule in this policy group sets a dummy input for releases such that the rulebased simulations will complete.

B.46.1. MaintainConstantNambePoolElevation

This rule simply bypasses inflows in the Nambe object such that the object will dispatch in RiverWare and the URGWOM rulebased simulations can continue.