APPENDIX I
WATER OPERATIONS TECHNICAL REPORT

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1.0 INTRODUCTION

This appendix describes the support provided by the Water Operations Team to the Upper Rio Grande Water Operations Review EIS. The Water Operations Team was composed of representatives of each of the three joint lead agencies and also included representatives of other agencies/entities participating in the development of the EIS. The Water Operations Team functioned as a support team, and did not represent any particular resource impacted by water operations. Rather, the Water Operations Team provided expertise regarding water operations at the various facilities under evaluation and assisted in the identification and evaluation of the alternatives, from a water operations perspective. Following the selection of alternatives, the Water Operations Team conducted modeling analyses and distributed model results to profile some of the differences between the alternatives. Model results were distributed to the resource teams for their use in analyzing impacts of operations alternatives on their resource of interest.

This appendix provides supporting information regarding the work conducted by the Water Operations Team. The information contained herein provides additional detail concerning the development and initial screening of alternatives, water operations modeling, and rating of the alternatives from a water operations perspective.

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2.0 OBJECTIVES

The Water Operations Team served to meet specific objectives in support of the Water Operations Review. These objectives included:

a) Provide a description of the existing conditions and regulatory framework for the projects and facilities in the study area;

b) Provide support to resource teams in understanding system flexibilities and limitations;

c) Identify flexibilities that could be used as a basis for articulating alternative actions;

d) Assess actions consistent with flexibilities and identify consistency with the Purpose and Need of this EIS and to identify fatal flaws of particular actions;

e) Group actions for facilities with identified flexibilities into preliminary alternatives;

f) Rate preliminary alternatives on the basis of engineering judgment, water operations and facility knowledge and preliminary model results;

g) Provide recommendations to the Interdisciplinary Team, based on preliminary screening analysis, for a short list of alternatives for detailed analysis;

h) Conduct simulations using the Upper Rio Grande Water Operations Model (URGWOM)[2] to illustrate some of the hydrologic differences among the identified alternatives;

i) Develop simplifying model input assumptions for the planning period;

j) Develop a 40-year synthetic sequence of hydrology to drive the planning model, for purposes of comparative analysis of alternatives;

k) Provide model results and other supporting analyses to the resource teams;

l) Assess the advantages and disadvantages of the alternatives from a water operations perspective.

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3.0 DESCRIPTION OF FACILITIES

3.1 Projects and Facilities in Colorado

Closed Basin Project: Located near Alamosa, Colorado, the Bureau of Reclamation (Reclamation) designed the Closed Basin Project to produce 600,000 acre-feet of groundwater from wells, in any ten-year period, to help Colorado meet downstream delivery obligations. Up to 5,300 acre-feet of that water may be used for wildlife habitat and deliveries to the river must be in accordance with the Clean Water Act. There may be no more than two feet of drawdown to the water table permitted in specified areas. Well degradation is presently limiting the annual production to approximately 25,000 acre-feet per year.

Platoro Dam: Platoro Dam, on the Conejos River, is a Reclamation facility operated by the Conejos Water Conservancy District. It was constructed in 1952 for irrigation and flood control and has an allocation of 54,000 acre-feet for irrigation and as well as serving as a temporary control for spring flooding events from snowmelt and rainfall (joint-use-pool). An additional 6,000 acre-feet is allocated exclusively to provide flood control on the Conejos River in Colorado and the Rio Grande in both Colorado and New Mexico. If flood space is needed, water in the conservation pool is released to make room. A 3,000 acre-foot pool is maintained for recreation, fish, and wildlife, and the reservoir is also managed to preserve fish and wildlife habitat downstream.

Procedures used in the flood control regulation of Platoro Reservoir are in accordance with part 208, Flood Control Regulation, Platoro Dam and Reservoir, Conejos River, Colorado, as published in the Federal Register. The operation of Platoro Reservoir for flood control involves communication and coordination between the State of Colorado, Division of Water Resources; Alamosa, Colorado; Conejos Water Conservancy District; and the US Army Corps of Engineers (Corps). The State of Colorado has the responsibility for the administration of water rights on the Conejos River and communication with the Corps on flood control problems on the Conejos River. The Corps has the responsibility for determining the flood control operation of Platoro. Pertinent elevation data is shown below. Additional information regarding this reservoir is provided in the Platoro Dam and Reservoir Water Control Manual[3].

Platoro Dam

	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Top of dam:	10,048.00	1,012	73,291
Maximum pool:	10,042.00	985	67,301
Total storage at spillway crest:	10,034.00	948	59,571
Top of conservation pool	10,027.57	917	53,571

3.2 Reservoirs on the Rio Chama

Three reservoirs, Heron, El Vado, and Abiquiu, were constructed on the Rio Chama and its tributaries to store water for flood control and water supply. Hydroelectric power plants are located at El Vado Dam and Abiquiu Dam, which are operated as "run-of-the-river" plants – that is, the demand for water release for hydroelectric power at these dams is subservient to other demands. Operations of El Vado are not within the scope of this EIS, but descriptive information concerning this reservoir and its operations are included below for informational purposes.

Heron Reservoir: Heron Reservoir stores and releases water imported from the San Juan River Basin and is the primary storage feature of the San Juan-Chama Project. Owned and operated by Reclamation, Heron Reservoir's entire capacity of about 401,300 acre-feet is dedicated to storing San Juan-Chama

Project water. All native Rio Grande inflow to Heron Reservoir is bypassed. The water imported to the Rio Grande Basin from the San Juan River Basin provides supplemental water supplies for various communities and irrigation districts. The project also provides fish and wildlife habitat as well as recreational opportunities. An average of 91,210 acre-feet per year of the firm yield is allocated annually by contract or project authorization; the remaining 4,990 acre-feet is as yet uncontracted.

Three basic principles control the water release schedule for Heron Reservoir. The first states that no Rio Grande water is to be stored in Heron; all natural inflow is bypassed. The second principle states that water is released from Heron only to individual Project contractors for storage in downstream reservoirs or for the irrigation consumption or offset of groundwater pumping depletions on the Rio Grande. These depletions are offset by releases of San Juan-Chama water from Heron Reservoir and ensure no residual effects to natural waters of the Rio Grande.

The third principle states that San Juan-Chama contractors are not allowed to carryover their annual allocations into the next calendar year. Contracted water not called for by December 31 remains in Heron Reservoir as part of project supply and no longer belongs to the individual contractor. In the past, Reclamation negotiated temporary waivers with contractors that allow carryover until April 30 in order to provide release rates on the Rio Chama that enhance the fishery between El Vado and Abiquiu Reservoirs during the winter and provide flexibility in managing river flows.

Pertinent elevation data is shown below. Additional information is provided in the Heron Reservoir Standing Operating Procedures[4].

Heron Reservoir

	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Top of dam:	7,199.00	6,600	475,000
Maximum pool:	7,190.80	6,148	429,657
Total storage at spillway crest:	7,186.10	5,906	401,334
Top of dead pool:	7,003.00	106	1,218

El Vado Reservoir: El Vado Dam was originally constructed to provide conservation storage for a supplemental irrigation supply for MRGCD lands along the Rio Grande from Cochiti Reservoir to below Socorro, New Mexico. Because El Vado Dam was constructed after 1929 (completed in 1935), operation of the reservoir for storage and release of Rio Grande water is subject to the Rio Grande Compact. Water imported into the Rio Grande Basin through the San Juan-Chama Project and stored in El Vado Reservoir is not subject to the storage and release restrictions of the Rio Grande Compact. Pertinent elevation data is shown below. Additional information is available in the El Vado Reservoir Standing Operating Procedures[5].

El Vado Reservoir

	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Top of dam:	6,914.50	3,620	232,500
Maximum pool:	6,908.00	3,418	206,205
Total active conservation storage:	6,902.00	3,232	186,252
Total storage at spillway crest:	6,879.00	2,454	120,544
Top of dead pool:	6,775.00	84	480

With respect to native water, El Vado Reservoir stores natural inflow that exceeds current Middle Rio Grande Conservancy District (MRGCD) and other needs below El Vado Dam. The major storage season is during spring runoff and storage can then be released during the irrigation season to users in the Middle Rio Grande Valley as needed.

Article VII of the Rio Grande Compact provides that no Rio Grande water in El Vado Reservoir can be stored when usable water in project storage (storage in Elephant Butte and Caballo Reservoirs) is less than 400,000 acre-feet. Article VI provides that any Rio Grande water stored in El Vado Reservoir must be held in storage to the extent of New Mexico's accrued debit under the compact.

El Vado is operated to store native water for the six Middle Rio Grande Pueblos of Cochiti, Santo Domingo, San Felipe, Santa Ana, Sandia, and Isleta. The Bureau of Indian Affairs (BIA) and Reclamation compute the amount of storage required, and Indian storage water is released only when the natural flow of the Rio Grande is insufficient to adequately supply irrigation to 8,847 acres of Indian lands.

No native water can be stored in El Vado Reservoir when doing so would deprive acequias along the Rio Chama downstream from El Vado of water to which they are entitled. In 1971, the New Mexico State Engineer required that El Vado Reservoir be operated during the irrigation season to pass all natural flow of the Rio Chama up to 100 cfs, as measured below Abiquiu Dam, during the irrigation season.

El Vado Reservoir operation is affected by the San Juan-Chama Project in two ways. First, San Juan-Chama Project water released from Heron Dam for use downstream of El Vado Reservoir is simply passed through. Secondly, large volumes of San Juan-Chama Project water in El Vado Reservoir may be stored for extended periods of time. The MRGCD has contracted for 20,900 acre-feet per year of San Juan-Chama Project water and maintains as much of this water in El Vado Reservoir as conditions permit. In addition, the MRGCD has contracted with various contractors of San Juan-Chama Project water to allow for storage of their water in El Vado Reservoir.

Abiquiu Dam and Reservoir: Abiquiu Reservoir is owned and operated by the Corps. Abiquiu Dam and Reservoir are operated for flood and sediment control in accordance with conditions and limitations stipulated in the Flood Control Act of 1960 (P.L. 86-645). Reservoir regulation for flood control is also coordinated with the operation of Jemez Canyon, Cochiti, and Galisteo Reservoirs. Abiquiu Reservoir is operated to limit flow in the Rio Chama, insofar as possible, to the downstream channel capacities of 1,800 cfs for the reach below Abiquiu Dam; 3,000 cfs for the reach below the Rio Chama at Chamita stream gage; and, on the Rio Grande main stem, 10,000 cfs for the reach below the Rio Grande at Otowi stream gage.

These channel capacity restrictions result in temporary storage of Rio Grande floodwater, which is then evacuated as quickly as downstream channel conditions allow, unless and until the conditions imposed by P.L. 86-645 are triggered. When P.L. 86-645 is triggered, Abiquiu Reservoir retains carryover flood storage because no Rio Grande water may be withdrawn from storage after July 1 at the natural flow (that is--exclusive of water released from storage upstream) at the Otowi gage is less than 1,500 cfs. Rio Grande water that is locked in must remain in storage until the end of the irrigation season (November 1). Flood storage that is retained throughout the summer is released after November 1 and must be fully evacuated by March 31 of the following year. Depending on the volume of water from spring runoff, Abiquiu Reservoir has either been able to safely pass inflow without any carryover or has locked in as little as 3,500 acre-feet in 1994 to as much as 215,000 acre-feet in 1987. Pertinent elevation data is shown below. Additional information can be found in the Abiquiu Reservoir Water Control Manual[6].

Abiquiu Reservoir

	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Top of dam:	6,381.00	16,480	1,639,800
Maximum pool:	6,374.70	15,536	1,535,300
Total storage at spillway crest:	6,350.00	15,580	1,192,800
Top of flood-control pool:	6,283.50	7,439	545,783
Top of San Juan-Chama storage:	6,220.00	4,029	183,882
Top of dead pool:	6,077.00	--	--

In 1981, P.L. 97-140 authorized the storage of 200,000 acre-feet of San Juan-Chama water in Abiquiu Reservoir. The City of Albuquerque has obtained a storage easement to an elevation of 6,220 feet. Real estate interests have not been obtained above elevation 6,220 feet to accommodate the full 200,000 acre-feet as authorized. San Juan-Chama capacity is annually reduced because of the estimated sediment deposition into the reservoir. San Juan-Chama storage is held below an elevation of 6,220 feet and released as requested by the storage contractors. The San Juan-Chama pool also serves to increase sediment trap efficiency and enhance recreational opportunities as well as fish and wildlife habitat at the reservoir.

3.3 Reservoirs in the Middle Valley

Three reservoirs were constructed on the Rio Grande in the Middle Valley for flood and sediment control. The projects are Cochiti Dam and Lake, Galisteo Dam and Jemez Canyon Dam and Reservoir.

Cochiti Dam and Lake: Cochiti Lake is owned and operated by the Corps in coordination with other Corps projects in the basin. Cochiti Lake has maintained a permanent recreation pool of approximately 50,000 acre-feet since the dam was completed. The permanent pool, which includes an intermittent pond in the arm of the Santa Fe River, provides sediment-control benefits that trap approximately 1,000 acre-feet of sediment per year. The permanent pool was established and is maintained by San Juan-Chama Project water. The remaining capacity of the reservoir, totaling about 545,000 acre-feet, is reserved for flood and sediment control.

Cochiti Dam is operated to bypass all inflow to the lake, to the extent that downstream channel conditions are capable of safely bypassing the flow. Flood-control operations are initiated when inflow to the lake is in excess of the downstream channel capacity. Stored floodwaters are retained in the reservoir and held until downstream channel conditions allow for its release, provided that, after July 1, the natural inflow is 1,500 cfs or and a minimum of 212,000 acre-feet of storage is available in Cochiti Reservoir to control summer flood flows. Flood storage that is "locked in" is released beginning November 1 (see discussion under carryover storage at Abiquiu Reservoir). Pertinent elevation data is shown below. Additional information can be found in the Cochiti Lake Water Control Manual[7].

Cochiti Lake

	Elevation (feet)	Area (acres)	Total capacity (acre-feet)
Top of dam:	5,479.00	11,176	771,719
Maximum pool:	5,474.10	10,636	718,019
Total storage at spillway crest:	5,460.50	9,307	582,019
Permanent pool (varies): 5,340.1 F	5,335.92	1,200	49,359
Conduit invert:	5,255.00	0	0

P.L. 88-293 authorized the release of 50,000 acre-feet of San Juan-Chama Project water for the initial filling of a permanent pool of 1,200 acres in Cochiti Lake and thereafter sufficient water annually to offset evaporation from such areas. A portion of the release of San Juan-Chama Project water is used to offset evaporation loss from the water surface of a small wetland on the Santa Fe River above Cochiti Dam.

Jemez Canyon Reservoir: Jemez Canyon Dam and Reservoir is owned and operated by the Corps. Jemez Canyon Dam and Reservoir were authorized by the Flood Control Act of 1948 and are operated in tandem with Cochiti Reservoir to control flows through the Middle Rio Grande Valley. Flood storage, if any, is accumulated atop the sediment-control pool and released as soon as possible thereafter. Jemez Canyon Dam is currently operated as a dry reservoir. Pertinent elevation data is shown below. Additional information can be found in the Jemez Canyon Dam and Reservoir Water Control Manual[8].

Jemez Canyon Dam

	Elevation (feet)	Area (acres)	Total capacity (acre-feet)
Top of embankment:	5,271.6	5,320	260,723
Maximum pool:	5,271.2	5,300	259,423
Total storage at spillway crest:	5,232.0	2,943	97,425
Sediment retention pool:	5,196.7	1,364	25,517
Zero storage:	5,154.0	0	0

3.4 Reservoirs in the Lower Valley

Two reservoirs were constructed on the Rio Grande in the Lower Valley as part of the Rio Grande Project: Elephant Butte Reservoir and Caballo Reservoir. Elephant Butte Reservoir is authorized to operate for conservation storage and generation of hydroelectric power. Caballo Reservoir is operated for conservation storage and flood control.

Elephant Butte Reservoir: Elephant Butte Reservoir is owned and operated by Reclamation, and is the principal water storage facility for 178,000 irrigated acres of the Rio Grande Project in south-central New Mexico and west Texas. The reservoir is operated to maintain a 25,000 acre-foot pool vacant for flood-control purposes in the winter months and 50,000 acre-foot pool for flood control in the summer months. A 50,000 acre-foot minimum recreation pool is authorized and maintained with San Juan-Chama Project water, when available. Elephant Butte Reservoir is also operated to ensure that the U.S. 1906 Treaty obligation with Mexico to deliver 60,000 acre-feet per year at the Acequia Madre headgate in Mexico can be met. Pertinent elevation data is shown below. Additional information can be found in the Elephant Butte Standing Operating Procedures[9].

Elephant Butte Dam and Reservoir

	Elevation (feet)	Area (acres)	Total capacity (acre-feet)
Top of dam:	4,414.0	39,918	2,289,017
Maximum pool:	4,410.0	37,670	2,133,841
Total storage at spillway crest:	4,407.0	35,984	2,023,400
Inactive:	4,231.5	0	0

In 1981, Congress authorized the Secretary of the Interior to enter into contracts for storage of San Juan-Chama Project water in Elephant Butte Reservoir. P.L. 97-140 provides that the amount of evaporation loss and spill chargeable to San Juan-Chama Project water shall be accounted for under procedures

established by the Rio Grande Compact Commission. San Juan-Chama Project water may also be stored in Elephant Butte Reservoir for recreational purposes.

Caballo Reservoir: Caballo Dam and Reservoir is operated for conservation storage purposes by Reclamation and for flood-control purposes by the U.S. Section of the International Boundary and Water Commission (IBWC). Completed in 1938, Caballo Dam provides flood protection for the El Paso/Juarez area by the reservation of 100,000 acre-feet of total capacity for a dedicated flood-control pool, which is under the jurisdiction of IBWC. The reservoir also serves to re-regulate releases made from Elephant Butte Reservoir for the generation of hydroelectric power.

Caballo Dam and Reservoir

	Elevation (feet)	Area (acres)	Total capacity (acre-feet)
Top of dam:	4,190.00	13,250	425,000
Total storage at spillway crest:	4,182.00	11,532	326,672
Top of conservation storage pool:	4,172.44	9,352	226,629
Top of dead storage:	4,104.0	0	0

4.0 OPERATIONAL FLEXIBILITIES AND GENERAL DESCRIPTIONS OF ALTERNATIVE ACTIONS

Operational flexibilities at facilities and within the river system were identified with consideration to existing authorizations through internal analysis and in public scoping meetings. Within the identified flexibilities, a range of actions were identified to be considered elements of alternative operating plans. These actions include: waivers for Contractor water from Heron Reservoir, conservation storage amounts in Abiquiu Dam, altering channel capacity downstream of Abiquiu Dam and Cochiti Dam, using the Low Flow Conveyance Channel for water diversions and enhancing communication and coordination protocols. No Action scenarios were also developed. A wide range of specific actions within the flexibility were identified and then screened in consideration of the EIS Purpose and Needs Statement. This gives a general overview of these flexibilities and the next section develops specific actions within the identified alternatives.

Heron Waivers – A waiver is a temporary relief of the requirement for contractors to take delivery of a current year San Juan-Chama (SJC) allocation before December 31 of the same year. Waivers came into existence when high discharge rates in December were determined to be detrimental to the trout fishery within the Wild and Scenic Reach of the Rio Chama. On November 3, 1983, Mr. Emmet Rice, Reclamation field solicitor, gave an opinion that SJC contractors could request a waiver from Reclamation to extend their water delivery date. A key point to Rice's opinion is that waivers "inure to the benefit of the United States to effect orderly project operations and do not inure to the benefit of any water user" (US Dept. of Interior, 1983).

In the past, temporary waivers have been used to enhance winter flows and fisheries management on the Rio Chama. Waivers generally would allow SJC water to remain in Heron Reservoir through April 30 of a particular year, but this date could be extended even further. This date has been extended in the past, but only under extreme circumstances. Currently, SJC water contractors must take deliver of contracted water in storage at Heron Reservoir by the end of the year, either by use, sale, or by contracts for storage elsewhere. The proposed alternatives in the EIS extend the waiver date. Extending the waiver date could allow for additional storage of native water downstream at El Vado and Abiquiu Reservoirs. There are certain conditions that have to be met to allow this to happen. Projected snowmelt runoff into Heron Reservoir would not impact Reclamation's ability to maximize diversions of SJC water. In other words diversion of SJC water would not be impacted. Another requirement would be that New Mexico must be in compliance with the Rio Grande Compact.

Conservation Storage – The proposed action is storage of native flows in Abiquiu Reservoir during the spring runoff period. Storage at Abiquiu Reservoir would be limited by the amount of storage available that is not being used for San Juan-Chama water. The water would be stored when native flows exceed downstream demands and when New Mexico is in compliance with the Rio Grande Compact. The available amount of runoff and the total volume of SJC water in the reservoir would also limit storage and Conservation storage (native water) and SJC water storage, shall not exceed elevation 6220.0 ft. In order to store conservation water the Abiquiu Reservoir release rate would be limited to 200 cfs respectively during the time when excess flows are being stored. The release rate would be increased to meet demand if needed but would not drop below the target rate (200 cfs). The proposed alternatives explore a range of options for storage of native Rio Grande water. The options include storing 20,000, 75,000, and 180,000 acre-feet of native water.

Channel Capacity – The proposed alternatives explore changes in channel capacity downstream from Abiquiu and Cochiti Dams. The options included decreases and increases in the release rates.

Low Flow Conveyance Channel (LFCC) – The LFCC was designed to increase conveyance and compact deliveries to Elephant Butte Reservoir by minimizing losses from evaporation, transpiration and infiltration. While diversions at San Acacia into the LFCC are not presently occurring, flows do occur in the LFCC through irrigation return and ground water seepage. Flows from ground water influx and drainage increase in the downstream direction. The proposed alternatives offer a range of operations. At one end, no diversions would be made from the river to the LFCC at San Acacia. Other options involve diverting 500, 1,000, and 2,000 cfs while maintaining a minimum bypass of 250 cfs in the river at San Acacia.

Communication and Coordination Protocol – Protocols to improve inter-agency processes within agencies and within the public have been developed and are provided in Attachment B. These protocols are common to all alternatives.

5.0 DEVELOPMENT OF ALTERNATIVES

This preliminary screening analysis is provided in detail in Attachment A. The table in Attachment A shows the actions under consideration, the water operations attribute used to evaluate each action and the rationale for determining whether or not each action could be maintained (or eliminated due to the presence of a fatal flaw), according to various attributes of the actions. The following discussion provides a reason why some actions moved forward, while others were dropped from consideration.

5.1 Heron Waivers

The use of waivers is appropriate for specific operational purposes, which "inure to the benefit of the United States" and not specifically to the benefit of contractors, even though contractors may benefit from the waiver. The use of waivers must never adversely impact Reclamation's ability to maximize diversions of SJC water. Various actions utilizing different dates for Heron waiver are summarized below, with comments derived from the initial screening process.

5.1.1 No waivers

The Water Operations Team reviewed the impacts of requiring all SJC contractor water to be released by December 31 of the same year in which it is allocated, essentially eliminating Reclamation's current operational flexibility to issue waivers for carryover storage into the following year. This option was eliminated because Reclamation currently has the flexibility to require contractors to take their allocation by December 31, or issue carryover waivers if it is of benefit to the United States. The "no waiver" option removes operational flexibility, which is contrary to the goals of Water Operations Review. This action would essentially impact winter flows on the Rio Chama between El Vado Dam and Abiquiu Reservoir in January and February. The flows released during this time would be limited to movement of the Cochiti Lake evaporation replacement water and whatever bypass of native flows there is. The evaporation replacement water for Cochiti Lake (5,000 acre-feet) is normally moved between November and February. Essentially with this type of operation the flows on the Rio Chama between El Vado Dam and Abiquiu Reservoir would be high during November and December and then drop to below 50 cfs during January and February. Another reason this action was eliminated is that contractors that do not take delivery of contracted water in storage at Heron Reservoir either by use, contracting for storage space elsewhere, or sale, would forfeit their allocation which would revert back to project storage.

5.1.2 No change (flexibility to issue waivers through April 30)

The Water Operations Team reviewed the feasibility of Reclamation retaining its current operational flexibility to issue waivers to SJC contractors for the carryover storage of their allocation in Heron Reservoir through April 30 of the following year. This option was retained for additional analysis because it essentially represents the "no change" alternative, and provides operational flexibility to the benefit of the United States. This action allows flexible water management that benefits the SJC contractors and provides for winter flows on the Rio Chama between El Vado Dam and Abiquiu Reservoir.

5.1.3 Flexibility to issue waivers through June 30

The Water Operations Team reviewed the feasibility of Reclamation expanding its current operational flexibility to issue waivers to SJC contractors by extending the carryover storage deadline to June 30 of the following year, if this action would prove beneficial to the United States. This option was eliminated from additional analysis because it was not seen to provide any significant benefits over the current practice of Reclamation's flexibility to offer waivers through April 30. The main objective with this

action is to create additional space in El Vado Reservoir and Abiquiu Reservoir for the storage of native water by holding SJC water in Heron Reservoir and delivering it at a later date. This action was eliminated because it allows only temporary space for additional storage of native water in El Vado Reservoir or Abiquiu Reservoir. SJC water would be delivered during the snowmelt runoff season and any native water stored during the March–May time frame would have to be evacuated to make space for the SJC water. The native water stored during the March-May time frame in most years could not be used because the Rio Chama and the main stem of the Rio Grande would provide enough water to meet all needs downstream from the reservoirs.

5.1.4 Flexibility to issue waivers through August 31

The Water Operations Team reviewed the feasibility of Reclamation expanding its current operational flexibility to issue waivers to SJC contractors by extending the carryover storage deadline to August 31 of the following year, if this action would prove beneficial to the United States. This option was retained for additional analysis because it has the potential to enhance the operational flexibility of the system for benefit of the United States. The operational flexibility to modify storage plans in downstream reservoirs could be enhanced by extending the waiver date to August 31. The main objective with this action is to create additional space in El Vado Reservoir and Abiquiu Reservoir for the storage of native water by holding SJC water in Heron Reservoir and delivering it at a later date. This action was retained because it allows for temporary space for additional storage of native water in El Vado Reservoir or Abiquiu Reservoir. SJC water would be delivered after the snowmelt runoff season in July and August. In most years, there is a call for native water out of storage in late June to meet downstream demands. The native water released from storage would then be replaced by a release of SJC water out of Heron Reservoir.

5.1.5 Flexibility to issue waivers through September 30

The Water Operations Team reviewed the feasibility of Reclamation expanding its current operational flexibility to issue waivers to SJC contractors by extending the carryover storage deadline to September 30 of the following year, if this action would prove beneficial to the United States. This option was retained for additional analysis because it has the potential to enhance the operational flexibility of the system for benefit of the United States. The operational flexibility to modify storage plans in downstream reservoirs could be enhanced by extending the waiver date to September 30. The main objective with this action is to create additional space in El Vado Reservoir and Abiquiu Reservoir for the storage of native water by holding SJC water in Heron Reservoir and delivering it at a later date. This action was retained because it allows for temporary space for additional storage of native water in El Vado Reservoir or Abiquiu Reservoir. SJC water would be delivered after the snowmelt runoff season in July and August. In most years, there is a call for native water out of storage in late June to meet downstream demands. The native water released from storage would then be replaced by a release of SJC water out of Heron Reservoir. Additional month would provide more flexibility.

5.2 Abiquiu – Conservation Storage

The Water Operations Team looked at the feasibility of storing native water in Abiquiu Dam in various amounts, ranging from 20,000 acre-feet to 200,000 acre-feet. The proposed action is for storage of native flows in Abiquiu Reservoir during the spring runoff period. Storage at Abiquiu Reservoir would be limited by the amount of storage available that is not being used for San Juan-Chama water. The water would be stored when native flows exceed downstream demands and when New Mexico is in compliance with the Rio Grande Compact. The available amount of runoff and the total volume of SJC water in storage would also limit the amount of conservation storage (native water) that could take place. The storage of SJC water and conservation water cannot exceed elevation 6,220.0 ft. In order to store

conservation water in Abiquiu Reservoir the release rate below the dam would be limited to 200 cfs respectively during the time when excess flows are being stored. The release rate would be increased to meet demand if needed but would not drop below the target rate (200 cfs).

Initial assessments of the feasibility of these actions indicated that storage in the amounts of 20,000, 50,000, and 100,000 were feasible assuming that the space was not needed for SJC storage. Storage in the amount of 200,000 acre-feet, on the other hand, appears infeasible, based on the fact that storage is presently limited to 183,000 acre-feet. Storage easements would need to be purchased in order to store the additional 17,000 acre-feet. This storage amount is depleted by sediment every year. URGWOM will be used to better understand under what conditions and how often storage in the various amounts can take place. Attachment A, Evaluation of Draft Alternatives, shows other considerations used in the analysis.

5.3 Abiquiu Channel Capacity

The Water Operations Team looked at feasibility of changing the channel capacity downstream from Abiquiu Dam. The options the team explored included decreases and increases in release rates. This section explores release rates ranging from 600 cfs to 2,500 cfs. Additional information regarding the alternatives can be found in **Attachment A**.

5.3.1 600 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Abiquiu Dam being lowered to 600 cfs. It became apparent during the preliminary analysis that it was not feasible to have such a low channel capacity. The decision to discard this action was based on the following: compact deliveries could not be met, irrigation demand through the middle valley would not be met, ESA deliveries could not be bypassed, and City of Albuquerque San Juan-Chama water could not be delivered. Abiquiu is operated to bypass the natural flow first; therefore, it would be extremely difficult to release SJC water.

5.3.2 800 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Abiquiu Dam being lowered to 800 cfs. It became apparent during the preliminary analysis that it was not feasible to have such a low channel capacity. The decision to discard this alternative was based on the following: compact deliveries could not be met, irrigation demand through the middle valley would not be met, ESA deliveries could not be bypassed, City of Albuquerque San Juan-Chama water could not be delivered, etc. While the increased channel capacity helped some, it was not enough to allow releases to meet the needs downstream. Abiquiu is operated to bypass the natural flow first; therefore, it would be difficult to release SJC water during the irrigation season. There would be no way to meet irrigation demand, domestic demand and endangered species flows with this type of release.

5.3.3 1,200, 1,500, 1,800, 2,000 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Abiquiu Dam in the range to the following increments: 1,200, 1,500, 1,800 and 2,000 cfs. It became apparent during the preliminary analysis that a more in-depth analysis would be needed to determine the most feasible channel capacity. The URGWOM along with Flo-2D and other resource models was used to determine the most feasible channel capacity. Attachment A: Evaluation of Draft Alternatives shows other considerations used in the preliminary analysis.

5.3.4 2,500 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Abiquiu Dam being increased to 2,500 cfs. It became apparent during the preliminary analysis that it was not feasible to have such a high channel capacity. The decision to discard this alternative was based on the following: there would be an increase in overbank flooding, more bank erosion, and the fact that most diversion structures on the Rio Chama are made of rock and brush. While the increased channel capacity would help in compact deliveries, overbank flooding and increased flood protection in the Middle Rio Grande Valley, the negative impacts eliminated this alternative.

5.4 Cochiti Channel Capacity

The Water Operations Team looked at feasibility of changing the channel capacity downstream from Cochiti Dam. The options the team explored included decreases and increases in release rates. Additional information regarding the alternatives can be found in Attachment A.

5.4.1 5,000 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Cochiti Dam being lowered to 5,000 cfs. It became apparent during the preliminary analysis that it was not feasible to have such a low channel capacity. The decision to discard this alternative was based on the following: it would impact compact deliveries, increase the chances for carryover storage in Abiquiu and Cochiti, provided no channel forming discharges, decreased flood protection, decreased overbank flooding, and the City of Albuquerque would not be able to take delivery of SJC water during snowmelt runoff. Cochiti Dam is primarily operated to bypass the natural flow; therefore it would be difficult to release SJC water during snowmelt runoff in some years.

5.4.2 7,000, 8,000, 9,000, 10,000 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Abiquiu Dam in a capacity ranging from 7,000 to 10,000 cfs. It became apparent during the preliminary analysis that a more in-depth analysis would be needed to determine the most feasible channel capacity. URGWOM, along with Flo-2D and other resource models will be used to determine the most feasible channel capacity.

5.4.3 12,500 cfs channel capacity

The Water Operations Team looked at the feasibility of the channel capacity below Cochiti Dam being increased to 12,500 cfs. It became apparent during the preliminary analysis that it was not feasible to have such a high channel capacity. The decision to discard this alternative was based on following: increase in bank sloughing, possible flooding of irrigation land in the reach extending from Cochiti to Bernalillo, and the effect high flows would have on bank protection. While the increased channel capacity would help in compact deliveries, overbank flooding, and increased flood protection in the Middle Rio Grande Valley, the multiple negative impacts eliminated this alternative.

5.5 Low Flow Conveyance Channel Diversions

The LFCC was designed to increase conveyance and compact deliveries to Elephant Butte Reservoir by minimizing losses from evaporation, transpiration and infiltration. Reclamation does not presently use the LFCC because of the lack of a viable outfall into Elephant Butte Reservoir. Although diversions at San Acacia have been suspended, flows do occur in the LFCC through irrigation return and groundwater

seepage. Flows from groundwater influx and drainage increase in the downstream direction. The proposed alternatives offer a suite of operations that range from having no diversions from the Rio Grande to the LFCC to diverting as much a 2,000 cfs from the River while maintaining minimum bypass target at San Acacia.

5.5.1 LFCC – No diversions

The Water Operations Team reviewed the impacts of disallowing all LFCC diversions. The no diversion option would limit Reclamation's operational flexibility to use the LFCC as an alternate conveyance for delivering water to Elephant Butte Reservoir. Though Reclamation does not currently use the LFCC, it could be operated to deliver between 0 and 2,000 cfs if a viable outfall were to be reconstructed at some future date, providing additional operational flexibility to the system. The "No Action Alternative" was modeled to reflect the present condition of no LFCC diversion, although the resumption of diversion to the LFCC is not inconsistent with the "No Action Alternative". Technical teams were cautioned to consider not only the modeled outcome in this respect, but also the potential for LFCC diversion under the "No Action Alternative". However, all quantitative analyses based on model output reflect the no diversion condition.

5.5.2 LFCC – 0 to 2,000 cfs diversions

The Water Operations Team reviewed the impacts of Reclamation retaining the potential operational flexibility to divert from 0 to 2,000 cfs into the LFCC at the San Acacia Diversion Dam. The LFCC could be operated to deliver between 0 and 2,000 cfs if a viable outfall were to be reconstructed at some future date, providing additional operational flexibility to the system. This option was retained for additional analysis because it provides the potential for added operational flexibility if a viable outfall is reconstructed in the future. Several diversion limits within this range were explored among the alternatives.

5.5.3 LFCC – Coordination and Protocol

The "coordination and protocol" alternative assumes that the Federal entities are required to meet presently unknown flow criteria related to endangered species or other issues. The "coordination and protocol" alternative was retained for additional analysis because it represents the potential establishment of currently unknown flow targets within the Socorro Reach of the Rio Grande.

5.5.4 LFCC – Leave 400 cfs past San Acacia

The Water Operations Team reviewed the impacts of requiring that operation of the LFCC leaves at least 400 cfs passing San Acacia Diversion Dam. The "leave 400 cfs past San Acacia" option was eliminated because it limits potential operational flexibility by essentially setting a minimum flow rate below San Acacia Diversion Dam, which is contrary to the goals of Water Operations Review. It was also noted that natural flows within this stretch of the Rio Grande can drop well below 400 cfs when no diversions are occurring.

5.5.5 LFCC – Leave 150 cfs past San Acacia

The Water Operations Team reviewed the impacts of requiring that operation of the LFCC leaves at least 150 cfs passing the San Acacia Diversion Dam. The "leave 150 cfs past San Acacia" option was eliminated because it limits potential operational flexibility by essentially setting a minimum flow rate below San Acacia Diversion Dam, which is contrary to the goals of Water Operations Review. It was also

noted that natural flows within this stretch of the Rio Grande could drop below 150 cfs when no diversions are occurring.

5.5.6 LFCC – Leave 50 cfs past San Acacia

The Water Operations Team reviewed the impacts of requiring that operation of the LFCC leaves at least 50 cfs passing the San Acacia Diversion Dam. The "leave 50 cfs past San Acacia" option was eliminated because it limits potential operational flexibility by essentially setting a minimum flow rate below San Acacia Diversion Dam, which is contrary to the goals of Water Operations Review. It was also noted that a flow of 50 cfs below San Acacia provides little or no support to any of the goals of Water Operations Review as outlined in the Purpose and Needs Statement.

5.5.7 LFCC – Leave 50 cfs past San Marcial

The Water Operations Team reviewed the impacts of requiring that operation of the LFCC be limited such that at least 50 cfs arrives downstream and passes the San Marcial gage. The "leave 50 cfs past San Marcial" option was eliminated because it limits potential operational flexibility by essentially setting a minimum flow rate at the San Marcial gage, which is contrary to the goals of Water Operations Review.

5.6 General Description of No Action Alternative

The No Action Alternative is the water operations alternative that depicts current storage and water delivery operations of federal facilities. The authorized function and current operation of each facility in the No Action is shown in Attachment B. Additional facility and operation descriptions are shown in Section 3.0. The No Action Alternative does include the City of Albuquerque Drinking Water Project, assumed to be operating by year 4 of the 40-year planning period.

6.0 DEVELOPMENT OF COMBINED ACTIONS INTO ALTERNATIVES

The ID and Water Operations Teams identified twenty-one draft alternative operation plans that combine actions from the preliminary screening. These twenty-one alternative plans were based on seven combinations of actions that appeared feasible considering the breadth of events that might occur within a 40-year planning period. Each of the seven combinations differentiated with variations deemed most feasible under dry (1), average (2) and wet (3) conditions. Despite that each plan will be evaluated under a range of dry, average and wet conditions in the 40-year analysis, it was considered worthwhile to build plans on combinations tailored to different water supply conditions in order to allow a more complete analysis of potential options.

Following the Water Operations Team's presentation of the original draft alternatives to the ID NEPA Team, alternatives C3 and E3 were combined due to the similarities in the proposed actions and to limit the number of alternatives. Three additional alternatives designated I1, I2, and I3 were also created at the request of the ID NEPA Team. Alternatives I1, I2, and I3 broaden the spectrum of the alternatives undergoing detailed analysis by including additional variation of LFCC operations. **Table I-6.1** shows the alternatives considered. In this table, Alternatives A-1 to I-1, A-2 to I-2, an A-3 to I-3 represent operational plans considered feasible under, and better suited for, dry, average and wet conditions, respectively. Alternative G represents the present operational condition and is identified as the No Action Alternative. However, this alternative also implements improved Elephant Butte/Caballo Reservoir coordination and improved communication within the Basin. See Attachment A for more details. Alternative G does not include specific variations addressing dry, average and wet conditions.

Table I-6.1 Draft Operational Alternatives for the Upper Rio Grande Basin Water Operations Review

Alternative	1	2	3
A	Heron waivers – April 30 Abiquiu storage 0 - 20,000 ac-ft Abiquiu channel capacity – 1,200 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept. 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 1,200 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept. 30 Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 1,200 cfs Cochiti channel capacity – 8500 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications
B	Heron waivers – April 30 Abiquiu storage – 0 - 20,000 ac-ft Abiquiu channel capacity – 1,500 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 1,500 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 1,500 cfs Cochiti channel capacity – 8500 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications
C	Heron waivers – April 30 Abiquiu storage – 0 - 20,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications
D	Heron waivers – April 30 Abiquiu storage – 0 - 20,000 ac-ft Abiquiu channel capacity – 2,000 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 2,000 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 2,000 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications

Table I-6.1 Draft Operational Alternatives for the Upper Rio Grande Basin Water Operations Review

Alternative	1	2	3
E	Heron waivers – April 30 Abiquiu storage – 0 - 20,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – April 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – April 30 (Sept 30) Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications
F	Heron waivers – April 30 Abiquiu storage – 0 - ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – April 30 Abiquiu storage – 0 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC – 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – April 30 Abiquiu storage – 0 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 10,000 cfs LFC– 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications
G (Base Run)	No Action – No change in operation Heron waivers – April 30 Abiquiu storage – 0 - ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC[1] – 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications	No Action – No change in operation Heron waivers – April 30 Abiquiu storage – 0 - ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC[1] – 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications	No Action – No change in operation Heron waivers – April 30 Abiquiu storage – 0 - ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC[1] – 0 cfs Elephant Butte and Caballo protocol/coordination Improved communications
I	Heron waivers – April 30 Abiquiu storage – 0 - 20,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 500 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 75,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 1,000 cfs Elephant Butte and Caballo protocol/coordination Improved communications	Heron waivers – Sept 30 Abiquiu storage – 0 – 180,000 ac-ft Abiquiu channel capacity – 1,800 cfs Cochiti channel capacity – 7,000 cfs LFC – 0 – 2000 cfs Elephant Butte and Caballo protocol/coordination Improved communications

1 – The LFCC is modeled with a diversion of 0 cfs in the Base Run because this is the present operational condition given to the current lack of a functional outflow channel into Elephant Butte Reservoir. However, under existing operational rules, diversions of up to 2,000 cfs are permitted in the LFCC.

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7.0 EVALUATION OF ALTERNATIVES

7.1 Methods

The Water Operations Team reviewed historic hydrologic data and considered multiple operational processes and constraints in the analysis of the alternatives. For example, the team considered information such as:

1.0 the number of years there was carryover storage at Abiquiu Reservoir,
2.0 the number of days flow reached channel capacity, and
3.0 historic peak flows in the river.

Preliminary analyses were qualitative based on knowledge integrated from data and operational experience.

More detailed analyses utilized the hydrologic model, URGWOM[10], developed with RiverWare[11] software. The model was used to compare and visualize water operations under selected alternative plans over the 40-year planning period. For this analysis, a 40-year synthetic sequence of flows were derived that represented the long-term climate condition, including drought, wet and average periods. Because the period of record available to URGWOM generally spanned a wet period, the available data were not used directly to generate the 40-year sequence of hydrology. Rather, the available data were used to develop a representative sequence that would capture a greater number of dry years in order to be representative of long-term conditions. This method and the resulting hydrology used to drive the 40-year URGWOM model for this planning analysis are described in an Appendix to this report.

The model results were used to compare the relative magnitude or occurrence of flood control problems, Rio Grande Compact delivery, conservation storage, carryover storage, reservoir drawdown, peak flow, sediment transport, water supply delivery, overbank flooding and other hydrologic impacts.

7.2 Initial Rating of Alternatives

Using the methods described above, and applying the judgment and experience of the water operations team, the 21 alternatives were rated using a numerical scale for multiple criteria. The criteria, their relative weighting, and the scores assigned are shown on **Table I-7.1**. From this analysis, alternatives B-3, C-3, D-3, E-3 and I-3 were most highly rated, with C-3 receiving the highest numerical score.

For consideration as final alternatives for detailed evaluation, the team recommended to the ID Team several alternatives that appeared to provide a high level of flexibility for the resources at each facility, recognizing that flexibility in operations is critically important to the ability to balance variable water supply conditions and demands. The ID Team chose to retain several of the alternatives among those rated highly by the Water Operations Team. In addition, the ID Team chose to retain alternatives I-1 and I-2 with more restrictive operational flexibility. For cases I-1 and I-2, the Low Flow Conveyance Channel is restricted to maximum diversions of 500, and 1,000 cfs (less than the value of 2,000 cfs that represents maximum flexibility). These were included to broaden the spectrum of alternatives analyzed in detail.

Alternatives B-3, D-3, E-3(C-3), I-1, I-2 and I-3, along with the No Action Alternative, G, were retained for detailed screening. Alternative C-3 was considered similar enough to E-3 that it could be included as a variant of the alternative E-3.

7.3 Discussion of Alternatives not Carried Forward for Detailed Analysis

Alternative A1, A2 and A3 were considered but discarded. The proposed alternatives were to store conservation water at Abiquiu Reservoir in the amounts of 20,000, 75,000 and 180,000 acre-feet in A1, A2 and A3, respectively. Other actions that were considered in the alternatives were a change in the Heron waiver day and the Cochiti channel capacity. Two actions that did not change in the three variants of alternatives was the channel capacity (1,200 cfs) at Abiquiu and the LFCC diversions (2,000 cfs maximum). Alternatives A1, A2, A3 were eliminated because they were associated with several negative impacts:

a) a decrease in operation flexibility;

b) greater difficulty meeting Rio Grande Compact delivery requirements;

c) an increased number of years with carryover storage;

d) difficulty in satisfying downstream demands;

e) and, operation of the Rio Chama at channel capacity throughout the snowmelt runoff and irrigation season in a large number of years

The Corps operates its projects to evacuate flood storage as rapidly as conditions downstream permit. A 1,200 cfs channel capacity below the dam would limit the Corps ability to evacuate flood storage and therefore create carryover storage in the reservoir on a regular basis over the 40 year hydrologic sequence. A key difficulty is presented with the ability to meet demands downstream; inspection of historic data indicates that a 1,200 cfs release from Abiquiu Dam is insufficient to meet demands downstream, considering that endangered species releases below Abiquiu Dam have been as high as 600 cfs, and irrigation releases in the past have been between 1,000 – 1,200 cfs.

Alternative B1, B2 were considered but discarded. The proposed alternatives were to store conservation water at Abiquiu Reservoir in amounts up to 20,000, 75,000 and 180,000 acre-feet in B1, B2 and B3, respectively. Other actions that were included were a change in the Heron waiver date and the Cochiti channel capacity. Two actions that did not change in the three variants of the alternatives were the channel capacity (1,500 cfs) at Abiquiu and the LFCC diversions (2,000 cfs maximum). These alternatives increased operational flexibility and were viable options, but the ability to store conservation water up 180,000 acre-feet was the alternative that was chosen from this group. The Water Operations decided that alternative B3 provided the maximum flexibility when operating the system. Alternatives B1 and B2 showed no readily identifiable benefits associated with the lower limit on conservation storage. Decreasing the channel capacity below Abiquiu dam does decrease the level of protection that the project can provide. In the last few years a 1,500 cfs release from Abiquiu Dam would be enough to meet demands downstream.

Alternative C1, C2, C3 were considered but discarded. The proposed alternatives were to store conservation water at Abiquiu Reservoir in the amounts of 20,000, 75,000 and 180,000 acre-feet in C1, C2 and C3, respectively. Other actions that were considered in the alternatives were a change in the Heron waiver day and the Cochiti channel capacity. Two actions that did not change in the three variants of the alternatives were the channel capacity (1,800 cfs) at Abiquiu and the LFCC diversions (2,000 cfs max). These alternatives increased operational flexibility and were viable options. The C alternatives are identical to the E alternatives with the exception of the Heron waiver date. Alternative C3 provides the greatest flexibility, but due to its similarity to Alternative E3, is not carried forward for separate analysis.

Alternative C1 and C2 are not carried forward, as there is no clear benefit to restricting the ability for conservation storage. Alternative C3 will be merged into a variation Alternative E3 in detailed analysis.

Alternatives D1 and D2 were considered but discarded. The proposed alternatives were to store conservation water at Abiquiu Reservoir in the amounts of 20,000, 75,000 and 180,000 acre-feet in D1, D2 and D3, respectively. Other actions that were considered in the alternatives were a change in the Heron waiver day and the Cochiti channel capacity. Alternatives D2 and D3, the Cochiti channel capacity is increased to 10,000 cfs and the Heron waiver limit is shifted to September 30. The two actions that did not change in the three variations of the D alternatives were the channel capacity (2000 cfs) at Abiquiu and the LFCC diversions (2,000 cfs max). These alternatives increased operational flexibility and were viable options. But the ability to store conservation water up 180,000 acre-feet was the alternative that was chosen from this group. The Water Operations Team decided that alternative D3 provided the maximum flexibility when operating the system. Alternative D1 and D2 are not carried forward, as they offer little benefit over D3, which is carried forward. An added benefit is that increasing the channel capacity below Abiquiu dam does raise the level of protection that the project can provide and increases compact deliveries.

Alternatives E1, E2 were considered but discarded. The proposed alternatives were to store conservation water at Abiquiu Reservoir in the amounts of 20,000, 75,000 and 180,000 acre-feet for E1, E2 and E3, respectively. Four actions that did not change in the three variants of the alternatives are the channel capacity (1,800 cfs) at Abiquiu, channel capacity at Cochiti (10,000 cfs) and the LFCC diversions (2,000 cfs max), and no change in the Heron waiver date. These alternatives increased operational flexibility and were viable options. However, the ability to store conservation water up 180,000 acre-feet was the alternative that was chosen from this group. The Water Operations team decided that alternative E3 provided the maximum flexibility when operating the system. Alternatives E1 and E2 are not carried forward, as they offer little benefit over E3. Alternative E3 is carried forward for further analysis and will be analyzed with the change in Heron waiver (to September 30, from plan C3) as a minor variant. Increasing the channel capacity below Cochiti dam increases the level of protection that the project can provide, increases sediment transport, provides for overbank flooding and increases compact deliveries.

Alternatives F1, F2, F3 are all the same in the table. Alternative F was considered but discarded. The proposed alternatives had no conservation water storage at Abiquiu Reservoir, a channel capacity (1,800 cfs) at Abiquiu, a channel capacity at Cochiti (10,000 cfs), no LFCC diversions, and no change in the Heron waiver date. This alternative was eliminated because it decreased operational flexibility. The inability to store water upstream was one of the reasons this alternative was eliminated. Another reason this alternative was eliminated is that alternative E3 uses the same channel capacity below Cochiti Dam. Furthermore, this alternative bears enough similarity to the No Action Alternative (as modeled for the present physical condition of the LFCC) that separate and detailed consideration was deemed unnecessary.

Alternatives I1, I2, I3 were considered and not discarded. This suite of alternatives is discussed in the next section.

7.4 Discussion of Alternatives Carried Forward for Detailed Analysis

The proposed alternative B-3 focuses on storing conservation water at Abiquiu Reservoir up to 180,000 acre-feet. Other actions that were included in the alternative are a change in the Heron waiver date, Cochiti channel capacity, Abiquiu channel capacity, and LFCC diversions (2,000 cfs max.). Alternative B-3 provided some operational flexibility. The benefits associated with this alternative are the ability to

store conservation water, Heron waiver date, operation of the low flow, and increased channel capacity below Cochiti Lake. The disadvantage of this alternative is the decrease in channel capacity below Abiquiu Dam. Decrease in channel capacity results in a decrease in the level of protection that the project provides for flood control. This also affects New Mexico's ability to deliver water to Elephant Butte Reservoir for compact obligations.

The proposed alternative D-3 allows storage of conservation water at Abiquiu Reservoir up to 180,000 acre-feet. Other actions that were included in the alternative are a change in the Heron waiver date, Abiquiu channel capacity, and the LFCC diversions (2,000 cfs max.). Alternative D-3 provided some operational flexibility. The benefits associated with this alternative are the ability to store conservation water, the Heron waiver date, and operation of the LFCC, ability to meet compact deliveries, and increased channel capacity below Abiquiu Dam. The disadvantages of this alternative is that the increase in channel capacity below Abiquiu would damage diversion structures, head gates, cause bank erosion and increased overbank flooding. The increase in channel capacity at Abiquiu would decrease the level of flood protection at Cochiti, since the channel capacity below the dam remains at 7,000 cfs.

The proposed alternative E-3 allows for storage of conservation water at Abiquiu Reservoir up to 180,000 acre-feet. Other actions in this alternative include a change in channel capacity at Cochiti of 10,000 cfs and LFCC diversions to the limit of 2,000 cfs. To limit the number of alternatives analyzed in detail, action alternatives C-3 and E-3 were combined due to similarities in proposed actions. The benefits associated with this alternative are the increased channel capacity below Cochiti Dam, increased level of flood protection, increased sediment transport, increased overbank flow, increased compact deliveries, the ability to store conservation water and utilizing the LFCC. The disadvantages of this alternative are that the Heron waiver date is April 30, and an increase of channel capacity below Cochiti Dam which would require increased maintenance to accommodate higher flows. Changing the waiver date at Heron to September would provide the maximum flexibility.

The proposed alternatives in I-1, I-2, I-3, allow for storage of conservation water at Abiquiu Reservoir up to limits of 20,000, 75,000 and 180,000 acre-feet for I1, I2 and I3, respectively. The LFCC is operated to maximum diversion limits of 500, 1,000, and 2,000 cfs, respectively, under the three variations. All 'I' alternatives included a channel capacity of 1,800 cfs at Abiquiu, channel capacity of 7,000 cfs at Cochiti and no change in the Heron waivers usage date. With the exception of the LFCC limitations, these alternatives increase operational flexibility and are viable. Although the ability to make compact deliveries is lessened with restricted diversions at the LFCC, these plans are maintained for further analysis due to interest from the ID Team in expanding the breadth of alternatives evaluated. The disadvantages of this suite of alternatives is that the Heron waiver date does not change (April 30), Cochiti channel capacity remains the same, operation of the LFCC is decreased in I-1 and I-2, and there is a decreased ability to store conservation water in I-1 and I-2.

The No Action Alternatives G1, G2, and G3 provide some operational flexibility but deviations are needed from the normal operations in order to accommodate the flexibility. The benefits associated with this alternative are the ability to extend Heron Reservoir waiver date (April), maintains channel capacity below Abiquiu Reservoir, maintains the ability to fulfill compact delivery obligations, and releases from Abiquiu do not impact water users needs downstream of the dam. The disadvantages of this suite of alternatives are that you need a deviation to store native water in Abiquiu Reservoir at the present time, channel capacity for Cochiti Dam is 7,000 cfs, Heron Waiver date is fixed, and the LFCC is not operational.

7.5 Results of Detailed Alternatives Screening

To illustrate some of the differences among the alternatives, hydrologic modeling was conducted using URGWOM at a daily timestep for the 40-year evaluation period. The model runs were structured to represent the maximum where ranges were represented in an alternative. For example, if an alternative indicated that conservation storage could occur up to 75,000 acre-feet, then, the rules were set such that storage in this amount would occur, if possible. Similarly, if the range of diversion identified for the LFCC was 0 – 2,000 cfs, then, the diversion was set at 2,000 cfs, if possible. While these simplifications were necessary to render the modeling practical, it must be understood that operators may have discretion to operate within the range, and not always at the extreme value of the range. The model results, therefore, represent what could result under the alternative – these results are useful for comparative purposes. However, it is important to consider the flexibility within each alternative qualitatively where specific model runs representing other possible manifestations of the alternative are not provided.

The model results are most useful for making comparisons between alternatives, but, due to limitations in assumptions and development within URGWOM, in some cases, may not be representative of absolute conditions. Particularly under lower flow conditions and in the reach below San Acacia, the model may not accurately represent flows. Therefore, projections of Compact deliveries or numbers of days of flow below a particular low value, i.e., below 200 cfs at San Acacia, may only be meaningful in a comparative sense.

Figures in Attachment D show some of the comparisons among alternatives. **Figure I-D.1** shows a 40-model year flow sequence at Otowi gage at Cochiti Dam. **Figure I-D.2** and **Figure I-D.3** evaluate the effects of different Abiquiu channel capacities and the effect they have on storage in Abiquiu Reservoir along with number of days per year channel capacity would be reached. **Figure I-D.8** compares the peak flows at Albuquerque for each alternative. **Figure I-D.9** compares the accumulated NM credit storage using various volumes of release and assumes a storage of 75,000 acre-feet in the conservation pool at Abiquiu Reservoir. **Figure I-D.10** and **Figure I-D.11** compare average annual storage in Abiquiu and Cochiti for all alternatives for 40 model years. **Figure I-D.12** through **Figure I-D.16** compare average annual flow at Albuquerque, Chamita, El Vado, Otowi, and San Acacia for all alternatives for 40 model years. Model years termed MY2003 to MY2042 are analogous to years 1 through 4 of the synthetic year flow sequence and are not intended to reflect condition for any specific future calendar year. Rather, they reflect a sequence of varied conditions that allow hypothetical future conditions under different alternatives to be compared.

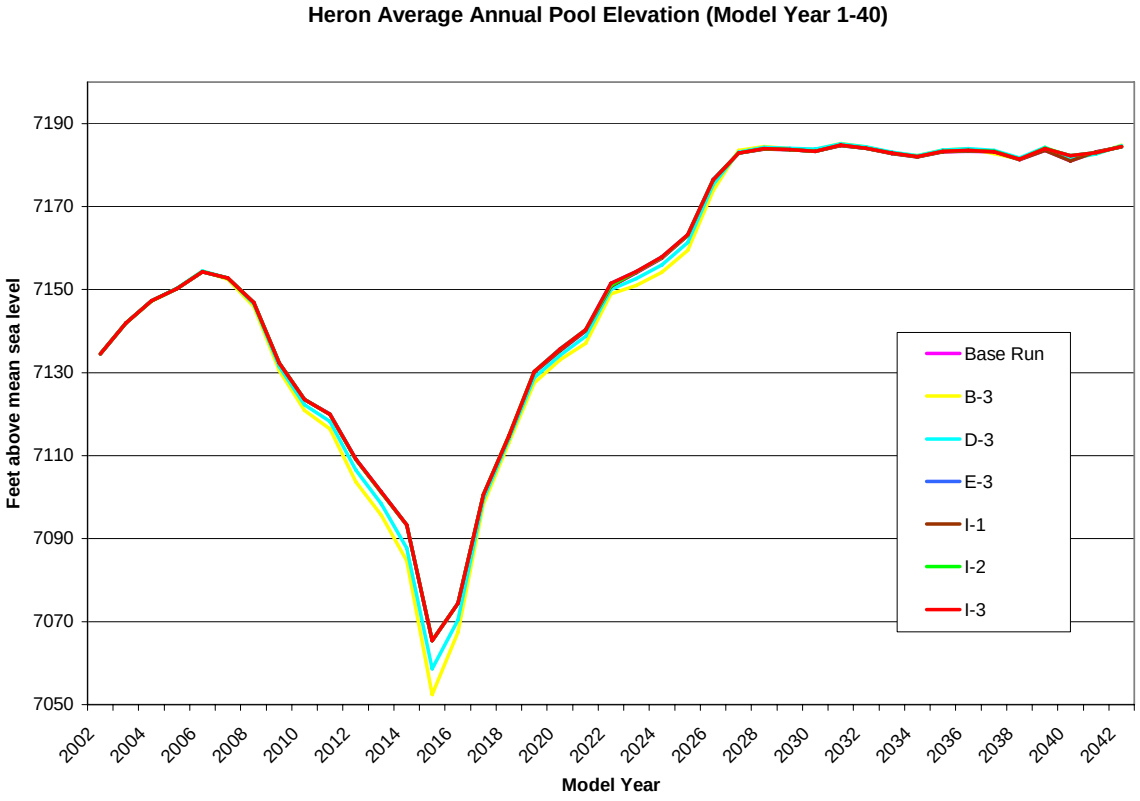
Tables in Attachment E provide a summary of statistical data for the different action alternatives. **Tables I-E.1 through I-E.4** summarize pool elevation data for Abiquiu, Cochiti, El Vado and Heron. **Tables I.E-5 and 6** summarize pool storage for Abiquiu and Cochiti. **Tables I.E-7 through I-E.11** summarize flow in Albuquerque, Chamita, El Vado, Otowi and San Acacia.

The Water Operations Team rated the subset of final alternatives using comparative model results in combination with engineering judgment and an understanding of system operations. The alternatives were rated relative to one another using a set of weighted criteria. The results of this analysis are provided on **Table I-7.2**. In consideration of the difficulty of anticipating all possible water supply conditions and future demands, the Water Operations Team recommends that flexibility in operations be considered a parameter of high value. This perspective is reflected in the weighting and scoring on **Table I-7.2**. From this analysis, the Water Operations Team prefers alternative E.

7.6 Impacts of Action Alternatives on Reservoirs

7.6.1 Heron Reservoir

Reservoir elevation was used to gauge the impact of each of the six action alternatives on Heron Reservoir. Reservoir elevation as simulated within URGWOM for each of the six alternatives was plotted and compared to the simulated base run elevation for the 40 year planning period. From May of Model Year (MY) 2006 to November of MY 2026, reservoir elevation as modeled by action alternatives B-3 and D-3 show significant departures below the base run elevation. From November of MY 2026 to the end of the 40 year planning period, reservoir elevations for alternatives B-3 and D-3 track slightly above the base run. During this later period, the average annual reservoir elevation as modeled using action alternatives B-3 and D-3 tracks less than 1 ft above the base run, although average weekly elevations exceed 2 ft above the base run during several years. Action alternatives E-3, I-1, I-2, and I-3 track well with the base run showing insignificant departures from the base run elevation throughout the 40 year planning period.

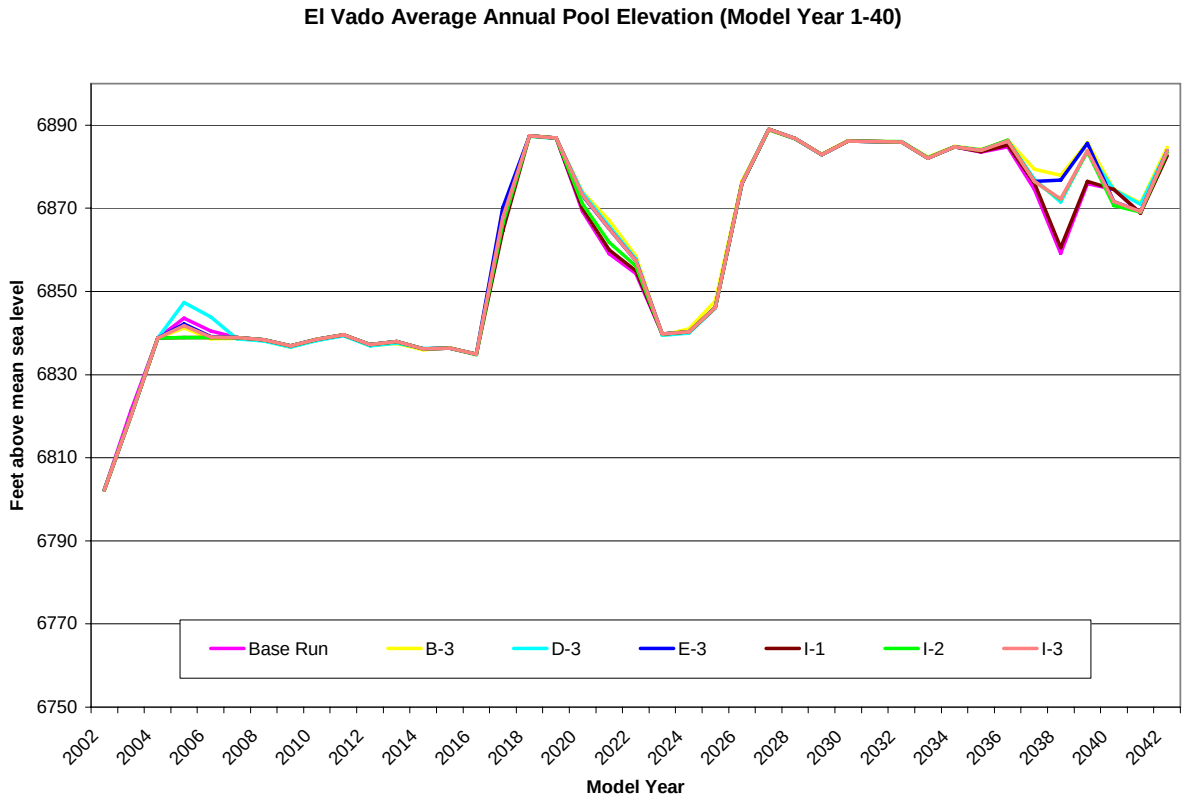


The differences observed in Heron reservoir elevation as modeled with action alternatives B-3 and D-3 appear to be the result of these alternatives having modeled SJC waiver dates of September 30 and August 31, respectively. The model is set up to assume that any excess SJC water within Heron that does not have a downstream destination will either revert back to the federal pool in Heron, or be transferred to MRGCD for use in Middle Valley irrigation during that same year if MRGCD is experiencing a shortage in supply. With the extended waiver dates modeled in B-3 and D-3, a greater volume of this SJC contractor water is being transferred to MRGCD during the extended dry period during the first portion of the 40 year planning period. Since any water that is not transferred or delivered prior to the waiver date reverts back to the Federal pool, these additional transfers to MRGCD result in less water reverting to the Federal pool during this dry period.

Although the total volume of additional water that is transferred to MRGCD because of the extended waiver dates modeled in B-3 and D-3 is only on the order of 6,000 to 7,000 acre-ft over the entire period, a significant drop in reservoir elevation occurs because of the critically low storage that is modeled within Heron during this time. At extremely low reservoir elevations, such as are modeled to occur in MY 2015 and 2016, a difference in storage of 6,000 acre-ft results in an approximate 12 ft reduction in reservoir elevation at Heron. Similarly, a 6,000 acre-ft reduction in reservoir content explains the 2 ft to 4 ft departures below the base run elevation observed during MY 2017 through MY 2027.

7.6.2 El Vado Reservoir

As in Heron Reservoir, reservoir elevation was used to gauge the impact of each of the six action alternatives on El Vado Reservoir. Reservoir elevation was used to gauge the impact of each of the six action alternatives El Vado Reservoir. Reservoir elevation as simulated within URGWOM for each of the six alternatives was plotted and compared to the simulated base run elevation for the 40 year planning period. In general, reservoir elevation from all action alternatives tracked fairly closely to the base run with a few notable exceptions. Relatively large departures from the base run elevation (greater than 5 ft above base run) can be observed from April of MY 2020 to September of MY 2022, and even larger departures (greater than 30 ft above base run) are observed from August of MY 2037 through June of MY 2039. These two periods were examined in greater detail to attempt to determine the cause of these relatively large deviations from the base run reservoir elevations.



The primary component of the action alternatives impacting El Vado reservoir elevation and storage as modeled over the 40 year period appears to be associated with the modeled operation of the Low Flow Conveyance Channel (LFCC) and modeled increases in channel capacity below Abiquiu and Cochiti Reservoirs. This conclusion is based on a review of Elephant Butte and Caballo Reservoir contents as an

indicator of Rio Grande Compact usable water and native Rio Grande storage in El Vado as an indicator of whether or not New Mexico is under Article VII storage restrictions.

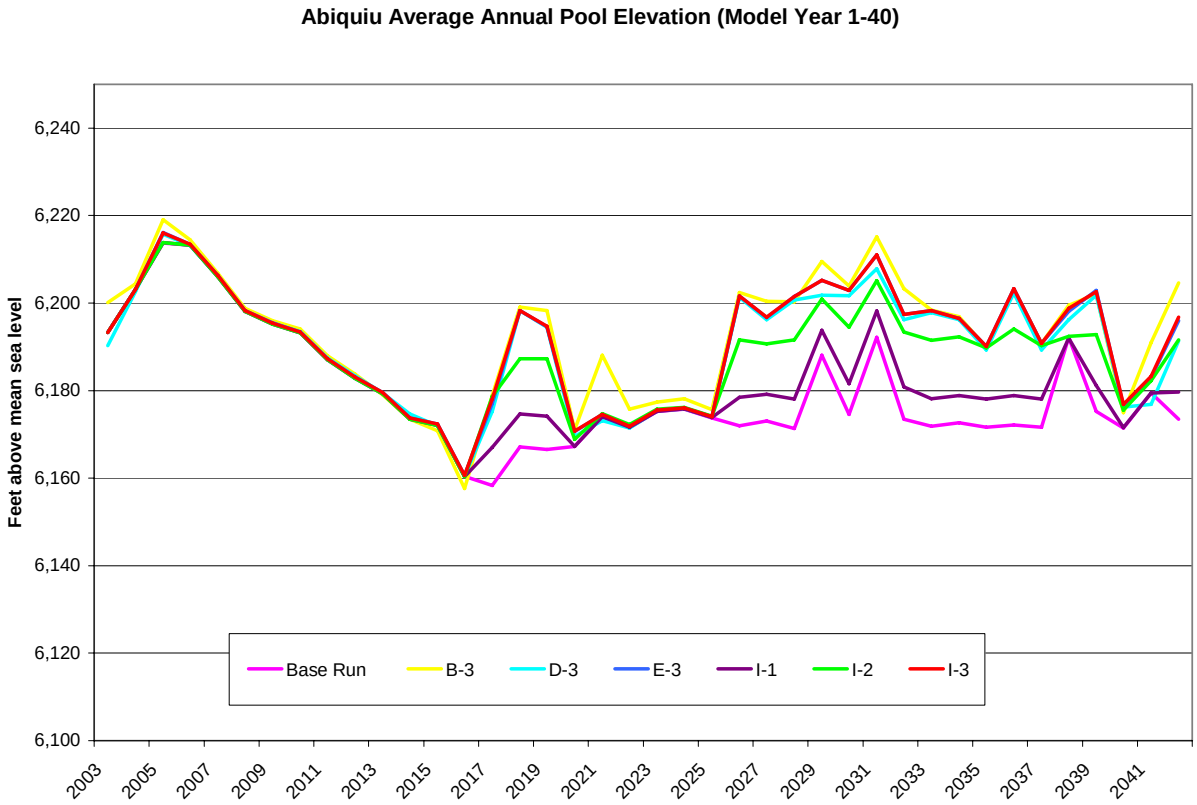
During extended periods within the 40 year planning horizon when Rio Grande Compact usable water either remains above or below the 400,000 acre-ft threshold, all six action alternatives track well together with rather insignificant departures from the base run elevation. It is believed that this is because all alternatives as well as the base run are initiating storage in El Vado in a similar fashion starting at near the same point each spring. However, during those periods when Article VII storage restrictions are repeatedly lifted and then enacted as Rio Grande Compact usable water oscillates around 400,000 acre-ft, noticeable departures from the base run elevation are observed. It appears that those alternatives that have the modeled ability to deliver water to Elephant Butte either more rapidly through higher channel capacity, and/or more efficiently through the LFCC are able to more efficiently capture the runoff in El Vado resulting in greater reservoir storage and greater water surface elevation.

During the MY 2037 to MY 2039 period, I-1 has the least departure from base run compared to the other alternatives which might be expected considering I-1 is the closest to the modeled base run conditions. Action Alternatives D-3, I-2, and I-3 are then clustered together with somewhat greater departures from the base run, perhaps due to LFCC operations being modeled to deliver up to 1,000 to 2,000 cfs. Action alternatives B-3 and E-3 are then grouped together with even greater departures, which may be a result of these alternatives being modeled with LFCC flows up to 2,000 cfs and below Cochiti channel capacity set to 8,500 to 10,000 cfs.

The modeled waiver delivery date for annual SJC water allocations out of Heron appears to have a lesser impact on modeled El Vado storage and reservoir elevation. During hydrologicaly and meteorologically wet periods when El Vado remains relatively full, the ability to hold MRGCD's annual SJC water allocation later in Heron Reservoir seems to result in El Vado being "topped off" later in the year after storage space is available following releases of stored water for Middle Valley irrigation. This results in slightly higher average reservoir elevations in El Vado for action alternativesB-3 and D-3, and a slightly smaller portion of MRGCD's annual allocation reverting to the Federal SJC pool in Heron after the modeled waiver date is reached on August 31 or September 30. All other alternatives as well as the base run were modeled with a Heron waiver date of April 30. These conclusions are based on the observed modeled storage within MRGCD's Heron SJC account and the modeled total storage in El Vado Reservoir for action alternatives B-3 and I-3.

7.6.3 Abiquiu Reservoir

Reservoir elevation was used to gauge the impact of each of the six action alternatives on Abiquiu Reservoir. The elevation as simulated within URGWOM for each of the six alternatives was plotted and compared to the simulated base run elevation for the 40-year planning period. In general, reservoir elevation from all action alternatives tracked close to the base run for the first 15 years. Departures from the base run elevation occur when conservation water is being stored. The range in departures (between 5 to 32 ft above the base run) depends on the volume of the conservation water being stored in each alternative and the channel capacity below Abiquiu Reservoir.



The primary components of the action alternatives influencing Abiquiu Reservoir elevation and storage as modeled over the 40-year is associated with the modeled operation of the LFCC, conservation storage space available by alternative, and channel capacity below Abiquiu and Cochiti Reservoirs. Conservation storage can only take place when New Mexico is not in Article VII of Rio Grande Compact. Review of Elephant Butte and Caballo Reservoir contents as an indicator of Rio Grande Compact usable water shows that storage at Abiquiu Reservoir under each of the action alternatives occurs within 0 to 8 days of each other.

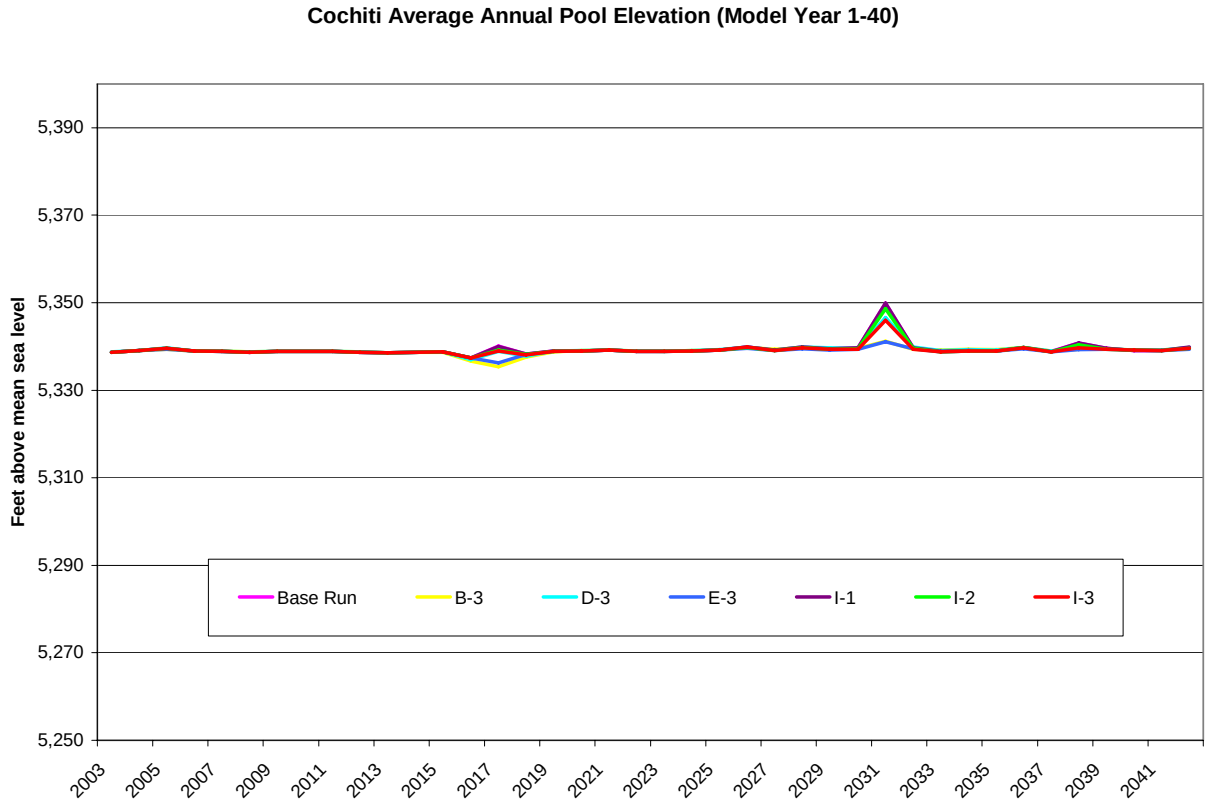
During extended periods within the 40-year planning horizon when Rio Grande Compact usable water remains above the 400,000 acre-feet threshold, all six-action alternatives have departures from the base run elevation. This is because all alternatives are initiating conservation storage in Abiquiu Reservoir. The alternatives that have the modeled ability to deliver water to Elephant Butte either more rapidly through higher channel capacity, and/or more efficiently through the LFCC are able to start the capture of conservation water earlier in Abiquiu Reservoir.

Alternative I-1 and I-2 have the least departure from base run compared to the other alternatives which is expected since I-1 and I-2 are the closest to the modeled base run condition. Action Alternatives B-3, D-3, E-3, and I-3 are then clustered together with greater departures from base run, due to the amount of conservation storage space available under each alternative. There is no impact on the ability to storage San Juan-Chama water in any of the alternatives.

7.6.4 Cochiti Reservoir

Reservoir elevation was used to gauge the impact of each of the six action alternatives (B-3, D-3, E-3, I-1, I-2, I-3) selected by the Water Operations Review Interdisciplinary Team on Cochiti Reservoir. The

elevation as simulated within URGWOM for each of the six alternatives was plotted and compared to the simulated base run elevation for the 40-year planning period. The reservoir elevation from all action alternatives tracked close to the base run for the 40-year period. The range in departures (between 0 to 9 ft below the base run) depends on the volume of conservation water being stored upstream, and the channel capacity below Abiquiu Reservoir and Cochiti Lake.



The main component of the action alternatives influencing Cochiti Lake elevation and storage over the 40-years is associated with the modeled channel capacity below and Cochiti Lake. A change in channel capacity below Abiquiu Reservoir in the action alternatives influences Cochiti Lake inflow by -300 or +200 cfs. A change in channel capacity below Cochiti has a larger impact. The Base Run channel capacity below Cochiti is 7,000, while some of the action alternatives have a channel capacity of 8,500 and 10,000 cfs. Cochiti Lake is operated to pass inflow up the channel capacity so the higher the release the less chance to store water.

In year 2017, the elevations in B-3 and E-3 are lower because of the stepped release function. Alternative B-3 and E-3 models over release water in storage in an effort to get down to the permanent pool. Year 2031 shows the largest departure from the base run condition. The large channel capacity in alternatives B-3 and E-3 allow Cochiti to be operated with very little storage above the Base Run condition.

Table I-7.1 Decision Support

DECISION SUPPORT: Alternative Performance vs. Water Operations Performance Measures

	Performance Measure	Compatibile w/Flood Control Operations	Compatibile w/Rio Grande Compact	Improves System Operational Flexibility	Supports Water Delivery	Maximizes Conservation Storage Opportunities	Maximizes Peak Discharge Opportunities	Maximizes Sediment Transport Opportunities	Supports Desirable Winter Flows	Supports Recreational Uses	Supports Stable Reservoir Levels		
	Threshold Criterion	X	X		X								
	Weight	0.20	0.20	0.15	0.15	0.10	0.08	0.05	0.04	0.02	0.01	Weighted Average Percent Met	Rank
	ALTERNATIVE												
1	**Plan G - No Action (Baseline)**	7	4	5	8	0	6	6	5	5	5	52.80%	19
2	Plan A1- Dry Hydrology Criteria	4	5	3	2	3	2	2	3	3	3	33.20%	22
3	Plan A2 - Normal Hydrology Criteria	4	5	4	2	7	2	2	1	1	1	37.30%	21
4	Plan A3 - Wet Hydrology Criteria	4	5	5	2	10	2	2	1	1	1	41.80%	20
5	Plan B1 - Dry Hydrology Criteria	6	7	6	7	3	5	5	4	4	4	57.80%	18
6	Plan B2 - Normal Hydrology Criteria	7	7	8	8	7	7	7	5	5	5	71.60%	16
7*	**Plan B3 - Wet Hydrology Criteria**	**9**	**9**	**10**	**8**	**10**	**8**	**9**	**5**	**5**	**5**	**87.40%**	**6**
8	Plan C1 - Dry Hydrology Criteria	7	8	6	8	3	6	6	5	5	5	65.30%	17
9	Plan C2 - Normal Hydrology Criteria	10	10	8	9	7	9	8	6	5	5	87.60%	5
10*	**Plan C3 - Wet Hydrology Criteria**	**10**	**10**	**10**	**10**	**10**	**9**	**9**	**6**	**5**	**5**	**95.60%**	**1**
11	Plan D1 - Dry Hydrology Criteria	10	8	7	10	3	8	8	5	5	5	78.40%	11
12	Plan D2 - Normal Hydrology Criteria	10	8	8	10	7	8	8	5	5	5	83.90%	8
2*	**Plan D3 - Wet Hydrology Criteria**	**10**	**10**	**10**	**10**	**10**	**8**	**8**	**5**	**5**	**5**	**93.90%**	**3**
14	Plan E1 - Dry Hydrology Criteria	10	10	6	8	3	9	9	5	6	5	79.40%	10
15	Plan E2 - Normal Hydrology Criteria	10	10	7	9	7	9	9	6	6	5	86.80%	7
16*	**Plan E3 - Wet Hydrology Criteria**	**10**	**10**	**9**	**10**	**10**	**9**	**9**	**6**	**6**	**5**	**94.30%**	**2**
17	Plan F1 - Dry Hydrology Criteria	10	8	5	10	0	9	9	6	6	6	74.40%	13
18	Plan F2 - Normal Hydrology Criteria	10	8	5	10	0	9	9	6	6	6	74.40%	13
19	Plan F3 - Wet Hydrology Criteria	10	8	5	10	0	9	9	6	6	6	74.40%	13
20**	**Plan I1 - Dry Hydrology Criteria**	**10**	**6**	**6**	**10**	**3**	**7**	**7**	**6**	**6**	**6**	**72.30%**	**15**
21**	**Plan I2 - Normal Hydrology Criteria**	**10**	**8**	**8**	**10**	**7**	**7**	**7**	**6**	**6**	**6**	**83.30%**	**9**
22*	**Plan I3 - Wet Hydrology Criteria**	**10**	**10**	**10**	**10**	**10**	**7**	**7**	**6**	**6**	**6**	**93.30%**	**4**

NOTES:

1. Performance Measure weights sum to 100 points total
2. Weighted Average Percent Met multiplies sums (scores * weights) for all measures
3. Alternatives are ranked from highest to lowest score
4. Top four alternatives selected for detailed analysis; supplemented by ID-NEPA Team dry and normal alternative selections

7*	**Alternative Selected by Water Operations Rankings for Detailed Analysis**
20**	**Alternative Selected by ID-NEPA Team for Broader Sepctrum Operations Analysis**
10***	**Alternative combined with E-3 for detailed analysis**

Table I-7.2 Decision Support

DECISION SUPPORT: Alternative Performance vs. Water Operations Performance Measures

	Performance Measure	Compatibile w/Flood Control Operations	Compatibile w/Rio Grande Compact	Improves System Operational Flexibility	Supports Water Delivery	Maximizes Conservation Storage Opportunities	Maximizes Peak Discharge Opportunities	Maximizes Sediment Transport Opportunities	Supports Desirable Winter Flows	Supports Recreational Uses	Supports Stable Reservoir Levels		
	Threshold Criterion	X	X		X								
	Weight	0.20	0.20	0.15	0.15	0.10	0.08	0.05	0.04	0.02	0.01	Weighted Average Percent Met	Rank
	ALTERNATIVE												
1	Plan G - No Action (Baseline)	70	10	0	20	0	30	40	30	20	20	25.00%	7
7	Plan B3 - Wet Hydrology Criteria	90	90	50	70	100	70	90	30	20	20	76.00%	4
2	Plan D3 - Wet Hydrology Criteria	100	90	90	90	100	70	70	30	20	50	86.00%	2
16	Plan E3 - Wet Hydrology Criteria	100	100	95	100	100	90	90	70	70	60	96.00%	1
20	Plan I1 - Dry Hydrology Criteria	100	20	10	30	30	50	50	70	40	60	44.00%	6
21	Plan I2 - Normal Hydrology Criteria	100	70	50	70	70	50	50	70	50	60	70.00%	5
22	Plan I3 - Wet Hydrology Criteria	100	90	85	90	100	50	50	70	70	60	86.00%	3

NOTES:

NOTES:

1. Use quantitative measures wherever possible: acre-feet of water delivered; acres habitat available; days of flooding > 100-year flood; etc.
2. Use criteria weights that sum to 100 points total
3. Apply the following equation to performance criteria in each cell - i.e., performance value* weight = cell number
4. Identify critical thresholds on applicable decision criteria

8.0 ATTACHMENT A OPERATIONAL FLEXIBILITIES AND PRELIMINARY SCREENING

Preliminary Screening of Operational Feasibility by Facility and Action.

This preliminary screening table documents the actions considered at each facility for which some flexibility was identified through internal and public scoping. It summarizes the facility, the action under consideration, the attribute that would be addressed, whether or not the action under consideration would represent a fatal flaw with respect to the attribute and the rationale. In identifying whether or not the action would represent a fatal flaw, the Purpose and Need Statement for Water Operations Review was considered. The following summarizes the elements of the Purpose and Need Statement that were considered in this preliminary screening evaluation.

Need: Under various existing legal authorities, and subject to allocation of supplies and priority of water rights under state law, the COE and BOR operate dams, reservoirs, and other facilities in the upper Rio Grande basin to:

N1. Store and deliver water for agricultural, domestic, municipal, industrial, and environmental uses;

N2. Assist the ISC in meeting downstream water delivery obligations mandated by the Rio Grande Compact;

N3. Provide flood protection and sediment control; and

N4. Comply with existing law, contract obligations, and international treaty.

Purpose: The Upper Rio Grande Basin Water Operations Review will be the basis of, and integral to, preparation of the Water Operations EIS. The purpose of the Review and Water Operations EIS is to:

P1. Identify flexibilities in operation of federal reservoirs and facilities in the upper Rio Grande basin that are within existing authorities of COE, BOR, and NMISC, and in compliance with state and federal law;

P2. Develop a better understanding of how these facilities could be operated more efficiently and effectively as an integrated system;

P3. Formulate a plan for future water operations at these facilities that is within the existing authorities of BOR, COE, and NMISC; complies with state, federal, and other applicable laws and regulations; and assures continued safe dam operations;

P4. Improve processes for making decisions about water operations through better interagency communications and coordination, and facilitation of public review and input; and

P5. Support compliance of the COE, BOR, and NMISC with applicable law and regulations, including but not limited to the National Environmental Policy Act and the Endangered Species Act.

The attributes of interest and rationale for evaluating the action with respect to each attribute are based on engineering judgment and knowledge of the Rio Grande Basin. Those attributes that meet do not appear to be inconsistent with specific purpose and/or need statements are marked with an X in the columns on the right. If an attribute contains a “fatal flaw” that would override other considerations, an X is placed in the column labeled Fatal Flaw.

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
Heron	Waivers – None	Water delivery	Does not affect the ability to deliver SJC water to contractors. No change in the way the reservoir is operated for natural flow.	X	
		Winter flows	Allows for higher winter flows below El Vado in November and December. SJC water would be delivered in November and December. Lower flows below El Vado in January and February.	X	
		Conservation storage	Does not allow for additional storage space in El Vado and Abiquiu. SJC water delivered before snowmelt runoff season.	X	
		Conservation storage	Contractors do not suffer evaporation losses until the water is released.	X	
		Reservoir levels	Less stable lake levels downstream since water is not delivered throughout the year. Delivery of SJC water would be November and December. Exception could be MRGCD Water delivery. Payback to river would be bypassed.	X	
		Channel capacities	No impact to channel capacities	X	
		Rio Grande Compact	There should be no impact to NM's capability to meet Rio Grande Compact obligations.	X	
		Low flow conveyance channel	Should have no impact on low flow conveyance channel operation	X	
		Reservoir levels	More stable lake levels at Heron throughout most of the year.	X	
		Rafting flows	There should be no impact to rafting flows	X	
Heron	Waivers - April 30	Water delivery	Does not affect the ability to deliver SJC water to contractors. No change in the way the reservoir is operated for natural flow.	X	
		Winter flows	Allows for higher winter flows below El Vado. SJC water could be delivered November through April.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Conservation storage	Does not allow for additional storage space in El Vado and Abiquiu. SJC water delivered before snowmelt runoff season.	X	
		Conservation storage	Contractors do not suffer evaporation losses until the water is released.	X	
		Reservoir levels	Less stable lake levels downstream since water is not delivered throughout the year. Delivery of SJC water would be November and December. Exception could be MRGCD Water delivery. Payback to river would be bypassed.	X	
		Channel capacities	No impact to channel capacities.	X	
		Rio Grande Compact	There should be no impact to NM's capability to meet Rio Grande Compact obligations.	X	
		Low flow conveyance channel	Should have no impact on low flow conveyance channel operation	X	
		Reservoir levels	More stable lake levels at Heron throughout most of the year.	X	
		Rafting flows	There should be no impact to rafting flows.	X	
Heron	Waivers - June 30	Water delivery	Could affect the ability to deliver SJC water to contractors. No change in the way the reservoir is operated for natural flow. Possible disadvantage that contractors might consider in deciding whether to utilize such a waiver is the possibility that El Vado could be at channel capacity bypassing natural flow in May and June and not be able to make SJC water deliveries.	X	
		Winter flows	Could have lower SJC flows below El Vado from November to June.	X	
		Conservation storage	Does not allow for additional storage space in El Vado and Abiquiu. SJC water is delivered during snowmelt runoff season	X	
		Conservation storage	Contractors do not suffer evaporation losses until the water is released.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Reservoir levels	Less stable lake levels downstream since water is not delivered throughout the year. Delivery of SJC water would be June. Exception could be MRGCD Water delivery. Payback to river would be bypassed.	X	
		Channel capacities	No impact to channel capacities.	X	
		Rio Grande Compact	Potential impact to NM's ability to meet Compact obligations, particularly in year of early run-off (if waiver results in greater MRGCD use of native water.)	X	
		Low flow conveyance channel	Should have no impact on low flow conveyance channel operation	X	
		Reservoir levels	More stable lake levels at Heron throughout most of the year.	X	
		Rafting flows	No impact to rafting flows	X	
Heron	Waivers - August 31	Water delivery	Does not affect the ability to deliver SJC water to contractors.	X	
		Winter flows	Could have lower SJC flows below El Vado during the winter.	X	
		Conservation storage	Does allow for additional storage space in El Vado and Abiquiu. SJC water is delivered after snowmelt runoff season.	X	
		Conservation storage	Contractors do not suffer evaporation losses until the water is released.	X	
		Reservoir levels	Could have more stable lake levels downstream since water is delivered during the irrigation season. Exception could be payback to river, which could be bypassed.	X	
		Channel capacities	Could impact channel capacities releases because of the additional water stored upstream	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries.	X	
		Low flow conveyance channel	Should have no impact on low flow conveyance channel operation	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Reservoir levels	More stable lake levels at Heron throughout most of the year.	X	
		Rafting Flows	Could have higher rafting flows.	X	
Heron	Waivers - September 30	Water delivery	Does not affect the ability to deliver SJC water to contractors.	X	
		Winter flows	Could have lower SJC flows below El Vado during the winter.	X	
		Conservation storage	Does allow for additional storage space in El Vado and Abiquiu. SJC water is delivered after snowmelt runoff season.	X	
		Conservation storage	Contractors do not suffer evaporation losses until the water is released.	X	
		Reservoir levels	Could have more stable lake levels downstream since water is delivered during the irrigation season. Exception could be payback to river, which could be bypassed.	X	
		Channel capacities	Could impact channel capacities releases because of the additional water stored upstream	X	
		Rio Grande Compact	Would diminish NM's capability to meet Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries	X	
		Low flow conveyance channel	Should have no impact on low flow conveyance channel operation	X	
		Reservoir levels	More stable lake levels at Heron throughout most of the year.	X	
		Rafting flows	Could have higher rafting flows.	X	
Abiquiu	20,000-acre-foot Conservation Storage	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demands. All demands downstream from Abiquiu need to be met before storage can take place.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated.	X	
		Flooding	Does not affect overbank flooding	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Does not affect low flow velocity	X	
		Flood control	Level of protection for flood control remains the same. Storage takes place within existing San Juan-Chama pool (elev. 6,220).	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water do not impact the rafting take out point (elev. 6,237).	X	
		Water delivery	Should not decrease the ability to move SJC water into storage during irrigation season and therefore not affect rafting releases.	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff.	X	
		Reservoir levels	Higher pool elevations during the irrigation season.	X	
		Peak discharge	There could be a slight reduction in peak discharge from Cochiti. Releases from Abiquiu could be increased when main stem of the Rio Grande is peaking to reduce impact.	X	
		Peak discharge	There could be a slight reduction in peak discharges below Abiquiu. Releases from Abiquiu could be increased up to channel capacity when main stem of the Rio Grande is peaking.	X	
		Narrowing of River Channel	Not likely to affect narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Should not impact maintenance flows required by riparian ecosystem.	X	
		Sediment transport	Slight reduction in the ability to transport sediment through the system when conservation storage is taking place.	X	
		Spawning flows	There should be no reduction in spawning flows. Conservation storage would only take place when all needs are met.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries. May require mitigation.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.	X	
		Floodplain encroachment	Should have no increase in encroachment (houses) in the floodplain.	X	
		Winter flows	Higher winter flows from November to March below Abiquiu if water is released during this time frame.	X	
		Pool elevations	More stable pools during the recreation season. If the water is released in November to March.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while conservation storage is taking place.	X	
		Carryover storage	Decreases the chance for carryover storage at Cochiti. Water held upstream in Abiquiu Reservoir.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
Abiquiu	50,000-acre-foot Conservation Storage	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demands. All demands downstream from Abiquiu need to be met before storage can take place.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Could affect overbank flooding below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem.	X	
		Flooding	Could affect low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem	X	
		Flood control	Level of protection for flood control remains the same. Storage takes place within existing San Juan-Chama pool (elev. 6,220).	X	
		Water delivery	Could decrease the ability to move SJC water into storage during irrigation season and therefore affect rafting releases. This could occur if main stem flows and MRGCD (El Vado) releases are enough to meet demand.	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water do not impact the rafting take out point (elev. 6,237).	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff.	X	
		Reservoir levels	Higher pool elevations during the irrigation season.	X	
		Pool elevations	Higher pool elevations during recreation season.	X	
		Peak discharge	Reduction in duration of peak discharge from Cochiti. Releases from Abiquiu could be increased when main stem of the Rio Grande is peaking to reduce impact.	X	
		Peak discharge	Reduction in duration of peak discharges below Abiquiu. Releases would be increased for a short time to match peak on main stem of Rio Grande.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Narrowing of channel	Likely to affect narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge if done every year.	X	
		Narrowing of channel	Conservation storage of this magnitude should have no effect on narrowing of river channel if done every three years.	X	
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem.	X	
		Sediment transport	Reduction in the ability to transport sediment through the system when conservation storage is taking place.	X	
		Spawning flows	There should be no reduction in spawning flows. Conservation storage would only take place when all needs are met.	X	
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries. May require mitigation.	X	
		Rio Grande Compact	.Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.	X	
		Narrowing of channel	Should have no increase in encroachment (houses) in the floodplain.	X	
		Winter flows	Higher winter flows from November to March below Abiquiu if water is released during this time frame.	X	
		Pool elevations	More stable pools during the recreation season if water is released from November to March.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while conservation storage is taking place.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Carryover storage	Decreases the chance for carryover storage at Cochiti. Water held upstream in Abiquiu Reservoir.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
Abiquiu	100,000-acre-foot Conservation Storage	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demands. All demands downstream from Abiquiu need to be met before storage can take place.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated.	X	
		Flooding	Does affect overbank flooding below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem.	X	
		Flooding	Could affect low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem.	X	
		Flood control	Level of protection for flood control remains the same. Storage takes place within existing San Juan-Chama pool (elev. 6,220).	X	
		Water delivery	Could decrease the ability to move SJC water into storage during and after irrigation season. Rafting releases could be affected. This could occur if main stem flows and MRGCD (El Vado) releases are enough to meet demand.	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water do not impact the rafting take out point (elev. 6,237).	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Reservoir levels	Higher pool elevations during the irrigation season.	X	
		Pool elevations	Higher pool elevations during recreation season.	X	
		Peak discharge	Reduction in peak discharge from Cochiti. May require mitigation.	X	
		Peak discharge	Reduction in peak discharges below Abiquiu.	X	
		Narrowing of channel	Likely to affect narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge if done every year. May require mitigation.	X	
		Narrowing of channel	Conservation storage of this magnitude should have no effect on narrowing of river channel if done every five to seven years	X	
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem. May require mitigation.	X	
		Sediment transport	Reduction in the ability to transport sediment through the system when conservation storage is taking place.	X	
		Spawning flows	There should be no reduction in spawning flows. Conservation storage would only take place when all needs are met.	X	
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries. May require mitigation.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation	X	
		Narrowing of channel	Could have an increase in encroachment (houses) in the floodplain with the lower releases when conservation storage is taking place.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Winter flows	Higher winter flows from November to March below Abiquiu if water is released during this time frame.	X	
		Pool elevations	More stable pools during the recreation season if water is released from November to March.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while conservation storage is taking place.	X	
		Carryover storage	Decreases the chance for carryover storage at Cochiti.	X	
		Low flow conveyance channel	Could impact low flow conveyance channel operation.	X	
Abiquiu	Up to elevation 6,220 (183,000 acre-feet) Conservation Storage	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demands. All demands downstream from Abiquiu need to be met before storage can take place.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated.	X	
		Flooding	Does affect overbank flooding below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem.	X	
		Flooding	Could affect low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. To reduce impact releases from Abiquiu could be increased to match peak flow on main stem.	X	
		Flood control	Level of protection for flood control remains the same. Storage takes place within existing San Juan-Chama pool (elev. 6220).	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Water delivery	Decreases the ability to move SJC water into storage during and after irrigation season. Rafting releases could be affected. This could occur if main stem flows and MRGCD (El Vado) releases are enough to meet demand.	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water do not impact the rafting take out point (elev. 6237).	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff and irrigation season months. Higher pool elevations during the irrigation season. Depends on the rate the water is used.	X	
		Reservoir levels	Higher pool elevations during recreation season.	X	
		Pool elevations	Higher pool elevations during recreation season.	X	
		Peak discharge	Reduction in peak discharge from Cochiti. May limit applicability or require mitigation	X	
		Peak discharge	Reduction in peak discharges below Abiquiu. May limit applicability or require mitigation	X	
		Narrowing of channel	Likely to affect narrowing of river channel (Rio Champ and Rio Grande) due to long-term reduction in channel forming discharge. May limit applicability or require mitigation	X	
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem. May limit applicability or require mitigation	X	
		Sediment transport	Reduction in the ability to transport sediment through the system when conservation storage is taking place. May limit applicability or require mitigation	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Spawning flows	There should be no reduction in spawning flows. Conservation storage would only take place when all needs are met.	X	
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water. May require mitigation.	X	
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries. May require mitigation.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.	X	
		Narrowing of channel	Could have an increase in encroachment (houses) in the floodplain with the lower releases when conservation storage is taking place.	X	
		Winter flows	Higher winter flows from November to March below Abiquiu if water is released during this time frame.	X	
		Pool elevations	More stable pools during the recreation season if water is released from November to March.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while conservation storage is taking place.	X	
		Carryover storage	Decreases the chance for carryover storage at Cochiti.	X	
		Low flow conveyance channel	Could impact low flow conveyance channel operation.	X	
Abiquiu	600-cfs Channel Capacity	Irrigation demand	Affects the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand. Historical operations during the irrigation show that MRGCD would not be able to meet demand.		X

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Water delivery	Affects the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated. SJC water would have to be released during winter months. Affects the ability to deliver water to Elephant Butte Reservoir.		X
		Pool elevations	Higher pool elevations as a result of the lower channel capacity could affect the rafting take out point (elev. 6,237).		
		Fluctuation in reservoir levels	More fluctuation in reservoir levels during spring runoff and winter months. Higher pool elevations during the irrigation season.	X	
		Flooding	Reduction in overbank flooding below Abiquiu and Middle Rio Grande Valley.		
		Flooding	Reduction in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley.		
		Peak Discharge	Reduction in peak discharge from Cochiti.		
		Narrowing of river channel	Narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.		
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem		X
		Flood control	Decrease in the level of protection for flood control as a result of the decrease in channel capacity.		X
		Sediment transport	Reduction in the ability to transport sediment through the system resulting in sediment plugs.		X
		Spawning flows	Reduction in spawning flows. Release of native flow limited by channel capacity.		
		Spawning flows	Would not have the ability to manufacture a spawning flow with SJC water.		X
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations. Water held up because of the lower channel capacity.		X

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.	X	
		Carry-over water	Increase in the number of years where the Corps would have carry-over water.	X	
		Conservation water	Increases the ability to store conservation water. Downstream minimum flow during conservation storage could be higher then 150-200 cfs range.	X	
		Encroachment in the floodplain	Increase in encroachment (houses) in the floodplain.		
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame.	X	
		Pools during the recreation season	More stable pools during the recreation season. MRGCD demand could be met with releases from El Vado. There would be no need to fluctuate the pool at Abiquiu.	X	
		Hydropower	Decreases peak hydropower generation. Could extent period when generating power. Flow could go through one unit.		
		Bank erosion	Reduces bank sloughing.	X	
		Reproduction of non-native plants	Increases reproduction of non-native plants on exposed banks and riverbed.		
		Low flow conveyance channel	Could impact low flow conveyance channel operation.		
		ESA compliance	Channel capacity reached earlier than existing condition. There would be no SJC releases during this time frame. If all demands are being met downstream the city of the Albuquerque could divert from the Rio Grande and payback the river with SJC at a later date. (July-September). Would add flow during the summer months for ESA compliance	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Channel capacity	Based on historical records (1975-1999) channel capacity of 600 cfs would be reached 100 percent of the time.		
Abiquiu	800-cfs Channel Capacity	Irrigation demand	Affects the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand. Historical operations during the irrigation show that MRGCD would not be able to meet demand. Would require more efficient MRGCD operations, i.e. reduced diversion demand		X
		Water delivery	Affects the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated. SJC water would have to be released during winter months. Affects ability to deliver water to Elephant Butte Reservoir.		X
		Pool elevations	Higher pool elevations as a result of the lower channel capacity could affect the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout.	X	
		Fluctuation in reservoir levels	More fluctuation in reservoir levels during spring runoff and winter months. Higher pool elevations during the irrigation season.	X	
		Flooding	Reduction in overbank flooding below Abiquiu and Middle Rio Grande Valley.		
		Flooding	Reduction in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley.		
		Peak Discharge	Reduction in peak discharge from Cochiti.		
		Narrowing of River Channel	Narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.		
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem.		

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flood control	Decrease in the level of protection for flood control as a result of the decrease in channel capacity.		
		Sediment transport	Reduction in the ability to transport sediment through the system resulting in sediment plugs.		
		Spawning flows	Reduction in spawning flows. Release of native flow limited by channel capacity.		X
		Spawning flows	Would not have the ability to manufacture a spawning flow with SJC water.		X
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations. Water held up because of the lower channel capacity. Might require mitigation measures		X
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. Water could be released during the winter months for compact deliveries	X	
		Carryover storage	Increase in the number of years where the Corps would have carryover water. Higher channel capacity decreases the chances for carry-over water.	X	
		Conservation water	Increases the ability to store conservation water. Downstream minimum flow during conservation storage could be higher then 150-200 cfs range.	X	
		Encroachment in the floodplain	Increase in encroachment (houses) in the floodplain.		
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame.	X	
		Pool elevations	More stable pools during the recreation season. Less fluctuation in pool elevation demand could be met with releases from El Vado.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Hydropower	Decreases peak hydropower generation. Could extent period when generating power. Flow could go through one unit.		
		Bank erosion	Reduces bank sloughing.	X	
		Bank vegetation	Increases reproduction of non-native plants on exposed banks and riverbed.		
		Low flow conveyance channel	Could impact low flow conveyance channel operation.		
		ESA compliance	Channel capacity reached earlier than existing condition. There would be no SJC releases during this time frame. If all demands are being met downstream the city of the Albuquerque could divert from the Rio Grande and payback the river with SJC at a later date. (July-September). Would add flow during the summer months for ESA compliance	X	
		Channel capacity	Based on historical records (1975-1999) channel capacity would be reached 100 percent of the time.	X	
Below Abiquiu	1,200-cfs Channel Capacity	Irrigation Demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand. Historical operations during the irrigation show that MRGCD would be able to meet demand.	X	
		Water delivery	Affects the ability to release San Juan-Chama water under existing laws. Natural flow into Abiquiu is the first water to be released or evacuated. The higher channel capacity improves the ability to move SJC during the irrigation. Could affect ability to deliver water to Elephant Butte Reservoir.	X	
		Pool elevations	Higher pool elevations as a result of the lower channel capacity could affect the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Reservoir levels	More fluctuation in reservoir levels during spring runoff and winter months. Higher pool elevations during the irrigation season. The higher channel capacity dampens the fluctuation during the months stated above.	X	
		Flooding	Reduction in overbank flooding below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of overbank flooding.		
		Flooding	Reduction in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of low flow velocity in overbanks.		
		Peak discharge	Reduction in peak discharge from Cochiti. Higher channel capacity improves the chances of Cochiti making channel capacity releases.		
		Narrowing of channel	Narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.		
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem.		
		Flood control	Decrease in the level of protection for flood control as a result of the decrease in channel capacity. Higher channel capacity increases the level of protection for areas below the dam.		
		Sediment transport	Reduction in the ability to transport sediment through the system resulting in sediment plugs. Sediment transport would likely be ok given this channel capacity on the Rio Chama but is most likely not sufficient for main stem of the Rio Grande.	X	
		Spawning flows	Slight reduction in spawning flows. Release of native flow limited by channel capacity. Historical operation for spawning flows was to increase release to 1,500 cfs.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Spawning flows	Should have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations. Water held up because of the lower channel capacity. May require mitigation	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. . Water could be released during the winter months for compact deliveries	X	
		Carryover storage	Increase in the number of years where the Corps would have carry-over water. Higher channel capacity decreases the chances for carry-over water.	X	
		Conservation storage	Increases the ability to store conservation water. Downstream minimum flow would have to set between 150-200 cfs.	X	
		Encroachment in the floodplain	Starts to limit encroachment on the Rio Chama.	X	
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame.	X	
		Pool elevations	Stable pools during the recreation season decrease. Both Abiquiu and El Vado can now be used more efficient as source of Water delivery.	X	
		Hydropower	Decreases peak hydropower generation. Could extent period when generating power. Flow could go through one unit.	X	
		Bank erosion	Increases bank sloughing.		
		Bank vegetation	Starts to decrease reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Could impact low flow conveyance channel operation.		

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		ESA compliance	Channel capacity reached earlier than existing condition. There would be no SJC releases during this time frame. If all demands are being met downstream the city of the Albuquerque could divert from the Rio Grande and payback the river with SJC at a later date. (July-September). Would add flow during the summer months for ESA compliance	X	
		Channel capacity	Based on historical record (1975-1999) channel capacity would be reached 96 percent of the time.	X	
Below Abiquiu	1,500-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand.	X	
		Water delivery	Higher channel capacity improves the ability to move SJC during the irrigation season. Natural flow into Abiquiu is the first water to be released or evacuated. Could affect ability to deliver water to Elephant Butte Reservoir.	X	
		Pool elevations	Higher pool elevations as a result of the lower channel capacity could affect the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout.	X	
		Reservoir levels	Starts to dampen fluctuation in reservoir levels during spring runoff and winter months. Higher pool elevations during the irrigation season. Higher channel capacity dampens the fluctuation during the months stated above.	X	
		Flooding	Could increase overbank flooding below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of overbank flooding.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Could start to see an increase in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of low flow velocity in the overbanks.	X	
		Peak discharge	Increases peak discharge from Cochiti. Higher channel capacity improves the chances of Cochiti making channel capacity releases.	X	
		Narrowing of channel	Helps to control narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Could help provided maintenance flows required by riparian ecosystem.	X	
		Flood control	Decrease in the level of protection for flood control as a result of the decrease in channel capacity. Higher channel capacity increases the level of protection for areas below the dam.	X	
		Sediment transport	Not likely to impact the ability to transport sediment through the system.	X	
		Spawning flows	Channel capacity releases could be used to add flow for spawning purposes. Higher channel capacity helps in the ability to manufacture a spawning flow. Under present operations would more then likely max out with a release of 1500 cfs for a spawning flow.	X	
		Spawning flows	Should have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Would there be less evaporation and transportation losses if water were held upstream.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.. Water could be released during the winter months for compact deliveries	X	
		Carryover storage	Increase in the number of years where the Corps would have carry-over water. Higher channel capacity decreases the chances for carry-over water.	X	
		Conservation storage	Increases the ability to store conservation water. Downstream minimum flow would have to set between 150 – 200 cfs. Normal max release from Abiquiu is 1,800 cfs.	X	
		Encroachment in the floodplain	Starts to limit encroachment on the Rio Chama.	X	
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame. Higher channel capacity decreases winter flows but would still be above most historical flows.	X	
		Pool elevations	Stable pools during the recreation season decrease. Both Abiquiu and El Vado can now be used more efficient as source of Water delivery.	X	
		Hydropower	Decreases peak hydropower generation. Could extent period when generating power. Need two units operating to pass flow.	X	
		Bank erosion	Increases bank sloughing.		
		Bank vegetation	Decrease in reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		ESA compliance	Channel capacity reached earlier then existing condition. There would be no SJC releases during this time frame. If all demands are being met downstream the city of the Albuquerque could divert from the Rio Grande and payback the river with SJC at a later date. (July-September). Would add flow during the summer months for ESA compliance.	X	
		Channel capacity	Based on historical record (1975-1999) channel capacity would be reached 80 percent of the time.	X	
Below Abiquiu	1,800-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand.	X	
		Water delivery	Higher channel capacity improves the ability to move SJC during the irrigation season. Natural flow into Abiquiu is the first water to be released or evacuated. Does not affect ability to deliver water to Elephant Butte.	X	
		Pool elevations	Lower pool elevations as a result of the higher channel capacity could impact the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout. Historically the pool has been above the rafting takeout three times during the rafting season.	X	
		Reservoir levels	Dampens fluctuation in reservoir levels during spring runoff and winter months. Lower pool elevations during the irrigation season. Higher channel capacity dampens the fluctuation during the months stated above.	X	
		Flooding	Increase in overbank flooding below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of overbank flooding.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Increase in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. Higher increase in channel capacity increases the chances of low flow velocity in the overbanks.	X	
		Peak discharge	Increases peak discharge from Cochiti. Higher channel capacity improves the chances of Cochiti making channel capacity releases.	X	
		Narrowing of channel	Helps to control narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Helps provide maintenance flows required by riparian ecosystem.	X	
		Flood control	No change in existing channel capacity means the level of protection for the project remains the same.	X	
		Sediment transport	No change in ability to transport sediment through the system.	X	
		Spawning flows	Channel capacity releases could be used to add flow for spawning purposes. Higher channel capacity helps in the ability to manufacture a spawning flow. Under present operations would more then likely max out with a release of 1,500 cfs for a spawning flow.	X	
		Spawning flows	Should have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	No change in delivery of water for compact obligations.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.		
		Carryover storage	No change in the number of years where the Corps would have carry-over water. Higher channel capacity decreases the chances for carry-over water.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Conservation storage	Still have the ability to store conservation water. Downstream minimum flow would have to set between 150-200 cfs.	X	
		Encroachment in the floodplain	Limits encroachment (houses) in the floodplain.	X	
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame. Higher channel capacity decreases the chance for carryover storage thereby decreasing winter flows.	X	
		Pool elevations	Stable pools during the recreation season decrease. Both Abiquiu and El Vado can now be used more efficient as source of Water delivery.	X	
		Hydropower	Helps with peak hydropower generation. Two units in operation.	X	
		Bank erosion	Increases bank sloughing.	X	
		Irrigation structures	Possible damage to rock and brush diversions.		
		Bank vegetation	Decrease reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Channel capacity reached during snowmelt runoff. There would be no SJC releases during this time frame. If all demands are being met downstream the city of the Albuquerque could divert from the Rio Grande and payback the river with SJC at a later date. (July-September). Would add flow during the summer months for ESA compliance.	X	
		Channel capacity	Based on historical record (1975-1999) channel capacity would be reached 72 percent of the time.	X	
Below Abiquiu	2,000-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Water delivery	Higher channel capacity improves the ability to move SJC during the irrigation season. Natural flow into Abiquiu is the first water to be released or evacuated. Does not affect ability to deliver water to Elephant Butte.	X	
		Pool elevations	Lower pool elevations as a result of the higher channel capacity could impact the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout.	X	
		Reservoir levels	Dampens fluctuation in reservoir levels during spring runoff. Lower pool elevations during the irrigation season. Higher channel capacity dampens the fluctuation during the months stated above.	X	
		Flooding	Increase in overbank flooding below Abiquiu and Middle Rio Grande Valley. Higher channel capacity increases the overbank flooding.	X	
		Flooding	Increase in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. Higher channel capacity increases the chance for low flow velocity in the overbanks.	X	
		Peak discharge	Increases peak discharge from Cochiti. Higher channel capacity improves the chances of Cochiti making channel capacity releases.	X	
		Narrowing of channel	Helps to control narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Does not limit potential for maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood control for areas below the dam as a result of the higher channel capacity. .	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Sediment transport	Increase in the ability to transport sediment through the system.	X	
		Spawning flows	Channel capacity releases could be used to add flow for spawning purposes. Higher channel capacity helps in the ability to manufacture a spawning flow. Under present operations would more then likely max out with a release of 1,500 cfs for a spawning flow.	X	
		Spawning flows	Should have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	May impact NM's ability to meet Rio Grande Compact obligations. Potential exists for increase in delivery with the higher channel capacity.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. Water could be released during the winter months for compact deliveries. Potential for decrease in the amount of water that would get caught up in Abiquiu.	X	
		Carryover storage	Decreases the number of years where the Corps would have carry-over water. Higher channel capacity decreases the chances for carry-over water.	X	
		Conservation storage	Still have the ability to store conservation water. Downstream minimum flow would have to set between 150-200 cfs.	X	
		Encroachment in the floodplain	Limits encroachment (houses) in the floodplain.	X	
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame. Higher channel capacity decreases the chance for carryover storage thereby decreasing winter flows.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Pool elevations	Stable pools during the recreation season decrease. Both Abiquiu and El Vado can now be used more efficient as source of Water delivery.	X	
		Hydropower	Increases peak hydropower generation. Two units in operation.	X	
		Bank erosion	Increases bank sloughing.		
		Irrigation structures	Damage to rock and brush diversions.		X
		Bank vegetation	Decreases the reproduction of non-native plants on exposed banks.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Based on historical record (1975-2000) channel capacity was reached 28 percent of the time. From 1980 to 1991 was the only time that Abiquiu was operated to release more then 1,800 cfs channel capacity.	X	
Below Abiquiu	2,500-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Abiquiu to meet MRGCD irrigation demand.	X	
		Water delivery	Higher channel capacity improves the ability to move SJC during the irrigation season. Natural flow into Abiquiu is the first water to be released or evacuated. Does not affect ability to deliver water to Elephant Butte.	X	
		Pool elevations	Lower pool elevations as a result of the higher channel capacity could impact the rafting take out point (elev. 6,237). The higher the channel capacity the less impact on the rafting takeout.	X	
		Reservoir levels	Dampens fluctuation in reservoir levels during spring runoff. Lower pool elevations during the irrigation season. Higher channel capacity dampens the fluctuation during the months stated above.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Increase in overbank flooding below Abiquiu and Middle Rio Grande Valley. Higher channel capacity increases the overbank flooding.	X	
		Flooding	Increase in low flow velocity in the overbanks below Abiquiu and Middle Rio Grande Valley. Higher channel capacity increases the chance for low flow velocity in the overbanks.	X	
		Peak discharge	Increases peak discharge from Cochiti. Higher channel capacity improves the chances of Cochiti making channel capacity releases.	X	
		Narrowing of River Channel	Helps to control narrowing of river channel (Rio Chama and Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Provides maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood control for areas below the dam as a result of the higher channel capacity	X	
		Sediment transport	Increase in the ability to transport sediment through the system.	X	
		Spawning flows	Channel capacity releases could be used to add flow for spawning purposes. Higher channel capacity helps in the ability to manufacture a spawning flow. Under present operations would more then likely max out with a release of 1500 cfs for a spawning flow.	X	
		Spawning flows	Should have the ability to manufacture a spawning flow with SJC water.	X	
		Rio Grande Compact	Potential for impact NM's ability to meet Rio Grande Compact obligations. Increase in potential delivery with the higher channel capacity.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. Water could be released during the winter months for compact deliveries. Decrease in the amount of water that would get caught up in Abiquiu.	X	
		Carryover storage	Decreases the number of years where the Corps would have carry-over water. Higher channel capacity decreases the chances for carry-over water.	X	
		Conservation storage	Still have the ability to store conservation water. Downstream minimum flow would have to set between 150-200 cfs.	X	
		Encroachment in the floodplain	Limits encroachment (houses) in the floodplain.	X	
		Winter flows	Could have higher winter flows from November to March if we have carry-over storage and water is released during this time frame. Higher channel capacity decreases the chance for carryover storage thereby decreasing winter flows.	X	
		Pool elevations	Stable pools during the recreation season decrease. Both Abiquiu and El Vado can now be used more efficient as source of Water delivery.	X	
		Hydropower	Increases peak hydropower generation. Max release from two units in operation.	X	
		Bank erosion	Increases bank sloughing.		
		Irrigation structures	Damage to rock and brush diversions.		X
		Bank vegetation	Decreases the reproduction of non-native plants on exposed banks.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Channel capacity	Based on historical record (1975-2000) channel capacity was reached 8 percent of the time. From 1980 to 1991 was the only time that Abiquiu was operated to release more then 1,800 cfs channel capacity.	X	
Cochiti	5,000-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Cochiti to meet MRGCD irrigation demand.	X	
		Water delivery	Affects the ability to release San Juan-Chama water under existing laws. Natural flow into Cochiti is the first water to be released or evacuated. SJC water would have to be released during winter months. Affects ability to deliver water to Elephant Butte Reservoir.		
		Fluctuation in reservoir levels	More fluctuation in reservoir levels during spring runoff and winter months. Possible higher pool elevations during the irrigation season. Could impact Cochiti delta and Bandolier Natural Park		X
		Flooding	Reduction in overbank flooding below Cochiti.		
		Flooding	Reduction in low flow velocity in the overbanks below Cochiti.		
		Narrowing of River Channel	Narrowing of river channel (Rio Grande) due to long-term reduction in channel forming discharge.		
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem.		
		Flood control	Decrease in the level of protection for flood control as a result of the decrease in channel capacity.		
		Sediment transport	Reduction in the ability to transport sediment through the system resulting in sediment plugs.		
		Spawning flows	There should be no reduction in spawning flows.		

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations. Water held upstream because of the lower channel capacity.		
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.. Water could be released during the winter months for compact deliveries.		
		Carry-over water	Increase in the number of years where the Corps would have carry-over water.		
		Conservation water	The lower channel capacity could increase the chance of storing water at Abiquiu.	X	
		Encroachment in the floodplain	Possible increase in encroachment (houses) in the floodplain.		
		Winter flows	Could have higher flows from November to March below Cochiti because of possible carryover storage.		
		Pools during the recreation season	Higher pools during the recreation season.	X	
		Bank erosion	Reduces bank sloughing.	X	
		Reproduction of non-native plants	Increases reproduction of non-native plants on exposed banks and riverbed.		
		Low flow conveyance channel	Should not impact low flow conveyance channel operation	X	
		Channel Capacity	Based on historical records (1975-1999) channel capacity of 5,000 cfs was reached 48 percent of the time. In some cases releases from Cochiti dictated by condition of channel downstream from dam and Elephant Butte storage. Percentage of the time Otowi was 5,000 cfs or above was 60 percent.	X	
Cochiti	7,000-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Cochiti to meet MRGCD irrigation demand.	X	
		Water delivery	Not likely to affect the ability to release San Juan-Chama water under existing laws.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Fluctuation in reservoir levels	Less fluctuation in reservoir levels during spring runoff and winter months. Should have very little impact Cochiti Delta and Bandolier National Monument.	X	
		Flooding	Increase in overbank flooding below Cochiti.	X	
		Flooding	Increase in low flow velocity in the overbanks below Cochiti.	X	
		Narrowing of River Channel	Helps control narrowing of river channel (Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Increase in maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood control as a result of the increase in channel capacity.	X	
		Sediment transport	Increase in the ability to transport sediment through the system.	X	
		Spawning flows	There should be no reduction in spawning flows.	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations. Increase in channel capacity helps delivery obligations.	X	
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. Water could be released during the winter months for compact deliveries.	X	
		Carry-over storage	Decrease in the number of years where the Corps would have carry-over water. Higher channel capacity decreases chance for carry-over storage.		
		Conservation water	Should have no impact on storage of conservation water at Abiquiu.	X	
		Encroachment in the floodplain	Possible decrease in encroachment (houses) in the floodplain.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Winter flows	Normal flows from November to March without carryover storage. Pass inflow.	X	
		Pools during the recreation season	Normal pools during the recreation season.	X	
		Bank erosion	Increase in bank sloughing.		
		Reproduction of non-native plants	Decreases reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Based on historical records (1975-1999) channel capacity of 7000 cfs was reached 24 percent of the time. In some cases releases from Cochiti dictated by condition of channel downstream and Elephant Butte storage. Percentage of the time Otowi was 7000 cfs or above was 48 percent.	X	
Cochiti	8,000-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Cochiti to meet MRGCD irrigation demand.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws.	X	
		Fluctuation in reservoir levels	Less fluctuation in reservoir levels during spring runoff. Should have very little impact Cochiti Delta and Bandolier National Monument.	X	
		Flooding	Increase in overbank flooding below Cochiti.	X	
		Flooding	Increase in low flow velocity in the overbanks below Cochiti.	X	
		Narrowing of River Channel	Helps to control narrowing of river channel (Rio Grande) due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Increase in maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood control as a result of the increase in channel capacity.	X	
		Sediment transport	Increase in the ability to transport sediment through the system.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Spawning flows	There should be no reduction in spawning flows.	X	
		Rio Grande Compact	Likely impact to NM's ability to meet Rio Grande Compact obligations. Increase in channel capacity increases potential for conveying delivery obligations.	X	
		Carry-over storage	Decrease in the number of years where the Corps would have carry-over water. Higher channel capacity decreases chance for carry-over storage.	X	
		Conservation water	Should have no impact on storage of conservation water at Abiquiu.	X	
		Encroachment in the floodplain	Possible decrease in encroachment (houses) in the floodplain.	X	
		Winter flows	Normal flows from November to March without carryover storage. Pass inflow.	X	
		Pools during the recreation season	Normal pools during the recreation season.	X	
		Bank erosion	Increase in bank sloughing. Some streambank protection could be needed to pass the higher flows.		
		Reproduction of non-native plants	Decreases reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Based on historical records (1975-1999) channel capacity of 8,000 cfs was reached 12 percent of the time. In some cases releases from Cochiti dictated by condition of channel downstream and Elephant Butte storage. Percentage of the time Otowi was 8,000 cfs or above was 44 percent.	X	
Cochiti	10,000-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Cochiti to meet MRGCD irrigation demand.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Pool elevations	Very little fluctuation in reservoir levels during spring runoff.	X	
		Fluctuation in reservoir levels	Less fluctuation in reservoir levels during spring runoff. Should have very little impact Cochiti Delta and Bandolier National Monument.	X	
		Flooding	Increase in overbank flooding below Cochiti.	X	
		Flooding	Increase in low flow velocity in the overbanks below Cochiti.	X	
		Narrowing of River Channel	Helps to control narrowing of river channel (Rio Grande) due to long-term reduction in channel forming discharge	X	
		Maintenance flows	Increase in maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood is needed control as a result of the increase in channel capacity.	X	
		Sediment transport sediment	Increase in the ability to transport sediment through the system.	X	
		Spawning flows	There should be no reduction in spawning flows.	X	
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations. Increase in channel capacity provides potential for improvement in meeting delivery obligations.	X	
		Carry-over storage	Decrease in the number of years where the Corps would have carry-over water. Higher channel capacity decreases chance for carry-over storage.	X	
		Conservation water	Should have no impact on storage of conservation water at Abiquiu.	X	
		Encroachment in the floodplain	Possible decrease in encroachment (houses) in the floodplain.	X	
		Winter flows	Normal flows from November to March without carryover storage. Pass inflow.	X	
		Pools during the recreation season	Normal pools during the recreation season.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Bank erosion	Increase in bank sloughing. Some streambank protection could be needed to pass the higher flows.		
		Reproduction of non-native plants	Decreases reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Based on historical records (1975-1999) channel capacity of 10,000 cfs was reached 0 percent of the time. In some cases releases from Cochiti dictated by condition of channel downstream and Elephant Butte storage. Percentage of the time Otowi was 10,000 cfs or above was 8 percent.	X	
Cochiti	12,500-cfs Channel Capacity	Irrigation demand	Does not affect the ability to release or pass water through Cochiti to meet MRGCD irrigation demand.	X	
		Water delivery	Does not affect the ability to release San Juan-Chama water under existing laws.	X	
		Fluctuation in reservoir levels	Very little fluctuation in reservoir levels during spring runoff.	X	
		Flooding	Increase in overbank flooding below Cochiti.	X	
		Flooding	Increase in low flow velocity in the overbanks below Cochiti.	X	
		Narrowing of River Channel	Controls narrowing of river channel (Rio Grande) due to long-term reduction in channel forming discharge	X	
		Maintenance flows	Increase in maintenance flows required by riparian ecosystem.	X	
		Flood control	Increase in the level of protection for flood control as a result of the increase in channel capacity.	X	
		Sediment transport	Increase in the ability to transport sediment through the system.	X	
		Spawning flows	There should be no reduction in spawning flows.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations. Increase in channel capacity potentially helps NM meet delivery obligations.	X	
		Carry-over storage	There should be no carry-over with the increased channel capacity.	X	
		Conservation water	Should have no impact on storage of conservation water at Abiquiu.	X	
		Encroachment in the floodplain	Possible decrease in encroachment (houses) in the floodplain.	X	
		Winter flows	Normal flows from November to March without carryover storage. Pass inflow.	X	
		Bank erosion	Increase in bank sloughing. Streambank protection would be needed to pass the higher flows from Cochiti to Elephant Butte. Possible water against the levees throughout most reaches. Bank sloughing of MRGCD facilities.		X
		Flooding	Possible flooding of irrigation land in the Cochiti to Bernalillo reach.		X
		Reproduction of non-native plants	Decreases reproduction of non-native plants on exposed banks and riverbed.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
		Channel capacity	Based on historical records (1975-1999) channel capacity of 12,500 cfs was reached 0 percent of the time. In some cases releases from Cochiti dictated by condition of channel downstream and Elephant Butte storage. Percentage of the time Otowi was 12,500 cfs or above was 4 percent.	X	
Jemez	4,000-acre-foot Sediment Pool	Irrigation demand	Does not affect the ability to pass water through Jemez to meet MRGCD irrigation demands.	X	
		Flooding	Does not affect overbank flooding	X	
		Flooding	Does not affect low flow velocity	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flood control	Level of protection for flood control remains the same. Storage takes place within sediment pool storage space.	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water. Native water would be exchanged with SJC water being released from Abiquiu.	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff and irrigation season.	X	
		Peak discharge	Should not impact peak discharge on mainstem below Cochiti.	X	
		Narrowing of River Channel	Not likely to affect narrowing of river channel due to long-term reduction in channel forming discharge.	X	
		Maintenance flows	Should not impact maintenance flows required by riparian ecosystem.	X	
		Sediment transport	Slight reduction in the ability to transport sediment through the system when storage is taking place.	X	
		Spawning flows	There should be no reduction in spawning flows. Storage would only take place when all needs are met.	X	
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water stored.	X	
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries.		
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation. Water could be released during summer or winter months for compact deliveries.		
		Floodplain encroachment	Should have no impact on encroachment (houses) in the floodplain in the middle valley.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Winter flows	Lower winter flows from November to March below Jemez if storage of native water is taking place.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while conservation storage is taking place.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
Jemez	24,000-acre-foot Sediment Pool	Irrigation demand	Does not affect the ability to pass water through Jemez to meet MRGCD irrigation demands.	X	
		Flooding	Does not affect overbank flooding	X	
		Flooding	Does not affect low flow velocity	X	
		Flood control	Level of protection for flood control remains the same. Storage takes place within existing sediment pool space.	X	
		Pool elevations	Higher pool elevations as a result of the storage of native water. Native water would be exchanged with SJC water being released from Abiquiu.	X	
		Reservoir levels	Could have more fluctuation in reservoir levels during spring runoff and irrigation season.	X	
		Peak discharge	Should not impact peak discharge on mainstem below Cochiti.	X	
		Narrowing of channel	Likely to affect narrowing of river channel due to long-term reduction in channel forming discharge if done every year.		
		Maintenance flows	Reduction in maintenance flows required by riparian ecosystem.		
		Sediment transport	Reduction in the ability to transport sediment through the system when storage is taking place.		
		Spawning flows	There should be no reduction in spawning flows. Storage would only take place when all needs are met.	X	
		Spawning flows	Could have the ability to manufacture a spawning flow with SJC water.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Rio Grande Compact	Likely impact to Rio Grande Compact obligations if water is stored for other purposes other then compact deliveries. Mitigation may be required		
		Rio Grande Compact	Changes in evaporation and transportation losses potentially favorable to Compact, depending on storage/release use/timing. If not, would require mitigation.		
		Narrowing of channel	Should have no impact on encroachment (houses) in the floodplain in the middle valley.	X	
		Winter flows	Lower winter flows from November to March below Jemez if storage of native water is taking place.	X	
		Pool elevations	More stable pools during the recreation season if water is released from November to March.	X	
		Bank erosion	Reduces bank sloughing because of lower releases while storage is taking place.	X	
		Low flow conveyance channel	Should not impact low flow conveyance channel operation.	X	
LFCC	No LFCC Diversions	Rio Grande Compact	Reduction in NM's ability to meet to Rio Grande Compact obligations. Greater transmission losses occur when all flow is left in the Rio Grande floodway. Mitigation required.		
		Irrigation demand	Negligible impact on ability of MRGCD to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		Irrigation demand	Negligible impact on ability of Bosque del Apache NWR to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		ESA Recovery	Under some conditions, may support ESA recovery efforts for Rio Grande Silvery Minnow and Southwest Willow Flycatcher by providing greater flow in floodway.	X	
		Spawning flows	Supports creating spawning surge flows for Silvery Minnow	X	
		Flooding	Supports overbank flooding and riparian recovery efforts.	X	
		Sediment transport	Supports transport of sediment below San Acacia through higher flood flows, and may decrease tendency for aggradation.	X	
		Flooding	May impair ability to control flooding below San Acacia.		
		Water delivery	No impact on SJC water deliveries.	X	
LFCC	LFCC Diversions Leave 400 cfs Past San Acacia	Rio Grande Compact	Possible impact to Rio Grande Compact obligations. Greater transmission losses occur when all flow is left in the Rio Grande floodway.		
		Irrigation demand	Negligible impact on ability of MRGCD to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		Irrigation demand	Negligible impact on ability of Bosque del Apache NWR to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		ESA Recovery	Supports ESA recovery efforts for Rio Grande Silvery Minnow and Southwest Willow Flycatcher by providing greater flow in floodway.	X	
		Spawning flows	May not provide sufficient flow for Silvery Minnow spawning surge. Will meet purpose and need if occasional flood flows are allowed to pass > 400 cfs.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	Little overbank flooding will occur if flows are always restricted to ≤ 400 cfs. Limits riparian recovery efforts. Will meet purpose and need if occasional flood flows are allowed to pass > 400 cfs.	X	
		Sediment transport	Restricts transport of sediment below San Acacia if flows are always restricted to ≤ 400 cfs, and may increase tendency for aggradation. Will meet purpose and need if occasional flood flows are allowed to pass > 400 cfs.	X	
		Flooding	Supports ability to control flooding below San Acacia.	X	
		Water delivery	No impact on SJC water deliveries.	X	
LFCC	LFCC Diversions Leave 150 cfs Past San Acacia	Rio Grande Compact	Possible impact to Rio Grande Compact obligations. Greater transmission losses occur when all flow is left in the Rio Grande floodway.		
		Irrigation demand	Negligible impact on ability of MRGCD to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		Irrigation demand	Negligible impact on ability of Bosque del Apache NWR to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		ESA Recovery	Supports ESA recovery efforts for Rio Grande Silvery Minnow and Southwest Willow Flycatcher by providing greater flow in floodway.	X	
		Spawning flows	Does not provide sufficient flow for Silvery Minnow spawning surge. Will meet purpose and need if occasional flood flows are allowed to pass much greater than 150 cfs.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	No overbank flooding will occur if flows are always restricted to ≤ 150 cfs. Limits riparian recovery efforts. Will meet purpose and need if occasional flood flows are allowed to pass.	X	
		Sediment transport	Restricts transport of sediment below San Acacia if flows are always restricted to ≤ 150 cfs, and may increase tendency for aggradation. Will meet purpose and need if occasional flood flows are allowed to pass.	X	
		Flooding	Supports ability to control flooding below San Acacia.	X	
		Water delivery	No impact on SJC water deliveries.	X	
LFCC	LFCC Diversions Leave 50 cfs Past San Acacia	Rio Grande Compact	Possible impact to Rio Grande Compact obligations. Greater transmission losses occur when all flow is left in the Rio Grande floodway.		
		Irrigation demand	Negligible impact on ability of MRGCD to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		Irrigation demand	Negligible impact on ability of Bosque del Apache NWR to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		ESA Recovery	Probably insufficient flow to support ESA recovery efforts for Rio Grande Silvery Minnow and Southwest Willow Flycatcher; unless conducted in combination with LFCC diversions to floodway.		
		Spawning flows	Does not provide sufficient flow for Silvery Minnow spawning surge. May meet purpose and need if occasional flood flows are allowed to pass much greater than 50 cfs.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	No overbank flooding will occur if flows are always restricted to ≤ 50 cfs. Limits riparian recovery efforts. May meet purpose and need if occasional flood flows are allowed to pass.	X	
		Sediment transport	Restricts transport of sediment below San Acacia if flows are always restricted to ≤ 50 cfs, and may increase tendency for aggradation. May meet purpose and need if occasional flood flows are allowed to pass.	X	
		Flooding	Supports ability to control flooding below San Acacia.	X	
		Water delivery	No impact on SJC water deliveries.	X	
LFCC	LFCC Diversions Leave Sufficient Water to get 50 cfs Past San Marcial	Rio Grande Compact	Possible impact to Rio Grande Compact obligations. Greater transmission losses occur when all flow is left in the Rio Grande floodway.		
		Irrigation delivery	Negligible impact on ability of MRGCD to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		Irrigation delivery	Negligible impact on ability of Bosque del Apache NWR to divert from LFCC. LFCC typically gains sufficient flow for limited diversions through irrigation drainage and groundwater inflow.	X	
		ESA Recovery	Supports ESA recovery efforts for Rio Grande Silvery Minnow and Southwest Willow Flycatcher by providing greater flow in floodway.	X	
		Spawning flows	Does not provide sufficient flow for Silvery Minnow spawning surge. May meet purpose and need if occasional flood flows are allowed to pass.	X	

Facility	Action	Water Operations Attribute	Rationale	No obvious inconsistency with Needs & Purposes	Fatal Flaw
		Flooding	No overbank flooding will occur if flows are always restricted to ≤ 50 cfs at San Marcial. Limits riparian recovery efforts. May meet purpose and need if occasional flood flows are allowed to pass.	X	
		Sediment transport	Restricts transport of sediment below San Acacia if flows are always restricted to ≤ 50 cfs at San Marcial, and may increase tendency for aggradation. May meet purpose and need if occasional flood flows are allowed to pass.	X	
		Flooding	Supports ability to control flooding below San Acacia.	X	
		Water delivery	No impact on SJC water deliveries.	X	

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9.0 ATTACHMENT B COMMUNICATION & COORDINATION PROTOCOL

9.1 Communication & Coordination Protocol

9.1.1 Coordination Protocol

The following is the general inter-agency process, which is part of the annual water operations coordination process.

Water managers meet in February, March and April, to discuss water operations issues, needs, and objectives for the upcoming year. The meeting in February provides a general overview of project operations based on the projected snowmelt runoff. The Bureau of Reclamation holds the meeting and invites all the stakeholders in the Basin. Presentations are made on water supply and endangered species operations.

Water managers meet or exchange information after the April snowmelt runoff forecast is available. Reclamation and the Corps develop an Annual Operating Plan (AOP) with input from the Irrigation Districts. Reclamation and the Corps hold open forum public meetings in April and May to discuss the AOP. After the AOP is developed public meetings are held in Albuquerque, Las Cruces, Socorro, Truth or Consequences, New Mexico, and El Paso, Texas. The Corps also holds open forum meetings at Abiquiu and Cochiti to discuss the current year water supply. The AOP is also placed on Reclamation web page. The Corps also uses the AOP to project flood control operations and expected maximum releases below the dams. The Corps has a 1-800-number at Abiquiu Reservoir project office, which provides a forecasted flow for the next day. The forecast is updated by 10:00 am each morning.

After runoff, through the end of the irrigation season, frequent coordination becomes more critical. Weekly, and often daily, communications occur between Reclamation, the Corps, the USFWS, Middle Rio Grande Conservancy District (MRGCD), City of Albuquerque, and the State of New Mexico during the irrigation season. This process involves meetings, conference calls, and information exchange. An important component of the daily conference calls is to agree on the operational adjustments necessary to meet the suite of water management objectives, such as the management of available supplemental water and irrigation demand in the Middle Valley based on real-time data.

The Corps and Reclamation are always conferring on the type of water (San Juan-Chama/Native) being released from reservoirs upstream of Cochiti Lake. The Corps stores San Juan-Chama (SJC) water that is destined for Abiquiu Reservoir and Cochiti Lake and bypasses SJC water that is payback to the river as a result of groundwater pumping, or SJC water being moved to Elephant Butte Reservoir. Reclamation coordinates SJC water releases with the Corps on a daily basis when needed. The New Mexico Interstate Stream Commission provides a letter to Reclamation with details on the amount of water owed to the river and the name of the contractors that need to payback the river for over pumping. Movement of SJC water to Elephant Butte would be at the request of the contractors.

The following is an outline to improve inter-agency coordination process within the agencies and also with the public.

a. Water managers meet in February, March, and April, to discuss water operations issues, needs, and objectives for the upcoming year. The meeting provides a general overview of project operations based on the projected snowmelt runoff. Post meeting notes and presentations on the web for the public access.

b. Provide snowmelt runoff projections from January to May and post on the web. Provide written descriptions of changes that occur from the existing projections.

c. Notify tribes along the river on reservoir operations.

d. Provide a weekly update on reservoir operations on the web throughout the year.

e. Provide a 1-800 number where the public can call in for the weekly update on reservoir operations.

f. Post on the web a description on how the supplemental water program works and the current plan for the year

The above discussion presents some key points in the coordination process. Representation from Reclamation, the Corps, MRGCD, ISC, F&WS, IBWC, city of Albuquerque and BIA form the core of agencies involved with day-to-day management of the Rio Grande. Regular conference calls could be the primary means of information exchange and meetings would be scheduled as necessary. While particular water operations plans may not pertain to all agencies everyone could benefit from the exchange of information.

9.1.2 Protocol For Operation Of Upstream Projects For Flood Control Below Elephant Butte And Caballo Reservoirs

The following is the general description of the coordination process that would occur if the Corps projects upstream of Elephant Butte were operating to provide flood protection below Caballo Dam.

The Corps will provide flood protection for areas below Elephant Butte and Caballo Reservoir if their conservation pools are full and releasing up to channel capacity. The USIBWC would be the agency determining what the channel capacity is below Caballo. However the Corps first priority would be the protection of its structures and flood protection for areas above Elephant Butte Reservoir and below the Corps structures.

Water managers meet in February, prior to the onset of the irrigation season, to discuss water operations issues, needs, and objectives for the upcoming year. The meeting in February provides a general overview of project operations based on the projected snowmelt runoff. The Bureau of Reclamation in Albuquerque holds the meeting and invites all the stakeholders in the Basin. Presentations are made on water supply and endangered species operations. Water managers meet or exchange information after the April 1, snowmelt runoff forecast is available. The Corps, Reclamation and United States Section of International Boundary and Water Commission (USIBWC) would start to discuss the operation of Elephant Butte and Caballo Reservoir flood control after the April 1 runoff projections. The Corps release rate from Cochiti and Jemez would be set to maintain a constant 5,000 cfs release below Elephant Butte Reservoir if operating for flood control below Caballo Dam. The key to successful flood control operation is weekly or daily communications as needed between the Corps, Reclamation, USIBWC and the New Mexico Interstate Stream Commission. The Corps would coordinate with the Rio Grande Compact Commissioners on the operation of the Corps reservoirs for flood protection below Caballo Dam. This process involves meetings, conference calls, and information exchange between the agencies.

The following scenario is one that did occur in 1987 and is provided as an example on how the Corps projects would be used to provide flood protection below Caballo Reservoir.

In January 1987 early season projections were for 110 to 130 percent of normal in the Colorado portion of the basin and 95 to 135 percent of normal in New Mexico. Fall precipitation was above normal over most of the basin. For the month of November, precipitation totals were 2 to 3 times normal monthly totals. Precipitation totals for the month of January were above normal over much of the basin. Strong storm

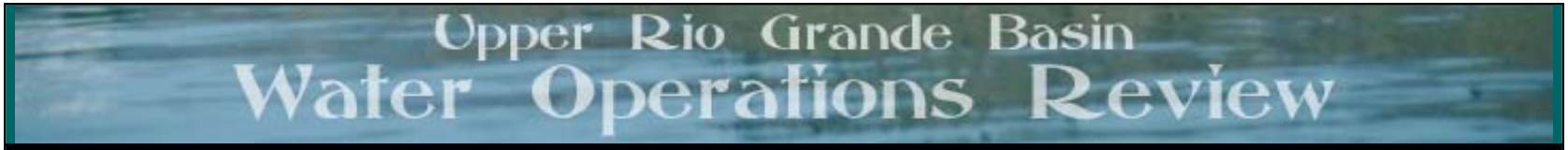
systems during the early and middle portion of the month produced relatively heavy amounts of precipitation resulting in monthly totals 2 to 4 times the long-term January normals over all of the San Luis Valley in Colorado and the northern Rio Grande valley in New Mexico. The March 1 snowmelt runoff forecast was for above average runoff. The Sangre de Cristos tributaries were expected to produce runoff 120 to 160 percent of average. Precipitation during the month of February was above average over most of the basin with the majority of the reporting stations receiving 150 to 200 percent of average. Stream flows based on April forecasts were expected to range from 140 to 167 percent average along the main stem and from 92 to 175 percent of average along the tributaries. March precipitation totals were variable in the basin. Above normal amounts 150 to 250 percent of average were recorded in the upper reaches of the basin above Del Norte in Colorado. Farther south, amounts decreased to around 50 to 70 percent in the Colorado/New Mexico border region and only 5 to 20 percent in the Albuquerque and Santa Fe area. The May 1 snowpack showed significant depletion at middle and lower elevations since early April, reflecting above normal temperatures for the last month. In Colorado the forecast was for 120 percent of average. In New Mexico forecasts ranged from 200 to 260 percent on the mainstem of the Rio Grande and 125 to 175 percent of average along the tributaries. A large percentage of the snowpack melted in April producing above normal runoff and streamflow for the month of April.

The weather system that moved in to produce the 1987 snowmelt runoff in the Rio Grande Basin of about 200 percent of normal as recorded at the Otowi gage was a remarkably persistent split-flow circulation pattern where polar-front jet stream remained in Canada north of its normal position and an active subtropical jet stream, which crossed the southern United States, led to above normal flows in the central one-third of the U.S. High volume discharges in the Rio Grande resulted from fall, winter, and spring precipitation throughout the entire Rio Grande Basin of Colorado and northern New Mexico.

Abiquiu Reservoir began storing snowmelt runoff on 12 April and reached a record pool elevation of 6,262.06 feet, NGVD (402,258 acre-feet) on 22 June. The maximum release was 1,826 cfs. Cochiti Lake began storing water on February 27 and reached a maximum pool at elevation 5434.50 feet (396,167 acre-feet). The peak discharge at Albuquerque occurred on 24 July and reached approximately 7,840 cfs. Jemez Canyon Reservoir also reached a record pool elevation in 1987 with flood control storage starting on April 13 and resulting in a maximum elevation of 5,220.30 feet (72,524 ac-ft) on June 2. The magnitude of storage was attributed to Elephant Butte and Caballo Reservoirs being full. Elephant Butte reached a maximum storage of 2,095,600 ac-ft on March 27. The maximum release from Elephant Butte was 4, 830 cfs on June 3. Caballo Reservoir reached a maximum storage of 262, 600 ac-ft on June 24. The maximum release from Caballo was 4,646 cfs on July 11.

The Rio Grande below El Paso, Texas had not experienced sustained flood flows since the early 1940's. Therefore, a considerable amount of sediment aggradation had occurred, which severely reduced channel capacities through Fort Quitman. This resulted in numerous levee breaches on the Mexican side of the river and high water tables in the agricultural areas on the United States side. The Corps, Reclamation and USIBWC were in frequent contact on the channel capacity below Caballo. Channel capacity issues extended all the way to the Fort Quitman area. The lack of channel capacity in these areas hindered the release of floodwater from Abiquiu, Cochiti and Jemez Canyon Reservoirs.

10.0 ATTACHMENT C NO ACTION ALTERNATIVE



No Action Alternative	
Goals	Maintain existing operational conditions: f) Provide flood and sediment control; g) Store and deliver water for agricultural, domestic, municipal, and industrial uses and for recreational and fish and wildlife benefits. h) Meet compact obligations and limit losses; i) Time scheduled deliveries, as approved by willing water owners, to provide incidental water quality, recreation, fish and wildlife and other environmental benefits.
Closed Basin Project Owned & operated by Reclamation Oversight provided by a three member Operating Committee consisting of one representative from the Colorado Water Conservation Board (CWCB), one from the Rio Grande Water Conservation District, and a member appointed by the Secretary of Interior (Reclamation). Purpose: First priority: assist Colorado in meeting annual deliveries under the Rio Grande Compact Second priority: maintain the Alamosa National Wildlife Refuge and the Blanca Wildlife Habitat Area, and stabilize San Luis Lake Third priority: allow Colorado to apply to the reduction and elimination of any accumulated deficit in the deliveries as determined by the Rio Grande Compact Commission. Fourth priority: provide irrigation supply and other beneficial uses in Colorado (has never occurred	Operated, subject to production and water quality constraints, for: ***a) Authorized production of up to 600,000 a-f from groundwater wells in any consecutive ten-year period specifically to assist the State of Colorado in meeting annual Rio Grande Compact deliveries.*** ***b) Up to 5,300 a-f/y for wildlife mitigation*** ***Constraints:*** ***a) Average annual production is currently limited to approximately 25,000 a-f/y due to well degradation.*** ***b) Deliveries to river require compliance with Clean Water Act standards.*** ***c) Pumping levels are also subject to drawdown constraint.*** Operating Committee composed of Colorado Water Conservation Board, Rio Grande Water Conservation District and Reclamation to provide oversight to ensure project is operated in accordance with authorizing legislation. Make recommendations on project operation.

No Action Alternative

Platoro Dam Only Flood Control within the authority of this review Owned by Bureau of Reclamation (Reclamation) Operated by Conejos Water Conservancy District (CWCD) Reclamation has safety of dams authority when flood control pool is exceeded. Purpose: Conservation storage (irrigation) and flood control Corps of Engineers (COE) has flood control authority	Operated for flood control with maximum releases up to channel capacity of 2,500 cfs at Conejos River at Mogote gage and 1,600 cfs at Conejos River at La Sauces gage. COE monitors joint-use pool (flood & conservation space) if flood space is needed, water in the conservation space is released to make room for flood inflows. Operated to maintain a 3,000 a-f permanent pool for recreation and fish and wildlife. Operated to preserve fish & wildlife habitat below Platoro Reservoir; CWCD maintains a 7 cfs release during the months of October through April, and bypass 40 cfs or natural inflow whichever is less, during the months of May through September

No Action Alternative

HERON RESERVOIR Owned & operated by Reclamation Purpose: Storage and delivery of San Juan Chama Project water for irrigation and municipal, domestic and industrial uses, and associated benefits to recreation, fish and wildlife	Maximize storage San Juan-Chama Project (SJC) water up to reservoir capacity of 400,000 a-f to provide reliable supply to meet contractor demands. Water is released at the request of the contractors for downstream beneficial use in New Mexico up to contracted amount. Limitations of San Juan Chama Project: a) Water available for release to SJC contractors is based on "Firm Yield" of 96,200 a-f per year. b) Transbasin diversions limited to 270,000 a-f in any one year and to 1,350,000 a-f in any 10 years. c) Not authorized for storage of native Rio Grande water. All such native inflow is released on a monthly basis. d) No hydropower allowed at Heron Reservoir (Colorado River Storage Project PL 84-485, 4/11/56). Carryover storage of unused individual contractor water not permitted except by use of waivers. A "waiver " is a temporary of requirement for contractors to take delivery of a current year allocation before December 31 of the same year. By agreement with SJC contractors, releases are timed to maintain winter flows below El Vado for fish and wildlife benefits in accordance with instream flow study recommendations, provided in the BLM Management Plan[1] for compliance with the wild and Scenic Rivers Act, and to provide higher weekend flows for whitewater rafting between El Vado and Abiquiu during a 6-8 week period in the summer. [1]Rio Chama Instream Flow Assessment, Denver, CO, U.S. Department of the Interior, Bureau of Land Management, 1992.

No Action Alternative

El Vado Reservoir (Not within authority of this review — all alternatives reflect no action) Owned by MRGCD (Outlet, spillway - Reclamation) Operated by Reclamation under contract with MRGCD Power generation facilities owned & operated by Los Alamos County Purpose: Water storage for irrigation Provides incidental recreation, flood and sediment-control, and run of river power generation	Store and release native water for MRGCD subject to state water law and Rio Grande Compact restrictions. Maximum storage about 180,000 a-f. Bypass native water inflow up to 100 cfs or actual inflow if less for Rio Chama diverters, adjudicated diversion right is satisfied at 100 cfs. Store and release native water for prior and paramount uses as needed by Pueblos. Store SJC water for MRGCD and other contractors as approved by the MRGCD on yearly basis. SJC water released from Heron for downstream use are passed through. Make voluntary release exchanges (borrow/payback between MRGCD storage in El Vado and City of Albuquerque storage in Abiquiu) to support irrigation, municipal and industrial uses; releases may be timed for recreation and/or environmental purposes. Safe channel capacity is 4,500 cfs below El Vado Dam. Generate power through "run of the river" releases, with turbines operational between 250 cfs to 900 cfs.

No Action Alternative

Abiquiu Reservoir Owned & operated by COE Power generation facilities owned & operated by Los Alamos County Land acquired in fee was 2860.41 acres (elevation 6215.0 ft). Land acquired in flood easement contains 6,133 acres (elevation 6293.5 ft). Purpose: Flood control Sediment control SJC water supply storage, authorized to store native water Incidental recreation Run of river power generation	Operates for flood control with maximum releases up to channel capacity of 1,800 cfs below Abiquiu, 3,000 cfs at Chamita, 10,000 cfs at Otowi; limit on rate of change in downstream stage of .25 to .50 feet per gate change at gage below Abiquiu Dam. Unless in flood control operations, all native water is bypassed at a rate that is below safe channel capacity. Store SJC water (released from Heron to contractors) for city of Albuquerque and other contractors up to elevation of 6220 ft; release on request. City of Albuquerque holds easements to store San Juan-Chama water up to elevation 6220.0 ft. Make voluntary release exchanges (borrow/payback between MRGCD storage in El Vado and City of Albuquerque storage in Abiquiu) to support irrigation, municipal and industrial uses; releases may be timed for recreation and/or environmental purposes. Strive to maintain minimum flows for fisheries, such as 70 cfs for trout from November to March. Operation subject to PL 86-645 restriction for Compact purposes: a) The COE is directed to hold (carry-over) floodwater in Abiquiu Reservoir or Cochiti Lake after July 1. When the natural flow at Otowi gage falls below 1,500 cfs, water must subsequently be released between November 1 and March 31. Generate power through “run of the river” releases. Note: Whenever flow falls below 150 CFS, turbines cannot generate power.

No Action Alternative

Cochiti Reservoir Owned and operated by COE Flood easements acquired from US Forest Service (8,236 acres), Pueblo de Cochiti (4,069 acres), Atomic Energy Commission (345 acres), National Park Service (361 acres), University of New Mexico (540 acres), and private concerns (139 acres). Purpose: Flood and sediment control, fish and wildlife enhancement, recreation Operated to bypass native inflow	Operated for flood control: release inflows as quickly as possible without causing flooding (in conjunction with Abiquiu, Jemez Canyon and Galisteo Reservoirs such that flows do not to exceed 7,000 cfs at Albuquerque); and subject to change of stage not to exceed 0.5 foot each change at the downstream gage from Cochiti Dam. Permanent SJC recreation pool of 1,200 surface acres (volume approximately 50,000 a-f) is maintained. Evaporative losses from recreation pool are replaced with San Juan Chama water. Operation subject to PL 86-645 restriction for Compact purposes. a) The COE is directed to hold (carry-over) floodwater in Abiquiu or Cochiti Reservoir after July 1 when the natural flow at Otowi gage falls below 1,500 cfs, water must subsequently be released between November 1 and March 31. b) A provision in the law requires that 212,000 a-f of space is available for control of summer floods. If 212,000 a-f of space is not available releases from Cochiti can continue from July 1 through November 1 to evacuate flood water in the space needed.
Jemez Canyon Reservoir Owned and operated by COE Located on Pueblo of Santa Ana land Purpose: Flood and sediment control	Operated for flood control (max. 73,000 af): release inflows as quickly as possible without causing flooding (in conjunction with Abiquiu, Cochiti and Galisteo Reservoirs such that flows do not to exceed 7,000 cfs at Albuquerque). Operated as a dry reservoir for flood and sediment control. Limitation on rate of change in stage at the downstream gage of .25 to .50 feet per gate change for public safety.
Low Flow Conveyance Channel Owned by Reclamation Purpose: Convey lower flows of the Rio Grande, improve drainage, supplement irrigation water supply and assist New Mexico in making compact deliveries.	Diversions up to 2,000 cfs at San Acacia are possible when physical outfall conditions allow. Drainage flows in the Low Flow Conveyance Channel: a) Supply the majority of the water needs at Bosque del Apache National Wildlife Refuge. b) Supply MRGCD with irrigation water. c) In 2000 and 2001 drainage flows were pumped to the river during low flows to support endangered species habitat as per State Engineer granted emergency authorizations.

No Action Alternative

Elephant Butte Reservoir Only Flood Control within the authority of this review Owned & operated by Reclamation Power generation facilities owned by Reclamation Purpose: Water supply for irrigation and M&I use, recreation and flood control Secondary operation for hydroelectric power Provides incidental sediment control	Operation of the project retains all inflows in excess of downstream irrigation demand. Releases from Elephant Butte Dam during the irrigation season are to satisfy irrigation demand downstream of Caballo Dam, and maintain Caballo Reservoir's lake level per Court Order of 1996. Maintain a 50,000 a-f flood control space from April 1 to September 30 (summer months) and a 25,000 a-f flood space from October 1 to March 31 (winter months). Releases are controlled to the channel capacity of 5,000 cfs below the dam. Generation of hydroelectric power is a secondary purpose. Maximum powerplant release is 2,400 cfs. Rio Grande Convention of 1906 and 1933 Extension between Mexico and the United States obligates the delivery of 60,000 a-f of water to Mexico's Acequia Madre headworks annually unless extraordinary or serious accident occurred to the irrigation system in the United States. . Flood control releases are required when the reservoir level is within the flood control space. Flood control releases are coordinated with Caballo Reservoir, upstream COE projects, and International Boundary and Water Commission (IBWC). Releases cease at the end of the irrigation season, typically mid-October.

No Action Alternative

Caballo Reservoir Only Flood Control within the authority of this review Owned by Reclamation Reclamation authorized to assume operations for the purpose of dam safety once the top of flood pool is exceeded. Purpose: Water supply for irrigation and M&I use, and flood control Provides incidental sediment control and incidental fish & wildlife purposes.	Flood Control operations are directed by IBWC. Generally, USIBWC requires the 100,000 a-f flood pool will be completely evacuated as quickly and safely as possible from June 1st to October 31st. Flood control releases are required when the reservoir level is within the flood control space. Releases are coordinated with Elephant Butte Reservoir, upstream COE projects and IBWC. Operation of the project retains all inflows in excess of downstream irrigation demand and safe river channel capacity of 5,000 cfs or per IBWC direction. Target range is 2500-3500 cfs due to flood damage effects beginning to occur in Selden canyon above that flow. IBWC, in coordination with Reclamation, controls the operation of the flood pool to control flow downstream of Caballo to less than 11,000 cfs at American Diversion Dam. IBWC's Canalization Project levee system flood control capacity varies from 5,000 to about 22,000 cfs. Impacts downstream in some places start below 3,000 cfs. Since Sept.17, 1991, Sec7 consultation, requires that Reclamation maintain a minimum pool of 25,000 a-f for fishery purposes and to support bald eagle habitat. Since Court Order of 1996, reservoir is operated to maintain a storage level below 50,000 a-f from October 1st to January 31st to leave enough space for winter accretions. From February 1st to September 30th the reservoir is operated within a flexible storage between 50,000 and 80,000 a-f. This operation is to minimize the evaporation of both Elephant Butte and Caballo Reservoirs. Rio Grande Convention of 1906 and 1933 Extension between Mexico and the United States obligates the delivery of 60,000 a-f of water to Mexico's Acequia Madre headworks annually unless extraordinary or serious accident occurred to the irrigation system in the United States.

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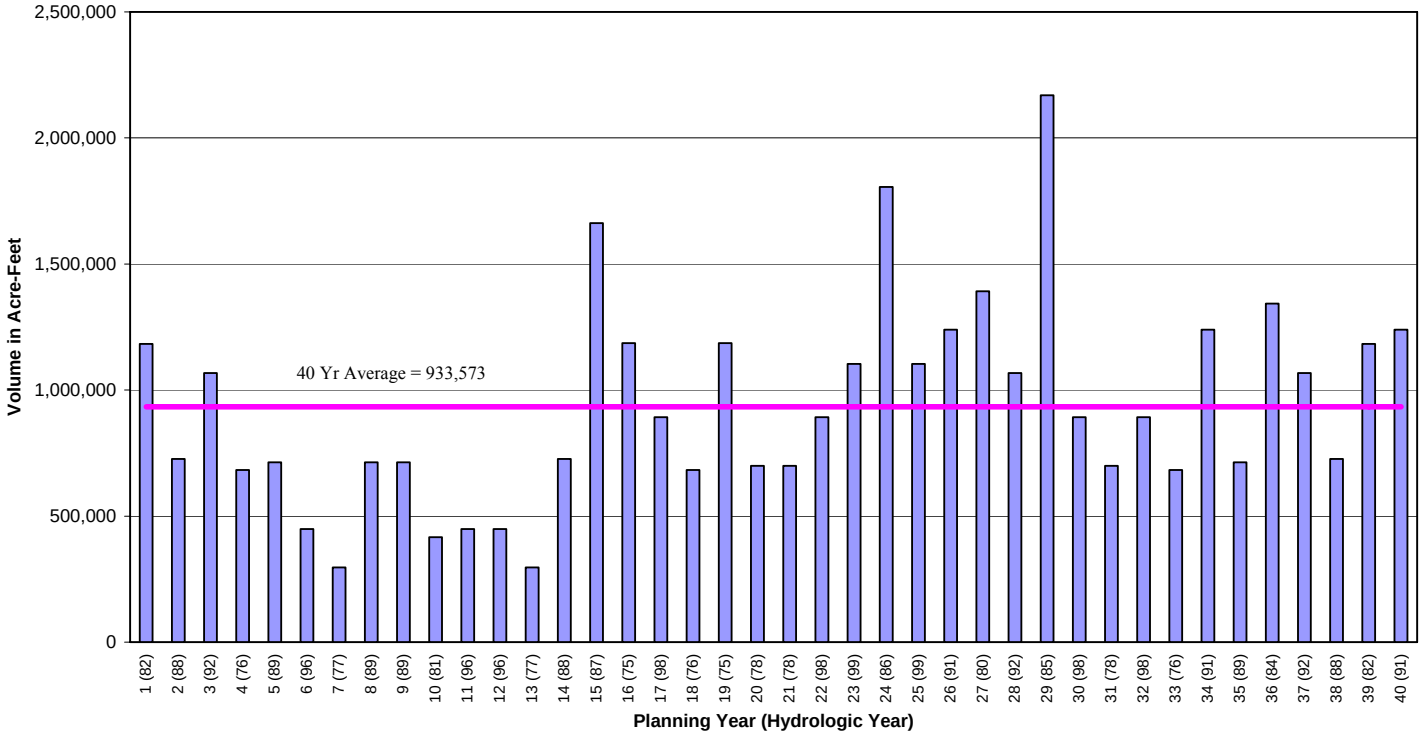
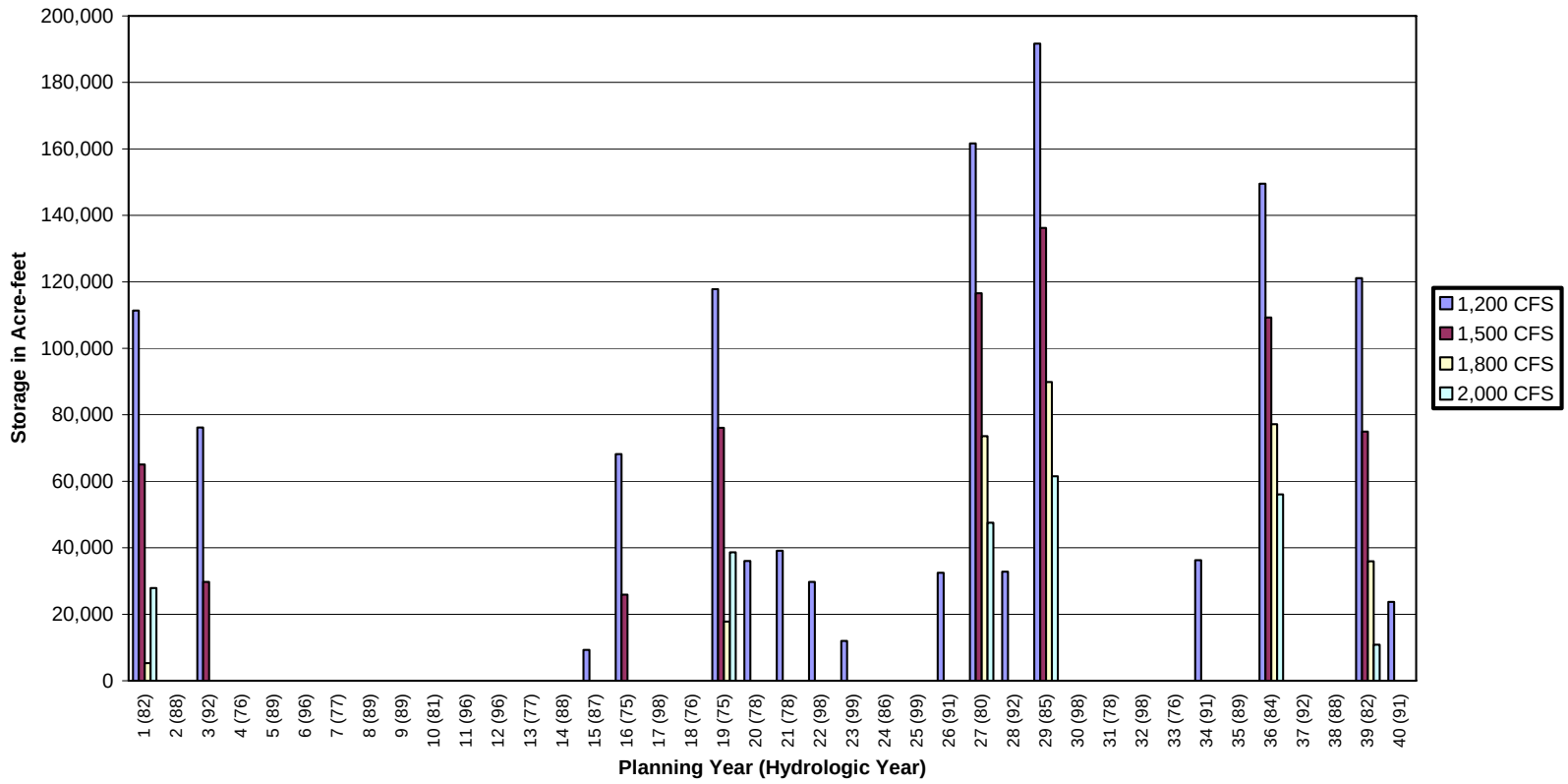
11.0 ATTACHMENT D FIGURES

Figure I.D-1: All Model Runs: 40 Year Otowi Flow Sequence



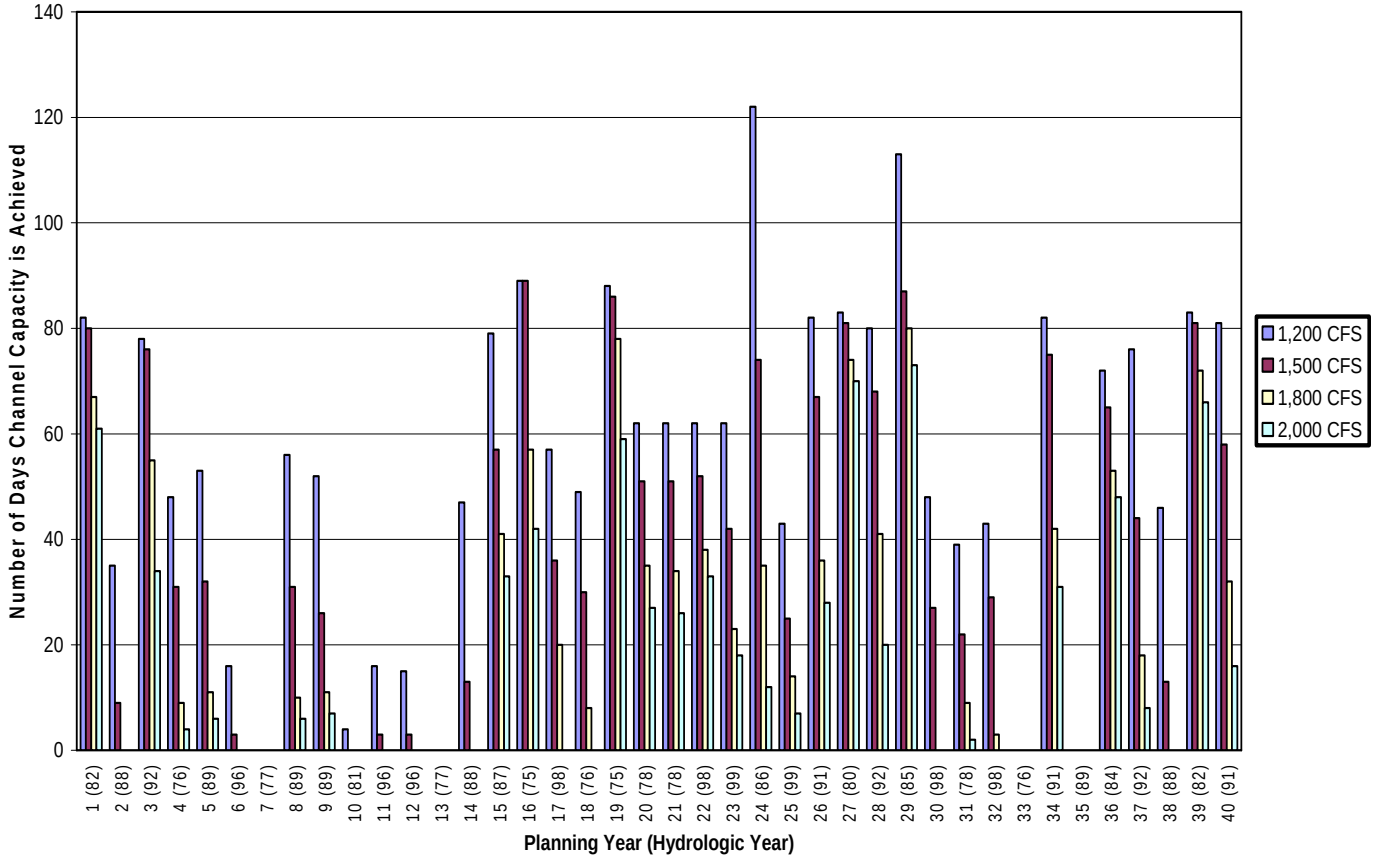
Hydrologic sequence for Otowi gage, developed by S.S. Papadopulos & Associates, Inc., described in a separate appendix.

Figure I.D-2: Sensitivity Analysis on Base Run of Various Abiquiu Channel Capacities



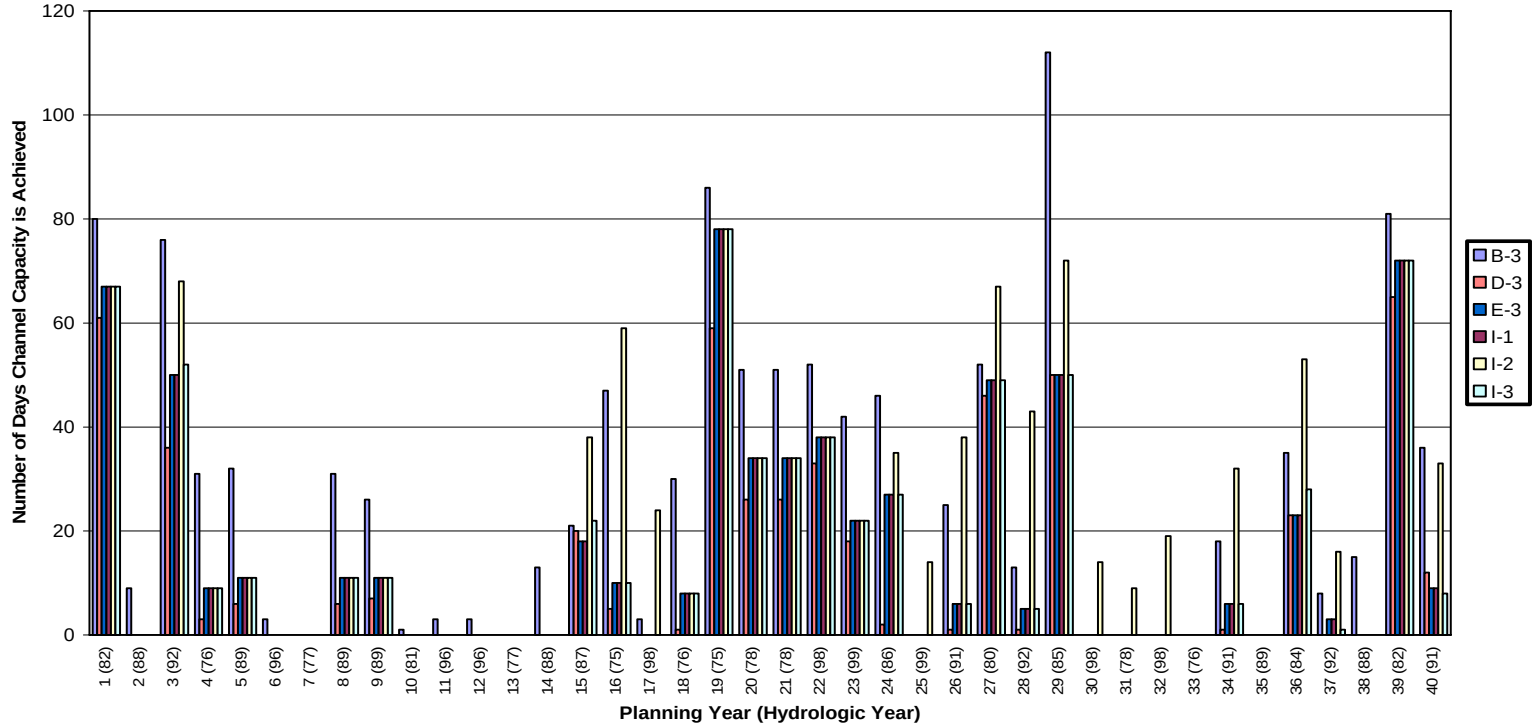
The graph above shows the results of lowering or increasing the channel capacity at Abiquiu Reservoir. The amount of carryover storage increases with a decrease in channel capacity and decreases with an increase in the channel capacity. Only channel capacity below Abiquiu Reservoir was varied in the Base Run Model.

Figure I.D-3: Number of Days in a Model Year that Abiquiu Channel Capacity Is Achieved



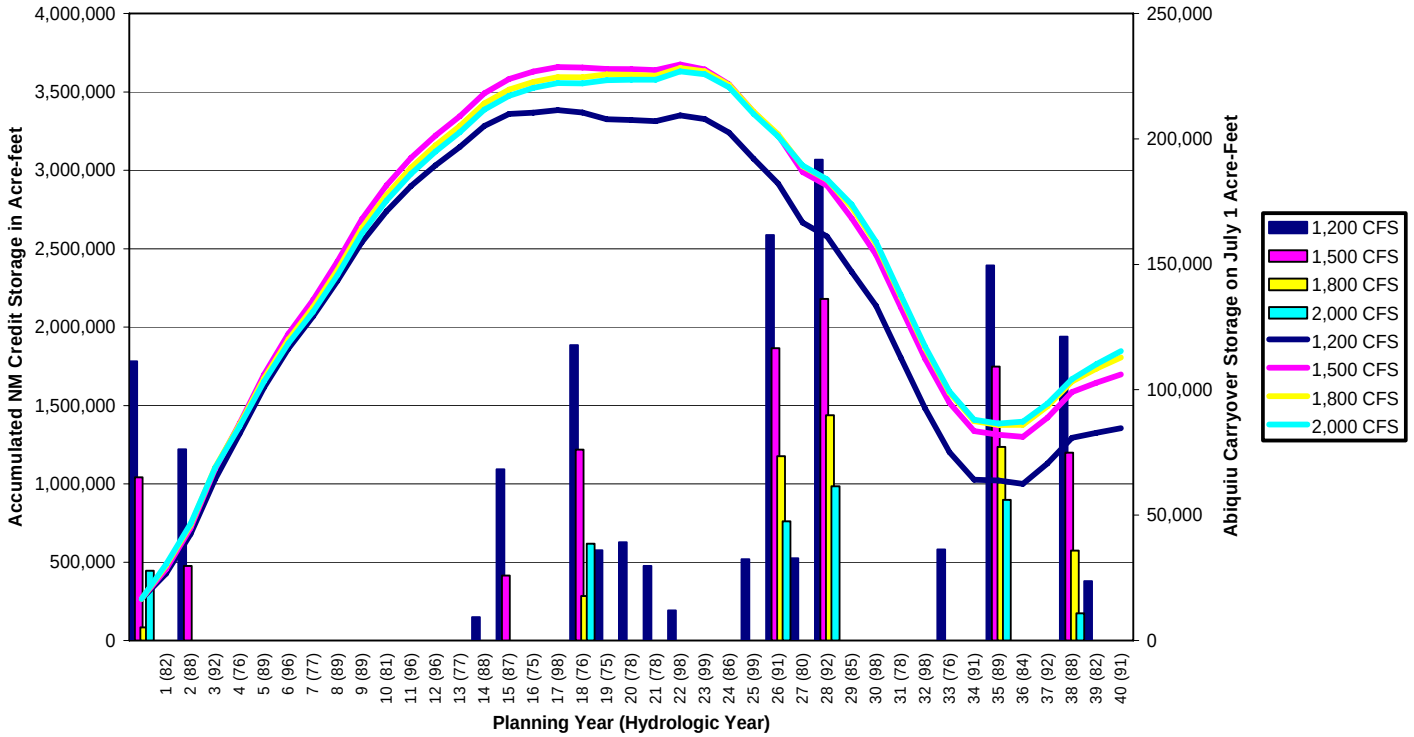
The graph above shows the results of lowering or increasing the channel capacity and the number of days that you would be at channel capacity. Lowering the channel capacity to 1200 cfs increases the number of days at flow and also increases the number of years that you would have carryover storage as shown in the previous graph.

Figure I.D-4: Number of Days Channel Capacity is Achieved at Abiquiu Per Action Alternative



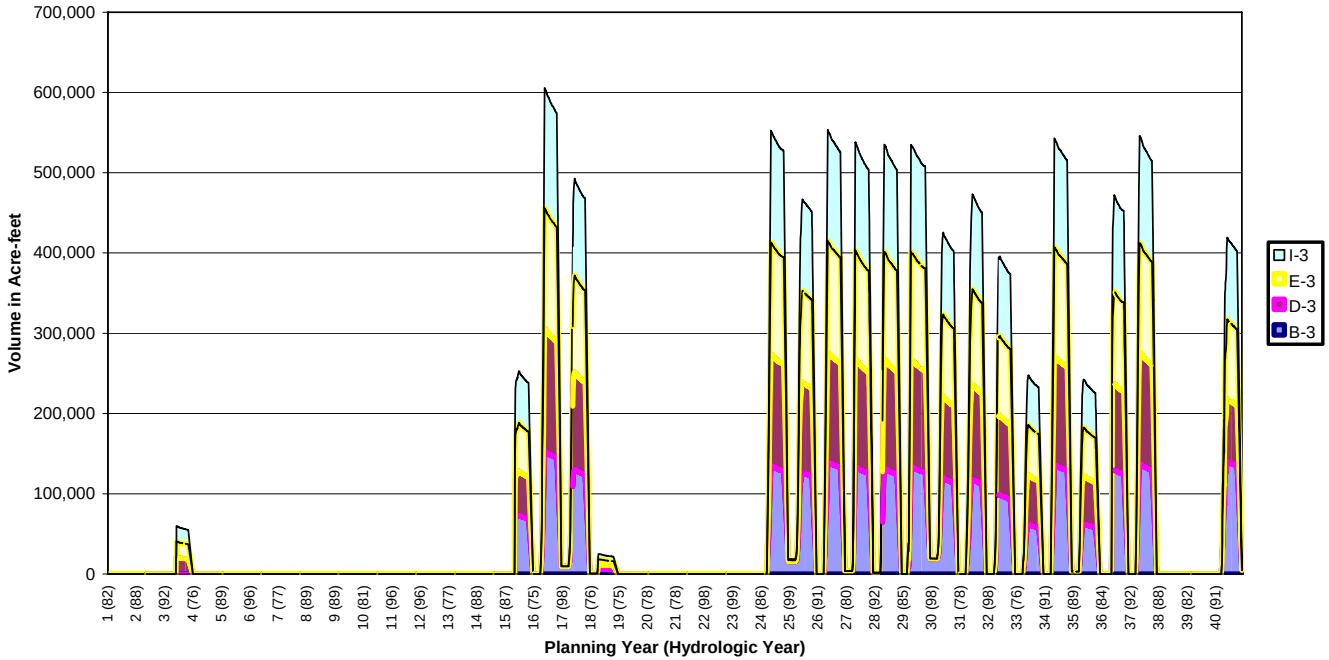
The graph shows the result of the different alternative model runs. Alternative B-3 in most years shows the highest number of days Abqiuiu Reservoir would be at channel capacity.

Figure I.D-5: Sensitivity Analysis on Base Run of Accumulated NM Credit Storage and Abiquiu Reservoir Carryover Storage Under Various Channel Capacities



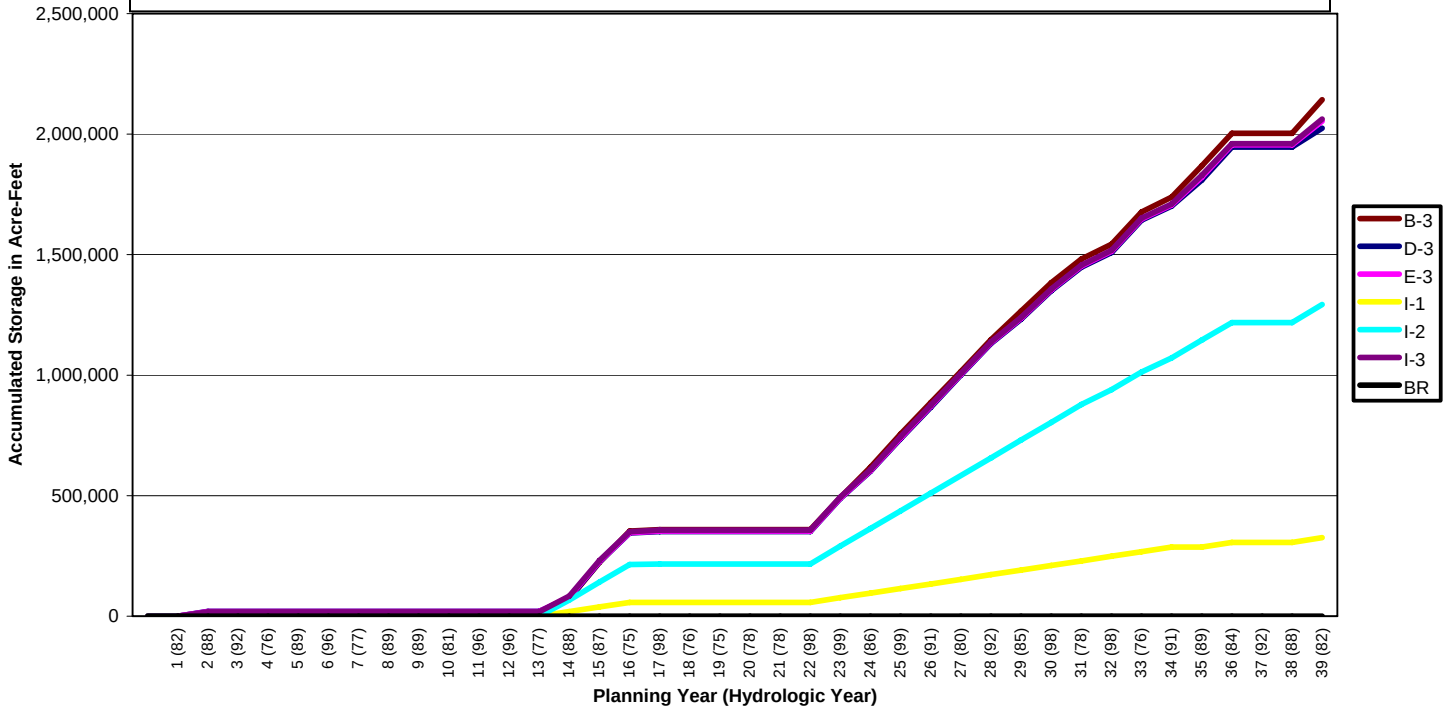
The results in the graph for accumulated NM credit should not be taken as actual values. The curves should be used only in relative terms to show trends and compare results between alternatives. The curves show that maintaining a higher channel capacity below Abiquiu Dam increases in compact deliveries.

Figure I.D-6: Abiquiu Conservation Storage Comparison Between Action Alternatives



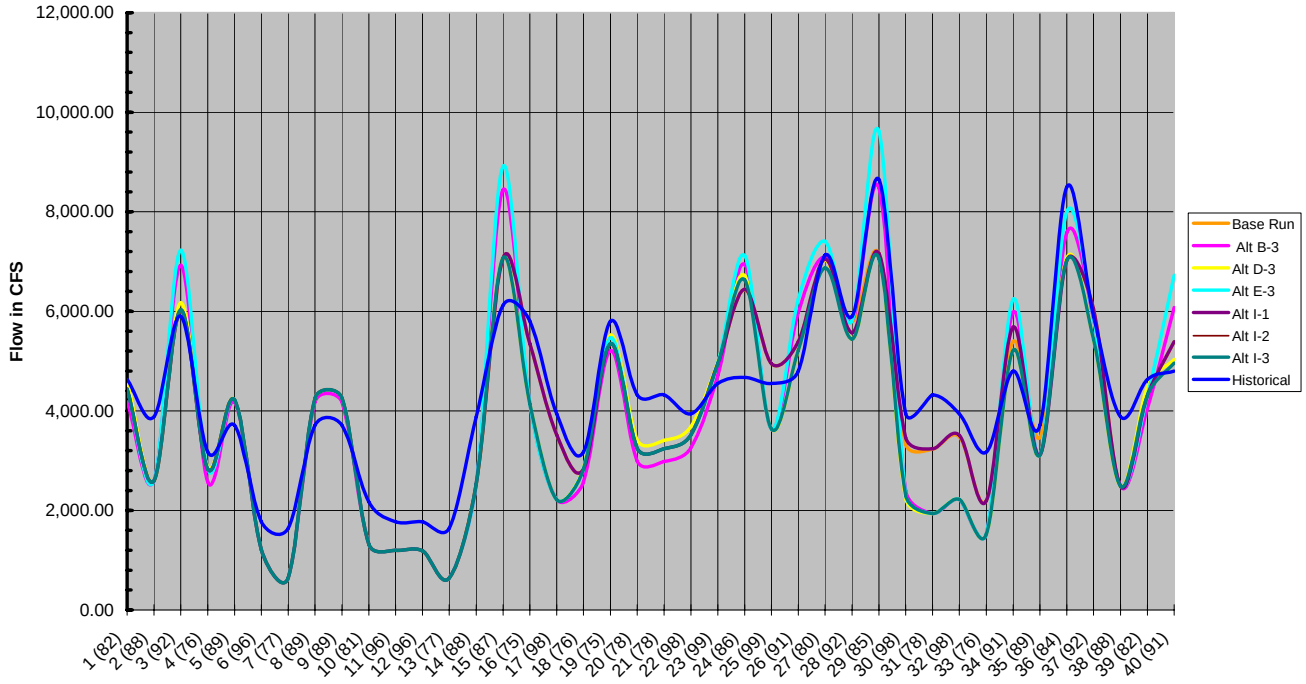
The results in the graph show the amount of conservation storage that could be captured under the different alternatives. The Base Run does not capture conservation therefore it is not shown. Alternative I-1 and I-2 conservation storage targets are below 180,000 acre-feet therefore were not plotted.

Figure I.D-7: Cumulative Annual Abiquiu Conservation Storage based on Annual July 1 Conservation Storage



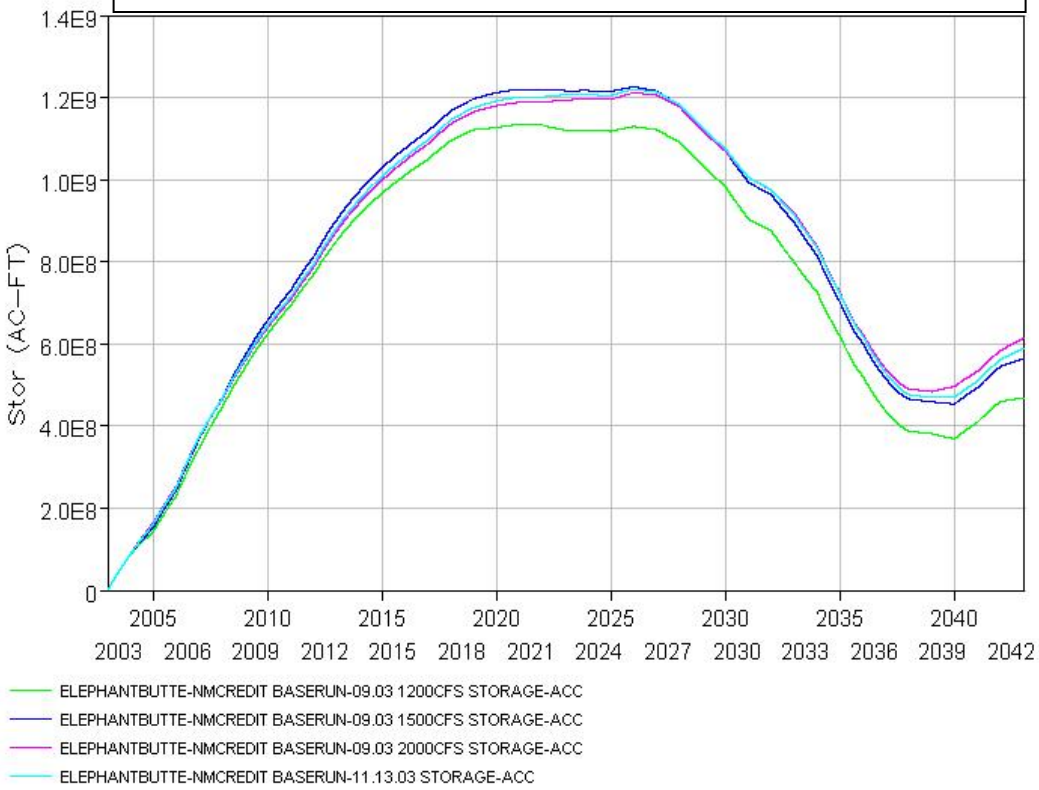
The graph shows the accumulated conservation storage over the 40-year model runs. Alternative B-3 has the most and I-1 with the least. The difference between alternatives B-3, D-3, E-3 and I-3 is relative small over the 40-years. The numbers shown on the graphs should not be used as actual numbers and used only in relative terms to show trends and compare results between alternatives.

Figure I.D-8: Summary of Peak Flows at Albuquerque



The graph above shows peak flows for all the alternatives, base run and the historical flow. The historical flow is presented only as a comparison. Starting conditions were different for the historical flows. Alternative E-3 provides the higher peak flows.

Figure I.D-9: Sensitivity Analysis on the Base Run to Evaluate NM Credit Storage with Various Rates of Release



The graph above shows the accumulated NM credit storage using the Base Run with a 1200, 1500, 2000 cfs release and allowing storage up to 75,000 acre-feet in the conservation pool at Abiquiu Reservoir. The Base Run with the 1800 cfs channel capacity is not storing conservation water. The graph is for comparison purposes only and values should not be taken as actual. The graph indicates a trend over the 40-years.

Figure I.D-10: Abiquiu Average Annual Storage (Model Year 1-40)

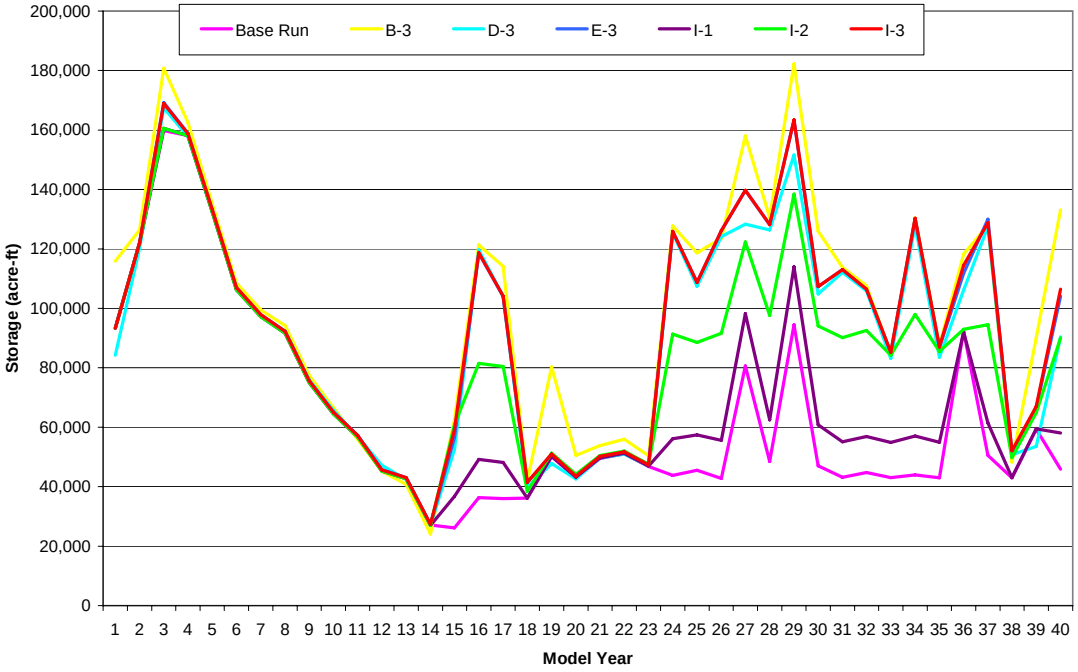


Figure I.D-11: Cochiti Average Annual Storage (Model Year 1-40)

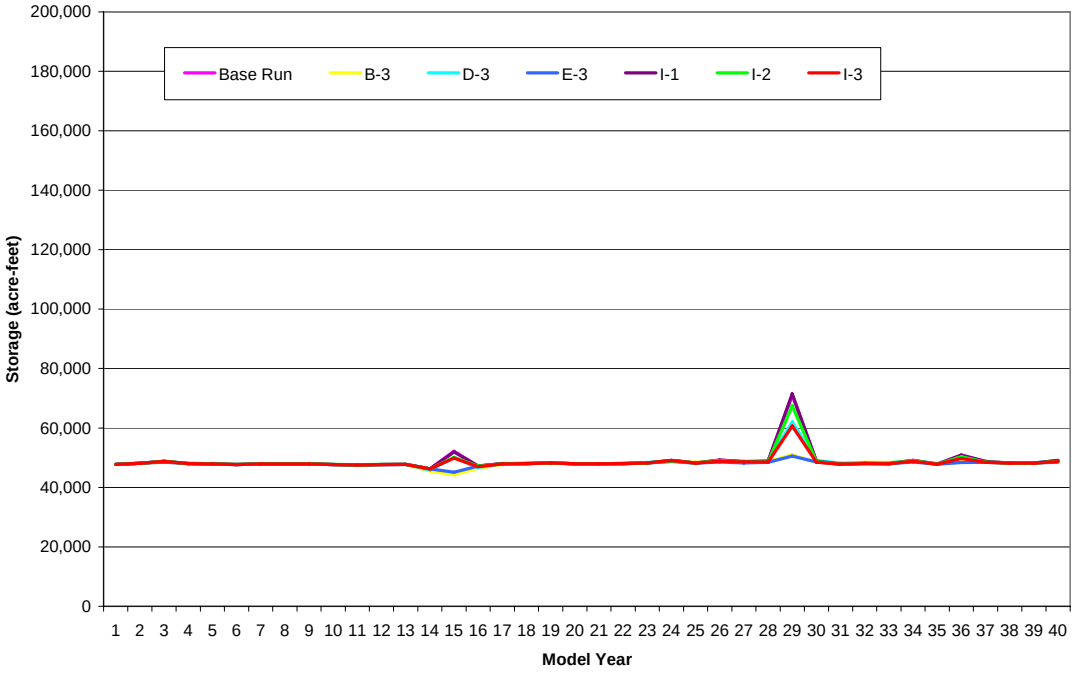


Figure I.D-12: Albuquerque Average Annual Flow (Model Year 1-40)

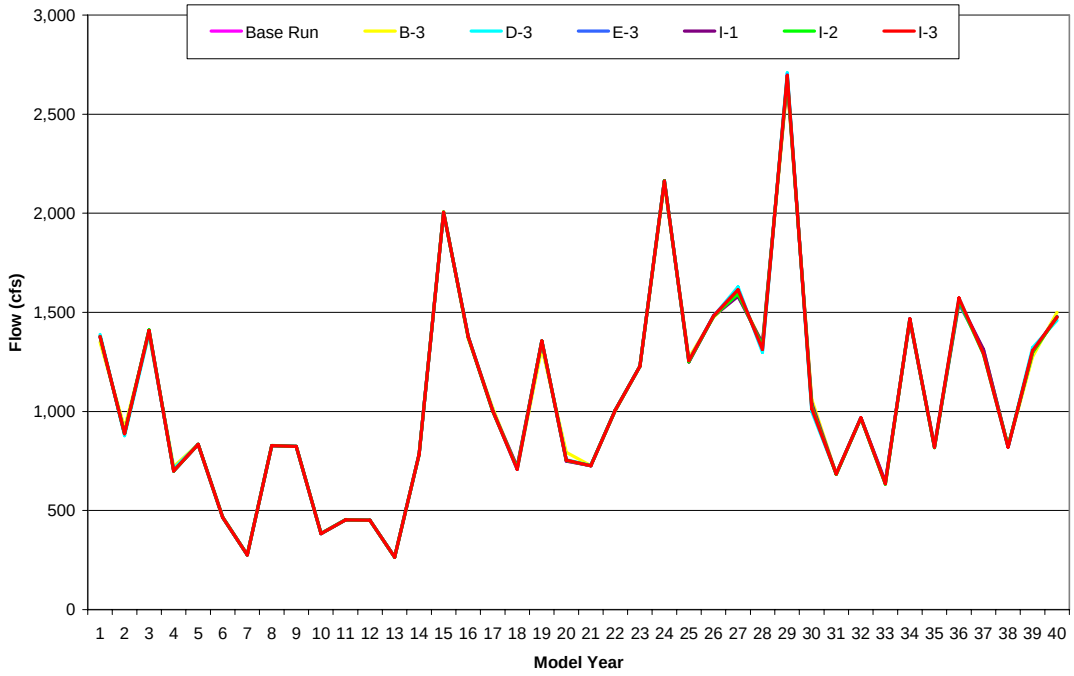


Figure I.D-13: Chamita Average Annual Flow (Model Year 1-40)

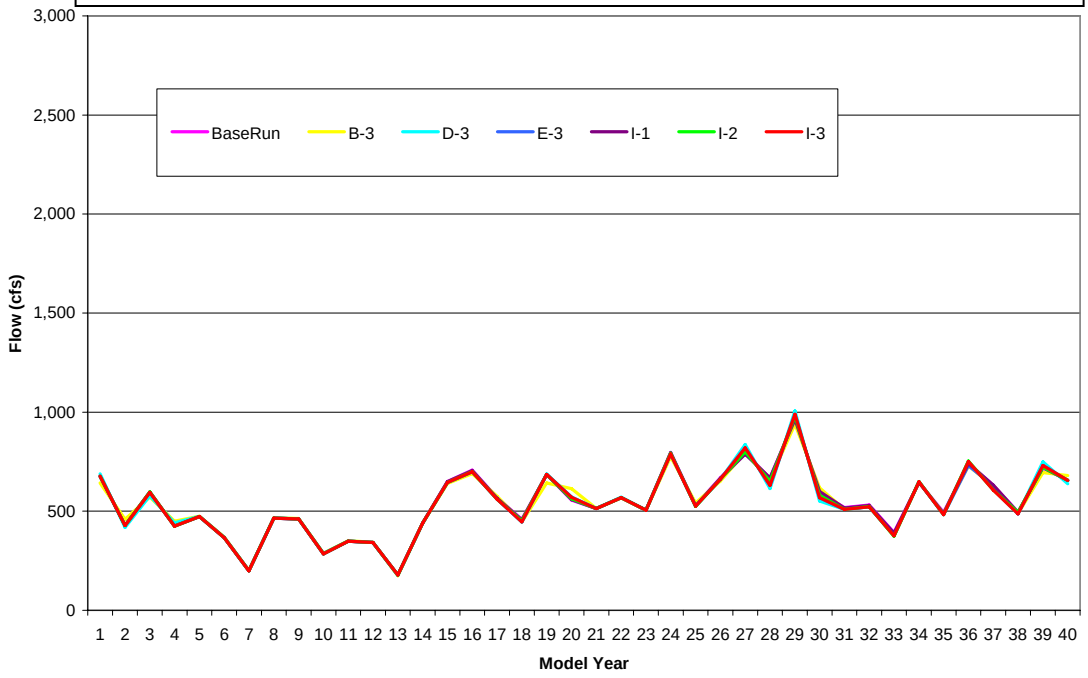


Figure I.D-14: El Vado Average Annual Flow (Model Year 1-40)

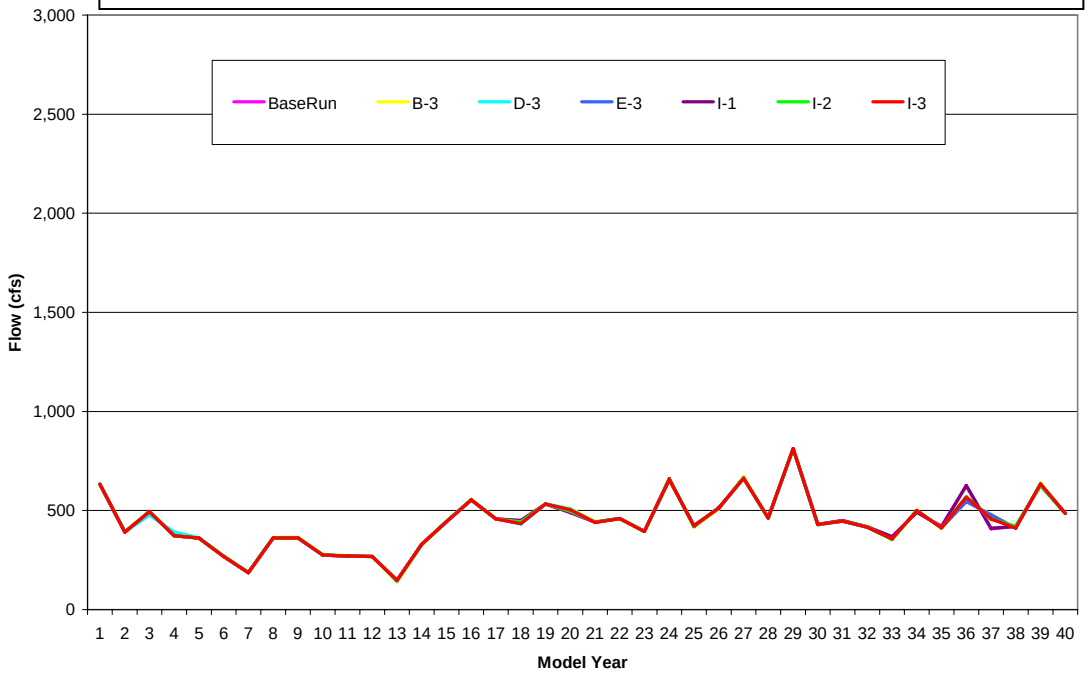


Figure I.D-15: Otowi Average Annual Flow (Model Year 1-40)

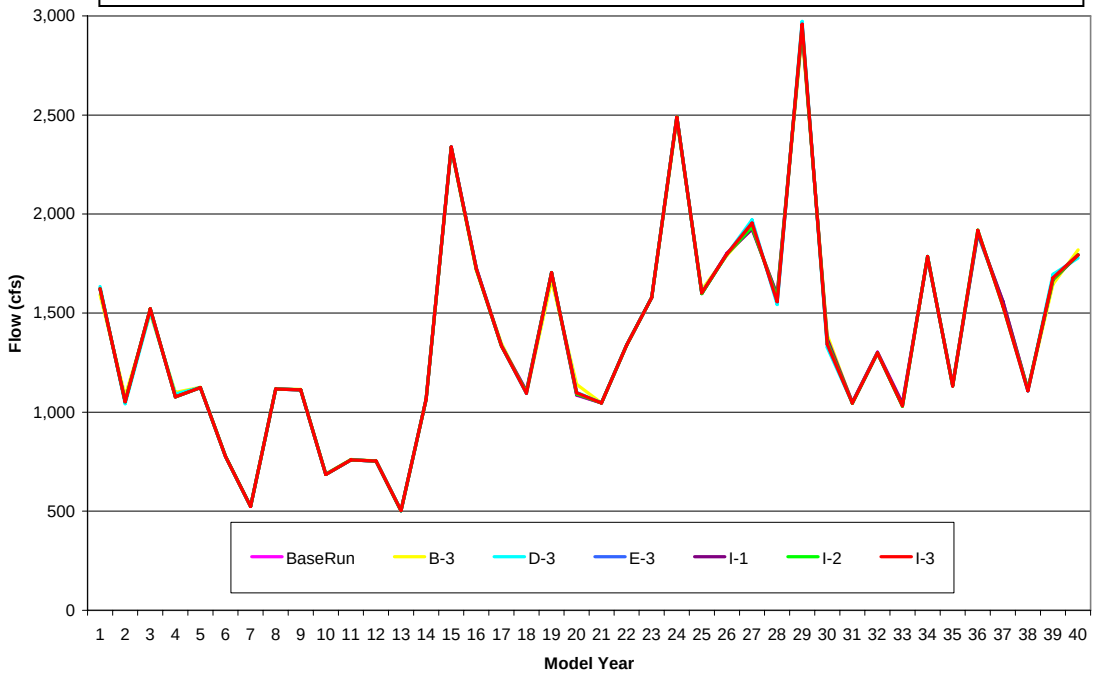
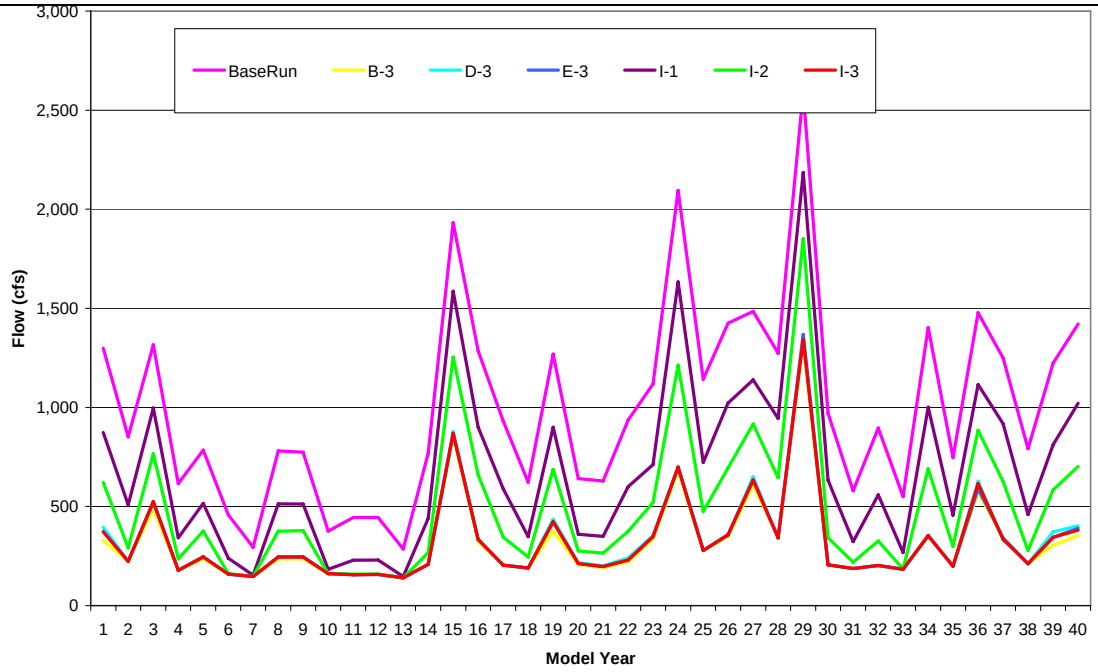


Figure I.D-16: San Acacia Average Annual Flow (Model Year 1-40)



12.0 ATTACHMENT E TABLES

Table I.E-1: Abiquiu Average Annual Pool Elevation (ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	6,173.9	6,197.6	6,194.0	6,195.1	6,179.1	6,191.1	6,195.1
Max	6,213.7	6,219.0	6,215.7	6,216.1	6,213.8	6,213.8	6,216.0
Min	6,158.3	6,157.6	6,160.4	6,160.6	6,160.3	6,160.3	6,160.6
Mean	6,179.9	6,192.9	6,190.1	6,191.0	6,182.8	6,188.2	6,191.1
25th percentile	6,171.8	6,179.1	6,176.2	6,177.0	6,174.5	6,178.1	6,177.8
75th percentile	6,189.1	6,202.6	6,200.9	6,201.5	6,192.3	6,193.6	6,201.5

Table I.E-2: Cochiti Average Annual Pool Elevation (ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	5,339.0	5,339.1	5,339.1	5,339.0	5,339.0	5,339.0	5,339.0
Max	5,349.9	5,341.2	5,346.6	5,341.1	5,349.9	5,348.6	5,346.0
Min	5,337.4	5,335.4	5,337.0	5,336.3	5,337.4	5,337.4	5,337.4
Mean	5,339.4	5,339.0	5,339.3	5,339.0	5,339.4	5,339.3	5,339.2
25th percentile	5,338.9	5,338.9	5,338.9	5,338.8	5,338.9	5,338.9	5,338.9
75th percentile	5,339.6	5,339.4	5,339.5	5,339.2	5,339.6	5,339.4	5,339.4

Table I.E-3: El Vado Average Annual Pool Elevation (ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	6,859.1	6,869.8	6,867.5	6,869.2	6,860.6	6,866.3	6,867.8
Max	6,889.0	6,888.8	6,888.9	6,889.0	6,889.0	6,889.0	6,889.0
Min	6,802.2	6,802.2	6,802.2	6,802.2	6,802.2	6,802.2	6,802.2
Mean	6,859.4	6,860.8	6,860.5	6,860.4	6,859.3	6,859.9	6,860.2
25th percentile	6,838.8	6,838.6	6,838.6	6,838.8	6,838.8	6,838.8	6,838.8
75th percentile	6,883.6	6,884.7	6,883.9	6,883.9	6,882.9	6,883.6	6,883.9

Table I.E-4: Heron Average Annual Pool Elevation (ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	7,154.1	7,152.5	7,152.7	7,154.3	7,154.1	7,154.2	7,154.3
Max	7,184.7	7,185.2	7,185.1	7,184.7	7,184.7	7,184.7	7,184.7
Min	7,065.4	7,052.4	7,058.6	7,065.4	7,065.4	7,065.4	7,065.4
Mean	7,151.2	7,149.5	7,150.4	7,151.3	7,151.2	7,151.3	7,151.3
25th percentile	7,132.3	7,130.5	7,131.5	7,132.3	7,132.3	7,132.3	7,132.3
75th percentile	7,183.2	7,182.9	7,183.1	7,183.0	7,183.2	7,183.0	7,183.0

Table I.E-5: Abiquiu Average Annual Pool Storage (acre-ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	47,788.5	108,066.0	95,062.0	100,967.5	56,957.0	89,251.0	100,997.0
Max	159,763.0	182,243.0	167,440.0	169,234.0	160,519.0	160,519.0	168,864.0
Min	26,154.0	24,118.0	27,084.0	27,329.0	26,985.0	26,985.0	27,303.0
Mean	64,011.0	99,308.5	90,930.9	93,417.4	69,542.8	83,643.4	93,622.6
25th percentile	43,104.8	60,853.3	52,136.0	55,287.3	49,550.8	55,519.3	55,941.3
75th percentile	83,418.3	126,698.3	121,259.8	123,024.8	91,736.8	95,196.3	123,038.5

Table I.E-6: Cochiti Average Annual Pool Storage (acre-ft) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	48,042.0	48,132.5	48,147.5	48,013.5	48,041.5	48,037.5	48,025.0
Max	71,023.0	50,925.0	62,020.0	50,564.0	71,501.0	67,493.0	60,653.0
Min	46,258.0	44,194.0	45,847.0	45,131.0	46,255.0	46,255.0	46,258.0
Mean	48,873.1	48,069.6	48,593.1	48,011.5	48,874.7	48,671.8	48,457.6
25th percentile	47,894.8	47,869.0	47,945.3	47,836.0	47,893.3	47,885.5	47,882.0
75th percentile	48,765.0	48,486.8	48,693.0	48,273.0	48,742.0	48,523.5	48,491.3

Table I.E-7: Albuquerque Average Annual Flow (cfs) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	986.4	986.0	983.8	986.1	984.7	983.6	986.1
Max	2,672.4	2,654.6	2,708.2	2,698.1	2,673.3	2,683.8	2,695.5
Min	265.3	263.8	264.9	265.3	265.3	265.3	265.3
Mean	1,067.2	1,067.4	1,067.3	1,066.8	1,067.1	1,066.0	1,066.9
25th percentile	724.9	725.3	723.6	721.7	724.4	723.4	721.6
75th percentile	1,377.0	1,354.1	1,380.7	1,376.6	1,376.2	1,375.1	1,376.6

Table I.E-8: Chamita Average Annual Flow (cfs) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	529.8	533.0	524.6	524.6	527.7	523.8	524.6
Max	969.9	939.6	1006.1	990.0	962.5	977.9	990.0
Min	178.5	174.7	176.3	178.5	178.5	178.5	178.5
Mean	543.6	540.9	541.4	540.9	542.8	541.2	540.9
25th percentile	454.4	456.9	444.1	444.6	452.6	449.7	444.7
75th percentile	658.6	644.0	645.7	650.2	658.4	652.6	650.0

Table I.E-9: El Vado Average Annual Flow (cfs) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	435.2	438.1	437.0	437.5	435.2	442.1	437.6
Max	811.9	811.8	812.1	811.7	811.6	811.7	811.7
Min	147.4	138.9	142.8	147.4	147.4	147.4	147.4
Mean	440.4	440.5	440.2	439.6	440.4	439.7	439.6
25th percentile	366.5	364.9	363.6	362.0	365.5	362.0	362.0
75th percentile	490.0	502.0	500.8	500.6	492.3	497.1	500.4

Table I.E-10: Otowi Average Annual Flow (cfs) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	1,320.2	1,316.9	1,312.1	1,316.1	1,318.3	1,315.7	1,316.2
Max	2,937.4	2,911.7	2,972.4	2,958.0	2,930.7	2,945.8	2,958.0
Min	503.8	500.2	501.6	503.8	503.8	503.8	503.8
Mean	1,375.9	1,374.7	1,374.8	1,374.4	1,375.3	1,374.1	1,374.4
25th percentile	1,061.8	1,077.7	1,060.0	1,061.8	1,061.8	1,061.8	1,061.8
75th percentile	1,676.8	1,650.9	1,698.1	1,684.6	1,676.8	1,678.3	1,684.6

Table I.E-11: San Acacia Average Annual Flow (cfs) (Model Year 1-40)

	No Action	B-3	D-3	E-3	I-1	I-2	I-3
Median	913.1	229.5	243.8	237.6	573.6	375.0	237.6
Max	2,591.4	1,327.4	1,357.5	1,368.7	2,185.7	1,852.0	1,342.7
Min	285.4	139.1	140.0	141.0	146.5	141.1	141.0
Mean	1,004.4	316.5	330.0	326.5	686.0	494.9	326.0
25th percentile	627.6	191.3	197.2	194.8	349.3	259.8	194.8
75th percentile	1,289.4	345.1	359.2	356.0	924.9	666.7	353.5