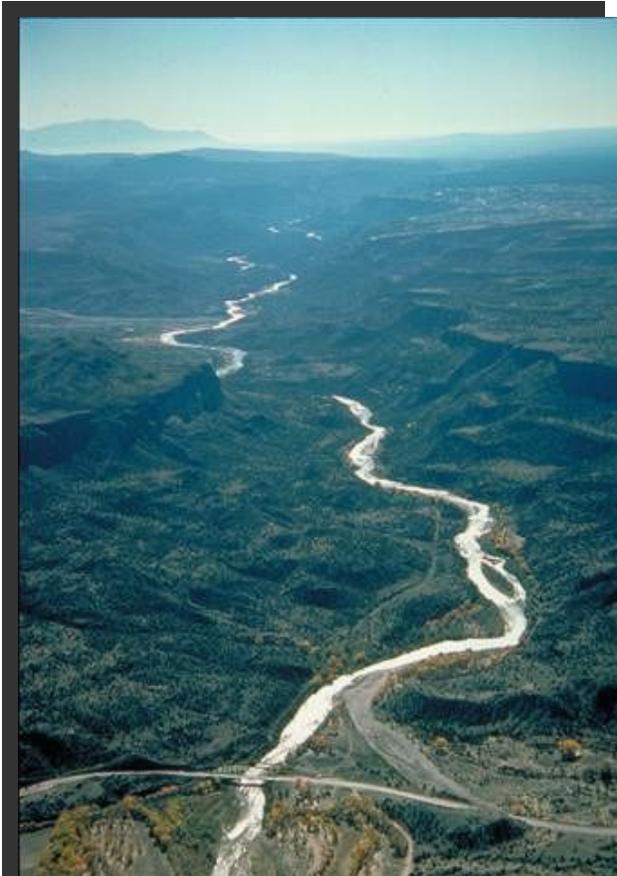


Upper Rio Grande Basin Water Operations Review

Final Environmental Impact Statement Summary



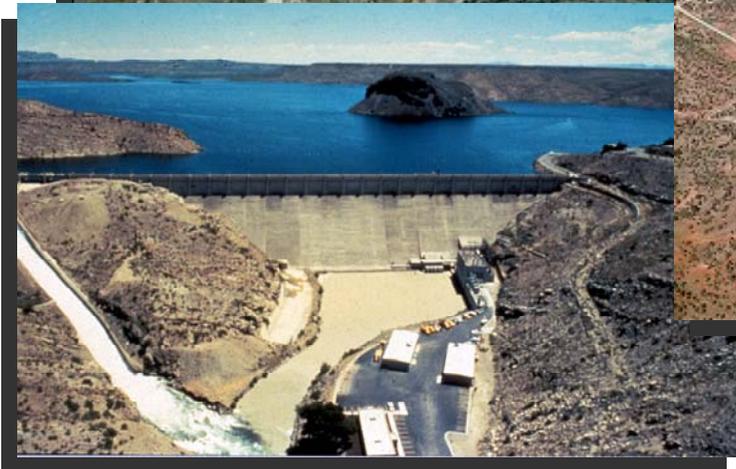
U.S. Army Corps of Engineers,
Albuquerque District



U.S. Department of the Interior,
Bureau of Reclamation



New Mexico
Interstate Stream Commission



FES-07-05

April 2007

Acronyms and Abbreviations

Corps	U.S. Army Corps of Engineers
DEIS	Draft EIS
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEIS	Final EIS
GIS	Geographic Information System
JLA	joint lead agencies
LFCC	Low Flow Conveyance Channel
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NMISC	New Mexico Interstate Stream Commission
NOI	Notice of Intent
SJC	San Juan-Chama
URGWOM	Upper Rio Grande Water Operations Model

Measurements

AF	acre-feet
cfs	cubic feet per second

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SUMMARY

1.0 BACKGROUND

This programmatic environmental impact statement (EIS) evaluates various alternatives and considers the effects of adopting an integrated plan for water operations in the upper Rio Grande basin. The basin includes the Rio Grande from its headwaters in Colorado through New Mexico to just above Fort Quitman, Texas. The development of this EIS is the result of a Memorandum of Agreement (MOA), signed in 2000, defining the scope, purpose, and need for the project, the rules and responsibilities of each Joint Lead Agency (JLA) entering into the agreement, and the organizational structure for participation and oversight. The JLAs for this EIS are the U.S. Bureau of Reclamation (Reclamation), the U.S. Army Corps of Engineers (Corps), and the New Mexico Interstate Stream Commission (NMISC). The MOA stipulates that the JLAs undertake a review of water management practices in the upper Rio Grande, subsequently named the Upper Rio Grande Basin Water Operations Review (Review). This EIS is prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended (Public Law [P.L.] 91-910, 42 United States Code (U.S.C.) 4321-4347). NEPA requires every federal agency to give appropriate consideration to all reasonably foreseeable environmental impacts of proposed actions as part of agency planning and decision making. Therefore, any proposed activity that uses or crosses public land, or uses federal funds, must be reviewed by the federal agency for its potential environmental impacts or concerns. This EIS is being conducted in accordance with NEPA to identify and assess potentially significant environmental, economic and social impacts and address other issues associated with changes in water operations of federally-operated facilities in the upper Rio Grande basin.

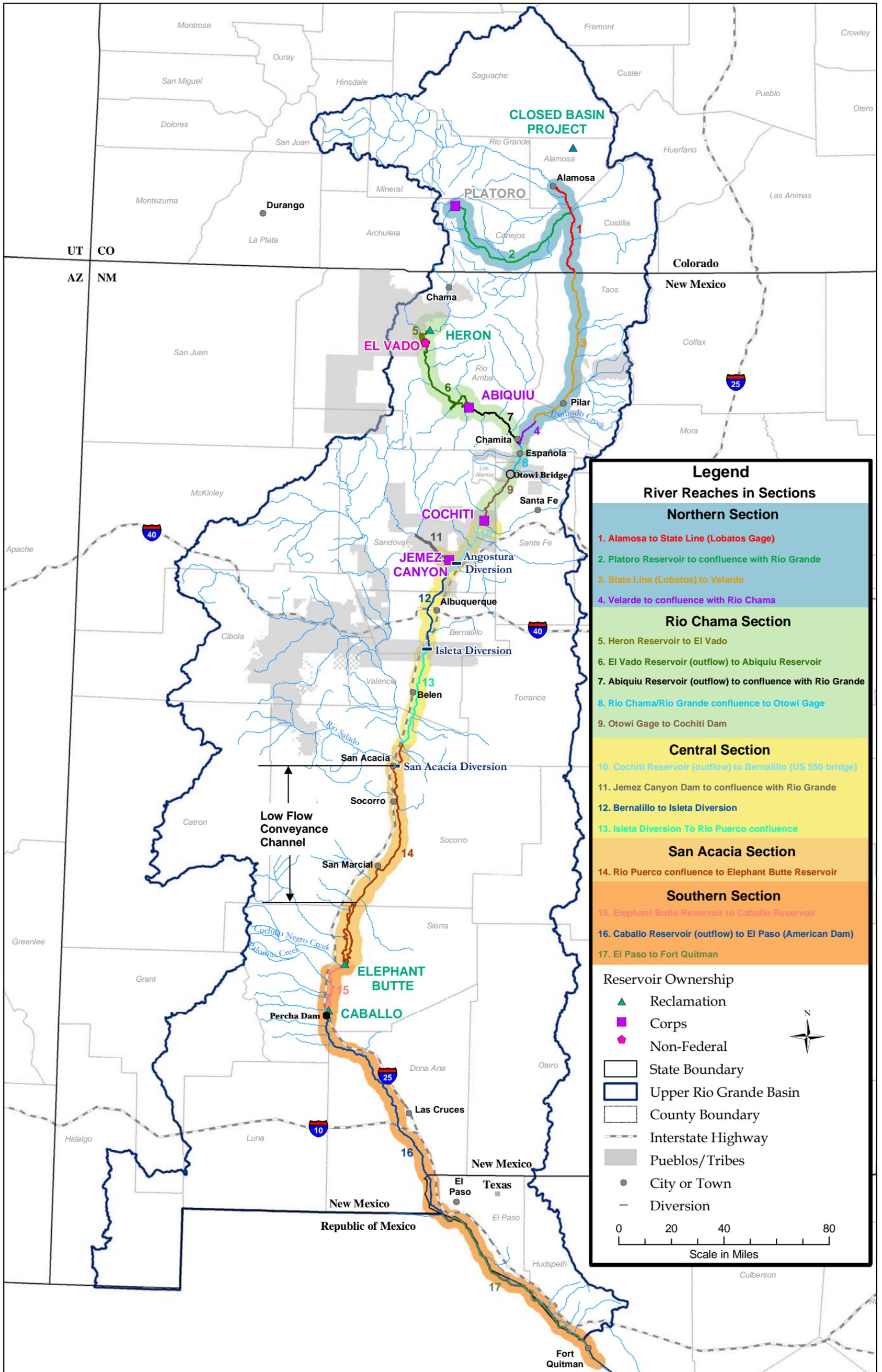
Water management in the upper Rio Grande basin is a complex undertaking: several distinct federal and state agencies with differing missions and methods are responsible for legislating, managing, and distributing water. A number of contracts and agreements between federal, state, local, or tribal entities require the delivery of water to various entities. The portion of the river designated as the upper Rio Grande is subject to the Rio Grande Compact signed on March 18, 1938; ratified by the States of Colorado, New Mexico, and Texas in 1939; and signed by the President of the United States on May 31, 1939.

The climate of the upper Rio Grande basin is variable: years of above-average precipitation can be followed by years of drought. Thus, the volume of available water to comply with agreements from year to year is equally variable. As a result, any water management plans for the area need to anticipate and proactively address wide-ranging hydrologic conditions.

Ten water operations facilities in this basin can be manipulated individually or in concert to address various situations. Five facilities are located on tributaries: Heron and El Vado Reservoirs operated by the U.S. Bureau of Reclamation (Reclamation), and Platoro, Abiquiu, and Jemez Canyon Reservoirs operated by the U.S. Army Corps of Engineers (Corps). The remaining facilities are on the mainstem of the Rio Grande, including Closed Basin Project operated by Reclamation in Colorado, Cochiti Lake operated by the Corps, and the Low Flow Conveyance Channel (LFCC) operated by Reclamation. In addition, two Reclamation facilities on the mainstem—Elephant Butte and Caballo Reservoirs—have operations limited to flood control under the scope of this EIS. **Map S-1** shows these facilities and **Figure S-1** highlights key features of the upper Rio Grande system. The NMISC is authorized to protect, conserve and

develop the waters of the state and monitors operations at reservoirs and water conveyance facilities for these purposes and to assure compliance with the Rio Grande Compact.

In addition to this summary document, the final EIS contains two volumes. Volume 1 describes the proposed action, the alternatives considered, the analysis of potential effects of integrated water operation plan on the Rio Grande basin and environmental commitments associated with the action alternatives. Volume 2 contains attachments comprised of documents and other supporting material that provide detailed technical information concerning this proposed action.



Map S-1. Watershed and Key Water Operations Structures in the Upper Rio Grande Basin

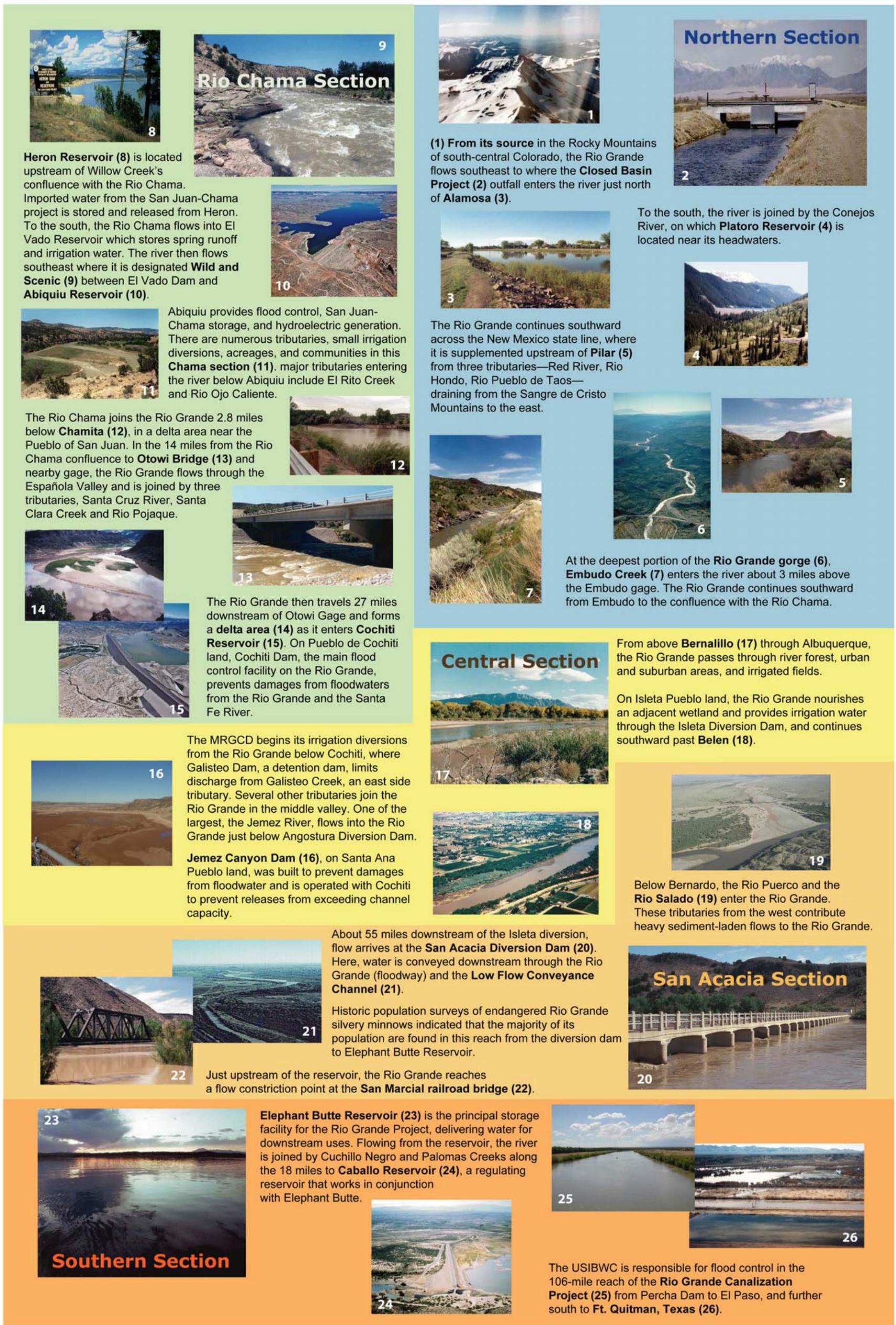


Figure S-1. A Trip Down the Upper Rio Grande

2.0 PURPOSE AND NEED FOR ACTION

Water management in the upper Rio Grande basin has evolved over decades, the result of separate and distinct authorizing legislation involving various federal and state agencies with differing missions and methods. While agency coordination historically occurred when necessary, it became more critical in the mid-1990s with the designation of two species as endangered under the federal Endangered Species Act (ESA). To meet species and habitat needs, manage flows in the highly variable flow regime of the Rio Grande, and satisfy competing water demands exacerbated by a multiple-year drought, additional cooperative efforts were needed. A new surface water model under development at the same time offered the capability to evaluate the operations of multiple water management facilities as a system, enabling technically valid comparisons of different scenarios. The goal was to use the model to evaluate a full range of water operations in an integrated systems approach and to examine whether the full range of discretionary actions was being implemented for better ecosystem management.

The three JLAs led the effort to develop an integrated plan for water operations at their existing facilities in the upper Rio Grande basin: Reclamation, the Corps, and NMISC. This project, the Water Operations Review (Review) and Environmental Impact Statement (EIS) for the upper Rio Grande basin, addresses the following proposed action: “The adoption of an integrated plan for water operations at existing Corps and Reclamation facilities in the Rio Grande basin above Fort Quitman, Texas.” The JLAs adopted the following purpose and need statements for this Review and EIS, based on their agency responsibilities and authorities.

Purpose—The Water Operations Review will be the basis of, and integral to, the preparation of the Water Operations EIS. The purposes of the Review and EIS are to:

1. Identify flexibilities in operation of federal reservoirs and facilities in the upper Rio Grande Basin that are within existing authorities of the Corps, Reclamation, and NMISC and that are in compliance with state and federal law.
2. Develop a better understanding of how these facilities could be operated more efficiently and effectively as an integrated system.
3. Formulate a plan for future water operations at these facilities that is within the existing authorities of the Corps, Reclamation, and NMISC, that complies with state, federal, and other applicable laws and regulations, and that assures continued safe dam operations.
4. Improve processes for making decisions about water operations through better interagency communications and coordination, and facilitation of public review and input.
5. Support compliance of the Corps, Reclamation, and NMISC with applicable laws and regulations, including, but not limited to, NEPA and the ESA.

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

1. Store and deliver water for agricultural, domestic, municipal, industrial, and environmental uses.
2. Assist the NMISC in meeting downstream water delivery obligations mandated by the Rio Grande Compact of 1938.
3. Provide flood protection and sediment control.
4. Comply with existing law, contract obligations, and international treaty.

2.1 Agency Coordination

Five Cooperating Agencies—Bureau of Indian Affairs, U.S. Fish and Wildlife Service, New Mexico Department of Agriculture, New Mexico Environment Department, Ohkay Owingeh Pueblo—signed formal agreements for participation in this Review and EIS. Each of these Cooperating Agencies provided team members and/or leadership on technical teams, contributed to review of findings during monthly Interdisciplinary NEPA Team meetings, and participated on the Steering Committee. The Interdisciplinary NEPA Team also included the participation of technical experts from other participating agencies. Project oversight and responsibility is the function of the Executive Committee, composed of the local officials of the lead agencies, which also provided project managers. The Steering Committee, composed of agency and tribal personnel, as well as interested stakeholders, facilitates coordination and information exchange with no decision-making role. Representatives from over 45 state and federal agencies and organizations, as well as many interested stakeholders, participated in technical resource teams, Interdisciplinary NEPA team meetings, and the Steering Committee. The organizational structure for this Review and EIS is shown in **Figure S-2**.

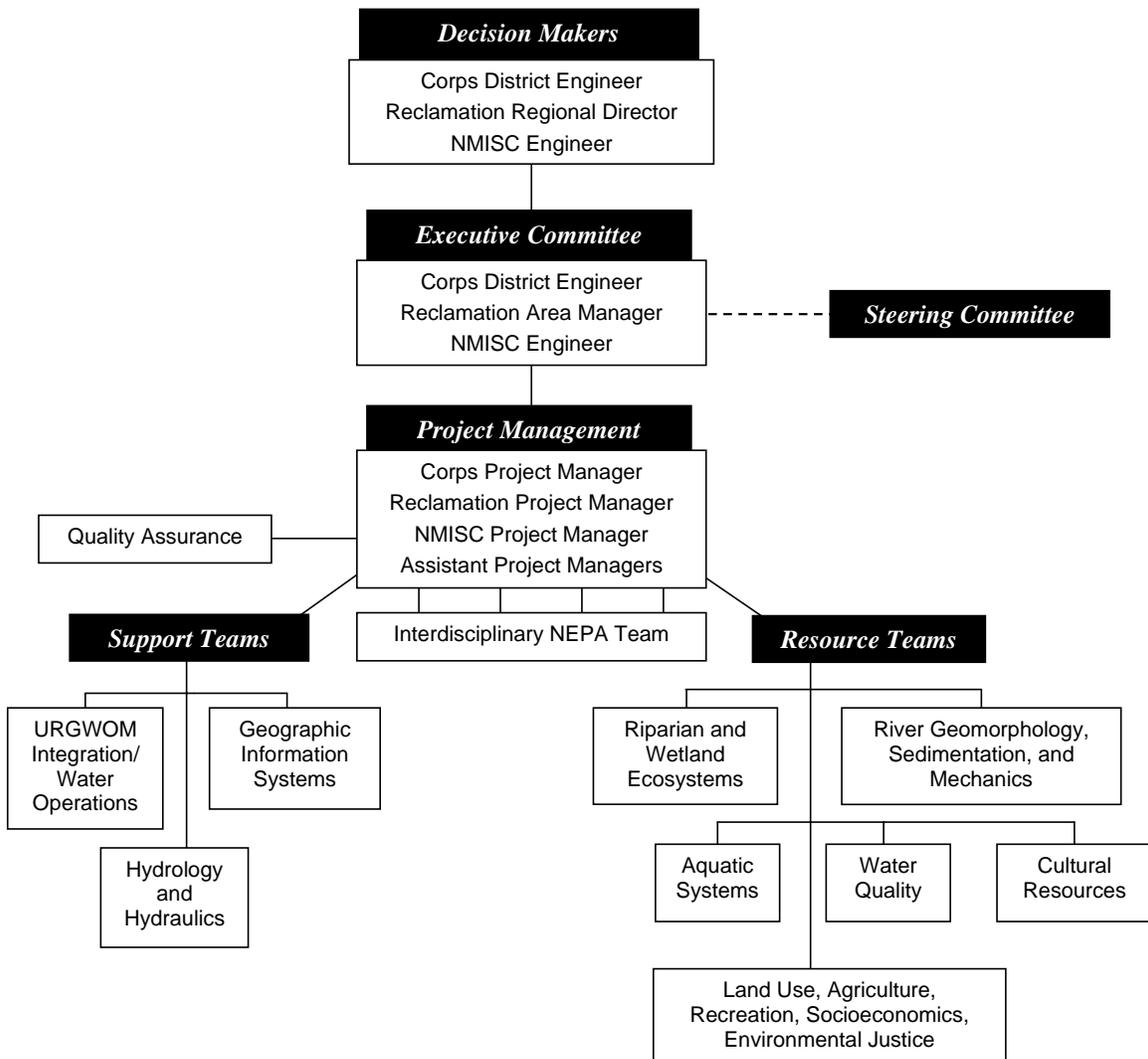


Figure S-2. Organizational Chart for the Water Operations Review and EIS

2.2 Public Involvement

In accordance with NEPA guidelines, a Notice of Intent (NOI) to prepare this EIS was published in the *Federal Register* on March 7, 2000. A news release announcing the NOI was sent to federal, tribal, state, and local officials; agency representatives; conservation organizations; news media; and others. The NOI and press releases to local newspapers also announced a series of public scoping meetings to be held at nine locations in Colorado, New Mexico, and Texas to obtain input on issues that should be considered in the EIS. A total of 76 people, excluding members of the JLA, attended the public scoping meetings. Over 190 comments were documented from the written and oral comments submitted during and after the meetings. All comments were reviewed and categorized according to content.

During the scoping process in 2000, meeting attendees expressed an interest in learning about the alternatives before they were finalized and analyzed in the EIS. In response, the JLA invited interested stakeholders to participate in the Review and EIS by identifying possible alternatives to be considered that would reflect the full range of operating flexibilities for water management along the upper Rio Grande. In addition to a Steering Committee meeting, 10 public meetings were held in 2002 to discuss possible components of the action alternatives and the strategy for developing them for detailed analysis in accordance with NEPA. The meetings on these draft alternatives were announced to more than 600 individuals and entities and publicized in the media, and attendance at the meetings ranged from 1 to 55 persons. Using the comments from the public, other agencies, and industry representatives, the interdisciplinary NEPA team developed a list of issues to address in the alternatives to be evaluated.

The issues identified through scoping and during alternatives development are briefly summarized below.

- **Low flows**—Improving water operations management flexibility during low flows is an important goal of this Review and EIS. While many of the operations and much of the infrastructure along the Rio Grande were developed to manage flood flows, in reality, the river is prone to drought and historically subject to frequent low flows that periodically leave parts of the channel dry and lead to increased sediment deposition.
- **Endangered species**—The river and adjacent riparian areas provide habitat to federally-listed endangered species, including the Rio Grande silvery minnow and the southwestern willow flycatcher. Provisions of the ESA require that operation of the river be consistent with the protection of listed species. The Review and EIS examines how changes to water operations may improve or maintain habitat for these species. As this is a 40-year planning study, the specific requirements of any current Biological Opinion were not considered in the analyses.
- **Water conveyance efficiency**—The Review and EIS examine improved efficiency in water conveyance through increased operational flexibility and coordination. Efficient conveyance of water to Elephant Butte Reservoir helps the United States meet its water delivery obligation to Mexico and helps the State of New Mexico meet its obligations under the Rio Grande Compact.
- **Sediment management and flood capacity of the channel**—The Review and EIS evaluates improved operations with the ability to mobilize sediment and keep the floodway open for flood flows. Management of the Rio Grande's heavy sediment load is fundamental to successful management of the river and its effect on adjacent lands. Adequate channel and floodway capacity are required to allow the higher flows of the Rio Grande to pass safely.

The draft EIS was made available for a 90-day public review and comment period, which began on January 20, 2006. The Notice of Availability was published on January 20, 2006 in the *Federal Register*, Volume 71, Number 13, page 3323. During this public review period, the JLAs hosted two workshops for interested Pueblo and Tribal leaders and technical staff, as well as eight public meetings at locations similar to those held previously during the project. Approximately 150 copies of the draft EIS were mailed to agency representatives, Pueblos and Tribes, and interested stakeholders who had expressed an interest in receiving a copy. In addition, over 200 letters were sent to others on the Review mailing list to notify them of the availability of the draft EIS and enabled them to request a copy if they wished. The draft EIS was posted on the project Website (<http://www.spa.usace.army.mil/urgwops/default.asp>) and copies were distributed to selected public libraries in the planning area.

The initial distribution of the draft EIS or the draft EIS plus appendices were sent to the Congressional delegation, 16 different federal agencies, 22 Pueblos or Tribes, 25 different state agencies or organizations under state authority, 4 local government agencies, and 8 stakeholder organizations. On March 24, 2006, the EPA published their rating of the draft EIS (*Federal Register*, Volume 71, Number 57, page 14892) which stated that the agency lacks objections (LO) to the selected alternative.

2.3 Key Tools

Due to the complexity and scope of the Review, a number of tools were developed and used in the evaluation of proposed plans for water operation. The Upper Rio Grande Water Operations Model (URGWOM), a surface water and reservoir modeling tool, was the primary tool used for analysis and data projection. The URGWOM planning model is a software package that simulates hydrologic response to changes in reservoir operation, channel capacity, or water diversion based on defined physical characteristics of the system.

In order to compare alternatives, a hypothetical 40-year hydrologic period was developed. Annual water data were analyzed for the years 1975–2000 and selectively sampled to generate the hypothetical 40-year dataset used in the URGWOM modeling. In order to simulate a full range of possible hydrologic conditions, the 40-year sequence includes a wet period, a drier than average period, and a period of extreme drought. Most of the analyses of alternatives was based on data generated by this hypothetical 40-year projection. The model also considered typical irrigation demands and demands of the City of Albuquerque Drinking Water Project, assumed to be operating by year 4 of the 40-year planning period.

Other important tools in the review and EIS included FLO-2D, RMA-2/Aquatic Habitat Model, San Acacia Surface/Groundwater Model, and Geographic Information Systems (GIS) spatial analysis. The Criterium Decision Plus decision support model was used to aid in comparing and contrasting results of the alternatives. This suite of tools provides the best available information concerning the operation of the Rio Grande system.

3.0 ALTERNATIVES EVALUATED IN DETAIL

3.1 No Action Alternative

The No Action Alternative is the water operations alternative that depicts current storage and water delivery operations of federal facilities, including those changes in the system that are already published in the public record and will occur in the foreseeable future. For this project, it specifically means current operation of the ten water operations facilities in the basin, without

integrating any of the flexibilities identified at Heron and Abiquiu Dams, Cochiti Lake, or the LFCC into a water operation plan (see Map S-1). The authorized function and current operation of each facility in the No Action Alternative that was considered and would be potentially affected by proposed changes is described briefly below:

- **Closed Basin Project (Reclamation)**—Located near Alamosa, Colorado, the Project uses wells to salvage groundwater from high water table conditions to assist Colorado in meeting its Rio Grande Compact delivery obligations. Salvaged groundwater varies in quality and is therefore blended to meet quality requirements of the Rio Grande Compact and the Clean Water Act. A network of observation wells monitors water levels in the underlying confined and unconfined aquifers to ensure that operations are within drawdown limits prescribed by the authorizing legislation. Well degradation and fouling is now limiting production. A well rehabilitation and replacement program is in progress.
- **Platoro Dam (Reclamation)**—Also in Colorado, Platoro Dam on the Conejos River is operated by the Conejos Water Conservancy District. A joint-use pool is used for both flood space and conservation; if flood space is needed, water in conservation storage is released to make room. A small permanent pool is maintained for recreation, fish, and wildlife. Platoro is managed to preserve fish and wildlife downstream. Flood control operation is the responsibility of the Corps and is the only function under review under the scope of this project.
- **Heron Dam (Reclamation)**—Heron Dam on Willow Creek in northern New Mexico stores no native Rio Grande water, therefore, this reservoir is not subject to Compact requirements. It was built in the late 1960s to store water from the upper Colorado River system and to import it to the Rio Grande through the San Juan-Chama (SJC) Project. Reclamation stores water in Heron Reservoir to meet the demands of its SJC Project water contractors who are required to take delivery of their annual allotment by December 31 of the irrigation year unless a waiver for delivery by April 30 of the subsequent year is authorized.
- **El Vado Dam (Reclamation)**—El Vado Dam is located on the Rio Chama. This reservoir was not part of the Review due to active litigation and changes to its operations were not considered.
- **Abiquiu Dam (Corps)**—Abiquiu Dam, also on the Rio Chama, is operated as a flood control facility. During flood control operations, water is released at a rate of up to 1,800 cubic feet per second (cfs) to evacuate the reservoir and maintain safe channel capacity downstream. The reservoir can also be used to store SJC Project water up to an elevation of 6,220 feet. The City of Albuquerque owns storage easements up to this elevation and has a current contract with the Corps to store SJC Project water in this incidental pool. The reservoir is also authorized to store native Rio Grande water in the SJC Project water space when this space is not needed. The Corps has specific requirements for holding and releasing carryover native Rio Grande water in the facility. Such storage is subject to other requirements such as a state engineer permit, a Corps deviation from normal operations, and unanimous concurrence of the deviation by the Compact Commission.
- **Cochiti Dam (Corps)**—Cochiti Dam is a sediment and flood control structure located primarily on Pueblo of Cochiti lands. The Pueblo of Cochiti provided easements and rights-of-way for the facility and the Corps coordinates with the Pueblo on actions involving this reservoir. Cochiti Dam spans the main stem of the Rio Grande and the Santa Fe River tributary to the Rio Grande on Pueblo land, south of Santa Fe, New Mexico. The Corps has specific requirements for holding and releasing carryover native Rio Grande floodwater in the facility. A permanent pool of SJC Project water is

maintained in Cochiti Lake for recreation, fish, and wildlife. There is no authorization to store native Rio Grande water in Cochiti Lake.

- **Jemez Canyon Dam (Corps)**—A sediment and flood control structure on the Rio Jemez, Jemez Canyon Dam is operated as a dry reservoir. The dam and reservoir area are on Pueblo of Santa Ana lands and the Corps coordinates with the Pueblo on actions involving this reservoir. There are no water contracts in place or proposed for re-establishing a sediment pool.
- **Low Flow Conveyance Channel (Reclamation)**—The LFCC was constructed in the 1950s to aid delivery of Compact waters to Elephant Butte Reservoir. It also served to improve drainage and supplement water supply for irrigation. The riprap-lined channel parallels an approximately 60-mile reach in the San Acacia Section of the Rio Grande from San Acacia to San Marcial, New Mexico. The LFCC collects river seepage and irrigation surface and subsurface return flows, thus reducing evaporation. The usefulness of the LFCC is dependent upon the water level of Elephant Butte Reservoir. When outfall conditions allow, up to 2,000 cfs can be diverted into the LFCC at San Acacia. The LFCC also provides water to both Bosque del Apache National Wildlife Refuge and to irrigators in the Middle Rio Grande Conservancy District.
- **Elephant Butte Dam (Reclamation)**—Elephant Butte Reservoir is the primary water storage facility for Rio Grande Project water, delivered primarily to New Mexican, Texan, and Mexican irrigators living downstream of Caballo Reservoir. However, only flood control activities were addressed in the Review and EIS. Generation of hydropower is a secondary purpose of the facility. Operation of the facilities for “prudent flood space” was included in the scope of this Review and EIS. A 50,000 acre-foot (AF) flood space is maintained from April 1 to September 30; 25,000 AF of flood space is reserved between October 1 and March 31. Flood release is required when the reservoir level is within the prudent flood space.
- **Caballo Dam**—Caballo Dam is similar to Elephant Butte, and only flood control activities were part of the Review and Water Operations EIS. Reclamation constructed Caballo and coordinates flood control operations with the U.S. Section of the International Boundary and Water Commission (USIBWC). Protocol for flood operations involving the Corps operation of Cochiti Dam for certain flooding conditions downstream of Caballo was developed and coordinated among the USIBWC, Reclamation, and the Corps as part of the Review. The No Action Alternative and all of the Action Alternatives would include the documentation of the circumstances and protocol for how the USIBWC, Reclamation, and the Corps will work together when it is necessary to hold back floodwaters in Cochiti to prevent flooding below Caballo. Elephant Butte and Caballo flood control protocol are documented in Appendix I.

3.2 Action Alternatives

Based on public scoping, review of historic hydrologic extremes, and considering the breadth of possible events that could occur within a 40-year planning period, draft operational plans (designated by letters) were developed using combinations of facility-specific actions. These plans were further differentiated (designated by numbers) recognizing natural limitations and operational feasibilities under a range of climatic conditions. Some draft alternatives necessarily fell out in the initial screening process through application of the three preliminary screening criteria presented in the public scoping meetings: (1) the alternative is physically possible; (2) the alternative meets the MOA purpose and need statement; and (3) the alternative is within the existing authorities of the agencies involved.

Action alternatives considered for detailed analysis were selected based on a review of preliminary URGWOM planning version results using the three threshold screening criteria, together with detailed water operations performance measures developed by the Water Operations Support Team, as well as consideration of significant issues identified by the public in the draft alternatives meetings. Threshold criteria included dam safety and flood control operations, Compact compliance, and meeting contractual water supply obligations. The alternatives which emerged from the screening process that are considered for implementation are listed below. **Table S-1** provides a brief synopsis of the key features of each alternative, listed by proposed changes from the No Action Alternative and organized by each facility identified as possessing operational flexibility.

Table S-1. Comparison of Alternatives Analyzed

Alternatives	Operation/Facility						
	Heron Waivers	Abiquiu Storage Capacity	Abiquiu Channel Capacity	Cochiti Channel Capacity	Diversions to LFCC	Elephant Butte and Caballo	Basin-wide
No Action ¹	April 30	0 AF ³	1,800 cfs ⁴	7,000 cfs	0–2,000 cfs	Informal coordination	Informal communication
B-3	Sept. 30	0–180,000 AF	1,500 cfs	8,500 cfs	No Change*	Protocol/coordination	Improved communications
D-3	Aug. 31	0–180,000 AF	2,000 cfs	No Change	No Change	Protocol/coordination	Improved communications
E-3 ²	Sept. 30	0–180,000 AF	No Change	10,000 cfs	No Change	Protocol/coordination	Improved communications
I-1	No Change	0–20,000 AF	No Change	No Change	0–500 cfs	Protocol/coordination	Improved communications
I-2	No Change	0–75,000 AF	No Change	No Change	0–1,000 cfs	Protocol/coordination	Improved communications
I-3	No Change	0–180,000 AF	No Change	No Change	No Change	Protocol/coordination	Improved communications

*Note: *No Change* means no difference from No Action alternative. Modeled diversions to the LFCC begin only when there is at least 250 cfs in the river.

¹ Least flexible alternative. ² Most flexible alternative. ³ AF = Acre feet. ⁴ cfs = Cubic feet per second.

The action alternatives are briefly described below.

- **Alternative B-3**—Alternative B-3 was chosen as an action alternative in order to evaluate the impacts of later SJC Project water delivery (September 30 as opposed to April 30) from Heron Dam, to take advantage of the flexibility available to store native Rio Grande water in Abiquiu Reservoir, consider lower flows below Abiquiu Dam, and higher flows below Cochiti Dam.
- **Alternative D-3**—The primary differences between Alternative D-3 and the No Action Alternative are a later Heron waiver date (August 31), storage of native Rio Grande water in Abiquiu Reservoir, and a higher maximum flow below Abiquiu Dam.
- **Alternative E-3**—The primary differences between Alternative E-3 and the No Action Alternative are a later Heron waiver date (September 30), storage of native Rio Grande

water in Abiquiu Reservoir, and a higher maximum flow in the channel below Cochiti Dam.

- **Alternative I-1**—The primary differences between Alternative I-1 and the No Action Alternative are storage of native Rio Grande water in Abiquiu Reservoir and a lower maximum diversion into the LFCC. These variations from No Action were included in an alternative to address concerns from the Interdisciplinary NEPA Team that a greater range of upstream storage and LFCC diversions should be analyzed in order to better understand the impacts to resources along the Rio Chama and the Rio Grande. It was also developed to increase the variation between alternatives in compliance with NEPA requirements.
- **Alternative I-2**—The primary differences between Alternative I-2 and the No Action Alternative are higher (greater than Alt. I-1) amounts of storage of native Rio Grande water in Abiquiu Reservoir and a lower maximum diversion into the LFCC. These variations were included in an alternative to address the same concerns from the Interdisciplinary NEPA Team as noted in Alternative I-1.
- **Alternative I-3**—The primary differences between Alternative I-3 and the No Action Alternative are high amounts of storage of native Rio Grande water in Abiquiu Reservoir and the maximum authorized diversion into the LFCC. These variations from No Action were included in an alternative to analyze the impacts to the system through exercising maximum flexibility in upstream storage and LFCC diversions in order to better understand the impacts on resources along the Rio Chama and the Rio Grande.

4.0 SUMMARY OF ENVIRONMENTAL CONSEQUENCES ANALYZED

An analysis of impacts on each resource was performed to estimate the amount of potentially significant change that a given resource might experience under each alternative. Changes to a resource were considered from multiple perspectives including: 1) how much change is expected, 2) whether the change would be beneficial or detrimental, 3) our understanding of complex relationships in the system, and 4) the reliability of the results of the analysis. **Table S-2** summarizes the results of the analyses for each alternative by noting improved or decreased impacts to a range of criteria when compared to the impacts under the No Action Alternative. The criteria were selected by each technical team because they were determined to be relevant to the resource.

Technical teams submitted recommendations for mitigation measures that may be selected in the Record of Decision to minimize the significant impacts identified through the effects analyses. Mitigation measures were specifically proposed to minimize potential adverse impacts under the Preferred Alternative for the following resource areas: Recreation, Cultural Resources, Water Quality, Biological Resources (including aquatic habitat, riparian areas and wetlands, and threatened and endangered species habitat), and hydrologic impacts on the river system.

Table S-2. Comparison of Action Alternatives to No Action by Potential Impact

Criterion/Resource	Subcategory	ALTERNATIVES						
		No Action	B-3	D-3	E-3	I-1	I-2	I-3
Dam Safety & Flood Control		Adequate	Met	Met	Met	Met	Met	Met
Water Deliveries		Adequate	Met	Met	Met	Met	Met	Met
Compact & Treaty Compliance		Inadequate	Met	Met	Met	Not Met	Not Met	Met
Ecosystem	Riverine	—	—	—	—	—	—	—
	Reservoir	—	■	■	■	■■	■■	■■
	Riparian	—	■■	■	—	□	—	■
	T&E Species - RGSM	—	—	—	—	□	□	—
	T&E Species - SWFL	—	■	■■	■■	□	—	■■
	Other T&E Species	—	■	—	—	□	—	■
Operating Flexibility	Reservoir	—	□□	□□	□□	□	□□	□□
	River	—	—	—	—	—	—	—
Water Quality		—	□	—	—	—	—	—
Sediment Management		—	■	■	■	■	■	■
Indian Trust Assets		—	□	■	□	—	—	—
Cultural Resources		—	□□	□□	□□	□	□□	□□
Land Use	Agricultural	—	□□	□	□	—	—	□
	Recreation	—	□□□	□	□□	—	□	□□
	Other Land Uses	—	□	□	□	—	□	□
	Hydropower	—	□	□□□	□□□	□□	□□	□□□
	Flood Control - Damages	—	□□	□□□	□□	□	□□	□□□
Fairness & Equity	Environmental Justice	—	□□	■■■	■	—	□	■■
			TR		PA	EP		
Legend:	—	No Significant Impact	T&E = Threatened & Endangered					
	□	Slight Improvement (10 – 25 percent)	RGSM = Rio Grande Silvery Minnow					
	□□	Moderate Improvement (25 – 50 percent)	SWFL = Southwest Willow Flycatcher					
	□□□	Substantial Improvement (50 percent or more)	EP = Environmentally-Preferred Alternative (based on Ecosystem Criteria)					
	■	Slight Decrease (10 –25 percent)	TR = Top-Ranked Alternative					
	■■	Moderate Decrease (25 – 50 percent)	PA = Preferred Alternative					
	■■■	Substantial Decrease (50 percent or more)						

4.1 Preferred Alternative

Alternative E-3 was identified as the Preferred Alternative because it meets the purpose and need and threshold criteria, and best satisfies the key goals of the EIS—to provide a plan for more efficient operation of federal reservoirs and facilities as an integrated system, to improve decision-making processes and interagency coordination, to support compliance with applicable laws and regulations, and to promote ecosystem sustainability. Of the alternatives evaluated that maximize native Rio Grande conservation water storage in Abiquiu Reservoir, Alternative E-3 ranked highest in ecosystem support. Alternative B-3 was identified as the Preferred Alternative in the Draft EIS. Alternative E-3 was selected over B-3 as the Preferred Alternative in this Final EIS in response to public comments, internal comments from agency personnel, and to facilitate implementation of a single Preferred Alternative that enables all three lead agencies to best meet their respective water management responsibilities.

No alternative was determined to be ideal for all resources. By applying the rankings derived from the performance of each alternative relative to the weighted decision criteria in the decision-support software shown on **Figure S-3**, Alternative B-3 was identified as the top-ranked alternative because it met the most evaluation criteria. This alternative is not the same as the environmentally preferable alternative (I-1) but was identified because it was the best at meeting the most criteria. Alternative B-3 did not rank as high as Alternative E-3 in some of the biological performance measures, and does not maximize flexibility in system-wide water operations. Alternative I-1 was identified as the environmentally preferable alternative because it performed slightly better in ecosystem support than the other alternatives. However, it does not meet Compact and Treaty compliance, which is one of the three threshold criteria.

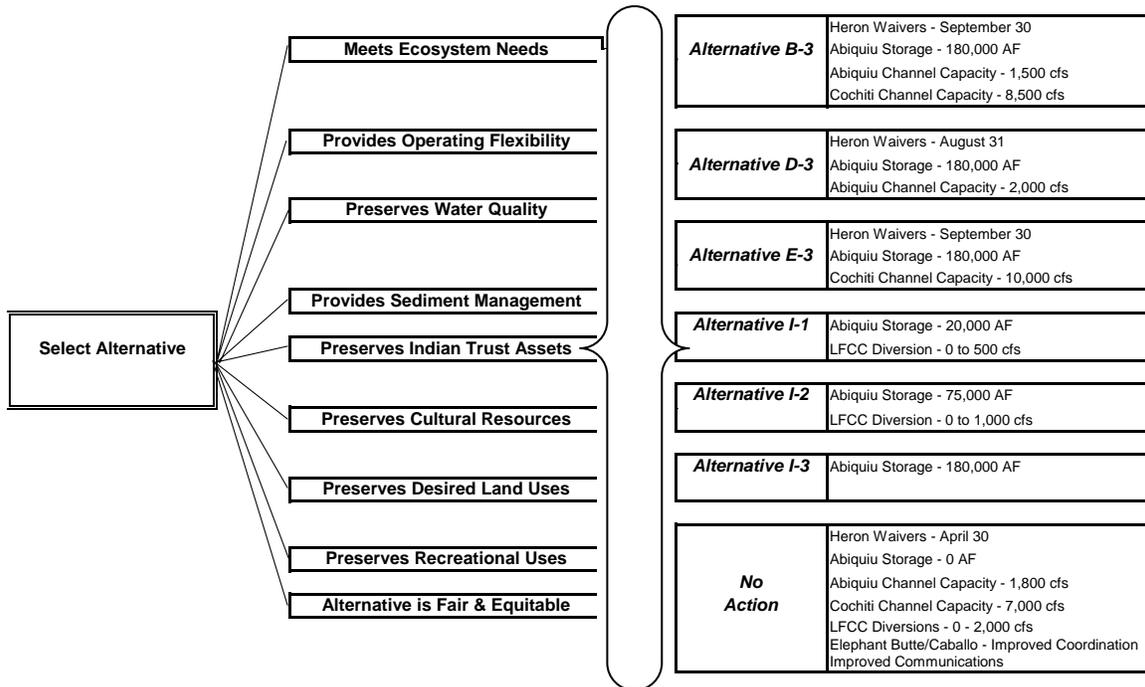


Figure S-3. Decision Hierarchy

Alternatives were evaluated by the technical teams using performance measures appropriate for each resource and scored for maximum benefit. Where quantitative analysis was possible, if an alternative provided the maximum benefit, it received a score of 100 percent. Alternatives with lesser results received a score reflecting the percentage of the maximum resource benefit attainable. Where quantitative information

was not available, qualitative scoring was performed using simple scales ranging from 1 to 10 and descriptors such as good, fair, or poor. The final ranking of the alternatives is displayed graphically and in order from highest to lowest in **Figure S-4**.

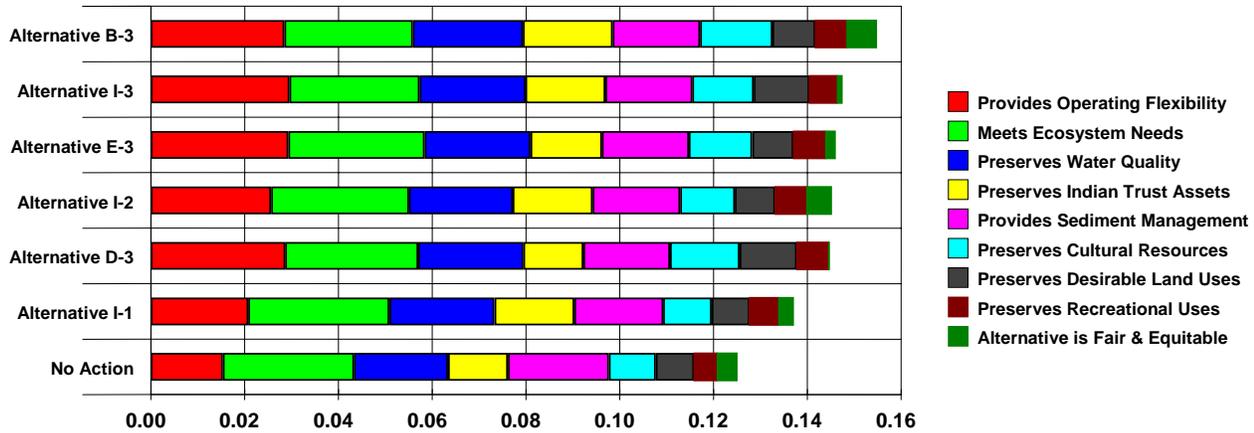


Figure S-4. Final Weighted Ranking of Alternatives

Beneficial and adverse impacts of each of the alternatives, including the Preferred Alternative E-3, are compared in Table S-2 and discussed in detail in Chapter 4 of this EIS. Adverse effects of Alternative E-3, compared to No Action, were primarily experienced in the San Acacia Section and were related to diversions to the LFCC. Some of the benefits associated with the implementation of Alternative E-3 are listed below.

- Maximize overall flexibility for water operations in the Upper Rio Grande Basin
- Maximize overall capacity in the system
- Maximize native Rio Grande conservation water storage
- Provide improved capability for higher flows during spring runoff
- Maintain channel capacity in the Rio Chama and Rio Grande
- Improve Compact delivery and management
- Increase overbank flooding through the Central Section of the Rio Grande
- Improve ability to provide supplemental flows for RGSM
- Provide recruitment flows for RGSM spawn
- Provide greater operational flexibility in trade-off between Rio Grande and San Juan-Chama water
- Increase potential for reduction of evaporative losses
- Improve ability to carry over water to better meet downstream water demands and biological requirements
- Improve ability to store water for use during drought

Implementation of the elements of Alternative E-3 would be conducted by the appropriate authorizing JLA. Reclamation is the federal agency responsible for actions at Heron Reservoir and the LFCC. The Corps is the federal agency responsible for actions at Abiquiu Reservoir, Cochiti Lake, and downstream channel capacities. It is anticipated that specific actions to implement Alternative E-3 would occur separately and over time, and that additional NEPA evaluation and coordination would first be conducted, as appropriate, by the lead federal agency.

4.2 Cumulative Impacts

Council of Environmental Quality regulations implementing NEPA define cumulative impacts as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such actions” (40 CFR 1508.7).

As this EIS considers a 40-year planning period, there are numerous past, present, and reasonably foreseeable future actions in the planning area. This discussion of cumulative impacts focuses on actions that may have a continuing, additive, or significant relationship to water operations and resources that may be affected under the Preferred Alternative E-3. This analysis is qualitative and is based on information gathered by public scoping; consultation with cooperating agencies, tribal governments, other stakeholders in the planning area; and through conversations among JLA representatives and the ID NEPA Team.

The identified actions for cumulative effects assessment were considered for actions proposed for implementation within the next 5 to 10 years, with operational impacts assessed for the 40-year planning period. The geographical scope of the analysis includes the river corridor along the Rio Grande and Rio Chama, extending from the Closed Basin Project in Colorado to Fort Quitman, Texas. Past and present actions that affect water operations and the resources along the river corridor were taken into account in the analyses of direct and indirect effects by modeling the existing physical system, as described in Chapter 1, Section 1.6.1 and in each resource section of Chapter 4.

The evaluation of cumulative impacts, therefore, considers the reasonably foreseeable future projects that have the potential to affect water operations or the resources along the river corridor. Many projects are planned or underway in the project area that address resource problems; maintain or reconstruct existing structures; or study conditions to support future planning, adaptive management, and project needs.

Table S-3 lists various major ongoing and reasonably foreseeable future projects, including planning and study efforts, in the planning area. All future projects or studies listed would only be implemented if funding were approved. This list is not all-inclusive, but can be used as a guide to evaluate future NEPA efforts in the basin, and provides a summary of the types of projects that are likely to occur that may affect water management in the planning area.

Table S-3. Summary of Ongoing and Reasonably Foreseeable Future Projects or Actions

Project or Action (Lead Agency)	Description	Estimated Timing	Effects on Water Operations or Other Resources
1. Abiquiu Dam Oxygenator Project (Corps)	This project considers modifications to the hydroelectric plant that would improve water quality below Abiquiu Dam in conjunction with power generation for Los Alamos County.	Constructed in 2001	Dissolved oxygen concentrations were a concern in the Southern Section—Elephant Butte and Caballo Reservoirs. This project directly affects the Rio Chama Section, with lesser impacts downstream. Upstream improvements may also help downstream dissolved oxygen concentrations.
2. Los Alamos National Laboratory (LANL) Site-Wide EIS (Department of Energy)	This draft EIS evaluates many proposed changes at LANL. Those related to water resources include changes to the quality and quantity of water discharges into canyons that flow to the Rio Grande	2007–2012	Elimination of several permitted effluent outfalls discharging treated water from LANL would reduce the contribution of treated water and supplemental flows into canyons upstream of the Rio Grande.

Project or Action (Lead Agency)	Description	Estimated Timing	Effects on Water Operations or Other Resources
	and the construction of new facilities.		
3. Conservation Pool Assessment (Corps)	Assess options to develop a conservation pool to assist in meeting ESA requirements in the Middle Rio Grande.	Planned pending funding; duration indefinite	A Project Management Plan is in development with anticipated study to start quantifying water sources and needs; establish multiple storage scenarios; develop potential impacts for scenarios that include legal/institutional, tribal, environmental, cultural, geotechnical, engineering, real estate, etc.; and develop storage recommendations.
4. Cochiti Dam and Lake Environmental Baseline Study (Corps)	Proposed baseline studies are intended to characterize the interactions of Cochiti Dam and Lake with Tribal resources, including surface and subsurface hydrological analysis, water and sediment quality and wildlife bioaccumulation, as well as assessments of biological, cultural, and economic resources.	Ongoing; estimated completion date 2007	Provide a baseline against which the impacts of any future operational changes at Cochiti Dam and Lake may be evaluated. Intended to contribute to an evaluation of alternative water management strategies that include considerations for maintenance and restoration of endangered species as well as other reservoir management activities.
5. Jemez Canyon Dam and Reservoir EA (Corps)	This project considers long-term operation of Jemez Canyon Dam and Reservoir as a dry reservoir.	Court order; duration indefinite	Continuing the use of Jemez Canyon Reservoir as a dry reservoir. No change from current conditions, as modeled in the URGWOM Planning Model.
6. Albuquerque Levees (Corps)	This study is evaluating the overall condition of the levee system, its ability to function as designed, and to make recommendations for required future actions. The project study area includes the east and west side levee areas from the North Diversion Channel south to Isleta Pueblo within Reach 12.	Ongoing, with Final Report scheduled for completion in 2007.	Preliminary investigations conducted in 2005 indicate that the existing levees, constructed by the Corps of Engineers in the 1950s, may require extensive reconstruction. The levees were designed and constructed to convey 42,000 cfs.
7. Middle Rio Grande Project River Maintenance (Reclamation)	Reclamation maintains the river channel for the Middle Rio Grande Project from Velarde to Caballo Dam, NM with the goals of effective water conveyance; water conservation; reducing aggradation; and protecting riverside structures and facilities.	Ongoing; duration indefinite	River maintenance activities complement the actions considered under water operations alternatives including bank stabilization, channel realignment, bioengineering, and habitat enhancements, river training works, sediment removal, vegetation control, levee maintenance.

Project or Action (Lead Agency)	Description	Estimated Timing	Effects on Water Operations or Other Resources
8. Middle Rio Grande Endangered Species Collaborative Program (Multiple Agencies)	This multi-agency and public collaborative program authorizes the planning, evaluation, and funding of projects to improve habitat, conduct research, and obtain water to benefit federally listed species.	Ongoing; duration indefinite	Adaptive management activities anticipated as a result of implementing the preferred alternative should be coordinated through the Collaborative Program to ensure that water operations changes are contributing to recovery efforts for the species.
9. Water Operations Associated with 2003 Biological Opinion (Corps and Reclamation)	Implement the Reasonable and Prudent Alternative (RPA) and Reasonable and Prudent Measures associated with the Programmatic Biological Opinion (BO) of Reclamation's water and river maintenance operations, Corps' flood control operations, and related non-federal actions on the Middle Rio Grande.	3/2003–2/2013	All actions affecting habitat must be in compliance with the RPA and Reasonable and Prudent Measures of this BO to assist in the survival and recovery of the RGSM, SWFL, bald eagle, and interior least tern.
10. Various Federal, State, Local Entities, Non-Profit Organizations, and Universities	Numerous ecosystem and habitat restoration projects and research studies.	Ongoing	Restoration activities are intended to provide a beneficial effect on geomorphology, water quality, riparian and aquatic habitat. Research is intended to monitor the physical and chemical effects of human activities.
11. Rio Grande Integrated Management Plan (Corps and Reclamation)	Proposed development of a master plan for the Rio Grande	Planned pending funding; duration indefinite	Intended to help tie together the various activities on the Rio Grande in order to improve planning, coordination, and collaboration for stakeholders on the Rio Grande.
12. Belen Levee Project (Corps)	This project extends from Isleta Pueblo to Belen, NM along both banks of the Rio Grande. The existing spoil-bank levees would be rehabilitated to withstand higher and longer duration floods, accommodating the safe release of higher flows from upstream flood control reservoirs.	Planning stages; duration indefinite	Completion of this project is critical to the implementation of any alternative that calls for a channel capacity greater than 7,000 cfs in the Central Section.

Project or Action (Lead Agency)	Description	Estimated Timing	Effects on Water Operations or Other Resources
13. San Acacia Diversion Dam Fish Passage and Related Projects EA (Reclamation)	EA for four proposed projects in the San Acacia Section, including installation of fish passage for RGSM at San Acacia Diversion Dam; installation of a siphon near Bernardo, NM; river maintenance upstream of the Diversion; and maintenance of the Diversion riprap apron.	2007–2010	Operation of the siphon and changes to the Diversion are likely to affect river flows in the vicinity, but the extent will depend on the options selected. The proposed projects are likely to affect habitat availability for RGSM.
14. Rio Grande Floodway Rehabilitation (Corps)	This project affects the east bank of the Rio Grande from the San Acacia Diversion Dam downstream to the San Marcial Railroad bridge. This project will rehabilitate the existing spoil-bank levee and relocate and increase the channel capacity below the railroad bridge.	Planning stages; duration indefinite.	Removes the restriction on channel capacity caused by the San Marcial railroad bridge, resulting in the ability to pass higher peak flows from upstream reservoirs. Completion of this project is critical to the implementation of any alternative that calls for a channel capacity greater than 7,000 cfs in the Central Section of the Rio Grande.
15. Rio Grande Realignment and LFCC Modifications (Reclamation)	This project proposes to realign the river channel and LFCC between San Acacia Diversion Dam and Elephant Butte Reservoir to improve water conveyance, enhance valley drainage, and improve sediment management.	Planning stages only; duration indefinite.	Possible operating impacts for a reconfigured LFCC range from 500 to 2,000 cfs diversion from the Rio Grande. This project has the potential to affect flows in the San Acacia Section. Changes due to physical realignment are not addressed but may occur.

There are many other public and private projects in the planning area that may modify surface water runoff and local inflows that are likely to affect the operation of specific facilities, especially for flood control. Where possible, operations of existing projects were considered during modeling and analysis. For example, City of Albuquerque Drinking Water Project diversions were considered in URGWOM modeling for all alternatives. In other cases, there was insufficient detail in future project operations and construction timelines to explicitly examine projects during quantitative analysis.

Each resource considered in this EIS was reviewed to determine whether the impact of implementing the Preferred Alternative, in combination with other reasonably foreseeable future actions, could significantly affect water operations and the resource impacts described in the direct and indirect effects analyses in this chapter. The purpose of this evaluation is to provide an understanding of the incremental impact of the Preferred Alternative, which may have individually minor but collectively significant effects over a period of time. A brief summary of the projects from Table S-3 that may affect the resources analyzed in the EIS is listed below.

- **Hydrology and Geomorphology**—Projects in the region that have the potential to affect river flows and geomorphology include Projects 2, 3, 5, 7, 8, 9, 10, 13, 14, and 15 listed in Table S-3. Overall, the reasonably foreseeable future projects in the planning area may have locally significant or short-term impacts, but would not have significant long-term impacts on hydrology and geomorphology. The combined effects are not anticipated to exceed the range of water operations of federal facilities evaluated under the Preferred Alternative E-3.

- **Biological Resources**—All of the projects listed in Table S-3 that involve construction (Projects 2, 6, 7, 12, 13, 14, 15) have some potential for short-term effects on aquatic habitat, riparian resources, or threatened and endangered species by altering habitat or river flows, contributing sediment to the river, or causing other changes to water quality. Mitigation measures implemented during construction would minimize adverse impacts. Overall, reasonably foreseeable future projects are likely to have some locally significant, primarily beneficial, impacts on biological resources, some of which may offset the projected slight adverse impacts to biological resources under the Preferred Alternative (E-3), by improving wetlands and aquatic habitat.
- **Water Quality**—Reasonably foreseeable future projects that change watershed characteristics and hydrologic processes may affect surface water quality by altering water chemistry, natural flow variation, and the transport of sediments, nutrients, and contaminants. The projects that have the potential to affect river flows (Projects 2, 3, 5, 7, 8, 9, 10, 13, 14, and 15) would not have significant impacts on hydrology or surface water quality. Projects 1 and 2 many have minor, but insignificant beneficial effects on water quality. The ongoing and reasonably foreseeable future projects in the planning area are more likely to result in minor incremental impacts on surface water quality than the implementation of Alternative E-3. Implementation of the Preferred Alternative E-3 would not significantly affect surface water quality.
- **Indian Trust Assets and Cultural Resources**—Cumulative impacts on Indian Trust Assets and cultural resources must consider the combined effects on unique and sensitive archaeological sites, traditional cultural properties, or acequias and other irrigation structures by implementation of reasonably foreseeable projects in combination with the Preferred Alternative E-3. The impacts to Indian Trust Assets and cultural resources were determined to be minor, with little difference across alternatives. Because only minor effects on hydrology, inundation of riparian areas, and agriculture are anticipated under any of the ongoing and reasonably foreseeable projects listed above, the cumulative impacts on ITAs and cultural resources would be insignificant overall.
- **Agriculture, Land Use, and Recreation**—Potential changes in water delivery, surface water flows, reservoir levels, or land use may be considered significant if they were to result from the implementation of the Preferred Alternative E-3, in combination with the ongoing and reasonably foreseeable projects listed above. Changes anticipated as a result of implementation of any of these projects, including Alternative E-3, may cause minor but insignificant impacts to acequia structures, land use, and recreational uses of rivers and reservoirs. Population increases are the most likely to result in land use changes, but the locations of the changes are difficult to predict at this time. No changes to irrigation water deliveries or agricultural land productivity would result from implementation of Alternative E-3.
- **Flood Control and Hydropower**—The Preferred Alternative E-3 evaluated the full range of potential water operations and provides the greatest flexibility to accommodate flood control operations in the upper Rio Grande system. This alternative supports improved flood routing and flood control operations. Projects 7 and 15 could improve river channel conditions to better mitigate the impacts of high flood flows on adjacent lands. However, none of the reasonably foreseeable projects would alter the flood control operations, flood damages, or hydropower generation evaluated in this Review and EIS, so no significant cumulative impacts are projected.
- **Economics**—Changes in visitation due to improved recreation opportunities were identified as the key parameter in evaluating economic impacts in this Review and EIS. None of the ongoing and reasonably foreseeable projects listed above would result in increased or decreased recreational opportunities. The analysis of the action alternatives in this Review and EIS project minor improvements in recreation opportunities and economics, with Alternative E-3, the Preferred Alternative, ranking in the middle of the action alternatives for effects on economics. Cumulative impacts from the Preferred Alternative, in combination with other reasonably foreseeable projects would be minimal.

- **Environmental Justice**—Impacts related to environmental justice have been evaluated in this Review and EIS by focusing on the potential effects on biological resources and cultural resources. Under Alternative E-3, a slight adverse impact on environmental justice is projected, primarily due to the combination of slight adverse impacts to riparian and aquatic habitats in the San Acacia Section, and inundation of archaeological sites in the Central and San Acacia Sections. However, these impacts have been determined not to be significant when compared across all action alternatives in this Review and EIS. The reasonably foreseeable projects listed above are not anticipated to result in disproportionate impacts on minority or low-income populations in the planning area. No additional impacts to environmental justice are projected as a result of the combination of the Preferred Alternative and the other ongoing and foreseeable projects, and those projected under the Preferred Alternative are likely to be insignificant.

In summary, implementation of the Preferred Alternative E-3, in combination with other past, present, and reasonably foreseeable future actions, would have insignificant direct or indirect effects on hydrology, geomorphology, biological resources, water quality, Indian Trust Assets, cultural resources, agriculture, land use, recreation, flood control, hydropower, economics, or environmental justice.

4.3 Adaptive Management

In the upper Rio Grande basin, an adaptive management program would improve management of federal facilities within an overall scientific-economic policy framework where decisions are based on data resulting from scientific inquiry and measured impacts. This decision framework can be considered as “continuing NEPA in action.” Under adaptive management, proposed actions are implemented, a period of monitoring and research occurs, and modified actions are implemented based on analysis of data collected, with cycles of further measurement and adjustment continuing to reach and sustain management objectives. Water managers and stakeholders must first agree on acceptable or desirable conditions (management objectives) specific to the Rio Grande and then commit to developing and practicing the art of adjusting operations to sustain those conditions.

Adaptive management activities in the Rio Grande system are underway. Multi-stakeholder collaborative efforts are ongoing in various portions of the basin, including the Middle Rio Grande ESA Collaborative Program and the Paso del Norte Watershed Council, and various regional water planning and watershed management groups.

Despite the actions of these agency and stakeholder groups, an overarching need exists for cooperative, adaptive management implementation across the entire planning area encompassing the federal facilities considered in this Review and EIS. A formal adaptive management program could be developed that extends from the Closed Basin Project and headwaters of the Rio Grande in Colorado to Fort Quitman, Texas with the charge of monitoring results of implementing the alternative adopted by the JLAs in individual agency Records of Decision.

The purpose of the adaptive management organization includes:

- Defining and recommending resource management objectives
- Conducting any additional research or studies to determine the impacts on various resources of the effects of operations conducted at Federal facilities along the Rio Grande
- Facilitating input and coordination of information among stakeholders
- Monitoring and reporting on regulatory compliance

4.3.1 Future Adaptive Management Activities

This EIS is a programmatic planning document that evaluates a range of feasible water operations in the upper Rio Grande basin under the agencies' existing authorities. Specific federal actions proposed in the future may require separate NEPA processes and environmental documents. Detailed adaptive management plans would be developed as specific federal actions are proposed and implemented.