

Chapter II

PROPOSED ACTION AND ALTERNATIVES

Chapter II

PROPOSED ACTION AND ALTERNATIVES



- I. *Introduction*
- II. *Alternatives Formulation*
- III. *Alternatives Development*
- IV. *Alternatives Description*
- V. *Alternatives Evaluation*
- VI. *Alternatives Considered but Eliminated*
- VII. *Preferred Alternative*

I. Introduction

The Colorado River Storage Project (CRSP) Act authorized the Navajo Unit (Navajo Dam and Reservoir) to regulate the flow of the San Juan River to assist the Upper Basin States in using their Upper Colorado River Basin Compact (Compact) apportionments. Water development supported by the Navajo Unit includes the San Juan-Chama Project, the Navajo Indian Irrigation Project (NIIP), portions of the Jicarilla Apache Nation water settlement, and development of the Animas-La Plata Project (ALP Project). Also included are numerous smaller water uses, both existing and proposed, and the Navajo-Gallup Water Supply Project (NGWSP), which is currently under study. The Navajo Unit provides benefits of river regulation, water supply, flood control, recreation, fish and wildlife uses, and generation of hydroelectric power.

From 1962 until 1991, Navajo Dam was operated to maximize water storage and minimize flow variation in the river below the dam. Such operation reduces the magnitude of peak spring flows and supplements flows in other seasons. The difference between this operation and the historical pre-dam hydrograph is depicted in figure II-1, which shows the 1930-62 pre-dam hydrograph, the 1973-91 historical operation post-dam hydrograph (representing the period of dam operations from 1973 to the beginning of the endangered fish test releases in 1992), and the 1992-2001 period, which reflects modifying releases to mimic a natural hydrograph.

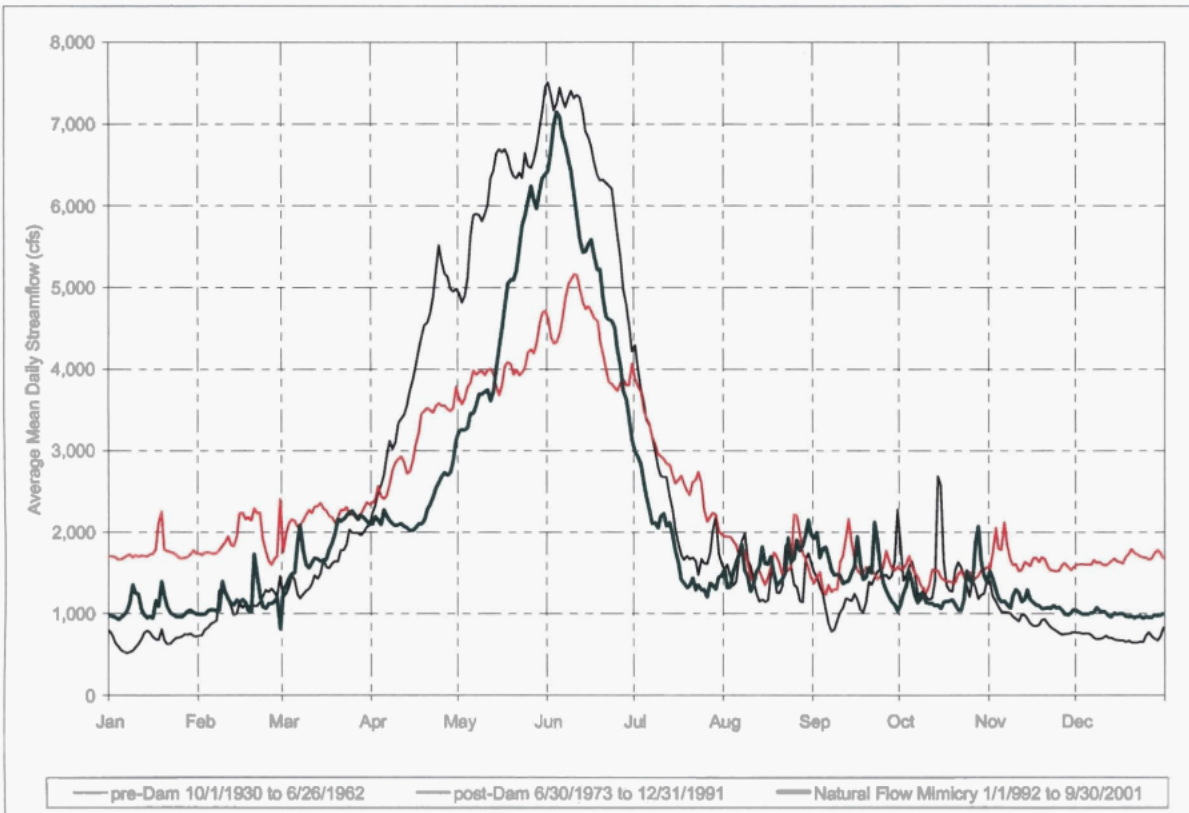


Figure II-1.—San Juan River near Bluff, Utah – U.S. Geological Survey average daily flow (compares pre-dam, post-dam, and natural flow mimicry hydrographs).

II. Alternatives Formulation

Formulation and Evaluation Criteria

The range of alternatives developed for this FEIS was initially formulated and subsequently evaluated using hydrologic modeling and each alternative's ability to:

- Maintain authorized purposes of the Navajo Unit
- Meet the goals of the San Juan River Basin Recovery Implementation Program (SJRBRIP) as described in chapter I
- Meet the *Flow Recommendations for the San Juan River* (Flow Recommendations) (Holden, 1999)

- Reflect public scoping meetings and informal public contacts
- Reflect coordination with cooperating agencies and interagency consultations
- Meet flood control procedures for Navajo Dam, as revised and established by the Corps of Engineers (Corps) to provide flood protection for areas along the San Juan River from the dam to Farmington, New Mexico¹
- Fulfill authorized and potential American Indian (Indian) and non-Indian water uses, including those pursuant to Indian water rights and Federal trust and interstate compact responsibilities to Tribes and Tribal nations, water contracts with the Secretary of the Interior for delivery of the Navajo Reservoir water supply, and compact apportionments
- Fulfill applicable water rights, laws, treaties, interstate compacts, court decrees, Indian trust responsibilities, and various rules, regulations, policies, and directives

Also taken into account in formulating the alternatives were such issues as water user concerns that high releases could wash out existing water diversion structures, while low releases could make it difficult to divert water. Other concerns centered on water quality, erosion, and minimizing adverse impacts of alternative dam operations on fish and wildlife, recreation, and hydropower generation benefits.

III. Alternatives Development

Introduction

Navajo Dam was operated for SJRBRIP test studies starting in 1992. The studies resulted in the Flow Recommendations and provided information for alternatives development as required under the National Environmental Policy Act (NEPA). Additional studies included:

¹ As noted, the previously approved river channel capacity as defined in the Report on Reservoir Regulation is 16,000 cubic feet per second (cfs) from below the dam to the Animas River confluence in Farmington. The Corps has determined and advised the Bureau of Reclamation (letter of December 5, 2001) that the channel capacity for this reach is now 5,000 cfs as proposed in the draft Water Control Manual (WCM). Upon completion of the Navajo Reservoir Operations EIS, the Corps intends to gain approval of the draft WCM to reflect current river channel conditions below the dam.

- In November 1996, the Bureau of Reclamation (Reclamation) began a 4-month low flow test to evaluate the effects of a 250 cubic feet per second (cfs) dam release during the winter months on downstream affected resources. (A detailed Winter Low Flow Test report is available from Reclamation offices in Grand Junction and Durango, Colorado (Reclamation, 1998b))
- In July 2001, Reclamation conducted a 7-day low flow test to evaluate impacts of a 250 cfs release from the dam during the summer months on the tailwater trout fishery, water diversions, water quality, recreation, and other affected resources (*Summer Low Flow Test Report*, Reclamation 2002b)

For this EIS, the following seven alternatives were developed²:

No Action Alternative

- No Action Alternative (Historical Operation – from 1973 to 1991)

Action Alternatives

- 250/5000 Alternative (minimum release 250 cfs; maximum release 5,000 cfs)
- 500/5000 Alternative (minimum release 500 cfs; maximum release 5,000 cfs)
- 250 Variable/5000 Alternative (minimum release 250-500 cfs; maximum release 5,000 cfs)
- 250/6000 Alternative (minimum release 250 cfs; maximum release 6,000 cfs)
- 500/6000 Alternative (minimum release 500 cfs; maximum release 6,000 cfs)
- Decommission and Breach Navajo Dam

Some of the above alternatives were subsequently eliminated prior to a more detailed evaluation, as explained later in this chapter.

² The action alternatives' titles refer to their minimum/maximum release range expressed in cfs; for example, the 250/5000 Alternative has a minimum release of 250 cfs and a maximum release of 5,000 cfs.

IV. Alternatives Description

Introduction

This section provides a description of the seven alternatives. Each of the alternatives is described in terms of its operating parameters. The effects of implementing each alternative are summarized later in this chapter.

No Action Alternative

The No Action Alternative is defined to represent, as nearly as possible, the historical operation of the dam after initial filling in 1973 until the beginning of endangered fish research releases in 1991, while taking into consideration water developments that occurred between dam construction and 1991 (for example, initial development of NIIP). These operations were judged to be the best representation of conditions that would be expected to occur in the future with no action taken to mimic a natural hydrograph downstream of Farmington. This alternative forms the basis against which impacts of the various action alternatives are evaluated, as required by NEPA.

Under this alternative, Navajo Dam and Reservoir would be operated essentially as it was from 1973 through 1991, with minimum releases of about 500 cfs and maximum controlled releases up to about 5,000 cfs.³ Navajo Dam would not be operated to mimic a natural hydrograph below Farmington to meet Flow Recommendations criteria; thus, the No Action Alternative does not simply represent a continuation of existing conditions, but it would represent a continuation of conditions from 1973 to 1991 (historical period). Generally, flows at Archuleta, New Mexico, throughout the entire year would rarely exceed 3,000 cfs and the norm would be 1,000 to 2,000 cfs. The operational goal from 1973-1991—to store as much water in the reservoir as possible and maintain uniform flows downstream of the dam—is assumed to occur under the No Action Alternative conditions.

The No Action Alternative was analyzed using the depletion of 675,423 acre-feet per year as identified in table II-1, which cites depletions that are predicted to occur under three alternatives retained for further analysis. Depletions are estimates of San Juan River Basin (Basin) water consumed by various uses.

³ Under extremely high inflow conditions, total releases plus spillway use could exceed the proposed 5,000-cfs maximum release.

Table II-1.—Summary of San Juan River Basin depletions for each alternative^{1, 2, 3}
(November 2005)

Depletion category	No Action Alternative (acre-feet/year)	250/5000 Alternative (acre-feet/year)	500/5000 Alternative (acre-feet/year)
New Mexico depletions			
Navajo lands irrigation depletions			
Navajo Indian Irrigation Project	⁴ 143,600	⁴ 280,600	⁴ 280,235
Hogback	26,163	⁵ 12,100	⁵ 12,065
Fruitland	10,233	⁵ 7,898	⁵ 7,898
Cudei	900	900	900
Chaco River offstream depletion	⁶ 2,832	⁶ 2,832	⁶ 2,832
Whiskey Creek offstream depletion	⁶ 523	⁶ 523	⁶ 523
Subtotal	184,251	304,853	304,453
Non-Navajo lands irrigation depletions			
Above Navajo Dam – private	738	738	738
Above Navajo Dam – Jicarilla	⁷ 2,195	⁷ 2,195	⁷ 2,195
Animas River	36,711	36,711	36,711
La Plata River	9,739	9,808	9,808
Upper San Juan	9,137	9,137	9,045
Hammond Area	10,268	10,268	10,164
Farmers Mutual Ditch	9,532	9,532	9,532
Jewett Valley	3,088	3,088	3,088
Westwater	110	110	110
Subtotal	81,518	81,587	81,391
Total New Mexico irrigation depletions	265,769	386,440	385,884
Non-irrigation depletions			
Navajo Reservoir evaporation	29,209	27,350	26,274
BHP Navajo Coal Company	39,000	39,000	38,981
San Juan Generating Station	⁸ 16,200	⁸ 16,200	⁸ 16,200
Industrial diversions near Bloomfield	2,500	2,500	2,500
Municipal and industrial uses	8,454	8,454	8,432
Scattered rural domestic uses	⁶ 1,400	⁶ 1,400	⁶ 1,400
Scattered stock ponds and livestock uses	⁶ 2,200	⁶ 2,200	⁶ 2,200
Fish and wildlife	⁶ 1,400	⁶ 1,400	⁶ 1,400
Total New Mexico non-irrigation depletions	100,363	98,504	97,387
San Juan-Chama Project exportation	107,514	107,514	107,514
Unspecified minor depletions	⁹ 1,500	¹⁰ 4,500	¹⁰ 4,486
Animas-La Plata Project		13,600	13,600
Jicarilla Apache Nation Navajo River Water Supply Project	¹¹ 6,570	¹¹ 6,570	¹¹ 6,570
Total New Mexico depletions	481,716	617,128	615,401

Table II-1.—Summary of San Juan River Basin depletions for each alternative^{1, 2, 3} (continued)

Depletion category	No Action Alternative (acre-feet/year)	250/5000 Alternative (acre-feet/year)	500/5000 Alternative (acre-feet/year)
Colorado depletions			
Upstream of Navajo Reservoir			
Upper San Juan	10,858	10,858	10,858
Navajo-Blanco	7,865	7,865	7,865
Piedra	8,098	8,098	8,098
Pine River	71,671	71,671	71,671
Subtotal	98,492	98,492	98,492
Downstream of Navajo Reservoir			
Florida	28,607	28,607	28,607
Animas	25,113	25,119	25,119
La Plata	^{12, 13} 13,245	^{12, 13} 13,245	^{12, 13} 13,245
Long Hollow Reservoir Project	¹³ 1,339	¹³ 1,339	¹³ 1,339
Mancos	19,530	19,532	19,532
McElmo Basin imports	(11,769)	(11,769)	(11,769)
Subtotal	76,065	76,073	76,073
Animas-La Plata Project		43,533	43,523
Total Colorado depletions	174,557	218,098	218,088
Colorado and New Mexico combined depletions			
Utah depletion	^{6, 14} 9,140	^{6, 14} 9,140	^{6, 14} 9,140
Arizona depletion	⁶ 10,010	⁶ 10,010	⁶ 10,010
Grand total	675,423	854,376	852,639

¹ The State of New Mexico does not necessarily agree with the depletions shown in terms of constituting evidence of actual water use, water rights, or water availability under the Compact. The SJRBRIP Hydrology Committee uses a hydrology model disclaimer that reads in part, "The model data methodologies and assumptions do not under any circumstances constitute evidence of actual water use, water rights, or water availability under Compact apportionments and should not be construed as binding on any party."

² The New Mexico Interstate Stream Commission (NMISC) and the San Juan Water Commission (SJWC) believe there are inconsistencies in depletion calculations (communications from NMISC and SJWC dated April 1 and March 21, 2002, respectively).

³ It should be noted that full development of State compact water and Indian trust water is not included in this table. Only existing projects and projects with Endangered Species Act and NEPA compliance are included in the depletion table.

⁴ Includes 10,600 acre-feet per year of annual groundwater storage. At equilibrium, the No Action Alternative drops to 133,000 acre-feet per year and the action alternatives drop to 270,000 acre-feet per year.

⁵ Accounts for 16,420 acre-feet per year transferred from Hogback, including the Hogback Extension, and Fruitland Projects to NIIP.

⁶ Indicates offstream depletion accounted for in calculated natural gains. The combined figures for the New Mexico portion include 2,185 acre-feet of historic and existing uses of Jicarilla Apache settlement water rights for scattered off-stream depletions on the reservation.

⁷ The Jicarilla Apache Nation recognizes this historic depletion as 2,195 acre-feet, but it was modeled as 2,190 acre-feet on average.

⁸ Water contract with the Jicarilla Apache Nation for long-term depletions for the San Juan Generating Station.

⁹ 1,500 acre-feet per year of depletion from minor depletions approved by SJRBRIP in 1992.

¹⁰ Includes an additional 3,000 acre-feet per year of depletion from 1999 Intra-Service consultation, a portion of which may be in Colorado. This amount includes 770 acre-feet of water subcontracted by the Jicarilla Apache Nation to "minor contractors" below Navajo Dam.

¹¹ Jicarilla Apache Nation Navajo River Water Supply Project Biological Opinion lists this depletion as 6,654 acre-feet, but model configuration shows 6,570 acre-feet on average. The model configuration is shown.

¹² Includes the Red Mesa Reservoir Enlargement depletion in the amount of 997 acre-feet.

¹³ Long Hollow Reservoir Project Biological Opinion lists this depletion as 1,535 acre-feet. Model configuration shows this as 1,339 acre-feet for Long Hollow Reservoir Project and an additional 198 acre-feet is included in the La Plata category.

¹⁴ 1,705 acre-feet per year San Juan River depletion, 7,435 acre-feet per year offstream depletion.

Action Alternatives

When compared to the No Action Alternative, the action alternatives are intended to mimic a natural hydrograph below Farmington with higher spring releases and lower releases at other times of the year. Based on the Flow Recommendations, two action alternatives were initially developed. The two alternatives had the same minimum release of 250 cfs, with maximum releases of 5,000 and 6,000 cfs, respectively.

The Flow Recommendations contain recommended operating criteria for Navajo Dam, providing examples of the ways in which Navajo Dam might be operated within the limits of the specified minimum and maximum release rates to mimic a natural hydrograph. However, while evaluation of the action alternatives in this EIS considers such operational parameters as examples, the action alternatives retain flexibility as to the amount and timing of releases within the boundaries set by the minimum and maximum release rates.

Reclamation used input from several public meetings in 1999 (as detailed in chapter V), at which time the No Action Alternative and the 250/5000 and 250/6000 Alternatives were presented. Based on suggestions from public meetings and cooperating agencies, four additional alternatives were formulated: 250 Variable/5000, 500/5000 and 500/6000 Alternatives, and Decommissioning and Breaching Navajo Dam.

250/5000 Alternative

This alternative is designed to enable water development to proceed and to meet the Flow Recommendations for the San Juan River below Farmington. Navajo Dam would be operated so that releases range from 250 cfs to 5,000 cfs and flexibility would be retained to adjust release rates within this range to respond to new information as it becomes available. There are some restrictions on when maximum and minimum releases can occur; typically, the dam would have a release pattern to mimic a natural hydrograph in the San Juan River below Farmington with high spring flows and low-stable base flows during the non-snowmelt runoff period. All Flow Recommendations criteria when modeled can be met under this operations alternative. In the future, if Flow Recommendations change in response to SJRBRIP monitoring and research activities, operating criteria may be adjusted within the parameters described in this EIS.

For this alternative, a spring peak release of 5,000 cfs is planned for most years (approximately 70 percent) to meet the Flow Recommendations criteria.⁴ The summer, fall, and winter releases support a target flow in the San Juan River downstream of Farmington of 500 to 1,000 cfs for endangered fish habitat and are also designed to conserve water for spring releases and for water development. The summer, fall, and winter flow

⁴ A decision chart (appendix J, volume II) would be used to determine peak releases in any given year.

target would require releases as low as 250 cfs. If high reservoir inflows occur during the summer and the reservoir content is high, water would be released in brief peaks in the fall and winter to avoid an uncontrolled spill.⁵

The 250/5000 Alternative was analyzed using the same water depletions as were used in the No Action Alternative, and it assumes the following additional depletions: 57,100 acre-feet per year for the ALP Project, 137,000 acre-feet per year for completion of the NIIP, with 16,400 acre-feet transferred from the Hogback and Fruitland Projects to the NIIP,⁶ and 3,000 acre-feet per year⁷ for minor depletions defined in other Endangered Species Act (ESA) consultations. Depletions under this alternative total approximately 854,376 acre-feet per year, or about 178,953 acre-feet per year greater than the total depletion under the No Action Alternative.

500/5000 Alternative

This alternative is similar to the 250/5000 Alternative, except that Navajo Dam releases would not fall below 500 cfs. The general Navajo Dam operation criteria outlined in the Flow Recommendations would be followed, with the exception of the minimum release.

Total depletions associated with this alternative are assumed to be 852,639 acre-feet per year, an amount assumed to be the same as that under the 250/5000 Alternative, except that Navajo Reservoir evaporation losses are less and some water shortages would occur in dry years, resulting in about 2,000 acre-feet per year less total depletion on average. While depletions similar to those of the 250/5000 Alternative are assumed for the analysis in this EIS, it should be noted that reconsultation under the ESA would be required on water projects that depend on meeting the Flow Recommendations for their biological opinions.

250 Variable/5000 Alternative

The 250 Variable/5000 Alternative would maintain the same 5,000 cfs maximum release from the dam, but would allow the minimum release to vary between 250 and 500 cfs, depending on conditions throughout the year and needs of various resources. This alternative was developed to reduce impacts from the 250 cfs minimum flow on downstream resources and water users. This alternative was formulated and analyzed with April through October releases at or above 400 cfs and November through March releases as low as 250 cfs. Water depletions would be maintained at the same level as those of the 250/5000 Alternative.

⁵ To date Navajo Dam has spilled only one time and that was to test the spillway.

⁶ The net difference to the Navajo Nation is 120,600 acre-feet.

⁷ An additional 1,500 acre-feet of depletions approved by SJRBRIP in 1992 is included; however, the impact of the additional 1,500 acre-feet of depletion is not considered substantial in this analysis.

250/6000 and 500/6000 Alternatives

These two alternatives would be configured in the same way as were the action alternatives above, except that the spring peak release would be increased to 6,000 cfs. Water depletions would be maintained at the same level as those for the 250/5000 Alternative. The increase of the maximum Navajo Dam release rate to 6,000 cfs was suggested as an alternative because the Flow Recommendations indicated that this maximum release rate would result in more frequently meeting the desired duration and magnitude of flows below Farmington during the spring runoff period.

Decommission and Breach Navajo Dam

This alternative would require decommissioning and physically breaching the dam, allowing the pre-dam hydrograph to be largely restored and providing endangered fish species access to the river upstream of the dam, if other barriers to fish passage were also removed.

Characteristics Common to Action Alternatives

Interim Operation

The two action alternatives retained for further analysis include the assumption that all the water uses listed in the depletion table (table II-1) are fully developed and utilized. In reality, there would be an interim period before this level of demand actually occurred (the interim period is the time until the ALP Project and NIIP are fully operational along with 3,000 acre-feet of minor unspecified water depletions). Operational flexibility exists to provide supplemental flows for various purposes in this interim period as a result of these unutilized depletions.

Participation in SJRBRIP

Reclamation's participation in the SJRBRIP includes:

- Providing substantial technical support in the development, refinement, ongoing maintenance, and use of a comprehensive hydrology model for the Basin to allow realistic, supportable projections of future hydrologic conditions under various water development scenarios

 - Participating in activities of the Coordination, Hydrology, and Biology Committees
-

- Continuing to optimize operating rules criteria for Navajo Dam and Reservoir to provide more efficient implementation of Flow Recommendations criteria, or a reasonable alternative to the Flow Recommendations, to assist in recovering endangered fish species and in making water available for further development in the Basin
- Constructing facilities to restore fish passage and support stocking plans

Reclamation will also do the following:

- Continue to conduct three Navajo Reservoir operations meetings annually to solicit input and concerns on planned operations
- The Durango Pumping Plant will be operated in a manner that ensures that its operations do not interfere with meeting the target flows recommended for the San Juan River, as described in the 2000 ALP biological opinion.
- Continue to work with all Tribes/Nations in the Basin to combine resources in evaluating options for proceeding with future water development, including the NGWSP, the Jicarilla Apache Nation Navajo River Water Supply Project (JANNRWSP), restoration of the Hogback Project, and development of up to approximately 38,000 acre-feet per year direct diversions provided for in the Colorado Ute Settlement Act that are not a part of the ALP and Dolores Projects

Changes to Flow Recommendations

Uncertainties are recognized in both the EIS alternatives for Navajo Dam re-operation and in the overall SJRBRIP recovery plan for the endangered fish. For example, hydrology modeling assumed that future precipitation and runoff patterns are reflected in the historic hydrology record. If this is not correct, Flow Recommendations may be more or less difficult to meet. Responses of the endangered fish to the Flow Recommendations and other recovery elements have been predicted based on scientific studies of the fish and their habitats, but only actual scientific monitoring conducted through SJRBRIP will determine the status and trends of the endangered fish and their habitats following implementation of the Flow Recommendations and other recovery activities. Also, it is uncertain to what extent non-native fish will benefit from the recommended flows and whether these benefits will offset the positive effects of the modified hydrology on endangered fish.

Criteria established to determine positive population responses and for overall species recovery are discussed in the biological assessment in volume II of this EIS. The SJRBRIP, which includes Federal, State, Tribal, and water development interests, would be responsible for conducting monitoring and research, and for communicating results of

this work to stakeholders and the public during Navajo Reservoir operation meetings. The SJRBRIP can also recommend recovery actions that would address all of the recovery factors related to the endangered fish. These actions may include experimentation to test new hypotheses, modifications to the Flow Recommendations, or control actions directed against non-native fish, if warranted by monitoring and research results. Any adjustments in, or modifications to, the Flow Recommendations must be approved by the Coordination Committee, which is the governing committee of the SJRBRIP.

Recommendations for dam release modifications then can be considered by Reclamation, the agency ultimately responsible for unit operations. Thrice-yearly Navajo Reservoir operation meetings will provide a forum for all interested parties to discuss Navajo unit operations and recovery program progress and recommendations. The SJRBRIP Biology Committee and other scientists will be invited to each meeting to discuss the effects of dam operations and other resource management actions on the endangered fish. Flexibility in dam releases, discussed later in this chapter, will also be discussed at these meetings. Future changes in the Flow Recommendations, dam operations and other management policies could be implemented long-term after compliance with applicable law.

Extreme Hydrological Conditions

While there are maximum and minimum release targets specified for each action alternative, the potential exists for modifications to these targets as a result of extreme hydrological conditions, emergencies, or unforeseen conditions. The extreme drought years of 2002 and 2003 have shown the need to recognize these extreme events.

During periods of exceptionally high inflow and high reservoir levels, the reservoir may need to be operated with releases higher than 5,000 cfs under any of the alternatives. This would result in flows that exceed the Corps' safe channel capacity upstream from Farmington.

In periods of extreme drought conditions, when water shortages are anticipated on Navajo Reservoir water supply contractors diverting above, at, or below Navajo Reservoir (such as occurred in 2003), shortage sharing plans will be developed based upon the available water, with input from the U.S. Fish and Wildlife Service (Service), New Mexico State Engineer, and reservoir water users. The available water, taking into account both the prospective runoff originating above Navajo Reservoir and the available water in storage in Navajo Reservoir, will be apportioned between the contractors as directed in Section 11 of Public Law 87-483. Reclamation will assess available water for the water year and determine whether shortages are anticipated. Reclamation will hold discussions with the Service and the SJRBRIP to determine flow targets and minimum base flows for endangered fish. The shortage sharing plans could include modifications to reservoir releases and target base flows. While Section 11 of Public Law 87-483 provides the framework for apportioning

water to Navajo Reservoir water users between those diverting above and those diverting at or below the reservoir, in years where shortages are anticipated, it is understood that this does not preclude water users from developing cooperative water sharing agreements, such as those that were developed in 2003 through 2005, so long as such agreements would not cause Reclamation to undertake any change in its operations from how they would operate under Section 11.⁸

Endangered Fish Releases

A Memorandum of Understanding and Supplemental Agreement to protect the releases for endangered fishes made from Navajo Reservoir to and through the endangered fish habitat of the San Juan River to Lake Powell was signed in October 1991. This Memorandum of Understanding remains in effect (Animas-La Plata Project FSEIS volume II, July 2000).

Variables Inherent in the Operation of Navajo Dam

A number of variables common to the action alternatives may affect the ability to maintain any prescribed pattern of releases from Navajo Dam. They include the following:

1. ***Inflow forecasts:*** Forecasting techniques may not accurately predict actual snowpack levels and available runoff; therefore, reservoir water availability may fluctuate in any given year. Regardless of these fluctuations, each alternative would pass inflows required for downstream senior direct flow water rights in accordance with New Mexico State water law.
2. ***Fluctuations in Animas River contributions:*** Flows from the Animas River have a significant effect on attempts to meet Flow Recommendations downstream from Farmington. The Animas, like any unregulated river, experiences a wide range of flows due to snowmelt and rain events. Trying to match Navajo Dam releases with Animas River flows, travel time uncertainties, and other issues discussed below complicate Reclamation's ability to meet the Flow Recommendations.

⁸ The criteria for computing shortages and allocating water supplies and shortages under the Recommendations for San Juan River Operations and Administration for 2003, 2004, and 2005 were agreed to for those years only by the 10 major water users on the San Juan River that were party to the Recommendations. The Recommendations clearly state that the agreements contained therein are not to be construed as precedent setting for San Juan River operations and administration in subsequent years or as establishing any party's rights or entitlements to divert and use water from the San Juan River, including undershortages.

3. ***Unanticipated precipitation events:*** Severe thunderstorms or rain events that occur on any tributaries that enter the San Juan River downstream from Navajo Dam affect the ability to meet the Flow Recommendations. These events cause flows to increase, and, depending on their duration, releases from Navajo Dam may be adjusted accordingly. Also, unanticipated flood inflows into Navajo Reservoir could require releases from the dam of up to 5,000 cfs at any time to avoid the occurrence of an uncontrolled spill.

During scheduled peak releases, Reclamation has monitored and will continue to monitor weather conditions. Flash floods occur in this region, and the San Juan River tributaries can contribute large volumes of water from those events. When possible, releases from Navajo Dam are/will be adjusted when weather conditions and tributary drainage inflows indicate possible flooding.

4. ***Travel time:*** An adjustment in water releases from Navajo Dam takes about 3 days travel time to reach the Bluff gage in Utah.
5. ***Gage errors:*** Gage errors are inherent with all measuring equipment, and changing river channel and flow conditions (i.e., sand deposits and erosion) compound gage errors.
6. ***Contractual obligations:*** Reclamation's contract with the city of Farmington for the operation and maintenance of the hydroelectric powerplant at Navajo Dam calls for Reclamation to provide the city 10 days' notice, to the extent possible, prior to changes in releases from the dam. The contract also states that the operation of the powerplant shall not be detrimental to the dam or the project, and as a result, the notification period has been informally modified to a 24-hour notice when increasing the releases and 7 days when decreasing releases. During extreme conditions, even less notification time may be given, as was the case in 2002 and 2003. Reclamation will coordinate closely with the city of Farmington to provide as much advance notification as possible during extreme conditions.
7. ***Maintenance needs:*** In the past few years, dam releases have been interrupted due to a variety of unforeseen events such as mechanical problems, repair of gates and other factors. In addition, regularly scheduled maintenance needs may impact Reclamation's ability to make specific releases.

V. Alternatives Evaluation

Introduction

This section presents alternatives retained for detailed analysis. Section VI discusses alternatives considered but eliminated from detailed consideration. This section begins

with an explanation of the hydrology considerations taken into account during alternatives formulation and evaluation. A summary comparison of the alternatives considered against the evaluation criteria is presented in table II-2 and impacts associated with the retained alternatives are presented in table II-9 at the end of this chapter.

The alternatives described below were retained for further analysis.

- No Action Alternative (Historical Operation)
- 250/5000 Alternative
- 500/5000 Alternative

Four alternatives were dropped from consideration as viable alternatives. These alternatives were: (1) the 250 Variable/5000 Alternative, (2) 250/6000 Alternative, (3) 500/6000 Alternative, and (4) Decommission and Breach Navajo Dam. The reasons these alternatives were dropped from further consideration are provided in the “Alternatives Considered but Eliminated” section of this chapter.

Hydrology Considerations

Determining viable alternatives for operating the dam to meet the Flow Recommendations criteria required modeling complex relationships, including fluctuating tributary inflow and flow depletions associated with multiple diversion and return flow points. A requirement of the modeling was the ability to assess water resources system responses over the long term.⁹

⁹ RiverWare was the simulation model software selected by Reclamation and the Bureau of Indian Affairs (BIA) for use in the development of a hydrology model for the Basin to be used to evaluate the Flow Recommendations. The model has been used by Reclamation and the BIA in the Basin since 1998 in support of assessing the relationship between flow recommendations for endangered fish in the San Juan River and water development. For this FEIS, three model configurations were developed to simulate future conditions: the No Action Alternative; the 250/5000 Alternative (Flow Recommendations); and the 500/5000 Alternative. Reclamation believes that the current model version is the best available; substantial revisions to the current model are being evaluated and tested by the SJRBRIP Hydrology Committee. Reclamation does not expect that revisions to the model would affect its selection of a Preferred Alternative, though new information provided through updated modeling in the future will be considered as appropriate in Reclamation’s Navajo Dam operations.

San Juan Basin Model Disclaimer: Use of the model in the work of the SJRBRIP does not necessarily constitute agreement or approval by individual program participants with the model data, methodologies, or assumptions. Use of the model does not change the responsibilities of the respective States to maintain records of water rights and water use. Official records of water rights and water use are maintained by the State agencies statutorily charged with that responsibility.

Table II-2.—The alternatives arrayed by evaluation criteria

Criteria	No Action	250/5000	500/5000	250/Var 5000	250/6000	500/6000	Decommission/ Breach Dam
Minimizes adverse impacts to existing/future authorized water uses	No	Yes	In part	In part	In part	In part	No
Levels of protection for Indian Trust Assets	Low	High	Moderate	Moderate	Moderate	Moderate	Low
Meets SJRBRIP Flow Recommendations	No	Yes	No	No	No	No	No
Meets various laws and policies (including Navajo Dam authorized purposes, ESA, State laws and interstate compacts)	Yes	Yes	Yes	Yes	No	No	No
Meets Corps flood control/channel criteria	Yes	Yes	Yes	Yes	No	No	No
Avoids impacts to diversions, water quality, erosion, fisheries, recreation, and others	Yes	No	Partial	Partial	No	Partial	No

(Please see summary comparison of alternatives [table II-9] at the end of this chapter)

As noted earlier, a summary of depletions used in the hydrology model for each alternative is shown in table II-1.

Table II-3 summarizes the degree to which each alternative retained for further consideration and analysis meets the Flow Recommendations.

Figures II-2 and II-3 and tables II-3 through II-7 illustrate the hydrology and operation of the No Action, 250/5000, and 500/5000 Alternatives, displaying the elevation of the water surface in Navajo Reservoir and average monthly flows at Archuleta (just downstream from Navajo Dam) and at Bluff, Utah. These tables were also developed to show the frequency of various flows at Archuleta and Bluff. Table II-8 presents flows measured during the Summer Low Flow Test conducted in July 2001 under a 250 cfs release scenario. Please note that these tables have not been updated to include recently approved depletions for the Long Hollow Reservoir Project or the JANNRWSP. However, both of these projects were modeled using the Navajo Reservoir Operation Preferred Alternative, and the Flow Recommendations were met with both projects.

Hydrology Model – No Action Alternative

The San Juan Basin hydrologic model was configured to simulate future conditions without meeting the Flow Recommendations by including all current depletions, all depletions that could occur without further Federal action (primarily exercise of some, but not all, State water rights not presently being used in Colorado and New Mexico), and all depletions from Federal projects included in the baseline for the 1991 ALP Project ESA consultation. Because the Flow Recommendations would not be met, it was assumed that the ALP Project, completion of NIIP, portions of the Jicarilla Apache Nation water rights settlement, and other water depletions (Florida and Mancos municipal and industrial [M&I] water contracts)—including the 3,000 acre-feet of unspecified minor depletions as allowed under various ESA consultations—would require reconsultation, so they were not included under this alternative. To simulate reservoir releases under the No Action Alternative, the model uses operation rules representing how the dam was operated, on average, from 1973 to 1991. The No Action Alternative depletions total about 675,000 acre-feet per year from the San Juan River. Depletions assumed for the No Action Alternative appear in the previously mentioned depletion table (table II-1).

Federal action (primarily exercise of some, but not all, State water rights not presently being used in Colorado and New Mexico), and all depletions which have received a favorable biological opinion from the Service. Such depletions include 57,100 acre-feet per year for the ALP Project, 137,000 acre-feet per year for completion of NIIP, with 16,400 acre-feet of restoration to the Hogback and Fruitland Projects, and 3,000 acre-feet per year for unspecified minor depletions. The action alternatives depletions total about 850,000 acre-feet per year. The overall technical configuration of the model is shown in volume II.

Table II-3.—Summary statistics of meeting Flow Recommendations criteria for alternatives retained for further analysis

	No Action Alternative				250/5000 Alternative				500/5000 Alternative			
	>10,000	>8,000	>5,000	>2,500	>10,000	>8,000	>5,000	>2,500	>10,000	>8,000	>5,000	>2,500
Duration	Average frequency (percent)				Average frequency (percent)				Average frequency (percent)			
1 day	26.2	36.9	53.8	100.0	33.8	56.9	73.8	95.4	27.7	43.1	55.4	96.9
5 days	18.5	33.8	43.1	90.8	27.7	47.7	69.2	86.2	21.5	35.4	47.7	86.2
10 days	7.7	30.8	38.5	81.5	15.4	38.5	66.2	81.5	13.8	29.2	44.6	80.0
15 days	4.6	23.1	36.9	72.3	7.7	30.8	56.9	75.4	6.2	27.7	41.5	72.3
20 days		13.8		69.2		24.6		72.3		21.5		66.2
21 days			36.9				53.8				40.0	
30 days		7.7	35.4	61.5		13.8	44.6	64.6		13.8	33.8	60.0
40 days			30.8	50.8			32.3	55.4			27.7	49.2
50 days			26.2	46.2			26.2	49.2			23.1	40.0
60 days			16.9	40.0			18.5	41.5			15.4	33.8
80 days			7.7	30.8			9.2	30.8			6.2	26.2
Maximum duration between events												
Flow criteria - Max duration	Allowed	Modeled			Allowed	Modeled			Allowed	Modeled		
9,700 cfs for 5 days - 10 years	10	14			10	10			10	14		
7,760 cfs for 10 days - 6 years	6	7			6	6			6	14		
4,850 cfs for 21 days - 4 years	4	7			4	4			4	7		
2,450 cfs for 10 days - 2 years	2	2			2	2			2	2		
Note: Shaded cells containing bolded numbers indicate failure to meet Flow Recommendations.												
Flow recommendations flow/duration statistics												
Discharge												
	>10,000	>8,000	>5,000	>2,500								
Duration	Average frequency (percent)											
1 day	30.0	40.0	65.0	90.0								
5 days	20.0	35.0	60.0	82.0								
10 days	10.0	33.0	58.0	80.0								
15 days	5.0	30.0	55.0	70.0								
20 days		20.0		65.0								
21 days			50.0									
30 days		10.0	40.0	60.0								
40 days			30.0	50.0								
50 days			20.0	45.0								
60 days			15.0	40.0								
80 days			5.0	25.0								

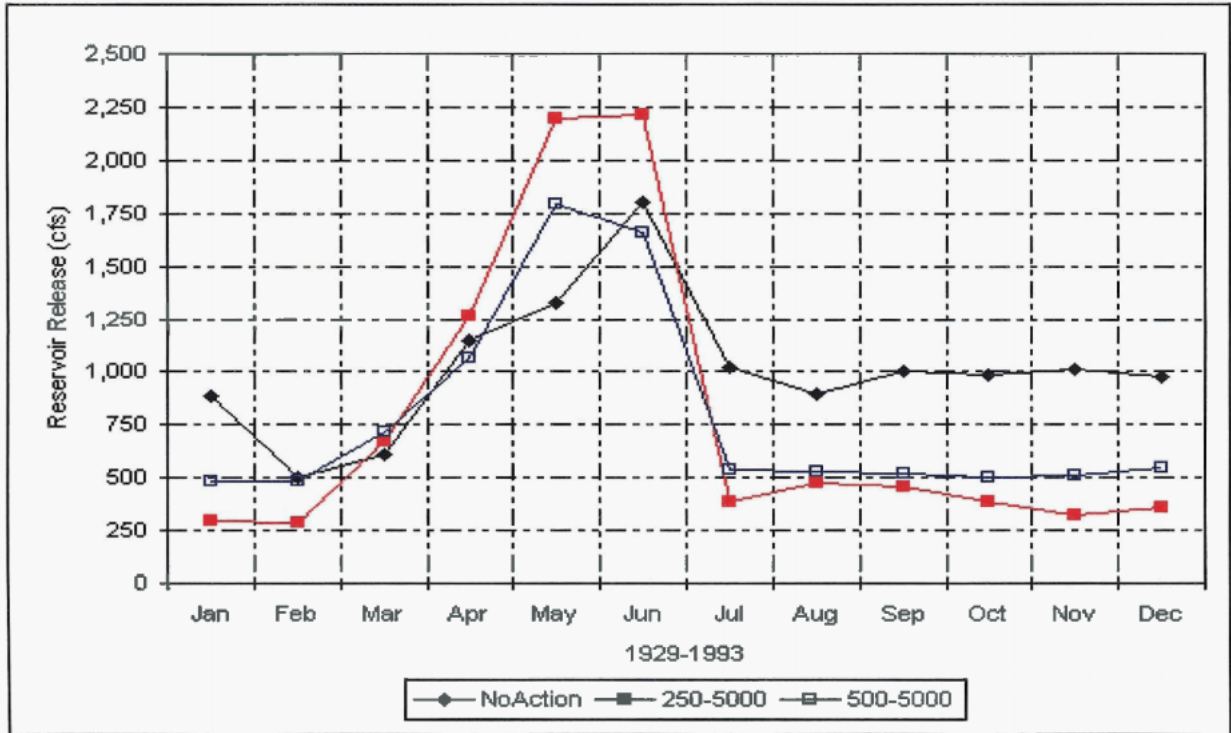


Figure II-2.—Navajo Reservoir average monthly release comparing three alternatives.

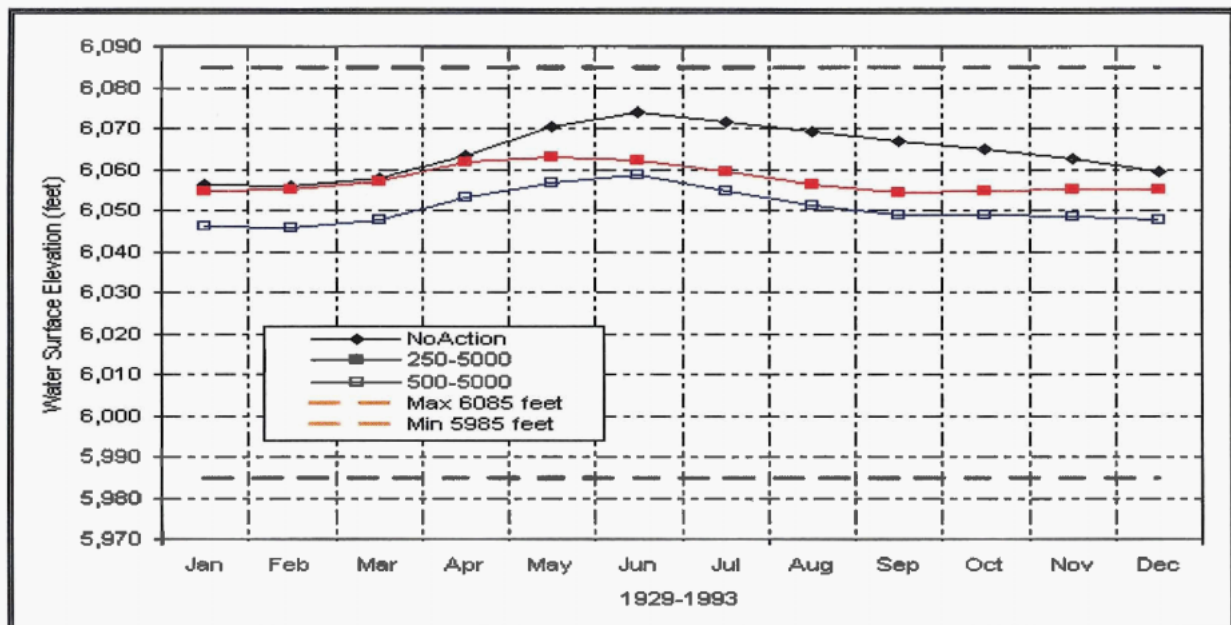


Figure II-3.—Monthly average water surface elevations for Navajo Reservoir projected for three Navajo Dam operating alternatives (1929-93 data).

Table II-4.—San Juan River flows at Archuleta monthly summary statistics for the No Action, 250/5000, and 500/5000 Alternatives (1929–93 data)

Month	San Juan at Archuleta								
	No Action			250/5000			500/5000		
	Average monthly flows (cfs)			Average monthly flows (cfs)			Average monthly flows (cfs)		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum
October	984	3,791	500	388	1,010	250	501	957	0
November	1,015	3,126	500	321	1,554	250	507	1,189	0
December	978	1,782	500	360	1,617	250	544	1,780	0
January	887	1,290	500	296	433	250	486	500	0
February	500	500	500	287	444	250	488	500	0
March	606	4,929	500	672	5,000	250	715	4,250	500
April	1,144	5,000	500	1,260	5,000	250	1,063	4,750	500
May	1,323	5,000	500	2,195	5,000	250	1,795	5,000	500
June	1,798	5,000	500	2,215	3,937	250	1,660	3,749	500
July	1,022	4,590	500	386	1,476	250	538	1,454	227
August	898	3,465	500	471	1,104	250	531	1,081	0
September	1,004	4,339	500	459	1,027	250	517	1,004	0
Average	1,013	3,568	500	776	2,300	250	779	2,184	186
Maximum	1,798	5,000	500	2,215	5,000	250	1,795	5,000	500
Minimum	500	500	500	287	433	250	486	500	0

Notes: Minimum flows of zero are shown under the 500/5000 Alternative because the reservoir is occasionally drawn down below the NIIP inlet works. In actuality, water uses would be shorted in advance to avoid this situation and/or the reservoir inflows would be bypassed to meet downstream senior water rights.

This table represents long-term changes. As discussed in the EIS in many places, flexibility would be used to increase irrigation-season minimums prior to full water development.

Table II-5.—San Juan River flows at Bluff, Utah, monthly summary statistics for the No Action, 250/5000, and 500/5000 Alternatives (1929–93 data)

Month	San Juan at Bluff								
	No Action			250/5000			500/5000		
	Average monthly flows (cfs)			Average monthly flows (cfs)			Average monthly flows (cfs)		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum ¹	Mean	Maximum	Minimum ¹
October	1,668	10,189	455	1,012	7,338	525	1,127	7,285	36
November	1,548	4,982	644	824	3,261	525	1,010	2,895	249
December	1,415	2,806	742	777	2,645	525	964	2,808	261
January	1,309	2,717	734	716	1,743	525	907	1,993	367
February	1,154	3,036	729	940	2,792	547	1,141	3,014	503
March	1,303	6,332	451	1,329	6,285	525	1,372	5,535	525
April	2,130	8,079	220	2,151	7,704	525	1,956	7,454	525
May	3,232	12,934	380	4,017	12,863	525	3,621	12,872	525
June	4,317	10,314	509	4,680	9,081	609	4,113	8,944	609
July	2,102	7,836	258	1,465	4,715	525	1,618	4,692	525
August	1,522	8,223	67	1,110	5,175	525	1,171	5,183	435
September	1,538	8,218	182	990	4,288	525	1,050	4,296	42
Average	1,936	7,139	448	1,668	5,657	534	1,671	5,581	384
Maximum	4,317	12,934	742	4,680	12,863	609	4,113	12,872	609
Minimum	1,154	2,717	67	716	1,743	525	907	1,993	36

¹ The target base flow is calculated as the weekly average of gaged flows throughout the critical habitat area; therefore, daily flows of less than 500 cfs may occur at some gages.

Table II-6.—Seasonal frequency distribution of monthly Navajo Reservoir releases for the three alternatives (based on 1929–93 hydrology)

Release range (cfs)		Number of occurrences			Occurrences as percent ¹		
All months							
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	15	0	0	2
249	251	0	222	0	0	28	0
251	350	0	191	0	0	24	0
350	499	0	144	0	0	18	0
499	501	345	3	593	44	0	76
501	1,000	185	103	93	24	13	12
1,000	2,500	196	38	24	25	5	3
2,500	5,000	54	79	55	7	10	7
Total number of months		780	780	780	100	98	100
December through February							
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	6	0	0	3
249	251	0	54	0	0	28	0
251	350	0	121	0	0	62	0
350	499	0	16	0	0	8	0
499	501	109	0	185	56	0	95
501	1,000	16	0	0	8	0	0
1,000	2,500	70	4	4	36	2	2
2,500	5,000	0	0	0	0	0	0
Total number of months		195	195	195	100	100	100
March through November²							
		No Action	250/5000	500/5000	No Action	250/5000	500/5000
0	249	0	0	9	0	0	2
249	251	0	168	0	0	29	0
251	350	0	70	0	0	12	0
350	499	0	128	0	0	22	0
499	501	236	3	408	40	1	70
501	1,000	169	103	93	29	18	16
1,000	2,500	126	34	20	22	6	3
2,500	5,000	54	79	55	9	14	9
Total number of months		585	585	585	100	102	100

¹ Total percentages differ slightly from 100 percent due to using rounded monthly percentages.² As discussed previously, releases would be increased in the irrigation season until additional water development occurs. This increase is not reflected in the table.

Table II-7.—San Juan River at Bluff – distribution frequency of monthly flow 1929–93¹

Month	Percent of time mean monthly streamflow is less than 500 cfs			Percent of time mean monthly streamflow is between 500 and 800 cfs			Percent of time mean monthly streamflow is greater than 800 cfs		
	No Action	250/5000	500/5000	No Action	250/5000	500/5000	No Action	250/5000	500/5000
January	0.0	0.0	3.1	6.2	78.5	26.2	93.8	21.5	70.8
February	0.0	0.0	0.0	12.3	49.2	12.3	87.7	50.8	87.7
March	3.1	0.0	0.0	23.1	55.4	29.2	73.8	44.6	70.8
April	12.3	0.0	0.0	21.5	44.6	40.0	66.2	55.4	60.0
May	1.5	0.0	0.0	6.2	9.2	9.2	92.3	90.8	90.8
June	0.0	0.0	0.0	1.5	3.1	1.5	98.5	96.9	98.5
July	4.6	0.0	0.0	10.8	18.5	13.8	84.6	81.5	86.2
August	6.2	0.0	1.5	15.4	40.0	36.9	78.5	60.0	61.5
September	12.3	0.0	3.1	10.8	53.8	41.5	76.9	46.2	55.4
October	3.1	0.0	3.1	15.4	66.2	43.1	81.5	33.8	53.8
November	0.0	0.0	3.1	9.2	67.7	18.5	90.8	32.3	78.5
December	0.0	0.0	3.1	7.7	76.9	26.2	92.3	23.1	70.8

¹ Flows shown are average monthly flows as modeled. Operationally, target base flow is calculated as the weekly average of gaged flows throughout the critical habitat area. As such, actual daily flows of less than 500 cfs at the Bluff Gage, as well as other gages, could occur.

Table II-8.—Summary of streamflows measured during the 2001 Summer Low Flow Test

Location	River mile	Average flow (cfs)
San Juan River at Archuleta	220	250.0
San Juan River at Soaring Eagle Lodge (below Citizens Ditch)	216.4	132.7
San Juan River above Turley Inlet Channel	214.4	131.4
San Juan River below Hammond Diversion	209.1	63.0
San Juan River below Blanco Bridge	207.0	87.7
San Juan River above Bloomfield Bridge	195.8	130.0
San Juan River below Bloomfield Sewer discharge	194.8	131.1
San Juan River below Lees Acre Bridge	188.5	185.7
San Juan River 1/4 mile above Animas River confluence	181.4	218.7

Alternatives Retained for Further Consideration

No Action Alternative

Because it does not address the Flow Recommendations, it is likely that implementing the No Action Alternative would adversely affect downstream endangered fish habitat and could adversely affect existing and future water development. However, this alternative would help maintain or enhance the downstream trout fishery and river rafting by moderating flow fluctuations.

If no action is taken by Reclamation to operate Navajo Dam and Reservoir to meet the Flow Recommendations criteria, future Indian water development in the Basin would probably not proceed as planned, and several existing or proposed projects could be affected as well. ESA consultations could be re-initiated on several existing projects such as the ALP Project, NIIP Blocks 7 through 11, Jicarilla Apache Nation third-party contracts, the NGWSP, and the JANNRWSP. It is uncertain whether the Service would issue favorable biological opinions on these projects or any other Indian water development projects in the Basin. If the water supply available from Navajo Reservoir is insufficient to meet additional future water uses pursuant to Indian water rights, this could result in negative impacts to Tribal water development projects and Tribal water uses:

Also at possible risk are existing Federal projects in New Mexico that have not yet undergone ESA consultation, including the San Juan-Chama Project. The Jicarilla Apache Nation and the San Juan Pueblo have contract allocations for water from the San Juan-Chama Project.

In addition, the current depletion allowance of 3,000 acre-feet for small unspecified water uses could no longer be valid and each minor use would need a separate ESA consultation. Future water delivery and associated renewal of existing water contracts from Lemon, Vallecito, and Jackson Gulch Reservoirs and the San Juan-Chama Project also could be at risk since there have been no ESA consultations on the operations of these projects.

Also, hydrologic impacts of the operation of existing projects, such as San Juan-Chama, might not be offset under this alternative. An additional 1,500 acre-feet of minor unspecified depletions approved by the SJRBRIP in 1992 might also be compromised. However, the impact of the additional 1,500 acre-feet is not considered substantial in this analysis.

250/5000 Alternative

Operations under this alternative would best meet the purpose of and need for the proposed action. It would support water projects that have completed ESA consultations

and NEPA compliance—including NIIP completion, the ALP Project, the Jicarilla Apache contract with PNM, the JANNRWSP, and 3,000 acre-feet for minor unspecified depletions—to proceed, and would meet the Flow Recommendations (see the summary statistics of meeting Flow Recommendations criteria, table II-3). Since this alternative meets Flow Recommendations, it also reduces the risk of impact to the other water uses listed under the No Action Alternative.

Reclamation would modify Navajo Dam operations to provide sufficient releases of water at times, quantities, and durations necessary to assist in conserving endangered fish and their designated critical habitat in concert with other recovery actions. Reclamation would maintain the authorized purposes of the Navajo Unit, enabling water development to occur in compliance with applicable laws, compacts, decrees, and Indian trust responsibilities.

Under this alternative, releases would range from 250 cfs to 5,000 cfs. Minimum releases would not fall below 250 cfs.¹⁰ The spring peak release would meet the Flow Recommendations criteria. Non-spring peak releases as low as 250 cfs are intended to meet the Flow Recommendations downstream of Farmington and to provide water storage in Navajo Reservoir. These releases would also help maintain a minimum 500 cfs flow downstream of Farmington, benefitting river rafting¹¹ in dry years. All releases would be made within the operational limitations/constraints of Navajo Dam. Some flexibility in reservoir releases exists because water committed for present or future development is not currently fully used. In the long term, flexibility will diminish; in certain drought years, flexibility to go above 250 cfs may not exist at all. Because of this, this FEIS addresses long-term impacts as if flexibility were not available. Currently, however, there may be a significant amount of water available in many, but not all, years, particularly when the reservoir is full or during high-runoff conditions. Water anticipated to be available for this flexibility will be identified and quantified to the extent possible during the Navajo Reservoir Operations meetings and the scheduling of releases will be discussed. Based on recommendations from resource experts, options will be presented for the use of this water and input will be solicited from the public. Reclamation will use this input to make decisions on the release of water from Navajo Dam.

¹⁰ Except possibly under extreme multi-year drought conditions, see chapter II of the FEIS, “Extreme Hydrological Conditions.”

¹¹ The target base flow is calculated as the weekly average of gaged flows throughout the critical habitat area; therefore, daily flows of less than 500 cfs may occur at some gages. The goal of the Flow Recommendations is to maintain San Juan River base flows downstream from the Animas River confluence at Farmington between 500 and 1,000 cfs. Because of variable inflows from the Animas River, occasional high inflow from intermittent tributaries, diversions, and return flow, and water travel time from Navajo Dam, this goal is difficult to consistently meet.

The Flow Recommendations call for using a 7-day moving average of two of the four downstream gages to monitor whether flows are kept between 500 and 1,000 cfs. This monitoring plan was presented in the DEIS.

(continued)

These decisions will reflect a priority desire to augment a 250 cfs minimum release during the irrigation season, maintaining irrigation-season releases above 350 cfs while assuring a spring release as described in the Flow Recommendations and assuring recommended minimum flows within critical habitat can be met. Such a release would reduce impacts to recreation, hydropower, water quality, fish and wildlife, and other resources. In response to information gained from monitoring, water release flexibility could also be used to conduct experiments guided by the SJRBRIP.

Under this alternative, unusually high inflows (other than those associated with spring runoff) resulting in very high reservoir elevations would be released as a spike flow, if necessary, to avoid an uncontrolled spill.

500/5000 Alternative

During the public scoping process, many people requested that minimum releases not be reduced below 500 cfs. This alternative was included to reduce potential impacts on downstream water users' ability to take water at their diversion structures and to downstream recreation users (trout fishery and rafting) by maintaining higher minimum releases than those under the 250/5000 Alternative.

Because Flow Recommendations are not fully met by this alternative, reconsultation under ESA on the ALP Project, NIIP completion, 3,000 acre-feet of minor unspecified depletions, and others would be required. In addition, Navajo Reservoir would infrequently (less than 1 percent of the time) be drawn down below the NIIP inlet works, thus interfering with irrigation deliveries to the NIIP. Further, maintaining the minimum release at 500 cfs limits the ability to develop water and results in spring peak releases of lesser duration and frequency. A minimum release of 500 cfs also limits the ability to meet Flow Recommendations below Farmington because it leaves less water available to meet spring peaks.

¹¹ (continued) There can be significant variability in these gage readings and the selective use of any two gages could give results above or below the intent of the Flow Recommendations. Because of this, in 2002 the SJRBRIP suggested that flows be monitored by the following: "Use the lesser of the average of Bluff, Four Corners, and Shiprock (gages) and the average of Farmington, Shiprock, and Four Corners (gages). . .extreme conditions (low or high flows) identified by. . .Reclamation will be handled on a case-by-case basis with recommendations of the Biology Committee." The Service has provided written support of this approach to monitoring.

Reclamation's intent, documented in the FEIS, will be to maintain the recommended base flows in the critical habitat reaches by using the best available gage information. In practice, Reclamation and the Service will discuss flows routinely during the irrigation season and (as needed) the remainder of the year to determine the operations needed to meet the base flows. Reclamation, in consultation with the Service, will use the lesser of the weekly moving average of the Bluff, Four Corners, and Shiprock gages and the average of the Farmington, Shiprock, and Four Corners gages as the guide in meeting this intent. In periods of severe drought, Reclamation will work with the Service to arrive at operating criteria to respond to these conditions.

Even though this alternative would not fully meet the Flow Recommendations (see the summary statistics of meeting Flow Recommendations criteria, table II-3), the purpose and need outlined in this EIS, or diversion demands from the Navajo Reservoir water supply, it was retained for analysis because of substantial public interest and concern.

VI. Alternatives Considered but Eliminated

During the alternatives formulation and evaluation process, some of the alternatives were found to have serious flaws either in meeting the project purpose and need or in technical/physical constraints. Accordingly, they were eliminated from further consideration and were not carried over for full evaluation.

250 Variable/5000 Alternative

The 250 Variable/5000 Alternative was developed with the intent to minimize potential impacts on downstream water users' ability to take water at their diversion structures. In addition, it would attempt to minimize impacts to downstream recreation users (trout fishing and rafting) by maintaining higher minimum releases during certain critical times of the year than does the 250/5000 Alternative. However, it would result in insufficient reservoir storage to provide releases to meet spring peak flow criteria.

Under the "Proposed Federal Action" section of the NOI, Reclamation stated the following:

Reclamation proposes to prepare a EIS which will describe the effects of operating the Unit to implement the flow recommendations, or reasonable alternatives, as contained in the recommendation from the Program's Biological Committee resulting from consultation under the ESA.

To further this effort, Reclamation met with the Service on August 8, 2001, in Albuquerque, New Mexico. The meeting focused on discussing the possibility of implementing the 250 Variable/5000 Alternative as a reasonable alternative to operating Navajo Dam to meet the Flow Recommendations. During the course of this discussion, it was determined that the Flow Recommendations contain flexibility, at least in the short term, that might allow for operations similar to those proposed in the 250 Variable/5000 Alternative; therefore, it was determined there was no need for a separate alternative that incorporated variability. This alternative was eliminated because it did not meet the Flow Recommendations in the long term.

250/6000 Alternative

This alternative was considered because it was modeled and discussed in the Flow Recommendations. However, studies completed by the Corps and Reclamation during summer, 1998 demonstrated that a maximum release of 6,000 cfs is not feasible without performing major structural modifications to the dam's outlet works and to channel and diversion improvements between the dam and the Animas River confluence.

As noted earlier, the Corps has determined that the current safe river channel capacity for this reach is 5,000 cfs. The Corps intends to gain approval of the draft WCM to revise the river channel capacity below Navajo Dam to the confluence of the Animas River from the approved flow of 16,000 cfs to 5,000 cfs to reflect current river operations. Further, alternatives with the 6,000-cfs maximum release reduce the active storage of the reservoir to a point where, during extended droughts, the water level would fall below the NIIP intake, preventing releases to NIIP.

500/6000 Alternative

This alternative was considered as a way to reduce potential impacts on downstream water users' ability to take water at their diversion structures by providing a higher minimum flow release of 500 cfs. In addition, it attempts to minimize impacts to downstream recreation (trout fishery and rafting) by maintaining higher minimum releases during certain critical times of the year than does the 250/5000 Alternative. However, it has the same limitations as the 250/6000 Alternative and also does not fully meet the Flow Recommendations. The 6,000-cfs release also exceeds the current safe river channel capacity, as discussed under the 250/6000 Alternative.

Decommission and Breach Navajo Dam

This alternative largely meets the conditions of a natural hydrograph, and removal of the dam would provide the endangered fish with access to the portion of the San Juan River now inundated by Navajo Reservoir, as long as fish passage is provided throughout the river. Although large spring peaks would be provided most years, low flows during the irrigation season would still be reduced by downstream diversions that would result in low flows substantially below 500 cfs within designated critical habitat downstream of Farmington. Therefore, this alternative does not meet the Flow Recommendations.

This alternative is considered unreasonable and impractical because it does not meet all the elements of the purpose and need for the proposed action and would not support maintaining the authorized purposes of the Navajo Unit. It would result in loss of reservoir

storage needed to allow contract water deliveries to the NIIP and other contractors and would make it extraordinarily difficult, if not impossible, for the States of New Mexico and Colorado to fully utilize their consumptive use apportionments under the Upper Colorado River Basin Compact. It also could precipitate expensive litigation of Indian versus non-Indian water rights in both States. In addition, this alternative would result in the loss of the following benefits provided by Navajo Dam and Reservoir: downstream flood control, reservoir and tailwater fisheries, reservoir and downstream recreation, and hydropower generation. The concept of decommissioning or removing the dam was not considered further in this EIS because it does not meet the purpose of and need for the proposed action.

VII. Preferred Alternative

After conclusion of a detailed analysis, Reclamation has selected the 250/5000 Alternative as the Preferred Alternative. This alternative best meets the purpose of and need for the Federal action as defined in chapter I (the 250/5000 Alternative is referenced in subsequent chapters of this EIS as the Preferred Alternative). The Preferred Alternative is also considered the environmentally preferred alternative because it benefits endangered species and provides the most natural hydrograph.

Potential measures to mitigate adverse impacts to fish and wildlife and other resources with statutory requirements to consider mitigation are presented in chapters III and IV.

Table II-9 provides a summary of the impacts of the Preferred Alternative and the 500/5000 Alternative as compared to the No Action Alternative.

Future Water Development

The Preferred Alternative assumes significantly more depletions than does the No Action Alternative. While the Preferred Alternative also does not preclude depletions beyond those shown in the depletion table, additional evaluation, NEPA compliance, and ESA consultation would be necessary for any depletions beyond these, if there is a Federal connection. The SJRBRIP has developed principles¹² that explain and outline the process under which additional water projects and depletions will be evaluated, as described below:

¹² *Principles for Conducting ESA Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin* (adopted by the Coordination Committee, SJRBRIP, June 19, 2001).

The SJRBRIP will produce a list of actions defined in a long-range plan that can be implemented to assist in the recovery of the endangered fish. When ESA consultation is initiated on a new water depletion, the Service will determine if progress toward recovery has been sufficient for the program to serve as a reasonable and prudent alternative (RPA) or measure. The Service will also consider whether the probable success of the SJRBRIP is compromised as a result of a specified depletion or the cumulative effects of depletions. The Service will assess the sufficiency of program actions in proportion to the potential impacts—that is, the smaller the impact of the action, the lower the level of actions by the SJRBRIP or others needed to avoid jeopardy and/or destruction or adverse modification of critical habitat. The Service will determine whether progress by the SJRBRIP is sufficient to provide a reasonable and prudent alternative or measure based on the following factors:

- (1) Actions that will result in a measurable positive fish population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction
- (2) Status of fish populations
- (3) Adequacy of flows
- (4) Magnitude of the impacts of the activities

If the Service finds that SJRBRIP and other efforts are sufficient, the biological opinions will conclude these are RPAs to jeopardizing endangered fishes. If the Service finds they are not sufficient, the biological opinion will be written to identify actions to avoid jeopardy by identifying an RPA.

Table II-9—Summary comparison of alternatives retained for further analysis^{1, 2}

Resource	No Action Alternative	250/5000 Alternative	500/5000 Alternative
Navajo Reservoir operations and content	Reservoir operated for flood control and existing uses; average July content 1.52 million acre-feet.	Reservoir operated for flood control, endangered fish, full NIIP water supply; average July content 1.35 million acre-feet.	Reservoir operated for flood control and endangered fish, potential shortage to NIIP water supply; average July content 1.3 million acre-feet.
San Juan River monthly flows at Archuleta (near dam)	Minimum flow 500 cfs; average annual flow of 1,015 cfs; average July flow 1,050 cfs; average January flow 880 cfs.	Minimum flow 250 cfs; average annual flow of 775 cfs; average July flow 385 cfs; average January flow 300 cfs	Minimum flow 500 cfs; average annual flow of 780 cfs; average July flow 540 cfs; average January flow 500 cfs.
Lower San Juan River monthly flows	Minimum flow 65 cfs; average annual flow of 1,900 cfs; average June flow 4,250 cfs; average August flow 1,570 cfs.	Minimum flow 500 cfs; ³ average annual flow of 1,670 cfs; average June flow 4,680 cfs; average August flow 1,110 cfs.	Minimum flow <100 cfs when reservoir storage exhausted; ⁴ average annual flow of 1,670 cfs; average June flow 4,110 cfs; average August flow 1,170 cfs.
Water uses and resources	Water supply adequate to meet existing uses; future water uses including NIIP completion and ALP Project is uncertain.	Water supply adequate to meet existing uses; completion of NIIP and ALP Project would occur. Best opportunity to accomplish future water development.	Water supply adequate to meet existing uses with possible shortages in dry years; completion of NIIP and ALP Project included with possible shortages.
Indian Trust Assets	Two types of ITAs potentially affected—water uses and cultural resources on trust lands. Uncertain opportunity for development of water uses. Employment opportunities adversely affected.	Two types of ITAs potentially affected—water uses and cultural resources on trust lands. Positive impacts to all Tribes by protecting water development that has ESA and NEPA compliance—allows best possibility for future water development.	Two types of ITAs potentially affected—water uses and cultural resources on trust lands. Shortages to water projects would occur and better chance for future water development than No Action. Employment opportunities adversely affected.
Environmental Justice	Uncertain opportunity for development of water resources. Hinders Tribal economic development.	Provides best opportunity for future water development.	Flow Recommendations not fully met and additional ESA consultation would be required. Hinders Tribal economic development.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 Alternative	500/5000 Alternative
Trout fishery	Maintains better downstream trout fishery than action alternatives.	Habitat reduced average of 34 percent in special regulation waters when flows drop from 500 to 250 cfs. Physical habitat and water quality problems projected to be significant downstream from Citizens Ditch.	Maintenance of 500 cfs maintains existing trout fishery, although in shortage years minimum releases may drop, with noticeable impact.
Trout fishery recreation	Provides more recreation opportunities than action alternatives.	Reduction in trout fishery results in lower quantity and quality of recreation associated with trout fishing.	Recreation maintained, very infrequent water-short years have adverse effects on quantity and quality.
Native fisheries (e.g., roundtail chub, flannelmouth and bluehead suckers, etc.)	Has greater adverse impact on native fishes than action alternatives.	Reduced habitat in the river reach between the Hammond Diversion and Farmington; habitat improvement downstream from Farmington due to more natural hydrograph.	Some habitat improvement downstream from Farmington due to more natural hydrograph.
Rafting recreation downstream from Farmington	Overall flow regime beneficial; however, periods of flow below 500 cfs adversely affect rafting.	Overall volume of flow for rafting declines; however, attempt to maintain minimum rafting flows near 500 cfs. ³	Overall volume of flow for rafting declines; however, attempt to maintain minimum rafting flows near 500 cfs. ³
Reservoir recreation	Less impact than action alternatives.	Generally recreation use levels maintained; reservoir drawdown adversely affects quality of recreation in dry periods.	Generally recreation use levels maintained; reservoir drawdown adversely affects quality of recreation in dry periods.
Reservoir fishery	Less impact to reservoir fishery than action alternatives.	Minor adverse effects to reservoir fishery due to increased reservoir drawdowns.	Moderate adverse effects to reservoir fishery due to increased reservoir drawdowns.
Hydropower	Existing hydropower operations by city of Farmington at Navajo Dam would continue.	Reduced annual energy production. Annual hydropower replacement cost up to \$7 million.	Reduced annual energy production. Annual hydropower replacement cost up to \$3.2 million.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 Alternative	500/5000 Alternative
Diversion structures	Existing diversions protected by flood control operations and 500 cfs minimum releases from dam.	Some existing diversions need additional operation and maintenance to handle high spring releases and lower summer minimums.	Some existing diversions need additional operation and maintenance to handle high spring releases.
River water quality	Existing conditions continue or improve due to water treatment and erosion control advances.	Dilution of pollutants reduced when minimum releases occurring; additional dilution during high releases. Improved channel maintenance.	Similar to existing conditions although dry year shortages may lead to increased water quality issues. Improved channel maintenance.
Reservoir water quality	Existing conditions continue.	Existing conditions continue.	Existing conditions continue.
Socioeconomics	Adverse impacts could occur as water development, including completion of the NIIP and ALP Project, is uncertain. Employment opportunities adversely affected, but recreation-based economy maintained.	Adverse impacts on trout fishery economy and hydropower; economic benefits associated with water development will occur.	Economic benefits associated with water development occur, although reduced due to water shortages. Employment opportunities adversely affected, but recreation-based economy maintained.
Special status species	Few Flow Recommendations to conserve endangered fish met; no significant effect on other endangered species.	All Flow Recommendations to conserve endangered fish met; no significant effect on other endangered species.	Some Flow Recommendations to conserve endangered fish partially met; no significant effect on other endangered species.
River vegetation and wildlife downstream from dam	Few adverse impacts to wildlife. No adverse impacts to wetland riparian vegetation.	No major loss of riparian habitat, though long-term reduction in vegetation vigor may occur. This could reduce riparian habitat for some wildlife species.	Inconsequential effects on existing riparian vegetation and associated wildlife habitat.
Reservoir vegetation and wildlife	Less impact to existing wetland and riparian vegetation and associated wildlife habitat as compared to action alternatives.	Minimal additional impacts to wetland and riparian vegetation and associated wildlife habitat associated with greater reservoir fluctuations.	Moderate additional impacts to wetland and riparian vegetation and related wildlife habitat associated with greater reservoir fluctuations.

Table II-9—Summary comparison of alternatives retained for further analysis (continued)

Resource	No Action Alternative	250/5000 Alternative	500/5000 Alternative
Land use	Current land uses not affected by reservoir operations. Possibly no future production of Blocks 7 and 8 (10,500 acres). Possibly no development of Blocks 9 - 11 (45,630 acres) of NIIP lands.	Blocks 9 - 11 (45,630 acres) of additional irrigation land developed under NIIP. Blocks 7 and 8 (10,500 acres) would continue under production.	Possible reduction of full NIIP development.
Cultural resources	Reservoir fluctuations continue to impact cultural resources in reservoir basin.	Reservoir fluctuations impact cultural resources; impact less than No Action and 500/5000 Alternatives.	Reservoir fluctuations impact cultural resources; impact less than that of No Action but greater than that of 250/5000 Alternative.
Flood control and erosion	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs.	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs; increased frequency of releases of 5,000 cfs would cause bank erosion until river stabilized itself or banks stabilized.	Flood control operations of Navajo Dam met; maximum releases limited to 5,000 cfs; increased frequency of releases of 5,000 cfs would cause bank erosion until river stabilized itself or banks stabilized.
Operation, maintenance, and safety of dams	Operations would be within designed capability of Navajo Dam.	Operations would be within designed capability of Navajo Dam. Increased monitoring of gaging stations and more frequent release changes required.	Operations would be within designed capability of Navajo Dam. Increased monitoring of gaging stations and more frequent release changes required.
Hazardous materials	No impacts.	No impacts.	No Impacts.
Geology and soils	No impacts.	No impacts.	No impacts.
Air quality and noise	No impacts.	Increased dust due to lower reservoir levels exposing more land.	Increased dust due to lower reservoir levels exposing more land.

¹ The table presents long-term impacts. Until further water development occurs in the Basin, additional water would be available to reduce impacts to various resources including irrigation, trout fishery, and recreation; this interim water would diminish as development occurs.

² Flows have been rounded to the nearest 5 cfs.

³ Measured as a weekly average.

⁴ Model analysis does not allow releases from Navajo Dam when water surface elevations drop below 5990 feet, so 15 months of the 65 years of analysis are predicted as zero. Actual operation would implement shortage-sharing for Navajo Reservoir contractors and some flows less than 500 cfs would occur.