1.0 Proposed Federal Action and Background

The Bureau of Reclamation (Reclamation) proposes to take action to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes found in the Green and Colorado River Basins (Proposed Action). The four endangered fish species are humpback chub *(Gila cypha),* Colorado pikeminnow *(Ptychocheilus lucius),* razorback sucker *(Xyrauchen texanus),* and bonytail *(Gila elegans*). Reclamation would implement the Proposed Action by modifying the operations of Flaming Gorge Dam, to the extent possible, to achieve the flows and temperatures recommended by participants of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). Reclamation's goal is to implement the Proposed Action and, at the same time, maintain and continue all authorized purposes of the Colorado River Storage Project (CRSP).

The recommended flows and temperatures are intended to provide water releases of sufficient magnitude and, with the proper timing and duration, to assist in the recovery of the endangered fishes and their designated critical habitat. The flow and temperature recommendations for the Green River are described in the Recovery Program's September 2000 report, *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations).

1.1 Purpose of and Need for the Proposed Federal Action

The purpose of the Proposed Action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat

of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact. The Proposed Action is needed for the following reasons:

- The operation of Flaming Gorge Dam, under its original operating criteria, jeopardized the continued existence of the endangered fishes in the Green River.
- Reclamation is required to comply with the Endangered Species Act (ESA) for the operation of CRSP facilities, including Flaming Gorge Dam. Within the exercise of its discretionary authority, Reclamation must avoid jeopardizing the continued existence of listed species and destroying or adversely modifying designated critical habitat.
- The Reasonable and Prudent Alternative (RPA) to the 1992 Biological Opinion on the Operation of Flaming Gorge Dam required modification of Flaming Gorge releases to benefit the endangered fish, a 5-year study period to evaluate winter and spring flows, and reinitiation of discussions with the U.S. Fish and Wildlife Service following the study period to further refine the flow recommendations. With the results of these studies, as well as other relevant information, the Recovery Program developed and approved the 2000 Flow and Temperature Recommendations report for the Green River. These recommendations are an extension of the 1992 jeopardy Biological Opinion RPA. Reclamation committed to assist in meeting flow requirements through the refined operation of Flaming Gorge and other Federal reservoirs in the 1987 agreement that formed the Recovery Program.
- Flaming Gorge Dam and Reservoir is the primary water storage and delivery facility on the Green River, upstream of its confluence with the Colorado River. The storage capacity and ability to control water releases of Flaming Gorge Dam allow Reclamation flexibility in providing flow and temperature management to protect and assist in the recovery of endangered fish populations and their critical habitat within specific reaches of the river. Thus, the refined operation of Flaming Gorge Dam is a key element of the Recovery Program.
- The refined operation will offset the adverse effects of flow depletions from the Green River for certain Reclamation water projects in Utah, as defined by existing jeopardy Biological Opinions. Modifying the operation of Flaming Gorge Dam will also serve as the RPA, as defined by the ESA, to offset jeopardy to endangered fishes and their critical habitat that could result from the operation of numerous other existing or proposed water development projects in the Upper Colorado River Basin.

1.2 LEAD AND COOPERATING AGENCIES

Reclamation is the lead agency in preparing this environmental impact statement (EIS). The eight cooperating agencies include the Bureau of Indian Affairs, Bureau of Land Management (BLM), National Park Service, State of Utah Department of Natural Resources, U.S. Fish and Wildlife Service, United States Department of Agriculture Forest Service (USDA Forest Service), Utah Associated Municipal Power Systems, and Western Area Power Administration (Western).

1.3 CONTENTS OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS consists of five chapters:

Chapter 1 describes the purpose of and need for the proposed Federal action and provides background information, a brief history of Flaming Gorge Dam and Reservoir, a scoping summary, and applicable regulatory requirements.

Chapter 2 describes the process used to formulate alternatives, discusses the alternatives considered in detail, describes the alternatives that were considered but eliminated from detailed study, and provides a summary comparison of alternatives and impacts.

Chapter 3 describes the environment and resources that could be affected by the Proposed Action.

Chapter 4 describes and analyzes the environmental impacts of each alternative considered in detail. It also includes other considerations required by NEPA including environmental justice, the relationship between short-term uses of the environment and long-term productivity, and the assessment of irreversible and irretrievable commitment of resources.

Chapter 5 includes consultation and coordination with other Federal and State agencies and Native American tribes and the EIS distribution list.

This document also contains a list of preparers, conversion tables, glossary, and bibliography. A separate volume of technical appendices is available upon request. An executive summary is also available upon request.

1.4 BACKGROUND

Flaming Gorge Dam, located on the Green River in northeastern Utah about 200 miles northeast of Salt Lake City, is an authorized storage unit of the CRSP. Flaming Gorge Dam was completed in 1962, and full operation of the dam and reservoir began in 1967. The powerplant, located at the base of the dam, began commercial operation in 1963 and was completed in 1964. Reclamation operates the dam and powerplant, and Western markets the power.

1.4.1 Brief History of Flaming Gorge Dam and Reservoir

1.4.1.1 Authorized Uses of Flaming Gorge Dam and Reservoir: Colorado River Development

Flaming Gorge Dam was authorized for construction by the CRSP Act of 1956 (Public Law [P.L.] 84-485). The underlying project purposes are defined by Section 1 of the Act (43 United States Code [U.S.C.] Section (§) 620) that authorized the Secretary of the Interior to "construct, operate, and maintain" Flaming Gorge Dam:

> *. . . for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes . . ..*

While an incident of the other listed project purposes, power generation finances the majority of both project repayment and the irrigation component of participating projects.

Section 7 of the CRSP Act of 1956 mandates the operation of CRSP powerplants to produce ". . .the greatest practicable amount of power and energy that can be sold at firm power and energy rates. . .." However, as described in this EIS in section 1.4.3, continued Upper Colorado River Basin development of water resources is dependent on the success of the endangered fish recovery efforts, which, in turn, may affect the practicable amount of power and energy generated. This EIS analyzes these effects in sections 4.4 and 4.16.1.

In 1968, Congress enacted the Colorado River Basin Project Act (43 U.S.C. § 1501 et seq.) which provided for a program for further comprehensive development of Colorado River Basin water resources. Section 1501(a) states:

> *This program is declared to be for the purposes, among others, of regulating the flow of the Colorado River; controlling floods; improving navigation; providing for the storage and delivery of the waters of the Colorado River for reclamation of lands, including supplemental water supplies, and for municipal, industrial, and other beneficial purposes; improving water quality; providing for basic public outdoor recreation facilities; improving conditions for fish and wildlife; and the generation and sale of electrical power as an incident of the foregoing purposes.*

In addition, the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (including Flaming Gorge Reservoir) were mandated by Section 602(a) of the 1968 Colorado River Basin Project Act. Article I.(2) of the criteria requires that the Annual Operating Plan for Colorado River reservoirs ". . . shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors."

1.4.1.2 Authorized Uses of Flaming Gorge Dam and Reservoir: Flaming Gorge National Recreation Area

The Flaming Gorge National Recreation Area was established by the Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540). According to that act, the purposes of the Flaming Gorge National Recreation Area are to provide (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic, and other values contributing to enjoyment, and (3) such management, utilization, and disposal of natural resources that will promote or are compatible with and do not significantly impair the purposes for which the recreation area was established. The act added about 123,000 acres to Ashley National Forest and assigned management of the entire recreation area to the USDA Forest Service. The Flaming Gorge National Recreation Area contains 207,363 acres of land and water that are almost equally divided between Utah and Wyoming.

1.4.2 Operational Modifications Since the Beginning of Dam Operations

Construction of Flaming Gorge Dam and Powerplant began in 1956. Filling of the reservoir began in 1962 when the dam was completed. Full operation began in November 1967. Until 1984, Flaming Gorge Dam was operated to provide for a full reservoir while maximizing power generation, providing associated ancillary services, and avoiding the use of the river outlet works or the spillway. Flows fluctuated as needed to meet system power demand, with consideration given to known fish and wildlife needs.

The history of Flaming Gorge Dam operations can be divided into five phases. During the first phase, from 1962 to 1966, the reservoir was filling with water, and Green

Riverflows downstream from the dam were reduced. The first full year of normal operations began in 1967. During the second phase, from 1967 to 1978, Flaming Gorge Dam was operated with few constraints, and water releases were made through the powerplant. The only constraint on releases during phase two was in 1974 when a 400-cubic-foot-per-second (cfs) minimum release was implemented to establish and maintain the tailwater trout fishery (1974 Interim Operating Criteria). This operating agreement between the Utah Division of Wildlife Resources and Reclamation stated:

> *A minimum flow of 400 cfs will be released from the reservoir at all times. However, for the foreseeable future and under normal conditions, a continuous flow of 800 cfs will be maintained as a minimum. To the extent the available water supply will permit and is compatible with multipurpose operations of all CRSP reservoirs, minimum flows in excess of 800 cfs will be maintained to enhance the use of the river for fishing, fish spawning, and boating.*

In 1978, the dam was retrofitted with a selective withdrawal structure to improve water temperatures for the tailwater trout fishery. During the third phase, from 1979 to 1984, operations were similar to those in the previous phase except for use of the selective withdrawal structure and the occurrence of spills in 1983 and 1984.

During the fourth phase, from 1985 to 1992, Reclamation began to constrain the operation of Flaming Gorge Dam to reduce negative impacts affecting endangered fishes in the Green River. Such constraints reduced operational flexibility and the ability to fluctuate flows to meet power system demands. In 1985, an interim flow agreement was established between Reclamation and the U.S. Fish and Wildlife Service to change Flaming Gorge Dam releases to protect critical nursery habitats for endangered fishes in the Green River downstream from Jensen, Utah. The recommended releases were based on observations made in 1985 that indicated "good" habitat conditions were available at lower flows. Reclamation also revised operational criteria at the dam to avoid spills. These changes were in place in the fourth phase, along with numerous research releases to support preparation of the Final Biological Opinion on the Operation of Flaming Gorge Dam issued on November 25, 1992. Significant financial impacts to hydropower generation, identified in section 4.16.2, occurred mainly as a result of flow changes implemented during this fourth phase.

In the fifth phase, from 1993 to present, Reclamation began making releases from Flaming Gorge Dam in an attempt to meet the flow and temperature recommendations given in the 1992 Biological Opinion. Flows recommended in the 1992 Biological Opinion were intended to restore a more natural hydrograph and protect nursery habitats of endangered fishes downstream from the Yampa River confluence. At the same time, Reclamation continued to meet the authorized purposes of Flaming Gorge Dam—regulating flows of the Green River, storing water, facilitating States' development of water resources, providing recreational opportunities, generating hydroelectric power, and improving conditions for fish and wildlife.

The Green River flows recommended in the 1992 Biological Opinion were based on the most reliable scientific data available at the time. The opinion included several actions Reclamation could take to avoid jeopardizing the recovery of endangered fishes in the Green River. One of these actions was to collect more information about the flow and temperature needs of the endangered fishes and, subsequently, to refine or modify the flow and temperature recommendations of the 1992 Biological Opinion. A 5-year research study began in 1992, and the resulting data and refinements were included in the 2000 Flow and Temperature Recommendations. The study included

periodic test flows to evaluate the effects of summer flows on endangered fishes or to test specific hypotheses.

1.4.3 Compliance With the Endangered Species Act

To comply with the ESA, an evaluation of the effects of any discretionary Federal action must be conducted by the action agency in consultation with the U.S. Fish and Wildlife Service.

During the late 1970s and early 1980s, the U.S. Fish and Wildlife Service rendered Jeopardy Biological Opinions for the Upalco, Jensen, and Uinta Units of the Central Utah Project stating that all relied on the operation of Flaming Gorge Dam to provide flows for endangered fishes. More recent Biological Opinions for the Duchesne River Basin, Narrows Project, Price-San Rafael Salinity Control Project, and other water development-related projects in the Colorado River Basin also rely on the operation of Flaming Gorge Dam to provide flows for endangered fishes.

On February 27, 1980, the U.S. Fish and Wildlife Service requested consultation under Section 7 of the ESA for projects currently under construction in the Upper Colorado River Basin and for the continued operation of all existing Reclamation projects in the basin (including the CRSP). Formal consultation on the operation of Flaming Gorge Dam began March 27, 1980. Issuance of a Final Biological Opinion by the U.S. Fish and Wildlife Service for the operation of Flaming Gorge Dam was delayed until data collection and studies related to habitat requirements for the endangered fishes could be completed and used to recommend specific flows in the Green River downstream from the dam. Dam operations were initially evaluated for potential effects on endangered fishes from 1979 to 1984. Reclamation served as the lead agency for this consultation, with Western becoming a party to the consultation in 1991.

Additionally, on February 27, 1980, the U.S. Fish and Wildlife Service issued a Final Biological Opinion for the Strawberry Aqueduct and Collection System, a major feature of the Central Utah Project. The Biological Opinion determined that Strawberry Aqueduct and Collection System flow depletions from the Duchesne and Green Rivers would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub. This Biological Opinion included a Reasonable and Prudent Alternative stating that Flaming Gorge Dam and Reservoir would compensate for those depletions and be operated for the benefit of the endangered fishes in conjunction with its other authorized purposes.

Both the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations were designed to account for the impacts of depletions mentioned above. The 2000 Flow and Temperature Recommendations as implemented under the Action Alternative would offset the impacts of water depletions on these other projects.

1.4.4 Upper Colorado River Endangered Fish Recovery Program

The Recovery Program was initiated in 1987 as a cooperative effort among the States of Utah, Colorado, and Wyoming; environmental and water user organizations; Federal agencies including the National Park Service, Reclamation, U.S. Fish and Wildlife Service, and Western; and the Colorado River Energy Distributors Association. The goal of the Recovery Program is to protect and recover the endangered fish species of the Upper Colorado River Basin so they no longer need protection under the ESA, while the Upper Basin States continue to develop their 1922 Colorado River Compact entitlements.

Under the Recovery Program, five key elements are needed to recover the endangered fish species: (1) habitat

management; (2) habitat development/ maintenance; (3) native fish stocking; (4) nonnative species and sport fish management; and (5) research, data management, and monitoring. The operation of Flaming Gorge Dam is essential to successful implementation of two of these five elements: habitat management and habitat development/maintenance. Operation of the dam is one of many management actions described in the 1993 Recovery Implementation Program Recovery Action Plan (Recovery Action Plan). The plan is periodically revised to accommodate programmatic Biological Opinions and annual updates as well as the designation of critical habitat for the endangered fishes. Implementation of all Recovery Action Plan recommendations is expected to achieve recovery of the endangered fishes.

1.4.5 Final Biological Opinion on the Operation of Flaming Gorge Dam and the Reasonable and Prudent Alternative

The U.S. Fish and Wildlife Service issued a Final Biological Opinion on the Operation of Flaming Gorge Dam on November 25, 1992, stating that the current operation of Flaming Gorge Dam was likely to jeopardize the continued existence of the endangered fishes in the Green River. The opinion also described elements of an RPA that, in the opinion of the U.S. Fish and Wildlife Service, would offset jeopardy to the endangered fishes. The RPA required implementing the following five elements:

(1) Refining the operation of Flaming Gorge Dam so flow and temperature regimes of the Green River more closely resemble a natural hydrograph.

(2) Conducting a 5-year research program, including implementation of winter and spring research flows, beginning in 1992, to allow for potential refinement of flows for those seasons. The research program was to be based on the Flaming Gorge Flow Recommendations Investigation and called for annual meetings to refine seasonal flows consistent with research findings and water year forecasts. Except for specific research flows during the 5-year research program, year-round flows in the Green River were to resemble a natural hydrograph described under element 1 of the RPA.

(3) Determining the feasibility and effects of releasing warmer water during the late spring/summer and investigating the feasibility of retrofitting the river bypass tubes to include power generation, thereby facilitating increased spring releases.

(4) Legally protecting Green River flows from Flaming Gorge Dam to Lake Powell.

(5) Initiating discussions with the U.S. Fish and Wildlife Service, after conclusion of the 5-year research program, to examine further refinement of flows for the specified endangered Colorado River fishes.

1.4.6 2000 Flow and Temperature Recommendations

The research program called for in the 1992 Biological Opinion concluded in 1996. At that time, the Recovery Program funded a synthesis of research and development of flow and temperature recommendations for the Green River. The final synthesis report, which contained the 2000 Flow and Temperature Recommendations for endangered fishes in the Green River downstream from Flaming Gorge Dam, provided the basis for Reclamation's Action Alternative analyzed in this EIS and for additional Section 7 consultation by Reclamation and Western with the U.S. Fish and Wildlife Service.

1.5 OPERATIONAL DECISIONMAKING PROCESS AT FLAMING GORGE DAM

The process of developing an operational plan for Flaming Gorge Dam takes into consideration all resources associated with Flaming Gorge Dam identified by the Flaming Gorge Working Group. The Flaming Gorge Working Group was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operation of Flaming Gorge Dam. Among others, these interests include power marketing, sport fisheries, endangered species, white water rafting, farming, land ownership, reservoir recreation, national park resources, land management, and wildlife refuge management.

The Flaming Gorge Working Group generally meets twice a year (April and August/ September). These meetings are open to the public, and participants are encouraged to comment. Operational decisions are not made during the Flaming Gorge Working Group meetings; rather, these meetings are a forum for information exchange about past, current, and proposed operations at Flaming Gorge Dam. They also serve as a forum through which stakeholders can share information about specific resources of interest and the relationship between the operation of Flaming Gorge Dam and these resources. The Flaming Gorge Working Group provides input to Reclamation as well as educating various constituencies on operations at Flaming Gorge Dam.

Reclamation has sole responsibility for operations at Flaming Gorge, although the needs and expectations of stakeholders are considered in operational planning. Reclamation's priorities are first, dam safety, and then second, meeting project purposes in compliance with ESA. When conflicts in operations arise, Reclamation's approach to conflict resolution and decisionmaking includes accepting input from all stakeholders and formulating a strategy that meets the most needs possible consistent with these established priorities.

Operational decisions for Flaming Gorge Dam are made through the Colorado River Annual Operating Plan process. A document, called the *24-Month Study*, is produced monthly and contains planned monthly releases from all CRSP reservoirs. In the 24-month study, reservoir inflows are revised to reflect forecasted inflow from the National Weather Service. These forecasted inflows are input into the 24-Month Planning Model. Planned releases from Flaming Gorge are adjusted monthly to reflect changing hydrology, to meet the requirements of the ESA, and to meet CRSP authorized purposes.

Reclamation continually coordinates release schedules with Western. Occasionally, Western will request that Reclamation consider modifying scheduled releases at Flaming Gorge Dam due to power market conditions. Reclamation considers all requests from Western for modified releases. Requests for modified operations by Western are usually met, although it is common for Reclamation and Western to negotiate a compromise solution that may alleviate pressure on other resources. The operation of the selective withdrawal structure, which affects release temperature, is coordinated among Reclamation, the U.S. Fish and Wildlife Service, and the Utah Division of Wildlife Resources.

Reclamation communicates with the U.S. Fish and Wildlife Service as release schedules are adjusted. Such communication generally takes place when proposals for modified releases are made by Western or when other requests are made for release modifications, including test flows for biological studies. Communication and coordination with the U.S. Fish and Wildlife Service also takes place each spring when peak releases, as required in the 1992 Biological Opinion, are set. Consultation between Reclamation and the U.S. Fish and Wildlife Service is

necessary when releases outside of the RPA of the 1992 Biological Opinion are required.

The 1992 Biological Opinion constrains releases at Flaming Gorge Dam in the summer and fall so that the Green River near Jensen, Utah, (106 river miles below the dam) does not deviate by more than 12.5 percent (%) of the daily average flow for the day. This constraint reduces the magnitude of hour-to-hour fluctuations at Flaming Gorge Dam during the summer and fall. Historically since 1992, hour-to-hour fluctuations have generally been maintained at about 800 cfs per hour with a single peak per day. However, there are no formalized constraints that require this.

The 1992 Biological Opinion states that "the goal for winter releases is to provide low, stable, flows near historic levels." While no formal ramping criteria has been established for the winter and spring, the guideline the past few years has been to use the plus or minus 12.5% constraint at Jensen, Utah, for the winter and spring seasons, as well as the summer and fall, to meet the stated requirement of the 1992 Biological Opinion to provide low stable flows in the winter.

Annually, the Utah Division of Wildlife Resources requests a steady 1,600-cfs release in the late afternoon and early evening hours on 2 consecutive days to conduct electro-fishing as part of its ongoing tailwater assessment. Requests for short-term modifications in releases have also come from the USDA Forest Service for search and rescue efforts and for removal of boats wedged in rocks. A variety of other requests are often received and accommodated if they are reasonable, necessary, and do not interfere with dam safety, other authorized project purposes, or operations for ESA compliance.

1.6 EMERGENCY POWERPLANT OPERATIONS

Normal dam and powerplant operations under the Action Alternative or any other alternative could be altered temporarily to respond to emergencies. These emergencies may be associated with dam safety, power system conditions, or personal safety of individuals or groups associated with recreation or other activities on the river. The North American Electrical Reliability Council and the Western Electricity Coordinating Council have established guidelines and requirements for emergency operations of interconnected power systems that apply to Flaming Gorge Dam operations and may account for changes outside of those identified in descriptions of the alternatives. These changes in operations are intended to be of short duration as a result of emergencies at the dam or within the transmission network.

To reduce the impact to individual powerplants and transmission lines responding to system emergencies, Reserve Sharing Groups are organized among electric utilities to share resources. The CRSP resources are included in the Rocky Mountain Reserve Sharing Group and the Southwest Reserve Sharing Group under Western's membership. The sharing of resources reduces the amount of generation each CRSP powerplant would otherwise be obligated to provide as well as giving flexibility to respond to the emergency. The North American Electrical Reliability Council provides operating policies for system emergencies, of which several examples are given here.

1.6.1 Insufficient Generation Capacity

A control area is a geographical area comprised of an electric system or systems, interconnected together by transmission lines

that is capable of controlling generation within the control area to maintain its interchange schedule with other control areas and that contributes to frequency regulation of the interconnection. When a control area has an operating capacity emergency, it must promptly balance its generation and interchange schedules to its load, without regard to financial cost, to avoid prolonged use of assistance provided by the interconnected power system. The emergency reserve inherent in frequency deviation is intended to be used only as a temporary source of emergency energy and must be promptly restored so the interconnected systems can withstand the next contingency. A control area unable to balance its generation and interchange schedules to its load must remove sufficient load to permit correction of its Area Control Error.

If a control area anticipates an operating capacity emergency, it must bring on all available generation, postpone equipment maintenance, schedule interchange purchases well in advance, and prepare to reduce load.

An example of insufficient generation capacity and the appropriate response could be as follows: if any coal-fired powerplant in Western's load control area was unexpectedly lost, the response would be an increase in CRSP generation or imports to compensate for the change in anticipated generation within the control area.

1.6.2 Transmission (Overload and Voltage Control)

If a transmission facility becomes overloaded or if voltage levels are outside of established limits and the condition cannot be relieved by normal means (such as adjusting generation or interconnection schedules), and a credible contingency under these conditions would adversely impact the interconnection, appropriate relief measures, including load shedding, are implemented promptly to return the transmission facility to within established limits. This action is taken by the system, control area, or pool causing the problem if it can be identified or by other systems or control areas, as appropriate, if identification cannot be readily determined.

An example of a response to an overloaded transmission system could be automatic relay tripping and taking a transmission line out of service or an increase in generation depending on the location of the overloaded transmission line. This action could cause Flaming Gorge Powerplant generation to be reduced or increased instantaneously to a predetermined level, based on the capacity or location of the line taken out of service.

1.6.3 Load Shedding

After taking all other steps, a system or control area, whose integrity is in jeopardy due to insufficient generation or transmission capacity, sheds customer load (i.e., disconnecting a load to an industrial facility or a section of a community) rather than risk an uncontrolled failure of interconnection components.

1.6.4 System Restoration

After a system collapse, restoration begins when it can proceed in an orderly and secure manner. Systems and control areas coordinate their restoration actions. Restoration priority is given to the station supply of powerplants and the transmission system. Even though the restoration should be expeditious, system operators avoid premature action to prevent a re-collapse of the system. Customer load is restored as generation and transmission equipment becomes available, while keeping load and generation in balance at normal frequency as the system is restored.

1.6.5 Emergency Information Exchange

A system control area or pool experiencing or anticipating an operating emergency communicates its current and future status to neighboring systems, control areas, or pools and throughout the interconnection. Systems able to provide emergency assistance make known their capabilities.

1.6.6 Special System or Control Area

Because the facilities of each system may be vital to the interconnection's secure operation, systems and control areas make every effort to remain connected. However, if a system or control area determines that it is endangered by remaining interconnected, it may take action as necessary to protect its system.

If a portion of the interconnection becomes separated from the remainder of the interconnection, abnormal frequency and voltage deviations may occur. To permit re-synchronizing, relief measures could be applied by those separated systems contributing to the frequency and voltage deviations.

An example of when the Flaming Gorge Powerplant might limit its response to the interconnected system would be during a search and rescue operation in the canyon where a need to control the releases exists.

Although emergency situations are infrequent, they do occur and require immediate, short-term changes in powerplant and dam operation. In general, changes resulting from emergencies at Flaming Gorge would result in decreases in flows while emergencies in the system away from the dam could result in either an increase or decrease in flows.

1.7 PUBLIC SCOPING PROCESS FOR THIS ENVIRONMENTAL IMPACT STATEMENT

The scoping process for the Operation of Flaming Gorge Dam EIS was initiated on June 6, 2000, to receive public comment to help determine the appropriate scope of the Flaming Gorge Dam EIS, consistent with requirements of the National Environmental Policy Act (NEPA). The formal scoping period ended on September 5, 2000. Scoping for this EIS was conducted for the following purposes:

- To identify relevant issues associated with the Proposed Action and its purpose and need.
- To help identify the geographic scope of the EIS—that is, how far upstream/downstream from the dam can impacts be meaningfully evaluated.
- To identify resources that may be affected by the Proposed Action.
- To identify the interested public or parties affected by the Action Alternative.
- To assist Reclamation in developing reasonable alternatives that are consistent with the purpose of and need for the Proposed Action.

A Notice of Intent to prepare a draft EIS and announcement of public scoping meetings was published in the *Federal Register* on June 6, 2000. A corresponding press release announcing that Reclamation was beginning the EIS process for Flaming Gorge Dam was issued the same date.

Public scoping meetings were held in July 2000 in Salt Lake City, Vernal, and Fort Duchesne, Utah; Grand Junction, Colorado; and Rock Springs, Wyoming. A total of 186 attendees registered at the five public scoping meetings, and verbal comments were received from 55 people.

In addition to the verbal comments provided at the five public scoping meetings, Reclamation received 175 form letters, 510 e-mail messages, signed petitions with a total of 1,476 signatures, and 40 letters and postcards from individuals and organizations. During the scoping process, the Forest Supervisor of the Ashley National Forest sent the Area Manager of Reclamation's Provo Area Office a position paper for the EIS (Forest Service Position Paper Appendix). The comments from each oral presentation and each written statement were separated according to the particular issue or resource of concern and placed into appropriate categories. A total of 2,270 separate comments were derived from all of the comments received.

1.8 SCOPE OF ANALYSIS FOR THIS ENVIRONMENTAL IMPACT STATEMENT

The purpose of this EIS is to identify and consider the impacts of developing and implementing dam operations guidelines that result in protecting and assisting in the recovery of the populations and designated critical habitat of the four endangered fishes living in the Green River downstream from Flaming Gorge Dam. The scope of analysis for this EIS will focus on responding to the following question:

> If Reclamation operates Flaming Gorge Dam to achieve the 2000 Flow and Temperature Recommendations needed to avoid jeopardy and protect and assist in the recovery of the endangered fishes and their critical habitat in the Green River, consistent with CRSP purposes, then the effect(s) on other relevant resources/issues, both upstream and downstream from the dam, would be . . .

1.8.1 Geographic Scope of Analysis for This Environmental Impact Statement

The geographic area analyzed for possible impacts of the Proposed Action and alternatives includes Flaming Gorge Reservoir and the Green River downstream from Flaming Gorge Dam, to its confluence with the Colorado River. Because the Proposed Action depends exclusively on the operation of Flaming Gorge Dam, which is dependent on inflow into the Flaming Gorge Reservoir, the Green River upstream of the reservoir is not affected. Please see the maps in the front of this document for a visual representation of the project area, including landmarks referenced throughout the EIS.

1.8.2 Public Issues and Concerns

Based upon scoping results, discussions with interested parties, and existing laws and regulations, Reclamation identified the following resources, issues, or concerns as potentially relevant to this EIS:

- Aquatic resources
- Biodiversity
- Cultural resources
- Disease vectors (mosquitoes)
- EIS/NEPA process (Proposed Action, purpose and need, scope, and alternatives)
- Environmental justice (potential impacts to low-income or minority populations)
- Facilities (dam and powerplant operation and maintenance and dam safety)
- Fish and wildlife (other than threatened and endangered species)
- Hydroelectric power generation and marketing
- Indian trust assets

- Land use (agriculture, national parks)
- Reservoir limnology
- Riparian/wetlands
- River and reservoir fisheries
- River and reservoir recreation
- Socioeconomics (tourism-related jobs and income)
- Threatened and endangered species
- Water (conservation, drought, flood control, riverflows, water quality, water rights, water safety, water supply, water temperature, and water use)

Other potentially relevant resources, issues, or concerns may be identified during the process of completing this EIS and would be considered and analyzed as appropriate.

1.8.3 Resources and Significant Issues to Be Analyzed in Detail

The necessary framework to describe the affected environment and assess impacts was provided by several recent EISs, the studies resulting from the U.S. Fish and Wildlife Service's 1992 Biological Opinion, and other recent resource studies. Reclamation has used the best available data in preparing this draft EIS.

The EIS team consolidated and refined the issues of concern to the public and Federal, State, and tribal governments, identifying the resources and their significant issues to be analyzed in detail. The terms "resource issue" and "resource indicator" as used in this EIS are defined below:

Resource Issue: An effect or perceived effect, risk, or hazard on a physical, biological, social, or economic resource within the affected environment.

Resource Indicator: A quantification (measurement) of any environmental consequence arising from the implementation of 2000 Flow and Temperature Recommendations, which would indicate the presence of certain environmental conditions.

The following presentation summarizes the issues and resource indicators used to measure the impacts of the alternatives.

Issue 1

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **fish**—their life cycles, habitat, and ability to spawn?

Indicators

Status and condition of the **aquatic food base**

Reproduction, recruitment, and growth of **native fish**

Reproduction, recruitment, and growth of **nonnative fish** (including trout)

Level of interactions between **native and nonnative** fish

Issue 2

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect cultural resources in the study area?

Indicators

Number of **sites** directly, indirectly, or potentially affected

Number of **Native American traditional cultural properties and resources** directly, indirectly, or potentially affected

Issue 3

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **paleontological resources** in the study area?

Indicators

Number of **paleontological resources** directly, indirectly, or potentially affected

Issue 4

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect disease **vectors** (particularly mosquitoes) in the study area?

Indicators

Area and frequency of **flooded bottomlands**

Issue 5

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **environmental justice** in the area?

Indicators

Proportion of affected minority populations and low-income populations

Issue 6

How would operating Flaming Gorge Dam to meet 2000 Flow and Temperature Recommendations affect **operation and maintenance** of the dam and powerplant, and would there be any impacts to **dam safety**?

Indicators

Operational limitations, types and frequency of **maintenance, costs, and hazards**

Issue 7

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **any Indian trust assets**?

Indicators

Leases or rights-of-use for lands, minerals, water rights, hunting and fishing rights, other natural resources, money, or claims

Issue 8

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **recreation** in the study area?

Indicators

River and reservoir **visitation**

River and reservoir **economic value**

River and reservoir **recreation safety**

Issue 9

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **vegetation** in the river corridor?

Indicators

Condition of vegetation and species composition of **wetlands**

Condition of vegetation and species composition of **riparian habitat**

Distribution and establishment of **invasive species**

Issue 10

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **wildlife (other than endangered species)** in the river corridor?

Indicators

Quality and composition of **woody and emergent marsh plants** for wildlife habitat

Abundance of **aquatic food base** for wintering waterfowl

Issue 11

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **land uses** in the area?

Indicators

Acres for **farming or ranching**

Mineral rights accessibility

Recreation uses

Issue 12

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the ability of Flaming Gorge Powerplant to supply **hydropower** at the lowest possible cost?

Indicators

Power operations flexibility

Power marketing resources, costs, and rates

Issue 13

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **sediment** resources throughout the study area?

Indicators

Contraction or expansion of **debris fans and rapids**

Riverbank erosion or aggradation

Sandbar development

Issue 14

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **threatened and endangered species** in the area?

Indicators

Reproduction, recruitment, and growth of the **Colorado pikeminnow, humpback chub, and razorback sucker**

Quality, condition, and use of habitat for the **southwestern willow flycatcher**

Distribution and abundance of **Ute ladies'-tresses**

Issue 15

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **amount and quality of water** in and available from Flaming Gorge Reservoir at specific times?

Indicators

Acre-feet of **streamflows**

Frequency of volume of **floodflow and other spills**

Acre-feet of **reservoir storage**

Chemical, physical, and biological characteristics of **water quality**

Issue 16

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **visual resources**?

Indicators

USDA Forest Service **visual resource** management goals

Issue 17

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **sport fishery** in the Green River?

Indicators

Reproduction, recruitment, growth, body condition, and population size

Issue 18

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **socioeconomics**?

Indicators

Regional economic activity (**output, employment, income**)

1.8.4 Issues Raised During Scoping Which Are Not Analyzed in Further Detail in This EIS

During the scoping process for this EIS, concerns were expressed regarding how the Proposed Action might affect water rights. A review of the hydrology modeling of both alternatives confirms that neither operational alternative would affect water rights within the context of the authorized purposes of Flaming Gorge Dam.

1.9 RELATED AND ONGOING ACTIONS

This section describes laws and projects that affect the operation of Flaming Gorge Dam and may affect the potential impacts of the Proposed Action. Where applicable, these laws and projects are factored into the analysis of potential impacts under both alternatives, particularly the Cumulative Impacts analysis (section 4.16).

1.9.1 Regulatory Requirements

Federal statutes establish a number of responsibilities for the Secretary of the Interior. These legislated responsibilities relate to the management of numerous agencies, projects, and lands, all or some relating to the operation of Flaming Gorge Dam. In some cases, the statutes specifically require the Secretary of the Interior to mandate responsibility for management of reservoirs; while in others, the statutes allow the Secretary of the Interior to grant discretionary authority.

1.9.1.1 The Law of the River

As a tributary of the Colorado River, the Green River is managed and operated according to a collection of over 50 compacts, Federal and State laws, court decisions and decrees, contracts, treaties, and regulatory guidelines collectively known as the Law of the River. This collection of documents apportions the water among the seven Basin States and Mexico, and regulates and manages riverflows. Some of the statutes included within the Law of the River having a major impact on dam operations are the Colorado River Compact of 1922, the Upper Colorado River Basin Compact of 1948, the Colorado River Storage Project Act of 1956 which authorized a comprehensive water development plan for the Upper Basin that included the construction of Flaming Gorge Dam, and the Colorado River Basin Project Act of 1968.

1.9.1.2 National Parks and Recreation Areas

The affected environment for this EIS includes portions of Flaming Gorge National Recreation Area, Dinosaur National Monument, and Canyonlands National Park. Enabling legislation for these units includes:

- Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540)
- Antiquities Act of 1906, 16 U.S.C. 431-433. The Dinosaur National Monument was originally designated by President Wilson in October 1915 and was enlarged by President Roosevelt in 1938.

Management authorities include:

- National Park Service Organic Act (16 U.S.C. 1-4, 22, 43)
- National Park Service General Authorities Act of 1970 (16 U.S.C. 1a-1)
- Redwood National Park Act of 1978 (P.L. 95-250, 92 Statute 163, as amended)

1.9.1.3 Environmental Compliance

Laws and Executive orders that were designed to restore and protect the natural environment of the United States relating to air, water, land, and fish and wildlife include the following:

- National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- Endangered Species Act of 1973 (16 U.S.C. 1532 et seq.)
- Wilderness Act of 1964 (16 U.S.C. 1131 et seq.)
- Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 et seq.)
- Clean Air Act (42 U.S.C. 7401 et seq.)
- Clean Water Act of 1972 (33 U.S.C. 1251 et seq.)
- Executive Order 11988, Floodplain Management, 1977
- Executive Order 13112, Invasive Species, 1999
- Executive Order 11990, Protection of Wetlands, 1977

1.9.1.4 Cultural Resource Laws

Laws designed to protect and preserve historic and cultural resources under Federal control include the following:

- National Historic Preservation Act (16 U.S.C. 470 et seq., 1966)
- Archaeological Resources Protection Act (16 U.S.C. 470aa et seq., 1974)

1.9.1.5 Native American Laws

Laws and policies relating to Native American consultation include the following:

- American Indian Religious Freedom Act (42 U.S.C. 1996, 1973)
- Enhancing the Intergovernmental Partnership, Executive Order 12875 of October 26, 1993 [58 *Federal Register* 58093]
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)
- Consultation and Coordination with Indian Tribal Governments, Executive Order 13084 of May 14, 1998
- Protection of Indian Sacred Sites, Executive Order 13007 of May 24, 1996 [61 *Federal Register* 26771]

1.9.2 Related Programs, Projects, and Activities

1.9.2.1 Recovery Program

As discussed in section 1.4.4, the Recovery Program's goal is to protect and recover the endangered fish of the Upper Colorado River Basin. The Recovery Program has a variety of programs and projects underway, concerning habitat acquisition or enhancement, levee removal, nonnative fish control, and native fish stocking, aimed at achieving that goal. The Proposed Action for which this EIS has been prepared—operating Flaming Gorge Dam as specified in the Recovery Program's 2000 Flow and Temperature Recommendations—would

complement the other Recovery Program activities in moving toward endangered fish recovery.

1.9.2.2 Interim Surplus Guidelines and Colorado River Basin Project Act 602(a) Storage Requirement

Flaming Gorge is part of the Colorado Basin and is indirectly affected by decisions made under the December 2000 Colorado River Interim Surplus Guidelines Final Environmental Impact Statement. However, the effects are not measurable. In addition, Reclamation is currently preparing an environmental assessment on a proposed guideline to be used to determine the amount of upper basin water required under Section 602(a) of the Colorado River Basin Project Act. This guideline could affect operations at Lake Powell but most likely would not influence operations at Flaming Gorge.

1.9.2.3 Relocation of Little Hole National Recreation Trail

The 7.2-mile segment of the Little Hole National Recreation Trail along the Green River between the Flaming Gorge Dam Spillway Recreation Complex (boat ramp launching and parking area) and Little Hole Recreation Complex (boat ramps, parking, and day use areas) will be relocated by the USDA Forest Service pending funding to prevent reoccurring trail damage and loss that has occurred from past high flows. Without relocation of the trail, further damage would be expected to occur under both the No Action and Action Alternatives.

This 7.2-mile trail segment provides access to the Green River for tens of thousands of annual visitors who participate in shore and boat fishing, scenic and recreational floating, hiking, and sightseeing activities. Several commercial operators also use the trail as part of their outfitting and guiding business. Annual trail use has ranged from 54,000 to 101,000 visitors over the past 11 years. Annual visitation numbers, types, and the economic value of uses along the trail are discussed and displayed in section 3.11 of this EIS.

The USDA Forest Service completed a field assessment and report in July 2001 of trail locations along the 7.2-mile trail segment. This assessment identified trail damage and repairs that have occurred from 1979 to the present due to releases from the dam, either in response to extremely wet hydrologic years or to support endangered fish research studies. The assessment also addressed alternative trail designs, locations, and costs that would prevent recurring trail damage and loss. Depending on alternative trail locations, the design and construction cost estimates ranged from $135,000 to $308,000. The USDA Forest Service will evaluate and analyze the alternative trail designs and locations as part of a separate NEPA process and document. In addition, the USDA Forest Service will evaluate and analyze the designs and plans for reconstruction of other ramps, picnic sites, and campsites affected during high releases along the Green River. Such facilities will also be relocated pending funding. The USDA Forest Service environmental document will tier to the EIS for the operation of the Flaming Gorge Dam, as appropriate, relating to environmental, social, and economic resources and issues.

The USDA Forest Service, Reclamation, and other concerned Federal and State agencies will cooperate during the preparation of the referenced environmental document for the relocation of the trail and related facilities to assure that issues are addressed for the operation of the dam, riverflows, user safety, and protection of natural and physical resources. Reclamation will support the USDA Forest Service in obtaining funding through the USDA Forest Service budgeting process that will be needed to complete the USDA Forest Service environmental document and the relocation of the trail and related facilities.

1.9.2.4 Browns Park Highway Environmental Impact Statement

An EIS is currently being prepared for a Daggett County, Utah, proposal to realign and pave Browns Park Road from its junction with U.S. 191 in Utah to Colorado Route 318. The existing, unpaved 16.8-mile long segment of road crosses BLM, State, and private lands. Scoping meetings were held by the Federal Highway Administration, Utah Department of Transportation, and BLM in December 1999.

1.9.2.5 Resource Management Plans

The BLM Vernal Field Office is preparing to scope the draft resource management plan (RMP)/EIS for approximately 1.8 million acres in northeastern Utah. This plan, known as the Vernal Resource Management Plan, will combine the existing Diamond Mountain and Book Cliffs RMPs into a single plan. The final EIS is scheduled to be completed in March 2005.

The Ashley National Forest began revisions in March 2004 of its Land and Resource Management Plan, commonly referred to as Forest Plan. The process for revision of this plan, including NEPA compliance, is expected to take 4 to 5 years.

1.9.2.6 Federal Reserve Water Rights

Canyonlands National Park and Dinosaur National Monument have incomplete Federal water rights to the Green River. However, the National Park Service is not actively working with the State of Utah to quantify those rights. Future plans for quantification are uncertain.

2.0 Description of Alternatives

2.1 INTRODUCTION

This chapter describes the two alternatives analyzed in detail in this environmental impact statement (EIS), the No Action Alternative and the Action Alternative. This chapter also explains the criteria for selecting alternatives and discusses alternatives that were considered but not analyzed in detail.

Based on descriptions of the relevant resources in **Chapter 3.0, Affected Environment**, and the predicted effects of the alternatives in **Chapter 4.0, Environmental Consequences**, this chapter also presents a summary comparison of the predicted environmental effects of both alternatives on the quality of the human environment in section 2.6.

Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended by the 1992 Biological Opinion on the Operation of Flaming Gorge Dam. Depending upon the hydrologic conditions of the upper Green River Basin, forecasted flows on the Yampa River would be supplemented by releases from Flaming Gorge Dam designed to achieve the peak flow, duration, and base flow (riverflows not associated with snowmelt runoff) recommendations described in the 1992 Biological Opinion.

Under the Action Alternative, Flaming Gorge Dam would be operated with a goal of achieving the flow and temperature regimes recommended in the September 2000 *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) report, prepared by participants of the Upper Colorado River Endangered Fish Recovery Program

(Recovery Program). The 2000 Flow and Temperature Recommendations specifically describe the peak flows, durations, water temperatures, and base flow criteria necessary for the recovery of the endangered fishes. The Action Alternative is the operational strategy that is in accord with these flow and temperature criteria and the authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project.

2.2 DEVELOPMENT OF ALTERNATIVES

2.2.1 Criteria Used to Select Alternatives

Potential alternatives to be analyzed in this EIS were studied to determine whether they could meet the purpose of and need for the Proposed Action. A number of scenarios for dam operation, originally thought to be viable alternatives, were determined to be more accurately described as possible subsets of the Action Alternative. Because of the inherent need for operational flexibility in dam operations, as acknowledged by and incorporated into the 2000 Flow and Temperature Recommendations, and because any potential impacts from discreet operational scenarios are already captured by analysis of the Action and No Action Alternatives, it was determined that analyzing subtle differences in dam operations as separate alternatives would not yield meaningful information for the public or the decisionmaker.

Alternatives that are included in this analysis are those which both:

- Meet flow and temperature recommendations as described in the 2000 Flow and Temperature Recommendations.
- Maintain all authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project (CRSP).

2.2.2 Alternatives Considered but Eliminated From Detailed Study

In accordance with Section 1502.14 (a) of the Council on Environmental Quality regulations implementing the National Environmental Policy Act, this section discusses alternatives that were considered but eliminated from detailed study, and briefly explains the reasons for their elimination.

2.2.2.1 Modified Run of the River Alternative

During the scoping process, the National Park Service and others requested consideration of a Run of the River Alternative. Under such an alternative, dam releases would match the reservoir inflow (unregulated) to provide a more natural flow regime including more natural variations in the daily flows of the Green River below Flaming Gorge Dam. Further analysis of this alternative led to the establishment of a Modified Run of River Alternative, where dam releases equaled 87 percent (%) of the unregulated inflow to the reservoir. This provided reservoir operators the ability to store 13% of the spring inflow volume for release to meet project purposes and flow recommendations at other times of the year. The 87% level was chosen because it was the highest percentage that provided enough water storage to achieve the base flow ranges recommended in the 2000 Flow and Temperature Recommendations. Percentages higher than 87% could not achieve the recommended base flows of the 2000 Flow and Temperature Recommendations.

Preliminary analysis of the historic inflows into Flaming Gorge did show that it might be possible to operate Flaming Gorge using a "Modified Run of River" approach to achieve the 2000 Flow Recommendations during the

spring. However, it was learned through this study that the effect of water consumption above Flaming Gorge played a much more significant role than was originally thought. The Flaming Gorge model did account for the inevitability that water consumption will increase in the future. The Consumptive Uses and Losses Report, published by Reclamation, estimates that current water consumption above Flaming Gorge Reservoir is about 450,000 acre-feet per year. This is about 25% of the mean annual unregulated inflow into Flaming Gorge Reservoir. In addition to the level of water consumed, irrigation diversions, which are not entirely consumed, occur most often during the months of May through August. While irrigation diversions are not usually completely consumed, there tends to be a lag period before the water returns to the river. Sometimes this lag period can be as long as several months. Water consumption and diversions can significantly decrease the unregulated inflow peaks that occur during the spring. As a result, the "Modified Run of River" approach released less water than would have been released under natural conditions. For this reason, the "Modified Run of the River" could not achieve the spring flow objectives of the 2000 Flow and Temperature Recommendations.

Water consumption on the Green River has an ever increasing effect on the inflows (and unregulated inflows) to Flaming Gorge Reservoir. Consequently, water consumption will further complicate Reclamation's ability to achieve the 2000 Flow and Temperature Recommendations in the future. This modeling study indicated that, in the case of a "Modified Run of River" approach for operating Flaming Gorge Dam, the current level of water consumption in the Green River Basin already makes it too difficult to achieve the 2000 Flow and Temperature Recommendations without having significant negative impacts on the other resources associated with Flaming Gorge Reservoir. Based on these findings, the "Modified Run of River" approach was not considered a viable alternative that could be included for analysis in the Flaming Gorge Environmental Impact Statement.

2.2.2.2 Decommissioning and Removing Flaming Gorge Dam

During the scoping process, a request was made to consider decommissioning the dam as an alternative to allow endangered fish to recover. This alternative was not selected for detailed study in this EIS because it does not meet the purpose of and need for the Proposed Action. Specifically, decommissioning the dam would prevent continuing the authorized purposes of the dam under the Colorado River Storage Project and the Flaming Gorge National Recreation Area authorizing legislation, among others.

2.3 DESCRIPTION OF THE ALTERNATIVES ANALYZED IN THIS ENVIRONMENTAL IMPACT STATEMENT

2.3.1 No Action Alternative

Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the 1992 Biological Opinion. Flows recommended in the 1992 Biological Opinion were intended to mimic a more natural hydrograph than what occurred under previous dam operations and to protect nursery habitats of endangered fishes downstream from the Yampa River confluence.

Under normal operations, reservoir releases through Flaming Gorge Powerplant range from 800 to 4,600 cubic feet per second (cfs). These flows adhere to the interim operating criteria for Flaming Gorge Dam established

by Reclamation in September 1974. Under these criteria, Reclamation agreed to provide (1) a minimum flow of 400 cfs at all times, (2) flows of 800 cfs under normal conditions and for the foreseeable future, and (3) flows exceeding 800 cfs when compatible with other CRSP reservoir operations.

Temperature requirements under the No Action Alternative were specified in the Reasonable and Prudent Alternative of the 1992 Biological Opinion (p. 30):

> *Releases from Flaming Gorge beginning July 1 and continuing until November 1 should be of the warmest water available, approaching 59 degrees F (15 degrees C) (highest lake levels). By releasing the warmest water available during this period, water temperatures in the upper Green River should not differ more than 9 degrees F (5 degrees C) in the Yampa River at Echo Park and should average near 72-77 degrees F (22-25 degrees C) in Gray Canyon from July 1 to August 15.*

2.3.2 Action Alternative

Under the Action Alternative, Flaming Gorge Dam would be operated with the goal of achieving the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of Flaming Gorge Dam and Reservoir. The 2000 Flow and Temperature Recommendations provide targets for each of the three sections or "reaches" of the Green River below Flaming Gorge Dam.

- Reach 1 begins at Flaming Gorge Dam and extends 65 river miles to the confluence of the Yampa River. In this reach, the Green River meanders about 10 river miles into northwestern Colorado and then flows southward for about 30 river miles. This reach is almost entirely regulated by releases from Flaming Gorge Dam.
- Reach 2 begins at the confluence of the Green and Yampa Rivers in Colorado and extends 99 river miles southwest to the White River confluence near Ouray, Uintah County, Utah. In this reach, tributary flows from the Yampa River combine with releases from Flaming Gorge Dam to provide a less regulated flow regime than in Reach 1.
- Reach 3 begins at the confluence of the Green and White Rivers and extends 246 river miles south to the Colorado River confluence in Canyonlands National Park at the boundary of Wayne and San Juan Counties in southeastern Utah. In this reach, the Green River is further influenced by tributary flows from the White, Duchesne, Price, and San Rafael Rivers.

Table 2-1 shows a summary of the recommended spring peak and summer-to-winter base flows from the 2000 Flow and Temperature Recommendations report for all three reaches of the Green River. Under the Action Alternative, Flaming Gorge Dam would be operated with the goal of achieving the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of Flaming Gorge Dam and Reservoir.

The 2000 Flow and Temperature Recommendations for each reach are not integrated in such a way that a particular release from Flaming Gorge Dam could equally achieve the recommendations for each reach simultaneously. The intent of the Action Alternative is first to meet the recommended objectives for Reach 2 and then, if necessary, make adjustments to releases so that the recommended objectives for Reach 1 could also be met. It is assumed that the flow objectives in Reach 3 are met whenever the flow objectives in Reach 2 are met.

Table 2-1.—Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream From Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

Location	Flow and Temperature Characteristics	Hydrologic Conditions and 2000 Flow and Temperature Recommendations[1]				
		Wet[2] (0–10% Exceedance)	Moderately Wet[3] (10–30% Exceedance)	Average[4] (30–70% Exceedance)	Moderately Dry[5] (70–90% Exceedance)	Dry[6] (90–100% Exceedance)
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	$8,600 cfs (244 cubic meters per second [m3/s])	$4,600 cfs (130 m3/s)	$4,600 cfs (130 m3/s)	$4,600 cfs (130 m3/s)	$4,600 cfs (130 m3/s)
	Peak flow duration is dependent upon the amount of unregulated inflows into the Green River and the flows needed to achieve the recommended flows in Reaches 2 and 3.					
	Summer-to-Winter Base Flow	1,800–2,700 cfs (50–60 m^3/s)	1,500–2,600 cfs (42–72 m^3/s)	800–2,200 cfs (23–62 m^3/s)	800–1,300 cfs (23–37 m^3/s)	800–1,000 cfs (23–28 m^3/s)
Above Yampa River Confluence	Water Temperature Target	$ 64 °F (18 °C) for 3-5 weeks from mid-August to March1	$ 64 °F (18 °C) for 3-5 weeks from mid-August to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-July to March 1	$ 64 °F (18 °C) for 3-5 weeks from June to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-June to March 1
Reach 2 Yampa River to White River	Maximum Spring Peak Flow	$26,400 cfs (748 m^3/s)	$20,300 cfs (575 m^3/s)	$18,600 cfsg (527 m^3/s) $8,300 cfsh (235 m3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m^3/s) should be maintained for 2 weeks or more, and flows 18,600 cfs (527 m^3/s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for at 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	2,800–3,000 cfs (79–85 m^3/s)	2,400–2,800 cfs (69–79 m^3/s)	1,500–2,400 cfs (43–67 m^3/s)	1,100–1,500 cfs (31–43 m^3/s)	900–1,100 cfs (26–31 m^3/s)
Below Yampa River Confluence	Water Temperature Target	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.
Reach 3 White River to Colorado River	Maximum Spring Peak Flow	$39,000 cfs (1,104 m^3/s)	$24,000 cfs (680 m^3/s)	$22,000 cfs9 (623 m^3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m^3/s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m^3/s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	3,200–4,700 cfs (92–133 m^3/s)	2,700–4,700 cfs (76–133 m^3/s)	1,800–4,200 cfs (52–119 m^3/s)	1,500–3,400 cfs (42–95 m^3/s)	1,300-2,600 cfs (32–72 m^3/s)

[1] Recommended flows as measured at the United States Geological Survey gauge located near Greendale, Utah, for Reach 1; Jensen, Utah, for Reach 2; and Green River, Utah, for Reach 3.

[2] **Wet** (0% exceedance): A year in which the forecasted runoff volume is larger than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.

[3] **Moderately Wet** (10–30% exceedance): A year in which the forecasted runoff volume is larger than most of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.

[4] **Average** (30–70% exceedance): A year in which the forecasted runoff volume is comparable to the long-term historical average runoff volumes.

[5] **Moderately Dry** (70–90% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.

[6] **Dry** (90–100% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.

[7] Recommended flows 18,600 cfs (527 m^3/s) in 1 of 2 average years.

[8] Recommended flows $8,300 cfs (235 m^3/s) in other average years.

[9] Recommended flows $22,000 cfs (623 m^3/s) in 1 of 2 average years.

The 2000 Flow and Temperature Recommendations focus primarily on the flow regimes in Reaches 2 and 3, which include flows from the Yampa River. However, since these riverflow criteria are based solely on upper Green River hydrology, the 2000 Flow and Temperature Recommendations in Reaches 1 and 2 would most likely be achieved to varying degrees. For example, in years when the upper Green River Basin is wetter than the Yampa River Basin, meeting the 2000 Flow and Temperature Recommendations in Reaches 2 and 3 would most likely exceed the minimum target for the peak flow recommendations for Reach 1.

Conversely, if the Yampa River Basin is wetter than the upper Green River Basin, meeting the 2000 Flow and Temperature Recommendations for Reaches 2 and 3 could result in falling short of the peak flow target for Reach 1. Under this scenario, the Action Alternative might require Flaming Gorge Dam releases to be increased so that the 2000 Flow and Temperature Recommendations in Reach 1 could also be met. Flows in Reaches 2 and 3 would then exceed their respective minimum 2000 Flow and Temperature Recommendations. Since only one release pattern can be selected each year, depending upon how water is distributed between the upper Green River and Yampa River Basins, each reach would achieve or exceed its respective minimum 2000 Flow and Temperature Recommendations to varying degrees.

Each year, Reclamation would work closely with the U.S. Fish and Wildlife Service and Western Area Power Administration in developing a flow regime consistent with the 2000 Flow and Temperature Recommendations and CRSP purposes and would also consider input from the Flaming Gorge Working Group meetings. The framework for this decisionmaking process is described in section 2.5. The overall effectiveness of implementing the objectives of the 2000 Flow and Temperature Recommendations would be measured by the long-term frequency of achieving flow thresholds described in the 2000 Flow and Temperature Recommendations. Consideration would be given to hydrologic conditions, operational limitations, and past operational conditions. An administrative record of the operational decisionmaking would be maintained and available to the public. This record would include analysis of previous operations and the effectiveness of achieving desired targets on a year-by-year basis.

Water release temperatures at the dam would be regulated with the objective of achieving target temperatures for upper Lodore Canyon and the Yampa River and Green River confluence during the first 2 to 5 weeks of the base flow period and/or when Colorado pikeminnow larvae are present at this confluence.

2.4 REVIEW OF FLAMING GORGE MODEL DEVELOPED FOR THE FLAMING GORGE DAM EIS

As detailed in section 4.3.1.1, a river simulation model (Flaming Gorge Model) was developed for the Green River system to assess impacts of Flaming Gorge Dam operations in this EIS. The model was developed using the RiverWare simulation modeling software package. The Flaming Gorge Model evaluates two alternative operations: the No Action Alternative (operation of Flaming Gorge Dam as prescribed by the 1992 Biological Opinion; FWS 1992) and the Action Alternative (operation of Flaming Gorge Dam consistent with the 2000 Flow and Temperature Recommendations). The model takes, as input, a set of natural flow volumes and estimates what release volumes and storage volumes would occur under the two operating regimes. The model then routes these release volumes through the Green River to the

U.S. Geological Survey (USGS) streamflow gauge on the Green River at Jensen, Utah, approximately 93 miles downstream from Flaming Gorge Dam.

For the Action Alternative, the Flaming Gorge Model predicts more frequent use of the bypass tubes and spillway at Flaming Gorge Dam when compared to the No Action Alternative. Under the Action Alternative, the Flaming Gorge Model predicts that the bypass tubes would be used in 50% of all years, and the spillway would be used in 29% of all years. In comparison, under the No Action Alternative, the bypass tubes would be used in 23% of all years, and the spillway would be used in 5% of all years.

A review of the Flaming Gorge Model was performed by three authors of the 2000 Flow and Temperature Recommendations to evaluate whether the degree of bypass and spill predicted by the Flaming Gorge Model would be necessary to meet the requirements of the 2000 Flow and Temperature Recommendations (see peer review report in the Hydrologic Modeling Appendix). The review did not include an evaluation of the No Action Alternative. While the main focus of the model review was the frequency of bypass and spillway use, the reviewers also examined the model's behavior and evaluated how the model simulated the year-round operation of Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations.

2.4.1 Review Findings

In most situations, the reviewers found that the Flaming Gorge Model properly simulates the operation of Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations in Reach 2, while minimizing the effects on authorized purposes of the dam.

The reviewers found that the Flaming Gorge Model performs well in dry, moderately dry, and average years. The review did show that the model appeared to bypass or spill more water than may be necessary in moderately wet and wet years, however.

A key issue with river simulation modeling is a lack of flexibility. Rules must be 'hard coded' into the operational decisionmaking of the model. While many model rules allow for decision trees, a model such as the Flaming Gorge Model cannot adjust to all situations or consider the balance of all available operating options. The inability to program extensive flexibility into the model's rules makes precise modeling of the effects of the 2000 Flow and Temperature Recommendations more difficult.

Reclamation acknowledges that the Flaming Gorge Model may overstate bypasses and, therefore, may overstate potential effects that result from bypassing water. Reclamation also notes that while the Flaming Gorge Model provides good information to assess potential effects of operating to meet the 2000 Flow and Temperature Recommendations, details and flexibility that cannot be captured by modeling will be factored into operational decisionmaking each year. Therefore, the following section provides further clarification on operations to implement both the No Action and Action Alternatives.

2.5 OPERATIONAL DESCRIPTION

This section describes how Reclamation would implement the Action and No Action Alternatives while maintaining the authorized purposes and ensuring safe operations of Flaming Gorge Dam under normal operational conditions as explained in section 1.6. Operational plans could change due to malfunction of dam and powerplant equipment and during public emergencies.

2.5.1 Safe Operation of Flaming Gorge Dam

Safe operation of Flaming Gorge Dam is of paramount importance and applies to both the Action and the No Action Alternative. To safely and efficiently operate Flaming Gorge Dam, forecasted future inflows must be incorporated into the decisionmaking process.

(See section 1.5 for a description of the operational decisionmaking process.)

These forecasted future inflows are provided by the National Weather Service through the River Forecast Center and are issued as monthly or seasonal (April through July) volumes of unregulated inflow that are anticipated to occur during the forecast period. When a forecast does not accurately predict the actual inflow that occurs, a forecast error is associated with the forecast. A forecast error is the volume difference between the forecasted inflow volume for the period and the actual inflow volume for the period. Forecast errors are attributable mostly to hydrologic variability and, to a much lesser degree, the forecasting procedure. For this reason, forecast errors will always be a factor associated with the operation of Flaming Gorge Reservoir.

Analysis of the historic forecast errors at Flaming Gorge was performed by the Colorado River Forecasting Service Technical Committee (CRFSTC) in April of 1987. This committee reported 5% exceedance forecast errors (table 2-2). Forecast errors of this magnitude occur in 1 out of every 20 years on average, and errors of greater magnitude occur less frequently. From the information provided by the CRFSTC, forecast errors at the 1% exceedance level (1 out of every 100 years) were computed. Exceedance levels indicate the frequency of the event in question. A 5% exceedance forecast error can be expected to occur about 5% of the time or about 1 out of every 20 years. A 1% exceedance error can be expected to occur about 1% of the time or about 1 year out of every 100 years.

Table 2-2.—CRFSTC Recommended Forecast Errors for Flaming Gorge Dam

Month	5% Exceedance Forecast Errors in 1 in 20 years (1,000 acre-feet)	1% Exceedance Forecast Errors in 1 in 100 years (1,000 acre-feet)
January	760	1,065
February	680	962
March	610	862
April	550	778
May	480	680
June	410	581
July	375	531

Safe operation of Flaming Gorge Reservoir limits the risk of uncontrolled spills to 1% when the greatest foreseeable forecast error occurs. In other words, the safe operation of Flaming Gorge Reservoir must assure that 99% of the foreseeable forecast errors can be successfully routed through the reservoir without uncontrolled spills occurring. To limit this risk, vacant storage space must be maintained in the reservoir at various times of the year to absorb the additional inflow volume if a forecast error occurs. For this reason, the reservoir elevation is intentionally drawn down during the fall and winter months.

The upper limit drawdown levels established as safe operating parameters for Flaming Gorge Reservoir were determined through routing studies of forecast error scenarios. These scenarios were based on the 1% exceedance forecast errors shown in table 2-2. The scenario that had the largest risk of an uncontrolled spill was routed through the reservoir beginning in May with various reservoir elevations and various inflow volumes that were based on historic records. The highest end of May elevations, where the 1% exceedance forecast error was successfully absorbed by the reservoir

without an uncontrolled spill, was established as the upper limit drawdown levels for that forecast volume.

Upper limit drawdown levels for the safe operation of Flaming Gorge Reservoir under both the Action and No Action Alternatives are shown in table 2-3.

Table 2-3.—Upper Limit Drawdown Levels for Flaming Gorge Reservoir

Unregulated Inflow Forecast Percentage Exceedance Range	May 1 Upper Limit Drawdown Level
1 to 10	6023
10.1 to 30	6024
30.1 to 40	6025
40.1 to 59.9	6027

2.5.2 Reservoir Operations Process Under the No Action Alternative

2.5.2.1 Operations in May Through July (Spring Period)

Under the No Action Alternative, the hydrologic condition of the upper Green River Basin, including the April through July unregulated inflow forecast and the condition of the reservoir, would be used to establish the magnitude and duration of a spring peak release for the current year. The magnitude of the spring release would usually be from 4,000 cfs to powerplant capacity (about 4,600 cfs), unless hydrologic conditions indicated that bypasses (or spills) would be necessary for safe operations of the dam. In such case, these bypasses (or spills) would be timed to occur when the Yampa River peak flows and immediate post peak flows occur. The bypass tubes or spillway could potentially be used to make releases when dam or powerplant equipment is unavailable due to malfunction or maintenance.

Through consultation with the U.S. Fish and Wildlife Service and Western Area Power Administration (Western), Reclamation would establish a range of spring operational scenarios that would achieve the objectives of the Reasonable and Prudent Alternative of the 1992 Biological Opinion on the Operation of Flaming Gorge Dam. These objectives include ramp rates, magnitudes, durations, and timing of a spring peak release and are described in the 1992 Biological Opinion. The range of spring operational scenarios would provide flexibility in operations to adjust to changing hydrologic conditions and would be based on the probable minimum and probable maximum Water Supply Forecasts issued in April by the River Forecast Center. These forecasts bound the range of reasonable (80% probability) runoff volumes that would likely occur during the April through July time period. Timing of the spring peak release under the range of possible operational scenarios would occur with the peak flows and immediate post peak flows on the Yampa River.

When the hydrologic condition is determined to be dry, the spring peak duration would be 1 to 2 weeks. Most likely, the magnitude of the release during the spring peak in dry years would be limited to powerplant capacity and could be limited to 4,000 cfs to conserve reservoir storage. Peak releases would be timed with the peak flows and immediate post peak flows of the Yampa River. In dry years, the spring peak release would be completed no later than June 20.

When the hydrologic condition is determined to be average, the spring peak duration would be 2 to 5 weeks. The magnitude of the release during the spring peak most likely would be limited to powerplant capacity (about 4,600 cfs). The timing of the peak releases would be with the peak flows and immediate post peak flows of the Yampa River. The spring peak release in average years would be completed by July 10.

Hydrologic conditions determined to be wet would establish a spring peak duration of 5 weeks or greater. Peak releases in wet years could include bypass releases and

possibly spillway releases, depending on the hydrologic condition of Flaming Gorge. The use of bypass tubes or the spillway would be based on avoiding uncontrolled spills through an analysis of potential forecast errors. The magnitude of peak releases in wet years would be at least powerplant capacity (about 4,600 cfs). The spring peak release in wet years would be completed by July 20.

2.5.2.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

Under the No Action Alternative, the use of the bypass tubes or the spillway would occur only when hydrologically necessary to maintain safe operations of Flaming Gorge Dam, during emergency operations, or when the full release capacity of the powerplant is unavailable. For the No Action Alternative, under normal operations, the magnitude of peak releases for endangered fish would be limited to powerplant capacity (about 4,600 cfs). However, if Reclamation determines that bypass releases would be likely for hydrologic reasons, Reclamation would attempt to schedule these bypass releases to occur with the peak flows and immediate post peak flows of the Yampa River.

2.5.2.3 Summer and Fall Operations (Early Base Flow Period)

Under the No Action Alternative, after the spring peak release is completed, releases from Flaming Gorge Dam would be reduced so that flows of the Green River, measured at Jensen, Utah, would achieve a target flow ranging from 1,100 to 1,800 cfs. Daily average flows would be maintained as close to this target as possible until September 15. After September 15, releases from Flaming Gorge Dam could be increased so that the daily average flow measured at Jensen, Utah, would achieve a target ranging from 1,100 to 2,400 cfs.

During the early base flow period, fluctuating releases for power production likely would occur. These fluctuating releases would be limited so that the hourly flow of the Green River, measured at Jensen, Utah, would be maintained at ±12.5% of the daily average flow of the Green River (measured at Jensen, Utah).[1]

2.5.2.4 Winter Operations (Late Base Flow Period)

There are no specific flow recommendations provided by the 1992 Biological Opinion for the period from November to May. Beginning November 1, the 1992 Biological Opinion calls for releases to be low and stable near historic levels. Under the No Action Alternative, Flaming Gorge daily average releases from November through May potentially could range from 800 cfs to powerplant capacity (about 4,600 cfs). However, it is anticipated that in most years, releases during this period would range from 800 cfs to about 3,000 cfs. Releases from Flaming Gorge Dam during the late base flow period would be designed to reduce the reservoir elevation to maintain safe reservoir operations. A discussion of the safe operation of Flaming Gorge is located in section 2.5.1, "Safe Operation of Flaming Gorge Dam."

Under the No Action Alternative, releases would achieve an upper limit drawdown elevation on March 1 of 6027 feet above sea level. The upper limit drawdown elevations for May 1 under the No Action Alternative are the same as those for the Action Alternative. These elevations can be found in table 2-3 in section 2.5.1.

During the late base flow period, fluctuating releases for power production would likely occur. The Reasonable and Prudent Alternative of the 1992 Biological Opinion

[1] The daily average flow measured at Jensen, Utah, would be determined from the average of the instantaneous flow readings during a 24-hour period from midnight to midnight each day.

does not specifically limit fluctuating releases during the late base flow period. Under the No Action Alternative, however, fluctuating releases would be limited, similar to the early base flow period, as they have been historically. The hourly flow of the Green River measured at Jensen, Utah, would be maintained from ±12.5% of the daily average flow measured at Jensen, Utah.

2.5.3 Reservoir Operations Process Under the Action Alternative

In general, the implementation of the 2000 Flow and Temperature Recommendations into the operational plans for Flaming Gorge Dam would occur through coordination as described on page 5-8 of the 2000 Flow and Temperature Recommendations. A Technical Working Group consisting of biologists and hydrologists involved with endangered fish recovery issues would be convened by Reclamation at various times throughout the year. Staff from Reclamation, U.S. Fish and Wildlife Service, and Western would be members of the Technical Working Group as well as other qualified individuals who choose to participate on a voluntary basis. Reclamation would develop an initial operational plan with balanced consideration of all of the resources associated with Flaming Gorge Reservoir and the Green River. Reclamation would present this initial operational plan to the Technical Working Group for comment and take into consideration the information described in table 2-5 (later in this chapter) and any new information that may be available to refine the plan to best meet the needs of the endangered fish. Reclamation could make refinements to the plan based on these comments and then present the new plan to the Flaming Gorge Working Group for additional comments. Reclamation could further refine the plan based on information gathered at the Flaming Gorge Working Group Meeting. This process would assure that the 2000 Flow and Temperature Recommendations and the authorized purposes of Flaming Gorge Dam are considered in a balanced and fair manner as the operational plan is developed.

These meetings would also provide an opportunity to discuss historic operations in terms of the accomplishments and shortcomings of meeting the 2000 Flow and Temperature Recommendations. Reclamation would maintain an administrative record of these meetings to document the planning process.

2.5.3.1 Operations in May Through July (Spring Period)

Under the Action Alternative, Reclamation would establish the hydrologic classification for the spring period (May through July) based on the forecasted unregulated inflow to Flaming Gorge Reservoir for the April through July period. This forecast is issued by the River Forecast Center beginning in early January and is updated twice a month until the end of July. During the spring period, Reclamation would classify the current hydrology of the Green River system into one of five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). Table 2-4 describes the percent exceedance ranges that would be used for each classification under the Action Alternative.

Table 2-4.—Percentage Exceedances and Hydrologic Classifications

Hydrologic Classification	Percentage Exceedance Range
Wet	<10
Moderately Wet	30 to 10.1
Average	70 to 30.1
Moderately Dry	90 to 70.1
Dry	>90

The hydrologic classification would be used to establish the range of flow magnitudes and

durations that could potentially be targeted for the approaching spring release period. These targets would be incorporated into a spring operations plan. This plan would be prepared each year by Reclamation under consultation with the U.S. Fish and Wildlife Service and Western and in coordination with the Technical Working Group prior to the spring Flaming Gorge Working Group meeting. The factors listed in table 5.3 of the 2000 Flow and Temperature Recommendations (shown as table 2-5), along with the established hydrologic classification, would be considered in the development of the operations plan.

In most years, it is expected that the flow magnitudes and durations achieved in Reach 2 each spring would be consistent with the flow magnitudes and durations described in the 2000 Flow and Temperature Recommendations for the hydrologic classification established in May of each year. However, because the factors listed in table 2-5 are also considered, particularly runoff conditions in the Yampa River, there would be some years where the peak flows that occur in Reach 2 achieve the targets for either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River. It is anticipated that in some years, when the hydrologic classification for the Green River is average, that the conditions of factors listed in table 2-5 could occur where it would be possible to achieve the targets established for either the moderately wet or wet classifications. Conversely, there would be some years classified as moderately wet when the conditions of these factors would be such that targets established for the wet or average classification would be met. There could also be years classified as wet where moderately wet targets would be achieved because of the conditions of these factors. It would be the responsibility of Reclamation to ensure that, over the long term, Flaming Gorge Dam and Powerplant are operated consistent with the 2000 Flow and Temperature Recommendations.

The operations plan would describe the current hydrologic classification of the Green River Basin and the hydrologic conditions in the Yampa River Basin, including the most probable runoff patterns for the two basins. The operations plan would also identify the most likely Reach 2 flow magnitudes and durations that would be targeted for the upcoming spring release. Because hydrologic conditions often change during the April through July runoff period, the operations plan would contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these alternate operating strategies would be limited to those described for one classification lower or two classifications higher than the classification for the current year.

As stated in section 1.5, the spring operations plan would be presented to the Flaming Gorge Working Group each spring for discussion. Reclamation could modify the plan based on information gathered at the Flaming Gorge Working Group meeting.

In years classified as wet, bypass releases would usually be required to operate the dam safely and to meet the 2000 Flow and Temperature Recommendations. In some years classified as wet, spillway releases also would be necessary for safe operation of the dam. Releases above powerplant capacity in these wet years would be expected to be made for a period of about 4 to 9 weeks. The exact magnitude of the release and duration of the release would depend upon factors identified in table 2-5. Wet year, high releases would be expected to occur from mid-May to early July (and, in very wet years, through July). The bypass and spillway releases, required for safe operation of the dam in wet years, would be timed with the objective to meet Reach 2 wet or moderately wet year targets, depending upon the hydrologic conditions in the Yampa

Table 2-5.—Examples of Real-Time and Other Year-Specific Information to Be Considered in Determining Annual Patterns of Releases From Flaming Gorge Dam for Implementation of the 2000 Flow and Temperature Recommendations to Benefit Endangered Fishes in Downstream Reaches From the Green River

Onset of Spring Peak Flow	Magnitude of Spring Peak Flow	Duration of Spring Peak Flow	Onset of Summer-Winter Base Flow	Magnitude of Summer-Winter Base Flow
Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir
Water surface elevation of Flaming Gorge Reservoir	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River	Forecasted and actual flow in the Yampa River
Forecasted and actual flows in the Yampa River	Desired areal extent of overbank flooding in Reaches 2 and 3	Desired duration of overbank flooding in Reaches 2 and 3	Initial appearance of drifting Colorado pikeminnow larvae in the Yampa River	Elevation of sand bars in nursery areas
Presence of adult razorback sucker congregations on spawning bars	Flow conditions and extent of overbank flooding in Reaches 2 and 3 in previous year	Desired base flow magnitude	Status of endangered fish populations	Status of endangered fish populations
Initial appearance of larval suckers in established reference sites in Reach 2 (e.g., Cliff Creek)	Existing habitat conditions	Presence of razorback sucker larvae in the Green River	Temperature of water released from the dam	Temperature of water released from the dam
Existing habitat conditions (e.g., condition of razorback sucker spawning sites in Reach 2)	Status of endangered fish populations	Existing habitat conditions	Temperature differences between the Green and Yampa Rivers at their confluence	Temperature differences between the Green and Yampa Rivers at their confluence
		Status of endangered fish populations		

Source: 2000 Flow and Temperature Recommendations, table 5.3.

River. The initiation of bypass and spillway releases would take place in mid- to late May coincident with the Yampa River peak. In extremely wet years, releases above powerplant capacity could be initiated in April or early May before the Yampa River peak.

In years classified as moderately wet, bypass releases usually (but not always) would be required for safe operation of the dam. Occasionally, some use of the spillway also might be required in moderately wet years for safe operation of the dam. The volume of the powerplant bypass in moderately wet years would be less than in wet years and would generally occur for a period of about 1 to 7 weeks. The timing of these releases would be from mid- to late May into June and sometimes extend into July. Releases from Flaming Gorge Reservoir in moderately wet years would be timed with the objective of meeting Reach 2 wet, moderately wet, or average year targets, depending upon the hydrologic conditions in the Yampa River basin and the information contained in table 2-5.

In years classified as average, bypass releases likely would not be required for safe operation of the dam but periodically would be required to meet the objectives of the 2000 Flow and Temperature Recommendations. In most average years, spring peak releases would be limited to powerplant capacity (about 4,600 cfs) with peak releases taking place for about 1 to 8 weeks, usually in the mid-May to late June (but occasionally extending into July) time period. In about 1 out of every 3 average years, bypass releases from Flaming Gorge would be required to achieve the Reach 2 flow recommendation peak and duration targets. In these years, the objective would be to achieve targeted flows in Reach 2 of 18,600 cfs for 2 weeks. To conserve water, bypass releases in these average years would be made only to the extent necessary to achieve this target. It can be expected that bypass releases, when required to meet the 2000 Flow and Temperature Recommendations in average years, would be implemented for a period of less than 2 weeks. In some years classified as average, the targets that would be achieved during the spring would be moderately wet or wet as a result of flows on the Yampa River that exceeded forecasted levels.

The objective in dry and moderately dry years would be to conserve reservoir storage while meeting the desired peak flow targets in Reach 2 as specified in the 2000 Flow and Temperature Recommendations. The bypass tubes and the spillway would not be used to meet flow targets in moderately dry and dry years but, on rare occasion, might be needed to supplement flows that cannot be released through the powerplant because of maintenance requirements. In dry years, a powerplant capacity release of 1 day to 1 week would occur during the spring, and this release would be timed with the peak of the Yampa River. In moderately dry years, a 1-week to 2-week powerplant capacity release would occur during the spring and would be timed with the peak and post peak of the Yampa River.

2.5.3.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

The bypass tubes and the spillway at Flaming Gorge Dam have been utilized historically, as needed, for safe operation of the dam. In years with high inflow, bypass releases, and sometimes spillway releases, may be required under the Action Alternative to meet the 2000 Flow and Temperature Recommendations. Bypass and spillway releases, required for safe operation of the dam and to meet the 2000 Flow and Temperature Recommendations, would be scheduled coincident with Yampa River peak and post peak flow (the mid-May to mid-June time period) with the objective of meeting flow recommendation targets in Reach 2.

There would be some years (moderately wet years and average years) where use of the bypass would not be required for safe operation but would be needed to meet the 2000 Flow and Temperature Recommendations. As part of the annual planning process discussed above, Reclamation would consult with the U.S. Fish and Wildlife Service and Western Area Power Administration and coordinate with the Technical Working Group and make a determination whether bypasses should be attempted to achieve the targeted Reach 2 magnitudes and durations.

Increased use of the spillway in comparison to past operations raises potential concerns for two reasons: (1) physical damage to the spillway, caused by cavitation, and (2) entrainment of potentially harmful nonnative fish into the Green River. Cavitation is a physical process that can occur when water flows across a surface at high velocity. This process has been shown to cause excessive erosion in concrete spillway structures at other Reclamation dams. In 1984, the spillway at Flaming Gorge was retrofitted with air slots, tested and deemed successful in reducing cavitation. However, should damage to the spillway become excessive, repairs would be made and use of the spillway would be limited to when

hydrologically necessary. Smallmouth bass, present in Flaming Gorge Reservoir, could potentially have a detrimental effect on native fish in the Green River if they survived entrainment and established populations in the river or caused an increase in populations known to exist in Lodore Canyon. The potential entrainment of nonnative fish has been identified as a potential concern of the Action Alternative. The potential entrainment of nonnative fish would be carefully monitored by the Recovery Program.

2.5.3.3 Operations in August Through February (Base Flow Period)

Under the Action Alternative, during the base flow period, Reclamation would classify the current hydrology of the Green River system into one of the five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). For the month of August, the hydrologic classification would be based on the percentage exceedance of the volume of unregulated inflow into Flaming Gorge Reservoir during the spring period. For the months of September through February, the percentage exceedance would be based on the previous month's volume of unregulated inflow into Flaming Gorge Reservoir. If the unregulated inflow during the previous month is such that the percentage exceedance falls into a different classification than the classification assigned for the previous month, then the hydrologic classification for the current month could be shifted by one classification to reflect the change in hydrology. This shift would only be made when the reservoir condition indicates that the shift would be necessary to achieve the March 1 drawdown level of 6027 feet above sea level. Otherwise, the hydrologic classification for current month would remain the same as for the previous month.

The range of acceptable base flows for Reach 2 would be selected from the 2000 Flow and Temperature Recommendations for the hydrologic classification set for the current month. Reclamation would make releases to achieve flows in Reach 2 that are within the acceptable range that also assure that the reservoir elevation on March 1 would be no higher than 6027 feet above sea level.

The 2000 Flow and Temperature Recommendations during the base flow period do allow for some flexibility, and the Action Alternative accommodates this flexibility. Under the Action Alternative, the flows occurring in Reach 2 during the base flow period would be allowed to vary from the targeted flow by ±40% during the summer to fall period (August through November) and by ±25% during the winter (December through February), as long as the day-to-day change is limited to 3% of the average daily flow and the variation is consistent with all other applicable 2000 Flow and Temperature Recommendations. Reclamation would utilize the allowed flexibility to the extent possible, to efficiently manage the authorized resources of Flaming Gorge Dam. Flaming Gorge Reservoir would be operated through the base flow period so that the water surface elevation would not be greater than 6027 feet above sea level on March 1.

During the base flow period, hourly release patterns from Flaming Gorge Dam would be patterned so that they produce no more than a 0.1-meter stage change each day at the Jensen gauge, except during emergency operations.

2.5.3.4 Operations in March and April (Transition Period)

From March 1 through the initiation of the spring peak release (typically, this occurs in mid- to late May), there are no specific flow requirements specified in the 2000 Flow and Temperature Recommendations. For the Action Alternative, releases during this transition period would be made to manage the reservoir elevation to an appropriate drawdown level based on the forecasted

unregulated inflow into Flaming Gorge for the April through July period. Appropriate drawdown levels under normal operations during the transition period are those that would allow for safe operation of the dam through the spring. These upper limit drawdown levels are shown in table 2-3 in section 2.5.1.

Table 2-3 implies that upstream regulation above Flaming Gorge Reservoir remains relatively consistent with historic regulation.[2] In the event that less storage space would be available above Flaming Gorge Reservoir during the spring, these drawdown levels may have to be lower than those specified in table 2-3 for safe operation of Flaming Gorge Dam. In extreme wet years, the drawdown level for May 1 could potentially be lower than what is specified to maintain safe operation of the dam.

Reclamation would determine the appropriate reservoir drawdown based on the percentage exceedance of the forecasted volume of unregulated inflow into Flaming Gorge Reservoir during the spring (April through July). The forecast is issued twice during March and twice during April. Under normal operations during the transition period, releases would be limited to a range from 800 cfs to powerplant capacity (4,600 cfs).

Releases during the transition period would be patterned so that they are consistent with the release patterns established during the preceding base flow period. The 2000 Flow and Temperature Recommendations do not address hourly fluctuation patterns during the transition period. During the transition period, Reclamation would maintain the fluctuation constraints as in the preceding base flow period to provide operational consistency as has been done historically.

[2] Historically (1988-2003), there generally has been about 200,000 acre-feet of vacant space at Fontenelle Reservoir (above Flaming Gorge) on May 1.

2.6 Summary Comparison of the Predicted Environmental Effects of All Alternatives

This section summarizes and compares the chapter 4 analyses of predicted environmental effects under both the Action and No Action Alternatives.

2.6.1 Hydrology

Tables 2-6, 2-7, and 2-8 present the key flow parameters and ranges described in both the 1992 Biological Opinion (No Action Alternative) and the 2000 Flow and Temperature Recommendations (Action Alternative) under dry, average, and wet hydrological conditions. The 2000 Flow and Temperature Recommendations report also provides recommended flow regimes for moderately wet and moderately dry hydrologic conditions; however, because the 1992 Biological Opinion does not address these conditions, they have been omitted from this comparative analysis.

The 1992 Biological Opinion does not specifically define the differences between wet, average, and dry hydrological conditions but rather, suggests that Reclamation and the U.S. Fish and Wildlife Service consult each year to make this determination. The 2000 Flow and Temperature Recommendations are more specific about how the hydrology of the upper Green River Basin is to be characterized.

The hydrologic conditions of the upper Green River Basin, as described in the 2000 Flow and Temperature Recommendations, are based on the forecasted or actual volume of unregulated inflow (adjusted for storage in upstream reservoirs) into Flaming Gorge Reservoir during the period from April through July. During the spring and early

Table 2-6.—Dry Hydrology Scenario
(Runoff Volume Exceeded 90 to 100% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Release Peak Determination	***Release Peak Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 1 week in dry years. Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River.	In dry years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: The combined flows of the Green and Yampa Rivers should provide a peak flow in Reach 2 that exceeds 8,300 cfs for at least 2 days. The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a dry year should be 350 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by June 20 in dry years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 900 cfs and 1,100 cfs during dry years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 degrees Fahrenheit (°F) (15 degrees Celsius [°C]).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-June to March 1) for dry years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table 2-7.—Average Hydrology Scenario
(Runoff Volume Exceeded 30 to 70% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination	***Peak Flow Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 2 to 4 weeks in average years. Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	In average years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: The peak release should provide a peak flow in Reach 2 that exceeds 18,600 cfs in 1 out of 2 average years. In 1 out of 4 average years, the peak flow in Reach 2 should exceed 18,600 cfs for at least 2 weeks. In all average years, the peak flow in Reach 2 should exceed 8,300 cfs for at least 2 weeks. The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for an average year should be 500 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 10 in average years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 1,500 cfs and 2,400 cfs during average years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, average daily the flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-July to March 1) for average years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table 2-8.—Wet Hydrology Scenario
(Runoff Volume Exceeded Less than 10% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination	***Peak Flow Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 6 weeks in wet years. Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	In wet years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: The peak release should provide a peak flow in Reach 2 that should exceed 26,400 cfs. Flows in Reach 2 should exceed 22,700 cfs for at least 2 weeks. Flows in Reach 2 should also exceed 18,600 cfs for at least 4 weeks. The minimum peak release from Flaming Gorge Dam should be 8,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a wet year should be 1,000 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 20 in wet years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 2,800 cfs and 3,000 cfs during wet years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (8 °C) for the first 2 to 5 weeks during the base flow period (mid-August to March 1) for wet years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period (the 2000 Flow and Temperature Recommendations indicate that this may not be possible in wet years).

summer, operational decisions would be based on forecasted inflows. After August 1, operational decisions would be based on the measured inflows that occurred during the previous month as well as the previous April through July period.

For purposes of this analysis, and as defined by the 2000 Flow and Temperature Recommendations, dry conditions in the upper Green River Basin are identified as unregulated April-July inflow volumes that are exceeded in 9 out of every 10 years (90% exceedance value). The year 1977 was historically dry at which time the unregulated April through July inflow measured only 254,000 acre-feet. In contrast, wet conditions in the upper Green River Basin are identified as unregulated April through July inflow volumes that are exceeded in only 1 out of every 10 years (10% exceedance value). For example, 1986 was a historically wet year at which time the unregulated April through July inflow measured 2,224,000 acre-feet.

2.6.2 Water Quality, Water Temperature, and Sediment Transport

When the operation of Flaming Gorge Dam was changed to meet the requirements of the RPA of the 1992 Biological Opinion, the frequency of summer and fall reservoir drawdowns that produced algal blooms was reduced. This operational change improved the water quality of Flaming Gorge Reservoir. The analysis of the effects of the Action and No Action Alternatives shows that the frequency of reservoir drawdowns likely would not differ from drawdown conditions observed since 1992. Under both alternatives, reservoir drawdowns during drought conditions would cause larger algal blooms. As an example, such a condition occurred in the fall of 2002.

For the Green River below Flaming Gorge Dam, the only water quality issue of concern with respect to the Action Alternative is water temperature. The No Action Alternative would result in future water temperatures based on the recommendations of the 1992 Biological Opinion. Under the Action Alternative, release temperatures and river temperatures in Reach 1 would be somewhat warmer in order to meet the temperature recommendation of 64 degrees Fahrenheit (°F) (18 degrees Celsius [°C]) or greater in upper Lodore Canyon. Reaches 2 and 3, because of their distance from Flaming Gorge Dam, would likely have similar water temperatures under either of the alternatives.

Sediment transport is presented in the "Water Quality" section because it is an important function in the river system, with the potential to affect both riverine and riparian habitat. In comparison to the estimated average annual sediment load for Reach 1 under the No Action Alternative, sediment transport under the Action Alternative represents an increase of about 14%. Seasonally, during May, June, and July, sediment transport is expected to be about 56% greater under the Action Alternative relative to the No Action Alternative in Reach 1. In comparison to the estimated average annual sediment load for Reach 2 under the No Action Alternative, estimated annual sediment transport in Reach 2 under the Action Alternative represents an increase of about 7%. Sediment transport during May, June, and July under Action Alternatives conditions would average nearly 11% more than sediment transport under No Action Alternative conditions during the same season in Reach 2. Annual sediment loads in Reach 3 are expected to be about 8% greater under the Action Alternative flows relative to the No Action flows. Sediment transport in Reach 3 would average about 9% more during May, June, and July under the Action Alternative conditions related to the No Action conditions. (See table 2-9 for a summary of this information.)

Table 2-9.—Weight and Percent Increase in Sediment Load Under the Action Alternative, Above That for the No Action Alternative

Reach Number	Time Period	No Action Alternative	Action Alternative	
		Estimated Sediment Load (tons)	Sediment Load Increase (tons)	Increase (percent)
Reach 1	Average Annual	92,000	+13,000	+14
	May-June-July	45,000	+25,000	+56
Reach 2	Average Annual	1.2 million	+800,000	+ 7
	May-June-July	970,000	+110,000	+11
Reach 3	Average Annual	3.5 million	+280,000	+8
	May-June-July	3.3 million	+290,000	+9

2.6.3 Hydropower

Hydropower analysis focuses on the potential impacts of the alternatives on powerplant operations at Flaming Gorge Dam. This analysis used a computer model developed by Argonne National Laboratory in collaboration with Reclamation. The model uses an estimate of the quantity of energy injected into the power grid along with a forecasted hourly electricity spot price (market price) to determine the economic value for each alternative. The model determined the revenue generated as a result of operating Flaming Gorge Powerplant to achieve each alternative over the period from 2002 to 2026. The revenues for each alternative were then discounted by 5.5% per year so that they reflected their net present value. The total net present value of the revenue generated under each alternative was then compared to determine the economic impacts to power production under the proposed alternatives.

The results are summarized in table 2-10 and show that the net present value of economic benefits for the No Action Alternative simulation was $403.1 million while generating about 11,904 gigawatthours (GWh) of energy. The Action Alternative showed a net present value of about $423.1 million for the 25-year simulation, an increase of $20.0 million (5.0%) over the estimate for the No Action Alternative. The Action Alternative would generate about 11,374 GWh of energy, about 4.5% less, compared to the No Action Alternative generation. The Action Alternative generates less energy but is able to generate more of the energy during the seasons when market prices are higher, leading to a slightly greater net present value. The Action Alternative has greater benefits with fewer GWh due to the fluctuations in the market price of energy. The Action Alternative calls for more generation in the summer months when energy sells at higher prices than in the fall, when the No Action Alternative generates more power. Given recent volatility in historical prices, there is uncertainty associated with future prices. Because there is less total annual generation with the Action Alternative, use of an alternative price set that does not assume as large a relative seasonal price difference could result in a negative rather than a positive impact. In any case, the impact is considered to be insignificant when the total value of Flaming Gorge generation is considered.

In addition to the economic analysis, a financial analysis was performed as described

Table 2-10.—Table of Comparisons of the Alternatives for Hydropower

	No Action Alternative	Action Alternative	Comparison of Action to No Action
Net Present Value	$403.1 million	$423.1 million	$20 million (5.0%)
Generation in GWh	11,904.1	11,374.3	-529.8 (-4.5%)
Wholesale Electricity Price Composite	20.72 mills/KWh[1]	20.57 mills/KWh	-0.15 mills/KWh (-0.73%)

[1] Mills per kilowatthour.

in section 4.4.3. While an economic analysis shows the impacts on the national economy as a whole, the financial analysis describes the impacts to the customers who purchase wholesale electricity generated at Flaming Gorge Powerplant. The results of this analysis show that, compared to the No Action Alternative, the Action Alternative would not have a significant impact on the rate CRSP power users pay.

2.6.4 Agriculture

Under both the No Action and Action Alternatives, about 245 acres of cropland in the historic Green River flood plain could be expected to be flooded in nearly half of all years. On average, affected lands would be inundated 2 days longer under the Action Alternative, but since this incremental time would not do further crop damage compared with the No Action Alternative, there are no differences in impacts between the two alternatives.

2.6.5 Land Use

There are no impacts to land use around the Flaming Gorge Reservoir under either alternative. In Reach 1 of the Green River, in wet years, the Action Alternative would have greater impacts to the use of campgrounds and other recreational facilities that have been built in the historic flood plain than would the No Action Alternative. In average hydrology years, the impacts to such facilities would be about the same under either alternative.

Under the No Action Alternative in Reach 2, the effects of the river on land use that have occurred over the past 10 years would continue. Under the Action Alternative, higher flows of longer duration would be expected to occur in wet years. This would result in inundation levels and durations in the historic flood plain that have not occurred in the recent past, and consequently, a temporary loss of land use in the flood plain on a more frequent basis. In Reach 3, there would not be a significant land use difference under either alternative.

2.6.6 Ecological Resources

Under the No Action Alternative, present conditions would be expected to continue for all flora and fauna around the Flaming Gorge Reservoir and in the Green River.

Under the Action Alternative, both native and nonnative fish in Reach 1 would likely benefit from the 2000 Flow and Temperature Recommendations. There is the potential for both positive and negative effects to trout in the area immediately below Flaming Gorge Dam, though long-term negative effects are not expected. There is also a potential for

negative impacts to trout in the Browns Park area if water temperatures in that area exceed 64 °F (18 °C).

Under the No Action Alternative, there would be continued proliferation of wetland plants and island marshes. Due to infrequent flooding, the flood plain forests of the old high water zone would continue to transition to desert. The old-growth cottonwoods would continue the trend of premature dieoff. There would be limited opportunity for establishment of cottonwoods and box elders. Under the Action Alternative, there may be erosion of wetland and riparian vegetation on islands and bars, followed by increased opportunity for cottonwood establishment. Larger floodflows may improve the health of mature cottonwoods.

Invasive species are present in all reaches and are expected to persist under the No Action Alternative. The Action Alternative could accelerate growth of some invasive species along the river. Tamarisk and giant whitetop are two such species that could increase in rate and acreage of invasion in higher flood plain settings under the Action Alternative.

In the short term, birds and animals along the Green River corridor could be negatively impacted by temporary loss of habitat due to increased flooding, but the potential impacts are not expected to be significant. In the long term, birds and animals are expected to benefit from enhancement of riparian vegetation and habitat.

2.6.6.1 Threatened and Endangered Fish

Under the No Action Alternative, existing conditions for the Colorado pikeminnow, humpback chub, and razorback sucker would be expected to continue. For both the No Action and Action Alternatives, conditions for the bonytail chub are assumed to be the same as for the other three endangered fish species. While these species would be expected to benefit from Recovery Program activities other than implementation of the 2000 Flow and Temperature Recommendations, it is believed that continuation of No Action flow regimes would not provide enough benefit to support their recovery. Under the Action Alternative, river conditions are expected to benefit the endangered fish and their designated critical habitat.

2.6.6.2 Other Threatened and Endangered Species

Under the No Action Alternative, continued decline in acreage and health of native riparian vegetation would have negative effects on the southwestern willow flycatcher. Under the Action Alternative, Ute ladies'-tresses could be lost in Reach 1. Suitable habitat may be lost or otherwise become unsuitable. Additional sites of potentially suitable habitat would likely develop at new locations under the Action Alternative. Long-term increases in cottonwood and native understory vegetation along the river corridor would benefit bald eagle and southwestern willow flycatcher. Other threatened and endangered species are not expected to be affected by either alternative.

2.6.6.3 Other Special Status Species

Under the No Action Alternative, continued decline in acreage and health of native riparian vegetation would have negative effects on yellow-billed cuckoo and other State sensitive songbirds. The Action Alternative may reverse degradation of riparian vegetation in Reach 2 and upper Reach 3.

2.6.7 Cultural Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to cultural resources under either alternative.

2.6.8 Paleontological Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to paleontological resources under either alternative.

2.6.9 Indian Trust Assets

The No Action Alternative would not affect Indian trust assets. The Action Alternative would not affect agriculture, oil and gas production, or other Indian Trust Assets if advance notice is provided on the timing of spring peak flows. There would be no significant difference between the Action and No Action Alternatives.

2.6.10 Safety and Public Health

There is public concern over the creation of mosquito habitat along the Green River due to the flow regimes under both alternatives, which are intended to inundate flood plain depressions for the benefit of endangered fish. Under the No Action Alternative, the population of mosquitoes along the river would not increase. In Reach 1, the Action Alternative could result in an increase in the mosquito population along the river. In Reach 2, the Action Alternative also could result in an increase in mosquitoes, though not as large or as often as in Reach 1. As it has in the past, under either alternative, Reclamation would continue to coordinate peak flow releases with State and county officials to minimize the mosquito problem in the Jensen, Utah, area to the extent possible. Under either alternative, mosquito abatement control by the county would continue. In Reach 3, there would not be a difference in the population of mosquitoes under either alternative.

Public safety on the Flaming Gorge Reservoir is expected to be unchanged under either alternative. Public safety along the Green River could be affected under the Action Alternative due to the potential for higher flows for longer durations. Existing safety procedures for dam operations would continue to be followed, along with notification to the public of scheduled high flows.

2.6.11 Air Quality

There are no significant impacts to air quality under either alternative.

2.6.12 Visual Resources

There are no significant effects on visual resources under either alternative.

2.6.13 Environmental Justice

No adverse impacts to minority or low-income populations have been identified under either alternative.

2.6.14 Recreation

On average, total water-based river and reservoir visitation within Flaming Gorge National Recreation Area for the Action Alternative is not expected to measurably change compared to the No Action Alternative (only +0.3% gain). Gains in economic value are expected to be higher (+9.5%) as a result of water levels moving closer to preferred conditions.

Under wet and dry conditions, each of which typically occur only 10% of the time, Action Alternative visitation and value on the river are expected to decline compared to the No Action Alternative but are more than offset by gains on the reservoir.

2.6.15 Socioeconomics/Regional Economics

The socioeconomic analysis evaluates the effect of changing expenditures on economic activity in the general vicinity of Flaming

Gorge National Recreation Area. The economic impact region is defined by the Daggett and Uintah Counties in Utah and Sweetwater County in Wyoming. Given the minor effect on local expenditures from changes in hydropower and agricultural production, the analysis focuses exclusively on recreation expenditures. The combined river and reservoir recreation expenditure impacts of the Action Alternative appear to be positive, but minor, under all hydrologic conditions.