CHAPTER I

Purpose of and Need for Action

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The Federal action considered in this environmental impact statement (EIS) is the operation of Glen Canyon Dam, Colorado River Storage Project, Arizona. The Secretary of the Interior (Secretary) called for a reevaluation of dam operations. The purpose of this reevaluation is to determine specific options that could be implemented to minimize—consistent with law—adverse impacts on the downstream environmental and cultural resources and Native American interests in Glen and Grand Canyons.

The need for this reevaluation stems from impacts to downstream resources caused by the operation of Glen Canyon Dam. Such impacts have been identified from scientific studies and have resulted in significant public concern. Analysis of an array of reasonable alternatives is needed to allow the Secretary to balance and meet statutory responsibilities for protecting downstream resources for future generations and producing hydropower, and to protect affected Native American interests.

The underlying project purpose(s) is defined by section 1 of the Colorado River Storage Project Act of 1956 (43 United States Code (U.S.C.) 620), which authorized the Secretary to "construct, operate, and maintain" Glen Canyon 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. . .*

In 1968, Congress enacted the Colorado River Basin Project Act (43 U.S.C. 1501 et seq.). This act 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 flood; improving navigation; providing for the storage and delivery of 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 Glen Canyon Dam) were mandated by section 1552 of the Colorado River Basin Project Act. Article 1.(2) of these 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.*

The Colorado River Compact (1922) and the Upper Colorado River Basin Compact (1948) do not affect obligations to Native American interests. Article VII and Article XIX, part a,

respectively, of the 1922 and 1948 compacts provide that:

> *Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian Tribes.*

The Colorado River Storage Project Act of 1956, the Colorado River Basin Project Act of 1968, and the associated *Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs* (Long-Range Operating Criteria) did not alter these compact provisions.

In addition to the Secretary's decision calling for a reevaluation, Congress subsequently enacted the Grand Canyon Protection Act of 1992. Section 1802 (a) of the act requires the Secretary to operate Glen Canyon Dam:

> *. . . in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreational Area were established, including, but not limited to natural and cultural resources and visitor use.*

Section 1802(b) of the act further requires that the above mandate be implemented in a manner fully consistent with existing law. Section 1802(c) states that the purposes for which Grand Canyon National Park and Glen Canyon National Recreation Area were established are unchanged by the act. Section 1804 (a) of the act requires the Secretary to complete an EIS no later than October 30, 1994, following which, under section 1804 (c), the Secretary is to "exercise other authorities under existing law, so as to ensure that Glen Canyon Dam is operated in a manner consistent with section 1802." Section 1804 (c) also requires that the criteria and operating plans are to be "separate from and in addition to those specified in section 602 (b) of the Colorado River Basin Project Act of 1968."

Glen Canyon Dam was completed by the Bureau of Reclamation (Reclamation) in 1963, prior to enactment of the National Environmental Policy Act of 1969 (NEPA). Consequently, no EIS was filed regarding the construction or operation of Glen Canyon Dam. Since the dam has long been completed, alternatives to the dam itself have been excluded from the scope of the analysis.

This EIS is intended to meet the disclosure requirements of the National Environmental Policy Act.

Environmental impacts of the alternatives will be considered, along with other factors, in a separate record of decision (ROD) that will be prepared after filing the final EIS. The ROD will include the type or nature of the decision to be made, the forcing event, background information significant to an understanding of the situation, issues and decision factors, unresolved issues, and a clear description of options. It also will address comments received by Reclamation after filing the final EIS. The Secretary of the Interior is the responsible decisionmaker.

BACKGROUND

Since the dam was completed, increasing concern has been expressed by the public and Federal and State agencies about how Glen Canyon Dam operations may be adversely affecting downstream resources. In response to these concerns, the Secretary directed Reclamation to prepare an EIS on Glen Canyon Dam operations. In his July 1989 news release announcing the EIS, the Secretary stated: "It is time to gather the facts about this issue, to give all interested parties a chance to explain their positions, and to do so in full view of the American people." The Secretary noted that this issue is "an opportunity to balance energy and environment needs."

Glen Canyon Dam—the key feature of the Colorado River Storage Project—is a multipurpose

facility. The Colorado River Storage Project Act directs the Secretary to operate project powerplants ". . . so as to produce the greatest practicable amount of power and energy that can be sold at firm power and energy rates . . .." To this end, the powerplant at Glen Canyon Dam historically has been used primarily for peaking power generation. Fluctuating releases associated with peaking power operations have caused concern among State, Federal, and Tribal resource management agencies; river users who fish in Glen Canyon and take white-water raft trips in Grand Canyon; and Native American and environmental groups concerned about detrimental effects on cultural resources and downstream plants, animals, and their habitats.

These concerns were expressed most forcefully by the public during two Reclamation studies on possible increases in peaking power generation at Glen Canyon Dam. The studies were made to determine benefits and costs of:

1. Adding one or more generators at the dam (Peaking Power Study)

2. Increasing the capacity of the existing generators (Uprate and Rewind Program)

Adverse public reaction to the Peaking Power Study led to its termination in 1980. Reclamation published an environmental assessment (EA) and a finding of no significant impact (FONSI) on the Uprate and Rewind Program in December 1982. Subsequently, the uprate and rewinduprate and rewind of the generators was completed, but Reclamation agreed not to use the increased powerplant capacity (as part of the EA and FONSI) until completion of a more comprehensive study on the impacts of historic and current dam operations on environmental resources throughout Glen and Grand Canyons. Therefore, maximum releases have been limited to 31,500 cubic feet per second (cfs) instead of the potential 33,200 cfs that resulted from the uprate and rewinduprate and rewind.

In December 1982, Reclamation initiated Phase I of the multiagency Glen Canyon Environmental Studies (GCES) to respond to the concerns of the public and other Federal and State agencies. GCES Phase I was completed in 1988. Phase II is further defining impacts to the natural environment, associated public uses, cultural resources, non-use value, and power economics. Additional information on the GCES is found later in this chapter.

The environmental studies included special research flows that were conducted from June 1990 to July 1991 to evaluate resource responses to a variety of discharge parameters and to provide data for this EIS.

To protect downstream resources until completion of this EIS and the ROD, Reclamation began testing proposed interim flows on August 1, 1991. An EA and a FONSI (Bureau of Reclamation, 1991d) were completed, and the interim operating criteria were implemented on November 1, 1991. Although the criteria may be modified based on new information, they will remain in effect until the EIS and ROD are completed. These interim criteria are essentially the same as those detailed under the Interim Low Fluctuating Flow Alternative in chapter II.

Cooperating Agencies

The Secretary designated Reclamation as lead agency in preparing this EIS. Cooperating agencies are: Bureau of Indian Affairs (BIA), National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), Department of Energy's Western Area Power Administration (Western), Arizona Game and Fish Department (AGFD), Hopi Tribe, Hualapai Tribe, Navajo Nation, Pueblo of Zuni, San Juan Southern Paiute Tribe, and Southern Paiute Consortium.

Representatives from Reclamation, NPS, FWS, Western, AGFD, U.S. Geological Survey (USGS), Hopi and Hualapai Tribes, the Navajo Nation, and a private consulting firm served on the EIS team. The preparation of this EIS required

close cooperation among the cooperating agencies, the interagency EIS team, and GCES (see figure I-1).

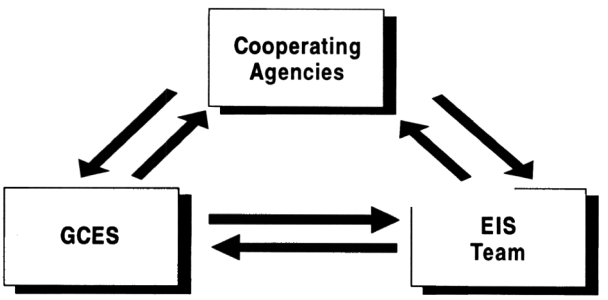

Figure I-1.—Ongoing interactive communication was essential to the Glen Canyon Dam EIS process.

Management Responsibilities

Federal agencies, the AGFD, the Hualapai Tribe, and the Navajo Nation have management responsibilities associated with Glen and Grand Canyons. These agencies have developed resource management objectives that describe the desired condition of specific resources and outline goals for future management.

Federal agencies with management objectives include Reclamation, NPS, FWS, Western, and BIA

Reclamation is responsible for operating the Colorado River Storage Project. Water management objectives are based on statutes specific to water storage and delivery (see "Law of the River"). Annual and long-term operating plans are prepared in consultation with the Basin States and the public, as well as agencies with jurisdiction by law.

NPS manages Grand Canyon National Park and Glen Canyon and Lake Mead National Recreation Areas. NPS management objectives, which are based on the National Park Service Organic Act and the various statutes reserving these lands for park purposes, are described in the Colorado River Management Plan and other general management plans. These plans are prepared with public involvement and in consultation with Indian Tribes and other agencies with jurisdiction by law.

- FWS provides Federal leadership to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the public. In Glen and Grand Canyons, the fish and wildlife resource concerns of FWS include threatened and endangered species, migratory birds, and native and sport fish. Objectives for fish and wildlife resources in the Grand Canyon ecosystem are addressed in the Fish and Wildlife Coordination Act Report (see FWS recommendations in attachment 4). Objectives for threatened and endangered species are specified in recovery plans, which are required by the Endangered Species Act.

- Western's management objectives are based on statutory responsibilities pursuant to the Department of Energy Organization Act; section 5 of the Flood Control Act; section 9 of the Reclamation Project Act; and, in the case of Glen Canyon Dam, the Colorado River Storage Project Act, as well as business, environmental, and other public concerns.

- Although BIA has no management role in the proposed action, it has management goals that include fostering the self-determination of Indian Tribes. Its role is to assure that Indian Tribe interests are coordinated with other Federal agencies and to provide advice and assistance to tribes when requested to do so.

AGFD management objectives for the Colorado River fishery are specified in its Arizona Cold Water Sportfishes Strategic Plan, 1991-1995, and Non-Game and Endangered Wildlife Program Strategic Plan, 1991-1995. These management objectives are in concert with NPS objectives for the river corridor.

The Hualapai Tribe and Navajo Nation manage all natural and cultural resources within their reservation boundaries, which includes some lands along the river corridor downstream of Glen Canyon Dam. In addition, many sites located on Federal lands have cultural, ancestral, and

spiritual significance to Native Americans—including Havasupai, Hopi, Hualapai, Navajo, Paiute, and Zuni—and these ties must be considered in Federal decisionmaking.

- The Hualapai Tribe cooperates with Federal, State, and local agencies in managing its resources. Management goals of the tribe are long-term sustainable and balanced multiple use of its resources. The Hualapai Tribe's responsibility in relation to the Colorado River and Grand Canyon is one of stewardship of a sacred trust. The basis for its objectives comes from its Conservation Ordinance 24-70, 1990 Revision.

  The Navajo Nation cooperates with Federal, State, and local agencies in managing its resources. The management objectives of the Navajo Nation are expressed in the Tribal regulations and internal policy statements and position papers.

- Management objectives of other Indian Tribes with interest in Glen and Grand Canyons, but whose lands do not border the Colorado River mainstem (Havasupai, Hopi, Paiute, and Zuni), are the preservation of the canyon's natural and cultural resources to maintain their values to the tribes.

Resource management objectives and an assessment of how well the various alternatives would achieve these objectives are presented in chapter II under "Summary Comparison of Alternatives."

DOCUMENT ORGANIZATION

This EIS document consists of five chapters:

Chapter I: describes the purpose of and need for the proposed Federal action, location and setting, authorities and institutional constraints, Glen Canyon Environmental Studies, the relationship between this EIS and Western's Electric Power Marketing EIS, and a scoping summary.

Chapter II: describes the process used to formulate alternatives, the alternatives considered in detail, the alternatives considered but eliminated from detailed study, and a summary comparison of alternatives and impacts.

Chapter III: describes the environmental and other resources of the area that would be affected by the alternatives if they were implemented.

Chapter IV: describes and analyzes the environmental impacts of each alternative considered in detail.

Chapter V: describes the scoping process and coordination with the public, Federal agencies, Tribal Governments, and private organizations that occurred during preparation of this EIS; and the distribution list.

A list of preparers, glossary, conversion tables, and bibliography also are included as part of the document.

The attachments in this volume include the environmental commitments, Grand Canyon Protection Act, Long-Range Operating Criteria, fish and wildlife consultation, programmatic agreement on cultural resources, and supporting data on the alternatives.

Two separate volumes accompany this volume. A volume entitled "Summary" contains a brief but complete overview of the contents of the final EIS. The "Comments and Responses" volume summarizes the more than 33,000 public comments that were received on the draft EIS, along with the EIS team's responses.

An appendix volume was distributed with the draft EIS and contains sections on long-term monitoring and research, hydrology, water quality, sediment, and hydropower.

LOCATION AND SETTING

The EIS focuses on the Colorado River corridor from Lake Powell, formed by Glen Canyon Dam in northwestern Arizona, southward through Glen and Marble Canyons and westward through Grand Canyon to Lake Mead (see frontispiece

map). However, this document will disclose all significant impacts of the alternatives wherever they may occur.

The uppermost 15 miles of the river are in Glen Canyon, which is part of the Glen Canyon National Recreation Area; the remaining 278 miles of the river flow through Grand Canyon National Park. The Navajo Indian Reservation is immediately east of both park units and comprises the eastern part of Glen and Marble Canyons. The Hopi Indian Reservation is on the plateau farther east of Marble Canyon. The Havasupai Indian Reservation surrounds upper Havasu Creek, immediately south of Grand Canyon National Park. The Hualapai Indian Reservation comprises the southern portion of western Grand Canyon, adjacent to Grand Canyon National Park.

Some regional impacts occur outside of the immediate geographic area and are also evaluated. For example, power generated at Glen Canyon Dam is marketed in Wyoming, Utah, Colorado, Arizona, Nevada, and New Mexico.

Grand Canyon National Park

Grand Canyon National Park, located downstream from Glen Canyon Dam, was first set aside for park purposes as a national monument on January 11, 1908, and was expanded and made a national park on February 16, 1919. Additions and boundary changes were made in 1927 and at various other times. The purposes for which these lands were reserved are stated in the various proclamations and acts creating the park. They identify these lands as "an object of unusual scientific interest, being the greatest eroded canyon within the United States" and warned unauthorized persons "not to appropriate, injure or destroy any feature" of the monument. In 1919, Congress dedicated these lands as "a public park for the benefit and enjoyment of the people" (Act of February 16, 1919, 40 Stat. 1175). In 1975, Congress declared that the entire Grand Canyon "is a natural feature of national and international significance" (16 U.S.C. 228a).

Grand Canyon National Park was dedicated as a World Heritage Site on October 26, 1979, joining "a select list of protected areas around the world whose outstanding natural and cultural resources form the common inheritance of all mankind."

Historical Perspective

Predam Flows

The predam period was characterized by large, year-to-year, seasonal, and sometimes daily variability in flow and sediment loads and large seasonal variation in water temperature. Melting of the Rocky Mountain snowpack typically produced high runoff of long duration during the late spring and early summer. Annual maximum daily flows greater than 80,000 cfs were common; in some years they exceeded 100,000 cfs. In contrast, flows less than 3,000 cfs were typical throughout late summer, fall, and winter. Flows did not fluctuate daily as they do with dam operations, but neither were they steady. During spring snowmelt periods and flash floods from tributaries or side canyons, short duration—but occasionally very high magnitude—changes in flow occurred at intervals of a few days or less. Sediment load increased during the spring runoff and again in late summer from tributary floods. Water temperatures ranged from near freezing in winter to more than 80 degrees Fahrenheit (°F) in late summer.

Postdam Flows (Historic Operations)

Glen Canyon Dam replaced seasonal flow variations with daily fluctuations, greatly reduced sediment load (supplied only by downstream tributaries), and resulted in nearly constant water release temperatures year-round—averaging a cool 46 °F.

The variability in average daily flows also has been reduced during the postdam period. Mean daily flows have exceeded 30,000 cfs (approximate powerplant capacity) only about 3 percent of the time (18 percent, predam) and have been less than 5,000 cfs only about 10 percent of the time (16 percent, predam). Fluctuations within the day, however, have increased for power generation purposes. Median (equaled or exceeded 50 percent of the time) daily fluctuations (difference

between minimum and maximum daily release) have ranged from about 12,000 cfs in October to about 16,000 cfs in January and August.

Glen Canyon Dam Operations

Glen Canyon Dam operations are affected by physical factors—including reservoir capacity, annual runoff, and discharge capacity—as well as by legal and institutional factors specified in various Federal laws, interstate compacts, international treaties, and Supreme Court decisions.

The *Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs* contains the principal guidelines for annual and monthly operations resulting from the physical, legal, and institutional factors. These criteria are determined by the Secretary with participation by the States and are subject to a formal review at least every 5 years. (See attachment 3.)

A detailed description of Glen Canyon Dam operations can be found in chapter II under the No Action Alternative.

Physical Constraints. Glen Canyon Dam stores and releases water from Lake Powell, which has an active capacity of about 24.3 million acre-feet (maf). Water can be released from Glen Canyon Dam in the following three ways (see figure I-2).

1. *Powerplant releases.* Glen Canyon Powerplant has eight generators with a maximum combined

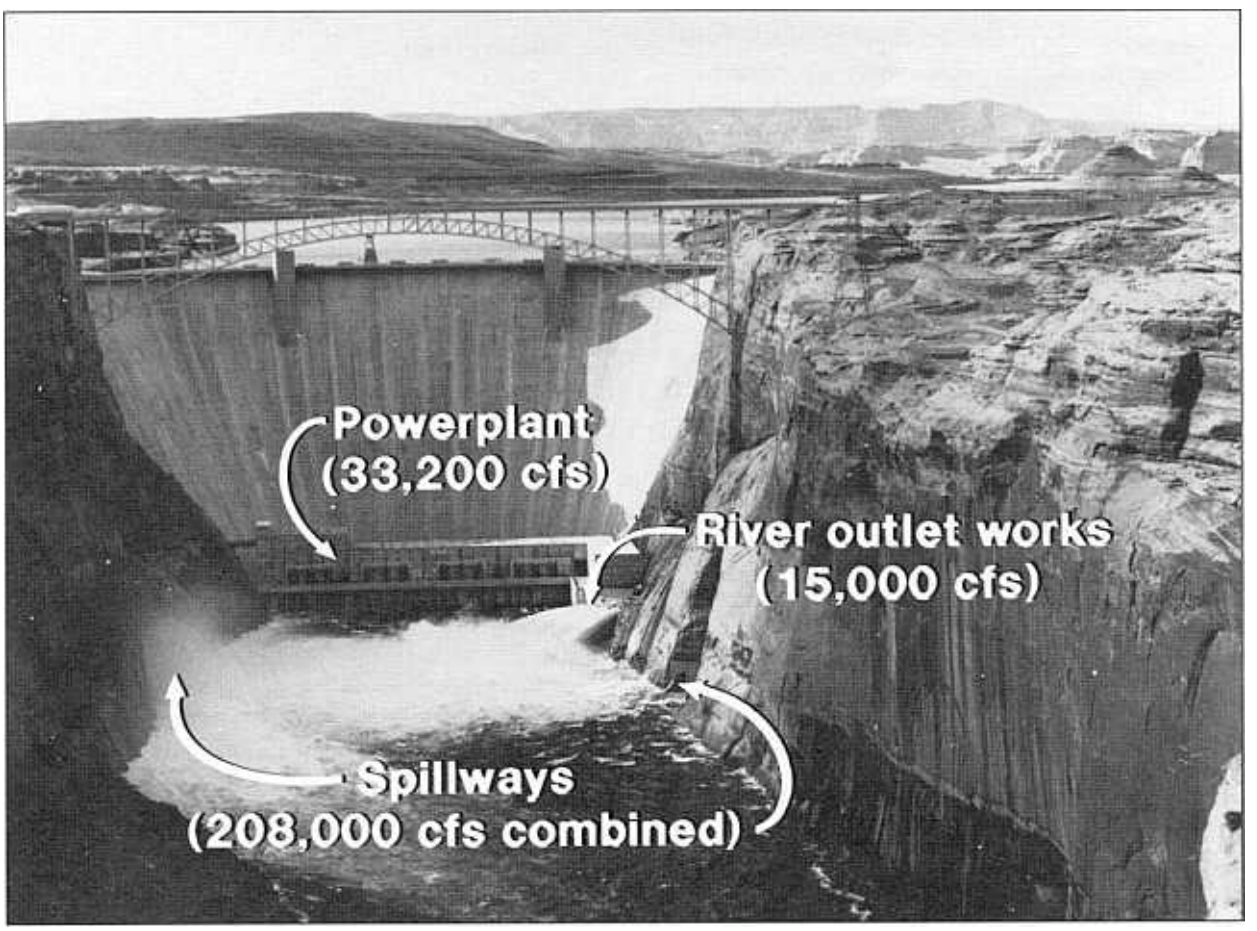

Figure I-2.—Photograph of Glen Canyon Dam and Powerplant showing water release capacities of the powerplant, outlet works, and spillways.

capacity of 1,356,000 kilowatts. The maximum combined discharge capacity of the eight turbines is approximately 33,200 cfs when Lake Powell is full; however, releases during fluctuations are limited to 31,500 cfs. When the reservoir is less than full, maximum possible discharge is reduced. Discharge through the turbines is the preferred method of release because electricity and its associated revenue are produced.

2. *River outlet works releases.* The capacity of the river outlet works is 15,000 cfs. The river outlet works are used when there is a need to release more water than can be passed through the powerplant. The outlet works are almost always used in conjunction with powerplant releases, producing combined releases up to 48,200 cfs.

3. *Spillway releases.* Releases through the spillways bypass both the powerplant and the river outlet works. The combined capacity of the right and left spillways is approximately 208,000 cfs. Spillway releases are made only when necessary to avoid overtopping the dam or to lower the level of Lake Powell. Spillway releases are avoided whenever possible, not only to prevent powerplant bypasses, but also because the service life of the spillways is shorter than that of the other release structures.

Although the combined release capacity of these facilities is 256,000 cfs, the maximum combined release from Glen Canyon Dam is expected never to exceed 180,000 cfs.

AUTHORITIES AND INSTITUTIONAL CONSTRAINTS

Federal statutes establish a number of responsibilities for the Secretary. These legislated authorities relate to management of numerous agencies, projects, and lands–many of which have bearing on how Glen Canyon Dam is operated. Many responsibilities are specifically mandated, while discretionary authority is given for dealing with others.

Grand Canyon Protection Act of 1992 (Public Law 102-575)

This act addresses protection of Grand Canyon National Park, Glen Canyon National Recreation Area, interim operating criteria, long-term monitoring and research, and replacement power, as well as other administrative provisions related to preserving Grand Canyon (see attachment 2).

Law of the River

The "Law of the River," as applied to the Colorado River, is a collection of Federal and State statutes, interstate compacts, court decisions and decrees, an international treaty with Mexico, and criteria and regulations determined by the Secretary. Included are (in chronological order):

Colorado River Compact of 1922 (Wilbur and Ely, 1948)

Boulder Canyon Project Act of 1928 (43 U.S.C. 617-617t)

California Limitation Act of 1929 (Chapter 16, 48th Session; Statutes and Amendments to the Codes, 1929, pp. 38-39)

California Seven-Party Agreement of 1931 (Nathanson, 1978)

Boulder Canyon Project Adjustment Act of 1940 (43 U.S.C. 618-618o)

Mexican Water Treaty of 1944, Treaty Series 994 (59 Statute (Stat.) 1219)

Upper Colorado River Basin Compact of 1948 (Nathanson, 1978)

Colorado River Storage Project Act of 1956 (43 U.S.C. 617)

General Principles to Govern, and Operating Criteria for, Glen Canyon Reservoir (Lake Powell) and Lake Mead during the Lake Powell Filling Period (*Federal Register*, 27 F.R. 6851, July 12, 1962)

Addition Regulation No. 1 (*Federal Register*, 27 F.R. 6850, July 12, 1962)

Arizona v. California et al., 373 U.S. 546 (1963)

Arizona v. California et al., (decree) 376 U.S. 340 (1964); (supplemental decree) 439 U.S. 419 (1979); (second supplemental decree) 466 U.S. 144 (1984)

Colorado River Basin Project Act of 1968 (43 U.S.C. 1501 et seq.)

Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (*Federal Register*, 35 F.R. 8951-52, June 10, 1970)

Colorado River Basin Salinity Control Act of 1974 (43 U.S.C. 620d, 1571-1578, 1591-1599)

Hoover Dam Flood Control Regulations of 1981 (33 Code of Federal Regulations (CFR) 208.11)

National Parks

Several laws established or added lands to national parks along the river corridor. These park units were established to provide for public outdoor recreation use and enjoyment and to preserve the scenic, scientific, and historic features of the area.

Antiquities Act of 1906 (16 U.S.C. 431 et seq.)

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)

Grand Canyon National Park Establishment Act (16 U.S.C. 221, 221a, 221b)

Grand Canyon National Park Enlargement Act (16 U.S.C. 227, 228a-228j)

Lake Mead National Recreation Area Establishment Act (16 U.S.C. 460n, 460n-1-9)

Glen Canyon National Recreation Area Establishment Act (16 U.S.C. 460dd-1-9)

Redwood National Park Act of 1978 (Public Law (P..L.) 95-250, 92-Stat. 163 as amended)

Energy Policy Act of 1992 (P.L. 102-486, Sec. 2402)

Environmental

Several laws and executive orders were designed to restore and protect the natural environment of the United States—air, water, land, and fish and wildlife.

Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq.)

Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 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.)

National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)

Clean Air Act (42 U.S.C. 7401 et seq.)

Clean Water Act of 1972 (33 U.S.C. 1251 et seq.)

Endangered Species Act of 1973 (16 U.S.C. 1532 et seq.)

Executive Order 11991, Protection and Enhancement of Environmental Quality, 1977

Executive Order 11988, Floodplain Management, 1977

Executive Order 11990, Protection of Wetlands, 1977

Cultural Preservation

Several laws and executive orders were designed to protect and preserve historic and cultural resources under Federal control in consultation with Indian Tribes.

Historic Sites, Buildings, and Antiquities Act (16 U.S.C. 461 et seq.)

Archaeological and Historic Preservation Act (16 U.S.C. 469 et seq.)

National Historic Preservation Act (16 U.S.C. 470 et seq.)

Executive Order 11593, Protection and Enhancement of the Cultural Environment, 1971

Archaeological Resources Protection Act of 1979 (16 U.S.C. 470 et seq.)

Native American

Several laws and treaties established reservations and protect the rights of Native Americans to express, believe, and exercise traditional religious practices. Federal agencies are responsible for consulting with Indian Tribal Governments and traditional religious leaders to determine appropriate actions necessary for protecting and preserving Native American religious cultural rights and practices.

American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)

Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.)

Religious Freedom Restoration Act of 1993 (P.L. 13-141)

Laws or treaties establishing Indian Reservations within or adjacent to the study area:

Havasupai Indian Reservation: established by Executive Orders of November 23, 1880; March 31 1882.

Hualapai Indian Reservation: established by Executive Orders of January 4, 1883; June 2, 1911; and May 29, 1912.

Navajo Indian Reservation: established by treaty of June 1, 1868, 15 Stat. 667. Other parcels were set apart as additions to the reservation or for Indian purposes by Executive Orders of October 29, 1878; January 6, 1880; May 17, 1884; and January 8, 1900. Congress added land to the Western Navajo Indian Reservation and created the Canyon de Chelly National Monument by Act of May 23, 1930, 46 Stat. 378, Act of February 14, 1931, 46 Stat. 1161 (codified at 16 U.S.C. section 445 to 445b); Act of June 14, 1934, 48 Stat. 960 described the exterior boundaries of the reservation.

GLEN CANYON ENVIRONMENTAL STUDIES

The Glen Canyon Environmental Studies are an interagency effort to examine short- and long-term effects of historic, current, and alternative dam operations on sediment, vegetation, fish, wildlife, recreation, cultural resources, power economics, and non-use values. Agencies cooperating in the studies are Reclamation, NPS, Western, USGS, FWS, Hopi Tribe, Hualapai Tribe, Navajo Nation, Pueblo of Zuni, San Juan Southern Paiute Tribe, and the Southern Paiute Consortium with contributions from AGFD, private consultants, universities, and river guides. Funding for these studies has been provided mainly from the sale of hydropower.

GCES technical studies are reviewed by the responsible agency, the GCES senior scientist, and the National Research Council. These studies form the basis of the effects analysis presented in "Chapter IV, Environmental Consequences."

Review of the GCES by a National Research Council committee began in 1986. This Committee to Review Glen Canyon Environmental Studies has provided review and comment on the scientific and technical research studies associated with the GCES program and advice on alternative operation schemes for Glen Canyon Dam. In 1987, the committee completed its first report, *River and Dam Management: A Review of the Bureau of Reclamation's Glen Canyon Environmental Studies* (National Research Council, 1987). When preparation of this EIS was announced, the committee was requested to review the EIS as it developed. In May 1990, the committee conducted a symposium on the application of GCES results to the management of Glen Canyon Dam. A proceedings of the symposium was published entitled *Colorado River Ecology and Dam Management* (National Research Council, 1991).

Phase I (1982-88)

The GCES began as an interagency effort to study conditions downstream from the dam related to two major questions:

1. Are current operations of the dam, through control of the flows in the Colorado River, adversely affecting the existing river-related environmental and recreational resources of Glen and Grand Canyons?

2. Are there ways to operate the dam, consistent with Colorado River Storage Project water

delivery requirements, that would protect or enhance the environmental and recreational resources?

To accomplish the study goals, more than 30 technical studies in the fields of biology, recreation, sedimentation, and hydrology were conducted. A final report integrating the results of all studies (U.S. Department of the Interior, 1988) as well as executive summaries of these reports (U.S. Department of the Interior et al., 1988) were published. These studies were conducted during the wettest 3 years on record (1983-85). While the studies provided considerable information on the effects of floods, they provided only limited information on the effects of powerplant operations.

Results of Phase I studies indicated the following relationships:

> Glen Canyon Dam and its operation have had an impact on the downstream environment. Changes have occurred and continue to occur to many ecosystem resources. Some changes are considered positive and some negative.
>
> Operations and management can be modified to minimize losses of some resources and to protect and enhance others.
>
> The ecosystem of Glen and Grand Canyons is dynamic and, with careful management, more harmonious environmental relationships may gradually be reestablished.

At the conclusion of these studies (now referred to as GCES Phase I), Reclamation determined that additional research was needed to more fully respond to the initial questions and to provide needed information; therefore, a second group of studies was initiated.

Phase II (1988-present)

In June 1988, the Department of the Interior determined that the GCES should be continued to gather additional data on specific operational elements. This phase of studies initially was to take place over 4 to 5 years; however, the timetable and research approach were adjusted after the Secretary announced on July 27, 1989, that an EIS would be prepared.

The research schedule was accelerated by using special "research flows" to provide more timely data for the EIS. These research flows were a series of carefully designed discharges and data collection programs conducted from June 1990 through July 1991. Each research flow lasted 14 days and included 3 days of steady 5,000-cfs flow and 11 days of either steady or fluctuating flow. The research flows provided a means to evaluate short-term responses of certain resources to a variety of discharge parameters, including minimum and maximum flows, rate of change in flow, and range of daily fluctuations.

Phase II research is based on an ecological system approach structured around specific hypotheses and research flows (Bureau of Reclamation, 1990c). Included are 10 primary study components and 2 monitoring components. Certain GCES studies will extend beyond the EIS schedule; however, sufficient information was available to prepare this EIS.

RELATIONSHIP BETWEEN GLEN CANYON DAM EIS AND ELECTRIC POWER MARKETING EIS

Western Area Power Administration is preparing an EIS on its Salt Lake City Area Integrated Projects (SLCA/IP) Electric Power Marketing and Allocation Criteria. The criteria establish the terms used to allocate capacity and energy generated by the dams of the Colorado River Storage, Collbran, and Rio Grande Projects (collectively called the SLCA/IP). Powerplants in the SLCA/IP operated by Reclamation are Glen Canyon, Flaming Gorge, Blue Mesa, Morrow Point, Crystal, Upper Molina, Lower Molina, Fontenelle, and Elephant Butte. Glen Canyon Dam is the largest power producer within this group.

Although all of these hydroelectric powerplants are interconnected, Glen Canyon operations by Reclamation and power marketing by Western are appropriately addressed as two separate (but related) matters. The primary focus of the Glen Canyon Dam EIS is the physical environment of the Colorado River downstream from the dam. The primary focus of the Western EIS is system-wide power marketing and allocation. The power marketing EIS looks at possible environmental or operational effects caused by changes in power marketing programs, while the Glen Canyon Dam EIS evaluates the effects of differing modes of dam operations on the human environment. Ultimately, the Glen Canyon Dam EIS identifies a level of power resource available for use by Western to meet its marketing commitments.

Western can evaluate different ways of marketing power before knowing the specific operational changes that may be adopted for Glen Canyon Dam. Similarly, a Department of the Interior decision to change how water is released from the dam can be made before the Department of Energy decides how to market power.

SCOPING SUMMARY

The Glen Canyon Dam EIS scoping process was initiated in early 1990 to receive public input on the appropriate scope of the EIS, consistent with NEPA requirements and implementing regulations. Thorough effort was made to notify all potentially interested parties about the Glen Canyon Dam EIS scoping process and opportunities to provide comment. Reclamation increased opportunities for public participation through public meetings, news releases, mailings, legal notices, and contacts with media, organizations, and individuals.

The *Federal Register* notice of environmental scoping meetings was published on February 23, 1990, with a corresponding news release announcing the opening of the scoping process. The scoping comment period initially established for March 12 through April 16, 1990, was extended to May 4, 1990, in response to public comment.

Public meetings were held in Salt Lake City, Denver, Phoenix, Flagstaff, Los Angeles, San Francisco, and Washington, DC. More than 17,000 comments were received during the scoping period, reflecting national attention and the intense interest of people in the Western States.

Public Issues and Concerns

Reclamation contracted with Bear West Consulting Team, a private business, to prepare a detailed content analysis of the oral and written scoping comments. Their methods and analysis were approved by the cooperating agencies.

As a result of the analysis, the following were determined to be resources or issues of public concern: beaches, endangered species, ecosystem, fish, power costs, power production, sediment, water conservation, rafting/boating, air quality, the Grand Canyon wilderness, and a category designated as "other" for remaining concerns. Comments regarding interests and values were categorized as: expressions about the Grand Canyon, economics, nonquantifiable values, nature versus human use, and the complexity of Glen Canyon Dam issues (Bureau of Reclamation, 1990b).

Following the formal public scoping period and review of the comments, representatives from the cooperating agencies and public interest groups met in July 1990 to determine criteria for developing reasonable alternatives for the EIS. These criteria directed that the alternatives:

- Be consistent with the scope of the EIS
- Be economically and technically feasible
- Reflect legal considerations
- Have general institutional acceptability
- Be timely to implement
- Be able to be monitored and adjusted
- Meet various agency mandates
- Be supported by data
- Be multipurpose (integrated) and include all major resources
- Include mitigation

A more detailed discussion of scoping can be found in "Chapter V, Consultation and Coordination."

Significant Issues Identified for Detailed Analysis

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

Issue: *How do dam operations affect the amount and quality of **WATER** available from Lake Powell at specific times?*

Indicators:
Acre-feet of ***streamflows***
Frequency and volume of ***floodflow and other spills***
Acre-feet ***reservoir storage*** in Lakes Powell and Mead
Acre-feet of annual ***water allocation deliveries***
Acre-feet of ***Upper Basin yield determination***
Chemical, physical, and biological characteristics of ***water quality***

Issue: *How do dam operations affect **SEDIMENT** resources throughout the study area?*

Indicators:
Probability of net gain in ***riverbed sand***
Active width and height of ***sandbars***
Erosion of ***high terraces***
Constriction of ***debris fans and rapids***
Elevation of ***deltas***

Issue: *How do dam operations affect **FISH**—their life cycles, habitat, and ability to spawn?*

Indicators:
Abundance of *Cladophora* and associated diatoms for ***aquatic food base***
Reproduction, recruitment, and growth of ***native fish***
Reproduction, recruitment, and growth of ***non-native warmwater and coolwater fish***
Level of ***interactions between native and non-native fish***
Reproduction, recruitment, and growth of ***trout***

Issue: *How do dam operations affect **VEGETATION** in the river corridor?*

Indicators:
Area of ***woody plants*** and species composition
Area of ***emergent marsh plants***

Issue: *How do dam operations affect area **WILDLIFE AND** their **HABITAT**?*

Indicators:
Area of ***woody and emergent marsh plants*** for wildlife habitat
Abundance of ***aquatic food base*** for wintering waterfowl

Issue: *How do dam operations affect the populations of **ENDANGERED AND OTHER SPECIAL SPECIAL STATUS SPECIES** throughout Glen and Grand Canyons?*

Indicators:
Reproduction, recruitment, and growth of ***humpback chub and razorback and flannelmouth suckers***
Trout and aquatic food base for ***bald eagle***
Aquatic food base for ***belted kingfisher***
Area of woody plants for ***southwestern willow flycatcher***
Maximum flow for ***Kanab ambersnail***

Issue:	*How do dam operations affect the continued existence of **CULTURAL RESOURCES** in the study area?*
Indicators:	Number of ***archeological sites*** directly, indirectly, or potentially affected Number of ***Native American traditional cultural properties and resources*** directly, indirectly, or potentially affected
Issue:	*How do dam operations affect other electrical production in the area, including those methods that have impacts on **AIR QUALITY**?*
Indicators:	Sulfates in ***Grand Canyon air*** Tons of sulfur dioxide and nitrogen oxides in ***regional air***
Issue:	*How do dam operations affect **RECREATION** in the study area?*
Indicators:	***Fishing*** trip attributes and angler safety ***Day rafting*** trip attributes and access ***White-water boating*** trip attributes, camping beaches, safety, and wilderness values ***Lake activities and facilities*** Net ***economic benefits*** of recreation
Issue:	*How do dam operations affect the ability of Glen Canyon Powerplant to supply **HYDROPOWER** at the lowest possible cost?*
Indicators:	***Power operations*** flexibility ***Power marketing*** resources, costs, and rates
Issue:	*How do changes in Glen Canyon Dam operations affect **NON-USE VALUE**?*
Indicators:	Non-use economic value in ***dollars***

Public Review of Draft EIS

On January 4, 1994, the draft EIS was filed with the Environmental Protection Agency. The official public comment period began with a January 7 *Federal Register* notice and concluded on April 11, 1994.

The full three-volume draft EIS was distributed to those listed on the distribution list in chapter V soliciting public comment. In addition, over 17,000 interested parties on the newsletter mailing list received the summary volume by itself. Reclamation received over 1,000 additional requests for either the full draft EIS or summary volume after the initial distribution.

To provide the public an opportunity to learn more about the draft EIS, members of the EIS team conducted information sessions in Salt Lake City, Phoenix, and Flagstaff in March 1994. These sessions were informational only; public comments were not taken. In addition, two briefings were conducted in Washington, DC. Public hearings were held in the same seven cities as the scoping meetings to receive oral comments on the draft EIS.

Over 33,000 written comments were received. More than 2,300 separate issues and concerns were extracted from the analysis of oral and written comments (Bureau of Reclamation, 1994b). A summary of the comments and responses is presented in a separate volume of this document, "Comments and Responses."

As a result of comments on the draft EIS and discussions with FWS, the preferred alternative described in the draft EIS was modified for the final EIS. The cooperating agencies broadly supported this modification. A more detailed description of the public review of the draft EIS can be found in "Chapter V, Consultation and Coordination."