WATER YEAR 1997 – 1998

REPORT TO CONGRESS: OPERATIONS OF GLEN CANYON DAM PURSUANT TO THE 1992 GRAND CANYON PROTECTION ACT

From

Secretary of the Interior

March 1998

TABLE OF CONTENTS

FIGURE

APPENDIXES

WATER YEAR 1997 – 1998
REPORT TO CONGRESS: OPERATIONS OF GLEN CANYON DAM PURSUANT TO THE 1992 GRAND CANYON PROTECTION ACT

REPORT TO CONGRESS

Section 1804 (c)(2) of the Grand Canyon Protection Act (GCPA) requires the Secretary of the Interior (Secretary) to:

> . . . transmit to the Congress and to the Governors of the Colorado River Basin States a report, separate from and in addition to the report specified in section 602(b) of the Colorado River Basin Project Act of 1968 on the preceding year and the projected year operations undertaken pursuant to this Act.

This report responds to the above-cited reporting requirements. The report focuses on Glen Canyon Dam operations and activities pursuant to water years 1997 and 1998, Adaptive Management Program (AMP) activities for water years 1997 and 1998, and activities of the Grand Canyon Monitoring and Research Center (GCMRC) for water years 1997 and 1998.

HISTORY

The Colorado River Storage Project (CRSP) Act of 1956 authorized the construction, operation, and maintenance of Glen Canyon Dam to regulate the flow of the Colorado River for flood control, consumptive use, and the generation of hydroelectric power. Seven years later, in 1963, Glen Canyon Dam was completed, making Lake Powell the key storage unit for the CRSP. Flow releases from the dam were adjusted daily to respond to variances in electrical demand.

At optimum operations, the generators at Glen Canyon Dam are capable of producing 1,296 megawatts of power. Water releases from the dam occur at 200-230 feet below the surface of Lake Powell, which results in clear cold water with year-round temperatures of 41°F to 45°F. The recreation, irrigation, and hydropower benefits introduced to the southwest by Glen Canyon Dam are extensive and continue to expand.

Since the damming of the river in 1963, there has been only one flow release which approached average pre-dam spring floods. In 1983, a combination of unanticipated hydrologic events in the upper Colorado River Basin, combined with a lack of available storage space in Lake Powell, resulted in emergency spillway releases from Glen Canyon Dam which reached 97,000 cubic feet per second (cfs). Except for the 1983 event, historic releases over the last 34 years have generally ranged between 1,000 cfs and 25,000 cfs, with flows averaging between 5,000 cfs and 20,000.

As a result of the construction of Glen Canyon Dam, the Colorado River ecosystem below the dam has changed significantly from its pre-dam natural character. In addition, Glen Canyon Dam's highly variable flow releases from 1964 to 1991 caused additional concern over resource degradation resulting from dam operations. In October 1991, the Secretary adopted interim operations criteria which narrowed the range of daily powerplant fluctuations. Since the signing of the operating criteria in February 1997 (see Appendix A), these releases do not now exceed 25,000 cfs, and most often range between 10,000 cfs and 20,000 cfs.

A NEED FOR SCIENTIFIC EVALUATION

Responding to concerns that changes to the Colorado River ecosystem were resulting from dam operations, the Bureau of Reclamation (Reclamation) launched the Glen Canyon Environmental Studies (GCES) program in 1982. The research program's first phase (1982-1988) focused on developing baseline resource assessments of physical and biotic resources. The second program phase (1989-1996) expanded research programs in native and non-native fishes, hydrology and aquatic habitats, terrestrial flora and fauna, cultural and ethnic resources, and social and economic impacts. Developing spatial and temporal data using a Geographic Information System was a critical part of the second phase.

By the late 1980s, sufficient knowledge had been developed to raise concerns that downstream impacts were occurring, and that additional information needed to be developed to quantify the effects and to develop management actions that could avoid and/or mitigate the impacts. This collective information, and other factors, led to a July 1989 decision by the Secretary to direct Reclamation to prepare an environmental impact statement (EIS) on the operation of Glen Canyon Dam. The intent was to evaluate alternative operation strategies to lessen the impacts of operations on downstream resources.

In October 1992, the President signed into law the Reclamation Projects Authorization and Adjustments Act, Public Law 102-575. Responding to continued concerns over potential impacts of Glen Canyon Dam operations on downstream resources, Congress included the GCPA as Title 18 of the Reclamation Projects Act. Section 1802(a) of the GCPA 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 Recreation Area were established, including, but not limited to natural and cultural resources and visitor use.

In addition, the GCPA directs the Secretary to implement section 1802 in a manner fully consistent with all existing laws that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

Section 1803 of the GCPA validated the interim operating criteria adopted by the Secretary in 1991 and provided for consultation, a deviation process, and a method for termination upon adoption of final operating criteria.

Section 1804 of the GCPA required preparation of an EIS on operations, adoption of operating criteria and plans, reports to Congress, and reallocation of costs. The EIS requirement merely validated the Secretary's earlier direction to Reclamation and provided specific timeframes for preparation and submittal. The final Environmental Impact Statement for the Operation of Glen Canyon Dam (GCDEIS) was filed with the Environmental Protection Agency in March 1995 and a Record of Decision (ROD) was signed in October 1996.

The ROD changed two flow parameters from those shown in the preferred alternative of the EIS. They were (1) increasing the normal maximum flow from 20,000 cfs to 25,000 cfs and (2) increasing the upramp rate from 2,500 cfs/hour to 4,000 cfs/hour. The ROD also changed the triggering mechanisms for conducting beach/habitat-building flows. Instead of conducting them in years in which Lake Powell storage is low on January 1, they will be conducted in years in which Lake Powell storage is high and requires reservoir releases in excess of powerplant capacity for dam safety purposes.

Following the signing of the ROD, the Secretary adopted a set of operating criteria and the 1997 Annual Plan of Operations (see Appendix B). This terminated the 1991 interim flow criteria.

Reclamation has begun the process of reallocating the costs of construction, operations, maintenance, replacement, and emergency expenditures among the purposes directed in section 1802 of the GCPA and the purposes established in the CRSP Act of April 11, 1956. Work began in water year 1997 and will continue in water year 1998. All work will be performed in consultation with the Secretary of Energy.

Section 1805 of the GCPA requires the Secretary to establish and implement a long-term monitoring and research program (see the section entitled "Adaptive Management Program" for details).

Section 1807 makes the costs of preparing the EIS, supporting studies, and long-term monitoring programs described in section 1805 nonreimbursable, except in fiscal years 1993-1997. In the years 1993-1997, the costs shall be nonreimbursable only to the extent that the effect of all provisions of the GCPA is to increase offsetting receipts. The Commissioner of Reclamation has submitted to the Congress reports on the results of the net operating receipts computations for fiscal years 1993, 1994, and 1995.

Section 1809 of the GCPA requires the Secretary of Energy, in consultation with the Secretary of the Interior and stakeholder representatives, to identify economically and technically feasible methods of replacing any power generation that is lost through adoption

of long-term operating criteria for the operation of Glen Canyon Dam. The Western Area Power Administration has completed a draft report and plans on meeting the two-year deadline cited in the GCPA.

GLEN CANYON DAM OPERATIONS – WATER YEAR 1997

Glen Canyon Dam was operated in 1997 in compliance with the ROD, operating criteria, and the 1997 Annual Plan of Operations. Total unregulated inflow to Lake Powell during 1997 was about 144 percent of normal, which resulted in an annual release of 13.8 million acre-feet (maf). Monthly releases ranged from 623,000 acre-feet (af) in November to 1,537,000 af in March. Many of these monthly releases were made as nearly constant high flows, at times reaching about 27,000 cfs in both March and June. A table of monthly release volumes and the associated power generation is shown in Appendix E.

The 1997 spring runoff forecast oscillated up and down during the late winter months as a result of varying month-to-month precipitation. The largest change occurred in early February, when the forecast increased to 171 percent of normal. This prompted an increase in releases up to the 27,000 cfs level in an effort to avoid an unplanned spill in the spring. Releases were generally above 20,000 cfs from February through September. The maximum reservoir elevation during the year was 3,695.1 during July, approximately 5 feet from full. Both high inflows and releases characterized the summer of 1997 as above normal precipitation fell across much of the Colorado River Basin. Since the end-of-water-year elevation in Lake Mead was higher than the elevation in Lake Powell, equalization provisions of the 1968 Colorado River Basin Project Act were not applicable in water year 1997.

GLEN CANYON DAM OPERATIONS – WATER YEAR 1998

The Secretary intends to operate Glen Canyon Dam in accordance with the 1998 Annual Plan of Operations (see Appendix C). The most significant event to occur thus far in water year 1998 was the November 1997 test flow. Fall 1997 inflows to Lake Powell were above normal as the result of high precipitation throughout much of the Colorado River Basin. Possibly an effect of the strong El Niño anomaly, the precipitation created several short duration flood events on the Paria River, a tributary to the Colorado River just downstream from Lees Ferry.

The floods brought an unusually large amount of sediment from the Paria drainage into the Colorado River, estimated at over 2 million cubic meters in volume. Researchers felt that this sediment would be quickly transported downstream and desired to carry out some type of high release from the dam in order to move the sediment from the main channel into eddies and channel margins where less sediment would be transported downstream. Since there were no hydrologic or dam safety reasons to conduct another beach/habitat-building

flow as in March 1996, a release at powerplant capacity was scheduled as a type of test of the habitat maintenance flow described in the GCDEIS.

On November 4-5, 1997, a 48-hour release at powerplant capacity (30,600 cfs at the time) was made. The average daily releases before and after the release were about 21,000 cfs; thus, the test flow increased the river discharge by about 10,000 cfs, a 45 percent increase. The river stage increased between about 1.5 feet to 3 feet depending on the location in the Grand Canyon. The preliminary impacts of the high flow are described in a memorandum from the GCMRC (see Appendix F).

ADAPTIVE MANAGEMENT PROGRAM

Section 1805 of the GCPA directs the Secretary to:

> . . . establish and implement long-term monitoring programs and activities that will ensure that Glen Canyon Dam is operated in a manner consistent with that of section 1802.

The Act also states that:

> Long-term monitoring of Glen Canyon Dam shall include any necessary research and studies to determine the effect of the Secretary's actions under section 1804(c) on the natural, recreational, and cultural resources of Grand Canyon National Park and Glen Canyon National Recreation Area.

One of the key elements specified in the GCDEIS and ROD is an "Adaptive Management Program." The AMP provides a process for incorporating science and recommendations from a diverse group of stakeholders in the evaluation and management of future dam operations. The AMP calls for the continued interaction of managers and scientists to monitor the effects of current dam operations on the Colorado River ecosystem, and to conduct research on alternative dam operating criteria that may be necessary to ensure protection of resources and improve natural processes.

The AMP, schematically characterized in Figure 1 on page 6, identifies the following entities that contribute to the adaptive management process:

- Adaptive Management Work Group (AMWG)
- Technical Work Group (TWG)
- Grand Canyon Monitoring and Research Center (GCMRC)
- Independent Science Review Groups (ISRG)

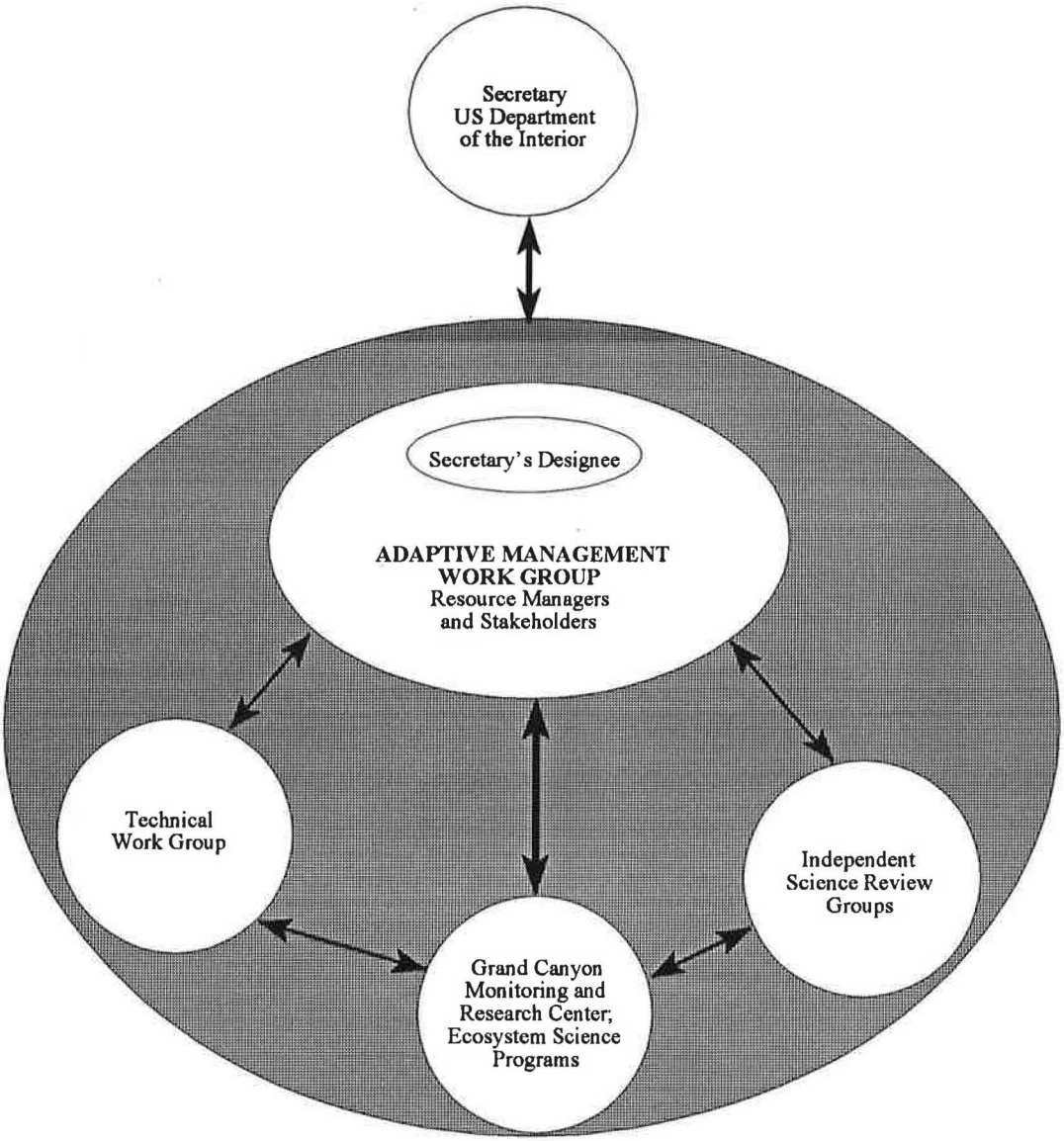


Figure 1.—Critical Entities of the Adaptive Management Program.

The AMWG is a Federal Advisory Committee chartered by the Secretary consisting of federal and state resource managers, Native American tribes, power marketers, environmental groups, recreationists, and other interested stakeholders (see Appendix G). The AMWG was established to develop, evaluate, and recommend alternative operations strategies for Glen Canyon Dam, and make recommendations to the Secretary. The AMWG does not displace federal agency legal authority and responsibility to manage resources in the best interests of both the environment and society.

In addition to creation of the AMWG, the TWG and the GCMRC were created to play vital roles as part of the adaptive management process. The TWG is composed of technical representatives appointed by the AMWG. The TWG provides the AMWG detailed guidance on issues and objectives, develops criteria and standards for monitoring and research programs, provides information for annual resource reports, and translates the AMWG's management objectives into research needs for the GCMRC. The GCMRC conducts the monitoring and research necessary to evaluate operations and the ISRG (which have yet to be formed) will provide a scientific review of overall program areas.

Adaptive Management Program Activities – Water Year 1997

In water year 1997, significant progress was made on activities relating to the AMP, including:

1. The AMP is being established by the Secretary through the development and approval of the Charter for the AMWG pursuant to the Federal Advisory Committee Act, and through the establishment of the GCMRC.

2. Formation of the AMWG and TWG and associated programs. The first meeting of the AMWG was held in September 1997 and the TWG has been meeting monthly since October 1997.

3. Complete formation of the GCMRC, completion of a "Transition Plan" for moving all activities from the GCES program to the GCMRC, and development of long-term and annual monitoring and research plans.

Actions taken for water year 1997 in the first meeting of the AMWG were as follows:

1. Approval of operating procedures for the AMWG.

2. Recommendation to the Secretary to approve the GCMRC's Water Year 1998 Annual Monitoring and Research Plan.

3. Recommendation to the Secretary for the GCMRC to develop and initiate water year 1998 monitoring and research programs for Lake Powell.

4. Objectives and information needs for all programs are to be reviewed in water year 1998 for implementation in water year 2000.

5. Recommendation to the Secretary to initiate an approximate 31,000 cfs test flow in October/November of water year 1998 to conserve sediment resources.

6. Recommendation to the Secretary to evaluate the effects of an approximate 45,000 cfs beach/habitat-building flow between January and June 1998 to mitigate the potentially negative effects of sustained high steady releases on the biological, physical, and cultural resources and riverine processes.

7. Selection of a TWG to work closely with the GCMRC in developing objectives, information needs, and monitoring and research programs.

The TWG, established as a subgroup of the AMWG, completed the following activities in water year 1997:

1. Initiated development of protocols and processes to evaluate and implement adaptive management flow regimes as recommended by the AMWG.

2. Reviewed and evaluated the GCMRC's Water Year 1999 Annual Monitoring and Research Plan.

3. Reviewed and evaluated the GCMRC's water year 1997 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem.*

4. Reviewed and evaluated the GCMRC's information on the effects of an approximate 45,000 cfs beach/habitat-building flow between January and June 1998.

Adaptive Management Program Activities – Water Year 1998

The AMWG/TWG activities include a broad cross-section of programs as follows:

1. Continue development of protocols/procedures for operation of the AMWG/TWG.

2. Review of the AMP budget process and budget allocations for short- and long-term programs.

3. Review and revision of objectives and information needs for the Colorado River ecosystem and Lake Powell monitoring and research programs.

4. Participation in conceptual modeling workshops for the Colorado River ecosystem and Lake Powell monitoring and research programs.

5. Review and recommendation of the following GCMRC documents:

- Water Year 1998 Adaptive Management Flow Regime Information.
- Water Year 1998 Contingency Monitoring and Research Plans for scheduled and unscheduled high flows.
- Water Year 1999 Annual Monitoring and Research Plan.
- Water Year 1998 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem.*

6. Development of improved processes for implementing adaptive management flows/activities.

7. Development of objectives and information needs for long-term planning for selective withdrawal (temperature control) programming.

8. In addition to ongoing monitoring and research, a high release within powerplant capacity was conducted in early November to redistribute sediment.

GRAND CANYON MONITORING AND RESEARCH CENTER

The GCMRC was established November 11, 1995, by the Assistant Secretary for Water and Science. The responsibility for the program was established in the Assistant Secretary's office, at the request of stakeholders, to represent and respond to the broad spectrum of resources, research, and monitoring needs that would have to be addressed in the AMP. The GCMRC was established early so that it could accomplish a critical transition from the GCES program which had been in place since 1982.

Grand Canyon and Monitoring and Research Center Activities – Water Year 1997

The GCMRC has developed extensive planning and documentation regarding its operation and monitoring and research plans. Activities for water year 1997 include the following:

1. Operation protocols were specified for the GCMRC cooperatively with stakeholders, and addressed planning, implementation instruments (interagency and cooperative agreements), and program and product reviews.

2. Stakeholder information needs were developed by all stakeholders in cooperation with the GCMRC. Needs were specified for a five-year period.

3. A five-year strategic plan and water year 1998 annual plan were developed, reviewed by the stakeholders, and recommended for approval by the Secretary.

4. A water year 1997 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem,* was developed to assist the AMWG in evaluating any new or modified dam operations criteria that they might recommend. The resources report will be drafted annually.

5. A total of 33 independent monitoring and research projects were managed by the GCMRC. These and other science activities contributed to 42 different technical reports and publications from the GCMRC in 1997.

6. A scientific symposium on the 1996 beach/habitat-building flow was convened by the GCMRC. Three major scientific papers are expected to result from the symposium.

Grand Canyon Monitoring and Research Center Activities – Water Year 1998

The GCMRC will implement diverse activities in water year 1998 to accommodate long- and short-term objectives and information needs of the AMWG/TWG. These activities are:

1. Develop final water year 1999 Annual Monitoring and Research Plan, requests for proposals, and cooperative agreements for implementation.

2. Prepare final water year 1998 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem*.

3. Prepare a summary of program accomplishments for water year 1998.

4. Evaluate the AMWG's specified adaptive management flows of 31,000 cfs and 45,000 cfs on the Colorado River ecosystem and Lake Powell resources.

5. Evaluate long-term sustained flows of 22,000 cfs to 27,000 cfs during much of 1997 on the Colorado River ecosystem and Lake Powell resources.

6. Initiate a program to develop conceptual ecosystem models for the Colorado River ecosystem and Lake Powell resources.

7. Review and revise where appropriate all measurement and assessment protocols for GCMRC monitoring and research programs.

APPENDIX A

OPERATING CRITERIA FOR GLEN CANYON DAM IN ACCORDANCE WITH THE GRAND CANYON PROTECTION ACT OF 1992

These Operating Criteria are promulgated in compliance with section 1804 of Public Law 102-575, the Grand Canyon Protection Act of 1992. They are to control the operation of Glen Canyon Dam, constructed under the authority of the Colorado River Storage Project Act. These Operating Criteria are separate and apart from the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs prepared in compliance with the Colorado River Basin Project Act of 1968.

1. Annual Report

As required in the Grand Canyon Protection Act, a report shall be prepared and submitted to Congress annually that describes the operation of Glen Canyon Dam for the preceding water year and the expected operation for the upcoming water year. The annual plan of operations shall include such detailed rules and quantities as are required by the Operating Criteria contained herein. It shall provide a detailed explanation of the expected hydrologic conditions for the Colorado River immediately below Glen Canyon Dam.

2. Review of Criteria

The Secretary shall review these Operating Criteria as the result of actual operating experiences to determine if the Operating Criteria should be modified to better accomplish the purposes of the Grand Canyon Protection Act. Such a review shall be made at least every five years in consultation with the appropriate federal agencies, Governors of the Colorado River Basin States, Native American tribes, representatives of academic and scientific communities, environmental organizations, the recreation industry, and contractors for the purchase of federal power produced at Glen Canyon Dam.

3. Specific Operational Constraints

The plan of operations will follow the description of the preferred alternative (Modified Low Fluctuating Flow) in the GCDEIS and the ROD. The specific criteria are as follows:

Minimum Releases – 8,000 cfs between 7:00 a.m. and 7:00 p.m. and 5,000 cfs at night.

Maximum Releases – 25,000 cfs. Several circumstances warrant exception to this restriction. These are the beach/habitat-building flows and the habitat maintenance flows (both described below) and the release of large volumes of water to avoid spills or floodflow releases from Glen Canyon Dam. These latter releases would most likely result from high snowmelt runoff into Lake Powell; if such high releases above 25,000 cfs are required, they shall be made at constant daily flow rates.

Allowable Daily Flow Fluctuations – 5,000 cfs/24 hours for monthly release volumes less than 600,000 acre-feet, 6,000 cfs/24 hours for monthly release volumes of 600,000 to 800,000 acre-feet, and 8,000 cfs/24 hours for monthly release volumes over 8,000 acre-feet.

Maximum Ramp Rates – 4,000 cfs/hr when increasing, and 1,500 cfs/hr when decreasing.

Emergency Exception Criteria – Normal powerplant operations will be altered temporarily to respond to emergencies. These changes in operations typically would be of short duration (usually less than 4 hours) and would be the result of emergencies at the dam or within the interconnected electrical system. Examples of system emergencies include:

1. Insufficient generating capacity

2. Transmission system: overload, voltage control, and frequency

3. System restoration

4. Humanitarian situations (search and rescue)

Flood Frequency Reduction Measures – The frequency of unanticipated flood flows in excess of 45,000 cfs will be reduced to no more than 1 year in 100 years as a long-term average. This will be accomplished initially through the Annual Operating Plan process and eventually by raising the height of the spillway gates at Glen Canyon Dam 4.5 feet.

Habitat Maintenance Flows – Habitat maintenance flows are high steady releases within powerplant capacity (33,200 cfs) not to exceed 14 days in March, although other months will be considered under the AMP. Actual powerplant release capacity may be less than 33,200 cfs under low reservoir conditions. These flows will not be scheduled when projected storage in Lake Powell on January 1 is greater than 19,000,000 acre-feet, and typically would occur when annual releases are at or near the minimum objective release of 8,230,000 acre-feet. Habitat maintenance flows differ from beach/habitat-building flows because they will be within powerplant capacity, and will occur nearly every year when the reservoir is low.

Beach/Habitat-Building Flows – These controlled floods will occur as described in the EIS (steady flows not to exceed 45,000 cfs, duration not to exceed 14 days, up-ramp rates not to exceed 4,000 cfs/hr, and down-ramp rates not to exceed 1,500 cfs/hr) except instead of conducting them in years in which Lake Powell storage is low on January 1, they will be accomplished by utilizing reservoir releases in excess of powerplant capacity required for dam safety purposes. Such releases are consistent with the 1956 Colorado River Storage Project Act, the 1968 Colorado River Basin Project Act, and the 1992 Grand Canyon Protection Act.

/s/ Bruce Babbitt
Secretary of the Interior

February 24, 1997
Date

APPENDIX B

GLEN CANYON DAM 1997 ANNUAL PLAN OF OPERATIONS PREPARED IN ACCORDANCE WITH THE OPERATING CRITERIA DEVELOPED FOR THE GRAND CANYON PROTECTION ACT

Under the most probable inflow conditions in water year 1997, Glen Canyon Dam is expected to release about 14.1 million acre-feet through the Grand Canyon to Lake Mead. This is about 5.9 million acre-feet greater than the minimum objective release and is the result of high snowpack conditions throughout the Colorado River Basin. Lake Powell is expected to fill in July.

Monthly release volumes from Glen Canyon Dam during 1997 are expected to range from 600,000 acre-feet to 1,500,000 acre-feet. Projected allowable fluctuations therefore will be 6,000 cfs or 8,000 cfs (see criteria). With projected monthly release volumes, it is likely that peak daily releases will exceed 20,000 cfs during the months of February through July, when monthly release volumes are at their highest for the year. Minimum releases of 5,000 cfs/hr decreasing will be followed. All of the above is outlined in the Record of Decision implementing the preferred alternative of the GCDEIS.

With projected monthly release volumes, it is likely that peak daily releases will exceed 20,000 cfs during the months of February through July, when monthly release volumes are at their highest for the year. Releases above 25,000 cfs will be made as steady flows. Since there are concerns for possible modifications of the environmental restoration in the Grand Canyon accomplished last year with the beach/habitat-building flow, monitoring of the impacts of this spring's releases will be an important objective of the Grand Canyon Monitoring and Research Center and may result in fluctuating flows to aid in this effort.

Every measure will be taken to prevent a powerplant bypass this spring in order to preserve the environmental enhancement accomplished by the beach/habitat-building test flow conducted in March 1996. Water year 1997 had a January 1, 1997, Lake Powell storage content greater than 19 million acre-feet; therefore a habitat maintenance flow of powerplant capacity is not planned.

This plan is prepared in conformance with section 1804(c)(1)(A) of the Grand Canyon Protection Act. Any changes to the plan would require reconsultation in accordance with this Act.

APPENDIX C

GLEN CANYON DAM 1998 ANNUAL PLAN OF OPERATIONS PREPARED IN ACCORDANCE WITH THE OPERATING CRITERIA DEVELOPED FOR THE GRAND CANYON PROTECTION ACT

This plan is prepared in conformance with section 1804(c)(1)(A) of the GCPA. Any changes to the plan would require reconsultation in accordance with this Act.

In water year 1997, Glen Canyon Dam was operated in accordance with the criteria established in response to the 1992 Grand Canyon Protection Act, including the constraints on daily fluctuations and ramping rates. Since the annual release volume was 13.8 maf, powerplant releases were above normal for much of the year. In portions of February, March, June, and July, average daily releases were 27,000 cfs, and thus were released at a steady flow rate. Lake Powell's peak elevation for the year was 3,695 feet and no water bypassed the powerplant.

As a result of the preparation of the Annual Operating Plan under the 1968 Colorado River Basin Project Act, monthly release volumes from Glen Canyon Dam during 1998 are expected to range from 600,000 af to 1,200,000 af. Under the most probably inflow conditions in water year 1998, Glen Canyon Dam is expected to release about 10.75 maf through the Grand Canyon to Lake Mead. This is about 2.5 maf greater than the minimum objective release and is the result of high reservoir storage in both Lakes Powell and Mead. Lake Powell is expected to fill in July. Monthly updates to these release projections will be made throughout the year.

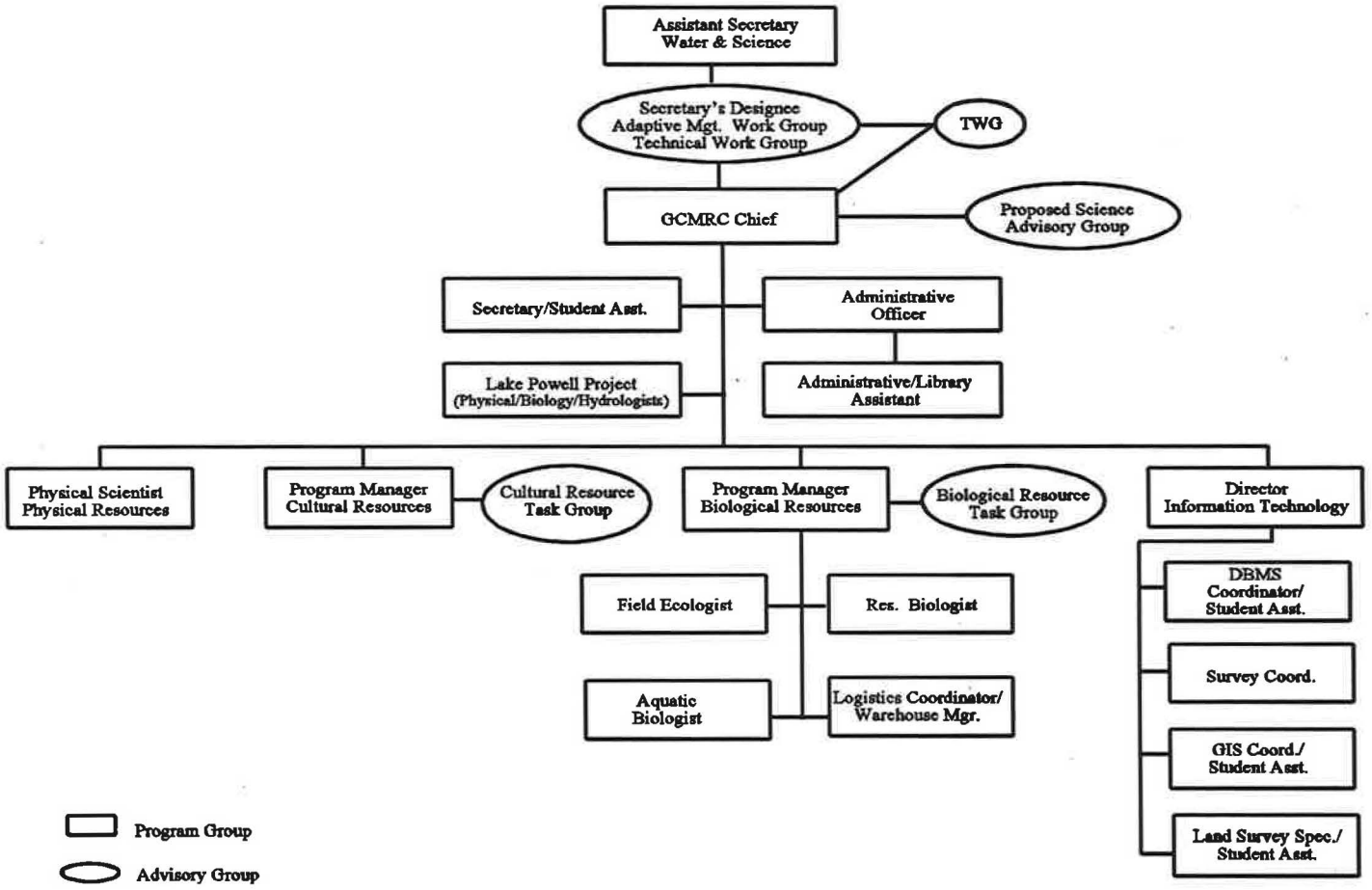
With current projected monthly release volumes, hourly powerplant releases will exceed 20,000 cfs from October through the month of January and again during the summer peak months of July and August, when monthly release volumes are at their highest for the year. Average daily releases of 20,000 cfs are expected during these months. If average daily releases above 25,000 cfs are made, they will be made as steady flows. Projected daily allowable fluctuations therefore will be between 6,000 cfs and 8,000 cfs (see criteria). Minimum releases of 5,000 cfs at night and 8,000 cfs during the day and ramping rates of 4,000 cfs/hr increasing and 1,500 cfs/hr decreasing will be followed. All of the above is outlined in the Record of Decision implementing the preferred alternative of the GCDEIS.

With the strong current El Niño Southern Oscillation anomaly, there is some indication that winter precipitation could be higher than normal in the southern portion of the Upper Colorado River Basin, and that spring precipitation could also be higher than normal in the northern portion of the Basin. Since there are concerns for resulting unplanned spills from Glen Canyon Dam, releases from Glen Canyon Dam are expected to be higher than normal during the fall months in order to achieve a prudent January 1, 1998, reservoir storage level. Releases throughout the year will be made in such a way so as to reduce the risk of uncontrolled spring releases that could result from large forecast errors similar to that which occurred in 1983.

Every measure will be taken to prevent such an uncontrolled powerplant bypass this spring in order to protect the Grand Canyon ecosystem downstream of Lake Powell. In this regard, technical discussions have recently occurred regarding the hydrologic triggering mechanisms under which beach/habitat-building flows could be released from Glen Canyon Dam. The Technical Work Group has evaluated and the Adaptive Management Work Group has recommended the following triggering criteria for the release of a beach/habitat-building flow:

1. If the January forecast for the January-July unregulated spring runoff into Lake Powell exceeds 13 maf (about 140 percent of normal), or

2. Anytime a Lake Powell inflow forecast would require a powerplant monthly release greater than 1.5 maf, then a beach/habitat-building flow could be released from Glen Canyon Dam if then deemed appropriate from an environmental perspective. The Annual Operating Plan prepared under the 1968 Act allows a beach/habitat-building flow to occur in 1998 if hydrologic conditions are appropriate.



Staffing Requirements of the Grand Canyon Monitoring and Research Center

APPENDIX E

GLEN CANYON DAM MONTHLY POWERPLANT RELEASES AND GENERATION WATER YEAR 1997

Month	Powerplant Release (acre-feet)	Powerplant Generation (kilowatt-hours)
October	661,878	323,029,000
November	622,632	304,844,000
December	894,715	439,683,000
January	1,061,804	517,814,000
February	1,247,752	594,841,000
March	1,537,685	726,426,000
April	1,295,291	614,733,000
May	1,281,759	613,516,000
June	1,486,191	731,258,000
July	1,318,401	657,442,000
August	1,251,341	622,292,000
September	1,142,142	563,903,000
Total	**13,801,591**	**6,709,781,000**

APPENDIX F

United States Department of the Interior
GRAND CANYON MONITORING AND RESEARCH CENTER
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Flagstaff, AZ 86001
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IMPACTS OF THE 3-5 NOVEMBER 1997 31,000 cfs TEST FLOW

Introduction

The Bureau of Reclamation and the Grand Canyon Monitoring and Research Center conducted a test of a "Habitat Maintenance" style flow from Glen Canyon Dam on 3-5 November 1997. The flow peak reached approximately 30,600 cfs for this 2-day test. This memo outlines the impacts of that flow event on resources through Grand Canyon.

Physical Resource Impacts

GCMRC coordinated pre- and post-event videography of the river corridor, and those images are being examined for backwater habitat changes.

Using the methods of Parnell et al. (1996), detailed topographic surveys of 35 sand bar monitoring sites were conducted immediately following the November 1997 test flow by members of the Northern Arizona University Department of Geology sand bar studies office. Information gathered from these surveys is compared to previous surveys conducted in August 1997 in order to quantify sand bar change. Based on this preliminary data, the November test flow benefitted the sediment resources by depositing sediment at higher elevations. The higher elevation areas of sand bars contain critical riparian habitats that are of particular interest to management agencies. Following the 1996 45,000ft^3/s test flow, erosion has steadily decreased the volume of sediment contained in the upper elevations of sand bars. Preliminary results show that the November 1997 test flow slightly increased the volume of sand bars (above the 20,000 ft^3/s stage elevation), calculated as a percentage of the pre-1996 test flow, from 87% to 91%. High flows above powerplant capacity are the only means by which the volume of the upper levels of sand bars can be maintained.

The U.S. Geological survey (G. Fisk, D.Topping, D.Rubin and S.Weile) monitored mainstream streamflow and suspended sediment at the Lees Ferry, Above Little Colorado River, Grand Canyon and Diamond Creek gauges once/day before, during and after the flow event. Bedload sampling was conducted in the mainstream and in eddies at selected sites following the high flow. Bar sedimentology, grain size, deposit thickness was conducted with the NAU effort immediately following the high flow.

Biological Resource Impacts

On November 6, 1997 the Arizona Game and Fish Department (AGFD) surveyed cobble bars in the Lee's Ferry reach to assess rainbow trout stranding post downramp. AGFD evaluated stranding by dividing each cobble bar examined into quadrants and obtaining a total count of stranded fish by examining total area of the bars. AGFD also noted stranding of macroinvertebrates. Cobble bars selected for evaluation were representative of this habitat type in the Lees Ferry reach and were in areas which receive preferential use by fishing guides and fishermen. Observations: At RM -14, no stranding of rainbow trout and no apparent stranding of *Gammarus lacustris* or other macroinvertebrates was observed. At RM -12.8, one dead rainbow trout (60mm) was observed to have been stranded and low concentrations of *Gammarus* were observed stranded in a few shallow pools, no other stranded macroinvertebrates noted. At RM -8, two live rainbow trout (90 mm and 400 -500 mm) were observed stranded in a large pool, *Gammarus* ($\geq$1,000) of diverse size range were observed stranded in one small pool, and several thousand snails (Physidae) were observed stranded on two small sand habitats associated with sedges nearshore. At RM -2.5, one dead adult flannelmouth sucker (*Catostomus latipinnis*) was observed in approximately 3 ft of water just inside mouth of backwater. This was judged not to be a stranding-related mortality.

Concern over endangered species, particularly endangered Kanab ambersnail, prompted development of a U.S. Fish and Wildlife Service Biological Opinion on this federal action. A 2-3 October 1997 habitat and population survey at Vaseys Paradise revealed that 29.8 m^2 of potential KAS habitat lay downslope from the 934 m^3/s (33,000 cfs) flood stage. Five habitat patches were predicted to be inundated and potentially scoured by the planned November Test Flow, but it was considered unlikely that the inundated vegetation would be completely eliminated. The habitat in the flood zone was estimated to support approximately 181 KAS (<1% of the estimated total population). Immediately prior to the November Test Flow, the Arizona Game and Fish Department salvaged habitat and 14 KAS from the inundated zone and is presently holding that material at the Phoenix Zoo. A GCMRC survey crew reported new sand and driftwood on the inundated habitat patches immediately following the event. Although losing 14.4% of the flood zone habitat to scour, the Test Flow did not completely eliminate vegetation in the habitat patches of concern. No impacts were anticipated or observed on endangered southwestern willow flycatcher habitat. Impacts on endangered humpback chub were not considered to be detectable, and hence no effort was made to monitor that species.

Conclusions

These preliminary results indicate that top-of-powerplant flows can be used to rebuild low-lying sand bar platforms, and result in little disruption of terrestrial endangered species. A flow of this magnitude is probably insufficient to create or substantially rejuvenate backwater habitats, which serve as nursery habitats for native and non-native fish. Although some sand bars increased in area and volume, this flow may not have been of sufficient duration to maximize sand bar rebuilding.

[January 14, 1998]

APPENDIX G

CHARTER

ADAPTIVE MANAGEMENT WORK GROUP

Establishment of a Federal Advisory Committee
to Advise the Secretary of the Interior
on the Impacts of
Glen Canyon Dam Operations

1. **Official Designation:** Glen Canyon Dam Adaptive Management Work Group.

2. **Background and Purpose:** The Grand Canyon Protection Act (Act) of October 30, 1992, embodied in Public Law 102-575, directs the Secretary of the Interior (Secretary), among others to operate Glen Canyon Dam in accordance with the additional criteria and operating plans specified in section 1804 of the Act and to 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 the Glen Canyon National Recreation Area were established, including but not limited to the natural and cultural resources and visitor use. The Secretary shall implement this section in a manner fully consistent with and subject to section 1802 of the Act. Section 1805 of the Act calls for implementation of long-term monitoring programs and activities that will ensure that Glen Canyon Dam is operated in a manner consistent with that of section 1802. As part of long-term monitoring, the Secretary's Record of Decision (ROD) mandates development and initiation of an Adaptive Management Program (AMP). The AMP provides for monitoring the results of the operating criteria and plans adopted by the Secretary and changes to those operating criteria and plans. The AMP includes an Adaptive Management Work Group (AMWG). The AMWG will facilitate the AMP, recommend suitable monitoring and research programs, and make recommendations to the Secretary as required to meet the requirements of the Act. The AMWG may recommend research and monitoring proposals outside the Act which complement the AMP process, but such proposals will be funded separately, and do not deter from the focus of the Act.

3. **Duration:** It is the intent that the AMWG shall continue indefinitely, unless otherwise terminated by the Secretary. In accordance with the Federal Advisory Committee Act (FACA), 5 U.S.C. App., this charter will terminate 2 years from the date of filing unless renewed by the Secretary prior to that time.

4. **Agency To Whom The AMWG Reports:** The AMWG reports to the Secretary through the Secretary's designee who shall serve as the chairperson of the AMWG.

5. **Administrative Support:** The logistical and support services for the meetings of the AMWG shall be provided by the Bureau of Reclamation (Reclamation).

6. **Duties:** The duties or roles and functions of the AMWG are to:

a. Establish AMWG operating procedures.

b. Advise the Secretary in meeting environmental and cultural commitments of the EIS, as requested.

c. Recommend the framework for the AMP policy, goals, and direction.

d. Develop recommendations for modifying operating criteria and other resource management actions pursuant to the Act.

e. Define and recommend resource management objectives for development and implementation of a long-term monitoring plan, and any necessary research and studies required to determine the effect of the operation of Glen Canyon Dam on the natural, recreational, and cultural resources of the Grand Canyon National Park and Glen Canyon National Recreation Area.

f. Review and provide input to the Secretary on the reports required in Sections 1804 (c)(2) and 1804 (d).

g. Facilitate input and coordination of information from stakeholders to the Secretary to assist in meeting consultation requirements under Sections 1804 (c)(3) and 1805 (c) of the Act.

h. Monitor and report on compliance of all program activities with applicable laws, permitting requirements, and the Act. The duties and functions of the AMWG are in an advisory capacity only.

7. **Meetings:** The AMWG is expected to meet biannually. The Secretary's designee, who will serve as the designated Federal Official, may call additional meetings as deemed appropriate. Fifteen members must be present at any meeting of the AMWG to constitute a quorum.

The Secretary's designee shall be responsible for preparation of meeting agendas and scheduling meetings of the AMWG. The Secretary's designee shall attend and chair all meetings of the AMWG. In accordance with FACA, a notice of each meeting of the AMWG shall be published in the Federal Register at least 15 days prior to the meeting advising the date, time, place, and purpose of the meeting. If it becomes necessary to postpone or cancel an announced meeting, a subsequent notice shall be published in the Federal Register as early as possible and shall explain the reasons for the postponement or cancellation. A similar notice of each meeting, postponement, or cancellation shall also be published in selected major newspapers in Phoenix and Flagstaff, Arizona, Denver, Colorado, and Salt Lake City, Utah.

In accordance with FACA, all meetings of the AMWG shall be open to the general public. Any organization, association, or individual may file a written statement or, at the discretion of the AMWG, provide verbal input regarding topics on a meeting agenda in accordance with FACA.

8. **Minutes:** The minutes of each AMWG meeting; reports; related documents; and copies of all documents received, issued, or approved by the AMWG shall be available for public inspection and duplication during regular business hours within 30 working days after the meeting at the:

Upper Colorado Regional Office
Bureau of Reclamation
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102
(801) 524-6096, Extension 1

The Secretary's Designee shall approve AMWG meeting agendas and minutes.

9. **Estimated Operating Costs:** The operating costs are estimated at $154,000 annually for the establishment and support of the AMWG. This includes costs for required staff support of about 0.3 of a person year. Expenses would also include the travel and per diem of some members and employees of the Department of the Interior while attending meetings of the AMWG, and for expenses incurred in the recording and reproduction of the minutes, reports, notices, etc.

10. **Allowances:** While engaged in the performance of approved business away from home or their regular places of business, members of the AMWG (tribal, environmental, recreation, and Contractors who purchase Federal power) shall be reimbursed for travel expenses, including per diem in lieu of subsistence.

11. **Membership:** Members of the AMWG to be appointed by the Secretary shall be comprised of:

a. Secretary's Designee, who shall serve as chairperson for the AMWG.

b. One representative each from the 12 cooperating agencies associated with the EIS:

(1) Bureau of Reclamation
(2) Bureau of Indian Affairs
(3) U.S. Fish and Wildlife Service
(4) National Park Service
(5) Western Area Power Administration
(6) Arizona Game and Fish Department

(7) Hopi Tribe
(8) Hualapai Tribe
(9) Navajo Nation
(10) San Juan Southern Paiute Tribe
(11) Southern Paiute Consortium
(12) Pueblo of Zuni

c. One representative each from the seven basin states:

(1) Arizona
(2) California
(3) Colorado
(4) Nevada
(5) New Mexico
(6) Wyoming
(7) Utah

d. Two representatives each from:

(1) Environmental groups
(2) Recreation interests
(3) Contractors who purchase Federal power from Glen Canyon Powerplant

Members will be appointed to the AMWG by the Secretary, with input and recommendations from the cooperating agencies, States, tribes, contractors for Federal power from Glen Canyon Dam, environmental representatives, and other stakeholders. To be eligible for appointment to the AMWG, a person must (a) be qualified through education, knowledge, or experience to give informed advice on water supply, diversion and delivery facilities, and their operation and management, or the environmental aspects of such operation; and (b) have the capability to constructively work in a group setting toward a common objective of structuring a mechanism for program implementation.

Members of the AMWG will be appointed for a 4-year term. At the discretion of the Secretary, members may be reappointed to additional terms. Vacancies occurring by reason of resignation, death, or failure to regularly attend meetings will be filled by the Secretary for the balance of the vacating member's term using the same method by which the original appointment was made. Failure to attend two consecutive meetings will substantiate grounds for dismissal.

To avoid conflict of interest issues arising from entities having representatives on the AMWG and also submitting responses to request for proposals to perform work, the Federal procurement process shall be strictly adhered to. While members of the AMWG may give

advice to the Secretarial Designee. all decisions in the procurement process shall be made by Federal procurement officials free of influence from AMWG members.

JAN 15 1997

Secretary of the Interior

Date

FEB 04 1997

Date charter filed: _____