FLOW MODIFICATIONS TO THE GLEN CANYON DAM ENVIRONMENTAL IMPACT STATEMENT PREFERRED ALTERNATIVE

April 25, 1994

I. INTRODUCTION

In early 1993 Western Area Power Administration (Western) approached the Glen Canyon Dam Environmental Impact Statement (EIS) cooperating agencies with a proposal to change two parameters of the existing interim flow regulations for Glen Canyon Dam. Those two requests were for:

(1) Increasing the upramp rate from 2,500 cfs/hour to 4,000 cfs per hour, and

(2) Increasing the maximum flow from 20,000 cfs to 25,000 cfs

Western requested that the Glen Canyon Environmental Studies (GCES) scientific coordination group evaluate the recommendations. Concurrent with the scientific discussions it was determined by the Commissioner that the proposed changes be subjected to the same level of National Environmental Policy Act scrutiny as the original EIS alternatives had been. Consequently the proposal for changes was included in the EIS alternative review process and added to the preferred alternative. The Bureau of Reclamation (Reclamation) followed with the review process through the EIS team with subsequent evaluation by the GCES scientific coordination group led by the Senior Scientist.

The preferred alternative identified in the Final Glen Canyon Dam Environmental Impact Statement document reflected the changes requested by Western. Concern was raised by the environmental community that the changes had not gone through a rigorous enough policy and scientific review prior to inclusion in the final EIS alternative. The **objective** of this document is to identify the baseline scientific conditions upon which the determination of the impact of the changes were made.

II. BACKGROUND

The Glen Canyon Dam <u>interim flows</u> had been implemented by the Bureau of Reclamation in August 1991 after considerable deliberation by the Glen Canyon Dam cooperators and recommendations made by the GCES scientific coordination group. The **purpose** of the

GCES interim flow recommendation was to operate the dam in a conservative fashion with the goal of not losing any more of the resources in the Grand Canyon, especially the sediment which was believed to the most sensitive and short-lived. The time period for the interim flows was defined to be from the end of the Research Flows (July 1991) until implementation of the Record of Decision. The interim flows were purposely designed to be conservative in protection of the natural and cultural resources. The specific objectives are:

(1) Store sediment in the channel of the Colorado River
(2) Minimize the erosion of the remaining beaches in the Grand Canyon
(3) Minimize the impacts to the remaining biological resources
(4) Protect the cultural resource areas being impacted by erosion

Specific operational parameters at Glen Canyon Dam included: ramping rates, maximum flows, minimum flows, and allowable changes per day. The flows were set conservatively due to the fact that the majority of the technical studies that would address the specific issues had only preliminary, non-reviewed, results. It was intended that the interim flows would trap as much sediment as possible and minimize the movement of the instream sediment downstream. The interim flows are defined in Table 1.

Table 1. Interim Flow Parameters

Minimum releases (cfs)	**Maximum releases (cfs)**	**Allowable daily fluctuations (cfs/24hr)**	**Ramp rate (cfs/hr)**
8,000 between 7a.m. and 7p.m. 5,000 at night	20,000	5,000 6,000 or 8,000 (based on monthly volumes)	2,500 up 1,500 down

The interim flows established in August 1991 have been successful in their original objectives. The results can be separated into the following sections:

A. Physical System

1. Sediment has been trapped in the main channel and has filled in most of the backwaters.

2. Beach erosion has continued at a significantly lower rate with overall beach sizes stabilized.

3. Sediment is moving downstream but at a rate sufficiently slow to allow net accumulation in the channel.

B. Biological System

1. The trout population has begun to rebuild in the Lees Ferry fishery having increased numbers of naturally produced fish and better fish condition factors.

2. The cladophora beds have expanded in size.

3. The numbers of Gammarus lacustris have increased substantially in the Lees Ferry drift.

4. The riparian areas utilized for nesting by the Southwestern Willow Flycatcher have stabilized in size.

5. The marshes have dried out and are filling in with sediment and riparian plants.

6. The riparian zone has begun to migrate down to the 20,000 cfs line.

III. DELIBERATIONS ON THE PROPOSED CHANGES TO THE PREFERRED ALTERNATIVE

In 1993 Western approached the GCES Scientific Coordination Group with a request to consider modifying the existing interim flows. The two changes proposed were:

(1) Increase the up-ramp rate from 2,500 cfs per hour to 4,000 cfs per hour, and

(2) Increase the maximum flow from 20,000 cfs to 25,000 cfs.

Western would continue to abide by the downramp rate, the maximum changes per day and the minimum flow schedules. Western further stated that during a low 8.23 maf year there would be insufficient water and use of the 20,000 to 25,000 cfs range would be unlikely. They anticipated only utilizing the increase from 20,000 to 25,000 cfs up to a maximum of five (5%) percent of the time and that would be during the winter and summer high monthly flow volume periods.

Western presented the graphs in Appendix A as documentation of what the proposed changes would mean to the releases at Glen Canyon Dam. Western requested that the GCES scientists review the requested changes and report back to the Glen Canyon Dam

Environmental Impact Statement Cooperators. The primary concerns raised by the GCES scientists were over the potential of stringing together 3 consecutive days of high flows. Western indicated that the flows would not be used that way and that the greatest concern was to be able to claim capacity for the additional 5,000 cfs.

It should be noted that in high and medium release volume years the potential for extended periods of 20,000 to 25,000 cfs flows exist and would be quite likely especially during the summer and winter seasons.

A. Increasing the Up-Ramp Rate

We deliberated over the impact that the up-ramp rate increase would have on the erosion of beaches in the Grand Canyon. Based on work completed by Budhu and Gobin (1995), Cluer, et. al. (1995) and the U.S. Geological Survey (Carpenter, et. al., 1994) it was determined that the upramp rate would have no impact on the increase of erosion of the beaches. This conclusion was based on:

1. The downramp has been shown to be the primary controlling factor in beach erosion (Budhu and Gobin, 1995). The downramp would remain the same (1,500 cfs/hr) and therefore the upramp should not cause any concern.

2. Ground water studies by Carpenter, et. al. (1994) have shown that the volume of water stored in the beaches and its subsequent release are controlling the dynamics of the ground water return flow.

3. Rill erosion studies performed by the National Park Service (Werrell, et. al, 1994) have shown that the rate of dropping of the water is what induces erosion of trapped water to cut away at beach faces.

4. The Smith and Wiele (1994) model showed that the higher upramp wave would be dissipated by Lees Ferry and therefore no impact would be found downstream.

Therefore, as long as the downramp rate is maintained at 1,500 cfs/hr and the change per day was still limited to between 5,000 cfs and 8,000 cfs per day, it was felt that the upramp rate could be changed with no anticipated impact on the sediment resources.

B. Increasing the Maximum Flow

The maximum flow cap of 20,000 cfs was established in 1991 based on the preliminary information and knowledge presented by the USGS that a threshold flow existed where the movement of sediment in the Colorado River channel was accelerated beyond which annual inputs could maintain it. It was believed that the flow level was

approximately 25,000 cfs based on the preliminary work of Smith and Wiele (1994) and Nelson (1994). It was believed by all that the interim period should be a period of storing sediment but that a controlled high release was necessary to redistribute that sediment from the river channel back up on the beaches.

In order to maximize the short term period of the interim flows for storing sediment needed for the controlled high releases a cap level of 20,000 cfs was selected, realizing that is was conservative.

When asked to evaluate the increase in the maximum flow from 20,000 cfs to 25,000 cfs we again listened to Westerns description of how often that flow would be used. In essence the flow level would be utilized **2 to 5% of the time** and would not be used for a series of consecutive days or for long periods within the day.

Our evaluation of the effects focused on two critical elements: (1) duration; and (2) timing. Based on the hydrology questions we then looked to the GCES scientific results. Of primary use was the flow and sediment model results of Smith and Wiele(1994), the eddy model of Nelson, et. al.(1993) and the results of Budhu and Gobin (1995) related to tractive force along the beach faces. Supporting documentation on the status of the sediment deposits in the Grand Canyon ongoing by Schmidt (1994), Cluer and Dexter (1994) and Beus and Avery (1993) and Beus, et. al (1995) provided additional data on ongoing beach response.

Based on this information several conclusions could be drawn:

(1) The 20,000 cfs was successful in trapping sediment in the main channel.

(2) The backwaters were/are in the process of filling in thereby eliminating them as sources of habitat for the native fish.

(3) Erosion of the beaches in the Grand Canyon, especially in the critical reaches had slowed but was still going on. In several instances local debris flows and tributary inputs had impacted the beaches more than the interim flow operations.

(4) There is still a need for a high controlled flood to move sediment from the main channel up onto the beaches.

(5) Based on results from the Smith and Wiele model, 25,000 cfs does not appear to increase the rate of sediment loss in the Grand Canyon.

(6) As long as the duration of 25,000 is not maintained for considerable periods of time (greater than 24 hours) nor

used on a series of consecutive days, no apparent negative impact will result.

Again the primary area of concern focused on the critical reach of river mile 1 to river mile 61, the confluence of the Little Colorado River.

IV. CONCLUSIONS AND RECOMMENDATIONS

With the information presently available, the proposed increase in the up-ramping rate from 2,5000 cfs/hour to 4,000 cfs/hour **and** the proposed increased maximum flow from 20,000 cfs to 25,000 cfs do not appear to present any specific problems to the goals of interim flows nor will lead to degradation of the gains made for the resources in the Grand Canyon.

From a scientific perspective we would argue not to change two parameters at once as it will be very difficult to ascertain which element led to the changes, if they occur. From a practical perspective the ability to exceed operationally 20,000 cfs only exists in months that are releasing in excess of 900,000 acre feet in an 8.23 maf year. The most probable months that increases above 20,000 cfs would occur is December, January, July and August. Evaluation of the upramp rate effects can be initiated immediately with evaluation of the increases in maximum flow relegated to the months with the highest volumes.

We further recommend that each of the changes in operations become elements to be further reviewed as part of the interim and transition monitoring program. Subsequent changes in operations should be evaluated under strict scientific process and further changes in operations back to previous conditions made if the scientific evidence supports it.

V. LITERATURE CITED

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