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CONTROLLED FLOOD STUDIES

GLEN CANYON DAM

SPRING 1996

STUDY PLAN AND OVERVIEW

GLEN CANYON ENVIRONMENTAL
STUDIES OFFICE

DEC 28 1995

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FLAGSTAFF, AZ

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Glen Canyon Environmental Studies Office
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I. INTRODUCTION

The Glen Canyon Dam Environmental Impact Statement (U.S. Bureau of Reclamation, 1995) identified a Preferred Alternative that included recommendations for specific daily flows and periodic *beach habitat building and habitat maintenance* flows. The validity of the preferred alternative rests on the ability to utilize the operations of Glen Canyon Dam to maintain and restore critical ecosystem elements and processes. The Glen Canyon Dam Transition Work Group and their predecessors, the Glen Canyon Dam Cooperating Agencies supported the concept of a "test" of the scientific theories and ecosystem processes upon which the Preferred Alternative was based.

On November 30, 1995, the Transition Work Group verbally approved the continuation of the technical planning, coordination and implementation of the March/April 1996 Controlled Flood Study. This document reflects the basic scientific approach and technical coordination that will be utilized to achieve the directed effort.

The objectives of this document are to outline the overall objectives of the program, the timetable and hydrograph, the consolidation and integration process, the scientific approach and the reporting schedule. This document outlines the coordination effort among the variety of research groups. Individual research and monitoring proposals are being prepared independently and will fit within the study areas identified in this document. A complete study plan, including the full proposals will be prepared in February 1996.

II. CONTROLLED FLOOD OBJECTIVES

The Glen Canyon Dam Environmental Impact Statement, Preferred Alternative specifically calls for daily, seasonal and annual flow objectives. Included as an integral part of the Preferred Alternative is the identification of a periodic Beach Habitat Building flow (i.e., controlled flood) to redistribute

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sediment resources in the Grand Canyon corridor. The objectives of the habitat building flow, as stated in the Environmental Impact Statement are:

- *Flush non-native fishes from the mainstem river*
- *Rejuvenate backwater habitats for native fishes*
- *Redeposit sand bars at higher elevations, followed by a decreasing erosion rate*
- *Preserve and restore camping beaches*
- *Protect cultural resources*
- *Reduce near-shore vegetation*
- *Provide water to old high water zone vegetation*
- *Meet the above objectives without significant adverse impacts to the trout fishery, Endangered species, cultural resources and economics*

In order to meet the identified Environmental Impact Statement objectives, it is necessary for the initial controlled flood release to focus on additional objectives to assist the resource managers and decision-makers on future controlled habitat building flows and management objectives. The additional objectives include:

- *Evaluation of sediment movement, transport and redistribution*
- *Evaluation of the dynamics of flow*
- *Evaluation of the reworking of recent deposits*
- *Evaluation of impacts to the aquatic food base*

The 1996 Controlled Release Flood is planned as an ecosystem management experiment and focuses on collection of data that will provide an information base for evaluation of the immediate effects of the higher flows, and development of improved predictive abilities relative to sediment and flow.

III. HYDROGRAPH AND TIMETABLE

The defined hydrograph includes a high release of approximately 45,000 cfs. The maximum level achievable without using the spillways. The 45,000 cfs is necessary to mobilize the sediment and move it above the levels that had been previously deposited by uncontrolled floods in 1993 from the Little Colorado River, which was at approximately 35,000 cfs. The timing of the controlled release was established for the March and April time period based on several criteria:

- Prior to the native fish larval dispersion into the mainstem
- After the peak of the rainbow trout spawning in the Glen Canyon reach
- After the endangered bald eagles have departed from the Grand Canyon
- Prior to the neotropical avifauna nesting
- It is a historical runoff month (can range from March to July)
- Prior to the tamarisk seed production
- Prior to the major recreation season

The release schedule (Figure One) is to begin at midnight on March 22nd with attainment of a constant 8,000 cfs level. The reduction of flow to the 8,000 cfs level will begin on March 21st. The steady flow release will be held for four days. On Tuesday, March 26th at approximately midnight, the flows will begin rising at 4,000 cfs/hr until the level of 45,000 cfs is reached. It is anticipated that the 45,000 cfs will be reached at 11:00 AM. The 45,000 cfs level will be held until approximately 11:00 AM on Tuesday, April 2nd. At that point the flow will be decreased in three distinct steps to maximize the sediment deposition. Step one will be a 1,500 cfs/hr decrease from 45,000 cfs to 35,000 cfs. The 35,000 level will be reached at approximately 5:00 PM on April 2nd. The second step will be a 1,000 cfs/hr decrease from 35,000 cfs to 20,000 cfs. The 20,000 cfs level will be reached at approximately 8:00AM on Wednesday April 3rd. The last step will be a 500 cfs/hr decrease from 20,000 cfs to 8,000 cfs. The 8,000 cfs level will be reached at approximately 8:00 AM on April 4th. The 8,000 cfs level will be held constant through Sunday, April 7th until approximately midnight. At that point the flows will be returned to the normal April interim flow pattern of release. Appendix 1 includes the anticipated hourly flow releases.

Glen Canyon Spike - 1996 Releases

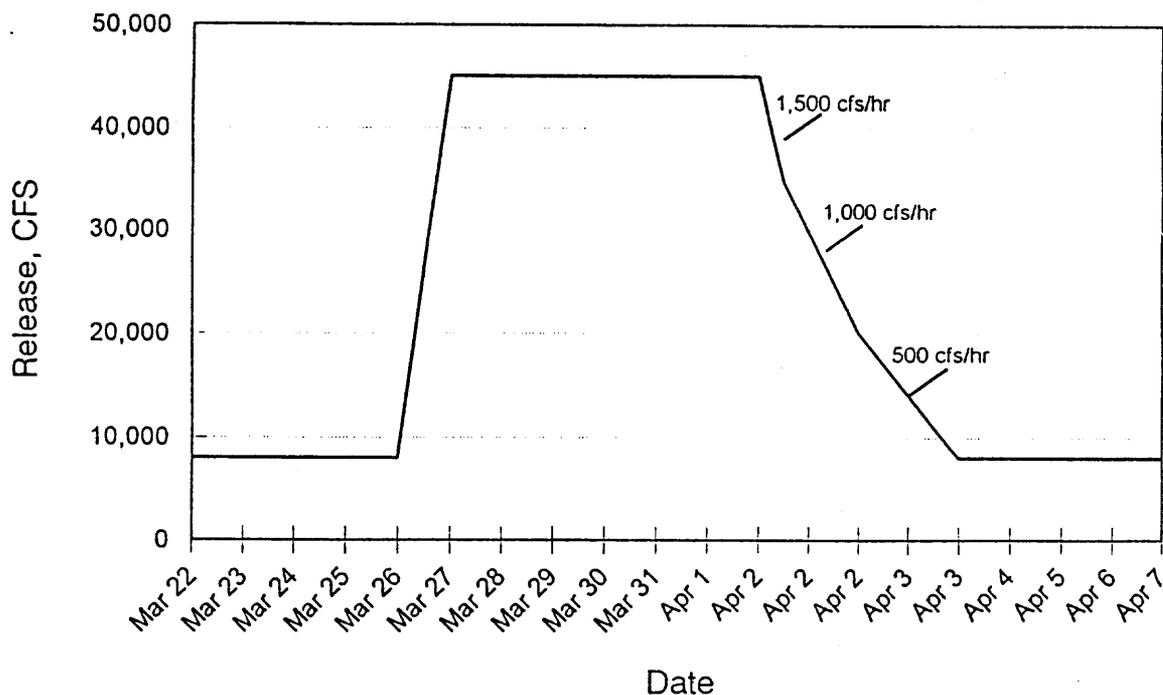


Figure One. Release hydrograph for the March/April 1996 controlled Glen Canyon Dam release.

The anticipated volume of water associated with the controlled release scenario is approximately 360,000 acre feet of water. Releases will be made through the Glen Canyon Dam powerplant and augmented with releases through the hollow jet valves. Actual release allocations will be made based on the level of Lake Powell and available generator capacity.

IV. CONSOLIDATION AND INTEGRATION

The controlled release will provide a unique opportunity to integrate and consolidate ecosystem level information into specific response evaluations. To maximize the utilization and integration of data and research studies, the studies will be organized around the long-term monitoring Geographic Information System areas developed through the Glen Canyon Environmental Studies (GCES) program. These sites already have extensive base maps and resource overlays developed. Data bases for each of the sites have been and are continuing to be populated with specific resource and process level information collected through the GCES programs.

The specific GIS site locations are identified on Figure Two have been selected based on specific geomorphic characteristics, ecosystem importance and management consideration. The areas between the GIS sites are linked through the ground control network maintained by GCES. Each research site will be georeferenced through the GCES geographic control network in the Grand Canyon. Where necessary Global Positioning and standard surveying will be used to further enhance link the individual site into the research network. Work accomplished on Lake Powell and Lake Mead will also be linked into the GCES/GIS program.

Glen Canyon Environmental Studies Location of Long-Term Monitoring Sites

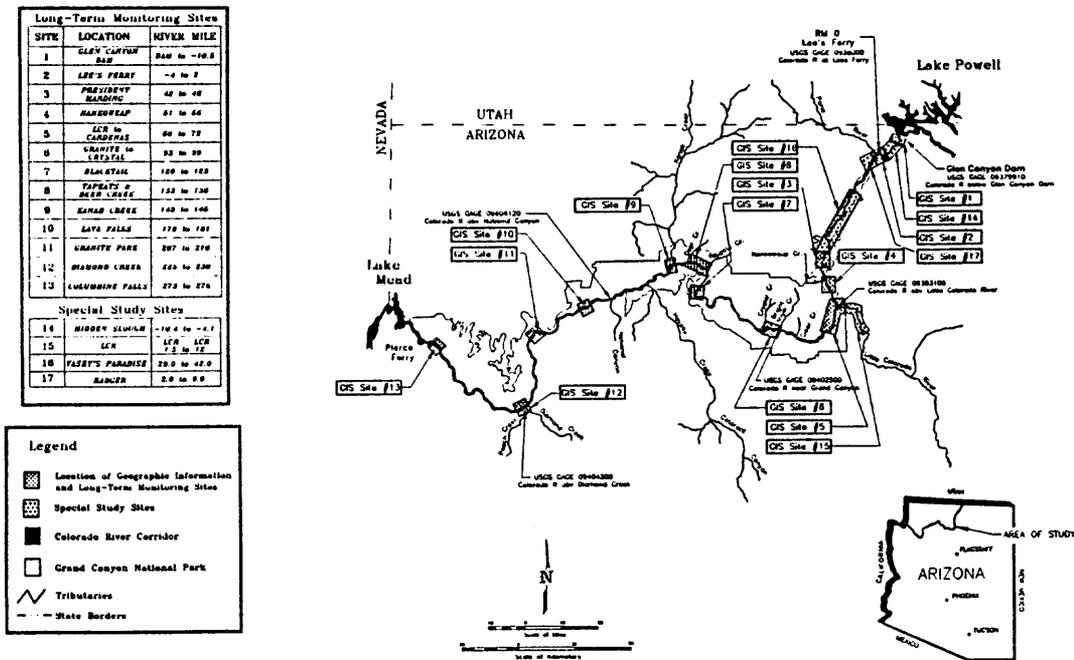


Figure Two. GCES/GIS long-term monitoring sites.

V. SPECIFIC RESEARCH AND MONITORING ACTIVITIES

In 1993 Dr. Duncan Patten, Senior Scientist for the Glen Canyon Environmental Studies, began the process of identifying the areas of study that should be focused on during the controlled flood event. Under Dr. Patten's guidance and direction a broad-ecosystem-based research plan was conceptually developed (Patten, 1994). Due to a combination of administrative and technical reasons, the controlled flood research was not achieved either in 1993 or 1995.

In the summer of 1995 an *uncontrolled* high flow release became significant. Reclamation was able to avoid excess releases in July 1995 as the runoff slowed. The potential presented in June and July, led to the reinitiation of the efforts to evaluate the habitat building flow in the spring of 1996. Through coordination with the Upper Colorado Region office of Reclamation, direction was given to resurrect the plans and pull together a proposal that could be presented to the Transition Work Group. The direction also included setting a budget level not to exceed \$1,500,000. This level was approximately \$1,250,000 less than the original proposal and required certain research study areas be reduced or eliminated.

The GCES office took the lead in coordinating several meetings of interested scientists and groups to discuss opportunities for integration and consolidation of efforts relative to the controlled release experiment. Central to this discussion was the need to reduce costs, coordinate and integrate the research and monitoring program on an ecosystem level.

The following information in this document identifies primary areas of research and monitoring with proposed funding levels. The costs fit within the \$1,500,000 level and follow specific one-page *preproposals* previously submitted to the GCES. Full proposals have subsequently been requested and will be made available in a final study plan after undergoing external peer review.

A. PHYSICAL SYSTEM COMPONENTS:

U.S. Geological Survey

1. **Data Collection:** The U.S. Geological Survey has been requested to develop a proposal for data collection on measurement of stage, discharge, flow velocity, sand-storage changes at monitoring sections, and suspended-sand transport related to the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. These data will be used to improve accuracy in predictive capabilities needed for management of resources downstream from Glen Canyon Dam. The data will also provide the fundamental information on which interpretation of responses to other riverine components will be based. Draft reports on the results of this work will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the objectives outlined in the one-page prospectus submitted to Reclamation on November 28, 1995, entitled "Streamflow, Sediment Transport, and Sand-Storage Changes-Measurement of Critical Data Option 2-Minimum Plan." The budget associated with this data collection work is not to exceed \$360,800, as outlined in the November 27, 1995, USGS memorandum from Mark Anderson, Chief, Hydrologic Investigations and Research, WRD, Tucson, AZ, to Dave Wegner, GCES, Bureau of Reclamation, Flagstaff, AZ.

2. **Debris-Fan Reworking:** The U.S. Geological Survey has been requested to develop a proposal to study debris-fan and rapid reworking resulting from the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. Information from this effort will be used to improve understanding of the interactive processes between sediment deposited in the Colorado River by recent tributary debris flows, and the effectiveness of habitat-building dam releases. The degree to which the controlled release removes aggraded debris fans and rapids is directly related to management of resources downstream from Glen Canyon Dam, such as sand stored in low-velocity pools of the river channel, as well as navigability of the river through Grand Canyon National Park and rejuvenation of camping beaches degraded by debris flows. A draft report on the results of this work will be due on September 30, 1996, and a final report will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the one-page proposal prospectus submitted to Reclamation on November 28, 1995, entitled "Reworking of Debris Fans by the Experimental Flood. Plan 1." The budget associated with this work is not to exceed \$70,000.

3. **Modeling:** The U.S. Geological Survey has been requested to develop a proposal that will further the development of predictive models for main channel streamflow and sediment transport related to the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. These improved models will be used to improve accuracy in predictive capabilities needed for management of resources downstream from Glen Canyon Dam. Draft report(s) on the results of this work will be due on September 30, 1996, and final report(s) will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the objectives outlined in the one-page prospectus submitted to Reclamation on November 28, 1995, entitled "Scenario 2: Main Channel Streamflow, Sediment Transport, and Sand Storage--Development of Predictive Methods." The budget associated with this model-development work is not to exceed \$100,000, as outlined in the November 27, 1995, USGS memorandum from Mark Anderson, Chief, Hydrologic Investigations and Research, WRD, Tucson, AZ, to Dave Wegner, GCES, Bureau of Reclamation, Flagstaff, AZ.

4. **Eddy Studies:** The U.S. Geological Survey has been requested to develop a proposal for work that will address issues of how Grand Canyon sand bars in lateral separation eddies respond during a period of sustained high discharge related to the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. Draft reports on the results of this work will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the one-page prospectus submitted to Reclamation on November 28, 1995, entitled "Deposition Rate and Topographic Evolution of Sand Bars in Lateral Separation Eddies During High Flows-Scenario 2." The budget associated with this work is not to exceed \$150,000, as outlined in the November 27, 1995, USGS memorandum from Mark Anderson, Chief, Hydrologic Investigations and Research, WRD, Tucson, AZ, to Dave Wegner, GCES, Bureau of Reclamation, Flagstaff, AZ.

Northern Arizona University

1. **Beach Survey Studies:** The Geology Department of Northern Arizona University has been requested to develop a proposal for work that will quantify responses of Grand Canyon sand bars presently monitored under Transition Monitoring contracts, as related to the Glen

Canyon Dam controlled release experiment, anticipated for March, 1996. Draft reports for these studies, will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the one-page prospectus submitted to Reclamation on November 20, 1995, entitled "NAU Sand Bar Survey Activities Surrounding the 1996 Experimental Flood from Glen Canyon Dam: Scenario 11, Meet Short Term Goals," and based on meetings and discussions held by GCES personnel on needs for studies of camping area changes related to the high-flow experiment. The budget associated with this work is not to exceed \$ 80,000.

Glen Canyon Environmental Studies

1. **Beach Camping Area Studies:** The Glen Canyon Environmental Studies office has been requested to develop a proposal for work that will quantify responses of Grand Canyon beach camping areas (sediment deposits) as related to the Glen Canyon Dam controlled release experiment. This study will follow the same protocols that were followed by the National Park Service in previous studies on campground area and will be fully integrated into the GCES Geographic Information System. Draft reports for this study will be due on September 30, 1996 with final reports due on December 31, 1996. This study was deemed necessary after discussions by the scientific coordination group and was supported by the discussions with the Transition Work Group and the Senior Scientist. The budget associated with this project is not to exceed \$15,000.

B. AQUATIC SYSTEM:

1. **Fisheries:** The Arizona Game and Fish Department, BIO/WEST Inc., Hualapai Tribe, and Glen Canyon National Recreation Area have been requested to jointly develop an integrated proposal jointly for studies concerning the effects on fishes in Glen, Marble and Grand Canyons resulting from the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. A draft report(s) will be due on September 30, 1996, and a final report(s) will be delivered to GCES by December 31, 1996. This work proposal should be developed based on the prospectus submitted to Reclamation at the November 28, 1995, planning meeting held in Phoenix, AZ, entitled "Joint Arizona Game and Fish Department, BIO/WEST, Hualapai Department of Natural Resources, Glen Canyon National Recreation Area Abstracts for 1996 Controlled Flow-Scenario (2): Meet Short Term Goals." The budget associated with this work is not to exceed \$90,000.

2. **Endangered Species:** The Glen Canyon Environmental Studies contractors, Arizona Game and Fish Department, and the U.S. Fish and Wildlife Service were requested to jointly develop a cooperative integrated proposal for a study on the impacts on Kanab Ambersnail at Vasey's Paradise [river-mile 31) that result from the Glen Canyon Dam controlled release experiment. A summary report will be presented to cooperating agencies in May, 1996, a draft report to GCES will be due on September 30, 1996, and a final report will be delivered to the GCES by December 31, 1996. This work proposal will be developed based on the prospectus submitted to Reclamation at the November 28, 1995, planning meeting held in Phoenix, AZ, entitled "A Minimal Proposal to Monitor the Impacts of an Experimental High Flow From Glen

Canyon Dam on the Endangered Kanab Ambersnail at Vasey's Paradise, Grand Canyon." The budget associated with this work is not to exceed \$20,000.

C. TROPHIC LINKAGES:

1. **Drift Studies:** The Biosciences Department at Northern Arizona University has been requested to develop a proposal for studies addressing the effects on mainstem drift of the Colorado River related to the Glen Canyon Dam controlled release experiment. Draft reports on the results of this work will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the one-page prospectus submitted to Reclamation on November 21, 1995, entitled "Effect of Spike Flows on the Aquatic Drift in the Colorado River-(2) Meet Short-Term Goals," and should be integrated with joint fisheries studies in order to address issues of dietary needs of mainstem fishes in relation to drift. The budget associated with this work is not to exceed \$73,000, as outlined in the November 21, 1995, memorandum from J. Shannon and D. Blinn, to Dave Wegner, GCES, Bureau of Reclamation, Flagstaff, AZ.

2. **Lake Powell Chemistry and Glen Canyon Productivity:** The U.S. Geological Survey has been requested to develop a proposal for work addressing the effects in Lake Powell and diel chemistry in Glen Canyon Dam tailwaters, related to the Glen Canyon Dam controlled release experiment. Draft reports on the results of this work will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the two one-page prospectuses submitted to Reclamation on November 28, 1995, entitled "The Effect of High Discharge Release From Glen Canyon Dam on the Vertical Thermal and Chemical Structure in Lake Powell," and "The Relationship Between Diffusion and Algal Metabolism and an Estimate of Primary Production in the Colorado River: Glen Canyon Dam to Lees Ferry." The budget associated with this work is not to exceed \$20,000, as outlined in the November 27, 1995, USGS memorandum from Mark Anderson, Chief, Hydrologic Investigations and Research, WRD, Tucson, AZ, to Dave Wegner, GCES, Bureau of Reclamation, Flagstaff, AZ.

D. TERRESTRIAL SYSTEM:

1. **Vegetation:** The Biosciences Department at Northern Arizona University, GCES, and the Hualapai Tribe Department of Natural Resources, have been requested to jointly develop a cooperative integrated proposal for a study of the effects on riparian vegetation in Grand Canyon that result from the Glen Canyon Dam controlled release experiment. A draft report(s) will be due on September 30, 1996, and a final report(s) will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the prospectus submitted to Reclamation at the November 28, 1995, planning meeting held in Phoenix, AZ, entitled "GIS - Based Vegetation Study for the 1996 Spike Flows: Option 2." The budget associated with this work is not to exceed \$24,000.

2. **Backwaters:** The Geology and Biological Sciences Departments at Northern Arizona University, ATA/GCES and Arizona Game and Fish Department have been requested to jointly develop an integrated proposal jointly for studies concerning the rejuvenating effects on

three backwaters in Grand Canyons that result from the Glen Canyon Dam controlled release experiment. A draft preliminary report will be due on September 30, 1996, and a final preliminary report will be delivered to GCES by December 31, 1996. Additional analyses and interpretations associated with this work, as related to Biological Opinion issues, may occur if funding is available during FY97. The FY96 component of this work proposal should be developed based on the prospectus submitted to Reclamation at the November 28, 1995, planning meeting held in Phoenix, AZ, entitled "A Minimal-Budget Proposal to Evaluate Backwater Rejuvenation Along the Colorado River in Grand Canyon." The budget associated with this work is not to exceed \$54,400.

E. CULTURAL RESOURCES:

1. Indirect Impacts on Cultural Resources - Stabilization of Arroyos: The Hopi and Hualapai Tribes have been requested to jointly develop a cooperative integrated proposal to study the arroyo stabilizing effects associated with sand depositon in tributary mouths, related to the Glen Canyon Dam controlled release experiment. A draft report(s) on the results of this work will be due on September 30, 1996, and a final report(s) will be delivered to GCES by December 31, 1996. This work proposal will be developed based on the prospectus submitted to Reclamation on November 22, 1995, entitled "High Elevation Sand Depositon and Retention From the 1996 Spike Flow: An Assessment for Cultural Resources Stabilization." It is understood that the only costs associated with this budget are for logistical support, and will be covered under the logistics budget associated with the experimental flood in conjunction with other field-based studies. Surveying at tributary mouths will be provided by the ATA/GCES personnel.

2. Direct Impacts on Cultural Resources - Inundation and Erosion: The National Park Service and interested Tribes have been requested to jointly develop a proposal for studies of direct impacts on cultural resources related to the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. A draft report(s) on the results of this work will be due on September 30, 1996, and a final report(s) will be delivered to GCES by December 31, 1996. The budget associated with this work is not to exceed \$40,000.

F. GLEN CANYON NATIONAL RECREATION AREA CONCERNS: The National Park Service, Glen Canyon National Recreation Area, has been requested to develop a proposal to study impacts on natural resources of Glen Canyon related to the Glen Canyon Dam controlled release experiment. Draft reports on the results of this work will be due on September 30, 1996, and final reports will be delivered to GCES by December 31, 1996. This work proposal package will be developed based on several one-page prospectus submitted to Reclamation on November 28, 1995, entitled "Impact to the Beach and Sediment Resources Between Glen Canyon Dam and Lees Ferry (Scenario 2: Meet Short Term Goals)," "Monitoring Waterfowl Use on the Colorado River Between the Glen Canyon Dam and Lees Ferry (Short term)," "Monitoring of -8.8 RM Marsh, Colorado River: Vegetation and Leopard Frogs (Scenario 2: Short-Term)," "Monitoring Songbird Use in the Colorado River Riparian Zones between the Glen Canyon Dam and Lees Ferry (Short-term)," "National Park Service Glen Canyon National Recreation Area 1996 Experimental Flood Research Proposal-Impacts on Fish in the Glen Canyon Reach (Scenario 2- short term goals)," and

"Glen Canyon National Recreation Area Effects of Experimental Flood on Water Quality (Scenario 2: Meet Short Term Goals)." The budget associated with these studies is not to exceed \$30,000.

G. AERIAL PHOTOGRAPHY AND VIDEOGRAPHY:

1. **Before and After Black and White Aerial Photography of the Colorado River between Glen Canyon Dam and Lake Mead:** Reclamation through contract for photography to be acquired before and after the controlled release during the 8,000 cfs steady flow periods.

2. **Videography of the Colorado River between Glen Canyon Dam and Lake Mead will be taken during the 45,000 period:** Reclamation will be responsible for the collection of the video imagery during the 45,000 cfs flow period.

H. GEOGRAPHIC INFORMATION SYSTEM PRODUCTS:

The U.S. Bureau of Reclamation's Remote Sensing Group D-8260, has been requested to develop a proposal for GIS mapping work related to physical changes of the Colorado River, including sand bars, backwaters, shoreline types between 8,000 and 20,000 cfs, cobble bars, (from before and after aerial photography, at 8,000 cfs), and water surface elevation at the 45,000 cfs level (from videography), related to the Glen Canyon Dam controlled release experiment, anticipated for March, 1996. GIS deliverables will be due on September 30, 1996, and final products will be delivered to GCES by December 31, 1996. The proposal will be developed based on the 2 one-page prospectuses submitted to GCES on November 22, 1995, entitled "Reclamation Remote Sensing and Geographic Information Group D-8260 Proposal for Development of A 45,000 cfs Water Line From the Controlled Flood Event," and "Reclamation Remote Sensing and Geographic Information Group D-8260 Proposal for Mapping Change in Riparian and Wetland Vegetation Due to the Controlled Flood Event." Identification of spatial coverage and criteria for mapping channel attributes in selected reaches of the river shall be coordinated Reclamation Technical personnel and GCES cooperating scientists through the GCES Office. The budget associated with this work is not to exceed \$50,000. GIS work will be completed in all miles of GCES/GIS Site 5 (river miles 60-72), and in river miles 44, 55, 30 (channel attributes plus water line), and water line only within the Glen Canyon GIS site. This work will be coordinated through the GCES Office in Flagstaff.

I. **RECREATION RESOURCES:** The National Park Service requested at the November 28, 1996 meeting of the Transitional Working Group to include a recreational safety study at selected rapids in the Grand Canyon as part of the March 1996 controlled release experiment. The National Park Service is concerned that the 45,000 cfs flows will lead to increased river accidents at specific rapids in the Grand Canyon. GCES has requested Grand Canyon National Park to prepare a proposal following the guidelines set for the other studies. The budget associated with this work should not exceed \$5,000.

VI. REPORTS AND SCHEDULES

Prompt reporting of results is necessary to address the concerns raised by the Transition Work Group and to evaluate and support the conclusions made and the recommendations developed in the Glen Canyon Dam Environmental Impact Statement. Therefore, a report schedule has been developed for each research and monitoring component.

Draft Reports - Due on or before September 30, 1996

Final Reports - Due on or before December 31, 1996 with GIS data tapes and/or supporting information

Metadata standards - Due on or before September 30, 1996

A consolidation and an initial results report will be coordinated through the GCES Office in Flagstaff along with a technical video tape documenting the types of studies and the immediate responses of the resources. The video tape will be utilized to show the Transition Work Group and educational groups the specific types of studies initiated.

A media plan is being developed through efforts of Reclamation, Upper Colorado Region, GCES and Grand Canyon National Park.

VII. LOGISTICS

In order to meet the logistical requirements and budget for the controlled release, a logistical coordination plan is being developed. It will include utilization of river logistics, base camps at selected research sites, helicopter transportation and hiking in/out of the Grand Canyon. All logistical requirements and permits in the Grand Canyon will be coordinated through the River Subdistrict Office and the Superintendent of Grand Canyon National Park.

Fixed wing aircraft will be used to acquire aerial photography and the Department of the Interior helicopter will be used to acquire the videography. All permits and flight plans will be coordinated with Grand Canyon National Park and the Federal Aviation Administration (FAA). All Special Flight Rules will be followed within the requirements specified by the National Park and FAA. GCES will be developing a coordination plan for all logistics and will officially provide Grand Canyon National Park with the information.

VIII. COORDINATION

A. Dam Operations. Reclamation, Western Power Administration and GCES have developed specific plans to operate Glen Canyon Dam during the controlled release. This includes identification of operational needs, communication networks, and contingency plans. This document will be finalized in March, 1996, prior to the controlled flood event.

B. National Environmental Policy Act. Reclamation, Upper Colorado Region is taking the lead on the development of the necessary National Environmental Policy Act (NEPA) documentation. The document will be distributed to all necessary parties for review and forwarded for approval to Washington.

C. Biological Opinion. Reclamation, Upper Colorado Region, GCES, Fish & Wildlife Service, Arizona Game & Fish, the Navajo Nation and the National Park Service are coordinating the development of the necessary documentation for the development of a Biological Assessment on the controlled flood. This document is presently out for review and will be finalized prior to the controlled flood event. GCES is taking the lead with Upper Colorado Region in the physical development of the Biological Assessment document.

D. Annual Operating Plan. Reclamation has taken the lead in including the controlled flood water in the 1996 Annual Operating Plan for the Colorado River system. The Annual Operating Plan for the Colorado River for water year 1996 has been signed and includes provisions for the controlled release. The AOP will be included in the project plan.

IX. LITERATURE CITED

Patten, et. al. 1994. Draft Work Plan. Experimental high discharge release from Glen Canyon Dam through Grand Canyon National Park. Glen Canyon Environmental Studies, Flagstaff, AZ
U.S. Bureau of Reclamation. 1995. Operation of Glen Canyon Dam: final environmental impact statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, UT

X. APPENDIX

- 1. Hourly releases**

Glen Canyon Spike Flow - 1996

Hour of Day	EOH Flow	Time of Day	Day	Date	Ave Daily Flow
0	8000	100	Sat	23-Mar	8000
24	8000	100	Sun	24-Mar	8000
48	8000	100	Mon	25-Mar	8000
72	8000	100	Tues	26-Mar	8000
96	8000	100	Wed	27-Mar	37083
97	12000	200			
98	16000	300			
99	20000	400			
100	24000	500			
101	28000	600			
102	32000	700			
103	36000	800			
104	40000	900			
105	44000	1000			
106	45000	1100			
107	45000	1200			
108	45000	1300			
109	45000	1400			
110	45000	1500			
111	45000	1600			
112	45000	1700			
113	45000	1800			
114	45000	1900			
115	45000	2000			
116	45000	2100			
117	45000	2200			
118	45000	2300			
119	45000	2400			
120	45000	100	Thurs	28-Mar	45000
144	45000	100	Fri	29-Mar	45000
168	45000	100	Sat	30-Mar	45000
192	45000	100	Sun	31-Mar	45000
216	45000	100	Mon	01-Apr	45000
240	45000	100	Tues	02-Apr	45000
264	45000	100	Wed	03-Apr	39021
265	45000	200			
266	45000	300			
267	45000	400			
268	45000	500			
269	45000	600			
270	45000	700			
271	45000	800			
272	45000	900			
273	45000	1000			
274	43500	1100			
275	42000	1200			
276	40500	1300			
277	39000	1400			
278	37500	1500			

279	36000	1600			
280	34500	1700			
281	33500	1800			
282	32500	1900			
283	31500	2000			
284	30500	2100			
285	29500	2200			
286	28500	2300			
287	27500	2400			
288	26500	100	Thurs	04-Apr	18188
289	25500	200			
290	24500	300			
291	23500	400			
292	22500	500			
293	21500	600			
294	20500	700			
295	20000	800			
296	19500	900			
297	19000	1000			
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310	12500	2300			
311	12000	2400			
312	11500	100	Fri	05-Apr	8583
313	11000	200			
314	10500	300			
315	10000	400			
316	9500	500			
317	9000	600			
318	8500	700			
319	8000	800			
320	8000	900			
321	8000	1000			
322	8000	1100			
323	8000	1200			
324	8000	1300			
325	8000	1400			
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327	8000	1600			
328	8000	1700			
329	8000	1800			
330	8000	1900			
331	8000	2000			
332	8000	2100			

333	8000	2200		
334	8000	2300		
335	8000	2400		
336	8000	100 Sat	06-Apr	8000
360	8000	100 Sun	07-Apr	8000
384	8000	100 Mon	08-Apr	8000