

**List of Individual Studies Planned by the USGS's Grand Canyon Monitoring and Research Center as Part of the Proposed Glen Canyon Dam Adaptive Management Program Experimental High Flow Test in November 2004.**

**Remote Sensing**

1. Immediate pre-release overflight to produce topographic map of all beach areas above 8,000 cfs flow line in FIST (fine sediment study sites) reaches 2-7 above Phantom Ranch. This will establish the baseline extant conditions against which we measure the post flow conditions to determine how much new sand was contributed to the beaches, sandbars, backwaters and other geomorphic features of the river by the high flow. This study will occur on November 17-20, 2004.
2. Immediate pre-release mapping of bathymetry using multi-beam scanner to get a record of all sediment stored on the river bottom in FIST reaches 2-7. This will give us a measure of how much sediment is stored in the river and thus available for redistribution by the high flow. When compared to the same measurement immediately post flow (No. 4 below), it will serve as the baseline against which to measure how much sediment was moved during the high flows. This study will occur on November 10-22, 2004.
3. Immediate post-release repeat of No. 1 above to record how much sand was deposited on the beaches at these study sites. Combined with No. 1, this will be the initial measure of how effective the high flow was in moving sand above the maximum ROD operation flow level. This study will occur on November 26-30, 2004.
4. Immediate post-release repeat of No. 2 above to see how much sediment was moved out of river bottom storage onto the beaches above normal ROD operations (i.e. maximum 25,000 cfs). See No. 2 above. This study will occur on December 2-11, 2004.
5. Six month later post-release repeat of No. 3 above to see how much newly deposited sand is retained on the beaches under normal ROD operations over this time period. This will give us a measure of how rapidly ROD operation flows erode the sand that was deposited by the high flow. This study will occur on June 2-11, 2005.
6. Six month later post-release repeat of No. 4 above to see how much of that remaining sand (if any) is retained on the river bottom under normal ROD operations over this time period. This will give us an indication of how fast, under ROD operation flows, the river transports on through the system any

sediment stored on the river bottom by tributary inputs. This study will occur on November 17-20, 2004.

7. Eighteen month later post-release repeat of No. 3 above to see how much newly deposited sand is retained on the beaches under normal ROD operations over this time period. This will give us a longer-term indication of how rapidly ROD operation flows erode sediment that was deposited by the high flow. This study will occur in May 2006.
8. Eighteen month later post-release repeat of No. 4 above to see how much of that remaining sand (if any) is retained on the river bottom under normal ROD operations over this time period. This study will occur in May 2006.

## **Sediment**

9. Mass balance project to track input and export of sediment at Lees Ferry, 30-mile, 61-mile, Phantom Ranch, and Diamond Creek. Will measure sediment content and water discharge to develop the mass balance. This is important in order to allow us to understand what is happening in various reaches of the river. Do some areas lose and some areas gain sand under these high flows, and if so, what may be accounting for these differences. Further, can we demonstrate by these mass balance calculations that indeed we are depositing (gaining) or eroding (losing) sediment in certain portions of the river? Can we understand why these gains/losses are occurring and can this knowledge help us manage future high flows for maximum benefit? This study will occur on November 17 - December 8, 2004.
10. Longitudinal profile of sediment exchange along the river corridor at selected sites. Measurements will be made of sediment concentration and grain size distribution in the water column at several locations during the high flow to see how this changes as the water moves through the Grand Canyon. This will give us some indication about where and perhaps the conditions under which sand is deposited or eroded by the high flow as it moves through the changing geomorphic conditions as one moves through various places along the river under the high flow conditions. This study will occur on November 22-29, 2004.

## **Biology**

11. Kanab Ambersnail protection – will remove Vasey's Paradise vegetation habitat from harms way during high flows then return the habitat back to its original position at end of study. Will monitor pre- and post-flow snail numbers to ensure that objectives are being met to protect this endangered species. This study will occur on November 18-29, 2004.

12. Aquatic Foodbase – sample organic drift (plant remains, wood fibers, mosses and other aquatic vegetation, invertebrates) at Little Colorado River confluence before, during, and after high flow conditions. Measure response of drift throughout the hydrograph. In January 2005 repeat these studies to see how the system recovers from this perturbation. Do these experimental high flows upset the foodbase within the river? If so, for how long and how seriously? This study will occur on November 17 - December 1, 2004.
13. Macrophytes – pre- and post-high flow qualitative assessment of macrophytes (aquatic plant life) in the Lees Ferry reach, being conducted by Arizona Game and Fish Department. This is an important food source for many aquatic invertebrates, which in turn are important as a food source for native and nonnative fish in the river. This study will occur on November 18-19, 2004 (pre-flow) and November 26-27, 2004 (post-flow).
14. Fish – Arizona Game and Fish Department fishery biologists, under contract to GCMRC, will conduct a mid-December 2004 assessment of relative abundance of non-native trout in the Lees Ferry reach following the high flow. They will measure size composition, condition, and diet. This post flow assessment will then be compared to a similar October 2004 assessment they conducted as part of the annual monitoring program by GCMRC. This reach is widely known as a world class trout fishery and, as such, is an important economic force in the region. The trout fishing guides are quite concerned with how dam operations might affect their livelihood. They demand that this 14-mile stretch of the river below Glen Canyon Dam, but above Grand Canyon National Park, be protected as a prized trout fishery. This study will occur on December 15-17, 2004.
15. Fish -- Contractor Josh Korman will conduct a survey of the location (hypsoetry) of trout redds in the Glen Canyon reach to see how the high flow may affect trout reproduction potential in that part of the system. This study is similar in purpose to that in No 14 above. This study will occur on December 15-17, 2004.
16. Fish – GCMRC will conduct a hoop net survey to examine the affect of this high flow on juvenile humpback chub in the region near the confluence of the Little Colorado River. Recent surveys (pre-high flow) showed a high number of juvenile chub in this reach. The 2004 reproduction year yielded some of the largest catches of young-of-the year chub in many years. This survey is needed to ensure that we understand how the timing of this high flow may have affected young humpback chub around the mouth of the Little Colorado River. It is hypothesized that because the chub evolved under the highly flood prone conditions of the Colorado River, they will not be negatively affected by this experimental high flow, but his needs to be tested to be sure. This study will occur on November 17 - December 1, 2004.

17. Fish – Mechanical removal of non-native trout, the other portion of this experimental plan, which is not sediment trigger dependent, has been ongoing for the past two years, and will continue 2005. The purpose of this study is to learn if the control of nonnative predators (rainbow and German brown trout) can assist the humpback chub to increase in population. Young chub need to achieve a certain minimum size before they can effectively avoid predation. Have the past two years of mechanical removal (electroshocking and euthanizing trout) allowed the high number of young chub found this year, or are other factors responsible? We don't know for sure, but whatever the cause, it is encouraging to see the high reproduction and survival thus far of the 2004 cohort of young chub. This study will occur in January, February, March, July, August, and September of 2005.

### **Water Quality**

18. Water quality measurements taken at the dam and at Lees Ferry, 30-mile, 61-mile, Phantom Ranch, and Diamond Creek will monitor conductivity, O<sub>2</sub>, temperature, and pH throughout the experimental hydrograph. Do these high flows alter the water quality in waters released from Glen Canyon Dam? If so, how and to what negative effects? This study will occur on November 17 - December 1, 2004.

### **Cultural Resources**

19. Sediment deposition will be monitored in relation to archaeological areas known as AZ C:13:099 and AZ C:13:100 in the Palisades area by replicating the 1996-1997 pre- and post-experimental flood surveys, and extending those surveys upslope to include more of the surrounding terrain. The 1996, 1997 and 1998 surveys in this area revealed that significant areas of new deposition occurred following the 1996 experiment, but these new deposits were rapidly removed during the following two years. This project will attempt to quantify post-flood erosion and reworking of the experimental flood sediments due to wind action and run-off. In addition, we will be conducting a one-time test of the efficiency, accuracy and environmental sensitivity of a ground-based LiDAR system for producing topographic maps relative to conventional survey and airborne LiDAR at the Palisades location, as well as in the 60-Mile vicinity. The project surveys will be conducted immediately before (November 19-21) and after the flood (early December 2004), and at approximate six months intervals afterward (May 05, Oct/Nov 05, May 06, Oct/Nov 06).

### **Lake Powell**

20. Profiles of common water quality parameters (i.e., temperature, specific conductance, dissolved oxygen, pH, and turbidity) will be collected in Lake Powell from the forebay up to the confluence with the San Juan River arm to

document conditions in the lake before the high flow release. During the high flow release, similar measurements will be collected in the forebay. Shortly after the high flow, the sampling stations will be revisited to determine changes in reservoir stratification and routing of water from upstream in the reservoir as a result of the high releases. This study will occur on November 19 - December 4, 2004.