

Replacement sections and pages for the GCMRC FY 2003 Annual Work Plan

Based on comments received from Technical Work Group members
on the
December 14, 2001 Final Draft of the FY 2003 Work Plan

Changes

Chapter 1, page 1 - Revise the section entitled **Geographic and Institutional Scope** as follows to make this section consistent with the AMP Strategic Plan.

GEOGRAPHIC AND INSTITUTIONAL SCOPE

The geographic scope of GCMRC's activities is defined by the Colorado River ecosystem (CRE) within Glen Canyon National Recreation Area and Grand Canyon National Park (Figure 1.1). The CRE is defined as the Colorado River mainstem corridor and interacting resources in associated riparian and terrace zones, located primarily from the forebay of Glen Canyon Dam (GCD) to the western boundary of Grand Canyon National Park. The Programmatic Agreement¹ defines the lateral extent of the CRE for cultural resources as the 256,000 cfs stage elevation. For physical, biological, recreational and other resources the lateral extent is ~~defined by the impacts of dam operations for inundation levels associated primarily with flows up to 100,000 cfs, the approximate upper limit of the historic Old High Water Zone (OHWZ)~~ an issue of ongoing research and investigation to determine where the effects of dam operations are located along the floodplain. In between these levels (100,000 cfs and 256,000 cfs), stakeholder concerns with respect to relict native vegetation, endangered species, and cultural resources may require activities by the GCMRC.

¹ The Programmatic Agreement (PA), finalized in August 1994, is a legal agreement between federal and state agencies and tribal groups that specifies the responsibilities of the parties to comply with the National Historic Preservation Act (1996; 1992) and 36 CFR 800. The area addressed by the PA is currently under discussion for possible modifications that would be based on geomorphic attributes rather than flow releases.

The Adaptive Management Program may do research outside the geographic scope defined above to obtain needed information. Such linkages with other areas should be made on a case-by-case basis, considering ecosystem processes, management alternatives, funding sources and stakeholder interests.” (National Research Council 1999:43; Loveless 2000).

Chapter 1, pages 17 - 24 – Replace the description of the **Information Technologies Program (ITP)** under the **Current Knowledge** section with an updated section.

See Attachment

Chapter 1, page 28 - Revise the section entitled **Protocol Evaluation Program** to describe how the recommendations from the Integrated Water Quality, Fish and Aquatic Foodbase, and Survey PEPs will be implemented.

PROTOCOL EVALUATION PROGRAM

The Protocol Evaluation Program (PEP) was initiated to provide independent external review of all GCMRC monitoring and research programs and provide recommendations to GCMRC regarding the specific monitoring protocols that will be used.

The PEP process for evaluating current and new alternative protocols in all program resources area is scheduled for completion by the end of FY 2002. Two PEP workshops were conducted in FY2001. These included the Integrated Water Quality Program and the Native Fish and Aquatic Food Base monitoring projects. The recommendations resulting from these workshops have been distributed to the TWG and AMWG and ~~used to modify the FY 2003 work plans as appropriate~~ will be used to modify the monitoring programs described in this work plan. This collaborative process involving GCMRC and the TWG is underway. Following TWG protocols, ad-hoc groups have been established to review the PEP panels' recommendations in both program areas and GCMRC is drafting revised long-term monitoring plans in both program areas that respond to the PEP panel's recommendations. These revised plans will be reviewed by the TWG in the spring and summer of FY 2002. Once agreement is

reached, these revised programs will be substituted for the programs described here and will be implemented in FY 2003 and subsequent years, as appropriate. An additional PEP is scheduled for Winter 2002 for assessment of survey support services to GCMRC.

Following the same TWG procedures, outlined above, GCMRC will endeavor to work with the TWG to respond to the Survey PEP's recommendations and have a revised plan ready for implementation in FY 2003. All PEP workshops and evaluations are conducted in cooperation with external experts identified through a nationwide scoping and competitive selection process, as well as GCMRC science cooperators, contractors, and Technical Work Group members.

Chapter 1, pages 29-30 - Revise the section entitled **Future Challenges** to address the need to establish a good understanding of Native Fish and the Aquatic Foodbase below Diamond Creek, especially in light of the potential warming that could occur in that part of the Colorado River ecosystem from implementation of a Temperature Control Device.

FUTURE CHALLENGES

GCMRC and the adaptive management program, in general, face a number of challenges with respect to designing monitoring and research activities to gather information on specific experimental management actions. These include potentially both the construction and operation of a temperature control device (TCD) on Glen Canyon Dam and the implementation of experimental endangered fish flows to satisfy the 1995 biological opinion on the operation of Glen Canyon Dam.

The FY 2003 Work Plan is based on the assumption that the TCD, if built, will not be operational until FY 2004 and that any activities required to supplement the planned monitoring and research activities will be supported out of Reclamation's Section 8 funds. In addition, GCMRC is working with the Lower Colorado Region of the Bureau of Reclamation to determine what monitoring activities they will be implementing below Diamond Creek that may provide support of Adaptive Management Program so that duplicate effort is not initiated. Areas of potential collaboration include monitoring of the Southwest Willow Flycatcher, native fish, and the aquatic foodbase. In conjunction with the reviews being conducted in response to the PEP panel recommendations described earlier for native-fish and the aquatic foodbase, GCMRC intends to co-ordinate with the

Lower Colorado Region of the Bureau of Reclamation on any work done below Diamond Creek. A plan will be brought to the TWG prior to implementation of the activities described in this work plan to ensure adequate coverage of resources below Diamond Creek. With respect to implementation of endangered fish flows, the FY 2003 Work Plan is based on the assumption that, if implemented, the actual flows to be implemented will follow those in the plan prepared for GCMRC by SWCA, Inc. We also assume that a decision for implementation of endangered fish flows in FY 2003 will not be made until January 2002, and given the short lead time, any supplemental activities will be implemented as modifications to contracts already in place. As with the issue of contingency planning discussed earlier, a mechanism for funding this additional work needs to be developed.

Chapter 2, page 80 - Revise the section entitled **Integration**: to indicate that these changes to the Integrated Water Quality Monitoring: Downstream Activities will be implemented in FY 2003 following revision of the long-term plan to address PEP recommendations.

Integration: This program will be heavily integrated with the sediment transport studies in the physical sciences and with the sampling for aquatic foodbase and downstream fisheries efforts. Specific parameters and integration strategies are being developed in FY 2002 and will be implemented in FY 2003.

Chapter 3, page 170 - Revise the section entitled **GCMRC BUDGET** to show the \$30,000 that will be sought from other outside sources to support the Kanab ambersnail taxonomy work.

GCMRC BUDGET

The total FY2003 budget for the GCMRC is ~~\$7,847,000~~ \$7,877,000. This includes \$6,773,000 from AMP – Power Revenues, \$300,000 from the Bureau of Reclamation Water Quality fund; ~~and~~ \$774,000 requested from federal appropriations, and \$30,000 that will be sought from outside sources to support Kanab ambersnail taxonomy activities that may occur outside the geographic scope of the program.

~~FY2002. In addition, annual monitoring of 34 campsite areas is on-going. Interim results from this monitoring indicate that camping areas continue to slowly erode. However, the erosion can be offset by flows greater than powerplant capacity combined with adequate sediment supply (Hazel et al., 2001). A more complete discussion of sediment monitoring is found in the previous sediment resources section for fine-sediment storage and sand bar monitoring.~~

~~A previous study assessed recreational preferences relative to experiences and camping beaches (Stewart et al., 2000). Based on user surveys, this study indicates recreational preferences for camping beaches and activities such as white water rafting, day-use rafting in Glen Canyon, and fishing and recreation experiences.~~

~~Low Steady Summer Flows in summer, 2000, provided additional data on recreational experiences, travel times, safety and economic impacts to concessionaires. Draft reports have been received and are currently under review. These data will be available in FY 2002. Recreational fishing data was compiled and synthesized in FY 2001. The final draft report for this study is currently being reviewed and the results of this study will be available in FY 2002.~~

section
replacement

Information Technologies Program (ITP):

Data Base Management System (DBMS): The DBMS is the first of three fundamental technologies for consolidating, storing, and distributing data gathered as part of monitoring and research projects at GCMRC. Its purpose is to store all tabular data available in electronic form and to reference additional data that is either not available in electronic form or is not tabular (e.g., digital imagery). The Oracle data base engine was selected for GCMRC data base development. Oracle is a state-of-the-art data storage and delivery system that can function either as a centralized or distributed data base and incorporates a high degree of information technology integration. The DBMS program is currently working on bringing together years of disparate historical data collected by multiple entities located in databases across the southwest in an organized fashion and then deliver it transparently to stakeholders and researchers for decision making and modeling purposes. A key aspect of this work has been integrating Oracle's database management software with the Center's ARC/INFO GIS, so that all tabular data sets can

be viewed and queried in a spatial context. An Oracle database developer has been selected to advise us on overall infrastructure and design issues, and to write key data access applications. Work has begun on a pilot project that demonstrates the look, feel, and functionality of the completed DBMS using a subset of GCMRC data, scheduled to be completed by the end of February 2002. After completion of this pilot project, remaining data collection efforts at the Center will be prioritized and integrated with the database design, and corresponding data sets imported.

Geographic Information System (GIS): The GIS is the second of three fundamental technologies for consolidating, storing, and distributing data gathered as part of monitoring and research projects at GCMRC. Its purpose is to store and analyze spatial data. The ESRI Arc/Info spatial data base engine was selected for GCMRC spatial data development. GIS is an important analytical tool for change detection of biological, cultural, and physical data. The GCES program developed up to 20 thematic coverages associated with spatial relationships of biological, cultural and physical resources at 17 GIS sites within the Colorado River ecosystem (CRE). Tabular attribute data exists as part of these data sets. These data sets are known as “base data”. In addition, other GIS data sets which were constructed as part of past GCES-supported investigations and delivered as part of a final product. These data sets are known as “contributor data”. Base and contributor data as well as recent remotely sensed imagery and topography data sets are now available on the GCMRC FTP site (accessible from the GCMRC web page or directly at <ftp.gcmrc.gov>) in the /data/basedata subdirectory. Efforts are now underway to integrate this data into the Oracle DBMS. The GCMRC is working to increase the GIS coverage of the CRE by using modern light detection and ranging (LIDAR) mapping techniques. Working with other IT programs, the GIS department has also developed data standards for consistent delivery of data and an archive structure to store all GIS layers, imagery, database tables, and library reports.

Library: The library is the third of three fundamental technologies for consolidating, storing, and distributing data gathered as part of monitoring and research projects at GCMRC. Its purpose is to store hardcopy reports, maps, videos, and

photographs as well as other miscellaneous documents. Although the nature of library materials is generally hardcopy, efforts are being made to catalog materials on-line. The Follet library catalog software was selected for this purpose. You can access the Follet library catalog from the GCMRC website at www.gcmrc.gov. Currently, all hardcopy reports and books pertaining to the CRE are searchable electronically using the on-line catalog. Other materials will be added as time permits. Efforts are underway to digitize historical library materials so that they may be distributed electronically via the Internet. The library has also implemented a consistent peer review process to help ensure the quality of scientific reports submitted in partial fulfillment of contract and cooperative agreement requirements. The GCMRC library continues to make strides in organization and accessibility. Accomplishments to date include the following:

- New materials are being cataloged as they arrive.
- Reports were subject to peer review before they were made available to the public.
- Electronic versions of reports were archived in the library and made available on the FTP (accessible from the GCMRC web page or directly at [ftp.gcmrc.gov](ftp://ftp.gcmrc.gov)) site for electronic distribution to stakeholders and the public.
- An archive structure was created for electronic data that will be used in the Oracle database.

The library is, for the most part, fully functional. In addition to serving patrons, FY2003 activities will focus on converting historical library materials to electronic form for distribution via the Internet.

Surveying: The GCMRC survey department provides support to GCMRC scientists and investigators for spatially referencing data collected in the field. In addition, the survey department provides terrestrial and hydrographic base maps and maintains a network of survey control throughout the ecosystem.

Terrestrial base maps: Prior to 2001, GCMRC had sub-meter accuracy terrestrial topographic maps of approximately 80 miles of the ecosystem in 17 areas of concentrated scientific effort that have been referred to as GIS sites. GCMRC also has similar topographic maps from GCD to Badger Rapid near river mile (RM) 8 derived

from our LIDAR evaluation in 1998. In FY2000, the GCMRC collected high-resolution orthophotography and topography of the entire CRE. This dataset provides one-foot resolution geo-referenced and rectified imagery and one meter interval contour maps as well as a four-meter digital elevation model. This data set was delivered, inspected, and incorporated into the GCMRC FTP site (accessible from the GCMRC web page or directly at <ftp.gcmrc.gov>) in the /data/orthophotos and /data/lidar subdirectories. In addition to sub-meter terrestrial base maps described above, we have high-resolution field surveys of 35 sand bar sites that have been repeated at varying intervals since 1991. We also have numerous field surveys of vegetation, cultural, and KAS surveys. Additional sub-meter accuracy terrestrial topographic coverage needs to be obtained for the remainder of the ecosystem.

Hydrographic base maps: The hydrographic mapping program was established for the purpose of producing a sub-aqueous channel map of the Colorado River within the ecosystem. Hydrographic mapping supports several GCMRC scientific initiatives including: streamflow and fine-grained sediment transport, fine-grained sediment storage, streamflows and suspended sediment modeling, advanced conceptual modeling of coarse grained sediment, fish habitat mapping, and measuring changes in morphology and topography of the sub-aqueous canyon ecosystem. We currently have low resolution (20 meter transects) single beam base data from GDC to Badger Rapid, and GIS Site 7. We currently have high resolution (10 meter square) single beam data repeated since 1993 at 35 NAU sand bar sites (Hazel, et.al. 1999; Kaplinski, 2000), repeated surveys from Paria (RM 1) to Cathedral Wash (RM 3), 4 large pool sites in Site 5 (Wiele, 1998), 5 repeated surveys in GIS Sites 4 and 5 to monitor the 1996 flood, and a pre- and post-flood survey on the Lake Mead Delta. We also have very high resolution (multi-beam) surveys in the pools from RM 9-11, 29-42, and 45-68. Additional channel mapping of all the GIS reaches and the remaining river channel needs to be obtained as control is established. In FY2001, hydrographic channel data was collected for approximately 30 additional miles of the CRE. This data will be processed in FY2002 and an additional 30 miles will be collected and processed as well.

Canyon control: Survey control in the Colorado River ecosystem is required to meet the demands of any spatial measurements for scientific monitoring and

research. Survey control also supports the spatial positioning of hydrographic and bathymetric channel mapping as well as ground control for aerial mapping or remote sensing applications. We currently have approximately 20 first order GPS grade base stations set on the rim of the Grand Canyon. This base station network is currently in good order to complete the control in the Canyon. We additionally have continuous traverse control (point-to-point line of sight) from GDC to RM 72. Downstream from RM 72 there is continuous traverse control in all existing GIS sites. In addition there is continuous traverse control from the LCR confluence to Blue Springs, approximately 14 miles upstream which encompasses GIS Site 15. The GCMRC Survey department objective is to complete the continuous control network in the Canyon by end of calendar year 2004.

In early 2001, preliminary DTM data from LIDAR measurements showed some inconsistencies in comparable ground measurements. The ground measurements referenced control from the existing CRE control network. The LIDAR data referenced the newly-established NGS rim control standard. The inconsistencies are a result of the unavailability of accurate GPS base stations when the original GCES control was established. The remote sensing initiative is requiring an upgrade of the existing coordinate values. This will allow a comparison of remotely sensed data and CRE legacy data can be accurately used for change detection. Furthermore, current data collection on the ground requires updated coordinate values for change detection.

In order to meet GCMRC's positioning needs, the existing control reference system must be continually enhanced to provide the high accuracy required for use with GPS and conventional measurements. In association with National Geodetic Survey, GCMRC has established a GPS control network of monumented points having three-dimensional positions. This control network is the positional infrastructure for all surveying, mapping, and remote sensing operations in the Grand Canyon that are implemented by GCMRC. Project objectives for the observations are to ensure 2-centimeter local accuracy and 5-centimeter accuracy overall. This additional work is described in the Development of a CRE Control Network section of Chapter 2.

Systems Administration: Systems Administration encompasses the entire computing and networking environment at the GCMRC. The core computing environment is, for the most part, fully implemented with the exception of the database management system, the Internet map server, and the World Wide Web server. It is anticipated that significant progress will be made in the non-fully implemented areas in 2002 with the staff additions of a full time system administrator and oracle consultant in 2001.

Remote Sensing: There are currently two aspects to GCMRC remote sensing: (1) remotely sensed data collection, and (2) the remote sensing initiative entitled "*Evaluating ground-based and airborne remote sensing technologies.*" Remotely-sensed data collection currently consists of annual aerial photography collected sometime between Memorial Day and Labor Day. Black-and-white stereo aerial photography is collected over the entire Colorado River ecosystem and natural color is collected in areas critical to vegetation studies. The GCMRC intends to continue the annual acquisition of aerial photography until other remotely-sensed data sets are identified and implemented into the monitoring program.

Accomplishments for remote sensing initiative in FY2001 include evaluations of various remote-sensing technologies that were deemed potential candidates for satisfying monitoring requirements of various GCMRC program elements. The program elements that were assessed included (1) mapping riparian vegetation, (2) mapping warm-water fish habitats, (3) detecting and monitoring cultural resources, and (4) monitoring terrestrial sand bar deposits.

Mapping Riparian Vegetation: We examined various airborne remote-sensing data that were collected during different seasons within a one-year time frame, with different spatial resolutions (11 cm to 100 cm), and with various technologies (CIR film, CIR CCDs, and multispectral data) to determine the relative merits of each data set for mapping riparian vegetation within the Grand Canyon. This study determined that digital, 3-4 band image data using appropriate wavelength bands can provide maps of riparian vegetation communities at a 60-70% accuracy level without field surveys. Field verification and limited surveys can increase this accuracy to about 80% or greater.

Mapping Warm-Water Fish Habitats and Cultural Features: We evaluated airborne thermal-infrared (TIR) data that were acquired at 100-cm resolution during maximum solar heating (at 1:30 p.m.) to determine the capability of such data for mapping warm backwaters and near-shore habitats for fish, in addition to mapping archaeological structural sites and natural springs within the Grand Canyon. Airborne TIR data can provide an instantaneous map of surface water temperature for very large regions, which cannot be obtained by in-situ measurement methods. Detection of archaeological structures requires the use of an airborne TIR sensor that can detect temperature differences as small as 0.1 degrees C, needs to be acquired at a spatial resolution of no more than 25 cm, and would be optimized by data collection after sunset or just after sunrise. Safety issues after dark and shadows during early morning make such data collections very difficult. Detection of natural springs is better approached using TIR data collected after sunset. TIR data collected during daylight hours detect only the largest springs, whose existence is already known. Detection of natural springs after sunset can and has been accomplished using rather low-resolution imagery (1-3 meters) because the spring waters spread from their source and present a large area and the spring water is much colder than the surrounding warm, dry ground.

Monitoring Sand-Bar Deposits: We evaluated light detection and ranging (LIDAR) and photogrammetric methods for remotely mapping sand bar deposits along the Colorado River to determine if these two remote-sensing technologies for mapping topography could approach the accuracies currently obtained using field survey methods and at a comparable cost, while providing more aerial coverage. Thus far, our studies have determined that LIDAR appears to be a suitable method for rapidly obtaining the topography of bare sediment surfaces over very large regions.

We are further investigating LIDAR and photogrammetry in terms of their ability to map volumes of terrestrial sediments, which does not require knowledge of absolute elevations. In FY2002, we are investigating remote-sensing technologies to determine vegetation habitat structures (area, volumes, heights), to map and monitor older river terraces, to map and monitor channel bottom deposits, and to monitor the river water's suspended load and turbidity.

The remote sensing initiative will be completed in FY2002. A report will be completed in FY2002 that presents recommended technologies for implementation within all GCMRC program areas. Remote sensing activities in FY2003 will largely consist of data collection in support of the biological, cultural, and physical science programs at GCMRC.

MANAGEMENT OBJECTIVES AND INFORMATION NEEDS

Introduction

Management objectives (MOs) and information needs (INs) help to define measurable standards of desired future resource conditions to be achieved by the AMP. The MOs and INs also drive the strategic planning process and they provide the basis for the annual monitoring and research program described in this plan.

Historical Development Of The Management Objectives And Information Needs

Using the nine resource areas in the EIS, meetings and workshops were held in 1996 to formulate management objectives and to define information needs associated with the various management objectives. These were intended to guide the development of GCMRC monitoring and research activities. In 1997 and 1998, additional discussions were held to revise Management Objectives and prioritize Information Needs. In FY 2001, the AMWG adopted a new set of MOs that resulted from its effort to develop an AMP strategic plan. The full AMP strategic plan will be completed in FY 2002.

Revision Process

As part of the AMP strategic planning process, the INs are being revised through a collaborative process led by the Grand Canyon Monitoring and Research Center. This process was initiated in Spring 2001 with a series of workshops and meetings with TWG representatives to discuss and refine the INs. A final meeting was held in October 2001 and the final draft of the Information Needs will be discussed at the November TWG meeting and forwarded to AMWG for their approval in January 2002. This plan references the current MOs, as the INs are currently under revision and have not been