**REMOTE SENSING, GCDAMP PROJECTS:**

**Background**

GCMRC is proposing to take the $163,000 for airborne remote sensing in the AMWG approved budget for FY04, and add to that about $130,000 that carried over from FY03 for a similar purpose. The result would be approximately $300,000 to be used to conduct an entire canyon remote sensing mission using state-of-the-art multi-spectral digital imagery (NOTE: the estimated cost of doing the entire canyon is about $330,000 but we will work with the contractor to determine if we can reduce the price or fly most of the canyon). The carryover is a result a failed mission in FY03. Equipment failure caused the contractor to default on a mission to collect analog imagery of the canyon and the money is now available for reprogramming. GCMRC recommends that the FY03 money be reprogrammed to provide the state-of-the-art product this year for the following reasons.

First, the original intent of the FY03 money was to support airborne remote sensing and is thus fully consistent with the intent of the AMWG for continuation of the same activity in FY04.

Second, combining the two sums of money gives the AMP the unprecedented opportunity to conduct a state-of-the-art airborne remote sensing mission of the entire canyon for the first time using multi-spectral digital technology. The AMWG-approved a four year study to evaluate remote sensing technologies in the Grand Canyon that was completed by Phil Davis under contract to GCMRC this year. The study cost about $1.5 million over the four years of approved work effort and resulted in the strongest recommendation from a leading expert in the field, and GCMRC, that the AMP move to implement multi-spectral digital imagery acquisition immediately and abandon the technologically-inferior analog technology utilized in the past. Digital imagery can be examined the same day it is flown to prevent total mission failures, and it is computer exportable. In contrast, analog imagery (like that taken with a Brownie camera) cannot be examined immediately and requires scanning to convert to digital format. The results of the remote sensing initiative study were presented to the TWG at the October, 2003 meeting and the full report is on the AMP website.

**Alternatives**

Two alternatives are recommended for AMWG consideration by GCMRC:

1) conduct a whole canyon airborne remote sensing mission every other year using the new technology
2) conduct a half canyon (upper) airborne remote sensing mission every year using the new technology

**GCMRC Recommendation to AMWG**

GCMRC does not support or advocate the continuation of airborne remote sensing using analog technology. Option number 1 is our preferred alternative. An added advantage of option number

1 is that it would reduce the number of flights over the park to 50% of that required with an annual approach.

**Comments from Phil Davis:**

A decision is needed now to allow time for us to work with the contractor to get a contract in place for a spring overflight.

Issues for AMWG and GCMRC discussion on annual remote-sensing data collection:

1. Digital versus analog image collection.

In order to make image data useful to scientists and the general public, the image data need to be rectified to accurately position the data on the ground and remove distortions due to topography. This process of orthorectification can be performed on analog or digital image data. To facilitate rapid and accurate data analysis, it would also be extremely useful to have the image data calibrated so that there is correspondence between image color and ground material throughout the canyon system. Only digital imagery can provide this requirement. In addition, digital image data captures a larger dynamic range of surface reflectance than analog film and therefore provides more detail on surface properties. In order to rectify analog film, the data need to be converted to digital format and that adds to the "apparent" lower cost for film collection. For example, collection of 1,200 film images for $84,000 can cost an additional $12,000 for the digital scanning.

Without digital, calibrated, orthorectified image products, users of the data are likely required to (1) rectify the data to get reasonably accurate surface areas or perform change detection, and (2) calibrate the color data to determine surface materials and changes in surface materials in a quantitative manner. Few of the current scientific co-operators can perform either function as well as companies that collect the data. In addition, only after GCMRC data collections became digital and calibrated did use of the image data increase and new uses were also discovered and implemented. Even using conventional analog cameras we have had complete acquisition failures due to non-functioning camera shutter, which cannot be detected during data collection. Digital sensors provide real-time viewing of data being collected. It was for all of the above reasons that the remote-sensing initiative strongly recommended that all future image data collections use digital, calibrated sensors.

2. Image data collection for 2004

Because of the conclusions of the remote-sensing initiative, which were not refuted as yet, GCMRC planned for digital image collections during May, 2004. Unfortunately, the sensor that provided GCMRC its best data set to date during 2002 is no longer available for commercial use. Similar sensors are available but most have an unacceptable characteristic. One sensor in Canada would provide useful data but the cost for data collection using the Canadian firm is too large ($411,000). Time constraints do not allow an affordable, alternative digital sensor to be located and tested. Therefore, we are forced to accept a conventional photographic survey using color-infrared film, but these data need to be orthorectified to be most useful to interested parties.

The cost for orthorectified, color-infrared data from an analog camera will be provided by a contract company tomorrow morning before the 9 AM conference call.

Although digital image collections were precluded for 2004, there are monitoring requirements for 2006 that will require digital, calibrated image data. It is hoped that such a data collection will be accepted by the AMWG and TWG.