SURVEY PROTOCOL EVALUATION PROGRAM

Final Report

Raad Saleh, Ph.D.
Chairperson, Peer Review Panel

Peer Review Panel Members

Dale Chayes
Columbia University

Richard D'Sanchez
U.S. Geological Survey

Jon Dasler
David Evans and Associates, Inc.

Michael Renslow
Spencer B. Gross, Inc.

David Doyle
National Geodetic Survey

John Rose
Maricopa County Department of Transportation

MANDATE

- Is to assist GCMRC in identifying optimum design and procedures for implementing an efficient and effective survey program that supports long-term monitoring of natural and cultural resources in the CRE.

MANDATE

- reviewing the technology, equipment, and methodology applied by GCMRC
- introducing new technology to reduce the impact of scientific field work in the Canyon corridor
- examining spatial data collected by GCMRC to ascertain whether user needs are being met
- recommending alternatives

SCOPE

- Review of survey data collection and processing, archiving, accuracy and error determination, QC/QA, record keeping, spatial data standards, and survey control networks

SCOPE

- Evaluating the requirements for spatially referencing and assessing aerial acquisition and other remotely sensed data sets.

SCOPE

- Requirements for automated spatial data processing methods using GIS, image processing, and softcopy techniques for mapping and change detection of natural and cultural resources

SCOPE

- Review of the acquisition and processing protocols of aerial and other remotely sensed data sets intended for seamless integration with land-based survey data.

PEP OVERVIEW

- Members of the Panel represented a variety of specialized and overlapping expertise relating to the review objectives.

PEP OVERVIEW

The protocol review process consisted of four parts:

1. pre-review orientation and application descriptions
2. on-site assessment including a river trip from the Glen Canyon Dam to Lee' s Ferry
3. technical briefing session by GCMRC
4. Panel discussion and drafting of report.

ORGANIZATION OF THE REPORT

- The report is divided into two parts based on a set of 19 questions most of which have sub-questions.
- All questions were addressed with direct answers, findings, and recommendations.
- Pointers and links to external reports and references were provided.
- Summaries of the findings and recommendations are listed in the executive summary.

FINDINGS AND RECOMMENDATIONS

General Observations

Terrestrial Surveying

Aerial Surveying

Hydrographic Surveying

Standards and Specifications

Staffing and Outsourcing

General Observations

- Difficult terrain for survey work
- Limited visibility for GPS in many areas
- Limited inter-visibility of GCP
- Panel acknowledges survey team performance
- Awareness of and willingness to adopt latest technologies
- External factors affect survey work, e.g., regulations, funding

Terrestrial Surveying

FINDINGS

- Current protocols cannot be generalized as adequate at all scales, accuracy requirements, and project specifications.
- Control points locations are not adequate for **vertical** measurements.
- Although the local geoid requires improvement, its impact on accuracy may not constitute a high priority considering the cost-benefit aspects.
- Datum conversion may not achieve high accuracy because of the lack of sufficient NSRS benchmarks in the region.

Terrestrial Surveying

RECOMMENDATIONS

- Establishing sets of GCPs that satisfy certain specifications of inter-visibility, access, and link to GPS.
- Coordinating with NPS and the FGDS to place new monuments and preserve existing control points.
- Evaluation of the effects of varying geoid undulations on accuracy and its economical impact; if justified, cooperation with NGS and the USGS to improve the geoid locally.
- Using NAD 83 and NAVD 88 as the vertical datum.
- That all equipment undergoes regular testing, adjustment, and calibration according to established schedules and procedures.

Aerial Surveying

FINDINGS

- GCMRC provides adequate SOW to airborne surveying contractors.
- Capabilities and resources are not currently compatible to make full use of the historical, near future, and mid-future photographic acquisition.
- Current archiving capabilities are severely inadequate to support high-volume operations.
- Specifications for remote sensing data are deficient, particularly in relation to intended applications.

Aerial Surveying

RECOMMENDATIONS

- Descriptive specifications be defined in conjunction with the intended project goals.
- To expand in-house image analysis capabilities.
- INS should be used in all remote sensing coverages to reduce GCP requirements for photogrammteric processing.
- More detailed specifications stipulating the methods, technologies, and accuracy standards.
- Networking needs be evaluated based on requirements of post-conversion processing of historical photography.

Hydrographic Surveying

FINDINGS

- With few exceptions, protocols are adequate and meet accepted survey practices
- Current heading sensor is not adequate and other heading sensor options should be considered.
- Under specific circumstances, present attitude sensor technology will likely to result in heave artifacts.
- Some processing techniques may eliminate actual data that may otherwise be helpful.

Hydrographic Surveying

RECOMMENDATIONS

- Using a multi-beam sonar with wider angular swath width,
- Detailed patch test results be included in each survey report,
- Perform careful analysis of the dynamics of survey platform
- Evaluation of potential sensors upgrades, including field trials and subsequent analysis.
- Automated statistical analyses be carefully conducted
- Proper reporting of results and improving documentation

Standards and Specifications

FINDINGS

- Adherence to declared standards is not consistent, nor is there established protocols to verify adherence to accuracy specification.
- Found no specific documentation of QA/QC procedures, and found no error determination protocols that apply, adequately, to any of the of survey categories.
- Found no established procedures to ensure consistency among staff.

Standards and Specifications

RECOMMENDATIONS

- conformity with the latest national standards for geospatial positioning accuracy in all categories.
- strict adherence to systematic and detailed documentation of meta data.
- establishing appropriate QA/QC procedures
- contractors submit their QA/QC procedures specifically used to realize specifications.
- establishing internal verification and validation protocols; and that GCMRC verify adherence to these protocols

Staffing and Outsourcing

FINDINGS

- Contracting of a surveying mission, end-to-end, has the potential of improving the ability of GCMRC to achieve its stated goals.
- GCMRC is at serious risk because of the size of its surveying staff. Very few individuals have intimate knowledge of all unique procedures, specifics of surveying projects, and other vital information on all aspects of spatial referencing of the area.

Staffing and Outsourcing

RECOMMENDATIONS

- Expanding the surveying staff, and adding a part time geodesist.
- knowledge of the area be documented, and disseminated.
- developing contingency plans to minimize the risks of staff relocation, downsizing, and retirement.
- Contractors selection be based on qualifications and not cost
- Subcontracting options, rather than end-to-end outsourcing, for terrestrial and hydrographic surveying missions, and
- close monitoring over the contracted work, and adherence by subcontractor(s) to QA/QC procedures and delivery schedule.

Conclusions

- **Difficult terrain for terrestrial surveying**
- **Regulations impose restrictions on operations**
- **Modification of reference systems is a matter of economics**
- **Significant room for improvement in protocols**
- **Adherence and consistency are main issues with standards**
- **Staff expansion should be seriously considered**