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Report on the Cultural Monitoring Research & Development Project

Helen Fairley

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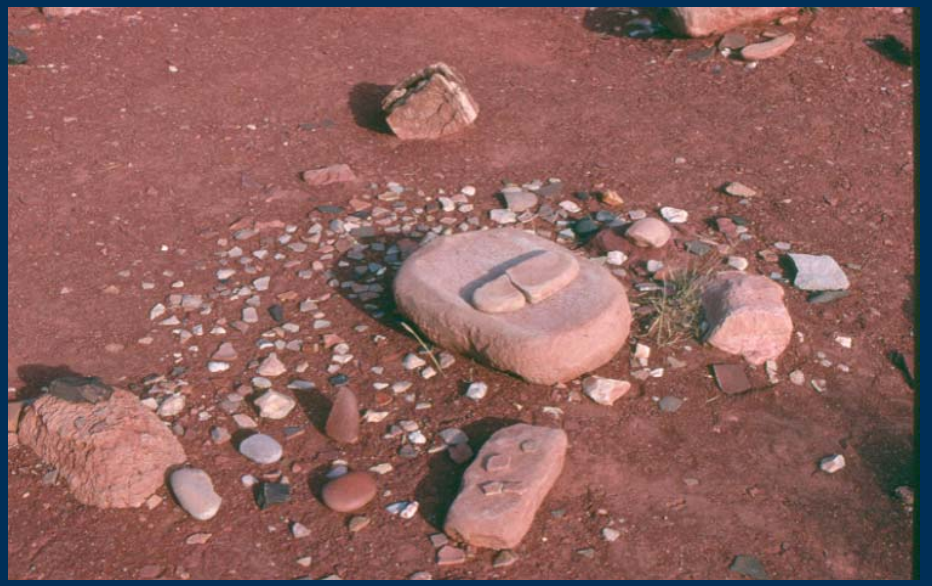
U.S. Department of the Interior
U.S. Geological Survey

Outline of this presentation

- 1: Project Goals
- 2: Project Background
- 3: Activities & Accomplishments to Date
- 4: Next Steps



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Primary Project Goal: Develop Quantitative Monitoring Protocols to meet *multiple* program needs

- **Grand Canyon Protection Act**
  Section 1805: monitor and research dam effects
  - assess progress towards achieving S1802 goals
  - assess effects of MLFF and other ROD flows

- **National Historic Preservation Act**
  - assess dam impacts on historic properties
  - assess effectiveness of mitigation actions
  - assess effectiveness of management

- **Adaptive Management Program**
  - track “status and trends” in resource condition
  - evaluate outcomes of experiments & treatments
  - “Learn by Doing”

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Project Guidance

AMP Planning

- 2003 AMP Strategic Plan
- CRAHG & TWG Discussions re: core monitoring information needs and work plans
- 2005-2006 Tribal Discussions
- 2007 Monitoring and Research Plan

External Reviews

- 1994 Review of GCES Monitoring Plan (NRC 1994)
- 1999 Review of Programmatic Agreement (King 1999)
- 2000 Protocol Evaluation Panel review (Doelle 2000)
- 2005 Geomorphology Symposium
- 2007 Legacy Data Review Panel (Kintigh et al. 2007)

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Monitoring Dam Effects is Not Straightforward

Dam effects can not be measured directly

- Few sites directly inundated
- Most dam effects “indirect”
- Complex interacting ecological factors affect site stability

- many factors affect condition in addition to dam operations

- Need to define appropriate “condition indicators” and measurement methods

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Summary of R&D Activities

1. Collected Data @ 232 sites (March 2006-Sept 2007)
   - Geomorphic database
   - Archaeological value data
   - GIS data
2. Reviewed NPS 1992-2005 Legacy Monitoring Data
3. Evaluated methods to measure erosion control effectiveness (March 2006-Sept 2007)
4. Evaluated monitoring tools (ongoing)

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Geomorphic Process and Erosion Control (Check Dam Effectiveness Study)

- Report completed July 2009

- Basic Conclusions
  - Check Dam Effectiveness
    - May capture sediment during periods of low or moderate rainfall
    - Not effective with intense rainfall (may cause more damage due to flanking and scouring)
    - Rock vs. Brush not significant
    - Short term benefits, if any
  - Monitoring Methods
    - Total stations surveys can not detect small changes
    - Profile surveys alone not adequate

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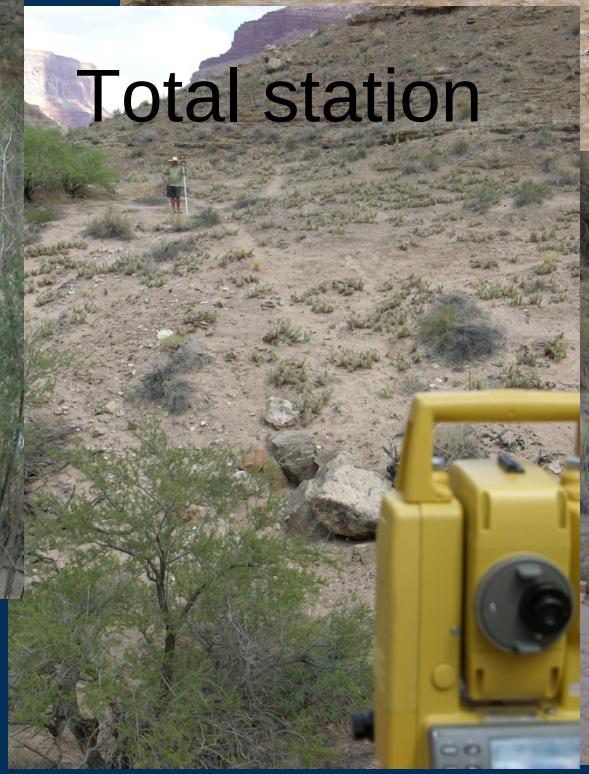
Evaluation of Monitoring Tools

Terrestrial lidar

Weather stations

Total station



RTK GPS

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Weather Stations as Monitoring Tool

- Precipitation drives gully erosion; wind redistributes fluvial sediment, potentially mitigates gully erosion
- Local weather variability not well documented in Grand Canyon
- Accurate weather data needed for check dam effectiveness studies
  - Status:
  - 9 weather stations deployed in 2007; 2 more deployed Feb 2008
  - Various technical and software issues tackled & resolved in 2007
  - 2007 Data Report completed; 2008 Data report in press

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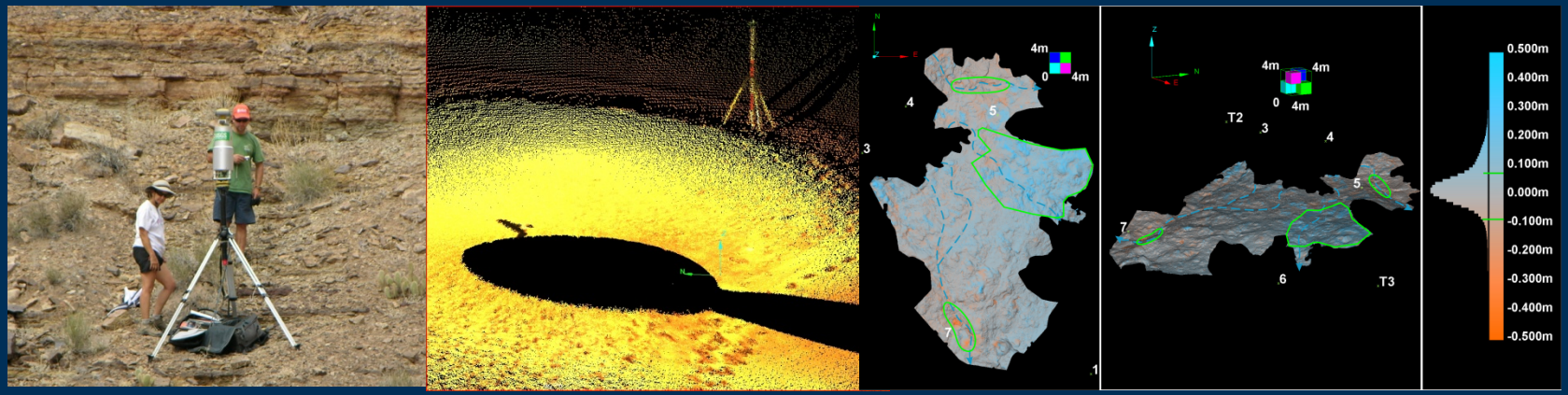
Ground-Based Lidar as Monitoring Tool

- Allows accurate comparisons of change over time
- Documents where and how much has eroded/deposited/changed
- Can quantify other indicators of change (i.e., artifact movement, soil crusts, vegetation, architecture)
- Portable; 2-3 person team; low impact compared to total station surveys



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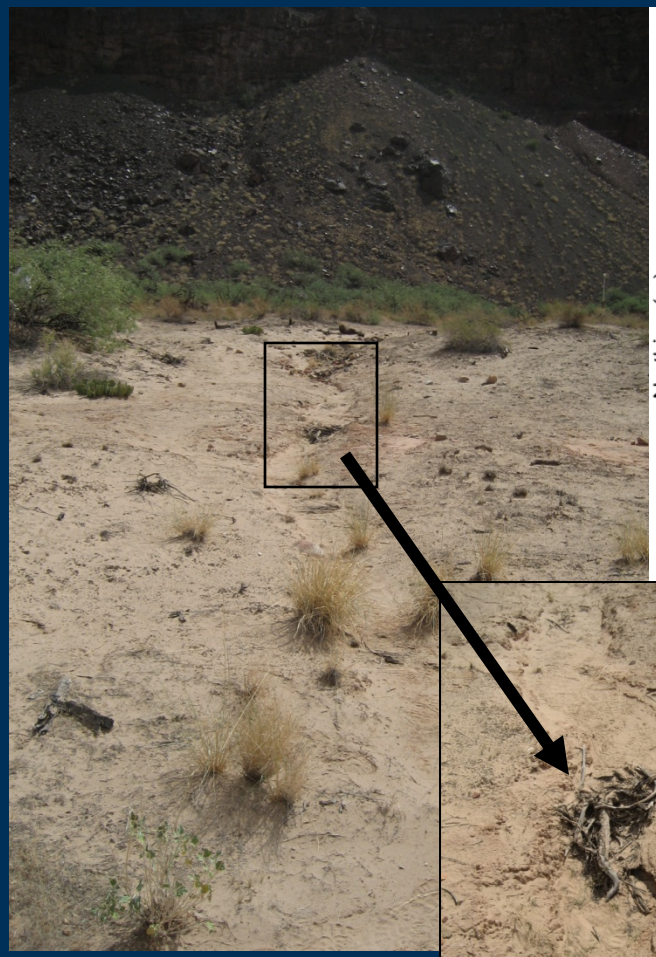
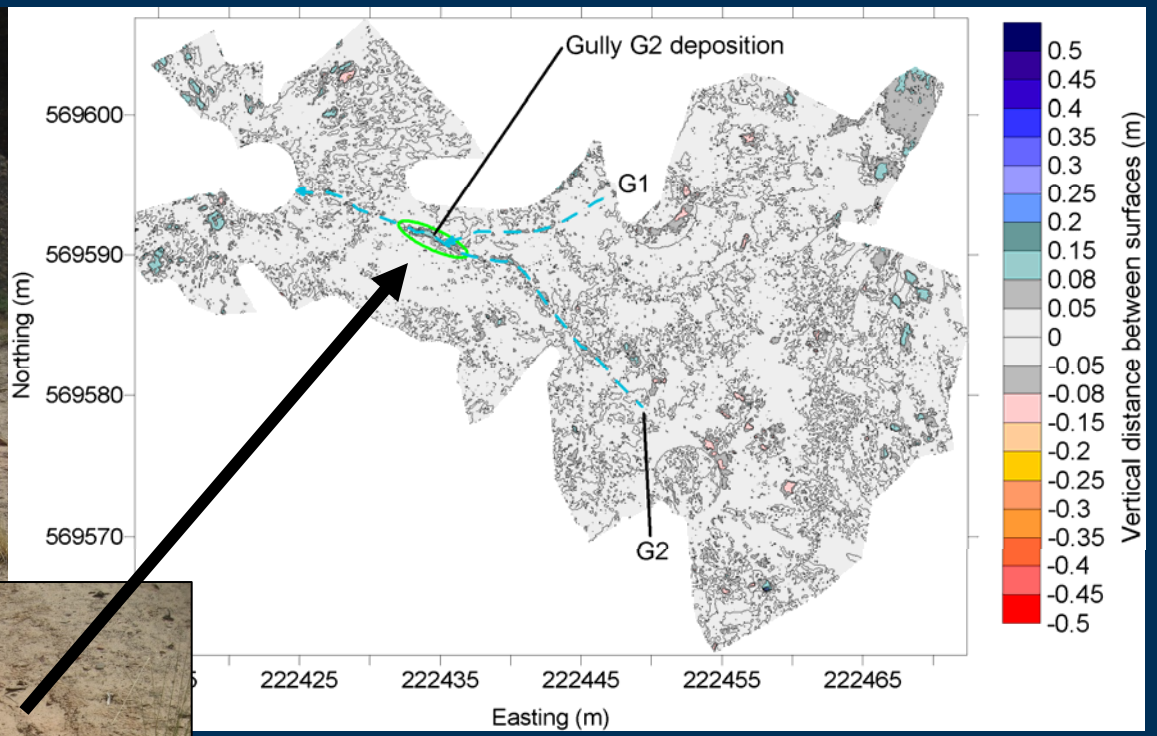
Example #1: AZ C:13:336





Measured Change May 2006-Sept 2007

- Area w/ measured erosion = 0 m^2
- Area w/ measured deposition = .9 m^2
- Total % site area w/ topo. change = .1
- Total site volume of erosion = 0 m^3
- Total site volume of deposition = .1 m3

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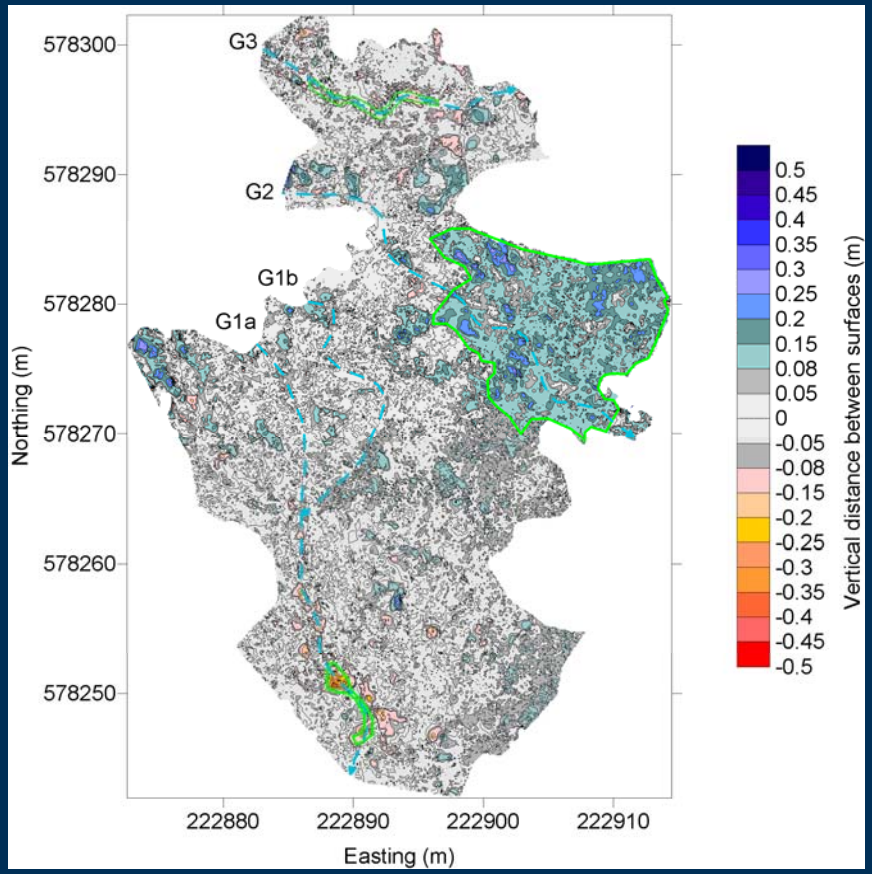
Example: AZ C:13:006



May 2006-Sept. 2007
Measured Changes:

Area w/ erosion = **12.0 m²**
Area w/ deposition = **260 m²**

Total erosion volume = **.7 m³**
Total deposition vol. = **26.9 m³**

% site area w/ change = **21.3%**

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2006-2007 Monitoring Data (NPS data vs. Lidar data)

Site No.	Condition	Threat or Disturbance Type	Disturb-ance Level	Measured change (in cubic m)	% Site Area w/ measured change
C:13:006	Fair	Water erosion, wind erosion, soil creep	Low	-0.7/+26.9	21.3%
C:13:336	Fair	Water erosion, trailing	Moderate	-0/+0.1	0.1%
C:13:348	Fair	Water and wind erosion, trailing, creep	Moderate	-0/+0	0

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Summary: Accomplishments to Date

- Baseline Data Collected (232 sites): Geomorphic database, NHPA integrity assessments, GIS maps
- Legacy monitoring data review (Kintigh et al. 2007)
- Comparison of total station vs. lidar for monitoring gully erosion (Collins et al. 2008)
- Lidar as change detection tool (Collins et al. 2009)
- Gully process and check dam effectiveness report (Obrien and Pederson, USU)
- Virtual shoreline analysis (report in progress)
- 2007 & 2008 weather monitoring reports (Draut et al. 2008; Draut et al., in press)

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Next Step: Complete Research and Development Phase

- Complete evaluation of monitoring tools while mapping additional sites
- Complete assessment of existing GIS data
- Complete additional Phase I reports

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Pilot Monitoring (FY10-12)

- Design and implement 3 year pilot program, using tools and protocols evaluated in Phase I
  - Integrate Colorado River Management Plan monitoring data
- Develop geomorphic model to serve as a predictive framework for future monitoring
- Conduct PEP review of pilot program
- Prepare final core monitoring plan

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Questions?