Update on the Status of Goal 1 Metrics for FY2024

- **Glen Canyon Dam Adaptive Management Program Annual Reporting Meeting**
- **April 9, 2025, Phoenix, AZ**
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Program Goals: Archaeological and Cultural Resources

GCDAMP Regulatory Goals:

- **GCPA goal**: Operate Glen Canyon Dam so as to protect, mitigate adverse impacts to, and improve … natural and cultural resources…
- **LTEMP and NHPA goals**: “Preservation in place.”
    - LTEMP Goal 1: Maintain the integrity of potentially affected National Register of Historic Places-eligible or listed historic properties in place, where possible, with preservation methods employed on a site-specific basis.

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Photo credit: J. Coster (USGS)

Metrics for Archaeological and Cultural Resources

Metric 1.1: Integrity

Metric 1.2: Topographic Change

Metric 1.3: Change in Vulnerability to Loss of Integrity

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Photo credit: J. Caster (USGS)

Metric 1.1: Integrity

- Integrity has a specific meaning in the National Historic Preservation Act (NHPA**): "the ability of a historic property to convey its significance"**
- Integrity is not measurable; it is a professional judgment
- Integrity is either present or absent (i.e., no "degrees" of integrity)
- Metric 1.1 documents how many sites have lost integrity during LTEMP
- Currently all sites in the GRCA APE continue to retain integrity, despite continuing damage from erosion

Eroding archaeological sites in Grand Canyon, 2017 (photos by J. Sankey)

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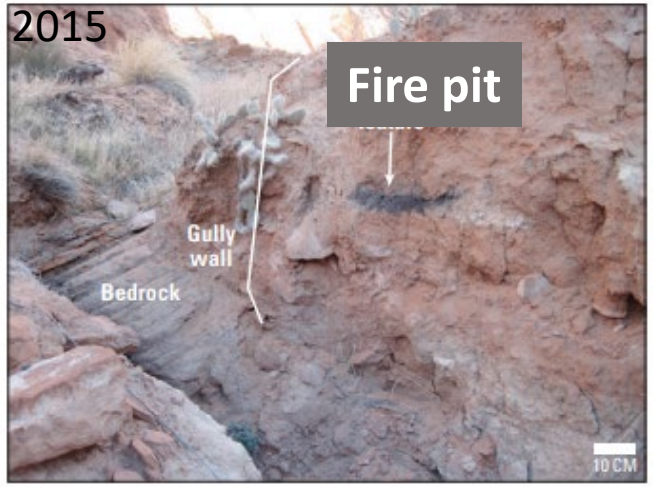
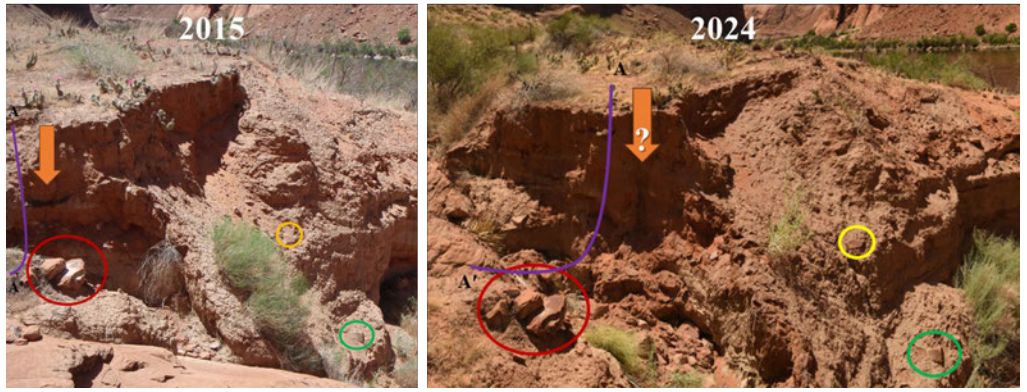
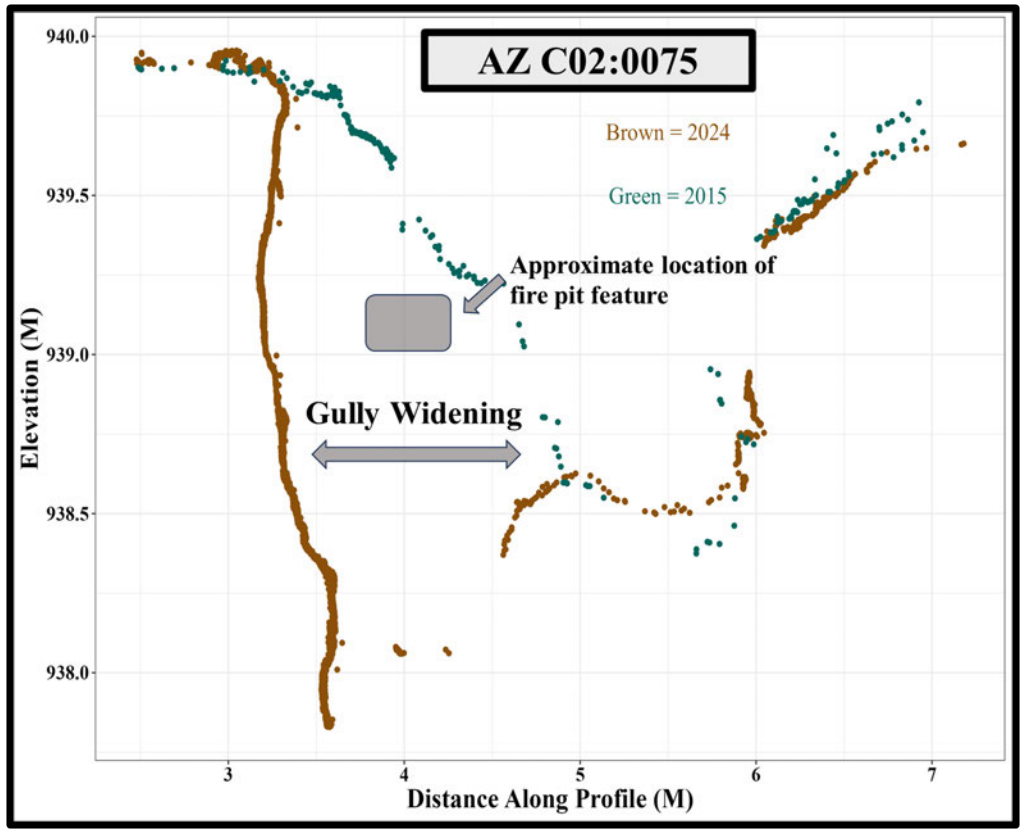
Ongoing erosion may eventually result in loss of site integrity

- Example: Site AZ C:2:75
- Erosion continues to expand gully that drains to the Colorado River
- Loss of fire feature (uncalibrated radiocarbon age = 2040 + 40 years







Preliminary results, please don't cite

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We use two different but complementary methods to monitor dam effects at archaeological sites

Method 1:

For entire population of sites within the Area of Potential Effect (n=362), we monitor changes in two classifications-- drainage evolution and fluvial sand connectivity -- at ~5-10 year intervals

This data is used for Metric 1.3

Method 2:

For a sample of sites, we monitor change in topography (sediment deposition and erosion) using repeat lidar surveys, once every ~3 years

This data is used for Metric 1.2

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Method 1/Metric 1.3: Change in Vulnerability to Loss of Integrity

- Requires analysis of <u>two types of site classifications</u>
  - Fluvial Sediment Connectivity (a.k.a. “Aeolian Classification)
  - Drainage Classification
- Classifications re-analyzed once every 5-10 years
- <u>Classifications rely on analysis of overflight imagery combined with field visits to verify changes in class</u>

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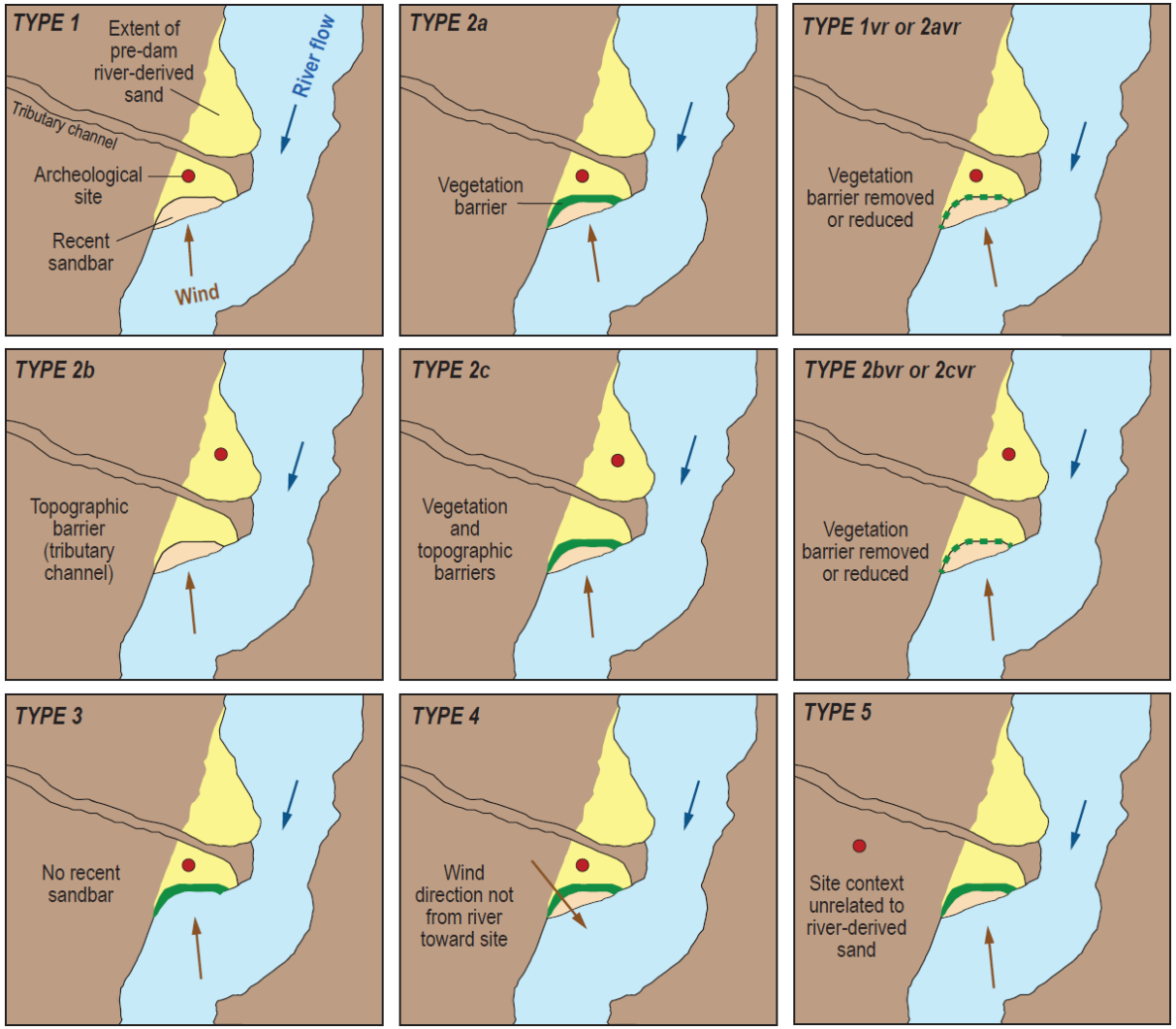
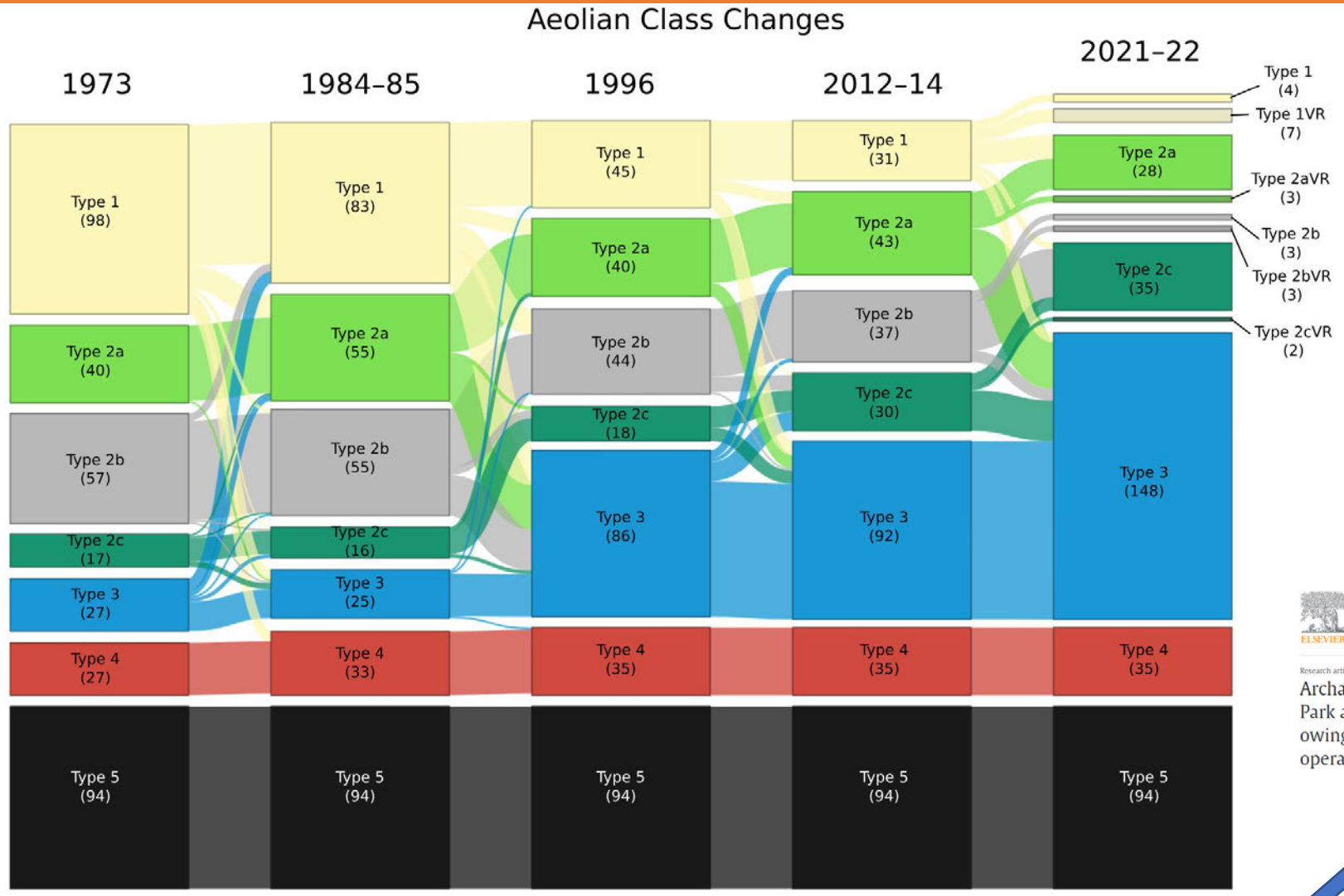
Classifcatoin 1: Fluvial Sediment Connectivity



(adapted from East et al., 2016, 2017)

- Ranked classification of relative potential for archaeological sites to receive windblown sand from upwind sandbars
- Windblown sand can keep sites buried with a protective cover of sand, potentially offsetting effects of erosion.

Results: Changes in Fluvial Sediment Connectivity Classification 1973-2022




Journal of Environmental Management
Volume 342, 15 September 2023, 118036

Research article

Archaeological sites in Grand Canyon National Park along the Colorado River are eroding owing to six decades of Glen Canyon Dam operations

From Sankey et al., 2023, Journal of Environmental Management

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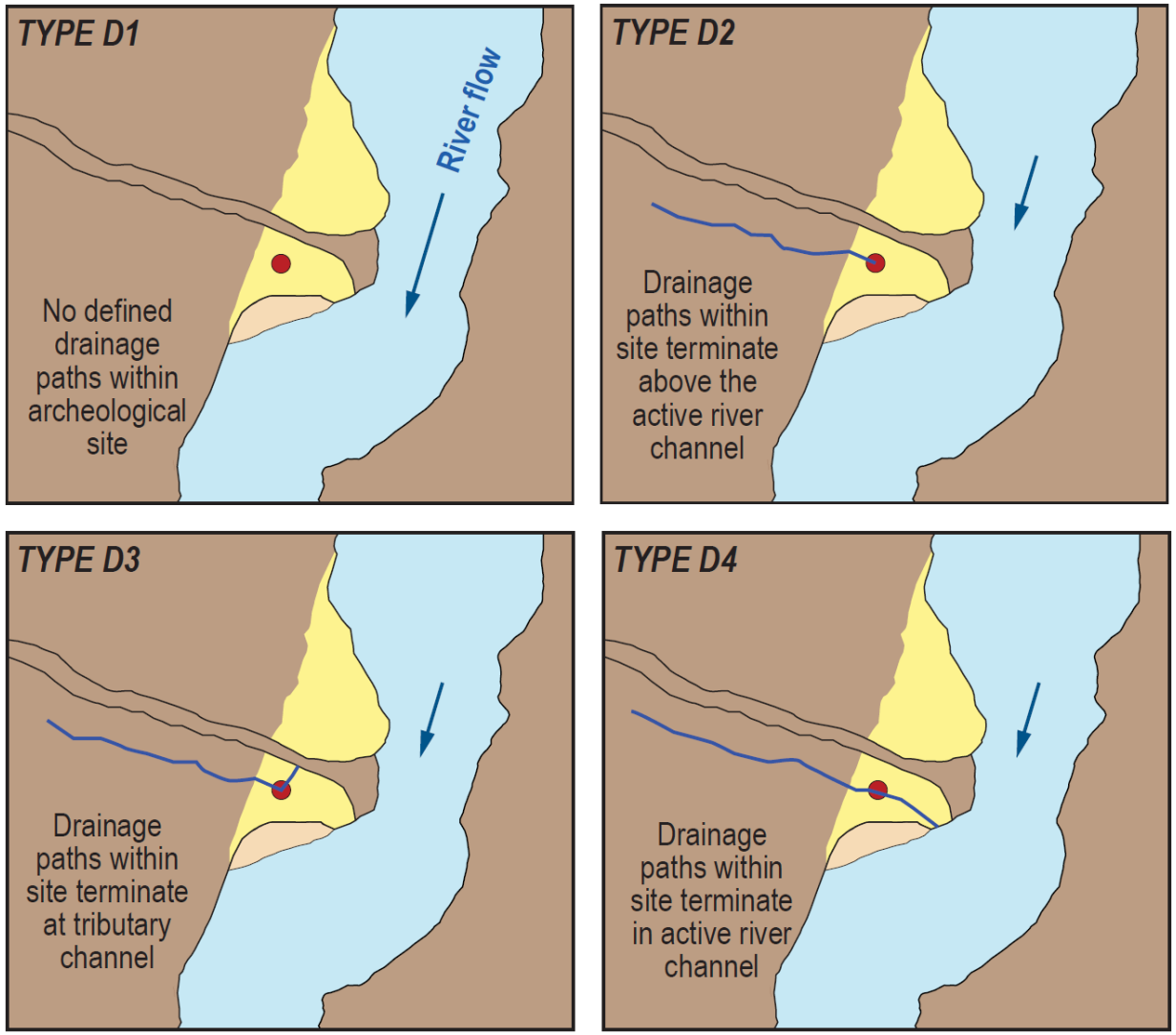
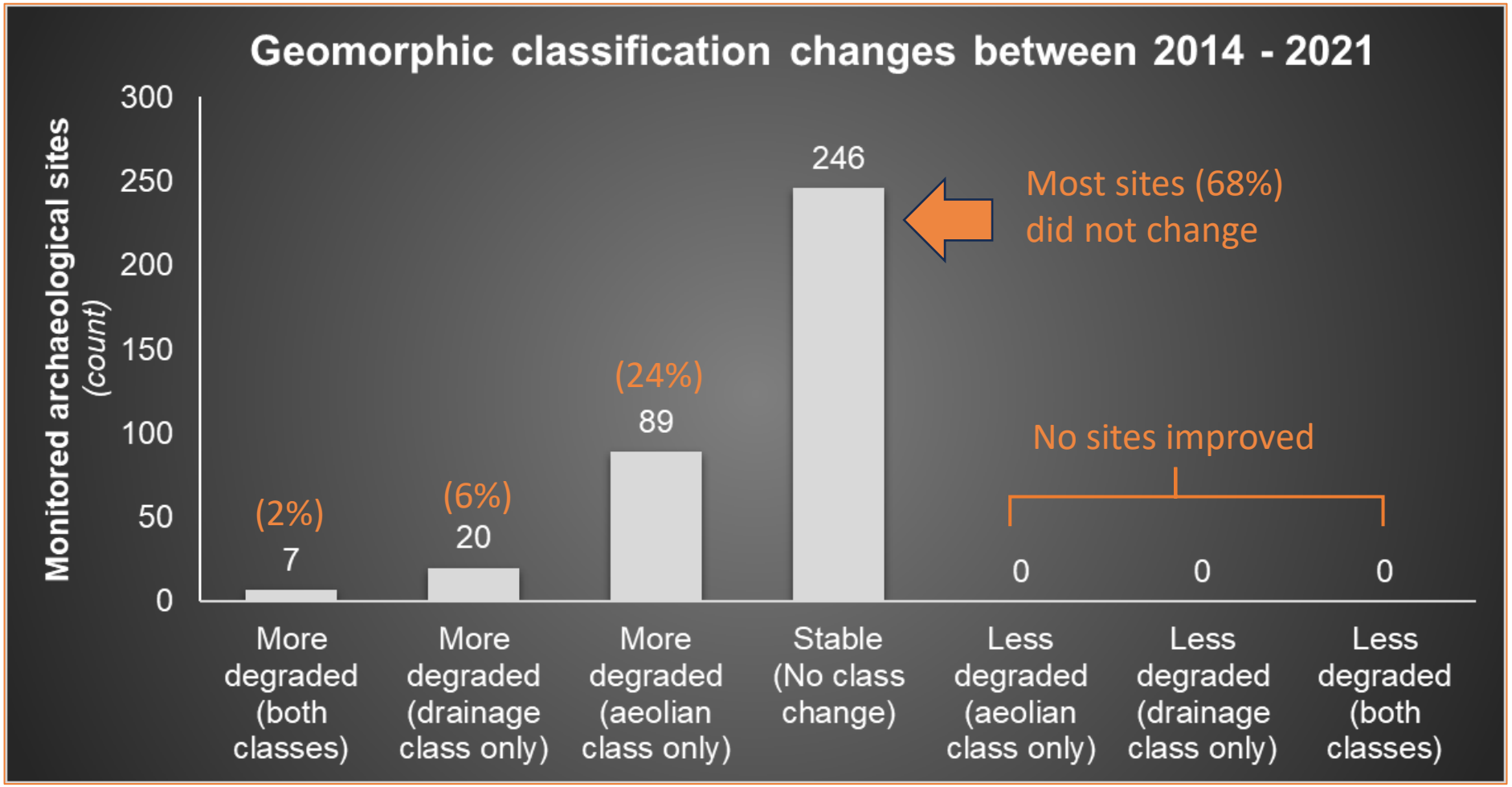
Classification 2: Drainage Classification



- Drainage classification system assesses the maximum local maturity of gully networks
- D1 = no gullies
- D2= Terrace-based (D2) - intermediary stage; may, in the future, become river-based.
- D4 & D3 = drainages graded to the lowest possible local base level; represent the evolutionary endpoint of drainage development.

(adapted from East et al., 2016, 2017)

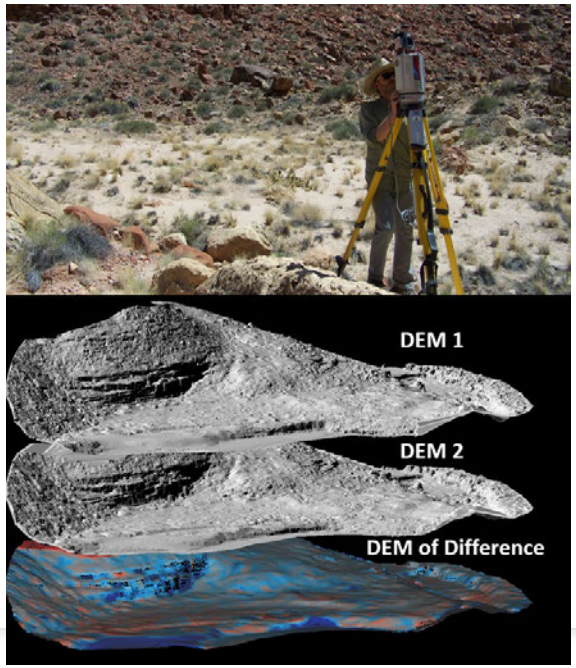
Changes in aeolian and drainage classifications reflect changes in site stability and condition linked to dam ops (Metric 1.3)

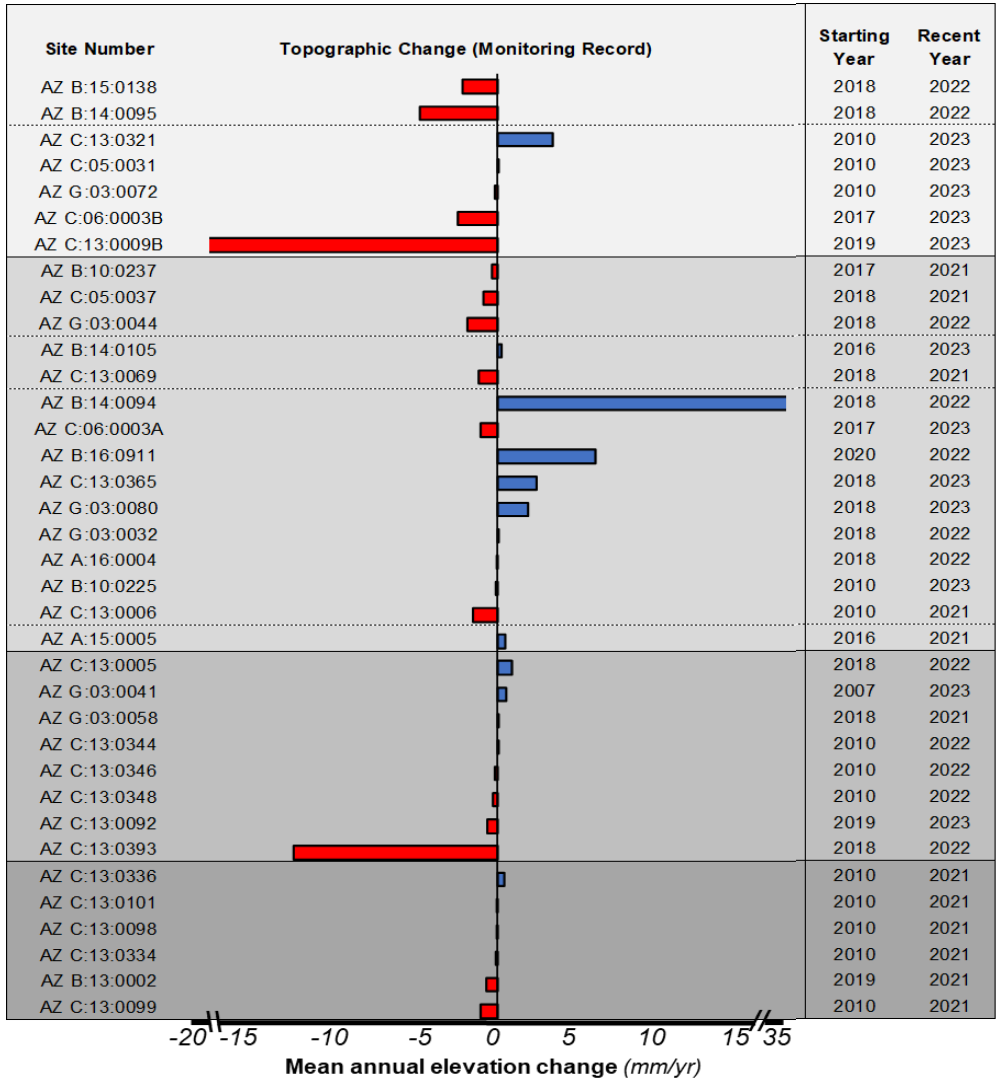


Sankey et al., 2023, Journal of Environmental Management

Method 2/Metric 1.2: Topographic Change

- Repeat lidar surveys accurately measure topographic change (erosion & deposition) at a sample of sites
- Metric based on resurveying each site in the sample once every 3 years





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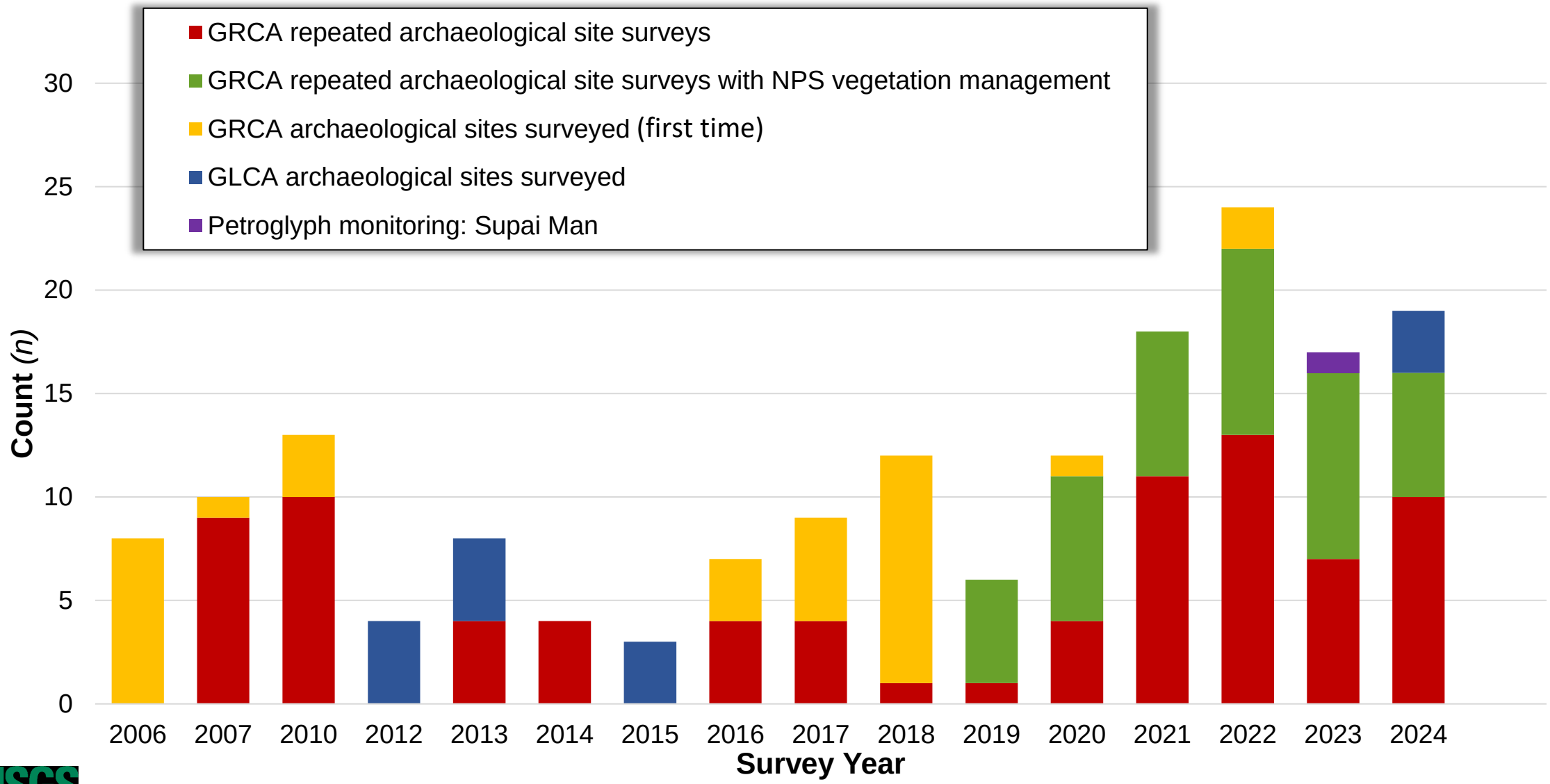
Summary of ground-based lidar monitoring of all archaeological sites



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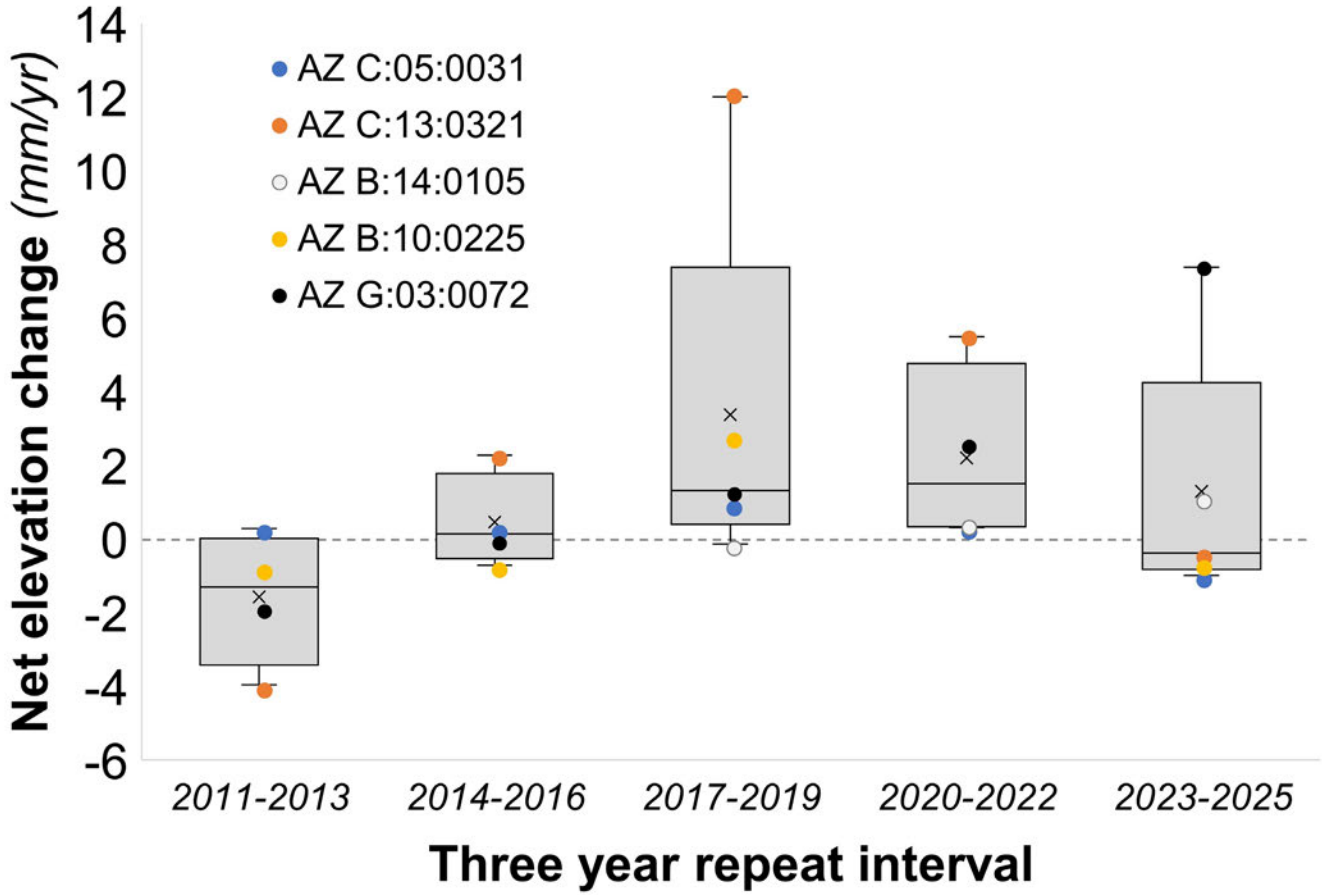
Future Metric 1.2 Graphical Presentation



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Questions?
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Photograph by Lauren Tango
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