

Project D: Geomorphic Effects of Dam Operations and Vegetation management on Archaeological Sites



Joel B. Sankey, Helen Fairley, Joshua Caster
US Geological Survey, Southwest Biological Science Center,
Grand Canyon Monitoring and Research Center, Flagstaff, AZ

Goals and Objectives

Project Objectives

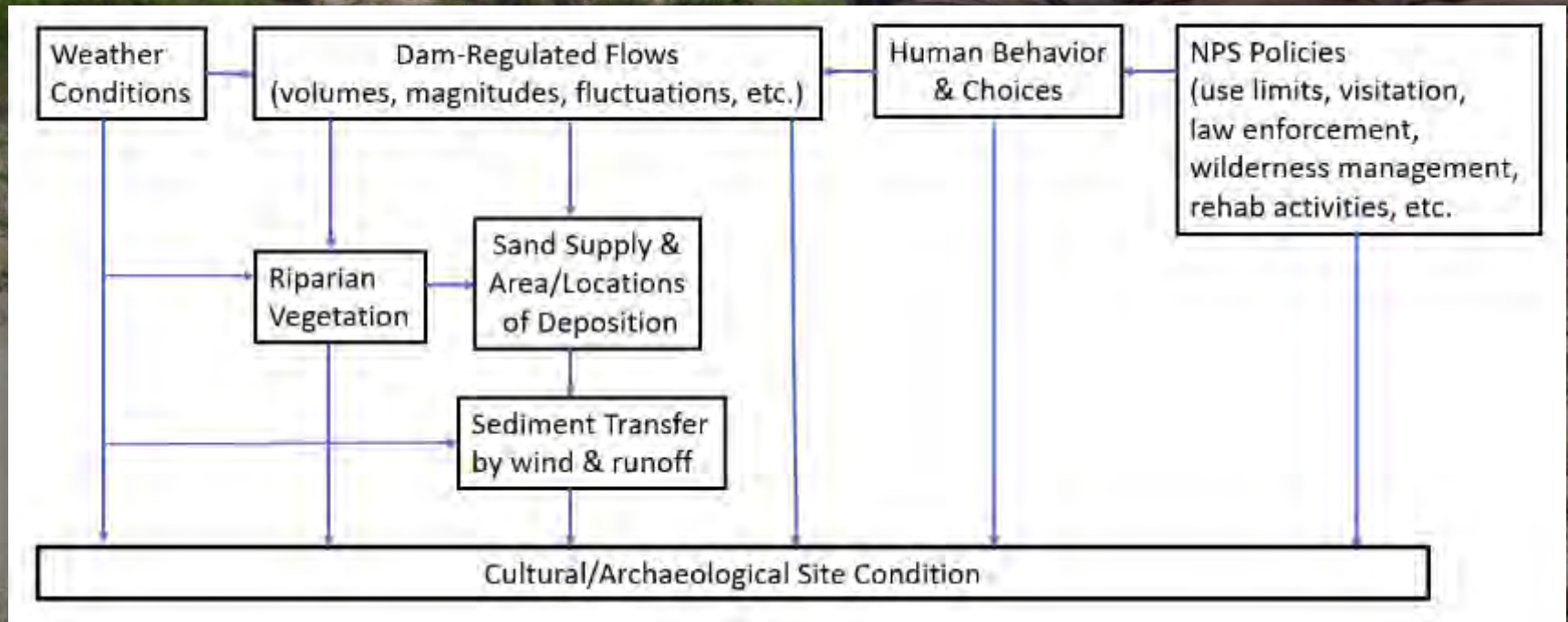
GCDAMP Regulatory Goals:

- **GCPA goal:** Resource improvement
- **LTEMP and NHPA goal:** “Preservation in place.”
 - Maintain the integrity of potentially affected NRHP-eligible or listed historic properties in place, where possible, with preservation methods employed on a site-specific basis.

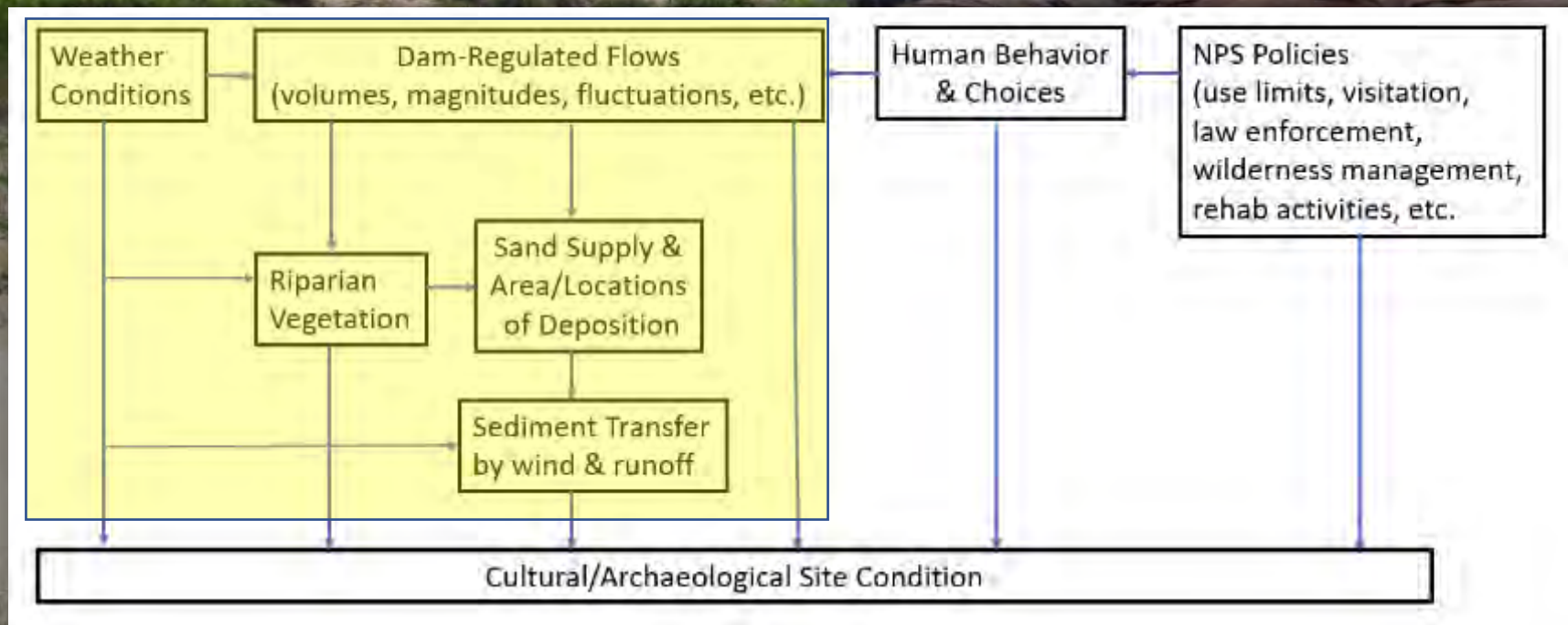
Project Objectives:

- Determine whether increasing the frequency of HFEs increases the resupply of river sand to archaeological sites in the river corridor and offsets erosion.
- Determine if removal of riparian vegetation located between HFE sediment supplied sand bars and archaeologic sites increases the probability of preservation in place.
- Determine if vegetation and biological soil crust cover within archaeological sites that are not resupplied with sediment from HFEs help to reduce erosion and increase the probability of achieving GCDAMP goals.

Project D: Geomorphic Effects of Dam Operations and Vegetation management for Archaeological Sites



Project D: Geomorphic Effects of Dam Operations and Vegetation management for Archaeological Sites



Background: Lack of floods and decrease in windblown (aeolian) river sand supply have resulted in expanded gullying at archaeological sites from pre- to post-dam time periods



Background: Long-term increases in riparian vegetation on sandbars have decreased windblown (aeolian) sand supply from sandbars to archaeological sites

**River Mile 194, River right
Borden-Weeden, 1973**



**River Mile 219, River right
Borden-Weeden, 1973**



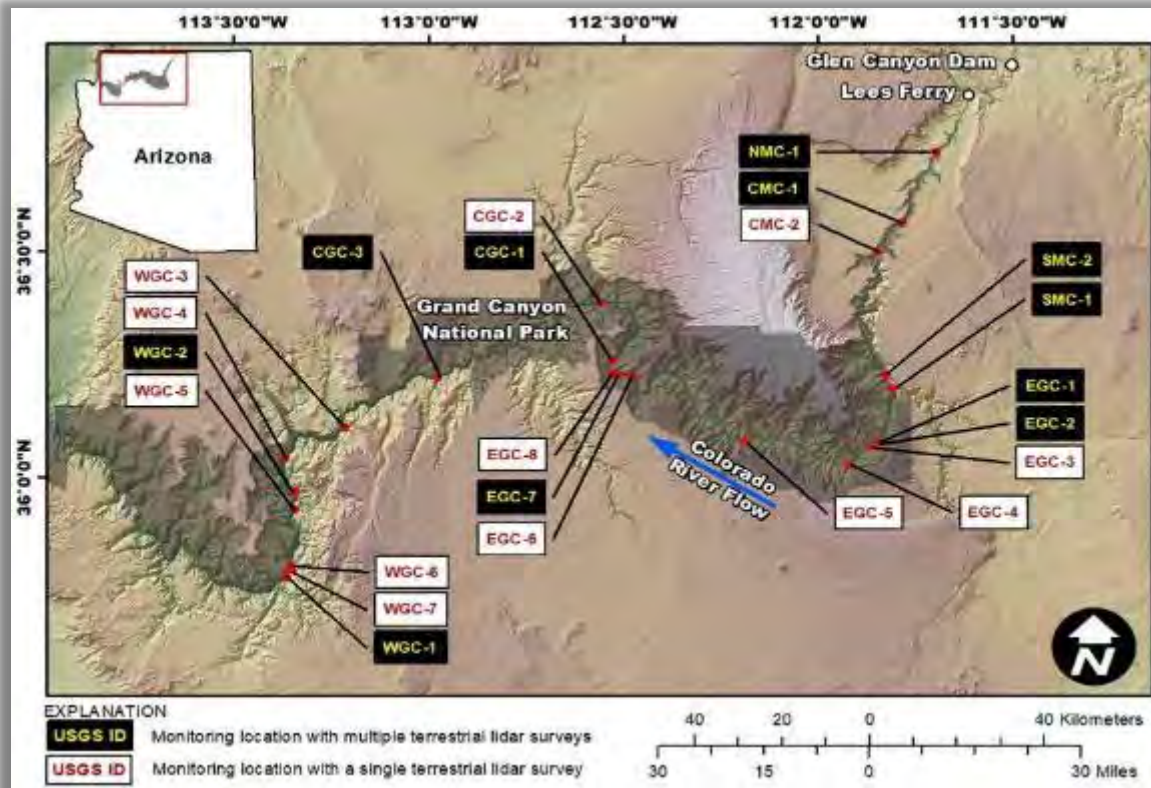
**River Mile 194, River right
Fairley-Fairley, 2021**



**River Mile 219, River right
Fairley-Fairley, 2021**



Background: Measuring physical changes to archaeological site condition with annual high-resolution lidar

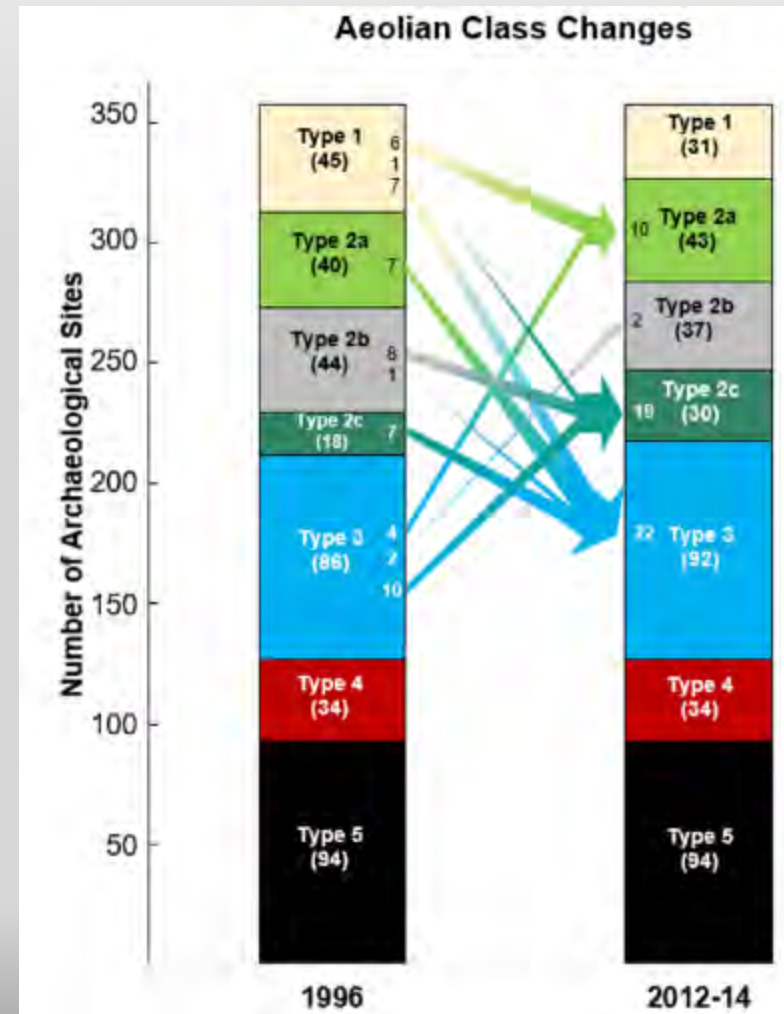
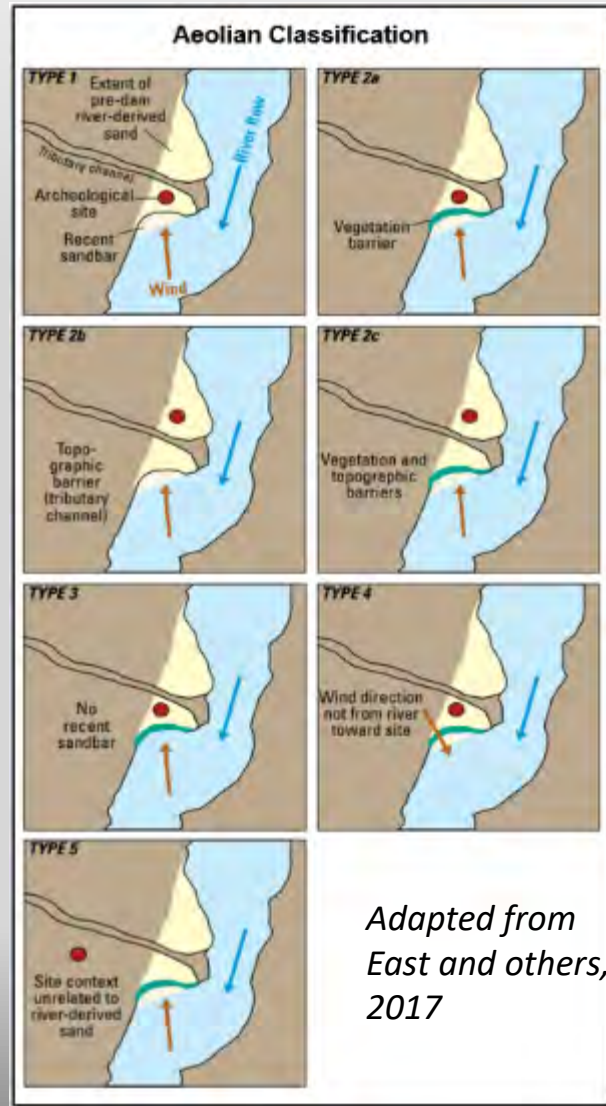


- Lidar surveys are used to measure changes in site condition owing to the burial or exposure of archaeological sites in sediment



Background: Interpreting physical changes to archaeological site condition through decadal geomorphic classifications

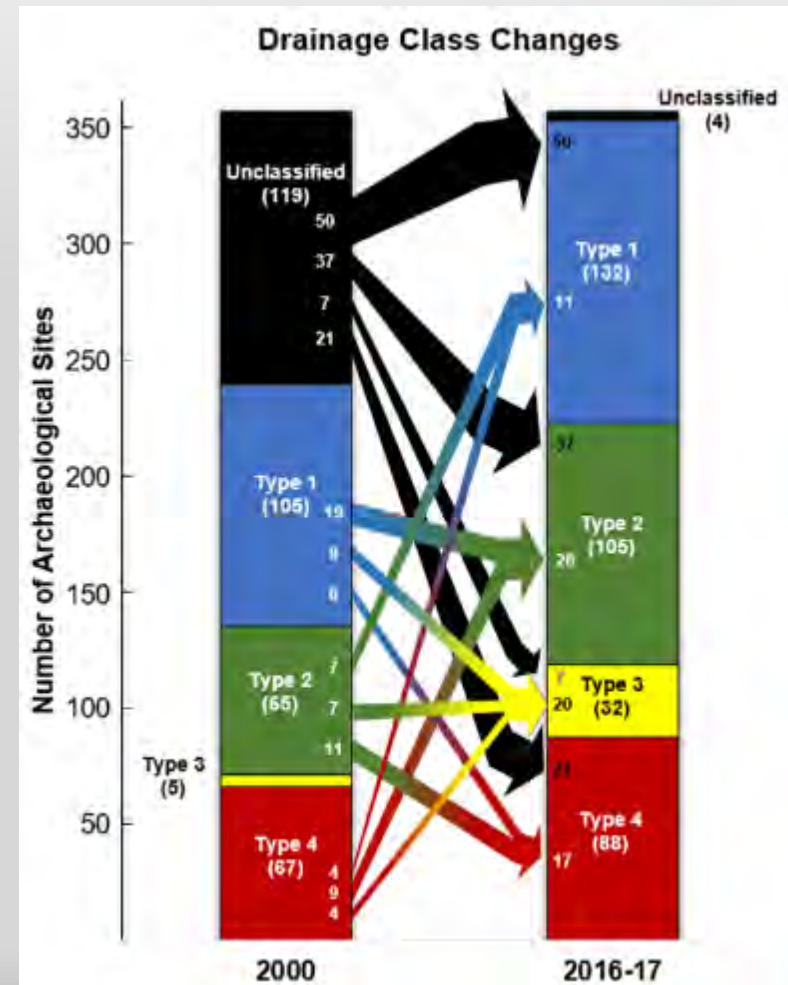
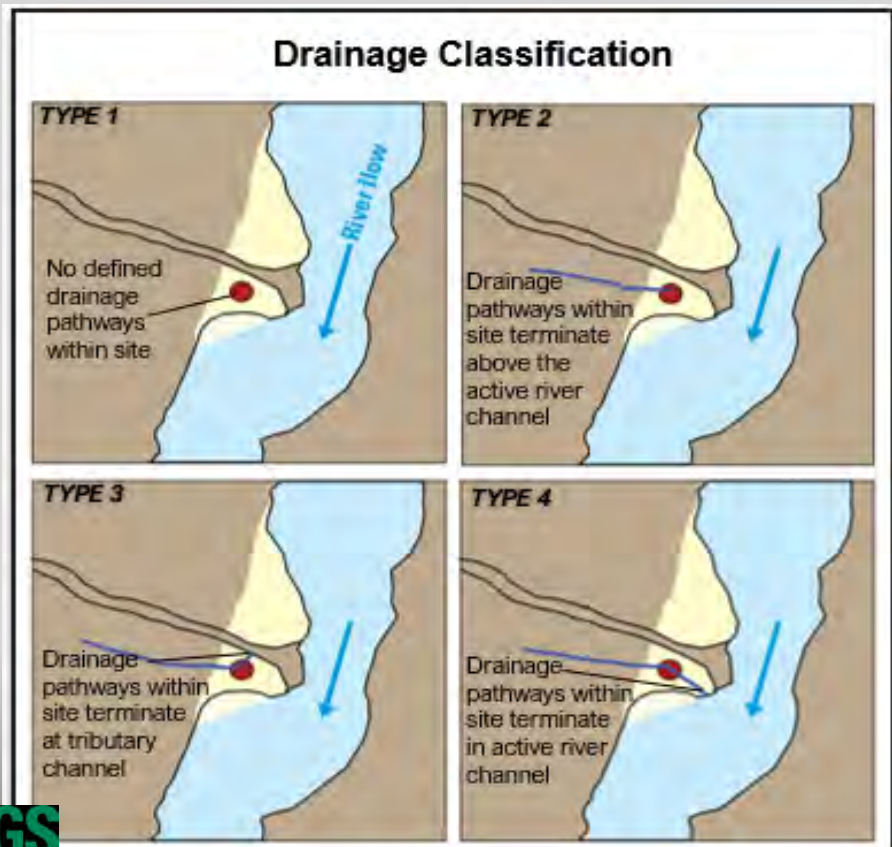
- Dam operations influence river flow elevation, sandbars, and vegetation growth.
- These factors in turn affect site stability through burial or exposure



East and others, 2017

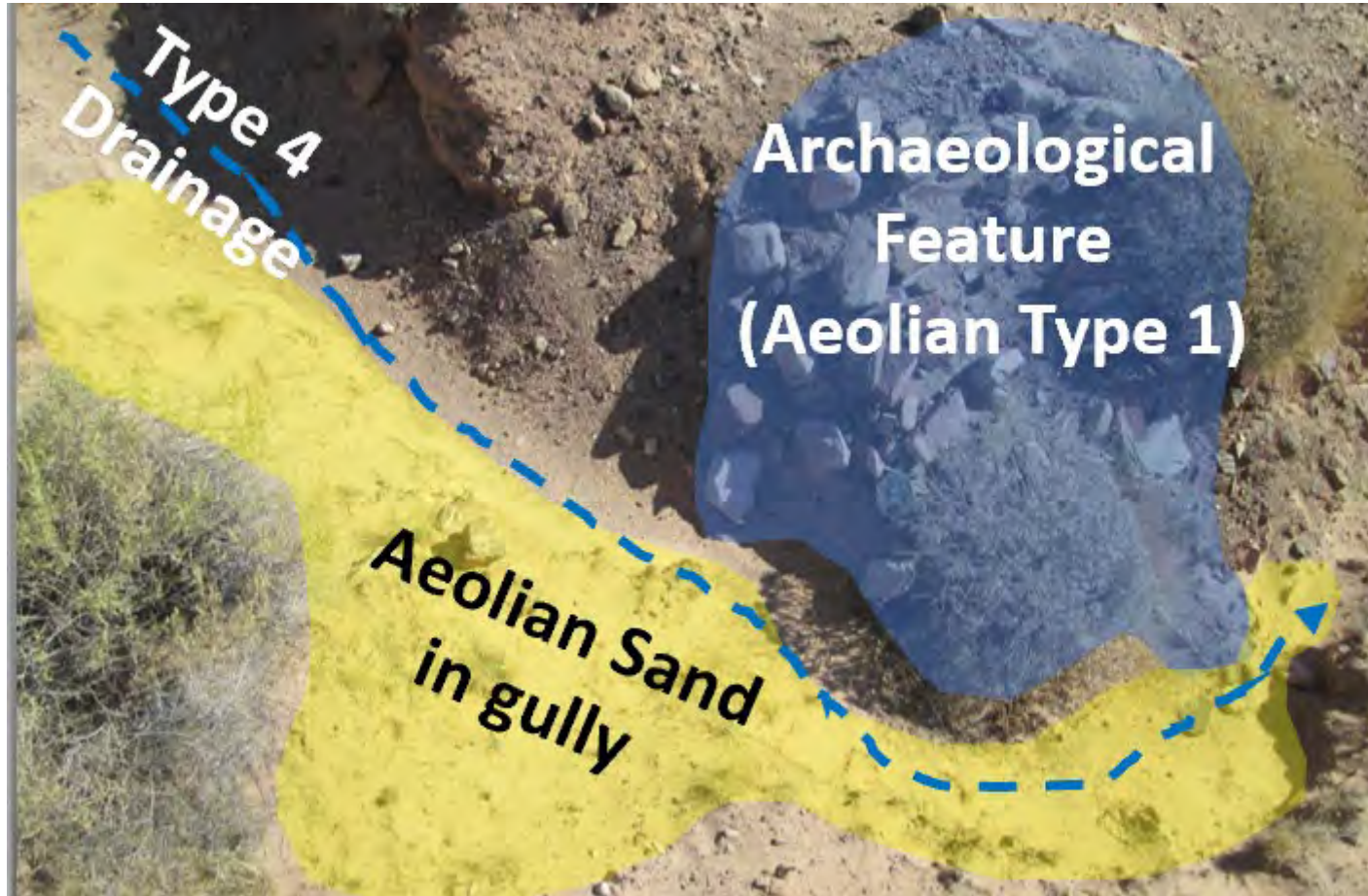
Background: Interpreting physical changes to archaeological site condition through decadal geomorphic classifications

- Dam operations influence river flow elevation, sandbars, and vegetation growth.
- These factors in-turn affect site stability through burial or exposure



Adapted from
East and others,
2017

D.1 Results: Status and trends in archaeological site condition through decadal geomorphic classifications



Scale = ~1 m

D.1 Results: Status and trends in archaeological site condition through decadal geomorphic classifications

Preliminary results, do not cite

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← Decreasing preservation potential

↑ Decreasing preservation potential

		Drainage Type				Total
		More Degraded	No Change	Less Degraded	Indeterminate	
Aeolian Type	More Degraded	11	20	3	3	37
	No Change	39	135	21	113	308
	Less Degraded	2	11	0	3	16
Total		52	166	24	119	361

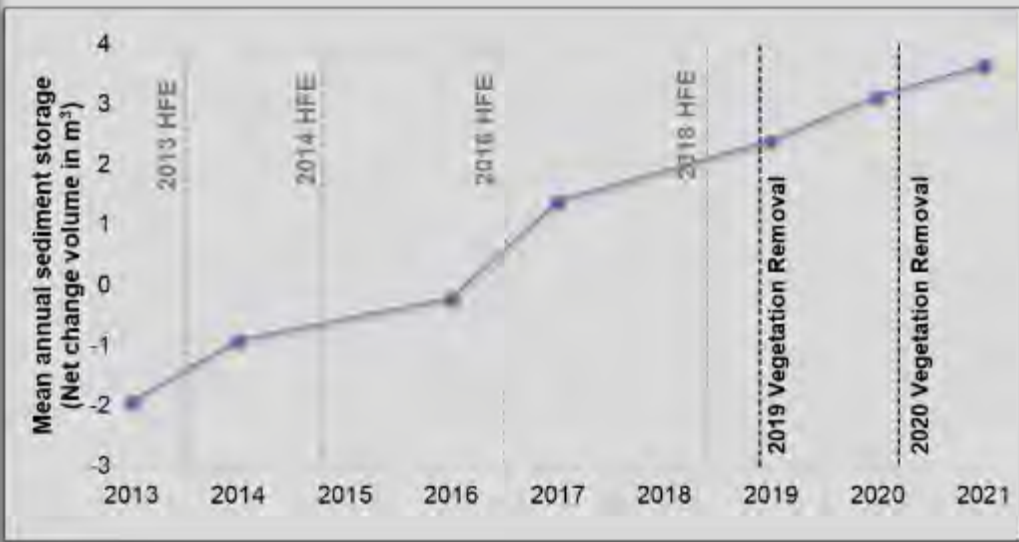
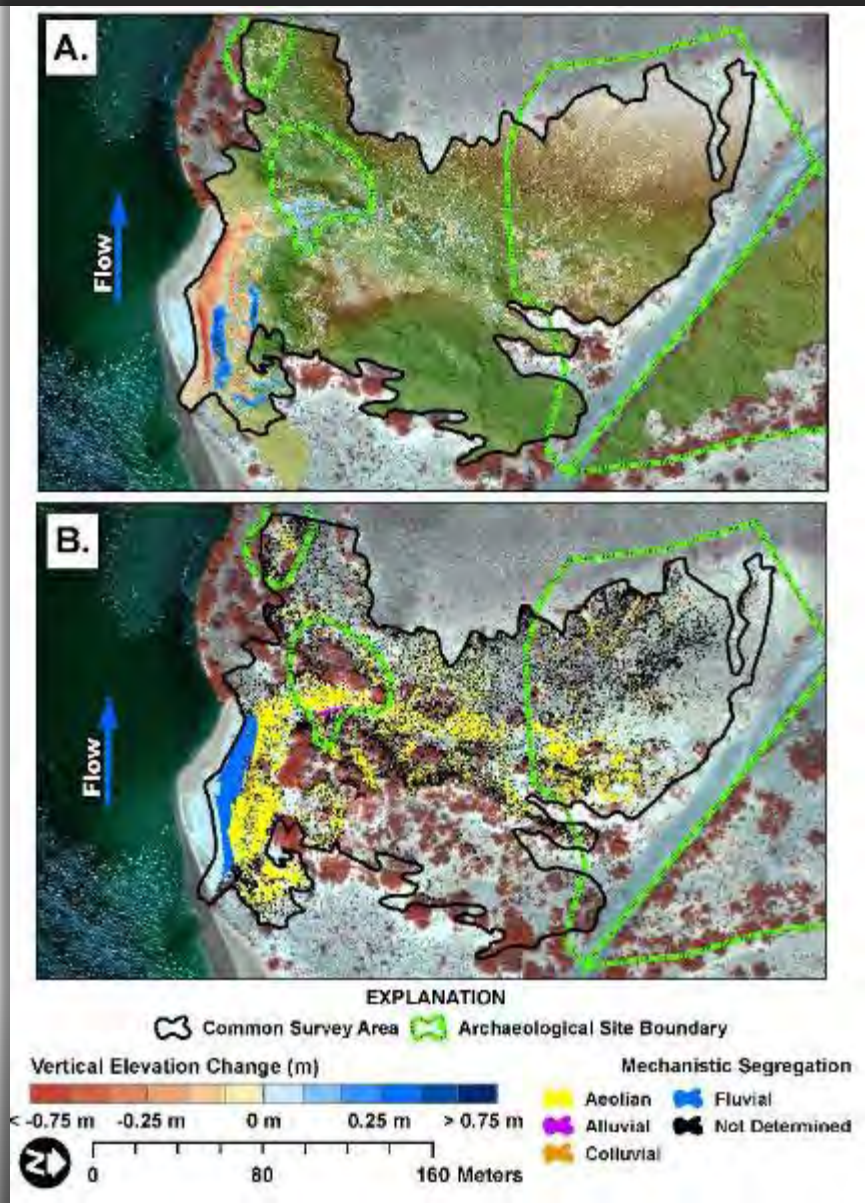
EXPLANATION

Decreased potential
for in-situ site
preservation

No change in site
preservation
potential

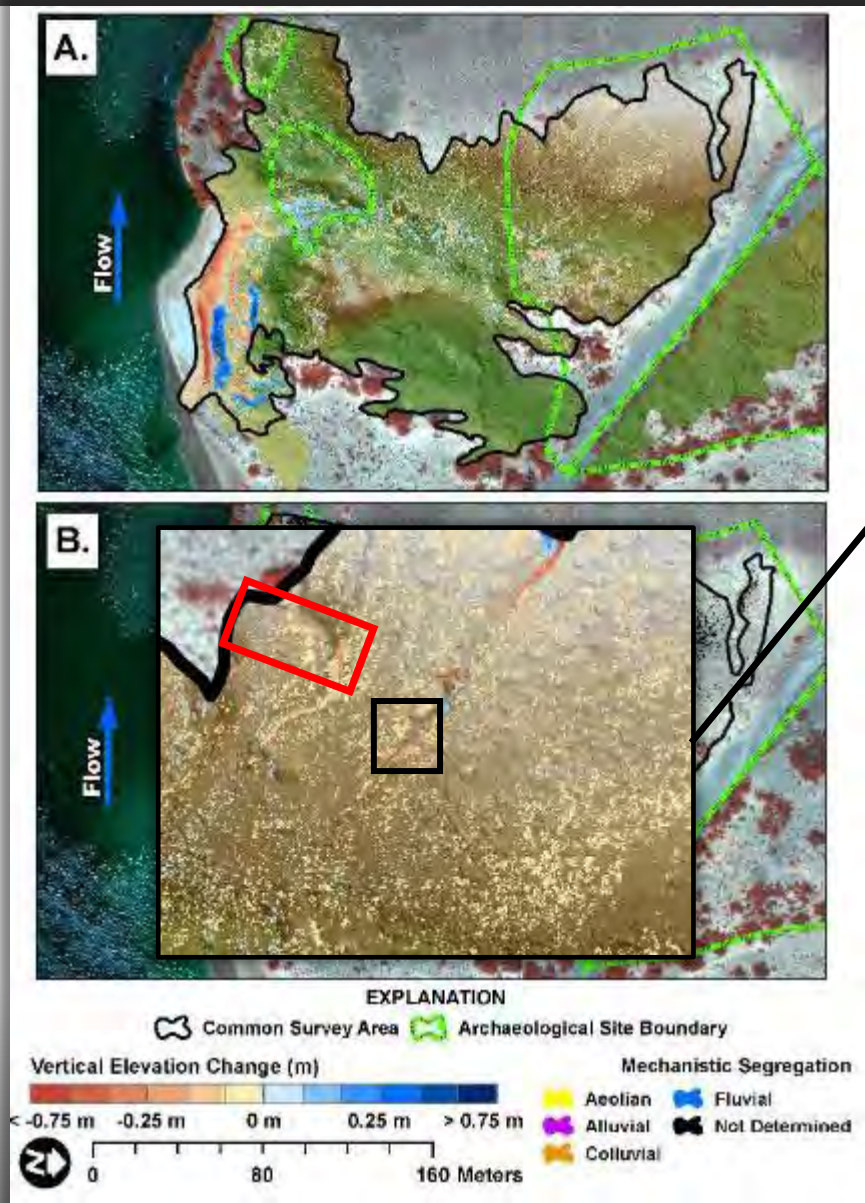
Increased potential
for in-situ site
preservation

D.1 Results: Measuring physical changes to archaeological site condition with annual high-resolution ground-based survey

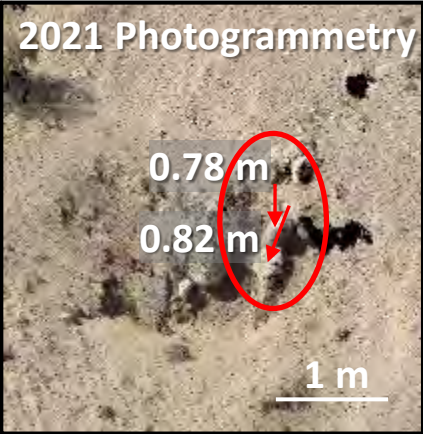
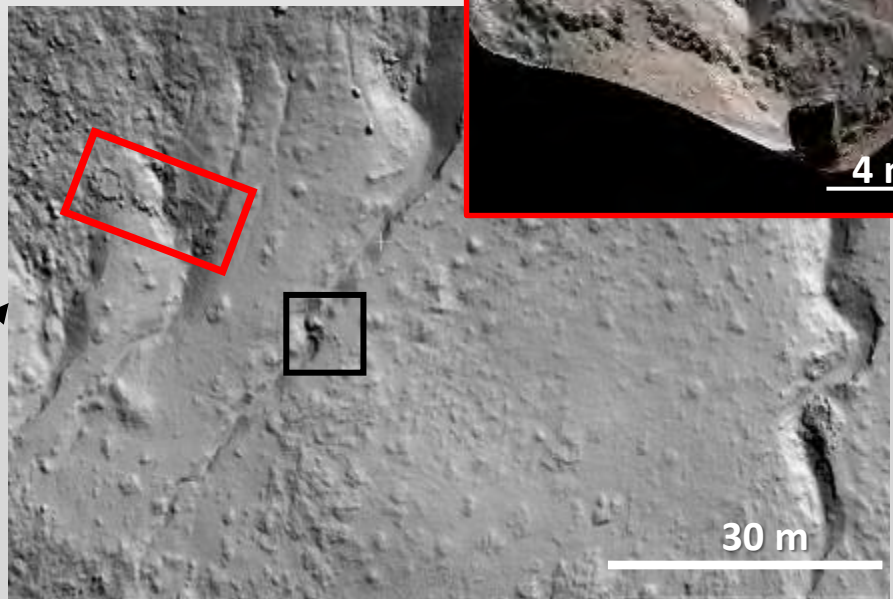


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D.1 Results: Measuring physical changes to archaeological site condition with annual high-resolution ground-based survey

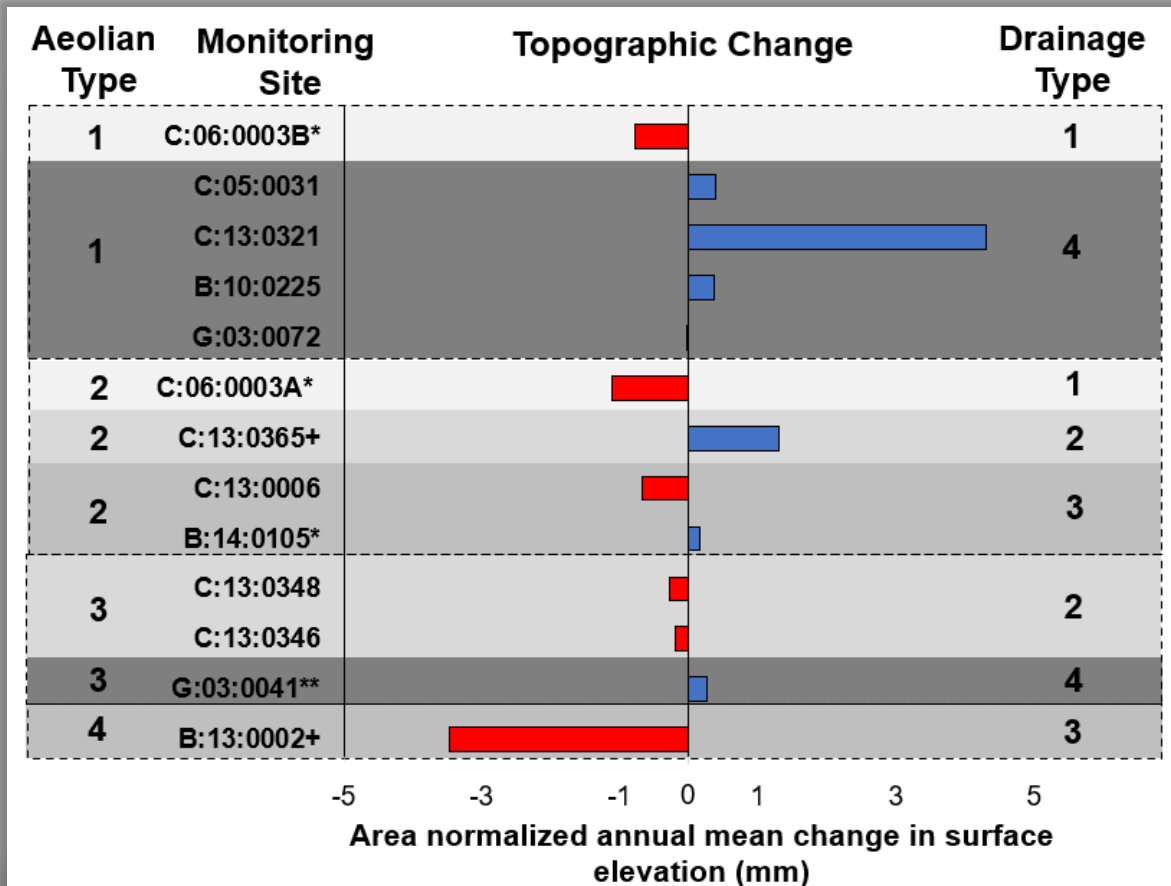


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D.1 Results: Status and trends in archaeological site condition with annual high-resolution ground-based survey

Preliminary results, do not cite



+ Annual mean represents a one-year survey interval

* Annual mean calculated from a survey interval of four years or less

**Annual mean calculated from survey interval of more than 10 years

	Drainage Type				Total
	1	2	3	4	
1	1	2	0	5	8
2a	0	0	1	3	4
2b	1	0	5	1	7
2c	0	1	1	1	3
3	3	4	0	1	8
4	0	0	1	0	1
Total	5	7	8	11	31



LTEMP Vegetation Project (Reclamation TWP projects C.7 and C.8 led by NPS)



- Experimental riparian vegetation treatments as mitigation for dam operations
 1. Control nonnative plant species affected by dam operations; including tamarisk and other highly invasive species
 2. Develop native plant materials for replanting through partnerships and the use of regional greenhouses
 3. Replant native plant species at priority sites along the river corridor; including native species of interest to tribes
 4. Remove vegetation encroaching on campsites
 5. Manage vegetation to assist with cultural site protection

Manage vegetation to assist with cultural site protection

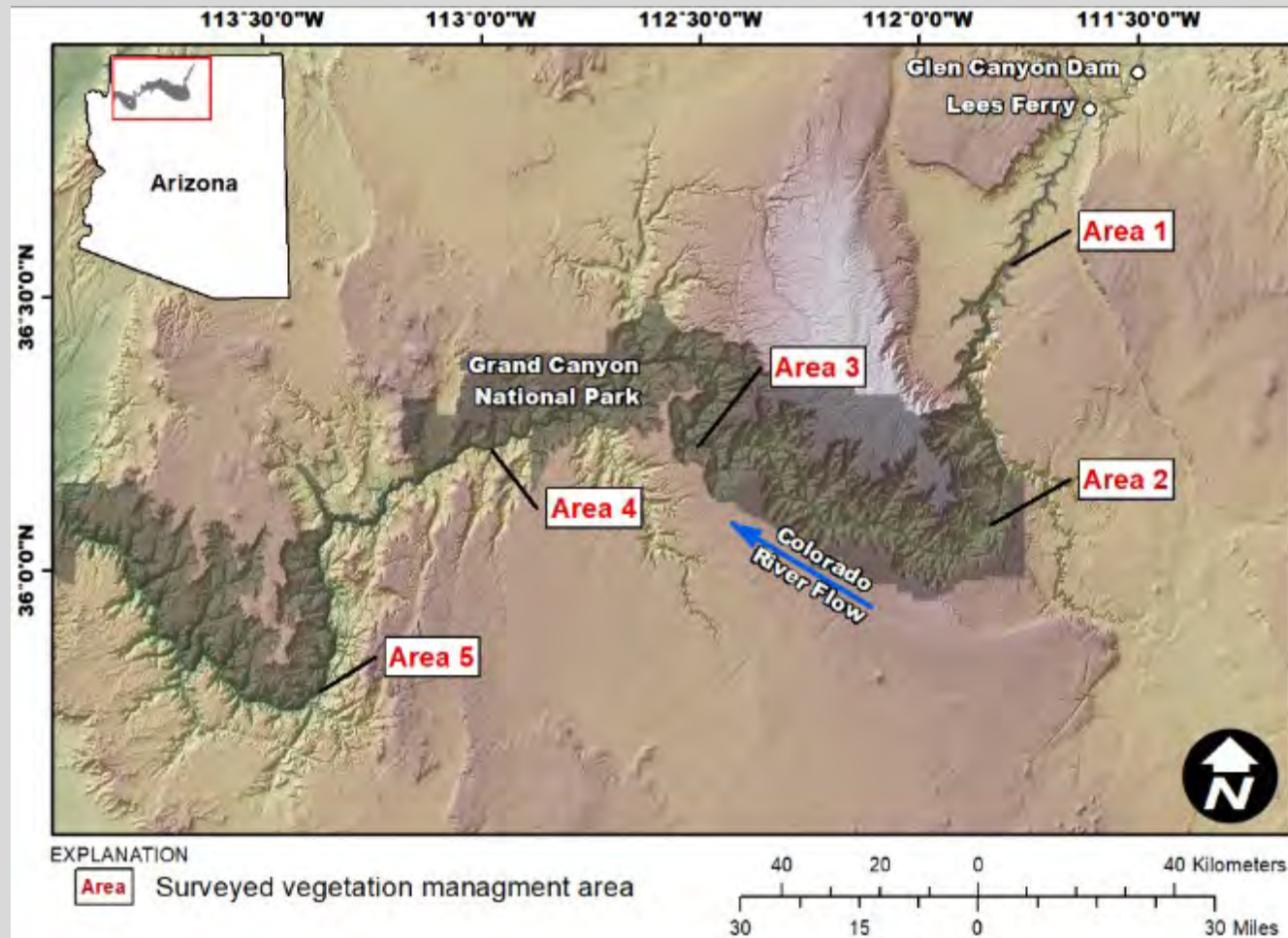
NPS has conducted experimental vegetation removal treatments on sandbars in Grand Canyon to increase the supply of HFE sediment via aeolian processes for in-situ preservation of archaeological sites in dunefields.

Initially Implemented: April 2019

Repeated: September 2020, October 2021, & 2022...



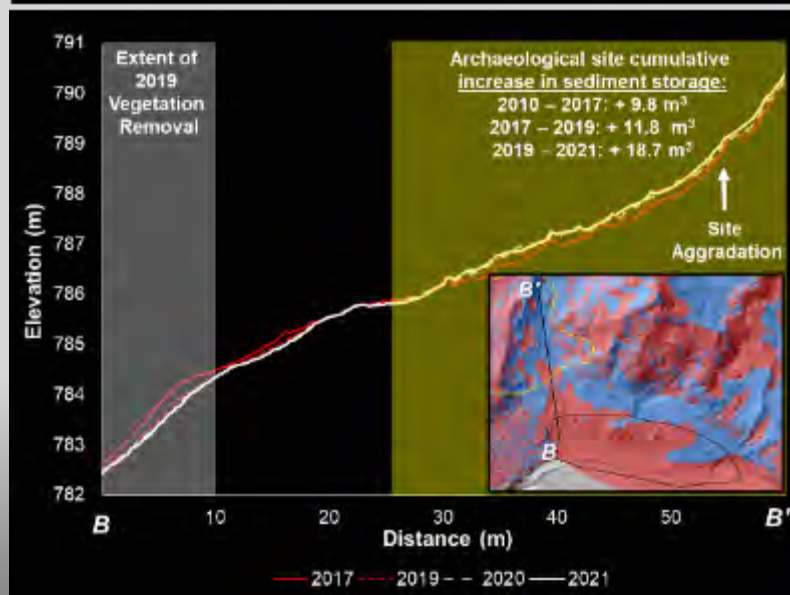
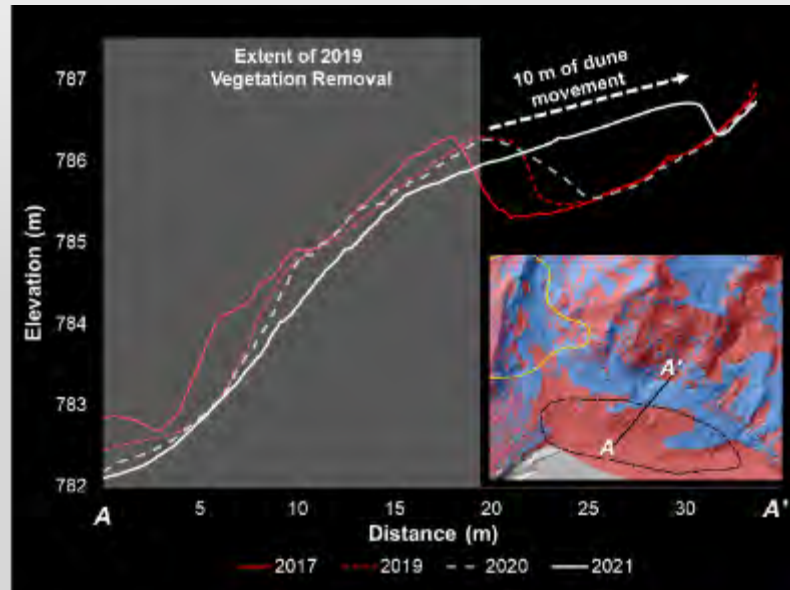
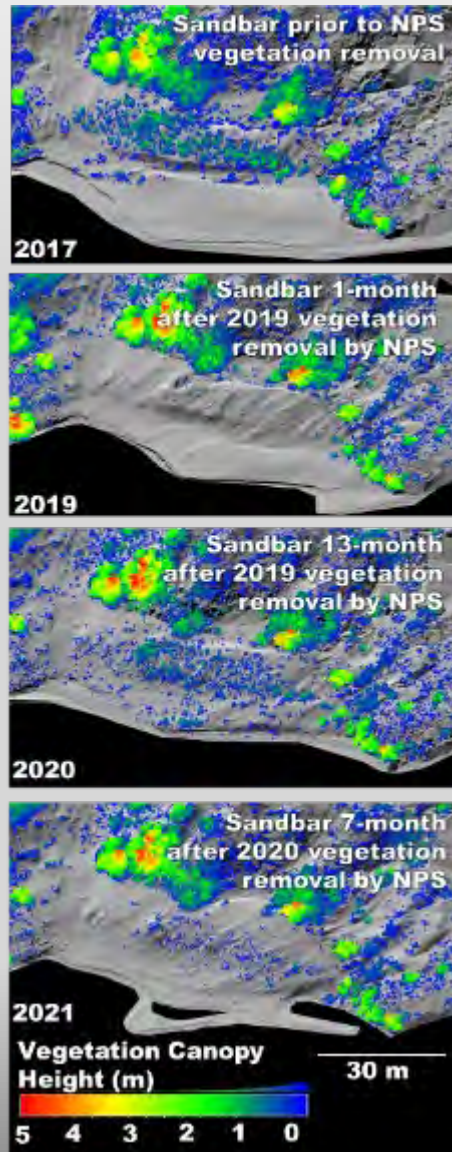
Manage vegetation to assist with cultural site protection



5 coupled sandbar-archaeological site areas selected based on:

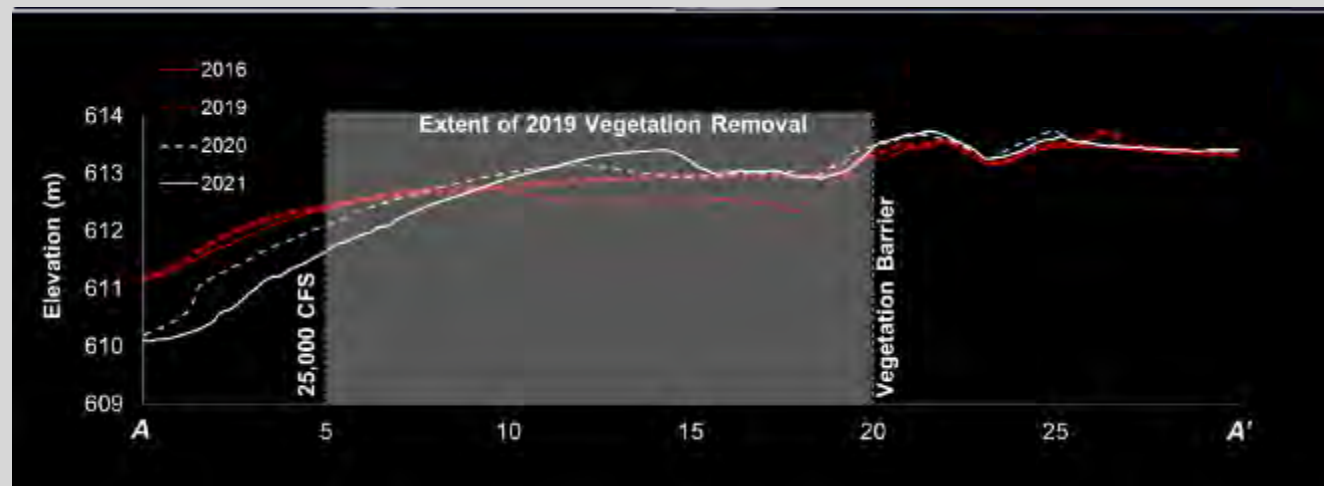
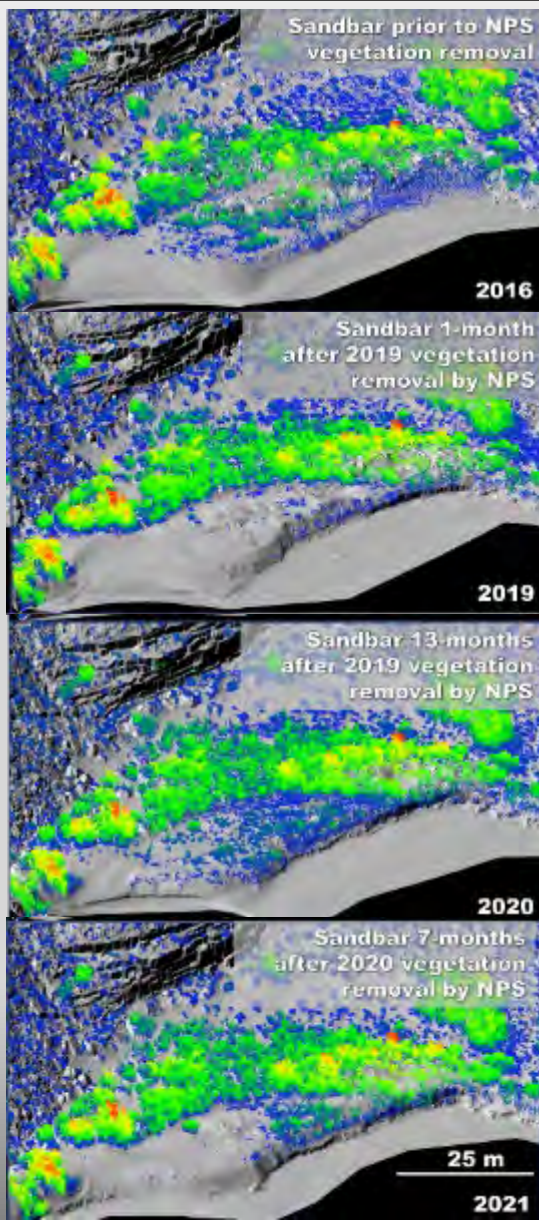
- NPS management priorities
- USGS lidar monitoring data with observed changes in geomorphic condition

Results: Effects of vegetation removal on sediment availability and implications for changes in site condition (Area 2)



Preliminary results, do not cite

Results: Effects of vegetation removal on sediment availability and implications for changes in site condition (Area 3)



Preliminary results, do not cite

The End

