Fine-Grained Sediment Inventory and Change Detection in the Grand Canyon River Corridor Using Airborne Digital Imagery

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PROJECT OBJECTIVES

- Map sand deposits and vegetation canyon-wide.
- Map the characteristics of all camping beaches.
- Evaluate remotely-sensed data as a tool for monitoring canyon-wide changes in sand deposits, vegetation and camping beach characteristics.

ADVANTAGES OF REMOTE SENSING

- Digital Data – Automated Analysis
- Monitor large areas in a short amount of time.
- Reduce the per unit (per mile) cost.
- Reduce the impact of data collection.

USING REMOTE SENSING AS AN INDIRECT SOURCE OF INFORMATION

- **Digital Imagery –** numeric reflectance data for a small area of the ground's surface.
- **Reflectance –** digital values representing the brightness of light being reflected in a specific wave length.
- **Spatial Resolution –** the size of the ground area for which reflectance values are averaged (e.g. 44 cm).
- **Panchromatic (Black & White) –** One reflectance value measured across the entire visible light spectrum.
- **Multi-Spectral –** multiple reflectance values measured across discrete portions of the visible and non-visible spectrum.

USING REMOTE SENSING AS A DIRECT SOURCE OF INFORMATION

- **Elevation Measurements**
- LiDAR
- Automated Photogrametry

PROJECT DELIVERABLES

- A canyon-wide set of digital sand-deposit maps.
- A canyon-wide set of digital vegetation maps.
- A set of sand-deposit change maps (RM 57 to 59).
- A canyon-wide set of camping-beach maps.
- Camping beach sand and vegetation characteristics.
- Sand and vegetation characteristics by river mile.

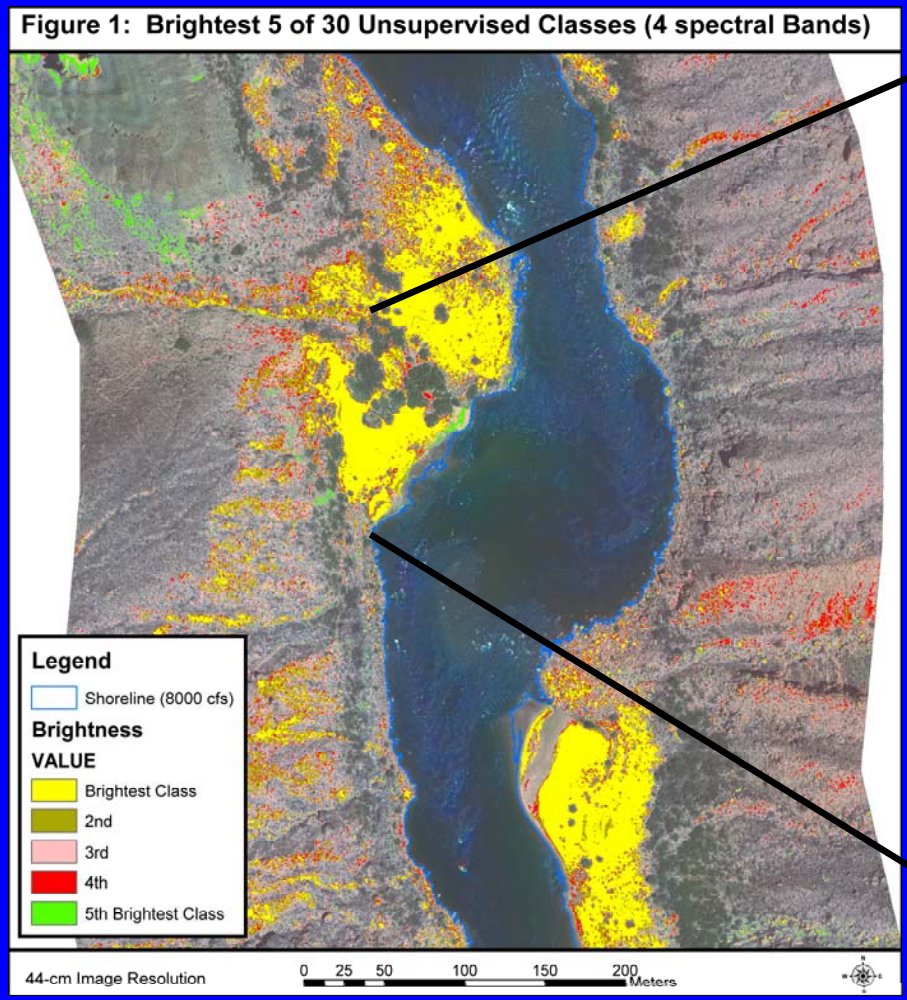
SOURCE MATERIALS

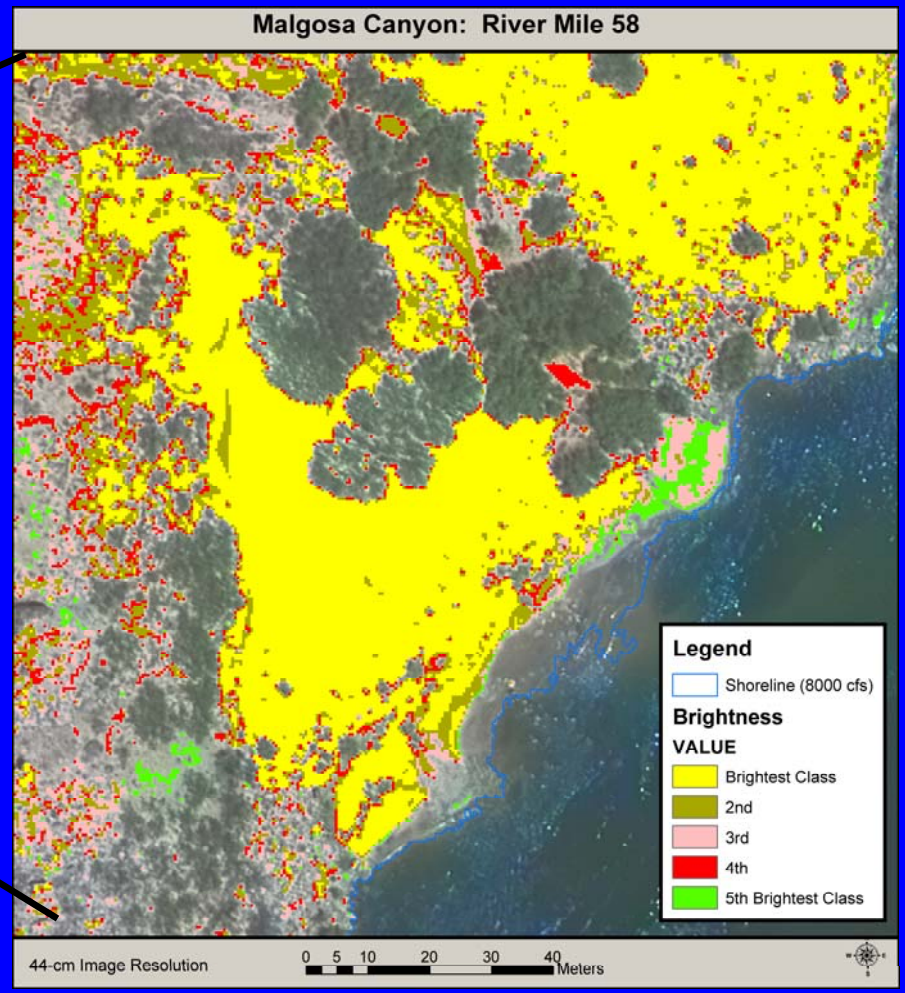
- **ISTAR**, canyon-wide multi-spectral and panchromatic digital imagery for May, 2002.
- **ISTAR**, digital elevation data for May, 2002.
- **LSSF** panchromatic digital imagery for river miles 57 to 59, September, 2000.

SPECTRAL PROPERTIES OF SAND DEPOSITS ABOVE 8,000 CFS.

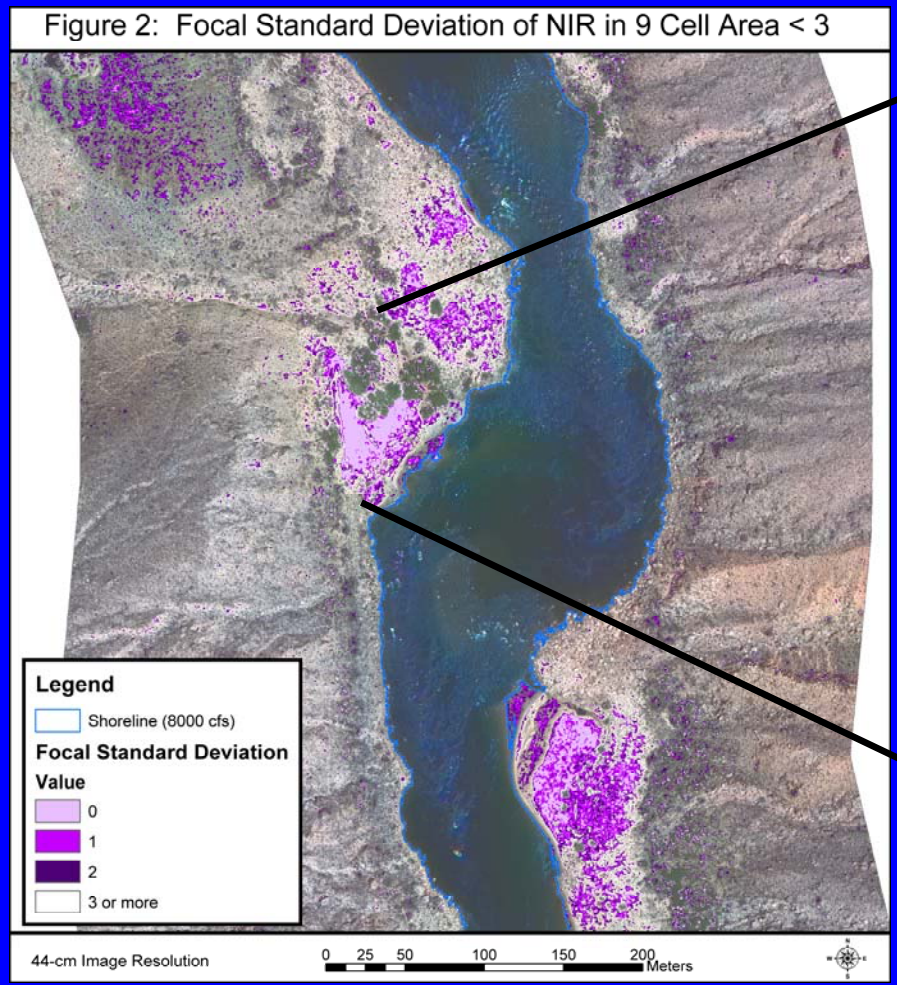
- **Highly Reflective**
- **Spatially Ubiquitous (reflective similarity)**

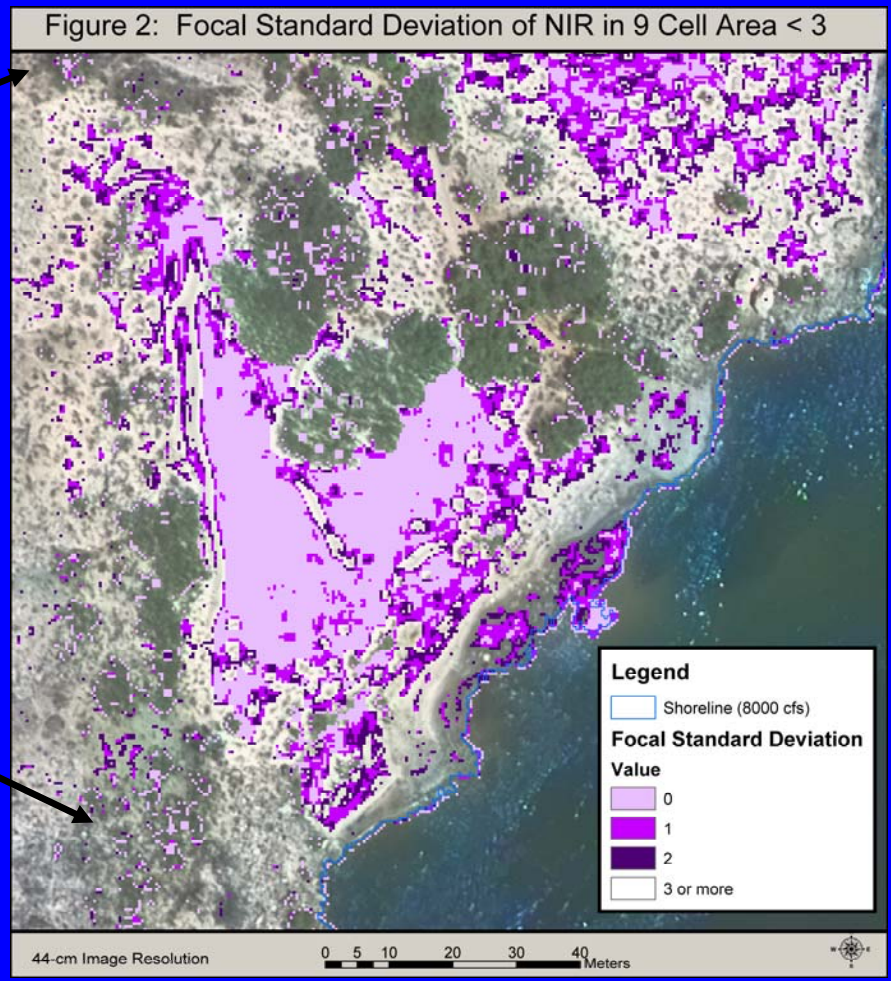
SAND REFLECTIVITY



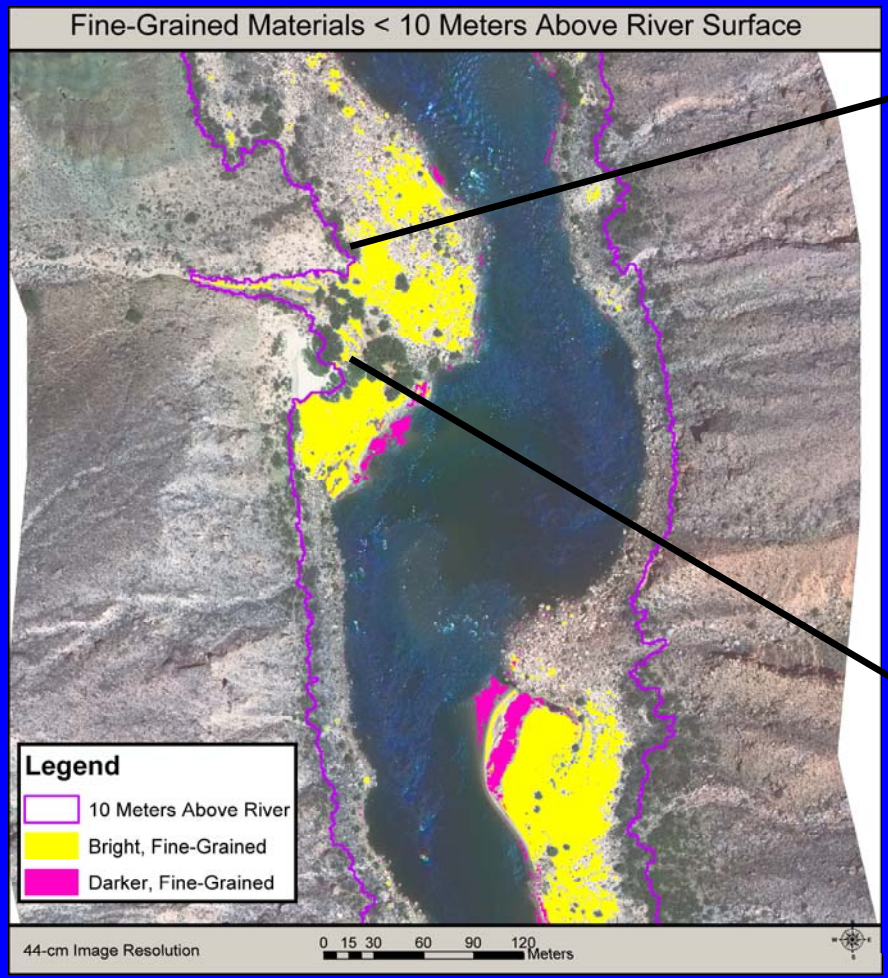


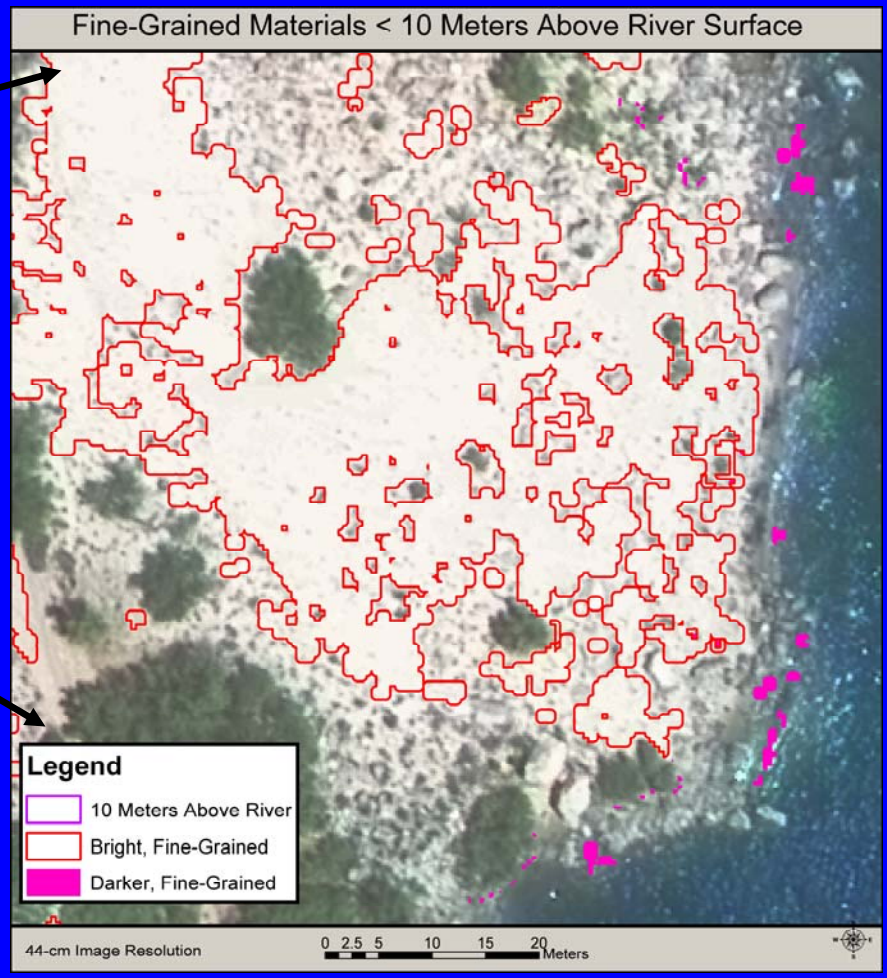
REFLECTIVE SIMILARITY





FINE-GRAINED SEDIMENT





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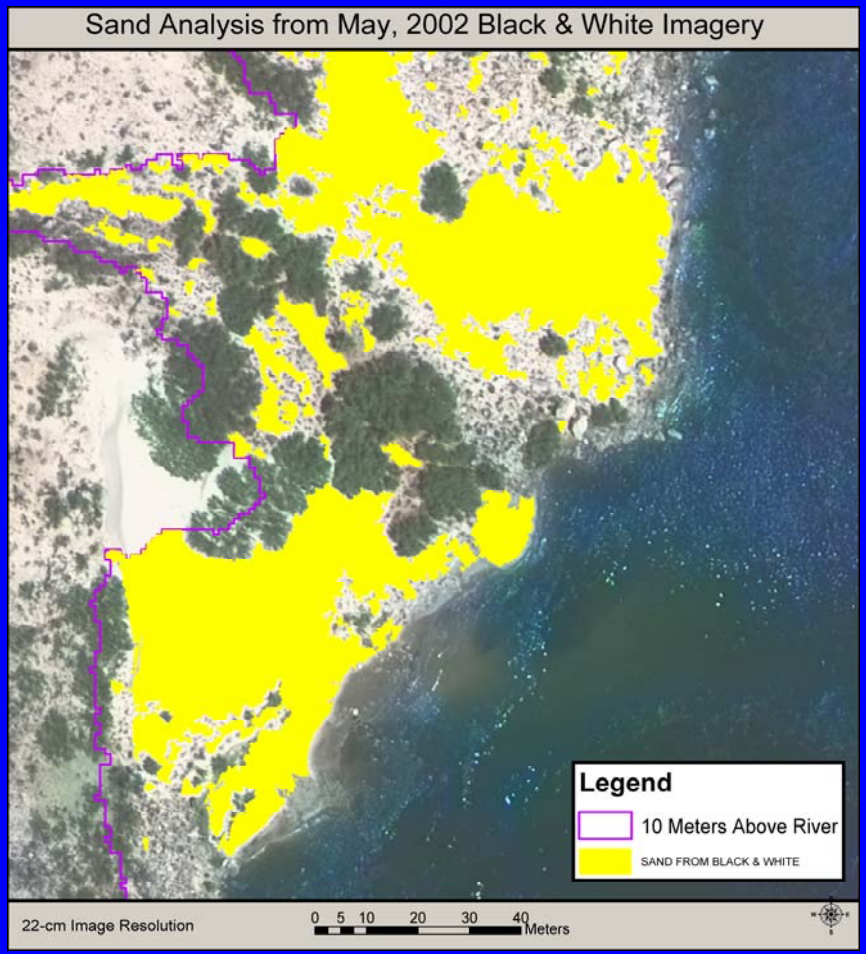
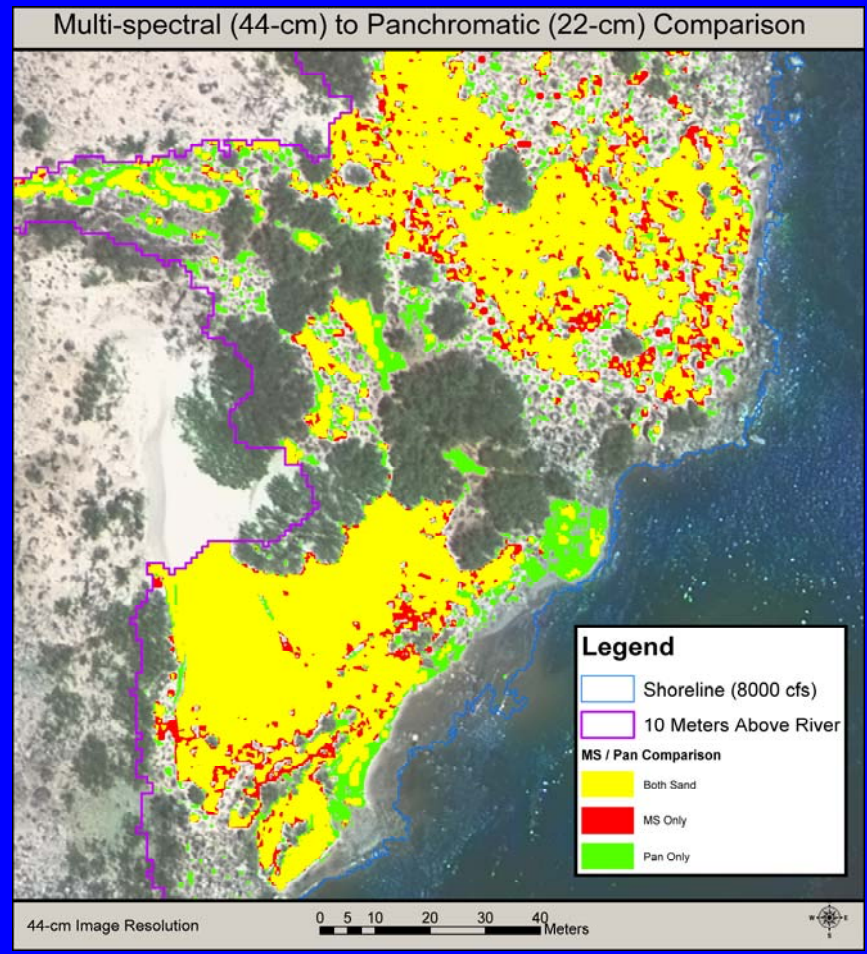
MULTI-SPECTRAL VS. PANCHROMATIC





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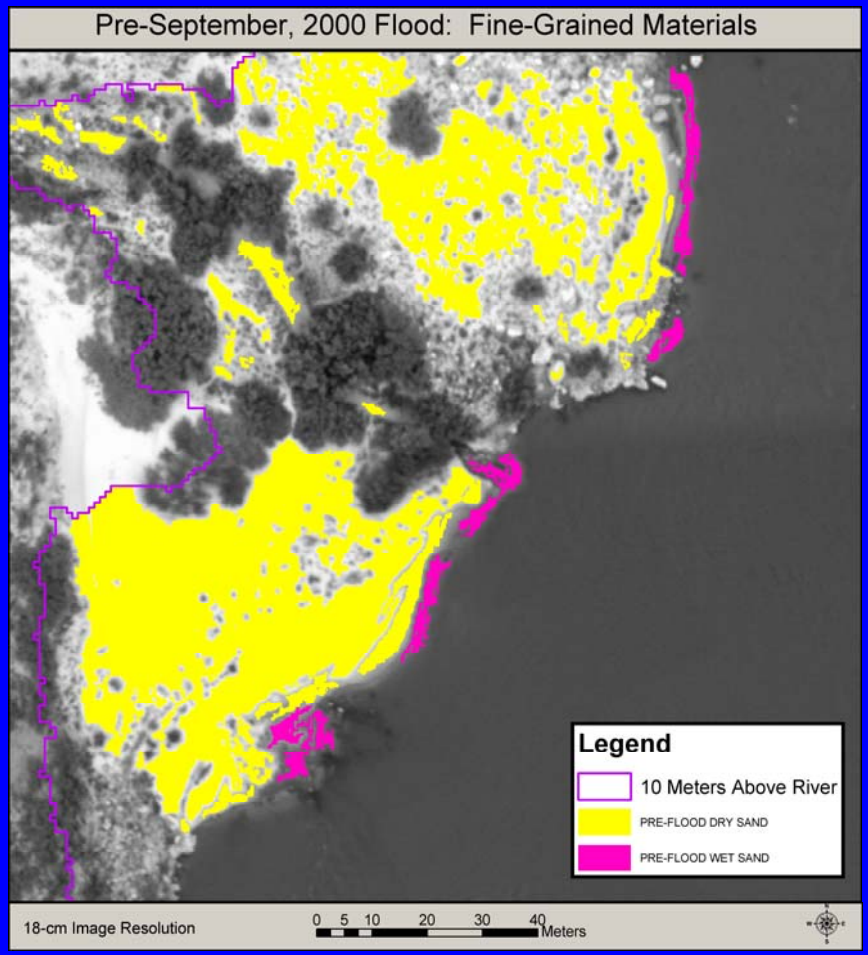
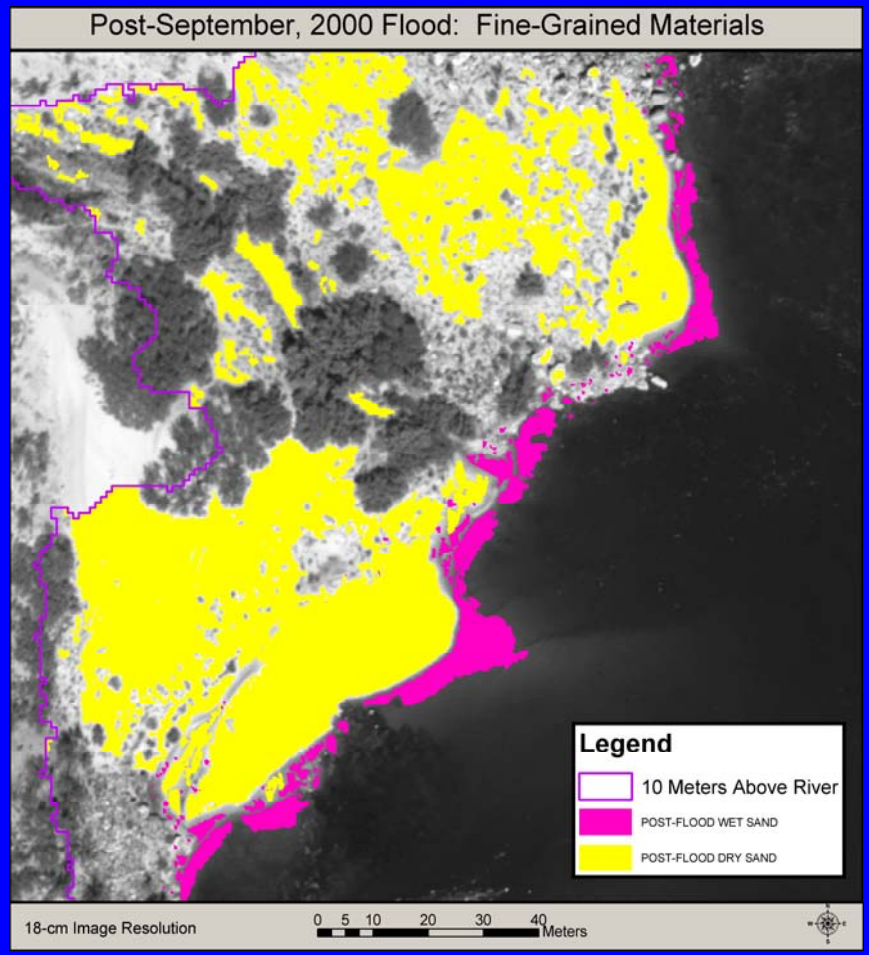
PRE & POST SEPTEMBER, 2000 FLOOD PANCHROMATIC SAND ANALYSIS





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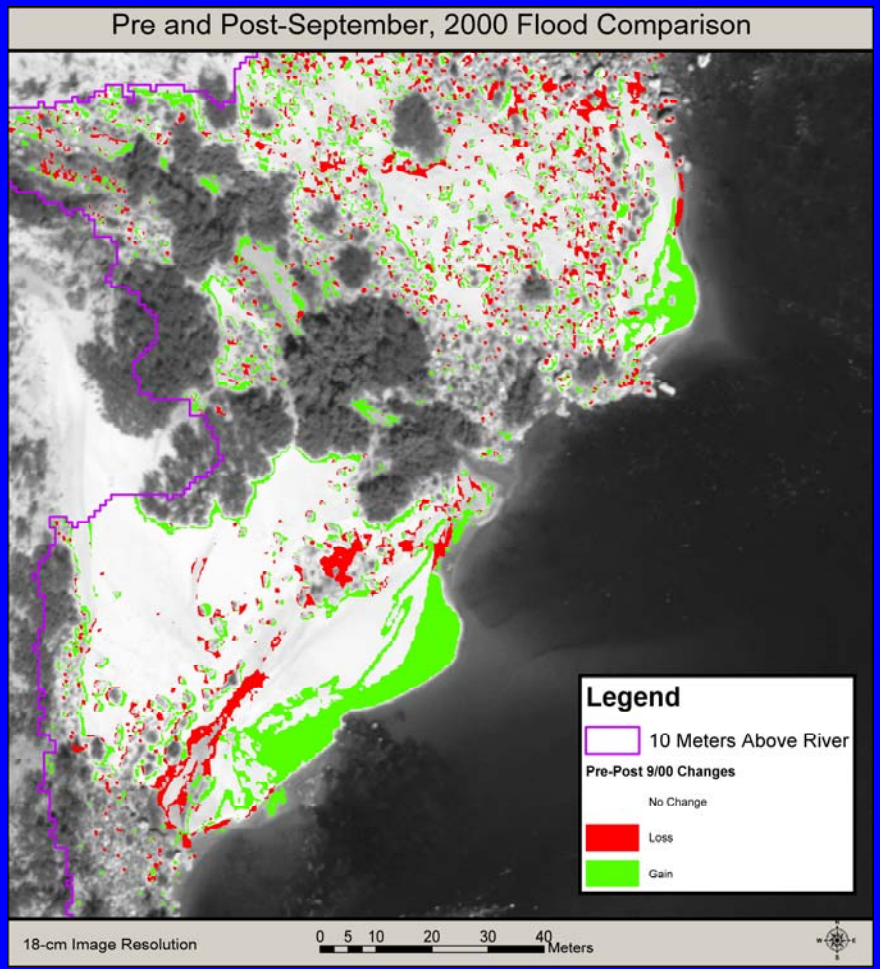
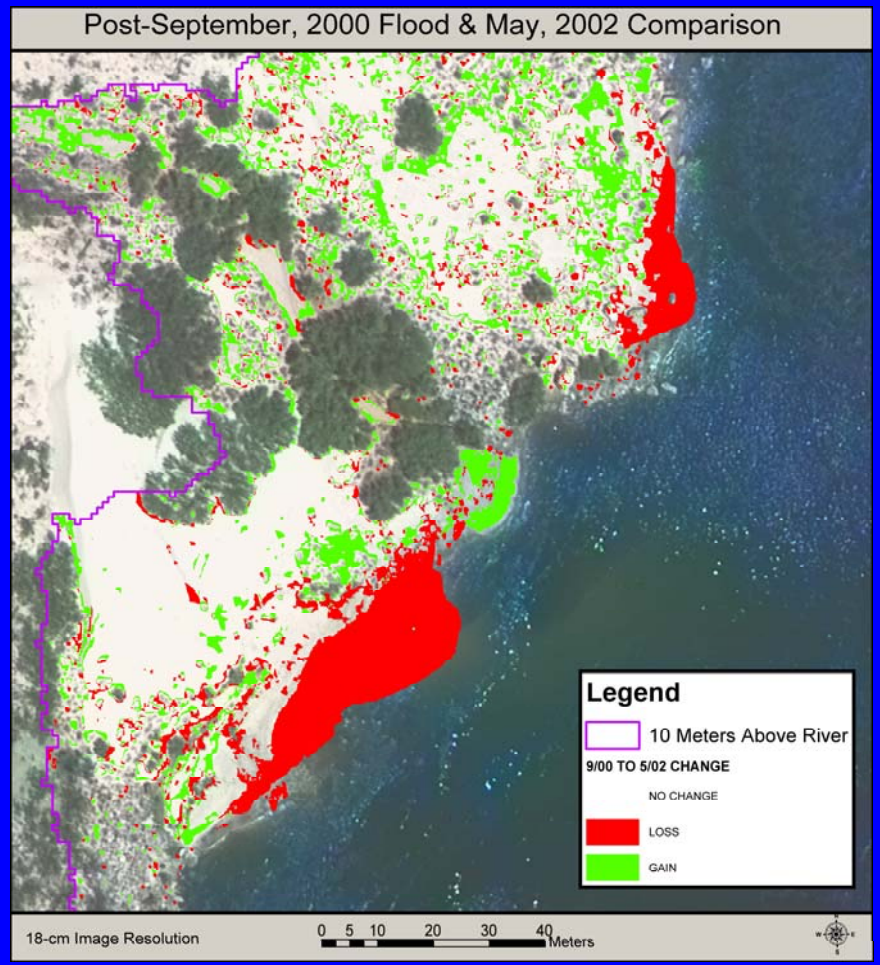
SAND DEPOSIT CHANGES





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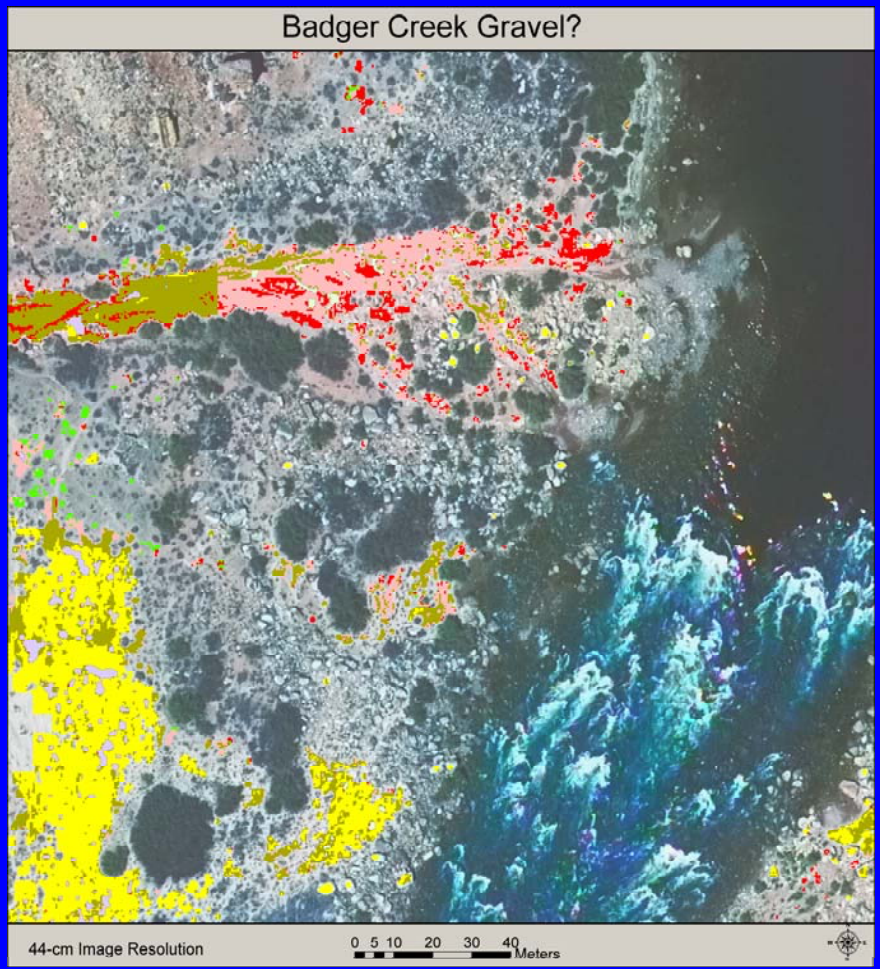
EVALUATION OF SAND CLASSIFICATION

Statistical Accuracy

- **Visual Assessment**
- **Field Survey**

OVERESTIMATES OF SAND AREA?



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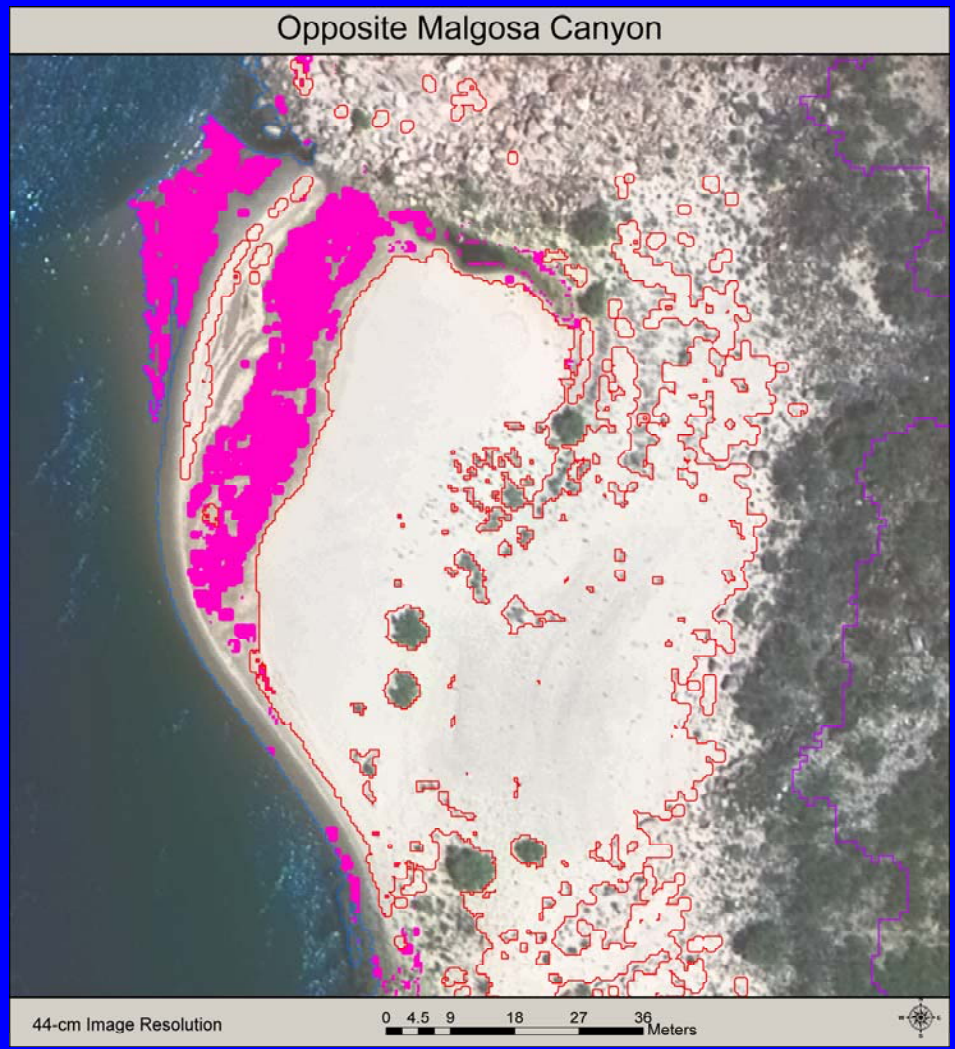
UNDERESTIMATES OF SAND AREA?



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IMPROVEMENTS

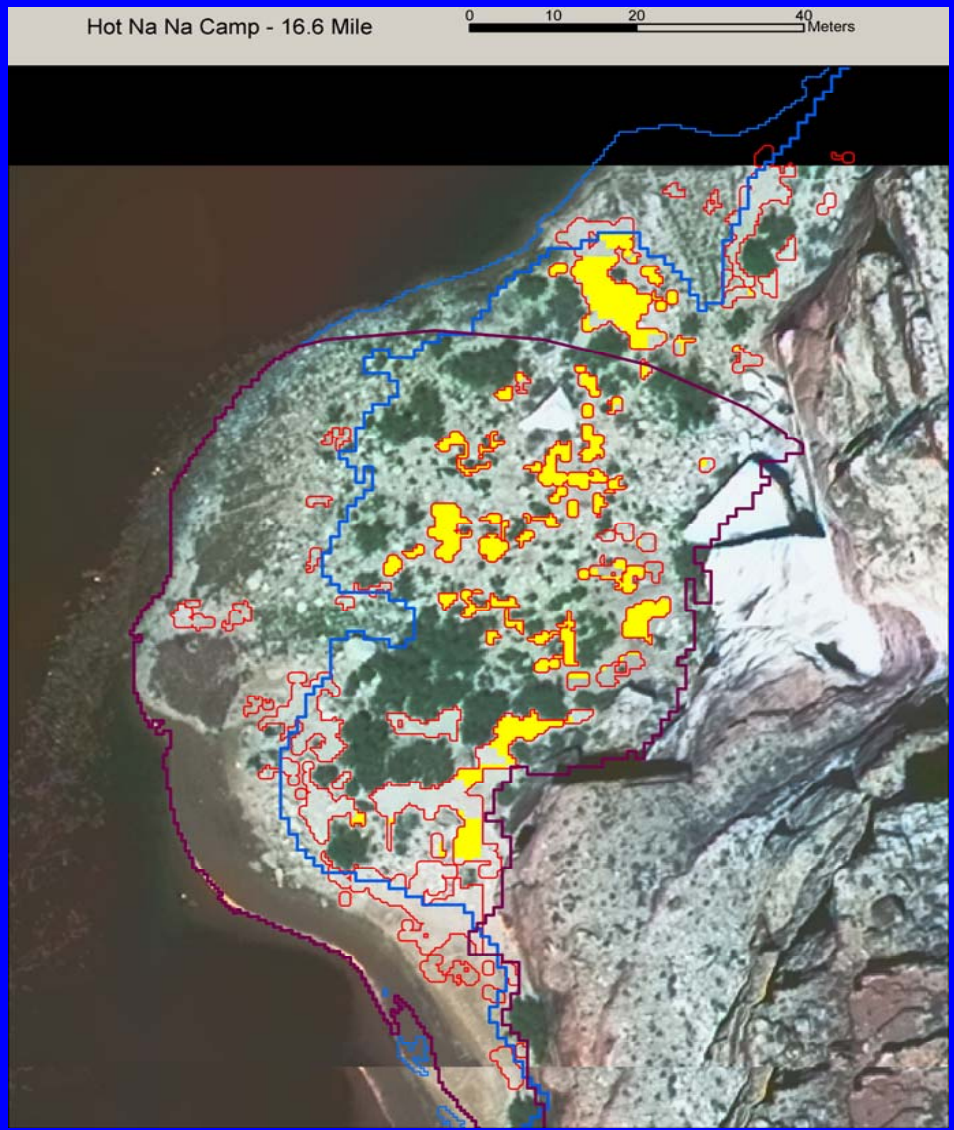
- Establish statistical accuracy of sand classes.
- Develop spectral signatures of verified sand areas.
- Run new classification based on signatures.

MONITORING VOLUMETRIC CHANGES IN SAND DEPOSITS

Surveys vs. automated photogrammetry

- NAU ground surveys vs. ISTAR digital elevation data.
- 30 to 60 cm difference.

CAMPING BEACHES – CAMPABLE AREA



Campable area criteria.

- Un-vegetated sand.
- Area > 2 sq. meters.
- Above 25,000 cfs.
- Slope < 8 degrees.

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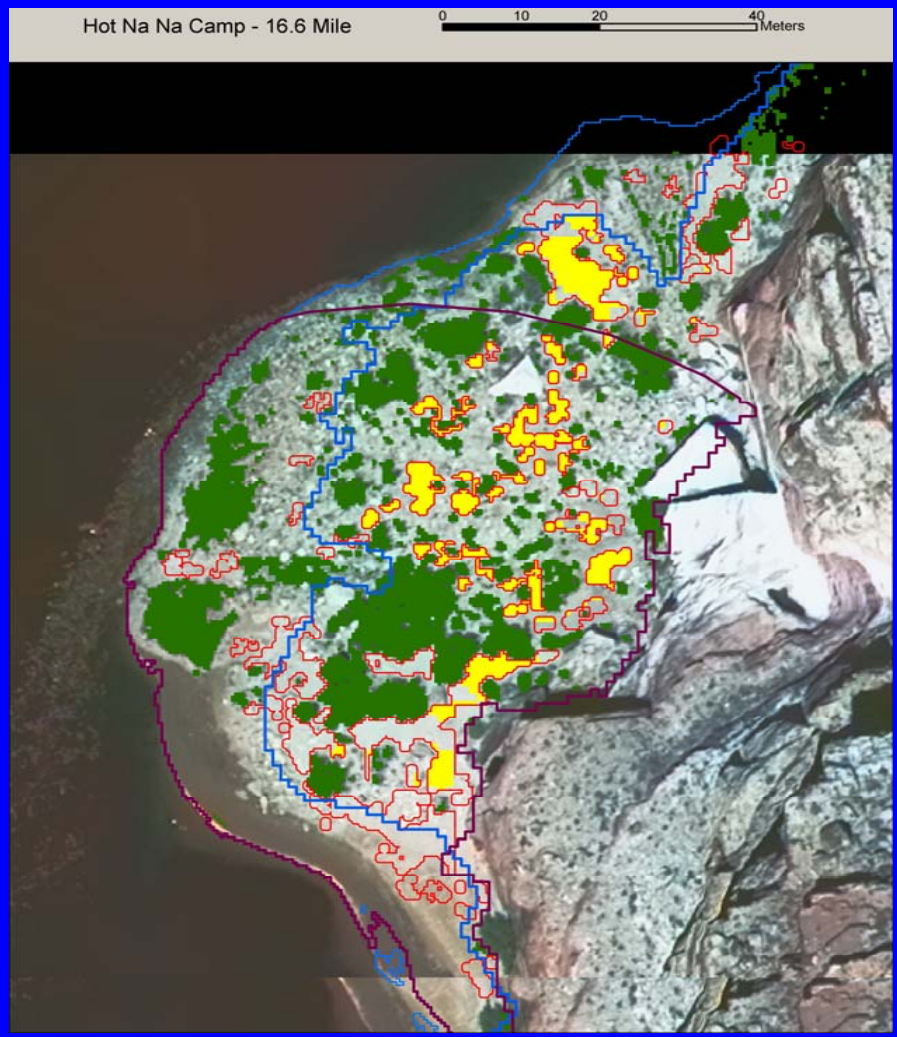
VEGETATION AND CAMPABLE AREA



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RESULTS & PRODUCTS

Glen Canyon Dam to Diamond Creek

- A canyon-wide set of digital sand-deposit maps.
- A canyon-wide set of digital vegetation maps.
- A set of sand-deposit change maps (RM 57 to 59).
- A canyon-wide set of camping-beach maps.
- Camping beach sand and vegetation characteristics.
- Sand and vegetation characteristics by river mile.

FUTURE DIRECTIONS

- Canyon-wide sand and vegetation monitoring (2-D).
- Canyon-wide volumetric sand monitoring (3-D).
- Canyon-wide camping-beach monitoring.
- Historical change analysis.
- Sub aqueous sand deposit monitoring.