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Sandbar Evolution: Extending the Historical Perspective

GCDAMP TWG Meeting, Phoenix

June 22, 2009

Paul Grams and Ted Melis with contributions from Joe Hazel (NAU) and Jack Schmidt (USU)

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

Why historical sandbar data? Why 1984?

- Current monitoring extends back to 1990
- This monitoring records the effects of the three experimental post-dam high flows
- Including 1984 would allow comparison of bar condition following the largest and longest post-dam high flow
- This would provide stakeholders an expanded reference when considering present sandbar condition
- 1980s sandbar conditions has been evaluated, but mostly based on bar area
- Aerial photographs taken in 1984 are high resolution and conducive to extracting volume information

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Current sandbar monitoring program

- Sandbar monitoring data series
  - ~ 35+ sites
  - 1990 – present (continuing every other year)
  - Measures sandbar area and volume
- Modern remote-sensing overflights (exist in digital orthorectified format)
  - Systemwide
  - 2002, 2004, 2005, 2009 (continuing every 4 years)
  - Measures sandbar area by semi-automated image processing

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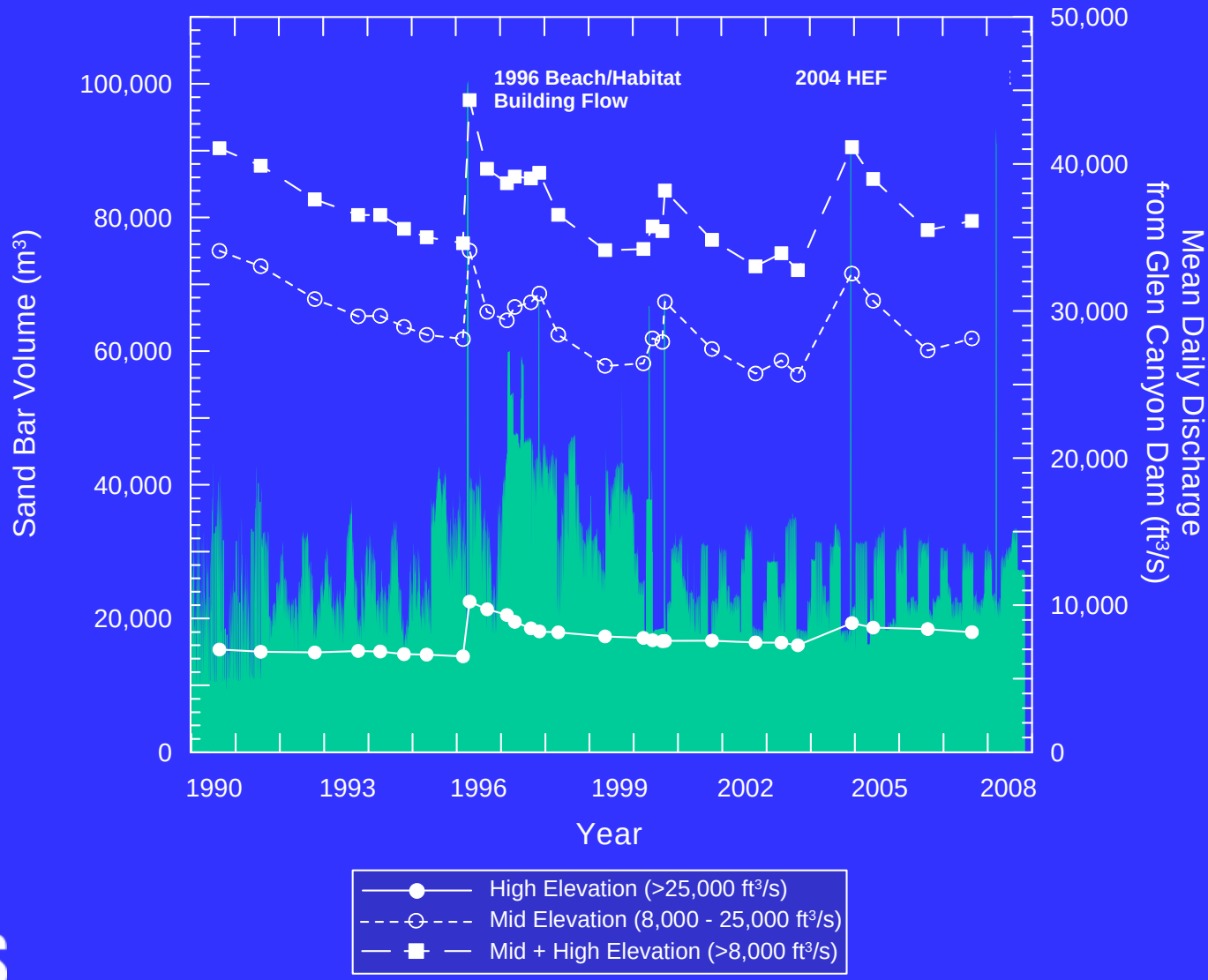
Sandbar monitoring data series



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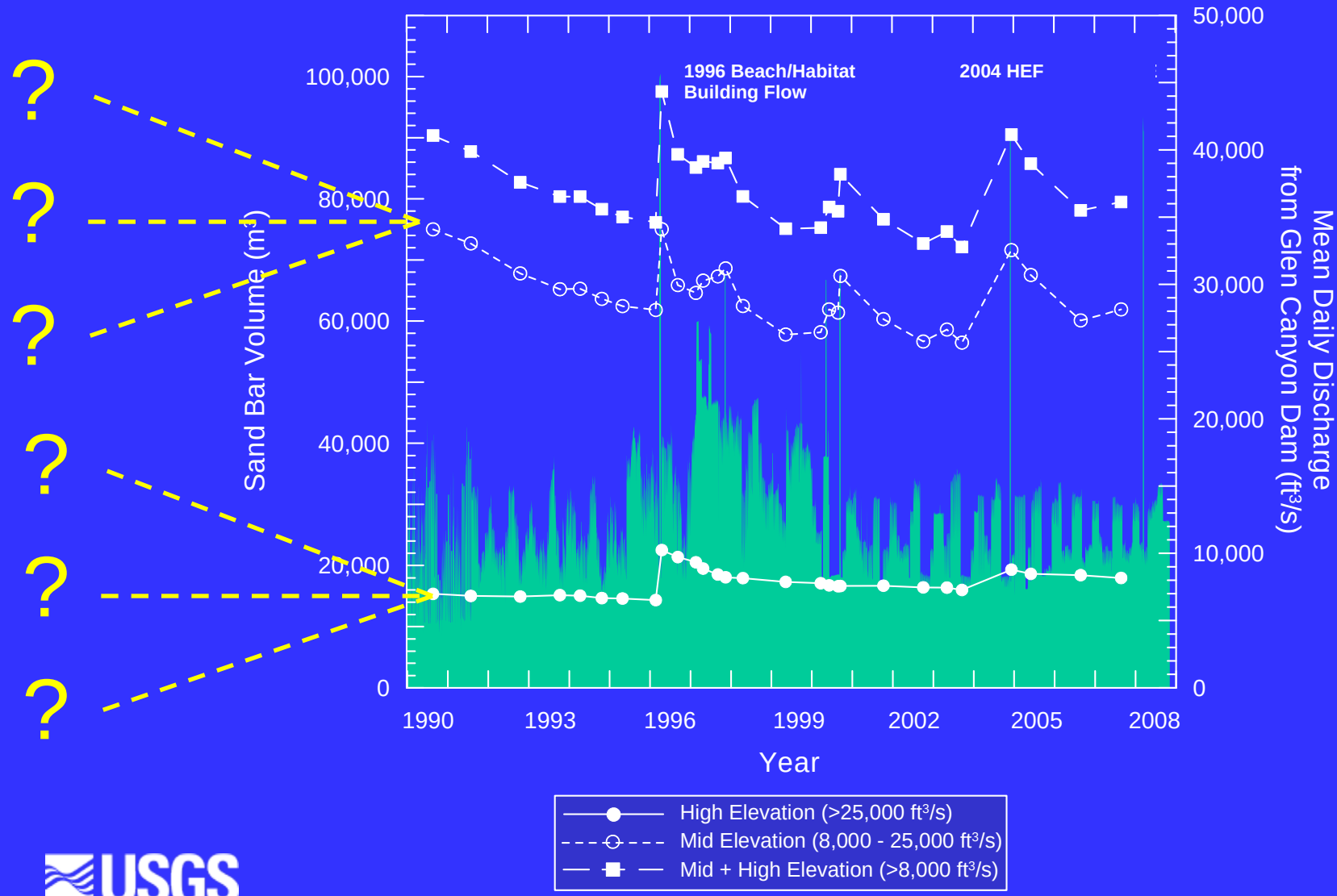
Provisional data: Northern Arizona University

Sandbar monitoring data series



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Sandbar research providing information on pre-1990 sandbar condition

- Reach-based geomorphic mapping
  - Several reaches 2 to 20 km in length
  - Uses pre- and post-dam air photos
  - Sandbar area only
- “Synthesis” reports for a few select sites where some pre-1990 survey data exist
- Historical oblique photos

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October 2004

SYSTEM-WIDE CHANGES IN THE DISTRIBUTION OF FINE SEDIMENT IN THE COLORADO RIVER CORRIDOR BETWEEN GLEN CANYON DAM AND BRIGHT ANGEL CREEK, ARIZONA

Final Report

By **John C. Schmidt, David J. Topping, Paul E. Grams, *and* Joseph E. Hazel**

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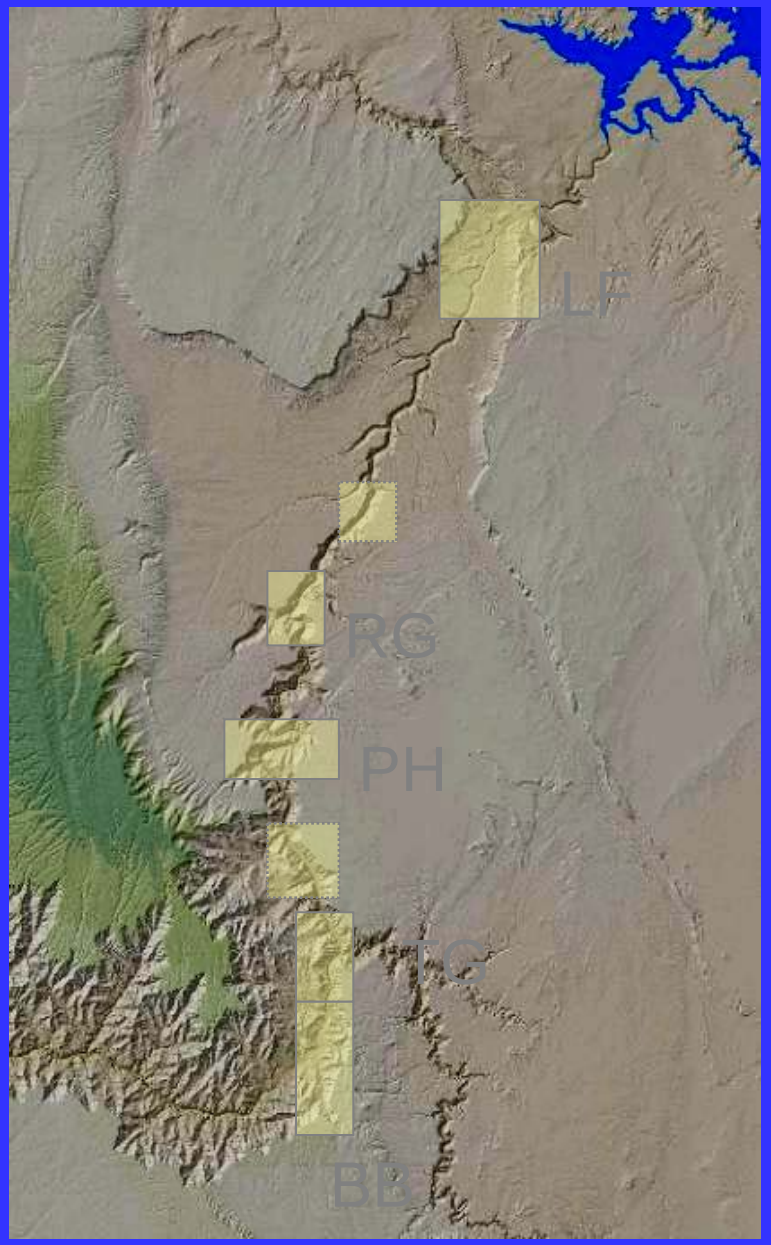
Reach-based Geomorphic Mapping

Mapping completed in several long reaches

7-9 years compiled

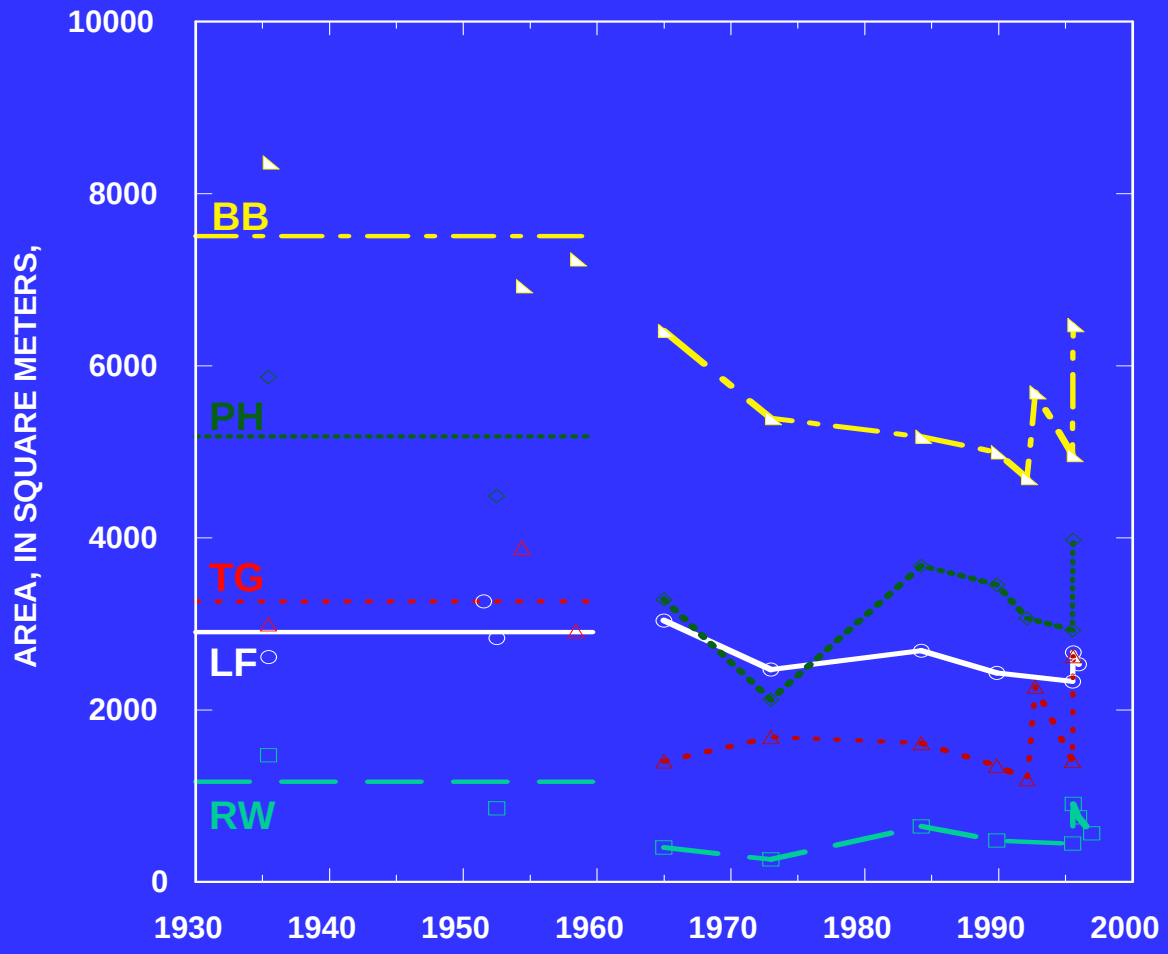
- 1930s
- 1950s
- 1965
- 1973
- 1984
- 1990s

~15,000 polygons in data base



Schmidt and others, 2004

Reach-based Geomorphic Mapping



Area of eddy bars is now smaller than in average pre-dam conditions.

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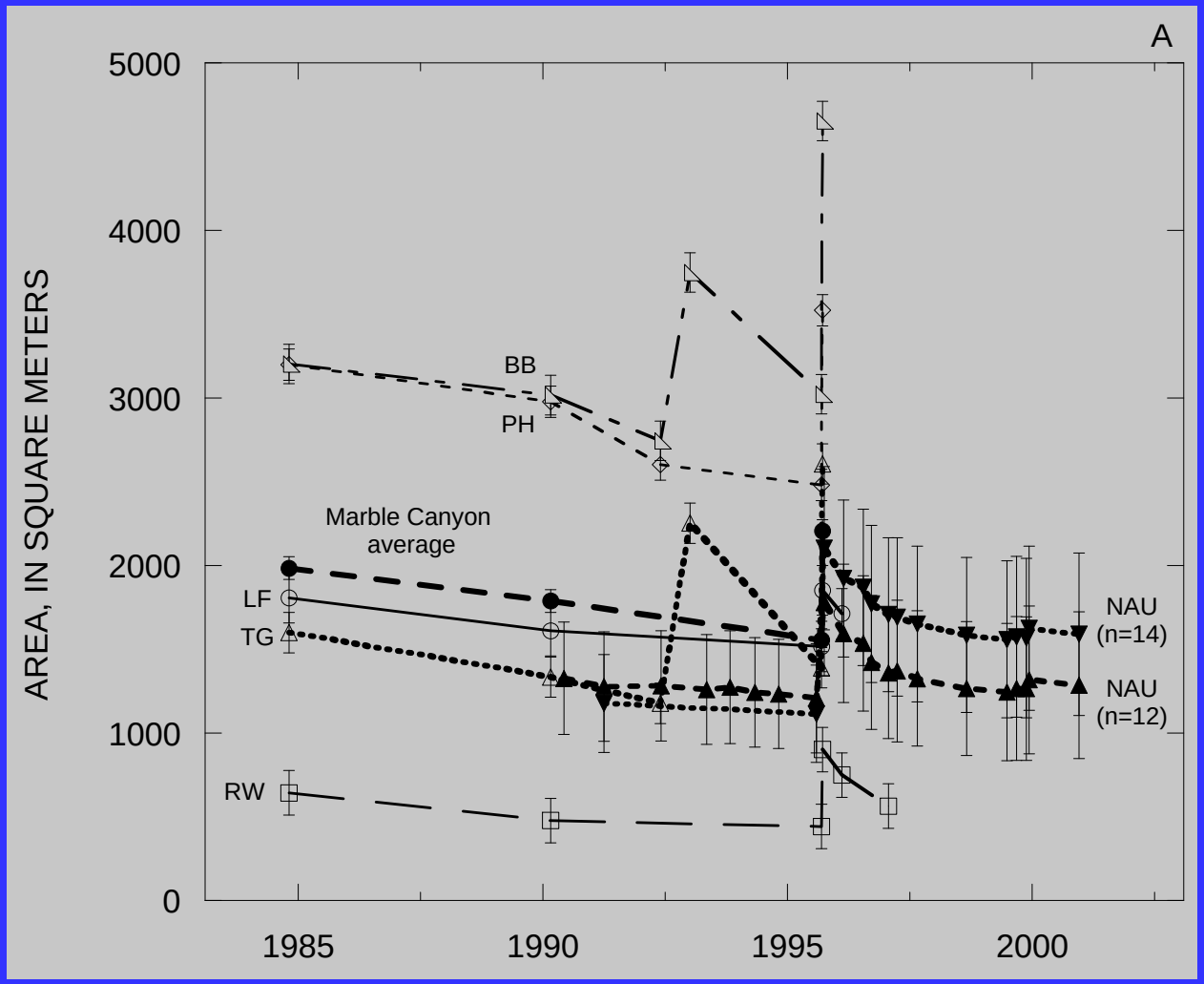
Schmidt and others, 2004

Integration of sandbar data series with reach-based geomorphic mapping for post-dam high flow sand



Area of eddy bars slightly greater in 1984 than in 1990s

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Schmidt and others, 2004

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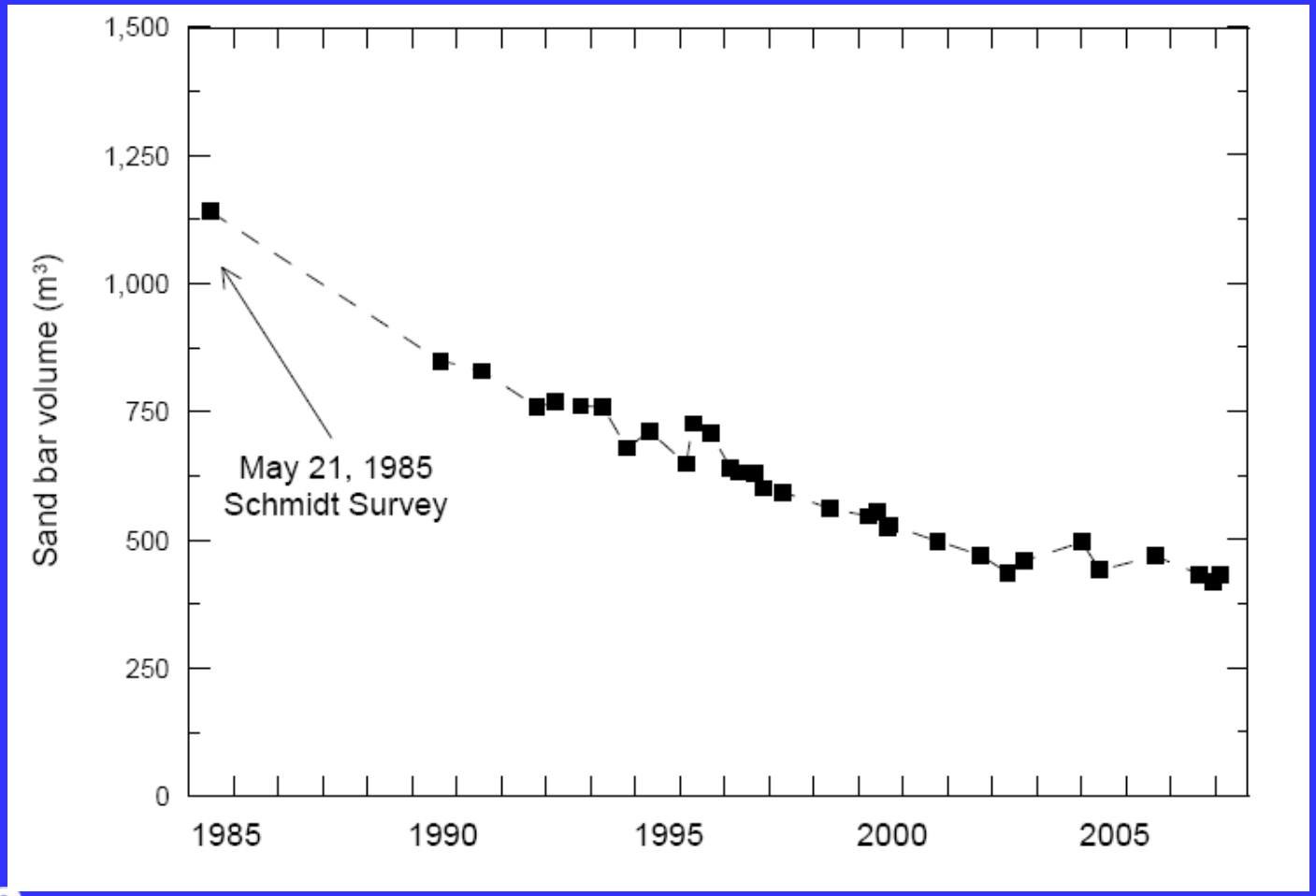
High-elevation bar volume at 8-mile (Jackass) camp



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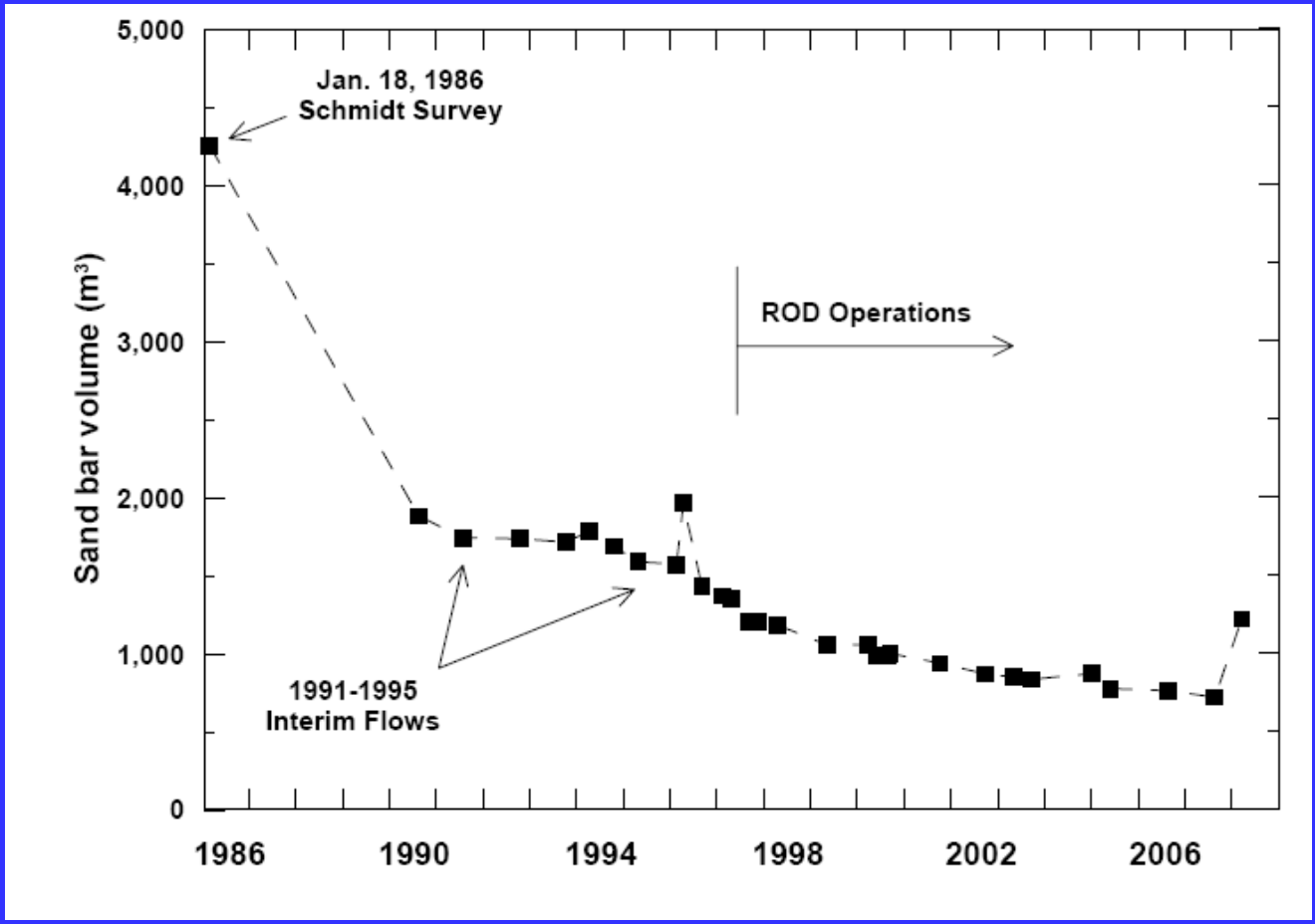
Provisional data: Northern Arizona University

High-elevation bar volume at 47-mile (Saddle) camp



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19 Mile Wash RM 19.41L: 1985-2008 comparison

1115 October 10, 1985 (~4,100 ft^3/s)

1100 March 30, 2008 (~7,700 ft^3/s)

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Provisional data: Utah State University

Eminence, RM 44.45L: 1985-2008 comparison

1730 October 12, 1985 (~6,800 ft^3/s)

1555 May 14, 2008 (~12,400 ft^3/s)

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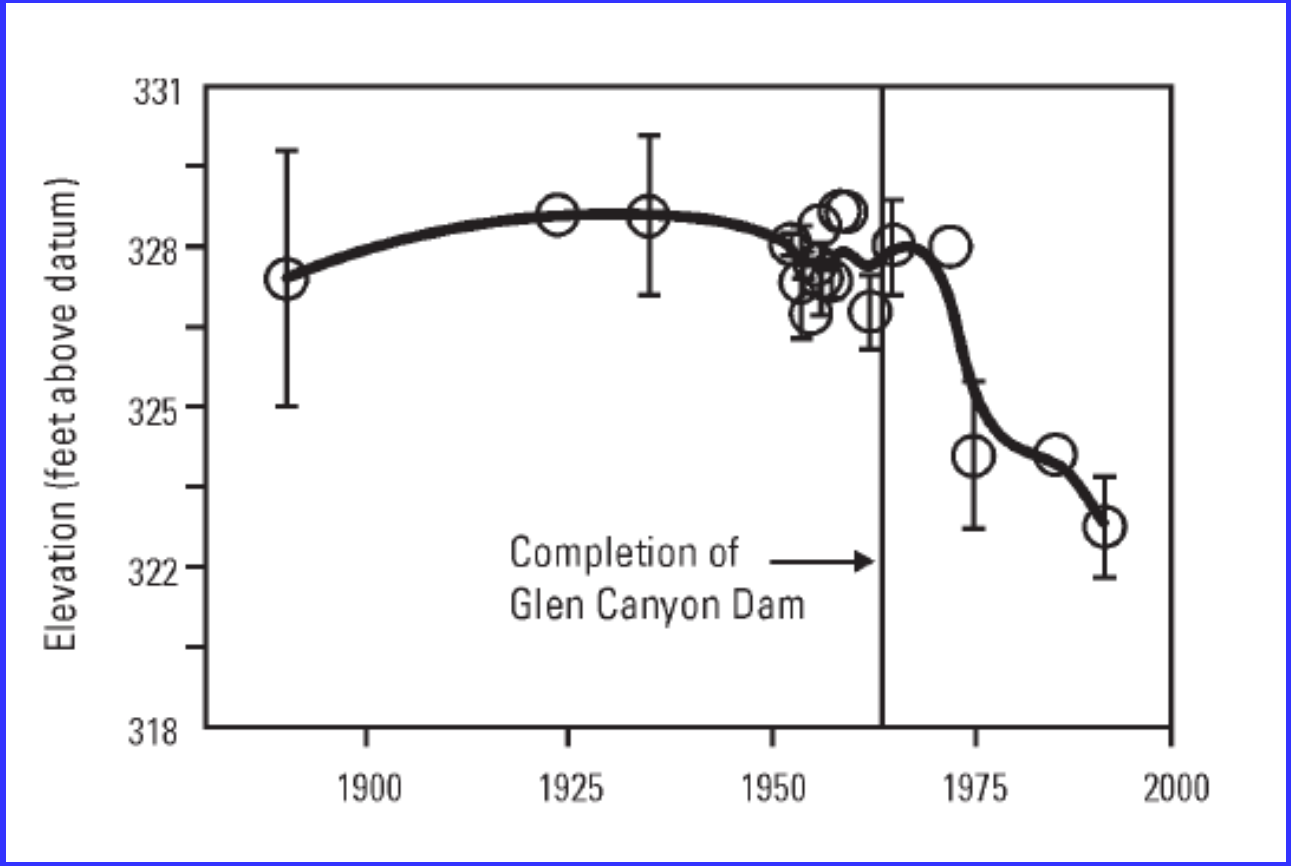
Provisional data: Utah State University

Sandbar elevation at 8-mile (Jackass) camp from interpretation of historical oblique photos



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Rubin and others, 2002; SCORE report, 2005

Summary: What do we know about historical sandbar conditions

- Average of 25% decrease in sandbar area between pre-dam period and 1990s
- By area, some bars larger in 1984 than in 1990s to present, but not uniformly larger. In some cases, present bar area is comparable to early 1980s.
- Difference between pre-dam and 1984 likely greater than difference between 1984 and 1990's - present

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What's to be learned by extending the sandbar monitoring data series to 1984?

- Large changes in bar area may be associated with small changes in volume or the reverse may be true
  - May result in revised opinion of 1984 relative to 1990s and present
- Allow a determination of how much of the sand present in 1984 was above vs. below the 45,000 cfs stage.
  - If bar volume was larger in 1984, how much of that volume can be regained by a ~45,000 cfs high flow?
- Quantification of the relative role of sandbar volume change and vegetation change in affecting changes in sandbar area from 1984 to present
  - How much of the perceived larger bar area in 1984 is the result of less vegetation covering those bars?

If a pre-1990 reference is desired, it can be better informed by including sandbar volume information

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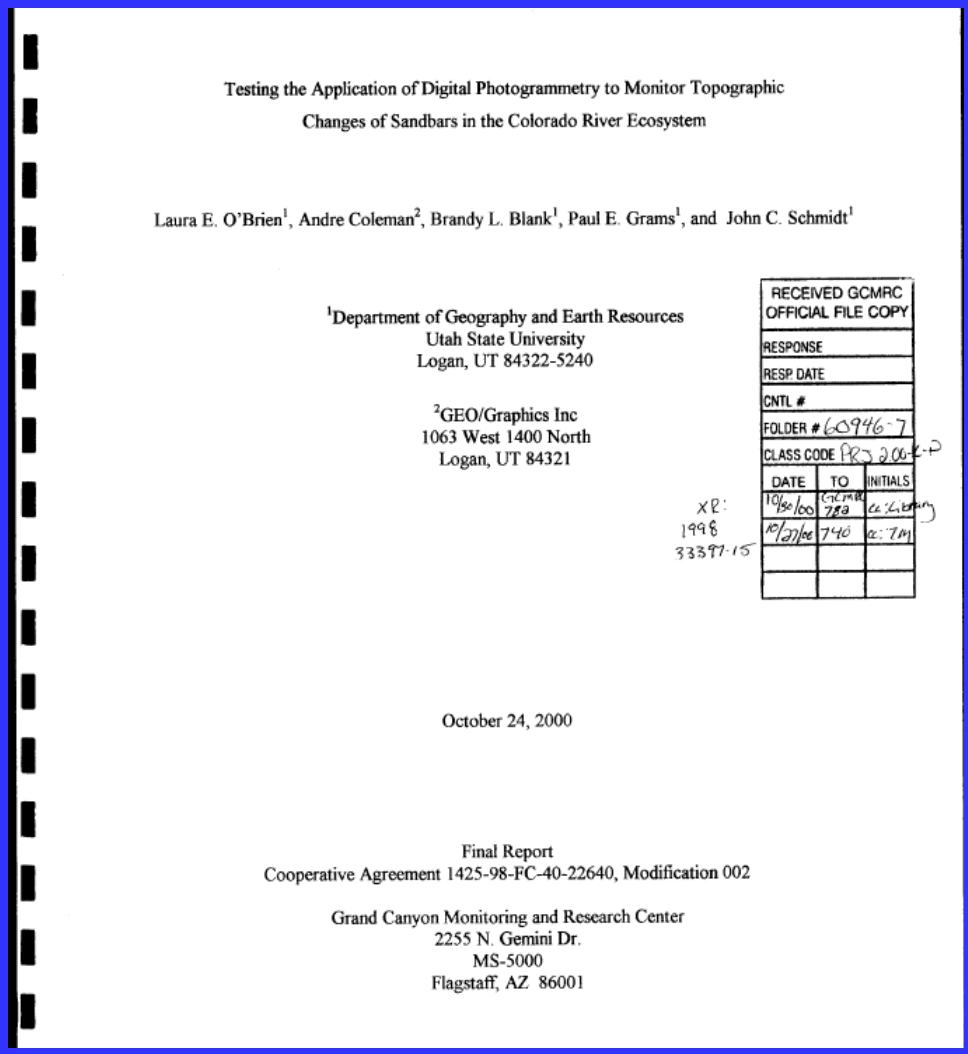
Use of photogrammetry to determine sandbar volume

- **Pilot study completed in 2000**



Testing the Application of Digital Photogrammetry to Monitor Topographic Changes of Sandbars in the Colorado River Ecosystem

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October 24, 2000

Final Report
Cooperative Agreement 1425-98-FC-40-22640, Modification 002

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O'Brien and others, 2000

Use of photogrammetry to determine sandbar volume

- Pilot study completed in 2000
- Used 1984 and 1996 photos for sandbar monitoring site at Badger Rapid

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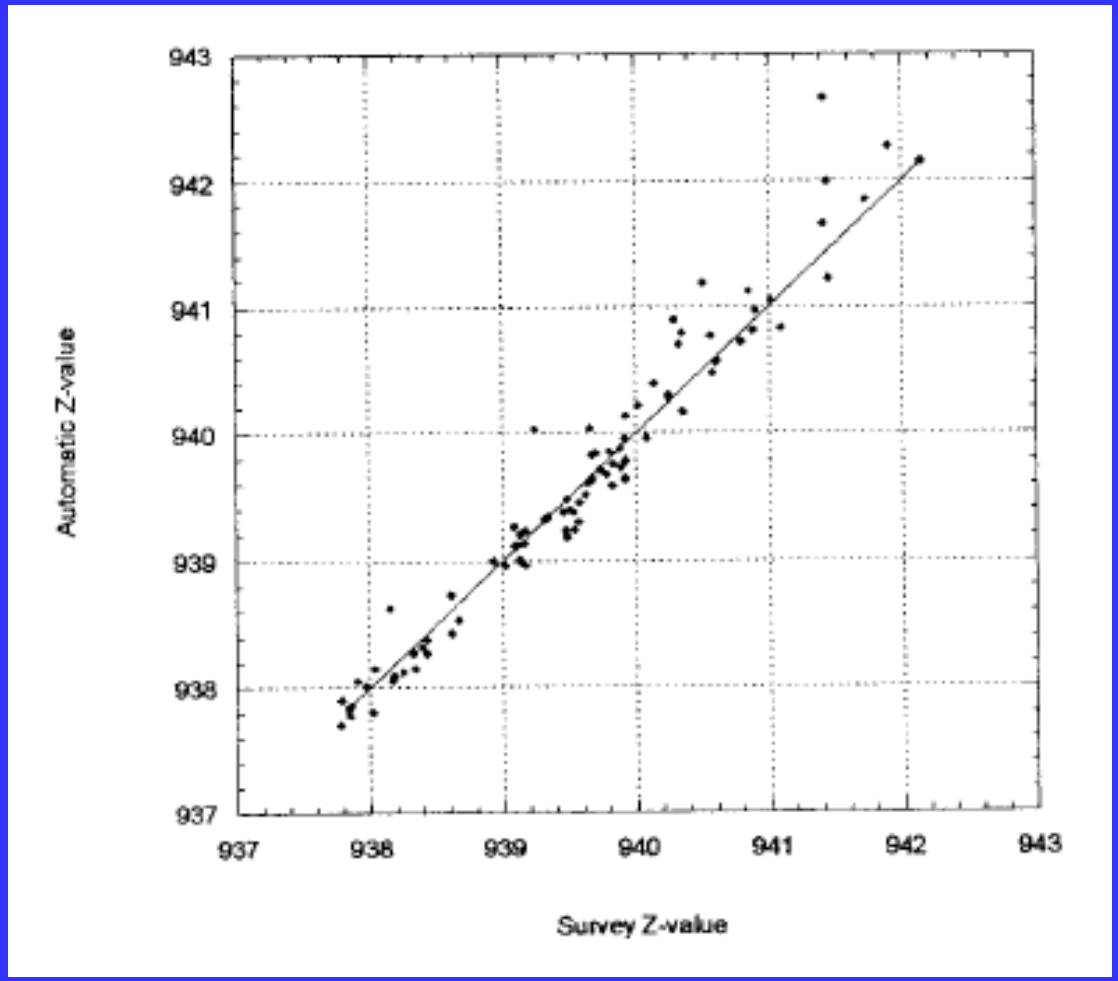
O'Brien and others, 2000

Use of photogrammetry to determine sandbar volume

- Pilot study completed in 2000
- Used 1984 and 1996 photos for sandbar monitoring site at Badger Rapid
- Demonstrated that methods can be used to create topography with 30 cm or better uncertainty



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O'Brien and others, 2000

Potential approach for photogrammetry project

- Establish agreement/contract with photogrammetry professional to determine and document methods using GCMRC equipment and train GCMRC personnel
  - Expect that topographic surfaces could be created for at least 2 to 3, possibly several more sites in first year.
  - At end of first year, GCMRC would report on progress and estimated time and cost to complete generation of surfaces for all sandbar monitoring sites
  - Once generated, topographic surfaces would be incorporated in sandbar data series

Estimated Cost: ~$85,000/yr
Not included in FY10-11 budget

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Conclusions

- Extending the sandbar monitoring data series back to 1984 would provide valuable perspective on present sandbar condition relative to condition following first and largest of the post-dam floods
- Implementing project requires cooperator assistance to develop methods and train staff
- GCMRC has placed project on deferred list to be implemented when funding is available

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