April 2008 Grand Canyon Sediment Update

David Topping, Ron Griffiths, Tom Sabol, Nick Voichick, Bob Tusso, Ted Melis, Paul Grams, and many others at the USGS
Large discharge-independent changes in suspended-sediment concentration and grain size over short (i.e., < hourly) timescales

Three orders of magnitude range in sand concentration at any given water discharge. Implication...high resolution direct measurements of sand concentration are required.

Preliminary results – subject to review and revision
Since 1999, we have been studying abnormal water years

- Knowing sand inputs is not enough to conduct future BHBFs, levels of sand retention in key reaches must be known!

- Only a 20% increase in downstream water delivery will result in a minimum factor of 2 increase in sand export (details depend on monthly water distribution and grain size)

- This return to a more “normal” flow scenario will negate any of the sand retention we have observed during “abnormal” 8.23 maf water years

- Demonstrable retention of tributary sand in the Colorado River under “normal” water years is < 2 months (Topping et al., WRR, 2000; Rubin et al., EOS, 2002; Wright et al., USGS-Circ., 2005)

- Flows may be increasing above 8.23 maf this year for the first time since 1999!
SEDIMENT-YEAR 2003 MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE

MASS-BALANCE UNCERTAINTY ENVELOPE
WATER DISCHARGE

ACCUMULATION
EROSION

LITTLE COLORADO RIVER FLOOD

Preliminary results – subject to review and revision
SEDIMENT-YEAR 2004 MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE

MASS-BALANCE UNCERTAINTY ENVELOPE
WATER DISCHARGE

PARIA RIVER FLOOD
ACCUMULATION
EROSION

DISCHARGE AT THE LEES FERRY GAGE (ft³/s)

Preliminary results – subject to review and revision
SEDIMENT-YEAR 2005 MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE

Preliminary results – subject to review and revision
SEDIMENT-YEAR 2006 MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE

Preliminary results – subject to review and revision
Antecedent reach-by-reach sand-supply conditions prior to the 2008 HFE

Preliminary results – subject to review and revision
TRIBUTARY SAND INPUT BETWEEN THE LEES FERRY AND GRAND CANYON GAGES
OCTOBER 2006 - JANUARY 2008

Preliminary results – subject to review and revision
OCT 2006 - JAN 2008 MASS-BALANCE SAND BUDGET FOR UPPER MARBLE CANYON (river-miles 1-30)

Demonstrable > 1 million metric tons sand accumulation

Preliminary results – subject to review and revision
Demonstrable > 200,000 metric tons sand accumulation

This reach was likely the major supplier of sand measured in transport downstream at the Grand Canyon gage (RM 88) during the 2008 HFE

Preliminary results – subject to review and revision
OCT 2006 - JAN 2008 MASS-BALANCE SAND BUDGET FOR EASTERN GRAND CANYON (river-miles 62-88)

NO DEMONSTRABLE SAND ACCUMULATION!

Preliminary results – subject to review and revision
ANY SAND ACCUMULATION FROM LOCAL TRIBUTARY INPUTS ONLY.
THIS IS LIKELY <300,000 metric tons of sand.

Preliminary results – subject to review and revision
On January 20, 2008, where was the sand supplied by tributaries since October 1, 2006?

- UPPER MARBLE CANYON (RM 1-30)
- LOWER MARBLE CANYON (RM 30-62)
- EASTERN GRAND CANYON (RM 62-88)
- CENTRAL & WESTERN GRAND CANYON (RM 88-226)
- FAR WESTERN GRAND CANYON & LAKE MEAD (RM > 226)

Preliminary results – subject to review and revision