What's Going on in Lake Powell?

- Declining Reservoir Levels
  - Current Elevation ~ 3559.60 ft
    - lowest elevation since 5/13/1969 (Pre-Woodstock)
  - Current Live Storage 8.29 MAF (34.1%)
  - Projected Low (March 2005) – 3556.8 ft
  - Projected High (July 2005) – 3605.2 ft
- Warming Releases
  - Maximum observed temperatures
    - 11/14/2003 – 13.2°C (56°F)
    - 10/5/2004 – 15.5°C (60°F)
  - 16° to 17°C possible by October 1, 2005?

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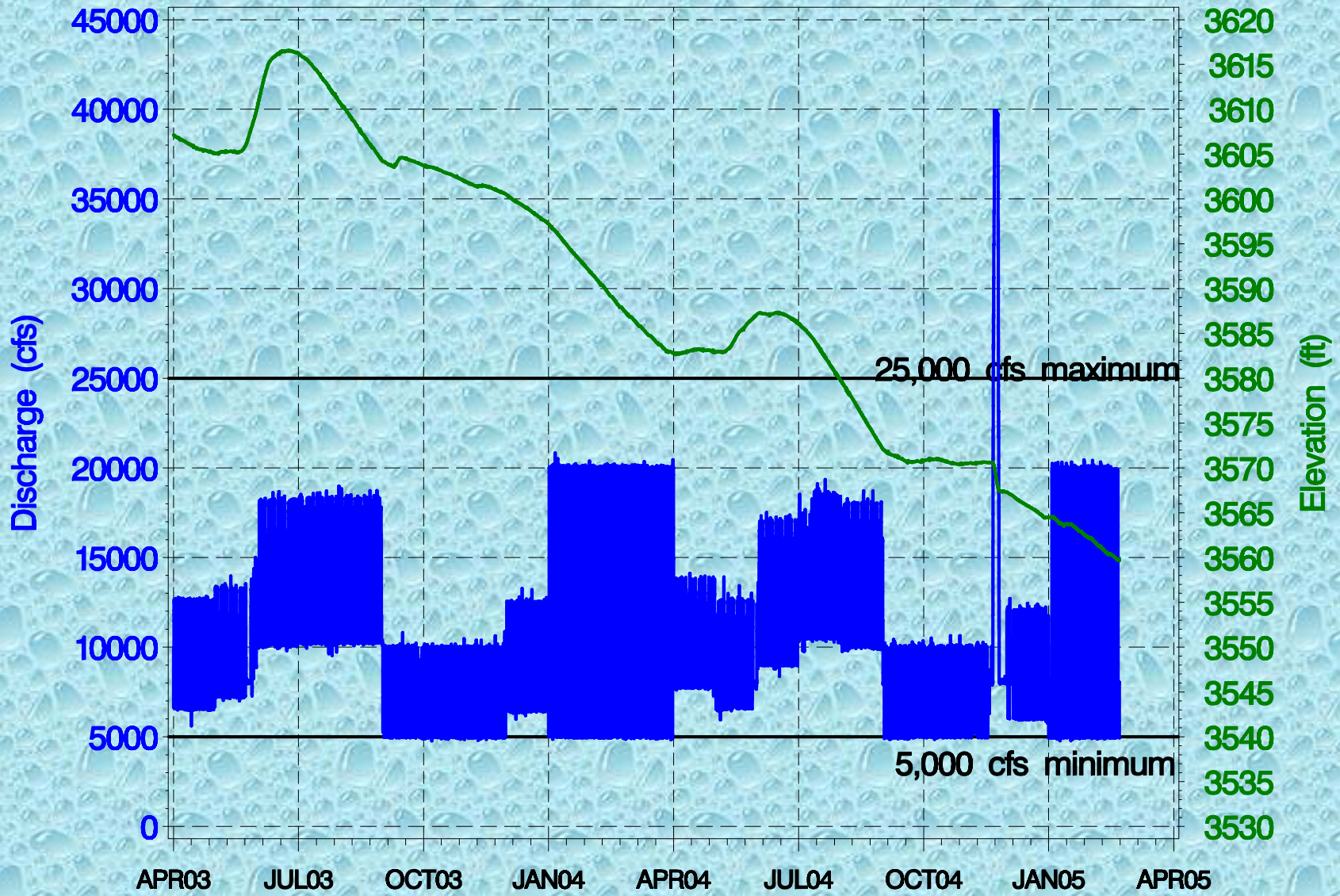
Glen Canyon Dam Powerplant Releases and Lake Powell Surface Elevation
01apr2003 to 01apr2005



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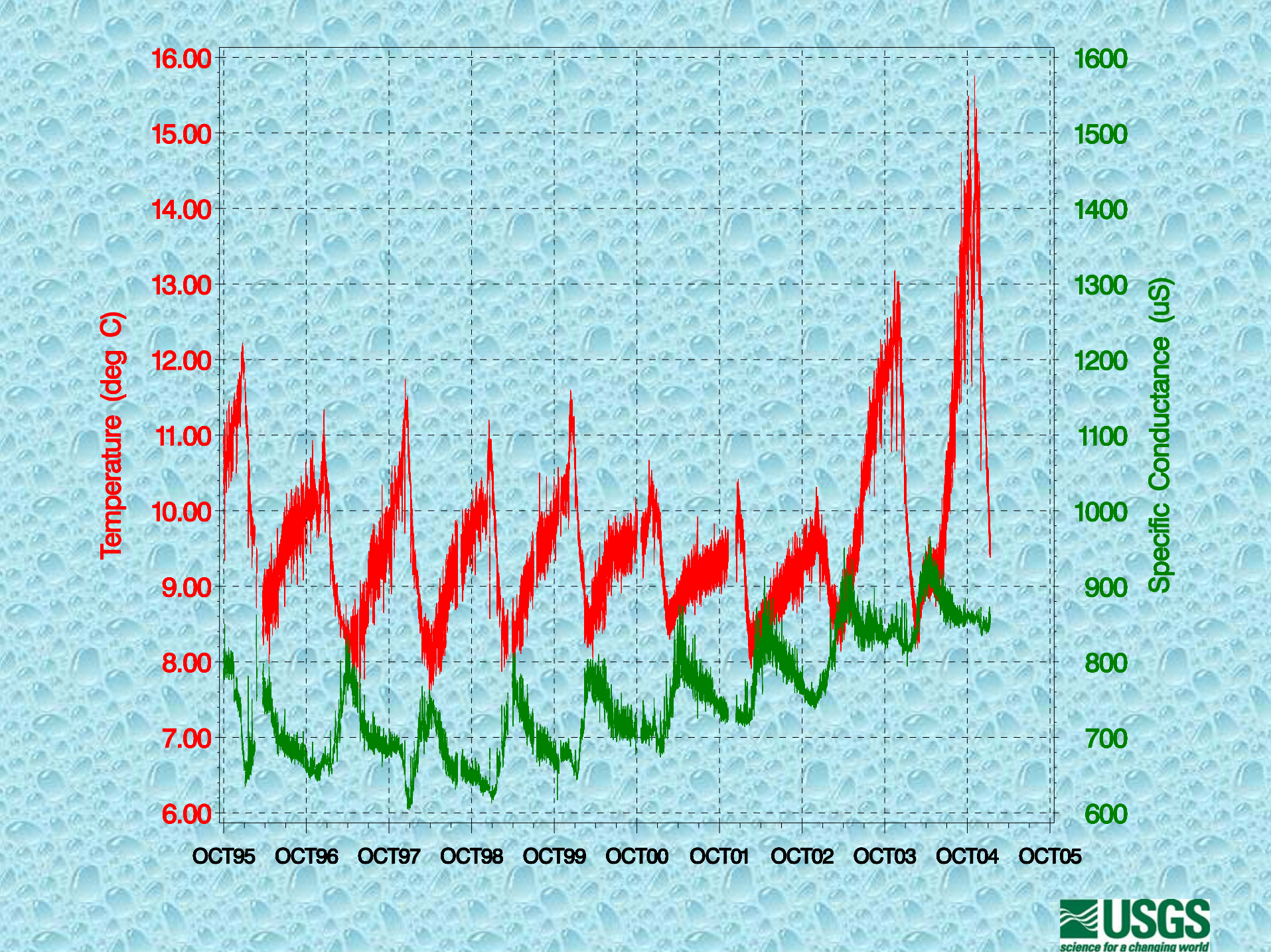
16.00
15.00
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Temperature (deg C)
1600
1500
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1200
1100
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800
700
600
Specific Conductance (uS)
OCT95
OCT96
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OCT98
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OCT01
OCT02
OCT03
OCT04
OCT05
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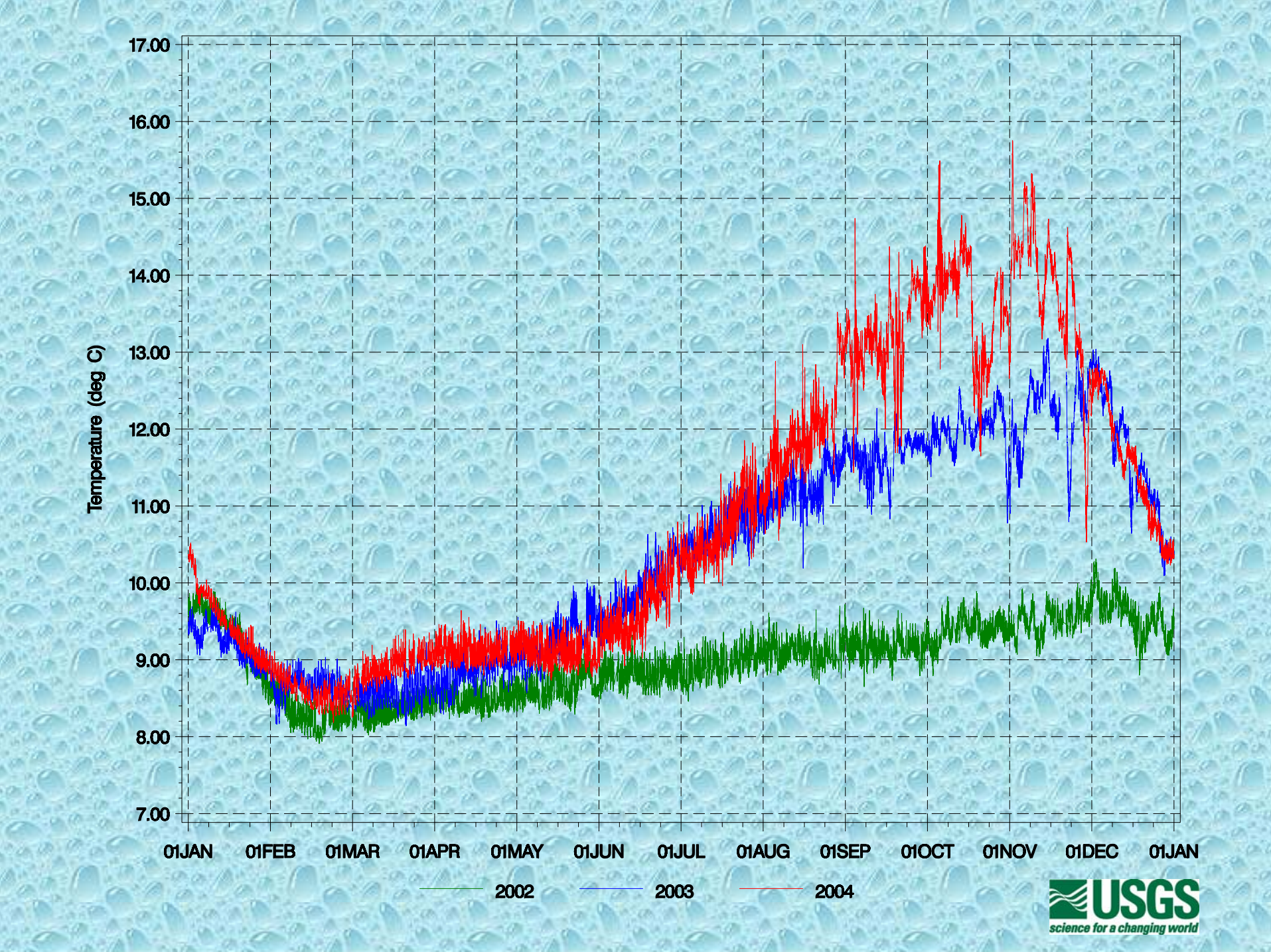
17.00
16.00
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Temperature (deg C)
01JAN
01FEB
01MAR
01APR
01MAY
01JUN
01JUL
01AUG
01SEP
01OCT
01NOV
01DEC
01JAN
2002
2003
2004
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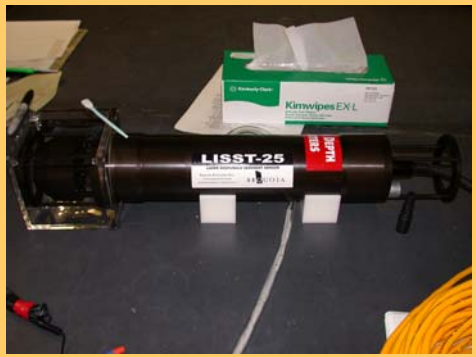
Update on Preliminary Experimental Results Associated with the November 2004 High-Flow Test at Glen Canyon Dam



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Sediment Experimental Overview

✓ Review Paria River Sediment Trigger & Activity (2004-05)

✓ Preliminary Results of Sand-Bar Area and Volume Changes Since 1990

✓ Preliminary Results of Sand Mass Balance in Upper Third of Ecosystem through Mid-February 2005, as Estimated by USGS (Topping et al.)

Paria River Provides the Key Sand Inputs in the Post-Dam EIS Era

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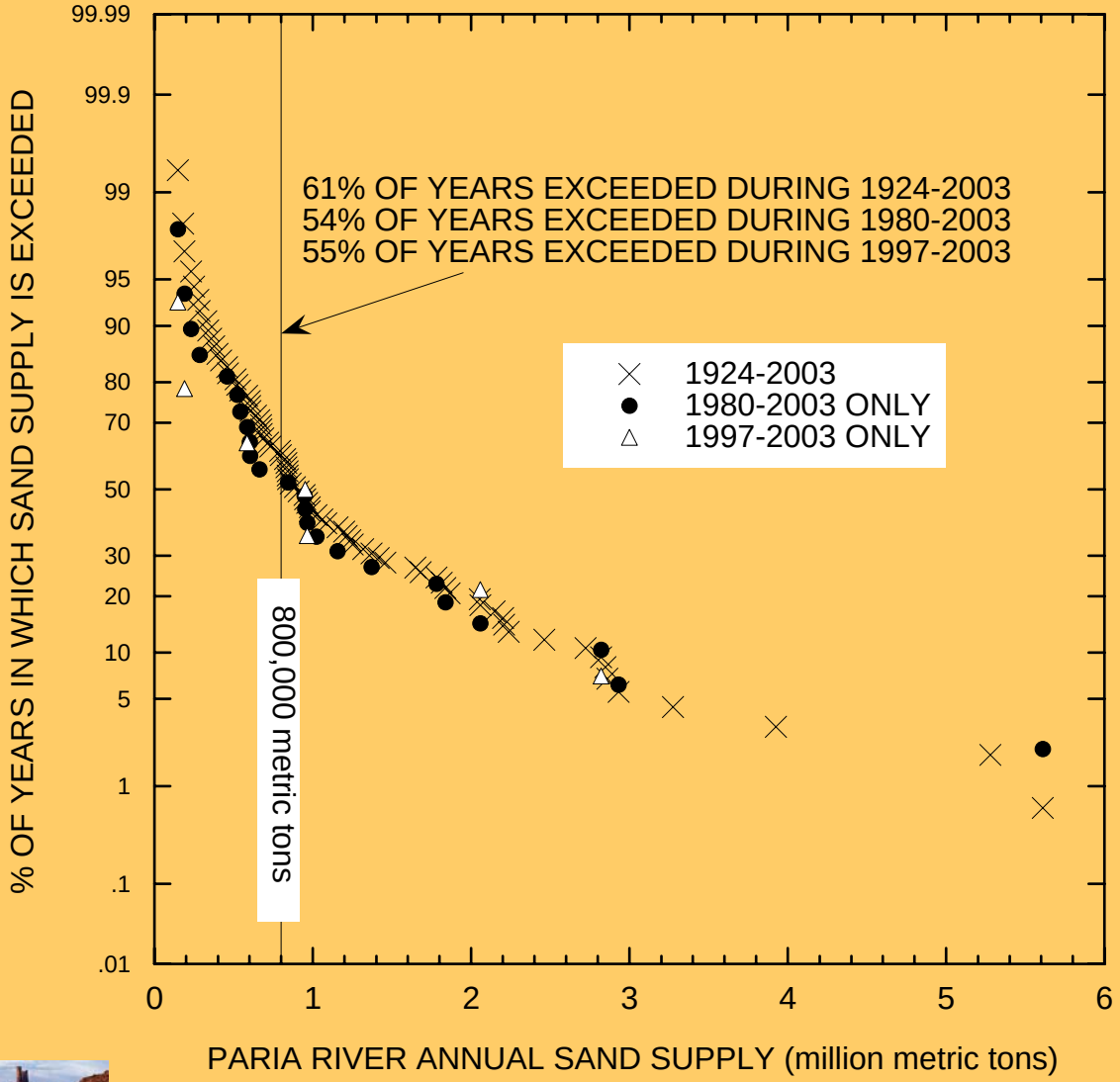
- Typically, inputs contain about 50% sand and 50% fines
- Concentrations as high as 1,000,000 mg/l (a world class muddy stream!)
- Average Annual Sand Input ~1.4 million metric tons
- Median Sand Grain Size ~ 115 μm (fine)
- Located 15 Miles Below Glen Canyon Dam
- Bars Structure Fish Habitats!

Basis for Experimental Design Relating to Paria River Sand Trigger



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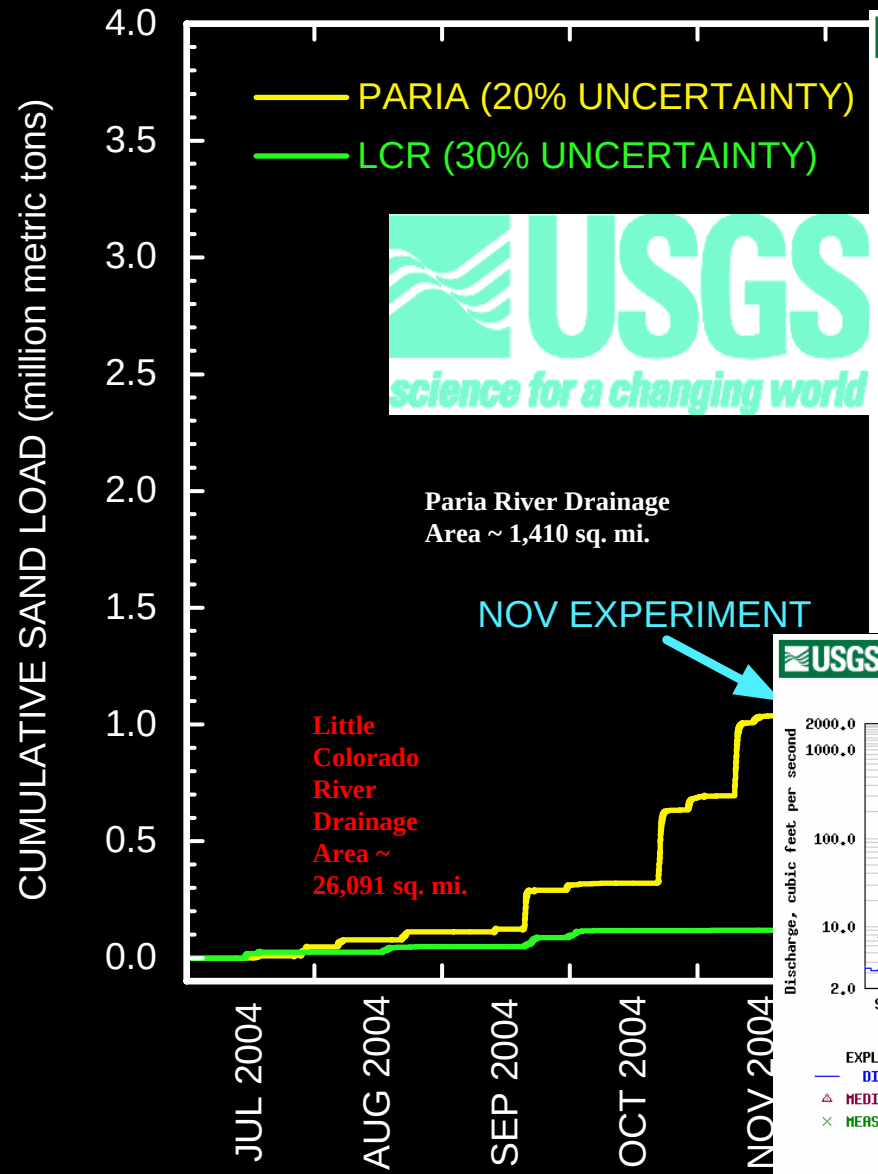
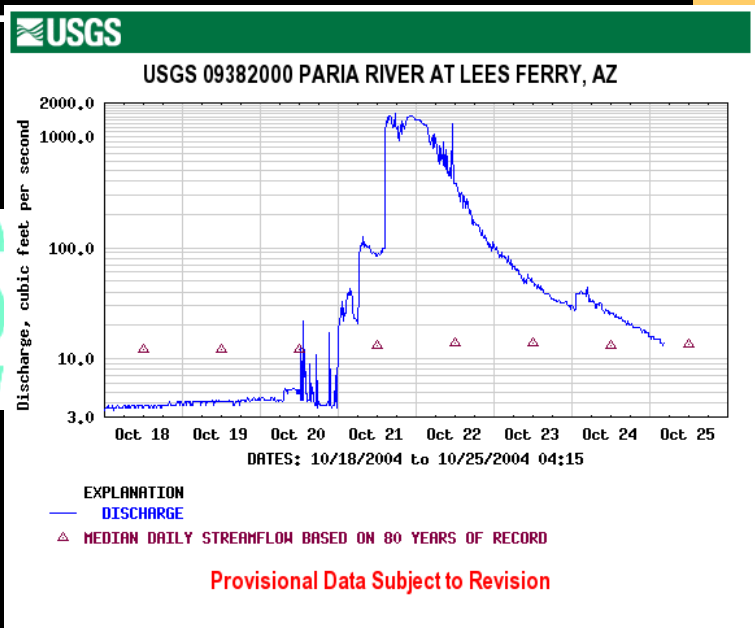
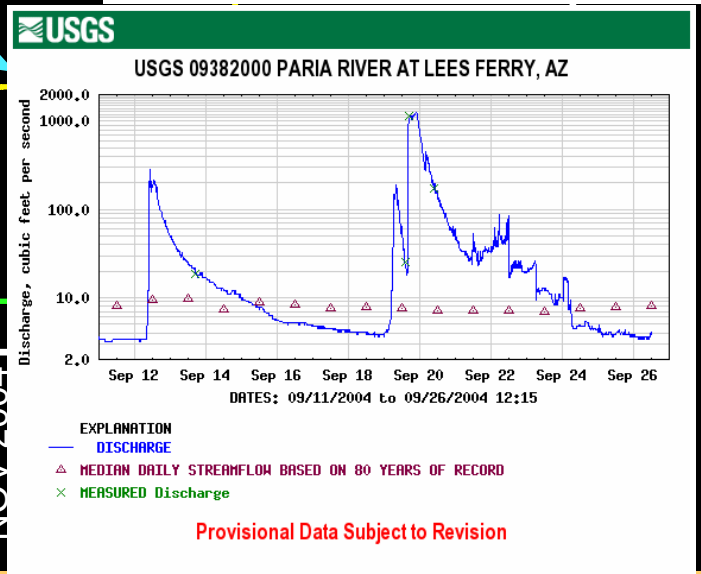
Preliminary Data – Subject to Review and Revision 02/02/05

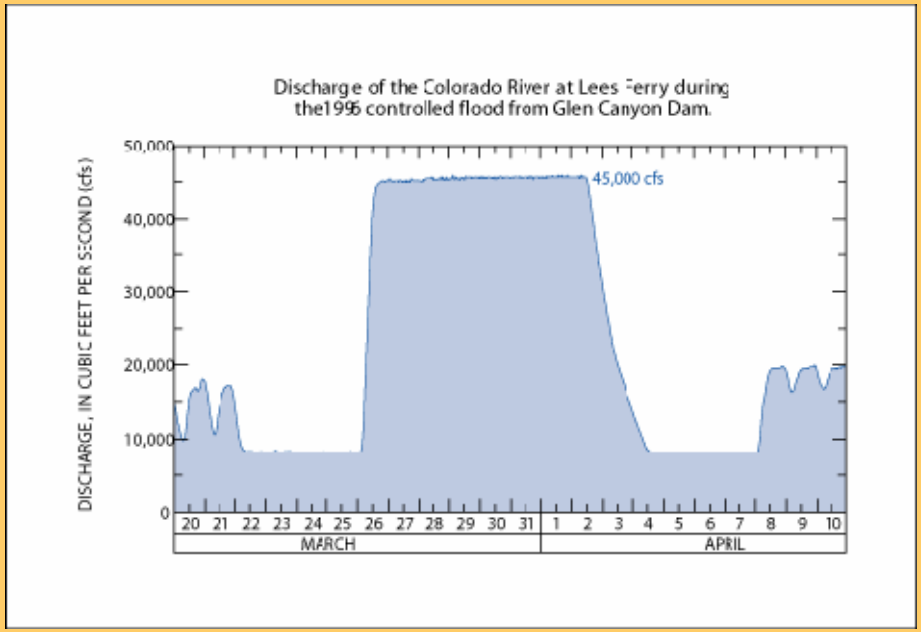
SED-YEAR 2005 SAND INPUT TO THE REACH BETWEEN THE LEES FERRY AND GRAND CANYON GAGES



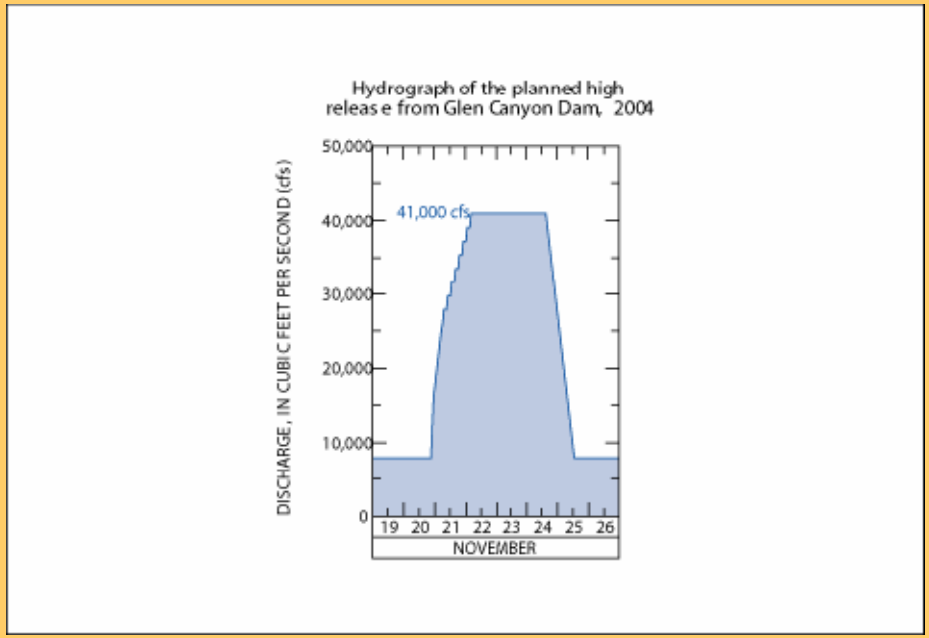




Comparison of Controlled Flood Hydrographs Released from Glen Canyon Dam in 1996 vs. 2004



1996 - Up Fast, Down Slow…



2004 - Up Slow, Down Fast!

NOTE: This Peak Discharge is 41,000 cfs in 2004 and the peak duration is 108 hours less than in 1996

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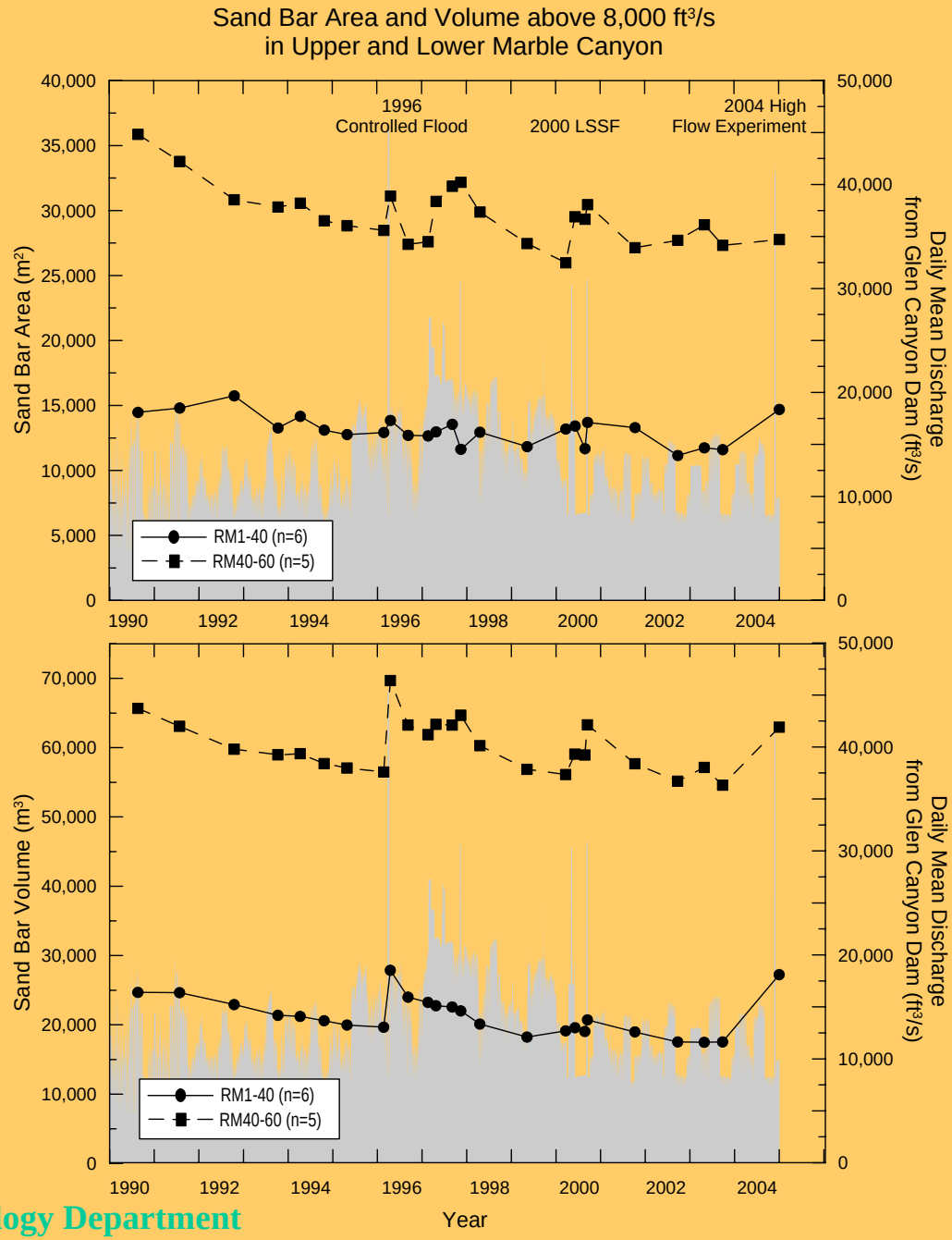
SAND BAR RESPONSES?

Example of Sand Bar Change at 30-Mile

Upper vs. Lower Marble Canyon Sand-Bar Study Sites (With Respect to Area & Volume)

Note that Upper Marble Canyon Sites Equaled or Exceeded 1990 Levels with Respect to Area & Volume!

Why? Likely Owing To More Abundant Sand Supply Locally, Related to The Paria River Inputs.



Data: Northern Arizona University Geology Department

NAU Sand Bar Surveys: 1996 vs. 2004

Of the Sites in Marble Canyon Where Sand-Bar Surveys Have Been Repeated Annually Since 1990:

Upper Marble Canyon Response - 2/3 of the sites in Upper Marble Canyon Were Larger with respect to Area and Volume after the 2004 Test than they were after the 1996 BHBF Experiment (in Dec 2004, the total area of Upper MC sites was back to 1990 level and there was 10% more sand volume!)

Lower Marble Canyon Response – Only 1/3 of the sites measured after the 2004 test were larger than they were following the 1996 BHBF Experiment (in Dec 2004, the total area was 23% less and the total volume was 4% less than that measured in 1990)

Preliminary Data – Subject to Review and Revision 02/02/05

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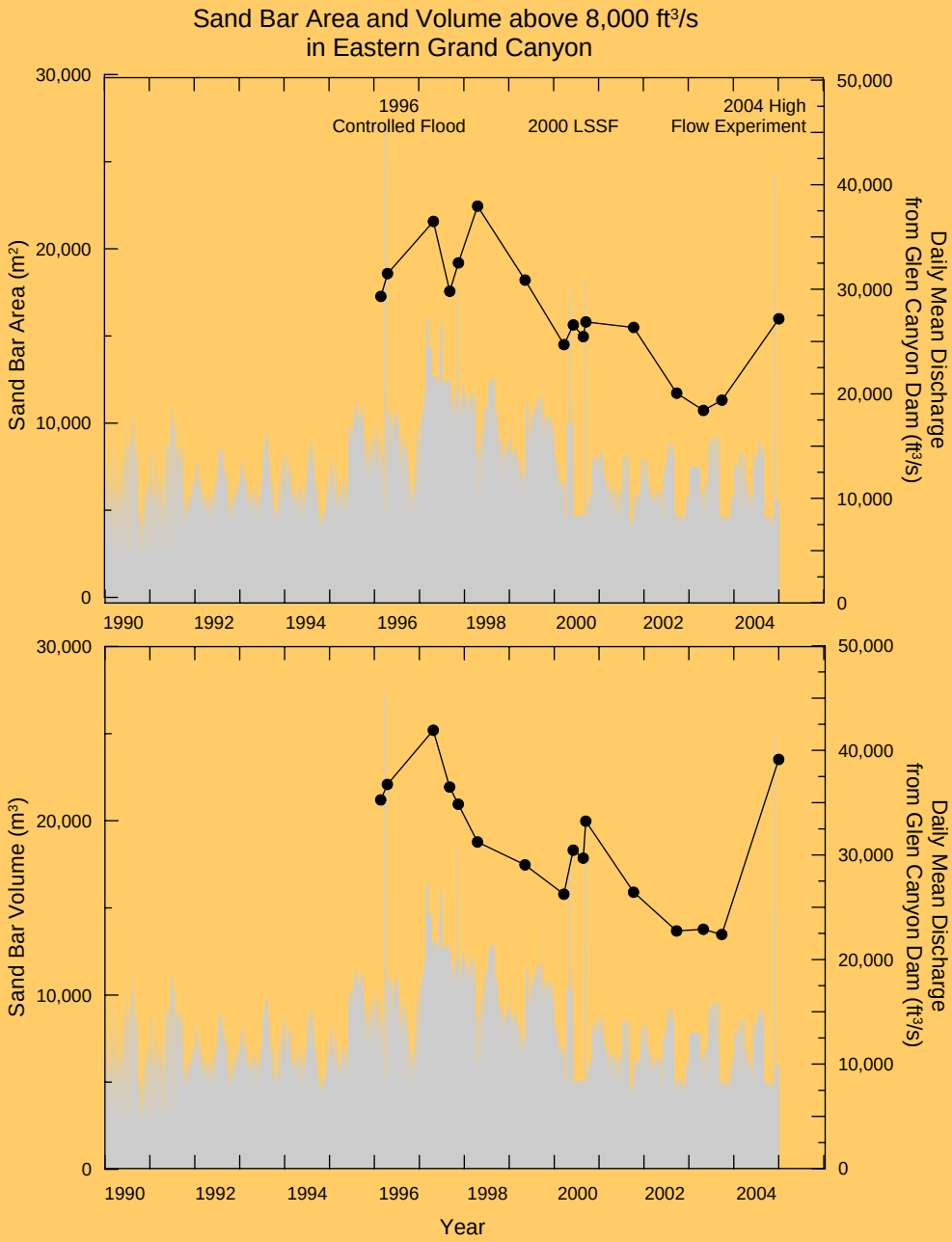
Eastern Grand Canyon Sand-Bar Study Sites (With Respect to Bar Area & Volume)

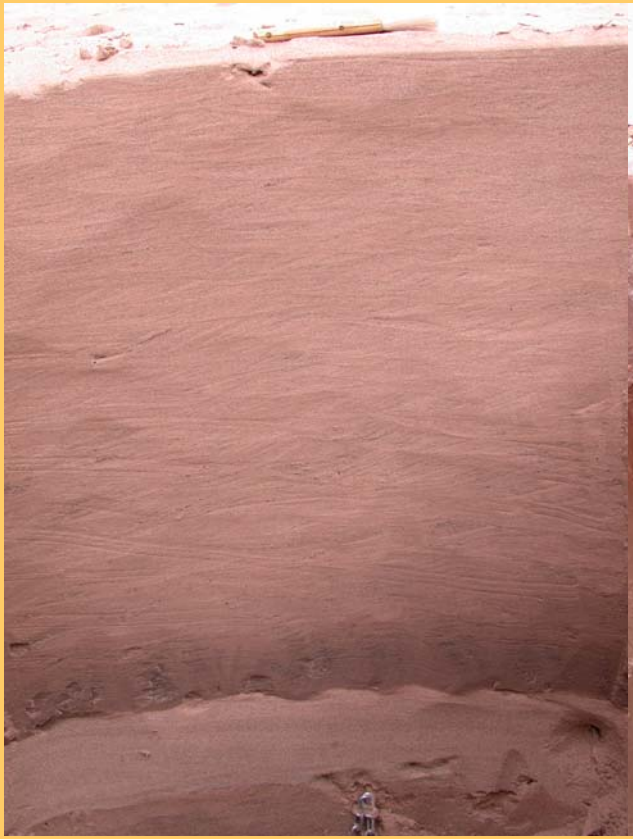
Note: Time Series for These Sites Starts in 1996, instead of 1990.

These sites also benefited, Likely as a result of LCR Inputs before & during the High-Flow Test Release. Bar Volume Exceeded the 1996 Response, but not Area?

Why? Perhaps Owing to Lower Peak Stage & Lower Sand Concentrations Downstream from Marble Canyon



Data: Northern Arizona University Geology Department



As in 1996, deposits coarsened upward …

Unlike in 1996, sand was finer and clay layer at/near base

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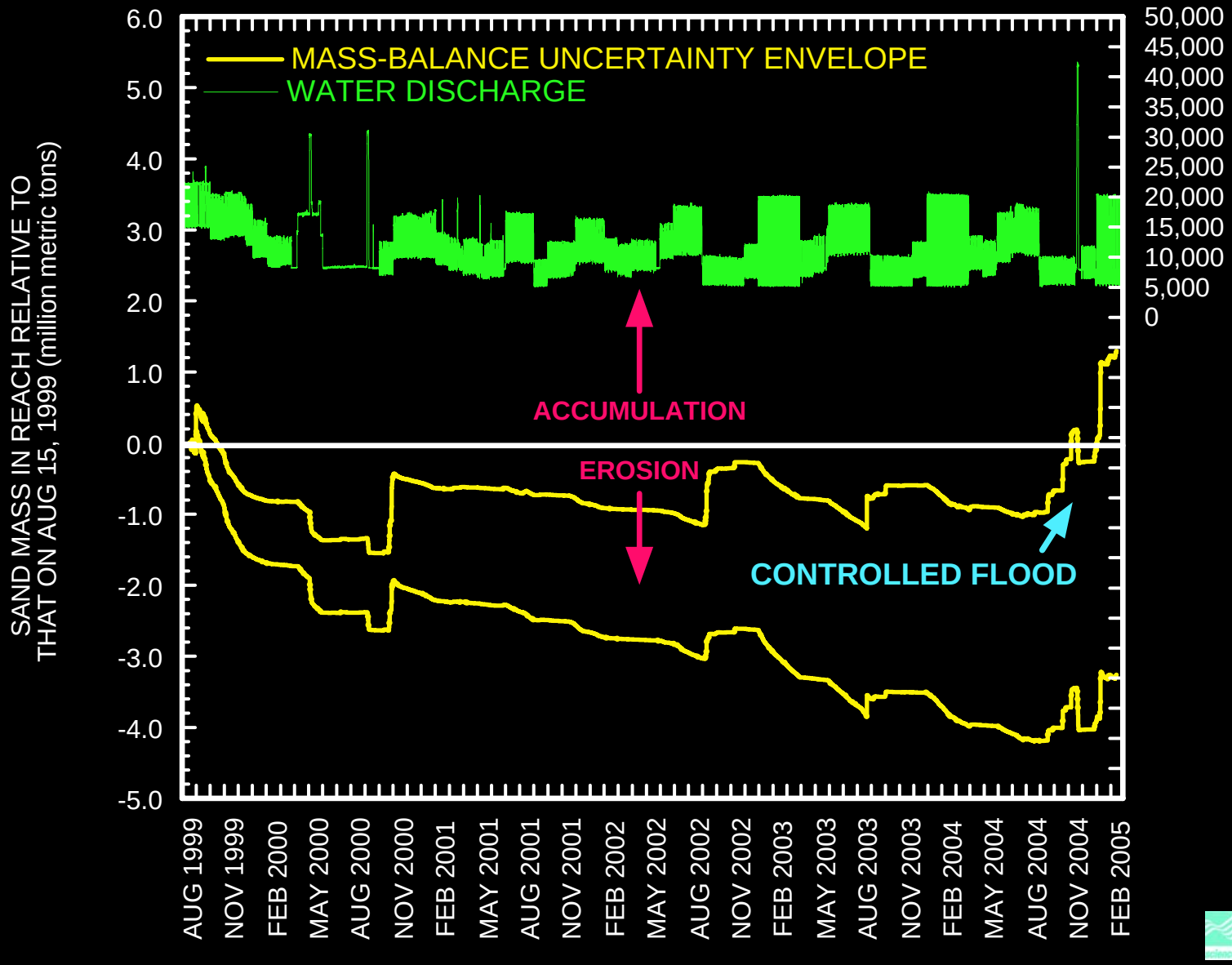
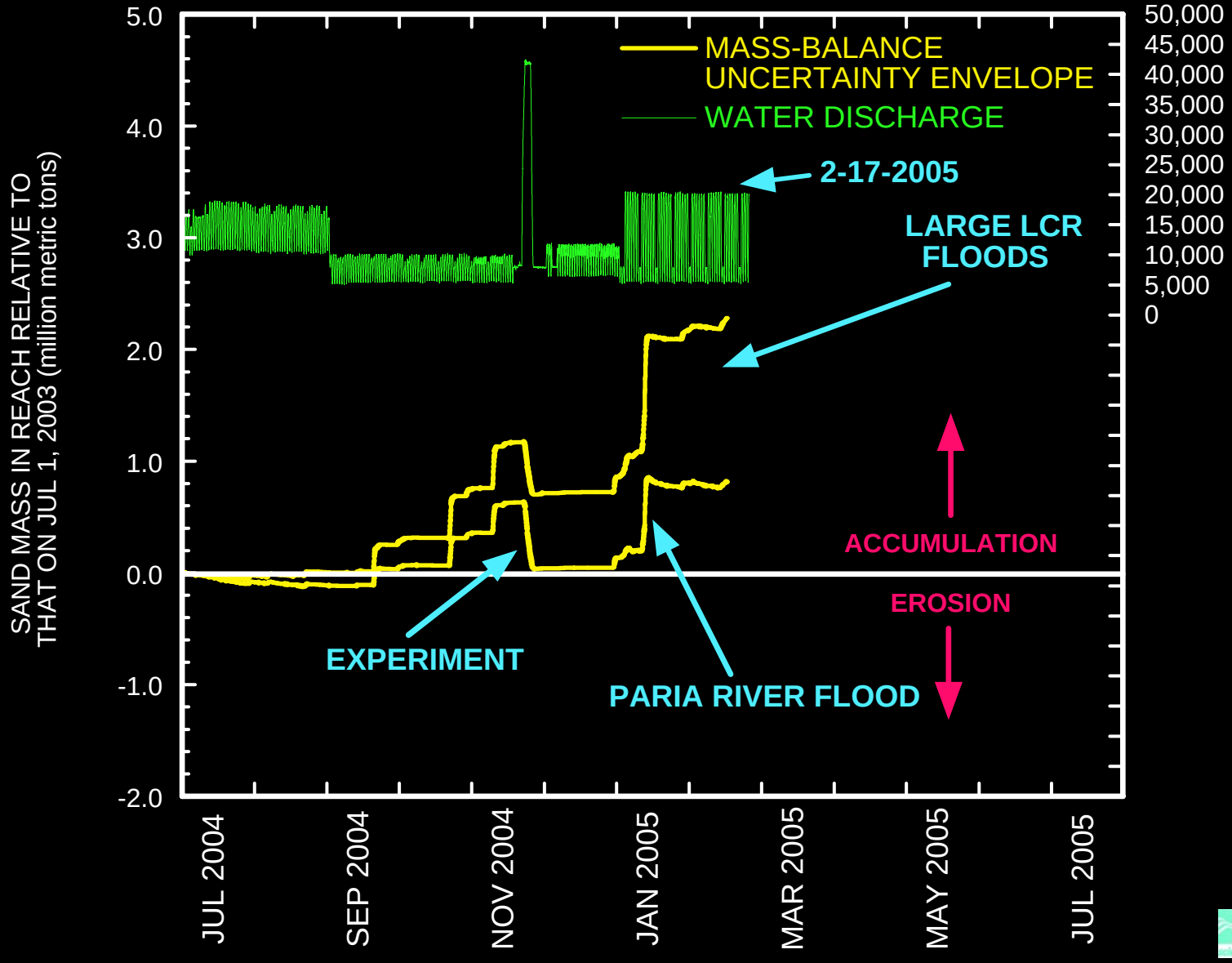
WHAT ABOUT THE SAND MASS BALANCE?

MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE



SEDIMENT-YEAR 2005 MASS-BALANCE SAND BUDGET BETWEEN LEES FERRY AND THE GRAND CANYON GAGE



WHAT HAPPENED IN 2004?

- Between July 1 and the November experiment 760,000-1,260,000 metric tons of tributary-supplied sand and 190,000-380,000 metric tons of tributary-supplied silt and clay were retained
- November controlled flood exported approximately 580,000 metric tons of sand past 30-mile and approximately 640,000 metric tons of sand past 61-mile and 87-mile (GC gage)
- November controlled flood exported approximately 200,000 metric tons of silt and clay past 30-mile and 400,000 metric tons of silt and clay past the Grand Canyon gage

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Very Preliminary Results

- Experimentally, it was a success AND seemed to succeed in full/partial restoration of sand bars in upper Marble Canyon
- Not enough sediment to achieve 1996 results(???) downstream (note 1996 did not achieve 1986 results)
- Erosion of sediment from the river exceeded several million metric tons between 1996 and 2004 (note continuous monitoring of sediment export only re-established in 1999)

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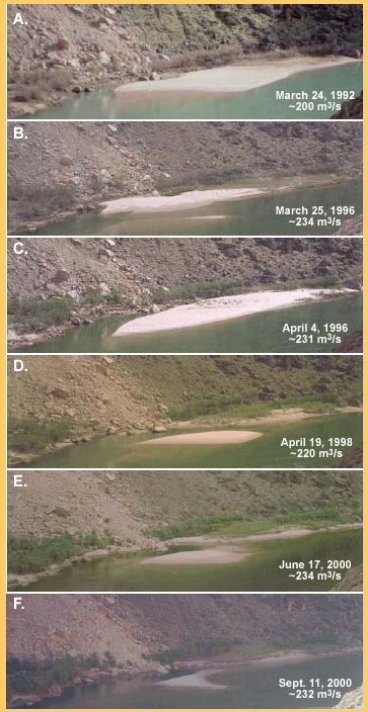
Main Points



RETENTION OF PARIA SAND INPUTS

Paria River sand inputs were largely retained in Upper Marble Canyon from Sept. through mid-Nov. 2004, as a result of daily fluctuations of between 5,000 – 10,000 cfs (as hypothesized by Topping et al. 2000).

EXPERIMENTAL HYDROGRAPH

Duration of the "controlled flood" was 108 hours less than the 1996 test, reducing the volume of water that bypassed the Glen Canyon Power plant. Sand mass balance in Upper Marble Canyon "Positive" with respect to enrichment episode (~ 200,000 metric tons retained)

SAND BAR UPDATE - Relative to the historical median sand input from the Paria River, sand bar restoration was notable in Upper Marble Canyon relative to both the 1996 Test and 1990 conditions, despite the reduced peak discharge and duration. However, results were less robust in Lower Marble and Eastern Grand Canyons.

"Muddy Waters"
Paria River Aug. 2003

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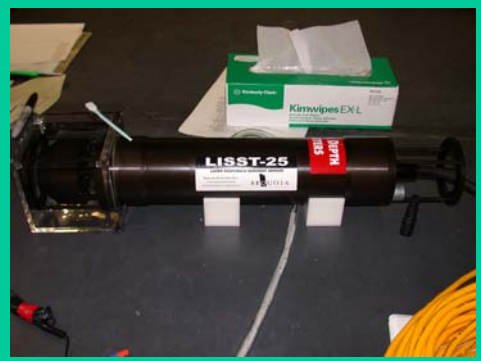
Thank You for Your Attention

Correspondence: tmelis@usgs.gov, dtopping@usgs.gov, sawright@usgs.gov

Southwest Biological Science Center - GCMRC

Status and Implementation of the 05 -06 Experiment



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Action Requested From AMWG

- **NONE, However, there is need for some clarification on the intent of the AMWG motions from August 2004, with respect to the direction that the GCMRC should take in summer – spring 2005-06, relative to additional sediment experimentation (scenarios #1-4) sediment transport monitoring.**

August 2004 AMWG Motions (Interim 05 Recommendation):

"That we replicate 04 with mechanical removal of trout in FY05, with consultation, a supplemental EA, and public outreach by the POAHG."

"That we replicate 04 with fluctuating flows (from 5,000 to 20,000 cfs) that continue adaptively (as needed for non-native control) through April."

"That there be no BHBF in FY05."

All Passed (August 11, 2004)

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Experimental Overview
"Four Scenarios for Sediment"

Scenario #1 = *Autumn Sediment Input Scenario* – summer-fall Paria River sand inputs meet/exceed trigger and are followed by constrained operations through December and an EHF (42,000-45,000) tested in January.

Scenario #2 = *Winter Sediment Input Scenario* – January-March Paria River sand inputs meet/exceed trigger and are followed immediately by an EHF (42,000-45,000) test release.

Scenario #3 = *No Sediment Input Scenario* – summer-fall Paria River sand inputs do not reach trigger through December. ROD operations continue until January-March experimental flows commence (since modified by 2004 Supplemental Environmental Assessment).

Scenario #4 = *Habitat Maintenance Flow Scenario* – summer-fall Paria River sand inputs meet/exceed trigger and are followed by HMF operations (at least 1 and perhaps up to several times) through December and are followed by an EHF (42,000-45,000) tested in January.

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EOS Test Recommendations
(Rubin et al., 2002)

- **1) Immediately follow large tributary floods with artificial floods released from the dam**

Recommendation not tested in January 2005, despite a 1.2 Mt sand input (likely, largest winter flood since 1966)

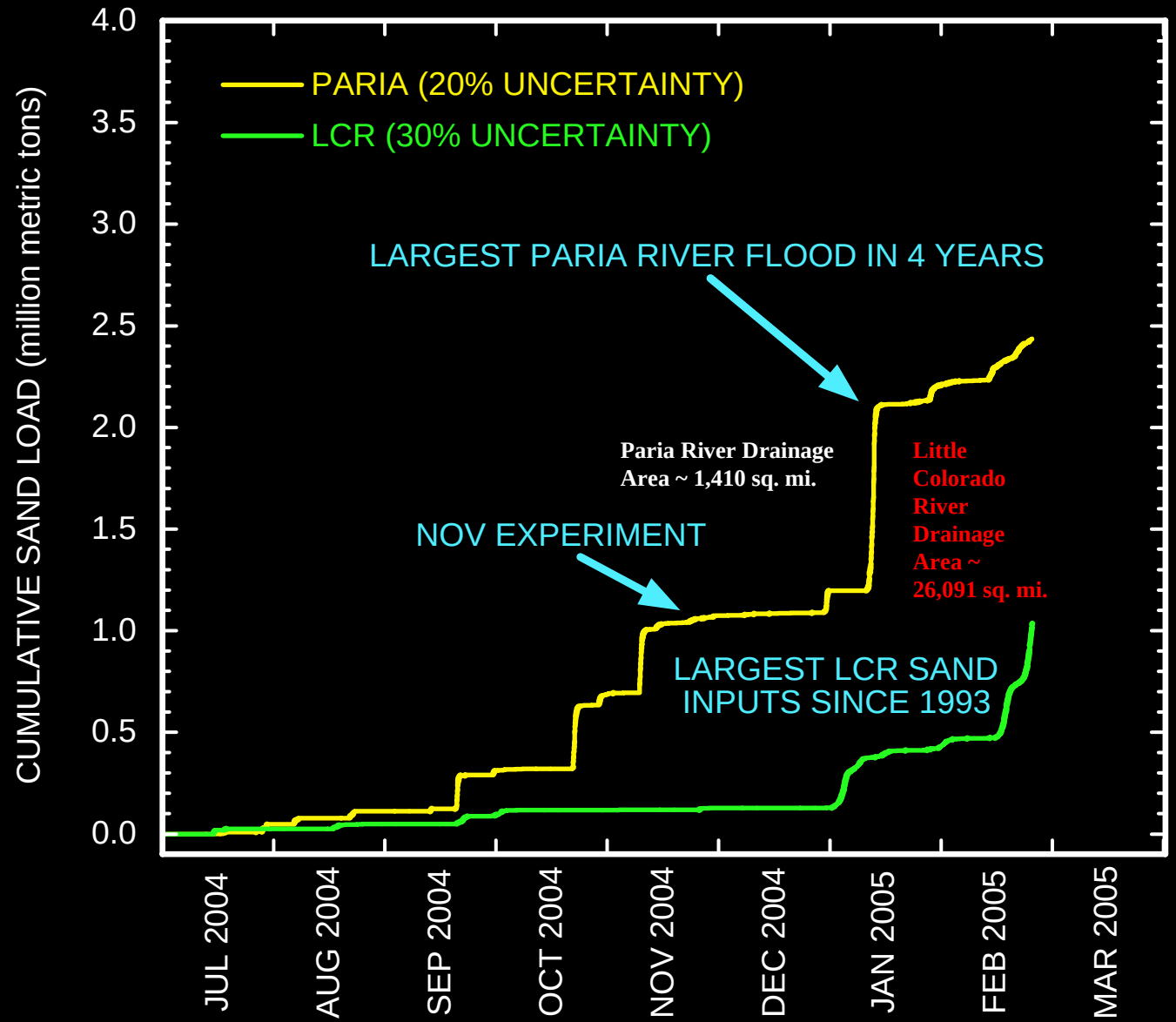
- **2) Follow tributary floods with low dam releases until artificial floods can be released from the dam (allows retention of multiple inputs)**

Recommendation that was Tested, Nov 2004, following 1.0 Mt sand inputs

- **IF neither of the above achieves the desired management outcome, THEN explore sediment augmentation as another alternative**

Currently, the focus of a feasibility study by BuRec

SED-YEAR 2005 SAND INPUT TO THE REACH BETWEEN THE LEES FERRY AND GRAND CANYON GAGES



’05 – ’06 Experimental Questions “RE: Sediment Treatments”

Scenario #1 = *Autumn Sediment Input Scenario* – The GCMRC believes that this is the option (with variation in timing of the EHF from Jan. to Nov.) that was implemented in 2004. Do the members concur?

Scenario #2 = *Winter Sediment Input Scenario* – The GCMRC reported in January 2005, that the Paria River trigger very likely occurred between Jan. 1st and 14th. However, the AMWG motion of Aug. 2004, recommended not to implement an EHF test in 2005. Is there still support to conduct this test?

Scenario #3 = *No Sediment Input Scenario* – summer-fall Paria River sand inputs do not reach trigger through December. ROD operations continue until January-March experimental flows commence (since modified by 2004 Supplemental Environmental Assessment). Is SS transport part of this?

Scenario #4 = *Habitat Maintenance Flow Scenario* – summer-fall Paria River sand inputs, followed by HMF operations (at least 1 and presumably, up to several times) through December and are followed by an EHF (42,000-45,000) tested in January. Is there still support to conduct this test?