

Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
August 24-25, 2016

Agenda Item

Science Behind High Flow Experiment Planning: From Chasing Storms in the Paria River Basin to Serving Data on the Web

Purpose of Agenda Item

The purpose of this agenda item is to review the scientific activities required to plan and implement High Flow Experiments

Action Requested

Information item only; we will answer questions but no action is requested.

Presenter

David Topping, Research Hydrologist, U.S. Geological Survey, Grand Canyon Monitoring and Research Center

Previous Action Taken

N/A

Relevant Science

N/A

Summary of Presentation and Background Information

This presentation will describe the steps required in the field, the laboratory, and on the web which are provided by GCMRC in support of planning for High Flow Experiments (HFE). In addition, this presentation will describe how the sediment-transport data served on the web are used as input to the model used to design HFE hydrographs, and how these data are also used to evaluate the model predictions and HFE response. An update on the current sediment status in Marble Canyon will also be provided.



Science behind High
Flow Experiment
planning: From
chasing storms in the
Paria River basin to
serving data on the
web

The USGS team

- David Topping, GCMRC
- Ron Griffiths, GCMRC
- Nick Voichick, GCMRC
- Tom Sabol, GCMRC
- Dave Dean, GCMRC
- Nancy Hornewer, AZ Water Science Center
- Joel Unema, AZ Water Science Center
- Jon Mason, AZ Water Science Center
- Brad Garner, Office of Water Information
- Megan Hines, CIDA
- Eric Everman, CIDA

Our website

http://www.gcmrc.gov/discharge_qw_sediment/
http://cida.usgs.gov/gcmrc/discharge_qw_sediment/

USGS
science for a changing world

Grand Canyon Monitoring and Research Center

[About GCMRC](#) [Science Activities](#) [Library and Publications](#) [Maps and Data Portal](#) [Education](#) [Meetings and Events](#)

Discharge, Sediment, and Water Quality Monitoring

Home > Discharge, Sediment and Water Quality

Networks

- Grand Canyon**
 - Monitoring Stations
 - Sediment Budget Reaches
 - Research Trip Data
- Canyonlands**
 - Monitoring Stations
 - Research Trip Data
- Dinosaur**
 - Monitoring Stations
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 - Research Trip Data
- Colorado River Delta**
 - Monitoring Stations
 - Sediment Budget Reaches
 - Research Trip Data
- Big Bend**
 - Monitoring Stations
 - Sediment Budget Reaches
 - Research Trip Data

For Additional Information

For additional information, please contact

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• Grand Canyon Monitoring Research Center
• Contact dtopping@usgs.gov or (928)556-7396

Database Designer/Programmer
Brad Garner
• USGS Arizona Water Science Center

Website Design and Programming
USGS Center for Integrated Data Analytics
• Contact cida_gcmrc@usgs.gov

Cooperating Agencies and Academic Institutions

- Bureau of Reclamation**
- National Park Service**
- Bureau of Land Management**
- Commission for Environmental Cooperation**
- Utah State University**

Cooperating USGS Water Science Centers

- Arizona Water Science Center**
- Utah Water Science Center**
- Colorado Water Science Center**
- Texas Water Science Center**

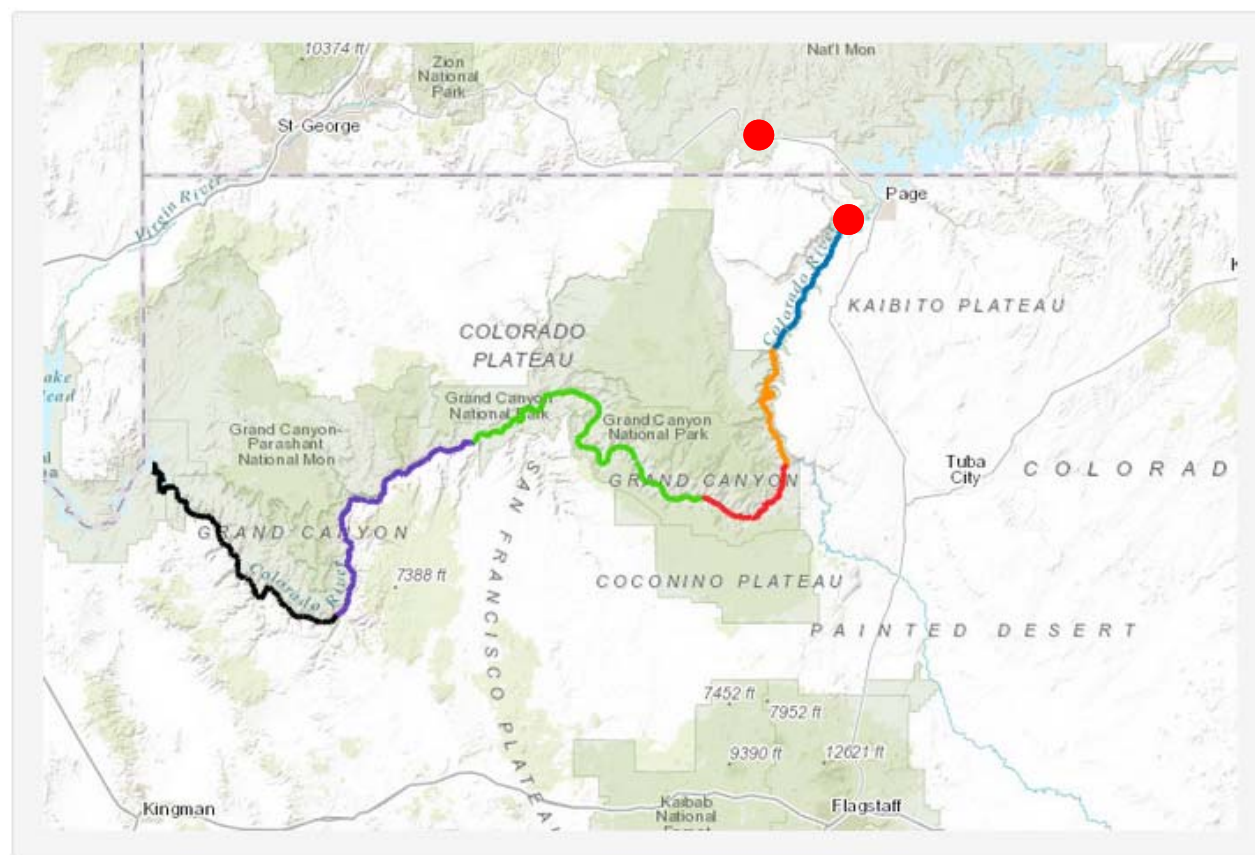
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The data are released on the condition that neither the USGS nor the U.S. Government may be held liable for any damages resulting from its authorized or unauthorized use.

Grand Canyon Reaches

[Home](#) > [Discharge, Sediment and Water Quality](#) > Grand Canyon Reaches



Reaches

- Upper Marble Canyon**
(Colorado River at Lees Ferry, AZ to Colorado River near river mile 30)
- Lower Marble Canyon**
(Colorado River near river mile 30 to Colorado River above Little Colorado River near Desert View, AZ)
- Eastern Grand Canyon**
(Colorado River above Little Colorado River near Desert View, AZ to Colorado River near Grand Canyon, AZ)
- East Central Grand Canyon**
(Colorado River near Grand Canyon, AZ to Colorado River above National Canyon near Supai, AZ)
- West Central Grand Canyon**
(Colorado River above National Canyon near Supai, AZ to Colorado River above Diamond Creek near Peach Springs, AZ)
- Western Grand Canyon and the Lake Mead Delta**
(Colorado River above Diamond Creek near Peach Springs, AZ to Pearce Ferry near river mile 280)

A wide, muddy river flows through a canyon with red rock walls. The water is brown and turbulent, carrying debris. The canyon walls are steep and layered, showing signs of erosion. The sky is overcast with heavy, grey clouds. In the foreground on the left, a person wearing a backpack is partially visible, looking towards the river.

The map displays a significant weather system over the southwestern United States, specifically covering parts of Utah, Arizona, and New Mexico. The system is characterized by a large, intense area of rain and thunderstorms, indicated by the green, yellow, and red colors on the radar scale. The intensity scale on the right ranges from 0.02 to 75, with colors corresponding to different levels of precipitation and storm severity. The map also shows major cities, state boundaries, and geographical features like the Grand Canyon and the Colorado River. The date and time at the top of the image are 2013-05-25 15:00.

Warnings: **Tornado** **Severe Thunderstorm** **Flash Flood** **Special Marine**

Step 2: National Weather Service issues flood warning

Cedar City 1-hour precipitation at
16:29 MST 8-23-2016

Flash Flood Warning

FLASH FLOOD STATEMENT
NATIONAL WEATHER SERVICE SALT LAKE CITY UT
604 PM MDT TUE AUG 23 2016

UTC025-240100-
/O.CON.KSLC.FF.W.0020.000000T0000Z-160824T0100Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.OO/
KANE UT-
604 PM MDT TUE AUG 23 2016

...THE FLASH FLOOD WARNING REMAINS IN EFFECT UNTIL 700 PM MDT FOR
SOUTH CENTRAL KANE COUNTY...

AT 604 PM MDT...FLASH FLOODING IS OCCURRING ON THE BUCKSKIN WASH
AREA OF THE GRAND STAIRCASE ESCALANTE NATIONAL MONUMENT. THE
BUCKSKIN WASH IS A VERY NARROW AND POPULAR SLOT CANYON THAT DRAINS
INTO THE PARIA RIVER DRAINAGE AS IT CROSSES INTO ARIZONA.

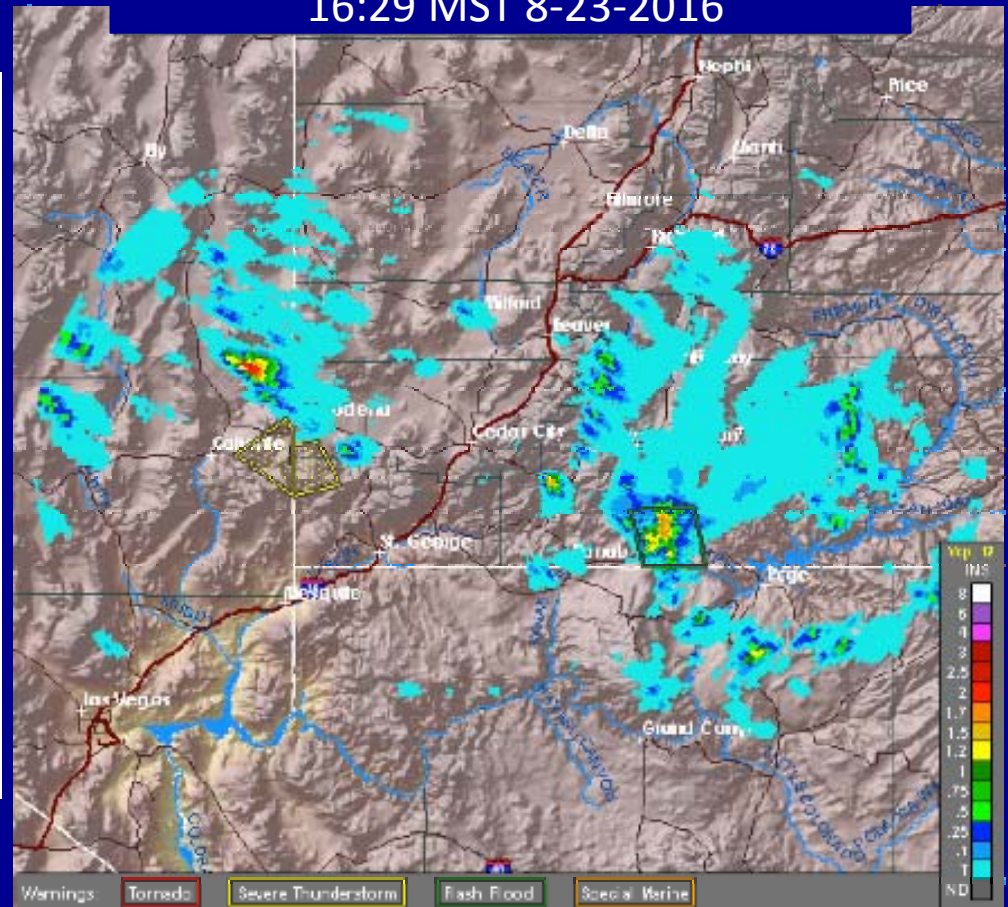
FLASH FLOODING IS ALSO ANTICIPATED ALONG THE PARIA RIVER UPSTREAM
ABOUT 15 MILES. ALL OF THE FLOOD WATERS WILL FLOW INTO THE EVENING
AND NIGHTTIME HOURS AND EVENTUALLY TERMINATE INTO THE COLORADO RIVER.

LIGHT RAINFALL IS OCCURRING OVER THE DRAINAGE AND MAY CONTINUE
THROUGH THE NIGHTTIME HOURS. PLEASE AVOID THESE DRAINAGES THROUGH
THIS TIME FRAME.

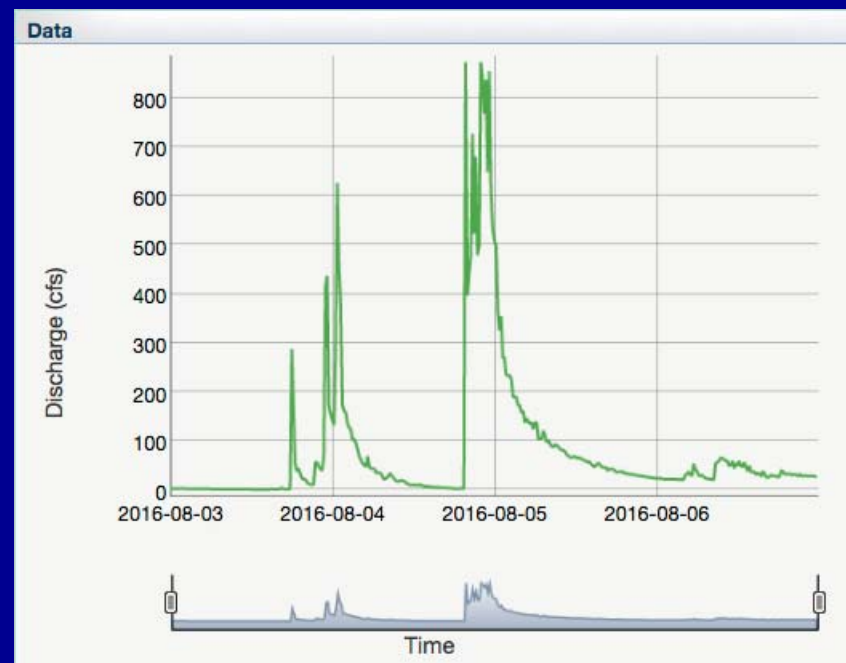
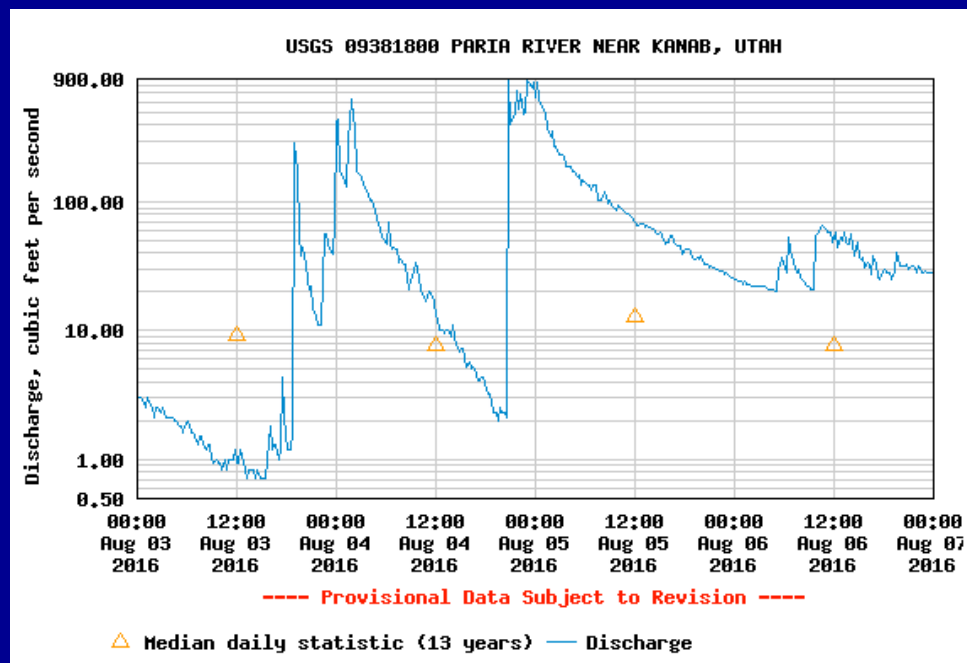
LAT...LON 3732 11220 3734 11185 3700 11178 3700 11213

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MCINERNEY



Step 3: Flood observed at upstream USGS Paria River near Kanab gage on highway 89

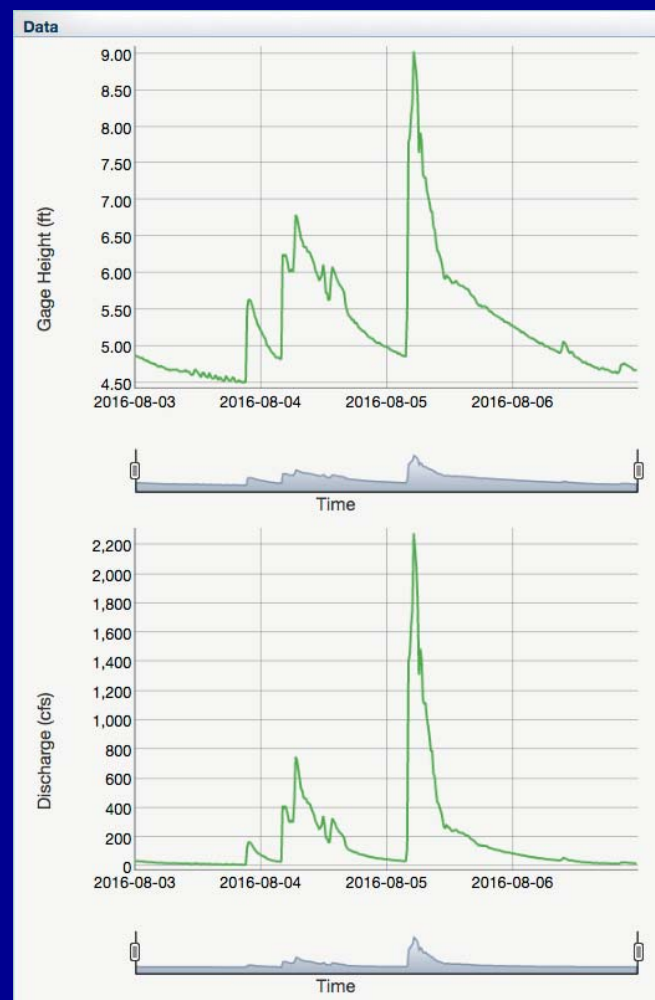


USGS field crews mobilized from Flagstaff to Lees Ferry
(typically in the middle of the night)

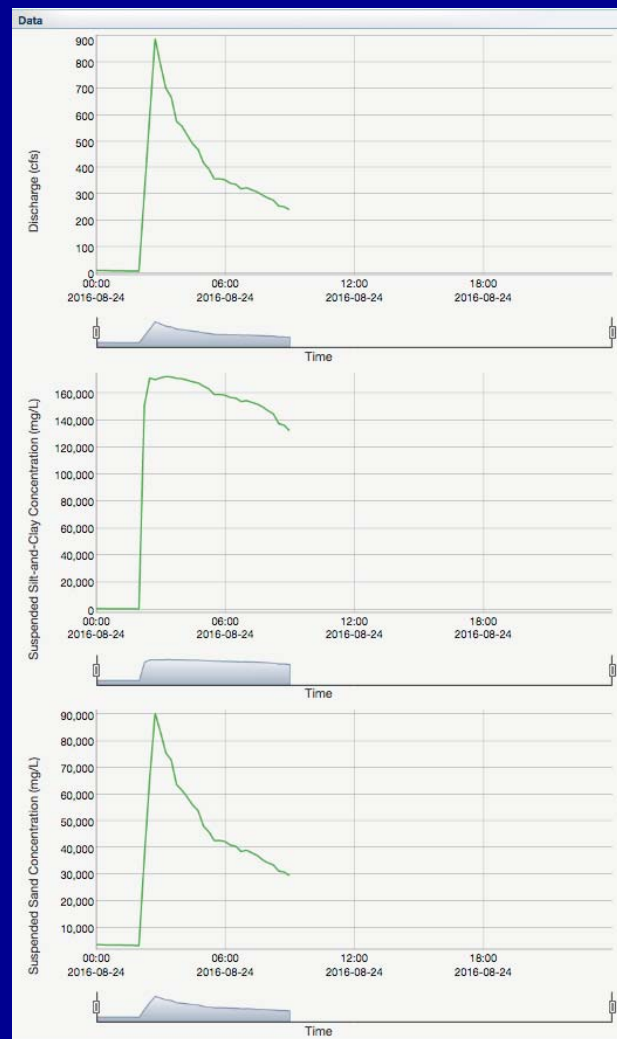
NWIS WEBSITE UPDATED HOURLY

GCMRC WEBSITE UPDATED ON DAILY BASIS

Step 4: Stage during flood recorded at USGS Paria River at Lees Ferry gage



Step 5: Silt and clay concentrations and sand concentrations estimated automatically on GCMRC website using Topping (1997) physically based model



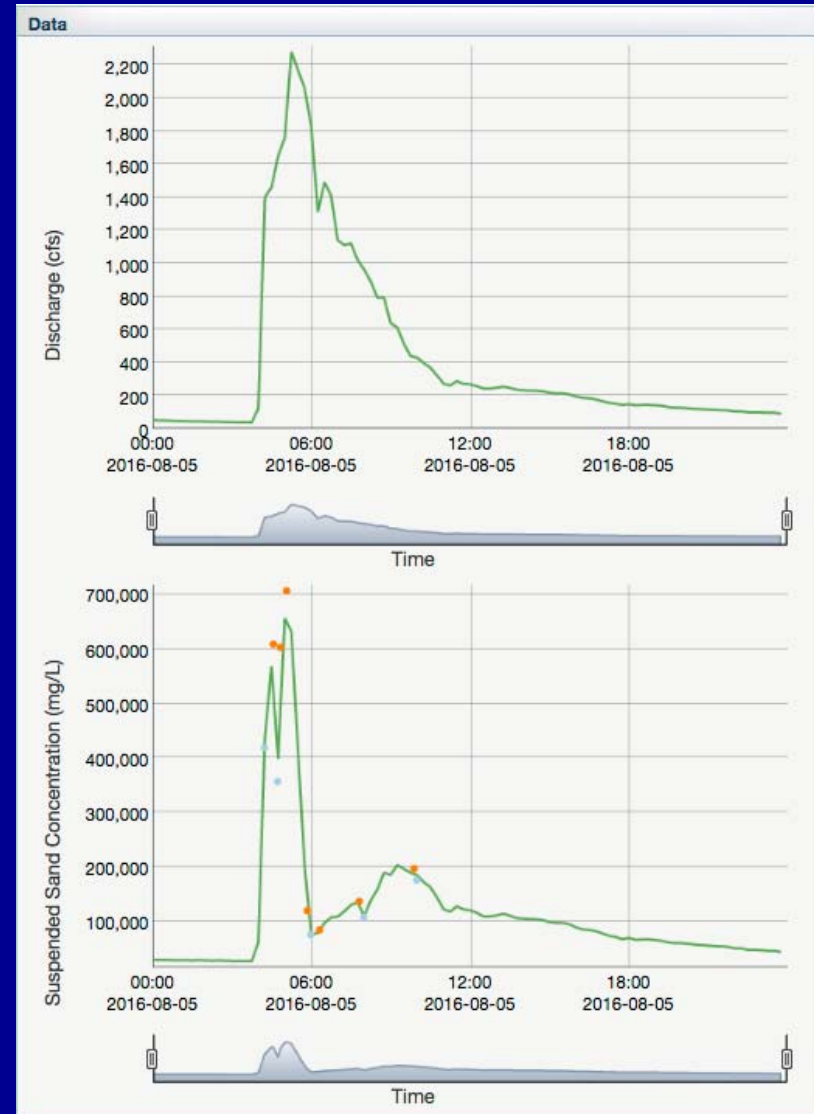
Step 6: USGS field crews verify stage-predicted discharge and collect suspended-sediment samples



Step 7: Initial samples processed through lab and sediment-transport model estimates on GCMRC website adjusted



GCMRC WEBSITE
UPDATED WEEKLY



Step 8: Bureau of Reclamation downloads data from GCMRC website and runs USGS Wright, Topping, Rubin, Melis (2010) sand routing model through Marble Canyon

Water Resources Research

AN AGU JOURNAL

[Explore this journal >](#)

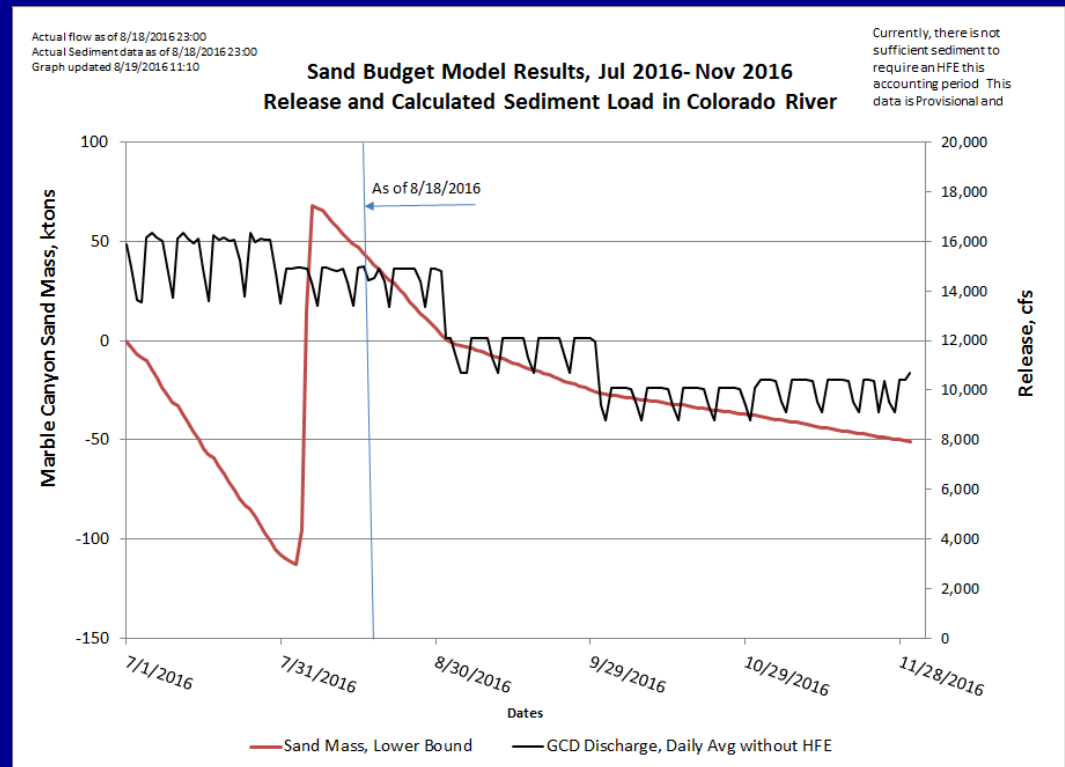
Regular Article

An approach for modeling sediment budgets in supply-limited rivers

Scott A. Wright, David J. Topping, David M. Rubin, Theodore S. Melis

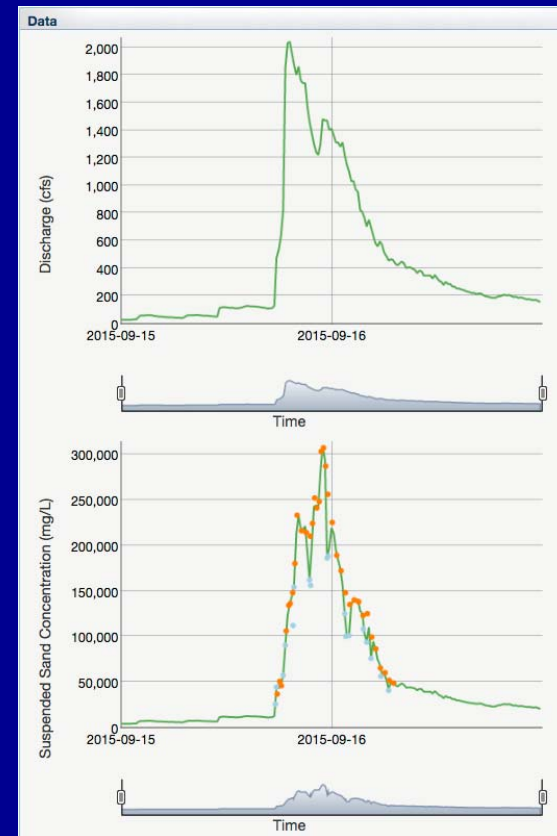
First published: 28 October 2010 [Full publication history](#)

DOI: 10.1029/2009WR008600 [View/save citation](#)



Model results courtesy of Keri Stout (USBR)

Step 9: Paria River suspended-sediment samples continue to get processed through laboratory



- Uncertainty in loads on GCMRC website decreases
- Loads ultimately finalized on GCMRC website

Step 10: USBR episodically reruns Wright and others (2010) model

- ...as more Paria River floods occur
- ...as more samples get processed through USGS GCMRC laboratory resulting in revised sand loads and lower uncertainties in sand loads

Step 11: If model predictions are favorable for an HFE during the implementation window.....

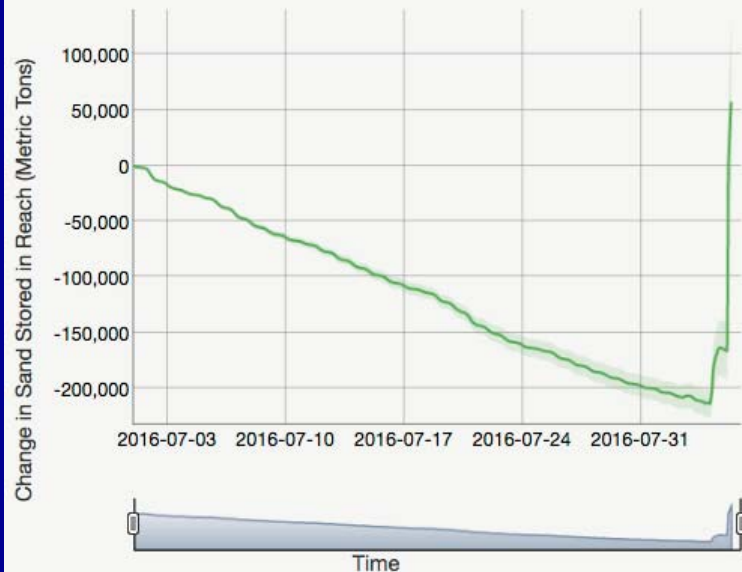
HFE hydrograph designed by USBR in consultation with
USGS-GCMRC

Step 12: Downstream USGS sand-transport measurements used to verify USBR predictions made using USGS Wright and others (2010) model

Upper Marble Canyon

Change in Sand Mass

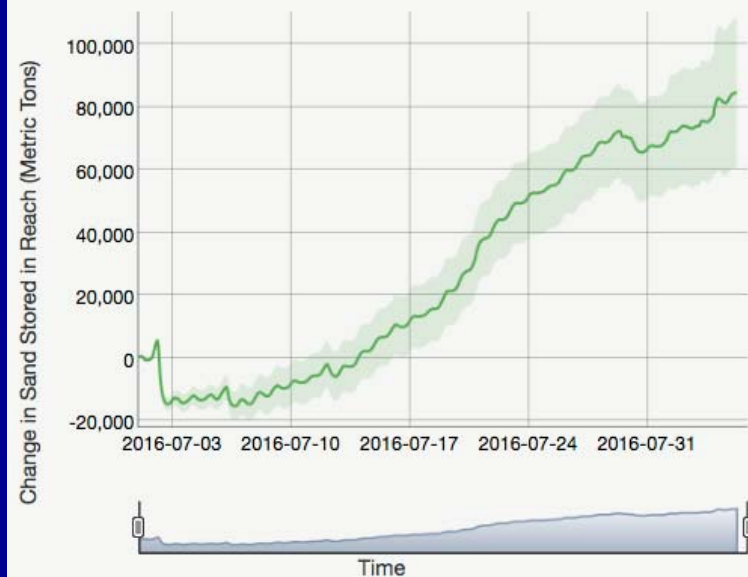
- Zero Bias Value: 57,000 Metric Tons
- Upper Uncertainty Bound: 130,000 Metric Tons
- Lower Uncertainty Bound: -20,000 Metric Tons



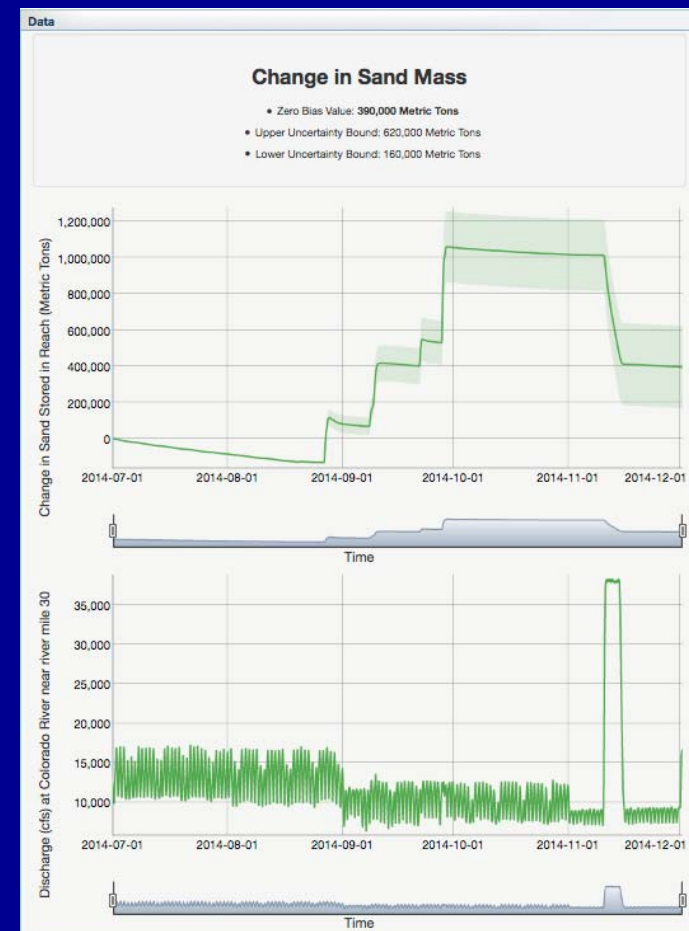
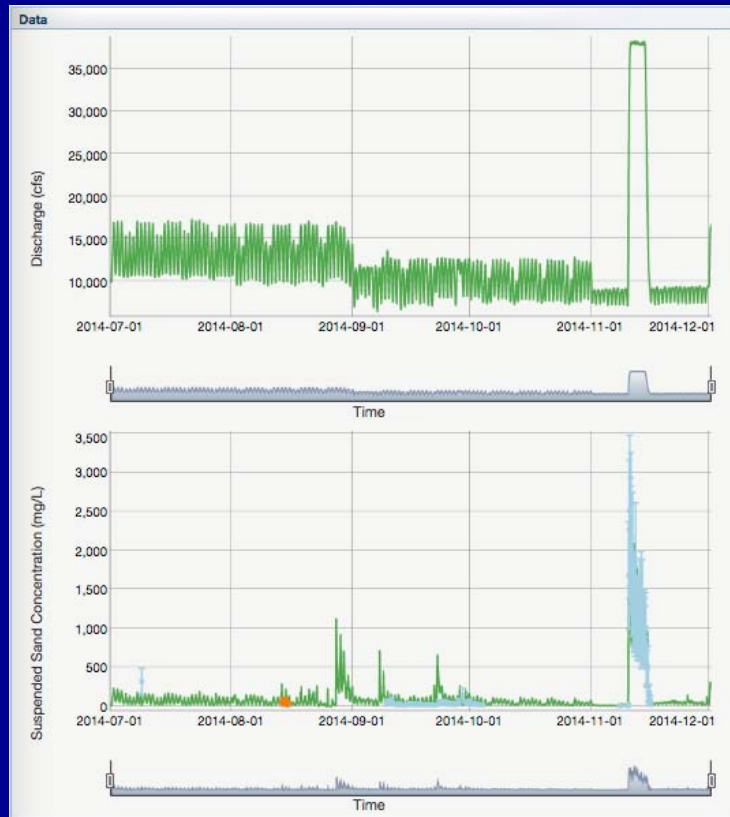
Lower Marble Canyon

Change in Sand Mass

- Zero Bias Value: 85,000 Metric Tons
- Upper Uncertainty Bound: 110,000 Metric Tons
- Lower Uncertainty Bound: 61,000 Metric Tons

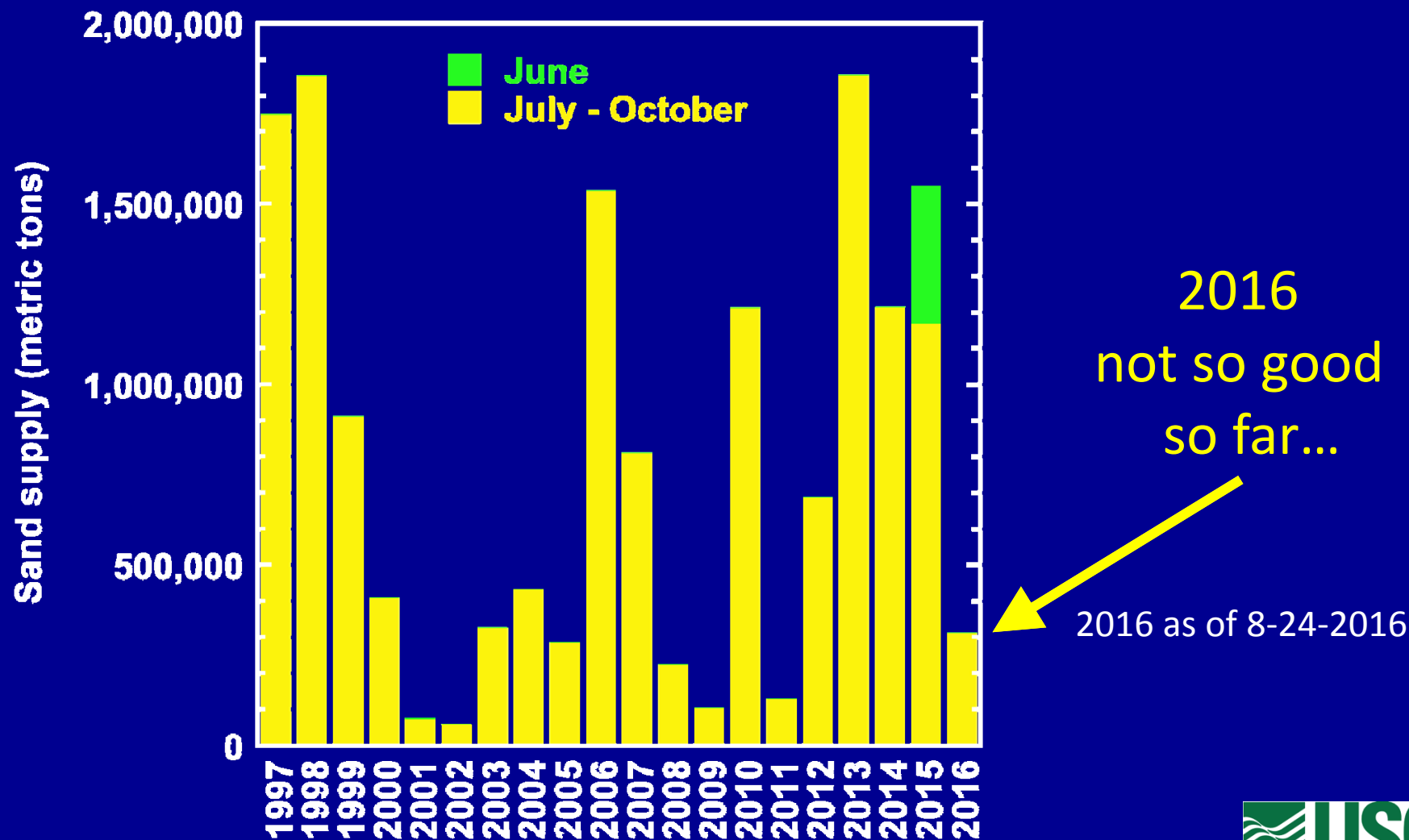


Step 13: Post-facto evaluation of sand transport and sand budgets during HFE period



GCMRC WEBSITE UPDATED MONTHLY OR AS NEEDED

2015 July-October Paria River sand inputs were the 7th largest since 1996



After USGS (2016)