1) The TWP Process

2) GCMRC and applied science in an adaptive management context

3) Some thoughts on High Flow Experiments

Anticipating Budget Shortfalls in FY16 and FY17

2: shortfall planning being implemented; expect full program
3: shortfall planning being implemented; Element 3.4 uncertain
4: shortfall planning being implemented; expect full program
5: shortfall planning for AMP elements being implemented; elements beyond CRe are uncertain, reduced level, or dropped
6: shortfall planning being implemented; budget savings may be difficult to achieve
7: shortfall planning being implemented; expect full program
8: shortfall planning being implemented; uncertain funding for some elements
9: shortfall planning being implemented; expect full program
10: shortfall planning being implemented; expect full program
11: shortfall planning being implemented; expect full program
12: shortfall planning being implemented; expect full program
13: shortfall planning being implemented; reduced support to cooperators likely

Annual Reporting meeting and knowledge assessment *(January 28)*
Technical Work Group meeting *(January 29-30)*
TWG Budget Ad Hoc Group webinar *(February 13)*
Adaptive Management Work Group meeting *(February 19-20)*

Initial identification of potential projects (Mar)

Technical Work Group meeting *(April 8-9)*
TWG Budget Ad Hoc Group webinar *(April 21)*
GCMRC/tribes meeting *(April 22)*

TWP Prospectus (May 9)

Budget Ad Hoc Group webinar *(May 20)*
GCMRC/tribes meeting *(May 22)*
Adaptive Management Work Group webinar *(May 27)*

First draft TWP (June 6)

Stakeholder and Science Advisors review *(June)*
Technical Work Group meetings *(June 24-25, July 15)*

Final draft TWP (August 1)

Important meetings that affected development of FY15/16/17 TWP

Annual Reporting meeting and knowledge assessment ***(January 28)***
Technical Work Group meeting ***(January 29-30)***
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AR meeting is critical for articulation of scientific basis of Work Plan development. Should include status of monitored resources and progress at resolving research questions. ***AR meeting must be carefully planned.***

What is the best way to elicit stakeholder concerns and responses? Increase time between AR and TWG meeting?

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It is challenging to develop this list of projects, because this list is revised and re-evaluated with time. This would be a good time for a Science Advisor/GCMRC workshop to think about science approaches/methods/budgets.

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What is the best way to elicit tribal input?

TWP Prospectus (May 9)

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GCMRC/tribes meeting *(April 22)*

TWP Prospectus (May 9)

Is this of value? Virtually no feed back was received.

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The review process for the TWP is too compressed and Science Advisor comments are developed in too short a timeframe. Need to reconsider how to get high level science review.

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Does anyone read the revised TWP and the response to reviewer comments?

Late November 2014 – GCMRC meets with DoI agencies to review science and management issues

Late January 2015 – 1-day Annual Reporting meeting; primary emphasis is on reporting of results/scientific advances of FY13/14 BWP

Late November 2015 – GCMRC meets with DoI agencies to review science and management issues

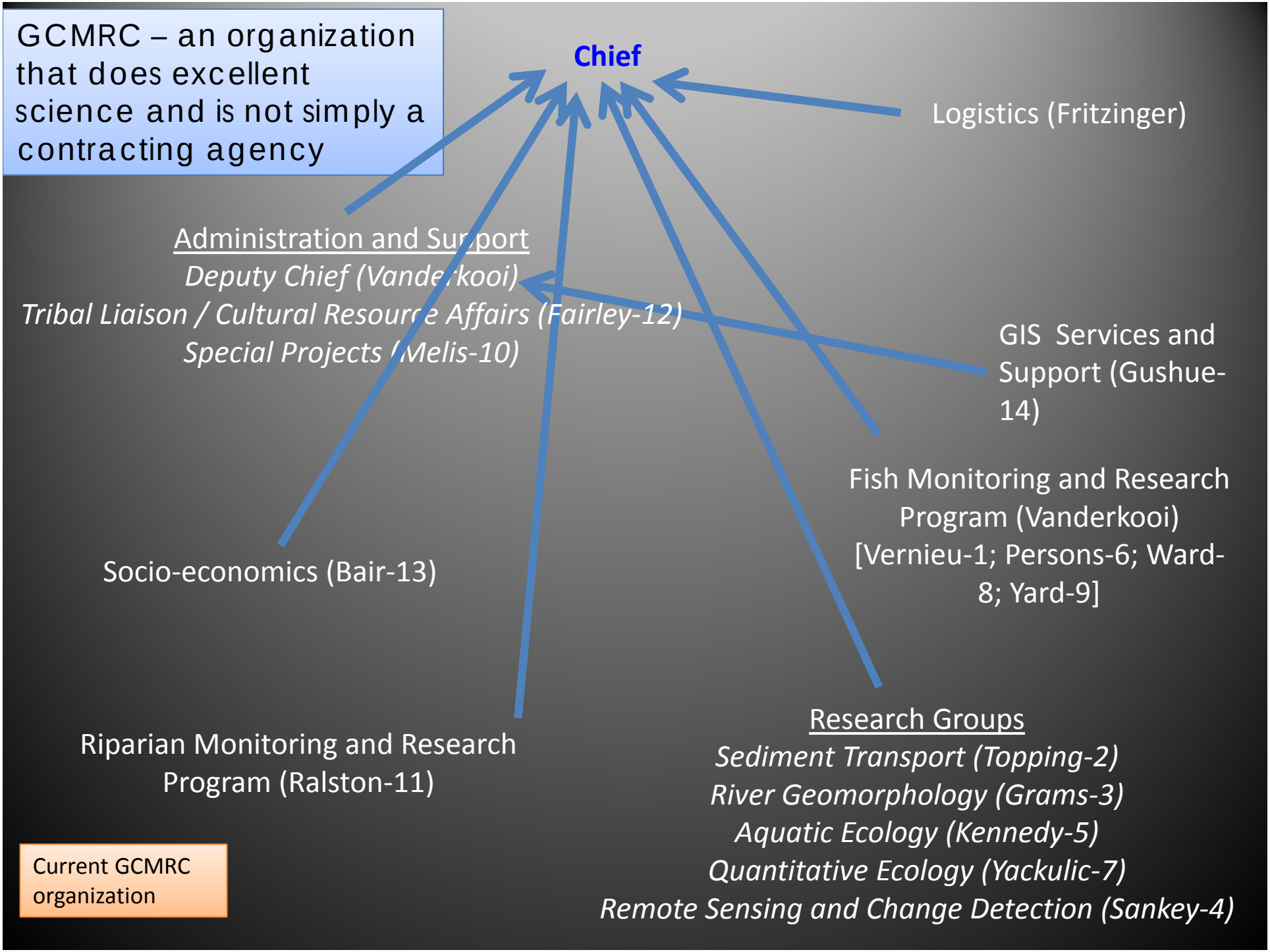
Late January 2016 – 1-day Annual Reporting meeting; primary emphasis is on implications to management and on results/findings of first year of activities of FY15/16/17 TWP

February/March 2016 – TWG considers mid-TWP adjustments to TWP

April 2016 – TWG recommends mid-TWP adjustments

Late November 2016 – GCMRC meets with DoI agencies to review science and management issues

Late January 2017 – 2-day Annual Reporting meeting; primary emphasis is on synthesis of existing knowledge and identification of fundamental monitoring issues and research questions to be addressed in FY18/19/20 TWP


GCMRC – an organization that does excellent science and is not simply a contracting agency
Chief
Logistics (Fritzinger)
Administration and Support
Deputy Chief (Vanderkooi)
Tribal Liaison / Cultural Resource Affairs (Fairley-12)
Special Projects (Melis-10)
GIS Services and Support (Gushue-14)
Fish Monitoring and Research Program (Vanderkooi) [Vernieu-1; Persons-6; Ward-8; Yard-9]
Socio-economics (Bair-13)
Riparian Monitoring and Research Program (Ralston-11)
Research Groups
Sediment Transport (Topping-2)
River Geomorphology (Grams-3)
Aquatic Ecology (Kennedy-5)
Quantitative Ecology (Yackulic-7)
Remote Sensing and Change Detection (Sankey-4)
Current GCMRC organization

Think about Big Questions, not Small

What is the largest amount of fine sediment that can occur along the banks of the Colorado River, especially as eddy sandbars?

What flow regime, in relation to the natural supply of fine sediment from tributaries, results in the most widespread distribution of fine sediment along the channel banks and in eddies?

Do larger amounts of fine sediment along the channel banks and in eddies significantly change the amount and distribution of fine sediment that occurs above the active channel and that occurs at or near archaeological sites?

What management strategies should be employed to maintain a high quality rainbow trout fishery in Glen Canyon while protecting, and potentially recovering, the endangered humpback chub fish community in Marble and Grand Canyons?

How “Big” are other questions?

Applied Science vs. Adaptive Management Planning: Dynamic Tension

Focus of the past three years has been on

- solidify position of GCMRC within USGS
  - build science capacity
  - invigorate and inspire research scientists
- promote a science vision for GCMRC
- leadership
- accountability
- transparency
- empowerment

Adaptive Management Planning:

- status of resources (a new **SCORE report**)
- **Core Monitoring Plan** linked to HFEs, NNFC, DFCs, LTEMP that incorporates a vision of what we mean by Adaptive Management in the context of the Grand Canyon segment of the Colorado River
  - priorities of resources
  - priorities of segments

Pointing towards the Future

Funded:

Reservoir Limnology/Ecology Science Panel: reservoir/river linkage; Lake Powell/Colorado River ecosystem/Lake Mead

Fish Population Monitoring Science Panel

Non-native Vegetation Control Science Panel

Other Things We Should Do:

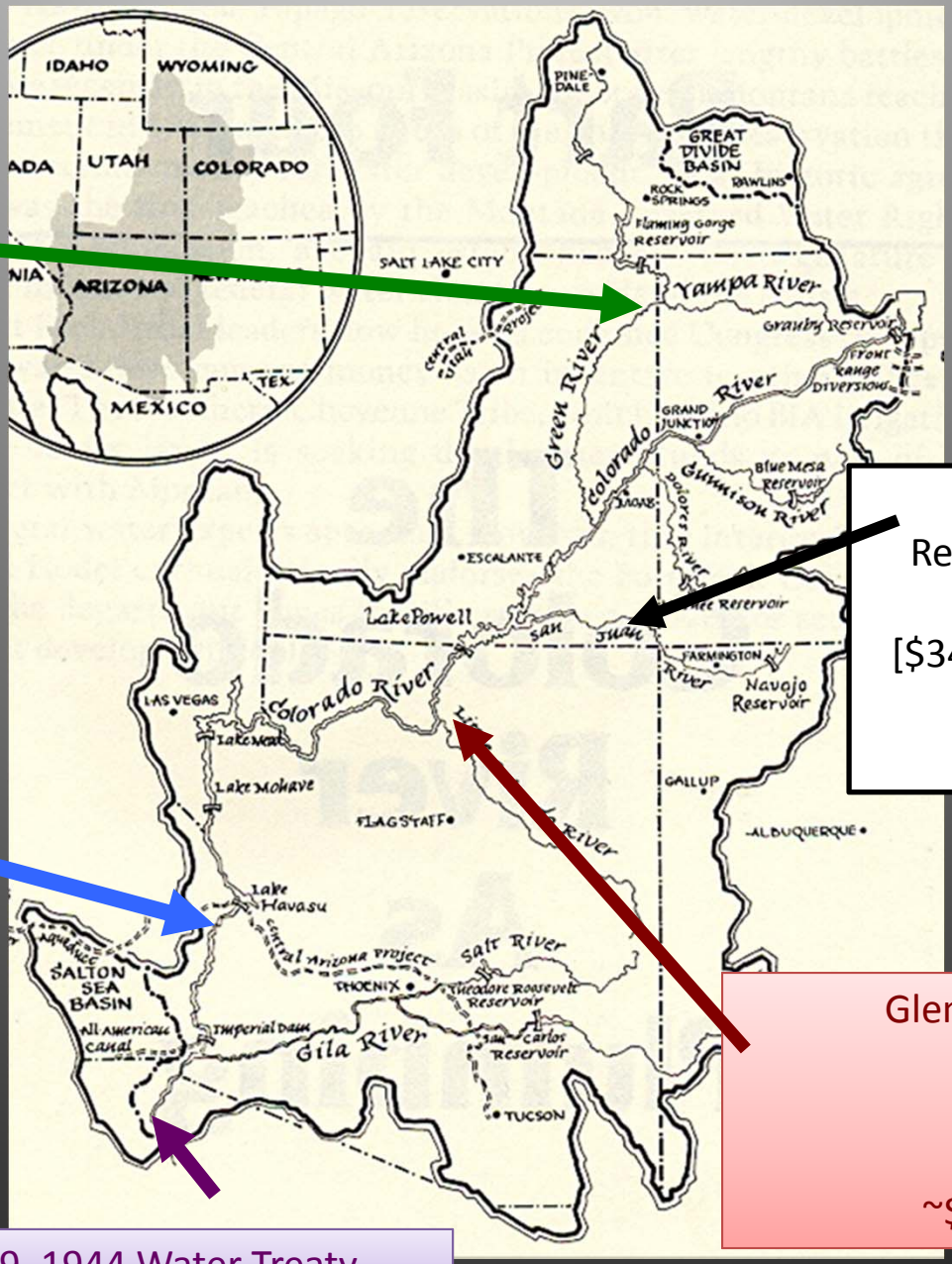
Sand bar monitoring program

Valley geomorphology and archaeology

Context

Upper Colorado River Endangered Fish Recovery Program (1988-2013)

[$161 mil. 1989-2006 ~$7 mil./yr;]



Lower Colorado River Multi-Species Conservation Program (2005-2055)

$620 mil. (50 yrs)

~$13 mil./yr

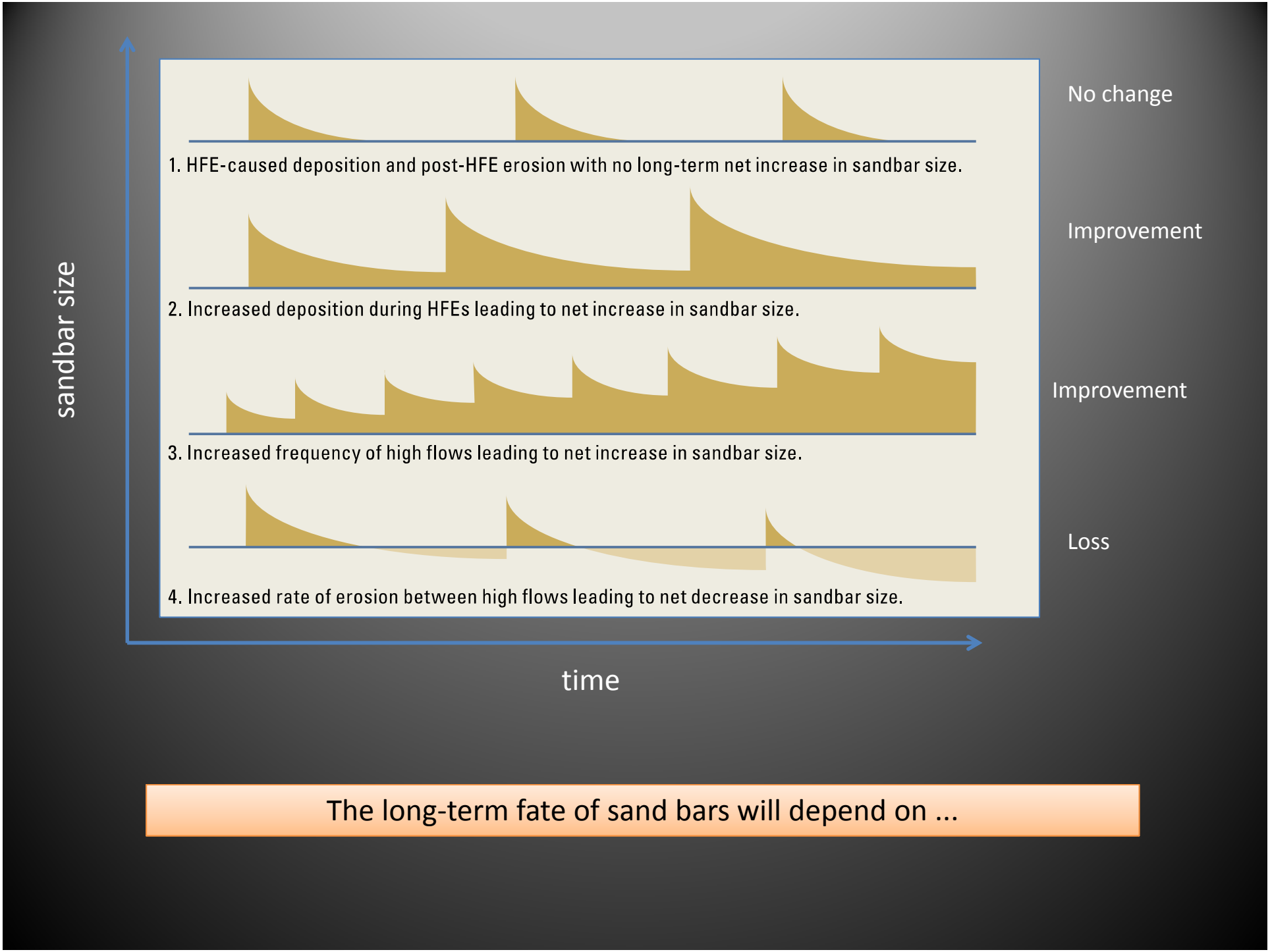
San Juan River Basin Recovery Implementation Program (1992-2023) [$34.6 mil 1992-2006; $2.1 mil FY06]

Glen Canyon Dam Adaptive Management Program

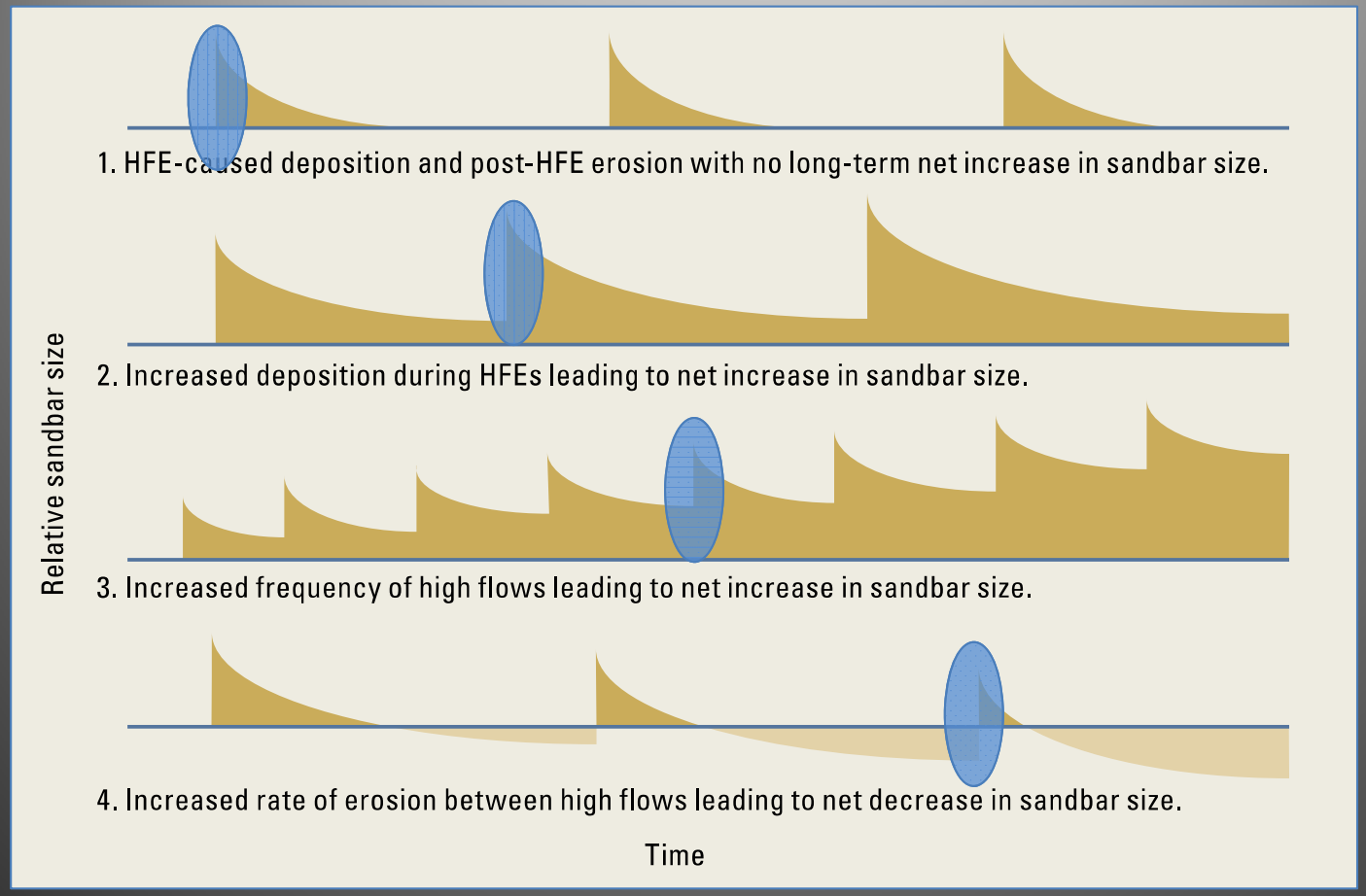
$11 mil./yr operating

~$40 mil./yr lost revenue

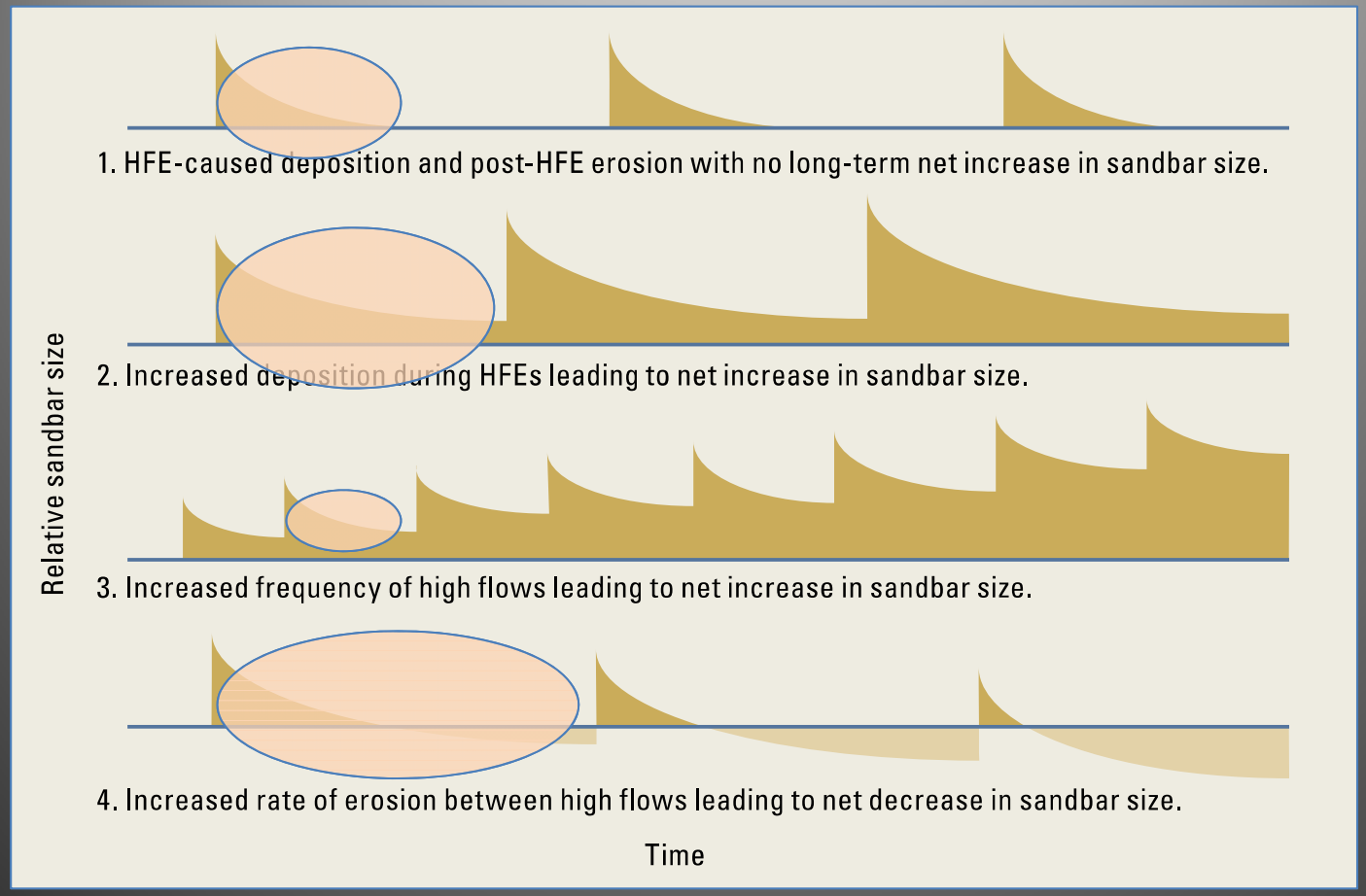
Minute 319, 1944 Water Treaty



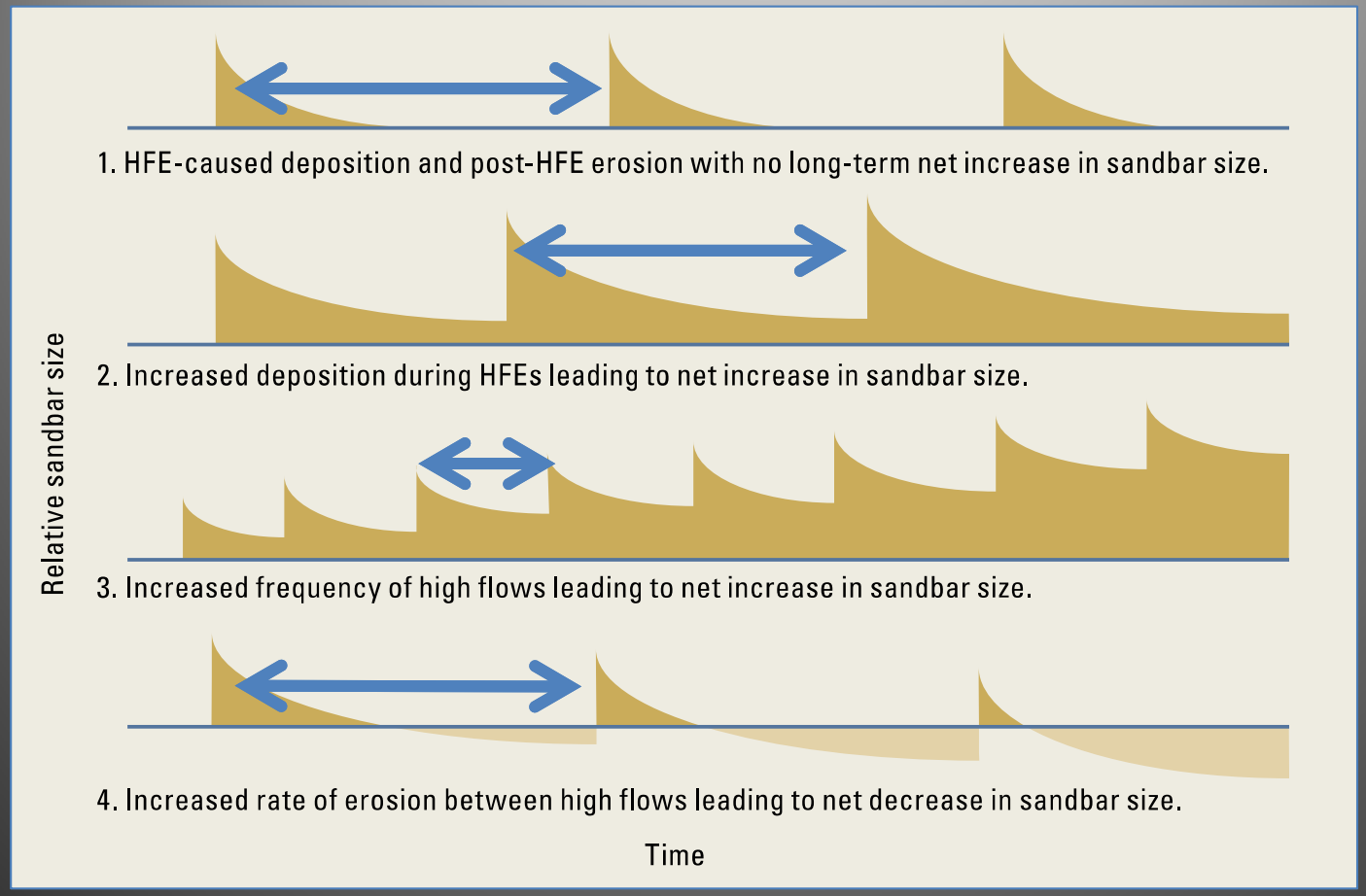
The long-term fate of sand bars will depend on ...



The long-term fate of sand bars will depend on … (1) <u>the magnitude of bar building during floods,</u>



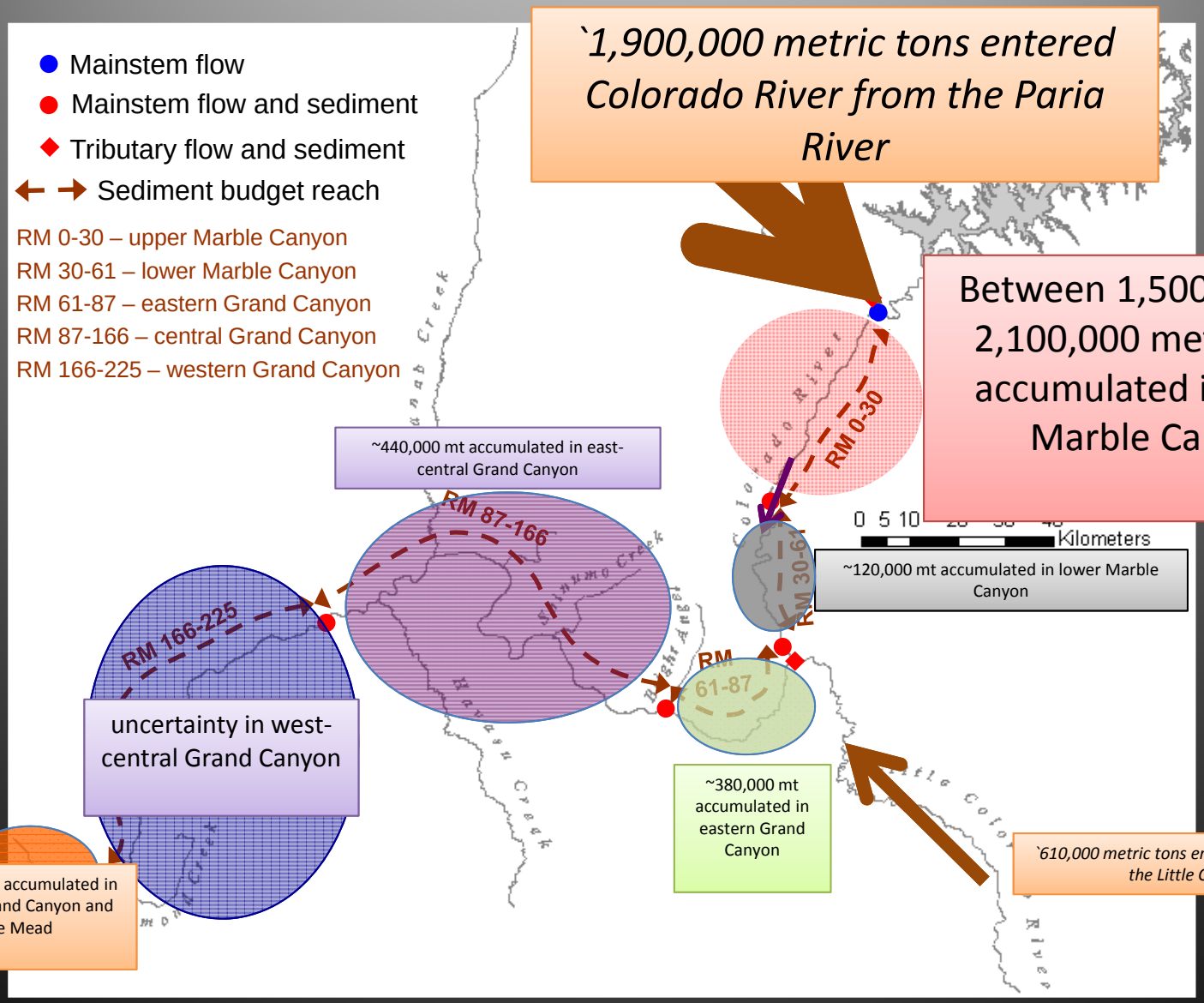
The long-term fate of sand bars will depend on … (2) <u>the amount of erosion that occurs between floods,</u>



The long-term fate of sand bars will depend on … (3) <u>the duration of time between floods.</u>

Inflows from the Paria River during the monsoon season are immediately stored in the Colorado River in upper Marble Canyon

July 1, 2013 – November 10, 2013



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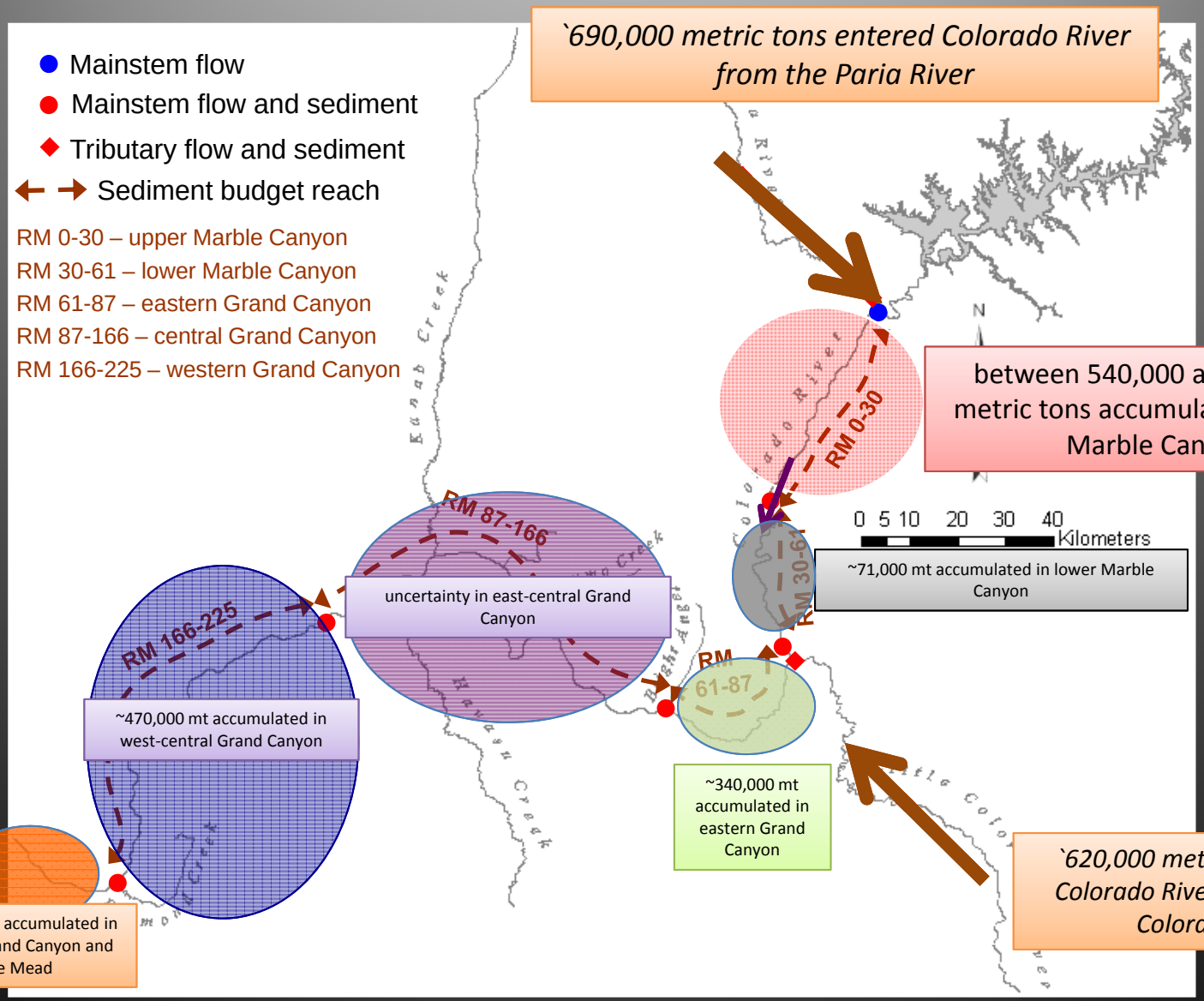
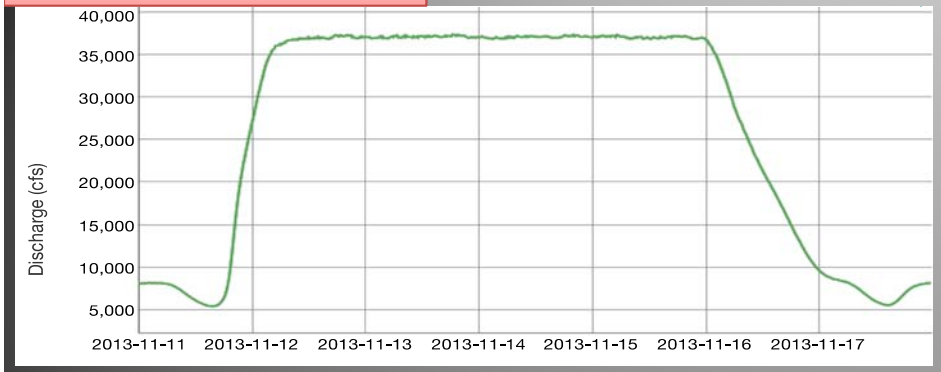
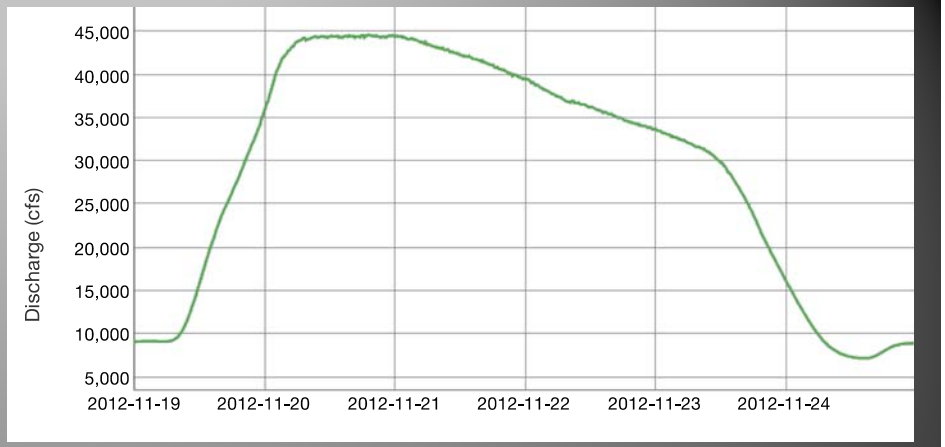


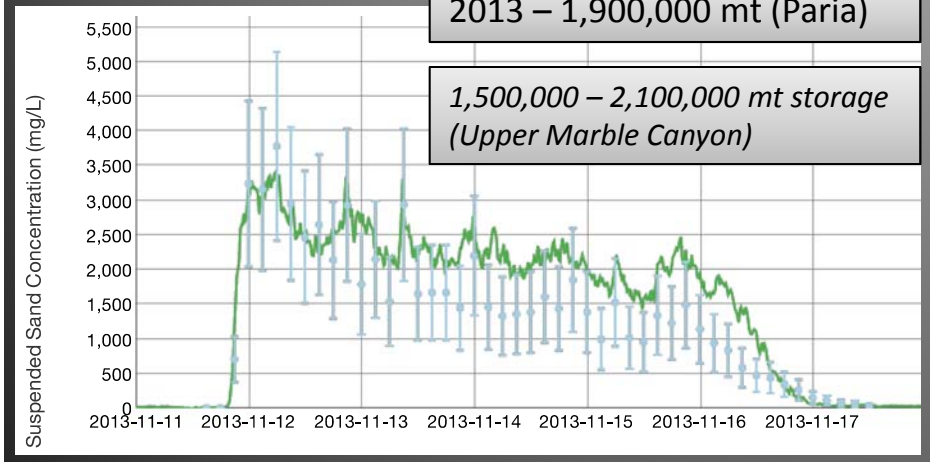
River Mile 30 gage





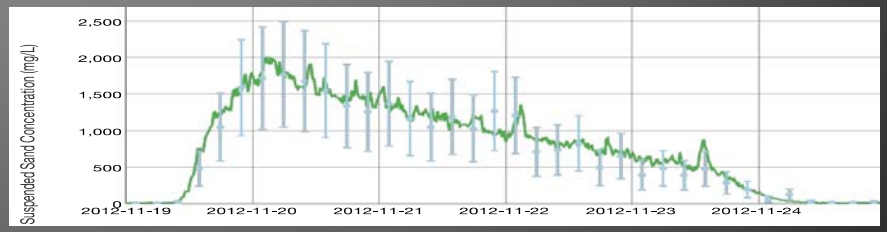
2013 – 1,900,000 mt (Paria)

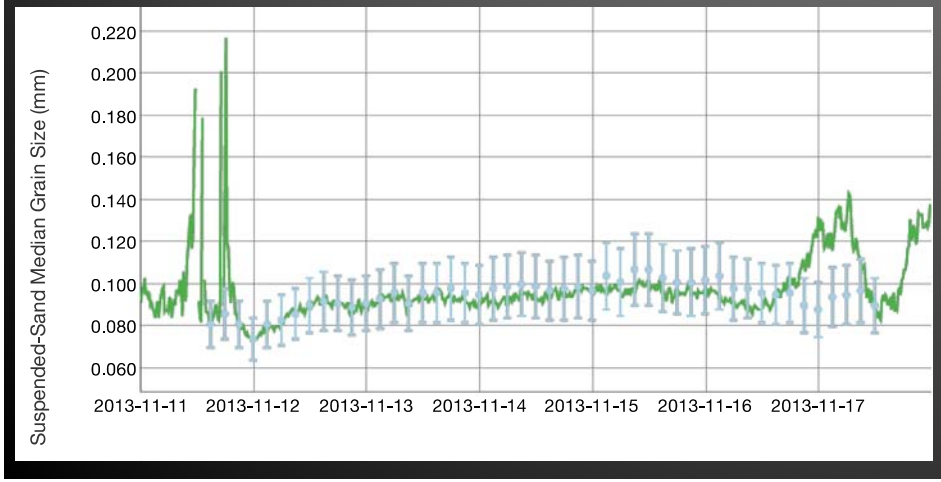
1,500,000 – 2,100,000 mt storage (Upper Marble Canyon)

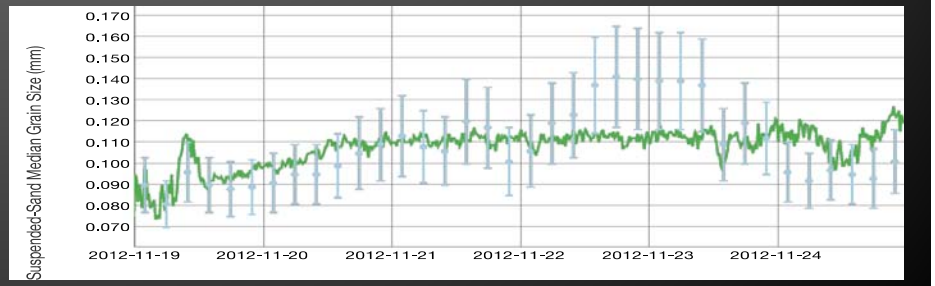


2012 – 690,000 mt (Paria)

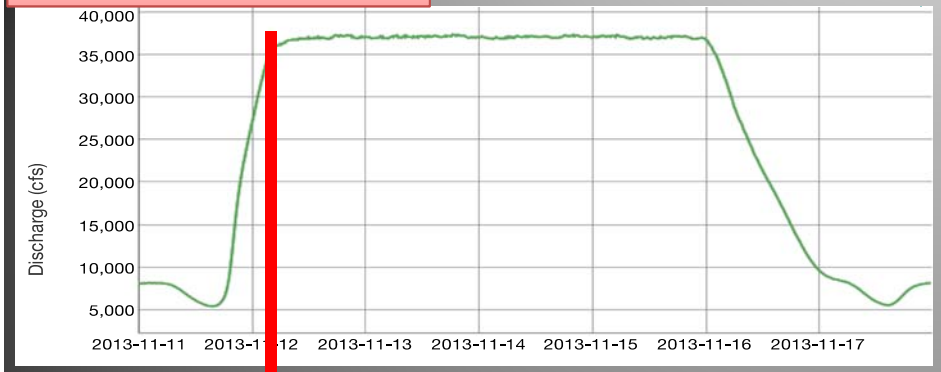
540,000 – 750,000 mt storage (Upper Marble Canyon)

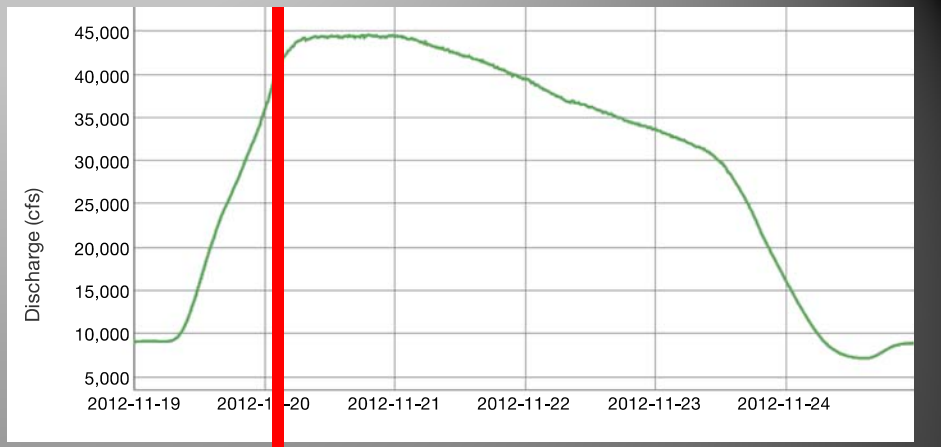






River Mile 30 gage





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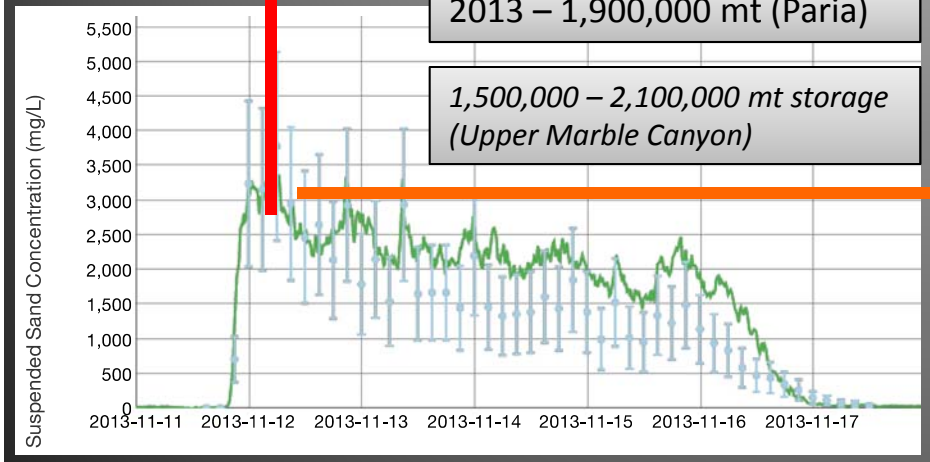

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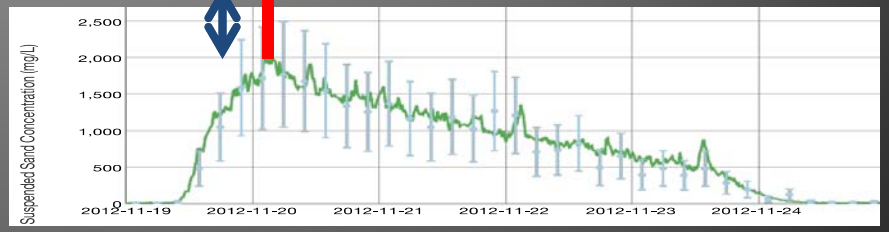
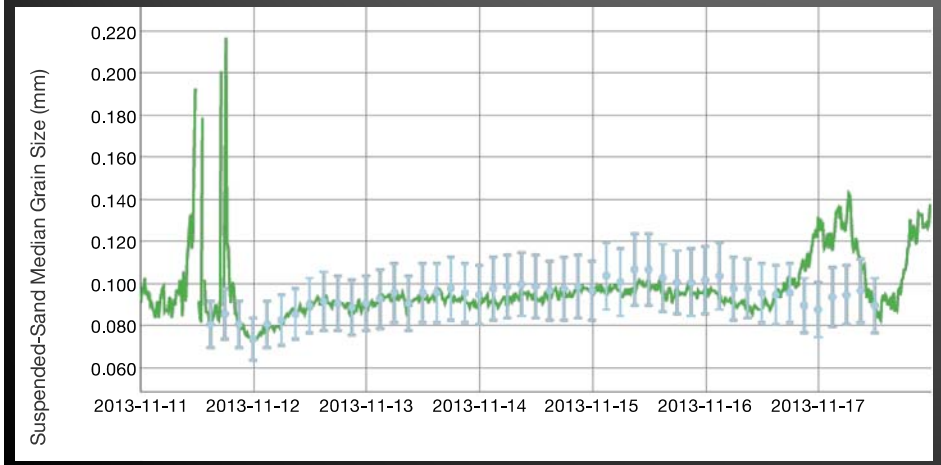
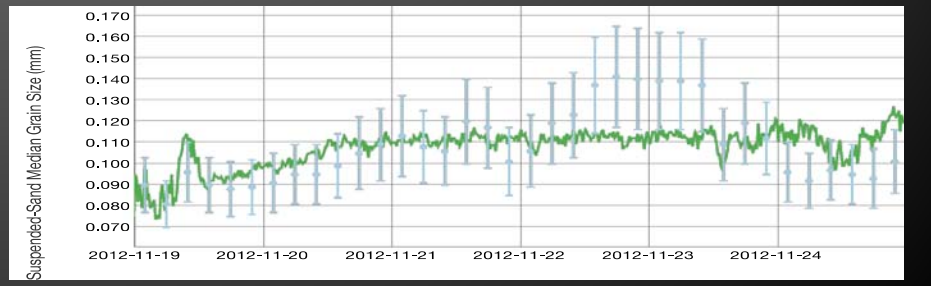
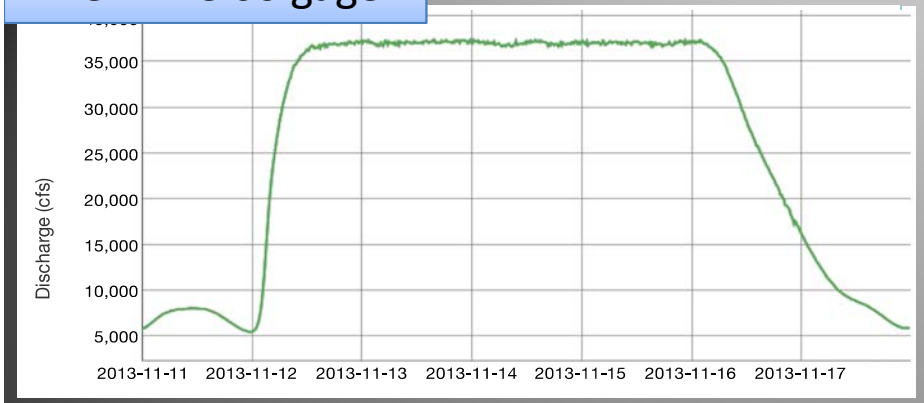
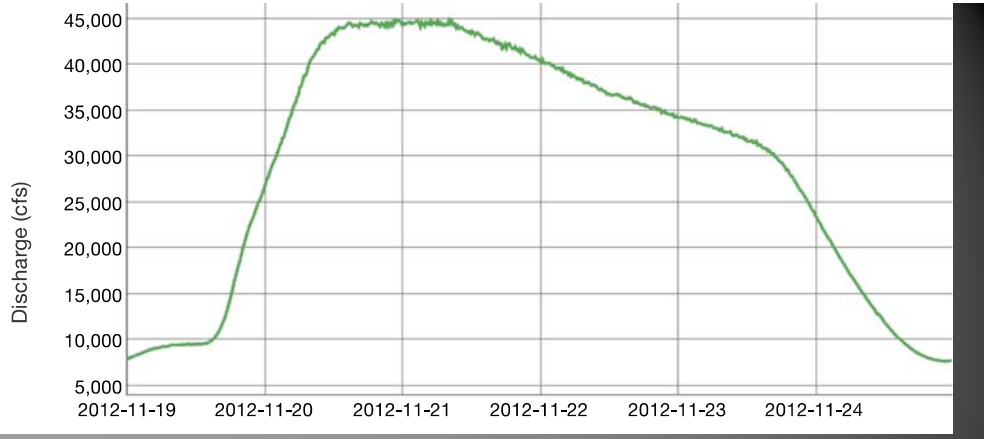






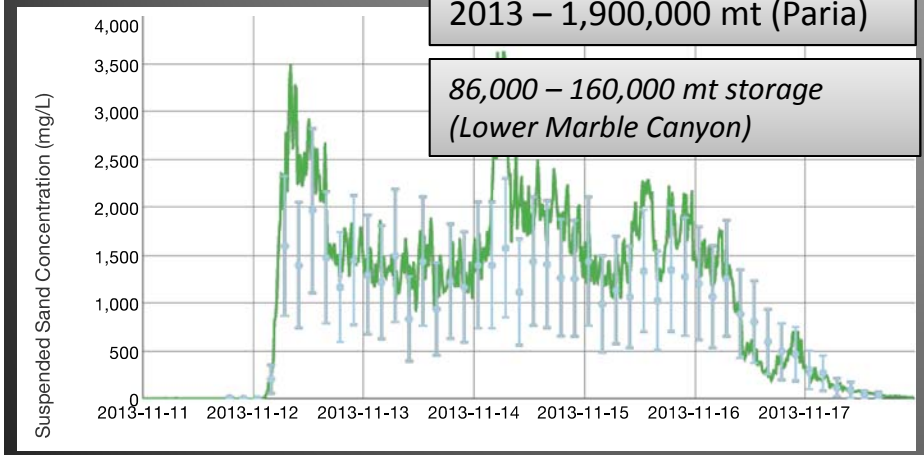
River Mile 60 gage

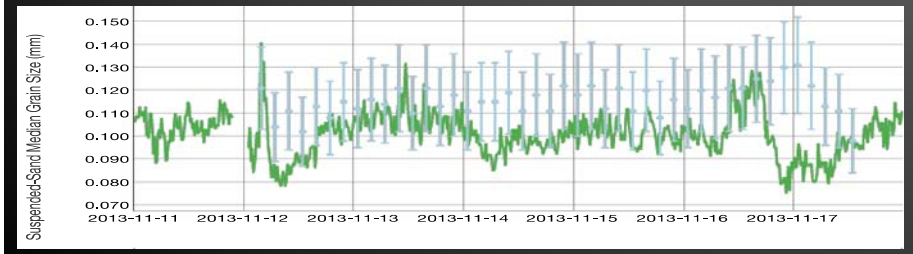




2013 – 1,900,000 mt (Paria)

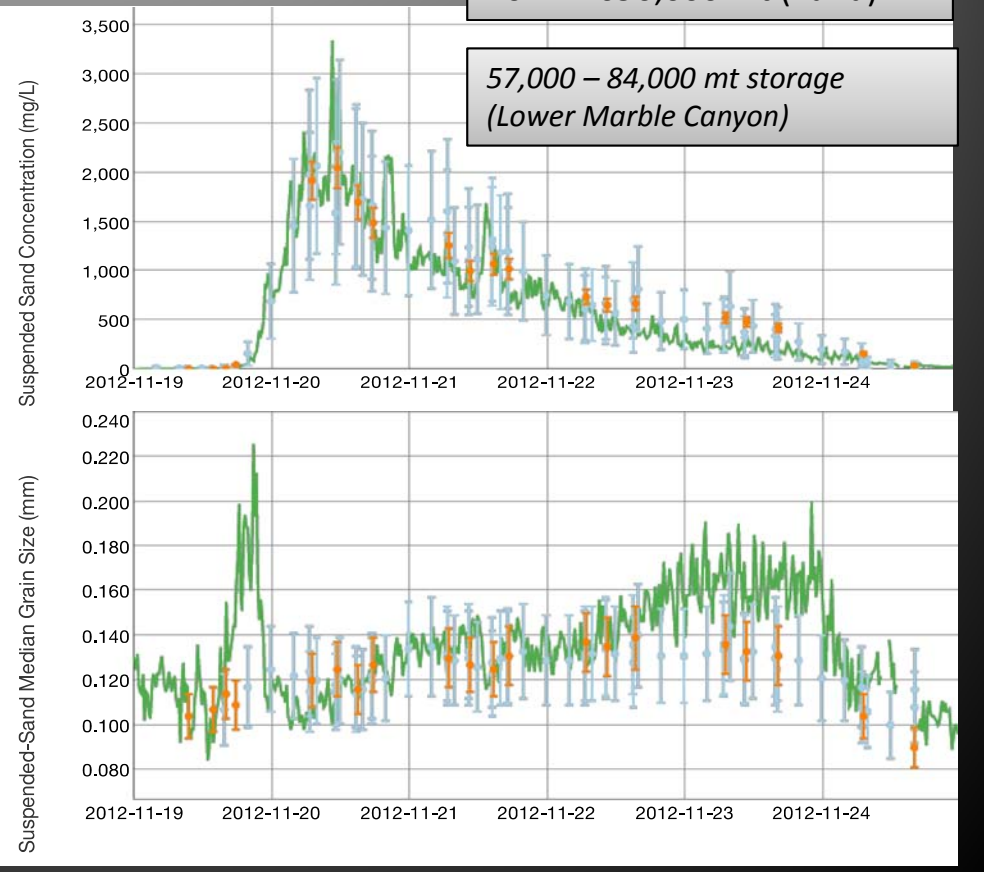
86,000 – 160,000 mt storage (Lower Marble Canyon)





2012 – 690,000 mt (Paria)

57,000 – 84,000 mt storage (Lower Marble Canyon)



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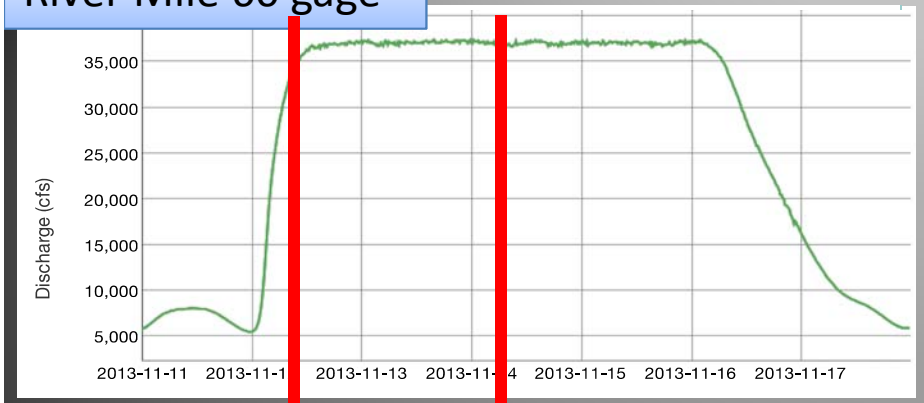

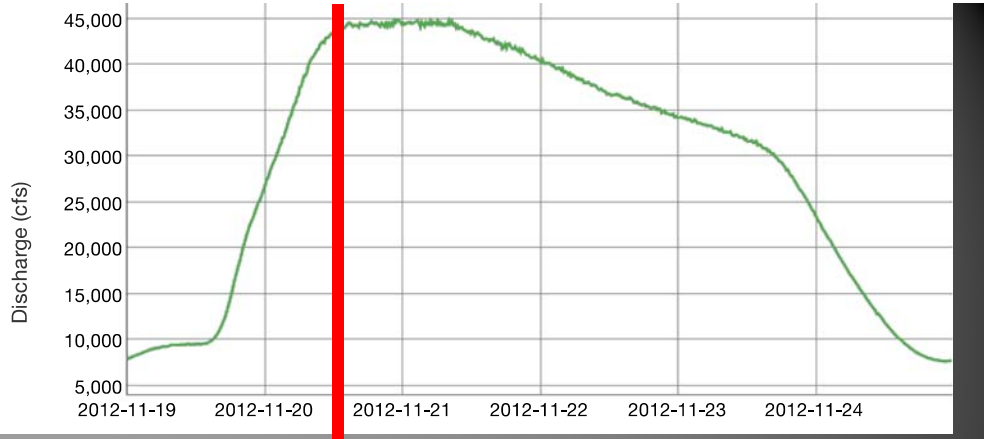

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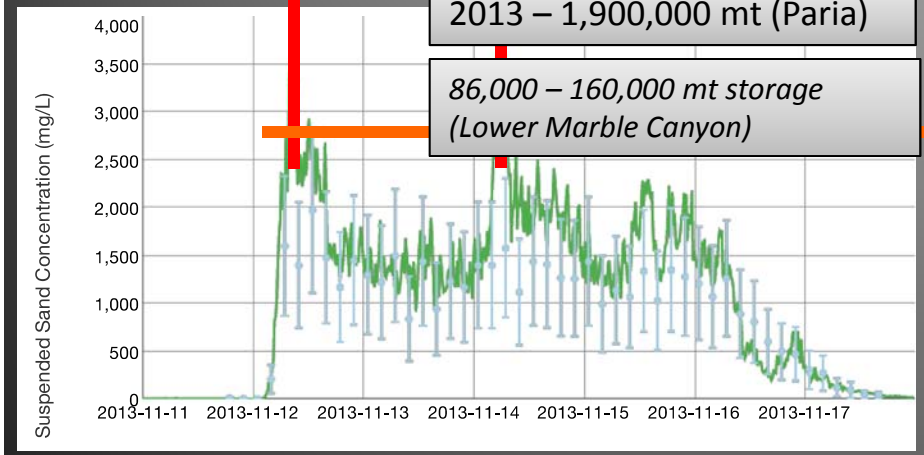

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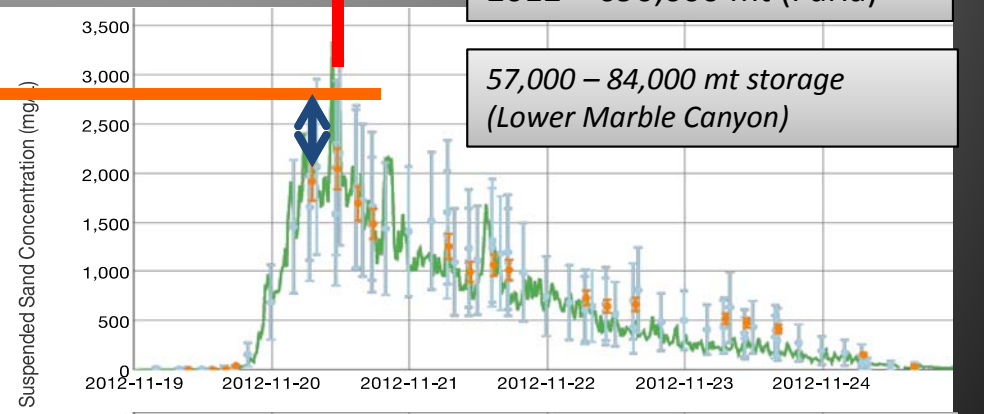
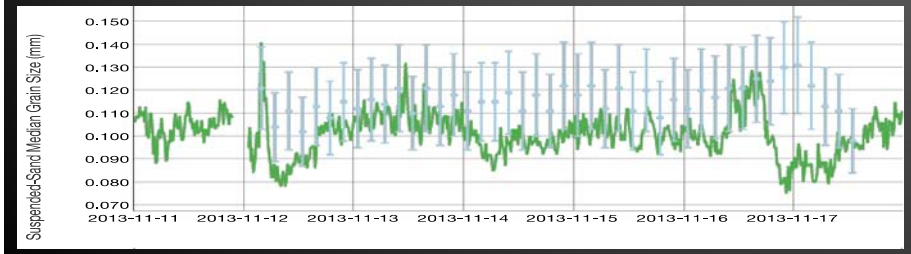
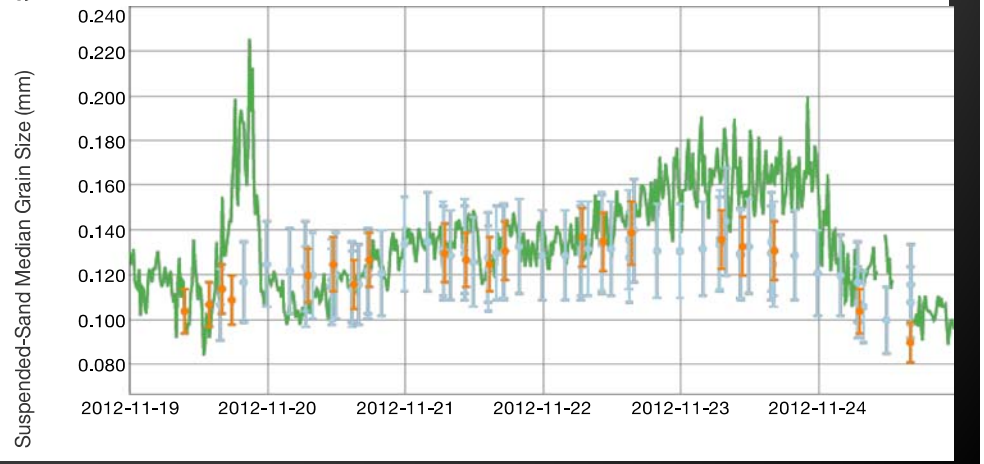
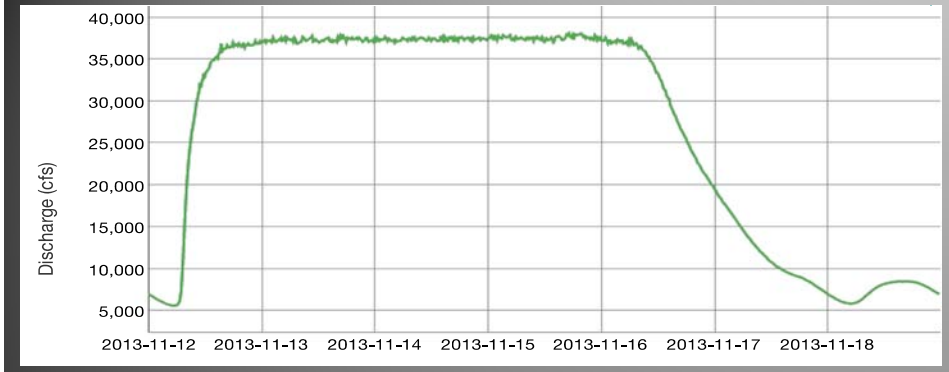
57,000 – 84,000 mt storage (Lower Marble Canyon)

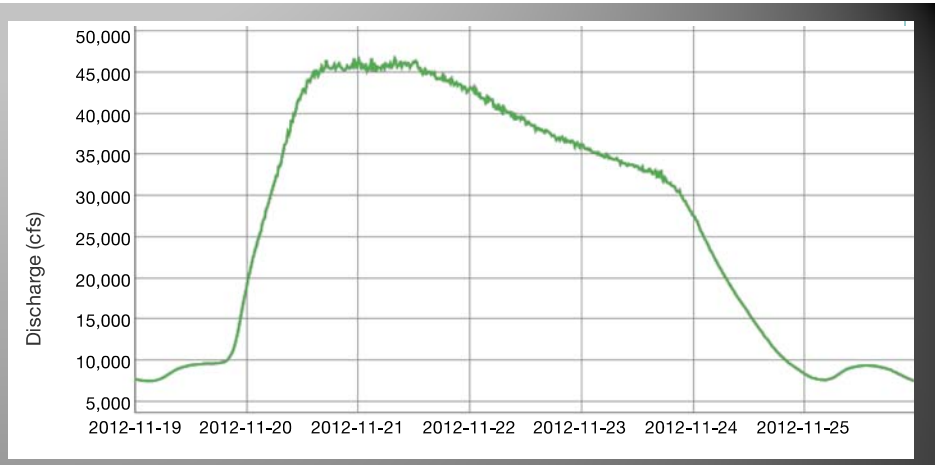






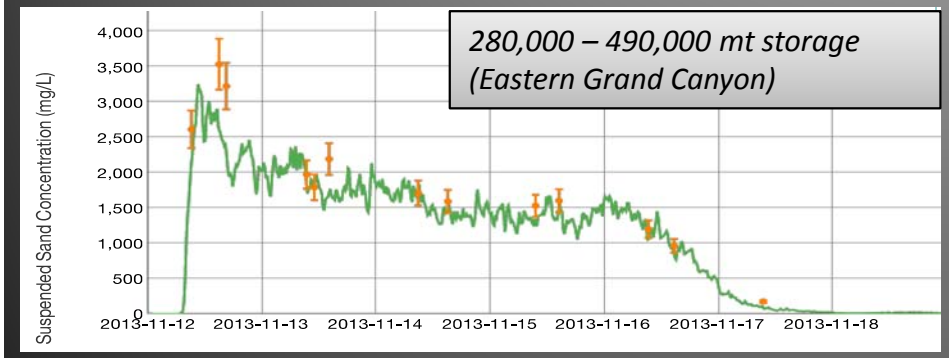
River Mile 87 gage





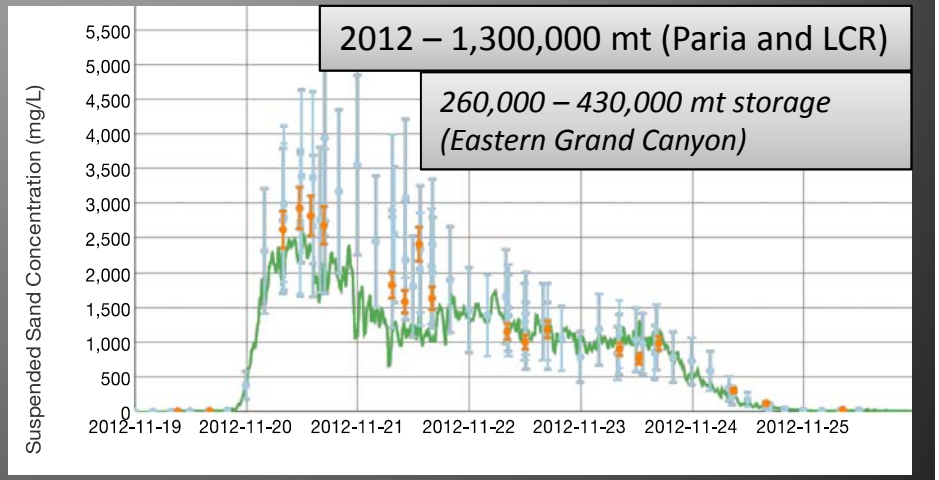
2013 – 2,500,000 mt (Paria and LCR)

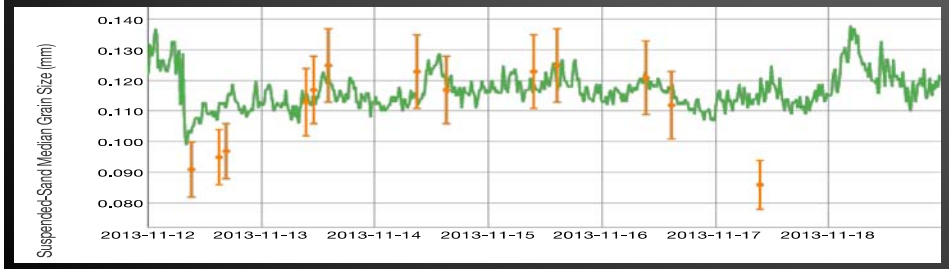
280,000 – 490,000 mt storage (Eastern Grand Canyon)

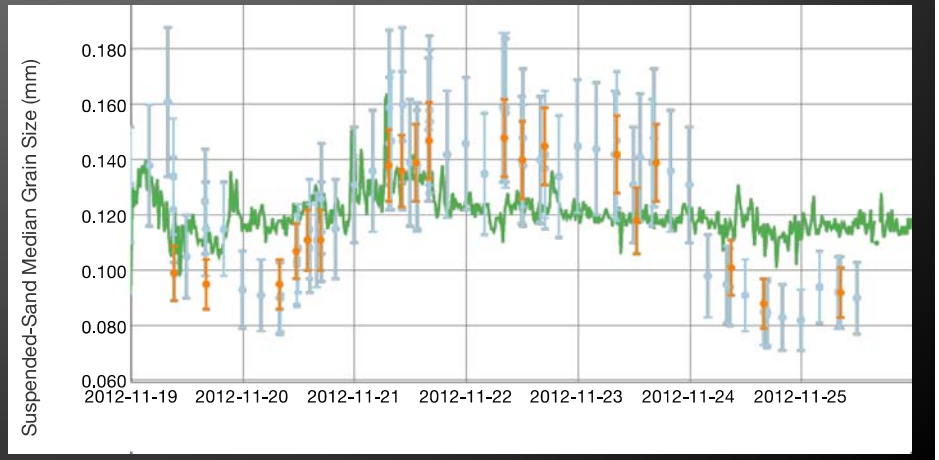


2012 – 1,300,000 mt (Paria and LCR)

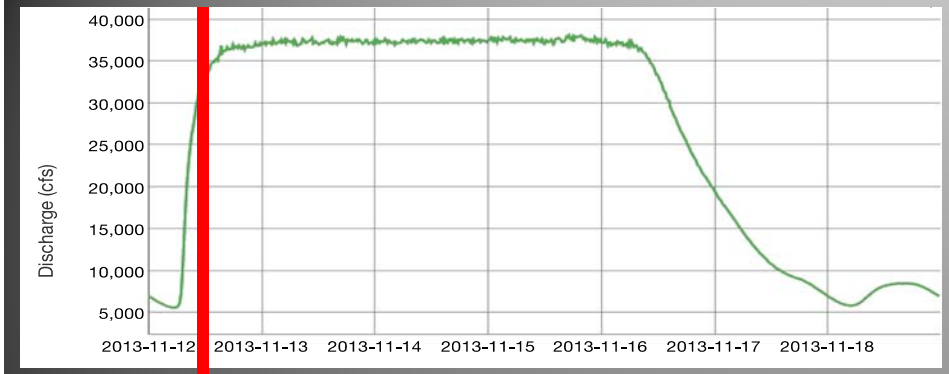
260,000 – 430,000 mt storage (Eastern Grand Canyon)





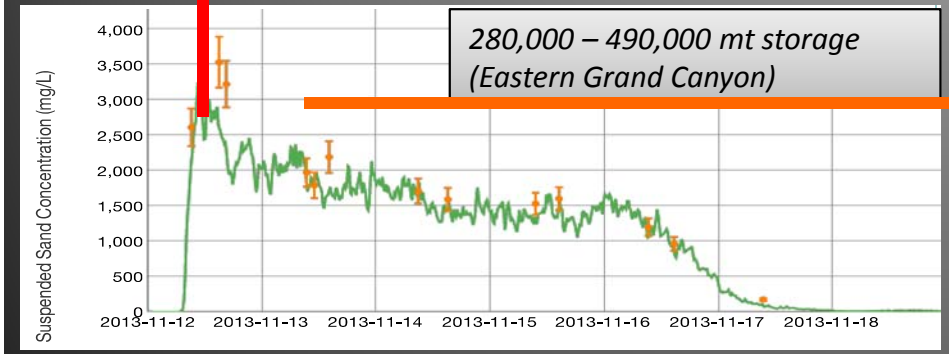


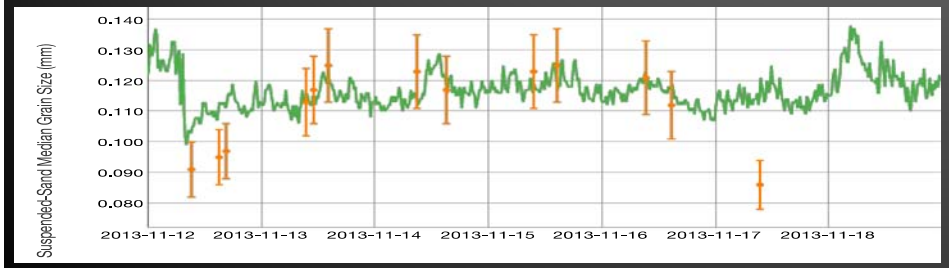
River Mile 87 gage

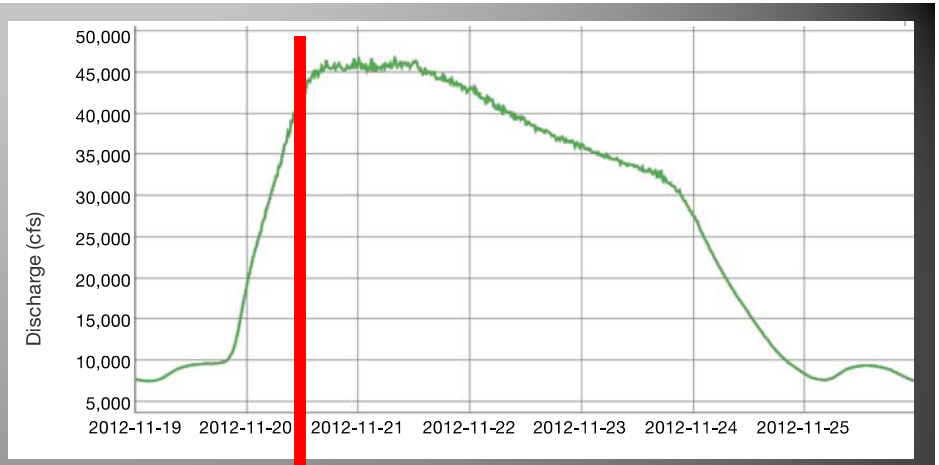


2013 – 2,500,000 mt (Paria and LCR)

280,000 – 490,000 mt storage (Eastern Grand Canyon)

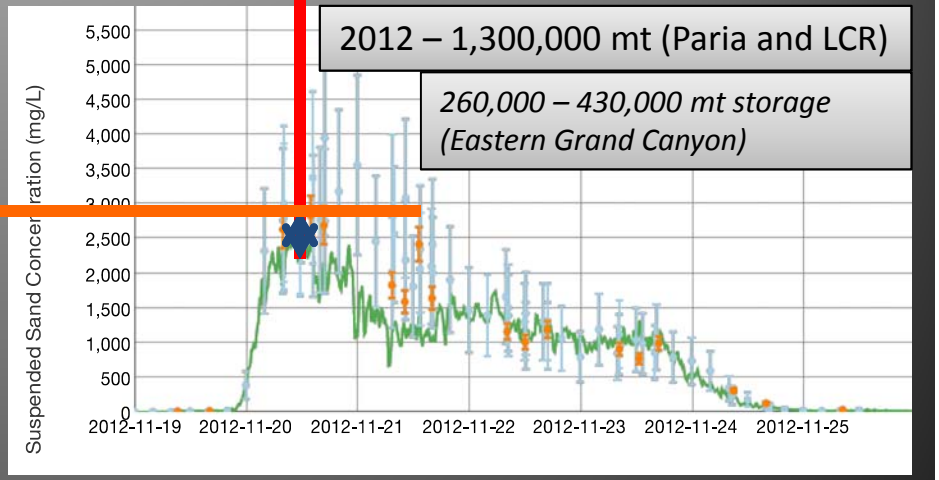


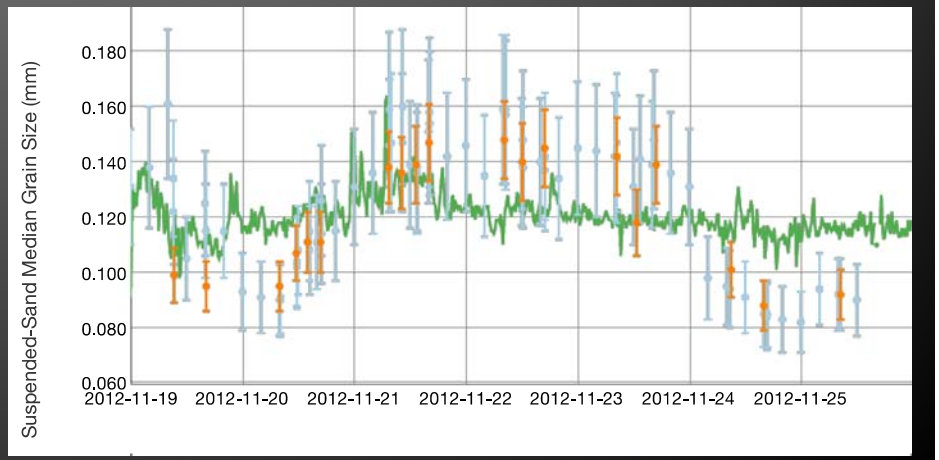




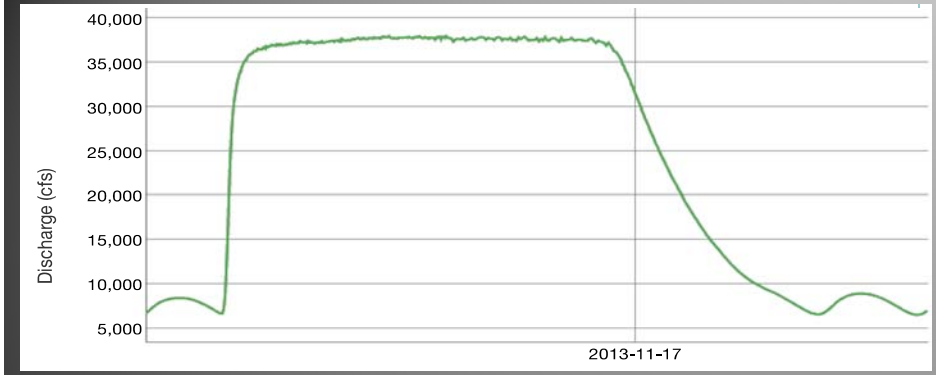
2012 – 1,300,000 mt (Paria and LCR)

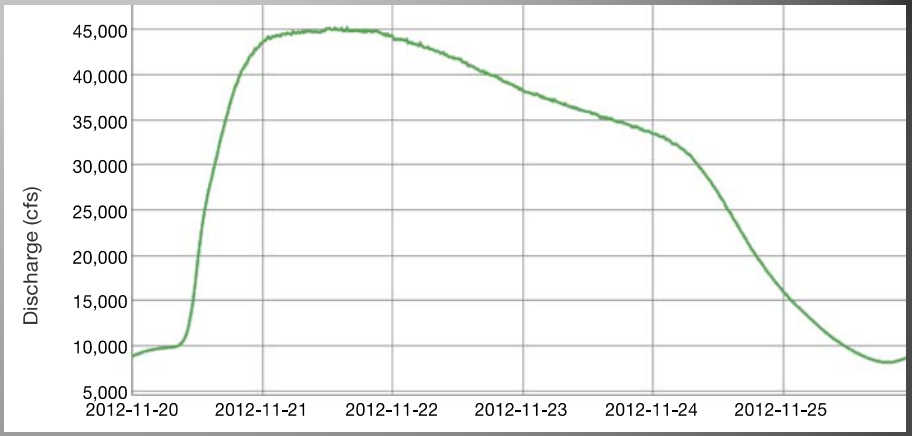
260,000 – 430,000 mt storage (Eastern Grand Canyon)

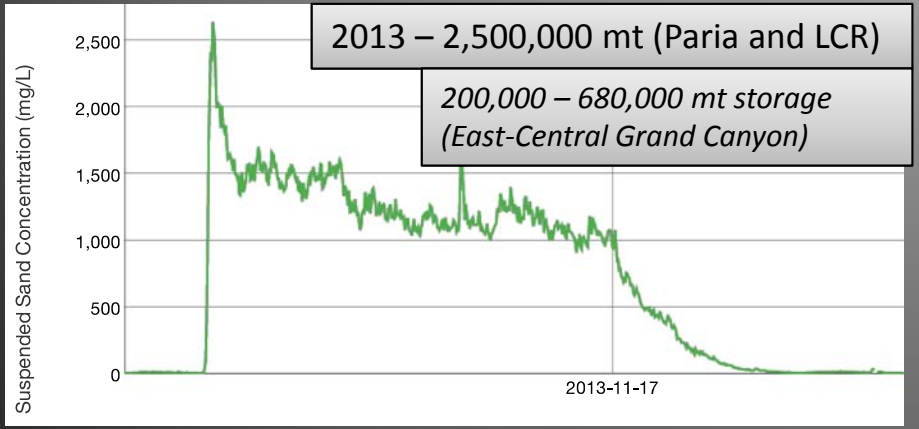


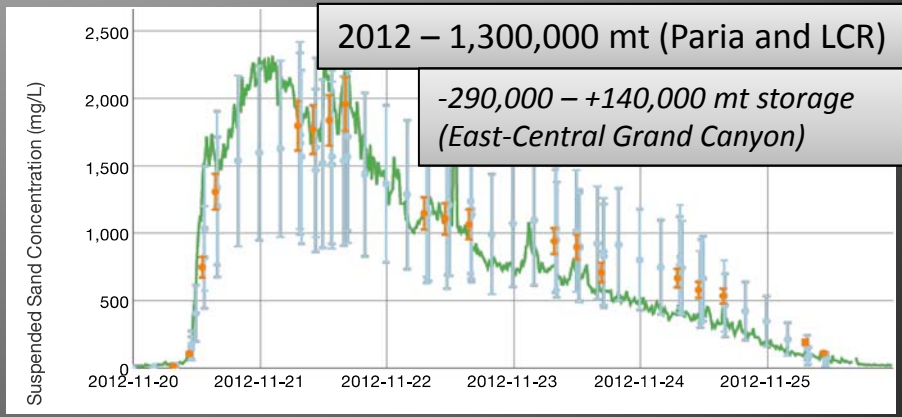


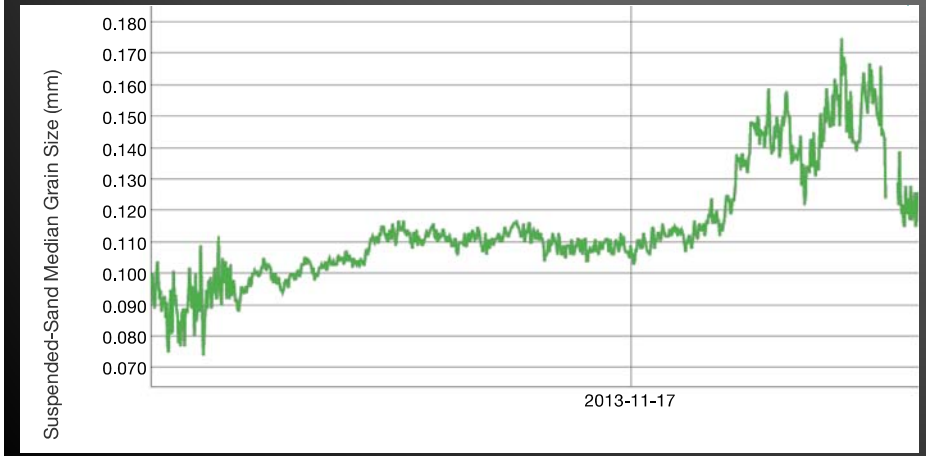
River Mile 166 gage

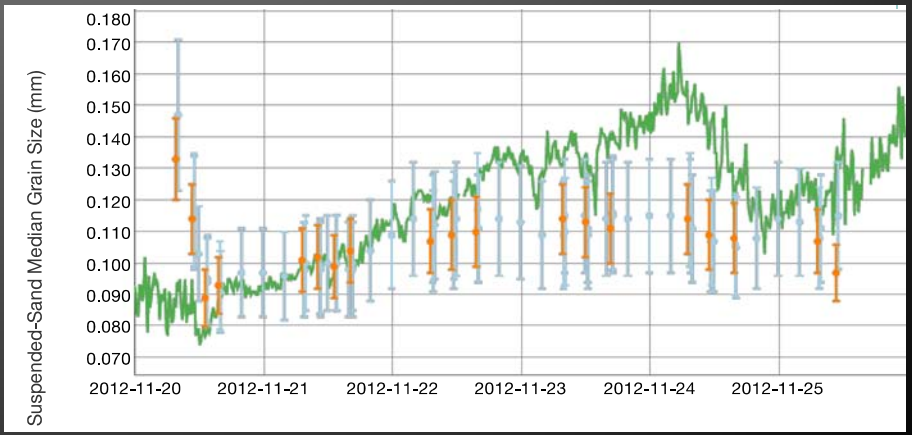




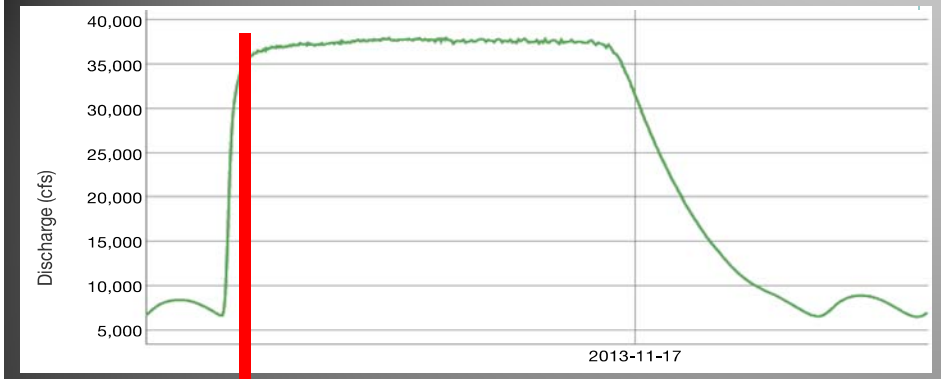


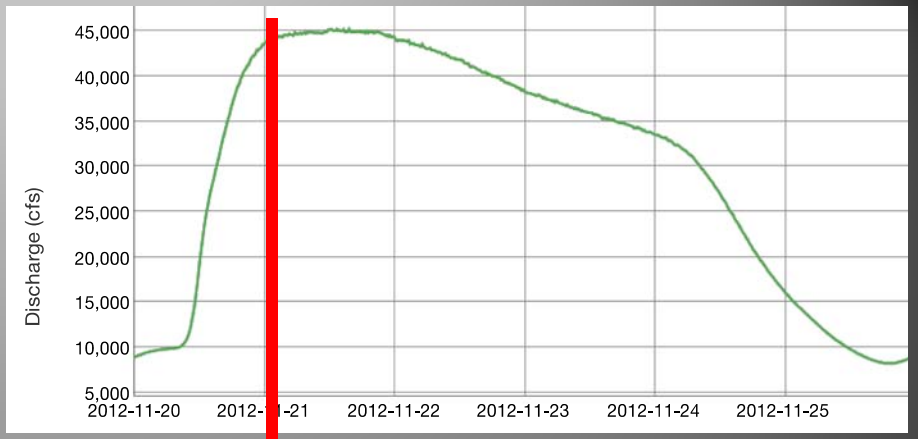






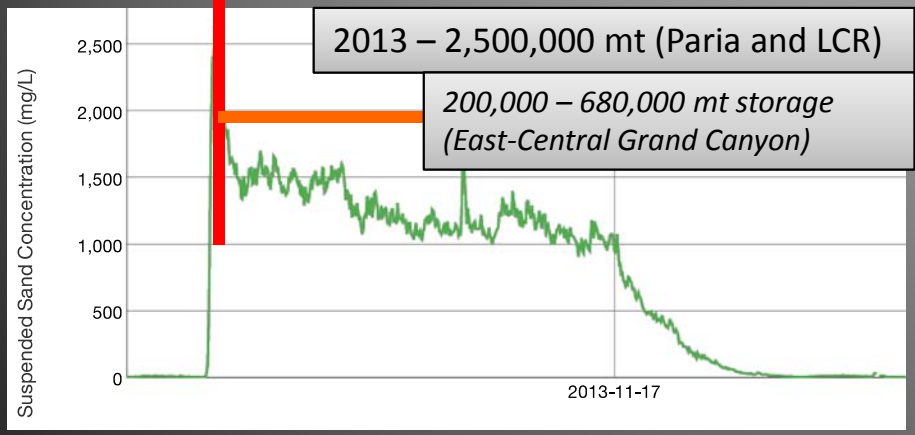
River Mile 166 gage





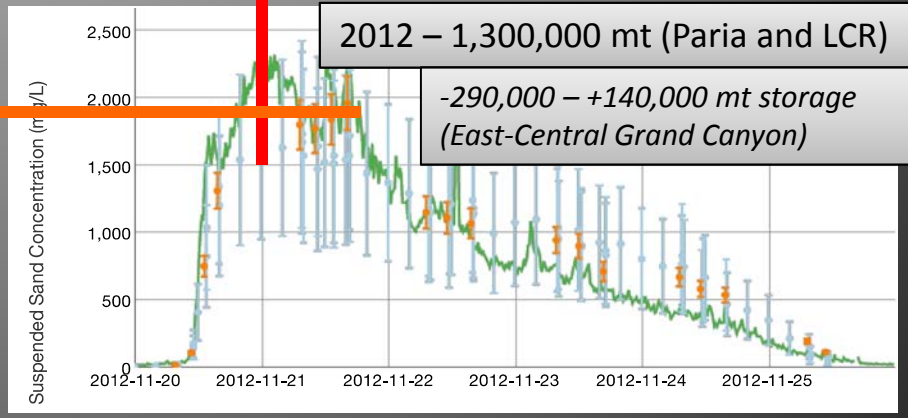
2013 – 2,500,000 mt (Paria and LCR)

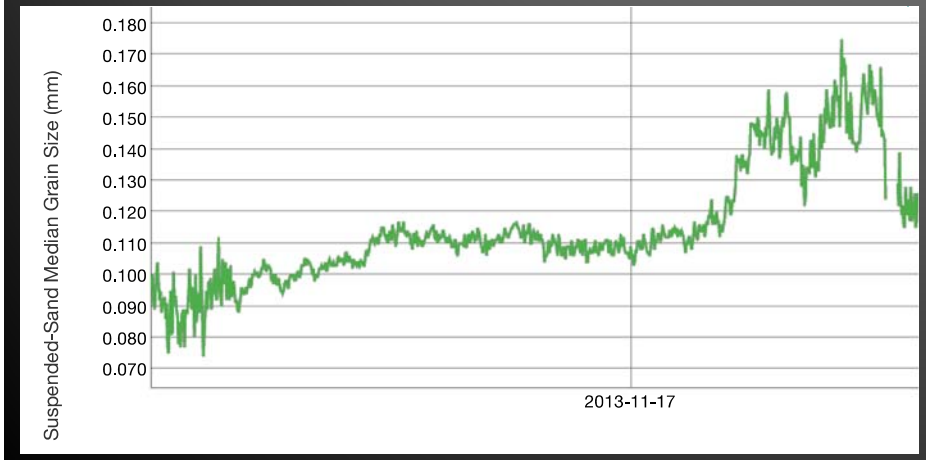
200,000 – 680,000 mt storage (East-Central Grand Canyon)

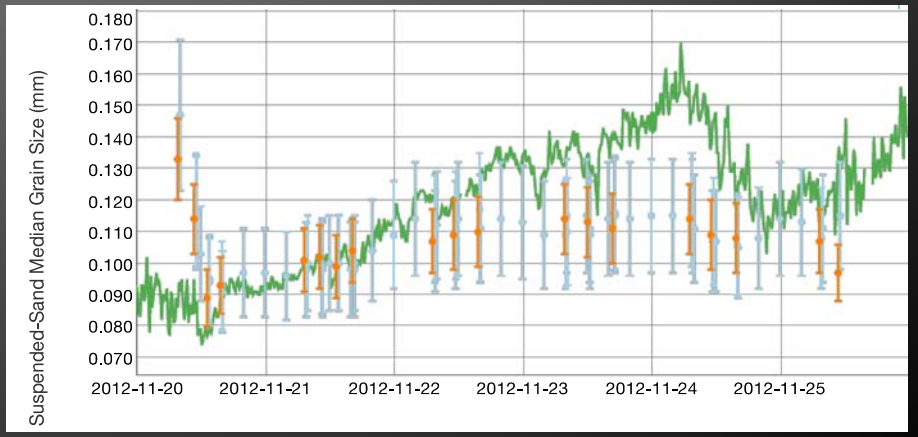


2012 – 1,300,000 mt (Paria and LCR)

-290,000 – +140,000 mt storage (East-Central Grand Canyon)



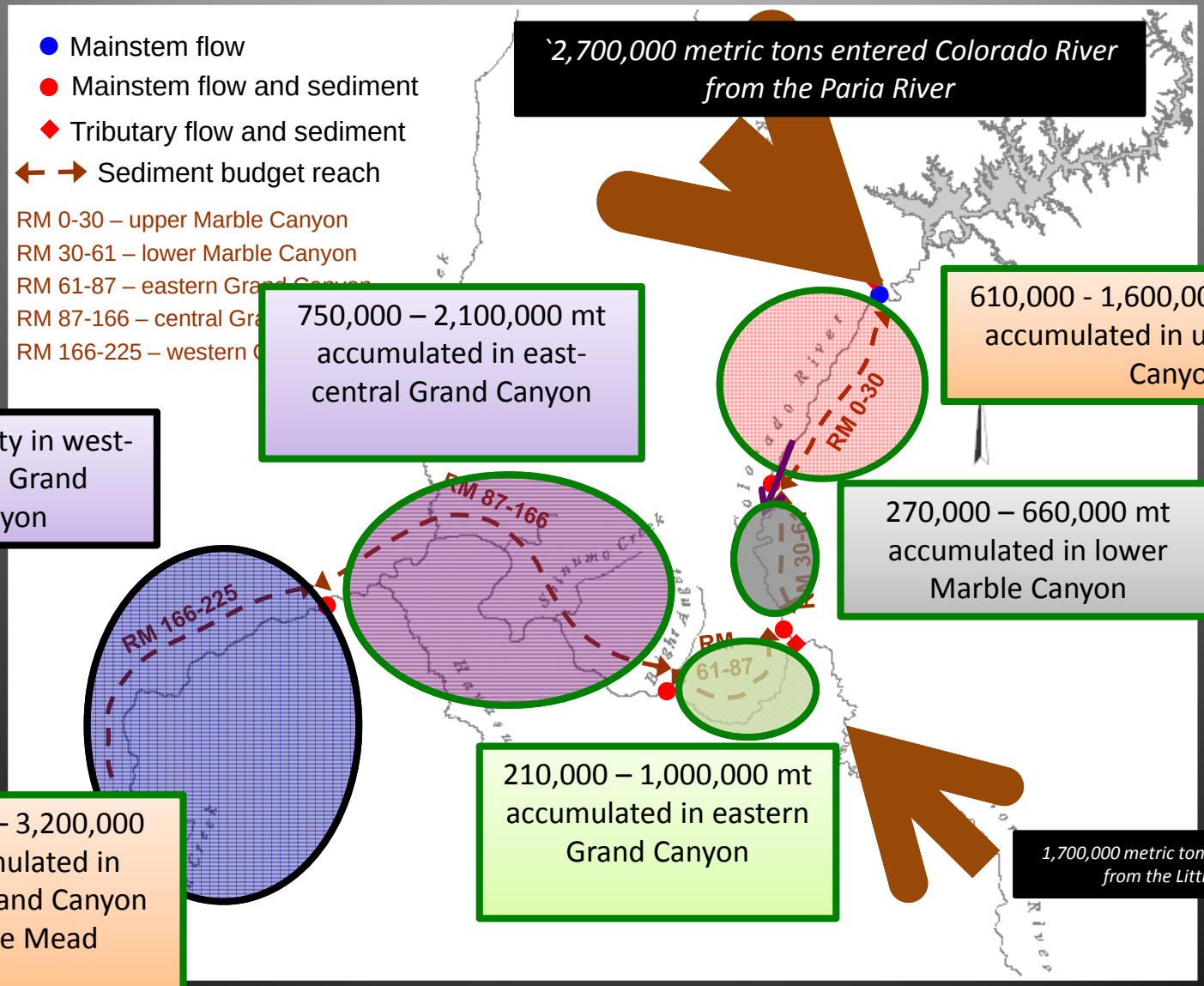




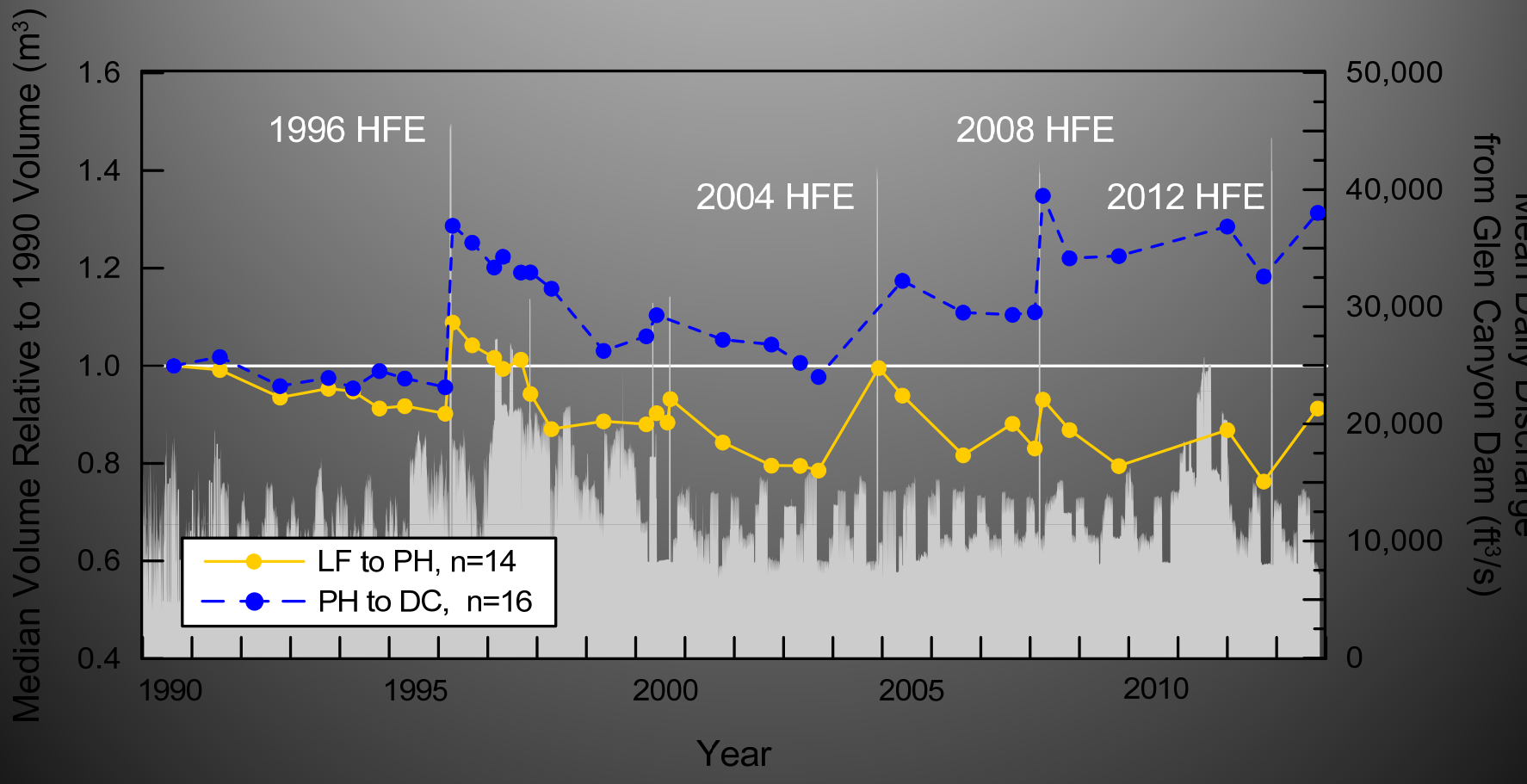
Lessons learned from mass balance

For the first two years of the HFE Protocol, sand has accumulated in most of Grand Canyon

July 1, 2012 – June 30, 2014



Long-term changes in sandbar volume in Marble and Grand Canyons, 1990-2013 (immediately before 2013 flood)



Changes following first flood caused by intervening operations

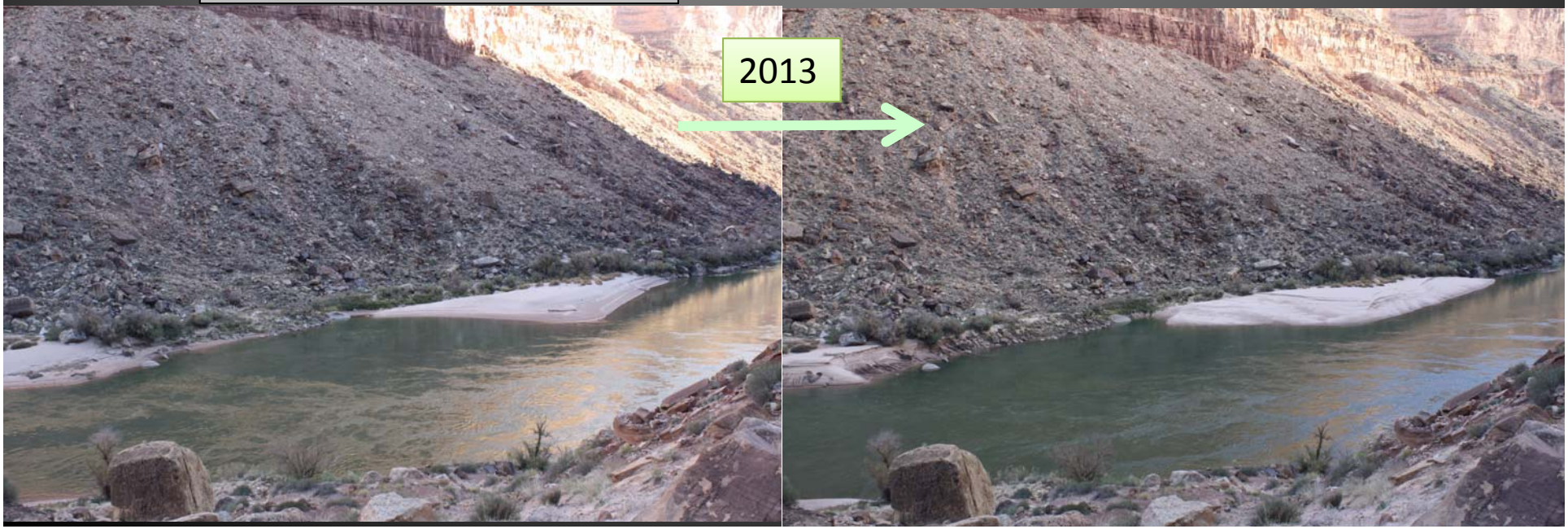
RM30

Rehabilitation

RM 9

The same eddy sand bar in two floods

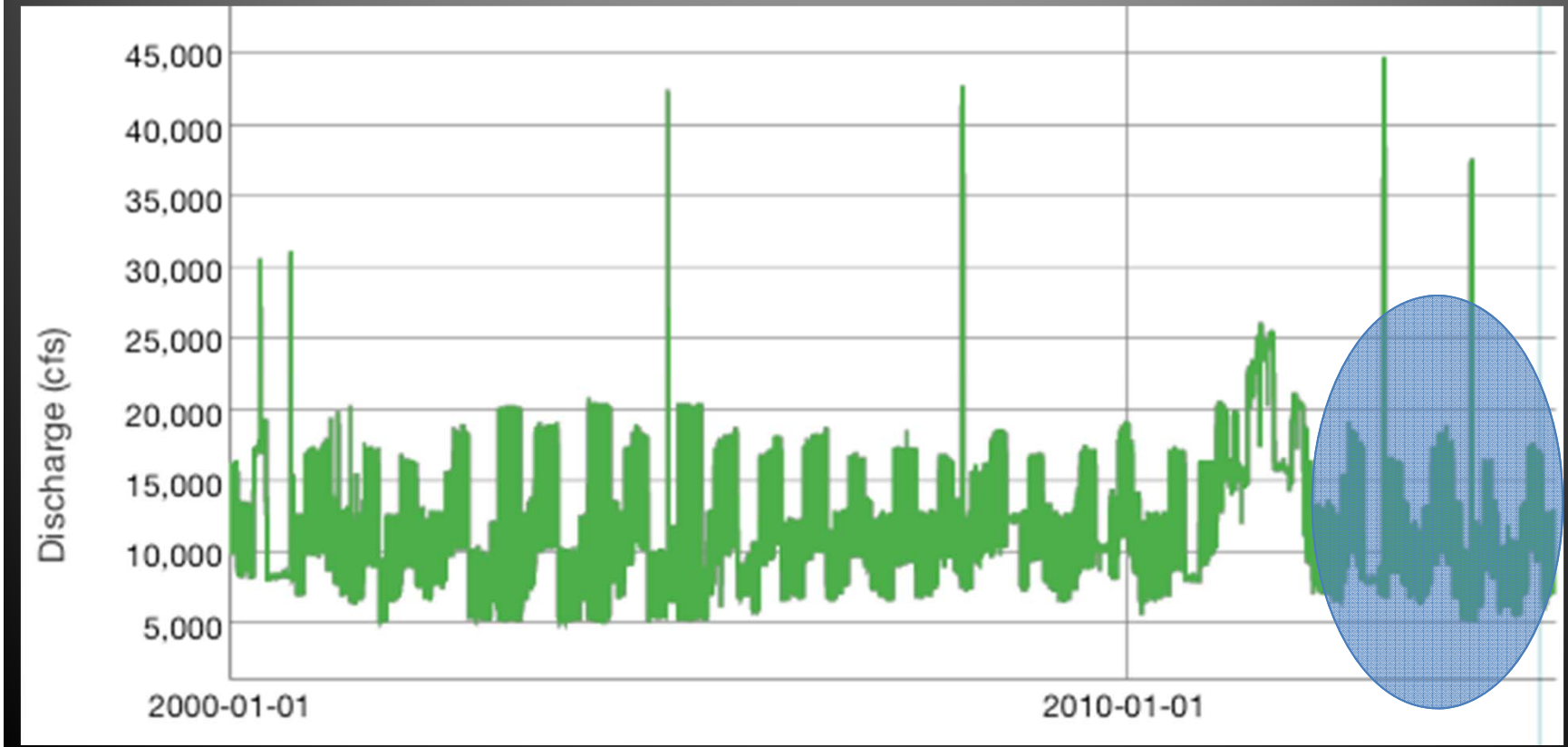
GCMRC automated camera program



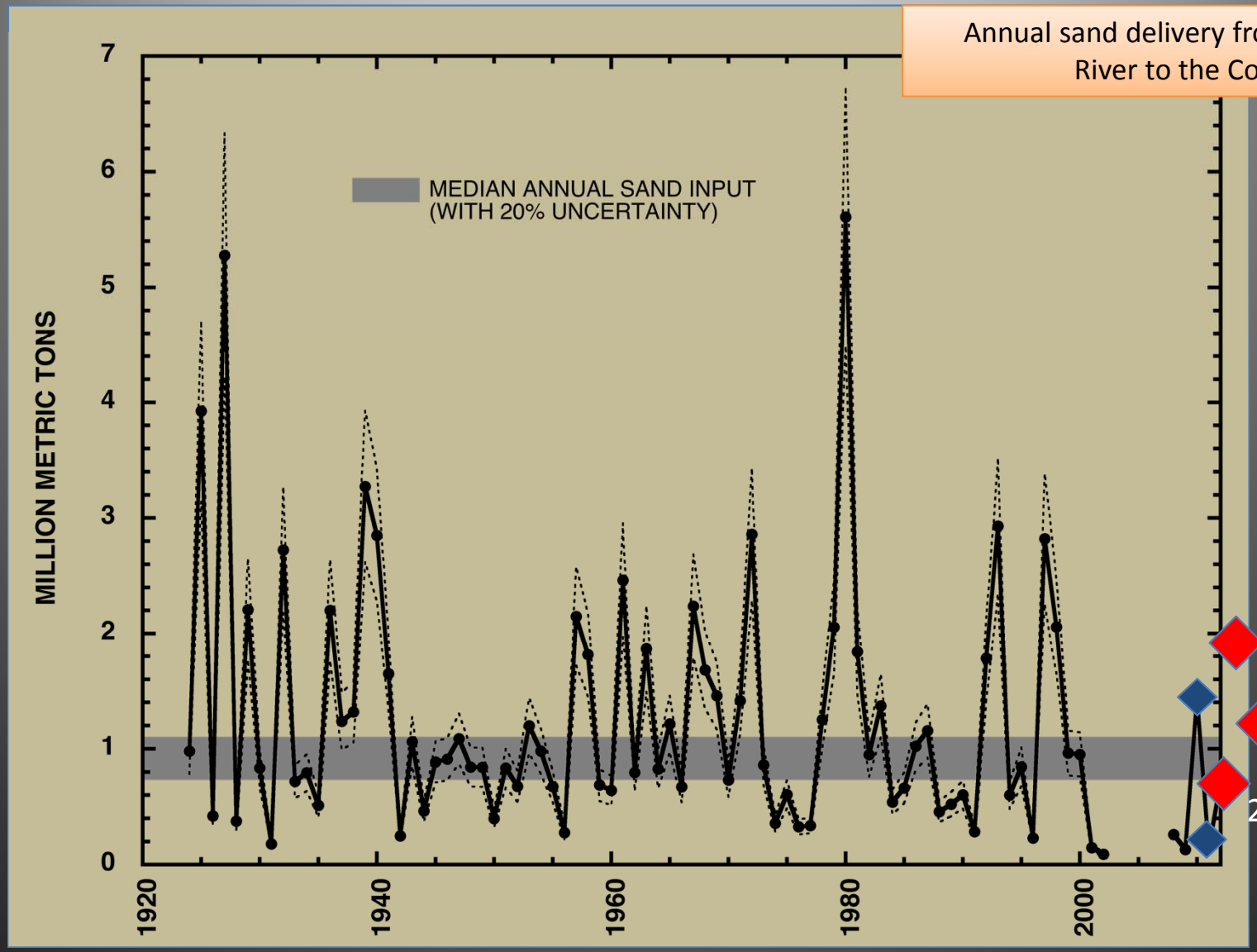
Remote camera results indicate gain in sand bar size immediately after floods at ~50% of sites

- November 2012 HFE
  - Images from remote cameras:
    - 52% (17 out of 33): noticeable gain
    - 39% (13 out of 33): no substantial change
    - 9% (3 out of 33): noticeable loss
- November 2013 HFE
  - Images from remote cameras:
    - 53% (21 out of 40): noticeable gain
    - 30% (12 out of 40): no substantial change
    - 18% (7 out of 40): noticeable loss

High Flow Experiment Protocol has been implemented at a time of relatively low dam releases

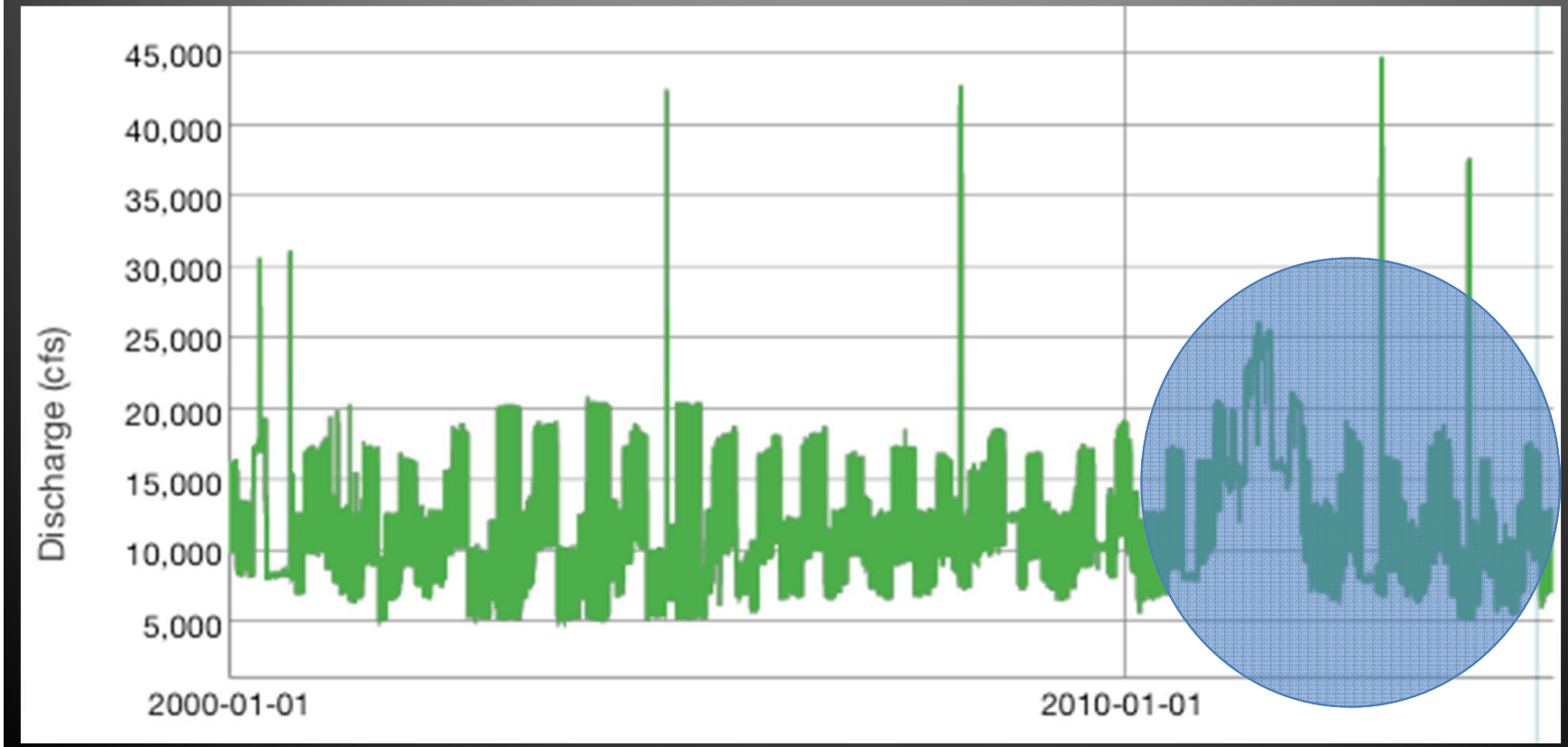


Annual sand delivery from the Paria River to the Colorado River



2012 and 2013 were relatively good years for sand delivery to the Colorado River

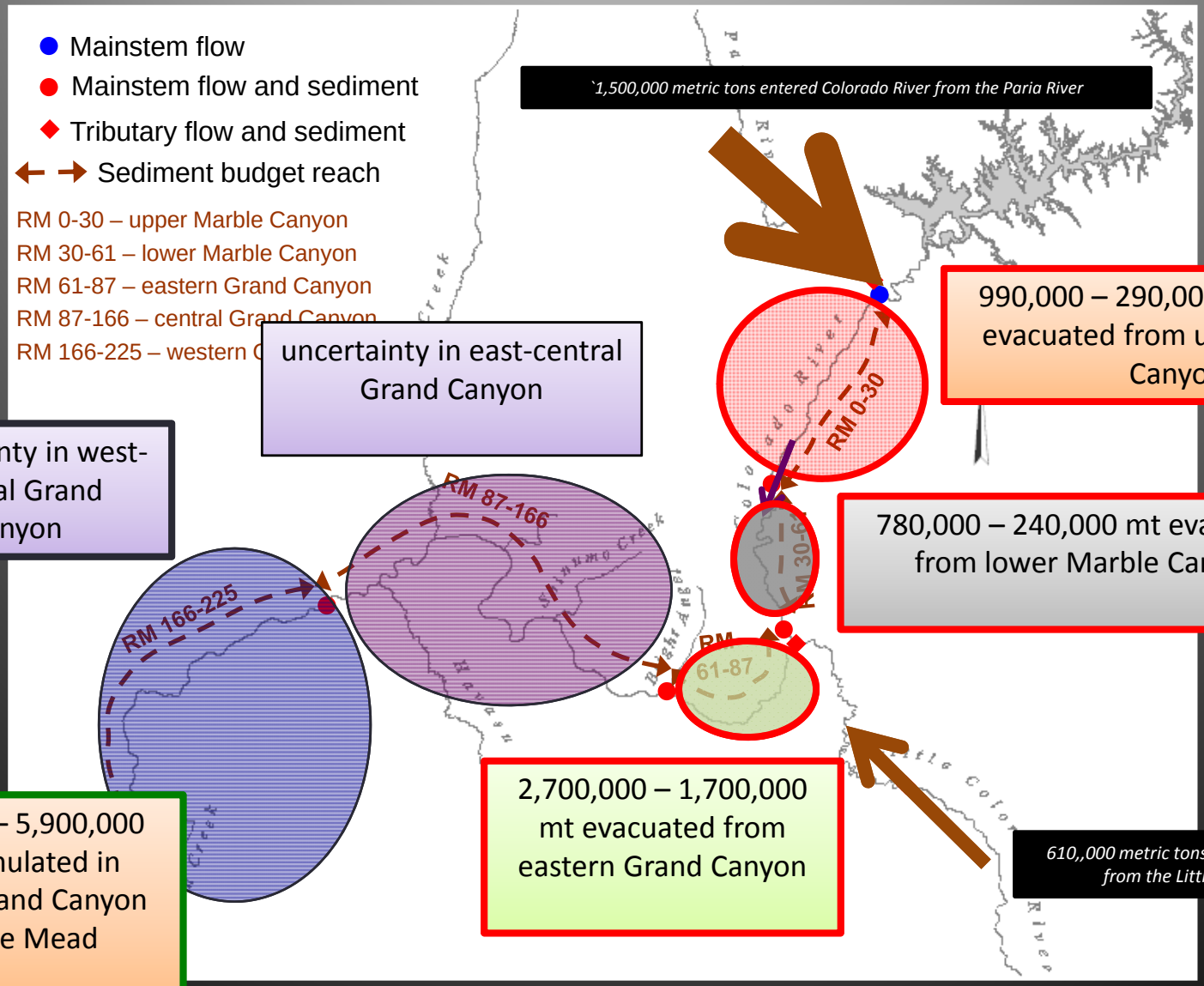
High Flow Experiment Protocol in the context of equalization flows



Lessons learned from mass balance

In the years of equalization flows, there was large-scale evacuation of sand

July 1, 2010 –
June 30, 2012



uncertainty in east-central Grand Canyon

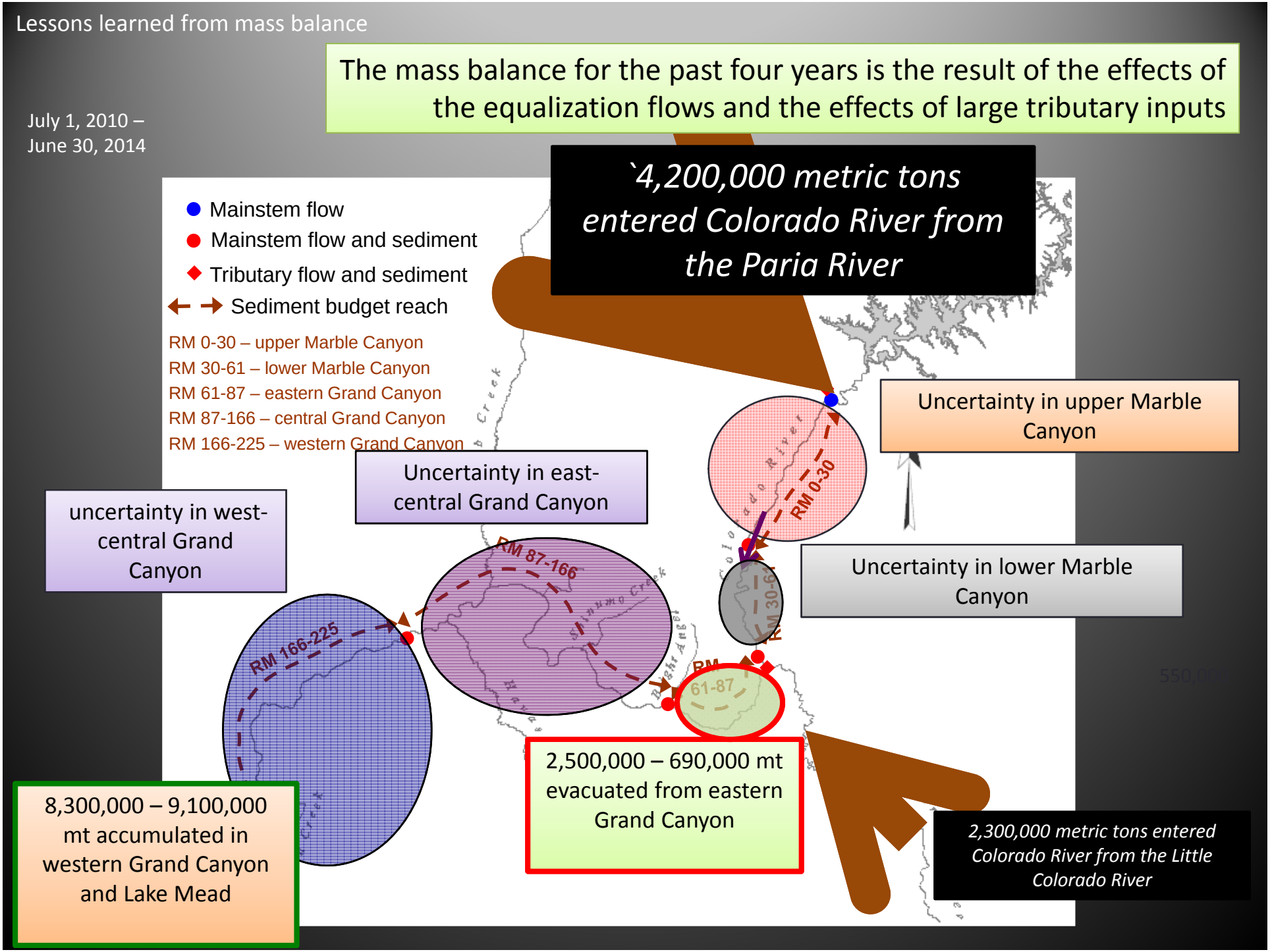
uncertainty in west-central Grand Canyon

5,400,000 – 5,900,000 mt accumulated in western Grand Canyon and Lake Mead

Lessons learned from mass balance

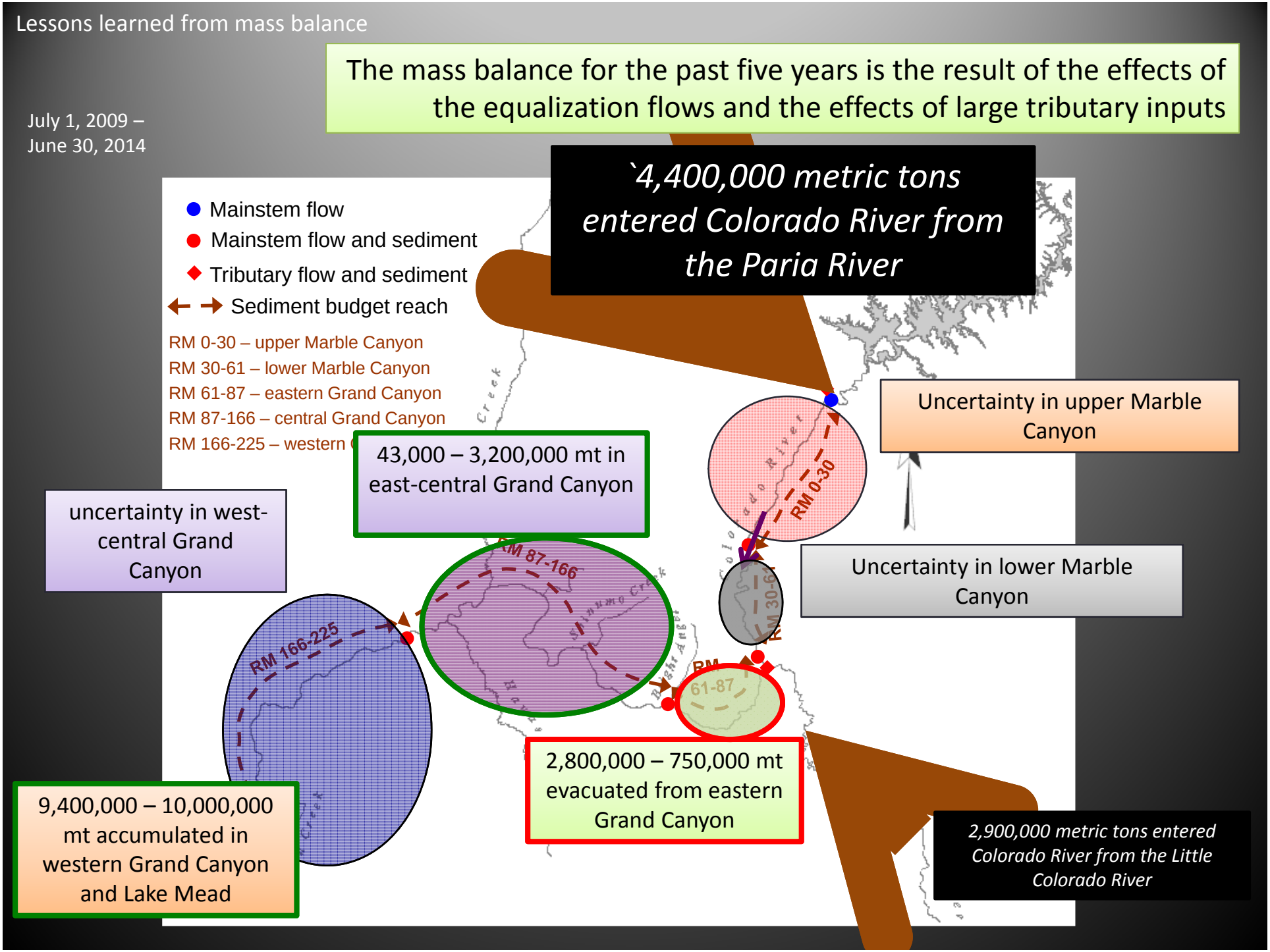
The mass balance for the past four years is the result of the effects of the equalization flows and the effects of large tributary inputs

July 1, 2010 – June 30, 2014

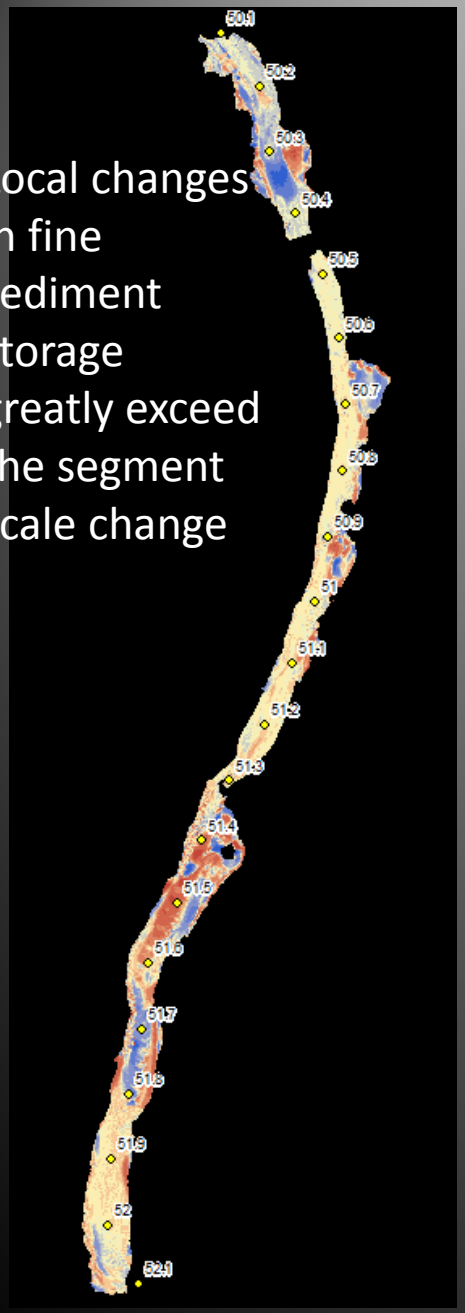


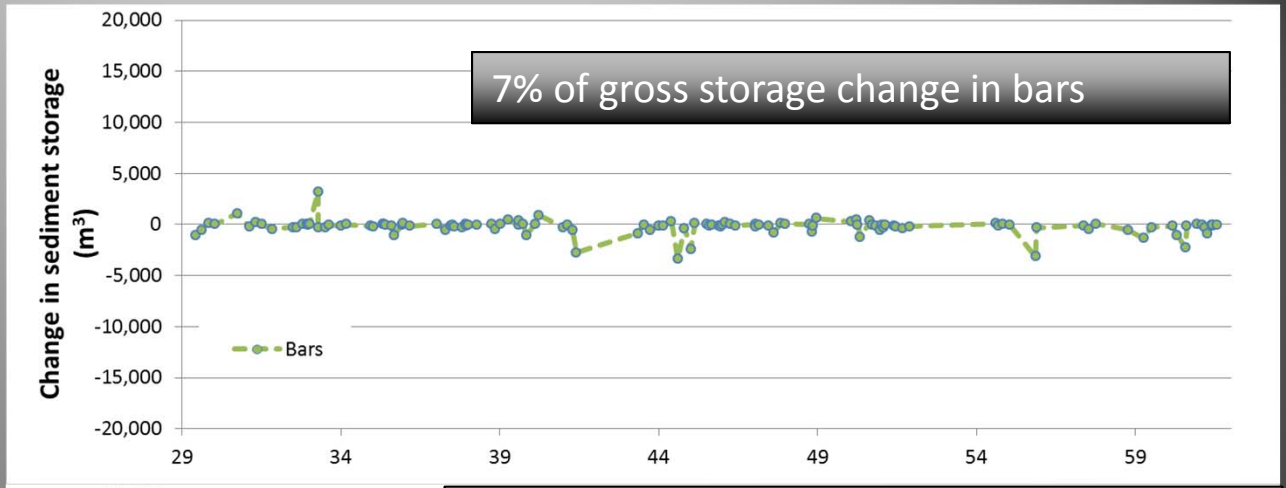
The mass balance for the past five years is the result of the effects of the equalization flows and the effects of large tributary inputs

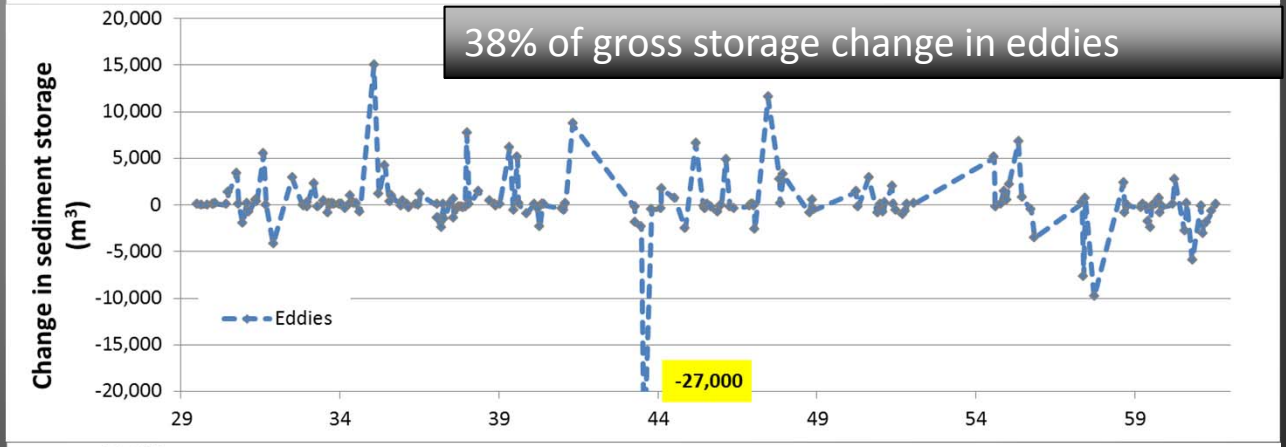
July 1, 2009 – June 30, 2014

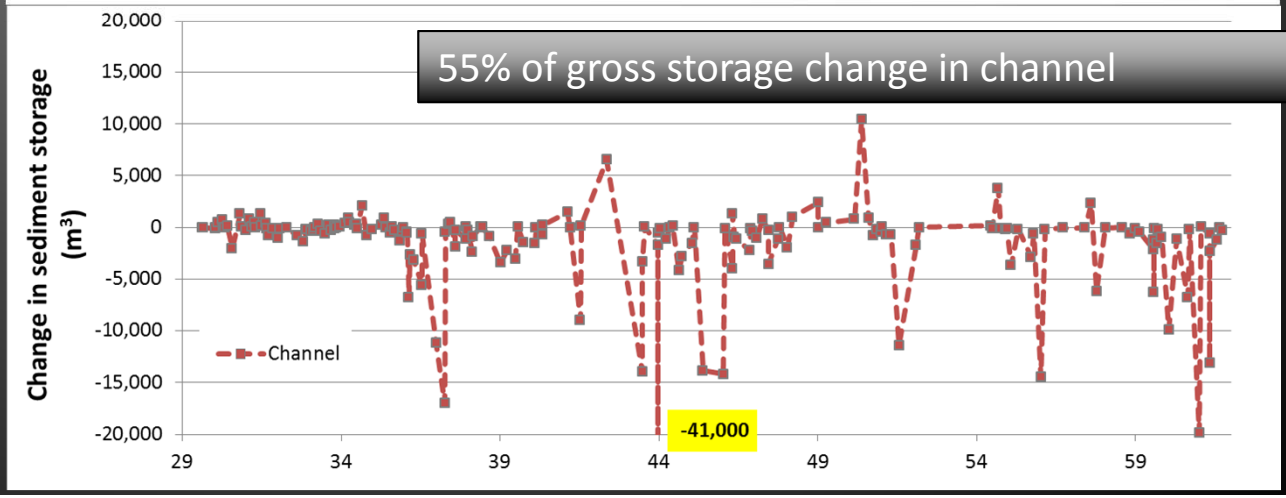


Local changes in fine sediment storage greatly exceed the segment scale change









Some science and management questions to consider

1) Plan HFEs based on Paria inputs or on estimated mass balance of Marble Canyon?
2) The model under estimates sand mobilized in Marble Canyon – good or bad? Need to improve model?
3) Alternative hydrograph shapes
4) Sand mass balance vs. bar/campsite changes

A) Scientific basis for patterns of concentration and grain size of sand in transport
B) Scientific basis of patterns in west-central Grand Canyon
C) What is equilibrium? At what time scale?

a) Reporting – timeliness, comprehensiveness

Big Issues:
I) HFEs within the context of equalization
II) Bar building within the context of normal operations and equalization.