

Lake Powell's Exposed Sediment Legacy

How much is moving, how fast, and what is driving it



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**RETURNING
RAPIDS
PROJECT**

Special Thanks to & Funding from :

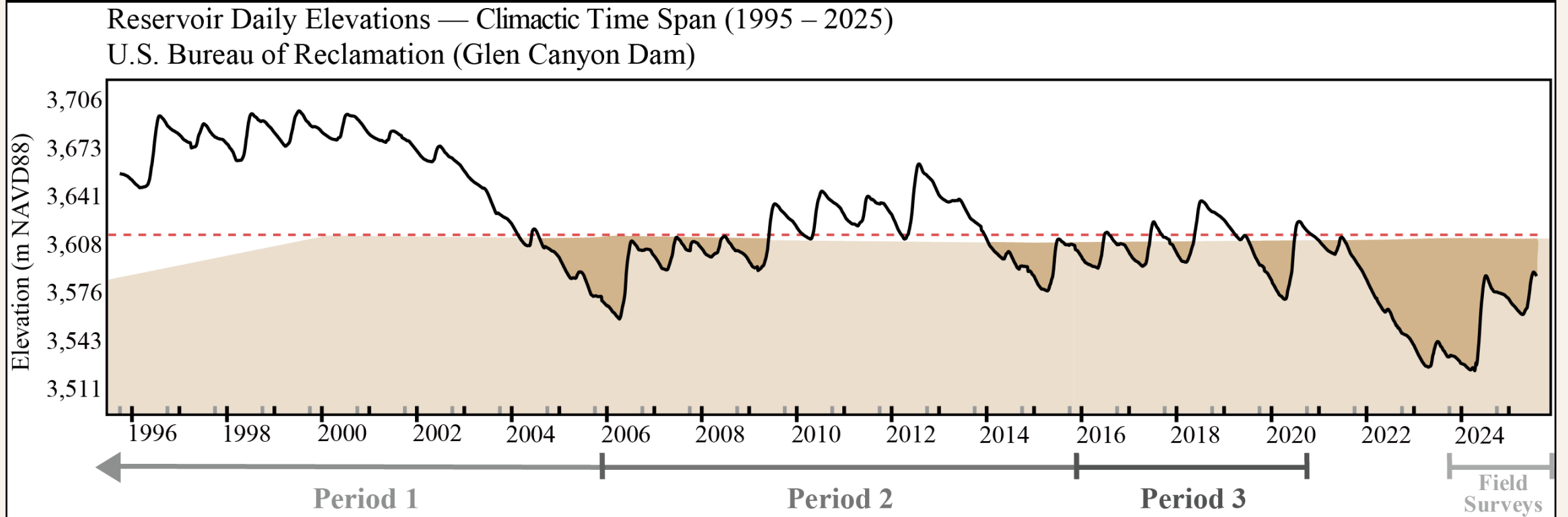


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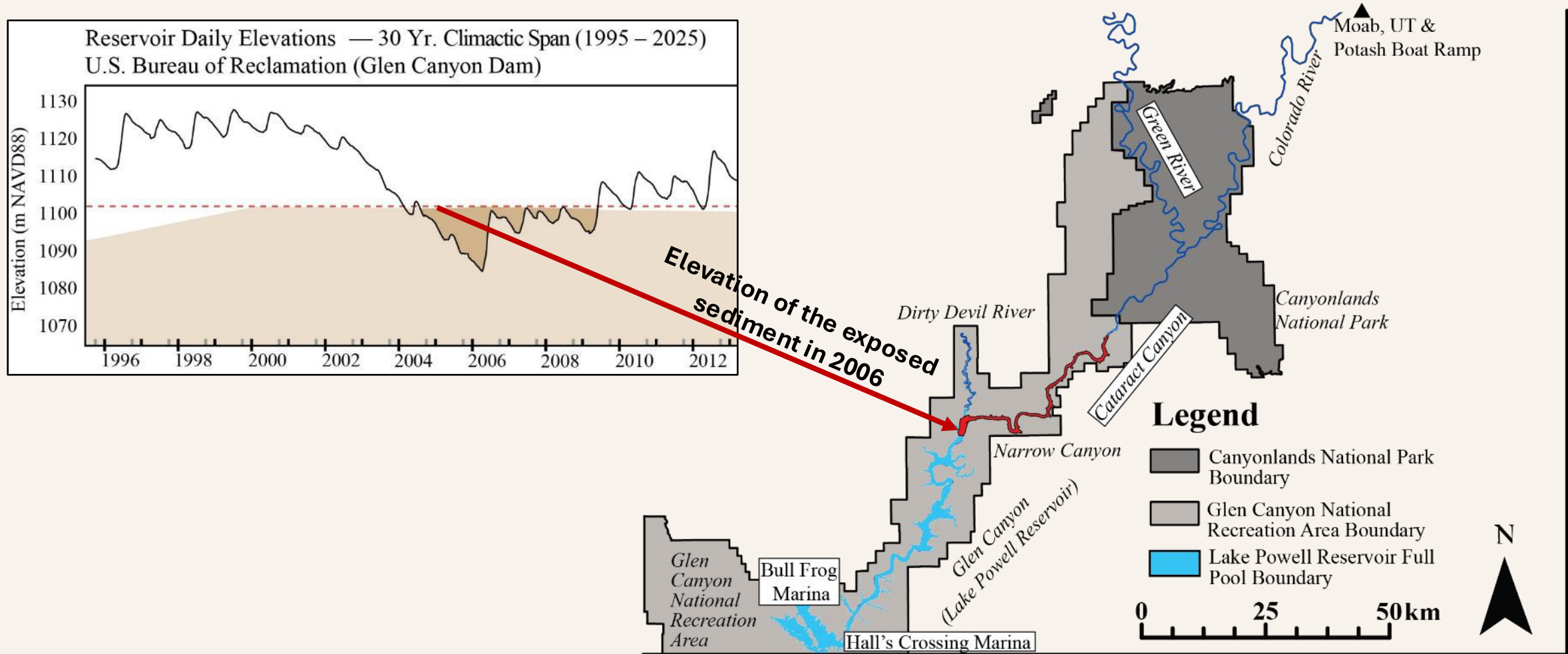


**NSF Futures Engine
in the Southwest**

As Reservoir Levels Fall, Large Amounts of Former Delta Sediment are Being Exposed & Remobilized



With Sustained Low Levels the River Begins to Take Control & Erode that Exposed Sediment

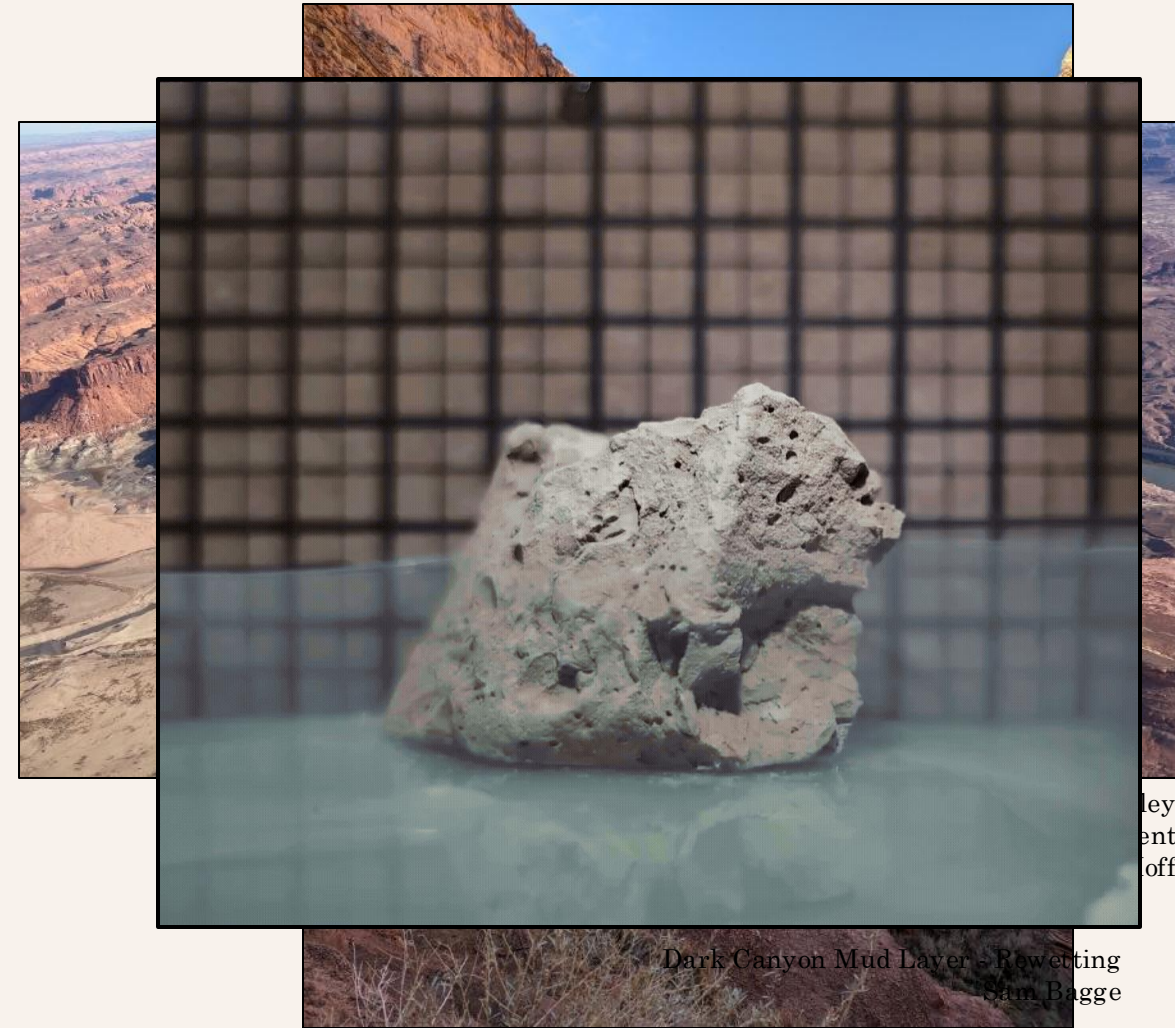


During Low Reservoir Levels We Looked At...

1- Seasonal Sediment Changes in Side Canyons

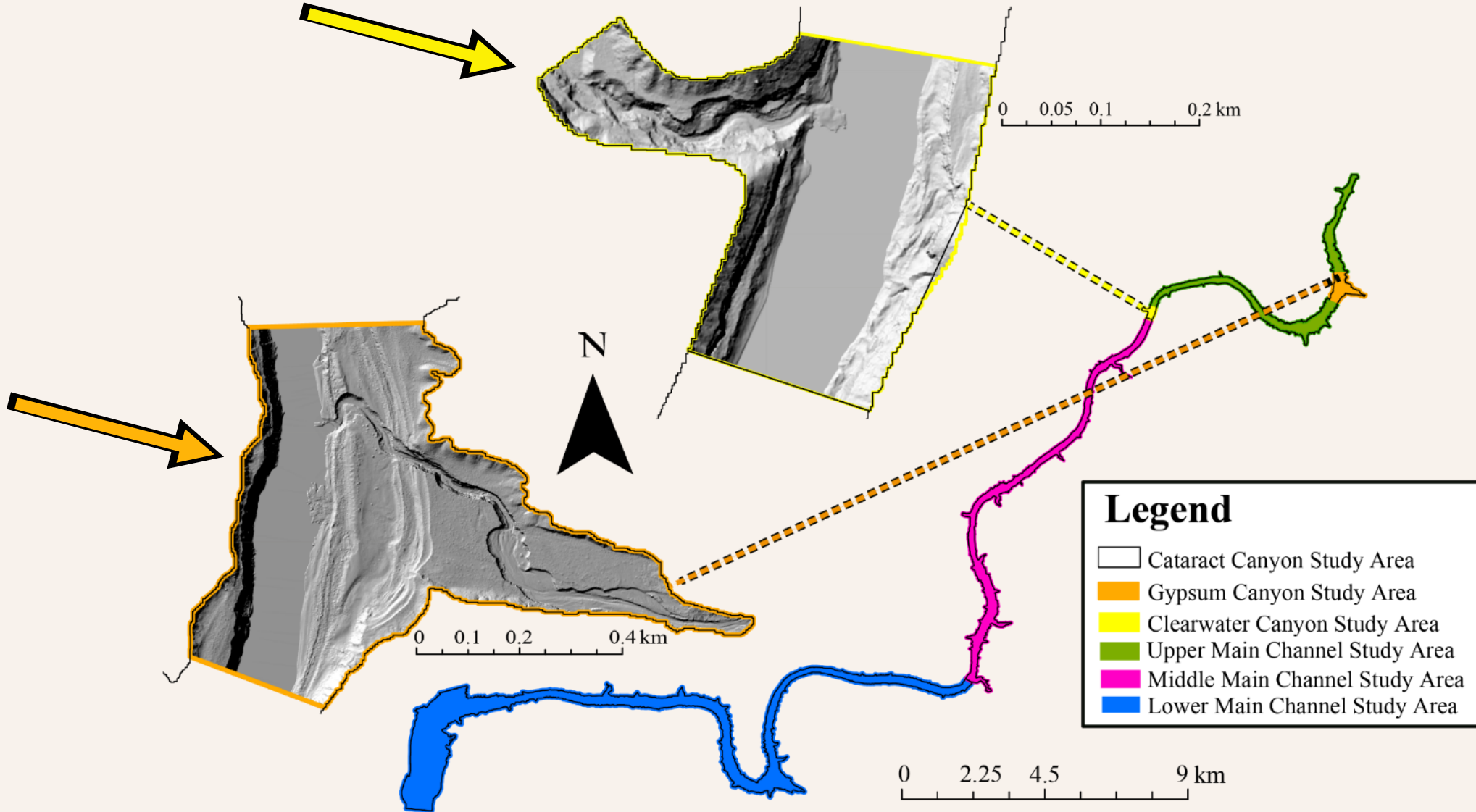
2 – Sediment Volume Change from 2006 to 2020 and how the river and reservoir influenced those changes

3 - Not all exposed sediments are the same.

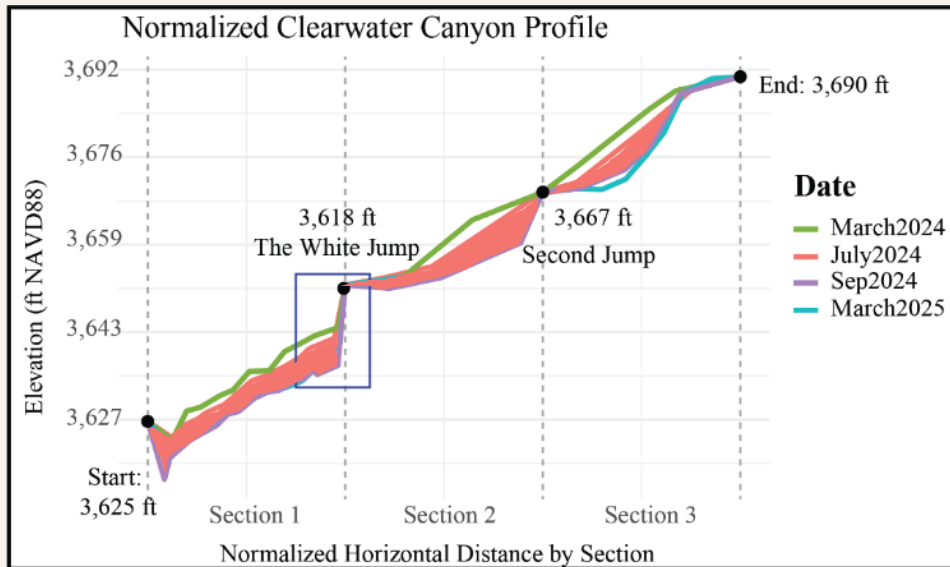
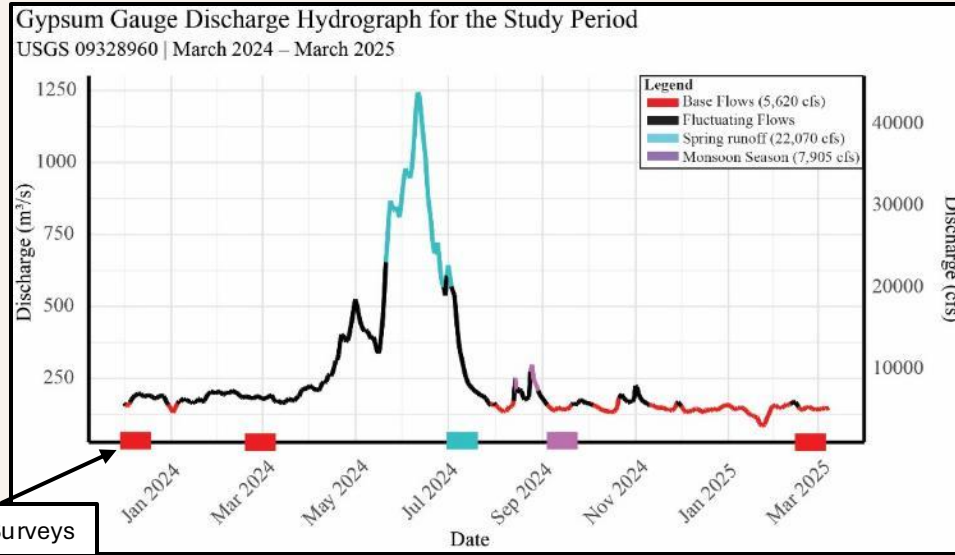


Looking up Clearwater Canyon
March 2024, Jesse Cattell

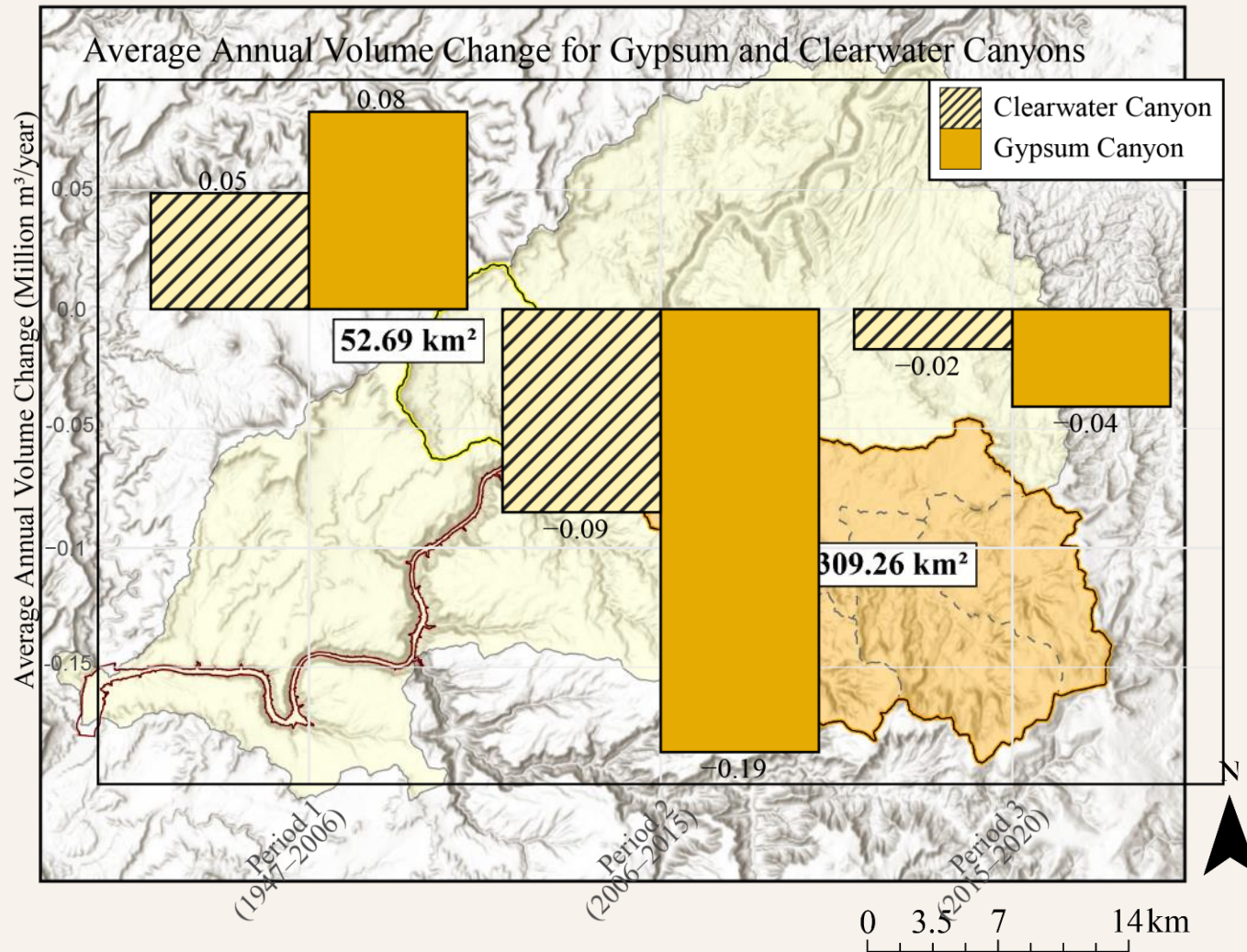
1- Flows Drive Sediment Movement & Canyon Form Defines Sediment Retention



Monsoon Flows Initiate the Greatest Sediment Movement in Tributary Canyons



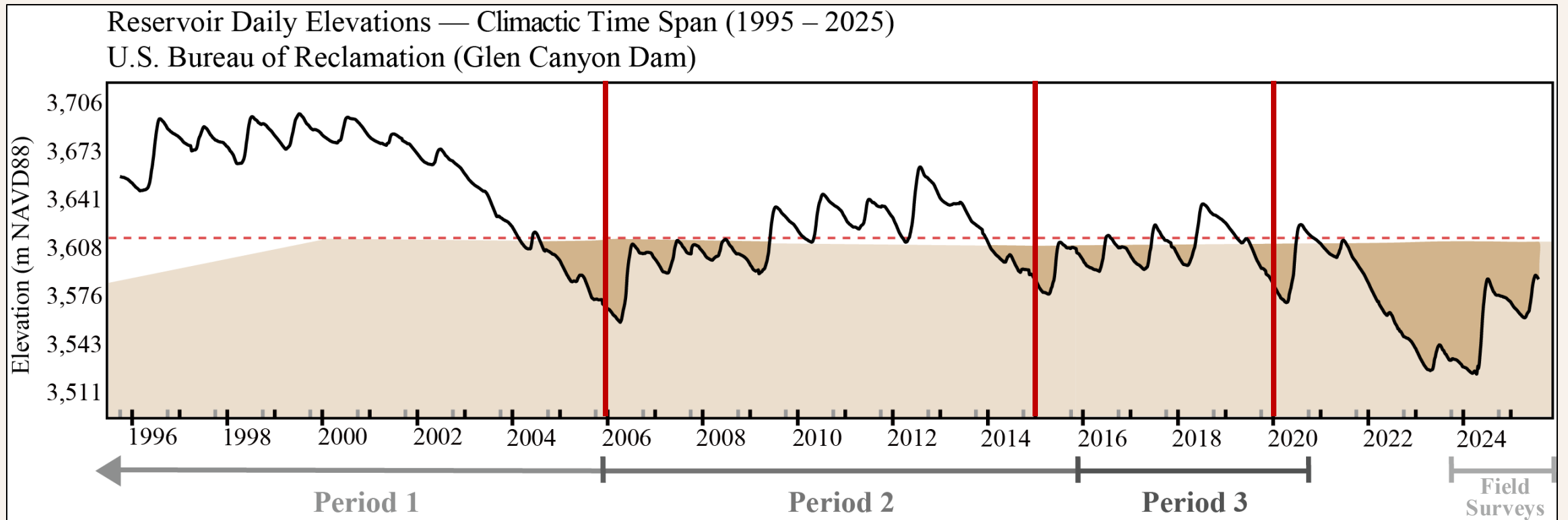
Canyon Morphology, Not Size, Controls Sediment Evacuation & Canyon Recovery



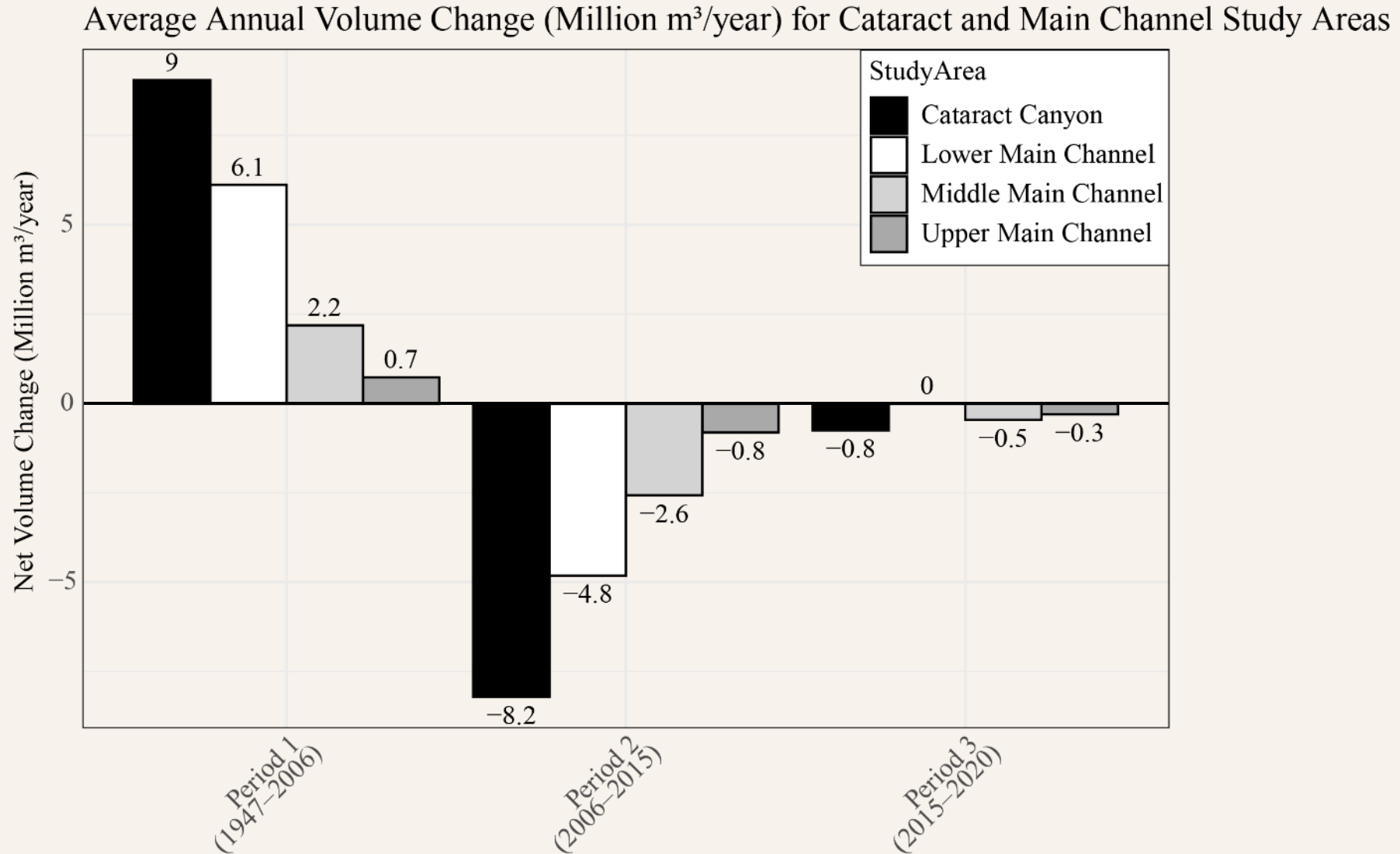
Period 2: At *Gypsum* erosion within the study area was **6X higher** than Clearwater, but *Clearwater's* sediment yield per watershed was **~60% lower**

Period 3: Erosion within *Clearwater's* study area became **70% higher** than *Gypsum's*, and its sediment yield was **2X as high**.

Remotely Sensed and Digitized Maps



2 - The River & Monsoon Floods Determine How Much Sediment Can Be MOVED Retreat of the Reservoir Dictates How Much Sediment Can LEAVE

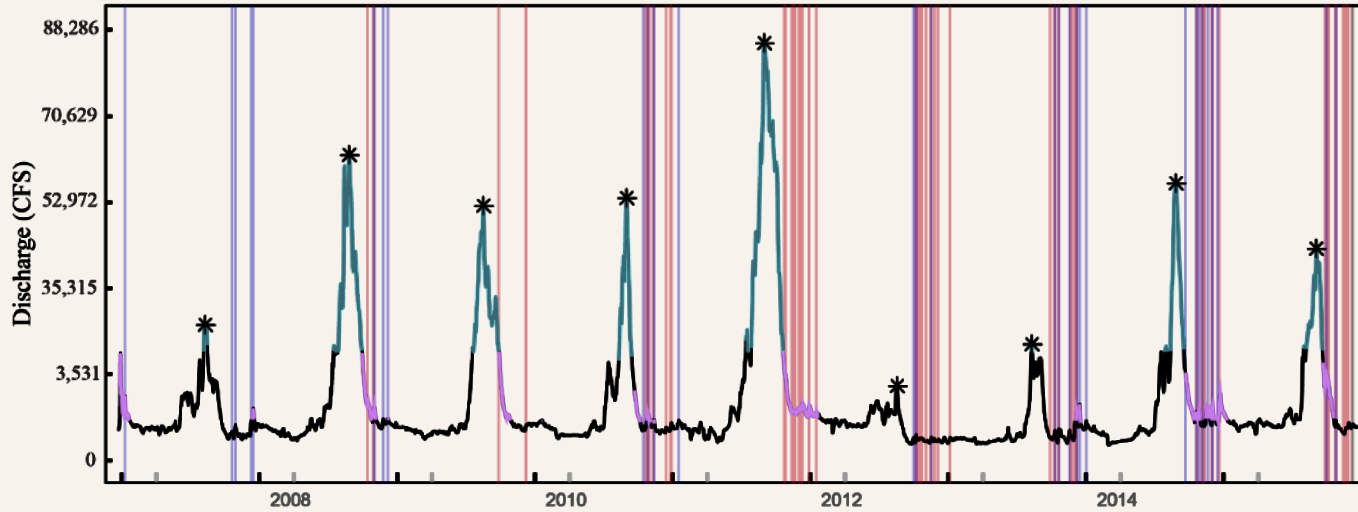


River & Monsoons Needed to Move Exposed Sediment Decreased During Period 3

Period 2 (2006 – 2015)

River Discharge in Cataract Canyon

Colorado River (USGS 09180500) + Green River (USGS 09315000)



Period 3 saw **significant decreases** in the ability for hydrologic forces to erode the exposed sediment

During Period 3...

Spring runoff peak discharge **decreased by 9%** = less river energy to move sediment out of study area

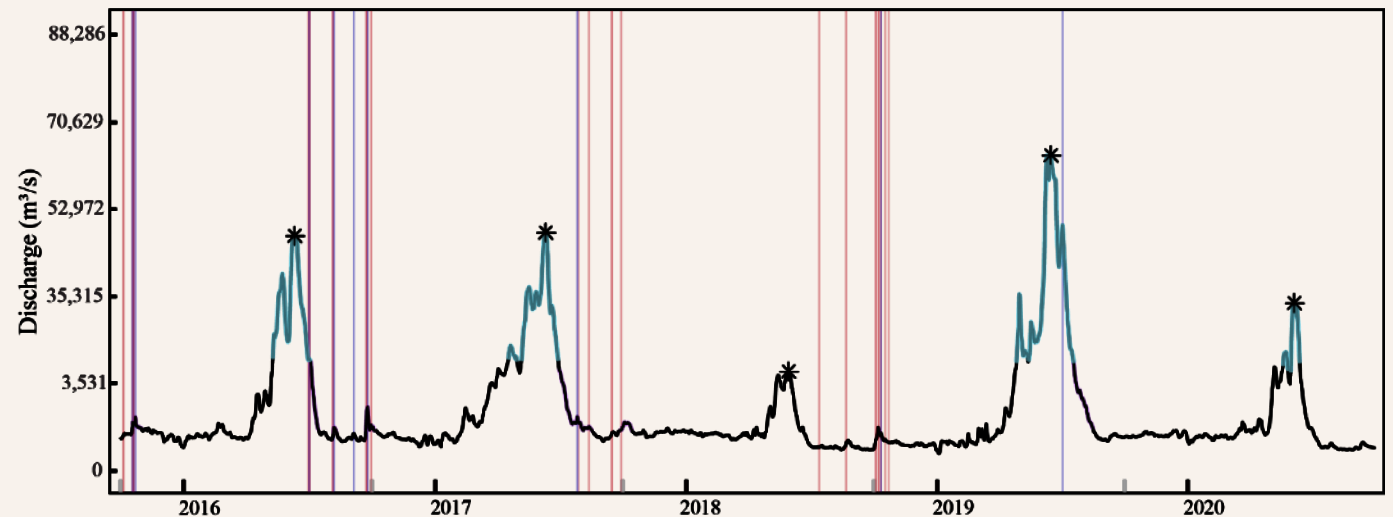
Regional & local monsoon events **decreased by 47%** = less local removal of exposed sediment

Annual Monsoon event days **decreased by 30%** = less late summer sediment erosion

Period 3 (2015 – 2020)

River Discharge in Cataract Canyon

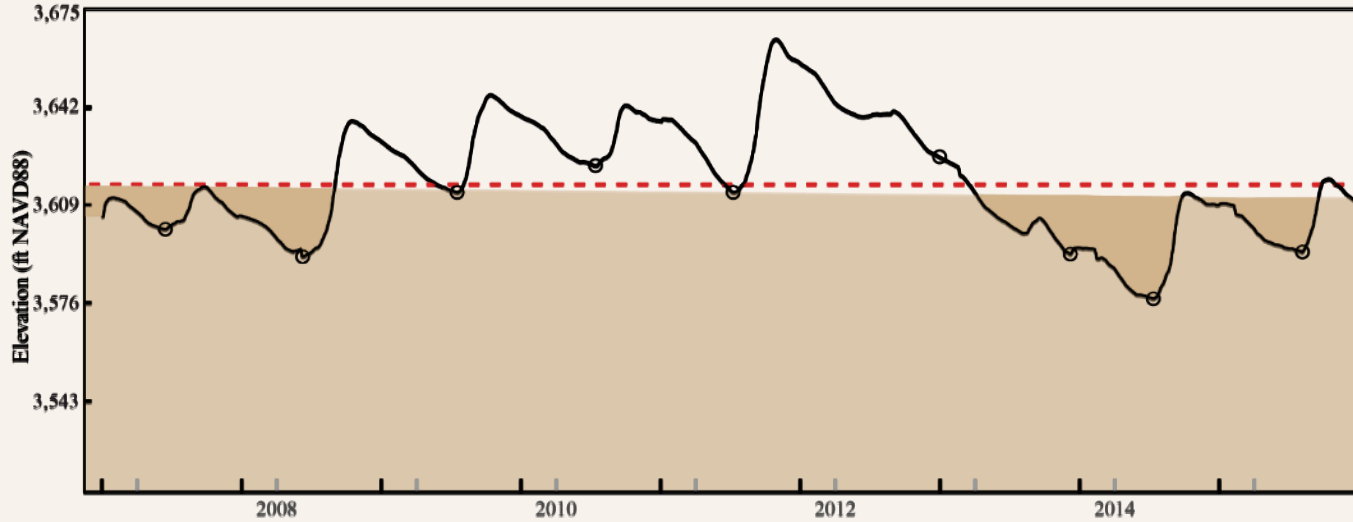
Colorado River (USGS 09180500) + Green River (USGS 09315000)



Period 3 Reservoir Conditions Favored Net Sediment Loss from the Cataract Canyon Study Area

Period 2 (2006 – 2015)

Reservoir Daily Elevations
U.S. Bureau of Reclamation (Glen Canyon Dam)



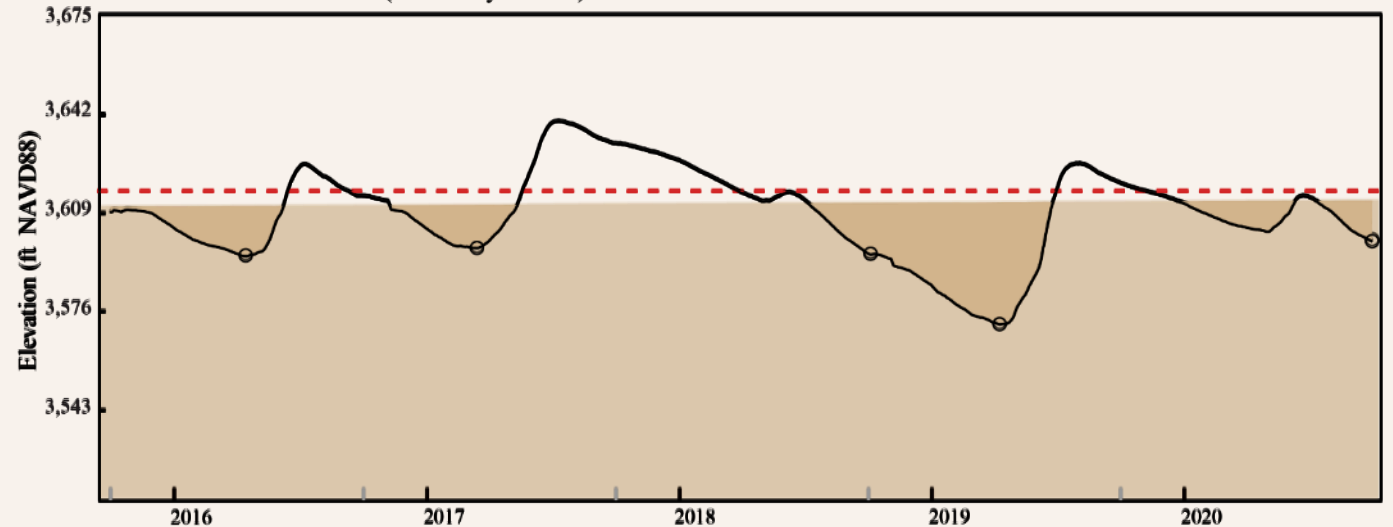
During Period 3

Annual minimum reservoir elevation **decreased by 11.5 ft** (4% of full-pool capacity)

Annual number of days below North Wash Canyon threshold **increased 36%** leading to sediment being exposed to river erosion longer

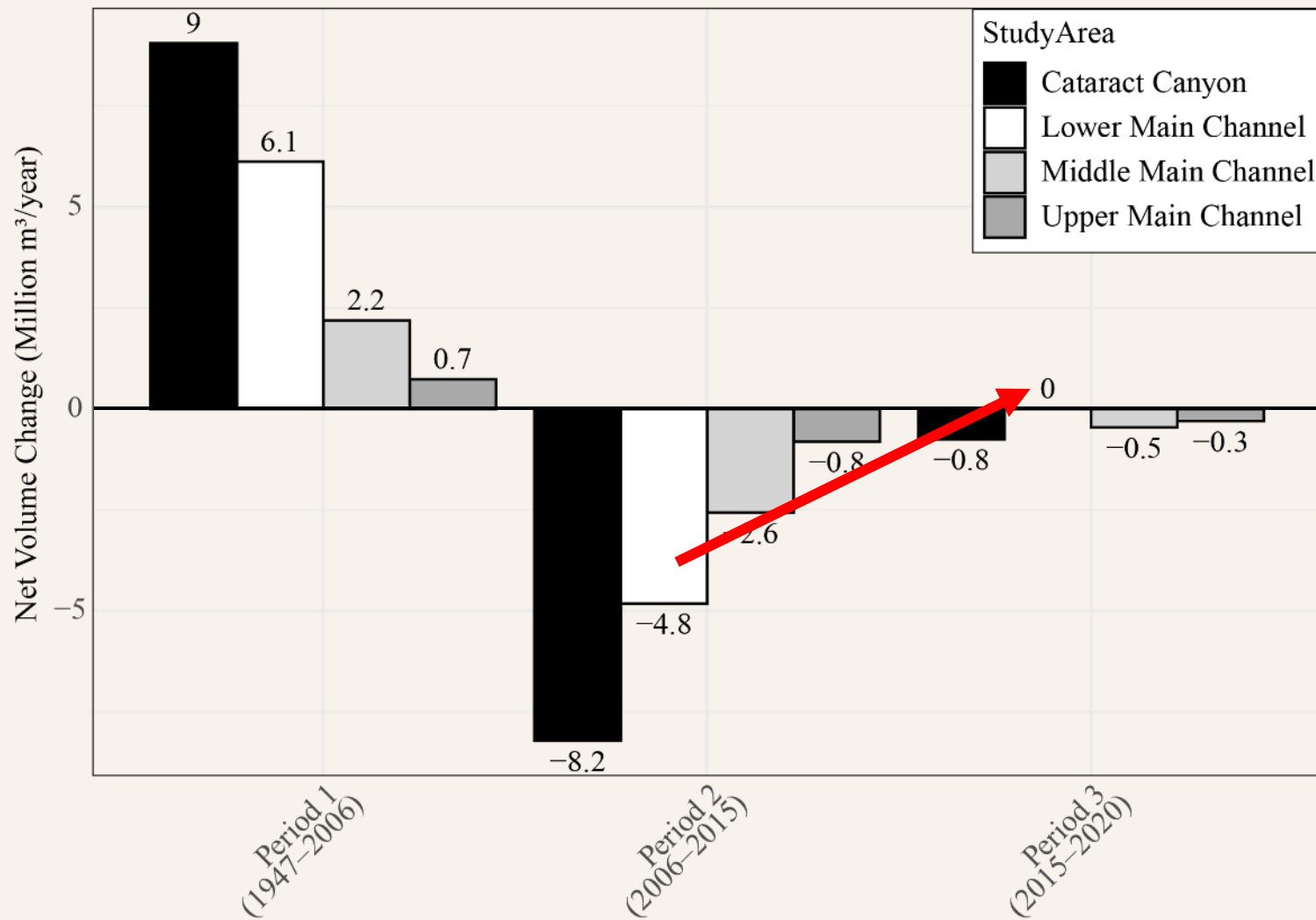
Period 3 (2015 – 2020)

Reservoir Daily Elevations
U.S. Bureau of Reclamation (Glen Canyon Dam)

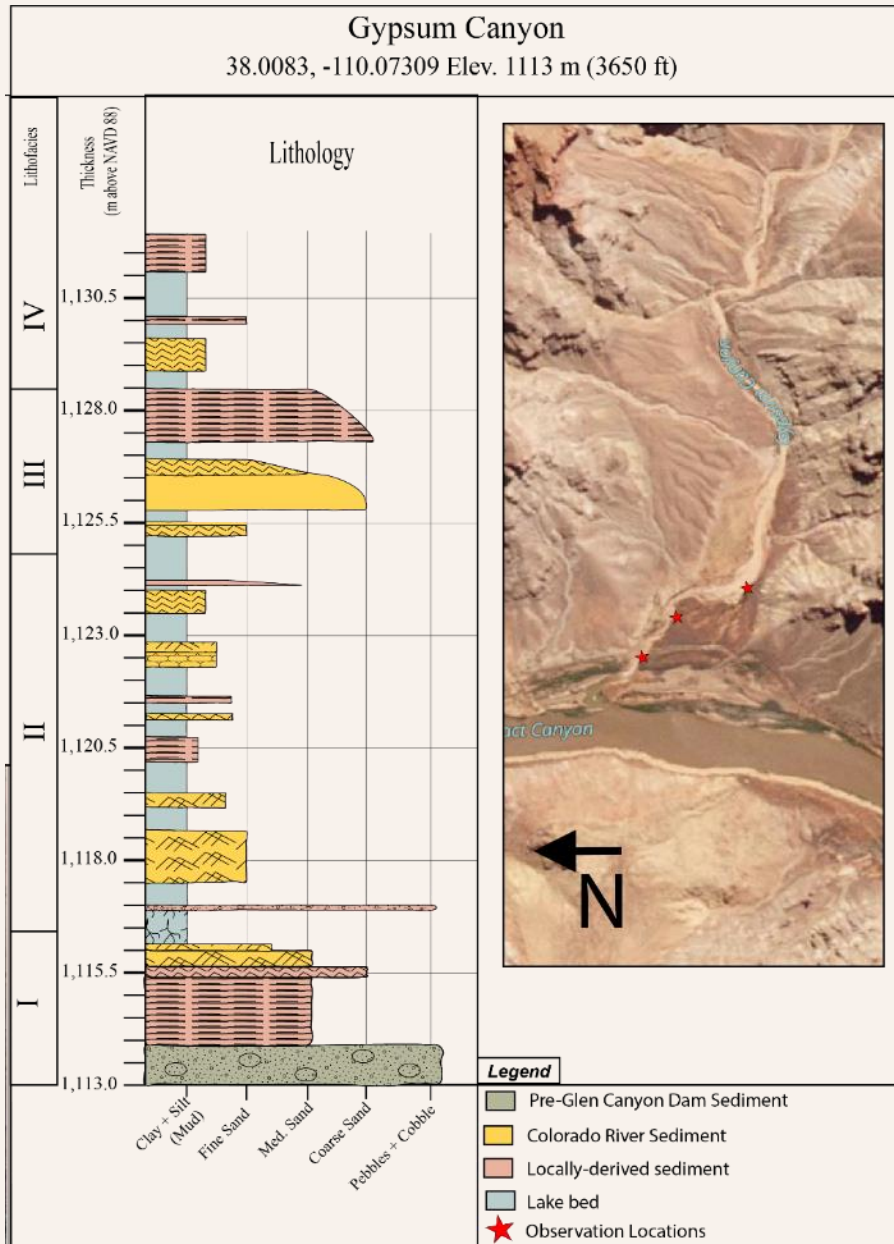


Unexpected Erosion Slowdown in the Lower Main Channel Hints at New Sediment Evacuation Controls

Average Annual Volume Change (Million m³/year) for Cataract and Main Channel Study Areas



3 - The “Exposed Sediments” Are Not All Equal

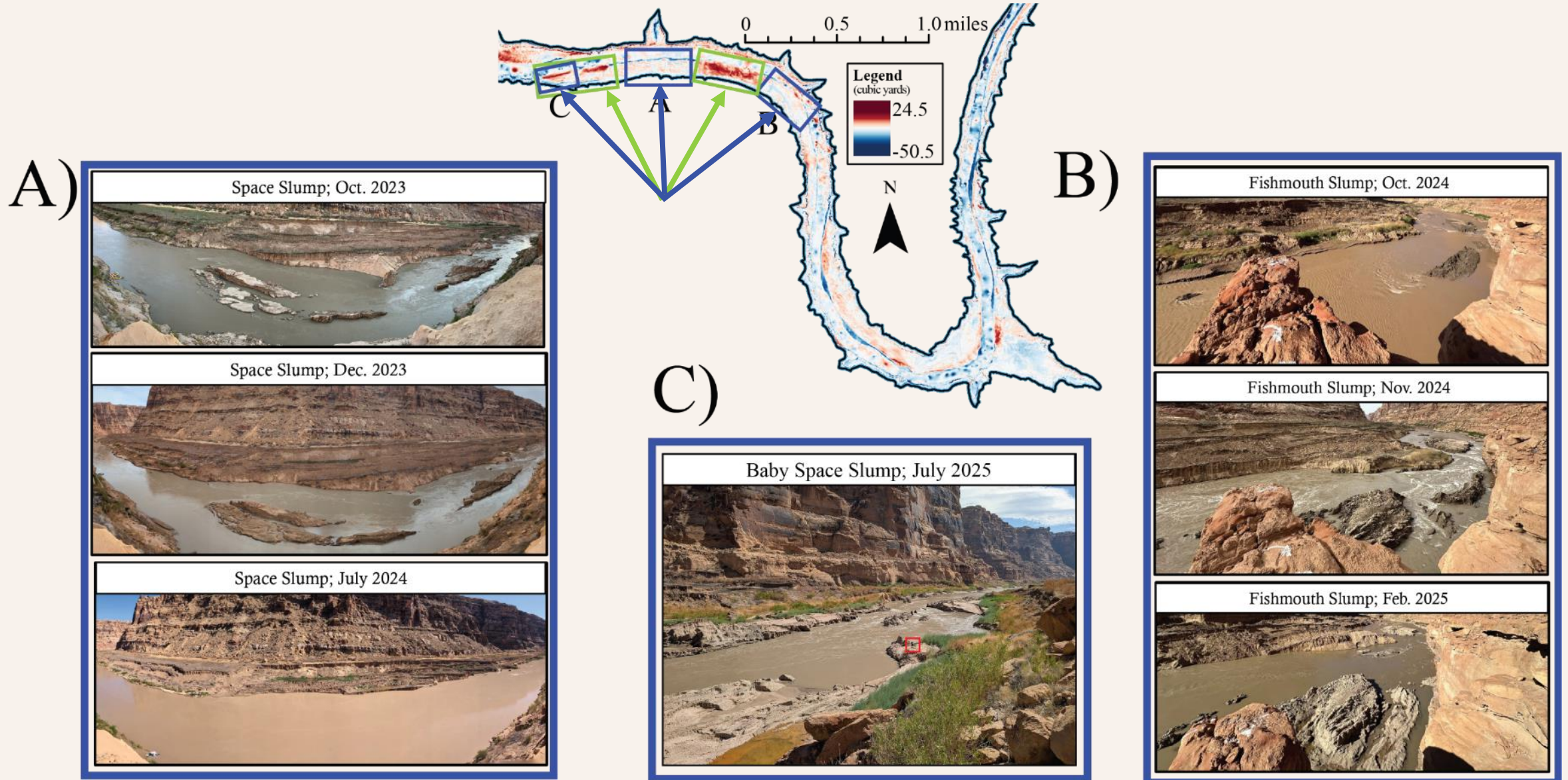


Space Slump
October 2023, Gary Gianniny

Coarse River Sands

Tightly-Packed Muds

Sediment Properties and Reservoir Influence Are Both Drivers of Modern Slump Events



3 Take Homes

1- Monsoon Floods Move the Most Sediment During the Year, While Canyon Shape Defines Rate of Removal

2 – Lower reservoir levels should've flushed sediment out, but weaker flows and new local controls caused deposition in the Lower Section instead

3 - Not all exposed sediments are the same. Coarse sands move more easily, while fine muds/clays are more durable



Thank you!

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Dr. Brenda Bowen – University of Utah

Dr. Cari Johnson – University of Utah

Mike DeHoff – Returning Rapids Project