RECLAMATION

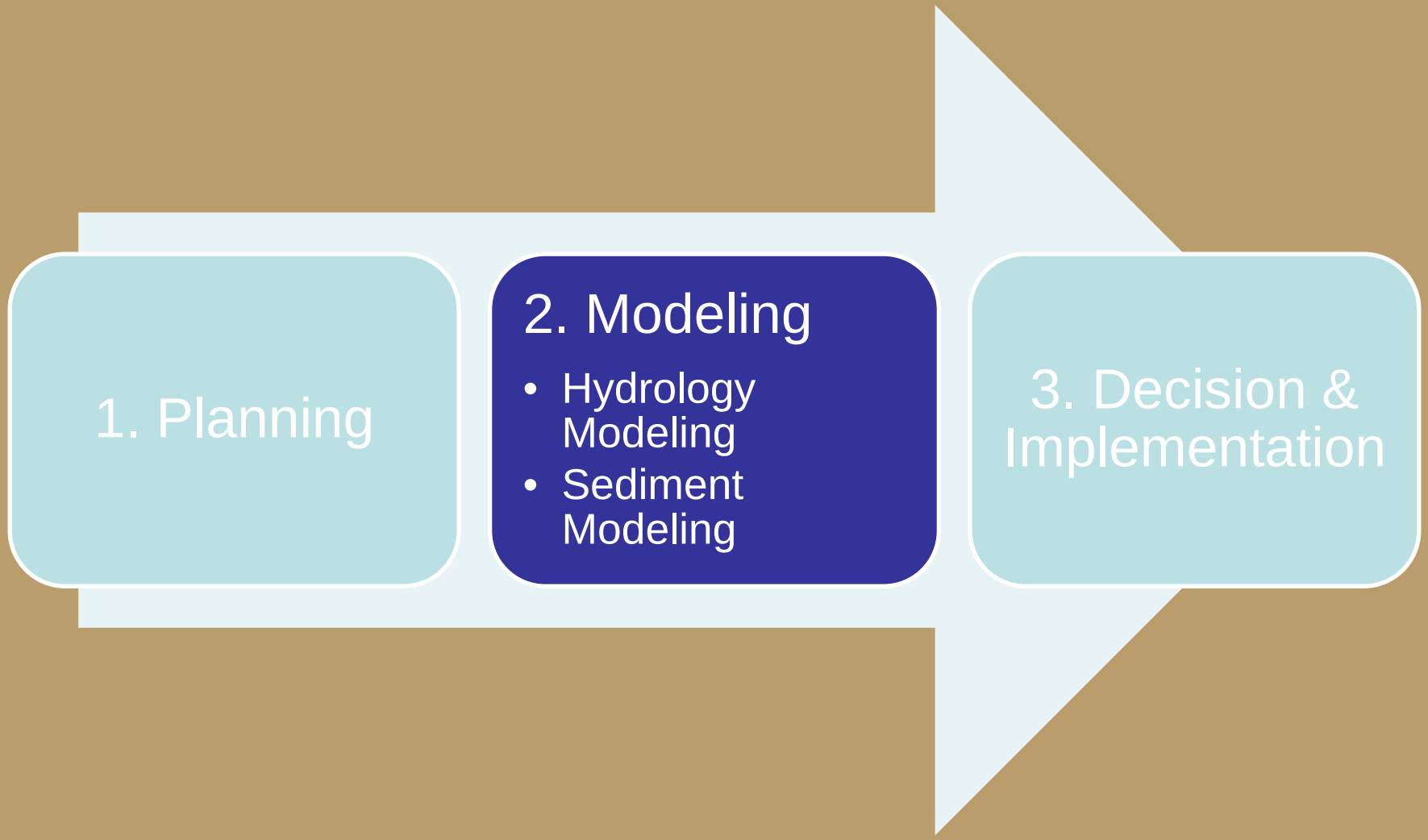
Managing Water in the West

High Flow Experiment Modeling Process

AMWG Meeting
August 29, 2012

U.S. Department of the Interior
Bureau of Reclamation

HFE Protocol



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Hydrology Modeling

- **Hourly release at Glen Canyon Dam**
  - **Historic hourly**
  - **Forecasted**
    - **24 Month Study**
    - **Hourly patterns by WAPA**

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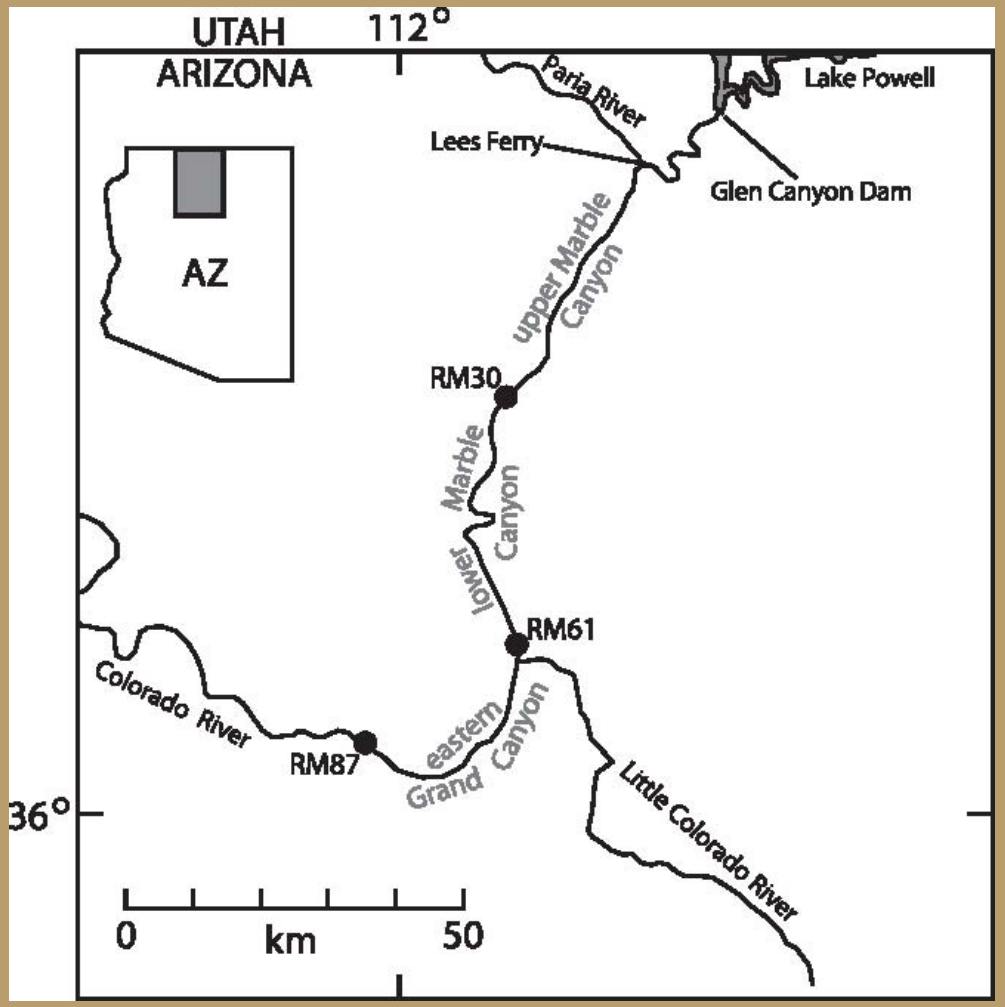
Hydrology Modeling

- Hourly flow at 3 locations
  - RM30 (upper Marble Canyon)
  - RM61 (lower Marble Canyon)
  - RM87 (eastern Grand Canyon)



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Sand Budget Model

- Developed from USGS model (Wright et al. 2010)
  - Empirically based rating curves
  - Computes sand budget in 3 reaches
- Inputs:
  - Hourly Paria sand load
  - Antecedent conditions
- Determines HFE peak and duration
  - Potential HFE range:
    - 45,000 to 31,000 cfs, 96 hours to 1 hour
- Output
  - Sand mass balance between RM 0 and RM 61

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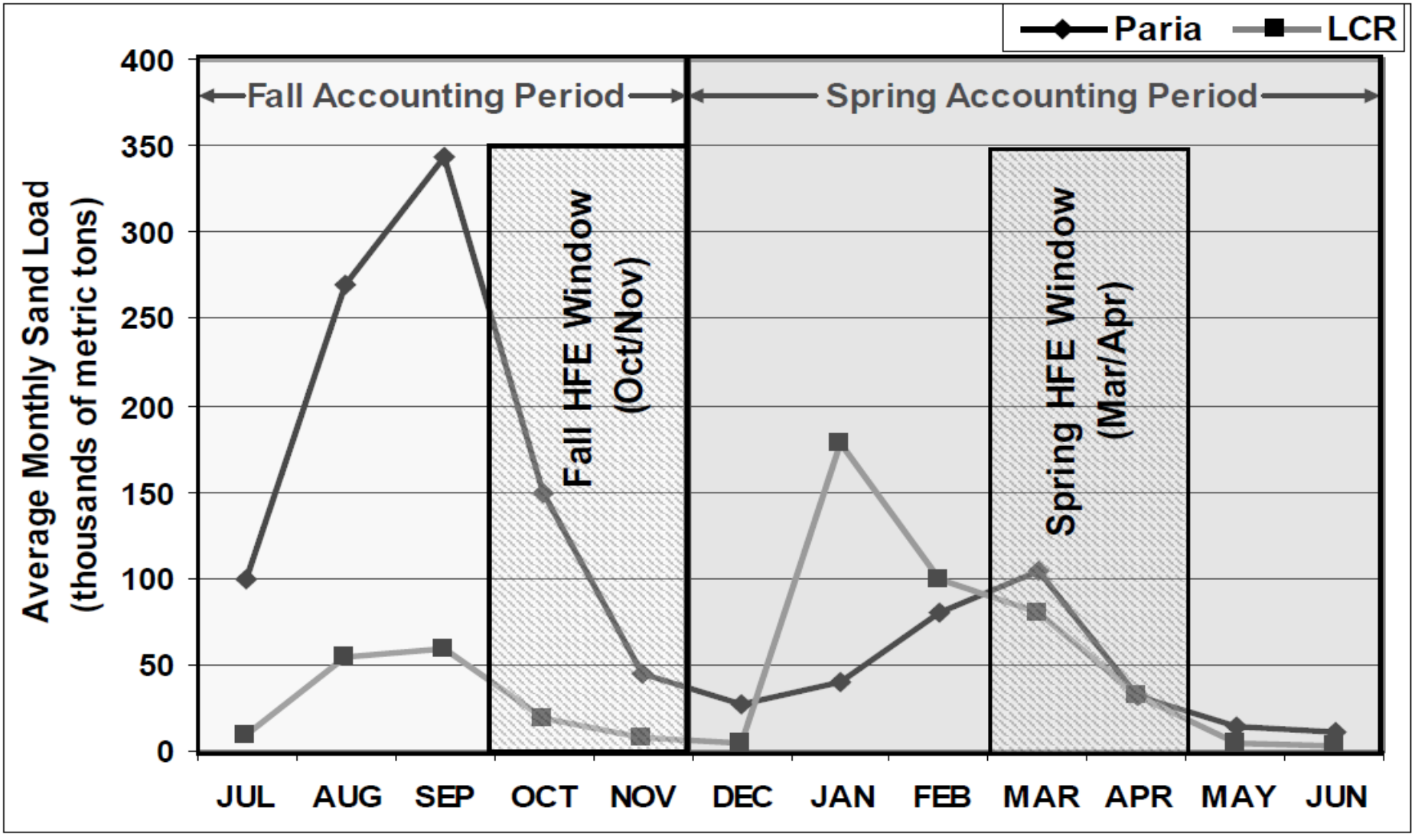
Sand Inputs



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HFE Types

HFE No.	Peak Magnitude (cfs)	Peak Duration (hrs)
1	37,000	96
2	37,000	72
3	37,000	60
4	37,000	48
5	37,000	36
6	37,000	24
7	37,000	12
8	37,000	1
9	35,125	1
10	33,250	1
11	31,375	1

Potential for Fall HFE

- August 28th model results
- Hydrology modeling
  - Observed hourly GCD release (through 8/28)
  - Most probable hydrology
- Sand budget modeling
    - Year-to-date sand load + zero future input

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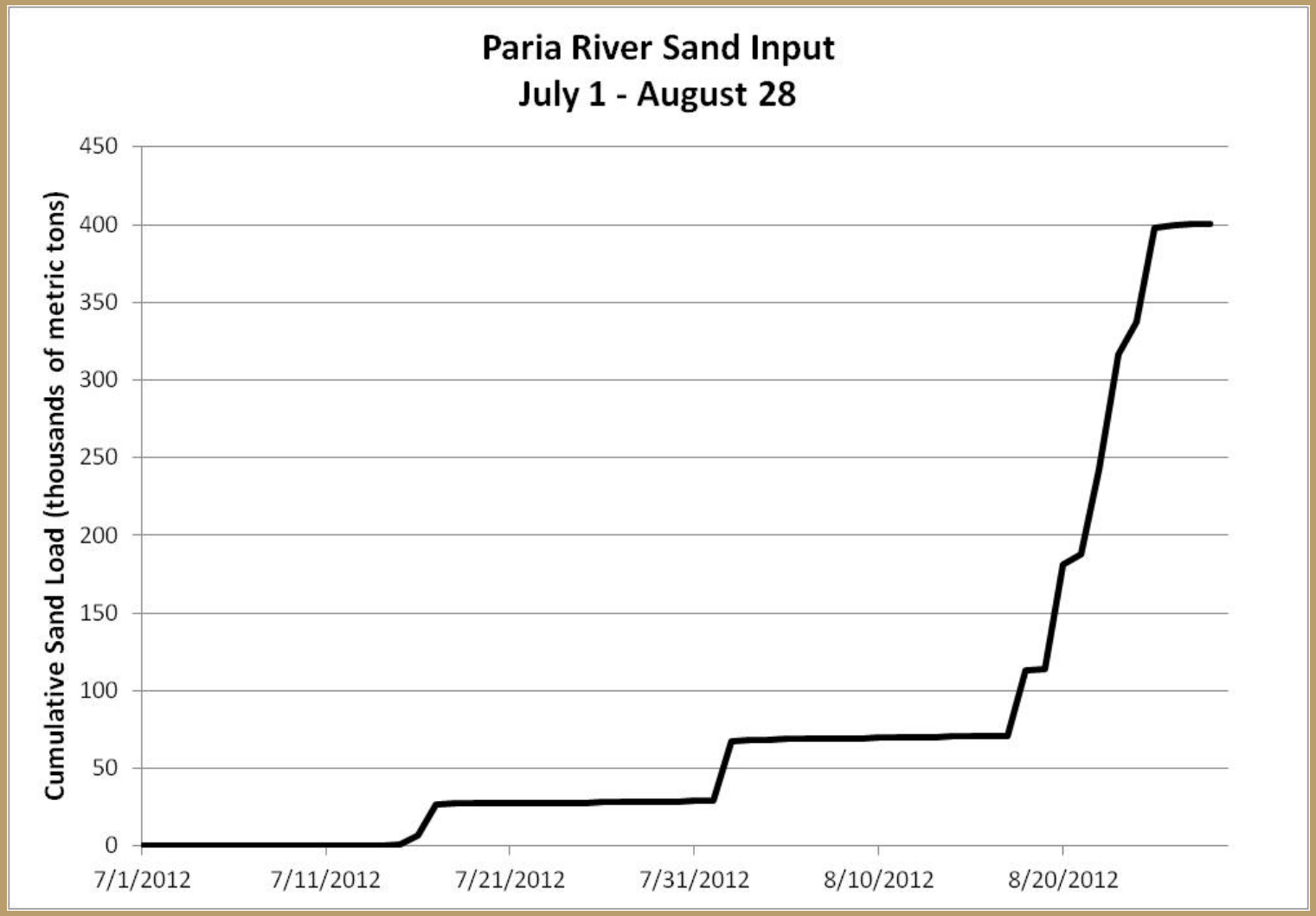
Paria Sand Inputs



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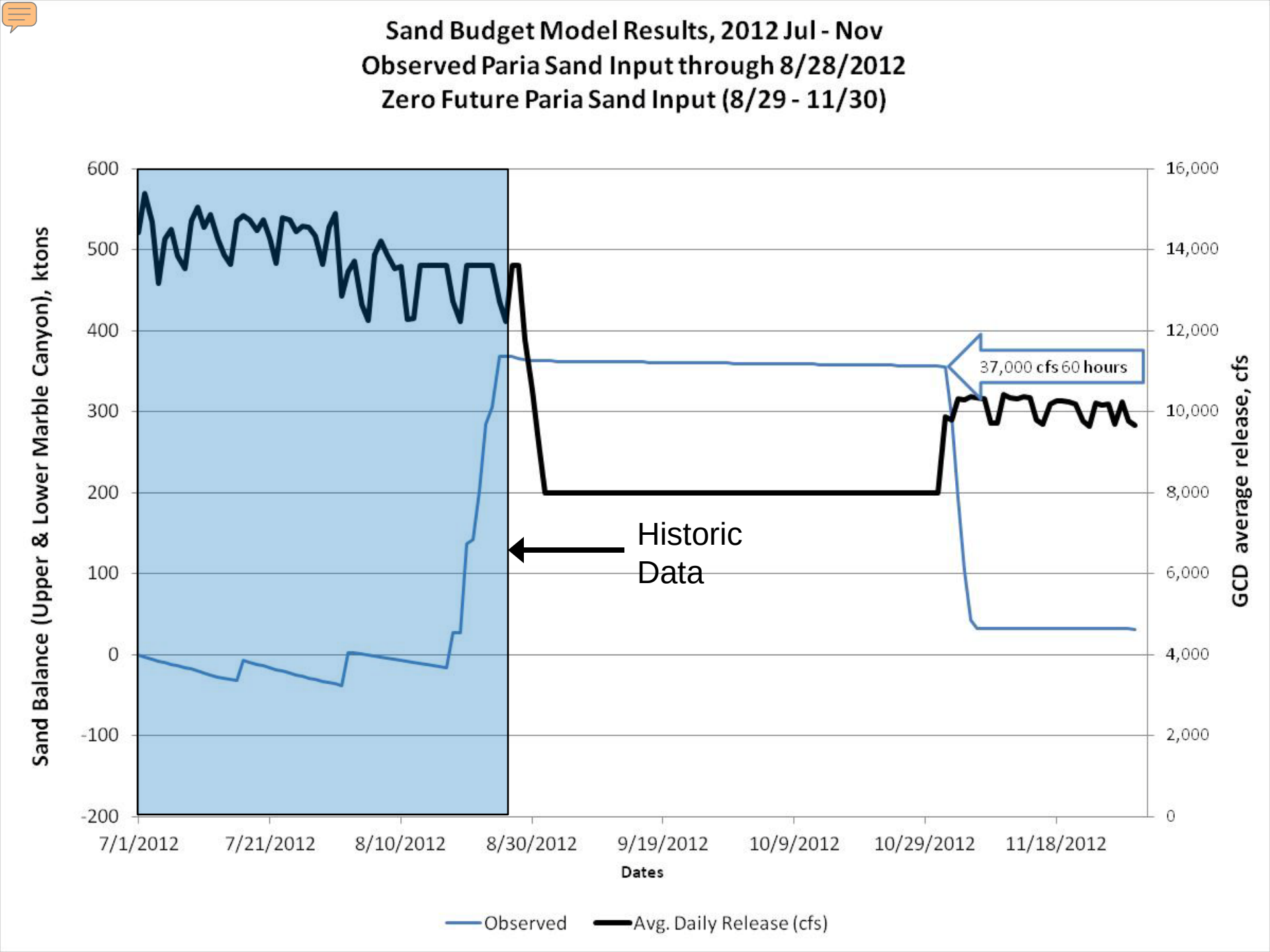
Sand Budget Model Results, 2012 Jul - Nov
Observed Paria Sand Input through 8/28/2012
Zero Future Paria Sand Input (8/29 - 11/30)
Sand Balance (Upper & Lower Marble Canyon), ktons
GCD average release, cfs
600
500
400
300
200
100
0
-100
-200
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
37,000 cfs 60 hours
Historic Data
7/1/2012
7/21/2012
8/10/2012
8/30/2012
9/19/2012
10/9/2012
10/29/2012
11/18/2012
Dates
Observed
Avg. Daily Release (cfs)

Questions?

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Supplemental Slides

24 Month Study

- Presents 2-year projected operations for the Colorado River system reservoirs given:
  - Existing reservoir conditions
  - Monthly reservoir inflow forecasts (from NWS-CRBRFC)
    - Most probable (50%) forecast
  - Operational policies & guidelines
- Maximum (90%) and minimum (10%) probable forecasts included in:
  - January
  - April
  - August
  - October

Sand Budget Modeling

- **Developed by USGS: "Modeling Long-Term Sediment Budgets in Supply-Limited Rivers" (Wright et. al. 2010)**
  - **Empirically based rating curves**
  - **Computes sand budget in 3 reaches**
- **Inputs**
  - **Hourly flow in each reach**
  - **Sediment inputs from Paria and Little Colorado Rivers**
- **Output**
  - **Sand mass balance**
  - **Thickness of bed, D_{50} of bed material, suspended sediment D_{50} and concentration**

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Sand Budget Modeling

- **Model simulates 13 HFEs**
  - **Magnitude 45,000 to 31,000 cfs**
  - **Duration 96 hours to 1 hour**
- **HFE windows**
  - **March/April**
  - **October/November**
- **Model determines greatest magnitude HFE that will not result in a negative sand balance**
  - **Spring accounting period (Dec 1 to Jun 30)**
  - **Fall accounting period (Jul 1 to Nov 30)**

Modeling Timeline

Modeling for Fall Accounting Period (Jul-Nov)											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Hydrology Component											
Most Probable	X	X	X	X	X	X	X	X	X	X	X
Minimum & Maximum	X			X							
Sediment Component											
Probabilistic (10,50,90)	X	X	X	X	X	X	X	X	X	?	?
Sediment Input to Date, Zero Future Input							X	X	X	X	X

Modeling Frequency:
Event-Driven

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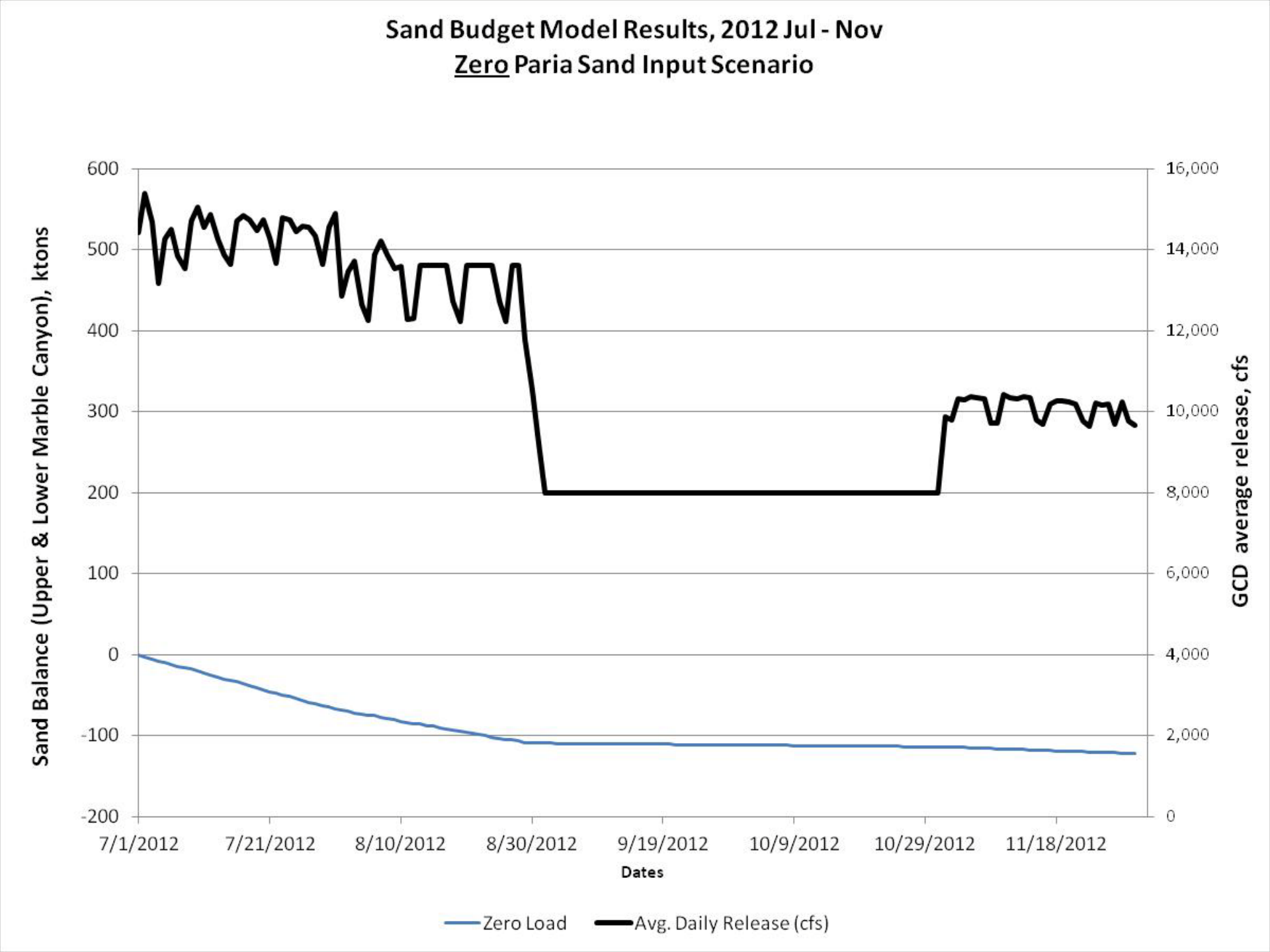
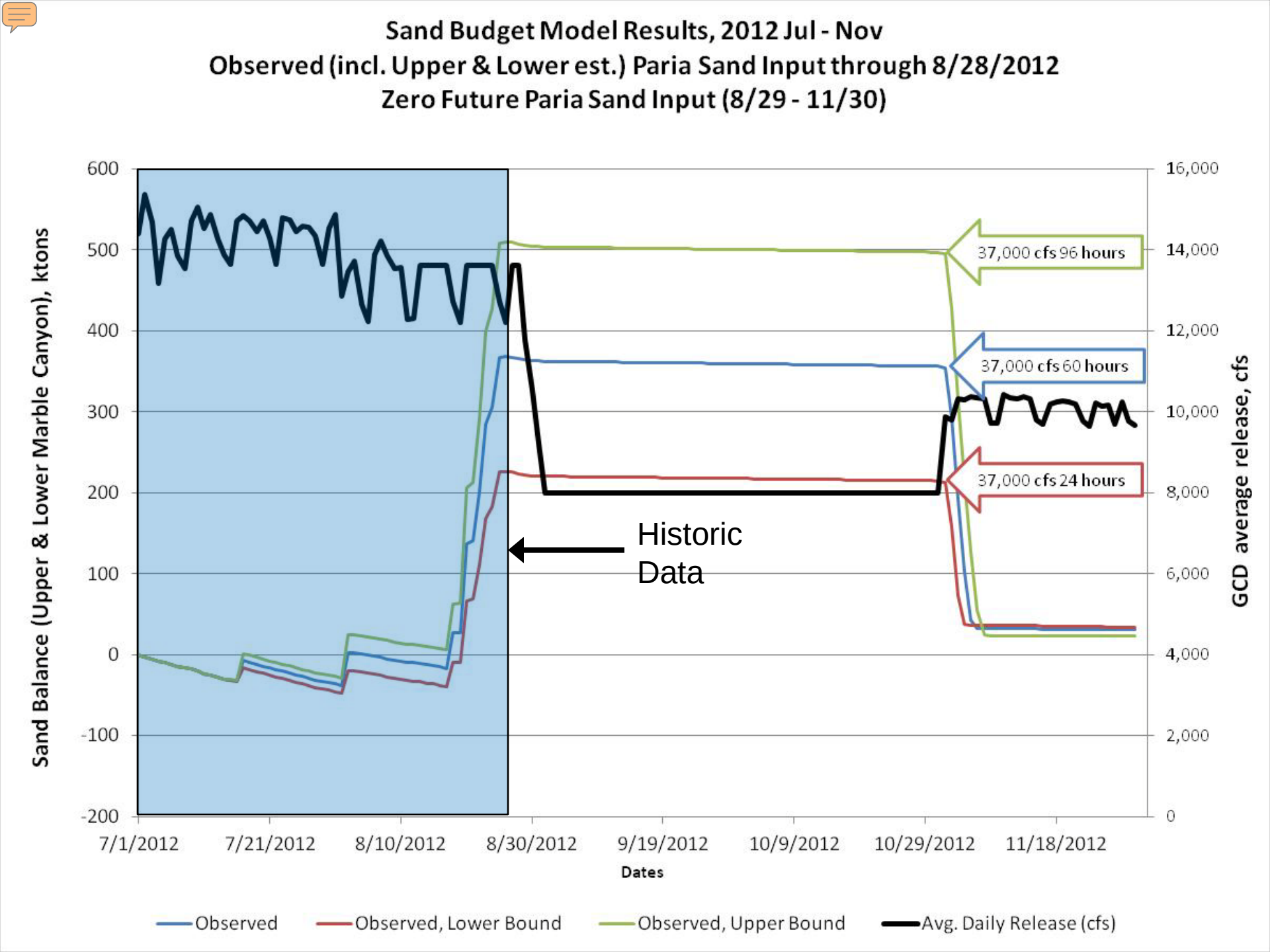

Sand Budget Model Results, 2012 Jul - Nov
Zero Paria Sand Input Scenario
Sand Balance (Upper & Lower Marble Canyon), ktons
GCD average release, cfs
600
500
400
300
200
100
0
-100
-200
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
7/1/2012
7/21/2012
8/10/2012
8/30/2012
9/19/2012
10/9/2012
10/29/2012
11/18/2012
Dates
Zero Load
Avg. Daily Release (cfs)


Sand Budget Model Results, 2012 Jul - Nov
Observed (incl. Upper & Lower est.) Paria Sand Input through 8/28/2012
Zero Future Paria Sand Input (8/29 - 11/30)
Sand Balance (Upper & Lower Marble Canyon), ktons
GCD average release, cfs
600
500
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6,000
4,000
2,000
0
7/1/2012
7/21/2012
8/10/2012
8/30/2012
9/19/2012
10/9/2012
10/29/2012
11/18/2012
Dates
37,000 cfs 96 hours
37,000 cfs 60 hours
37,000 cfs 24 hours
Historic Data
Observed
Observed, Lower Bound
Observed, Upper Bound
Avg. Daily Release (cfs)