Geomorphic Monitoring of the Patapsco River Following the Removal of the Simkins Dam, Patapsco River, Maryland

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NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

McCormick Taylor
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Thriving By Nature

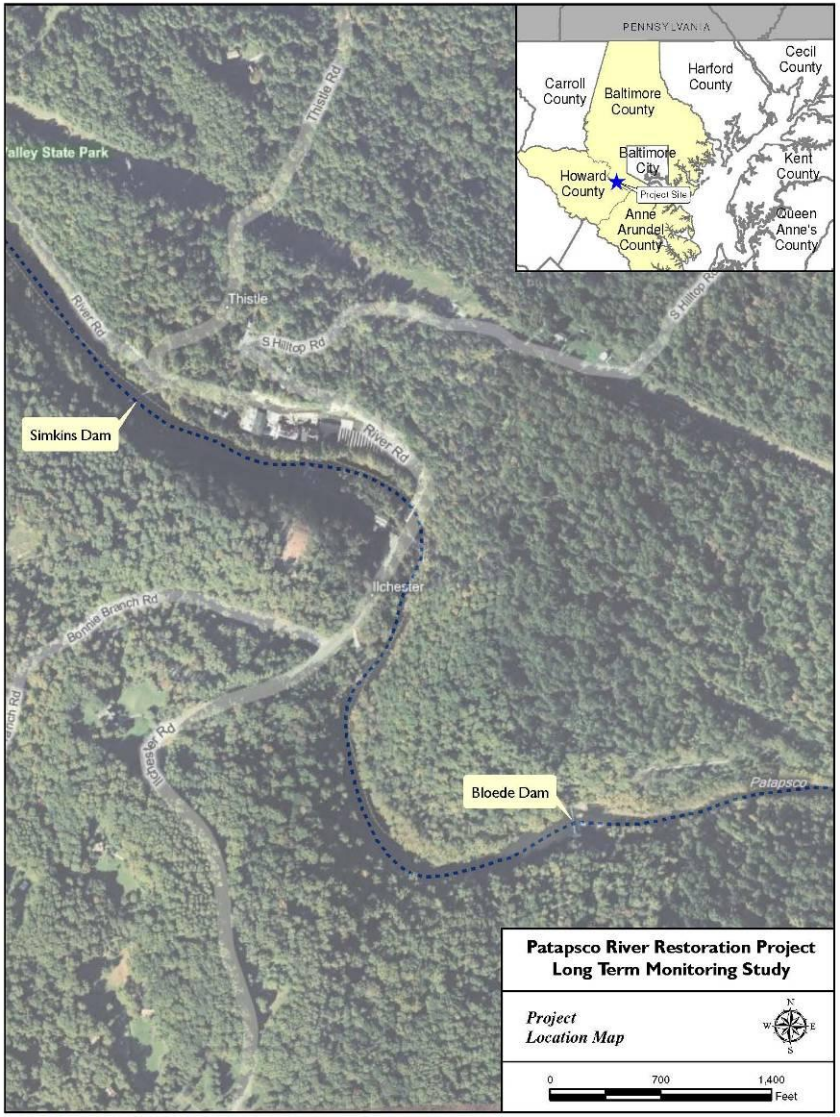
Johns Hopkins University

USGS science for a changing world

UMBC An Honors University in Maryland

Background

- Union Dam removed February/March, 2010
- Simkins Dam removed December, 2010
  - 10-foot high, 150-foot long concrete structure, trapping an estimated 110,000 cy of sediment
  - Passive sediment management
- Bloede Dam removal currently in the design phase
  - 34-foot high, 220-foot long concrete structure, trapping an estimated 90,000 cy of sediment



Morphometric Monitoring

Goals

- Track sediment transport from the Simkins Dam
- Determine areas of erosion and deposition
- Provide data for the adaptive management plan
- Confirm simulations provided by the DREAM-1 model
- Provide a tool to assist in public relations and aid future efforts

Tools

- 31 Cross Sections
  - 2 Reference Reach Sections
  - 2 Union Dam Sections
  - 63,750 feet, 12 Miles
- 5 Digital Elevation Models (12,900 lf, 2.4 Miles)
- Facies and Site Mapping
- Grain Size Analysis
- >100 Permanent Photo Monitoring Sites
- Bathymetric Survey

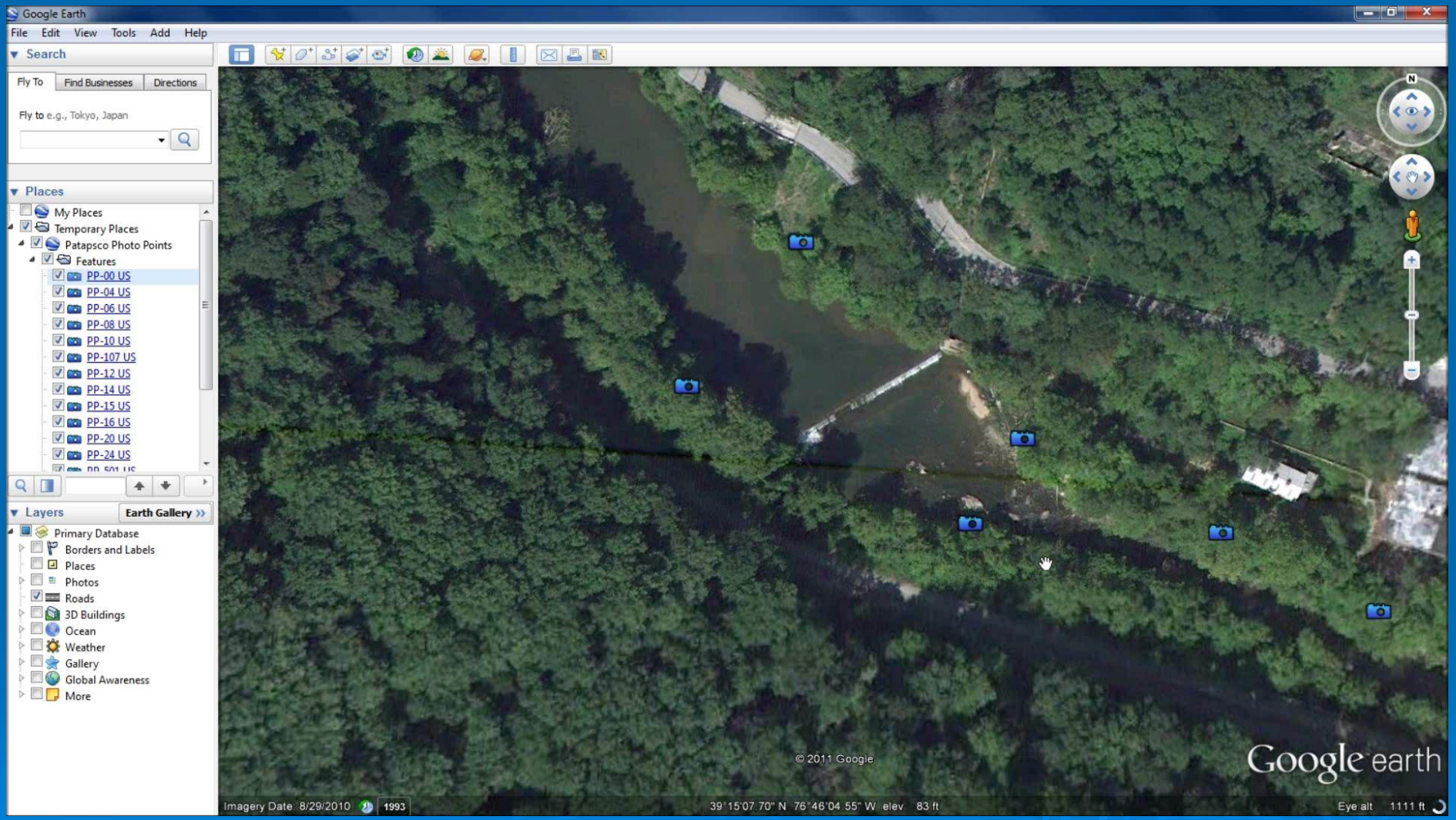
Three year monitoring effort including two surveys per year with one event driven survey

Simkins Dam

Bloede Dam

Approximately 4350 feet downstream of the Simkins Dam

Google Earth Photos



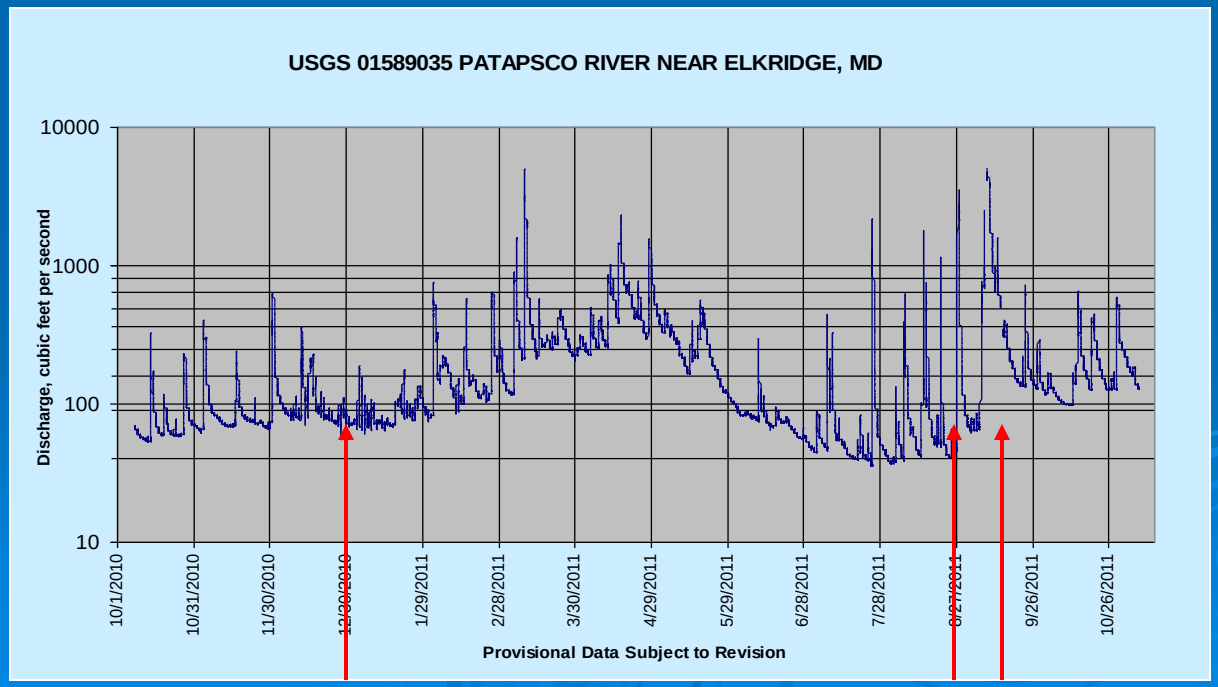
103 Benchmarked Photo Monitoring Sites including camera height and bearing

Storm Events- Elkridge Gage

Approximately 3.5 river miles downstream of Simkins Dam

- 5010 cfs 3/10/11
- 3270 cfs 3/28/11
- 2500 cfs 7/25/11
- 2500 cfs 4/28/11
- 2300 cfs 4/17/11
- 2300 cfs 4/13/11
- 1600 cfs 3/7/11

9/8/11 TS Lee, Recorded as 16,600 cfs at Hollofield Gage



Dam Removal

Hurricane Irene/TS Lee

Sediment Dispersal

Post Removal 2/13/11

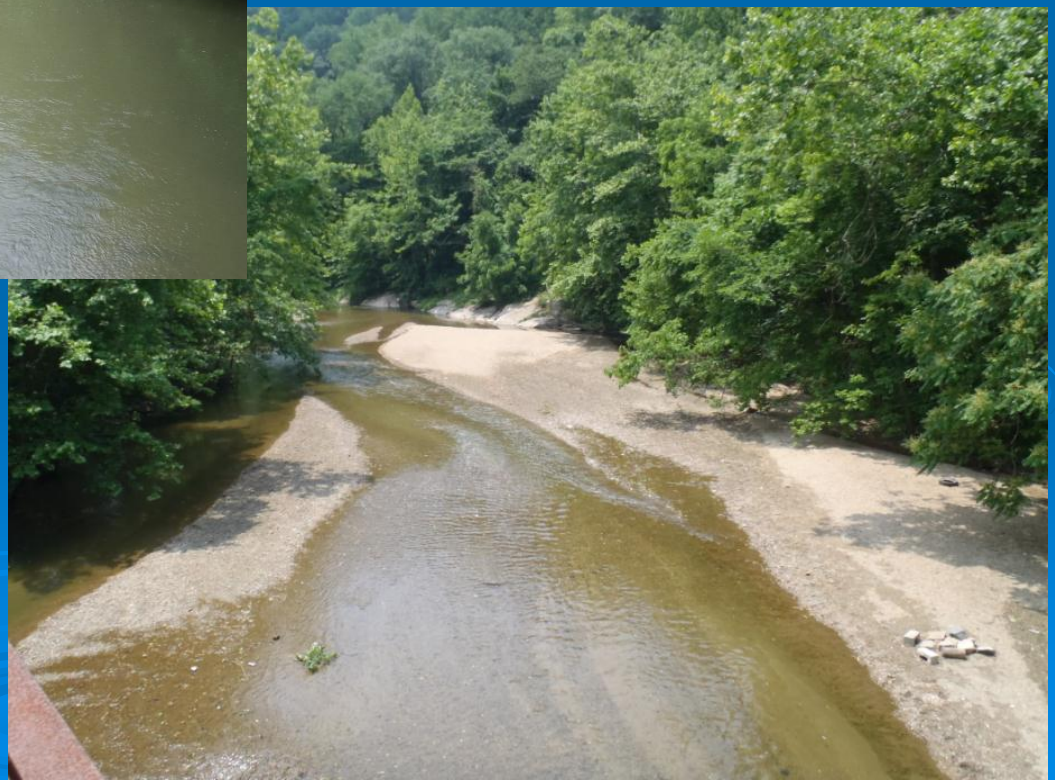
Sediment Dispersal

Approximately 2400 feet Downstream of the Simkins Dam

Before Removal 5/24/10

Sediment Wedge

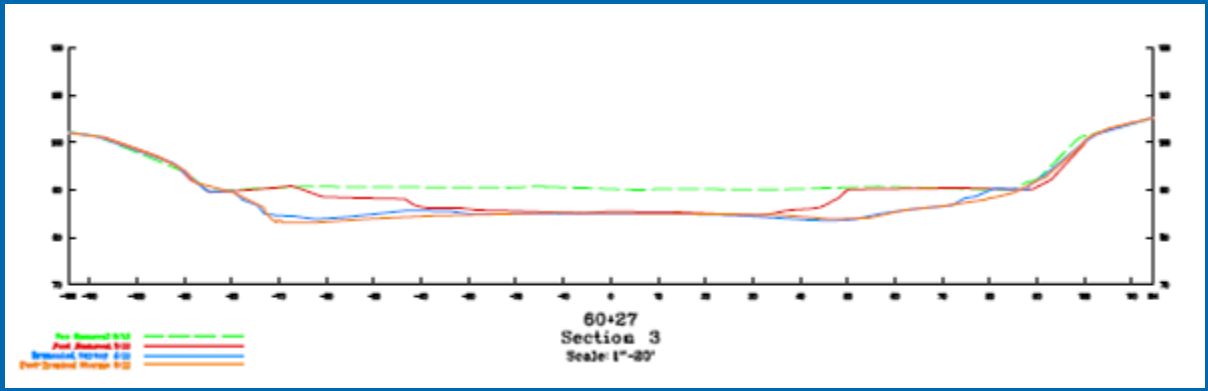
Post Removal 6/10/11



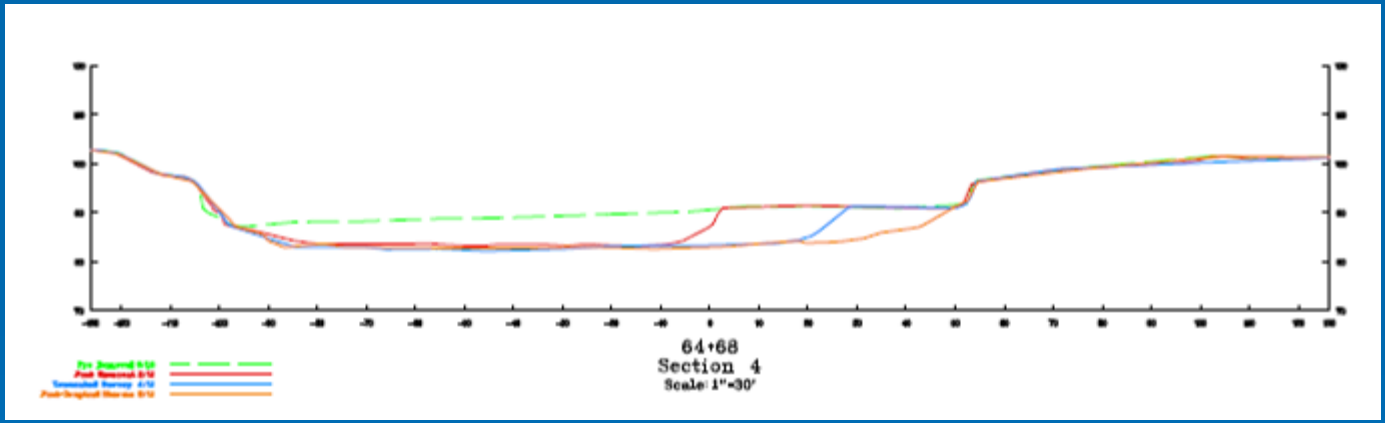
Bed Composition Changes

Sediment Dispersal

Post Removal 4/11/11

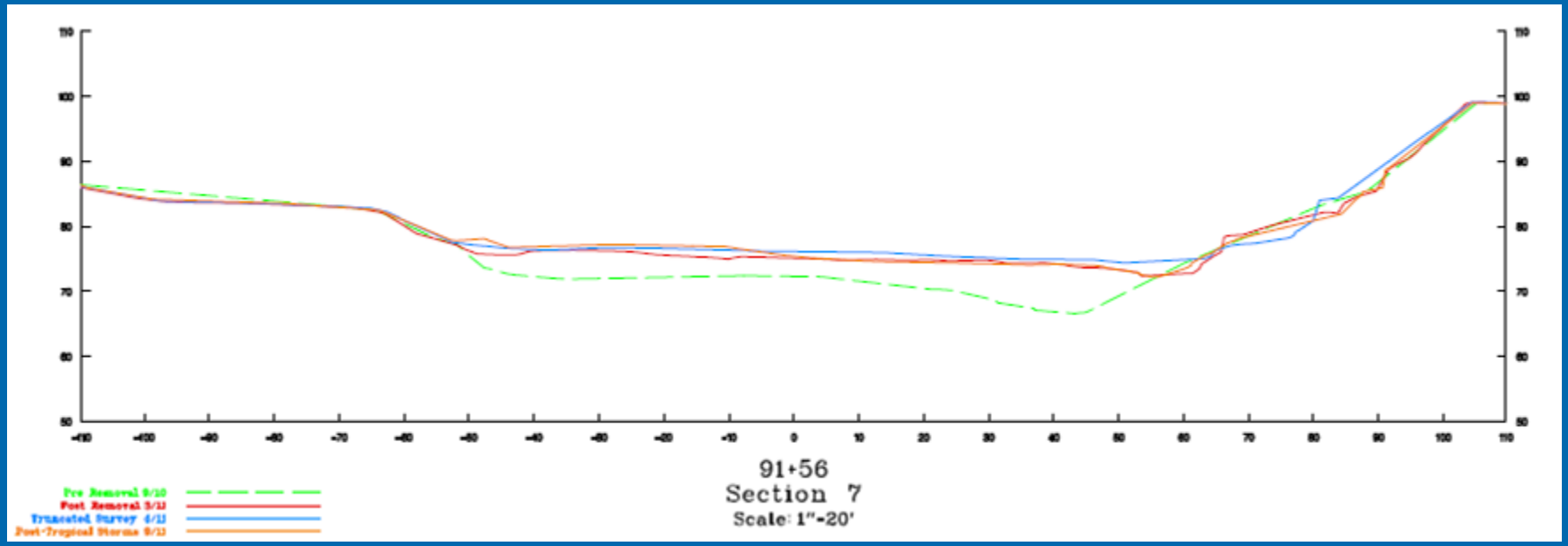


RS 63600- 1000’ US of Simkins Dam
885.37 SF Net Cut

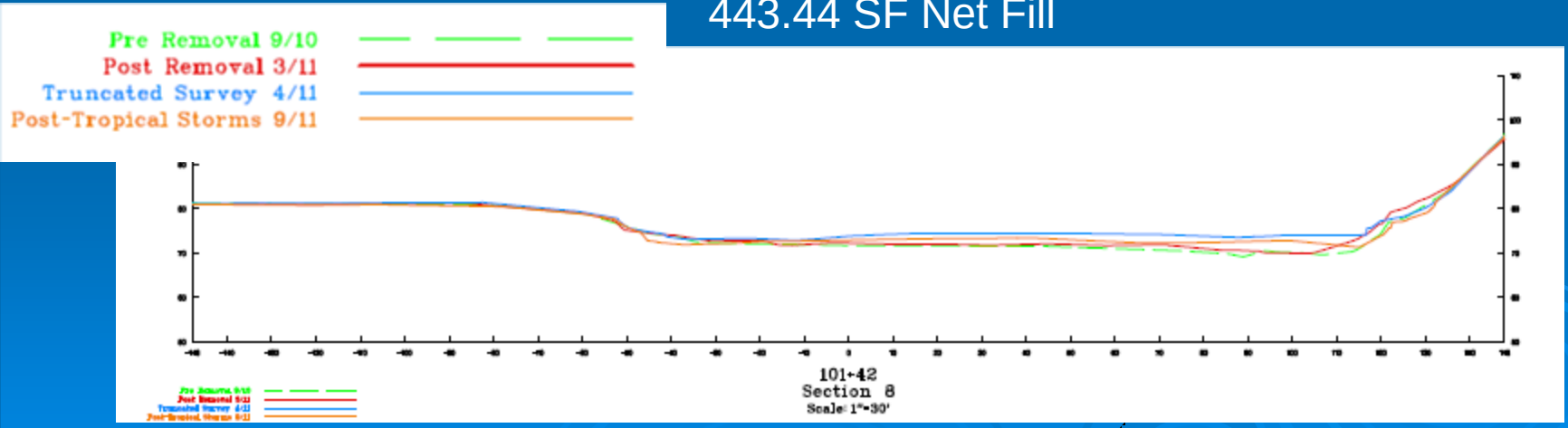


RS 63200- 600’ US of Simkins Dam
858.26 SF Net Cut

Channel downcutting and widening in Simkins Impoundment

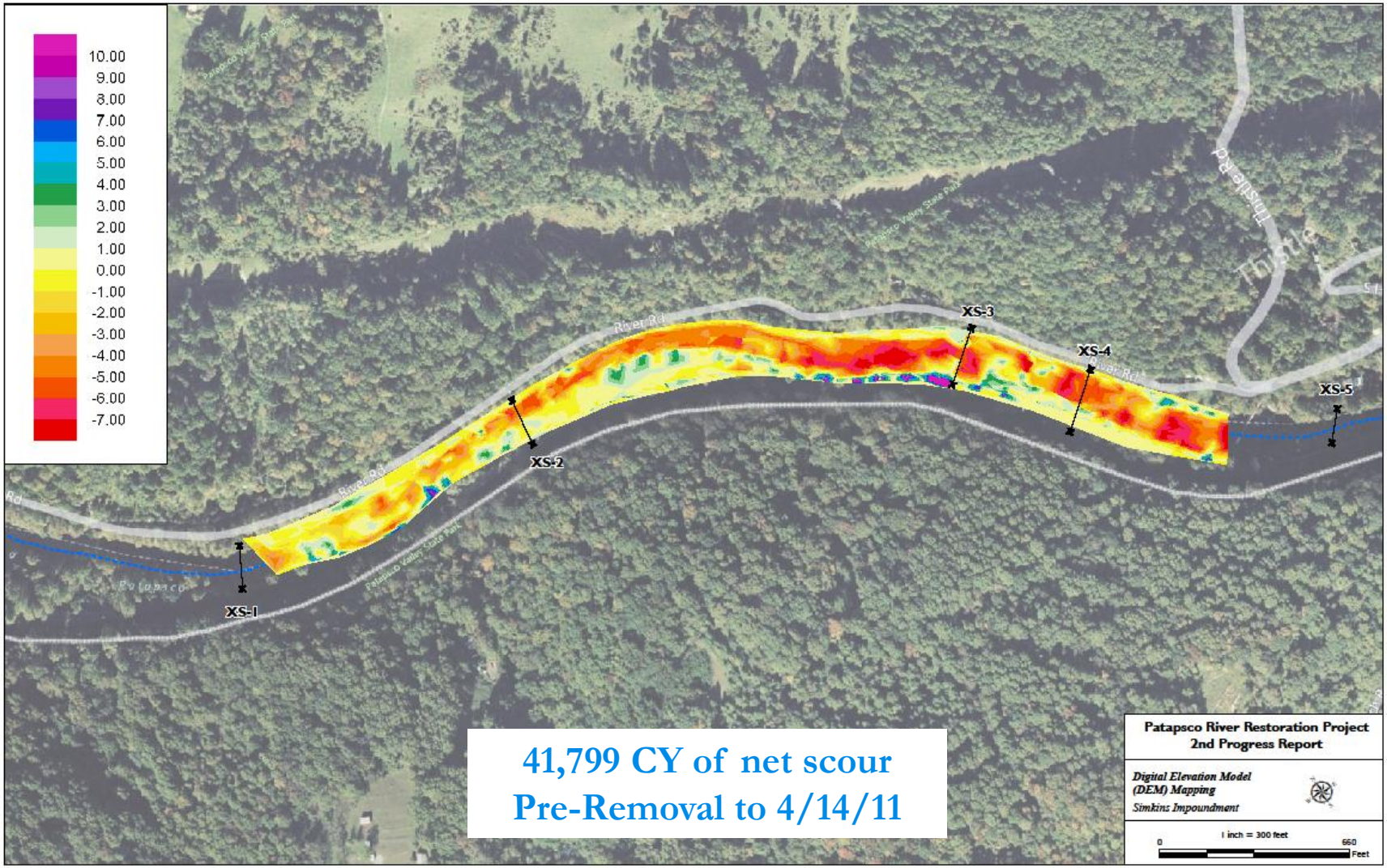


RS 59800- 2800’ DS of Simkins Dam
1500’US of Bloede Dam
443.44 SF Net Fill



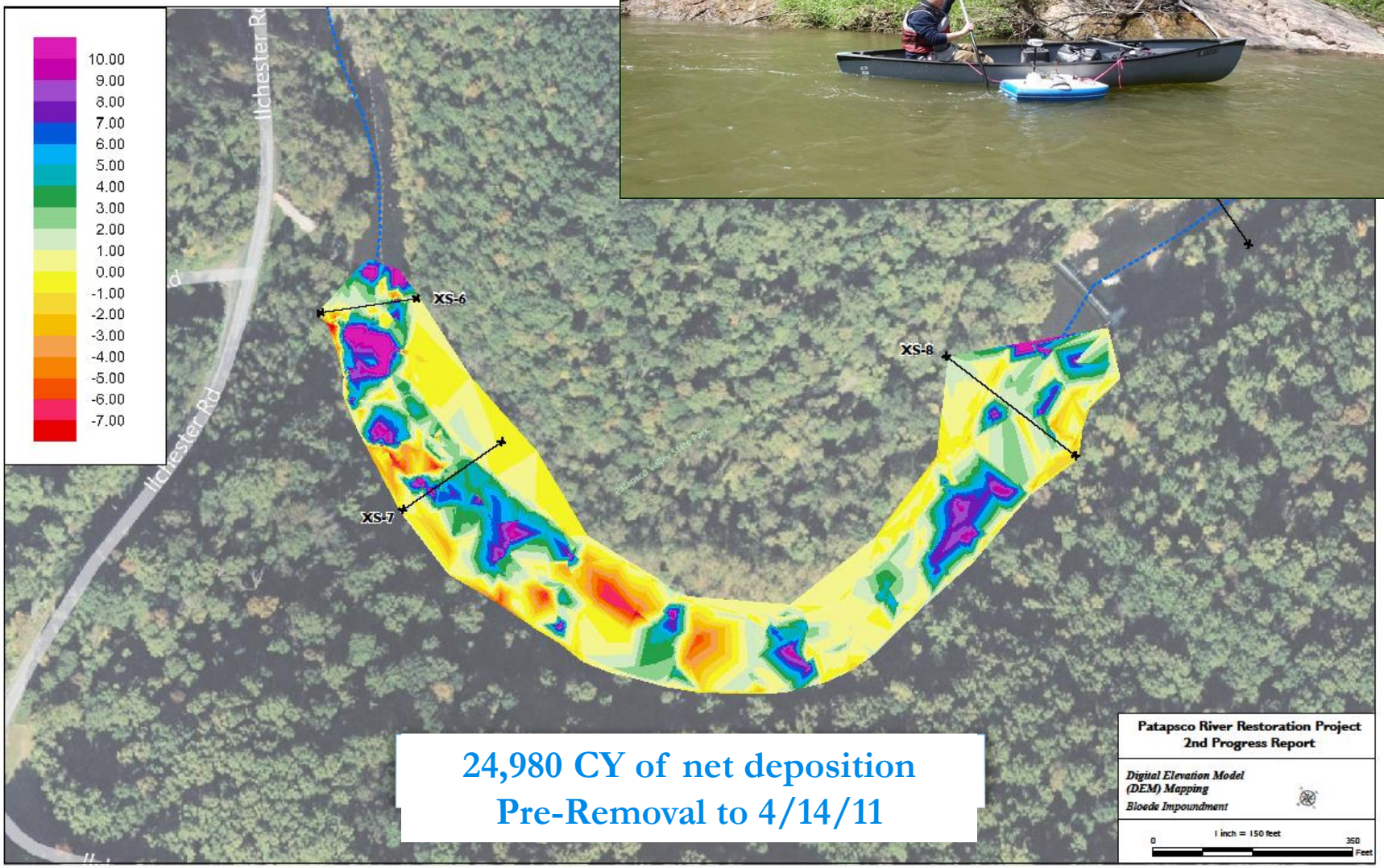
RS 58500- 4100’ DS of Simkins Dam
200’ US of Bloede Dam 450.91 SF Net Fill BUT Cut Post Storms

Simkins DEM



41,799 CY of net scour
Pre-Removal to 4/14/11

Bloede DEM



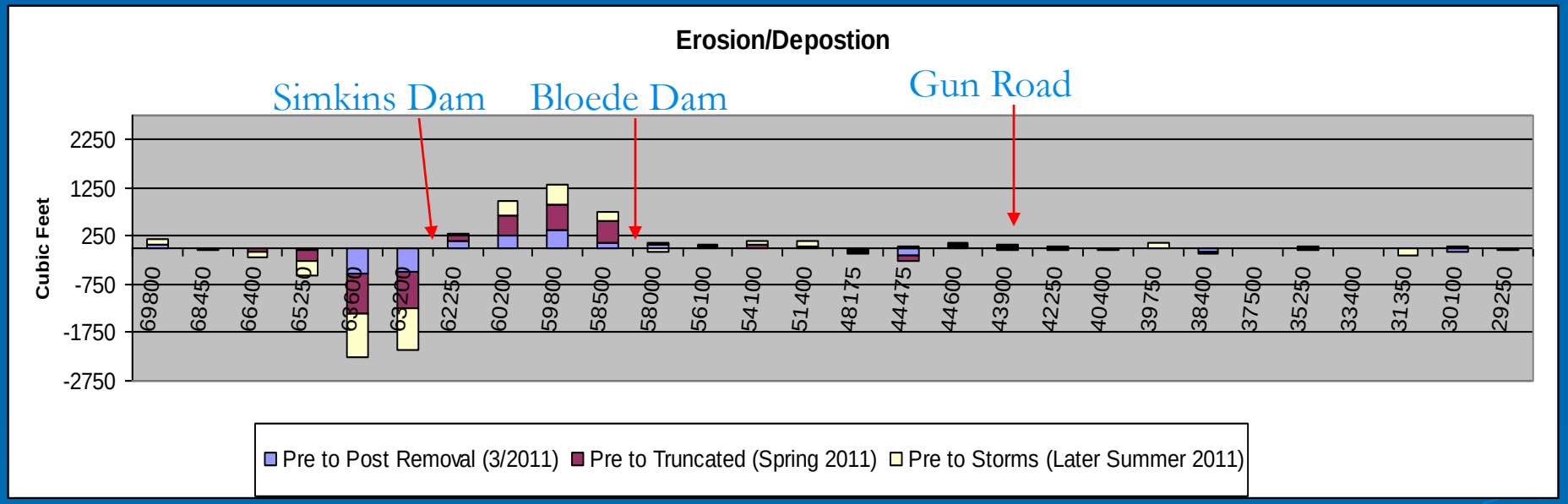
24,980 CY of net deposition
Pre-Removal to 4/14/11

Volumetric Channel Changes
(using Post Removal Survey: Pre Irene/Lee)

DEM Area	Station To	Station From	Area SY	Net Cut/Fill CY	Net Cut/Fill TONS	Survey Dates
Simkins	58400	60100	75901	**-41,799**	**-45,217**	September 2010 and April 2011
Bloede	62650	66300	38236	**24,980**	**28,710**	September 2010 and April 2011
DEM 1	48100	49150	19689	1,301	1,495	October 2010 and April 2011
DEM 2	42800	46700	71513	-115	-132	October 2010 and April 2011
DEM 3	37600	39000	36440	1,472	1,692	October 2010 and April 2011

Simkins Impoundment Estimate Pre-Removal- 110,000 cy

Erosion and Deposition at Sections



Simulating Sediment Transport in the Patapsco River following Dam Removal with Dam Removal Express Assessment Model-1 (DREAM-1)

Technical Report January 2010

- Yantao Cui (Stillwater Sciences)
- 1-Dimensional model
- Simulate transport of non-cohesive fine sediment deposit (sand and silt)
- Historical pre-dam gravel beds treated as immobile
- Input Data
  - River Longitudinal Profile and Channel Width
  - Composition of Reservoir Deposit
  - Hydrology
  - Tidal Effect from Chesapeake Bay
  - Sediment Supply at Simkins Dam
  - Surface Gravel Median Size
- Zero Process Modeling: Simulate Current Conditions in the Project Area and Downstream

Stillwater Sciences

Patapsco River Dam Removal DREAM-1 Simulation

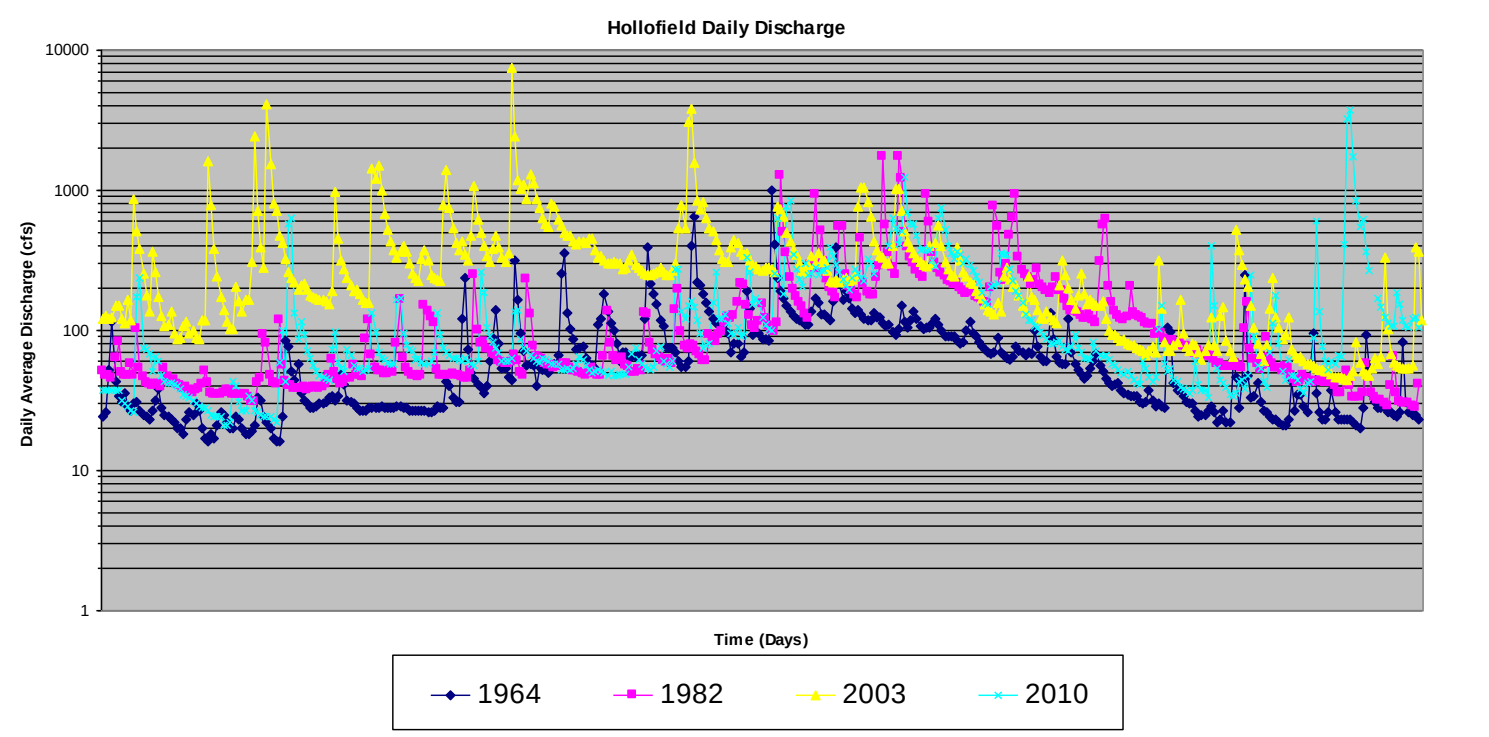


Figure 7. Patapsco River daily average discharge at USGS USGS gauging station #01589000 for three typical water years (including two months [August and September] of previous water year).

Recurrence Interval (year)	Discharge (cfs)
1.2	2,300
1.5	3,500
2	5,100
5	11,400
10	18,200

Table 2. Annual peak flow for typical recurrence intervals in the Patapsco River, based on a log-Pearson III fit of annual peak flow series at USGS gauging station #01589000 for the period of 22 May 1944 through 30 September 2004.

Patapsco River Dam Removal DREAM-1 Simulation

Run 2 – Average Hydrologic Year

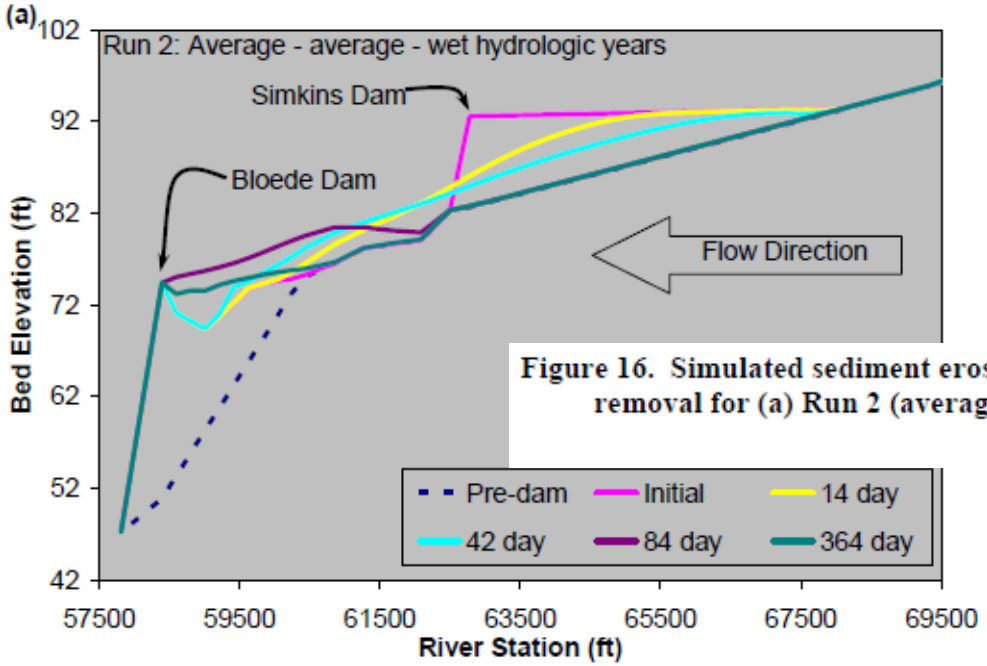
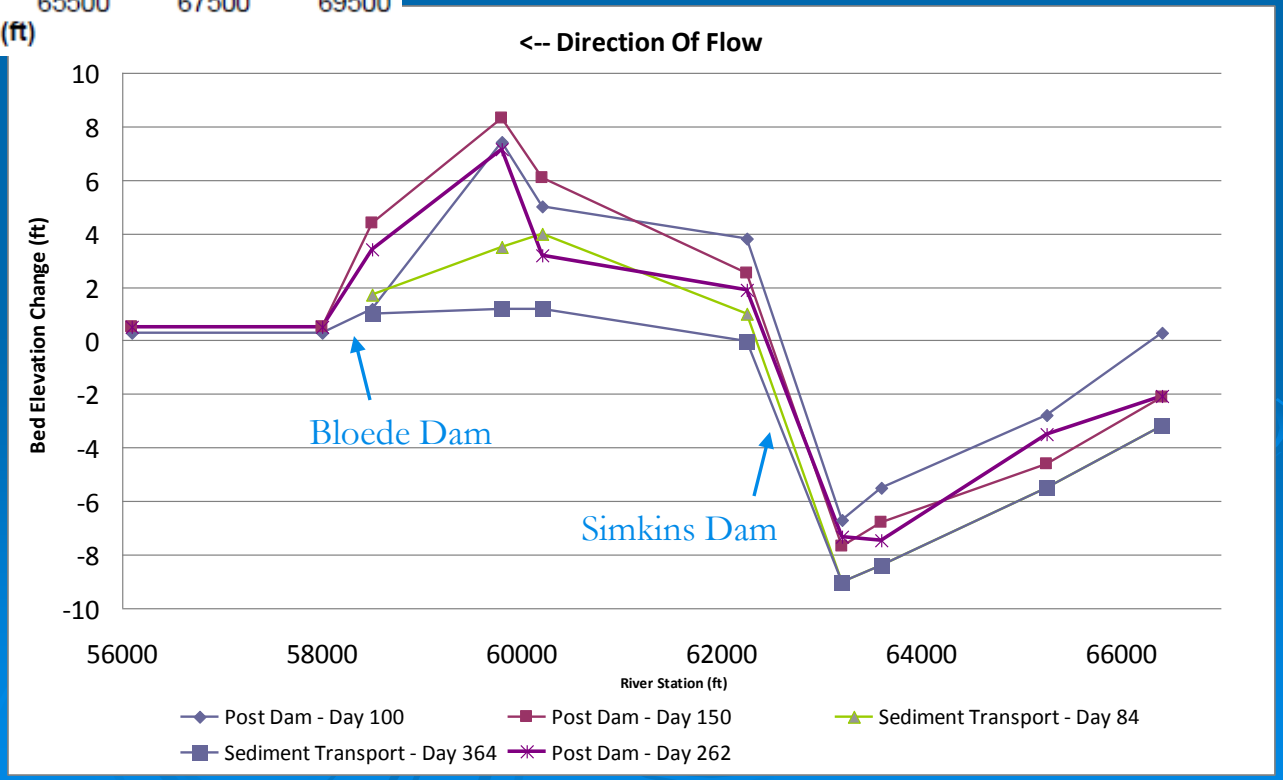


Figure 16. Simulated sediment erosion and deposition upstream of Bloede Dam following Simkins Dam removal for (a) Run 2 (average-average-wet year scenario); and (b) Run 3 (dry-average-wet year scenario).



CONCLUSIONS

- Monitoring is to continue- Fall 2011 Complete- Next Spring 2012
- Work to complete Sediment Budget- Input? Gaps?
- Bloede Dam Removal design is underway
- Data/Analysis to be published and data eventually public

Questions?

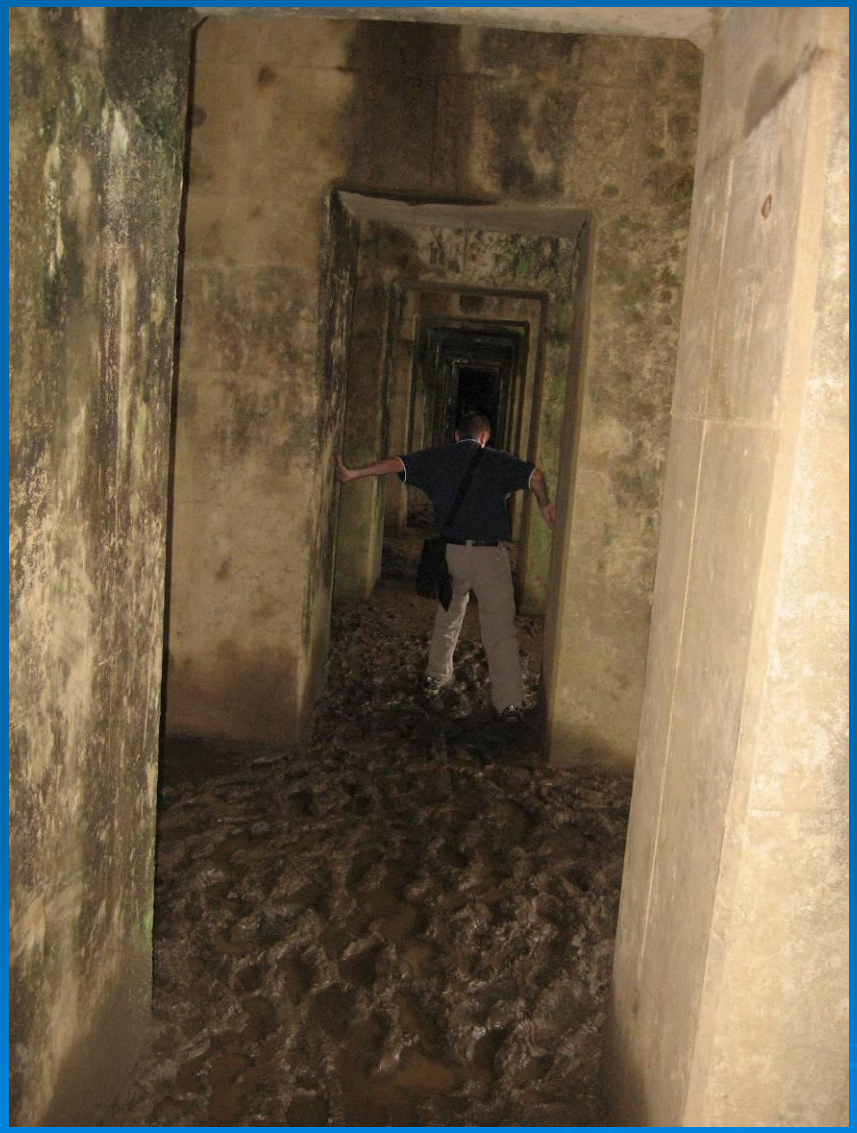


Photo: Nick Nelson

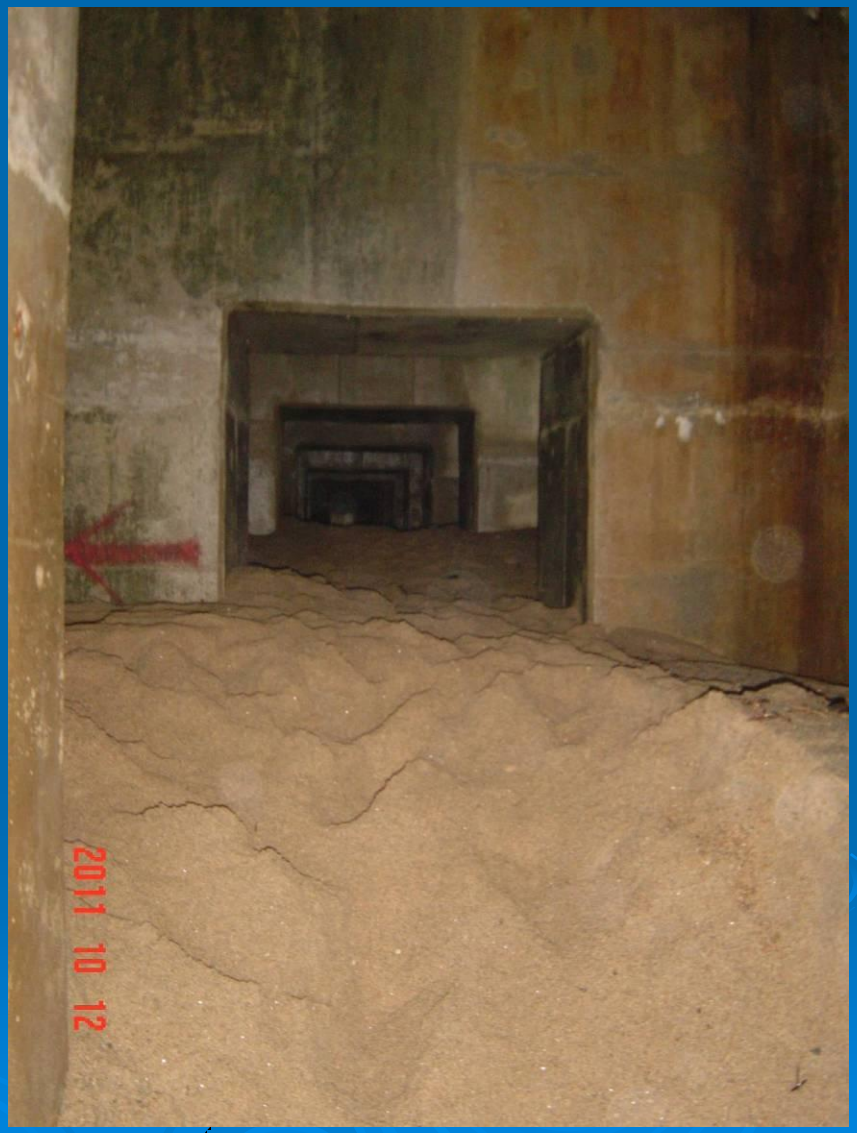


Photo: Charlie Wallis