Patapsco River Restoration Project
Physical Monitoring

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

Graham C. Boardman- McCormick Taylor

- Union Dam- 1914- March, 2010
  - Partially breached in 1972
  - Active sediment management

- Simkins Dam -December, 2010
  - 10-foot high, 150-foot long concrete structure
  - 110,000 cy of sediment
  - Passive sediment management

- Bloede Dam Removal
  - 34-foot high, 220-foot long concrete structure, 1906
  - 310,000 cy of sediment
  - Sediment management?

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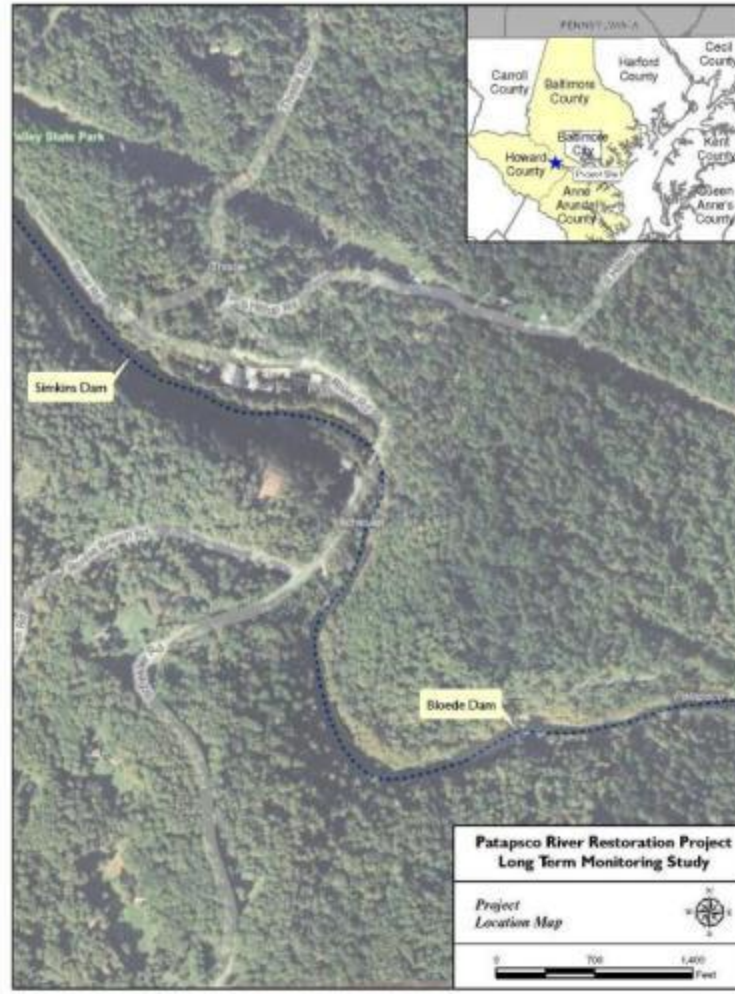
Project Setting

- Simkins Dam located 4250 feet upstream of the Bloede Dam
- Bloede Dam is downstream of the Simkins Dam
- Now covered steep slope between the dams with high valley walls contributing debris flows



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Goals

- Track sediment transport
- Determine areas of erosion and deposition
- Provide data for adaptive management
- 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 In Reference Reach
  - 2 At Union Dam
  - 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

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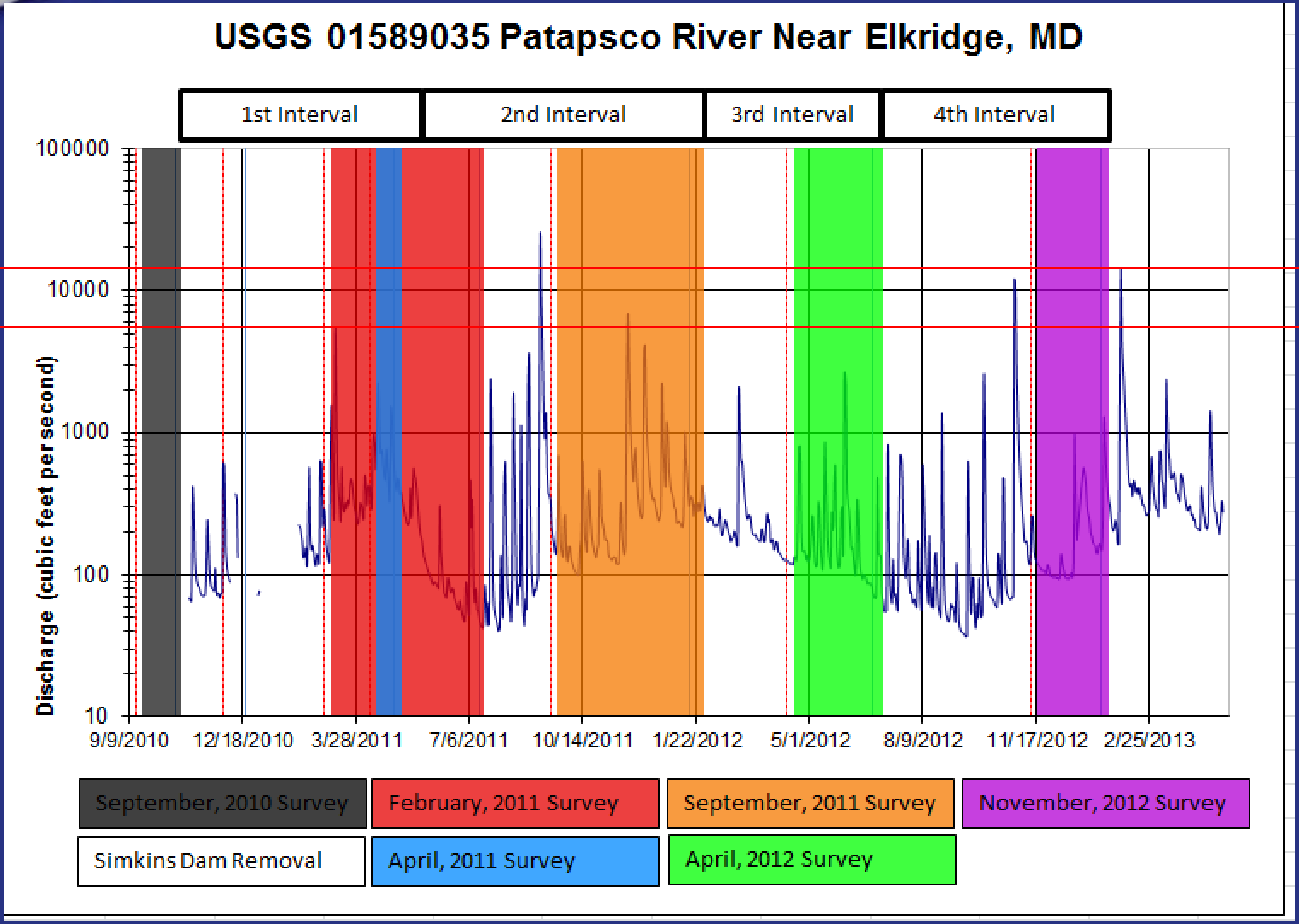
5 YR
10,700 cfs

2 YR
4895 cfs



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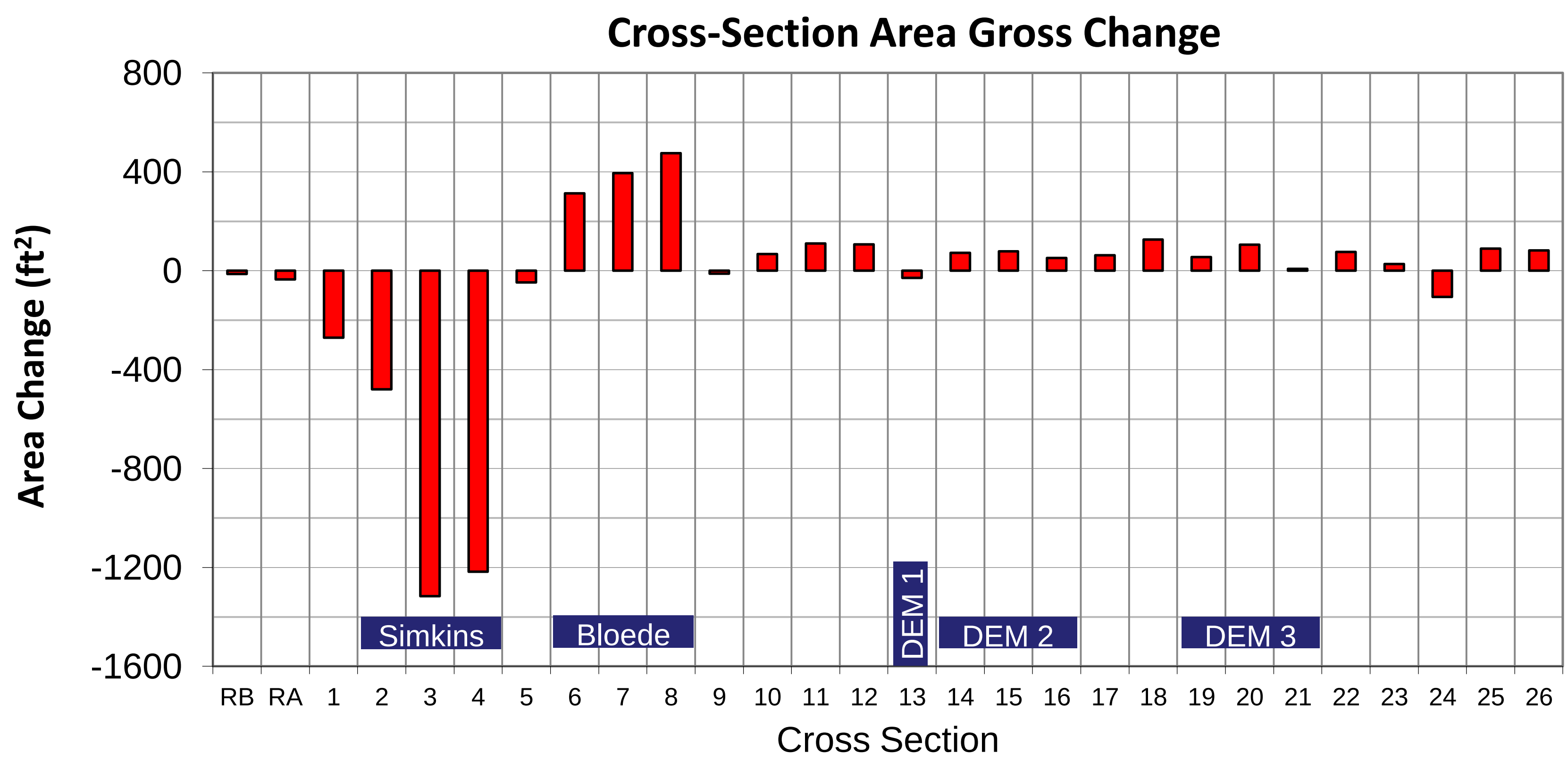

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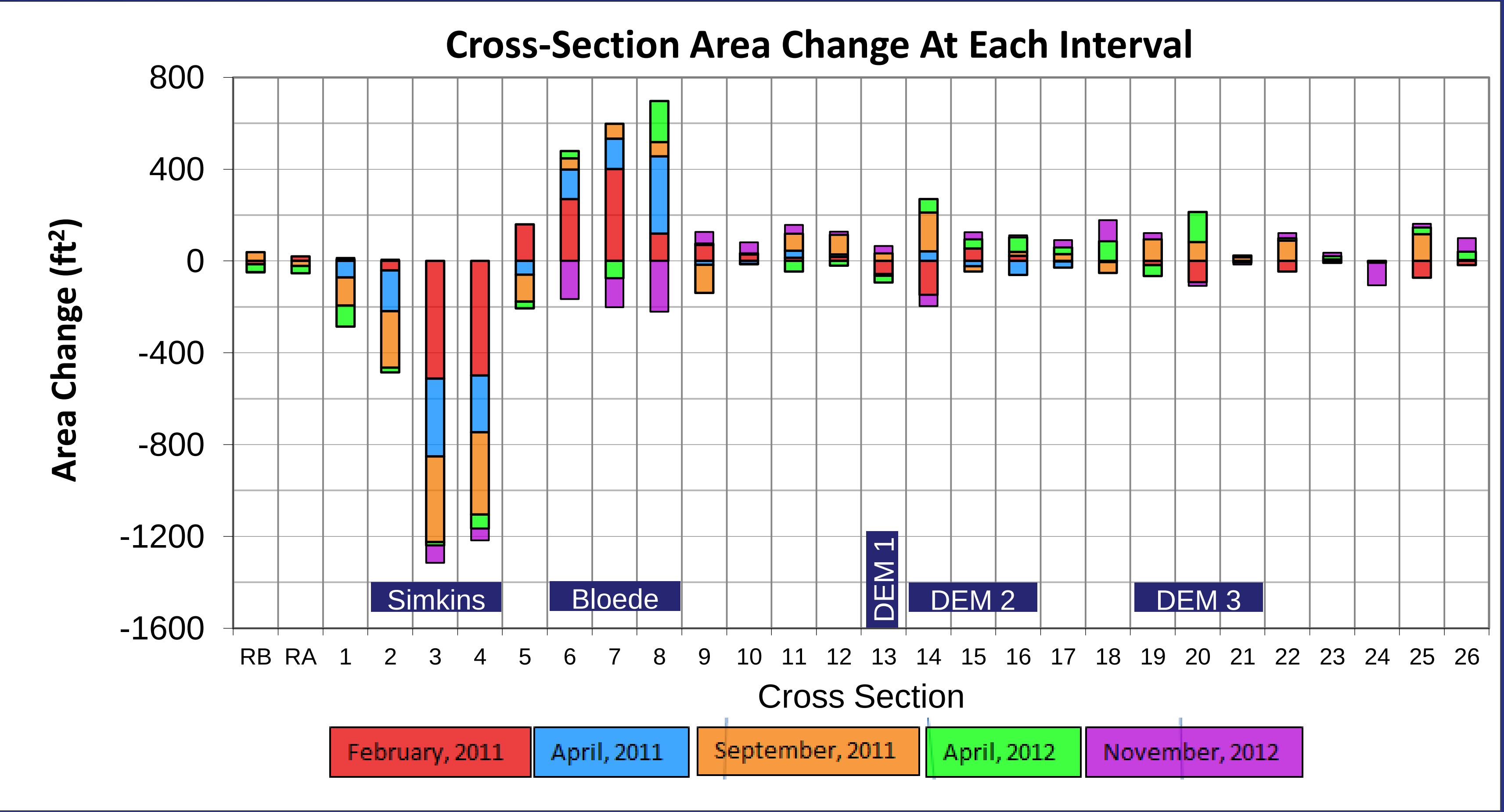
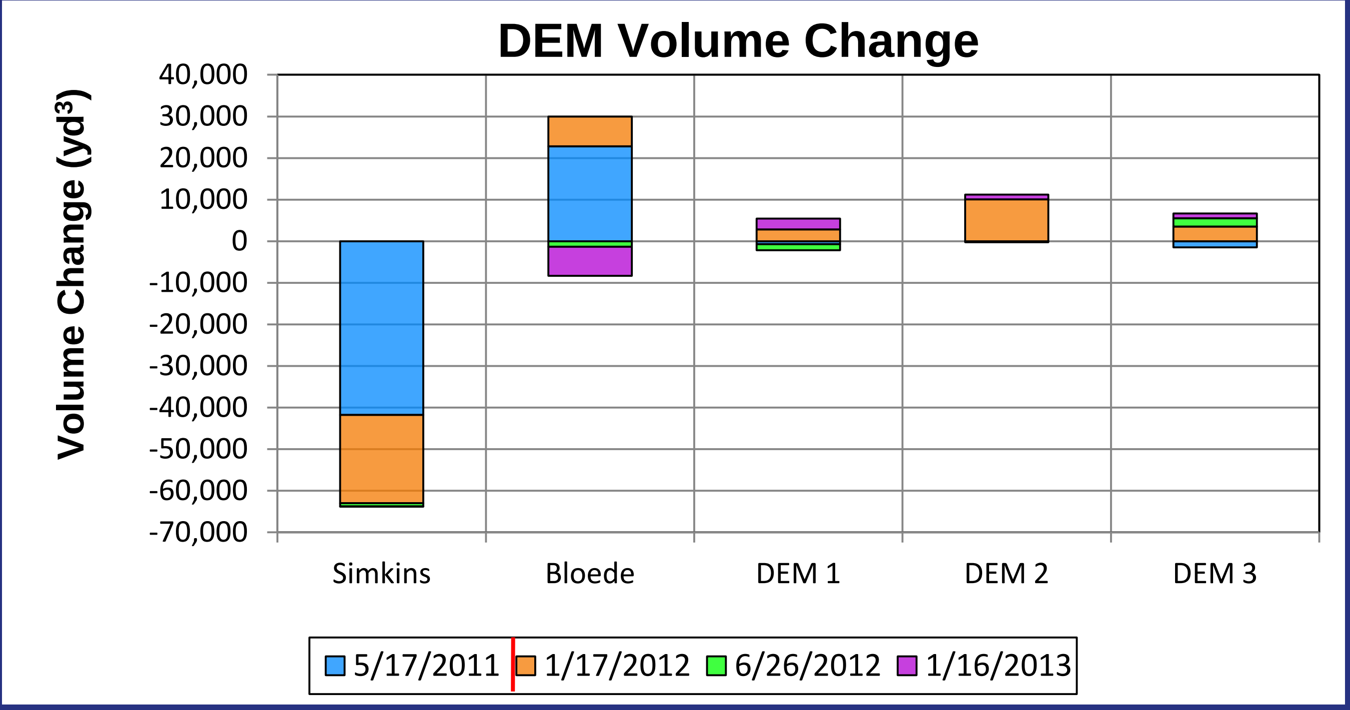


Simkins Impoundment

- 65% existing evacuation occurring within 5 months, 46% of total impoundment volume
- 98% existing evacuation within one year, 70% of total impoundment volume
- ~30,000cy remain in large armored bars



	5/17/2011	1/17/2012	6/26/2012	1/16/2013	Gross (CY)
Simkins	-44080.53	-21400.06	-753.03	63.21	-66170.41
Bloede	22814	7129	-1362	-6939	21642
DEM 1	-727	2810	-1450	2641	3273.64
DEM 2	-50	10030	-218	1196	10958.3
DEM 3	-1472	3541	1967	1122	5158.32

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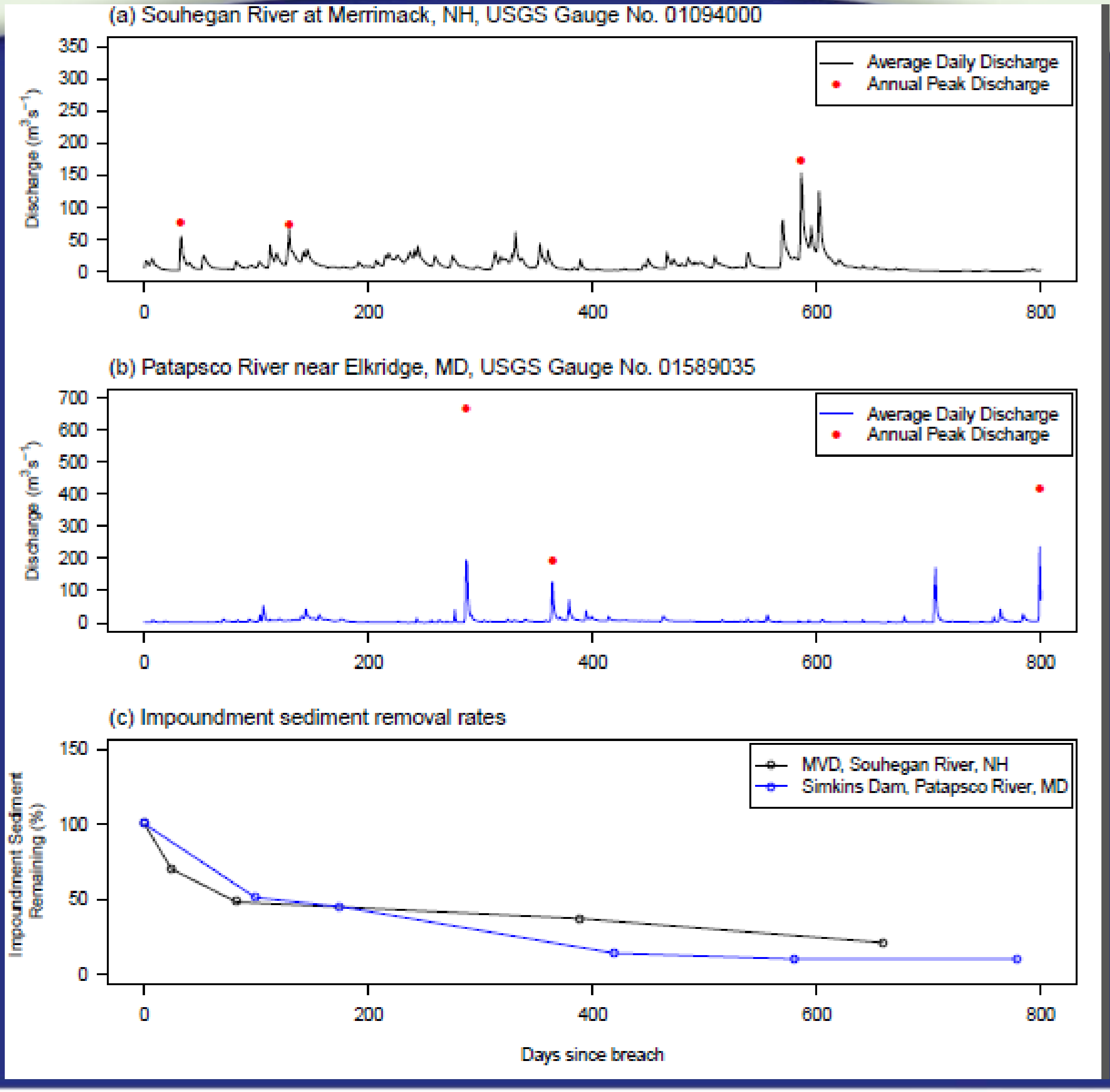
~ 62,000 cy impounded at Merrimack Village Dam



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Process Driven

11/10/2010
~100 cfs

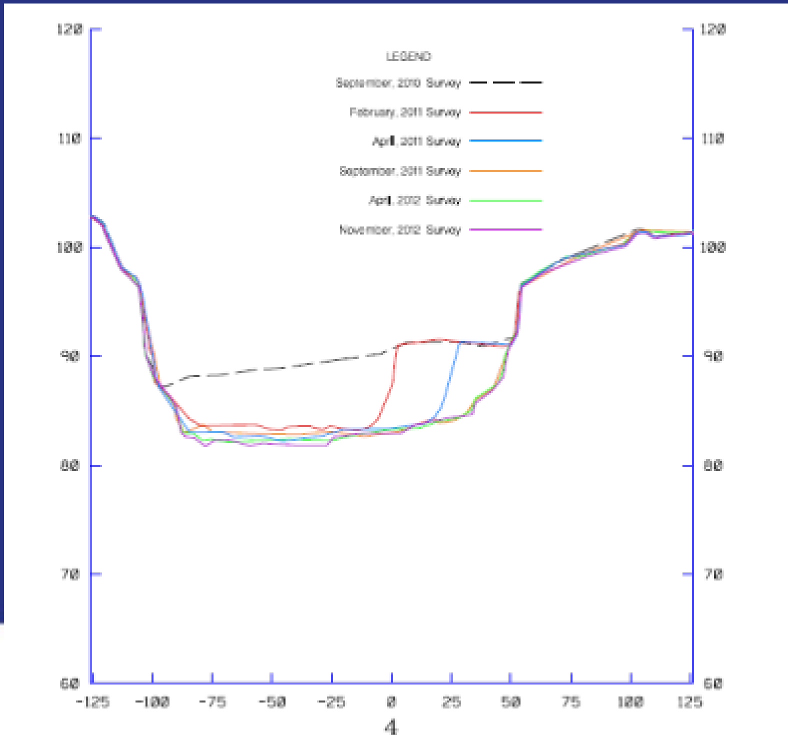
Event Driven

9/7/2011
~1500cfs

Simkins Impoundment

Uniform coarse grained sand

1. Downcutting to historic bed attributed to mass wasting on banks.
2. Widening
3. Stability



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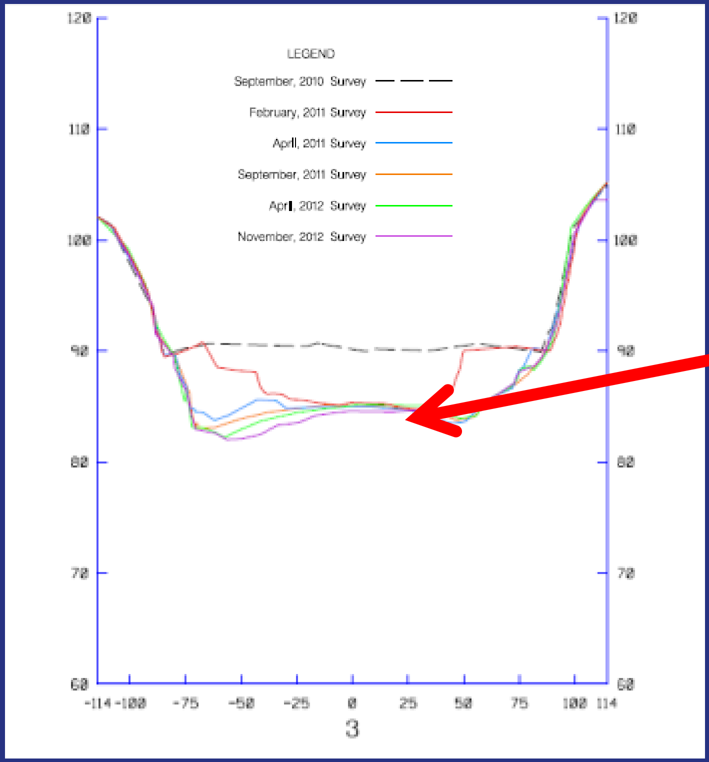

Stored material in Simkins Impoundment in armored mid-channel bars

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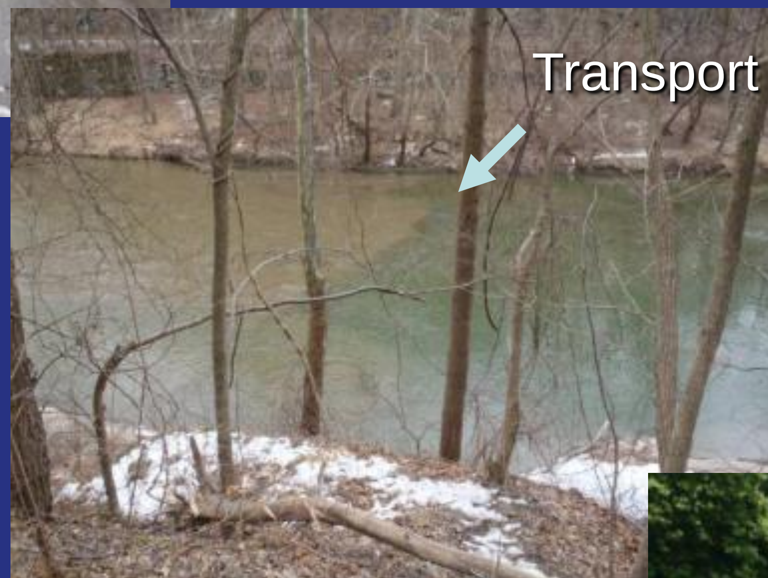
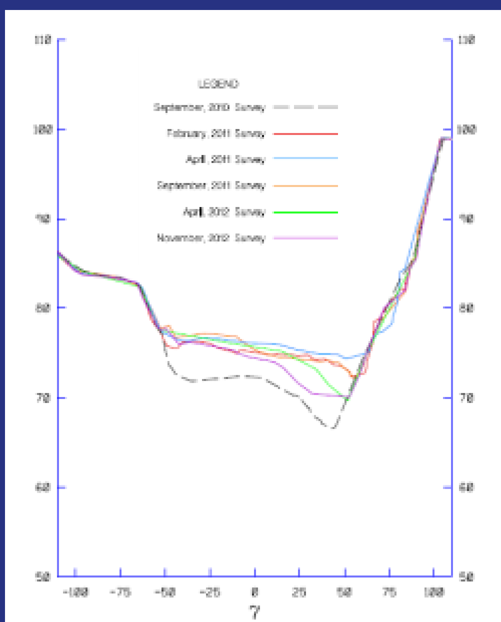
Bloede Impoundment/Low Slope Areas

Bloede Impoundment- Aggradation in low slope areas.



Transport with concentrated leading edge.



Bloede dam "full"

Conditions observed pre-removal have returned in high slope areas downstream of the Simkins Dam

Pre-Removal September, 2010

Aggradation post dam removal

Post-Removal March, 2011

Recovery begins less than one year after removal

Post-Removal September, 2011

Recovery continued

Post-Removal March, 2012

Recovery continued (Pre-Sandy)

Post-Removal October, 2012

Recovery continued (Post-Sandy)

Post-Removal November, 2012

Current Conditions

Post-Removal October, 2013

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Calculate Bed Material Load Sediment Mass Budget

- Inputs- Upstream of Simkins and Tributaries
- Output from Simkins- DEM and cross sections
- Storage in Bloede and downstream reaches- DEMs and extrapolating cross sections
- Close budgets at each gage to utilize independent sources

$$I_{ho} + I_{tr} + \Delta S_{cu/s} + \Delta S_{smkdem} + \Delta S_{cmi} = O_{cat}$$

$$I_{tr} + \Delta S_{cu/s} + \Delta S_{smkdem} + \Delta S_{cmii} + \Delta S_{Blddem} + \Delta S_{cd/s} = O_{elk}$$

$\Delta S_{cu/s}$	Channel upstream of Simkins to Hollofield
ΔS_{cmi}	Channel Simkins to Catonsville (Ilchester Road)
ΔS_{cmii}	Channel Simkins to Bloede Pool

$\Delta S_{cd/s}$	Channel downstream of Bloede to Gun Road
ΔS_{smkdem}	Simkins DEM
ΔS_{Blddem}	Bloede DEM

Conclusions

- Sand dominated impoundments react rapidly to dam removal
- Response is both process and event driven
- Base flow is capable of transporting significant quantities of material shortly after dam removal (process based)
- Larger events are required to access materials for mobilization from mid channel bars, etc. (event based)
- Recovery occurs quickly in downstream reaches as equilibrium is regained
- How does data translate to dams without “mufflers” downstream
- What does this tell us about the Bloede Dam removal?