

Science, Service, Stewardship



Designing and Implementing Dam Removal Projects in the Context of the Regulatory Climate: Patapsco River Dam Removal Case Study

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FISHERIES
SERVICE**



Overview

- Background
- Union Dam Removal Case Study
- Bureau of Reclamation Guidelines – Simkins Case Study
 - Sediment Characterization
 - Contaminant Analysis
 - Sediment Transport Study
- Long Term Monitoring Plan



Simkins Dam Removal



Patapsco River Restoration

- Habitat restoration – opened 42 main stem miles; 374 tributary miles for American eel by **dam removal**
- Restoration of an historic fishery
 - Target species include American eel, alewife, blueback herring, American shad
- Removal of aging infrastructure
- Removal of safety hazards
- Learning opportunity for Maryland and the Mid-Atlantic

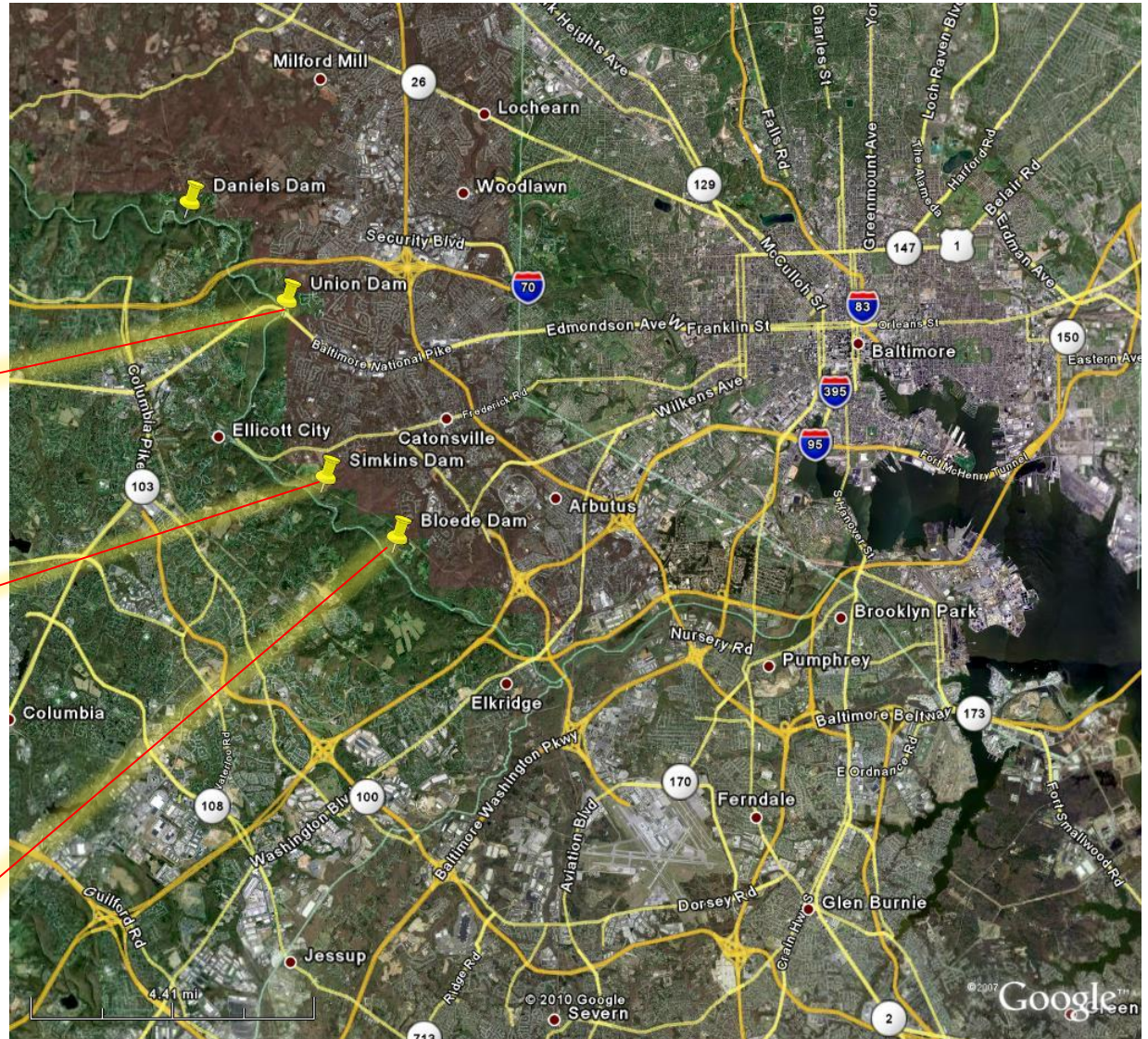
NOAA FISHERIES SERVICE

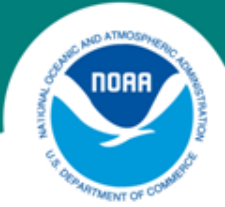


**Union Dam (1808, 1914,
1972) - Removed Feb/Mar
2010**

**Simkins Dam (pre-1857,
1868, 1889, 1972) -
Removed Nov 2010**

**Bloede Dam (1868,
1906,1972) – Design
Contract underway for
Removal**

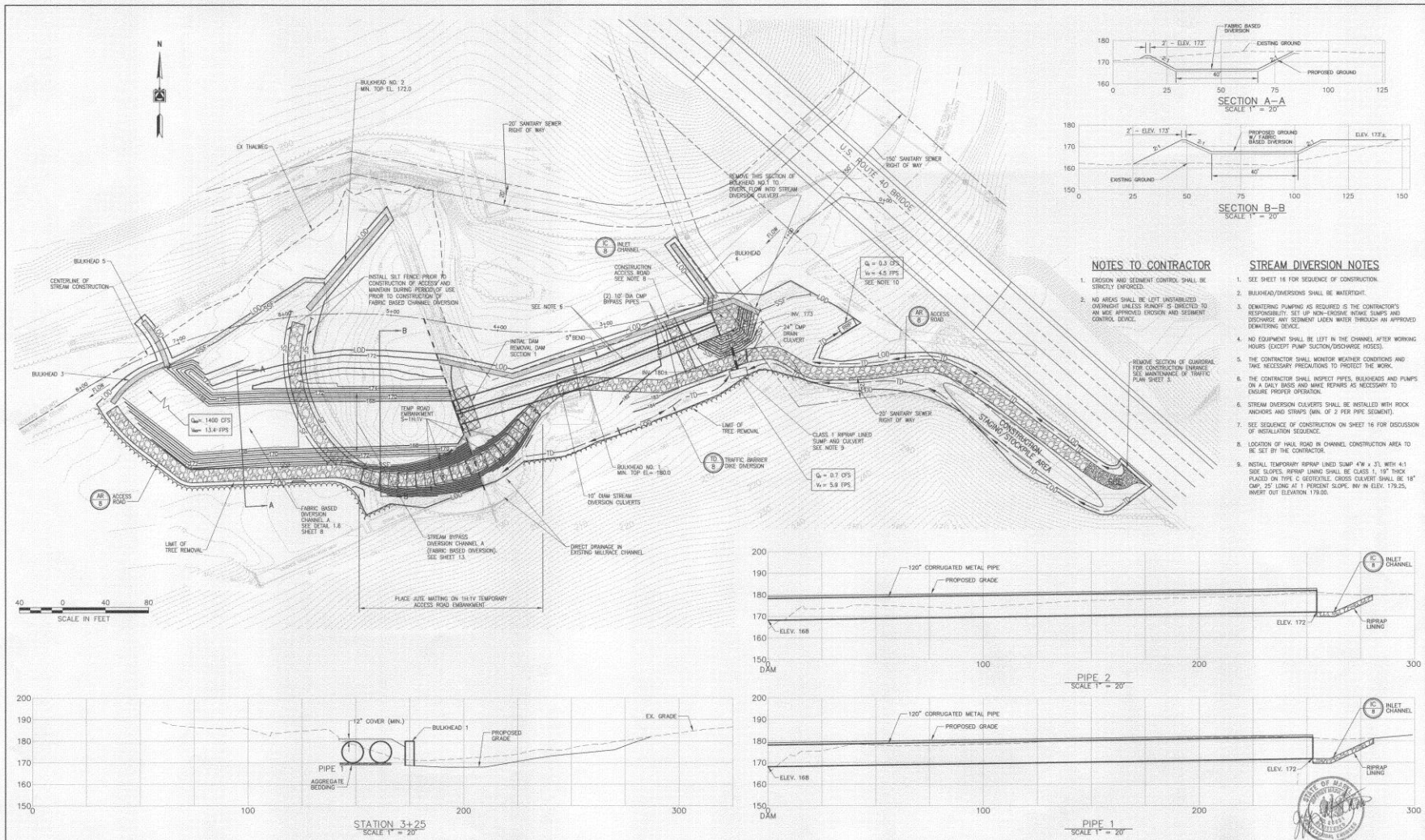




Union Dam

- Height: 24 ft
- Spillway length: 220 ft
- Impoundment: Breached
- Sediment behind dam: None to very little (all reused on site)
- Cost: \$1,552,705





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No.	DESCRIPTION	DATE	BY	DESIGNED	TRACED	SCALE
				ETK	NTS	1"=40'
				DRAWN	CHECKED	APPROVED
				ETK	JMS	JCD

EROSION AND SEDIMENT CONTROL PLAN PHASE 1	UNION DAM DEMOLITION D.G.S. PROJECT: P-020-013-010	9F PROJECT NO. 30308 DATE: JANUARY 2009
	PATAPSCO STATE PARK BALTIMORE COUNTY, MARYLAND	
	SHEET 13 OF 31	

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Breached Prior to Dam Removal



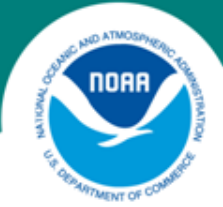
Storm Event Damage



Diversion Channel (fabric lined) to Divert Water through Breached Dam



Construction Period: Sept 2009 – Sept 2010



Simkins Dam

- Height: 10 ft
- Spillway length: 150 ft
- Impoundment: 95 acre-feet
- Normal pool length: 3,500 ft
- Maximum sediment behind dam: 115,000 CY
- Removal Cost: ~\$850,000





Characterize Reservoir Sediment

- Reservoir sediment volume
- Sediment 3D spatial distribution
- Grain size (gravel, sand, silt, clay)
- Sedimentation history, including sluicing or dredging
- Structures or debris buried in the sediments

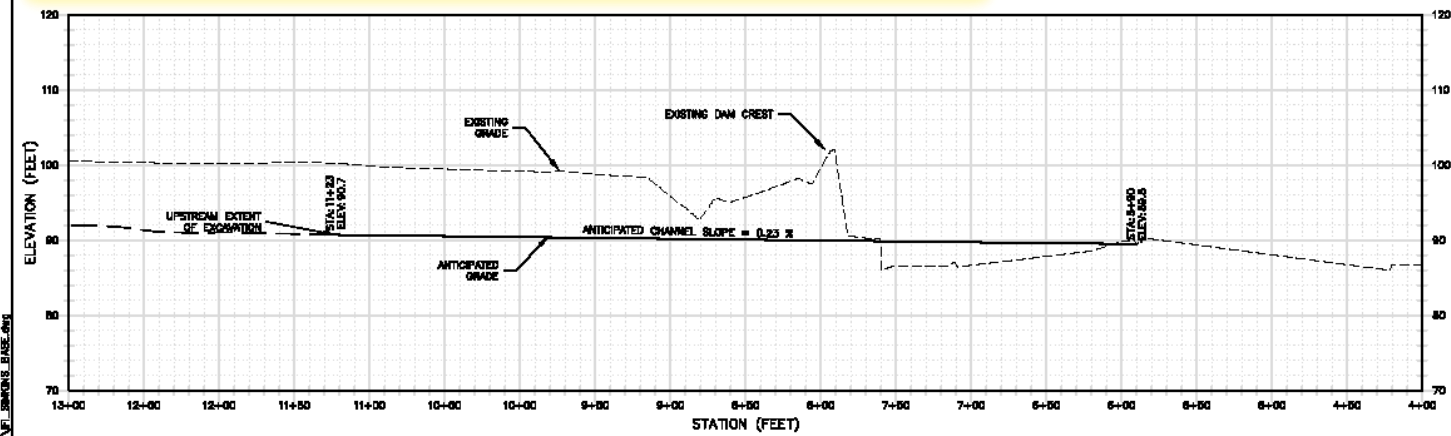




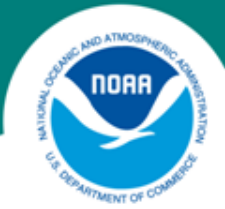
Longitudinal Profile

Impoundment: ~95 acre-feet
Normal pool length: 3,500 ft

Preliminary Not
For Construction



Z:\Projects\Baltimore\Simkins Dam\3 - Drawings\1 - Base.dwg



Sediment Character

Photo Credit: MDGS



- Grain size - 10 cores (Interfluve) + 4 cores (MDGS)
- 94% primarily coarse sand with some gravel; ~ 6% finer sand and silt

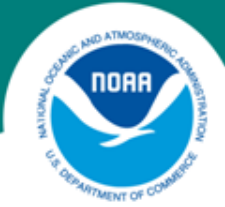


Assess Contaminants

- Historical land use activities
 - Likely contaminants?
 - Prior sediment sluicing or flushing?
 - Present upstream contaminant sources?
- Contaminant testing requirements
 - Screening level sampling
 - Definitive survey



RECLAMATION



Contaminants Testing

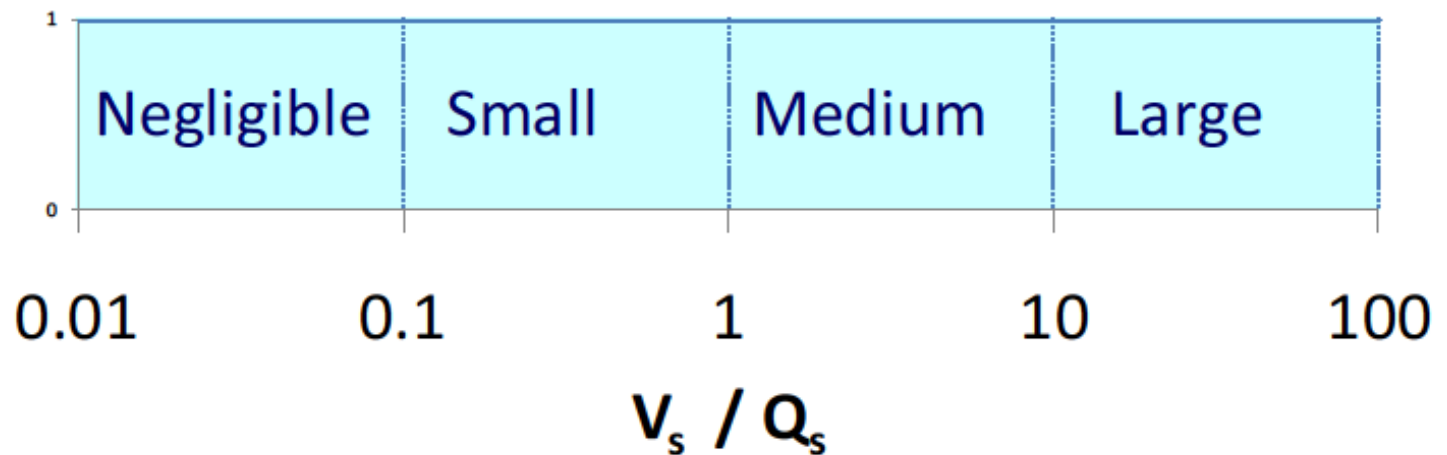
Ten total cores taken in the impoundment + 4 MDGS cores
No contaminants found above regulatory thresholds

Table 1: Compound groups tested at Simkins Dam

	<i>Total number of compounds tested</i>	<i>Number of compounds present in Sample 1</i>	<i>Number of compounds present in Sample 2</i>
<i>Chlorinated herbicides</i>	9	not detected	not detected
<i>Organochlorine pesticides</i>	21	not detected	not detected
<i>PCBs</i>	7	not detected	not detected
<i>PAH</i>	17	not detected	11 low
<i>Metals</i>	13	5 low	5 low

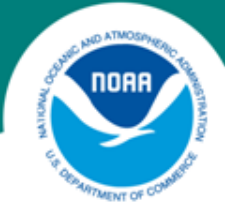


Reservoir Sediment Volume (V_s) Relative to the Average Annual Sediment Load (Q_s)



- Average annual sediment load based on
 - downstream transport capacity for coarse sediment
 - upstream supply for fine sediment

RECLAMATION



Scaling Sediment Volume to Annual Sediment Load

Volume of Sediment = **113,000 CY**
(Interfluve 2009 survey effort)

Volume Transported = **54,000 CY**
(McCormick Taylor monitoring efforts)

Estimated Annual Sediment Load =
5,200 CY
(DREAM model estimate)

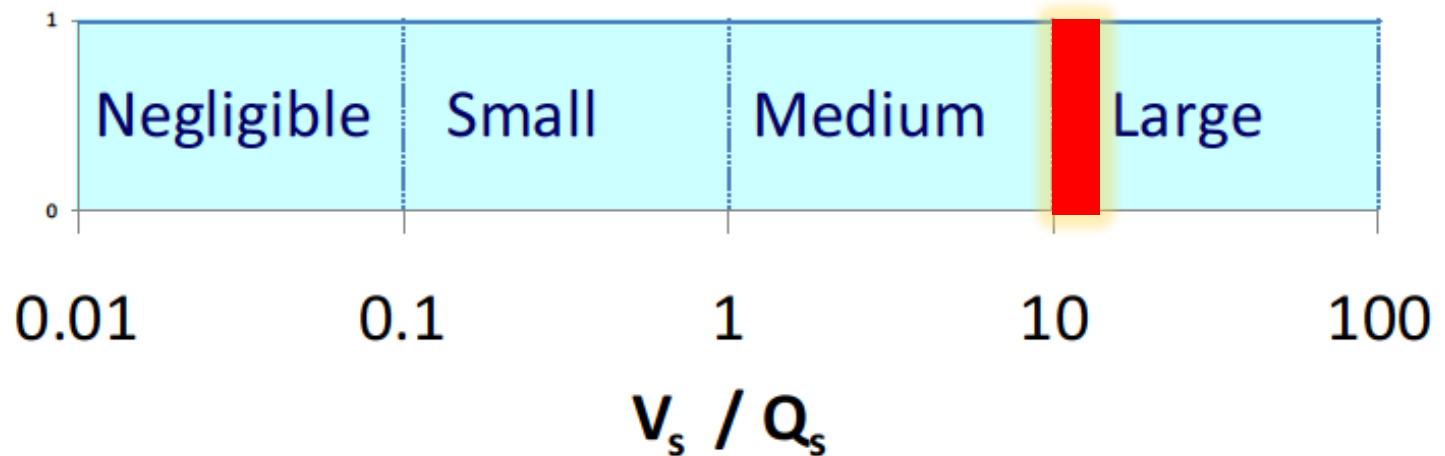
$V_s/Q_s = 113,000/5,200 = 21.7$ (Large)

$V_s/Q_s = 54,000/5,200 = 10.4$
(Medium/Large)





Reservoir Sediment Volume (V_s) Relative to the Average Annual Sediment Load (Q_s)



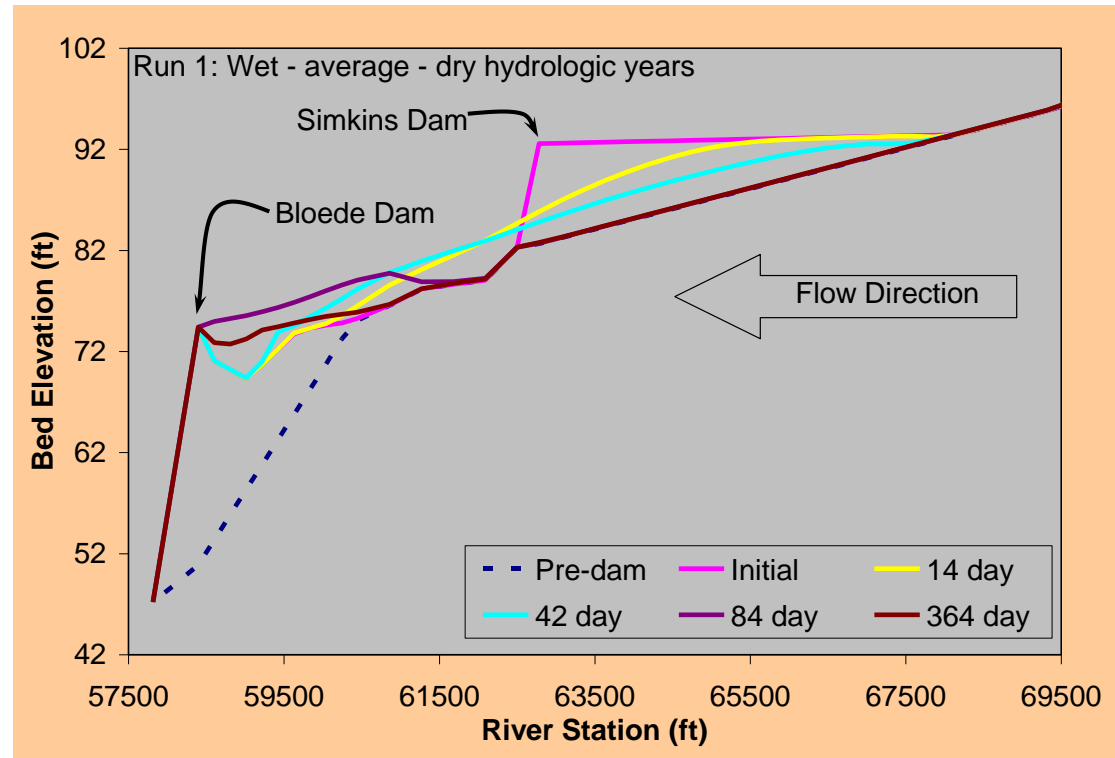
- Average annual sediment load based on
 - downstream transport capacity for coarse sediment
 - upstream supply for fine sediment

RECLAMATION



DREAM Model

- Dam Removal Express Assessment Model-1 – Stillwater Sciences
- Peer-reviewed and tested with both flume and field data
- 1D model simulates cross-sectionally and reach averaged sediment aggradation and degradation
- Three basic runs
 - Run 1: wet – average – dry
 - Run 2: average – average – dry
 - Run 3: dry – average – wet



Graphic Courtesy of Stillwater Sciences



Results of DREAM Model

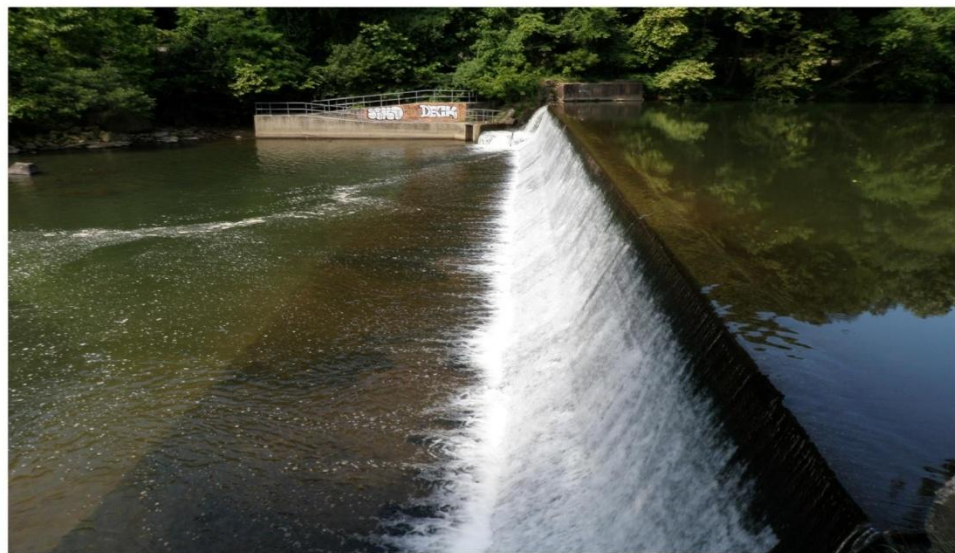
- Release 88,000 – 104,000 cubic yards of sediment, depending on channel geometry following dam removal
- Complete evacuation of reservoir deposit in 3 months to 2 years, depending on hydrologic conditions
- Up to 4 ft deposition upstream of Bloede Dam that dissipates quickly, return to pre-dam removal condition soon after Simkins deposit is emptied
- Less than 2 ft deposition downstream of Bloede Dam that dissipates slowly in time

Result of design effort – demonstration permit issued for “passive” dam removal approach

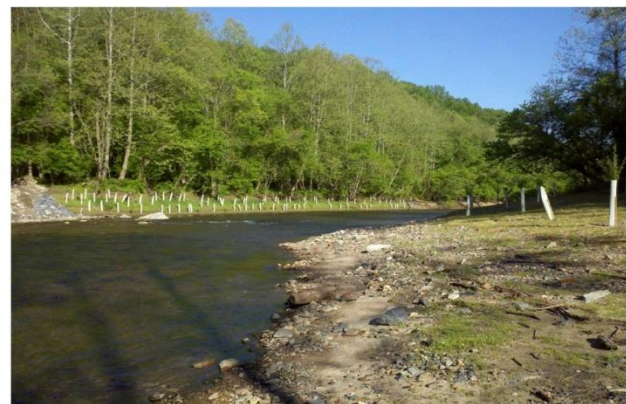


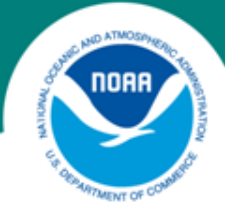
January 2011 – 9 months pregnant for scale





Photos Courtesy of Department of Natural Resources



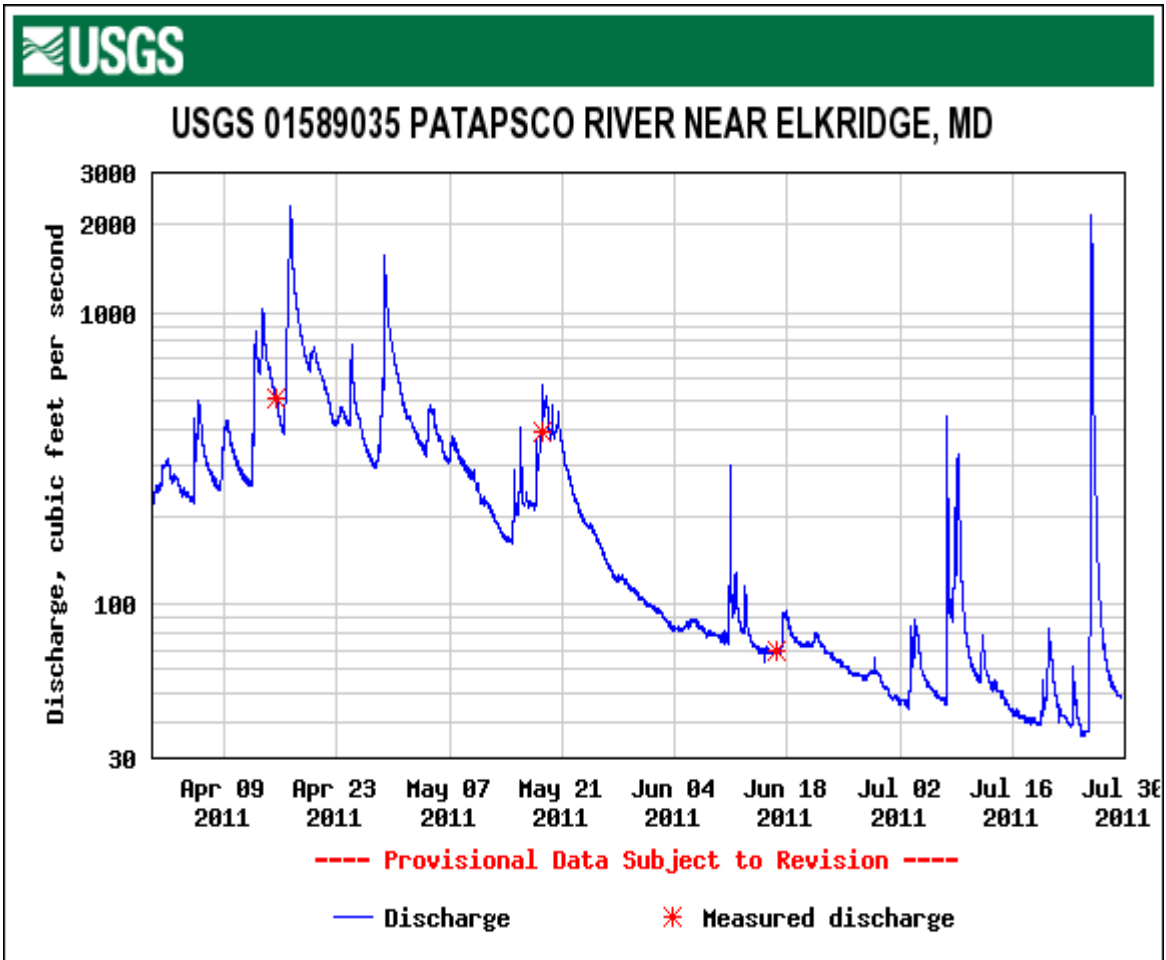


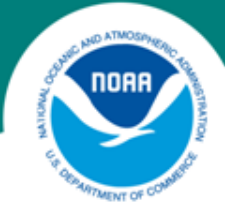
Physical Monitoring Study

- > 100 Permanent Photo Monitoring Sites
- 31 Cross Sections
 - 2 Reference Reach
 - 2 Union Dam Sections
- 5 Digital Elevation Models (12,900 lf)
- Facies and Site Mapping
- Grain Size Analysis
- Biological Monitoring too...

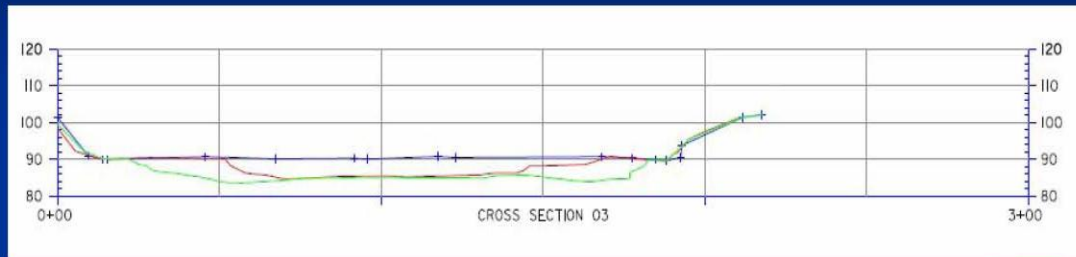


Flow Events Post Removal

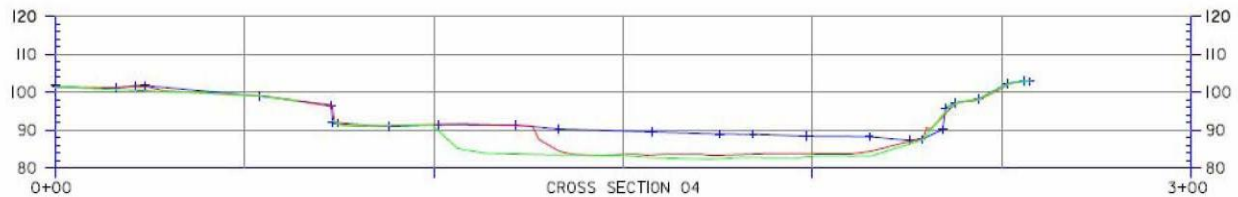




Cross Sections US Simkins



RS 63600- 1000' US of Simkins Dam

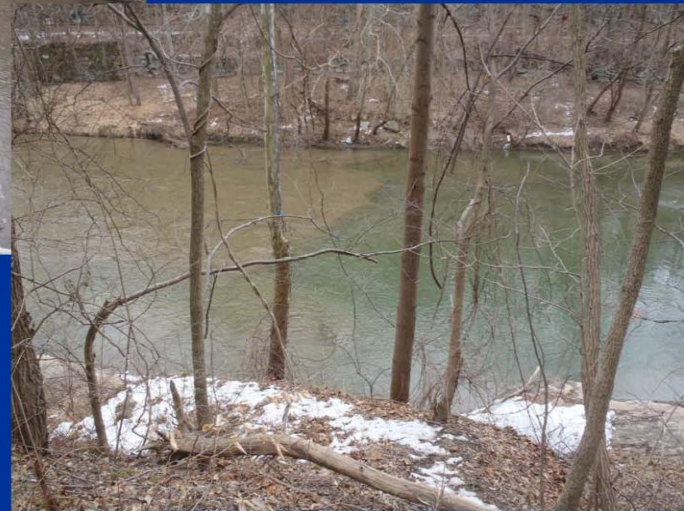


RS 63200- 600' US of Simkins Dam



Sediment Transport Post Removal

Sediment Dispersal



Post Removal 2/13/11

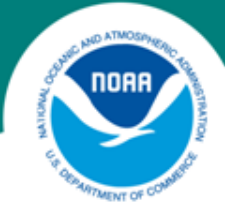


Sediment Transport Post Removal

Sediment Wedge



Post Removal 6/10/11



Partners

- **American Rivers**
- **Maryland Department of Natural Resources**
- **Friends of the Patapsco Valley State Park**
- **Interfluve**
- **McCormick Taylor**
- **USGS**
- **Maryland Geological Survey**
- **Stillwater Sciences**
- **Johns Hopkins**
- **University of Maryland Baltimore County**
- **AB Consultants, Inc.**