Assessment of stream restoration impacts on urban sediment load and comparison with TMDL guidelines

Chesapeake Bay Trust Pioneer Grant 12507

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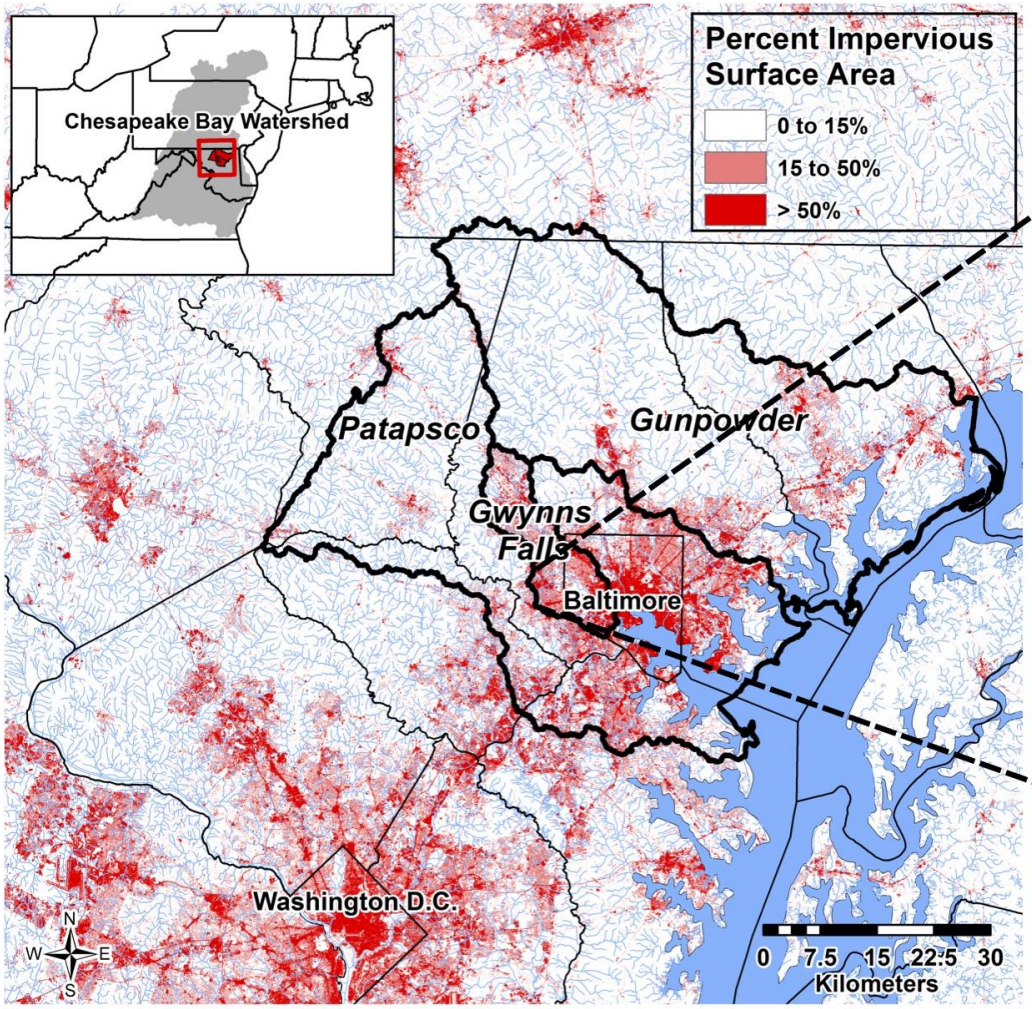
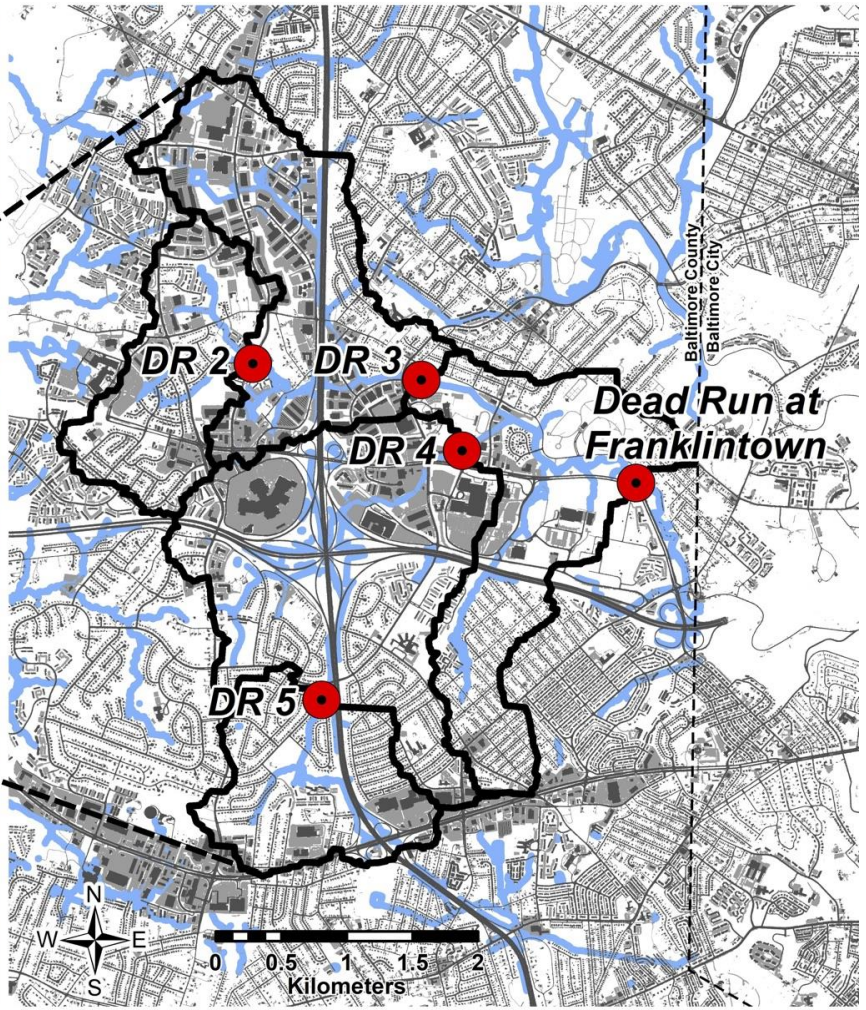
Research Questions

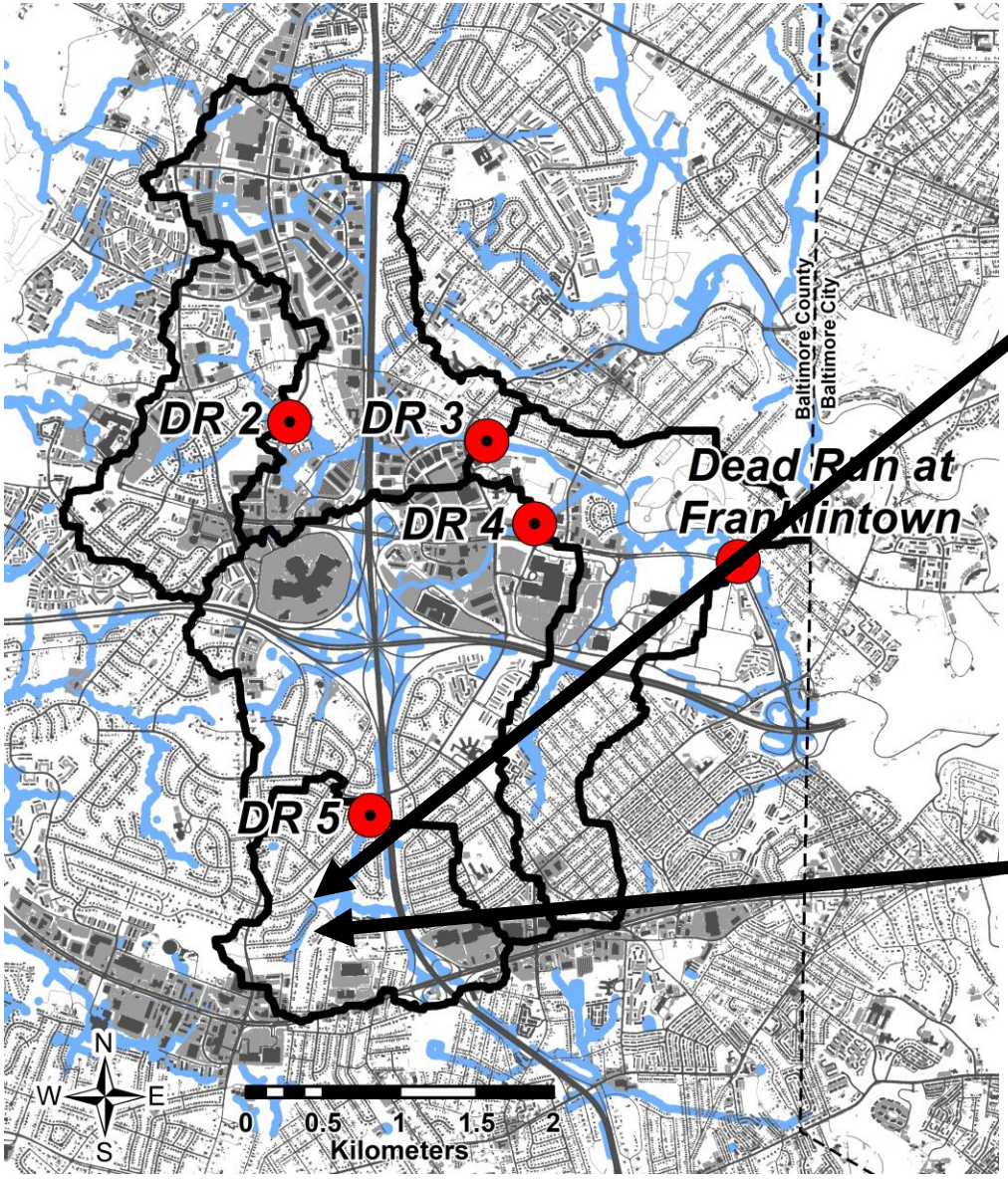
- Can we detect reductions in watershed sediment yield associated with a stream restoration project in a small urban watershed with a history of severe erosion?
- If change can be detected, can a paired- and nested-watershed approach allow us to assess whether the stream restoration project is responsible?

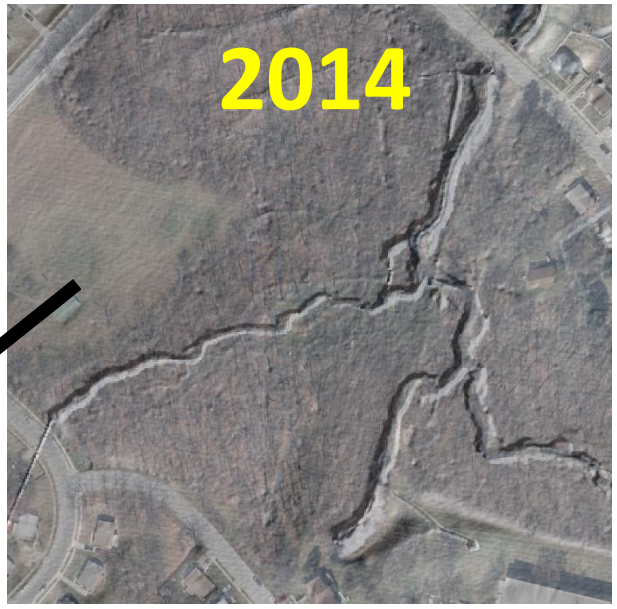
Dead Run watershed in Baltimore, MD nested sampling sites



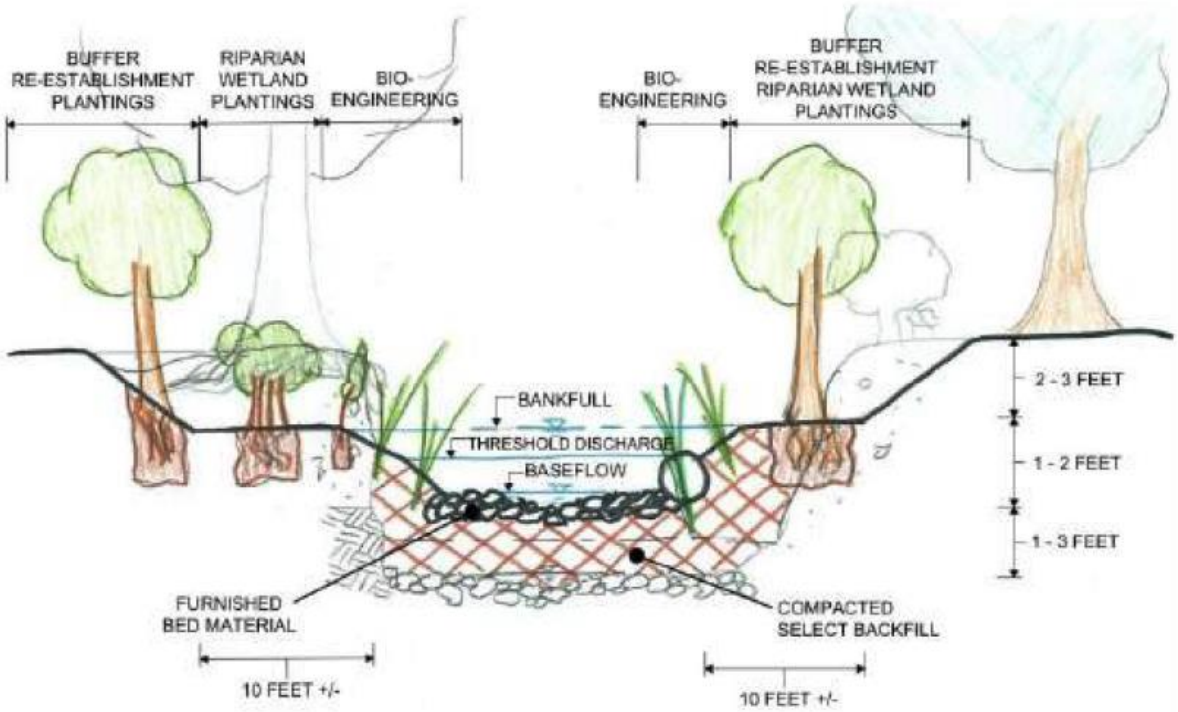


Restoration site: pre- and post- views

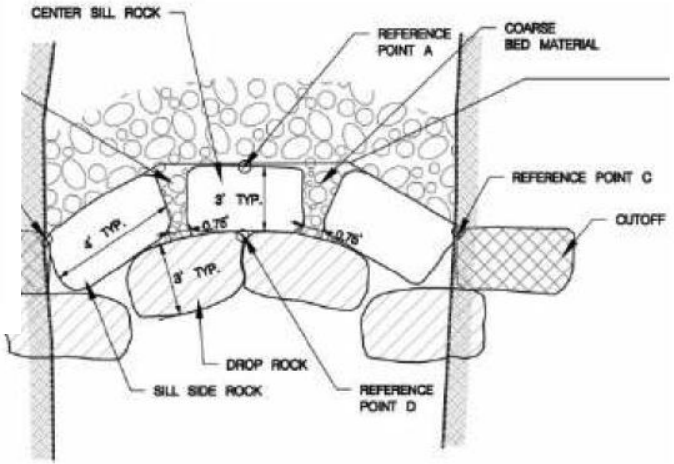




Priority 2 type of restoration (1760 ft)

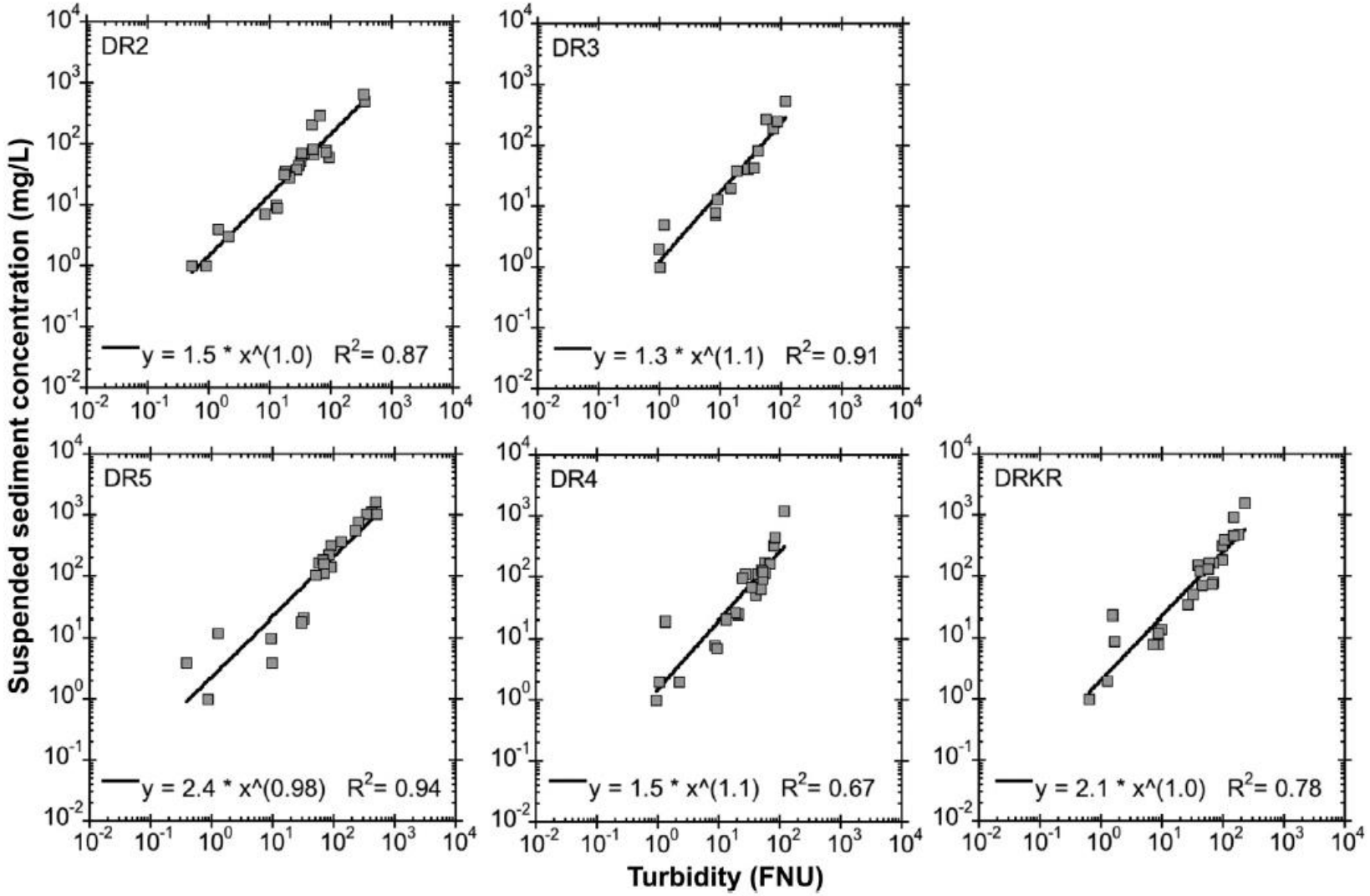


BANKFULL STAGE ESTABLISHED AT NEW INTERMEDIATE BENCH



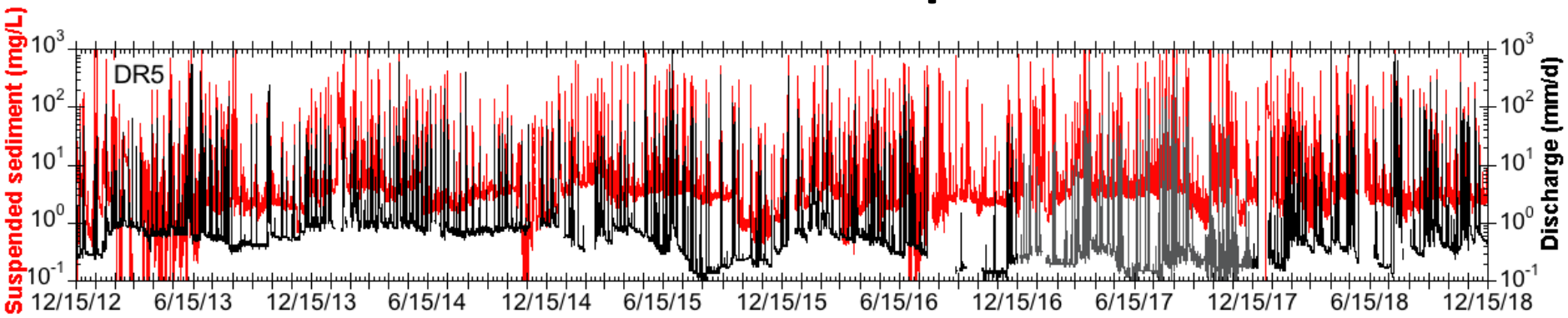
Plan view of a typical type 2 rock sill.

Suspended sediment was derived from turbidity measurements and field data.



Time series of suspended sediment and discharge were developed for all sites.

DR5 example



Recent paper was published on pre-restoration sediment data.

Contents lists available at ScienceDirect

Geomorphology

journal homepage: www.elsevier.com/locate/geomorph

Spatial and temporal patterns of suspended sediment transport in nested urban watersheds

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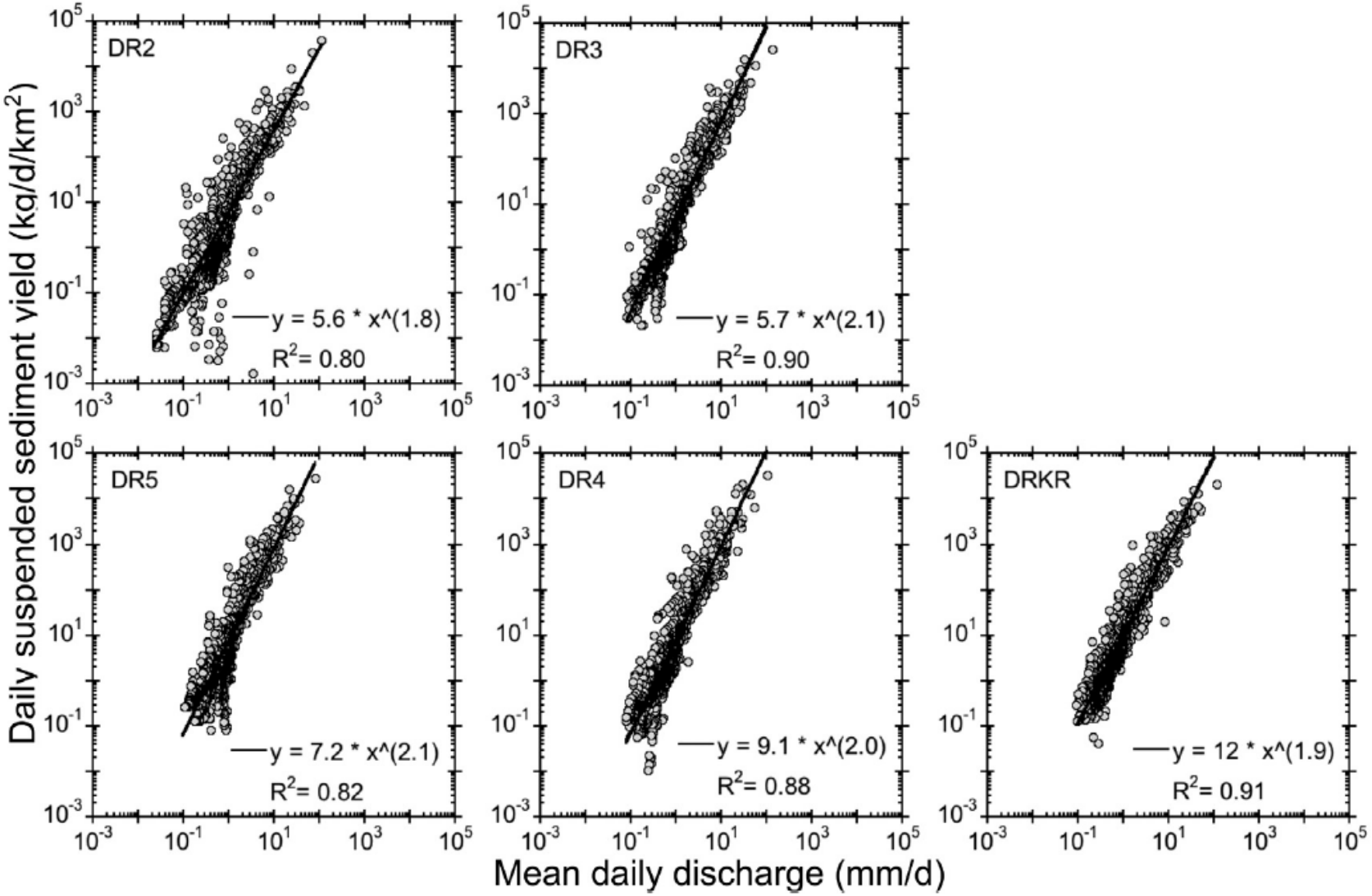
Mean daily discharge is a good predictor of suspended sediment yield.

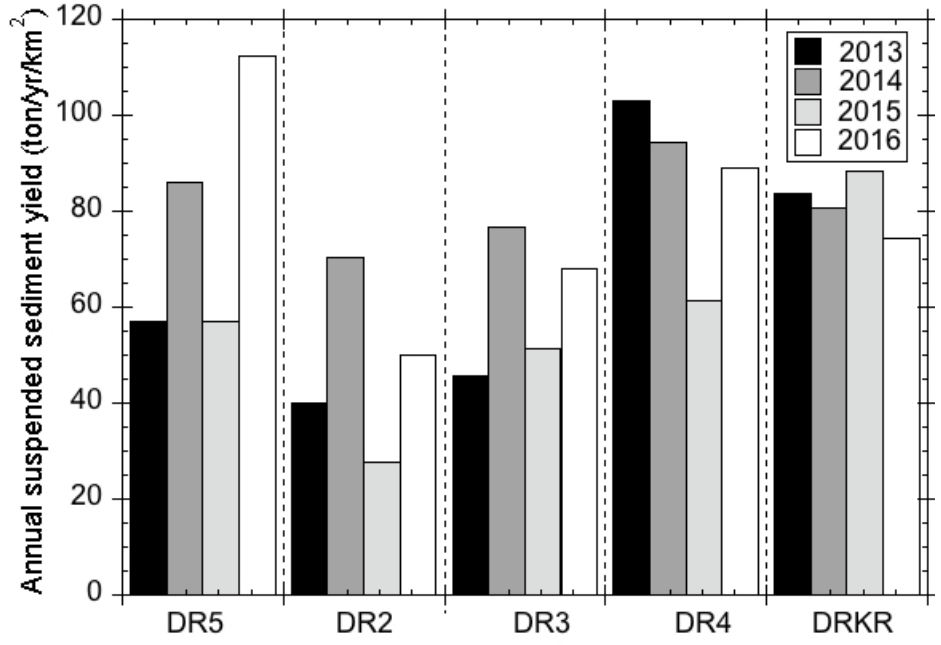


Most of the suspended sediment load (SSL) moves in just a few days per year.

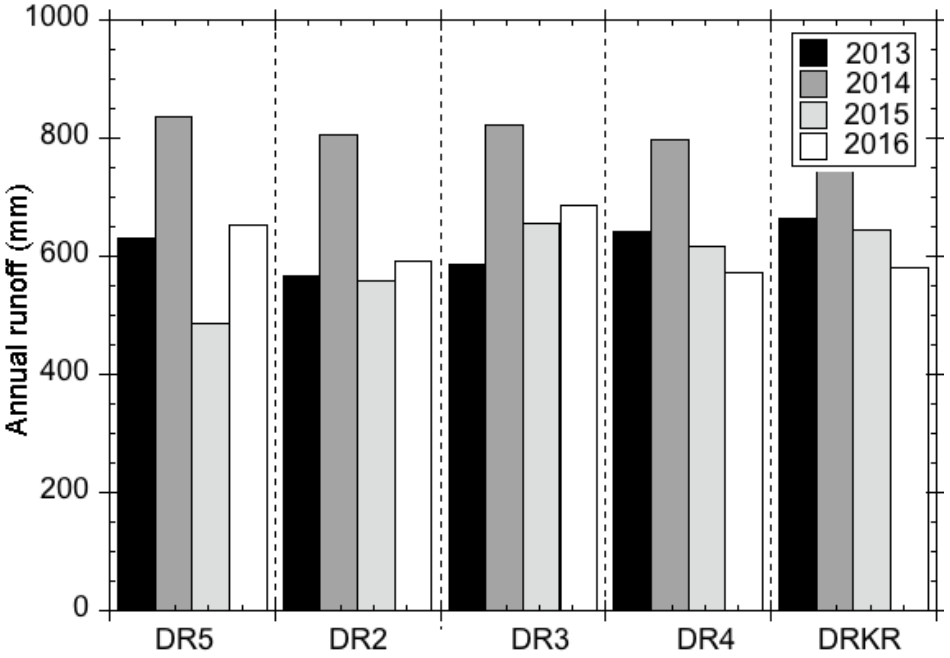
	Days to move		
Subwatershed	50% total SSL (d/yr)	75% total SSL (d/yr)	90% total SSL (d/yr)
DR5	3	13	31
DR2	2	11	27
DR3	4	11	25
DR4	3	11	27
DRKR	5	14	30

Spatial and temporal variability of annual sediment yields is greater than that of annual runoff, across watersheds.

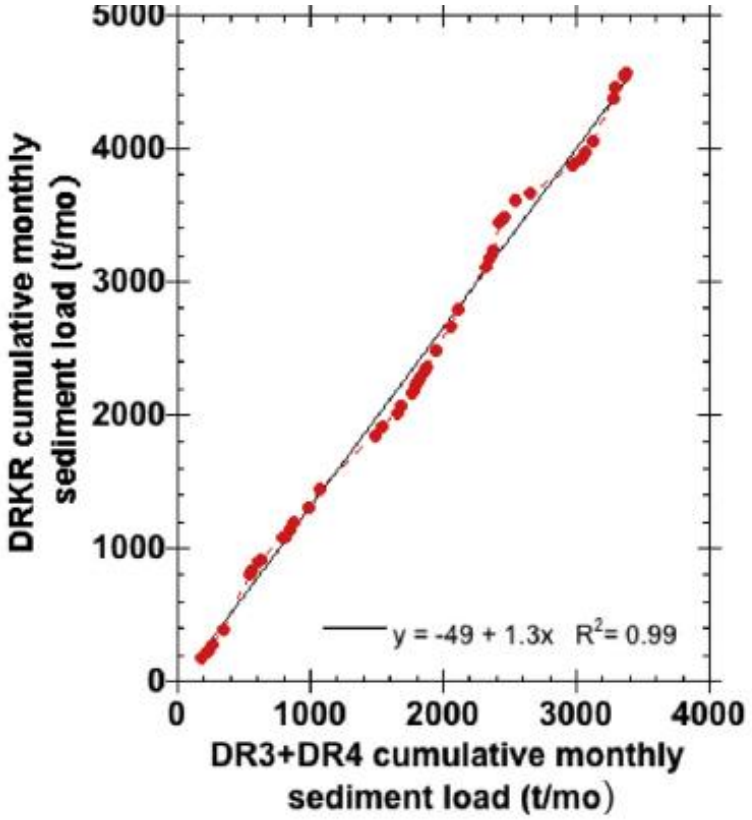
Annual sediment yields

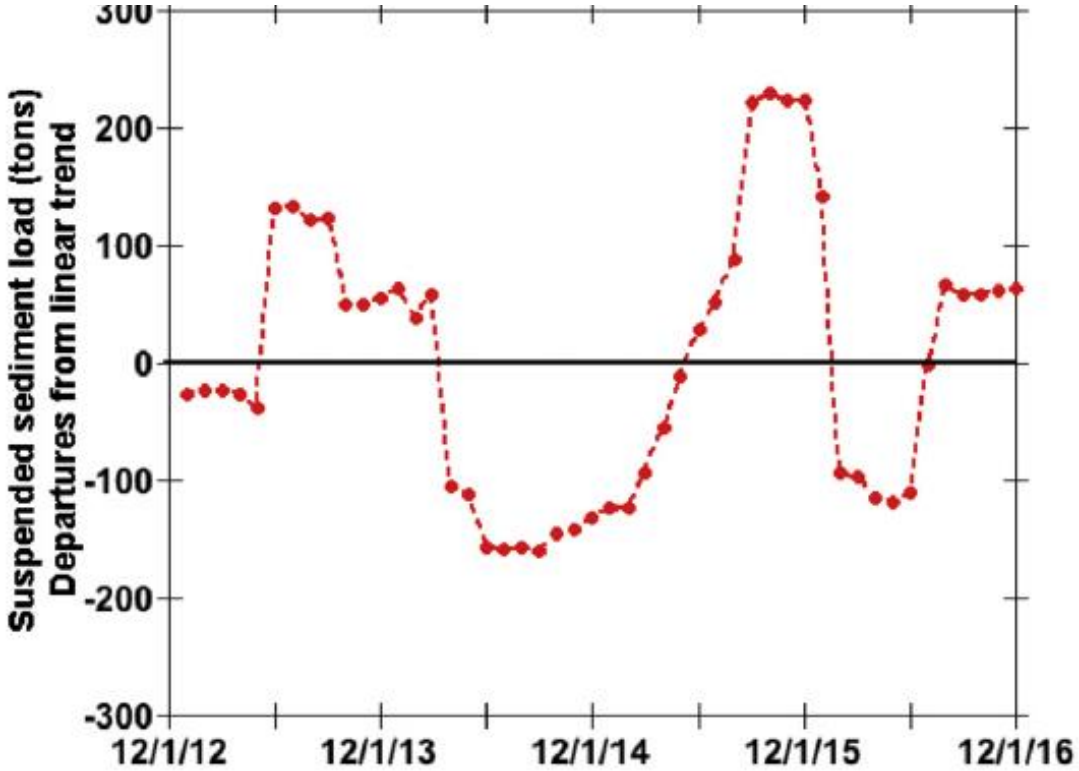


Annual runoff values



Comparison of DRKR cumulative load with its two major tributaries suggests dynamic storage and remobilization.





One possible explanation of dynamic storage?

Conclusions

- Sampling design allows quantification of spatially and temporally variable sediment loads
  - Value of high-frequency data to detect changes in small, flashy watersheds has been demonstrated.
  - Method is transferable to other locations.

Conclusions, cont'd

- Baseline data imply that
  - most of the annual sediment load is carried in a small number of days per year.
  - upstream signals may be dampened with increasing drainage area, with or without restoration.

Conclusions, cont'd

- Evidence of dynamic storage and remobilization of sediment suggests
  - even a significant sediment reduction in a restored watershed may not be detectable at a downstream station within the same year.
  - multiple years of pre- and post-restoration monitoring are needed to assess significant changes.

Acknowledgments

- Chesapeake Bay Trust Pioneer Grant 12507
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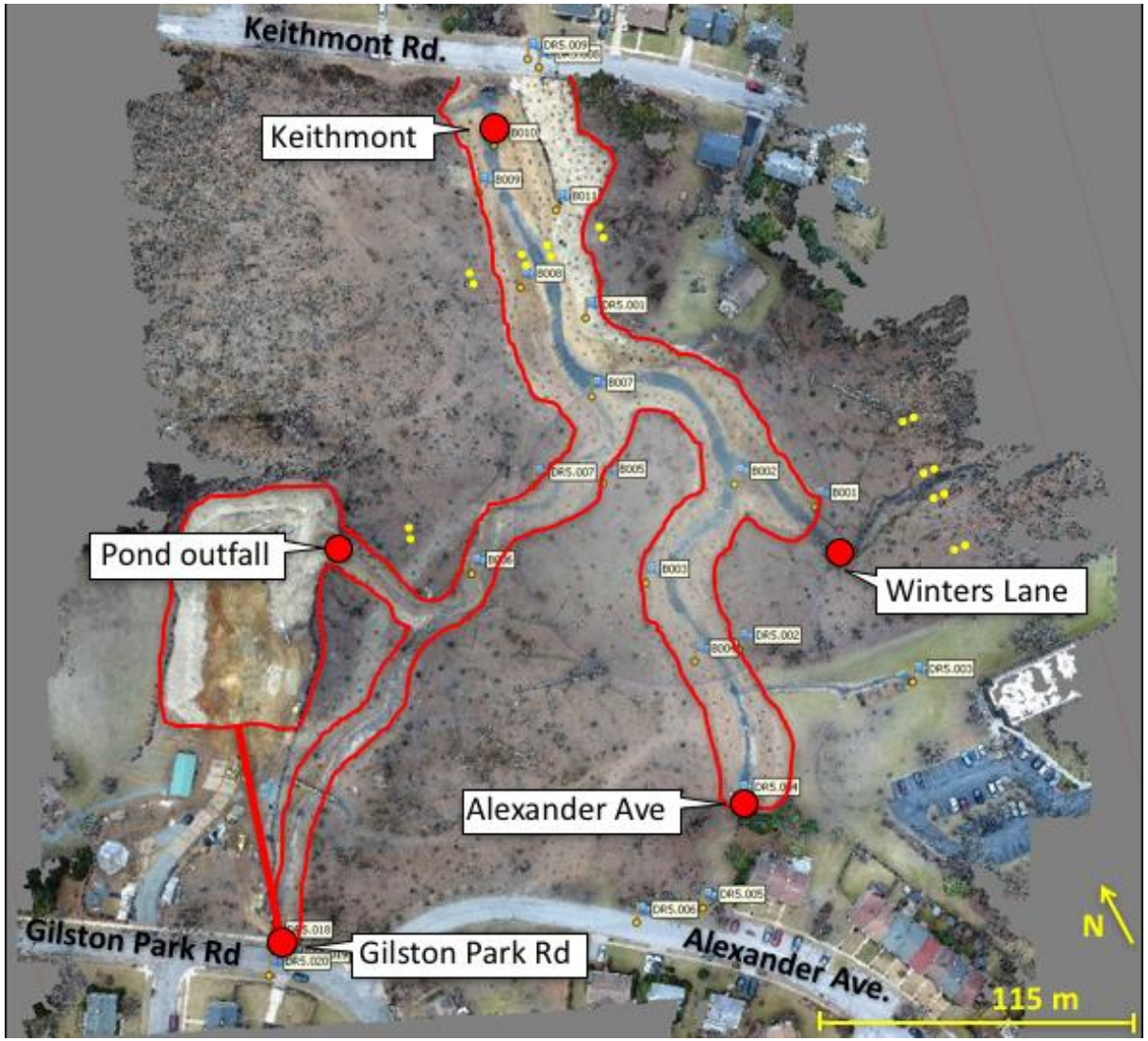
- John Kemper

New CBT stream restoration project



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Translation Slides by Erik Michelsen

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What does this mean for me?

- Measuring sediment in these systems requires continuous sampling at several sites to understand how sediment moves through the watershed.
- Sediment pulses through stream systems like a conveyor belt, more erratic in the headwaters and consistent further downstream.
- Tools like hi-resolution LiDAR could be an option to try to better understand in-stream storage and erosion over time.

What does this mean for me?

What do I take from this if I am a practitioner:

- Sediment scour/transport is occurring disproportionately a few days per year.
- Similar rain events can have different sediment responses in separate sub-watersheds, based on factors like in-stream storage and bank erodibility.

What do I take from this if I am a regulator:

- Getting an accurate handle on the sediment impacts of stream restoration work takes several years of monitoring both before and after project implementation.
- The sediment reduction benefits of restoration could take years to see.