US EPA ARCHIVE DOCUMENT

Ecological Sustainability in Rapidly Urbanizing Watersheds: Evaluating Strategies Designed to Mitigate Impacts on Stream Ecosystems

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Environmental Systems Analysis

Collaborative Science and Technology Network for Sustainability
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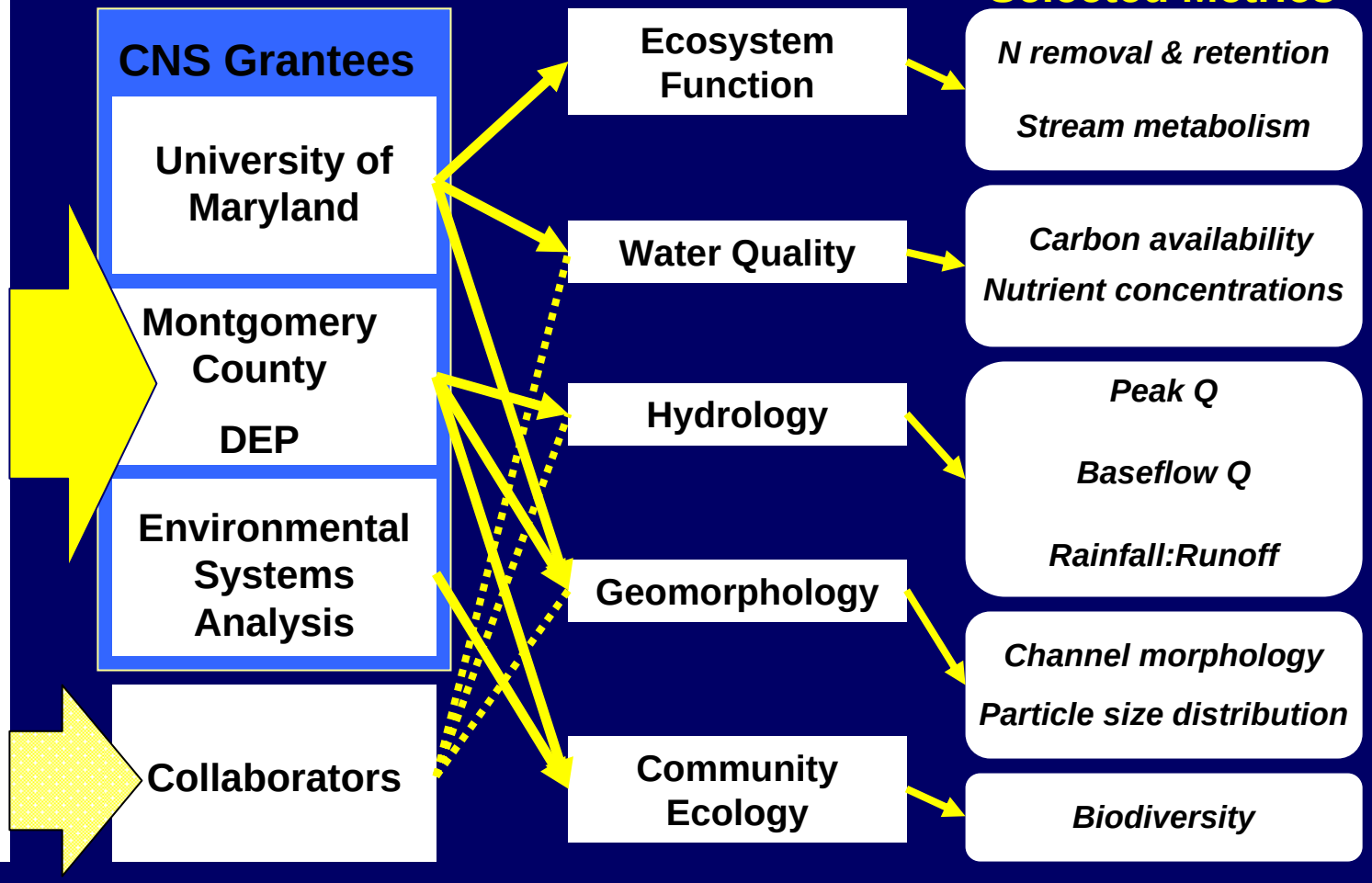
Questions:

When compared to pre-2K SWM strategies, are post-2K strategies better at mitigating the effects of urbanization on stream ecosystems?

How does watershed development affect receiving streams?



Study System:

1 pre-2K control watershed

1 forested watershed

3 post-2K watersheds

Valuable Tools:

5 USGS stream gages

2 rain gages

LiDAR imagery

Expected Contributions to Sustainability & Understanding Ecosystem Services

- Document ecosystem response to long term and significant landscape changes
- Document effectiveness of sediment and erosion control and SWM BMP's
- Gain a better understanding of the degree of ecosystem recovery from landscape changes
- Gain a better understanding of N delivery and removal in suburbanized streams

Dramatic Changes to the Landscape

May 2005

August 2005

August 2006

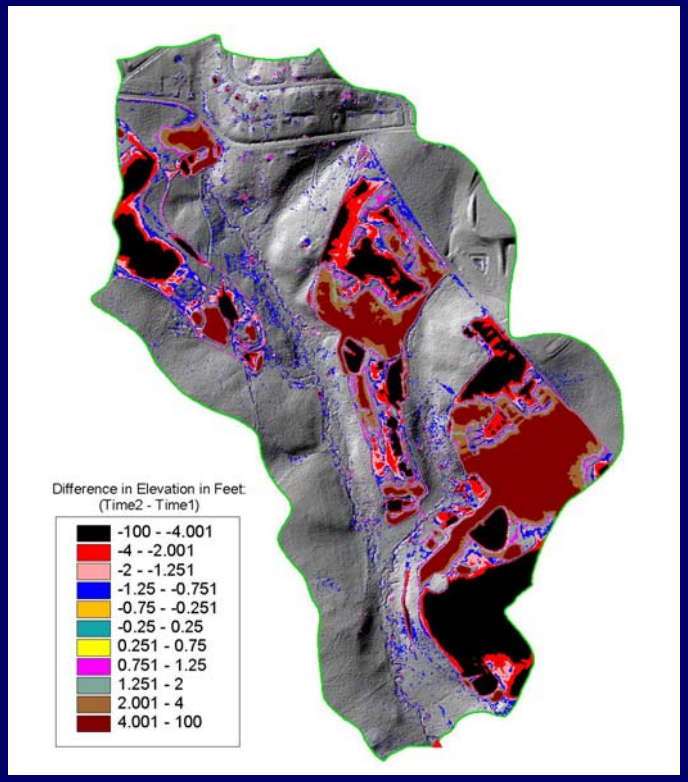
Update on Collaborators and Partners

- S. Taylor Jarnagin, EPA-EPIC
- Dianna Hogan, USGS-Reston
- John W. Jones, USGS-Reston
- Yusuf M. Mohamoud, EPA-NERL
- Kaye Brubaker, University of Maryland
- Gary Fisher, WRD, USGS
- M-NCPPC Park Managers and Ecologists

S. Taylor Jarnagin

Research Ecologist, EPA, EPIC

- Can LiDAR accurately map channel morphology at catchment scales, in forested environments?
- Can LiDAR effectively map changes in channel morphology with repeat LiDAR collects (precision)?
- Can channel change be associated with changes in landscape and streamflow?

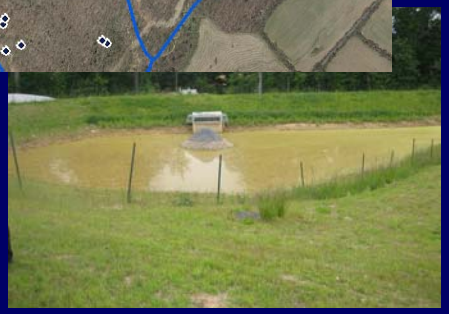


Dianna Hogan

USGS Reston

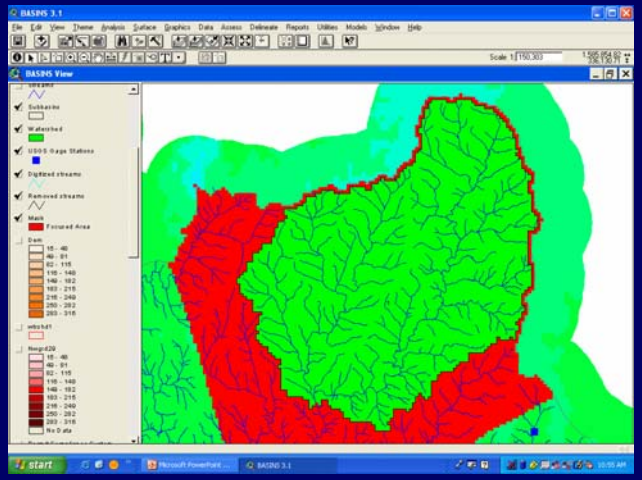
- What are the environmental values of different BMPs for water quality mitigation based on location, type, substrate, and land use?

- Identify mitigation strategies (location, type, utilization, soils, etc.) to promote ecologically sustainable land use



Yusuf M. Mohamoud

EPA, NERL



- Modeling Urban Development Impacts With HSPF Model
- Assessing impacts of individual as well as cumulative projects to receiving streams
- Develop an integrated Modeling Framework to address hydrology, water quality, channel morphology, and biological integrity at the watershed scale

1. Quantify land use change

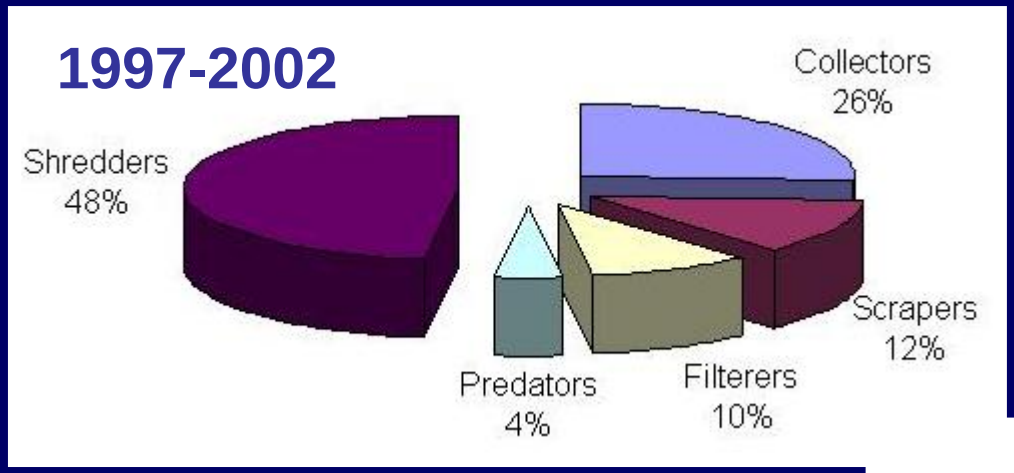
2. Assess the consequences of land use change (Integrated watershed modeling)

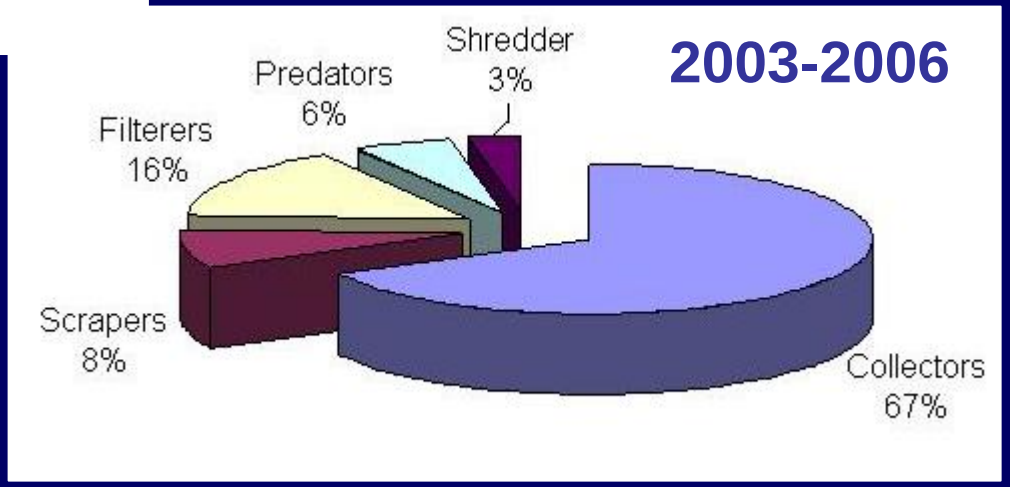
3. Manage the impacts of land use change (Best management practices)

4. Monitor and evaluate model results to achieve sustainability (Adaptive management

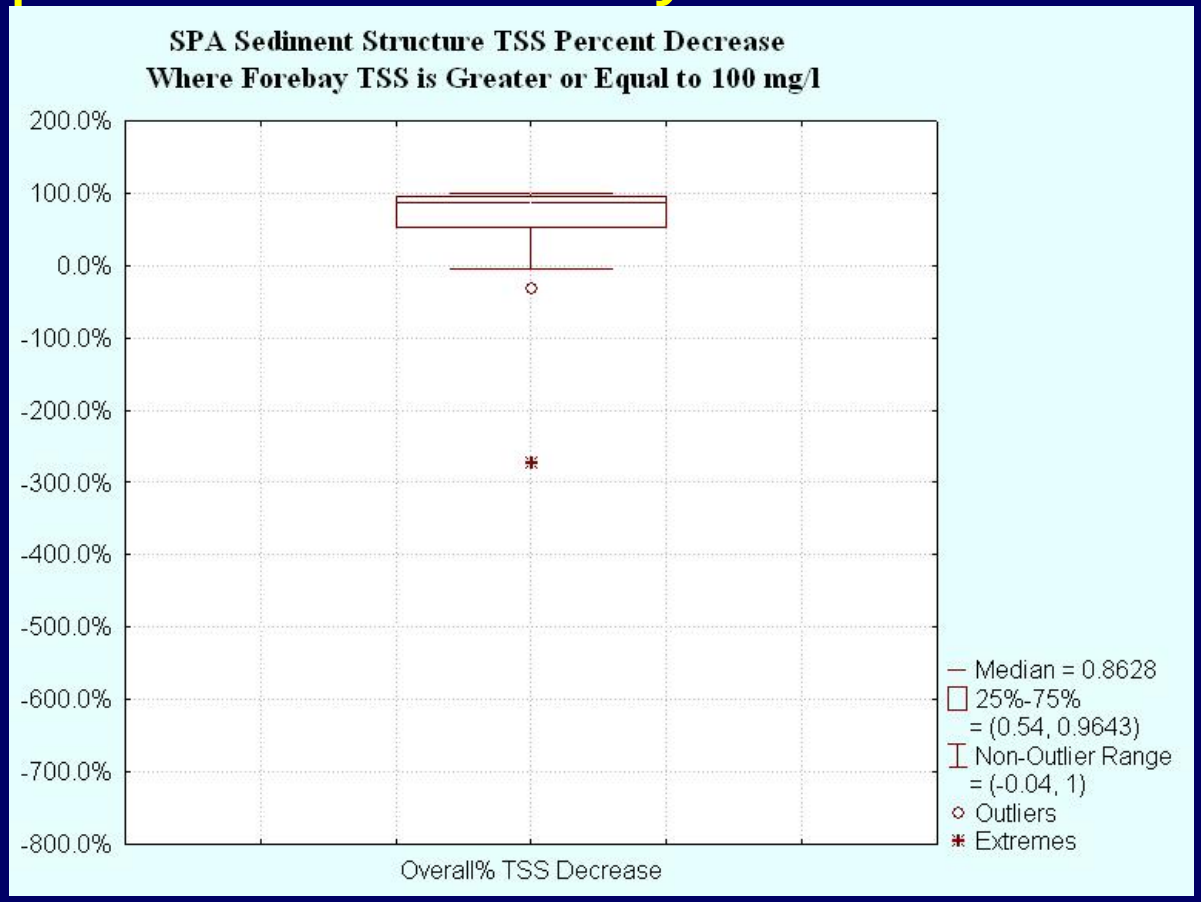
Preliminary Results

Construction phase profoundly changes benthic macroinvertebrate community composition

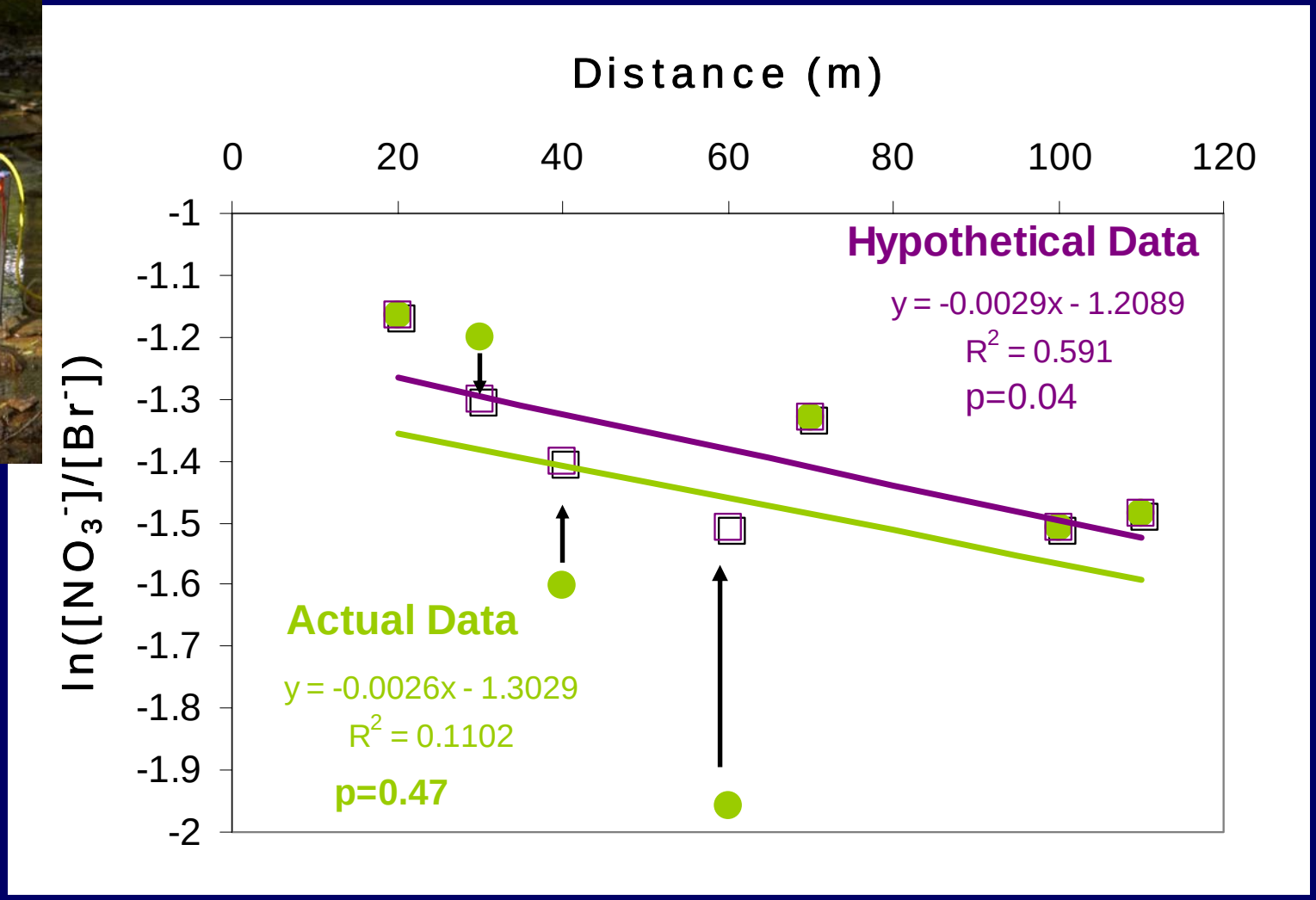




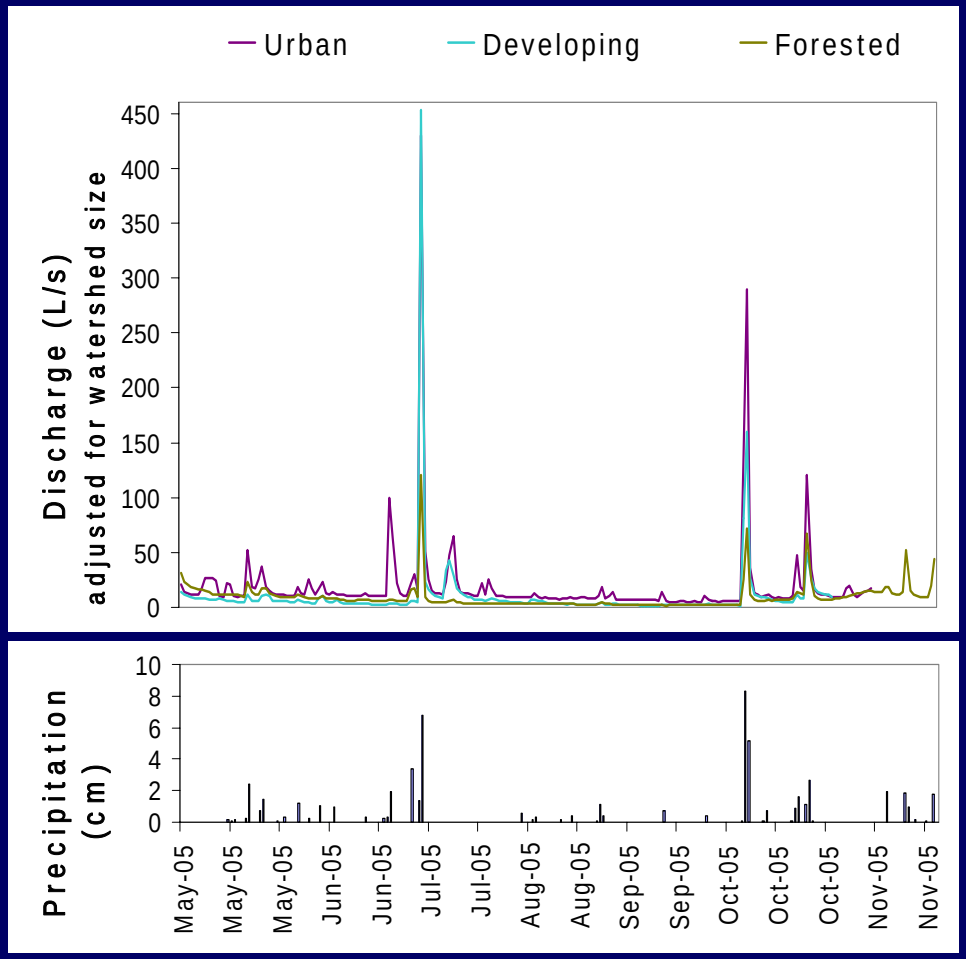
Sediment and erosion control devices appear to be 86% efficient in removing fine sediments, an improvement over reported values from other parts of the country.

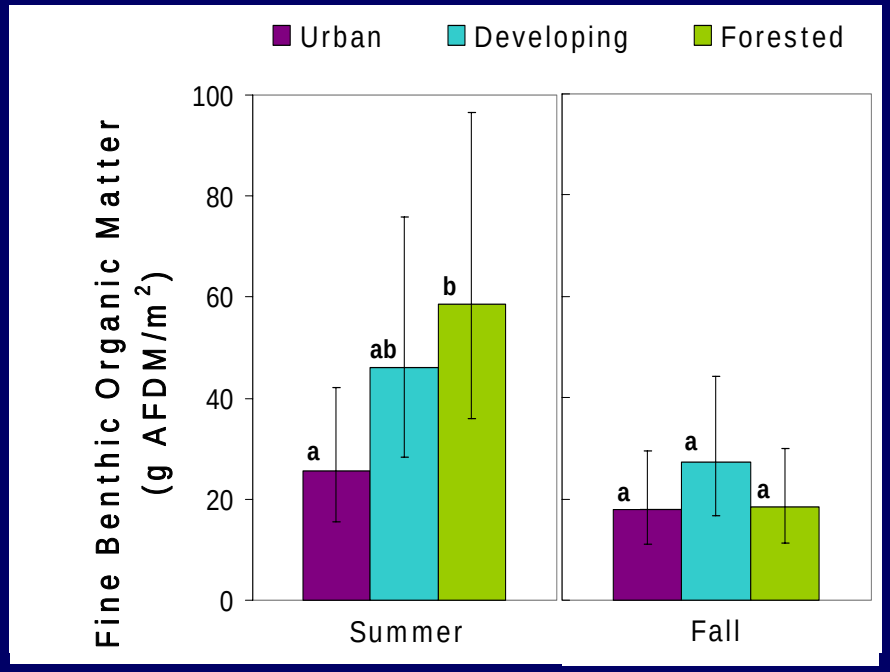


Nitrate removal cannot be detected in short (~110m) study reaches.

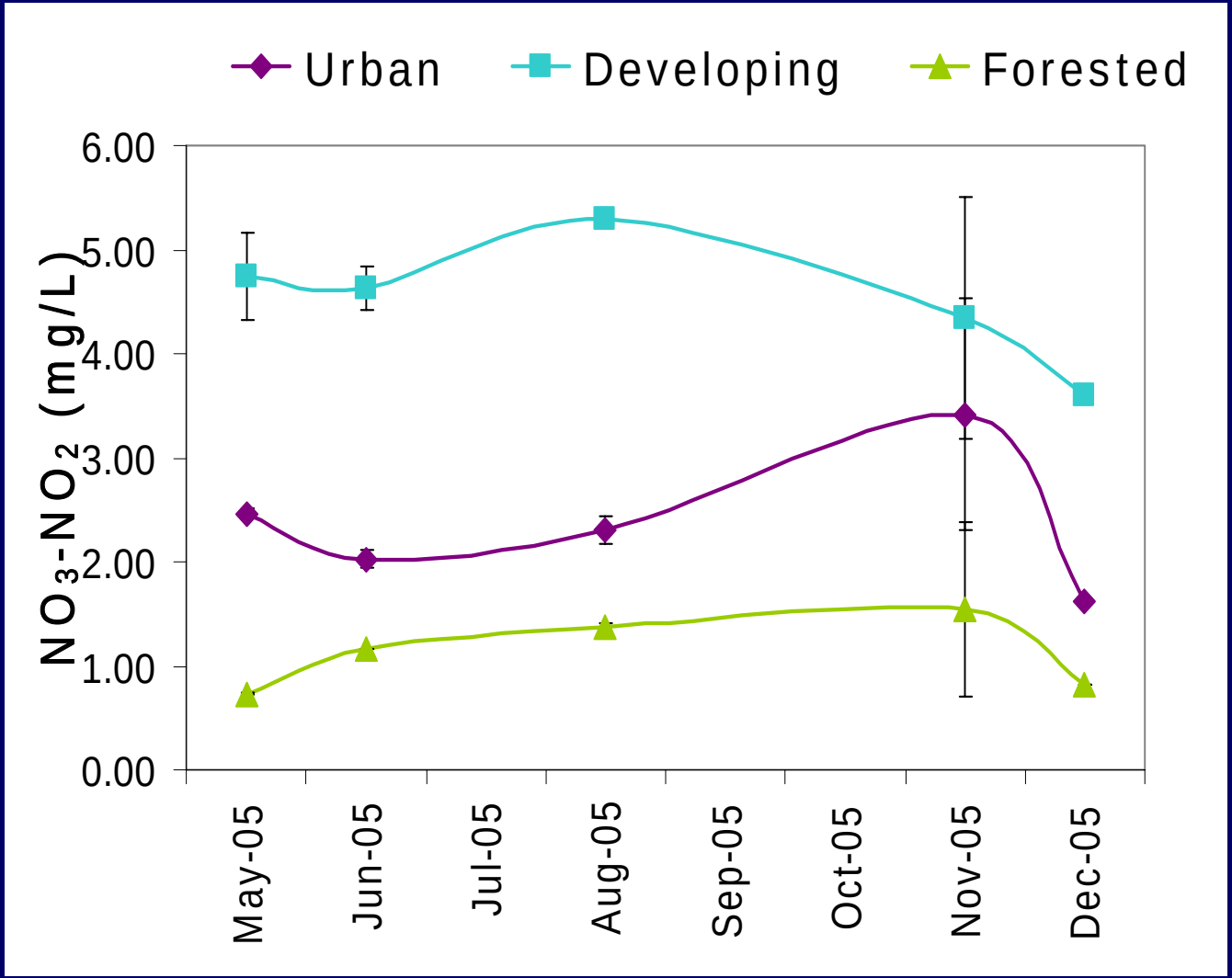


But data suggest N uptake may follow expected patterns.





Recent agricultural land use in developing watershed appears to influence N loading and may influence N uptake.



Difficult to assess groundwater flow paths in Piedmont without appropriate expertise.

“Lessons Learned”

Questions and methods must be adaptable when studying large-scale treatments that you cannot control

- For example:
  - Turnover from sediment control to SWM has been slower than initially expected
  - Speed of development has slowed over the course of the study

Ways the CNS Funding & Program have Helped Us

- Increased recognition of the Clarksburg Integrated Ecological Study Partnership to potential partners
- Helped leverage funding and in-kind services
- Provided a level of “legitimacy” to the county’s efforts to understand effects of land use change to receiving streams and biota
- Networking has provided increased access to information, people, and equipment
- A better sense of the needs of managers & practitioners allows us to focus our research questions more appropriately

Questions to Explore and Contacts to Make

We are interested in learning how to *directly* measure water quality benefits of stormwater control structures.

Methods?

Potential contacts?