

Assessing Watershed-Scale Restoration Effectiveness: Treatment Impacts and Monitoring Requirements



Thomas E. Jordan, Carey E. Pelc
Smithsonian Environmental
Research Center

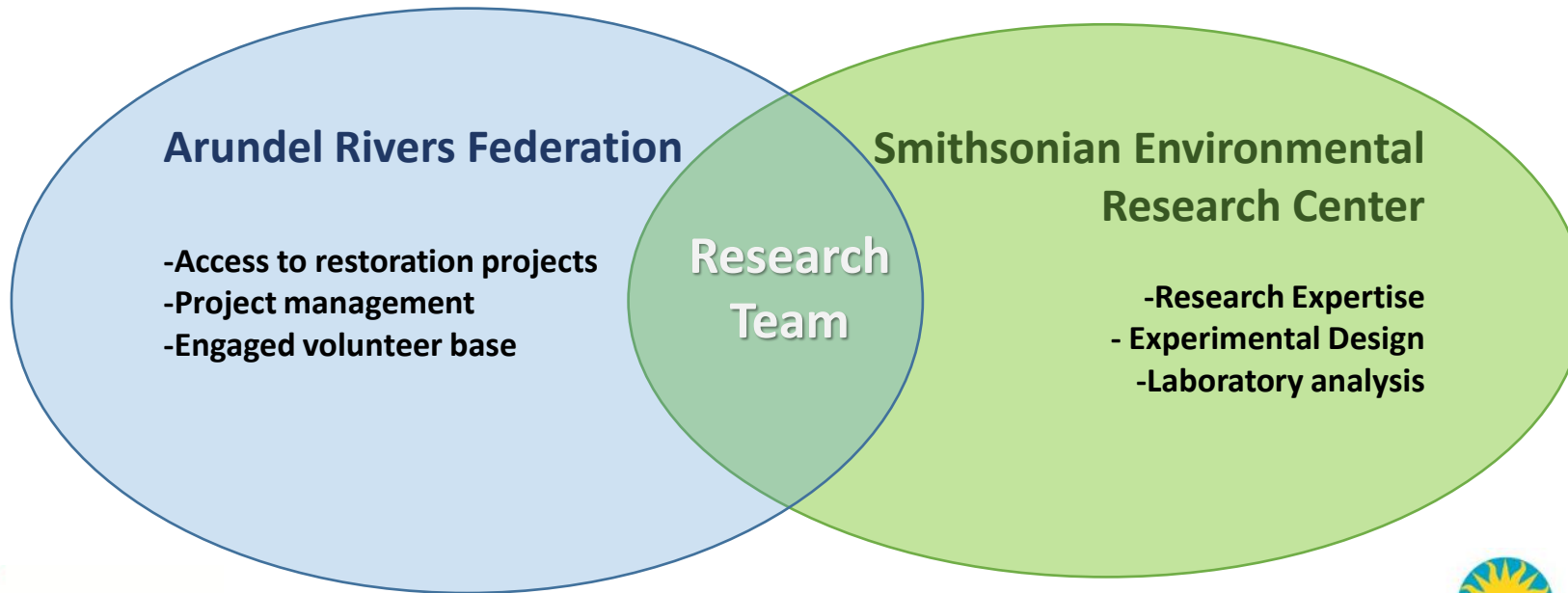


Jesse Iliff, Sarah Giordano,
Wayne Martin
Arundel Rivers Federation

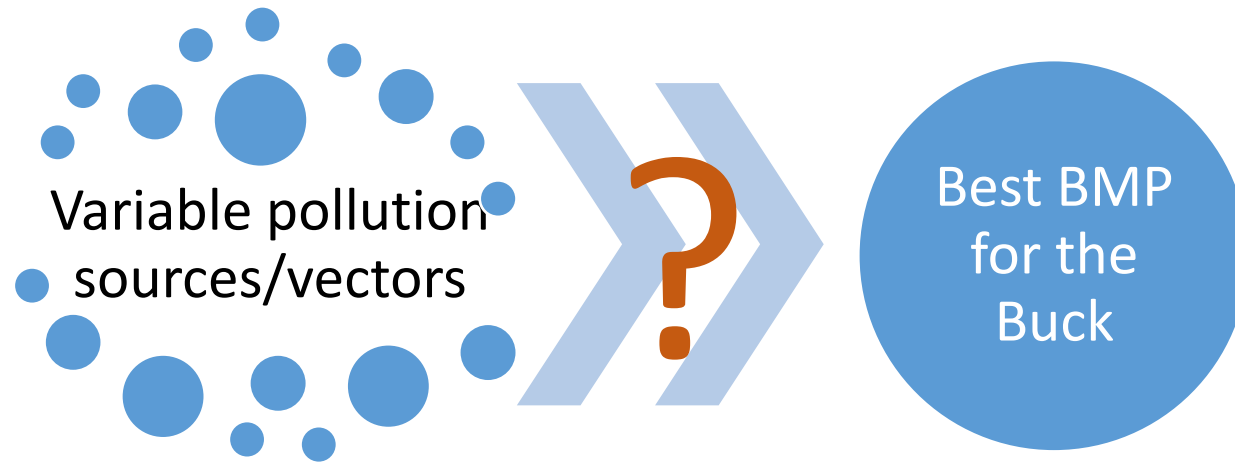
Partnership Makes Our Work Possible...



...But What Partnerships Can Make Our Work More Productive?



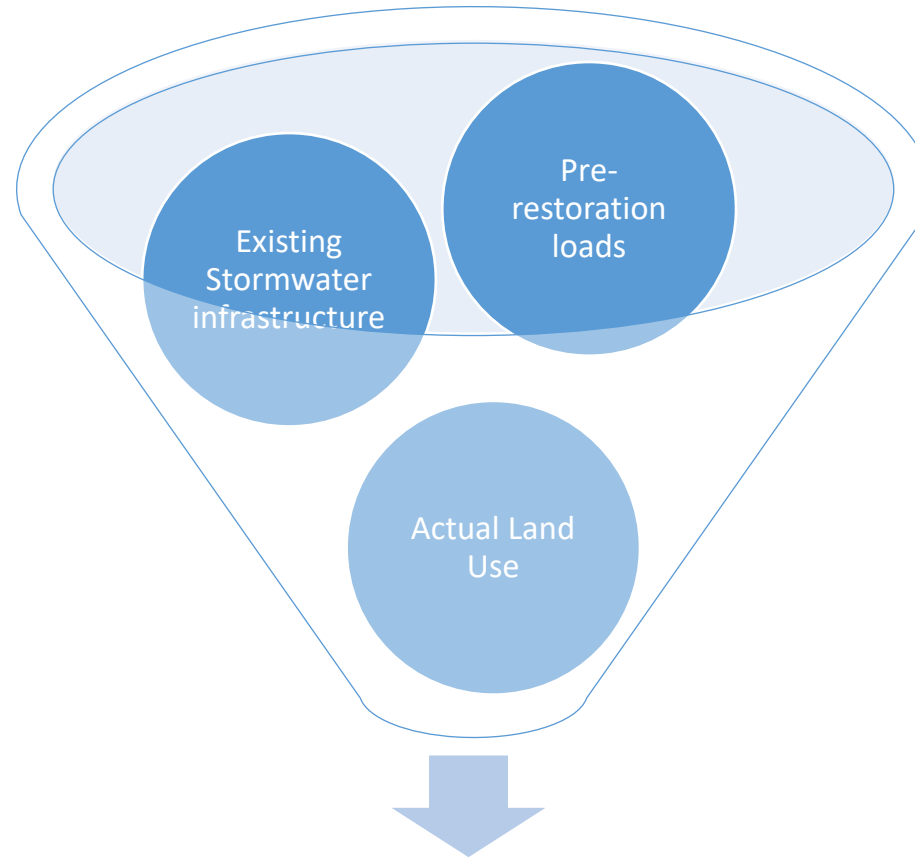
Data-driven Decision-making



Unique
Watersheds

TMDL
Compliance





Partnerships can help overcome these limitations:

- NGO, research and academic institutions can help to establish baselines
- Local governments and government contractors can help define stormwater infrastructure impacts
- Civic Groups, Schools, HOA, Places of Worship, Local Businesses can define land use considerations

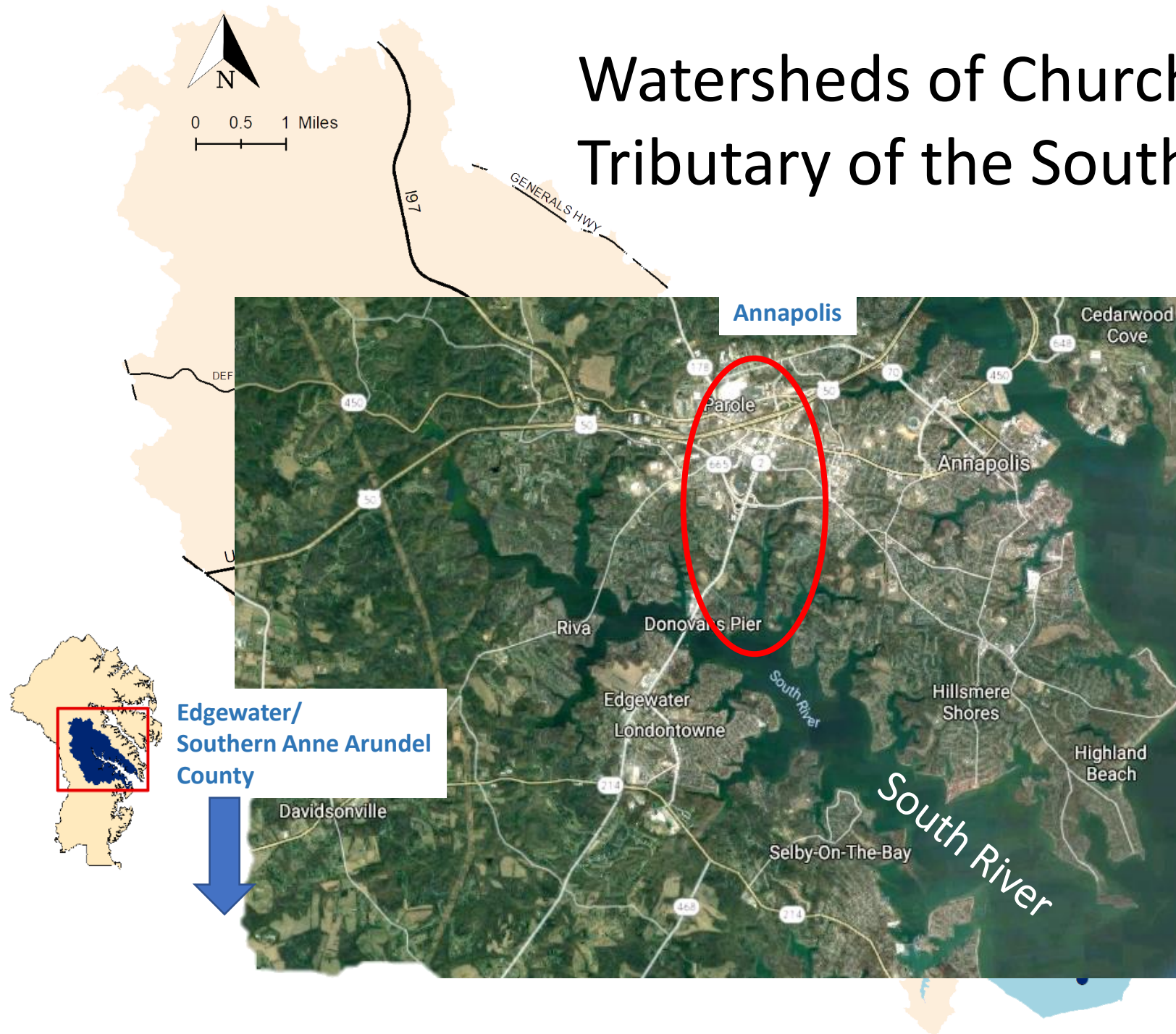


Partnerships can help overcome these limitations:

- Non-Profits, Research & Academic Institutions--can help to establish baseline data
 - ***You don't need a lot of data to learn a lot***
- Local Governments and Contractors--can help define stormwater infrastructure impacts
 - ***Get the best information on flows, age, non-topographical drainage***
- Civic Groups, Schools, HOA, Places of Worship, Local Businesses--can define land use considerations
 - ***Learn what happened on the land draining to the BMP, past, present, future.***



Watersheds of Church Creek Tributary of the South River





Nutrients- Algal Blooms



Sediment



The Focus Area: Church Creek

- South River Federation: 17 Best Management Practices (BMPS)
- Not including County or City projects
- Taking advantage of this unique research opportunity

How does layering projects together impact their ability to reduce nutrients and sediment?



Goal of the Study:

Measure effects of urban stream restorations and other management practices on discharges of:

Nitrogen, Phosphorus, and Total Suspended Solids (TSS)

Sources of N, P, and TSS in Urban Watersheds

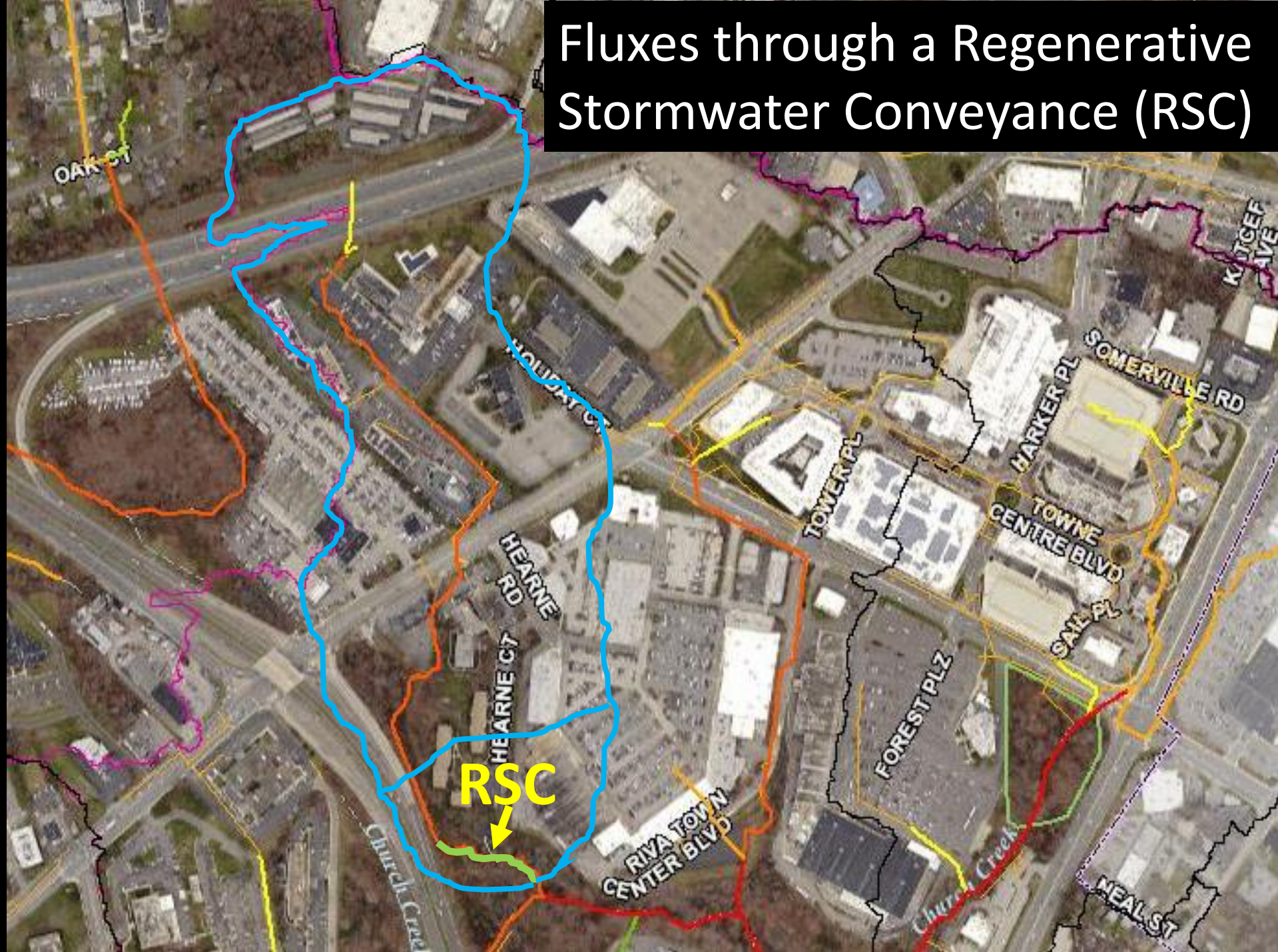
- Atmospheric deposition of nitrate and ammonium
- Erosion accelerated by urban runoff (TSS and P)
- Fertilizer
- Pet waste
- Sewage leaks
- Septic systems

Assessing Effects of Stream Restorations:

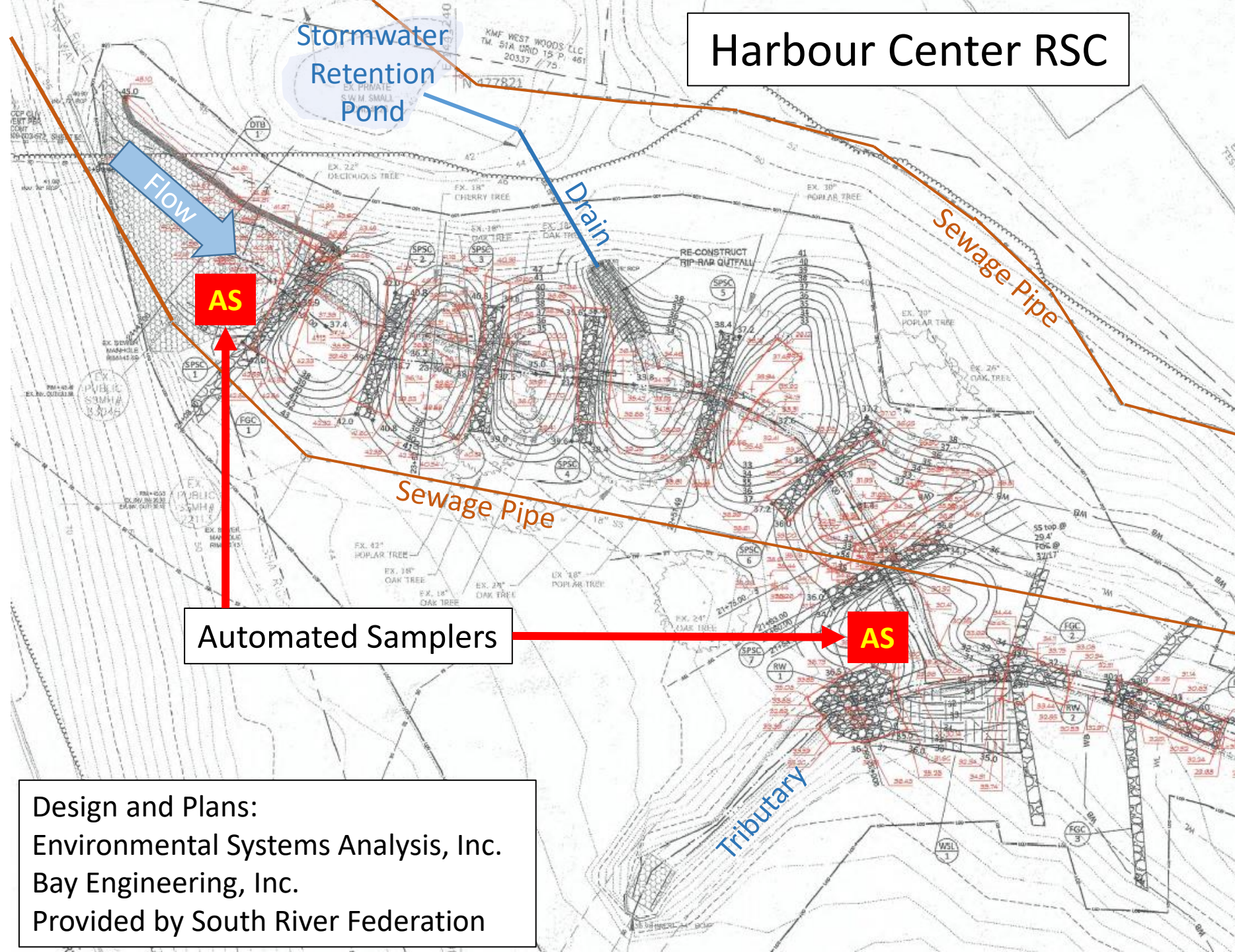
Two main approaches:

- Measuring fluxes of nutrients and TSS through a stream restoration.
- Comparing discharges of nutrients from watersheds with different management practices in place.

Fluxes through a Regenerative Stormwater Conveyance (RSC)



Harbour Center RSC



Design and Plans:
Environmental Systems Analysis, Inc.
Bay Engineering, Inc.
Provided by South River Federation

Upstream End of Harbour Center RSC

Automated Sampler

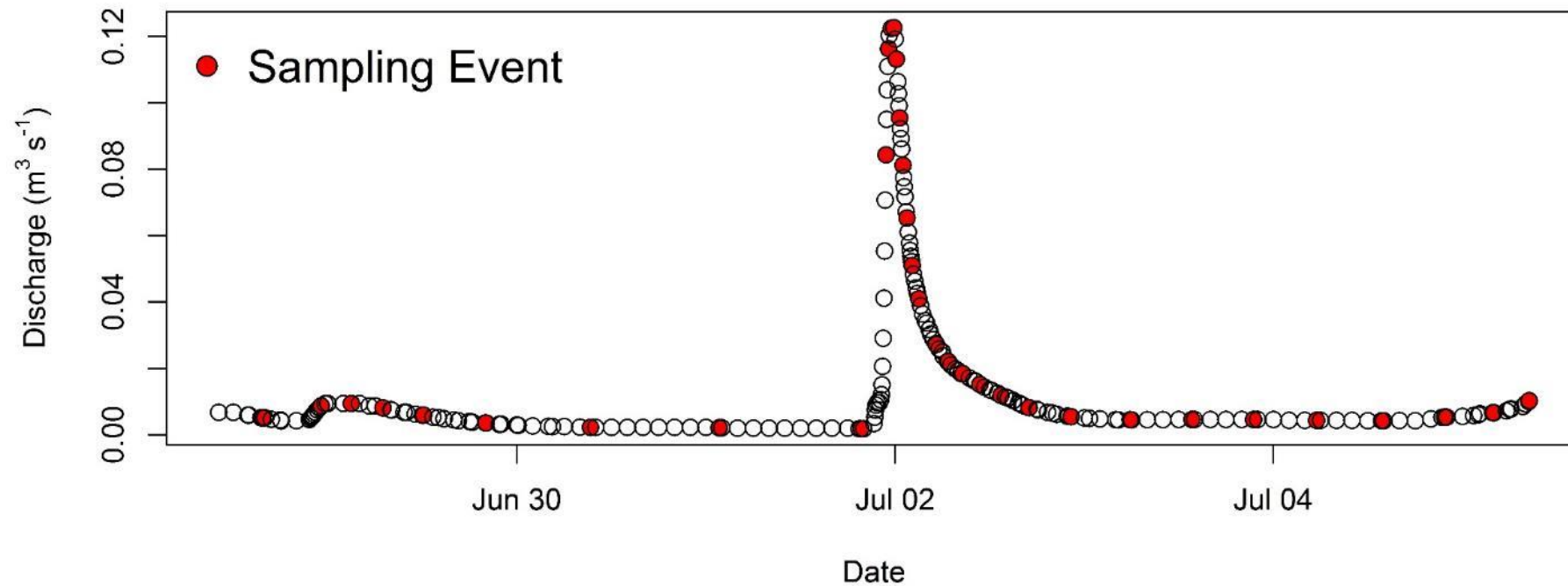


Rock Weirs Along Harbour Center RSC



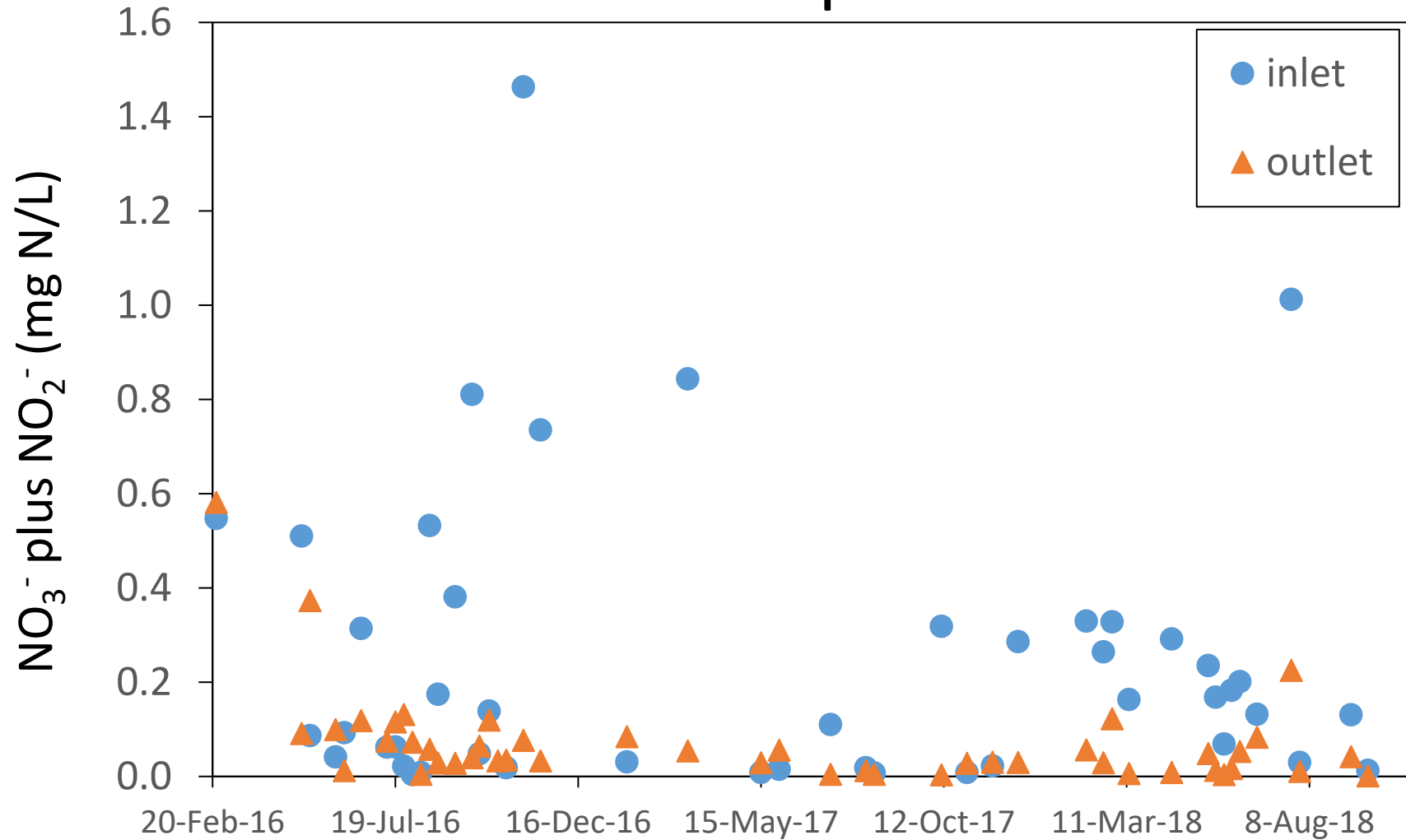
Automated Sampler at the downstream end of the Harbour Center RSC



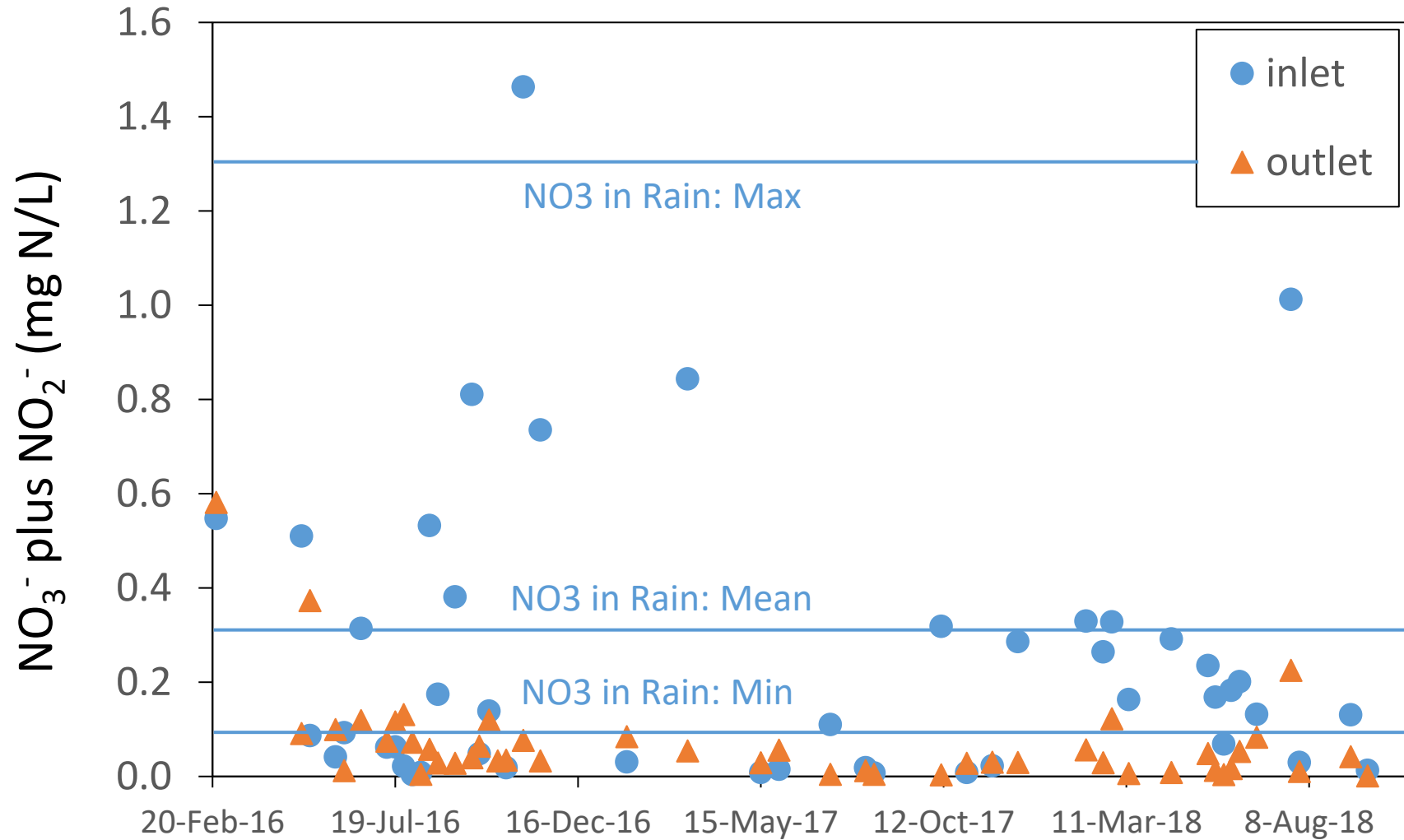


- Flow-paced sampling (e.g. 30-60 water samples per week).
- Water samples composited for a weekly mean concentration.
- Acid preservative is added to the accumulating samples.
- Concentration X weekly water flow = Weekly load.

Big Drop in Concentration of Nitrate plus Nitrite at RSC Outlet Compared to Inlet.



Nitrate plus Nitrite Concentrations Similar To or Less Than In Rain



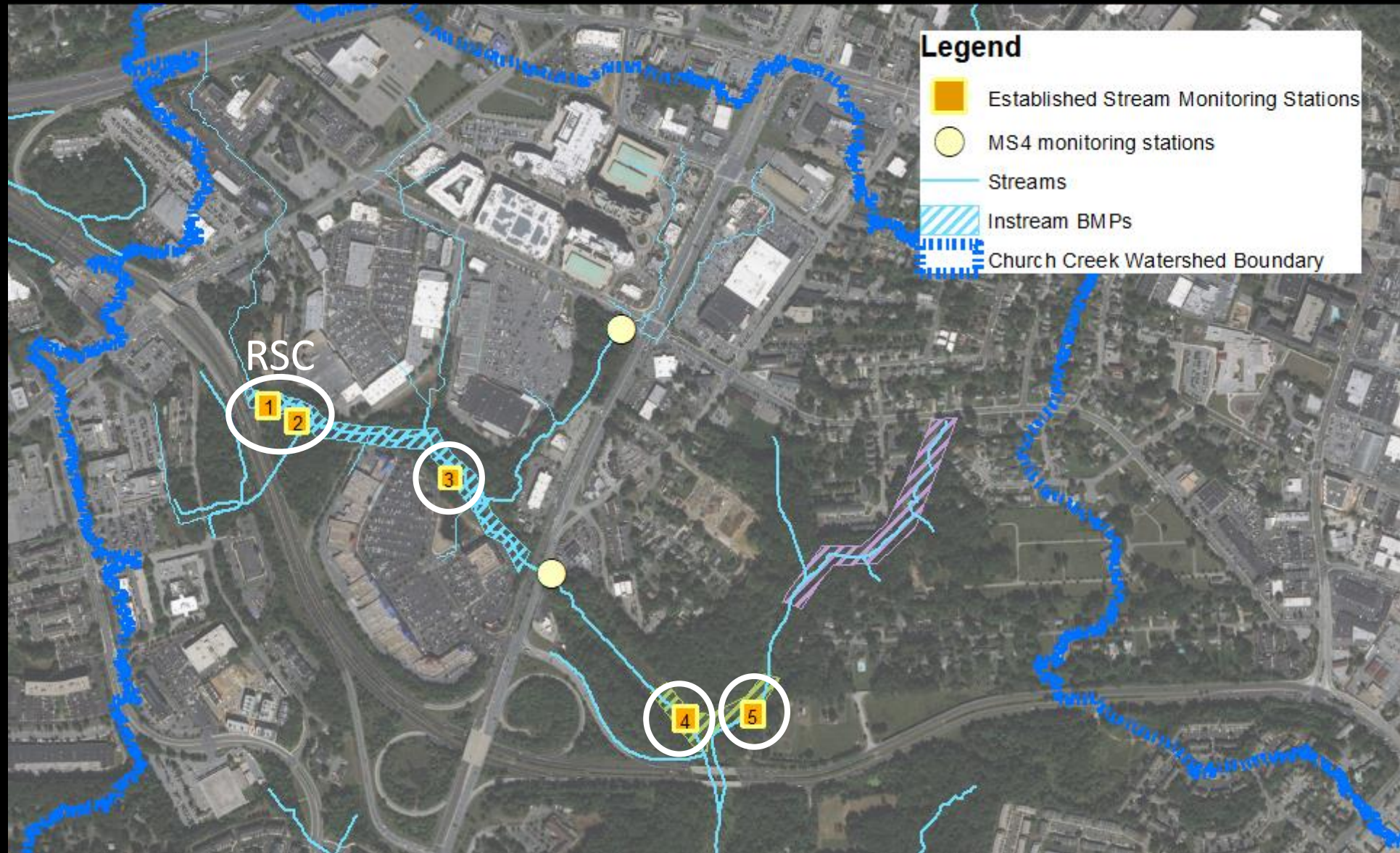
Calculating Retention

Concentration X Water Flow = Load

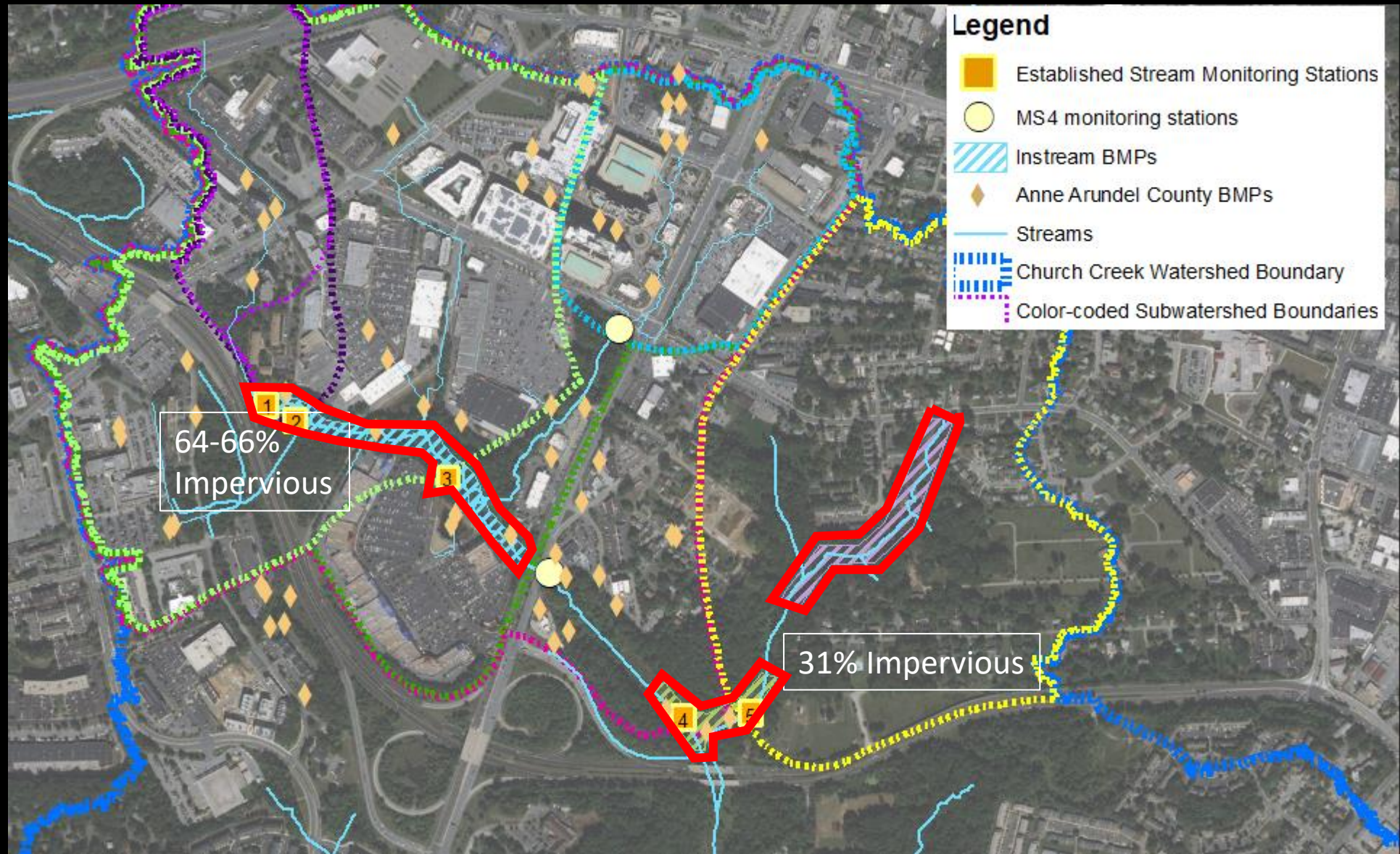
Load in – Load Out = Amount Retained

% Retained = (Amount Retained / Load In) X 100

70% of the Nitrate plus Nitrite was retained



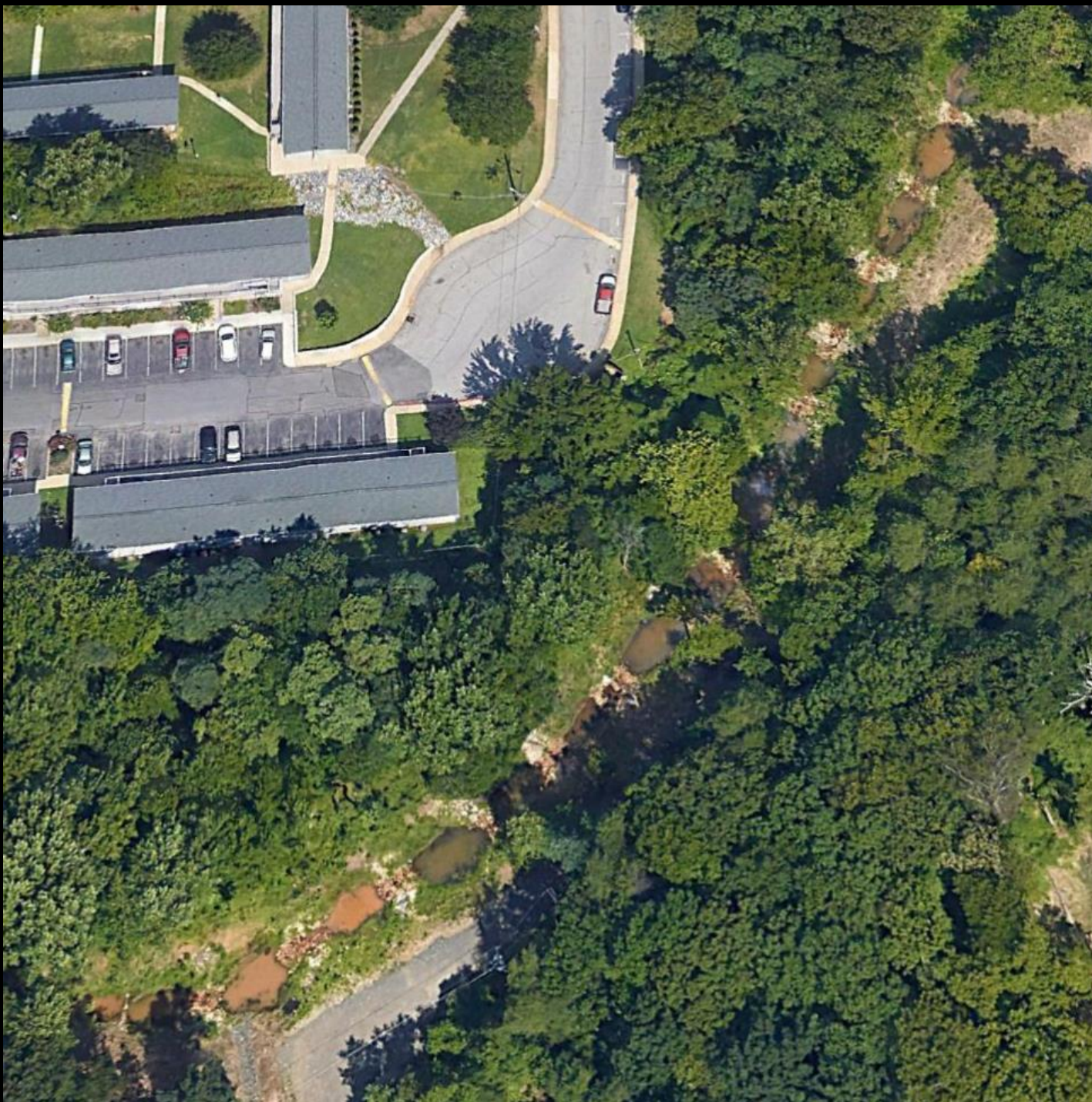
Comparing watersheds with different management practices.



Comparing watersheds with different management practices.

Rock weirs at junction of West and Allen Branches: Automated Samplers 4 and 5

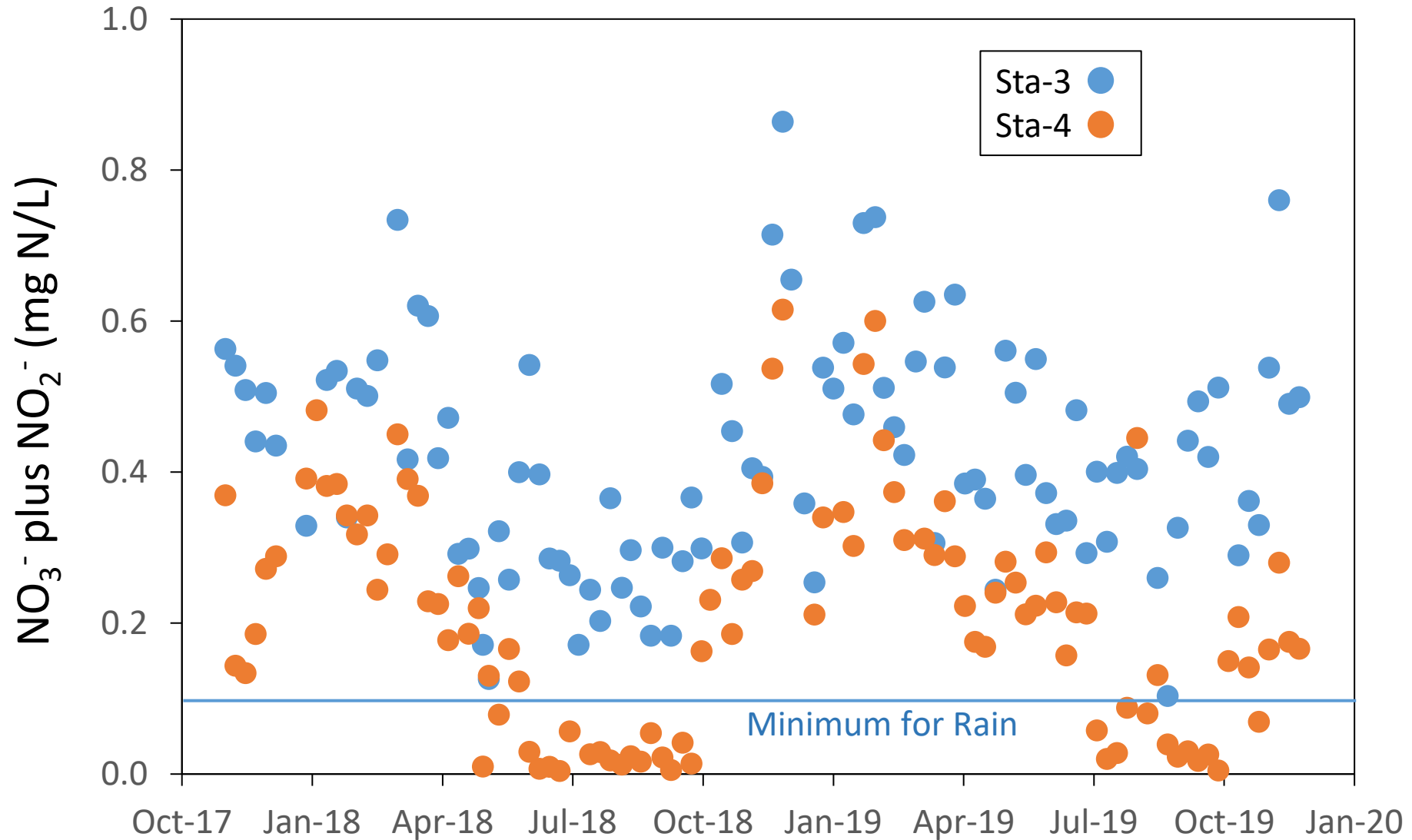




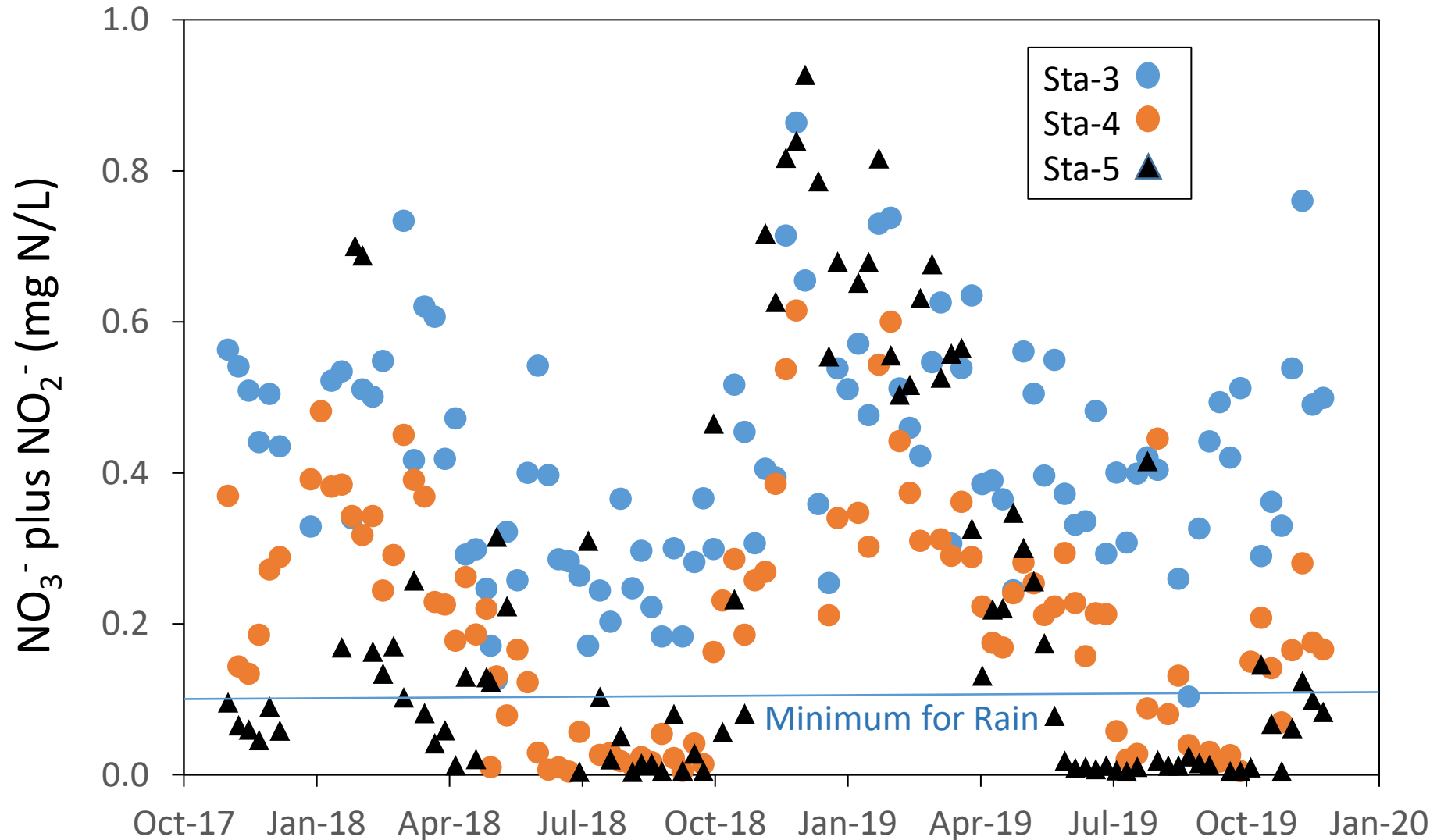
Allen Branch
RSC

Step Pools
and Rock
Weirs

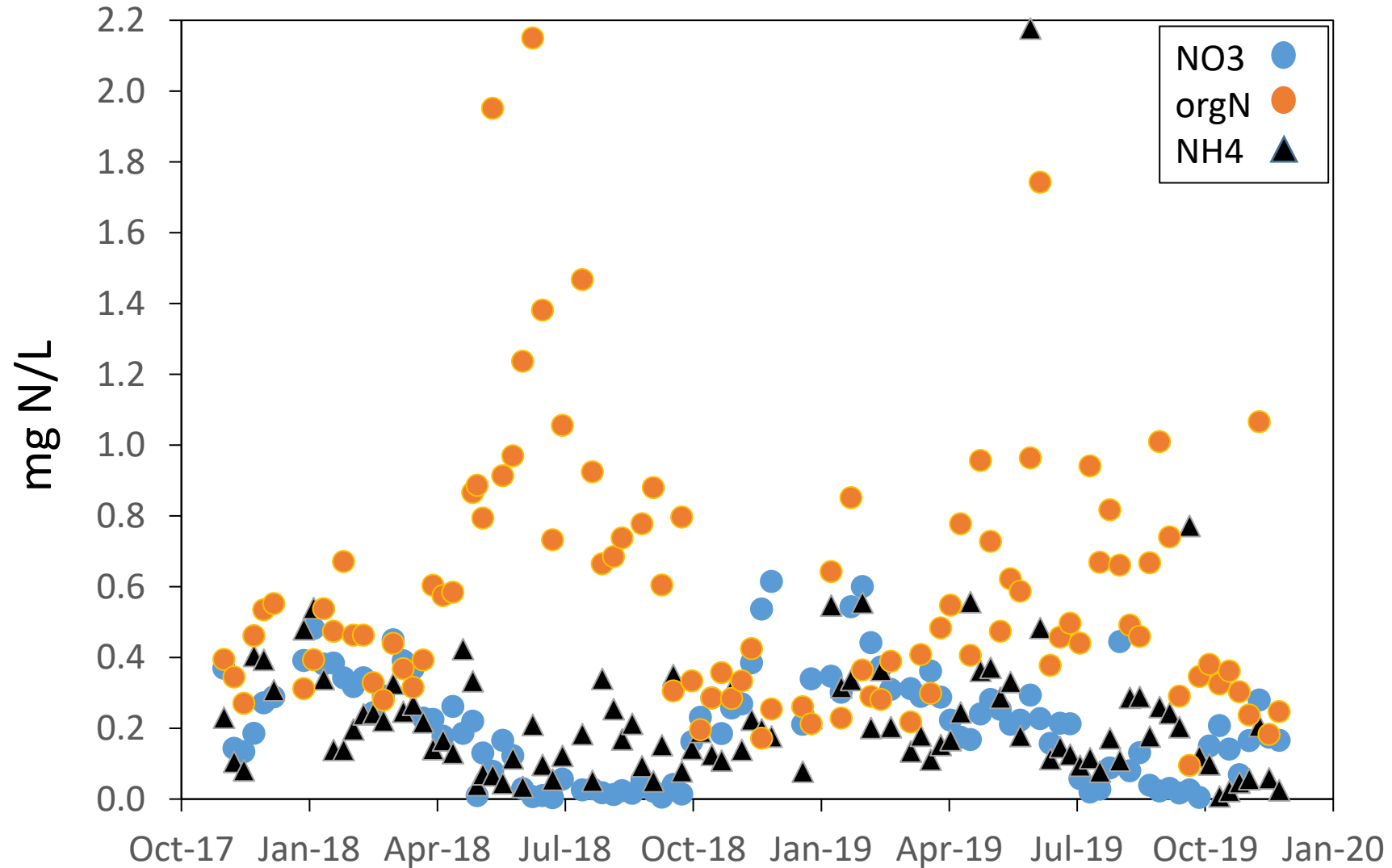
Summer Drawdown of Nitrate plus Nitrite at Sampling Stations 3 and 4



Summer Drawdown of Nitrate plus Nitrite at Sampling Stations 3, 4, and 5



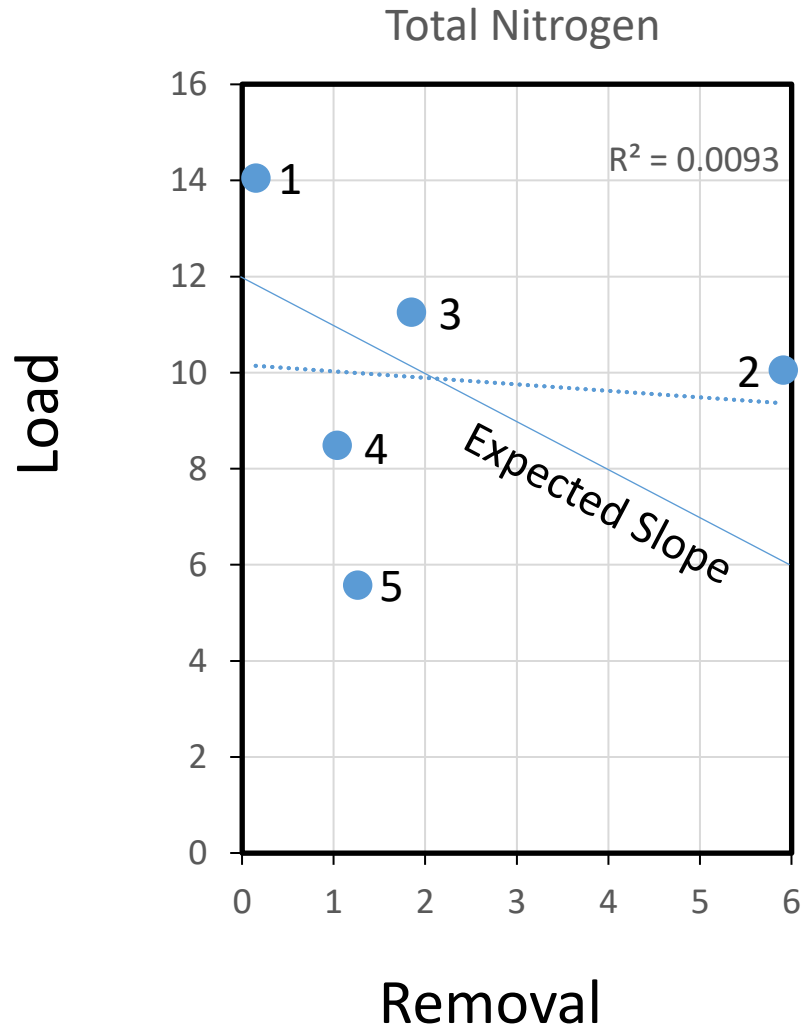
Different forms of N at station 4: Nitrate plus Nitrite, Ammonium, and organic N



Compare Nutrient and TSS Loads with
Expected Removal Rates

Watershed Load vs. Expected Removal by Combined BMPs

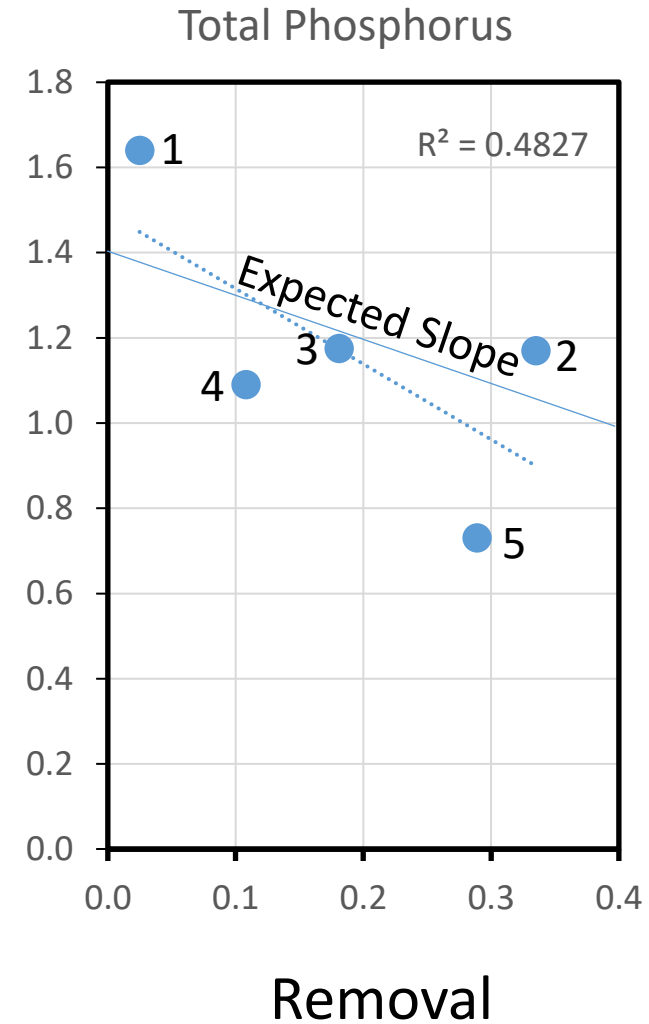
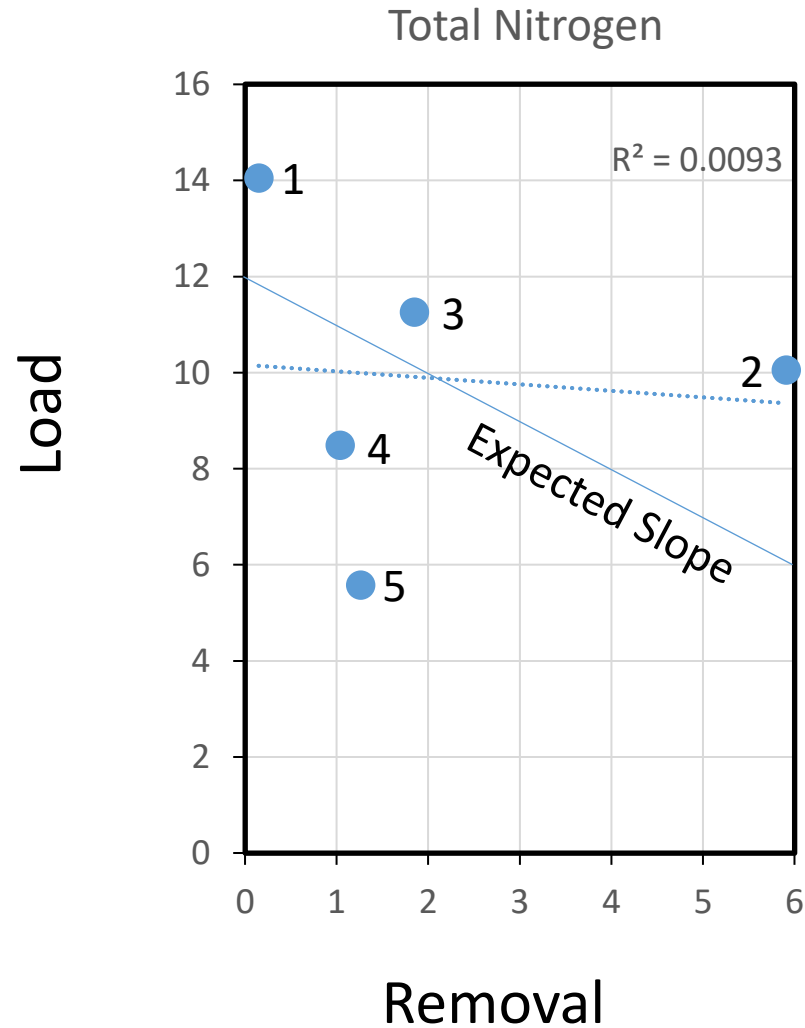
Pounds per Acre Per Year



Sampling station numbers
shown for each watershed

Watershed Load vs. Expected Removal by Combined BMPs

Pounds per Acre Per Year



Comparing Nutrient and TSS Loads with Expected Removal Rates

No significant correlations of total N, P, or TSS loads and expected removal rates among our 5 study watersheds.

Maybe due to:

Small number of watersheds compared.

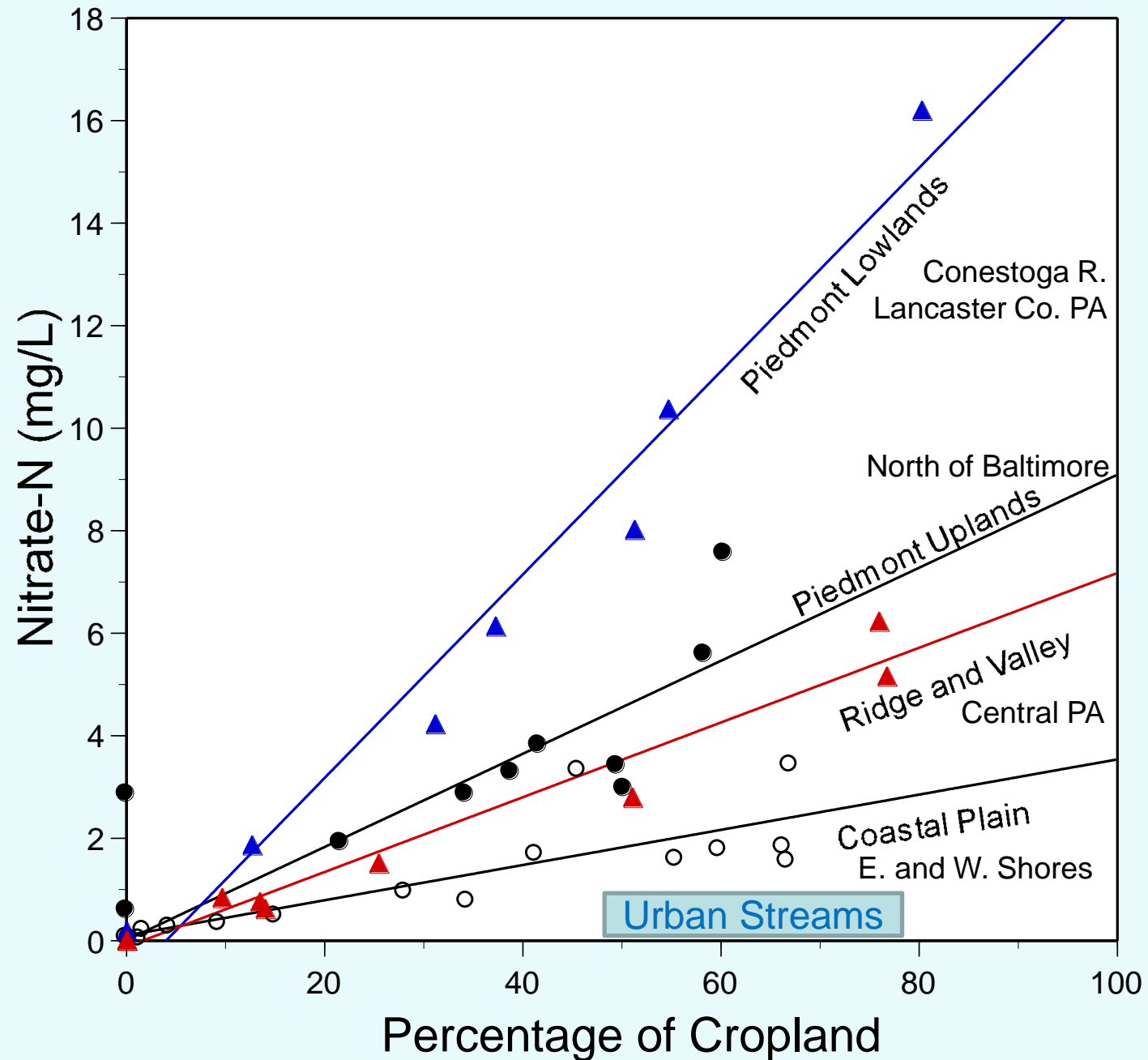
Variability in nutrient and TSS sources within the watersheds.

Uncertainty in measuring concentrations and water flow.

Uncertainty in estimating removal rates.

Lack of information on removal rates for all management practices.

Annual Flow-Weighted Mean Nitrate Concentrations



Summary

- Urban RSC retained about 70% of the nitrate input.
- Low concentrations of nitrate and ammonium in the summer suggest biological uptake in the streams and RSCs.
- Nitrate concentrations in urban streams were low compared to rainfall and agricultural watersheds.
- Nutrient and TSS loads did not correlate with expected removals by management practices.

Parting Thoughts...

Before restoring streams to remove nutrients maybe one should:

- Measure the nutrient concentrations
- Consider ways to reduce the sources

We thank these organizations for
support and partnership:



Tom Jordan & Jesse Iliff

Translation Slides by Erik Michelsen, Anne Arundel
County Watershed Protection & Restoration
Program

What does this mean for me?

- RSC's can significantly reduce nitrogen in stormwater, even in challenging urban settings.
- In at least some cases, in the absence of wastewater driven pollution, nitrogen loading in urban streams is fairly low to begin with.
- Getting accurate phosphorus and sediment reductions very likely requires pre-restoration monitoring, as once stabilization occurs, those contributions are likely to be low.

What does this mean for me?

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

- There's value to identifying pollution "hot spots" before selecting sites.
- RSC's can be an effective nutrient reduction tool.

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

- RSC's can be effective at reducing nitrogen in urban and rural contexts (based on other work by SERC).
- It's important to allow implementers to put projects where pollution occurs.