

Monitoring and Assessing Change in Urban Waters

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Our questions....

What are the **hydrologic conditions** in urbanized watersheds?
How are they **changing over time**?

What are the **nutrient and sediment loads** from urbanized watersheds across different **physiographic provinces**? How are they **changing over time**?

What is the **benthic macroinvertebrate** community structure?
How is it **changing over time**?

How do these conditions **compare to urbanized watersheds** in other areas?

How do monitored conditions (ie. Loads) **compare to modeled conditions**?

What are the **drivers of the changes** observed?

What effect are **management actions** having on small urban/suburban watersheds?



Urban Stream & Stormwater Monitoring Approaches

Intensive Monitoring

Monitoring Scale \propto Watershed Scale
(Temporal) (Spatial)

Monitoring smaller-scale watersheds
requires finer-scale data

- Scaling of hydrographic response time with watershed scale
- Desire to understand processes and detect/describe changes



Approaches

Intensive Monitoring

Continuous Monitoring

- 5-minute interval data
 - Streamflow
 - Water Quality (temperature, turbidity, SC, pH, DO, NOx)

High Frequency Sampling

- Autosamplers
- Nutrient and Sediment Analyses

Surrogate Methods for Load Computation

- Using continuous WQ data to compute

Benthic Macroinvertebrate Sampling



Fairfax County Virginia
20 stations since 2007



Hampton Roads Virginia
12 stations since 2014



City of Roanoke Virginia
1 station since 2016



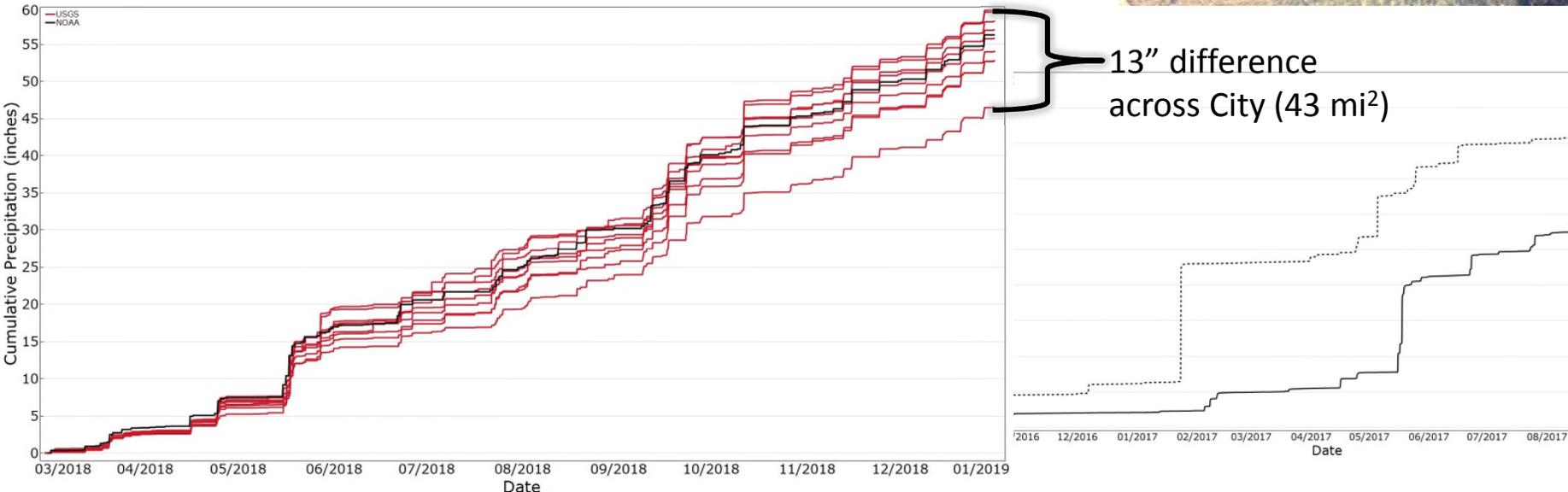
City of Roanoke Virginia

City of Roanoke Virginia

Objectives:

- 1. Compute suspended sediment loads for Lick Run using methods which permit rapid computation of accurate and precise loads.
- 2. Assess relations between monitored loads and implementation of management practices.
- 3. Operate a 9-station precipitation monitoring network to inform stormwater management.

Approach: Intensive Monitoring



13" difference across City (43 mi²)

Hampton Roads Virginia

Hampton Roads Virginia

Problem:

Data describing sediment and nutrient loading rates within the urbanized Coastal Plain are lacking.



Limitations on the calibration of the Chesapeake Bay Watershed Model in these areas

Objectives:

1. Collect high quality nutrient and sediment data representative of the Coastal Plain
2. Compute loads that can be compared to those developed for the Chesapeake Bay TMDL

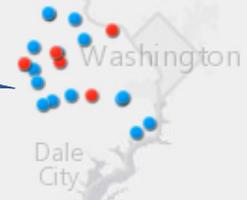
Approach:

Intensive Monitoring

- IN Stormwater System



Fairfax County Virginia 20 stations since 2007





Stream
Monitoring
Station

01656903
For information:
<http://va.water.usgs.gov>
- or -



Fairfax County

Water-Resources Monitoring:

Assessing Watershed Scale Responses to BMP Implementation in Urban Watersheds



Fairfax County, VA

Northern Virginia – Washington, DC Suburbs

Highly urbanized

Population 1+ million

Potomac River Watershed

Piedmont and Coastal Plain Provinces

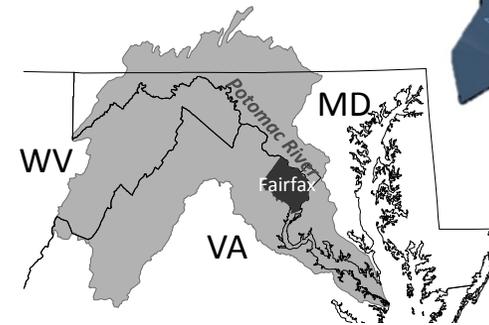
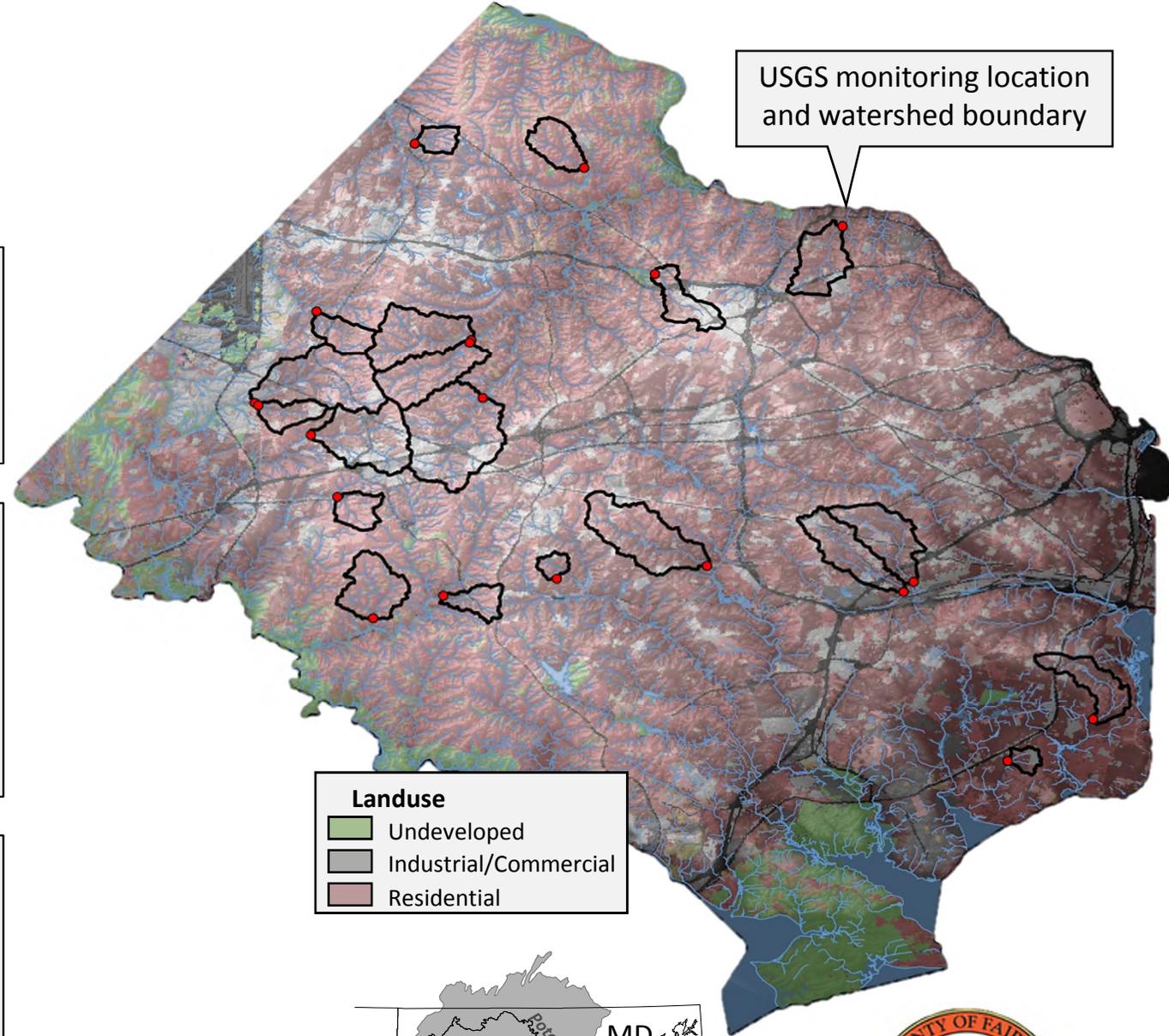
>1,600 miles of streams

>75% rated Fair, Poor, or Very Poor

2nd highest median household income in nation

County Budget ≈ \$8.4 billion

\$83 million for stormwater



Study Objectives

Phase 1

Ongoing since 2007

1. Generate long-term monitoring data to describe:

- Current water-quality conditions,
- Trends in water-quality,
- Nutrient and Sediment Loads and Yields.



Phase 2

2. Transfer the understanding gained to other less-intensively monitored watersheds.

3. Evaluate relations between observed conditions/trends and BMP implementation.

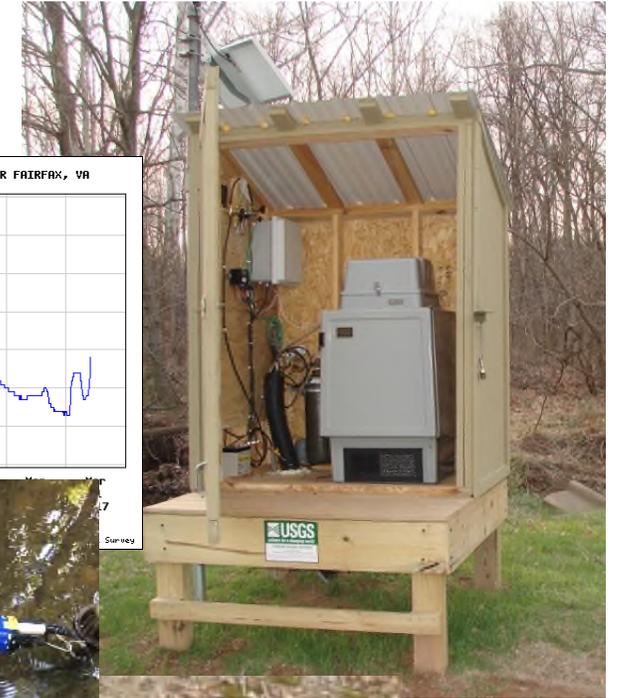
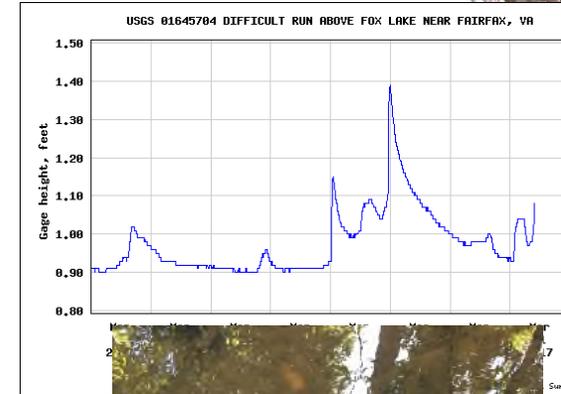
Approach: Intensive Monitoring

5 intensive monitoring stations

10+ years of data collection

- Continuous Streamgage
- Continuous water-quality monitor
(turbidity, pH, SC, water temp, DO)
- Nutrient & Sediment Sampling
 - Automated sampler (storm samples)
 - Scheduled monthly sampling

Annual benthic macroinvertebrate monitoring



Approach: Knowledge Transfer – Trend Monitoring



15 trend monitoring stations

Partial-record stream gage

Nutrient & sediment sampling
Scheduled monthly sampling

Annual benthic macroinvertebrate
monitoring

Evaluate long-term trends with
greater spatial density

Evaluate spatial patterns with
greater resolution

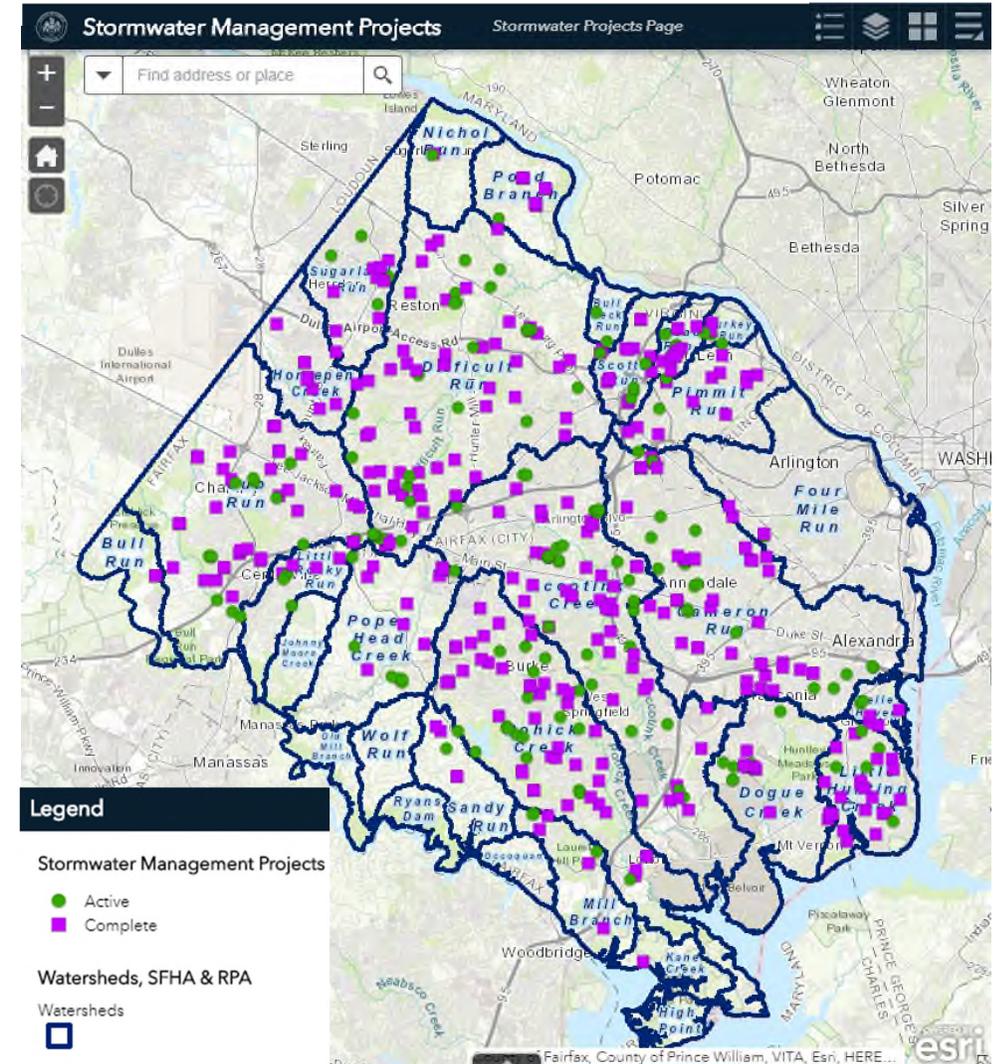
Approach: BMP Evaluation

Assembling datasets to describe landscape change

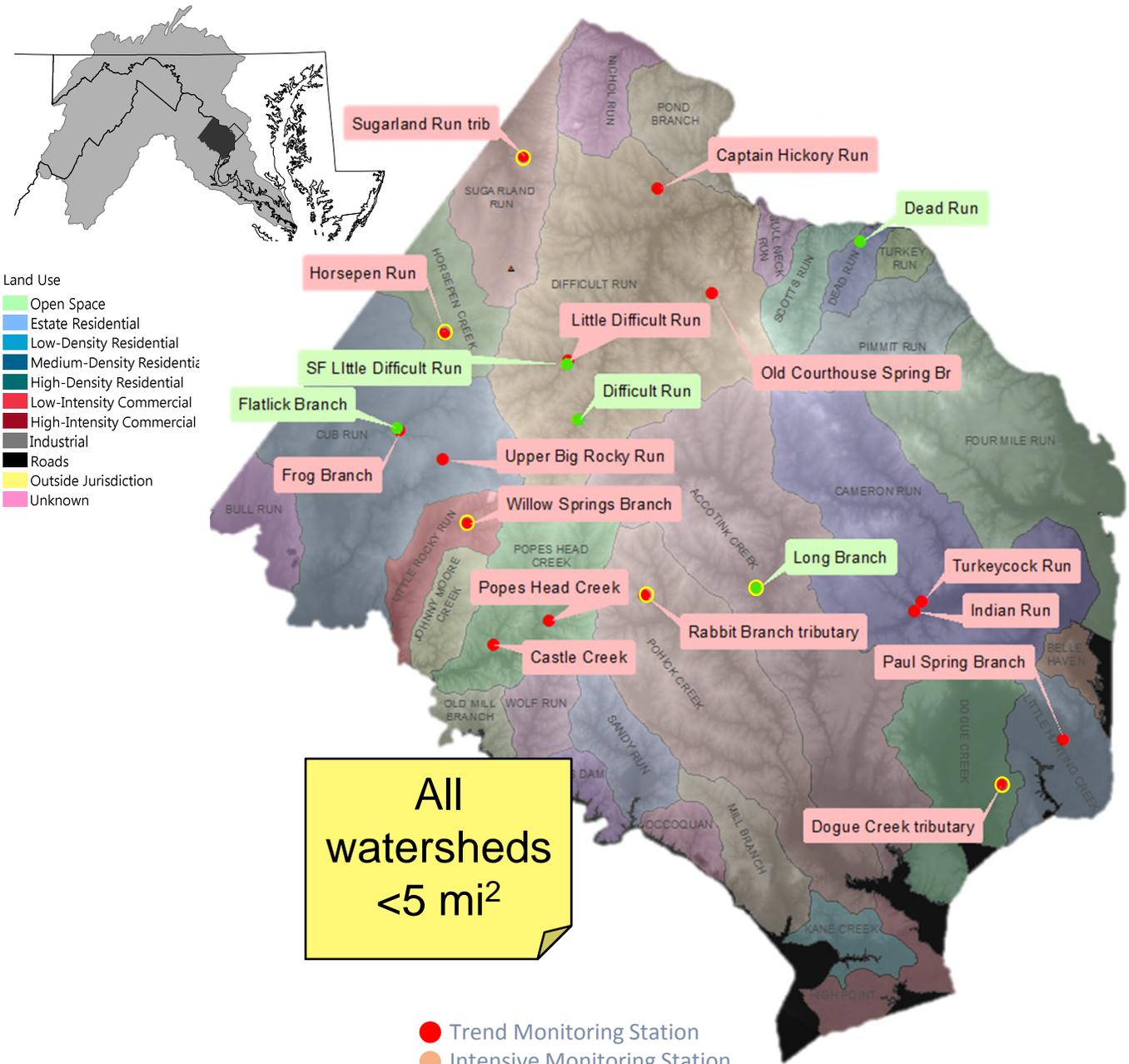
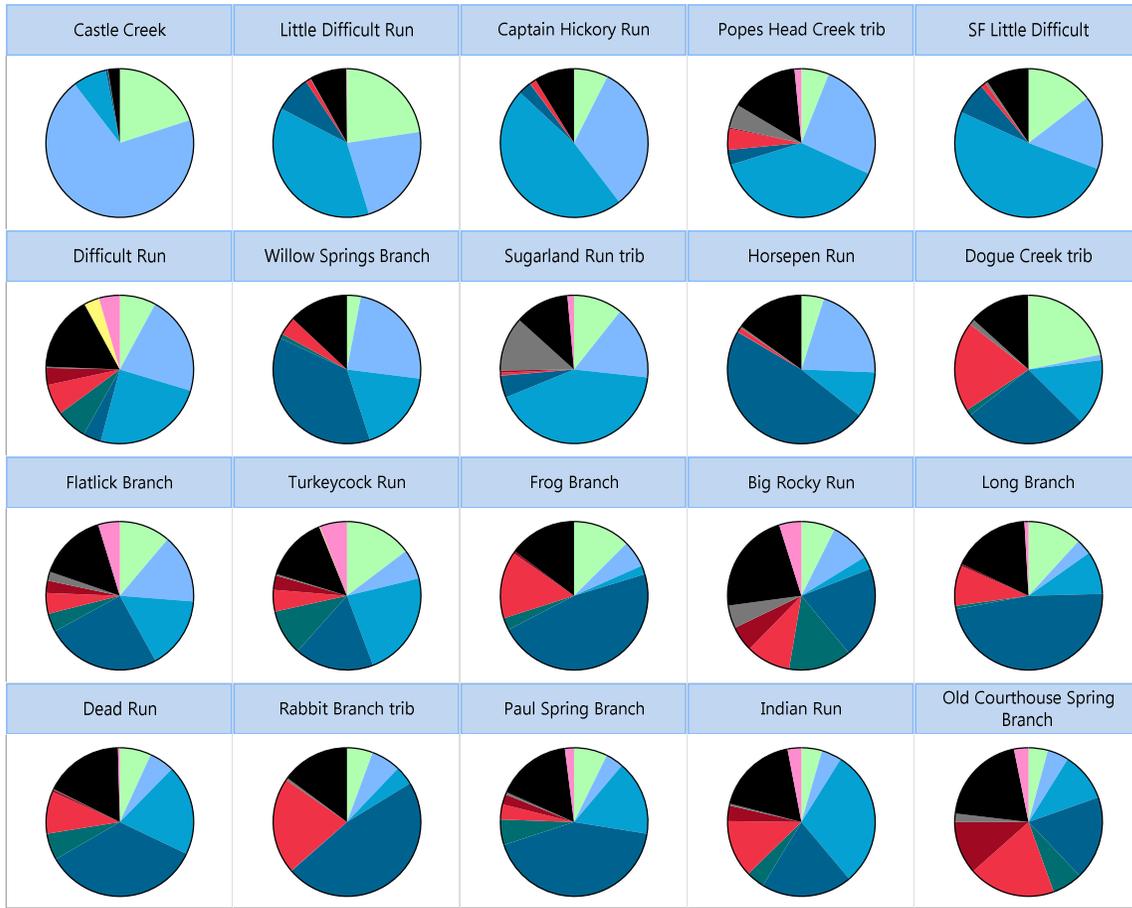
BMP Implementation
Development
Other Factors

Evaluate relations between stream responses and implementation

Stream restoration is the primary management strategy in Fairfax Co.



Network Design



All watersheds <5 mi²

- Trend Monitoring Station
- Intensive Monitoring Station
- Site Added in WY 2013

Where are we now?

≈11 years of monitoring

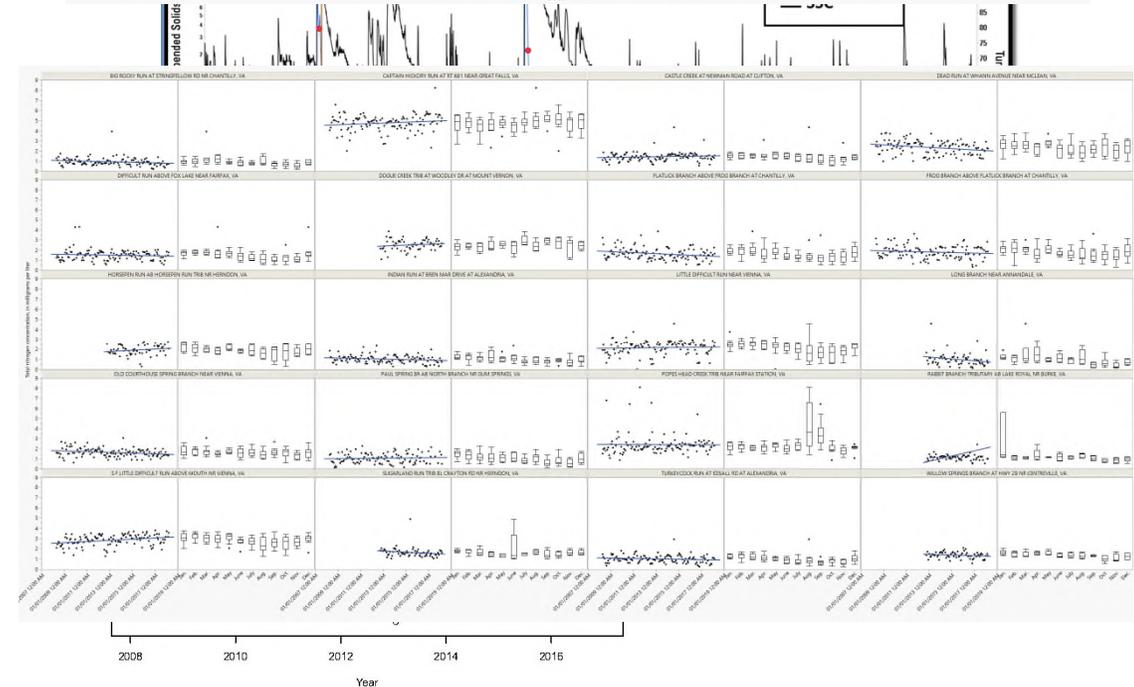
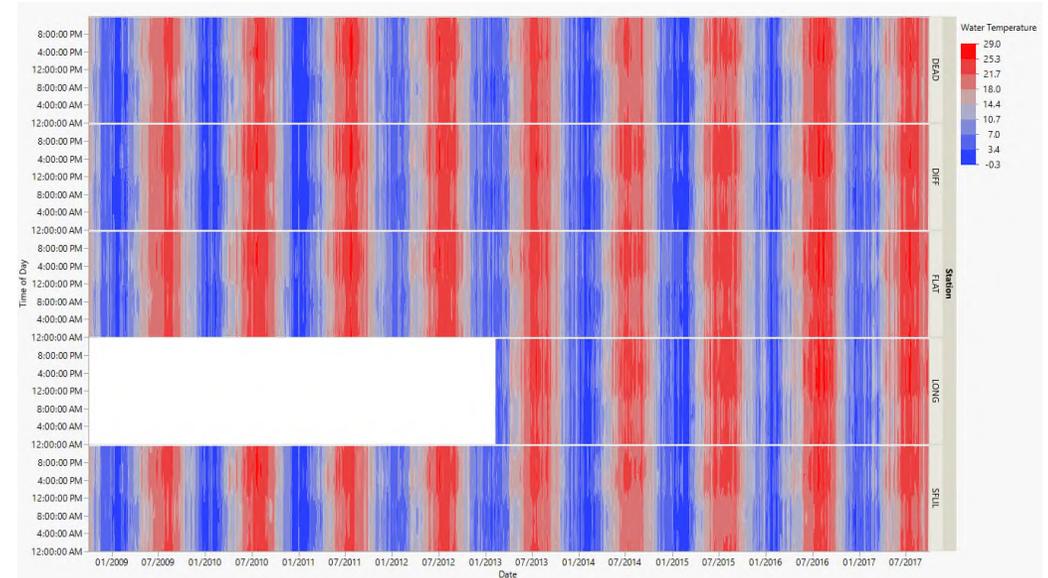
- >50 site-years of continuous WQ & Flow
 - Tens of millions of individual measurements
- ≈ 100,000 records from discrete WQ samples
- >50 site-years of benthic macroinvertebrates

2014 Report – SIR 2014-5073

- Study design
- Characterizations from 1st 5 years of monitoring
- Nutrient & Sediment Loads

Extensive implementation County-wide

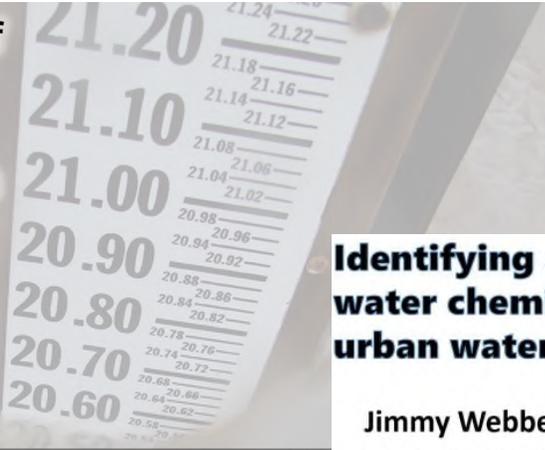
Comprehensive analysis and reporting effort underway



Presentations to follow...

An exploration of streamflow and water chemistry patterns in urban waters

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Identifying and evaluating water chemistry trends in urban waters

Jimmy Webber

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Objective: To compute trends for a suite of water-quality constituents collected from 14 Fairfax County watersheds between 2008-2018.



Fairfax County Monitoring Objective:

1. Determine how streamflow, water-quality, and benthic macroinvertebrate (across monitored watersheds) and temporally (seasonally/annually)
2. Compute annual nutrient and sediment loads
3. Link changes in hydrology, water-quality, and benthic macroinvertebrate changes in the landscape (e.g. development, BMPs)



Castle Creek, April 2008



In cooperation with
Fairfax County, VA



This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. Neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the use of the information.

Detecting and Assessing Ecological Responses in Urban Waters

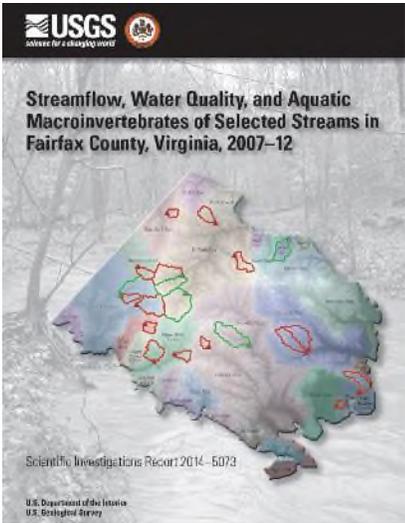
Shannon Curtis, Fairfax County, Stormwater Planning

Department of Public Works and Environmental Services
Working for You!



Publications and Websites

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Fairfax County Monitoring

Program Website: <https://va.water.usgs.gov/fairfax/>

2014 Report: SIR 2014-5073 <http://pubs.usgs.gov/sir/2014/5073>

- *Describes study design*
- *Summarizes initial 5-years of monitoring*
- *Nutrient and Sediment Loads*

Hampton Roads Monitoring

Program Website: <https://va.water.usgs.gov/HRstormwater>

2016 Fact Sheet: <https://doi.org/10.3133/fs20163095>



City of Roanoke Monitoring

Program Website: <http://www.usgs.gov/projects/CityofRoanoke>

