

Watershed and Stormwater Management in Fairfax County

Challenges and Opportunities

Department of Public Works and Environmental Services
Working for You!



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Presentation Outline

Duration: 20-30 minutes

Shannon:

- Countywide Watershed Conditions & Stream Health
- Causes, Impacts
- Opportunities for Improvements

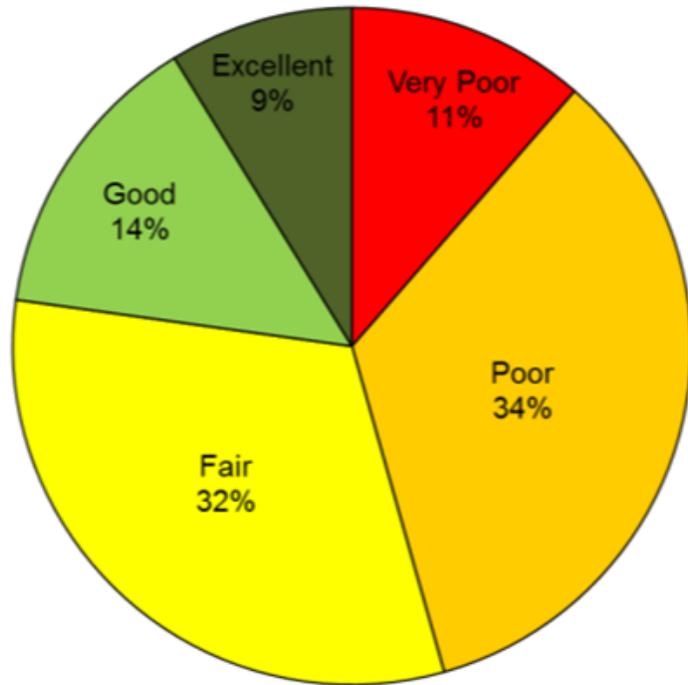
Catie:

- Stormwater Management (SWM) Solutions
- Case Study: Public Safety Headquarters
- Ongoing SWM Challenges and Opportunities



Watershed Conditions – 2001 SPS Baseline Study

Baseline Study Ratings
(126 sites)



Countywide stream health conditions
(using Fairfax Index of Biological Integrity, IBI)

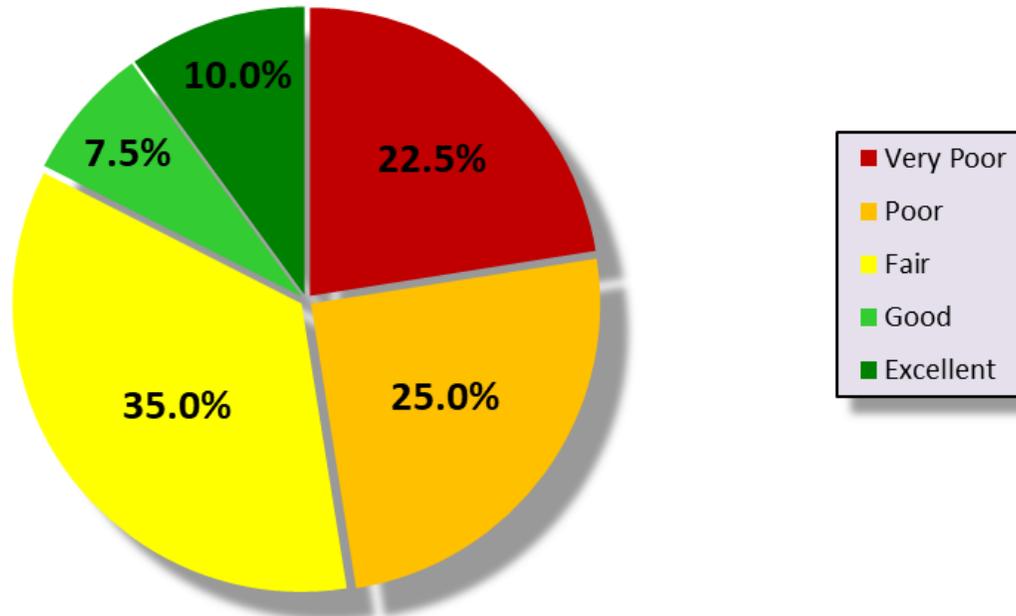
- **>75% of county streams classified as “fair”, “poor”, or “very poor” quality**
- Likely to be considered **“impaired”** by Clean Water Act standards and require remediation
- Primary driver for poor conditions: human **land use impacts**

Report: <https://www.fairfaxcounty.gov/publicworks/stormwater/stream-protection-strategy-baseline-study>



Watershed Conditions - 2020

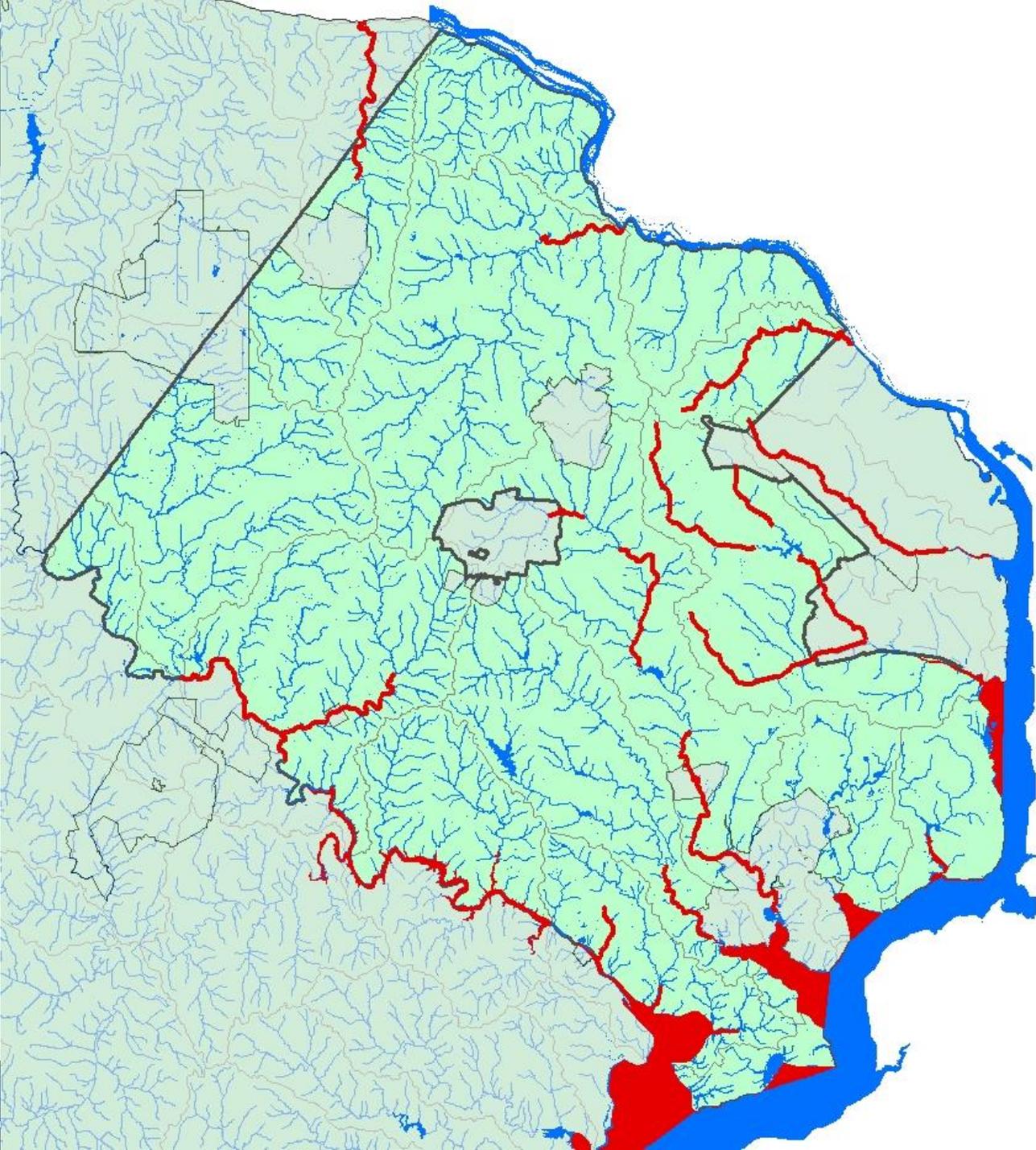
**Fairfax County Stream Quality Index
2020 (40 sites)**



Countywide stream health conditions (using Fairfax IBI)

- Conditions have changed very little over 2 decades
- >75% streams are still considered “impaired”
- Continued land development





2004 VA DEQ Impaired Waters

Impaired Segments:

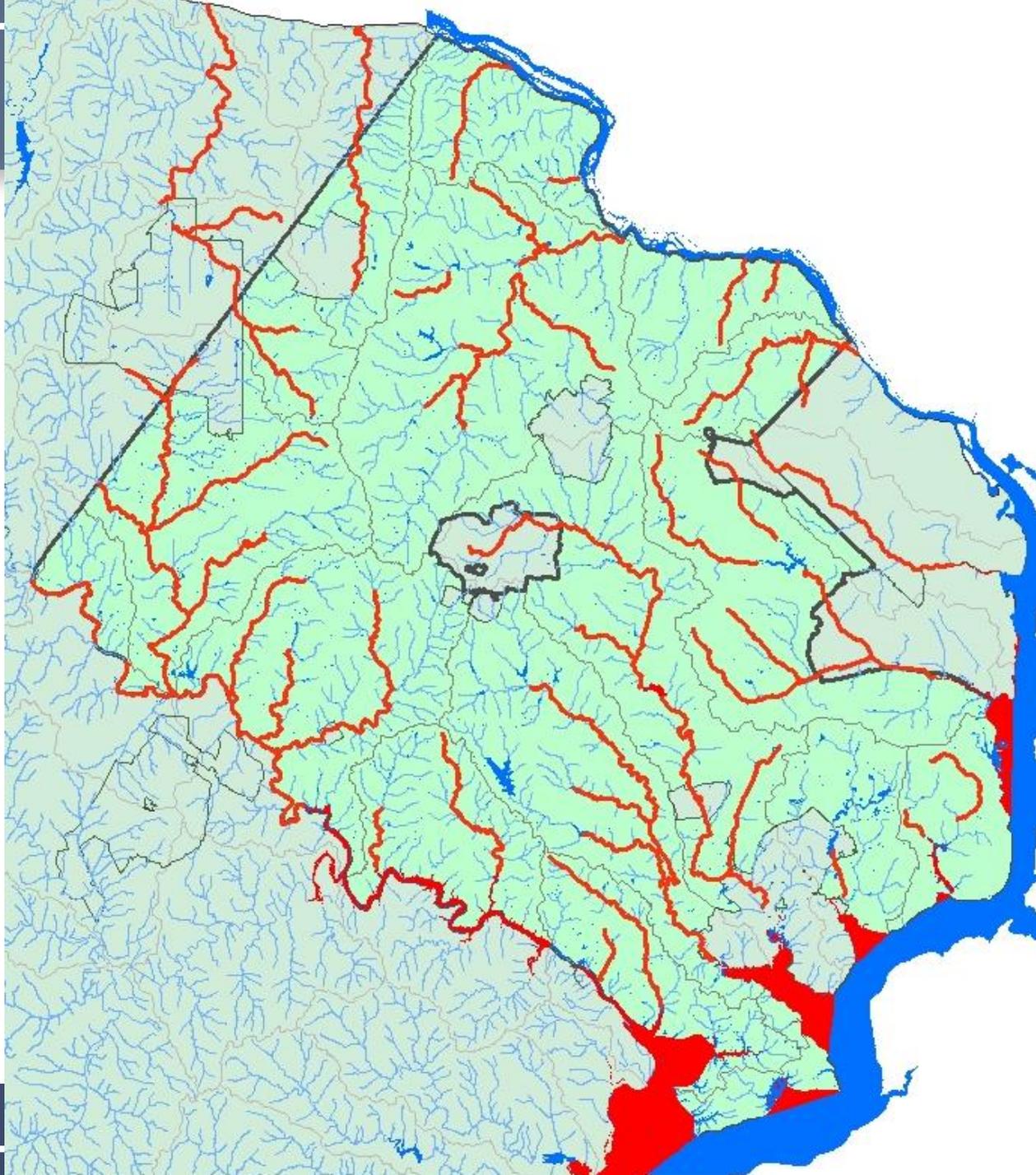
16 Streams

1 Reservoir

9 Estuarine

26 Total

****Regulatory Requirements
(TMDLs) to restore these
streams to health**



2020 VA DEQ Impaired Waters

Impaired Segments:

77 Streams

3 Reservoir

29 Estuarine

109 Total

****Regulatory Requirements
(TMDLs) to restore these
streams to health**

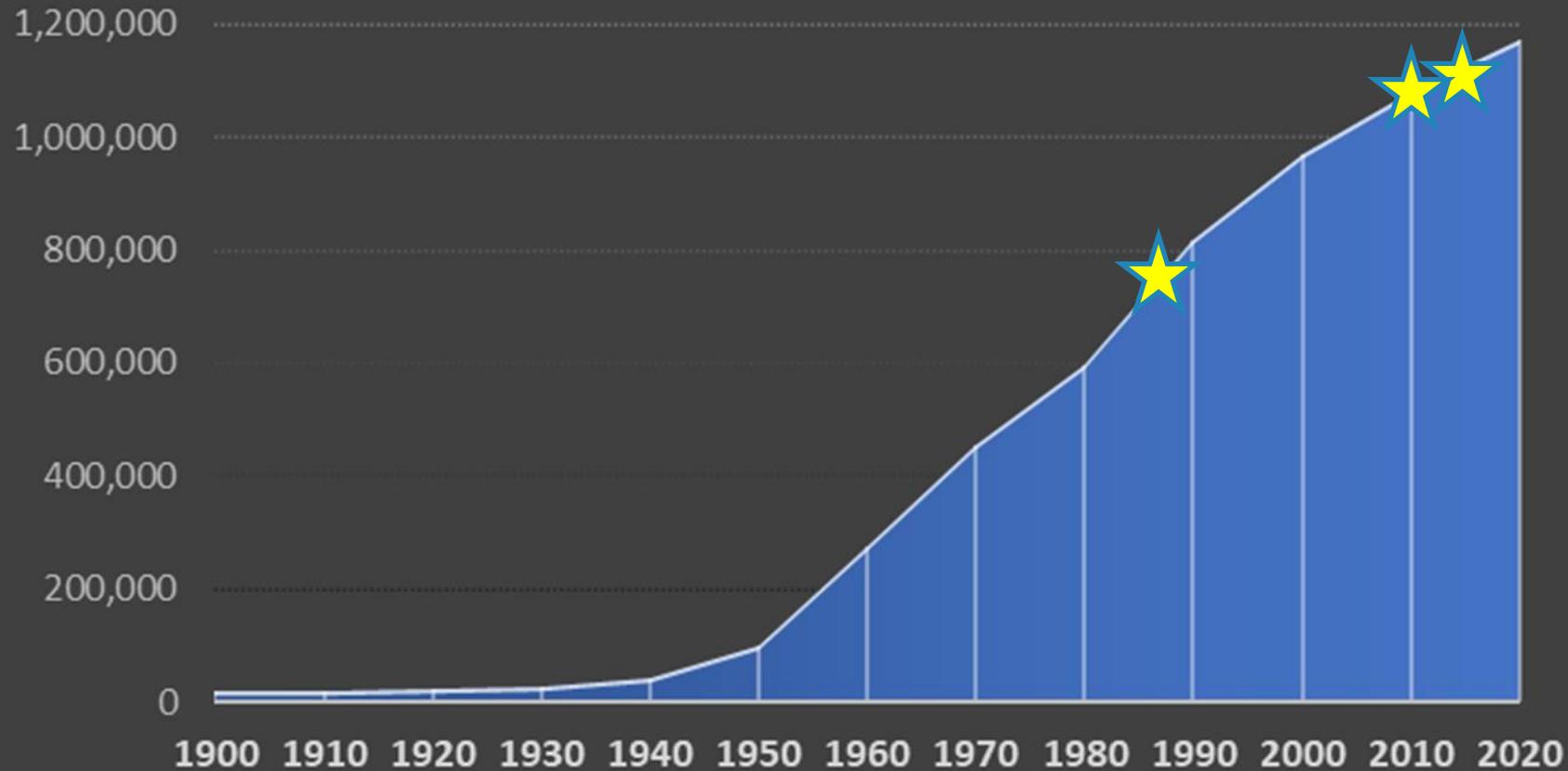
Why? (how did we get here)

- Human land use impacts for centuries:
 - Deforestation
 - Agriculture (tobacco, dairy)
 - Mill dams in most stream valleys
 - Rapid Urbanization, post-WWII
 - **Fill in floodplains**
 - Burying/piping streams
 - Intense Residential Infill
 - Commercial Redevelopment
 - Transportation infrastructure



Fairfax County Watersheds

Fairfax County Population 1900 - 2020



- **No** water quantity and quality requirements until 1980's & 90's
- Watershed Improvement Program initiated in 2010 (stormwater fund)
- Modernized Stormwater Ordinance 2014

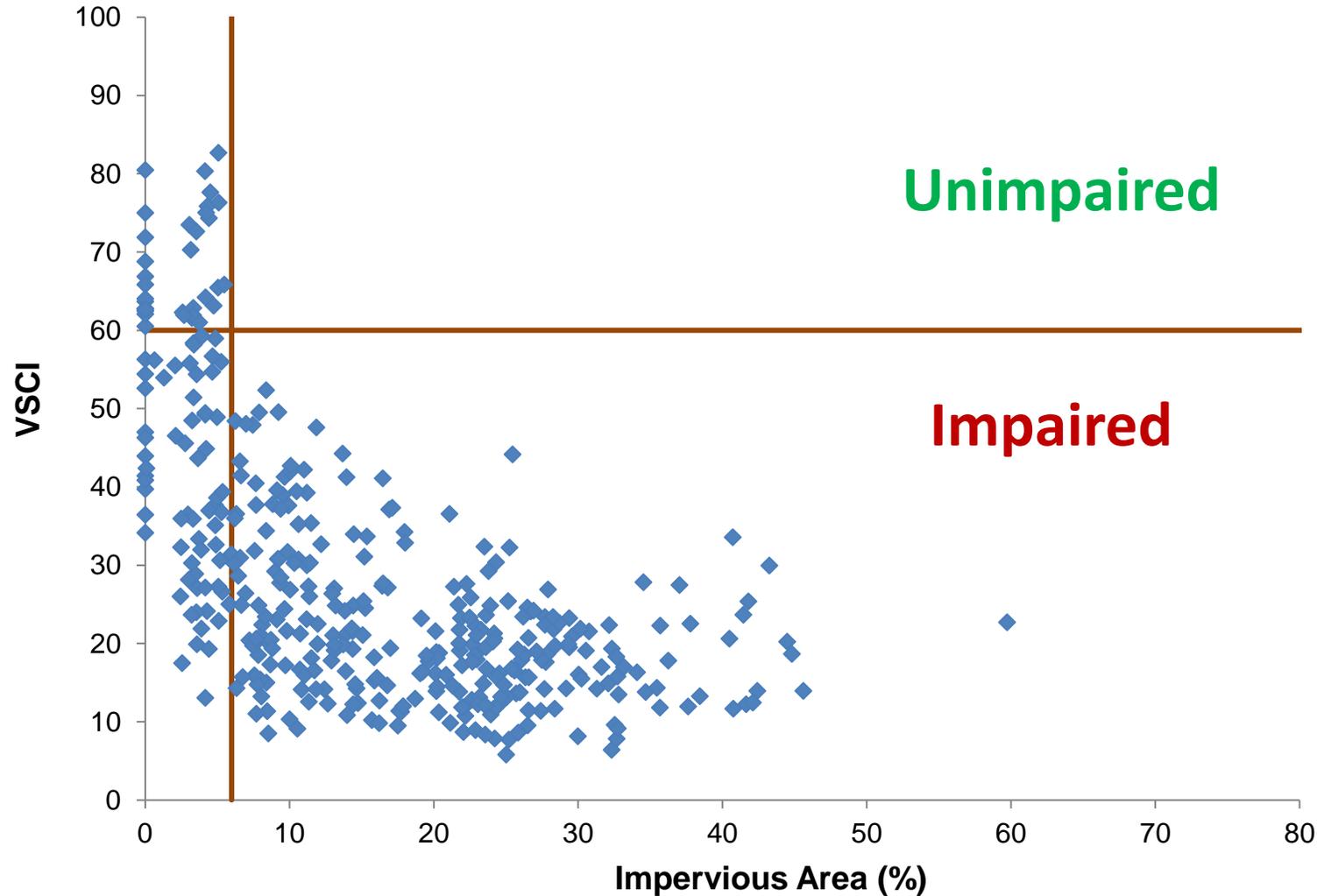


Fairfax County Watersheds

- Results:
 - High levels of impervious surfaces
 - More runoff volume, more flooding
 - Altered hydrology
 - More pollutants in runoff
 - Severe erosion and sedimentation
 - Incised channels and disconnected floodplains
 - Poor physical, chemical and biological conditions in streams
 - Imposed regulatory requirements on impaired streams (TMDLs). More \$\$\$



VA Stream Condition Index (VSCI) and % Impervious Area



- In Fairfax County, **no** streams with > 6% impervious area in their watersheds pass the state's VSCI - and can be considered impaired
- Very few watersheds in Fairfax County with < 6% Imperviousness



Fairfax Watersheds

What are we doing? What challenges?

- Stormwater infrastructure retrofits and stream restoration projects in receiving systems
 - We own/have access rights
 - mostly address *symptoms* -> not the *causes*
 - Funded by taxpayers (\$100M since 2009)
- Upland improvements address source problems - but we don't have much control here
 - Most upland areas privately owned
- We need both downstream improvements (streams) AND more/better **upland source controls**
- Development must share the burden to achieve success in protection/restoration
 - Opportunities during development/redevelopment
 - Stay out of floodplains!



Fairfax Watersheds

- No way County can remediate this problem alone. Requires:
 - Evolving science
 - Improved regulations (Federal, State, Local)
 - (Re)Development controls must go above legal minimum, whenever possible
 - Development community apprehensive to try “new” things – we have to push



Before



2018
Two years after Construction

Stormwater Management Solutions

Takeaways

- Impervious cover reduction is key
- Green stormwater infrastructure (GSI) only addresses small storms
- Detention is required to adequately mitigate stream erosion and flooding



Franklin Park Retrofit

Stormwater Management (SWM) Definition

- **Slow it down and Soak it in**
 - Tree preservation
 - Natural landscaping
 - Green stormwater infrastructure (GSI) and stormwater reuse
- **If it must go, hold the overflow**
 - Detention and slow release of larger storms



Slow it Down and Soak it In: Tree Preservation



- **Preserve** existing good quality forests and place in easement
- **Enhance** existing tree canopy through non-native invasive management and additional native plantings
- Stay out of floodplains and Resource Protection Areas (RPAs)



SWM Target

- ✓ Higher tree canopy standard (County Code Chapter 122)

Slow it Down and Soak it In: Natural Landscaping

- Preserve and recreate land and water features and native plant communities
- Restore soil to a hydrologically functioning state
- Multiple benefits

SWM Target
✓ Natural landscaping policy



Slow it Down and Soak it In: Green Stormwater Infrastructure (GSI)

Green Stormwater Infrastructure (GSI)

- Suitable for managing small more frequent storm events (1" inch storm)
- Designed to meet state water quality standards



Franklin Park Retrofit



SWM Target:

Using runoff reduction GSI:

- ✓ Meet water quality requirements on site
- ✓ % reduction in phosphorus below pre-development load
- ✓ Capture the 1" storm event on site through GSI



Broyhill McLean
Retrofit

When it Must Go, Hold the Overflow: Detention



- Larger storm events (2-year and 10-year storms) may exceed GSI capacity
- Detain runoff from larger storm events and slowly release at a non-erosive rate



SWM Target:

- ✓ Reduce peak flow rate by % below pre-development condition
- ✓ Release at good forested condition rate

Case Study: Public Safety Headquarters

VEGETATED ROOF (GREEN ROOF)

Five vegetated roofs use special drainage systems to slow down, evaporate, and filter rainwater before it enters the drain. Green roofs also moderate internal temperatures.

\$663,700 lb P/yr \$113,900 lb N/yr \$4,000 lb Sediment/yr

RAINWATER HARVESTING SYSTEM

Rainwater is harvested from the top roof and collected in an underground, 25,000-gallon cistern. Water from the cistern is used to irrigate landscaping around the building.

\$342,100 lb P/yr \$47,800 lb N/yr \$2,200 lb Sediment/yr

WET POND CONTINUOUS MONITORING & ADAPTIVE CONTROL (CMAC)

Using a cloud-based platform, the CMAC system continuously watches the weather forecast and monitors the pond water levels. The system automatically adjusts valves to meet site pollutant removal and volume control goals.

\$133,600 lb P/yr \$15,100 lb N/yr \$160 lb Sediment/yr

REGENERATIVE STORMWATER CONVEYANCE (RSC)

RSC systems (the outfall to the pond) is an open-channel, sand seepage filtering system that utilizes a series of shallow aquatic pools, riffle weir grade controls, native vegetation and underlying sand channel. The system combines features and treatment benefits of swales, infiltration, filtering and wetland practices.

\$263,100 lb P/yr \$36,700 lb N/yr \$1,700 lb Sediment/yr

PERVIOUS PAVERS

The PSHQ service driveway is paved with permeable pavers. These interlocking brick pavers allow water to drain through the gaps between the bricks into a gravel base below. The water then infiltrates or slow flows into the storm drain system that discharges to the wet pond.

\$248,400 lb P/yr \$42,600 lb N/yr \$1,500 lb Sediment/yr

BIORETENTION BASIN OR RAINGARDEN

These depressed, landscaped gardens capture and filter stormwater runoff. During storms, runoff temporarily ponds then rapidly filters through a bed of sand, soil, and organic filtering media. Native plants like rushes and sedges help take up and treat stormwater, provide wildlife benefits, and create appealing landscaping.

VEGETATED SWALES

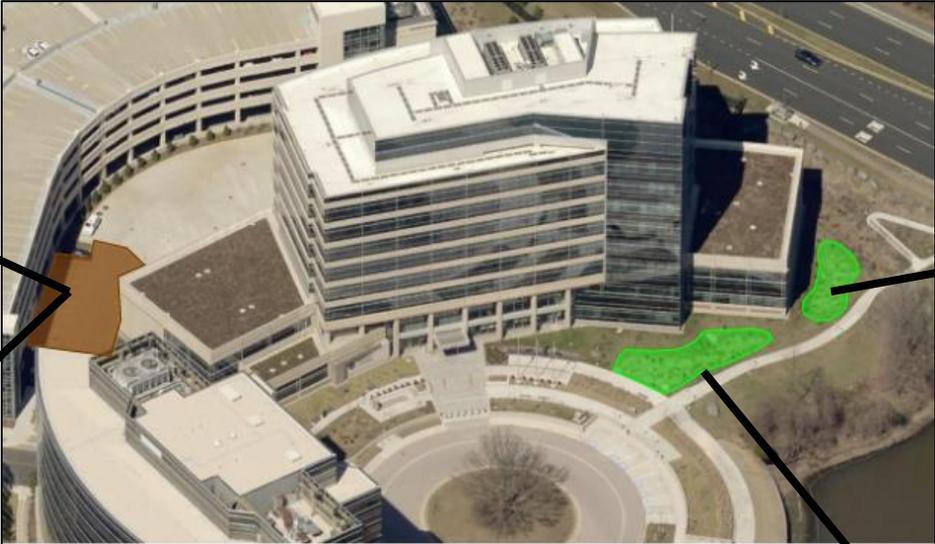
Vegetated swales provide the same services as bioretention cells, but they are shallower, configured as linear channels, and can be planted with sod or native plants. These swales create a 1,100-foot-long treatment path that terminates at an engineered outfall.



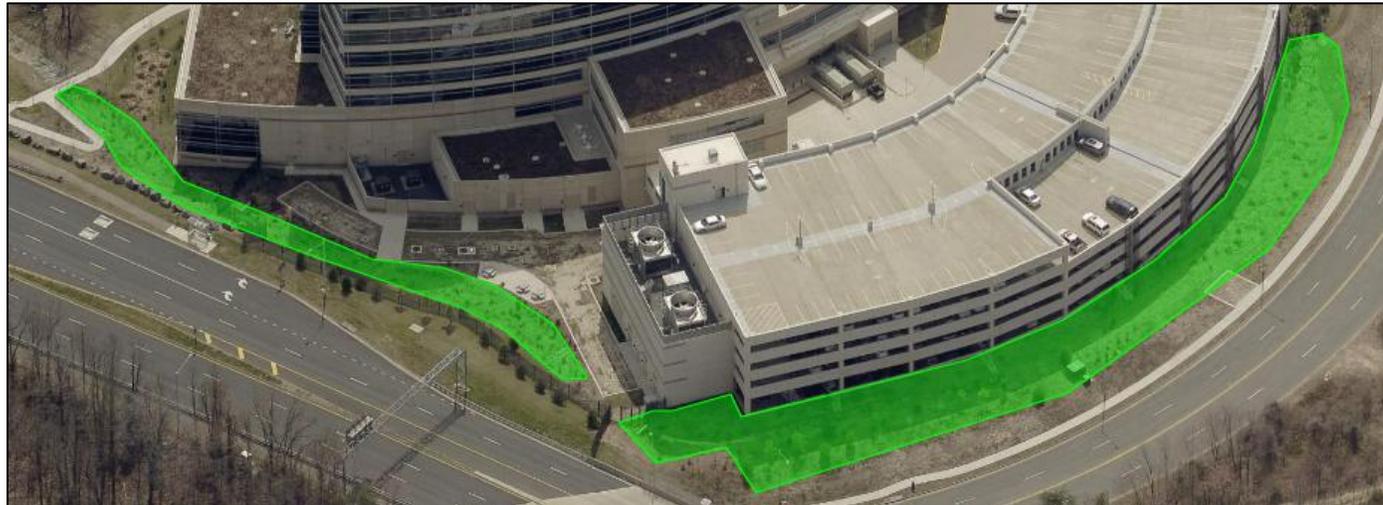
PSHQ: Green Roofs and Natural Landscaping



PSHQ: Permeable Pavers and Bioretention



PSHQ: Vegetated Swale



PSHQ: Cistern and Wet Pond



Challenges & Opportunities

- Increased pressure to develop in environmentally sensitive areas
 - RPA encroachments
 - Fill in the Floodplain
- GSI
 - Cost
 - Designed to support multiple functions
- Climate Adaptation and Resilience

Alt.	Description	Capital Cost (\$M)	O&M Cost (\$M/yr)	NPV 30 years (\$M)	% Over Low
1	All Gray (9.5 mg storage)	\$ 185	\$ 0.28	\$ 211	+2%
2	All Green (365 ac of GI) <ul style="list-style-type: none"> • 27.4 ac Project 1 • 266.6 new ac • <u>71 ac DC Stormwater Regs</u> 365 ac total	\$ 206	\$ 4.3	\$ 401	+94%
3	Hybrid (9.5 mg) <ul style="list-style-type: none"> • 92 ac of GI (27 ac Project 1 + 65 new ac, including downspout disconnect) • Gray storage • BMPs per DC Stormwater Regs Total	\$ 133	\$ 1.5	\$ 207	0%

<https://www.dcwater.com/sites/default/files/project/documents/gi-webinar.pdf>



Summary

- More than 75% of county streams are classed as “fair,” “poor,” or “very poor” quality
- We need both downstream improvements (streams) AND more/better upland source controls
- Watershed health is a shared responsibility between public and private entities
- Stormwater Management Solutions
 - Impervious reduction and preservation of natural vegetation is key to stream health
 - For the small storms, slow it down and soak it in
 - To prevent stream erosion and flooding, hold the overflow through detention
- Do not allow development in the floodplains (and RPAs)



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