



Setting the Stage: The State of the Urban Nutrient Management BMP

Bay-wide Stormwater Partners' Retreat
April 13, 2023

HISTORY

- Panel formed in 2011 and approved in 2013
- Panel weighed in on three key areas:
 - Fertilizer application rates on urban land uses
 - BMP efficiencies for P fertilizer legislation
 - BMP efficiencies for proper fertilizer application on turf grass (UNM plans)

STATE-WIDE FERTILIZER BAN

- State-wide fertilizer ban credit expired in 2016 to be replaced by valid state data
- Assumed 70% reduction in P application rate for states that have adopted phosphorus fertilizer legislation and 60% for those that had not
 - Resulting TP credit was 25% TP reduction to turfgrass (20% for no legislation) based on model runs
- Phase out in 2016 was designed to verify/capture these trends with updated reporting data

THE CORE UNM PRACTICES

- The panel defined 10 core UNM practices and set credits based on 11 high risk export factors



Urban Nutrient Management UNM²

Low risk: 3%
High risk: 10%
Blended: 4.5%

Need to survey high-risk every 5 years;
Renew UNM every 3 years

Low risk: 6%
High risk: 20%
Blended: 9%

how it started



**WE CAN
SAVE THE WORLD**

how it's going



**ONE MORE
Dataset PLEASE**

CORE CHALLENGES

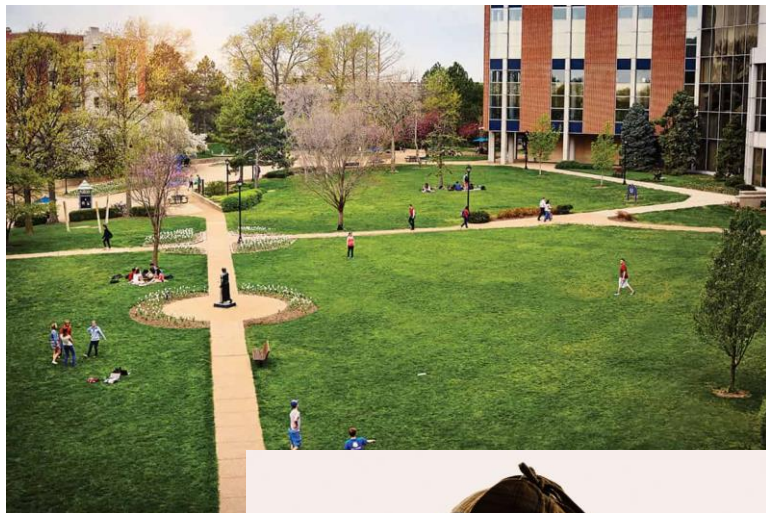
- *High Variability in Urban Nutrient Application Rates*
- *Lapsing Credit for State-wide Fertilizer Legislation*
- *Differentiation of Fertilized and Non-fertilized Land*
- *Tracking, Reporting and Verification of UNM Plans*



FERTILIZER REPORTING

- Past difficulty acquiring state-reported estimates of P fertilizer applications
- Lags in AAPFCO reporting make changing trends difficult to detect
- Year-to-year variability in reported data are difficult to explain

TRACKING, REPORTING AND VERIFICATION



- Challenges with properly crediting large, non-fertilized properties.
- Individual UNM plans are not highly reported, and are difficult to track and verify

UNDERSTANDING URBAN NUTRIENTS

- How can we better simulate the movement of nutrients and sediment through our urban landscape?
- We rely on fertilizer application and air deposition for nutrient inputs.
 - How do legacy nutrients factor in – especially on new development
 - Impacts of compaction and soil health
 - Relationship between impervious cover and streambank erosion
 - Other improvements?
- Implications for BMPs and loads



WE ARE MAKING PROGRESS! TO BE CONTINUED...

DAVID WOOD

CHESAPEAKE STORMWATER NETWORK

WOOD.CSN@OUTLOOK.COM

Chesapeake Bay Program fertilizer use

Outline

The Chesapeake Assessment Scenario Tool (CAST)

Room to improve

A broader context

Chesapeake Assessment Scenario Tool ([CAST](#))

- Estimate load changes due to management over time
- Requires inorganic Nitrogen (N) and Phosphorus (P) nutrient data
- Association of American Plant Food Control Officials (AAPFCO)
 - National scale
 - State reported fertilizer sales tonnage data
 - Contains both farm and nonfarm information



Chesapeake Assessment Scenario Tool

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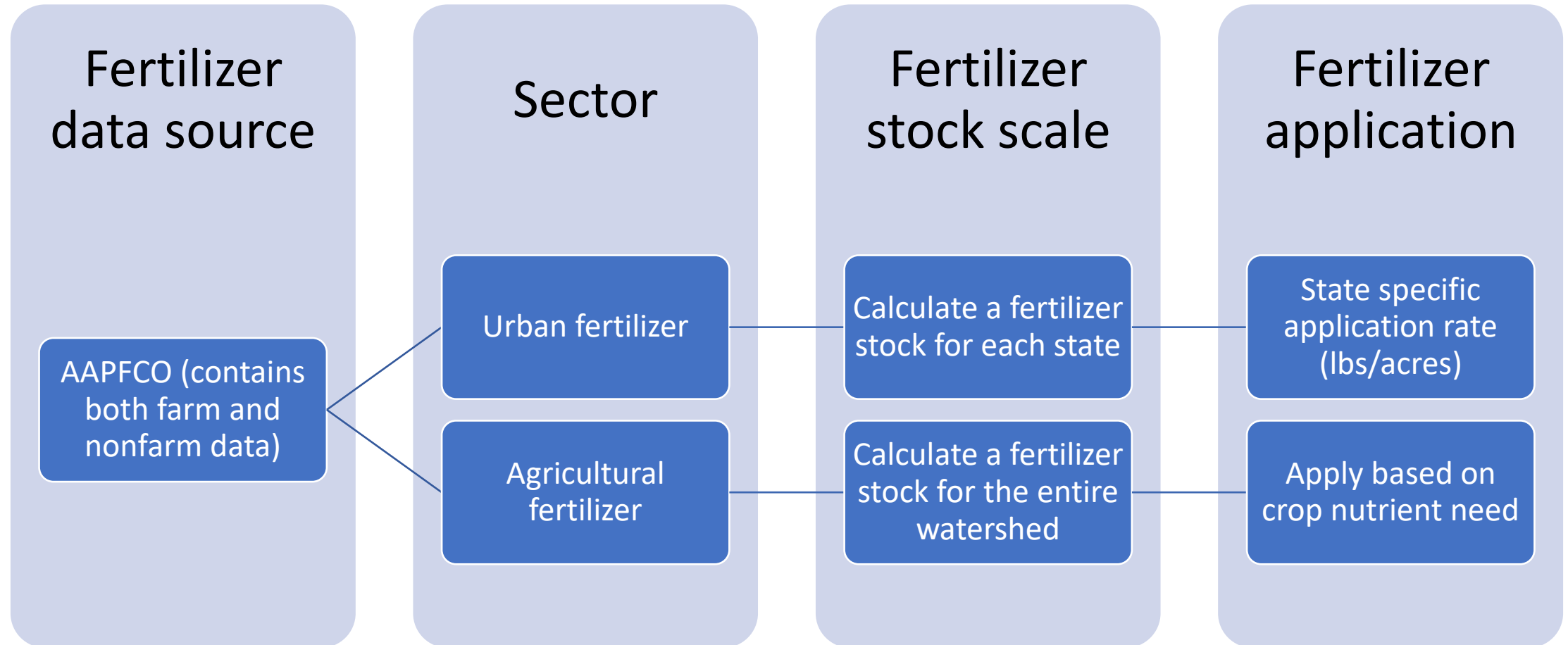


New to CAST?

Register to create and edit scenarios for reducing nitrogen, phosphorus, and sediment with varying best management practices to streamline environmental planning. Registration also includes access to additional data, tools and resources including CAST's monthly newsletter.

Register

Inorganic fertilizer use in CAST



How are we working to improve these data?

- Fertilizer Expert Group (FEG)
 - Agricultural focus
 - Examine potential data sources with
 - States
 - Fertilizer industry
 - Government agencies
- **NOTE*** if new data for agricultural fertilizer is found urban fertilizer data will also be gathered



What are we finding?

Many organizations use AAPFCO

Large scale survey feasibility is low

Information directly from states is very beneficial:

- Reduced latency
- Responsive to questions
- More in tune with local issues

It is very difficult to get industry data

Questions?

Urban Nutrients and Sediments Panel

2023 Bay-Wide Stormwater Partners' Retreat
Shepherdstown, West Virginia
April 12-14, 2023



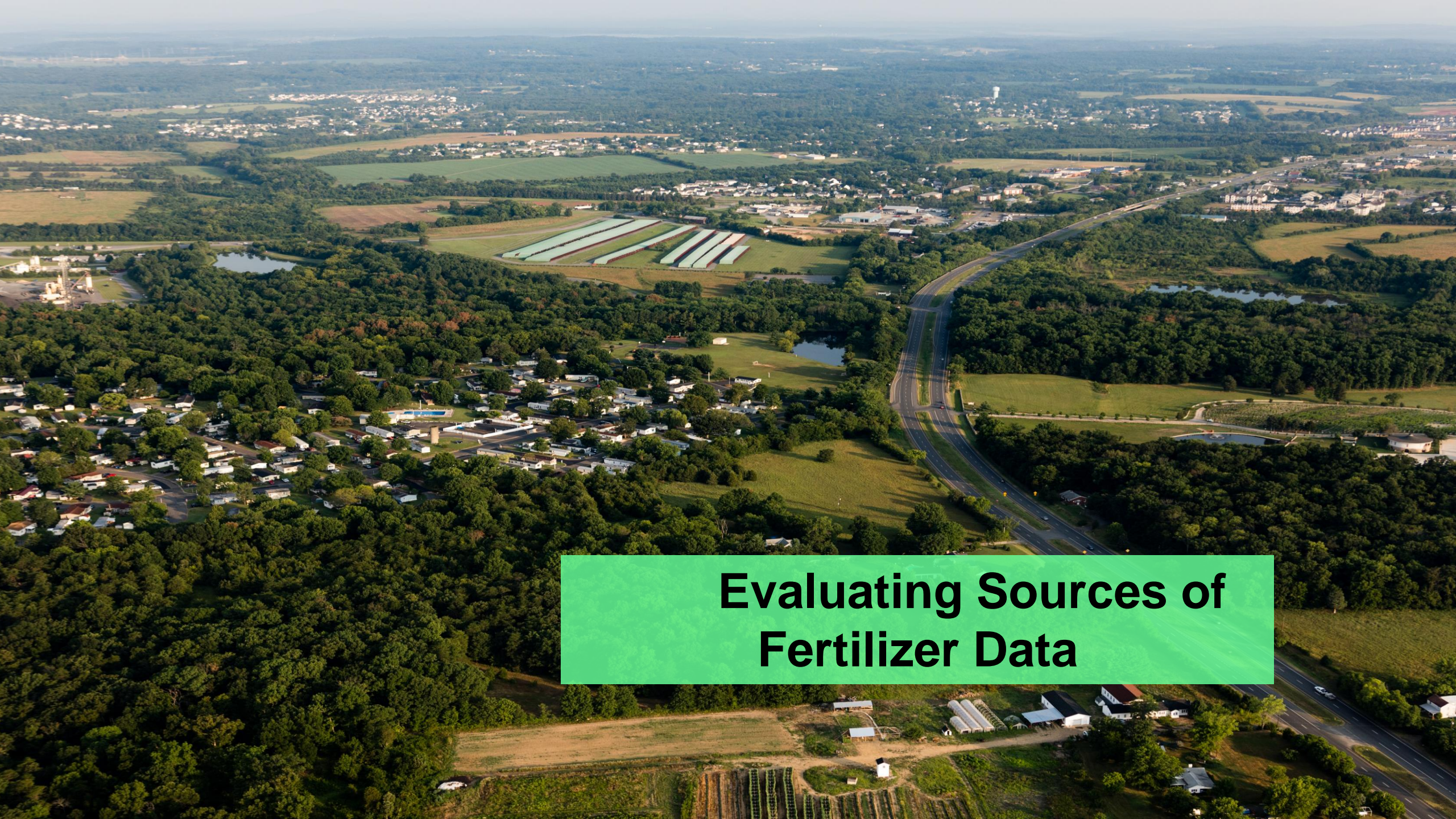
Mark Dubin
Senior Agricultural Advisor
University of Maryland Extension-College Park
College of Agriculture and Natural Resources
Department of Environmental Science &
Technology
mdubin06@umd.edu
EPA Chesapeake Bay Program Office
mdubin@chesapeakebay.net



Presentation Outline

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ Table of Contents
 - ▶ Evaluating Sources of Fertilizer Data
 - ▶ Enhancing Existing Fertilizer Data
 - ▶ Exploring Alternative Options
 - ▶ Summary
 - ▶ Questions



Evaluating Sources of Fertilizer Data

What are we finding?

Many organizations use AAPFCO

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**Enhancing Existing
Fertilizer Data**

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Enhancing Existing Fertilizer Data**
- ▶ **Benefits** – AAPFCO Point of Sales (POS) Data
 - ▶ **Single Source** – state reported, single POS data source.
 - ▶ **Consistent Data** – standard POS data reporting requirements that include separation of ag and urban.
 - ▶ **Spatial Coverage** - spatial coverage of all CB watershed counties, excepting Federal and District of Columbia.
 - ▶ **Published Data** – regularly published POS data for deriving countywide inorganic fertilizer applications.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Enhancing Existing Fertilizer Data**
- ▶ **Challenges** – AAPFCO Point of Sales (POS) Data
 - ▶ **Data Limitations** – published POS data does not include Federal properties, the District of Columbia, or states which do not report.
 - ▶ **Data Latency** - published POS data is delayed on average five-plus years.
 - ▶ **Data Transparency** – POS data analysis process is not fully documented.
 - ▶ **Data Updates** – published POS data can be updated without notice.
 - ▶ **Data Purchase** – POS data must be purchased for every published year as available.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Enhancing Existing Fertilizer Data**
- ▶ **Benefits** – Federal/State Point of Sales (POS) Data
 - ▶ **Direct Collaboration** – with Federal and state agencies to annually obtain fertilizer data.
 - ▶ **Reduce Latency** – from five-plus year delay to two-year.
 - ▶ **Federal Property** – obtain fertilizer data not in AAPFCO reports, including the District of Columbia.
 - ▶ **Hybrid Approach** – combine new data with AAPFCO POS data to create a full record over time.
 - ▶ **Data Consistency** – increase data consistency between land use sectors and jurisdictions.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Enhancing Existing Fertilizer Data**
- ▶ **Challenges** – Federal/State Point of Sales (POS) Data
 - ▶ **Inconsistent Data** – states differ in how they collect and report fertilizer POS data
 - ▶ **Laws and Regulations** – differ between states and amending them to create consistency is an obstacle.
 - ▶ **Missing Data** – one Bay state is seven-plus years behind on publishing data.
 - ▶ **District of Columbia** – does not collect any POS data.
 - ▶ **Data Limitations** – POS data issues can not be fully addressed.



Exploring Alternative Options

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Exploring Alternative Options**
- ▶ **Benefits – Fertilizer Point of Use (POU) Data**
 - ▶ **Fertilizer POU Data** – could eliminate many of the current limitations of using POS data. Including:
 - ▶ **Spatial Distribution** – eliminate or reduce distribution issues of POS data to reduce uncertainty.
 - ▶ **Reduced Latency** – directly sourced annual data.
 - ▶ **Regional Partnership** – multi-year direct agreements for consistent data availability.
 - ▶ **Enhanced Management Data** - document and verify precision nutrient management BMPs.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Exploring Alternative Options**
- ▶ **Process** – Fertilizer Point of Use (POU) Data
 - ▶ **Regional Collaboration** – public agencies, fertilizer sales industry and land grant universities can develop a new approach to fertilizer data – POU data.
 - ▶ **Data Protection** – land grant universities can provide research FOIA protection of private data.
 - ▶ **Data Verification** – private data can be verified using comparison with multiple data sources.
 - ▶ **Scale of Data** – private data can be aggregated at the county/jurisdiction scale for ag and urban land uses.
 - ▶ **Publish Data** – verified and aggregated private data can be published as POU data for ag and urban land uses.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Exploring Alternative Options**
- ▶ **Examples** - Fertilizer Point of Use (POU) Data
 - ▶ **Commercial Industry Data** – data sharing with livestock industry has been successful in Pennsylvania and Virginia.
 - ▶ **Published Industry Data** – data published by Penn State and Virginia Tech in 2017, and updates coming for 2023.
 - ▶ **Regional Data** – replaced national-scale livestock nutrient data and feed management BMP reporting.
 - ▶ **CBP Phase 6 Data** – published data is currently representing swine and turkey production in all Bay States.

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Exploring Alternative Options**
- ▶ **Results** – Fertilizer Point of Use (POU) Data
 - ▶ **Nutrient Reductions** – commercial industry data documented nutrient reductions over existing data.
 - ▶ **Data Confidence** – commercial industry data increased data confidence for all users.
 - ▶ **Bay TMDL Goals** – industry partnership with the land grant universities assisted the Bay jurisdictions with meeting their nutrient reduction goals without additional regulations or enforcement.



Summary

Documenting Chesapeake Bay Nutrient Reduction Goals - Fertilizer

- ▶ **Fertilizer Data Sources**
- ▶ **What is the data need?**
 - ▶ **Annual Fertilizer Data** – to estimate N and P applications for all agricultural and urban land uses.
 - ▶ **Consistently Reported Data** – annual data required for regular model updates.
 - ▶ **Complete Data** – can be processed to remove high variation and distribution issues, and separate ag vs urban.
 - ▶ **Scale of Data** – can be applied at the county/jurisdiction scale based on annual nutrient needs.
 - ▶ **Data Confidence** – improved partner and public confidence in the data and model analysis results.

A scenic view of a farm with a pond, barns, and a house, with text overlay. The image shows a peaceful rural landscape with a calm pond in the foreground reflecting the sky and the buildings. In the middle ground, there are several white farm buildings, including a large barn and a silo. In the background, a white house is visible on a hillside. The sky is blue with some light clouds. The text is overlaid in the center of the image.

**For More Information go to
<https://www.chesapeakebay.net/>**

Stormwater Retreat Nutrient and Sediment

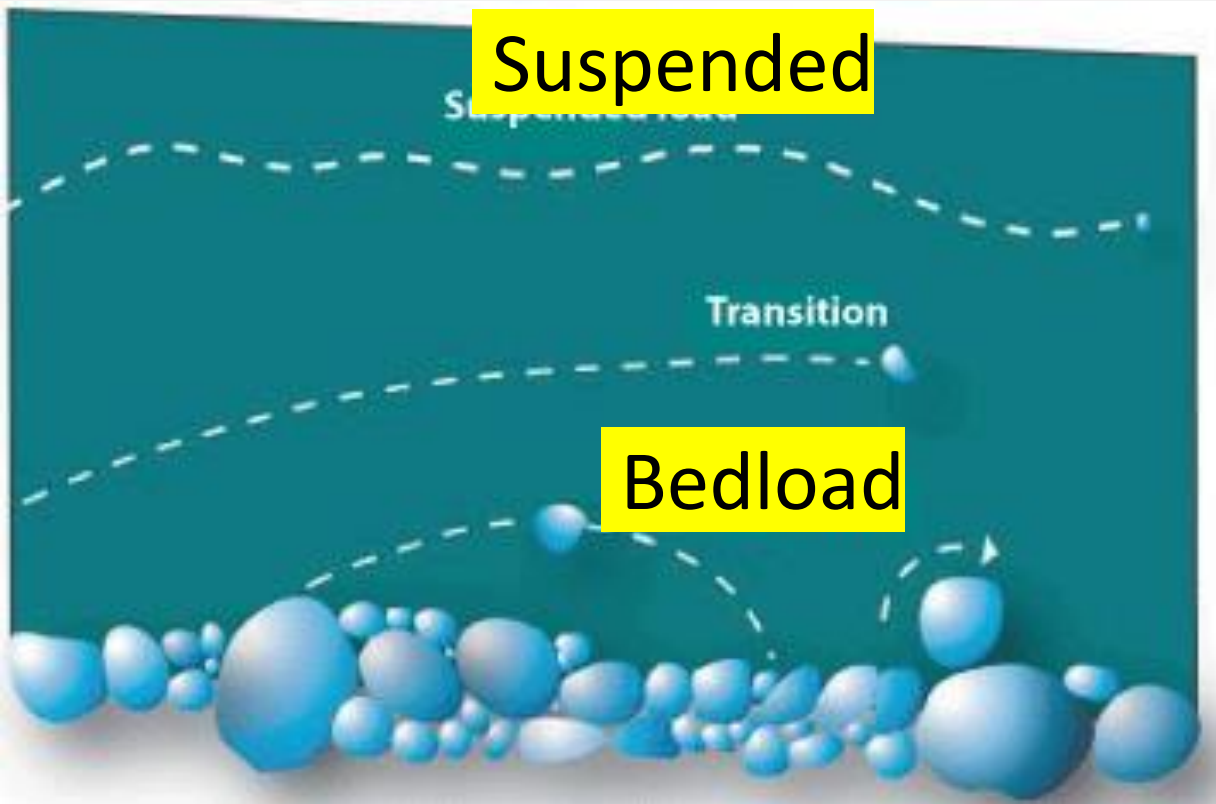
What do we know about urban/suburban sediment?

What are sediment characteristics – transport, yields, sources in urban areas?

*** Urban – includes suburban and urban (inner city)

Allen Gellis, USGS

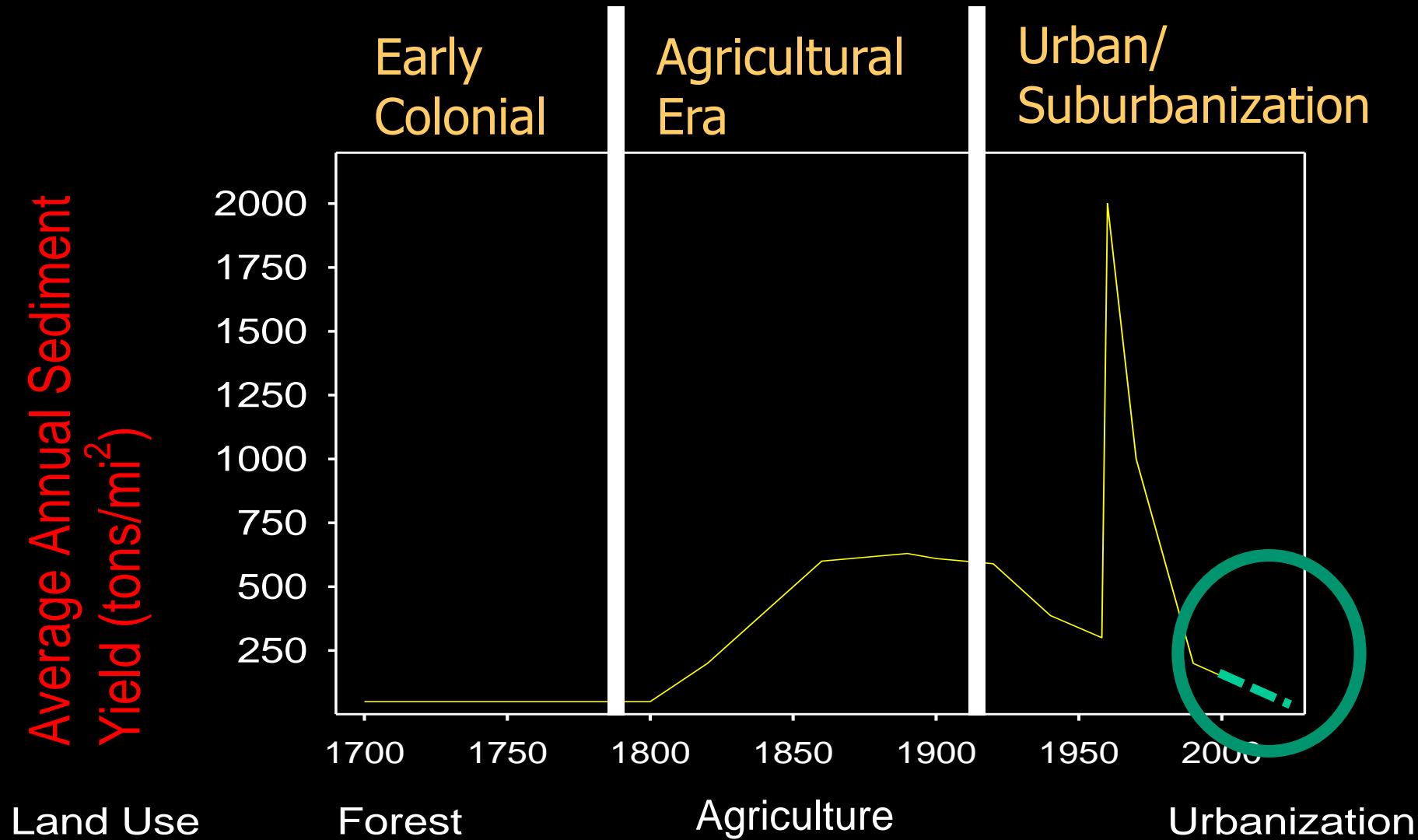
GEOMORPH 101: Modes of sediment transport



Suspended (silt, clay, <2mm sand) - substrate smothering, gill suffocation, light attenuation, nutrients (e.g. P); contaminants (e.g. metals) Typically >70% of the annual sediment load.

Bedload (sand, gravel, cobble, boulder) – clogging streams, alters channel morphology.

Wolman Curve – Sediment & Land use change



After Wolman, 1967

Stream Burial

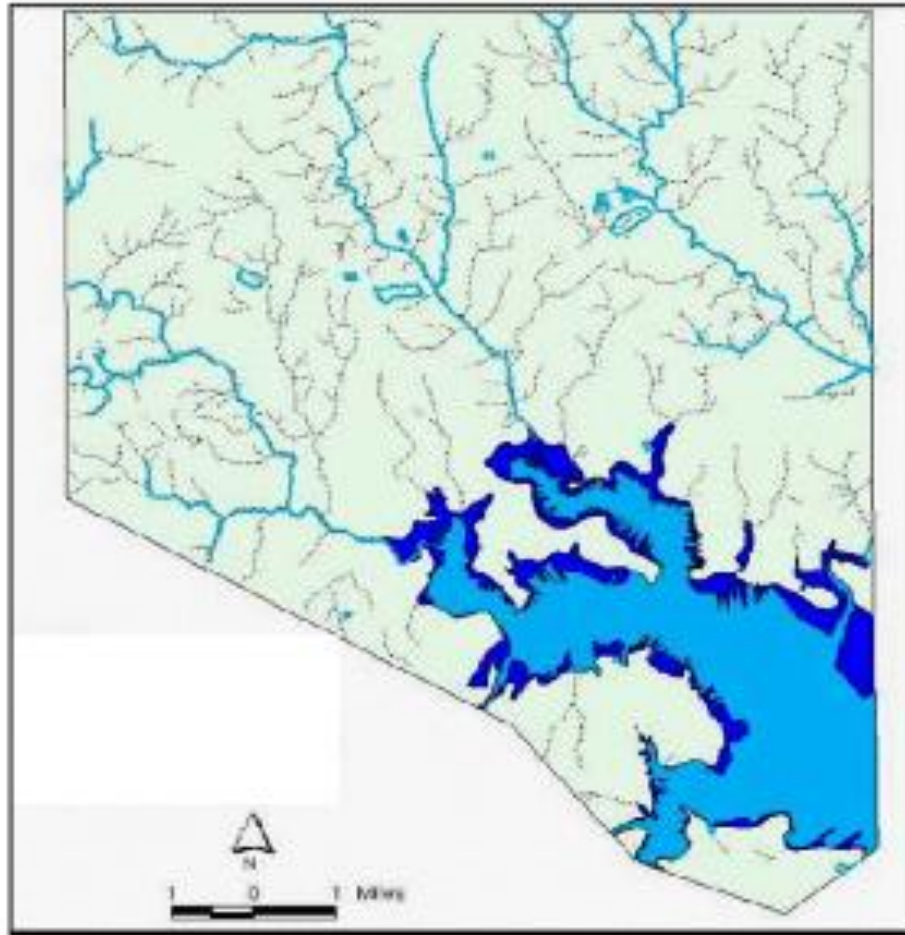


FIGURE 3-18 Baltimore City before and after development of its stormwater system. The left-hand panel shows first- and second-order streams lost to development. The right-hand panel shows the increase in drainage density resulting from construction of the modern storm-drain network. SOURCE: Courtesy of William Stack, Baltimore Department of Public Works.

Shenandoah



Washington D.C



Forest

Agriculture

Suburbs

Outer urban

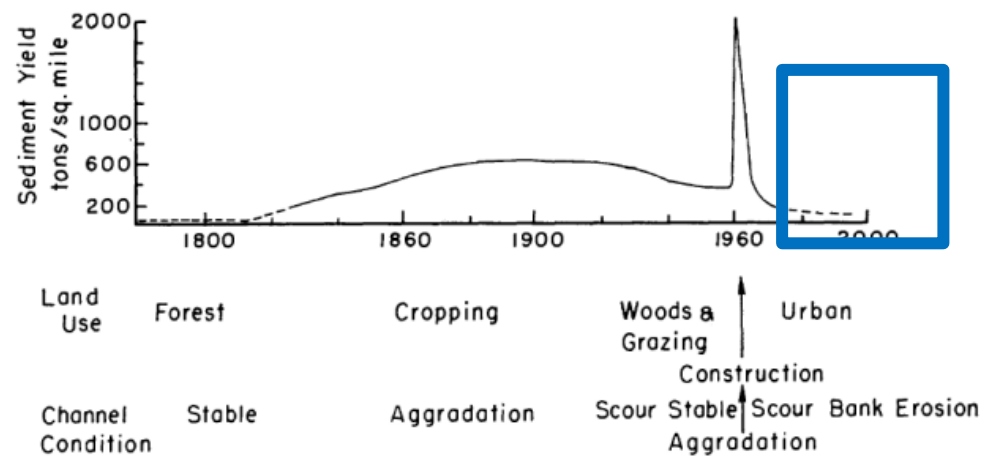
Inner city





INNER CITY

SCHMATIC SEQUENCE: LAND USE, SEDIMENT YIELD
AND CHANNEL RESPONSE
FROM A FIXED AREA



Wolman, 1967





Finding New York City's Ghost Streams, With Old Maps and New Technology



What do we know about the morphology of urban/suburban rivers?

- Globally, urbanization of catchments has commonly resulted in what is termed the **urban stream syndrome**: (Walsh et al., 2005).
- Typically, channels in urban catchments are incised
- With reduced physical habitat (e.g. less mobile bed substrate, fewer bars and riffles, less wood, disengaged floodplains) and altered rates of sediment transport, all contributing to degradation of stream ecosystems (Vietz et al., 2015).

Increased Peak Flows

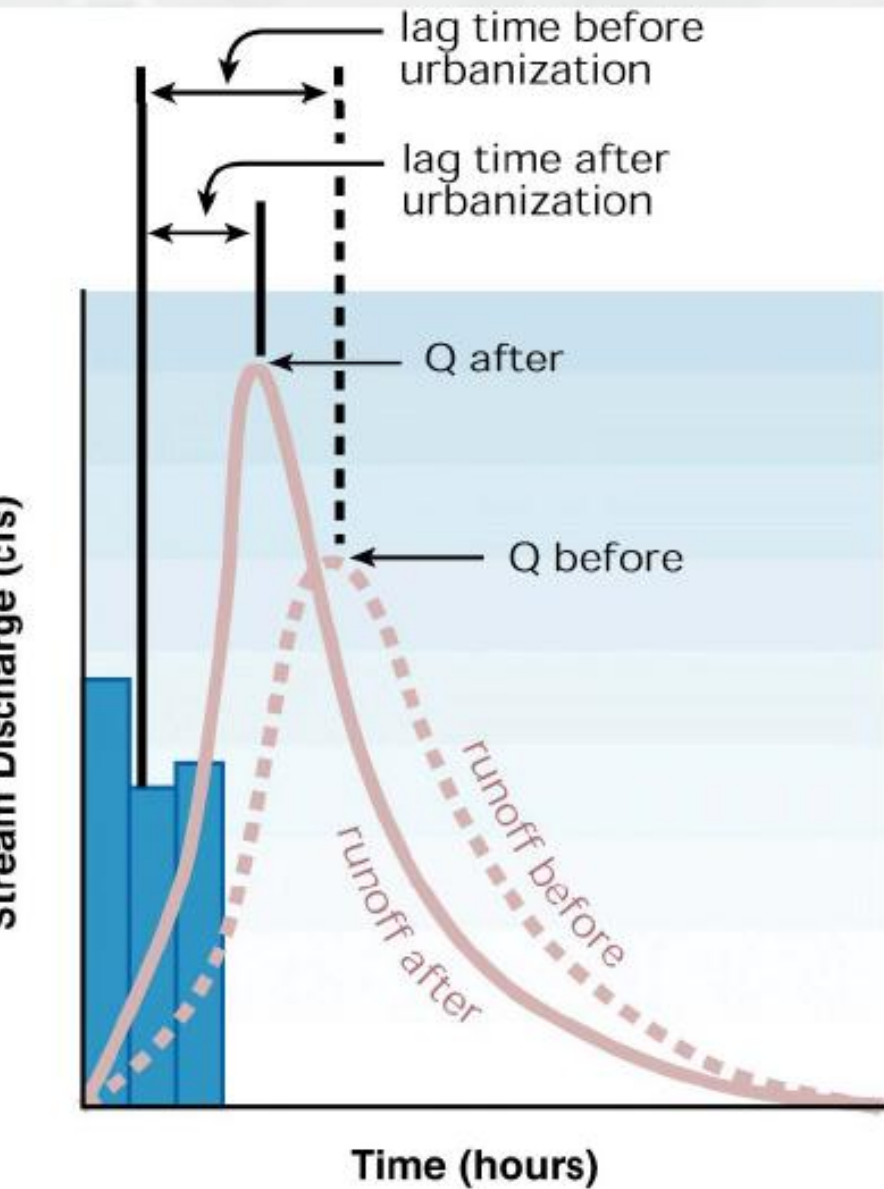
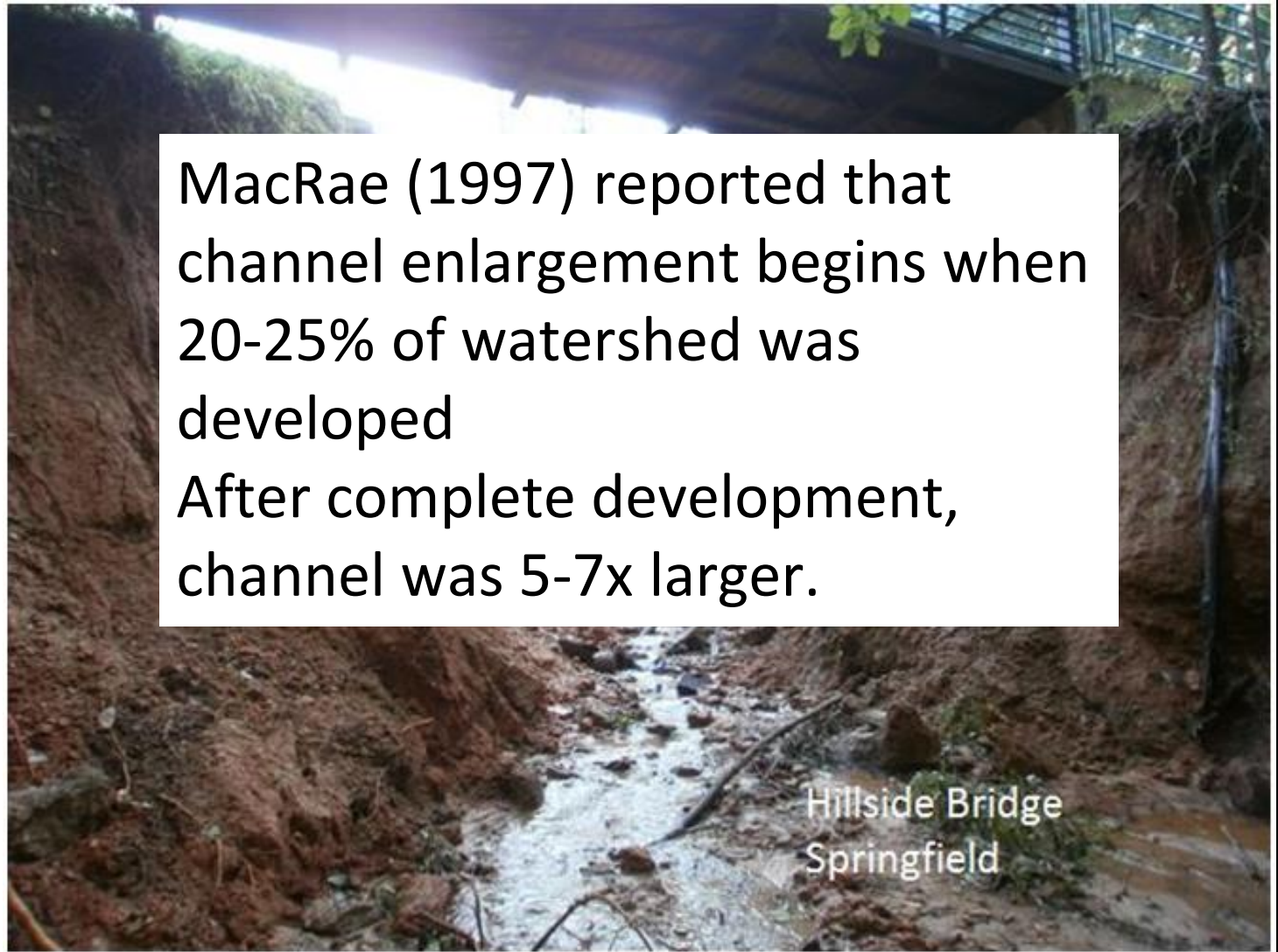
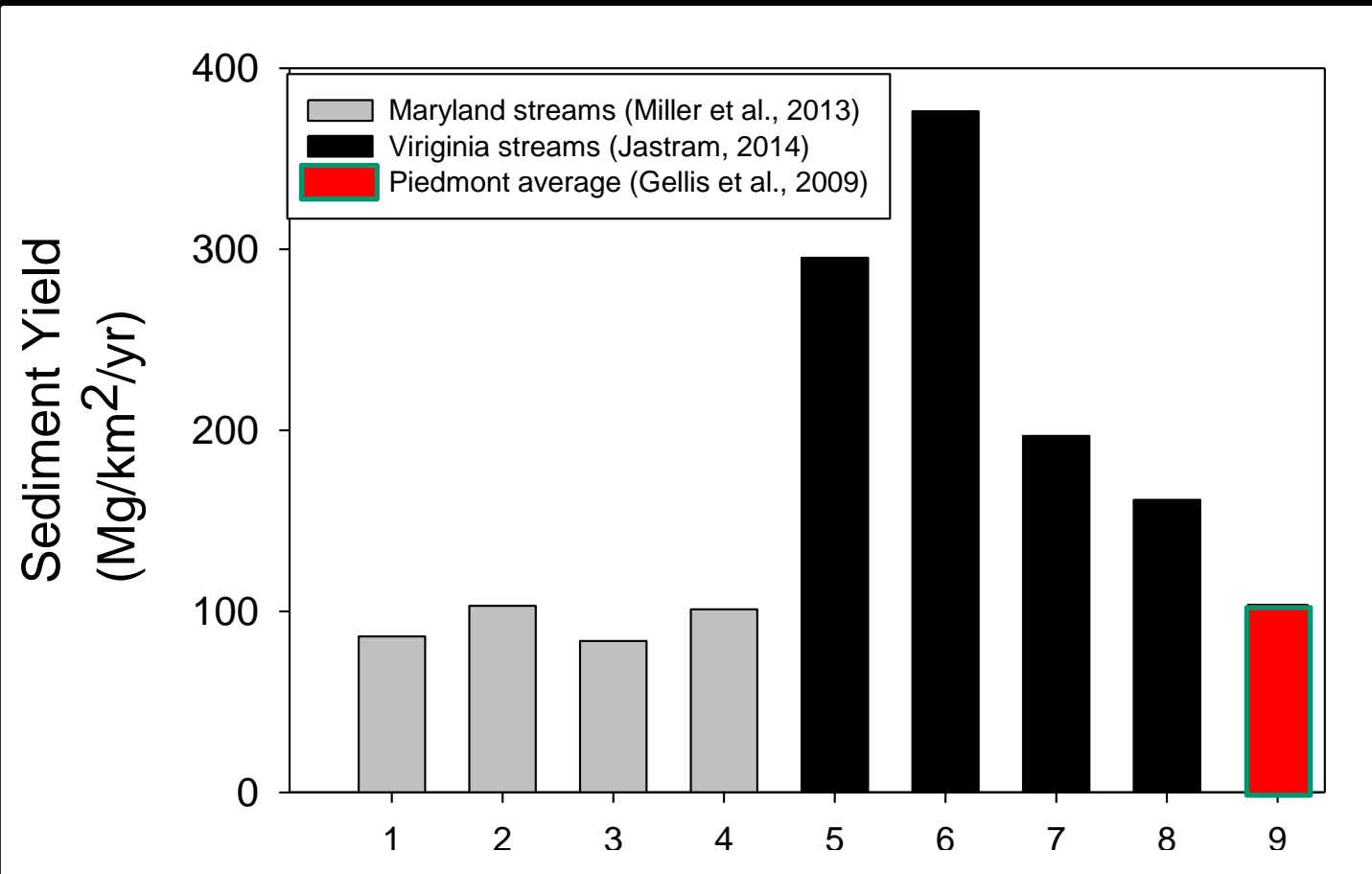


Fig. 1.15 -- A comparison of hydrographs before and after urbanization. The discharge curve is higher and steeper for urban streams than for natural streams. In Stream Corridor Restoration: Principles, Processes, and Practices (10/98). Interagency Stream Restoration Working Group (15 federal agencies)(FISRWG).



MacRae (1997) reported that channel enlargement begins when 20-25% of watershed was developed
After complete development, channel was 5-7x larger.

Sediment in Urban Areas - Chesapeake Bay



1. Paint Br near College Park, MD
2. NE Anacostia River at Riverdale, MD
3. NW Br Anacostia River near Hyattsville, MD
4. Rock Creek at Joyce Road, Washington, D.C.
5. Difficult Run above Fox Lake near Fairfax, VA
6. South Fork Little Difficult Run, VA
7. Flatlick Br above Frog Branch at Chantilly, VA
8. Dead Run at Whann Avenue near Mclean, VA
9. Average for Piedmont Physiographic Province

Where is all that sediment coming from?



Sediment Fingerprinting for Sources

Underlying principle: potential sediment **sources** can be characterized using a selected suite of diagnostic physical and chemical properties – the fingerprints

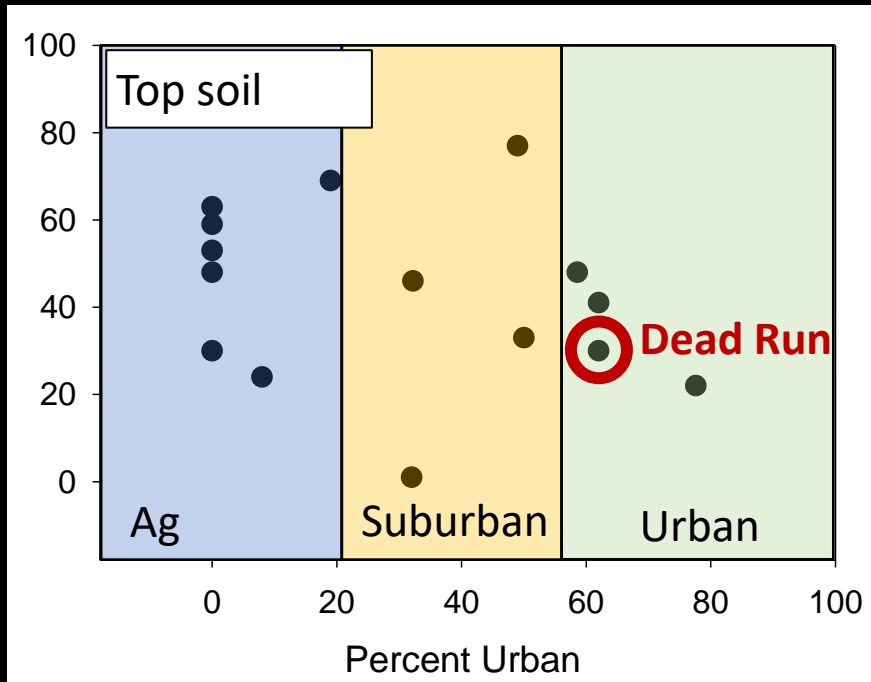
Comparison of these fingerprints with equivalent information for **fluvial (target)** samples permits the relative importance of the potential sources

Gellis and Walling, 2011

** On fine sediment – silts and clays

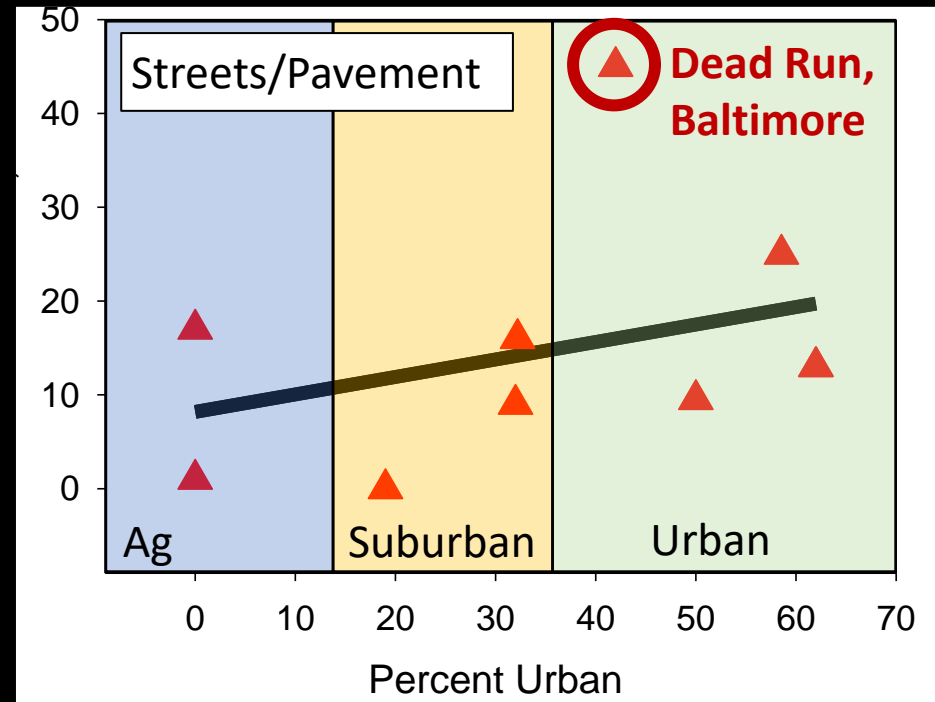
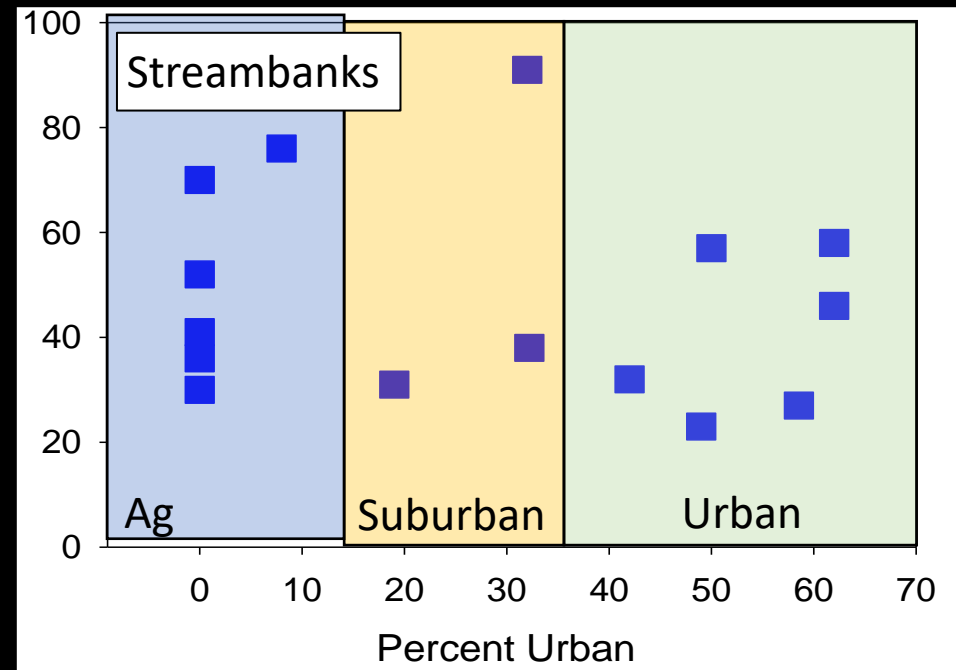
**Provides sources of delivered sediment

Sediment Source, %



Sediment Fingerprinting
Results by land use in
Chesapeake Bay and NE-Mid
Atlantic Region

Sediment Source, %



Examples Chesapeake Bank Erosion



Difficult Run, VA



Smith Creek, VA



Denlinger's Mill Reservoir (W. Br. Little Conestoga, PA) Sediment, 2002L. Manion (F&M, 2003)

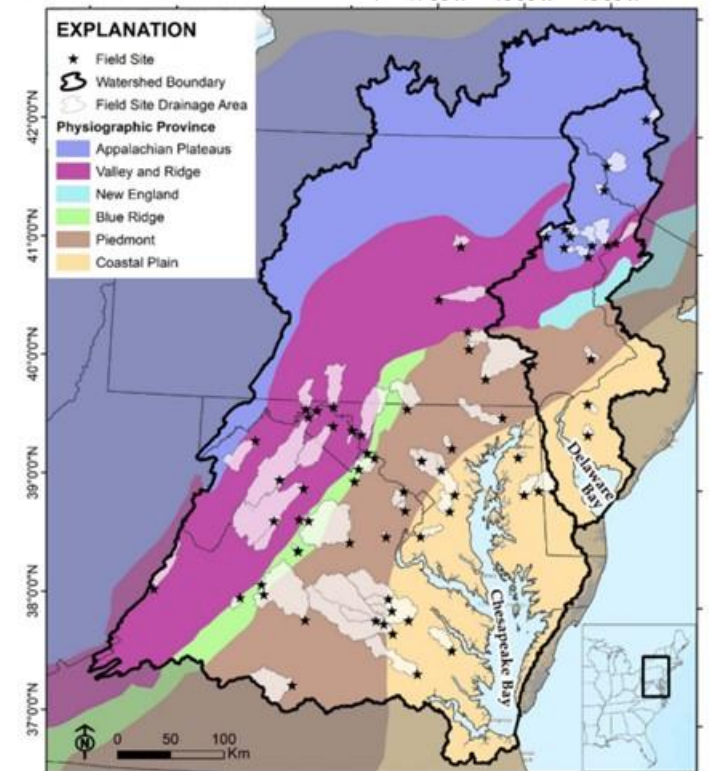
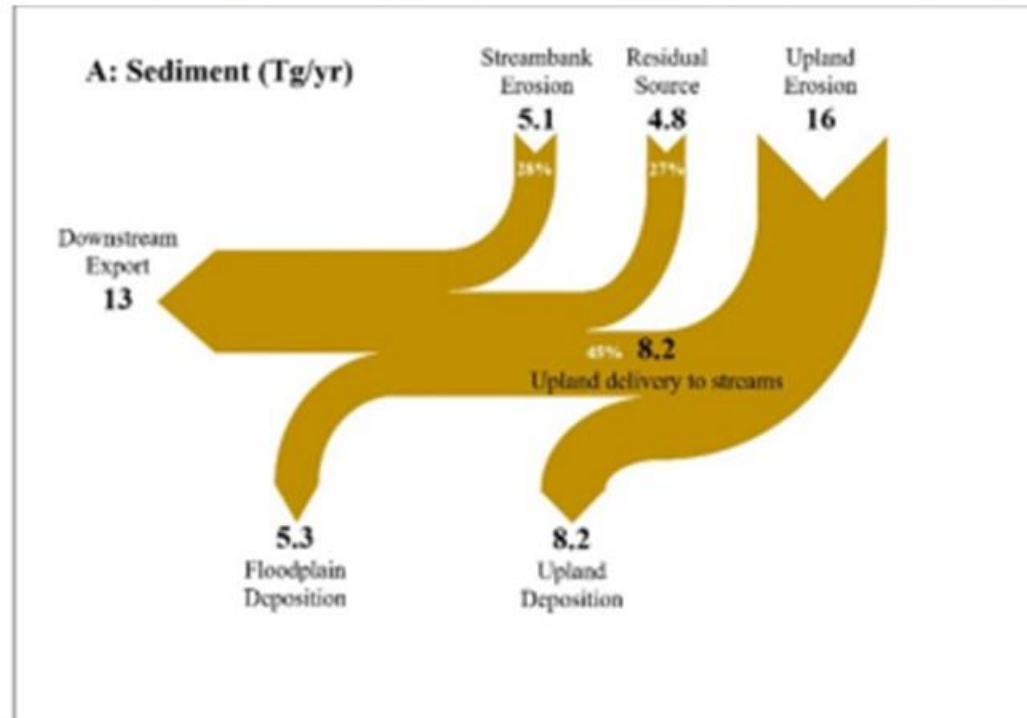


Linganore Creek, MD

LETTER

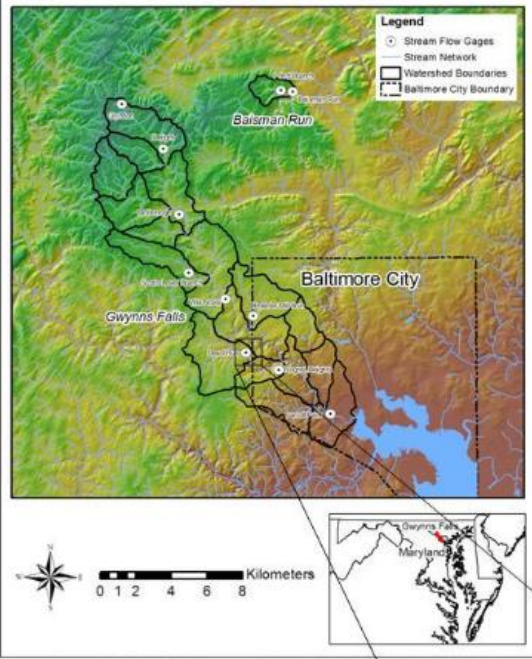
Streambank and floodplain geomorphic change and contribution to watershed material budgets

G B Noe^{1,*}, K G Hopkins², P R Claggett³, E R Schenk⁴, M J Metes⁵, L Ahmed³, T R Doody¹ and C R Hupp¹

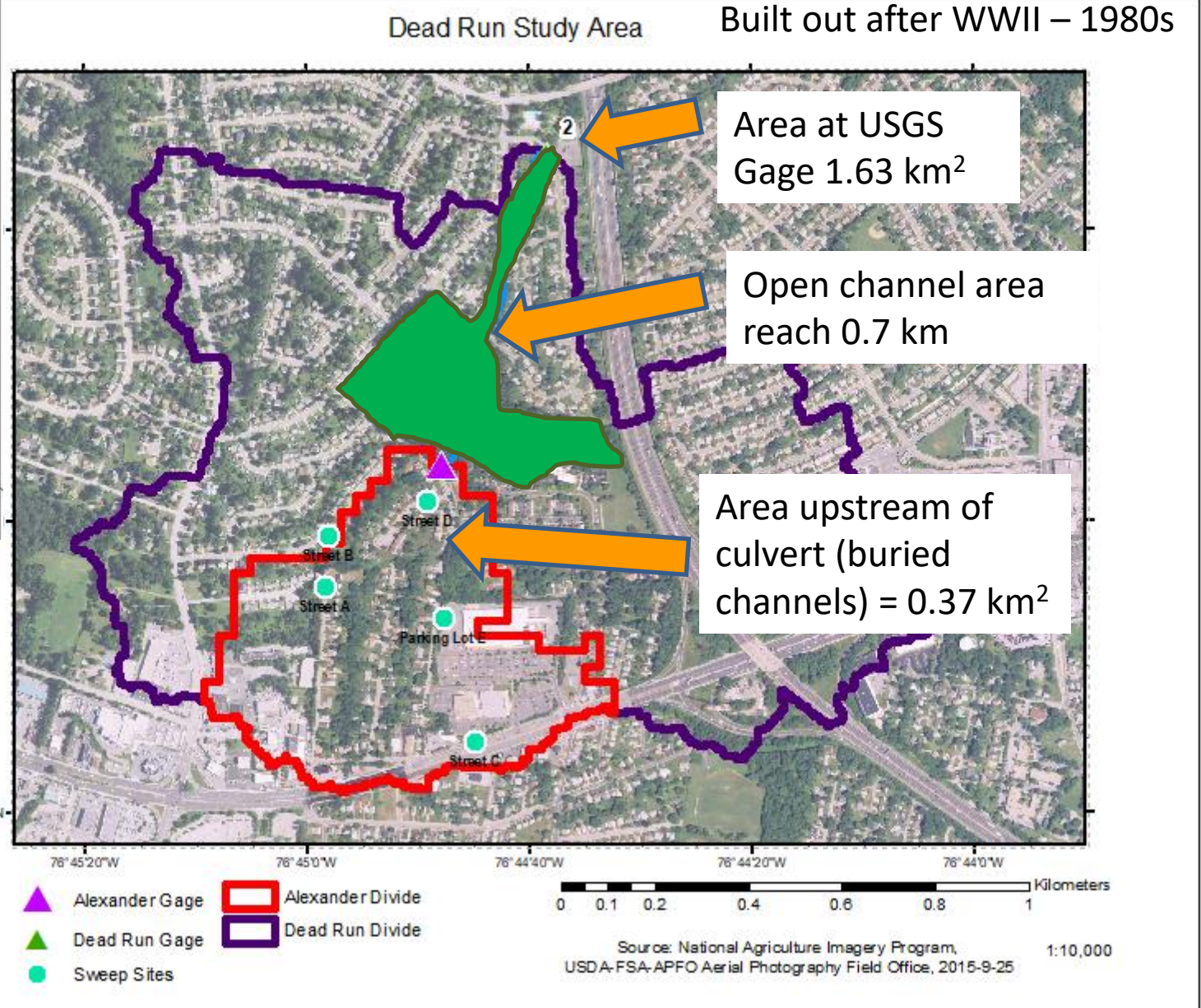


In these buried channel parts of the watershed, streambank erosion does not occur and surface-derived sediment (e.g. soil, impervious surfaces) might be expected to dominate fluvial sediment (suspended sediment (SS) and bed sediment).



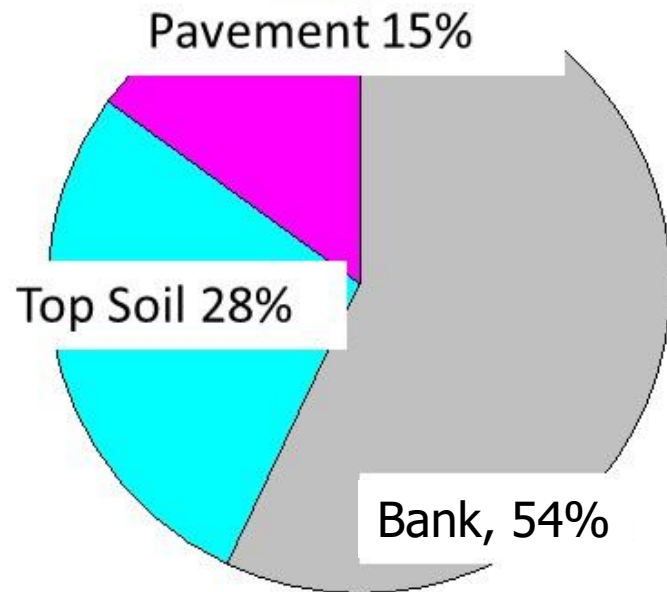


Source: Center for Urban Environmental Research and Education (CUERE) by Mike McGuire

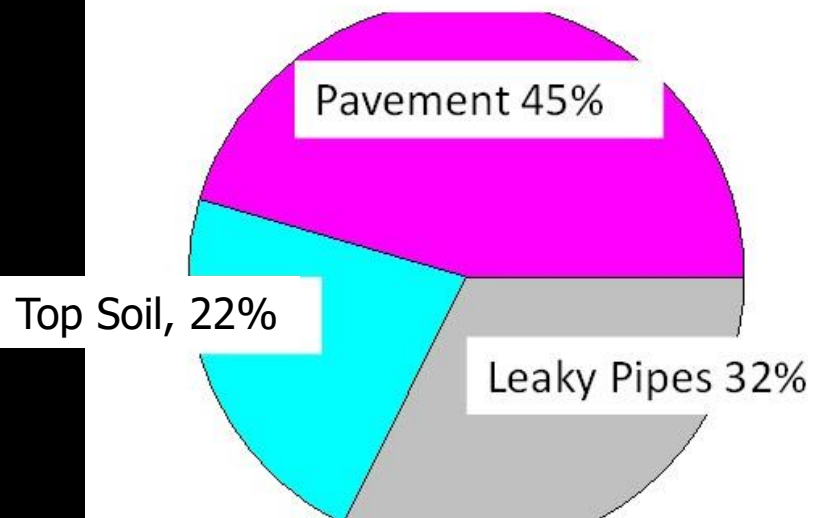


Sediment sources changing from buried to open channel

OPEN SECTION

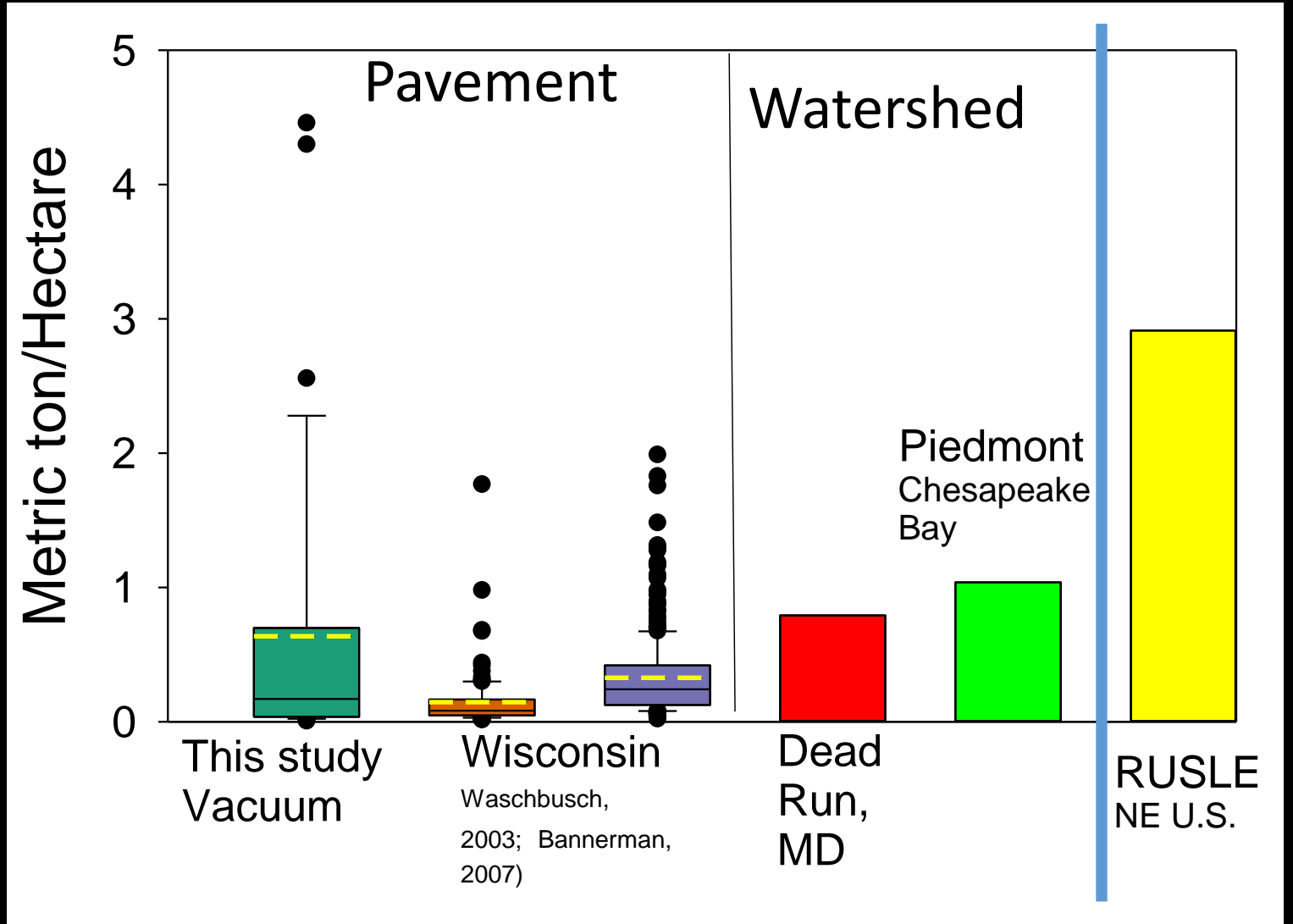
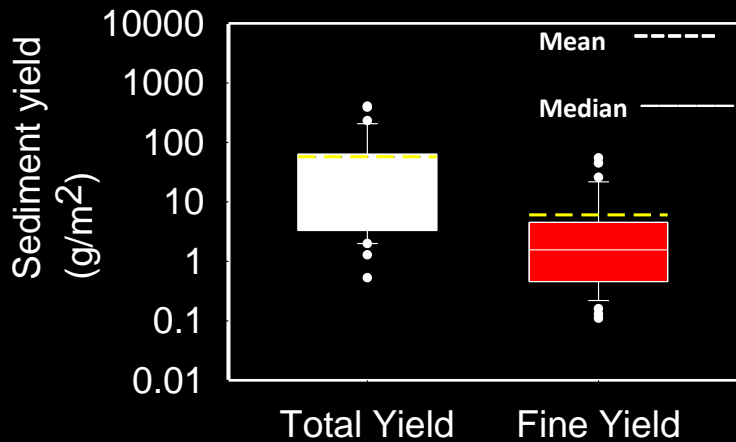


Buried Channel Sources

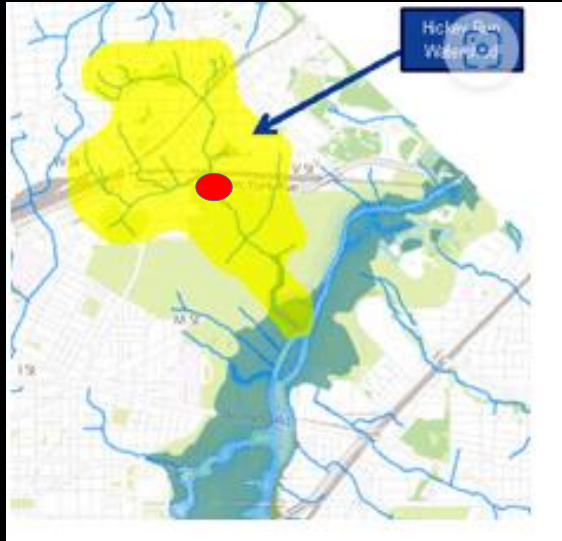


Sediment sources changing from buried to open channel

How much sediment is available?



Hickey Run, DC Outfall Sediment Cleanup \$\$\$



Take Home Points

Suburban to Outer City

- Sediment yields are high as streambanks from incised channels become important
- Top soil erosion still a source; pavement becomes more important

Inner City

- Producing sediment – pavement, construction, roads, eroding pipes

Where top soil is also an important source

THANK YOU