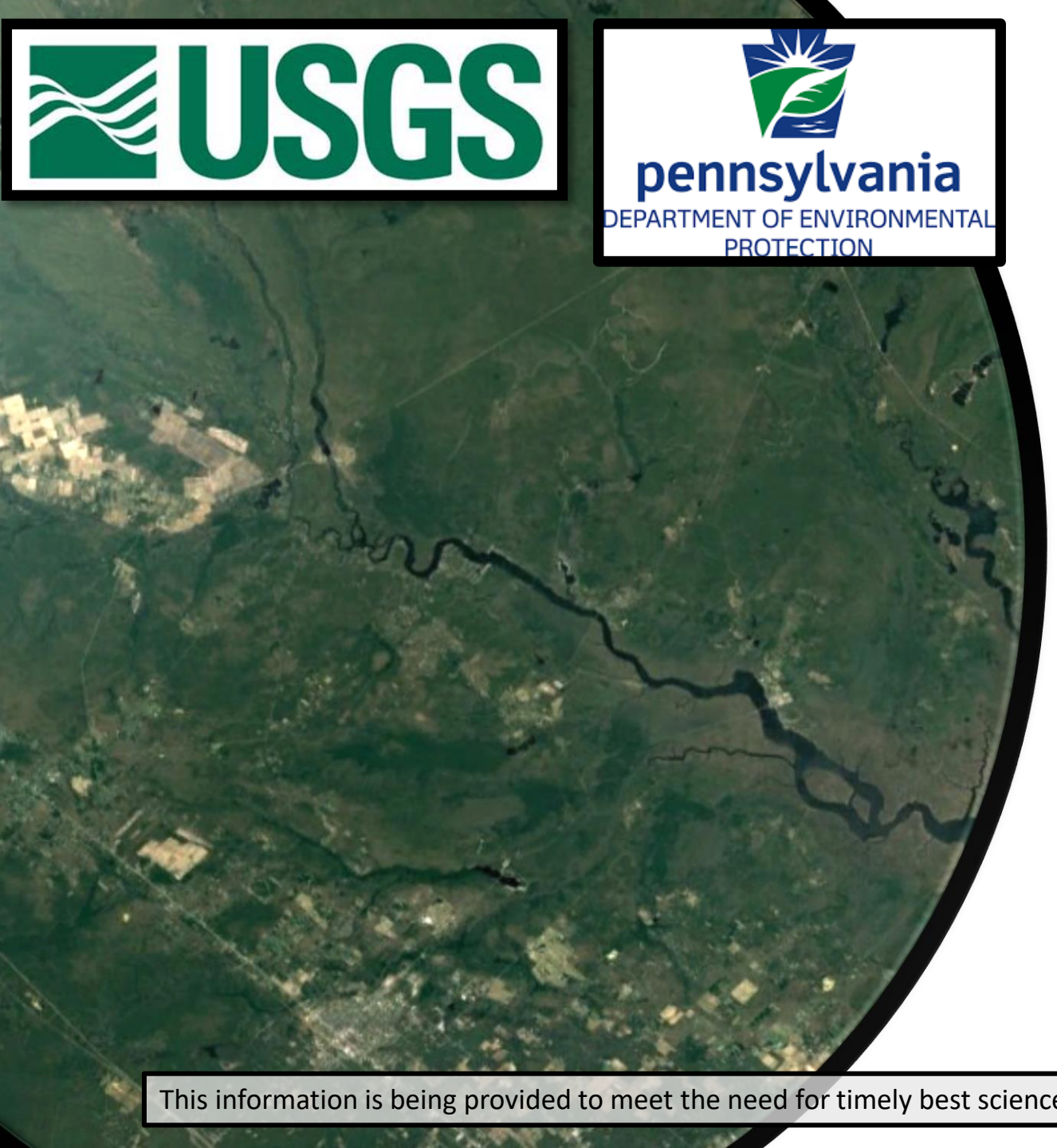


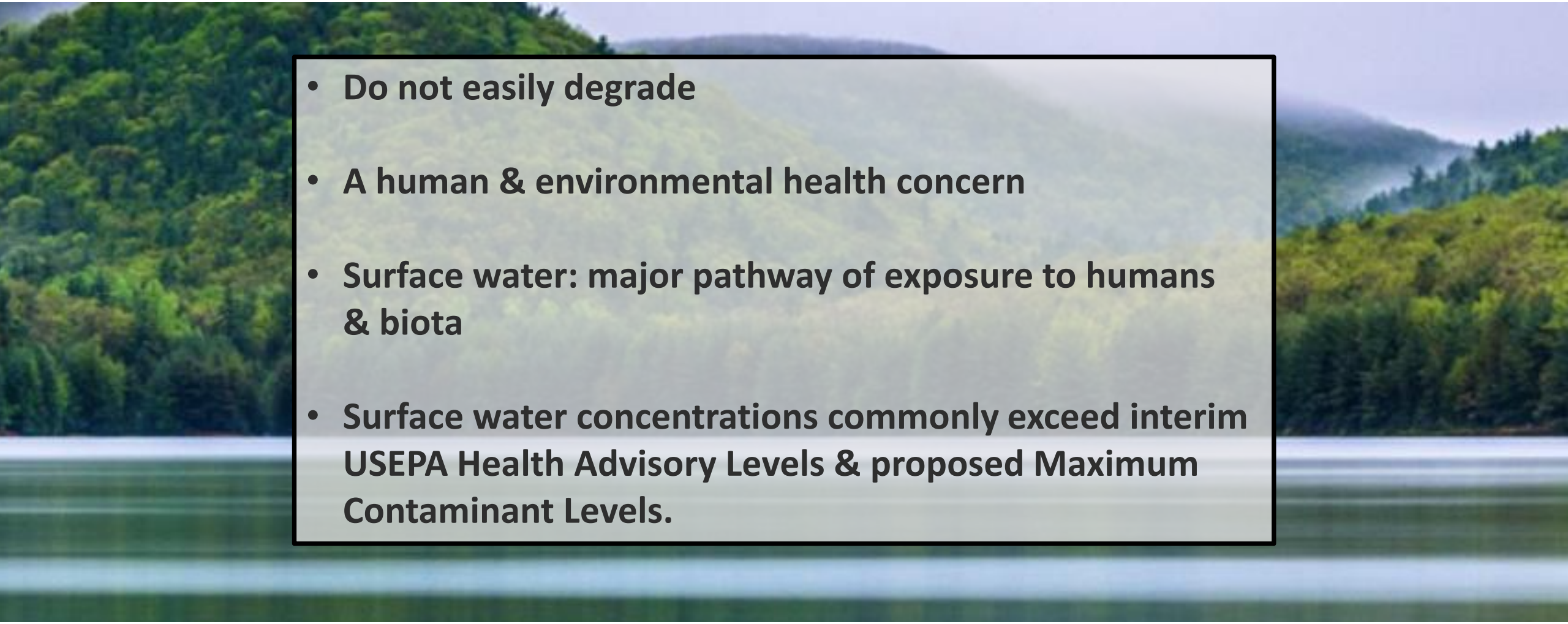
Per- & polyfluorinated alkyl substances (PFAS) in Pennsylvania surface waters: A statewide assessment & associated sources

Sara E. Breitmeyer, Amy M. Williams, Joseph W. Duris, Lee W. Eicholtz, Dustin R. Shull, Timothy A. Wertz, Emily E. Woodward

U.S. Geological Survey & Pennsylvania Department of Environmental Protection (PADEP)

Scan for Journal Article

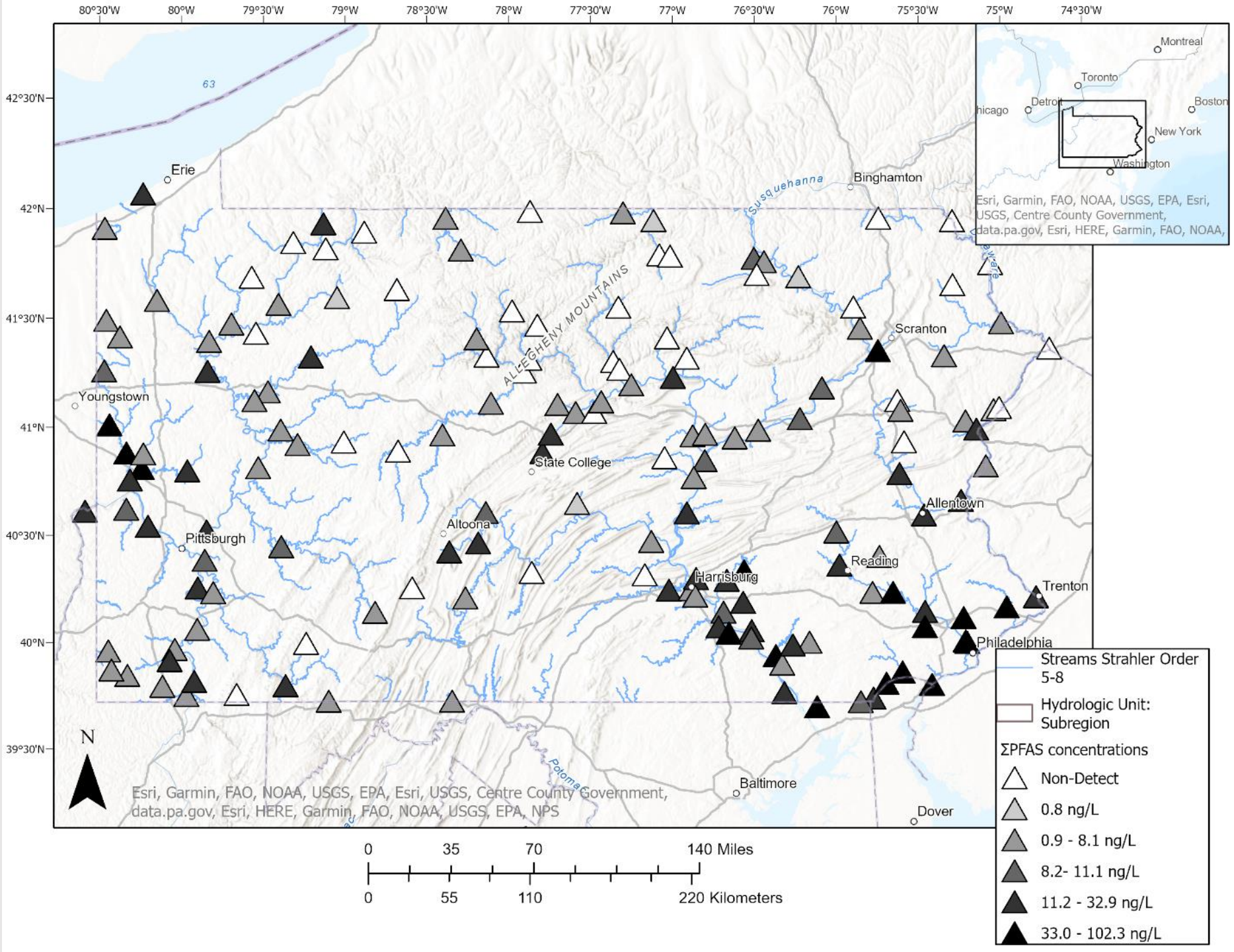
Per- & polyfluorinated alkyl substances (PFAS)



- **Do not easily degrade**
- **A human & environmental health concern**
- **Surface water: major pathway of exposure to humans & biota**
- **Surface water concentrations commonly exceed interim USEPA Health Advisory Levels & proposed Maximum Contaminant Levels.**

Pennsylvania Water Quality Network Streams (n=161)

- Sampled once- September 2019
- 33 target PFAS concentrations (EPA draft method 1633)
- pH, alkalinity, total dissolved solids, total nitrogen (TN), ammonia, chloride, & sulfate



This information is being provided to meet the need for timely best science and provided on the condition that it is not for citation or distribution.

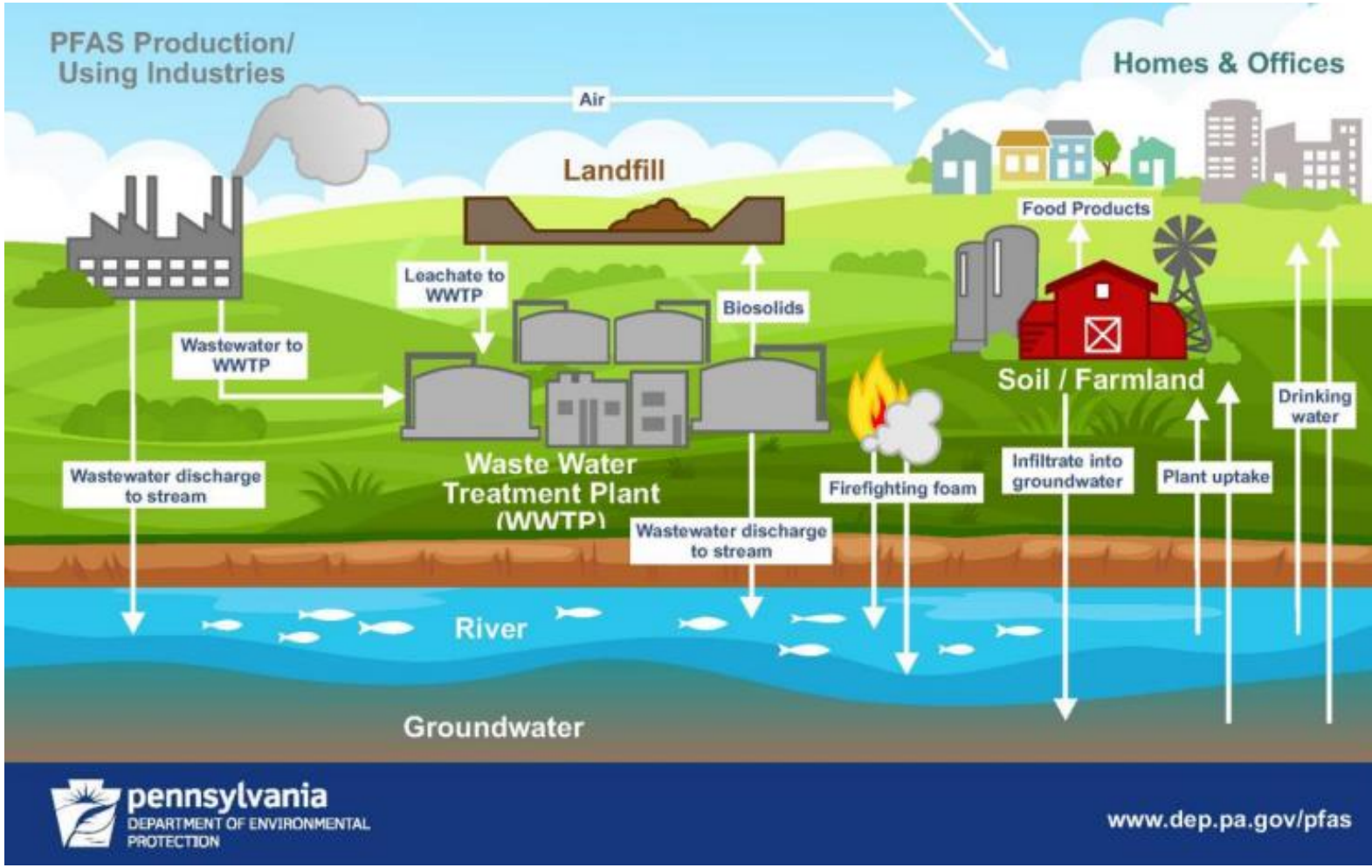
Geospatial Analysis

Land use (upstream catchment)

- Wetland
- Cropland
- Development

Potential PFAS sources (local catchment)

- Sinkholes
- Water pollution control facilities
- Military installations
- Airports
- Fire training schools
- Combined sewer overflow outfalls
- Oil & gas wells
- Land recycling cleanup locations
- Superfund sites
- Major groups of EnviroFACTS industries (manufacturing/service facilities w/ permitted discharges)



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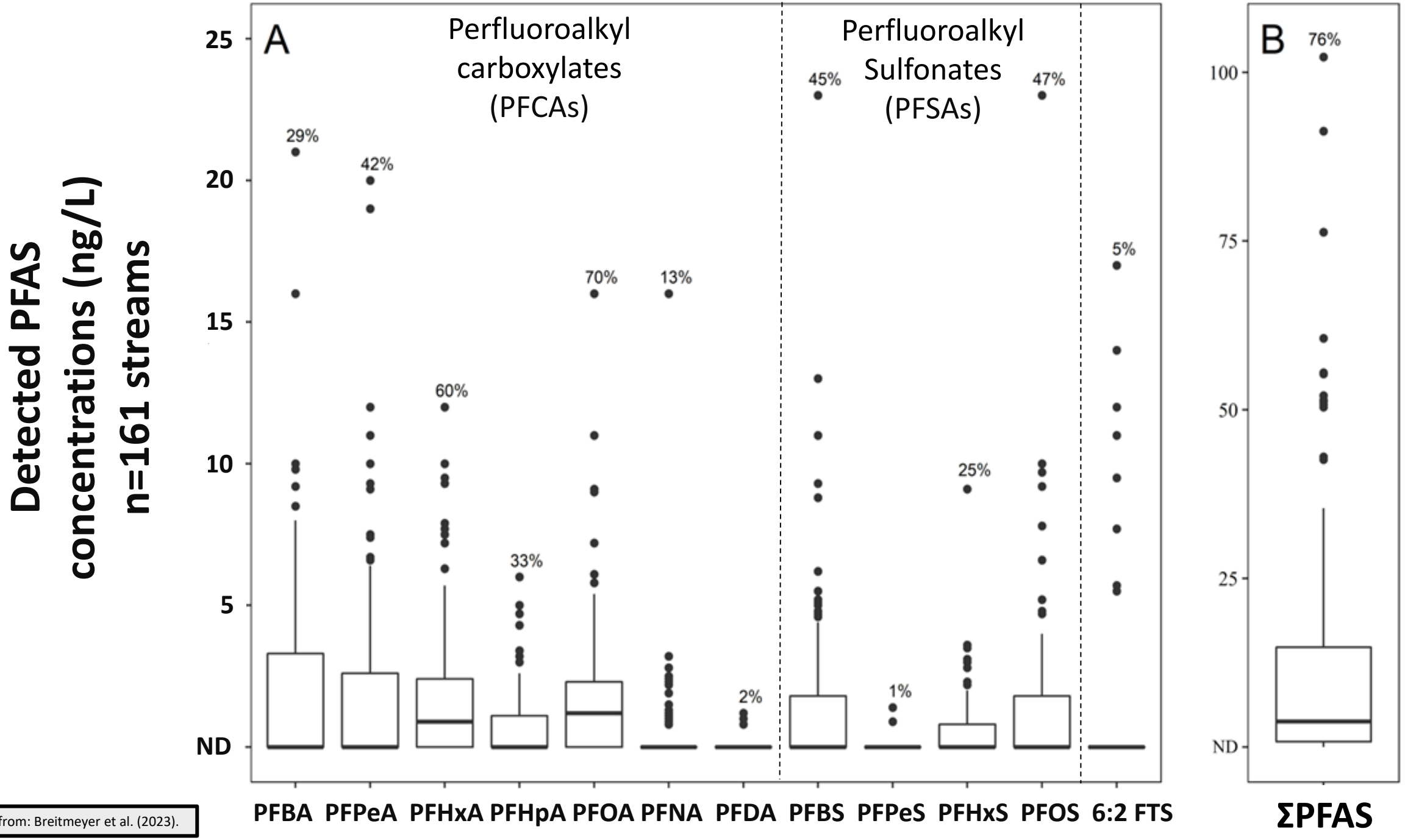


Figure from: Breitmeyer et al. (2023).

Urbanization & PFAS

- n=161 streams
- 38 total input features
- Total PFAS yield (median)= $11.9\ \frac{\mathrm{ng}}{\mathrm{s}}/\mathrm{km}^2$
- dev_pct,
  % development

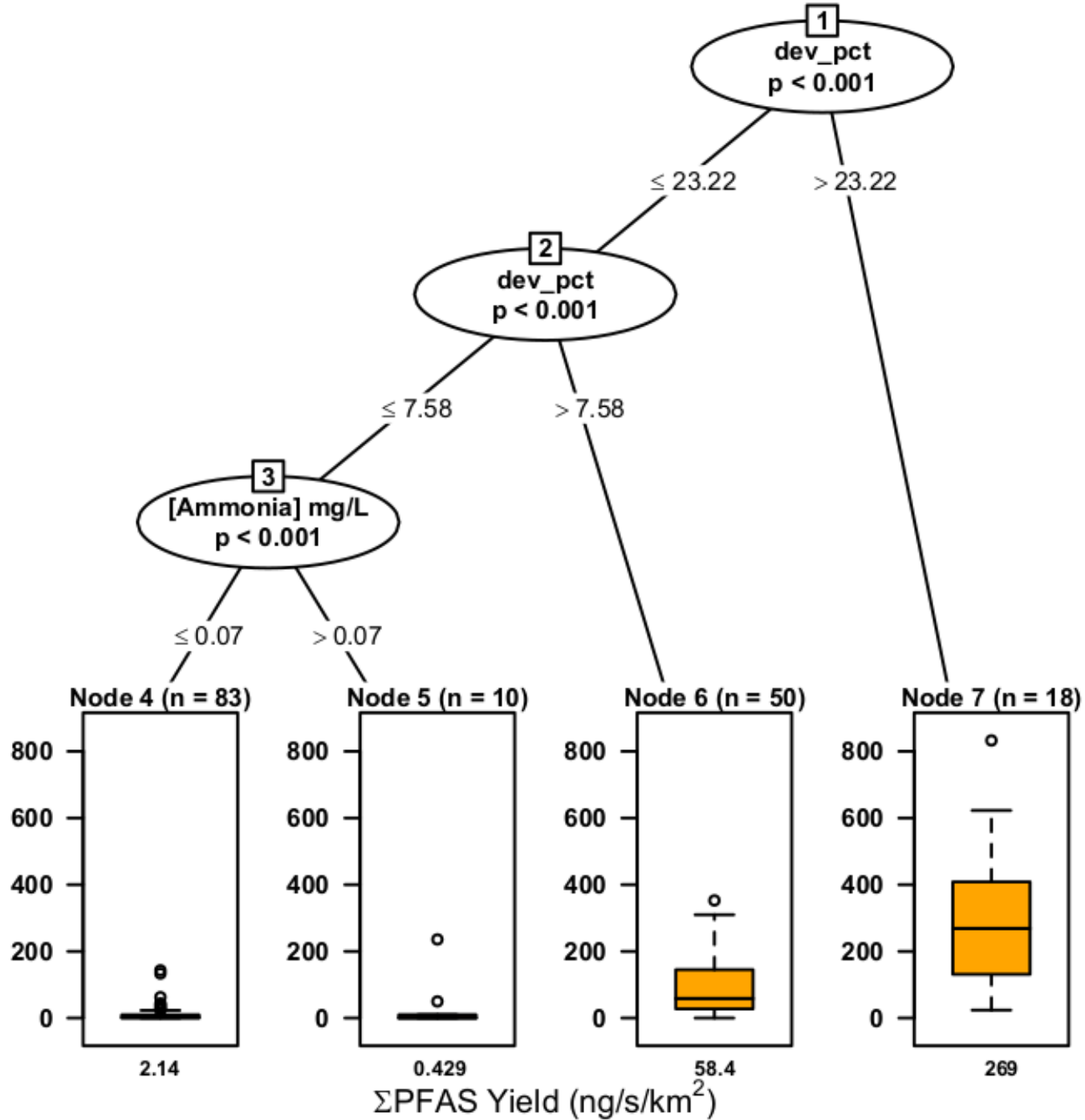
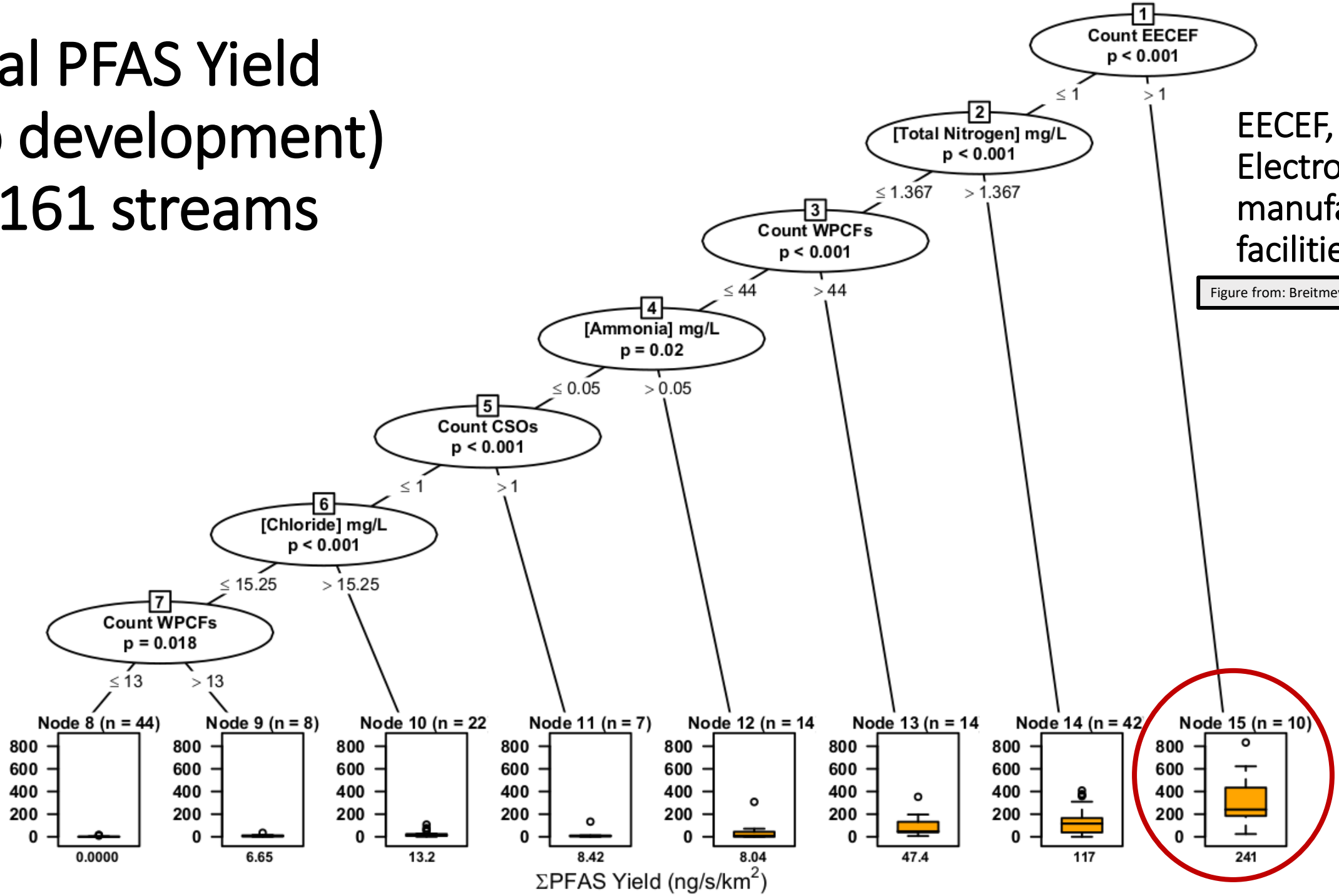


Figure from: Breitmeyer et al. (2023).

Total PFAS Yield (no development) n= 161 streams

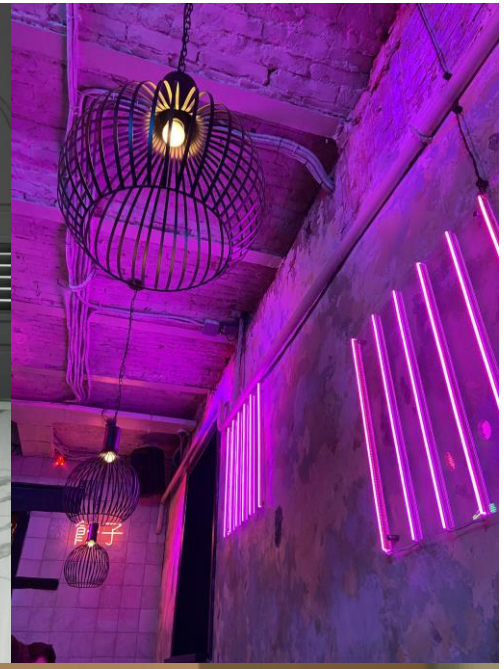


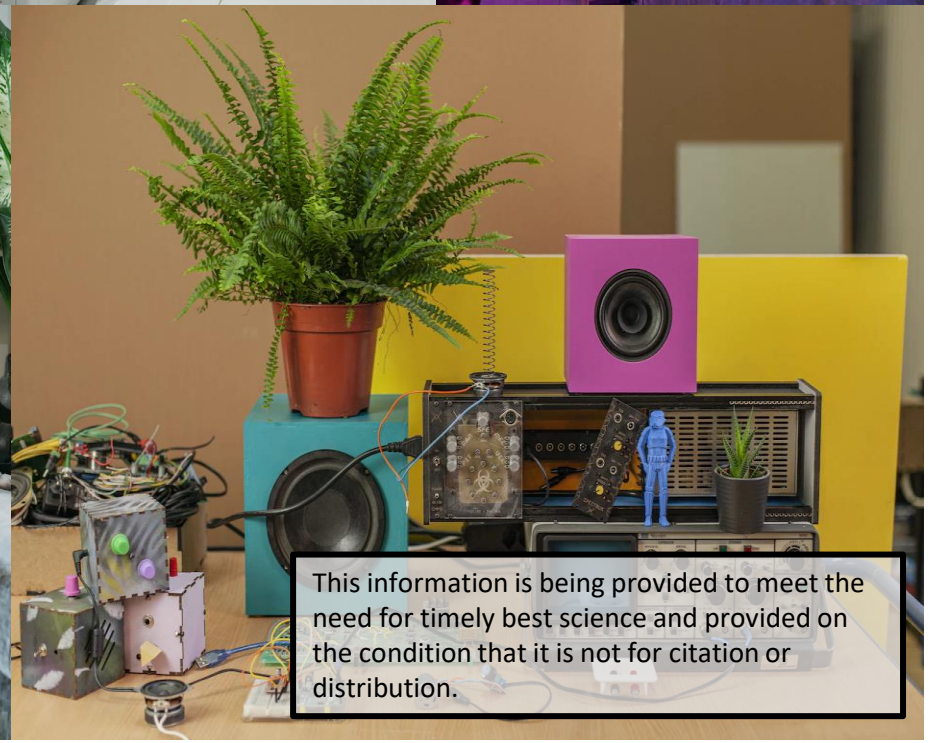
EECEF, Electronics manufacturing facilities

Figure from: Breitmeyer et al. (2023).

Electronic & Other Electrical Equipment & Components (Except Computer Equipment):

- Electrical industrial apparatus
- Household appliances
- Electrical lighting & wiring
- Radio & television
- Phones
- Electronic components & accessories





Total PFAS Yield

Excluded:

- Development
- Highest outlier site

WPCF, water pollution control facilities
CSO, combined sewage overflow outfall

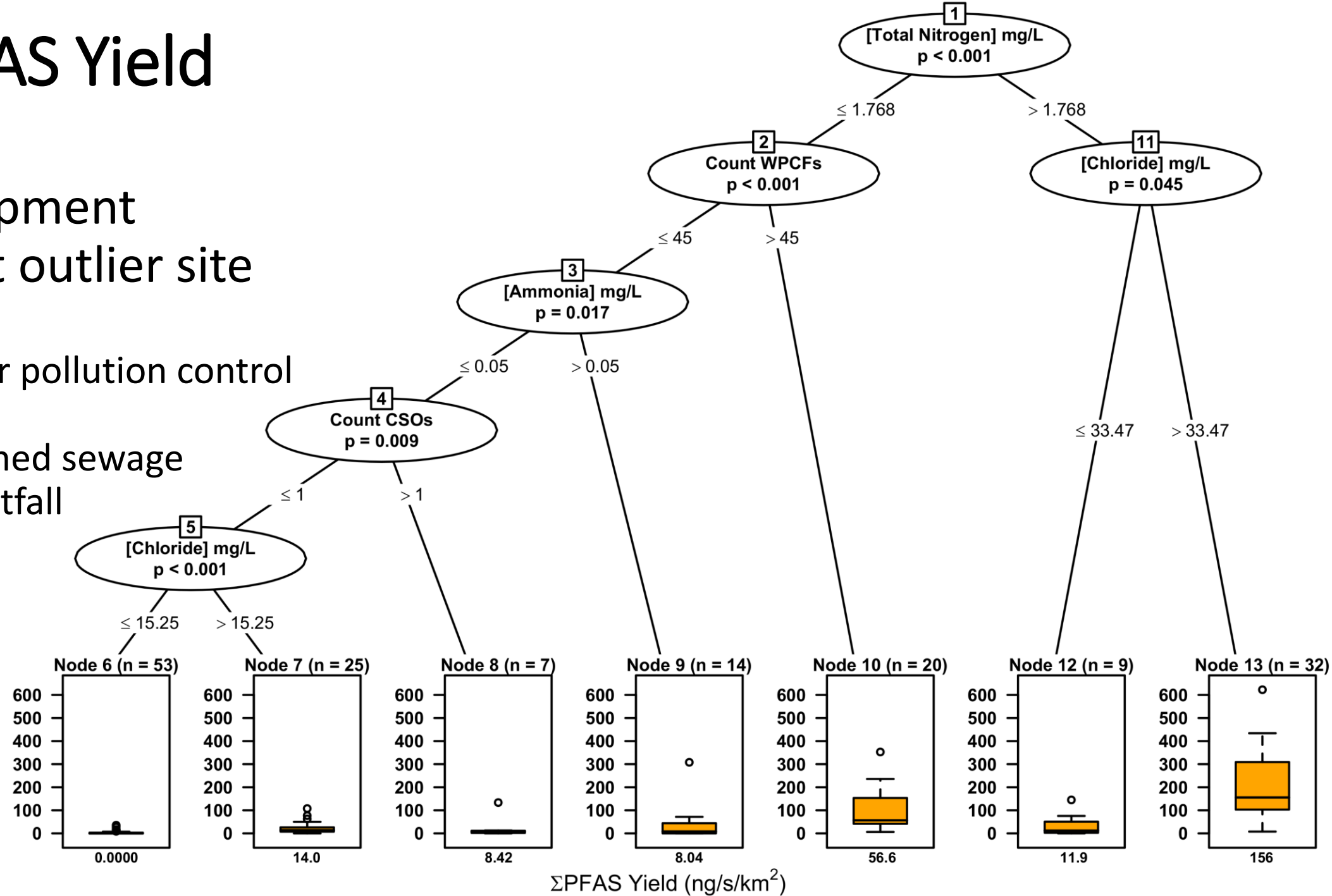
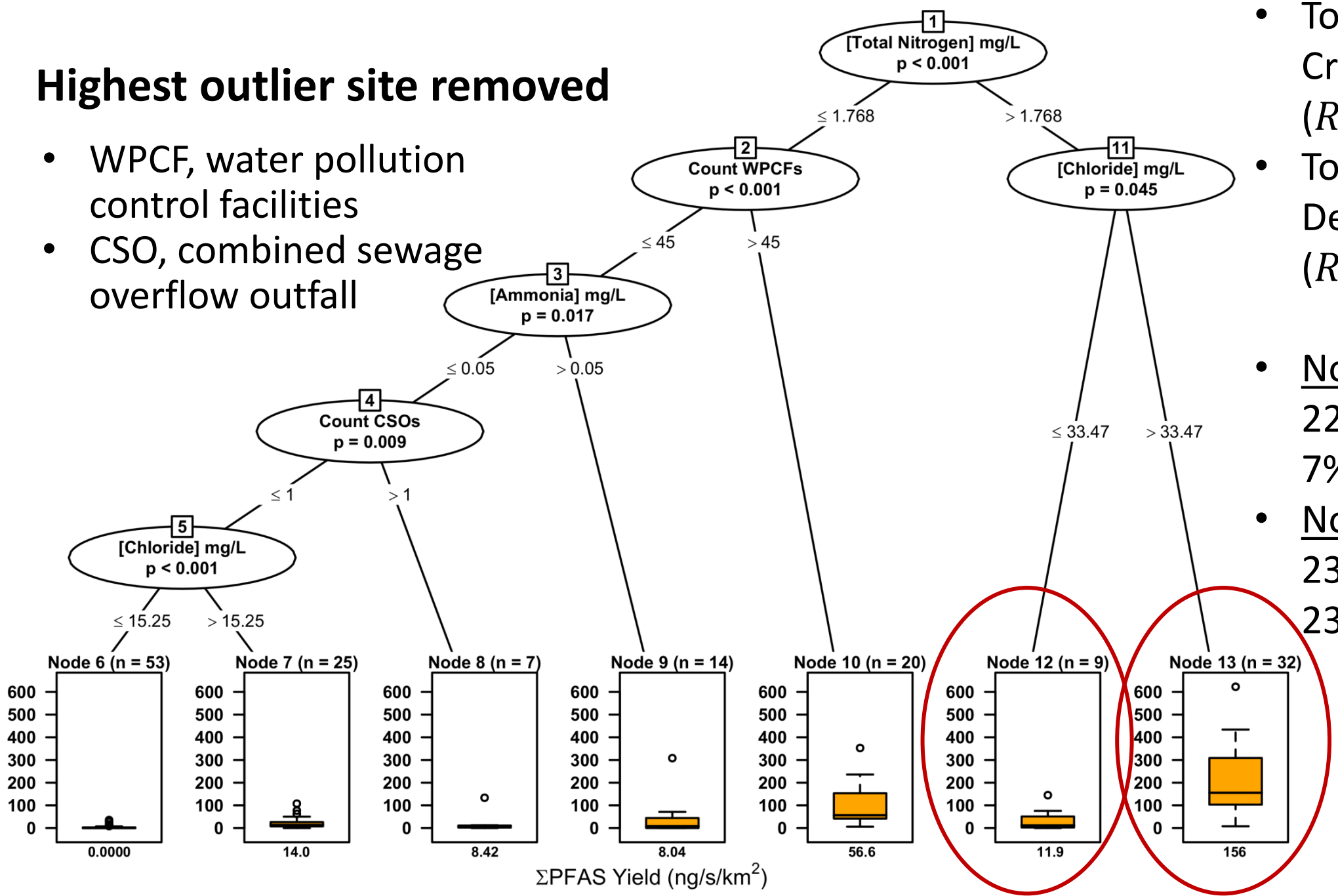


Figure from: Breitmeyer et al. (2023).

Highest outlier site removed

- WPCF, water pollution control facilities
- CSO, combined sewage overflow outfall



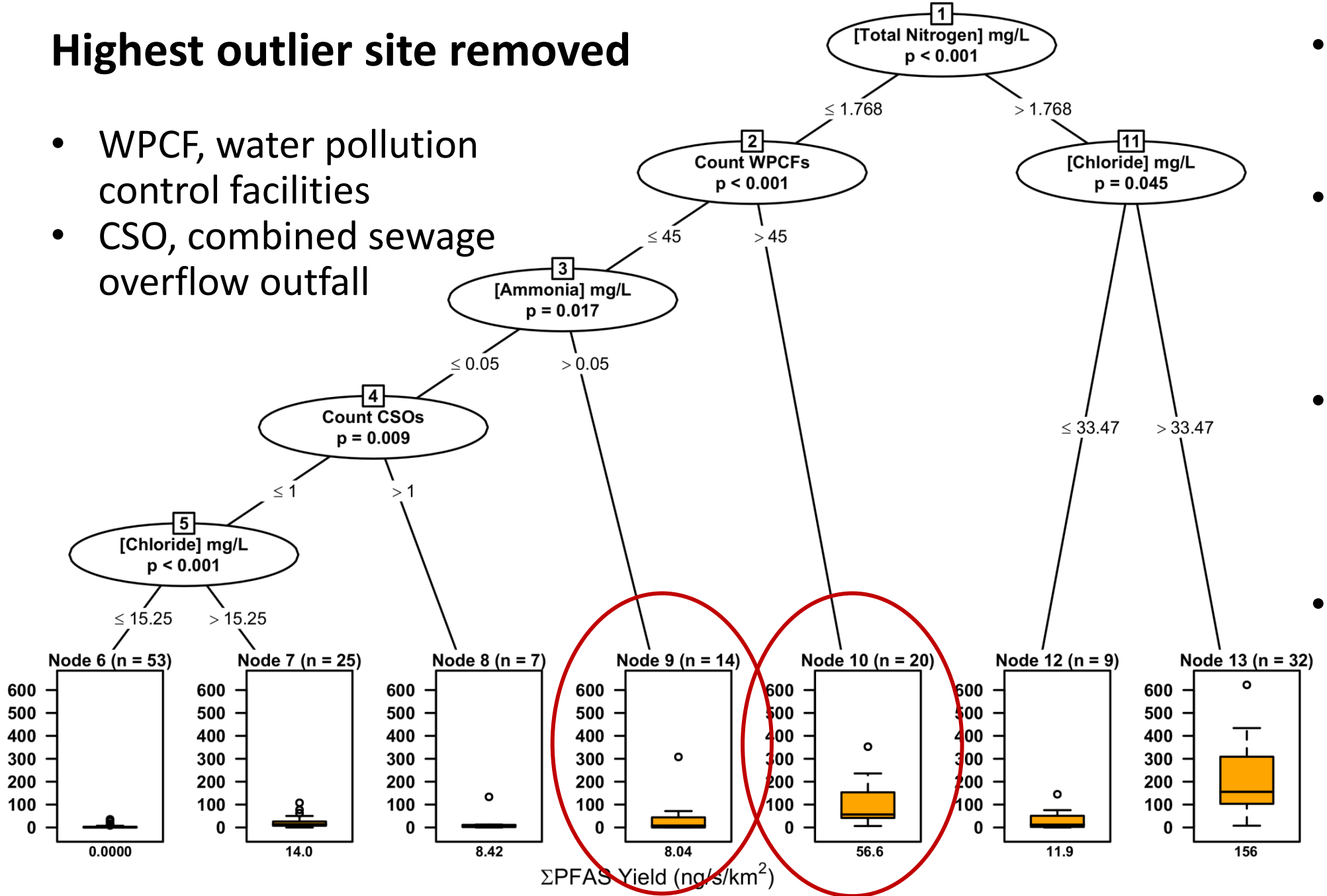
- Total PFAS & Cropland (R^2=0.35, p<0.001)
- Total PFAS & Development (R^2=0.77, p<0.001)

- <u>Node 12:</u>
  22% Cropland
  7% Developed
- <u>Node 13:</u>
  23% Cropland
  23% Developed

Figure from: Breitmeyer et al. (2023).

Highest outlier site removed

- WPCF, water pollution control facilities
- CSO, combined sewage overflow outfall

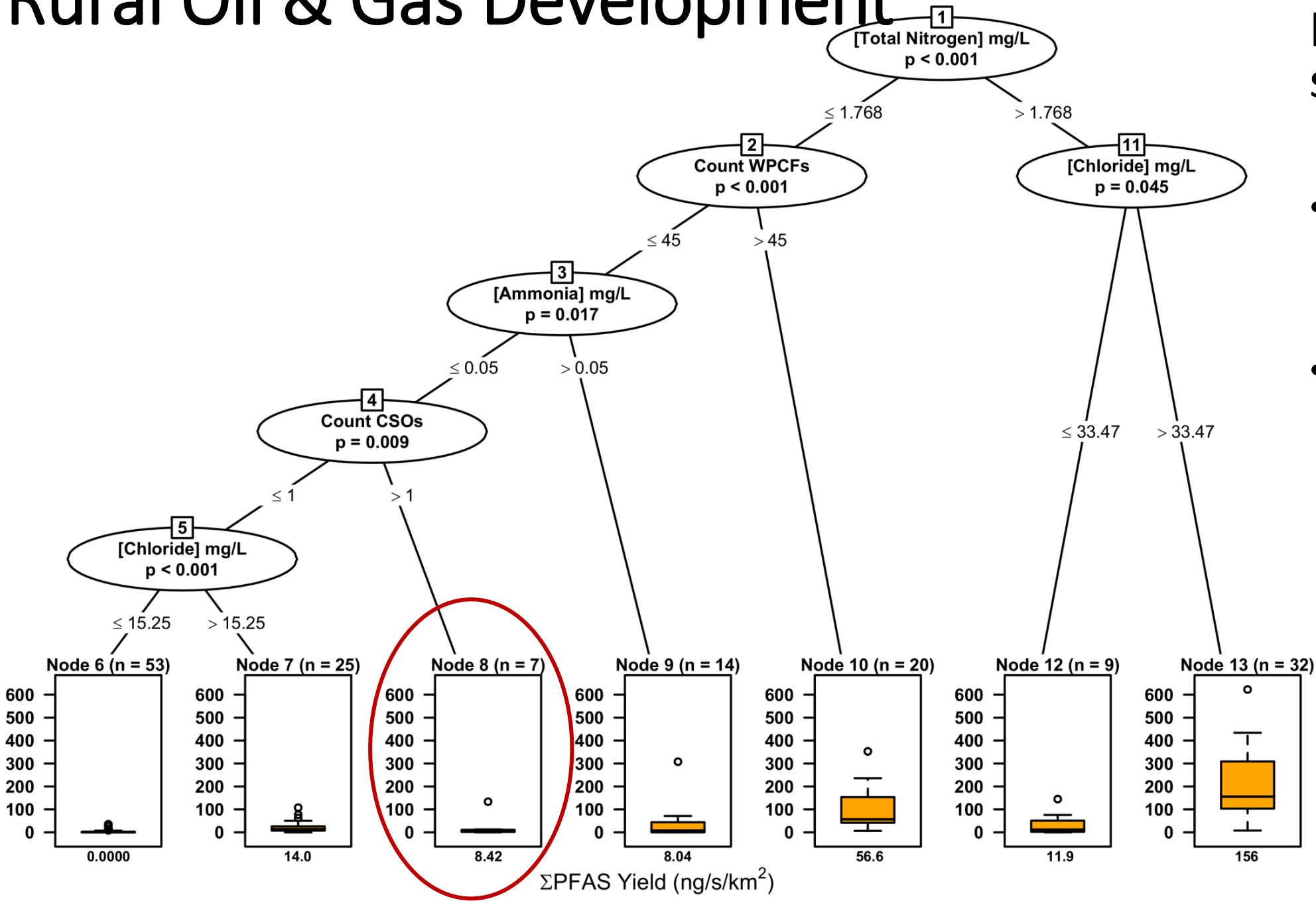


- Total PFAS & Cropland (R^2=0.35, p<0.001)
- Total PFAS & Development (R^2=0.77, p<0.001)

- <u>Node 9:</u>
  8% Cropland
  7% Developed
  (86% Open Space)
- <u>Node 10:</u>
  12% Cropland
  9% Developed

Figure from: Breitmeyer et al. (2023).

Rural Oil & Gas Development

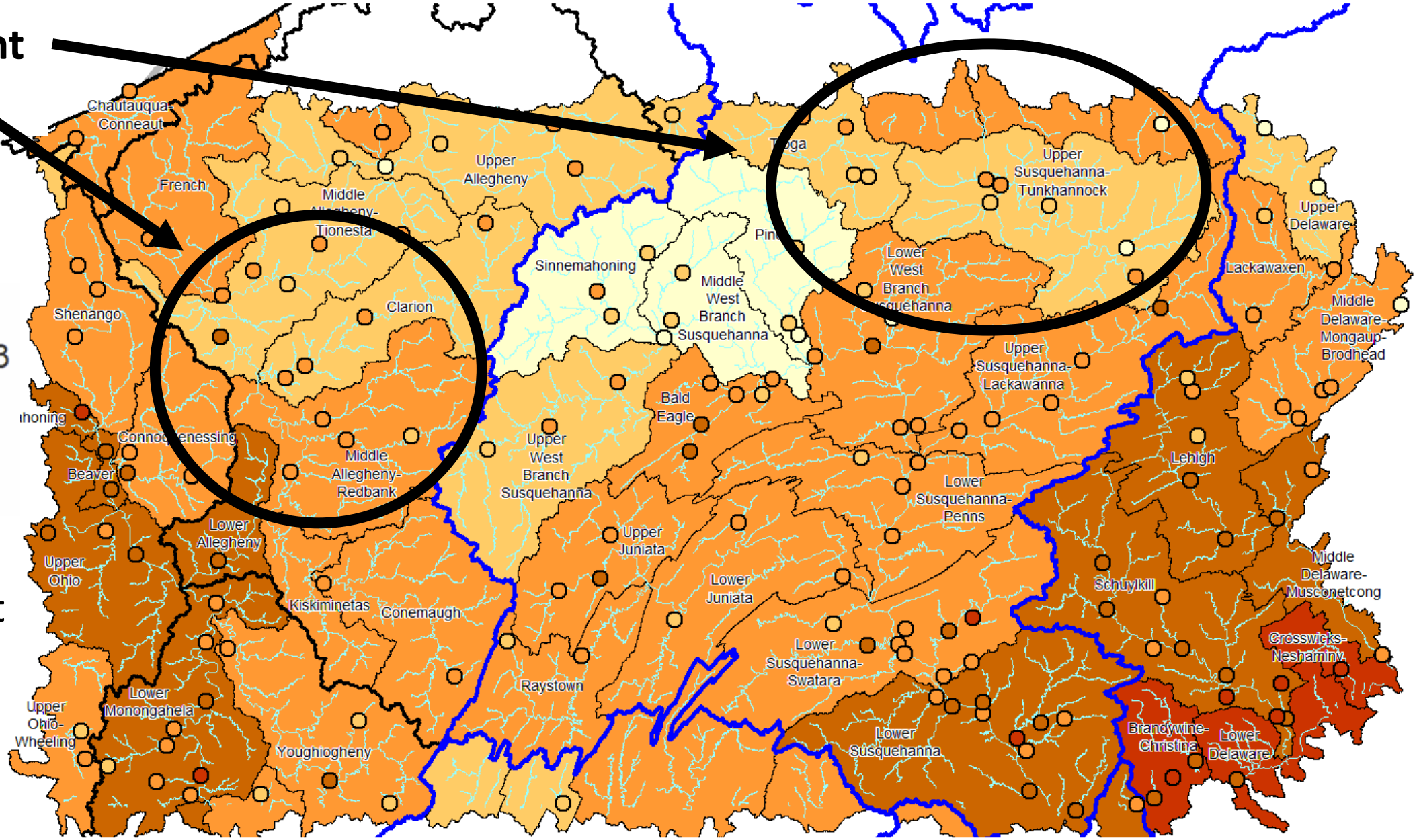


Highest outlier site removed

- WPCF, water pollution control facilities
- CSO, combined sewage overflow outfall

Figure from: Breitmeyer et al. (2023).

Oil & Gas Development Regions



Streams Total PFAS Yield

- No Detections
- 0.000001 - 1.23
- 1.24 - 87.1
- 87.2 - 352
- 353- 1127

Watershed % Development

- 3.4 - 4.6
- 4.7 - 6.9
- 7.0 - 19.3
- 19.4 - 33.3
- 33.4 - 64.2

USEPA Drinking Water Human Health Criteria (ng/L)		
	Interim Health Advisory Level (HAL)	**Proposed Maximum Contaminant Level (MCL)**
PFOA	0.04	4.0
PFOS	0.02	4.0
PFNA	--	1.0 (unitless) Hazard Index
PFHxS	--	
PFBS	2000	
Gen-X	10	

$$\text{Hazard Index} = \left(\frac{[\text{GenX}_{\text{water}}]}{[10\ \text{ppt}]}\right) + \left(\frac{[\text{PFBS}_{\text{water}}]}{[2000\ \text{ppt}]}\right) + \left(\frac{[\text{PFNA}_{\text{water}}]}{[10\ \text{ppt}]}\right) + \left(\frac{[\text{PFHxS}_{\text{water}}]}{[9.0\ \text{ppt}]}\right)$$

Values from: USEPA (2022) & USEPA (2023).

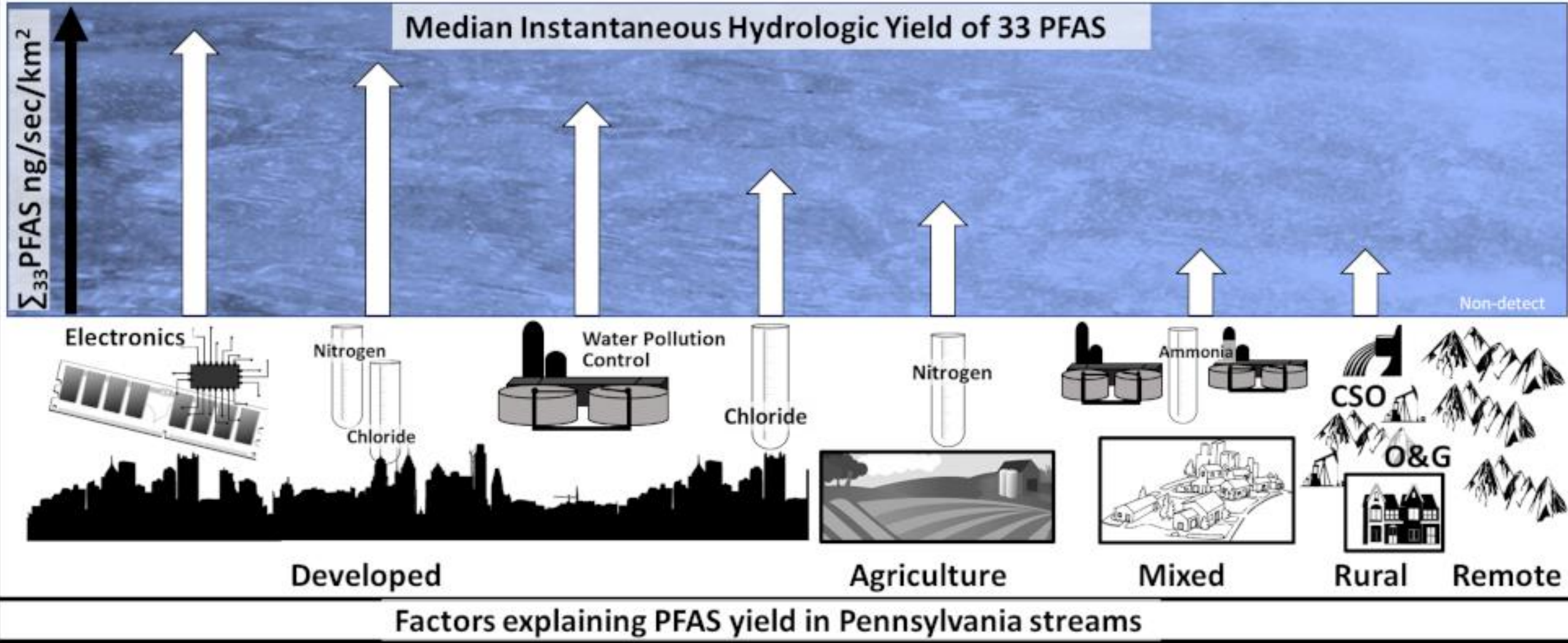


Figure from: Breitmeyer et al. (2023).

Thank You

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References

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