Water Cooler Talk: PFAS & 6-PPDq in the Delaware River Basin

Penn State Master Watershed Stewards Webinar
August 25, 2025

Jeremy L. Conkle, Ph.D., Sr. Chemist/Toxicologist
Elizabeth Koniers Brown, Director of External Affairs

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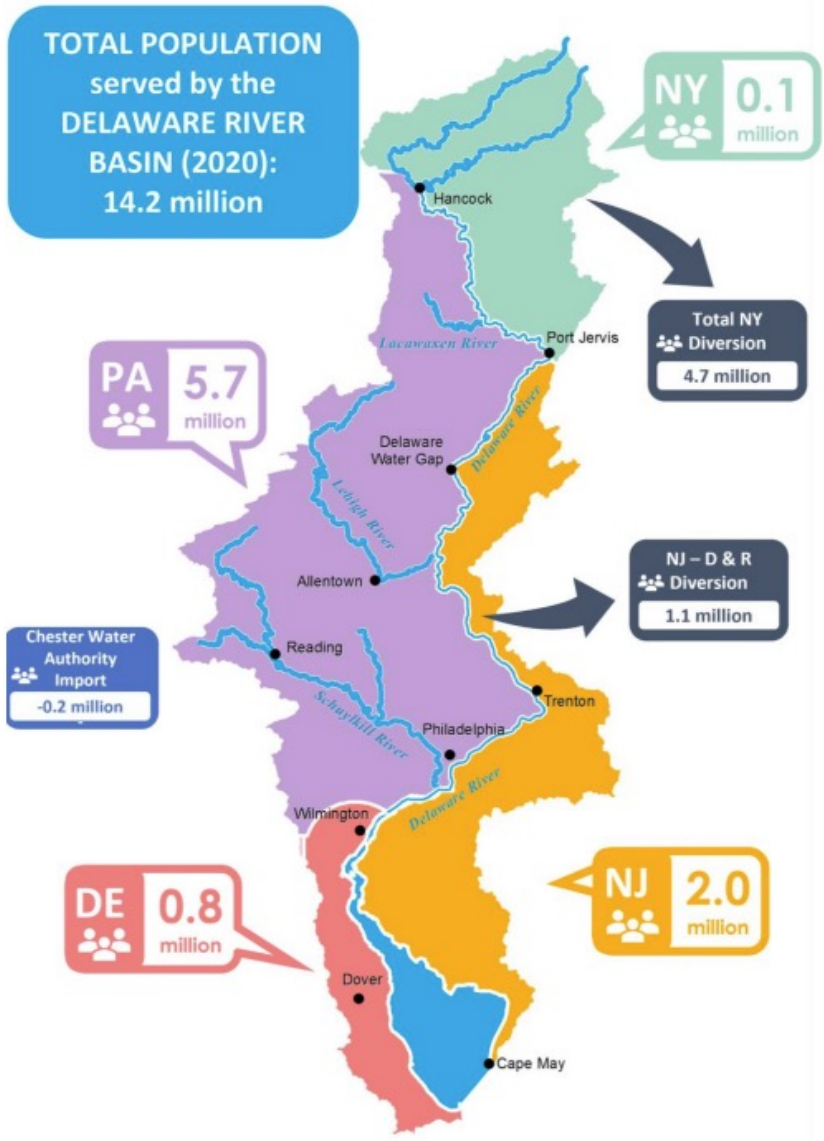
The Delaware River

- 330 miles
- 13,500 sq. mi. watershed
- Free-flowing mainstem
- Tidal from ocean to Trenton
- Unique habitats & communities

The Delaware River Basin meets our needs.

- 14+ million people in four states
- Half of NYC drinking water
- $21+ billion in economic value
- Interstate boundary



The Delaware River Basin Commission is a federal-interstate government agency.

Our Mission

Manage, protect, and improve the water resources of the Delaware River Basin.

Our Vision

Provide trusted, effective, and coordinated management of the Basin's shared water resources.

DRBC's programs cover two broad categories.

FLOW

1

An adequate and sustainable supply of water

WATER QUALITY

2

Clean and healthy water resources

Contaminants of Emerging Concern

Today we'll focus on two contaminants of emerging concern.

- Recently discovered
- Potential impact on human or aquatic life
- No or draft regulatory standard
- Includes PFAS & 6-PPDq

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The following slides describe ongoing staff research as of August 23rd, 2025, and do not necessarily reflect policies or proposals of the Delaware River Basin Commission.

This presentation is provided as a contribution to an ongoing dialogue in the spirit of advancing collective understanding of environmental processes.

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PFAS in the Delaware River Basin: Preliminary data synthesis

Jeremy L. Conkle, Ph.D., Sr. Chemist/Toxicologist
Matt Amato, Ph.D., Water Resource Scientist

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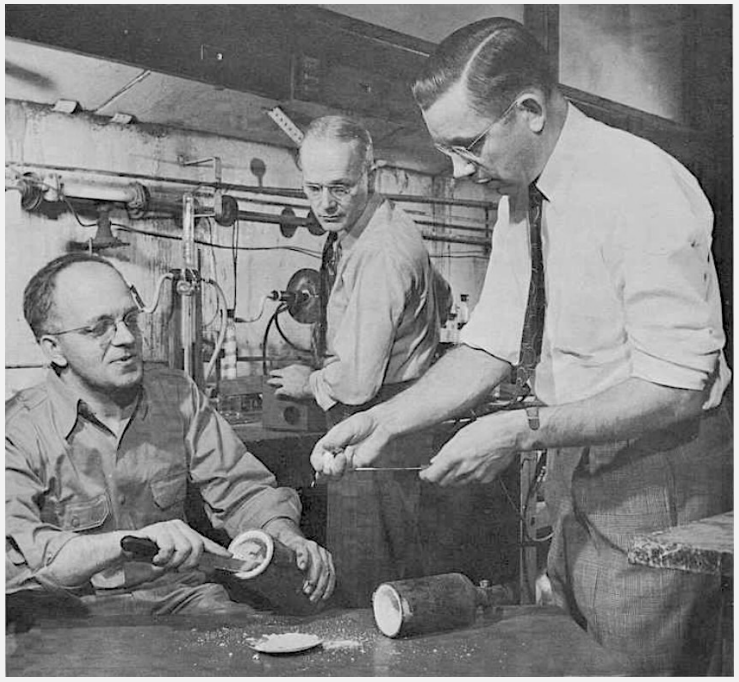
PFAS Got Their Start in the Delaware River Basin

THE DISCOVERY

An "Accident" Derived from Solid Research



DISCOVERY of fluorocarbon polymers in 1938 was made by Dr. Roy Plunkett (*right*),who holds the original patent. Technician Jack Rebok (*left*) helped. Chemist Robert McHarness did early fluorocarbon research. In photograph, Plunkett and Rebok re-enact the discovery at the Jackson Laboratory.

"The Wide World of Teflon"

E.I. du Pont de Nemours & Company, 1963

Hagley Museum & Library
Digital Archives

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PFAS: 13,000+ Diverse Chemicals

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Pros

- Extremely durable
- Water/stain repellent
- Non-stick/low friction
- Smothering fires
- Surfactants
- Other industrial applications

Cons

- Extremely durable
- Ubiquitous
- Mobile in water, but also sticky
- Found in every human
  - Carcinogens, immunosuppressants, thyroid disease, developmental issues, birth defects, …
- Difficult/expensive to treat/remove

Where Did We Get All the PFAS Data?

- Download state and federal data from EPA's PFAS Analytic Tool, the National Water Quality Portal Data, and USGS's Water Data API
  - DRBC uploads all data to the National Water Quality Portal (WQP)
- This effort is only possible because our state (Del, NJ, Pa and NY) and federal (USGS, EPA ORD) partners have also been generating PFAS data from the Delaware River Basin

Water Quality Portal

PFAS Analytic Tools

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PFAS Sampling Numbers

Dataset Sample Counts			
n = 944	**Water**	**Sediment**	**Tissue**
All Samples	***641***	151	152
Non-Tidal	160	25	50
Tidal	***299***	***98***	***82***
Bay	182	28	20

- Water samples dominate dataset (68%)
  - Need more multi-matrix sampling
- Tidal samples account for 51% of samples (Trenton through Wilmington)
  - Focused on region with the most PFAS

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All of Our Data, So Far...

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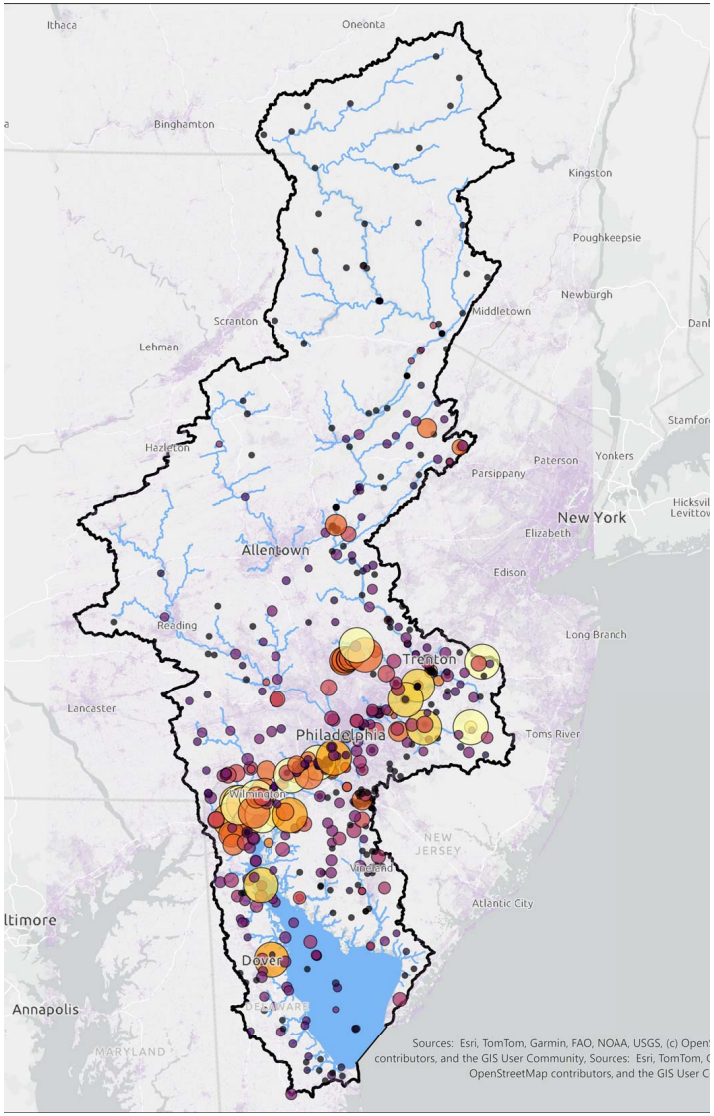
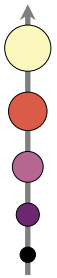


Concentration
parts per-trillion (ppt)

High



Low

WATER CRITERIA:
PFOS, PFOA, PFBS

	Draft EPA Human Health Water Quality Criteria	
	Water + Organism ($ng\ L^{-1}$; ppt)	Organism Only ($ng\ L^{-1}$; ppt)
PFOA	0.0009	0.0036
PFOS	0.06	0.07
PFBS	400	500

EPA Draft Human Health Water Quality Criteria December 2024

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WATER CRITERIA:
PFOS, PFOA, PFBS

	Draft EPA Human Health Water Quality Criteria		Presence in Delaware River Watershed Surface Water Samples	
	Water + Organism (ng L^{-1}; ppt)	Organism Only (ng L^{-1}; ppt)	% Detection	Concentration (Avg ± StDev; ng L^{-1})
PFOA	0.0009	0.0036	93.7 (n=632)	7.38 ± 19.70
PFOS	0.06	0.07	90.7 (n=622)	4.75 ± 10.10
PFBS	400	500	81.5 (n=605)	3.15 ± 3.40

EPA Draft Human Health Water Quality Criteria December 2024

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PFOA in Surface Water

- Below Detection
- ~~Below ***Draft*** Human Health Criteria~~
- Above ***Draft*** Human Health Criteria
- Above Maximum Contaminant Level
- >4x Maximum Contaminant Level

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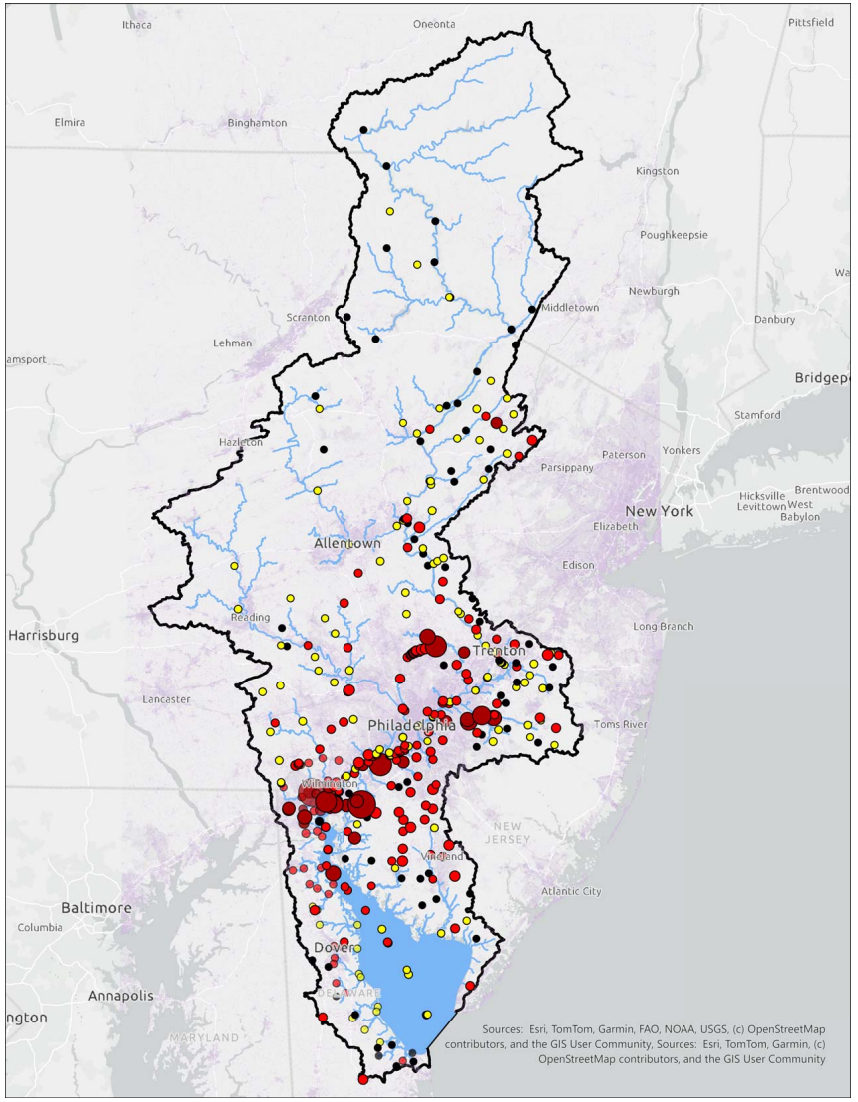

PFOS in Surface Water

- Below Detection
- ~~Below ***Draft*** Human Health Criteria~~
- Above ***Draft*** Human Health Criteria
- Above Maximum Contaminant Level
- >4x Maximum Contaminant Level

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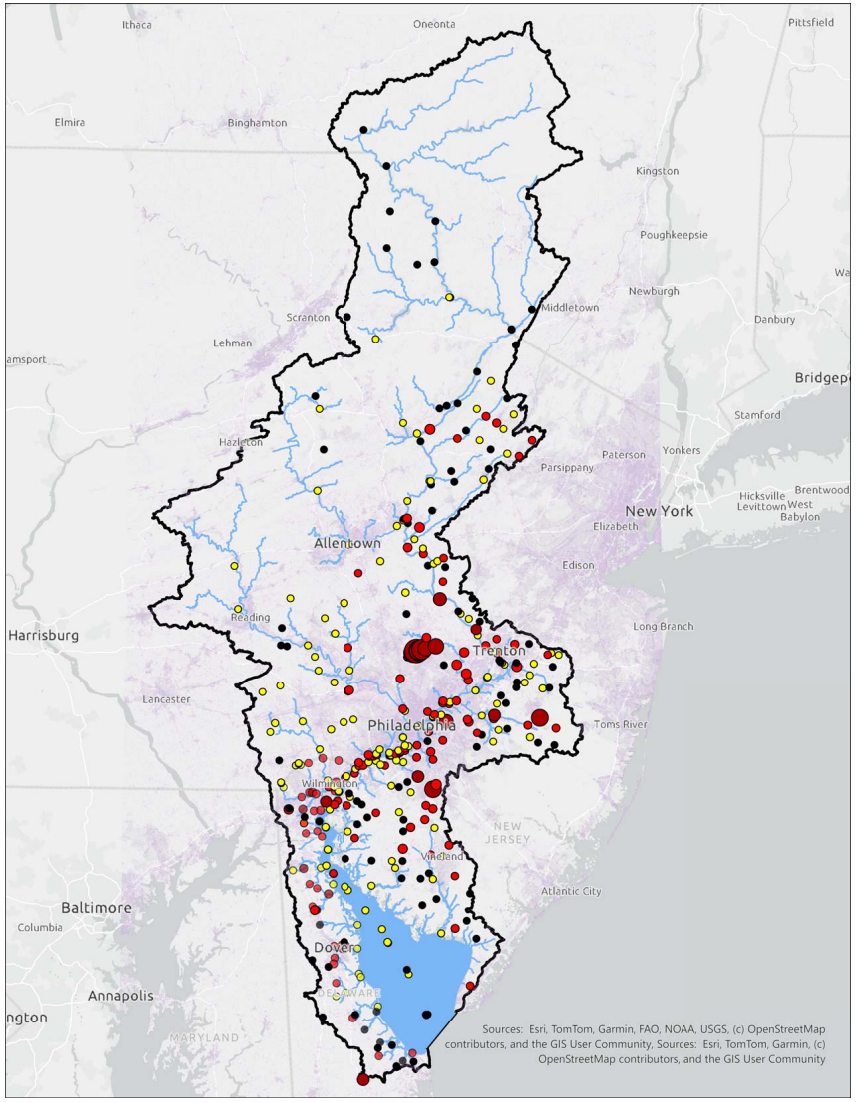

DRBC's Plans

- Currently
  - Wrapping up ongoing PFAS studies
  - Building and checking the 20-year dataset
- Goals
  - Determining hotspots and trends
  - Find and close gaps in the data that are needed to determine sources
  - Locate PFAS sources
  - Work with states to reduce loading and cleanup hotspots
  - Create a regularly updated web app to view PFAS data in the basin

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PFAS is a persistent problem in the Delaware River Basin. DRBC is working to better understand PFAS trends and locate sources to reduce this pollution in our basin.

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6-PPDq in the Delaware Basin

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Gangadhar Andaluri, Ph.D., Temple University
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Death by dirty water: Storm runoff a risk for fish

POULSBO, Wash. -- Just hours into the experiment, the prognosis was grim for salmon that had been submerged in rain runoff collected from one of Seattle's busiest highways. One by one, the fish were removed from a tank filled with coffee-coloured water and inspected: They were rigid. Their typically red gills were gray.

"He's way dead," David Baldwin, a research zoologist with the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center, declared at the four-hour mark.

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Monday, November 17, 2014

AP

Tire Wear Particles

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What Makes Tire Wear Particles Toxic?

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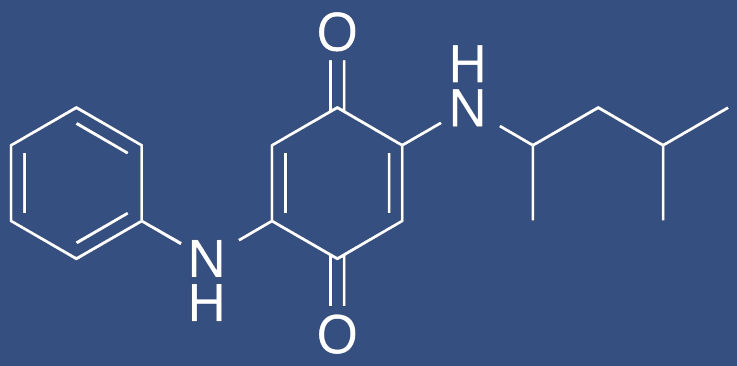
6-PPD & 6-PPDq: *Background and Properties*



- 6-PPD is used in tires and other rubber car parts
- 6-PPDq environmental behavior & properties not well known
  - Solubility 0.67 mg L^{-1}
  - Half-life in water is 33 hrs
  - Bonds with sediment

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6-PPDq Toxicity… so far

Common Name	Species	LC_{50} (ng L^{-1})	Test Duration	Endpoint	Reference
		41	24h	Mortality	(Lo et al. 2023)
Coho Salmon	Oncorhynchus kisutch	80.4	24h	Mortality	(Greer et al. 2023)
		95	24h	Mortality	(Tian et al. 2022)
Brook Trout FRY	Salvelinus fontinalis	200	24h	Mortality	(Philibert et al. 2024)
Brook Trout	Salvelinus fontinalis	590	24h	Mortality	(Brinkmann et al. 2022)
		640	96h	Mortality	(Nair et al. 2023)
Rainbow Trout	Oncorhynchus mykiss	1000	96h	Mortality	(Brinkmann et al. 2022)
		2260	96h	Mortality	(Di et al. 2022)
Brown Trout	Salmo trutta	> 12160	48h	Mortality	(Foldvik et al. 2022)

Not yet published USGS Study by David Soucek – Columbia, MO
3 week old Brook Trout: 96 hr LC_{50} = 90 ng L^{-1}

ITRC (Interstate Technology & Regulatory Council). 2024. 6PPD & 6PPD-quinone **Table 2-1**. Washington, D.C.: Interstate Technology & Regulatory Council, Tire Anti-degradant (6PPD) Team. www.itrcweb.org.

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Studying 6-PPDq in the Delaware River Basin

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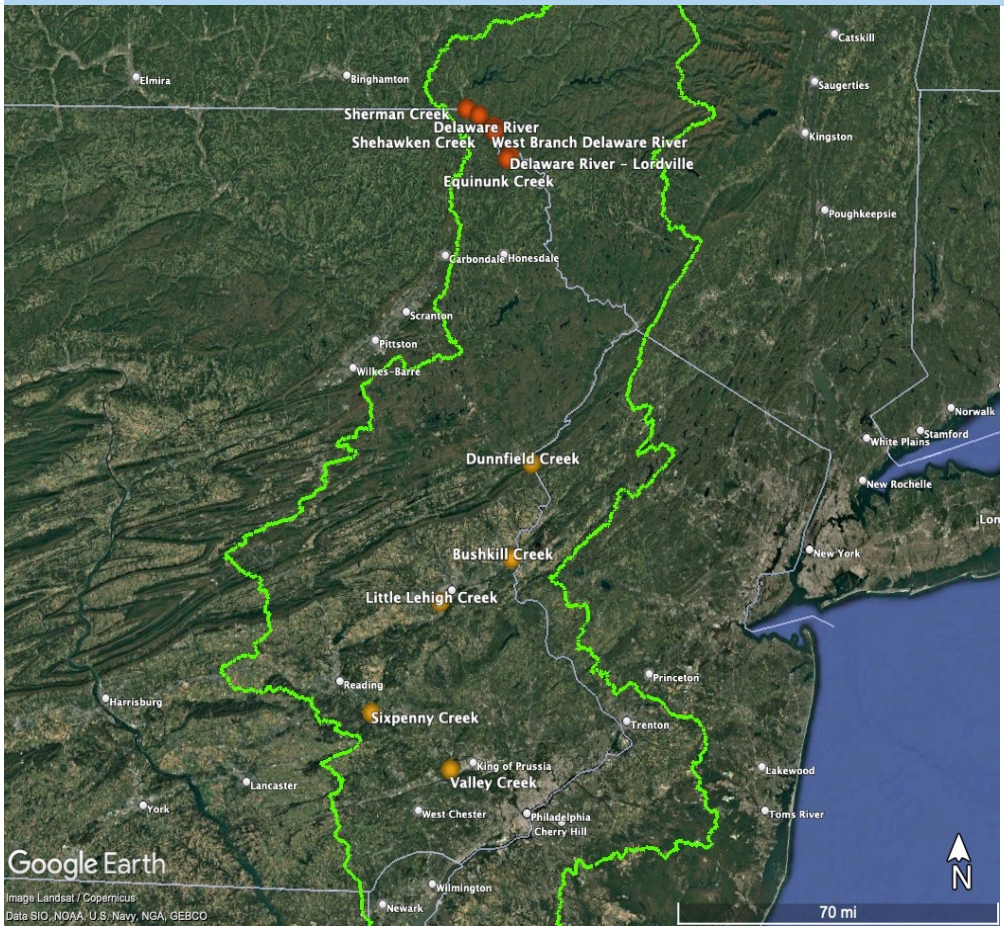
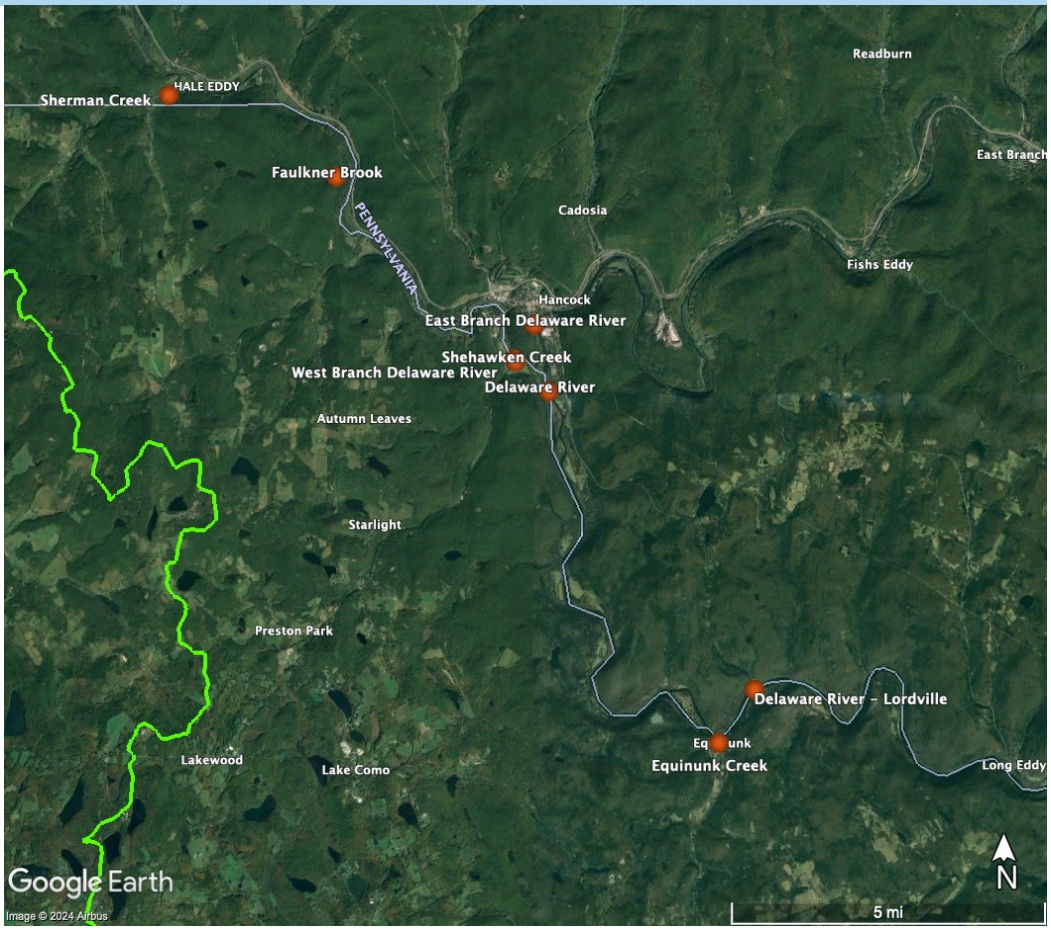
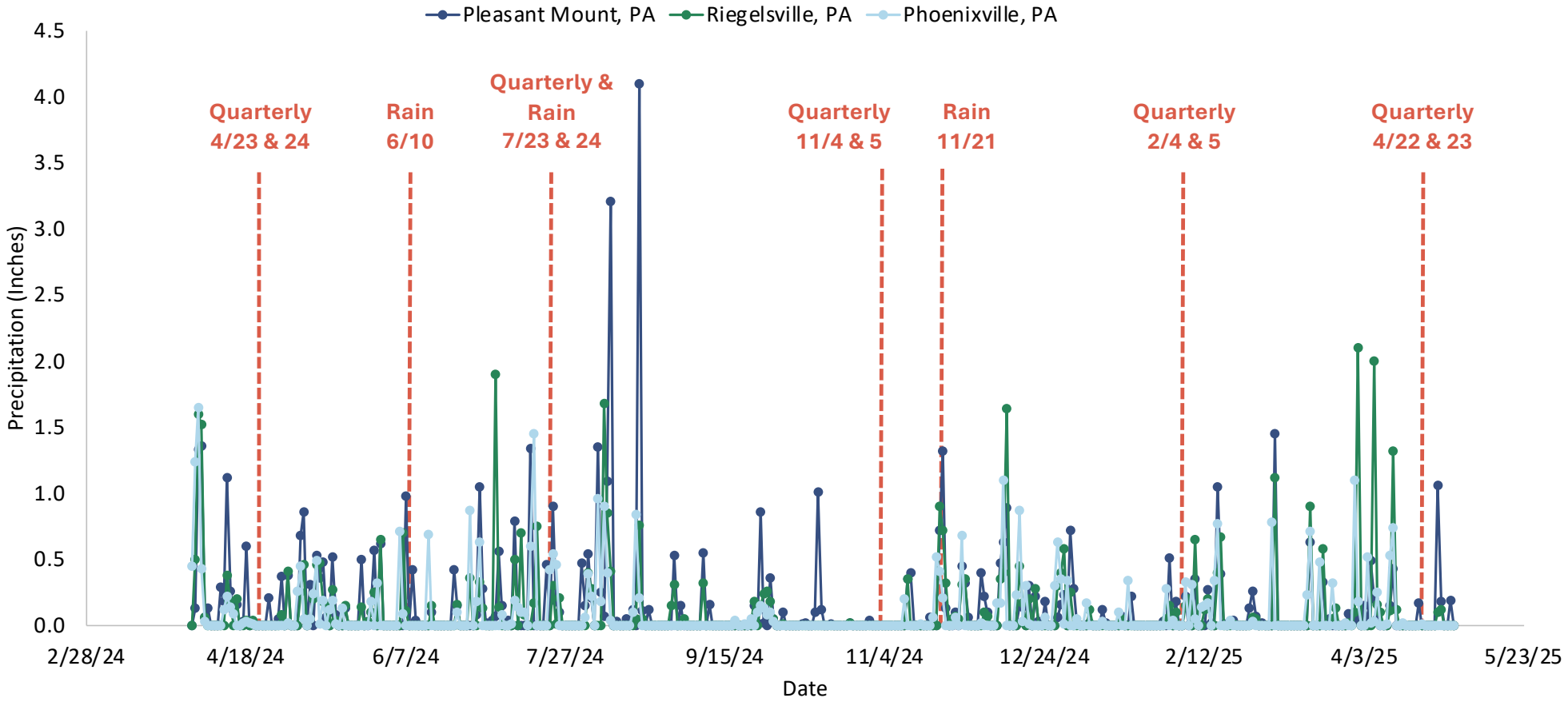




Precipitation During the Study



Valley Creek Stands out

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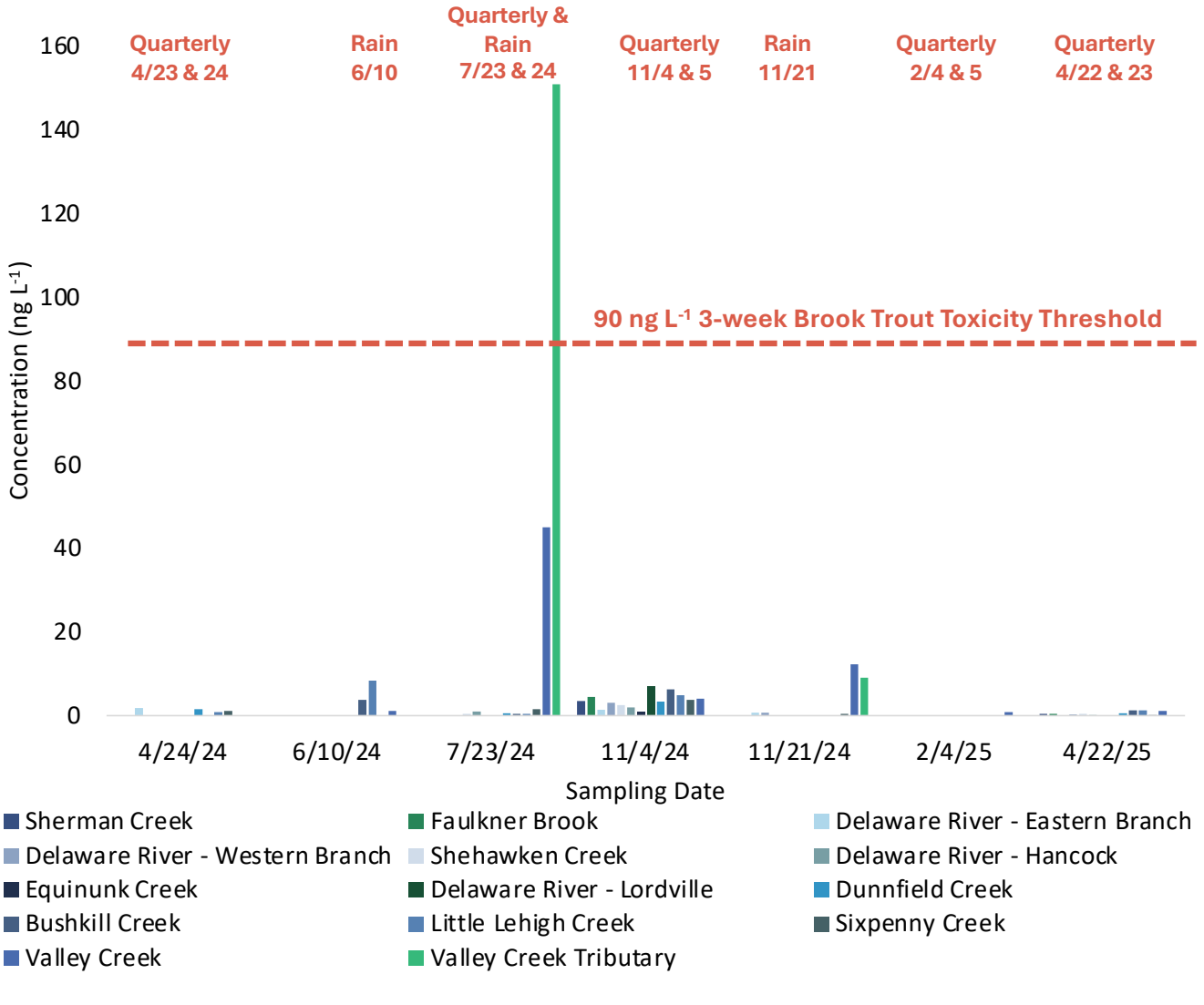
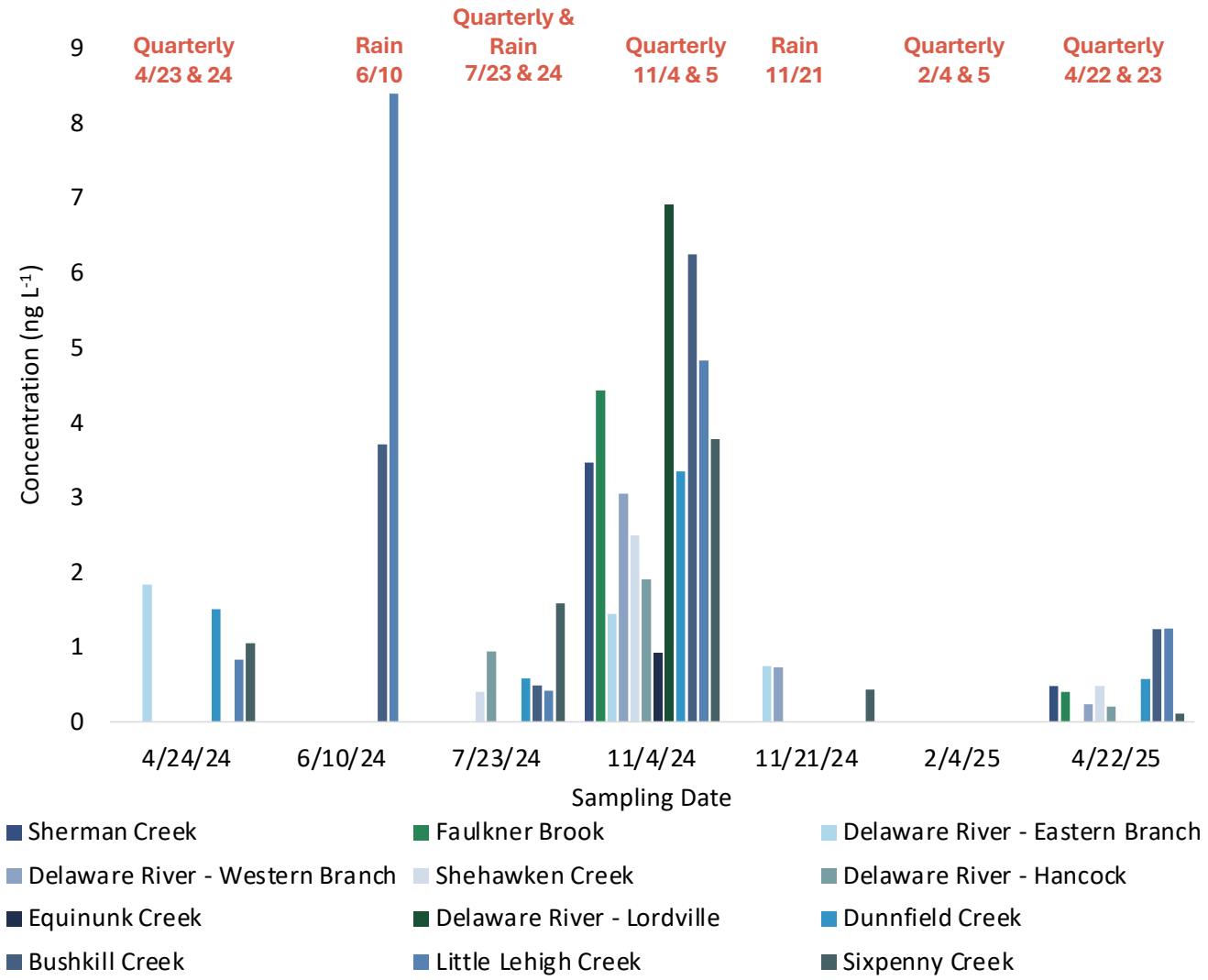


6-PPDq Was Found at Every Site



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Present, but largely below Toxicity Thresholds

- Concentrations varied, but nearly all were well below known acute toxicity thresholds
- Valley Creek was the outlier during wet weather
  - Avg: 19 ng L^{-1}, but ranged from 0.86 to 44.97 ng L^{-1}
- 6-PPDq was found at every site sampled
  - 49% detection during dry weather
  - 70% detection during wet weather
- 6-PPDq Basin Averages
  - Dry: 2.2 ± 1.9 ng L^{-1}
  - Wet: 1.7 ± 2.4 ng L^{-1} (excluding Valley Creek)

Additional Points & Future Efforts

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- During November drought, 6-PPDq detected at every site
  - Reason Unknown
  - Background concentration not diluted below detection?
- Sublethal toxicity thresholds are not well known
- Future
  - Planning a study for additional streams using a USGS tool that scores watersheds based on 6-PPDq threat

https://geonarrative.usgs.gov/6ppdqsourcedashboard/

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6-PPDq is present daily, but not at acute levels. Stormwater events could temporarily spike concentrations to levels of concern in the lower basin. We still have a lot to learn, especially about sub-lethal toxicity thresholds.

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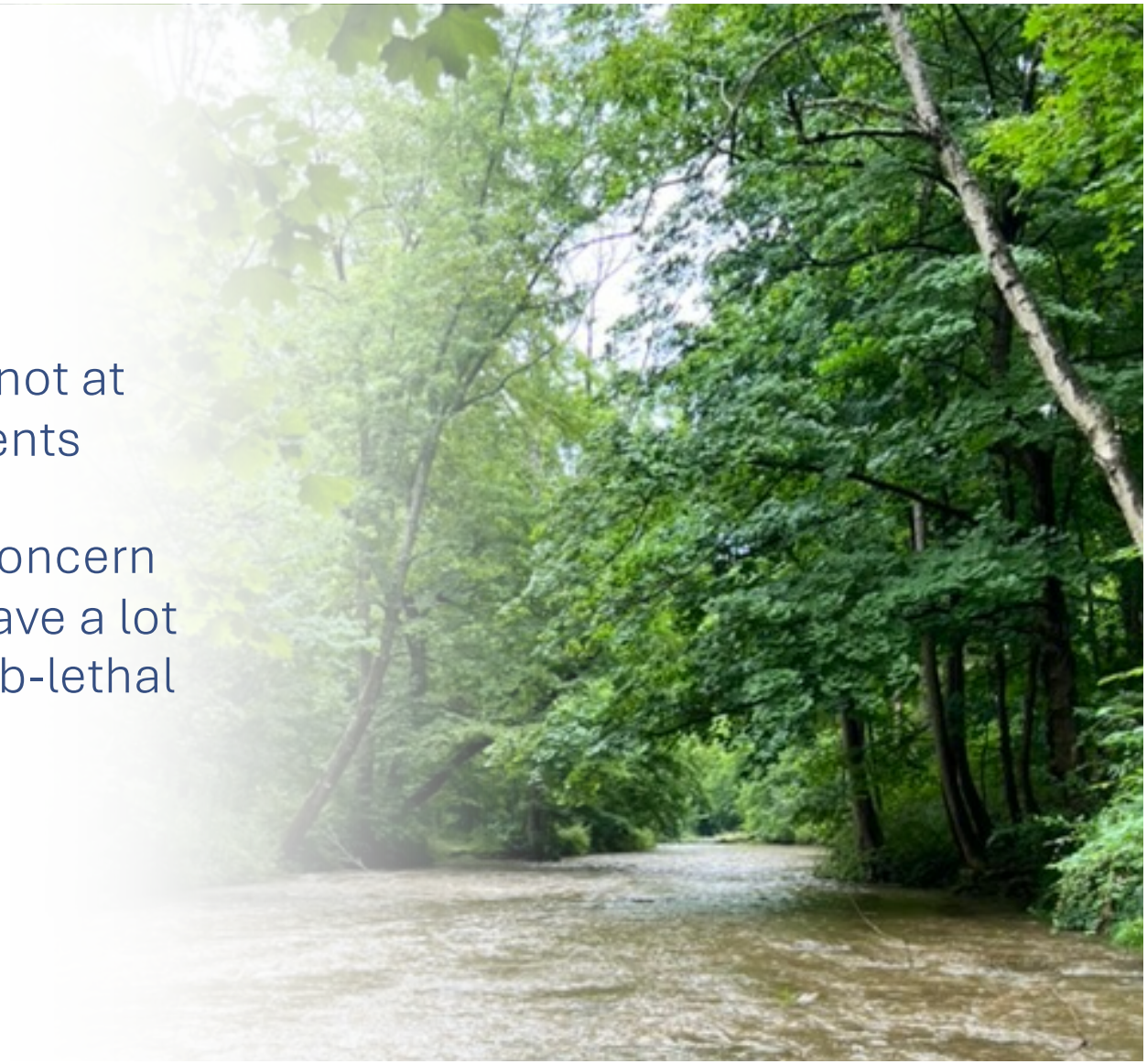

DRBC PFAS Website

DRBC 6-PPDq Website

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Thank you to our funders:

- 6-PPDq
  - National Fish & Wildlife Foundation (NFWF), Delaware Watershed Conservation Fund (DWCF)
- PFAS
  - NFWF DWCF (x3)
  - PA Coastal Zone Management
  - Partnership for the Delaware Estuary Bipartisan Infrastructure Law
  - USEPA Water Pollution Control (Section 106) Grants

Thank you for the support:

- DRBC Staff: Elaine Panuccio, Jake Bransky, Ron MacGillivray, Bailey Adams, Avery Lentini, Beth Brown, Amber Munchback, Sum Harris, Carl Bargery, Kyle McAlister