Long-term PFAS Monitoring in the Delaware River and Tributaries

Partnership for the Delaware Estuary Science Summit
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DRBC and other agencies have collected PFAS data in the Delaware Basin for ~20 years. Most of that work has been done in the last few years, as scrutiny of PFAS has dramatically increased, and we are still assessing those results. Next steps will be to draft a roadmap on how to reduce loading into the Delaware River Basin. In this presentation, I will show you the high-level preliminary results of our efforts to look at PFAS in the Delaware River Basin.

The following slides describe ongoing staff research as of February 10, 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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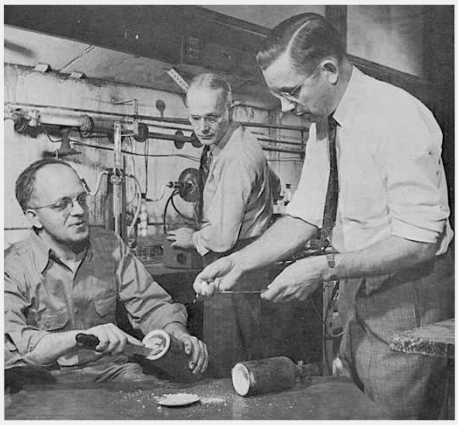
PFAS is a Homegrown Problem

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
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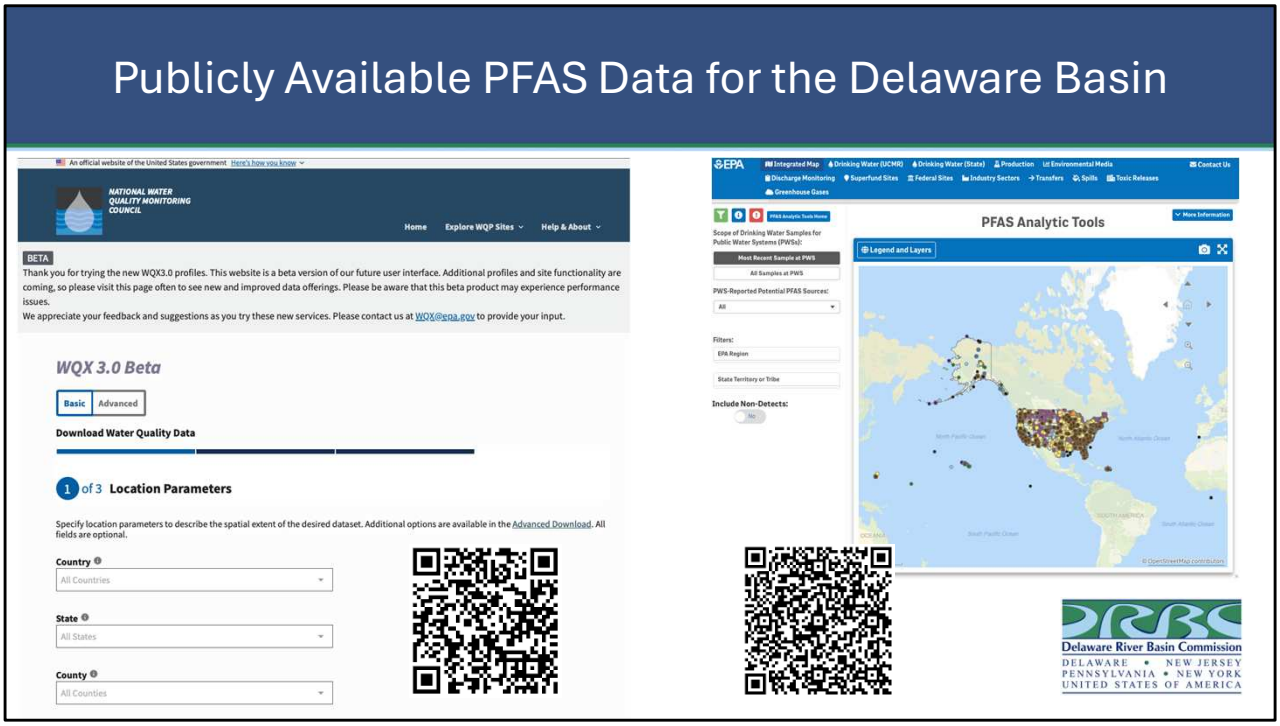
The first fluoropolymer, Teflon (PTFE, polytetrafluoroethylene), was discovered in the Delaware Basin, in a lab at DuPont's Chambersworks by accident in 1938. You can read the whole story that I'm about to summarize by scanning the QR Code, which takes you to a booklet DuPont published in 1963, called the Wide World of Teflon.

These men were exploring a new way to produce "Freon", which is a fluorinated hydrocarbon refrigerant that is no longer in use. They made several gas cylinders of tetrafluoroethylene and stored them in dry ice overnight for processing the next day. When they came back in the morning, the cylinders were no longer pressurized. At first they thought the cylinders might have somehow leaked, but the cylinder masses were the same as when they put them on ice the day before. They cut it open to discover that the tetrafluoroethylene had reacted, forming a white powder that coated the inside of the cylinder. They had polymerized tetrafluoroethylene to polytetrafluoroethylene or PTFE, which would be marketed as Teflon.

So… fast-forward 86 years…. There are an estimated 15,000 PFAS chemicals used in many, many different applications and products. As with many legacy pollutants, some of the properties that make PFAS so useful also make it problematic from an environmental perspective, which is why research has exploded in recent years.

Publicly Available PFAS Data for the Delaware Basin



You can look up data from that research on two publicly available resources shown on this slide.

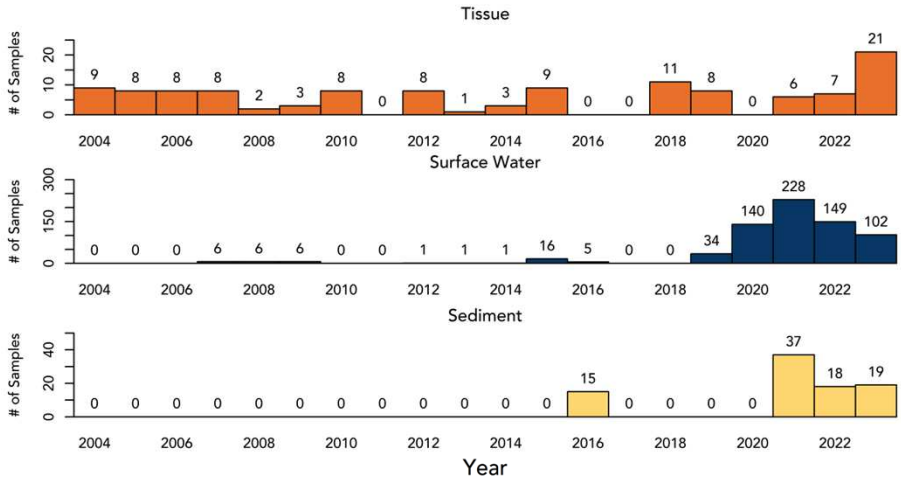
These websites, which you an access via the shown QR codes are tremendous resources that hopefully remain publicly available, and can help you or your organization examine PFAS in your area.

The website on the left is where DRBC uploads all of our data. The USGS, EPA and to some extent, states also provide data here. DRBC data is current through our 2022 sampling for PFAS, and we have more data to upload in the coming months.

On the right is the PFAS Analytic Tools website, which is the most user-friendly of the two. It is a mapper application, so you can visually see what data is available at any location. This website pulls data from all publicly available PFAS sources at regular intervals so that data is always up to date.

So let's look at what data is available for water, sediment and animal tissues in the Delaware River Basin.

PFAS Sampling in the Delaware River Basin



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This data is publicly available in the National Water Quality Portal

These bar graphs show the number of samples collected in the Delaware River Basin that are available in the Water Quality Portal.

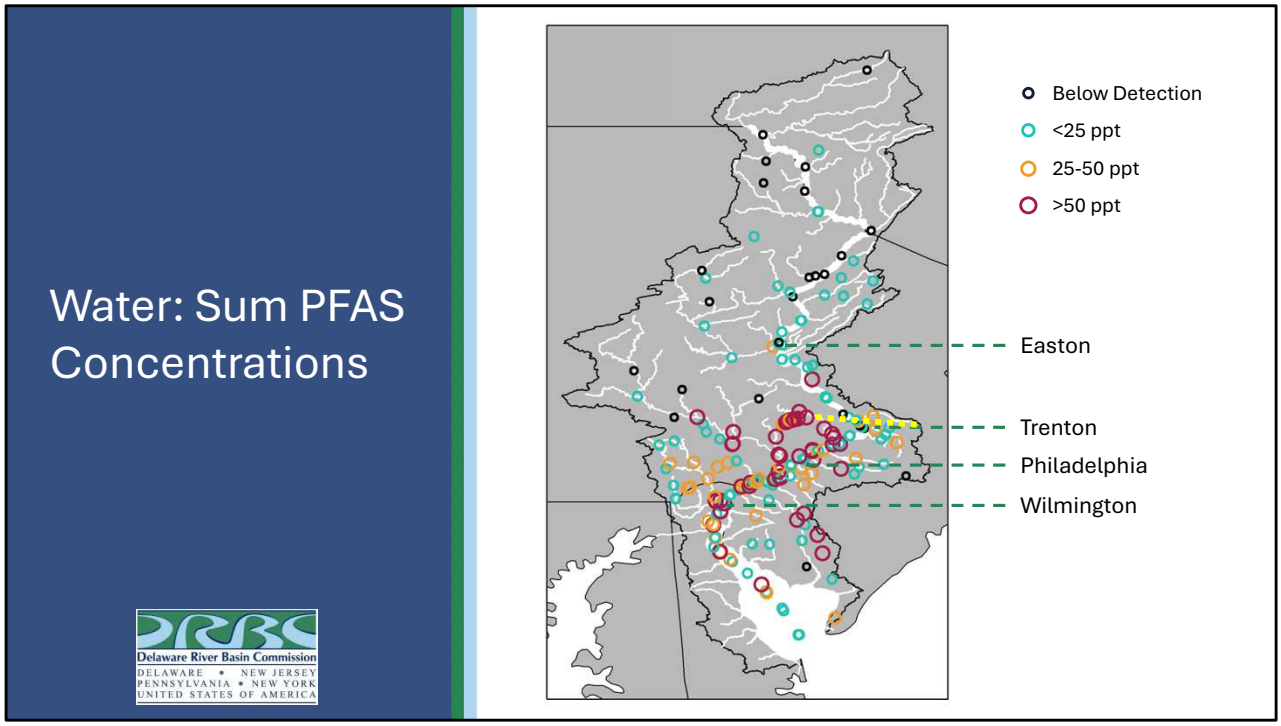
It all started with DRBC fish tissue samples in 2004, and you can see that fish have been frequently sampled, with an increase in 2023.

Water samples were first collected by DRBC in 2007. Little sampling was done until 2019, and sampling has greatly expanded since then.

Last is sediment, which was first sampled 9 years ago in 2016 and has much less data collected. Sediment data is less variable, so you don't need to sample it as much as water.

One thing to note about this data is that samples collected before 2021 have fewer target analytes, typically from 10-15 compounds. Most of this sampling done in 2022 and beyond is using EPA method 1633, which has 40 target analytes.

We are early in the data processing stage. What I will discuss over the next few slides are the big picture things we are seeing in the data.



This map – which also appears on a few upcoming slides – shows the Delaware River Basin, defined by the black line border. The large white line is the mainstem river and the yellow dotted line is the tidal divide. Anything below is tidal and above non-tidal. The Chesapeake Bay is on the bottom left, and Delaware Bay is in the middle bottom.

The map shows surface water concentration ranges at every site where water was collected since 2007. Circles represent sampling sites. If the same site was sampled more than once, the most recent sampling concentration is shown.

Things that stand out to me with this high-level data:

- There are very few black dots representing “below detection” and most of these are in the upper watershed, above the mainstem tidal zone
- Most of the sampling has been done in the estuary, from Trenton south, where most of the PFAS pollution is found.
- Some tributaries are hotspots for PFAS, including the Schuylkill River, Neshaminy Creek and the Christina River.
- This is a broad overview and we are still working through the data to look for relationships, trends and hotspots that we don’t already know.

However, after collecting data over the last 20 years, the actual impact or importance of the information generated is just now coming into focus. What I mean is that we know these chemicals are there, and we know there are impacts, but until there are toxicological guidelines and water quality criteria, the data was lacking important context. With the recent EPA MCL or Maximum Contaminant Level values and the DRAFT Human Health water quality criteria, the PFAS problem, at least for a few of the 15,000 compounds, has come into focus.

WATER:
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})	Lowest Detection (ng L^{-1})
PFOA	0.0009	0.0036	90.4 (n=198)	6.37 ± 8.88	0.94
PFOS	0.06	0.07	84.5 (n=657)	8.88 ± 11.67	0.70
PFBS	400	500	70.0 (n=657)	4.54 ± 2.73	0.80

EPA Draft Human Health Water Quality Criteria December 2024

These DRAFT Human Health Criteria were released in December 2024. These draft values represent concentrations that "will protect the general population from adverse health effects due to ingesting water, fish and shellfish from inland and nearshore water bodies".

What is important to note here is that this is 3 out of ~15,000 compounds, but these are 3 of the compounds with the most data to make an informed decision about their toxicity.

For PFOA and PFOS, their DRAFT criteria is sub nanogram per liter. These are very low concentrations that are below detection limits for contract labs, so it remains to be seen how these values would be implemented. PFBS is much higher.

Let's look at how the concentrations measured in the Delaware River Basin compared to these draft criteria.

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EPA Draft Human Health Water Quality Criteria December 2024

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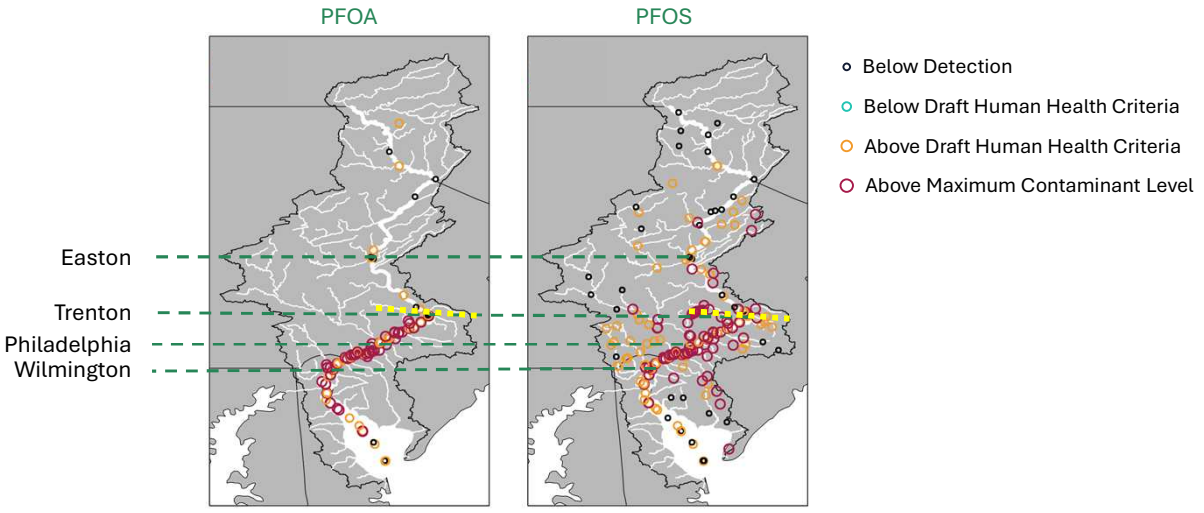
Each of the three compounds was detected in the overwhelming majority of the samples collected. So, they are ubiquitous in the Delaware River Basin. The average concentration of PFOA and PFOS is 2-4 orders of magnitude higher than the draft water quality criteria. Additionally, each detection of PFOA and PFOS was above the draft criteria. However, this is a function of the detection limit limits I previously mentioned.

For PFBS, concentrations were well below the draft water quality criteria.

Water: PFOA & PFOS Summary

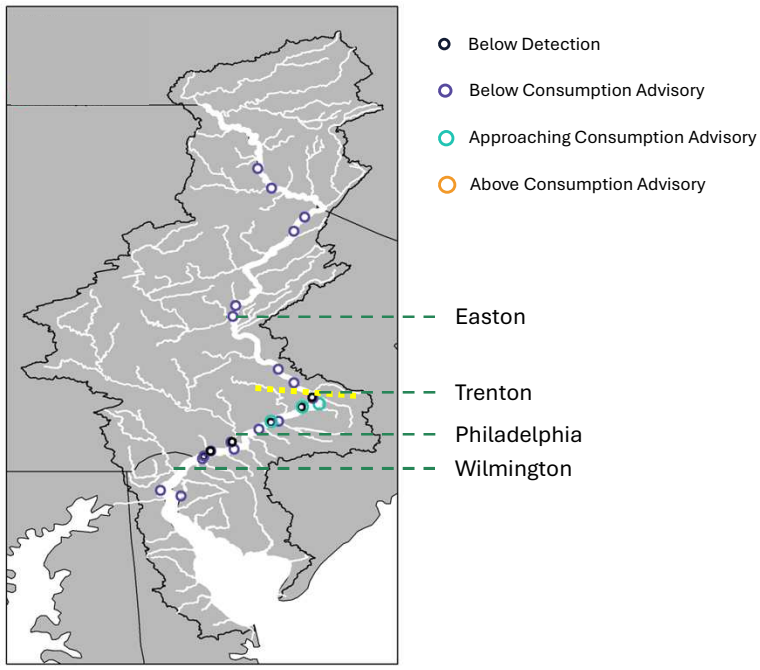


These 2 maps show PFOA and PFOS values from data in the water quality portal. Note how the symbol colors represent water quality criteria values.

There are some black circles located largely up in the Delaware Watershed or tributaries in the lower basin.

There are no light blue circles indicating that all detections are above the draft human health criteria, which is sub nanogram per liter. However, there are also a lot of red circles, which are the MCL (maximum contaminant levels) at 4 nanograms per liter.

Tissue: PFOS Summary



This map shows concentrations based on PFOS consumption advisory levels for PA and NY, which is 200 ppb. New Jersey's value is slightly higher at 204 ppb.

What stands out on this map is that most circles are purple, meaning values are well below consumption advisory levels. There are a few sites with light blue circles (point them out) where values are approaching the consumption advisory level. But there are none where the PFOS concentrations exceed these thresholds.

However, there is one tributary in the Basin where there is a Do-Not-Eat advisory due to PFOS: Neshaminy Creek. DRBC does not have any data for that watershed in the Water Quality Data Portal.

DRBCs Plans

- Wrap up ongoing PFAS studies
- Assess the 20-year dataset
  - Find gaps in the data
  - Determine hotspots and trends
- Address gaps in data
- Locate PFAS sources independently or with the help of outside agencies
- Work with states to reduce loading and cleanup hotspots

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So, what are DRBC's plans? First, we are wrapping up a few studies and hope to have some reports out this spring. Then, we will more fully assess the 20-year dataset and look for gaps in data while determining hotspots and trends.

When we have that information, we can address the data gaps and do the work we need to locate possible sources of PFAS in the basin. Then, we will work with partners in the Basin to address the PFAS problem.

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PFAS is a persistent problem. DRBC is examining the data and will then work to mitigate PFAS in the Basin

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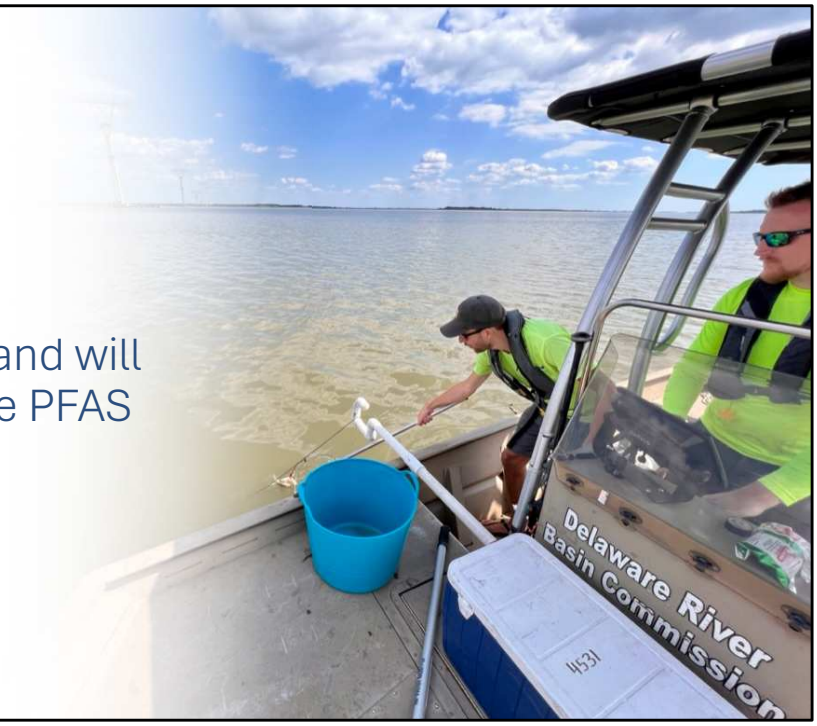

The take-home message is that PFAS is a persistent problem in the Delaware River Basin and that DRBC is reviewing the data available to map out the next steps that will help us mitigate PFAS in the Basin.