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# PFAS Water Quality and Fish Tissue Assessment Study - Year 1

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Managing, Protecting and Improving the Water Resources of the Delaware River Basin since 1961

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# PFAS Water Quality and Fish Tissue Assessment Study – Year 1

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## Acknowledgements and Disclaimers

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# EXECUTIVE SUMMARY

In year one of the PFAS Water Quality and Fish Tissue Assessment Study reported here, the Delaware River Basin Commission (DRBC) collected Per- and polyfluoroalkyl substances (PFAS) occurrence data along 215 miles of the mainstem Delaware River and multiple tributaries in 2021. Surface water and sediment samples were collected in October and November 2021 from six non-tidal main stem sites between Lackawaxen, Pennsylvania, and Ewing, New Jersey, as well as from one tidal main stem site at Pea Patch Island and five tributary sites. Concurrent fish collection was intended; however, fish collection was unsuccessful in fall 2021 due to high river flows and adverse weather conditions. Thus, fish collection will occur in year two of the study. The DRBC instead analyzed tissues from frozen samples that DRBC had preserved from previous mussel studies conducted prior to, and as separate studies not funded as part of, this year one PFAS study.

The ability to broadly interpret the results of this study are limited by the experimental design, which involved a single sampling event. However, the subsequent year 2 and 3 studies will replicate much of the year 1 work providing a more robust understanding of PFAS in the Delaware River Basin. The general conclusions from year 1 are that the 40 targeted PFAS compounds, if present, were not detectable at quantifiable levels in surface water or sediment above the Lehigh River. As you move from the Leigh River south (downstream) toward the Delaware Bay, concentrations of the targeted PFAS and number of compounds found at a site generally increased. This is likely due to a similar increasing pattern in population and commercial and industrial densities as you move closer to Delaware Bay. The studies conducted in years 2 and 3 will help to clarify these results and the patterns observed.

# LIST OF ACRONYMS/ABBREVIATIONS

| | |
|---|---|
| AFFF | Aqueous film-forming foams |
| CECs | Contaminants of emerging concern |
| DRBC | Delaware River Basin Commission |
| DWCF | Delaware Watershed Conservation Fund |
| EPA | United States Environmental Protection Agency |
| FWS | United States Fish and Wildlife Service |
| HDPE | High-density polyethylene |
| NFWF | National Fish and Wildlife Foundation |
| PDE | Partnership for the Delaware Estuary |
| PFBC | Pennsylvania Fish and Boat Commission |
| PPCPs | Pharmaceuticals and personal care products |
| PFAS | Per- and polyfluoroalkyl substances |
| TOC | Total organic carbon |

# TABLE OF CONTENTS

# 1. INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) are a group of >10,000 chemicals [1] that are in a variety of industrial and household products such as stain-repellant textiles, aqueous film-forming foams (AFFF), and paper coatings. PFAS have varying degrees of persistence, toxicity, and bioaccumulation in the environment. Human and wildlife exposure to several PFAS is widespread. Discharges to the environment include industrial outfalls, municipal treatment plants, usage of AFFF for firefighting, stormwater runoff, and landfill leachate. There is increasing information on the adverse effects of some PFAS on human health and the environment. The adverse effects of PFAS on human health can include liver damage, increased cholesterol, thyroid disease, decreased response to vaccines, asthma, decreased fertility, and birth weight, and pregnancy-induced hypertension. Exposure through drinking water and fish consumption are areas of concern. Understanding the occurrence and bioaccumulation of PFAS is important to protect water resources. PFAS has been detected in surface water worldwide and is present in the Delaware River, raising numerous environmental concerns, especially for potential impacts to surface water used as a drinking water source and fish consumption.

The Delaware River Basin Commission (DRBC) performs ongoing research and activities in various areas to support water resource management, including protecting water quality for drinking water and improving and restoring critical fish and wildlife habitats. Current and past research on contaminants of emerging concern (CECs) has included pharmaceuticals and personal care products (PPCPs), 1-4 dioxane, bromides, PFAS, microplastics, and chlorides/freshwater salinization. In year one of the PFAS Water Quality and Fish Tissue Assessment Study reported here, the DRBC collected PFAS occurrence data along 215 miles of the mainstem Delaware River and multiple tributaries in 2021. This work was completed as part of a grant from the U.S. Fish and Wildlife Service (FWS) through the National Fish and Wildlife Foundation (NFWF) Delaware Watershed Conservation Fund (DWCF), grant number 0403.20.068693. The project included monitoring of mussels, surface water, and sediment for 40 PFAS that includes 11 perfluorinated carboxylates (C4-C14), 8 perfluorinated sulfonates (C4-C10, C12), 3 fluorotelomer sulfonates (2:4, 2:6, 2:8), 3 perfluorooctane sulfonamides, 2 perfluorooctane sulfonamide ethanols, 2 perfluococtane sulfonamideacetic acids, 4 additional analytes in United States Environmental Protection Agency (EPA) Method 537 Rev 1, HFPO-DA, ADONA, 11CL-PF3OUdS, 9CL-PF3ONS, 4 additional analytes in EPA Method 533, PFEESA, PFMPA, PFMBA, NFDHA and three analytes associated with landfill leachate 3:3 FTCA, 5:3 FTCA, 7:3 FTCA. Furthering the understanding, occurrence, and bioaccumulation of PFAS is vital to protecting water resources.

A second and third year of this PFAS study have also been funded as part of NFWF DWCF grant numbers 0403.20.072417 and 0403.20.075117, respectively.

# 2. SAMPLING AND ANALYSIS

## 2.1 Surface Water Sampling

Surface water samples were collected for PFAS analysis (**Table 1** and **Figure 1**). Sample collection followed the New York State Department of Environmental Conservation methods for PFAS sampling.[2] Surface water grab samples were collected in two 500 ml high-density polyethylene (HDPE) bottles. Subsurface water samples were collected directly into the laboratory container by submerging them with a gloved hand or bottle holder. The water samples were placed on ice in coolers to maintain a temperature of 4 ± 2 $^{o}$C while transported and then frozen before shipping to the laboratory for analyses. SGS AXYS supplied PFAS-free water was transferred to a second sample bottle on site as a field blank. Field duplicates, a second sample at a given location, were also collected. In-field surface water measurements were collected at sample sites, including specific conductivity, water temperature, dissolved oxygen, turbidity, and pH.

## 2.2 Sediment Sampling

Surficial sediment sample collection (**Table 1** and **Figure 1**) followed the New York State Department of Environmental Conservation methods for PFAS sampling.[2] Sediment samples were collected by a decontaminated Ponar stainless-steel grab or pre-washed stainless-steel spoon. The sediment was then placed into a large decontaminated stainless-steel bowl and homogenized with a stainless-steel spoon, and a subsample was separated for analysis. Sample containers were 250 ml HDPE jars for PFAS, 500 ml amber glass jars for grain size, and 120 ml amber glass jars for total organic carbon (TOC). Sediment samples were placed in a cooler maintained at 4 ± 2$^{o}$ C using ice. SGS AXYS PFAS-free water was used as an equipment rinse blank. Total organic carbon was measured in sediment. Sediment size was determined.

## 2.3 Mussel Collection

An adult mussel can filter >10 gallons of water daily, resulting in pollutant bioaccumulation. As a result, freshwater mussels can serve as water quality indicators. This mollusk trait led DRBC and the Partnership for the Delaware Estuary (PDE) to use bivalves, specifically the Alewife floater (*Anodonta implicata*), to examine Delaware River water quality above and below its confluence with the non-tidal Lehigh River near Easton, Pennsylvania. Staff from DRBC and PDE tagged and measured mussels (raised as part of PDE's Mussels for Clean Water Initiative) deployed in cages for one year (September 2019 to September 2020) with periodic monitoring of survival and growth (**Table 2**). Indigenous (wild) Alewife floater were also collected as part of a mussel survey in the tidal river by Pennsylvania Fish and Boat Commission (PFBC) staff in 2021. Both the PDE mussel study and the PFBC mussel survey were conducted prior to, and as separate studies not funded as part of, this PFAS Water Quality and Fish Tissue Assessment Study. A subset of the caged (translocated) mussels, selected indigenous mussels, and a control group of hatchery mussels not deployed in cages were analyzed for PFAS. The mussels analyzed for PFAS were selected from frozen samples that had been preserved from these previous studies.

## 2.4 Fish

Fish collection was unsuccessful in fall 2021 due to high river flows and weather. The collection of fish will be conducted in year two of the study.

## 2.5 PFAS Analysis

Samples were analyzed by a subcontracted analytical laboratory, SGS AXYS. Surface water, surficial sediment, caged mussels, and indigenous mussels were analyzed using Method MLA-110 (equivalent to Draft EPA Method 1633) for 40 PFAS analytes (**Table 3**) out of the >10,000 chemicals in this class. After spiking with isotopically labeled surrogate standards and cleanup on SPE-WAX cartridges, samples were analyzed by LC-MS/MS. Final sample concentrations were determined by isotope dilution/internal standard quantification against extracted calibration standards in water.

## 2.6 Data Limitations and Interpretation

This experimental design, a single sampling of sediment and water at each site, provides a snapshot of concentrations at that time and may not be representative of long-term concentrations. That is particularly true for water, which can be highly variable in the short and long term. However, sediment is typically less temporally variable than water. While this experimental design limits DRBC's ability to interpret results broadly, it was implemented with the expectation that future funding would provide additional sampling resources. Therefore, this data will be pooled with data collected during two additional years of data collection (NFWF DWCF grant numbers 0403.20.072417 and 0403.20.075117) to provide a more robust understanding of PFAS data in surface waters, sediment, and species of the Delaware River Basin.

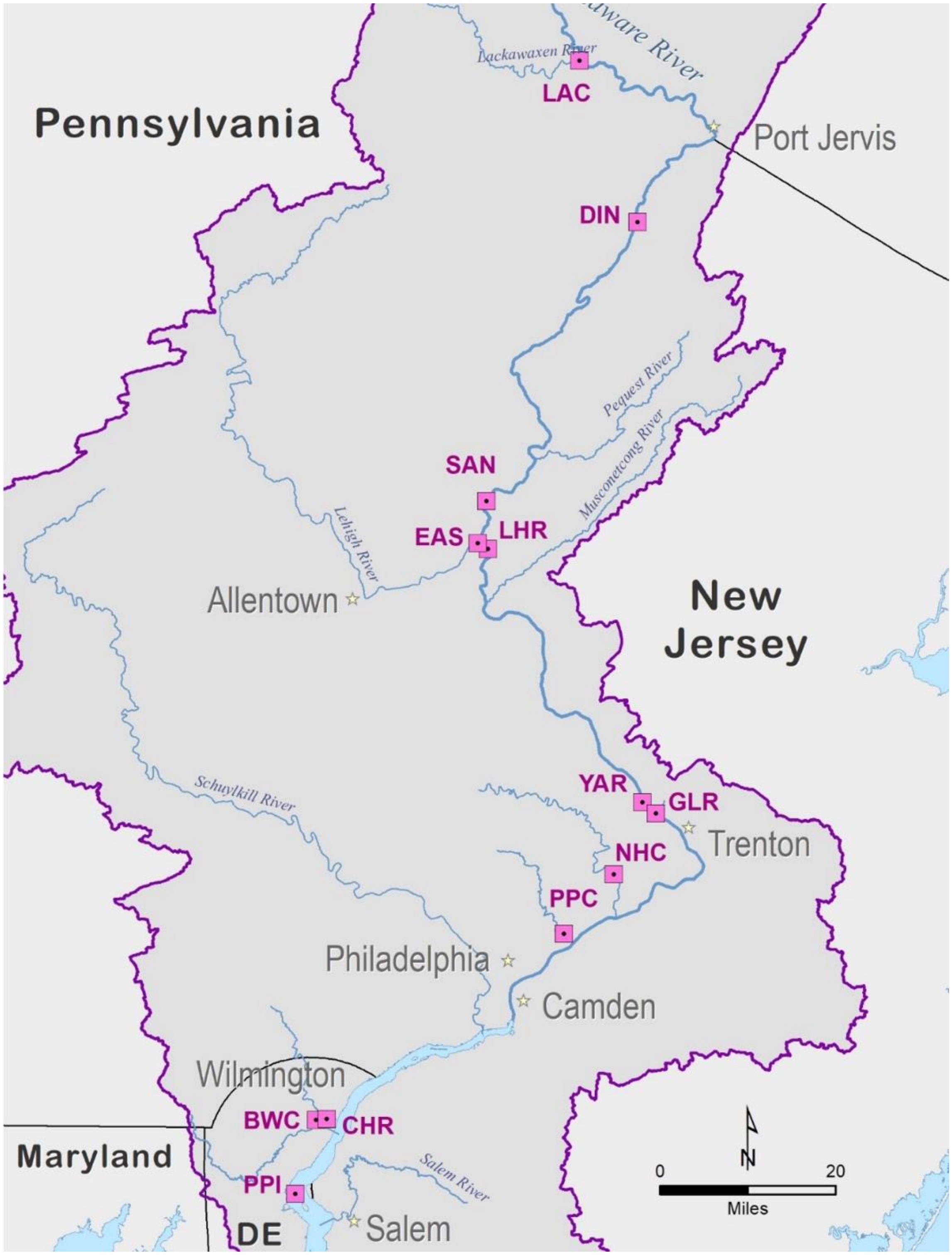


***Figure 1****. Water and sediment sampling locations in the Delaware River and its tributaries*

*Table 1. List of water and sediment samples from fall 2021.*

| Name | ID | River Mile | Latitude<br>Water and Sediment | Longitude<br>Water and Sediment | Zone |
|---|---|---|---|---|---|
| ***Non-tidal main stem*** | | | | | |
| Lackawaxen, PA | LAC | 277 | 41.48596 | -74.98643 | 1A |
| Dingmans Ferry, PA | DIN | 239 | 41.21951 | -74.86008 | 1C |
| Sandts Eddy, PA | SAN | 189 | 40.75822 | -75.18807 | 1D |
| Easton, PA (downstream of WWTP) | EAS | 182.25 | 40.67934 | -75.1852 | 1E |
| Yardley, PA | YAR | 139 | 40.26075 | -74.85145 | 1E |
| Gold Run, NJ (downstream of mouth) | GLR | 137 | 40.24218 | -74.82188 | |
| ***Tidal main stem*** | | | | | |
| Pea Patch Island (north of) | PPI | 62.25 | 39.61261 | -75.59309 | 5 |
| ***Non-tidal tributary*** | | | | | |
| Lehigh River, PA | LHR | | 40.688896 | -75.20662 | 1D |
| ***Tidal tributary*** | | | | | |
| Neshaminy Creek, PA (head of tide Hulmeville Rd) | NHC | | 40.141702 | -74.912663 | 2 |
| Pennypack Creek, PA (head of tide Frankford Ave) | PPC | | 40.0436 | -75.020498 | 2 |
| Christina River, DE | CHR | | 39.73484 | -75.55027 | 5 |
| Brandywine Creek, DE | BWC | | 39.73692 | -75.52657 | 5 |

***Table 2.*** *List of mussel samples from 2021.*

| Name | ID | River Mile | Taxonomic Name | Common Name | # of mussels | Note |
|---|---|---|---|---|---|---|
| ***Non-tidal main stem*** | | | | | | |
| Belvidere, NJ | BV-AF | 198 | Anodonta implicata | Alewife floater | 3 | caged |
| Sandts Eddy, PA | SE-AF | 189 | Anodonta implicata | Alewife floater | 3 | caged |
| Phillipsburg, NJ, | PG-AF | 184 | Anodonta implicata | Alewife floater | 3 | caged |
| Raubs Island, PA | RI-AF | 178 | Anodonta implicata | Alewife floater | 3 | caged |
| Riegelsville, PA | RH-AF | 174 | Anodonta implicata | Alewife floater | 3 | caged, high growth rate |
| Riegelsville, PA | RL-AF | 174 | Anodonta implicata | Alewife floater | 2 | caged, low growth rate |
| Riegelsville, PA | VH-AF | 174 | Anodonta implicata | Alewife floater | 3 | caged, high growth rate |
| Riegelsville, PA | VL-AF | 174 | Anodonta implicata | Alewife floater | 3 | caged, low growth rate |
| Control group | CT-AF | NA | Anodonta implicata | Alewife floater | 3 | hatchery |
| ***Tidal main stem*** | | | | | | |
| Tacony-Palmyra Bridge | TP-AF | 107 | Anodonta implicata | Alewife floater | 2 | mussel survey |
| Tacony-Palmyra Bridge | TR-AF | 107 | Anodonta implicata | Alewife floater | 2 | mussel survey |

***Table 3.*** *Targeted PFAS analytes.*

| Group | Analyte | CAS # |
|---|---|---|
| carboxylates | Perfluorobutanoate (PFBA) | 45048-62-2 |
| carboxylates | Perfluoropentanoate (PFPeA) | 45167-47-3 |
| carboxylates | Perfluorohexanoate (PFHxA) | 92612-52-7 |
| carboxylates | Perfluoroheptanoate (PFHpA) | 120885-29-2 |
| carboxylates | Perfluorooctanoate (PFOA) | 45285-51-6 |
| carboxylates | Perfluorononaoate (PFNA) | 72007-68-2 |
| carboxylates | Perfluorodecanoate (PFDA) | 73829-36-4 |
| carboxylates | Perfluoroundecanoate (PFUnA) | 196859-54-8 |
| carboxylates | Perfluorododecanoate (PFDoA) | 171978-95-3 |
| carboxylates | Perfluorotridecanoate (PFTrDA) | 862374-87-6 |
| carboxylates | Perfluorotetradecanoate (PFTeDA) | 365971-87-5 |
| sulfonates | Perfluorobutanesulfonate (PFBS) | 45187-15-3 |
| sulfonates | Perfluoropentanesulfonate (PFPeS) | 175905-36-9 |
| sulfonates | Perfluorohexanesulfonate (PFHxS) | 108427-53-8 |
| sulfonates | Perfluoroheptanesulfonate (PFHpS) | 146689-46-5 |
| sulfonates | Perfluorooctanesulfonate (PFOS) | 45298-90-6 |
| sulfonates | Perfluorononanesulfonate (PFNS) | 474511-07-4 |
| sulfonates | Perfluorodecanesulfonate (PFDS) | 126105-34-8 |
| sulfonates | Perfluorododecanesulfonate (PFDoS) | 343629-43-6 |
| precursors/fluorotelomer sulfonic acids | 4:2 fluorotelomersulfonic acid (4:2 FTS) | 414911-30-1 |
| precursors/fluorotelomer sulfonic acids | 6:2 fluorotelomersulfonic acid (6:2 FTS) | 425670-75-3 |
| precursors/fluorotelomer sulfonic acids | 8:2 fluorotelomersulfonic acid (8:2 FTS) | 481071-78-7 |
| precursors | Perfluorooctane sulfonamide (PFOSA) | 754-91-6 |
| precursors | N-Methylperfluorooctanesulfonamide (N-MeFOSA) | 31506-32-8 |

| | | |
|---|---|---|
| precursors | N-Ethylperfluorooctanesulfonamide (N-EtFOSA) | 4151-50-2 |
| precursors | N-methyl perfluorooctane sulfonamido acetic acid (MeFOSAA) | 2355-31-9 |
| precursors | N-ethyl perfluorooctane sulfonamido acetic acid (EtFOSAA) | 2991-50-6 |
| precursors | N-Methylperfluorooctanesulfonamidoethanol (N-MeFOSE) | 24448-09-7 |
| precursors | N-Ethylperfluorooctanesulfonamidoethanol (N-EtFOSE) | 1691-99-2 |
| replacements/carboxylates | Perfluoro-2-proxypropanoate (HFPO-DA), aka GenX | 13252-13-6 |
| replacements/carboxylic acids | Dodecafluoro-3H-4,8-dioxanonanoic acid (ADONA) | 2127366-90-7 |
| replacements/ether sulfonic acids | 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS) | 1621485-21-9 |
| replacements/ether sulfonates | 11-chloroeicosafluoro-3-oxaundecane-1-sulfonate (11Cl-PF3OUdS) | 2196242-82-5 |
| precursors/fluorotelomer carboxylates | 4,4,5,5,6,6,6-Heptafluorohexanoate (3:3 FTCA) | 1169706-83-5 |
| precursors/fluorotelomer carboxylates | 2H,2H,3H,3H-Perfluorooctanoate (5:3 FTCA) | 1799325-94-2 |
| precursors/fluorotelomer carboxylic acids | 4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Pentadecafluorodec-2-enoic acid (7:3 FTCA) | 755-03-3 |
| ether sulfonates | Perfluoro(2-ethoxyethane)sulfonate (PFEESA) | 113507-82-7 |
| carboxylic acids | Perfluoro-3-methoxypropanoic acid (PFMPA) | 377-73-1 |
| carboxylates | Perfluoro-4-methoxybutanoate (PFMBA) | 863090-89-5 |
| carboxylic acids | Nonafluoro-3,6-dioxaheptanoic acid (NFDHA) | 151772-58-6 |

# 3. RESULTS AND DISCUSSION

## 3.1 Main Stem – Surface Water

Surface water and sediment samples were collected in October and November 2021 at six non-tidal main stem sites above Ewing, New Jersey, one tidal main stem north of Pea Patch Island, and five tributary sites in and south of the Lehigh River (**Table 1** and **Figure 1**). This experimental design provides a snapshot of concentrations in surface waters at each site at the time of their collection.

PFAS was not detected above the quantification levels in surface water samples collected at the six non-tidal sites north of Ewing, New Jersey. Sample-specific detection limits were between 0.4 to 4.0 ng/L for most analytes except for 10 ng/L for two fluorotelemer carboxylates, 7:3 FTCA, and 5:3 FTCA. At the lone tidal site north of Pea Patch Island, seven PFAS totaling 40.63 ng/L were observed (**Figure 2**). This first-year data suggests that if present in the non-tidal main stem of the river, the 40 target PFAS compounds are below this study's limits of quantification. Additionally, the lack of quantifiable concentration in the non-tidal river, while seven were found lower in the Basin, implies that there are one or more sources between Ewing, New Jersey, and Pea Patch Island.

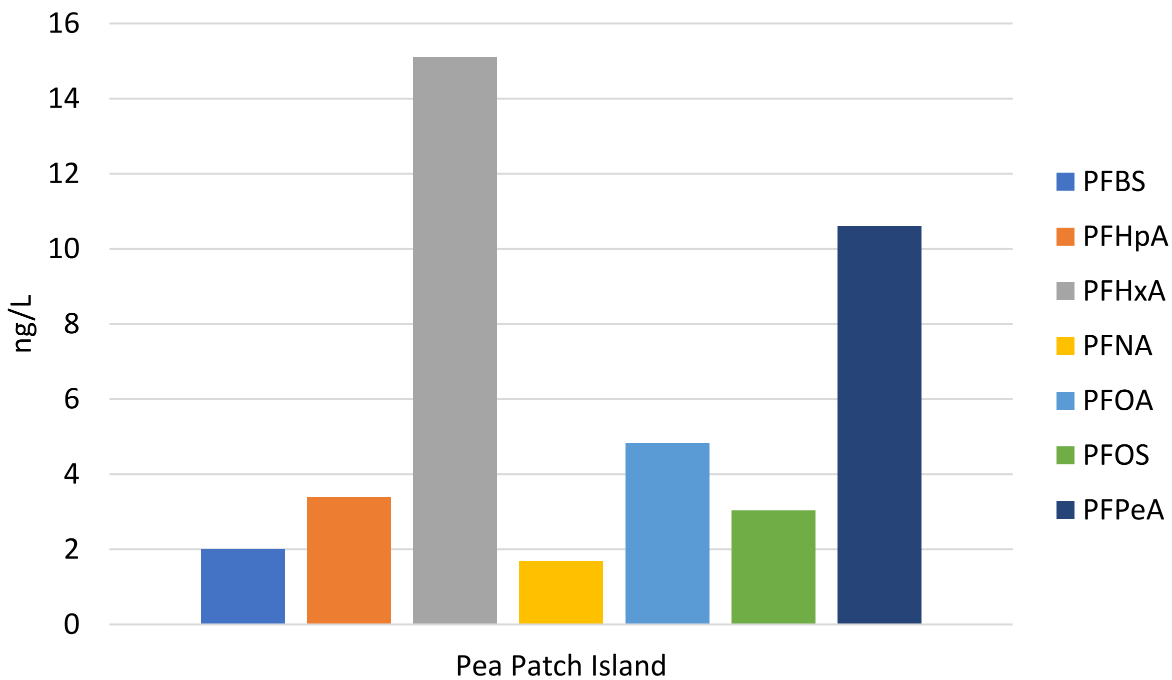


***Figure 2.*** *PFAS in surface water north of Pea Patch Island from fall 2021.*

In the second year of this study, efforts will be made to better assess whether PFAS was below the limits of quantification or not present in the surface waters of the Delaware River Basin. Therefore, collection volumes will be doubled for samples collected above Trenton to achieve a two-fold increase in quantification limits and potentially expose the presence of more target PFAS. Additionally, to better assess the presence of PFAS and its potential sources in the mainstem south of Ewing, New Jersey, there will be a focus on tidal mainstem sites in year two of the study.

## 3.2 Main Stem - Sediment

PFAS was not detected above quantification limits at the three northernmost non-tidal sites (LAC, DIN, and SAN). Sample-specific detection limits were between 0.032 to 0.993 µg/kg for most analytes except for detection limits at 1.2 ng/kg for two fluorotelemer carboxylates 7:3 FTCA and 5:3 FTCA. PFOS was detected at 0.3 to 0.6 µg/kg in samples from the three southernmost non-tidal sites (EAS, YAR, and GLR). The precursor N-EtFOSAA was also detected at 0.616 µg/kg at EAS. At the tidal site (PPI), PFDoA was detected at 0.278 µg/kg, and PFUnA was detected at 0.273 µg/kg.

Unlike main stem water samples, targeted PFAS compounds were found in sediment above Ewing, New Jersey. Sediment acts as a longer-term record of contamination by sorbing and accumulating chemicals over time. Therefore, the long-term presence of a chemical in water, even at concentrations below the limits of quantification, can result in the buildup of quantifiable concentrations over time in sediment. These sediment results demonstrate that there ***was or is*** a source of PFAS south of Sandts Eddy, Pennsylvania, that was not apparent based on the surface water sampling.

## 3.3 Tributaries – Surface Water

Each of the five tributaries had quantifiable levels of PFAS in surface water samples. The lowest total PFAS concentration was at the only non-tidal tributary site, the Lehigh River (7.98 ng/L; **Figure 3**). As tributaries get closer to Delaware Bay, total PFAS concentrations range from 6.3 times higher than the Lehigh River (at Pennypack Creek) to 12.1 times higher than the Lehigh River (at Brandywine Creek). Eight PFAS were observed at Pennypack Creek (PPC) head of tide with total PFAS at 50.06 ng/L. Seven PFAS were observed at Neshaminy Creek head of tide (NHC) with total PFAS at 55.26 ng/L. PFOS concentration of 14.7 ng/L at NHC was higher than other tributary sites sampled. Both Brandywine Creek (BWC) and Christina River (CHR) had the same 10 PFAS compounds detected. PFBA was observed only at BWC (19.3 ng/L) and CHR (14.4 ng/L). PFDA was observed only at BWC (2.38 ng/L) and CHR (1.8 ng/L).

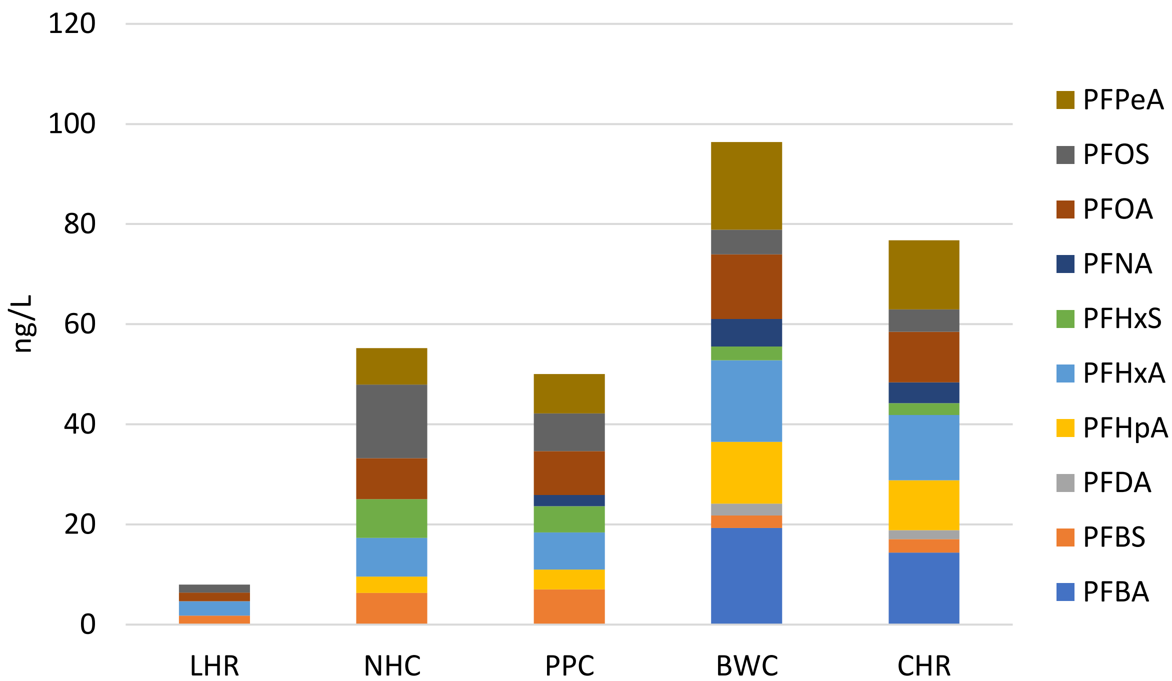


***Figure 3.*** *PFAS in tributary surface water collected in Fall 2021. LHR = Lehigh River, NHC = Neshaminy Creek (head of tide) and PPC = Pennypack Creek (head of tide), BWC = Brandywine Creek, CHR = Christina River.*

The PFAS quantified in tributaries is a function of the sources from within that watershed rather than inputs from upstream or downstream. However, it is worth noting that more of the target compounds and higher concentrations were generally found as you moved downstream in the systems closer to Delaware Bay. This indicates that there are more sources of PFAS as you move lower in the Delaware River Basin. The accuracy of the trend observed is difficult to know based on the limited sampling of this experimental design. Therefore, sampling in years two and three are essential to assessing the presence and potential sources of PFAS in these systems.

## 3.4 Tributaries - Sediment

No PFAS were observed above quantification limits in sediment at the Lehigh River (LHR), Neshaminy Creek (NHC - head of tide), or Pennypack Creek (PPC - head of tide) sites. However, the two tributary sediment sites closest to Delaware Bay, Christina River and Brandywine Creek, had numerous detections. Of the 40 target PFAS analytes, 10 long-chain compounds were observed in sediment at the Christina River (CHR) site with PFTrD at 3.99 µg/kg, PFDoA at 3.53 µg/kg, PFTeDA at 2.13 µg/kg, PFUnA at 1.77 µg/kg, PFOS at 0.583 µg/kg, EtFOSAA at 0.419 µg/kg, PFDA at 0.395 µg/kg, PFOSA at 0.328 µg/kg, PFNA at 0.264 µg/kg, PFOA at 0.232 µg/kg and PFHpA at 0.199 µg/kg (**Figure 4**). Four long-chain PFAS were observed at the

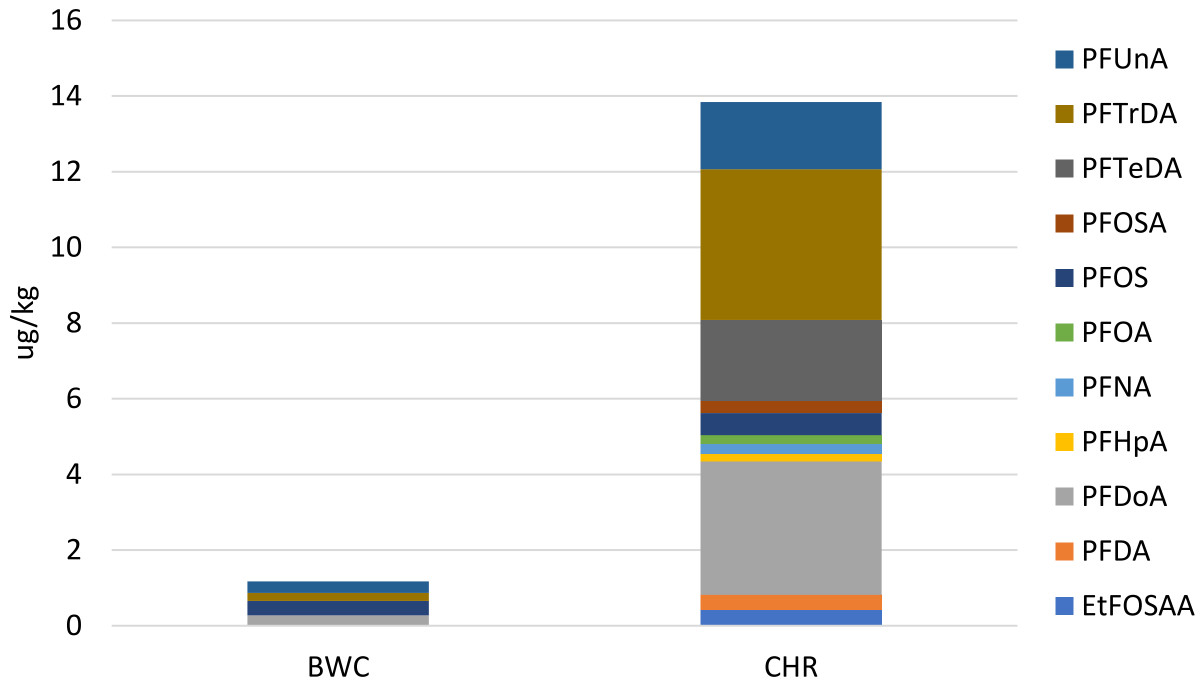


***Figure 4.*** *PFAS in tributary sediment collected in Fall 2021. BWC = Brandywine Creek, CHR = Christina River. LHR = Lehigh River, NHC = Neshaminy Creek (head of tide) and PPC = Pennypack Creek (head of tide) were below the quantification limit.*

Brandywine Creek (BWC) site with PFOS at 0.383 µg/kg, PFUnA at 0.306 µg/kg, PFDoA at 0.278 µg/kg, and PFTrDA at 0.208 µg/kg (**Figure 4**).

The non-detection of PFAS in sediment of tributaries where compounds were quantified in water is unexpected as sediment often accumulates higher concentrations than the water column. The sediment results from these tributaries will be further examined with data from years 2 and 3. The presence of PFAS in the Christina River and Brandywine Creek was expected based on water detections and also indicates that there are significant sources in those catchments.

## 3.5 Mussels

Non-tidal and tidal freshwater mussels were analyzed for PFAS. Although PFAS have been reported to bioaccumulate in indigenous and translocated freshwater mussels *Dreissena bugensis* and *Corbicula fuminea*,[3] none of the target PFAS were observed above quantification levels in the non-tidal caged (translocated) or tidal wild (indigenous) freshwater mussels from the main stem of the Delaware River in our limited study. Sample-specific detection limits were < 0.4 ng/L for most analytes, except for detection limits at 2.49 ng/L for two fluorotelemer carboxylates, 7:3 FTCA, and 5:3 FTCA. Mussels from the hatchery that were not deployed and used as controls had low levels of long-chain PFAS with Perfluoroundecanoate (PFUnA) at

0.408 ng/g, Perfluorododecanoate (PFDoA) at 0.861 ng/g, Perfluorotridecanoate (PFTrDA) at 0.861 ng/g and Perfluorotetradecanoate (PFTeDA) at 1.11 ng/g.

## 3.6 Outreach

In this project, the DRBC conducted a deliberate scientifically-based research study to focus on PFAS in the Delaware Watershed. This consisted of collecting surface water, sediment, and freshwater mussels from the main stem and tributary sites for analysis of PFAS, including replacement compounds currently being used as alternatives to legacy long-chain PFAS, persistent short-chain PFAS being used in increasing amounts, and precursors that can be transformed to PFOS and other persistent PFAS. The work reported here increases information on the occurrence of PFAS in the Delaware River Basin by an extended list of PFAS. Outreach and intergovernmental coordination were accomplished by sharing information gained with the scientific community and stakeholders through presentations at the Joint Chesapeake-Potomac Regional Chapter and Hudson-Delaware Chapter Society of Environmental Toxicology and Chemistry Meeting on April 11, 2022 and at the joint meeting of the DRBC Toxics Advisory Committee and Southeast Pennsylvania Regional PFAS Discussion Group on January 19, 2022, The Greater Lehigh Valley Chamber of Commerce Environmental Summit on April 22, 2022, the Schuylkill Action Network on May 11, 2022, and Chesapeake Bay Scientific and Technical Advisory Committee on May 17, 2022. Data were made readily accessible by uploading to USEPA Water Quality Portal (WQP) https://www.waterqualitydata.us/portal/.

Furthering the understanding, occurrence, and bioaccumulation of PFAS is vital to protect water resources. This first year of the study and subsequent years will contribute to the development of comprehensive strategies to identify, characterize, and evaluate uses and releases of PFAS, to improve water quality, to support fish and wildlife habitat, increase scientific knowledge and understanding to improve recreation/fishing opportunities, provide safe drinking water, and improve the health of poor and minority communities who are disproportionately affected by existing health consumption advisories related to PFAS bioaccumulation in fish. The results from this work can inform management actions such as adopting fish consumption advisories, developing stream quality objectives, and other environmental management approaches in cooperation with the EPA and basin states to minimize impacts on human health and aquatic life.

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