

Sampling of PFAS in Aqueous Media to Determine Contaminant Signatures Using a Statewide Approach

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Resources and Environmental
Control



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PFAS in Delaware

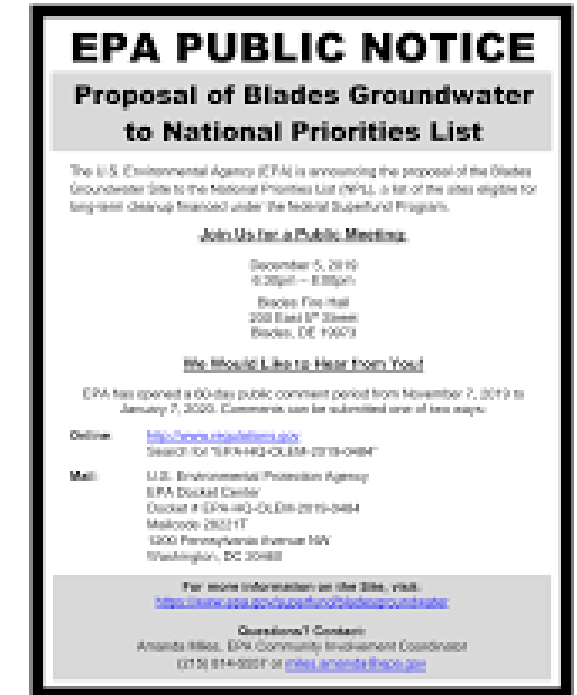
- History of research, manufacture, and application of PFAS compounds from chemical companies within the State.
- This legacy is primarily concentrated in the I-95 corridor in the Northern part of State.
- Other products (such as AFFF) also widely used.



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Federal PFAS Sites in Delaware

- Three Federal Facilities currently being investigated for PFAS.
- All originally listed or investigated for contaminants other than PFAS.
- Good working relationships with Federal partners.
- The PFAS investigations at each Site are in different phases of investigation.



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Delaware PFAS Team



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**NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL**



DELAWARE HEALTH AND SOCIAL SERVICES
Division of Public Health



Delaware Department
of Transportation

- DNREC
 - Division of Waste and Hazardous Substances
 - Division of Water
 - Division of Watershed Stewardship
 - Division of Fish and Wildlife
 - Division of Air Quality
- Delaware Health and Social Services
 - Division of Public Health – Health Systems Protection
- Delaware Department of Agriculture
- Delaware Department of Transportation



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Statewide Aqueous Sampling Effort



Waste Water

Division of Water

In support of the Biosolids study. Covered sampling from influent of wastewater to monitoring discharge of effluent.



Private Wells

Waste & Haz Sub

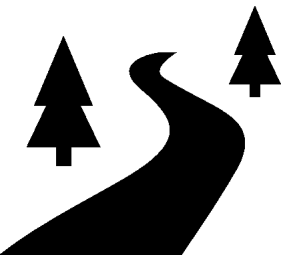
Follow-up sampling from all Statewide sampling efforts, citizen requests for sampling, and expanded DNREC and DHSS sampling programs.



Groundwater

Collaborative

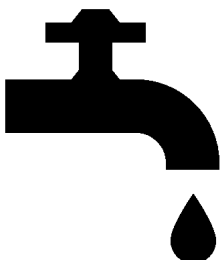
A collaborate efforts from many sections of DNREC, the Department of Agriculture, and from data submitted to DNREC during Brownfield or Voluntary Cleanup Programs.



Surface Water

Waste & Haz Sub

Also includes data from Watersheds, Division of Water, and Remediation Cleanup Sites.



Public Water Systems

Division of Water

Supported by the Division of Waste & Hazardous Substances and the Office of Drinking Water in DHSS

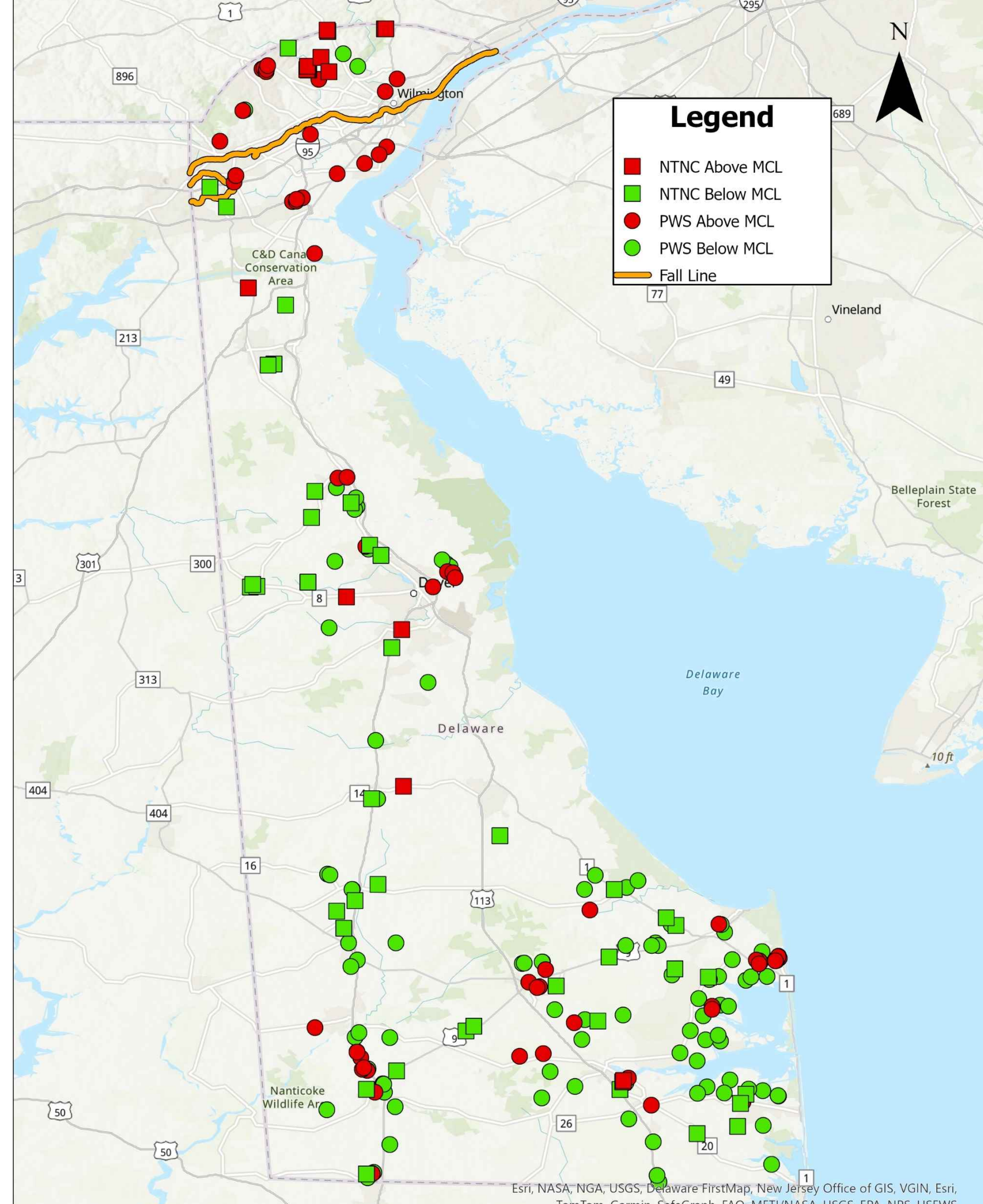


Fish tissue data collection in support of these studies have also been completed since 2019

Statewide Public Water System

- **Sampling** Public Water System (PWS) sampling: 545 samples from 134 unique (out of 457) water systems from 219 different wells
 - Community Water Systems (municipalities, mobile home park, sub-divisions) **over 90% participation**
 - Non-Transient / Non-Community (schools, factories, office buildings, and hospitals) **over 60% participation**
 - Transient Non-Community (gas stations, campgrounds) **~10% participation**
 - Sensitive Populations in confined wells: daycares, healthcare centers, schools, retirement communities

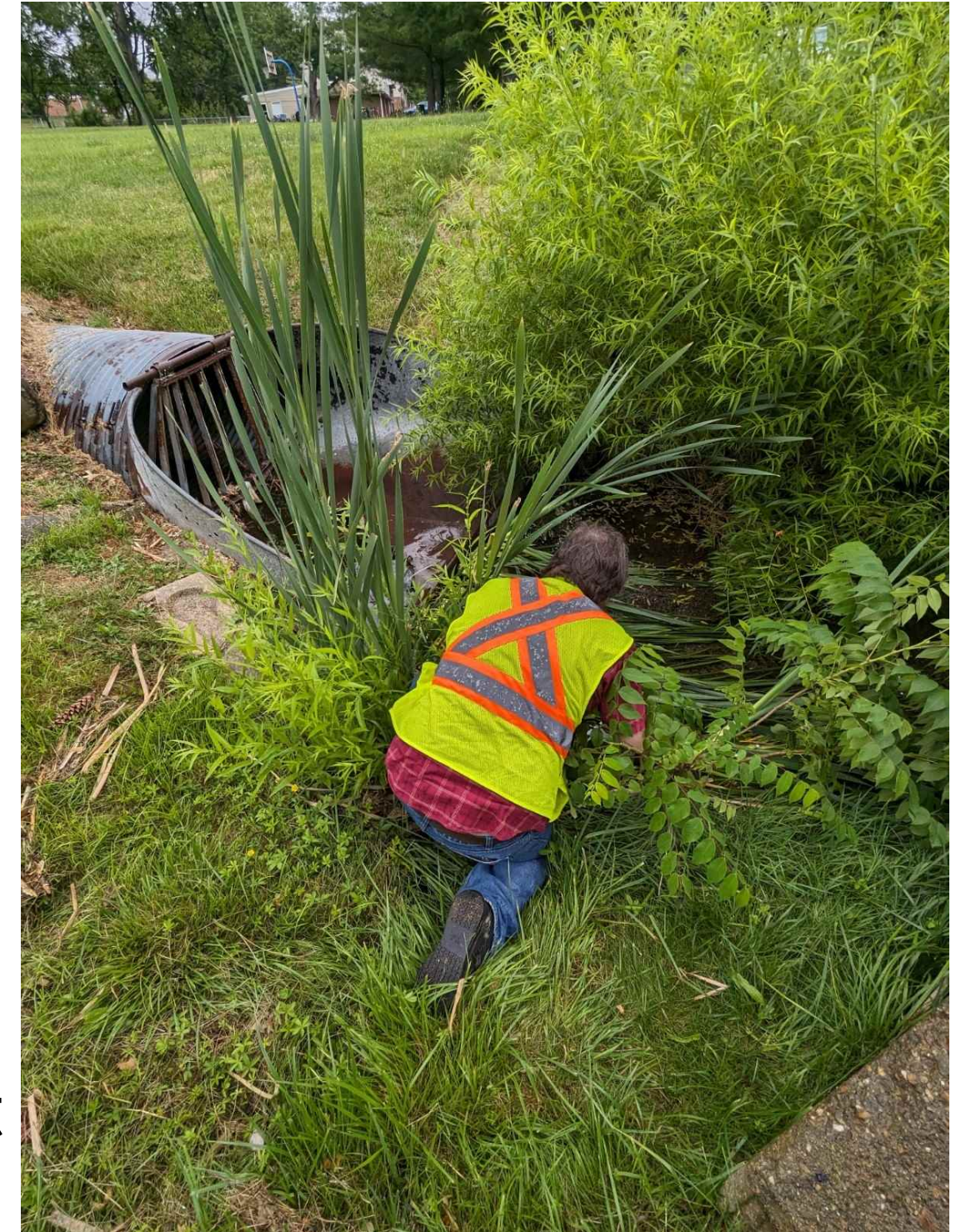


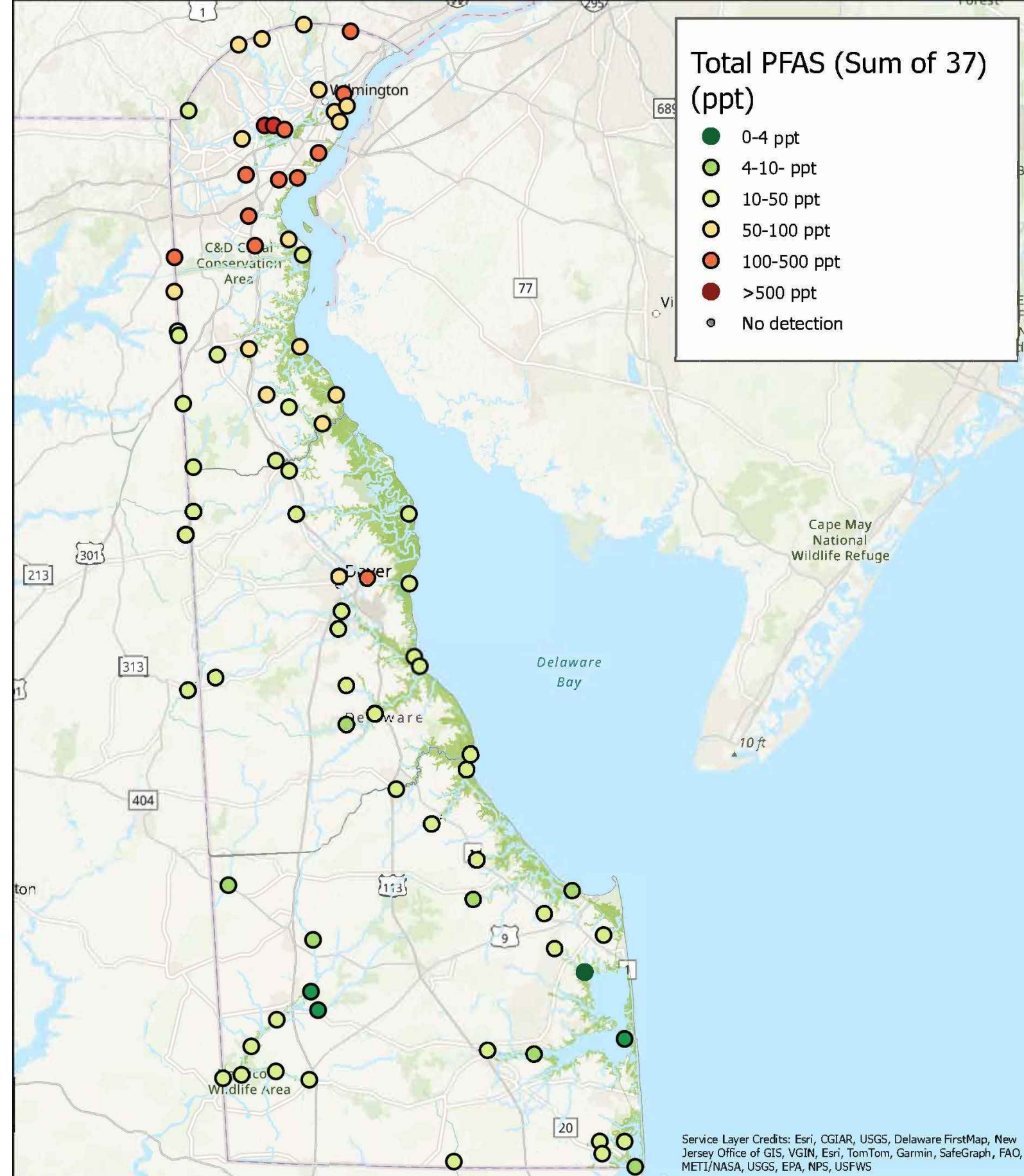


Surface Water Sampling

Sampling focused on three targeted efforts: Statewide Head of Tide, Focused Watershed, and in support of the Biosolids Study.

- Head of Tide Sampling included two analytical approaches
- Watershed study (Red Clay Creek) focused on tributaries and headwaters sampling to evaluate the source of the streams.
- Biosolids study investigated both influent and effluent from treatment plants and run-off from applied fields.





0 5 10 15 Miles

Head of Tide Wetlands (non-regulatory)

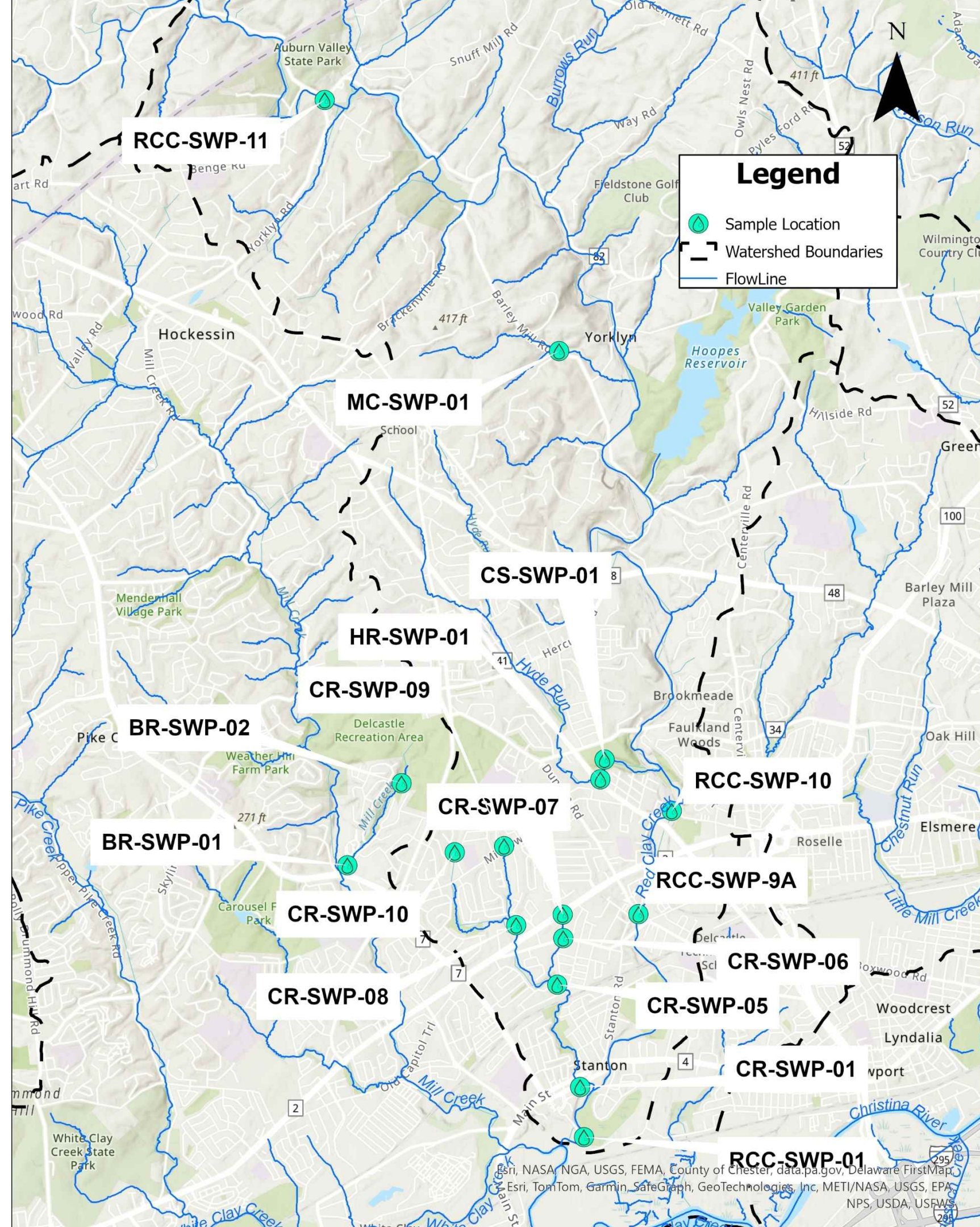
Water

State Boundary



WATAR

Figure 12:
Total PFAS (Sum of 37
Compounds) in Delaware
Surface Water – Fall 2022



RCC Data Table

n = 12

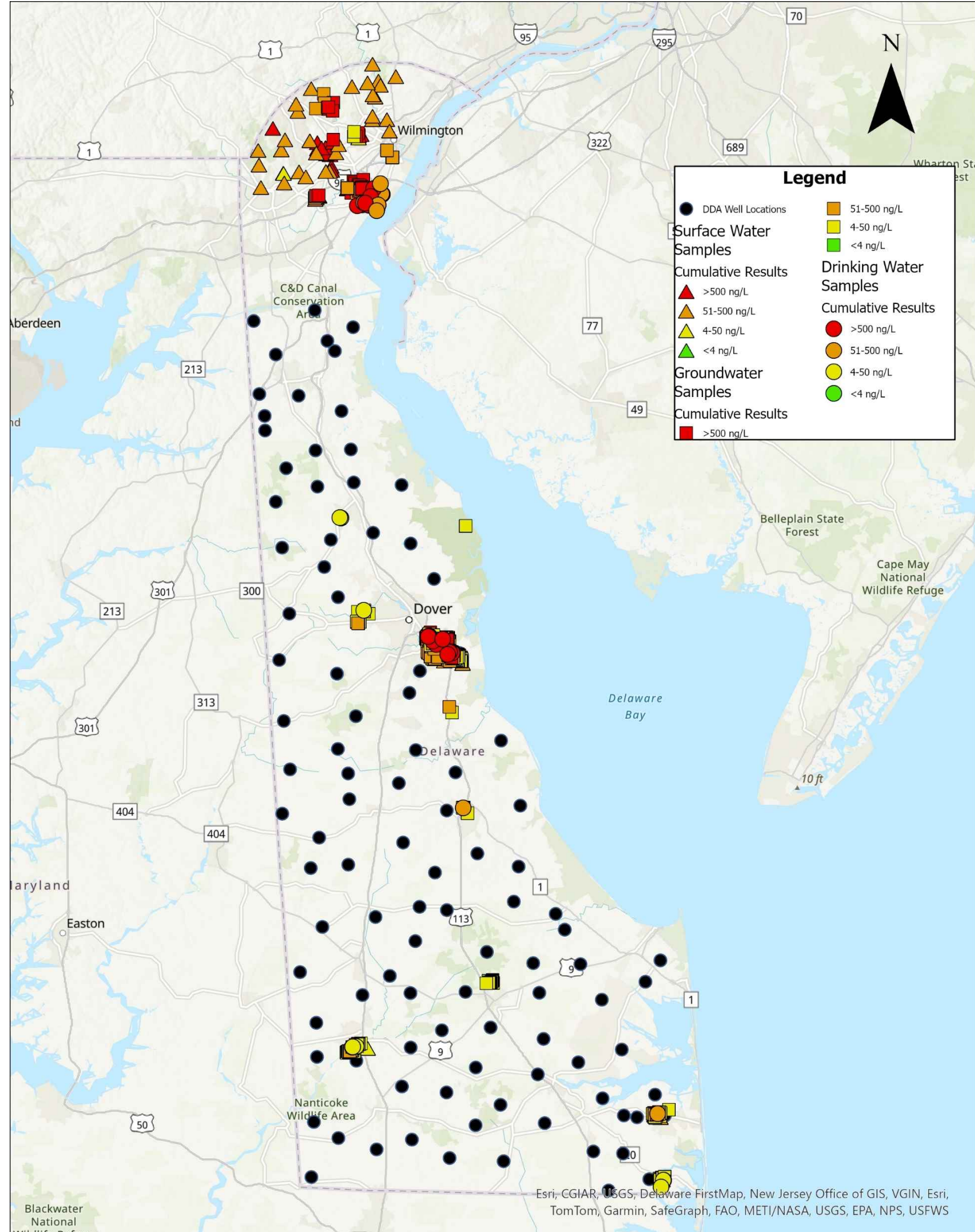
Location	PFAS Min Value	PFAS Max Value	ΣPFAS Avg Value
RCC-SWP-11	0.15 ng/L	120 ng/L	3.71 ng/L
RCC-SWP-10	0.15 ng/L	93.8 ng/L	5.02 ng/L
RCC-SWP-9A	0.15 ng/L	158 ng/L	10.49 ng/L
RCC-SWP-01	0.15 ng/L	228 ng/L	17.01 ng/L
CS-SWP-01	0.15 ng/L	1030 ng/L	24.12 ng/L

Groundwater Sampling

Sampling focused on three targeted efforts: Statewide DDA well network, Private Domestic Wells , and PFAS monitoring at remediation sites.

- DDA wells only in southern 2/3 of the state
 - (AKA: “Below the Canal”)
- Private wells and Miscellaneous Public Wells were also used in this assessment. (Majority in the Coastal Plain)
- Monitoring wells from active remediation sites.

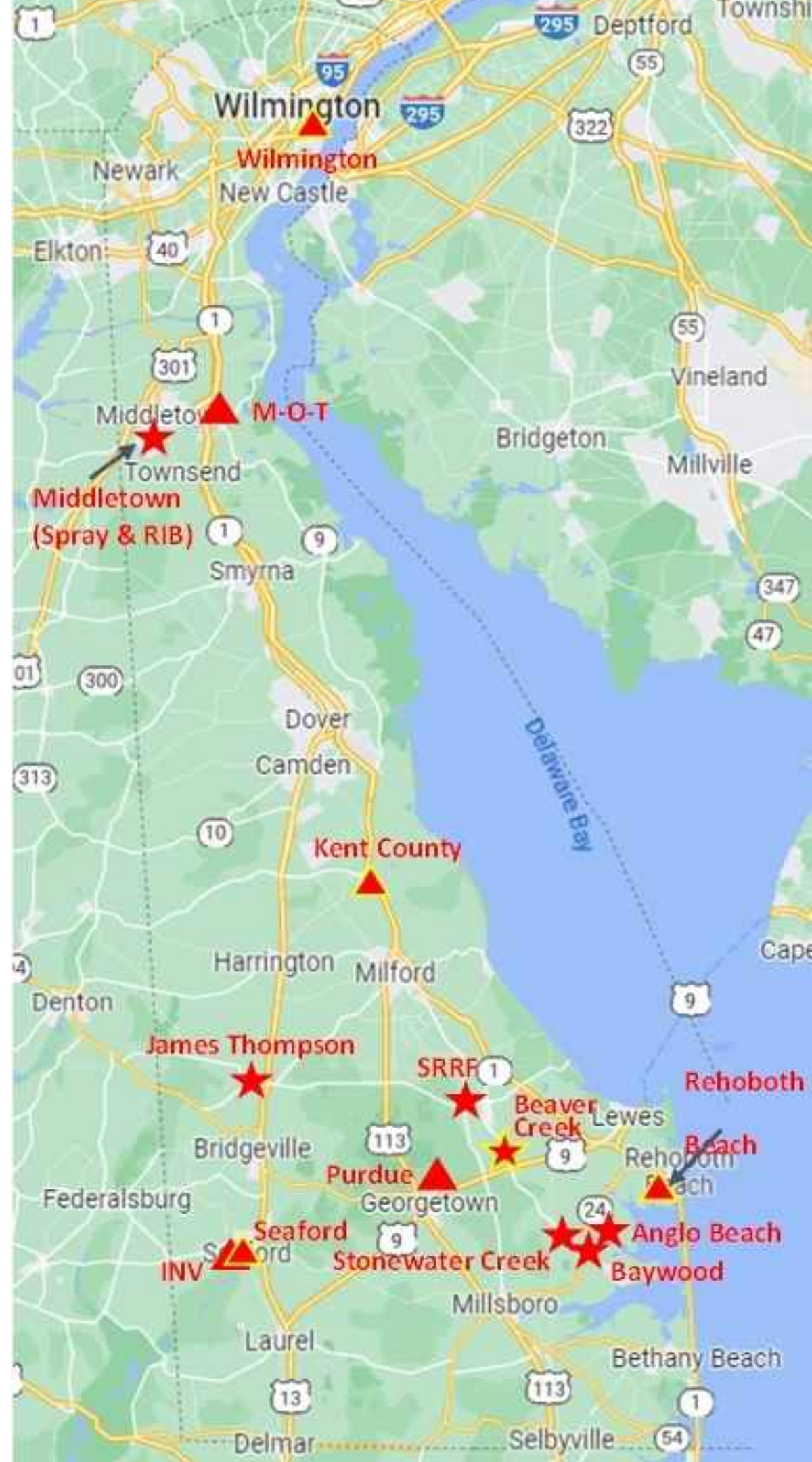




Biosolids Study

- Samples were collected from all media applications including; the influent & effluent of the treatment plant, the soils where biosolids were applied, the groundwater beneath, and surface water located near the application sites.
- PFAS concentration and signature varied between the media.
- Soil, groundwater and surface water did not vary from the surrounding signature.







DNREC's own PFAS Analyte List

537M DNREC

REM

Meets and exceeds PFAS
analytes included with
UCMR5 at 37 compounds.

Developed with our
contract laboratory.

The Biosolids study used
Method 1633

PFAS Functional

Perfluoroalkyl Carboxylic
Acids (PFCAs)

Groups

PFBA,
PFHxA,
PFOA,
PFDoA,
PFPrA

Perfluoroalkyl Sulfonic
Acids (PFSAAs)

PFBS,
PFHxS,
PFOS,

Fluorotelomer Sulfonic
Acids (FTSAs)

4:2 FTS
6:2 FTS
8:2 FTS

Perfluorooctane
Sulfonamides (FOSAs)

PFOSA
N-MeFOSA
N-EtFOSAA

Perfluorooctane
Sulfonamidoacetic Acids
(PFSAAs)

N-MeFOSAA
N-EtFOSAA

Per- and Polyfluoroether
carboxylic Acids (PPFCAs)

HFPO-DA
ADONA
PFMOAA
PFO3OA

Perfluoro Ether Sulfonic
Acids (PFESAs)

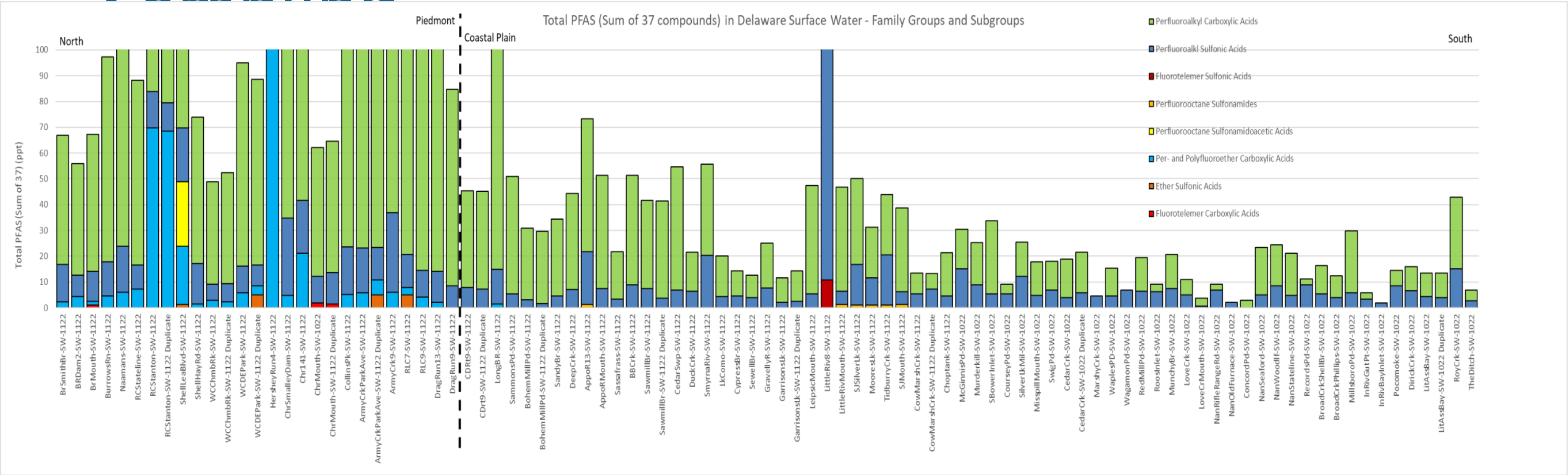
F-53B Minor
F-35B Major
PES

Fluorotelomer Carboxylic
Acids (FTCAs)

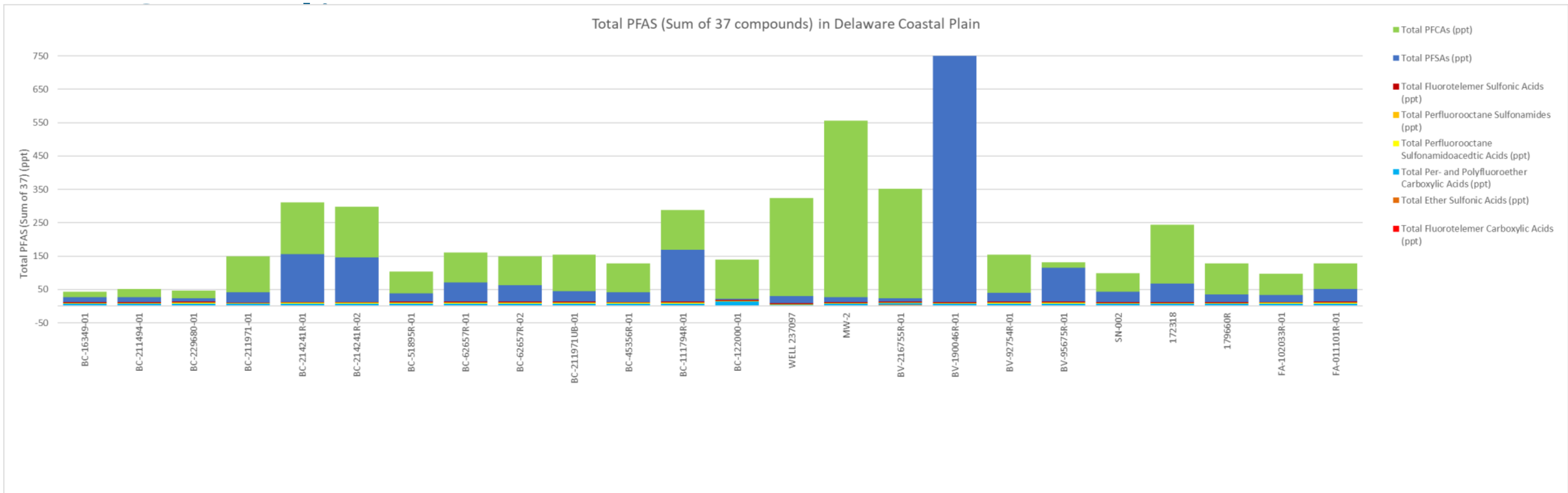
5:3 FTCA
6:2 FTCA
6:2 FTUCA
7:3 FTCA

Head of Tide Surface Water

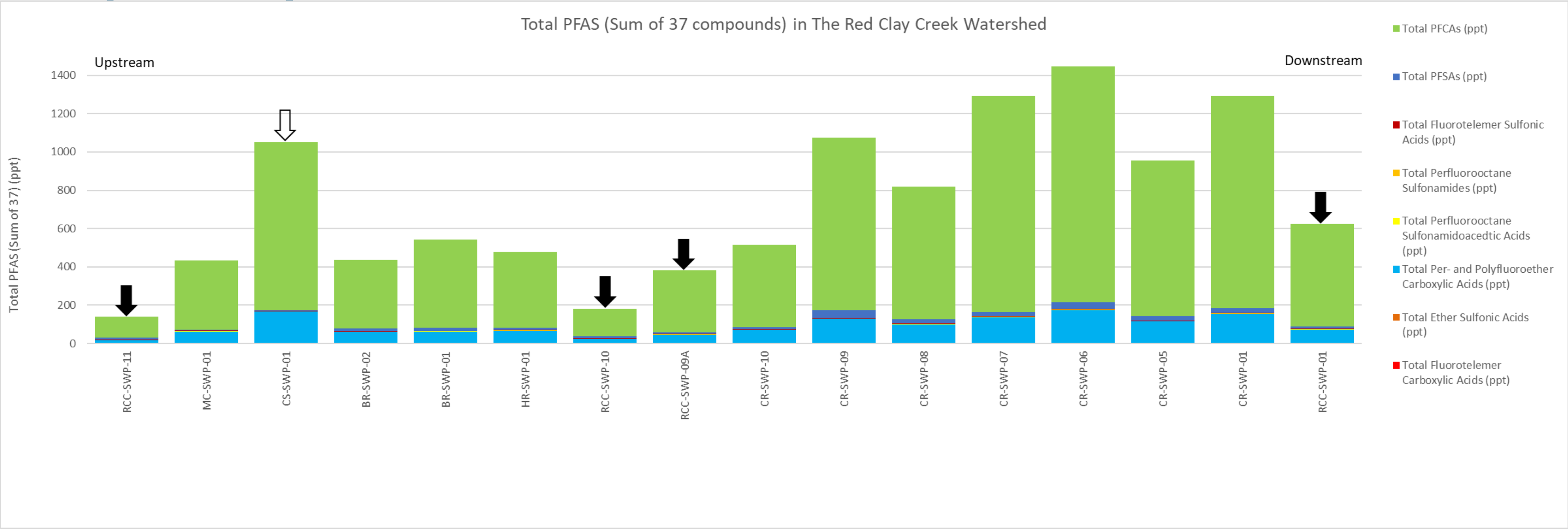
Sampling



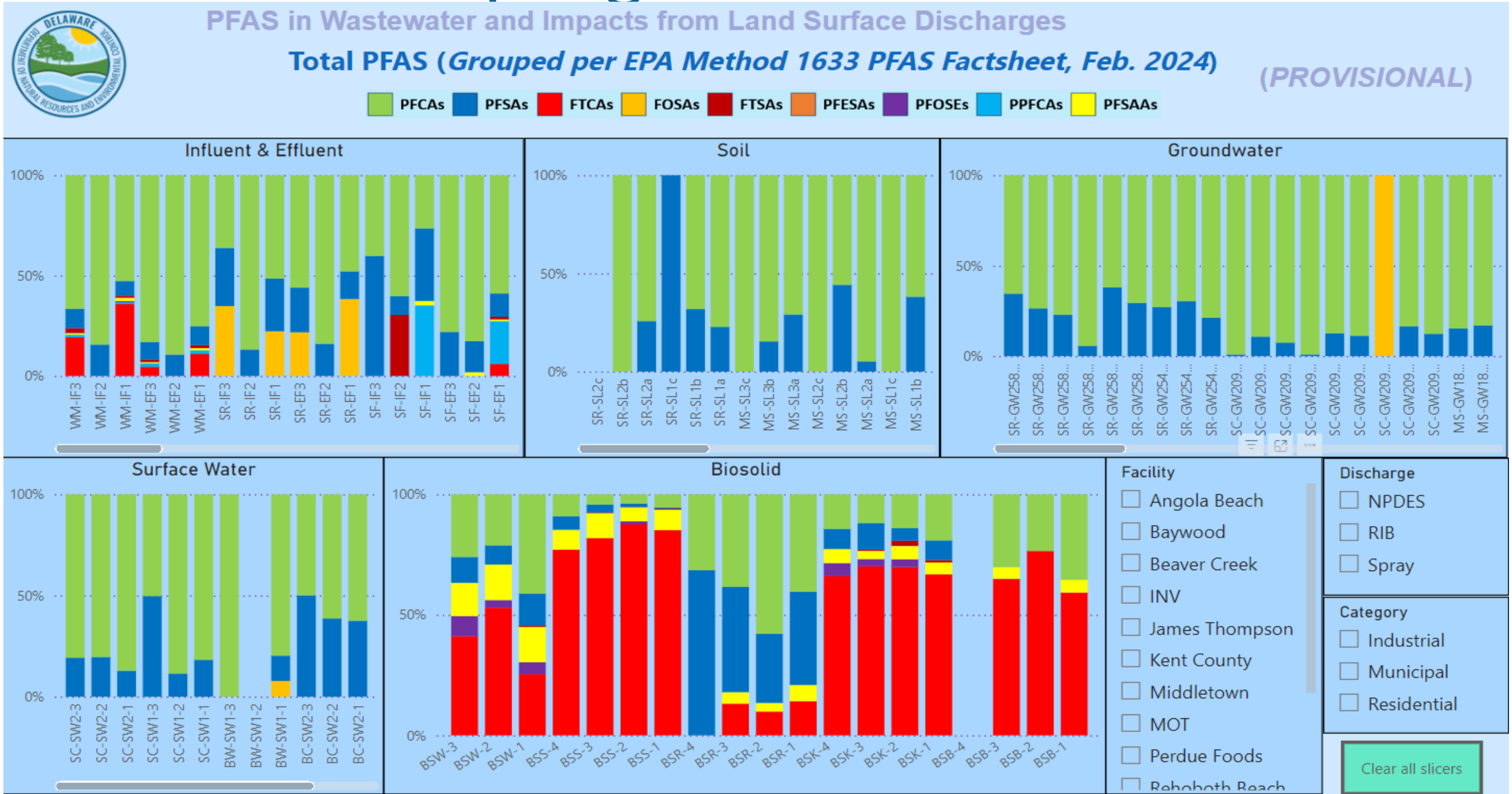
Coastal Plain Groundwater



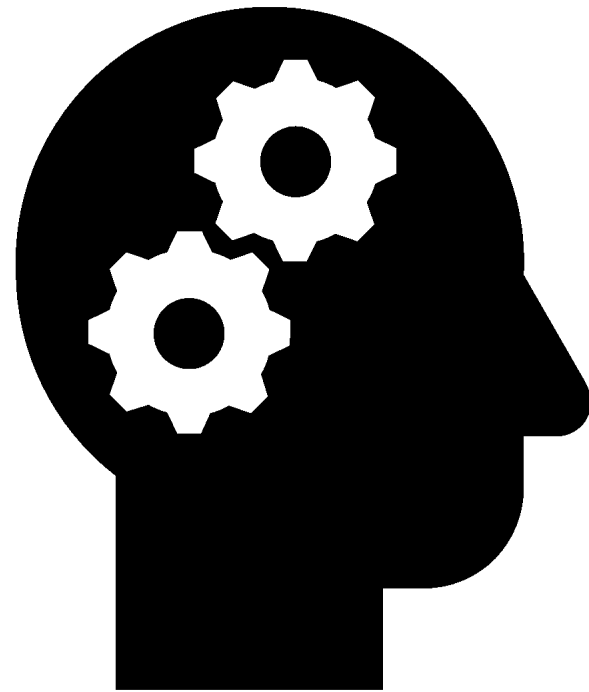
Red Clay Creek Watershed



Biosolids Sampling Data



How is Delaware using the data?



Statewide Signature

By evaluating additional PFAS analytes in functional groups, we can assess potential sources, sinks, and the fate & transport of PFAS compounds. This can assist in directing resources appropriately.

Σ PFAS Concentration

Instead of focusing solely on regulated (or “hazardous”) PFAS, focusing on a high concentration is useful in prioritizing efforts.

Mitigation

Combining signature + Total Concentration allows us to steer resources to efforts proven to reduce risks associated with PFAS and help those tasked with remediation of PFAS to select the best strategies for effective remedies.

Thank You to the Delaware PFAS Team Contributors

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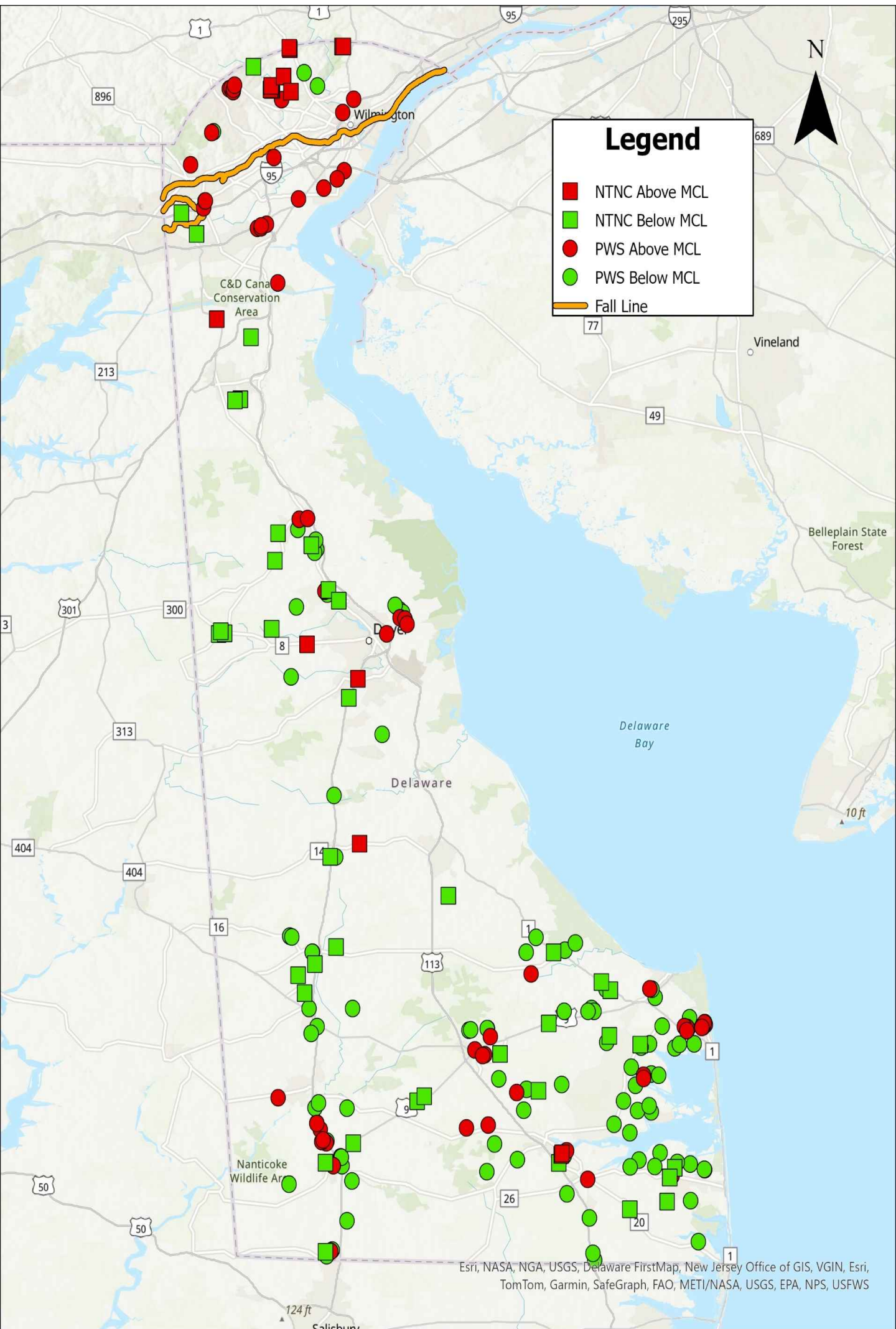
Laura Lochard, Chemist

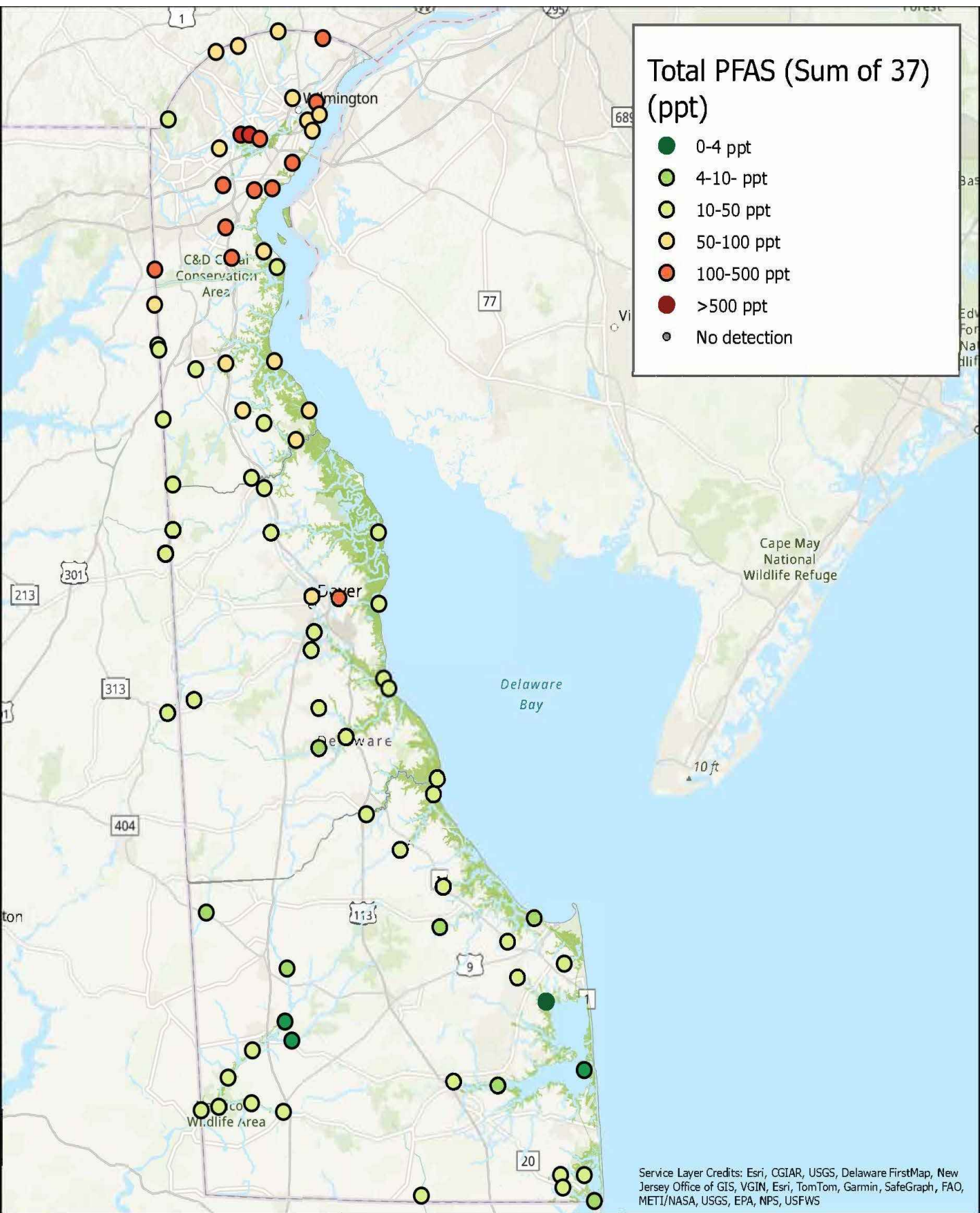
Morgan McGee-Solomon, GIS

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Head of Tide Wetlands (non-regulatory)

Water

State Boundary



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Figure 12:
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