Fingerprinting the Sources of PFAS Contamination in Delaware and Rural Pennsylvania

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PFAS Solutions

PFAS SOLUTIONS

Is a 501(C)(3) which started in March 2020 with a grant from the Longwood Foundation

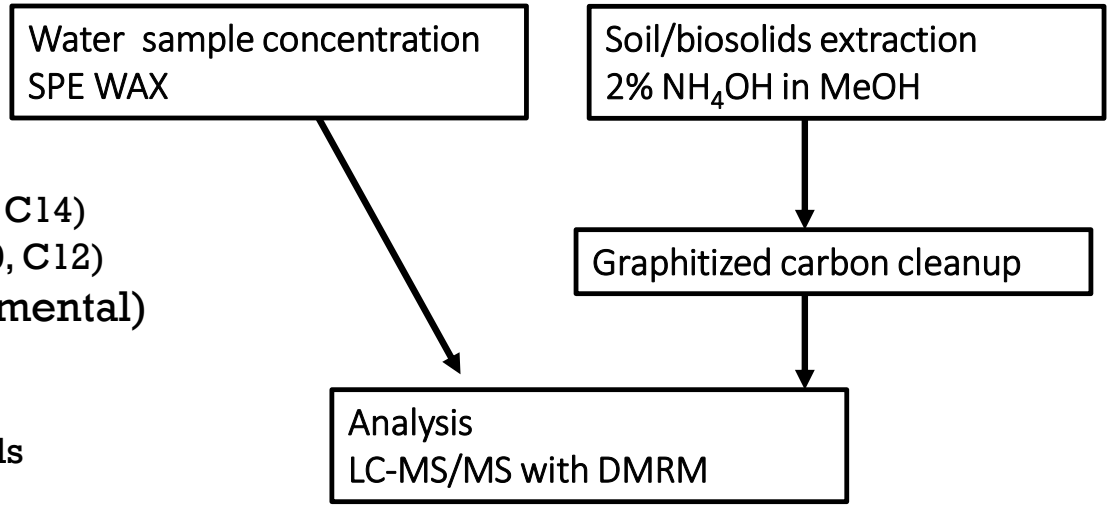
Presentation Objectives

- EPA Draft Method 1633 and what it can tell us
- Example studies
  - Groundwater
  - Surface water
  - Farms using biosolids

US EPA Draft Method 1633 for Environmental Analysis

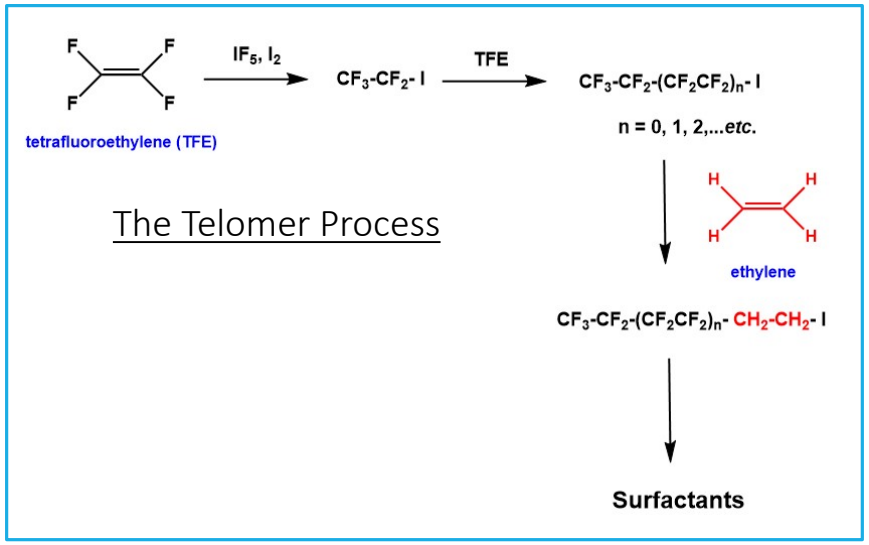
Scope

- 40 Native PFAS compounds
- Terminal compounds
  - 11 Perfluoroalkyl carboxylic acids (C4 to C14)
  - 8 Perfluoroalkyl sulfonic acids (C4 to C10, C12)
- Intermediates (manufacturing, environmental)
  - 3 Fluorotelomer sulfonic acids
  - 3 Perfluorooctane sulfonamides
  - 2 Perfluorooctane sulfonamidoacetic acids
  - 2 Perfluorooctane sulfonamide ethanols
  - 5 Per- and polyfluoroether carboxylic acids
  - 3 Ether sulfonic acids
  - 3 Fluorotelomer carboxylic acids
- Drinking water, wastewater, ground water, surface water, landfill leachate
- Also soil, sediment, and biota

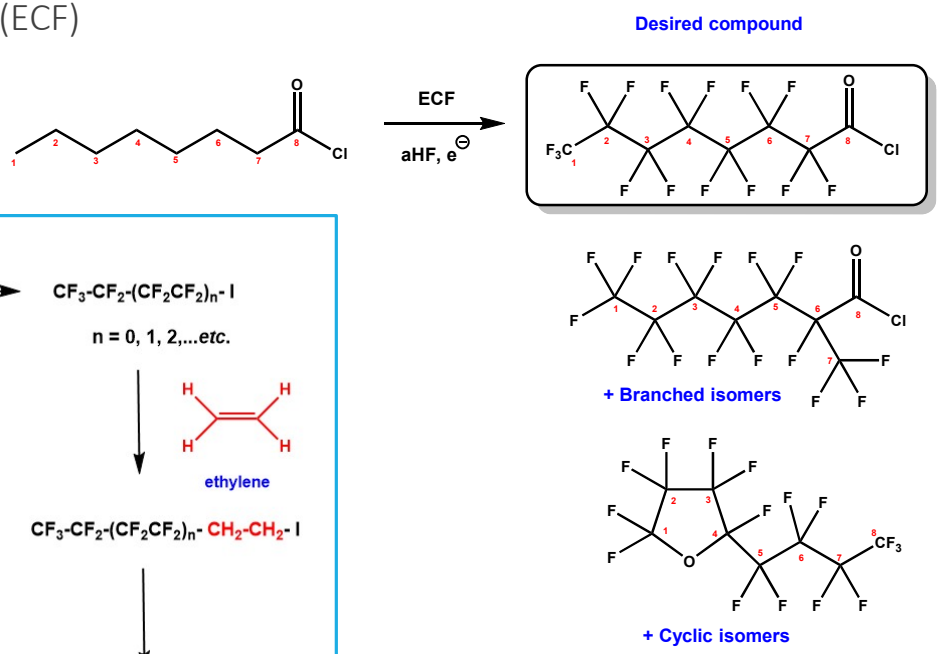


PFAS Process Chemistry

- Two major processes used to produce PFAS
  - Electrochemical fluorination (ECF)
  - Telomer



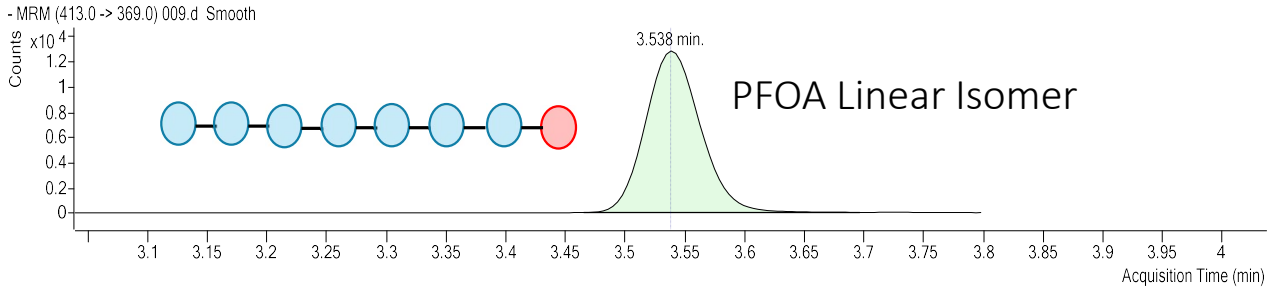
The ECF Process



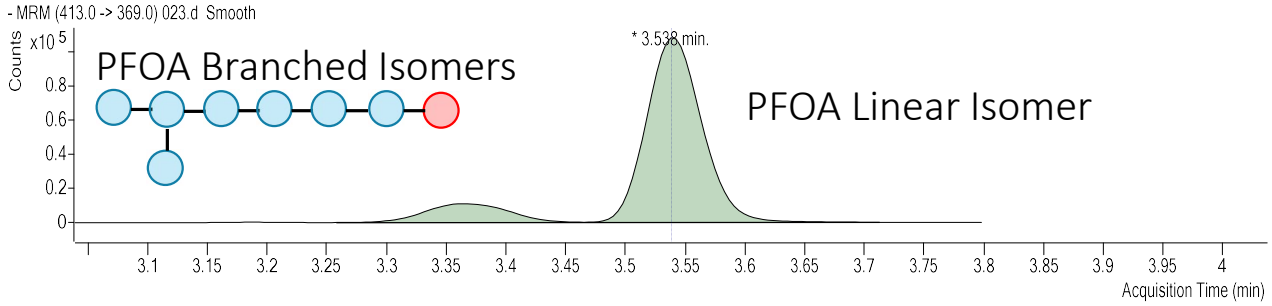
Figures courtesy of Chris Junk, CJIdeas LLC

Branched and Linear Isomers by LC-MS/MS

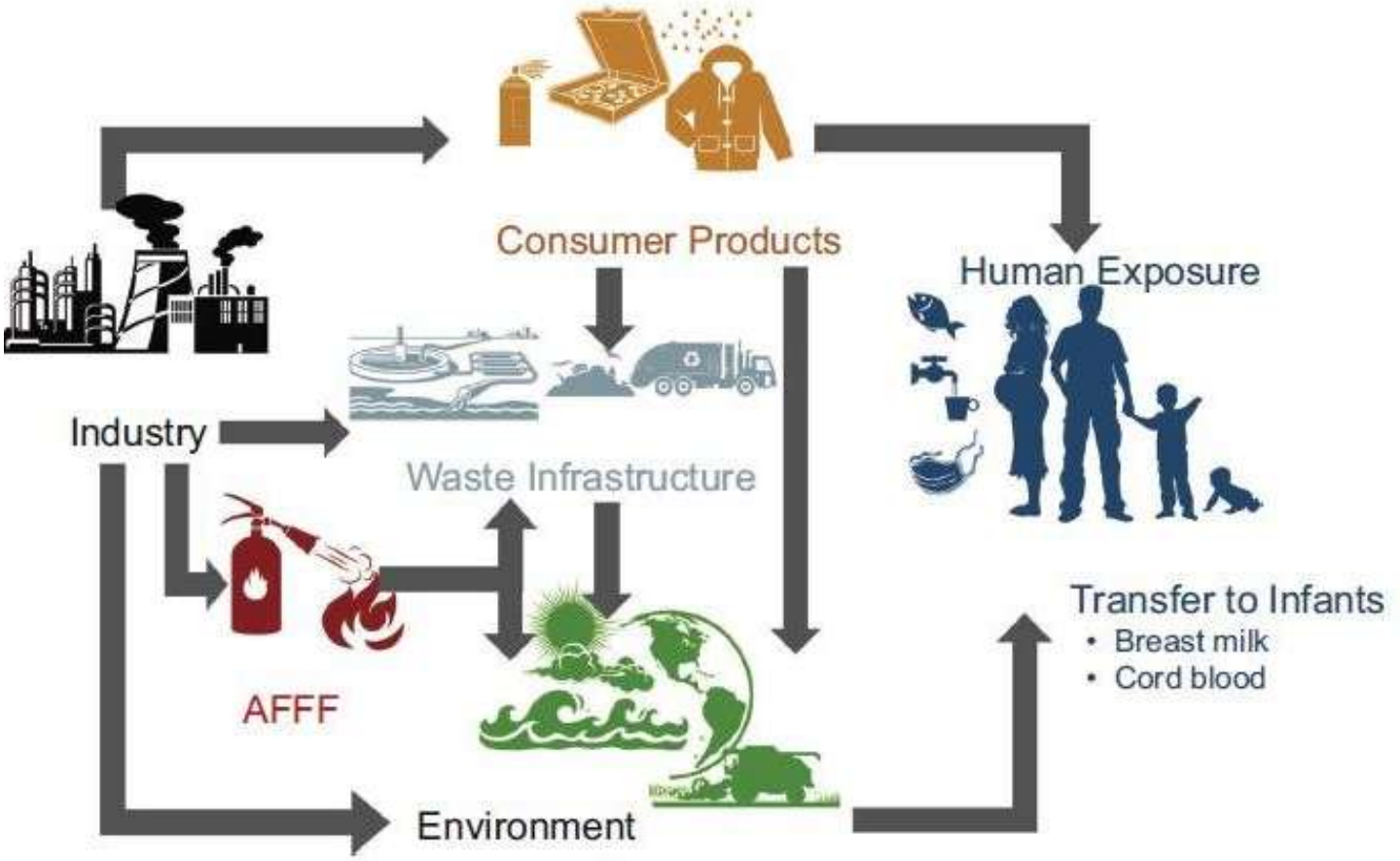
- PFOA - Telomer process



- PFOA – ECF process

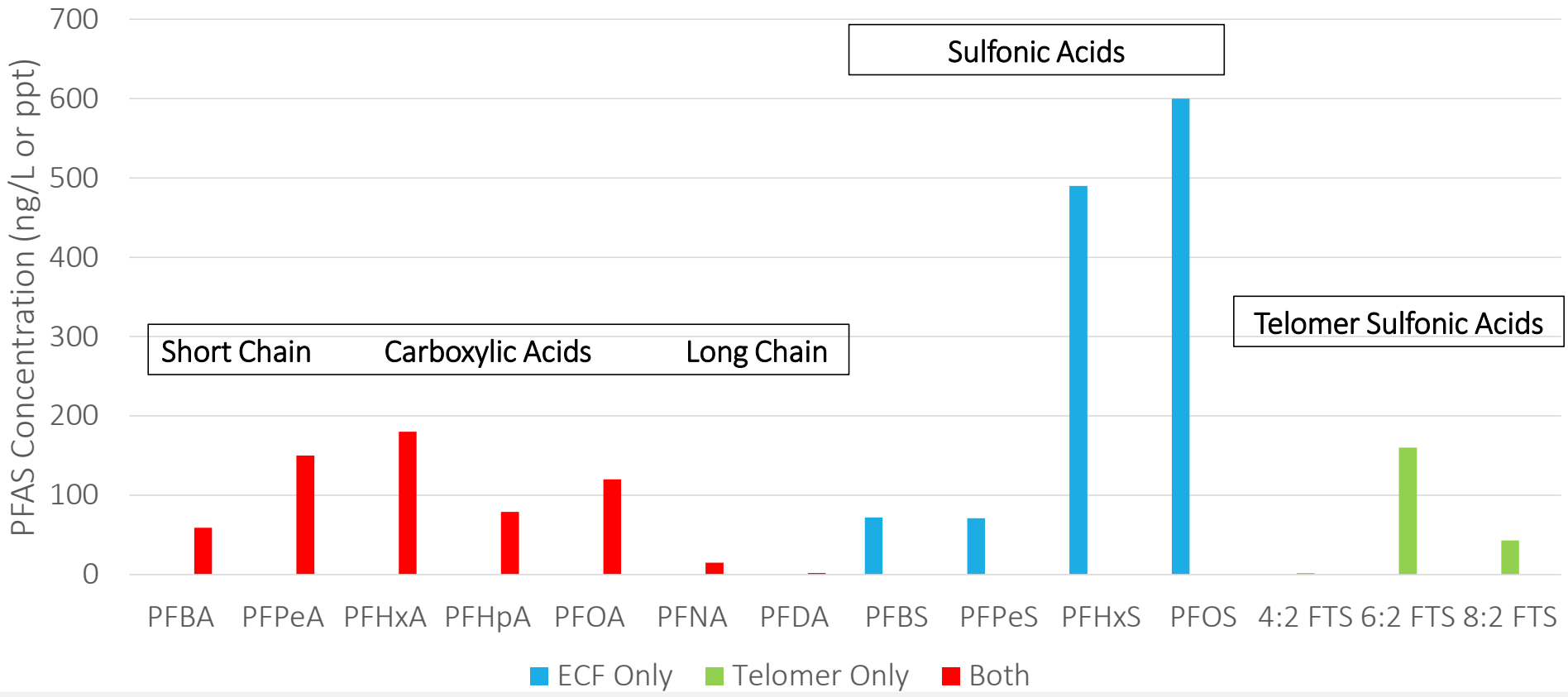


PFAS: Pathways of Releases into the Environment



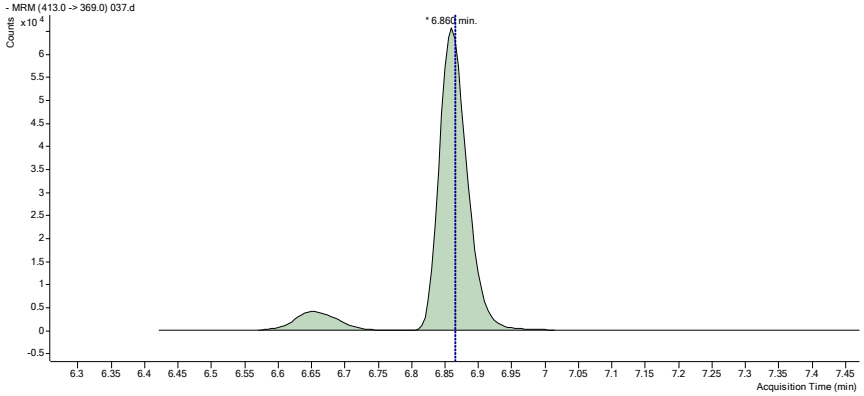
New Castle and Dover Well Water Analyses

(AFFF ECF Signature)

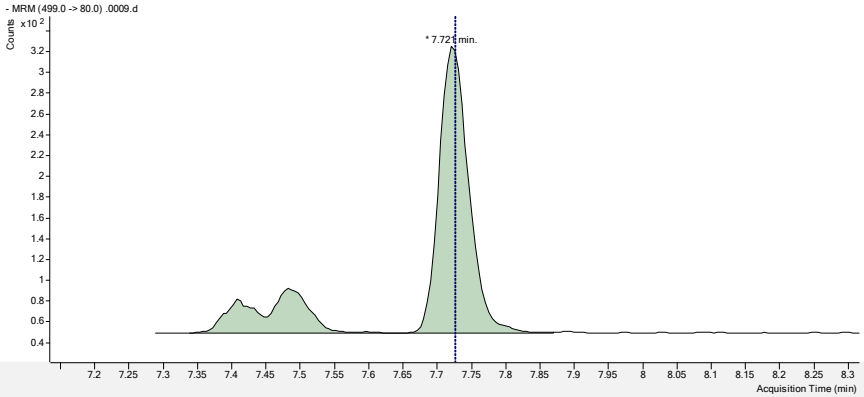


Interpretation of Profile Data

PFOA in New Castle well water



PFOS in New Castle well water



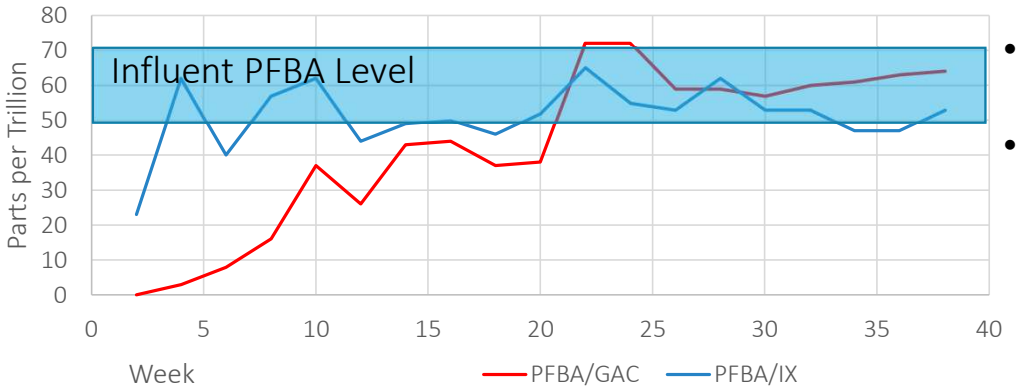
- Main source of PFAS contamination due to AFFF use at nearby USAF and DANG bases
- Dominance of branched PFCA and PFSA isomers reflects ECF produced AFFF (ca 1970 to 2000)
- Lower contribution of telomer produced materials reflects improved AFFF handling practices

Pilot Column Studies Conducted in New Castle, DE

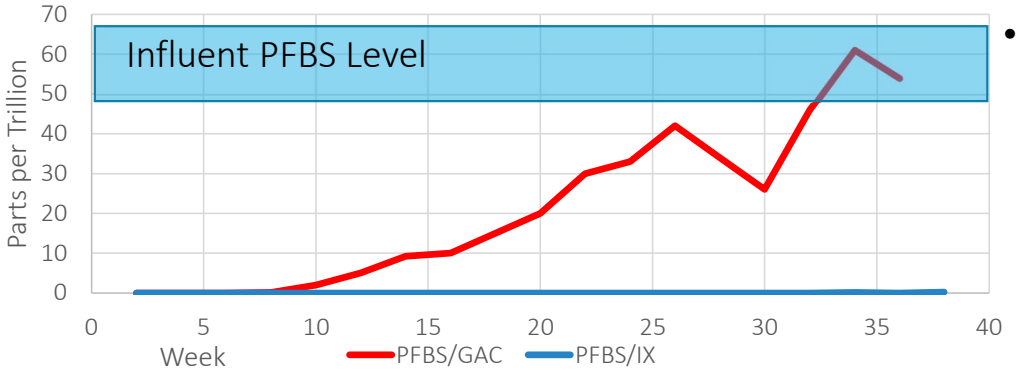
- Pilot column study in conjunction with Calgon Carbon and New Castle Municipal Services Corp.
- 2 GAC and 2 IX columns with developmental sorbents, sampled biweekly.
- Analysis of influent and effluents using EPA 537.1 and 533.

Pilot Column Study Setup

PFBA and PFBS Pilot Column Studies

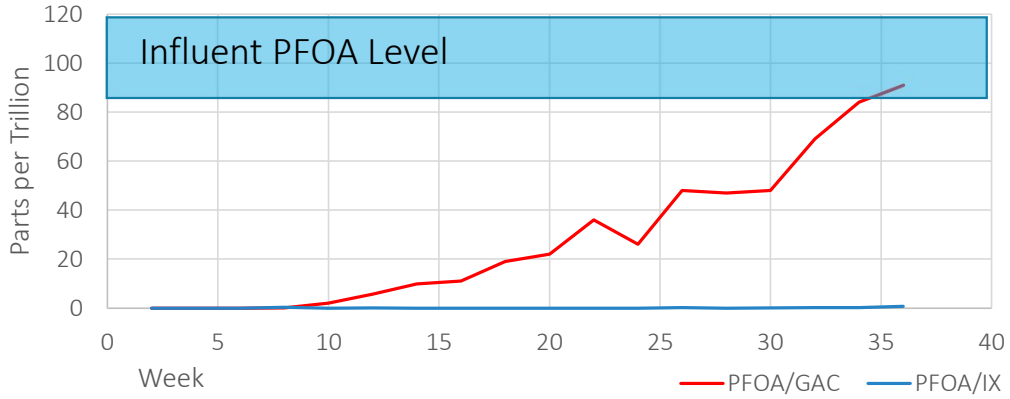


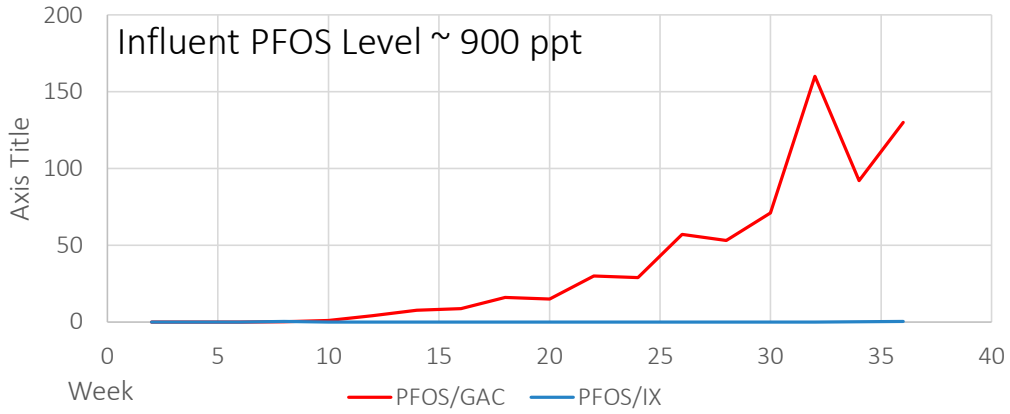
- PFBA broke through both sorbents early in the study.
- GAC showed somewhat better performance in the beginning.



- PFBS is strongly retained by the IX resin due to low organic matter and ionic strength of the influent.

PFOA and PFOS Pilot Column Studies

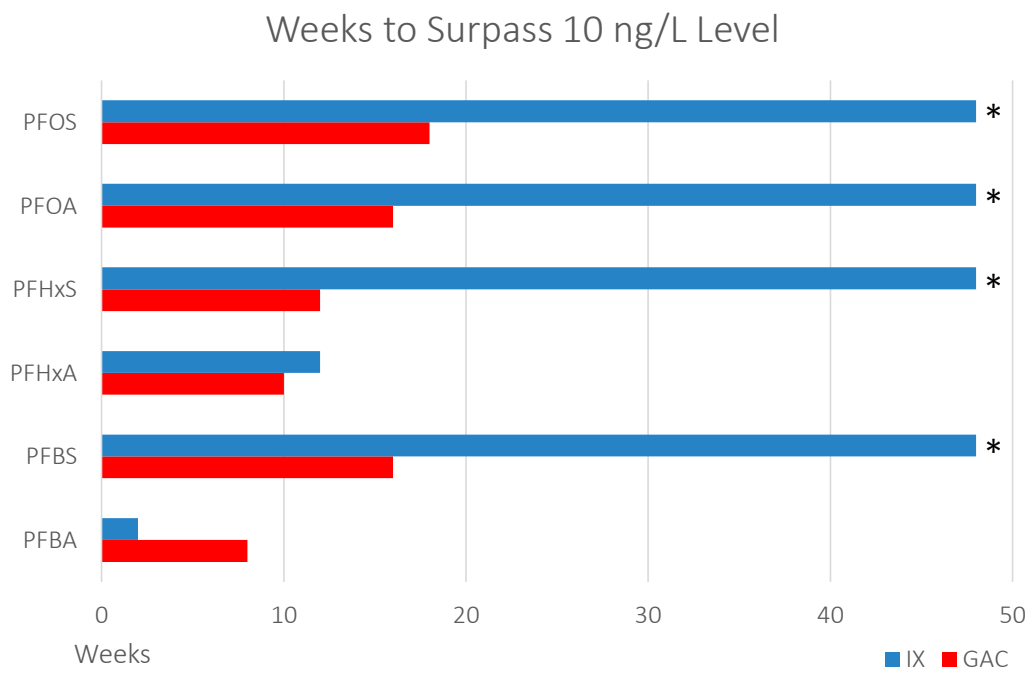




- PFOA is more strongly retained by the IX resin due to low organic matter and ionic strength of the influent.

- Both sorbents demonstrate good performance for PFOS.
- PFOS is more strongly retained by the IX resin due to low organic matter and ionic strength of the influent as well as the effect of the sulfonate group.

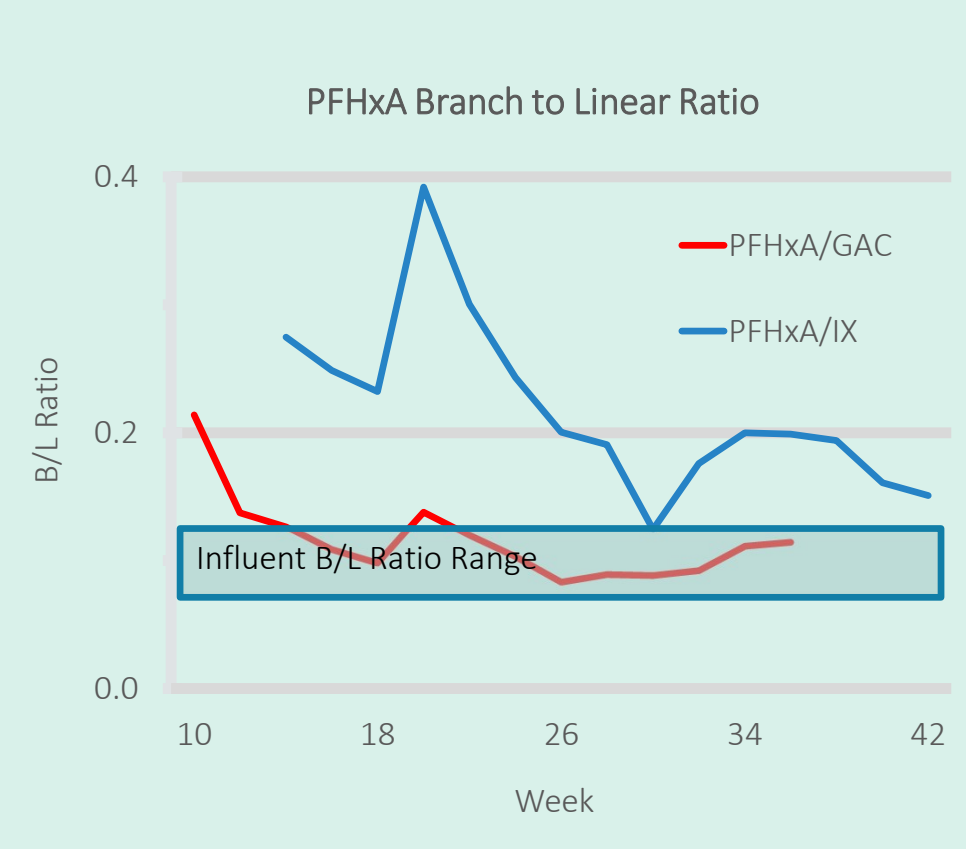
Summary – Early Breakthrough



* 10 ng/L not reached after 48 weeks

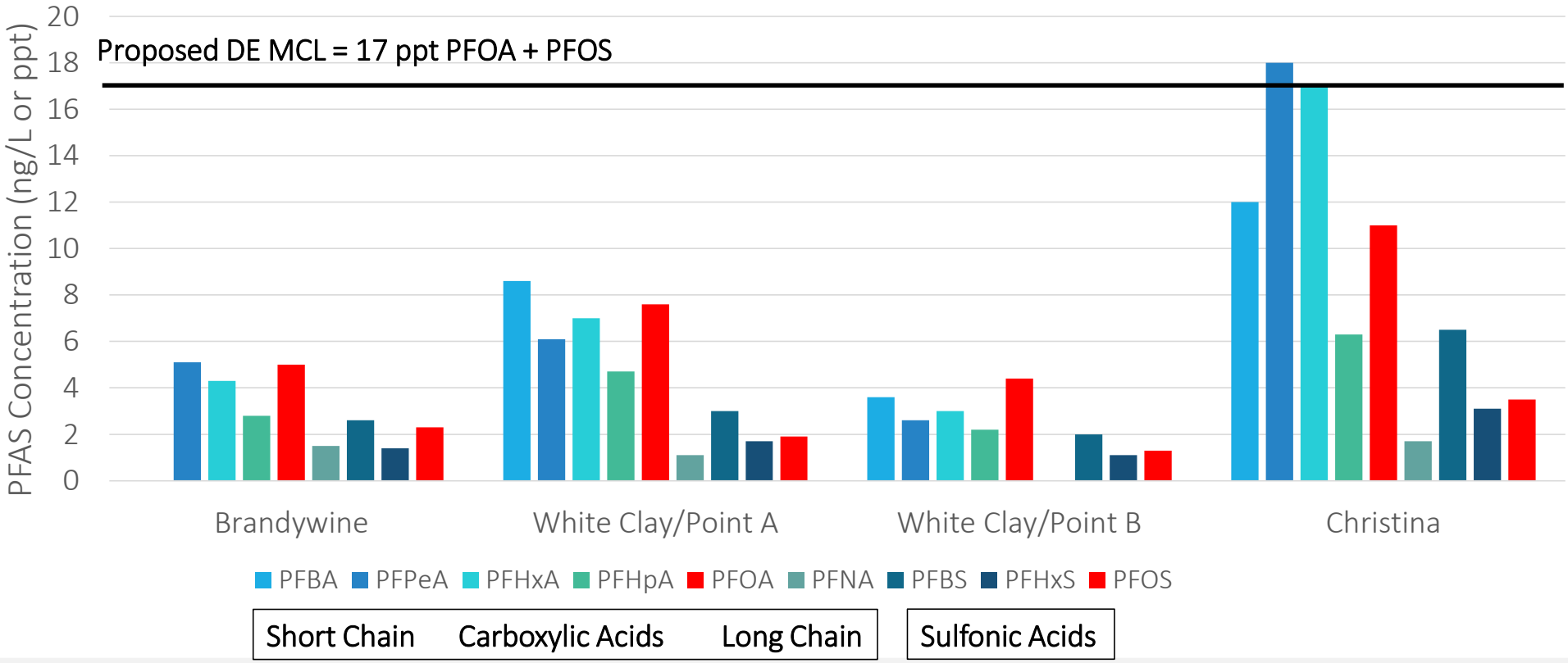
- Both commercial sorbents show good performance for long chain PFAS with reduced effectiveness for the short chain compounds.
- IX may be a better choice than GAC for this source water.
- PFBA (and PFPeA) are more strongly retained by GAC.
- Conclusion – there will a need for improved sorbents if short chain PFAS are to be addressed.

Branch/Linear Comparisons

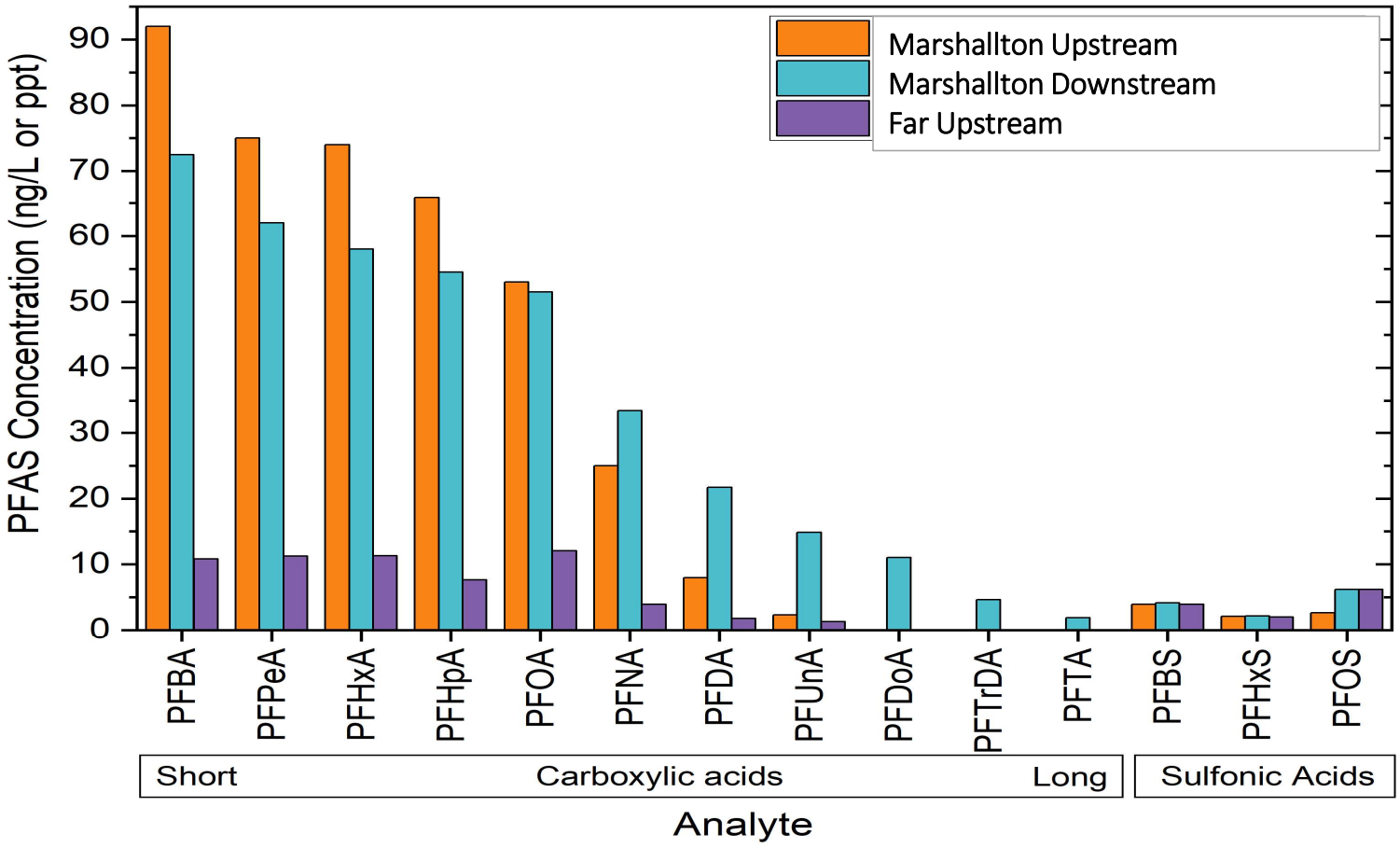


- Branched isomers were observed for all PFCAs with 6 or more carbon.
- Linear isomers adsorbed more strongly than branched on both GAC and IX, approached influent ratio upon breakthrough.
- Same trend observed for sulfonates.

Surface Water Analysis in New Castle County, DE



Red Clay Creek Water Analyses

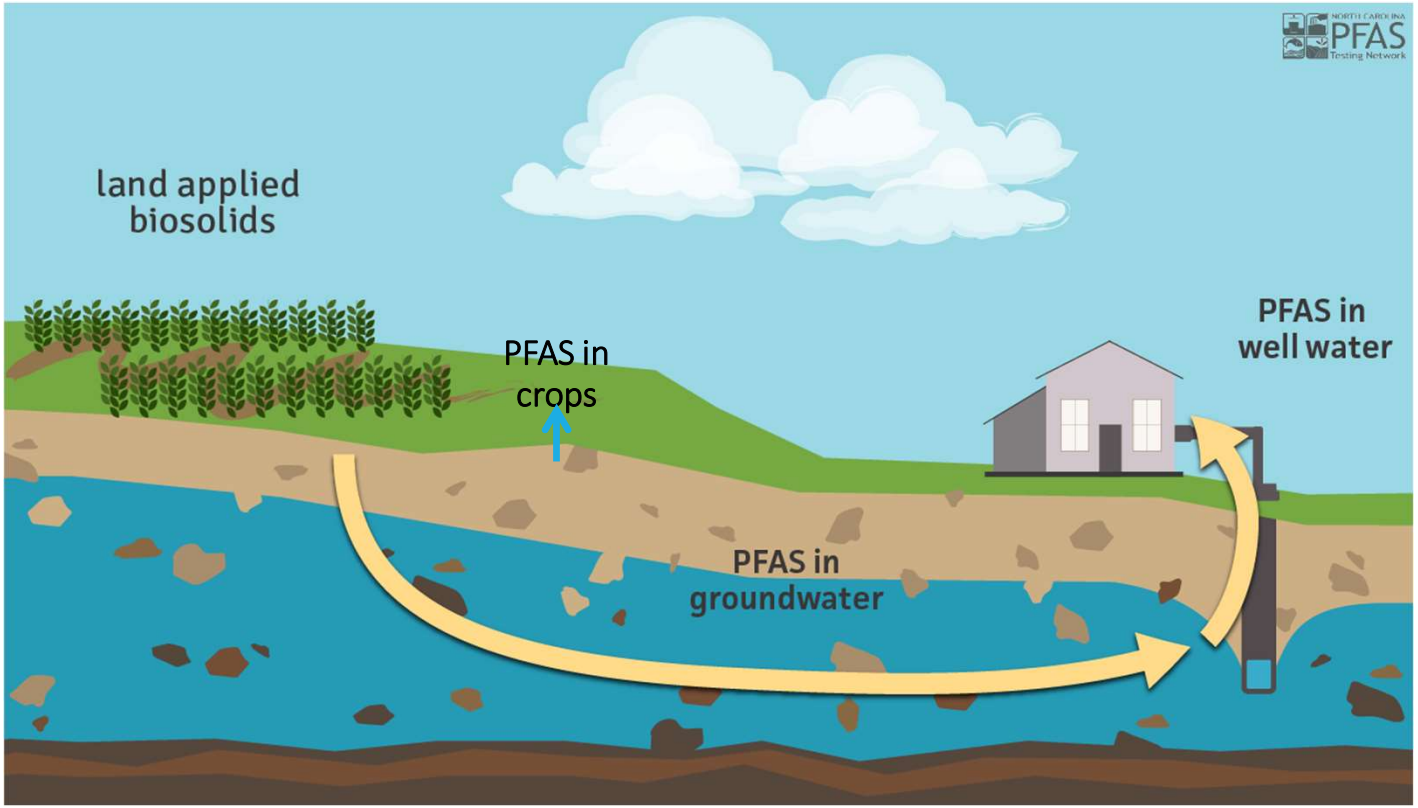


- Telomer signature

Red Clay Creek Conclusions

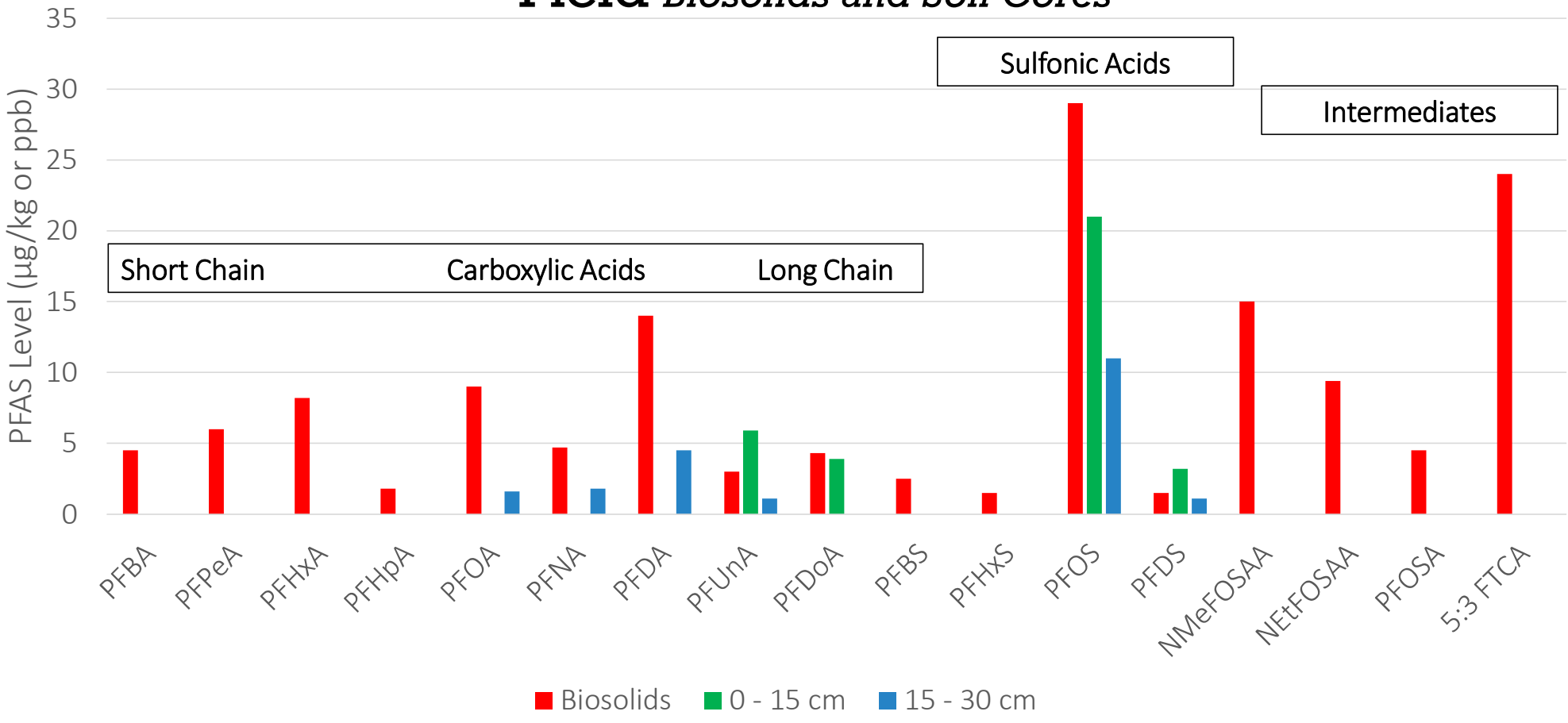
- Samples were collected upstream and downstream of a shuttered polymer processing plant
  - Main processes were powdering and irradiation of PTFE
- Explains signature oligomer distribution and lack of branched isomers
- Sulfonates likely came from source(s) further upstream
- Expect to find olefins and cyclic species as well

PFAS in Biosolids



USDA/FFAR Stroud/PFAS Solutions Joint PFAS Project

Field *Biosolids and Soil Cores*



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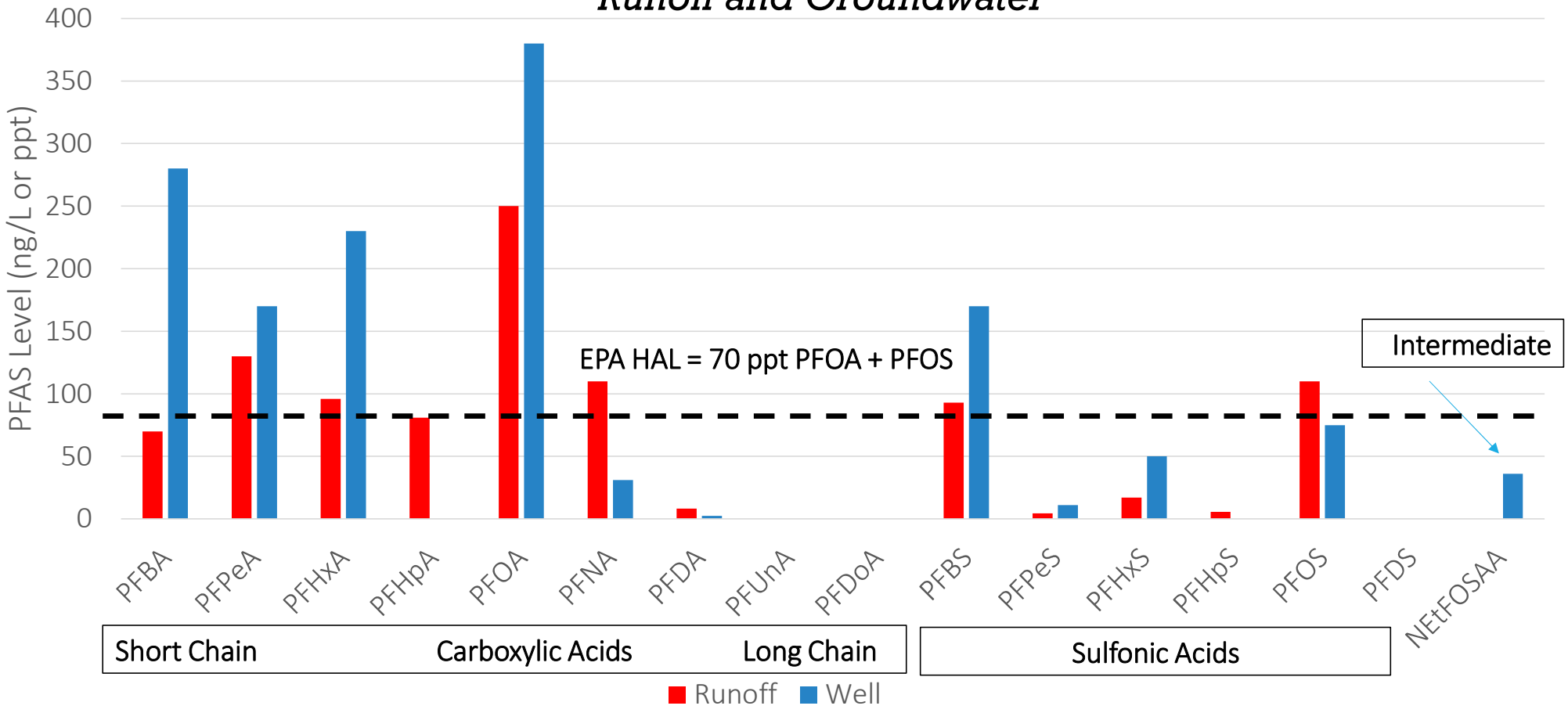
Runoff and Groundwater



Farm-Applied Biosolids Conclusions

- Soil cores taken from fields at same farm where biosolids were not applied had negligible PFAS levels
- Shorter chain compounds showed preferential migration to groundwater as expected
- Intermediates found in biosolids appear to transform into terminals in soil and water

Acknowledgements

PFAS Solutions

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