



# PFAS detection in Cape Cod, MA watersheds

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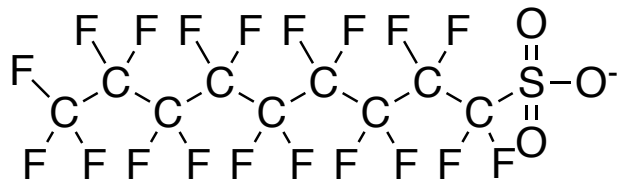
Santuit River  
July 2018



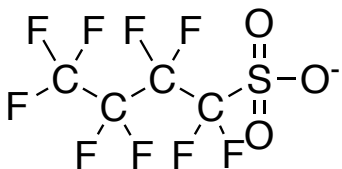
# What are PFAS?

## Carbon – fluorine chemicals produced by humans

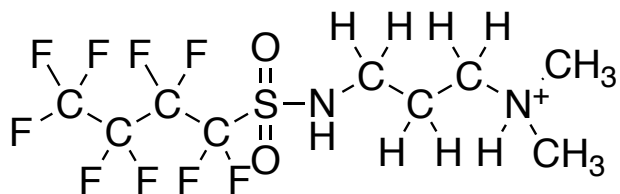
### long chain (C9) terminal



### short chain (C4) terminal



### short chain (C4) precursor



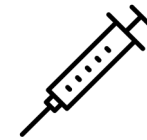
## Many PFAS sources on Cape Cod



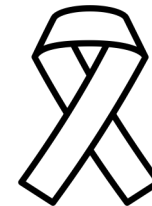
## Adverse health effects (examples)



Liver and kidney  
disease



Decreased  
antibodies after  
vaccination



Kidney and  
testicular cancer



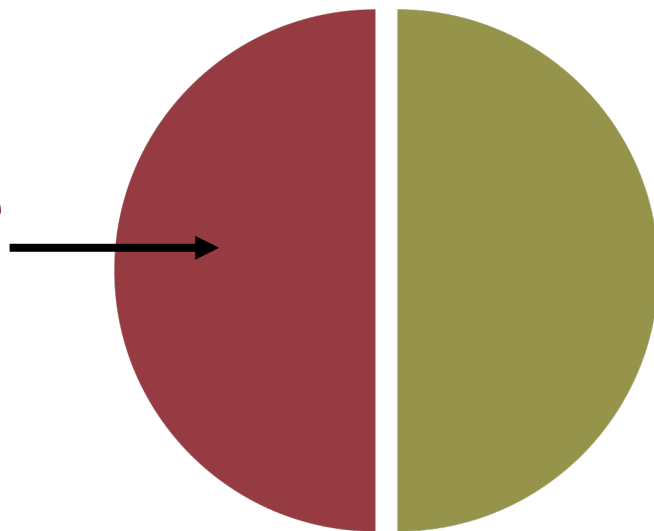
High cholesterol  
and obesity

# Thousands of new PFAS structures

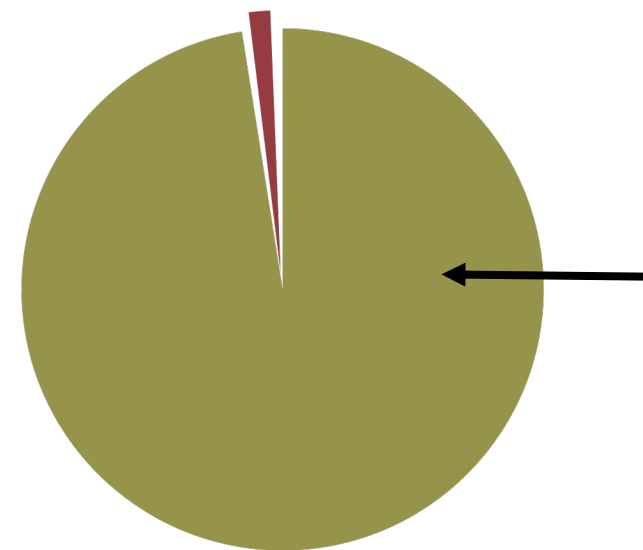
Many are precursors that degrade into terminal PFAS of concern

**PFAS in aqueous film forming foams (AFFF) used for fire-fighting**

Terminal PFAS  
(i.e., detectable  
using standard  
EPA method)



Old foams



Precursors (i.e.,  
not detectable  
using standard  
EPA method)

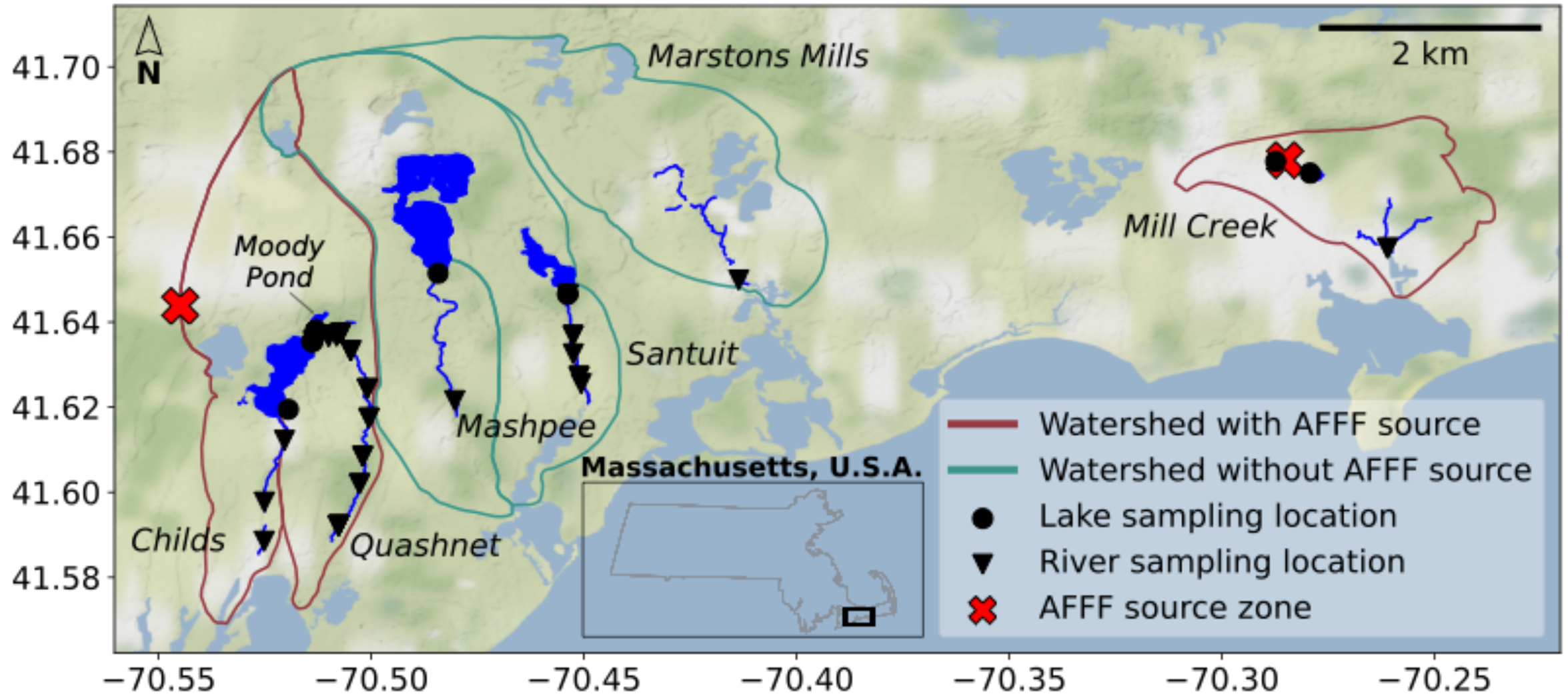
New foams

# Study goals



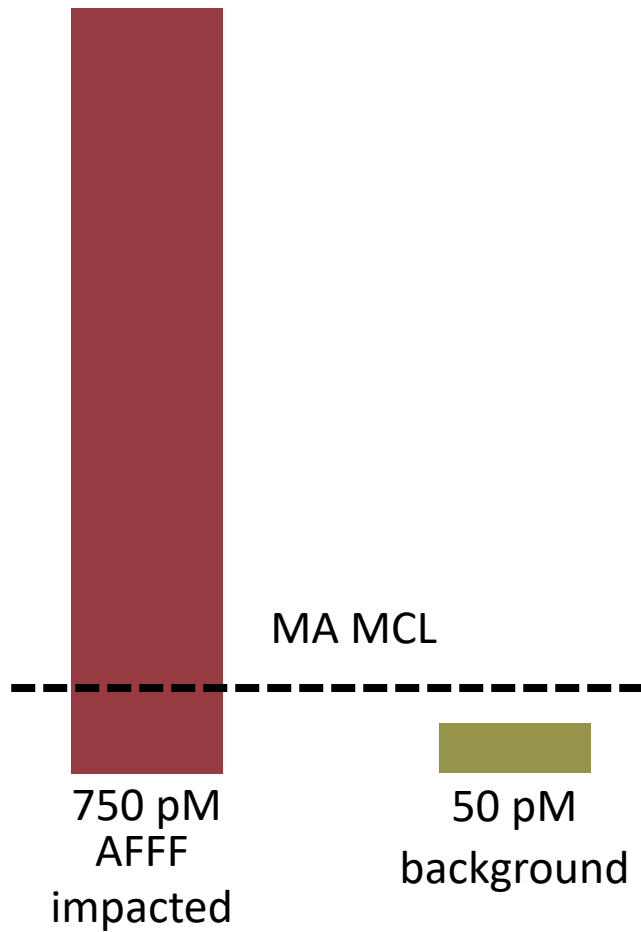
- Can PFAS from AFFF be distinguished from other sources in watersheds?
- How much organic fluorine on Cape Cod is accounted for by EPA's PFAS testing protocols and precursors?

# Sampling overview



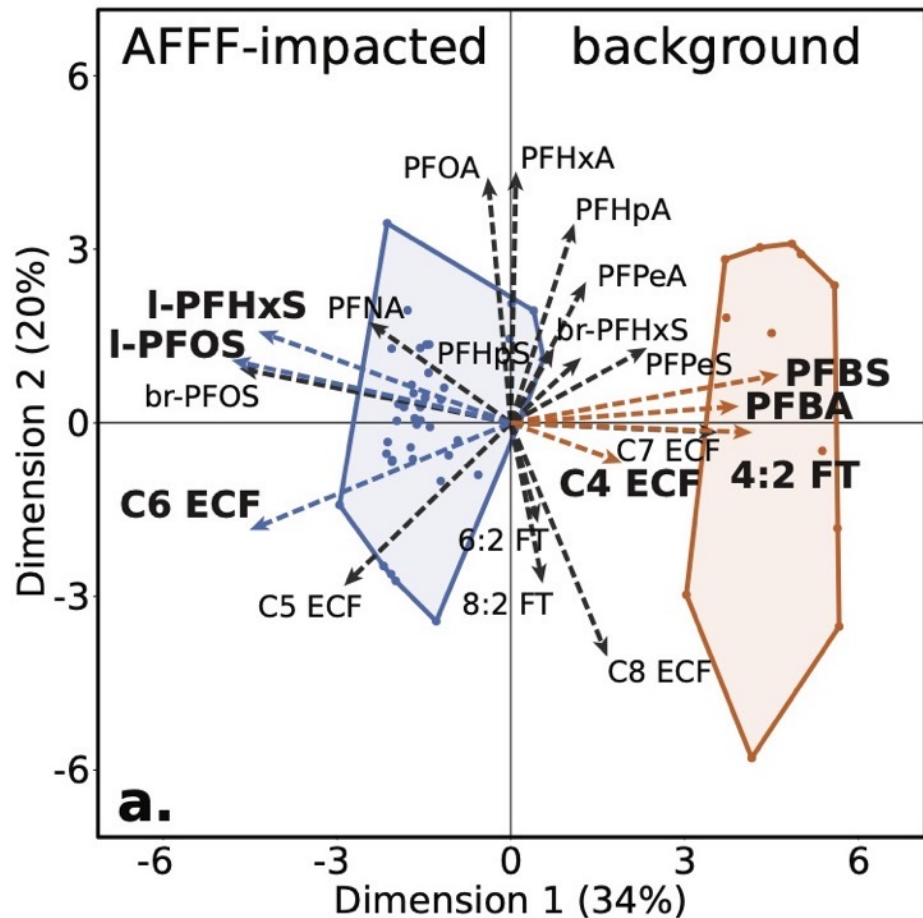
# PFAS detectable in all samples

## Average PFAS Concentrations



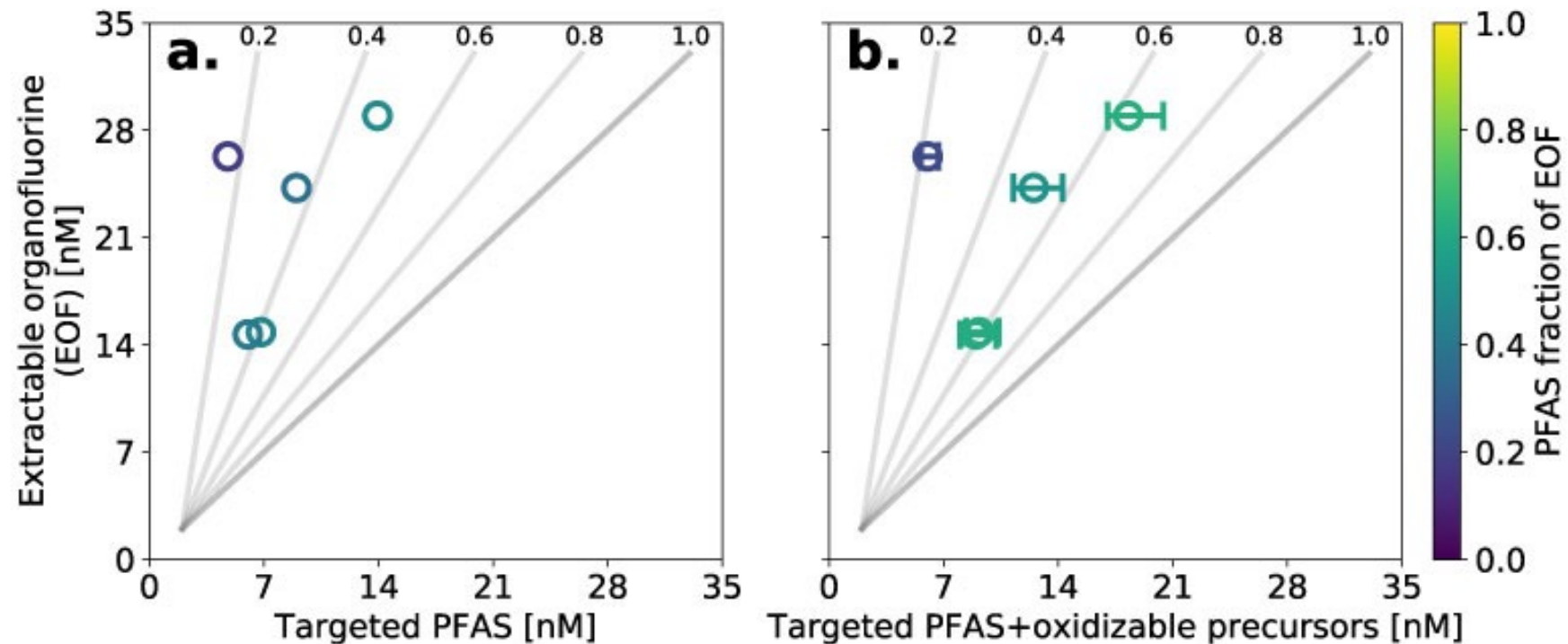
Ruyle, B. J.; Pickard, H. M.; LeBlanc, D. R.; Tokranov, A. K.; Thackray, C. P.; Hu, X. C.; Vecitis, C. D.; Sunderland, E. M.. *Environ. Sci. Technol.* **2021**, *55* (6), 3686–3695.

# AFFF source in PFAS profiles



# High concentrations of unknown organic fluorine in AFFF impacted rivers

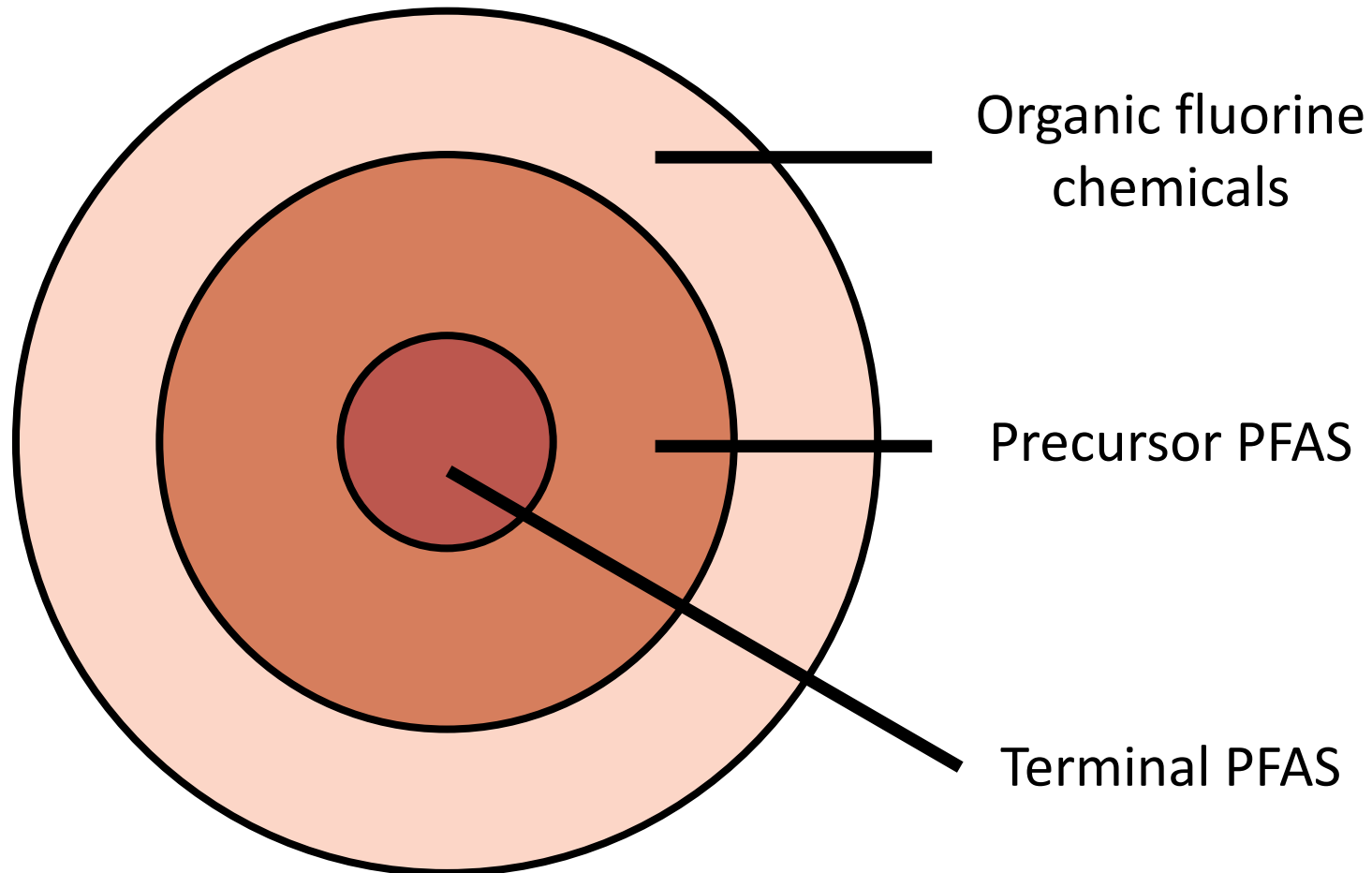
All PFAS in AFFF can be accounted for in the TOP assay so the source of unknown organic fluorine must be different



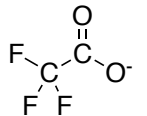
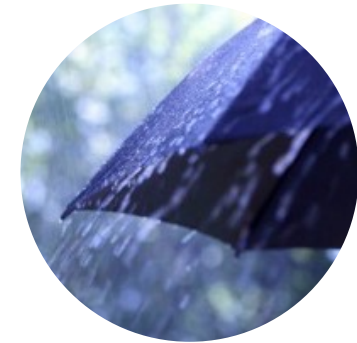
40 to 80% of unknown organic fluorine chemicals identified in the Quashnet



# Future work to identify unknown PFAS



Ultrashort terminal PFAS



Fluorinated pharmaceuticals and agrochemicals



These chemicals are not traditionally thought to be PFAS but some could form ultrashort terminal PFAS

# Summary

- PFAS detected in all samples from Cape Cod watersheds
- Watersheds impacted by AFFF-use have highest PFAS concentrations and exceed MA MCL for drinking water in most locations (Sum of PFOS, PFOA, PFHxS, PFHpA, PFNA, and PFDA greater than 20 ppt)
- AFFF source clearly identifiable in PFAS profiles
- Precursors make up 20-30% of PFAS at most locations on Cape Cod
- 40-80% of organic fluorine remains unknown in Quashnet River