

PFAS COMPOSITION IN SURFACE WATER ECOLOGIES

International Symposium on
Bioremediation and Sustainable
Environmental Technologies

Baltimore, Maryland
15-18 April 2019

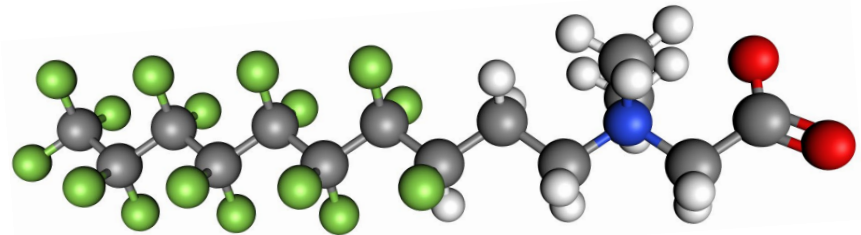


Andrew Mitchell, RPS
Casey O'Farrell, Coffey
Sarah Richards, Coffey



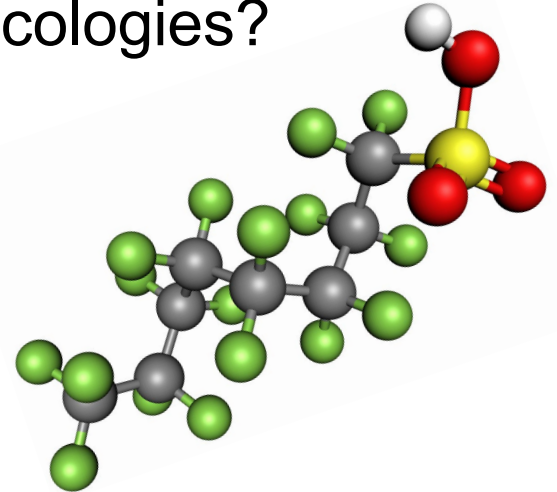
Disclaimer and Attribution

- I am an employee of RPS and a contractor to the Australian Department of Defence
- The data used in this presentation is publicly available at <http://www.defence.gov.au/Environment/PFAS/>
- This presentation is my original work and does not necessarily represent the views of the Department of Defence



Presentation Overview

1. Overview of the Defence PFAS program
2. Context from a large PFAS data set
3. Outline of this study
4. What happens to PFAS in surface water ecologies?
5. Why is that important?
6. What does that mean for you?

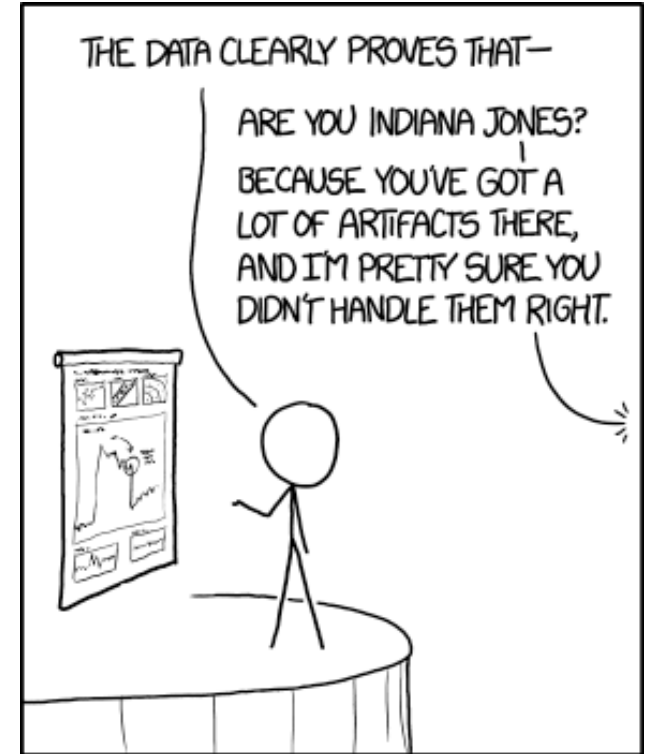


Overview of Defence investigations

- Legacy of extensive use of AFFF
- 27 bases investigated between 2016 and 2019
- Investigation area sizes ranged from 16 km² to 180 km² ; median = 40 km²
- >40,000 environmental samples have been analysed for PFAS including 6500 groundwater, 3200 surface water, 2000 point of use water, 9600 soil, 2600 sediment, 1900 leached soils and 4500 biota
- Most investigations delivered a detailed site investigation report within 12 months that included comprehensive sampling of receptors

A high-level view of a large data set

- Which PFAS are present?
 - Soil and sediment
 - Groundwater and surface water
 - Biota
- What about precursors?
- How far can PFAS travel?
- What questions does this raise?

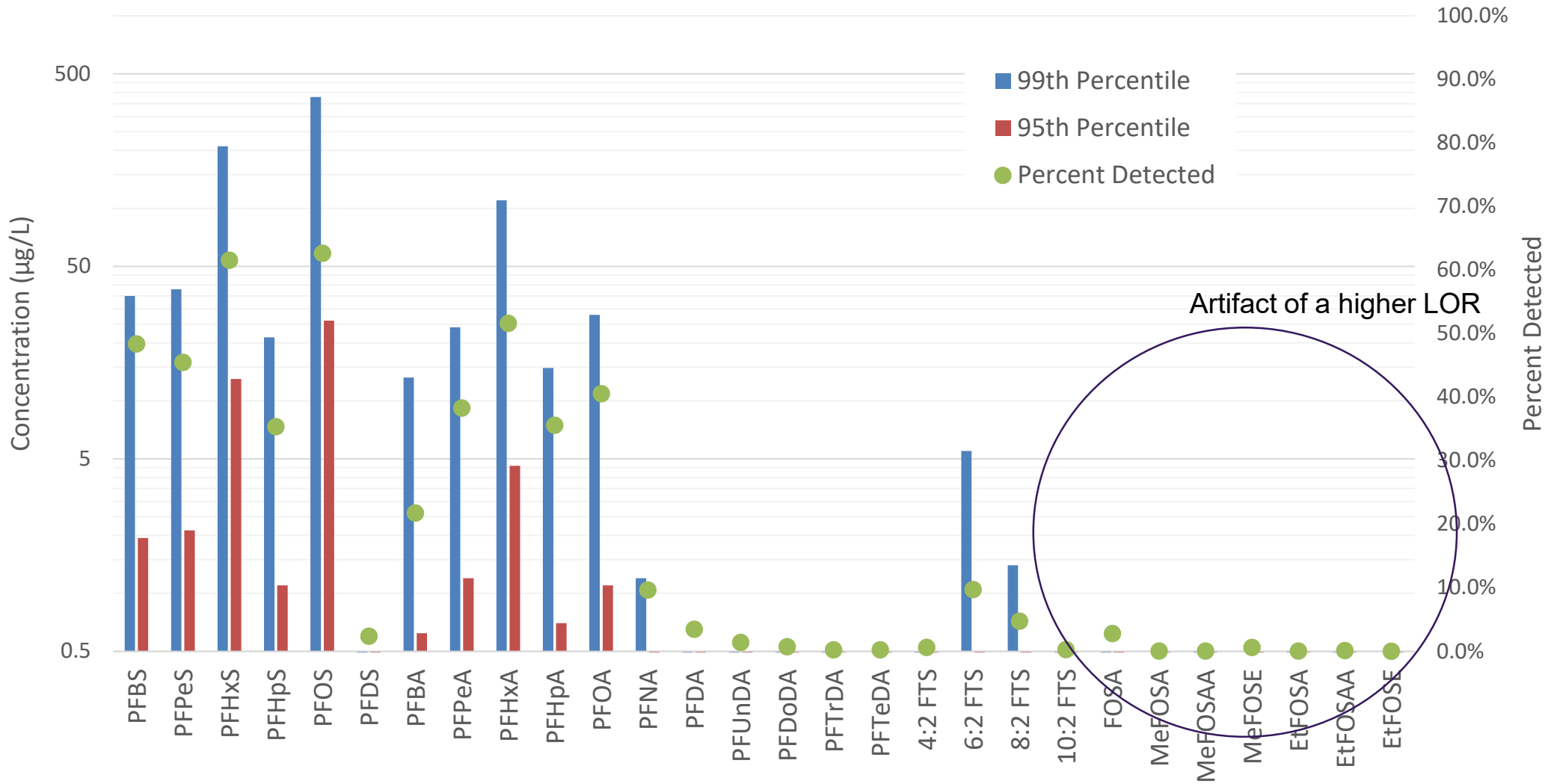


<https://xkcd.com/1781/>

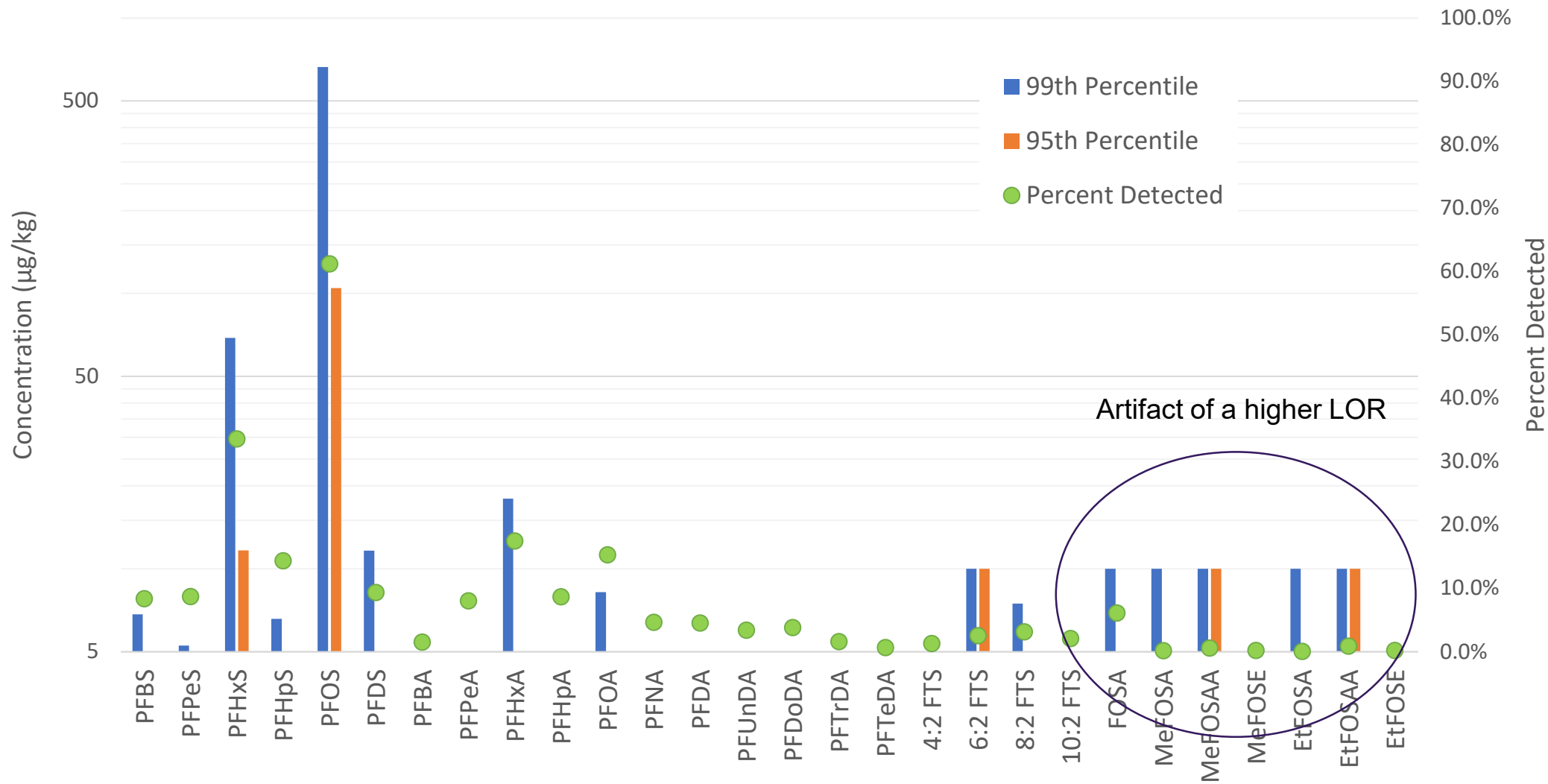
And now for some graphs

- Displaying 95th and 99th percentile to highlight different PFAS
- Displaying 90th percentile to examine the behaviour of specific PFAS
- Censored data (non-detects) included at LOR
- Log scale
- Percent detected and number of samples shown where relevant
- Grouping and categories used to smooth the data in some cases

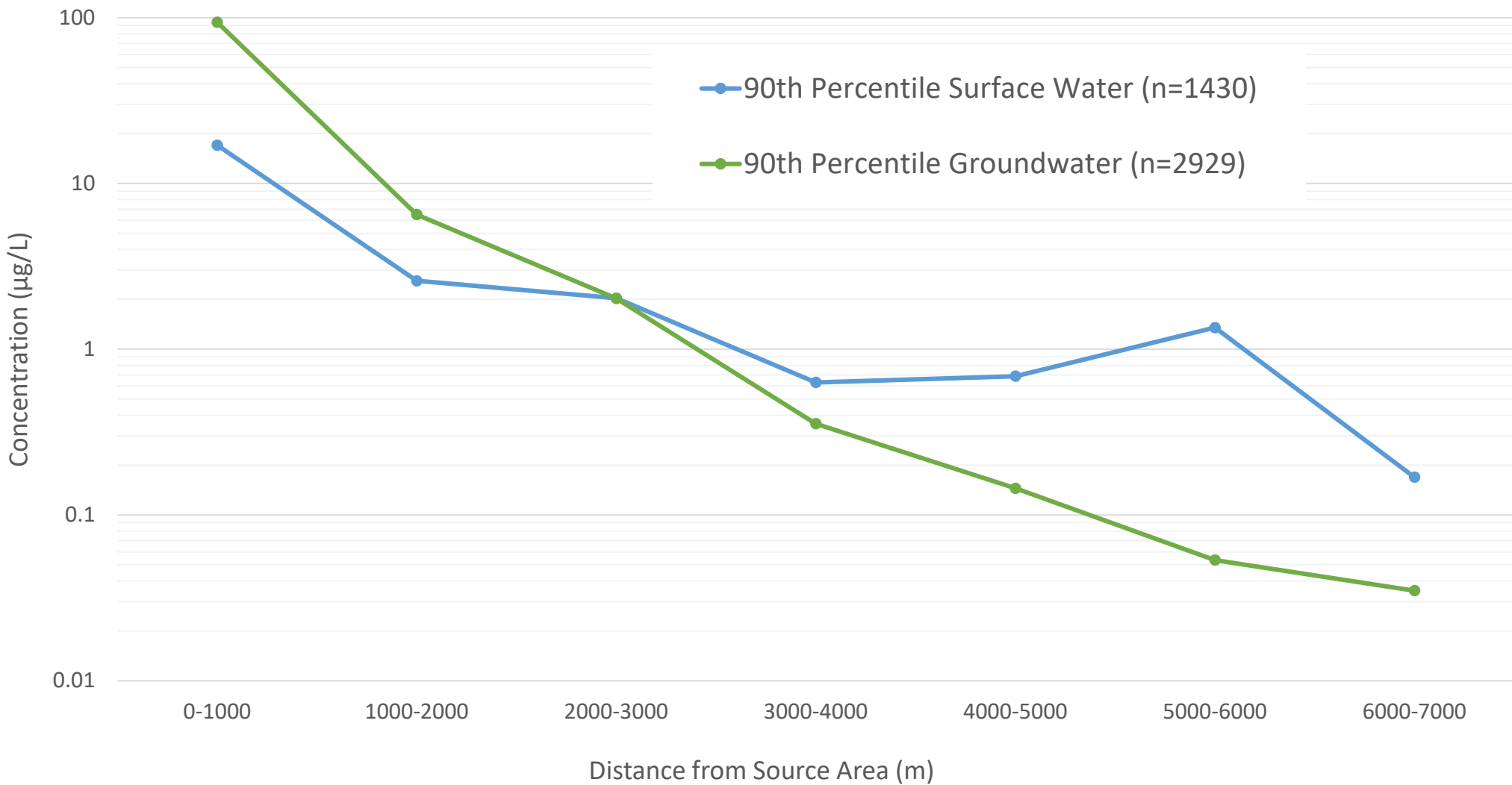
PFAS in Surface Water and Groundwater - all data (n=12023)



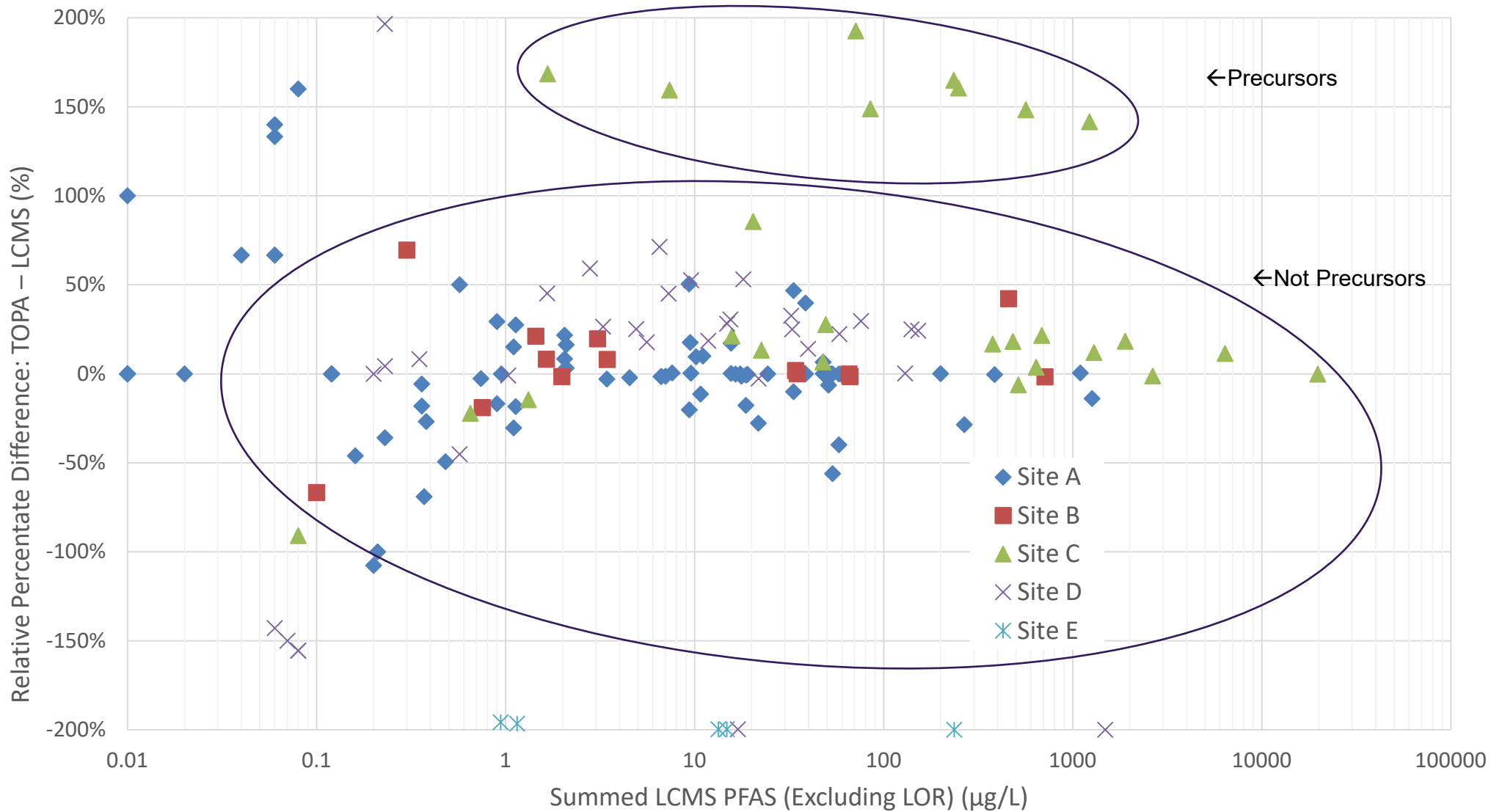
PFAS in Sediments > 500m from Source Area (n=2091)



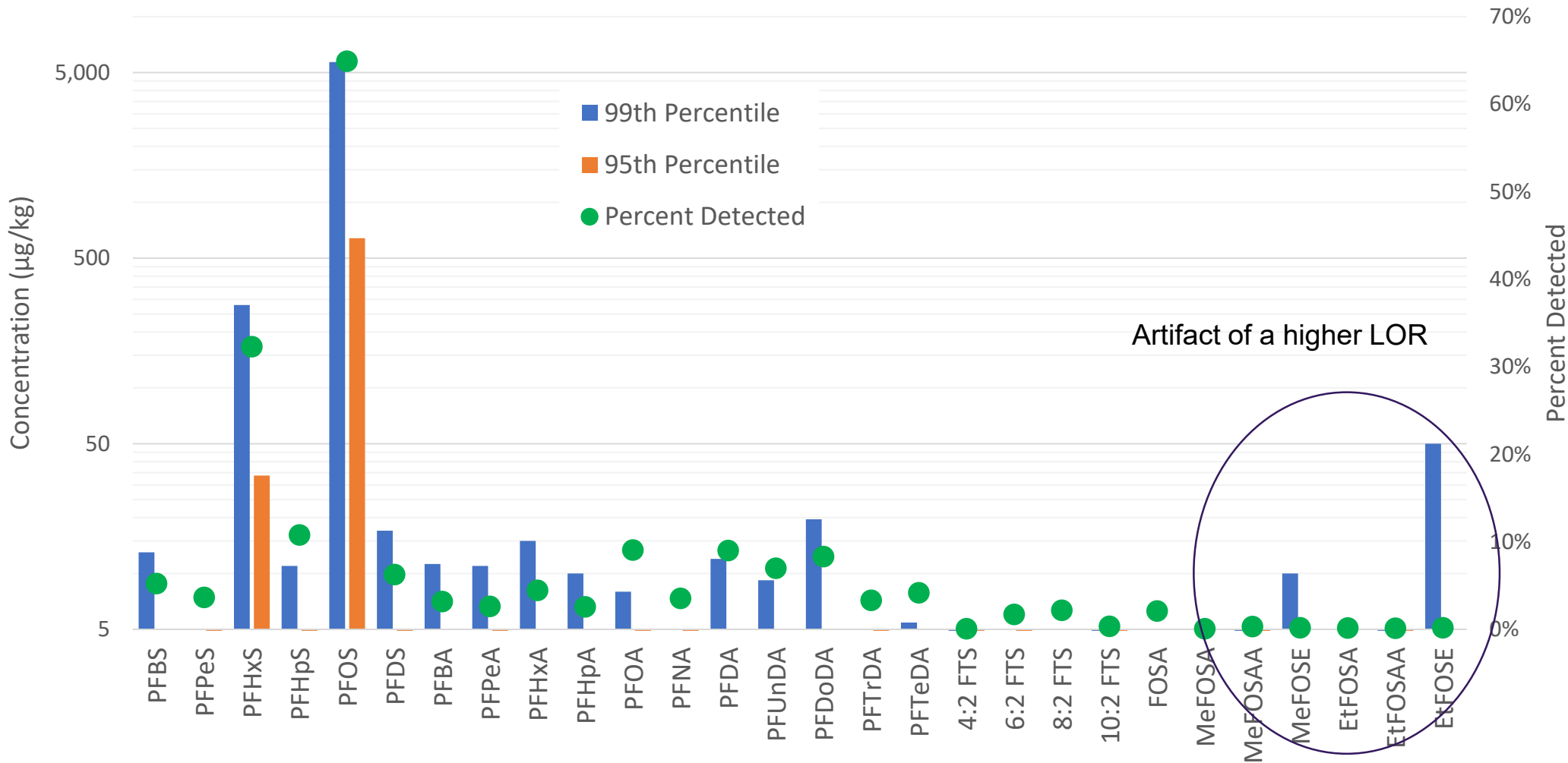
PFOS + PFHxS in Water by Distance from Source Area



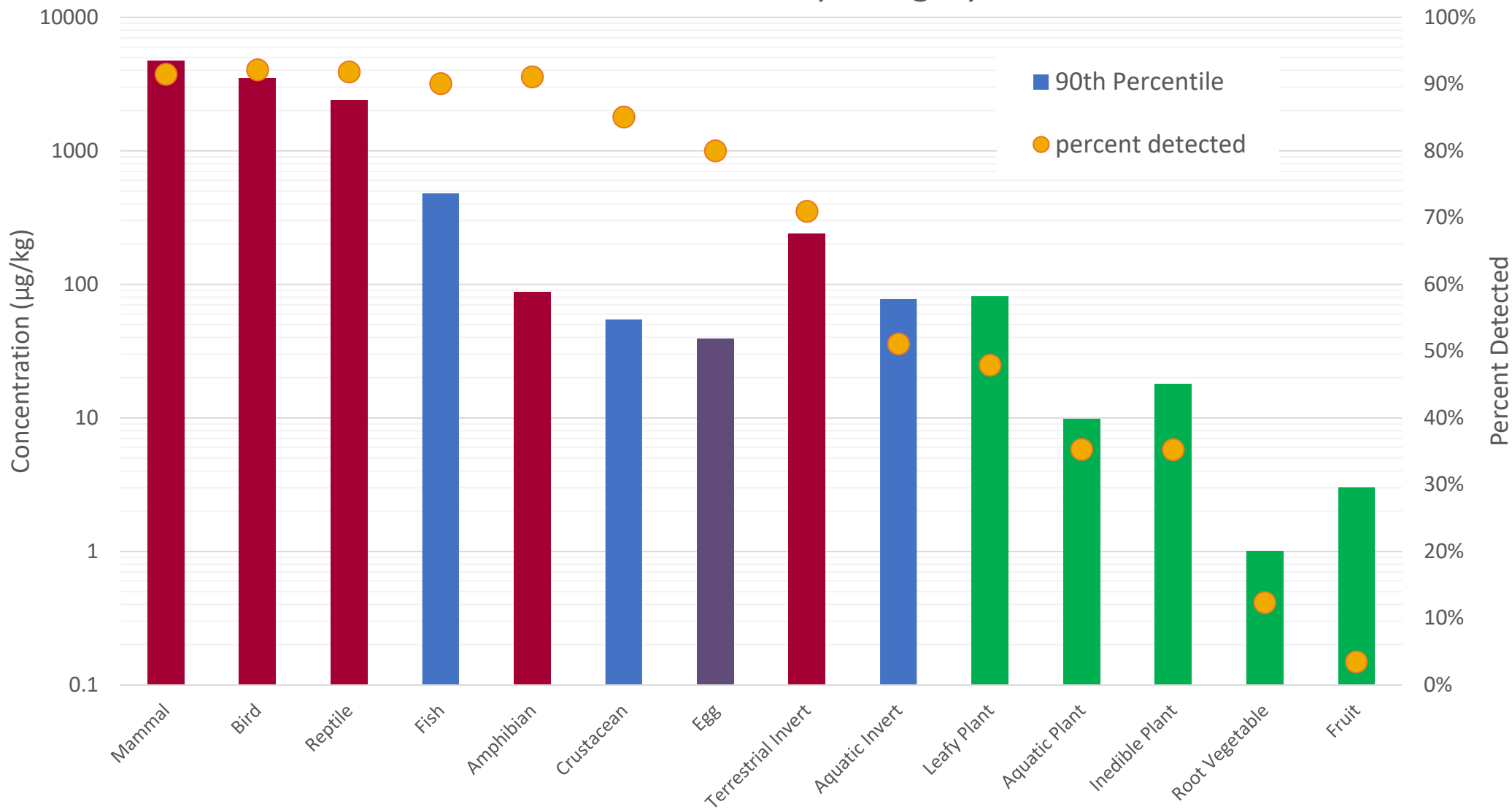
Analysis of Total Oxidisable Precursor Assay results for PFAS in Water (n=179)



PFAS in Biota - all data (n=4158)



PFOS in Biota by Category



Some Key Observations

- PFHxA is detected more often and at higher levels than PFOA
- PFOS and PFHxS are the primary PFAS distant from the source
 - in groundwater, surface water, sediments and biota
- TOPA should be used with judgement, to answer specific questions
- Lung breathers generally have higher levels than gill breathers
- Uptake to plants is much less significant

Study areas

- Four bases selected for in-depth assessment
- All have significant contamination sources which have impacted surface water systems
- All have extensive sampling of surface water, sediments and biota
- Conceptual sites models were prepared by the relevant consultants
- Calculated PFAS ranges at different distances along the creeks

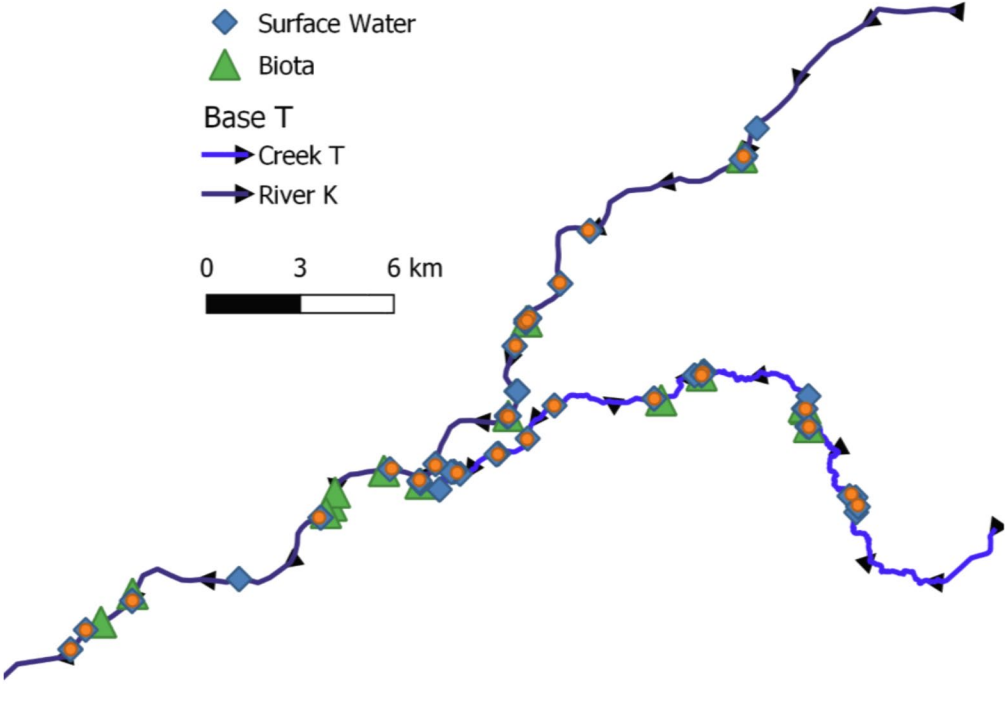
- Sediment
- ◆ Surface Water
- ▲ Biota

Base T

→ Creek T

→ River K

0 3 6 km



- Sediment
- ◆ Surface Water
- ▲ Biota

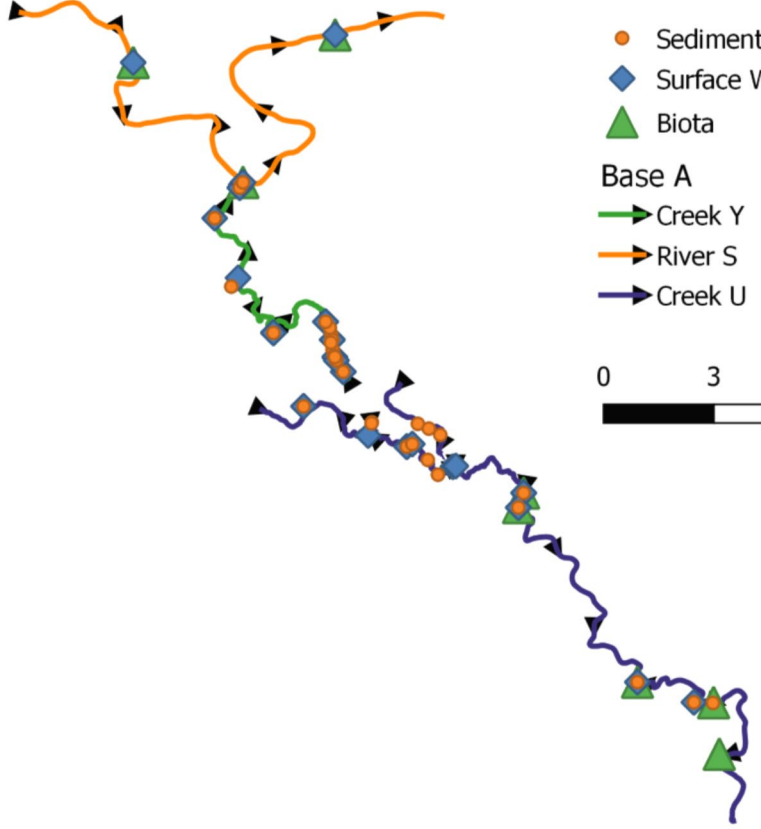
Base A

→ Creek Y

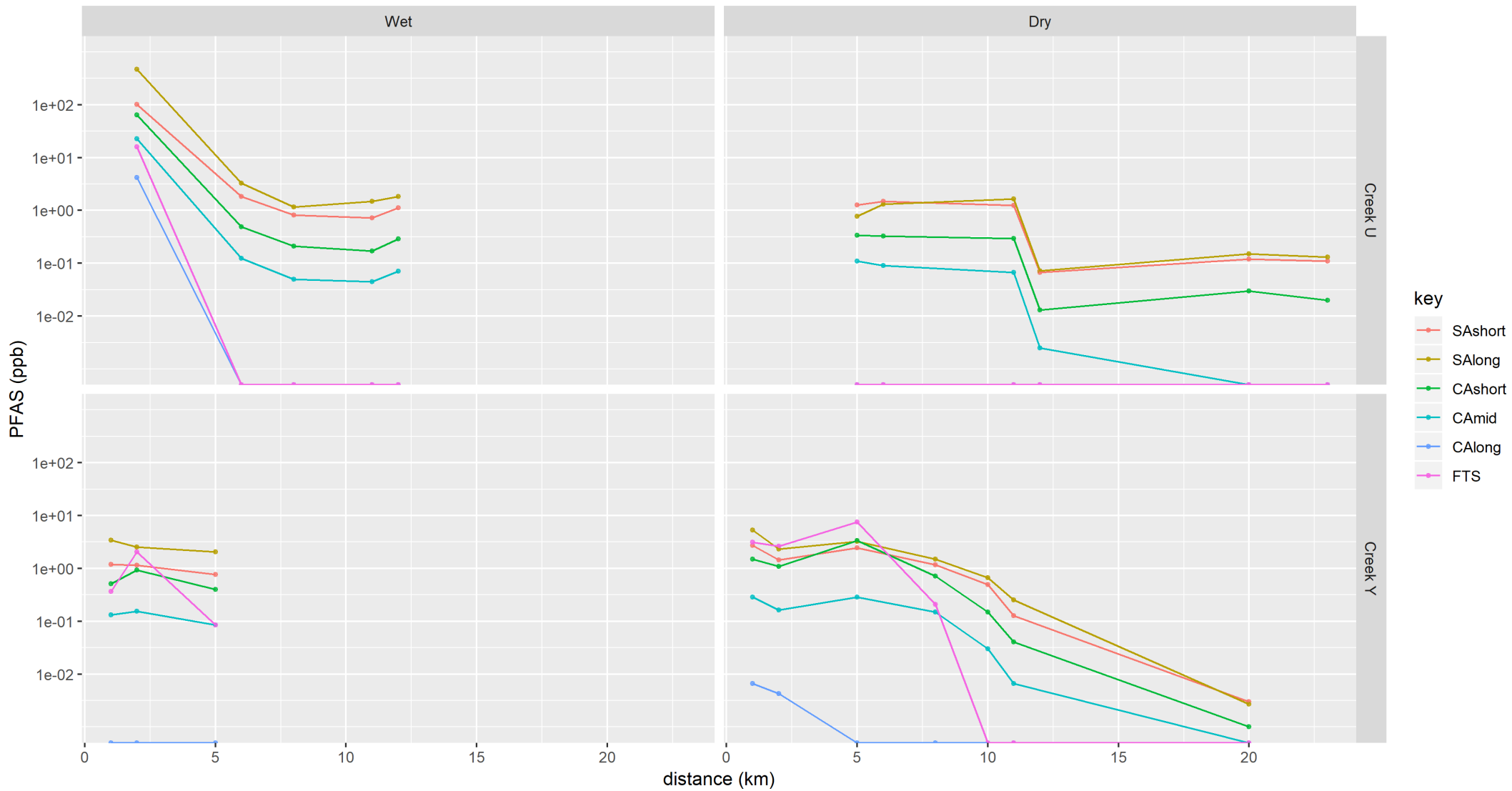
→ River S

→ Creek U

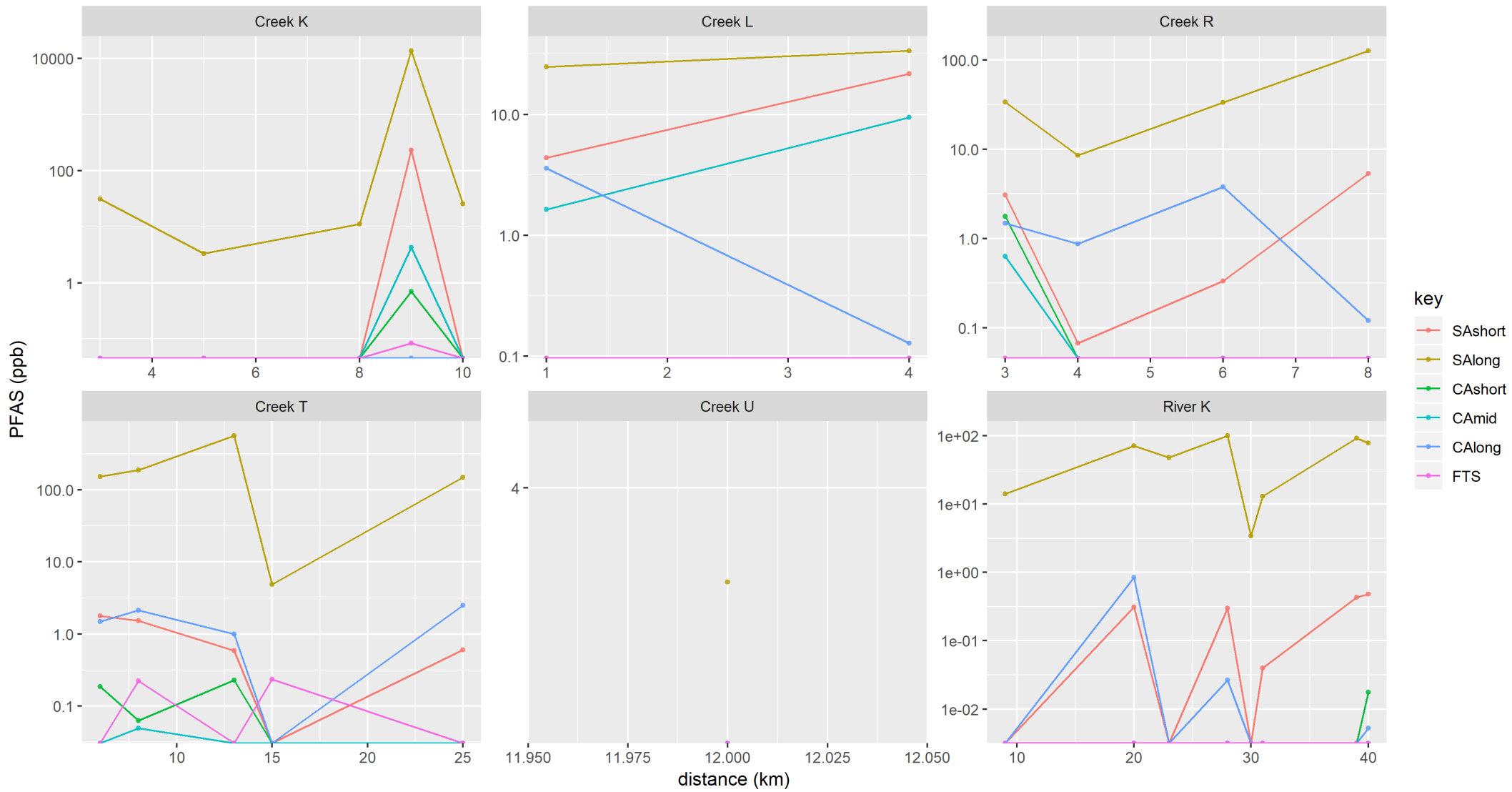
0 3 6 km



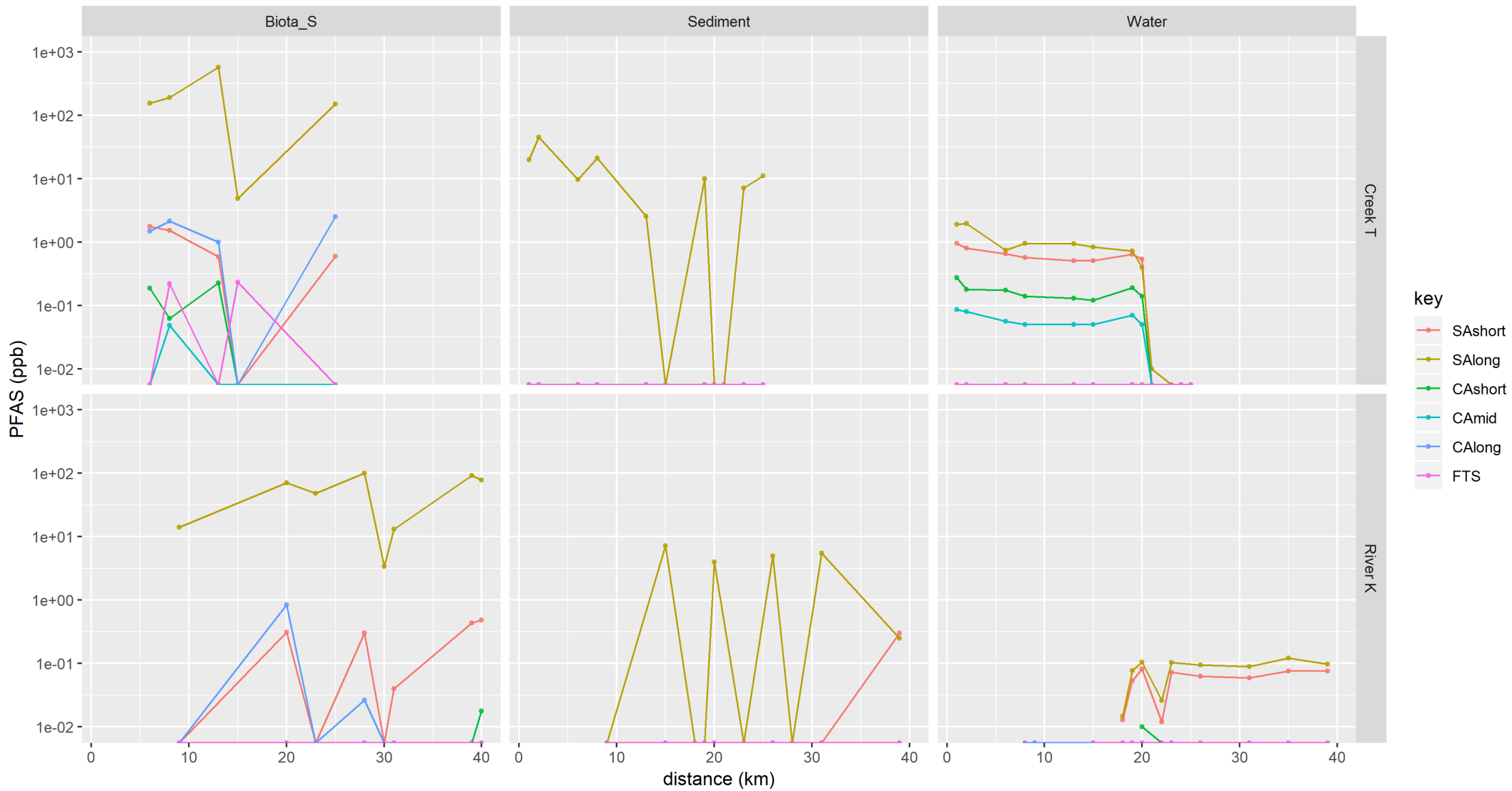
Base A Average Wet vs Dry Weather results for each PFAS range per km
excluding LOR in summed range



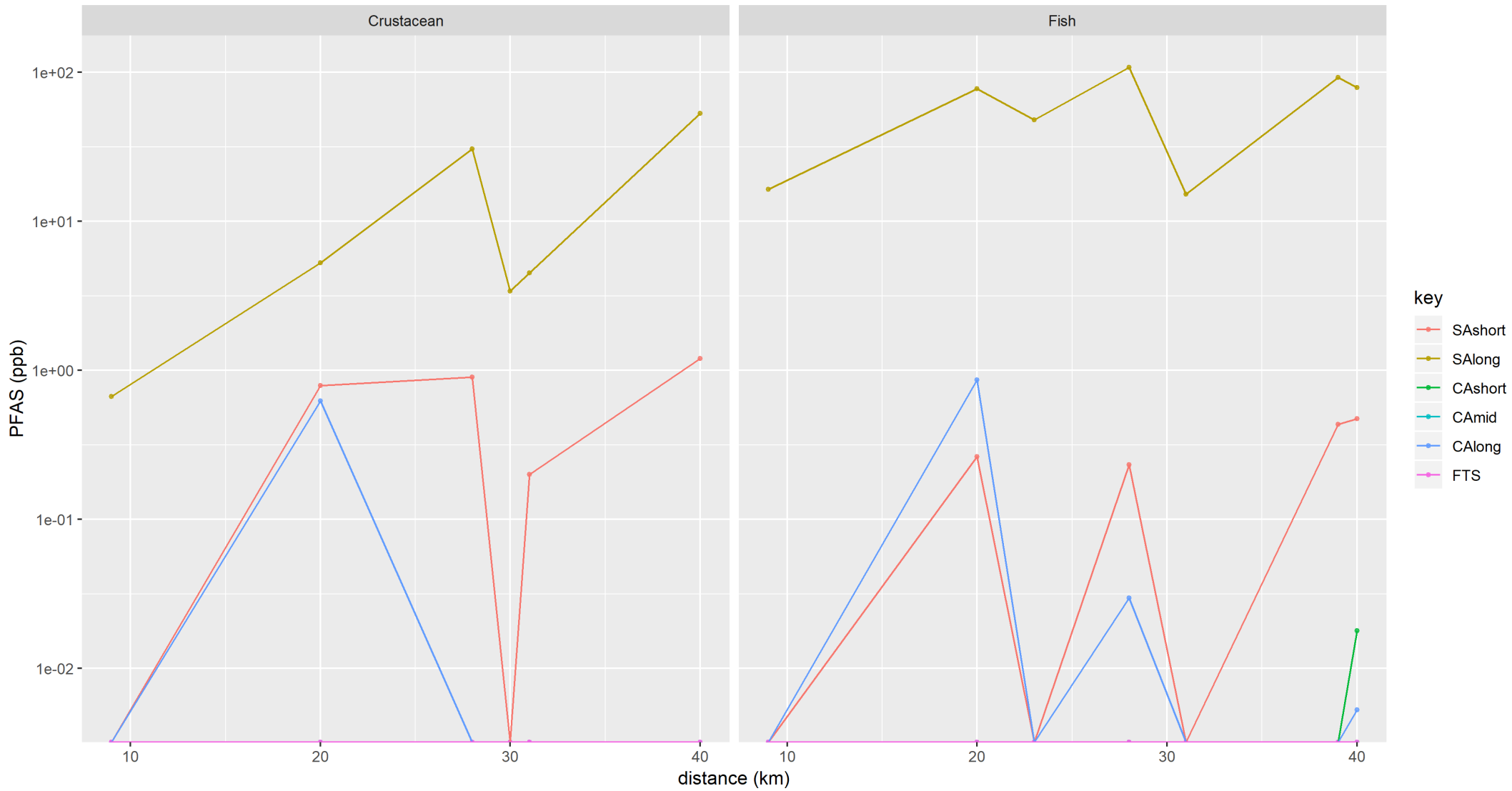
Biota Average results for each PFAS range per km excluding LOR in summed range



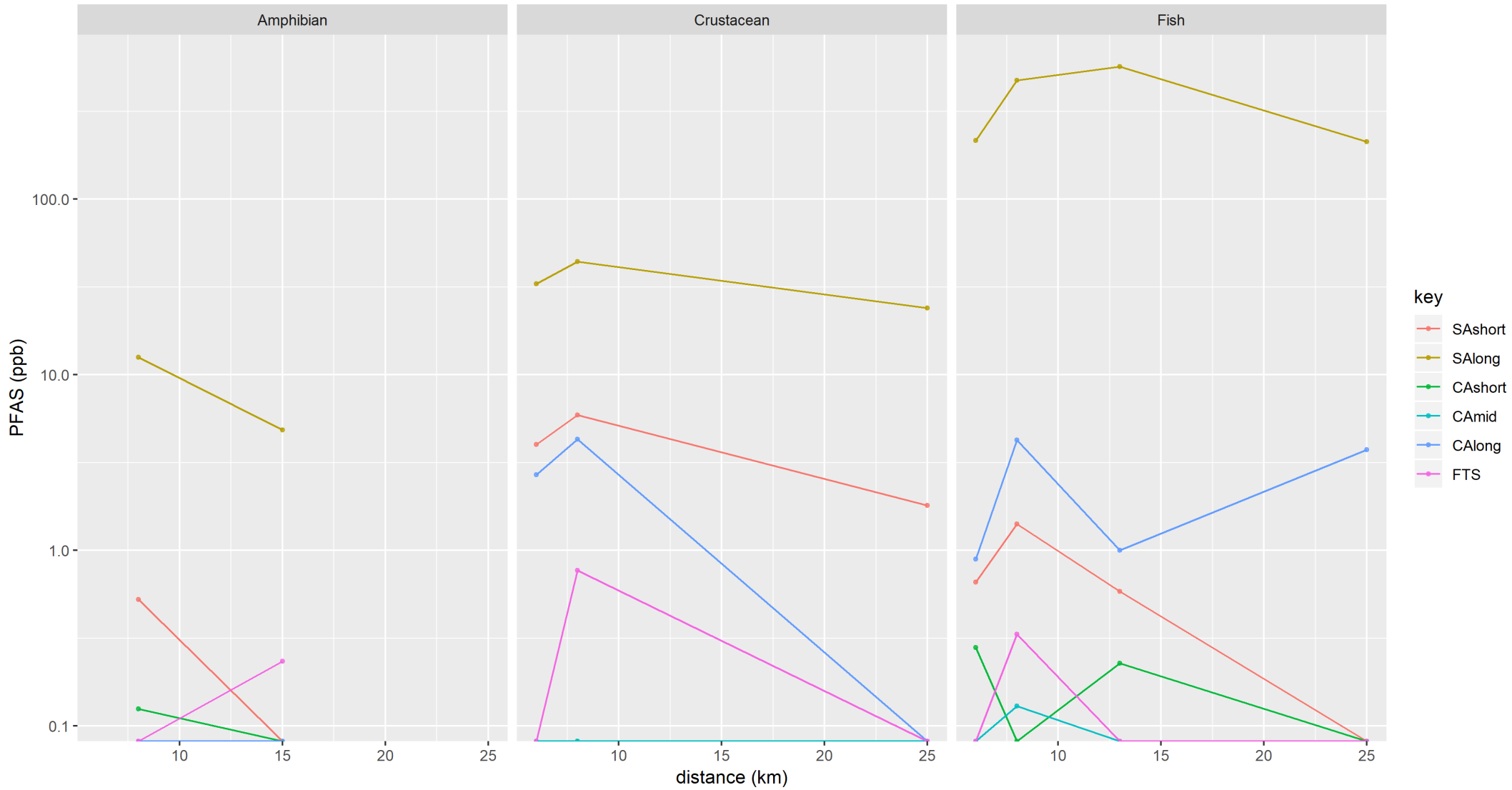
Base T Average results for each PFAS range per km
excluding LOR in summed range



River K Biota Average results for each PFAS range per km
excluding LOR in summed range

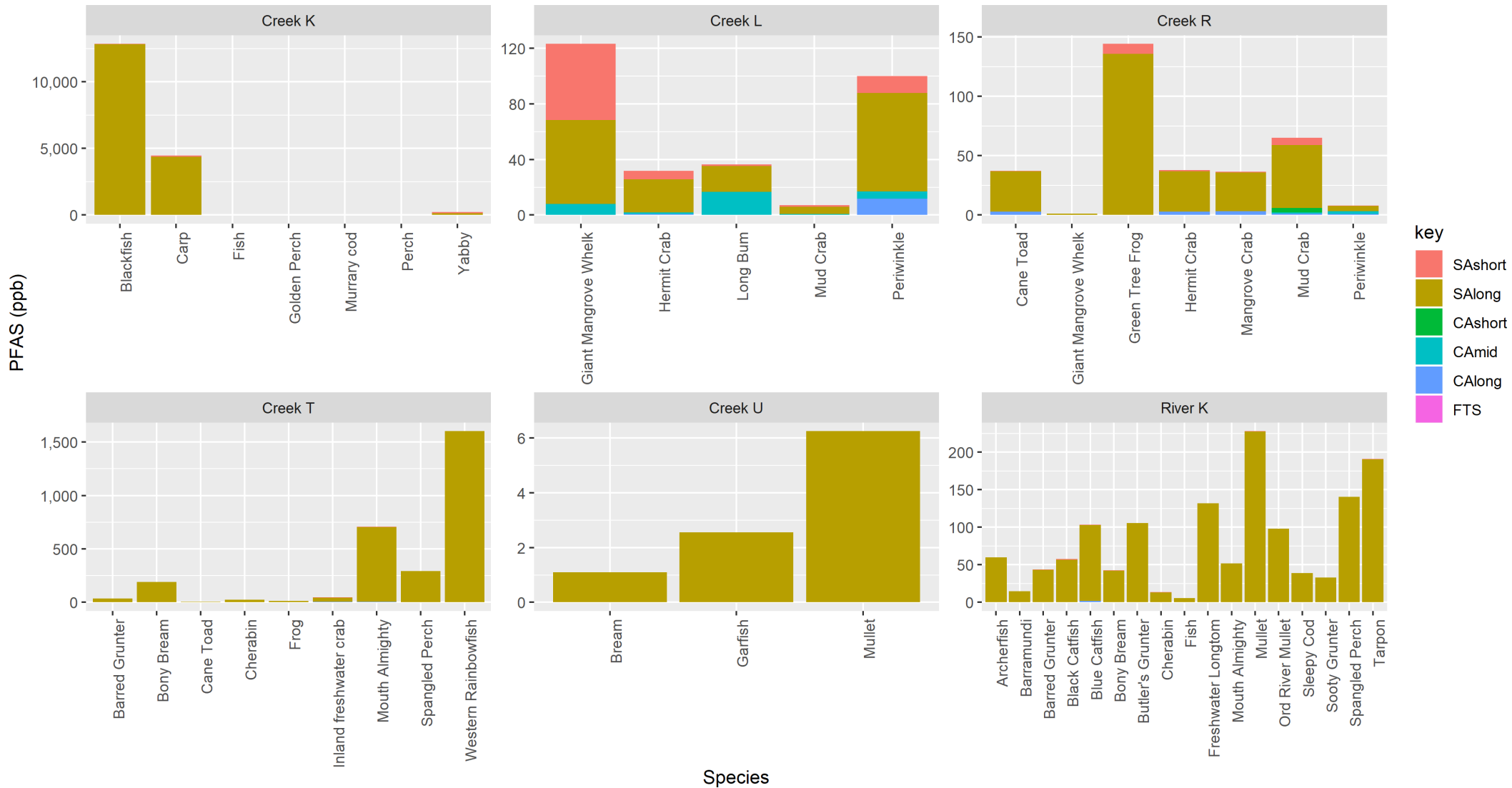


Creek T Biota Average results for each PFAS range per km
excluding LOR in summed range



Biota Average results summed for each Species

excluding LOR in summed range



Conclusions

- PFOS is highly persistent and travels long distances in surface water
- A good conceptual site model is critical for interpretation of monitoring data
- PFAS levels in environmental media are highly variable over time and space
- Wet and dry weather monitoring is necessary to understand contaminant flux
- Biota monitoring is challenging and requires multiple samples per event, and repeated events

Questions, comments, criticisms and ideas?