The Fate, Transportation, & Transformation of PFAS and Implications for WWTPs: A Case Where 1 + 1 Does Not Equal 2

NJWEA & AAEES
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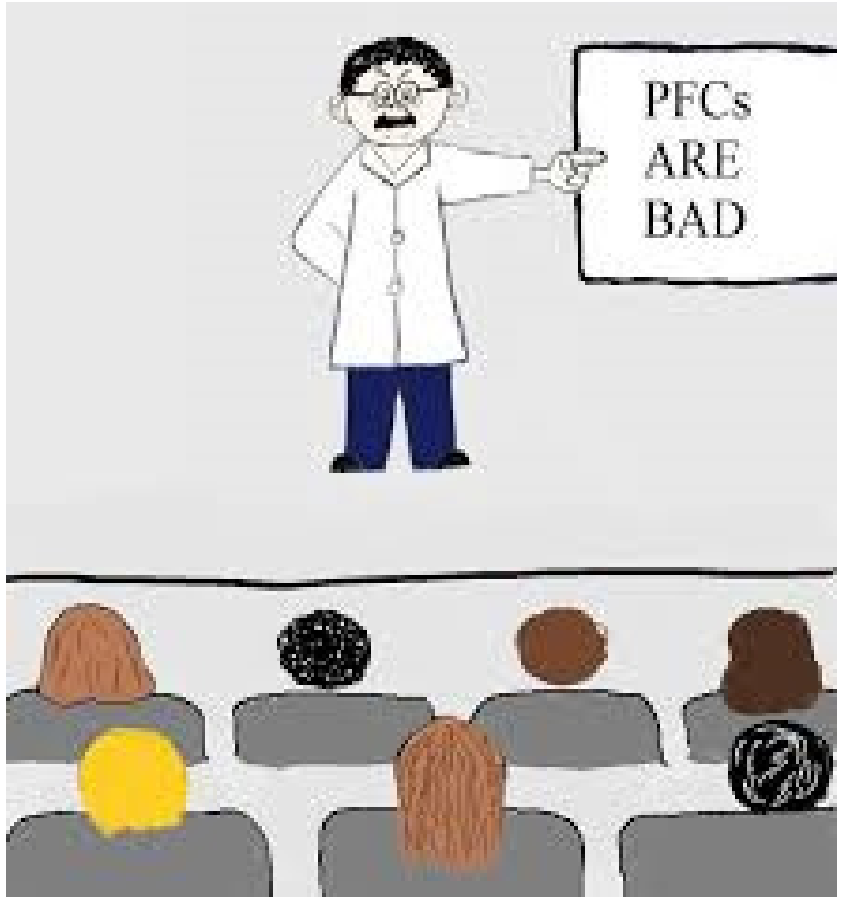
Photo: Lance Cpl. Shawn Valosin/U.S

Presentation Outline

- PFAS Background – Why Do We Care
- Transformation of PFAS (Lab)
  - Insoluble to Soluble
  - Less Hazardous to More Hazardous
- Transformation of PFAS (WWTPs)
- Potential Sources to WWTPs
- Source Identification and Fingerprinting
- Q&A



And now it is even BAD to say or type PFC

PFAS Background – Why Do We Care

PFAS in the News

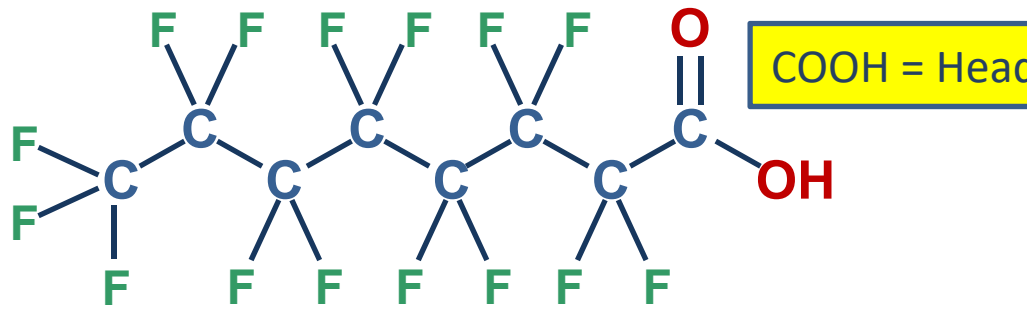
Quick Chemistry Lesson #1

- Remember: PFAS are **Per** and **Poly**fluoroalkyl substances
- **Per-fluoroalkyl substances**: fully fluorinated alkyl tail
  - Perfluoroalkane carboxylates (or carboxylic acids): **PFCAs**

NJDEP MCLs or Proposed MCL

13 ppt

(PFOA)

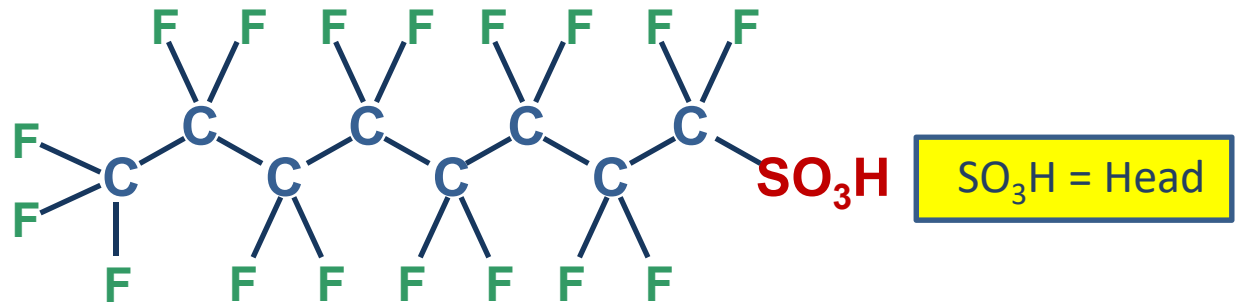


PFAAs

- Perfluoroalkane sulfonates (or sulfonic acids): **PFSAs**

14 ppt

(PFOS)



Quick Chemistry Lesson #2

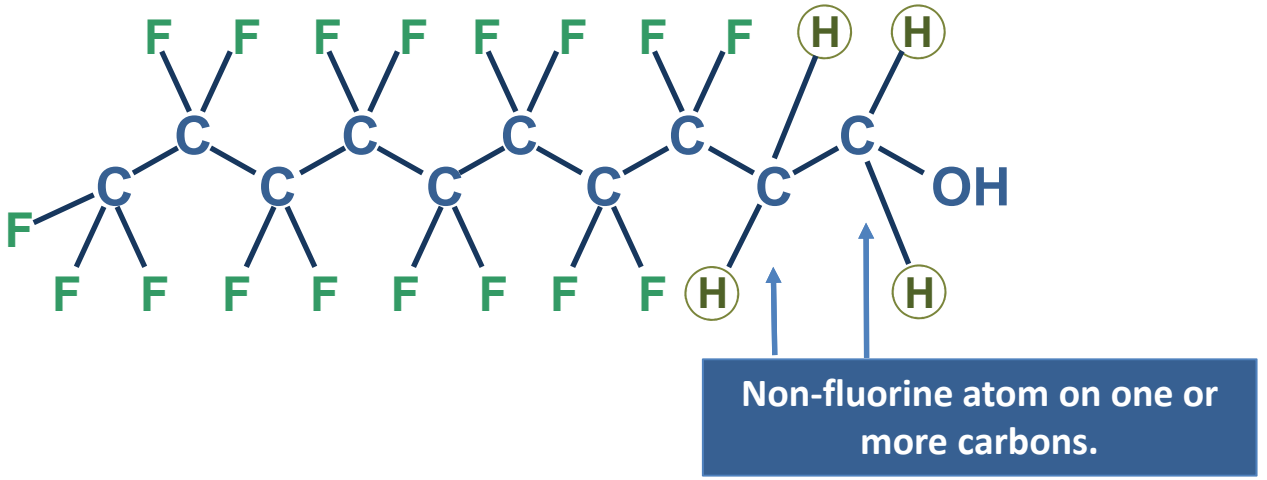
- Remember: PFAS are **Per** and **Poly**fluoroalkyl substances

- **Poly-fluoroalkyl substances**: non-fluorine atom (typically hydrogen or oxygen) attached to at least one carbon atom in the alkane chain

NJDEP MCLs or Proposed MCL

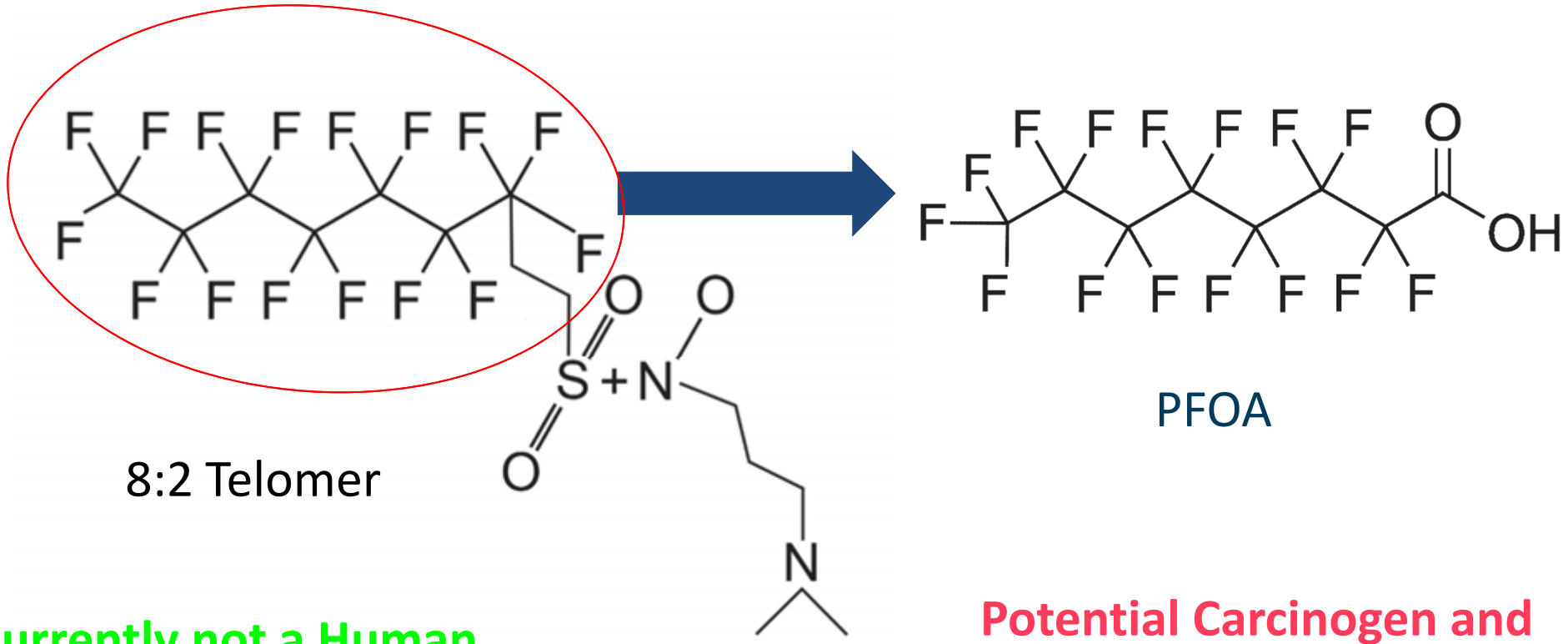
None

Fluorotelomer Alcohol (8:2 FTOH)



Polyfluoroalkyl substances may also be degraded to perfluoroalkyl substances (e.g., PFOS or PFOA): PRECURSORS

Transformation of Poly-Fluoroalkyl Substances to PFOA



8:2 Telomer

PFOA

Currently not a Human Health or Environmental Concern

Potential Carcinogen and other Potential Health Effects

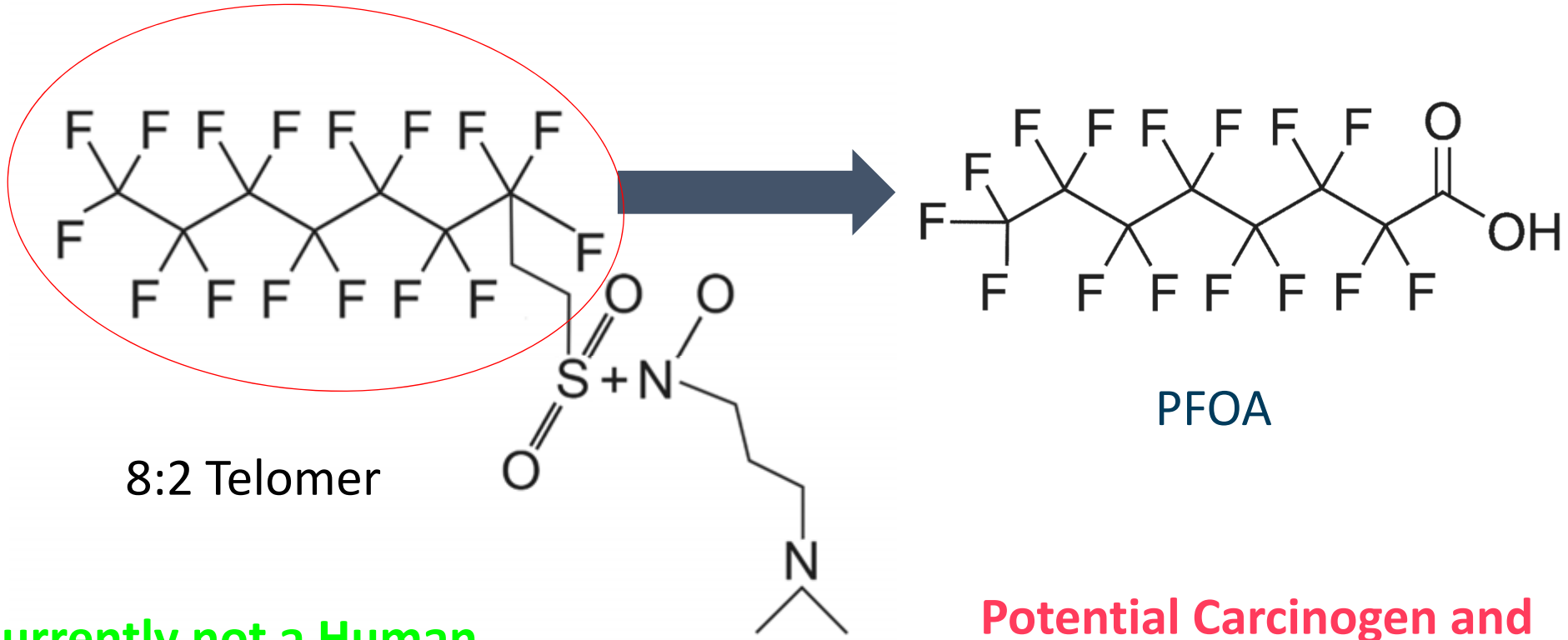
Exposure in Humans

- Majority of US population exposed to PFAS
- Half-life = 2 - 10 years (humans)
- Prevalent in blood and urine samples – baseline exists
- Can cross placental barrier – exposure to developing fetus
- C8 Health project, 70,000 residents with drinking water exposure linked to serum-PFOA concentrations and variety of health outcomes

High cholesterol	Ulcerative colitis	Thyroid disease	Pregnancy-induced hypertension	Cancer (testicular, kidney)

Transformation of PFAS (Lab)

Transformation of Poly-Fluoroalkyl Substances to PFOA



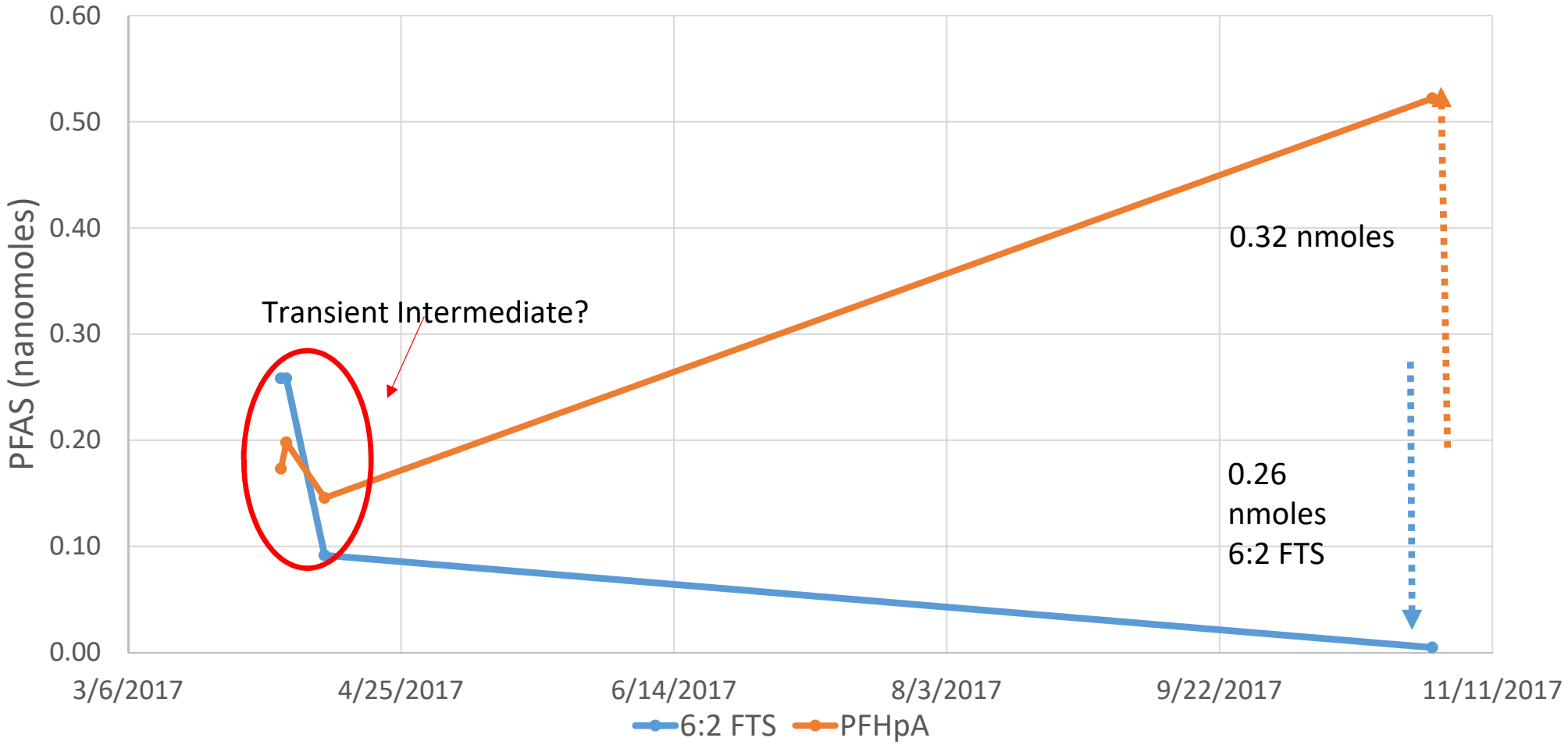
8:2 Telomer

PFOA

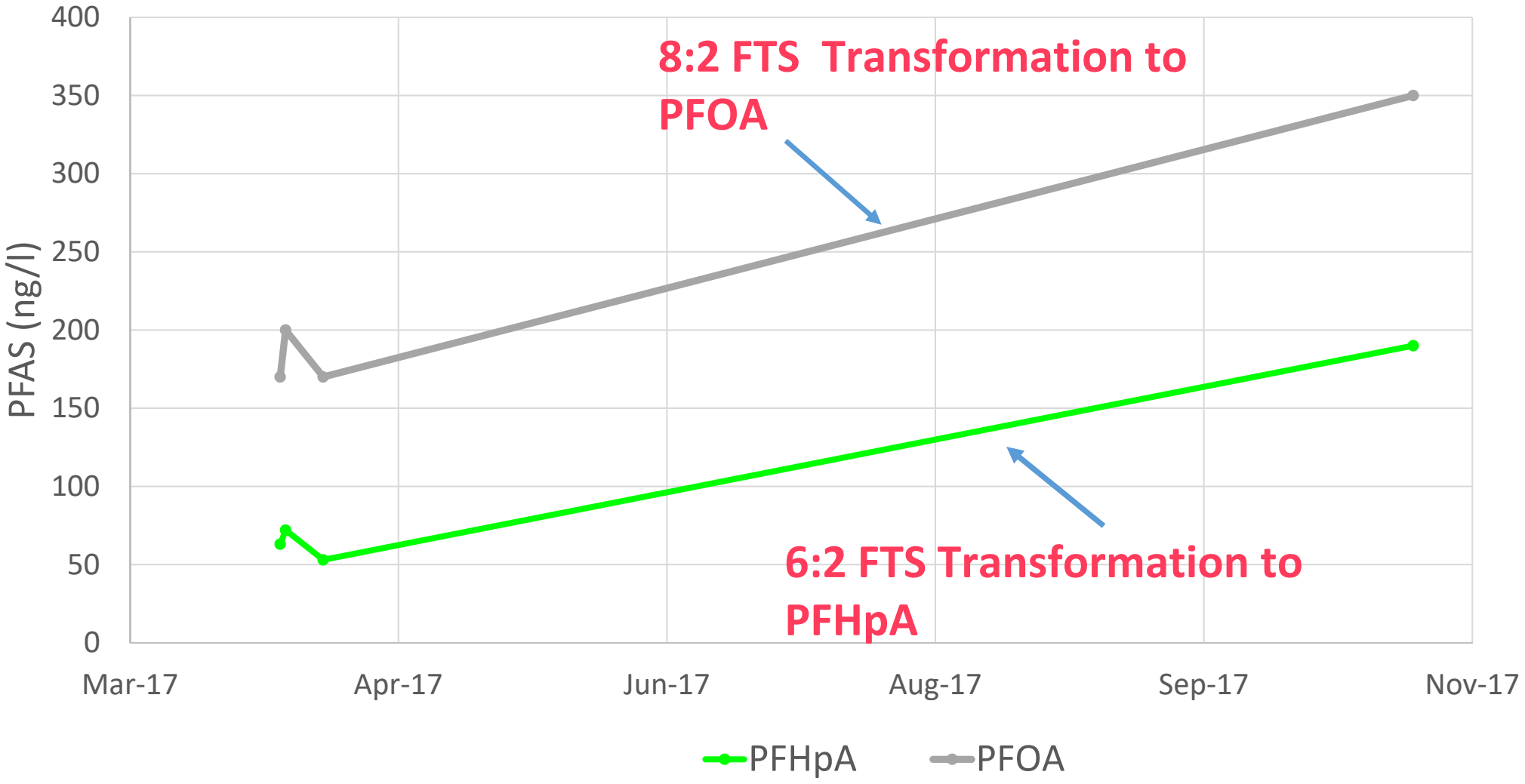
Currently not a Human Health or Environmental Concern

Potential Carcinogen and other Potential Health Effects

TRC Research - Observed Transformation of 6:2 FTS to PFHpA



TRC Research - Transformation of Telomers



Transformation of PFAS Across WWTPs

NJ Projected/Potential Surface Water Discharge PFAS Concentrations

- PFOA 13 ng/l (ppt)
- PFNA 13 ng/l (ppt)
- PFOS 14 ng/l (ppt)

Michigan WWTP PFAS Discharge Concentrations Limits to POTWs

- PFOS 11 ng/l (ppt)
- PFOA 400 ng/l (ppt)

Influent

Oxidation
Chemical and
or Biological

Effluent

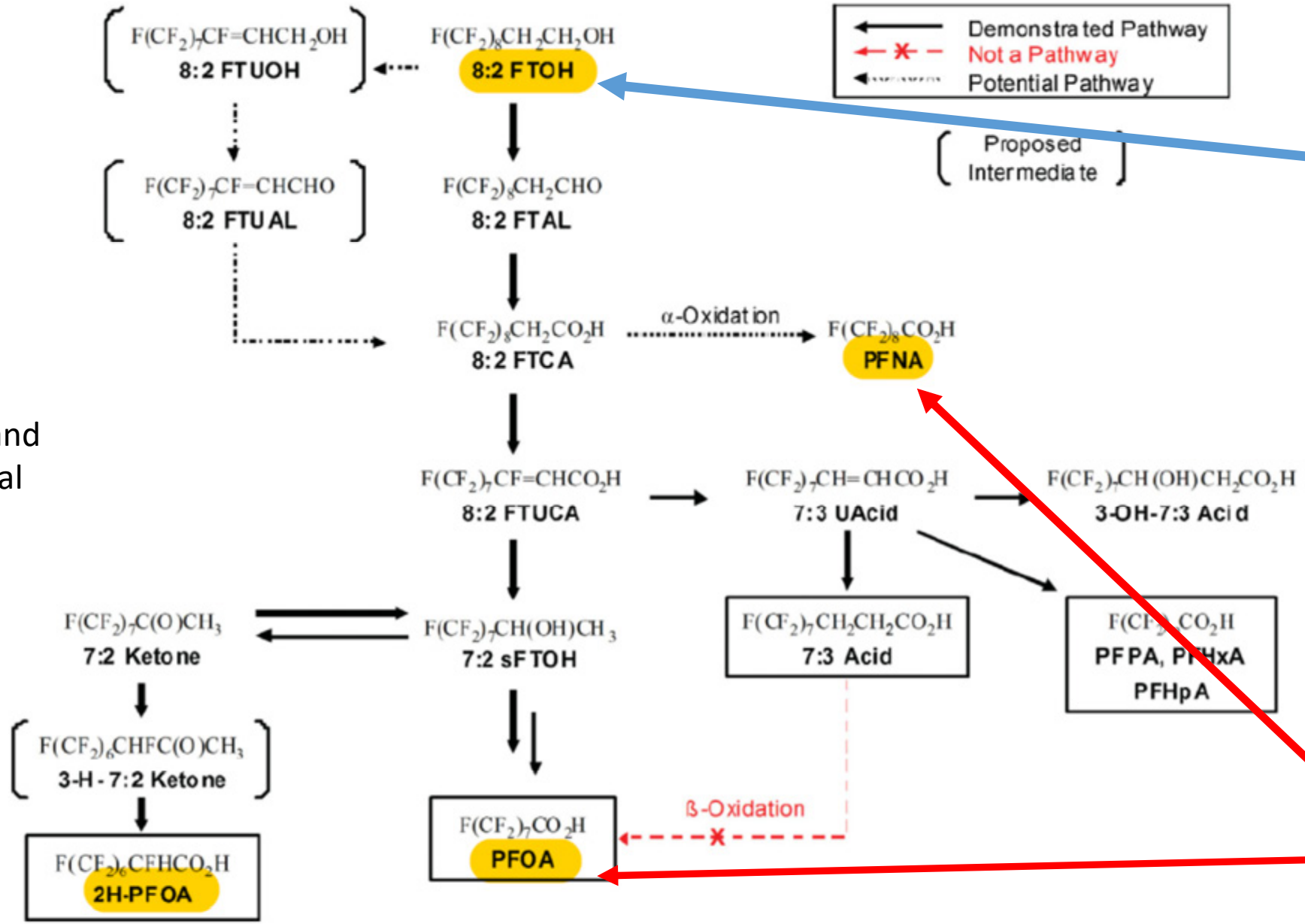
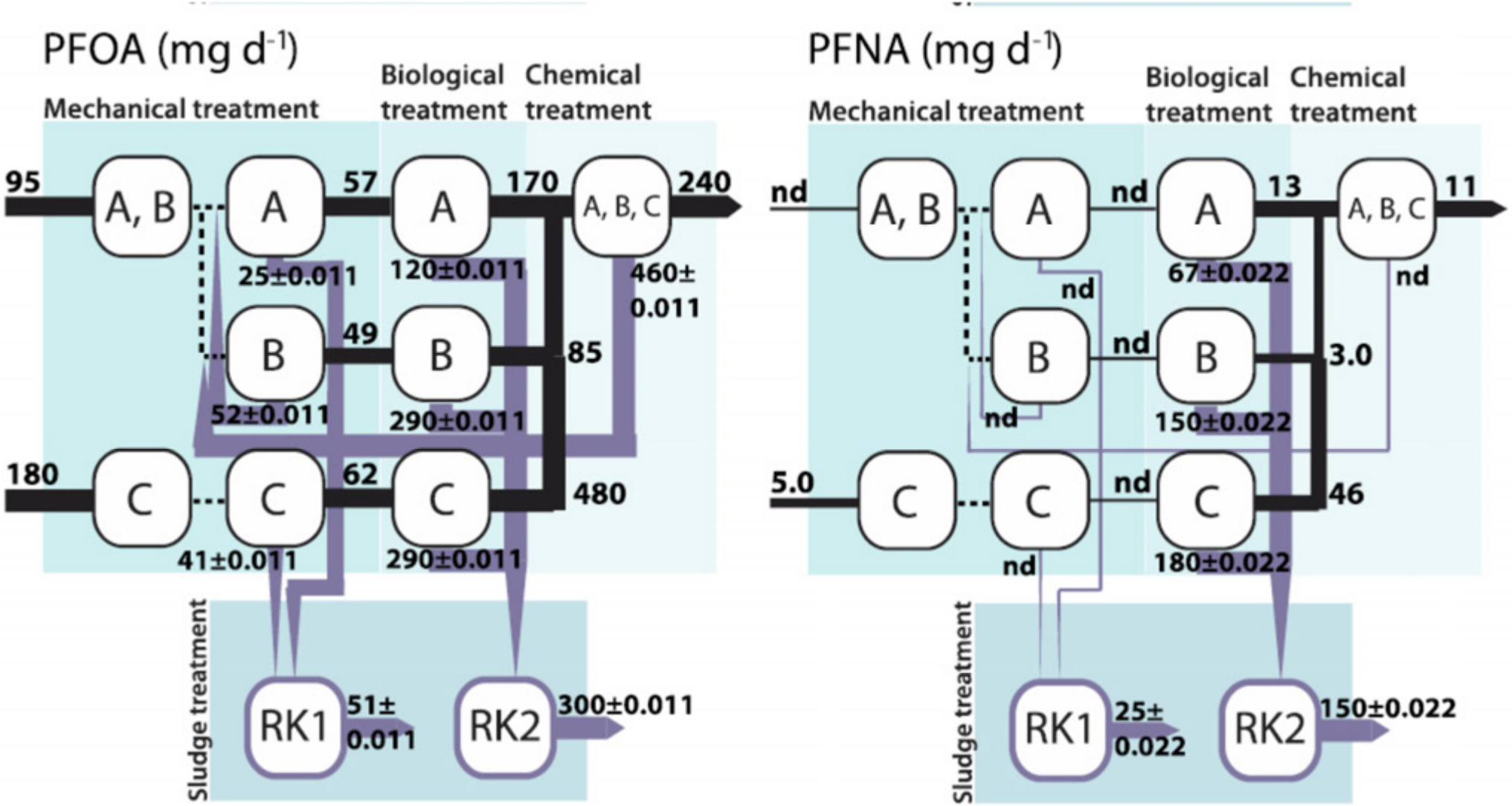


Figure 5. Aerobic biotransformation pathways for 8:2 fluorotelomer alcohol (8:2 FTOH). Adapted from Wang et al. (2009).

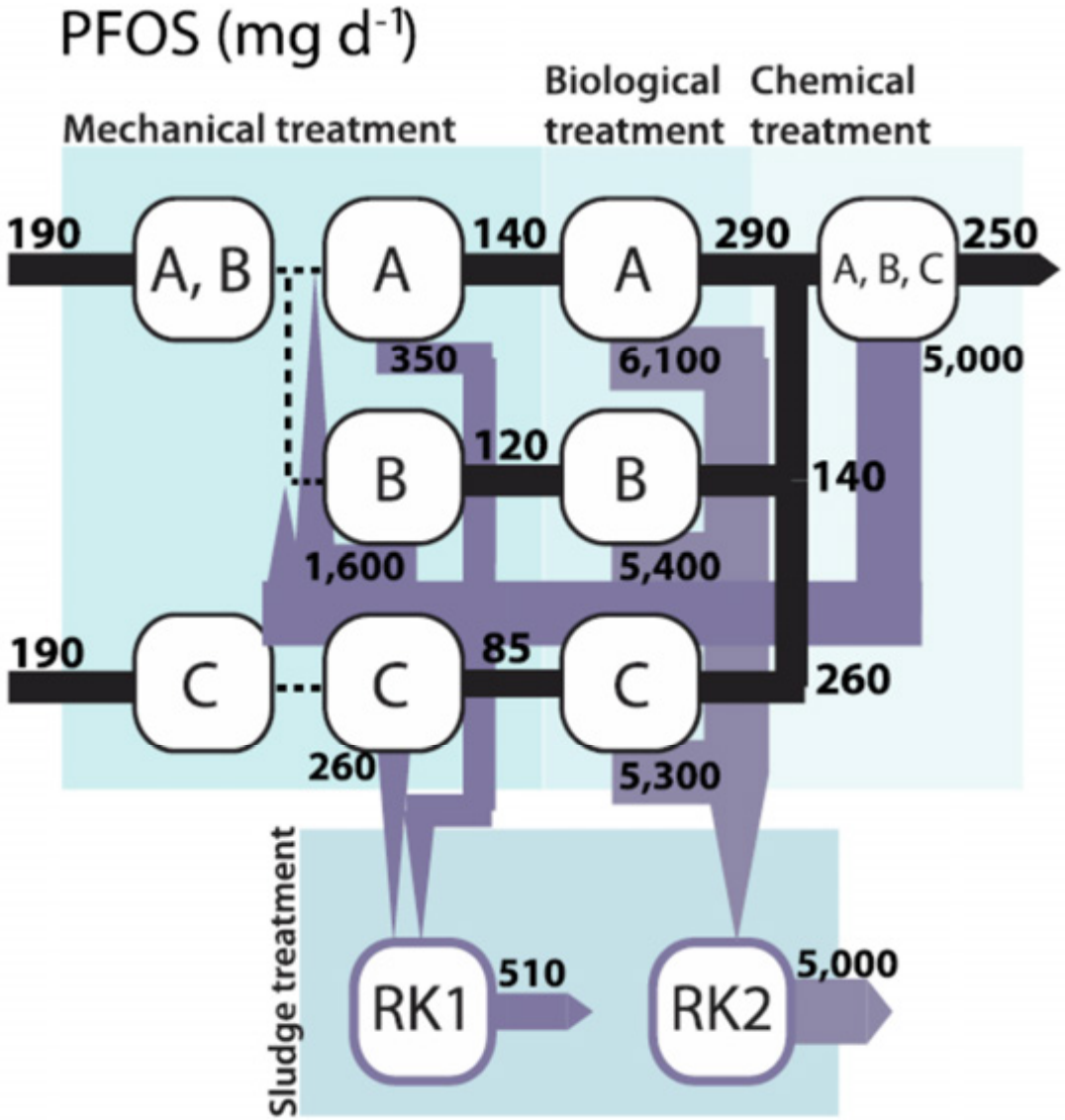
Non-Regulated
8:2 FTOH
8:2 FSA
8:2 FTS

Regulated in NJ
PFNA
PFOA

PFAS Mass of WWTP Effluent > Influent



PFAS Accumulation in Biosolids



380 mg/day into the system

5,250 mg/day Leaving the Facility

PFAS Impacted Biosolids Currently a Major Issue in Michigan

Potential Sources to POTWs

Potential PFAS Sources to POTWs

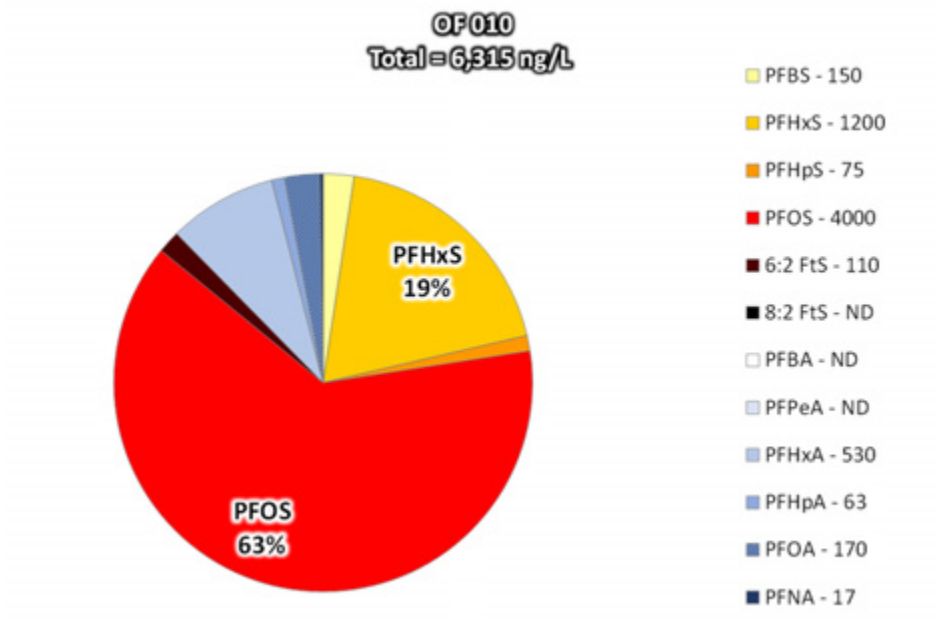
- Metal (Mainly Chromium) Plating Facilities
- Electronic Manufacturing
- Paper Mills and Process Facilities
- PFAS Manufacturing Plants
- Landfill Leachate
- Textile / Carpet Manufacturing
- Septic Tank Services
- Car Wash Waste Waters

Source Identification and Fingerprinting

Industrial Waste Water vs Car Wash Source

PFAS Mix Discharged in Treated Industrial Waste Water

Total PFAS 6,315 ppt

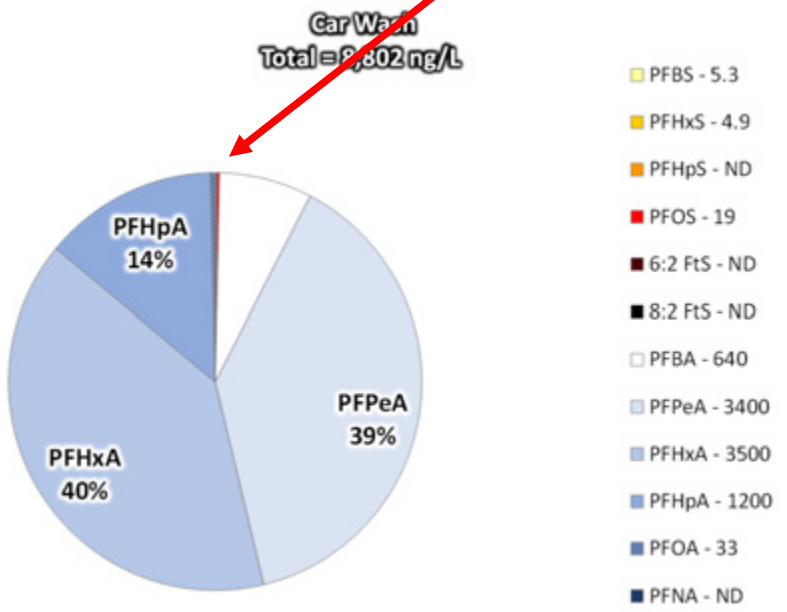


PFOS 4000 ppt
PFOA 170 ppt

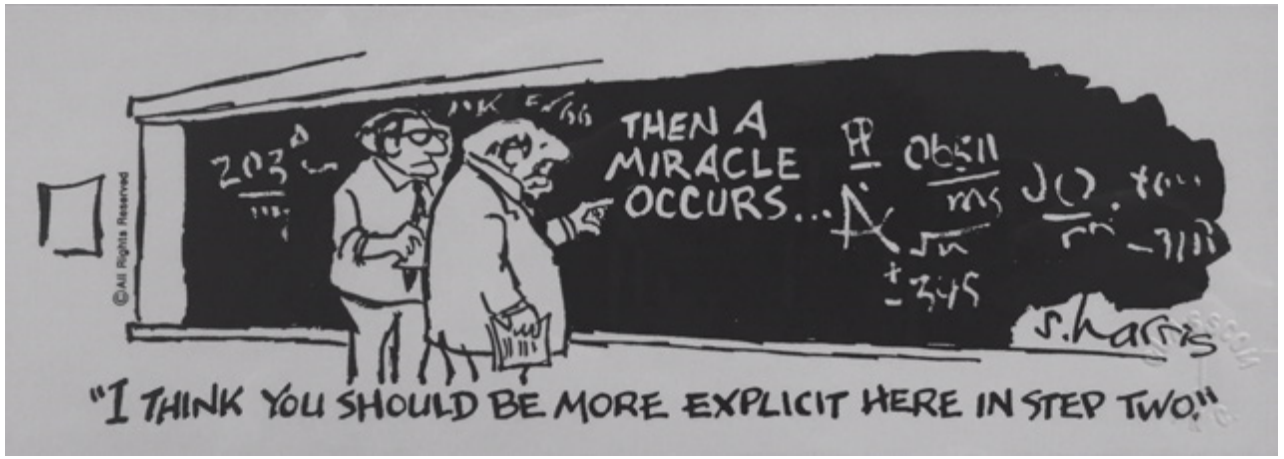
Car Wash Waste Water Discharge

PFOS & PFOA

Total PFAS 8,800 ppt



PFOS 19 ppt
PFOA 33 ppt
Total 52 ppt (2nd round 110 ppt)



Thank you

Questions?

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