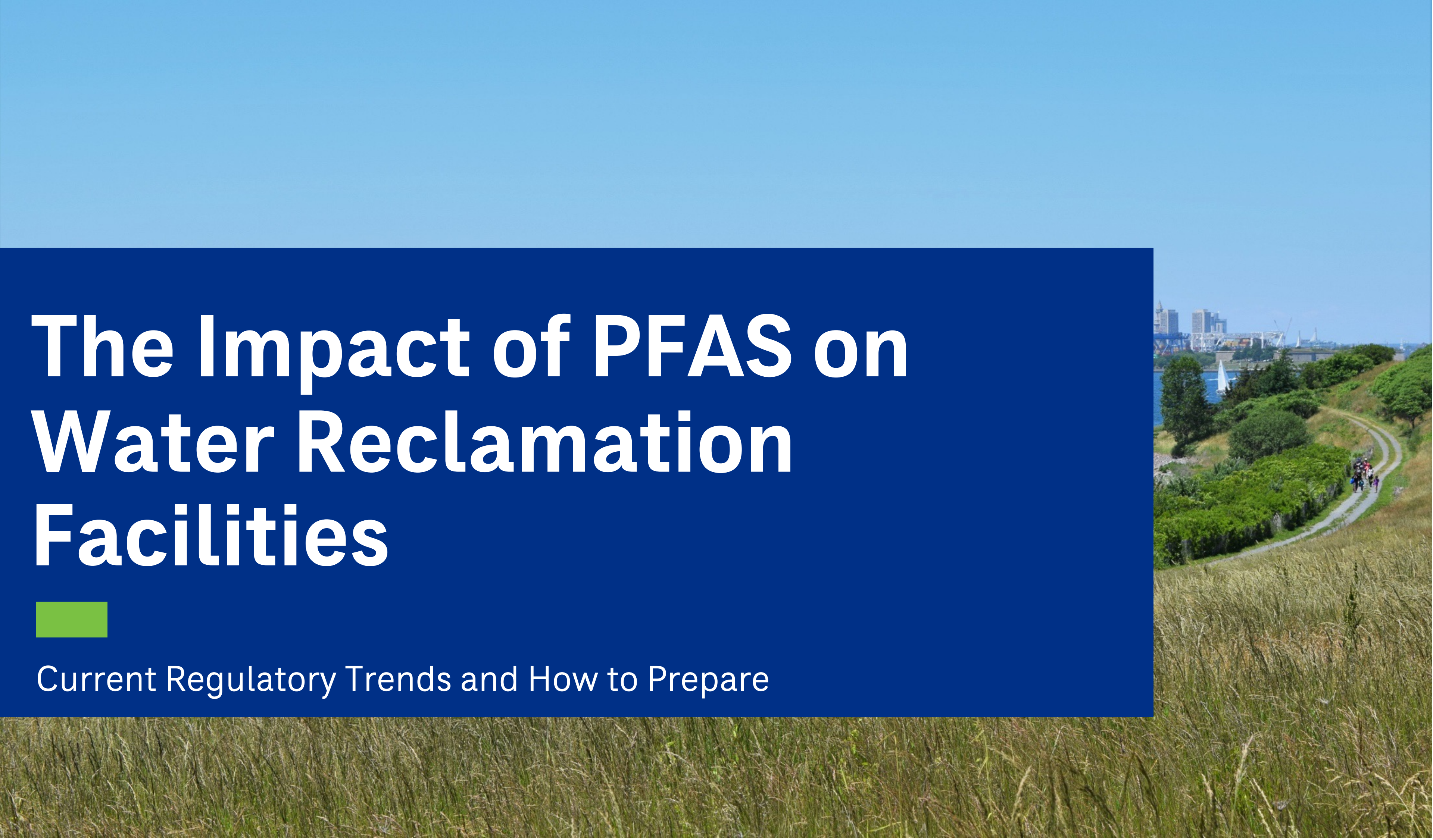

The Impact of PFAS on Water Reclamation Facilities

Current Regulatory Trends and How to Prepare

Eric Spargimino, PE, PMP, LEED AP

January 22, 2024

NEWEA
WORKING FOR WATER QUALITY
2024 Annual Conference & Exhibit
January 21-24 | Boston

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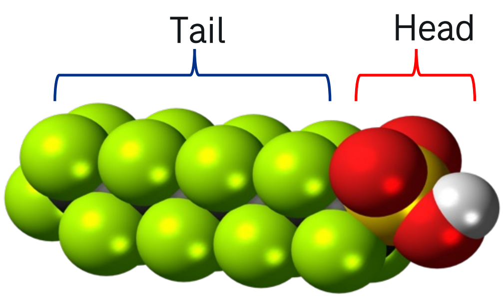
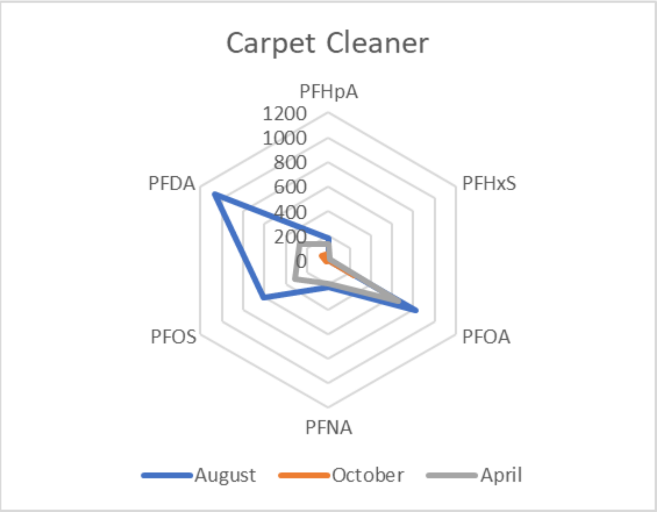
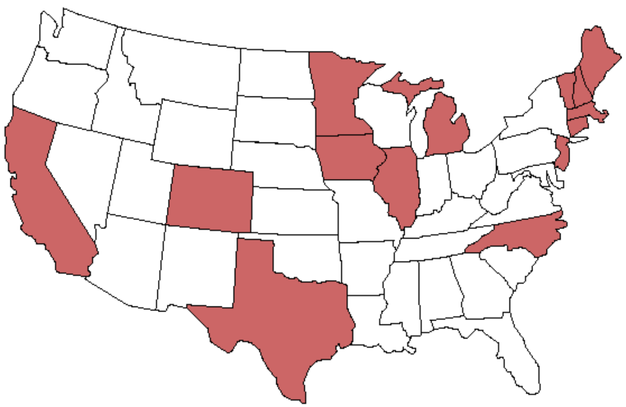
Outline



- Regulatory Environment
- PFAS within Water Reclamation Facilities
- Source Reduction
- What should we do?



Regulatory Environment – Drinking Water



2009 Health Advisor
- PFOA: 400 ppt
- PFOS: 200 ppt

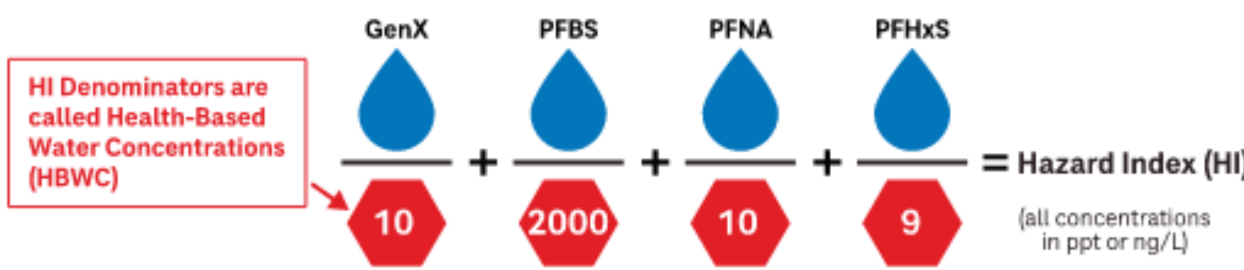
2016 Health Advisor
- PFOA: 70 ppt
- PFOS: 70 ppt
- Sum: 70 ppt

2022 Health Advisor

Interim:
- PFOA: 0.004ppt
- PFOS: 0.02ppt

Current:
- GenX: 10 ppt
- PFBS: 2,000 ppt

EPA **2023** Draft Regulations
- PFOA: 4.0 ppt
- PFOS: 4.0 ppt
- HI 1.0
  - PFNA
  - PFHxS
  - PFBS
  - GenX



Regulations are rapidly changing; States in red have either guidance, notification limits OR MCLs in place for PFAS.

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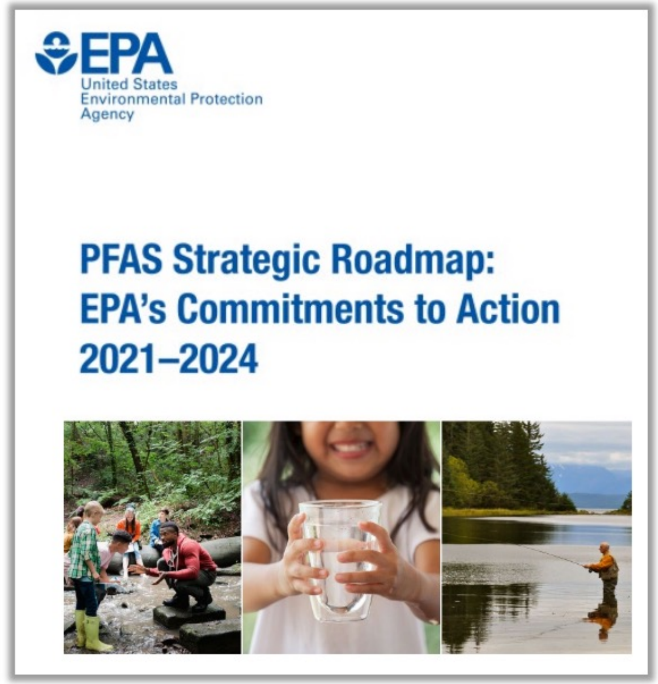
EPA PFAS roadmap for biosolids

Winter 2024: Completion of the risk assessment for PFOA and PFOS

2025-2026: Anticipated that EPA would issue a Final Rule

2026-2031: Assuming a 5-year compliance schedule



The risk assessment will serve as the basis for determining whether regulation of PFOA and PFOS in biosolids is appropriate

State Regulations

- PFAS – Regulatory Actions

Authority	Compound	Effect
EPA	**PFOA & PFOS**	**Actively conducting risk evaluation of PFOA & PFAS in biosolids.** **Anticipated completion Q4 2024.**
California	30+ PFAS compounds	General Order - Monitor Only
New Hampshire	100+ CECs	Monitor Only
Massachusetts	PFHxS, PFNA, PFOA, PFOS, PFHpA, PFDA (AOF)	Monitor Influent, Effluent and Biosolids
Maine	All PFAS Compounds	Prohibit land application of biosolids
Michigan	PFOS	Developed interim land application plan with limits: ▪ >125 ug/kg – Industrially impacted/no land app. ▪ 50 – 125 ug/kg – reduce land app. rate to 1.5 dt/acre ▪ <50 – normal application rate (20 to 50 ug/kg – investigate sources)
Pennsylvania	PFOA & PFOS	Proposed Monitor Only (Anticipated Fall 2023 implementation)

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State Regulations

- PFAS – Regulatory Actions

Authority	Compound	Effect
Colorado	40 PFAS compounds	Source control program and monitoring
Vermont	PFOA & PFOS	Monitor Only
Minnesota	PFAS compounds	Monitor Only
New Jersey	PFOA & PFOS	Monitor Only
New York	PFOA & PFOS	Developed interim land application plan with limits (May 2023): ▪ >50 ug/kg – prohibited land application ▪ 20 – 50 ug/kg – restricted land application ▪ <20 – No action required
Connecticut	PFOA, PFOS, PFNA, PFHxS, PFHpA	Suggested land application limits: • Combined concentration of >1.4 ug/kg - no land app.

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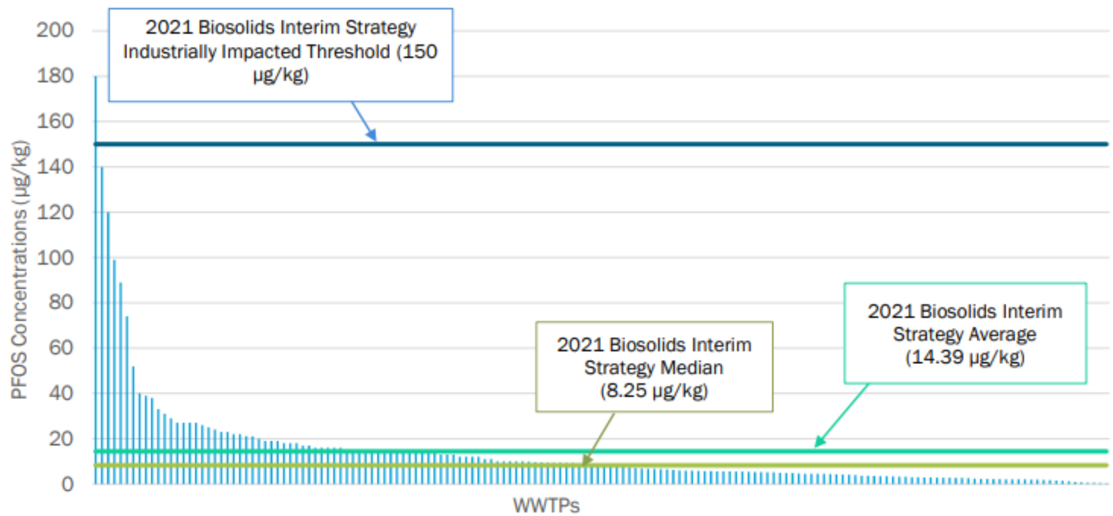
Michigan EGLE – Biosolids Land Application Interim Strategy

- PFOS > 125 µg/Kg (ppb)
  - No land application allowed.
  - Investigate source reduction
- PFOS > 50 µg/Kg (ppb)
  - Land application allowed
    - max 1.5 dt/acre
  - Investigate source reduction
- PFOS < 50 µg/Kg (ppb)
  - Land application allowed
  - If PFOS > 20 ppb, consider investigating sources



Source: Michigan EGLE: Updated interim strategy, April 2022 (MI EGLE Interim Strategy)

Strategy effective July 1, 2022

EPA is reportedly adopting this strategy!

Other PFAS Actions and Regulations

- Other State Actions
  - Vermont Agency of Transportation (VTrans) disallows use of Biosolids, revoked.
  - Arizona biosolids prohibition, revoked
  - MA S-2053 "An Act Establishing a Moratorium on the Procurement of Structures or Activities Generating PFAS Emissions" – Referred to Senate Ways and Means
  - Local requirements for testing of water in connection with sale of a home: CT and Nantucket, MA
- Canada:
  - March 2023 - Quebec Government announces temporary moratorium on the import of Biosolids from the US.
  - May 19, 2023 – Notice to Industry, proposed interim standard for PFAS in Biosolids (50 ppb PFOS)
  - 60 day public consultation seeking comments on proposed standard for important biosolids. Ends February 20, 2024
    - https://inspection.canada.ca/about-cfia/transparency/consultations-and-engagement/interim-standards-for-pfas/eng/1702575266741/1702575267417

MassDEP

Quarterly reporting of influent, effluent and biosolids

- PFHxS
- PFNA
- PFOS
- PFOA
- PFHpA
- PFDA

6 months after approved method available

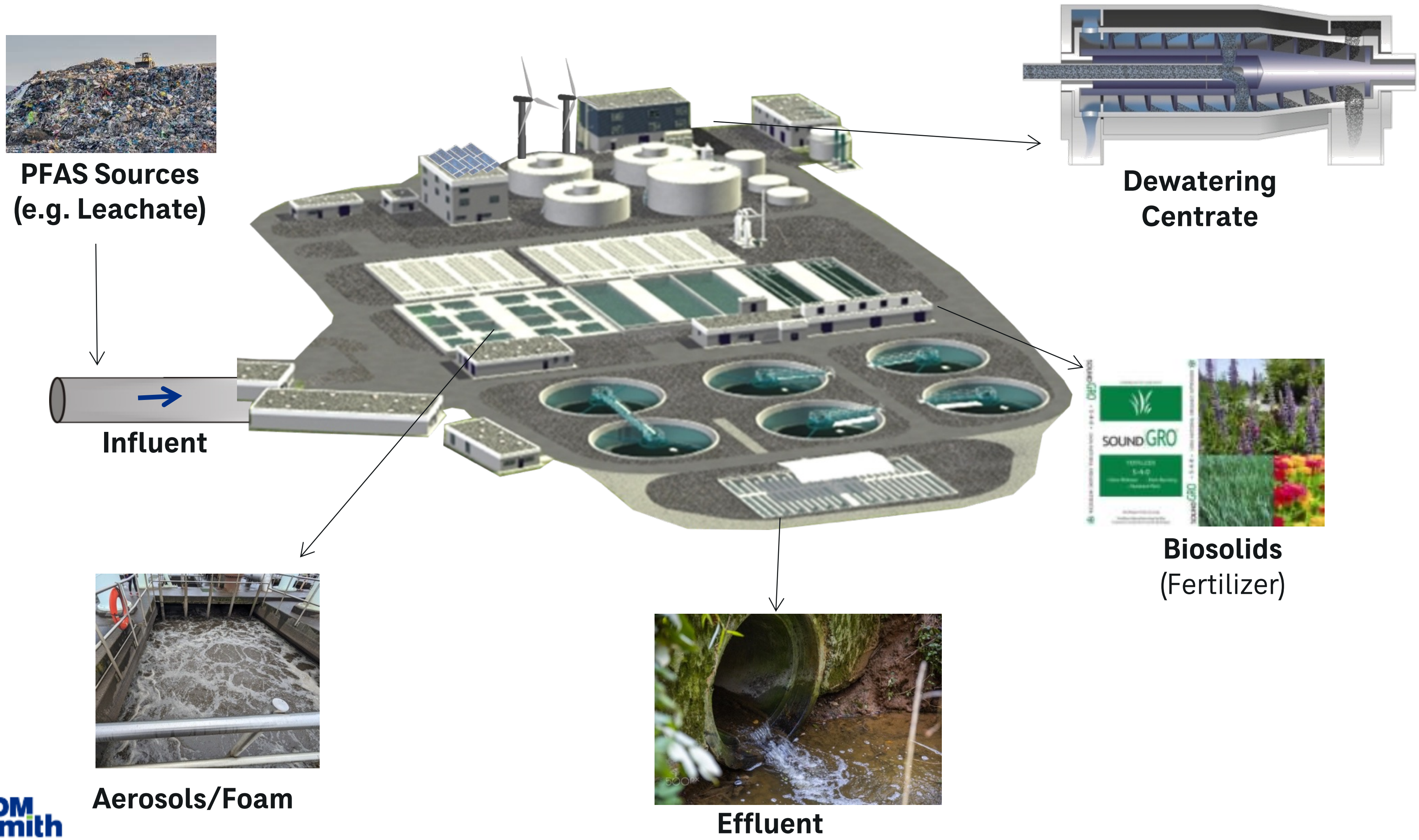
Requiring AOF sampling & not renewing some AOS permits

CERCLA Rule

- Proposed hazardous substance designation of two PFAS under CERCLA
  - Perfluorooctanoic acid (PFOA)
  - Perflourooctanesulfonic acid (PFOS)
- Reporting requirements for release of 1 pound or more of PFOA ***or*** PFOS in a 24-hour period
- Most WRRF will not exceed this reportable quantity (RQ)
  - 10 mgd x 12,000 ng/L x $(8.34/10^6)$ = 1 lb/day
- Longer term impacts as Potentially Responsible Party (PRP) most concerning for utilities
- Reportable Quantity Calculator: https://www.nacwa.org/Login?ReturnUrl=/issues-in-depth/reportable-quantity-calculator

Occurrence, Fate & Transport

Where are the opportunities to cost effectively remove PFAS?



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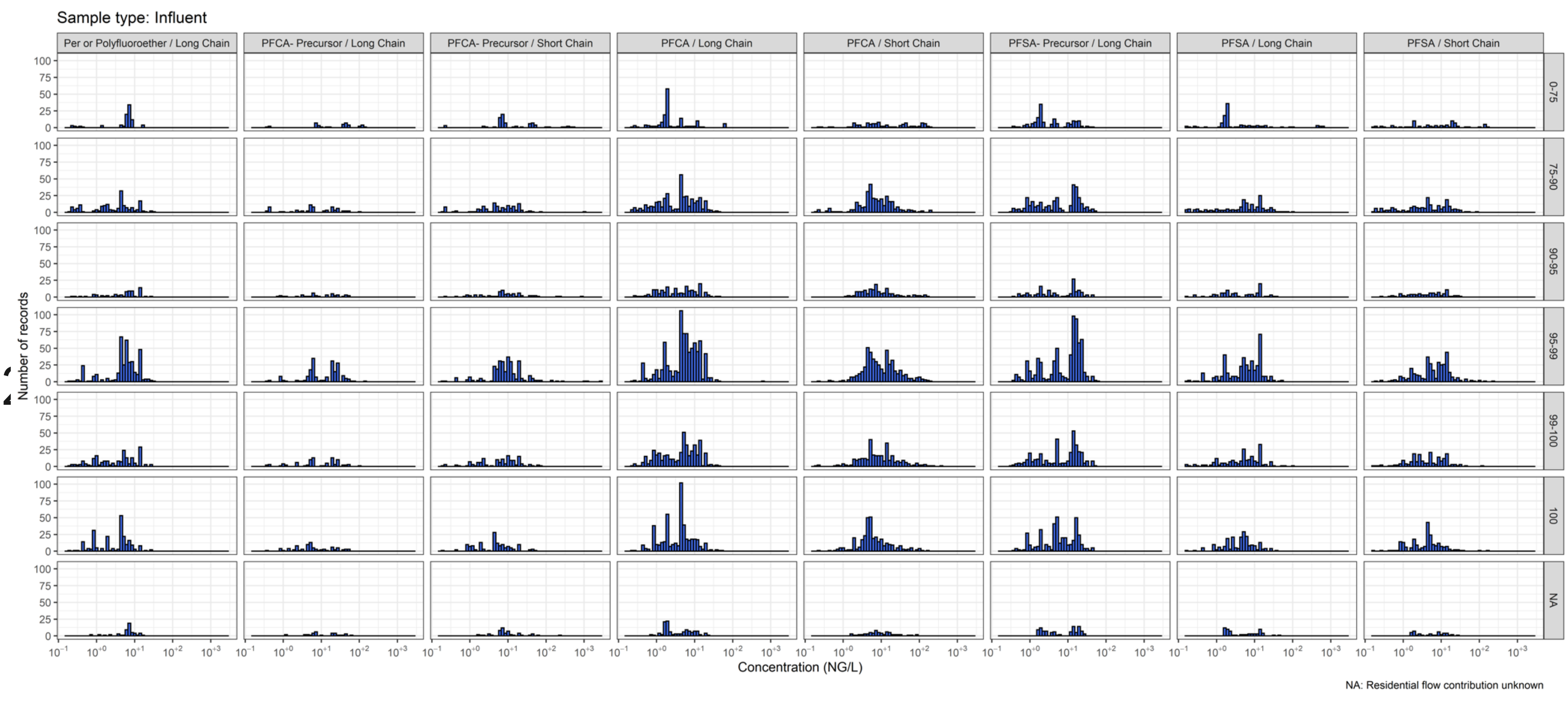
California Association of Sanitation Agencies (CASA)



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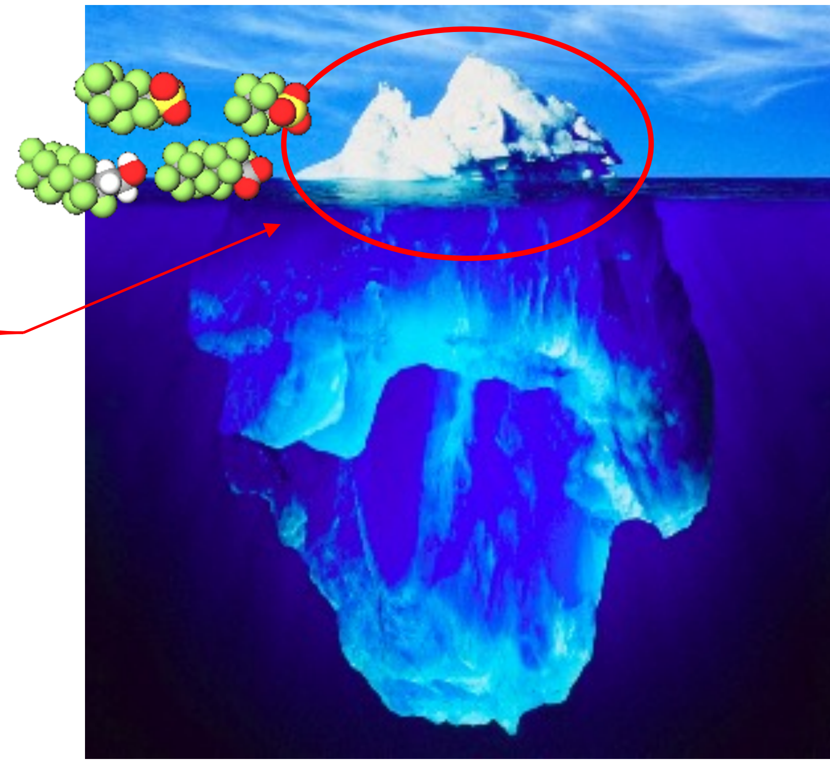
Laboratory Analysis

Targeted Analysis

Methods to Detect Target Polyfluoroalkyl substances

- USEPA Method 537.1
  - 18 PFAS (12 PFAAs + 6 Other PFAS Including GenX)
- USEPA Method 533
  - 25 PFAS (16 PFAAs + 9 Other PFAS Including GenX)
  - Focuses on Short Chain
- Draft Method 1633 for 40 PFAS
- DWI 47 PFAS



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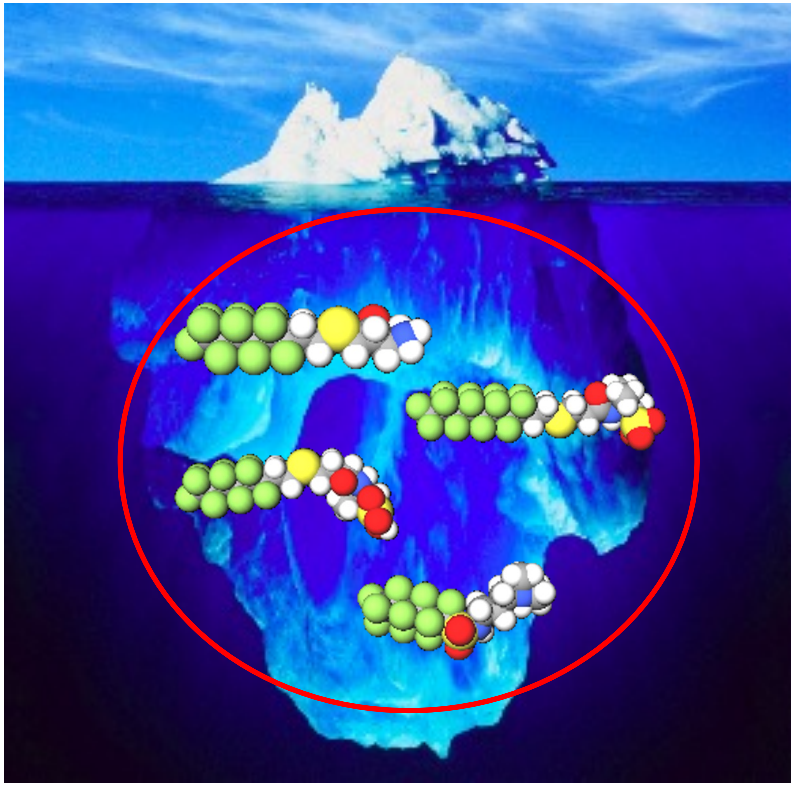
Laboratory Analysis

Non-Target Analysis

Methods to Detect Non-Target Polyfluoroalkyl Substances

- Total Oxidizable Precursor (TOP) Assay
  - Converts Precursors to PFAAs so can detect chain lengths of precursors
- Total/ Adsorbable/ Extractable Organic Fluorine by combustion ion chromatography (e.g. USEPA 1621)
  - Mutiple organofluorine compounds that can be present / extracted
- High Resolution Mass Spectrometry



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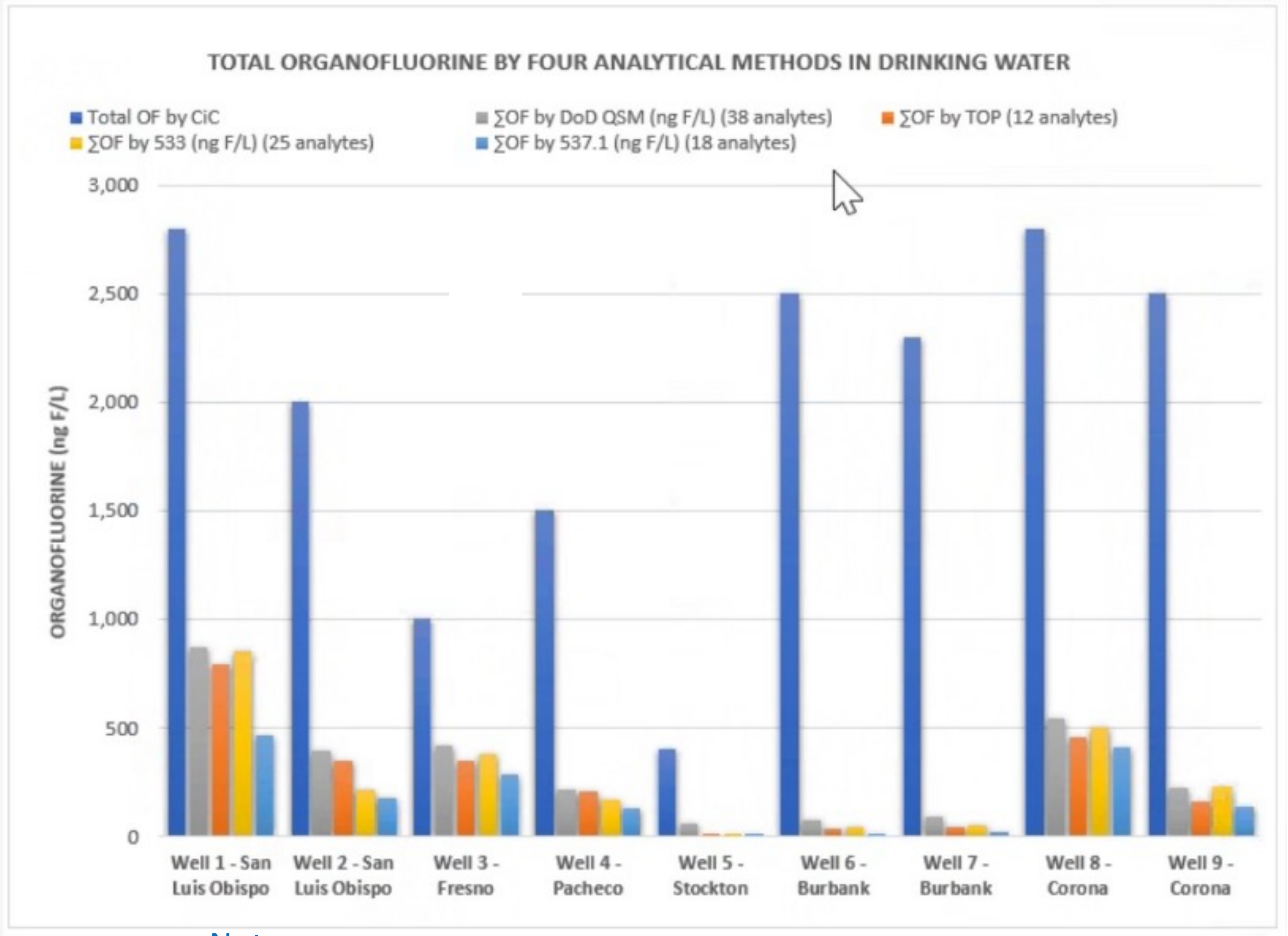
California Waterboards Non-Target Analysis of PFAS

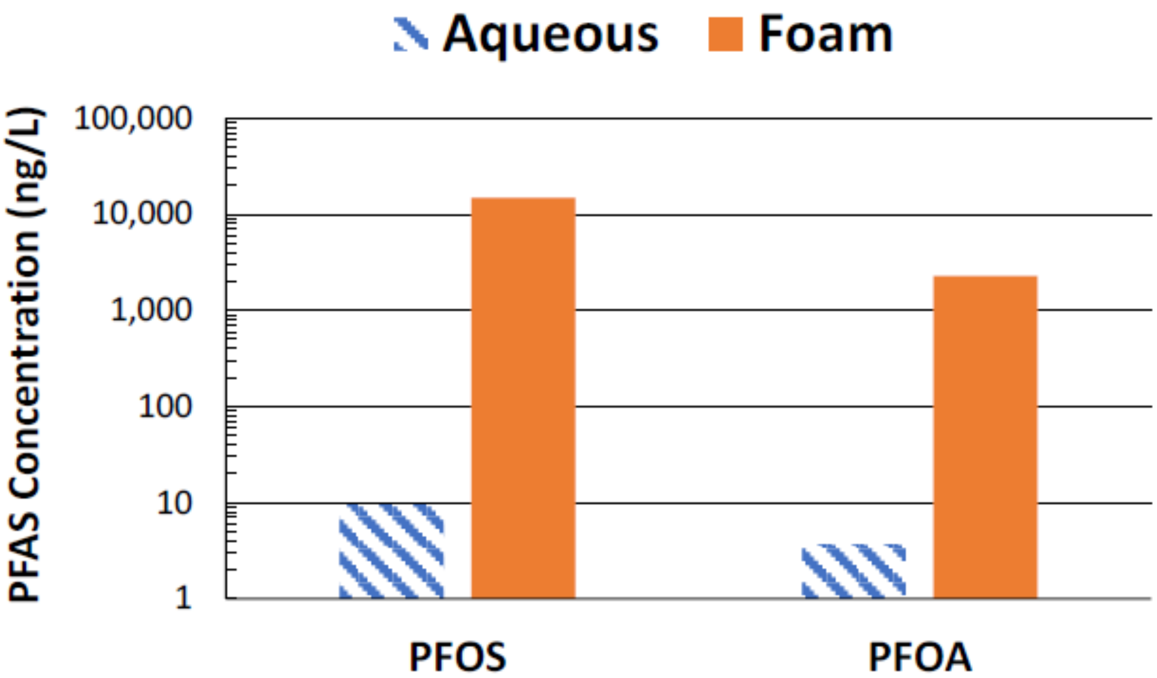


Note:

Ultrashorts PFAAs such as TFA not detected using AOF using USEPA 1621

https://www.youtube.com/watch?v=pGtg26tN4PM&t=12345s

PFAS in Foam vs Aqueous Phase



PFOS and PFOA concentrations measured in the aqueous phase and foam/scum during biological aeration.

WWTP Aeration Basins: Foam Formation & PFAS

At 2 WWTPs:

- Collect wastewater entering aeration basin and analyze for PFAS
- Collect foam, then analyze the re-collapsed foam for PFAS
- Calculate PFAS enrichment factors

$$EF = \frac{C_f}{C_w}$$

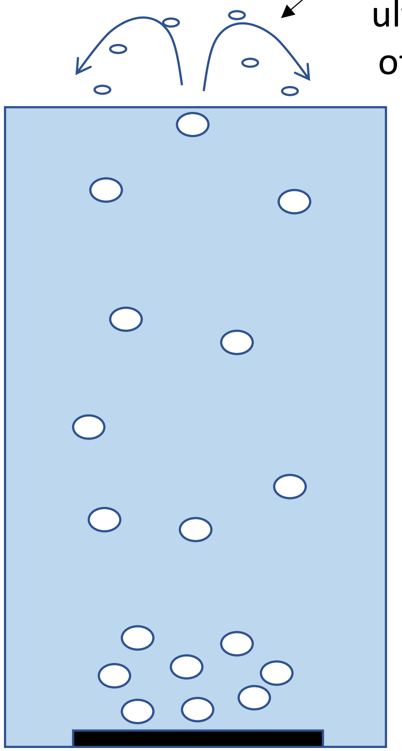
AWWA WATER SCIENCE
Theory and Practice of Safe, Sustainable Water

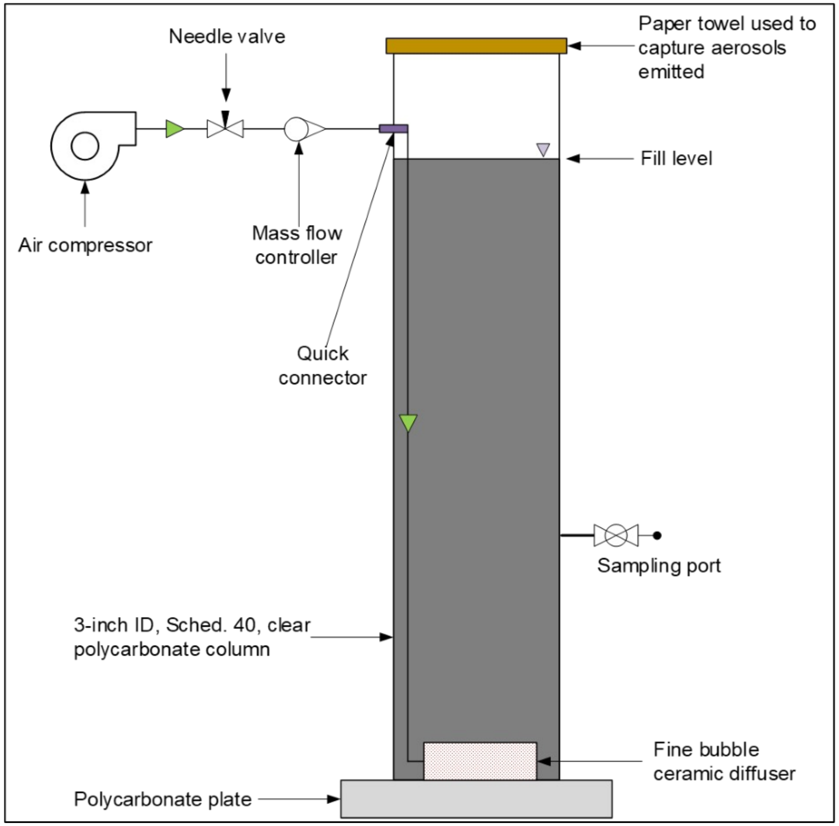
"PFAS in Foam and Dewatering Streams at Wastewater Treatment Plants"
C.E. Schaefer, J.L. Hooper, L.E. Strom, K. Wu, J.L. Guelfo

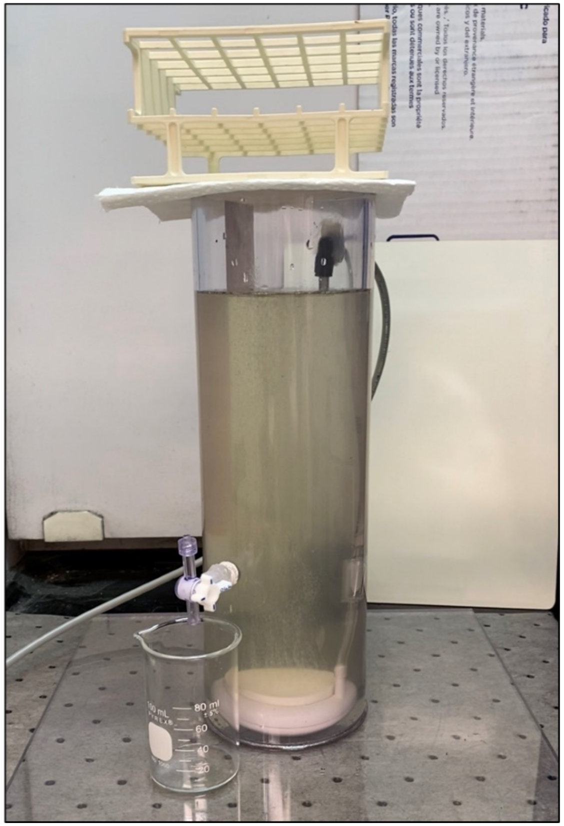
Potential Role of Aerosols

PFAS enrichment in aerosols due high area:volume ratio

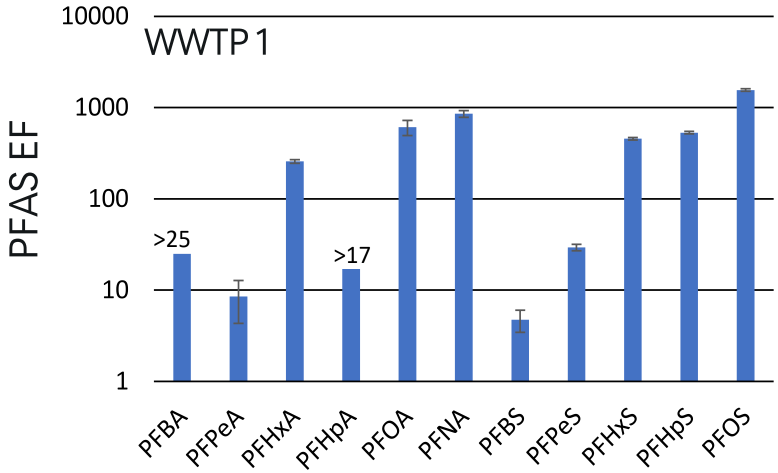
PFAS released via aerosolization, but fall back to water surface with ultimately no net removal of PFAS from wastewater

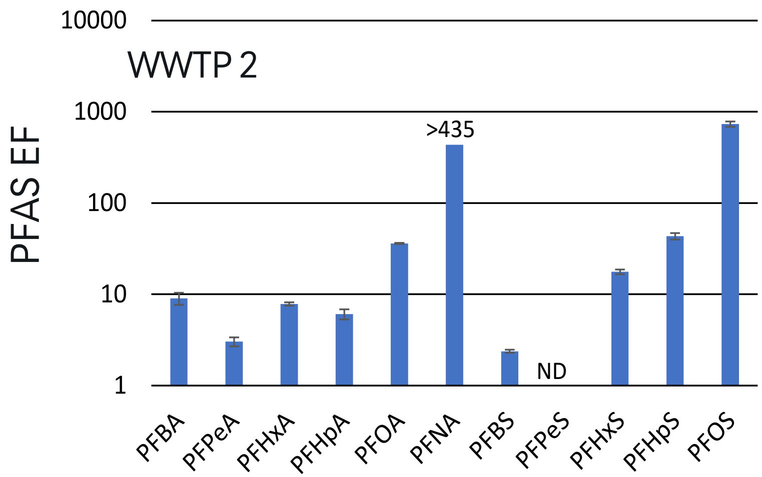






WWTP Aeration Basins: Foam Formation & PFAS



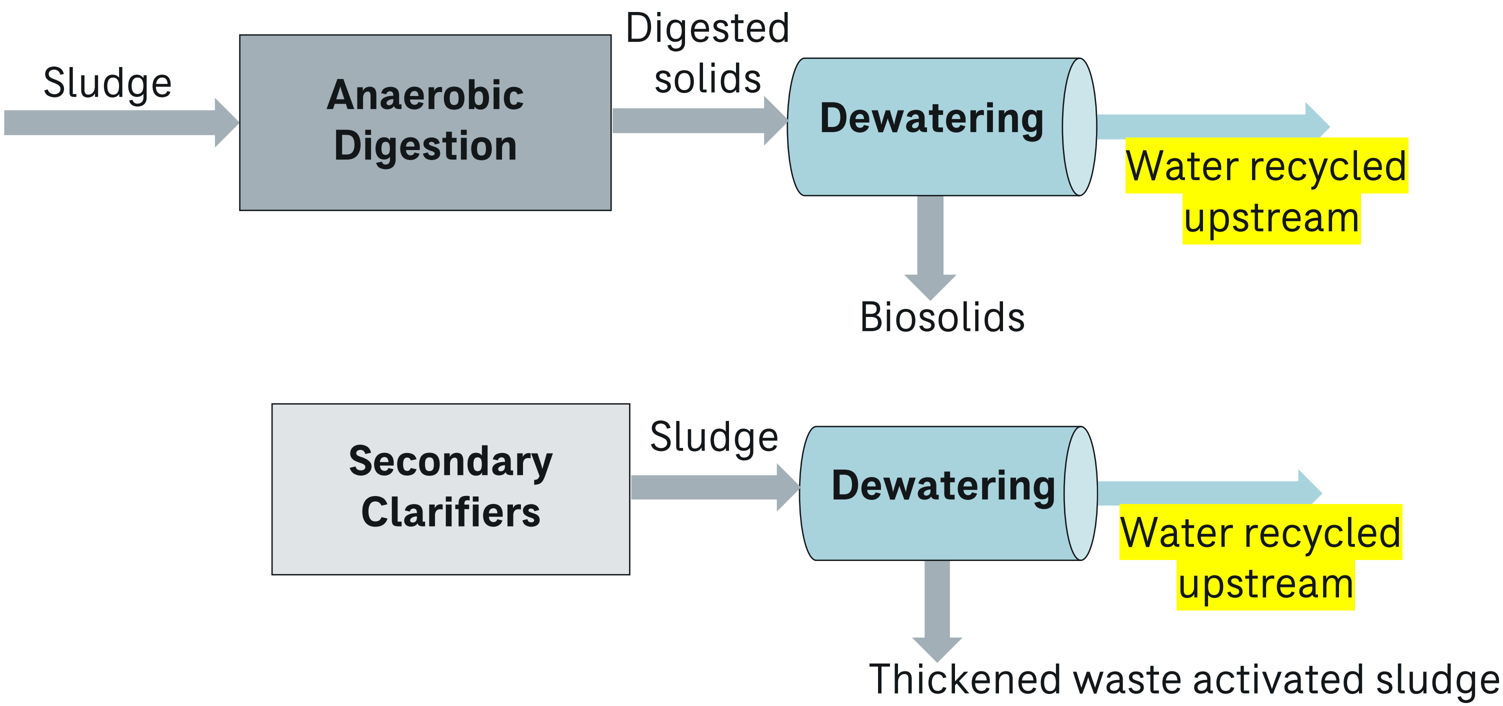


- Substantial PFAS enrichment
  - *Up to 14,900 ng/L PFOS in foam*
    - *Up to 7,040 ng/L 5:3 FTCA in foam*
- Enrichment Factor (EF) increases with increasing perfluorinated chain length
- No significant decreases in PFAS upstream and downstream of aeration basins
  - *PFAAs in foams represent ~0.1% of PFAA mass*
    - *Should foam extraction be considered?*

WRF 5031: Solids Dewatering

"PFAS in Foam and Dewatering Streams at Wastewater Treatment Plants"

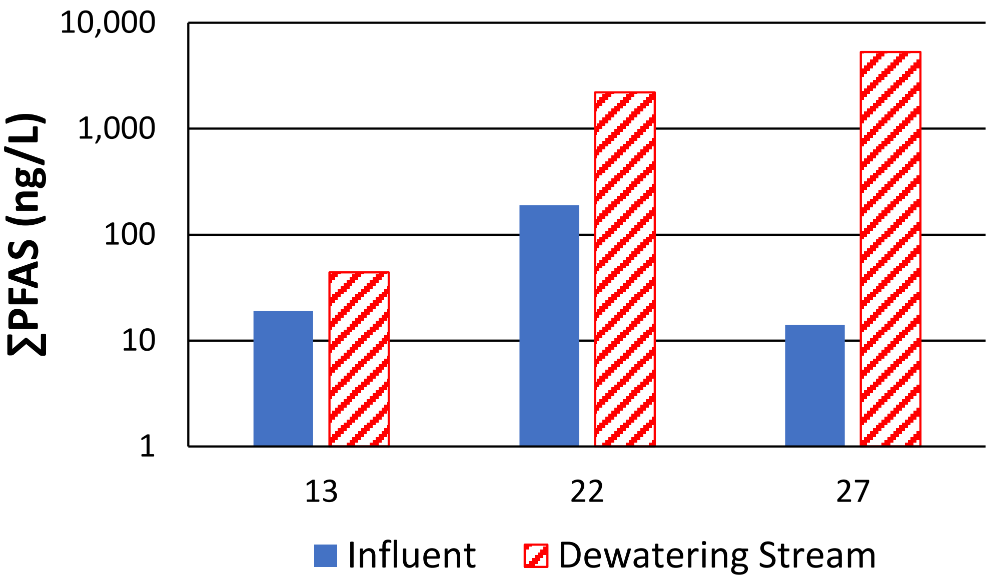
C.E. Schaefer, J.L. Hooper, L.E. Strom, K. Wu, J.L. Guelfo



Facility 22
Facility 27

Facility 13

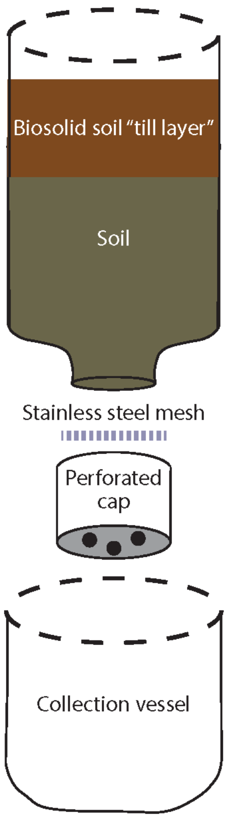
PFAS Phase Behavior Through Dewatering

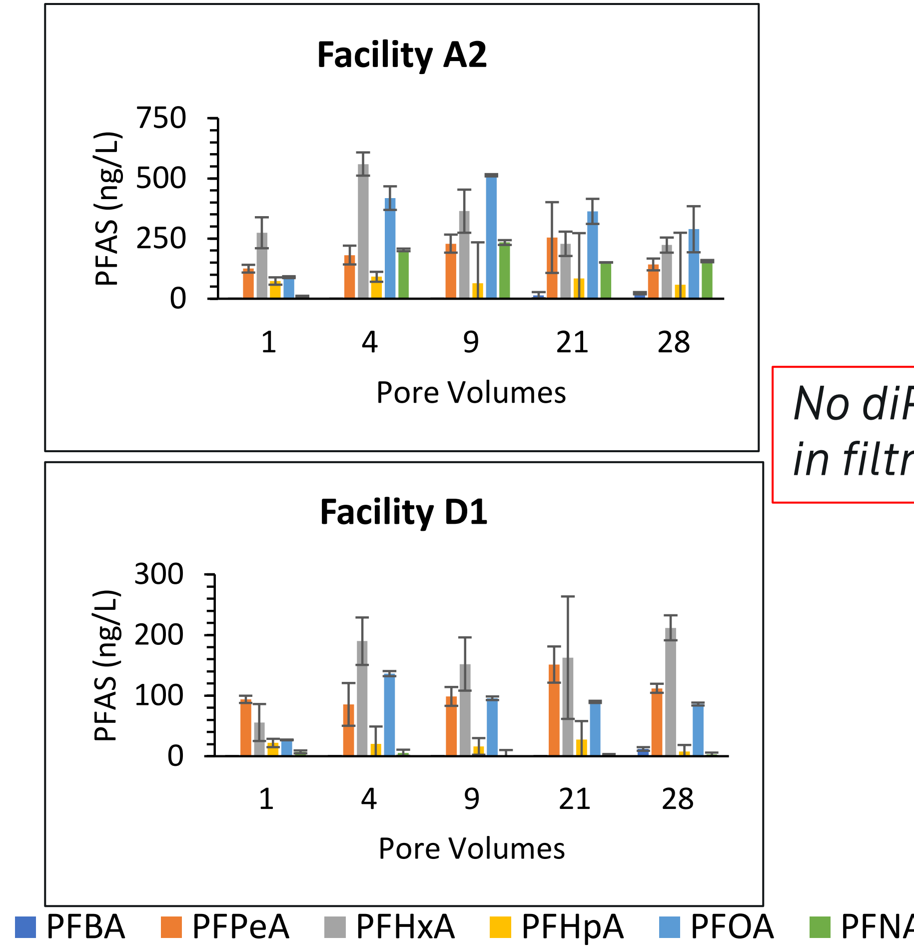


- For facilities 22 and 27, PFAS in dewatering streams primarily FTCAs *(diPAP transformation product)*
- *diPAPs in facility 27 biosolids 5-times greater than in facility 22*

Facility	∑PFAS mass flow in dewatering stream (g/day)	∑PFAS mass flow in WWTP aqueous influent (g/day)	
13	0.063 ± 0.084	6.9 ± 0.087	(0.1%)
22	1.1 ± 0.06	25 ± 1.4	(4.4%)
27	1.1 ± 0.12	0.38 ± 0.04	(290%)

PFAS Leaching from Biosolids: 6 Month Study WRF 5042

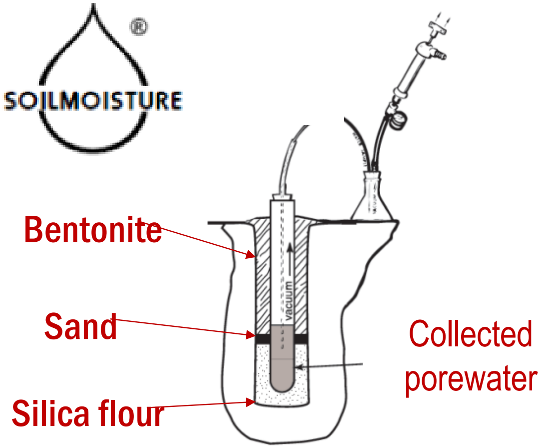




No diPAPs in filtrate

WRF 5214: PFAS Leaching through Soil

Lysimeters

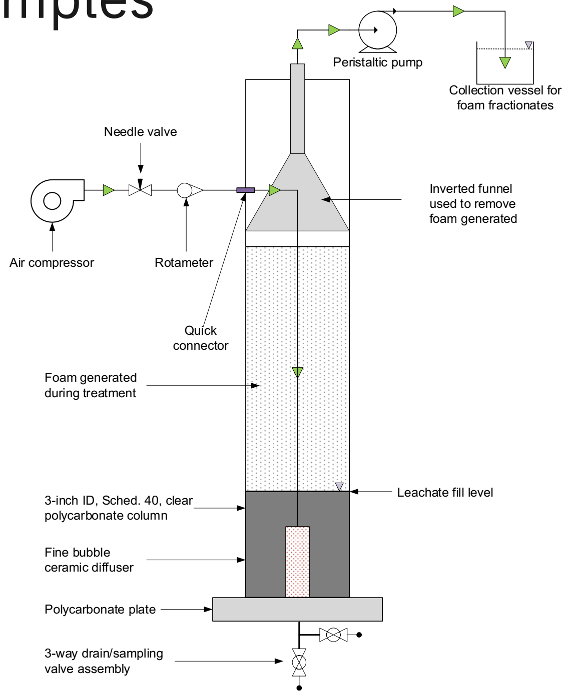


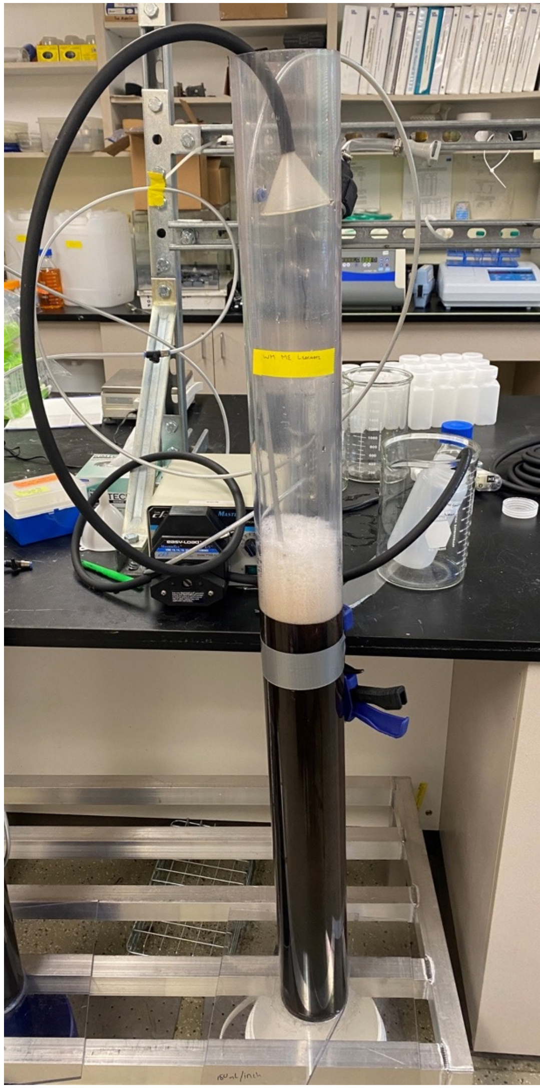
Source Reduction

Bench Scale Leachate Analysis

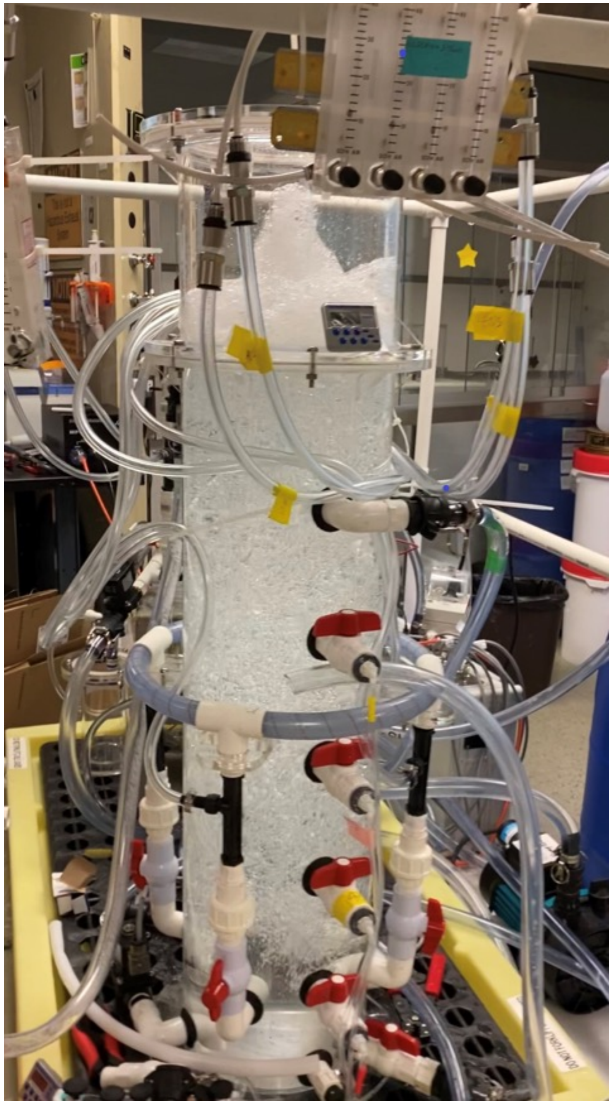
Simulation of a single stage of foam fractionation

- 3 test conditions:
  - As-is
  - With low (2 mg/L) CTAB addition
  - With high (5 mg/L) CTAB addition
- Collection of time-series samples
  - T0
  - T30 mins
  - T60 mins
  - T90 mins
  - Foam fractionate
- Testing in duplicate
- Laboratory analytical tools:
  - Target PFAS (1633)
  - TOP assay
  - AoF
  - Basic water quality parameters





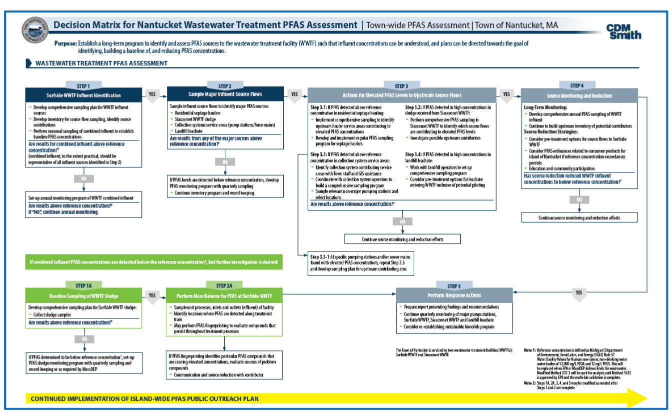
Leachate Analysis Conclusions



- Bench results indicate that foam fractionation can be effective:
  - Multi-log removal of PFOA & PFOS
  - More difficult to remove short-chained PFAS
  - ~75% total target PFAS removal
  - Treated MassDEP's PFAS6 to <10 ng/L
  - Good mass balance
  - PFAS concentrated by a factor of 50-75x through a single stage of foam fractionation
- **Represents ~5% of the total PFAS load to this WRF**

What Should Utilities Do Next?

- Become familiar with local regulations, legislation and the implications of sampling.
- Develop a better understanding of mitigation opportunities in your community:
  - Upstream of WRF (i.e. SOURCE REDUCTION)
  - Within the WRF (Foam, Centrate, etc.)
- Work with your regulators and stakeholders so all parties can better understand the science of PFAS.
  - Be on the communication offensive, not defense.



Questions?

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