WATERTECTONICS

PFAS Today

Part 2: How are we treating it in water discharges?

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Speaker

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Outline

- WaterTectonics
- Treatment Solutions
- PFAS in California
- PFAS Chemistry
- Sampling/Analysis Challenges
- PFAS Treatment Options
- Units Primer
- California PFAS Case Study
- PFAS Destruction
- Current PFAS Research Areas
- New (?) CECs

WT Overview

- Since 1999, WaterTectonics has designed, manufactured, and installed industrial water treatment systems for clients in a wide range of markets
- We provide a range of simple-to-advanced solutions that can be customized to meet site-specific customer conditions and water quality goals
- Our in-house design and lab services can help with technology selection and treatability testing to validate the approach for a facility
- Our field team provides year-round field service support to ensure long-term project success

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Treatment Solutions

Pre-Treatment

- Electrocoagulation
- Chemical Treatment
- Dissolved Air/Gas Flotation
- Incline Plate / Circular Clarifiers
- pH Adjustment
- Media Filtration

PFAS Treatment

- Granular Activated Carbon
- Ion Exchange
- RO Membrane Treatment
- Ozofractionation

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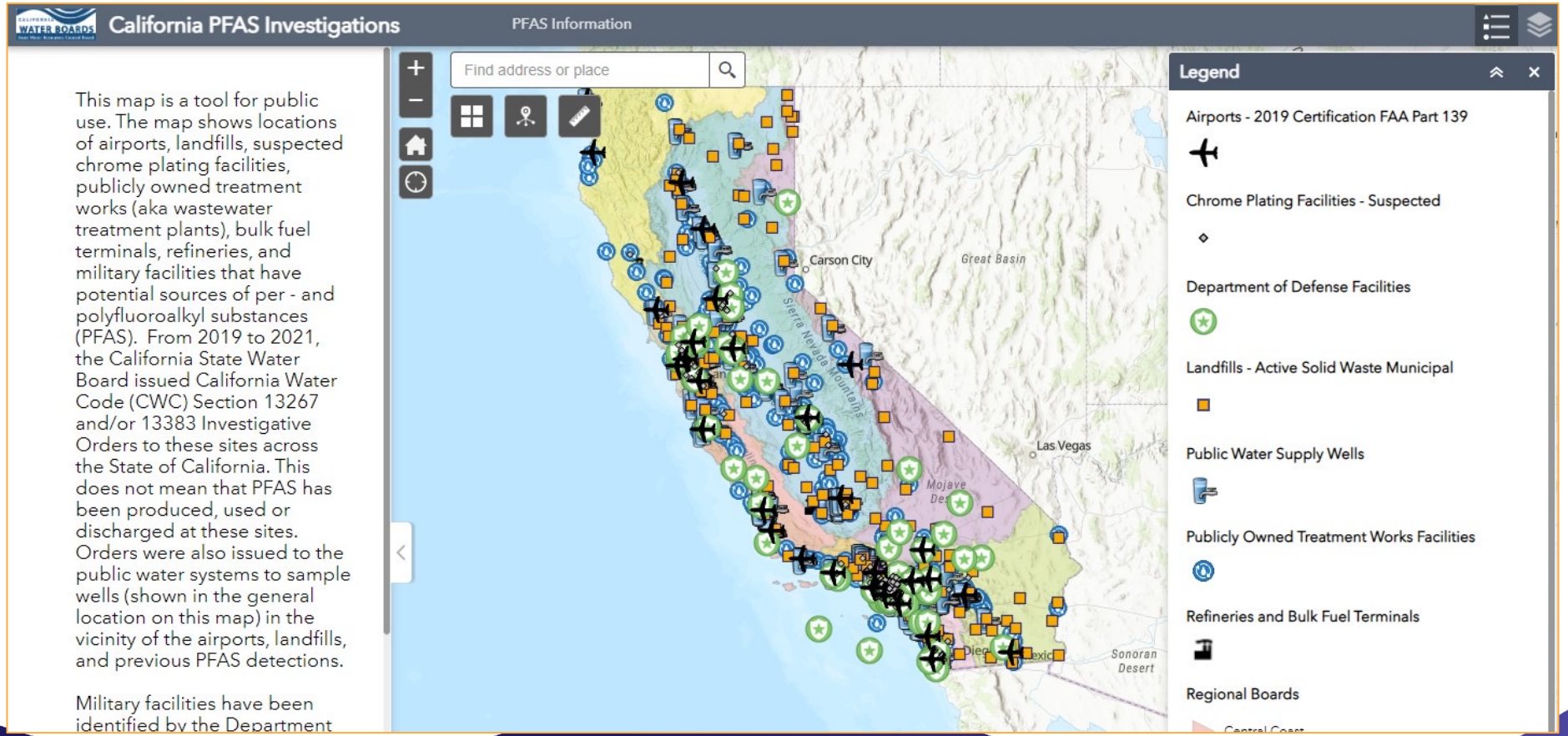


https://www.waterboards.ca.gov/pfas/

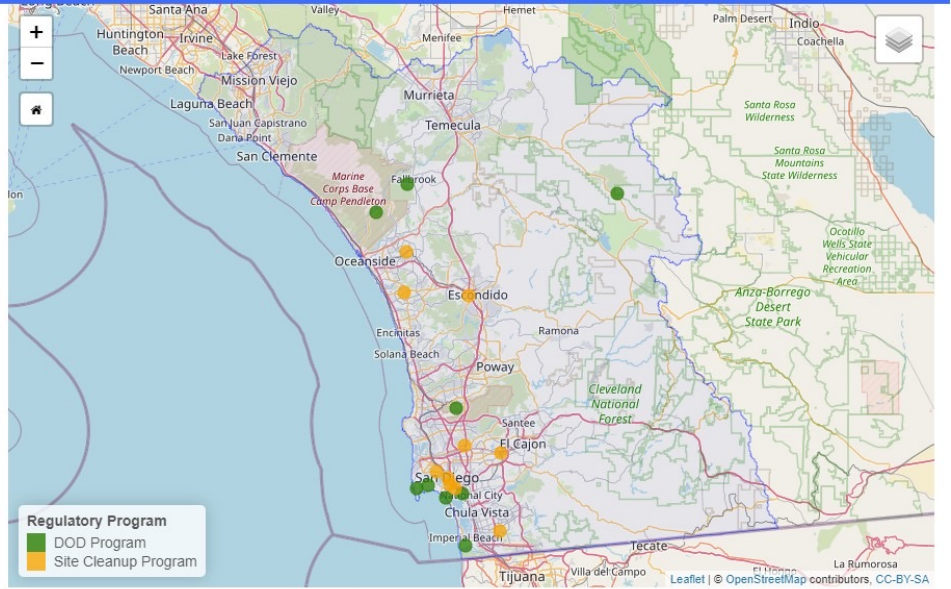
https://gispublic.waterboards.ca.gov/portal/apps/webappviewer/index.html?id=4feba1766c224dc99eadea06ef3bd019

San Diego Region PFAS Cases

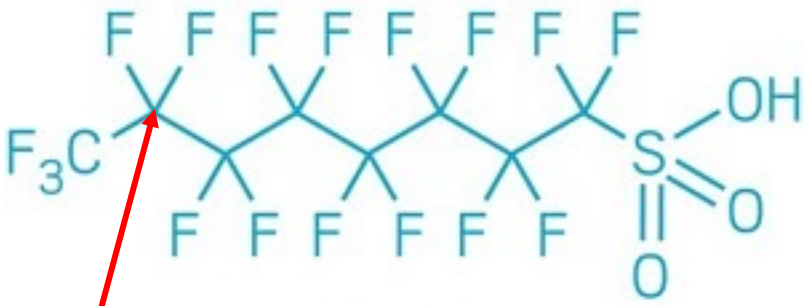
Search:

Case Name	ID Number
DOD Program********	
CAMP PENDLETON BASE WIDE PFAS	T10000017516
FallBrook Naval Weapons Station PFAS	T10000017517
MCAS Miramar PFAS	T10000017518
Naval Base Point Loma, NTC, Nise-West, SW - PFAS	T10000017519
Naval Base Coronado - PFAS	T10000017520
Naval Base San Diego - PFAS	T10000017521
Imperial Beach NALF - PFAS	T10000017522
Coronado Amphibious Base - PFAS	T10000017523
PFAS Investigations Warner Springs SERE Camp	T10000020068
Site Cleanup Program********	
San Diego International Airport	T10000012787
McClellan-Palomar Airport	T10000012786
West Coast Plating	T10000013642
Sanchez Polishing and Plating	T10000013639
Equality Plating Co.	T10000013632
Mission Valley Terminal	SL607392800

Showing 1 to 18 of 21 entries

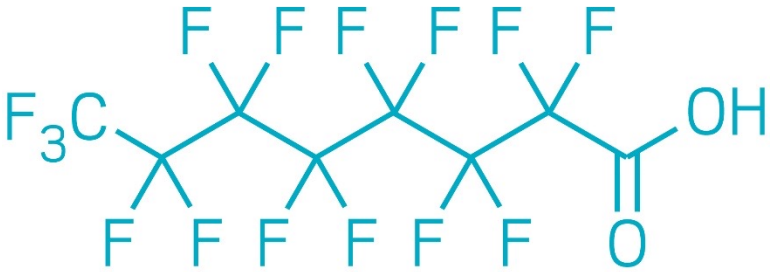


PFAS Chemistry



PFOS

C-F Bond is one of strongest in nature!



PFOA

Perfluorobutanoic acid	PFBA
Perfluoropentanoic acid	PFPeA
Perfluorohexanoic acid	PFHxA
Perfluoroheptanoic acid	PFHpA
Perfluorooctanoic acid	PFOA
Perfluorononanoic acid	PFNA
Perfluorododecanoic acid	PFDoA
Perfluorotetradecanoic acid	PFTeA
Perfluorobutanesulfonic acid	PFBS
Perfluorohexanesulfonic acid	PFHxS
Perfluoroheptanesulfonic acid	PFHpS
Perfluorooctanesulfonic acid	PFOS
4:2 FTS (fluorotelomer sulfonate)	4:2 FTS
6:2 FTS (fluorotelomer sulfonate)	6:2 FTS
8:2 FTS (fluorotelomer sulfonate)	8:2 FTS
GenX	GenX

Sampling/Analysis Challenges

NOT RECOMMENDED	RECOMMENDED
Teflon, LDPE, Polypropylene	HDPE, Silicon
Waterproof field books, plastic clipboards, binders, spiral hard cover notebooks, sticky notes, glue	Loose paper with aluminum clipboard
Markers	Pens
Chemical ice packs	Bags of ice
Water resistant, waterproof, or stain-treated clothing, including GoreTex and Tyvek	Cotton clothing laundered a minimum of 6 times from time of purchase

PFAS Treatment Overview

- Treatments are widely available but case specific and often require multi-stage processes with robust pre-treatment to effectively remove to part per trillion levels
- Pre-treatment can often be needed to address total suspended solids, oil & grease, heavy metals, total organic carbon, and bacteria
- Treatment selection will depend on influent PFAS levels, effluent targets, other contaminants present, total volume requiring treatment, and final waste disposal options

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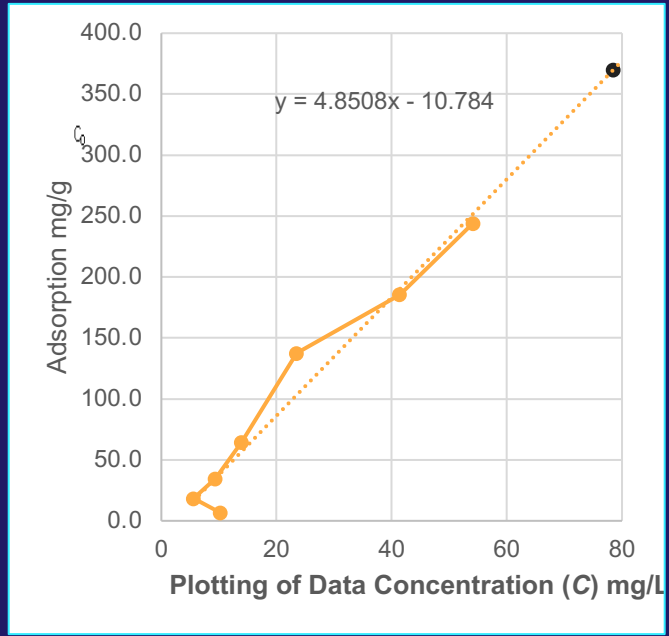
PFAS Treatment Options

Treatment	Pre-Treatment Needs	Removal	Waste	Modeling
GAC	Moderate	Tail adsorption	Incinerate or off-site regen	Need to bench test
IX	High	Tail & head adsorption	Incinerate or on-site regen (specialty)	Can do via software
RO	High	Size exclusion of PFOA (414) and PFOS (500)	20-30% liquid reject stream	Can do via software
Ozofractionation	Low	Micro nano-bubble phase	Concentrated aqueous stream	Need to pilot

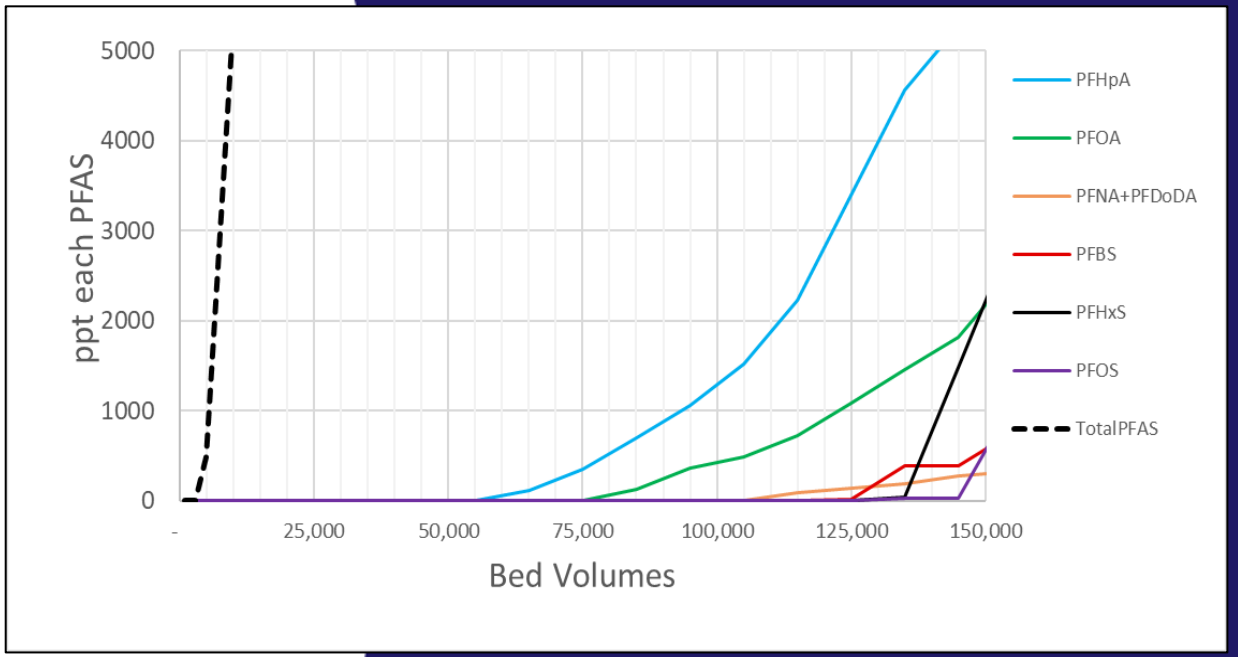
GAC Modeling

- Isotherm Study = Identifies which type of GAC is best for a given application by determining the absolute adsorptive capacity
- Rapid Small-Scale Column Testing (RSSCT) = Predicts the adsorption of target compounds and breakthrough time for the media (and ultimately, operating cost)
- Both tests often require water specific method planning and have various ways of being run

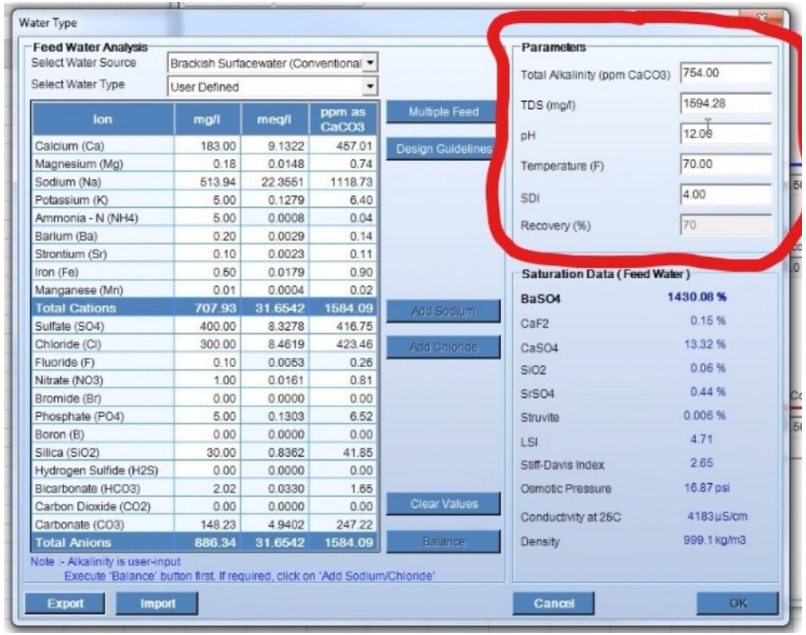


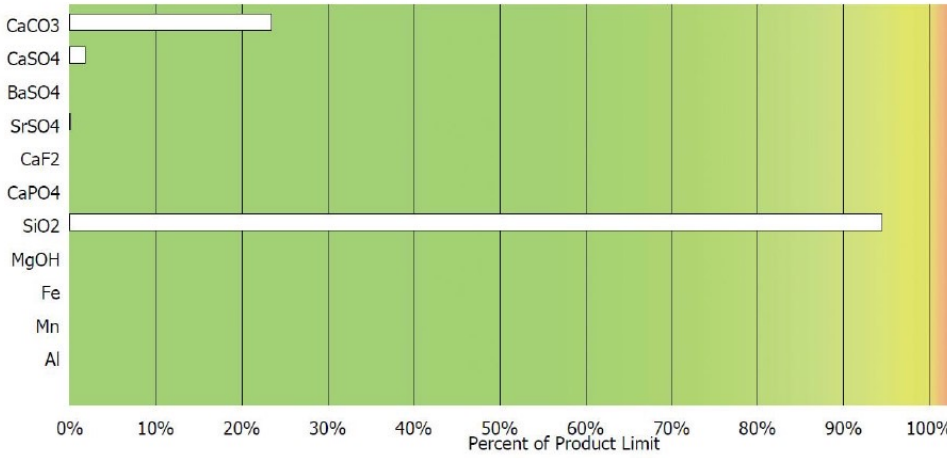
IX Modeling

- Requires additional analysis of related anions/cations and other compounds
- Often proprietary and vendor/media specific
- Model reliability is generally high if enough background data
- RSSCT can be done here too



RO Modeling





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Units Primer

- mg/L = milligrams per liter = PPM = parts per millions
- µg/L = micrograms per liter = PPB = parts per billion
- ng/L = nanograms per liter = PPT = parts per trillion
- pg/L = picograms per liter = PPQ = parts per quadrillion

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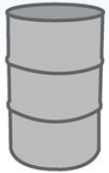
How much is one part per ...

million (ppm)
milligrams/liter (mg/L)

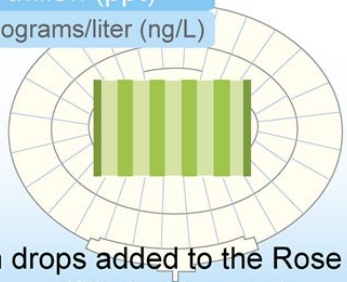


= three drops added to a 42-gallon barrel

billion (ppb)
micrograms/liter (µg/L)

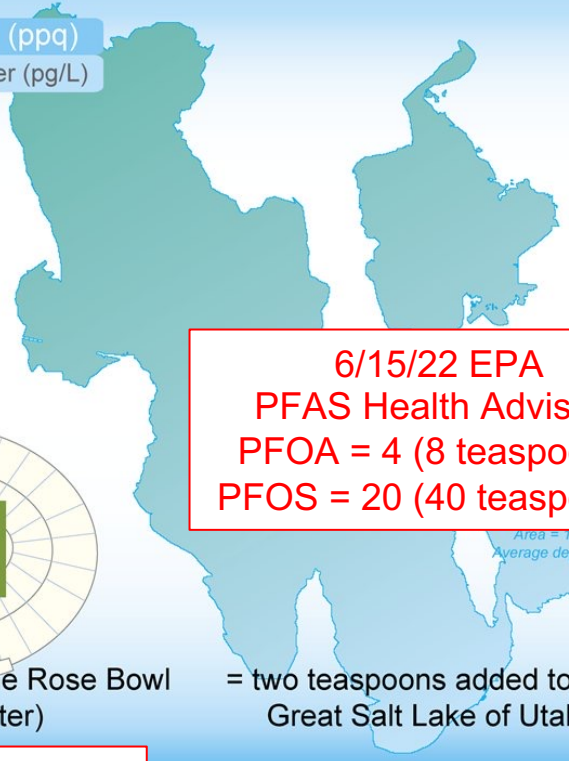
= one drop added to a large tanker truck

trillion (ppt)
nanograms/liter (ng/L)



= ten drops added to the Rose Bowl (filled with water)

quadrillion (ppq)
picograms/liter (pg/L)



= two teaspoons added to the Great Salt Lake of Utah

6/15/22 EPA
PFAS Health Advisory
PFOA = 4 (8 teaspoons)
PFOS = 20 (40 teaspoons)

PFOA=40 | 400 drops

Credit: Metropolitan Water District of SoCal

PFAS Case Study

- Multi-stage treatment system to address PFAS contamination from firefighting activity that took place on site
- 100gpm treatment system includes ultrafiltration, carbon filtration, and ion exchange
- Treated approx. 8M gal to date

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PFAS Case Study

- WaterTectonics wrote ATS plan (treatment system operating plan) and provides all operating labor through its field service division
- System has met effluent PFAS targets since install and is in year three of operations
- Due to results, system is being tripled in size to accommodate more flows

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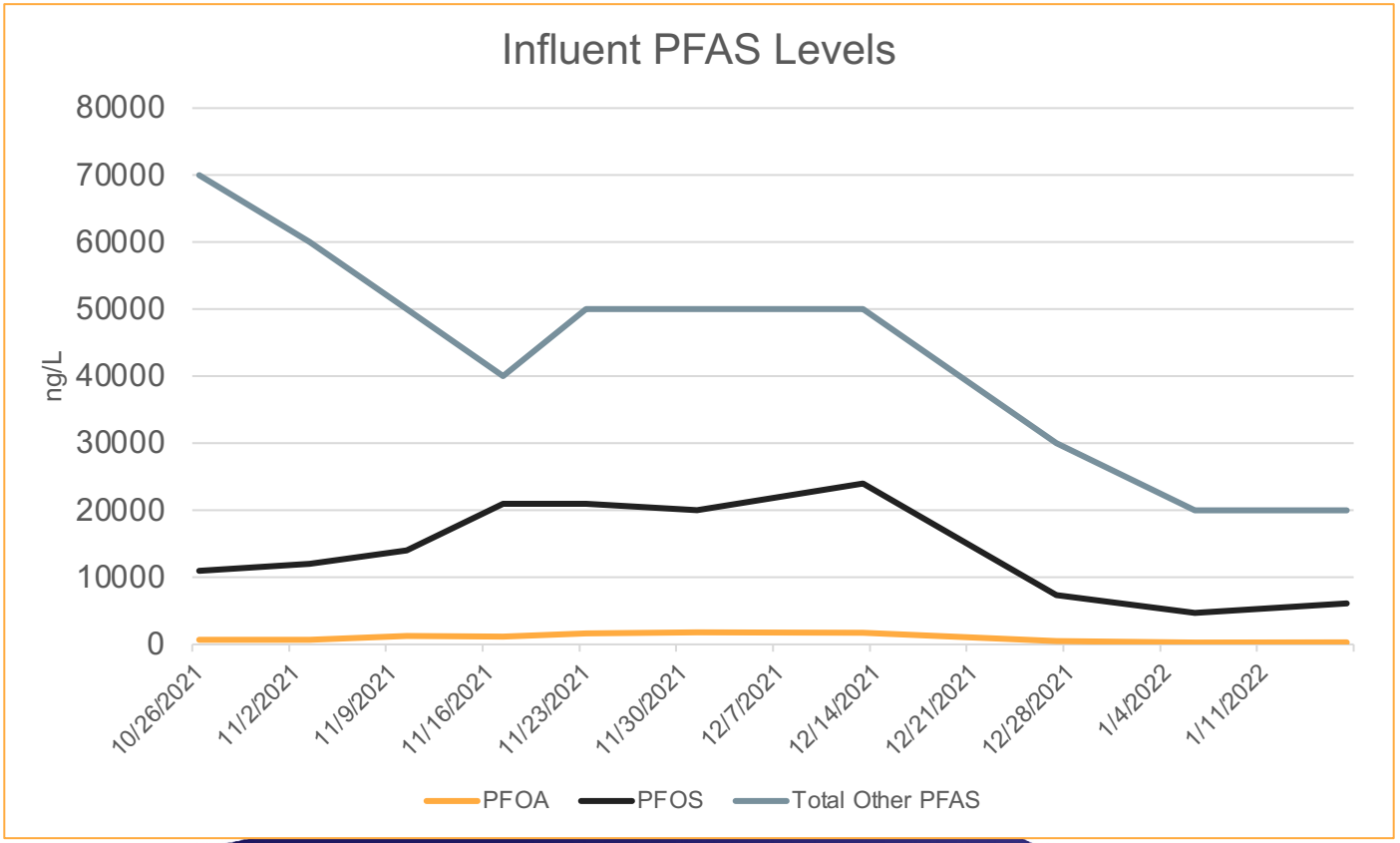
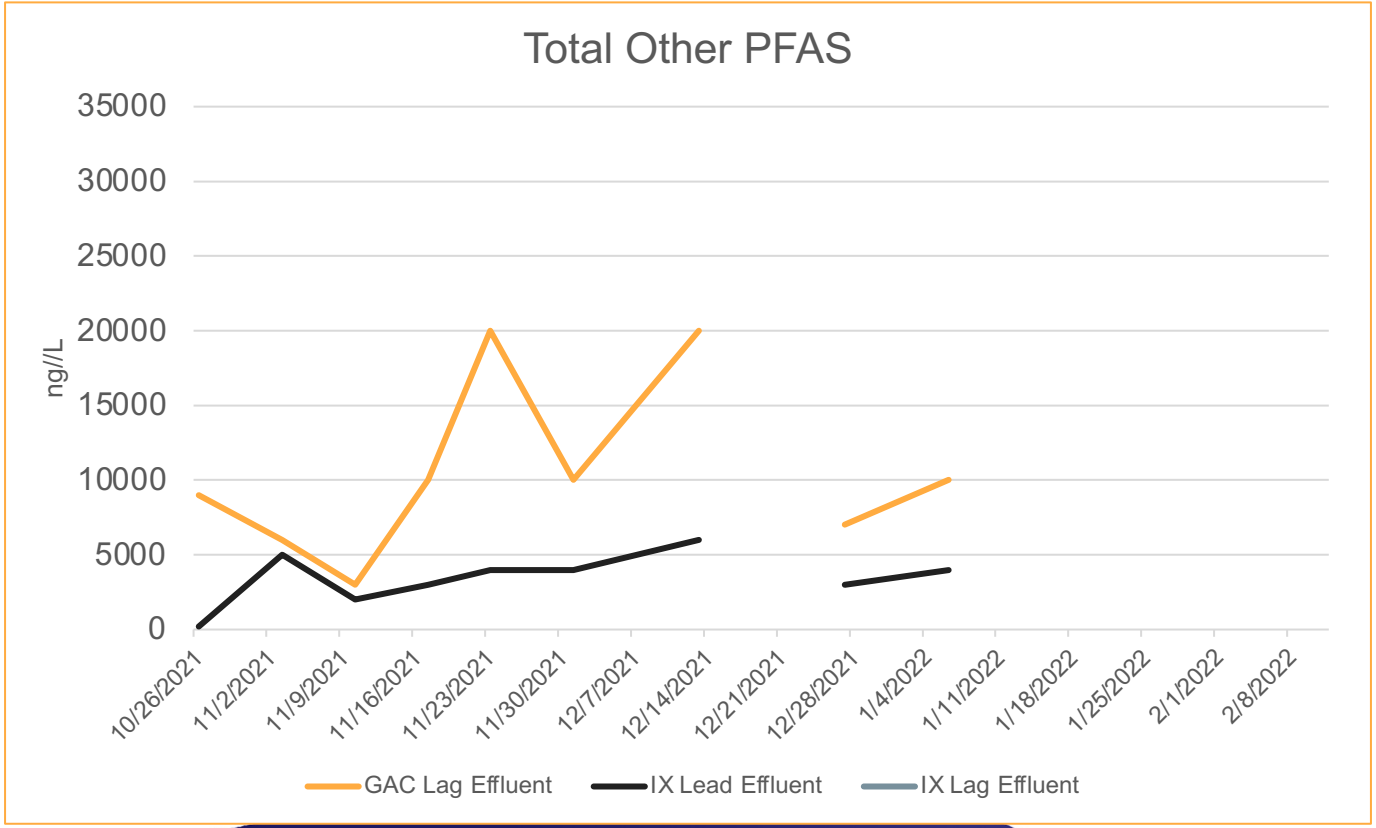
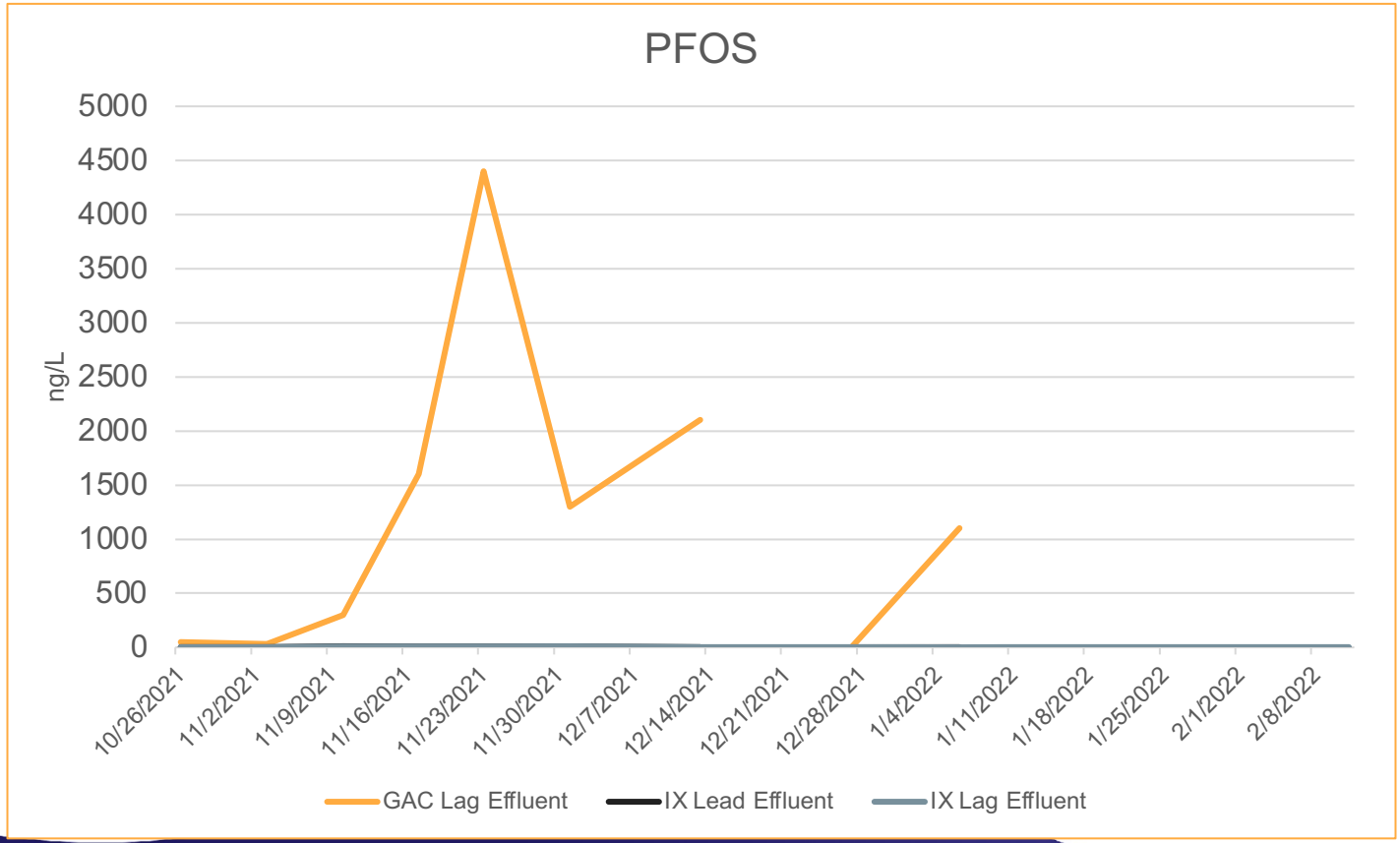

Influent PFAS Levels
80000
70000
60000
50000
40000
30000
20000
10000
0
ng/L
10/26/2021
11/2/2021
11/9/2021
11/16/2021
11/23/2021
11/30/2021
12/7/2021
12/14/2021
12/21/2021
12/28/2021
1/4/2022
1/11/2022
PFOA
PFOS
Total Other PFAS


Total Other PFAS
35000
30000
25000
20000
15000
10000
5000
0
ng//L
10/26/2021
11/2/2021
11/9/2021
11/16/2021
11/23/2021
11/30/2021
12/7/2021
12/14/2021
12/21/2021
12/28/2021
1/4/2022
1/11/2022
1/18/2022
1/25/2022
2/1/2022
2/8/2022
GAC Lag Effluent
IX Lead Effluent
IX Lag Effluent


PFOS
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
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11/2/2021
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11/16/2021
11/23/2021
11/30/2021
12/7/2021
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12/21/2021
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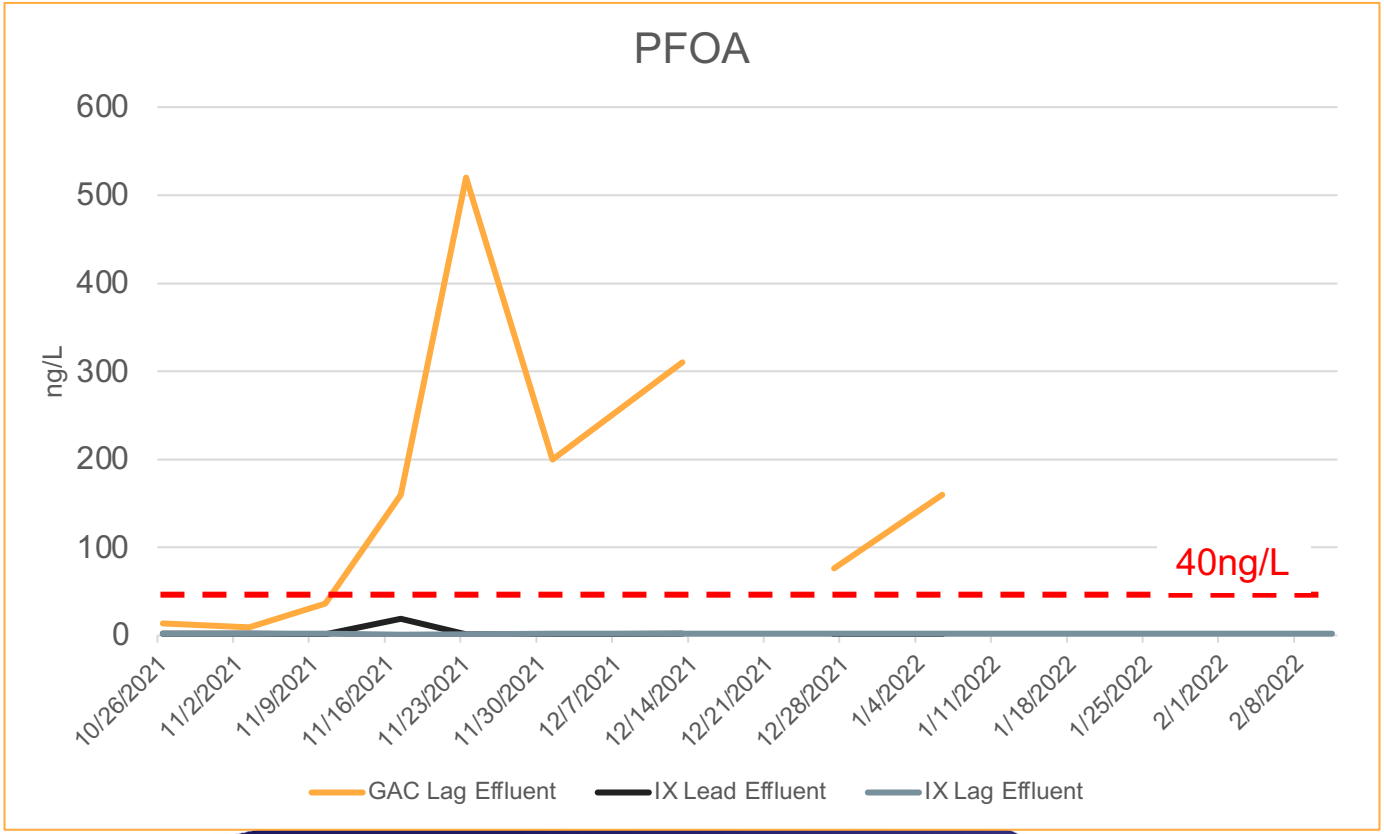
PFOA
600
500
400
300
200
100
0
ng/L
40ng/L
10/26/2021
11/2/2021
11/9/2021
11/16/2021
11/23/2021
11/30/2021
12/7/2021
12/14/2021
12/21/2021
12/28/2021
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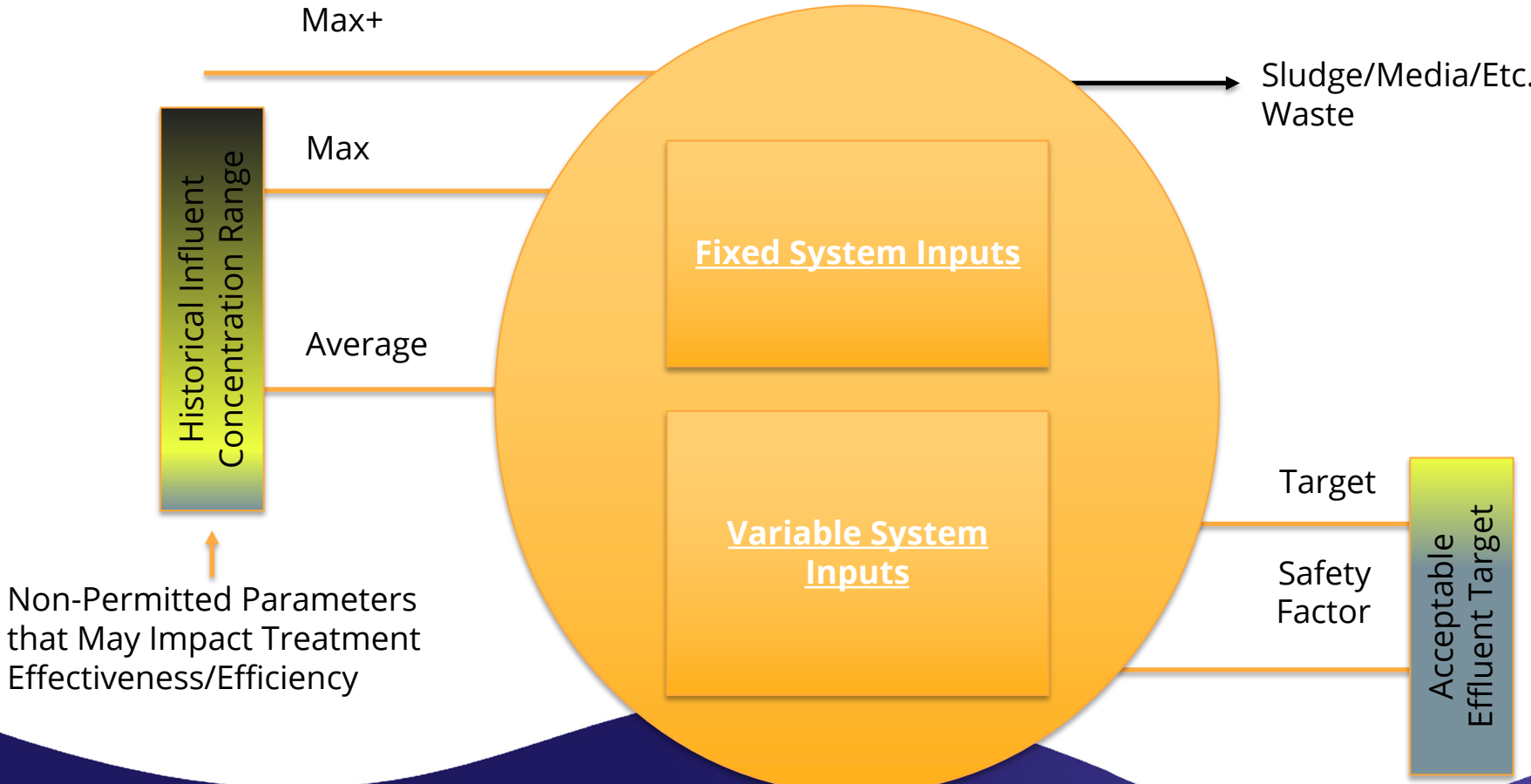
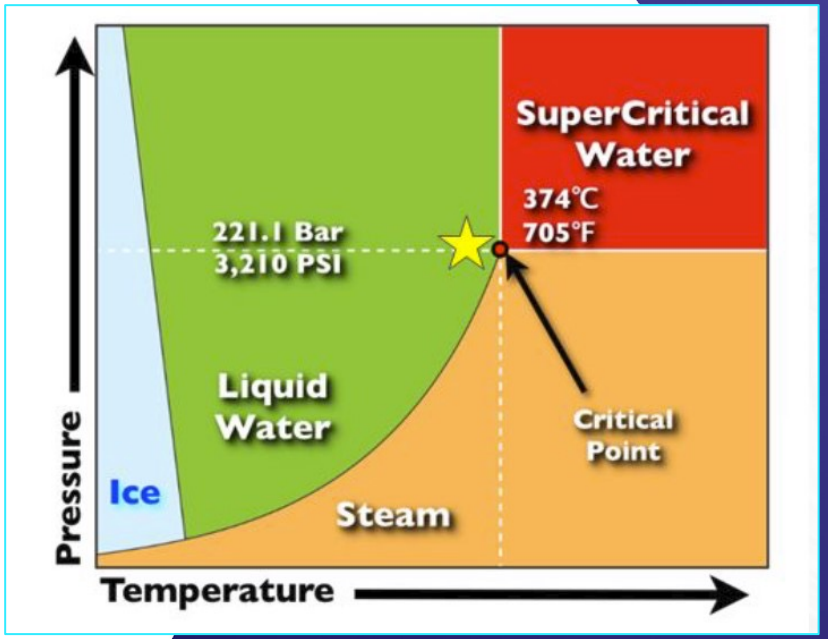

Max+
Max
Average
Historical Influent Concentration Range
Non-Permitted Parameters that May Impact Treatment Effectiveness/Efficiency
Fixed System Inputs
Variable System Inputs
Sludge/Media/Etc. Waste
Target
Safety Factor
Acceptable Effluent Target

PFAS Destruction

- Thermal (Incineration, Smoldering, Electrical Resistance)
- Reduction/Oxidation (Activated Persulfate, Electrochemical, Photolysis, Zerovalent Iron)
- Other (Ball Milling, Sonolysis, Plasma, Electron Beam, Supercritical Water Oxidation, Hydrothermal Alkaline Treatment)
- And so on…



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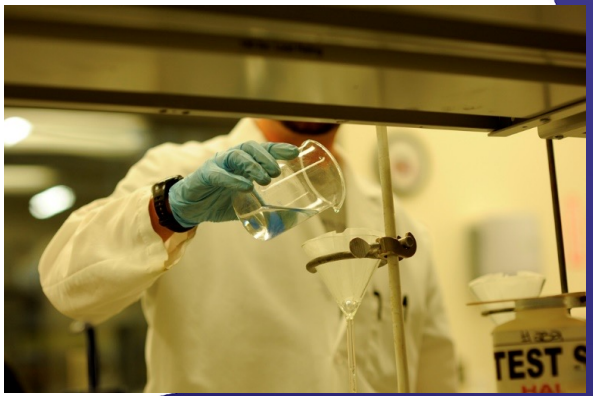
Current PFAS Research Areas

- How to degrade PFAS in brine & residuals
- Develop real-time PFAS sensors
- Develop electrode materials for PFAS treatment
- Develop new anoxic/anaerobic PFAS treatments



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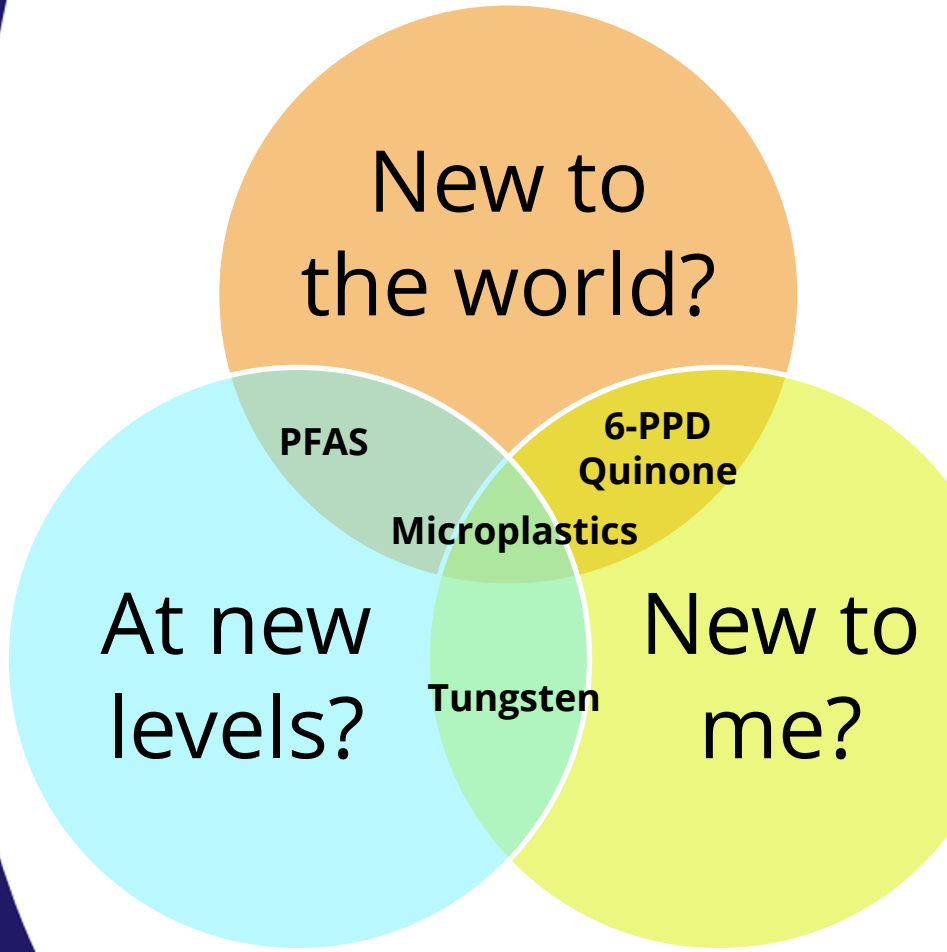
New (?) CECs

"Although there is no federal statutory or regulatory definition of CECs, the term generally refers to unregulated substances detected in the environment that may present a risk to human health, aquatic life, or the environment, and for which scientific understanding of potential risks is evolving."*

*Congressional Research Service R45998

EPA has fact sheets for 12 CECs:
https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern



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Thank you!

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