

Site-Specific Technology Selection for PFAS Treatment

Loureiro Engineering Associates, Inc.

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Introduction

Loureiro is a full-service solutions provider from inception to completion. We provide top-tier service for every step of your project through a diverse offering of integrated solutions. We integrate engineering, assessments and surveys, construction, EH&S, energy, waste management, and laboratory services.

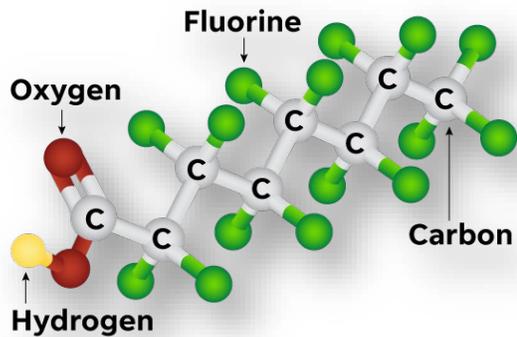


Presentation Overview

How to manage PFAS treatment at your site:

1. What are PFAS?
2. How does this affect me?
3. What can I do at my site?
4. How have other sites managed this?

Background on PFAS



Group of more than 3,000 manmade chemicals used in industrial and consumer applications



Possible links to liver effects, reproductive and developmental effects, cardiovascular effects, cancers, and additional health effects



Common applications include fire fighting foam, non-stick coatings, stain and water resistant products



Regulatory focus on drinking water quality, shifting also to include wastewater effluent limits and remediation of historic releases

PFAS Regulatory Framework

- **Federal (EPA)**

- PFOA and PFOS listed as emerging contaminants
- Lifetime health advisory established (70 ppt)
- Working towards regulatory determination for PFOA and PFOS under SDWA
- 172 PFAS compounds added to TRI program for annual reporting (100-lb reporting threshold)
- No federal water quality standards under CWA at this time
- Draft analytical method published for wastewater and other environmental media

- **State**

- 27 states have developed state-specific standards and/or guidance
- Some states promulgating standards or guidance < EPA advisory (e.g. Michigan)

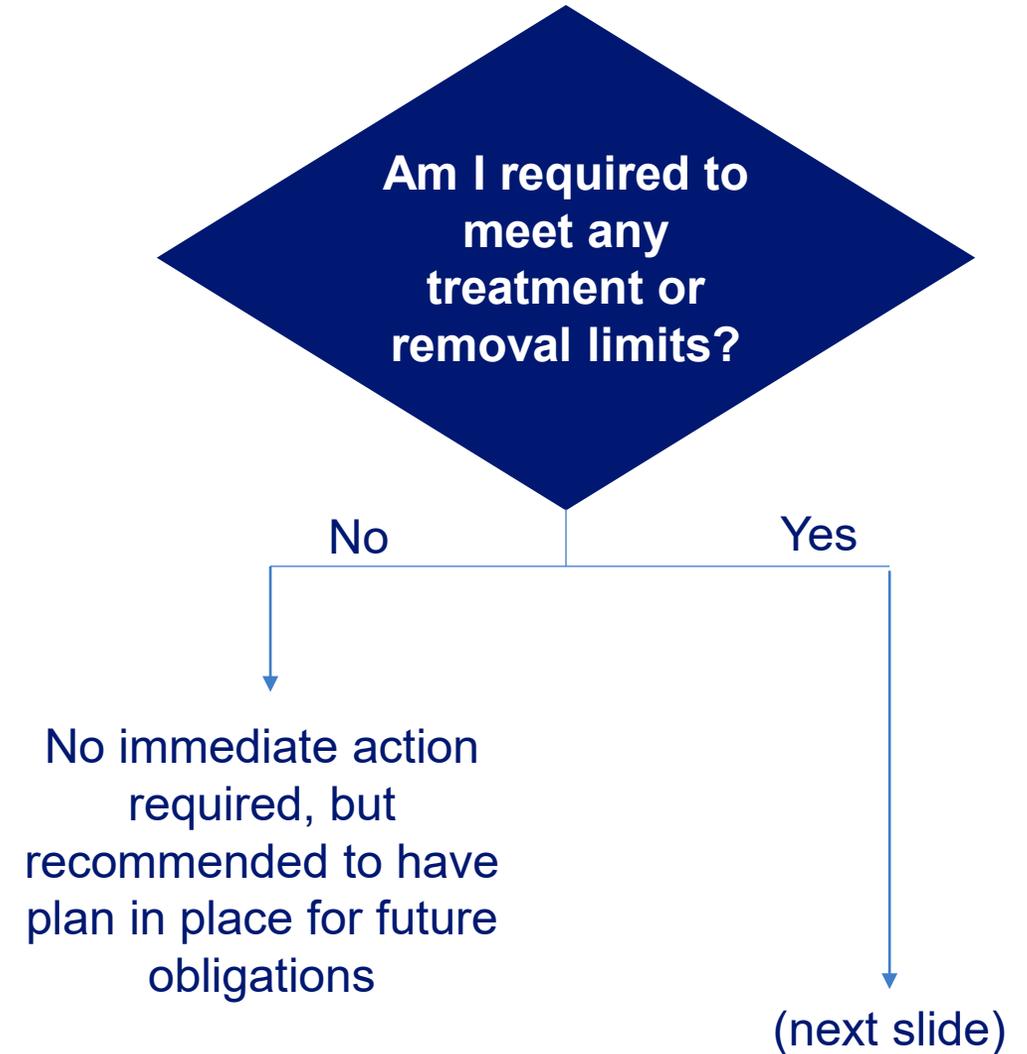


ITRC is a recommended quick resource to check status of regulations in your state

Designing Site-Specific Treatment

Determine your obligations:

- Do I have any federal requirements?
- What state or local requirements apply?
- What conditions may apply from permits I hold?
- Can I expect data requests from regulatory agencies?



Designing Site-Specific Treatment

Determine sources of PFAS at your site:

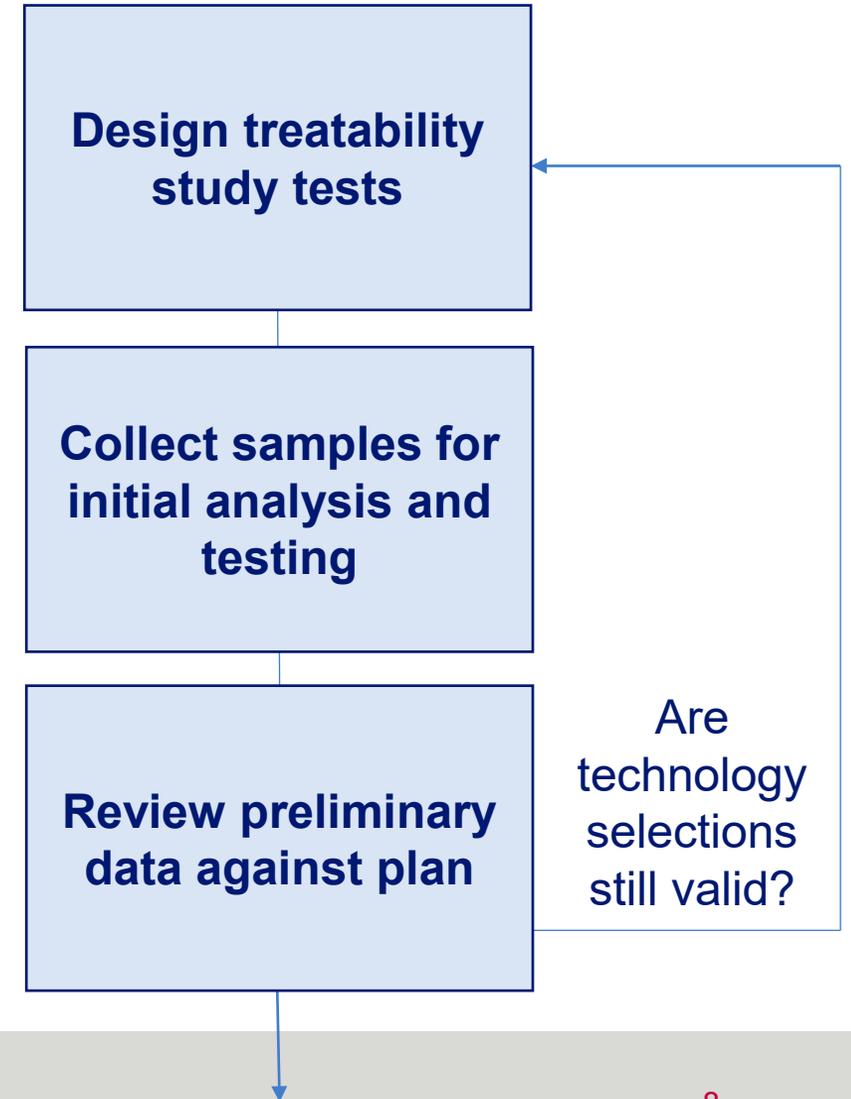
- What processes may have used (or currently use) PFAS-containing chemistry?
- What is the likelihood of environmental releases?
- Do I have current wastewater or remediation treatment systems?
- Which technologies are most feasible for my site based on cost, space, or operational constraints?



Designing Site-Specific Treatment

Design study per treatment goals:

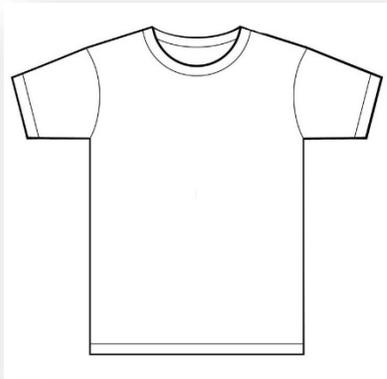
- Design sampling procedure following best practices to obtain representative samples
- Are selected technologies still valid for detected PFAS compounds?
- What competing species may be present in water needing treatment?
- Is pretreatment (including pH adjustment) required? What waste streams may be generated?



Obtaining Representative Samples

Sample Collection Clothing:

- Well-laundered clothing not recently washed with fabric softener
- No waterproof clothing, including field boots
- No sun screen, insect repellent, moisturizers



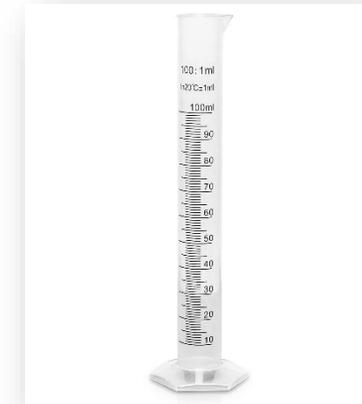
Sampling Equipment:

- Glass not recommended
- No equipment (e.g. pumps) with Teflon® material
- Exclude use of Sharpies, Post-It® notes, waterproof notebooks



Sample Volume and Location:

- Collect samples as would be expected as influent to a WWTS
- Create flow composite in field or provide instructions to laboratory
- Collect extra volume if samples are difficult to collect



Proven Treatment Technologies

Granular Activated Carbon (GAC)

Technology	Primary Advantage(s)	Considerations
Use of adsorbent media made from highly porous organic materials to sorb aqueous phase contaminants	<ul style="list-style-type: none">✓ Widely demonstrated with removal efficiencies between 90% to >99%✓ Not operationally complex	<ul style="list-style-type: none">• Lower removal efficiency of short-chain PFAS• Competitive adsorption if high organic content in water



Proven Treatment Technologies

Ion Exchange

Technology	Primary Advantage(s)	Considerations
Species in water with a greater affinity for acid or base functional groups sorb to media by displacing present ions	<ul style="list-style-type: none">✓ Resins developed for selective removal of PFAS (including short-chain)✓ Smaller vessel footprint	<ul style="list-style-type: none">• Higher resin costs (purchase and disposal)• Presence of organics and inorganics can lower PFAS removal capacity



Proven Treatment Technologies

Membrane Filtration

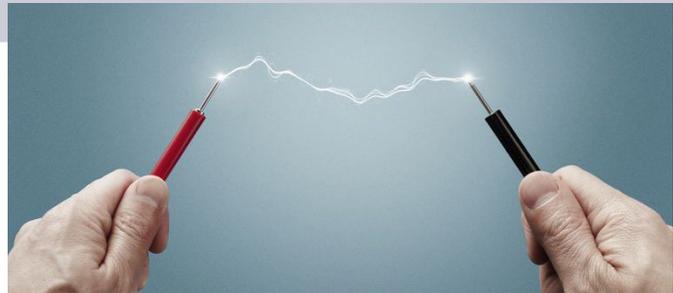
Technology	Primary Advantage(s)	Considerations
<p>Semi-permeable membrane structures separate contaminants from liquid, with RO and NF most studied applications in PFAS treatment</p>	<ul style="list-style-type: none">✓ Removal of even the smallest PFAS compounds (e.g. PFBA) - permeate✓ Less popular alternative application to concentrate waste stream for further treatment - reject	<ul style="list-style-type: none">• Concentrated liquid waste stream• Pretreatment may be necessary to prevent fouling and/or scaling



Proven Treatment Technologies

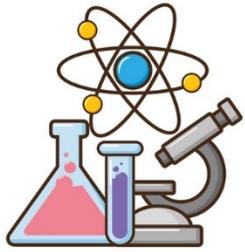
Redox Treatment

Technology	Primary Advantage(s)	Considerations
Destruction of PFAS compounds through transfer of electrons between reactants after changing the oxidation-reduction potential of water (through amendments or addition of energy)	✓ True destruction of compounds	<ul style="list-style-type: none">• Potential for partial transformations• Less demonstrated full-scale• Higher operational complexity



Treatability Study Best Practices

✓ Selection of laboratories



✓ Comprehensive documentation



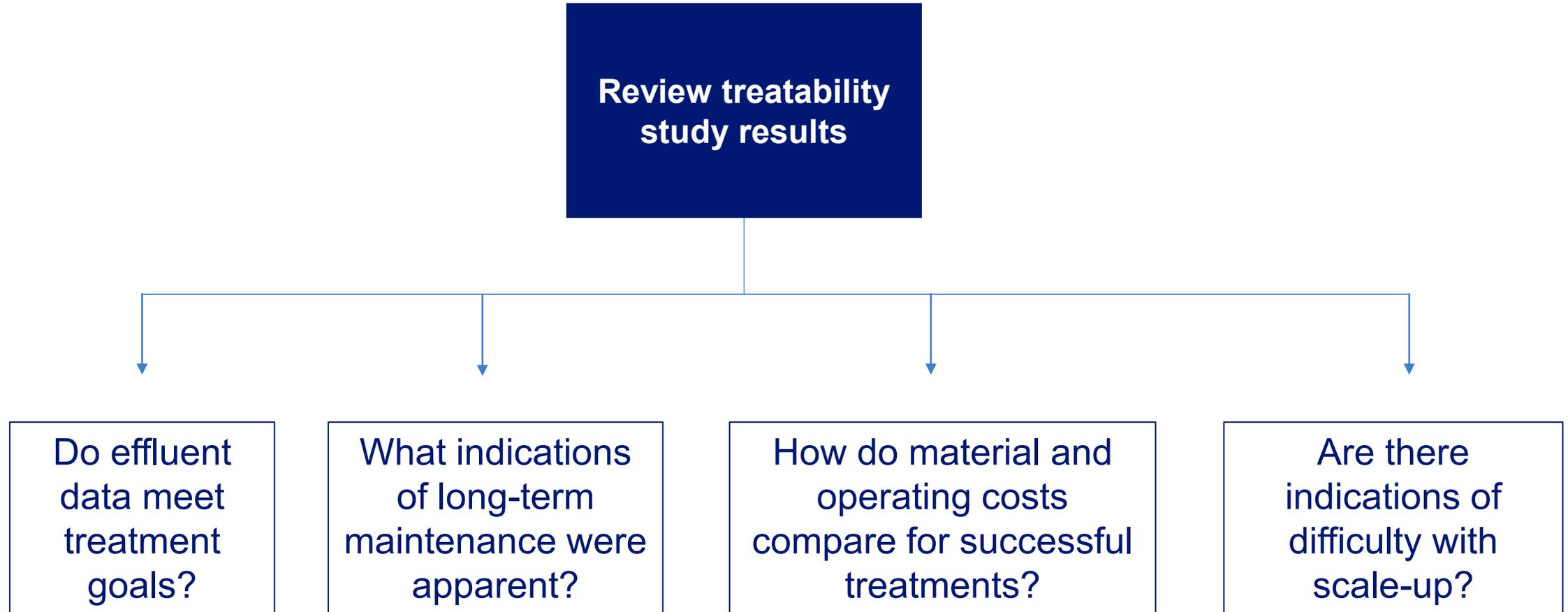
• Review laboratory capabilities:

- How are results communicated?
- What is lab's familiarity with scale-up of treatment?
- Can laboratory perform preferred analytical methods to required project goal limits?

• Detailed work plan for sample collection and treatability study tests:

- How to best mimic actual conditions on a benchtop?
- What are important data points you're looking to obtain during testing?
- What theoretical values do you expect, and how to adjust based on observed reaction during testing?
- Can report be supplemented with photographs?

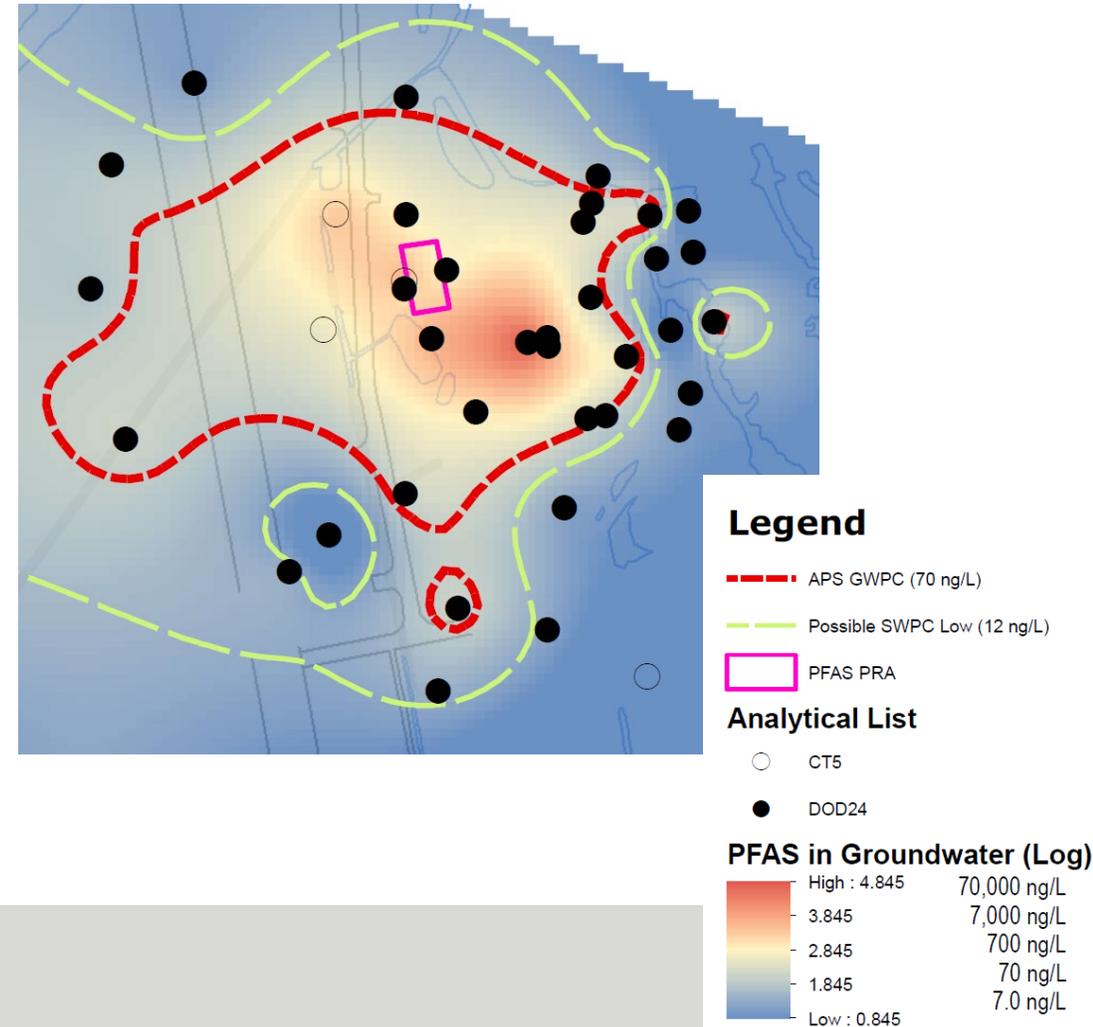
Designing Site-Specific Treatment



Project Spotlight: Investigative Phase

Sitewide Groundwater Investigation of PFAS | Confidential Client

- **Assessment of over 100s of Potential Release Areas (PRAs)**
 - Review of historical processes
 - Previously established releases of other constituents
- **Conducted supplemental soil and groundwater investigations**
 - Confirmed PFAS release areas and evaluated the three-dimensional distribution of PFAS in soil and groundwater.
 - Included advancing over 100 soil borings and installing more than 40 additional monitoring wells
 - Collected more than 500 soil and groundwater samples
- **Designed remedial alternatives evaluation for soil and groundwater**



Project Spotlight: Updating Treatment

Upgrade of treatment system for PFAS capability | Confidential Client

- **Existing SVE system and groundwater extraction system for VOCs remediation**
 - Existing out-of-service liquid phase granular activated carbon (LGAC) polishing system
- **PFAS identified in area of concern through groundwater data – designed treatment addition**
 - Modeling calculations to select LGAC for PFAS adsorption
 - Retrofit of existing system for PFAS treatment
- **Lessons learned**
 - Bag filters sized up for iron solids removal; however, difficulty with startup from suspected accumulation during shutdown
 - Switched carbon vendor and saw much faster rate of breakthrough after approximately two years of operation



Questions

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