Session 1: PFAS Technical Panel

Georgia Brownfield Association Seminar

April 11, 2023

Session Leader: *William A. Butler, P.E., BCEE – NewFields*

Presenters: *Steve Ellingson, Ph.D. – Shannon & Wilson*

Heath McCorkle – Pace Analytical

Lucas Barroso-Giachetti, P.E., CHMM – S&ME

SHANNON & WILSON

ASTM Phase I ESA and PFAS

Georgia Brownfields Association (GBA)
Brownfield Seminar Presentation
Session 1: PFAS Technical Panel
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Overview & Introduction

1. New ASTM Phase I ESA
2. PFAS Updates
3. Summary/Path Forward

ASTM Phase I ESA

- "New" ASTM Standard E1527-21 Phase I Environmental Site Assessments
  - Many Clarifications, No Substantive Charges
  - Effective February 13, 2023
- Superfund Liability Protections for Purchasers
  - Conduct All Appropriate Inquires (AAI)
  - Limited to *Hazardous Substances*
- Don't Forget Your Superfund Continuing Obligations
- Other Potential Liabilities not Addressed
  - Waste Management, Stormwater, Drinking Water, etc.
  - PFAS Not (Yet) a *Hazardous Substance*

PFAS as Emerging Contaminant

- Include in ASTM Phase I ESA as "Additional Service"
  - Describe in Your Proposal or Scope of Work
- Business Environmental Risks (BER)
  - Current or Planned Use of Property
  - Potential Material Impact on Business
- Non-Scope Considerations
  - Can Include Chemicals not yet Hazard Substances
  - Potential Phase II Sampling and Analysis
  - Regulatory Compliance

EPA's List of Potential PFAS Sources

- **Aviation Operations***
- Carpet Manufacturers
- Chrome Electroplating, Anodizing, and Etching
- Coatings, Paints, and Varnish
- Firefighting Foam Manufacturers
- **Landfills***
- Medical Devices
- **Municipal Fire Departments and Firefighting Training Centers***
- Paper Mills
- Petroleum Refineries and Terminals
- Pesticides and Insecticides
- Photographic Film Manufacturing
- Polishes, Waxes, Cleaning Products
- Polymer Manufacturing
- Textile Mills (textiles and upholstery)
- **WWTPs***

* = Potential EPA Superfund enforcement discretion

2. PFAS Updates

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PFOA/PFOS Hazardous Substances

- September 2022, EPA Proposed Listing PFOA/PFOS as Superfund Hazardous Substances
- Must Immediately Report Release Over 1 Pound in 24 Hours
- More Sites Could be Added to Superfund Cleanup List
  - Allow Private Party Cost Recovery
  - Potential Reopener for Closed Superfund Sites

PFOA/PFOS Enforcement Discretion

- EPA to Focus on Facilities That Cause Significant Releases of PFAS
  - EPA May Choose to Not Take Superfund Enforcement Action
  - EPA May Settle and Provide Superfund Contribution Protection
- EPA May Provide Discretion for:
  - Water Utilities & POTWs
  - Publicly Owned/Operated Municipal Solid Waste Landfills
  - Farms Applying Biosolids
  - Certain Airports & Fire Departments

Limitations: Facility cannot cause an imminent and substantial endangerment, limited to CERCLA, & facility must cooperate.

Proposed Maximum Contaminant Levels

Compounds	Proposed MCL (ng/L)	HBWC (ng/L)
PFOA	4.0	- - -
PFOS	4.0	- - -
GenX	Hazard Index = 1.0	10.0
PFBS		2000.0
PFHxS		9.0
PFNA		10.0

NOTE: Trigger levels for additonal monitoring are 1.3 ng/L for PFOA & PFOS and HI = 0.3 for GenX, PFBS, PFHxS, & PFNA

GenX = Hexafluoropropylene Oxide Dimer Acid, HBWC = Health Based Water Concentration, HI = Hazard Index, MCL = Maximum Contaminant Level, PFBS = Perfluorobutane Sulfonic Acid, PFHxS = Perfluorohexane Sulfonic Acid, and PFNA = Perfluorononanoic Acid.

3. Summary Path Forward

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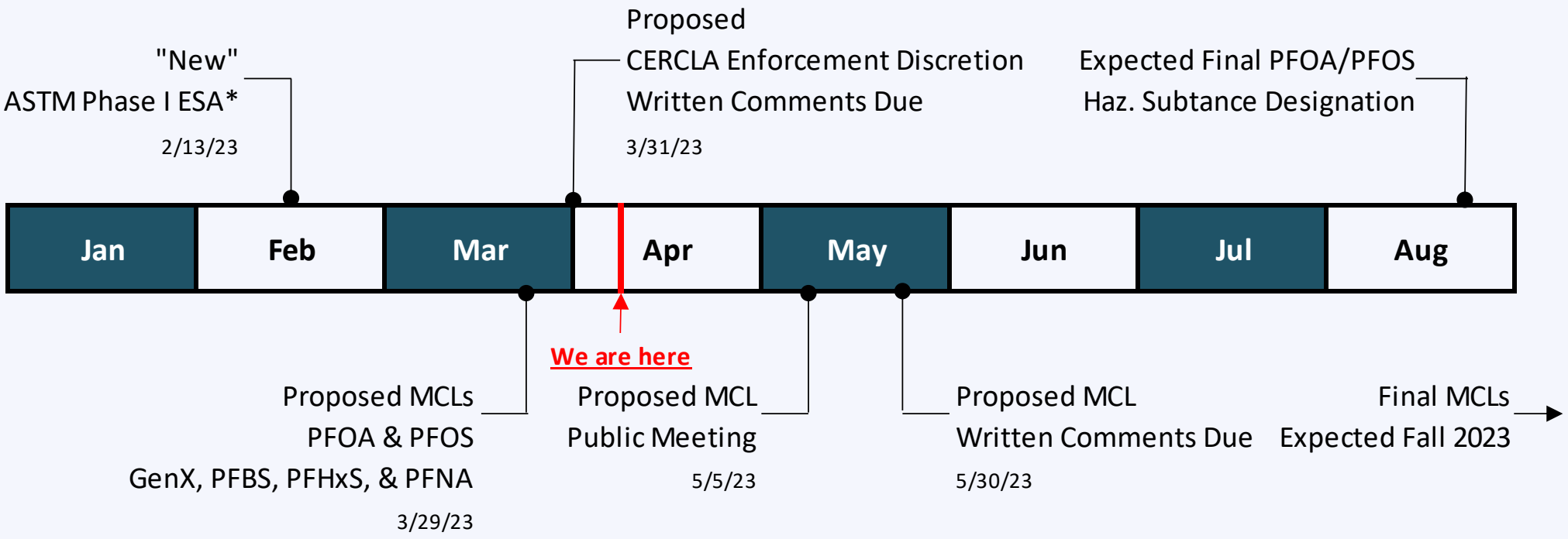
2023 Summary Path Forward



* = "Old" ASTM Phase I ESA Std. can be used until Feb'24

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Thank You

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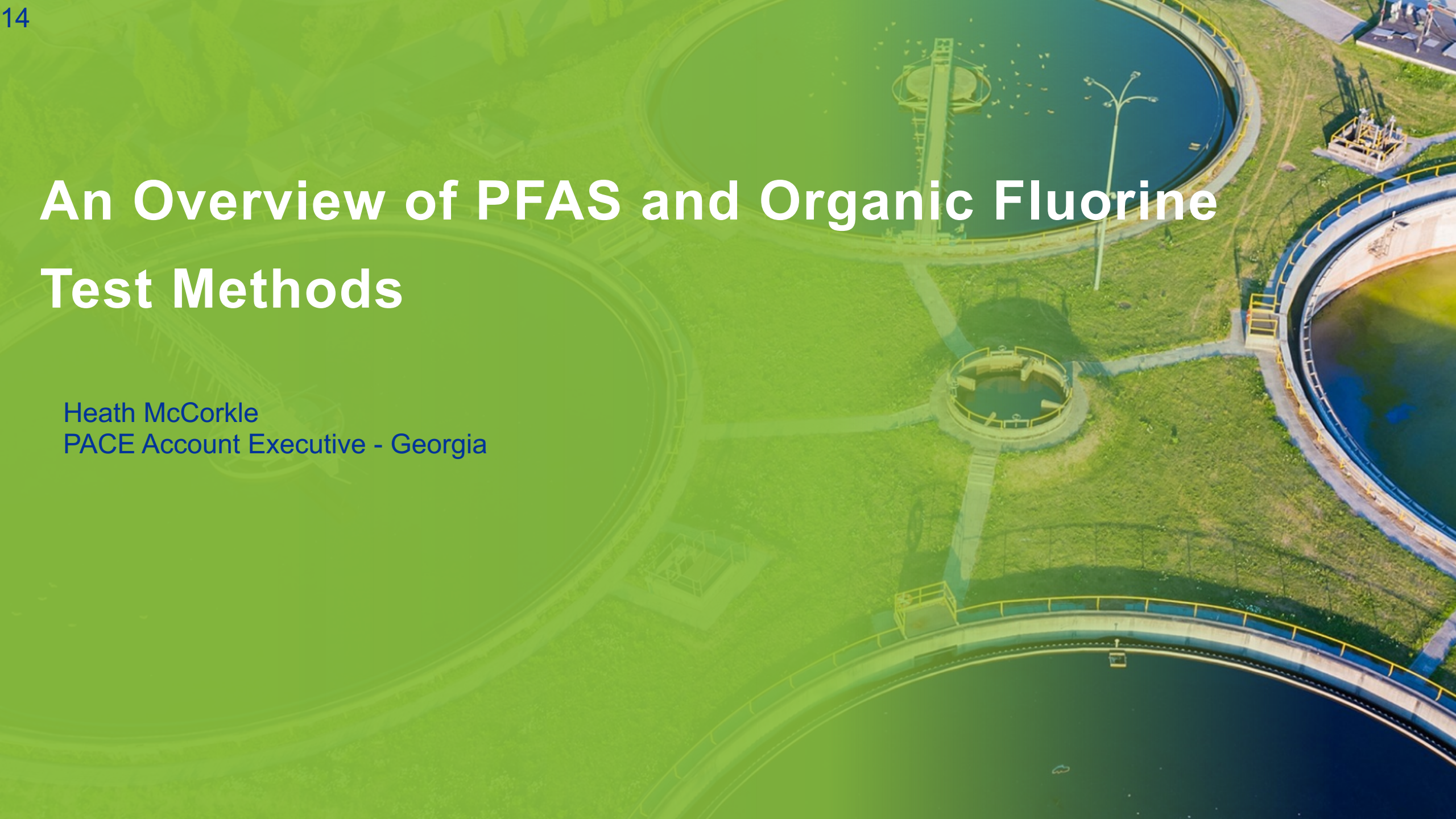
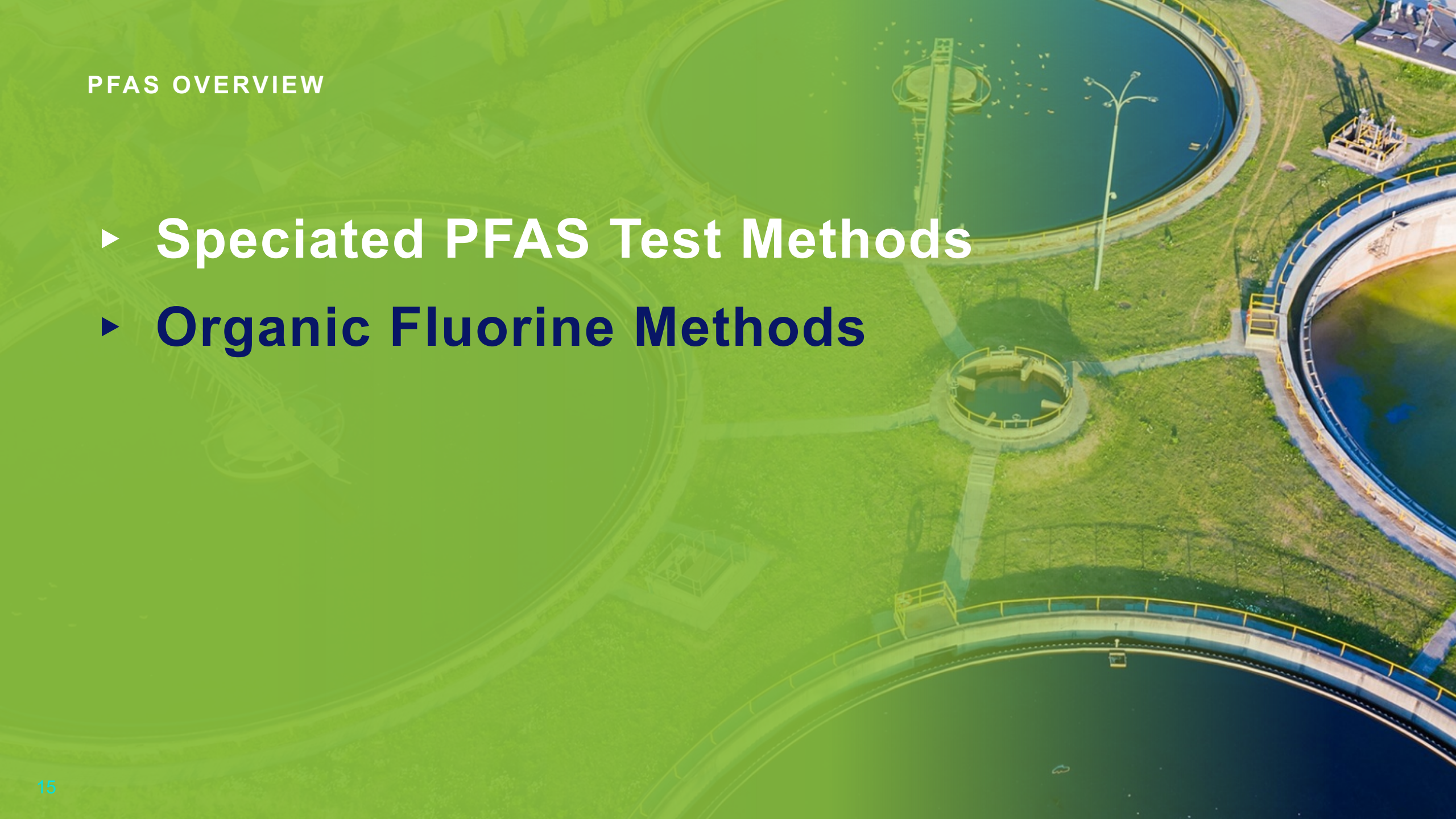
An Overview of PFAS and Organic Fluorine Test Methods

Heath McCorkle
PACE Account Executive - Georgia



- Speciated PFAS Test Methods
- Organic Fluorine Methods



TEST METHODS

Drinking Water

METHOD	EPA 537.1	EPA 533
MATRIX	Drinking Water	Drinking Water
COMPOUNDS	18	25
HOLDING TIMES, DAYS	14/28	28/28
EXTRACTION	Solid Phase (SPE)	Solid Phase (SPE)
QUANTIFICATION	Internal Standard (IS)	Isotope Dilution (ID)
NOTES		Developed for UCMR 5 and additional PFAS. **Does replace 537.1.**

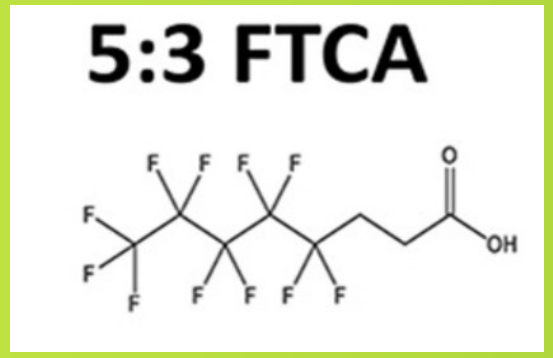
Draft EPA 1633

- EPA announced the method September 2, 2021
- Matrices eight different environmental media- wastewater, surface water, ground water, soils, biosolids, tissues, leachate, and sediment
- Single lab validation, 2022 multi lab validation
- We are on Draft 3
- EPA/DOD combined effort
- This should phase out and eventually eliminate the use of “Modified” methods
- 1633 will be finalized for aqueous matrices such as leachate ahead of solids-~end 2023
- DOD QSM 5.4 adds Table B24 which is additional QC criteria and clarifications
- This method is being added to NPDES permits and some municipal landfill groundwater monitoring programs

40 PFAS Compounds in Draft 1633

Analyte	Analyte
PFBA	8:2 FTS
PFPeA	PFOSA
PFHxA	N-MeFOSAA
PFHpA	N-EtFOSAA
PFOA	HFPO-DA
PFNA	PFMOPrA
PFDA	ADONA
PFUnDA	9Cl-PF3ONS
PFDoDA	11Cl-PF3OUdS
PFTrDA	**3:3 FTCA**
PFTeDA	**5:3 FTCA**
PFBS	**7:3 FTCA**
PFPeS	N-EtFOSA
PFHxS	N-EtFOSE
PFHpS	NFDHA
PFOS	N-MeFOSA
PFNS	N-MeFOSE
PFDS	PFDoS
4:2 FTS	PFEESA
6:2 FTS	PFMOBA

- 1633 will help unify PFAS lists
- All 29 PFAS from UCMR 5 are included in this method. This can aid drinking water plants in source identification of PFAS present in their raw and finished product.



5:3 fluorotelomer carboxylic acid (FTCA) is a common and often dominant constituent of PFAS found in landfills and is released from carpet in model anaerobic landfill reactors. This compound could prove to be an indicator of PFAS in the environment originating from landfills (Lang et al. 2017[63], 2016[64]).

New Features / Protocols

- Protocol Standardization – **EPA + DoD Bottle 500 mL X2 plus 125 mL**
- Multiple matrices addressed with one method – WW/GW/SW, landfill leachate, soils/sediments, biosolids, tissues
- Additional QA/QC (Bile salt resolution, new branched isomers, duplicate LCS)
- Prep restrictions
  - **Method is only applicable to AQ <100mg/L TSS**
  - Extract dilutions >10X require re-extraction
- SPE required for solid and tissue matrices – identical to AQ SPE procedure
- Sample storage: refrigerated OR frozen

Aqueous: DM1633 vs. Legacy Method

Sample volume: 500 mL vs. 125 mL or 250 mL

- Landfill leachates: 100 mL (RLs 5X higher)

Pre-preparation: TSS required; subsample >100 mg/L

- Draft 3: TSS flexibility; centrifugation allowed
  - QSM Table B-15: centrifugation allowed >1% solids
  - QSM Table B-24: silent on this matter (current version)

Lower sorbent mass SPE (+ Glass wool) = slower sample loading

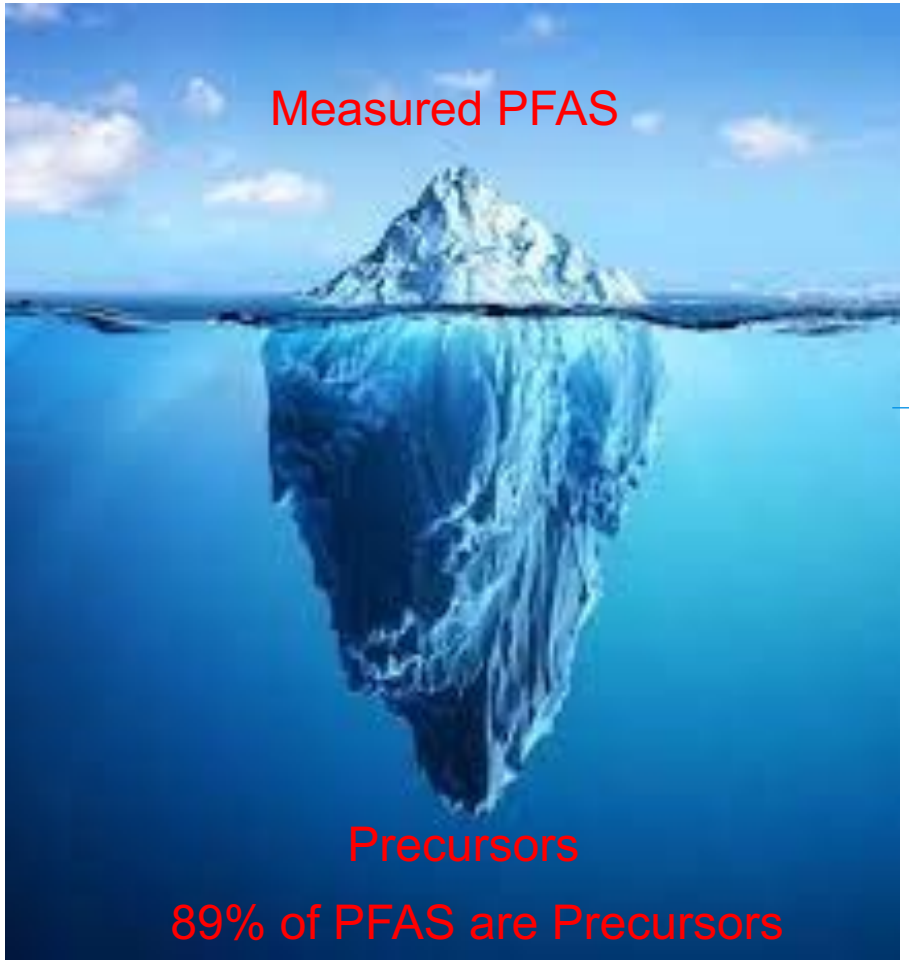
Dispersive carbon (dGCB) cleanup

Syringe filtration

Solids: DM1633 vs. Legacy Method

- Sample mass: 5 g (dry mass) vs. various masses (1 - 5 g)
  - Biosolids: 0.5 g (dry mass; RLs 10X higher)
- Three-fold solvent extraction (Methanolic NH4OH) – shake/centrifuge/decant; dGCB cleanup-**Solids have a robust extraction procedure**
- Solvent exchange/volume reduction – methanolic to aqueous
  - % Solids / sample water content
- SPE – identical to aqueous SPE protocol (~50 mL volume)
- Method modification?

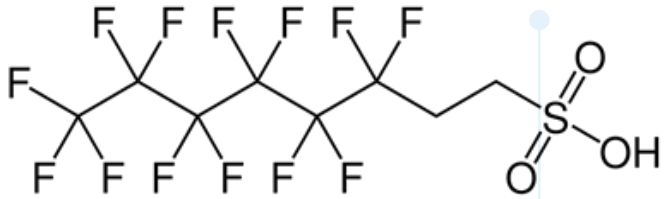
TOP (Total Oxidizable Precursor Assay)



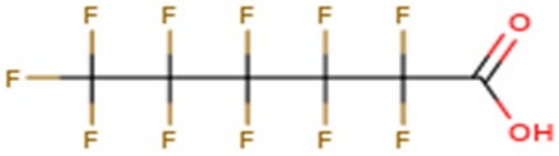
Estimate of total measurable PFAS from both unknown and known precursors.

Heat/Oxidation →

Under TOPS conversion occurs of known and unknown precursors to terminal PFAS (PFCA). Degradation of any precursor would be to an equal or shorter chain length.



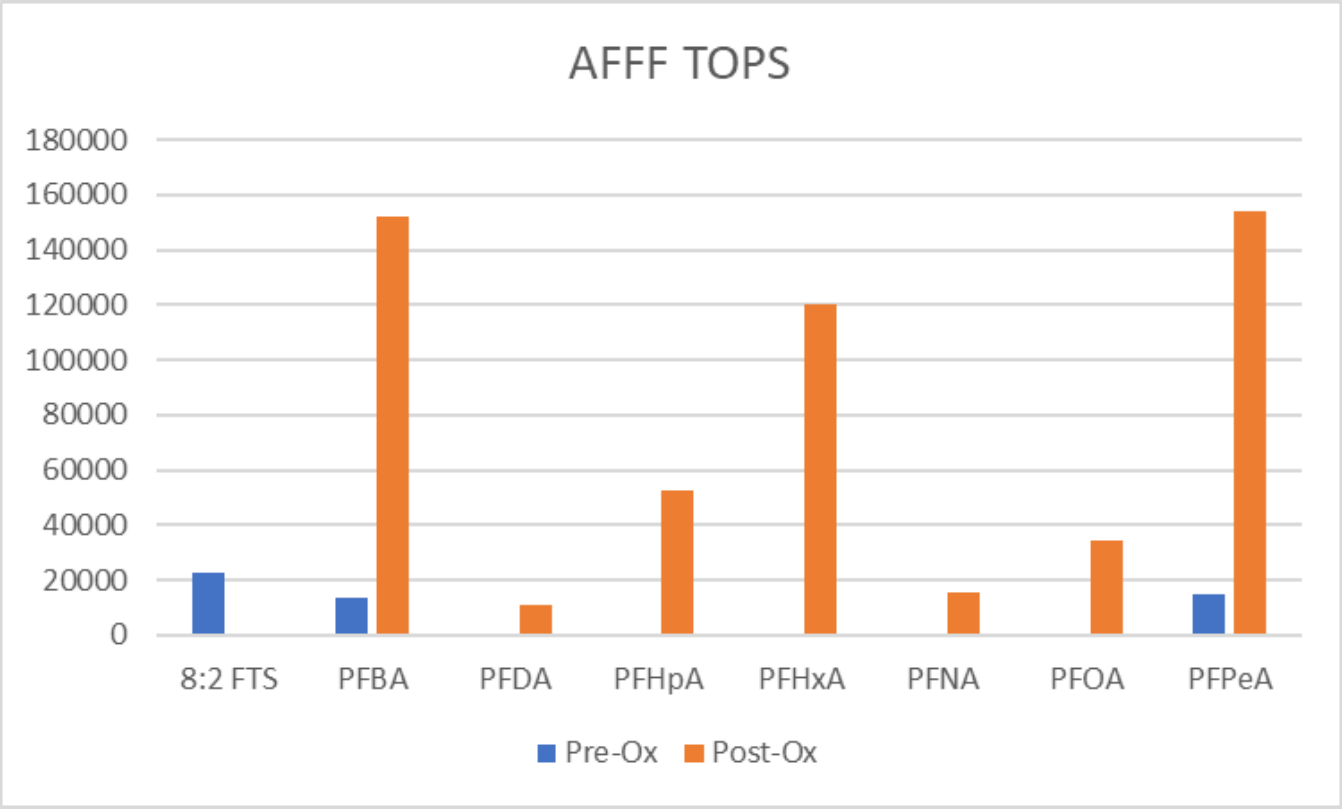
6:2 FTS



PFHxA

https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/

TOPS Table Pre-Ox and Post-Ox

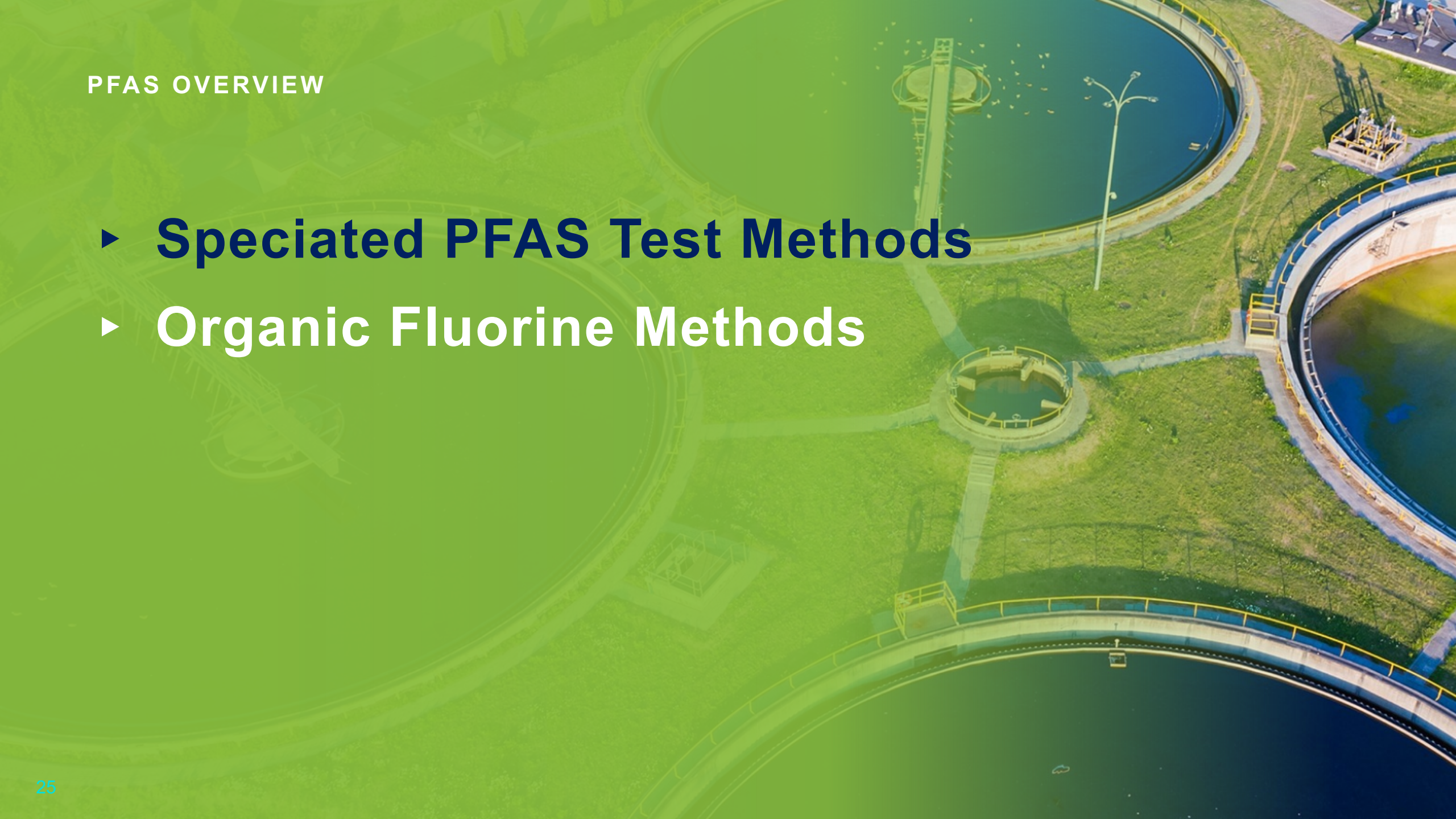


	Pre-Ox	Post-Ox
8:2 FTS	22300	0
PFBA	13700	152000
PFDA	0	10900
PFHpA	0	52600
PFHxA	0	120000
PFNA	0	15500
PFOA	0	34500
PFPeA	14900	154000
Total	50900	539500

PFAST®
EPA 8327/ASTM D8421

- LOQ ~10 ppt
- Pricing is a plus
- Faster on average TAT
- Currently 10 PFAS Compounds- which include your heavy hitters like PFOA, PFOS, PFBS, and Gen X
- List to expand to 40 plus PFAS 2023
- Useful for pilot studies, bench scale remediation technologies, destruction technologies
- SW-846 8327 and ASTM D8421 needs vary by regulatory agency

- Speciated PFAS Test Methods
- Organic Fluorine Methods



What is True-TOF®?

True-TOF® is a capability that Pace has brought to market that involves the use of a novel combustion-ion chromatography (CIC) platform developed by Metrohm. The technology involves a built-for-purpose CIC (Profiler^{F}) that was developed solely for organofluorine testing. Pace partnered with Metrohm and was the first commercial testing laboratory to offer this service.

Total Fluorine – Inorganic Fluorine = Total Organic Fluorine

The advantage of the True-TOF® method is that it allows Pace to simultaneously quantify total fluorine, or TF (combusted at high temperature) and inorganic fluoride (IF) using two parallel IC modules. Subtracting the TF from the IF gives you the True-TOF® value.

LOQ_a = 50 ppb OR 30%IF Conc.
VOLUME = 10 mL

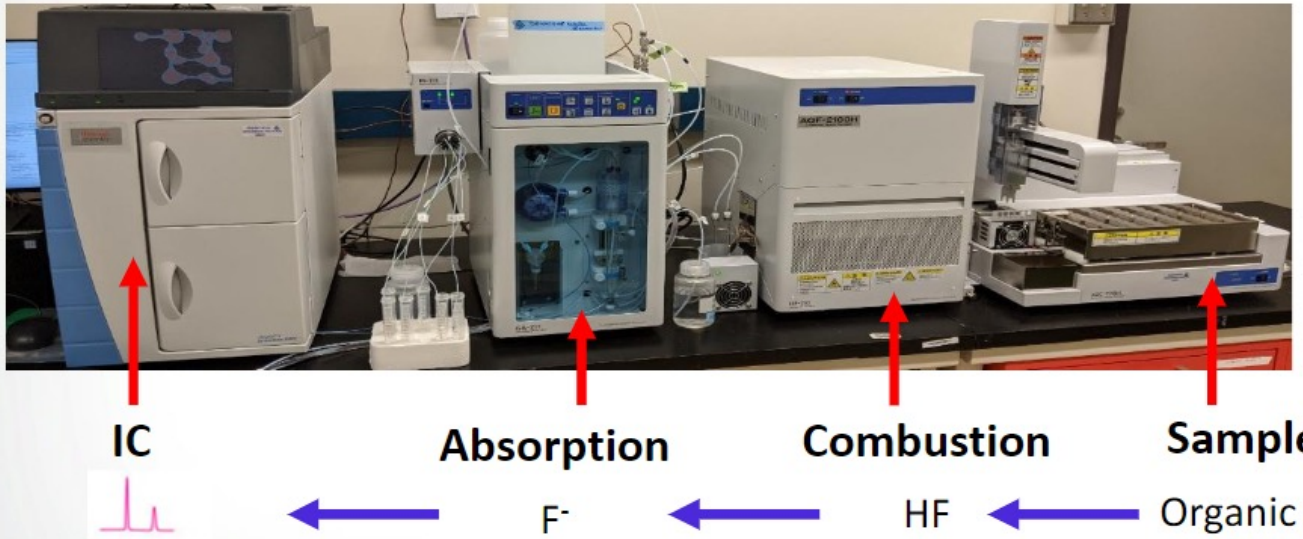
You are missing PFAS in speciated analysis. Organic Fluorine lumps them together in one number. However, it picks up all C-F bonds. For example, an herbicide would be picked up. PFAS might be regulated as a class of compounds so Organic Fluorine results could be used.

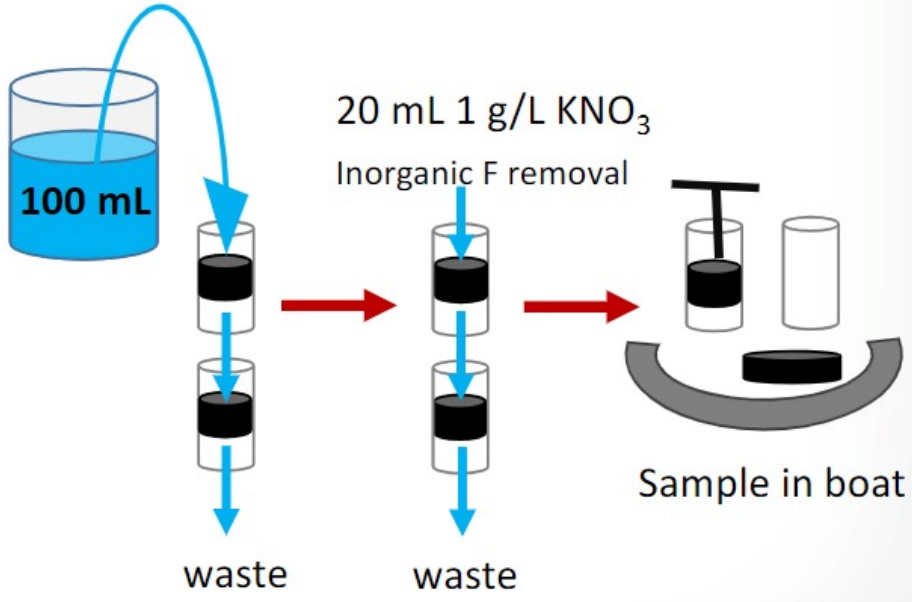
Approach – AOF/CIC

EPA 1621-Pace® Single lab validation

How:

- Screening method adsorbs contaminants onto granular activated carbon, removal of inorganic fluoride with nitrate solution, followed by combustion of the carbon
- Organofluorine compounds are converted to fluoride in the combustion process and measured by ion chromatography





On NPDES permits with 1633

Method Detection Limit: 1.4 - 2.2 µg/L

PFAS TEAM

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THANK YOU

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Additional resources:

- PFAS.com
- PACELABS.COM | Search: PFAS

PFAS Assessment

A New Approach: The Chess Game

Lucas Barroso-Giachetti, PE, CHMM

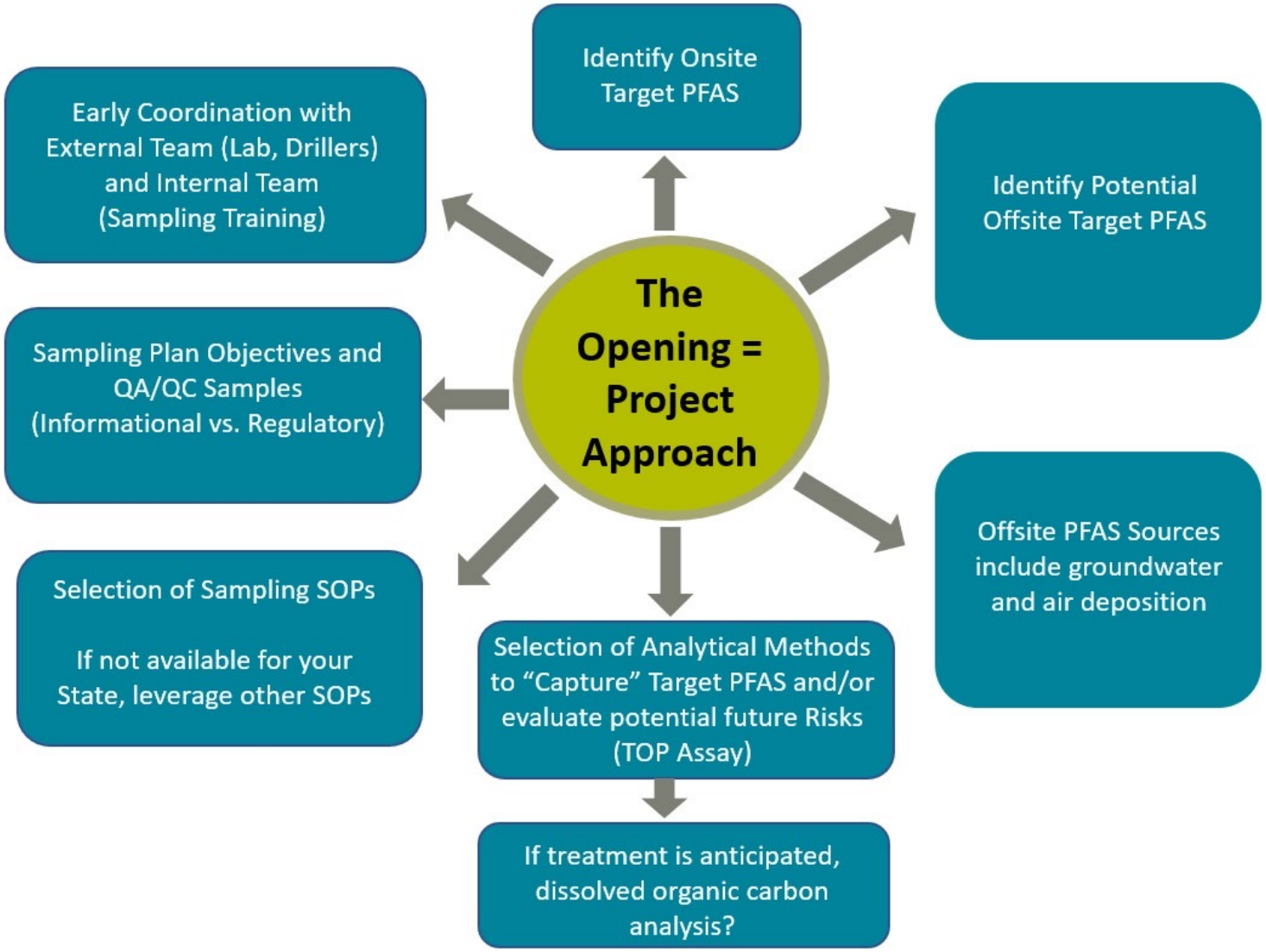
Georgia Brownfield Association

PFAS FORCES US TO THINK AND PLAN DIFFERENTLY!

TRADITIONAL ASSESSMENT (PETROLEUM AND METALS)

PFAS ASSESSMENT

THE OPENING = PROJECT APPROACH



ENVIRONMENTAL PROTECTION DIVISION

INTERSTATE COUNCIL ITRC TECHNOLOGY REGULATORY

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

DIFFERENT REGULATIONS/STATES = DIFFERENT PFAS

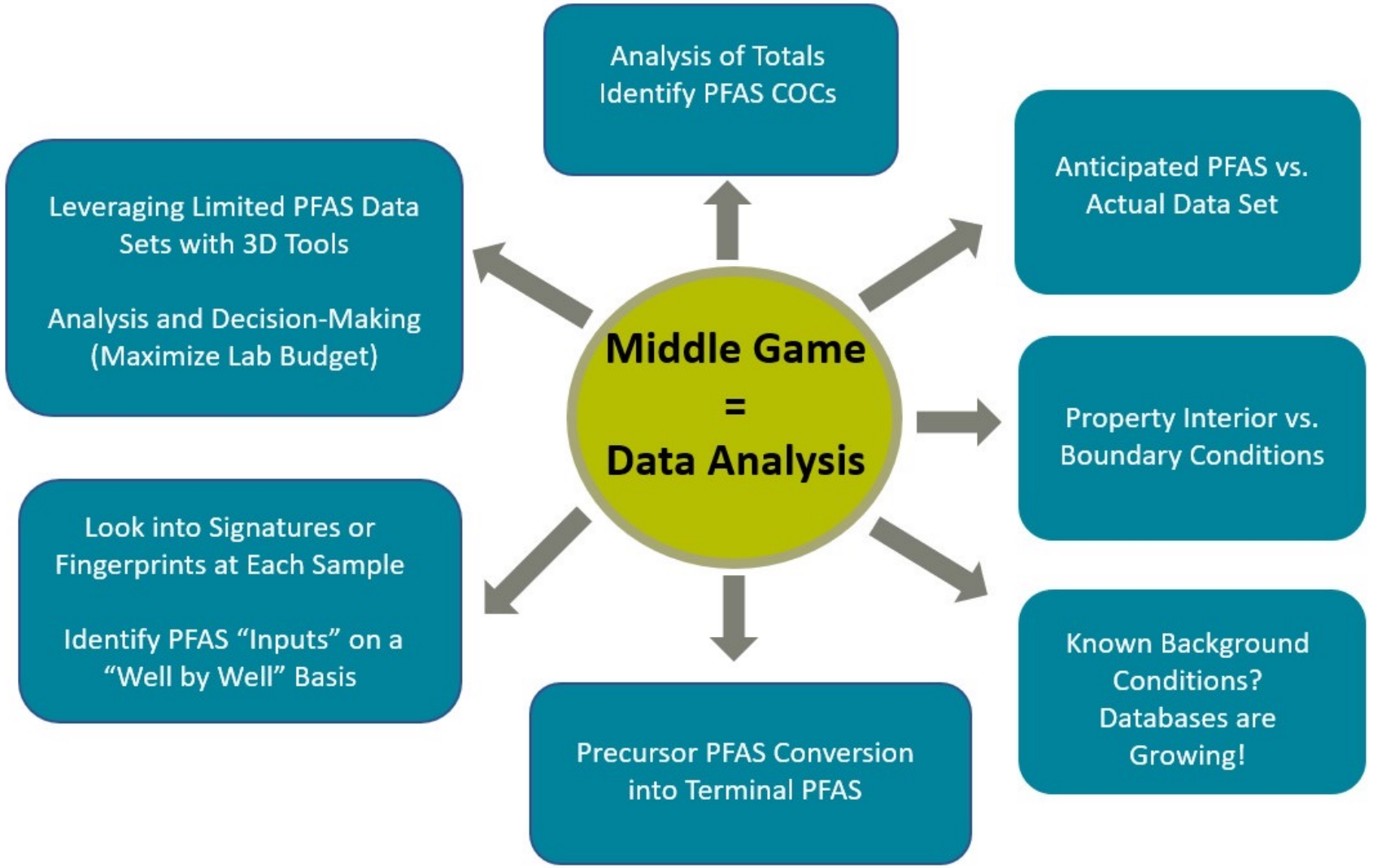
SUMMARY OF REGULATED PFAS BASED ON REGULATORY PROGRAM OR GUIDANCE				
CERCLA (PHASE I ESA) (Prop. Aug. 2022)	RCRA (LANDFILLS)	DRINKING WATER MCLs (Prop. March 2023)	National Academies Sciences, Engineering and Medicine (Blood Serum)	UCMR 5 DRINKING WATER
PFOA PFOS	PFOA PFOS PFBS GenX	PFOA PFOS PFBS PFNA PFHxS GenX	**PFOA** **PFOS** **PFHxS** **PFNA** PFDA PFUnDA MeFOSAA	29 PFAS

DIFFERENT SOURCES = DIFFERENT PFAS

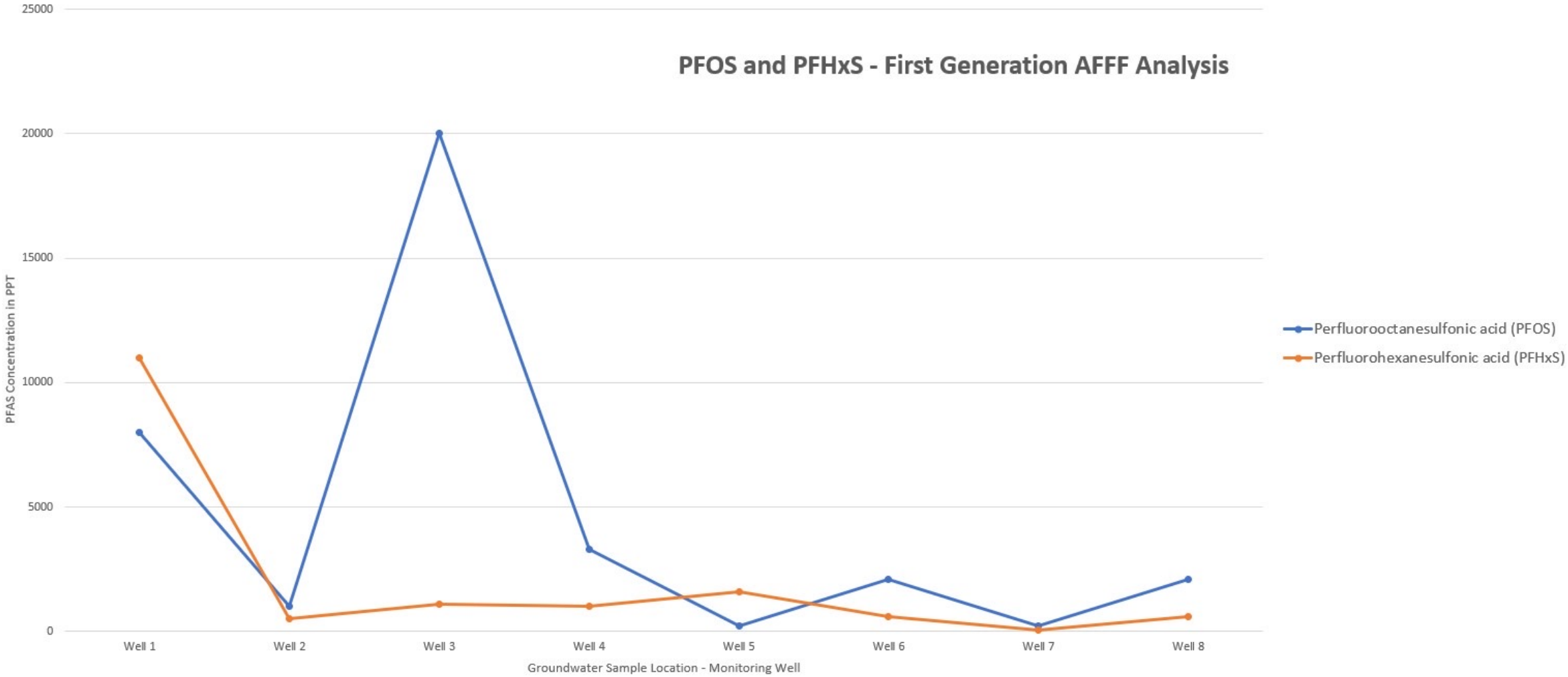
For Example:

- ✓Chemical Coatings – PFOA, PFNA
- ✓"Old" AFFF – Electrochemical Fluorination (ECF) – PFOS, PFHxS
- ✓"New" AFFF – Fluorotelomerization (FT) – 6:2 FTS, PFPeA, PFAxA
- ✓Landfills and WWTPs – 5:3 FTCA, FOSE, FASAAs, FTOHs

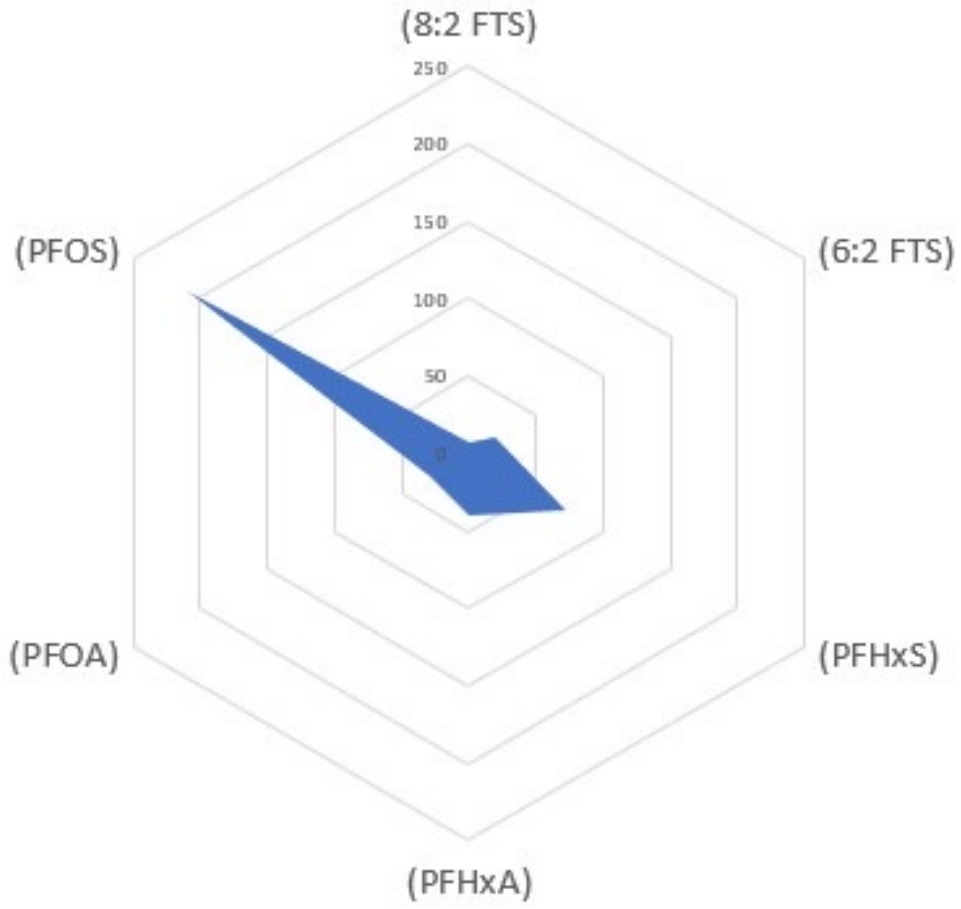
MIDDLE GAME = DATA ANALYSIS

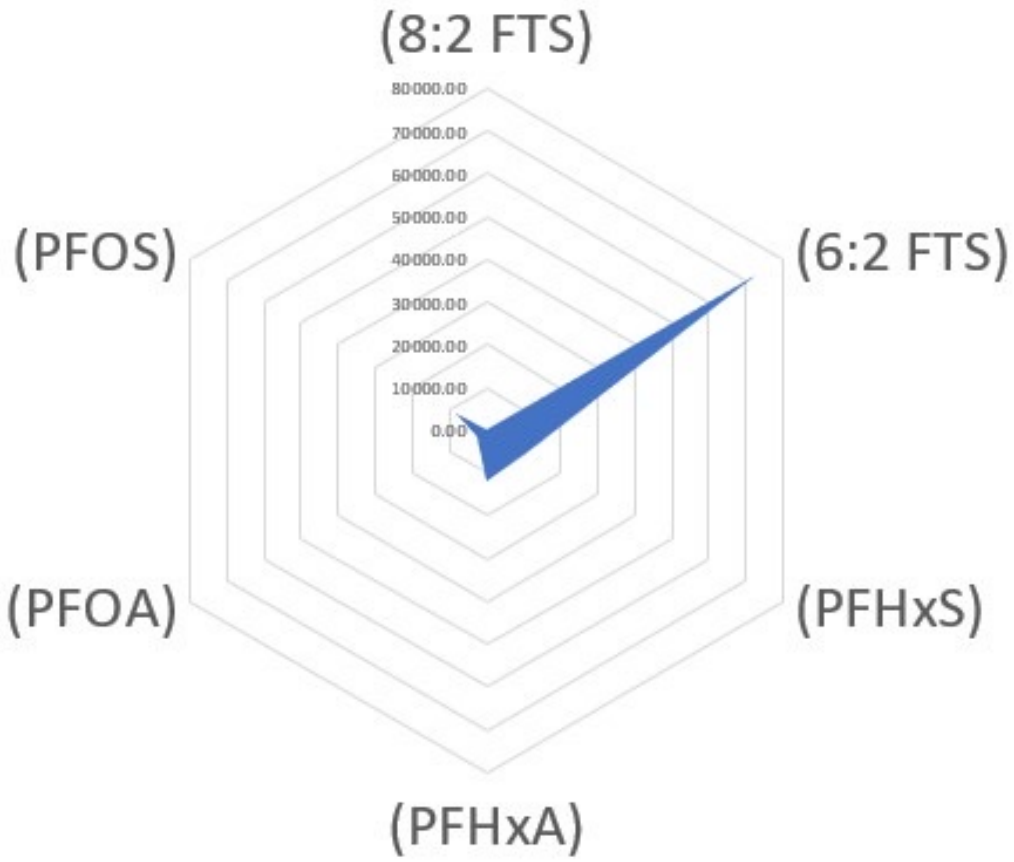


PFAS DATA ANALYSIS – AFFF SOURCES



PFAS DATA ANALYSIS
UNDERSTANDING DISTRIBUTIONS TO “FINGERPRINT”





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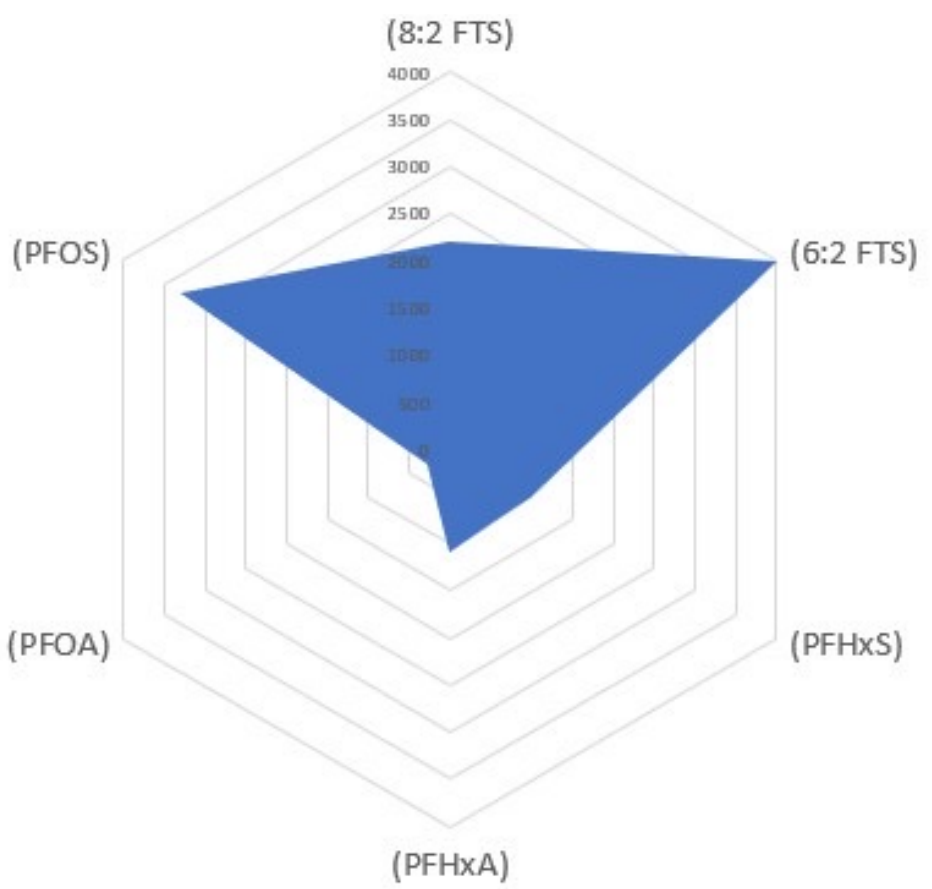
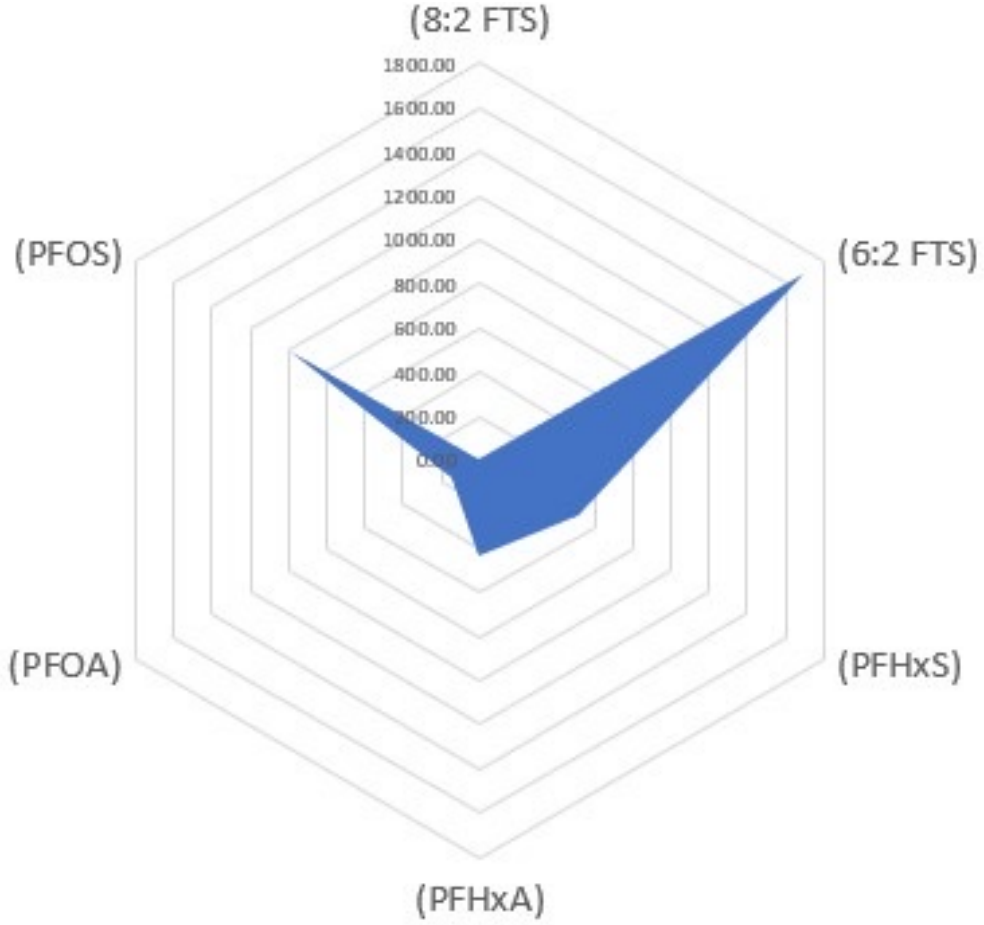
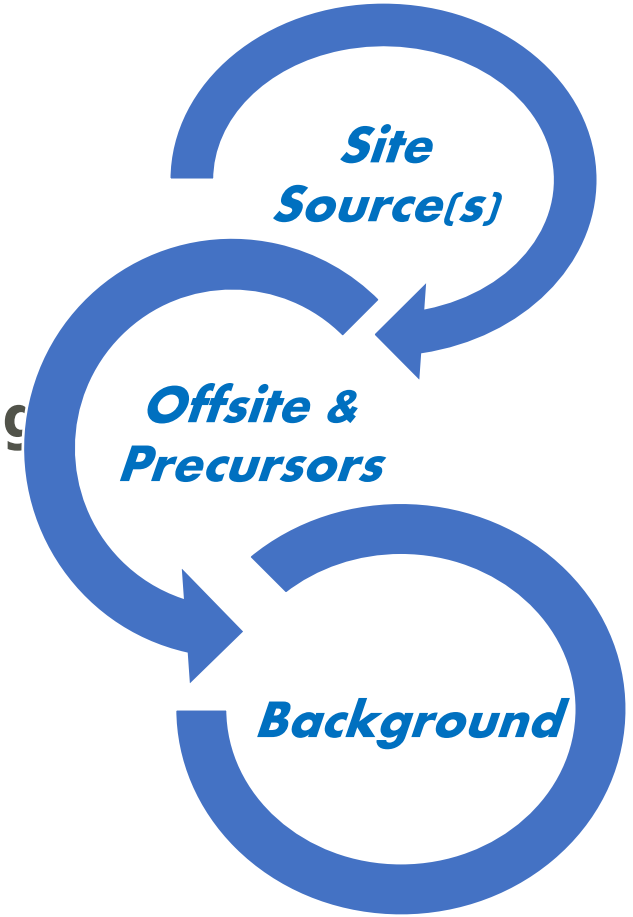
UNDERSTANDING DISTRIBUTIONS TO “FINGERPRINT”



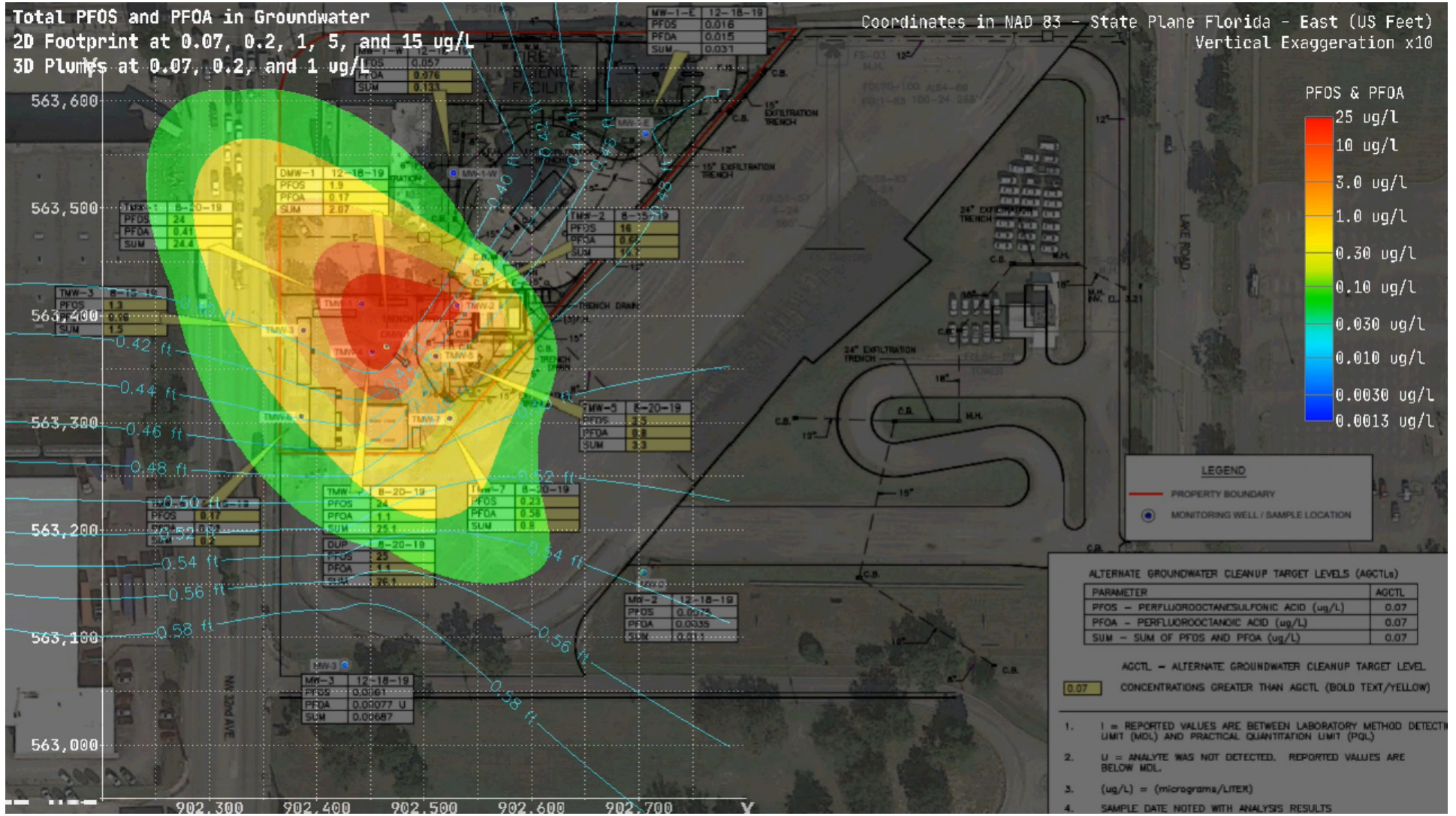


BACKGROUND CASE STUDY
FIRE TRAINING ACADEMY

- ✓Assessment reported elevated levels of PFOA and PFOS
- ✓AFFF Training Area reporting PFOA + PFOS ~25,000 ppt
- ✓Groundwater quality ~200 to 300 feet away from AFFF Training Area was consistent with Miami-Dade County Background
- ✓"My PFAS" were now undiscernible from "Our PFAS"
- ✓Property Boundary Conditions?
- ✓Site Redevelopment Considerations? Worker Safety? Dewatering?



PFAS DATA ANALYSIS
LEVERAGING 3D VISUALIZATION



THE END GAME
UNDERSTAND SITE CONDITIONS FOR REDEVELOPMENT

End Game = Understand Site Conditions for Brownfield Redevelopment

- Ion Exchange (IX) Resins More Effective Removal of Short-Chain PFAS (PFBA)
- GAC Sulfonate Functional Groups Greater Removal Efficiency than Carboxylate Groups
- Longer Chain vs. Short Chain Analysis
- Dewatering = PFAS Remediation System?
- Stabilization "Timeout" at the Boundary? Colloidal Activated Carbon Injections

- PFAS Data Set Findings = Defined Impacts vs. Background Conditions?
- Does Initial Assessment and Analysis Tools Suggest Obvious Gaps?
- Evaluation of Construction Plans?

  Manage and Dispose of Soil/Groundwater?
- IF Disposal of Soil or GW with PFAS is needed, Who Will Accept the Waste? Costs?

Thank you!

Questions?

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