



# ECT2 & Enspired Solutions – Complete PFAS Removal and Destruction Process for Landfill Leachate



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# Presenters



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# Presentation Outline

- Introduction to Emerging Compounds Treatment Technologies (ECT2)
- PFAS 201 Overview
- Landfill Leachate PFAS Treatment System using FOAM-X™ Foam Fractionation
- Introduction to Enspired Solutions
- Separate/Concentrate/Destruct
- Questions and comments



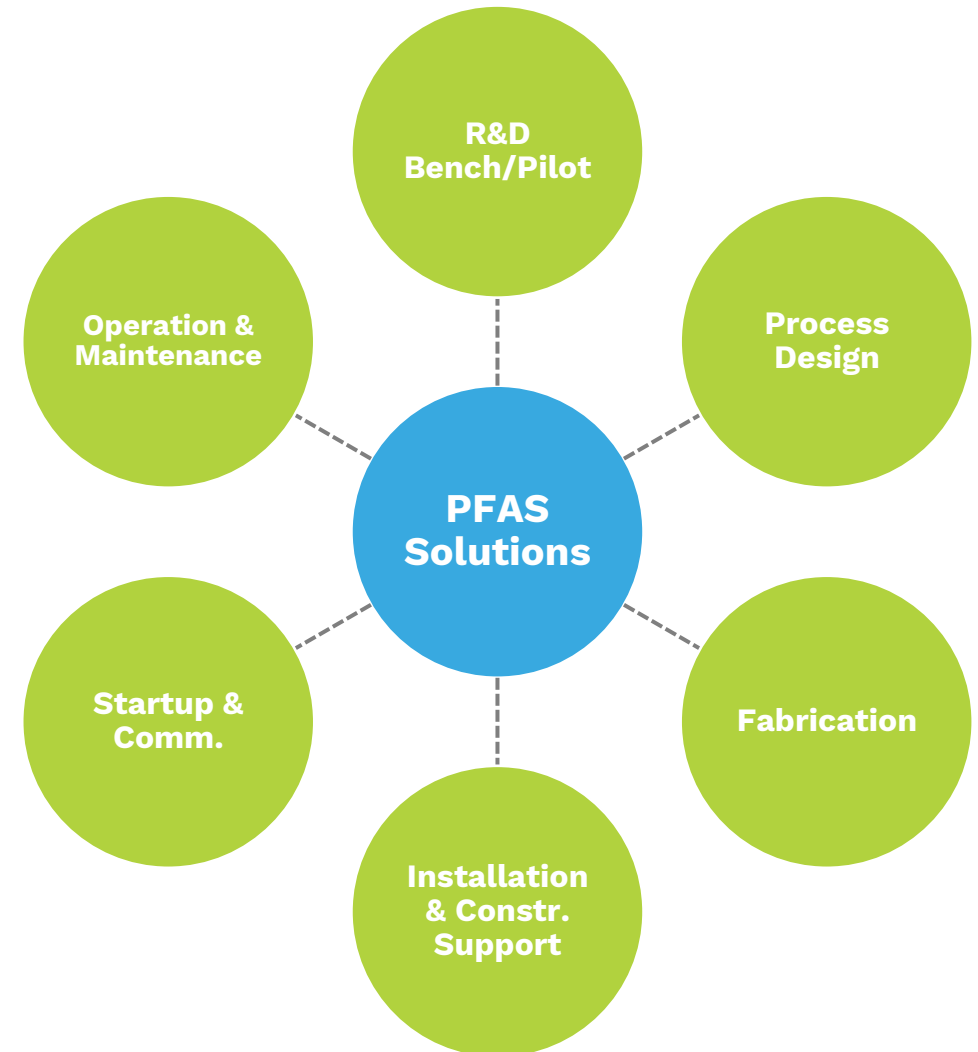


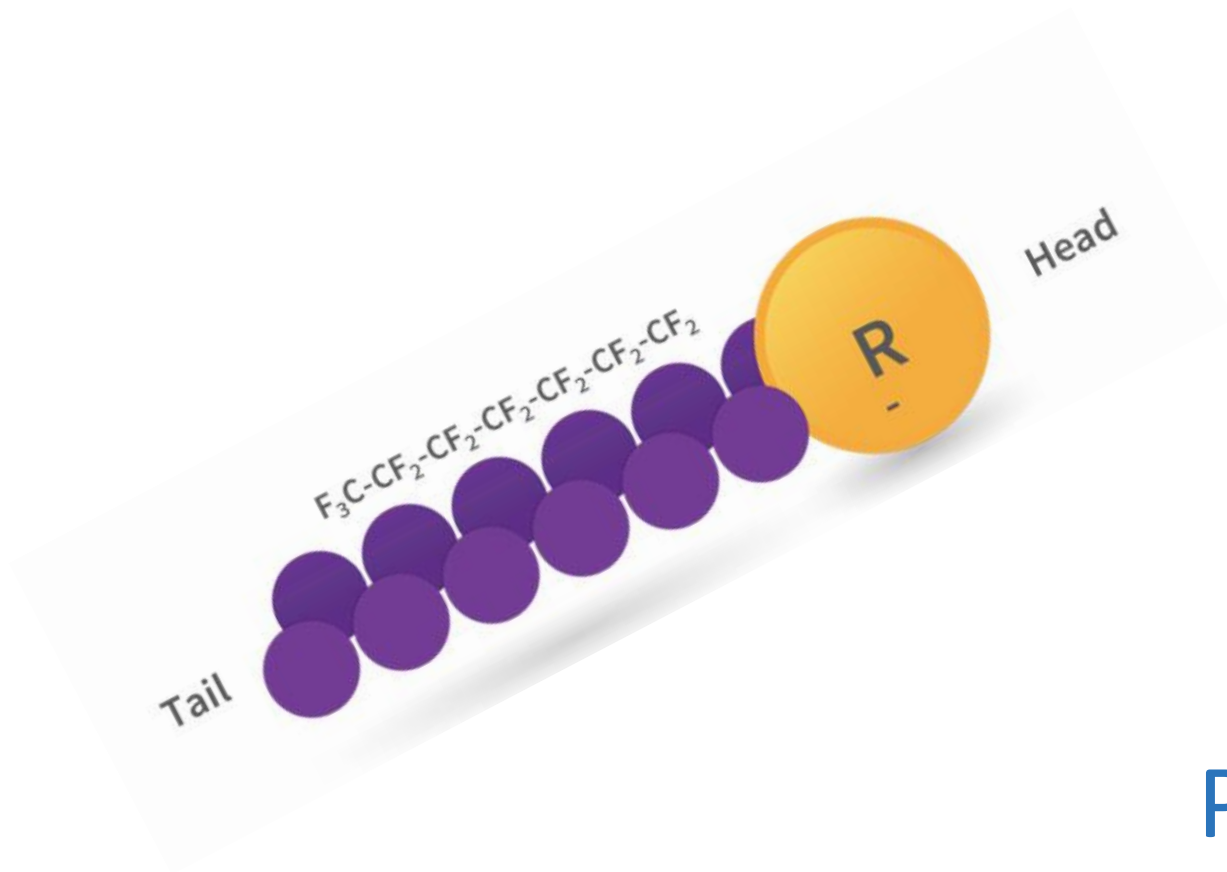
# ECT2: Emerging Compounds Treatment Technologies, Inc.

ECT2 is a solutions provider of cutting-edge technology solutions to remove emerging and difficult to treat contaminants such as PFAS and 1,4-dioxane, from:

- **Investigation-derived waste**
- **Groundwater**
- **Surface Water**
- **Construction dewatering liquids**
- **Drinking water**
- **Wastewater**
- **Foam spills**
- **Landfill leachate**

**ECT2's Vision:** Removing emerging and recalcitrant compounds from the environment while producing as little waste as possible. Differentiate technology driven by R&D with an intense focus on efficacy, reliability, cost, and safety



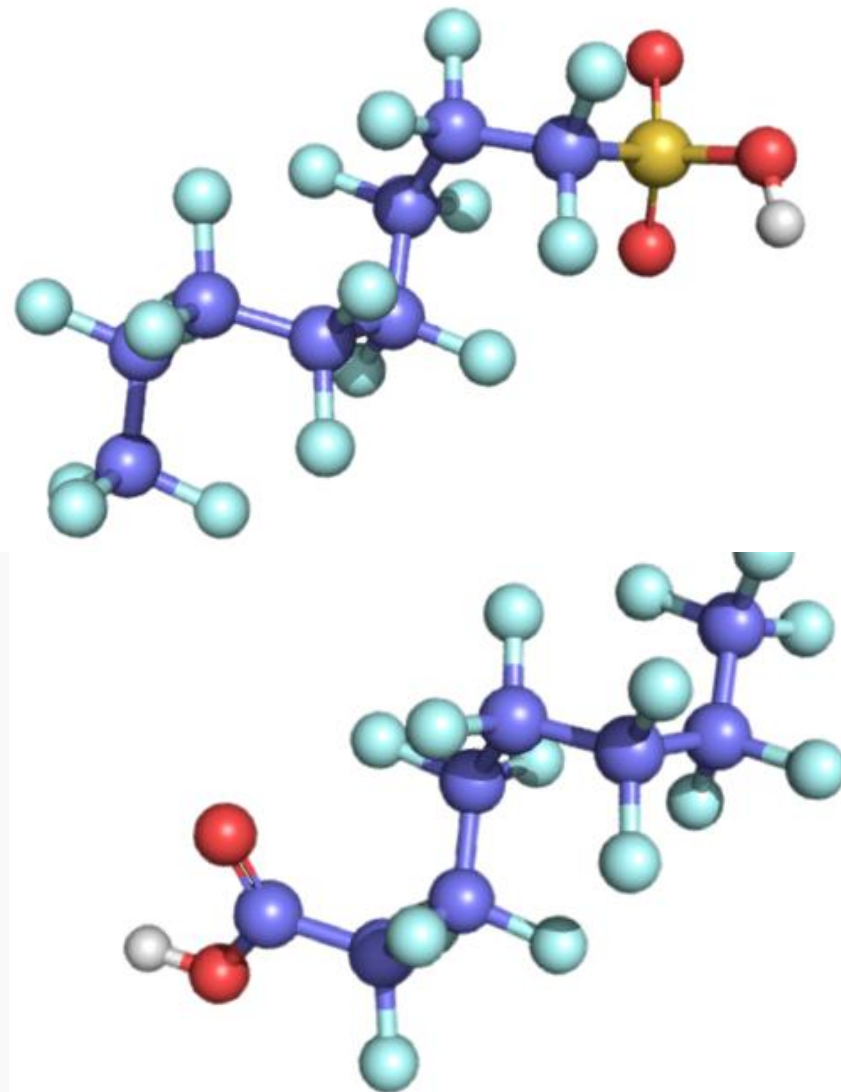


# PFAS 201



# PFAS Overview

- PFOA & PFOS most common form
- Very stable compound, carbon fluorine bond is strongest in nature, and considered inert
- Exhibits strong negative charge
- C-F “Tail” is hydrophobic (non-water soluble) and oleophobic (non-fat soluble)
- Each molecule has a functional group “Head” that is hydrophilic – extremely soluble in water.
- Limited health data outside of PFOA, PFOS, PFHxS, Gen-X
- Evidence suggests health impacts on kidneys, immune response, cholesterol, among other systems
- Concentrated up in breastmilk – most at risk are developing fetus, nursing baby



# PFAS Names, Carbon Chains, Removal Difficulty

- Perfluorobutanonic acid (PFBA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorohexanoic acid (PFHxA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorodecanoic acid (PFDA)
- Perfluoroundecanoic acid (PFUnA)
- Perfluordodecanoic acid (PFDoA)

Increasing # carbon

- 4 • Perfluorobutane sulfonic acid (PFBS)
- 5 • Perfluoropentane sulfonic acid (PFPeS)
- 6 • Perfluorohexane sulfonic acid (PFHxS)
- 7 • Perfluoroheptane sulfonic acid (PFHpS)
- 8 • Perfluorooctanesulfonic acid (PFOS)
- 9 • Perfluorononane sulfonic acid (PFNS)
- 10 • Perfluorodecane sulfonic acid (PFDS)
- 11 • Perfluoroundecane sulfonic acid (PFUnS)
- 12 • Perfluorododecane sulfonic acid (PFDoS)



# Demonstration Scale Testing to Inform Detailed Design

Off-site Testing Leads to Full Scale Success



Flow-Through Testing System

System in Operation:



Thorough Vetting of Design Sizing Alternatives:

Trial Number	HRT (per Fractionator)	Boost Agent (Stage 1)	Boost Agent (Stage 2)	Air Injection Rate - Stage 1 (SCFH)	Air Injection Rate - Stage 2 (SCFH)
1	40	--	--	High	High
2	30	--	--	High	High
3	20	--	--	High	High
4	40	Foam Control	Boost 1	High	High
5	30	Foam Control	Boost 1	High	High
6	20	Foam Control	Boost 1	High	High
7	40	Foam Control	Boost 1	Low	Low
8	30	Foam Control	Boost 1	Low	Low
9	20	Foam Control	Boost 1	Low	Low
10	120	N/A	N/A	N/A	N/A





# FOAM-X™ Mobile Assets

## Single Stage Skid Mounted



- Ability to deploy to tight building footprints to demonstrate technology
- Dual stage mode possible with storage tank for batching
- Treat flows from 1-6 gpm depending on chemistry and discharge goals

**Single Stage Foam Fractionation Mobile  
Asset Prior to Deployment**



# On-site Pilot with FOAM-X™4 System

## Pre-Engineered Fully Automated Flow-Through Packaged System

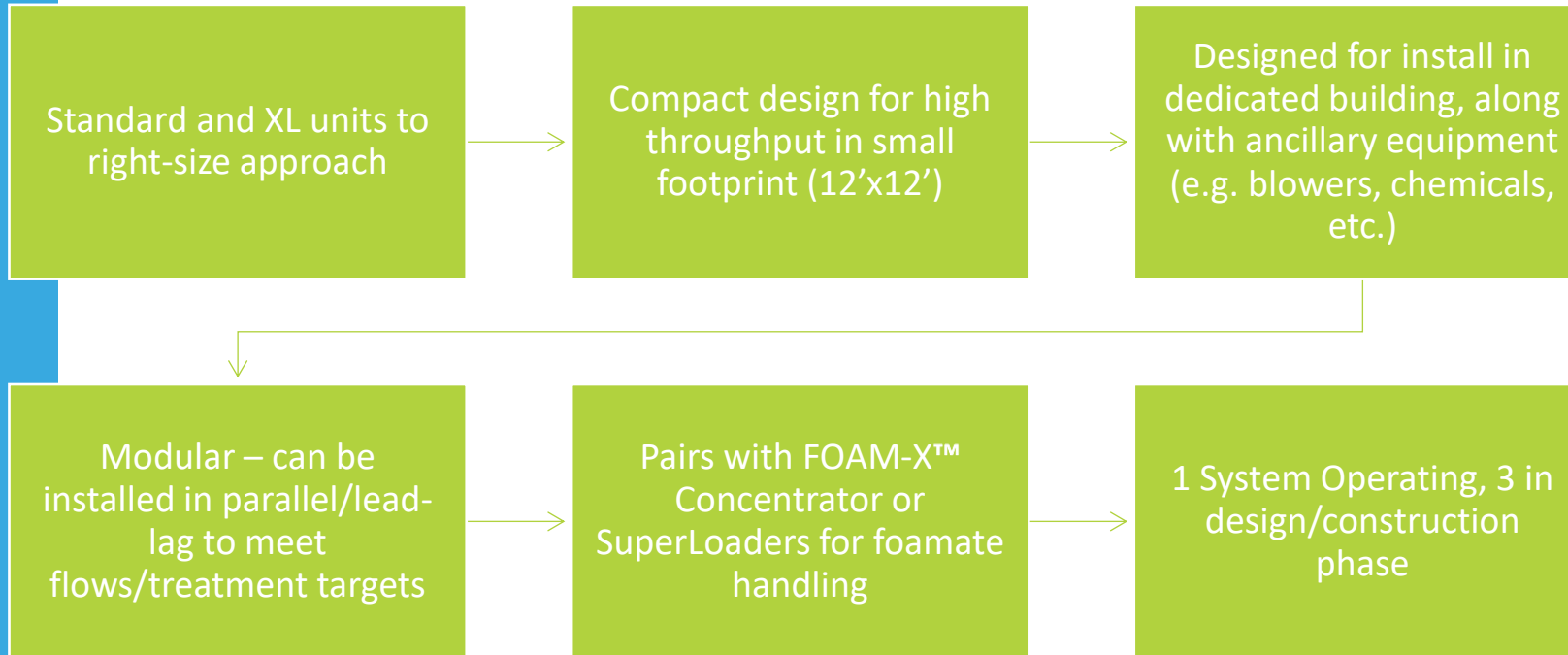
- Includes 4 FOAM-X Fractionators within 40-ft High Cube Container
- Operates in Series or Lead/Lag configuration
- Treat flows up to 160 gpm (single stage, 11 minute HRT)
- Onboard foamate treatment included using patented SuperLoading™ process
- Residuals concentration factors up to 10,000:1 (leachate) and 100,000:1 (remediation)

### Typical Treatment Flow Range (GPM)

Parallel	Lead/Lag
64-160	32-80



# Overview of FOAM-X™ 3000



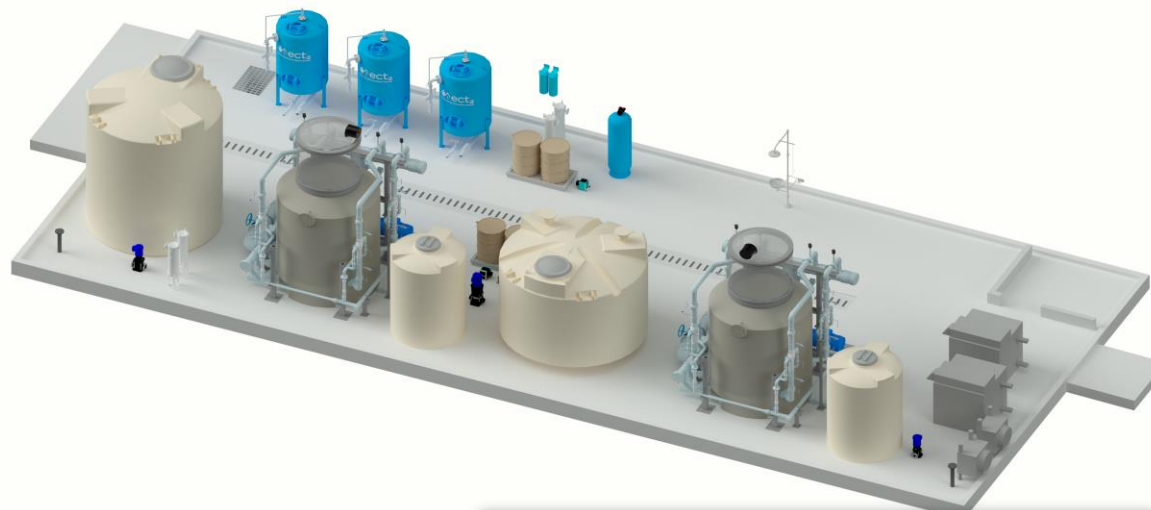
Typical Treatment Flow Range (GPM)	
Standard	XL
50-160	75-200





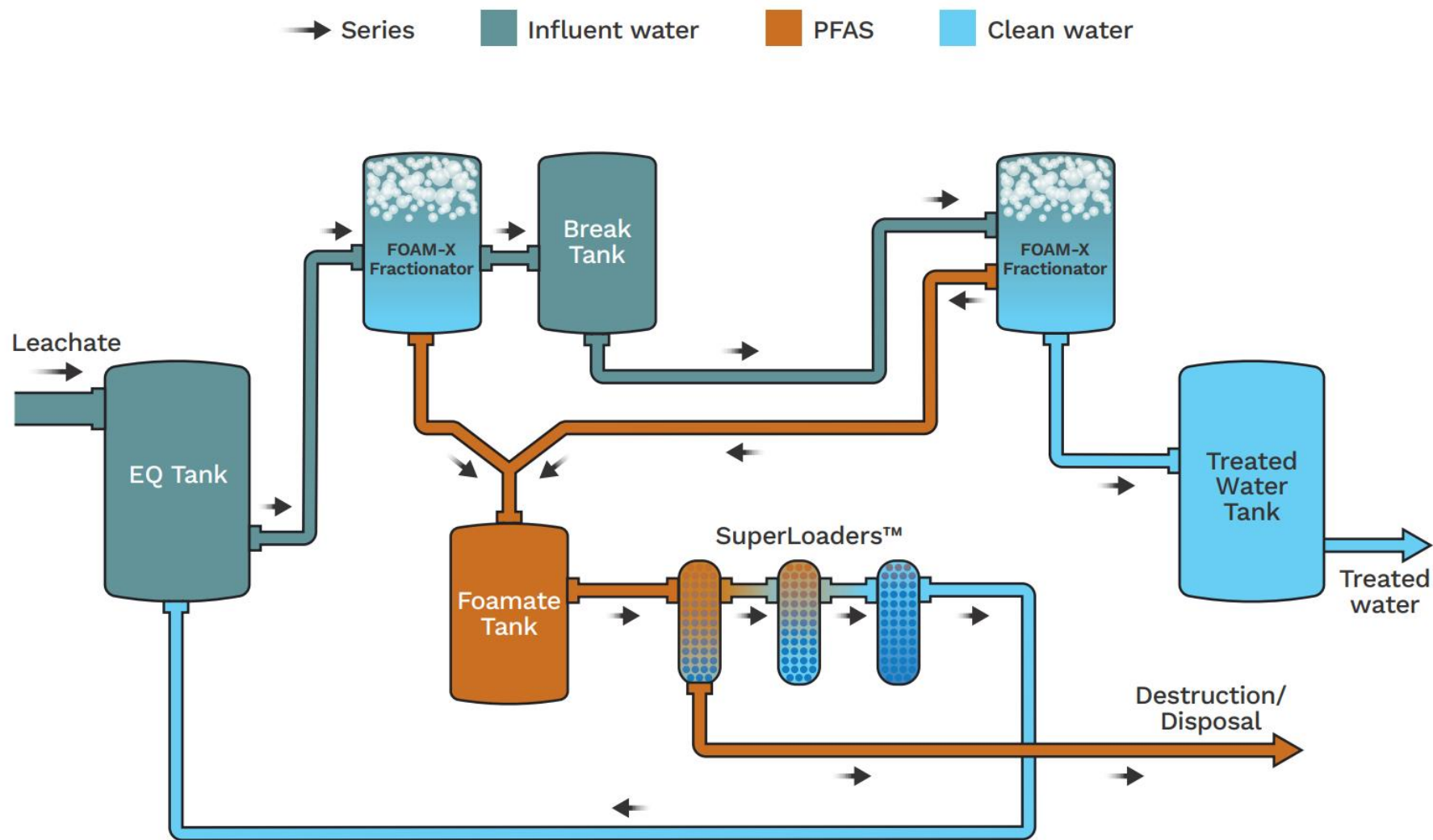
# Champ Landfill, Maryland Heights, MO

- System operating at 73 GPM treatment of Landfill Leachate 24 hrs/day
- Dual Stage FOAM-X™ 3000 with SuperLoader solution concentrating liquid raffinate to solids media

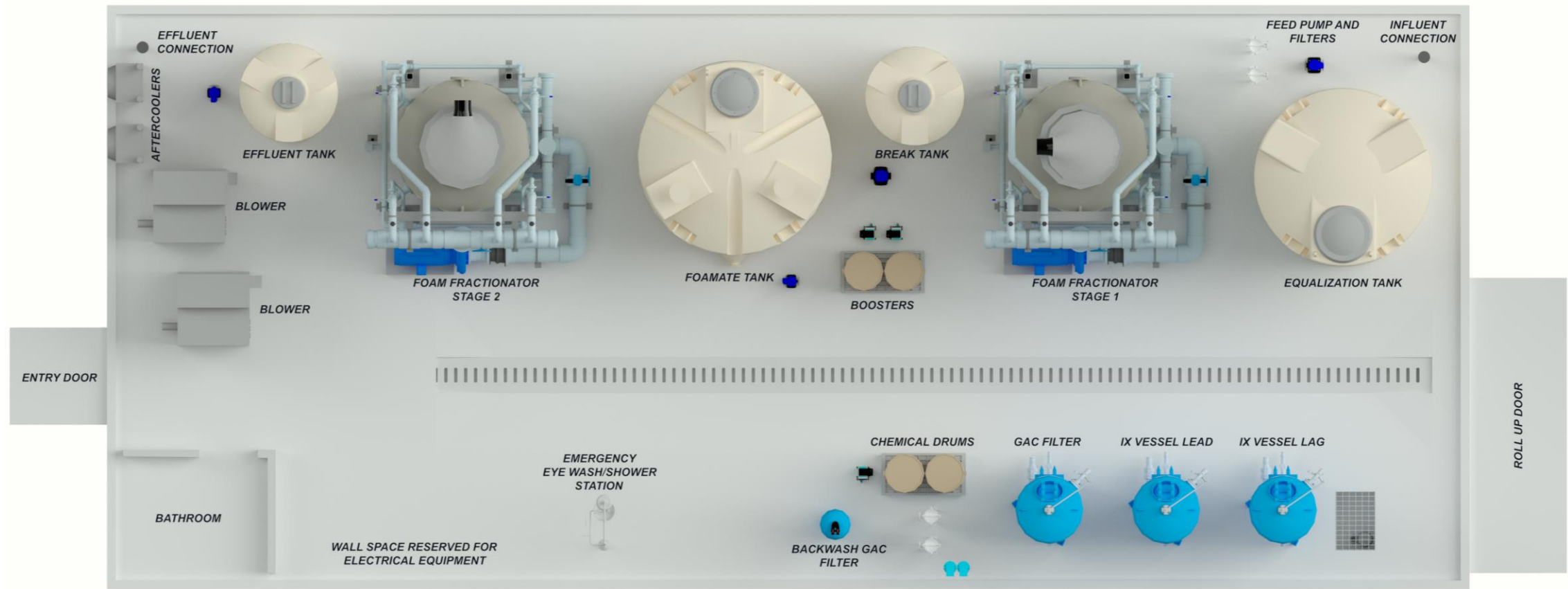




# FOAM-X™ 3000 Champ Landfill Layout



# ECT2 FOAM-X™ 3000 – Champ Landfill PFAS Treatment System



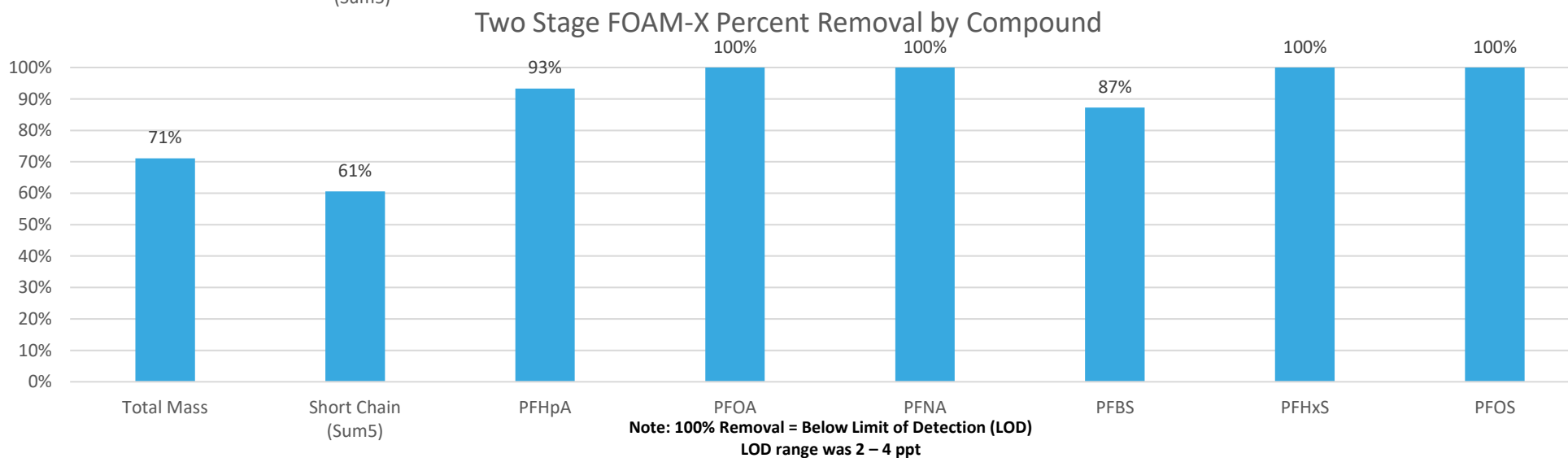
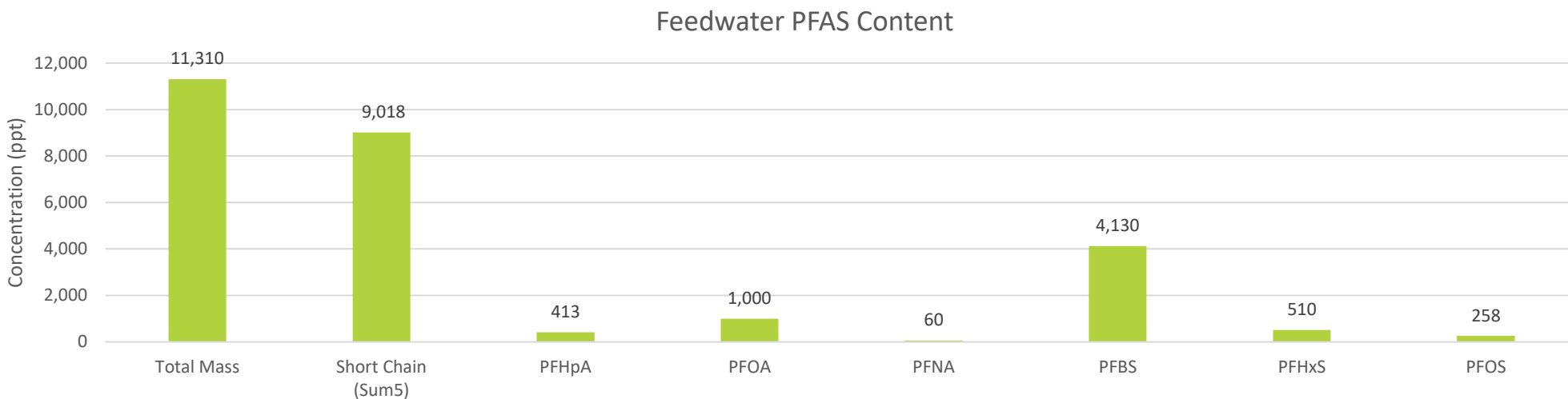
# Smith's Creek Landfill – Smiths Creek, MI

- System operating at 35 gpm treatment of Landfill Leachate 24 hrs/day (with capacity for 70+ gpm)
- Single Stage FOAM-X™ 3000 Fractionator with SuperLoader solution concentrating liquid raffinate to solids media
- Treating to meet EGLE PFAS Limits for St. Clair County pre-POTW discharge without any chemical additives and very low energy consumption



# Champ Landfill – Leachate Influent and Treatment Data

## Two-Stage ECT2 FOAM-X™ 3000 Foam Fractionation System

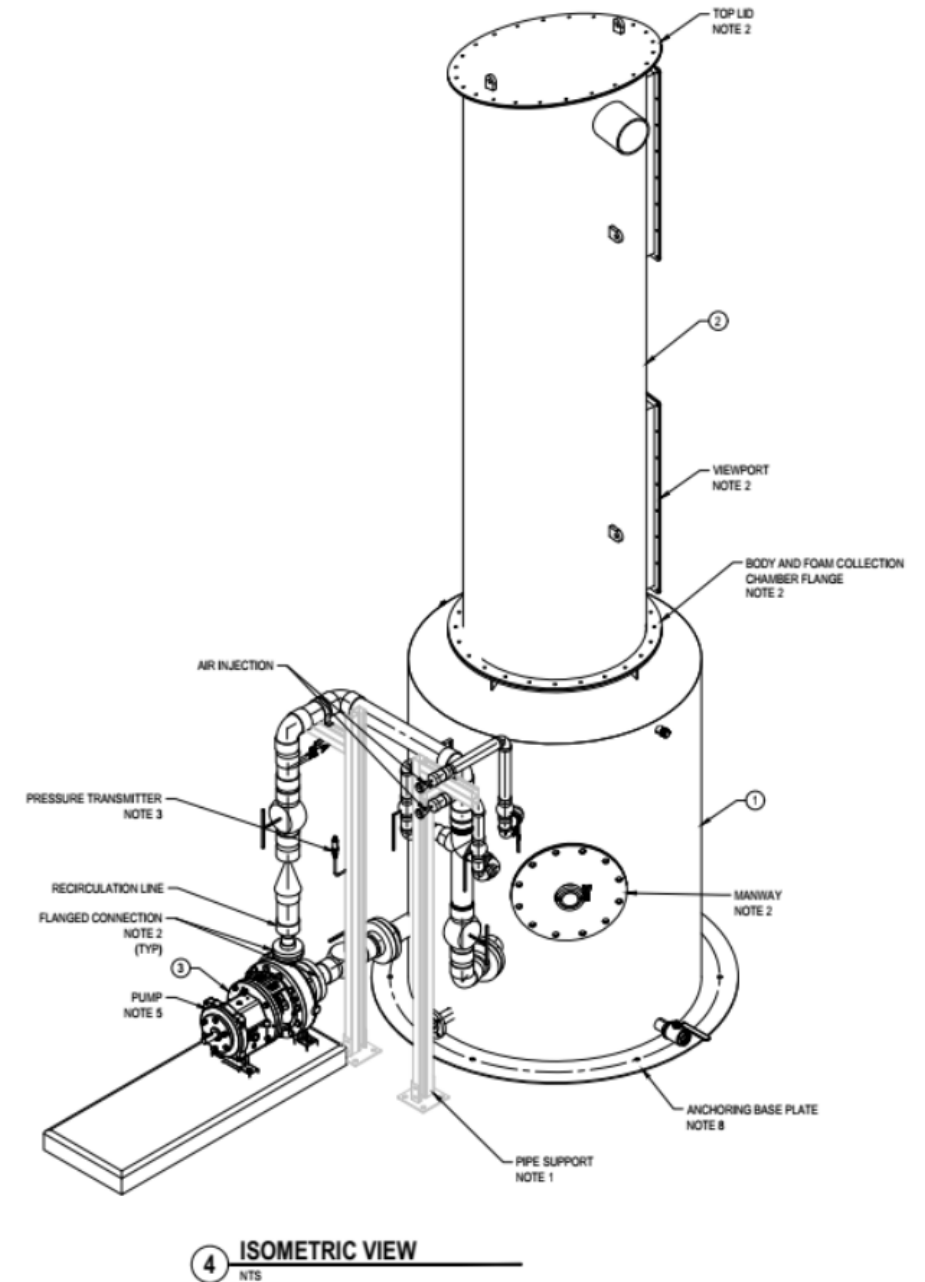




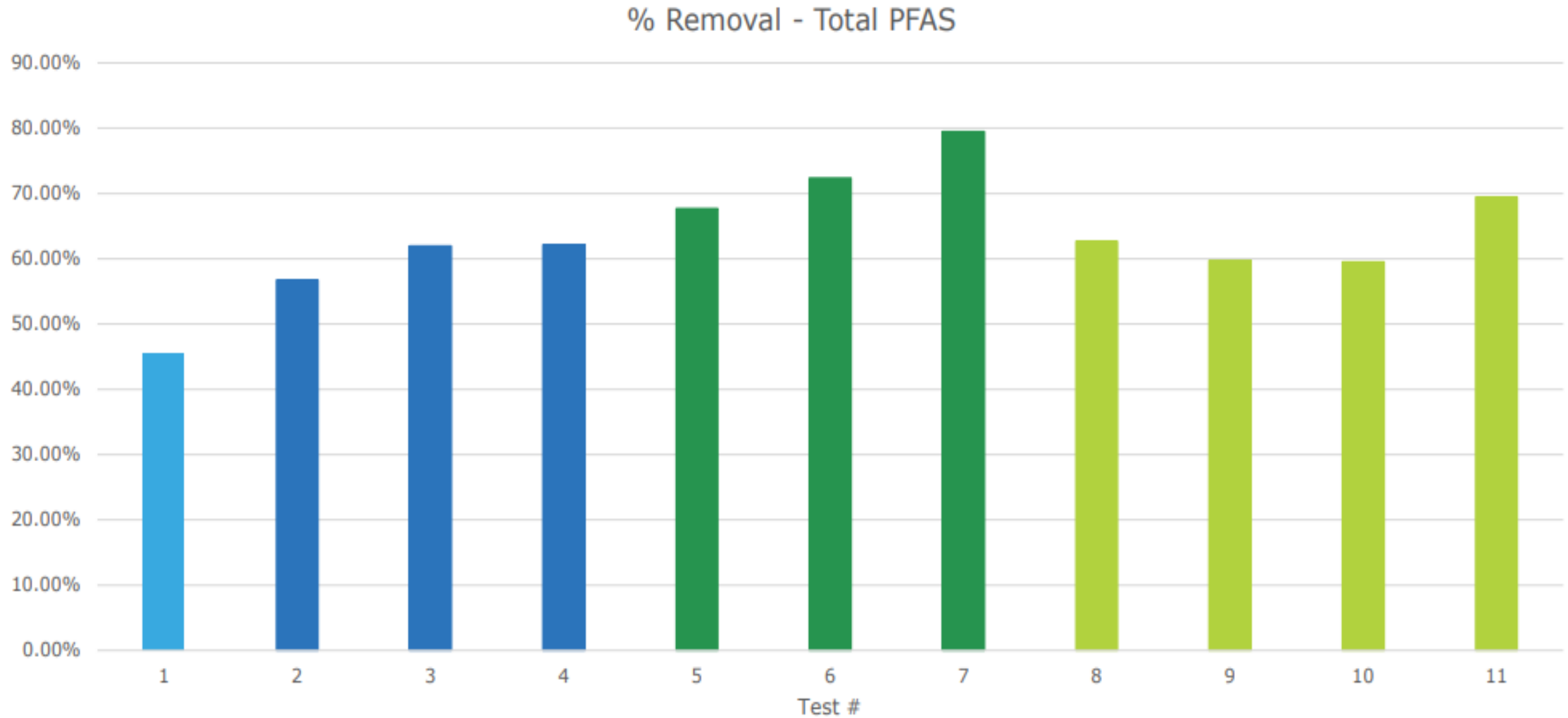
# FOAM-X™ Foamate Concentrator

## Concentrate Leachate Residuals up to 100

- Foamate volume reduction while maintaining high PFAS recovery
- System overall height ~16'
- Compact footprint ~7x10'
- Intended for integration with waste destruction technologies
- Also available in FOAM-X™ 4/6 Containerized Options



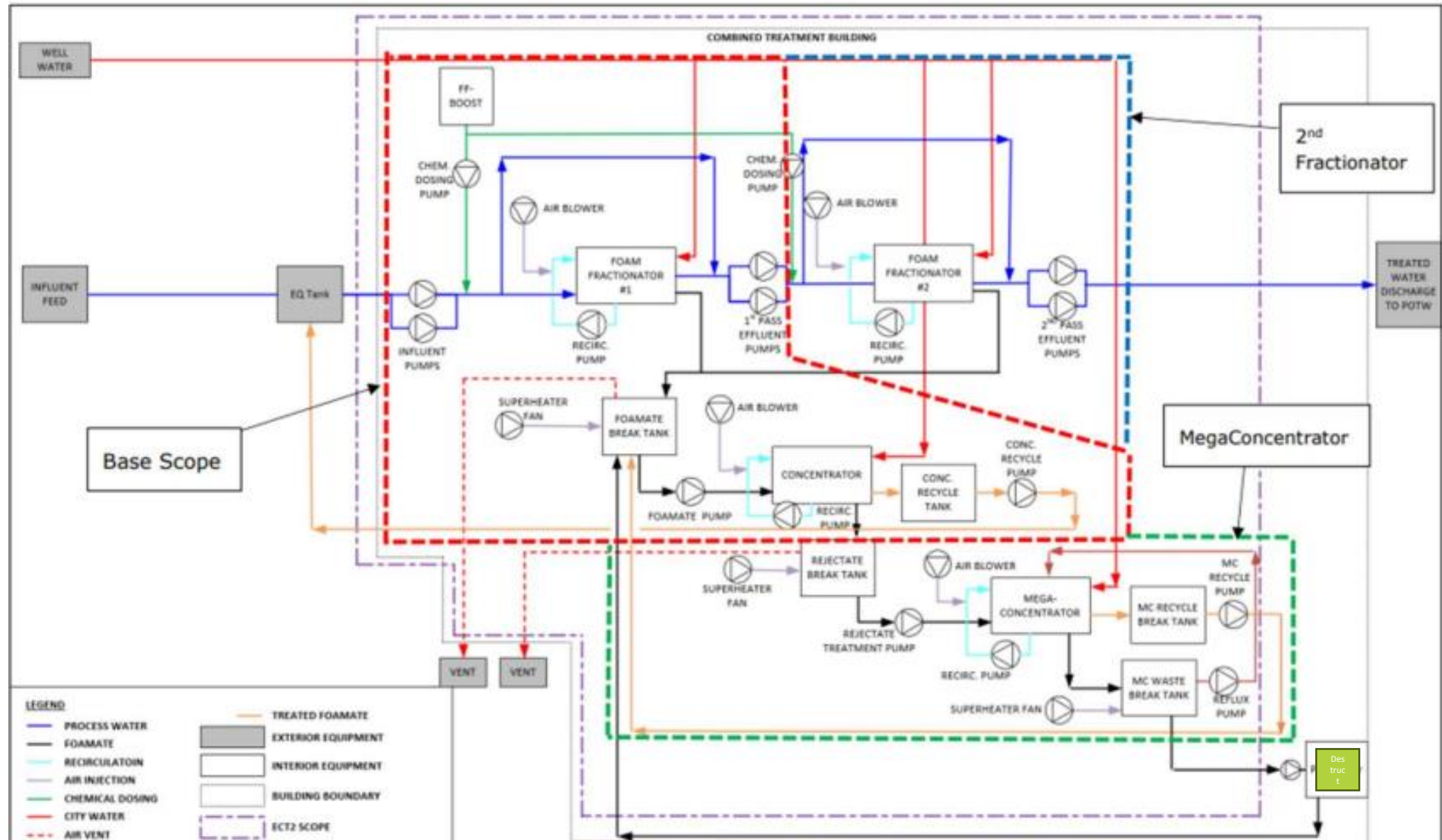
# Landfill Leachate Varying Operation PFAS Removal Results



- Each test # indicated different conditions, each color notates a different boosting agent
- Test 1 has no chemical addition. Influent PFAS total 18ppb

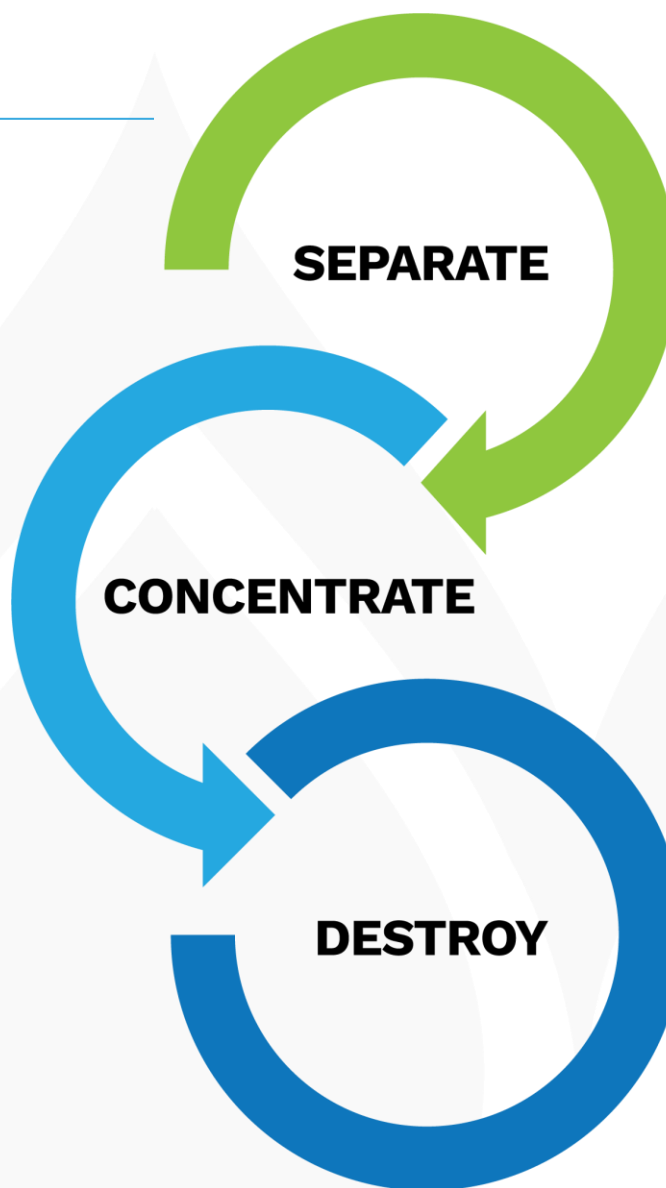


# Three Phase FOAM-X™ 3000 Treatment System Approach



## Applications

- Investigation-derived waste
- Groundwater
- Surface Water
- Industrial Wastewater
- Construction dewatering
- Drinking water
  - POET
  - Larger systems
- Sewage Treatment plants
- Foam spills/events
- Landfill leachate
- Fire System conversion
- Fire System maintenance/calibration/repair





# **Enspired Solutions**

## **Photoactivated Reductive Defluorination**

### *Bolt-On Destruction Technology*





# ENSPIRED SOLUTIONS

PFAS destruction innovation startup

Women-owned and women-led

Founded in 2021

Headquartered in Lansing, Michigan, USA

**SBA WOSB**  
Woman Owned Small Business



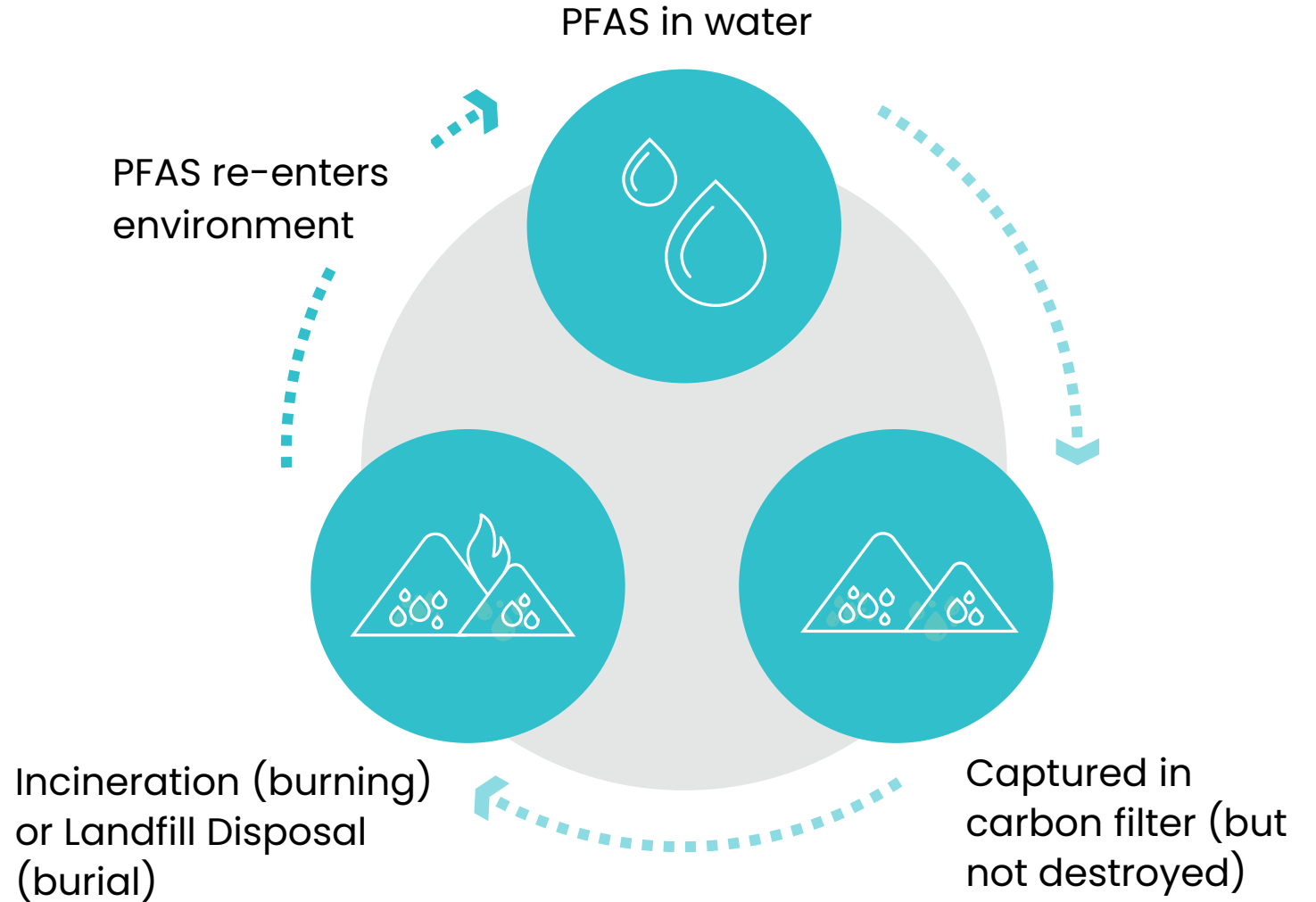


# TECHNOLOGY INTRODUCTION

The background of the slide is an aerial photograph of a body of water, showing intricate patterns of white foam and deep blue-green hues, suggesting a powerful current or a storm's edge.



# Current methods







## PFAS in water



Our photo-activated reductive defluorination (PRD) process destroys PFAS and breaks the cycle of capture, disposal and re-release.

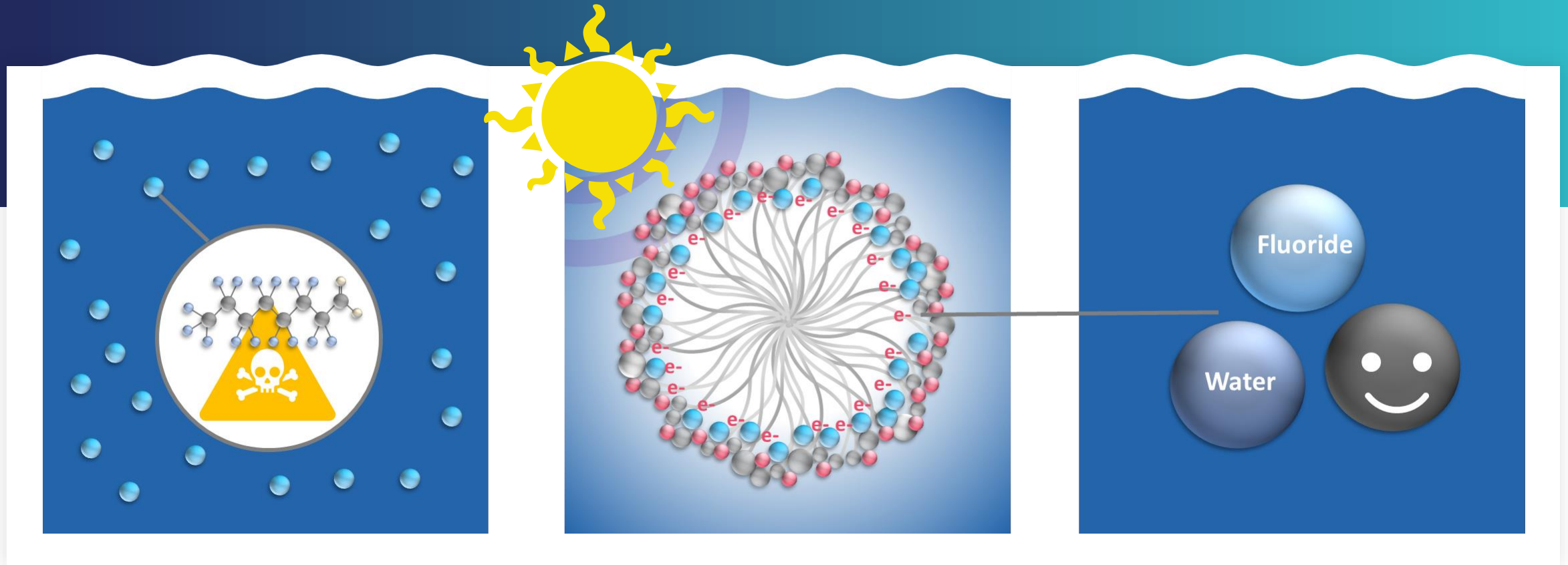


**ENSPIRED**  
SOLUTIONS™

**Non-toxic Discharge**



# How Photo-activated Reductive Defluorination (PRD) Works



# Recognized technology



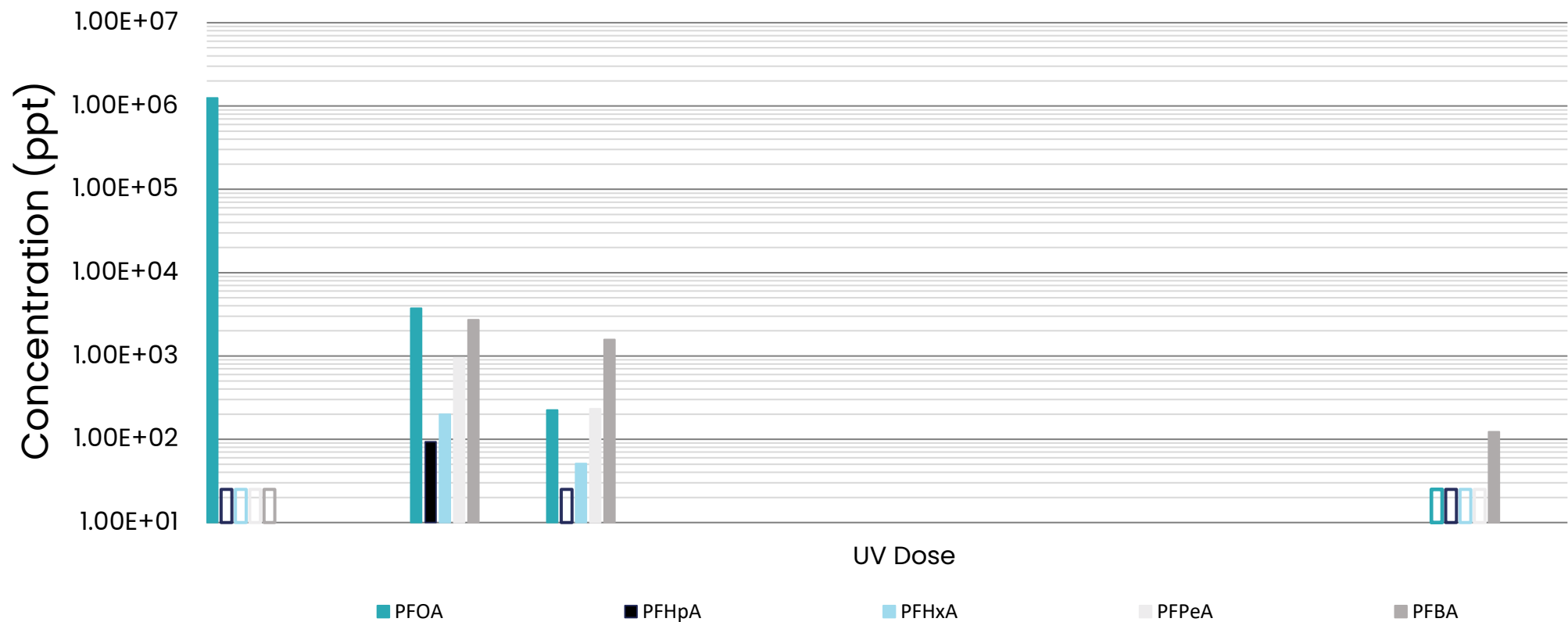
U.S. Department of Defense

## USEPA + Dept. of Defense

AWARD-WINNING CHEMISTRY



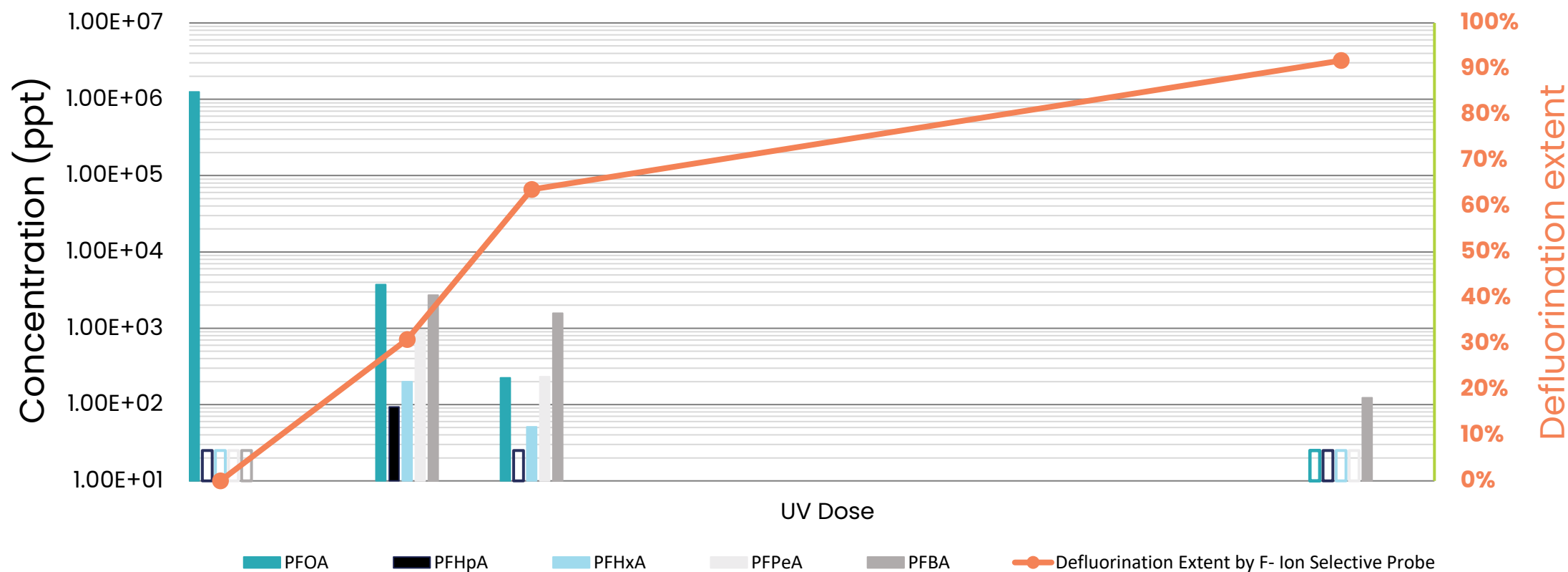
# 1.25 ppm PFOA Spiked DI Water Sequential Mineralization



\*Hollow bars represent non-detect



# 1.25 ppm PFOA Spiked DI Water Sequential Mineralization

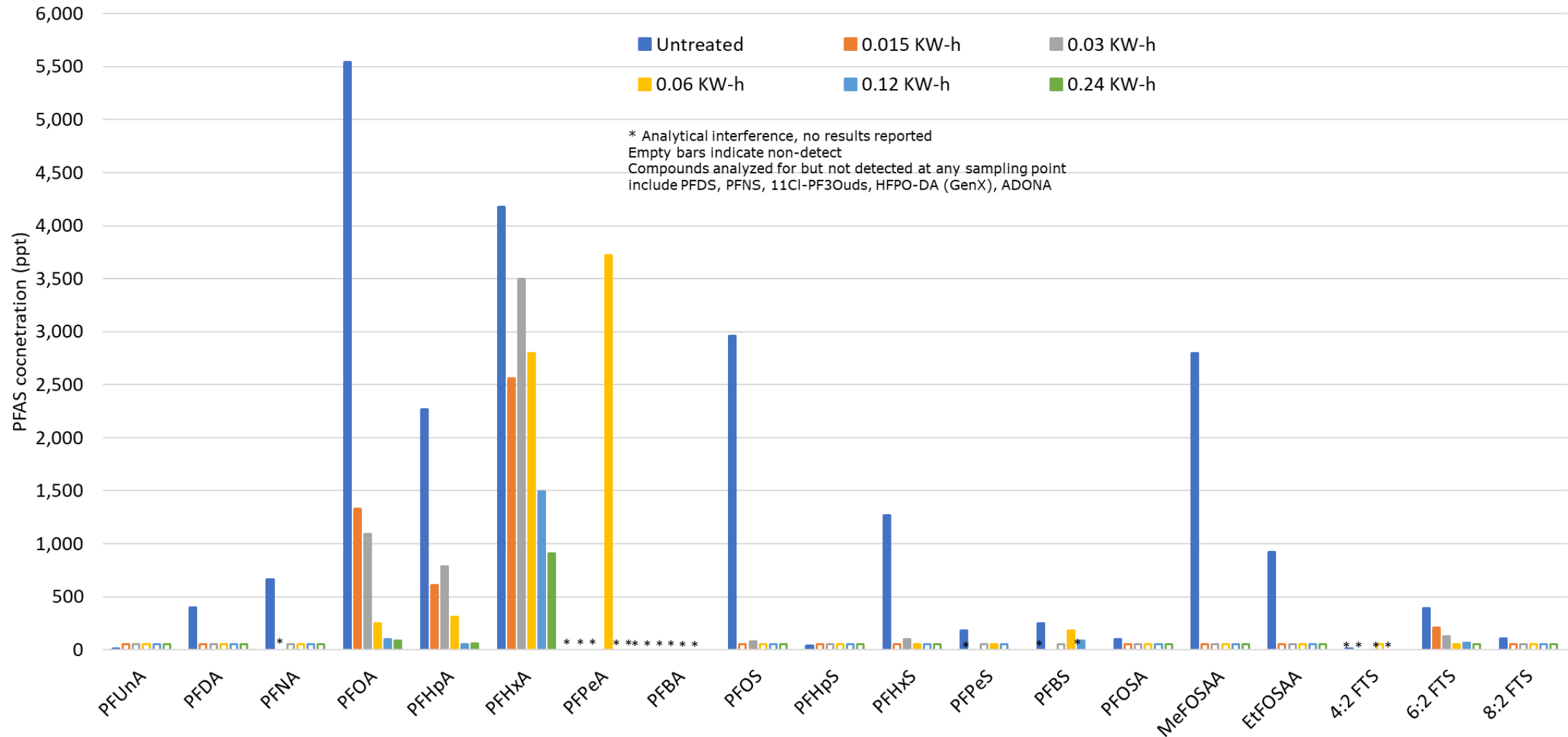


\*Hollow bars represent non-detect





# Destruction of PFAS in Landfill Leachate



The background of the image is an aerial photograph of a body of water, showing intricate patterns of white foam and deep blue-green hues, suggesting a powerful current or a storm's edge. The texture is highly detailed with swirling eddies and fine white spray.

# **COMMERCIAL-SCALE PFAS DESTRUCTION EQUIPMENT**



# PFASigator Sequencing

PFAS destruction  
occurs

Treated solution is  
discharged back  
to the waste  
treatment system

Concentrated PFAS solution  
enters and reagents are mixed



# PFASigator Monitoring & Control

- Automatic batch loading & discharging
- Automatic reagent dosing
- Real-time fluoride measurement confirms PFAS mineralization
- Remote monitoring & control



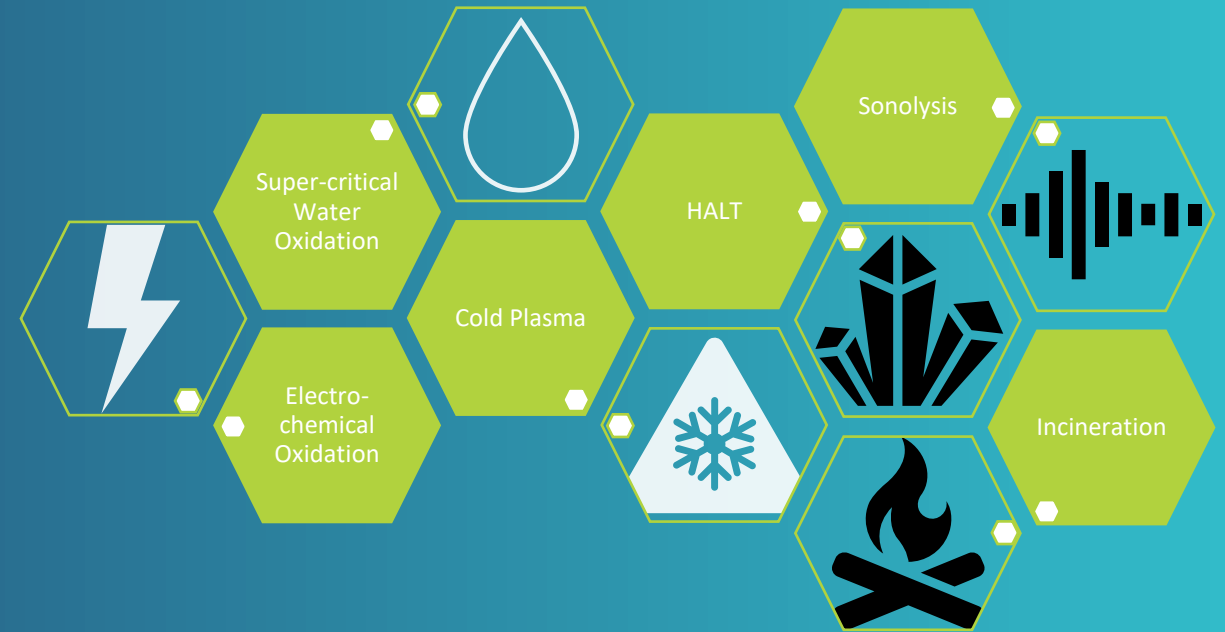


# PFAS Destruction Considerations



## Photo-activated Reductive Defluorination

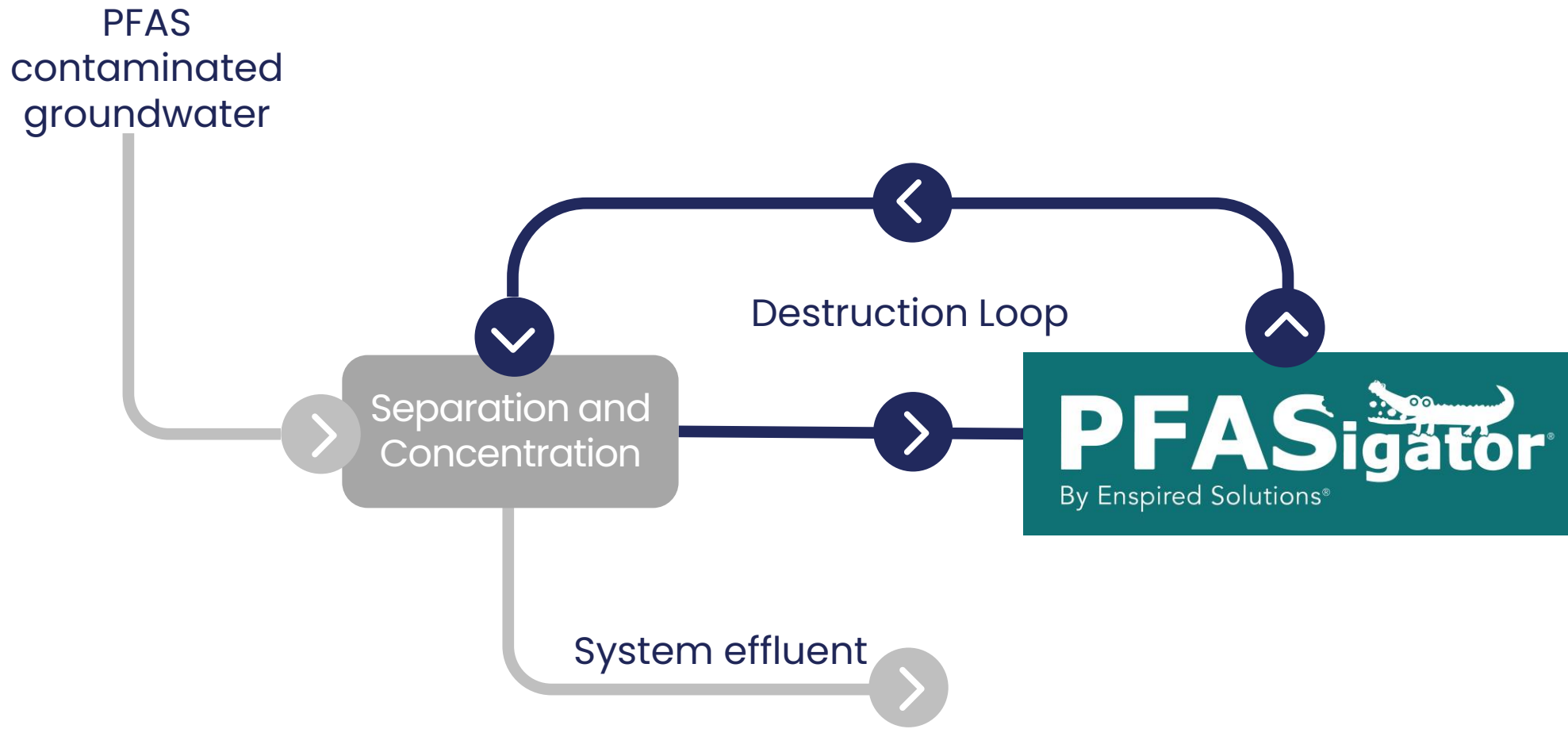
Energy use	⚡
Safe	✓
Tunable reaction	✓
No toxic byproducts	✓
Automated	✓
At commercial scale	✓
Buy or lease	✓
Owner operated	✓



The background of the slide is an aerial photograph of a body of water, likely the ocean, showing intense turbulence and white foam from breaking waves. The colors range from deep navy blue to a lighter, vibrant teal where the foam is more prominent.

# **TECHNOLOGY APPLICATIONS – CASE STUDIES**

# Field Pilot Recirculating Process Flow

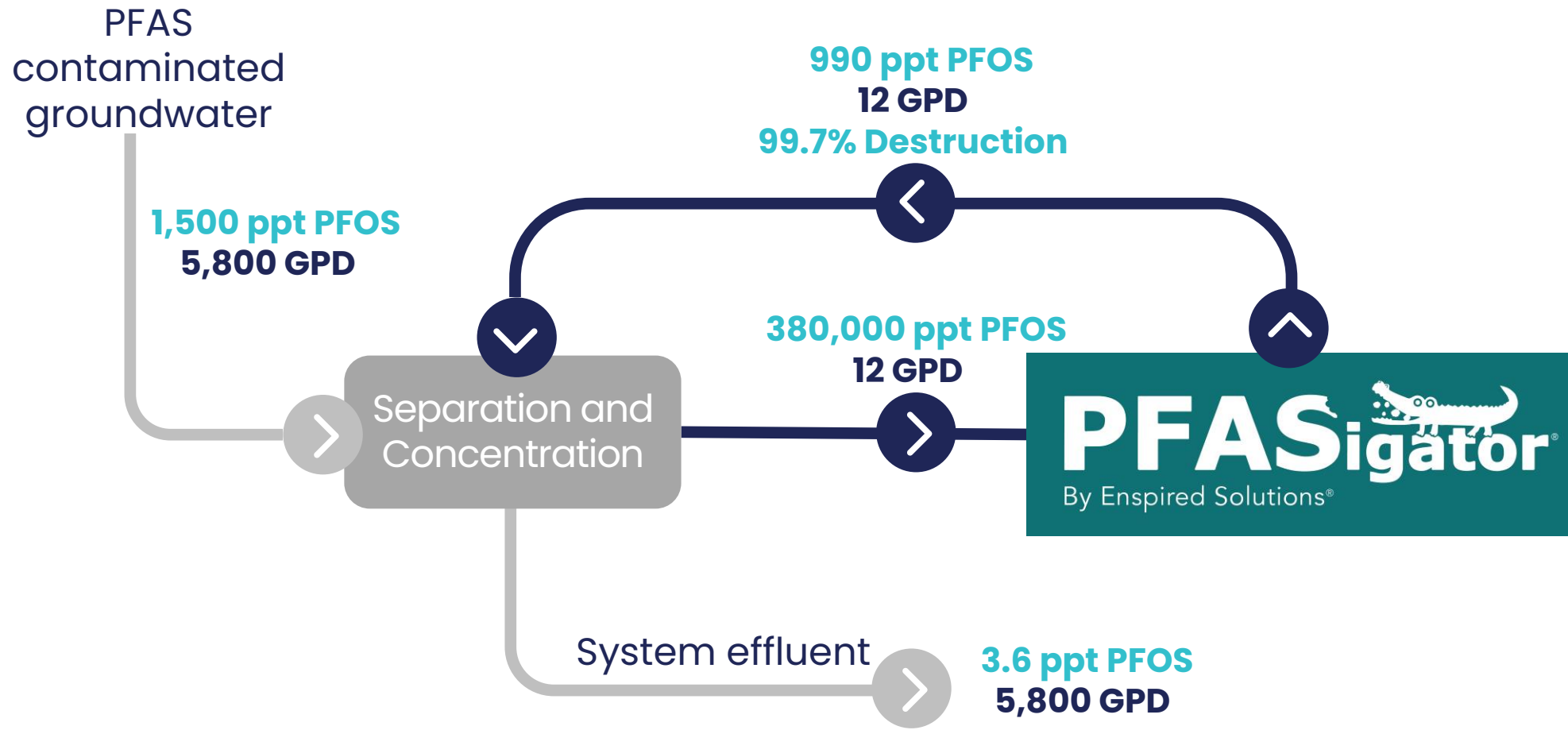




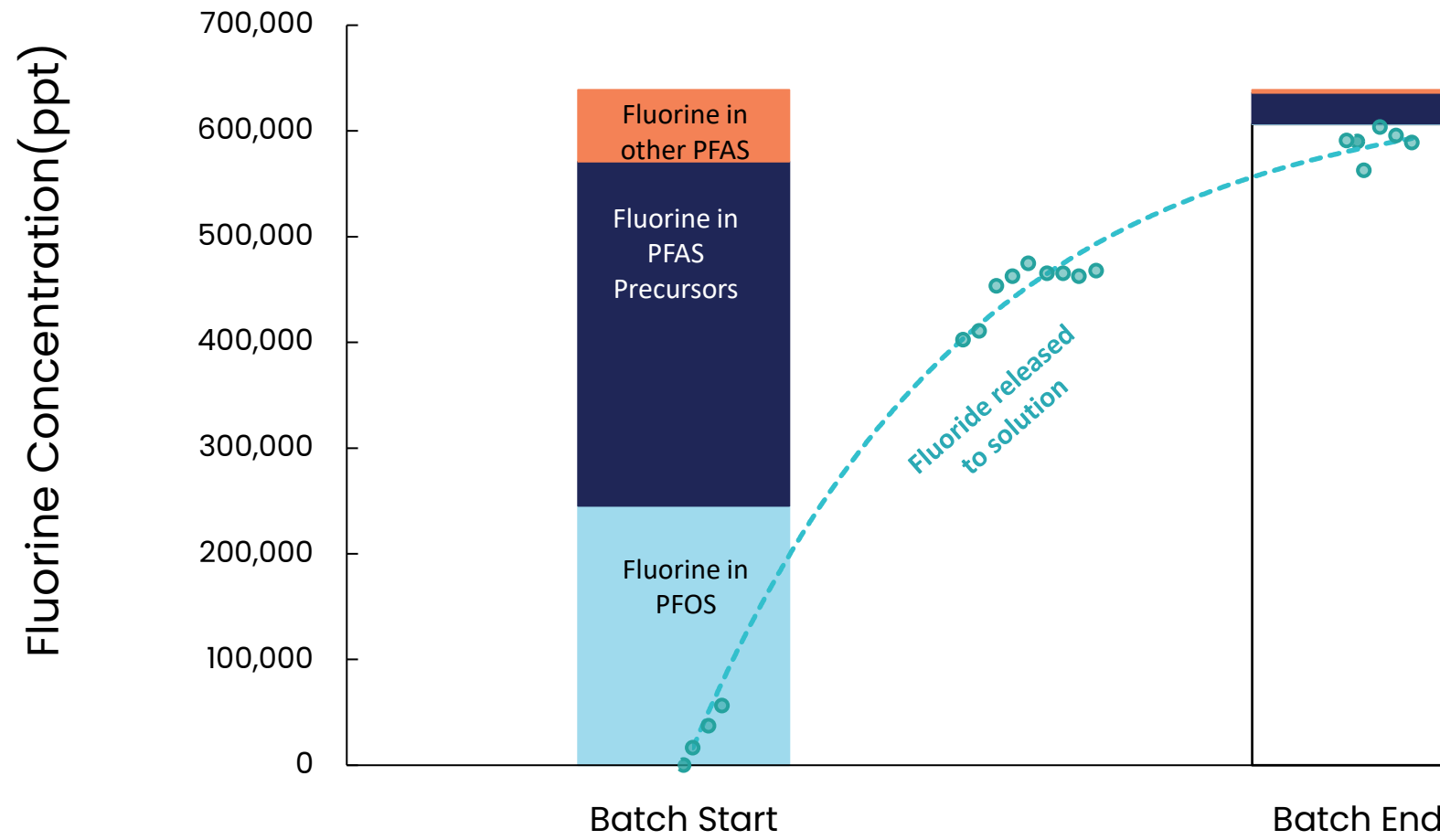




# Field Pilot PFOS Destruction Performance



# Fluoride Mass Balance



## Fluorine/Fluoride Mass Balance

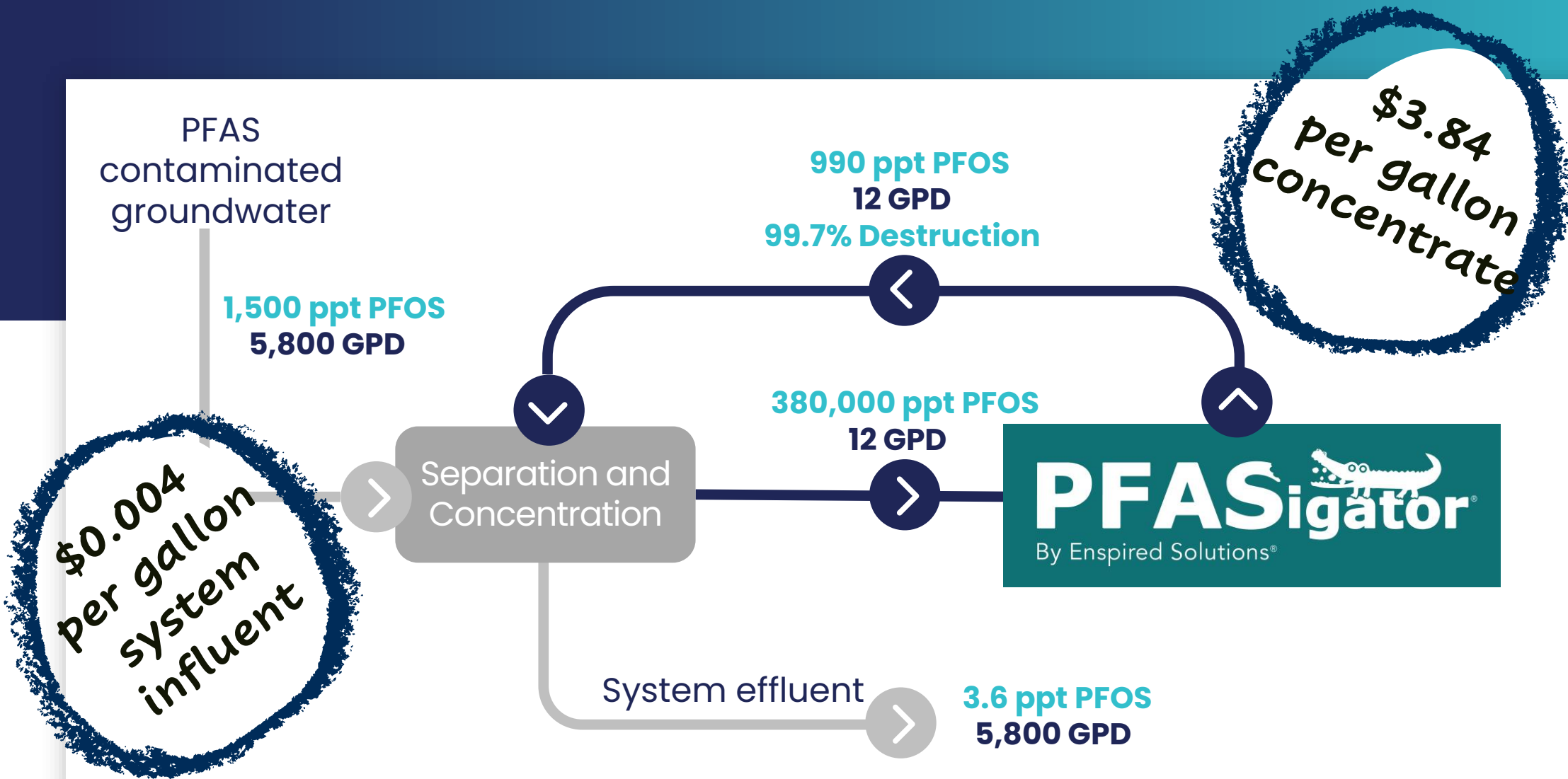
Fluorine - Start:  
638,847 ppt

Fluorine - End:  
32,517 ppt

Fluorine Decrease:  
606,330 ppt

Fluoride Detected:  
580,600 ppt (97%)

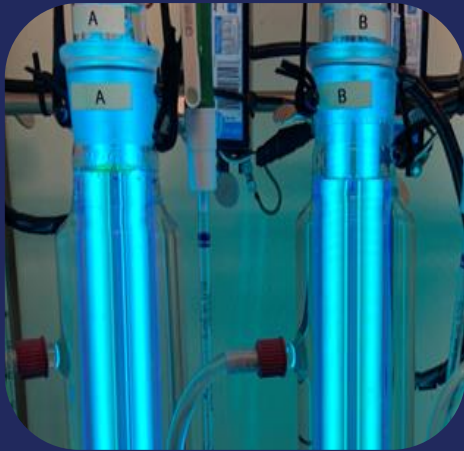
# Field Pilot PFOS Destruction Performance



# PFASigator Implementation Roadmap



**ENSPIRED**  
SOLUTIONS™



Screening Test



Field Pilot

Equipment  
Sale/Lease







# Comments and Questions?

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