

# Large Full-Scale In Situ Remediation of PFAS in Groundwater Using PlumeStop®

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# Overview

What is PlumeStop?

Site Background

Pilot Study

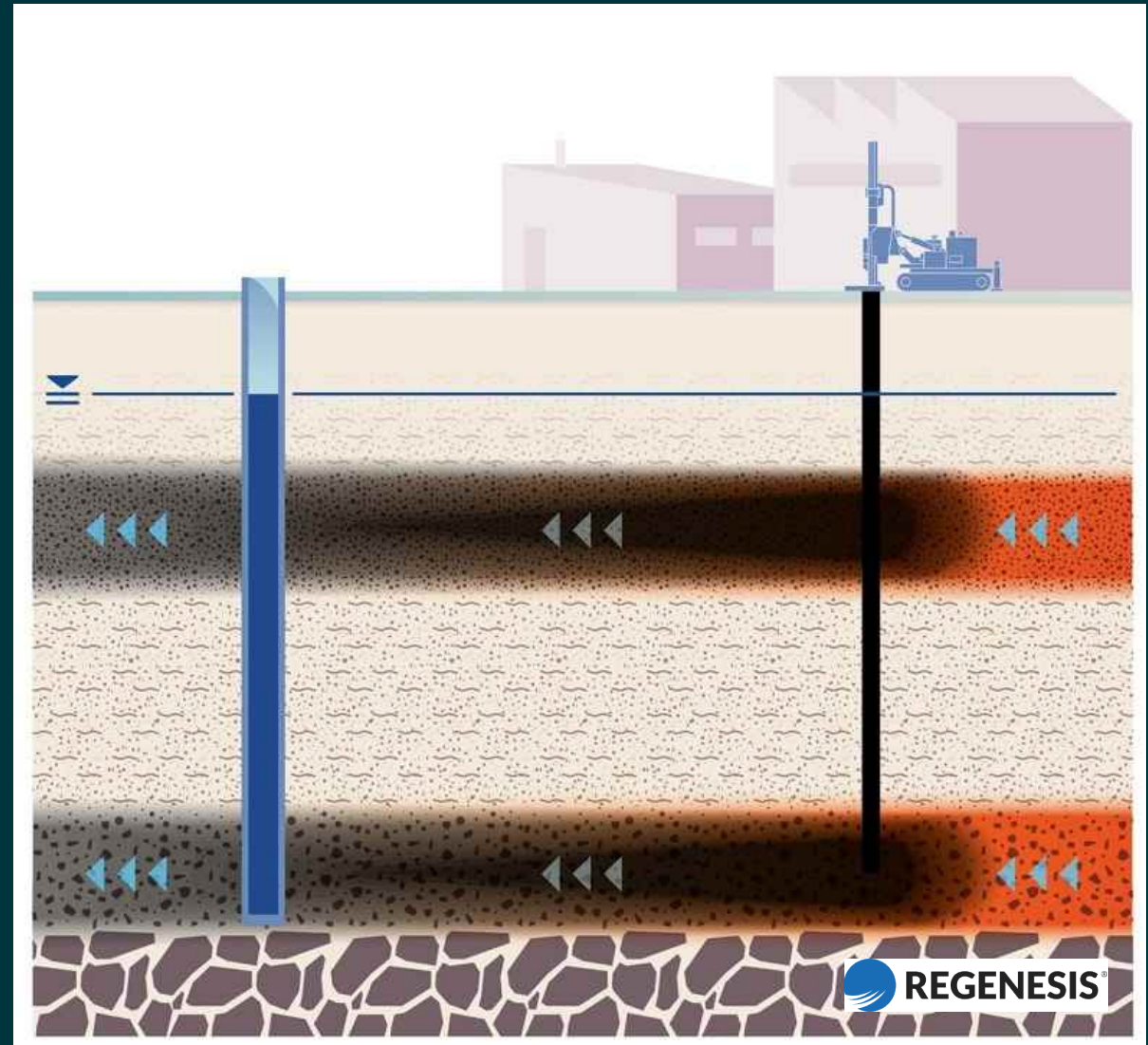
Full-Scale Barrier Installation

Full-Scale Results

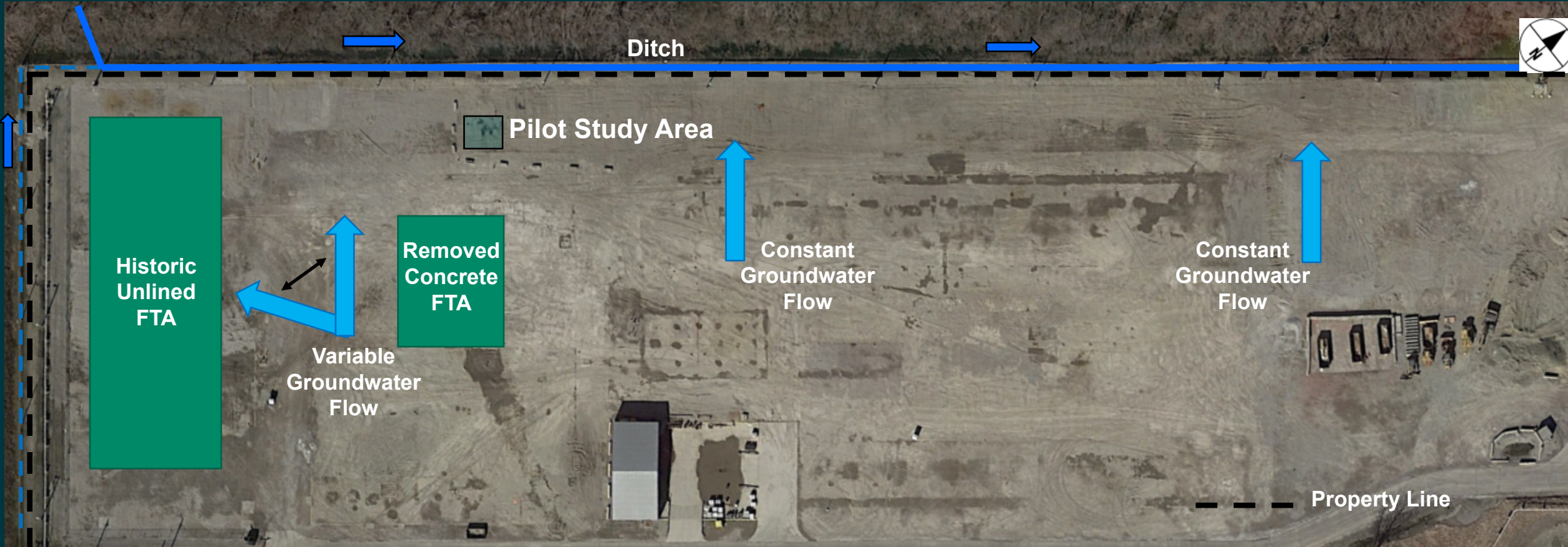


## What is PlumeStop®

- Colloidal Activated Carbon (CAC)
- Particle sizes very small (1–2 microns)
- Suspended as a colloid in a polymer solution
- Distributes Widely Under Low Pressure
- Converts underlying soils into purifying filter
- Provides extremely fast sorption
- Can be installed perpendicular to groundwater flow as a treatment barrier





# Site Background – Former Fire Training Area





# Pilot Study – Approach


LEGEND

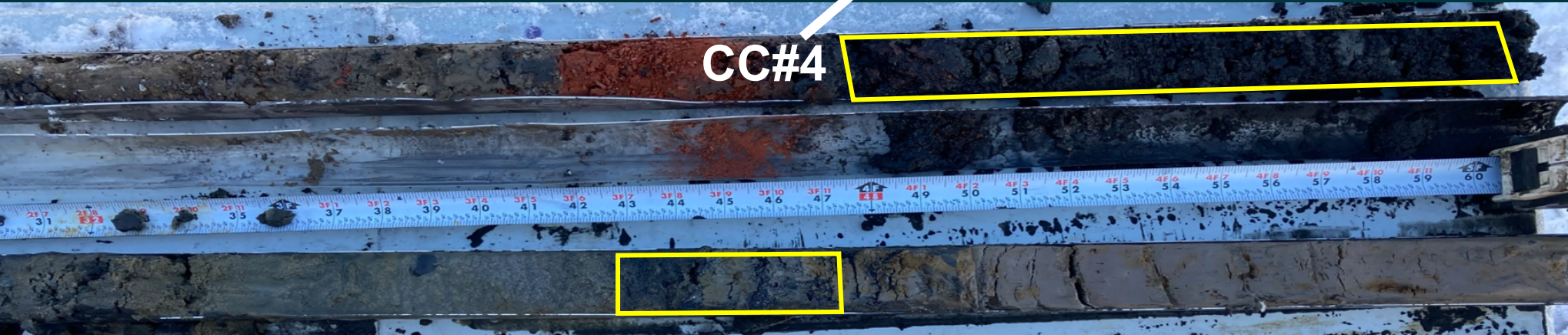
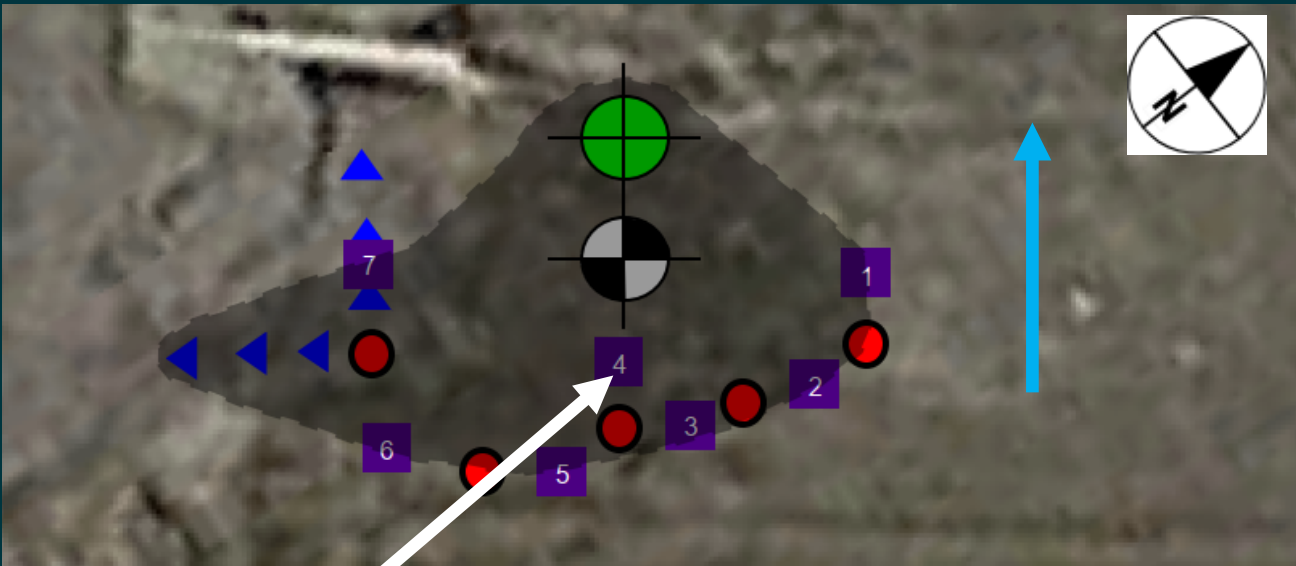
 - 2" Performance MW

 - 1" Temporary PZ

 - Proposed Injection Points

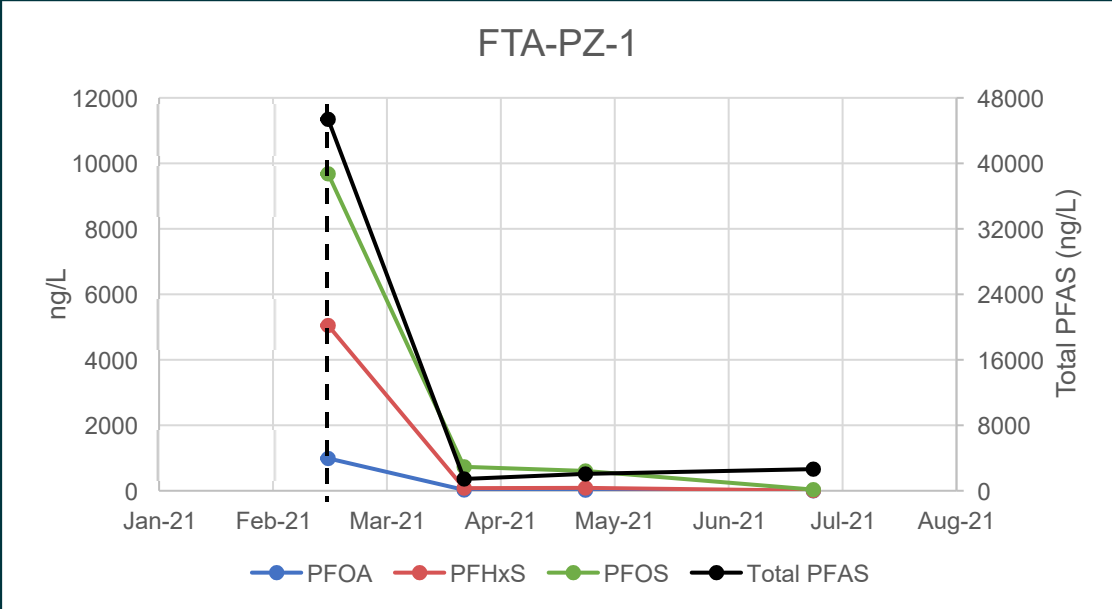
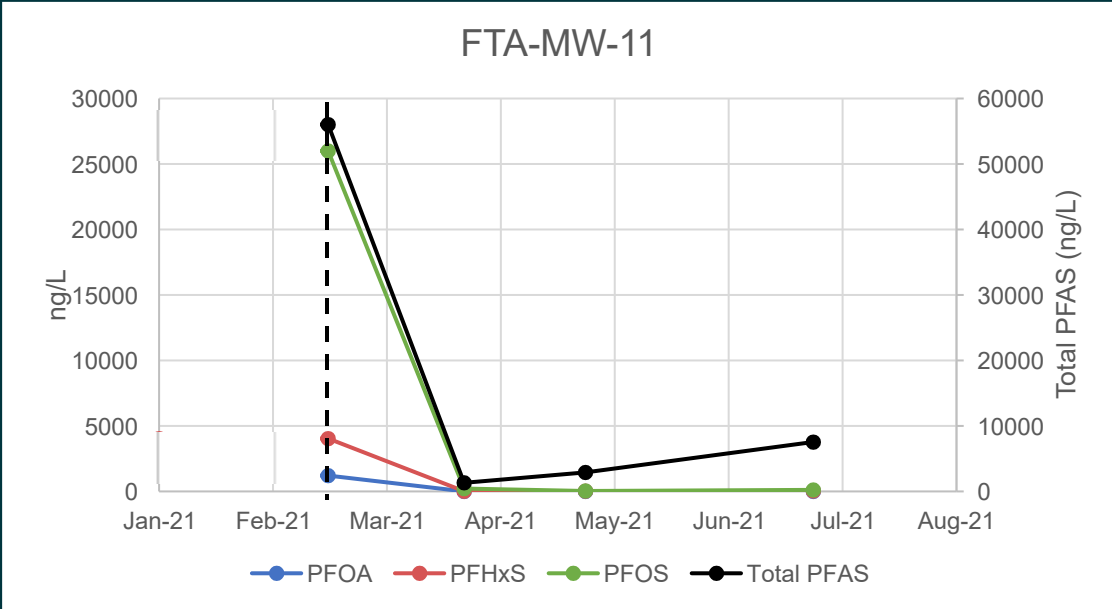
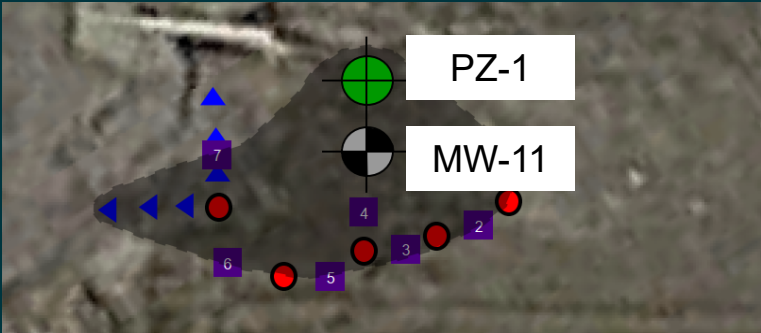
 - Temporary Piezometers

 - Post Injection Soil Cores



# Pilot Study – Results

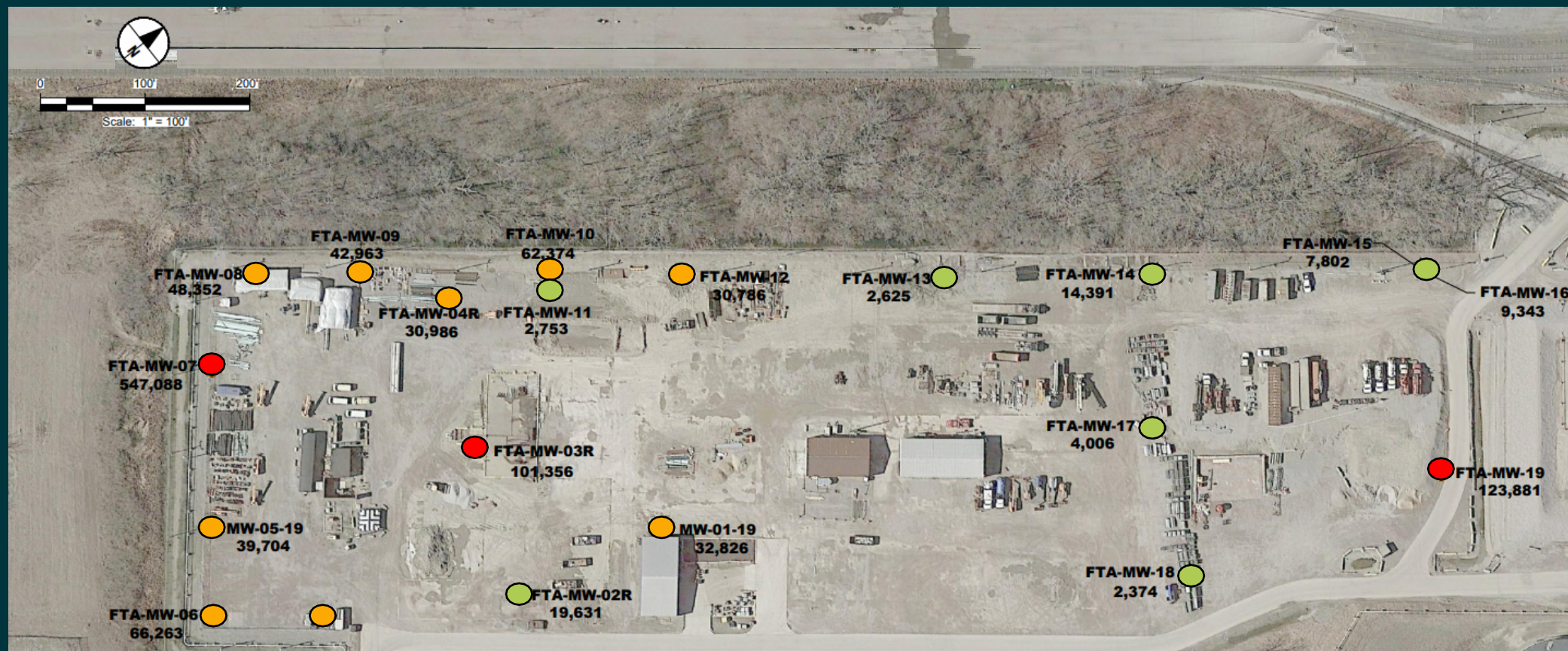
Well ID	Sampling Date	PFAS Concentration (in ng/L)			
		PFOA	PFHxS	PFOS	Total PFAS
MW-11	02/16/21	1210	4040	26000	56030
	03/25/21	4.43	15.7	218	1315
	04/27/21	4.6	22.9	32.9	2903
	06/28/21	5.87	32.8	117	7546
	Month-4 Reduction	-99.5%	-99.2%	-99.6%	-86.5%
PZ-1	02/16/21	990	5050	9680	45385
	03/25/21	26.6	80.1	731	1443
	04/27/21	21.3	88.7	606	2065
	06/28/21	1.13	4.24	35.8	2643
	Month-4 Reduction	-99.9%	-99.9%	-99.6%	-94.2%



## A Few Words about going to Full-Scale

- Client interested in moving rapidly to full-scale
  - Perceived regulatory and public pressure
- Wanted to show action/be proactive
- Reduce PFAS concentrations in groundwater migrating towards the nearby/off-site ditches

# Initial Site Characterization – Total PFAS Concentrations



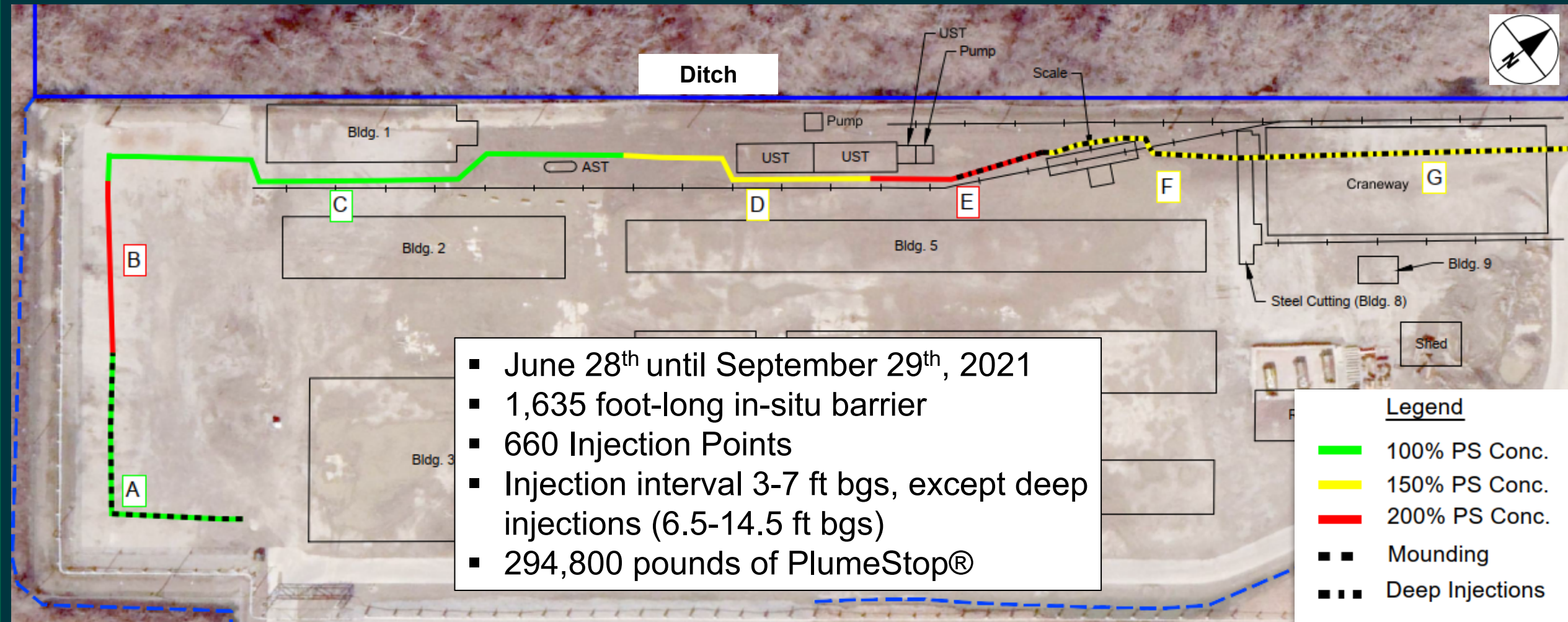
Total PFAS (ppt)

- >100,000
- 20,000 – 100,000
- 1,000 – 20,000

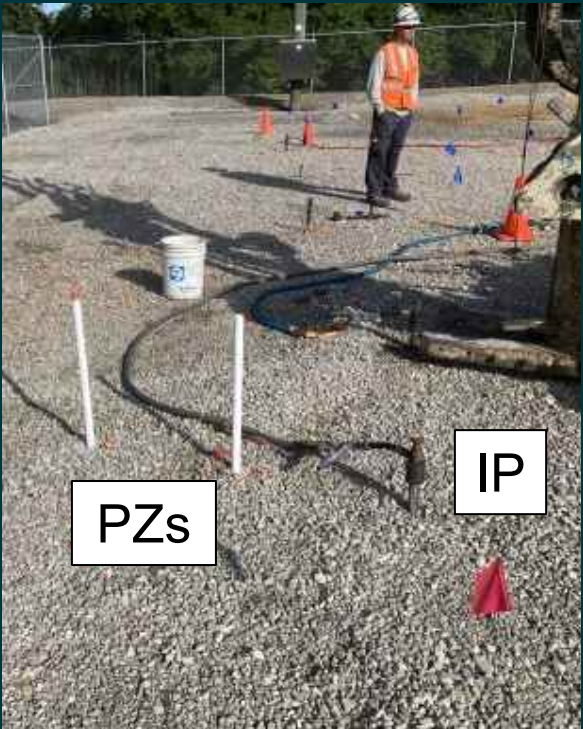
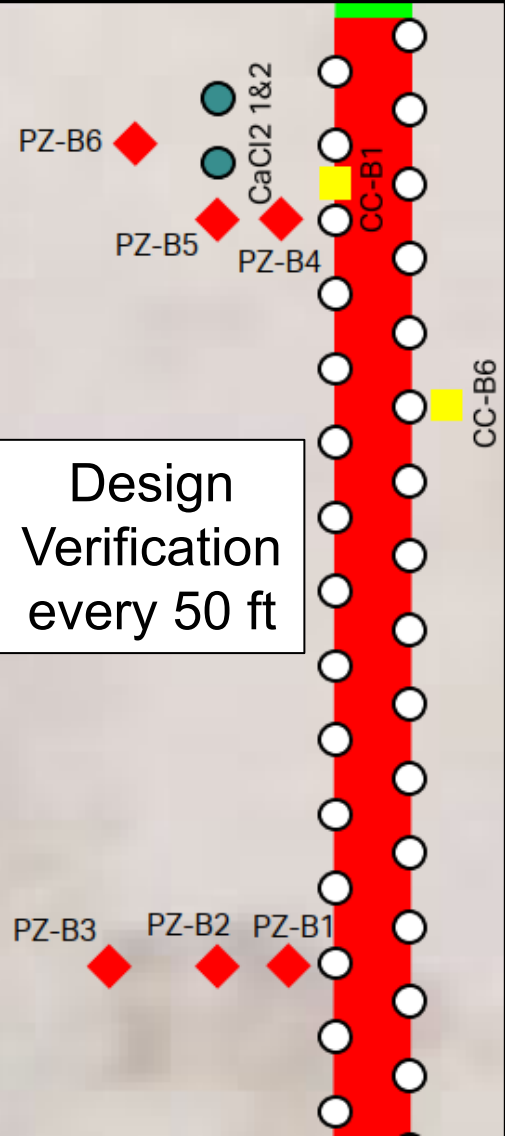
MWs 100-200 feet apart

Lithology, Concentrations, Slug tests used for full-scale design

# Full-Scale PlumeStop® Injection



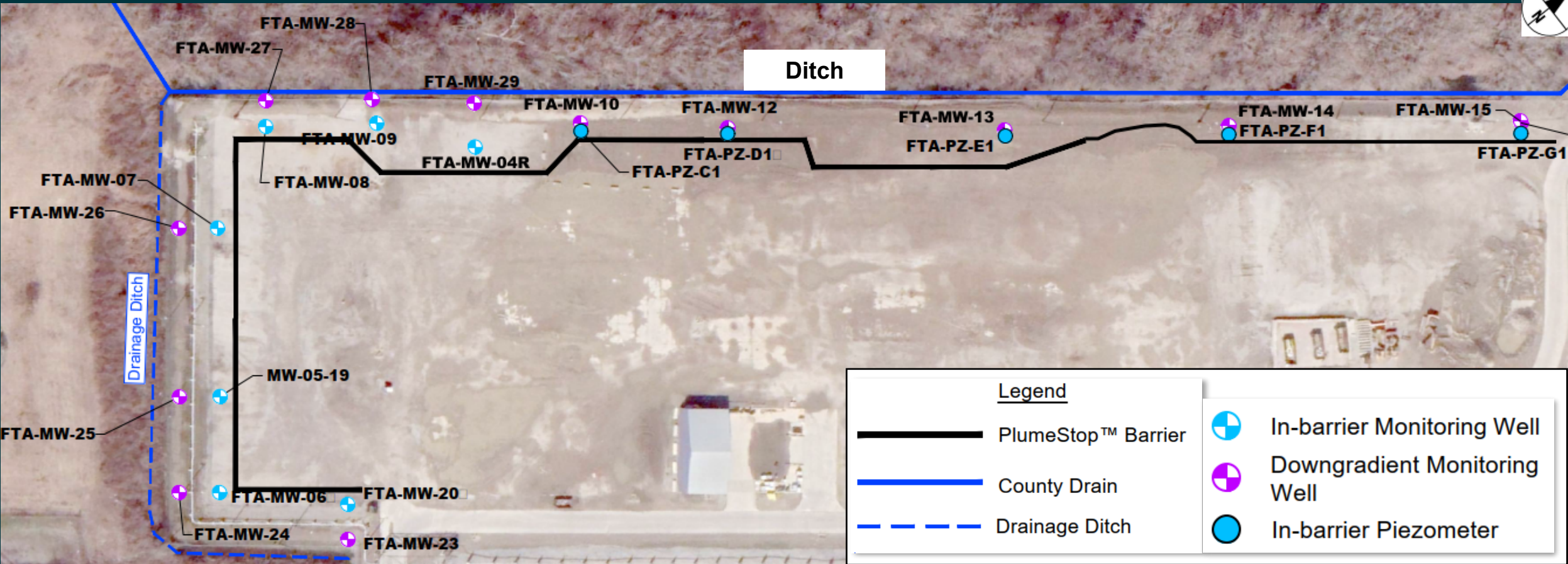
# Injection Approach and Optimization



Legend

○ - Injection Points	◆ - Piezometers
● - CaCl <sub>2</sub> Injection Points	■ - Confirmation Core

# PlumeStop® Barrier Performance Monitoring Approach



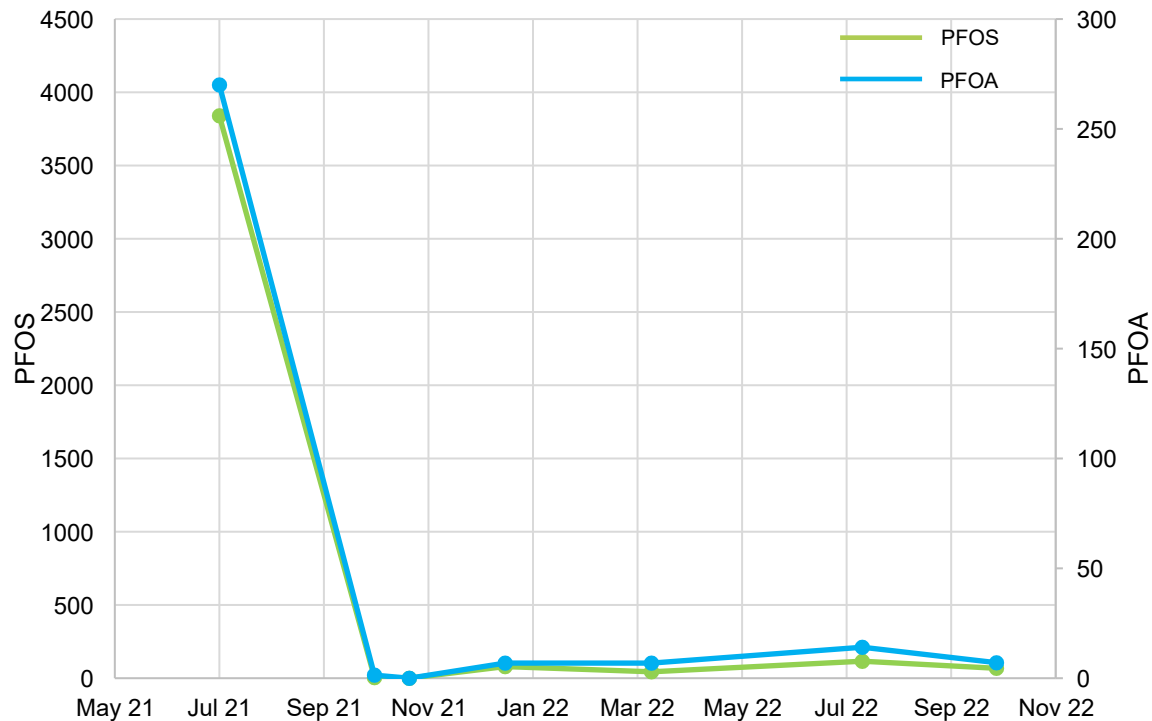
# In-Barrier and Downgradient Well Pair

## Area Performing Well

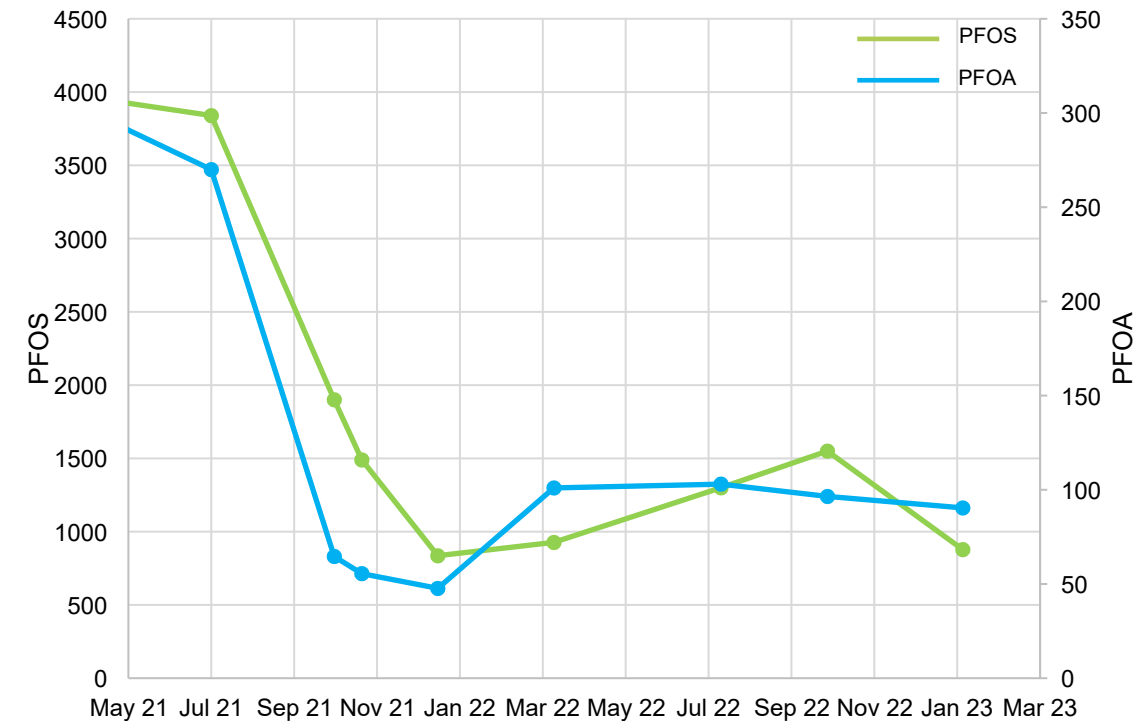
- In-Barrier well 99% reduction
- Downgradient well 80% reduction
- This area of barrier doing well; away from source



FTA-PZ-F1 (In-Barrier)



FTA-MW-14 (18 ft Downgradient)



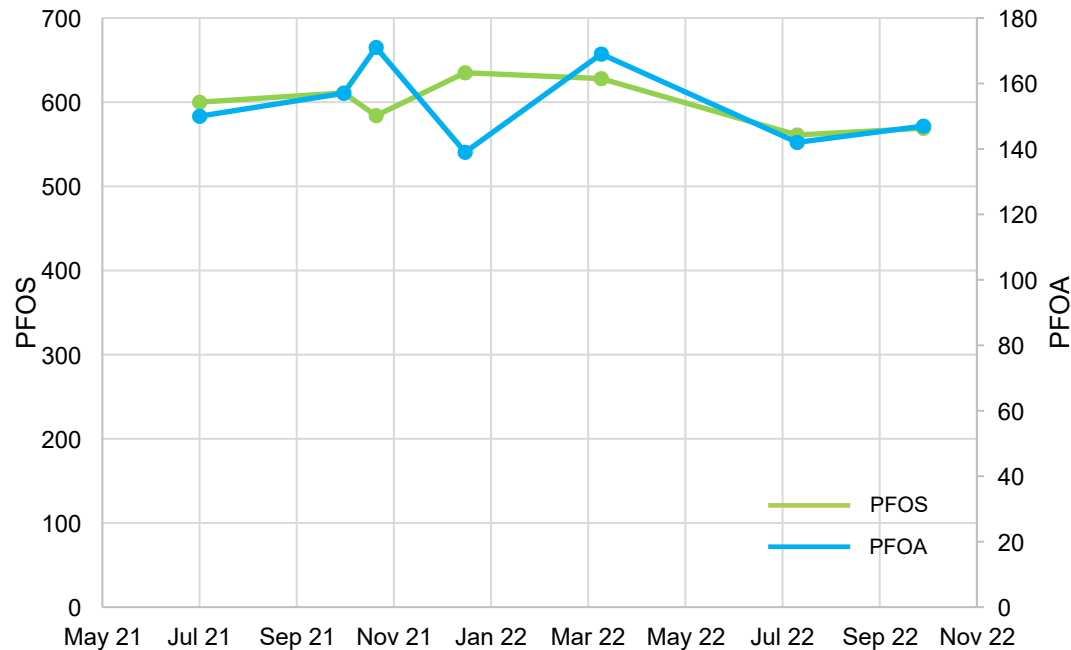
# In-Barrier and Downgradient Well Pair

## No Real Response

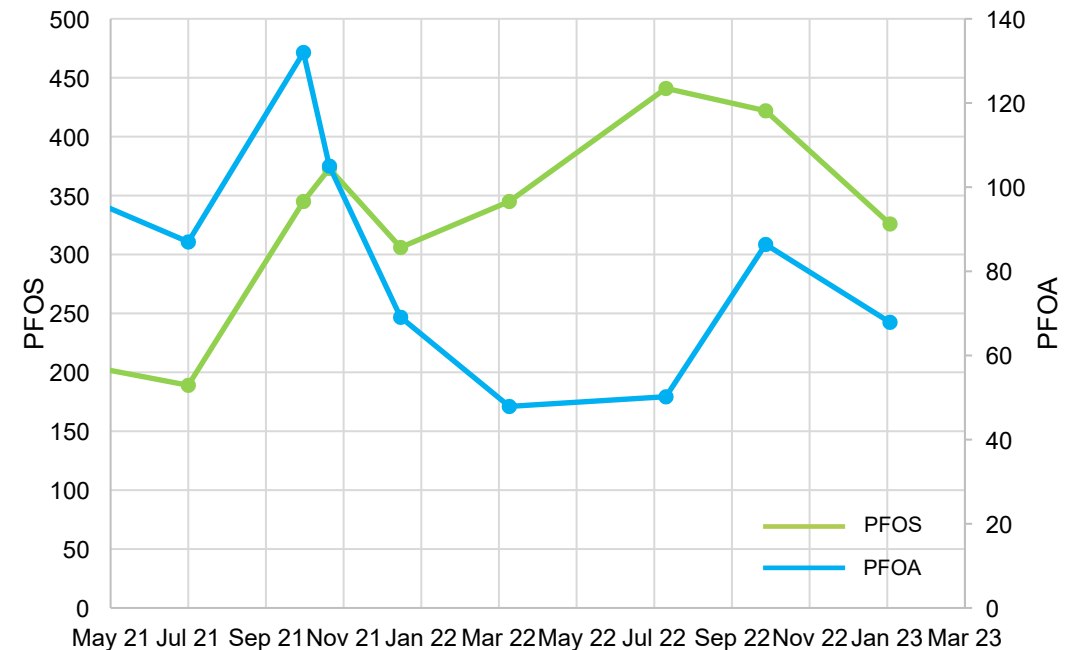
- PFAS concentrations are significantly lower
- DRO highest in this area; has been reduced 97%
- Presence of DRO may affect PFAS sorption
- May not see reductions, but not as much risk



FTA-PZ-E1 (In-Barrier)



FTA-MW-13 (27' Downgradient)



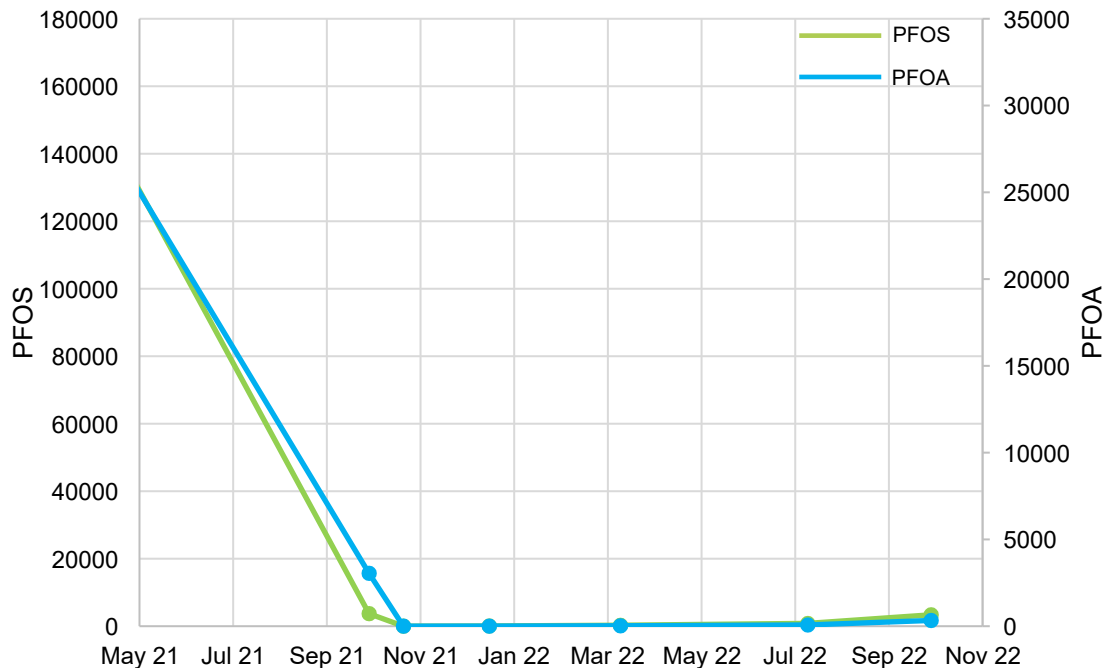
# In-Barrier and Downgradient Well Pair

## In-Barrier Good, Downgradient Fluctuates

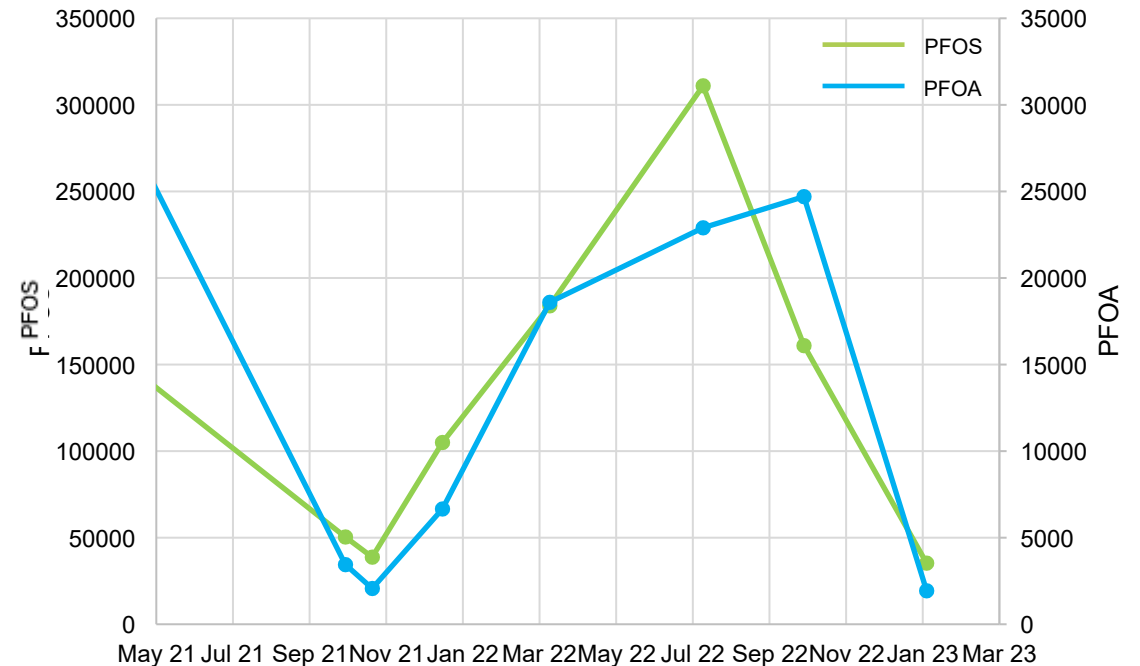
- Highest PFAS (550 ppb Total PFAS)
- In-barrier reduced ~100%, slight increase at 1 yr
- Downgradient well significantly fluctuates, likely due to rainfall, water level or gw flow direction fluctuation and source mass present downgradient of barrier



FTA-MW-07 (In-Barrier)



FTA-MW-26 (54 ft downgradient)



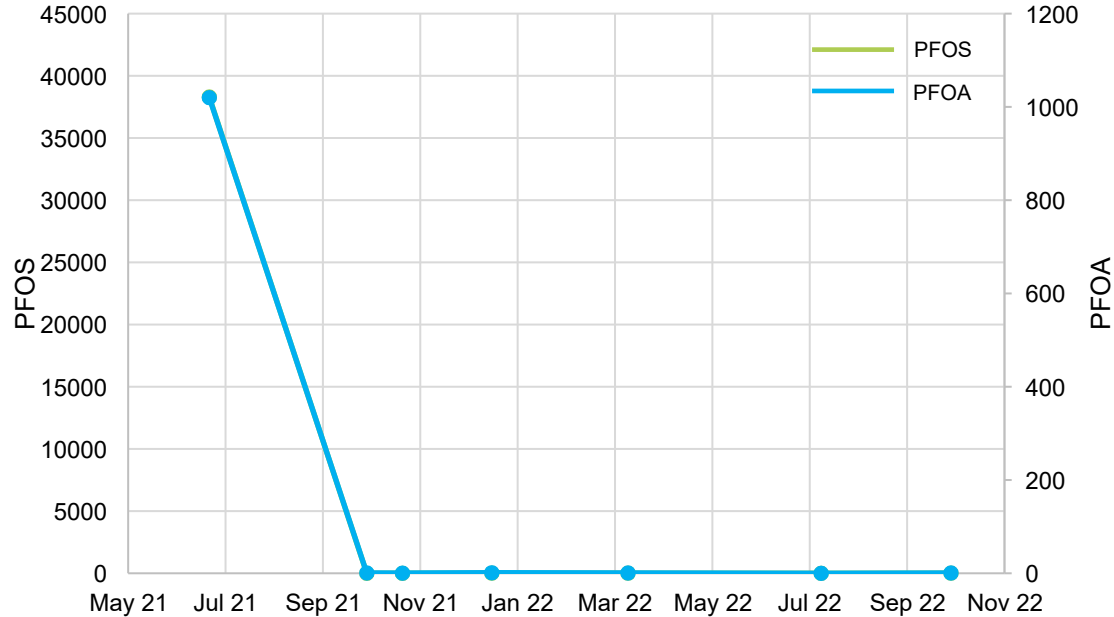
# In-Barrier and Downgradient Well Pair

## Area Performing Well

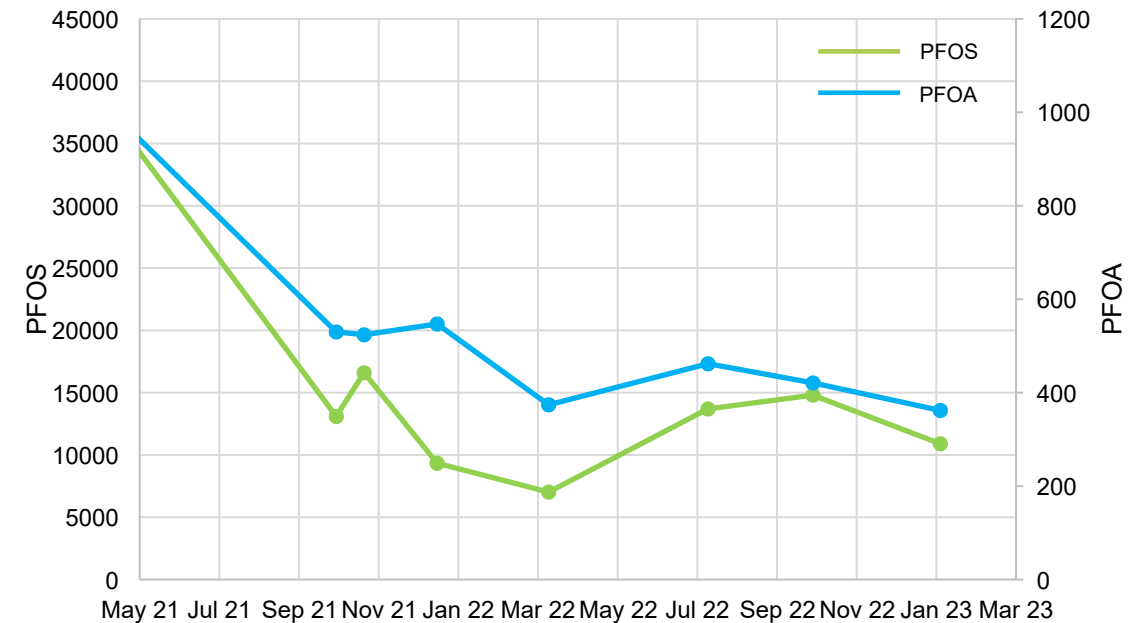
- In-Barrier well ~100% reduction
- Downgradient well 82% reduction in PFOS
- Appears to be doing well, but may need extended time to see further reductions downgradient



FTA-MW-6 (In-Barrier)



FTA-MW-24 (60 ft Downgradient)



## Results Summary

- Based on >1 year of monitoring data, barrier appears to be holding with no evidence of breakthrough, even in areas with >500,000 ppt Total PFAS
- In-barrier wells responded immediately
- Downgradient well response depends on:
  - Distance from the barrier
  - Groundwater velocity in that area
  - Presence of residual PFAS mass already downgradient of the barrier
- Downgradient wells located in areas away from historical source areas are performing best
- Co-contaminants (DRO) can compete with PFAS for sorption to PlumeStop
- Monitoring will continue to further evaluate barrier longevity, improvement in downgradient water quality, and the need for any further injections

# Thank You!

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