

Large Full-Scale In-Situ Remediation of PFAS in Groundwater using Colloidal Activated Carbon

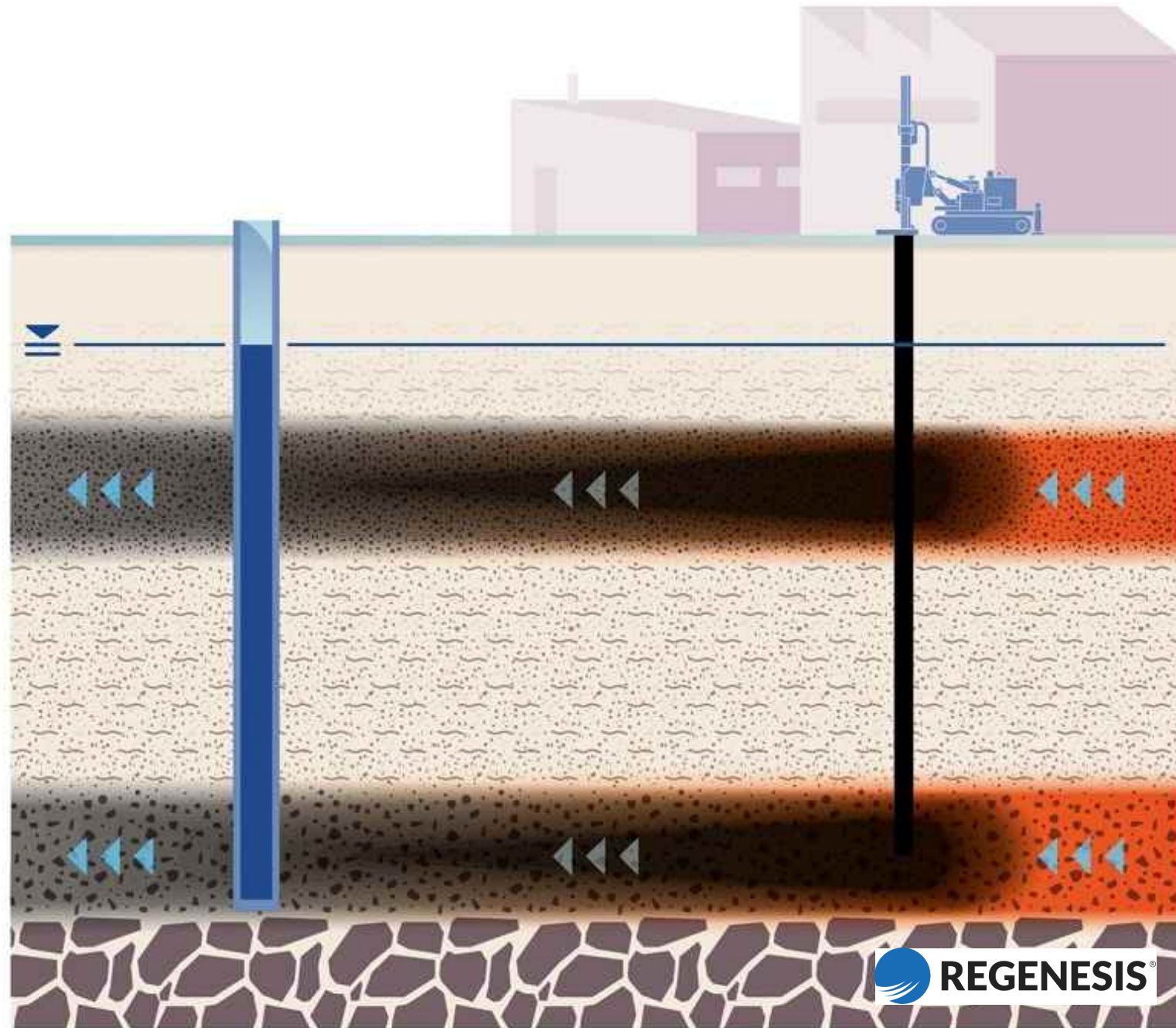
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Agenda

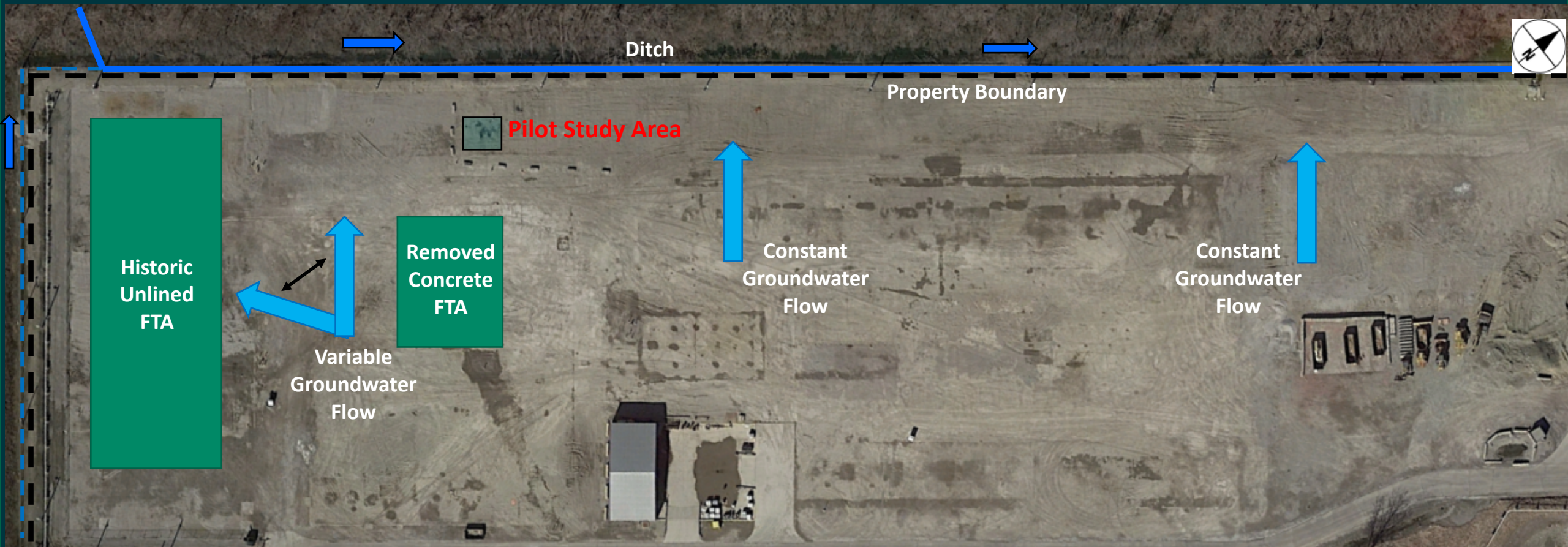
- 01 What is PlumeStop®
- 02 Site Background
- 03 Pilot Study / Full Scale Implementation
- 04 2-Year Results
- 05 Lessons Learned

What is PlumeStop®

- Colloidal Activated Carbon (CAC)
- Particle sizes very small (1–2 microns)
- Suspended as a colloid in a polymer solution
- Converts underlying soils into purifying filter



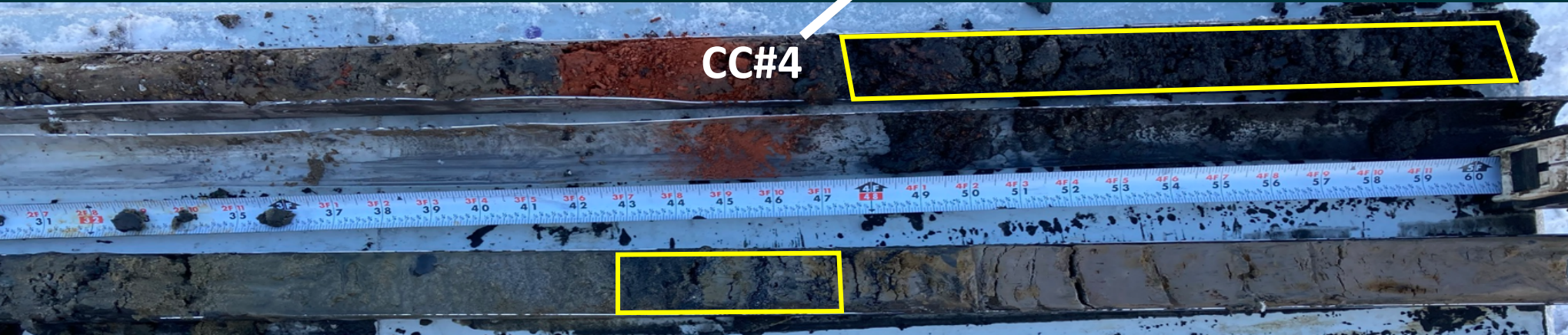
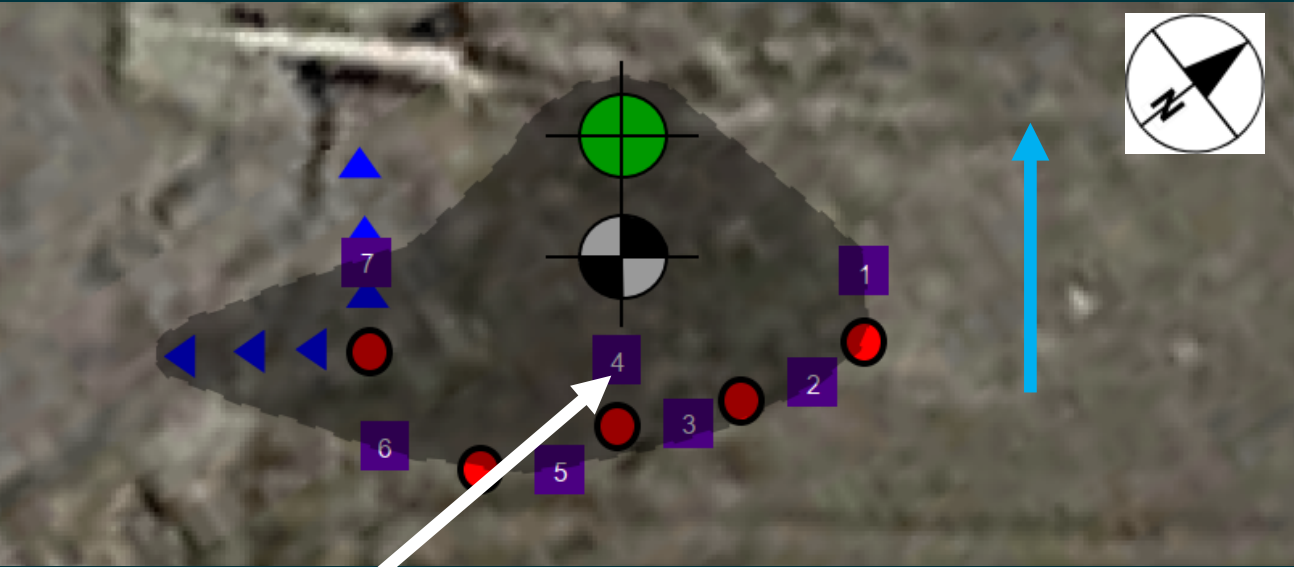
Site Background – Former Fire Training Area



Pilot Study – Approach

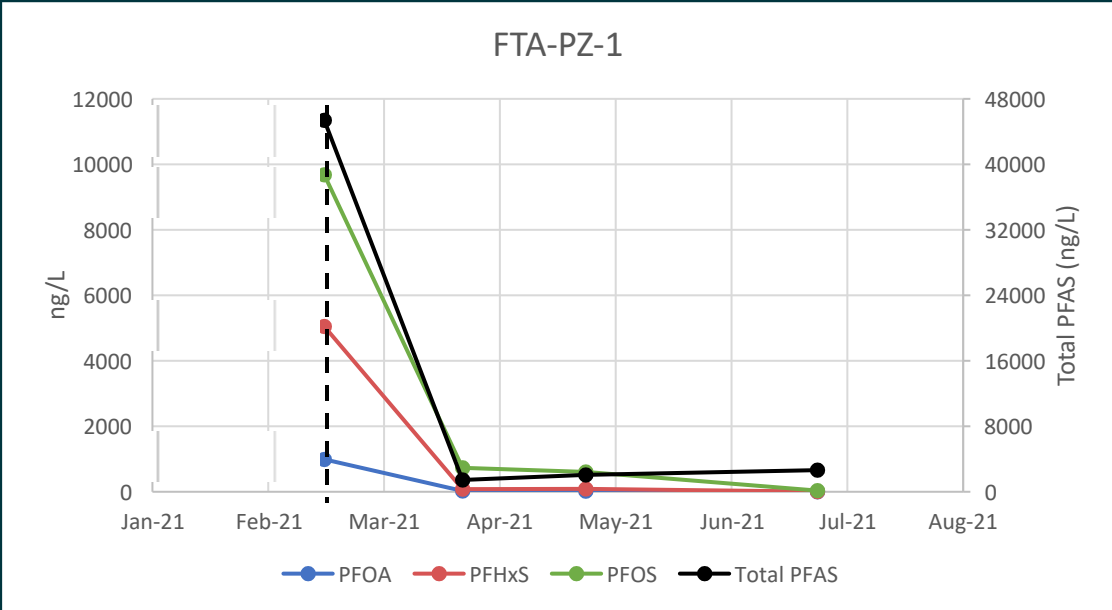
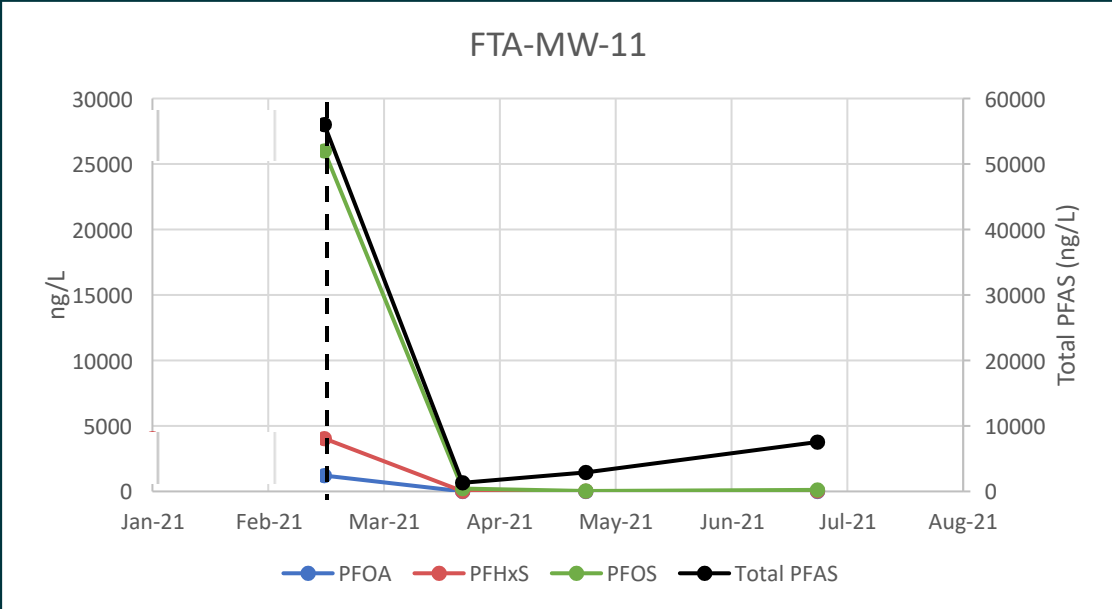
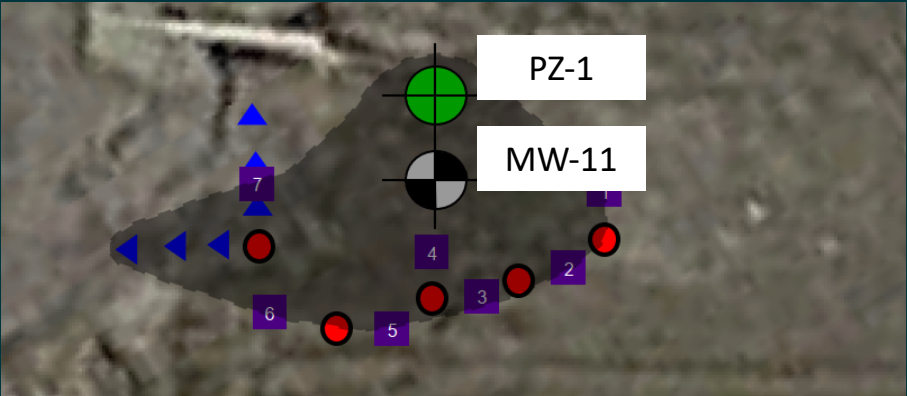
LEGEND

-  - 2" Performance MW
-  - 1" Temporary PZ
-  - Proposed Injection Points
-  - Temporary Piezometers
-  - Post Injection Soil Cores



Pilot Study – Results

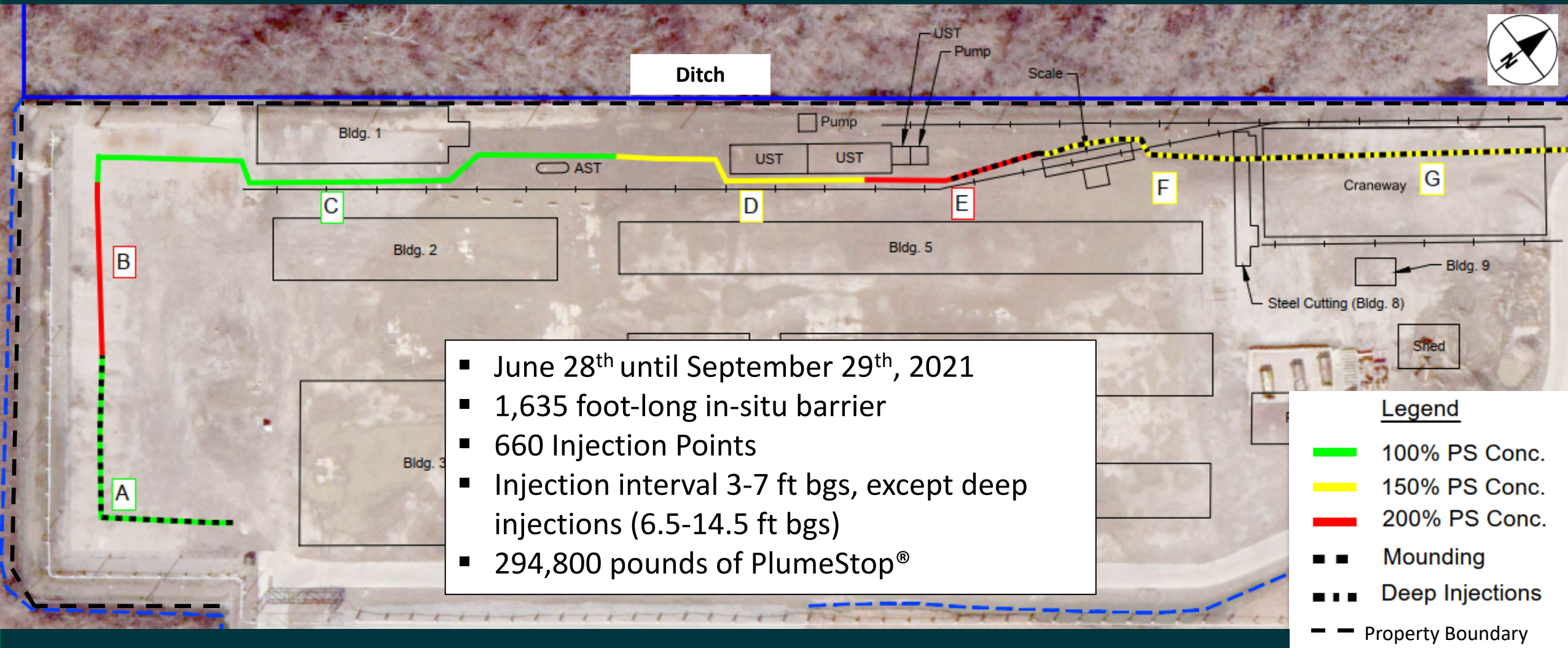
Well ID	Sampling Date	PFAS Concentration (in ng/L)			
		PFOA	PFHxS	PFOS	Total PFAS
MW-11 7 ft down-gradient	02/16/21	1210	4040	26000	56030
	03/25/21	4.43	15.7	218	1315
	→ 04/27/21	4.6	22.9	32.9	2903
	06/28/21	5.87	32.8	117	7546
	Month-4 Reduction	-99.5%	-99.2%	-99.6%	-86.5%
PZ-1 9 ft down-gradient	02/16/21	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

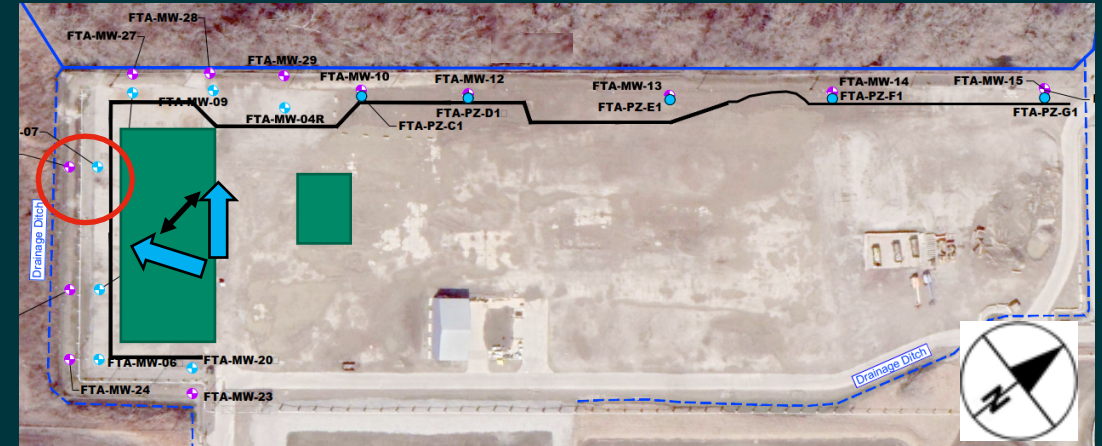
- Client wanted to move rapidly to full-scale
 - Perceived regulatory and public pressure
 - Wanted to show immediate action/be proactive
- **Objective:** Reduce PFAS concentrations in groundwater migrating towards the off-site ditches

Full-Scale Injection

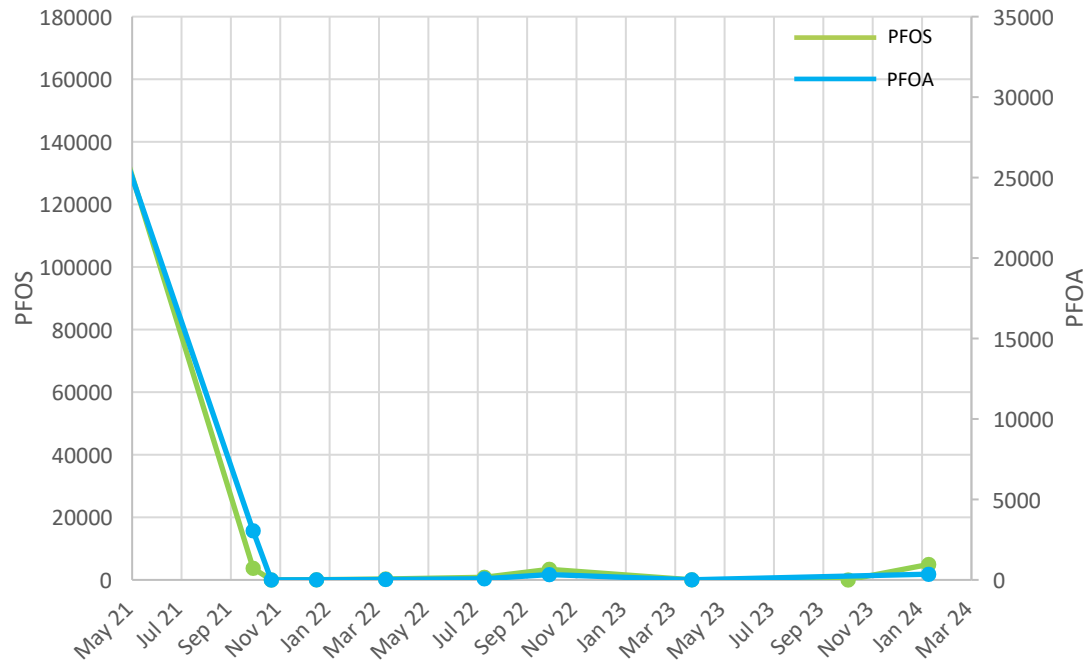


In-Barrier Good, Downgradient Fluctuates

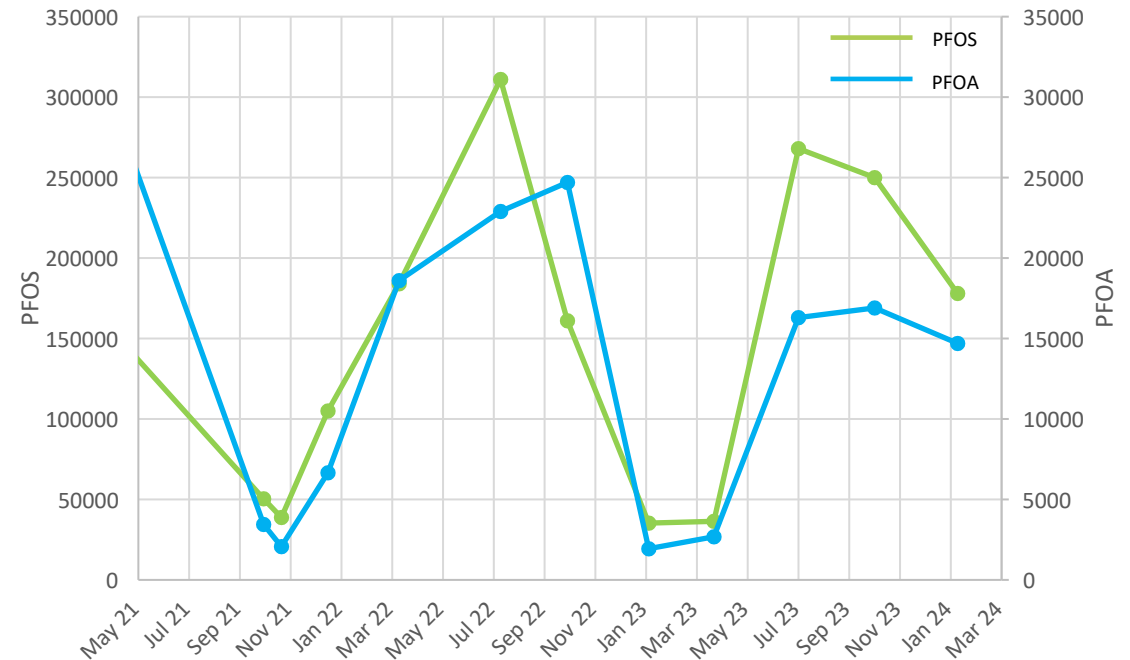
- Highest PFAS (550 ppb Total PFAS)
- In-barrier reduced ~100%, maintained 2 yrs
- Downgradient well significantly fluctuates, likely due to seasonal infiltration and leaching of PFAS source mass in the vadose zone downgradient of barrier



FTA-MW-07 (In-Barrier well)



FTA-MW-26 (54 ft downgradient)

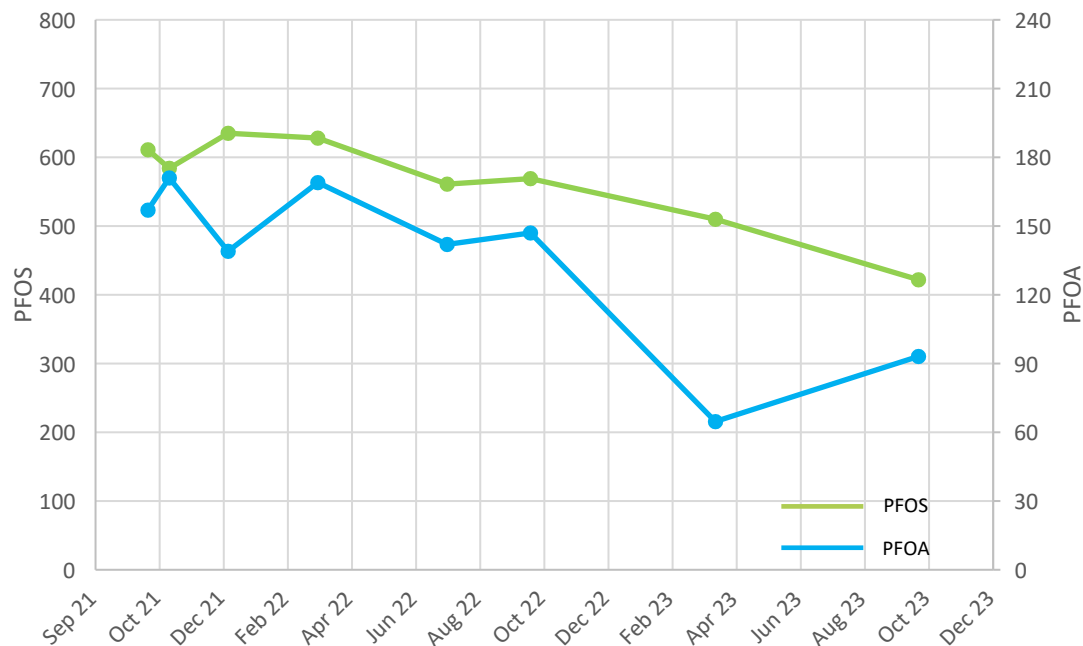


Slow/Limited Response Due to DRO

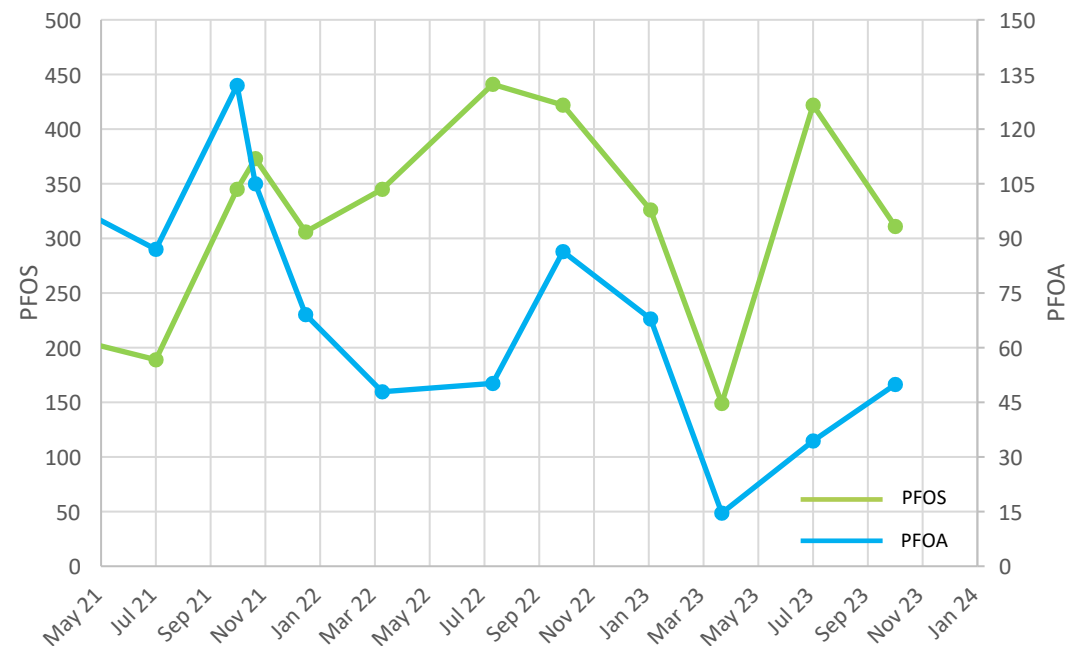
- PFAS concentrations are significantly lower
- DRO (7 ppm) has been reduced 97%
- Presence of DRO may affect PFAS sorption
- May see limited PFAS reductions, but not as much risk



FTA-PZ-E1

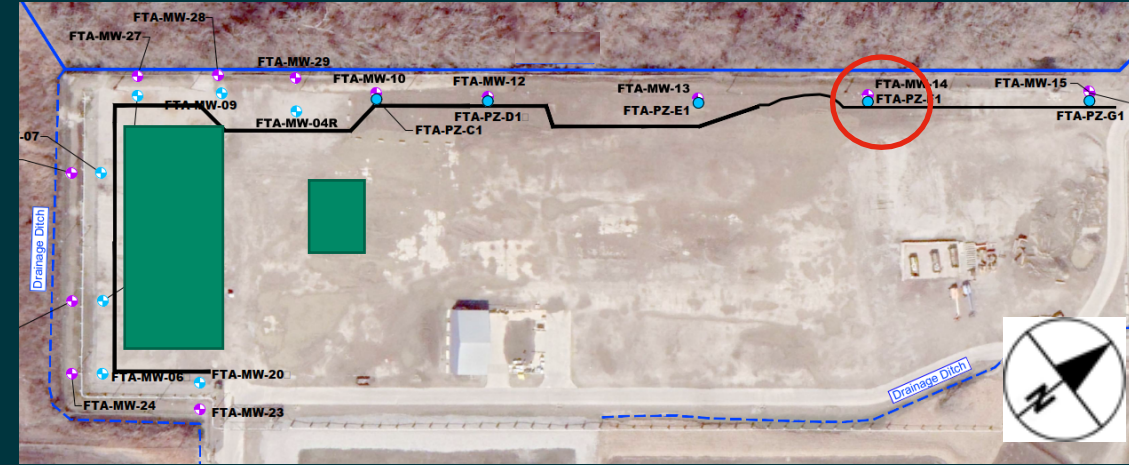


FTA-MW-13 (27 ft downgradient)

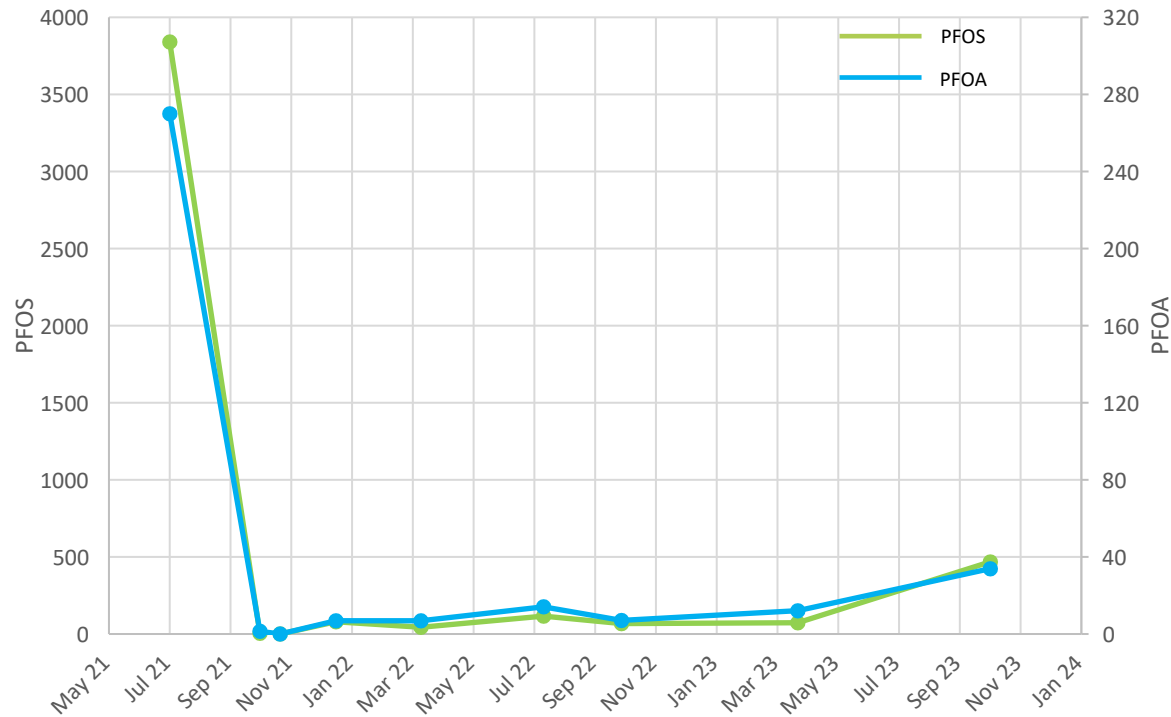


Area Performing Well

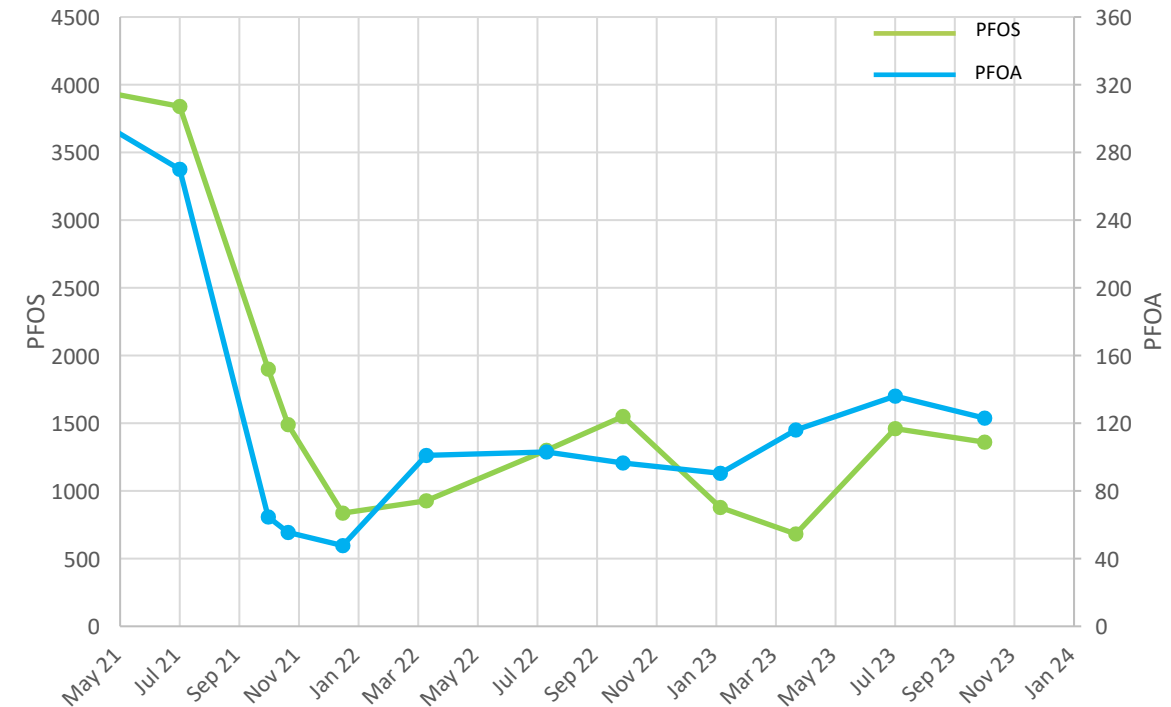
- In-Barrier well 99% reduction; slight uptick at 2 yr
- Downgradient well 80% reduction
- This area of barrier doing well; away from source
- Uptick does not appear to be breakthrough – all PFAS increased



FTA-PZ-F1



FTA-MW-14 (18 ft Downgradient)

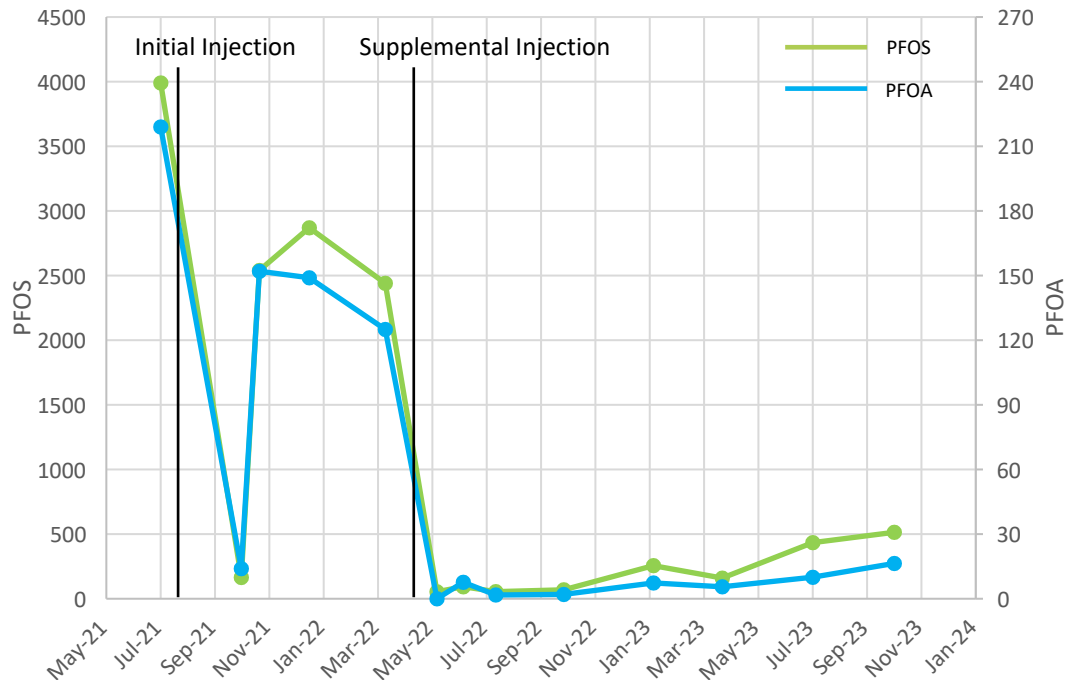


Area Performing Well After Supplemental Injection

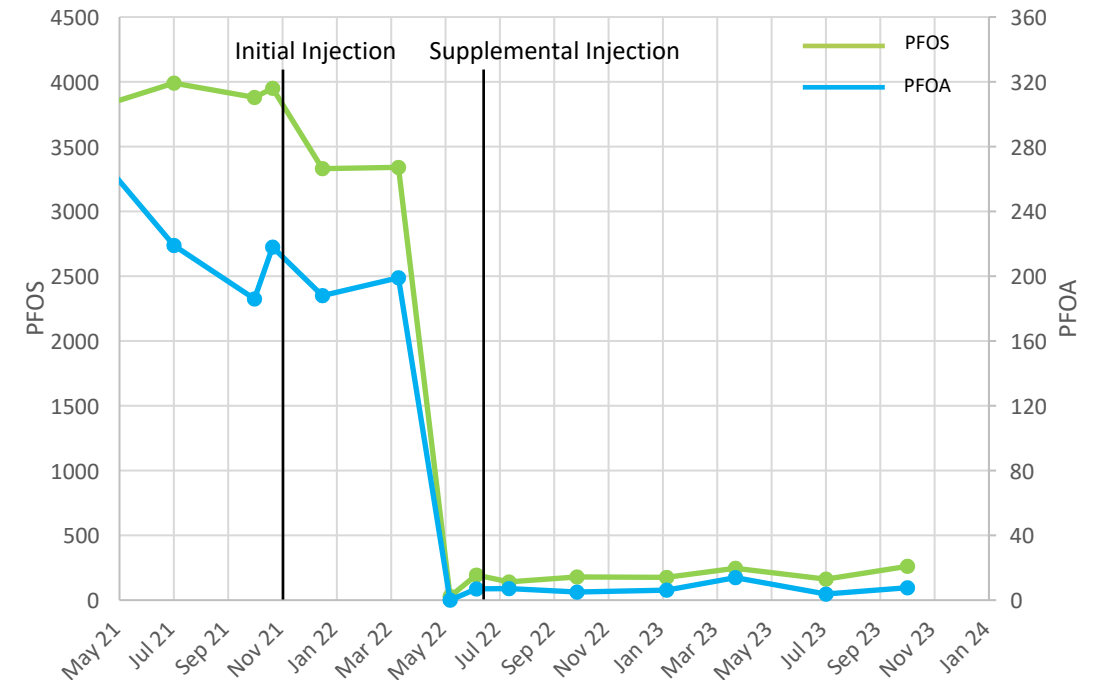
- Supplemental injection performed in April 2022 using top-down approach rather than bottom-up
- In-Barrier well 99% reduction; slight uptick at 2 yr
- Downgradient well 96% reduction
- This area of barrier doing well; away from source



FTA-PZ-G2 (In-Barrier Well)



FTA-MW-16 (17 ft downgradient)



Results Summary

- Based on 2 years 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
 - Presence of residual PFAS **mass already downgradient** of the barrier
- Downgradient wells located in areas away from historical source areas are **performing best**
- 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

Lessons Learned Summary

- **Co-contaminants compete** with PFAS for sorption sites on the carbon. If co-contaminant demand is affecting your ability to meet your treatment objective, supplemental injections may be needed.
- If early results are not as expected, **revisit lithology and PlumeStop distribution** (including collection of additional cores). May need supplemental injections if there are gaps in distribution or installation of new monitoring wells if not screened appropriately.
- PlumeStop barrier is performing best away from source areas, which is **more typical** for PlumeStop applications.
- Increased concentrations of PlumeStop have been effective at addressing high PFAS concentrations for at least 2 years. Could be applicable to **source area control** objectives.
- While challenging, we learned that it is feasible to design and implement a **rapid** full-scale PlumeStop barrier installation that is successful at **significantly reducing** PFAS migration towards a receptor.

THANK YOU!

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