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In Situ Soil Stabilization to Mitigate PFAS Transport via Stormwater at an AFFF Source Area

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Agenda

1. Grant Overview
2. Pre-Pilot Characterization and Results
3. Treatability Study and Results
4. Proposed Pilot Testing Approach
5. Conclusions and Next Steps

GRANT CONSORTIUM

■ Gerald R. Ford International Airport Authority (GFIAA)

- Casey Ries, P.E. - Project Director
- Michelle Baker - Project Manager

■ CDM Smith

- Jill Greene, P.G., PMP - Project Manager
- Jeff Bamer, P.E. - Project Technical Lead
- Chris Gurr, P.E. – Task Lead Conceptual Site Model/Fate and Transport
- Dung (Zoom) Nguyen – Task Lead Feasibility Study

■ LimnoTech

- Scott Bell, P.E. - Project Manager
- Chris Cieciek - Task Lead Fieldwork

■ Michigan State University

- Cheryl Murphy, Ph.D. - Task Lead Modeling
- A. Pouyan Nejadhashemi, Ph.D.
- Vahid Rafiei, Ph.D.

■ Office of Aeronautics, Michigan Department of Transportation

- Brian Budds. C.M., – State of Michigan Airport Liaison

■ American Association of Airport Executives

- Justin Barkowski – Aviation Industry Liaison



AMERICAN ASSOCIATION
OF AIRPORT EXECUTIVES

Project Approach

■ Can novel in situ adsorbents reduce or mitigate PFAS impacts on water quality?

- RemBind®
- FLUORO-SORB®

Reduction in PFAS Leachability over 16 Months

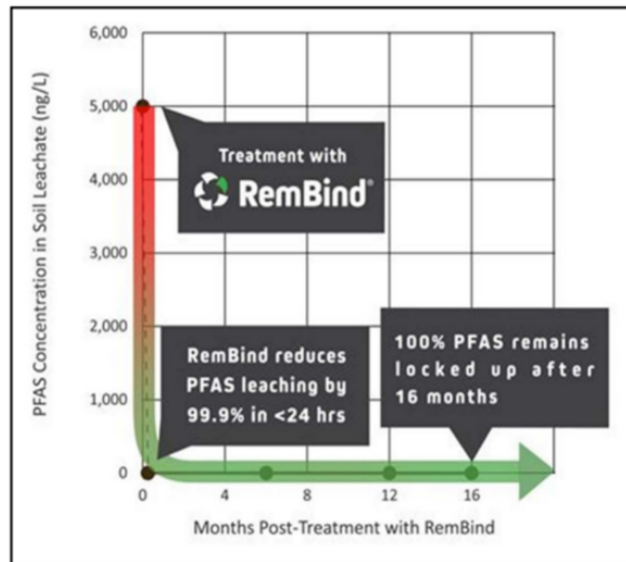
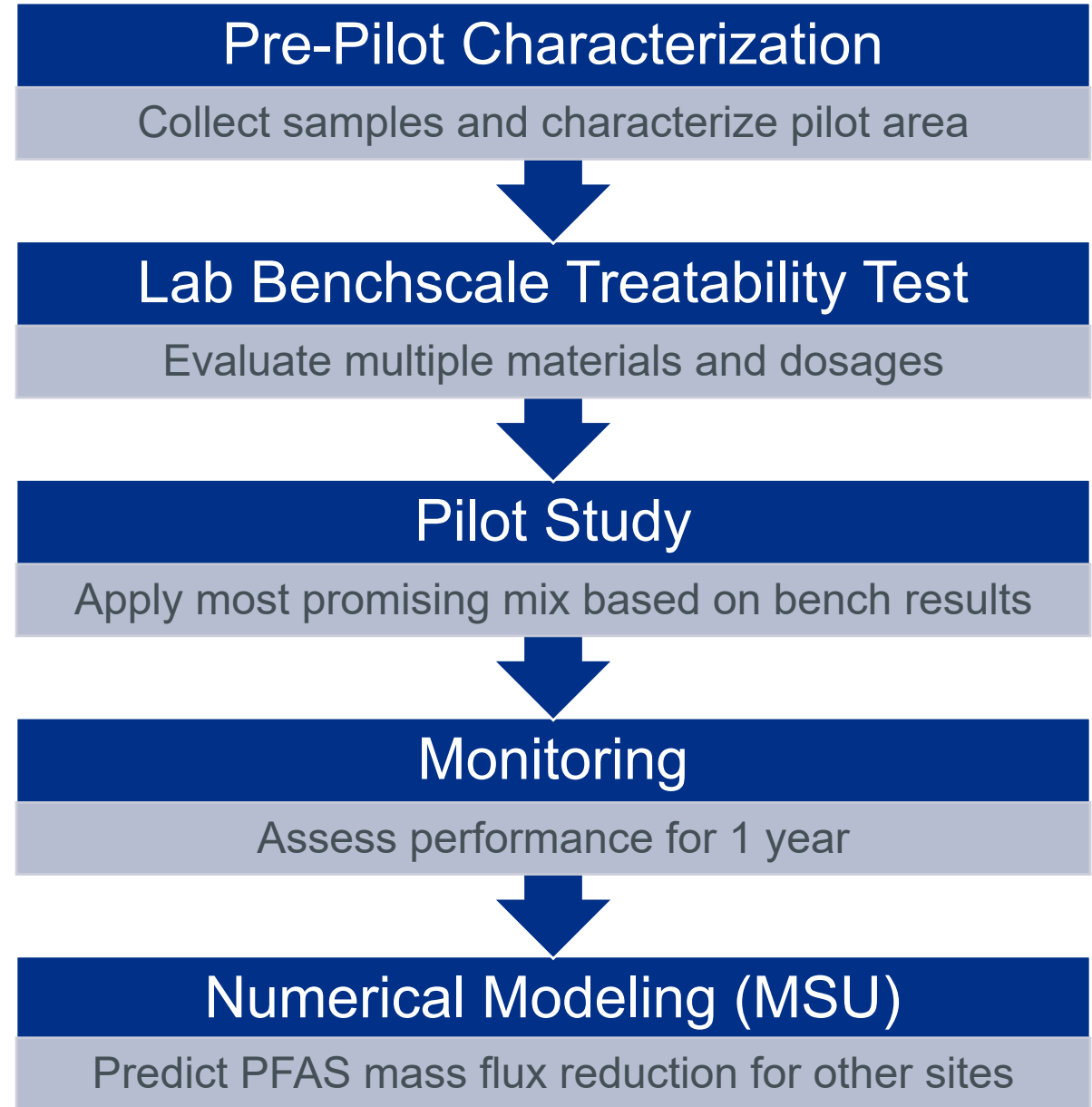
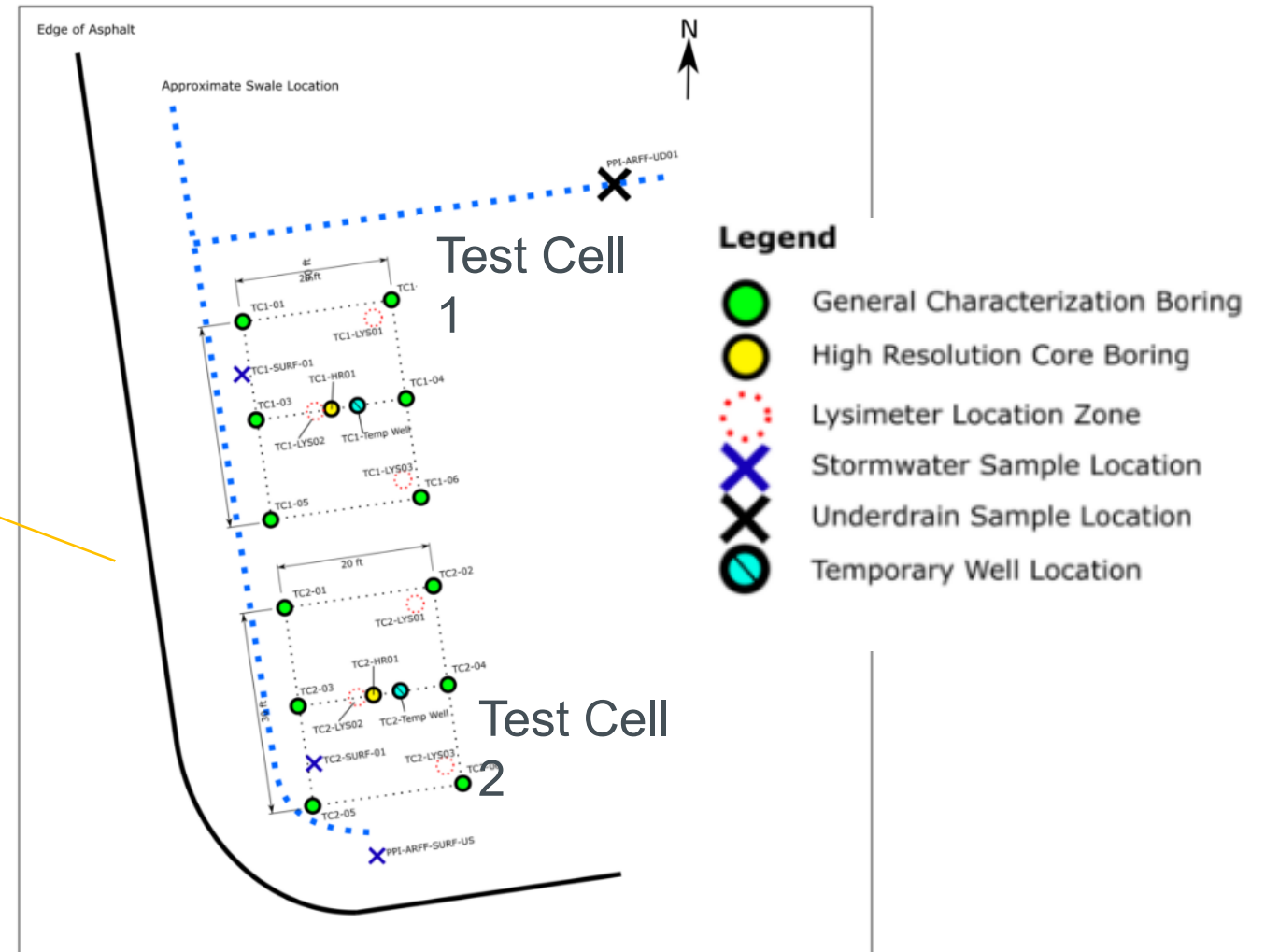
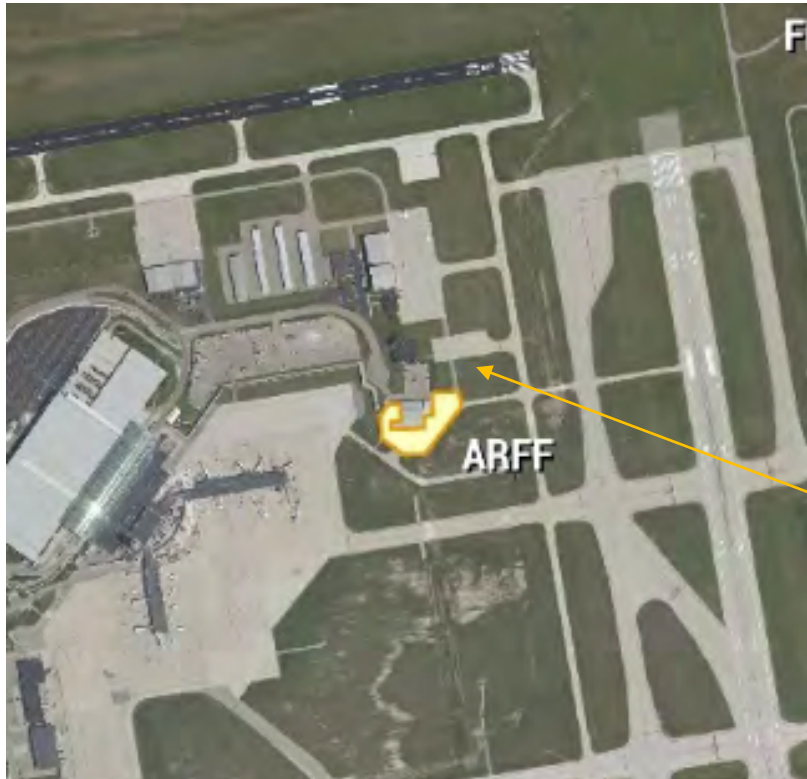


Exhibit 2. Performance Data from a US field trial of RemBind®

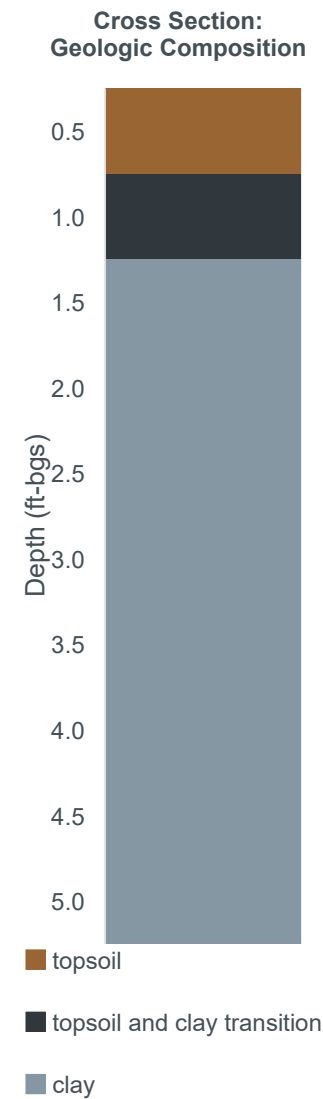
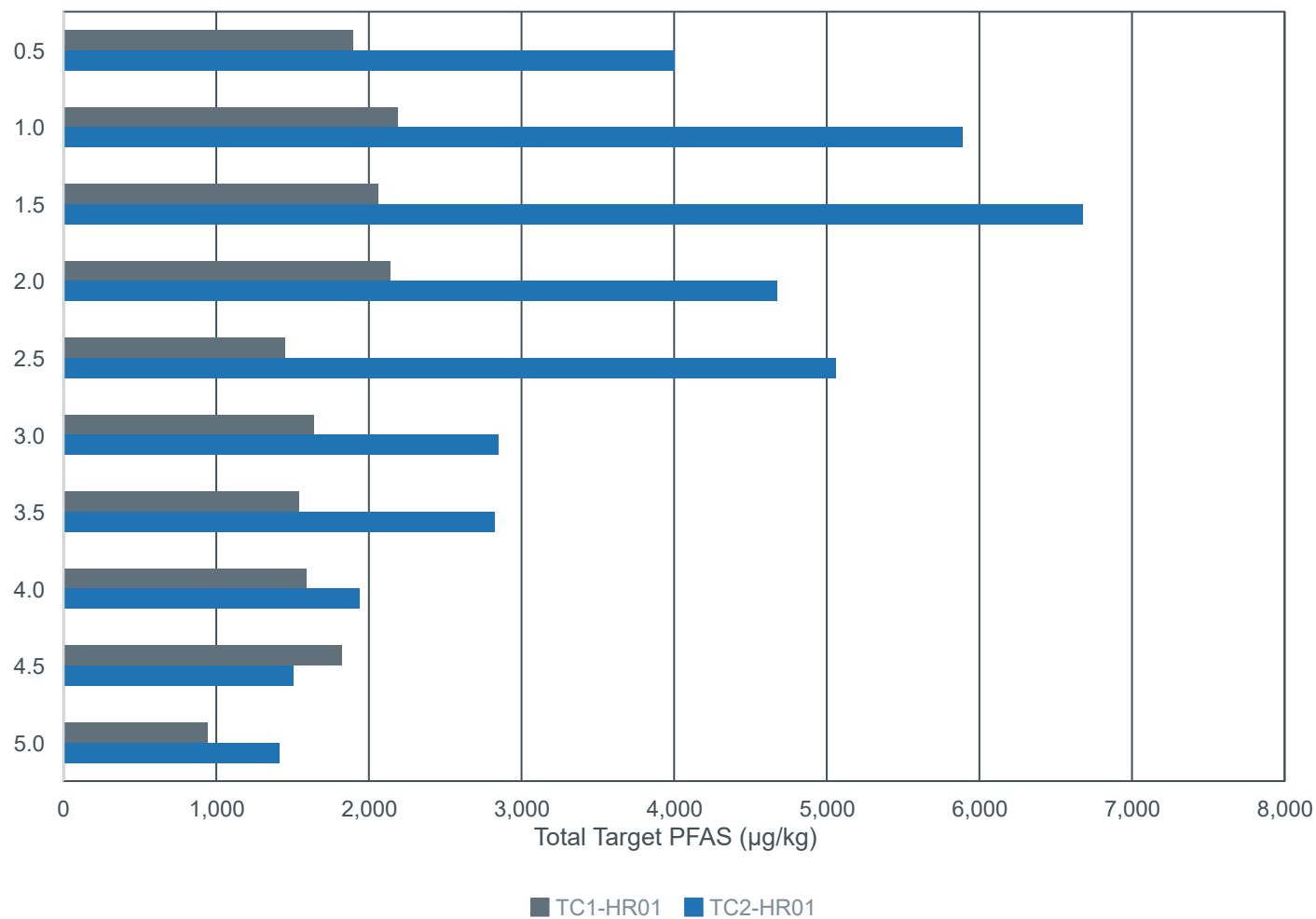


Overview Map

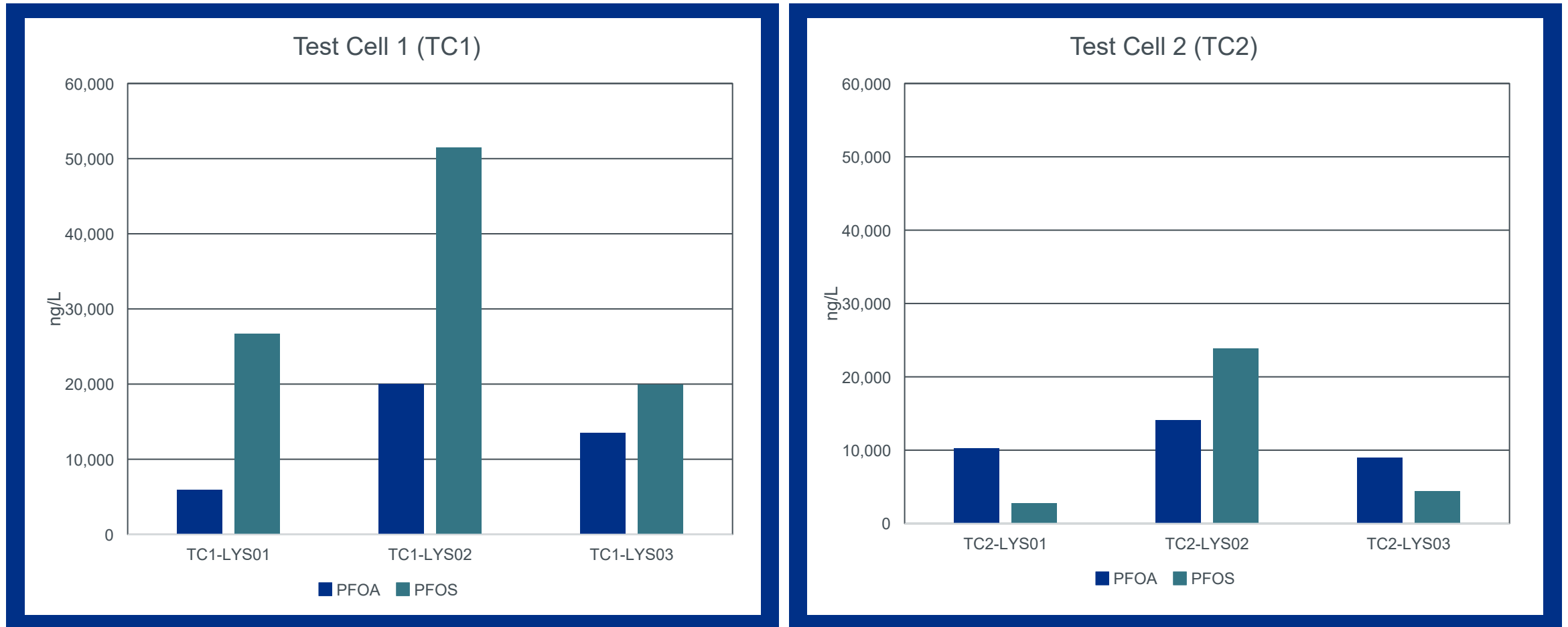


- Water table is very deep and overlain by thick clay
- Only shallow soil, porewater, and stormwater were investigated

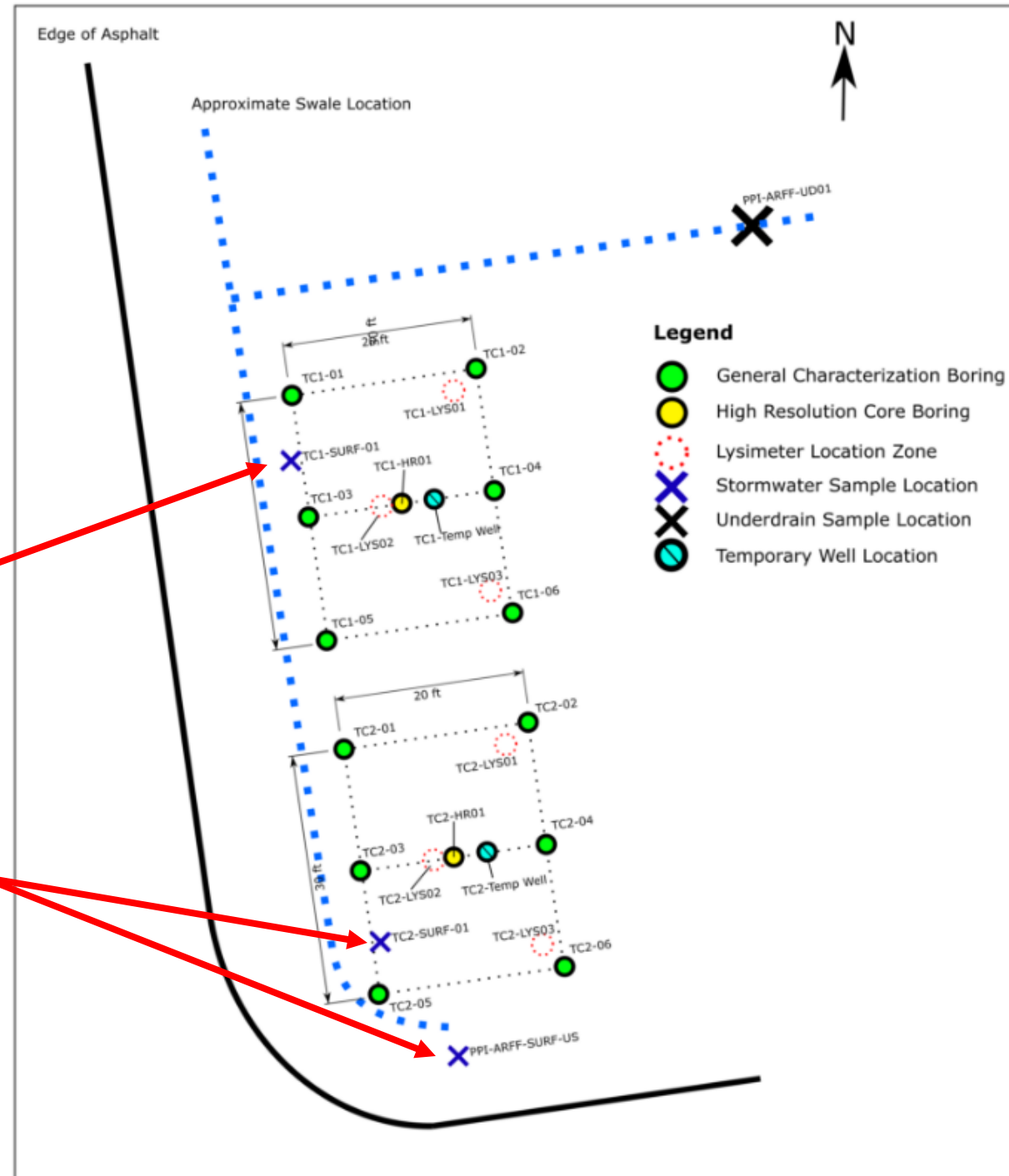
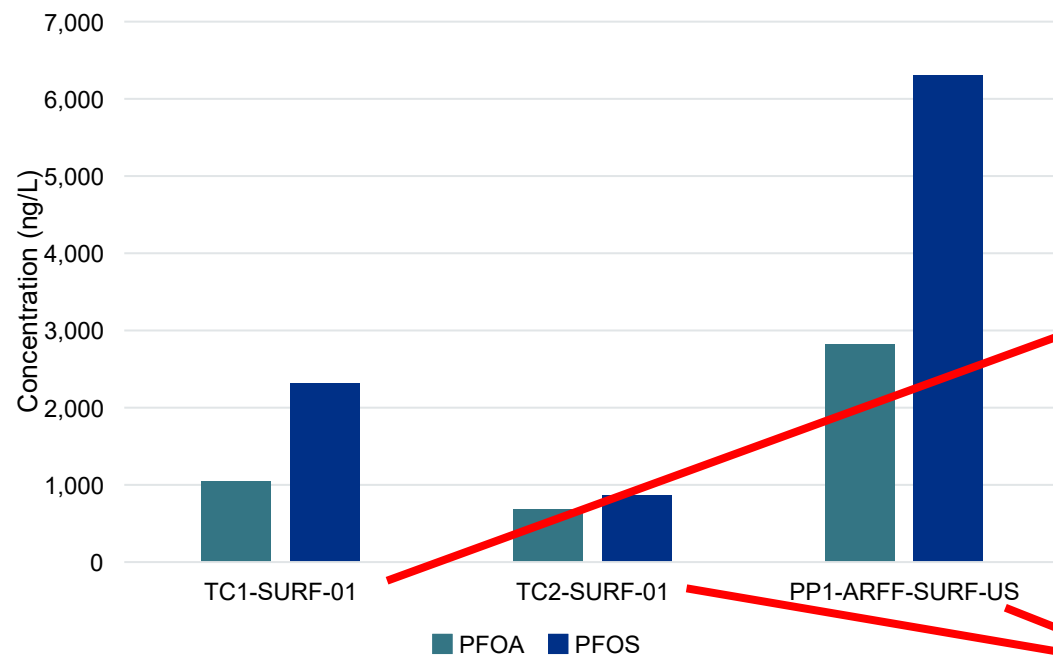
High Resolution Cores: Total Target PFAS in Soil with Depth



Soil Porewater: PFOS and PFOA



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Conceptual Site Model

■ Geology

- Thin topsoil (~0.5 ft bgs or less) overlaying very thick clay

■ Stormwater Hydraulics

- Higher hydraulic conductivity in topsoil (if present)
- Low hydraulic conductivity in the clay layer

■ PFAS Transport

- Stormwater can leach PFAS from **topsoil** and carry it to storm drains – “**PFAS migration**”
- Partitioning of PFAS to the solid phase and the air-water interface is very significant in **clay** – “**PFAS retention**”

PFAS migration

PFAS retention



Experimental Objectives & Design

Objectives:

- Compare the effectiveness of soil amendments in sequestering PFAS:
 - For different soil mixtures (100/0, 50/50, 0/100 topsoil/clay)
 - For different amendments (RemBind vs. FluoroSorb 200)
 - Under wetting and drying cycles
 - As a function of amendment dosage used (1%, 5%, 10%)
- Evaluate adverse impacts on the surface water quality

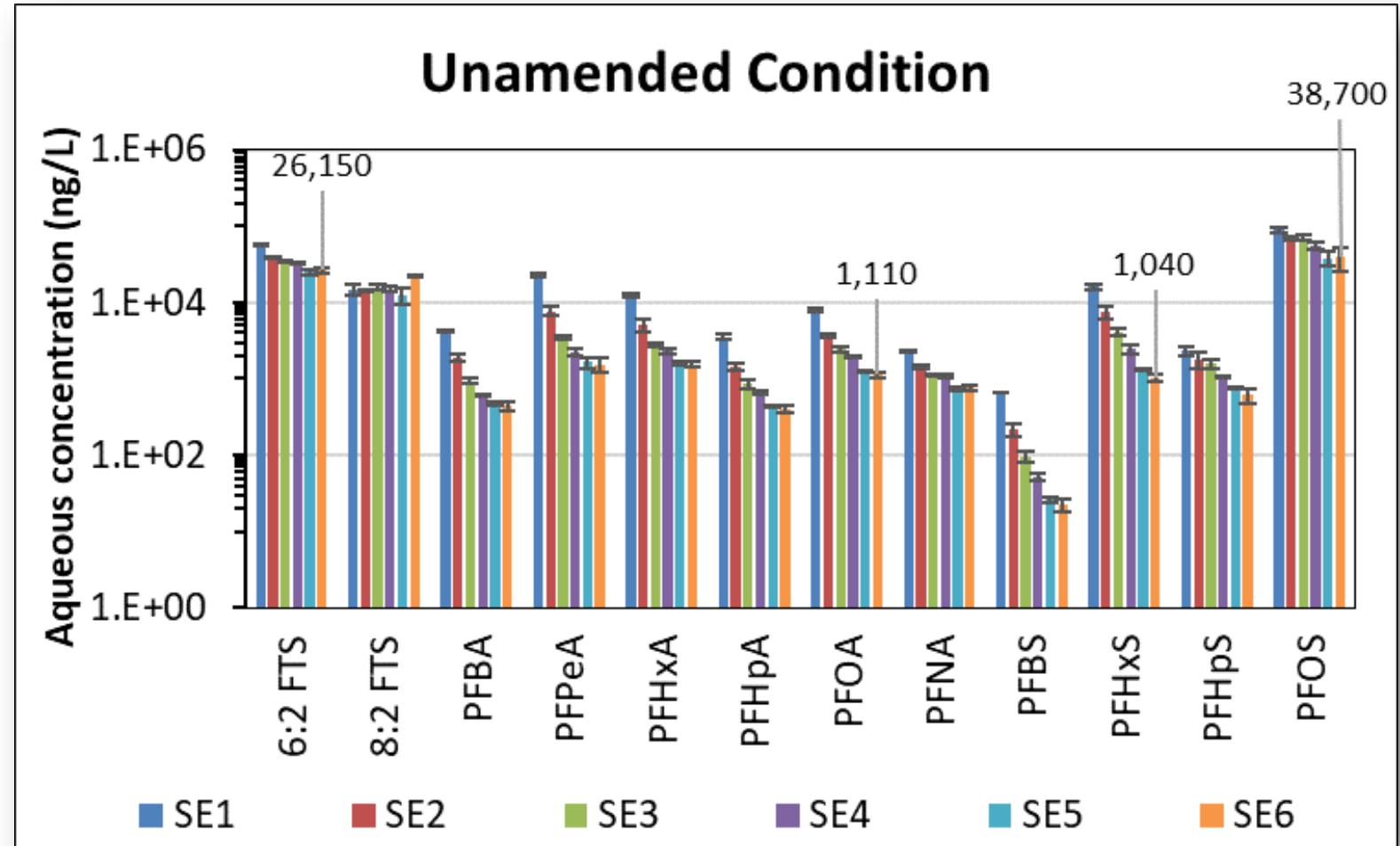
Experimental design:

- Simple batch experiments
- PFAS-"free" rainwater
- Serial dilution approach
- Simulated wetting & drying cycles (6 times)



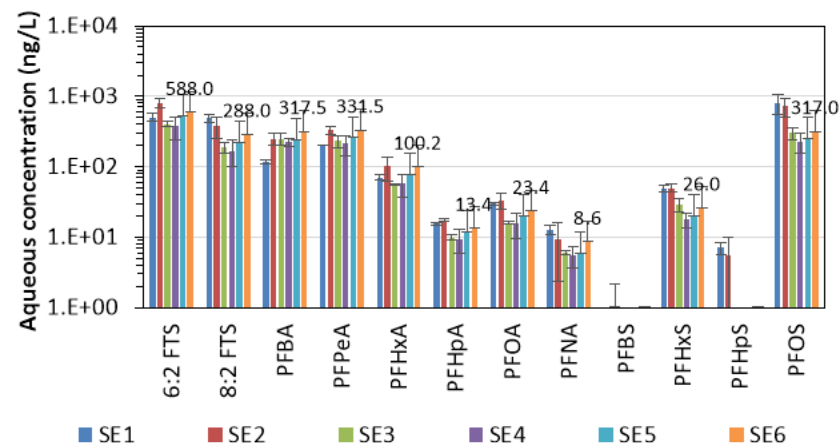
Unamended Soil

- Significant PFAS release in aqueous phase from unamended soil
- Expected reduction in release with successive rain events
- Expected relative differences between short and long chain PFAAs

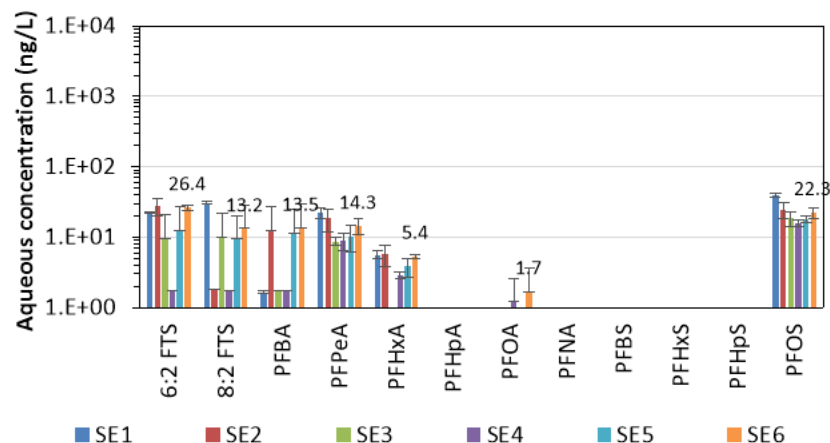


Notable Results (50/50 Mix)

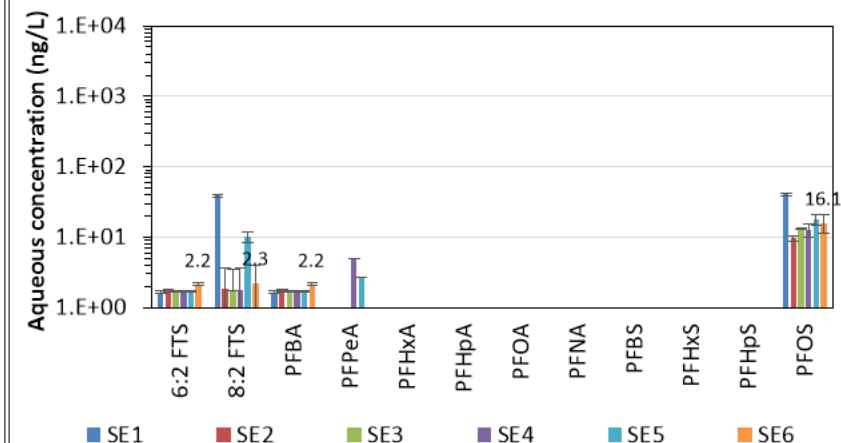
RemBind (1%)



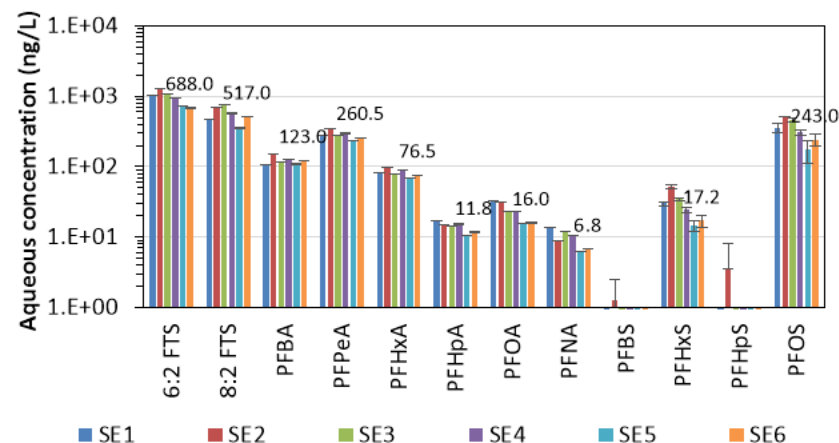
RemBind (5%)



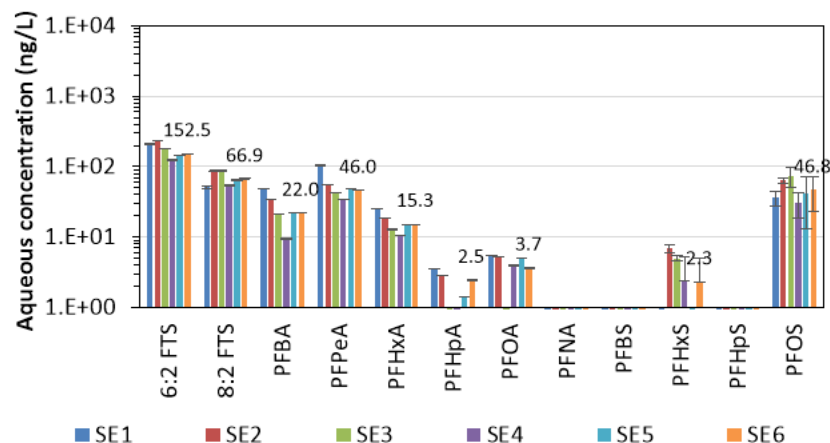
RemBind (10%)



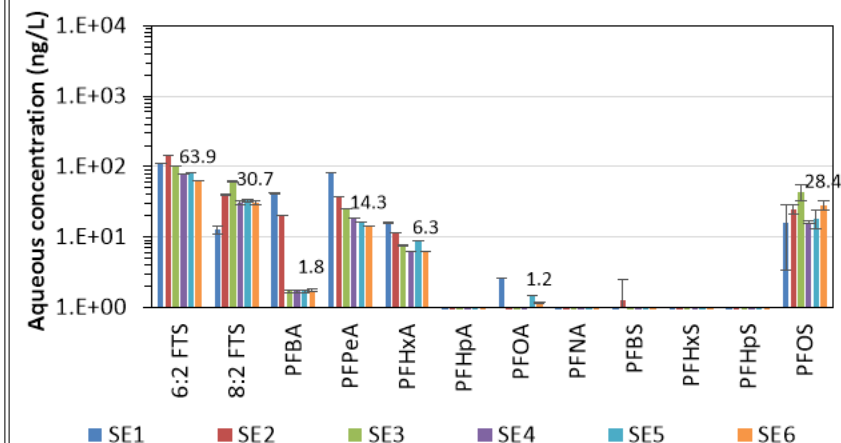
FluoroSorb (1%)



FluoroSorb (5%)



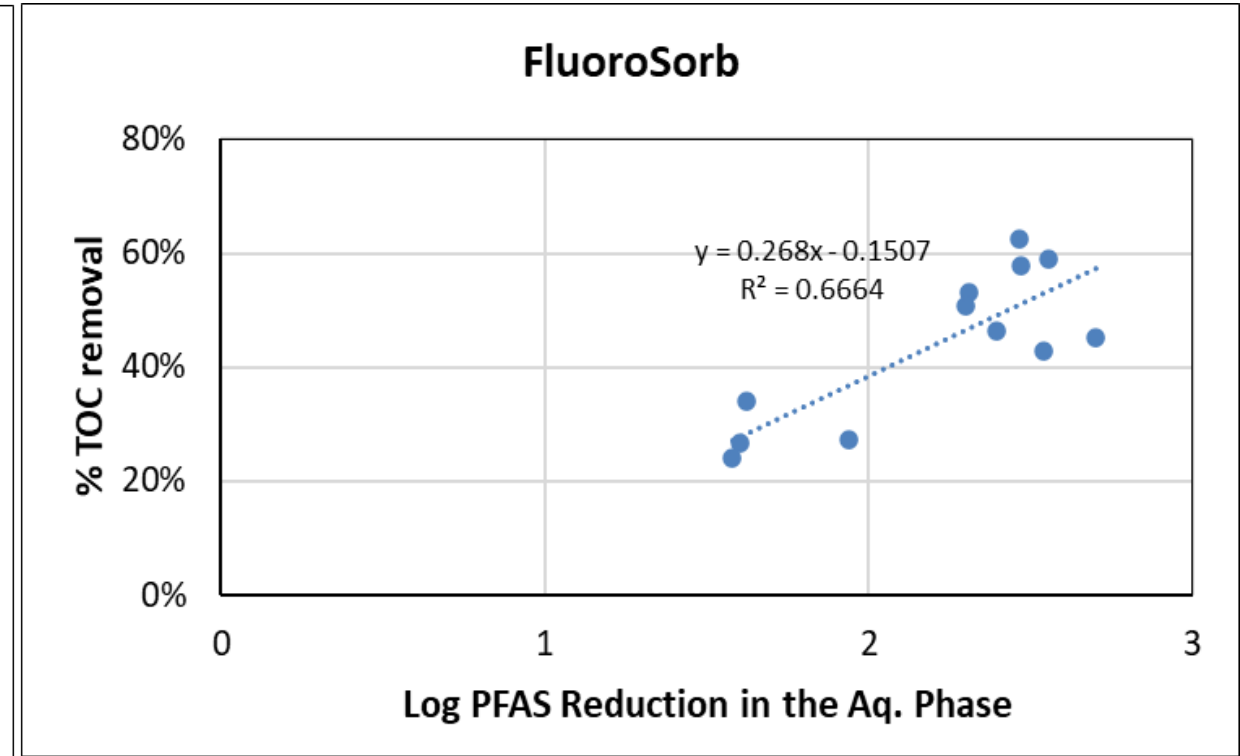
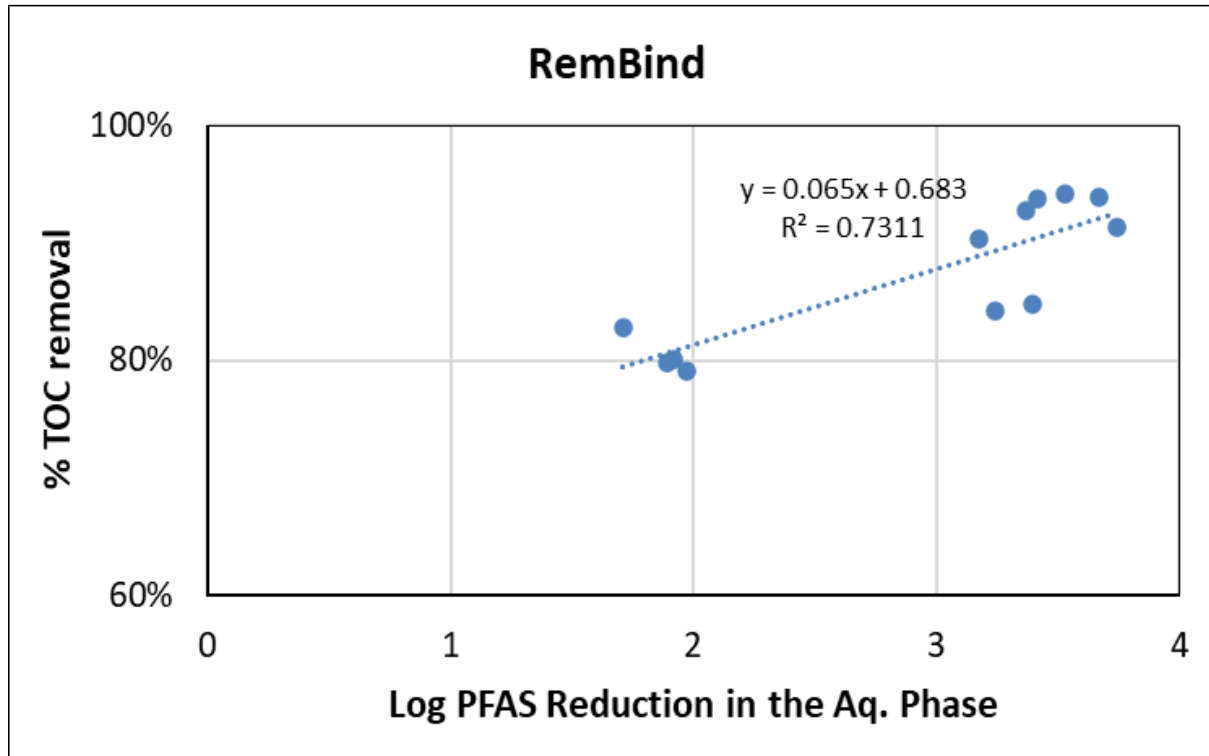
FluoroSorb (10%)



Increased PFAS sequestration with amendment dosages

No unintended consequences because of treatment

PFAS – TOC Correlations



Expected correlation between PFAS and TOC removal

Conceptual Pilot Study Strategy

Pilot objective

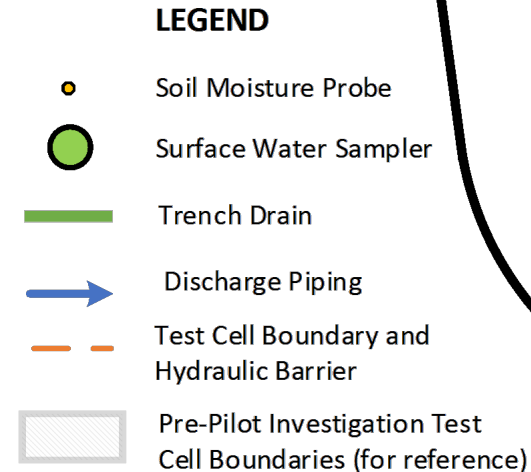
- Mitigate PFAS leaching from test cell soils to stormwater

Conceptual site model basis

- Target topsoil and shallow clay where migration occurs

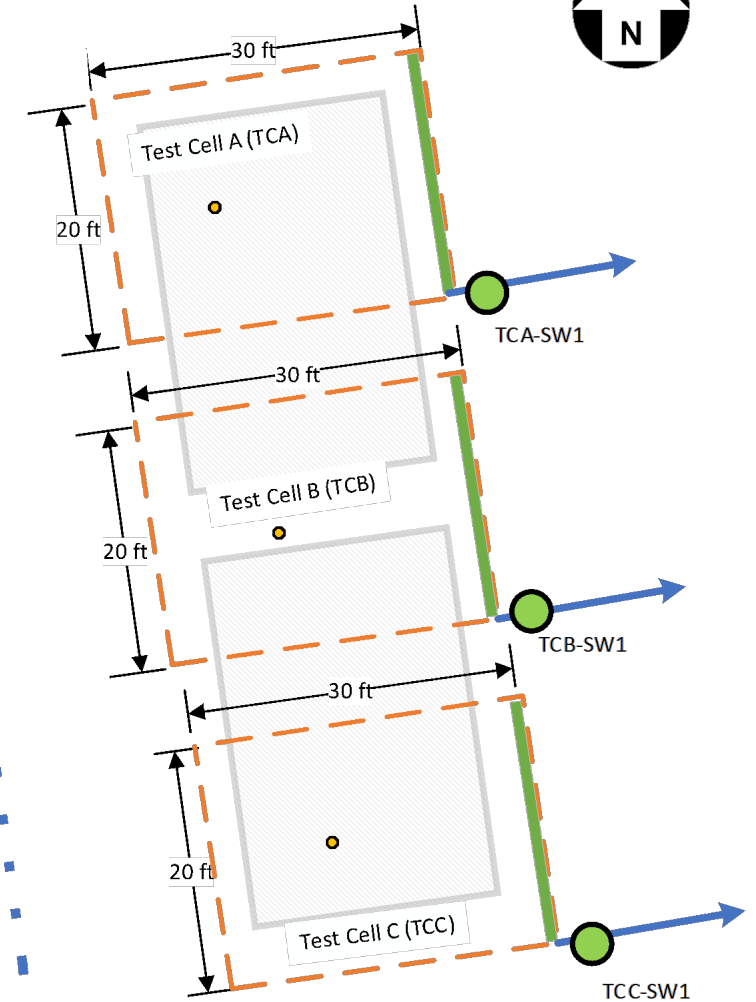
Conceptual approach (TBD)

- Mix RemBind at 2.5% into shallow soil to immobilize PFAS and mitigate PFAS migration
- Three test cells to assess sensitivity to mixing depth (0" control, 6", and 18")



Approximate
Swale Location

Edge of Asphalt

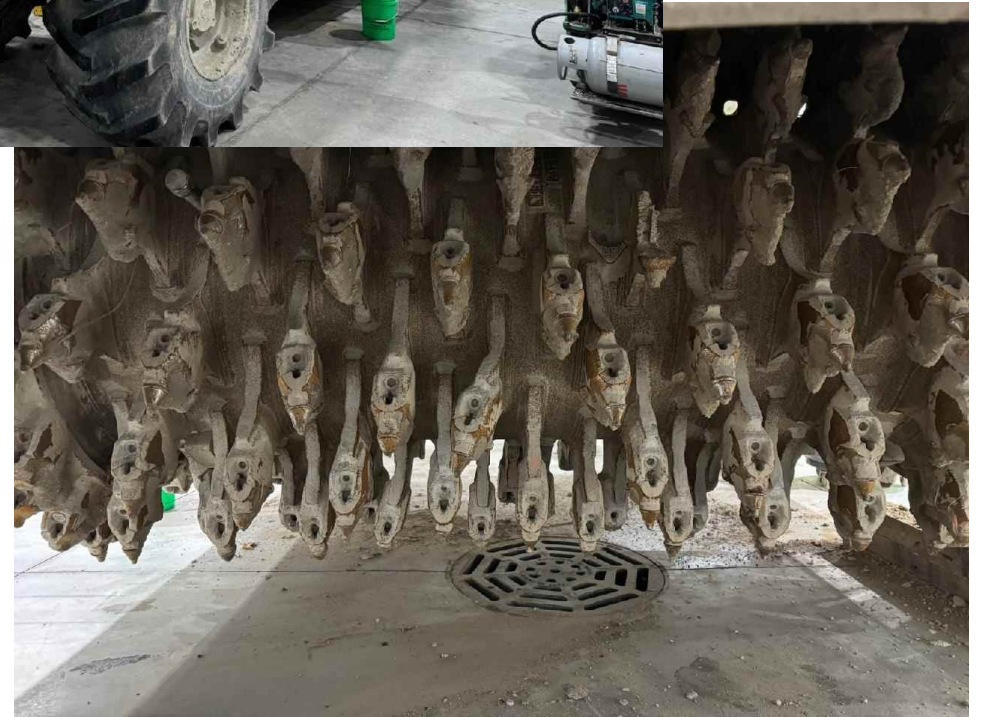


Mixing Equipment

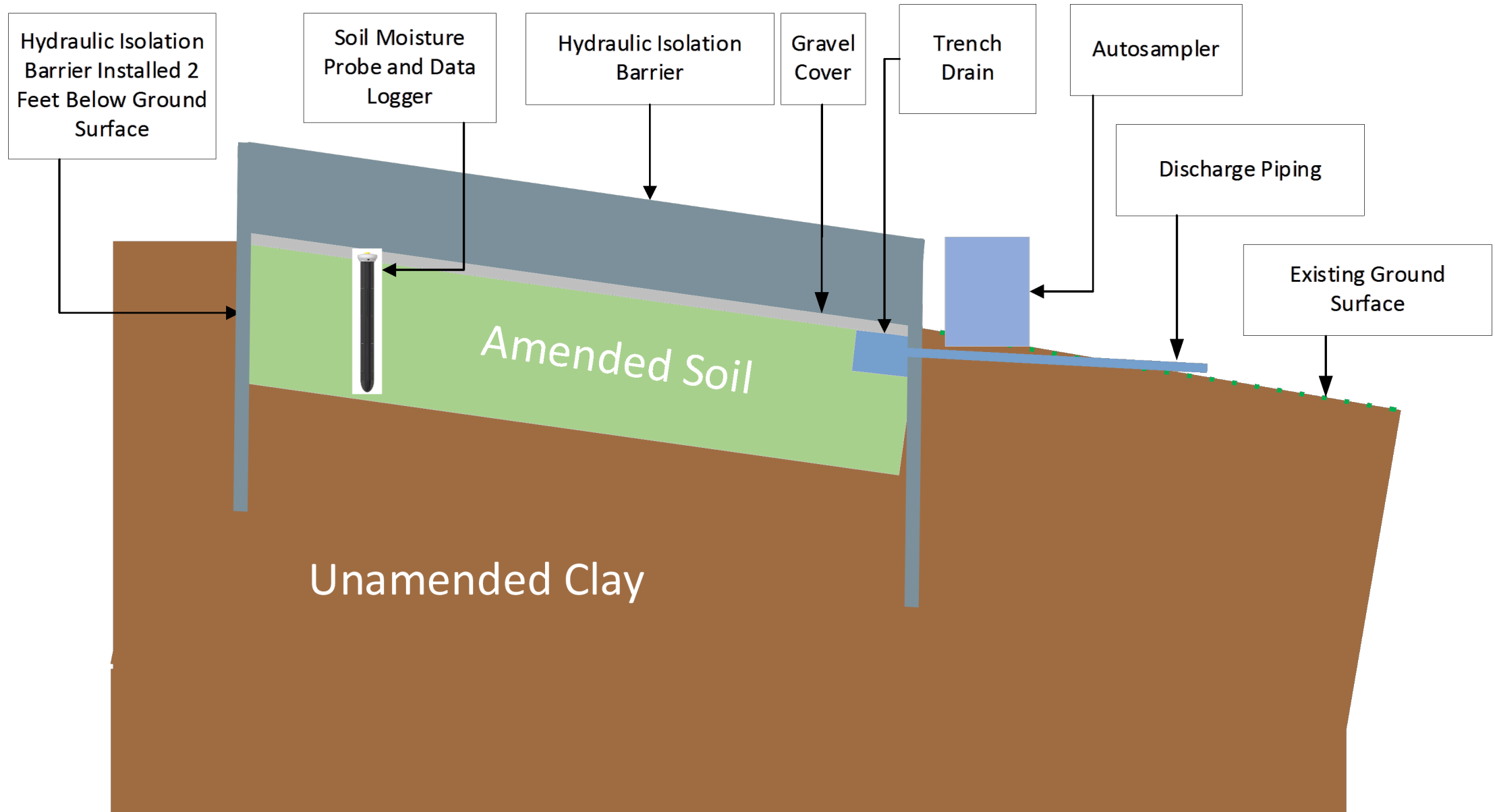
■ Surficial application of RemBind

■ Reclaimer will mix to depth

- Typically used for mixing of lime or fly ash into shallow soils for roads
- Pneumatic distribution of RemBind
- Shallow mixing
- Commonly used for clayey soils



Cell Configuration and Function



Pilot Testing Sequence and Monitoring

- **Baseline sampling before mixing (with barriers)**
- **Conduct mixing and reinstall barriers**
- **Monitor multiple storms**
 - Flow-paced storm composites
 - Some “first flush” grab samples
 - Flow measurement via weir and level transducer
 - Autosamplers
- **Analytes**
 - Target PFAS (Method 1633)
 - Total Organic Fluorine
 - Total Oxidizable Precursor Assay
 - Total Suspended Solids



Conclusions and Next Steps

Pre-Pilot Characterization

Provided data necessary to understand pre-treatment conditions

Confirmed ARFF suitability for pilot testing

Bench-Scale Studies

Identified optimal amendment and mixture

Provided a successful basis for pilot testing

Pilot Test Planning

Target: pilot implementation starting in June

Thank you!



To learn more, contact:

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