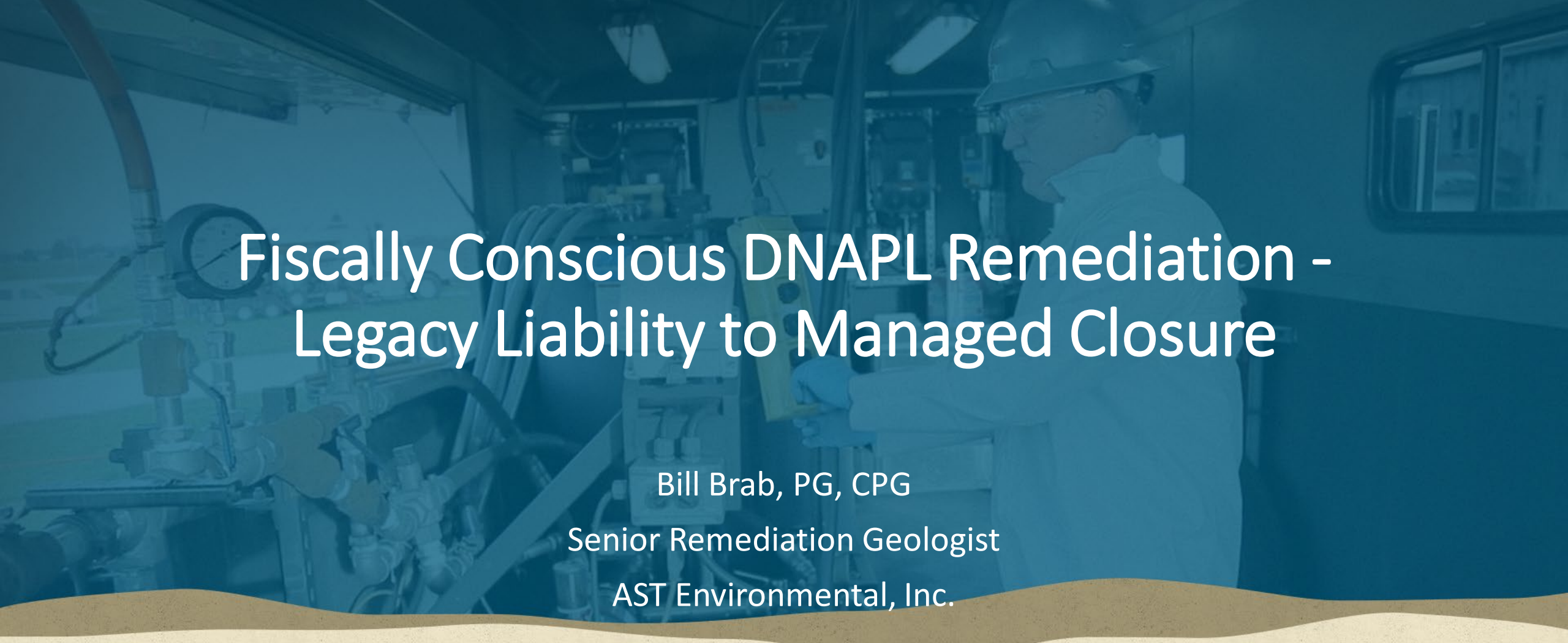


Fiscally Conscious DNAPL Remediation - Legacy Liability to Managed Closure

Bill Brab, PG, CPG

Senior Remediation Geologist

AST Environmental, Inc.

AST ENVIRONMENTAL, INC.

RPI GROUP

Site Background

- Former chemical plant in Western KY
- Multiple solvents:
  - Methylisolbutyl carbinol (MIBC)
  - Tetrachloroethene (PCE)
  - Hydrogen Peroxide
  - Acetone
  - Ethanol
  - Diesel Fuel

Remedial Objectives

1. Refine the existing CSM: accurately quantify total contaminant mass in soil and groundwater
2. Implement a multi-year remedial plan
3. Significant reductions = managed closure
4. Stop CVOCs from migrating onto off-site residential properties

Phased Remedial Approach

- Remedial Design Characterization: Data Gap Elimination (2011, 2012, & 2020), Soil Gas Survey (2012)
- Phase 1a: Off-Site BOS 100® Permeable Reactive Barrier (2013 and 2014)
- Phase 1b: Off-Site Shallow Soil Blending with ISCO (2013)
- Phase 2: CAT 100 Field Scale Pilot Study in Source (2016)
- Phase 3: CAT 100 PRB Extension (2018)
- Phase 4: CAT 100 1st Source Treatment Cell (2019)
- Phase 5: CAT 100 2nd Source Treatment Cell (2020)
- Phase 6: CAT 100 3rd Source Treatment Cells (2021)
- Optional Phase Future Consideration: Shallow Unsaturated Soil Blending with ISCO in Source

Original Projected Phases

Historical CSM

- Multiple releases
- Subsurface investigation began in 1991, CVOCs present
- PCE highest concentration and most widespread
- Combination of ex-situ and in-situ remediation methods selected

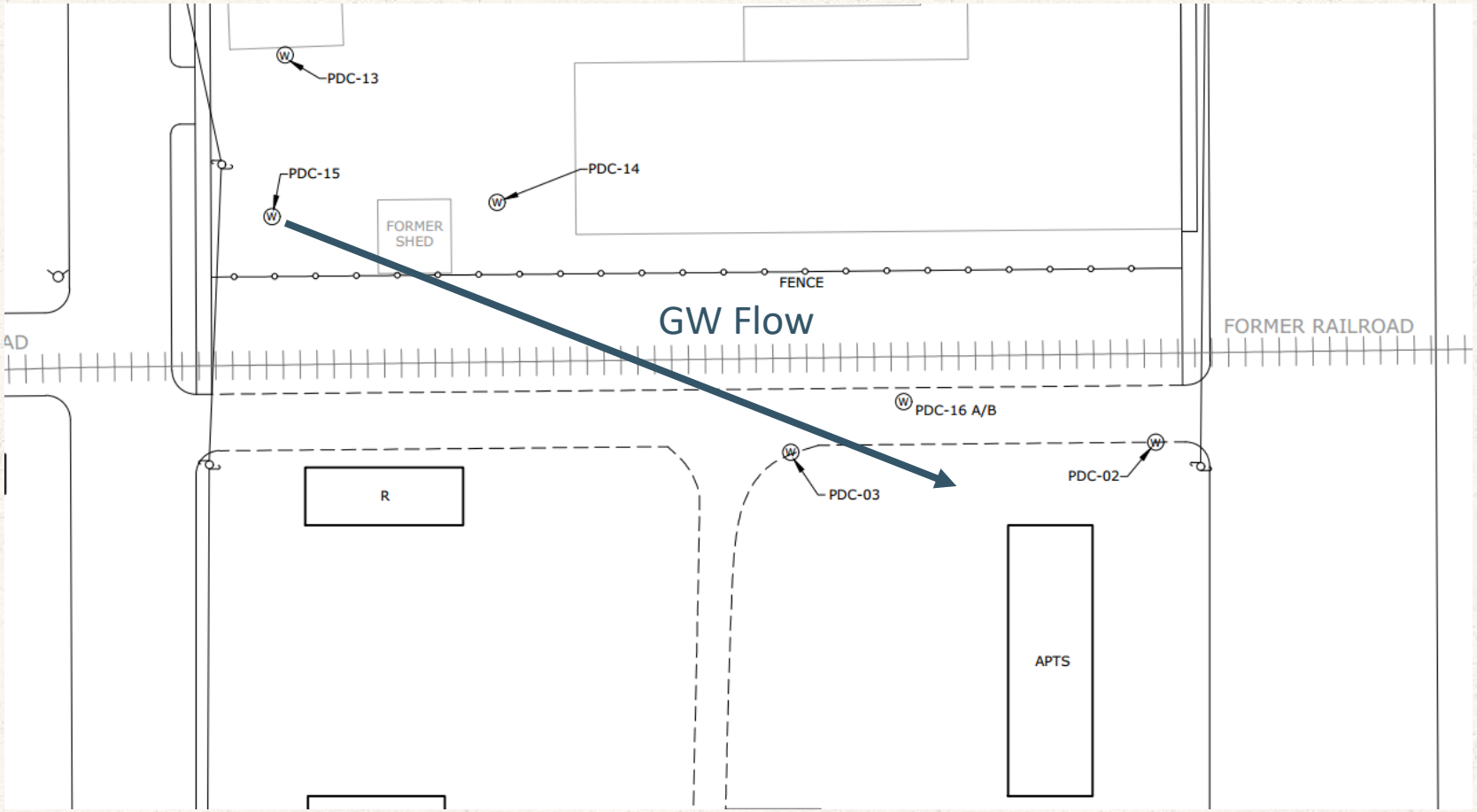
Historical CSM (cont.)

Source

- PCE 23,000 µg/L
- TCE 40,000 µg/L
- cis-DCE 258,000 µg/L
- VC 19,600 µg/L

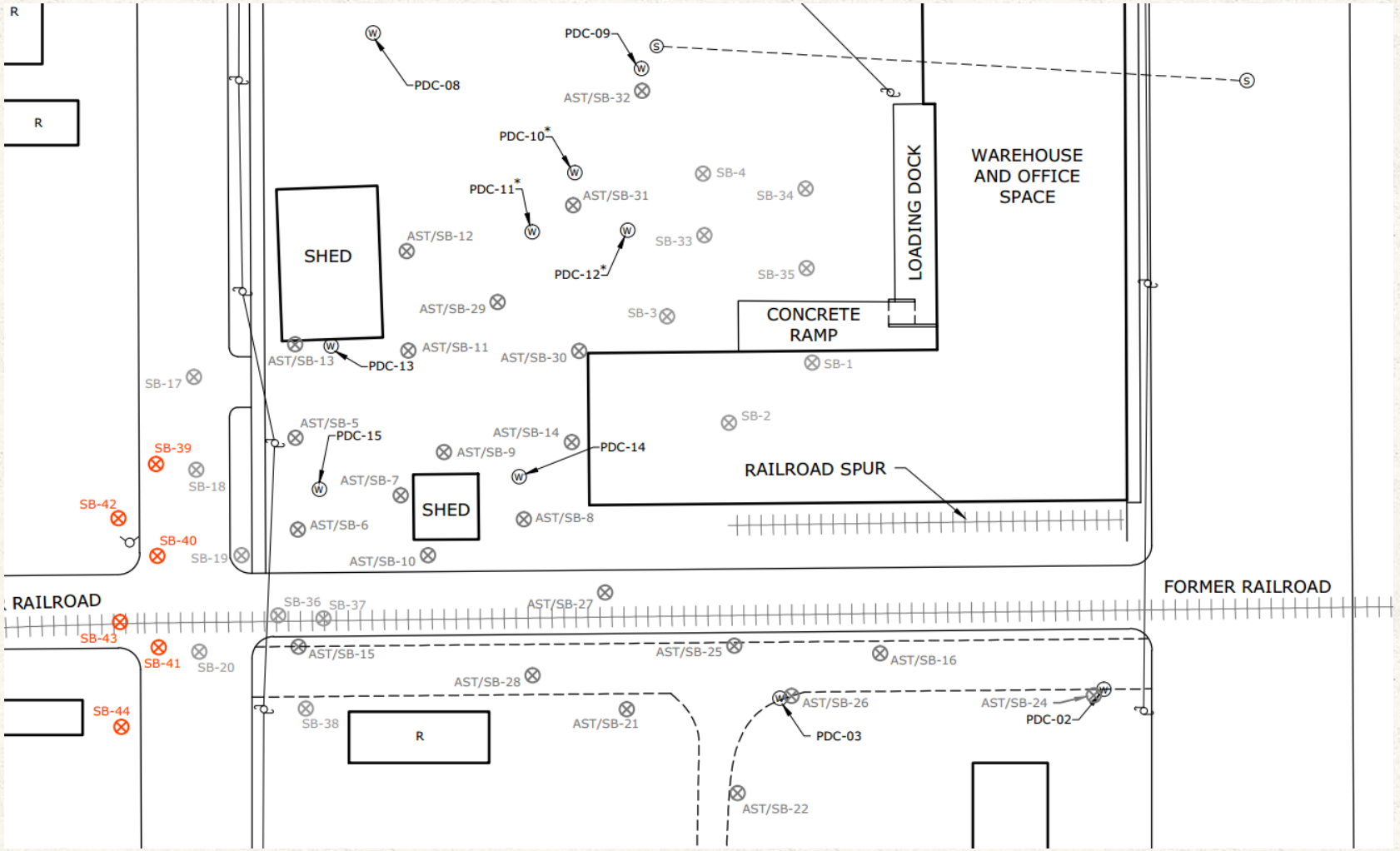
Distal Downgradient

- PCE 34,500 µg/L
- TCE 7,300 µg/L
- cis-DCE 3,630 µg/L



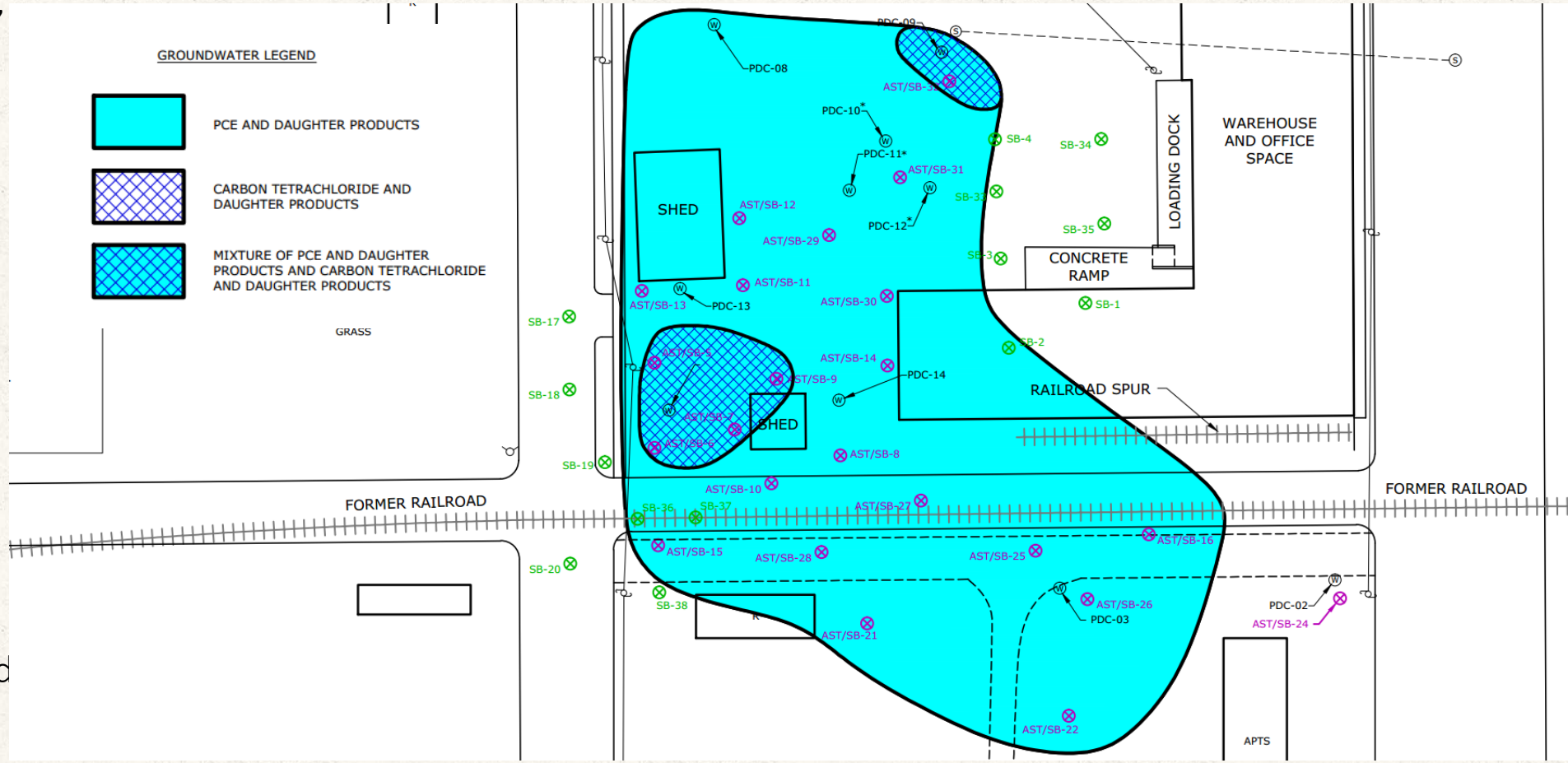
Initial Phase(s) 2011 thru 2013: Remedial Design Characterization (RDC)

- Forty-four (44) soil borings
- Nested wells at each soil boring location
  - Shallow and deep groundwater assessment
- Full monitoring network sampling



RDC Findings

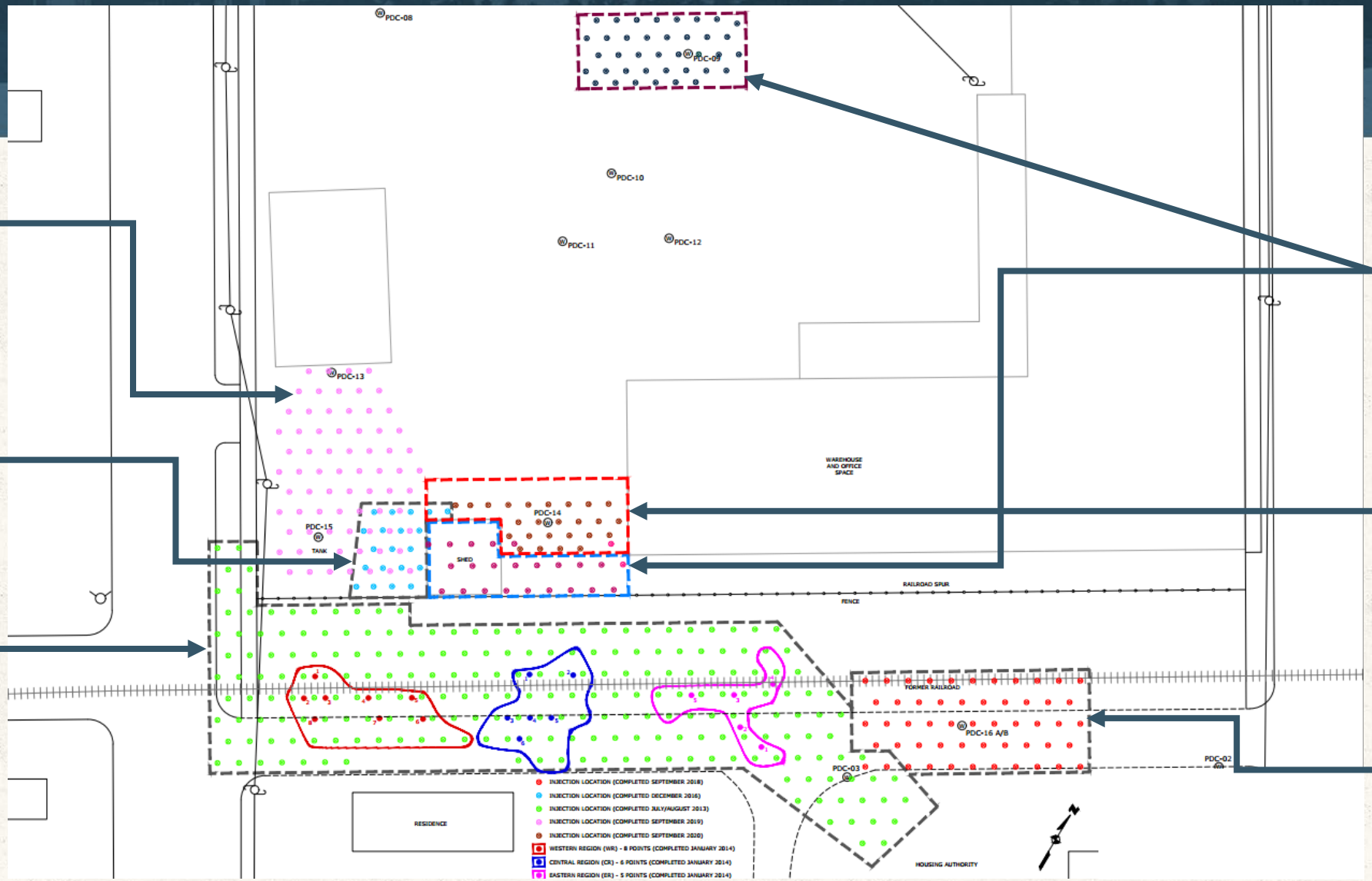
- Source/Saturated Soils (~20-40’ bgs)
  - PCE 2,700 mg/kg
  - TCE 40 mg/kg
  - cis-DCE 52 mg/kg
  - CT 42 mg/kg
  - MC 120 mg/kg
  - MIBK 220 mg/kg
- Geology: 0-40’ bgs low-permeability silts and clays, k = 1x10^{-7} cm/s
- 40’ -? Poorly sorted fine-grained sand, artesian groundwater



Phase 4: CAT 100 1st Source Treatment (2019)

Phase 2: CAT 100 Source Pilot Test (2016)

Phase 1: BOS 100 PRB and Shallow ISCO Soil Blend (2013/2014)



Phase 6: CAT 100 3rd Source Treatment (2021)

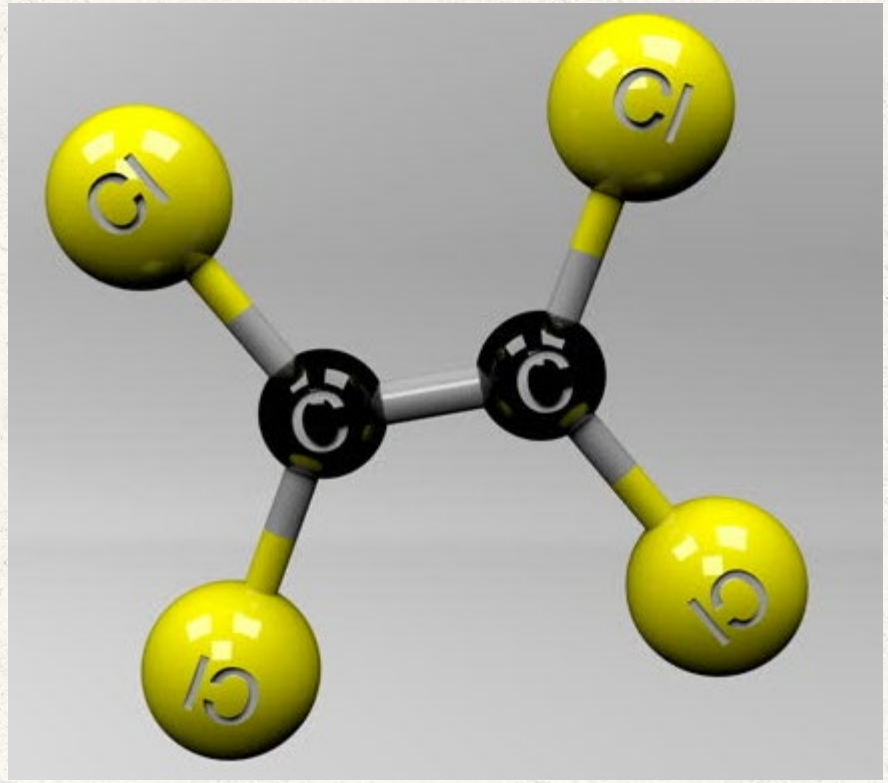
Phase 5: CAT 100 2nd Source Treatment (2020)

Phase 3: CAT 100 PRB Extension (2018)

Phase 1 Selected Technologies

BOS 100®

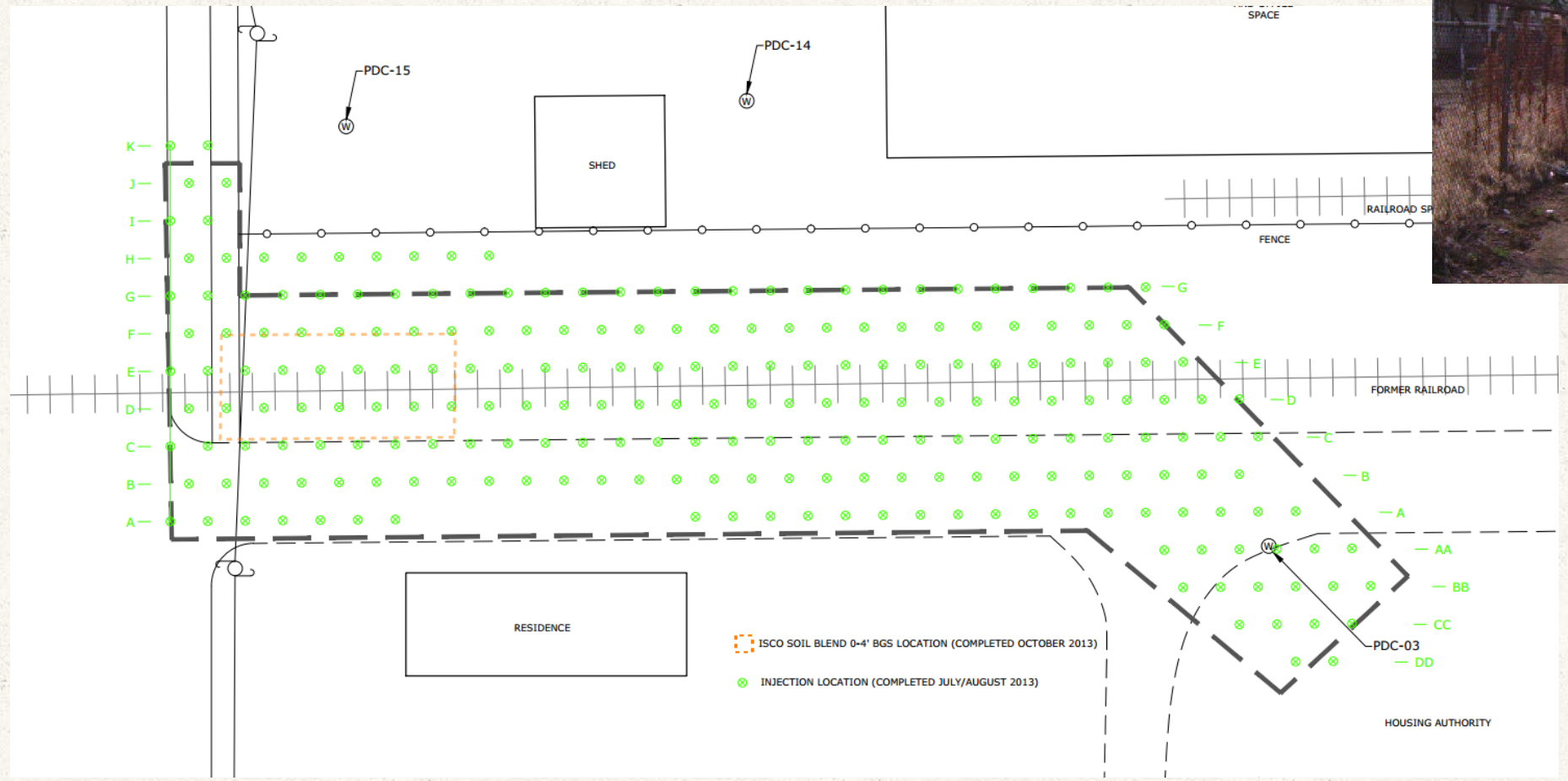
- Granular activated carbon impregnated with metallic iron
- Abiotic ß-Pathway Elimination
- Treatment of chlorinated solvents



Soil Blending

- Activated Persulfate

Phase 1: Off-Site PRB BOS 100® and Unsaturated Soil Blending (ISCO)

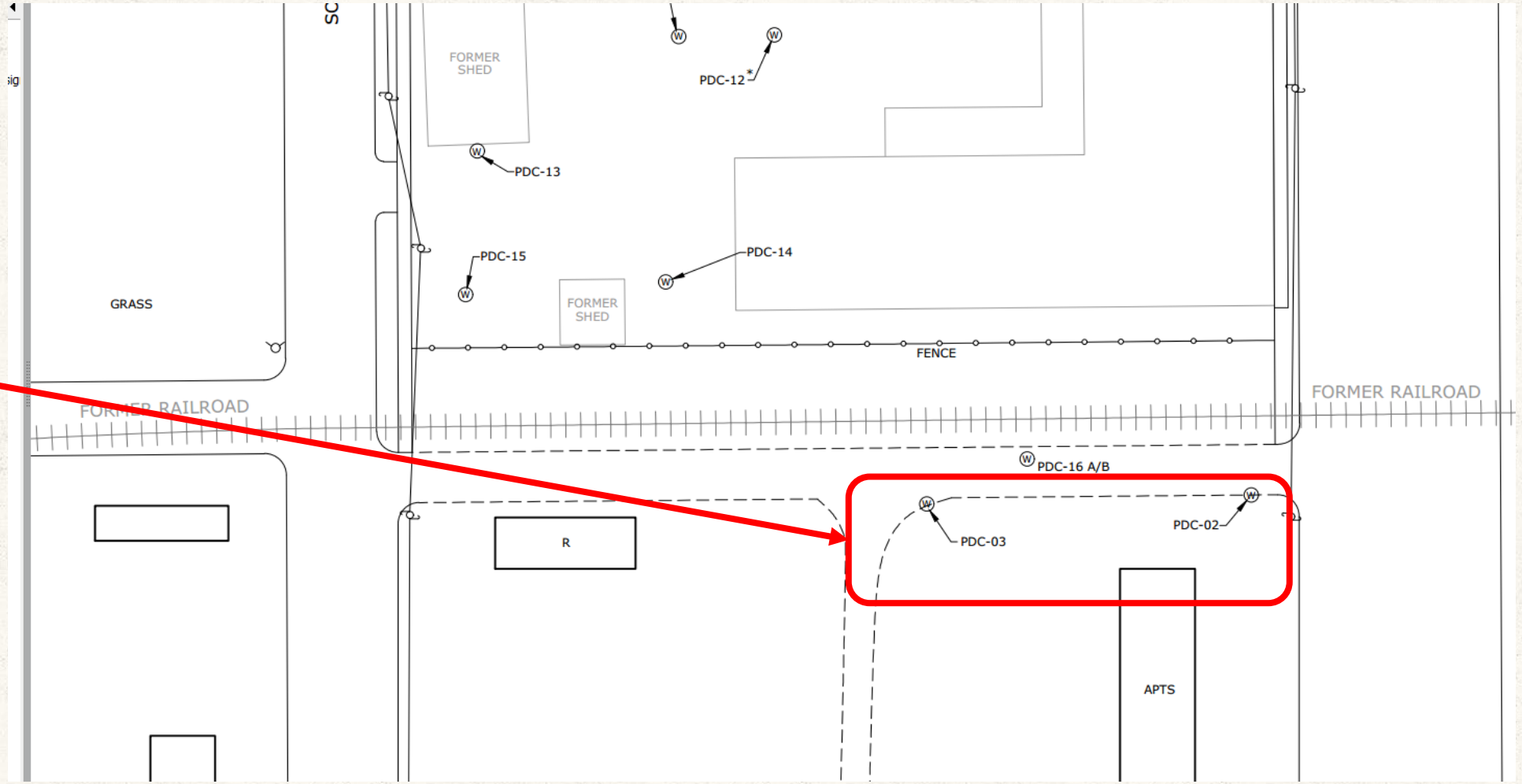


Phase 1: 180-day Post-Injection Results

Downgradient

% Reductions

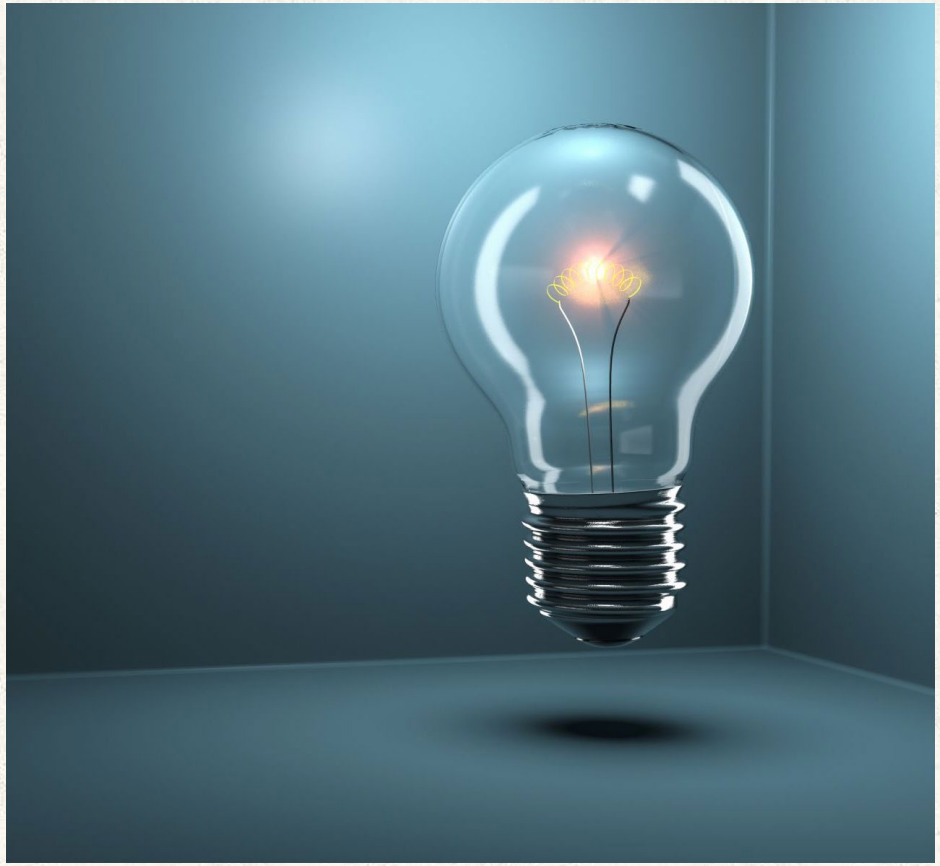
- PCE ~84-99%
- TCE ~59-99%
- cis ~64-99%
- VC ~99%



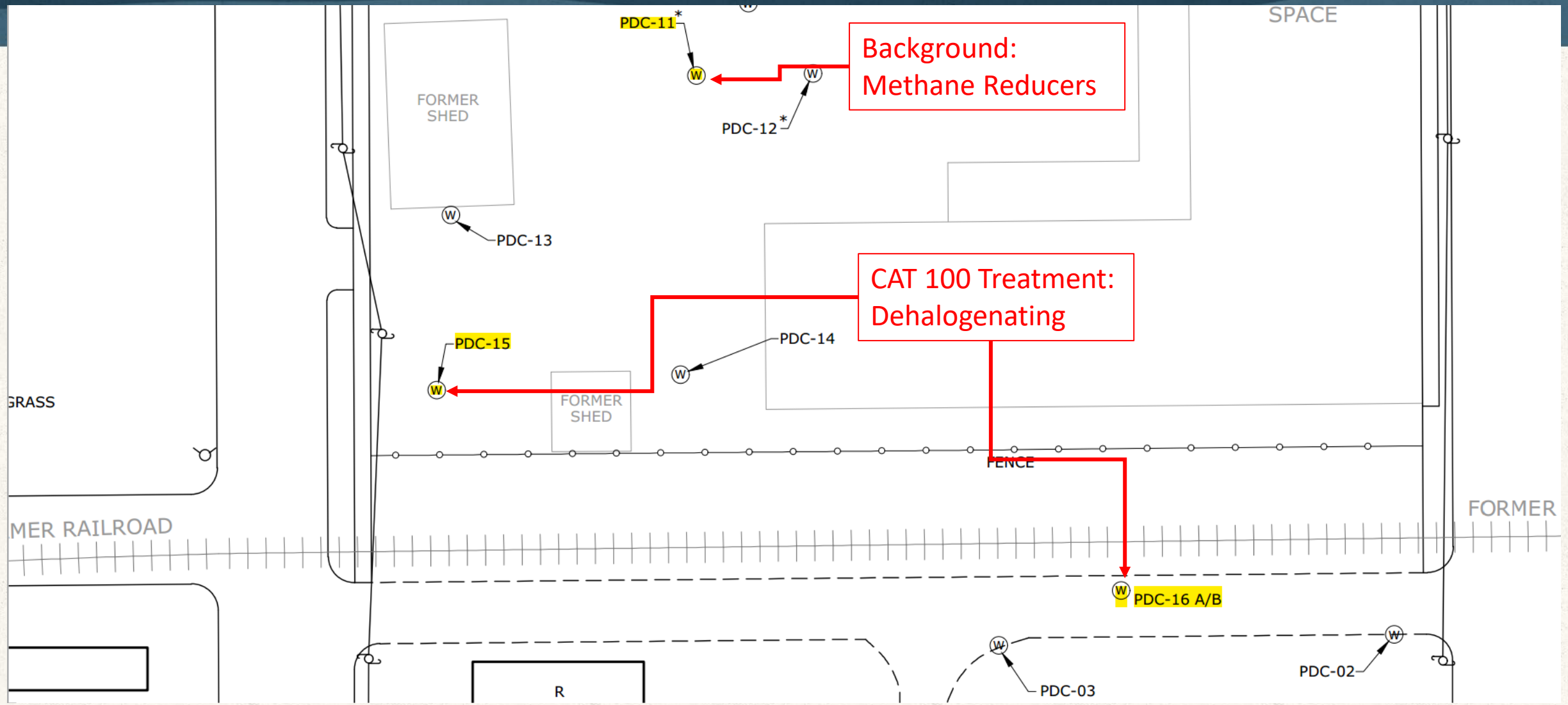
Innovations in Technology

CAT 100

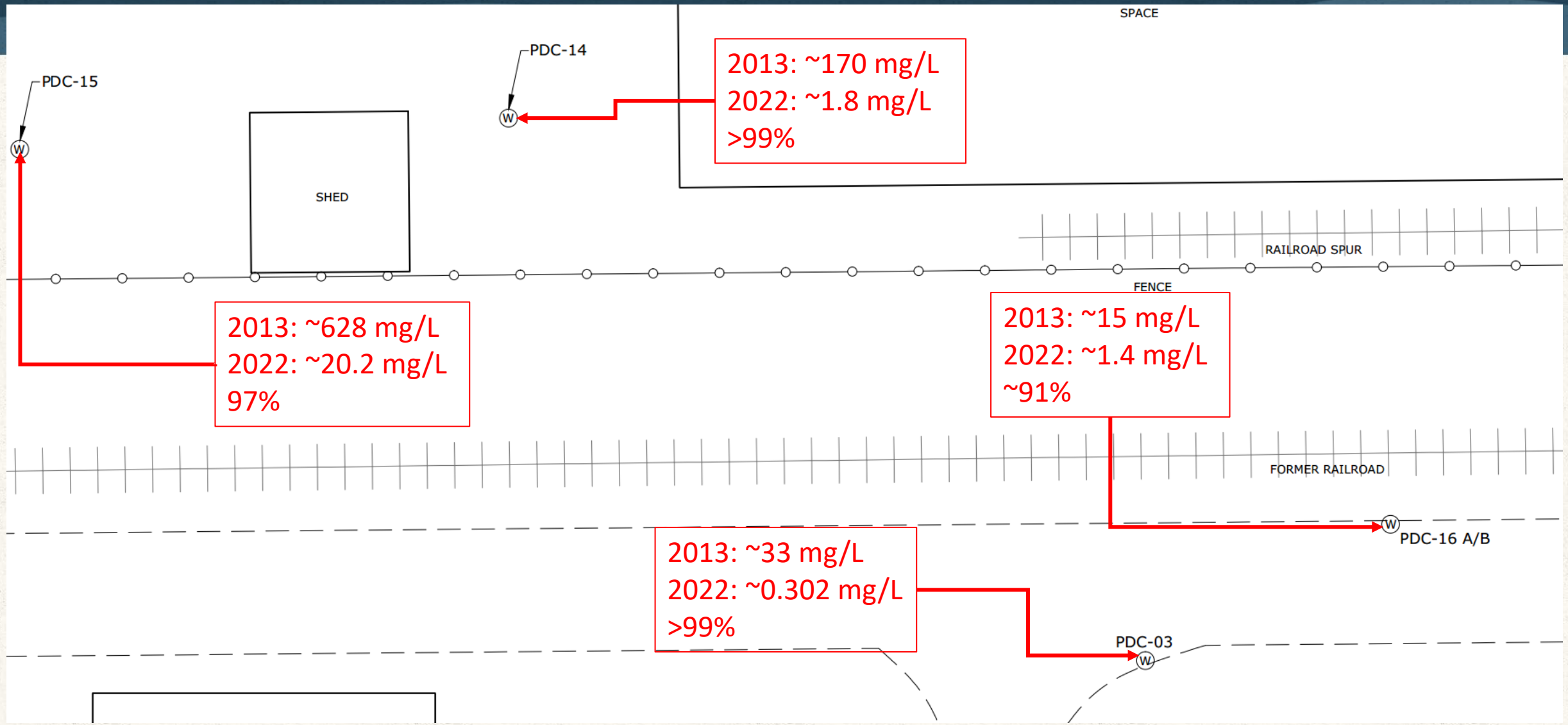
- Activated Carbon Impregnated with Metallic Iron (BOS 100®)
- Complex Carbohydrate
- Microorganisms
  - One Set Designed to Degrade COCs
  - Second Set Degrades the Carbohydrate
- Developed for High Concentration Scenarios (DNAPL)



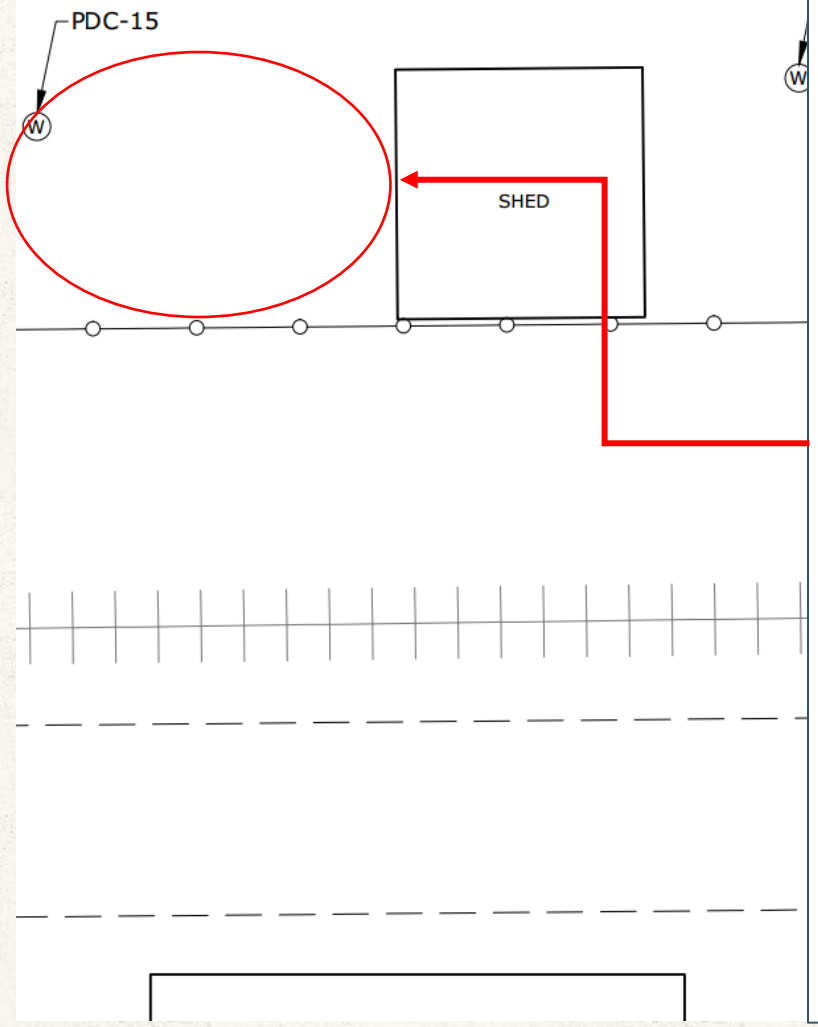
Microbial Diagnostics

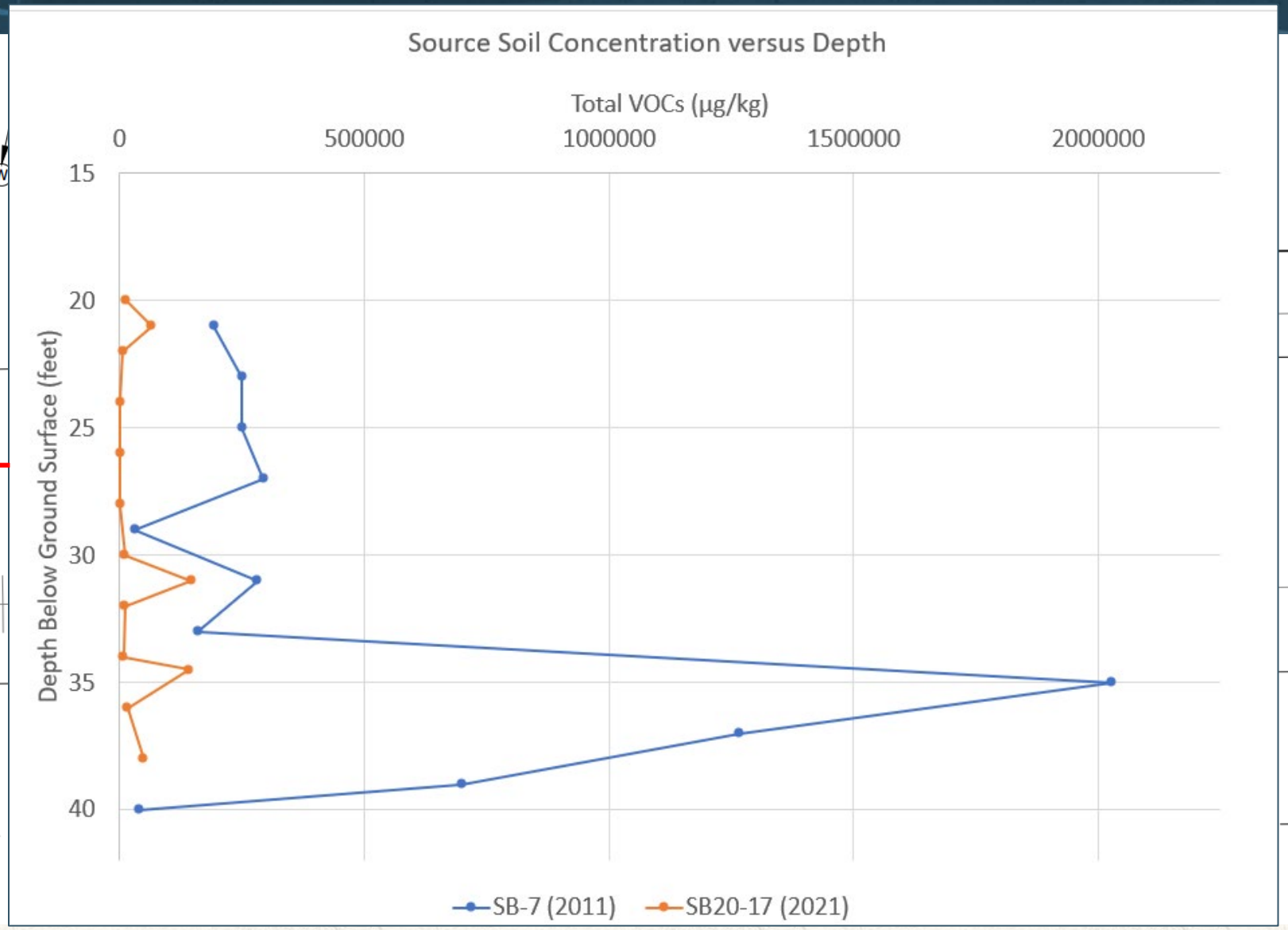


Performance As of November 2022 (Total CVOCs)



Performance As of November 2022 (Total VOCs)





Fiscal Consciousness

1. Remedial Design Characterization (RDC) – 3 Events ~$74k
2. ISCO Soil Blending - ~$38k
3. In-Situ Injection
    1. 6 Events ~$1.02M
    2. ~$170k/event or ~$128k/year (2013-2020)

Final Actions

1. On-site Structures Razed in Spring 2021 for Future Redevelopment
2. Final Source Treatment Completed in September 2021
3. Carbon Tetrachloride Alt. Source Treatment In-Situ Fall 2021
4. Managed Closure Recommended 4Q2022

Thank You For Joining Me

AST Webinars: https://astenv.com/webinars/

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