Permeable Reactive Barriers in a Residential Setting

Watertown, CT

- Water
- Environmental
- Health & Safety
- Compliance & Assurance
- Infrastructure

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ISOTEC
REMEDIATION
TECHNOLOGIES

Retail Petroleum Station

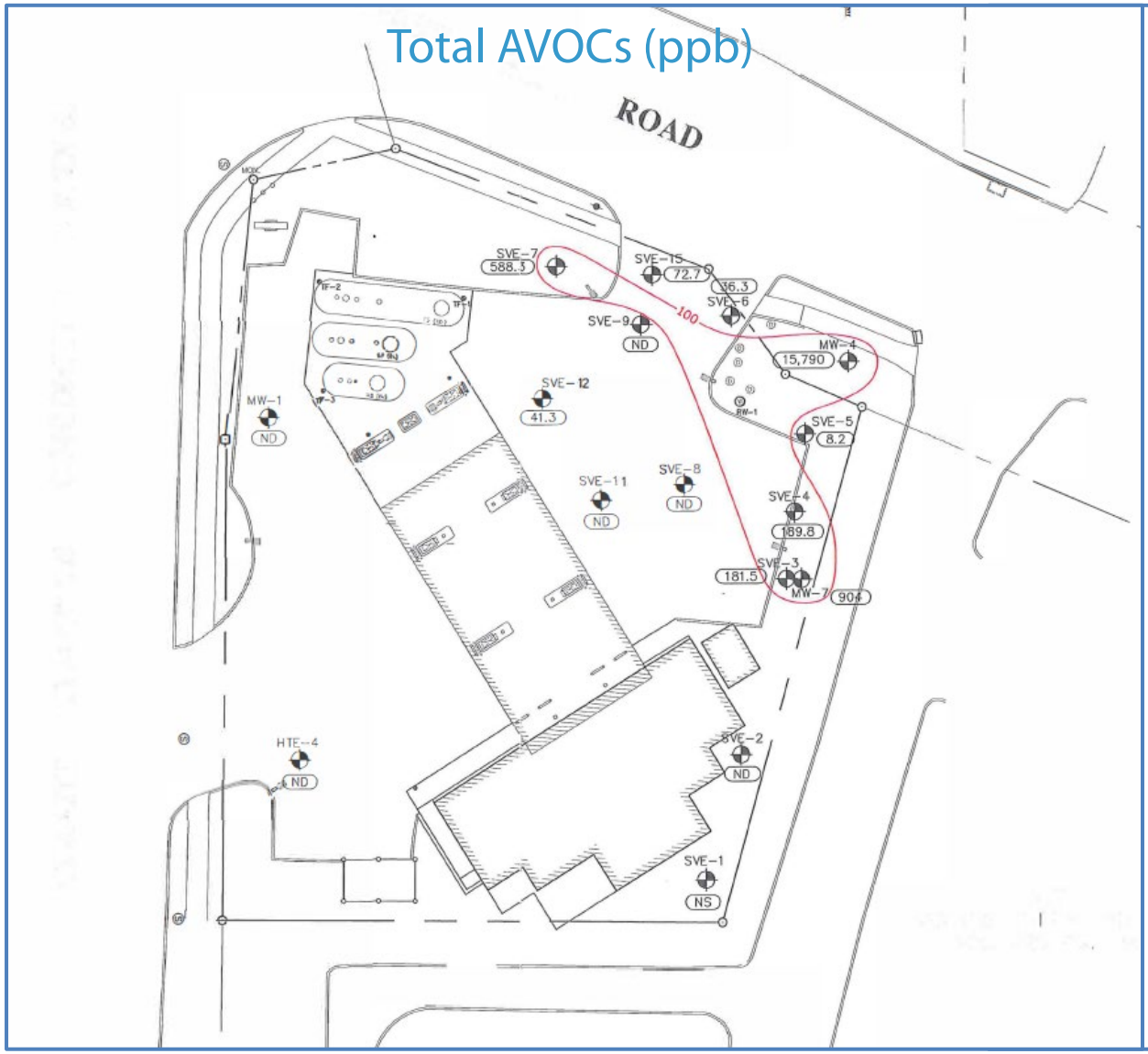
Watertown, CT

History

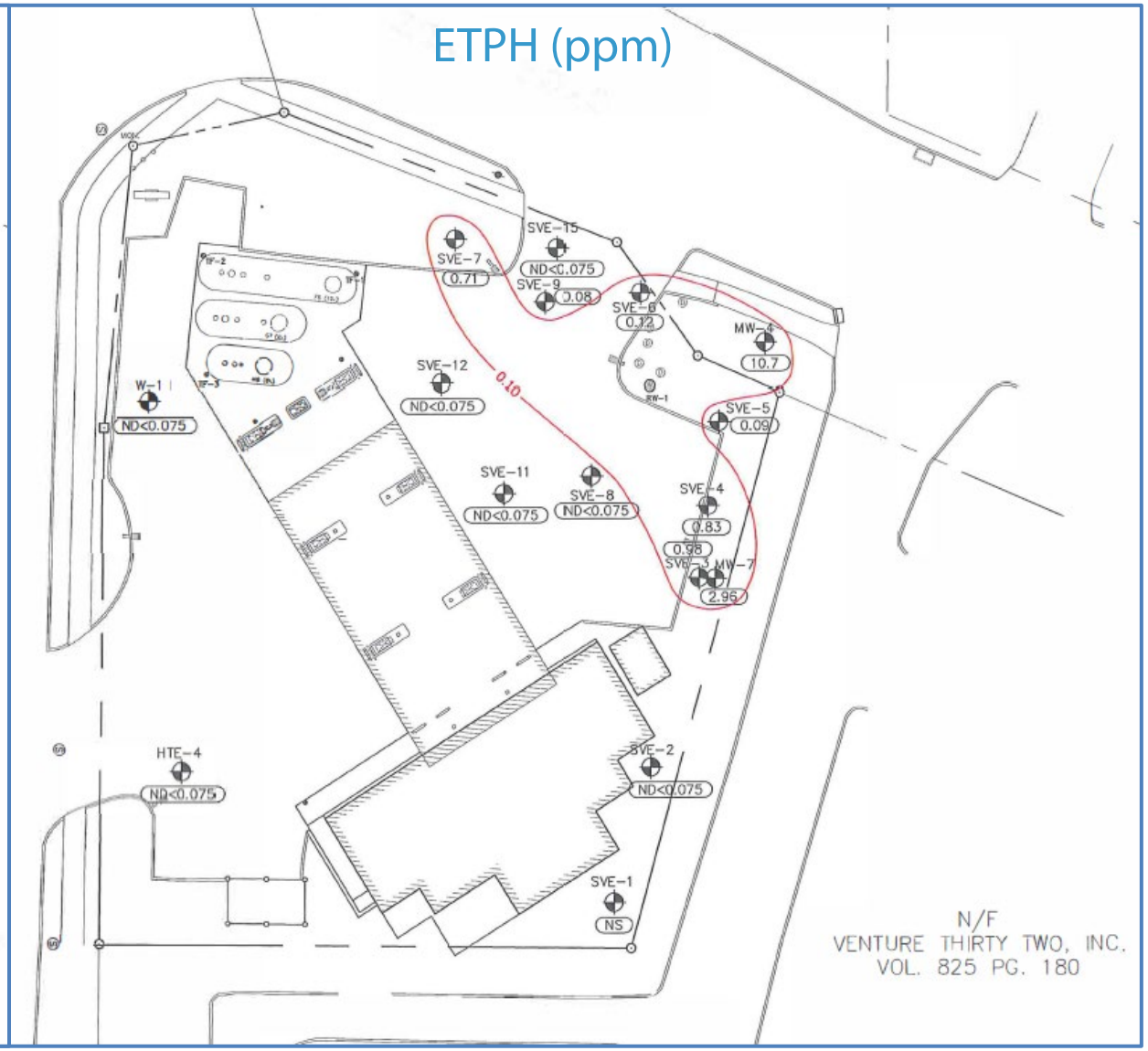
- Site has operated as a retail service station since the 1930s (kerosene/diesel/gasoline USTs)
- Potential auto repair operations 1930s-1980s
- 1981 – first-generation UST system removed
- 1999 – 8,000-tons excavated / 200,000-gallons of groundwater extracted
- 2000-2010 – GWP&T, AS, and SVE systems operated on the station property
- 1999-2009 – GWM performed, MNA determined to be appropriate remedial strategy
- 2009 – Isopleth maps skewed during closure assessment

Isopleth Maps – December 2009

Total AVOCs (ppb)

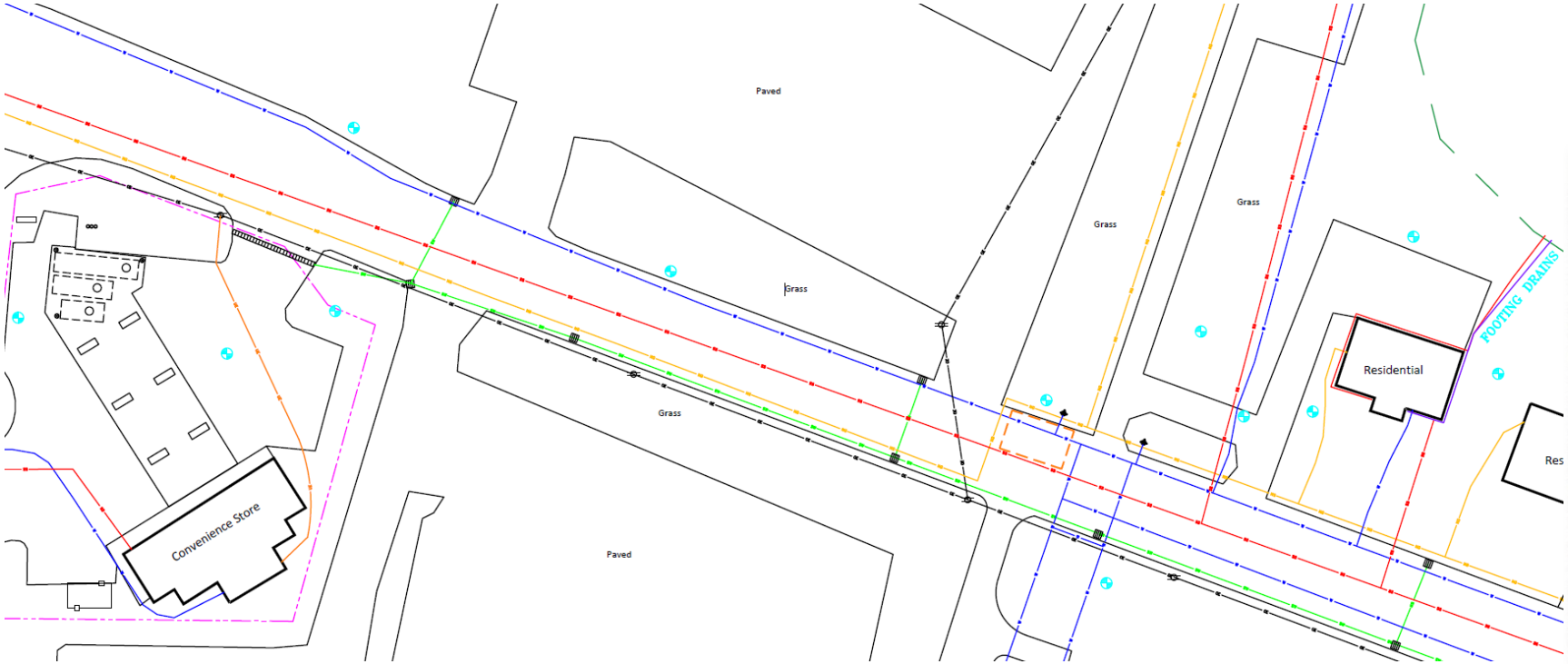


ETPH (ppm)



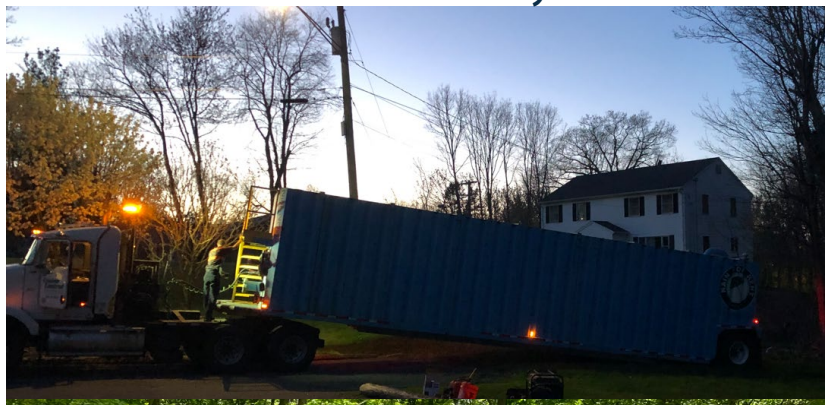
Water Line Repair / Impacts to Residential Properties

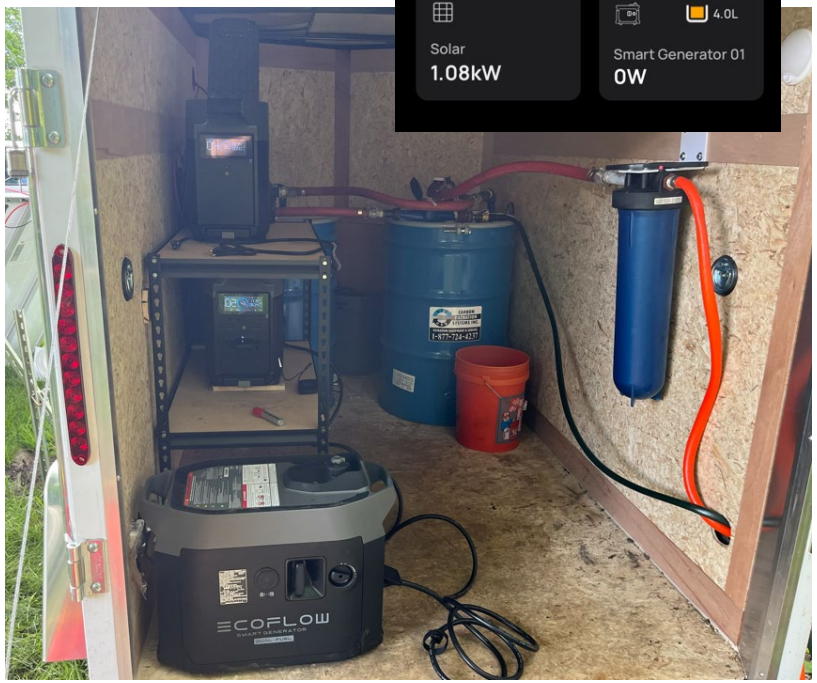
- Petroleum contamination discovered during hydrant repair ~300' from Site
- CTDEEP ERU installed 5 monitoring wells in the immediate area
- Elevated AVOCs & PAHs identified in groundwater
- Contaminated groundwater discharging to wetlands via footing drains
- Residents complaining of petroleum odors in backyard
- 9 additional monitoring wells installed across the area

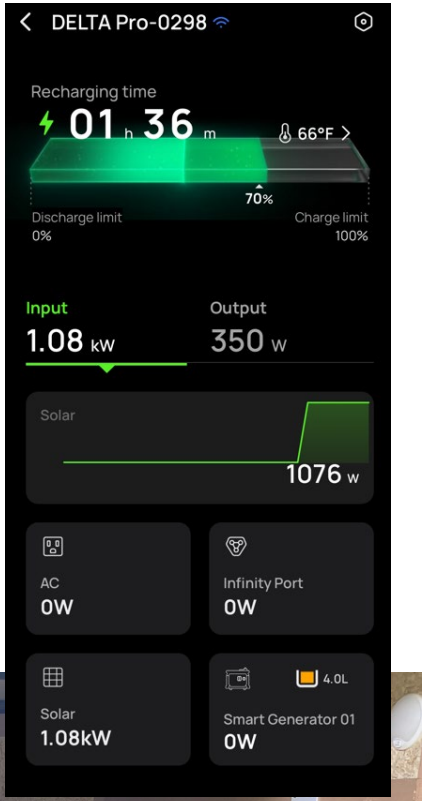


Groundwater Pump & Treat System

- Collection sump installed to collect footing drain discharge
- Water initially containerized in 21,000-gallon frac
- Treatment system implemented - sediment filter / GAC
- Challenges included power source and remote telemetry - Wi-Fi hotspot added for remote monitoring
- Custom-built solar array constructed with battery bank and backup propane generator







Remedial Design Characterization

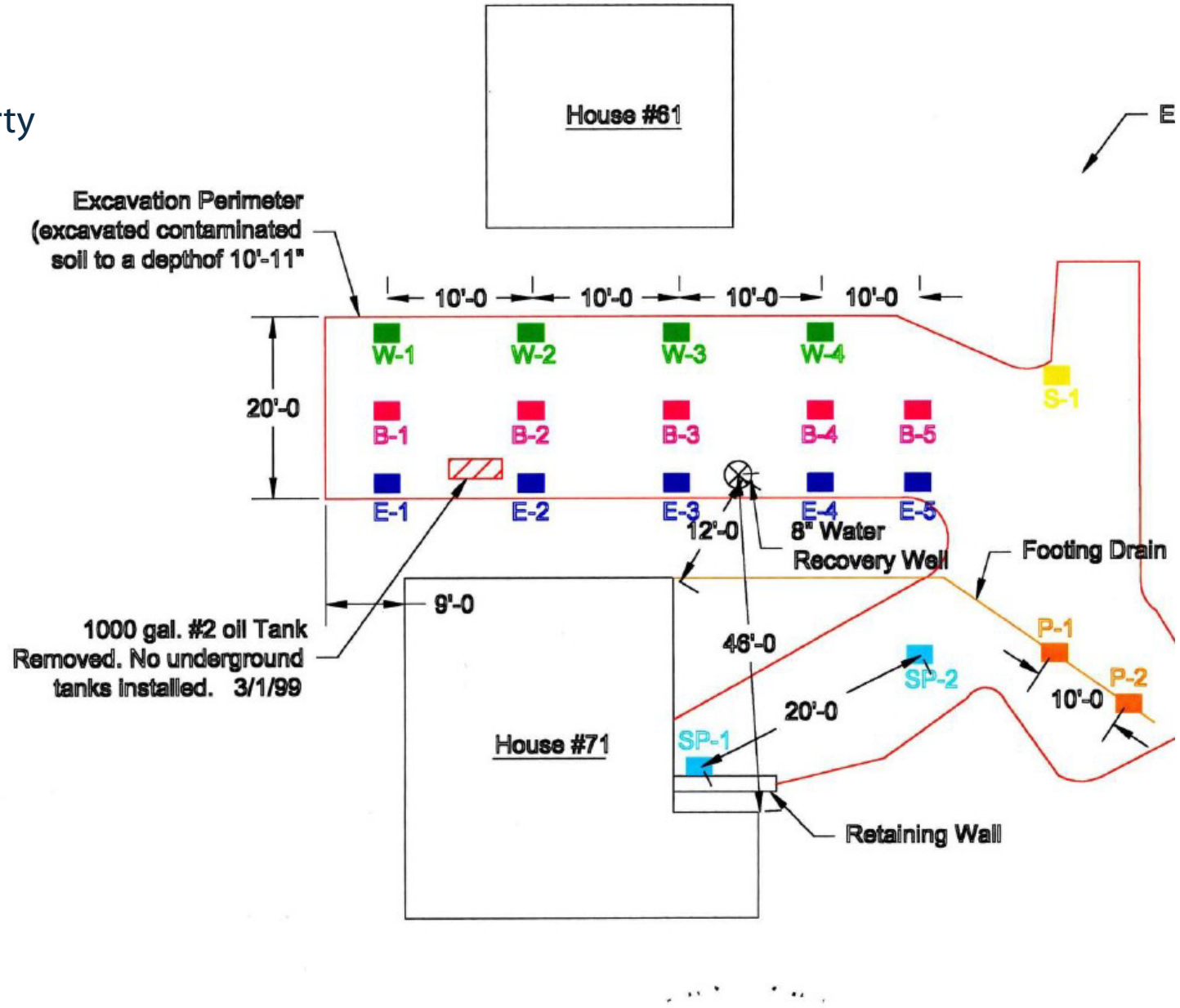
- 23 soil borings advanced across the residential properties
- Interior soil vapor characterization in residential basement, as well as indoor/outdoor air quality sampling
- Area-wide groundwater characterization
- Geological evaluation of soil strata

Geology

- Soil in the area classified as till
- Sand with 30-40% silt 0-10’
- Becoming extremely dense >10’
- Utility corridors bedded with crushed stone
- Bedrock >30’
- Roadway built up with imported fill in 1980s

Comingled Petroleum Plume

- 1999 – Leaking fuel oil UST at residential property
- Over 650-tons of soil removed
- Footing drains and former septic leaching field impacted
- Contamination left in-place due to proximity to foundations



Remediation Design

PRB Design

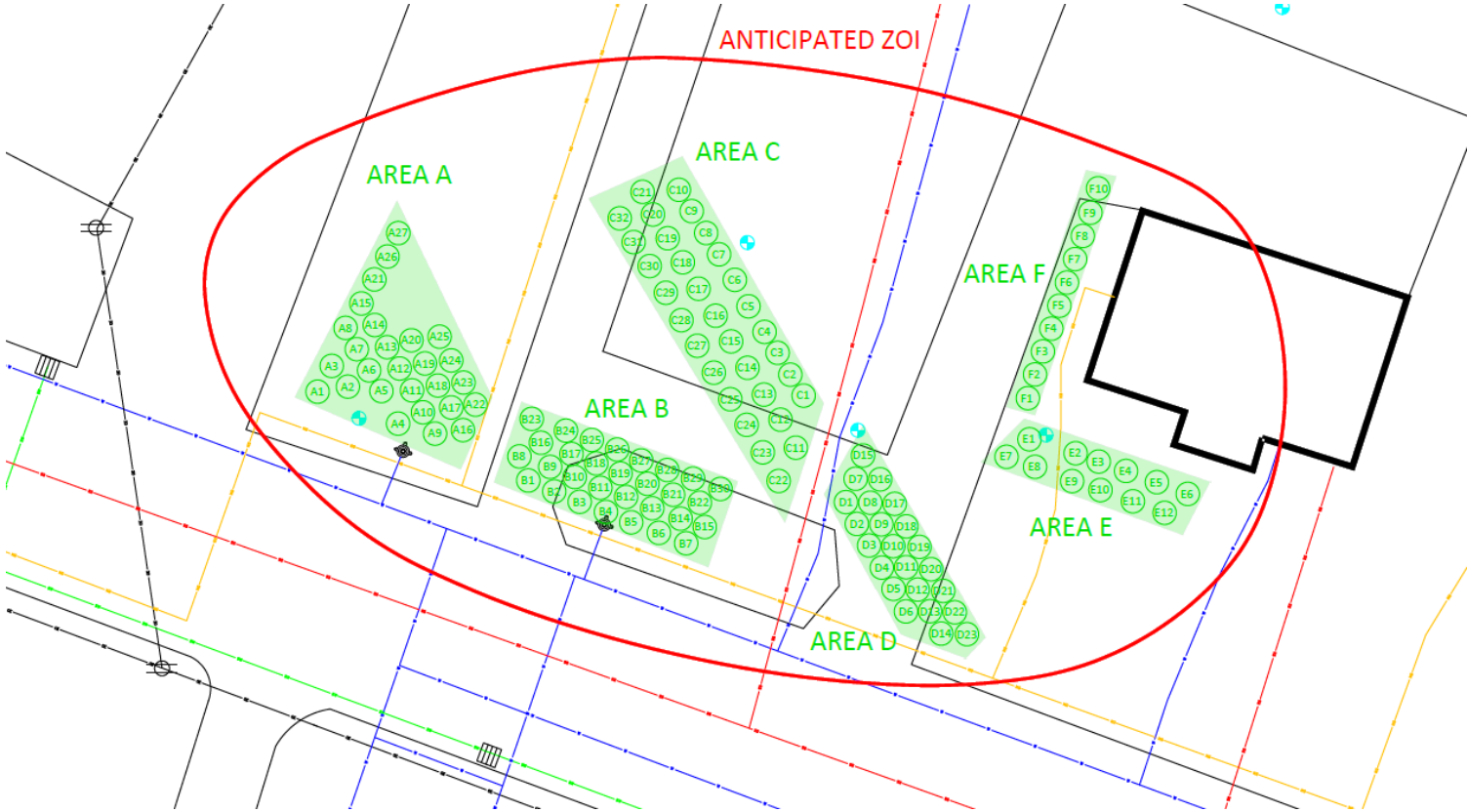
- 6 separate treatment areas totaling 3,100-square feet
- 134 injection points, triangular grid spacing of 4-5’
- 2-foot vertical intervals between 5-13’
- 24 gallons per minute average flow rate
- 200-600 PSI
- 5,590-gallons of BOS 200® solution

PRB Cost

- Chemicals and application
- Driller (17 days)
- Consultant – Oversight and planning

Challenges

- CTDEEP Permitting - Temporary Authorization
- Assumptions of contaminant mass
- Delivery of materials
- Utilities
- Access agreements



Technology Overview

Two Key Remediation Processes:

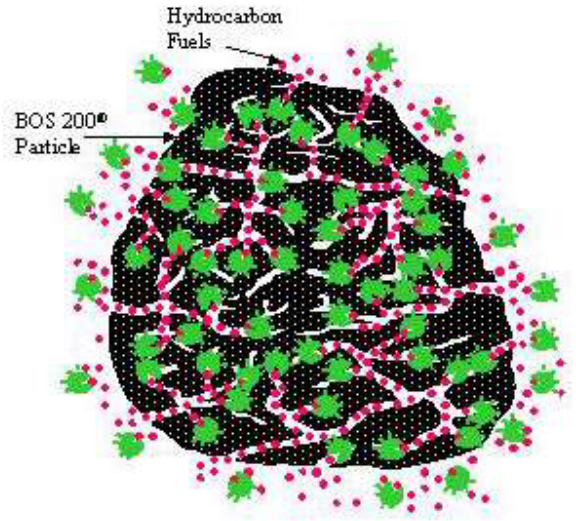
- Partition / trap contaminants via carbon adsorption
- Biodegradation

BOS 200® Remedial Components:

- Activated carbon
- Calcium sulfate (gypsum)
- Facultative blend of microbes
- Additional reagents
- Magnesium sulfate as a quick-release source of soluble sulfate
- Food-grade starch
- Yeast extract

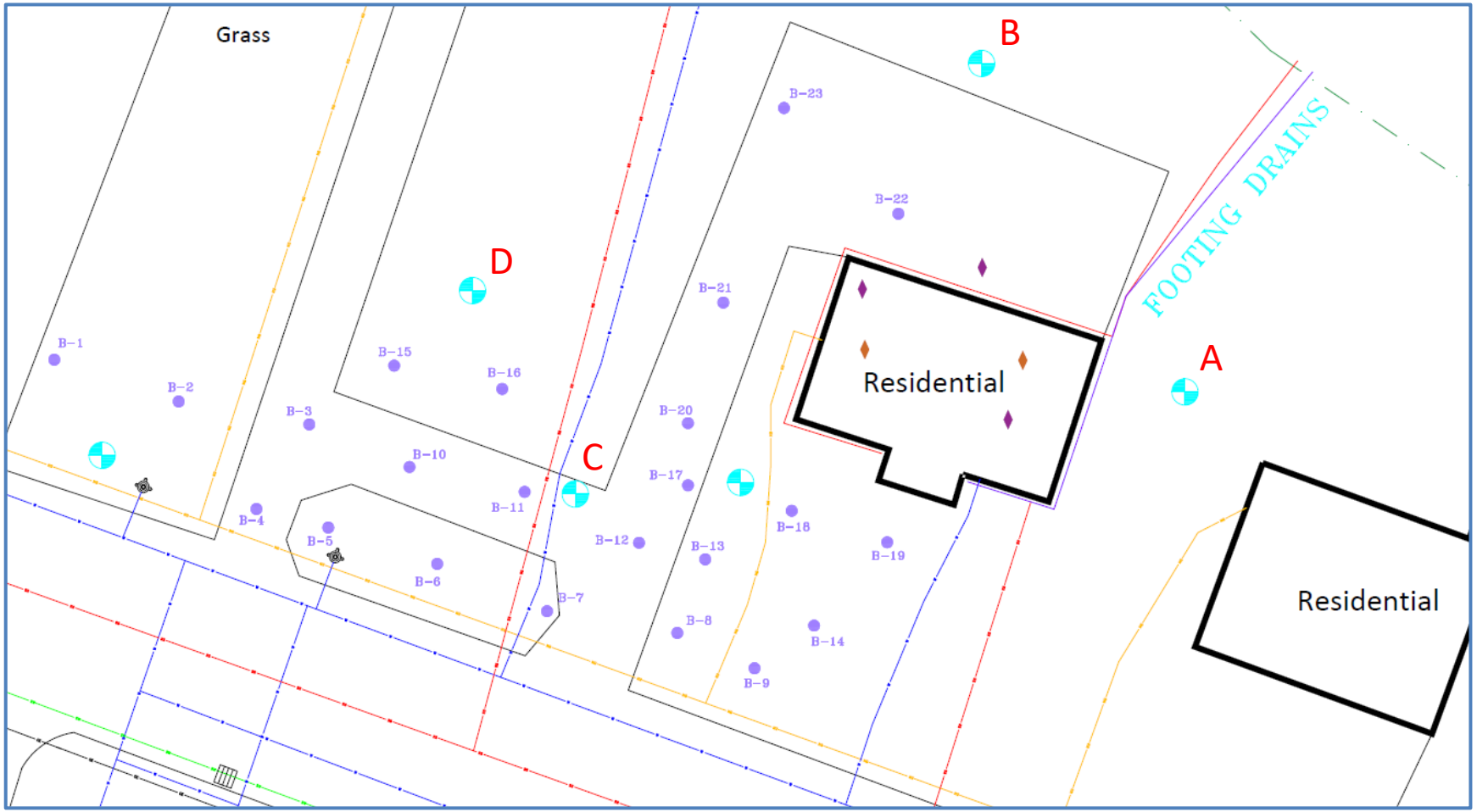
Quantities Used

- 5,600 lbs BOS 200®
- 5 gallons BOS 200® bacteria
- 6,950 lbs magnesium sulfate
- 2,850 lbs starch
- 7,250 lbs gypsum
- 110 lbs yeast



PRB Remediation

Post-Remediation Groundwater Results – Inside ZOI



Post-Remediation Groundwater Results – Inside ZOI

PRB Injections

Contaminants

Sample ID	Sample Date	CTDEEP ETPH (mg/L)
A	5/1/2024	<0.066
	7/17/2024	**0.22**
	12/3/2024	<0.20
	2/18/2025	**0.30**
	5/19/2025	**0.28**
	8/18/2025	**0.28**
B	5/1/2024	**0.20**
	7/17/2024	**0.21**
	12/3/2024	**0.22**
	2/18/2025	**0.21**
	5/19/2025	**0.25**
	8/18/2025	**0.43**
C	7/17/2024	**0.62**
	12/3/2024	**0.85**
	2/18/2025	**1.1**
	5/19/2025	**0.52**
	8/18/2025	**0.60**
D	7/17/2024	**1.9**
	12/3/2024	**1.5**
	2/18/2025	**1.4**
	5/19/2025	**1.6**
	8/18/2025	**2.0**

Non-Target Parameters

Monitoring Well	Sample Date	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate-Nitrite (N) (mg/L)	Total Phosphorous (mg/L)	Sulfate (mg/L)
A	7/17/2024	<0.050	<0.0500	--	**0.053**	**7.0**
	12/3/2024	--	--	<0.02	<0.050	**27**
	2/18/2025	<1.0	<1.00	--	**0.070**	**21**
	5/19/2025	**1.4**	<1.00	--	<0.050	**17**
	8/18/2025	**0.4**	<0.100	--	<0.050	**65**
B	7/17/2024	<0.050	<0.0500	--	**0.088**	**7.8**
	12/3/2024	--	--	**0.13**	<0.050	**190**
	2/18/2025	**0.14**	<0.100	--	**0.074**	**31**
	5/19/2025	<0.10	<0.100	--	<0.050	**81**
	8/18/2025	**0.37**	<0.100	--	<0.050	**44**
C	7/17/2024	<0.050	<0.0500	--	**0.12**	<1.0
	12/3/2024	--	--	<0.02	<0.050	**570**
	2/18/2025	<1.0	<1.00	--	**0.087**	**72**
	5/19/2025	<1.0	<1.00	--	<0.050	**46**
	8/18/2025	<0.10	<0.100	--	<0.050	**13**
D	7/17/2024	<0.050	<0.0500	--	**0.13**	<1.0
	12/3/2024	--	--	<0.02	<0.050	**940**
	2/18/2025	<0.50	<0.500	--	**0.068**	**500**
	5/19/2025	<1.0	<1.00	--	<0.050	**44**
	8/18/2025	<0.10	<0.100	--	<0.050	**220**

Q&A

- Questions?
- Comments?
- Eagerly awaiting Luke to stop talking?