



TOPIC TALK

PRECISION CLEANUP: HIGH-RESOLUTION RESULTS

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High-Resolution Site Characterization (HRSC)

A Bay Area Dry Cleaner Case Study

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SF Bay Water Board
September 30, 2026

Site History

- Historic Dry Cleaner - operated from 1965-1992. Released PCE.
- **PCE Concentrations in GW > Screening Levels**
- Shopping Center – New owner in 1999
- Remedial Excavation – ~30 cubic yards of soil
- Lots of monitoring wells, soil vapor probes, sub-slab probes...
- **Shallow GW is primary source of CVOCs detected in IA**
- 2011 – SSDS installed in former dry cleaner suite
- Cleanup and Abatement Order in 2014
- **Goal: Reduce CVOCs concentrations in soil vapor to ESLs and in GW to MCLs**

Regulatory Mandates

- CERCLA and RCRA
- Porter-Cologne Water Quality Control Act (1969) - Broad Authority
 - 9 Regional Water Boards – Basin Plans and WQOs
 - Section 13267 – Investigative Orders
 - **Section 13304 – Cleanup and Abatement Orders**
 - **State Board Resolution 92-49: Cleanup to Background**
 - WDRs – permits to discharge waste to land and groundwater
 - ACLs

2009 Assessment Tool for CVOCs

Assessment Tool for Closure of Low-Threat Chlorinated Solvent Sites

Prepared by:

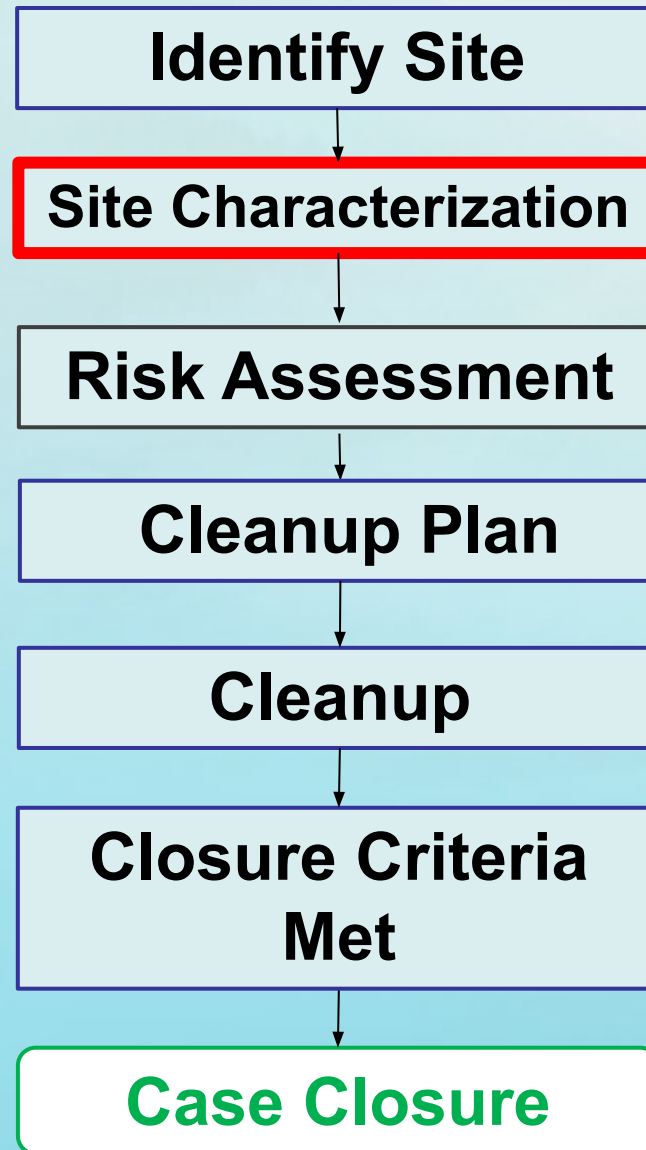
Groundwater Committee, a staff committee of the
California Regional Water Quality Control Board
San Francisco Bay Region

Draft Final – July 31, 2009

S.F. Bay Water Board staff strongly encourages use of state-of-the-art, high-resolution methods, where appropriate, to identify and evaluate sources. High-resolution methods generally reduce uncertainty and increase confidence in conclusions about potential risks and threats, plume behavior, acceptable closure concentrations, and the timeframe to meet groundwater cleanup standards.

Reference: Assessment Tool for Closure of Low-Threat Chlorinated Solvent Sites
(2009; Brown, Carlton, Naugle, and Thompson)

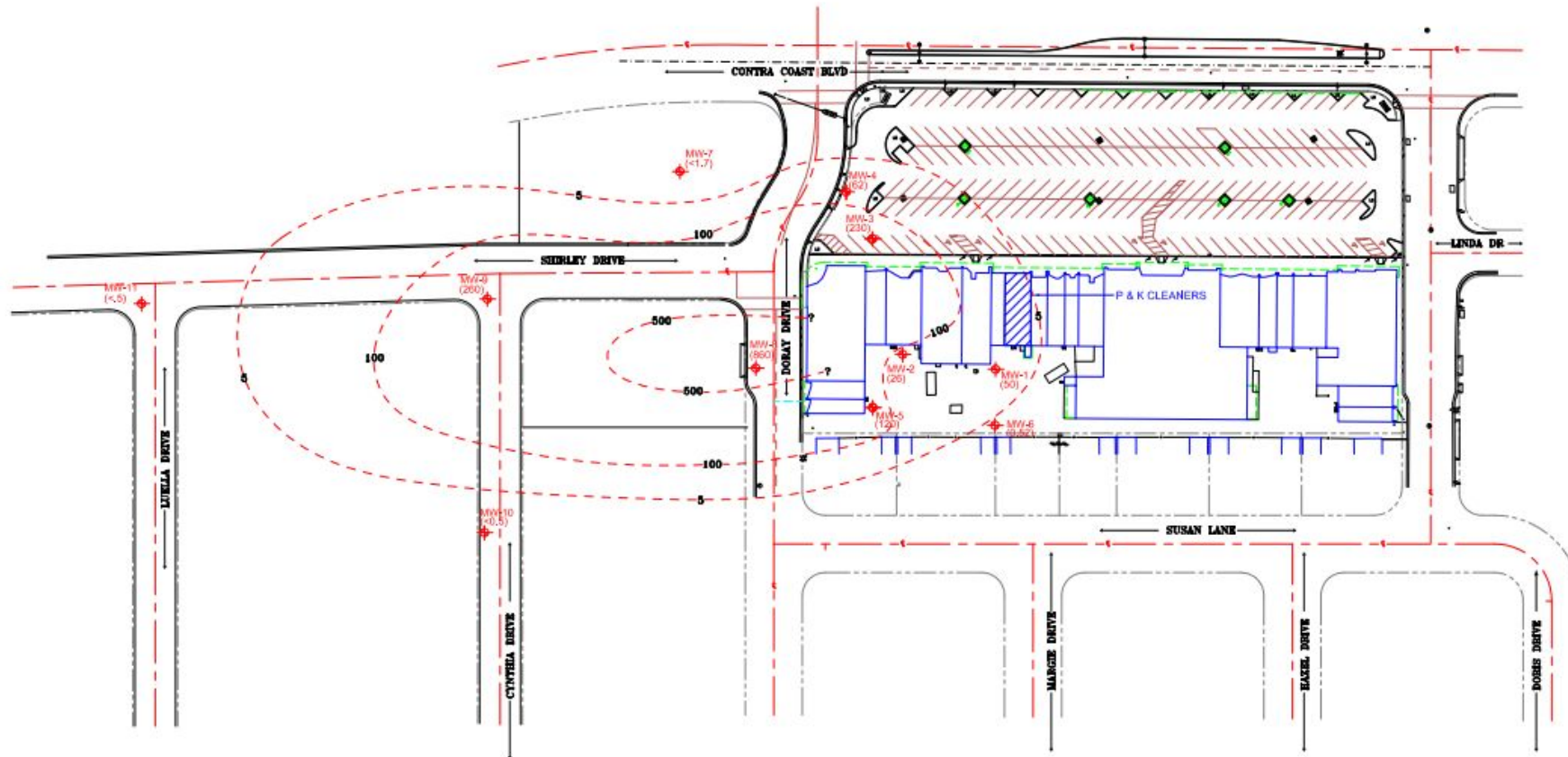
Site Cleanup Process



What is Site Characterization?

- Describes the **nature** and the **extent** of the contamination
- Defines contaminant **pathways** and **receptors**
- Includes the **spatial** and **temporal** assessment of contaminants

2008 PCE in Groundwater Plume Map



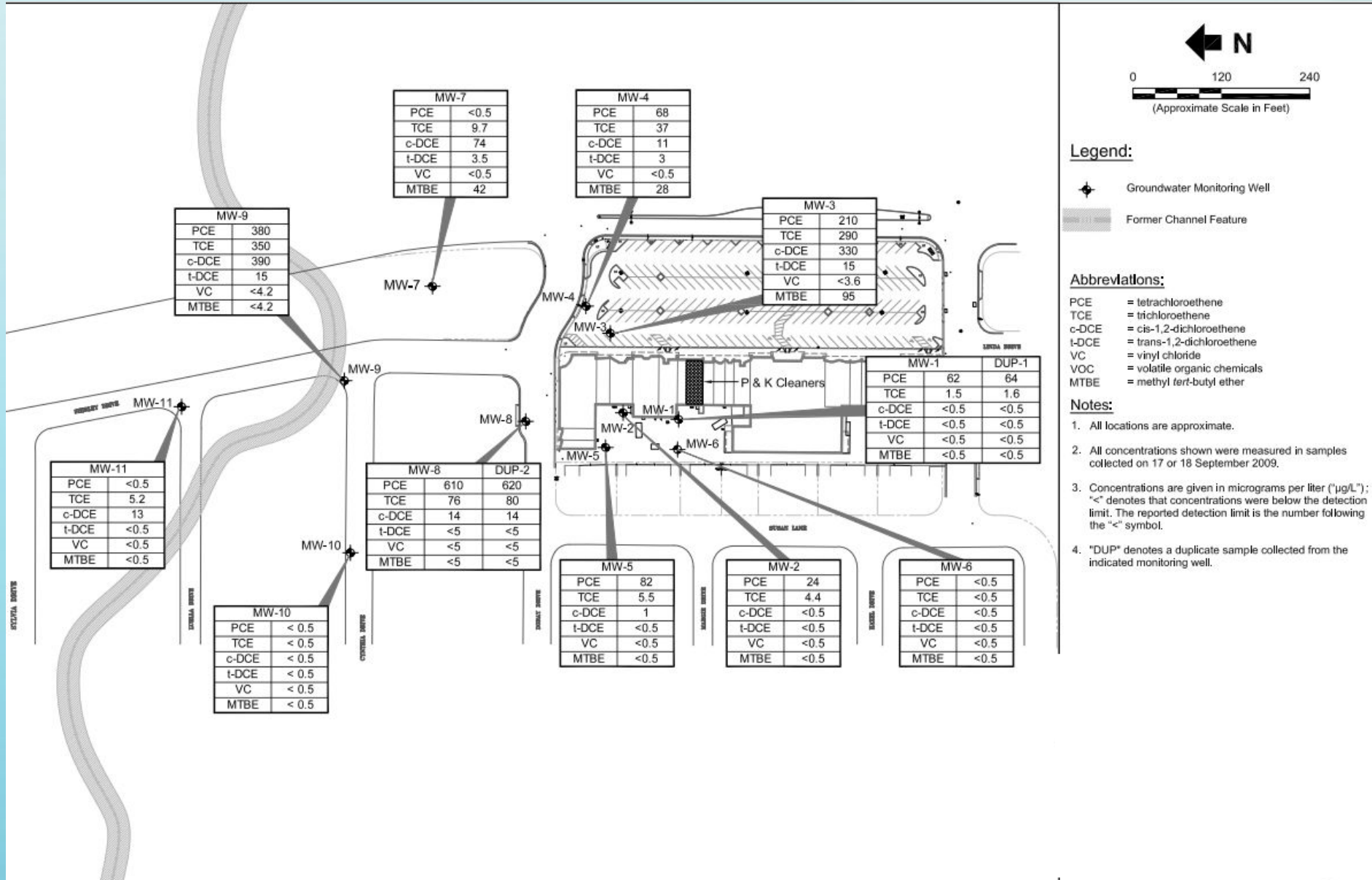
LEGEND

5 100 500 1000 THIRD QUARTER 2008 PCE ISO COUNTOUR (CONCENTRATION IN MICROGRAMS PER LITER ($\mu\text{g/L}$) OR PAR)

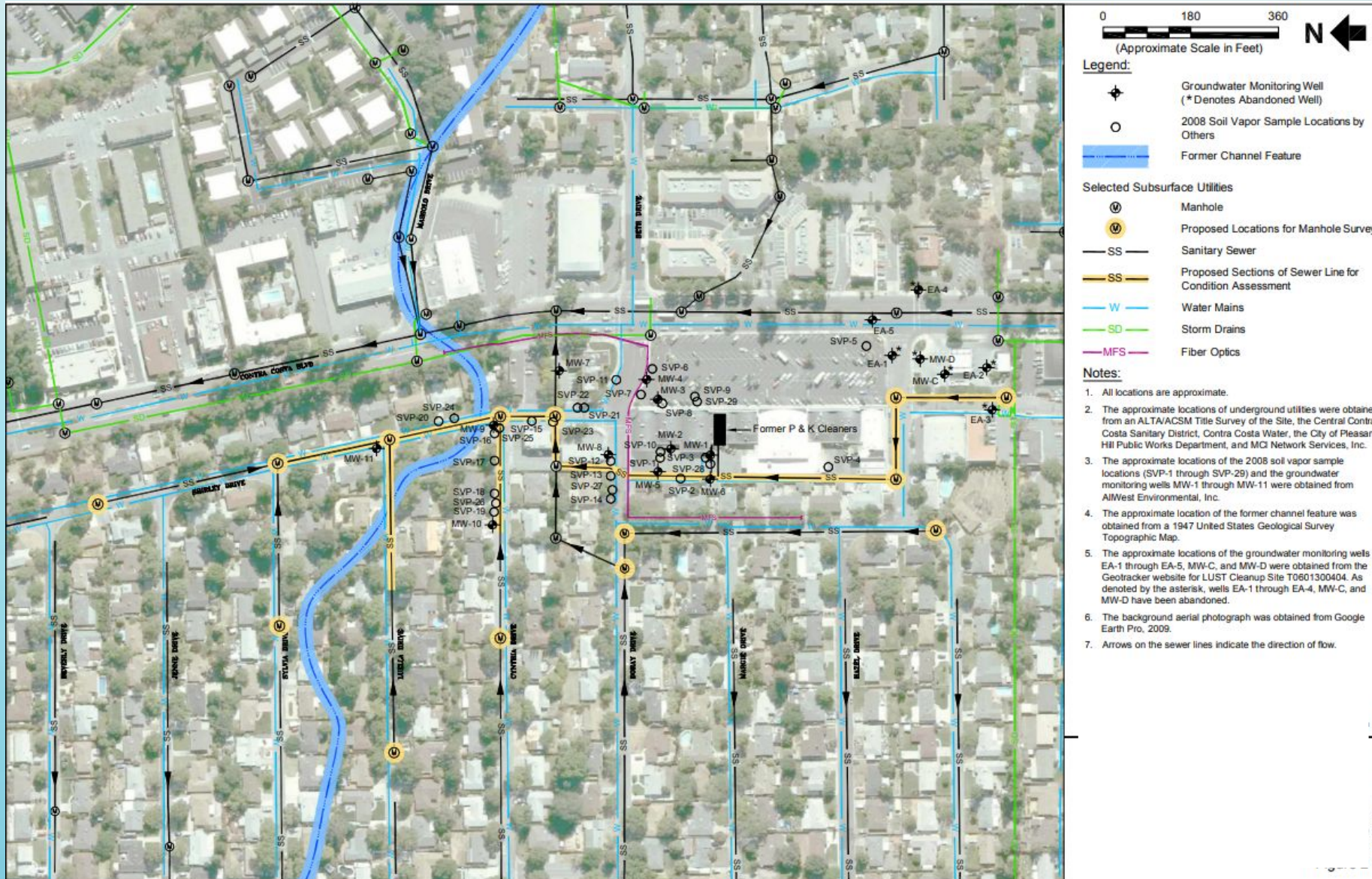
MW-1 (45) - MONITORING WELL WITH PCE LEVELS CONCENTRATION IN $\mu\text{g/L}$

- SAMPLES COLLECTED ON SEPTEMBER 3 AND 4, 2008

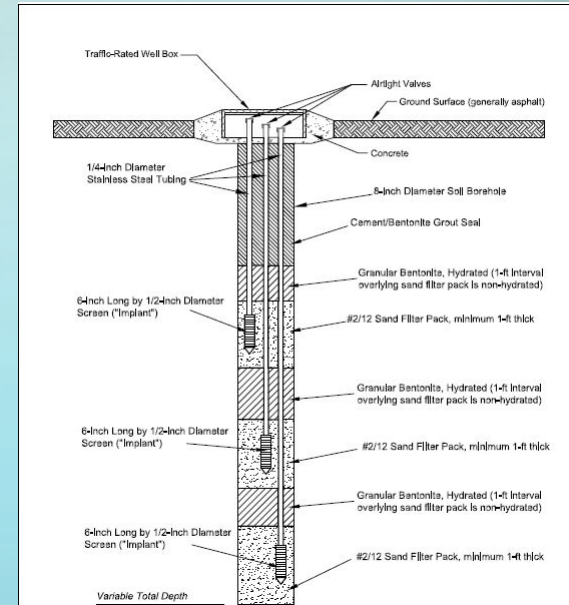
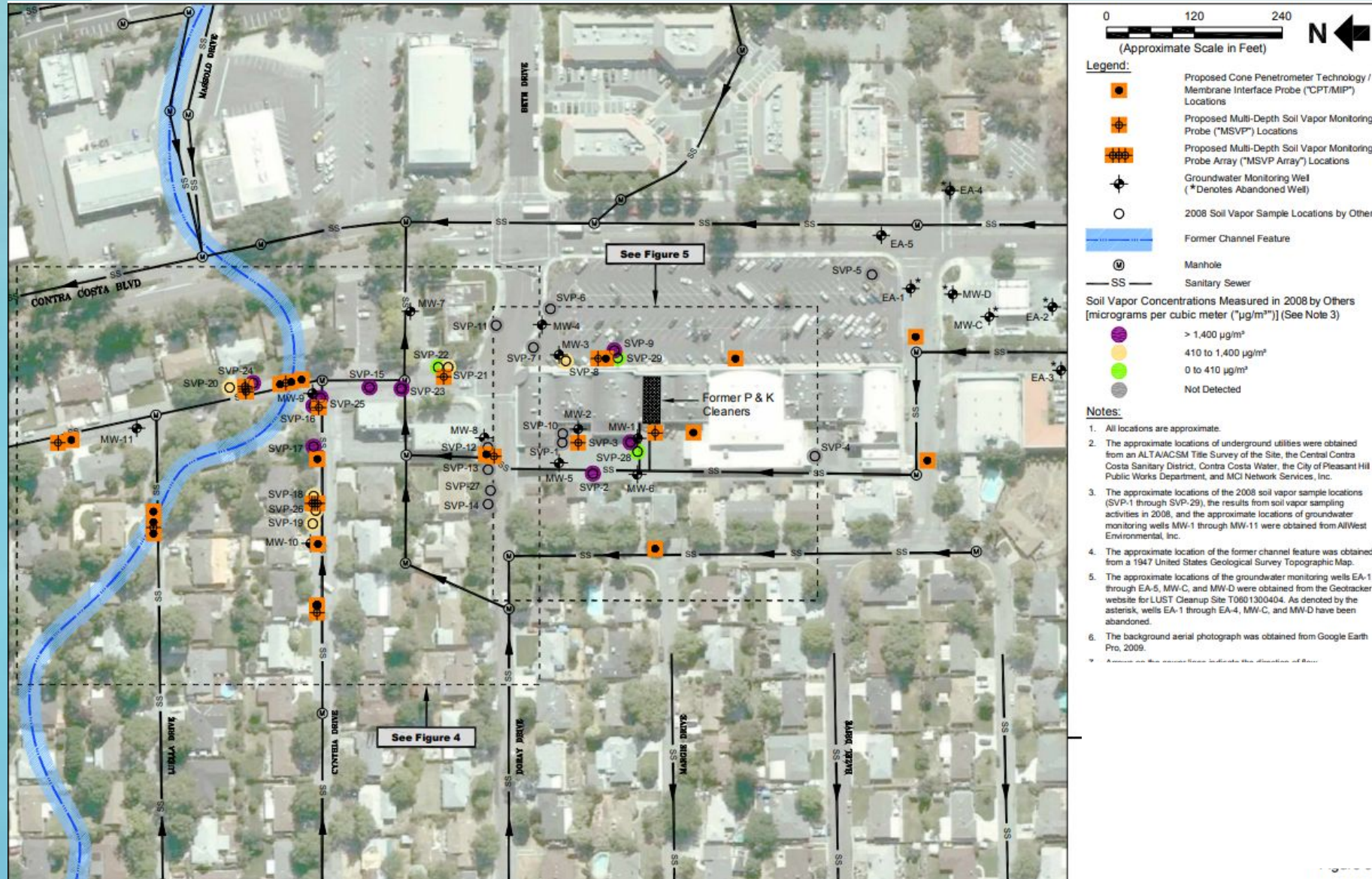
2009 CVOCs in Groundwater Map



2009 Sanitary Sewer Pathway Assessment

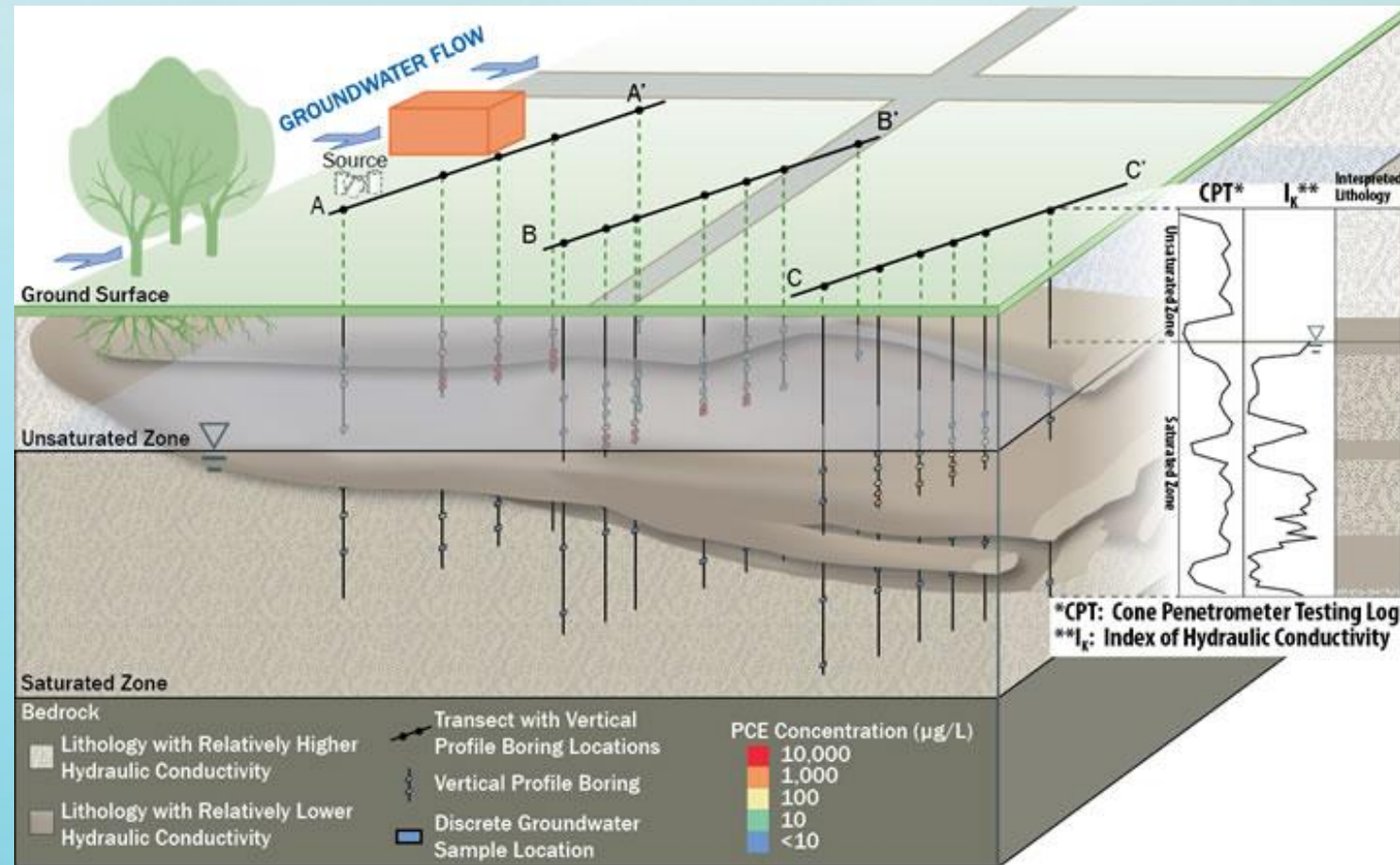


2009 Proposed Soil Vapor Investigation



What is HRSC?

“High-resolution site characterization (HRSC) strategies and techniques use scale-appropriate measurement and sample density to define contaminant distributions, and the physical context in which they reside, with greater certainty, supporting faster and more effective site cleanup.”



Reference: USEPA (<https://www.clu-in.org/characterization/technologies/hrsc/hrscintro.cfm>)

Traditional versus HRSC

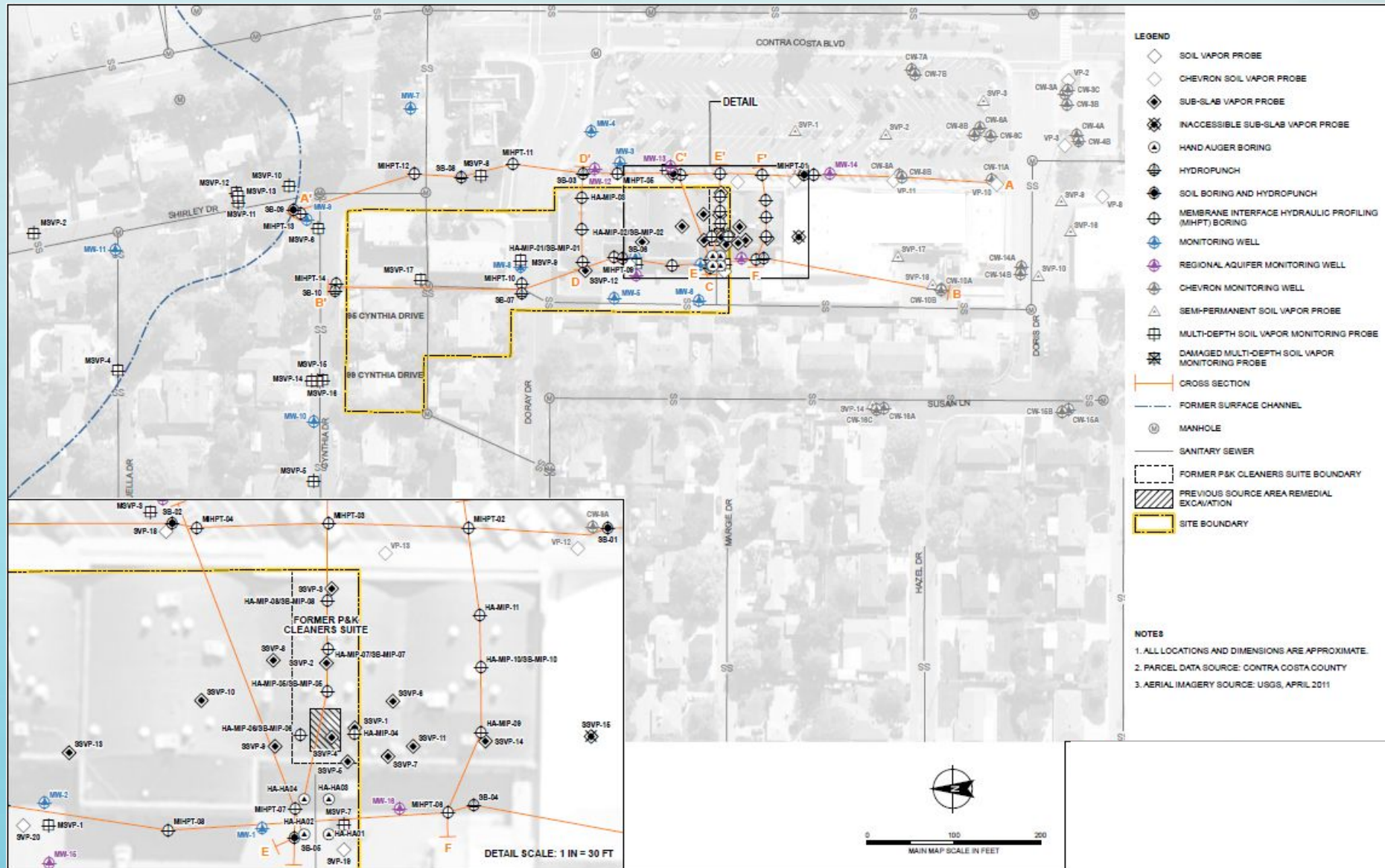
Attribute	Traditional Characterization	HRSC
Primary Tools	Hollow-stem augers, permanent monitoring wells, split-spoon sampling	Direct Push Technology (DPT), Membrane Interface Probe (MIP), MiPHPT
Data Resolution	Set sampling intervals (e.g., every 5 feet), 10- to 30-foot well screens)	Continuous real-time logging and creating a centimeter-scale visual map
Plume Definition	Heavy reliance on interpolation (increasing the probability of data gaps)	Precise mass distribution mapping to isolate actual migration pathways
Cost Efficiency	High drilling and laboratory costs per data point	Low cost per data point (reduces the number of permanent monitoring points)

Geology Controls Everything!

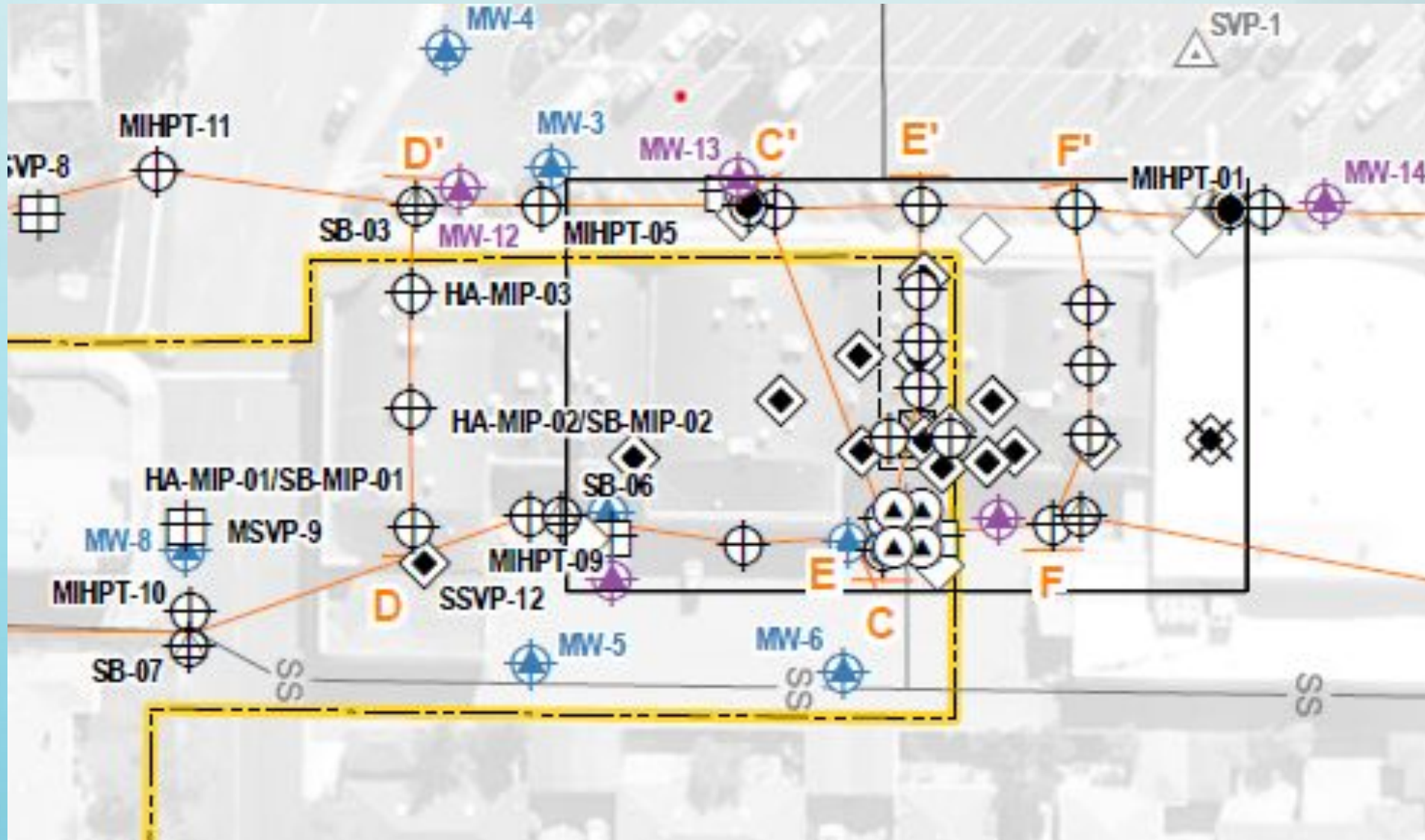
Heterogeneities in the subsurface control contaminant distribution and ultimately the fate and transport of the contaminants:

- Exposure pathways
- Processes affecting fate of the contaminants
- Mass distribution and flux by phase and media type (mobile and immobile)

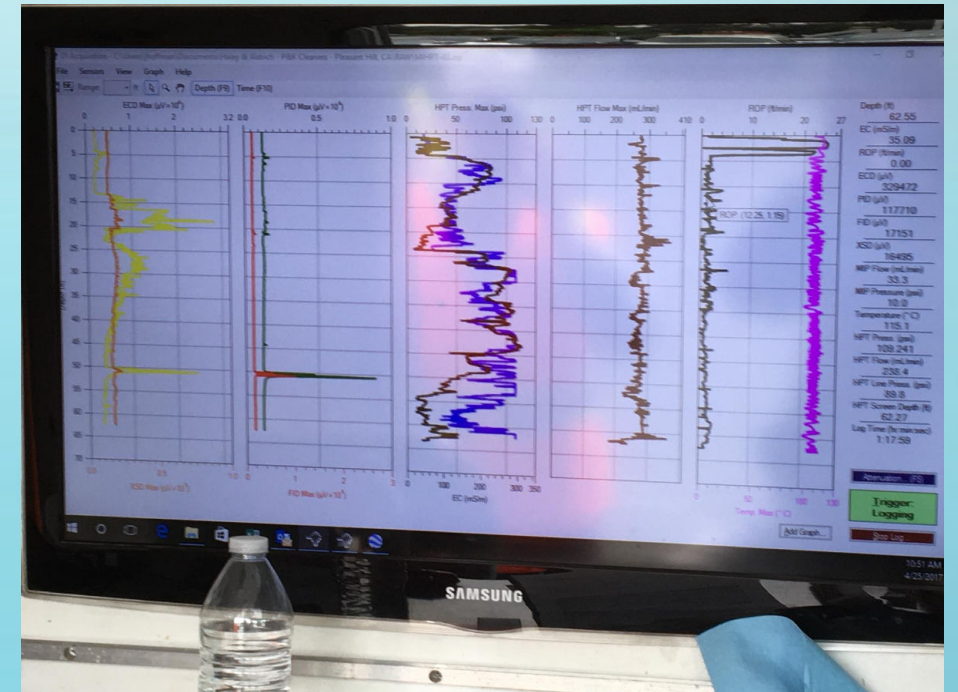
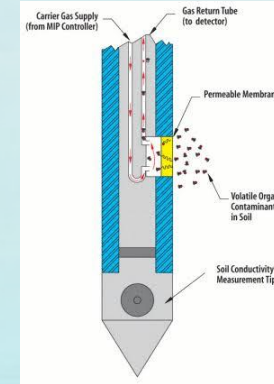
2017 Remedial Investigation



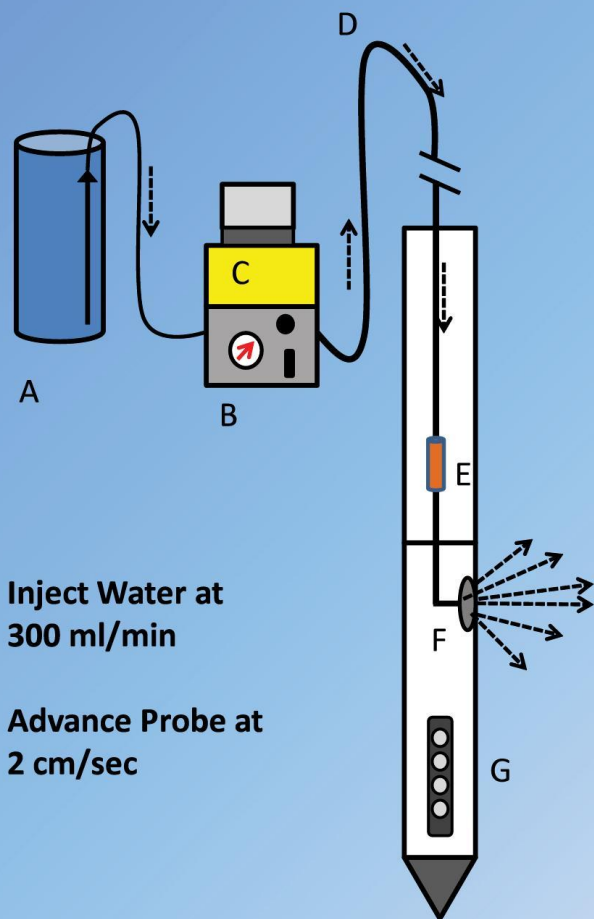
2017 Remedial Investigation



MIP and MiHPT



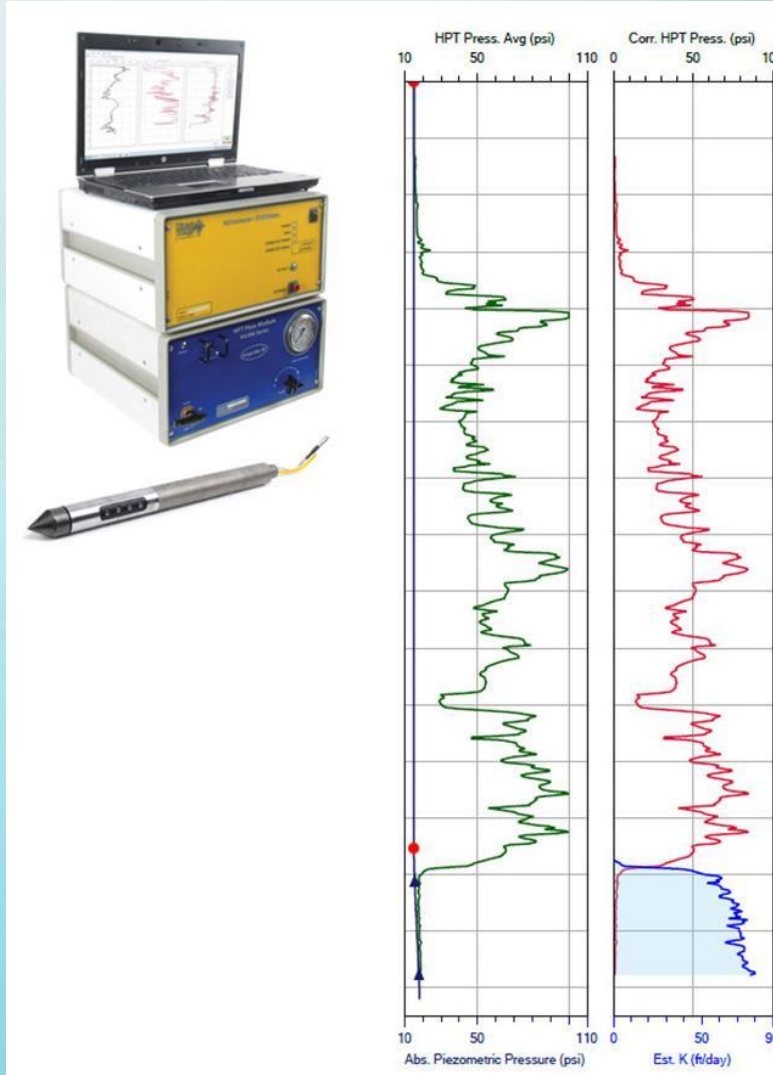
HPT Principles of Operation



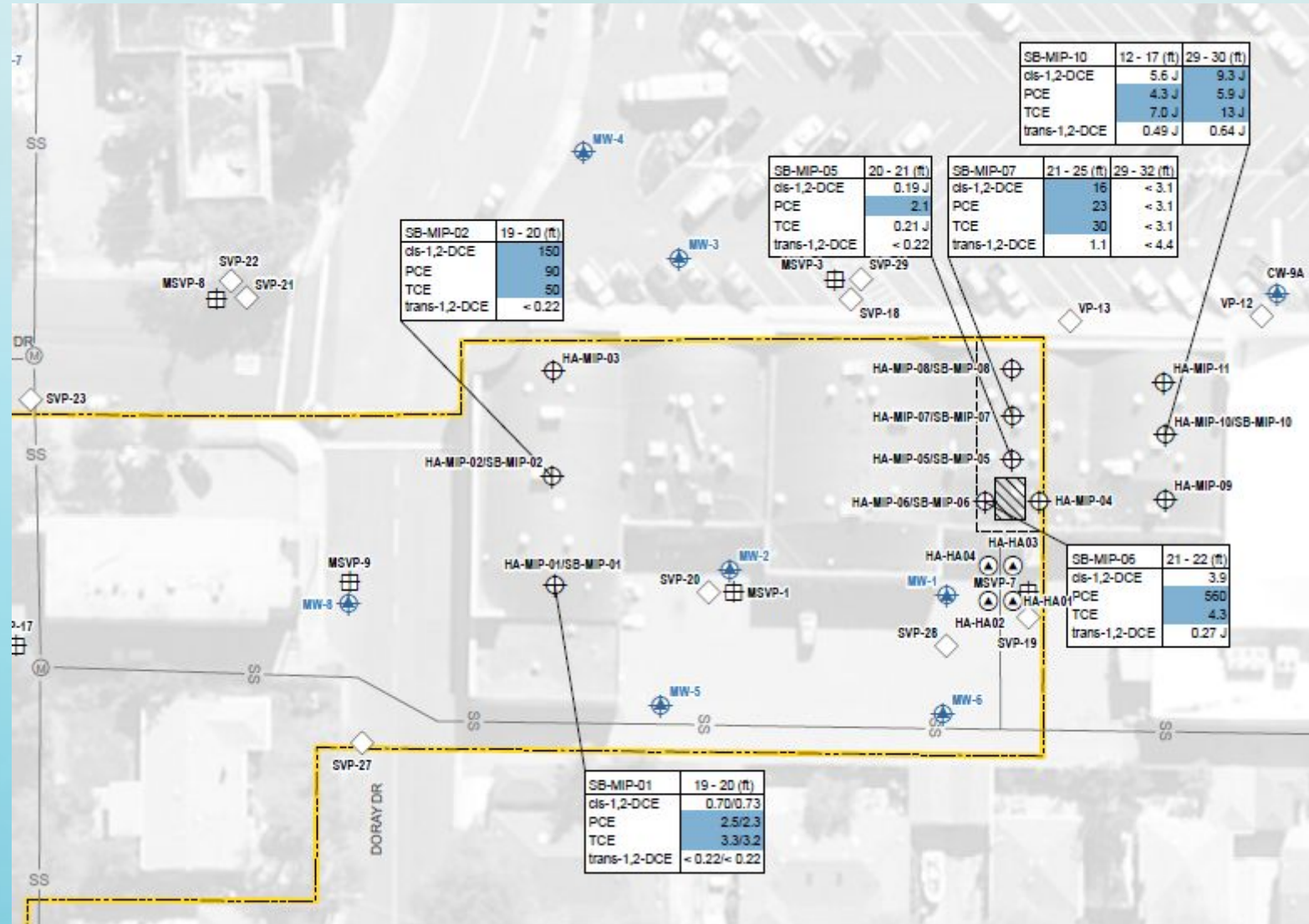
**Inject Water at
300 ml/min**

**Advance Probe at
2 cm/sec**

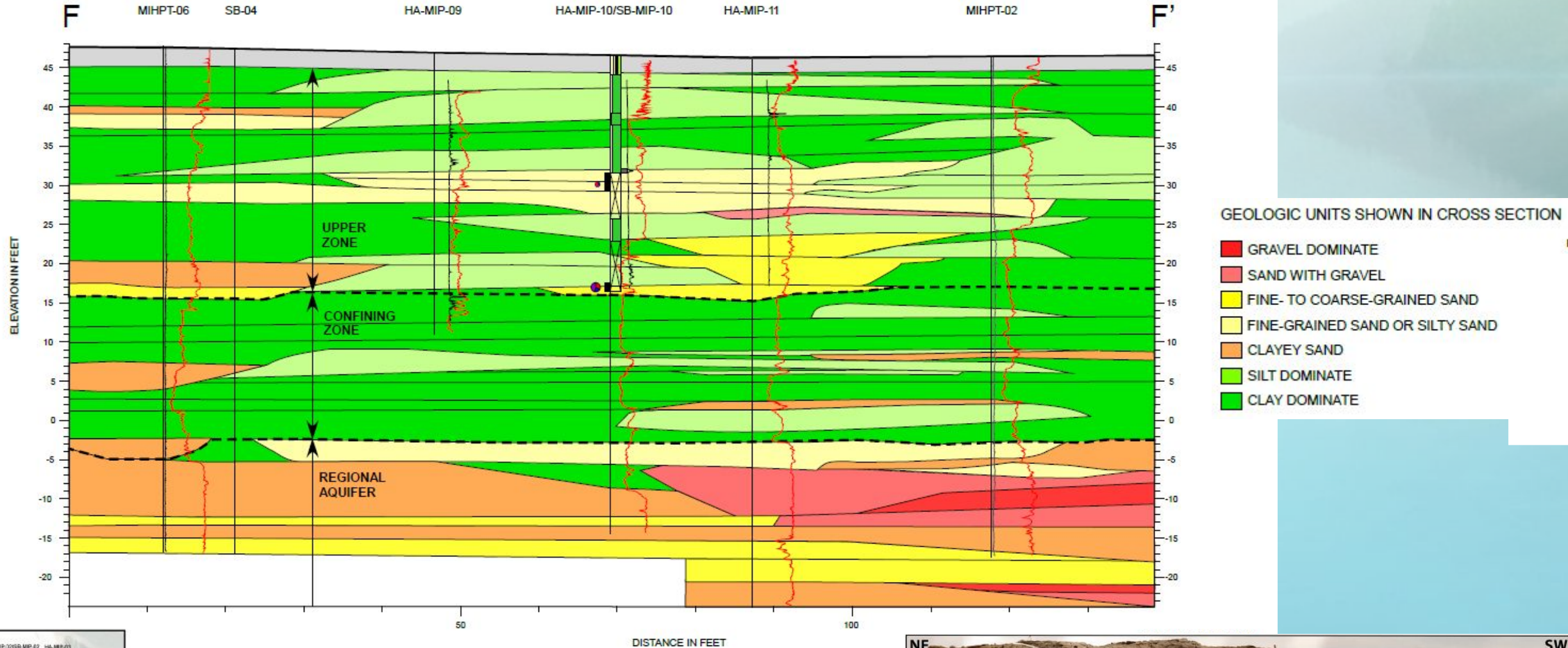
- A) Water Tank
- B) Pump & Flow Meter
- C) Electronics/computer
- D) Trunkline
- E) Pressure Sensor
- F) Screened Injection Port
- G) Elec. Conductivity Array

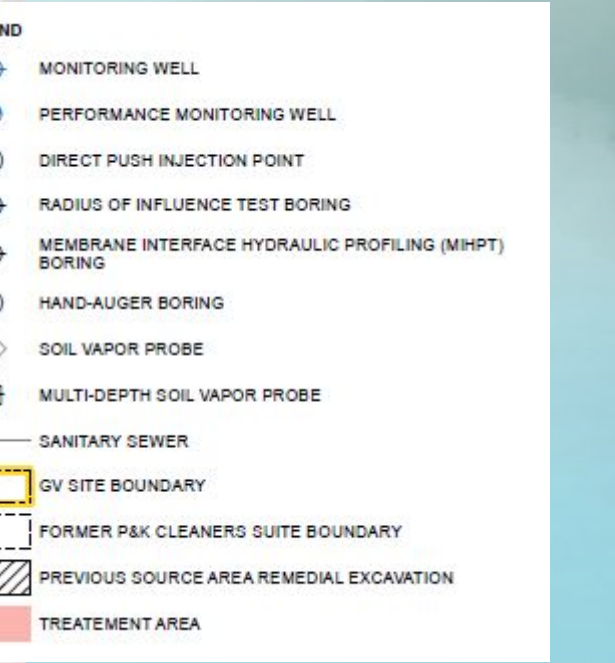


2023 Remedial Investigation

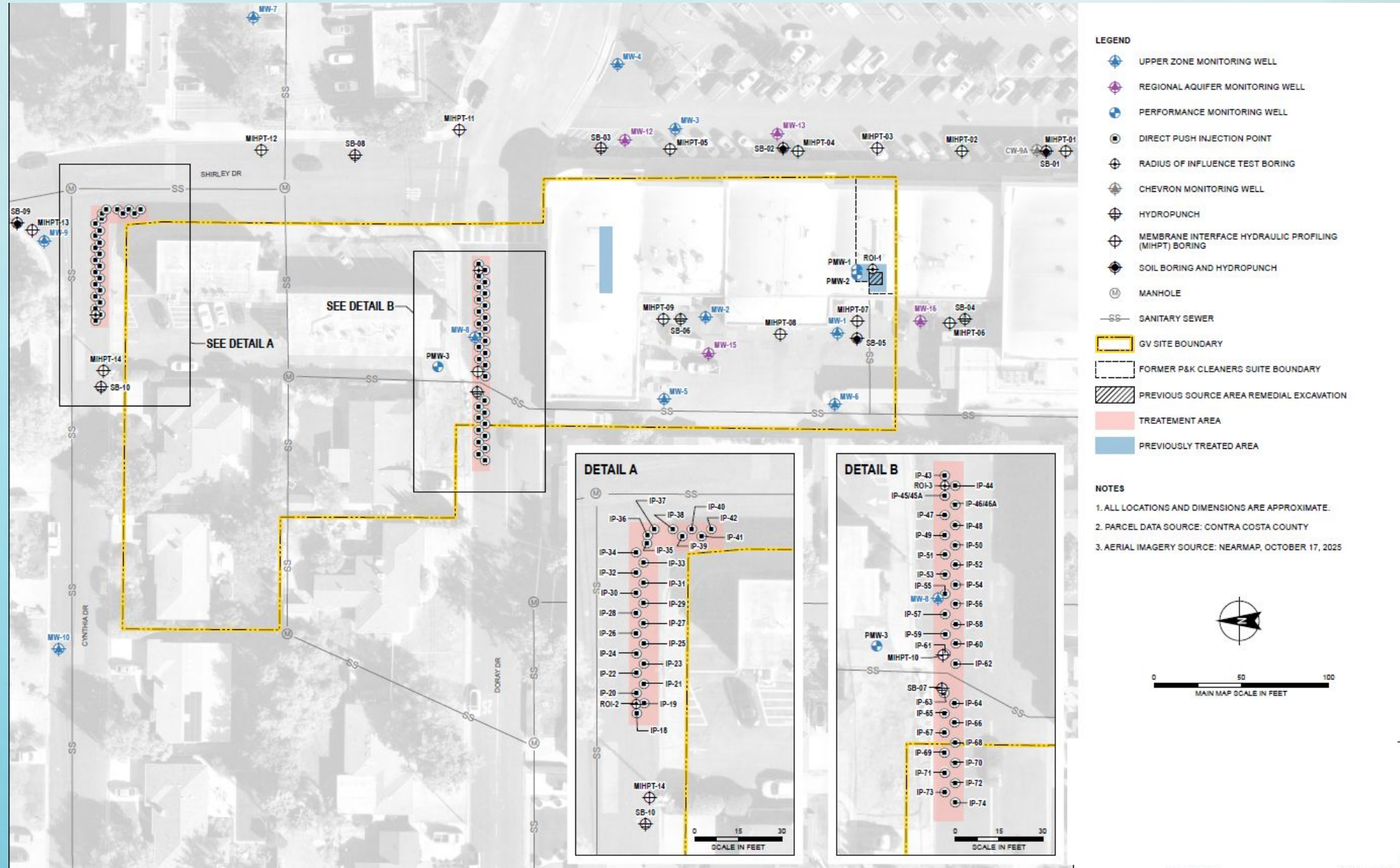


2023 Geologic Cross Section



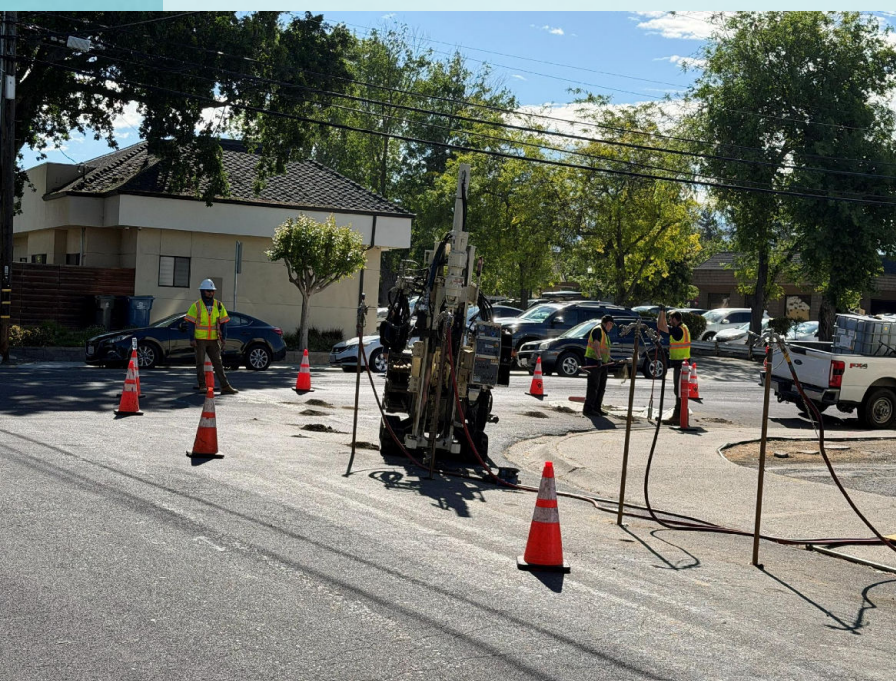


2026 Remediation – Phase II

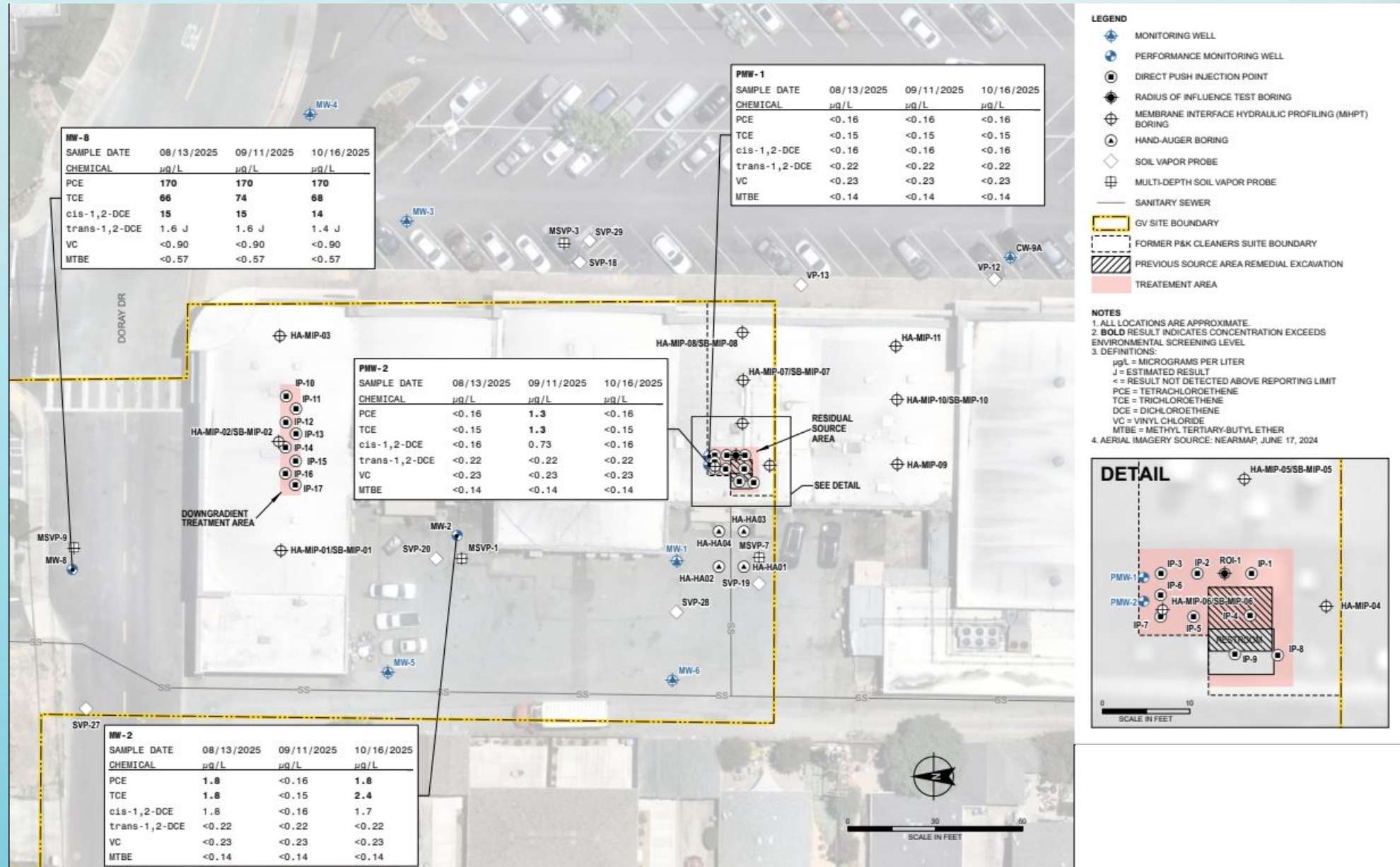


2025-2026 Remediation Photos





2026 Post-Injection Results



Closing

- **HRSC eliminates geological uncertainty** by replacing widespread monitoring with highly focused data screens.
- **Primary source identified** through MIP/MipHPT investigations.
- Understanding the micro-stratigraphy **protects remedies from failing** due to hidden and undetected storage zones (i.e., low permeability layers that trap CVOCs).
- HRSC **reduces the long-term remediation footprint**, thereby reducing costs.
- **Improves plume migration prediction** (i.e., where is the plume going?).
- **Targeted remediation** reduces the concentrations in groundwater, thereby reducing the vapor intrusion threat.



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THANK YOU!

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THE FUTURE OF LAND RECYCLING**



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your photos, insights and highlights!**



OFFICE OF BROWNFIELDS
Department of Toxic Substances Control - Cleanup in Vulnerable Communities Initiative



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LAND RECYCLING**
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