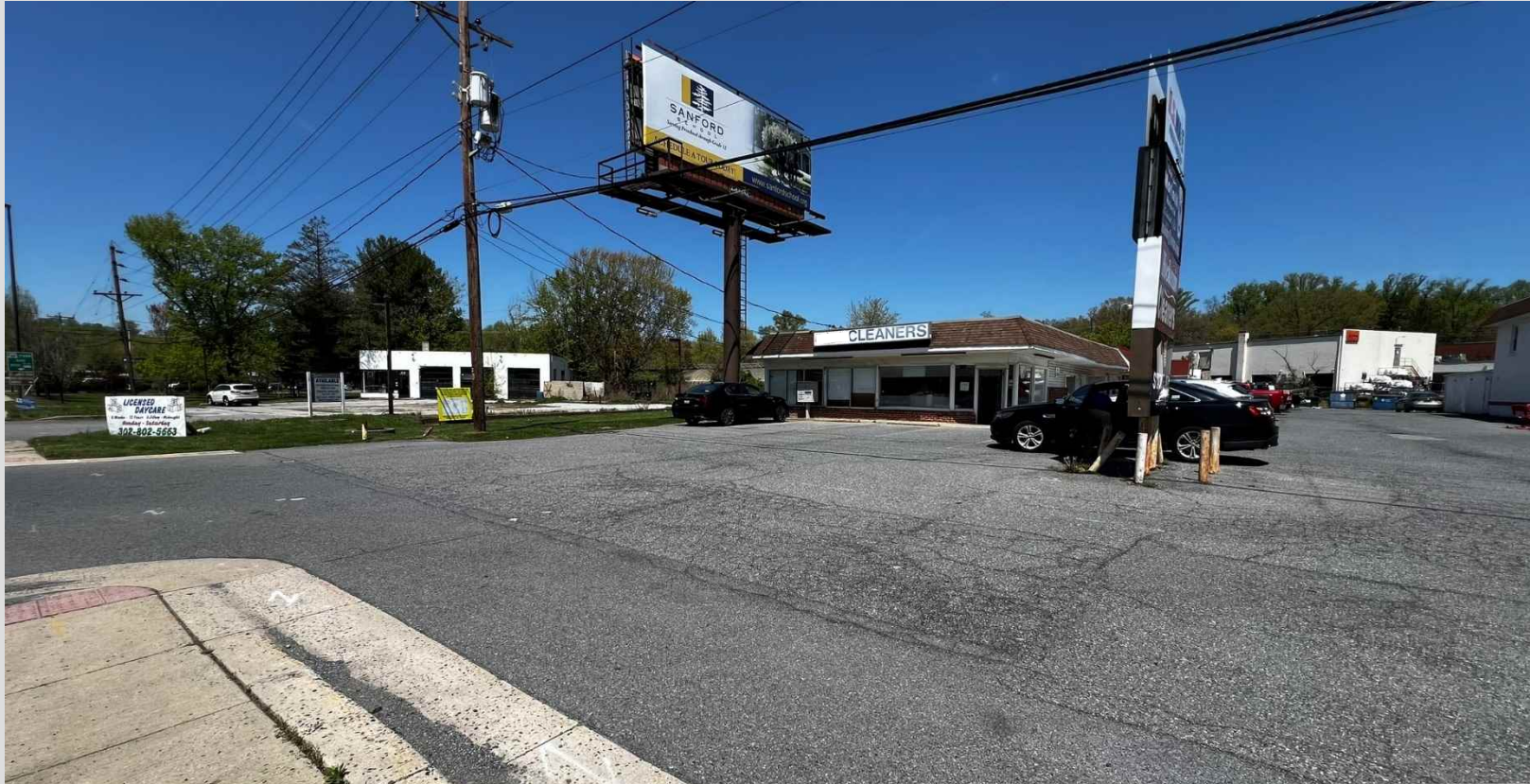


High Resolution Site Characterization for PCE Source Area to Support a Time-Critical Removal Action



Presented For:

The Thirteenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds

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Presented By:

EA[®] EA Engineering,
Science, and
Technology, Inc., PBC

Kathy Fox, P.G.

Project Setting and Background

❑ Two Active Dry Cleaners in Northern Delaware

- Commercial and residential setting
 - ❖ One located in a commercial building also occupied by a restaurant
 - ❖ Another one located in a strip mall to the south
- Past operations resulted in releases of PCE
- Impacted municipal supply well fields
 - ❖ Carbon treatment
- Impacted residential domestic wells
 - ❖ Point of Entry Treatment Systems
- Site placed on the National Priority List in May 2018



Project Setting and Background

❑ Site Comprised of Three Operable Units (OU)

- OU1 – 235 acres site-wide deep groundwater in bedrock
- OU2 – Northern dry cleaner surface/subsurface soil and shallow groundwater
- OU3 – Southern dry cleaner surface/subsurface soil and shallow groundwater



Geology and Hydrogeology

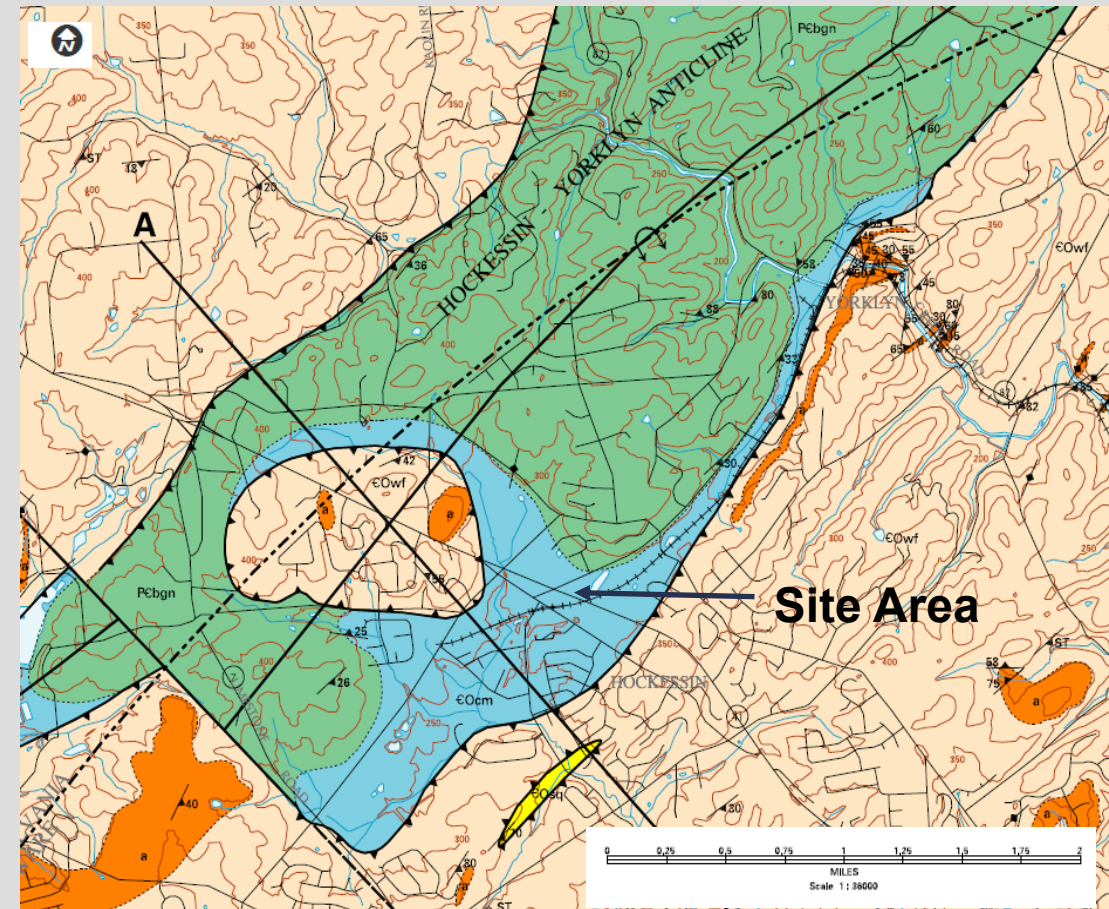
❑ Crystalline Bedrock Units

- Wissahickon Formation
- Cockeysville Marble (Dolomite)
- Baltimore Gneiss
- Highly metamorphosed, folded, and overturned forming anticlines and stacked with series of thrust faults

❑ Overburden Heterogeneous

❑ Groundwater

- Flow controlled by the municipal well field; flows to the south-southwest
- Hydraulically interconnected overburden and bedrock units

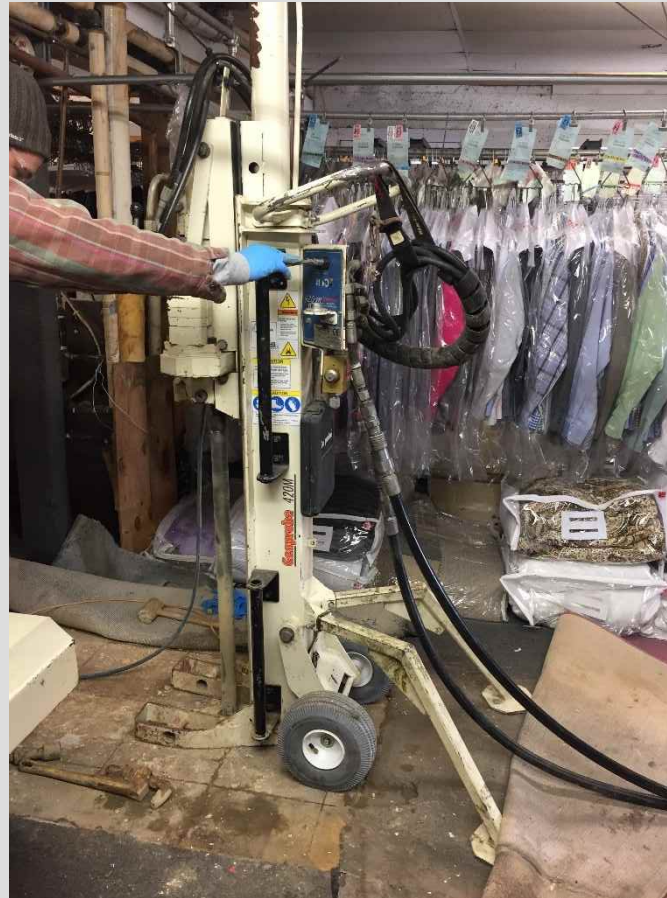


Bedrock Geologic Map of the Piedmont of Delaware and Adjacent Pennsylvania
by
William S. Schenck, Margaret O. Plank, and LeeAnn Srogi
2000

Remedial Investigation

❑ Remedial Investigation Activities

- High Resolution Site Characterization
 - ❖ MiHPT
 - ❖ Confirmatory soil and groundwater sampling
 - ❖ Surface geophysics
- Vapor Intrusion
 - ❖ Sub-slab samples
 - ❖ Indoor/outdoor air samples
- **Presentation will focus on OU2**



MiHPT inside OU2 dry cleaner building



Confirmatory sampling northwest of The OU2 dry cleaner building

High-Resolution Site Characterization

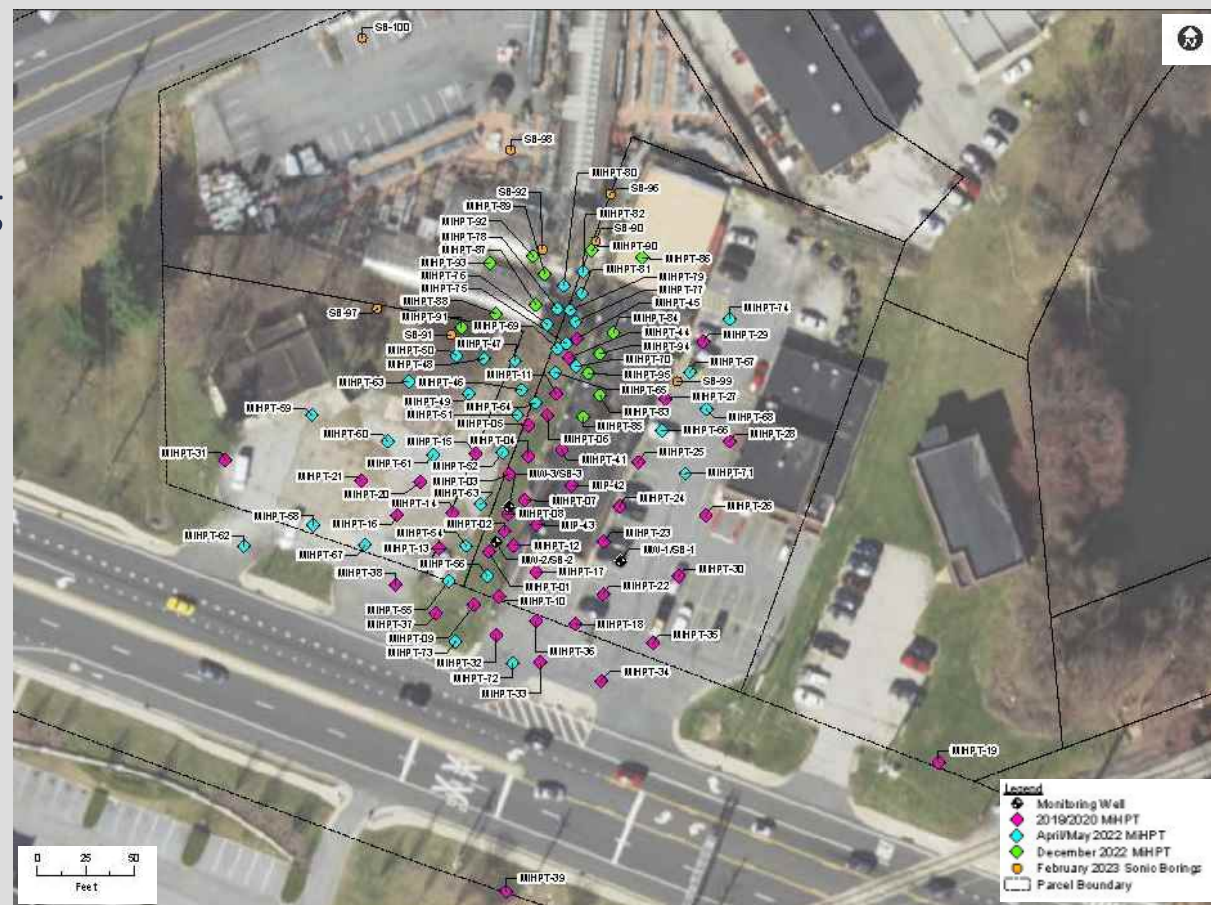
□ Membrane Interface Probe (MIP)

- 95 borings using Geoprobe™
 - ❖ 12 of the 95 borings were inside the building and greenhouses
 - ❖ Depths ranged from 25 to 75 feet (ft) below ground surface (bgs)

□ Confirmatory Sampling

- 108 soil and 45 groundwater samples using sonic drilling
 - ❖ Collected soil at various depths - MIP responses and boring termination
 - ❖ Collected groundwater at boring termination

□ Bedrock Ranged From 48 to >200 ft bgs



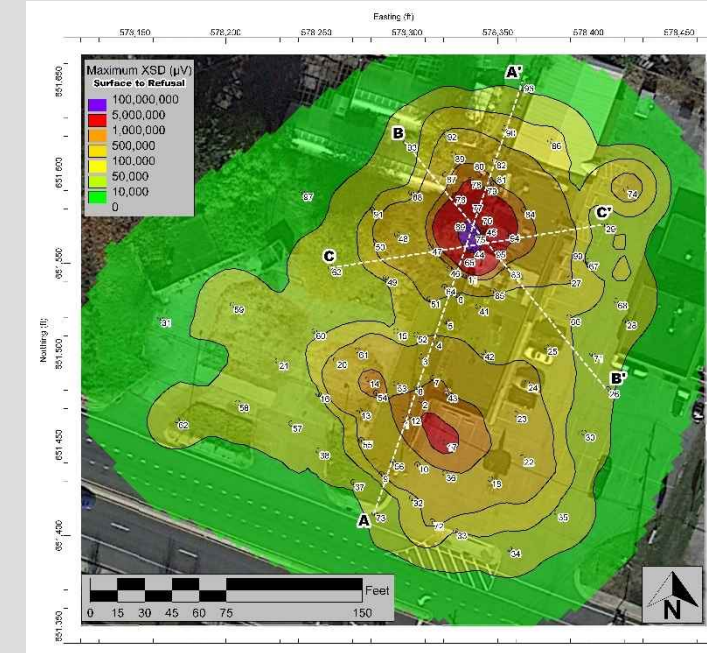
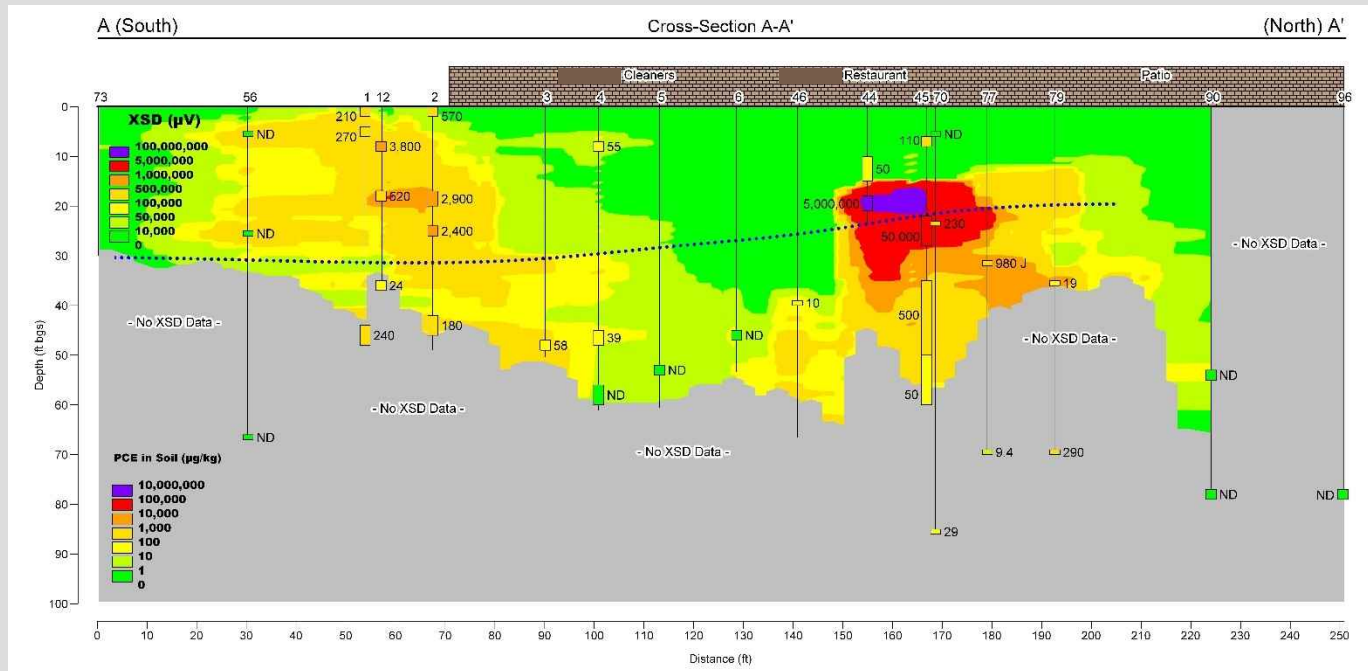
High-Resolution Site Characterization

□ MIP Results

- XSD responses ranged from 10^4 to 10^7 μV
- Two source areas identified with significant XSD responses $>10^5$ μV
 - ❖ Observed within upper 20 ft southwest corner of dry cleaner building
 - ❖ Observed at depths ranging from 18 ft to 60 ft bgs northwest of dry cleaner
 - ❖ Localized zone of DNAPL (10^7 μV) at 18 ft bgs at one boring
- Horizontal extent of PCE plume delineated



High-Resolution Site Characterization



Line of Section

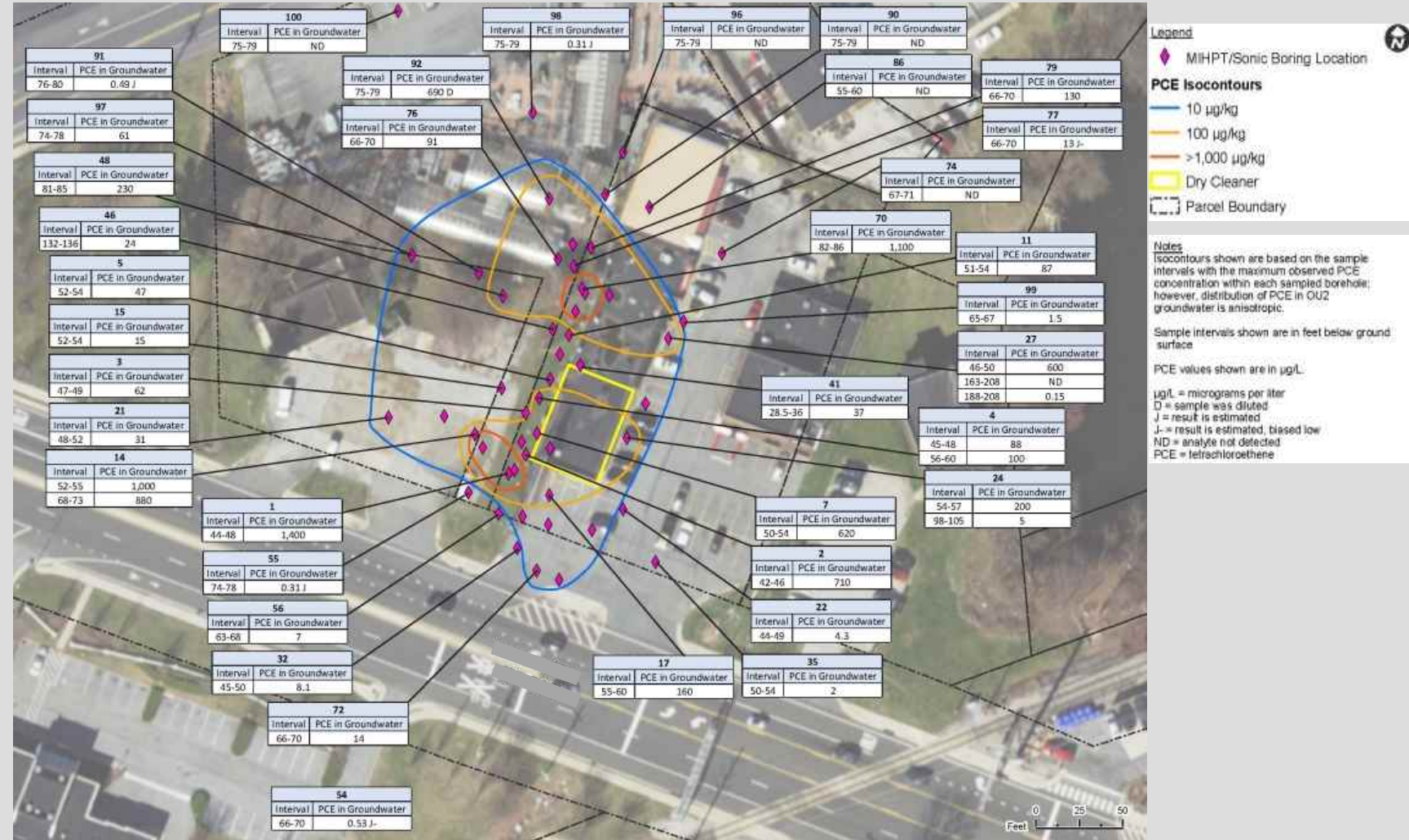
Confirmatory Soil Sampling Results Comparable to XSD Responses

- PCE concentrations ranged from non detected (ND) to 5,000,000 parts per billion (ppb)
- Two significant source areas
 - ❖ Upper 20 ft southwest
 - ❖ Significant mass between 18 and 60 ft northwest and under the footprint of the building

High-Resolution Site Characterization

Confirmatory Groundwater Sampling

- PCE concentrations ranged from ND to 1,400 ppb
- Source area concentrations
 - ❖ Southwest - 1,400 ppb at 44-48 ft bgs
 - ❖ Northwest – 1,100 ppb at 82-86 ft bgs



High-Resolution Site Characterization

□ Surface Geophysics to Map Top of Cockeysville Marble

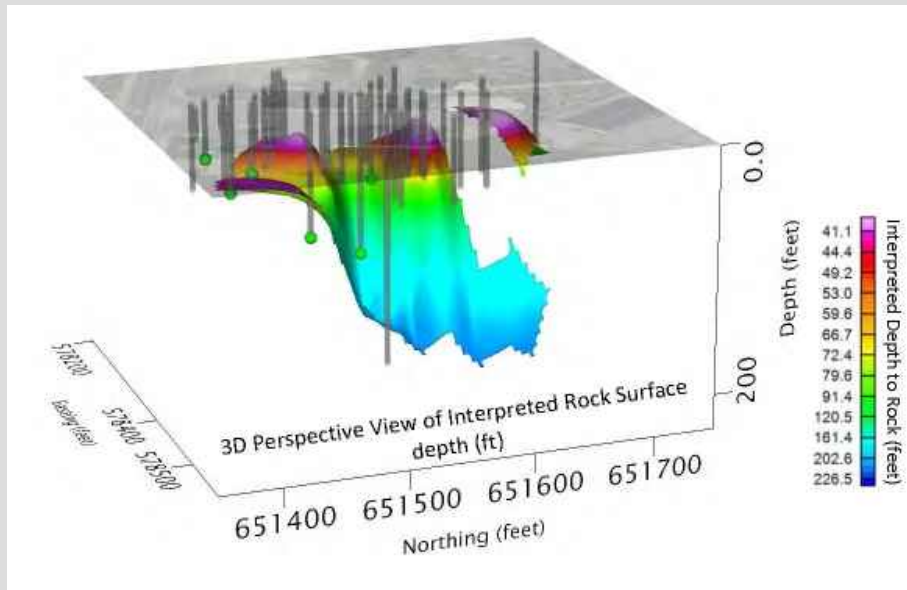
- Multi-channel analysis of surface waves (MASW) mapping tool
- Model the shear-wave velocities of the subsurface based on measured surface waves
- Collected 40 sounding locations in 4 grids
- MASW data was processed using a surface wave recognition and modeling program
- Other surface geophysical mapping tools used but unsuccessful



Green X represents MASW locations
Image provided by Schnabel

High-Resolution Site Characterization

- MASW was able to map top of bedrock at a minimum depth of 42 ft and greater than 200 ft
- Bedrock is deeper than MASW was able to image north-northwest and east of building
- 3D perspective view of bedrock greater than 200 ft



Note – No vertical exaggeration for this image

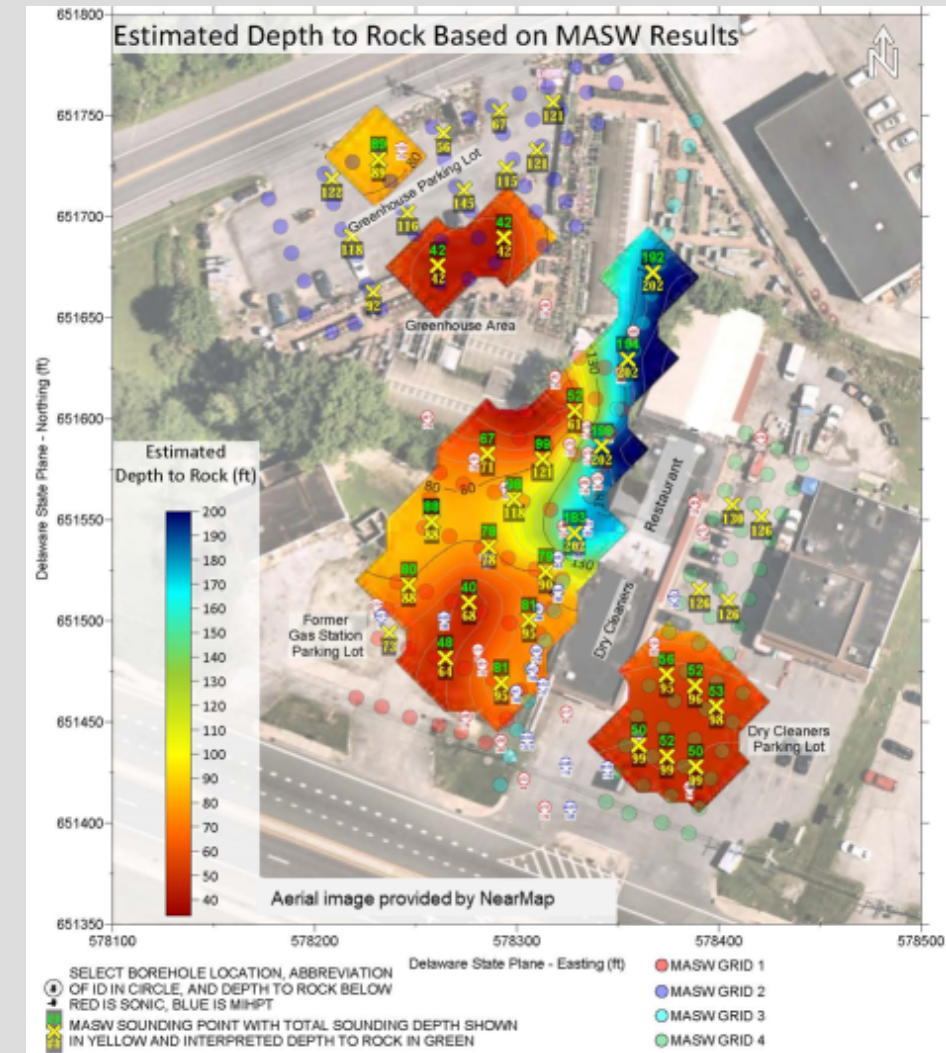


Image and figure provided by Schnabel

Vapor Intrusion and Results

- ❑ 7 indoor, 6 sub-slab, 2 soil gas, and 1 ambient air samples collected at OU2
- ❑ Samples deployed for an 8-hour period
- ❑ Maximum PCE concentration – dry cleaner
 - Sub-slab – 99,000 $\mu\text{g}/\text{m}^3$
 - Indoor air – 8.8 $\mu\text{g}/\text{m}^3$
- ❑ Restaurant had low levels of PCE
- ❑ PCE not detected in greenhouse or former gas station samples
- ❑ Results indicate that a risk of high vapor intrusion exists for the dry cleaner



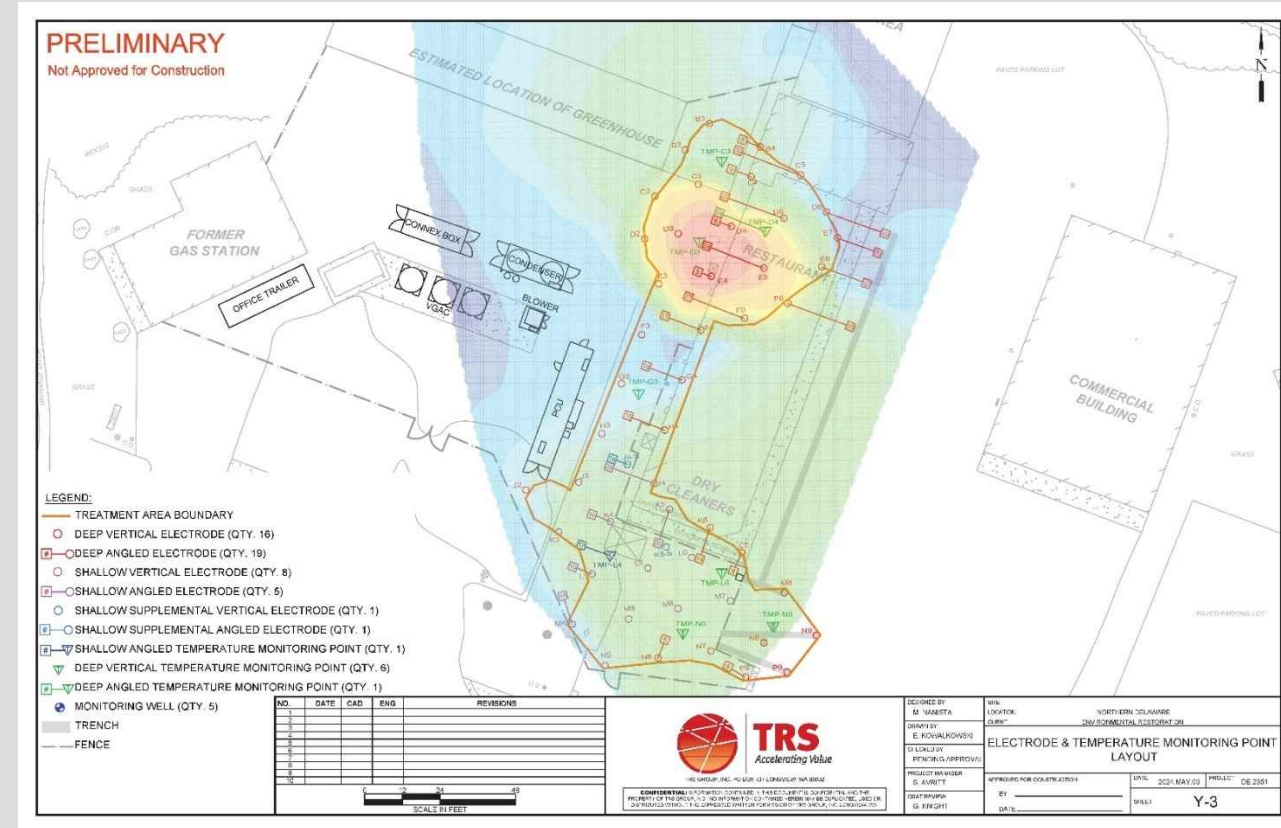
Time-Critical Removal Action

- ❑ **Demonstrate an Imminent and Substantial Threat to Public Health and the Environment of an Uncontrolled Hazardous Substance**
 - OU2 results indicate
 - ❖ High PCE concentrations in the soil at two source areas
 - ❖ Residual DNAPL
 - ❖ Impact to groundwater and municipal well field and residential potable drinking wells
 - ❖ Unacceptable risk for vapor intrusion at the dry cleaner
 - Conditions at the site meet the requirements and the data was used to support an Action Memo for a Time-Critical Removal Action
- ❑ **Mitigate the Imminent Threats Posed by the Release of PCE into the Subsurface at the Site**
- ❑ **EPA Approved the Action Memo for a Time-Critical Removal Action**

Time Critical Removal Action

❑ Electrical Resistivity Heating

- Utility delays
- Start up 4Q24
- Preliminary layout to address both source areas and under the footprint of the building
 - ❖ Southwest source area – 9 vertical and 6 angled electrodes to address the shallow mass in the upper 20 ft
 - ❖ Northwest source area - 16 vertical and 19 angled electrode to address the deeper mass from 18 to 60 ft in depth
 - ❖ Each electrode co-located with soil vapor extraction wells



Thank You!



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