



Implementation of a Strategic Approach for Vapor Intrusion Assessment and Mitigation along a 1,200-foot long Trichloroethene Groundwater Plume

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Abstract

Background/Objectives. Historical operations at a manufacturing facility resulted in the release of trichloroethene (TCE) to groundwater, ultimately resulting in a 1,200 feet long TCE plume migrating beneath commercial and residential properties. TCE was present in shallow groundwater at concentrations suggestive of possible vapor intrusion risk. Two commercial and 36 residential homes were identified to be at risk for vapor intrusion.

Approaches/Activities. In cooperation with stakeholders and state officials, a strategic approach was developed to evaluate and mitigate potential vapor intrusion risk along the TCE groundwater plume, facilitated by the collection of soil gas, sub slab soil gas and indoor air samples.

Results/Lessons Learned. Vapor mitigation challenges included structural building issues (e.g., brick-lined basements, sub-slab HVAC systems, etc.) disinterested property owners, a global pandemic, and commingled groundwater plumes. This case study presents the technical and community challenges, and lessons learned, associated with vapor assessment and mitigation in industrial and residential settings.

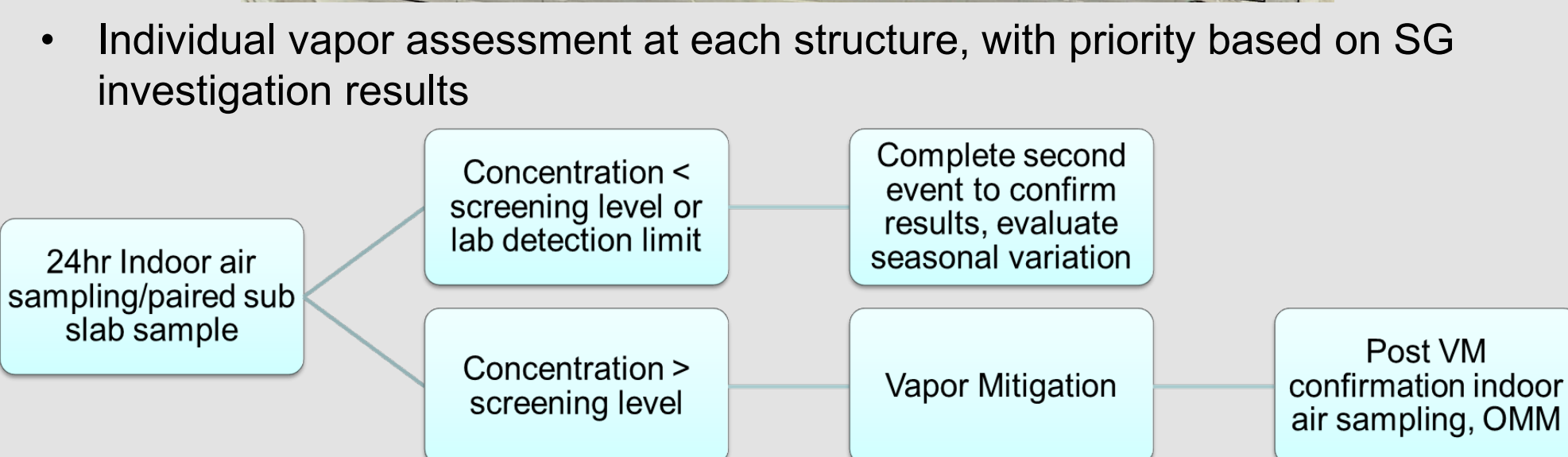
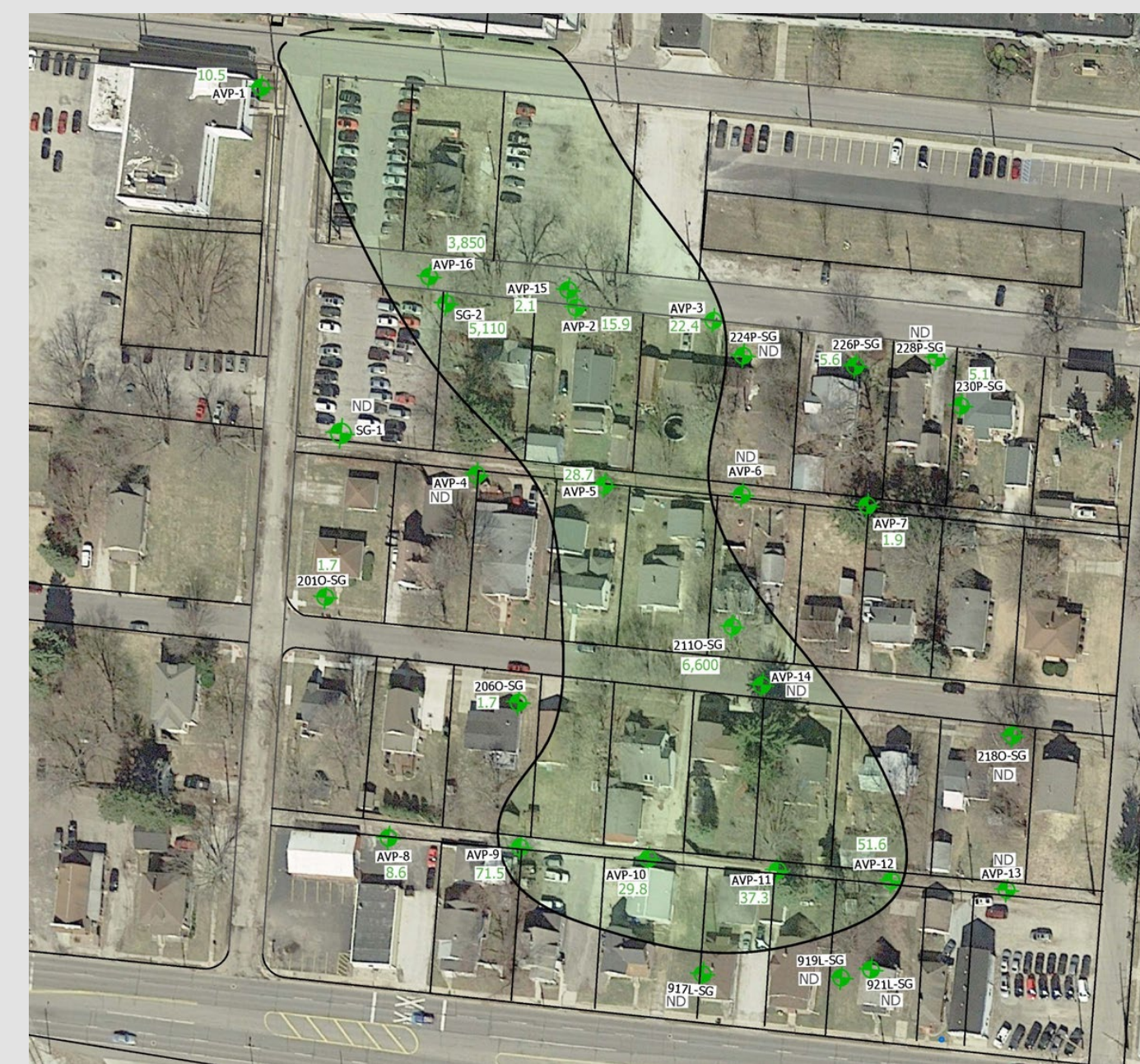
Introduction

- Approximately 242,000 ft² manufacturing facility
- Historical manufacturing processes utilized trichloroethene (TCE) as part of operations during WWII
- Property currently operates as a manufacturing facility that does not use VOCs in any processes
- 2017 – 2022: Investigations completed both on and off-Site
 - Sand box geology with sand & gravel to depths > 150 feet
 - Water table at approximately 20 feet below grade
 - Investigations conducted to:
 - Delineate horizontal and vertical distribution of soil and groundwater cVOC impacts
 - Evaluate on-Site and off-Site vapor assessment/intrusion
 - On-site interim remedy
 - Installation and operation of soil vapor extraction (SVE) system
 - SVE remedies soil impacts and serves as on-Site vapor mitigation system
 - Off-Site soil vapor assessment
 - Installation of vapor mitigation systems at problematic homes
- Release resulted in a 1,200-foot long TCE plume
- TCE concentrations in groundwater of 1 µg/L can create sub slab vapor concentrations of >150 µg/m³



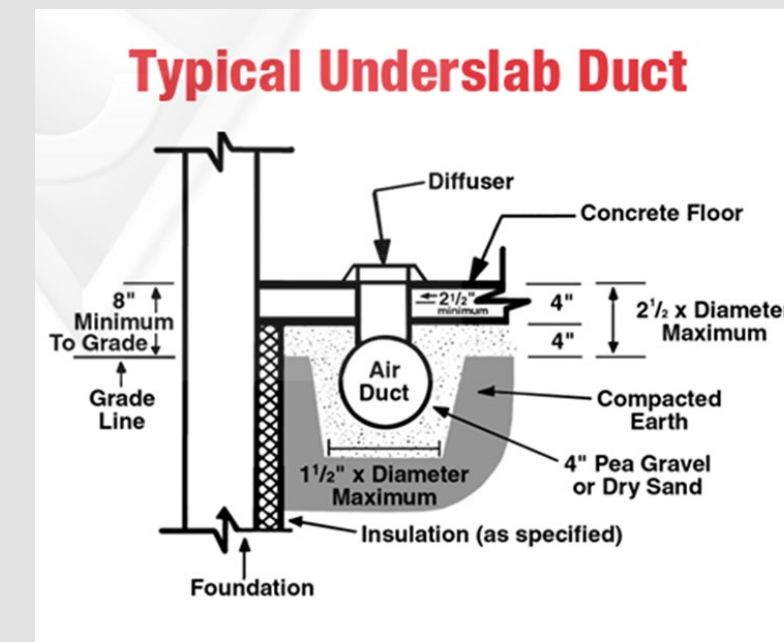
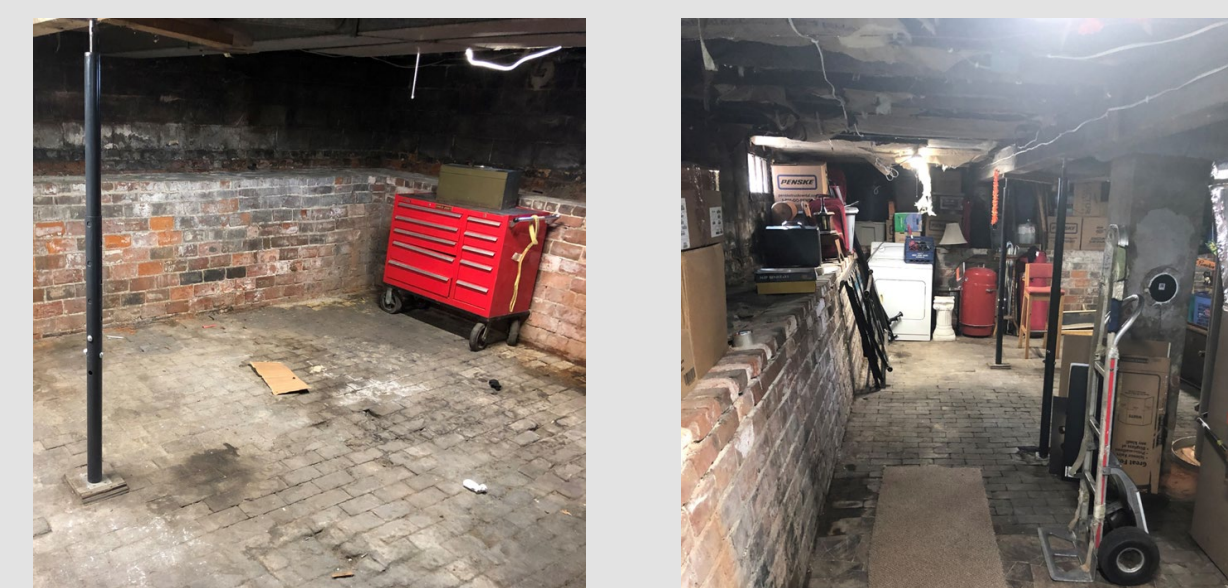
Methodology

- Based on groundwater impacts a soil gas (SG) investigation was conducted
- SG results used to determine potentially impacted homes
- State screening level was 70 µg/m³



Vapor Mitigation Challenges

- “Michigan style” basements
 - Crawl space converted to basement, often hand dug
 - Dirt or brick lined basement floors, open conduit to vapors
- Weeping” basements
 - Sumps and moisture collection systems which collect moisture/water infiltration
 - Preferential pathway
 - Short circuit vapor extraction
- Sub slab HVAC piping
 - Preferential pathway
 - Short circuit vapor extraction



Vapor Mitigation Strategies & Results

“Michigan Style” Basement

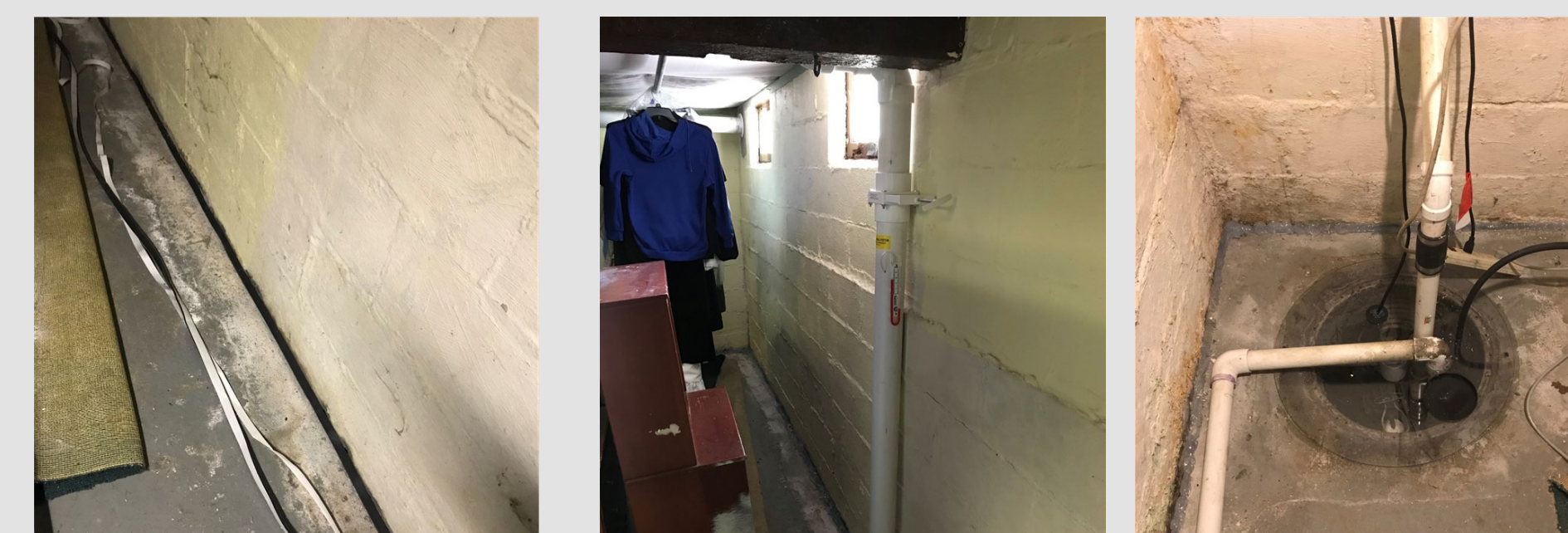
- The magnitude of preferential pathways made simple SSDS problematic
- Initial 160 ft² heat recovery/ventilation (HRV) system installed
 - Confirmation sampling results above screening levels
- Replaced with larger HRV and Fantech Eco-Touch Controller for greater air exchange
 - Confirmation sampling results failed over two separate events, equal distribution during heating season
- Abandoned HRV and installed a sub-membrane depressurization system (SMDS)
 - Installation of 20-mil vapor barrier placed over treated wood frame built upon brick floor and walls
 - OSB wood panels used to cover floor and wall to protect vapor barrier
 - Fan connected to two extraction points sealed to and below the membrane
 - Confirmation sampling confirmed efficacy



	Initial Investigation	Post HRV Install	Post HRV Modification	Post 2 nd HRV Modification	Post SMDS Install	Additional Confirmation
Basement	36.9	21.8	33.3	48.3	ND	ND
1 st Floor	24.7	2.9	13.6	40.3	Not sampled	ND

“Weeping” Basement

- Initial HRV system installed
 - Confirmation sampling results above screening levels
- Abandoned HRV and installed sub-slab depressurization system
 - Sealed the open channels of the moisture capture system
 - Fortunately, new HVAC system reduced moisture in basement and channels not needed
 - Replaced sump cover lid with an airtight model
 - Installed two extraction points into the basement slab
 - Confirmation sampling confirmed efficacy

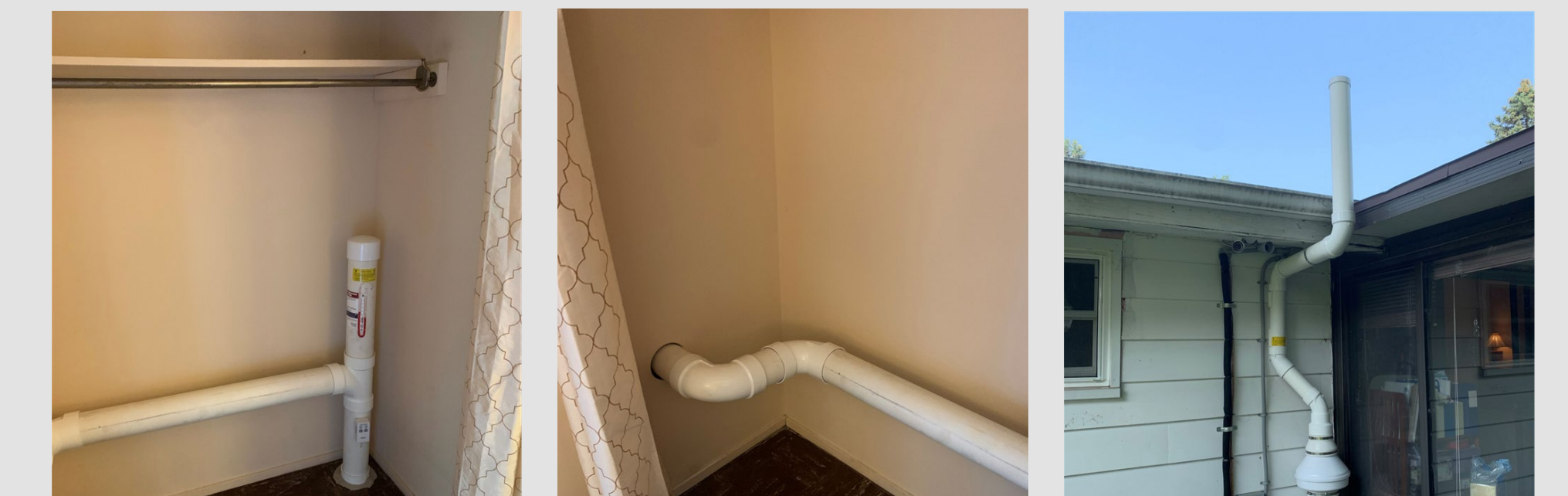


	Initial Investigation	Post HRV Install	Post HRV Additional	Post SSDS Install	Additional Confirmation
Basement	9.0	4.5	4.9	ND	ND
1 st Floor	1.6	1.4	4.0	ND	ND

Vapor Mitigation Strategies & Results

Sub Slab HVAC Piping

- In floor duct work
 - Depth of duct work below slab ruled out a horizontal extraction point into the foundation wall
 - Luckily, the duct work did not have major cracks/separations which could act as preferential pathways, or short circuit the SSDS
- SSDS installed in interior closet
 - Extraction point “inside” of the HVAC ductwork “loop”
 - Confirmation sampling confirmed efficacy



	Initial Investigation	Post SSDS Install
1 st Floor	2.54	ND

Summary

- TCE groundwater impacts resulted in elevated TCE soil gas concentrations
- Installation of SVE system effectively mitigated VI at the subject Site
- Off-Site soil gas screening investigation identified 36 homes and 1 commercial building within VI risk area
- Off-Site indoor air sampling confirmed VI was occurring in residential area
 - A total of 19 properties accessed
- Some of the community was averse to vapor assessment and remediation
- Structural designs of residences caused VM challenges
- Confirmation testing at VM Sites identified compliance with indoor air standards

Lessons Learned

- Various building construction types which present mitigation challenges
 - Be willing to pivot from a technology that isn’t demonstrating effectiveness
- Get the best understanding of house construction details prior to proceeding with mitigation
- You must be flexible to adjust to pandemic/post-pandemic restrictions for safe work practices
- Utilizing the State Agency for access can be beneficial in some events
- When someone says “Over my dead body”, they probably mean it... move on to the next house