

A Navy Vapor Intrusion Case Study Post-Mitigation



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Background

- Site – Former Drum Management Area (1940s to 1970s)
- VOCs in soil & groundwater
- On-Site air-sparging / soil vapor extraction system
 - Operated 1998 to 2002
 - Reduced ppm-level VOCs in groundwater to near MCLs



Background

- Coarse-grained sands and gravels
- Groundwater ~ 50 ft
- Low organic carbon content
 - Little retardation or degradation
- Clay lens in SE corner of site
 - SVE ineffective in SE corner of site
- Soil vapor investigation at fence line and adjacent neighborhood
 - Risk communication



Soil Vapor Investigation

- On-site fence-line soil vapor
 - TCE 19,000 $\mu\text{g}/\text{m}^3$ at ~ 8 ft bgs
 - TCE 180,000 $\mu\text{g}/\text{m}^3$ at ~20 ft bgs
- Off-site soil vapor
 - TCE 34,000 $\mu\text{g}/\text{m}^3$ at ~ 8 ft bgs
 - TCE 89,000 $\mu\text{g}/\text{m}^3$ at ~20 ft bgs
- Higher concentrations at depth
- Soil vapor concentrations generally decrease rapidly from site
 - TCE < 5 $\mu\text{g}/\text{m}^3$ within 1.5 blocks



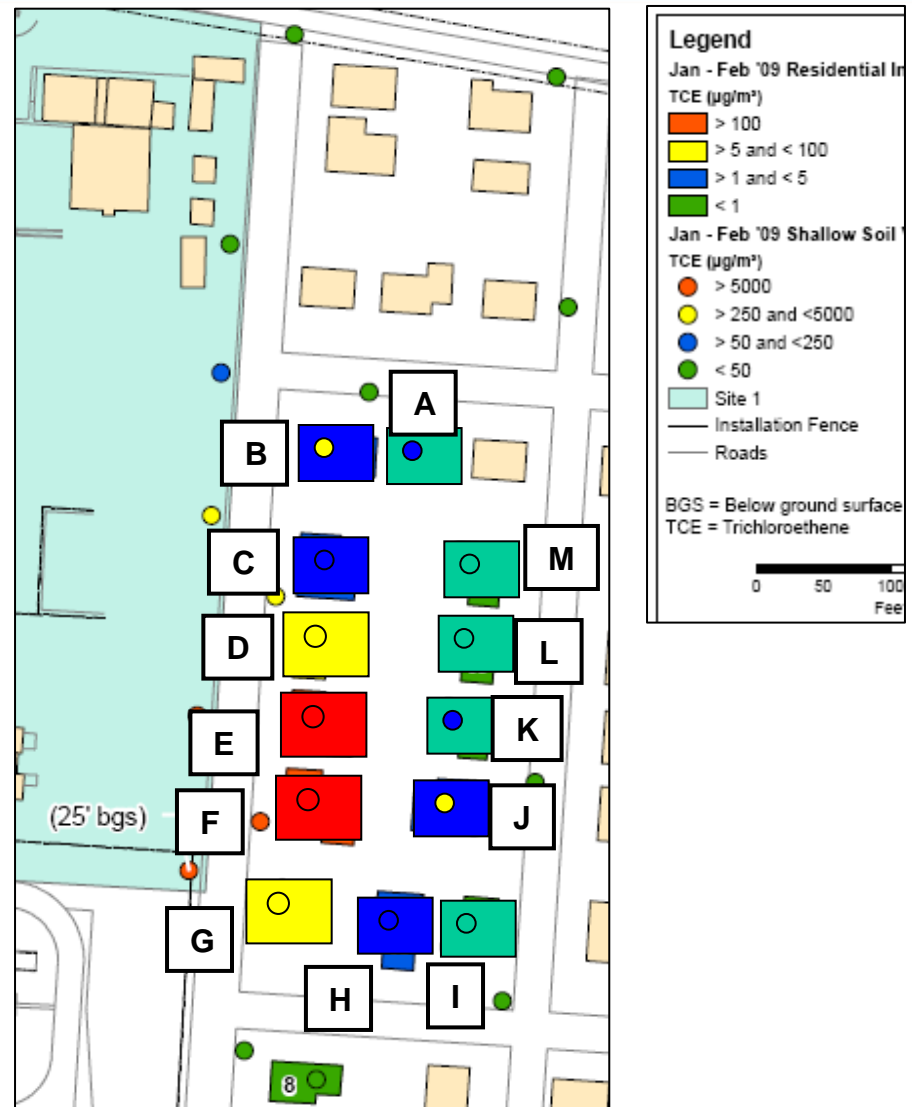
Vapor Intrusion Investigation

- Sub-slab, indoor & outdoor air
 - Summa canisters 6-liter, 24 hour
 - TO 15 analysis



Vapor Intrusion Investigation

- Sub-slab TCE = 160 to 15,000 $\mu\text{g}/\text{m}^3$
- Indoor air TCE = 2.2 to 180 $\mu\text{g}/\text{m}^3$
- Outdoor air
 - TCE not detected (Jan-Feb)



Mitigation Matrix

Soil Vapor/Indoor Air Matrix 1 October 2006

SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m ³)	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m ³)			
	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

http://www.health.state.ny.us/environmental/investigations/soil_gas/svi_guidance/

Mitigation

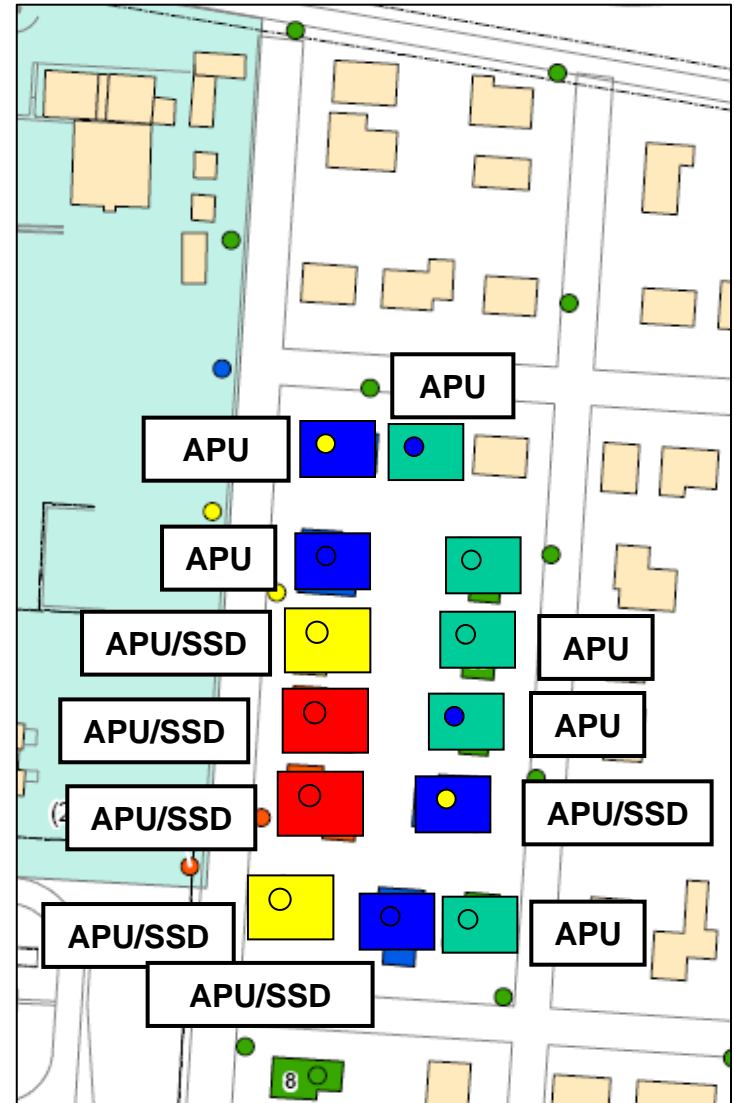
- Installed activated carbon air purifying unit (APU) in basement of 12 homes
 - Second unit also installed in living space in 2 of the homes



- Installed sub-slab depressurization systems in 6 of the 12 homes

Mitigation

- APU recommended if indoor air TCE > 5 $\mu\text{g}/\text{m}^3$
 - APU installed at resident request if TCE detected
- Sub-slab depressurization systems recommend to residents with sub-slab soil vapor > 250 $\mu\text{g}/\text{m}^3$
- On-site SVE system at source
 - Design/construction in progress
 - Operational Dec 09



Mitigation Monitoring

- APU Performance

- Average ~80% reduction in TCE concentration

TCE concentration $\mu\text{g}/\text{m}^3$

APU Basement Install

Jan 09	Jan 09	Feb 09	Feb 09	March 09	March 09
subslab	Basement 1	1 st Floor 1	Basement 2	1 st Floor 2	Basement 3
16,000	140	100	46	3.1	4.2

Subslab	Basement 1	1 st Floor 1	Basement 2	1 st Floor 2	1 st Floor 3
13,000	180	110	34	32	2.8

Shaded value exceeds State indoor air guideline

APU 1st Floor Install



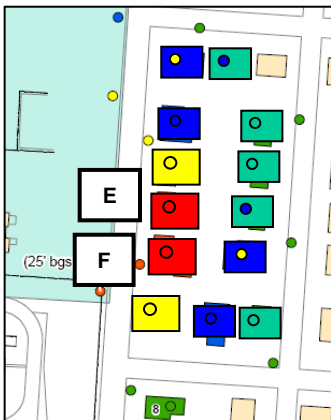
Mitigation Monitoring

- **Install Sub-slab Depressurization Systems (May 09)**
 - Stack flow rates 28 to 31 cfm
 - Installation/startup pressure readings demonstrate system function
- **Collect air stack and indoor/outdoor air samples**
 - June and August 09
 - Next sampling planned Nov 09



Mitigation Monitoring

- Post-SSD - ~ 35% reduction (**less than expected**) from sub-slab (Jan 09) to SSD stack (Aug 09)
 - Significant rainfall prior to sampling
- Slight indoor air increase March - June
 - Some residence turned down APUs due to noise



Results for homes nearest source

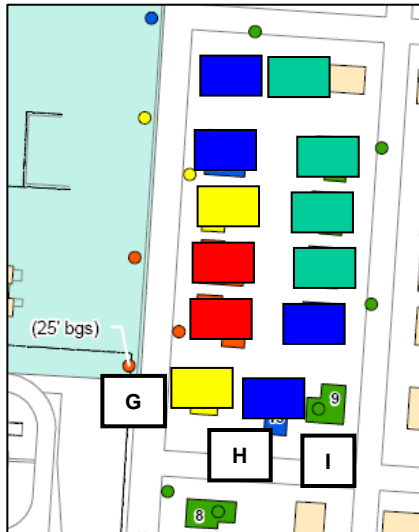
House # E		TCE $\mu\text{g}/\text{m}^3$
Sub-slab	1 (Jan 09)	16,000
	1 (Jan 09)	140
APU Install		
Basement	2 (Feb 09)	46
	3 (Mar 09)	4.2
	SSD Install	
	4 (June 09)	61
APU Install		
1st Floor	5 (Aug 09)	41
	1 (Feb 09)	100
	APU Install	
	2 (Mar 09)	3.1
SSD Install		
SSD Stack Air	3 (June 09)	9.2
	3 (Aug 09)	3.4
SSD Stack Air	1 (June 09)	11,000
	2 (Aug 09)	12,000

House # F		TCE $\mu\text{g}/\text{m}^3$
Sub-slab	1 (Jan 09)	13,000
	1 (Jan 09)	180
APU Install		
Basement	2 (Feb 09)	34
	3 (Mar 09)	32
	4 (April 09)	52
	SSD Install	
1st Floor	5 (June 09)	79
	6 (Aug 09)	27
	1 (Feb 09)	110
	APU Install	
SSD Stack Air	2 (Mar 09)	2.8
	SSD Install	
	3 (June 09)	16
SSD Stack Air	3 (Aug 09)	9.9
	1 June 09)	7,700
SSD Stack Air	2 (Aug 09)	10,000

Mitigation Monitoring

- Post-SSD samples
 - 69-89% reduction from sub-slab (Jan 09) to post-SSD stack (Aug 09)

Results for homes farther from source



House # G		TCE $\mu\text{g}/\text{m}^3$
Sub-slab	1 (Jan 09)	1,400
Basement	1 (Jan 09)	6.8
	APU Install	
	2 (Feb 09)	1.2
	SSD Install	
	5 (June 09)	3
1st Floor	1 (Feb 09)	6.1
	APU Install	
SSD Stack Air	2 (Mar 09)	1.1
	1 June 09)	160
	2 (Aug 09)	360

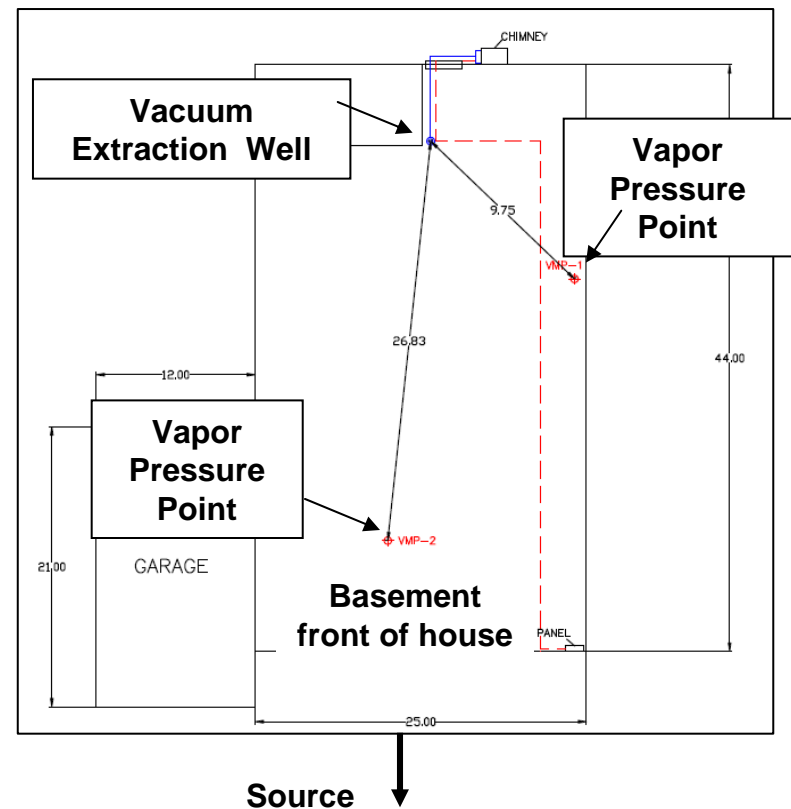
House # H		TCE $\mu\text{g}/\text{m}^3$
Sub-slab	1 (Feb 09)	250
Basement	1 (Feb 09)	1.5
	APU Install	
	2 (Mar 09)	0.5
	SSD Install	
	4 (June 09)	1.9
	5 (Aug 09)	0.67
1st Floor	1 (Feb 09)	Non-detect
SSD Stack Air	1 (June 09)	70
	2 (Aug 09)	48

House # I		TCE $\mu\text{g}/\text{m}^3$
Sub-slab	1 (Mar 09)	290
Basement	1 (Mar 09)	1.9
	APU Install	
	2 (Mar 09)	Non-detect
	SSD Install	
	1st Floor	1 (Mar 09)
SSD Stack Air	1 (June 09)	88
	2 (Aug 09)	30

Post SSD Vapor Pressure Test

- Condition 0: Pre-SSD
 - Positive pressure under slab
- Condition 1: Open window fans on then off
 - Negative pressure maintained
- Condition 2: Close window fans on then off
 - Negative pressure maintained
- Condition 3: Dryer on, window closed, bath fans off
 - Slight positive pressure
 - Door opened – negative pressure returned

House # F Vapor Pressure Test



Outdoor Air

- **Measured concurrent with indoor air**
 - Summa canisters 6-liter, 24 hour
 - TO 15 analysis
- **Pre-SSD outdoor air (Jan-May)**
 - TCE detected 2 of 13 samples
 - 0.4J and 27 $\mu\text{g}/\text{m}^3$ (both in April)
 - Private PRP off-site SVE upwind
- **Post-SSD outdoor air (Jun-Aug)**
 - TCE detected 6 of 9 samples
 - Non-detect to 4.2 $\mu\text{g}/\text{m}^3$



Mitigation Monitoring

- SSD functioning as expected in three of six homes
- Considerations for Homes D, E and F (sub-slab Jan 09 to SSD stack Aug 09)
 - Continuing source contribution
 - Proximity to source (80 ft)
 - Permeable vadose zone soil
 - Asphalt/concrete cover (road, sidewalk, driveways)
 - Limited sod/topsoil
 - Fan power
- Considerations for indoor air increase (June/August)
 - APU performance summer/winter-humidity
 - Outdoor air contribution
 - Vapor intrusion

Mitigation Monitoring Path Forward

- **Recent Actions**
 - Replace carbon filters in APUs
 - Reposition APU
 - Pressure testing
 - Increase fan speed on APUs
- **Consideration for modifying SSD systems at Homes E and F**
 - Increase fan power
 - Add granular activated carbon adsorption to SSD stack
- **Continue quarterly sampling of homes with APUs and SSDs**
 - If results show same or decreasing levels, sampling frequency reduced to 6 months, then annually

Mitigation Monitoring Path Forward

- On-site SVE system startup Dec 09
 - SVE effectiveness monitoring – off-site soil vapor
 - Quarterly monitoring of homes with APUs and SSD
 - March 2010 – sample all homes within the adjacent block (pending owner access agreements)
- Continue partnership with regulators
- Continue public participation

Questions

