Evaluation of Observed Vapor Attenuation in Upstate New York

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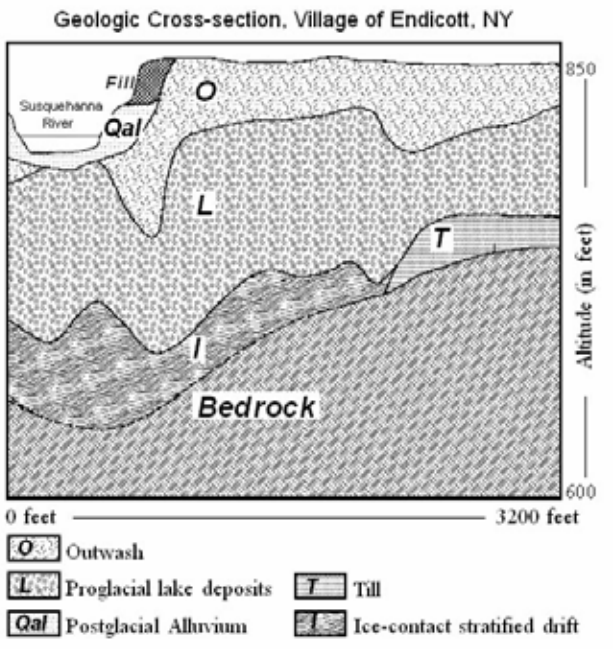
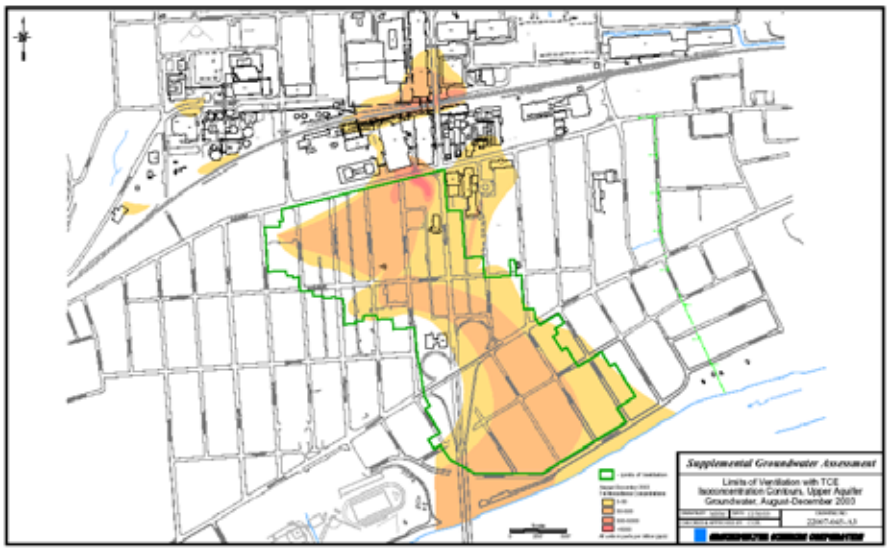
Endicott Site - Case Specifics

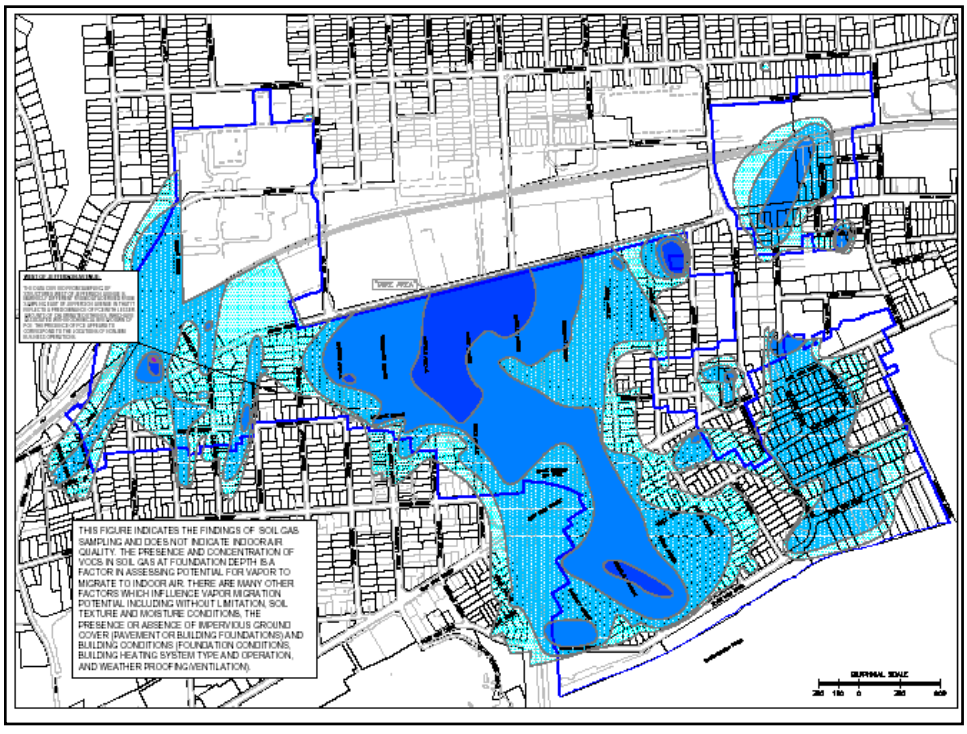
- 300 + acre groundwater plume
- Typically 20-40 feet to groundwater
- Sand & gravel soils
- 234 sets of indoor, outdoor and subslab air samples
- ~75% Residential, 25% Commercial & Mixed
- Most buildings = pre-WW II vintage


Geologic Cross-section, Village of Endicott, NY
Fill
O
Susquehanna River
Qal
L
T
I
Bedrock
850
600
Altitude (in feet)
0 feet
3200 feet
O Outwash
L Proglacial lake deposits
T Till
Qal Postglacial Alluvium
I Ice-contact stratified drift

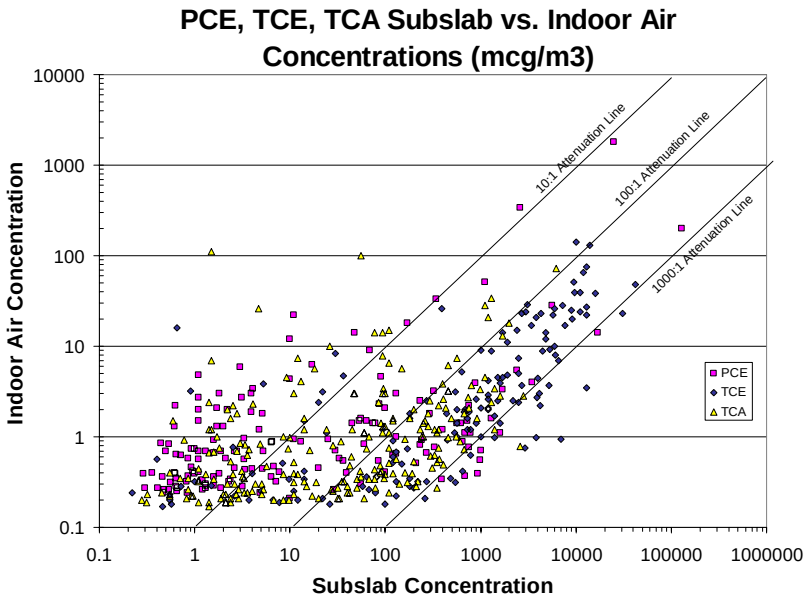

Supplemental Groundwater Assessment
Limits of Ventilation with TCE Isoconcentration Contours, Upper Aquifer Groundwater, August-December 2003

Investigation Methods

- Samples collected during heating season
- Concurrent 24-hour Summa®
- 11 VOCs
- TO-15 SIM
- Detection limits +/- 0.22 µg/m^3



More than 480 properties have been offered ventilation systems.



Results - Ranges of Indoor Air and Soil Gas Concentrations ($\mu g/m^3$)

	PCE (152)		TCE (148)		TCA (215)	
	SS	IA	SS	IA	SS	IA
25%	1.1	0.4	2.4	0.36	2.8	0.3
50%	3.9	0.73	79	2.0	32	0.62
75%	74	1.8	1400	8.0	170	1.6

Definitions

- Attenuation - the ratio of sub-slab soil gas contaminant concentration to indoor air concentration.
- Background - expected indoor air concentration of a chemical. Based on statistical summaries of background studies.

Study of VOCs in NY State Homes Indoor "Background" ($\mu g/m^3$)

Chemical	PCE	TCE	TCA
$N_{Observations}$	406	406	406
25% conc.	<0.25	<0.25	<0.25
50% conc.	0.34	<0.25	0.35
75% conc.	1.2	<0.25	1.4

- Observation - Data suggest that lower observed attenuation rates result from indoor confounding chemical sources.
- Hypothesis – Sample sets with high subslab concentrations should have higher observed attenuation factors because the contribution from confounding sources "background" would be proportionately smaller.

Evaluating Background Influence on Attenuation

- Tabulate the $1/\alpha$ for high and low ranges of subslab concentrations
- Look for graphic trends (subslab vs. $1/\alpha$)
- Compare observed $1/\alpha$ values for different compounds in the same building

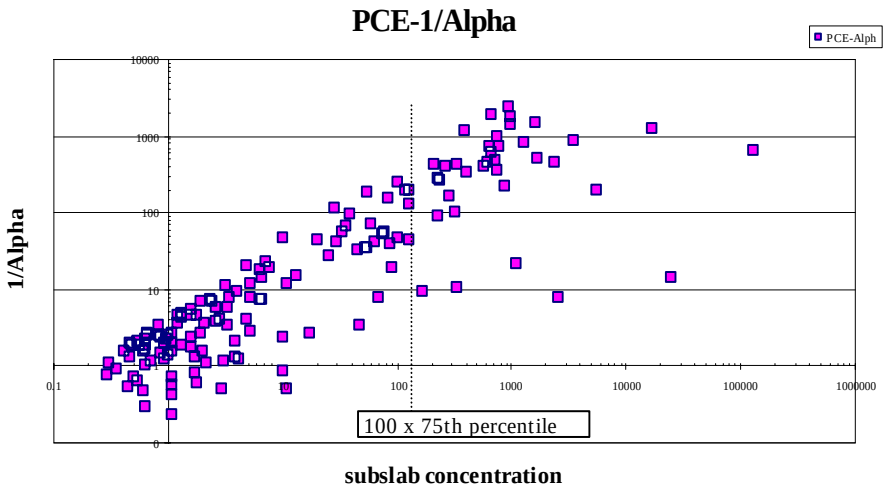
Tabulate the 1/α for high and low ranges of subslab concentrations

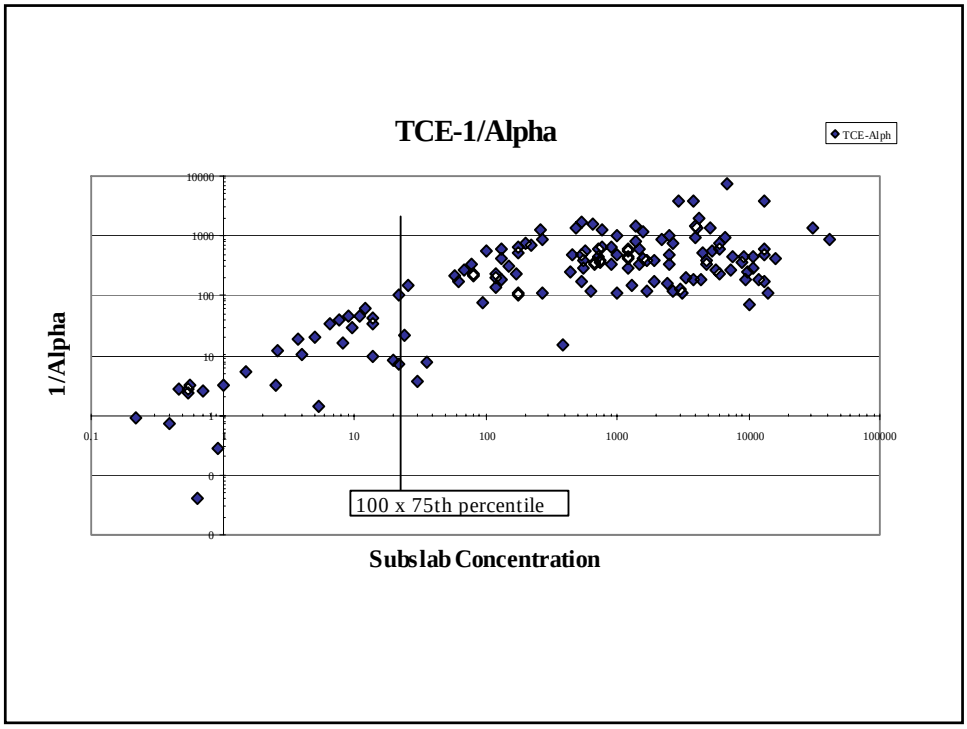
Subslab Concentrations and Associated Attenuation Factors (1/α)

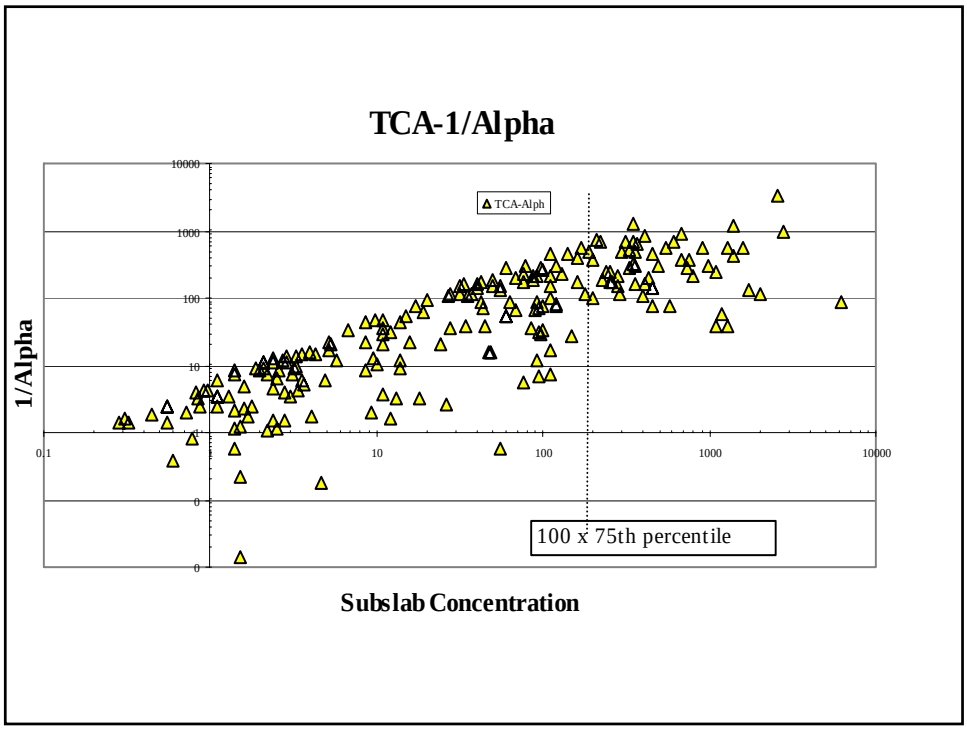
	Low Sub-Slab Range SS< 100 x background			High Sub-Slab Range SS > 100 x background		
Sub-Slab concentration ($\mu g/m^3$)	PCE <120	TCE <25	TCA <140	PCE >120	TCE >25	TCA >140
N (observations)	113	31	154	39	117	61
Median Attenuation	2.9	8.3	13	410	400	280

SS > 100 X background is associated with higher 1 / α

Look for graphic trends (subslab vs. 1/α)

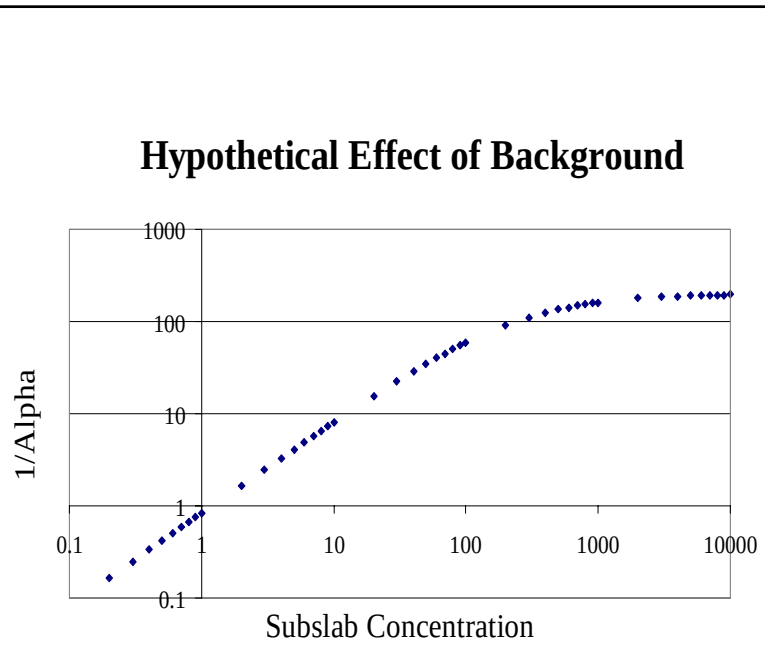



TCE-1/Alpha
TCE-Alph
1/Alpha
10000
1000
100
10
1
0
0.1
10
100
1000
10000
100000
100 x 75th percentile
Subslab Concentration

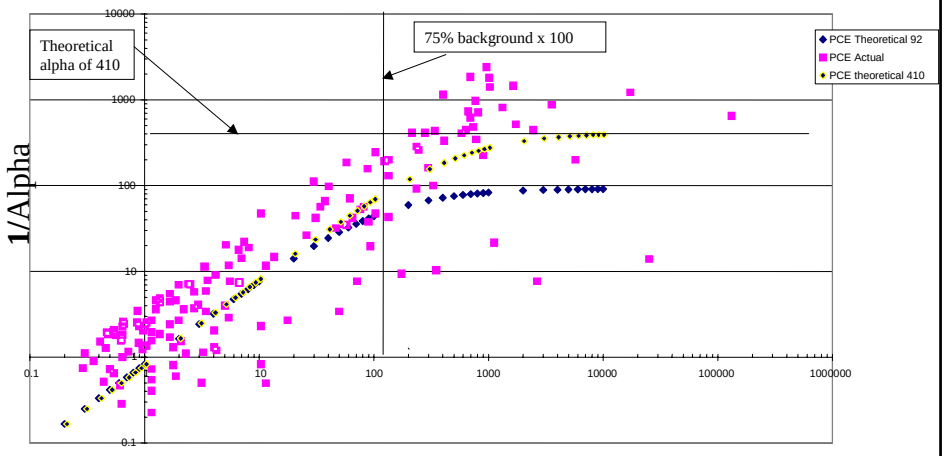

TCA-1/Alpha
TCA-Alph
1/Alpha
10000
1000
100
10
1
0
0.1
10
100
1000
10000
100 x 75th percentile
Subslab Concentration

Hypothetical Effect of Background on 1/α of 200

SS conc.	SS/200	Background IA	Measured IA	Observed 1/α
1.0	0.005	1.2	1.2	0.83
10	0.05	1.2	1.2	8.3
50	0.25	1.2	1.5	33
120	0.6	1.2	1.8	67
1000	5	1.2	6.2	160
10,000	50	1.2	51.	200

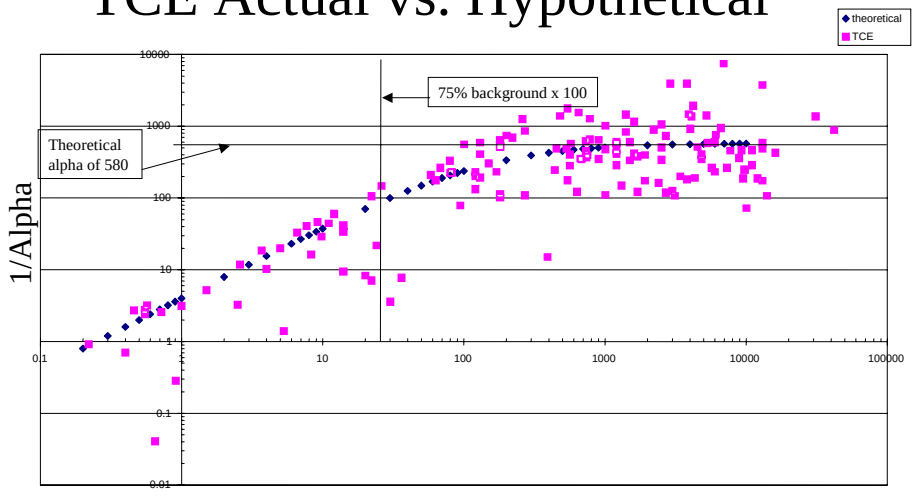


PCE Actual vs. Hypothetical



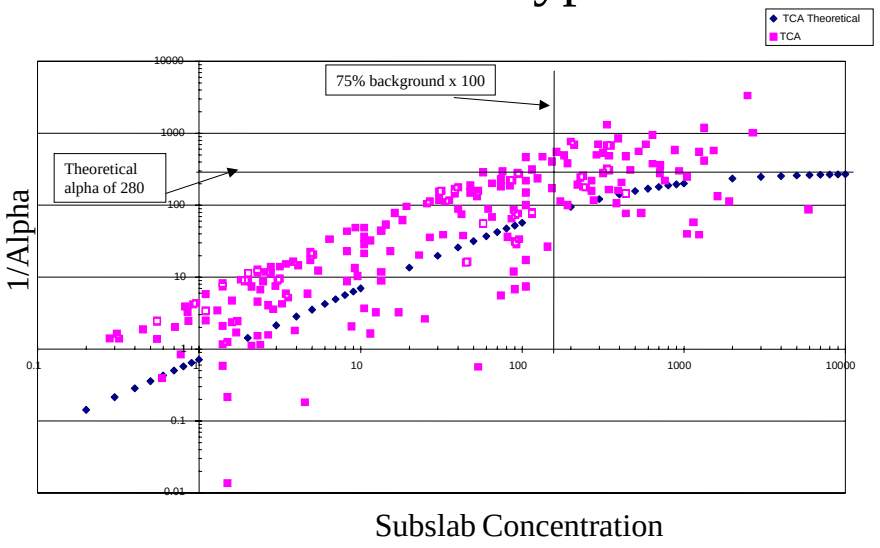
Subslab Concentration

TCE Actual vs. Hypothetical

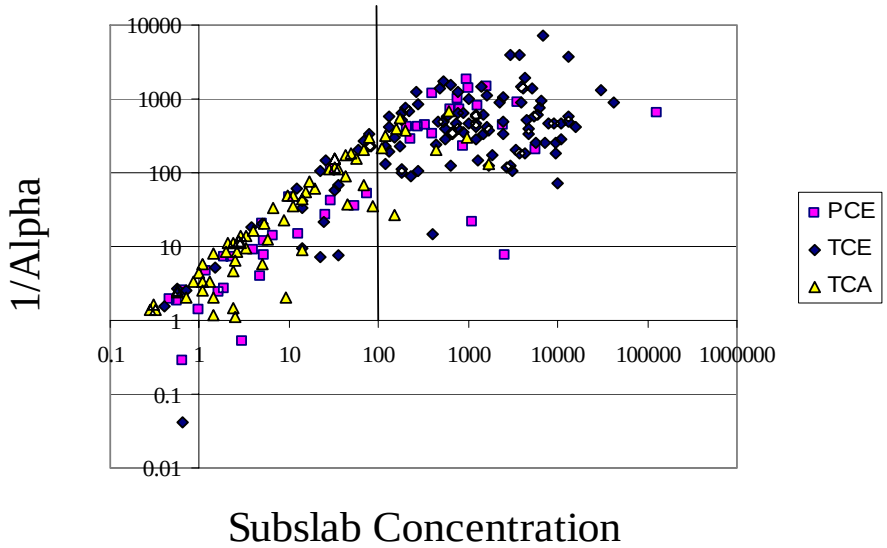


Subslab Concentration

TCA Actual vs. Hypothetical



Max 1/Alpha vs. Subslab



Compare observed 1/α values for different compounds in the same building.

Varying 1/α Observations in Specific Buildings

	PCE			TCE		
Building ID	SS (conc.)	IA (conc.)	1/α	SS (conc.)	IA (conc.)	1/α
107	**56**	**1.6**	35	**80**	**0.36**	220
142	**170**	**18**	9.5	**42,000**	**48**	875
147	**11**	**22**	0.5	**130**	**0.32**	410

Ratios of Compound Specific Attenuation Factors in a Building

PCE			TCE			TCA			R1	R2
SS	IA	Att.	SS	IA	Att.	SS	IA	Att.		
100	0.41	**240**	6000	10	**600**	360	0.75	**480**	**2.5**	**1.3**
680	0.37	**1800**	6900	0.94	**7300**	2600	0.78	**3300**	**4**	**2.2**
56	0.3	**190**	7300	28	**260**	1100	4.5	**240**	**1.4**	**1.1**
240	0.93	**260**	7700	17	**450**	1100	28	**39**	**12**	**1.7**
720	1.5	**480**	8900	25	**360**	1200	21	**57**	**8.4**	**1.3**
5600	28	**200**	12000	65	**180**	6200	72	**86**	**2.3**	**1.1**
880	3.9	**230**	13000	75	**170**	2000	18	**110**	**2.1**	**1.4**
130	0.65	**200**	13000	22	**590**	1300	2.4	**540**	**3.0**	**1.1**
170	18	**9.4**	42000	48	**880**	1600	2.8	**570**	**94**	**1.5**

SS is subslab concentration and IA is indoor air concentration. Units are in $\mu g/m^3$.

R1 is the ratio of the highest to lowest attenuation factors

R2 is the ratio of the two higher attenuation factors

Conclusions

- The effect of vapor intrusion in a “typical” building results in a subslab to indoor air 1/alpha greater than 100.
- Observed 1/alphas less than 100 likely result from confounding sources or from adverse building conditions (major foundation penetrations, large pressure differences).
- Where subslab concentrations are relatively small (< 100 x background), observed 1/alphas are skewed low by interference from background sources.

Conclusions

- Comparison of 1/alphas for different compounds at each building can help identify potential indoor sources.
- View observed $1/\alpha < 100$ with caution!

Next Steps

Develop long-term soil vapor monitoring program to track plume clean up.

Synoptic sampling of groundwater, deep soil gas and shallow soil gas.