Zoom Guidelines & Instructions for RR Program's Issues & Trends Webinar

December 16, 2020

Zoom Guidelines
& Instructions

✓No video, please.

✓Please remain muted throughout presentation.

Zoom Guidelines
& Instructions

Zoom technical support at

support.zoom.us

Issues & Trends

Schedule coming soon to:

dnr.wisconsin.gov/topic/Brownfields/Training.html

- No January Webinar
- Issues & Trends Resumes in February

Issues & Trends

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rr-report.blogs.govdelivery.com

Issues & Trends

Recordings of previous webinars
can be found in the Training Library:

dnr.wisconsin.gov/topic/Brownfields/TrainingLibrary.html

Jennifer Borski – Hydrogeologist / Vapor Intrusion Team Leader

Jim Walden – Hydrogeologist / Vapor Intrusion Technical Expert

Issues & Trends 2020

Wednesday, December 16

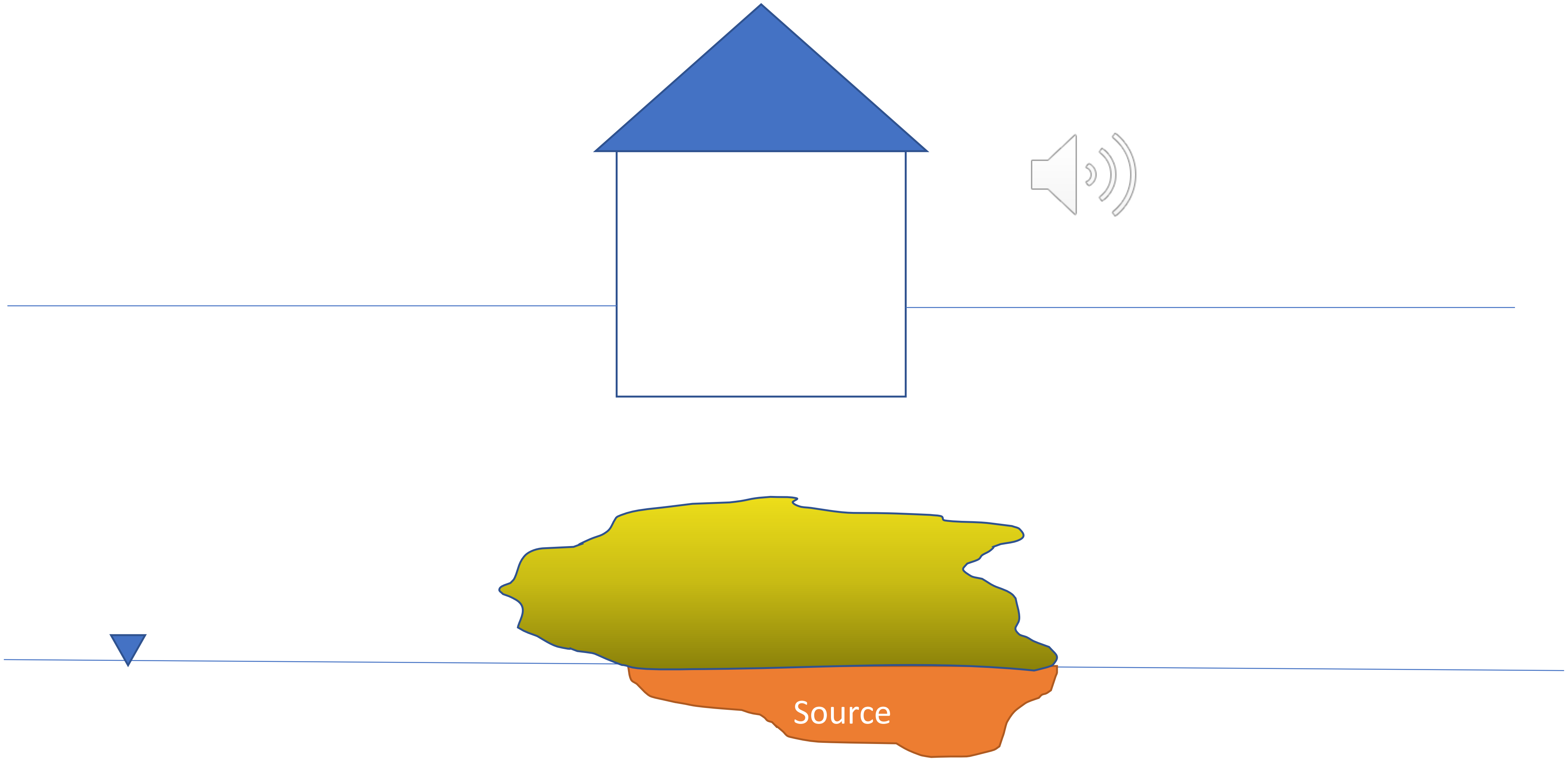
Vapor Data Variability as a factor in Screening and Mitigation Decisions

Jim Walden and Jennifer Borski

Zoom recording at DNR.WI.GOV (search: rr training)

Questions/Comments/Suggestions to:
DNRRRComments@wisconsin.gov

Vapor Data Variability



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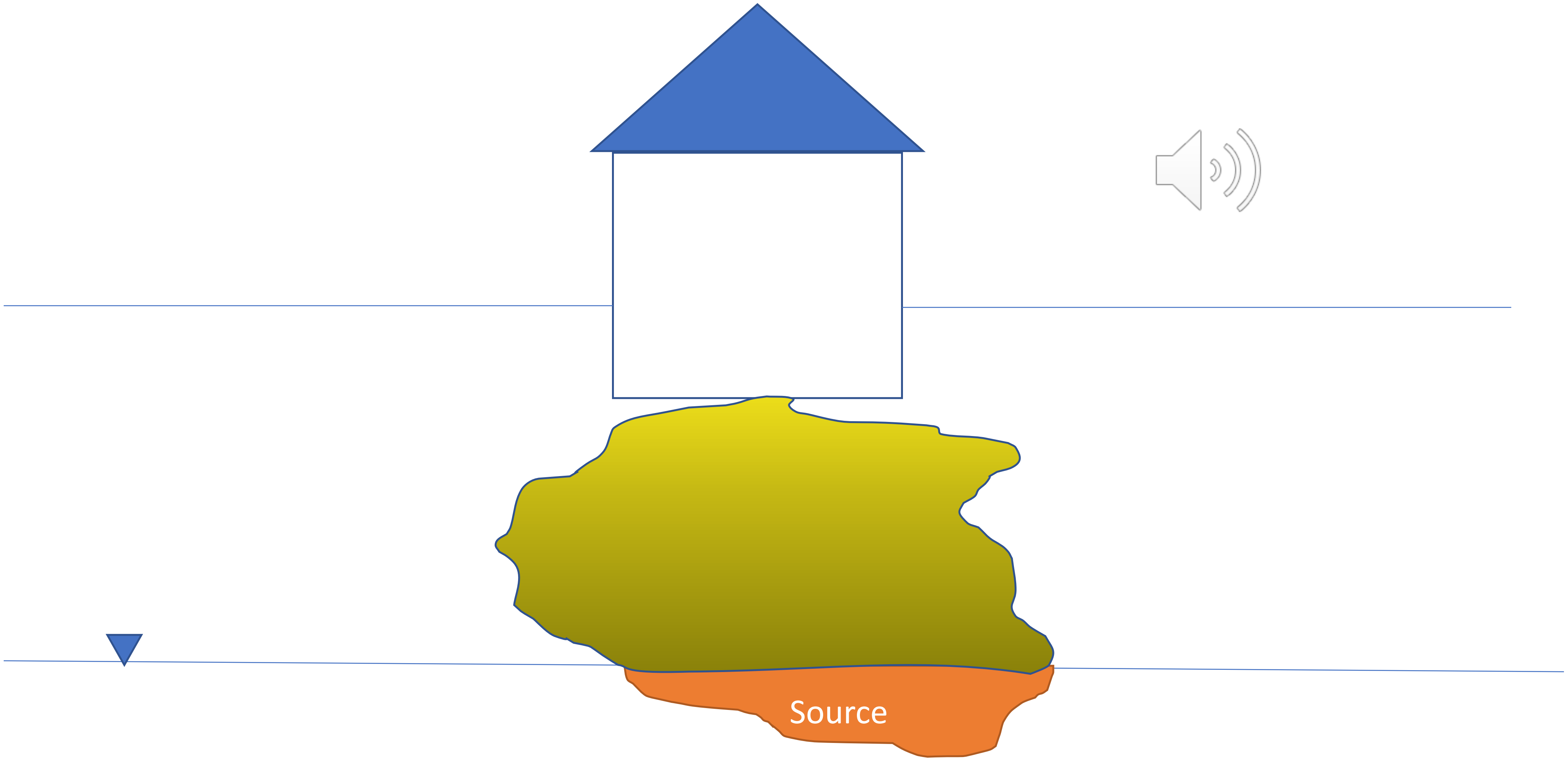

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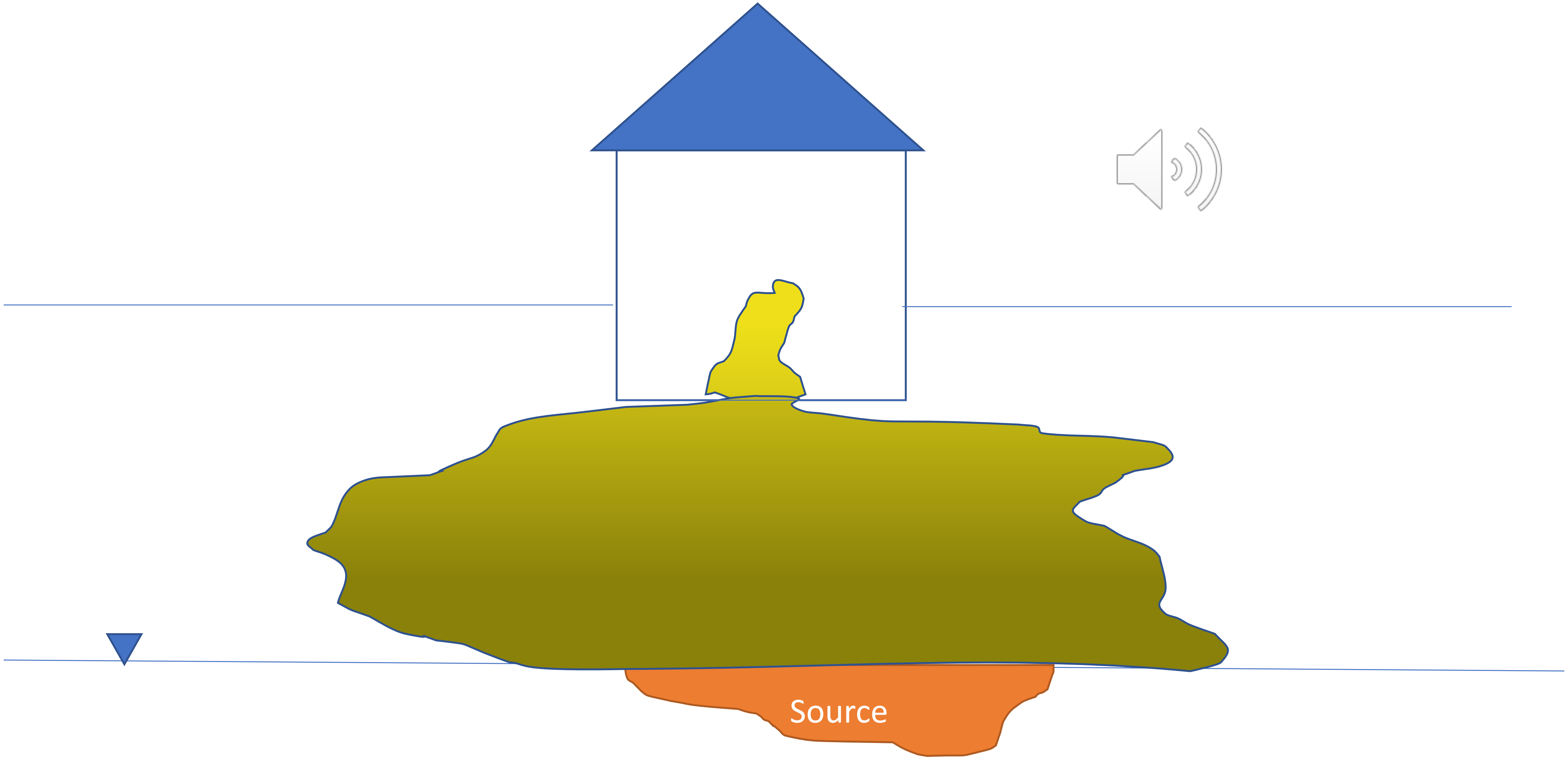
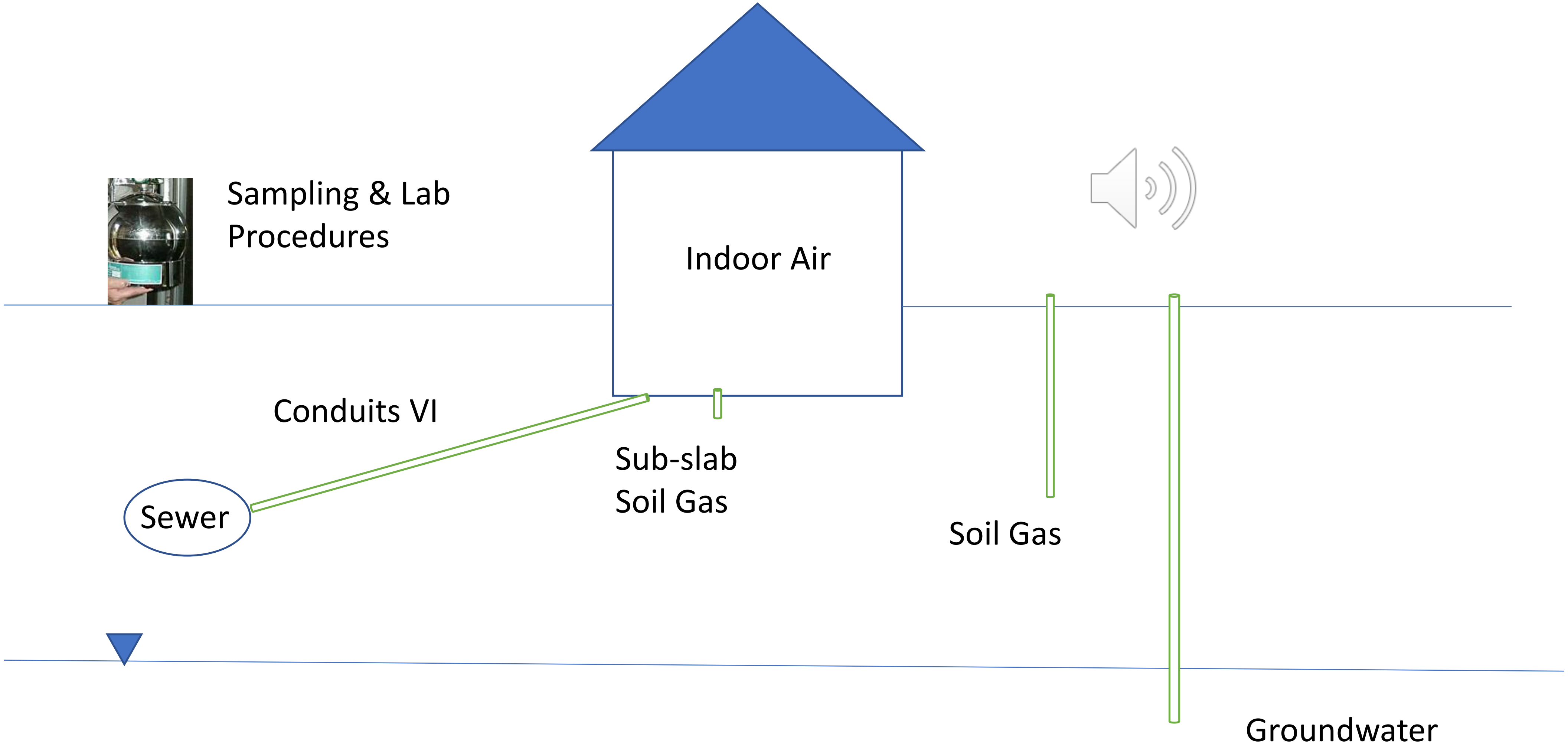
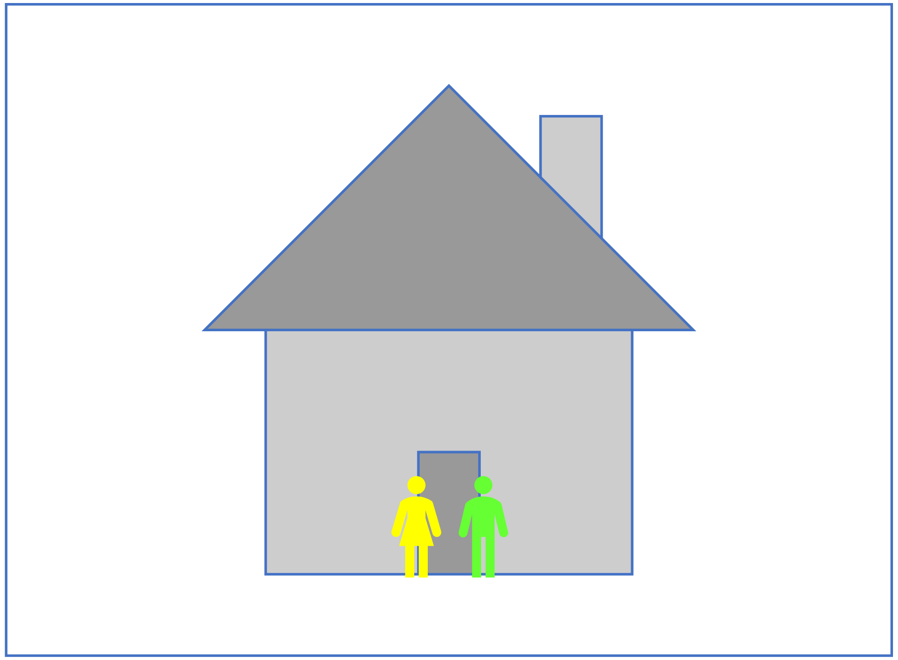


VI Path - Points of Variability



Building Screening:

Do we need to knock on the door?



VAPOR INTRUSION RESOURCES FOR ENVIRONMENTAL PROFESSIONALS

Screening for the vapor intrusion (VI) pathway must be conducted at every contaminated site in Wisconsin. The need to investigate VI is elevated when screening indicates the potential for VI is present, especially when trichloroethylene (TCE) is present due to its potential for acute (shortterm) health risks. Mitigation is the process of interrupting the VI exposure pathway such that the vapors no longer affect occupants. Mitigation is not a form of remediation. This page provides resources to help environmental consultants screen the vapor pathway, assess vapor risk and, where necessary, investigate and mitigate vapor intrusion at specific buildings. General information about vapor intrusion for property owners, tenants and the general public is available on the vapor intrusion page.

Guidance | Screening levels | Community outreach | Training | Other resources | Contacts

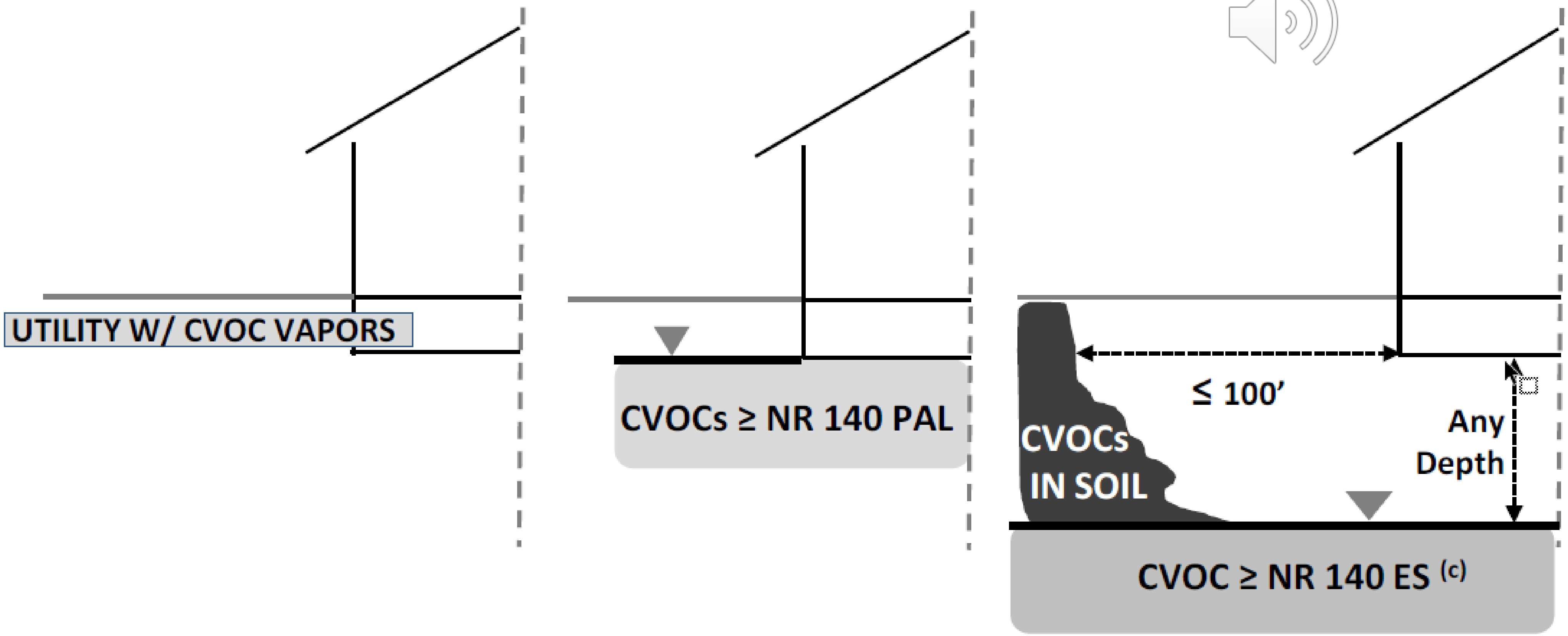
GUIDANCE ON ADDRESSING VAPOR INTRUSION (VI)

Environmental cleanup & brownfields redevelopment

- RR Report Newsfeed
- Find Contaminated Land Activities
- Request Green Team Assistance
- Submit Files Related to ch. NR 700, Wis. Adm. Code
- Report a Spill

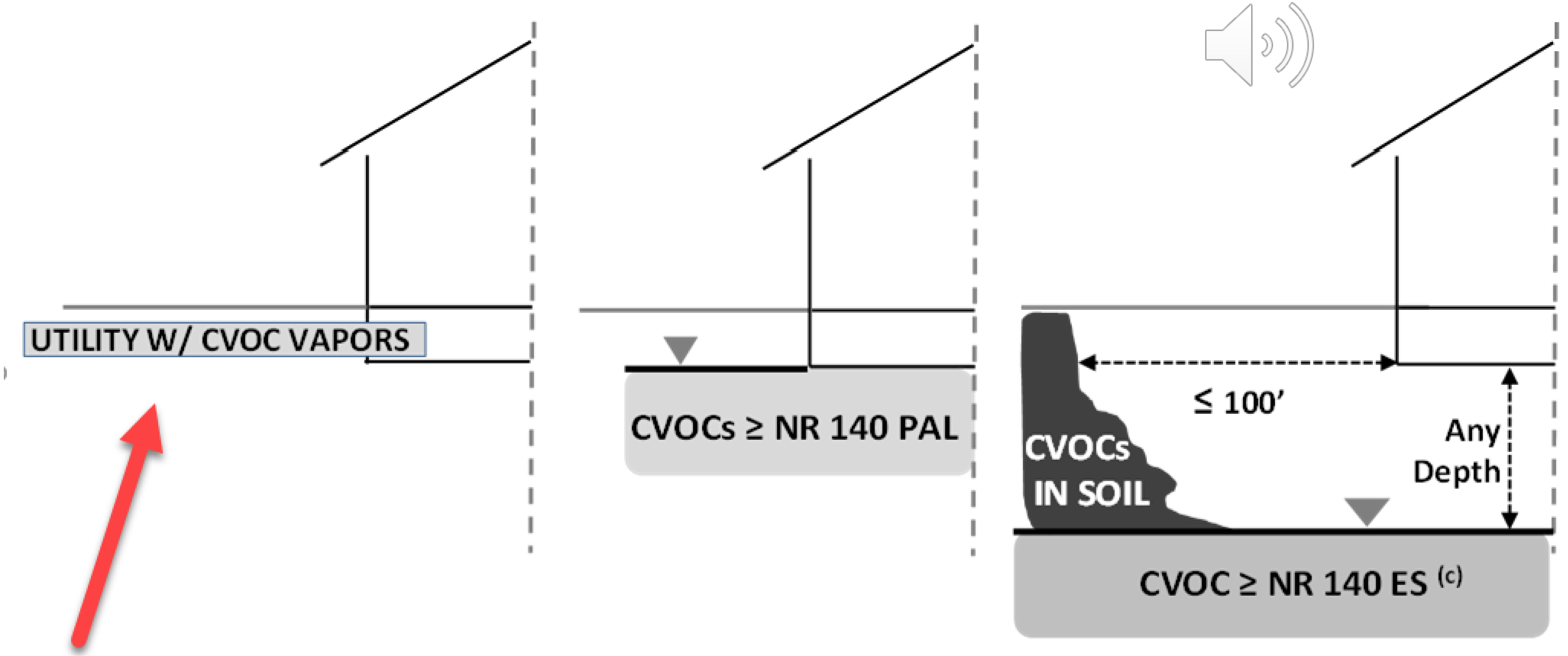
RR-800 Figure 3a – CVOC Screening Criteria

SITUATIONS WHERE A VAPOR SAMPLING IS RECOMMENDED *



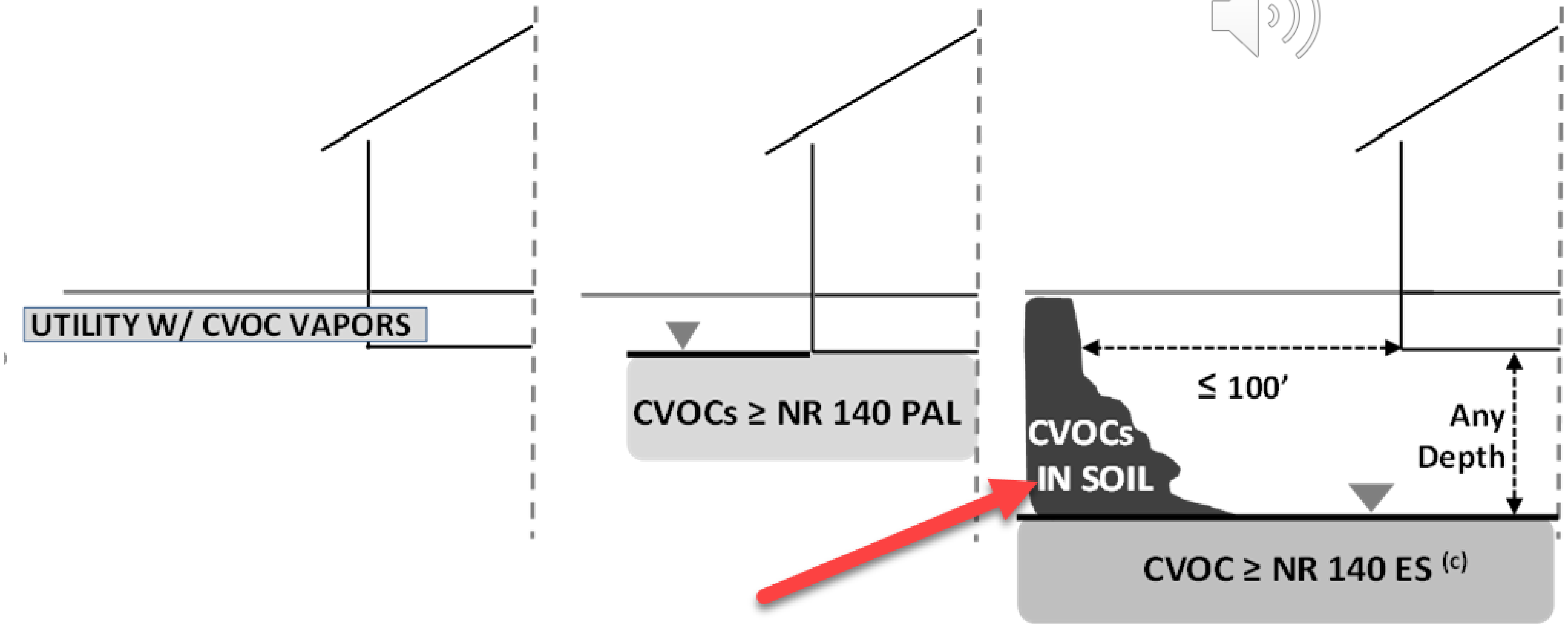
RR-800 Figure 3a - Utilities

SITUATIONS WHERE A VAPOR SAMPLING IS RECOMMENDED *

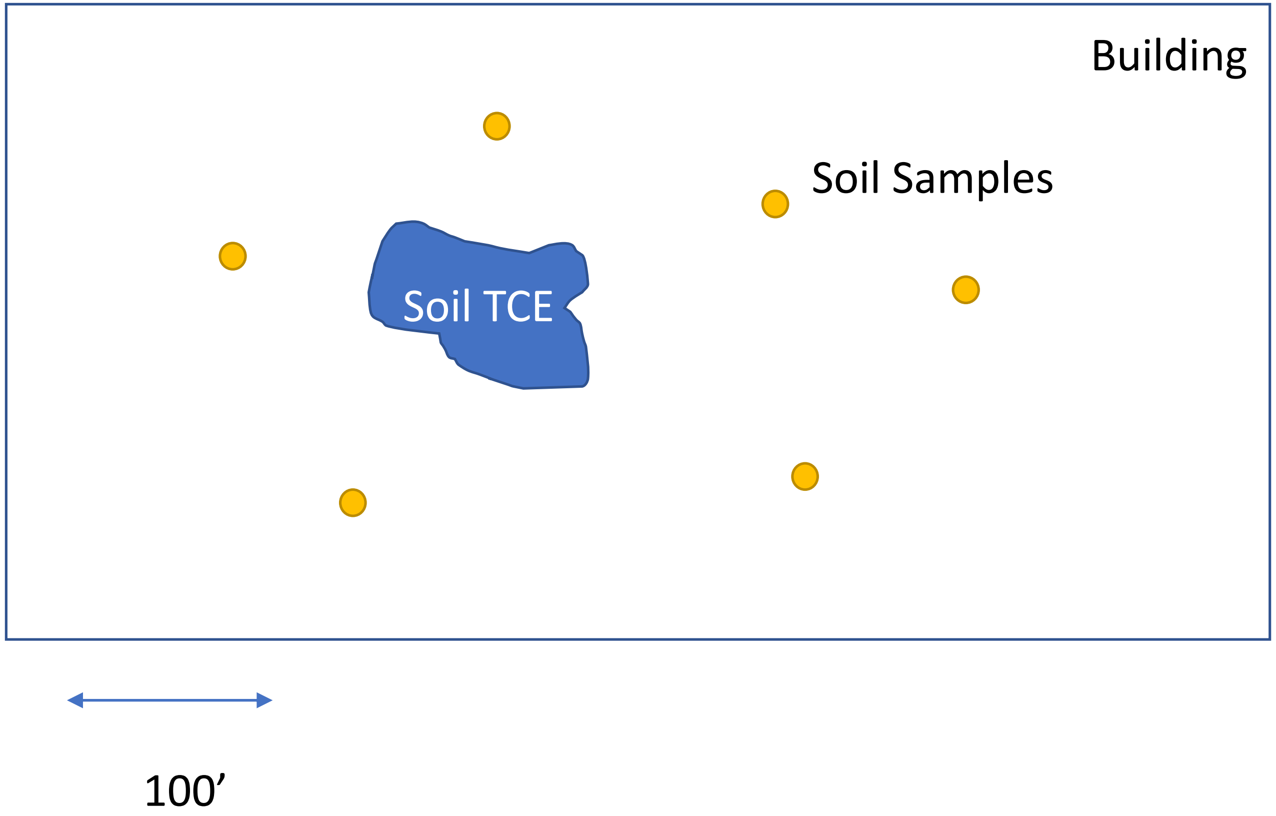


RR-800 Figure 3a - Soil

SITUATIONS WHERE A VAPOR SAMPLING IS RECOMMENDED *



Sub- Slab Soil Contamination



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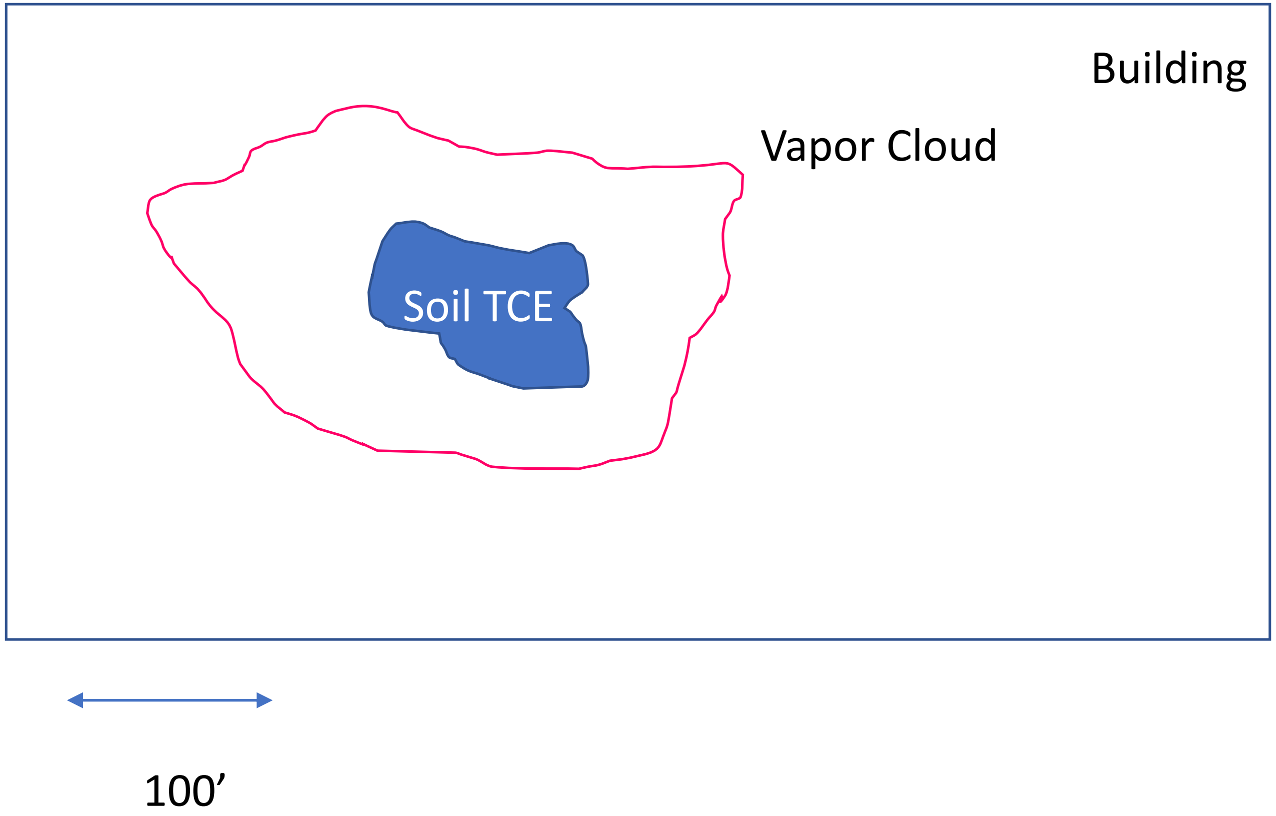

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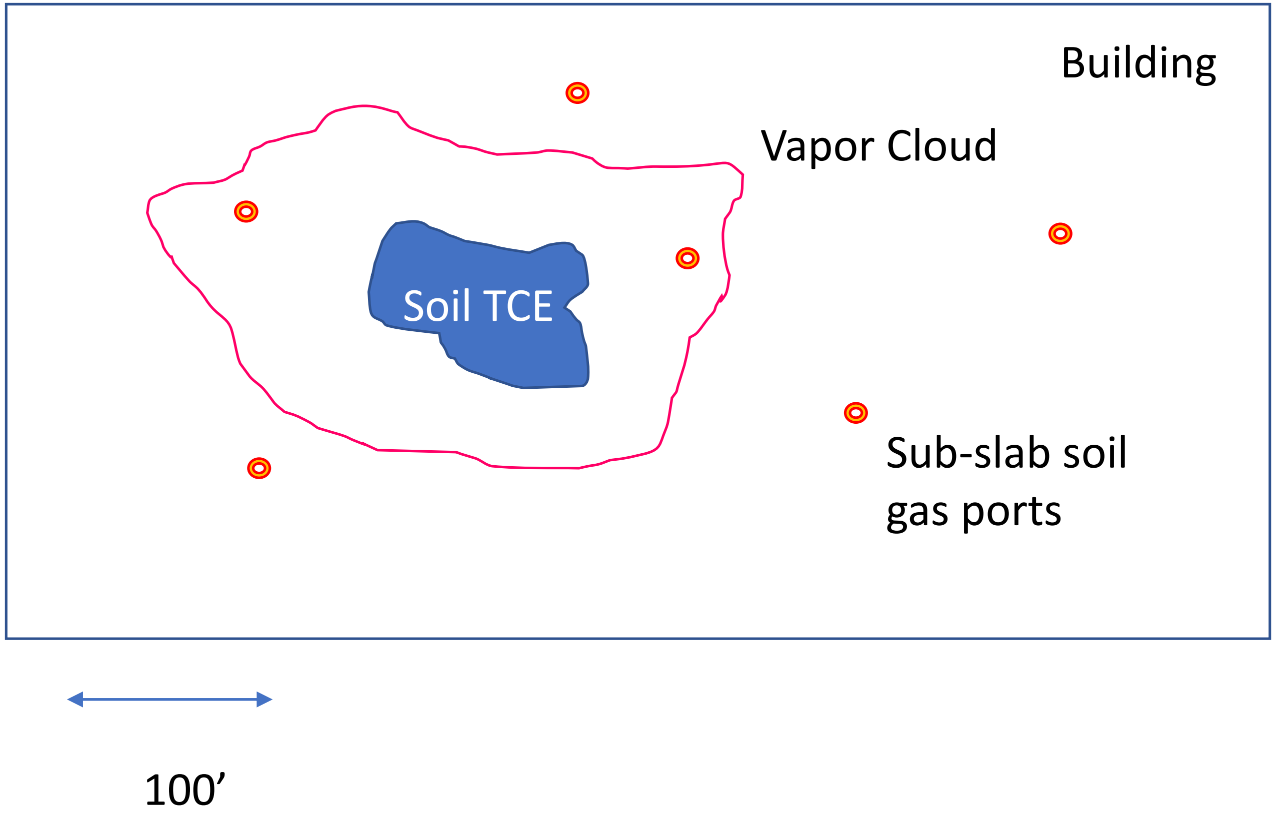
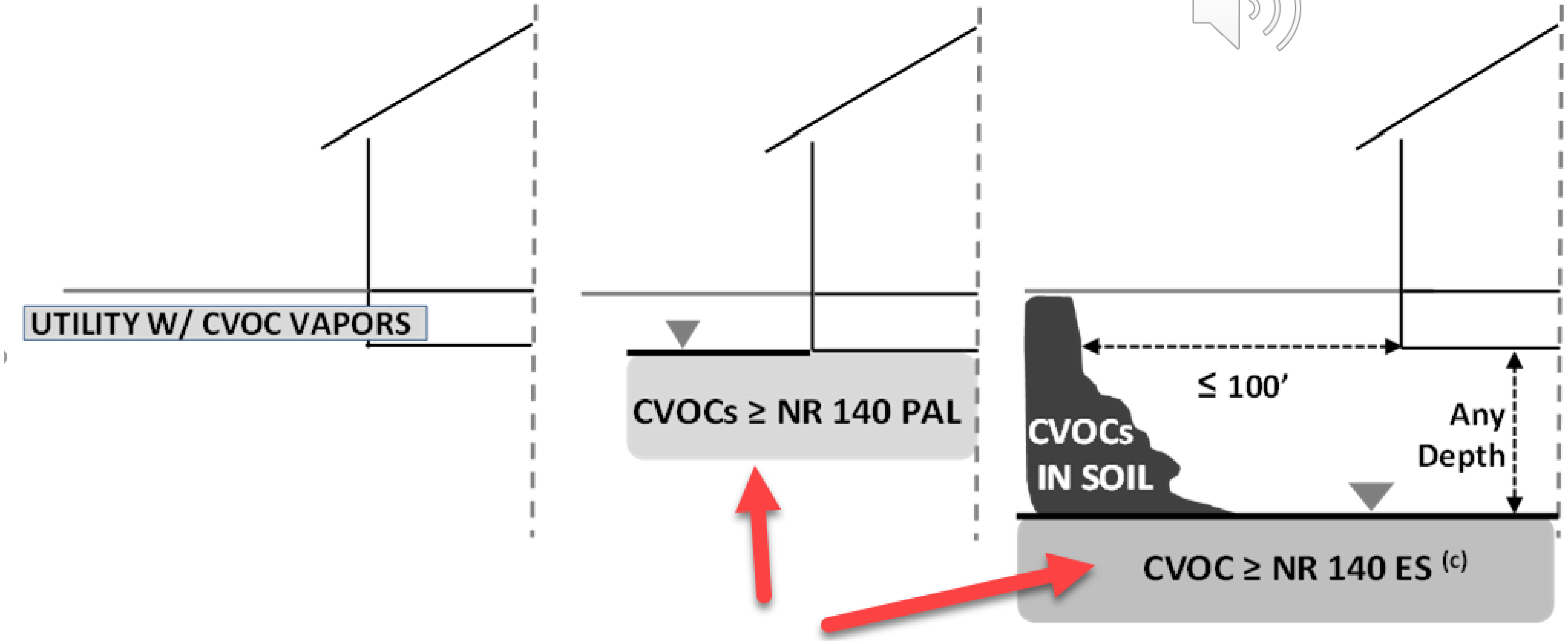


RR-800 Figure 3a Groundwater

SITUATIONS WHERE A VAPOR SAMPLING IS RECOMMENDED *



RR-800 Figure 3a Groundwater

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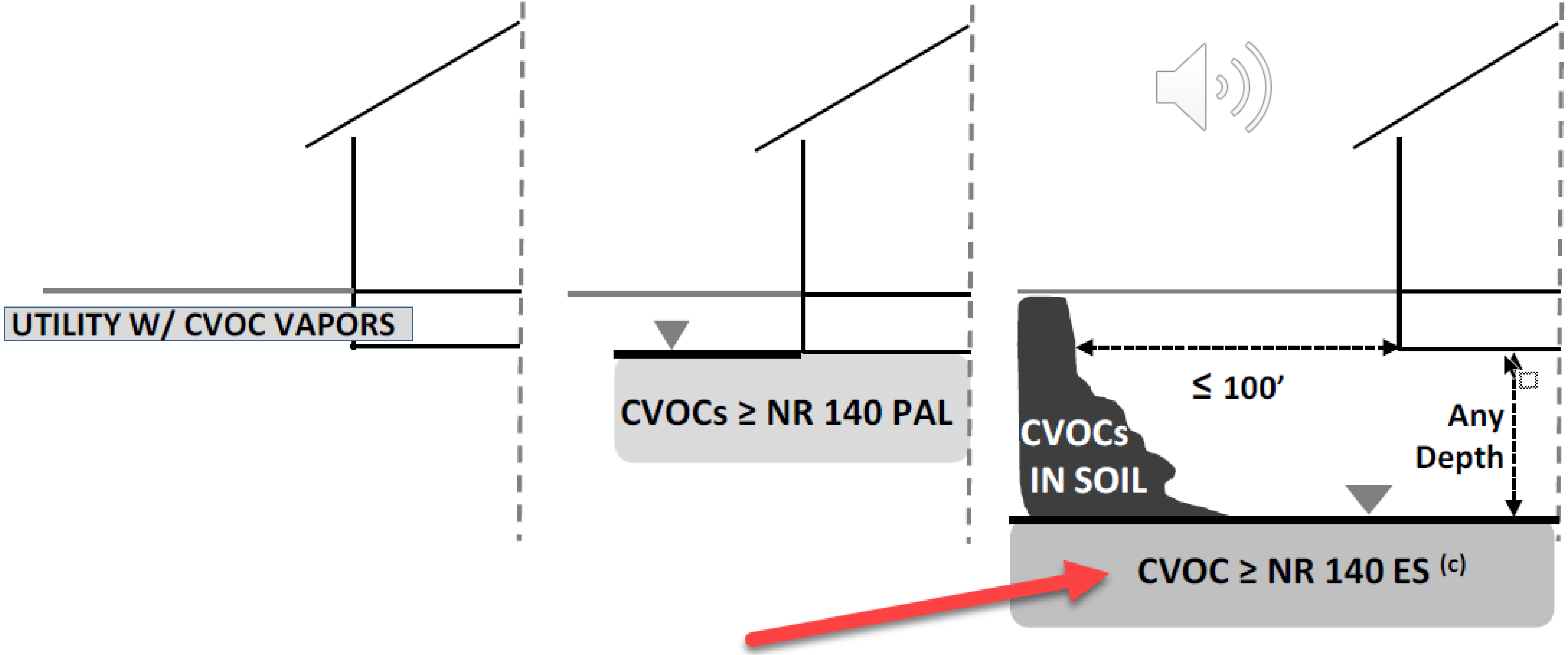

RR 800 Figure 3A Groundwater

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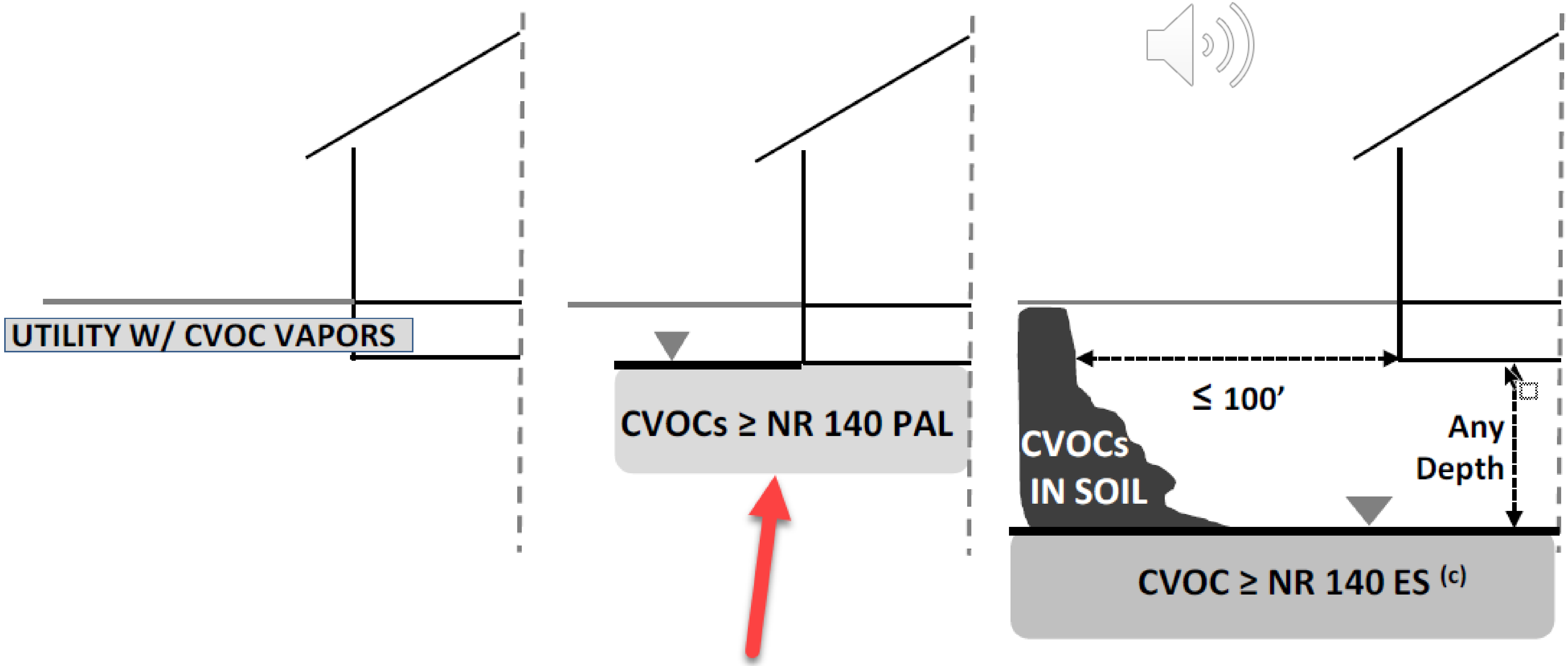
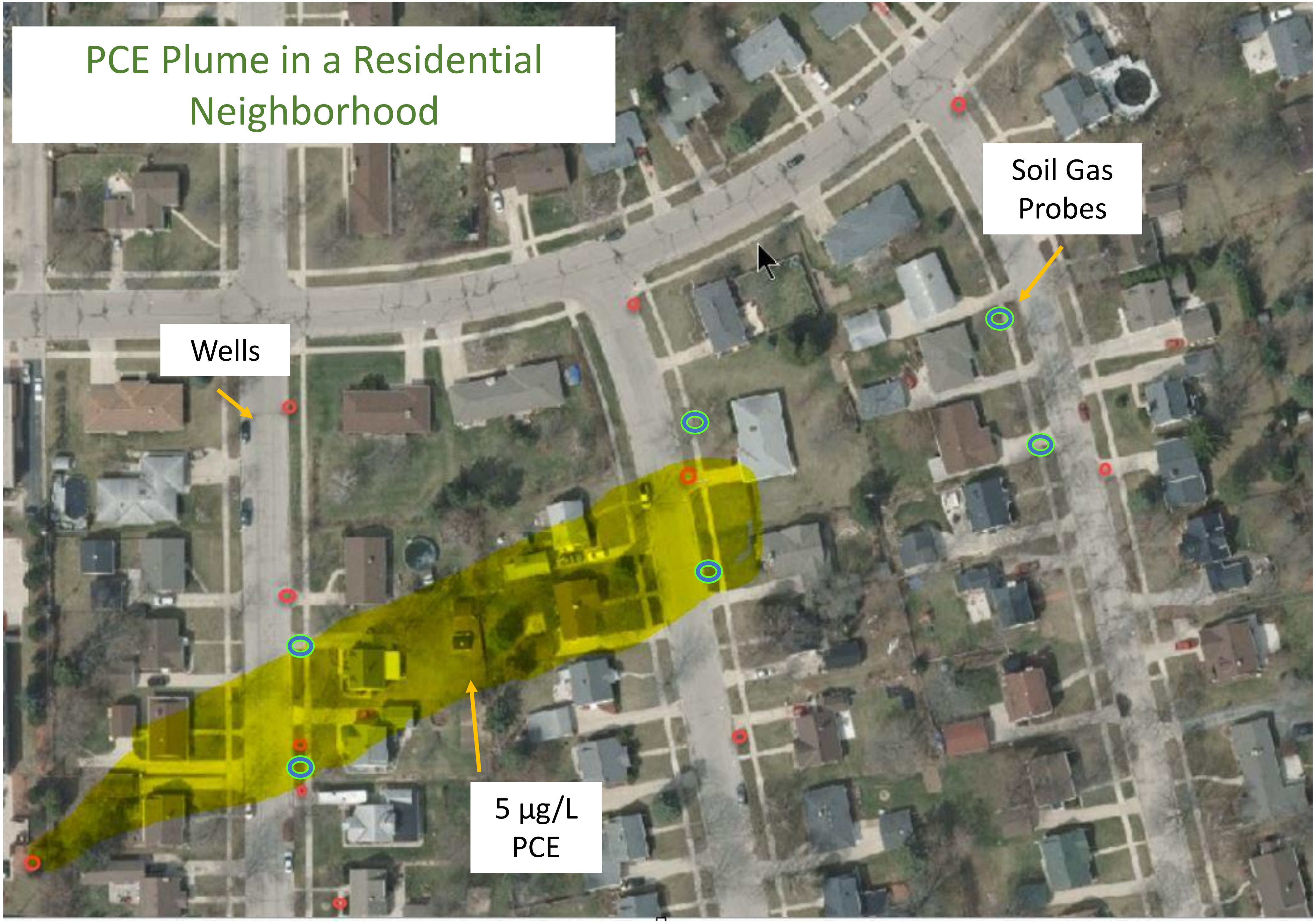



PCE µg/L
16
14
12
10
8
6
4
2
0
Apr-07
Feb-08
Dec-08
Oct-09
Aug-10
Jun-11
Apr-12
Feb-13
Dec-13
Oct-14
Aug-15
Jun-16
Apr-17
Feb-18
Dec-18
Wells

PCE Plume in a Residential Neighborhood

PCE Plume in a Residential Neighborhood

PCE Plume in a Residential Neighborhood

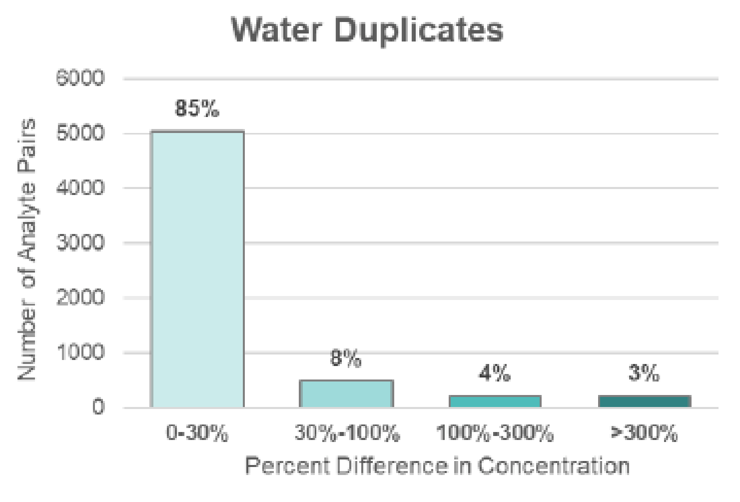


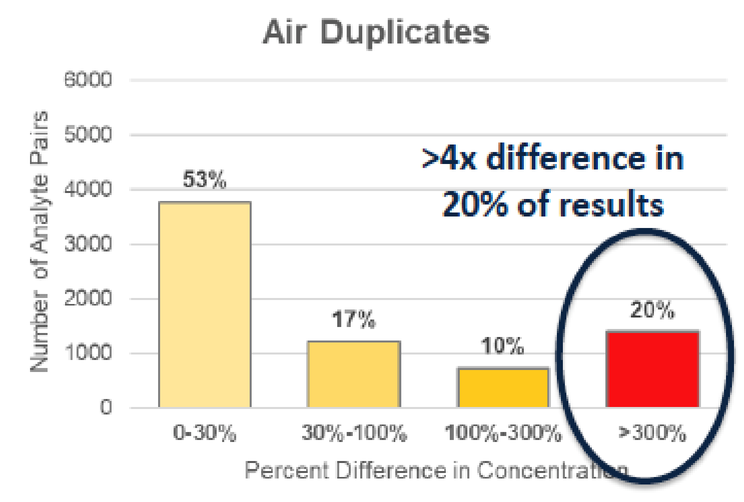
Groundwater vs Vapor Duplicates

IS THERE A DIFFERENCE BETWEEN GW AND VAPOR PAIRS?

GSI ENVIRONMENTAL

- **YES!**





KEY POINTS:

- Large differences more common in vapor pairs.
- Initial results confirmed anecdotal observations that vapor samples are more variable than groundwater samples.

Note: Evaluation of one- and two-detect groups. Detection limit substituted for non-detect results.

Beckley, L., McHugh, T., Villarreal, C., and Rauch, S. AEHS 28th Annual International Conference on Soil, Water, Energy, and Air, San Diego, CA, 21 March 2018

Soil Gas Variability

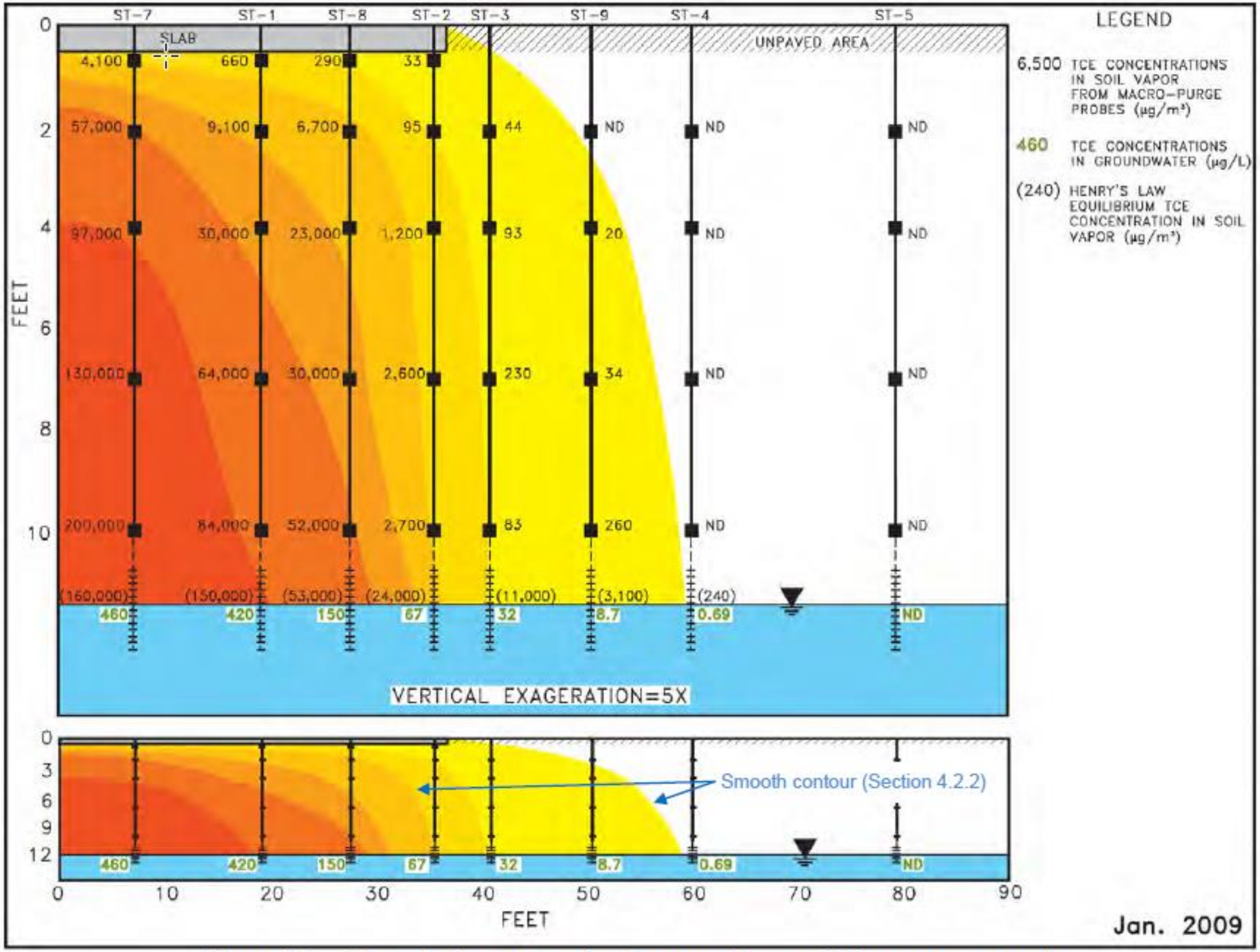
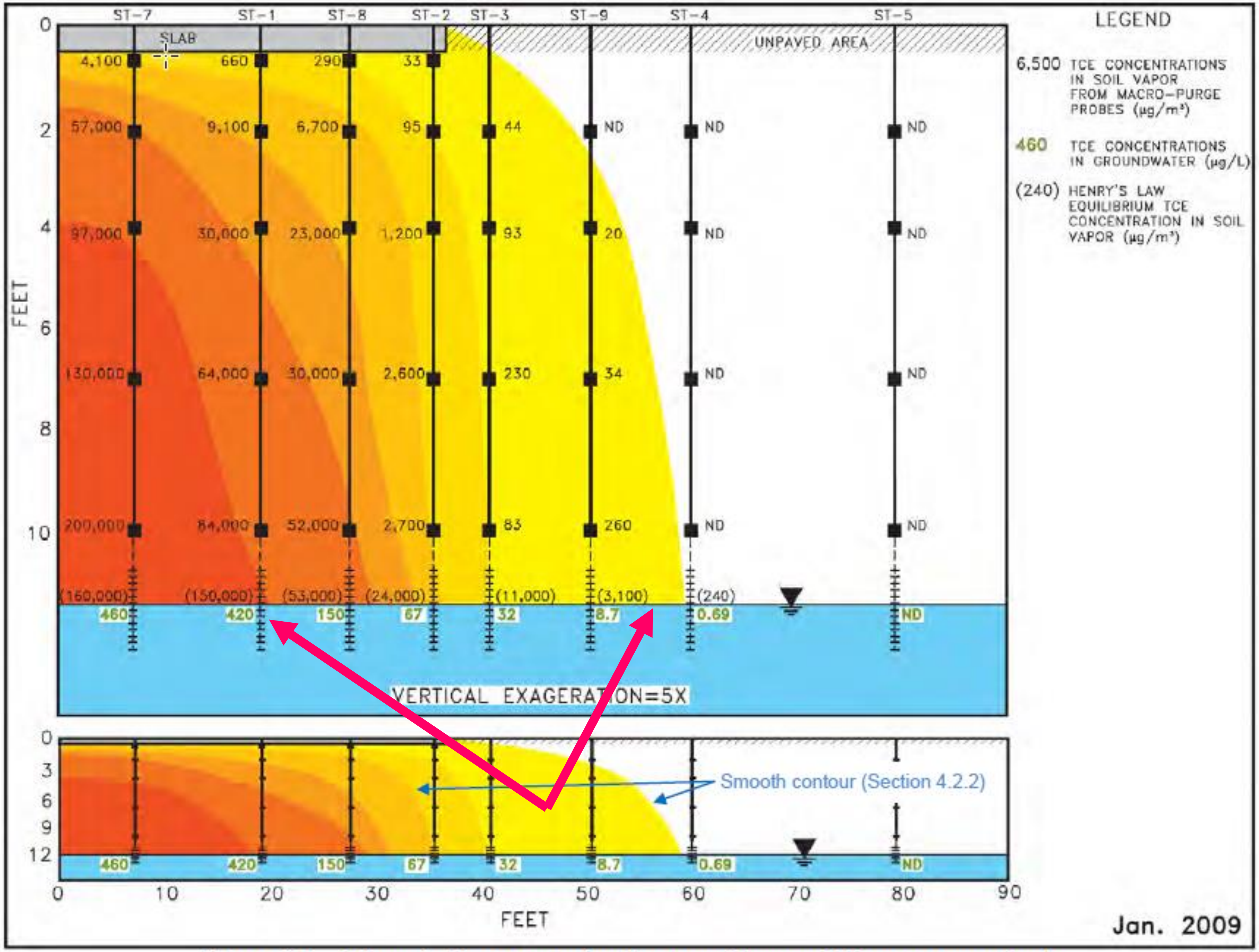


Figure 4-6 Schematic Isoconcentration Contours (January 2009 macro-purge data)

EPA/600/R-10/118
October 2010

Soil Gas and Groundwater Variability



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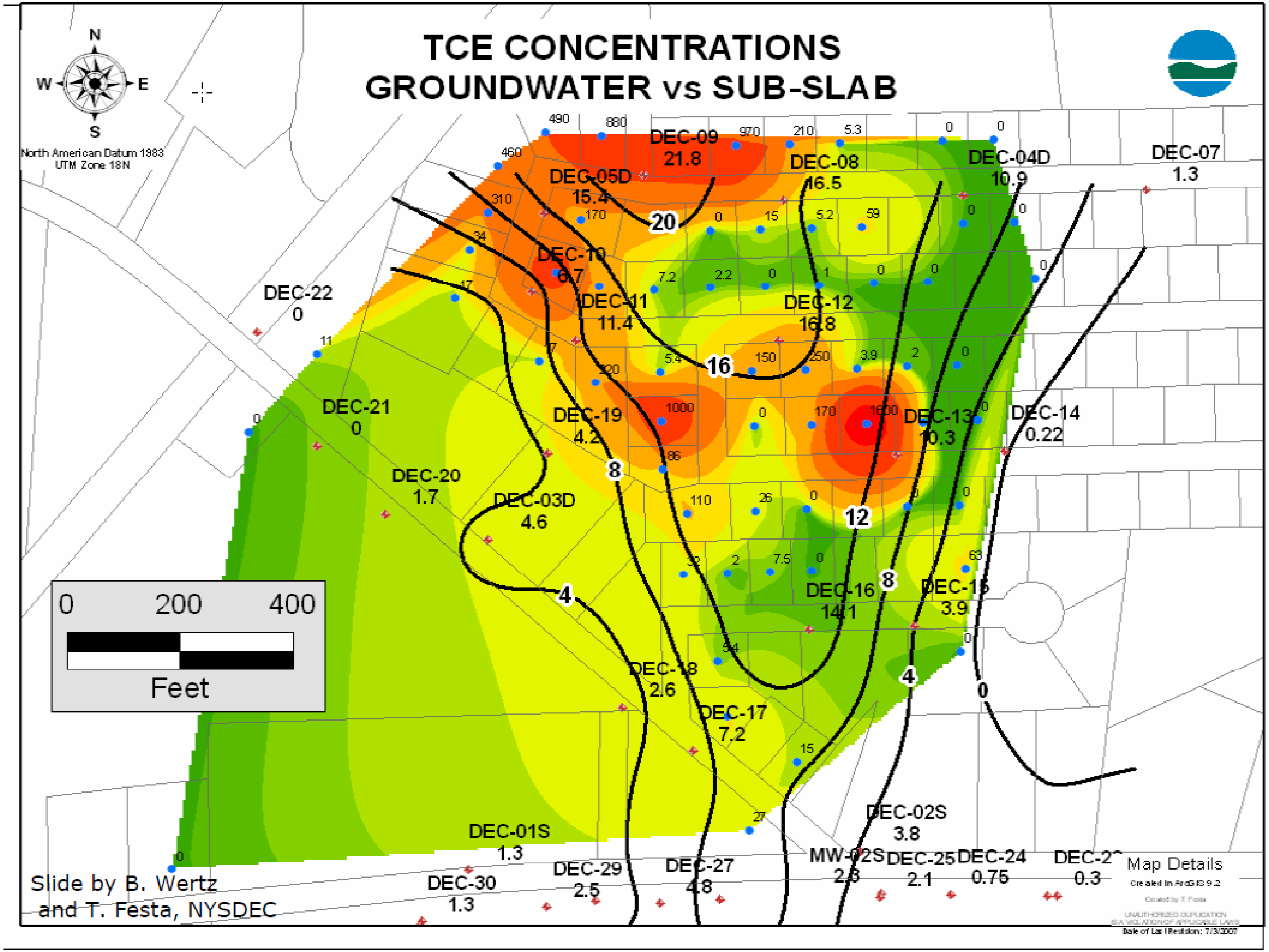
TCE CONCENTRATIONS
GROUNDWATER vs SUB-SLAB
N
W
E
S
North American Datum 1983
UTM Zone 18N
DEC-09
21.8
DEC-05D
15.4
DEC-08
16.5
DEC-04D
10.9
DEC-07
1.3
DEC-10
6.7
DEC-11
11.4
DEC-12
16.8
DEC-22
0
DEC-21
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DEC-19
4.2
DEC-13
10.3
DEC-14
0.22
DEC-20
1.7
DEC-03D
4.6
DEC-16
14.1
DEC-15
3.9
DEC-18
2.6
DEC-17
7.2
DEC-02S
3.8
DEC-01S
1.3
DEC-29
2.5
DEC-27
4.8
DEC-30
1.3
MW-02S
2.3
DEC-25
2.1
DEC-24
0.75
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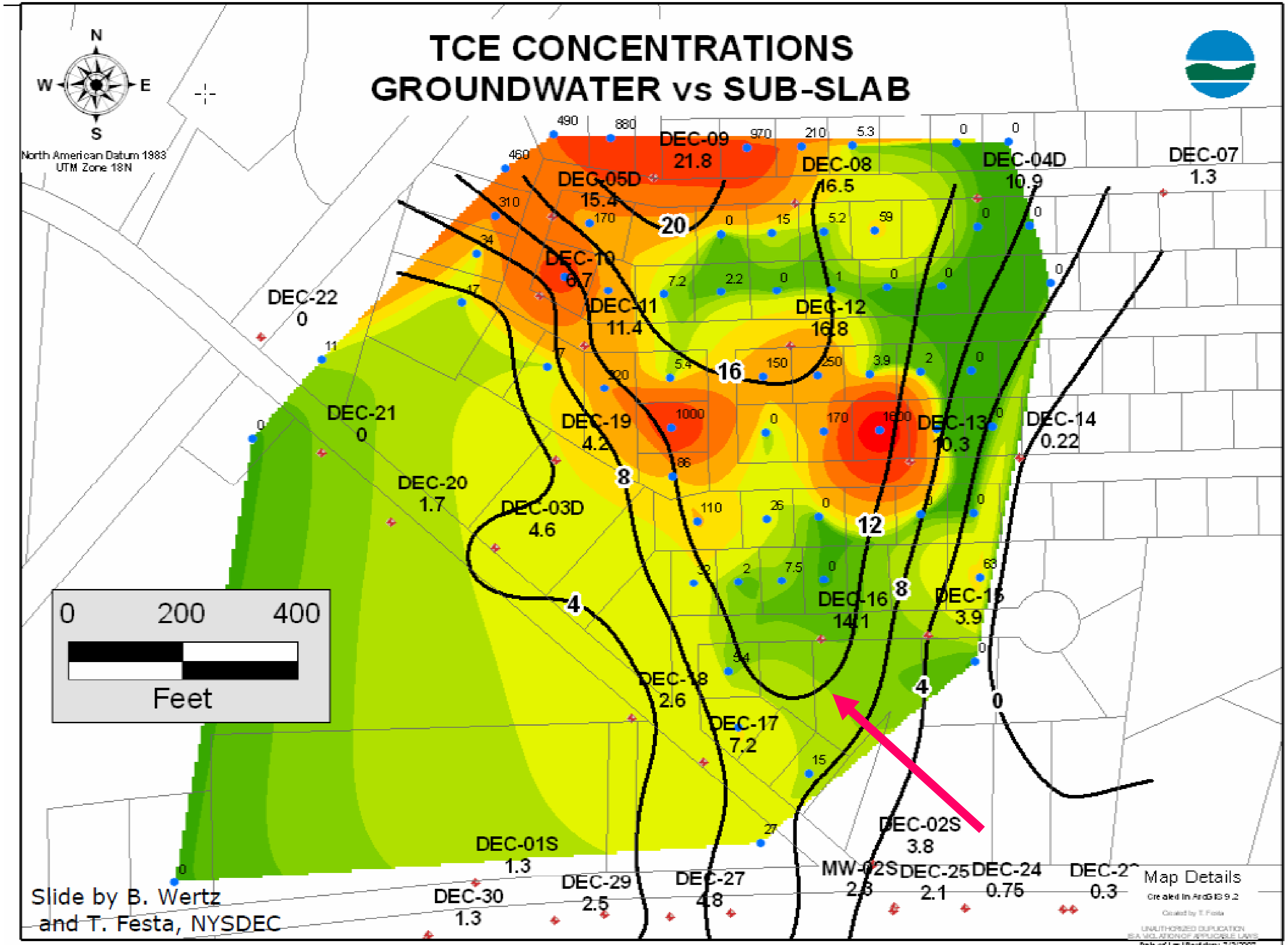
0 200 400
Feet
Map Details
Slide by B. Wertz
and T. Festa, NYSDEC

Deming
2008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0.3
0 200 400
Feet
Map Details
Slide by B. Wertz
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Deming 2008

Exterior Soil gas

EPA/600/R-15/70

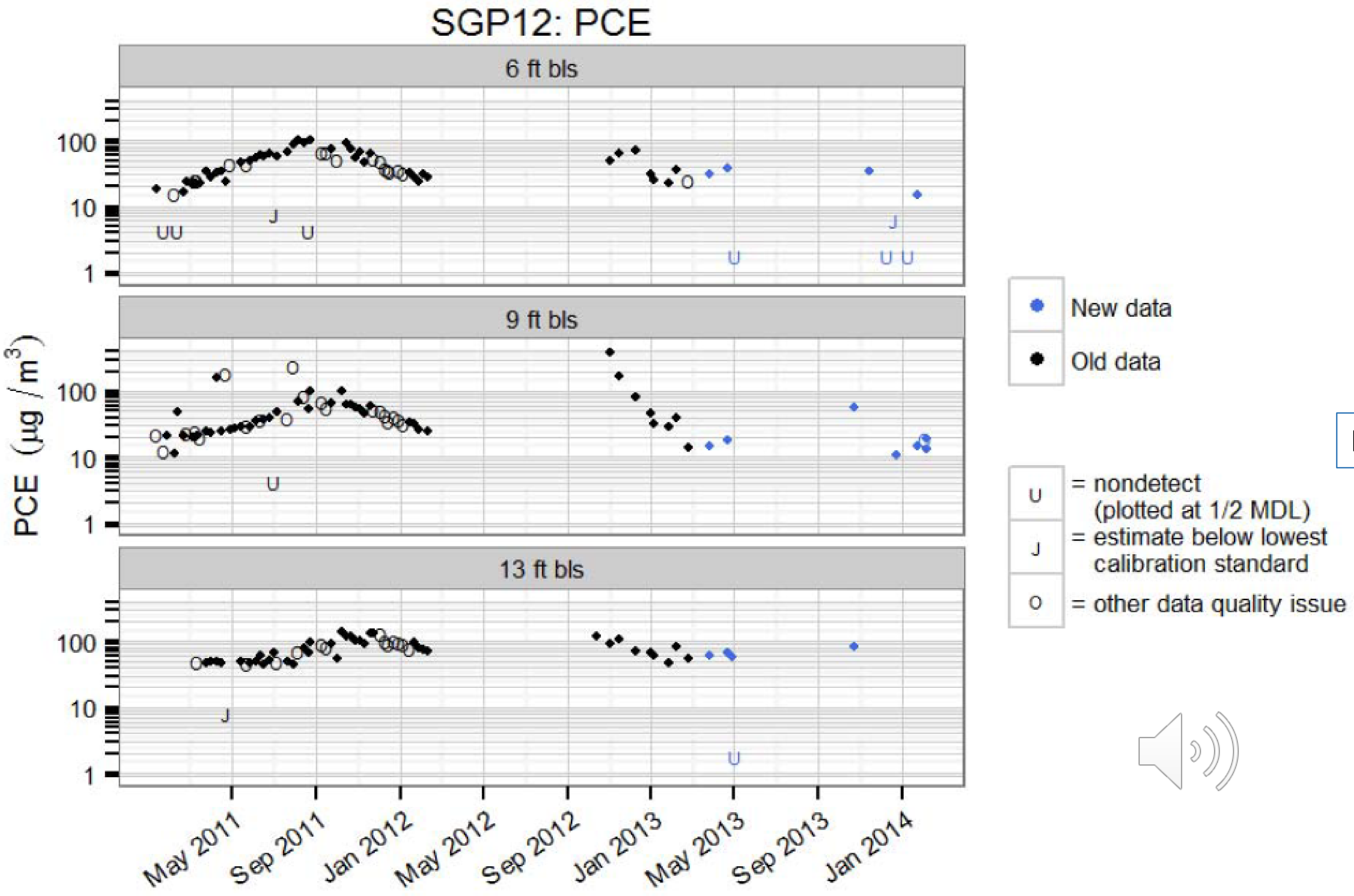


Figure 5-13. PCE at SGP12 on the 420 side of the duplex.

Exterior Soil gas

EPA/600/R-15/70

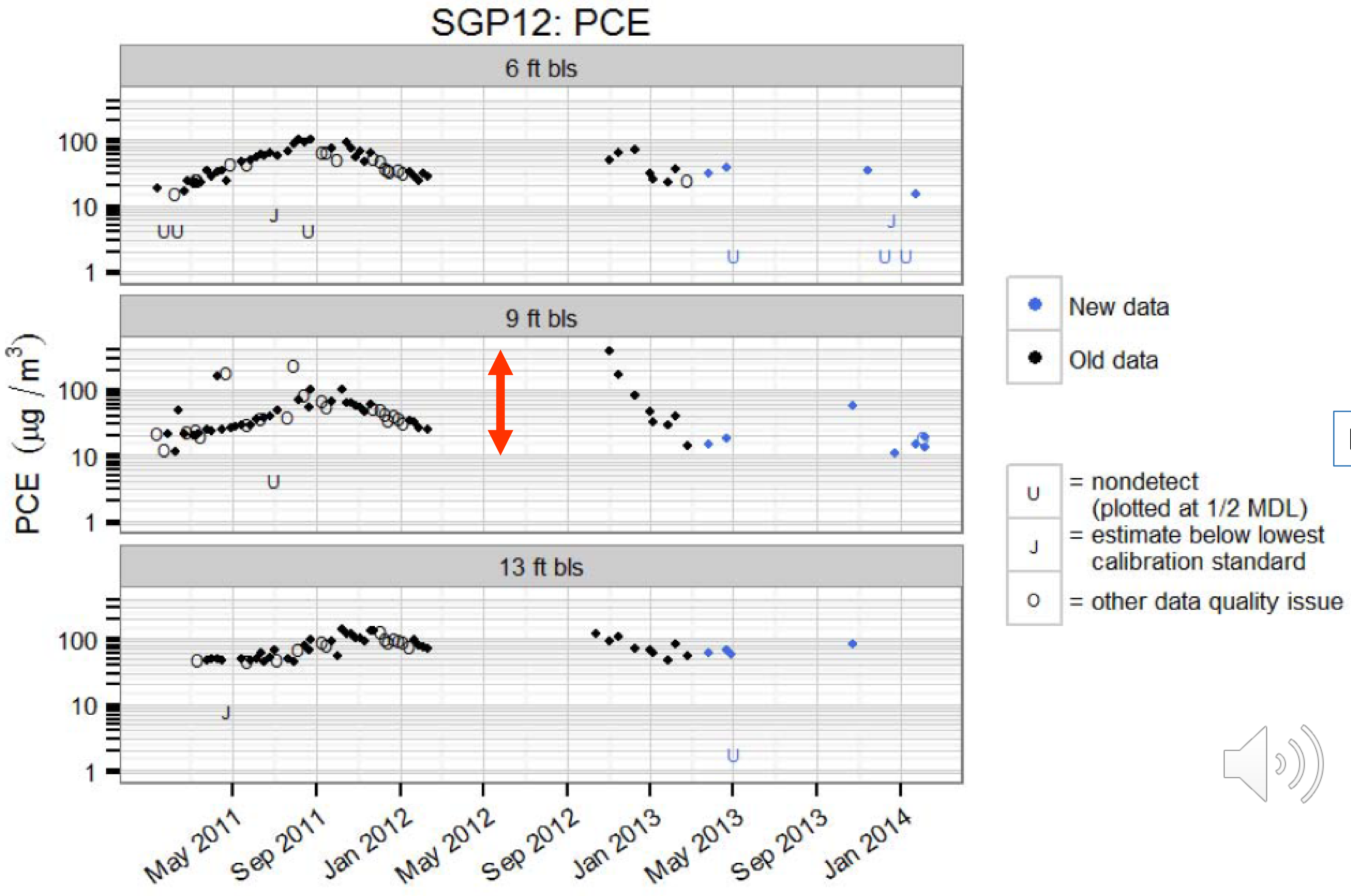
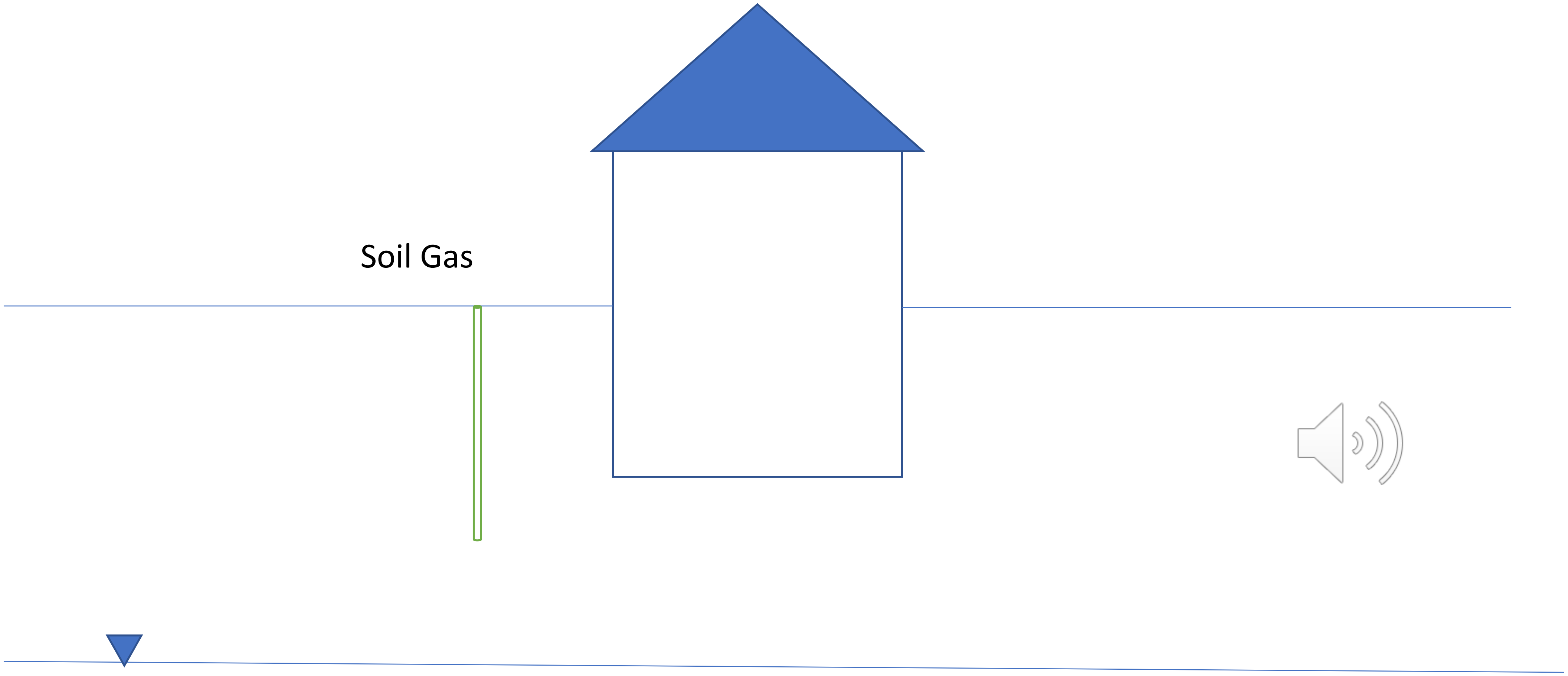


Figure 5-13. PCE at SGP12 on the 420 side of the duplex.

Best gas probe placement



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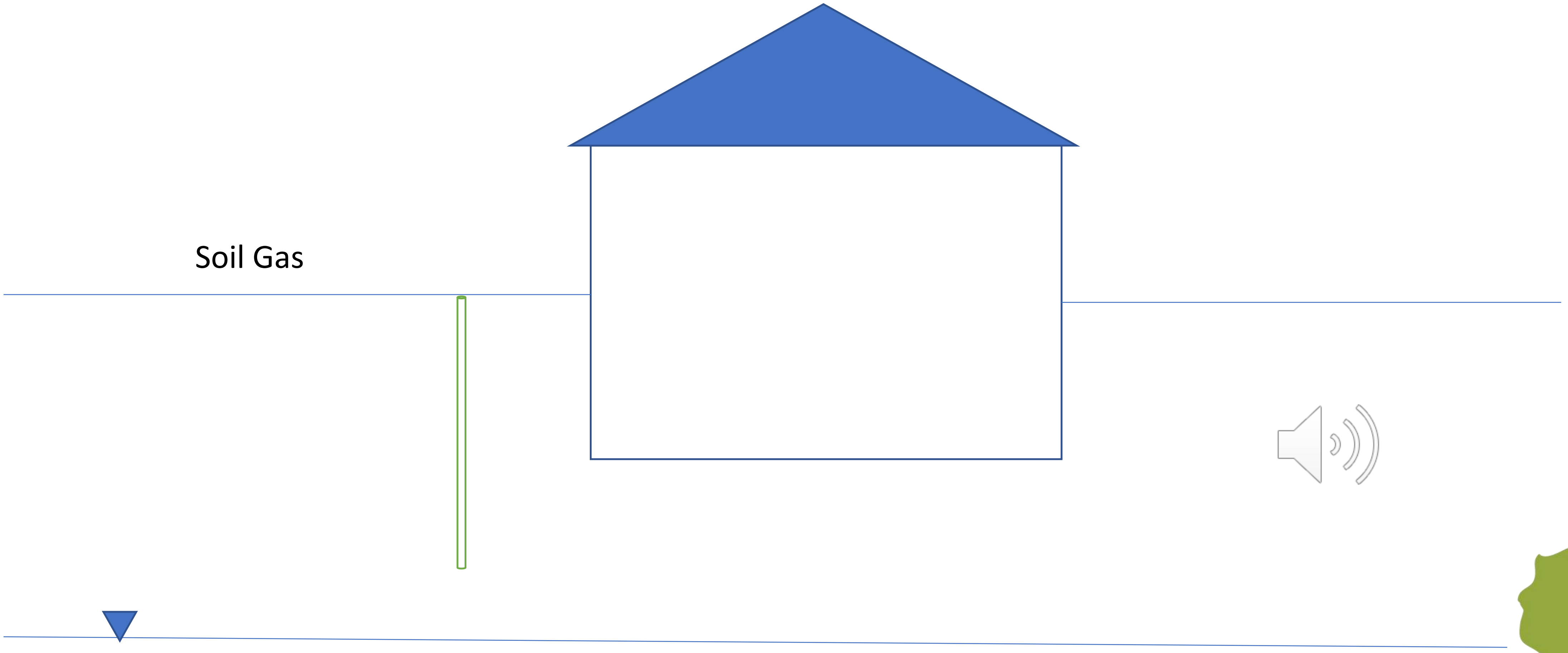

Screening & Exterior Sampling Takeaways

- Cautious - interpretation of plume boundaries
- Cautious - quantitative use of exterior soil gas samples
- Cautious - quantitative use of shallow groundwater concentrations
- Review previous screening decisions
- Discuss with DNR Project Manager

Screening Sampling Takeaways

- Cautious - interpretation of plume boundaries
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Screening Sampling Takeaways

- Conservative in interpretation of plume boundaries
- Cautious - quantitative use of exterior soil gas samples
- Cautious - quantitative use of shallow groundwater concentrations
- Review previous screening decisions
- Discuss with DNR Project Manager

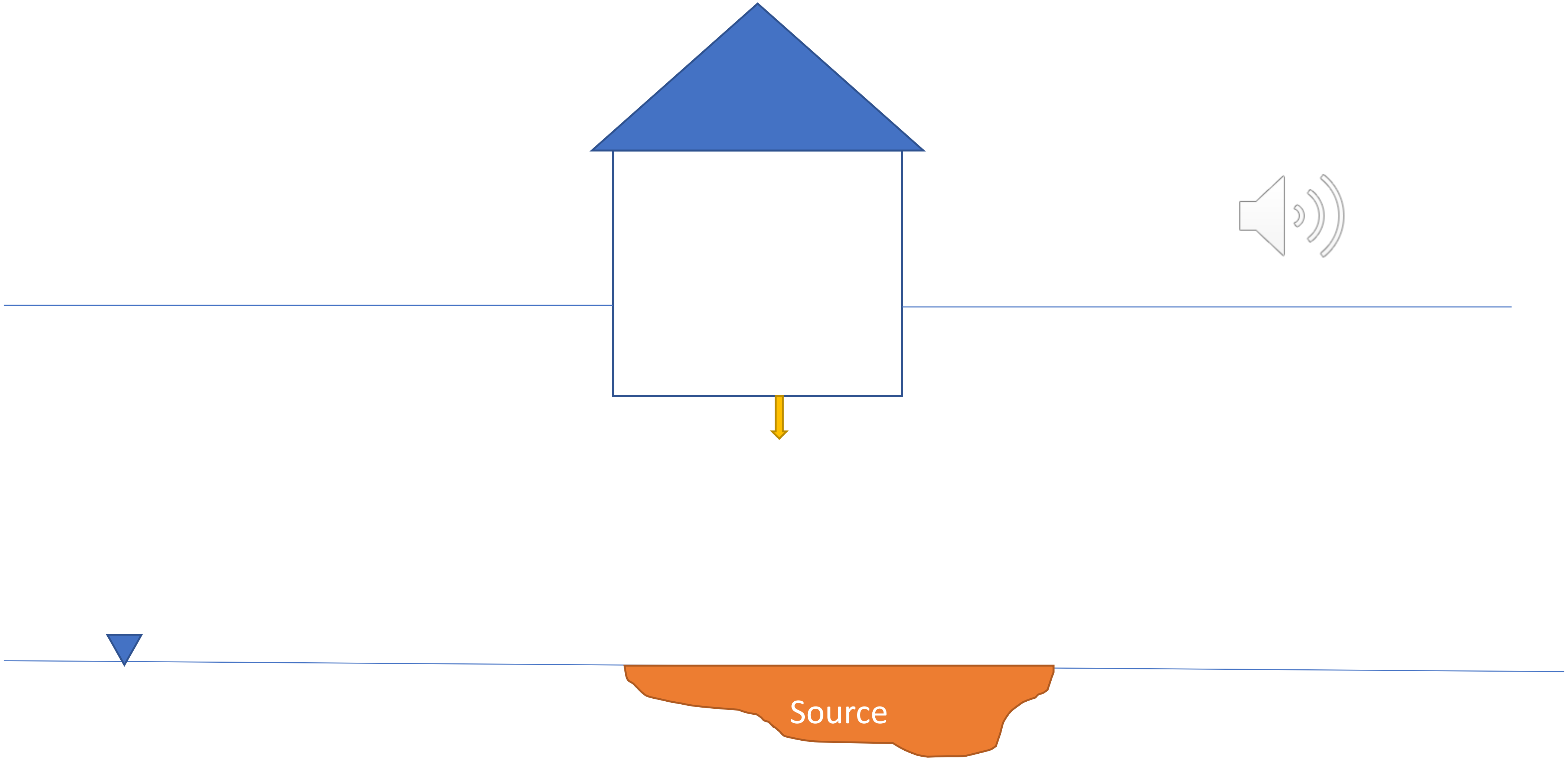
Building Assessment - Sub-Slab and Indoor Air Vapor

TABLE 5c
GUIDELINES & RECOMMENDATIONS FOR SCOPING VAPOR INVESTIGATIONS

SCOPE ITEM	SETTING					
	RESIDENTIAL	RESIDENTIAL MULTI-FAMILY	LARGE RESIDENTIAL (e.g. SCHOOL or DAYCARE)	MIXED USE	COMMERCIAL	INDUSTRIAL
SUB-SLAB SAMPLES[a] [b]	~1/1,500 sf	~1/ 2,000 sf or 1/residence on lowest level	Fewer samples/sf than residential homes. Number of samples will depend on site conditions: – Focus samples near areas where highest vapor contamination is expected. – Depending on results, additional samples may be needed over an expanded area to delineate extent of vapor impacts. – **Barriers (e.g. footings or old exterior walls) should be factored into the selection of sample locations.** – Fewer sample points are needed for high purge volume sampling as compared to standard sub-slab vapor sampling.			
INDOOR AIR RECOMMENDED? [c]	Yes			Depends on sub-slab results (Not recommended if contaminants of concern are in use at the business.)		
SAMPLING FREQUENCY [d]	3 times		2 – 3 times		1 time (high purge volume sampling)[e] 2 – 3 times (standard sampling)	
TIME OF YEAR	At least one sample in winter and one sample in another season. (Times during decreasing temperature change may be best time to sample).				Winter preferred for at least one sample. (No restrictions for high purge volume sampling)	

RR-800

Sub-slab sampling required (NR 716.11(5)(g))



RR-800

TABLE 6a
DEFAULT ATTENUATION FACTORS

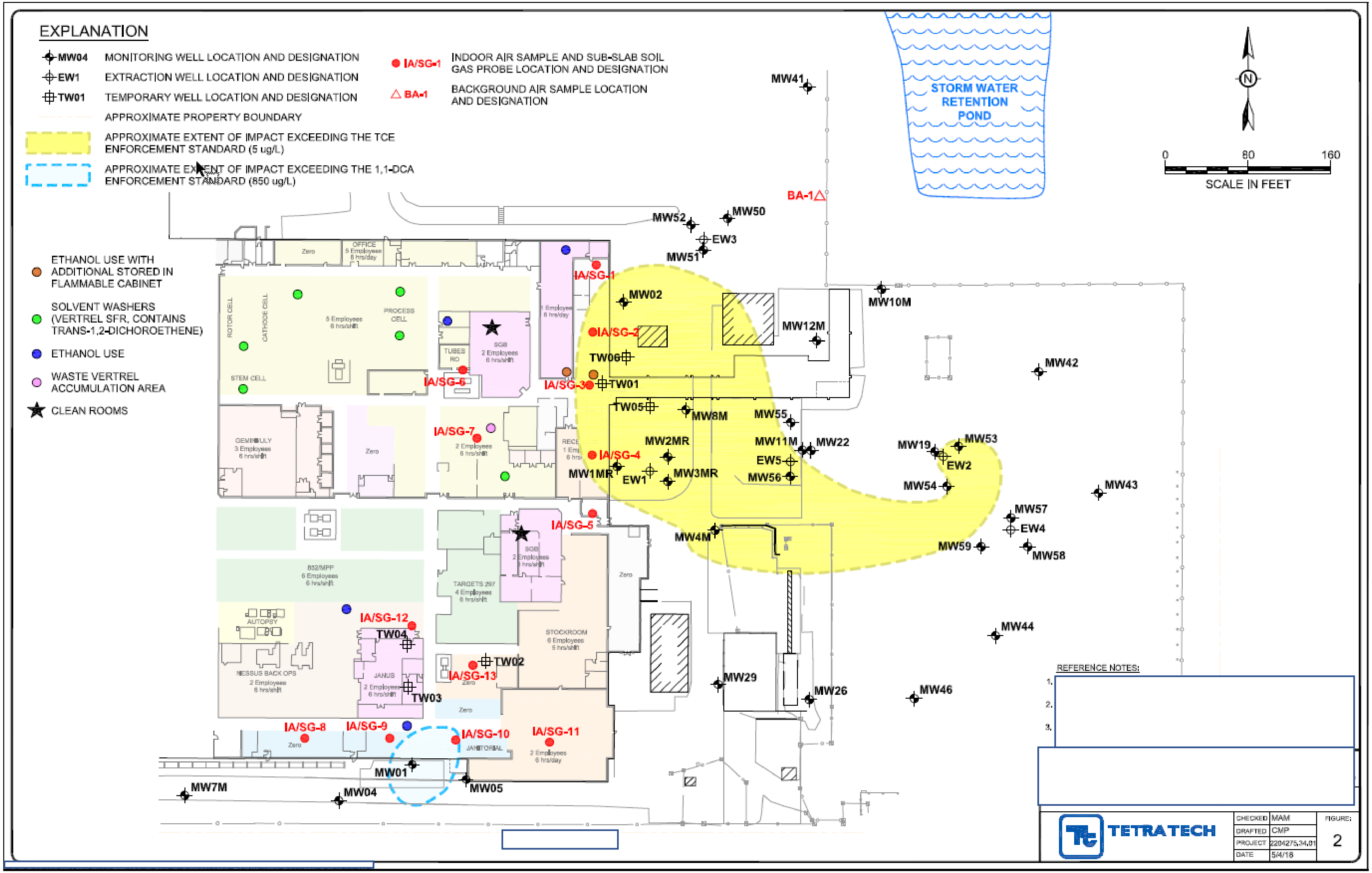
MEDIA	RESIDENTIAL & SMALL COMMERCIAL	INDUSTRIAL & LARGE COMMERCIAL[a]
Crawl Space	1	1
Sub-Slab Vapor	0.03	0.01
Soil Gas [b]	0.03	0.01
Deep Soil Gas/Utility[c]	0.01	0.001
Groundwater[d]	0.001	0.0001

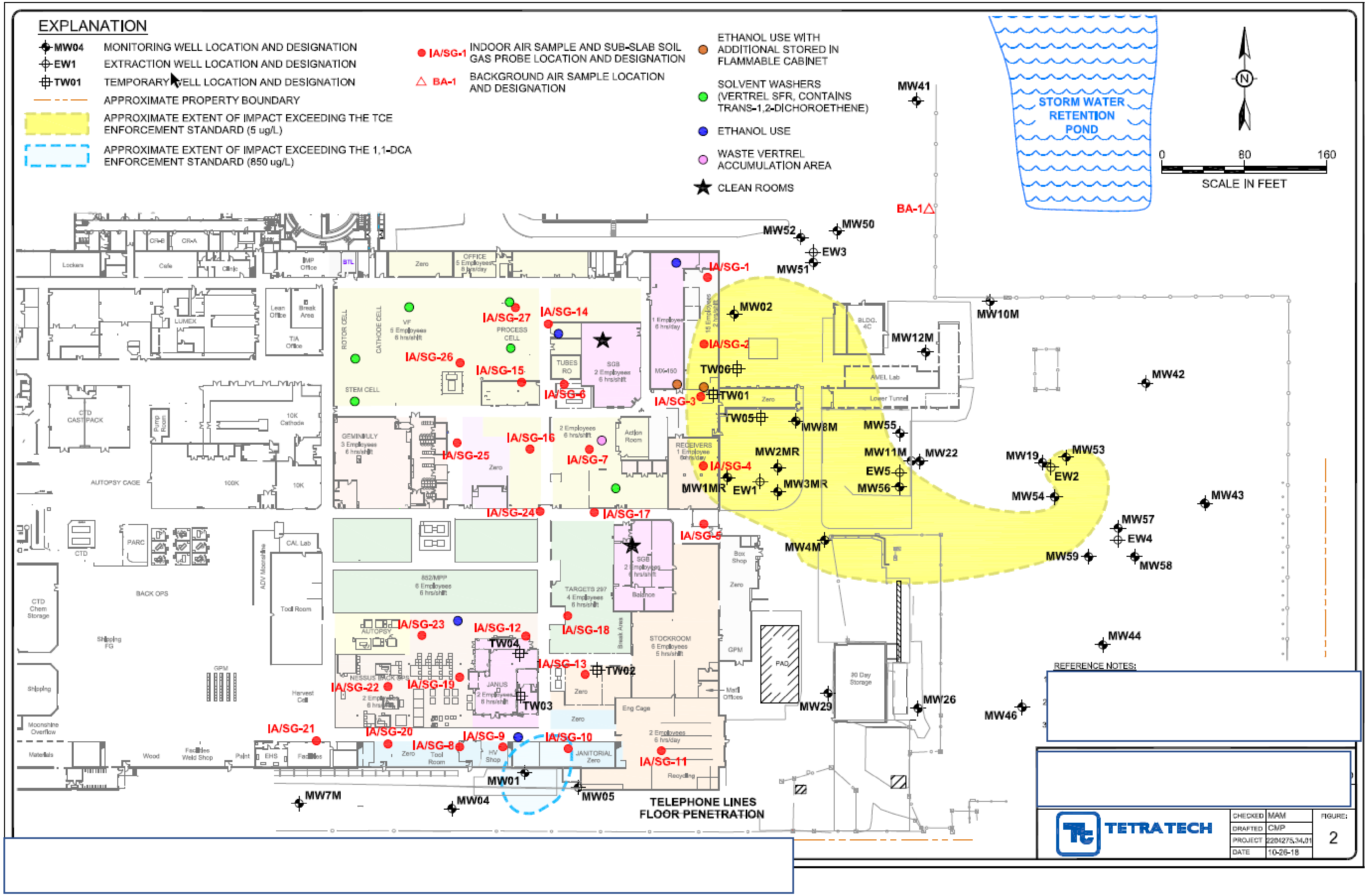
Site Specific Attenuation Factor (RR-800, 6.2.4)

$$Attenuation\ Factor_{Site\ Specific} = \frac{Tracer\ Concentration_{\ indoor\ air}}{Tracer\ Concentration_{\ sub-slab\ vapor}}$$

Getting DNR approval is recommended prior to starting the work to measure the site-specific attenuation factor. To get approval, submit a work plan with the technical assistance review fee to the DNR.

Industrial Site





Industrial Site

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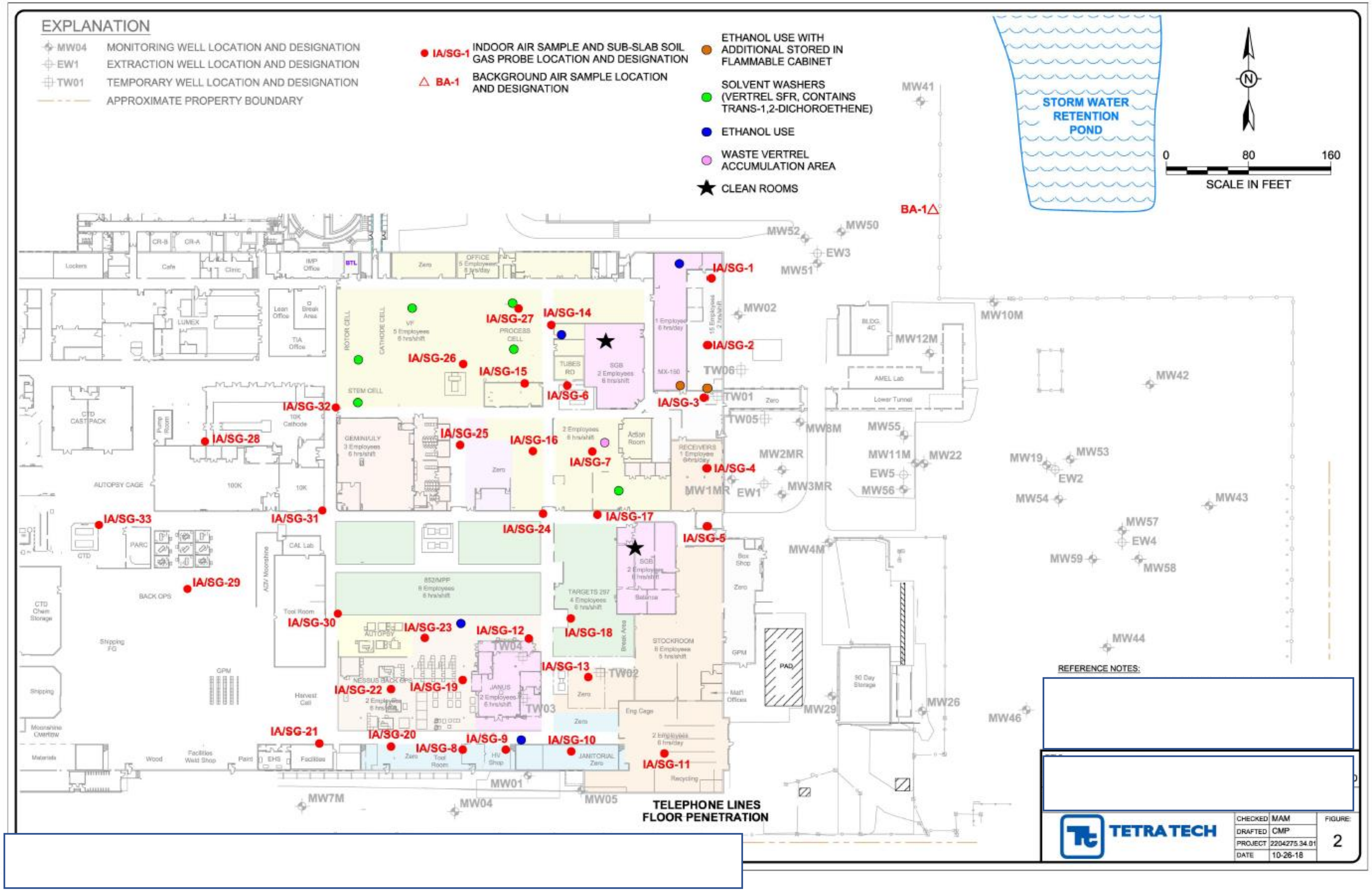
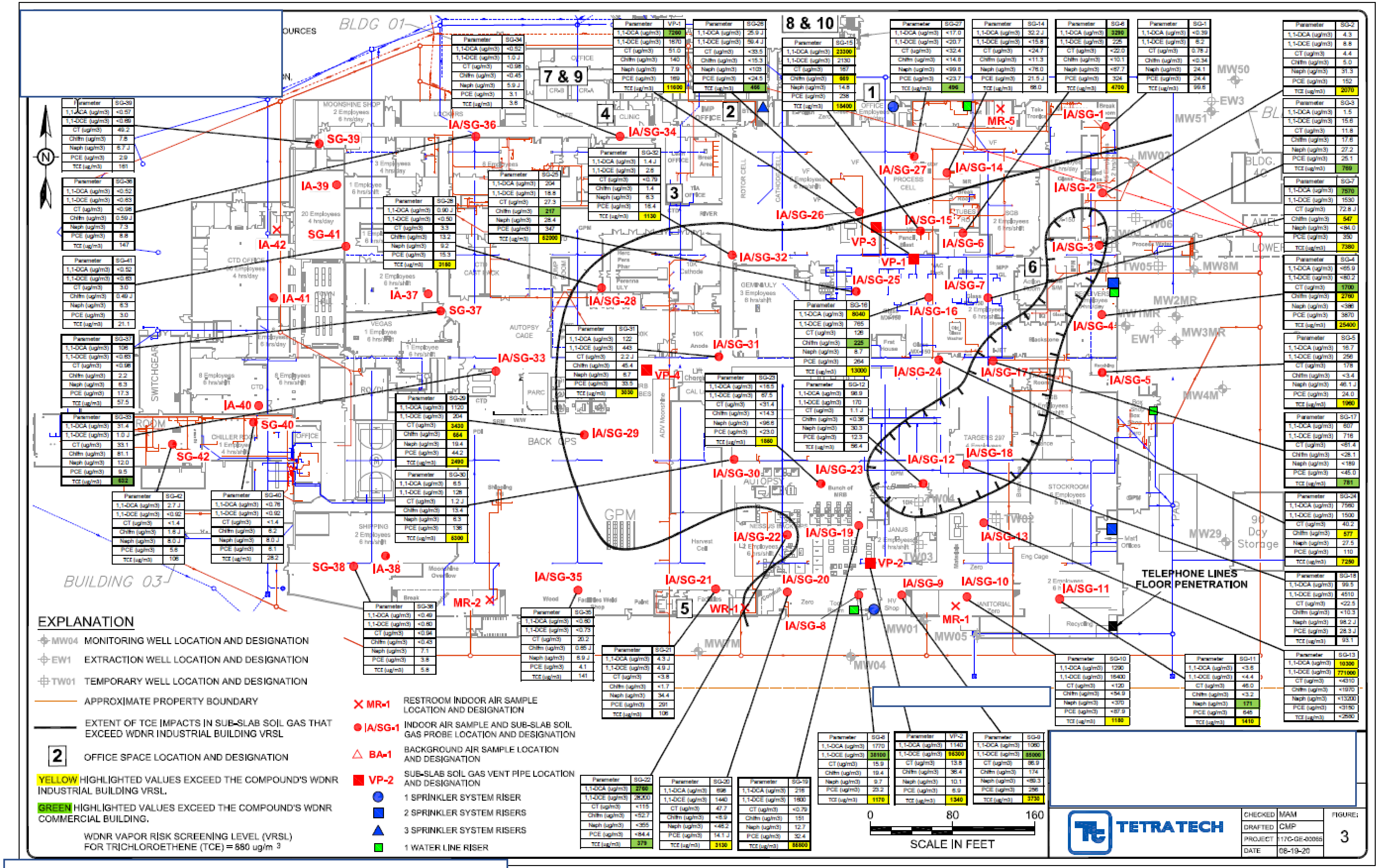
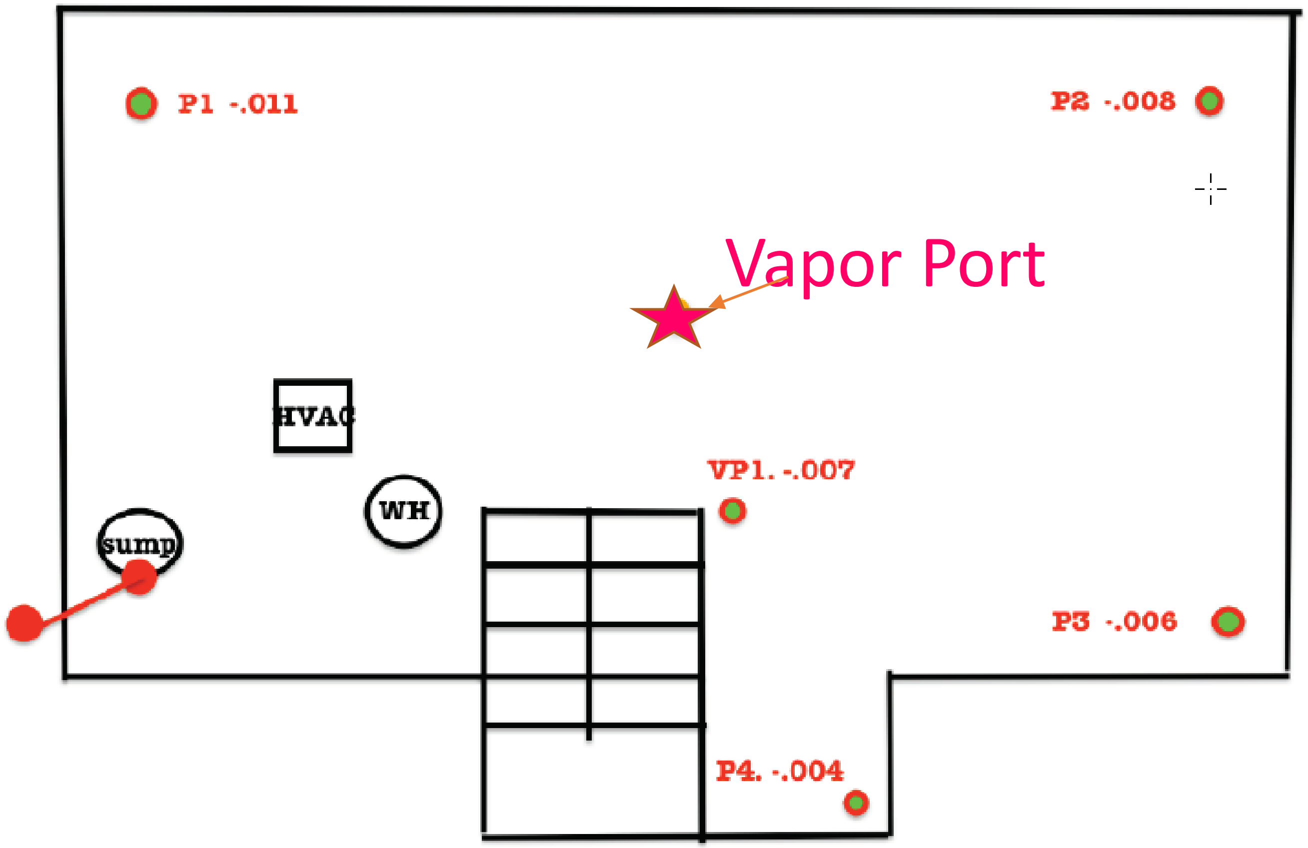


Industrial Site



Typical Single Family Vapor Sampling in Wisconsin

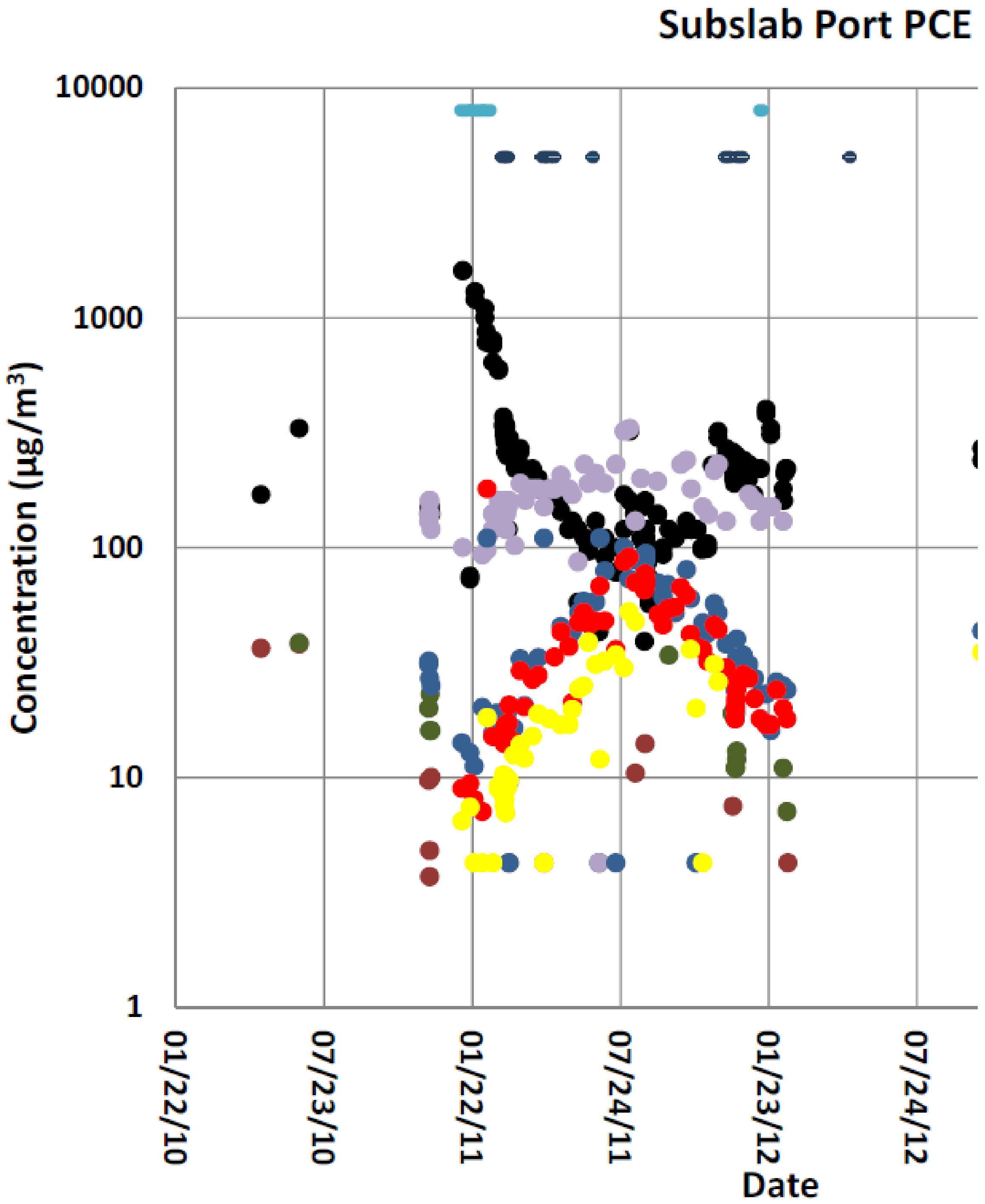


1600 square foot House

EPA Indianapolis Study House

Subslab Ports

- SSP-1 PCE
- SSP-2 PCE
- SSP-3 PCE
- SSP-4 PCE
- SSP-5 PCE
- SSP-6 PCE
- SSP-7 PCE
- SSP-8 PCE



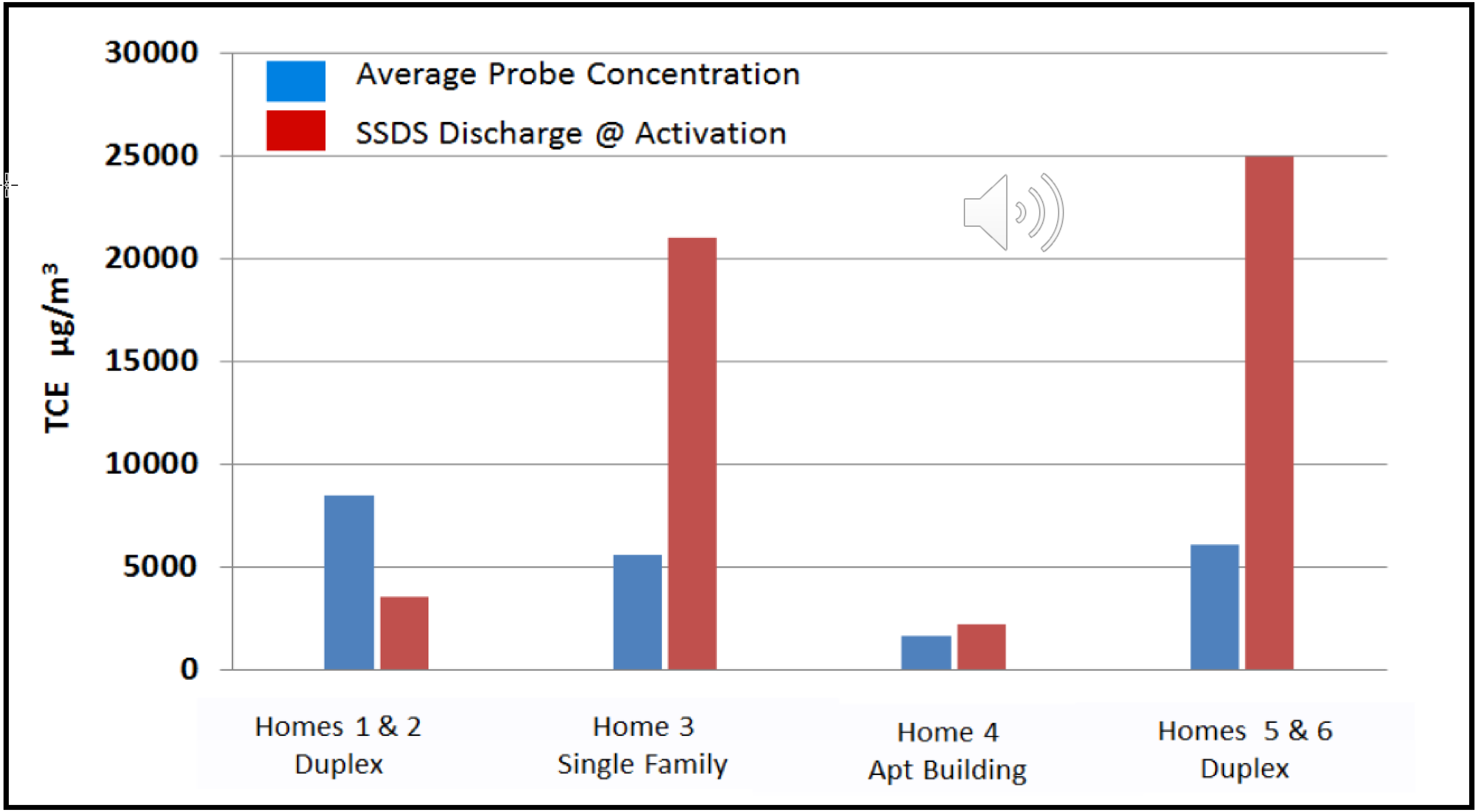


Figure 6 – TCE Concentrations in Sub-Slab Vapor Points vs. SSDS influent

MA DEP, October 2016

WI Residential Houses with High Attenuation Factors

TCE µg/m^3

IA VAL TCE = 2.1
Sub-slab VRSL TCE = 70

Sub-slab	Indoor Air	Post Indoor Air	Attenuation Factor
3.6	22.6	<0.36	6.278
8.8	12.3	<0.36	1.398
6.5	7.4	<0.35	1.138
1.8	1.9	<0.41	1.056
2	2.5	<0.38	1.250
29.1	20.9	<0.38	0.718
6.5	4.2	<0.38	0.646
11.7	5.9	0.33j	0.504
14.2	6.2	<0.38	0.437
23.8	8.9	<0.38	0.374
12.8	4.3	<0.51	0.336
11.7	3.6	<0.38	0.308
10.6	3.2	<0.59	0.302
47.7	14.2	<0.38	0.298
6.5	1.9		0.292
286	73.6	0.73J	0.257
4.9	1.2	<0.33	0.245
15.6	3.8	<0.34	0.243
11.3	2.5	1.4	0.221
460	89.6	<.38	0.195
16	3.1	<0.4	0.193
15.3	2.5	<0.51	0.163
23.7	3.5	<0.38	0.148
105	15.4	<0.35	0.147
2790	407	1.1	0.146
335	46.4	<0.34	0.139
15	1.3	<0.38	0.087
717	56.9	<0.39	0.079
121	9	<0.35	0.074
175	9.9	<0.38	0.057
6.2	4.7	<0.39	0.055
514	21.8	1.1	0.042
275	9.6	0.5j	0.035

Attenuation Factor = IA / Sub-slab Concentration

Default AF = 0.03

High Purge Volume vs Vapor Port Results
PCE µg/m^3

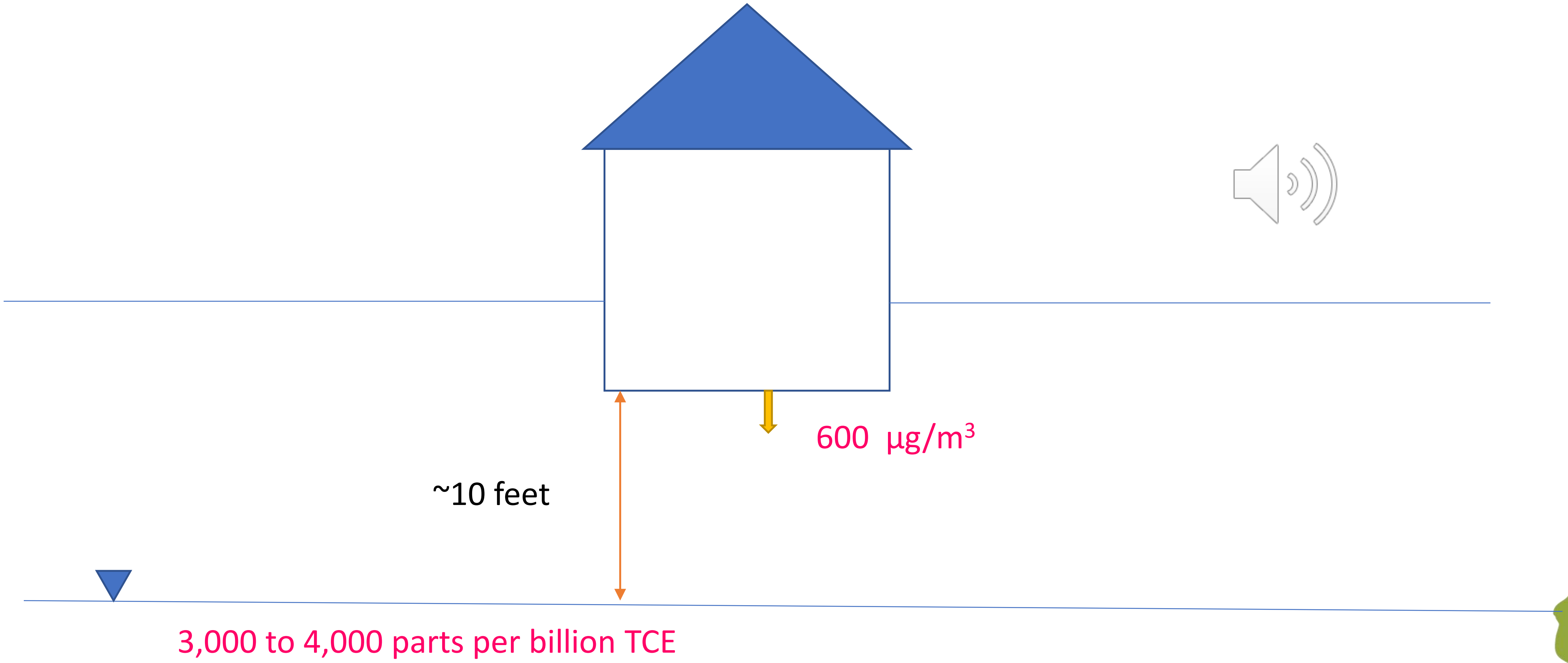
Vapor Port	High Purge Volume	VP/HPV
1550	250	6
5570	862	6.5
4730	367	12
36,400	1580	23
4740	70	67
13,000	9.4	1383

High Purge Volume vs Vapor Port Results PCE µg/m^3

135,000

Vapor Port	High Purge Volume	VP/HPV
1550	250	6
5570	862	6.5
4730	367	12
36,400	1580	23
4740	70	67
13,000	9.4	1383

High Purge Volume vs Groundwater Concentrations



Takeaway:

Presume a high degree of spatial sub-slab soil gas variability

Building Assessment - Indoor Air

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RR-800

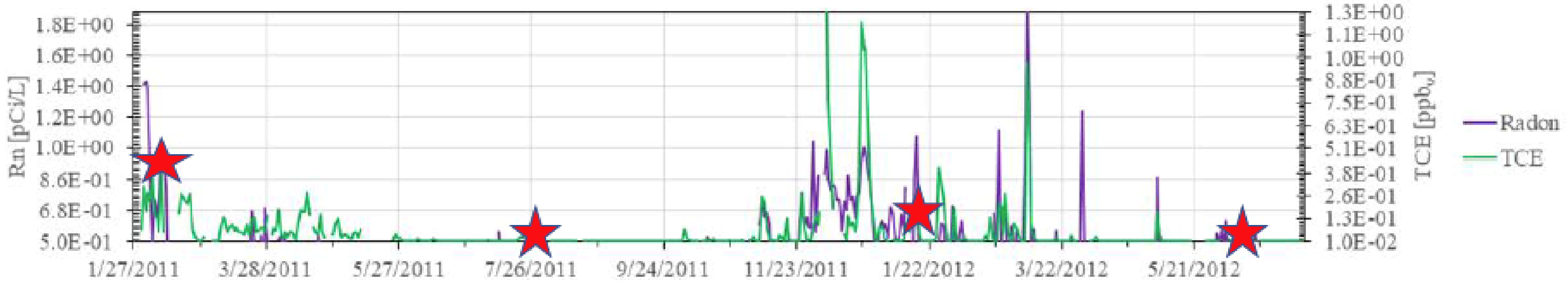
PID Screening Indicating Sewer Preferential Pathway

Date	Time	Unit	Location	Result (ppb)	Comr
Roof					
4/2/2020	11:32	1233	8" roof vent (drycleaning unit)	479	
4/2/2020	11:33	1233	4" plumbing vent	55	
4/2/2020	11:34	1235	4" plumbing vent	0	
4/2/2020	11:36	1239	"chimney vent"	17	
4/2/2020	11:36	1231	4" plumbing vent	0	
4/2/2020	11:38	1231	4" metal furnace vent (from ceiling)	284	
4/2/2020	11:38	1231	2" PVC furnace vent from basement	19	
4/2/2020	11:39	1219	bathroom vent	127	
4/2/2020	11:39	1219	4" plumbing vent (CI)	0	
4/2/2020	11:40	1219	Basement fan vent	126	
4/2/2020	11:41	1219	4" plumbing vent (ABS)	>10,000	
4/3/2020	14:24	1233	8" roof vent (drycleaning unit)	3,718	
4/3/2020	14:25	1233	4" plumbing vent	518	
4/3/2020	14:26	1233	2" pipe near chimney	1,124	
4/3/2020	14:27	1235	4" plumbing vent	52	
4/3/2020	14:28	1235	bath fan vent	13	
4/3/2020	14:28	1239	bath fan vent	0	
4/3/2020	14:29	1239	4" plumbing vent	0	
4/3/2020	14:29	1239	"chimney vent"	0	
4/3/2020	14:32	1231	4" plumbing vent	0	
4/3/2020	14:31	1231	4" metal furnace vent	357	
4/3/2020	14:34	1219	bathroom vent	164	
4/3/2020	14:34	1219	4" plumbing vent (CI)	0	
4/3/2020	14:33	1219	Basement fan vent	160	
4/3/2020	14:36	1219	4" plumbing vent (ABS)	4,958	

How confident are we of VI exposure est.?

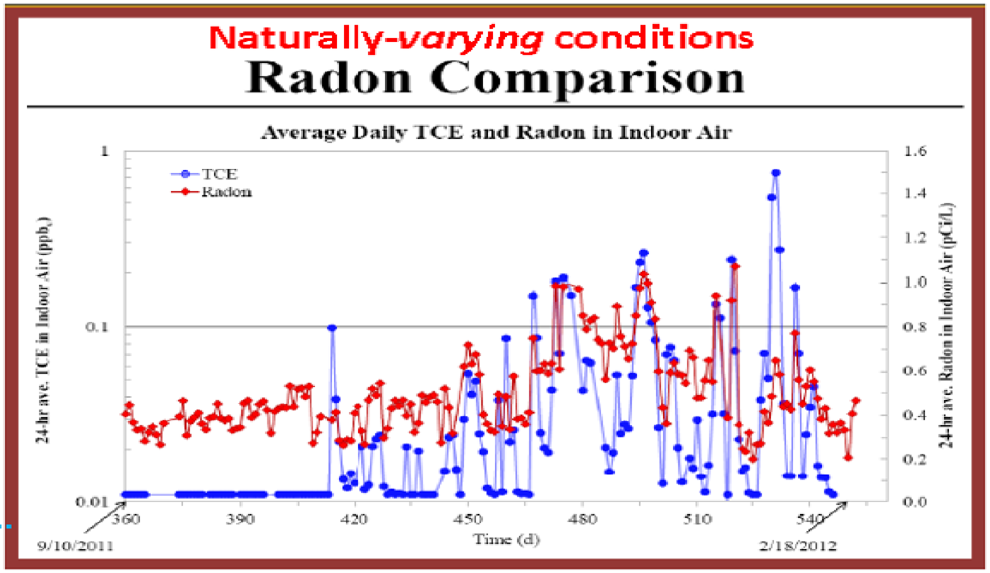
What level of confidence is appropriate?

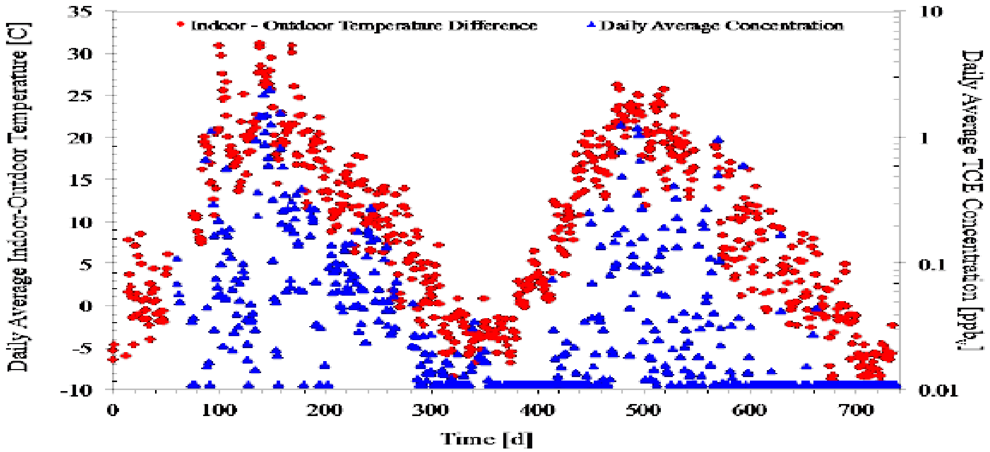
- **Chronic** risk
  - Long-term Average (95%UCL)
  - Typical quarterly ~ OK ?
- **Sub-chronic** (developmental) risk
  - Reasonable Max. Exposure (RME)
    - ~ 95th%ile
  - Could be as short as 1-day



Henry Schuver, EPA, Introduction, Regulatory Context and Quantitative Confidence, October 22, 2019: US EPA Workshop on: Measurement-Based Methods for Protective & Defensible Chlorinated VI Exposure Determinations, Amherst, MA.

Extra Slide





Comparison between Rn and DT as indicator of TCE

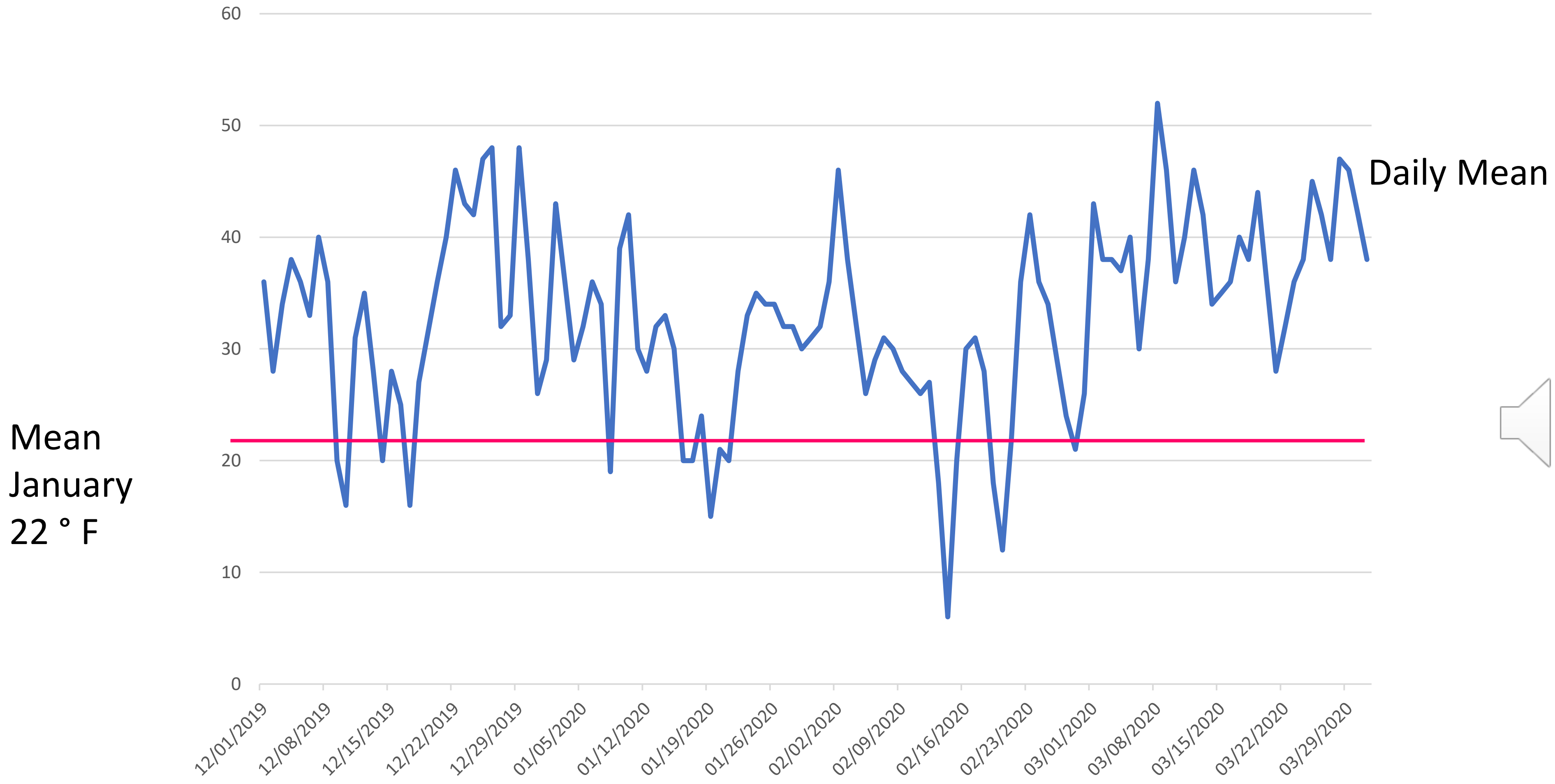
Henry Schuver, EPA, Introduction, Regulatory Context and Quantitative Confidence, October 22, 2019: US EPA Workshop on: Measurement-Based Methods for Protective & Defensible Chlorinated VI Exposure Determinations, Amherst, MA.

Golder Associates

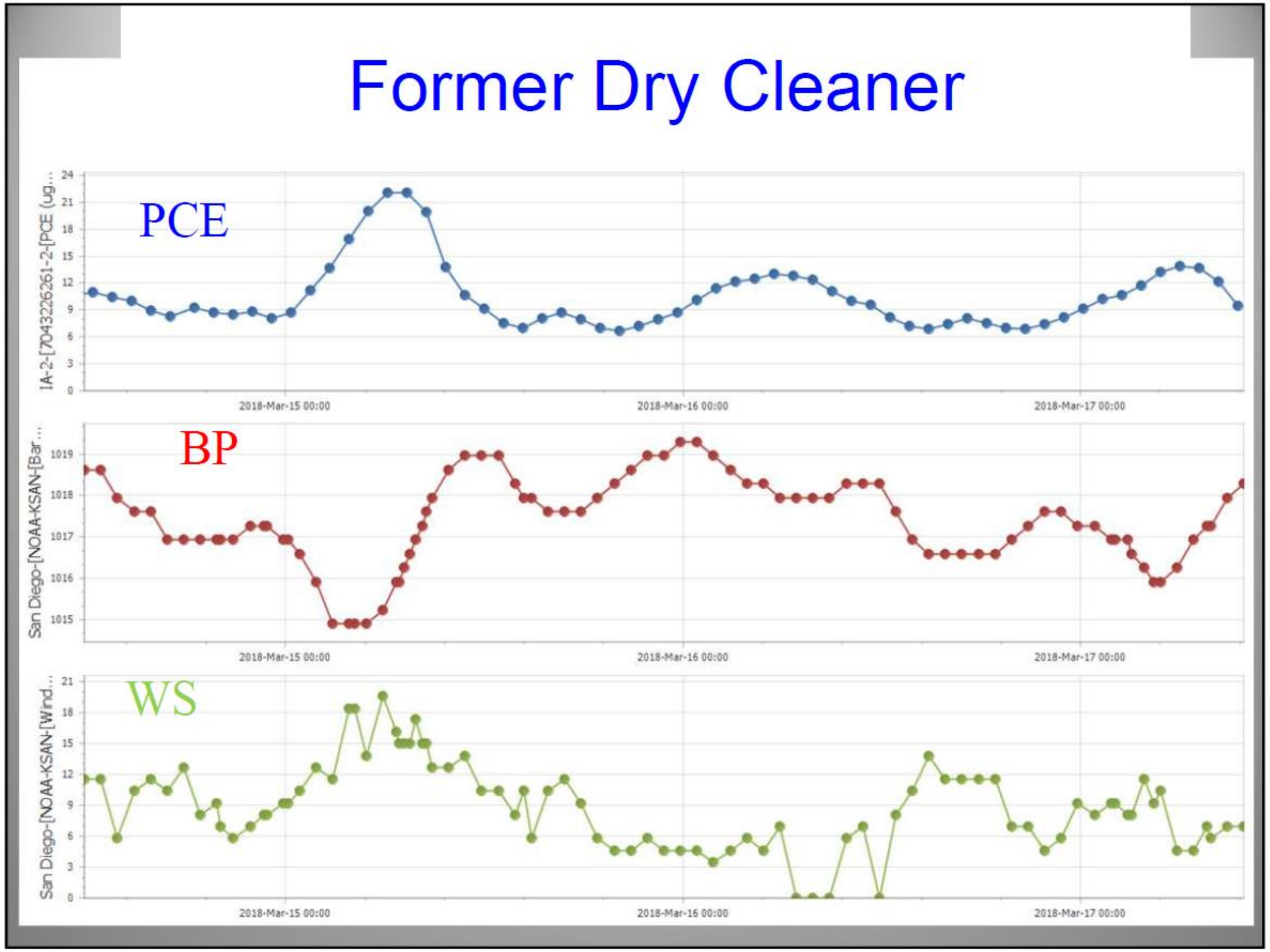
Outdoor Air January Mean Temperatures in WI

City	January Mean °F
Beloit	21
Green Bay	18
Kenosha	23
La Crosse	19
Madison	20
Manitowoc	21
Milwaukee	22
Minoqua	13
Oshkosh	19
Superior	15
Waukesha	22
West Bend	21

January Mean vs Daily Mean Temperature ° F Milwaukee



Real Time Sampling



Hartman, 2018

Barometric Pressure

Wind Speed

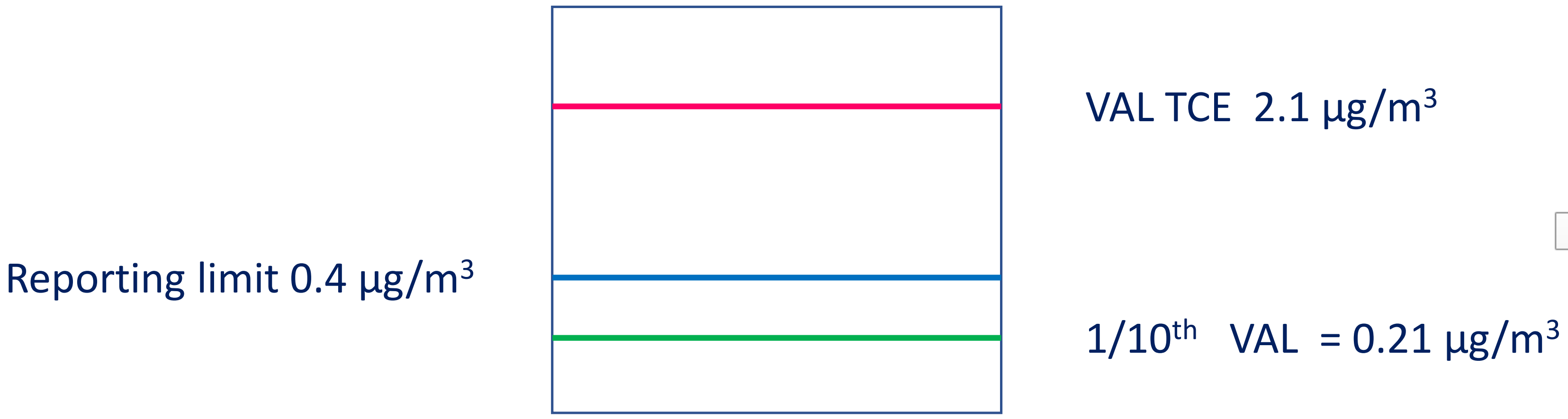
Reported Spatial Ranges of Indoor Air Concentrations

Industrial
2-100X

Residential
2-10x

Kram, 2020

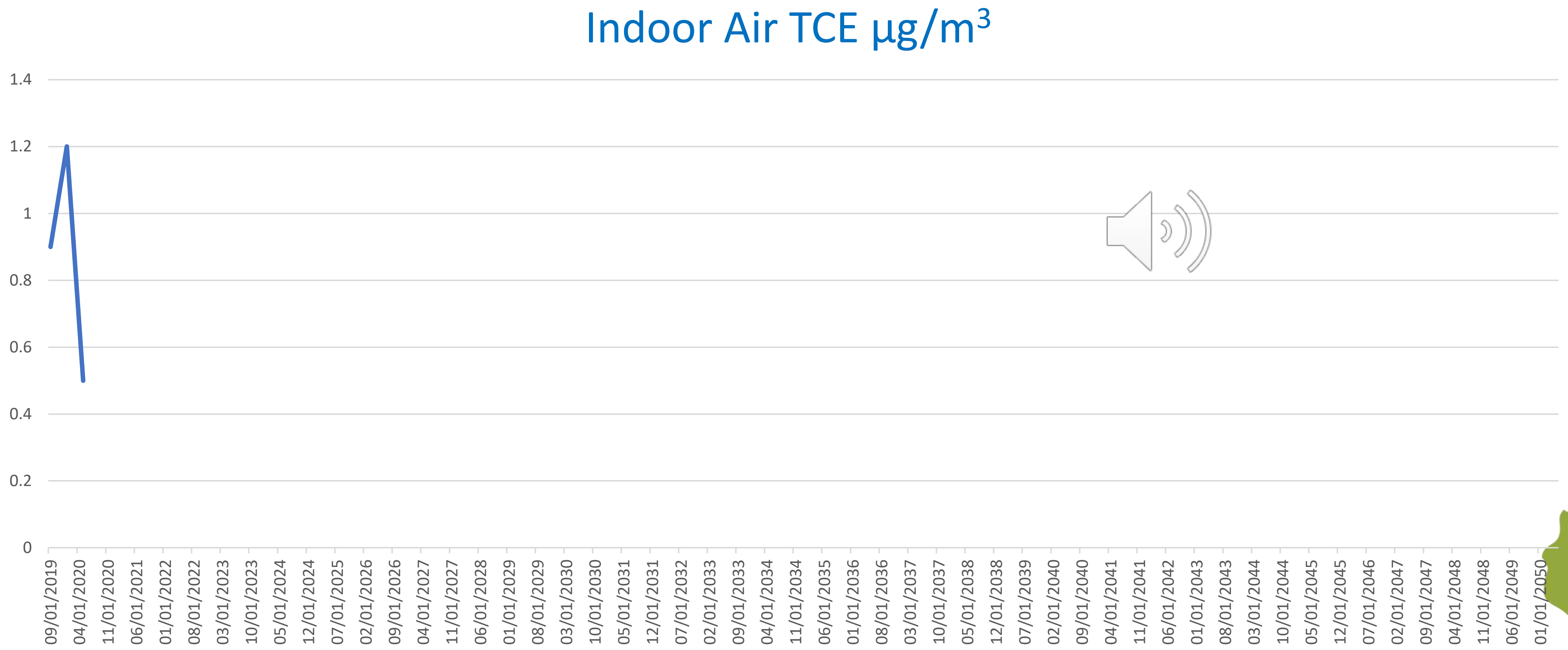
Reported Ranges of Temporal Indoor Air Concentrations (mostly <10 times)



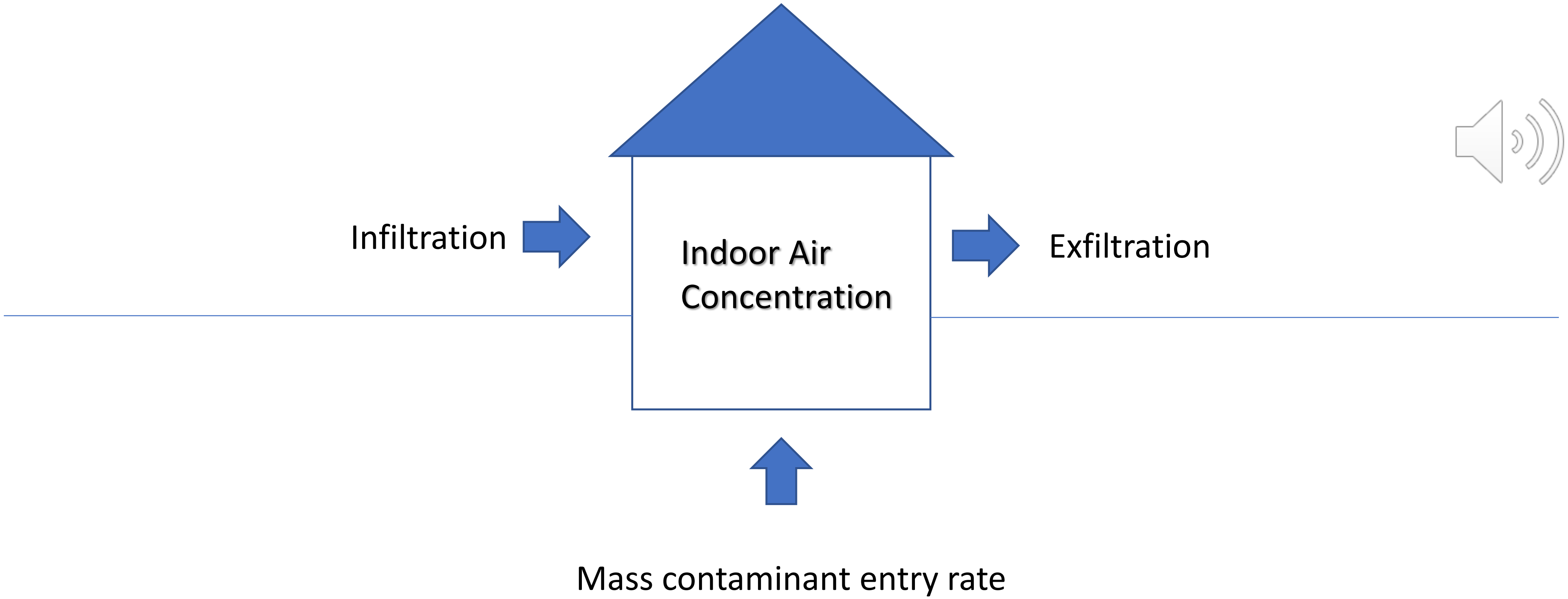
Ström, 2020

Short assessment period …

……..Long prediction period



Factors that can affect VI in a building



Factors that can affect VI in a building

- Decreasing integrity of the slab (gas permeability of material, cracks)
- Introduction of a preferential pathway: drain tiles/sumps, utility penetrations, critters
- Climate: year to year variation, long-term change
- Changing Air Exchange Rate (HVAC, leakage, exhaust fans, occupancy)
- Change in surrounding surface
- Change in water table elevation

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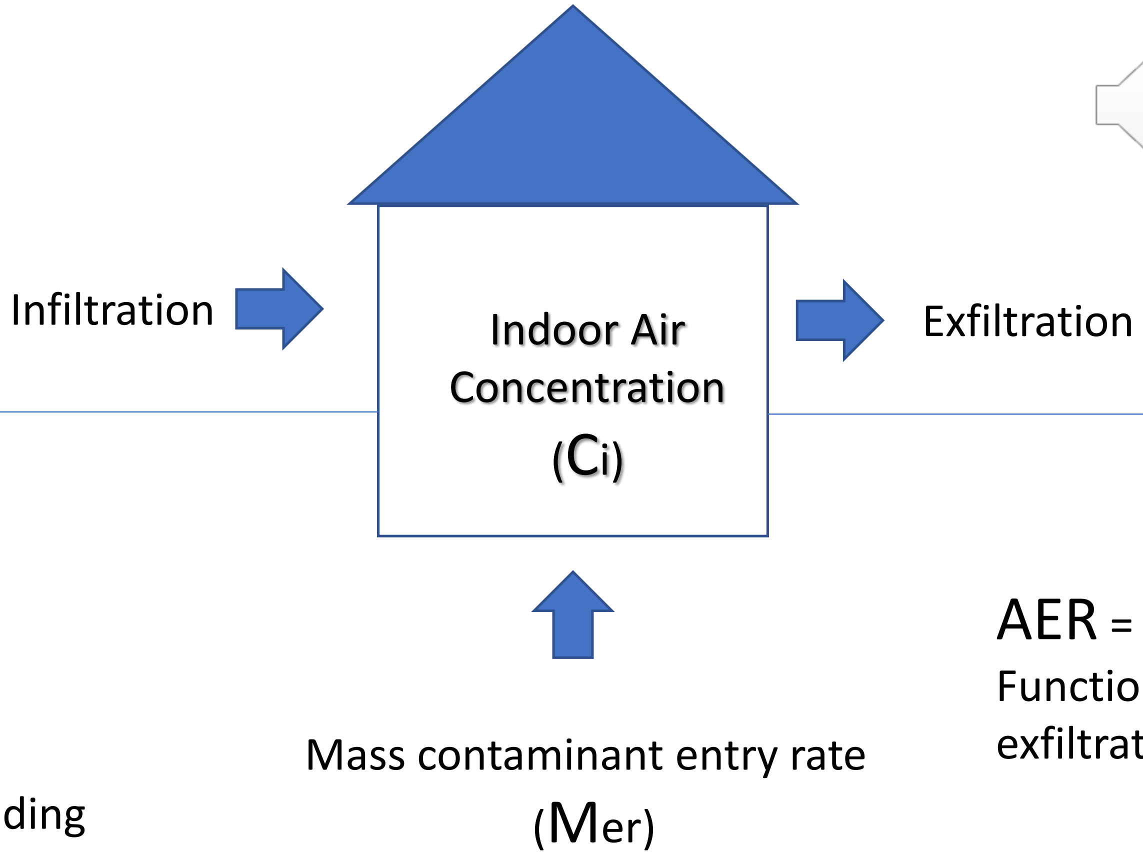
Indoor Air Concentration a Function of AER

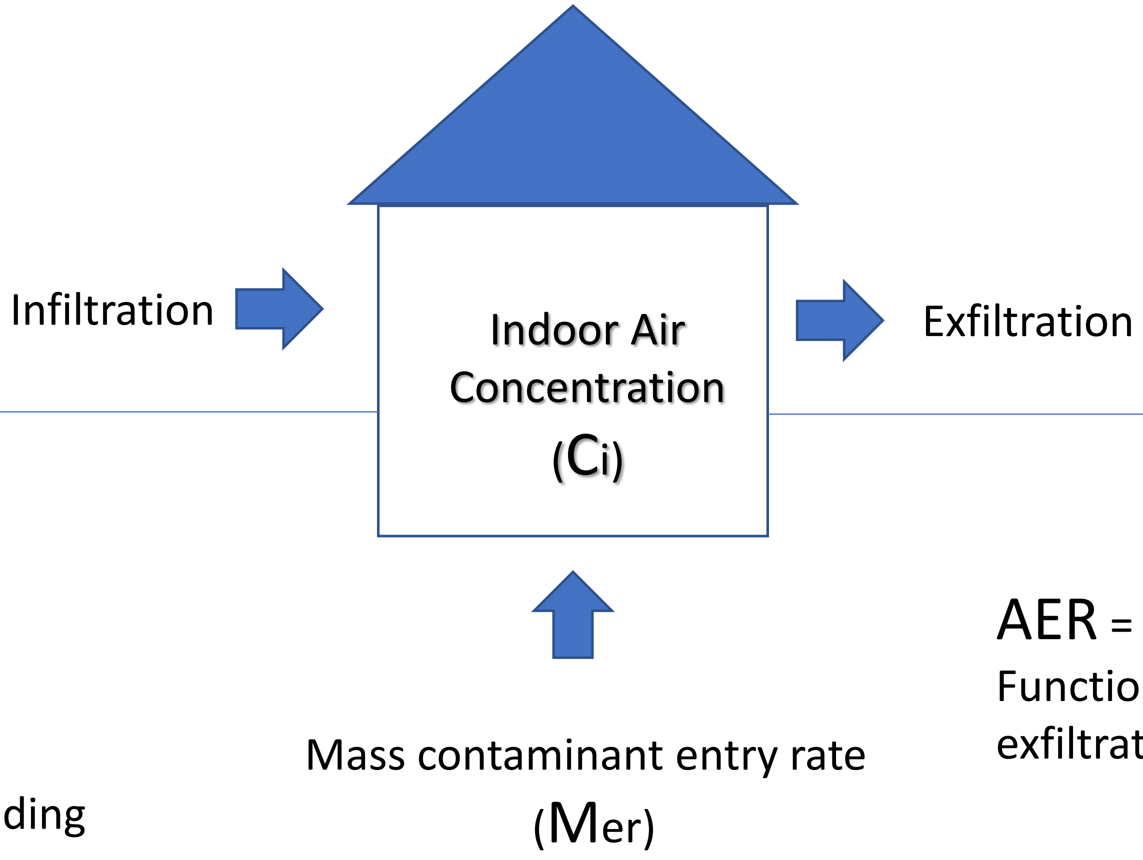


$$C_i = \frac{M_{er}}{AER \times V_b}$$

V_b = volume of building

AER = Air Exchange Rate
Function of infiltration and exfiltration rates

Indoor Air Concentration a Function of AER



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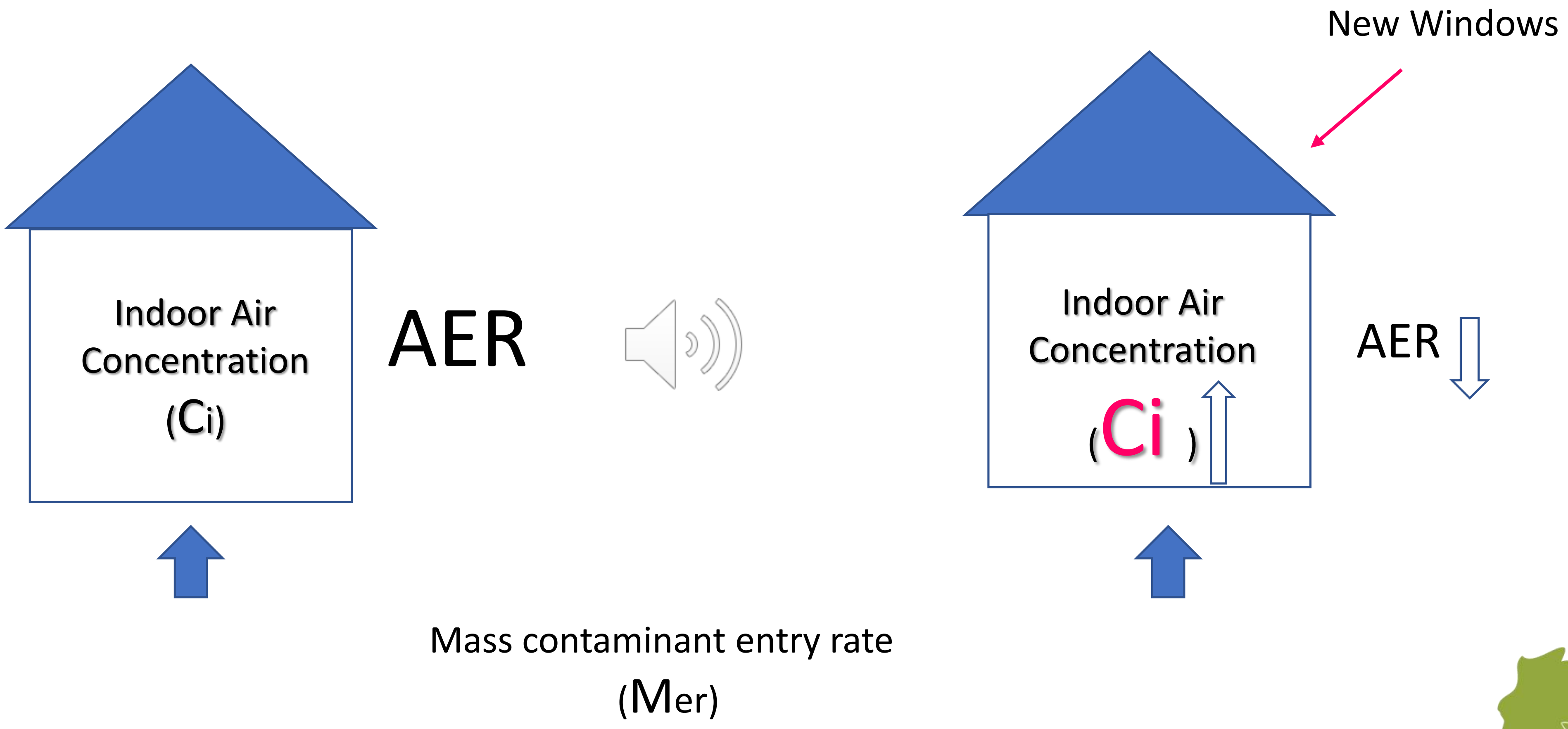
Effect of Weatherization



Factors that can affect VI in a building

- Decreasing integrity of the slab (gas permeability of material, cracks)
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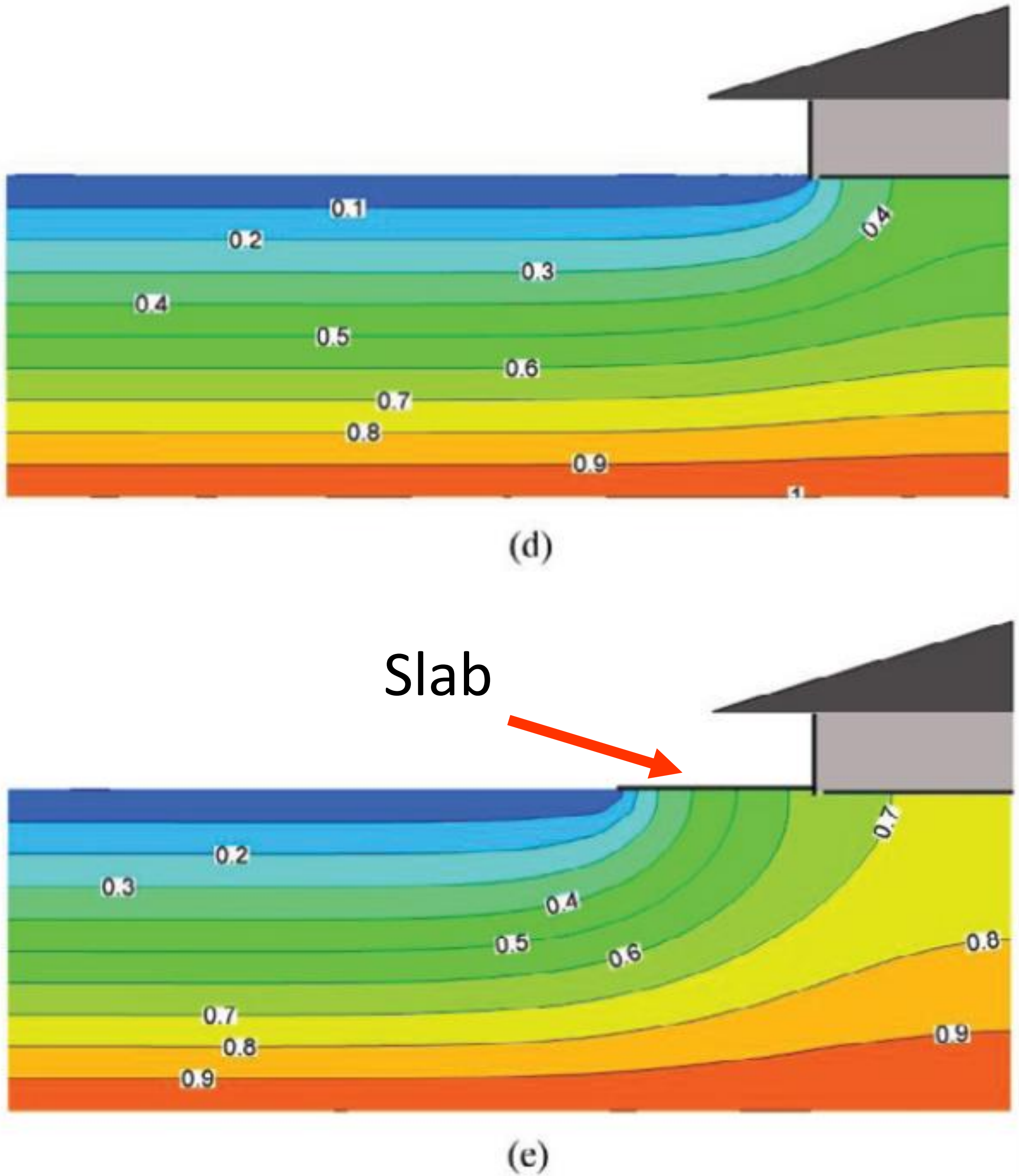
Effect of a slab on vapor concentrations



Yao, Y., Pennell, K., Suuberg, E., Vapor intrusion in urban settings: effect of foundation features and source location, Procedia Environmental Sciences 4 (2011) 245–250.

Factors that can affect VI in a building

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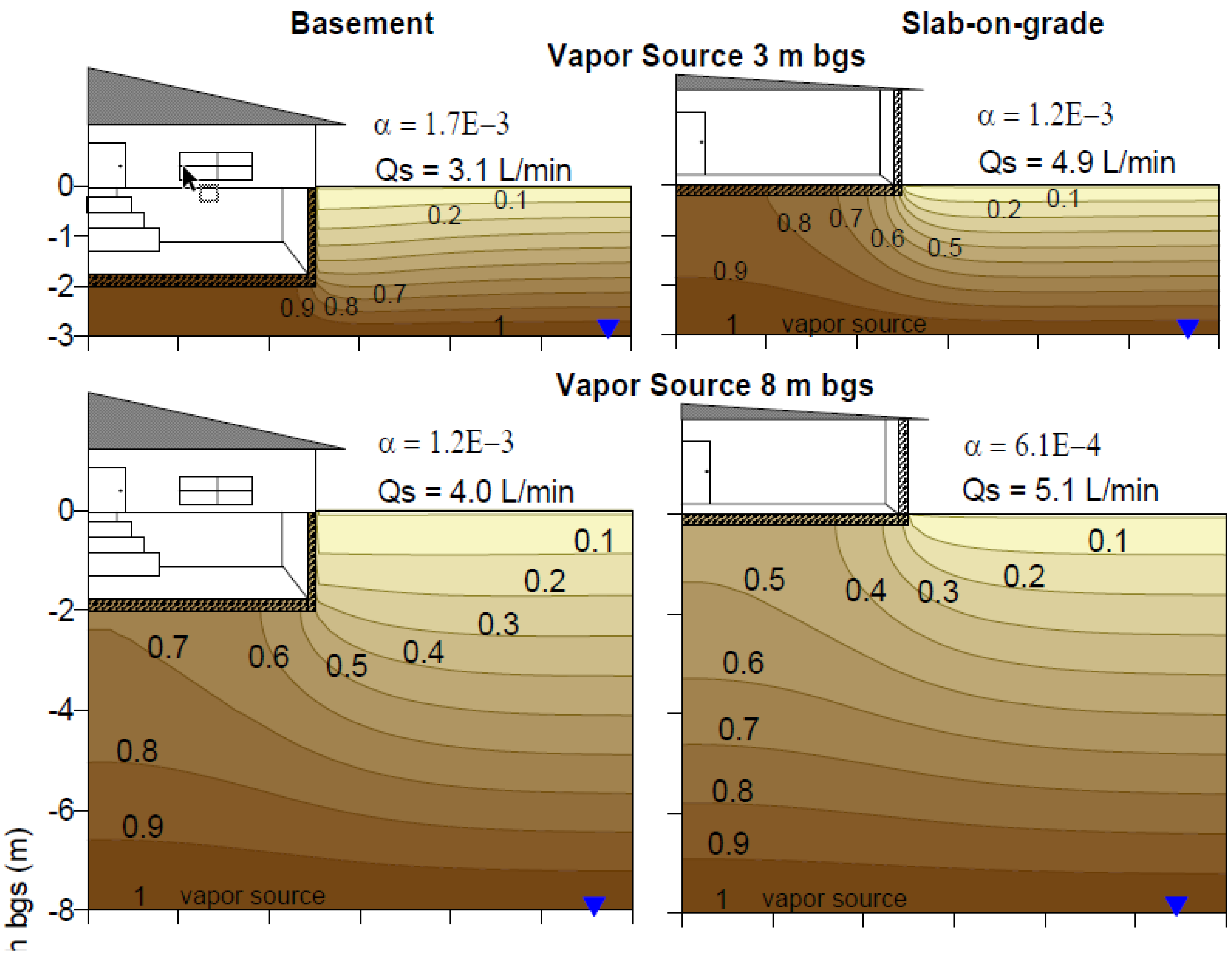
Changing Water Table Elevation



EPA, 2012, Conceptual Model Scenarios for the vapor intrusion pathway, EPA 530-R-10-003

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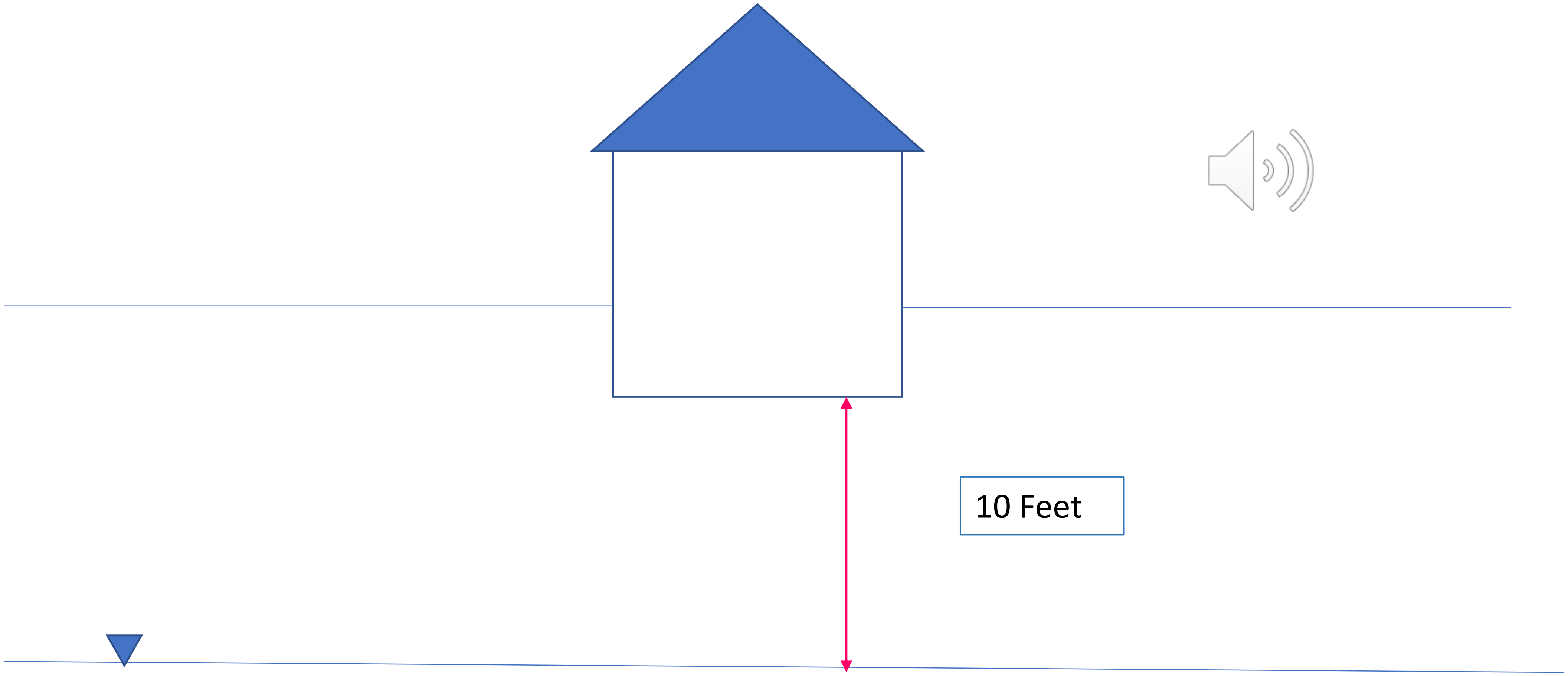

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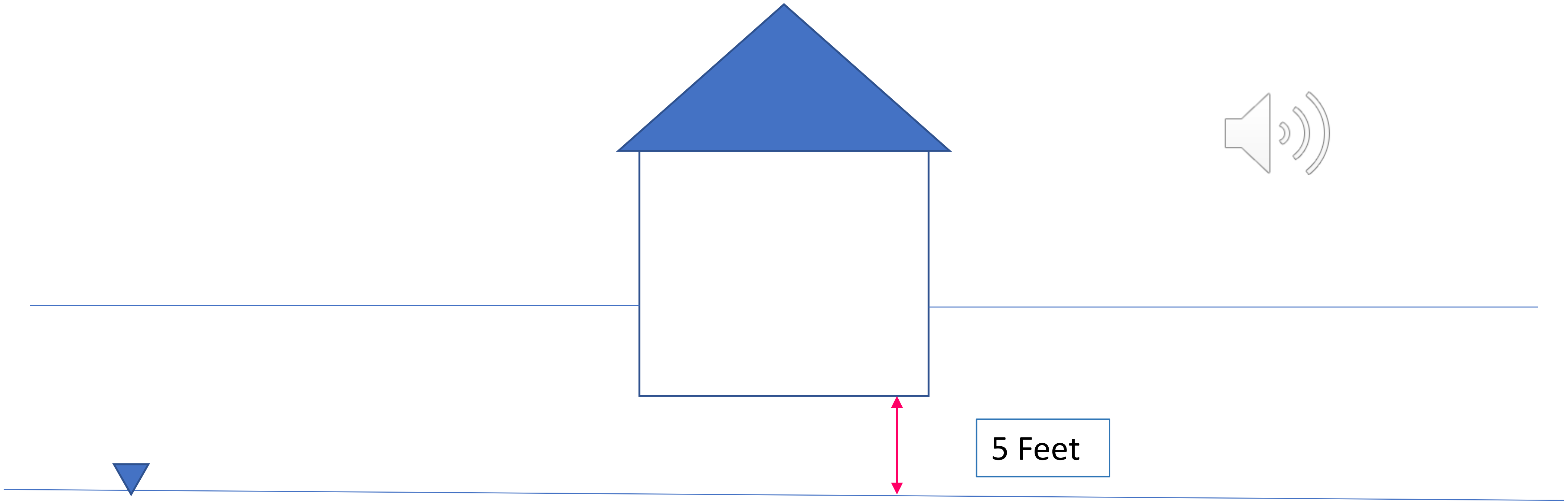

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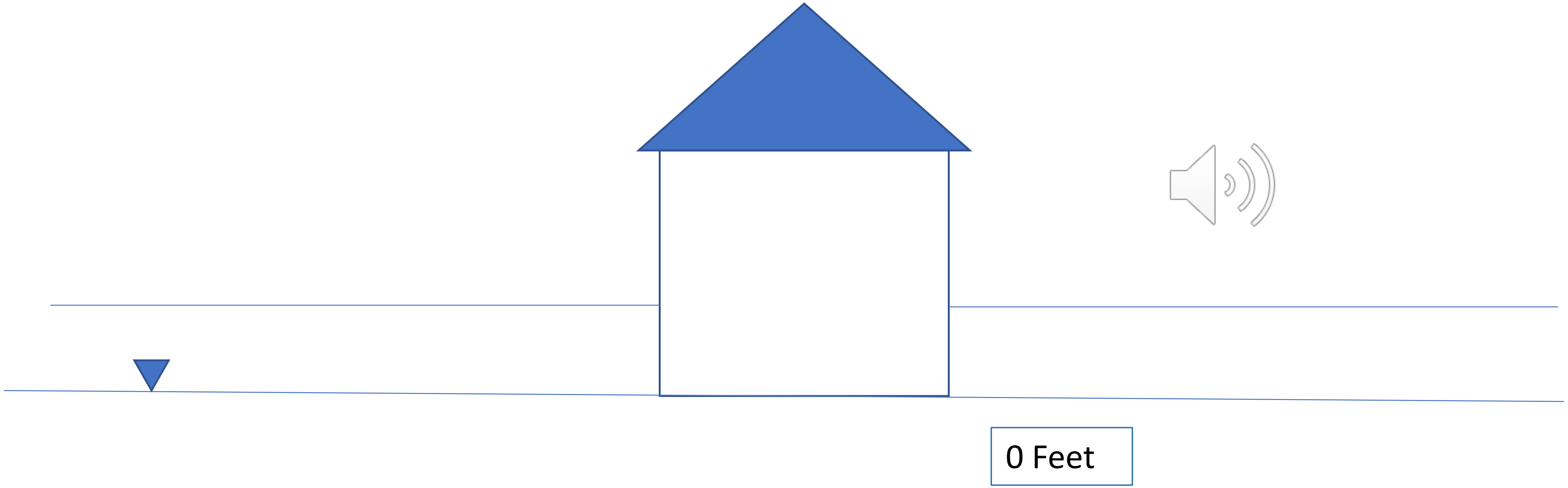

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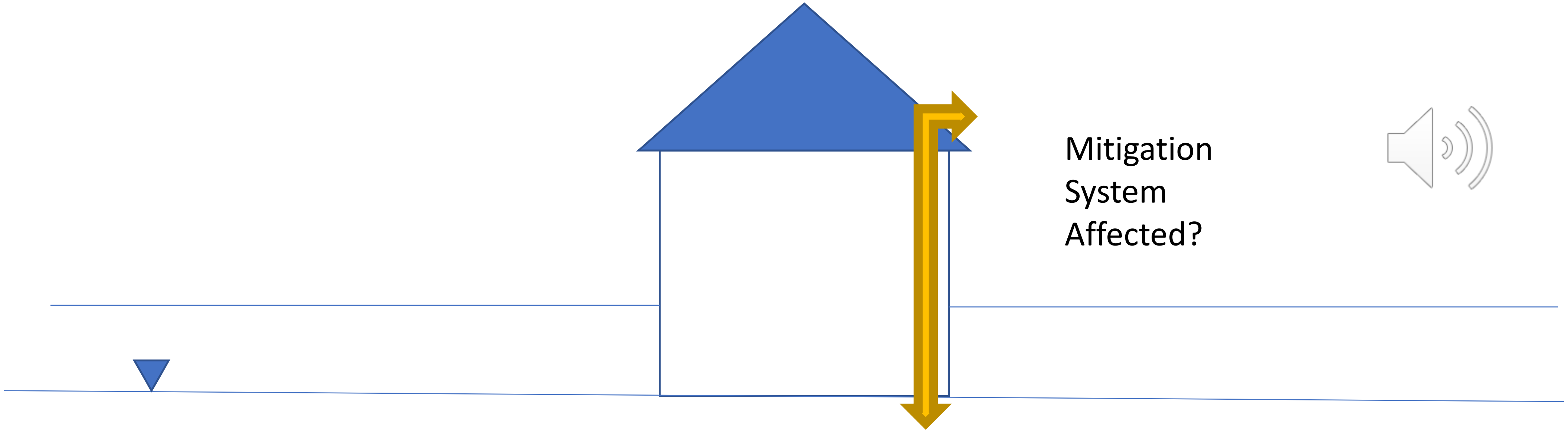
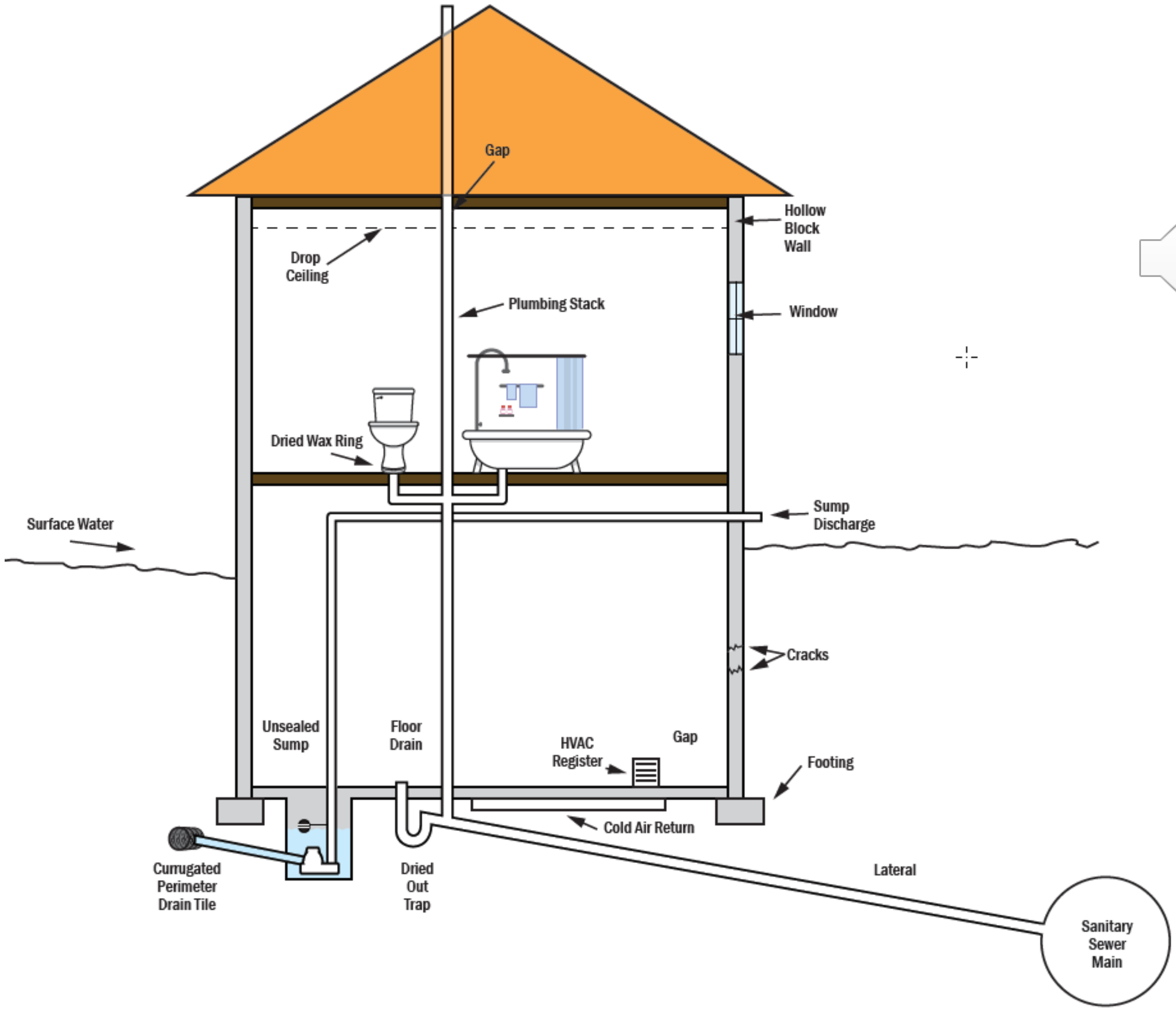


Mitigation System Affected?

Complicated VI Pathway



Mitigation Decisions – Dealing With Variability and Changing Conditions

- Sufficient samples: Time and space ($, time, intrusive)
- Longer-term samples: Passive
- Building Pressure Cycling ($, intrusion, some buildings)
- Indicators, Tracers, Surrogates (fewer samples, logistics)
- Long-term monitoring (responsibility)
- Owner education (reliability)
- Conservative Assumptions
- Protective Mitigation

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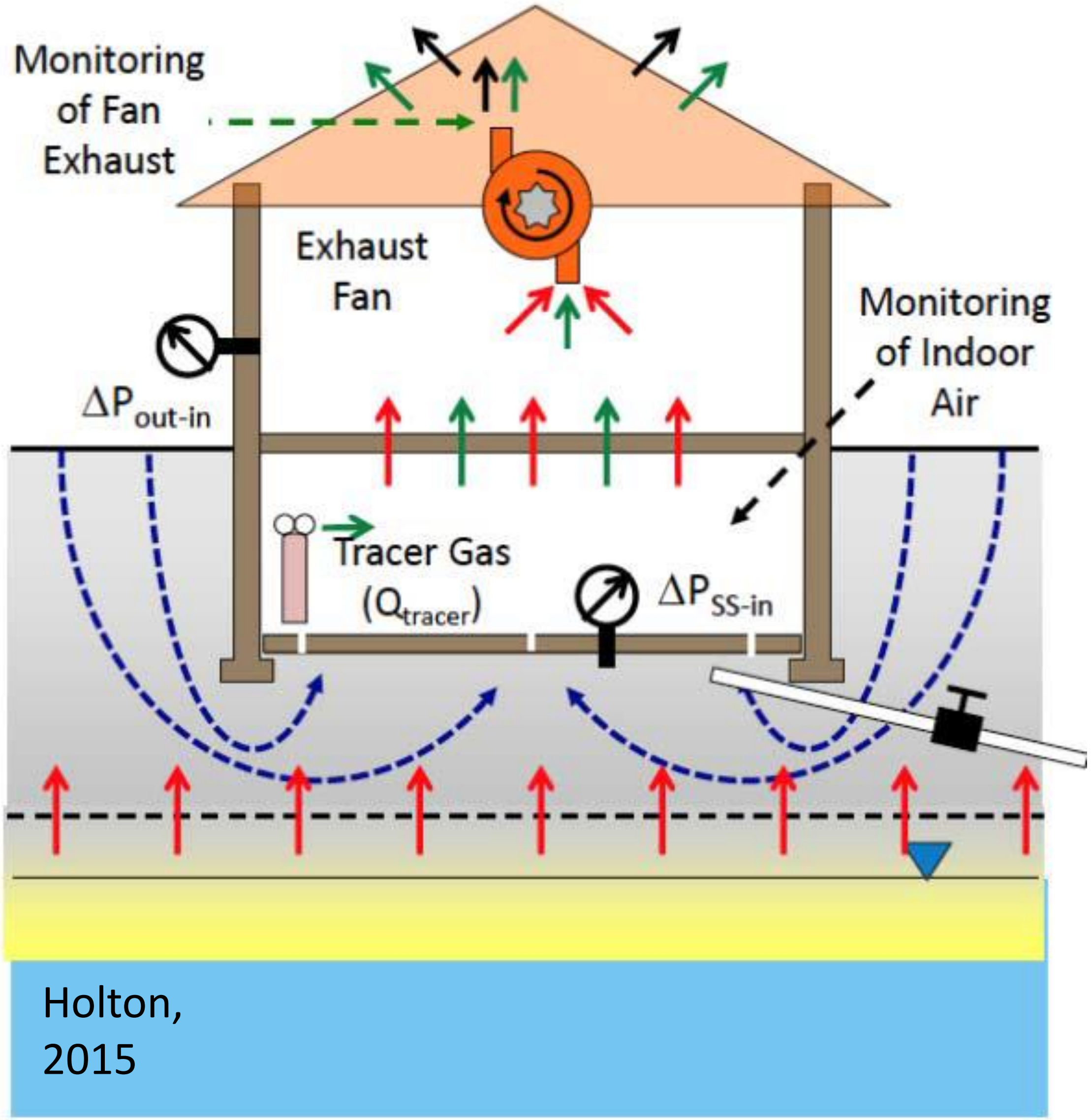
Building Pressure Cycling



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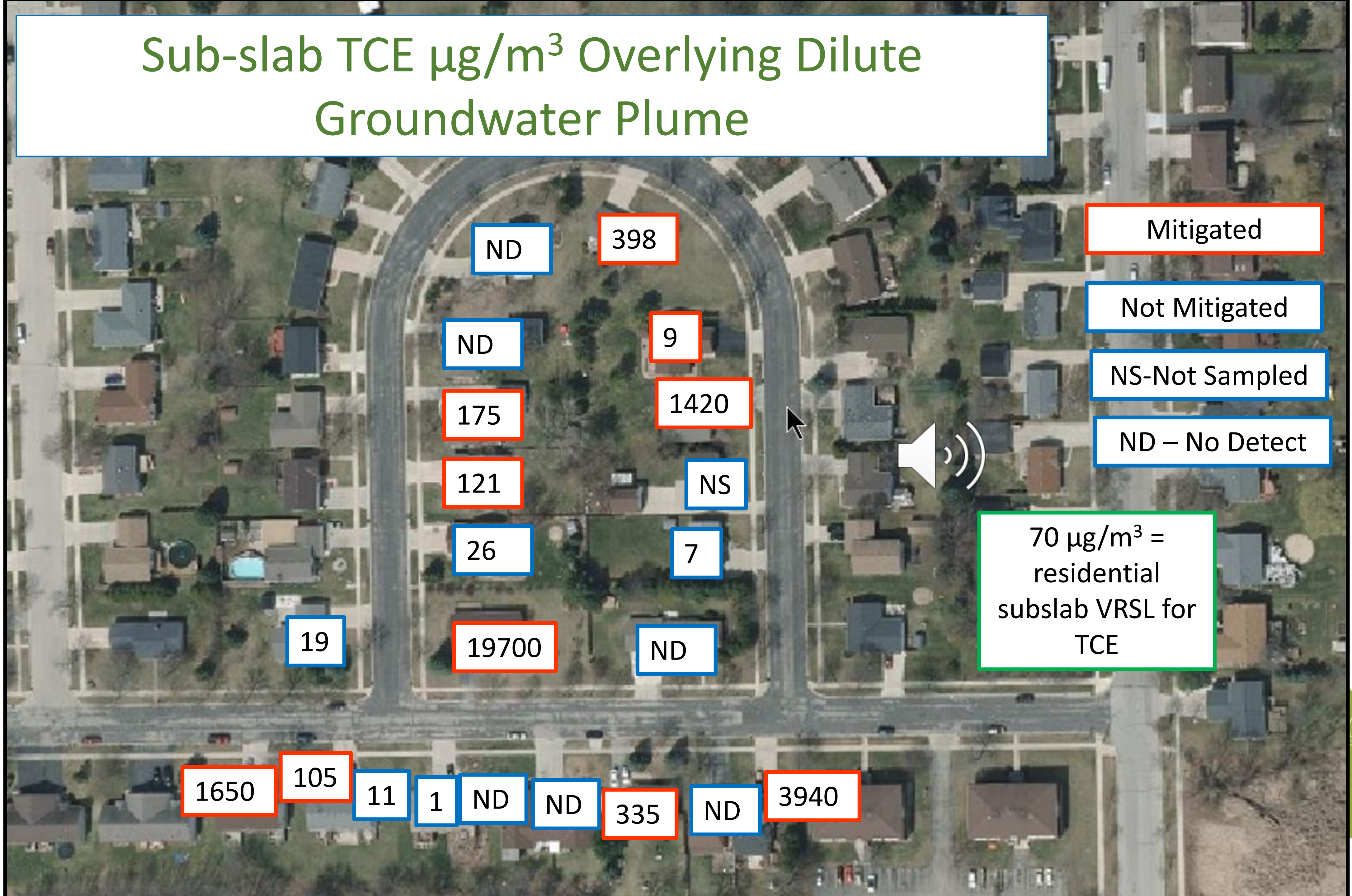
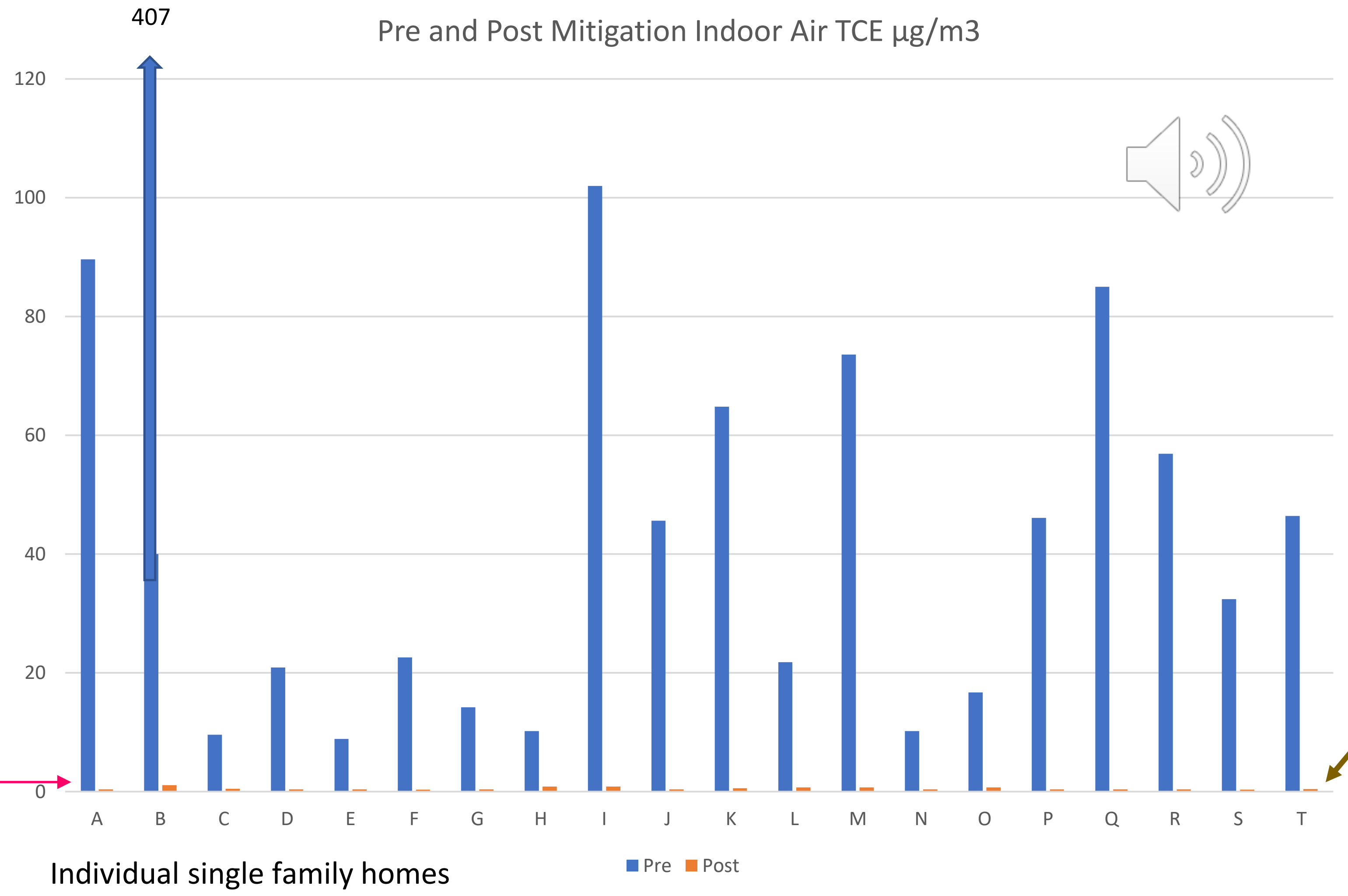
Sub-slab TCE $\mu g/m^3$ Overlying Dilute Groundwater Plume



70 $\mu g/m^3$ = residential subslab VRSL for TCE

SSDS – Must remain operational to be effective!



VAL = 2.1 µg/m^3

Post Mitigation - all 1 µg/m^3 or less

Mitigation System Alarm and Telemetry Units

Takeaways - Recommendations

- RR Program re-evaluating RR-800
- Account for variability in your investigations
- Check if mitigator is complying with ANSI/AARST
- Consider telemetry system for TCE impacted buildings > VAL
- Site specific questions – contact DNR Project Manager

Takeaways - Recommendations

- RR Program re-evaluating RR-800
- Account for variability in your investigations
- Check if mitigator is complying with ANSI/AARST
- Consider telemetry system for TCE impacted buildings > VAL
- Site specific questions – contact DNR Project Manager

Takeaways - Recommendations

- RR Program re-evaluating RR-800
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Questions?

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