PVI Risk Pathway: Sampling Considerations

AEHS – PVI Workshop

March 2015

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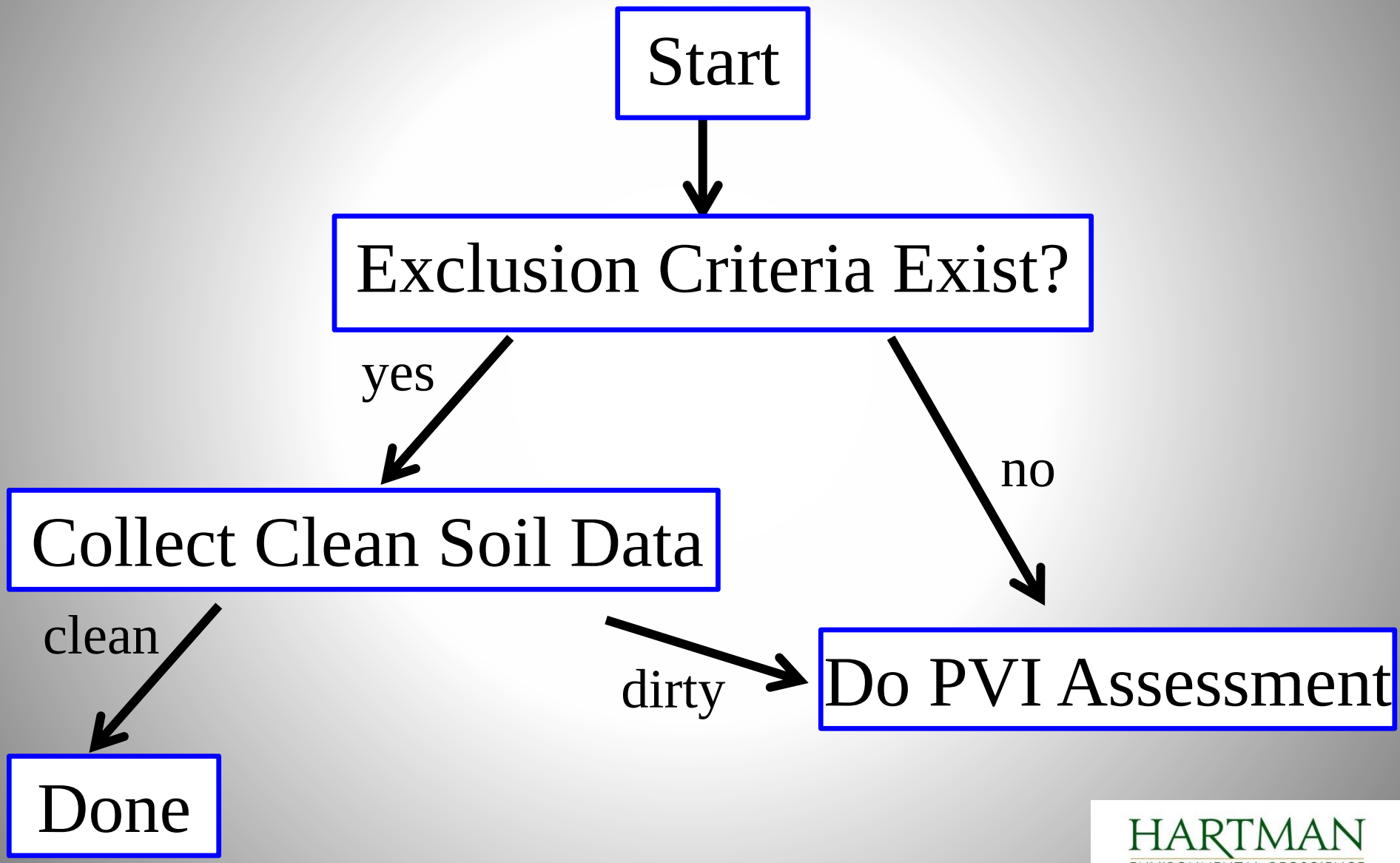
PVI VI Pathway Made Simple



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Exclusion Criteria: A PVI Pathway Game Changer

- Step 1: Can Site Be Screened Out?
  - Based upon concentration & depth to source
  - In CA if site is an active fueling station
  - No field work
- Step 2: Can "Screen-Out Data" be Collected?
- Step 3: Do PVI Assessment

Makes PVI Assessments Much Simpler & Less Expensive

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Table 3 Required Vertical Separation Distance Between Contamination And Building Foundation, Basement, Or Slab.

Media	Benzene	TPH	Vertical Separation Distance (feet)*
Soil (mg/kg)	≤10	≤250	6
	>10 (LNAPL)	>250 (LNAPL)	15**
Groundwater (ug/L)	≤ 5,000	≤30,000	6
	>5,000 (LNAPL)	>30,000 (LNAPL)	15**

The thresholds for LNAPL indicated in this table are indirect evidence of the presence of LNAPL. These thresholds may vary depending on site-specific conditions (e.g., soil type, LNAPL source). Investigators may have different experiences with LNAPL indicators and may use them as appropriate. Direct indicators of LNAPL also apply; these include measurable accumulations of free product, oily sheens, and saturated bulk soil samples.

*Vertical separation distance represents the thickness of clean (TPH ≤ 100 mg/kg), biologically active soil between the source of PHC vapors (LNAPL, residual LNAPL, or dissolved PHCs) and the lowest (deepest) point of a receptor (building foundation, basement, or slab).

** EPA recommends that sub-slab monitoring be used to evaluate the risk of vapor intrusion whenever LNAPL is present in any sample and the vertical separation distance is less than 15 feet. When LNAPL is

CA-LTCP VI Exclusion Criteria

Site Screens Out from VI Pathway if:

- If 30’ of Biozone, NAPL screens out
  - Vertically & horizontally
- If 10’ of Biozone, benzene up to 1000 ug/L
- If 5’ of Biozone, benzene up to 100 ug/L

Bioattenuation zone: TPH-soil < 100 mg/kg

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NJDEP Gasoline Exclusion Criteria

VI Investigation is not required when:

- ≥10 ft between water table and foundation and benzene in GW is ≤1,000 µg/L; or

- ≥5 ft between seasonal high water table and foundation, oxygen levels measured at ≥2% (v/v), and benzene in shallow GW is ≤1,000 µg/L.

O_2 Drops Separation Distance from 10' to 5'

Step 2: Collect "Screen-Out Data"

- Soil Phase TPH
- Oxygen in Vadose Zone
  - CA & NJ for sure
- Soil Headspace PID Data (<100 ppmv)

Soil Gas VOC Data – not required at this step

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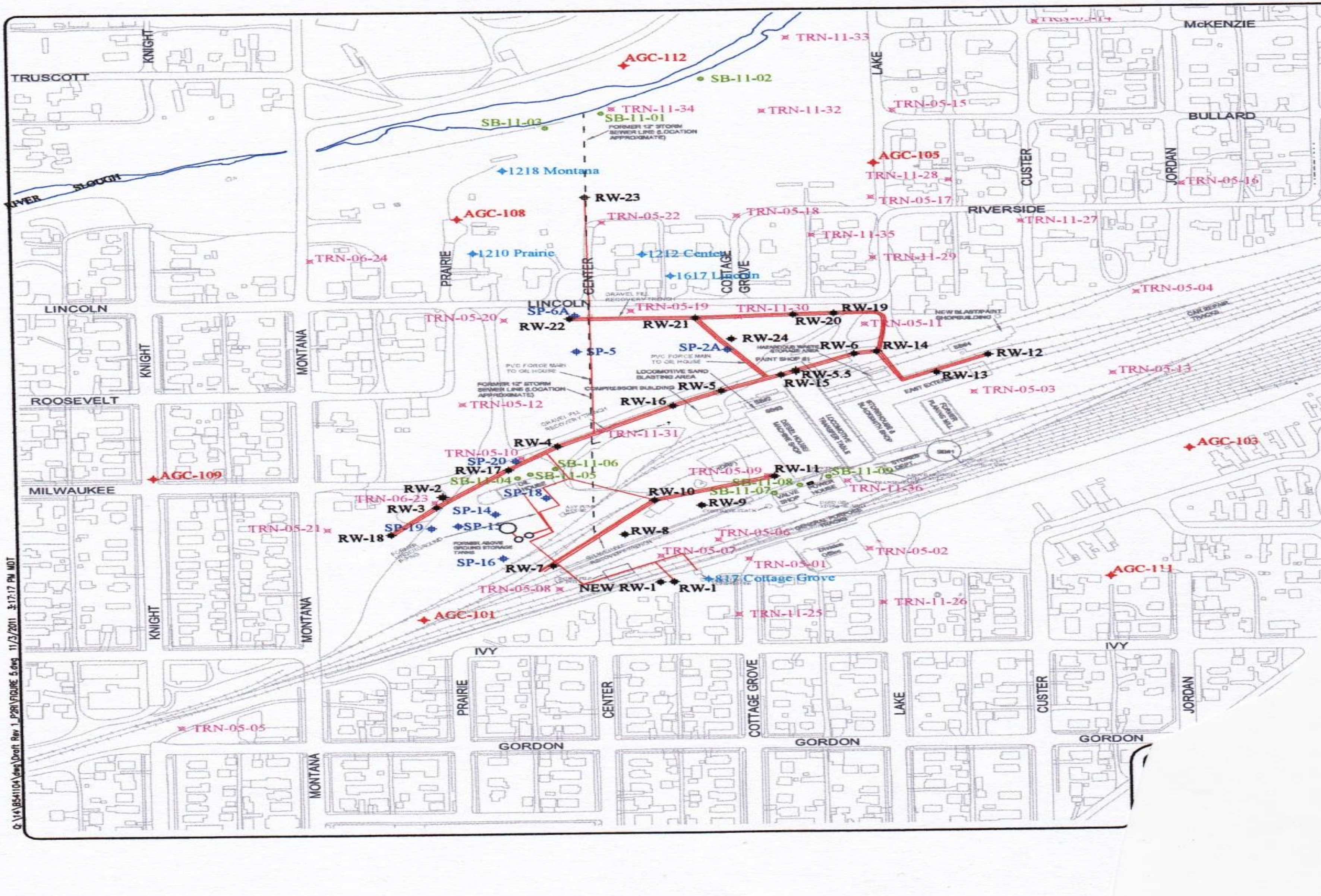
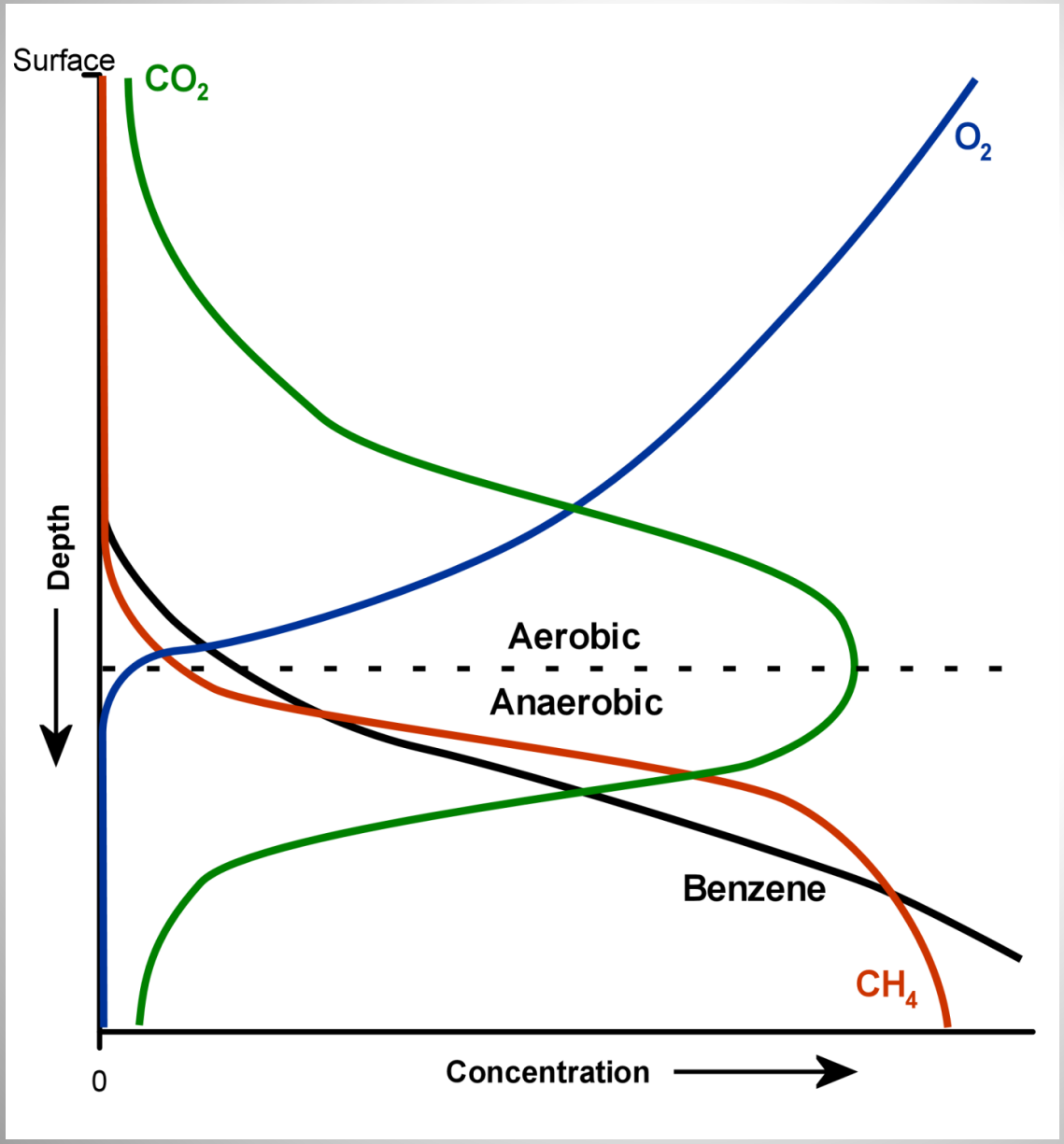


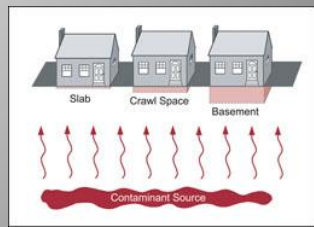
McKENZIE
TRN-11-33
KNIGHT
AGC-112
TRUSCOTT
SB-11-02
LAKE
TRN-11-34
TRN-11-32
TRN-05-15
BULLARD
SB-11-03
SB-11-01
FORMER 12" STORM SEWER LINE (LOCATION APPROXIMATE)
AGC-105
RIVER SLOUGH
1218 Montana
TRN-11-28
CUSTER
JORDAN
TRN-05-16
RW-23
TRN-05-17
AGC-108
TRN-05-22
TRN-05-18
RIVERSIDE
TRN-11-27
TRN-11-35
TRN-06-24
1210 Prairie
1212 Center
PRAIRIE
CENTER
COTTAGE GROVE
1617 Lincoln
TRN-11-29
TRN-05-04
LINCOLN
LINCOLN
TRN-05-19
TRN-11-30
RW-19
SP-6A
TRN-05-20
RW-20
TRN-05-11
RW-22
RW-21
RW-24
SP-5
SP-2A
RW-6
RW-14
RW-12
KNIGHT
MONTANA
PVC FORCE MAIN TO OIL HOUSE
LOCOMOTIVE SAND BLASTING AREA
RW-5.5
RW-15
RW-13
TRN-05-13
FORMER 12" STORM SEWER LINE (LOCATION APPROXIMATE)
COMPRESSOR BUILDING
RW-5
TRN-05-03
ROOSEVELT
RW-16
TRN-05-12
TRN-11-31
RW-4
TRN-05-10
SP-20
SB-11-06
AGC-103
RW-17
RW-11
SB-11-09
TRN-05-09
AGC-109
SB-11-04
SB-11-05
SB-11-08
MILWAUKEE
RW-2
SP-18
RW-10
SB-11-07
TRN-11-36
TRN-06-23
RW-9
RW-3
SP-14
TRN-05-21
SP-19
SP-17
RW-8
TRN-05-06
RW-18
TRN-05-07
TRN-05-02
SP-16
TRN-05-01
RW-7
AGC-111
817 Cottage Grove
TRN-05-08
NEW RW-1
RW-1
TRN-11-26
TRN-11-25
AGC-101
KNIGHT
MONTANA
IVY
IVY
PRAIRIE
CENTER
COTTAGE GROVE
LAKE
CUSTER
JORDAN
TRN-05-05
GORDON
GORDON
GORDON
MONTANA
Q:\1A\B54110\4\dwg\Draft Rev 1_P2R\FIGURE 5.dwg 11/3/2011 3:17:17 PM MDT

Clean Soil Model for HC Vapors



Bio-barrier

Reaction Zone



O_2 Profiling - Approach

- 18 Locations Throughout Neighborhood
- Vertically Every Foot Down to 8’-10’ bgs
  - Used direct-push (not PRT)
  - Oxygen by portable meter (& CO2 & CH4)
- Soil Samples at 1’ & 5’ bgs – (backup)
- Did All Locations in 11 Hours!

Low-Threat Closure Policy
The Power of Oxygen

If oxygen in soil gas >4%:

- Separation distance drops from 10’ to 5’ for benzene up to 1,000 ug/L
- Soil gas SLs increase by 1000x!

TPH-soil required for all scenarios but O2 not

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Methods to Assess VI

- Indoor Air Sampling
- Groundwater Sampling
- Soil Phase Sampling
- Predictive Modeling
- Measure Flux Directly
- Soil Gas Sampling
- Supplemental Tools/Data

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Approach Generalizations

- Indoor Air
  - Always find something
  - Multiple sampling rounds:
- Groundwater Data
  - Typically over-predicts risk
- Soil Phase Data
  - Typically not allowed; over-predicts risk for HCs
- Soil Gas Data
  - Transfer rate unknown
  - Sub-slab intrusive

Step 3: PVI Specific Sampling Issues

- Soil Gas VOC Analysis
  - Benzene, ethylbenzene & naphthalene
  - **TPH??**
- Might Need to Sample <5’ bgs
  - If samples >5’ bgs exceed allowable levels
  - How to know? On-site analysis best
  - If not, collect samples anyway
- Always Collect Oxygen Data

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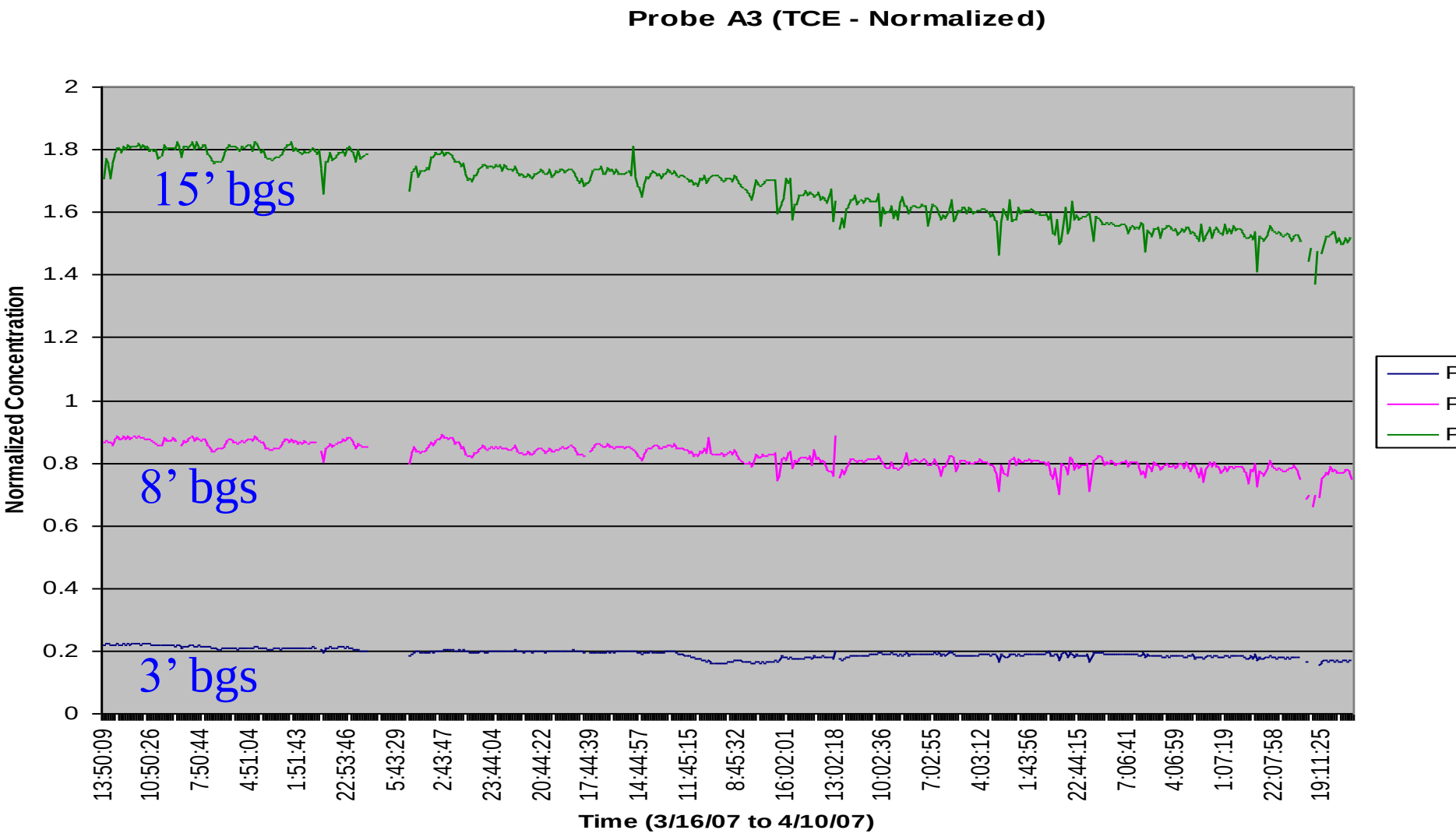
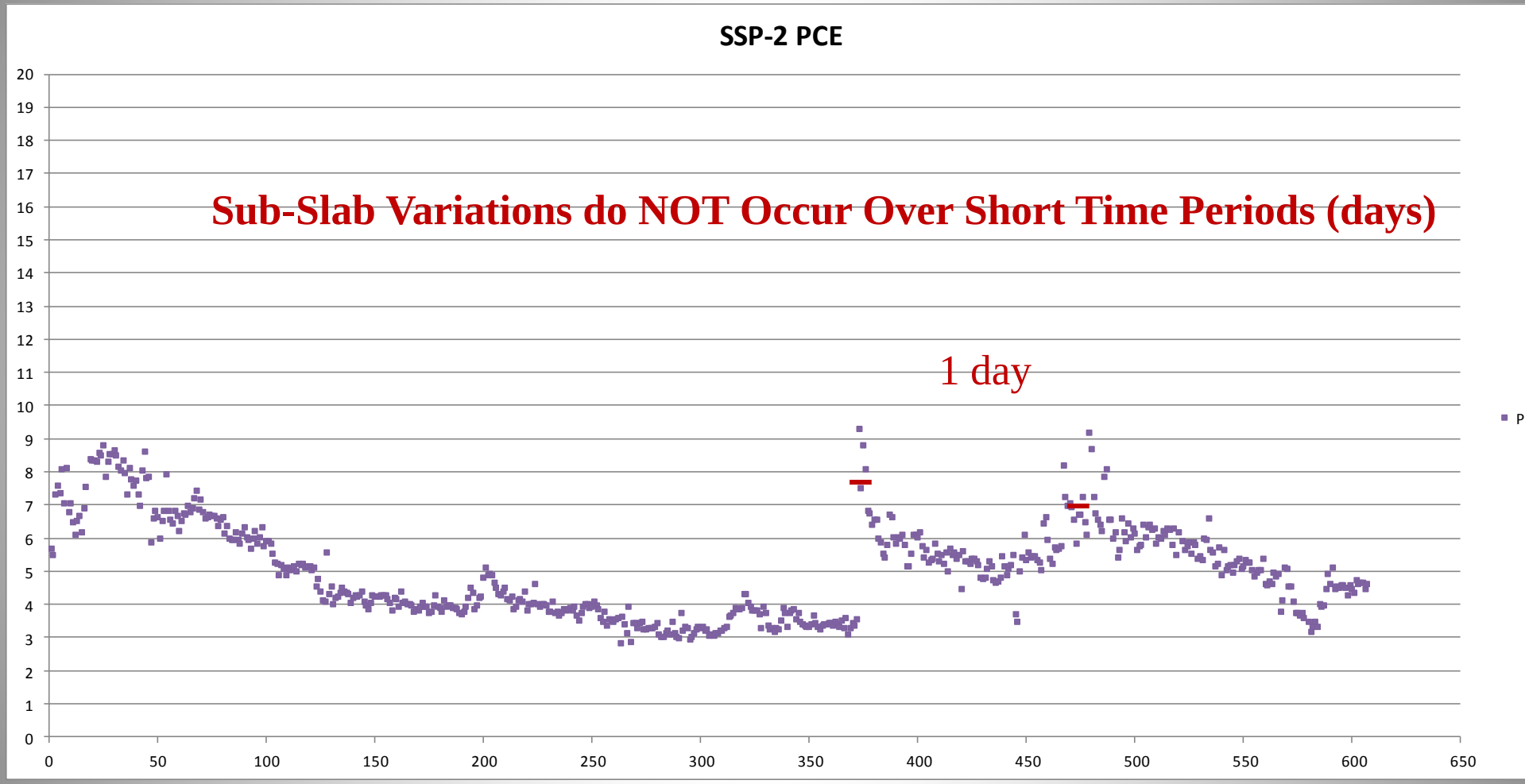
Soil Gas Temporal Study – EPA-ORD



Sub-slab Soil Gas Data



12/2012 1/2013 2/2013 3/2013

Ingredients for Effective VI Assessments

- Investigatory Approach
- Determine Correct Screening Levels
- Sample & Analyze Properly
- Know & Use Supplemental Tools
- Demonstrating Bioattenuation

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The Most Important Ingredient

- Experience:
  - Consultant
  - Collector – done soil gas before?
  - Lab – certified for methods?
  - Regulator
  - Public
  - YOU!

What level person is going in the field?

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Most Common VI Bloopers

- Unit Confusion
  - Assuming ug/L equivalent to ppbv
  - Assuming ug/m3 equivalent to ppbv
- Screening Levels
  - Comparing to generic screening levels
  - Not calculating correct levels
- Sampling & Analysis Errors
  - Program design: soil gas? GW? SS? IA?
  - Using wrong hardware
  - Using wrong analysis

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It Won't Happen To Me …

Sample ID	Date Sampled	TPH Gas mg/L	Benzene mg/L	Toluene mg/L	Ethylbenzene mg/L	Xylenes mg/L	MTBE mg/L
Residential Land Use ESL ((Shallow Soil Gas)	NA	10.0	0.084	63.0	0.98	21.0	9.4
SG1	10/1/2010	NT	<0.005	<0.005	<0.005	<0.005	<0.005
	11/10/2009	<0.25	<0.05	<0.05	<0.05		NT
SG2	10/1/2010	NT	<0.005	<0	<0.005	<0.005	<0.005
	11/10/2009	<0.2	<0.05		<0.05		NT
SS	10/1/2010	NT	<0.005		<0.005	<0.005	<0.005

Notes

<### Below
mg/L Milligra
MTBE Methyl *ter*
NA Not applicab
NT Analyte
TPH

Values

Uncertifed Lab

Not Low Enough

CHEM ORIES, INC.

PORT

--- VOL GANICS O-15 (GC/MS) –

Page 2 of 2

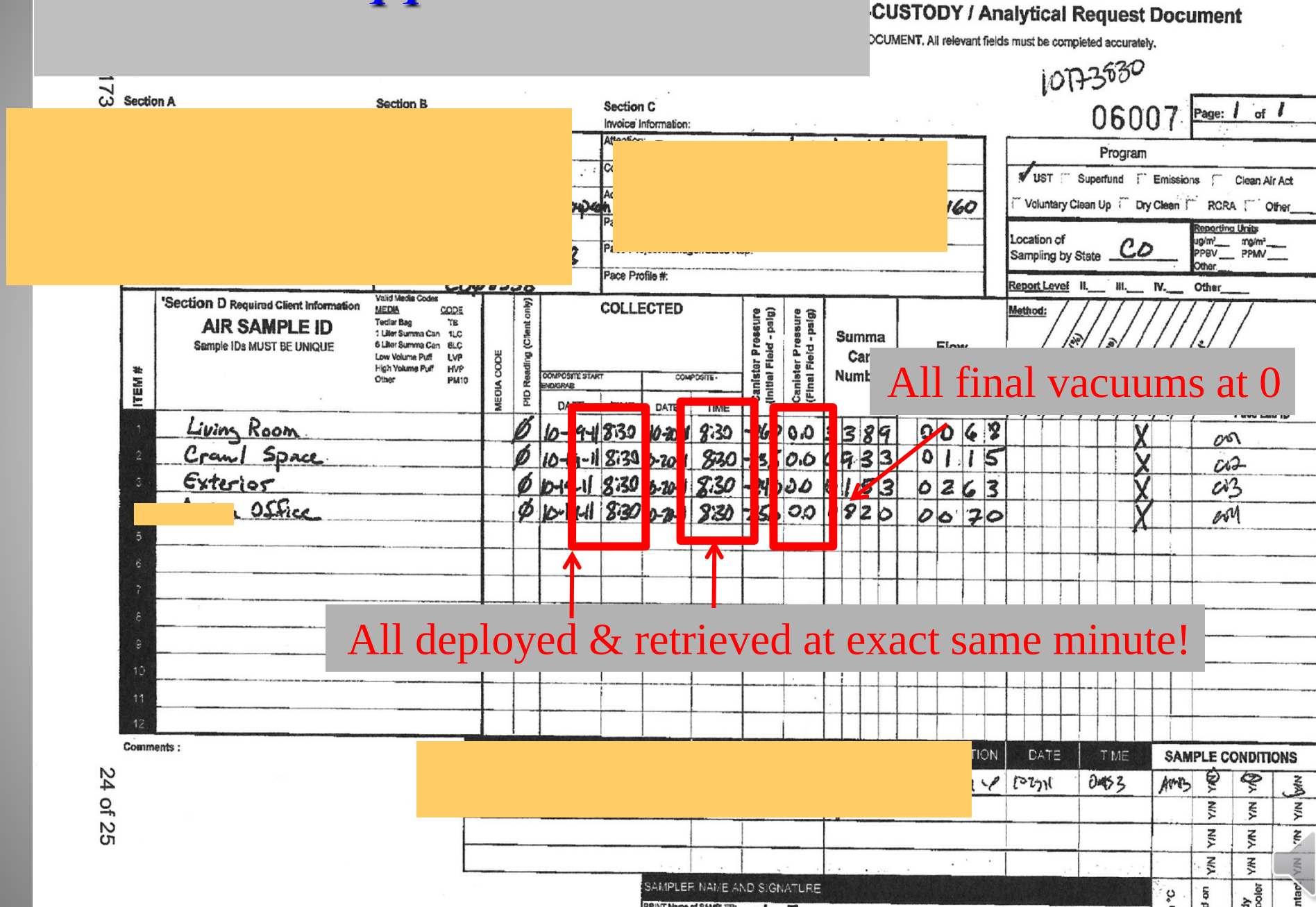
Date Sampled :
Date Received :
Date Analyzed :
Date Reported :

Units: ppmv

Air
ppm v

SAMPLE ID	S Closet	SG1	SG		MDL	PQL
C&E LAB ID						
DILUTION FACTOR	1	1	1			
1,2,4-Trimethylbenzene	ND	ND	ND		0.005	0.01
1,3-Dichlorobenzene	ND	ND	ND		0.005	0.01
1,4-Dichlorobenzene	ND	ND	ND			0.01
	ND	ND	ND		0.005	0.01

It Won't Happen To Me #2…



VI Assessment Point #1:

Long Term IA Samples Maximize Your Chances to Fail the VI Pathway

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Passive IA Collectors

Longer Collection Times: Increases Odds of False Positives

Got A Life?

Longer Collection Times = False Positives

Odor Eliminating & Odor Producing

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Scented Ethylbenzene

Trichloroethene	ND	550	ug/m3	100	ED22607	26-Apr-12	26-Apr-12	EPA TO-15
1,2-Dichloropropane	ND	940	"	"	"	"	"	"
Bromodichloromethane	ND	680	"	"	"	"	"	"
cis-1,3-Dichloropropene	ND	460	"	"	"	"	"	"
4-Methyl-2-pentanone (MIBK)	ND	830	"	"	"	"	"	"
trans-1,3-Dichloropropene	ND	460	"	"	"	"	"	"
Toluene	**660**	380	"	"	"	"	"	"
1,1,2-Trichloroethane	ND	550	"	"	"	"	"	"
2-Hexanone (MBK)	ND	830	"	"	"	"	"	"
Dibromochloromethane	ND	860	"	"	"	"	"	"
Tetrachloroethene	ND	690	"	"	"	"	"	"
1,2-Dibromoethane (EDB)	ND	780	"	"	"	"	"	"
1,1,1,2-Tetrachloroethane	ND	700	"	"	"	"	"	"
Chlorobenzene	ND	470	"	"	"	"	"	"
Ethylbenzene	**3400**	440						
m,p-Xylene	ND	880						
Styrene	ND	430						
o-Xylene	ND	440	"	"	"	"	"	"
Bromoform	ND	1000	"	"	"	"	"	"
1,1,2,2-Tetrachloroethane	ND	700	"	"	"	"	"	"
4-Ethyltoluene	ND	500	"	"	"	"	"	"
1,3,5-Trimethylbenzene	ND	500	"	"	"	"	"	"
1,2,4-Trimethylbenzene	ND	500	"	"	"	"	"	"
1,3-Dichlorobenzene	ND	1200	"	"	"	"	"	"
1,4-Dichlorobenzene	ND	1200	"	"	"	"	"	"
1,2-Dichlorobenzene	ND	1200	"	"	"	"	"	"
1,2,4-Trichlorobenzene	ND	750	"	"	"	"	"	"
Hexachlorobutadiene	ND	1100	"	"	"	"	"	"
TPHv (C5 - C11)	**390000**	10000	ug/m3					

EthylBenzene: 3400 ug/m3

TPH: 390,000 ug/m3

VI Assessment Point #4:

Is Sub-Slab Sampling for the Birds?

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Why Not Sub-Slab?

- Large Spatial Variation Under Slabs
- What Value to Use?
- Poor Correlation with Indoor Air
- SS SLs Can Be < Ambient Air

SS Data Are Poor Predictors of IA!!

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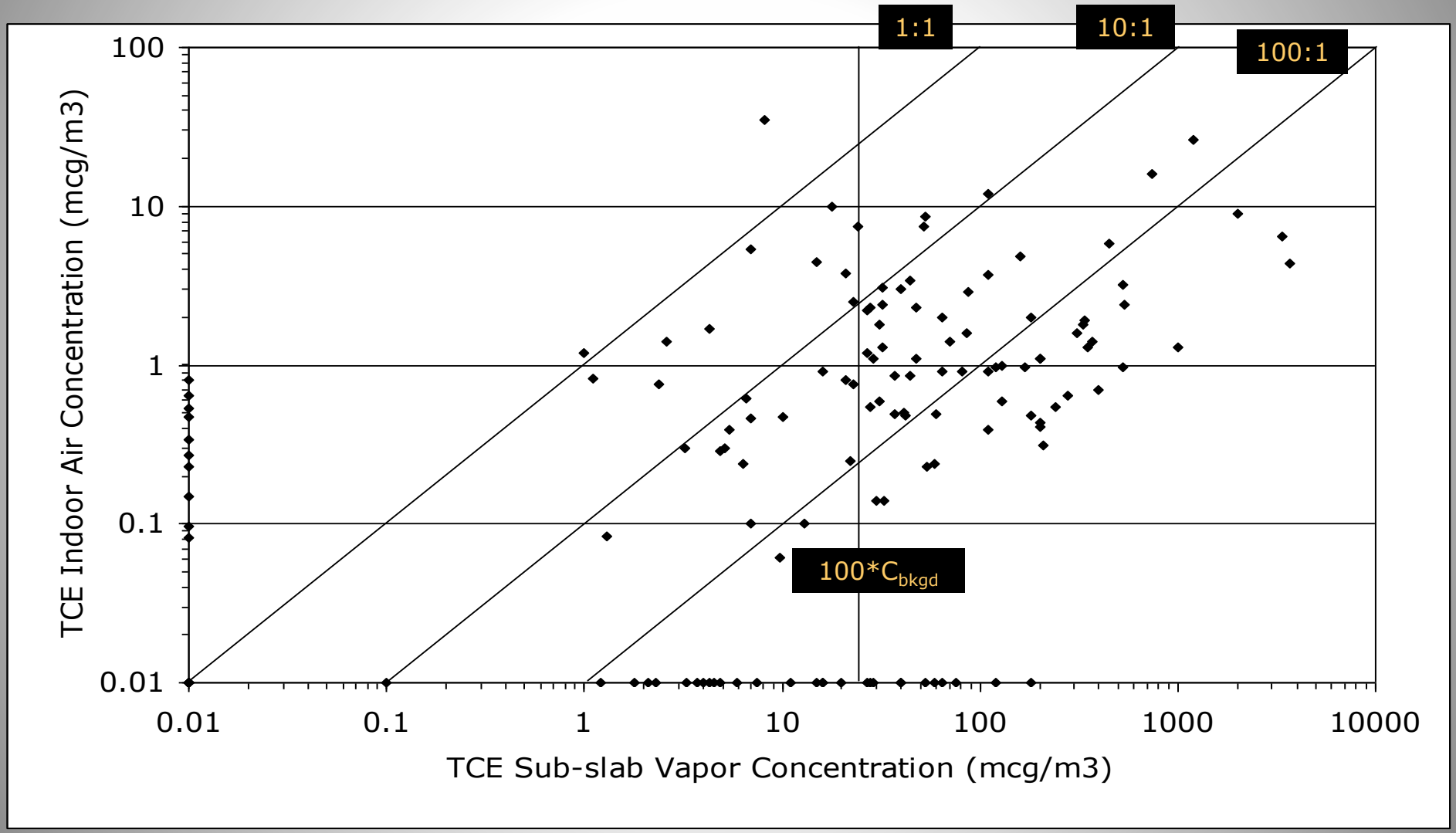
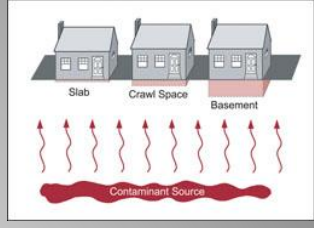
Indoor Air & Sub-slab Vapor -- TCE



TPH Compounds



- Typical
  - BTEX (BE only risk drivers)
  - Methane
  - Naphthalene (risk about same as benzene)

- Some States:
  - Aliphatics (C5-C8 & C9-C18)
  - Aromatics (C6-C8 & C9-C16)
  - 1-2 dichloroethane (EDC) & 1-2 dibromoethane (EDB)

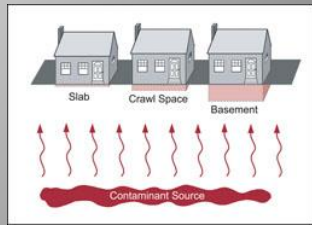
TO-17 gets PVOCs, TPHg, TPHd in same run!!

TPH Analysis Considerations

- Laboratory Issues
  - –Has does the lab ca[illegible]?
  - –Do they su[illegible]?
  - –What volu[illegible]ney need?
- FID Based M[illegible]TO-3, 8015)
  - –Can't distinquish non-HCs from HCs
  - –Will over-report

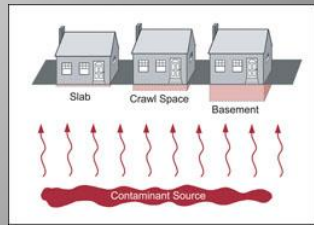
Certified?

Best to Use a Mass Spec Method (8260, TO-15, TO-17)



Practical Strategies
(Things to Do)

- Get Enough Data
- Consider Less Expensive Methods (8260)
- CL-HCs: Vertical Profiles Around Structure
- HCs: Shallower Samples
- Use Radon for Slab-Specific Alpha
- Measure Ventilation Rate
- Have Competent Subs
- Check Your Units!



Previews of the PVI Future

- PVI Less Likely at UST Sites
- PVI More Likely if Shallow Contamination
- EPA OUST Guidance Coming Out?
- ASTM Standard Increase # of Sites

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Forthcoming VI Events

- 2-Day VI Course – Kn[illegible] March 31, 2015

Sold Out!

- 2-Day VI Course – Chicago May 28 & 29, 2015
  - At Argonne Nat'l Lab

- Fall 2015:
  - Texas (Dallas or Austin)

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