Method to Sample & Assess the VI Pathway

Michigan DEQ VI Training

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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

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 houses?

Approach Generalizations

- Indoor Air
  - Always find something
  - Multiple sampling rounds: extra time & money
- Groundwater Data
  - Typically over-predicts risk (for PVI)
- Soil Phase Data
  - Likely will over-predict risk (for PVI)
- Soil Gas Data
  - Transfer rate unknown
  - Spatial Variability
  - Sampling Protocols

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Indoor Air Measurement

- Pros:
  - Actual Indoor Concentration
- Cons:
  - Where From?
    - Inside sources (everything!)
    - Outside sources (exhaust)
    - People activities – NO CONTROL!
  - Time-intensive protocols
  - Snapshot, limited data points
  - Expensive!!

Not a Preferred Method by MI-DEQ

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Indoor Air Sampling Methods (App F4)

- Evacuated Canisters
  - Typically 6 L with flow choke
- Adsorbents with Pump
  - Need lots of pumps
- Passive Adsorbents
  - Longer collection periods (7 to 30 days)

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Indoor Air Sampling Lessons

- Always Collect Ambient Air Sample
- How Long To Collect For?
- Hardware Issues
  - Blanks From Previous Use
  - Performance – Filling At Proper Rate?
  - Fittings Tight? Cross-threaded?
  - Pen/Marker Type – Don't Use Sharpies
  - Gauges On Cans, Not On Flow Chokes

Good Hardware is the Key

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But We Don't Use "CHLORINATED" Chemicals Anymore……

Gun Cleaner: TCE	Pepper Spray: TCE	Brake Cleaner: TCE/PCE	Hobby Glue: PCE	Plastics: 1,2-DCA

B'LOONIES
3 PACK
Directions On Back!
BLUE
B'LOONIES
GREEN
B'LOONIES
RED
B'LOONIES
WARNING:
CAUTION:

Bloonie Analysis Results

12)	Isopropyl alcohol	3.317	45	94670	~~3850.82 ng~~	~~#~~	~~1~~
13)	Methylene Chloride	3.680	84	6533	7.84 ng	#	1
16)	Diisopropyl ether*	4.264	45	1756282	~~817.99 ng~~	~~#~~	~~1~~
17)	1,1-Dichloroethane	4.091	63	52909	~~25.95 ng~~	~~#~~	~~1~~
18)	Ethyl-t-butyl ether*	4.710	59	501954	~~253.12 ng~~		~~67~~
19)	2-Butanone	4.871	72	36815	~~861.58 ng~~	~~#~~	~~1~~
22)	Chloroform	4.859	83	22151	~~9.38 ng~~	~~#~~	~~35~~
23)	Bromochloromethane	4.728	128	217	0.58 ng		
26)	1,1-Dichloropropene	5.109	75	2475	1.63 ng		
29)	1,2-Dichloroethane	5.151	62	1445	1.00 ng		
30)	TAME* (2-methoxy-2-met	5.347	73	5913	~~3.94 ng~~	~~#~~	~~54~~
31)	Benzene*	5.264	78	2724469	750.89 ng		100
32)	Trichloroethene	5.705	95	1454	~~1.23 ng~~	~~#~~	~~12~~
33)	1,2-Dichloropropane	5.847	63	109116	~~143.17 ng~~	~~#~~	~~1~~
34)	Bromodichloromethane	6.008	83	127010	~~88.94 ng~~	~~#~~	~~47~~
35)	Dibromomethane	5.961	93	794	1.84 ng	#	28
36)	cis-1,3-Dichloropropene	6.336	75	3448	2.82 ng	#	1
38)	Methyl Isobutyl Ketone	6.520	43	737901	~~1989.35 ng~~	~~#~~	~~49~~
39)	Toluene*	6.592	92	7153783	2744.00 ng	#	57
40)	trans-1,3-Dichloropropene	6.651	75	14157	12.87 ng	#	1
41)	1,1,2-Trichloroethane	6.860	83	219678	~~553.89 ng~~	~~#~~	~~1~~
42)	1,2-Dibromoethane	7.139	107	424	0.84 ng		
46)	2-Hexanone	7.127	43	490027	~~809.97 ng~~		
47)	Dibromochloromethane	7.312	129	11484	~~6.08 ng~~		
48)	Chlorobenzene	7.717	112	60252	~~10.78 ng~~	~~#~~	~~26~~
49)	Ethylbenzene*	7.669	106	2499510m	715.67 ng		

751 ng

716 ng

Bloonie Analysis Results (continued)

60) n-Propylbenzene	8.616	91	8054470	1288.03 ng	#	26
62) 1,3,5-Trimethylbenzene	8.741	105	6061679m	1318.01 ng		
63) 2-Chlorotoluene	8.681	91	6809750	~~1789.21 ng~~		~~49~~
64) 4-Chlorotoluene	8.741	91	1265341	~~322.07 ng~~		~~50~~
65) tert-Butylbenzene	9.027	119	1891115	~~435.53 ng~~		~~75~~
66) 1,2,4-Trimethylbenzene	9.027	105	8143013m	1879.66 ng		
67) sec-Butylbenzene	9.027	105	8143968	~~1416.03 ng~~		~~60~~
68) p-Isopropyltoluene	9.253	119	54681	11.06 ng		92
71) n-Butylbenzene	9.562	91	27682	5.95 ng		99
76) Naphthalene	11.033	128	869	0.69 ng		100
79) Ethanol	2.978	45	983528	207445.35 ng		100
80) t-Butanol *	3.317	59	432657	~~9715.81 ng~~	#	~~1~~

Ethanol: 207, 445 ng!!

Cleaning Your Dishes?
(or Polluting Your House)

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Dawn VOC Analysis Results

DRAFT: Soap Head Space (E012073-01) Vapor Sampled: 10-Dec-10 Received: 13-Dec-10

2,2,4-Trimethylpentane	**54**	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-10	EPA TO-1
n-Heptane	**230**	5.0	"	"	"	"	"	"
Trichloroethene	ND	5.0	"	"	"	"	"	"
1,2-Dichloropropane	ND	5.0	"	"	"	"	"	"
1,4-Dioxane	**2100**	5.0	"	"	"	"	"	"
Bromodichloromethane	ND	5.0	"	"	"	"	"	"
cis-1,3-Dichloropropene	ND	5.0	"	"		"	"	"
4-Methyl-2-pentanone (						"	"	"
trans-1,3-Dichloroprope						"	"	"
1,3-Dichloropropane						"	"	"
Toluene	**120**	5.0	"	"	"	"	"	"
1,1,2-Trichloroethane	ND	5.0	"	"	"	"	"	"
2-Hexanone (MBK)	ND	10	"	"	"	"	"	"
Dibromochloromethane	ND	5.0	"	"	"	"	"	"
Tetrachloroethene	ND	5.0	"	"	"	"	"	"
1,2-Dibromoethane (EDB)	ND	5.0	"	"	"	"	"	"
1,1,1,2-Tetrachloroethane	ND	5.0	"	"	"	"	"	"
Chlorobenzene	ND	5.0	"	"	"	"	"	"
Ethylbenzene	**25**	5.0	"	"	"	"	"	"
m,p-Xylene	**27**	5.0	"	"	"	"	"	"
Styrene	ND	5.0	"	"	"	"	"	"
o-Xylene	**16**	5.0	"	"	"	"	"	"
Bromoform	ND	20	"	"	"	"	"	"
1,1,2,2-Tetrachloroethane	ND	5.0	"	"	"	"	"	"
4-Ethyltoluene	**13**	5.0	"	"	"	"	"	"
1,2,3-Trichloropropane	ND	10	"	"	"	"	"	"
Isopropylbenzene (Cum						"	"	"
Bromobenzene						"	"	"
2-Chlorotoluene						"	"	"
n-Propylbenzene	ND	10				"	"	"
p-Isopropyltoluene	**1200**	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-10	EPA TO-1
1,2-Dichlorobenzene	ND	10	"	"		"	"	"
n-Butylbenzene	ND	10	"	"	"	"	"	"
1,2-Dibromo-3-chloropropane	ND	20	"	"	"	"	"	"
Naphthalene	**31**	10	"	"	"	"	"	"

1,4-Dioxane 2100

Naphthalene 31

No Wonder She's Smiling …

DRAFT: Soap Head Space (E012073-01) Vapor Sampled: 10-Dec-10 Received: 13-Dec-10

Propene	**190**	10	ug/m3	1	EL01310	13-Dec-10	13-Dec-10	EPA TO-15
Dichlorodifluoromethane (F12)	ND	10	"	"	"	"	"	"
Chloromethane	**190**	5.0	"	"	"	"	"	"
Dichlorotetrafluoroethane (F114)	ND	10	"	"	"	"	"	"
Vinyl chloride	ND	5.0	"	"	"	"	"	"
1,3-Butadiene	**7.2**	5.0	"	"	"	"	"	"
Bromomethane	ND							
Chloroethane	ND							
Ethanol	**6000000**							
Trichlorofluoromethane (F11)	ND	5.0	"	"	"	"	"	"
Acetone	ND	20	"	"	"	"	"	"
Isopropyl alcohol	ND	10	"	"	"	"	"	"
1,1-Dichloroethene	ND	5.0	"	"	"	"	"	"
Tertiary-butyl alcohol (TBA)	ND	20	"	"	"	"	"	"
1,1,2-Trichlorotrifluoroethane (F113)	ND	10	"	"	"	"	"	"
Methylene chloride (Dichloromethane)	ND	10	"	"	"	"	"	"
Carbon disulfide	ND	5.0	"	"	"	"	"	"
trans-1,2-Dichloroethene	ND	5.0	"	"	"	"	"	"
Methyl tertiary-butyl ether (MTBE)	ND	5.0	"	"	"	"	"	"
Vinyl acetate	ND	10	"	"	"	"	"	"
1,1-Dichloroethane	ND	5.0	"	"	"	"	"	"
2-Butanone (MEK)	**100**	5.0	"	"	"	"	"	"
n-Hexane	**110**	5.0	"	"	"	"	"	"
cis-1,2-Dichloroethene	ND	5.0	"	"	"	"	"	"
Diisopropyl ether (DIPE)	ND	5.0	"	"	"	"	"	"
Ethyl acetate	ND	5.0	"	"	"	"	"	"
Chloroform	**130**	5.0	"	"	"	"	"	"
2,2-Dichloropropane	ND	10	"	"	"	"	"	"
Tetrahydrofuran	ND	5.0	"	"	"	"	"	"
Ethyl tert-butyl ether (ETBE)	ND	5.0	"	"	"	"	"	"
1,1,1-Trichloroethane	ND	5.0	"	"	"	"	"	"
1,2-Dichloroethane (EDC)	ND	5.0	"	"	"	"	"	"
1,1-Dichloropropene	ND	10	"	"	"	"	"	"
Benzene	**19**	5.0	"	"	"	"	"	"
Carbon tetrachloride	ND	5.0	"	"	"	"	"	"
Dibromomethane	ND	10	"	"	"	"	"	"
Cyclohexane	ND	10	"	"	"	"	"	"
Tertiary-amyl methyl ether (TAME)	ND	5.0	"	"	"	"	"	"

Ethanol 600,000 ug/m3!!

Odor Eliminating & Odor Producing

H&P Mobile GeoChemistry, Inc

Febreze – No Odors (just TPH)

DRAFT: FEBREZE FINAL (E204146-04) Vapor Sampled: 25-Apr-12 Received: 25-Apr-12

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	ND	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	"	"				

TPH: 230,000 ug/m3

Surrogate:

DRAFT: FEBREZE FINAL (E204146-04) Vapor Sampled: 25-Apr-12 Received: 25-Apr-12

TPHv (C5 - C11)	**230000**	10000	ug/m3	100	ED22607	26-Apr-12	26-Apr-12	EPA TO-15

Glade Airwick: Scented Ethylbenzene

DRAFT: AIRWICK FINAL (E204146-02) Vapor Sampled: 25-Apr-12 Received: 25-Apr-12

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	100				

EthylBenzene: 3400 ug/m3

TPH: 390,000 ug/m3

DRAFT: FEBREZE INITIAL (E204146-03) Vapor Sampled: 25-Apr-12 Received: 25-Apr-12

Got Gas? (natural that is)

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Which Soil Gas Method?

- Active?
- Passive? (limited use)
- Flux Chambers? (limited use – Appendix F5)

Active method most often employed for VI

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Passive Soil Gas

- Pros:
  - Easy to Deploy
  - Can Find Contamination Zones
  - Low Permeability soils
- Cons:
  - Does not Give Concentration
  - No Less Expensive

Considered as Screening Tool – Appendix B2

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Passive Soil Gas Samplers

Adsorbent inside tube open on one end

Adsorbent inside badge

Adsorbent inside vapor permeable, waterproof membrane

Active Soil Gas Sampling

- Considerations
  - Probe installation
  - Purge and sample volumes
  - Flow rate, vacuum, and leak tests
  - Sample containers
  - Temporal effects

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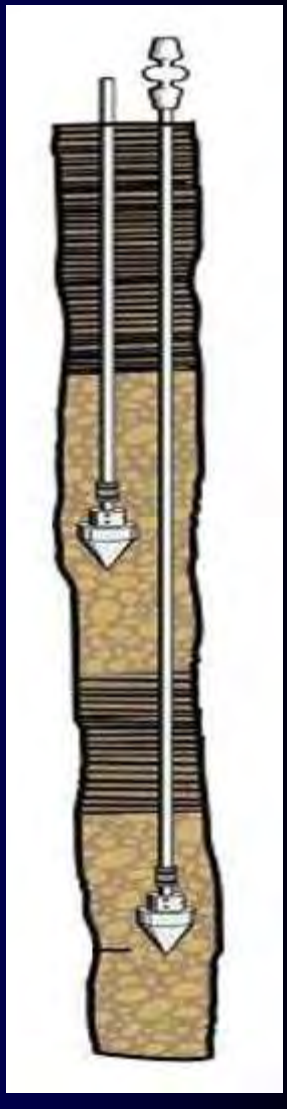
Probe Installation Methods
Appendices F1 & F3

- Driven Probe/Rod Methods
  - Hand Equipment, Direct-Push
  - Collect sample while probe in ground

- Vapor Mini-Wells/Implants
  - Inexpensive & easy to install/remove
  - Allow repeated sampling
  - Near surface & deep (down auger flights)
  - Can “nest” in same bore hole



Appendix SOPs are Optional

Sampling Through Rod

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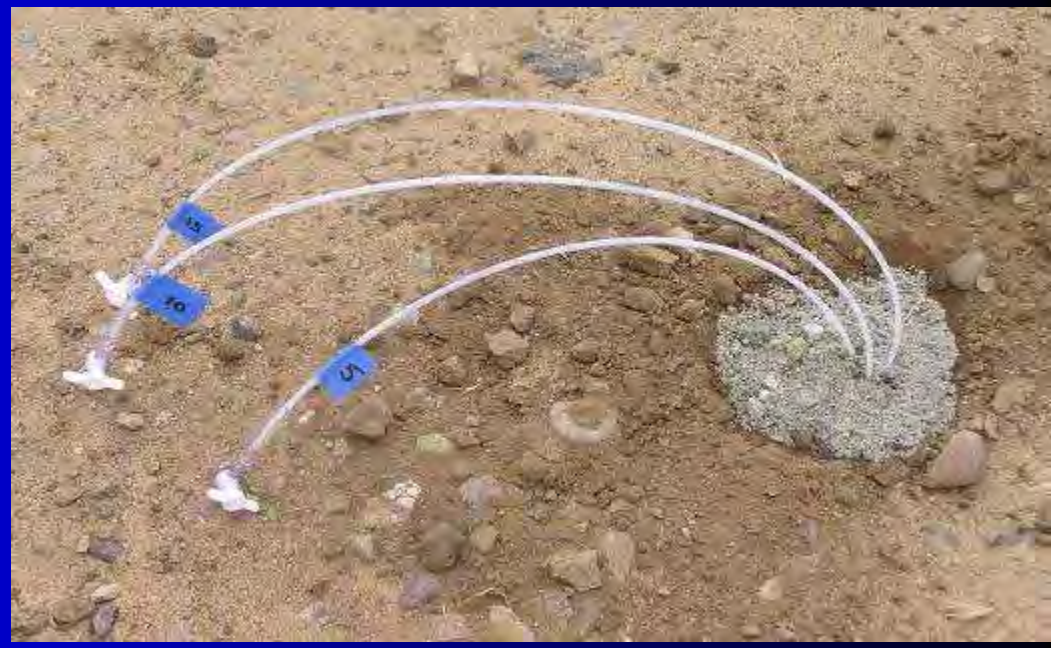
Soil Gas Implants



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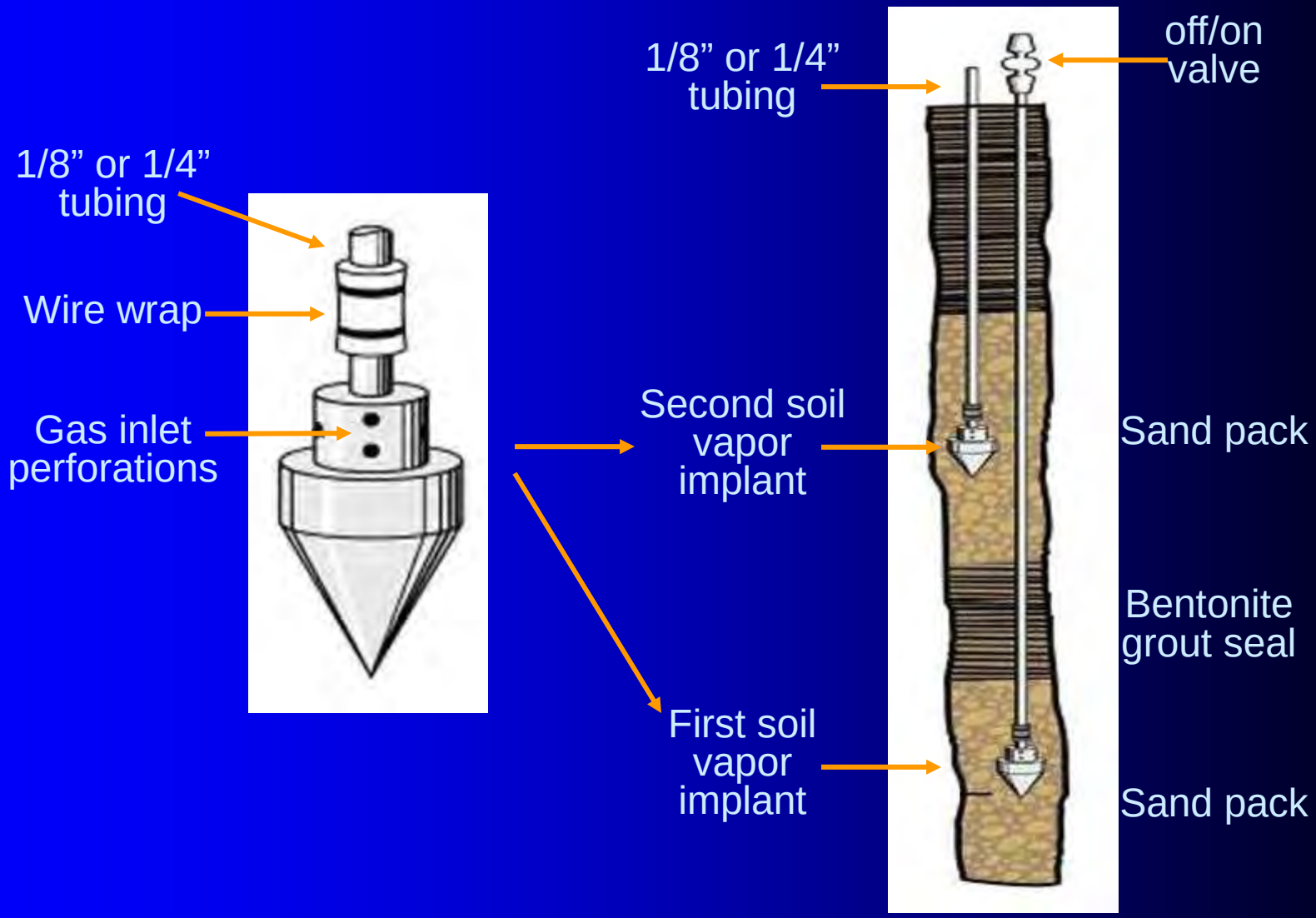
Multi-Depth Nested Well



Probe Considerations

- Tubing Type
  - Rigid wall tubing ok (nylon, teflon, SS)
  - NOT Geoprobe polypropylene used for GW
  - NOT Flexible tubing (as shown in App F3-3)
- Probe Tip
  - Beware metal tips (may have cutting oils)
- Materials Used to Bury Probes
  - Sand, bentonite, cement
- Equipment Blanks
  - Need to collect blank through collection system

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a Path : D:\111406.12p\
a File : SG-06-03RDF10.D
On : 14 Nov 2006 6:05 pm
rator : cb
ple : [redacted]
C : 10
Vial : 11 Sample Multiplier: 1

nt Time: Nov 15 08:59:47 2006
nt Method : C:\MSDCHEM\1\METHODS\102406TOUGM3.M
nt Title : TO-15 Full Scan Mode
st Update : Fri Oct 27 07:30:49 2006
ponse via : Initial Calibration

Some Lessons Learned

- Do not mark sample locations with spray paint: toluene
- Watch what you use to seal holes

Loaded with TCE

Loaded with TBA

Soil Gas Sampling Issues

- Sample Size
  - Greater the volume, greater the uncertainty
  - Smaller volumes faster & easier to collect
- Containers
  - Canisters: More blank potential. Higher cost
  - Tedlars: Good for ~2 days. Easier to collect
- Flow Rate & Purge Volume
  - MI prefers < 200 ml/min (App C3)
- Tracer/Leak Compound
  - Crucial for sub-slab & larger sample volumes
  - Gases (He, SF6, Propane) & Liquids (IPA)

DEQ SOP: Wait 45 Minutes before Sampling

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Sample Volumes

Check with Lab to See Volume Required to Reach SL

Container Issues

Large vs. mini-canisters

Filling a tedlar bag with syringe

Use of Tedlar Bags

Advantages:

- Many Consultants More Familiar With than Swageloks
- Easy to Fill: Perastalic Pump, Syringe, Lung Box
- Disposable - No Chance of Carry-over/False Positives
- Allows Repeat Analysis of a Sample if in Field
- Allows Measurement of Gaseous Tracer
- Allows On-site & Off-site Analysis of Same Sample!

Appendix C3 & C4 is Being Modified to Allow

Leak Testing

Liquids

Gases

Tent Shroud

Vacuum Test

Liquid Tracer Method

- Pros
  - Fast & easy
  - Can cover multiple spots easy
  - Very conservative (100 ug/L = 0.1% leak)
- Cons
  - Typically qualitative
  - Don’t know results in real-time without lab
  - Small leak can raise DLs of VOC analysis

OK Method if Lab On-site

Gas Tracer Method

- Pros
  - Quantitative
  - Real-time results with portable meters
  - Must measure sample AND shroud concentration
- Cons
  - More complicated and slower. Increases costs.

MI SOP in Appendix F3 – 10% Leak OK

Purging

Sample Collection

Sample Collection

Sample Transfer

SVOC TO-17 Sampling

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Beware of the Hardware

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Some Final Issues

- Vacuum Pumps
  - Collect on upstream side. Watch vacuum applied
- Time-Integrated Samples?
  - Existing data does not show large variations
- Certified Clean Canisters
  - Not needed if DL > 1ppbv
- Residual Vacuum in Canisters
  - Not critical for soil gas samples
- Dedicated Flow Restrictors
  - Not necessary if cleaned between samples

PVI Specific Sampling Issues

- 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
- Might Need Soil Phase Data

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Common Soil Gas Analyses

- VOCs (MDEQ Prefers TO)
  - Air Methods: TO-14, TO-15, TO-17
  - Soil and Water Methods: 8021, 8260
- Hydrocarbons
  - 8015 m, TO-3, TO-15, 8260
- Oxygen, carbon dioxide
  - ASTM 1945-96
- SVOCs
  - TO-4, TO-10, TO-13

Autosampler GC/MS for TO-17 Analysis

ITRC VI Document, Appendix D, API Table D-1

High SG Concentrations Create Headaches

- Typical Soil Gas Concentrations
  - Benzene near gasoline soil: >100,000 ug/m3
  - TPH vapor: >1,000,000 ug/m3
  - PCE under dry cleaner: >100,000 ug/m3
- TO-15 Maximum Conc: 2,000 ug/m3
  - Must do large dilutions, DL goes up
  - False positives from hot samples
- Canister & Hardware & Instrument Blanks

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How to Cover So Many Units Effectively?

Don’t Forget TO-14/8021

- Can get to 1 ug/m3 for TCE, CCl4, PCE
- Can get to ~25 ug/m3 for Benz & Napthalene
- 5 minute run time for benzene, TCE & PCE
- Cost ~ 1/5 of TO-15

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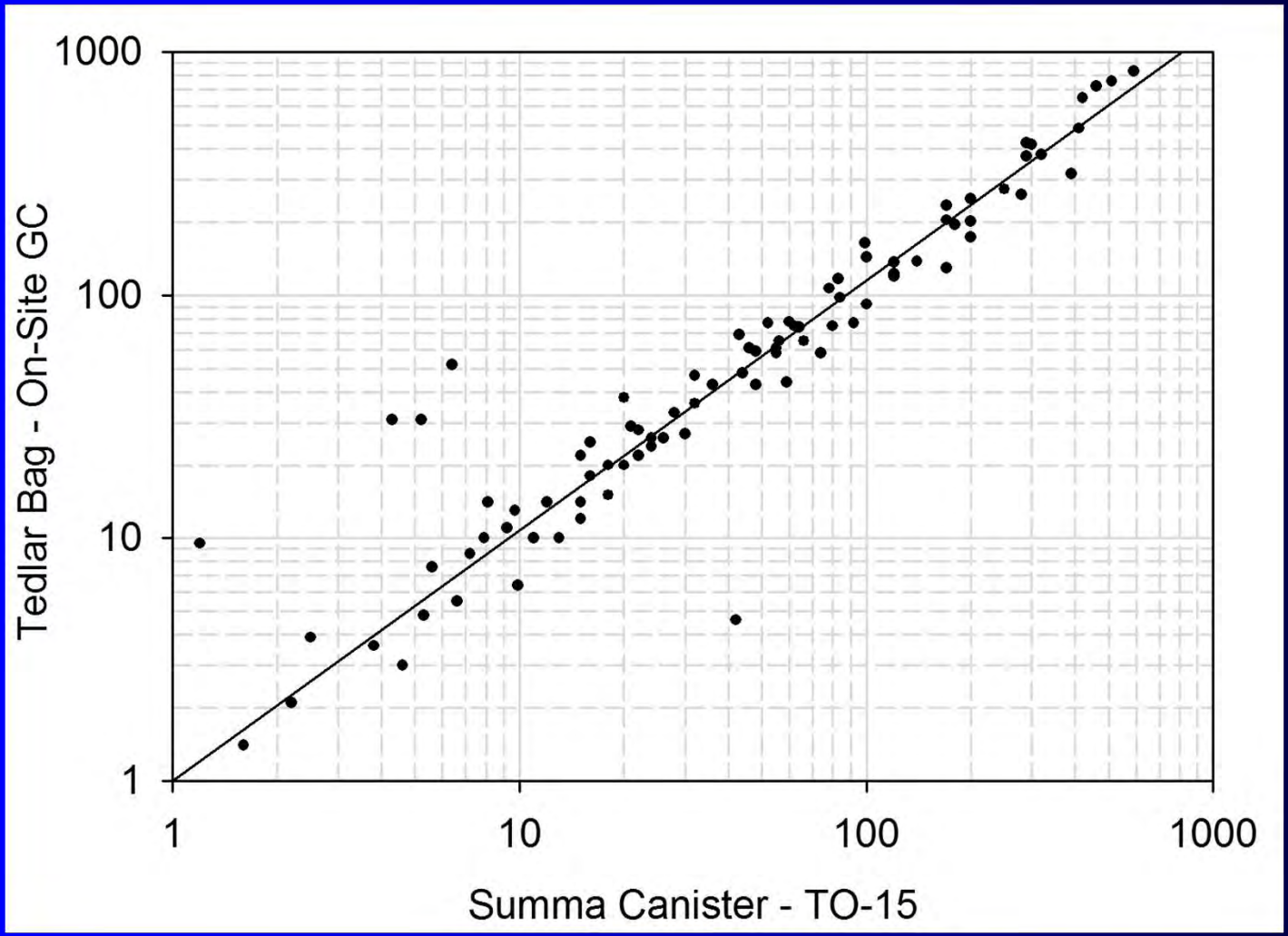
On-Site 8021 vs Off-site TO-15



Spatial Variability – What to Do?

- Soil Gas Not Homogeneous
- Spatial & Vertical Variations Exist
- Don’t Chase 1 pt Anomalies
- Get Enough Data Near/Around/Under
- On-site Analysis Enables Real-Time Decisions

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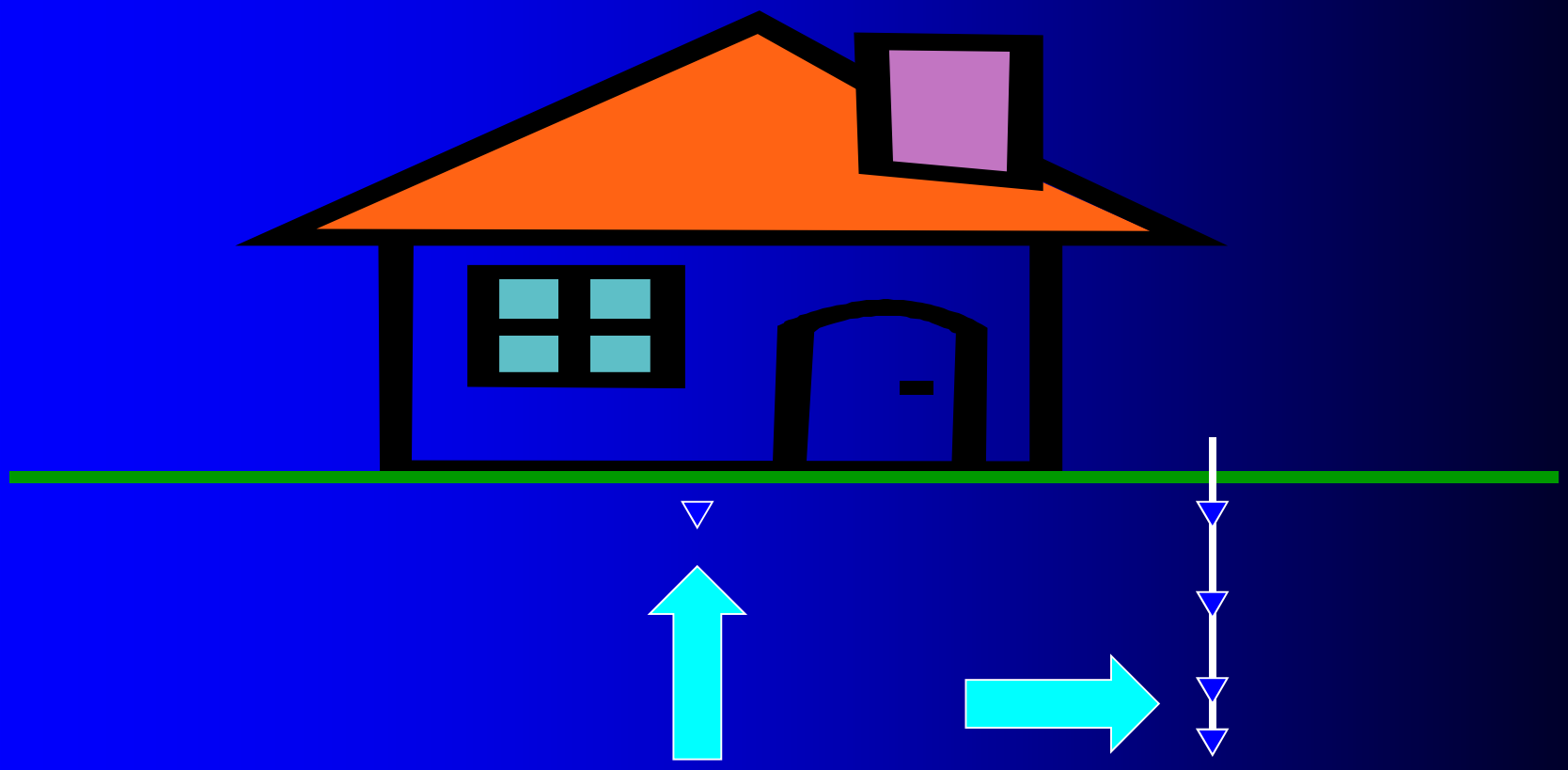
Sub-Slab vs. Near-Slab Samples



Are these better than these ?

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Sub-Slab vs. Near-Slab Samples

- EPA Prefers. Some States Require
- Very Intrusive; Legal Complications
- HCs: If O_2 Present, Near-slab OK
- Cl-HC: Deeper (>10’) exterior data more reflective of sub-slab

Recent ASU Study Suggests <u>LOW</u> Conc is Likely Entry Point

Table 5-2 for # of Sub-slab Points

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How Often to Sample?

- Depth Below Surface
  - 3’ to 5’ bgs generally considered stable
- Seasonal Effects – How Important?
  - Most studies show less than 5x
- Extreme Conditions?
  - Heavy rain
  - Extreme heating/cooling

Refer to Tables 4-1 & Table 5-3

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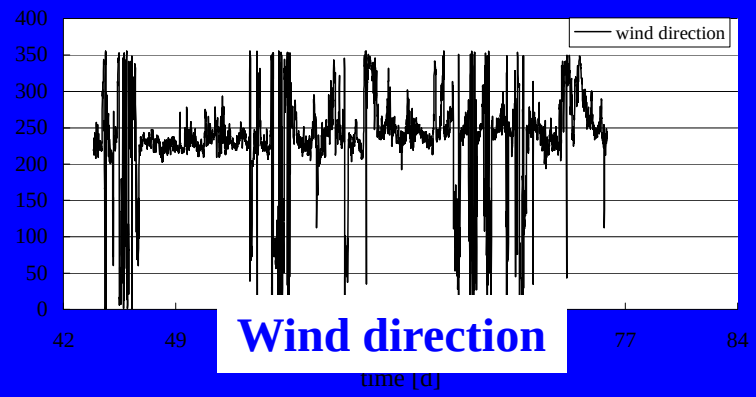
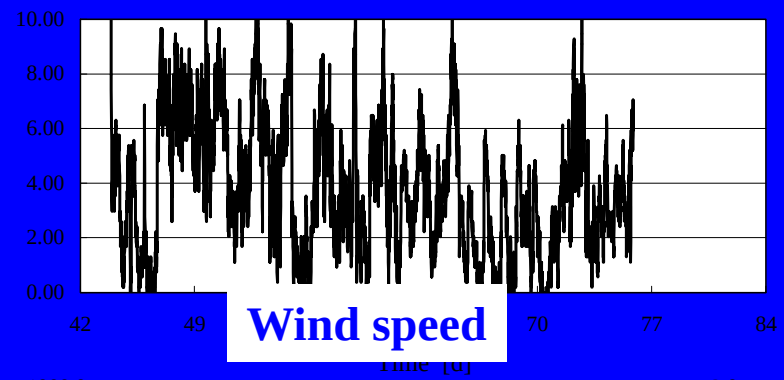
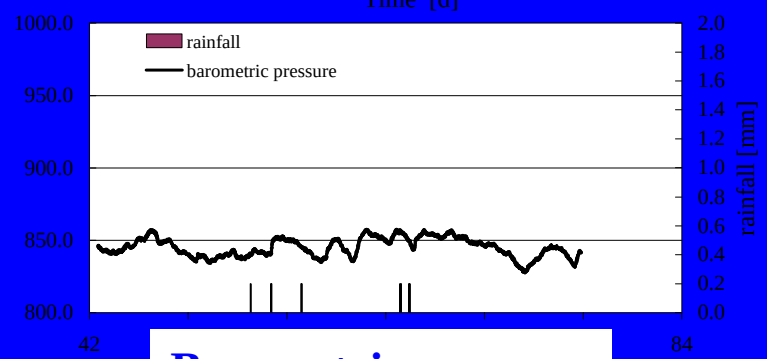
Meteorological Effects on Soil Gas



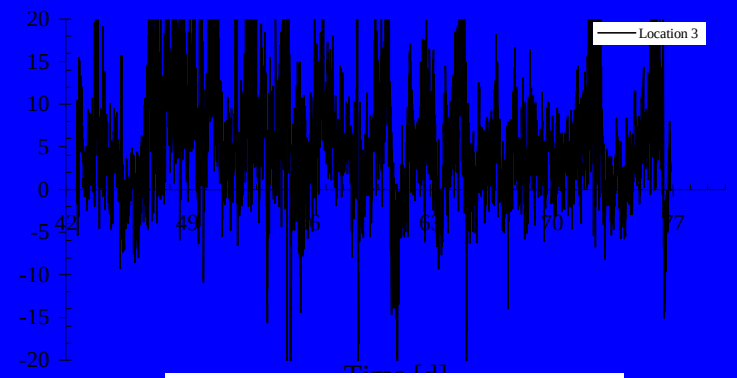
Wind direction



Wind speed

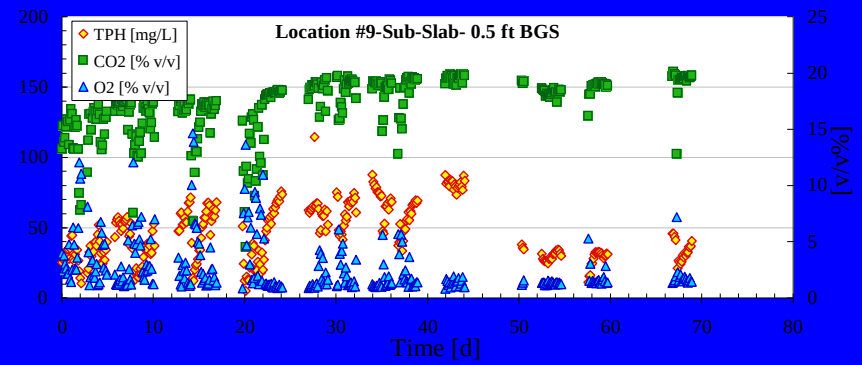


Barometric pressure



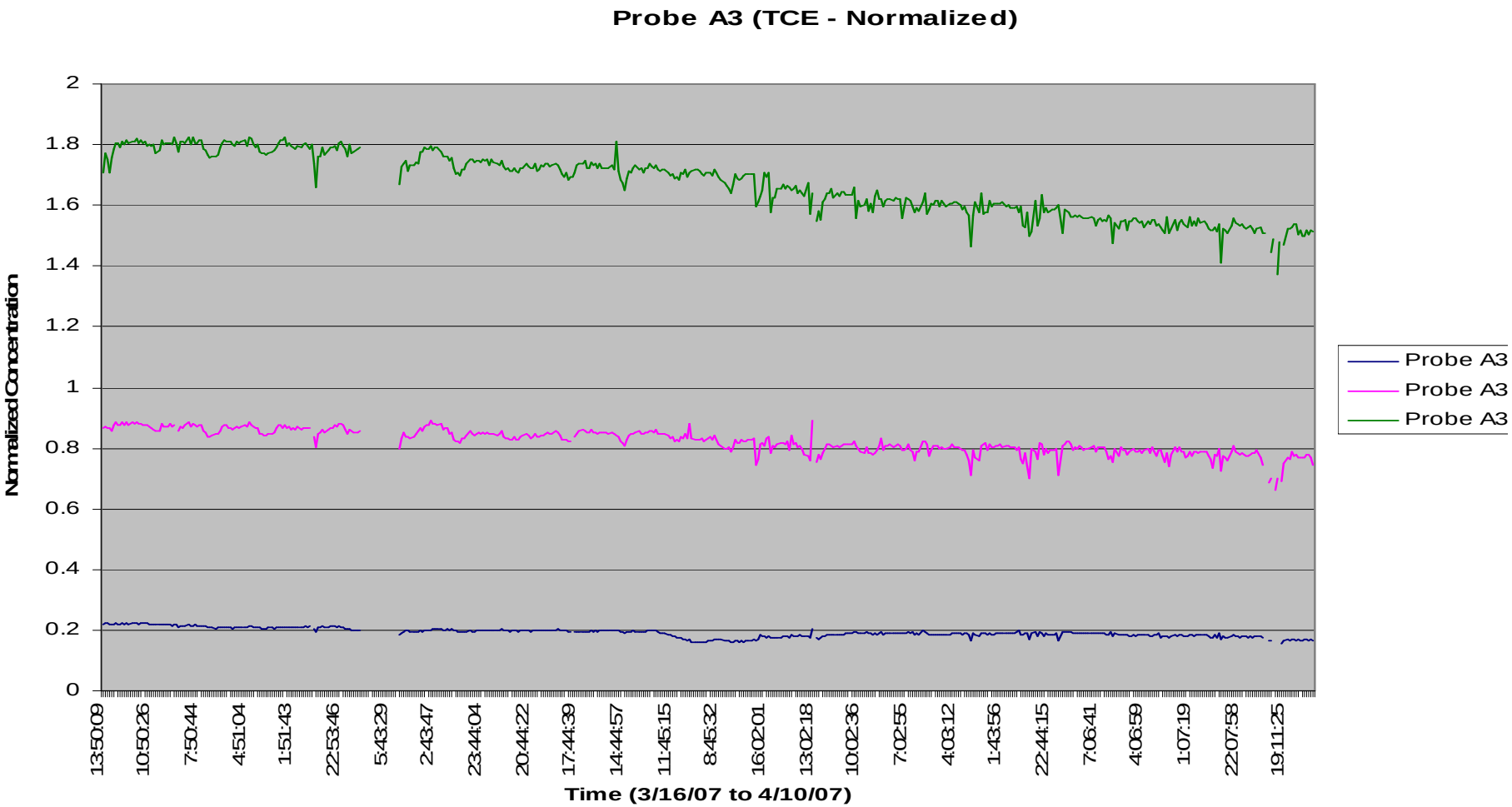
Pressure differential

?



O_2 and HC Concentrations

Soil Gas Temporal Study



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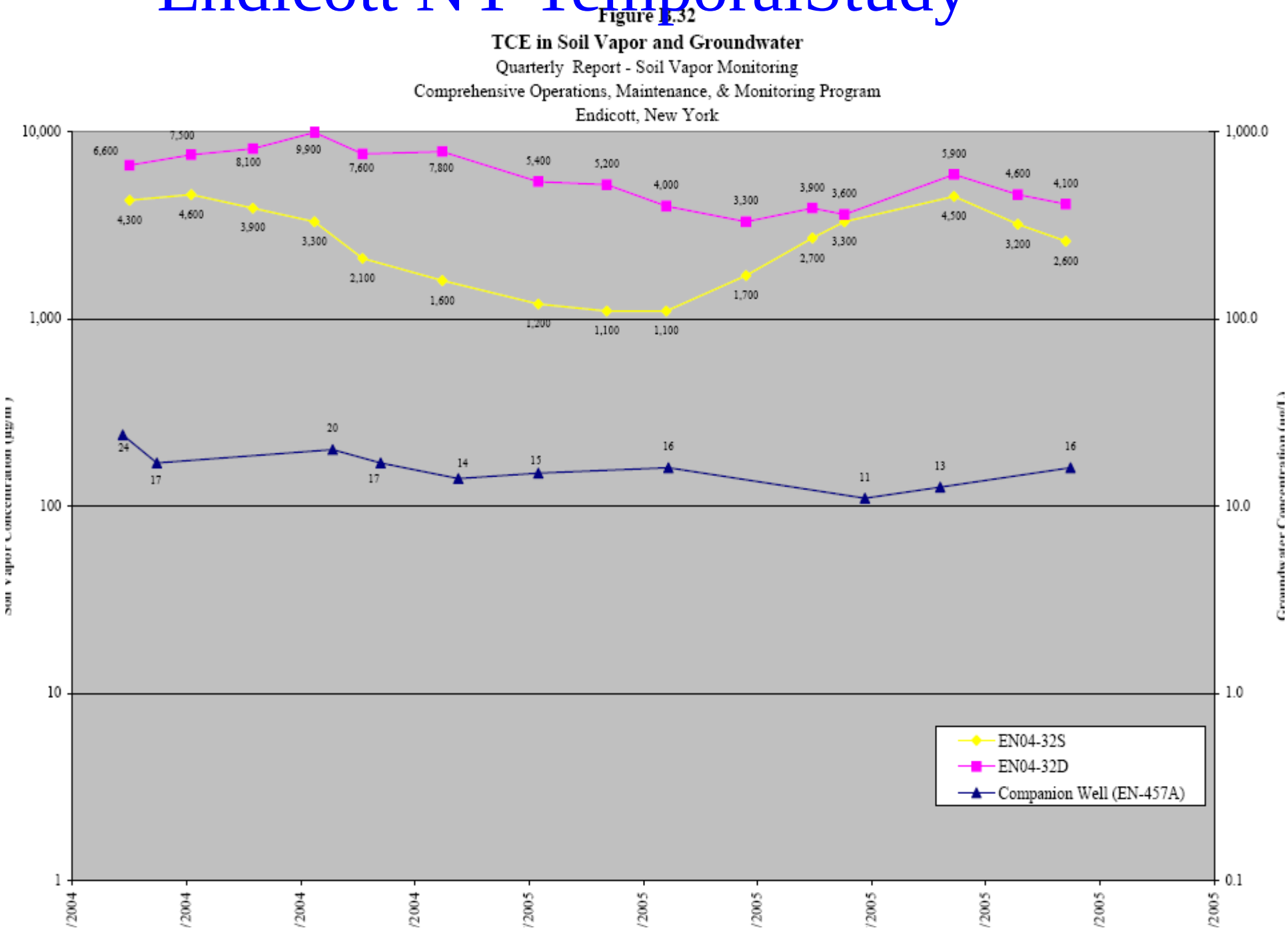
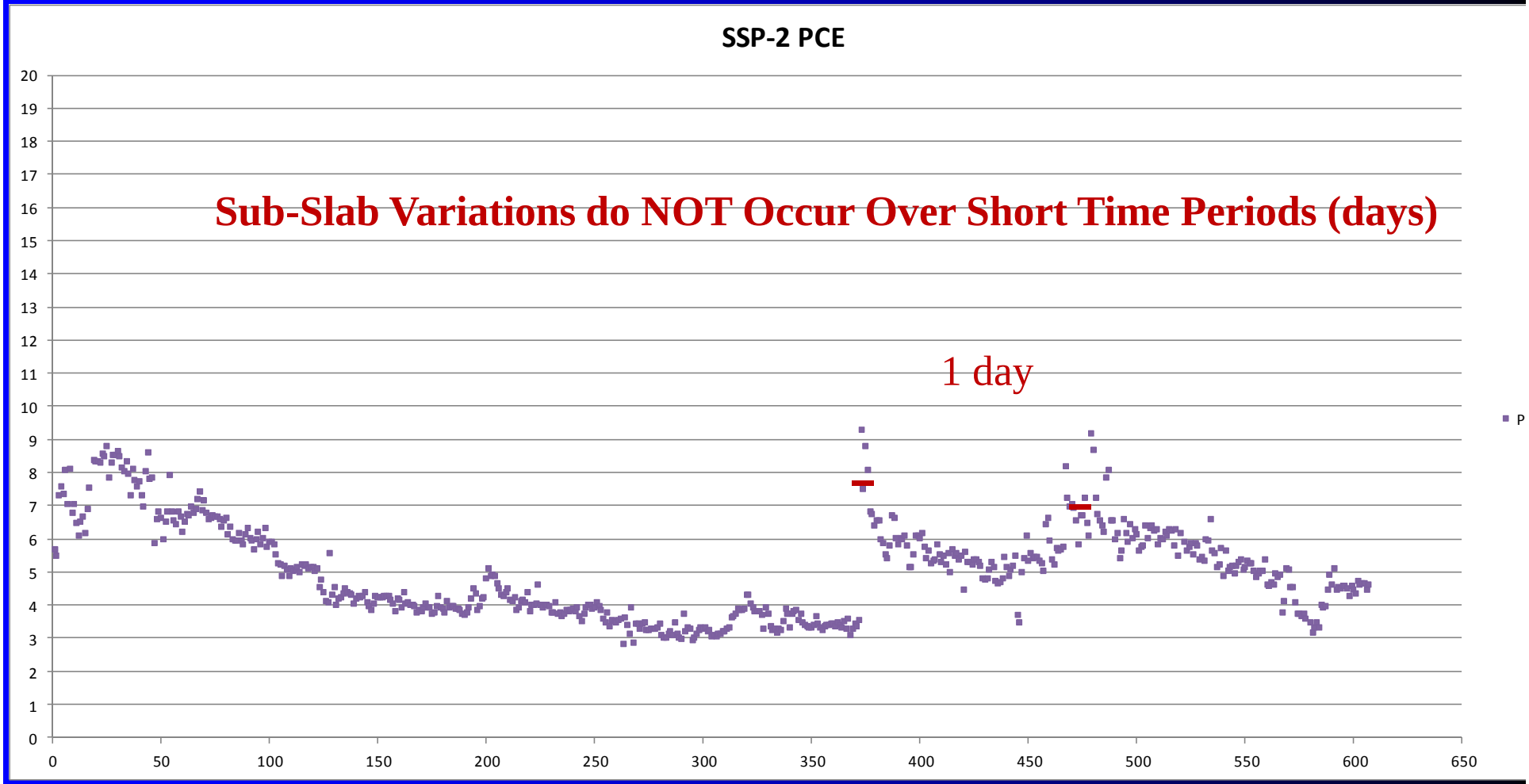
Endicott NY TemporalStudy



Sub-slab Soil Gas Data



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

Supplemental Tools/Data

- Site Specific Alpha Using Radon
  - Factor of 10 to 100. $100/sample
- Indoor Air Ventilation Rate
  - Factor of 2 to 10. <$1,000 per determination.
- Continuous analyzers
  - Real-time monitoring
- Pressure Manipulation
  - Can help interpret indoor air results

Refer to ASTM E2600-08 Table X.1 for Summary Table

Practical Investigation Strategies
(Things to Do)

- Get Enough Data
- Consider Less Expensive Methods (TO-14, 8260)
- CL-HCs: Vertical Profiles Around Structure
- HCs: Oxygen Profiles Around Structure
- Use Radon for Slab-Specific Alpha
- Measure Ventilation Rate
- Have Competent Subs
- Check Your Units!

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Previews of the VI Future

- VI Likely to be a Concern at Your Sites
- Variable Regulatory Guidance Makes Assessment Tricky & Slow
- New EPA OSWER Guidance to be Stricter
- ASTM Standard Increase # of Sites
- Hydrocarbons to be Less of a Concern

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Forthcoming VI Events

- AEHS – San Diego: March 17th - 20th, 2014
  - All-day EPA VI session
  - 1.5 days of Presentations
  - Petroleum VI Workshop (3 - 4 hours)
- AWMA – Cherry Hill NJ: Sept 2014
  - 2 days of VI

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VI Sampling Articles

- Overview of SV Methods (www.handpmg.com)
  - LustLine Part 1 - Active Soil Gas Method, 2002
  - LustLine Part 2 - Flux Chamber Method, 2003
  - LustLine Part 3 - FAQs October, 2004
  - LustLine Part 4 – Soil Gas Updates, Sept 2006
  - LustLine – VI For Petroleum Hydrocarbons, Dec 2010

Forthcoming Sampling Guidance: ITRC PVI Toolkit

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