Update & Status of USEPA's Vapor Intrusion Guidance

AEHS West Coast Conference
San Diego, Calf.
March 13, 2008

Presented by:
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**A personal perspective, does not represent Agency positions*
See: http://iavi.rti.org

Outline

- History of EPA's development
- Technical approaches
  - EPA & ITRC
- Path forward being considered

OSWER's 2002 Draft-Subsurface Vapor Intrusion Guidance

- Signed Nov. 22, 2002 (**for use**)
  - By OSWER Assist. Admin. (AA) Marianne Horinko
- Published in Federal Register Nov. 29, 2002
  - 90-day Comment Period (Nov. 29 - Feb. 27)
- Guidance, Comments, & Training available at:
  - http://www.epa.gov/correctiveaction/eis/vapor.htm
  - http://www.epa.gov/edocket RCRA-2002-033
  - http://www.clu-in.org/conf/tio/vapor_021203/
  - http://iavi.rti.org (Indoor Air Vapor Intrusion database)

Tier 1- Primary Screening

OSWER's draft-Subsurface Vapor Intrusion Guidance

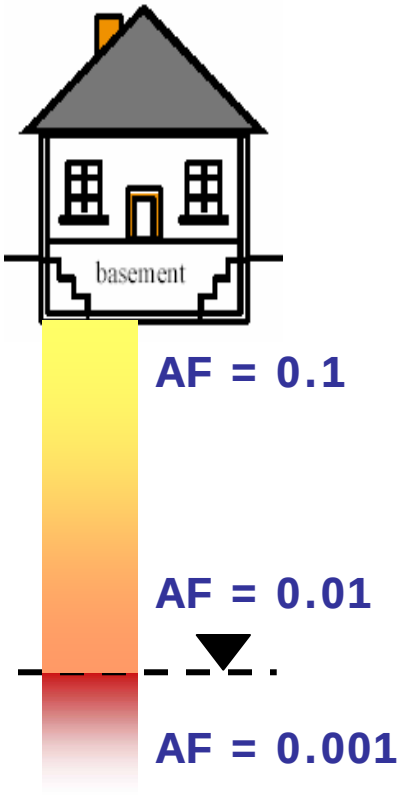
- "quickly identify ... any potential exists"
- Q1 Volatiles?
- Q2 Buildings?
- Q3 Immediate concerns?
  - May be due to a mixture and/or non-toxic
- If ... not ... "incomplete" ... proceed to Secondary Screening

Tier 2- Secondary Screening

Q4 OSWER's draft-Subsurface Vapor Intrusion Guide

- Compare to numerical criteria
  - Measured or "reasonably estimated" conc. (GW, SG, IA)
  - Three risks levels 10-4, 10-5, 10-6 cancer (HI = 1)
- Q4 - Generic criteria *(based on observed=empirical)*
- Q5 – Semi-site-specific criteria *(based on model)*
- If ... not ... incomplete ... proceed to Site-Specific

Calculation of Soil Gas and Groundwater Generic Target Screening Levels (Ques. 4)



- Select indoor air target screening level.
- Shallow soil gas screening level ($SGSL_{shallow}$) is 10 times indoor air target screening level.

$$SVSL_{shallow} = IASL * 10$$

- Deep soil gas screening level ($SGSL_{deep}$) is 100 times indoor air target level.

$$SVSL_{deep} = IASL * 100$$

- Groundwater screening level (GWSL) is the aqueous concentration corresponding to a soil gas concentration 1000 times greater than the indoor air target level.

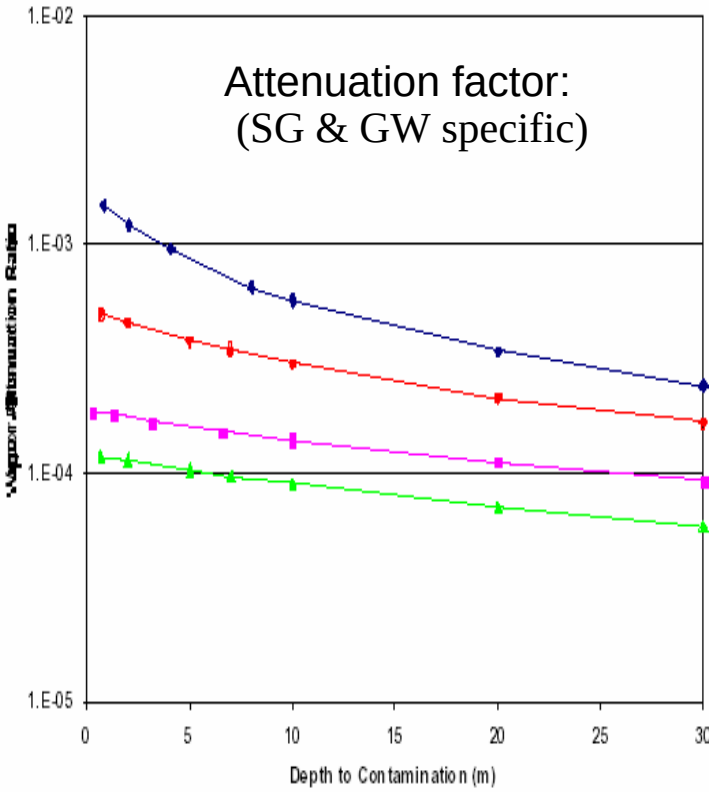
$$GWSL = IASL * 1000/Hc$$

Slide by Dr. H. Dawson

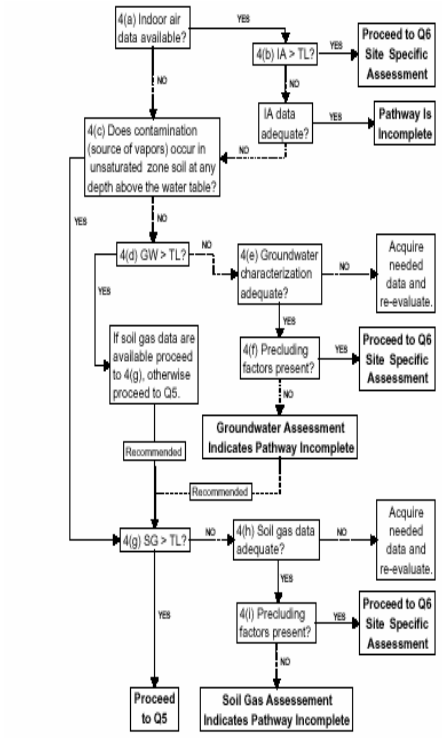
Secondary Screening (Ques. 5)

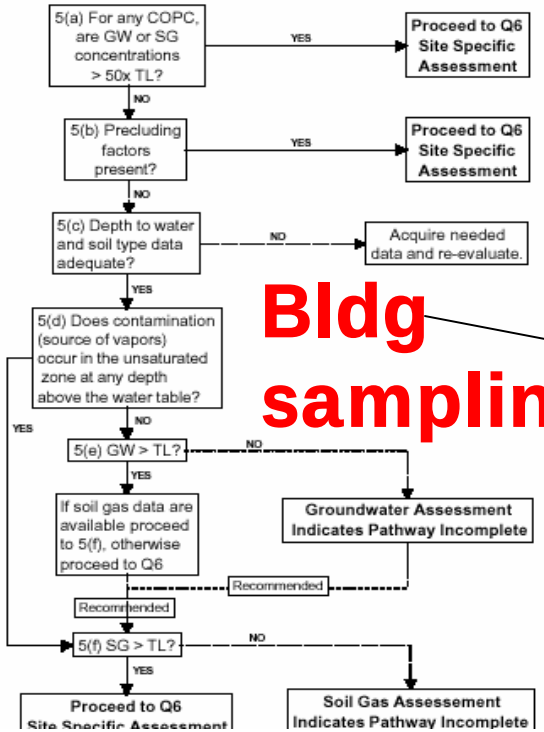
OSWER Vapor Intrusion Guidance

- Q5: Do media concentrations exceed semi-site specific criteria? (Table 3 (a, b ,c))
  - *'canned' J&E model-based*
  - *conservative model input parameters (all, but)*
  - **Soil type** *sand – loam (color)*
  - **Depth** *to contamination: 1 – 30 meters*

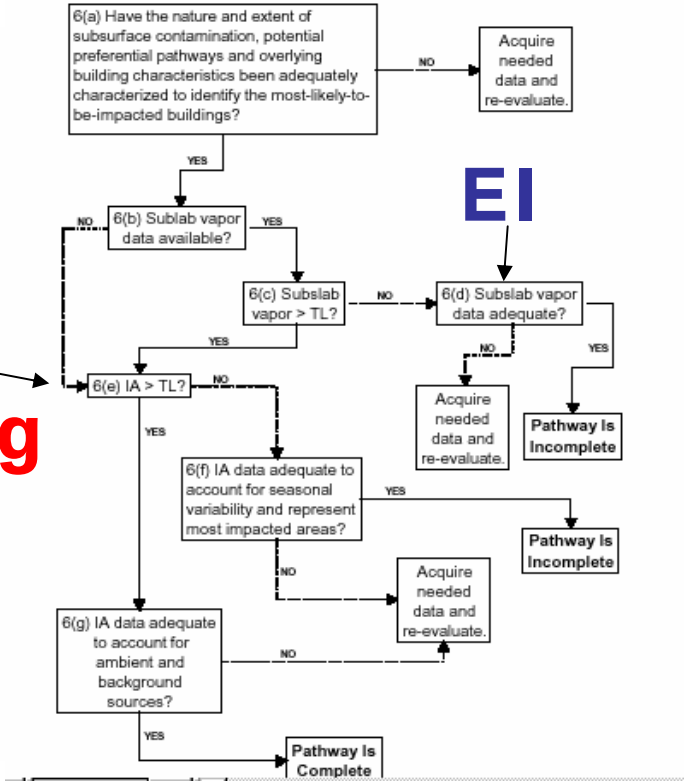


OSWER's (**2002**) Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (from Groundwater and Soils)





Bldg sampling



Q4 **Q5** **Q6**

Appendices

OSWER's draft-Subsurface Vapor Intrusion Guidance

- A: Data Quality
- B: Conceptual Site Model
- C: Flow Charts
- D: Tables 1, 2, & 3
- E: Methods & Techniques
- F: Empirical Attenuation Factors
- G: J&E Model "Considerations"
- H: Community Involvement
- I: "Background"

Workshop Slide March 2006

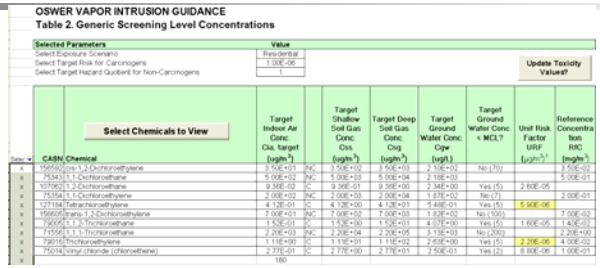
OSWER VAPOR INTRUSION GUIDANCE
Table 1. Chemicals Sufficiently Toxic to Pose an Inhalation Risk via Vapor Intrusion

Check (x) If Present	CASN	Chemical	Target Indoor Air Conc. Cia, target (ug/m³)	Basis C = cancer NC = noncancer	Saturated Vapor Conc. Cv (ug/m³)	Sufficiently Toxic? Cv.Cia,target? (yes/No)
x	83329	Acenaphthene	2.10E+02	NC	2.07E+04	No
x	75070	Acetaldehyde	1.11E+00	C	2.14E+09	Yes
x	67641	Acetone	3.50E+02	NC	7.19E+08	Yes
x	75058	Acetonitrile	6.00E+01	NC	2.01E+08	Yes
x	156592	cis-1,2-Dichloroethylene	3.50E+01	NC	1.06E+09	Yes
x	75343	1,1-Dichloroethane	5.00E+02	NC	1.21E+09	Yes
x	107062	1,2-Dichloroethane	9.36E-02	C	4.20E+08	Yes
x	75354	1,1-Dichloroethylene	2.00E+02	NC	3.13E+09	Yes
x	127184	Tetrachloroethylene	4.12E-01	C	1.66E+08	Yes
x	156605	trans-1,2-Dichloroethylene	7.00E+01	NC	1.74E+09	Yes
x	79005	1,1,2-Trichloroethane	1.52E-01	C	1.67E+08	Yes
x	71556	1,1,1-Trichloroethane	2.20E+03	NC	8.88E+08	Yes
x	79016	Trichloroethylene	1.11E+00	C	5.19E+08	Yes
x	75014	Vinyl chloride (chloroethene)	2.77E-01	C	1.00E+10	Yes

1 Preliminary Screening

2 Generic Screening

OSWER VAPOR INTRUSION GUIDANCE
Table 2. Generic Screening Level Concentrations



Based on **Empirical Alphas**

Just need **one media**

- Groundwater
- Soil-gas (shallow or deep)
- Indoor air

3 External Site-Specific Screening

Based on J&E **Model Predicted Alphas**

Sub-slab & indoor air

In-Building Concentrations		Indoor Air Conc. < 0.1 TL	Indoor Air Conc. > 0.01 TL to < TL	Indoor Air Conc. > TL	No Indoor Air Data
Sub-Slab Conc.	< 0.1 TL/AF	No Action	No Action or Investigate IA Sources	Investigate IA Sources	No Action
	> 0.1 TL/AF to < TL/AF	Resample SS or No Action	Investigate IA Sources or No Action	Investigate IA Sources and Monitor IA	Resample SS or Sample IA
	> TL/AF	Monitor IA or Mitigate	Monitor IA or Mitigate	Mitigate	Monitor IA or Mitigate
No Subslab Data		No Action**	Resample IA or Sample SS	Investigate IA Sources or Mitigate	Sample IA and/or SS

Single Line of Evidence - **Screen Out**

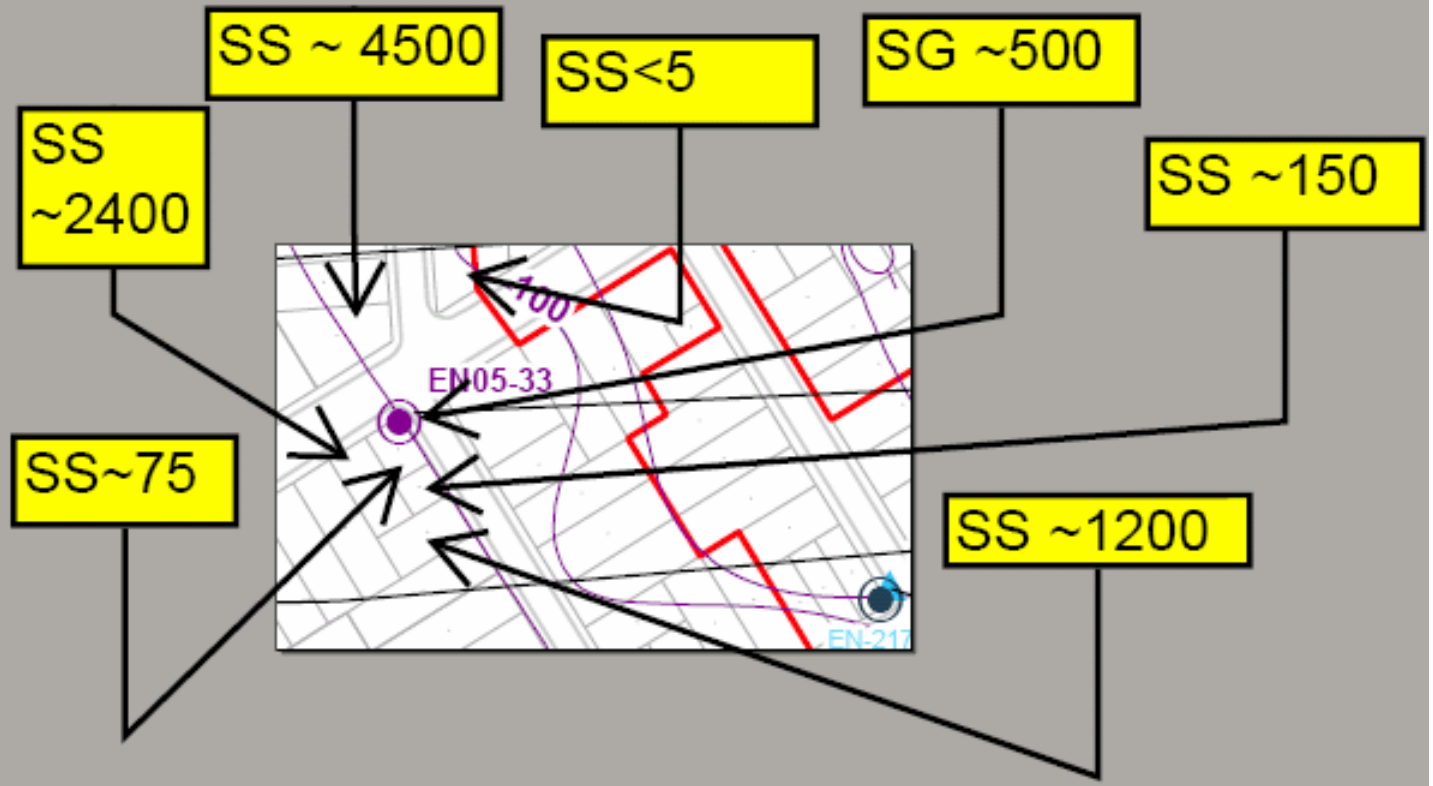
Internal Site-Specific Assessment

Spatial Variability (at one point in time)

[And this is only Sub-Slab (add bldg variability to IA)]

SG=Soil-Gas

SS=Sub-Slab



Variation in Sub-slab conc. within a few hundred feet.

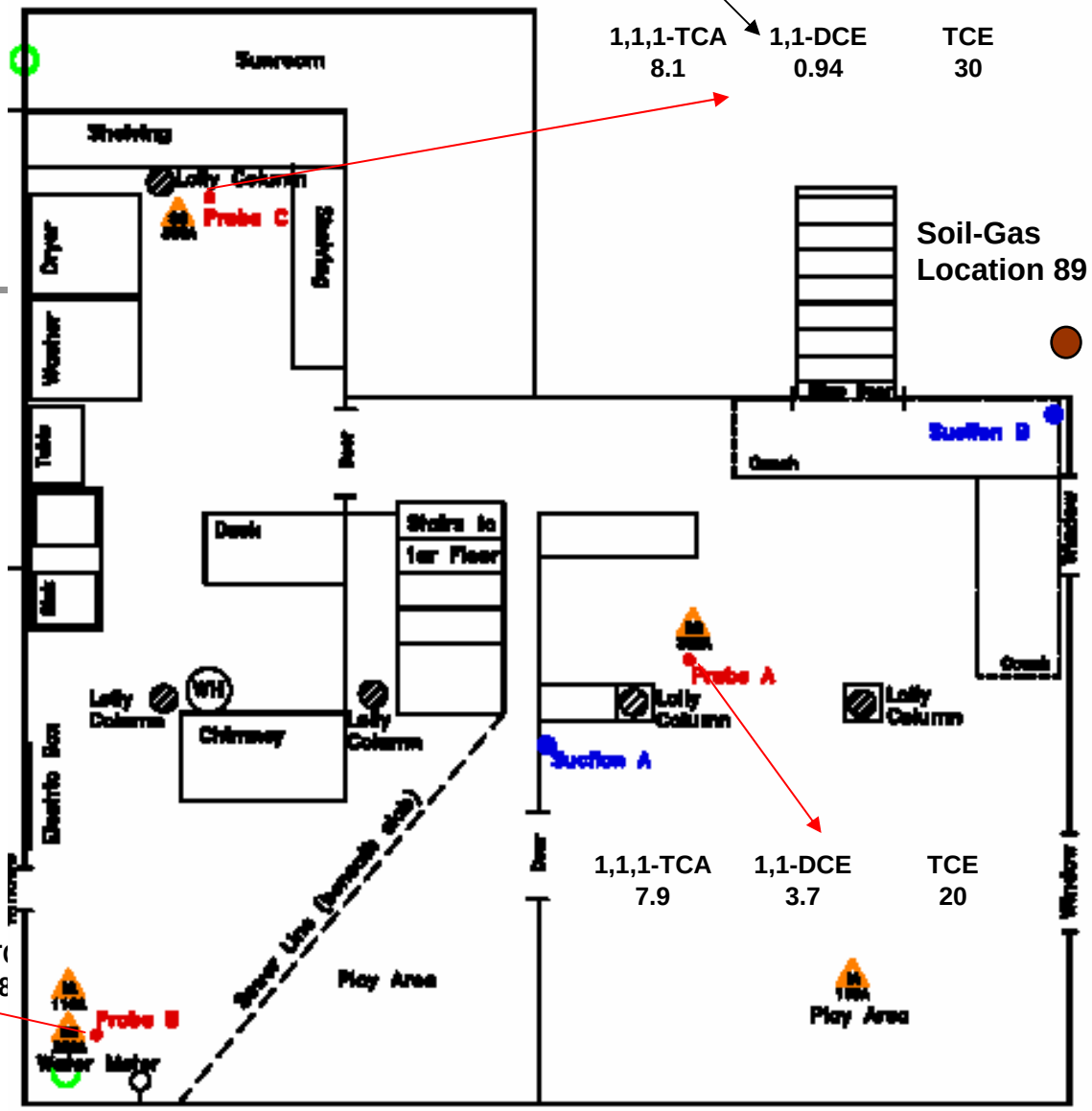
Endicott, NY (graphic from presentation by B. Wertz)

Sub-Slab Concentrations at House B Raymark site, CT

MW215 showed no VOCs

2008 - Now we ask, which sub-slab sample do we use for alpha?

Not a sample of the intruding vapors? **> 44 x**



Slide by **D. Digiulio** (EPA-ORD)

w/ mod. HJS

IA of 11DCE = 0.11 ug/m3

Using sub-slab *mean* – $Alpha_{ss}$ = 0.11/16 = 0.0065

Using sub-slab point **C** – $Alpha_{ss}$ = 0.11/0.94 = 0.118

Workshop Slide Fall 2006

Spatial Variability

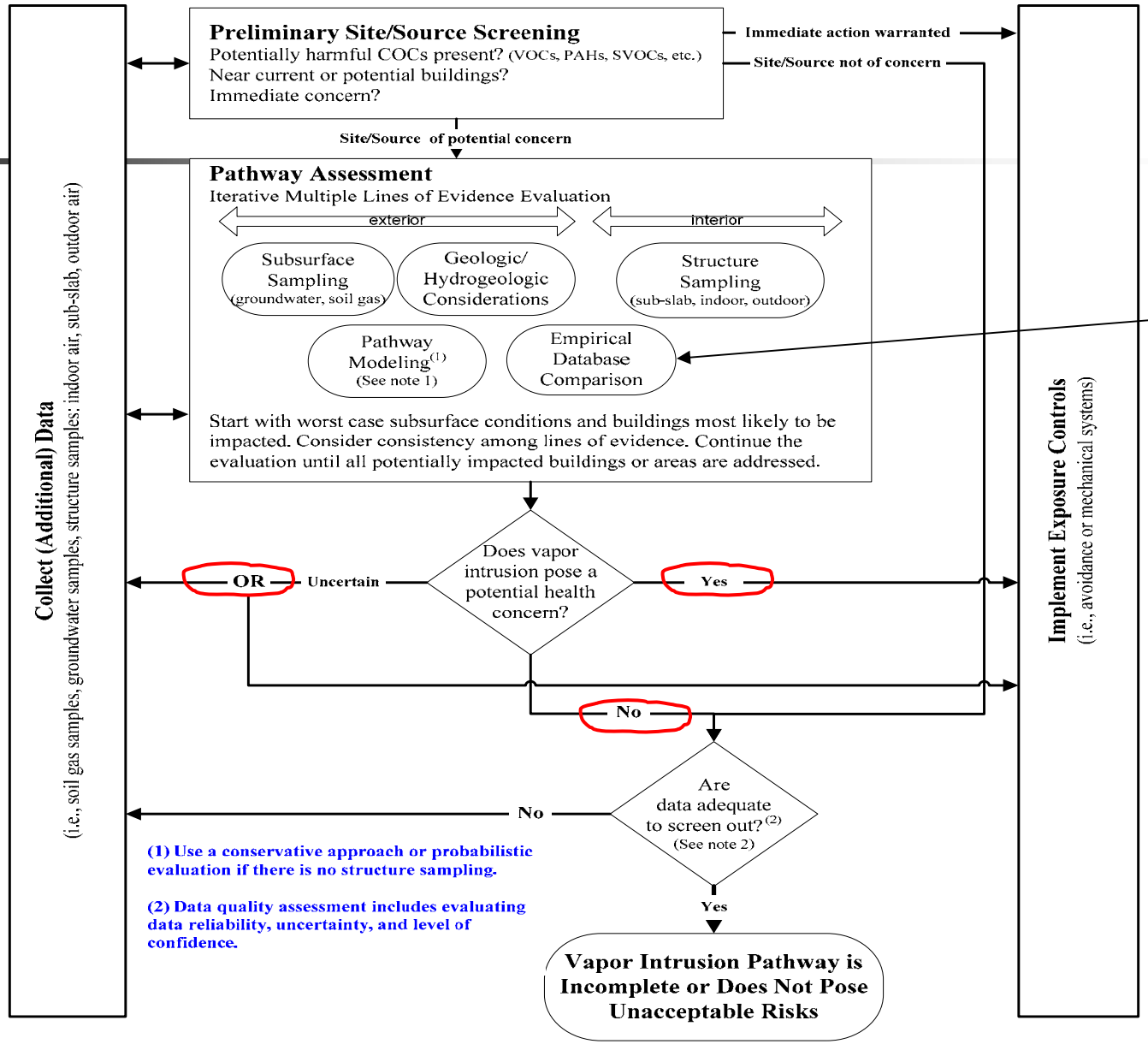
Nov. 2002

- Tier 1: **Primary** Screening
  - Q1: VOCs present?
  - Q2: Near buildings?
  - Q3: Immediate concern?
- Tier 2: **Secondary** Screening
  - Q4: Generic screening
  - Q5: Semi-site specific screening (alphas from charts & tables)
- Tier 3: Site-Specific Pathway Assessment
  - Q6: Indoor air (and/or subslab)

Fall 2006

- **Preliminary Site** Screening
  - VOCs present?
  - Near buildings?
  - Immediate concern?
- **Source** Screening
  - Generic residential and non-residential screening levels
- **Pathway Assessment**
  - **Multiple Lines of Evidence Evaluation**
    - Interior assessment: structure sampling
    - Subsurface sampling: gw, sg
    - Geology/hydrogeology evaluation
    - Pathway modeling

Workshop Slide March 2007 - Vapor Intrusion Assessment
Multiple Lines of Evidence Investigative Approach



New line of evidence

Part II

- Technical approaches
  - EPA & ITRC

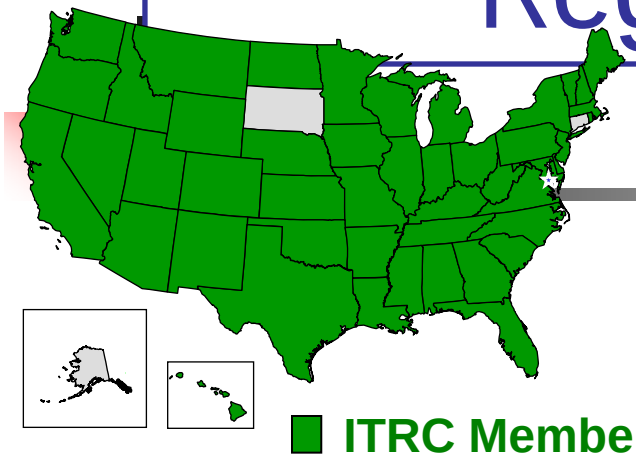
Latest Vapor Intrusion Guidance

flexible framework, variety of tools,

multiple-lines of evidence

Interstate Technology & Regulatory Council

ITRC



ITRC Member State

Host Organization

ECOS

Federal Partners

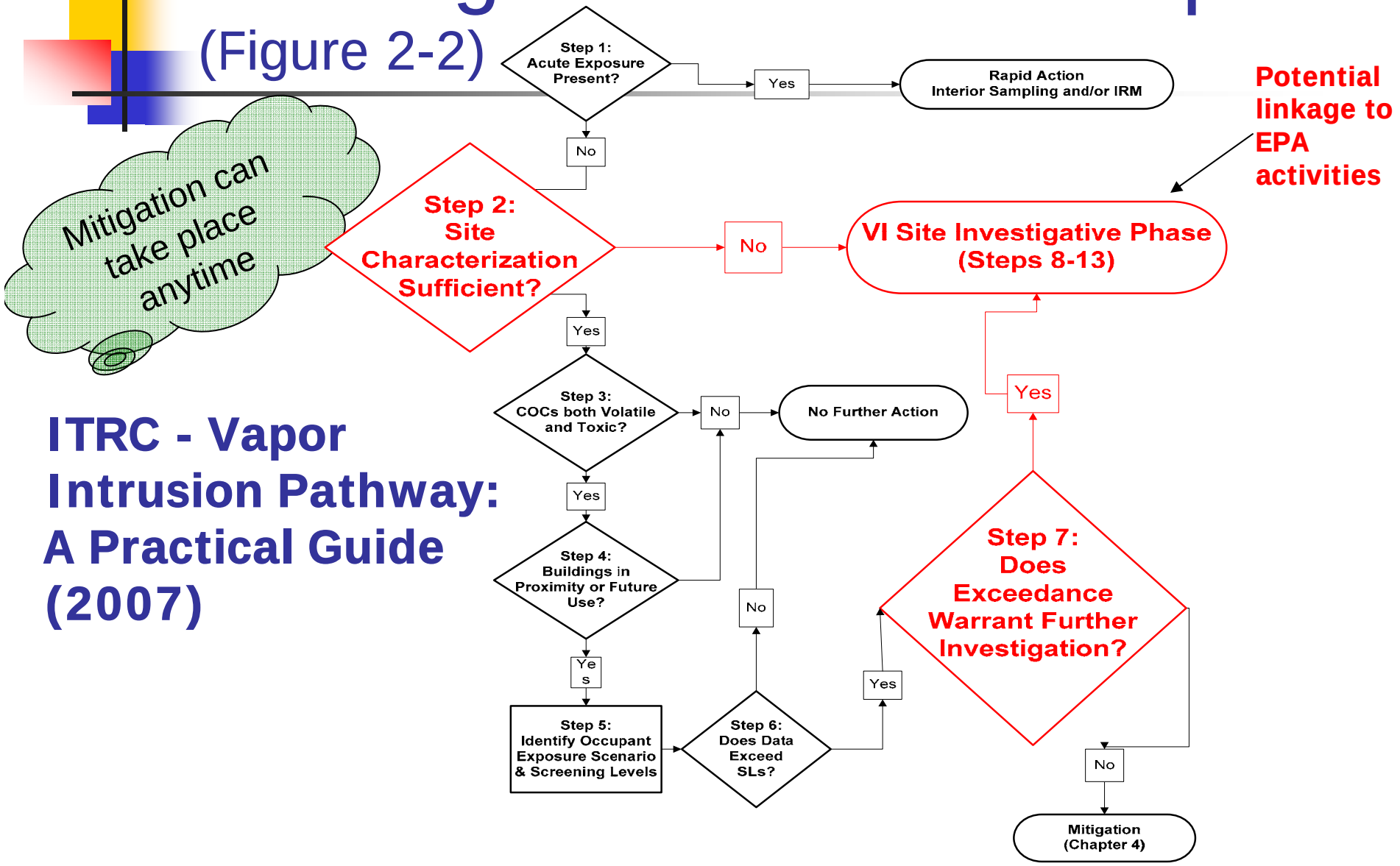
DOE DOD EPA

Vapor Intrusion Pathway: A Practical Guide

(VI-1, 2007)

Web-based training was **co-sponsored** by the **US EPA** Office of Superfund Remediation and Technology Innovation

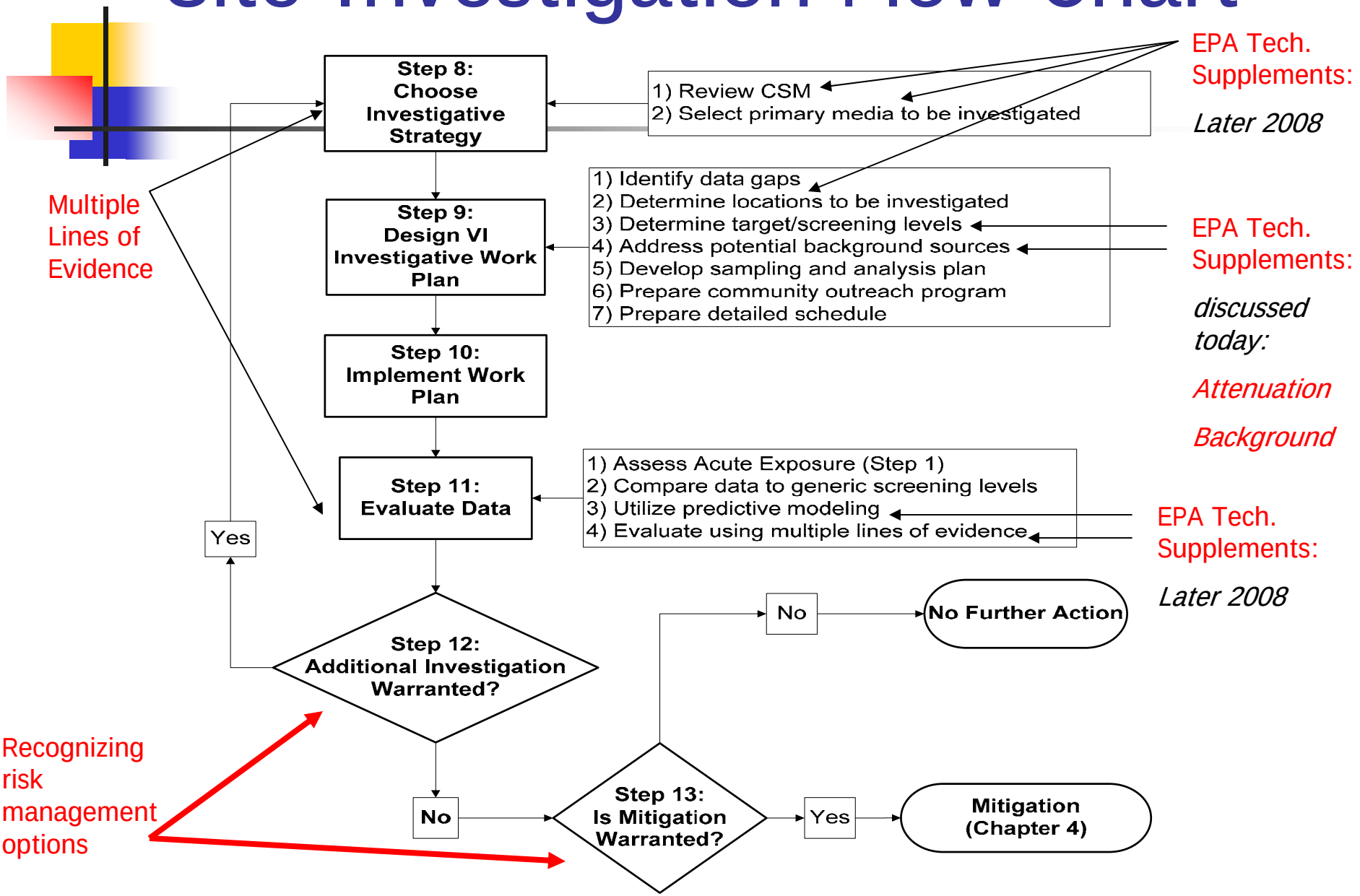
Preliminary Screening Flow Chart:
Investigation Decision Steps
(Figure 2-2)



ITRC - Vapor Intrusion Pathway: A Practical Guide (2007)

ITRC - Vapor Intrusion Pathway: A Practical Guide (2007) (Figure 3-1)

Site Investigation Flow Chart



Comparison of flowcharts EPA & ITRC

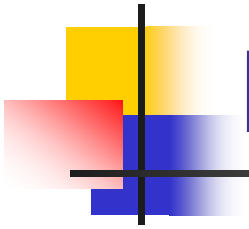
- EPA (2002)
  - Focused on the appropriateness of exits
    - Assumes a single line of evidence (media) could be used to screen out (i.e., make a reliable VI determination)
      - Even at the higher tiers
    - Less focused on the practical collection of data
- ITRC (2007)
  - Focused on collection of appropriate data
    - Less focused on the appropriateness of exits
      - Makes references to regulatory guidance for exits
      - Makes references to regulatory guidance for all policies

ITRC references EPA (2002) 16+ times

- Definitions: VI, VOCs, Chemicals (Table 1)
- Henry's constants
- Scope - residential & non-residential settings
- CSM and DQO (Appendix B & D)
- Worst-case Buildings, 100 ft criterion
- Developing generic alphas
- ***Generic screening levels***, development, & use
- Site-specific screening & J&E model
  - Awaits updated USEPA J&E model (w/ better inputs)
- Soil-gas measurement & screening levels
- Use of soil samples

ITRC also references regulatory guidance (state &/or federal) 19+ times

- Definitions: receptors, VI, VOCs, screening vs. action levels,
- Constraint to ITRC guidance, source of additional guidance,
- Constraint to screening values, ICs, OSHA
- Partner/overseer in the decision making process
- To determine:
  - When SS & IA samples are warranted
  - QA/QC levels
  - Distance criterion
  - When models can be used,
  - When mitigation is warranted
  - Soil-gas sampling criteria
  - Indoor air sampling criteria
  - Developing other default values
  - Use of Constituent ratios
  - Screening out with sub-slab data
  - Screening out with exterior or interior measurements



Part III

- Path forward being considered

EPA is considering the benefits of using the ITRC (2007) framework

- *Vapor Intrusion Pathway: A Practical Guide*
- ITRC
  - Organization of state technical experts
  - Who have worked with responsible parties
  - Evaluating available data and approaches to vapor intrusion

ITRC 2007 VI Guide

- Consensus document that:
  - provides a flexible framework
  - highlighting both
    - advantages and disadvantages
  - of a variety of tools
    - screening with various subsurface samples
    - more direct indoor air samples
    - exposure mitigation options

ITRC's Guide is based upon newer information and science

- Acknowledging the more recent understanding of the importance of evaluating
  - **Multiple Lines of Evidence**
  - when determining the potential for vapor intrusion into buildings

EPA's Supplemental Technical Documents

- EPA is considering developing the following additional technical documents:
- Drafts discussed today:
  - **Background** levels of contaminant vapors in non-impacted buildings
  - **Database** of vapor intrusion observations
- Available later in 2008:
  - **Conceptual Site Model** - update and expansion to assist investigators to visualize the vapor intrusion processes and pathways
  - **Johnson & Ettinger Model** - improvements to the ranges and compatibility of inputs

EPA is Continuing to Work on VI Issues

- Keeping pace with the rapidly developing science of vapor intrusion
  - EPA is Continuing the Dialogue with:
    - federal partners
    - state regulators
    - industry
    - academia
    - environmental groups, and
    - general public;
  - to continue to improve the science of vapor intrusion prevention

Today's Meeting Focuses on *Preliminary Drafts* of two documents:

- **Database** of vapor intrusion observations
  - See http://iavi.rti.org/OtherDocuments
- **Background** levels of contaminant vapors in non-impacted buildings
  - Summary presentation today, paper not yet available
- Participants can:
  - Hear Summaries of the Papers
  - Have an Opportunity for Comments
  - Interact with Expert Panels

Evidence-Based Approaches

- Increasing number & quality of observations:
  - Allows empirical approaches
    - Attenuation (today, just laying a foundation)
    - Media-concentration screening-values (soon?)
  - Decreasing reliance on theory
    - VI theory is evolving with observations
      - # factors influencing VI is still growing
      - Direction and range of influence (e.g., temporal)
      - Interaction of factors