

Air Force Center for Engineering and the Environment

Integrity - Service - Excellence

Air Force Strategy for Vapor Intrusion Pathway Evaluation



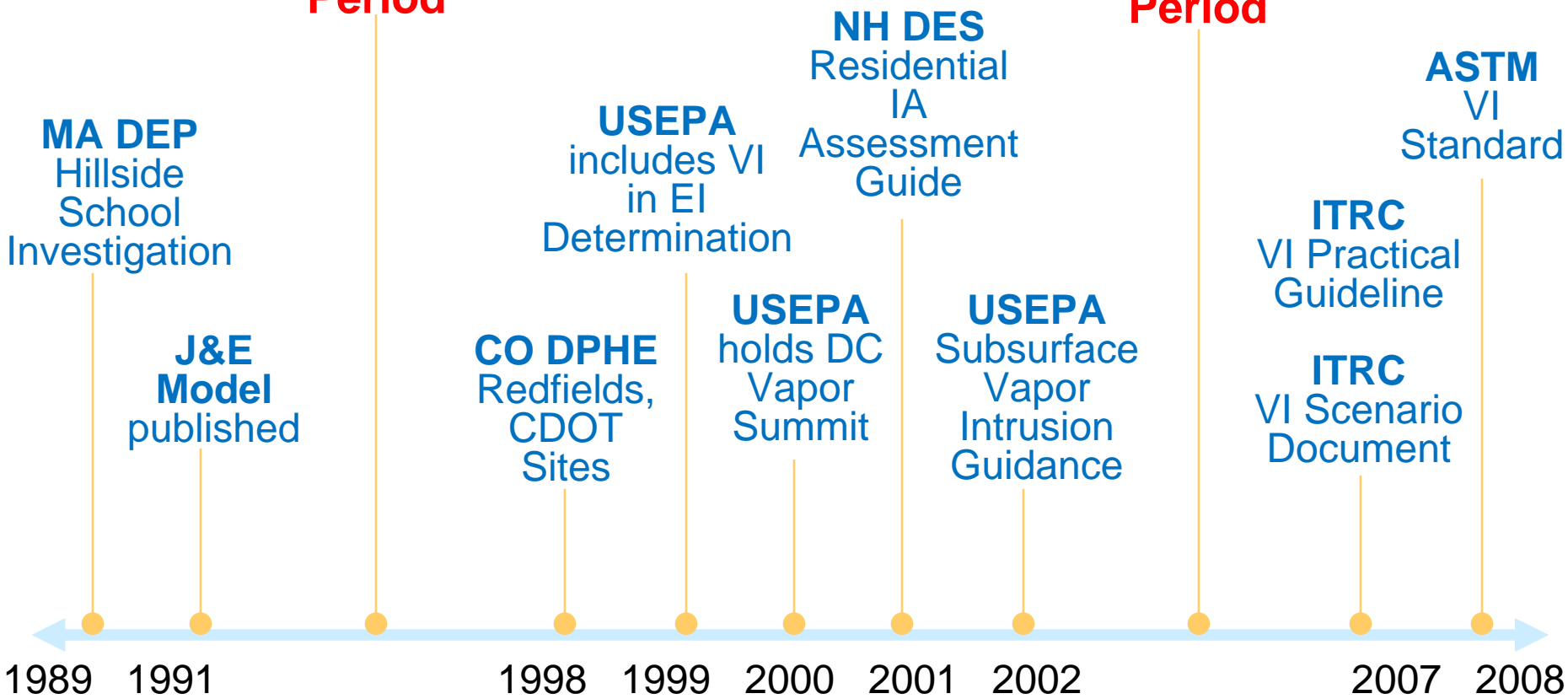
**Mr. Cornell Long
AFCEE/TDV
10 Nov 2009**



Historical Perspective

The Missing Pathway Period

The National VI Discussion Period




Blayne Hartman, H&P Mobile Geochemistry



Historical AF Approach

- Farmer Model
- Box Model
- Early versions of the J&E Model
- EPA's "Air/Superfund National Technical Guidance Study Series: Assessing Potential Indoor Air Impacts for Superfund Sites (1992)"
- Heavy on modeling; aversion to collection of indoor air samples

AL/OE-TR-1996-0110



UNITED STATES AIR FORCE
ARMSTRONG LABORATORY

Evaluation of Potential Indoor
Air Impact of TCE in Groundwater
on Building 864, Air Force
Plant 44, Arizona

G. Cornell Long
Jody R. Wireman

October 1997

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Approved for public release;
distribution is unlimited.

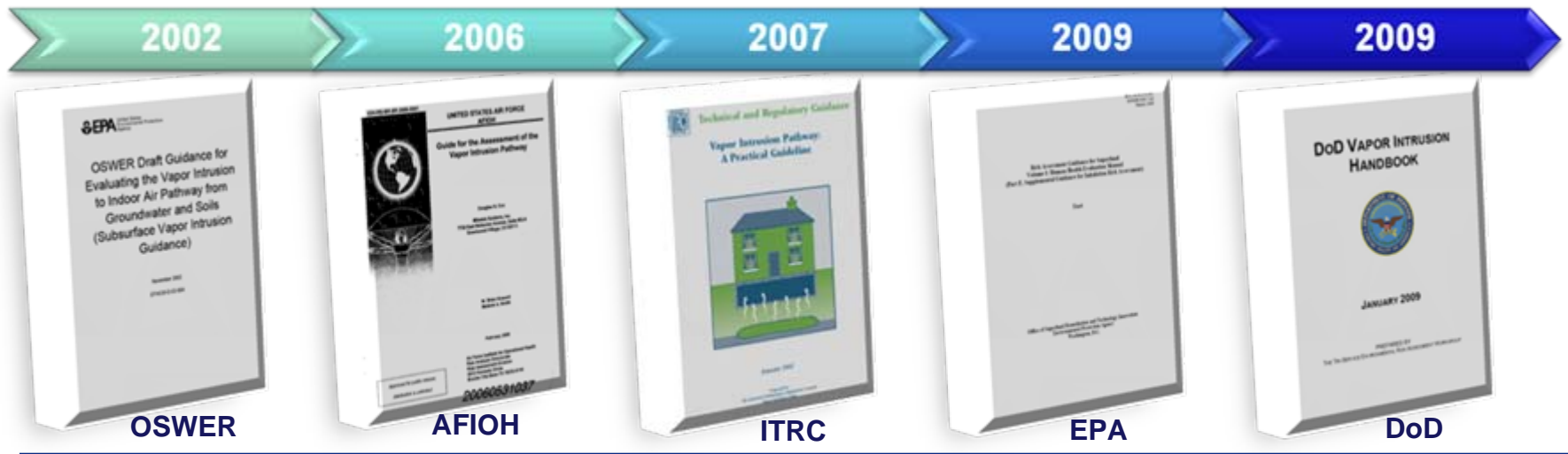
Occupational and Environmental Health
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Occupational Medicine Division
2402 E Drive
Brooks AFB, TX 78235-5114



Vapor Intrusion Guidance Development Timeline

KEEP UP WITH EVOLVING UNDERSTANDING

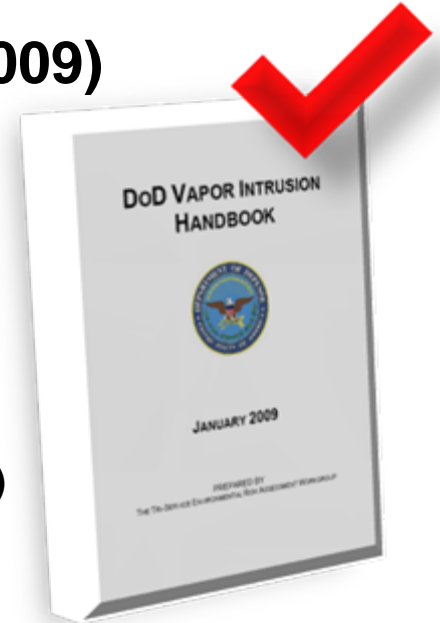
- OSWER Guidance (2002)
- AFIOH (2006)
- Various State Guidance Documents
- ITRC Guidance (2007)
- EPA RAGs Part F (2009)
- DoD Guidance (2009)





Air Force Approach to Vapor Intrusion

- **Follow DOD Vapor Intrusion Handbook (Jan 2009)**
 - OSD Memo 9 April 2009
 - Multiple Lines of Evidence - ITRC 2007
 - Consistent with EPA 2002 Draft Guidance
- **Decisions to be Risk Based**
 - Determine Legal Drivers (Consult Legal)
 - Requires site characterization (Systematic Planning, DQOs)
 - Conceptual Site Model (Contaminant, Pathway, Receptor)
 - Exit Strategy (Appropriate Approach)
 - Mitigation vs Remediation (Feasibility and Life Cycle Cost)
- **Trichloroethylene Primary Chemical of Concern**
 - Pending IRIS update - use Tier 3 toxicity value from Cal EPA
 - Manage TCE VI Inhalation at 10^{-5} , cancer risk
 - CALEPA unit risk value (IUR) of $2.0E-06(\mu\text{g}/\text{m}^3)^{-1}$ action decisions at $12 \mu\text{g}/\text{m}^3$





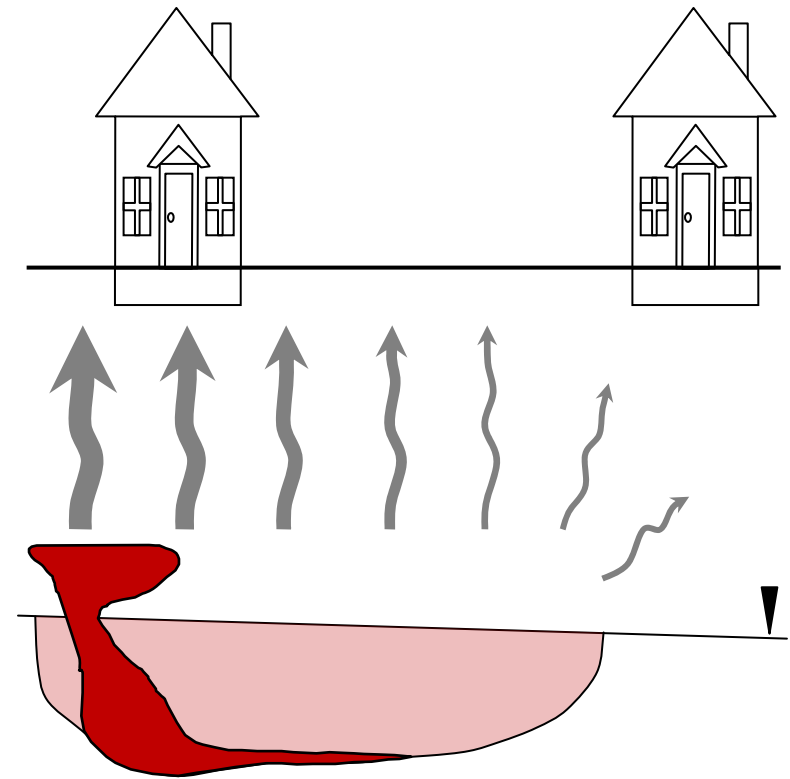
Air Force Approach to Vapor Intrusion

- **Multiple lines of evidence approach following ITRC (2007) and DoD (2009) Guidance**
 - **Current Building within 100 ft**
 - **Future Building (Model the potential exposure – Address in design)**
- **Apply residential assessment for plumes off-base in residential areas**
- **Majority of AF sites with VI issues in commercial/industrial settings**
 - **Use Commercial/ Industrial Scenarios (site-specific)**
 - **Experience and data suggest no mitigation needed at majority of non-residential sites**



Multiple Lines of Evidence

- Indoor air data
- Modeling predictions
- Background sources
- Building construction
- Geology – soil type, porosity
- Sub-slab data
- Soil gas data
- Groundwater data
- Constituent ratios
- Building condition
- Spatial distribution
- Temporal pattern





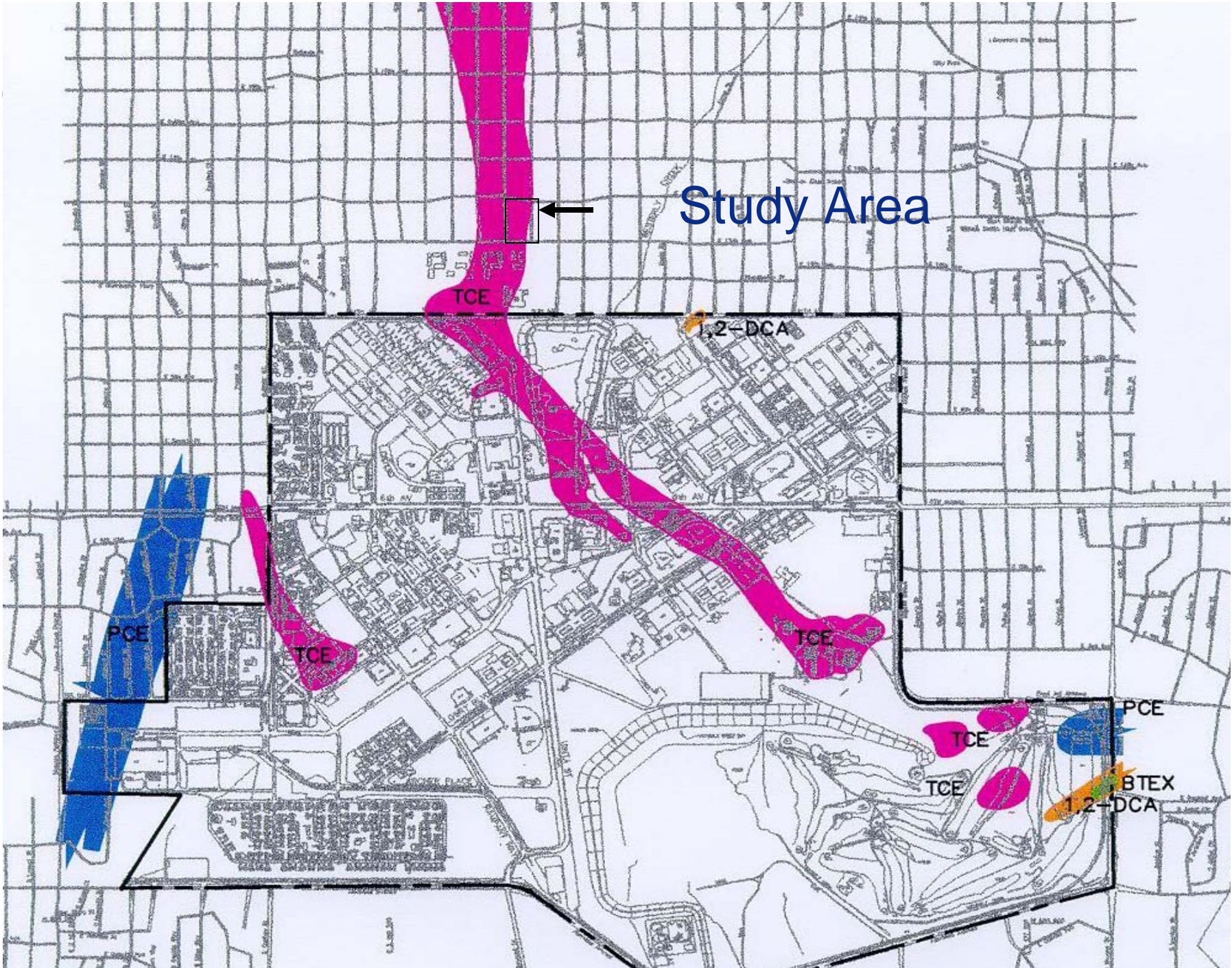
AF Case Study – Lowry AFB



Methods of Investigation

- Indoor air samples
- Substructure air or soil gas samples
- Outdoor air samples
- Groundwater samples

Study Area



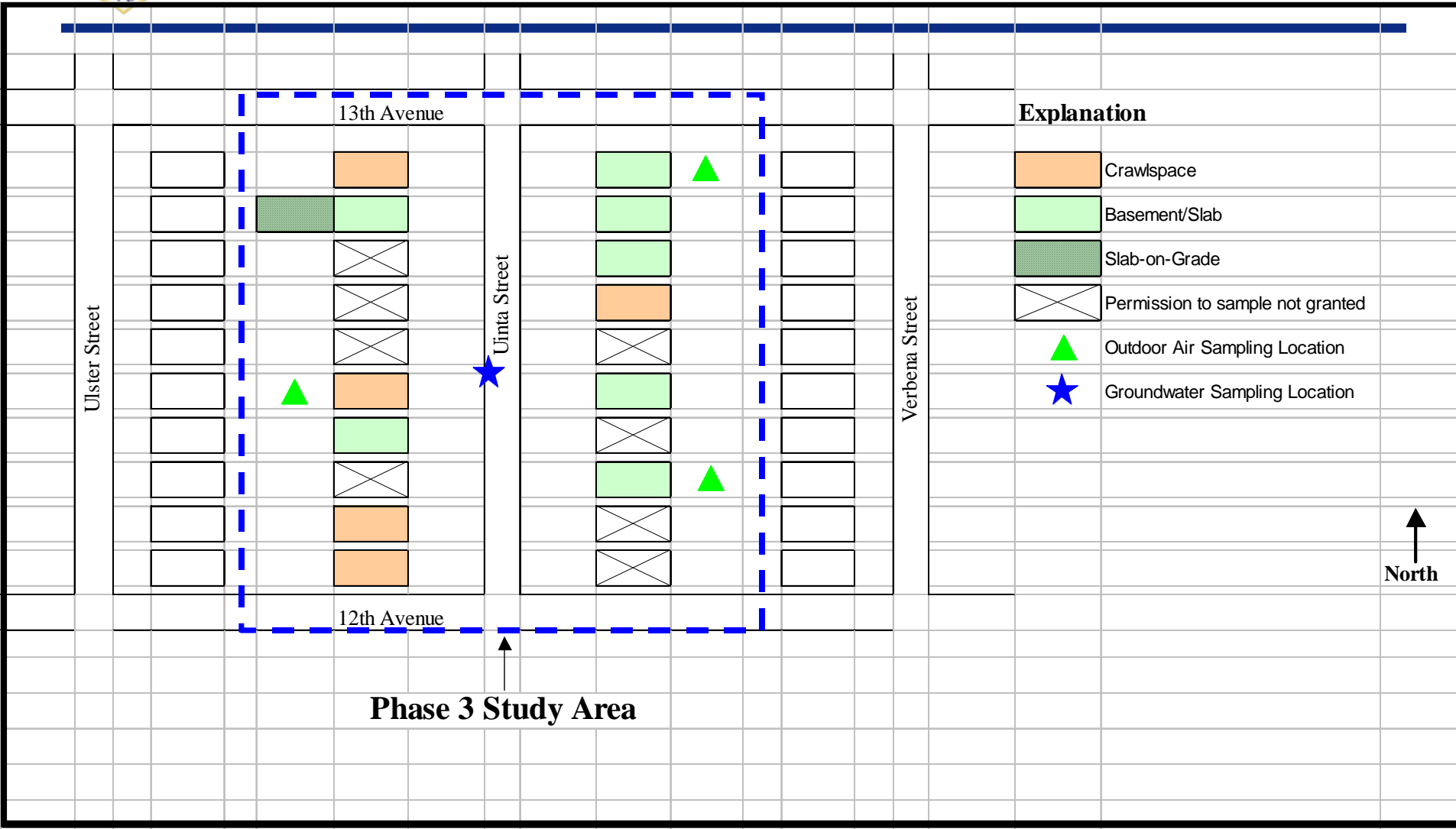


Background Information

- **Previous investigations**
 - **Heritage Estates--system installed**
 - **OU 5 RI--high soil gas concentrations in area**
- **Conceptual Model**
 - **Variable house construction**
 - **Seasonal climate changes**
 - **Subsurface conditions**



Sample Location Map





Sample Types

- **Indoor Air Samples**
 - Summa canisters (Method TO-15)
 - One sample every 2 months for one year
- **Crawlspace Air Samples**
 - Summa canisters
 - Centrally located; 18 inches above ground
- **Subslab Soil Gas**
 - Collected at end of indoor air study
- **Groundwater**
 - MWOB21, centrally located in study area
 - Results used for J&E modeling



Results

- **Higher concentrations in subslab soil gas than in crawlspace air (100-1000 times)**
 - **Also higher attenuation factors when compared to indoor air (VOCs reduced more dramatically)**
 - **No apparent pattern to subslab soil gas concentrations**
 - **Crawlspace air TCE concentrations generally decreased through summer and early fall**
- **Indoor air does show pattern--higher in cool months, lower in warmer months**



Results (cont)

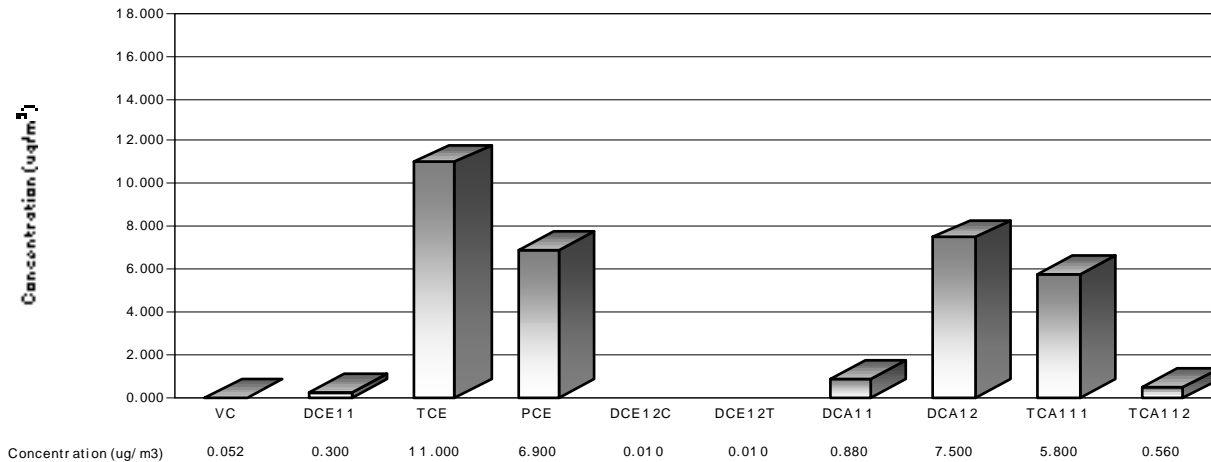
- Indoor air TCE concentrations comparable
- Two houses exceeded CDPHE target risk level (1E-5)
- However, one residence discounted
 - Indoor air contributing sources; not from groundwater
 - One chemical higher in home than crawlspace



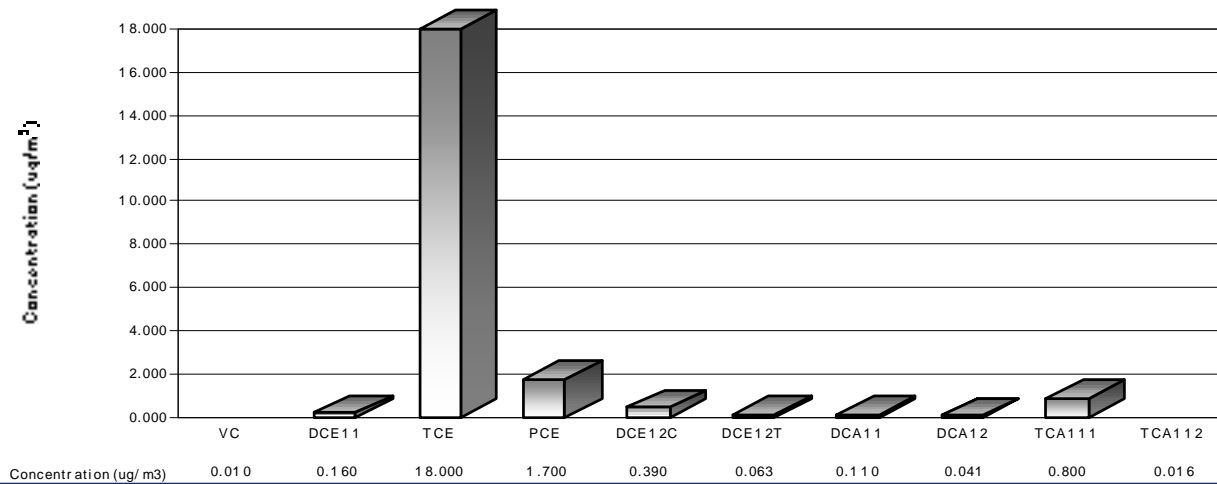
Event Specific Data Charts

Evidence for an Indoor Air Contributing Source

Indoor Air



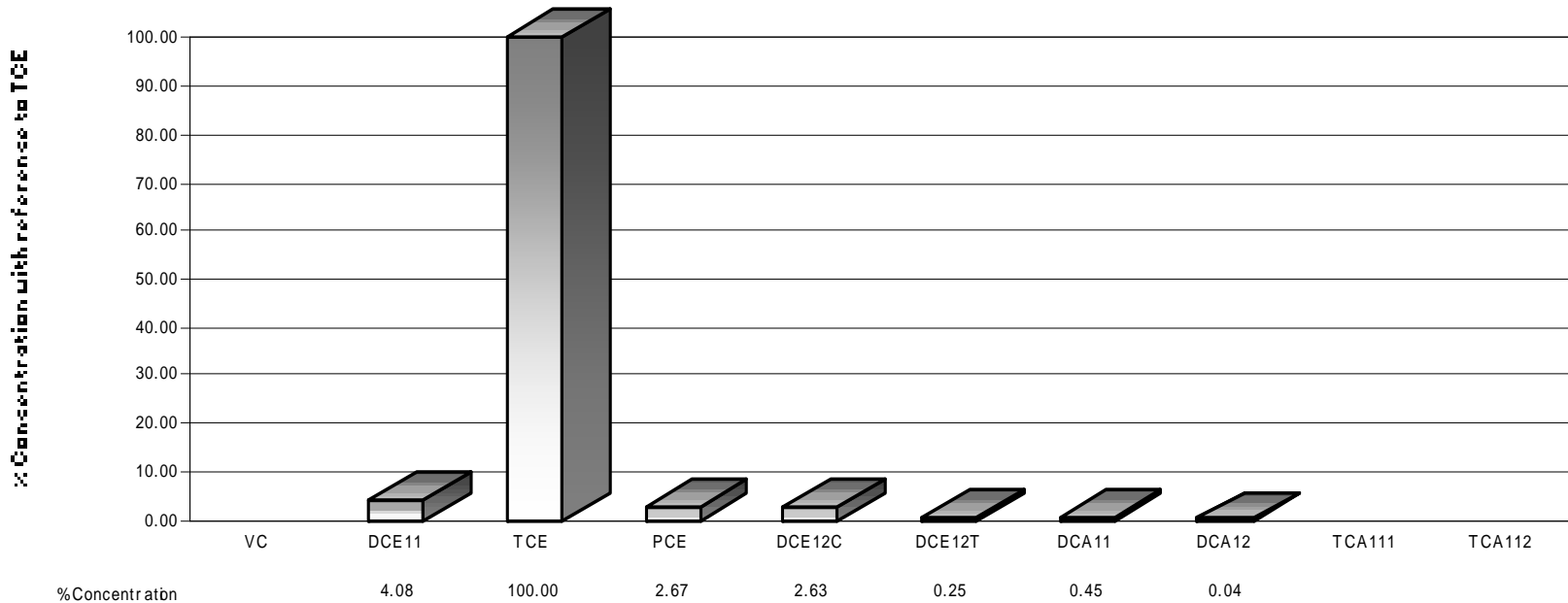
Subfloor Soil Gas





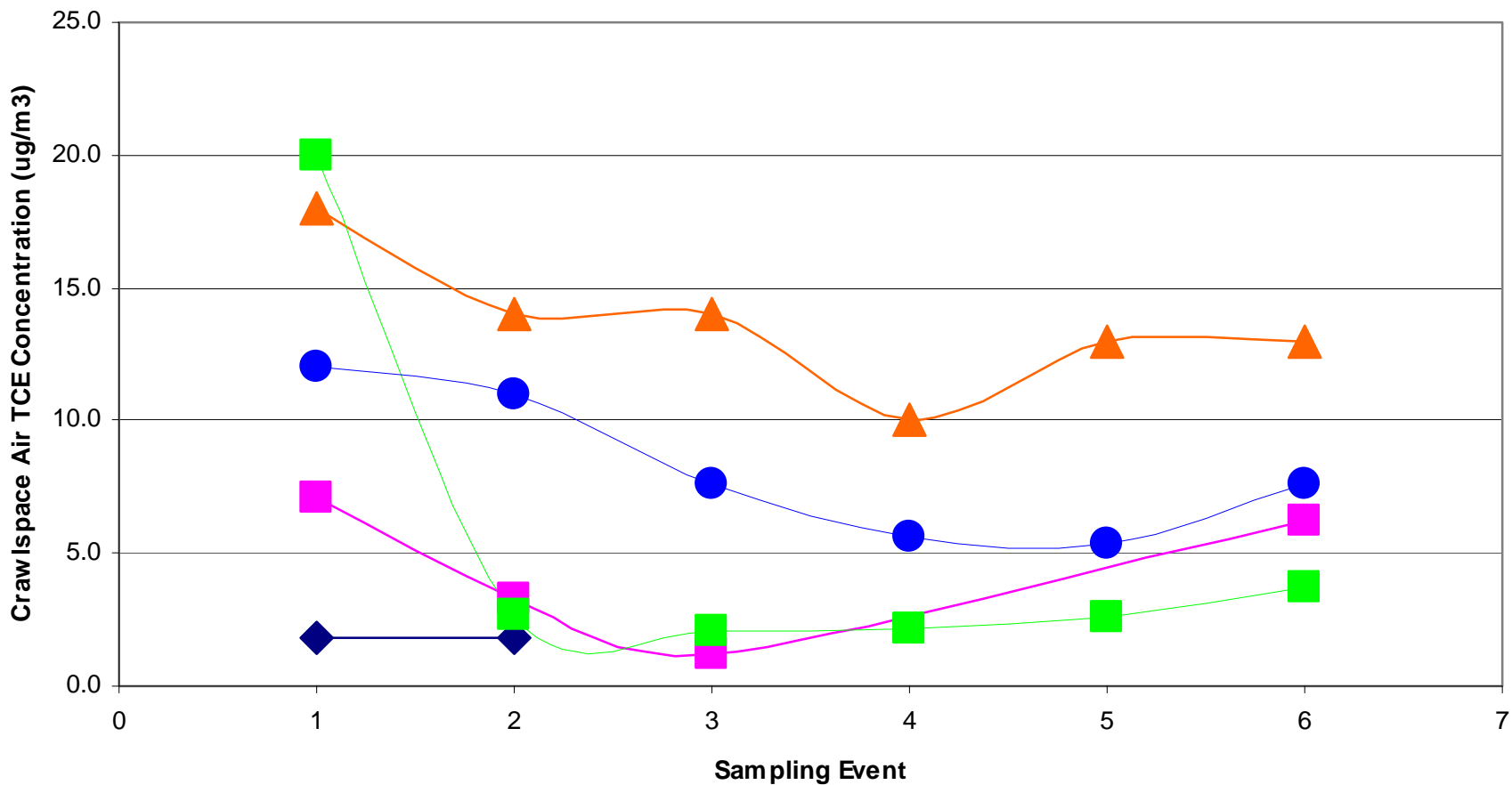
Relative Concentrations Predicted using Groundwater Data and the J & E Model

The Johnson and Ettinger (1991) Model



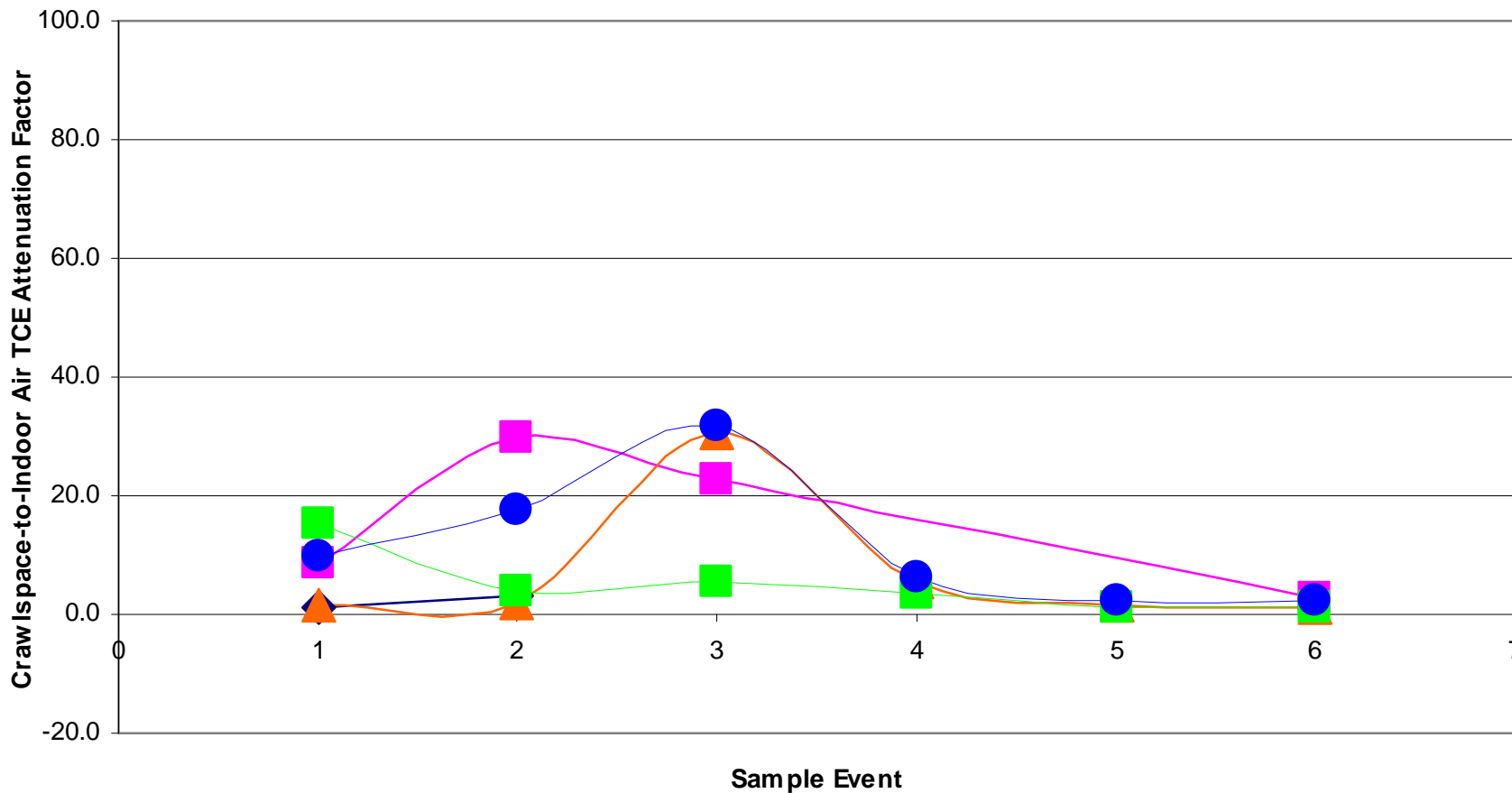


Crawlspace Air TCE Concentrations



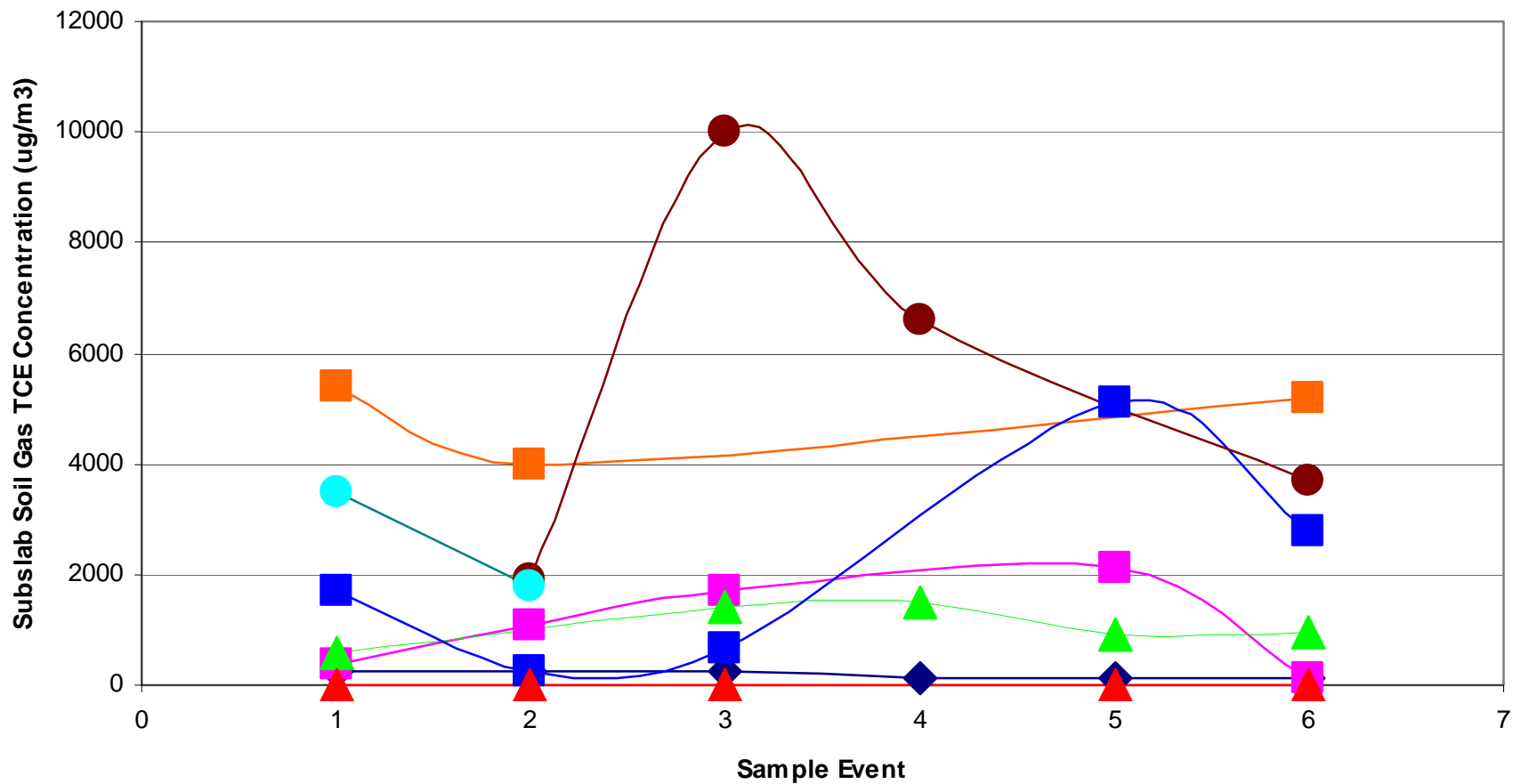


Crawlspace – Indoor Air TCE Attenuation



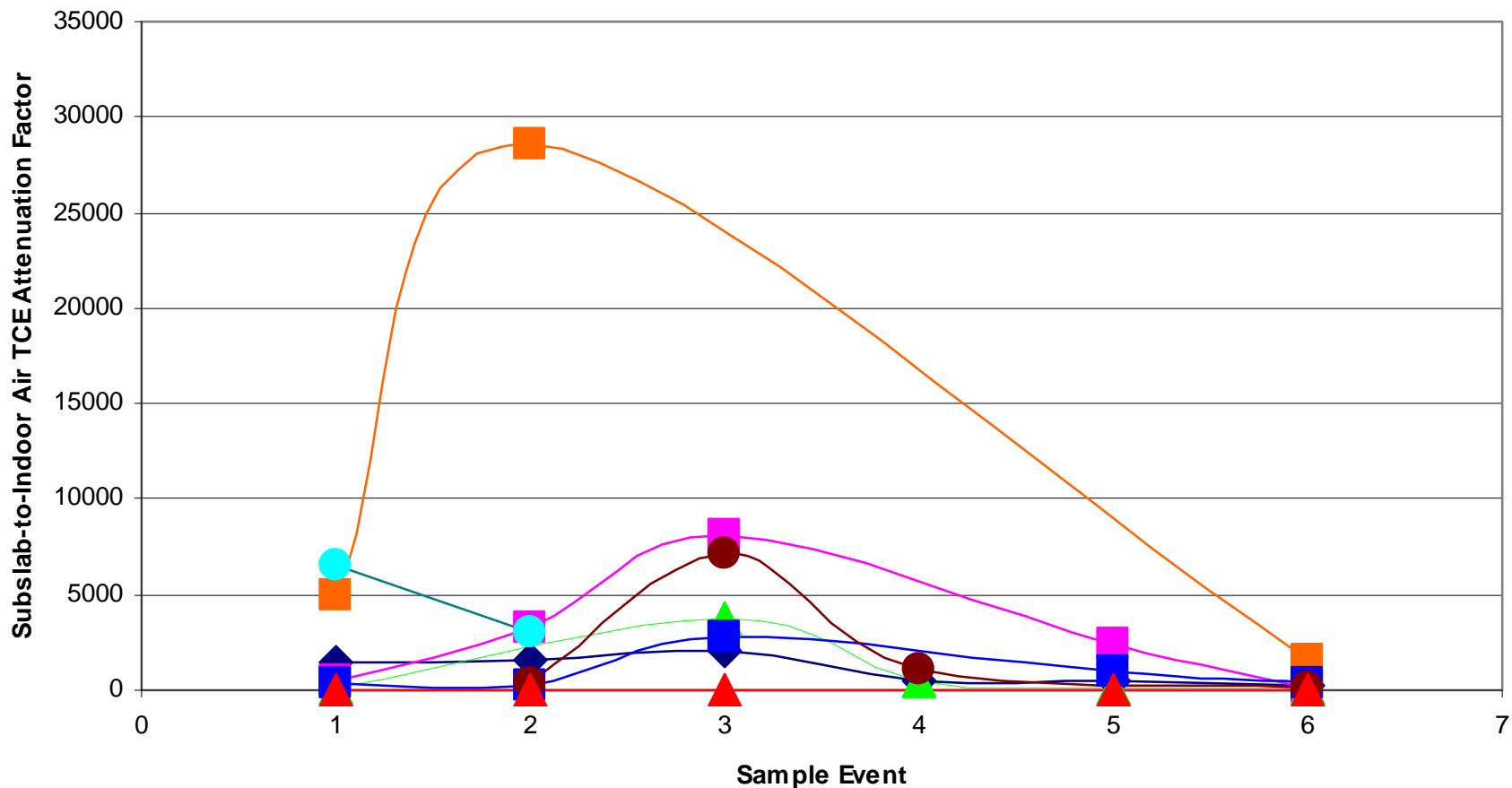


Subslab Soil Gas TCE Concentrations



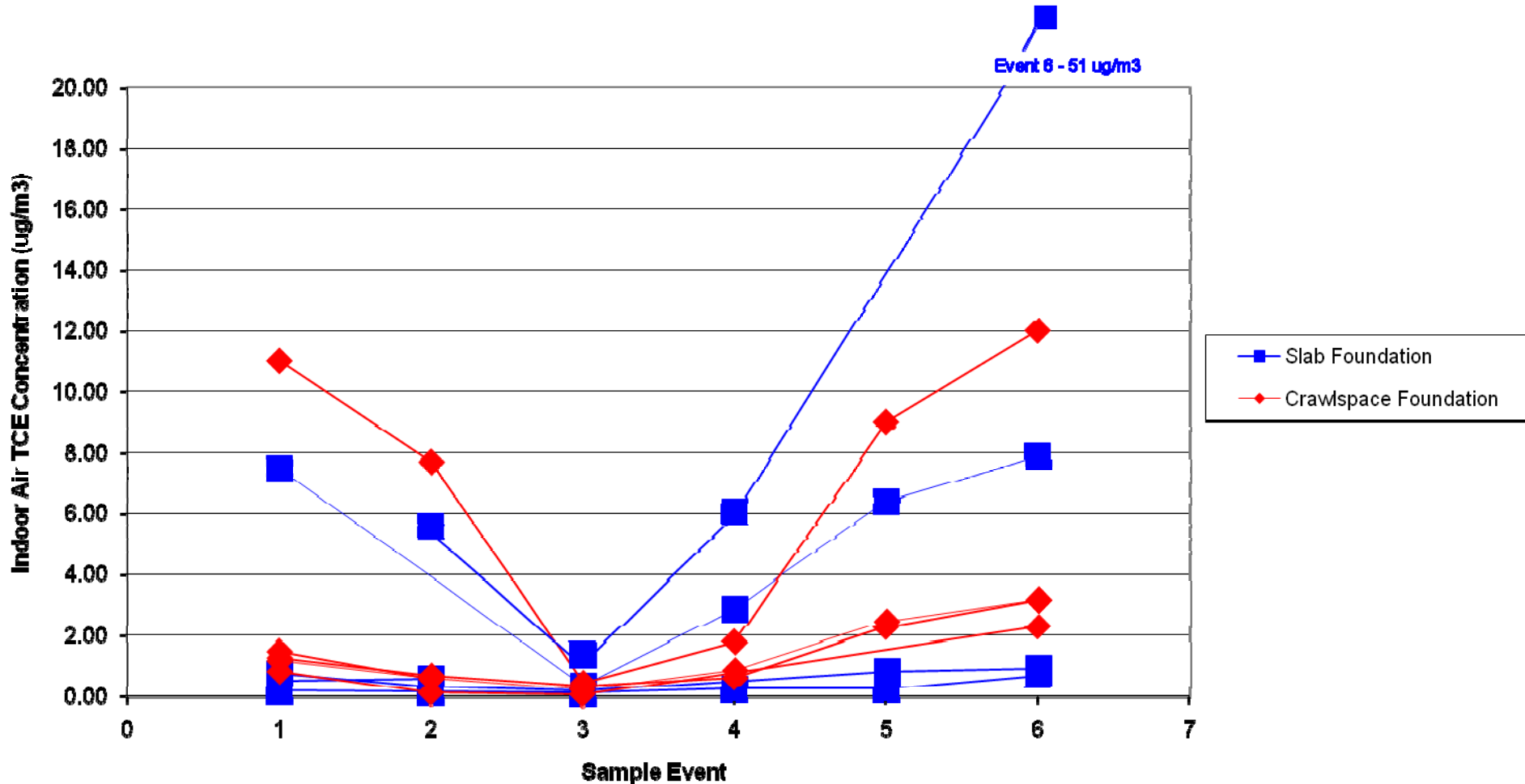


Subslab – Indoor Air TCE Attenuation





Indoor Air TCE Concentrations





Case Study Conclusions

- **Target risk level for indoor air exceeded at one home**
 - Remedial action required by state
 - Active subslab depressurization system installed
- **Only 13 of 21 homes in study area sampled**
 - Future efforts to contact owners and residents
 - Possible sampling to reduce uncertainty
- **Multiple lines allowed indoor air source to be identified**



Vapor Intrusion Research and Development

Environmental Security Technology Certification Program

■ *Completed & Verified Project*

- Detailed Field Investigation of Vapor Intrusion Processes (ER-0423)

■ *Ongoing Projects (Fact Sheet only)*

- [Application of Advanced Sensor Technology to DoD Soil Vapor Intrusion Problems \(ER-0702\)](#)
- [Protocol for Tier 2 Evaluation of Vapor Intrusion at Corrective Action Sites \(ER-0707\)](#)
- [Development of More Cost-Effective Methods for Long-Term Monitoring of Soil Vapor Intrusion to Indoor Air Using Quantitative Passive Diffusive-Adsorptive Sampling Techniques \(ER-0830\)](#)

AFCEE Broad Agency Announcement

- [Validation of New Tools to Better Manage Vapor Intrusion Liability \(FA8903-09-C-8016\)](#)

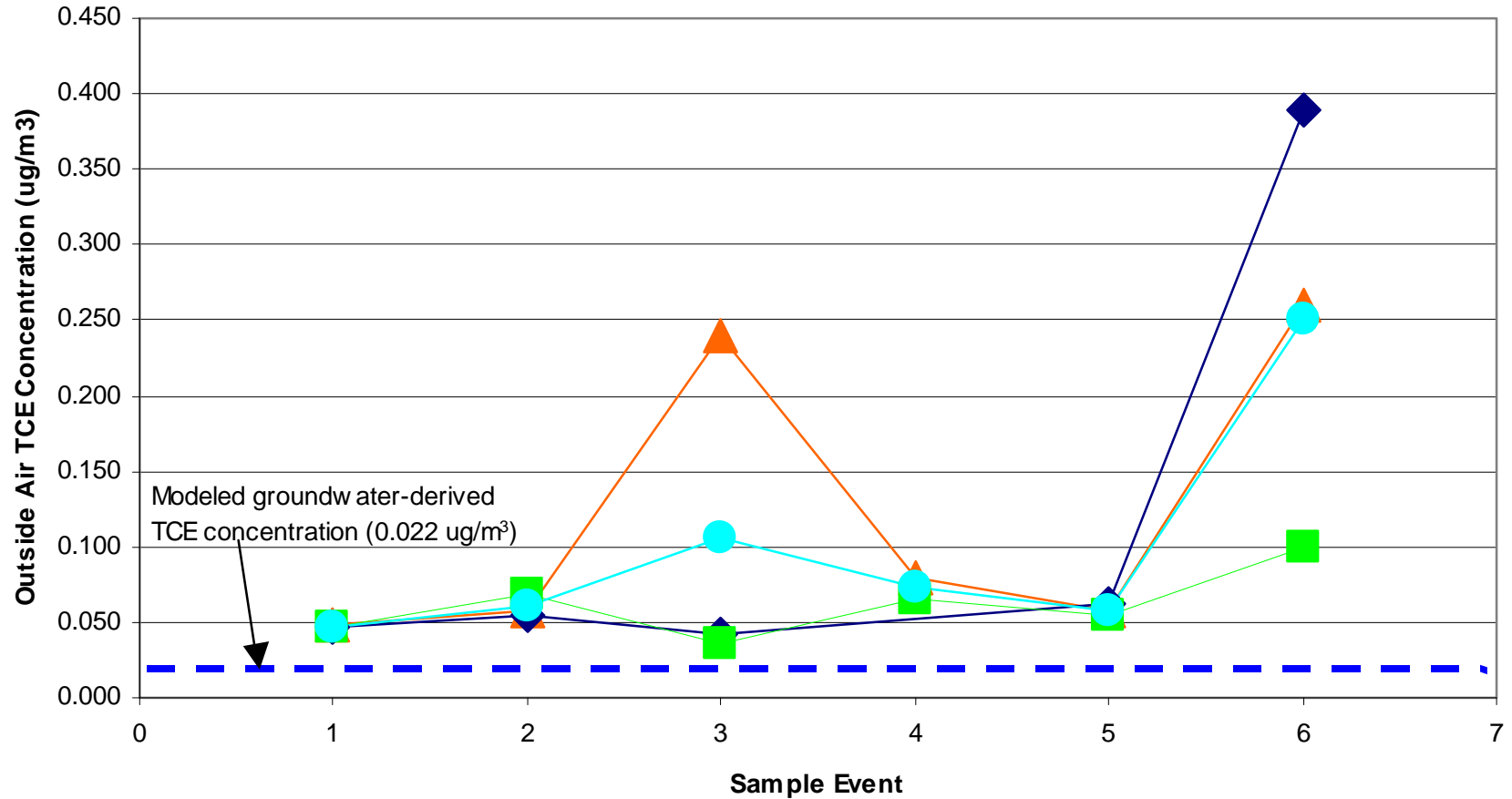


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Questions?



Outdoor Air TCE Concentrations





TCE Concentrations in Groundwater

