

Indoor Vapor Intrusion

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Regulatory Status

- EPA – Promulgated Draft Guidance dated November 2002, final guidance under development
- States – estimated to be 20-25 states that have published or are developing guidance or regulations on vapor intrusion
- EPA Region IV States – none
- ITRC – has IVI work group which has draft guidance under development

Draft EPA Guidance Evaluation Procedure

- Multiple lines of evidence in tiered evaluation with progressive complexity
 - Chemical properties and proximity of site/contamination vapor source to buildings
 - Groundwater contamination and depth information
 - Soil & soil vapor contamination and depth of contamination information
 - Sub slab or crawlspace vapor concentrations
 - Indoor air samples (as last resort)

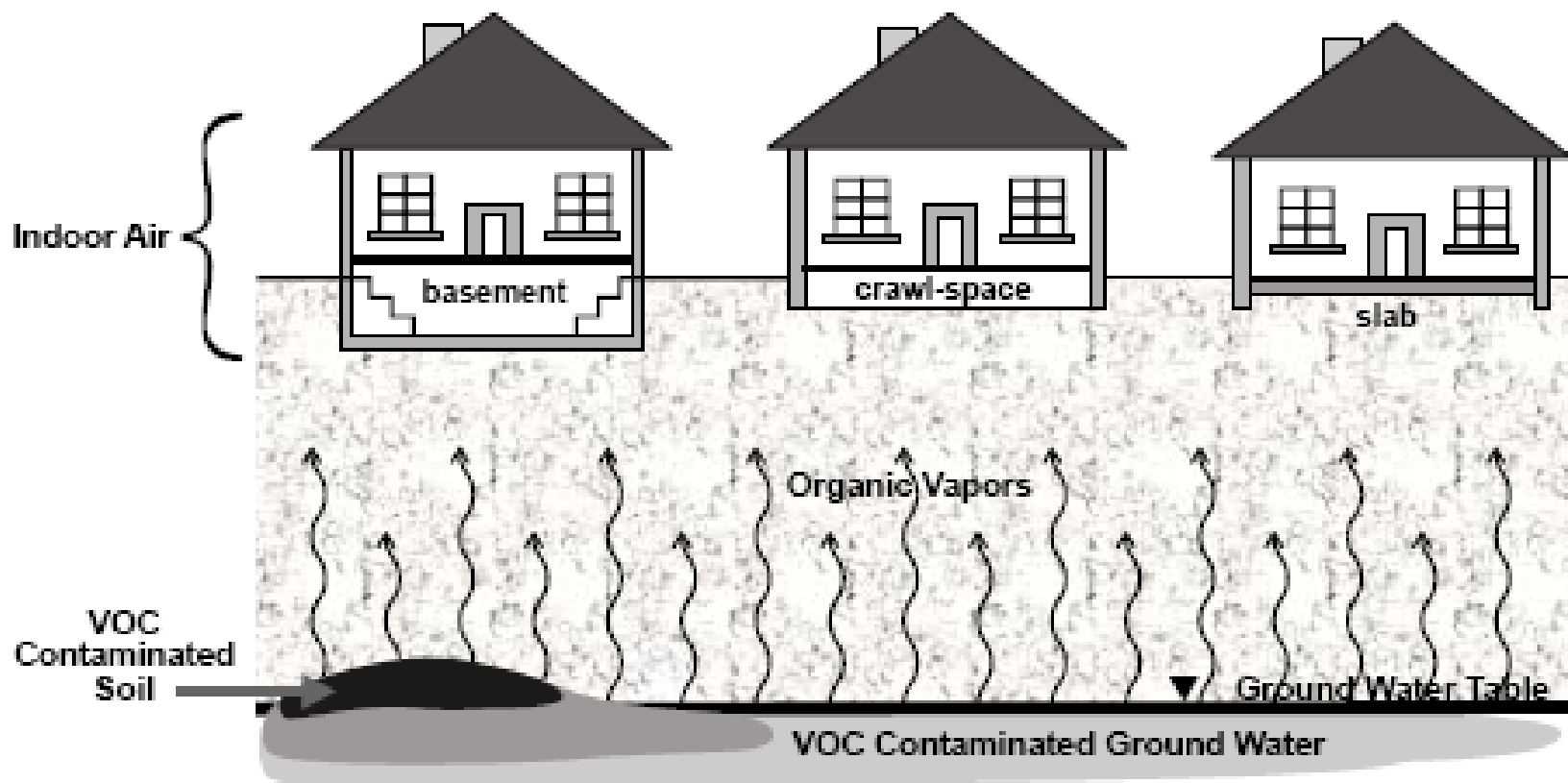


Diagram adapted from USEPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Ground Water and Soils*, November 2002

Procedure of Draft EPA Guidance

- Tier 1- Primary Screening
 - Volatility of chemicals present
 - Toxicity of chemicals present
 - Proximity of site to buildings

Tier 1 – Primary Screening Examples

- Chemical = TCE, sufficiently volatile and toxic so pathway may be complete, proceed to Tier 2
- Chemical = Phenol, sufficiently toxic but not sufficiently volatile so pathway not complete, IVI evaluation completed at Tier 1
- Inhabited buildings within 100 ft vertically or horizontally from vapor source – pathway potentially complete, proceed to Tier 2
- Inhabited buildings are greater than 100 feet vertically or horizontally – pathway incomplete, IVI evaluation complete at Tier 1

Procedure of Draft EPA Guidance

- Tier 2 – Secondary Screening
 - Groundwater or deep soil vapor concentrations
 - Depth to groundwater or soil vapors
 - Proximity to inhabited structures
 - Soil type classification
 - Lookup tables

Tier 2 – Secondary Screening Examples (1×10^{-5} Risk Level)

- PCE in groundwater at 100 ug/L, depth to groundwater = 30 ft., inhabited buildings are above groundwater plume, soil type = loam; Lookup tables indicate pathway incomplete, IVI evaluation concluded
- Benzene in groundwater at 500 ug/L, depth to groundwater = 20 ft., inhabited buildings are above groundwater plume, soil type = loamy sand, Lookup tables indicate pathway may be complete, proceed to Tier 3 evaluation

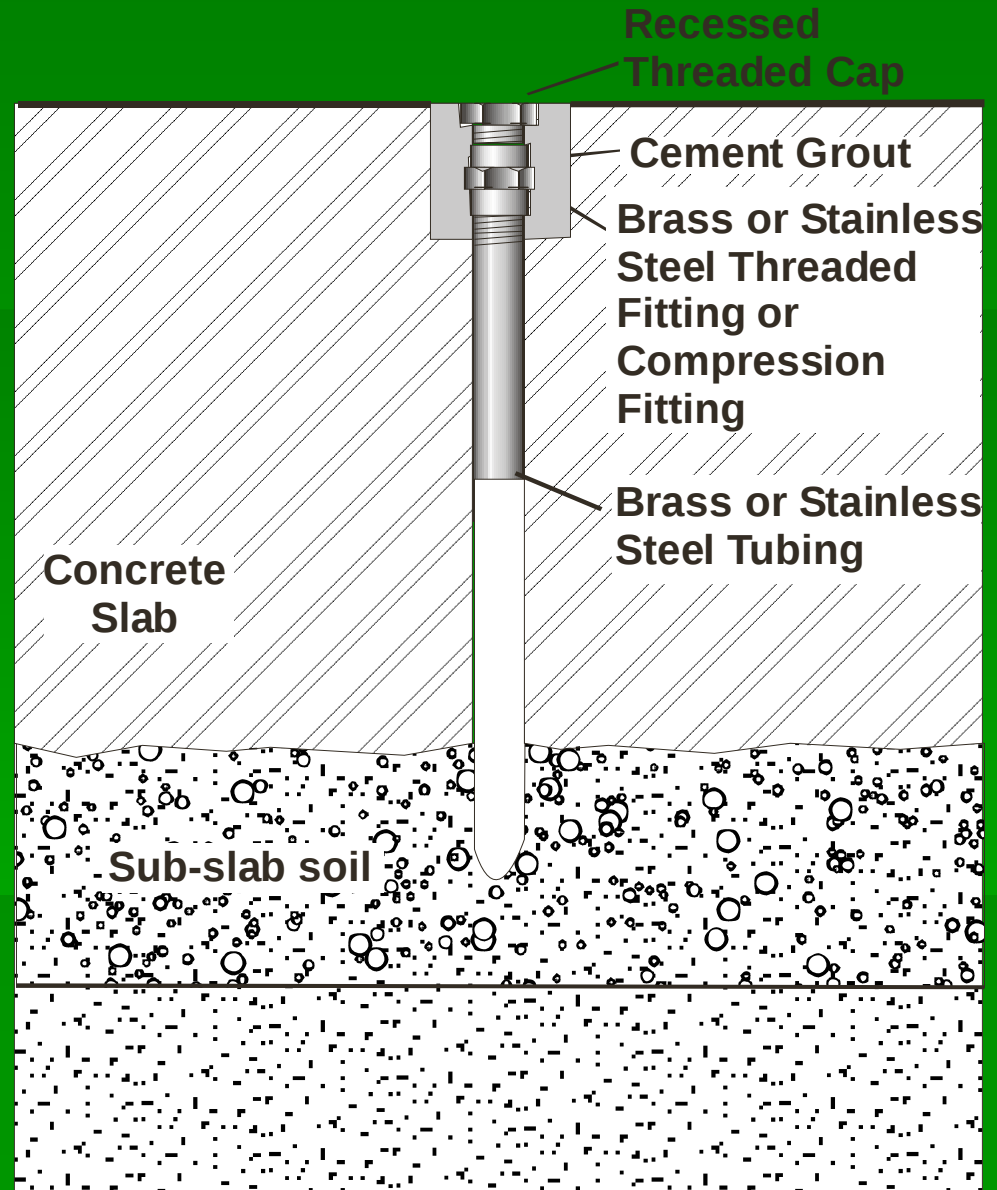
Procedure of Draft EPA Guidance

- Tier 3 – Site Specific Assessment
(affected properties)
 - Identify most-likely-to-be-impacted buildings
 - Collect direct measurements of foundation (sub slab or crawlspace) vapor concentrations
 - Direct measurement of indoor air vapors (don't do it if you can avoid it)



Figure 1. Drilling through a slab

General Schematic for Installation of Sub-Slab Vapor Probes



Completed 3/8" Diameter Hole



Grouted Hole with Vapor Probe



Sampling with Tedlar Bags



Sampling System Using Mechanical Flow Controller and Evacuated Canister



Affect of State Cleanup Procedures on Approaches to IVI Evaluation

- Wide range of site assessment, cleanup and RBCA approaches among the states
- Affected by population density, major source of drinking water, prevailing depth to groundwater and other factors
- Some states allow final closure of sites without significant site assessment info
- Florida requires complete characterization of soil and groundwater prior to closure decisions

Florida Cleanup Procedures

- All sites have soil and groundwater contamination completely characterized & sites are either cleaned up to groundwater standards and residential soil CTLs or need to have institutional controls for final closure
- Florida could potentially require IVI evaluations to coincide with completion of site assessment and remediation/closure decisions for sites currently under site rehabilitation
- Initiate evaluation at advanced Tier 2 level.

Categories of Sites of Possible Concern in Florida

- No Further Action with Conditions (source property buildings may be only concern)
- Long term NAM monitoring (off-site plume could result in off-site IVI potential)
- Eligible program sites with low scores and no assessment or cleanup action currently proceeding

Florida Petroleum Program Evaluation of IVI Potential

- Selected 312 sites with site assessment of soil and groundwater complete
- Screened sites for contaminant concentrations in groundwater, depth to groundwater
- Evaluated both on-site and off-site IVI risk potential
- Made conservative assumptions of soil lithology
- Performed evaluation of IVI potential with EPA procedure and advanced Tier 2 procedure

Evaluation of IVI Potential

- Toluene has 11 times higher screening threshold compared to benzene
- Ethylbenzene has 5 times higher screening threshold compared to benzene
- Xylenes has 160 times higher screening threshold compared to benzene
- Therefore, benzene was the default target chemical of concern for this study

Evaluation of IVI Potential

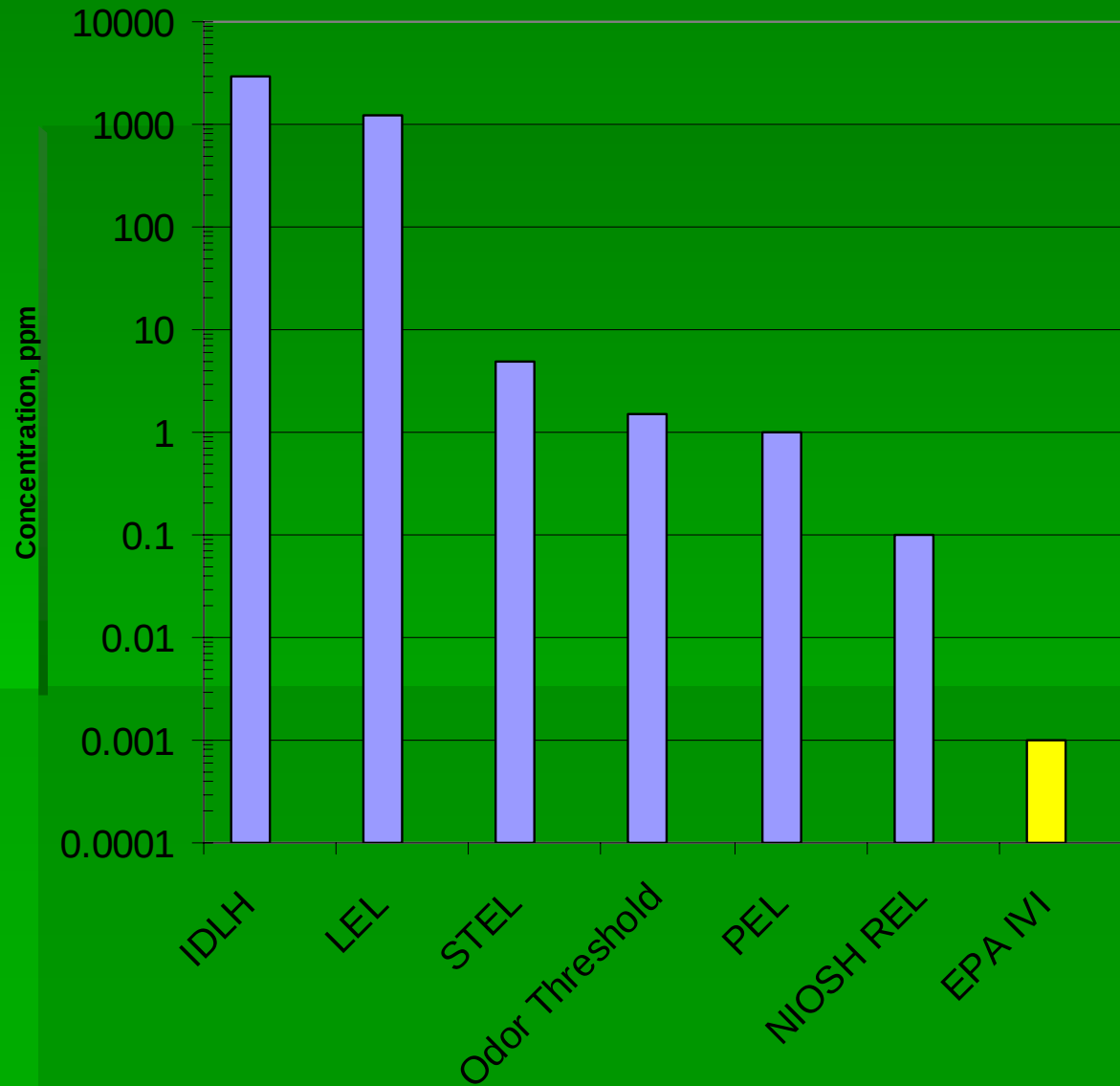
- Results -

- Pathway incomplete for off-site buildings for 93% of sites; 7% of sites in survey had theoretical potential for vapor intrusion in off-site buildings
- Pathway incomplete for on-site buildings for 55% of sites; 45% of sites in survey had theoretical potential for vapor intrusion in on-site buildings
- This does not indicate that buildings at or adjacent to these sites had vapor intrusion problems, but that the next Tier of evaluation might be appropriate for further analysis

Conservative Nature of EPA Evaluation Procedures

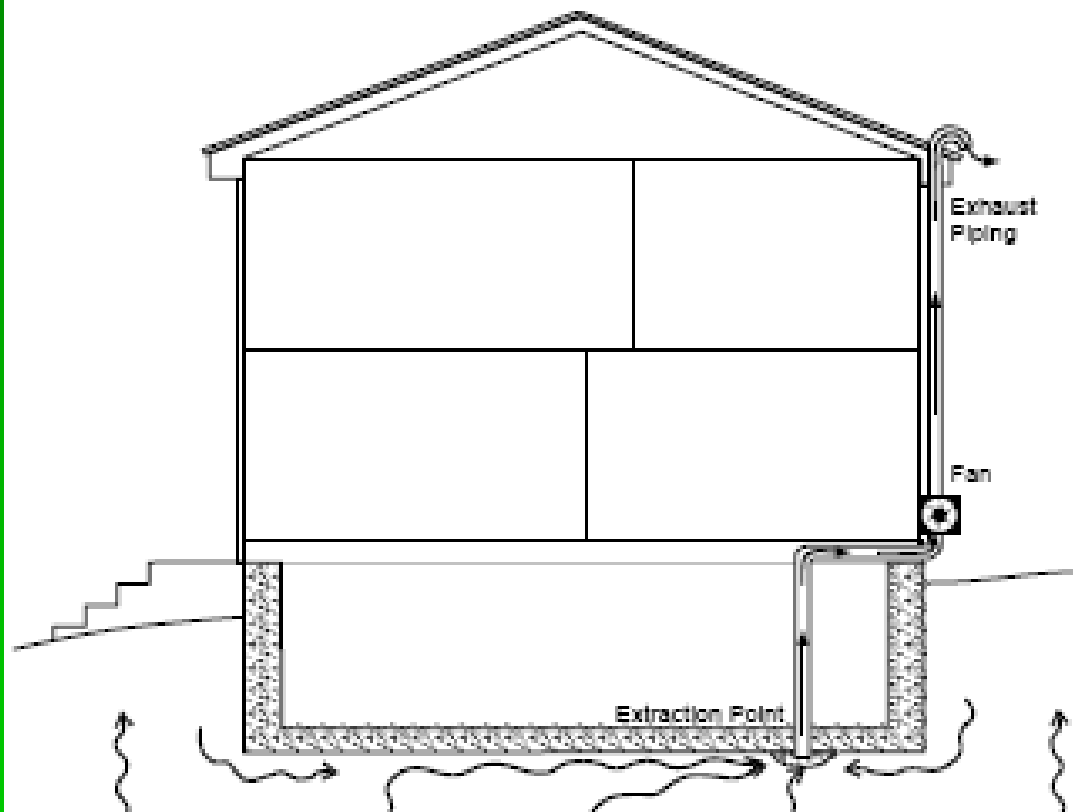
- Bioremediation not considered in attenuation rates
- Conservative assumptions of soil characteristics and homogeneity
- Building foundation type and condition is an important limiting parameter to prevent pathway completion
- Target concentrations are based health affects due to long-term (lifetime) chronic exposure

Indoor Vapor Criteria - Benzene



Interim Mitigation Measures

Foundation Depressurization



A subsurface depressurization system prevents vapor intrusion by directing hazardous vapors in the soil to the exterior of the building.



A subsurface depressurization system fan on the outside of a building.





DWM Indoor Vapor Intrusion Work Group

- Representatives from multiple program areas
 - Bureau of Petroleum Storage Systems (3)
 - Hazardous Waste Cleanup Section (2)
 - Hazardous Waste Regulation Section (1)
 - Site Investigation Section (1)

Indoor Vapor Intrusion Work Group Mission/Objectives

- Evaluate potential significance of vapor intrusion problems in Florida
- Orientation of staff in different program areas on IVI issues
- Develop capability and resources to respond to IVI problems if any are identified
- Development of DWM policy and strategy for IVI evaluation and mitigation

IVI Work Group – Building Foundation Vapor Data Collection Project

- 25 sites in each of petroleum contaminated site and dry cleaner contaminated site cleanup programs to be selected for study
- State cleanup contractors to develop knowledge and capability to perform vapor monitoring
- Task assignments will be issued to collect foundation sub slab vapor samples
- Compare/correlate results with EPA model predictions

Indoor Vapor Intrusion In Summary...

- Literature suggests that significant and widespread problems with vapor intrusion are not likely
- It is prudent for the FDEP to develop a strategy to evaluate the issue and also develop concepts for program technical procedures
- DWM will be performing vapor monitoring at selected sites to better characterize the significance of IVI potential in various contaminated site scenarios
- IVI work group to track the status of EPA draft IVI guidance, ITRC, as well as other states regulations...
- with the intention of making a recommendation for Florida-specific evaluation procedures that best fits our regulatory environment