Vapor Intrusion: Regulatory and Legal Developments

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"GAS PROBLEM? TAKE THIS CUPOLEX AND CALL ME IN THE MORNING."
What Is VI-2002

- Commercial/Industrial Worker:
  - Working over Contamination

- Resident:
  - Living over Contamination
  - Basement or Crawl Space
  - Without Basement

- Sources of Contamination:
  - Indoor Air
  - Unsaturated Soil, Vadose Zone, Soil Gas
  - Soil and Groundwater Contamination
The Middlefield-Ellis Whisman (MEW) Superfund Study Area in Mountain View and Moffett Field, California
CVI EPA Support Documents

- Background Indoor Air Concentrations of VOCs in North American Residences (1990 – 2005)
- EPA VI Database:
- Conceptual Model Scenarios for the VI Pathway
- Indoor Air Vapor Intrusion Mitigation Approaches
- Sampling and Analytical Methods for VI Investigations
- Technical Basis for Selection, Design, Installation and O&M of VI Mitigation Systems
- Vapor Intrusion Screening Levels (VISL) User’s Guide
Other EPA Guidance

- Assessing Protectiveness at Sites For Vapor Intrusion: Supplemental Guidance to the Comprehensive Five-Year Review Guidance (OSWER 9200.2-84)
- Operation and Functional Determination and the Transfer of Fund-lead Vapor Intrusion Mitigation Systems to the State (OSWER 9200-2.72)
- EPA Region 5 Vapor Intrusion Guidebook (Oct 2010)
- Brownfields Technology Primer: Vapor Intrusion Considerations for Redevelopment (March 2008)
Other VI Guidance

- Army Interim Vapor Intrusion Policy (2006)
- ATSDR Evaluating Vapor Intrusion Pathways at Hazardous Waste Sites (2008)
- Navy/Marine Corps Policy on Vapor Intrusion (2008)
- DOD Vapor Intrusion Handbook (2009)
- US Postal Service Vapor Intrusion Guidance (2009)
Dry Cleaners: Not So Clean

- 75% have had releases that have impacted soil or groundwater
- Leading cause of PCE contamination in California is dry cleaners discharging to sewers (Izzo 1992)
- 2nd Common Source of Contaminated Sites in NY
Typical Example of Vapor Intrusion Pathway

1. Partitioning Between Source and Soil Vapor
2. Advection and Diffusion Through Unsaturated Soil and Building Foundation
3. Building Attenuation Due to Exchange with Ambient Air

- Effects of Atmospheric Pressure (Barometric Pumping)
- Oxygen Vapor Migration
- Air Exchange
- Utility Line: Preferential Pathway
- Stack Effects
- Adveotive vapor Flow Cracks/Openings
- Wind Effects

Building

Unsaturated Soil
Affected Soil
Affected Groundwater
Groundwater-Bearing Unit
What is Required For VI

- Source of Vapors
- Pathway To Building
- Entry Routes
- Driving Forces
  - Advection- pressure gradients
  - Diffusion- molecular flow from high to low concentration
Vapor-Forming Chemicals

- Chlorinated VOCs (CVC)
- Petroleum Hydrocarbons (PHCs)
- Mercury
- Radon (from uranium/radium SW)
- Methane from Landfills, pipelines and degrading PHCs
- PCBs
What is a Source?

- Presence of Contamination
  - Soil Gas
  - NAPLs in unsaturated soil or top of water table
  - Dissolved Contaminants in Groundwater

- Sufficient Volatility and Toxicity

- Volatilize under NORMAL temperature and pressures
Common Vapor Intrusion Sources

- **Primary Vapor Sources**
  - USTs
  - Sewers (cracks, joints, breaks) and septic tanks
  - Pipelines
  - Former and Current Landfills
  - HWMUs/SWMUs

- **Secondary Sources**
  - Contaminated Groundwater
  - Sanitary Sewers
Principal Transport Mechanisms

- **Diffusion** - flow from high concentrations (source) to low concentration (surrounding area)
- **Advection** - Bulk movement caused by pressure gradients
- **Phase Partitioning** - transport from one media to another
Numerous Factors Affect Transport Mechanisms

- Source Concentration
- Source Depth and Lateral Distance
- Subsurface Conditions
- Building Design and Operation
- Wind and Barometric Pressure
Source Concentrations

- Higher source concentrations tend to lead to higher soil gas and indoor air concentrations.
- Higher concentrations under slab than at similar depths away from building.
Source Location

- For Shallowest sources (<10 feet)
  - soil gas is 90% of source concentration for basement
  - Soil gas 30%-80% for slab-on-grade
- Deep Sources (>36 feet), soil gas:
  - Foundation scenario is 20%-30% of source
  - Slab-on-grade 10%-20% of source
- Indoor air concentrations more influenced by lateral distance than foundation (e.g., concentrations for shallow sources decrease faster with lateral depth than for deeper sources)
Variable Source Characteristics

- Transport primarily upward when source:
  - At water table
  - Ground surface uncovered

- Transport For Deep Groundwater
  - Lateral Transport More Significant than Vertical
  - Long and narrow
  - May travel over mile

- Soil Gas
  - May extend in lateral directions
  - May be larger than groundwater plume
Influence of Building Conditions

- Openings or Cracks in Foundation
- Building Pressurization—
  - Temperature Differences (Stack Effect)
  - Ventilation (Air Exchange Rate and Air Flow Rate)
  - Exhausting air may depressurize building
  - Increasing more outside air may over-pressurize bldg
- Crawl Spaces
  - Good dilution but does not impede flux
Building Influences

- Perimeter cracks (influences advection)
- Fractures or porous areas in concrete floor due to improper curing
- Conduit penetrations (sewer, water, electrical, floor drains)
- Mobil Homes
- Parking Garages
Subsurface Factors

- Soil Moisture
- Organic Material
- Soil Permeability
- Layering
- Fresh Water Lens
- Ground Cover
- Fluctuating Water Table
2012 EPA VI Initiatives

- Final Guidance For Assessing And Mitigating The Vapor Intrusion Pathway From Subsurface Sources To Indoor Air (CVI Guidance)
- Guidance For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites (PVI Guidance)
- Addition of Subsurface Intrusion (SsI) to the HRS
CVI Guidance

- Moves Away from Tiering Approach
  - Preliminary Assessment
  - Pre-emptive Mitigation?
  - Detailed Investigation

- Emphasizes
  - Empirical Data Rather Than Screening with model
  - Multiple lines of evidence
  - Collection of soil gas near source with less emphasis on data distal to source
  - Soil matrix samples to delineate source

- Lots of Recommendations
CVI Guidance Applicability

- RCRA Corrective Action
  - EI (Current Human Exposure Under Control)
  - RFI/CA
- CERCLA
  - Removal and Remedial Actions
  - Five Year Reviews (FYRs)
  - NPL Scoring
  - Federal Facilities
  - Brownfield Development
Applies to ALL Building Uses

- **Residential**
  - Single-family, mobile homes, multi-family

- **Non-Residential**
  - Schools, libraries, hospitals

- **Commercial**
  - Hotels, office, retail, warehouses

- **Industrial**
Non-Residential Considerations For Determining if Sampling Warranted

- Contact Owners/Tenants For Site-Specific Info
  - Occupants (workers, visitors, customers, suppliers)
  - Chemicals used
  - Training, engineering controls
- Building Design
- Occupant Characteristics (general public, sensitive population, EJ)
- Background Chemicals
- ECs/workpractices in place?
- Document Reasons For No Further Action
- Request Notice of Significant Changes (e.g, building ownership, use, public access, renovation/construction)
Preliminary Assessment

- Assembling Information about building
  - History of operations and chemicals used
  - Odor or health complaints
  - Wet basements
  - Locations and history of nearby buildings for redevelopment
  - Current and reasonably anticipated future land use
  - Location of utilities
  - Identify Data Gaps

- CSM
Identify Conditions Requiring Prompt Action

- **Explosive Conditions**
  - Vapors in conduits, sumps or other subsurface drains exceed 10% of LEL
  - EPA recommends evacuation

- **Health Concerns**
  - Vapor concentrations exceed chronic or acute toxicity values
  - EPA recommends ventilation, indoor air treatment or evacuation
Understand site-specific conditions including:

- Nature of contamination, location and spatial extent
- Location, use and construction of local buildings
- Surface Settings (hydrogeologic and geologic)
- Suspected preferential pathways
- Potentially exposed populations (children, women of child-bearing age, elderly, chronic ill and EJ)
- Potential exposure routes (not limited to inhalation)

Evaluate Data Quality

Preliminary Screening
Detailed Investigation

- Collect and Evaluate Multiple Lines of Evidence to Characterize Vapor Pathway
- Modeling not recommended as only line of evidence
- Identify Indoor Air Screening Tools
- Develop Vapor “Inclusion” Zone
- Characterize Nature and Extent of Vapor Sources
Risk Management Decisions

- More than one round of sampling and several may be required to understand temporal and spatial variability of indoor air concentrations
- Ensure past vapor intrusion decisions supported by current conditions
- If lines of evidence not agree or weight of evidence does not support confident decision, additional sampling or lines of evidence may be necessary
- Considerable scientific judgment may be required to evaluate lines of evidence and decide if pathway complete
- Recommends human health assessment
Screening Distances

- Generally 100 Feet laterally or vertically from boundary of source
- Modify for site-specific inclusion zones
- Beware of Preferential Pathways (Conduits, sewers, hydrogeologic features) that facilitate migration of unattenuated vapors
VISL Calculator

- Identifies Chemicals Prone to Vapors
- Recommended Screening Level Concentrations
- Calculator for Site-Specific Screening Levels
  - User-defined target risk levels
  - Exposure scenarios
  - Medium specific
  - Semi-specific attenuation Factor
Empirical Attenuation Factors

- Based on Database
- 95 Percentile
- Apply Source Strength and Indoor Air Screens to eliminate “background” interference
- Soil Gas AF (50x Bkgd)
  - Residences (basements) 3E-02 (0.03)
  - Residences (slab) 1E-01 (0.01)
### Attenuation Factors Cont’d.

- **Groundwater AF (1000x bgkd)**
  - Fine Soil: $5 \times 10^{-4}$ (0.0005)
  - Coarse Soil: $1 \times 10^{-3}$ (0.001)
  - Very Coarse Soil: $4 \times 10^{-3}$ (0.004)
  - Depth to GW $< 1.5m$: $7 \times 10^{-3}$ (0.007)
  - Depth to GW 1.5-3m: $2 \times 10^{-3}$ (0.002)
  - Depth to GW 3-5m: $2 \times 10^{-3}$ (0.002)
  - Dept to GW $> 5m$: $6 \times 10^{-4}$ (0.0006)
AF

- **Exterior Soil Gas AF (50 x Bkgd)**
  - All residences 3E-01 (0.3)

- **Crawlspace AF (indoor air screen)**
  - All residences 9E-01 (0.9)
Mitigation

- **Temporary Measures**
  - Increasing ventilation, sealing entry routes and treating indoor air

- **Engineering Controls**
  - Active Depressurization Technology (ADT) preferred for Existing Buildings
  - More options for New Buildings
Mitigation O&M

- O&M Plan Manual
  - Routine Inspections
  - Pressure Measurements
  - Air Sampling
  - Alarms

- Provide User Guide to owners and operators
Institutional Controls

- Recommends Use of Institutional Controls Implementation and Assurance Plan (ICIAP)
- Current or Future Use
- Termination/Exit Strategy
  - Identify termination criteria
  - Cleanup levels for source areas for all media
  - Attainment period when mitigation system turned off
  - Site-specific monitoring data for passive mitigation systems
Institutional Controls for Future Use?
Pre-emptive Mitigation (PEM)

- Prevent or Reduce Vapors Into Building
- Reduce or Eliminate Vapors in Building
- Form of CERCLA “Early Action” or RCRA Interim Action and Site Stabilization

Most suitable for:
- Shallow acquifer
- High-Permeable Soils
- Preferential Pathways (conduits, bedrock fractures)
Petroleum VI (PVI)

- Guidance For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites

- Technical Support Document
  - Petroleum Hydrocarbons And Chlorinated Hydrocarbons Differ In Their Potential For Vapor Intrusion (March 2012)
  - EPA’s Petroleum Vapor Intrusion Efforts Q/A (May 2011)
Petroleum VI Guidance

- RCRA Subtitle “I” USTs
- Excluded: Petroleum Releases from Petroleum Bulk Storage Terminals, Refineries, ASTs and Pipelines
- LUSTF may not be used to assess or cleanup non-UST or non-PHC contaminants (MTBE, TBA, TEL, TML, EDB, DCA)
Recommended Approach

- Assess and Mitigate Immediate Threats
- Conduct Site Characterization
- Develop Conceptual Site Model (CSM)
- Delineate Lateral Inclusion Zone
- Identify Preferential Transport Pathways
- Determine Vertical Separation Distance For Each Building within Inclusion Zone
- Mitigate As Appropriate
Lateral Inclusion Zone

- Area surrounding contaminant mass where petroleum vapors may migrate.

- Properties outside zone may be excluded unless:
  - Preferential transport
  - Extensive Impermeable Cover Impeding Biodegradation
  - Inhospitable soil conditions (e.g., dry soils, high organic content)
PVI-Lateral Distance
Vertical Separation Distance

- Thickness of “clean”, biologically active soil
  - 95% attenuation of benzene vapors below thresholds of concern
- Measured from lowest point of the overlying building (foundation, basement or slab) and historic water table
- Based On Site-Specific Observations On Effectiveness of Biodegradation
- No “generic” vertical separation distance
No Further Investigation

- **Vertical Separation Distance 6 or more feet**
  - GW has no more 5 mg/l Benzene or 30 mg/l TPH (gasoline); or
  - Soil contamination no more 250 mg/kg TPH (gasoline) or 10 mg/kg Benzene
  - These are indirect LNAPL thresholds

- **Vertical Separation 15 or more feet**
  - GW has > 5 mg/l benzene) or 30 mg/l (TPH), or
  - Soil is > 10 mg/kg benzene or 250 mg/kg TPH
Sampling Recommendations

- **Sub-Slab**
  - Dissolved GW w/i 6 ft
  - LNAPL w/i 15

- **Exterior Soil Gas and bulk soil sampling**
  - LNAPL w/i 15 to 30 ft
PVI-Vertical Distance

- UST
- Vapors
- Residual or Liquid Phase NAPL
- Dissolved Phase

≥ 15 ft
Impact on Due Diligence

- Revisions to ASTM E1527
- Viability of E2600
VI IS DILIGENCE GAME CHANGE

- Historic Uses
- Urban “Rogue” Plumes
- Old/ RBCA Cleanups (Dry Cleaner Funds)
- Off-site Sources
- School and Day Care Facilities
- Varying State Standards
- Complex Pathway
- Often the Only Completed Pathway
OFF-SITE MIGRATION

- Driving Listing and Re-opener Decisions
- Leading Cause of Litigation
VAPOR INTRUSION LIABILITY

- CERCLA (Removal Actions, UAOs, RI, RD/RA, 5-YR Reviews, HRS?)
- RCRA Corrective Action (EI/HE)
- UST
- State Remedial Programs
- Common Law
- Disclosure Laws
CERCLA and VI

- EPA considering incorporating VI into HRS
  - HRS weighted to drinking water
  - New pathway or incorporate into groundwater or air pathways
- Impact on Listing Decisions?
CERCLA and VI

- Exclusion from Releases:
  - Exposures to persons solely in workplace
  - for claims asserted against employer (workers compensation?)

- 1993 Contaminated Building Guidance
- 1986 Methane Guidance
2002 Guidance-PELs not applicable for indoor air contaminated by releases from the environment

Regions ask for further clarification b/c PELs used at RCRA sites for Human Exposures Under Control EI

OSHA Reportedly Conceded in 2004 That No Authority to Preclude EPA from Taking Action Under CERCLA
CERCLA Continued

- Third Party Defense
  - Due Care Element
  - Precautionary Element

- ILO, BFPP and CPO
  - appropriate care (Pre-emptive Mitigation?)
RCRA

- Corrective Action 3004 (u) and (v)
- Closure (TSDF and Generator)
- Section 3013 AO
- Section 7002
- Section 7003
- Section 3008(h)
- Sub-title I (USTs)
Perhaps More Important Than CERCLA

Low Pleading Threshold
- May be “contributing to”
- May be creating “Imminent and Substantial Endangerment”

Injunctive Relief

Attorney Fees
Primary Jurisdiction

- Asserted in cases with outgoing cleanups
- Most courts are rejecting use with common law claims
- Mixed results in RCRA 7002
Common Law

- Negligence
- Trespass
- Nuisance
- Strict Liability
- Negligent Misrepresentation
- Malpractice
- State Disclosure
Notable 2012 Litigation

- Ivory v International Bus. Machines Corp, 2012 N.Y. Misc. LEXIS 5229 (Sup. Ct.-Broome Cty 11/15/12)
- Forest Park Nat'l Bank & Trust v. Ditchfield, 2012 U.S. Dist. LEXIS 103007 (N.D.Ill. 7/24/12)
- Sisters of Notre Dame De Namur v. Mrs. Owen J. Garnett-Murray, 2012 U.S. Dist. LEXIS 78747 (N.D. Cal. 6/6/12),
2012 Litigation Cont’d.

- Doris Alexander v Exxon Mobil, No. BC435640, Super. Ct-Los Angeles cty 06/06/2012
Other Notable Litigation

- Voggenthaler v Maryland Square LLC (D.NV 7/10)
- Stoll v Kraft (S.D.Ind. 6/10)
- U.S. v. Apex (7th Cir 8/25/09)
- West Coast Home Builders v. Aventis Cropscience; SPPI-Sommersville v TRC Cos. (N.D. Ca. 8/21/09)
Notable Litigation

- Rochester Technology Park (NY VCA)
- Moutenot v DuPont (NJ-Passaic Cty)
- Spear v. Chrysler LLC; First Property Group, Ltd v. Behr Dayton Thermal Products LLC; Martin v. Behr Dayton Thermal Products LLC
- Sher v. Raytheon
Statute of Limitations

  - 20-year old groundwater plume
  - *SOL* not preclude claim because *VI* pathway not known

- Role of newspapers, public meetings for determining when person should have reasonably known of potential exposure

- Federal Commencement Date
Disclosure

- NY Adopted Vapor Intrusion Notification Law
- Common Law Disclosure Obligations
  - Misrepresentation
  - Fraud
  - Negligent Non-Disclosure
Environmental Quality Review

Litigation


- Bronx Committee for Toxic Free Schools v. NYSCA, 2012 N.Y. LEXIS 2742 (10/23/2012)
Useful EPA Websites

- EPA Vapor Intrusion webpage: [http://www.epa.gov/oswer/vaporintrusion](http://www.epa.gov/oswer/vaporintrusion)
- EPA Vapor Intrusion and the Superfund Program (HRS Website): [http://www.epa.gov/superfund/sites/npl/hrsaddition.htm](http://www.epa.gov/superfund/sites/npl/hrsaddition.htm)
- EPA Clean-up Information website for Vapor Intrusion: [http://www.clu-in.org/issues/default.focus/sec/Vapor_Intrusion/cat/Overview/](http://www.clu-in.org/issues/default.focus/sec/Vapor_Intrusion/cat/Overview/)