Vapor Intrusion: A Georgia Regulatory Perspective Update

Presented at the Georgia Air and Waste Management Association Regulatory Update Conference

March 25, 2015

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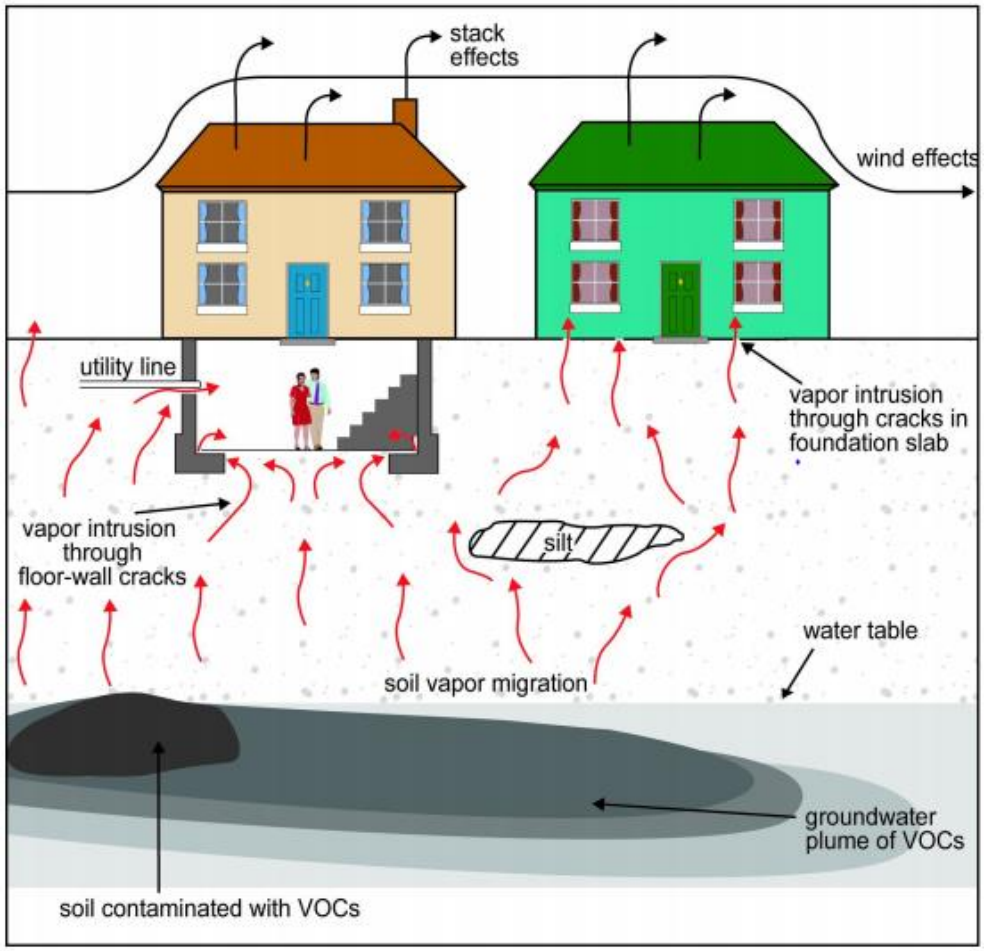
Introduction

- Views expressed in this presentation are those of the presenter and are not necessarily EPD or EPA policy
- Vapor Intrusion (VI) is the migration of volatile chemicals from subsurface contamination into the indoor air of buildings
- VI is an exposure pathway that may be evaluated at regulated sites

Introduction



Source: EPA Vapor Intrusion Webpage

Introduction

- Not a lot of specifics in GA statutes and regulations regarding VI
  - Example: *"[t]he corrective action shall not allow…the accumulation of vapors in buildings or other structures which pose a threat to human health or the environment."* – Rules for Hazardous Site Response Section 391-3-19-.07(4)(c)
- VI evaluations have traditionally been handled on a site-specific basis
- Typically relied on guidance from EPA and others (e.g., ITRC)

Review of VI History

- 2002: EPA Draft VI Guidance
- ‘02-Present: States, EPA Regions, others release various VI guidance
- 2007: ITRC VI Guidance
- 2009: EPA OIG Report recommends that EPA finalize VI guidance
- 2010: EPA review of 2002 Draft VI Guidance
- 2010: ASTM Vapor Encroachment Screening
- 2012: EPA releases technical supporting documents for Final Guidance
- 2013: Updated ASTM Phase I ESA standard
- 2013: EPA External Review Drafts of Final VI Guidance
- 2015: EPA VI Guidance under OMB review

Survey of VI Guidance in Southeast

- AL: VI included in RBCA Guidance (2008)
- FL: Draft Petroleum VI Guidelines
- GA: Workgroup, VI webpage
- KY: Workgroup, VI included in UST guidance
- MS: no state-specific VI guidance
- NC: VI guidance (2014)
- SC: no stand-alone VI guidance
- TN: Workgroup, VI included in UST guidance
- EPA Region 4: relies on recent EPA headquarters guidance (no final Region-specific guidance)

New and Upcoming Documents

- Upcoming: EPA OSWER VI Guidance
  - Includes chlorinated hydrocarbons at CERCLA, RCRA, brownfield sites
  - Additional supporting documents already on VI website
- Upcoming: EPA OUST VI Guidance
  - Petroleum hydrocarbons at UST sites
- New (October 2014): ITRC Petroleum VI Guidance
  - Releases from USTs and other sources
  - Internet-based training available

Petroleum hydrocarbons vs. chlorinated hydrocarbons

- Biodegradation is the key difference

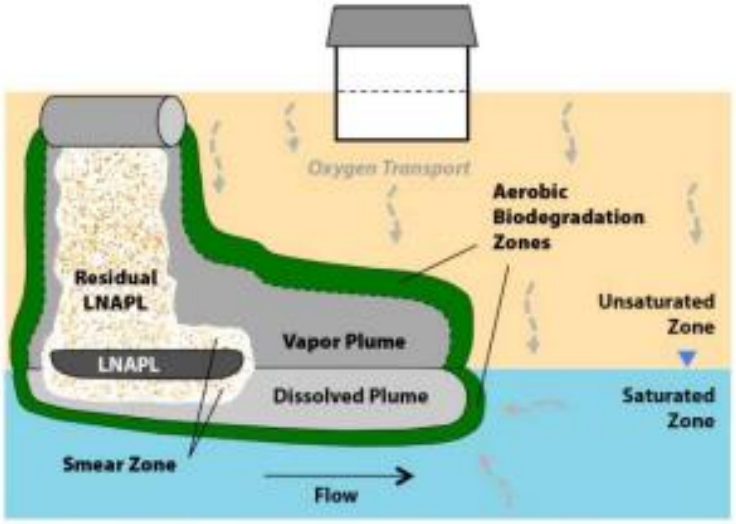


Figure 1. Typical petroleum hydrocarbon transport conceptual scenario

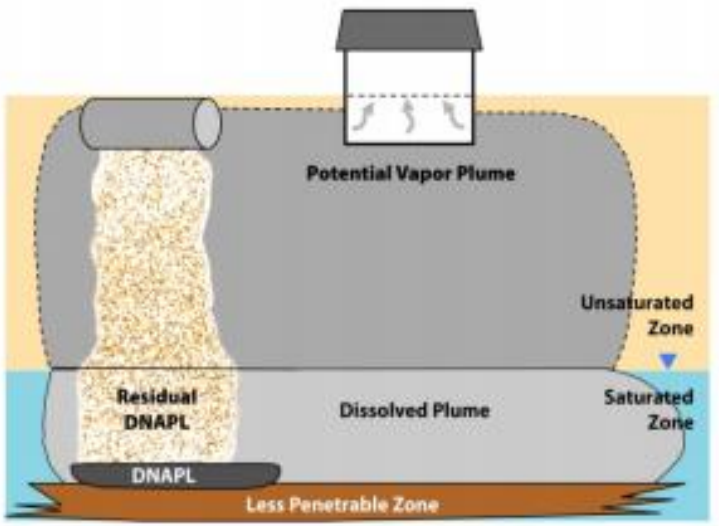


Figure 2. Typical chlorinated solvent transport conceptual scenario

Source: EPA 2012d

EPD Vapor Intrusion Workgroup

- Composed of people from various programs within the Land Protection Branch
  - Shanna Alexander (Risk Assessment)
  - Kevin Collins (HSI and VRP)
  - David Hayes (HSI and VRP)
  - Undine Johnson (UST)
  - Kent Pierce (Brownfields)
  - Amy Potter (DOD Facilities)

EPD Vapor Intrusion Workgroup

Goals:

- Promote discussion among EPD programs that may deal with VI at sites
- Promote consistency when evaluating VI
- Promote the use of current information and methods when evaluating VI
- Recommend information for posting on EPD website to assist stakeholders

EPD Vapor Intrusion Webpage

www.epd.georgia.gov/vapor-intrusion-technical-guidance

2013 External Review Draft of EPA OSWER Final VI Guidance

- Reflects knowledge gained since 2002
- “Multiple lines of evidence” approach
  - General idea: VI pathway is complex, more supporting evidence = more confident decisions
  - Importance of particular lines depends on site-specific factors
  - Not a new concept (e.g., ITRC 2007)
- Attenuation factor updates

Multiple Lines of Evidence: Examples

- Site history / source information
- Site geology / hydrology information
- Building construction
- Groundwater data
- Soil gas data
- Sub-slab data
- Indoor air data
- Outdoor air data
- Comparison of media concentrations (e.g., groundwater) to screening levels
- Preferential pathway assessment
- Tracer data
- Pressure data
- Mathematical modeling
- Data trends

Attenuation Factor (AF)

- Quantifies reduction in vapor concentration from source to indoor air

$$AF = \frac{C_{indoor}}{C_{source}}$$

C_{indoor} = vapor concentration in indoor air

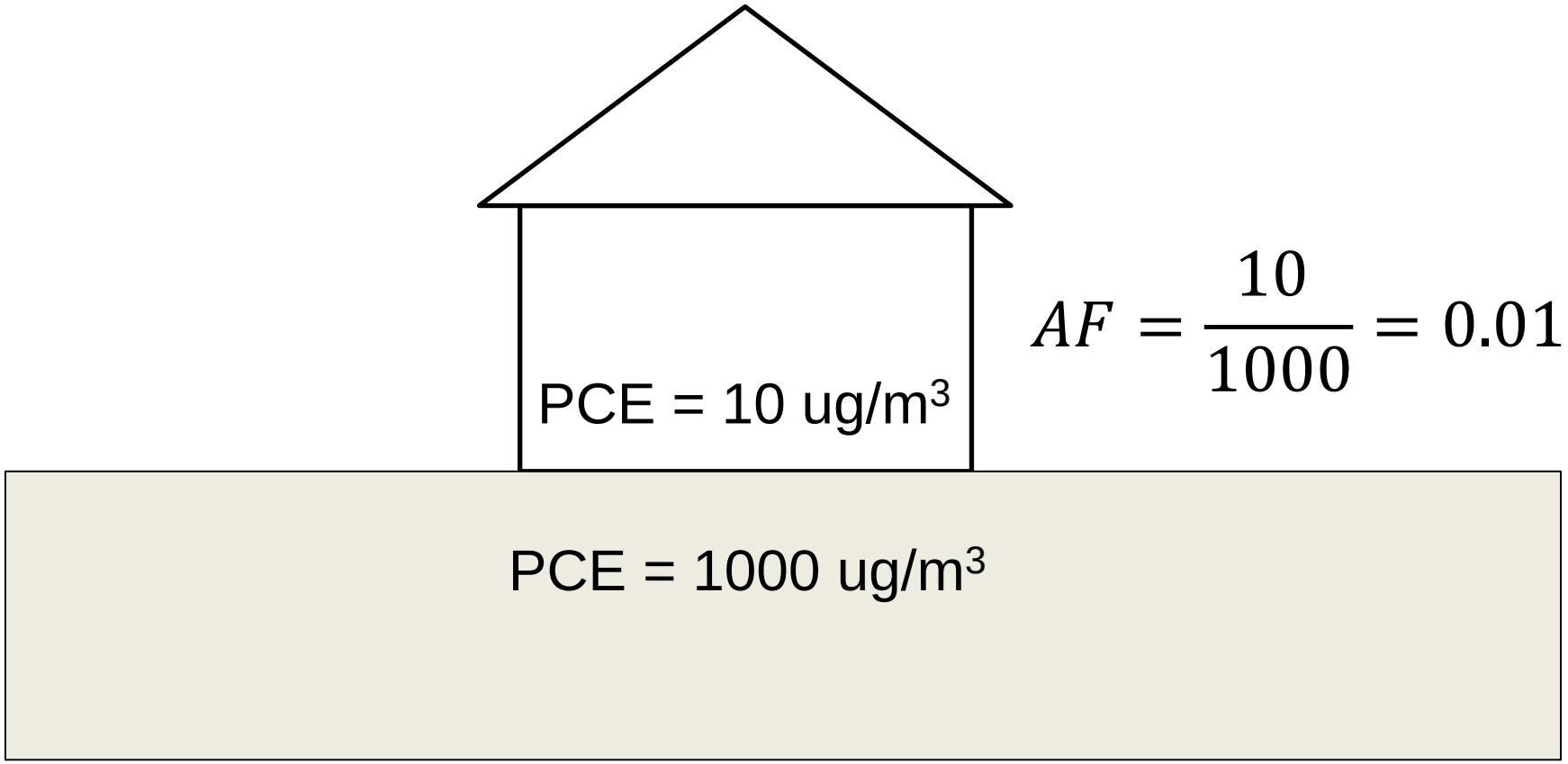
C_{source} = vapor concentration at source

- Used to calculate media screening levels:

$$C_{subslab} = \frac{C_{indoor}}{AF_{subslab}}$$

- Lower AF = more attenuation = higher screening levels
- Can calculate AF using empirical data (e.g., paired indoor air and sub-slab data) or mathematical modeling

Attenuation Factor Example



$$AF = \frac{10}{1000} = 0.01$$

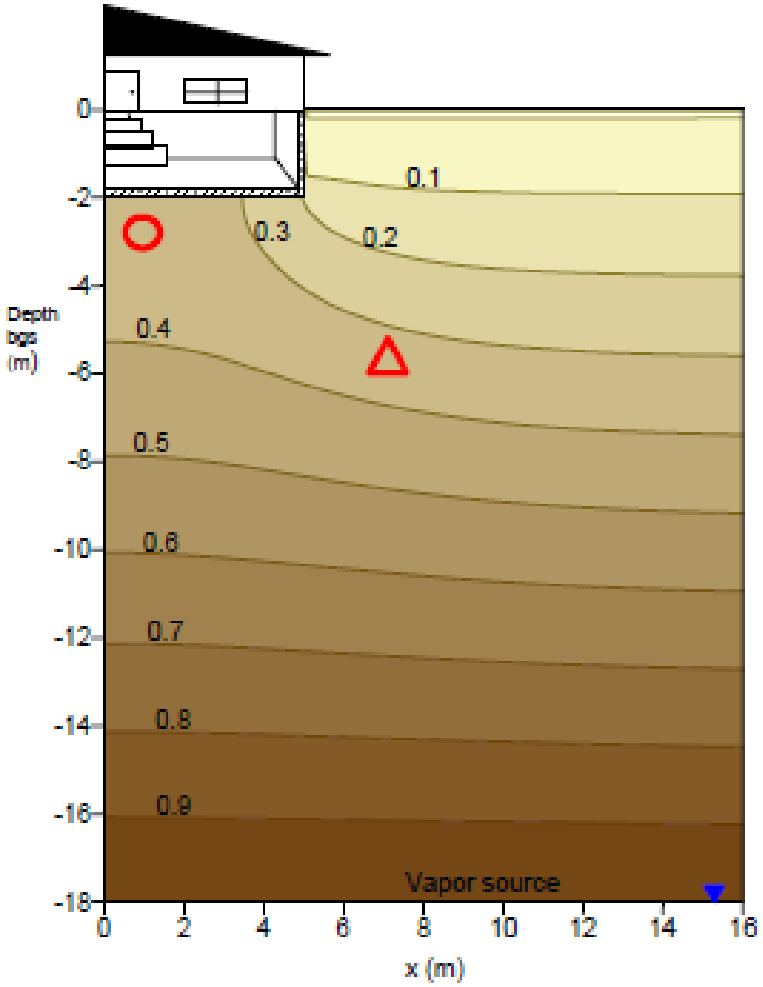
EPA Attenuation Factor Updates: Default

media	2002 Draft	2013 Draft
	AF	AF
sub-slab	0.1	0.03
exterior soil gas	0.1 (<5 ft below foundation) 0.01 (>5 ft below foundation)	0.03 (near-source)
groundwater	0.001	0.001

EPA Attenuation Factor Updates: Semi-Site-Specific

media	2002 Draft		
	AF	factors	source
exterior soil gas	approx. 0.002 – 0.0002	soil type, depth	J & E Model
groundwater	approx. 0.001 – 0.0001	soil type, depth	J & E Model
media	2013 Draft		
	AF	factor	source
exterior soil gas	0.03	---	empirical database
groundwater	0.0005	fine soil type	empirical database

Sub-slab vs Exterior Soil Gas



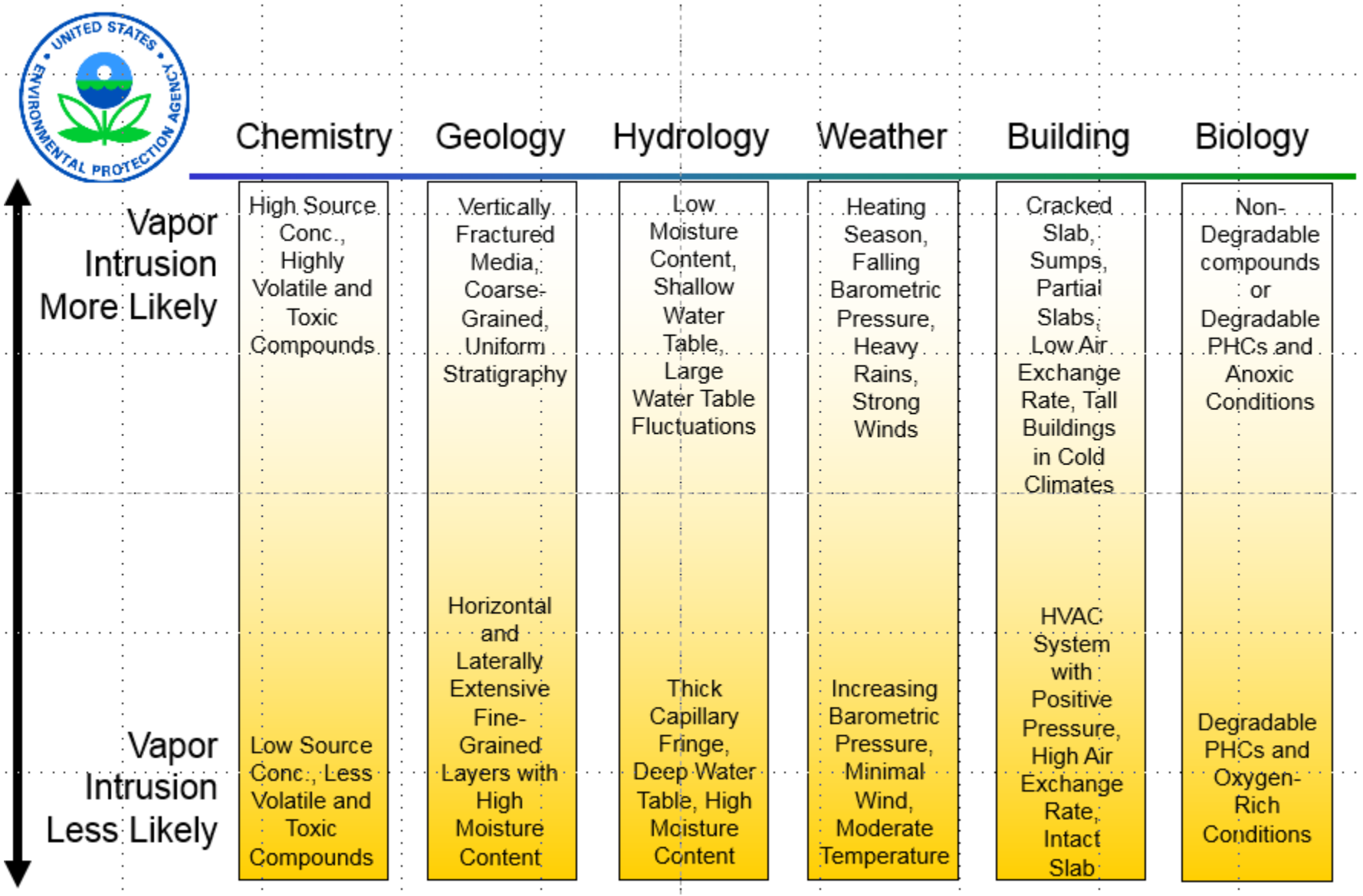
Source: EPA 2012a

Recommendations for Evaluating the VI Pathway in Georgia

- Consult with the EPD site compliance officer
- Develop a conceptual site model for VI
- Support decision-making with recent reference material (e.g., see EPD VI webpage)
- Use EPA Vapor Intrusion Screening Level (VISL) Calculator
- Consider vapor mitigating design with new construction if VI is a concern

Conceptual Site Model for VI

- Examples of important elements
  - Nature and extent of vapor sources
  - Data trends (e.g., groundwater concentrations increasing, stable, or decreasing)
  - Soil lithology
  - Depth to groundwater and flow direction
  - Building use (e.g., residential) and construction information
  - Preferential pathways
- Geologic cross-sections are helpful for visualizing
- CSM is needed to evaluate if screening levels or modeling are applicable

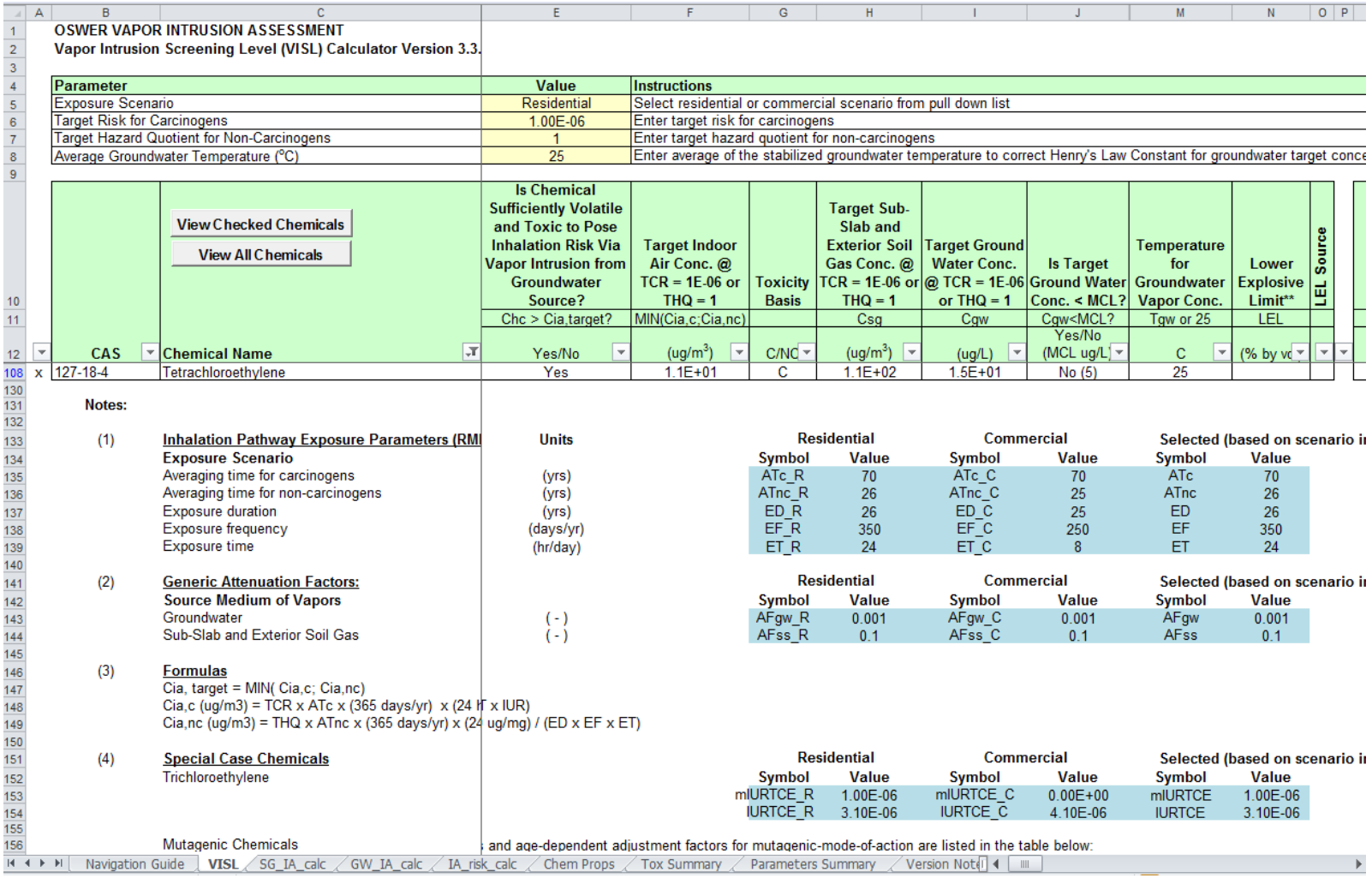


Source: H. Dawson
USEPA

EPA Vapor Intrusion Screening Level Calculator: Overview

- Automated Excel spreadsheet
- Calculate groundwater, soil gas, and indoor air screening levels
- Uses current EPA risk assessment methodology
- Toxicity values updated regularly
- Residential and commercial exposure scenarios
- Attenuation factors (adjustable)
- Groundwater temperature (adjustable)

VISL Calculator



OSWER VAPOR INTRUSION ASSESSMENT
Vapor Intrusion Screening Level (VISL) Calculator Version 3.3.

Parameter	Value	Instructions
Exposure Scenario	Residential	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	1.00E-06	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (°C)	25	Enter average of the stabilized groundwater temperature to correct Henry's Law Constant for groundwater target conce

View Checked Chemicals
View All Chemicals

	CAS	Chemical Name	Is Chemical Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source?	Target Indoor Air Conc. @ TCR = 1E-06 or THQ = 1	Toxicity Basis	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 1E-06 or THQ = 1	Target Ground Water Conc. @ TCR = 1E-06 or THQ = 1	Is Target Ground Water Conc. < MCL?	Temperature for Groundwater Vapor Conc.	Lower Explosive Limit**	LEL Source
			Chc > Cia,target?	MIN(Cia,c;Cia,nc)		Csg	Cgw	Cgw<MCL?	Tgw or 25	LEL	
			Yes/No	(ug/m³)	C/NC	(ug/m³)	(ug/L)	Yes/No (MCL ug/L	C	(% by vo	
x	127-18-4	Tetrachloroethylene	Yes	1.1E+01	C	1.1E+02	1.5E+01	No (5)	25		

Notes:

(1) **Inhalation Pathway Exposure Parameters (RMI**

Exposure Scenario	Units	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario i Symbol	Selected (based on scenario i Value
Averaging time for carcinogens	(yrs)	ATc_R	70	ATc_C	70	ATc	70
Averaging time for non-carcinogens	(yrs)	ATnc_R	26	ATnc_C	25	ATnc	26
Exposure duration	(yrs)	ED_R	26	ED_C	25	ED	26
Exposure frequency	(days/yr)	EF_R	350	EF_C	250	EF	350
Exposure time	(hr/day)	ET_R	24	ET_C	8	ET	24

(2) **Generic Attenuation Factors:**

Source Medium of Vapors		Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario i Symbol	Selected (based on scenario i Value
Groundwater	(-)	AFgw_R	0.001	AFgw_C	0.001	AFgw	0.001
Sub-Slab and Exterior Soil Gas	(-)	AFss_R	0.1	AFss_C	0.1	AFss	0.1

(3) **Formulas**

Cia, target = MIN(Cia,c; Cia,nc)
Cia,c (ug/m3) = TCR x ATc x (365 days/yr) x (24 hr x IUR)
Cia,nc (ug/m3) = THQ x ATnc x (365 days/yr) x (24 ug/mg) / (ED x EF x ET)

(4) **Special Case Chemicals**

Trichloroethylene

	Residential Symbol	Residential Value	Commercial Symbol	Commercial Value	Selected (based on scenario i Symbol	Selected (based on scenario i Value
mIURTCE	mIURTCE_R	1.00E-06	mIURTCE_C	0.00E+00	mIURTCE	1.00E-06
IURTCE	IURTCE_R	3.10E-06	IURTCE_C	4.10E-06	IURTCE	3.10E-06

Mutagenic Chemicals ; and age-dependent adjustment factors for mutagenic-mode-of-action are listed in the table below:

Navigation Guide | VISL | SG_IA_calc | GW_IA_calc | IA_risk_calc | Chem Props | Tox Summary | Parameters Summary | Version Not

Recommended Parameters

Recommended Attenuation Factors:

Medium	Default AF	Semi-Site-Specific AF
sub-slab	**0.03**	**---**
exterior soil gas	**0.03 (near source)**	**---**
groundwater	**0.001**	**0.0005 (fine soil type)**

- Support “fine soil type” with site-specific data
- Target Risk Levels (HSI, VRP, and Brownfield sites):
  - Cancer Risk = 1E-5
  - Hazard Quotient = 1
  - Consider cumulative risks
- Support GW temp. using EPA map or site-specific data

Groundwater Temperature Map

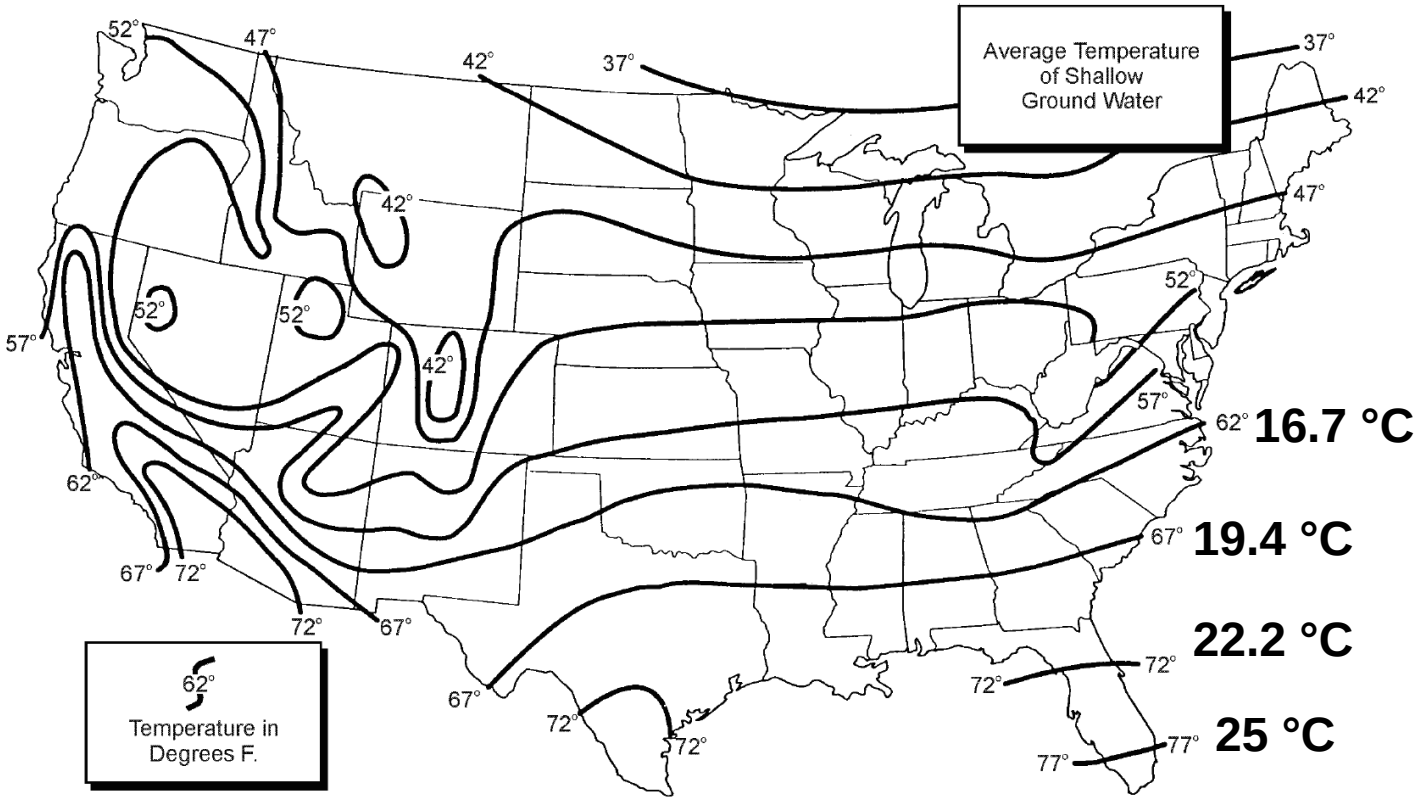


Figure 1. Average Shallow Ground Water Temperatures in the United States

(Adapted from EPA 2001)

Impact of AF and Temperature on Groundwater VISL

Substance	Groundwater Screening Levels (Commercial) (ug/L)			
	AF = 0.001 25 °C	AF = 0.001 20 °C	AF = 0.0005 25 °C	AF = 0.0005 20 °C
PCE	240	320	480	640
TCE	22	28	44	55

Notes:

- Table is provided as an example only (these are not necessarily approved screening levels)
- Calculated using VISL Calculator Version 3.3.1 May 2014
- Commercial exposure assumptions
- Cancer Risk = 1E-5
- Hazard Quotient = 1
- AF = attenuation factor
- PCE = tetrachloroethene
- TCE = trichloroethene

Closing Thoughts

- Evaluation of VI can be challenging for all parties involved (consultants, attorneys, regulators, property owners, etc.)
- VI state-of-practice will continue to evolve
- Stakeholder input is important

References

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EPA. 2002. OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, (Subsurface Vapor Intrusion Guidance). Office of Solid Waste and Emergency Response. EPA 530-D-02-004. www.epa.gov/osw/hazard/correctiveaction/eis/vapor/complete.pdf

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EPA 2013b. Guidance For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites (External Review Draft). April. www.epa.gov/oust/cat/pvi/petroleum-vapor-intrusion-review-draft-04092013.pdf

EPA. 2014. Vapor Intrusion Screening Level Calculator. May. www.epa.gov/oswer/vaporintrusion/guidance.html

Interstate Technology and Regulatory Council (ITRC). 2007. Vapor Intrusion Pathway: A Practical Guideline. VI-1. Washington, D.C.: Interstate Technology & Regulatory Council, Vapor Intrusion Team. www.itrcweb.org/Documents/VI-1.pdf

References Continued

EPA Vapor Intrusion Webpage:
www.epa.gov/oswer/vaporintrusion/

EPA Petroleum Vapor Intrusion Compendium:
www.epa.gov/oust/cat/pvi/index.htm

ITRC Petroleum Vapor Intrusion Webpage:
www.itrcweb.org/Team/Public?teamID=12

GA EPD Vapor Intrusion Webpage:
www.epd.georgia.gov/vapor-intrusion-technical-guidance

Links to Vapor Intrusion Information by State:

- http://www.envirogroup.com/links.php
- http://vapor-intrusion.blogspot.com/

Questions or Comments

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