A Review of Vapor Intrusion Guidelines by State

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Northeast Waste Management Officials' Association (NEWMOA)
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Vapor Intrusion Updates Workshop
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Fri., Sept. 27, 2013, Westford, MA

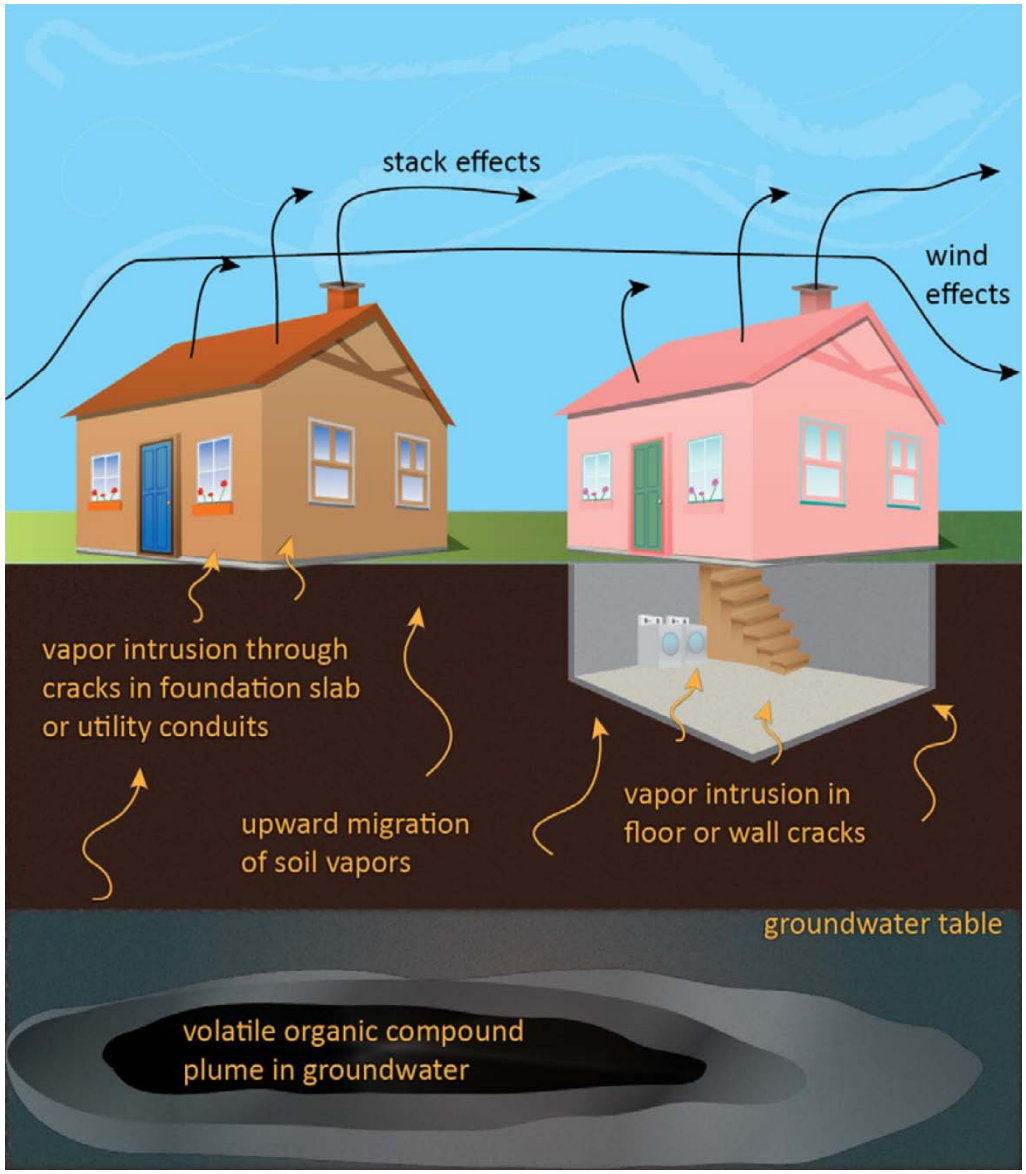
GRADIENT

What is Vapor Intrusion?

- **Vapor Intrusion (VI):** The migration of volatile chemicals from the subsurface into overlying buildings (EPA, draft VI guidance, 2002).

- The **VI Pathway** may pose unacceptable risks of long-term exposure via inhalation of chemicals present in indoor air resulting from VI.

- A **complicating factor** for VI investigations is the common presence of those same volatile chemicals within buildings unrelated to VI ("background levels").



A Brief History of Vapor Intrusion

- 1970s – Primary focus on intrusion of fuel vapors into buildings, potential fire/explosion, and acute effects.

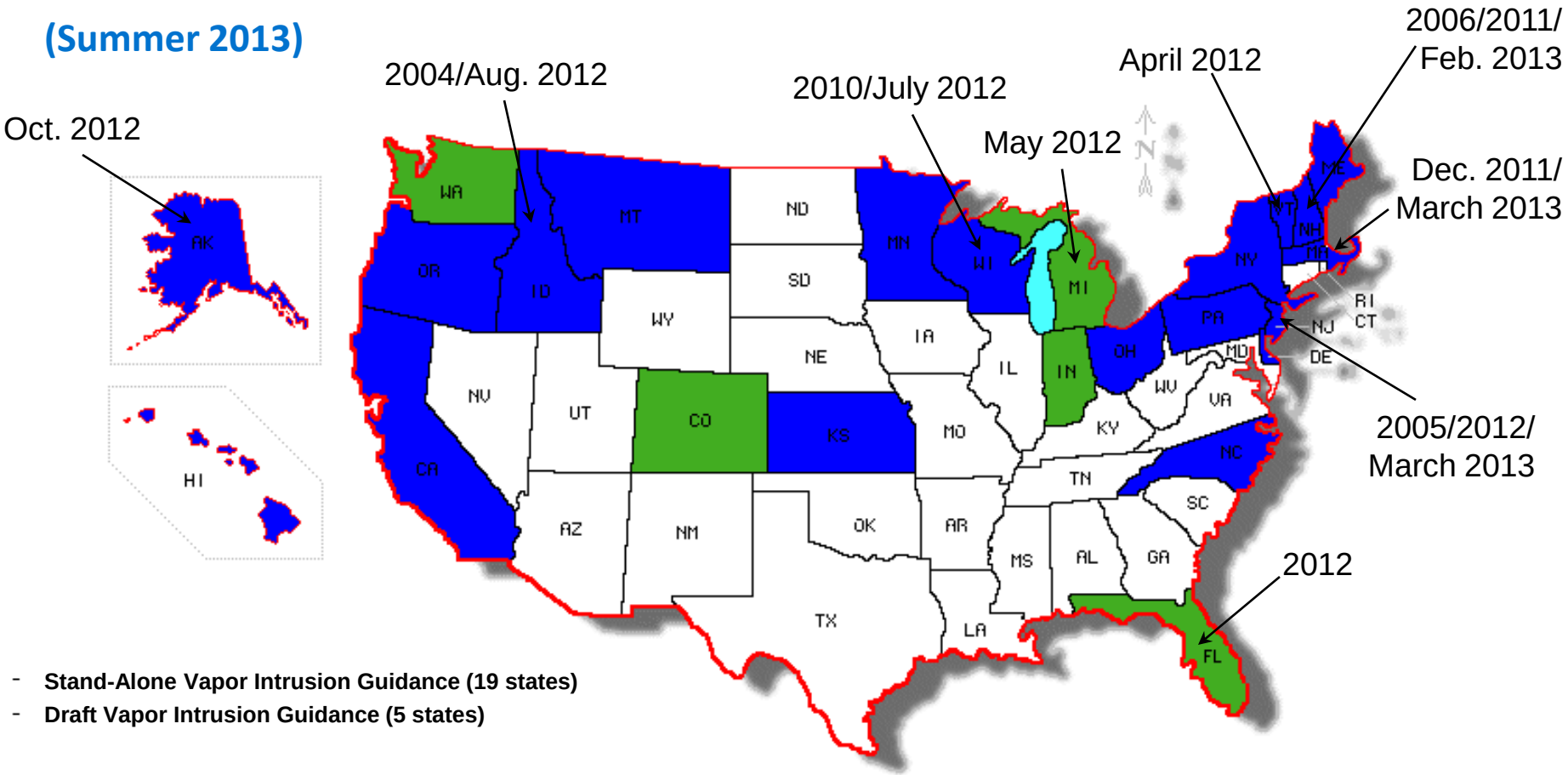
- 1980s – Focus on residential indoor air quality and radon intrusion. Early stages of vapor intrusion/inhalation pathway.

- 1990s – Regulatory focus on chronic VI (e.g., Superfund, certain states). Johnson and Ettinger 1-D Diffusion/Advection Model developed in 1991 to "risk away" VI as a concern. In 1995, ASTM publishes risk-based corrective action (RBCA) standard to assess petroleum releases (three-tiered approach).

- 2000s – Large scale VI sites (e.g., Endicott, NY; Redfield, Denver, CO). Draft EPA VI Guidance published in 2002. Several states develop their own guidance (e.g., NY, NJ). In 2007, ITRC develops a comprehensive VI guidance document.

States with Final or Draft VI Guidance

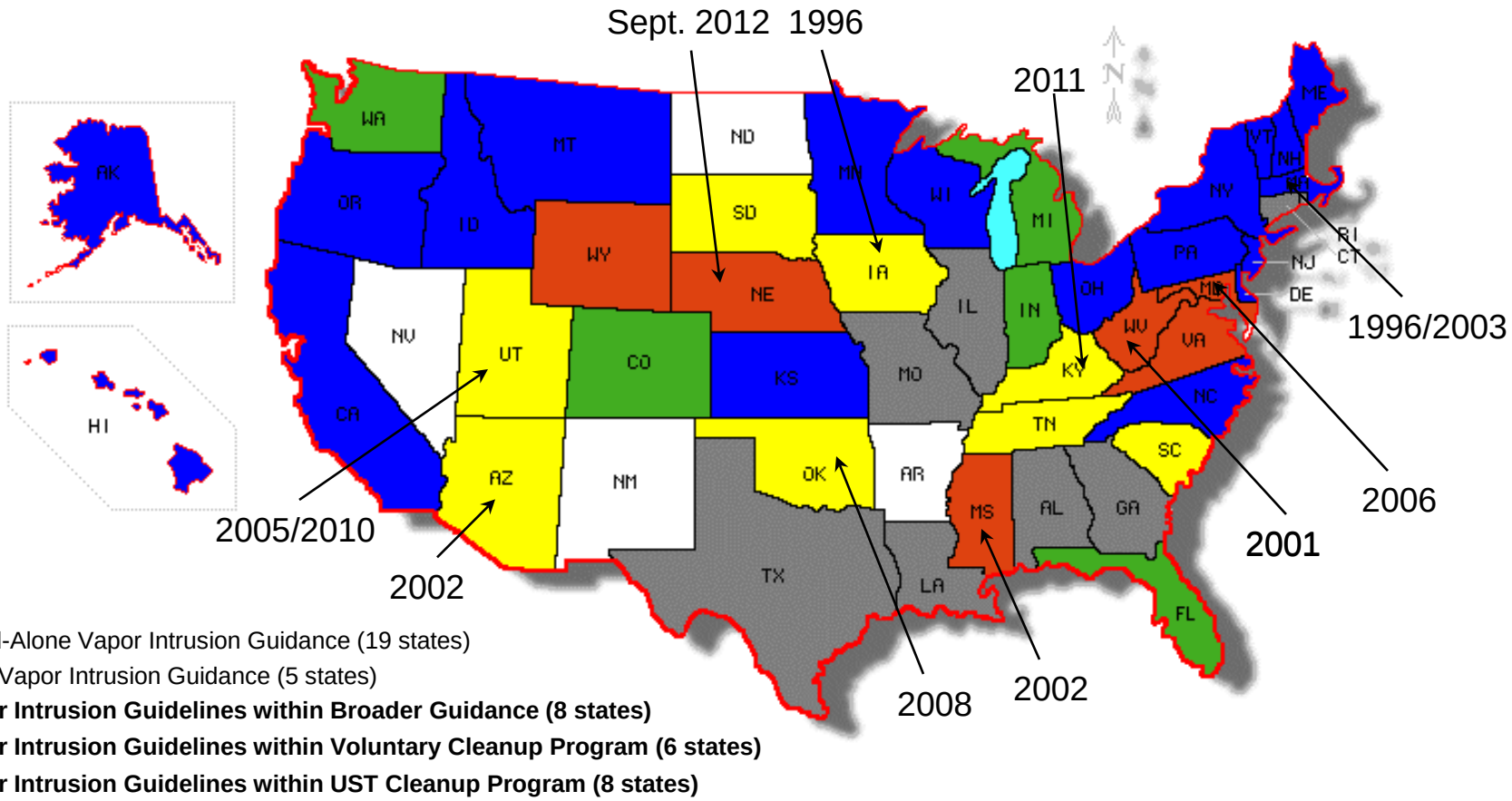
(Summer 2013)



- Final, final interim, or draft stand-alone VI guidance document or appendix
- Most guidance documents published after 2006
- VI focus in the northeastern states (industrial legacy, climate, property)
- Recently released: VT, AK, MI, ID and FL (petroleum)
- Several states have updated existing final guidance (e.g., CA, NJ, NH, WS, MA)

States with VI Guidelines within Cleanup Program

(Summer 2013)



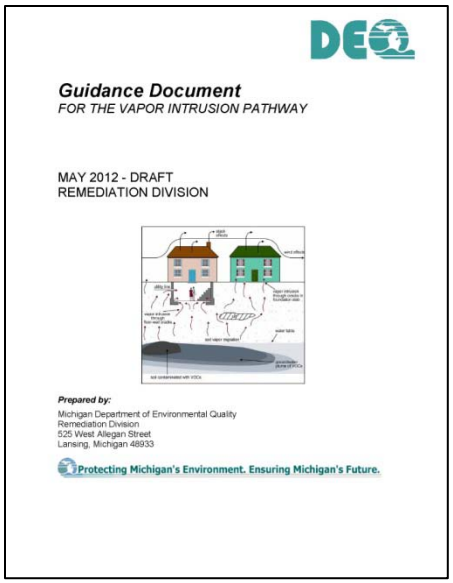
- Stand-Alone Vapor Intrusion Guidance (19 states)
- Draft Vapor Intrusion Guidance (5 states)
- **Vapor Intrusion Guidelines within Broader Guidance (8 states)**
- **Vapor Intrusion Guidelines within Voluntary Cleanup Program (6 states)**
- **Vapor Intrusion Guidelines within UST Cleanup Program (8 states)**

- Varying degree of detail…
- Often found in risk-based corrective action documents (e.g., AL, LA, MO, OK, IA, UT) where vapor inhalation pathway is typically addressed as part of a Tier 2 approach
- Volatilization criteria provided for gw, soil and/or soil gas (CT, IL, MO, TX, VA, IA, SD, TN)

Typical Approach Found in VI Guidance

- Use of a multi-step or tiered approach (consistent with EPA 2002 draft guidance)
- Rely on multiple lines of evidence approach, incl.
  - groundwater, soil, soil gas, subslab vapor, indoor air data
  - outdoor air data, flux data, tracer data (e.g., radon)
  - NAPL presence, spatial/temporal variability of data
  - differential pressure data; building characteristics

1. Conduct preliminary screening and assess VI potential (is VI pathway potentially complete?)
2. Address imminent hazards
3. Develop CSM and sampling work plan
4. **Conduct subslab vapor sampling and compare to screening/target levels (use of attenuation factor)**
5. Conduct expanded investigation (indoor air)
6. Remediate or mitigate (engineering controls)
7. Long-term monitoring and termination

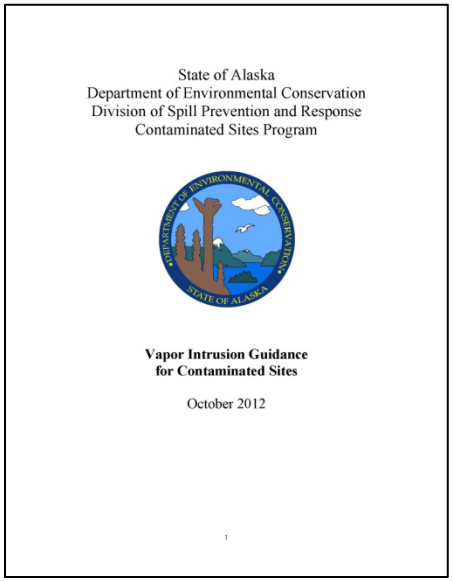

DEQ

Guidance Document
FOR THE VAPOR INTRUSION PATHWAY

MAY 2012 - DRAFT
REMEDIATION DIVISION

Prepared by:
Michigan Department of Environmental Quality
Remediation Division
525 West Allegan Street
Lansing, Michigan 48933

Protecting Michigan's Environment. Ensuring Michigan's Future.

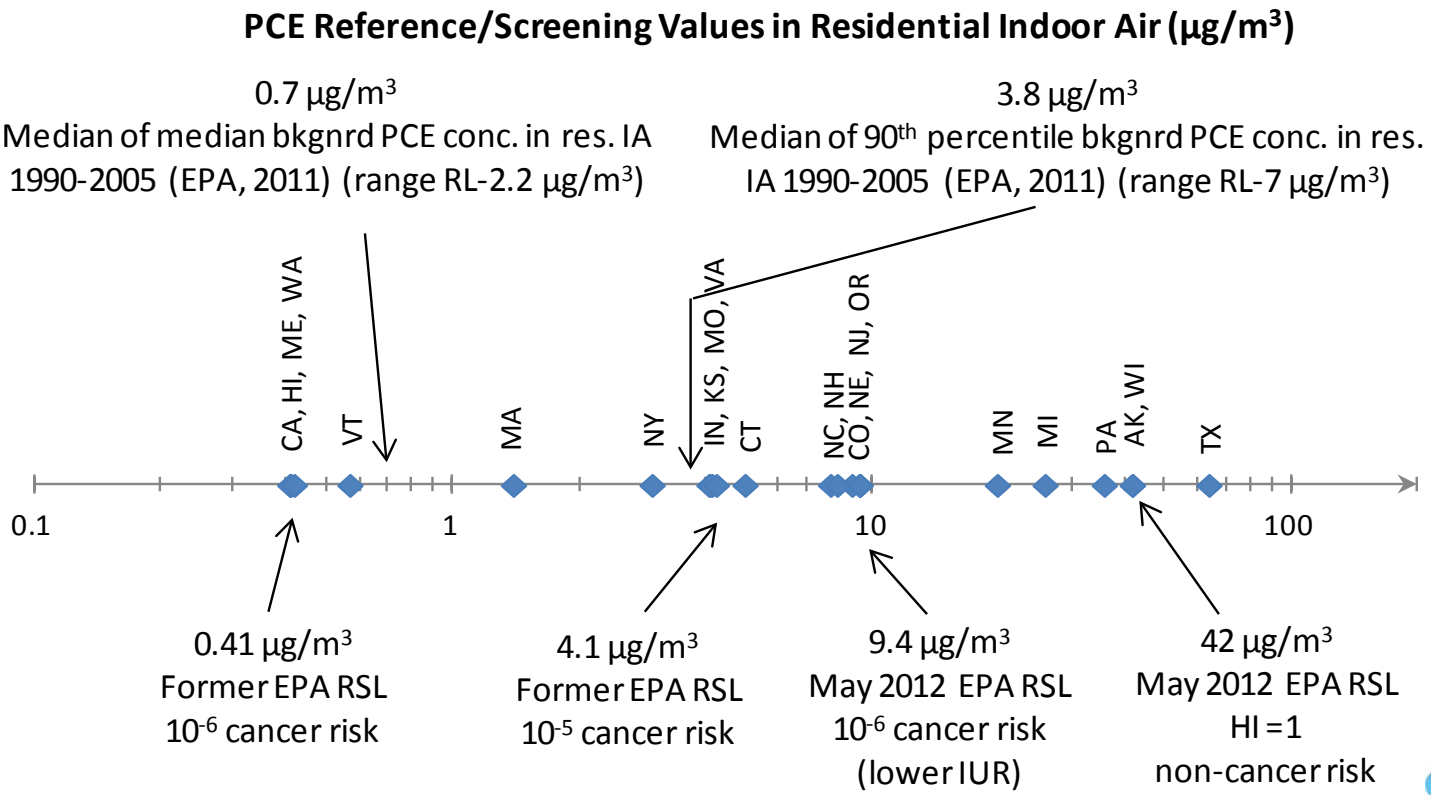

State of Alaska
Department of Environmental Conservation
Division of Spill Prevention and Response
Contaminated Sites Program

Vapor Intrusion Guidance
for Contaminated Sites

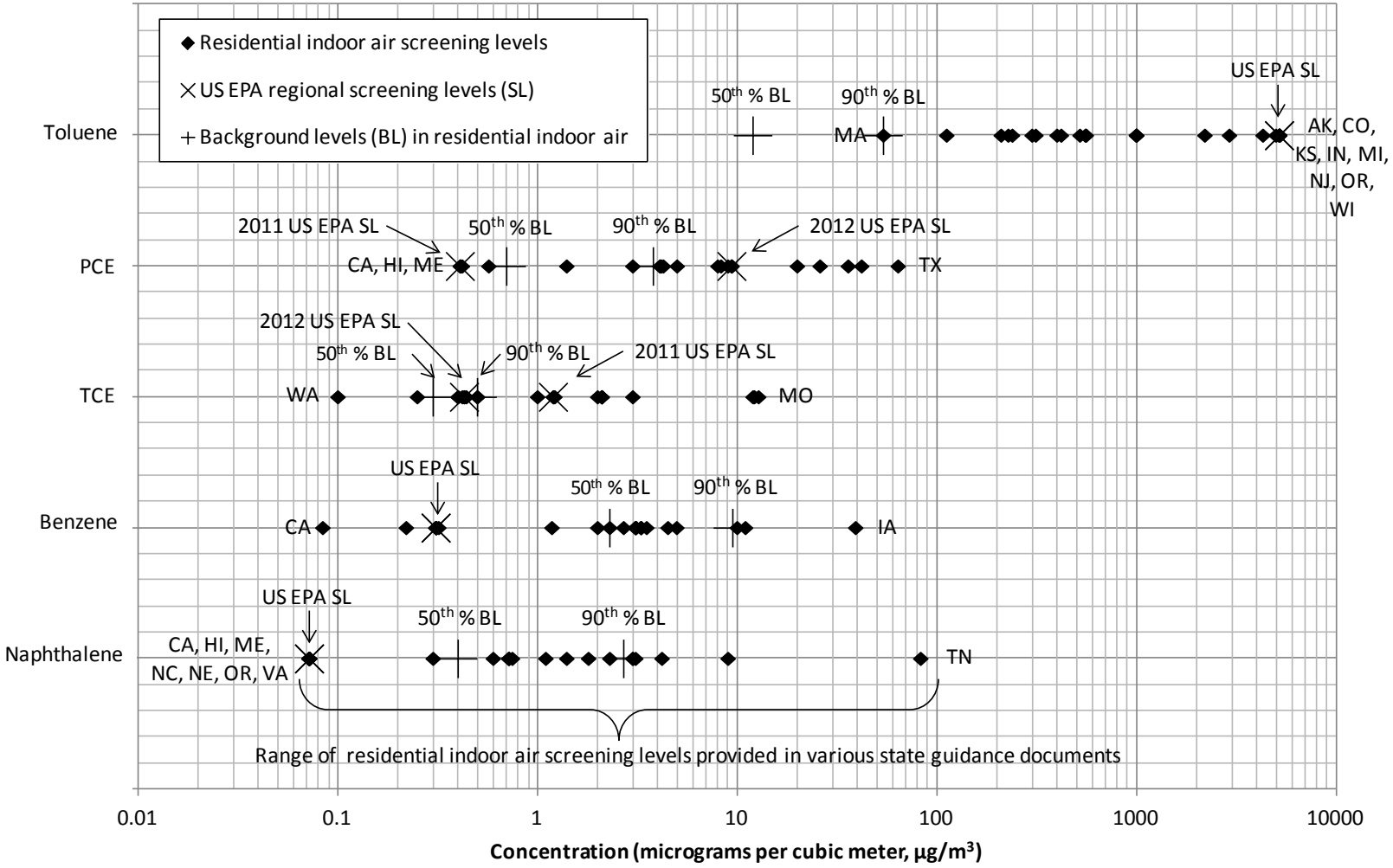
October 2012

Indoor Air Screening Levels Vary Broadly Between States

- Typically health-based criteria (10^{-5} or 10^{-6} cancer risk and HI = 1 or 0.2)
- Sometimes based on background level studies (e.g., MA, CT, NH, NY, PA, VA, VT)
- Occasionally based on TO-15 reporting limits (e.g., MA, NH)
- State-specific toxicity study or study interpretation (e.g., CA, MA, VT)
- Example for tetrachloroethene (PCE). Range of screening values spans two orders of magnitude with several states relying on former EPA RSL



Indoor Air Screening Levels (Continued)

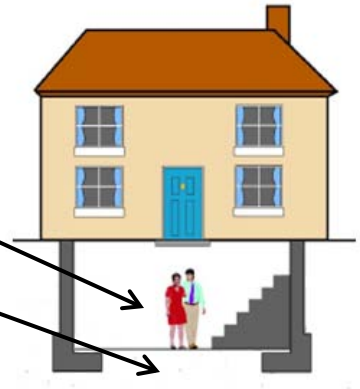


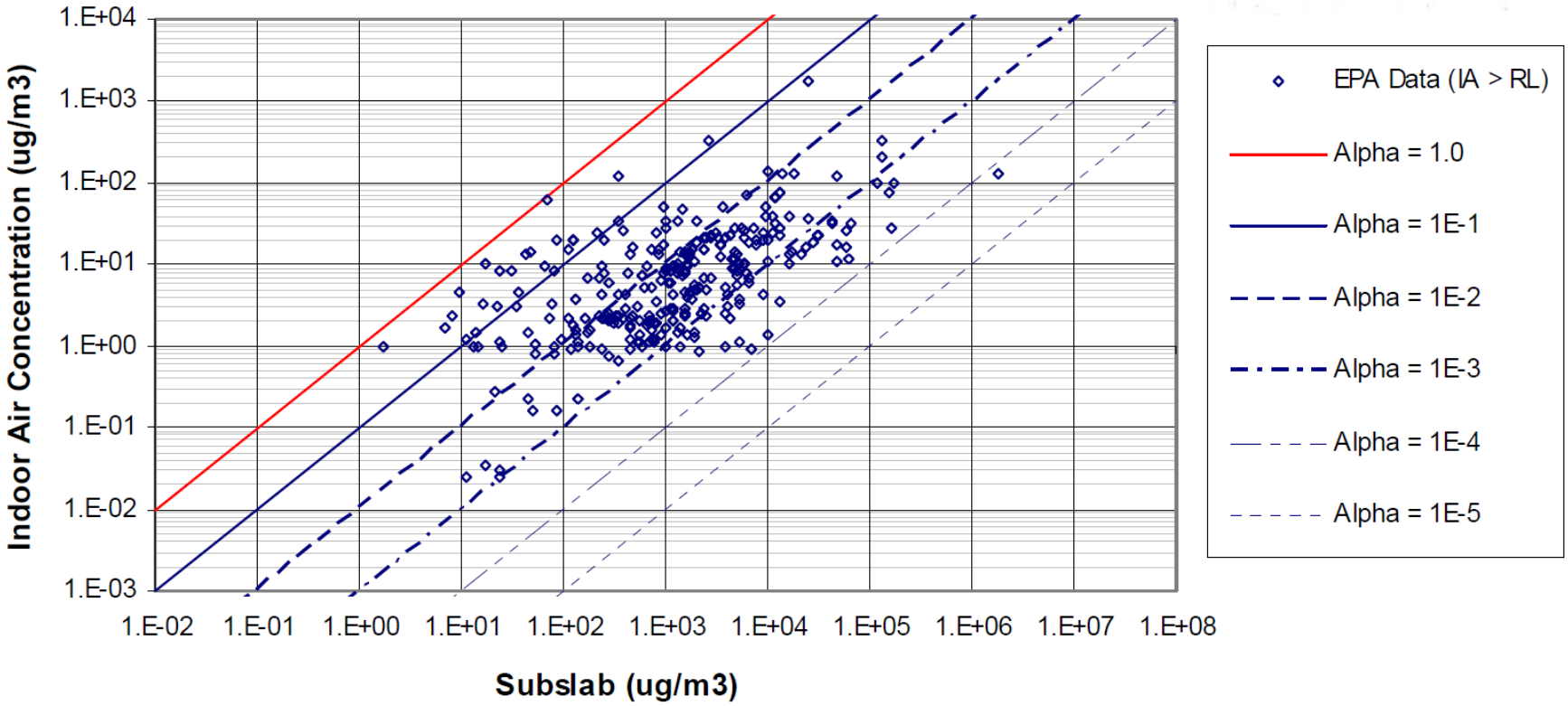
- Range of two orders of magnitude (varying risk levels, non risk-based SL, NC/C)
- TCE less common in background than PCE although certain SL are below background
- Most SL for benzene and naphthalene within or below background

Attenuation Factors

The ratio of indoor air to subslab vapor concentration

$$AF = \frac{C_{\text{indoor air}}}{C_{\text{subslab vapor}}}$$

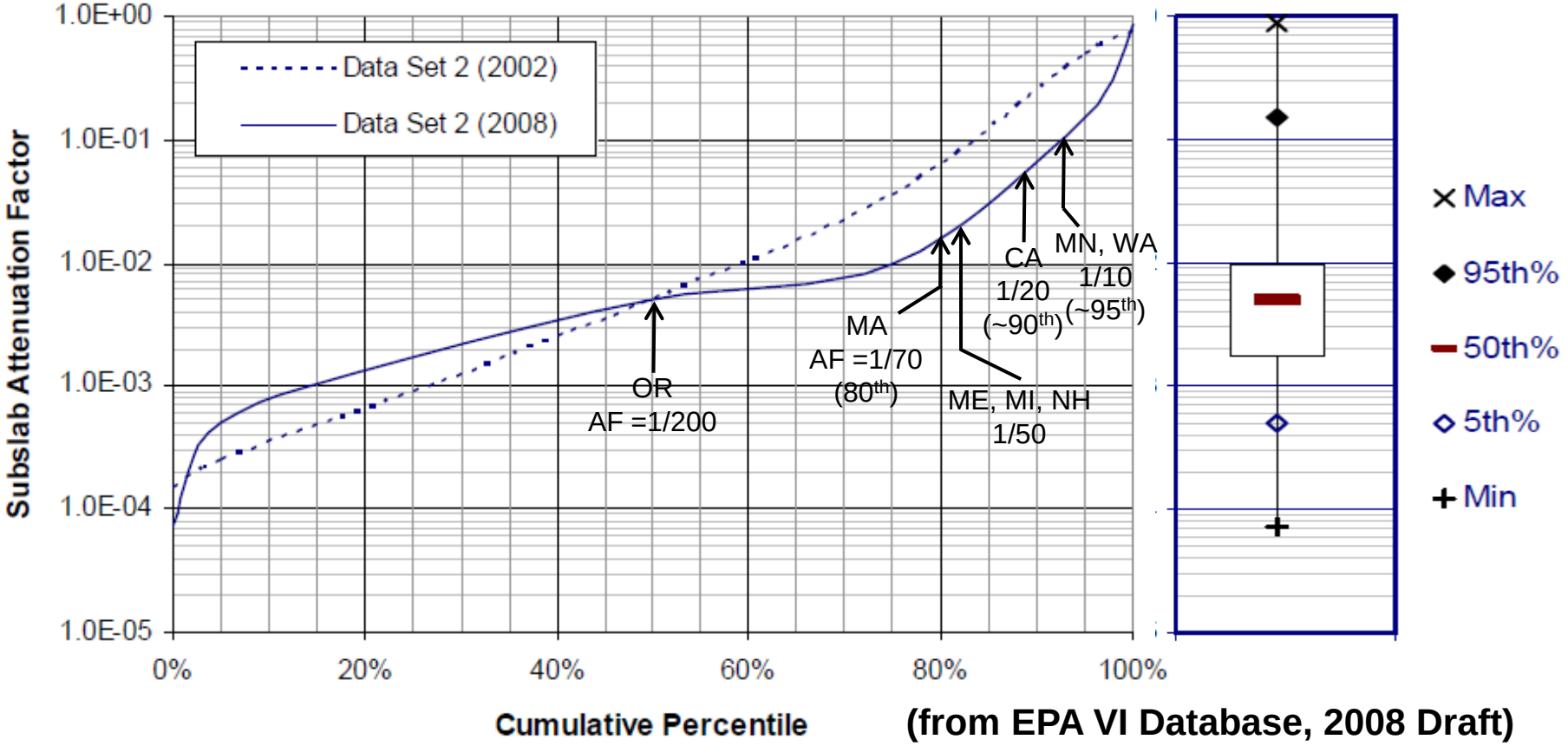




311 paired subslab vapor-to-indoor air data points from 13 sites (after **EPA VI Database, Draft 2008**, Finalized in March 2012)

→ **For most data pairs, AF is less than 0.1**

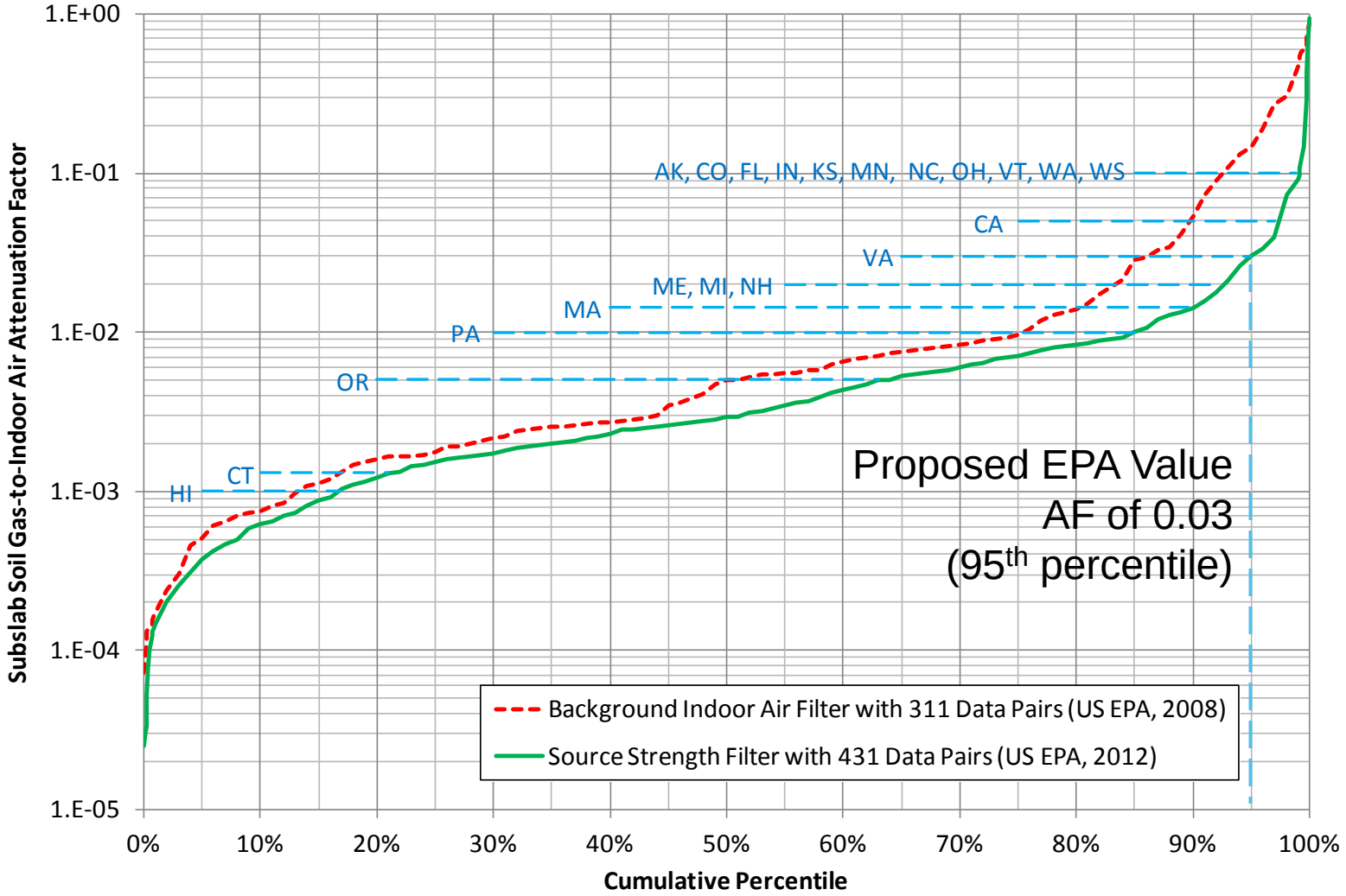
Attenuation Factors (continued)



(from EPA VI Database, 2008 Draft)

- Indoor air concentration predictions using subslab vapor data and assumed AF
- Most states use AF of 0.1 (1/10) based on EPA 2002 draft VI guidance recommendation (AK, CO, IN, KS, NC, OH, VT, WS)
- Several states have relied on results from EPA VI database study (2008 draft) to use less conservative AF

Attenuation Factors — from EPA 2008 to EPA 2012



- 2012 '50x 90th BL source strength' filter replaces 2008 '95th BL IA' filter
- Remaining data pairs show more attenuation than previously derived
- Accordingly, generic AF are more conservative than originally thought

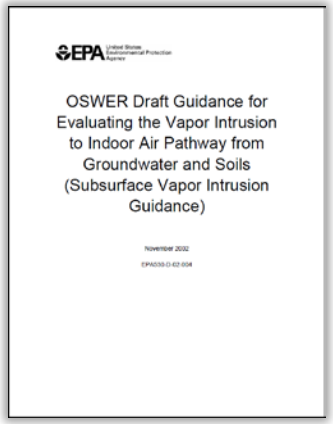
VI Screening Levels for Groundwater – An Illustration for Benzene

	Vermont	New Hampshire
Indoor Air Screening Level	1.18 µg/m^3 (Background Study)	3.3 µg/m^3 (Background Study)
Groundwater-to-Indoor Air Attenuation Factor	10^{-3} (EPA 2002 Draft VI Guidance)	10^{-4}
Biodegradation for Petroleum Compounds	No	Yes (attenuation of 0.1)
Dimensionless Henry's Constant	Assume standard water temperature of 25^{o}C H = 0.227	Assume groundwater temperature of 10^{o}C H = 0.116
Resulting Groundwater Screening Level	**5.2 µg/L**	**2,900 µg/L**

EPA Final VI Guidance is Coming

- Final EPA VI guidance was due to be released at the end of 2012 ten years after draft was published
- Draft final guidance released for comments on April 16, 2013 (http://www.epa.gov/oswer/vaporintrusion)
- Draft final guidance:
  - Draws from EPA VI database study (e.g., less conservative subslab-to-indoor air AF, limitations associated with exterior soil gas data)
  - Differentiates between VI by chlorinated hydrocarbons and VI by petroleum hydrocarbons ("PVI") (vadose zone aerobic biodegradation may result in lower AF)
    → separate PVI Guidance
  - Does not recommend modeling as a single line of evidence to rule out the VI pathway (i.e., empirical evidence preferred)
- Will States follow suit ?
  (if they have not already done so)

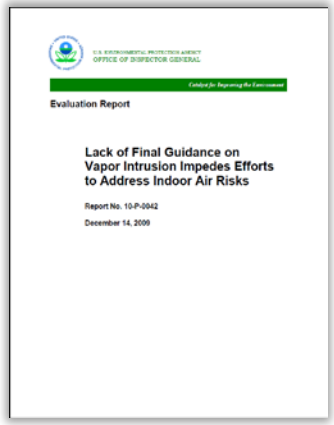
Nov. 2002


EPA

OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)

November 2002

Dec. 2009


OFFICE OF INSPECTOR GENERAL

Evaluation Report

Lack of Final Guidance on Vapor Intrusion Impedes Efforts to Address Indoor Air Risks

Report No. 10-P-0042

December 14, 2009

April 2013


OSWER FINAL GUIDANCE FOR ASSESSING AND MITIGATING THE VAPOR INTRUSION PATHWAY FROM SUBSURFACE SOURCES TO INDOOR AIR
(EXTERNAL REVIEW DRAFT)

NOTICE

U.S. Environmental Protection Agency

Office of Solid Waste and Emergency Response

April 2013

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Questions?

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