Methods to Identify and Address Conduit Vapor Intrusion Preferential Pathways

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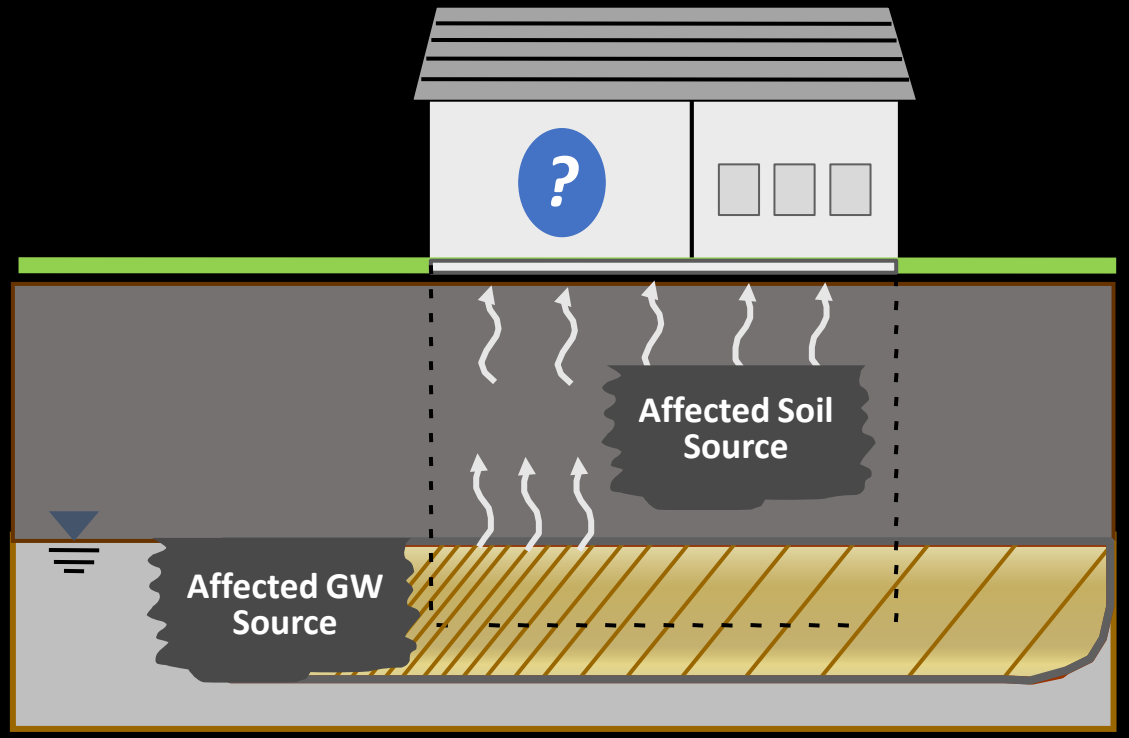
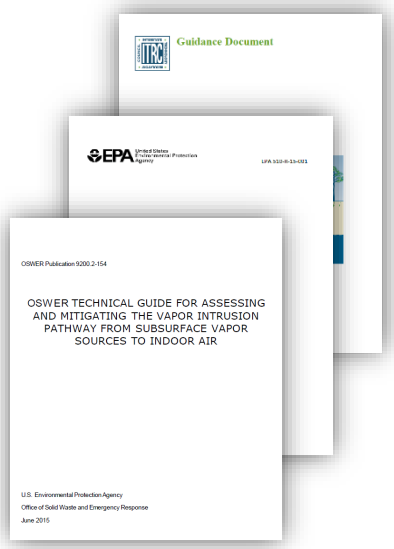
Agenda

- Introduction
- Conceptual Site Models
- Case Study
- Wrap-up



A Brief History of Vapor Intrusion



- 1980s Radon intrusion
- 1990s More focus on VOC vapor intrusion, Johnson and Ettinger Model
- 2000s More studies (e.g., Redfield, CO), guidance – Federal (draft), ITRC, States
- 2008-2013 ASTM E2600 (Vapor Encroachment) & ASTM E1527 (Phase I)
- 2011-2014 Petroleum vs. non-petroleum VI
- 2015 USEPA finalizes VI guidance
- 2015 More changes, principally recognition of sewer/conduit preferential pathways

KEY POINT

Regulations, guidance, and the science have been evolving, with many recent changes.

Motivations

REGULATORY DRIVERS (chemical releases)

- State requirements
- USEPA guidance
- HRS & CERCLA 5-year reviews

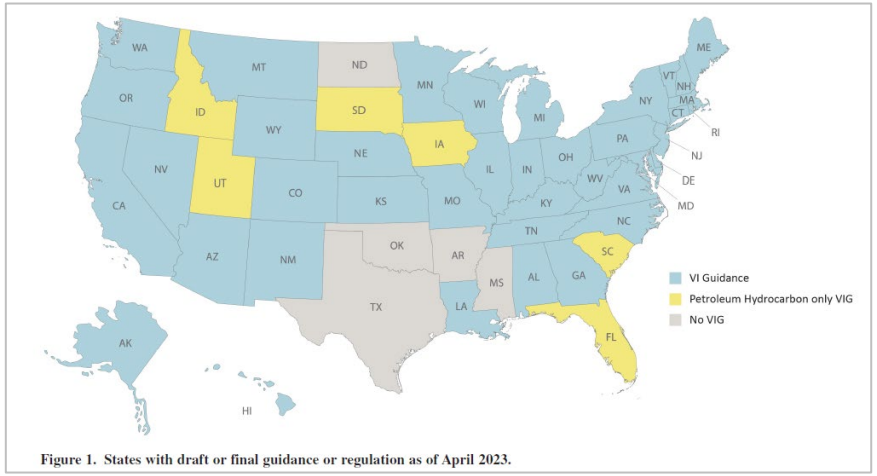
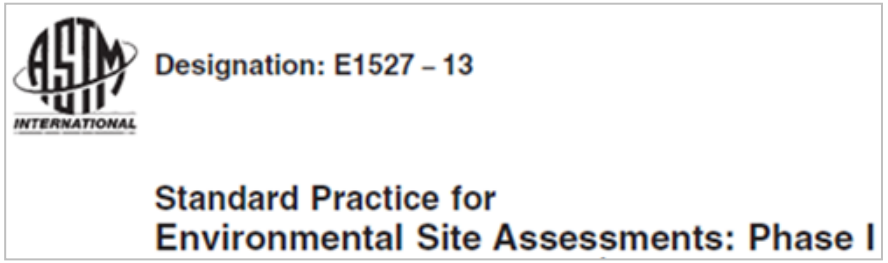


Figure 1. States with draft or final guidance or regulation as of April 2023.

Eklund, Regan, Rago, Beckley, 2024. Overview of state approaches to VI

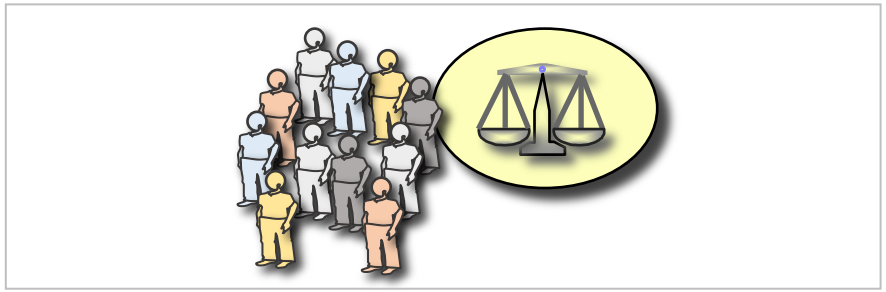
BUSINESS DRIVERS

- Due Diligence
- ASTM Phase I Standard



OTHER

- Community Concerns
- Litigation



KEY POINT Vapor intrusion concerns can come up from many different perspectives.

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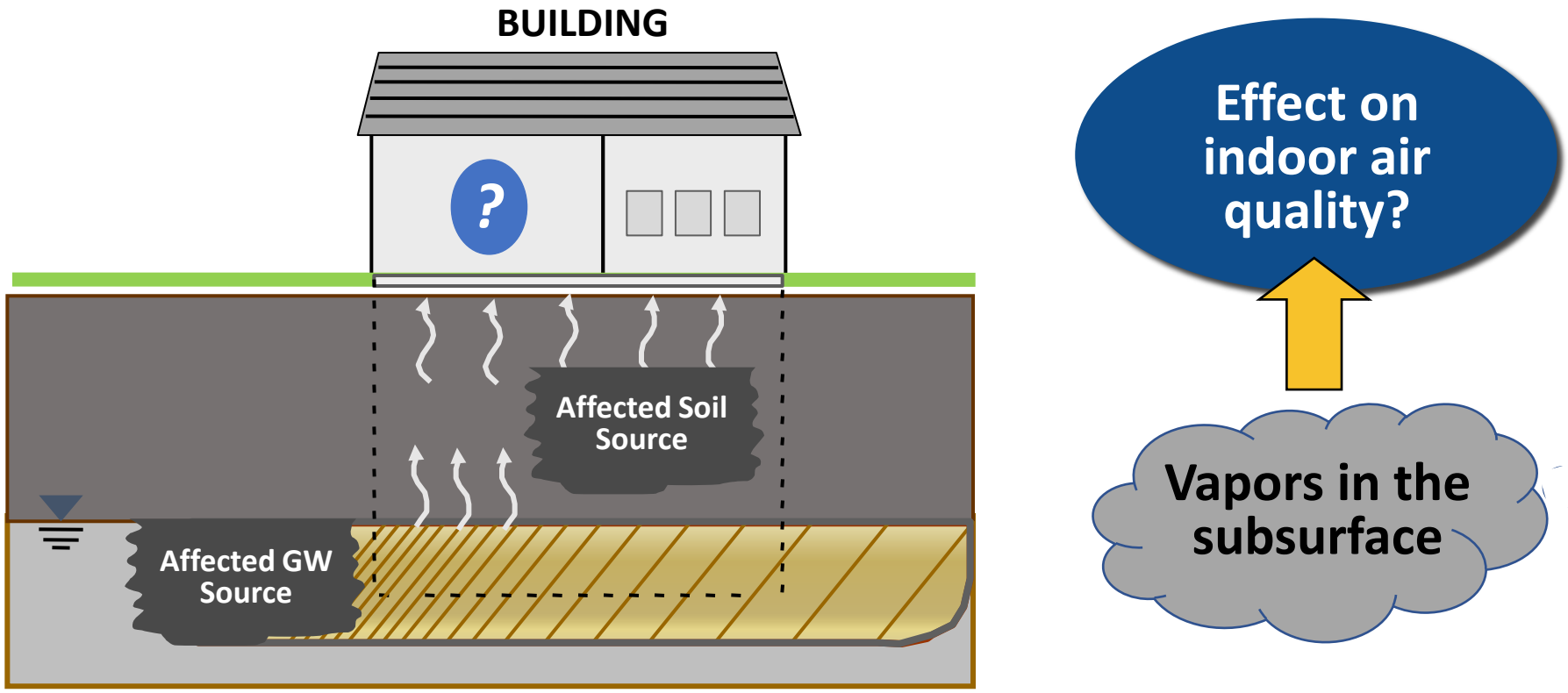
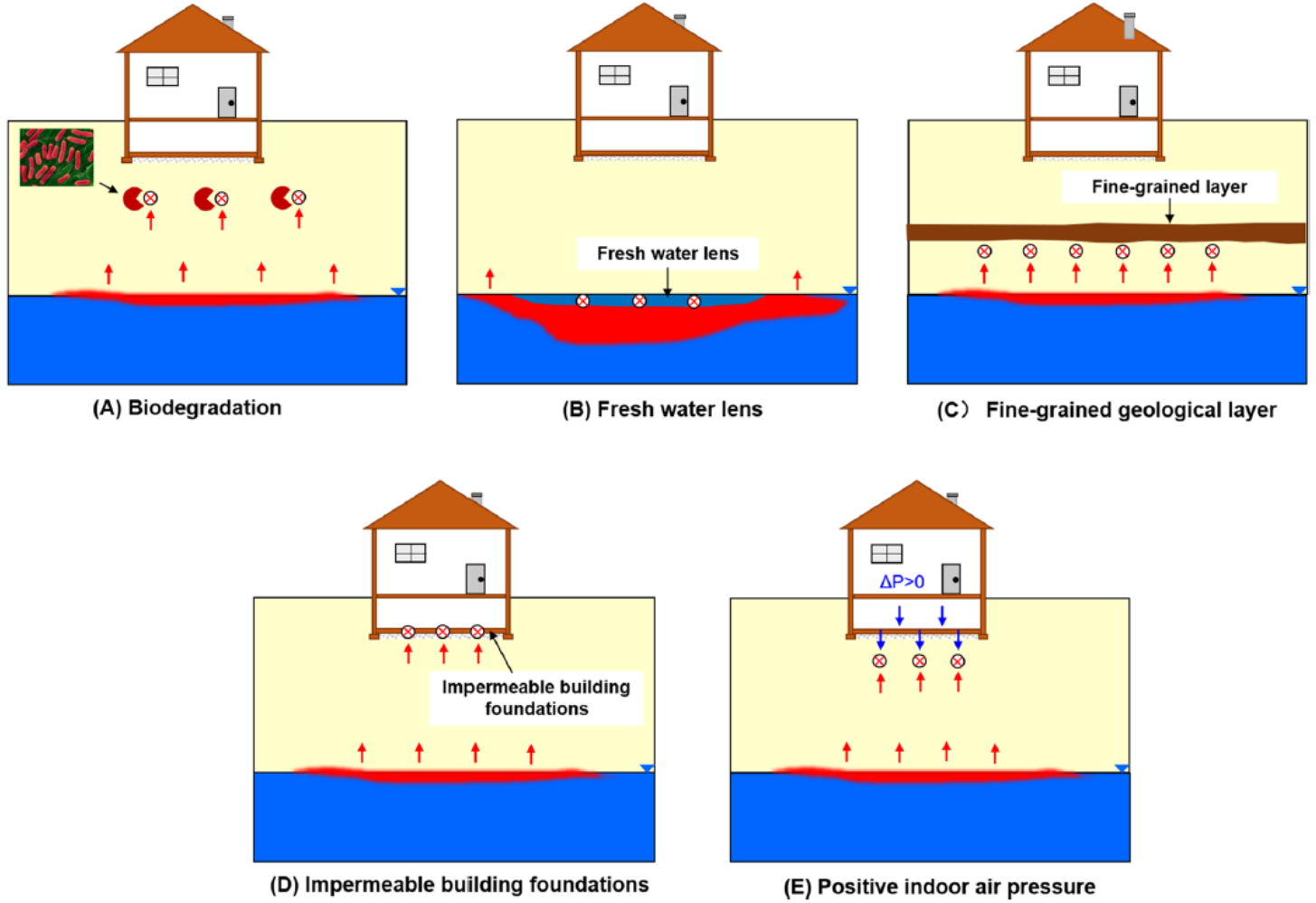
Basic Vapor Intrusion Conceptual Model



DEFINITION

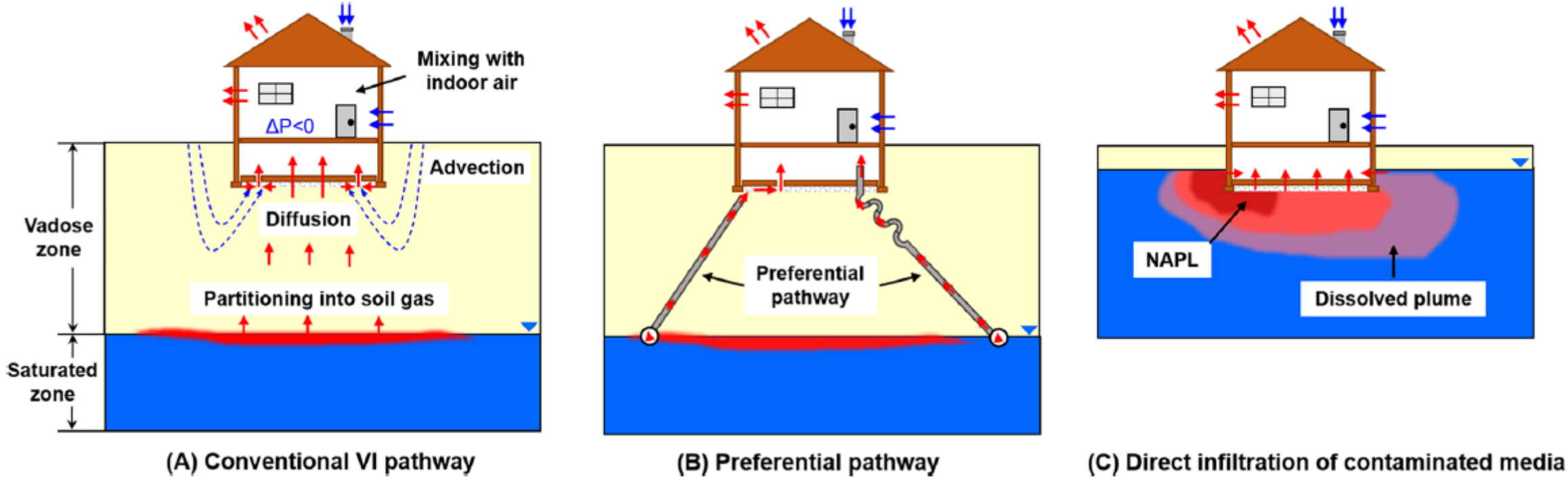
Vapor intrusion is the vapor-phase migration of volatile organic compounds (VOCs) from the subsurface into indoor air.

Common Barriers for (Conventional) VI



Source: Ma, et al., 2020, Vapor Intrusion Investigations and Decision-Making: A Critical Review. ES&T.

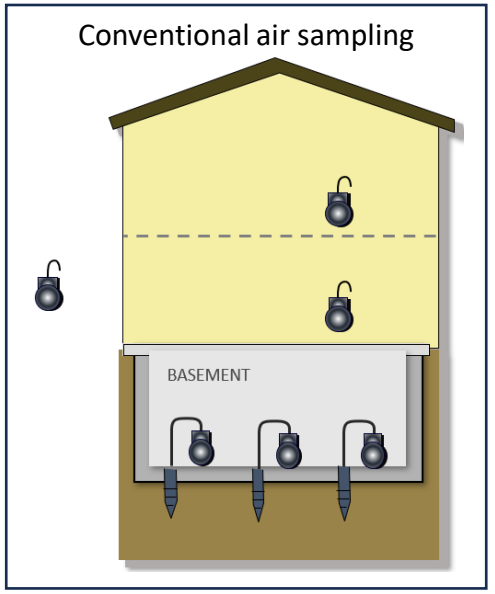
More Nuanced CSMs



Source: Ma, et al., 2020, Vapor Intrusion Investigations and Decision-Making: A Critical Review. ES&T.

So, is VI a concern or not??

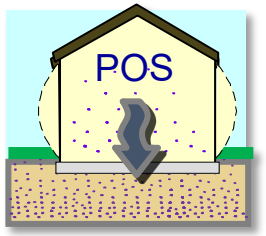
- Many tools in the toolbox
  - Screening distance
  - Screening concentrations
  - Building-specific testing approaches
- Interpretation informed by
  - Conceptual site model
  - Multiple lines of evidence



Other approaches

On-site Analysis

Building Pressure Control



…and more!

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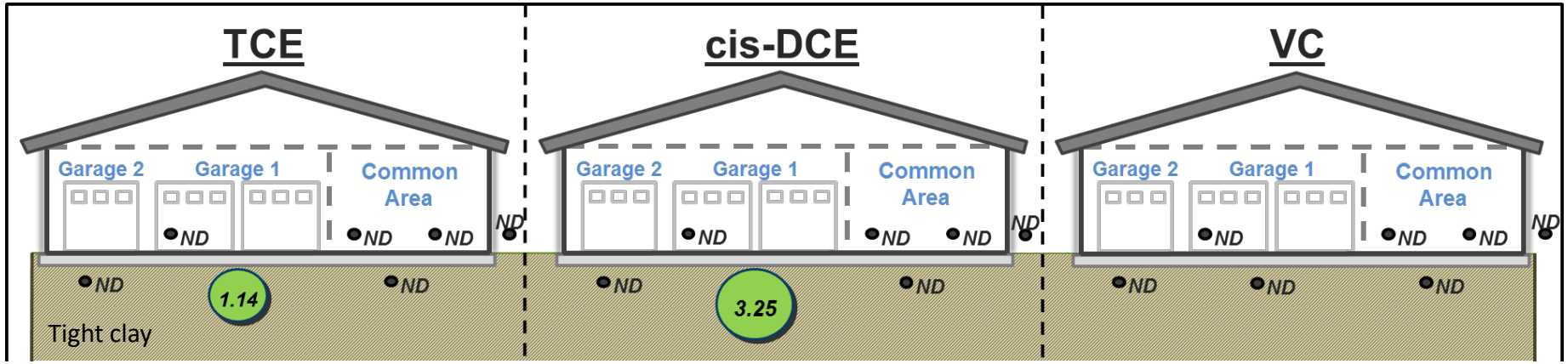
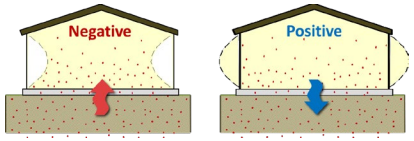
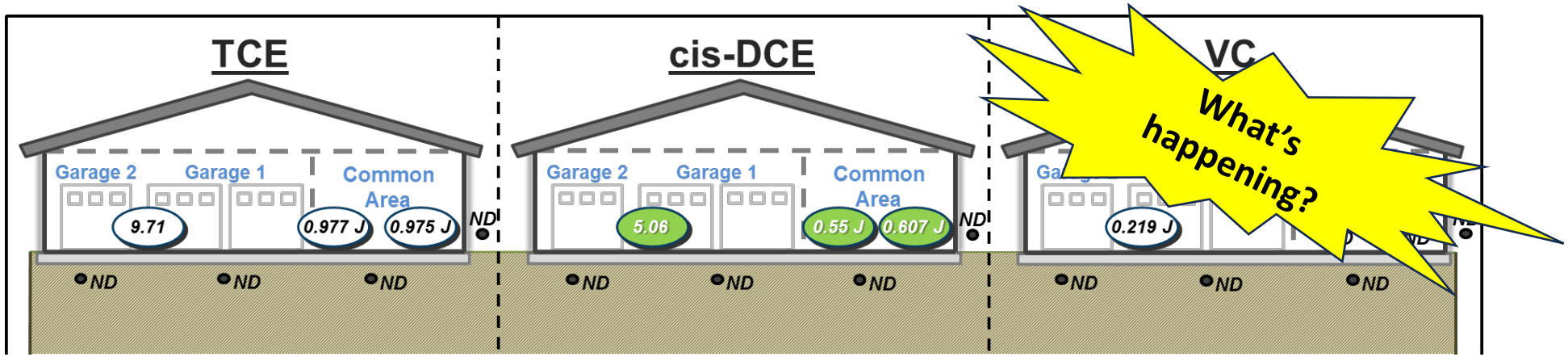
Building within 100 ft of TCE Plume

Round 1
Conventional Sampling Approach



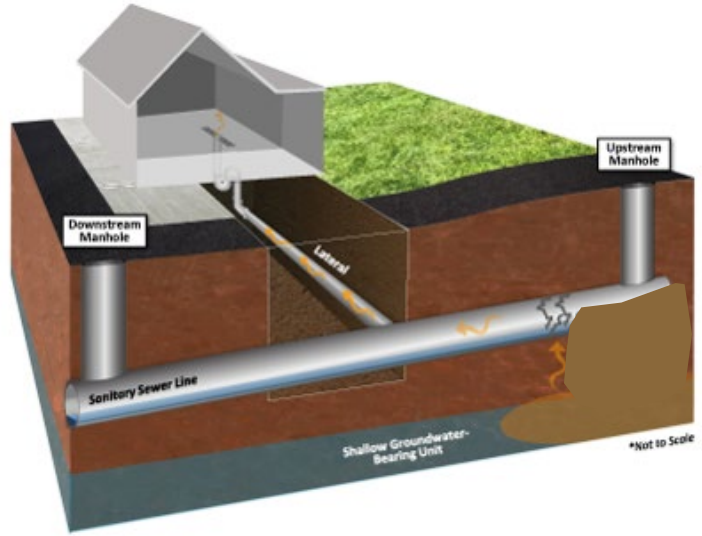
Round 2
Testing under Depressurized Conditions





Building within 100 ft of TCE Plume

- Data do not support “conventional” VI; rather: indoor source or conduit pathway
- Hypothesis tested using on-site analysis, sewer video surveys
  - Conduit pathway more likely
  - Sewer vapor concentrations in nearby manhole: TCE & cis-DCE > 100 ug/m3
- Updated conceptual model
  - Sewer line ran near old on-site waste disposal area
  - Intermittent off-site VI resulting from conduit pathway



Mitigation Options

- SSDS not appropriate
- Mitigate at any of three main steps along the VOC transport route:*
  - Entry of VOCs into the sewer/conduit
  - Migration of VOCs within the sewer line
  - Migration of VOCs from the sewer into the building

*References: Nielsen and Hvidberg, 2017. Beckley and McHugh, 2020.

Mitigation Approach and Results

1. Lined portion of on-site sewer main and on/off-site manholes to prevent infiltration of VOCs into sewer line
2. Identified and abandoned historical on-site sewer laterals
3. Replaced portion of on-site sewer main

	Pre-mitigation TCE	Post-mitigation TCE
Sewer Vapor (MH downstream of repaired line)	38 - 2,880 ug/m3	ND (<0.3 ug/m3) *10,000x concentration reduction*
Manhole sewer liquid (MH downstream of repaired line)	5 – 15 ug/L	1.9 ug/L

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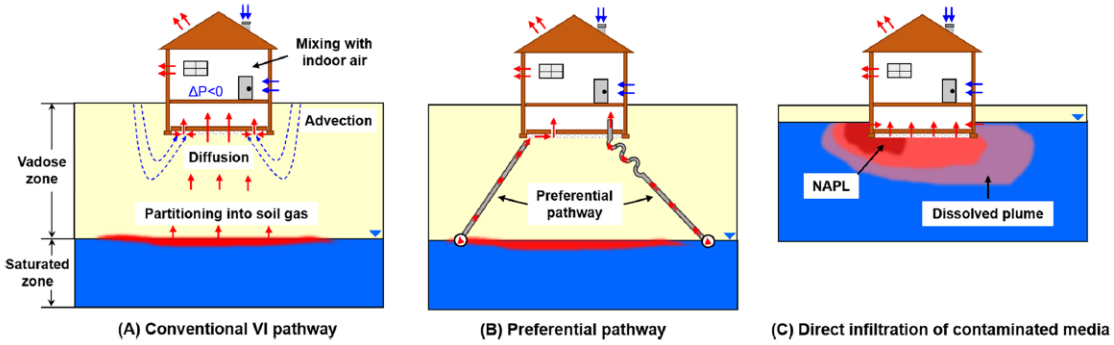
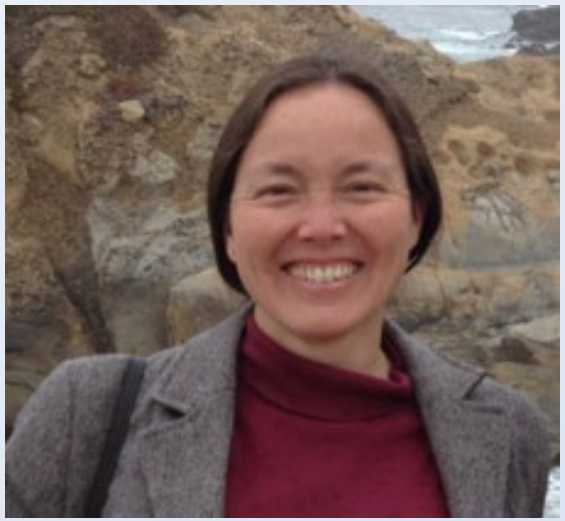
Wrap-up



- Most regulatory guidance and testing (and mitigation) programs are based on “conventional CSM”
- In reality, many site- and building-specific factors at play
  - Indoor sources
  - Conduit pathways
- Understanding VOC source, source strength, and details of the VOC migration pathway are critical for decision-making
  - Non-standard testing methods may be needed to understand vapor source(s)
  - VI mitigation likely ineffective unless source is understood

Questions?



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