Vapor Control and Site Management

Key Topics:

- Vapor Control and Site Management vs Remediation Strategies
- Types of Vapor Control and Site Management
- Evaluate and select a strategy for addressing an unacceptable human health risk
- Importance of community engagement

Afternoon

Petroleum VI Screening

↓

Investigative Approach

↓

Data Evaluation

↓

Vapor Control and Site Management

↓

General Remediation

Why Vapor Control and Site Management?

- Your site screens in
  - Need to address a short term risk
  - Time/redevelopment issues
  - For PVI it is a result of steps 1-8
- Cheaper to mitigate than more investigation
- Other reasons to mitigate
  - Political
  - Resident
  - More

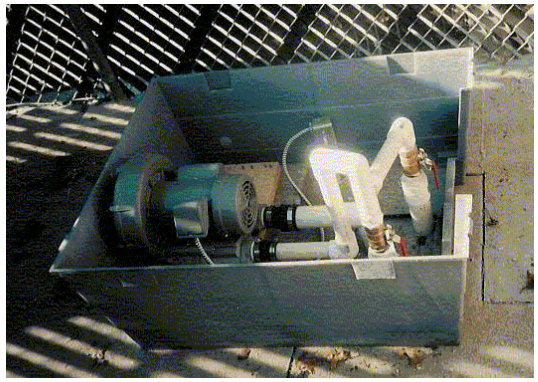
Considerations of Risks

- Short term
  - Explosive or flammable conditions
  - Odor complaints
  - Acute health issues
- Long term
  - Long term exposure and health issues

Vapor Control Strategies

- Mitigation approaches
- Remediation approaches
- Institutional controls

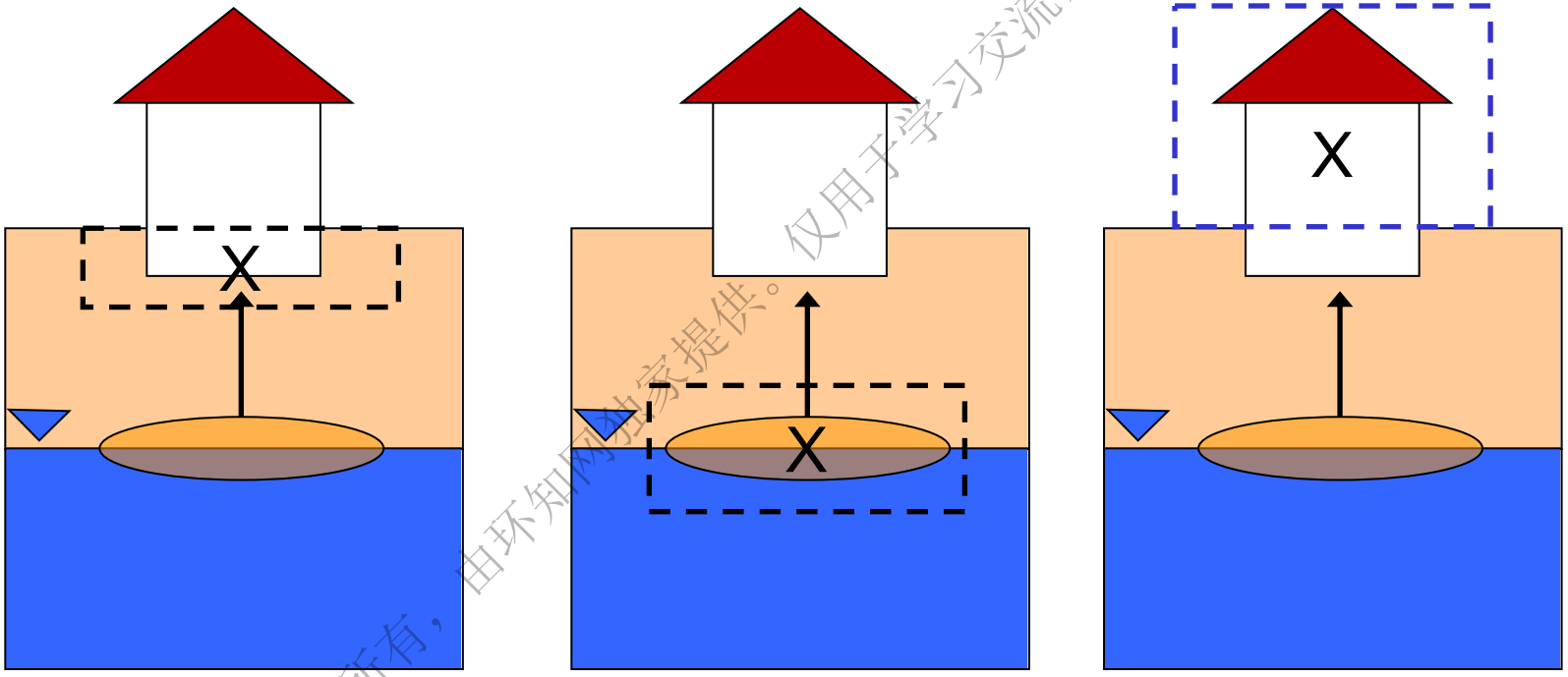
or any combination of these approaches



ITRC PVI-1, Figure 6-1. Small-scale soil vapor extraction (SVE) system designed to address the source of vapors and protect building. Photo Source: Vapor Mitigation Sciences, LLC.

KEY POINT: **Both short-term and long-term risks should be considered to determine the appropriate response action**

Vapor Control Strategies



Mitigation and Building Control

Remediation

Institutional Control

Mitigation vs Remediation Strategies

- Mitigation
  - Often only addresses the exposure, not the vapor source
  - Rarely a permanent solution
  - Can be implemented in short time-frames
  - Cost more short term but often requires maintenance
- Remediation
  - An action taken to remedy a situation
  - Eliminates or removes an identified health risk
  - Commonly requires detailed specifications

Factors Unique for PVI Mitigation

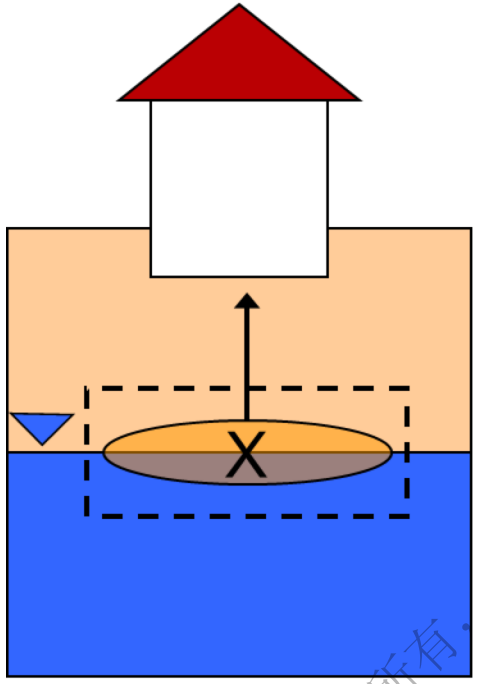
- Soil/groundwater impacts less extensive
- Easier to remediate than chlorinated solvents
- Petroleum vapors limited by bioattenuation
- Introduction of oxygen below building may reduce or eliminate impacts
- High concentrations potentially explosive/flammable

KEY POINT: **The unique properties of petroleum VOCs may affect the appropriate response action**

Vapor Control System Closure for PVI

- Vapor control systems may not be necessary in the near future, which is different than CVI
  - Residents need to understand this concept
  - What parameters will be used to determine closure
  - How will those parameters be verified
  - Who will verify those parameters
  - What happens to the vapor control system now that it is no longer needed

Strategy Option
Environmental Remediation

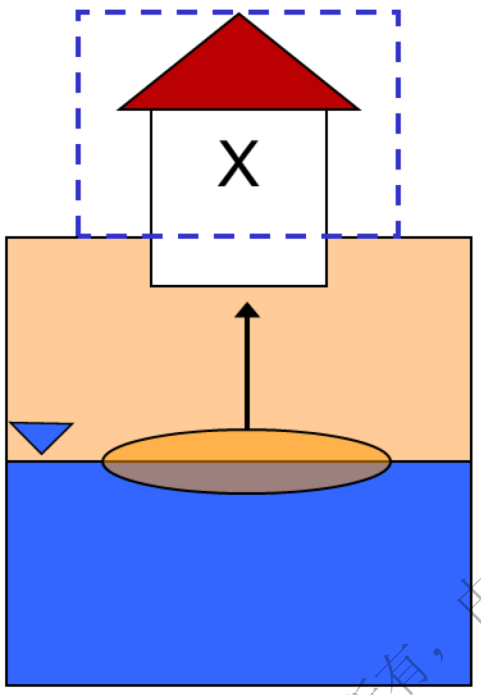


Remediation

- Remedial options in lieu of building controls
  - Source near building
  - VI related to preferential pathway
  - May require effluent treatment
    - Can be problematic for building controls

Source: Source: Vapor Mitigation Sciences, LLC

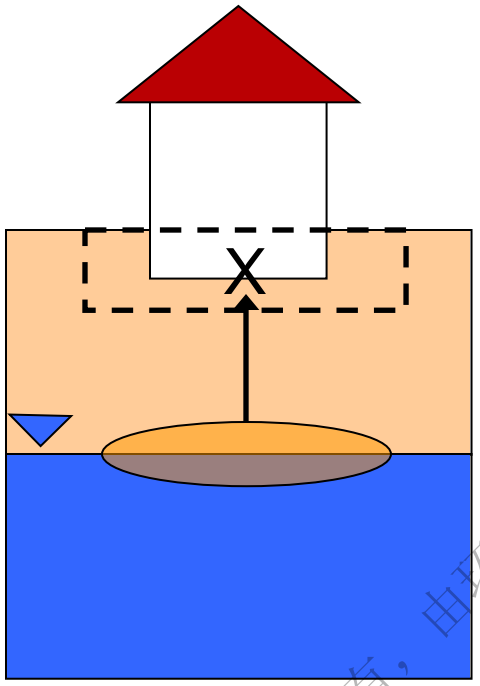
Strategy Option
Institutional Controls



Institutional Control

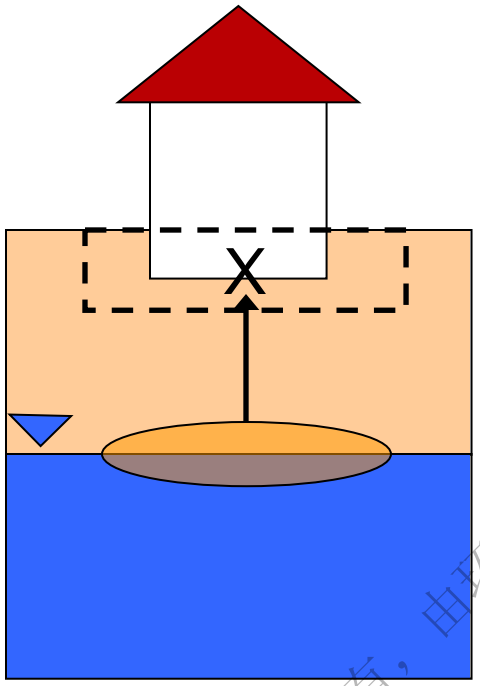
- Placed on a deed or property and could
  - Restrict on where or how to build
  - Requiring additional screening or evaluation prior to use
  - Restrict the type of use to a specific use like
    - Nonresidential
    - Industrial
- ITRC guidance on Long Term Contaminant Management Using Institutional Controls

Strategy Option
Mitigation – Building Control Technologies



- Understand basic principles behind each approach, so that you can
  - Understand strengths and weaknesses of each approach
  - Ensure the best approach is selected based on building and site conditions
  - Deal with unusual conditions

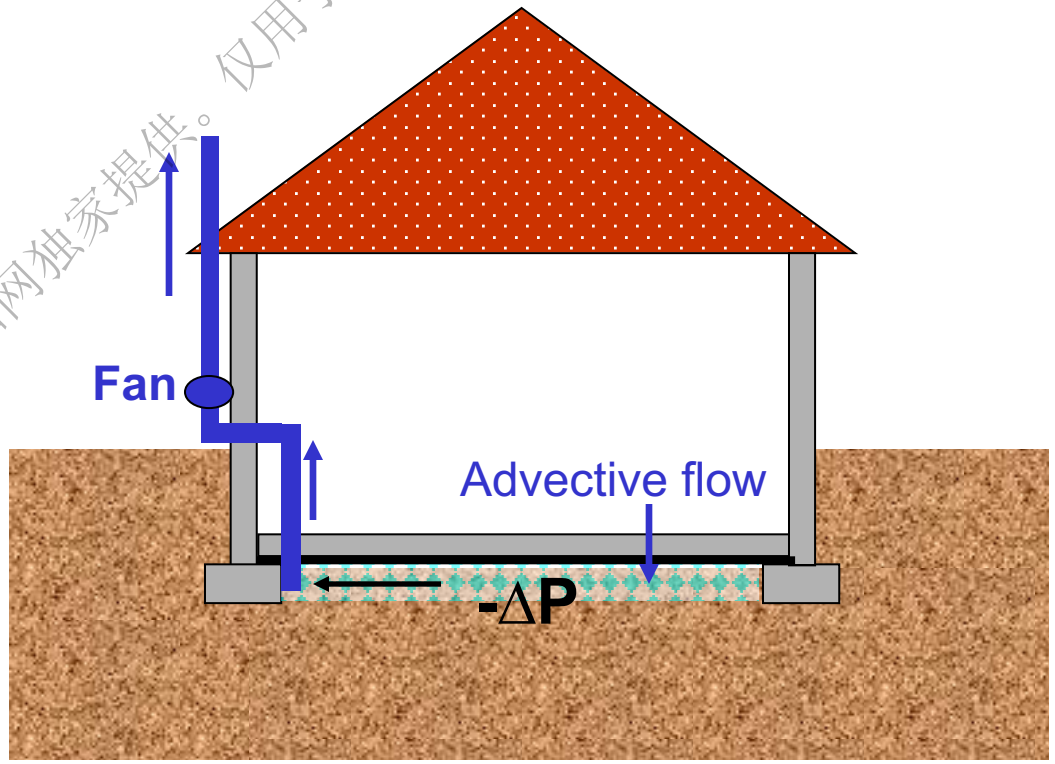
Strategy Option
Mitigation – Building Control Technologies



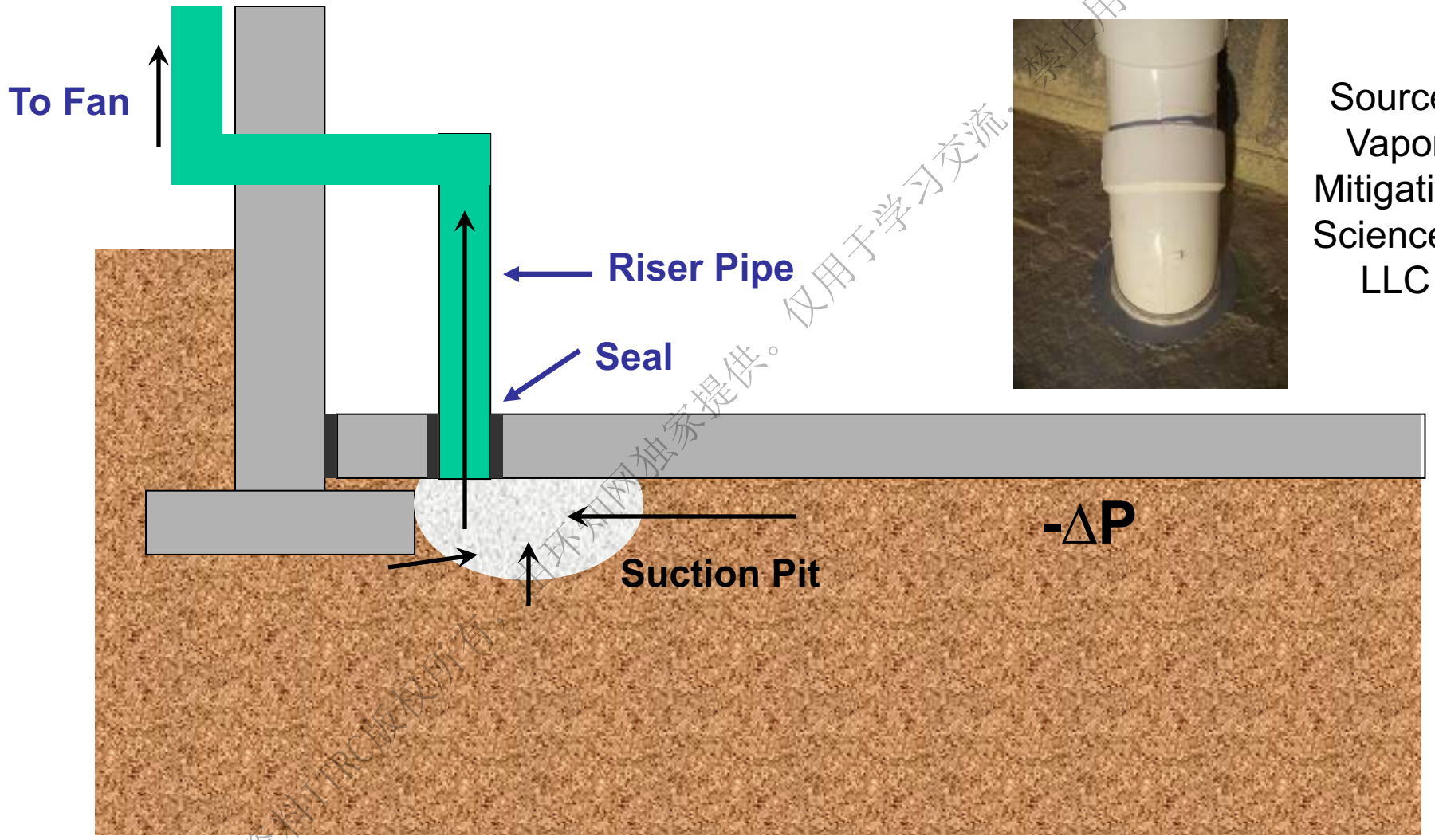
- Common Methods that are utilized:
  - Active Venting or Depressurization Systems
    - Sub-Slab Depressurization (SSD)
    - Different variations of SSD
  - Aerated Floors
  - Barriers
  - Others

Active Venting

- Active venting layers rely on fans to create suction (i.e., depressurize venting layer)



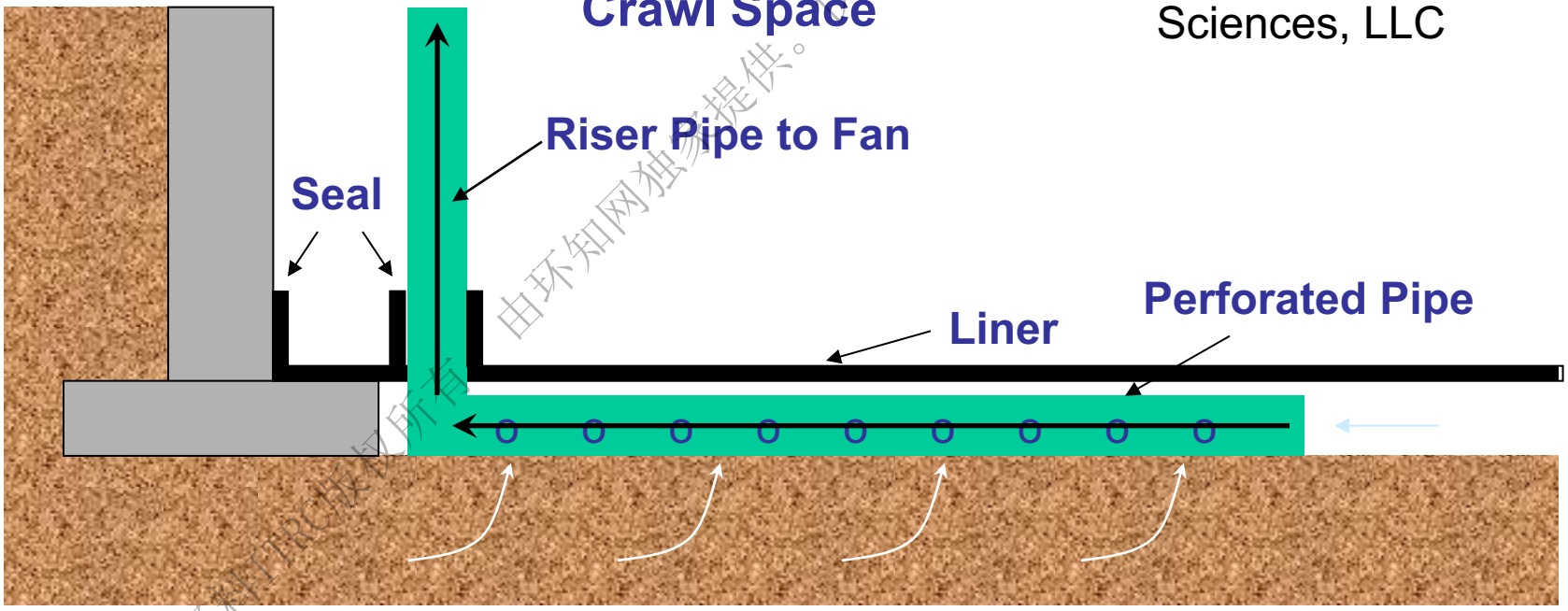
Sub-Slab Depressurization (SSD)



Source: Vapor Mitigation Sciences, LLC

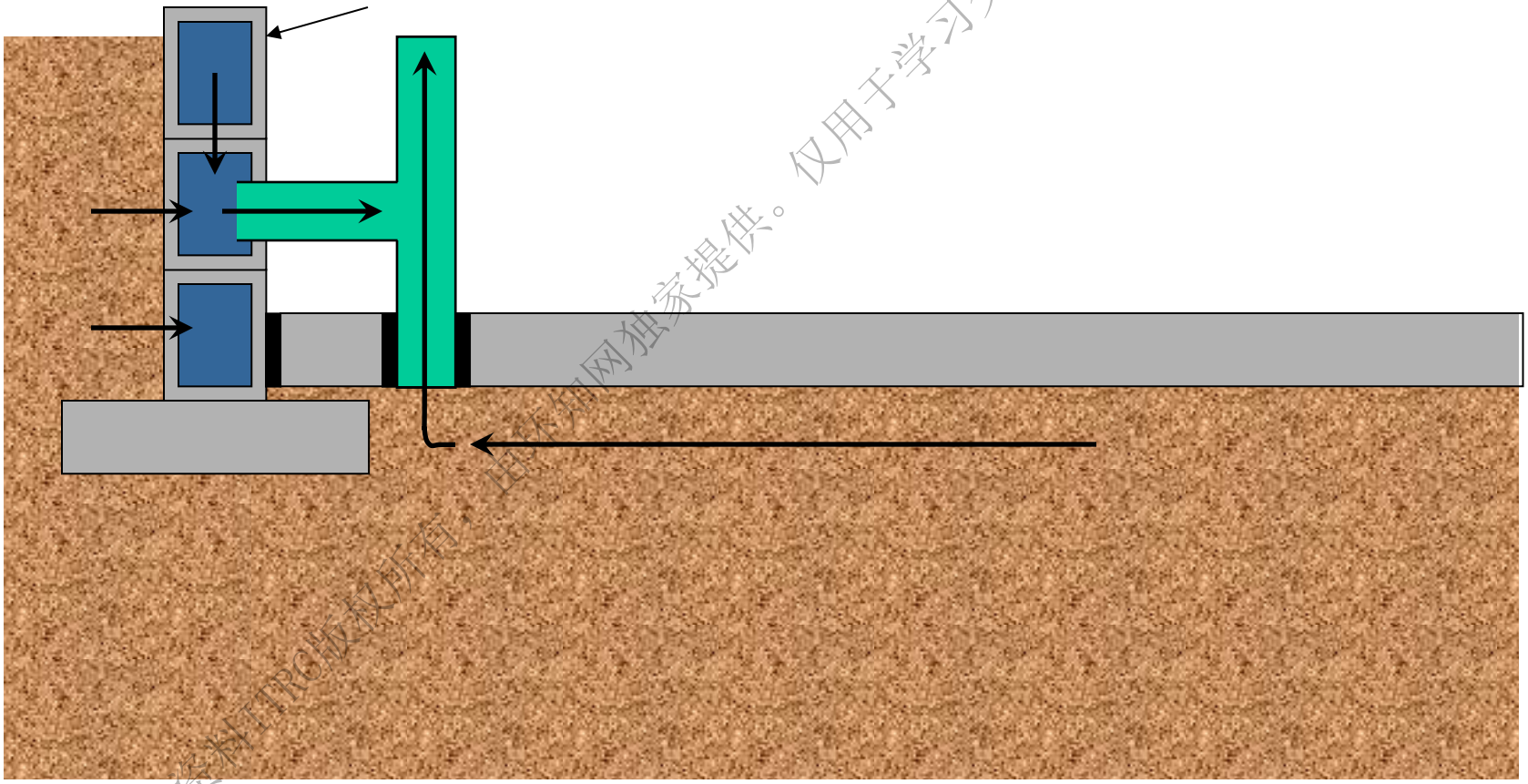
SSD Variations
Sub-Membrane Depressurization (SMD)

Source: Vapor Mitigation Sciences, LLC



SSD Variations
Block Wall Depressurization

Cinder block foundation wall

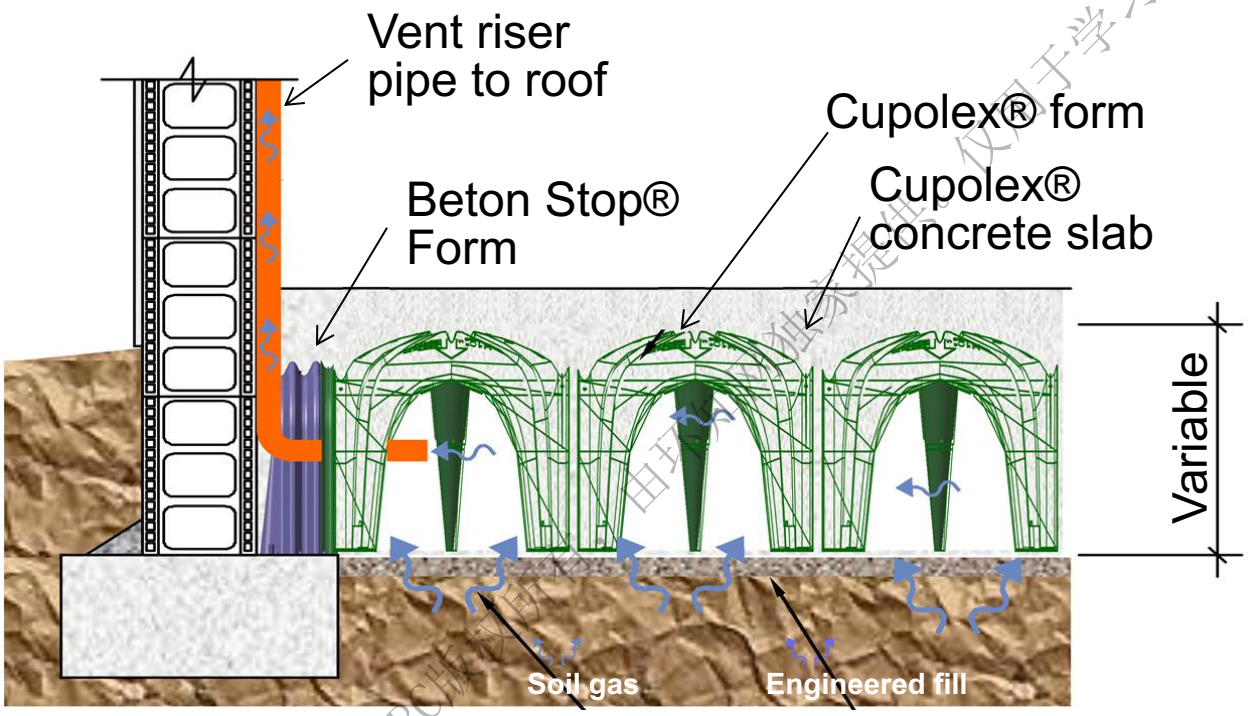


SSD Variations
Foundation Drain Depressurization

Source: Kansas Department of Health and Environment

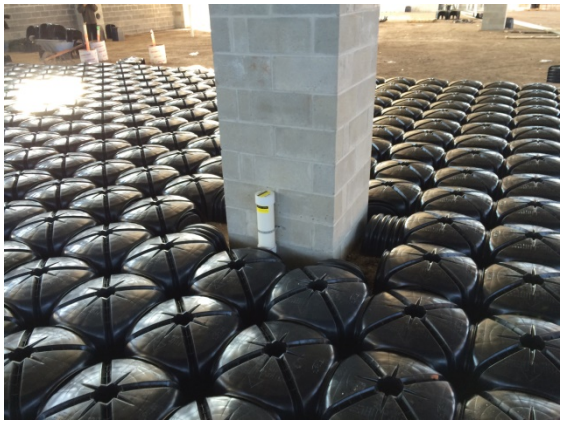
Aerated Floor System

- Forms create continuous cavity below slab
- Passive or active venting



Source: Pontarolo Engineering, Inc.

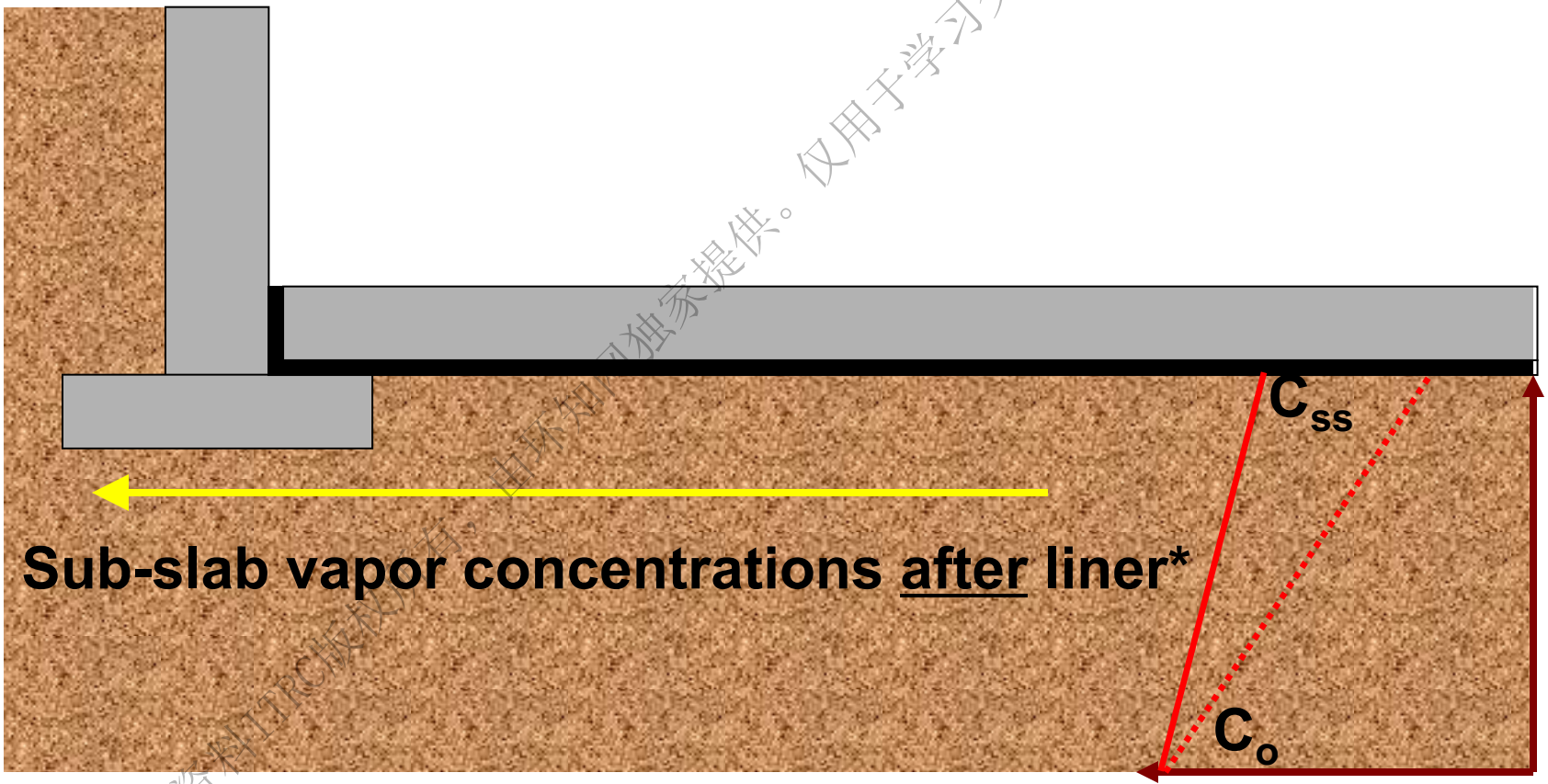
No product endorsement intended by this presentation



Source: Vapor Mitigation Sciences, LLC

Barrier Concept

- Vapors must diffuse or flow laterally



* No venting layer

Barriers

- Not all barriers are equal
  - Diffusion Coefficient is important for the contaminant

Source: Land Sciences Technologies

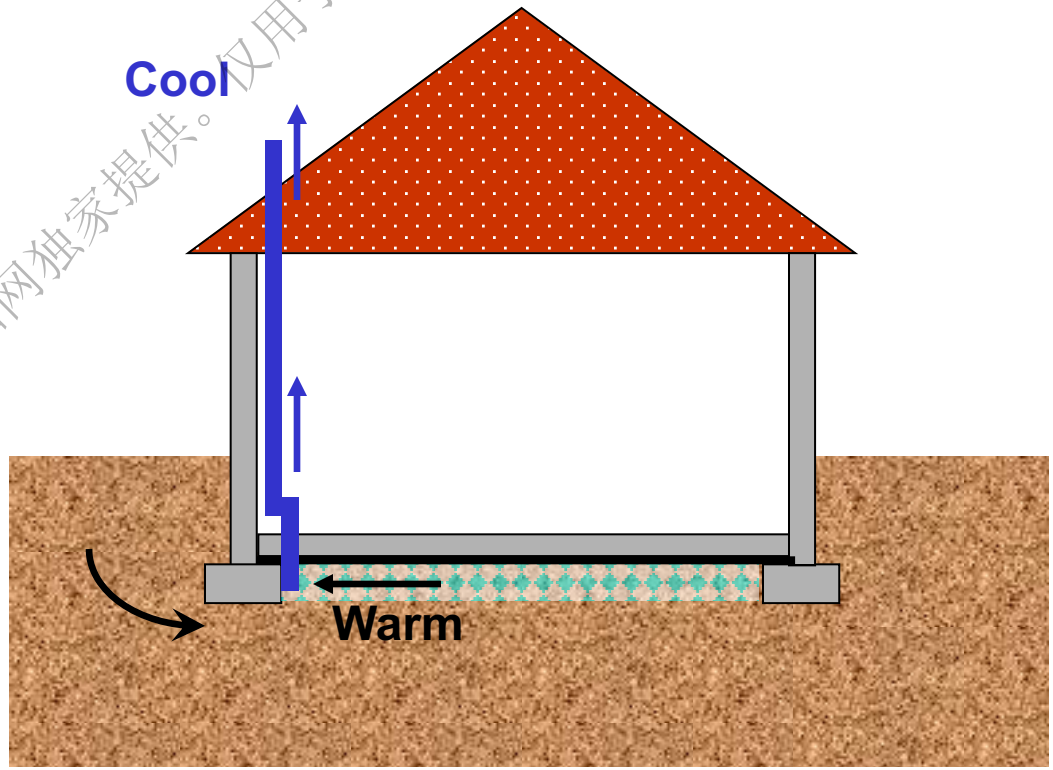
Source: LBI Technologies, Inc.

No product endorsements intended by this presentation

Passive Venting Mechanisms Often a Component of Barriers

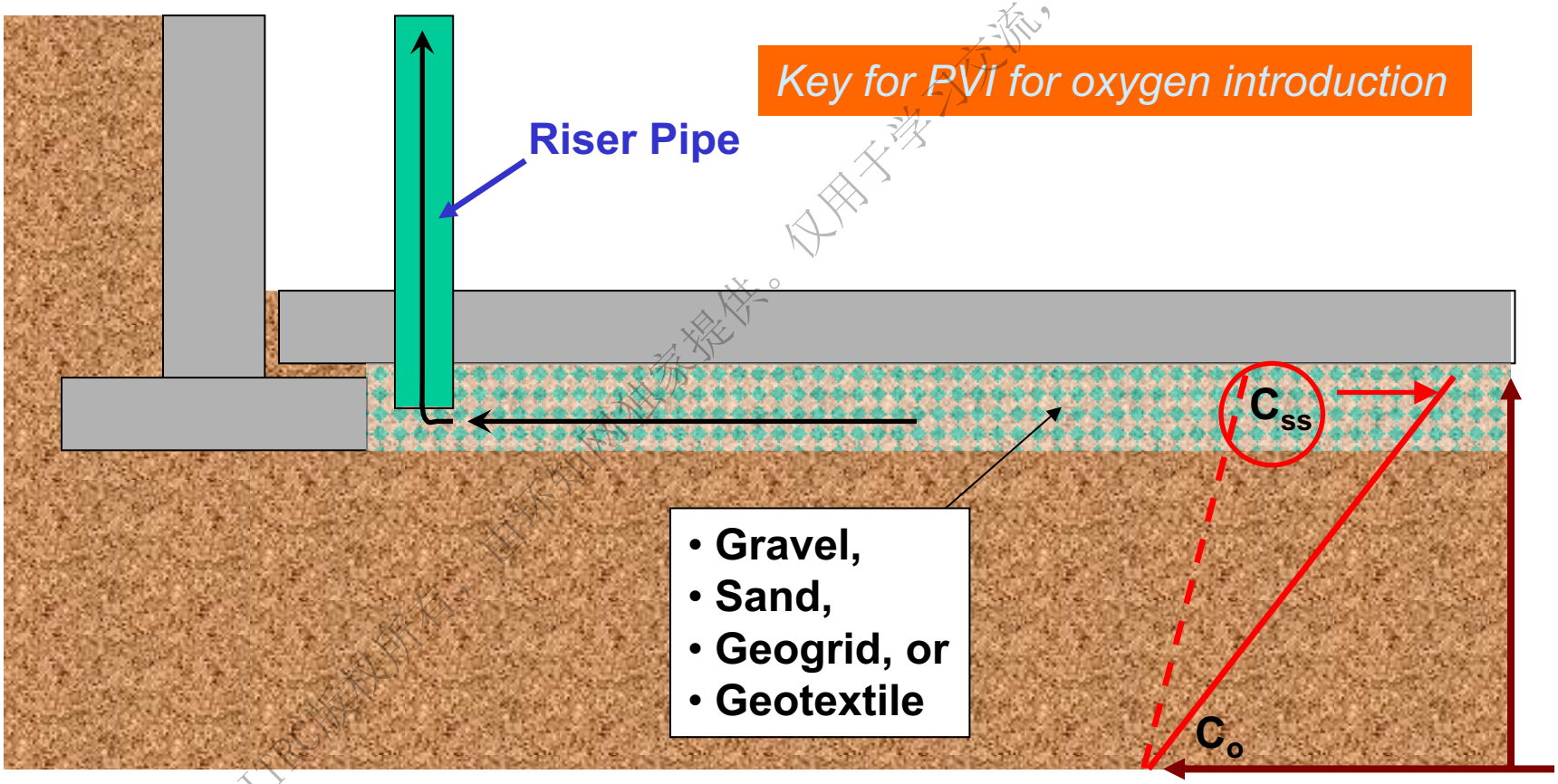
- Passive venting layers rely on diffusion and natural gradients
- Passive venting may not occur naturally at all times
- Passive venting primarily new construction
  - May be square footage or concentration dependent.

Source: Vapor Mitigation Sciences, LLC



Passive Venting Layers

- Provide vapor pathway to reduce C_{ss}



KEY POINT: May not be approved as a "stand-alone" option for CVI

Other Mitigation Strategies

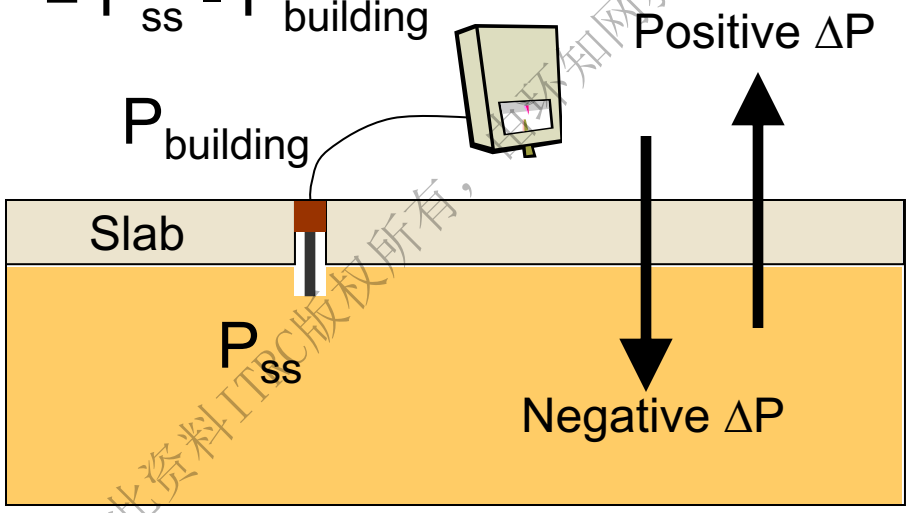
- Indoor air cleaners
- Passive venting
- Venting layers
- Building Pressurization
- Seal Cracks and Penetrations
- Building designed to prevent vapor intrusion

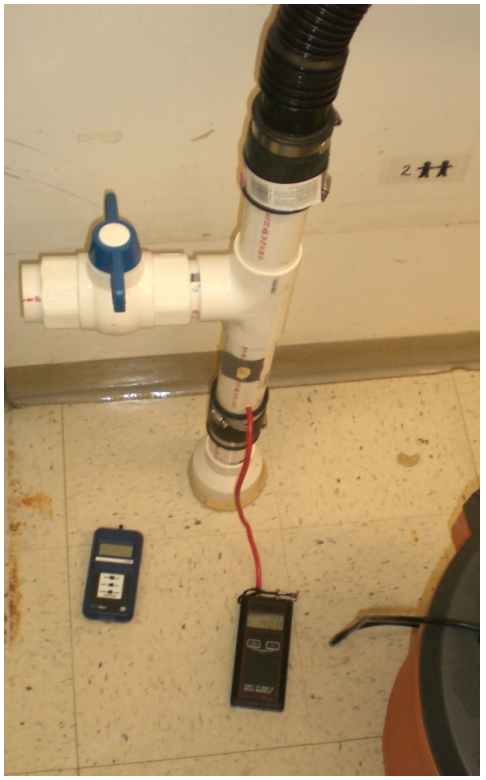
Source: www.allerair.com

Diagnostic Testing – Example

- School in Pennsylvania
- Multiple suction points tested - one shown in this example (TP4)
  - Shop vac used to apply ≈-40” water column suction
  - Pressure difference measured at 12 test holes

$$\Delta P = P_{ss} - P_{building}$$

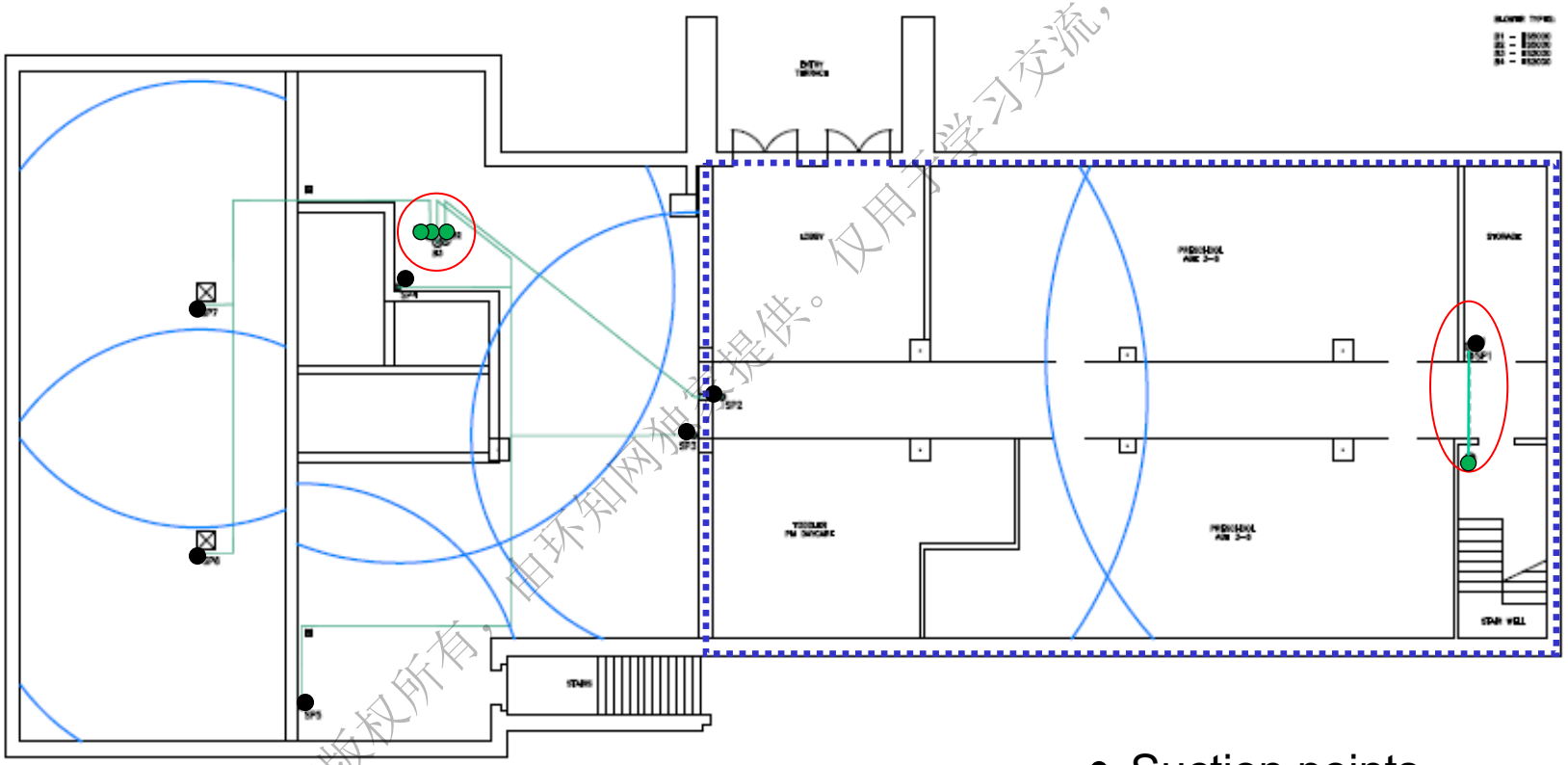




Source: Vapor Mitigation Sciences, LLC

Proposed Design and Expected Radius of Influence

Proposed Design based on diagnostic testing



- Suction points
- Blower locations
- Pipe runs

Source: Vapor Mitigation Sciences, LLC

Operation, Maintenance, and Monitoring (OM&M)

- Is it working?
  - Performance measurements
    - Vacuum
    - Flow
    - Pressure differentials
    - Sampling (IA, Sub-slab, Effluent)
    - Monitoring equipment
- Frequency of OM&M?
  - Quarterly, semi-annually, annually
  - Residential, commercial, industrial

Operation, Maintenance and Monitoring

- Operation
  - Electrical costs
  - Emission controls
- Maintenance
  - Fan replacement
- Monitoring
  - Testing
  - Inspections

Source: Vapor Mitigation Sciences, LLC

Low Pressure Monitoring Panel
Source: Tom Hatton, Clean Vapor, Inc.

Closure

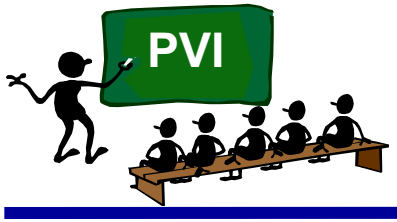
- When long term cleanup objectives are met
  - Building mitigation will no longer be required
  - Institutional controls can be retired/removed
- Consider how decisions to stop mitigation will be made at the beginning of process
- Collect sufficient information during operations and maintenance (O&M) to make closure decisions
  - Develop correlations between subsurface media concentrations and indoor air concentrations

Mitigation Resources

- Chapter 6 (Vapor Control and Site Management)
  - Overview of strategies
  - Factors unique to PVI mitigation
- Appendix J (Vapor Intrusion Control)
  - Detailed information on methods, selection factors, design, O&M, closure strategies
  - Table J-1 – Summary of Mitigation Methods
    - Technology
    - Typical applications
    - Challenges
    - Range of installation costs

Table J-1. Summary of mitigation methods

Technology	Typical applications	Challenges	Range of installation costs (per ft²)[1]
Active system			
Subslab depressurization (SSD)	Most structures; sumps, drain tiles, aerated floors, and block wall foundations may also be depressurized if present	Low permeability and wet soils may limit performance, otherwise, highly effective systems; may require a discharge permit	$2–$10/ft²; residential systems typically in the $2-4/ft² range
Subslab ventilation (SSV) or Crawl space venting	New and existing structures relies more on influencing air flow over depressurization	Low permeability and wet soils may limit performance, otherwise, highly effective systems; may require a discharge permit	$2–$10/ft²; residential systems typically in the $2-4/ft² range
Submembrane depressurization (SMD)	Existing structures, crawl spaces	Sealing to foundation wall, pipe penetrations; membranes may be damaged by occupants or trades people accessing crawl space	$1–$6/ft²; residential systems typically in the $1.50–$2/ft² range



Community Engagement

- How did I get a petroleum vapor intrusion problem?
- How long will I have a vapor control system in my home?
- What is a vapor control system and how does it work?
- How do I know when it's over?
- Where can I find more information about PVI?

Petroleum Vapor Intrusion: Frequently Asked Questions
Is a Petroleum Vapor Intrusion Problem Ever Over?
(PVI FAQ Sheet 4)

How long will it take to get rid of the petroleum vapor intrusion problem?

The answer can vary widely, depending on factors such as the severity of the petroleum leak and extent of contamination, the regulations of the state or municipality in which the leak occurred, the cleanup and vapor control methods used. Even efficiently run investigations and cleanups of petroleum leaks can take several years to finally resolve.

So, I may have a vapor control system in my home for years?

It is possible. It is often difficult to clean up contamination that has migrated away from its initial source. Cleanup may occur on-site (such as a gas station), leaving off-site contamination underneath homes and other structures. The remaining contamination may be slowly decreasing over time, but remain as a threat to indoor air. Vapor control systems may need to remain in place until clean up goals are met. At that point, the vapor control system may not be needed any more.

Underground fuel storage tank being removed. Removing the source of contamination is a key step in correcting a PVI problem. *Source: Courtesy Delaware Department of Natural Resources and Environmental Control.*

How will I know how long it will take for clean-up and vapor control?

If you are asked for permission to sample air in your home, or install a vapor control system, ask the party who is responsible. Contact the state or local environmental agency to find out details of a project in your neighborhood. Also, public outreach may be performed through community meetings, web pages, and newsletters. Keep alert for opportunities to become informed and involved.

How do I know when it's over?

Typically, you will receive notification from the responsible party or the responsible party's representative (typically an attorney or environmental professional) and notification or correspondence from your state or other regulatory agency. It is important that you are made aware that the state or other regulatory agency has agreed that the remediation is complete and that remediation system equipment can be removed. A contractor may remove any remediation and monitoring equipment that is no longer required.

Where can I find more information about PVI?

USEPA Office of Underground Storage Tanks (www.epa.gov/oust/pubs/pvi/index.htm)
and ITRC (www.itrcweb.org/Team/Public?teamID=12) both provide in-depth information on PVI.

Advancing Environmental Solutions
Documents, free Internet-based training, contact information: www.itrcweb.org

ITRC PVI-1, Appendix K – Frequently Asked Questions Fact Sheets

Vapor Control and Site Management Summary

- More than one mitigation strategy may be appropriate
- Unique factors may affect mitigation approach
  - Remediation may be more appropriate than building mitigation
  - Consider explosion potential
  - Think outside the box
- ITRC PVI guidance provides useful information and references for mitigation
- Remember community engagement