This document references Chapters and Sections from the ITRC Vapor Intrusion Technical and Regulatory Guidance, and Fact Sheets and Technology Information Sheets from the ITRC Vapor Intrusion Toolkit, published January 2026. These resources can be accessed at: https://itrcweb.org/vapor-intrusion-toolkit.

COMMON MISTAKES IN VAPOR INTRUSION EVALUATIONS, INVESTIGATIONS, AND MITIGATION FACT SHEET

Introduction

The state of the science related to vapor intrusion (VI) screening, sampling and assessment, and mitigation has evolved considerably over the past few decades. There have been substantial changes in our understanding of the many variables influencing the migration of vapor-forming chemicals (VFCs) in the subsurface, the evolution of sampling methodologies and best practices, screening level updates for specific VFCs, and development of and revision to regulatory guidance documents. Staying up to date with current practices is critical to reduce uncertainties and produce usable data for risk management decisions. This fact sheet summarizes many of the common mistakes encountered when evaluating VI.

Deviation from Applicable Regulatory Guidance

VI guidance documents authored by specific regulatory agencies often detail specific information related to methods, procedures, or practices that are recommended. It is advisable to discuss proposed deviations from applicable guidance with regulators ahead of sampling and investigation activities. See Appendix A: Summary of State Vapor Intrusion Practices for additional information.

Units and Unit Conversion

Take care to understand units used when evaluating and reporting compound concentrations in air or soil vapor. Commonly reported units of air and soil vapor samples are micrograms per cubic meter (µg/m^3), micrograms per liter (µg/L), parts per billion volume (ppbv), parts per million by volume (ppmv), and percent by volume (%). Unlike concentrations in water (e.g., µg/L is equivalent to ppb in water), concentrations by volume are not equivalent to concentrations by mass in air or soil vapor. Concentrations reported in ppbv equate to the volume of a compound per billion volumes of the compound/air mixture. Conversely, concentrations reported in µg/m^3 refer to the mass of a compound per cubic meter of air. Unit conversion is dependent on the molecular weight of a compound along with temperature and air pressure. Since many indoor air and soil vapor screening levels are in units of µg/m^3, analytical results in other units are not recommended because they require unit conversion to appropriately compare results to applicable screening levels. See Chapter 8: Data Evaluation and Vapor Intrusion Risk Assessment and the Units and Unit Conversions Fact Sheet for additional information.

Laboratory Reporting Limits

Analytical reporting limits exceeding applicable screening level concentrations introduce uncertainty when evaluating results. This situation most commonly occurs when a sample is diluted by the laboratory or when a screening level is below the method capability. Consult with the selected laboratory to confirm the minimum sample volume required and ensure that selected analytical methods are sufficiently sensitive to achieve required screening levels, if possible. A particular compound may also have an indoor air screening level below even the most sensitive analytical method detection limits. In these cases, practitioners are advised to discuss available options, such as sampling soil vapor and applying a site-specific attenuation factor developed from other compound ratios, surrogates, or other methods to estimate indoor air concentrations. See **Chapter 8: Data Evaluation and Vapor Intrusion Risk Assessment** and the **Attenuation Factors Fact Sheet** for additional information.

Soil Vapor Probe Construction and Sampling

Construct soil vapor probes to avoid using materials (particularly tubing) that sorb or desorb VFCs. Use materials that are free of volatile organic compounds to reduce uncertainties. It is good practice to clean metal components of residual oils prior to installation and sampling. See **Chapter 7: Sampling and Analysis** for additional information.

Equilibration Time: A period of equilibration is required following installation of soil vapor sample probes due to the disturbance associated with installation. The time needed for soil vapor equilibration is dependent on probe installation methodology and can range from 30 minutes to days or weeks. Recommended equilibration times based on probe installation methods are discussed in **Chapter 7: Sampling and Analysis.**

Number of Samples: Some states specify sample density requirements based on site conditions and the sample matrix (air and/or soil vapor), while others do not explicitly address the topic. The exact number and spacing of samples vary on a site-specific basis, but sufficient soil vapor and/or sub-slab vapor samples should be taken to make appropriate decisions. For smaller sites (e.g., houses surrounding a dry cleaner or a gas station), at least one soil vapor and/or sub-slab vapor sample should be taken for every existing or future building. At larger sites (e.g., a groundwater plume under a large neighborhood), enough samples should be collected to give sufficient spatial coverage of the area over and near the contamination. For sites where current and future land use will be restricted by a land use covenant, the soil vapor and/or sub-slab vapor sampling density may be modified as a function of the size of the current and future buildings.

The number of air background samples should also be based on sampling methodology and state requirements. While shorter-duration samples are typically placed upwind of a subject site, longer-duration samples may require multiple locations to account for changes in atmospheric conditions.

Collecting samples at locations that would otherwise screen out can confound interpretation of results by potentially attributing impacts to the site that are more likely from sources other than the subject site. Site screening should indicate and prioritize the initial investigation area, results of which would facilitate determining whether the area of concern should be expanded, reduced, or reconfigured.

Quality Control Procedures

Quality control/quality assurance procedures conducted during soil vapor and indoor air sampling typically include a vacuum test (often referred to as a “shut-in test”) and leak testing involving gaseous, liquid tracer, or water barrier methods. Appropriate leak testing methods should be conducted and documented to ensure the integrity of each sample. These procedures are often insufficiently documented, incorrectly applied, or not conducted. See **Chapter 7: Sampling and Analysis** for additional information.

Inappropriate Use of Models

While regulatory authorities may not accept VI modeling as a sole line of evidence, modeling is often used as one of the many potential lines of evidence in VI investigations. Additionally, modeling can be a useful tool for proposed development when indoor air sampling is not possible. Not only should model selection be based on physical site characteristics, but it should also be based on the specific chemicals present and objectives. These topics are discussed in detail in **Chapter 9: Modeling** and the **Johnson and Ettinger Model Fact Sheet.**

Screening Levels

Screening levels may be matrix specific, depth dependent, or specific to individual compounds with regard to applicable risk thresholds or exposure endpoints. Occupational Safety and Health Administration standards or other occupational criteria should not be used to evaluate VI risk or establish screening levels. It is good practice to confirm the use of appropriate screening levels, many of which are routinely updated by regulatory agencies. See **Chapter 8: Data Evaluation and Vapor Intrusion Risk Assessment** and the **Screening Levels Fact Sheet** for additional information.

Petroleum Vapor Intrusion

Migration of VFCs in soil vapor, and therefore potential for VI, may be overestimated for petroleum hydrocarbons and other compounds known to degrade aerobically. Analysis of fixed gases, such as oxygen, can support the identification of conditions conducive to aerobic degradation. See **Chapter 7: Sampling and Analysis**, the **Petroleum Vapor Intrusion Fact Sheet**, and the **Multiple Lines of Evidence Fact Sheet** for more information.

Evaluating Potential for Vapor Intrusion During Mild or Stable Conditions Only

Collecting sub-slab vapor, conduit vapor, and indoor air samples during mild conditions only and not evaluating the potential for VI during worst-case conditions such as high temperature and pressure differentials, high/low water table, heavy wind/rain events, etc. may not provide sufficient representation of site conditions. This is also true when commissioning VI mitigation systems (VIMS), which also needs to be performed over a variety of weather conditions. See **Chapter 7: Sampling and Analysis** and **Chapter 10: Vapor Intrusion Mitigation** for additional information.

Conclusions Based on Limited Data

Sufficient data should be collected to conclude whether the VI pathway is or is not a significant exposure pathway. What constitutes “sufficient” often varies depending on the specific site and may refer to the number of and/or types of media sampled, sample density, or other lines of evidence used to support risk management decisions. VI is episodic in nature; therefore, relying on limited data (e.g., only indoor air) entails a degree of uncertainty. Characterizing soil vapor, and potentially preferential pathways, provides a better weight of evidence to determine whether VI is a potential concern and provides insight on sources of detections. Additionally, conclusions based on limited data may not account for spatial or temporal variability from building to building or even within a building. See the **Multiple Lines of Evidence Fact Sheet, Chapter 5: Site Screening**, and **Chapter 11: Vapor Intrusion Component Determination, Exit Points, and Closure** for additional information.

Vapor Barrier Selection

Vapor barriers commonly used in construction typically refer to water VI prevention, not chemical VI related to VFCs in soil vapor. Barriers intended for VI mitigation should be designed to mitigate chemical VI and adhere to applicable design criteria where applicable. See **Chapter 10: Vapor Intrusion Mitigation** for additional information.

Post-Mitigation System Verification

VIMS installation typically includes some form of post-installation verification to ensure the VIMS is effective. Post-mitigation verification may include pressure field extension monitoring, indoor air sampling, or other options discussed in **Chapter 10: Vapor Intrusion Mitigation**.

Vapor Intrusion Mitigation System Labeling and Communication with Owners and Occupants

There should be clear instructions for what off-site owners/occupants are to do when notification alarms sound, fans stop running, the membrane appears compromised, or there is other evidence that the VIMS is not functioning optimally. The VIMS should be designed for long-term success beyond the commissioning phase. See **Chapter 10: Vapor Intrusion Mitigation** for more information.

Mitigation at Existing Structures—Dead Zones

When VI mitigation is conducted at existing structures, it frequently relies on sub-slab depressurization systems consisting of suction pits installed under the foundation. The extent of the sub-slab vacuum is typically established by measuring the pressure differential across the slab at distinct monitoring points during a pilot test. Large foundation areas frequently are subdivided into distinct compartments with little or no soil vapor flowing between them. Care must be taken to review the foundation plans of the building as part of the pilot test design and subsequent system construction, and to place the suction points and vacuum monitoring points appropriately to access these unconnected zones. See **Chapter 10: Vapor Intrusion Mitigation** for additional information.

Depressurization System Mitigation—Groundwater Table Fluctuations

Groundwater typically fluctuates in response to precipitation events, seasonal changes, or anthropogenic activities (e.g., groundwater extraction and recharge). In some cases, these fluctuations may be significant. Depressurization systems function only in the presence of the unsaturated zone immediately under the floor slab. If the water table fluctuations result in frequent and prolonged flooding of that zone, the long-term effectiveness of the depressurization system(s) may be compromised. Where available, long-term groundwater table elevation records should be obtained and reviewed prior to depressurization method selection. In addition, any depressurization system should be designed so that the sub-slab portion of the system could readily drain following the intrusion of the groundwater into the plenum or collection piping (e.g., providing weep holes at low points). See **Chapter 10: Vapor Intrusion Mitigation** for additional information.

Not Allowing Sufficient Time for Equilibration (Vapor Intrusion Mitigation System)

Assessments, investigations, and mitigation of VI should consider the time required for soil vapor concentrations to achieve equilibrium concentrations after a change in site conditions. For example, not only will it take time for VFCs to diffuse back into the void space created by the installation of a sampling probe, as mentioned above, but the same is true for changes in site conditions related to plume migration and installation and/or shutdown of active mitigation systems. At the lower boundary of the vadose zone, it may take weeks or months for soil vapor concentrations to reach equilibrium concentrations after a groundwater plume (vapor source) first arrives below a building or after the source is remediated

(Johnson et al. 1999). At the upper boundary of the vadose zone, an active VIMS (see **Section 2.4.2**) will typically reduce sub-slab vapor concentrations over time, until the vapor concentration profile and the resulting upward diffusion mass flux achieves equilibrium with the mass flux of the VIMS (Folkes and Sanpawanitchakit 2011). Similarly, when an active VIMS is turned off, it will take time for sub-slab vapor concentrations to rebound to the higher levels consistent with initial conditions (unless vapor concentrations in the vadose zone have been reduced due to source remediation or depletion). Therefore, sampling to confirm that mitigation is no longer required must consider the time required for rebound, if any, to occur.

Incorrect Placement of Vapor Intrusion Mitigation System Exhaust Components

Emissions from VIMS exhaust have the potential to re-enter buildings if placed in incorrect locations. This most often occurs when risers or other exhaust components are located in the vicinity of windows, air intakes, or roof penetrations. Sub-slab depressurization systems can depressurize buildings due to the vacuum created by the VIMS, inducing differential pressure across the foundation with flow direction oriented downward toward the extraction point. In some instances, VFCs drawn from beneath a building can be transported into the depressurized building.

REFERENCES

Folkes, D. J., and C. Sanpawanitchakit. 2011. *Modeling of Vapor Intrusion Mitigation*. **https://www.researchgate.net/publication/320067948_Modeling_of_vapor_intrusion_mitigation**.

Johnson, P. C., M. W. Kemblowski, and R. L. Johnson. 1999. “Assessing the Significance of Subsurface Contaminant Vapor Migration to Enclosed Spaces: Site-Specific Alternatives to Generic Estimates.” *Soil and Sediment Contamination* 8 (3): 389–421.