BACKGROUND SOURCES TO INDOOR AIR FACT SHEET

Introduction

Background sources of vapor-forming chemicals (VFCs) can be found both inside and outside a building. Their presence can confound the evaluation of the vapor intrusion (VI) pathway because they influence the concentrations of VFCs found in indoor air. Background sources may be solely responsible for the concentrations observed in indoor air or they may add to contributions from the VI pathway. Background indoor air sources in particular pose a complicated issue as sources can be varied, difficult to locate, and difficult to remove. Background indoor air sources can come from chemicals/products used or stored in a building, the building's construction materials, or other objects/materials used or stored in a building. This fact sheet discusses common sources of background concentrations in indoor air and how to evaluate their presence in a VI investigation.

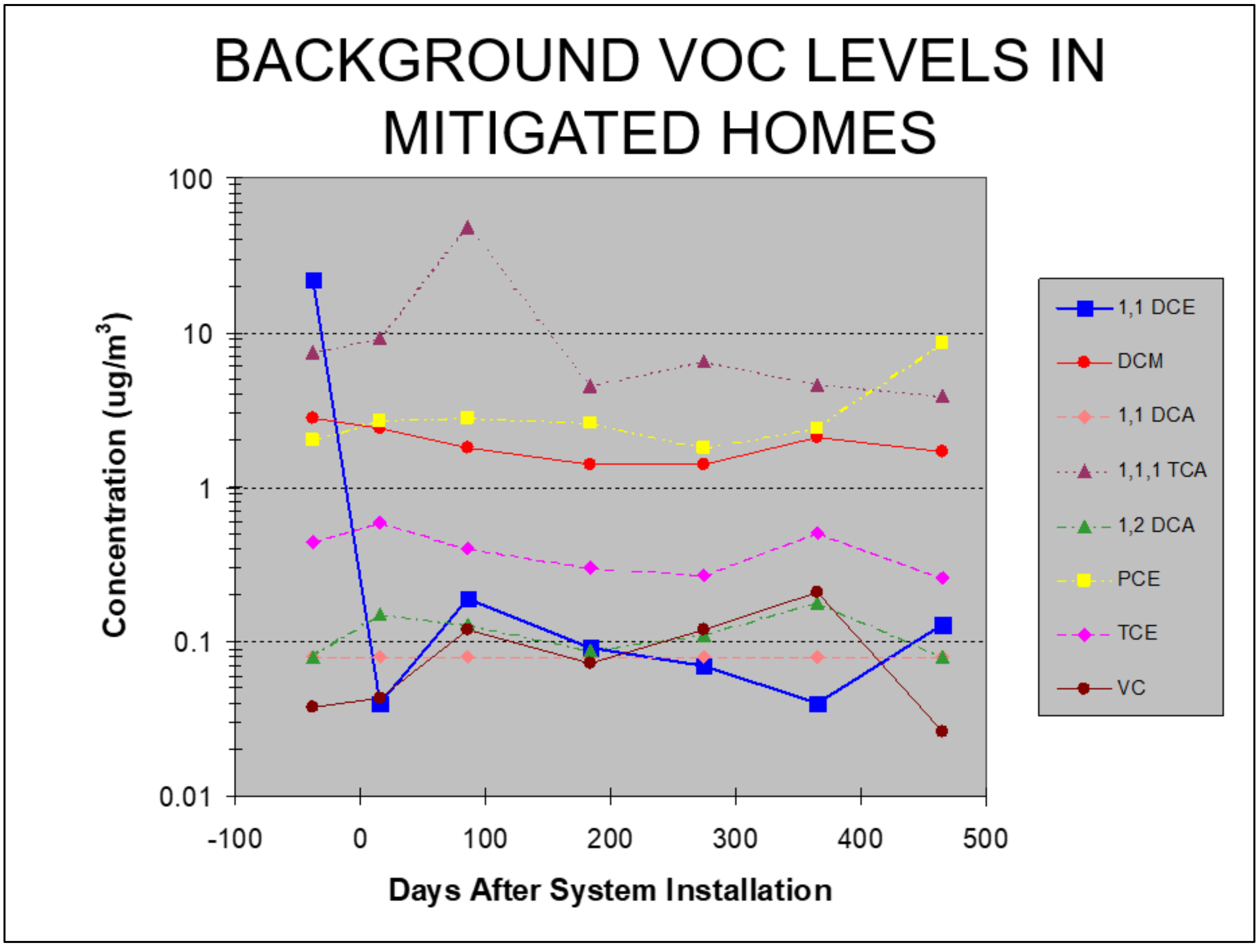
For environmental investigations, the term "background" generally refers to levels of contaminants that are present due to naturally occurring phenomena or those otherwise present in the absence of a release of that substance to environmental media (USEPA 2002). In this fact sheet and within the **Interstate Technology & Regulatory Council VI Toolkit**, background is defined as indoor air concentrations of VFCs that are present in the absence of a release to the environment or in the absence of a complete VI pathway. In other words, background sources are sources that are above ground, that are influencing indoor air, and that would not be considered to be coming from VI. These sources include cleaning products, residential heating fuels, household materials, building materials, and many other sources. Indoor air often contains measurable concentrations of VFCs resulting from emissions from storage or use of these items. Outdoor air may be affected by background sources as well and may also influence indoor air.

In some cases, background contributions of VFCs exceed health-based target concentrations for VI. Benzene is a notable example. Benzene attributable to background sources is commonly detected in indoor air at concentrations above the incremental 10^{-5} (one in one hundred thousand) cancer risk threshold for a residential scenario.

Since background levels in indoor air may confound VI investigations, the role of indoor air background requires careful consideration and is an important concept to understand for regulators and the regulated community. VFCs such as benzene, toluene, ethylbenzene, and xylenes (BTEX) often require particular attention, since these compounds are frequently present as background in both indoor air and outdoor air. Beyond BTEX, many other VFCs, such as tetrachloroethene (PCE; also called perchloroethene and tetrachloroethylene), trichloroethene, 1,2-dichloroethane, carbon tetrachloride, naphthalene, and chloroform, can be common in indoor air depending on what is used or stored in a given residential, commercial, or industrial building. Thus, distinguishing between indoor or outdoor background sources and VI plays an important role in site management and decision-making. A list of studies that summarize concentrations empirically found in indoor air of both residential homes and commercial businesses is provided in the Background Concentration Studies and Other Relevant References section of this fact sheet.

Because their source is not in the subsurface, compounds present in indoor air due to background levels generally will not be affected by steps taken to mitigate VI. This is illustrated in **Figure 1**, which shows average indoor air concentrations of several VFCs from dozens of residential buildings that were mitigated for 1,1-dichloroethylene. The indoor air concentrations 1,1-dichloroethylene decreased by more than two orders of magnitude when sub-slab venting was initiated. Other compounds present in the indoor air, however, exhibited no significant change in indoor air concentrations after mitigation. Any

VFCs present in the subsurface would be expected to be mitigated by the sub-slab venting systems, so VFCs, such as PCE and trichloroethylene or trichloroethene in this example, that were not controlled by the mitigation system were present as background indoor air compounds.



Note: µg/m³ = micrograms per cubic meter, DCA = 1,2-dichloroethane , DCE = 1,2-dichloroethene , DCM = dichloromethane, PCE = tetrachloroethene (also called perchloroethene and tetrachloroethylene), TCA = trichloroethane, TCE = trichloroethylene or trichloroethene, VC = vinyl chloride , and VOCs = volatile organic compounds.

Figure 1. Example indoor air concentrations of vapor-forming chemicals in a vapor intrusion–mitigated home before and after mitigation system start up.

Source: David Folkes, Geosyntec, used with permission.

Common Background Sources

Background sources that influence indoor air could come from products, chemicals, or materials used or stored in a building. The background source influencing indoor air could also be outside the building; VFCs from this source are then introduced to the indoor air by natural and mechanical ventilation of the building. The following two sections highlight types of background VFCs that come from indoor air sources or outdoor air sources.

Background Indoor Air Sources

Background VFC sources found inside a building contribute to the overall makeup of indoor air and often can be difficult to locate. Background indoor sources may be different for residential buildings than for commercial or industrial buildings. Residential background indoor sources may include various consumer products used or stored in the building (Doucette et al. 2010; 2018), building materials, and home heating oils and fuels. Examples of potential background VFC sources include but are not limited to the following:

- Household cleaners, stain removers for fabrics, lubricants, bonders, antistatic aerosols, jewelry polish, and insect repellants
- Supplies for personal hobbies
- Off-gassing from interior surfaces such as furniture (Bingham et al. 2023) and wood surfaces
- Dry-cleaned materials (e.g., clothing containing residual dry-cleaning solvents)
- Cigarette smoke
- Adhesives (automotive, household, craft, and plumbing) and adhesive removers
- Automotive parts and cleaners
- Maintenance products such as gun cleaners, paint strippers, water repellants, spray paints, caulks, and sealants
- Cosmetics (e.g., hair spray, nail polish, nail polish remover, and perfume)
- Air fresheners/odor eliminators, candles, and plug-in wall diffusers

The sorbtive nature of some materials (e.g., carpeting, drapes, upholstery) should also be considered as they may retain VFCs and slowly release them to the indoor environment over a period of weeks or more (Dawson and McAlary 2009; Xie et al. 2023).

Commercial/industrial background indoor sources may include some or all of the above materials and products as well as chemicals used or stored as part of manufacturing processes or materials used as part of a manufacturing process. Information on common household products that cause measurable levels of VFCs in indoor air can be found in the Consumer Product Information Database (DeLima Associates 2025).

Some background sources, such as off-gassing from consumer product use or storage, occur on a fairly consistent basis. Other

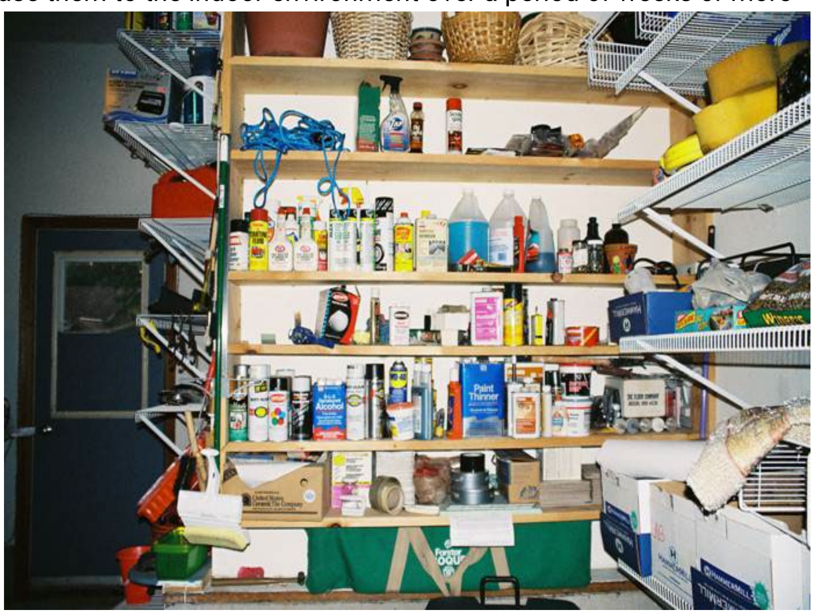


Figure 2. Example of typical chemicals used/stored in a residential building.

Source: Rich Rago, Haley & Aldrich, used with permission.

sources may be intermittent or variable and may randomly skew data. For example, smoking in a rental property may be present one month and absent during the next. Or, as another example, shipments of materials to a commercial/industrial facility that off-gas VFCs may ship at irregular intervals, may come from different suppliers and have different VFC content, or may move through buildings at irregular intervals. It may be possible for intermittent background sources to consistently confound interpretation of indoor air results (e.g., cigarette smoke, air fresheners, cleaning supplies, etc.).

Empirical data has found that certain chemicals have background detection frequencies in indoor air that are greater than 90 percent, absent a complete VI pathway (e.g., BTEX, acetone, certain freons, carbon tetrachloride) (Dawson and McAlary 2009; USEPA 2011; Rago et al. 2021; Plantz et al. 2025). Petroleum hydrocarbons in particular are common as background in indoor air. BTEX levels have been identified in new (finished but unoccupied) prefabricated and site-built houses (Hodgson et al. 2000), and higher background levels of VFCs have been observed in homes with attached garages (Dodson et al. 2007; Graham et al. 2004; MTDEQ 2012) versus unattached or no garages. Petroleum VFCs are also commonly found in commercial buildings (Daisey et al. 1994; Girman et al. 1999; Rago et al. 2021). For example, indoor air background concentrations of BTEX have been identified at significantly higher levels than indoor air levels observed during VI investigations at manufactured gas plant (MGP) sites (EPRI 2007).

Investigators should pay careful attention to indoor air background sources. Some guidance has recommended that potential background sources (typically limited to residential buildings) be removed from an indoor space prior to indoor air sampling, if they are identified and if practical and safe to do so. Even if they are removed, these products were likely used within the space, and the presence of VFCs may not dissipate quickly (or at all) after product removal. In addition, indoor air that contains background VFCs may also influence sub-slab vapor concentrations, potentially complicating VI assessments (McHugh et al. 2006; Johnson et al. 2016; Holton et al. 2018). In the event that indoor air background levels have confounded or are suspected to be confounding a VI investigation, additional sampling techniques and forensic analysis (see the **Approaches for Vapor-Forming Chemical Source Determination Fact Sheet**) may be needed to assess the relative contribution from subsurface and background sources. Multiple lines of evidence (MLE; see the **Multiple Lines of Evidence Fact Sheet**) and multiple methods of interpretation may be required (Plantz et al. 2008).

One other potential source of indoor air impacts not yet covered by this section are sumps (typically residential basement sumps). If the sump is in contact with or contains shallow groundwater and if that shallow groundwater is impacted with VFCs, the VFCs may off-gas directly into the indoor air. These impacts do not migrate through the subsurface and then across a building foundation and thus do not constitute a typical VI pathway but instead are due to direct volatilization. The **Direct Volatilization to Indoor Air Fact Sheet** discusses this pathway as it relates to VI investigations and VI mitigation.

Background Outdoor Air Sources

VFCs in outdoor air may affect concentrations in indoor air. Some background sources, such as emissions from nearby industrial facilities or vehicle traffic, occur on a fairly consistent basis and can result in exceedances of generic indoor air screening levels for certain chemicals (e.g., benzene, carbon tetrachloride, naphthalene, 1,2-dichloroethane). This is particularly relevant in urban or industrial areas where the number of detectable VFCs and relative concentrations in outdoor air tend to be higher relative to suburban or rural areas (USEPA 2024; Weitekamp et al. 2021). VFC concentrations in outdoor air often exhibit considerable temporal (diurnal, seasonal, and annual) and spatial variation (Folkes et al. 2009; Logue et al. 2010; Jia et al. 2012), especially in areas where emission sources, emission rates, and environmental factors can impact dispersion. Detectable levels of certain VFCs may also result from secondary atmospheric transformation, biogenic, or nonspecific sources (USEPA 2024); however, these contributions tend to be minimal. Some VFCs in outdoor air are considered ubiquitous due to atmospheric persistence, such as chloromethane and carbon tetrachloride (Rago et al. 2021), while others are more commonly detected in the vicinity of vehicle traffic (e.g., BTEX, 1,3-butadiene, acrolein) or in commercial areas (BTEX, freons, PCE, and others). Compounds present in outdoor air are usually detected in indoor air due to building air exchange through leaks in the building envelope and natural and mechanical ventilation. As a general rule of thumb, when comparing outdoor air samples collected contemporaneously with indoor air samples, indoor air concentrations within a factor of two of the outdoor air concentrations may indicate outdoor air contributions to indoor air (USEPA 2015).

Background Concentration Studies and Other Relevant References

Concentrations of VFCs present in indoor air that are due to background sources can vary widely based on building type, use, and location. General ranges of background indoor air VFC concentrations, however, are available from studies focused on compiling indoor air data from sets of general residential, commercial, and industrial buildings that have not been impacted by the VI pathway. The following list includes studies of background indoor air concentrations presented in reverse chronological order. Please note this list is not exhaustive. Also note that background concentrations in indoor air may change over time as manufacturing processes change. For example, Weschler (2009) showed a general decrease in concentrations of some chemicals over decade-long timescales, suggesting that older studies may not be as applicable to newer conditions. Conversely, changes in manufacturing can lead to increases in concentrations of other chemicals in indoor air—for example, 1,2-dichloroethane, as described in Doucette et al. (2010).

Studies of background indoor air concentrations are listed below:

- "Indoor Air Background Concentrations of Volatile Organic Compounds (VOCs) in California Residences" (Plantz et al. 2025)
- "Indoor Air Background Levels of Volatile Organic Compounds and Air-Phase Petroleum Hydrocarbons in Office Buildings and Schools" (Rago et al. 2021)
- "Background Levels of Volatile Organic Chemicals In Homes: A Review of Recent Literature" (NJDEP 2016)
- "Levels and Sources of Volatile Organic Compounds in Homes of Children with Asthma" (Chin et al. 2014)
- "Typical Indoor Air Concentrations of Volatile Organic Compounds in Non-Smoking Montana Residences Not Impacted by Vapor Intrusion" (MTDEQ 2012)
- "EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic Compounds and Residential Buildings" (USEPA 2012)
- "Background Indoor Air Concentrations of Volatile Organic Compounds in North American Residences: A Compilation of Statistics for Assessing Vapor Intrusion" (1990–2005) (USEPA 2011)
- "A Compilation of Statistics for VOCs from Post-1990 Indoor Air Concentration Studies in North American Residences Unaffected by Subsurface Vapor Intrusion" (Dawson 2009)
- "Residential Typical Indoor Air Concentrations Technical Update" (MADEP 2008)
- "Indoor Air VOC Concentrations in Suburban and Rural New Jersey" (Weisel et al. 2008)
- "Influence of Basements, Garages, and Common Hallways on Indoor Residential Volatile Organic Compound Concentrations" (Dodson et al. 2008)

- "Residential Indoor Air Background Data: A Comparison of Indoor Air Results from Vapor Intrusion Studies at MGP Sites in New York" (EPRI 2007)
- "Concentrations and Emissions of Gasoline and Other Vapors from Residential Vehicle Garages" (Batterman et al. 2006)
- "Soil Vapor Intrusion Guidance, Appendix C. Study of Volatile Organic Compounds in Air of Fuel Oil Heated Homes, 1997–2003" (NYSDOH 2006)
- "Contribution of Vehicle Emissions from an Attached Garage to Residential Indoor Air Pollution Levels" (Graham et al. 2004)
- "Comparison of Personal, Indoor, and Outdoor Exposures to Hazardous Air Pollutants in Three Urban Communities" (Sexton et al. 2004)
- "Volatile Organic Compounds in Indoor Air: A Review of Concentrations Measured in North America Since 1990" (Hodgson and Levin 2003)
- "Volatile Organic Compound Concentrations and Emission Rates in New Manufactured and Site-Built Houses" (Hodgson et al. 2000)
- "Individual Volatile Organic Compound Prevalence and Concentrations in 56 Buildings of the Building Assessment Survey and Evaluation (Base) Study" (Girman et al. 1999)
- "Volatile Organic Compounds in Twelve California Office Buildings: Classes, Concentrations and Sources" (Daisey et al. 1994)

Two additional reference lists are provided below that may be useful when evaluating the potential presence of background sources. The first list contains information specific to sampling, collecting, or interpreting background source data, and the second list contains studies documenting specific off-gassing materials.

Studies discussing evaluation of potential background sources are listed below:

- "1,2-Dichloroethane in Indoor Air" (Eklund et al. 2025)
- "Fate and Transport of Chloroform in VI Evaluations" (Eklund and Rago 2024)
- "Vapor Intrusion Investigations and Decision-Making: A Critical Review" (Ma et al. 2020)
- "Determining the Influence of Background Sources on Indoor Air Concentrations in Vapor Intrusion Assessment" (USDOD 2017)
- "EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic Compounds and Residential Buildings" (USEPA 2012)
- "Changes in Indoor Pollutants Since the 1950s" (Weschler 2009)
- "Evaluating the Vapor Intrusion Pathway, Challenges and Source Identification" (Plantz et al. 2008)
- "Reference Handbook for Site-Specific Assessment of Subsurface Vapor Intrusion to Indoor Air" (EPRI 2005)
- "Exposure to Multiple Air Toxics In New York City" (Kinney et al. 2002)
- "The use of indoor air measurements to evaluate intrusion of subsurface VOC vapors into buildings" (Hers et al. 2001)

- "National Human Exposure Assessment Survey (NHEXAS): Distributions and Associations of Lead, Arsenic and Volatile Organic Compounds in EPA Region 5" (Clayton et al. 1999)
- "Neurobehavioral and Sensory Irritant Effects of Controlled Exposure to a Complex Mixture of Volatile Organic Compounds" (Otto et al. 1990)

Studies documenting specific off-gassing materials are listed below:

- "Emissions of Trichloroethylene from Bedroom Furniture Set as a Source of Indoor Air Contamination" (Bingham et al. 2023)
- "Emission Rates of Chlorinated Volatile Organics from New and Used Consumer Products Found During Vapor Intrusion Investigations: Impact on Indoor Air Concentrations" (Doucette et al. 2018)
- "Emissions of 1,2-Dichloroethane from Holiday Decorations as a Source of Indoor Air contamination" (Doucette et al. 2010)
- "Acrolein Measurements" (Shelow et al. 2009)

Sampling for Background Sources

Sampling methods used to account for background contributions to indoor air may include relatively simple practices or innovative technologies and forensics. Several sampling approaches that may assist in background source evaluation are listed below. These sampling approaches are further detailed in **Chapter 7: Sampling and Analysis**. These sampling tools provide data to help interpret the presence of background sources when completing an MLE evaluation of background influence (see the **Evaluating Background Sources Using Multiple Lines of Evidence** section in this Fact Sheet as well as the **Multiple Lines of Evidence Fact Sheet**).

- **Collecting outdoor air samples with indoor air samples** (**Section 7.3.1 Indoor and Outdoor Air Sampling Points** and **Section 7.4 Sampling Methods**): One basic tool used to help understand outdoor air influence on indoor air is to obtain outdoor air samples upwind of a site or building when collecting indoor air samples. In this way, outdoor air quality may act as a baseline, to which interior and subsurface sources are additive. This simple, long-standing practice allows direct comparison of concurrent indoor and outdoor air results but may not account for transitory outdoor air sources or the presence of indoor sources. Indoor air concentrations within a factor of two of outdoor air concentrations may indicate outdoor air contributions to indoor air (USEPA 2015).
- **Limiting analytical reporting list to target VFCs** (**Section 7.10 Analytical Methods and Section 7.8.2.3 Background Sources**): Focusing the analytical reporting list to only those VFCs that are of interest in the VI investigation may eliminate the "noise" of other VFCs present in indoor air from background sources.
- **Conducting a building survey and chemical inventory** (**Section 7.3.1.1 Building Survey and Appendix B: Example Documents**): It is appropriate to conduct a building walkthrough in advance of indoor air sampling events to identify potential background sources. See the **Indoor Air Quality Questionnaire and Building Inventory Checklist** for an example.
- **Potentially removing chemicals prior to sampling** (**Section 7.3.1.1 Building Survey and Section 7.4 Sampling Methods**): Some guidance recommends that potential background sources (typically limited to within residential buildings), if they are identified and if practical, be removed from an indoor space prior to indoor air sampling (typically at least 24 hours in advance). It should be noted that, in many cases, product removal may not be feasible or allowed by a homeowner or business; even if they are removed, these products were likely used within the space, and the presence of VFCs may not dissipate quickly (or at all) after product removal. It is also often difficult to find and remove

all potential background sources (Doucette et al. 2010; Bingham et al. 2023), although field screening with portable instruments, such as portable gas chromatography/mass spectrometry (GC/MS), can help (Gorder and Dettenmaier 2011). See the **Real-Time Monitoring Fact Sheet** for more information. A detailed inventory is important to account for suspected background sources regardless of whether they were removed prior to sampling.

- **Building pressure control (BPC) testing** (**Section 7.7.2 Differential Pressure Monitoring and Building Pressure Control and Pressure Monitoring and Building Pressure Control Fact Sheet**): BPC testing uses mechanical means to manipulate the overall pressure within a space relative to the subsurface. This can be helpful in determining whether VFCs observed in indoor air are present due to VI or are generally present from background sources (Beckley et al. 2013; Lutes et al. 2019; McHugh et al. 2012; Yao et al. 2020).

- **Continuous/real-time indoor air monitoring** (**Section 7.2 Real-Tine Data Collection and Real-Time Monitoring Fact Sheet**): Real-time indoor air sampling or monitoring can be done using portable quantitative instrumentation (e.g., GC/MS and other field-ready instruments). Concentrations can be collected at a single location or at multiple locations, over a day or multiple days, and may be collected concurrently with other types of data (e.g., weather conditions; building conditions; differential pressure conditions; heating, ventilation, and air conditioning conditions, etc.). Results may help distinguish between the presence of background sources of VFCs or VFCs due to VI.

- **Compound-specific isotope analysis (CSIA)** (**Approaches for Vapor-Forming Chemical Source Determination Fact Sheet**): CSIA is typically a more complicated analysis. It uses the relative difference in isotope signatures between indoor air and impacts typically in groundwater to determine whether the signatures are correlated.

Evaluating Background Sources Using Multiple Lines of Evidence

The following section discusses the importance of using MLE to help understand whether background sources are a factor at a particular site or building. Use of the MLE approach to evaluate background levels is discussed in more detail in the **Multiple Lines of Evidence Fact Sheet**, which also summarizes an example that uses MLE to evaluate the presence of background sources. Other sources of information on tools and strategies used to assess the presence of background sources have been written in other VI guidance (e.g., USDOD 2017) and peer-reviewed papers (e.g., Ma et al. 2020). The **Approaches for Vapor-Forming Chemical Source Determination Fact Sheet** also discusses forensic approaches to understanding the sources of VFCs, including background sources. Some of these approaches are the same or similar to those discussed below.

As noted previously, compounds present in the indoor air due to background levels generally will not be affected by steps taken to mitigate VI, and funds may be expended ineffectually on mitigation systems if indoor air impacts are predominantly caused by background sources. Thus, if background sources are suspected, it may be necessary to gather MLEs to support a VI assessment, make remedial/mitigation decisions, and/or to include or exclude certain chemicals from a risk evaluation. The premise is that if it can be demonstrated through MLEs that an indoor air concentration above a particular threshold value (e.g., cleanup goal, target screening level, etc.) is not derived from a subsurface source, no remediation/mitigation is warranted because the indoor air concentrations are due to background source(s). If this is the case, then the practitioner would move to close out the VI assessment as detailed in **Chapter 11: Vapor Intrusion Component Determination, Exit Points, and Closure**. The more evidence gathered to support such a conclusion, the stronger the justification for the resulting decision. Site-specific decisions should be made as to the number and types of information employed. The use of MLE may not be required if only a few or even one provide clear evidence of either background or VI sources.

Strategies for assessing the influence of background sources on indoor air concentrations can be conducted prior to, concurrent with, or after a VI investigation (USDOD 2017). Field methods to determine background contributions to indoor air concentrations can be employed during an investigation or as a stand-alone evaluation as discussed in **Chapter 7: Sampling and Analysis** of the guidance document and may include various analyses to determine indoor or outdoor source strengths and locations. Data evaluation tools for determining background often use data from previous investigations, studies, and/or regulatory databases to support a background source conclusion. Common data evaluation tools for background source evaluation are listed below and are also listed in the **Multiple Lines of Evidence Fact Sheet** as Table 3. Example Lines of Evidence.

- Constituent ratios—Significant differences in ratios between different VFCs in soil vapor and indoor air may indicate contributions from unaccounted indoor or outdoor air sources.
- Attenuation factors—When evaluating data for the potential influence of background sources, paired subsurface and air samples collected in close proximity to one another and relatively contemporaneously can be used to calculate compound-specific attenuation factors. These attenuation factors can be compared compound by compound or paired location by paired location. For example, if VFCs are present in indoor air at elevated concentrations and attenuation factors (indoor air concentration divided by sub-slab vapor concentration) are close to or greater than 1, then this may indicate indoor or outdoor background source(s) are the primary contributor to indoor VFC levels.
- Outdoor air review—In addition to collecting outdoor air samples at the target site or building, it may be helpful to review data from regional and local air monitoring stations, such as USEPA's ECHO Clean Air Tracking Tool (USEPA 2025b), the Ambient Monitoring Technology Information Center (USEPA 2025a), or the California Air Resources Board (CARB 2025). These air monitoring stations may be helpful if background outdoor air sources may be an issue.
- Background indoor air studies—As noted in the **Background Concentration Studies and Other Relevant References** section, numerous studies have been conducted summarizing measured background concentrations of VFCs in residential and nonresidential indoor air from sources unrelated to VI. Comparisons can be made between site or building indoor air concentrations and the range of published background concentrations as a line of evidence supporting the presence of background sources. It may also be useful to include studies completed on potential specific indoor air sources, such as studies done on off-gassing furniture, plastic decorations, or other consumer products (Bingham et al. 2023; Doucette et al. 2010; 2018) as these can provide insight into potentially unexpected sources of background indoor air VFC concentrations. Data from such studies should prove to be valuable as one line of evidence, although personal preferences and consumer products will vary among properties.
- Interpretation of the results of sampling methods listed in the **Sampling for Background Sources** section, including outdoor air sampling, building survey/chemical inventory, BPC testing, continuous/real-time air monitoring, and CSIA, can provide additional lines of evidence supporting the presence and impact of background indoor air sources.

The process of evaluating and interpreting data in general is discussed in **Section 7.7 Supplemental Tools and Methodologies for Physical Vapor Intrusion Characteristics**, **Section 7.8 Advantages and Disadvantages of Various Investigation Strategies**, **Section 8.2 Data Evaluation**, and the **Multiple Lines of Evidence Fact Sheet**.

It should be noted there is some uncertainty associated with assessing the potential for background sources, regardless of the number of lines of evidence considered. The relative strength or significance of each line of evidence is also a factor to consider. A VI interpretation based on one or two data points is different from an evaluation using 20–30 data points. Multiple corroborating lines of evidence may also decrease uncertainty versus having only one line of evidence. Decisions should be made based on reasonable and logical professional judgment.

If background sources are determined to be present, this may affect future site or building investigations and site management decisions. If a risk assessment is needed, it is recommended that the contribution of "background" to total exposure concentration(s), and therefore associated risks, be distinguished in a human health risk assessment (USEPA 2015). See **Section 8.5.2 Background Concentrations and Section 8.6 Site-Specific Risk Assessment** for information on the consideration of background concentrations applied to site-specific screening levels and in VI risk assessments, respectively. If background sources are found to be primarily responsible for indoor air concentrations, then actions for VI would generally not be warranted for current conditions (USEPA 2015).

Communicating Information about Background Sources

It is important to engage with stakeholders about background sources of impacts to indoor air at several stages of a VI project life cycle. This typically starts with initial engagements prior to indoor air sampling. Residential property owners, for example, are often unaware that many items used or stored in homes could contribute VFCs to their indoor air environment and that these VFCs may be detected during sampling. Communicating the concept of background sources and how they can interfere with indoor air results may be a difficult topic to discuss with property owners. Having a communication plan that includes easy to understand fact sheets about everyday products and the chemicals that are used in everyday life is an important tool during sampling and when discussing sampling results with property owners. **Appendix B** includes some of these as example documents.

The Community Engagement Chapter of the guide provides more information on communicating with building owners and occupants about sampling, sampling results, and the concept of background sources. Section 3.4.4 Sources of the **Chapter 3: Community Engagement** specifically discusses background indoor air sources.

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