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**.

BUILDING CHARACTERISTICS FACT SHEET

Introduction

The purpose of this fact sheet is to provide additional details about the characteristics of buildings that should be considered when assessing the vapor intrusion (VI) pathway into buildings and determining the appropriate response action within the buildings.

Building Types

Buildings are commonly categorized according to their use, and each category may have different purposes and features. It is important to consider which building type is being evaluated since the duration of occupancy, occupant activities, and background sources can vary considerably among building types. Buildings may not fit conveniently into the types listed below but may include elements of different types.

Residential Buildings

A residential building is where people live. It is primarily used for dwelling purposes and provides sleeping facilities. Single- and multi-family buildings are common in many areas. Stand-alone homes, condominiums, townhouses, apartments, and cohousing communities are some examples of residential buildings. Potential VI exposure duration is expected to be greater in residential spaces than most other building types.

Institutional Buildings

Institutional buildings focus on serving the public. Examples include government facilities and offices, schools, hospitals, libraries, and museums. The purposes are to provide public services, support community welfare, or serve governmental needs. Occupancy rates and times for these buildings will be highly variable. Governmental buildings may be subject to stricter government-set regulatory standards including accessibility and sustainability requirements. Hospitals, care facilities, daycares, and schools may be occupied by more sensitive populations that require additional consideration of health and safety. For example, heating, ventilation, and air conditioning (HVAC) and other air handling systems designed to filter and limit the spread of airborne pathogens may also require additional consideration for VI activities.

Commercial Buildings

Commercial buildings are designed for conducting business and generating profit through commerce and are owned by private stakeholders. Examples include office buildings, restaurants, hotels, malls, and stores. Occupancy rates and times for these buildings will be highly variable. Unlike many residential buildings, HVAC systems in commercial, institutional, and industrial buildings may be used to increase air exchange rates or operate at slight positive pressures to reduce or control VI.

Industrial Buildings

Industrial buildings focus on business operations. Examples include storage centers, factories, manufacturing facilities, power plants, refineries, distribution centers, and data centers. These buildings often have office spaces as well as the industrial areas where occupancy may be more limited. VI activities will frequently differ in approach between different types of industrial spaces.

Mobile Buildings

Mobile buildings can be included in any of the previous categories. Examples include office trailers, mobile food units, and mobile homes. Most of these buildings have building envelopes that include insulation and vapor management; however, the foundations may be on wheels or on piers and usually are above ground. If air can freely move beneath these structures, VI may not be a concern. If the mobile building has skirting or is transferred to a foundation, soil vapors can be drawn up into the building, and the VI pathway must be considered. Moving or isolating mobile buildings from the VI source is frequently easier than other building types.

Historic Buildings

Special considerations may be needed for VI efforts carried out on historic buildings. In particular, the aesthetics of historic buildings may not only be important to the building owner or tenant but may also be guided by a historic preservation society. Installation of sampling ports or mitigation systems may require additional efforts to maintain aesthetics.

New Buildings and Additions vs. Existing Buildings

When VI is known or suspected near an area of proposed construction, construction of new buildings or building additions provides a unique opportunity to manage the potential VI pathway. Source removal of vapor-forming chemicals can be conducted, or clean fill can be added prior to construction. New buildings and additions can incorporate indoor air exchange systems, energy efficiency, and vapor management designs, or they can be designed to include passive or active vapor mitigation systems that target contaminants of concern in the building site.

Evaluating the VI pathway in the proximity of existing buildings poses additional challenges over new construction. Building foundations and construction can limit access to impacted areas and require coordination with building owners, operators or maintenance staff, and occupants. Building age and soundness, previous construction history, the HVAC system, utilities, and other preferential pathways must be considered.

Building Survey

A building survey is typically conducted prior to carrying out indoor air sampling and designing a VI mitigation system. Photographic documentation, a building sketch, and detailed notes should be included as part of the building survey. A sample building survey checklist form is included in **Appendix B: Example Documents** and in the **Indoor Air Quality Questionnaire and Building Inventory Checklist** portion of this guidance document.

Building Elements That May Impact Vapor Intrusion

This section summarizes items typically reviewed during a building survey and building information that needs to be considered to design an effective mitigation system. This summary is not exhaustive; as construction designs change, different VI pathways may need consideration.

A building envelope is the "skin" of a building. It separates the conditioned interior of the building from the unconditioned exterior environment. This includes the foundation, exterior building walls and windows, and the roof. Insulation is used to reduce the rate of heat movement in and out of the building, and vapor barriers restrict movement of air and water vapor through the building envelope. Vapor barriers can restrict advective transport of vapors across the building envelope; however, they may not provide effective barriers for the diffusion of vapors they are not specifically designed to restrict.

Building Foundations

Building foundations support buildings across the land surface and are the most common entry point for soil vapor into the building. Water drainage management systems near the building foundation are often necessary. Sumps and perimeter drains placed near or within foundations can act as preferential pathways for soil vapors to enter the building. Special foundation considerations may be necessary in areas of high seismic activity, expansive soils, annual freezing soils, and permafrost, all of which can influence the movement of soil vapor through the foundation and into the building.

Basements and crawl spaces are directly connected to the building foundation and are a frequent point of entry for soil vapor since they are usually located below grade. Basements are often designed to allow human access while standing and may be used for utilities, storage, and human occupancy. Basement spaces are frequently conditioned spaces within the thermal and vapor envelopes; however, they can be isolated from the thermal and vapor envelopes. Crawl spaces provide space for utility access but usually have limited headroom. Surface and groundwater can more easily enter below-grade building spaces such as basements and crawl spaces than foundations on or above grade.

Building Openings

Building openings such as windows, entryways, open skylights, and garage and bay loading doors can create rapid air exchange between indoor and outdoor air, temporarily reducing VI potential.

Tall Buildings

Taller buildings generally experience greater stack effect as the temperature differential increases between inside and outside air. As the building temperature increases relative to the outside temperature and the vertical air movement in the building increases in height, VI potential increases with the increasing pressure differential across the building foundation. Elevator shafts common in taller buildings frequently enhance soil vapor movement vertically in the building.

Large Buildings

Large buildings come in a variety of building types as described above. They can have large open areas or be subdivided into many rooms. Each large building poses unique challenges to conducting a VI assessment.

Key Points for Large vs. Small Buildings

Large building footprints reduce atmospheric gas exchange and cap precipitation infiltration. Heat transfer between the buildings and the surrounding soil occurs over a larger area. Utilities servicing the building can be larger or more numerous. Precipitation management of roof run-off and building perimeter drainage must handle greater volumes of water. Pressure differential across the large building areas may vary significantly, especially with multiple air and heat systems and many rooms. Large buildings with below-grade foundations increase VI potential across a larger area.

Building Materials

Building materials such as wood, concrete, metal, and plastic can have very different properties that may impact VI. Vapor-forming chemicals may diffuse through these materials, adsorb onto surfaces, and absorb into porous materials. The shape or placement of some building materials, such as hollow concrete blocks or air/water gaps beneath siding, along basement walls, or between studs, joists, and rafters, can provide preferential pathways for vapors.

Concrete slabs are used in many types of construction and can provide different functions in the building. A slab-on-grade foundation is a specific type of reinforced concrete slab that has thickened edges to support the building load. A slab can also be poured within a foundation supporting loads within the building but not the building load. A seam between the inner slab and the foundation can act as a preferential pathway for vapor-forming chemicals from the subsurface to enter the building. Concrete slabs can also be in buildings that are elevated above the ground but do not directly overlie soil. Novel building methods such as “slab-less slabs” or concrete-free slabs may also be encountered. These methods use other materials such as thick plywood that can function similarly to interior slabs.

Building Air Management

HVAC systems can heat, cool, filter, and redistribute air in buildings and can directly influence VI. Considerations for HVAC operation include occupant air comfort and quality, energy efficiency, and air exchange rates. Controls of some HVAC systems can be adjusted to reduce or control VI potential. Air exchange rates can be increased to reduce indoor air vapors by mixing with more outdoor air. Building pressure can be adjusted to reduce the potential for soil vapors to enter the building. These adjustments can also be optimized when considering building occupancy and seasonal temperatures. HVAC systems can also enhance vapor movement from the subsurface. Intake vents and leaks in the ducting can draw basement or crawl-space air into the HVAC system, redistributing the air and any contaminant concentrations it contains to other parts of the building.

Other air intake and exhaust systems should also be considered. Range hoods can exhaust large volumes of air. Bath fans, dryers, fireplaces, and other exhaust appliances commonly remove air from buildings. If make-up air of a similar volume is not being provided, negative building pressures can develop, especially in buildings with lower uncontrolled infiltration rates due to increased air tightness. Buildings that operate with negative building pressure can increase VI potential.