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Standard Practice for Assessment of Vapor Intrusion into Structures on Property Involved in Real Estate Transactions[1]

This standard is issued under the fixed designation E2600; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 *Purpose*—The purpose of this practice is to define good commercial and customary practice in the United States of America for conducting a *vapor intrusion assessment (VIA)*[2] on a property parcel involved in a *real estate transaction* with respect to *chemicals of concern (COC)* that may migrate as vapors into existing or planned structures on a property due to contaminated soil and groundwater on the property or within *close proximity* to the property. This practice may be used as a voluntary supplement to Practice E1527 and does not alter or in any way define the scope of that practice. In addition, performance of this standard is not a requirement of and does not constitute, expand, or in any way define "all appropriate inquiry" as defined or approved by U.S. EPA under CERCLA and the regulations thereunder, including 40 CFR Sec. 312.11.

1.1.1 *Vapor Intrusion Condition (VIC)*—In defining a standard of good commercial and customary practice for conducting a *VIA* on a parcel of property, the goal of the process established by this practice is to identify whether or not a *vapor intrusion condition (VIC)* exists or is likely to exist on the property. The term *VIC* means the presence or likely presence of any *COC* in the indoor air environment of existing or planned structures on a property caused by the release of vapor from contaminated soil or groundwater either on the property or within *close proximity* to the property, at a concentration that presents or may present an unacceptable health risk to occupants. The term is not intended to include *de minimis conditions* that do not normally represent an unacceptable health risk to occupants and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. A condition determined to be *de minimis* does not represent a *VIC*.

1.1.2 *Other Federal, State, and Local Environmental Laws*—This practice does not address requirements of any federal, state, or local laws with respect to vapor intrusion. *Users* are cautioned that federal, state, and local laws, regulations or policy may impose *VIA* obligations that are beyond the scope of this practice (refer to Appendix X5 and Appendix X9). *Users* should also be aware that there are likely to be other legal obligations, for example, disclosure, with regard to *COC* discovered on the property that are not addressed in this practice and that may pose risks of civil or criminal liability, or both.

1.1.3 *Documentation*—The scope of this practice includes investigation and reporting requirements. Sufficient documentation of all sources, records, and resources used in the inquiry required by this practice shall be provided in the *report* (refer to Section 12).

1.2 *Objectives*—Objectives guiding the development of this practice are: *(1)* to synthesize and put into writing good commercial and customary practice for conducting a *VIA* on a property involved in a *real estate transaction*, *(2)* to supplement a *Phase I environmental site assessment (ESA)* conducted in accordance with Practice E1527, *(3)* to ensure that the process for assessing vapor intrusion is practical and reasonable, and *(4)* to provide an industry standard for a *VIA* on a property involved in a *real estate transaction*.

1.3 *Considerations Beyond Scope*—The use of this practice is strictly limited to the scope set forth in this section. Section 13 of this practice identifies, for informational purposes, certain tasks (not an all-inclusive list) which may be conducted on a property that are beyond the scope of this practice but which may warrant consideration by parties to a *real estate transaction*. The need to include an investigation of any such conditions in the *environmental professional's* scope of services should be evaluated based upon, among other factors, the nature of the property and the reasons for performing the site assessment (for example, a more comprehensive evaluation of *business environmental risk*) and should be agreed upon between the *user* and *environmental professional* as additional services beyond the scope of this practice prior to initiation of the *Phase I ESA* or initiation of an independent *VIA*.

1.4 *Organization of This Practice*—This practice has thirteen sections and nine appendices. The appendices are included for informational purposes and are not part of the procedures prescribed in this practice.

[1] This practice is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.02 on Real Estate Assessment and Management.

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[2] Whenever terms defined in 3.2 or 3.3 are used in this practice, they are in *italics*.

Section 1	contains the scope of the practice.
Section 2	includes the referenced documents.
Section 3	has definitions of terms pertinent to this practice, terms used in this practice but defined in Practice E1527, and acronyms.
Section 4	is directed at the significance and use of this practice.
Section 5	discusses the relationship between this practice and the Practice E1527 *Phase I ESA* practice.
Section 6	describes the *user's* responsibilities under this practice.
Sections 7-12	are the main body of the *VIA* process, including evaluation and *report* preparation.
Section 13	provides additional information regarding non-scope considerations (see 1.3).
Appendix X1	provides the legal background on federal and state liability for vapor intrusion.
Appendix X2	provides guidance on suggested qualifications for the *environmental professional* conducting the *VIA*.
Appendix X3	provides a sample questionnaire for the *environmental professional* to obtain pertinent information for the *VIA* from the property *owner/operator/occupants*.
Appendix X4	provides a recommended table of contents and report format for the *VIA* investigation when not incorporated into a *Phase I ESA* report.
Appendix X5	includes a listing of federal and state agency web sites discussing their vapor intrusion policies and guidance.
Appendix X6	includes a list of typical *chemicals of concern*.
Appendix X7	provides a table of background levels of common *chemicals of concern* in ambient and indoor air.
Appendix X8	provides guidance and references for data collection in the conduct of a *VIA*.
Appendix X9	provides a supplemental bibliography of federal and state vapor intrusion initiatives and other publications that may assist the *environmental professional* conducting a *VIA*.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

E1739 Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites

2.2 *Federal Statutes:*

42 U.S.C. U.S. Code, Title 42, The Public Health and Welfare, Solid Waste Disposal, Identification and Listing of Hazardous Wastes, §6901, 6903, 6921, 9605, 9601, *et seq.*

2.3 *USEPA Documents:*

40 CFR Part 300, Title 40, Protection of Environment, Chapter 1, Environmental Protection Agency, Parts 300, 302, 312, 355, *et seq.*

2.4 *Other Documents:*

NTP National Toxicology Program, "Annual Report on Carcinogens," (latest edition)

IARC International Agency for Research on Cancer, "Monographs" (latest editions)

NIOSH National Institute for Occupational Safety and Health," Registry of Toxic Effects of Chemical Substances"

3. Terminology

3.1 This section provides definitions and descriptions of terms used in this practice and of terms used in this practice extracted from Practice E1527, and a list of acronyms for key words used in this practice. The terms are an integral part of this practice and are critical to an understanding of the practice and its use.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *advective transport*—the process by which a *solute* such as a contaminant is transported by the bulk motion of a fluid such as groundwater from higher to lower hydraulic potential.

3.2.2 *air change rate*—the ratio of the volumetric rate at which air enters (or leaves) a room or building divided by the volume of the room or building, usually expressed as air changes per hour.

3.2.3 *aquifer*—rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells or springs.

3.2.4 *area of concern*—the area closely and completely surrounding a *target property* (primary *area of concern*, see 8.3.2), plus the area further away but only hydrogeologically up-gradient from a *target property* (secondary *area of concern*, see 8.3.3) that, if sources of known or suspect contamination with *COC* are identified within, could result in a *pVIC* or *VIC* at the *target property*. The *area of concern* is determined in Tier 1 of this practice. For Tier 1 screening purposes, the up-gradient area may be inferred by the *environmental professional* based upon groundwater flow direction experience in the area, hydrogeological and hydrologic considerations, topographical gradients, and/or available groundwater flow information collected in Phase II delineation of contamination reports associated with nearby contaminated sites.

3.2.5 *attenuation factor (also referred to as attenuation coefficient)*—a factor representing the process by which vapors in the subsurface are reduced in concentration through degradation and dilution as they migrate vertically toward the surface.

3.2.6 *background level*—the concentration of chemicals commonly found in the indoor air environment that has not been impacted by chemical vapors released from contaminated soil and/or groundwater. Background levels are influenced by chemicals in ambient air, for example, generated by industrial or motor vehicle emissions, and so forth, by chemical emissions from building materials, by chemical emissions from

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

indoor activities such as smoking, or by emissions such as radon associated with the natural geology of an area.

3.2.7 *biodegradation*—a process by which microbial organisms transform or alter (through metabolic, enzymatic, or other action) the structure of chemicals present in the environment.

3.2.8 *carcinogen*—a compound that has been identified in a publication of the National Toxicology Program (NTP), "Annual Report on Carcinogens" (latest edition) or of the International Agency for Research on Cancer (IARC) "Monographs" (latest editions) as causing or potentially causing cancer. (The "Registry of Toxic Effects of Chemical Substances" published by the National Institute for Occupational Safety and Health (NIOSH) indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.)

3.2.9 *chemical(s) of concern (COC)*—a chemical in the subsurface environment that is known or reasonably expected to be present, that can potentially migrate as a vapor into an existing or planned structure on a property, and that is generally recognized as having the potential for an adverse impact on human health. *COC* generally meet specific criteria for *volatility* and *toxicity*, and include volatile organic compounds, semi-volatile organic compounds and volatile inorganic analytes (such as mercury). Typical *COC* for the vapor intrusion pathway are presented in Appendix X6.

3.2.10 *close proximity*—close enough to a *target property* such that there is a reasonable possibility a *COC* vapor could migrate into the indoor air environment of existing or planned structures on the *target property* (refer to *critical distance* and 8.5.3).

3.2.11 *conduit*—a preferential pathway along which vapors released from contaminated soil or groundwater may migrate to a building or into a building's indoor air space.

3.2.12 *contaminant*—any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water or soil.

3.2.13 *contaminated plume*—plume where concentrations of *COC* known to be present in the soil gas and/or groundwater exceed applicable standards established by the responsible regulatory agency. A *contaminated plume* can take the form of a groundwater *contaminated plume* or a soil gas *contaminated plume*. In a groundwater *contaminated plume*, *COC* are conveyed as solutes away from the point at which they were introduced into groundwater. They move with the migrating groundwater mass in the direction of groundwater flow. When dispersion within the groundwater plume brings a dissolved *COC* to the groundwater-soil gas interface, the *COC* may transition from the dissolved state to the vapor state and evolve from groundwater into soil gas in the vadose zone. Once a *COC* evolves into soil gas in the vadose zone, its migration is no longer connected with groundwater movement. In a soil gas *contaminated plume*, *COC* in their vaporous state mix freely with soil gas that exists within soil voids in the vadose zone. *COC* in the soil gas *contaminated plume* can be introduced from underlying contaminated groundwater, as a result of a liquid spill into vadose zone soils, or by the direct release of gas from a leaking underground pressurized gas line. Migration of the soil gas *contaminated plume* through the vadose zone may be in any direction; however, it preferentially follows the path of least resistance.

3.2.14 *contaminant source*—the origin of the soil and groundwater contamination; may be a general property location (for example, a dry cleaner property address) or, if known, a specific location on a property (for example, the dumpster behind the dry cleaners where filters with perchloroethylene dry cleaning solvent were disposed).

3.2.15 *critical distance*—lineal distance (horizontal, vertical, and so forth) from the nearest edge of a *contaminated plume* to the nearest potentially impacted structure existing or planned on the *target property* involved in the *real estate transaction*, or to the nearest property boundary if there are no planned structures on the *target property*, for example, the *target property* is undeveloped.

3.2.16 *de minimis conditions*—conditions, such as the presence of *COC* at trace concentrations within a structure, that generally do not present an unacceptable health risk to occupants and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. A condition determined to be *de minimis* is not a *pVIC* or *VIC*.

3.2.17 *dwelling*—a structure or portion thereof used for residential habitation.

3.2.18 *environmental professional*—a person meeting the education, training, and experience requirements as set forth in Practice E1527 (see 3.3.7).

3.2.19 *fracture*—a break in a rock formation or building concrete foundation due to structural stresses. Faults, shears, joints, and planes of fracture cleavage are all types of fractures.

3.2.20 *groundwater*—the water contained in the pore spaces of saturated geologic media.

3.2.21 *hazard quotient*—the ratio of the actual concentration of a non-carcinogenic *COC* divided by its safe exposure level. The sum of the *hazard quotients* for multiple compounds is the *hazard index*.

3.2.22 *Henry's law*—the relationship between the partial pressure of a compound in air and the concentration of that compound in water under equilibrium conditions. *Henry's law* constants are temperature dependent.

3.2.23 *hydrocarbon*—a chemical compound composed only of carbon and hydrogen atoms.

3.2.24 *Integrated Risk Information System (IRIS)*—an EPA database of human health effects that may result from exposure to various substances in the environment.

3.2.25 *intrinsically safe building design*—building designs that significantly reduce or eliminate potential vapor intrusion concerns. Examples of *intrinsically safe building designs* include well ventilated underground parking facilities below office buildings and open air first floor parking below residential living space.

3.2.26 *moisture content (of soil)*—the amount of water lost from a soil upon drying to a constant weight, expressed as the weight per unit weight of dry soil or as the volume of water per unit bulk volume of the soil. For a fully saturated medium, moisture content expressed as a volume fraction equals the porosity.

3.2.27 *necessary mitigation*—mitigation measures taken to mitigate a *VIC*.

3.2.28 *non-aqueous phase liquid (NAPL)*—substances that do not dissolve readily in water and that remain in the original bulk liquid form in the subsurface. Light NAPL (LNAPL) such as gasoline can accumulate above the water table, while dense NAPL (DNAPL) such as many chlorinated solvents including trichloroethylene and perchloroethylene can penetrate into the water table.

3.2.29 *permeability*—a qualitative description of the relative ease with which rock, soil or sediment will transmit a fluid (that is, a liquid or gas).

3.2.30 *petroleum*—crude oil or any fraction thereof that is liquid at standard conditions of temperature and pressure (60°F at 14.7 psia). The term includes substances comprised of a complex blend of hydrocarbons derived from crude oil through the process of separation, conversion, upgrading, and finishing, such as motor fuels, jet oils, lubricants, and petroleum solvents, and also includes used oils.

3.2.31 *petroleum hydrocarbon chemicals of concern*—for the purpose of this practice, those volatile petroleum hydrocarbon compounds that are a subset of COC and that readily biodegrade to carbon dioxide and water by ubiquitous soil microbes in aerated environments. *Petroleum hydrocarbon chemicals of concern* may be present in several forms in environmental media, including adsorbed to soil, as constituents of LNAPL above the water table, as dissolved solutes in groundwater, or as vapors in soil gas. Where present as substantial constituents in LNAPL, *petroleum hydrocarbon chemicals of concern* may constitute a significantly stronger vapor source than where present as dissolved solutes in groundwater.

3.2.32 *Phase I environmental site assessment (ESA)*—the process described in Practice E1527.

3.2.33 *porosity*—the volume fraction of a rock or unconsolidated sediment not occupied by solid material but usually occupied by liquids, gas and/or air.

3.2.34 *potential vapor intrusion condition (pVIC)*—the potential for the presence or likely presence of any *COC* in the indoor air environment of existing or planned structures on a property caused by the release of vapor from contaminated soil or groundwater either on the property or within *close proximity* to the property, at a concentration that presents or may present an unacceptable health risk to occupants. A *pVIC* exists when the screening defined by this practice (see Tiers 1 and 2) indicates the potential for a *VIC* but where there is insufficient data to ascertain the presence or likely presence of *COC* in the indoor air environment of existing or planned structures on a *target property*. A condition determined to be *de minimis* is not a *pVIC*. Should a known or suspect source of soil and groundwater contamination with *COC* be present hydrogeologically up-gradient of the *target property* in the *area of concern*, a *pVIC* is presumed to exist if no further information is available. Should a known or suspect source of soil or groundwater contamination with *COC* suspected to be present exist within the *critical distance* of the *target property* in any direction, if no further information is available, a *pVIC* is presumed to exist.

3.2.35 *pre-emptive mitigation*—mitigation measures taken to mitigate a *pVIC*, taken for precautionary reasons or taken for any other reason not related to a *VIC*.

3.2.36 *preferential pathway*—the pathway that has the least amount of constraint on the migration of *COC* vapors. Preferential pathways are natural or man-made and may provide direct contact between the internal environment of a structure and the vapor contaminant source. Natural preferential pathways may include, for example, vertically fractured bedrock where the fractures are interconnected and in direct contact with the foundation of the structure and the vapor contaminant source. Man-made preferential pathways may include, for example, utility conduits and sewers. Typical arterial underground utilities are not normally considered significant preferential pathways.

3.2.37 *real estate*—undeveloped real property, real property used for industrial, retail, office, agricultural, other commercial, medical, or educational purposes, or property used as a single family or multi-family residential *dwelling*.

3.2.38 *real estate transaction*—a transfer of title to or possession of real property or receipt of a security interest in real property.

3.2.39 *risk assessment*—the evaluation of scientific information about the hazardous properties of *COC* that are known or suspected to be present, their dose-response relationships, the extent of human exposure to those *COC* and the consequential health impact.

3.2.40 *risk-based concentrations (RBCs)*—acceptable concentrations of contaminants in soil, and/or soil gas, and/or groundwater that will not result in a *VIC*. Most federal and state *VIA* guidance include generic *RBCs*. Site-specific *RBCs* may be developed by the *environmental professional* conducting the *VIA* screen in Tier 2 of this practice (refer to Guide E1739).

3.2.41 *report*—a document prepared by an *environmental professional* identifying the presence or likely presence of *VIC* on a property.

3.2.42 *saturated zone*—the zone in which all of the voids in the rock or soil are filled with water at a pressure that is greater than atmospheric. The *water table* is the top of the *saturated zone* in an unconfined *aquifer*.

3.2.43 *semi-volatile organic compound*—a general term for an organic compound that has a high enough vapor pressure at standard temperature (20°C) and pressure (1 atm) to vaporize (albeit at a slower rate than *volatile organic compounds*) and enter the atmosphere.

3.2.44 *soil gas sampling*—any one of a number of methods utilized to collect a soil gas sample from the subsurface (see Appendix X8 and Appendix X9).

3.2.45 *solute*—a substance such as a contaminant that is dissolved in another substance such as groundwater.

3.2.46 *sub-slab soil gas sampling*—the collection of soil gas from the zone just beneath the lowest floor slab of a building (see Appendix X8 and Appendix X9).

3.2.47 *standard practice*—the application of the activities set forth in this document.

3.2.48 *target property (TP)*—the property involved in the *real estate transaction* that is the subject of the *VIA* defined by this practice.

3.2.49 *toxic chemical*—a chemical whose vapor concentration of the pure component poses either an incremental lifetime cancer risk (ILCR) or a non-cancer hazard quotient greater than acceptable values established by applicable federal, state, or local regulatory agencies (for example, refer to U.S. EPA, 1990, National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300; Federal Register, Volume 55, No. 46, pp. 8666-8865, Washington, D.C., March 8, 40 CFR 300.430(e)(2)(i)(2)).

3.2.50 *toxicity*—the effect on human health that is exhibited by a *toxic chemical*.

3.2.51 *user*—the party seeking to obtain the results of the application of this *standard practice*. Commonly, the *user* is the prospective purchaser of a parcel of property.

3.2.52 *vadose zone (or unsaturated zone)*—the zone between the land surface and the water table within which moisture content is less than saturation (except in the capillary fringe) and pressure is less than atmospheric. Soil pore space typically contains air or other gases. The capillary fringe is included in the *vadose zone*.

3.2.53 *vapor intrusion (VI)*—the migration of a *COC* vapor from a subsurface soil or groundwater source into the indoor air environment of an existing or planned structure.

3.2.54 *vapor intrusion assessment (VIA)*—an assessment of the potential for *COC* vapors released from contaminated soil or groundwater to impact the indoor air environment of a structure and present a health risk to occupants. The objective of a *VIA* is to determine if a *pVIC* or *VIC* exists.

3.2.55 *vapor intrusion condition (VIC)*—the presence or likely presence of any *COC* in the indoor air environment of existing or planned structures on a property caused by the release of vapor from contaminated soil or groundwater either on the property or within *close proximity* to the property, at a concentration that presents or may present an unacceptable health risk to occupants. (See 1.1.1.)

3.2.56 *volatile organic compound (VOC)*—a general term for an organic compound that has a high enough vapor pressure (for example, greater than 0.5 to 1 mm Hg) at standard temperature (20°C) and pressure (1 atm) to significantly vaporize and enter the atmosphere.

3.2.57 *volatility*—a chemical is considered to be sufficiently *volatile* if its Henry's law constant is greater than 10^{-5} atm-m^3-mol^{-1} and its vapor pressure is greater than 1 mm Hg at room temperature.

3.2.58 *water table*—the top of the *saturated zone* in an unconfined *aquifer*.

3.3 *Practice E1527 Terms Used in This Standard:*

3.3.1 *adjoining properties*—any real property or properties the border of which is contiguous or partially contiguous with that of the *target property*, or that would be contiguous or partially contiguous with that of the *target property* but for a street, road, or other public thoroughfare separating them.

3.3.2 *approximate minimum search distance*—the area for which records must be obtained and reviewed pursuant to Section 8 of this practice, subject to the limitations provided in that section. This may include areas beyond the *target property* and shall be measured from the nearest *target property* boundary. This term is used in lieu of radius to include irregularly shaped properties.

3.3.3 *business environmental risk*—a risk which can have a material environmental or environmentally-driven impact on the business associated with the current or planned use of a parcel of *real estate*, not necessarily limited to those environmental issues required to be investigated in this practice. Consideration of *business environmental risk* issues may involve addressing one or more non-scope considerations, some of which are identified in Section 13 of this practice.

3.3.4 *Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)*—the list of sites compiled by EPA that EPA has investigated or is currently investigating for potential *hazardous substance* contamination and for possible inclusion on the *National Priorities List*.

3.3.5 *CORRACTS list*—a list maintained by EPA of *hazardous waste* treatment, storage, or disposal facilities and other RCRA-regulated facilities (due to past interim status or storage of *hazardous waste* beyond 90 days) that have been notified by the EPA to undertake corrective action under RCRA. The *CORRACTS list* is a subset of the EPA database that manages RCRA data.

3.3.6 *engineering controls (EC)*—physical modifications to a site or facility to reduce or eliminate the potential for exposure to *hazardous substances* or *petroleum products* in the soil or groundwater on the property.

3.3.7 *environmental professional*—a person meeting the education, training and experience requirements set forth in 40 CFR 312.10(b). The person may be an independent contractor or an employee of the *user*.

3.3.8 *environmental site assessment (ESA)*—the process by which a person or entity seeks to determine if a particular parcel of real property (including improvements) is subject to *recognized environmental conditions* (see 3.3.28).

3.3.9 *fire insurance maps*—maps produced for private fire insurance map companies that indicate uses of properties at specified dates and that encompass the property. These maps are often available at local libraries, historical societies, private resellers, or from the map companies who produced them.

3.3.10 *hazardous substance*—a substance defined as a *hazardous substance* pursuant to CERCLA 42 U.S.C. 9601(14), as interpreted by EPA regulations and the courts.

3.3.11 *hazardous waste*—any *hazardous waste* having the characteristics identified under or listed pursuant to Section 3001 of RCRA, as amended (42 U.S.C. 6921) (but not including any waste the regulation of which under RCRA (42 U.S.C. 6901-6992k) has been suspended by Act of Congress). RCRA defines a *hazardous waste*, at 42 U.S.C. 6903, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration or physical, chemical or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed."

3.3.12 *hazardous waste contaminated sites*—sites on which a release has occurred, or is suspected to have occurred, of any *hazardous substance*, *hazardous waste*, or *petroleum products*, and where that release or suspected release has been reported to a government entity.

3.3.13 *institutional controls (IC)*—a legal or administrative restriction (for example, deed restrictions or restrictive covenants, easements or zoning) on the use of, or access to, a site or facility to *(1)* reduce or eliminate potential exposure to *hazardous substances* or *petroleum products* in the soil or groundwater on the property, or *(2)* to prevent activities that could interfere with the effectiveness of a response action, in order to ensure maintenance of a condition of no significant risk to public health or the environment. An IC is a type of activity and use limitation (AUL).

3.3.14 *landfill*—a place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *solid waste disposal site* and is also known as a garbage dump, trash dump, or similar term.

3.3.15 *local government agencies*—those agencies of municipal or county government having jurisdiction over the *target property*. Municipal and county government agencies include but are not limited to cities, parishes, townships, and similar entities.

3.3.16 *local street directories*—directories published by private (or sometimes government) sources that show ownership, occupancy, and/or use of sites by reference to street addresses. Often *local street directories* are available at libraries, or historical societies, and/or local municipal offices.

3.3.17 *LUST sites*—state lists of leaking *underground storage tank* sites. RCRA gives EPA and states, under cooperative agreements with EPA, authority to clean up releases from UST systems or require *owners* and *operators* to do so.

3.3.18 *material threat*—a physically observable or *obvious* threat which is reasonably likely to lead to a release that, in the opinion of the *environmental professional*, is threatening and might result in impact to public health or the environment. An example might include an aboveground storage tank system that contains a *hazardous substance* and which shows evidence of damage. The damage would represent a *material threat* if it is deemed serious enough that it may cause or contribute to tank integrity failure with a release of contents to the environment.

3.3.19 *National Priorities List (NPL)*—list compiled by EPA pursuant to CERCLA 42 U.S.C. §9605(a)(8)(B) of properties with the highest priority for cleanup pursuant to EPA's Hazard Ranking System. See 40 C.F.R. Part 300.

3.3.20 *obvious*—that which is plain or evident; a condition or fact that could not be ignored or overlooked by a reasonable observer while visually or physically observing the property.

3.3.21 *occupants*—those tenants, subtenants, or other persons or entities using a property or a portion of the property.

3.3.22 *operator*—a person responsible for the overall operation of a facility.

3.3.23 *owner*—generally the fee *owner* of record of the property.

3.3.24 *petroleum products*—those substances included within the meaning of the petroleum exclusion to CERCLA, 42 U.S.C. §9601(14), as interpreted by the courts and EPA, that is: petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a *hazardous substance* under Subparagraphs (A) through (F) of 42 U.S.C. §9601(14), natural gas, natural gas liquids, liquefied natural gas, and synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). (The word fraction refers to certain distillates of crude oil, including but not limited to gasoline, kerosene, diesel oil, jet fuels, and fuel oil, pursuant to Standard Definitions of Petroleum Statistics.[4])

3.3.25 *publicly available*—information that is *publicly available* means that the source of the information allows access to the information by anyone upon request.

3.3.26 *practically reviewable*—information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the property without the need for extraordinary analysis of irrelevant data. The form of the information shall be such that the *user* can review the records for a limited geographic area. Records that cannot be feasibly retrieved by reference to the location of the property or a geographic area in which the property is located are not generally *practically reviewable*. Most databases of public records are *practically reviewable* if they can be obtained from the source agency by the county, city, zip code, or other geographic area of the facilities listed in the record system. Records that are sorted, filed, organized, or maintained by the source agency only chronologically are not generally *practically reviewable*. Listings in *publicly available* records which do not have adequate address information to be located geographically are not generally considered *practically reviewable*.

3.3.27 *reasonably ascertainable*—information that is *(1) publicly available*, *(2)* obtainable from its source within reasonable time and cost constraints, and *(3) practically reviewable*.

3.3.28 *recognized environmental condition (REC)*—the presence or likely presence of any *hazardous substances* or *petroleum products* on a *target property* under conditions that indicate an existing release, a past release, or a material threat of a release of any *hazardous substances* or *petroleum products* into structures on the *target property* or into the ground, groundwater, or surface water of the *target property*. The term includes *hazardous substances* or *petroleum products* even under conditions in compliance with laws. The term is not intended to include *de minimis conditions* that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be *de minimis* are not *RECs*.

[4] *Standard Definitions of Petroleum Statistics*, American Petroleum Institute, Fourth Edition, 1988.

3.3.29 *records review*—the part that is contained in Section 8 of this practice that addresses which records shall or may be reviewed.

3.3.30 *solid waste disposal site*—a place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *landfill* and is also known as a garbage dump, trash dump, or similar term.

3.3.31 *solvent*—a chemical compound that is capable of dissolving another substance and may itself be a *hazardous substance*, used in a number of manufacturing/industrial processes including but not limited to the manufacture of paints and coatings for industrial and household purposes, equipment clean-up, and surface degreasing in metal fabricating industries.

3.3.32 *standard environmental record sources*—those records specified in 8.3 of this practice.

3.3.33 *standard historical sources*—those sources of information about the previous uses of a property specified in 8.4 of this practice.

3.3.34 *underground storage tank (UST)*—any tank, including underground piping connected to the tank, that is or has been used to contain *hazardous substances* or *petroleum products* and the volume of which is 10 % or more beneath the surface of the ground.

3.4 *Acronyms:*

3.4.1 *AST*—Aboveground Storage Tank

3.4.2 *ATSDR*—Agency for Toxic Substance and Disease Registry

3.4.3 *BTEX*—Benzene, Toluene, Ethylbenzene, and Xylenes

3.4.4 *CERCLA*—Comprehensive Environmental Response, Compensation and Liability Act of 1980 (as amended, 42 U.S.C. §§9601 *et seq*.)

3.4.5 *CFR*—Code of Federal Regulations

3.4.6 *COC*—Chemical(s) of Concern

3.4.7 *DNAPL*—Dense Non-Aqueous Phase Liquid (often referred to as a "sinker" that can penetrate the water table)

3.4.8 *EC*—Engineering Controls

3.4.9 *EPA*—United States Environmental Protection Agency

3.4.10 *ESA*—Environmental Site Assessment

3.4.11 *HQ*—Hazard Quotient

3.4.12 *IARC*—International Agency for Research on Cancer

3.4.13 *IC*—Institutional Controls

3.4.14 *ILCR*—Incremental Lifetime Cancer Risk

3.4.15 *IRIS*—Integrated Risk Information System

3.4.16 *LNAPL*—Light Non-Aqueous Phase Liquid (often referred to as a "floater" that can accumulate on the water table)

3.4.17 *LUST*—Leaking Underground Storage Tank

3.4.18 *NAPL*—Non-Aqueous Phase Liquid

3.4.19 *NPL*—National Priorities List

3.4.20 *NTP*—National Toxicology Program

3.4.21 *OSHA*—Occupational Safety and Health Administration (or Act)

3.4.22 *PEL*—OSHA Permissible Exposure Limit

3.4.23 *pVIC*—potential Vapor Intrusion Condition

3.4.24 *RBC*—Risk-Based Concentration

3.4.25 *REC*—Recognized Environmental Condition

3.4.26 *TSDF*—Hazardous waste treatment, storage or disposal facility

3.4.27 *USC*—United States Code

3.4.28 *USGS*—United States Geological Survey

3.4.29 *UST*—Underground Storage Tank

3.4.30 *VI*—Vapor Intrusion

3.4.31 *VIA*—Vapor Intrusion Assessment

3.4.32 *VIC*—Vapor Intrusion Condition

3.4.33 *VOC*—Volatile Organic Compound

4. Significance and Use

4.1 *Uses*—This practice is intended for use on a voluntary basis by parties who wish to conduct a *VIA* on a parcel of *real estate*, or more specifically conduct a screening evaluation to determine whether or not there is potential for a *VIC*, and if so, identify alternatives for further investigation. To determine whether the vapor intrusion exposure pathway is complete and, if so, whether it poses or may pose an unacceptable risk to human health (that is, whether a *VIC* exists), this practice directs the *user* and *environmental professional* to existing federal or state vapor intrusion policy, regulation and guidance (refer to Appendix X5 and Appendix X9). The process defined in this practice begins with a reasonably conservative screening process that requires information generally collected as part of a Practice E1527 *Phase I ESA*. If a *pVIC* is identified in this initial screening, the process gradually progresses toward a more complex assessment involving increasingly greater use of site-specific data. For those sites unable to be screened out, the process provides alternative methods to determine whether a *VIC* exists. If a *VIC* is found to exist, the process describes general mitigation alternatives. This practice is intended primarily as an approach to conducting an inquiry designed to identify *pVICs* or *VICs* in connection with a property involved in a *real estate transaction*. This practice is intended to reflect a commercially practical and reasonable inquiry (see 1.2). The practice can be applied to property with existing structures, property with structures that will be substantially rehabilitated, property without existing structures but having planned structures (for example, property in development), or property without existing structures and with no planned structures (for example, undeveloped property with no planned development).

4.2 *Clarifications on Use*:

4.2.1 *Use in Conjunction with Practice* E1527 *Phase I ESA*—This practice, when added as a supplemental scope of work to a Practice E1527 *Phase I ESA*, is designed to assist the *user* and *environmental professional* in developing information about *pVICs* or *VICs* associated with a *target property* and, as such, has utility for a wide range of persons, including those who may not be involved in a *real estate transaction*.

4.2.2 *Independent Use*—This practice may also be used independently of any other property environmental assessment to determine if a *pVIC* or *VIC* exists. However, prior to use the *user* and *environmental professional* should be familiar with the data collection requirements associated with a Practice E1527 *Phase I ESA* that are referenced in this practice (see 5.3).

4.2.3 *Site-Specific*—This practice is property-specific in that it relates to assessment of *pVICs* or *VICs* in existing structures or planned structures on a specific parcel of *real estate*. Consequently, this practice does not address many additional issues raised in transactions such as purchases of business entities or interests therein, or of their assets, that may well involve environmental liabilities pertaining to properties previously owned or operated or other off-site environmental liabilities. The practice is not intended to replace a *Phase I ESA* conducted by an *environmental professional*, but rather to supplement it.

4.3 *Who May Conduct*—A *VIA* shall be performed by an *environmental professional* as specified in 7.5.1 and Practice E1527. No practical standard can be designed to eliminate the role of professional judgment and the value and need for experience in the party performing the inquiry. The professional judgment of an *environmental professional* is, consequently, vital to the performance of this assessment.

4.4 *Additional Services*—As set forth in Section 13, additional services may be contracted for between the *user* and the *environmental professional*. Such additional services may include *business environmental risk* issues not included within the scope of this practice, examples of which are identified in 13.3.

4.5 *Principles*—The following principles are an integral part of this practice and are intended to be referred to in resolving any ambiguity or exercising such discretion as is accorded the *user* or *environmental professional* in performing a *VIA*.

4.5.1 *Uncertainty Not Eliminated in Screening*—No vapor intrusion screen, such as included in Sections 8 and 9 of this practice, can wholly eliminate uncertainty regarding the potential for identifying *VICs* in connection with a *target property*. Screening is intended to reduce, but not eliminate, uncertainty regarding the potential for a *VIC* to exist in connection with a property.

4.5.2 *Not Exhaustive*—The practice is not meant to be an exhaustive assessment. There is a point at which the cost of information obtained or the time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of *real estate transactions*. One of the purposes of this practice is to identify a balance between the competing goals of limiting the costs and time demands inherent in performing a *VIA* and the reduction of uncertainty about unknown conditions resulting from additional information.

4.5.3 *Level of Inquiry is Variable*—Not every property will warrant the same level of assessment. Consistent with good commercial or customary practice, the appropriate level of assessment will be guided by the type of property subject to assessment, the risk tolerance of the *user*, and the information already available or developed in the course of the inquiry.

4.5.4 *Comparison with Subsequent Inquiry*—It should not be concluded or assumed that an inquiry was not adequate because the inquiry did not identify *pVICs* or *VICs* in connection with a property. The *VIA* must be evaluated based on the reasonableness of judgments made at the time and under the circumstances in which they were made. Subsequent *VIAs* should not be considered valid standards to judge the appropriateness of any prior assessment based on hindsight, new information, use of developing technology or analytical techniques, or other factors.

4.6 *Continued Viability of VIA*—Subject to 4.7, a *VIA* meeting or exceeding this practice and completed less than 180 days prior to the date of acquisition of the property (EPA, under "All Appropriate Inquiry," 40 C.F.R. Part 312, defines date of acquisition as the date on which a person acquires title to the property), or (for transactions not involving an acquisition) the date of the intended use of the *VIA*, is presumed to be valid. If within this period the assessment will be used by a different *user* than the *user* for whom the assessment was originally prepared, the subsequent *user* must also satisfy the *User's* Responsibilities in Section 6. Subject to 4.7 and the *User's* Responsibilities set forth in Section 6, a *VIA* meeting or exceeding this practice and for which the information was collected or updated within 1 year prior to the date of acquisition of the property or (for transactions not involving an acquisition) the date of the intended use of the *VIA* may be used provided that the following components of the inquiries were conducted or updated within 180 days of the date of purchase or the date of the intended transaction:

4.6.1 Reviews of federal, tribal, state, and local government records;

4.6.2 Update on the operations existing at the *target property*;

4.6.3 Evaluation of any new significant potential preferential pathways for vapor migration;

4.6.4 Assessment of any new plume migration that can potentially cause a *pVIC* or *VIC* on the *target property*; and

4.6.5 Assessment of any new contaminant releases in the *area of concern* that can potentially cause a *pVIC* or *VIC* on the *target property*.

4.7 *Prior Assessment Usage*—This practice recognizes that *VIAs* performed in accordance with this practice will include information that subsequent *users* may want to use to avoid undertaking duplicative assessment procedures. Therefore, this practice describes procedures to be followed to assist *users* in determining the appropriateness of using information in *VIAs* performed more than one year prior to the date of acquisition of the property or (for transactions not involving an acquisition) the date of the intended use of the *VIA*. The system of prior assessment usage is based on the following principles that should be adhered to in addition to the specific procedures set forth elsewhere in this practice:

4.7.1 *Use of Prior Information*—Subject to the requirements set forth in 4.6, *users* and *environmental professionals* may use information in prior *VIAs* provided such information was generated as a result of procedures that meet or exceed the requirements of this practice. However, such information shall not be used without current investigation of conditions likely to affect *pVICs* or *VICs* in connection with the *target property*. Additional tasks may be necessary to document conditions that may have changed materially since the prior *VIA* was conducted.

4.7.2 *Contractual Issues Regarding Prior Assessment Usage*—The contractual and legal obligations between prior

and subsequent *users* of *VIAs* or between *environmental professionals* who conducted prior *VIAs* and those who would like to use such prior *VIAs* are beyond the scope of this practice.

4.8 *Actual Knowledge Exception*—If the *user* or *environmental professional* conducting a *VIA* has *actual knowledge* that the information being used from a prior *VIA* is not accurate or if it is *obvious*, based on other information obtained by means of a Phase I and/or Phase II *ESA* or known to the person conducting the Phase I and/or Phase II *ESA*, that the information being used is not accurate, such information from a prior *VIA* may not be used.

4.9 *Rules of Engagement*—The contractual and legal obligations between an *environmental professional* and a *user* (and other parties, if any) are outside the scope of this practice. No specific legal relationship between the *environmental professional* and the *user* is necessary for the *user* to meet the requirements of this practice.

5. Relationship to Practice E1527 Phase I ESA

5.1 *Indoor Air Quality as a Non-Scope Consideration in Practice* E1527—Indoor air quality, and therefore vapor intrusion as a contributing indoor air quality issue, is a non-scope consideration in a Phase I conducted in accordance with the Practice E1527 standard. Non-scope considerations may be included in the Practice E1527 *Phase I ESA*, but only if a separate scope of work is specifically agreed to between the *user* and *environmental professional*. This practice is not meant to preclude an environmental professional from providing a professional opinion in the Phase I ESA on the impact of potential vapor migration onto a target property if deemed necessary to satisfy "all appropriate inquiry."

5.2 *VIA*—This practice is intended to be used independently or as a supplement to the Practice E1527 *Phase I ESA*.

5.2.1 The *VIA* may be conducted concurrently with the Practice E1527 *Phase I ESA*.

5.2.2 The *VIA* may be conducted independent of a Practice E1527 *Phase I ESA*. When conducting a *VIA* independent of the Phase I, the data requirements specified in this practice shall be collected (see 5.3).

5.3 *Use of Information Collected in a Phase I Conducted in Accordance with the Practice* E1527 *Standard*—The initial screening (see Section 8) identified in this practice makes use of information typically collected in a Practice E1527 *Phase I ESA*, including but not limited to federal, state, local, and tribal government records, chemical use and historical records of prior uses on the *target property* and within proximity of the *target property*, soil characteristics, geological characteristics, contaminant characteristics, plume migration, significant conduits that could potentially accelerate vapor migration, groundwater depth and groundwater flow direction data, and property information data.

5.4 *Assumptions Made in the Practice* E1527 *Phase I ESA*—Any assumptions or limitations made in the conduct of a *Phase I ESA* and which are applicable in the *VIA* process as described in this practice shall be specifically identified.

6. User's Responsibilities

6.1 *Scope*—The purpose of this section is to describe tasks to be performed by the *user* that will help the *environmental professional* identify the potential for *pVICs* or *VICs* to exist in connection with the *target property*. These tasks do not require the technical expertise of an *environmental professional* and are generally not performed by *environmental professionals* performing a *Phase I ESA*, unless directed to do so by the *user*. In a *real estate transaction*, it is common to find the *user* to be the prospective property purchaser, with the *environmental professional* working for this *user*. However, the relevant information about the *target property* is best obtained from the property *owner* (that is, the seller), *operator* and/or occupants. As such, it is not unusual to find the *user* requesting information directly from the seller. It is also not unusual to find the *user* requesting the *environmental professional* to obtain the information needed from the seller (that is, as part of the interview process of the property *owner*, *operator* and major occupants). Appendix X3 provides a sample Questionnaire that can assist the *user* and/or the *environmental professional* in gathering information on the *target property* that may be material to identifying *pVICs* or *VICs* in connection with the *target property*.

6.2 *Specialized Knowledge or Experience of the User*—If the *user* has any specialized knowledge or experience that is material to the assessment of *pVICs* or *VICs* in connection with the property, it is the *user's* responsibility to communicate any information based on such specialized knowledge or experience to the *environmental professional*. The *user* should do so before the *environmental professional* conducts the *VIA*. Such specialized knowledge might include, for example, tenant odor complaints or occupancy-related health issues.

6.3 *Commonly Known or Reasonably Ascertainable Information*—If the *user* is aware of any commonly known or *reasonably ascertainable* information within the local community about the *target property* that is material to the assessment of *pVICs* or *VICs* in connection with the property, it is the *user's* responsibility to communicate such information to the *environmental professional*. The *user* should do so before the *environmental professional* conducts the *VIA*. Such information might include, for example, the existence locally of publicized area-wide *contaminated plumes*.

6.4 *Non-responsiveness*—If the *user* is unable to obtain the information requested from the seller, the *user* shall instruct the *environmental professional* to collect the information, if available, through an interview process with the property *owner* and/or property manager and/or property *operator* and/or property occupants.

6.5 *Other*—Either the *user* shall make known to the *environmental professional* the reason why the *user* wants to have the *VIA* performed or, if the *user* does not identify the purpose of the *VIA*, the *environmental professional* shall assume the purpose is to evaluate *pVICs* or *VICs* that could adversely impact persons living or working in existing or planned structures on a real estate parcel. The *user* and the *environmental professional* may also need to modify the scope of

services performed under this practice for special circumstances, including, but not limited to, unique local or site-specific conditions.

7. Vapor Intrusion Assessment

7.1 *Objective*—The purpose of the *VIA* described in this practice is to identify, to the extent feasible pursuant to the processes prescribed herein, *pVICs* or *VICs* in connection with a *target property* (see 1.1.1). The practice is a tiered process so that properties with a low risk of vapor intrusion can be screened out quickly and inexpensively as the data justify. The first two tiers of the process can be used to determine whether a *pVIC* exists and, if so, the third tier is designed to provide confirmation (that is, a *VIC* exists) or reduce the level of uncertainty. The fourth tier provides general mitigation alternatives to address either a *pVIC* or *VIC*. The *VIA* process described in this practice is intended to be used independently, or to supplement but not replace the existing Practice E1527 *Phase I ESA*. The *VIA* process described in this practice is also designed to complement existing federal and state vapor intrusion laws, regulations, policies or guidance. For example, in Tier 3, reference is specifically made to the use of existing federal or state laws, regulations, policy or guidance, where available. In addition, Appendix X5 and Appendix X9 identify select federal, state, and other vapor intrusion resources.

7.2 *Four Tiers*—The *VIA* process described in this practice consists of four tiers as follows (refer to the flow chart in Fig. 1 that is based upon a *VIA* conducted in conjunction with a *Phase I ESA*):

7.2.1 *Tier 1*—Initial (non-invasive) Screening; see Section 8,

7.2.2 *Tier 2*—Semi-Site Specific Numeric Screening (the non-invasive component of the investigation may be combined with Tier 1, if appropriate); see Section 9,

7.2.3 *Tier 3—VIC* Assessment; see Section 10, and

7.2.4 *Tier 4*—Mitigation; see Section 11.

7.2.5 *Flexibility*—Timeliness may be more important than investigation or mitigation costs during *real estate transactions*. Therefore, if the potential for vapor intrusion cannot reasonably be eliminated at the Tier 1 and/or Tier 2 levels and the user desires to continue, the process provides *users* with three options: *(1)* proceed with a more site-specific and comprehensive investigation (Tier 3), in the hope that this investigation will eliminate vapor intrusion concerns; *(2)* proceed directly to mitigation (Tier 4), on the assumption that mitigation conducted pre-emptively may be more cost effective to address a *pVIC*; or *(3)* identify the presence of a *pVIC* based on a limited scope of investigation (for example, a Tier 1 investigation) and provide options for either additional investigation or mitigation. A *user* may proceed directly to any of the tiers, including proceeding directly to mitigation. In most cases, however, it is expected that it would be more cost effective and that sufficient time would be available to conduct a Tier 1 evaluation, and possibly a Tier 2 evaluation before proceeding to a more costly Tier 3 investigation or Tier 4 mitigation.

7.3 *Report*—Evaluation and a separate *report* shall be prepared (see Section 12), unless the *VIA* is being performed as part of a *Phase I ESA* conducted on the *target property*, in which case the *VIA* findings and conclusions can be provided with the Phase I *report*.

7.4 *Coordination of Parts*:

7.4.1 *Parts Used in Concert*—The government and historical *records review*, and other information collected, such as from the *Phase I ESA*, are intended to be used in concert with each other. If information from one source indicates the need for more information, other sources may be available to provide information.

7.4.2 *User's Obligations*—The *environmental professional* shall note in the *report* whether or not the *user* has reported to the *environmental professional* information pursuant to Section 6 of this practice.

7.5 *Who May Conduct a VIA*:

7.5.1 *Environmental Professional's Duties*—The screening for *VIA* (that is, Tiers 1 and 2) shall be performed by an *environmental professional* or conducted under the supervision or responsible charge of an *environmental professional* as defined in Practice E1527. This can be the same individual(s) responsible for conducting the Practice E1527 *Phase I ESA*. The assessment shall be performed by a person possessing sufficient training and experience necessary to conduct the evaluation in accordance with this practice, and having the ability to identify issues relevant to *pVICs* and *VICs* in connection with the *target property*. At a minimum, the *environmental professional* must be involved in planning the assessment, and review and interpretation of the information upon which the *report* is based. The *VIA* referred to in Tier 3 requires specialized expertise dependent upon the nature of the specific investigation and may be beyond the capability of the *environmental professional* conducting the Phase I. Vapor intrusion mitigation (that is, Tier 4) also requires specialized expertise, particularly in engineering design and installation, that may be beyond the capability of the *environmental professional* conducting the Phase I. Appendix X2 provides additional information on the type of expertise that may be necessary.

7.5.2 *Information Obtained From Others*—Information for the *records review* needed for completion of a *VIA* may be provided by a number of parties including government agencies, third-party vendors, the *user*, and present and past *owners* and *occupants* of the property, provided that the information is obtained by or under the supervision of an *environmental professional* or is obtained by a third-party vendor specializing in retrieval of the information. Prior *Phase I ESAs* may also contain information that could be appropriate for usage in a current *VIA*. The *environmental professional(s)* responsible for the *report* shall review all of the information provided.

7.5.2.1 *Reliance*—An *environmental professional* is not required to verify independently the information provided by others and may rely on the information provided unless he or she has *actual knowledge* that certain information is incorrect or unless it is *obvious* that certain information is incorrect based on other information obtained in the *VIA* or otherwise actually known to the *environmental professional*.

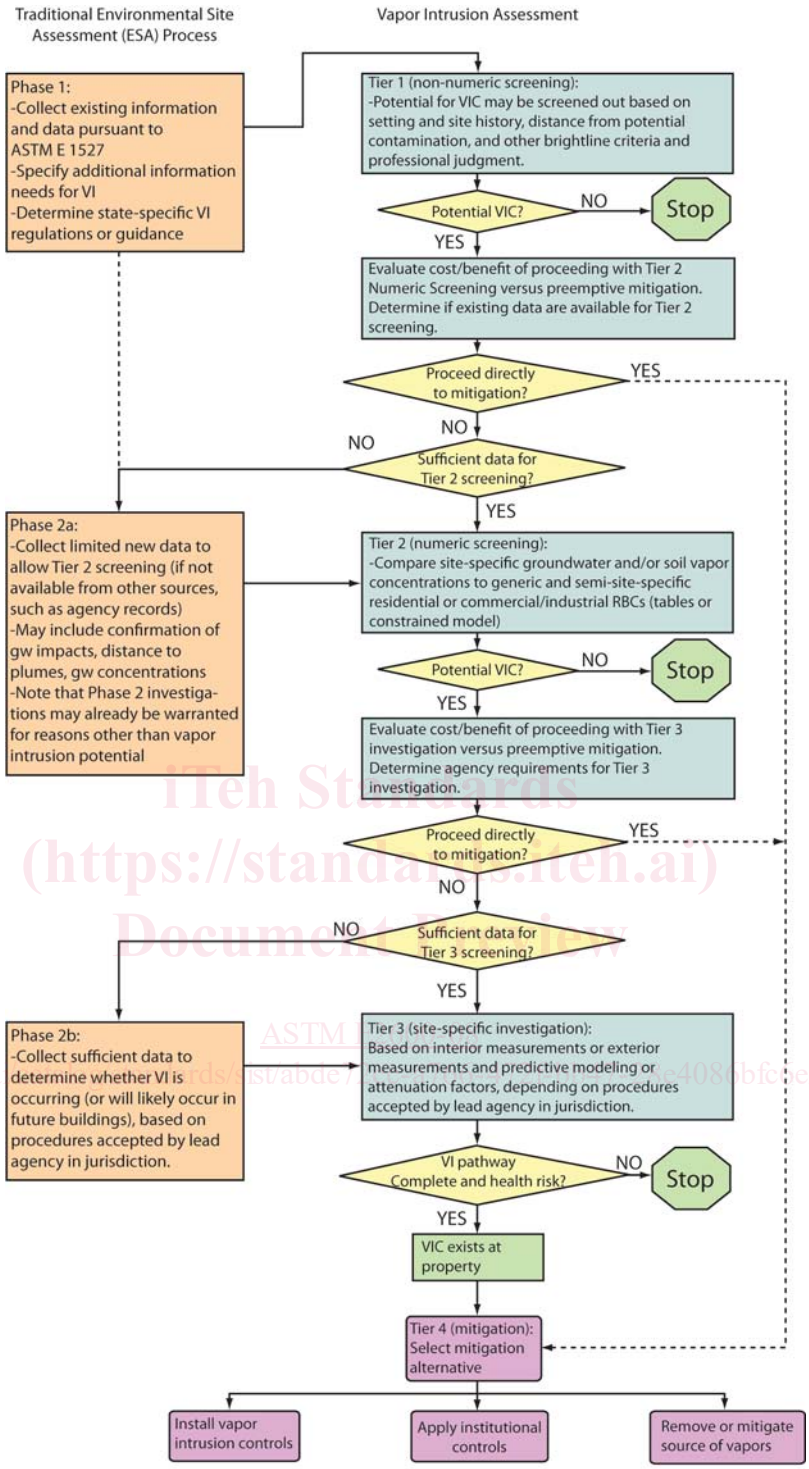

FIG. 1 Flowchart of the General Vapor Intrusion Assessment Process as a Supplement to a Phase I

8. Tier 1 Screening

8.1 *Introduction*:

8.1.1 *Objective*—The purpose of Tier 1 is to conduct an initial screen to determine if a *pVIC* exists in connection with the *target property*. Tier 1 may be considered a supplement to a Practice E1527 *Phase I ESA* or stand on its own if not conducted as a supplement to a *Phase I ESA*. When used as a supplement to a *Phase I ESA*, the practice is designed to make use to the maximum extent possible of information collected in the *Phase I ESA* process.

8.1.2 Tier 1 screening begins with collection of specific data (see 8.1.3). If the *VIA* is conducted as a supplement to a Practice E1527 *Phase 1 ESA*, Tier 1 uses select information generally collected during the *Phase 1 ESA* process. Tier 1

screening uses non-numerical information designed to identify conditions and/or physical settings where a *pVIC* is unlikely to occur.

8.1.3 The minimum information needed to conduct a Tier 1 screen includes:

8.1.3.1 Existing/planned use of the *target property* (that is, developed, undeveloped, industrial, commercial, or residential), if it can be ascertained. If the future use is uncertain, then the *environmental professional* shall assume the most conservative use for the category in which the property is zoned. If zoning information is not available, then the *environmental professional* shall assume residential use.

8.1.3.2 Type of structures existing or planned on the *target property* (for example, single family residential, multifamily residential, office, industrial, retail, hotel, warehouse, institutional, and so forth).

8.1.3.3 Surrounding area description.

8.1.3.4 Federal, state, local, and tribal government records on the *target property* and surrounding area to identify known or suspect potentially contaminated sources having *COC* on or near the *target property* (see 8.2).

8.1.3.5 Historical records related to prior use of the *target property* and surrounding properties to identify known or suspect potentially contaminated sources having *COC* on or near the *target property*.

8.1.3.6 General physical setting information including local soil type, and geological, hydrological, hydrogeological, and topographical information.

8.1.3.7 Significant natural or man-made conduits, such as utility corridors, sewers, storm drains, Karst terrain, and so forth, that may provide a more direct path for vapors to enter structures on the *target property*.

8.1.3.8 *User* specialized knowledge, experience, and commonly known or *reasonably ascertainable* information related to the *target property* and the surrounding area that has been supplied to the *environmental professional*.

8.1.3.9 If the *VIA* is a supplemental scope of work to a *Phase I ESA*, all of the information collected in the Phase I investigation, including information collected in site reconnaissance, interviews and actual or probable chemical usage on the *target property* or nearby property, shall be considered in conducting the *VIA*. If the *VIA* is not a supplemental scope of work to a *Phase I ESA*, the *environmental professional* shall collect and review the information identified in 8.1.3.1 through 8.1.3.9 on the *target property* and properties within close proximity, including information (such as *COC* usage and the potential for release) obtained from site reconnaissance and as a result of interviews of knowledgeable site personnel.

8.1.4 Vapor intrusion may be eliminated as a concern at Tier 1 because it was previously evaluated and eliminated by other parties. In this case, the adequacy of the prior evaluation (particularly if conducted prior to this practice) shall be evaluated by a qualified professional (refer to 4.7 and 7.5). In other cases, existing engineering controls (for example, vapor barriers, and so forth) or *intrinsically safe building design* (for example, well ventilated underground parking, and so forth) may pre-empt the potential for vapor intrusion impacts. In these cases, the adequacy of the controls, including operation and maintenance, shall be reviewed by a qualified professional.

8.2 *Government Records Review*:

8.2.1 *Approximate Minimum Search Distance*—Records to be reviewed pertain not just to the *target property* but also to nearby properties within an *approximate minimum search distance*, to assess the likelihood of a *pVIC* from migrating *COC*. The term *approximate minimum search distance* for this practice shall be measured from the *target property* to a known or suspect source of soil and/or groundwater contamination. The term *approximate minimum search distance* is used in lieu of radius in order to include irregularly shaped properties.

8.2.2 *Accuracy and Completeness*—Accuracy and completeness of record information varies among information sources, including governmental sources. Record information is often inaccurate or incomplete. The *user* or *environmental professional* is not obligated to identify mistakes or insufficiencies in information provided. However, the *environmental professional* reviewing records shall make a reasonable effort to compensate for mistakes or insufficiencies in the information reviewed that are *obvious* in light of other information which the *environmental professional* has actual knowledge.

8.2.3 *Reasonably Ascertainable/Standard Sources*—Availability of record information varies from information source to information source, including governmental jurisdictions. The *user* or *environmental professional* is not obligated to identify, obtain, or review every possible record that might exist with respect to a property. Instead, this practice identifies record information that shall be reviewed from *standard sources*, and the *user* or *environmental professional* is required to review only record information that is *reasonably ascertainable* from those *standard sources*. Record information that is *reasonably ascertainable* means *(1)* information that is *publicly available*, *(2)* information that is obtainable from its source within reasonable time and cost constraints, and *(3)* information that is *practically reviewable*.

8.2.3.1 *Publicly Available*—Information that is *publicly available* means that the source of the information allows access to the information by anyone upon request.

8.2.3.2 *Reasonable Time and Cost*—Information that is obtainable within reasonable time and cost constraints means that the information will be provided by the source within 20 calendar days of receiving a written, telephone, or in-person request at no more than a nominal cost intended to cover the source's cost of retrieving and duplicating the information. Information that can only be reviewed by a visit to the source is *reasonably ascertainable* if the visit is permitted by the source within 20 days of request.

8.2.3.3 *Practically Reviewable*—Information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the property without the need for extraordinary analysis of irrelevant data. The form of the information shall be such that the *user* can review the records for a limited geographic area. Records that cannot be feasibly retrieved by reference to the location of the property or a geographic area in which the property is located are not generally *practically reviewable*. Most databases of public

records are *practically reviewable* if they can be obtained from the source agency by the county, city, zip code, or other geographic area of the facilities listed in the record system. Records that are sorted, filed, organized, or maintained by the source agency only chronologically are not generally *practically reviewable*. Listings in *publicly available* records which do not have adequate address information to be located geographically are not generally considered *practically reviewable*.

8.2.4 *Alternatives to Standard Sources*—Alternative sources may be used instead of *standard sources*, if they are of similar or better reliability and detail, or if a standard source is not *reasonably ascertainable*.

8.2.5 *Coordination*—If records are not *reasonably ascertainable* from *standard sources* or alternative sources, the *environmental professional* shall attempt to obtain the requested information by other means specified in this practice, such as questions posed to the current *owner* or *occupant(s)* of the *property* or other knowledgeable persons available at the time of the request.

8.2.6 *Sources of Standard Source Information*—Standard source information or other record information from government agencies may be obtained directly from these government agencies or from commercial services. Government information obtained from nongovernmental sources may be considered current if the source updates the information at least every 90 days or, for information that is updated less frequently than quarterly by the government agency, within 90 days of the date the government agency makes the information available to the public.

8.2.7 *Documentation of Sources Checked*—The *report* shall document each source that was used, even if a source revealed no findings. Sources shall be sufficiently documented, including name, date request for information was filled, date information provided was last updated by source, date information was last updated by original source (if provided other than by original source). Supporting documentation shall be included in the *report* or adequately referenced to facilitate reconstruction of the assessment by an *environmental professional* other than the *environmental professional* who conducted it.

8.2.8 *Significance*—If a *standard environmental record source* (or other sources in the course of conducting the *Phase I ESA*) identifies the *target property* or another site within the *approximate minimum search distance* defined by this practice, the *report* shall include the *environmental professional's* judgment about the significance of the listing with respect to analysis of *pVICs* in connection with the *target property*.

8.3 *Environmental Information*:

8.3.1 *Standard Environmental Record Sources*—The following *standard environmental record sources* shall be reviewed, subject to the conditions of 8.2.1 through 8.2.8, to identify if there are known or suspect sources of contamination within the *area of concern*. The *approximate minimum search distance* is based upon the type of *COC*, that is, petroleum hydrocarbons versus non-petroleum hydrocarbons, and the location of a known or suspect source of contamination, that is, *primary area of concern* (surrounding the *target property*) or *secondary area of concern* (hydrogeologically up-gradient of the *target property* beyond the *primary area of concern* distances). The search radii for the *primary area of concern* are defined in 8.3.2, and for the *secondary area of concern* in 8.3.3. The *VIA* process to be followed using these criteria is described in 8.5.2. The *approximate minimum search distance* may be adjusted by the *environmental professional* conducting the *VIA* based upon experience in the local area. If there are known or suspect sources of contamination within the *area of concern*, the *environmental professional* shall determine if *COC* may be present. *Petroleum hydrocarbon chemicals of concern* are distinguished from other *COC* because petroleum hydrocarbons often undergo biodegradation in the vadose zone in the presence of oxygen.

8.3.2 *Approximate minimum search distances* surrounding the *target property* (primary *area of concern*):

Standard Environmental Record Sources (where available)	Approximate Minimum Search Distance—Surrounding the Target Property, miles	
	Chemicals of Concern	Petroleum Hydrocarbon Chemicals of Concern
Federal *NPL* site list	⅓	1/10
Federal CERCLIS list	⅓	1/10
Federal RCRA CORRACTS facilities list	⅓	1/10
Federal RCRA non-CORRACTS TSD facilities list	⅓	1/10
Federal *RCRA generators list*	*property* only	*property* only
Federal institutional control/engineering control registries	*property* only	*property* only
Federal *ERNS list*	*property* only	*property* only
State and tribal lists of *hazardous waste* sites identified for investigation or remediation:		
State- and tribal-equivalent *NPL*	⅓	1/10
State- and tribal-equivalent CERCLIS	⅓	1/10
State and tribal *landfill* and/or *solid waste disposal site* lists	⅓	1/10
State and tribal leaking storage tank lists	⅓	1/10
State and tribal registered storage tank lists	*property* only	*property* only
State and tribal institutional control/ engineering control registries	*property* only	*property* only
State and tribal voluntary cleanup sites	⅓	1/10
State and tribal Brownfield sites	⅓	1/10

8.3.3 *Approximate minimum search distances* up-gradient of the *target property* (secondary *area of concern*):

Standard Environmental Record Sources (where available)	Approximate Minimum Search Distance—Up-gradient Only of Target Property, miles	
	Chemicals of Concern	Petroleum Hydrocarbon Chemicals of Concern
Federal *NPL* site list	1	1
Federal CERCLIS list	½	½
Federal RCRA CORRACTS facilities list	1	1
Federal RCRA non-CORRACTS TSD facilities list	½	½
State and tribal lists of *hazardous waste* sites identified for investigation or remediation:		
State- and tribal-equivalent *NPL*	1	1
State- and tribal-equivalent CERCLIS	½	½
State and tribal *landfill* and/or *solid waste disposal site* lists	½	½
State and tribal leaking storage tank lists	½	½
State and tribal voluntary cleanup sites	½	½
State and tribal Brownfield sites	½	½

8.3.4 *Physical Setting Sources*—Information about the geologic, hydrologic, hydrogeologic, and topographic characteristics of a site shall be used, pursuant to local good commercial or customary practice, to assist in the assessment of *COC* vapors migrating from contaminated soil and/or groundwater on the *target property* or *COC* vapors migrating to the *target property* into existing or planned structures on the *target property*.

8.4 *Current and Historical Use Information*:

8.4.1 *Objective*—The objective of reviewing current property use and consulting historical sources is to develop a history of the uses of the *target property* and surrounding area, to help identify the likelihood of uses leading to *pVICs* in connection with the *target property*. The *approximate minimum search distance* for past uses involving *COC* shall be set consistent with 8.3.2 and 8.3.3 to the extent possible. Current or past uses such as gas stations (using petroleum hydrocarbons), dry cleaning establishments (using chlorinated volatile organic compounds), former manufactured gas plant sites (using volatile and semi-volatile organic compounds) and former industrial sites such as those that had vapor degreasing or other parts cleaning operations (using chlorinated volatile organic compounds) are of particular concern due to the pervasiveness of these sources.

8.4.2 *Uses of Properties in Surrounding Area*—Uses in the area surrounding the *target property* shall be identified in the *report*.

8.4.3 *Standard Historical Sources*:

8.4.3.1 *Applicable Historical Sources*—The *standard historical sources* (researched as part of a Practice E1527 *Phase I ESA*) that will provide the most useful information for conducting the *VIA* include: *(1)* fire insurance maps; *(2)* local street directories; *(3)* aerial photographs; and *(4)* USGS topographic maps.

8.4.3.2 *Fire Insurance Maps*—The term *fire insurance maps* means maps produced for private fire insurance map companies that indicate uses of properties at specified dates and that encompass the property. These maps are often available at local libraries, historical societies, private resellers, or from the map companies that produced them.

8.4.3.3 *Local Street Directories*—The term *local street directories* means directories published by private (or sometimes government) sources and showing ownership and/or use of sites by reference to street addresses. Often *local street directories* are available at libraries of local governments, colleges or universities, or historical societies.

8.4.3.4 *Aerial Photographs*—Historical *aerial photographs* typically going back to the early 1930s may allow identification of activities on or within close proximity to the *target property*. *Aerial photographs* are often available from government agencies, commercial aerial photography companies or private collections unique to a local area.

8.4.3.5 *USGS Topographic Maps*—Historical USGS *topographic maps* may provide an indication of past uses of the *target property* and the area surrounding the *target property*. These maps are available from the U.S. Geological Survey.

8.4.3.6 *Other Historical Sources*—The term *other historical sources* means any source or sources other than those designated in 8.4.3.2 through 8.4.3.5 that are credible to a reasonable person and that identify past uses of the *target property* and properties within *close proximity*. This category includes, but is not limited to: miscellaneous maps, newspaper archives, internet sites, community organizations, local community knowledge, local libraries, historical societies, current owners or occupants of neighboring properties, or records in the files and/or personal knowledge of the property *owner* and/or occupants.

8.5 *Tier 1 Screening Assessment*:

8.5.1 The *VIA* at Tier 1 consists of a review of the minimum information included in 8.1.3.1 through 8.1.3.9 combined with the application of professional judgment.

8.5.2 The Tier 1 screening assessment shall include: *(1)* a search distance test to determine if there are any known or suspect contaminated sites in the primary *area of concern* identified in 8.3.2 and the secondary *area of concern* identified in 8.3.3; *(2)* a *chemicals of concern* test to determine for those known or suspect contaminated sites within the *area of concern* whether or not *COC* are likely to be present (see Appendix X6); and, if the information is available, for example, from the *Phase I ESA* investigation, *(3)* a plume test to determine whether or not *COC* in the *contaminated plume* may be within the *critical distance*, and, if so, whether *RBCs* are exceeded (see 9.2.2 and 9.2.3). For this practice, the *critical distance* is defined as the lineal distance in any direction from the nearest edge of a *contaminated plume* to the nearest existing or planned structure on the *target property*, or to the nearest property boundary if there are no planned structures on the *target property*. Information related to the size of the *contaminated plume* from known contaminated sites as required for conducting the plume test may or may not be available at the Tier 1 level (for example, from the *Phase I ESA* investigation). If the non-invasive component of Tier 2, which specifically involves collection of available *contaminated plume* delineation data in Phase II reports (see 9.1), is conducted at the same time as the Tier 1 investigation,