

References Vapor Intrusion Mitigation Team | December 2020

AARST, 2017 AARST. "Soil Gas Mitigation Standards for Existing Homes." In AARST Consortium on National Radon Standards: ANSI/AARST, 2017. .

AARST, 2018a AARST. "Radon Mitigation Standards for Multifamily Buildings." In AARST Consortium on National Radon Standards: ANSI/AARST, 2018a. https://standards.aarst.org/RMS-MF-2018/index.html.

AARST, 2018b AARST. "Radon Mitigation Standards for Schools and Large Buildings." In AARST Consortium on National Radon Standards: ANSI/AARST, 2018b. https://standards.aarst.org/RMS-LB-2018/index.html.

AARST, 2018c AARST. "Soil Gas Control Systems in New Construction of Buildings." In AARST Consortium on National Radon Standards: ANSI/AARST, 2018c. https://standards.aarst.org/CC-1000-2018/index.html.

AARST, 2020 AARST. "Reducing Radon in New Construction of 1 & 2 Family Dwellings and Townhouses." In AARST Consortium on National Radon Standards: ANSI/AARST, 2020. https://standards.aarst.org/CCAH-2020/index.html.

ASHRAE, 2013 ANSI/ASHRAE. "Ventilation for Acceptable Indoor Air Quality." Atlanta, GA: American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 2013.

ASTM E2121-13 ASTM International. "Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings." West Conshohocken, PA: ASTM International, 2013.

ASTM D1709 ASTM International. "Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method." West Conshohocken, PA: ASTM International, 2016.

ASTM F1869 ASTM International. "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride." West Conshohocken, PA: ASTM International, 2016.

ASTM E1745 ASTM International. "Standard Specifications for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs." West Conshohocken, PA: ASTM International, 2017.

ASTM D4437 ASTM International. "Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymetric Sheet Geomembranes." West Conshohocken, PA: ASTM International, 2018.

ASTM D5820 ASTM International. "Standard Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes." West Conshohocken, PA: ASTM International, 2018.

ASTM D882 ASTM International. "Standard Test Method for Tensile Properties of Thin Plastic Sheeting." West Conshohocken, PA: ASTM International, 2018.

ASTM E96 ASTM International. "Standard Test Methods for Water Vapor Transmission of Materials." West Conshohocken, PA: ASTM International, 2016.

ASTM F2170 ASTM International. "Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes." West Conshohocken, PA: ASTM International, 2019.

ASTM, 2020 ASTM International. "PFAS—Per- and Polyfluoroalkyl Substances." Interstate Technology Regulatory Council, 2020. ASTSWMO, 2012 ASTSWMO. "A Long-Term Stewardship State Conceptual Framework to Estimate Associated Cost." Association of State and Territorial Solid Waste Management Officials. Washington, DC, 2012,

http://astswmo.org/files/policies/CERCLA_and_Brownfields/2012-05-LTS_State_Conceptual_Framework_to_Estimate_Associate d Cost.pdf.

ATSDR, 2017 ATSDR. "Investigating Vapor Intrusion." Agency for Toxic Substances and Disease Registry, 2017.

Beringer, 2017 Beringer, M. "Revised Vapor Intrusion Risk Management Decision Matrix February 24, 2017, https://semspub.epa.gov/work/07/30352706.pdf.

CalEPA, 2011 CalEPA. "Vapor Intrusion Mitigation Advisory, Revision 1" California Environmental Protection Agency, Department of Toxic Substances Control, 2011,

https://dtsc.ca.gov/wp-content/uploads/sites/31/2016/01/VIMA_Final_Oct_20111.pdf.

CalEPA, 2012 CalEPA. "Vapor Intrusion Public Participation Advisory." California Environmental Protection Agency, Department of Toxic Substances Control, 2012,

https://dtsc.ca.gov/wp-content/uploads/sites/31/2016/01/VIPPA_Final_03_05_12.pdf

Caulfield, 2008 Caulfield, S.M. "HVAC Systems and Vapor Intrusion." In Workshop on Vapor Intrusion in Commercial and Industrial Buildings: Assessment and Mitigation. Westford, MA, 2008.

https://clu-in.org/download/contaminantfocus/vi/HVAC%20Influence.pdf.

Dawson, 2016 Dawson, Helen. "Mass Flux Characterization for Vapor Intrusion Assessment." U.S. Department of Defense:

ESTCP, 2016,

https://www.serdp-estcp.org/Program-Areas/Environmental-Restoration/Contaminated-Groundwater/Emerging-Issues/ER-201 503/ER-201503 .

DeVaull, 2007 DeVaull, George E. "Indoor Vapor Intrusion with Oxygen-Limited Biodegradation for a Subsurface Gasoline Source." Environmental Science & Technology 41, no. 9 (May 1, 2007): 3241-48.

Dickson, 2013 Dickson, Bruce. "Guide to Closing and Conditioning Ventilated Crawlspaces," Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, Golden, CO, 2013, https://www.nrel.gov/docs/fy13osti/54859.pdf.

DNREC-SIRB, 2007 DNREC-SIRB. "Policy Concerning the Investigation, Risk Determination and Remediation for Vapor Intrusion Pathway," Delaware Department of Natural Resources & Environmental Control, Site Investigation and Restoration Branch, 2007, .

Eklund et al., 2018 Eklund, Bart, Lila Beckley, and Rich Rago. "Overview of State Approaches to Vapor Intrusion: 2018." Remediation Journal 28, no. 4 (2018): 23-35.

Hatton and Salcone, 2014 Hatton, Thomas, and M. Salcone. "Applying Dynamic Controls to Vapor Intrusion Mitigation Systems to Manage Pressure Differentials, Effluent Concentrations and Energy Conservation." 2014.

IDEM, 2019 IDEM. "Vapor Remedy Selection and Implementation," Indiana Department of Environmental Management, 2019, https://www.in.gov/idem/cleanups/files/remediation_tech_guidance_vapor_remedy_selection.pdf.

International Code Council, 2018 International Code Council. "International Mechanical Code 2018 Section 404 Enclosed Parking Garages." Florence, KY: Cengage Learning, 2018.

ITRC, 2006 ITRC. "Above Ground Treatment Technologies." Washington, DC: Interstate Technology Regulatory Council, 2006. ITRC, 2007a ITRC. "Vapor Intrusion Pathway: A Practical Guideline." Washington, DC: Interstate Technology & Regulatory Council, 2007a.

ITRC, 2007b ITRC. "Vapor Intrusion Pathway: Investigative Approaches for Typical Scenarios." Washington, DC: Interstate Technology & Regulatory Council, 2007b.

ITRC, 2014 ITRC. "Petroleum Vapor Intrusion: Fundamentals of Screening, Investigation, and Management." Washington, DC: Interstate Technology & Regulatory Council, 2014.

ITRC, 2016 ITRC. "Long-Term Contaminant Management Using Institutional Controls." Washington, DC: Interstate Technology & Regulatory Council, 2016.

ITRC, 2018 ITRC. "LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies." LNAPL-3. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team. 2018. https://lnapl-3.itrcweb.org.

ITRC, 2020 ITRC. "Risk Communication Plan Toolkit." Washington, D.C.: Interstate Technology & Regulatory Council, 2020. https://rct-1.itrcweb.org/

Johnson et al., 1998 Johnson, Paul C., C. Cruce, R. Johnson, and M. Kemblowski. "In Situ Measurement of Effective Vapor-Phase Porous Media Diffusion Coefficients." Environmental Science & Technology 32, no. 21 (November 1, 1998): 3405-09.

Kilmer et al., 2016 Kilmer, Doug, G. Crockford. S. Metz, and D. Litz. Vapor Intrusion Mitigation, Let Me Count the Ways. TRC, 2016. https://cdn.trccompanies.com/legacy/images/TRC-white-paper-Vapor-Intrusion-FINAL-March-2016.pdf.

Luo et al., 2013 Luo, Hong, P. Dahlen, P. Johnson, and T. Peargin. "Proof-of-Concept Study of an Aerobic Vapor Migration Barrier beneath a Building at a Petroleum Hydrocarbon-Impacted Site." Environmental Science & Technology 47, no. 4 (February 19, 2013): 1977-84.

Lutes et al., 2011 Lutes, C., R., Studebaker, R. Uppencamp, L. Abreu, and N. Weinberg "Efficient Assessment and Mitigation of Vapor Intrusion: Optimal Subslab Depressurization Design Strategies and Handling the Problems of Variability with Long-Term Integrated Samplers." Paper presented at the USEPA Workshop: Addressing Regulatory Challenges in Vapor Intrusion, Association of Environmental Health and Sciences Conference, San Diego, CA, 2011.

MADEP, 2016 MADEP. "MassDEP Vapor Intrusion Guidance: Site Assessment, Mitigation and Closure," Massachusetts Department of Environmental Protection, 2016,

https://www.mass.gov/doc/wsc-16-435-vapor-intrusion-guidance-site-assessment-mitigation-and-closure/download.

McAlary et al., 2018 McAlary, Todd, W. Wertz, and D. Mali. "Demonstration/Validation of More Cost-Effective Methods for Mitigating Radon and VOC Subsurface Vapor Intrusion to Indoor Air," U.S. Department of Defense: ESTCP, 2018, https://clu-in.org/download/issues/vi/ER-201322-Final-Report.pdf.

McAlary et al., 2020 McAlary, Todd, W. Wertz, D. Mali, and P. Nicholson. "Mathematical Analysis and Flux-Based Radius of Influence for Radon/VOC Vapor Intrusion Mitigation Systems." Science of the Total Environment 740, no. 139988, 2020. McWatters and K. Rowe, 2018 McWatters, Rebecca, and K. Rowe. "Barrier Permeation Properties of EVOH Thin-Film Membranes under Aqueous and Non-Aqueous Conditions." Geotextiles and Geomembranes 46, no. 4 (2018): 529-41.

MDEQ, 2013 MDEQ. "Guidance Document for Vapor Intrusion." Remediation and Redevelopment Division, Michigan Department of Environmental Quality, Lansing, Michigan, 2013,

https://www.michigan.gov/documents/deq/deq-rrd-VIGuidanceDoc-May2013 422550 7.pdf.

MDOH, 2020 MDOH. "Vapor Intrusion Website," Minnesota Department of Health, September 2020,

https://www.health.state.mn.us/communities/environment/hazardous/topics/vaporintrusion.html.

Moorman, 2009 Moorman, L. "Energy Losses and Operation Costs of Radon Mitigation Systems." In American Association of Radon Scientists and Technologists (AARST) Conference, 1-27. St. Louis, MO, 2009.

MPCA, 2015 MPCA. "Diagnostic Testing, Installation and Confirmation," Minnesota Pollution Control Agency. Minnesota, 2015.

MPCA, 2019 MPCA. "Parking Facilities and Vapor Intrusion Mitigation: Design and Operation Considerations for Parking Facilities as Vapor Intrusion Mitigation Options," Minnesota Pollution Control Agency, 2019,

https://www.pca.state.mn.us/sites/default/files/c-rem3-06i.pdf.

MPCA, 2020a MPCA. "Vapor Intrusion Website," Minnesota Pollution Control Agency, September 2020a, https://www.pca.state.mn.us/waste/vapor-intrusion.

MPCA, 2020b MPCA. "Vapor Mitigation Best Management Practices," Minnesota Pollution Control Agency, 2020b, https://www.pca.state.mn.us/sites/default/files/c-rem3-06.pdf.

Mudarri, 2010 Mudarri, D. "Building Codes and Indoor Air Quality," Office of Radiation and Indoor Air, U.S. Environmental Protection Agency. Washington, DC, 2010,

https://www.epa.gov/sites/production/files/2014-08/documents/building_codes_and_iaq.pdf.

NAVFAC, undated NAVFAC. "Technologies Overview Website." Department of Navy. Washington Navy Yard, DC. Undated.

NAVFAC, 2011 NAVFAC. "Vapor Intrusion Mitigation in Construction of New Buildings Fact Sheet," Department of the Navy. Washington, DC, 2011, https://clu-in.org/download/contaminantfocus/vi/vi_mit_new_bldg_fs.pdf.

NHDES, 2019 NHDES. "WMD-REM-30, Vapor Intrusion," New Hampshire Department of Environmental Services. Concord, New Hampshire, 2019, .

NJDEP, 2020 NJDEP. "Vapor Intrusion Pathway Website and Community Outreach," New Jersey Department of Environmental Protection, 2020, https://www.nj.gov/dep/srp/guidance/vaporintrusion/.

NJDEP, 2018 NJDEP. "Vapor Intrusion Technical Guidance, Version 4.1," New Jersey Department of Environmental Protection, 2018, https://www.nj.gov/dep/srp/guidance/vaporintrusion/vit_main.pdf?version_4.1.

NYSDOH, 2006 NYSDOH. "Guidance for Evaluating Soil Vapor Intrusion in the State of New York," New York State Department of Health, 2006,

https://www.health.ny.gov/environmental/investigations/soil_gas/svi_guidance/docs/svig_final2006_complete.pdf.

NYSDOH, 2005 NYSDOH. "Vapor Intrusion Fact Sheets," New York State Department of Health, 2005,

https://www.health.ny.gov/environmental/indoors/vapor_intrusion/fact_sheets/.

Osborne, 1989 Osborne, M. "Radon Reduction in Crawl Space House." Journal of Environmental Engineering 115, no. 3 (June 1989): 574-89.

PADEP, 2019 PADEP. "Land Recycling Program Technical Guidance Manual," Pennsylvania Department of Environmental Protection, 2019,

https://www.dep.pa.gov/Business/Land/LandRecycling/Standards-Guidance-Procedures/Guidance-Technical-Tools/Pages/Technical-Guidance-Manual.aspx.

Pontarolo Engineering, 2012 Pontarolo Engineering. "Cuplox® E-rated Floor Systems Venting Design Guide." Las Vegas, NV, 2012.

USEPA, 2017 Schumacher, B, J. Zimmerman, R. Truesdale, K. Owen, C. Lutes, M. Novak, and K. Hallberg. "Adsorption-Based Treatment Systems for Removing Chemical Vapors from Indoor Air," U.S. Environmental Protection Agency. Washington, DC, 2017, https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=532560&Lab=NERL.

Shea, 2017 Shea, D. "Long-Term Performance Monitoring for HVAC Engineering Controls for VI Mitigation of Large Buildings." Paper presented at the AEHS Foundation's Annual International Conference on Soil, Water, Energy, and Air, Amherst, MA, March 2017.

Shea and Green, 2010 Shea, D., and B. Green. "HVAC Influence on Vapor Intrusion in Commercial and Industrial Buildings." Paper presented at the Air and Waste Management Association (AWMA) Vapor Intrusion Conference, Chicago, IL, September 2010. Shea and Green, 2017 Shea, D., and B. Green. "HVAC Systems for VI Mitigation in Large Buildings: Reliability and Long-Term Performance Monitoring Considerations." Paper presented at the Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies Conference, Miami, FL, May 2017.

Shea et al., 2020 Shirazi, Elham, G. Hawk, C. Holton, A. Stromberg, and K. Pennell. "Comparison of Modeled and Measured Indoor Air Trichloroethene (TCE) Concentrations at a Vapor Intrusion Site: Influence of Wind, Temperature, and Building Characteristics." Environmental Science: Process & Impacts 22, no. 3 (2020): 802-11.

Steward, 2020 Stewart, Lloyd, Chris Lutes, Robert Truesdale, Brian Schumacher, John H. Zimmerman, and Rebecca Connell. "Field Study of Soil Vapor Extraction for Reducing Off-Site Vapor Intrusion." Groundwater Monitoring & Remediation 40, no. 1 (2020): 74-85.

Tillman and Weaver, 2007 Tillman, Fred, and J. Weaver. "Temporal Moisture Content Variability beneath and External to a Building and the Potential Effects on Vapor Intrusion Risk Assessment." Science of the Total Environment 379, no. 1 (2007): 1-15.

USDOD, 2009 Tri-Service Environmental Risk Assessment Workgroup. "DOD Vapor Intrusion Handbook," U.S. Department of Defense. Washington, DC, 2009, https://clu-in.org/download/char/dodvihdbk200901.pdf.

US Army Corps of Engineers, 1999 US Army Corps of Engineers. "Multi-Phase Extraction," EM 1110-1-4010, Engineering and Design. Washington, DC, 1999,

https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-4010.pdf.

US Army Corps of Engineers, 2002 US Army Corps of Engineers. "Soil Vapor Extraction and Bioventing," EM 1110-1-4001, Engineering and Design. Washington, DC, 2002,

https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-4001.pdf.

USDA, 2004 USDA. "Crawl Space Ventilation." Madison, WI: Forest Products Laboratory, 2004.

USDOE, 2009 USDOE. "Details for Mechanically Vented Crawlspaces—Code Notes," U.S. Department of Energy. Washington, DC, 2009, .

USEPA, 1993 USEPA. "Radon Reduction Techniques for Existing Detached Houses, Technical Guidance (Third Edition) for Active Soil Depressurization Systems," U.S. Environmental Protection Agency. Washington, DC, 1993, https://www.wbdg.org/FFC/EPA/EPACRIT/epa625 r 93 011.pdf.

USEPA, 1994 USEPA. "Model Standards and Techniques for Control of Radon in New Residential Buildings," Air and Radiation, U.S. Environmental Protection Agency. Washington, DC, 1994,

https://archive.epa.gov/epa/sites/production/files/2014-11/documents/model_standards.pdf.

USEPA, 2008 USEPA. "Indoor Air Vapor Intrusion Mitigation Approaches," U.S. Environmental Protection Agency. Washington, DC, 2008, . "Local Government Planning Tool to Calculate Institutional and Engineering Control Costs for Brownfield Properties," Office of Brownfields and Land Revitalization, U.S. Environmental Protection Agency. Washington, DC, 2010, https://www.epa.gov/sites/production/files/2015-09/documents/ic_ec_cost_tool.pdf.

USEPA, 2011 USEPA. "Exposure Factors Handbook 2011 Edition (Final Report)," U.S. Environmental Protection Agency. Washington, DC, 2011, https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252.

USEPA, 2012a USEPA. "A Citizen's Guide to Soil Vapor Extraction and Air Sparging," Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, DC, 2012a,

https://www.epa.gov/sites/production/files/2015-04/documents/a_citizens_guide_to_soil_vapor_extraction_and_air_sparging.p df.

USEPA, 2012b USEPA. "Community Involvement for Superfund Sites Affected by Vapor Intrusion," Region VI, U.S. Environmental Protection Agency. 2012b, https://semspub.epa.gov/work/11/176269.pdf.

USEPA, 2012c USEPA. "EPA's Vapor Intrusion Database: Evaluation and Characterization of Attenuation Factors for Chlorinated Volatile Organic Compounds and Residential Buildings," Office of Solid Waste and Emergency Response U.S. Environmental Protection Agency. Washington, DC, 2012c,

https://www.epa.gov/sites/production/files/2015-09/documents/oswer_2010_database_report_03-16-2012_final_witherratum_ 508.pdf.

USEPA, 2012d USEPA. "Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Control at Contaminated Sites," Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, DC, 2012d, https://www.epa.gov/sites/production/files/documents/final_pime_guidance_december_2012.pdf.

USEPA, 2015a USEPA. "Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites," Office of Underground Storage Tanks, U.S. Environmental Protection Agency. Washington, DC, 2015a, https://www.epa.gov/ust/technical-guide-addressing-petroleum-vapor-intrusion-leaking-underground-storage-tank-sites. USEPA, 2015b USEPA. "Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air", Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. Washington, DC, 2015b, https://www.epa.gov/sites/production/files/2015-09/documents/oswer-vapor-intrusion-technical-guide-final.pdf.

USEPA, 2018a USEPA. "Compilation of Triple Site Outreach Materials July 2014 through August 2018," Region IX, U.S. Environmental Protection Agency, 2018a, https://semspub.epa.gov/work/09/100017073.pdf.

USEPA, 2018b USEPA. "Residential Air Cleaners: A Technical Summary," Indoor Environments Division, U.S. Environmental Protection Agency. Washington, DC, 2018b,

https://www.epa.gov/sites/production/files/2018-07/documents/residential_air_cleaners_-_a_technical_summary_3rd_edition.pdf.

FDA, 2018. U.S. Food and Drug Administration. "Plain Language Principles," Department of Human Health Services. Washington, DC. 2018, https://www.fda.gov/about-fda/plain-writing-its-law/plain-language-principles.

WDNR, 2018 WDNR. "Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin," Remediation and Redevelopment Program, Wisconsin Department of Natural Resources, 2018, .

WDNR, undated WDNR. "Vapor Intrusion Resources for Environmental Professionals Website," Wisconsin Department of Natural Resources, https://dnr.wisconsin.gov/topic/Brownfields/Vapor.html.

Wilson et al., 2014 Wilson, Steve, S. Abbot, and H. Mallett. "Guidance on the Use of Plastic Membranes as VOC Vapour Barriers." Construction Industry Research and Information Association C748, 2014.

WSDOE, 2016 WSDOE. "Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action," Toxics Cleanup Program, Washington State Department of Ecology, 2016,

https://fortress.wa.gov/ecy/publications/documents/0909047.pdf.