

Mass Flux Characterization as an Alternative Approach to Evaluating Upper Bound Impacts of Vapor Intrusion on Building Occupants

Helen Dawson, Ph.D. (Geosyntec Consultants, Washington DC, USA)

William Wertz, Ph.D. (Geosyntec Consultants, Castleton, NY, USA)

Todd McAlary, P.E., Ph.D. (Geosyntec Consultants, Toronto, ON, Canada)

Daniel Carr, PE, PG (Sanborn Head & Associates, Dayton, ME, USA)

Background/Objectives. Vapor intrusion (VI) is challenging to assess using conventional discrete indoor air and sub-slab sampling because of spatial and temporal variability in volatile organic compound (VOC) concentrations, which leads to uncertainty in identifying a Reasonable Maximum Exposure (RME) for the occupants of a building. The characterization and monitoring of vapor phase contaminant mass flux (mass per unit time per unit area) offers a promising alternative to conventional indoor air and sub-slab sampling, because mass flux measurements have been found to exhibit considerably less temporal variability than indoor air measurements. Additionally, mass flux characterization techniques can be implemented in a short time frame (for example, over a weekend), yet provide conservative estimates of the potential impacts that may arise from VI under natural conditions. This paper presents the results of a mass flux characterization study conducted as part of an ongoing ESTCP SERDP research project (ER 201503).

Approach/Activities. The test building is a small commercial building at the former Raritan Arsenal in Edison, New Jersey. The total mass flow or loading (i.e., mass flux times building footprint area) below and through the building has been characterized in three ways:

- Estimating the potential diffusive mass flux through the vadose zone by measuring the compound's vertical concentration profile in soil and/or soil gas and estimating the effective diffusion coefficient by measuring soil properties. The mass flux times the building footprint provides an estimate of the mass loading that may enter the building.
- Assessing the extractable mass loading under the building foundation by measuring the concentrations and flow rates in the exhaust pipes of an existing sub-slab venting system, which provides another estimate of the mass loading that could enter the building.
- Measuring the mass loading that actually enters the building under controlled conditions by measuring indoor air concentrations and building ventilation rates under different levels of building depressurization, which induces VI into the building.

Results/Lessons Learned. This paper presents the results of the mass flux testing conducted and compares those results with conventional, historical VI characterization data collected at the building. The results are evaluated to determine how well the applied mass flux characterization techniques address both regulatory and industry concerns. Evaluation criteria include: Are the three mass flux characterization techniques comparable? Do the results provide reasonable estimates of potential upper bound indoor air concentrations arising from VI? Are the results repeatable over time? Can the techniques be used in lieu of conventional approaches for determining if VI mitigation is necessary and for developing exit strategies for sites with active mitigation systems? How do the techniques compare in terms of cost and ease of implementation relative to repeat indoor air and sub-slab sampling using conventional means? What are the potential technical limitations of each mass flux testing protocol for buildings of different size and construction?