Vapor Intrusion of 1,4-Dioxane: Regulatory Myth or Real Issue?

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Background/Objectives. Typically, the physical and chemical properties of a constituent can be used to predict migration potential from the subsurface into a building via the vapor intrusion pathway. For example, 1,4-dioxane would not be expected to volatilize from water given that its Henry's law constant is less than $4.8x10^{-6}$ atm-m^3/mole and high aqueous solubility. In fact, 1,4-dioxane is often quantified by analytical methods designed for semi-volatile compounds. In 2015, the United States Environmental Protection Agency changed the definition of a volatile constituent to include compounds with vapor pressures greater than 1 mm Hg. With a vapor pressure of 38.1 mm Hg, 1,4-dioxane is now technically considered a volatile compound based on these criteria. As a result, various states have begun to focus on 1,4-dioxane as a potential vapor intrusion concern and raises the question: would we even expect 1,4-dioxane to migrate into a building through the vapor migration pathway?

Approach/Activities. This work examines the factors that influence 1,4-dioxane vapor migration such as soil type and building construction through multiple case studies. 1,4-Dioxane detected in groundwater in a downgradient area versus soil gas near a source area were modeled to predict indoor air concentrations in an overlying building. Whereas groundwater data may indicate no potential risk to receptors, soil gas concentrations for buildings located near a source area result in predicted risks above regulatory levels.

Results/Lessons Learned. Site-specific data including groundwater, soil gas, depth to water, and soil type were used to evaluate potential exposures and risks due to 1,4-dioxane detected in the subsurface. The results of this analysis were two-fold. Firstly, when 1,4-dioxane was present in groundwater the vapor intrusion concern was minimal – due to its limited potential for volatilization from groundwater. Secondly, when 1,4-dioxane was present in vadose zone source areas, there was potential for a vapor intrusion pathway to be of concern – due to its vapor pressure and boiling point when not in water. These results suggest that vapor intrusion is not an exposure pathway that can be excluded without appropriate considerations for site-specific characteristics.