A Vapor Intrusion Mitigation Site's Follies and Lessons Learned

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Background/Objectives. During remedial investigation activities for a groundwater plume caused by the improper discharge of dry cleaning waste to city sewers, residential indoor air (RIA) sampling indicated concentrations exceeded action levels prompting implementation of remedial action. The indoor air concentrations exceeded remedial action screening levels (RALS) for both tetrachloroethylene (PCE) and trichloroethylene (TCE). The residence has impacted groundwater assumed to be less than a foot of the basement slab with the potential for seepage into the lower living space under wet conditions. In this semi-arid region localized groundwater surfacing can occur due to bedrock fractures and significant topographic relief. In this complex hydrogeologic environment, the selection of the appropriate vapor intrusion mitigation system is critical to the success of mitigating residential exposure and providing cost effective operations and maintenance of the system. Regrettably, reactionary decision making by the client in remedial action (RA) selection rather than sound hydrogeologic evaluation and engineering design resulted in ongoing performance/technical issues and inconsistent residential indoor air treatment at the site.

Approach/Activities. Based on preliminary RAL exceedances indoor VOC air purifiers were deployed as an interim action. Problems experienced at another site with shallow groundwater with a sub-slab depressurization system lead to the client preemptively selected the use of a whole house air purifier for the RA. Technical advice regarding long term viability of sub-slab depressurization or venting were disregarded and the scope was dictated by the client resulting in the installation of a preselected whole house air purifier. The off the shelf system included high efficiency particulate air (HEPA)/oversized carbon filters installed on the suction side of the furnace for indoor air removal of PCE and TCE.

Results/Lessons Learned. The indoor air treatment system operations and monitoring (O&M) are ongoing and the life of carbon filters are significantly less than predicted. Issues with selected indoor air treatment include the following. Cleaner air in the house increases diffusion gradient into the house from sub-slab vapors. Groundwater seeps into the basement increase humidity and brings in contaminants reducing carbon life. Reduced house temperatures while unoccupied in the winter increases humidity and further reduce carbon life. The carbon is also fouled by domestic activities such as cooking and cleaning which cannot be quantified by periodic inspections. Reduction in blower speed due to noise levels by the homeowner reduce treated air turnover rate and carbon effectiveness. Visual impurities in the carbon were noted during change out which creates the realization that the quality of the carbon cannot be verified and the single pass carbon filters are designed for allergy relief rather than actual contaminant treatment. Indoor air treatment also ties the need for continuous filter changes and monitoring into perpetuity. The cost to operate the system far exceed the cost required to install and operate the recommended sub-slab depressurization system with a sump. Additional benefits of the sub-slab system include removing vapors before that enter the house reversing the diffusion gradient to below the slab, possibility of resale of the property, less intrusive monitoring of basement sub-slab vacuum readings with limited indoor air sampling, low noise external fan mounted in remote location, requires no treatment of off-gas eliminating filter change out cost, and flow monitoring on stack outside the house reduces need to enter home.