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Detailed Field Evaluation of Soil Vapor Extraction to Prevent Vapor Intrusion

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Background/Objectives. Soil vapor extraction (SVE) is widely used to remediate volatile organic compounds (VOCs) from soil. In SVE vacuum blowers and wells are used to extract VOCs from unsaturated soil. Theoretically, this applied vacuum could reduce or prevent vapor intrusion (VI) into nearby buildings – analogously to subslab depressurization (SSD) technologies. SVE could prevent VI through multiple mechanisms: depressurization across the slab, lowering soil gas concentrations, removal of vadose zone sources, and/or interception of VOCs migrating from groundwater. Implementation and testing of SVE can also yield an enhanced conceptual site model for vapor intrusion (VI) assessments. Although SVE is well established for cleaning up VOC-contaminated soil, and is being applied to control VI, this application needs further refinement and validation.

Approach/Activities. EPA funded an SVE pilot study to investigate and optimize how SVE works to control and mitigate VI and to begin to assess whether SVE could serve as a viable neighborhood scale VI mitigation technology. Study objectives include 1) monitoring the cost effectiveness of the SVE system in reducing/preventing VI in seven neighboring buildings as measured by reduction of concentrations in indoor air; 2) determining how long the SVE system needs to be operated to achieve “remedial success” from both the SVE and VI perspectives; 3) determining the distance over which this SVE system can prevent VI in neighboring buildings; 4) determining how SVE rebound tests influence VI and whether they provide mass flux measurements useful for VI assessments; and 5) comparing SVE costs over time with conventional SSD. To achieve these objectives, a study was designed employing 10 indoor and 10 subslab locations, along with external soil gas and groundwater samples to monitor the effect of three centrally located triple screened SVE well clusters. The study buildings are primarily slab on grade with various commercial uses. Operational phases have included background determination, SVE step testing, full SVE operation, shutdown and rebound SVE testing. Thirty rounds of indoor air, fifteen rounds of soil gas and ten rounds of subslab samples have been collected. Numerous measurements of differential pressure (subslab and exterior soil gas points at multiple depths) were obtained.

Results/Lessons Learned. Initial results are promising for mass removal and the influence of SVE on soil gas. Some external soil gas locations experienced two orders of magnitude of concentration reduction in the first months of operation. However concentrations remained above conservative vapor intrusion screening levels in some locations. The amount of rebound observed was markedly different with depth, suggesting that impervious surfaces were limiting the removal of stored VOC mass in the shallowest depth intervals. The systems effectiveness in reversing the pressure differential across building slabs was not uniform with distance to extraction wells, suggesting that urban infrastructure or diverse foundation types were influential.