# ARC© FOR SOIL VAPOR INTRUSION

OTIE has developed **ARC©—Assess, Respond, Control**—which integrates our scientific and engineering expertise with innovative technical approaches to rapidly assess and resolve vapor intrusion (VI) problems.

## Assess

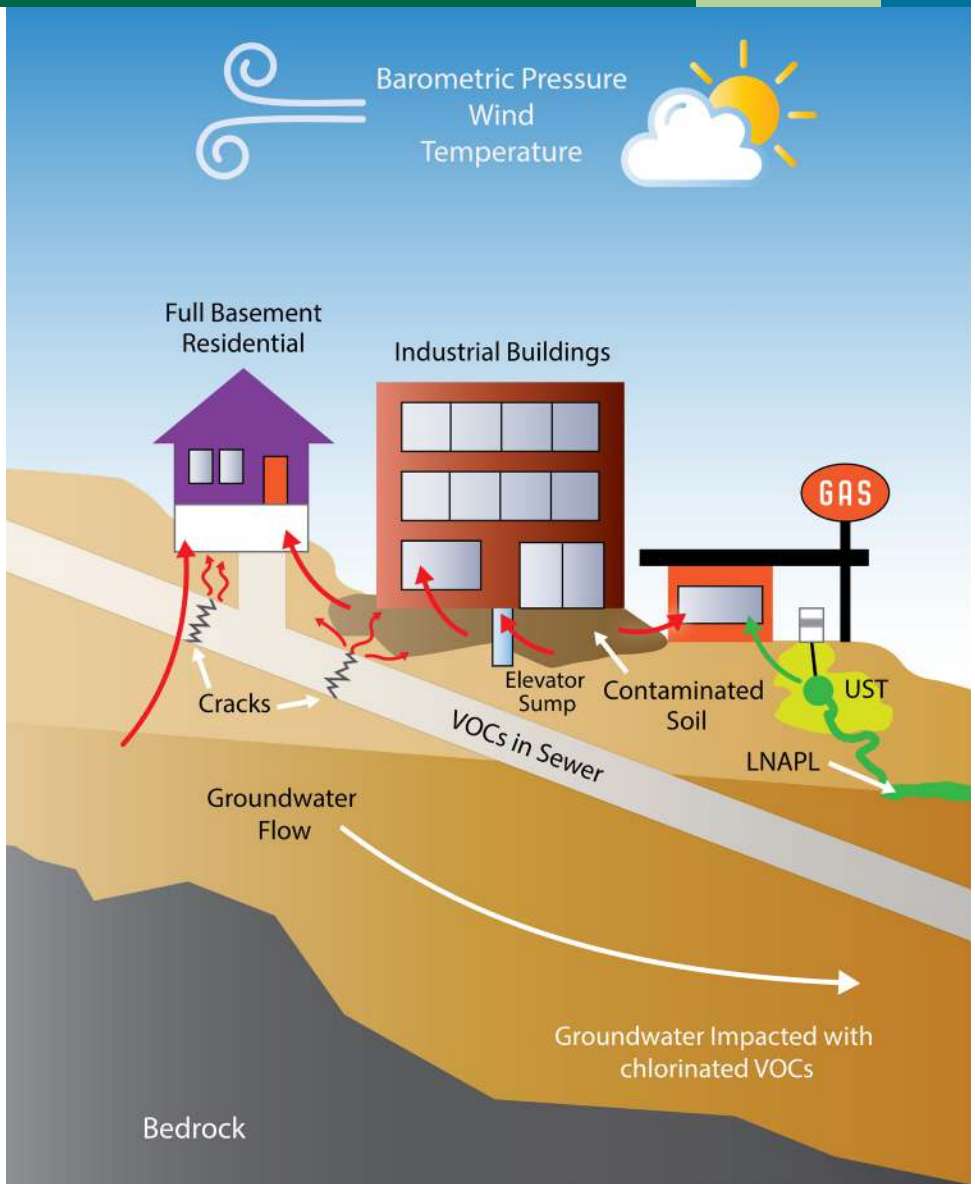
- OTIE efficiently builds accurate and complete Conceptual Site Models for VI using both grab samples and continuous monitoring techniques in a single initial assessment phase. First, we review building histories, layouts, daily use patterns, preferential pathways, and conduct interviews to identify factors that may contribute to VI vulnerability. HVAC systems and operations can be reviewed by experienced OTIE engineers. Continuous VOC and pressure-differential monitoring at multiple locations along with Cloud-based data visualizations generate the relevant temporal and spatial patterns in VI that support critical decision-making.

## Respond

- If indoor air concentrations are found to be above risk-based exposure limits, OTIE can rapidly and effectively respond to VI through short-term and/or long-term mitigation measures. These measures may include sealing floor cracks and seams, making adjustments to HVAC operations, venting, air purification systems, or subslab depressurization. Once in place, we conduct monitoring to ensure the response is working as intended and building occupants are being protected.

## Control

- We design, construct, and operate remedies that cost-effectively control VI and ultimately remove the VOC source, drawing on our deep experience and expertise in soil vapor extraction, bioremediation, thermal treatment, and other remedial technologies. Long-term VI control can be integrated with HVAC and on-site mitigation systems through remote telemetry and/or triggered-response systems.




## Technology Partner: VaporSafe™

VaporSafe™ is a technology that integrates a GC-ECD/PID detector with a user-friendly, fully customizable web-based interface. The analytical system is integrated with remote telemetry to automatically report results in near-real-time through a Cloud-based visualization and response platform available 24/7 to the project team. The system can be used in discrete sample or continuous monitoring modes without remobilization. OTIE integrates VaporSafe™ with our ARC© approach to provide our customers with timely quantitative data to differentiate contaminant sources (indoor source versus VI), accurately evaluate health risks, and then effectively mitigate VI in as little as a week. We have successfully used VaporSafe™ at Navy and EPA Superfund sites.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## EXPERIENCE

- **AMCO Superfund Site, Oakland, CA.** For EPA, OTIE designed and implemented a thermal treatment removal action at a former chemical packaging plant in Oakland, CA. This EPA-led cleanup action addressed subsurface non-aqueous phase liquids, soil, and groundwater contamination by pesticides, solvents, and oil from near surface to 30 feet below grade. Continuous vapor monitoring and web-based data reporting using the VaporSafe™ system allowed OTIE and EPA to actively manage the site during 11 consecutive months of heating. Workers in an on-site industrial building and residents living adjacent to the site were successfully protected from exposure to TCE, PCE, and Vinyl Chloride. Over 40,000 lbs of contaminant mass were removed while the public was kept informed through regular data uploads.

- **Navy Site, San Clemente Island, CA.** OTIE conducted a VI study to evaluate if TCE- and PCE- contaminated subslab soil gas was entering an industrial building on a remote military installation. Following the ARC© process, we did an initial building assessment, screened for on-site VOC sources, and performed seven days of continuous air monitoring with simultaneous pressure differential monitoring (subslab, indoor, outdoor) at six locations using VaporSafe™ technology. The study revealed patterns of pressure/VOC concentration changes that were linked to typical room entry/occupancy patterns as confirmed by interviewing on-site personnel. Discrete gas samples using vacuum canisters confirmed continuous monitoring results. Based on the investigation, OTIE was able to develop recommendations for long-term management of VI at this site.

- **Suspected Preferential Pathway Assessment, Indiana.** For EPA, SRS is conducting an assessment of chlorinated VOCs (CVOCs) VI into residences from identified industrial sources at a site in Indiana. A multi-phased assessment is being conducted to 1) identify if combined waste/storm sewers are impacted with CVOCs and serving as VI preferential pathways, and 2) evaluate if VI is occurring in selected households requiring mitigation. The investigation is ongoing and anticipated to be completed during the fall of 2018. Vapor samples are being collected and analyzed from at least 50 monitoring locations distributed among sewer lines, soil vapor probes, and occupied residences using the VaporSafe™ system. Remote telemetry integrated with GIS and web-based data reporting/visualization are available 24-7 to the project team. Data are also automatically uploaded to EPA's VIPER database.

**COST COMPARISON: TRADITIONAL VS OTIE'S ARC©**

| VI ASSESSMENT | TRADITIONAL VACUUM CANISTERS | OTIE ARC© USING VAPORSAFE™ |
|---|---|---|
| Site: Three buildings Work: vapor sampling, data evaluation, data management, report | $84,500 for 49 summa canister samples collected over a 2-week period | $55,000 for site and building survey, 65 discrete real-time samples plus 48 hours of continuous monitoring at locations selected based on discrete results |
| Total time to complete | ■ Two weeks in the field<br>■ Two weeks for laboratory results<br>■ Additional 4 to 6 weeks to deliver draft report | ■ Two weeks field<br>■ Real-time data report<br>■ Two weeks to draft report complete with data |
| Value of data | Time-average concentrations only; uncertain influences; unknown or uncertain SVI entry points and preferential pathways | Real-time quantified results; temporal variations; comparative pressure-differential data; comprehensive survey of VI entry points and preferential pathways |

VI can be an extremely sensitive issue—the inhalation of indoor air contaminated with trichloroethene (TCE) can cause direct health effects such as fetal abnormalities if there is residential exposure exceeding 2 µg/m3 within a 24-hour period or an industrial exposure exceeding 6 µg/m3 exposure within an 8-hour period during the first trimester of pregnancy (U.S. EPA 2016). Therefore, it is paramount to monitor for acute and chronic TCE exposure with the best possible technologies to reach low-detection limits and provide both timely and accurate data.

We believe new technical and communication approaches are needed to assess, respond, and control vapor intrusion in a time- and cost-efficient manner:

- Gas migration is dynamic; temporal and spatial changes are often missed by the conventional VI investigation approach which relies on time-weighted average data from passive samplers or vacuum canisters. Often multiple phases of investigation are required and sometimes the questions of VI remain unresolved for years, potentially increasing exposure risks to building occupants. Two-dimensional vapor diffusion modeling and attenuation factors used to assess potential exposure risks ignore both spatial and temporal vapor migration dynamics. OTIE believes understanding the temporal and spatial concentration patterns of VI is the key to developing the correct response and control measures.
- Each building has unique characteristics, contaminant history, occupancy patterns, temporal air-pressure profile, preferential pathways, and other factors that need to be understood to address VI effectively. Through our holistic ARC© approach and the use of cutting-edge tools like VaporSafe® we can solve our customers' short-term vapor intrusion problems and reduce their long-term liability.
- If VI exposure risks are high, our customers can avoid severe measures such as building evacuations and workflow disruptions by testing mitigation measures, sometimes in the same mobilization as the initial assessment. Identifying VI entry points into a room, blocking them, and continued monitoring to verify the effect on air quality is just one example of an approach that can be done "on the fly" with OTIE's ARC© approach using VaporSafe™. No waiting weeks for lab results.

## About Oneida ESC Group

Oneida Engineering, Science, and Construction Group, LLC (Oneida ESC Group) is a Native American, tribally-owned family of companies that deliver technical services with a fundamental commitment to safety and quality. We offer four subsidiary companies: Oneida Total Integrated Enterprises (OTIE), Sustainment Restoration Services (SRS), Mission Support Services (MS2), and Oneida Engineering Solutions (OES). We integrate engineers, scientists, and construction managers for cooperative and businesslike delivery of services. We maximize responsiveness to our customers' requirements by harnessing our diverse network of resources to meet customers' challenges for creative, cost-effective project delivery.