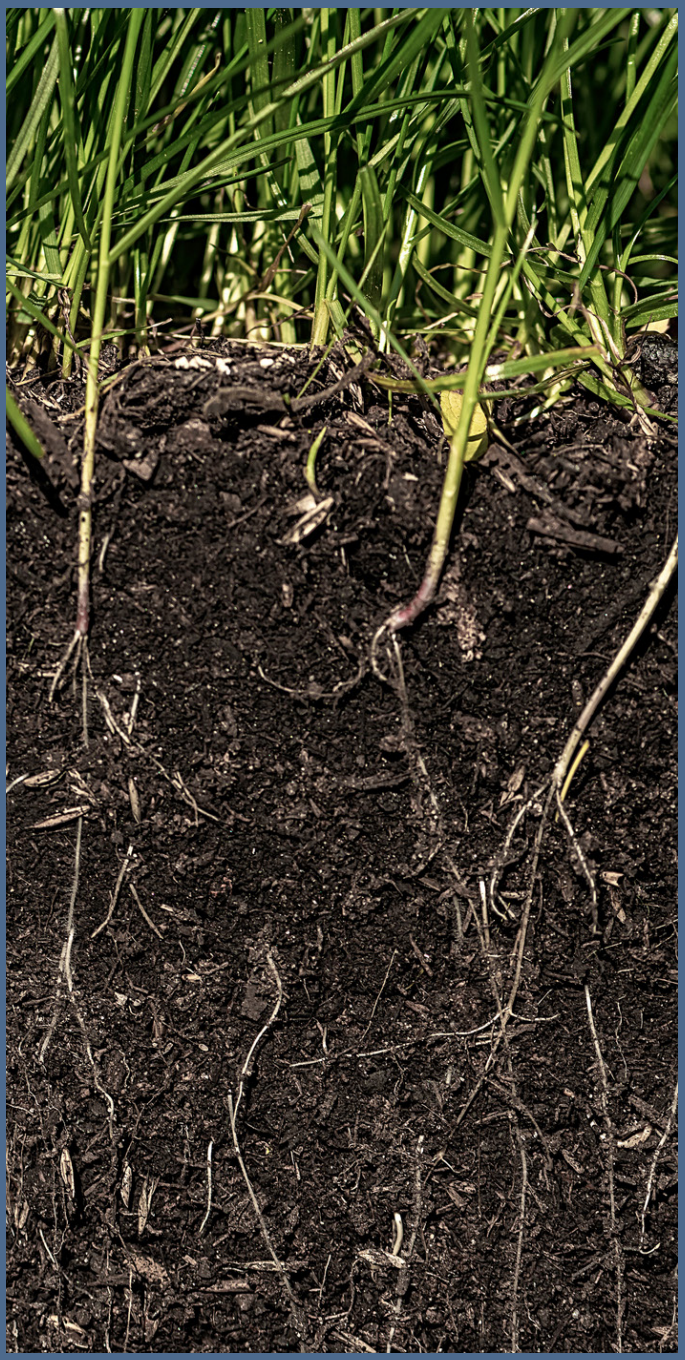

JS|HELD

PERSPECTIVES

Benefits of Passive Soil Gas Sampling: An Efficient and Cost-Effective Subsurface Investigation Tool

Our perspectives feature the viewpoints of our subject matter experts on current topics and emerging trends.

INTRODUCTION

There are numerous approaches that can be used during an environmental investigation to evaluate subsurface conditions. These can vary based on the media requiring investigation and the ultimate project goals. Information obtained is used to develop and refine the conceptual site model (CSM) for the project. The CSM is a representation of the site conditions, migration and impacts of chemical contaminants, and the potential effects on receptors. The CSM is a dynamic document or visualization of the project that helps determine appropriate investigation and remedial activities. It is not uncommon for those involved in the evaluation and remediation of a subsurface issue to have an incomplete understanding of the project, and investigation activities should be continued to obtain as much information as possible within the project's budget considerations.

Investigation tools can vary, and while each has their own benefits, each approach should be carefully selected based on the goals of the project. Typical subsurface investigation tools include soil borings with field screening equipment to investigate soil and groundwater sampling via temporary wellpoints or permanent monitoring wells. These methods of data collection can require specialized equipment and vendors, can be intrusive, and need a significant work footprint. Furthermore, these investigations are not always the most efficient and cost effective ways to gather initial and wide-spread subsurface information. While the conditions of soil and/or groundwater can be qualitatively evaluated via field screening (e.g. visual observation, odors, readings from field meters), typically laboratory analysis is required for quantifiable data comparison or to achieve low screening levels. Therefore, soil boring or well investigation work frequently requires multiple vendor costs (e.g. drillers and laboratories).

Passive soil gas sampling is an investigative approach that can be implemented to obtain a significant amount of quantitative data in a relatively cost efficient manner. A passive soil gas survey can be beneficial when evaluating volatile organic (VO) compounds. Passive soil gas samplers can be installed throughout an investigation area without the need for specialized equipment or training. Since work can be done with handheld equipment, sampling access is not as restricted as when a drill rig is needed. Each passive soil gas sample is only required to be installed to a shallow depth via a small-diameter hole installed through to the subsurface; therefore, multiple locations can be installed by a trained crew allowing for increased coverage of the investigation area. This allows the investigation area to be evaluated in a manner that provides a snapshot of subsurface conditions and helps identify worst-case areas where follow-up investigations may be targeted.

DEVELOPMENT OF A CONCEPTUAL SITE MODEL

Before beginning any subsurface environmental investigation, a CSM should be developed to compile what information is known about the project. The CSM should identify the contaminants of concern (COCs), the source of the COCs in the subsurface, how the COCs behave in the subsurface, migration pathways, and what potential receptors would be. The amount of information known for the project will vary based on the stage of the investigation. Early in the process much of the information may not be known, and assumptions will need to be made. However, as the subsurface investigation progresses site-specific information will be incorporated to refine the CSM. This makes the CSM a truly dynamic tool within the investigation process. The following are some items to consider when developing a CSM for a subsurface investigation:

- What is the source of the impacts and what COCs are involved?
- Is this a surface or subsurface discharge?
- What are the soil conditions, as soil type can affect contaminant migration?
- What are the groundwater conditions?
- Are subsurface preferential pathways present?
- What are the potential receptors?
- Is there a complete pathway from source to receptors?

When limited or no information is initially known and the CSM is being developed, it is paramount to select investigation tools that help reveal site information to focus the CSM and plan for future evaluation.

TYPICAL SUBSURFACE INVESTIGATIVE TOOLS

Traditional approaches to the start of an environmental investigation are usually geared toward investigating recognized environmental conditions (RECs) or areas of concern (AOCs). This process typically entails the advancement of a network of soil borings and/or monitoring wells by hiring an experienced vendor with highly specialized equipment to collect soil and/or groundwater samples in order to assess soil and/or groundwater quality in the vicinity of the RECs/AOCs being investigated. If contamination is present, numerous additional iterations of step out soil and/or groundwater sampling may be required to fully characterize the site and achieve delineation in accordance with the applicable regulations. This course of action can evolve and take many years to complete with an ever increasing project/investigation cost. The ability to fully characterize contamination at a site can be difficult based on several factors including access and spatial challenges with drilling equipment, time limitations on how much sampling can be completed in a day, disruption to site business operations, training and experience needed for field staff, and multiple mobilizations to the site in an effort to locate clean end point sampling zones. These challenges can lead to extended timeframe and milestone completion dates as well as inflated budgets.

Elevated VO soil and/or groundwater concentrations may exceed applicable vapor intrusion (VI) triggers, and VI investigations may be warranted to assess soil gas and/or indoor air quality within nearby buildings. Typical VI sampling is conducted with the use of inert sample collection devices (e.g. summa canisters and regulated flow controllers). Sub-slab soil gas sampling is completed using low profile hand tools for sample collection; however, if sub-slab soil gas sampling cannot be conducted within a building due to site access or other issues, the use of a drill rig is required for near slab sampling in exterior areas adjacent to the building. The utilization of a shroud and seal testing procedures are recommended prior to the start of soil gas sampling if warranted by site conditions and the presence of potential background sources. On average, an experienced two-person team can install up to approximately six (6) to seven (7) soil gas samples per day while using summa canisters and seal testing equipment . Sample canisters are cumbersome especially if multiple quantities are needed for large sampling events. Periodic supervision of the canisters is often required to ensure the proper operation and collection of samples. In addition, the sampling can be limited by availability and quality of the equipment provided by the laboratory. These complications can lead to additional effort and funding expended on a project. Lastly, these methodologies are designed to collect data from a "snapshot" in time, whereas data collected employing other methods can be collected over longer time periods, and time weighted averaging of concentrations may be more representative of seasonal soil gas concentration trends at a site.

DESCRIPTION OF PASSIVE SOIL GAS SAMPLING PROCESS

Passive soil gas sampling is a non-traditional approach that can be used to gather critical data in the early stages of a project. Not only is soil gas quality assessed via this sampling, but this technology allows the user to better develop a CSM by gaining an understanding of VO soil and groundwater contamination and behaviors as well. The sampling can be completed "in-house" and does not require hiring an experienced vendor to provide specialized equipment. The technology is straightforward and requires little experience or technical knowledge. A two-person team can install approximately 25 to 50 samplers per day depending on the ground surfacing and site conditions. After the designated sample period, one person can retrieve approximately 50 samplers per day and restore the ground surface. The data and knowledge of a site obtained from a single passive soil gas sampling event could equal what may be obtained in three (3) or more mobilizations using more traditional methods, such as drilling, saving both time and money. The process is non-invasive and low profile in comparison to traditional drilling methods, and clients/property owners are more likely to accommodate this method as impacts to their business operations will be minimal.

While specifics can vary based on brand, the technology utilizes tubes (or samplers) measuring approximately five (5) to six (6) inches in length containing an absorbent material placed in a matrix near the surface. As VO contaminants in the soil and groundwater volatilize, the sorbent will encounter the soil gas that moves through the soil matrix via molecular diffusion or advection (pressure-driven transport), and these gases are absorbed onto the material. The samplers are typically placed in a structured unbiased grid-like pattern (including limited access areas) to envelop as much surface area as possible.

Additional biased locations can be added to target specific features. Generally, a grid with 25-foot spacing between sample locations is recommended to identify source areas, but this can be dependent on focused investigation areas and project budgets. A slam bar or electric rotary hammer drill is used to make a small (less than one-inch) diameter pilot hole to deploy the samplers into the ground. The sampler is then removed from its shipping container and is inserted into the bottom of the pilot hole using push rods to the targeted depth (typically does not exceed 24 inches below grade). A cork or other "cap" fastened to the top of the sampler is tamped flush with the ground surface to seal the hole. Helium shrouds or other leak check procedures are not required. The samplers remain in the ground for an extended period (typically ranging from one week to one month). The time period for screening is dependent upon several factors including the volatility of the contaminant(s), the depth of the contaminant(s), and soil density. The samplers are then retrieved by hand and are shipped to a laboratory for analysis. Because of their small size, the samplers are extremely easy to transport and ship when compared to summa canisters.

EVALUATION OF DATA

Passive samplers allow for the collection of samples over days or weeks to measure compounds in soil gas. Data is reported as average concentrations over time and can be more representative of actual subsurface conditions as opposed to an instantaneous grab sample, which may be biased due to site conditions. Data is typically reported in units of mass, but concentration data can also be reported similarly to traditional sub-slab soil gas methods (summa canister analysis). Analytical evaluation can be completed for screening purposes or via an EPA method for data comparison purposes. This data can be compiled into a visual representation of the data via an isoconcentration map (See Figure 1). Sample locations and isoconcentrations can be overlaid on existing site plans and be used as layers with mapping software to adjust the CSM.

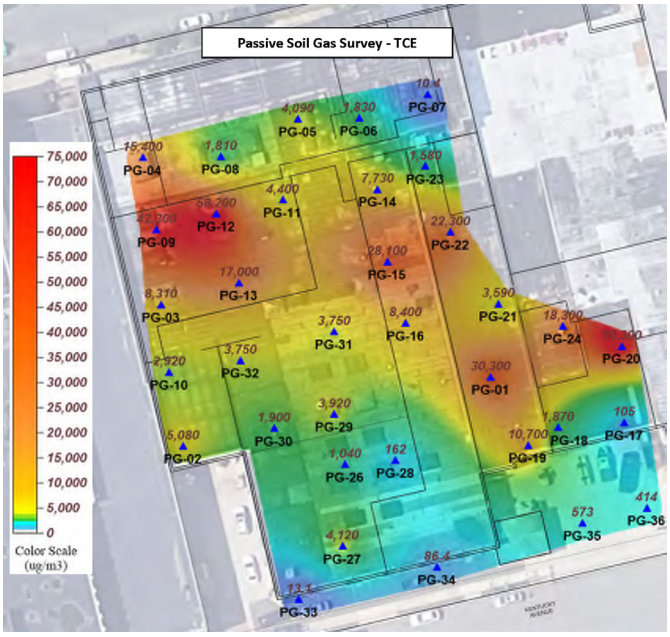

Figure 1 *- Example isoconcentration map.*

While some regulatory agencies do not accept passive soil gas sampling results as the only line of evidence in assessing the VI pathway or achieving soil and/or groundwater delineation, the quantity of data obtained from a passive soil gas sampling event can be astounding and can truly paint a picture of the conditions beneath a site. Instead of blindly placing samples, this technology provides a guide to the investigator on where to place confirmatory samples using traditional sampling approaches acceptable by regulatory agencies. Investigations that would have normally taken multiple iterations of traditional step out sampling can now be completed with a more refined CSM, which should result in significant cost reductions.

CONCLUSION: BENEFITS OF PASSIVE SOIL GAS SAMPLING

The main goal of using passive soil gas sampling is to refine the project's CSM. When the source of subsurface impacts is not known or has not been sufficiently characterized yet, passive soil gas sampling is a useful investigation tool to help obtain a snapshot of where the most impacted areas are located or where contaminants may be migrating. The implementation of passive samplers in a grid system helps to

identify where subsequent targeted investigation activities should focus. This grid can be employed over a specific REC or AOC, or a larger portion of the site depending on the phase of the investigation. The ability to hone the CSM allows for a more efficient use of the investigation budget.

Another benefit of passive soil gas sampling is the volume of samples that can be collected in comparison to traditional subsurface investigation methods. Depending on site conditions, 25 to 50 samplers can be deployed by an experienced field crew in one day, while installing 15 soil borings in a day, depending on soil conditions and drilling depth, would be exceptional.

Furthermore, passive soil gas samplers are installed primarily with hand equipment and do not need specialized drilling tools or vendors, which reduces the overall sampling costs. In addition, drilling equipment requires a larger footprint and can be intrusive to ongoing operations. Due to the installation methods, passive soil gas sampling can be conducted where access limitations would prohibit traditional drilling activities and in a manner that would not be as intrusive to ongoing operations.

Passive soil gas sampling allows for the efficient collection of a multitude of representative subsurface samples that help refine the CSM and develop a cost-effective approach for continued project evaluation activities. The procedures for passive soil gas sampling allow for these investigations to be done with limited disturbances and in a cost-effective manner.

ACKNOWLEDGMENTS

We would like to thank Nicholas Potkalesky and Erik Weber for providing insight and expertise that greatly assisted this research.

Nicholas Potkalesky is a Project Manager in J.S. Held's Environmental, Health and Safety Practice and a Licensed Site Remediation Professional in New Jersey. Nick has over 15 years of experience in environmental remediation. He specializes in complex remedial cases at commercial and industrial properties where many contaminants and areas of concern need to be addressed. He also works legacy sites to achieve regulatory compliance. While working with an incredibly talented team from the Summit, New Jersey office, it is his privilege to help clients navigate the dynamic landscape of environmental compliance.

Nick can be reached at npotkalesky@jsheld.com or +1 973 528 7029.

Erik Weber is an Environmental Scientist in J.S. Held's Environmental, Health and Safety Practice. Erik joined J.S. Held in 2022 with over ten years of experience in environmental remediation working on projects varying from small residential properties to large multi-tenant industrial/commercial complexes. He has supported projects through all phases of the site remediation process from initial due diligence activities to final case closure. Erik has extensive experience in environmental investigation and remediation. In his current role with J.S. Held, Erik works closely with senior and junior staff members predominately focusing on soil, groundwater, and vapor investigations at commercial and industrial projects in New Jersey.

Erik can be reached at erik.weber@jsheld.com or +1 732 724 5283.