

Effective Treatment of a CVOC Plume beneath an Active Manufacturing Facility Using Deep Horizontal Sparge Wells

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Background/Objectives. A five-acre site in Torrance, California, has been used for commercial manufacturing since the early 1960s, and is currently occupied by a 109,000-square foot manufacturing building. The facility operates 24 hours a day, 6 days a week. Subsurface geology consists of fine- to medium-grained sand with dense, partially cemented sands in localized zones; depth to groundwater ranges from 75-80 feet (ft) below ground surface (bgs), while the aquifer bottom extends to approximately 200 ft bgs. The site has been affected by contaminants of concern, including chlorinated volatile organic compounds (CVOCs) tetrachloroethylene (PCE) and trichloroethylene. The CVOC groundwater plume extends under the building to a depth of approximately 130 ft bgs or 60 ft below the water table. The aquifer is highly aerobic with dissolved oxygen concentrations ranging from 4 to 8 milligrams per liter.

Approach/Activities. Due to limited access and site sensitivity, horizontal directional drilling (HDD) technology was selected to implement the preferred groundwater remedy, air sparging (AS), to complement an existing soil vapor extraction (SVE) system with 16 vertical wells. Two deep HDD AS wells were installed in late 2015, each constructed of approximately 700-800 ft of Schedule 80 PVC slotted pipe and 700-800 ft of blank rising casing. The wells were installed to a depth of 130 ft bgs using single-entry (blind) completion methods—the longest and deepest wells of this type installed to date, based on known case studies. The sparge wells are pulsed on an alternating sequence, while maintaining a minimum flow of 100 standard cubic feet per minute (scfm) (i.e., 500-600 scfm in one well and 100-150 scfm in the other). This approach mitigates pressure spikes and excessive water table displacement while reducing air compressor capacity and power requirements. Compressed air is supplied by a 200-horsepower Sullair® rotary screw compressor capable of delivering approximately 980 scfm. The SVE system, including three rotary lobe, positive displacement blowers, operates at a minimum of 1.5 times the maximum sparge rate, or at least 1,470 scfm, to ensure vapor capture.

Results. Blind entry drilling of horizontal wells to this length and depth, with limited access along the drilling path, required an innovative cased well installation technique recently developed by Directed Technologies Drilling, in conjunction with gyro steering tool navigation technology. Sparge well slot design was custom engineered to promote relatively uniform air flow across the wells. The sparge system was activated in December of 2015 and has reduced total CVOC concentrations in groundwater by over 90 percent (on average) as of October 2017. PCE concentrations have decreased from a maximum of over 1,900 micrograms per liter ($\mu\text{g/L}$) to $<150 \mu\text{g/L}$ in source area wells, with concentrations in most wells reduced to less than 50 $\mu\text{g/L}$. The estimated distance of influence, based on dissolved oxygen plume monitoring and CVOC reductions, is at least 50 to 60 ft on both sides of each HDD well. Cleanup of groundwater to established levels is expected to occur within three years, as scheduled.

This case study presentation will describe the construction of the sparge system, discuss operational considerations, and review current monitoring data.