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Biosparging Large Plume with Horizontal Wells at an Active Terminal

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Background/Objectives. Horizontal biosparge wells were the selected in situ remedial technology to aerobically biodegrade organic contaminants of concern (COCs) at a bulk petroleum terminal and primary supplier of petroleum products to the region. This included COCs in groundwater, within the capillary fringe and absorbed to saturated soils. Horizontal biosparge wells enhance bioremediation by inducing low air flow based on the expected metabolism of microorganisms to remediate the saturated zone. Placement of the horizontal wells considered the distinct layers of unconsolidated sediments, as well as the horizontal and vertical distribution of the COCs on-site and off-site.

The majority of petroleum impacts were detected in the intermediate zone and in monitoring wells screened from 32 to 35 feet below land surface (bls). Loose, silty and clayey sands in the upper 40 feet were underlain by a 15 foot thick clay layer, which essentially functioned as a vertical hydraulic barrier or aquitard. Groundwater fluctuated between 2 to 6 feet bls.
The remedial approach to recover and treat petroleum impacts within the surficial aquifer at the site considered various factors. This included, but was not limited to, the long-term and short-term environmental impacts, remedial implementation, operation and maintenance (O&M), reliability, and comparing to available alternatives. Primary considerations were remediation of dissolved phase COCs, prevention of further plume migration and potential impacts on system operation to adjoining properties and surrounding community.

Approach/Activities. Twenty-one (21) horizontal biosparge wells, totaling over 13,000 linear feet, were installed to bioremediate petroleum-impacted soil and groundwater. On-site horizontal biosparge wells were installed beneath roadways, fueling racks and storage tanks at an active fuel terminal. Off-site horizontal biosparge wells stretched across busy and congested four-lane roads as well as underneath an operating gas station and warehouse. The horizontal biosparge wells were installed without disruptions to operations, vehicular traffic or occupants.

Results/Lessons Learned. Performance test results indicated that the horizontal biosparge wells had a greater range of influence than initially estimated. Influence was observed at least 40 feet from the horizontal biosparge well at a flow rate of 0.1 scfm/ft. Groundwater mounding was minimal at this flow rate. Test results indicated that a greater range of influence could be achieved at higher flow rates (e.g., greater than 50 feet at 0.3 scfm/ft), but mounding of groundwater posed an issue during periods when the water table was near the land surface.
The proposed remedial approach with horizontal biosparge wells minimized the overall project life and costs while also minimizing adverse conditions such as groundwater mounding or fugitive vapors in nearby buildings. Horizontal biosparge wells remediate petroleum impacts without disrupting on-site operations or off-site vehicular traffic and neighboring properties. Bioremediation with horizontal wells will attain the natural attenuation default concentrations and achieve site closure within 5 years.