Using Three-Dimensional Modeling to Optimize Investigation and Remedial Injection Programs at CVOC-Contaminated Sites

Stephen Sherman, P.G., Avram Frankel, P.E., Integral Consulting Inc.

San Francisco Bay Area

We present three case studies using 3D implicit modeling at sites where CVOCs in groundwater are being addressed.

Case 1: Former Plating Shop Investigation

We used 3D modeling to build a CSM and strategically design a groundwater monitoring well network to support redevelopment. The investigation used rapid site characterization tools, including MiHPT, CPT, and depth-discrete groundwater samples.



CVOC results from depth-discrete groundwater samples collected from 10 to 44 ft.

The site is currently undergoing long-term monitoring to evaluate natural CVOC degradation in the tidally influenced groundwater.

Case 2: Former Dry Cleaning Facility Remedial Design

We plotted the CVOC plume, soil lithology, and hydrogeologic conditions to develop a CSM that supported design of an onsite remedial injection program (ERD and abiotic reduction) and an offsite PRB (abiotic reduction and CAC sorption).



slice roughly aligns across IW-1B and IW-2I roughly along the groundwater flow direction

Cross section produced from 3D model showing site topography, plotted CVOC plume, soil lithology, and water levels.



Constructed injection well layout with target radii of influence for each reagent. The remediation will involve a combination of abiotic chemical reduction, ERD, and a colloidal activated carbon PRB.

Plan and side view of the 3D model used to support injection well layout.

Case 3: Former Dry Cleaner Remediation

At another former dry cleaner, an efficient site characterization, remedial design, and implementation schedule was needed to fit redevelopment plans for the site. We utilized 3D modeling to establish an adaptive CSM that has been used throughout the project.



The frequently updated model was used to:



Delineate the CVOC plume by identifying data gaps, areas of elevated concentrations, and potential preferential flow paths.



Plotted CVOC plume with zones of estimated relative hydraulic conductivity compiled from limited and varied sources to streamline the characterization approach at a hydrogeologically complex site.



Target optimal locations for *in situ* remediation using a combination of abiotic chemical reduction and ERD.





Group 1

3 Review performance monitoring results

Total CVOC concentration Baseline Sampling Even January 2019

Total CVOC concentrations Performance Monitoring December 2022

(All concentrations in µg/L





Conclusion

3D modeling was very effective in supporting site characterization, remedial design, and remedy optimization for the three case studies. The models also accelerated the projects to meet redevelopment and funding challenges through the design and remedial action phases.

The direct-push injections targeted depth intervals between approximately 20 and 70 ft applied through 2- to 4-ft long retractable screens. The 3D model was used as a remedial design tool by visualizing injection points and predicting injectability at each interval.



Stephen Sherman, P.G. Consultant 408.710.6809 ssherman@integral-corp.com

