REGENESIS®

TCE Plume Quickly Eliminated at Indiana Brownfield Site

PlumeStop, S-MicroZVI and 3-D Microemulsion Achieve Complete TCE Removal within Six Months



Summary

A focused in situ remediation program using PlumeStop, 3-D Microemulsion, S-MicroZVI, and BDI Plus rapidly eliminated all detectable TCE from groundwater across the site within six months. Subsequent monitoring through 15 months shows TCE remains non-detect, while chlorinated daughter products continue progressing to non-toxic end products. Plume-wide average total CVOCs have been substantially reduced, and sustained ethene and ethane production confirms ongoing reductive dechlorination. These results support site redevelopment under an Environmental Restrictive Covenant (ERC).

100% Reduction
of TCE to below detection with complete dechlorination

Under 6 Months
Results achieved in under 6 months

Site type
Industrial (former plating facility)

Contaminants of concern
Widespread TCE concentrations in groundwater, ranging from 22.1 to 236 µg/L

Geology/Hydrogeology
Shallow water table (5–14 ft), heterogeneous fill overlying silty and sandy deposits; groundwater flow to the west-southwest

Project driver
Reduce TCE in groundwater to below IDEM R2 published levels and support safe redevelopment. This project was funded by an USEPA grant, managed by the Indiana Brownfields Program.



Treatment
Two PlumeStop permeable reactive barriers and three grid injection zones

Technologies applied
Advanced colloidal technologies - PlumeStop®, 3-D Microemulsion®, S-MicroZVI and Bio-Dechlor INOCULUM® Plus

Background

The former plating facility operated from the 1970s through 2009 and was historically used for electroplating, soap manufacturing, and metal finishing. Investigations completed between 2014 and 2023 identified trichloroethylene (TCE) impacts in soil and shallow groundwater extending from five to fourteen feet below ground surface. The TCE plume was traced primarily to an upgradient source at a nearby property; however, data indicated a potential secondary source beneath the former building slab. dditional contaminants of concern include arsenic, hexavalent chromium, and cyanide, all associated with former plating operations.

Figure 1 Aerial view of site

Aerial view of Indiana brownfield (former electroplating) site.



In 2022, the City of Indianapolis, working through the Indiana Brownfields Program and supported by a U.S. EPA Cleanup Grant, selected IWM Consulting Group (IWM), a leading environmental remediation consulting firm based in Indianapolis, Indiana, to implement a full-scale in situ remedy combining advanced activated carbon and iron-based colloidal technologies from REGENESIS. The objective was to achieve rapid contaminant mass reduction, control off-site migration, and restore aquifer conditions suitable for future redevelopment.

Remediation Goals and Approach

IDEM's R2 Framework

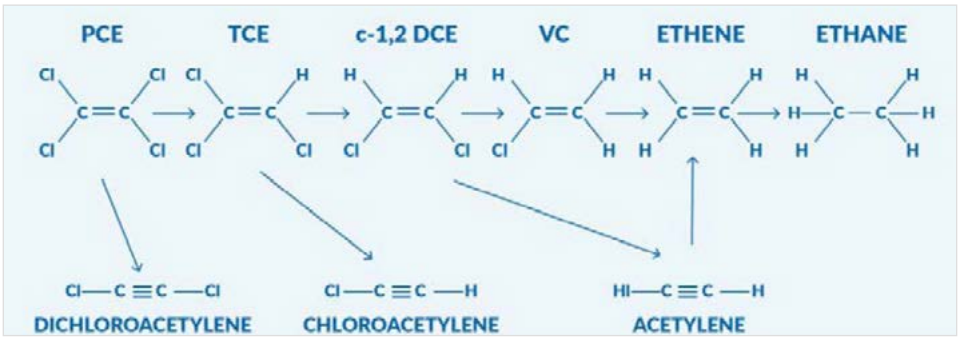
IDEM's R2 is Indiana's risk-based cleanup guidance. It sets numeric screening levels for soil, groundwater, and vapor, and outlines how risk must be evaluated and managed. Cleanup can be achieved through active remediation, natural attenuation, or institutional controls such as an Environmental Restrictive Covenant or ERC.

Under IDEM's Risk-Based Closure Guide (R2), the primary remediation goals were to reduce soil and groundwater concentrations below the applicable Excavation Soil Published Levels (XSPLs) and Groundwater Published Levels (GWPLs), while maintaining plume containment and reducing vapor intrusion potential.

The full-scale design used PlumeStop to provide immediate flux control and long-term adsorption, while 3-D Microemulsion, S-MicroZVI, and BDI Plus were applied in grid areas to drive abiotic and biotic reductive dechlorination through predicted pathways (Figure 2). The target vertical interval was identified between 10 and 20 feet below ground surface.

Figure 2 Degradation Pathways

Degradation pathways for PCE and TCE, including biological and abiotic routes leading to ethene and ethane.



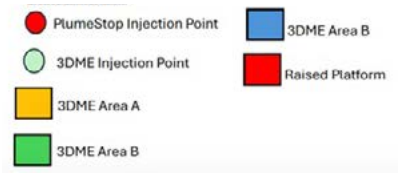


Application

Remedial injections were conducted by REGENESIS Remediation Services (RRS) under IWM oversight. Injections were installed via direct-push rods equipped with retractable stainless-steel screens, injected over the target interval. In the grid zones, 3-D Microemulsion and S-MicroZVI were co-mixed with water and injected simultaneously, while the anaerobic BDI Plus was slip-streamed into the injection line under nitrogen to prevent oxygen exposure. Details of the application are depicted on Figure 3 and summarized in the following table.

Figure 3 Injection Application Map

Injection application map.





Application Details Summary Table

Injection Area	Amendments Applied	Injection Points	Volume Injected (gal)
PlumeStop Barrier A (Downgradient)	PlumeStop + S-MicroZVI	60	22,140
PlumeStop Barrier C (Upgradient)	PlumeStop + S-MicroZVI	42	14,022
3DME Area A	3DME + S-MicroZVI + BDI Plus	90	9,360
3DME Area B	3DME + S-MicroZVI + BDI Plus	142	16,898
3DME Area BX2	3DME + S-MicroZVI + BDI Plus	42	4,472

Totals: 376 injection points; ~66,900 gallons injected containing 10,800 lb PlumeStop, 17,500 lb S-MicroZVI, 18,000 lb 3DME, and 118 L BDI Plus.

Temporary piezometers confirmed effective distribution and radius of influence. Baseline groundwater sampling was completed prior to injection, with the first post-injection monitoring event occurring approximately six months after the conclusion of the injection activities.

Results

Monitoring through 15 months shows that complete reductive dechlorination is occurring along the expected biotic and abiotic pathways. Before treatment, there was limited evidence of natural attenuation.

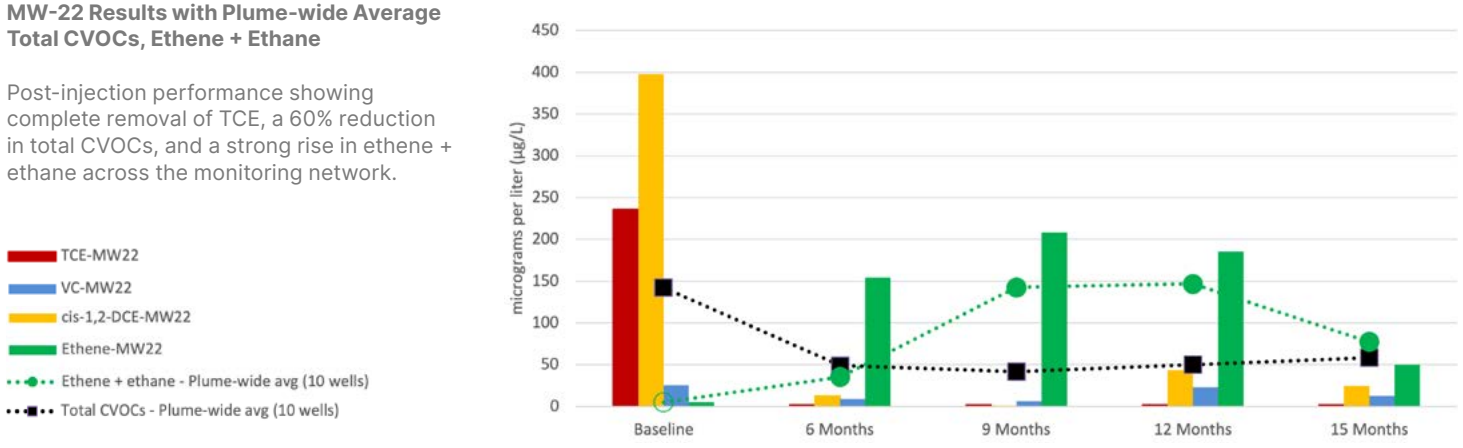
- By the first monitoring event, TCE concentrations were below laboratory reporting limits in all ten monitoring wells, representing complete removal of the parent compound in less than six months (Figure 4).
- Plume-wide average total CVOCs declined sharply from baseline and remained substantially reduced through 15 months.
- Concentrations of ethene and ethane exceed the remaining total CVOCs, confirming continued conversion of chlorinated solvents to non-toxic end products.

These results demonstrate that remedial amendments remain active and the treatment process is continuing as designed.

Figure 4 Post-Injection Performance

MW-22 Results with Plume-wide Average Total CVOCs, Ethene + Ethane

Post-injection performance showing complete removal of TCE, a 60% reduction in total CVOCs, and a strong rise in ethene + ethane across the monitoring network.



Field parameters supported these findings: oxidation-reduction potential (ORP) dropped to uniformly negative values, dissolved and total iron increased, and reducing conditions were fully established. No rebound or exceedances occurred in downgradient well MW-27, confirming effective plume containment.

Conclusions

The combined in situ remedy of PlumeStop, 3-D Microemulsion, S-MicroZVI, and BDI Plus has proven highly effective, achieving rapid TCE removal and demonstrating complete dechlorination to non-toxic ethene and ethane within six months.

Quarterly groundwater monitoring over two years will confirm long-term performance and document the full progression of daughter products to end-stage compounds. A final evaluation report will determine whether any follow-up actions are needed to support closure under IDEM's R2 risk-based program.

These results show the site is progressing rapidly toward conditions that will support safe redevelopment under an Environmental Restrictive Covenant (ERC), in alignment with the City of Indianapolis' ongoing brownfield revitalization efforts.

About the Consultant

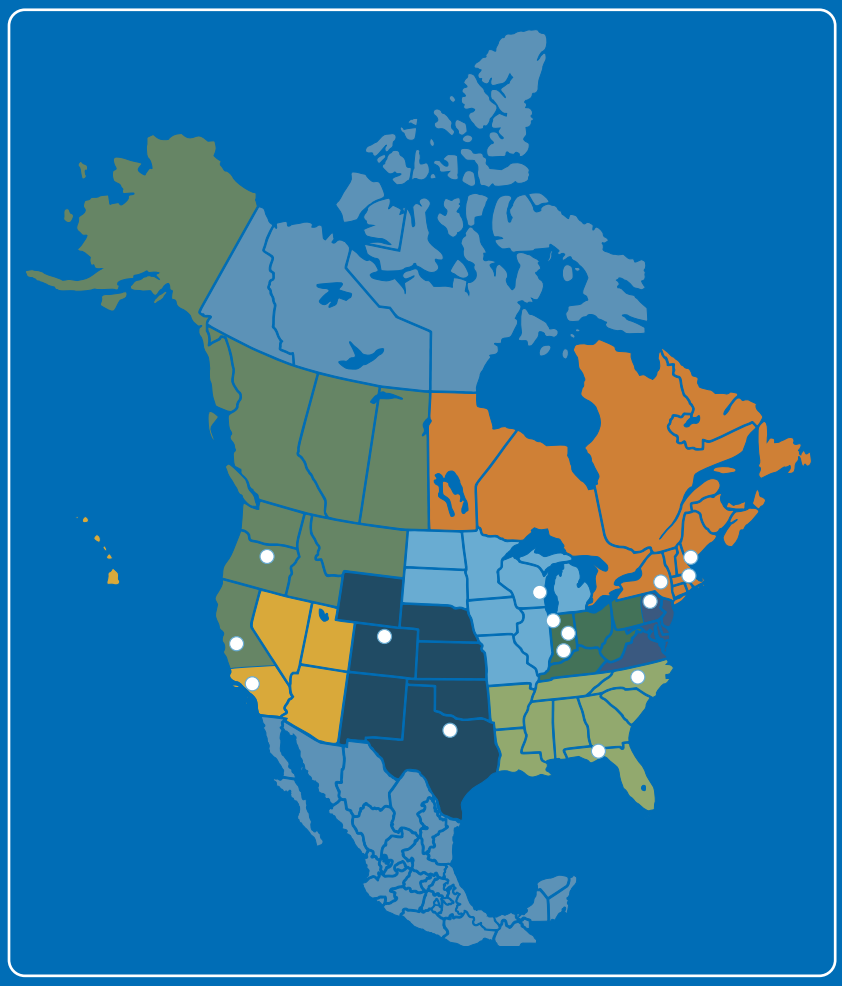


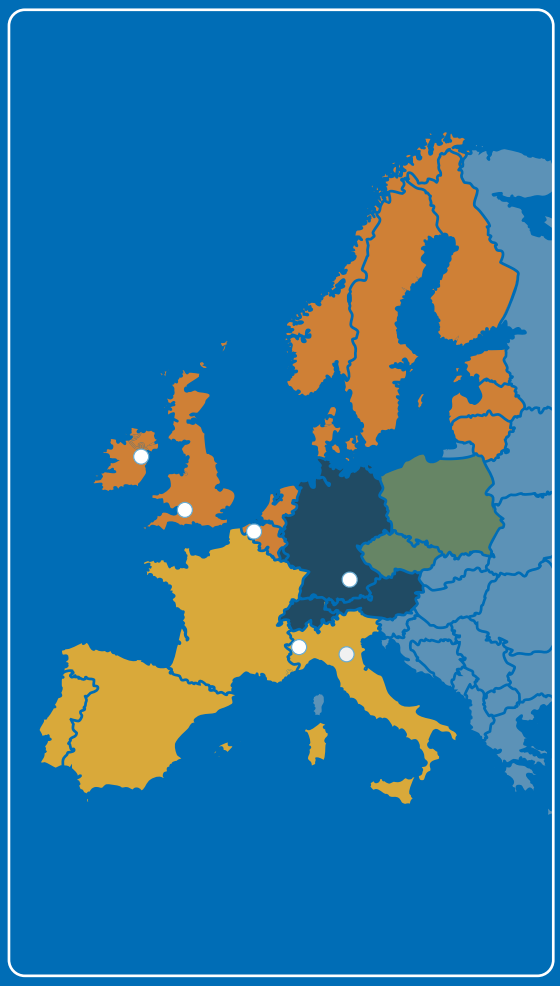
Brad Gentry
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IWM Consulting is an environmental consulting firm aimed at helping our clients to maximize their assets and mitigate the risks associated with site utilization and environmental concerns. From reclaiming a Brownfield site to providing vapor mitigation in a manufacturing facility, our resources are focused on helping our clients optimize their profitability and provide them with factual information to make educated decisions. Our organization is staffed with environmental scientists, geologists, engineers, construction professionals and other technically trained individuals to bring the resources that our client organizations need. By having the expertise to both define the problems as well as correct them, we provide our clients with a single point of contact and focused accountability to ensure an efficient resolution and measurable improvement.

Have a challenge? Let's solve it together.

Contact us today to discuss your specific needs.





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