



Project Highlights

- **ERDENHANCED™** biostimulated existing site biogeochemistry in the presence of residual source mass.
- **ERDENHANCED™** amended wells averaged **>95.9% REDUCTION** in total [cVOC] contaminants.
- **ERDENHANCED™** expedited mass destruction with average **>98.5% REDUCTION** in P:D Ratio.
- **ERDENHANCED™** created safe and sustainable reducing conditions and complete biotransformation.

ERDENHANCED™

Cost-Effective
Long-Term Compliance
Low-Impact
Safe
Cost-Effective



TerraStryke® ERDENHANCED™

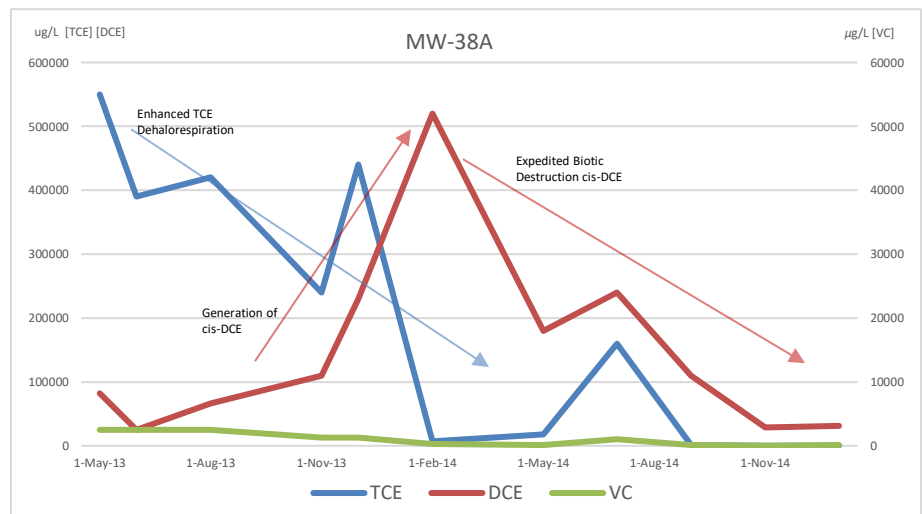
Residual DNAPL Source Zone Remediation

Using Simple Additive Delivery Approach; Ohio Manufacturing Facility

TerraStryke® Remediation Products LLC (**TerraStryke®**) develop and distribute biostimulation additives proven to cost-effectively enhance any bioremediation project, expediting contaminant destruction & site compliance with minimal impact. **ERDENHANCED™** enhances site biogeochemical conditions to attain sustainable and complete biotransformation of cVOC contaminants. The following case study demonstrates product efficacy. A former industrial facility with Trichloroethylene (TCE) in groundwater at ~30% solubility, indicating significant DNAPL.

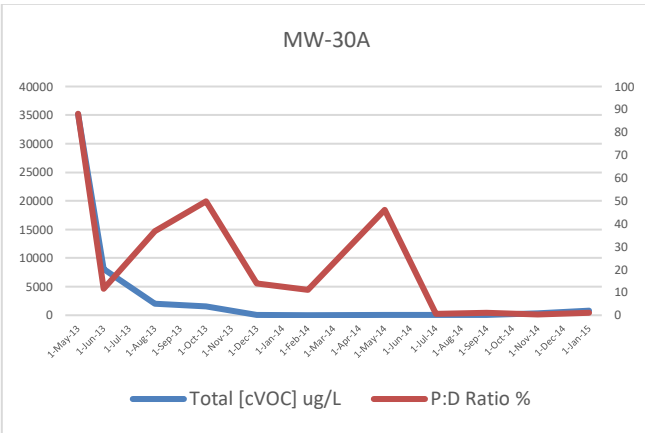
PROCESS: The evaluation extended over 20-months. Three monitoring wells were amended using additive filled Passive Release Sock (PRS) deployment units; a fourth non-amended well, was chosen as a control. PRS units are suspended vertically; remain for 6-8 weeks, and are replaced 6 times. Final deployment was July 2014 (month 14). Groundwater monitoring and sampling was performed at each replacement event. See the **TerraStryke®** Pilot Study Guidance Document for complete details. BioTraps were deployed in all 4 monitoring wells.

RESULTS: in terms of moles of contaminant destroyed: the 3 amended treatment zones averaged **98.5% reduction** in parent-parent/daughter ratios. Secondary lines of evidence to support enhanced reductive dechlorination include temporal increases in carbon, expedited alternative electron scavenging, and general increases in ethene concentrations in each amended well. The graph depicts performance in amended well MW-38A:

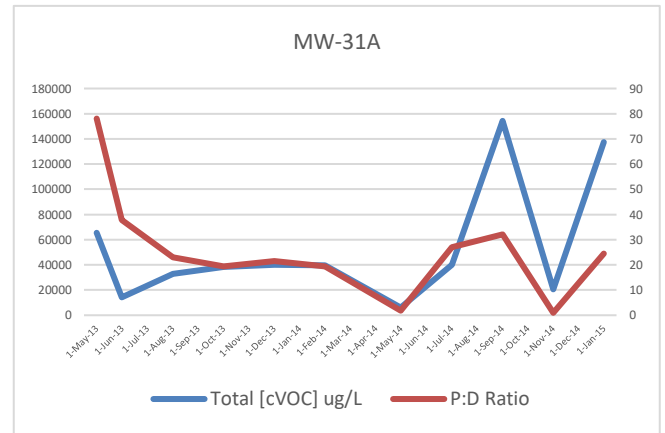


- **>99.9%** reduction in TCE over 20-month evaluation period.
 - **>94.8%** reduction in cis-DCE after **>538%** increase.
- Steady production/decline in VC/ethene throughout the evaluation period.
 - Enhanced residual mass solubilization (**>782%** increase in total cVOCs).
- **>98.1%** reduction in total cVOCs from peak dissolved phase contaminant bioavailability.
 - **>99.4%** reduction in total cVOCs over the evaluation period.

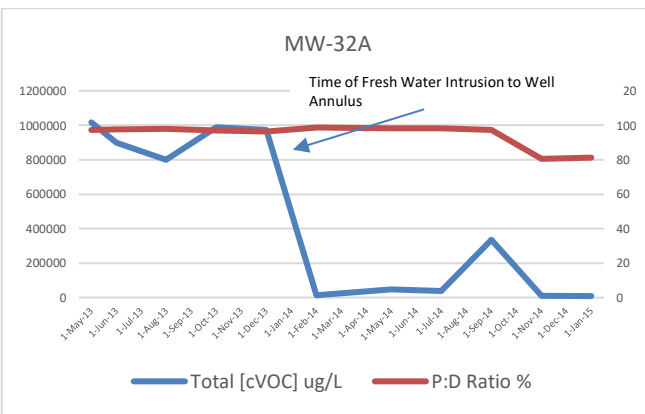
BioTrap® samplers were also deployed in each well; with each amended well demonstrating increases in *Dehalococcoides* populations with three positive biomarkers recorded: tceA, bvcA and vcrA. The non-amended well tested “ND” for *Dehalococcoides* and negative for the referenced biomarkers. The following graphs plot total concentrations of cVOCs vs. changes in Parent:Parent/Daughter Ratio (P:PD), dividing moles of TCE by the sum of moles of TCE, DCE, VC, and ethene recorded.



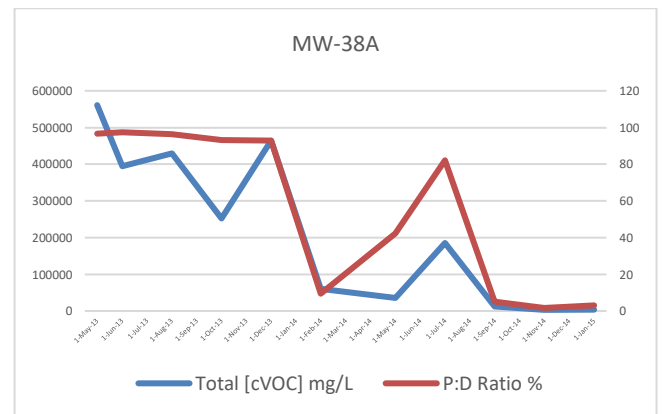
- **~100%** decrease in total cVOCs months 9-10
- **>97.6%** decrease in total cVOCs by evaluation end
- **>98.9%** decrease in P:D Molar Ratio
- General increases in ethene



- **>90%** decrease in total cVOCs after year 1
- Enhanced **solubilization** month 14-16 (**>2,400%** increase)
- **>96.8%** decrease total cVOCs 2-months later
- **>97.6%** decrease in total cVOCs by evaluation end
- **>98.8%** decrease in P:D Ratio month 18



- Non-amended Control Well
- **<1.0%** decrease in P:D Ratio at month 7; **4.3%** decrease in total cVOCs
- Influx of surface water due to Spring thaw flooding
- **>98.5%** decrease in total cVOCs; **NO CHANGE** in P:D Ratio
- **<17%** decrease in P:D Ratio due to late influence of MW-38A



- Up-gradient to non-amended Control Well MW-32A
- **<99.3%** decrease total cVOCs by evaluation end
- **>90%** decrease P:D Ratio month-9; then **>782%** increase
- **>98.4%** decrease in total cVOCs from peak bioavailability