



### Project Highlights

- **ERDENHANCED™** Pilot Study **76.8% reduction** in total cVOCs over an 8-month period.
- PCE initially decreased 74.5%. The additive enhanced solubilization of residual source mass represented by a 275% increase in PCE; followed by a 76.6% reduction from peak PCE concentrations.
- **ERDENHANCED™** additive enhances the natural co-solvent effect, increasing contaminant bioavailability to eliminate rebound out-front.
- **ERDENHANCED™** enhances cVOC biotransformation; realizing increases in daughter products:
  - 176% TCE
  - 452% cis-1,2-DCE, and
  - 191% VC by month 6
- **ERDENHANCED™** enhances reductive dechlorination of parent and daughter cVOCs realizing the following reductions from peak:
  - 81.8% TCE
  - 91.0% cis-1,2-DCE
  - 78.8% VC
- Proven Cost-Effective Strategy for **Sustainable** destruction of residual source mass contaminants



### TerraStryke® ERDENHANCED™

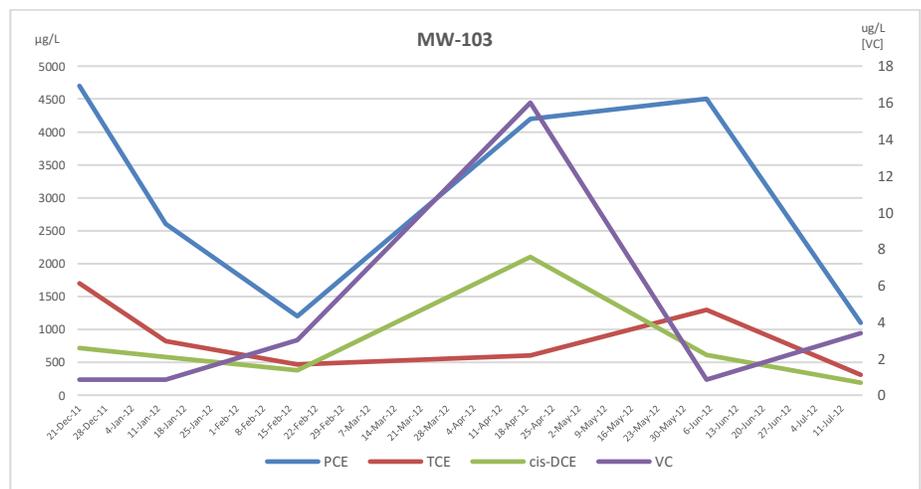
#### In-Situ Passive Pilot Study - Chlorinated DNAPL Source Zone Former Dry Cleaner Operations; Stoney Creek, Ontario Canada

TerraStryke® Remediation Products LLC (**TerraStryke®**) develop and distribute biostimulation additives proven to cost-effectively enhance chlorinated volatile organic compound (cVOC) biotransformation safely and completely. Our patented biostimulation additive **ERDENHANCED™** leverages existing biogeochemical conditions to facilitate chlorinated alkane/alkene destruction. **ERDENHANCED™** is proven to expedite residual mass (sorbed/ganglia/blebs) solubilization representing today's low-cost, low-impact solution.

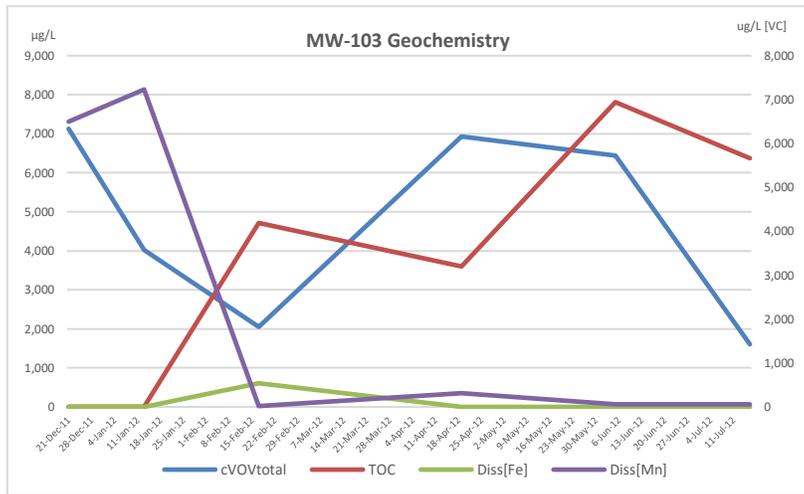
**Background:** Former operating dry cleaner, current Site use includes dry cleaning store front, retail, offices, and apartments. Past Site use included use/storage of chlorinated volatile organic compounds (cVOCs); specifically, Tetrachloroethylene (PCE). Past characterization activities documented adverse impacts to subsurface soils and groundwater. Previous remedial efforts proved ineffective and costly. The owner desired a low-cost, low-impact remedial solution that meets compliance and redevelopment objectives.

**Method:** In 2011, the City of Hamilton Ontario sponsored an on-site Pilot Study to evaluate additive efficacy under site biogeochemical conditions. Additive filled Passive Release Sock (PRS) deployment units were suspended, undisturbed for 6-week periods, in the screened interval of monitoring well MW-9A. PRS units passively amend a limited treatment zone (≤3ft AOI). Five replacement events were completed over a 7-month evaluation, with baseline and performance groundwater monitoring, sampling and analytical testing completed each event. **ERDENHANCED™** efficacy was determined by comparing performance data to baseline data.

**Results:** 8-months post amending with **ERDENHANCED™** the following results were realized:



Specifically, in terms of total cVOC reductions; *after* a 275% increase in PCE due to additive enhanced co-solvent effect, a **76.8% reduction in total cVOCs** was realized after the 8-month evaluation period. Additionally, a **76.6% reduction in PCE**, 81.8% reduction in TCE, 91.0% reduction in cis-1,2-DCE, and 78.8% reduction in VC were observed. A discussion of supportive geochemistry follows.



- Three Order of Magnitude Increase in TOC
- **77.5% reduction in total cVOCs**
- **99.1% decrease in dissolved iron**
- **99.2% decrease in dissolved manganese**
- Three Order of Magnitude increase in chloride

Consultant of record did not sample or analyze groundwater for either DO or ORP values.

Additionally, ethene was observed in the 6<sup>th</sup> month of the evaluation and methane was detected months 2-7 of the evaluation.

Nitrates were not detected above laboratory reporting limits throughout the 7-month evaluation.

TerraStryke® ERDENHANCED™ enhances site biogeochemistry to facilitate the generation of volatile fatty acids (VFAs), providing a co-solvent ‘surfactant affect’, to assist the solubilization and desorption of residual source mass contaminants; effectively expediting the destruction of dissolve phase contaminants.

TerraStryke® ERDENHANCED™ expedites the scavenging of competing terminal electron acceptors (TEAs) such as oxygen, nitrate, oxidized iron/manganese, and sulfate which typically limit cVOC dechlorination. As with any in-situ project it is imperative that a vigorous groundwater monitoring and analytical testing program be performed to include, at a minimum, the parameters presented in the adjoining table.

TerraStryke® ERDENHANCED™ facilitates increasing contaminant bioavailability and dissolved phase destruction.

TerraStryke® amendments are suitable for any type of deployment such as Direct Push Technology (DPT), infiltration galleries, and direct application due to enhanced solubility.

TerraStryke® amendments are easy to handle, require less water, less pore space displacement, less site time, and less overall remedial costs; TerraStryke® amendments **maximize project margins while minimizing project impacts.**

Parameter	Methodology	Container & Preservative	Notes
Methane	EPA Method 3C GC Screen	Glass 40-ml VOA	HCl Preserved
Nitrate, Nitrites	EPA Method 6010b	Plastic 250 ml	48-hr Holding Time
Sulfate	EPA Method 375.4	Plastic 250 ml	No Preservative
Chloride <sup>1</sup>	Not Applicable for TPHenhanced	Plastic250 ml	No Preservative
Dissolved Manganese & Iron	ICP EPA Method 6010b	Plastic 500 ml	None, Lab Filtered
Total Organic Carbon (TOC)	TOC SM-5310B	Glass	H <sub>2</sub> SO <sub>4</sub> Preserved
pH	Field Monitored	NA	No Purge
Conductivity	Field Monitored	NA	No Purge
Dissolved Oxygen (DO)	Field Monitored	NA	No Purge
Oxidation-Reduction Potential (ORP)	Field Monitored	NA	No Purge

Required Testing Parameters for Each Sampling Event