

TerraStryke® ERDENHANCED®

**DNAPL Source Zone Green Remediation
Optics Manufacturing Facility, Lebanon, New Hampshire**

BACKGROUND: Optical manufacturer desired *sustainable* low-impact groundwater remediation. **ERDENHANCED™** (2,600 pounds) deployed in 2001 via direct-push technology (26 nodes) into two, silty-clay, laterally continuous, hydraulically conductive source zones. Baseline concentrations of trichloroethylene (TCE) were ≈97,400 micrograms per liter (µg/L); roughly 9% solubility, indicating significant residual source mass in saturated soils as non-aqueous phase liquid (NAPL).

RESULTS: Post 6-months deployment TCE decreased 86%, followed by 4-5 years of enhanced solubilization of residual parent PCE DNAPL into dissolved phase, recorded as asymptotic TCE. Concurrent with the period of expedited solubilization was increased cis-1,2-DCE and ethene concentrations, indicating *complete* biotransformation and >**99.9%** reduction in PCE by 2010.



Highlights

ERDENHANCED™ cVOC BIOTRUSTIMATION

safe, sustainable, effective

- Faster Kinetics
- Expedited Solubilization
- Increased Bioavailability
- Greater Longevity
- Complete Biotransformation

ERDENHANCED™ Superior Kinetics completes biotransformation faster

ERDENHANCED™ Sustainable creates extended reducing conditions

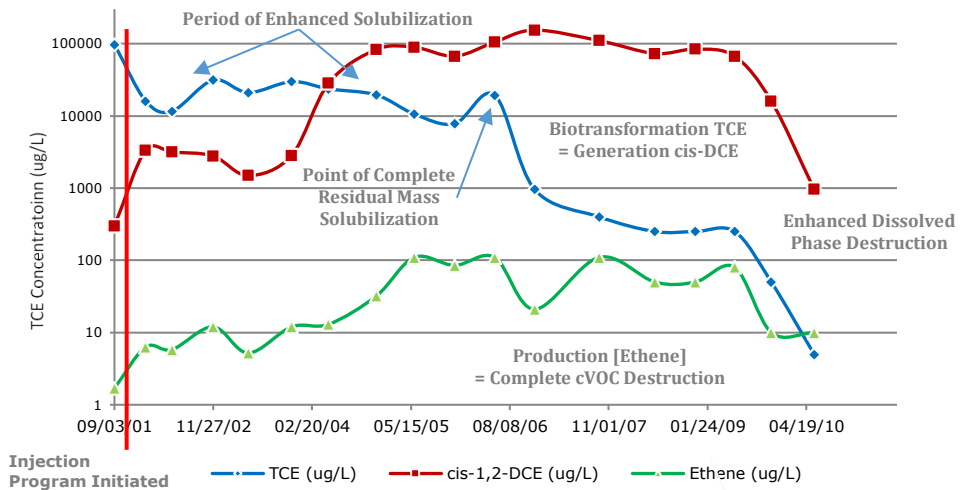
ERDENHANCED™ Biostimulates native microbial populations

ERDENHANCED™ Cost-effective lowering overall remediation costs

Call **TerraStryke® NOW** to realize safe, sustainable, and effective cVOC destruction!!

www.terrastryke.com

- CIS-1,2-DCE INCREASED THROUGHOUT THE FIRST 6-YEARS OF THE PROGRAM.
- ETHENE INCREASED CONCURRENT WITH CIS-1,2-DCE BIOTRANSFORMATION.
 - VC BELOW LABORATORY DETECTION LIMITS DURING ENTIRE PROGRAM.
- >99.99% REDUCTION IN PARENT-PARENT/DAUGHTER MOLAR RATIO AT YEAR 7.
 - TCE DECREASED 99.99% TO <1 µg/L IN 2014.
- NO ADDITIONAL DEPLOYMENTS WITH **No** OBSERVED REBOUND IN 2014.



TerraStryke® ERDENHANCED™ is a Patented Carbon based biostimulation additive formulated with macro-micro nutrients to nourish **native bacteria** and enhance treatment zone geochemistry; realizing long-term reducing conditions supportive of safe, sustainable, and cost-effective **complete biotransformation** after a *single* full-scale deployment event. **ERDENHANCED™** expedites residual mass solubilization (additive enhanced **co-solvent** effect) and increases contaminant bioavailability to eliminate rebound up-front and realize compliance objectives with less-risk, less-cost, less impact.



Project Summary: Source zone contamination was generated via poor site housekeeping of spent TCE. To accomplish Site objectives approximately 2,600 pounds of **ERDENHANCED™** was injected in 2001, with **NO** additional additive required since, over 16-years post the single full-scale deployment event in 2001. Subslab-subsurface injections into saturated soils were completed using direct push technology (DPT); 25-injection nodes installed using ≤ 100 pounds additive/ ≤ 80 gallons each.

Subsurface conditions included ≈ 35 -ft silty clay with two impacted sand/silt lenses; one at ≈ 18 ft-25ft below ground surface (bgs), the second ≈ 30 -33ft bgs. Both laterally continuous, hydraulically conductive. Each lens was targeted for remediation. Baseline groundwater concentrations of parent TCE $\approx 100,000$ $\mu\text{g/L}$ (source zone); with total concentrations of the daughter products cis/trans-1,2-dichloroethene (DCE); 1,1-DCE; and, vinyl chloride (VC) ≈ 400 $\mu\text{g/L}$. On a molar basis, baseline parent (TCE) contaminant represents $\approx 99.6\%$ of the total signature, indicating little to no biotic activity. 6-yrs after single 2001 deployment event TCE had decreased by $>99.99\%$ with similar reductions in all daughter products likewise achieved.

TerraStryke® **ERDENHANCED™** attained project objectives after a single deployment event with minimal Site impacts. Non-compliant source area cVOCs were reduced to $<1,000$ $\mu\text{g/L}$ within 5-years, allowing seamless transition to enhanced monitored natural attenuation (MNA). Additive proved capable of biostimulating native microbial populations, expediting residual mass solubilization, realizing sustainable reducing conditions, and enhancing dissolved phase cVOC destruction. **ERDENHANCED™** leverages Mother Natures' momentum to enhance natural attenuation, maximize microbial performance and effect-residency time sustainability to realize safe, low-impact, and cost-effective Site compliance.

ERDENHANCED™ is a proven cost-effective remediation strategy for dissolved phase **and** residual source mass contaminants. Additive components expedite the attainment of reducing conditions, introducing and maximizing the recirculation of beneficial Carbon by leveraging and enhancing site biogeochemical conditions. Microbial utilization of additive components generates both a 'co-solvent' effect and intra-extra species 'communication' to expedite residual DNAPL solubilization, maximizing contaminant bioavailability by getting the rebound out 'up-front' to ensure maximum degradation rates and the realization of long-term compliance objectives.

