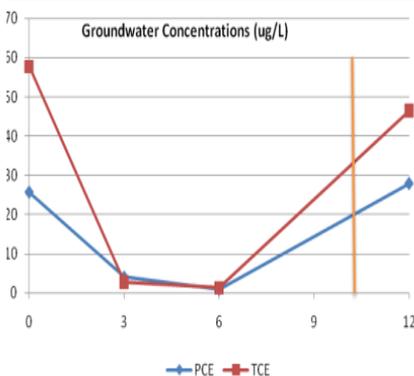


Project Highlights

- In-situ innovative formulation designed to destroy dissolved, sorbed, and residual DNAPL.
- **ERDENHANCED™** achieved >96% contaminant reduction.
- **ERDENHANCED™** expedites contaminant destruction.
- [Ethene] increased 40,000 % in 3 weeks confirming transformation of vinyl chloride.
- [Cl⁻] increased confirming dechlorination of cVOCs
- Full scale **ERDENHANCED™** deployment based on Pilot Study.



DNAPL Source Zone Green Remediation Manufacturing Facility Morris County, New Jersey

Plant Products Co. Ltd. manufactures and distributes BioStryke® Remediation Products designed to cost-effectively biostimulate existing site conditions to expedite contaminant destruction. BioStryke® **ERDENHANCED™** is an *in-situ* formulation proven to passively-aggressively destroy chlorinated volatile organic compounds (cVOC) by leveraging existing *anaerobic* conditions. The following documents the cost-effective use of the parent product from which **ERDENHANCED™** has been developed. The case study demonstrates the ability of our formulations to cost-effectively remediate chlorinated volatile organic compounds (cVOC) in groundwater and saturated soils.

The Site is a manufacturing facility in Morris County, New Jersey, USA at which a Site investigation identified trichloroethene (TCE) and tetrachloroethene (PCE) related vapor intrusion issues. The source of the chlorinated volatile organic compound (cVOC) contaminants was believed a result of cVOC impacts at other portions of the Site migrating via preferential groundwater pathways created by subterranean piping.

Upon installation of a vapor-intrusion mitigation system, the consultant of record determined long-term source zone groundwater remediation using **ERDENHANCED™**, an in-situ electron exchange formulation, would most cost-effectively manage both groundwater and long-term ambient air issues. An **ERDENHANCED™** Pilot Study was implemented to quantify the products ability to destroy recalcitrant cVOC groundwater and saturated soil contaminants. The **ERDENHANCED™** amendment was introduced to the groundwater by suspending a PRS Deployment Unit within the screened interval of an existing 2-inch monitoring well. PPCL Pilot Studies represent low-cost/low-risk treatability studies performed under actual site conditions, eliminating the 'jar effect' and creating a 'GO-No-GO' decision process regarding potential full-scale remediation.

Performance monitoring and analytical testing completed during the 12-week Pilot Study determined **ERDENHANCED™** enhanced the dehalorespiration of dissolved cVOCs. Groundwater samples were collected weeks 3, 6 and 12; with a one time PRS replacement at week 6. Shortly after initial deployment, Total Organic Carbon (TOC) values increased significantly then, by week 12 had returned to below pre-deployment conditions reflecting complete **ERDENHANCED™** utilization. Within 6-weeks, [PCE] and [TCE] decreased by 96% and 98%, respectively. Upon amendment depletion, rebound was experienced in the test area indicating dehalorespiration 'shut-down'. During this same period, [DCE] decreased at week 3 but returned to baseline week 6, indicating initial dechlorination and subsequent parent biotransformation. Similarly, [VC] increased over 1,000% then dramatically decreased as VC was dechlorinated to ethene.

Additional points of interest associated with regards to the performance of the Pilot Study include:

- The generation of ethene and reduction of VC confirmed the presence of the limited number of Genera of *Dehalococcoides* capable of supporting the biotransformation of the parent compounds TCE & PCE to ethene.
- The molar ratio of parent compounds (TCE+PCE) to daughter compounds (DCE+VC) decreased from a baseline of 30.9% to 1.3% within the first 6-weeks of the evaluation period.
- Dissolved Oxygen (DO) concentrations initially decreased, but rebounded to half-baseline concentrations at week in response to the depletion of amendment within the test area.
- Oxygen Reduction Potential (ORP) decreased from -65mV to -231mV before rebound at week 12, also in response to the depletion of the amendment within the test area.
- [Methane] increased **640%** before decreasing to baseline conditions as amendment consumption completed.
- [Ethene] increased over **40,000%** by week 3, decreased by one order-of-magnitude by week 6, and returned to baseline by week 12 in correlation with the complete depletion of amendment within the test area.
- Sulfate, which may act as a competing electron acceptor to available cVOCs, decreased to **ND** during amendment depletion, then returned to baseline conditions at the end of the evaluation period.
- Concentrations of the reduced form of Iron increased over **9,000%** in the first 3-weeks owing to enhanced reduction of ferric iron to ferrous iron forms. By week 6 as the **ERDENHANCED™** was being consumed, [Fe⁺⁺] decreased by 75%, and by the completion of the study period decreased to slightly above [baseline].
- [Cl⁻] remained elevated throughout the **ERDENHANCED™** Pilot Study period indicating the enhanced liberation of the chloride anion during and beyond the test period.

The table below summarizes the results of the **ERDENHANCED™** Pilot Study demonstrating a viable and cost-effective method to enhance the biotransformation of parent cVOC contaminants to ethene, with less impact to the environment. The Pilot Study also demonstrates the effectiveness of targeting source mass contaminants using in order to positively reduce long-term liabilities associated with ambient air contaminant issues, plume management, sampling, and analytical testing. In short, **ERDENHANCED™** represents a sustainable and cost-effective remediation program that works with Mother Nature, not against Her, generates a smaller carbon footprint, and reduces overall remediation costs.

	Parameter	Baseline	Week 3	Week 6	Week 12*
Geochemistry	Dissolved Oxygen (mg/L)	4.01	0.96	0.99	2.35
	Oxygen Reduction Potential (mV)	-65	-152	-231	-58
	Nitrate (mg/L)	0.2	<0.11	<0.11	0.37
	Dissolved Iron (µg/L)	203	19,300	4,390	1,200
	Sulfate (mg/L)	30	<10	<10	30.3
	Methane (µg/L)	96.4	577	617	73.8
	Ethene (µg/L)	<0.02	8.5	0.86	<0.02
	Chloride (mg/L)	54.1	91.5	88.3	66.5
	Total Organic Carbon (mg/L)	13.3	280	263	8.9
cVOCs (µg/L)	Tetrachloroethene (PCE)	25.7	4.1	1	27.9
	Trichloroethene (TCE)	57.7	2.7	1.3	46.5
	cis-1,2-Dichloroethene	118	33.6	110	116
	trans-1,2-Dichloroethene	1.1	0.51	0.69	1.4
	Vinyl Chloride	6.2	77.3	6.4	1.4

* End of Pilot Study and system representative of complete **ERDENHANCED™** consumption.