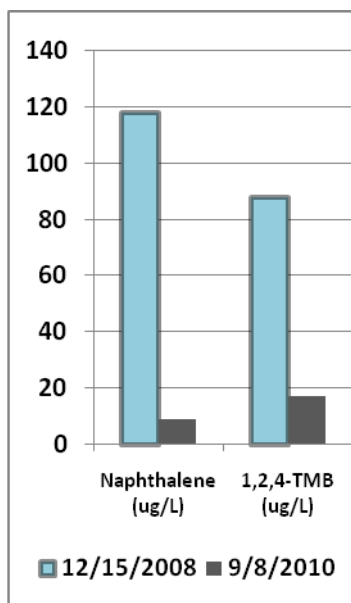


Project Highlights

- Innovative, Green process proven to remediate recalcitrant petroleum compounds in groundwater and saturated soils.
- Achieved regulatory compliance within 6 months after additive was introduced to the groundwater meeting regulatory requirements for all required compounds.
- Cost of remediation approximately equal to a single groundwater monitoring, sampling, and analytical testing event
- Realized Client savings expediting site compliance reducing future O&M costs.



Pilot Study Project

Residual Petroleum Remediation Philadelphia, Pennsylvania

Plant Products Co. Ltd. (PPCL) manufactures and distributes BioStryke® Remediation products; innovative and green remedial products which leverage existing site conditions. BioStryke **TPHENHANCED™** is designed to biostimulate existing *anaerobic* conditions and cost-effectively expedite the destruction of petroleum hydrocarbon contaminants. **TPHENHANCED™** is proven to destroy dissolved solute, sorbed phase, and residual source mass contaminants in groundwater and saturated soils without the use of above-ground energy consuming, emissions generating equipment. Our processes work with Mother Nature, not against.

The following case study documents the ability of **TPHENHANCED™** to expedite the destruction of 1,2,4-trimethylebenze (TMB) and naphthalene contaminants at a Pennsylvania manufacturing facility. Residual petroleum source mass was adversely impacting groundwater. In November 2002, heating oil was documented leaking from a 7,500-gallon underground storage tank (UST). The UST was pumped and removed; however, during UST removal activities impacted soil was detected on the floor of the excavation. Excavation was continued to the top of bedrock, ≈12 feet below ground surface (bgs). Petroleum sheen was observed atop the groundwater within the UST grave yet post-excavation soil sampling and analytical testing indicated the remaining soil met regulatory limits.

The Pennsylvania Department of Environmental Protection (PADEP) required three groundwater monitoring wells installed to evaluate groundwater quality and flow direction. Groundwater monitoring occurred from June 2003 to December 2008. Initially, a light non-aqueous phase liquid (LNAPL) was present in monitoring wells MW-1 (located proximate to the former UST) and downgradient well MW-3. The LNAPL layer was reported 1.3 ft in MW-1 and 0.18 ft in MW-3. In 2004 a pneumatic LNAPL recovery pump was installed in MW-1, discharging into an oil/water separator; however, the system was discontinued in 2007 due to negligible LNAPL detection and recovery.

Prior to the commencement of remedial activities, the groundwater contained benzene and naphthalene in excess of PADEP Medium Specific Concentration (MSC) standards for non-residential used aquifers. By 2006, only naphthalene occasionally exceeded the MSC of 100 micrograms per liter ($\mu\text{g/L}$). In March 2008, PADEP revised its required sampling parameters for heating oil releases to include 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB. The concentrations of 1,2,4-TMB between June and December 2008 ranged from 68.2 to 97.7 $\mu\text{g/L}$ (MSC = 35 $\mu\text{g/L}$), while naphthalene concentrations ranged from 92 to 118 $\mu\text{g/L}$.

In 2009 the consultant of record was requested to evaluate alternative remedial strategies to expedite the remediation of the residual concentrations of naphthalene and 1,2,4-TMB. PPCLs BioStryke **TPHENHANCED™** was recommended as an alternative, green remedial formulation, proven to cost-effectively expedite the destruction of dissolved, sorbed phase, and residual petroleum source mass contaminants in groundwater and saturated soils. In March 2010, after the submittal of a work plan to the PADEP, **TPHENHANCED™** was introduced into the treatment zone, generally located within and including the former UST excavation area.

In September 2010, groundwater samples were collected and analyzed. Laboratory results documented the decrease of both 1,2,4-TMB and naphthalene concentrations within six months after the introduction of the additive **TPHENHANCED™**. Specifically, concentrations of 1,2,4-TMB decreased by roughly 83% (from 97.7 $\mu\text{g/L}$ to 17 $\mu\text{g/L}$) and naphthalene concentrations decreased by roughly 92% (from 118 $\mu\text{g/L}$ to 8.8 $\mu\text{g/L}$).

The site is presently moving towards obtaining MADAP approved regulatory closure subsequent to obtaining three additional quarterly groundwater sampling results with target compound results remaining less than PADEP's MSCs.

Costs associated with the implementation of a **TPHENHANCED™** remediation strategy were comparable to that incurred through a single round of groundwater sampling. As such, the **TPHENHANCED™** remedial strategy proved effective at achieving site compliance, while realizing significant client savings, faster and with less adverse environmental impact. Our products work to reduce actual remedial costs while also reducing future site costs associated with long-term groundwater monitoring, sampling, and analytical testing.