



Geosyntec successfully demonstrated the effectiveness of enhanced in situ bioremediation at treating multiple chlorinated solvents at high concentrations in a complex geochemical and hydrogeological environment

Client: Orica Australia Pty

Services Provided:

- ✓ Treatability Testing
- ✓ Remedial Design and Field testing
- ✓ Remedial Evaluation and Strategy

Project Objective

The Orica Botany Site contained chlorinated volatile organic compounds (VOCs) in groundwater that ranged up to solubility limits (g/L range), with multiple plumes and dense, non-aqueous phase liquid (DNAPL) source areas. The primary objective of the project was to evaluate alternative technologies to pump & treat for containment and treatment of the plumes. Few remedial technologies are available that have the ability to overcome the complexities and challenges of the Site conditions, which includes low groundwater pH (4.5 to 5.5), heterogeneous soil, high organic soil content, multiple contaminants, multiple DNAPL source areas and plumes, high mass flux and a significant amount of VOC mass not readily accessible (i.e., sorbed to organic component of soil, low solubility DNAPL, and diffused into low permeability layers). In accordance with regulatory mandate, a full-scale pump and treat system was installed, consisting of three containment lines (totalling over 2 km long) of closely spaced extraction wells. A large groundwater treatment plant was constructed to handle up to 15 million L/day of extracted groundwater at a capital cost of \$110M. Within the first year of operation, over 150 tonnes of VOCs were extracted from groundwater with little to no observed reduction in plume concentrations. A zero-valent iron permeable barrier was successfully tested to treat tetrachloroethene, trichloroethene and carbon tetrachloride, but had limited effectiveness against the primary contaminant in the central plume (1,2-dichloroethane; 1,2-DCA), which was present at concentrations of several thousand mg/L.

Geosyntec's Scope of Services

Geosyntec was retained to evaluate the effectiveness of enhanced in situ bioremediation (EISB) to evaluate the technology for enhanced in situ removal of dissolved phase and mass sorbed to the soil. The amount of VOC mass sorbed to the soil is significant at this Site, and will likely result in persistence of the plume for decades to centuries after the DNAPL has been treated. Geosyntec completed treatability testing to provide a preliminary evaluation of technology feasibility and four EISB field trials, testing passive and active EISB approaches under a range of geochemical and hydrogeological conditions.

Notable Accomplishments

The trials showed that EISB is a robust technology for treatment of the VOCs within the complex and challenging environment, including enhanced desorption of mass from the soil. Engineering controls such as mixing and dilution were used to overcome inhibition issues related to high concentrations of certain VOCs (biodegradation was successfully stimulated at concentrations of 1,000 mg/L 1,2-DCA and up to 5 mg/L chloroform). Biodegradation to innocuous end products was achieved; with somewhere in the range of 3,800 to 11,000 kg of total VOC mass biodegraded at rates of up to 60 kg/day over an 18 month period. Concentration reductions of up to 99% of influent concentrations were seen and contaminant degradation half-lives on the order of hours to days were achieved. Also demonstrated was the ability to reverse the inhibitory effect of high DCA concentrations and stimulate growth of natural microbial communities in previously inhibitory environments.