

## PHC Remediation of a Complicated Site Using a Multi-Technology Approach (Case Study)

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Remediation of petroleum hydrocarbon compounds (PHCs) has evolved with the evolution of remedial technologies. From excavation to pump and treat systems (P&T) to in-situ injections, the remediation of PHCs has advanced over the years. While there is still no 'silver bullet', the ability to treat PHCs has developed to the point where complicated site remediation can progress with confidence. Multiple remediation technologies can be applied simultaneously or consecutively with planned changes occurring from one technology to the next based upon magnitude of the PHC concentrations, the type of soil or bedrock, and changing above ground site activities.

This talk will showcase a Site where multiple technologies were implemented. A staged approach was planned due to the presence of light non-aqueous phase liquids (LNAPL) and the existence of PHC contamination in both soil and bedrock aquifers. Multiple PHC sources were present across the Site along with an on-site PHC spill that occurred part way through the clean-up efforts. Access to all PHC contaminated areas was not possible due to interior sensitive activities and exterior busy trucking routes. During site remediation new PHC sources were discovered and remedial plans/approaches were adjusted to mitigate/include these new sources with minimal impact to the overall budget of the project.

Use of a multi-remediation technology approach can significantly enhance the overall remediation plan when implemented correctly (i.e. timely). Prior to remediation, and somewhat during remediation, multiple subsurface investigations were completed and hundreds of monitoring wells installed providing fairly detailed delineation of the PHC impacts.

Remedial implementation began after pilot scale investigations that included both injection testing and 24-hr pumping tests at multiple locations on-Site. The remediation plan for the Site involved multiple excavations, an automated pump and treat system, bedrock and overburden injection well installations (both horizontal and vertical), and in-Situ injections of multiple amendments.

During this talk, Site plans will be presented, the entirety of the remediation process will be explained and presented, and plots of the PHC concentrations will be shown.

### Bruce Tunncliffe, MASc, PEng

Mr. Tunncliffe is President of Vertex Environmental Inc., is an Environmental Engineer, and has years of experience designing and implementing remediation of chlorinated solvents and petroleum hydrocarbons. Mr. Tunncliffe holds a Master's degree from the University of Waterloo where he studied oxidation in fractured bedrock.