

Workshop on

Toolkits for Management of Petroleum Hydrocarbon Sites

June 19, 2018
Golder Associates
2920 Virtual Way, Vancouver, BC
8:15-4:30

Natural source zone depletion (NSZD) of petroleum hydrocarbons (PHC) is an emerging remediation technology for management of PHC-impacted sites. Active remediation technologies that promote enhanced biodegradation of PHCs and that are complementary to NSZD, while being cost effective and sustainable, are also receiving increased interest. A framework for site management is being developed for PHC-impacted sites that recognizes the importance of NSZD and monitored natural attenuation (MNA) for dissolved plumes. This framework recognizes that comparisons of depletion and compositional change of PHCs for active and passive remedies can help inform decisions on when to transition to NSZD and promote more optimized and sustainable site remediation.

To address this new paradigm, Golder Associates in partnership with Contaminated Sites Approved Professional Society and Shell has prepared four toolkits that provide comprehensive guidance and set of tools to evaluate petroleum hydrocarbon remediation with a focus on methods for assessment of NSZD rates and compositional change. The four toolkits are as follows:

- Toolkit #1: Conceptual Site Model and Case Studies
- Toolkit #2: Monitoring and Modeling of NSZD and MNA
- Toolkit #3: Remediation Technology Evaluation
- Toolkit #4: Sustainability Evaluation

This workshop will provide for comprehensive overview of science, methods and application of NSZD within the broader context of sustainable petroleum hydrocarbon remediation. The learning objectives include an improved understanding of the conceptual site model, measurement and modeling methods for assessment of NSZD and MNA, enhanced bioremediation through technologies such as bioventing and soil heating, and how concepts and metrics for sustainability can be used to assess remedial options. The workshop will cover both the theory on fate and transport processes and practical methods for NSZD estimates including demonstration of the Dynamic Closed Chamber (DCC) method for CO₂ efflux measurements and the Vadoze Zone Biodegradation Loss (VZBL) model, developed by Golder Associates and Dr. John Wilson of Scissortail Environmental Solutions, LLC. Each participant will be provided with computer tools created as part of this project including the VZBL model and publically available tools will be reviewed. Several case studies demonstrating use of methods and tools for NSZD will be demonstrated.

The approaches and methods in the toolkits are designed to answer the following key questions:

- 1) What are the estimated NSZD rates?
- 2) Approximately how long will it take for source depletion to occur?
- 3) Is the dissolved hydrocarbon groundwater expanding, stable or shrinking and what attenuation processes are occurring?

- 4) What are the options for petroleum hydrocarbon remediation and potentially how effective and sustainable are these measures compared to a transition to NSZD?
- 5) What are appropriate monitoring strategies to support prediction and verification of NSZD and enhanced bioremediation methods?

Workshop Outline

8:15 to 8:30 Registration

8:30 to 12:00 Morning Session (will include morning refreshment break)

1. Introduction and learning objectives
2. Invited talk: *Natural Source Zone Depletion – the Shell Perspective*. Dr. Matthew Lahvis, Shell Global
3. Tool kit #1: Review of conceptual site model and case studies
 - a. LNAPL weathering: biodegradation, volatilization and dissolution processes
 - b. Review of database studies on groundwater plume stability and length
 - c. BC case studies on groundwater concentration attenuation
4. Tool kit #2: Measurement and modeling of NSZD and MNA
 - a. MNA lines of evidence approach and practical tools for assessment of plume stability
 - b. Methods for NSZD assessment
 - i. Unsaturated zone estimates: Gradient, CO₂ efflux and temperature methods
 - ii. Saturated zone estimates: Biodegradation and dissolution
 - c. Multi-process models

12:00 to 1:00 Lunch on your own

1:00 to 4:30 Afternoon Session (will include afternoon refreshment break)

1. Case studies: Field trials and application of NSZD assessment at a former refinery
2. Tool kit #3: Remediation technology evaluation
 - a. Technology screening framework
 - b. Overview of remedial technologies (targets, objectives, primary mechanisms)
 - c. Transitions from active to passive remediation technologies
3. Toolkit #4: Sustainability evaluation
 - a. Concepts for green and sustainable remediation (GSR)
 - b. Roadmap for implementation of GSR and Technology Factsheets
 - c. GSR Dashboard for footprint analysis (e.g., greenhouse gas emissions)
4. Case study: Technology and sustainability evaluation

3:45 to 4:30 Q & A and Panel Discussion

Cost: Free

Participation is open to all

Registration: <https://csapsociety.bc.ca/events/>

Instructors: Dr. Parisa Jourabchi and Dr. Ian Hers, Golder Associates Ltd., Vancouver, BC

Dr. Parisa Jourabchi is a senior consultant of Golder Associates with over 20 years of experience in applied research and computational methods for the characterization of soil, sediment, and aquatic environments. At Golder, Parisa provides technical guidance on site investigation and remediation projects, particularly on vapour intrusion, modeling, monitored natural attenuation (MNA) and natural source zone depletion (NSZD). Parisa has led several applied research projects including field trials for NSZD assessment and the development of toolkits for management of petroleum hydrocarbon sites in context of natural depletion and sustainability.

Dr. Ian Hers is a senior consultant and Principal of Golder Associates with 28 years professional experience, and is Golder's global site investigation and remediation practice leader. He has led numerous research projects on natural source zone depletion, petroleum vapor intrusion and LNAPL management for industry and government clients in United States, Canada, Europe and Australia. Dr. Hers has made significant contributions to development of innovative approaches and methods for more effective and sustainable management of petroleum hydrocarbon contamination. For past decade, as part of the ITRC petroleum vapor intrusion, LNAPL and TPH teams, he has contributed to guidance development and conducted training in these areas.

