GEI developed the patent-pending FRACTioN™ analysis methodology for NAPL present in fractured rock. (Modification to ASTM E2856 for LNAPL transmissivity testing in porous media.)

GEI Consultants

FRACTioN™ - HIGH RESOLUTION ANALYSIS OF NAPL IN FRACTURED ROCK

Benefits

Accurate, supportable results for an improved CSM and more confident decision-making

Support a risk-based closure evaluation by documenting that NAPL is recovered to the maximum extent practicable (MEP)

Understand if hydraulic recovery is going to help achieve site remediation goals

Understand if it makes economic sense to perform hydraulic recovery

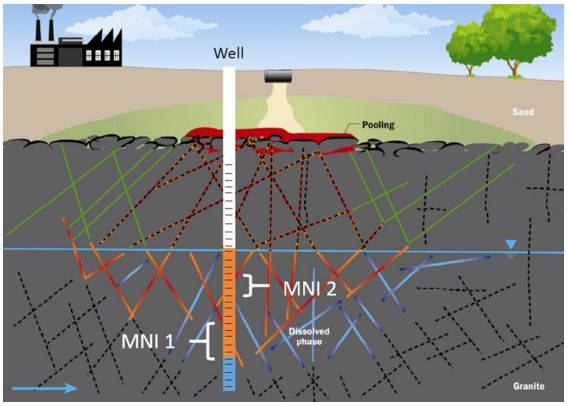
Support the design of a hydraulic recovery system to target only the fractures with recoverable NAPL

How Does FRACTioN™ Work?

FRACTioN™ identifies the number, location, and size of fractures that are transmissive to NAPL in a monitoring well. It quantifies the NAPL transmissivity of each fracture and quantifies an aggregate NAPL transmissivity value for the wells.

FRACTioN™ is a potential solution when:

- NAPL is present in fractured media
- The presence of NAPL or NAPL thickness is the only remaining risk-based driver for remediation
- You need to quantify recoverability of NAPL in fractured media
- You need to design a recovery approach for NAPL in fractured media
- There is large NAPL thickness in wells but low NAPL recovery rates
- Previous NAPL transmissivity tests are not consistent with recovery rates



[Figure modified from: CL:AIRE. 2014. An illustrated handbook of LNAPL transport and fate in the subsurface. CL:AIRE, London. ISBN 978-1-905046-24-9. Download at www.claire.co.uk/LNAPL] Conceptual diagram of LNAPL in fractured granite or other igneous rock. Note the complex migration pathways and pattern of fractures with and without mobile LNAPL underneath the source area, and the submergence of LNAPL in vertical to subvertical fractures. Mobile LNAPL will appear only in wells that encounter one or more of the fractures containing mobile LNAPL. As shown, a well that penetrates more than one fracture with mobile LNAPL will exhibit more than one mobile LNAPL interval as each fracture represents an individual mobile LNAPL interval in communication with that well. Measured NAPL thicknesses in such wells will typically be exaggerated.

Refinery with Fractured Basalt

GEI used the FRACTioN™ methodology at a refinery in fractured basalt. The number, size, and location of fractures transmissive to LNAPL were identified for each test well. LNAPL transmissivity values were also calculated for each fracture as well as an aggregate value for each well. The results were used to optimize the operation of a hydraulic recovery system. Based on the LNAPL transmissivity results wells were categorized by whether hydraulic recovery would be beneficial.

Some locations were identified that could be removed from the recovery system, despite exhibiting large thicknesses of LNAPL. Other wells that were not connected to the recovery system were identified where it would be appropriate to initiate hydraulic recovery. The results were also used to support regulatory negotiations for remedial endpoints based on LNAPL transmissivity rather than the observed thickness in wells.

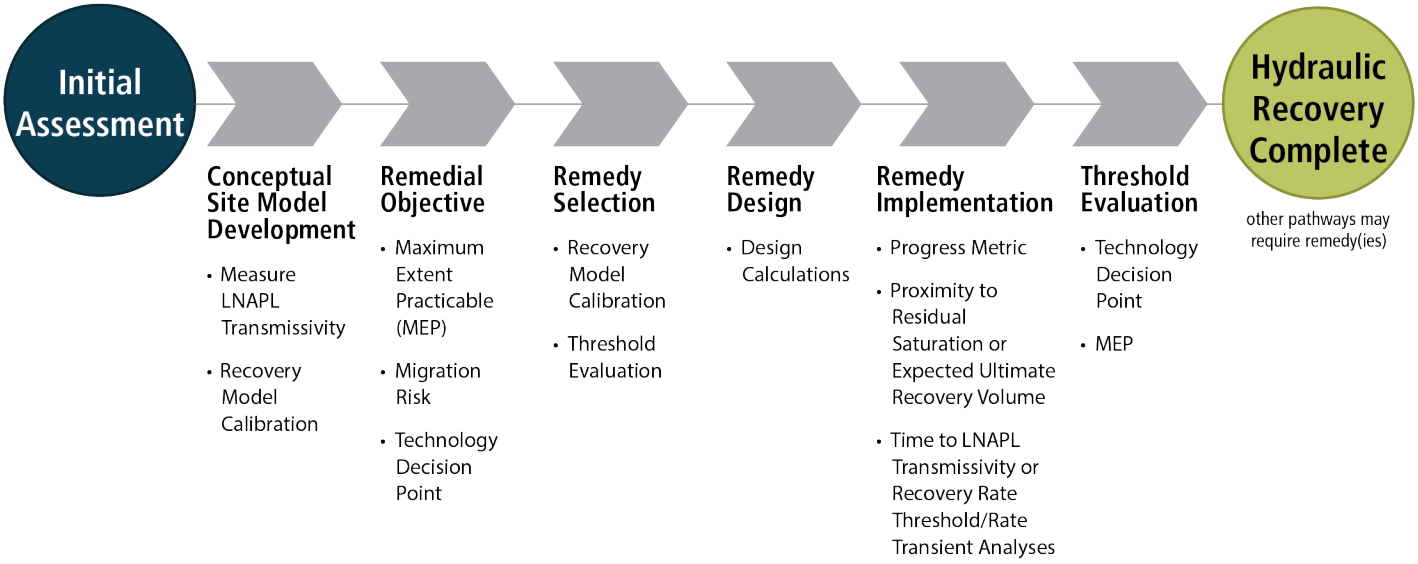
Contact Information

Lisa Reyenga, PE
(817) 380-3901
lreyenga@geiconsultants.com

Camille Carter
(970) 224-7350
ccarter@geiconsultants.com

Michael Hawthorne, PG
(817) 380-3892
mhawthorne@geiconsultants.com

Uses for FRACTioN™ in the Remedial Process



GEI Consultants, Inc.

GEI Consultants, Inc. is a consulting engineering firm that delivers value-laden professional services that improve our world's built environment. Founded in 1970, the firm was built on the foundation of geotechnical engineering and has evolved into a multidisciplinary engineering firm serving the water, energy, buildings, infrastructure, and industrial markets. GEI has over 800 staff, 45+ years of technical experience, and has completed over 50,000 projects globally.