

## “Typical LNAPL Mobility” Analytical Program

Description	Test Method	Sample or Test Frequency
<b>Pore Fluid Saturation Package:</b> Dean-Stark Method: Includes initial fluid saturations, total porosity, grain density, bulk density, and air-filled porosity.	API RP 40	One sample every six inches; usually 8 - 12 samples per boring. The samples are taken vertically across the area of NAPL impact.
<b>Grain Size Analysis:</b> Laser and/or sieve method; includes tabular data, statistical sorting and graphics in Excel format.	ASTM D422 or ASTM D4464	One sample every six inches; usually adjacent to pore fluid saturation samples plus one or two samples per lithology. Laser method for fine-grained sediments and sieve method for coarse-grained sediments.
<b>Intrinsic Permeability - Water:</b> Includes specific permeability to water (intrinsic permeability) and hydraulic conductivity.	API RP 40 EPA 9100 ASTM D5084	One or two samples per lithology and fluid.
<b>Intrinsic Permeability – Product:</b> Includes specific permeability to product (intrinsic permeability).	API RP 40	One or two samples per lithology and fluid.
<b>Drainage Capillary Pressure Data: Centrifugal Method;</b> Air/Water. Includes initial and residual fluid saturations, final water production vs. capillary pressure, effective (total) porosity, bulk density, air permeability and hydraulic conductivity.	API RP 40 ASTM D425M EPA 9100	One or two samples per lithology.
<b>Demonstrate Free Product Mobility – Centrifuge Method:</b> Apply centrifugal force of 1000 times gravity for one hour to demonstrate product mobility. Includes initial and residual pore fluid saturations, porosity and bulk density.	ASTM D425M	One or two samples per lithology. Usually conducted on sample taken from zone identified by Dean-Stark analysis as having highest NAPL saturation.
<b>Fluid Properties Package – NAPL &amp; Water:</b> Includes dynamic viscosity and fluid density at three temperatures, surface tension for each fluid, and interfacial tension (three phase pairs; oil/water, oil/air, and water/air).	ASTM D445 ASTM D1481	One per every water/NAPL pair.

## Additional Test Methods and Options (LNAPL Mobility)

Description	Test Method	Sample or Test Frequency
<b>Atterberg Limits</b>	ASTM D 4318	One or two samples per lithology. Necessary to provide an accurate USCS classification. Used in conjunction with grain size analysis data.
<b>Total Organic Carbon:</b> includes fraction organic carbon (foc)	Walkley-Black	One or two samples per lithology.
<b>Water/Product Relative Permeability:</b> Water/product unsteady-state method; includes production history, endpoint saturations and relative permeability curve.	JBN or J&R	One or two samples per lithology.
<b>Drainage Capillary Pressure Data: Centrifugal Method;</b> LNAPL/Water: Includes initial and residual fluid saturations, final water production vs. capillary pressure, effective (total) porosity, bulk density, specific permeability to LNAPL and hydraulic conductivity.	API RP 40 ASTM D425M EPA 9100	One or two samples per lithology.
<b>Imbibition Capillary Pressure Data: Centrifugal Method;</b> LNAPL/Water: Includes initial and residual fluid saturations, final LNAPL production vs. capillary pressure, effective (total) porosity, bulk density, hydraulic conductivity and specific permeability to oil (LNAPL).	API RP 40 ASTM D425M EPA 9100	One or two samples per lithology.
<b>Pore Size Distribution:</b> Mercury Injection Porosimetry; ambient conditions, to 2000-psia injection.	ASTM D4404	One or two samples per lithology.
<b>Core Photography:</b> color (white light) plus ultra violet, full-scale strip format, per print (one print/foot).	Proprietary	Per every foot of core recovered. White light (color) photographs are high-detail engineering documents that provide permanent records of the subsurface. Ultra violet photographs record NAPL fluorescence.
<b>Core Image Archive:</b> full-scale/continuous strip format (requires full-scale photography color prints) supplied on cross-platform ISO 9660 CD-ROM (analytical data may also be embedded as MS Excel type report).	Proprietary	One per project. Allows posting of data and digital images on corporate server.