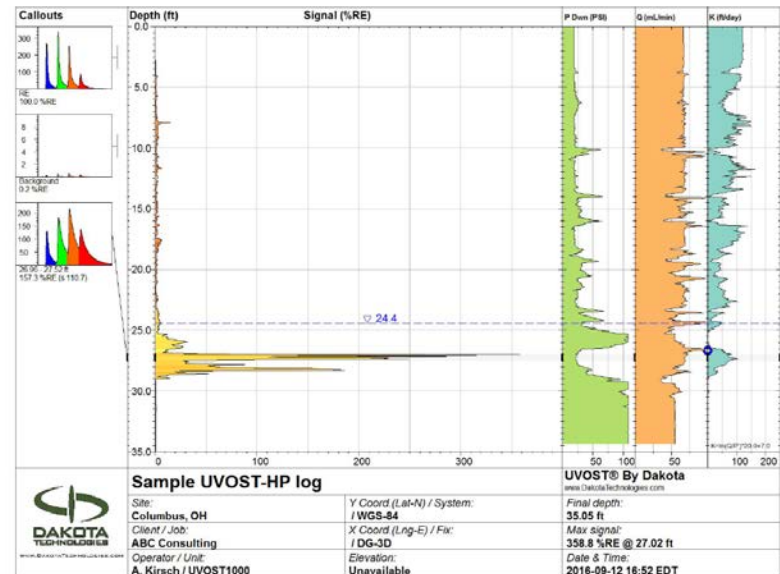
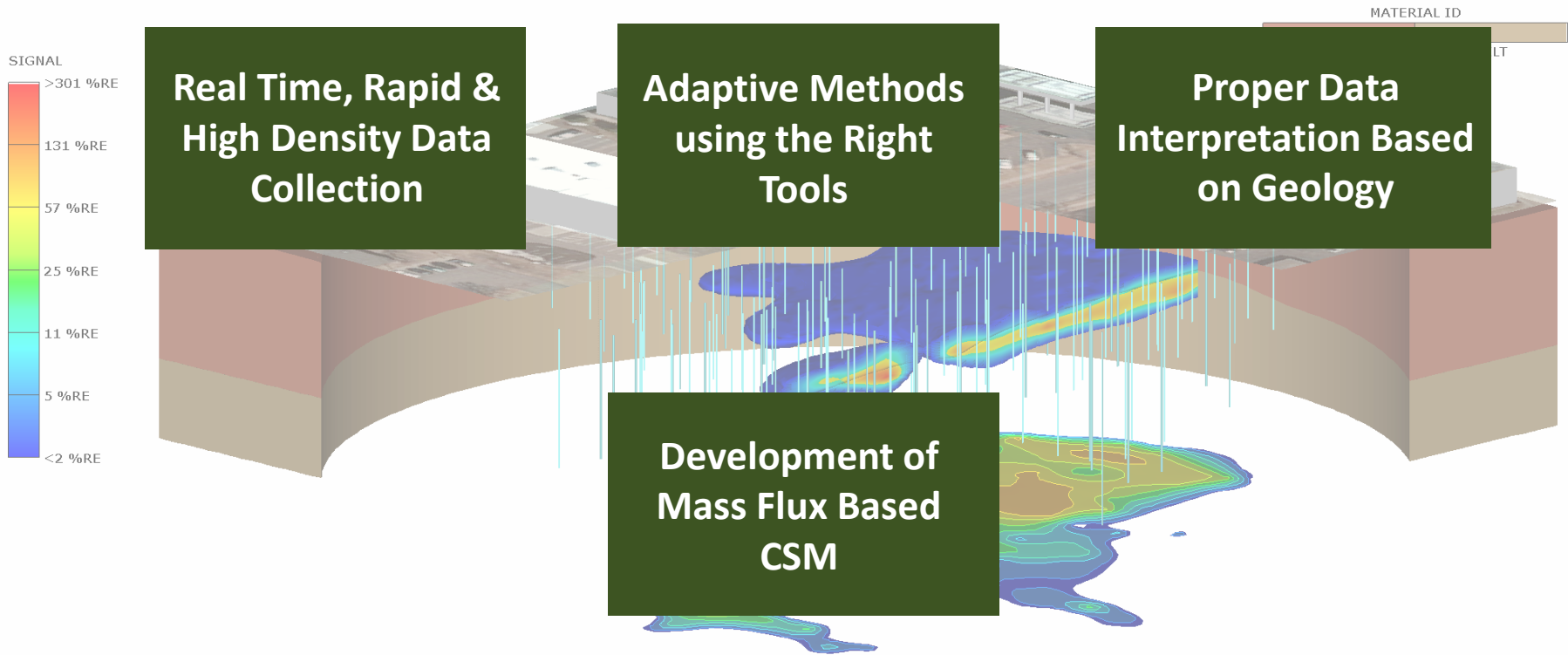


High Resolution Site Characterization

An Adaptive, Real-Time Approach to Comprehensive Site Assessment



What is High Resolution Site Characterization



What is High Resolution Site Characterization

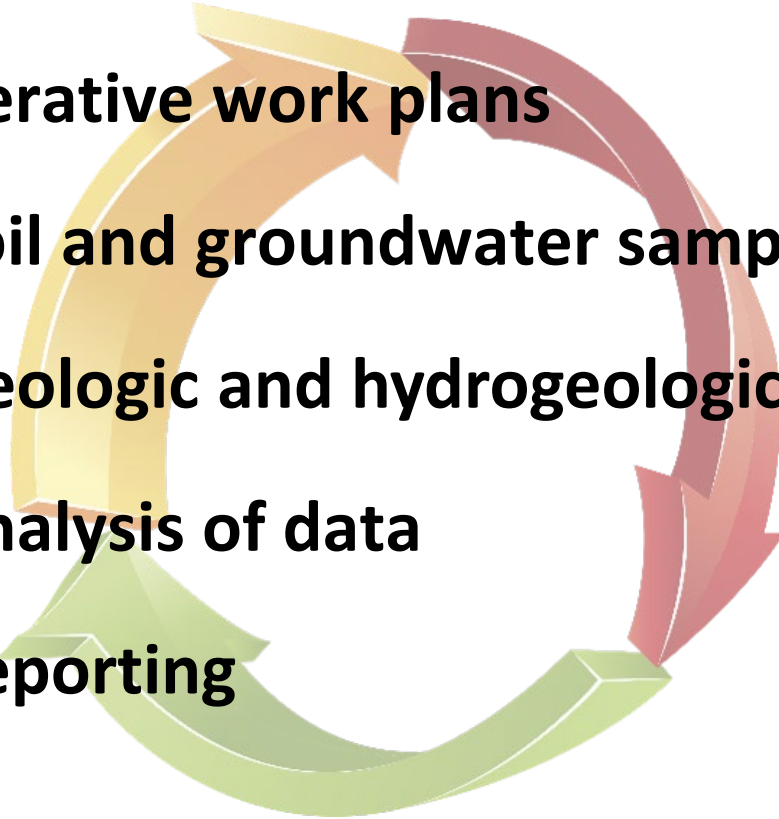
- **HRSC Tool Kit – picking the right tools for the job (many more than these!)**

UVOST	HPT	CPT	WCSS
TarGOST	MIP	Waterloo APS	Field GC
DyeLIF	MiHPT	VAP	FLUTe

Traditional Site Characterization

Linear Process

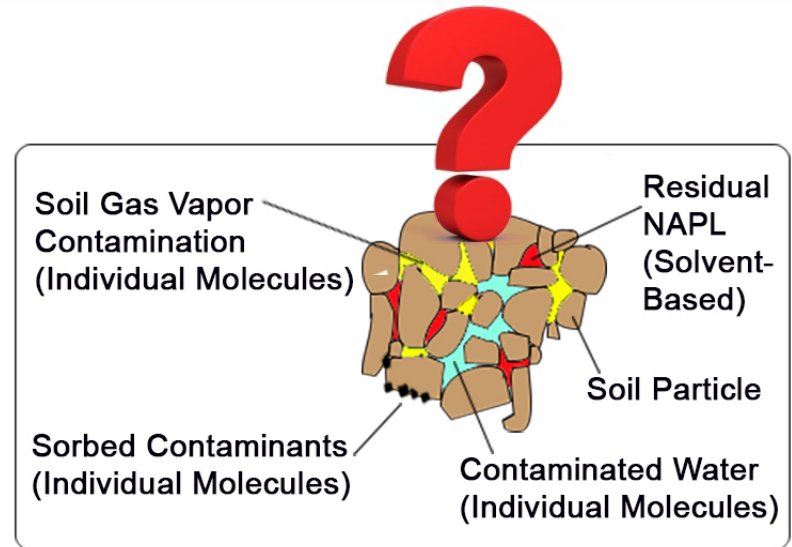
- Iterative work plans
- Soil and groundwater sampling
- Geologic and hydrogeologic testing
- Analysis of data
- Reporting



Traditional Site Characterization

Methods

- Soil Boring Investigation
- Monitoring Well Network
- Vapor Survey



Responsive to all four phases of contamination

Poor contaminant phase differentiation and delineation

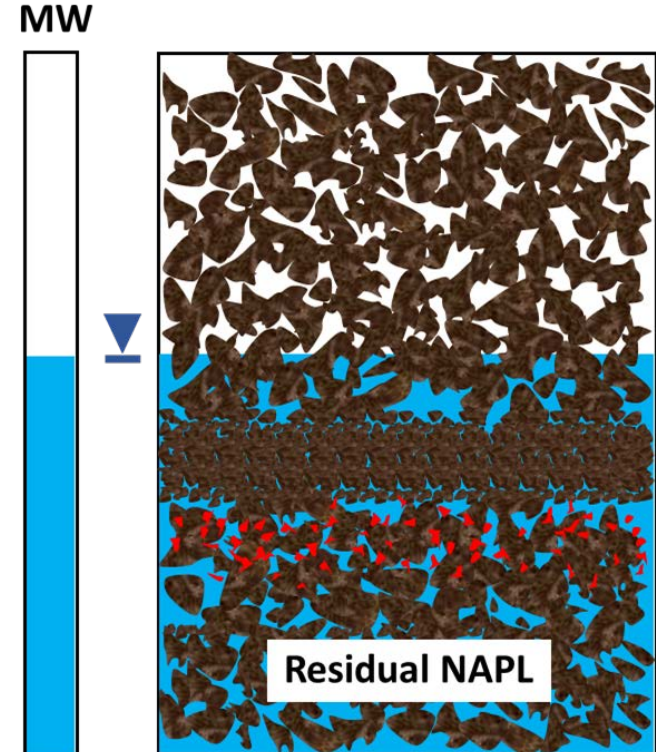
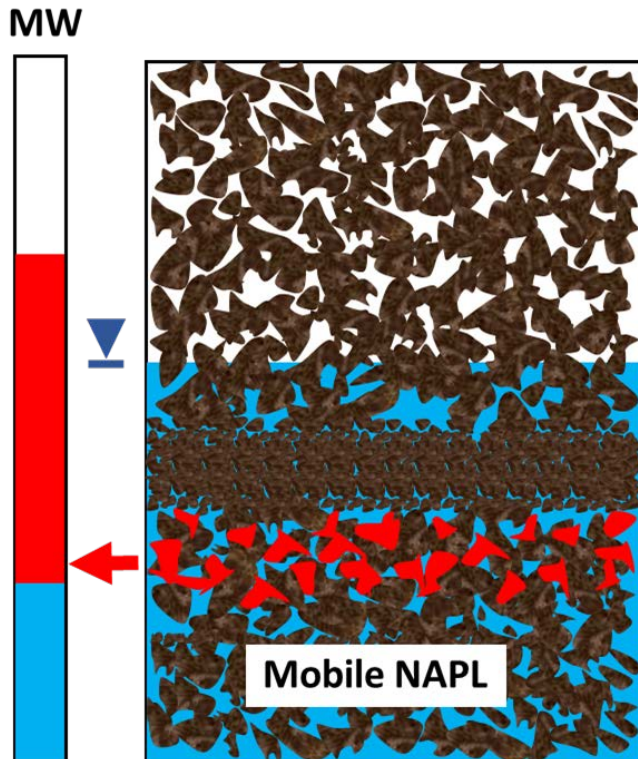
Traditional Soil Borings & Sampling

- Unreliable sample recovery
- Relatively low daily production rates
- Generates IDW
- Ex-situ sample handling and analysis
- Subjective interpretation of lithology
- Contamination sampling commonly limited to vadose zone

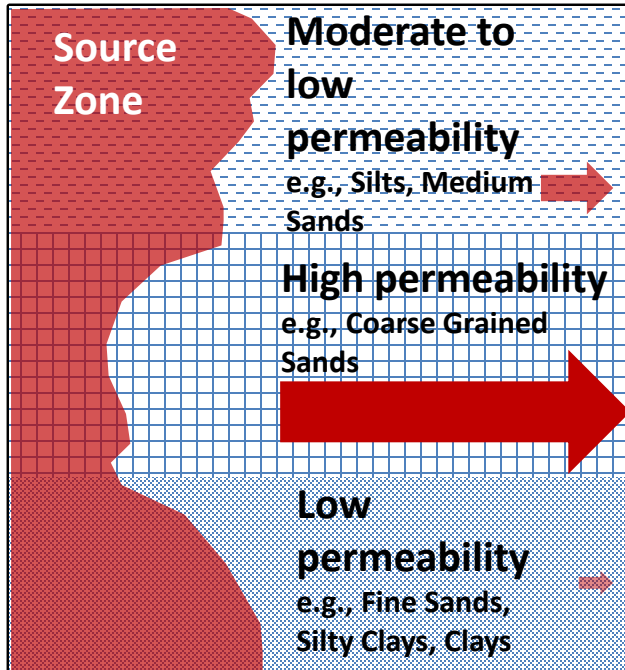


Monitoring Wells & NAPL

- In-well NAPL thickness measurements can lead to *significant* overestimation or underestimation of true NAPL saturation



Improving CSMs with Relative Mass Flux Data



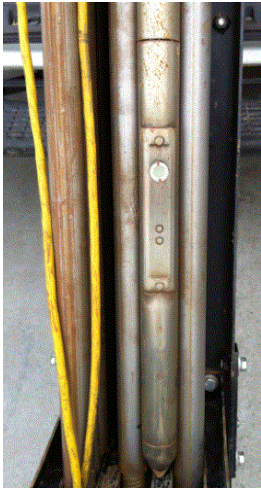
Slow Advection Zone
(<10-20% of mass flux)

Transport Zone
(~80-90% of mass flux)

Storage
(<1% of mass flux)

HRSC Down-Hole Tools

Membrane Interface Probe MIP



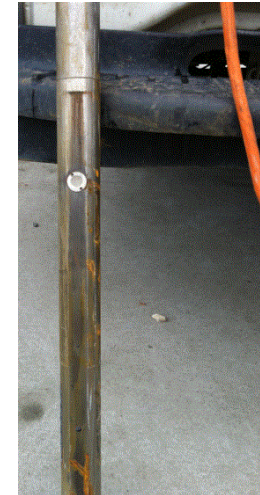
- Vapor, Dissolved and Sorbed phase VOCs
- DNAPLs
- CVOCs (PCE, TCE, etc.)
- BTEX
- Methane

Laser Induced Fluorescence LIF



- NAPL
- Residual Petroleum
- Diesel
- Gasoline
- Fuel Oil
- Jet Fuel
- Coal Tars/Creosotes

Hydraulic Profiling Tool HPT



- Formation Hydraulics
- Soil Lithology
- K Values
- Water Table Elevations

Laser-Induced Fluorescence – LIF

Developed by Dakota Technologies, Fargo, ND

UVOST[®]

*Ultra-Violet Optical
Screening Tool*

Detects fuels/oils (LNAPL)
containing low to moderate
PAH concentrations

TarGOST[®]

*Tar-specific Green
Optical Screening Tool*

Detects coal tars/creosote
(DNAPL) containing
moderate to heavy PAH
concentrations

DyeLIF[™]

*Dye-enhanced Laser
Induced Fluorescence*

Detects chlorinated
DNAPL at a variety of sites
such as former dry
cleaners

- Real-time data production, typically 300 to 500 feet per day using DPT
- UVOST and TarGOST employ lasers for excitation of polycyclic aromatic hydrocarbons (PAHs) present in NAPL
- DyeLIF combines LIF technology with the injection of fluorescent dye. Dye injection backpressure provides information on soil permeability

New Combination LIF Tools

Developed by Dakota Technologies, Fargo, ND

UVOST-HP & TarGOST-HP

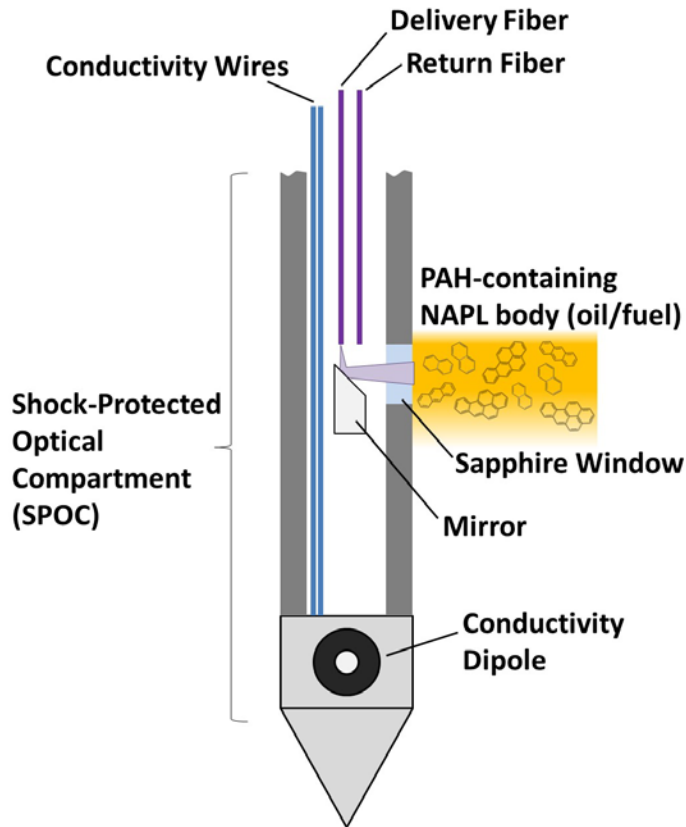
Hydraulic profiling component now available with all LIF technologies

Dual LIF

Combines UVOST and TarGOST technologies in single tool

- **Optimize LIF and hydrostratigraphic data correlation**
- **Reduce time in field required for comprehensive assessment**
- **Dual LIF provides simultaneous LNAPL and DNAPL data collection for commingled sites**

LIF Technology Description

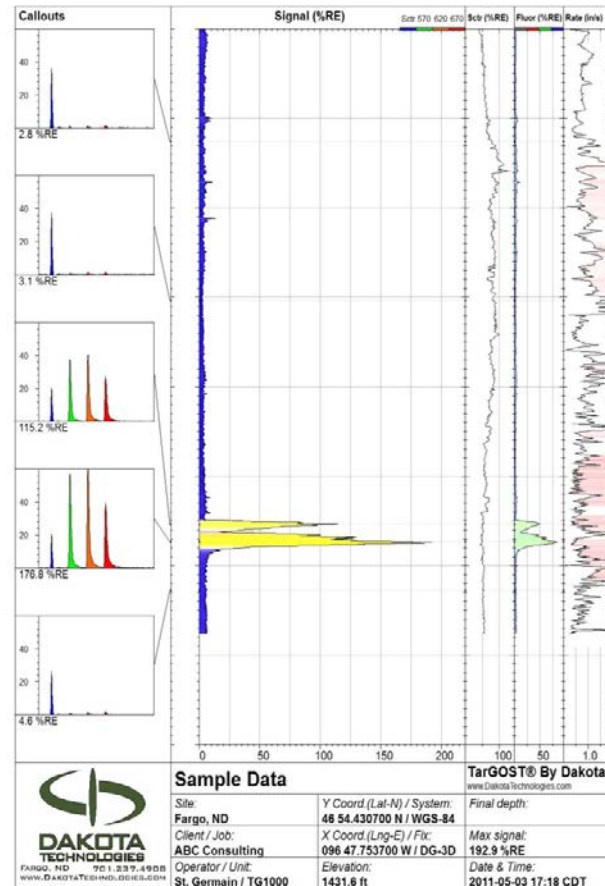
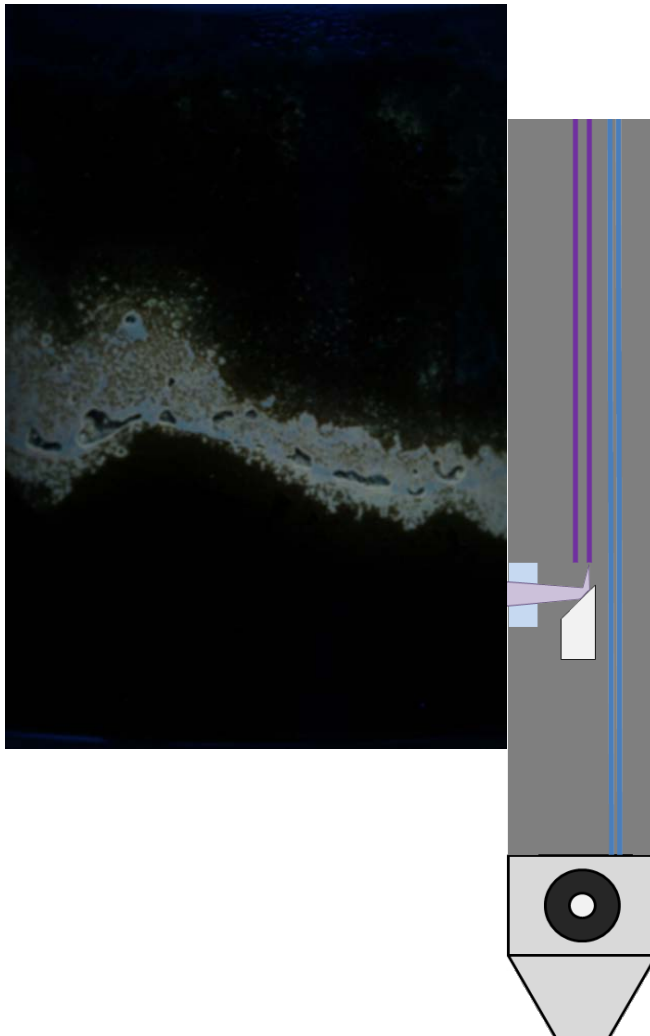


Shock-resistant and water-tight SPOC is advanced with direct-push equipment.



UVOST and computer provide real-time data logging during assessment.

LIF Technology Description – UVOST & TarGOST



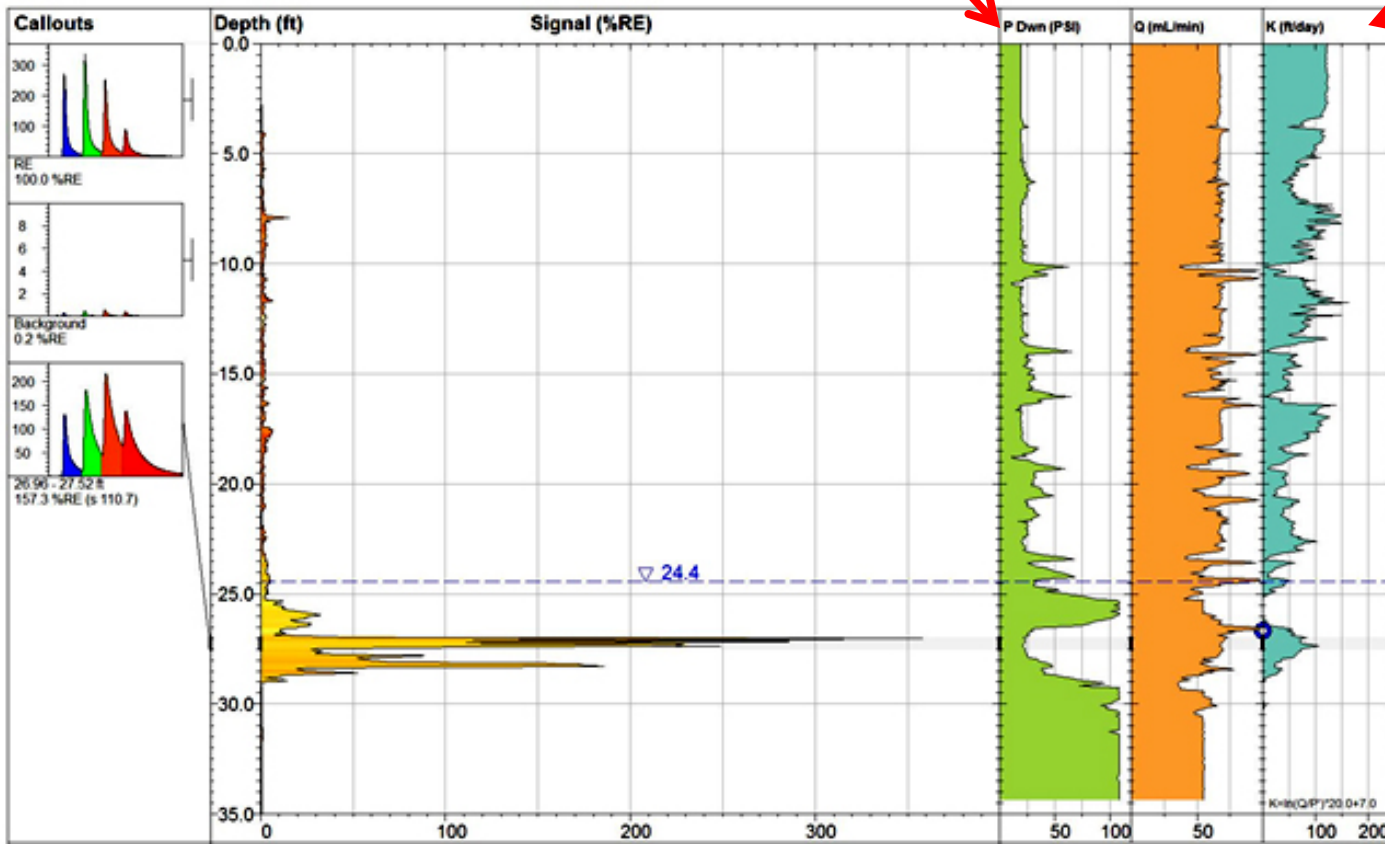
Sample Data		TarGOST® By Dakota <small>www.DakotaTechnologies.com</small>	
Site:	Fargo, ND	Y Coord. (Lat-N) / System:	46 54.430700 N / WGS-84
Client / Job:	ABC Consulting	X Coord. (Long-E) / Fix:	096 47.753700 W / DG-3D
Operator / Unit:	St. Germain / TG1000	Elevation:	1431.6 ft
		Final depth:	
		Max signal:	192.9 %RE
		Date & Time:	2011-05-03 17:18 CDT

UVOST-HP Output

Downhole hydraulic pressure

Changes in flow

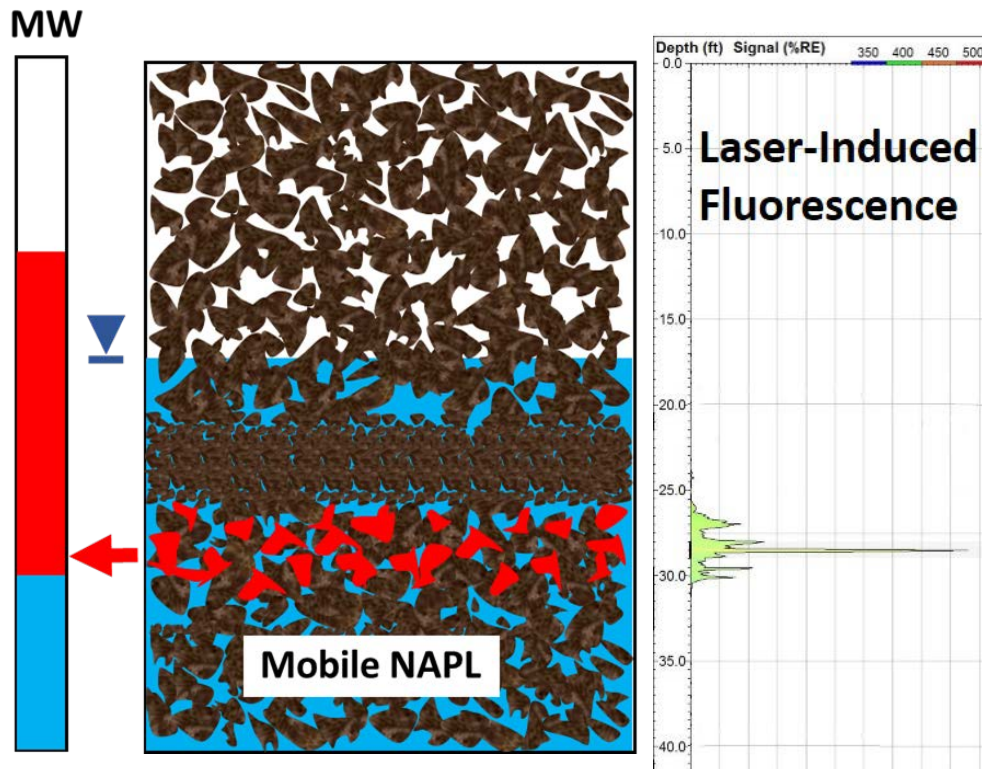
Estimated K



Representative UVOST-HP Log

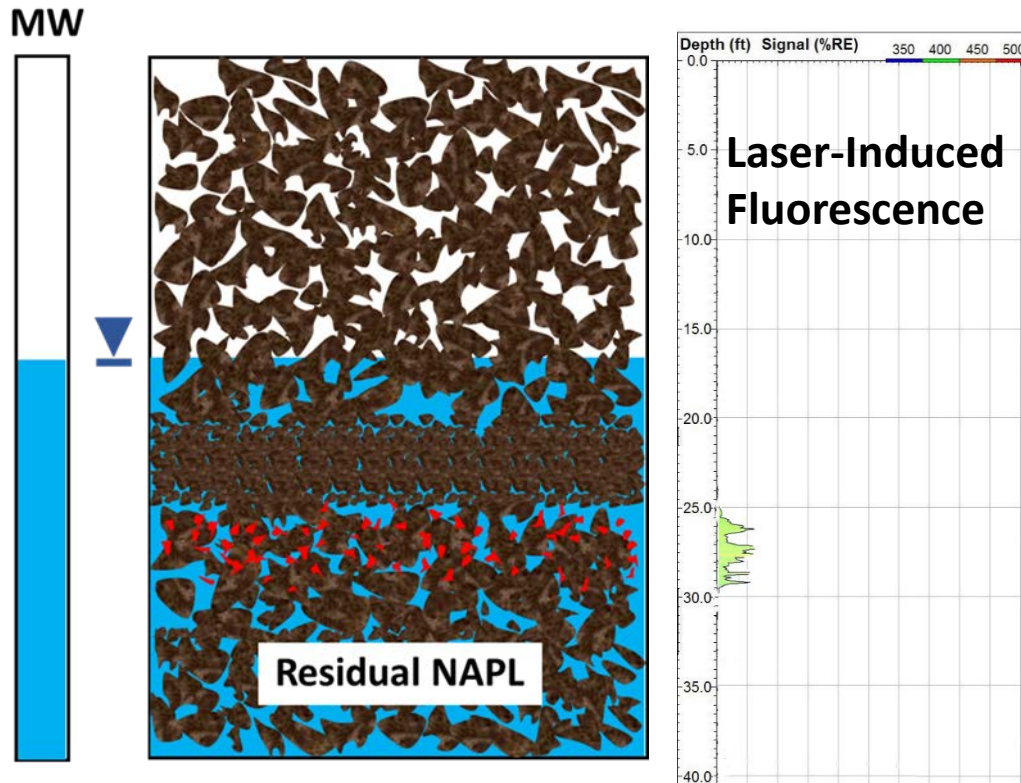
Monitoring Wells & NAPL

- Another look at our in-well NAPL thickness compared to LIF logging true NAPL thickness



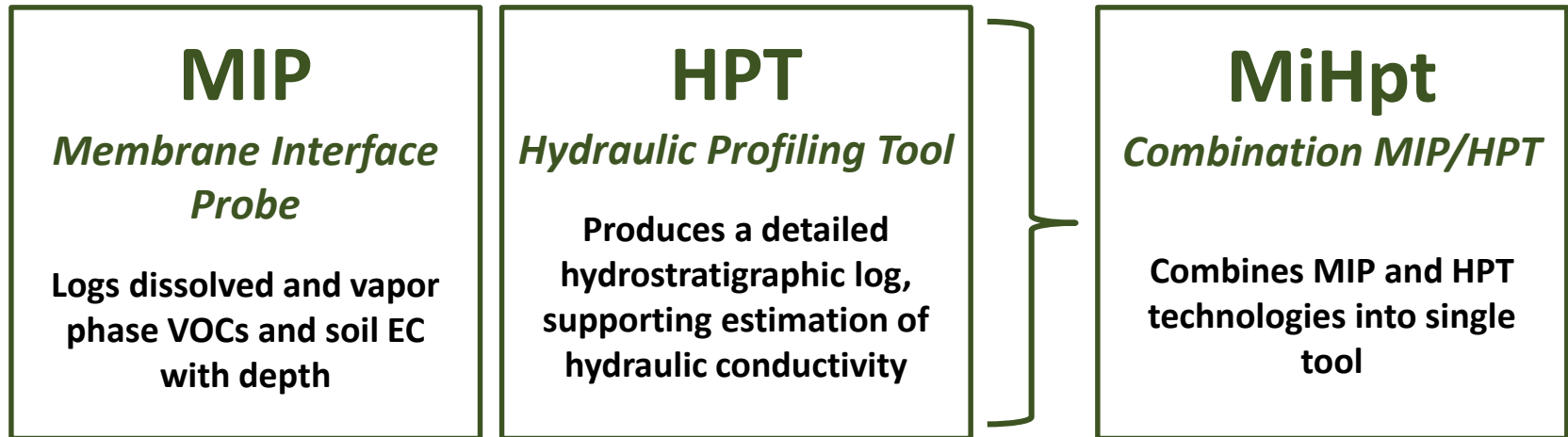
Monitoring Wells & NAPL

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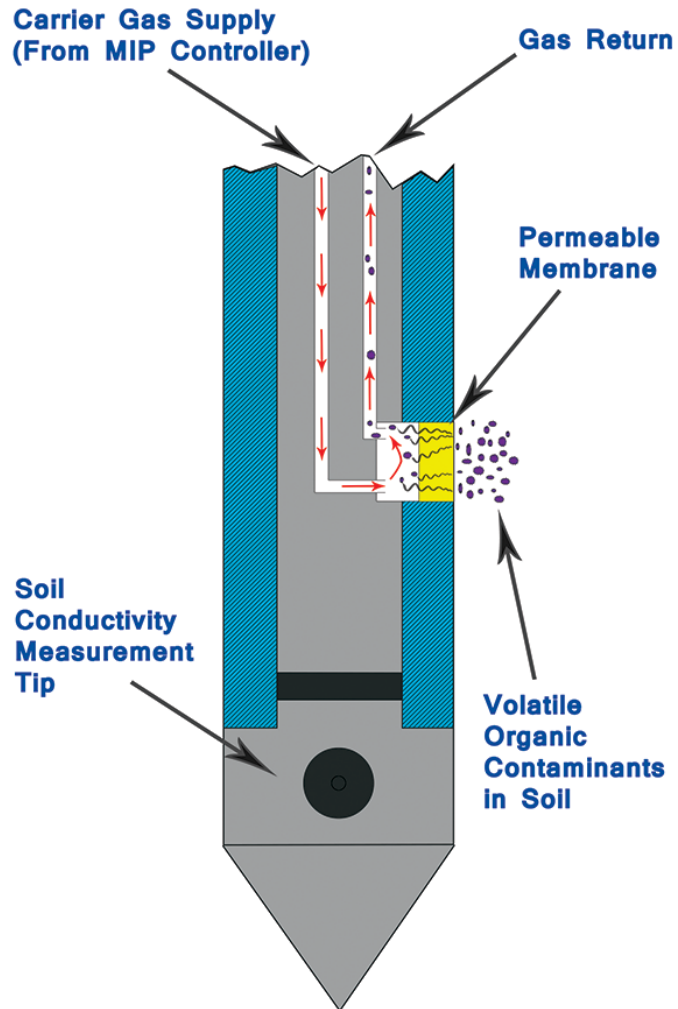
Direct Image[®] Technologies

Developed by Geoprobe Systems[®], Salina, KS



- Real-time data production, typically 125 to 150 feet per day
- MIP not the most effective tool for NAPL screening

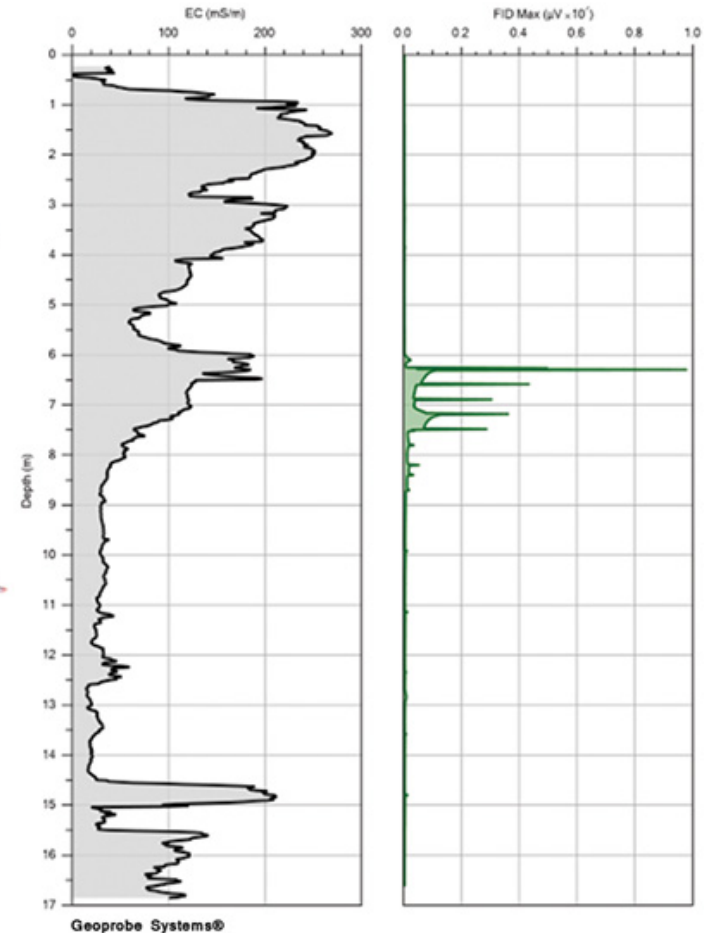
Membrane Interface Probe (MIP)



- Field screening/mapping tool
- DPT deployment
- Vapor, dissolved and sorbed phase VOCs

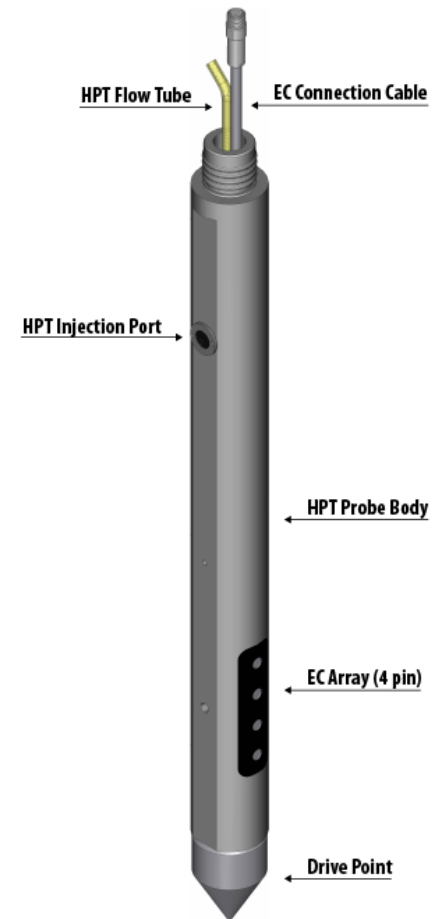
MIP Log

- CVOCs (PCE, TCE, etc.)
- BTEX
- Methane
- Semi quantitative
- Requires additional lines of evidence to interpret properly

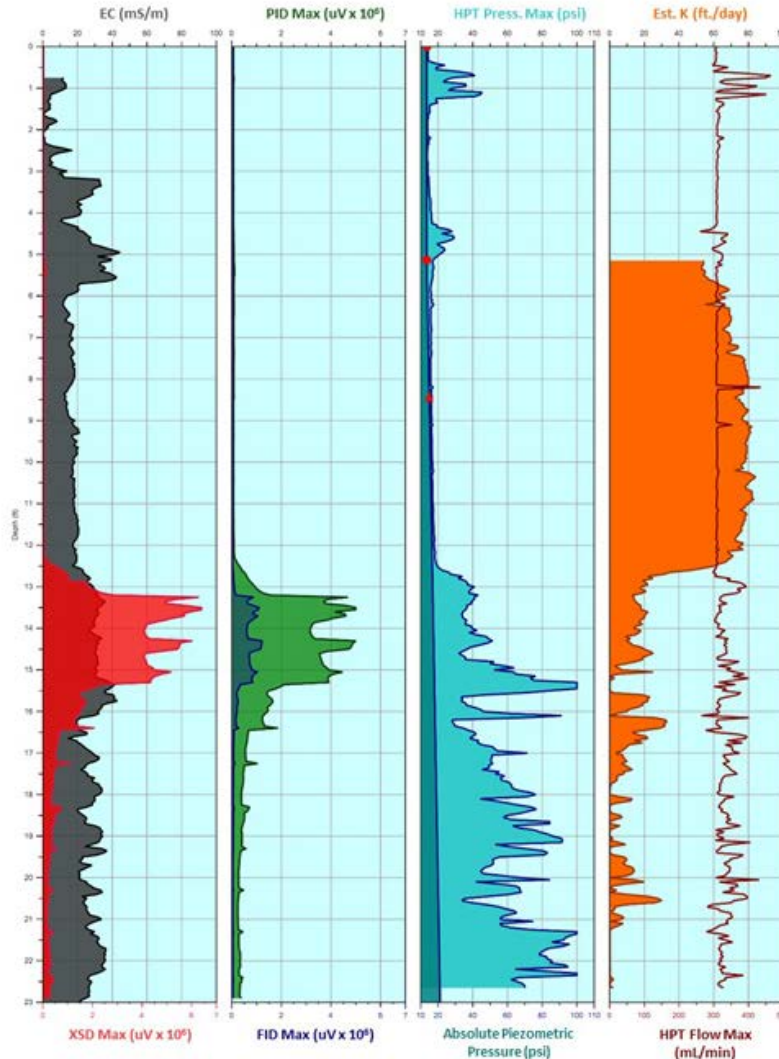


Hydraulic Profiling Tool (HPT)

- In-situ lithologic and hydraulic properties
- Electrical conductivity measurements indicate soil types (sand, silts, clays)
- Relative subsurface hydraulic permeability
- Water table elevations
- Estimates K values

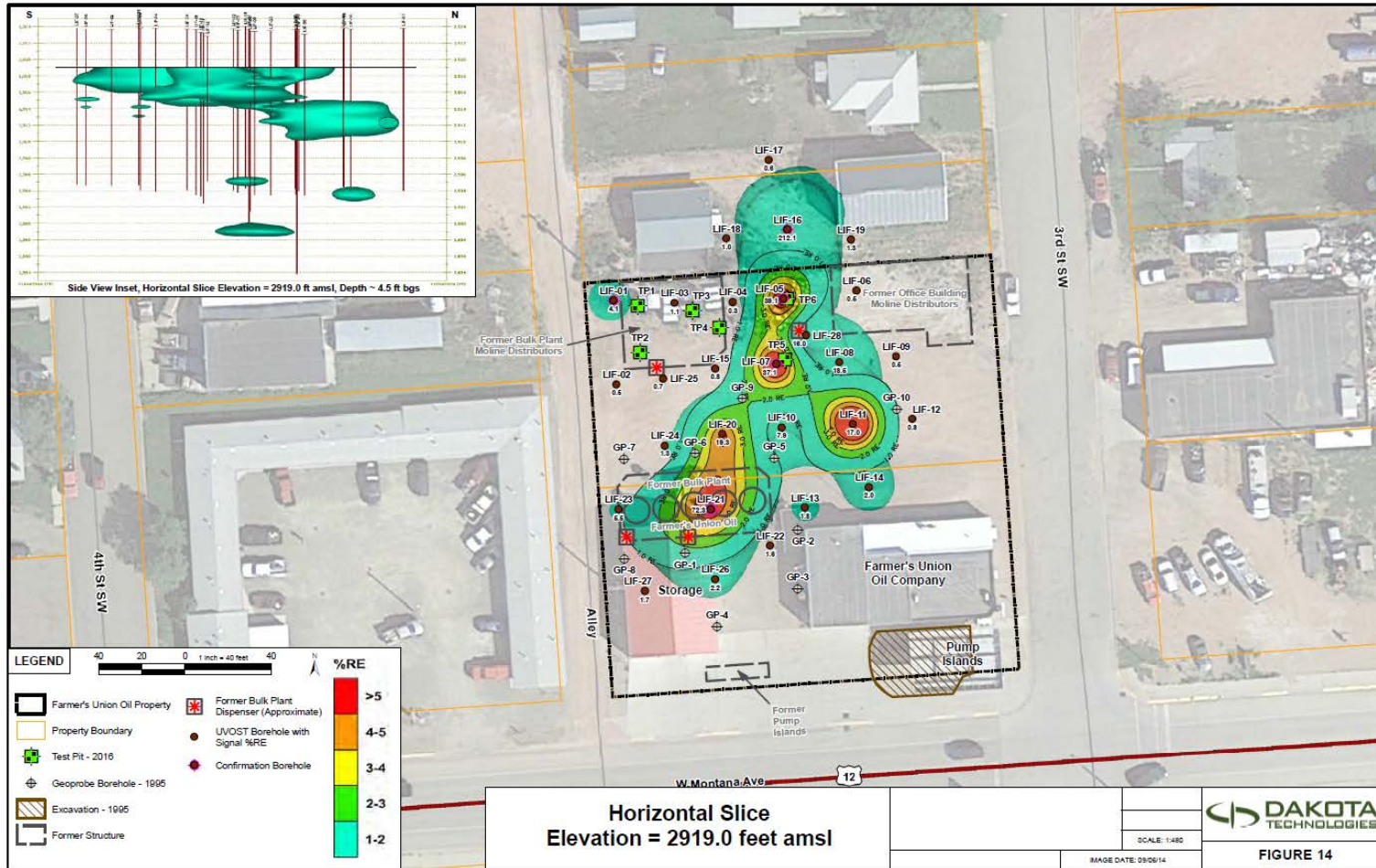


Membrane Interface Probe / HPT (MiHpt)

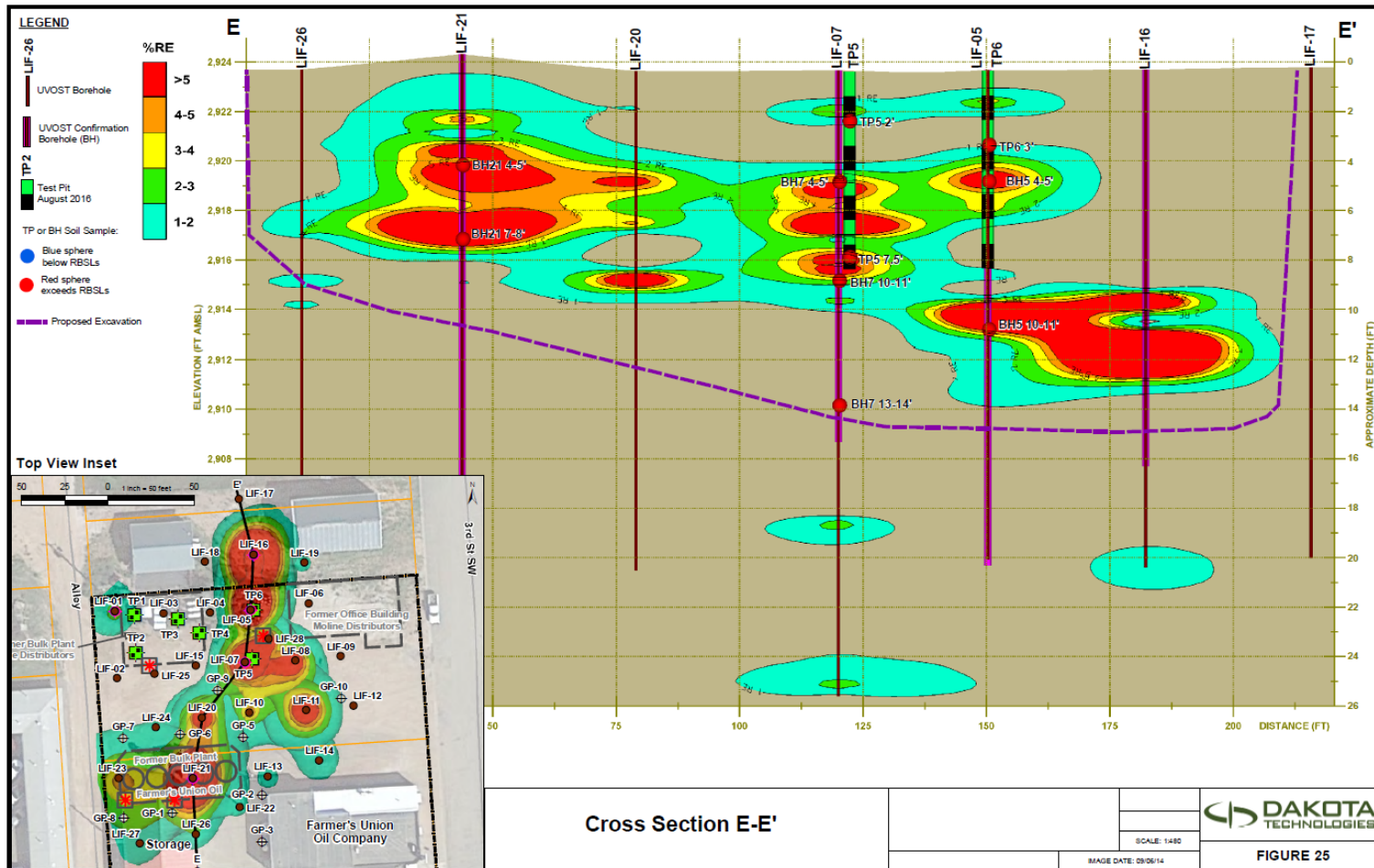


- Combines MIP and HPT data in single push
- Prevents correlation 'inconsistencies' from adjacent borings

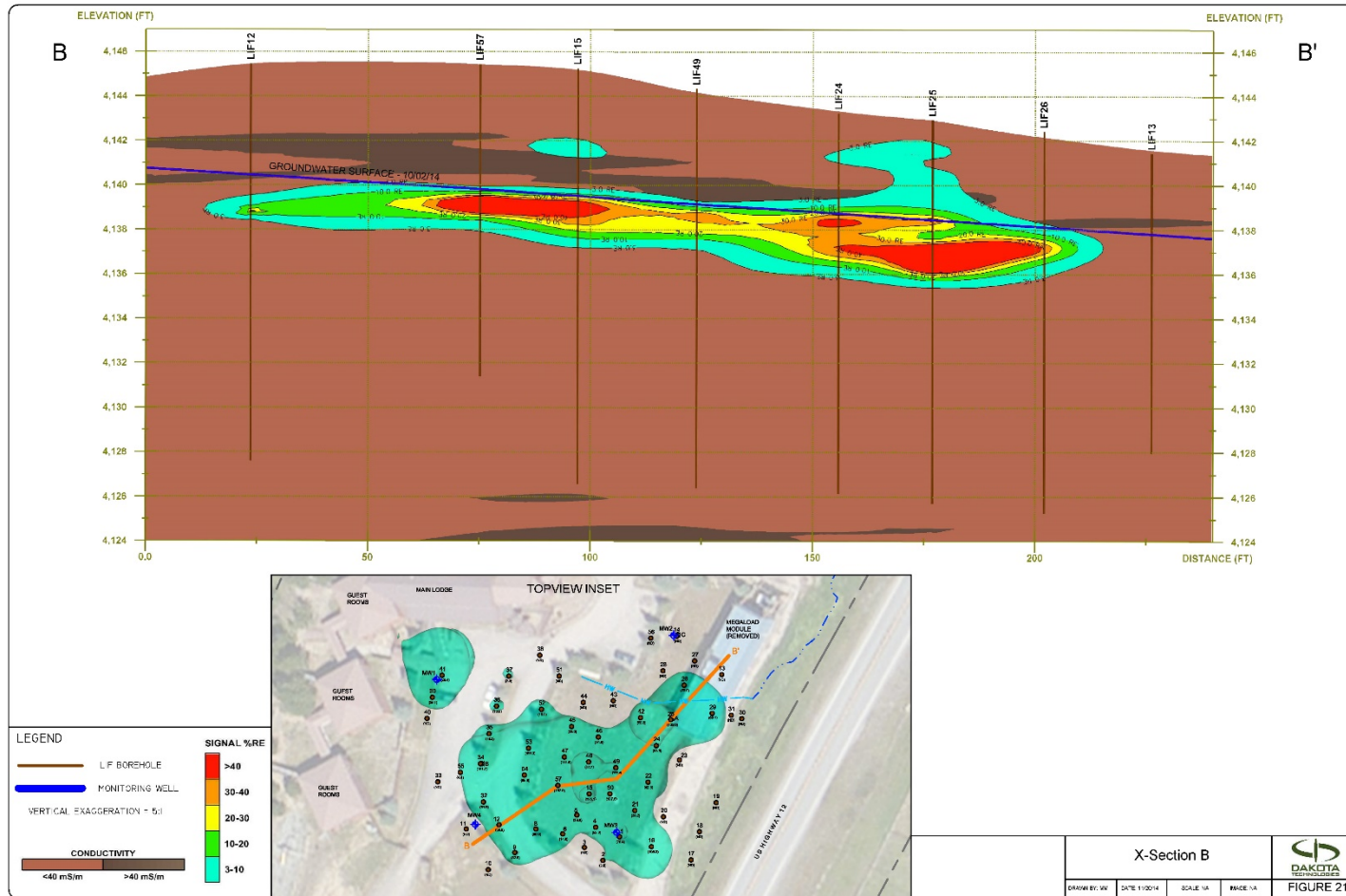
Mapping LNAPL in 3D



Mapping LNAPL in 3D



Mapping LNAPL in 3D



Thank you!

David J. Heicher

Southeast Regional Manager/HRSC Specialist

dheicher@dakotatechnologies.com

843.789.9095

www.dakotatechnologies.com