Missouri Department of
Natural Resources

LASER-INDUCED FLUORESCENCE

"LESSONS LEARNED"

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Remediation Unit, Tanks Section, HWP

Missouri UST sites utilizing

Laser-Induced Fluorescence:

Dominator Fuels in Rock Port

&

Former Kennett Conoco in Kennett

LIF Components:

- Laser
- 2 Fiber Optic Cables
- Optical Detection System
- Laptop
- Shock Protected Optical Compartment:
  - Sapphire Window
  - Parabolic Mirror
  - Shock Absorbing Gel

Dominator Fuels Truck Stop

Rock Port

2009

FREMONT
PAGE
43
42
41
40
39
38
37
Westboro
Elmo
Magnet
Watson
ATCHISON
Lonlon
Burlington
Jc.
Tarkio
Rockport
York
Phelps City
(Phelps Sta.)
Langton
Fairfax
Quitman
Dotham
Guy
Nishnabotna
Milton
Corning
Missouri
Nodaway
Atchison
Nishnabotna
Buffalo R.
Cy.
Cy.
Cy

Rock Port Geology

- Soil composed of glacial loess and till
- Average depth to bedrock is 125 feet below ground surface
- Site is specifically underlain by silt with minor lenses of silty clay and sand

Rock Port Hydrogeology

- Shallow groundwater in the area considered potable
- Municipal wells are cased to 100 feet below ground surface in the Missouri River Alluvium Aquifer
- Site specific data include Depth to Groundwater at 21 to 26 feet below ground surface

Laser-Induced Fluorescence (LIF) was conducted at the site from July 20 through July 23, 2009.

- 28 direct push soil borings were associated with this LIF investigation.
- Diesel and gasoline releases have been documented at the site.

The location of the LIF borings and the assumed LNAPL plume (shown in **YELLOW**) are included on the next two slides:

LIF Plume Volume = 31,023 Cubic Feet
LIF Response >2.00%
Relative Azimuth = 180°, Elevation = 90°
Print Date: 08/05/2009 10:11
LIF
100 %RE
10 %RE
1 %RE
4,475,800
4,475,750
4,475,700
4,475,650
Depth (feet)
282,900
282,950
283,000
283,050
X
LIF20
LIF19
LIF18
LIF17
LIF27
LIF16
LIF09
LIF25
LIF24
LIF06
LIF01
LIF28
LIF03
LIF07
LIF15
LIF10
LIF04
LIF23
LIF08
LIF14
LIF22
LIF21
LIF13
LIF12
LIF11
LIF26
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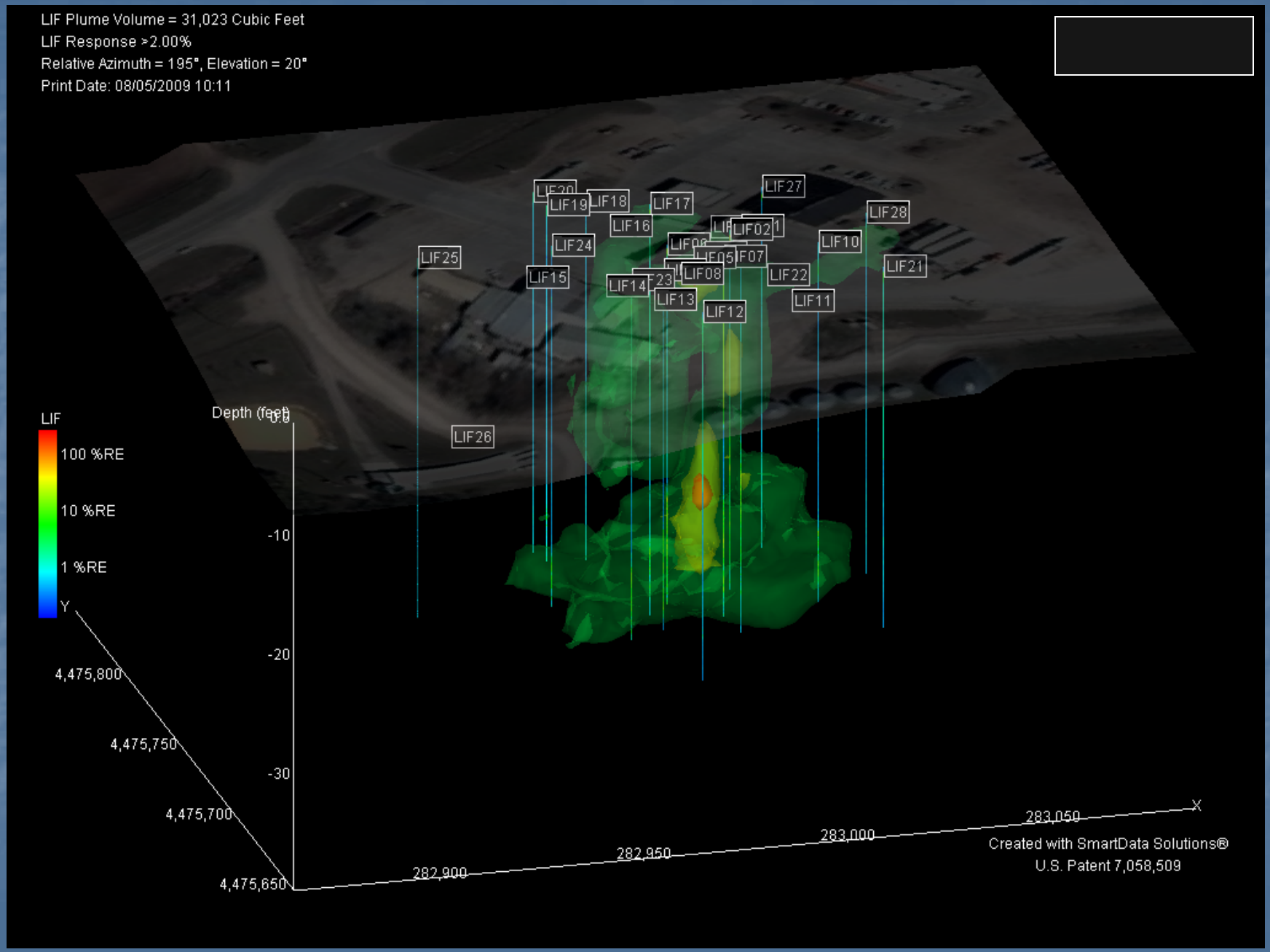
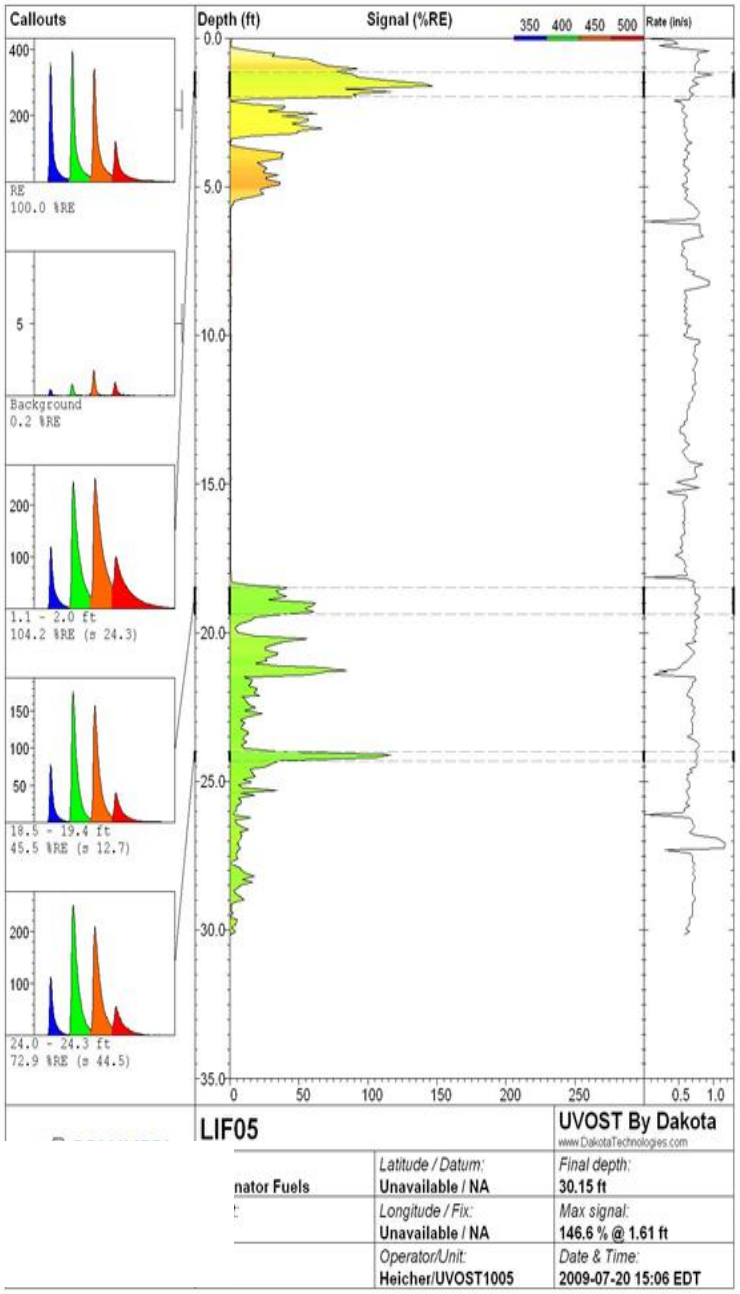
U.S. Patent 7,058,509


LIF Plume Volume = 31,023 Cubic Feet
LIF Response >2.00%
Relative Azimuth = 195°, Elevation = 20°
Print Date: 08/05/2009 10:11
LIF
100 %RE
10 %RE
1 %RE
Depth (feet)
0.0
-10
-20
-30
Y
4,475,800
4,475,750
4,475,700
4,475,650
X
282,900
282,950
283,000
283,050
LIF27
LIF19
LIF18
LIF17
LIF28
LIF16
LIF02
LIF10
LIF24
LIF25
LIF07
LIF21
LIF15
LIF14
LIF08
LIF22
LIF13
LIF11
LIF12
LIF26
Created with SmartData Solutions®
U.S. Patent 7,058,509

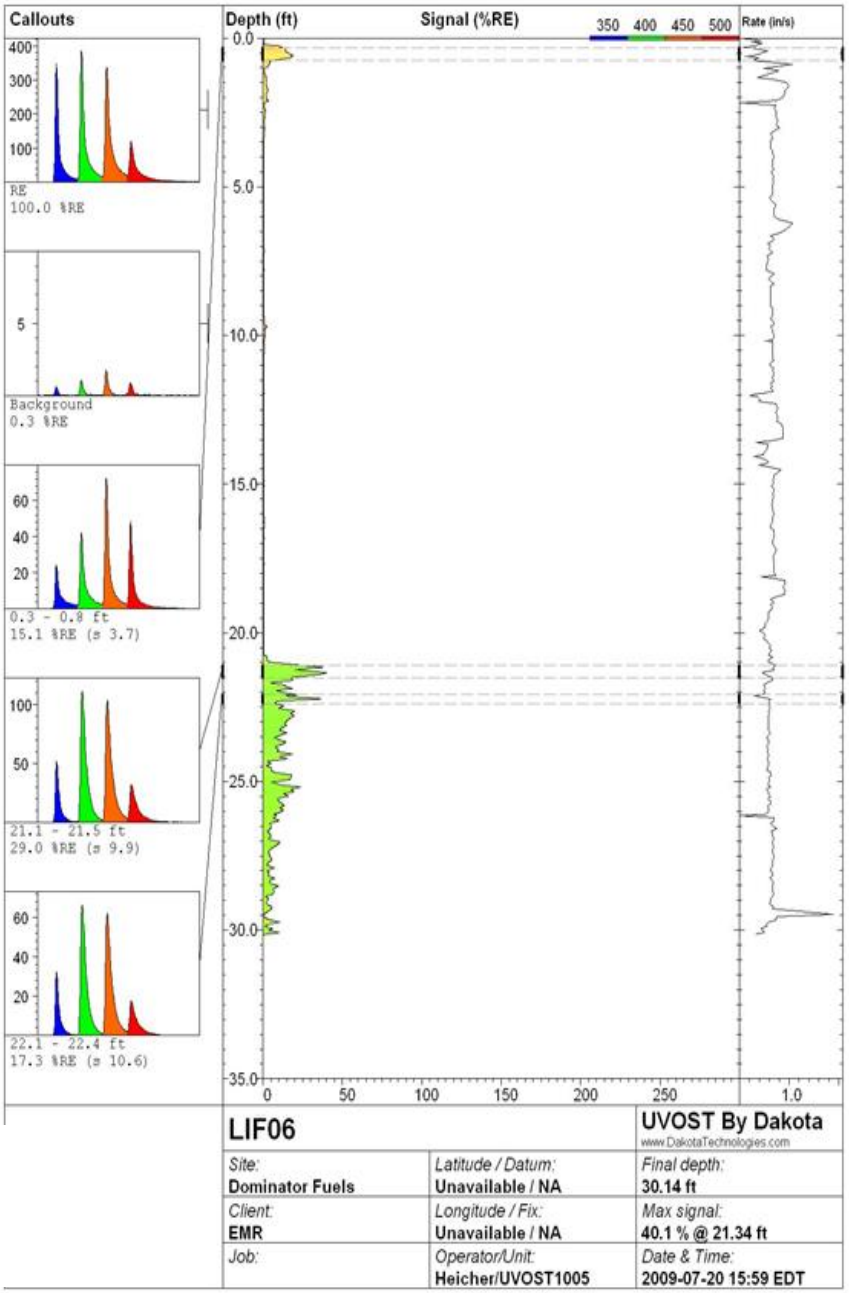


Assumed

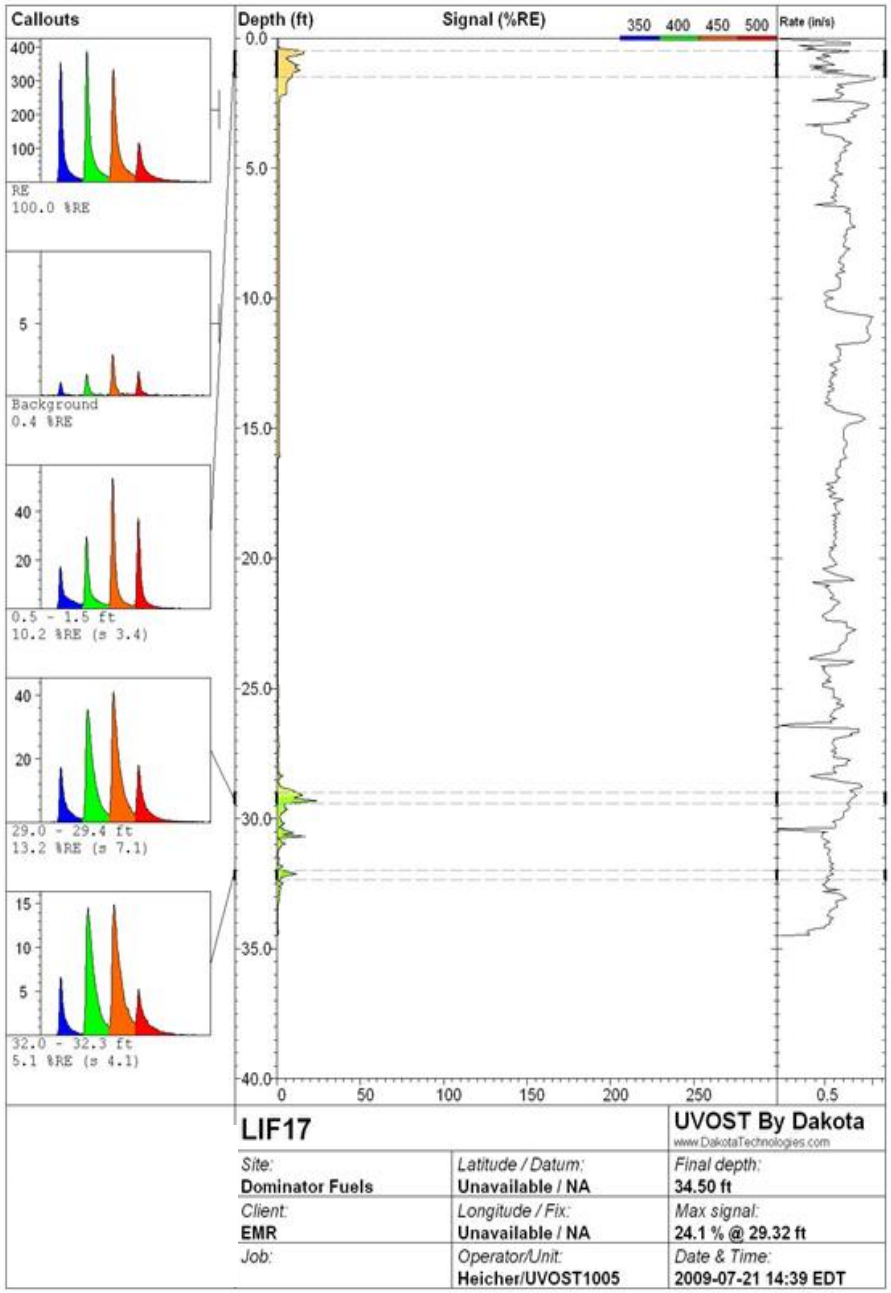
LNAPL is presented

by YELLOW

on the graph.



Based upon previously conducted investigations, the Department expected the highest concentrations of diesel contamination to be found near LIF boring 6.



The Department expected the highest concentrations of gasoline contamination to be found near

LIF boring 17.

LESSONS LEARNED

- LIF results were not as reliable as traditional site characterization methods
- LIF sensor sensitive to variations in the soil matrix
- Organic matter, man-made chemicals, other minerals can fluoresce
- There is a potential for smearing and a memory effect on the sensor

Former Kennett Conoco

Kennett

2010

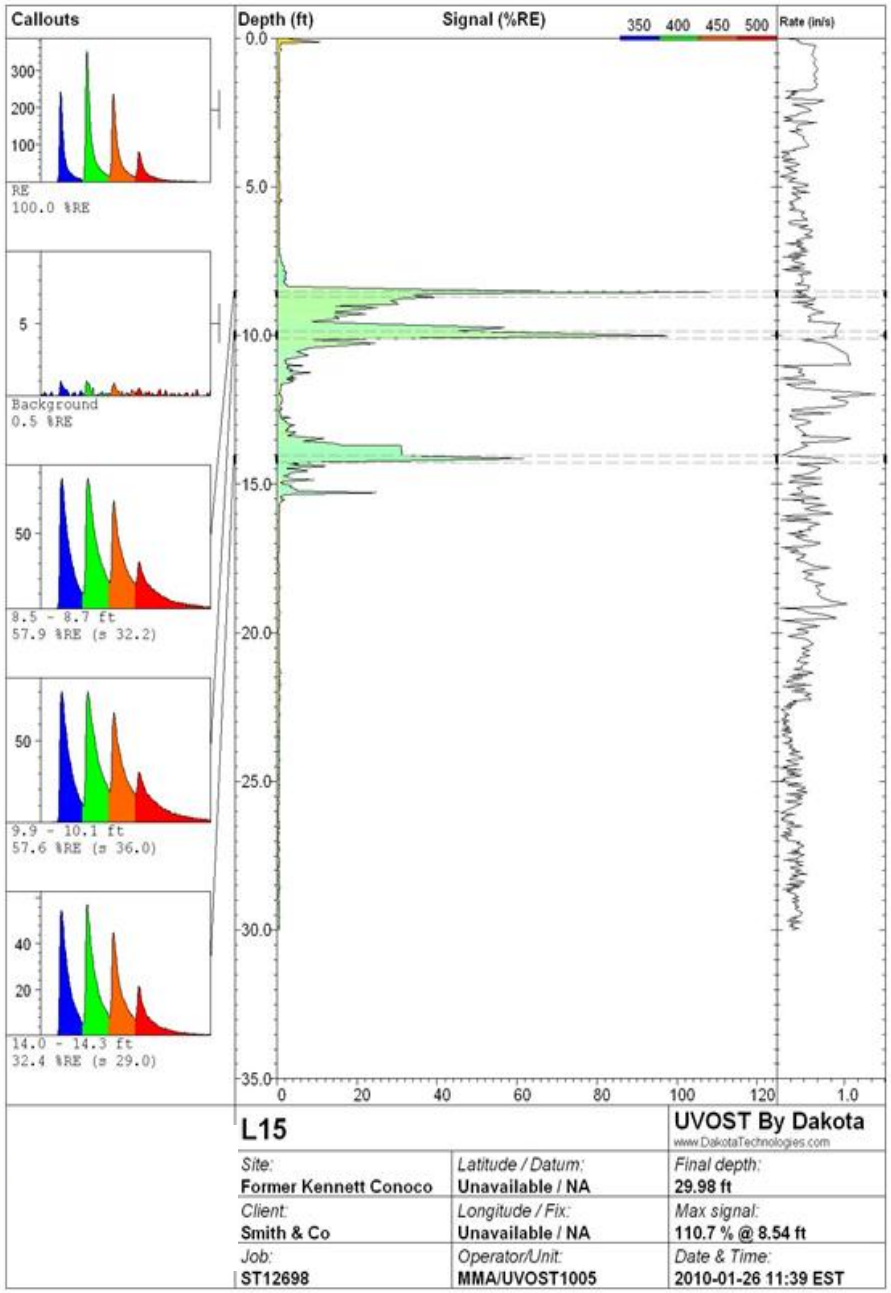
MISSOURI
1860
IOWA
ILLINOIS
KANSAS TERR.
INDIAN TERR.
ARKANSAS
TENN.
ATCHISON
NODAWAY
HARRISON
MERCER
PUTNAM
SCOTLAND
CLARK
HOLT
GENTRY
GRUNDY
SULLIVAN
ADAIR
KNOX
LEWIS
BUCHANAN
DAVIESS
LIVINGSTON
MACON
SHELBY
MARION
CLINTON
CALDWELL
CHARITON
RANDOLPH
MONROE
RALLS
PIKE
CLAY
RAY
CARROLL
AUDRAIN
SALINE
HOWARD
LINCOLN
JACKSON
LAFAYETTE
BOONE
MONTGOMERY
COOPER
CALLAWAY
WARREN
ST CHARLES
ST LOUIS
CASS
JOHNSON
PETTIS
MONITEAU
COLE
OSAGE
GASCONADE
FRANKLIN
JEFFERSON
HENRY
KENTON
MORGAN
BATES
MILLER
MARIES
ST CLAIR
HICKORY
CAMDEN
CRAWFORD
WASHINGTON
STE GENEVIEVE
VERNON
PHELPS
ST FRANCOIS
PERRY
CEDAR
POLK
DALLAS
LACLEDE
PULASKI
IRON
BARTON
DADE
DENT
MADISON
CAPE GIRARDEAU
BOLLINGER
JASPER
GREENE
WEBSTER
WRIGHT
TEXAS
REYNOLDS
SHANNON
WAYNE
LAWRENCE
CHRISTIAN
DOUGLAS
CARTER
SCOTT
NEWTON
HOWELL
STODDARD
MISSISSIPPI
BARRY
STONE
TANEY
OZARK
OREGON
RIPLEY
BUTLER
McDONALD
NEW MADRID
DUNKLIN
PEMISCOT

Kennett Geology/Hydrogeology:

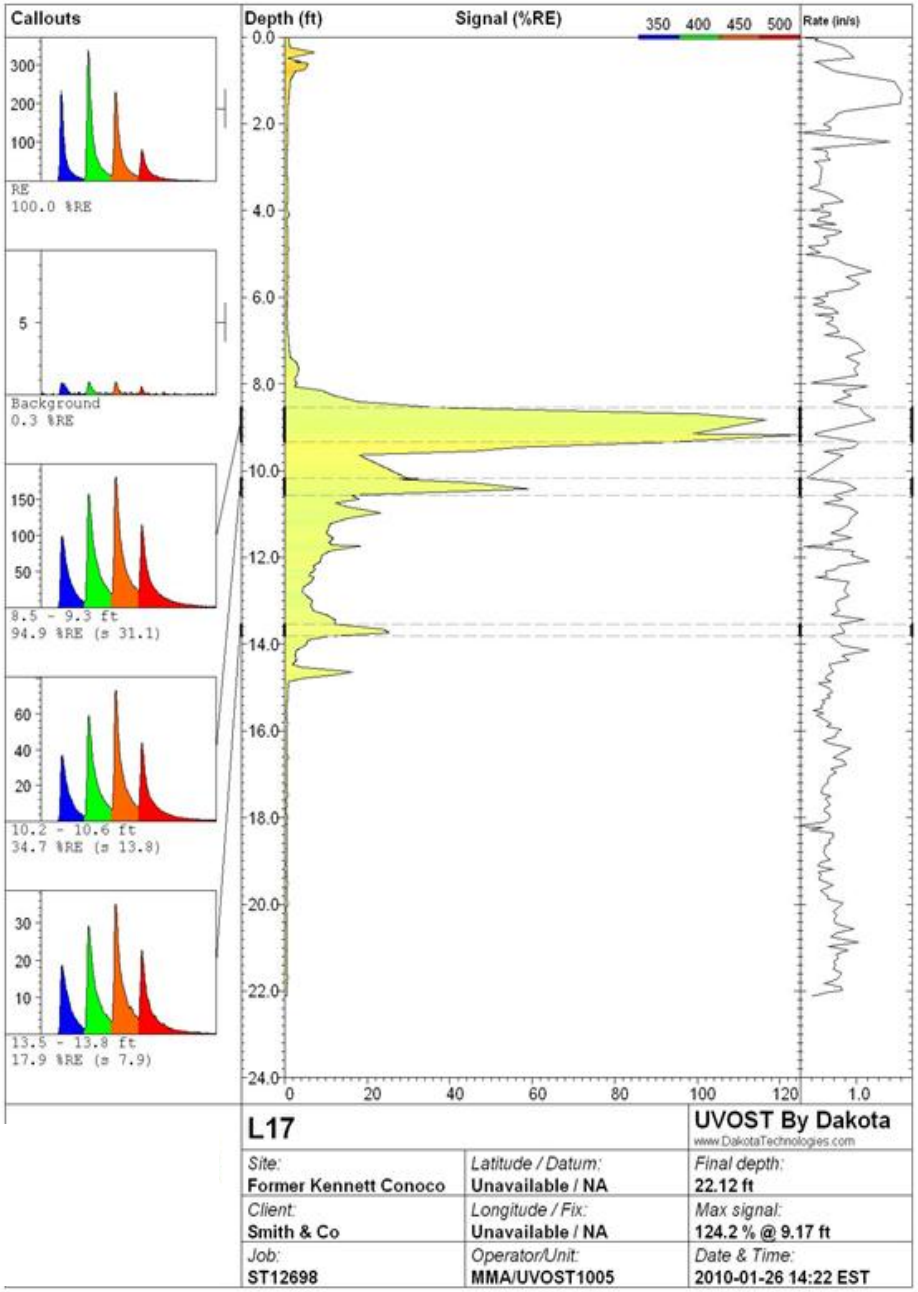
- 0 – 5 feet of silty soil
- 5 – 40 feet of sand
- 40 – 175 feet of sand and gravel
- 175 –195 feet of sandstone
- Unconfined aquifer starting at 10 feet is utilized as drinking water source

Laser-Induced Fluorescence was conducted at the site from January 25 through January 28, 2010.

- 41 direct push soil borings were associated with this LIF investigation.
- Diesel and gasoline releases have been documented at the site.
- LNAPL has been observed in several existing monitoring wells

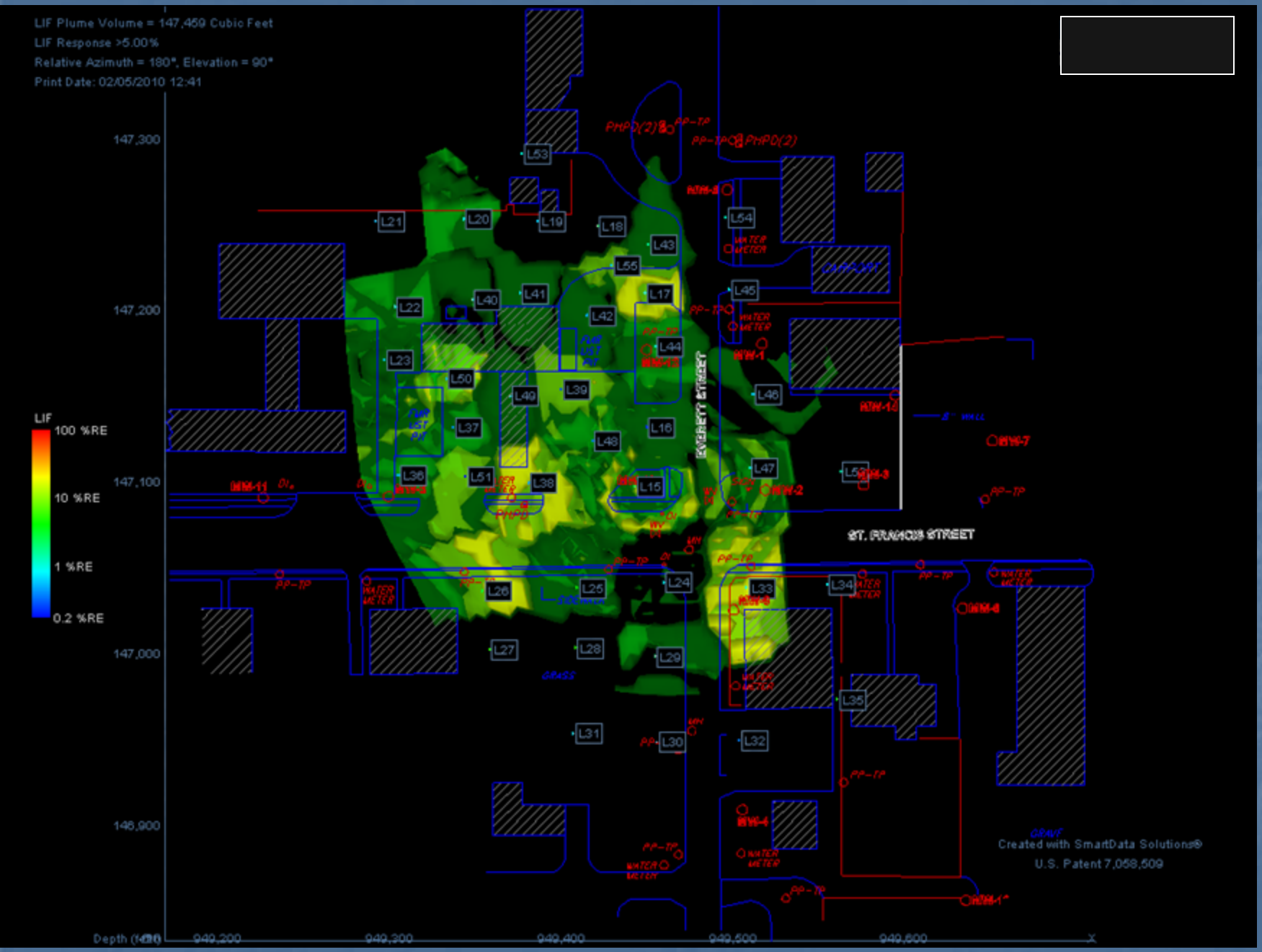


L15 is near a monitoring well where free phase product has been identified for several years.



L17

was located near another well with LNAPL


LIF Plume Volume = 147,459 Cubic Feet
LIF Response >5.00%
Relative Azimuth = 180°, Elevation = 90°
Print Date: 02/05/2010 12:41
LIF
100 %RE
10 %RE
1 %RE
0.2 %RE
147,300
147,200
147,100
147,000
146,900
949,200
949,300
949,400
949,500
949,600
EVERETT STREET
ST. FRANCIS STREET
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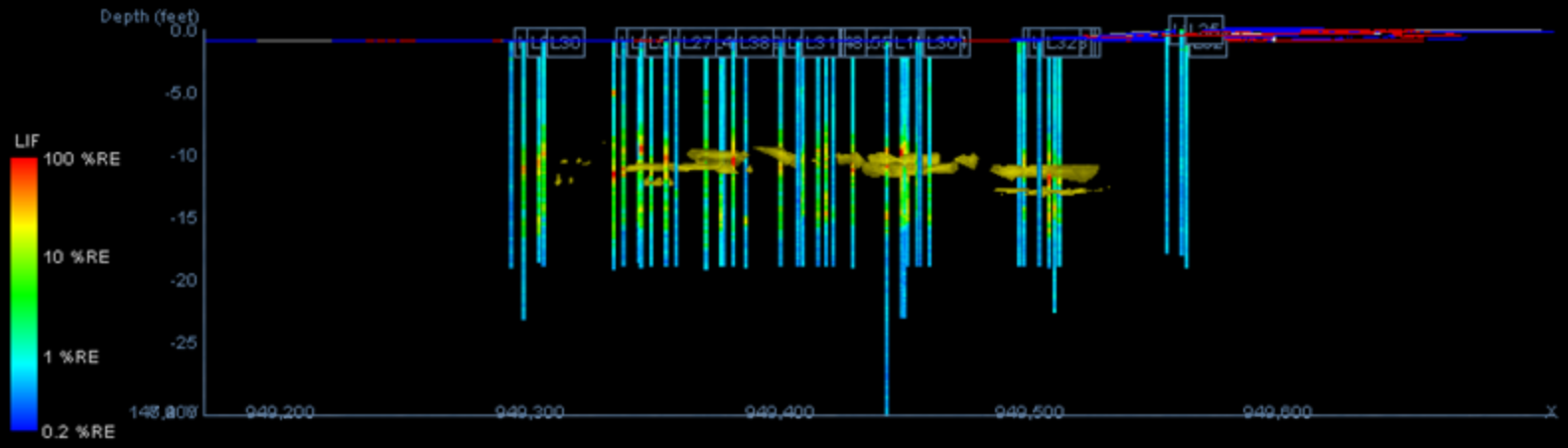
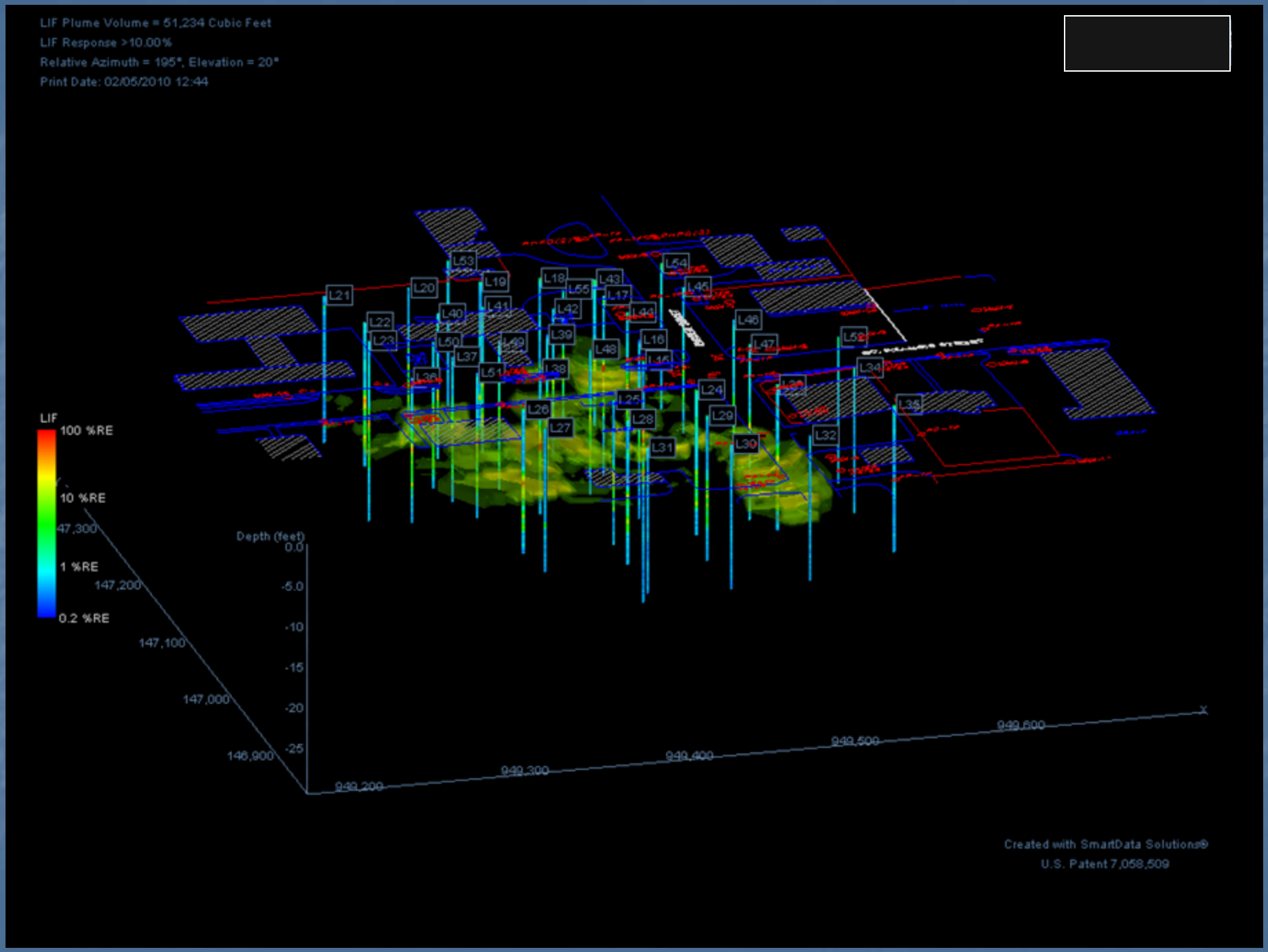
LIF Plume Volume = 2,116 Cubic Feet
LIF Response >25.00%
Relative Azimuth = 180°, Elevation = 0°
Print Date: 02/05/2010 12:50



Created with SmartData Solutions®
U.S. Patent 7,058,509


LIF Plume Volume = 51,234 Cubic Feet
LIF Response >10.00%
Relative Azimuth = 195°, Elevation = 20°
Print Date: 02/05/2010 12:44
LIF
100 %RE
10 %RE
1 %RE
0.2 %RE
Depth (feet)
0.0
-5.0
-10
-15
-20
-25
47,300
147,200
147,100
147,000
146,900
949,200
949,300
949,400
949,500
949,600
X
Created with SmartData Solutions®
U.S. Patent 7,058,509

LESSONS LEARNED

- LIF was useful in defining the extent of the LNAPL plume.
- LIF results were used to determine the optimal location for monitoring wells and LNAPL recovery wells.
- Filters are available to reduce or eliminate unwanted responses

Questions?

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