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ENVIRONMENTAL REMEDIATION

# Laser-Induced Fluorescence Survey

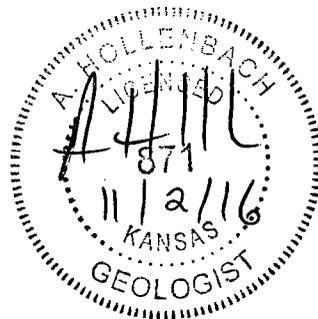
## Former Coastal Mart #7301 Site

10330 West Central Avenue  
Wichita, Kansas

SW1/4 SW1/4 SW1/4 SW1/4 S.17-T27S-R01W

KDHE Project Code: U2-087-13357

Prepared by:  
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November 2, 2016



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785-865-4282 | fax

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## 1.0 Discussion

The Former Coastal Mart #7301 site (Site) is located at 10330 West Central Avenue in Wichita, Kansas.

The Kansas Department of Health and Environment's Site Remedial Unit is assessing the Site for remediation. A laser-induced fluorescence (LIF) survey was conducted to evaluate the presence of light non-aqueous phase liquids (LNAPL) observed in Site groundwater monitoring wells MW-3 and MW-4 (Figure 1). The work was conducted in accordance with the KDHE-approved Remedial Design Field Workplan.

This Remedial Design Report (RDR) describes the Laser-Induced Fluorescence (LIF) survey conducted at the Site from September 27 to September 28, 2016.

RDR format is provided in Attachment K of the KDHE-BER Storage Tank Section's Site Remedial Design Plan - Request for Proposal (RFP), revision 11, dated February 2016. However, this RDR is intended to present the results of the LIF survey and sections of the format have been omitted or revised.

### 1.1 Report Summary

The Ultra-Violet Optical Screening Tool (UVOST<sup>®</sup>) and integrated Electrical Conductivity (EC) Tool is pushed into the sub-surface using a Geoprobe<sup>®</sup> direct-push rig for the purpose of delineating the extent of LNAPL.

The September 27 to September 28 mobilization consisted of advancing the UVOST<sup>®</sup>/EC tool at 21 boring locations in the vicinity of the former UST basin and collecting groundwater samples from groundwater monitoring wells MW-3 and MW-4. A field emulation test was also performed.

Groundwater samples collected from monitoring wells MW-3 and MW-4 were analyzed for benzene, toluene, ethylbenzene, xylene, methyl-tert-butyl-ether (MTBE), 1,2 dichloroethane, and naphthalene by Method 8260.

**TABLE 1 - SUMMARY OF WORK COMPLETED**

BORING ID	FOOTAGE	BORING ID	FOOTAGE
LIF - 01	50	LIF - 12	34
LIF - 02	40	LIF - 13	34
LIF - 03	40	LIF - 14	30
LIF - 04	40	LIF - 15	34
LIF - 05	40	LIF - 16	34
LIF - 06	40	LIF - 17	34
LIF - 07	40	LIF - 18	34
LIF - 08	40	LIF - 19	38
LIF - 09	30	LIF - 20	34
LIF - 10	32	LIF - 21	30
LIF - 11	34		
Total Footage:		762	

MW ID	Laboratory Groundwater Samples
MW-3	1
MW-4	1
Total Samples:	2

Emulation Tests	1
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## 2.0 Wells and Groundwater Sampling

### Survey

Site monitoring wells MW1, MW2R, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8 and the 21 LIF borings were surveyed by a Kansas Licensed Surveyor. Survey data is provided in Appendix A.

### Sampling Results

The sampling results for the groundwater samples collected from monitoring wells MW-3 and MW-4 are summarized in Table 2. Laboratory Analytical Reports are provided as Appendix B.

## 2.1 LNAPL Discussion

### Monitoring Data

LNAPL was confirmed at the site in 2004 during a KDHE Limited Site Assessment (LSA). Monitoring data collected to 2016 confirms the presence of LNAPL in monitoring wells MW-3 and MW-4, located in the vicinity of the former UST tank basin. Monitoring well MW-4, located on the southern corner of the former UST basin, has consistently been impacted by LNAPL since installation.

The LNAPL in MW-3 and MW-4 has ranged in thicknesses from less than 1/8<sup>th</sup> of an inch to 2.08 ft (MW-4, August 2006). Only site monitoring wells MW-3 and MW-4 have been impacted by LNAPL, suggesting that the horizontal extent of the LNAPL impact is delimited to the vicinity of the former UST tank basin and these two monitoring wells.

### LIF Survey – UVOST®

The LIF Survey consisted of 21 borings in the area of the former UST basin and adjacent former pump island. LNAPL was identified in 6 out of 21 borings locations (LIF-07, LIF-10, LIF-12, LIF-15, LIF-16, and LIF-19) at depths ranging from 11 to 22 ft. The LIF logs are included in Section 3.0. Dakota Technologies, Inc.'s Standard Report is provided as Appendix C which includes a description of the technology and the results of the Site LIF Survey.

In general, UVOST® data collected during the LIF Survey is consistent with the monitoring well data, indicating that the horizontal extent of LNAPL is relatively delimited to the immediate vicinity of the former UST basin. Boring location LIF-15 presents the only detection of LNAPL that is not in the immediate vicinity of the former UST basin. LIF-15 is located in the approximate vicinity of the former pump island.

For ease of review, see Figure 2 which approximates the horizontal extent of LNAPL.

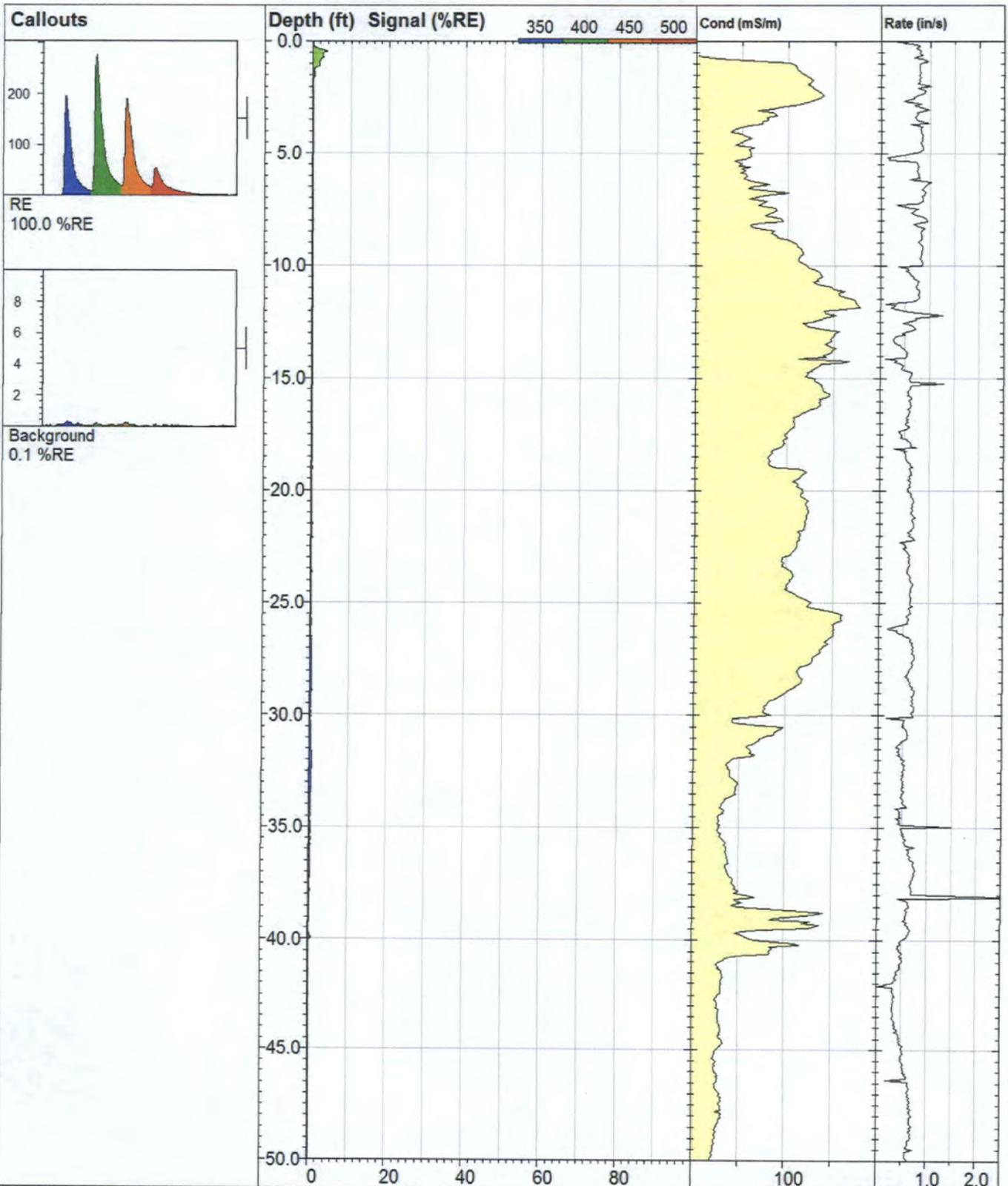
### LIF Survey - EC

EC logs indicate that 8 of the 21 LIF borings locations (LIF-06, LIF-07, LIF-08, LIF-10, LIF-15, LIF-16, LIF-17, and LIF-20) are within the backfill material as evidenced by differences in conductivity readings. This data is consistent with the approximate location of the former tank basin. Figure 3 approximates the location of the former UST basin based on the EC logs.

### LIF Survey - Emulation

A small amount of LNAPL was collected and analyzed with the UVOST® tool for the purposes of performing a field emulation test. The results of this test were compared to example waveforms provided online at <http://www.dakotatechnologies.com/info/newsletters/article/2013/07/12/interpreting-lif-waveforms>. The LNAPL appears to emulate waveforms typical of weathering gasoline. The emulation log is included in Section 4.0.

**3.0 LIF Boring Logs**



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**LIF-01**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord. (Lat-N) / System:  
Unavailable / NA

Final depth:  
50.07 ft

Client / Job:  
Larsen & Associates / 025

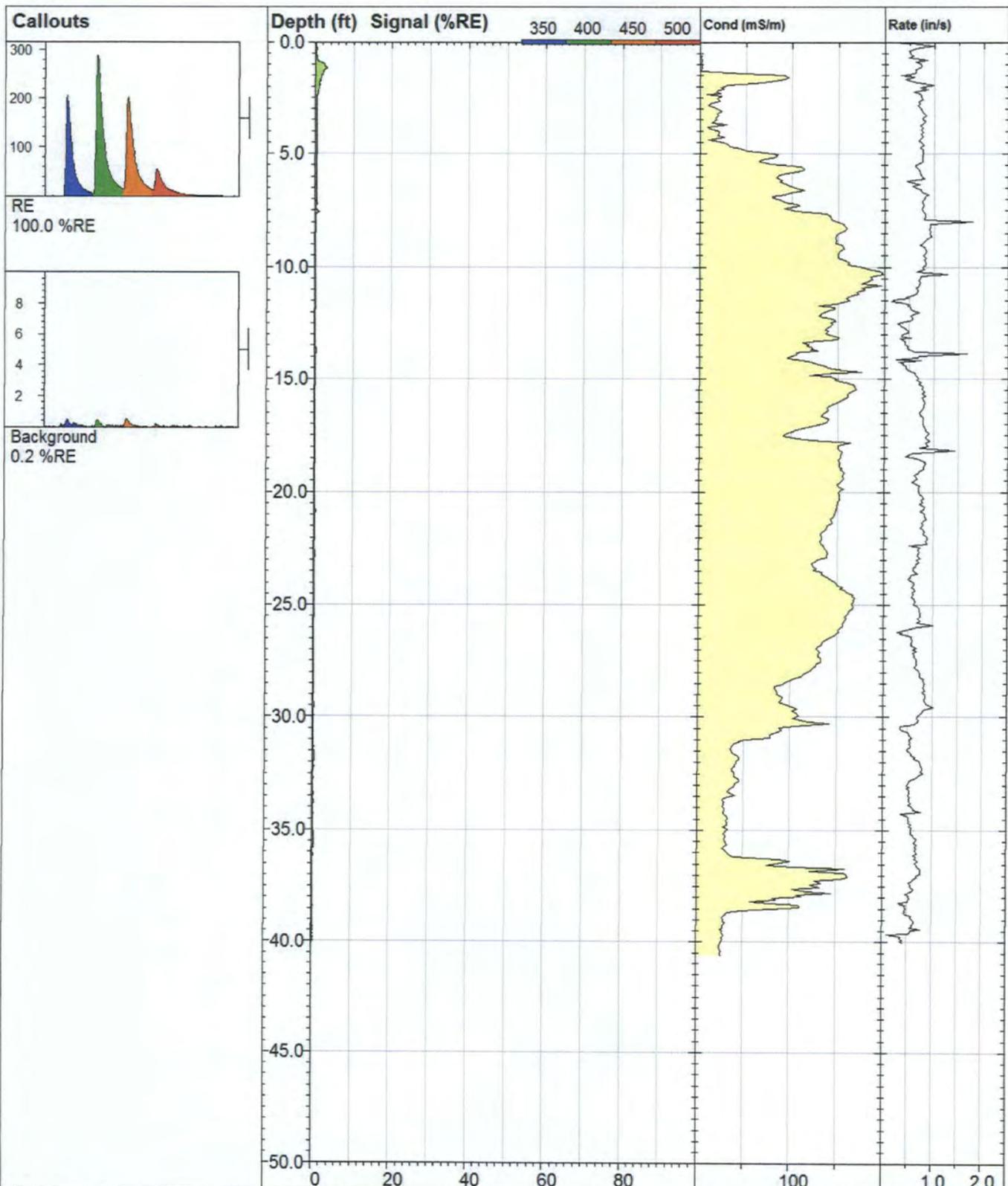
X Coord. (Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.7 %RE @ 0.44 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 08:53 CDT



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**LIF-02**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
40.05 ft

Client / Job:  
Larsen & Associates / 025

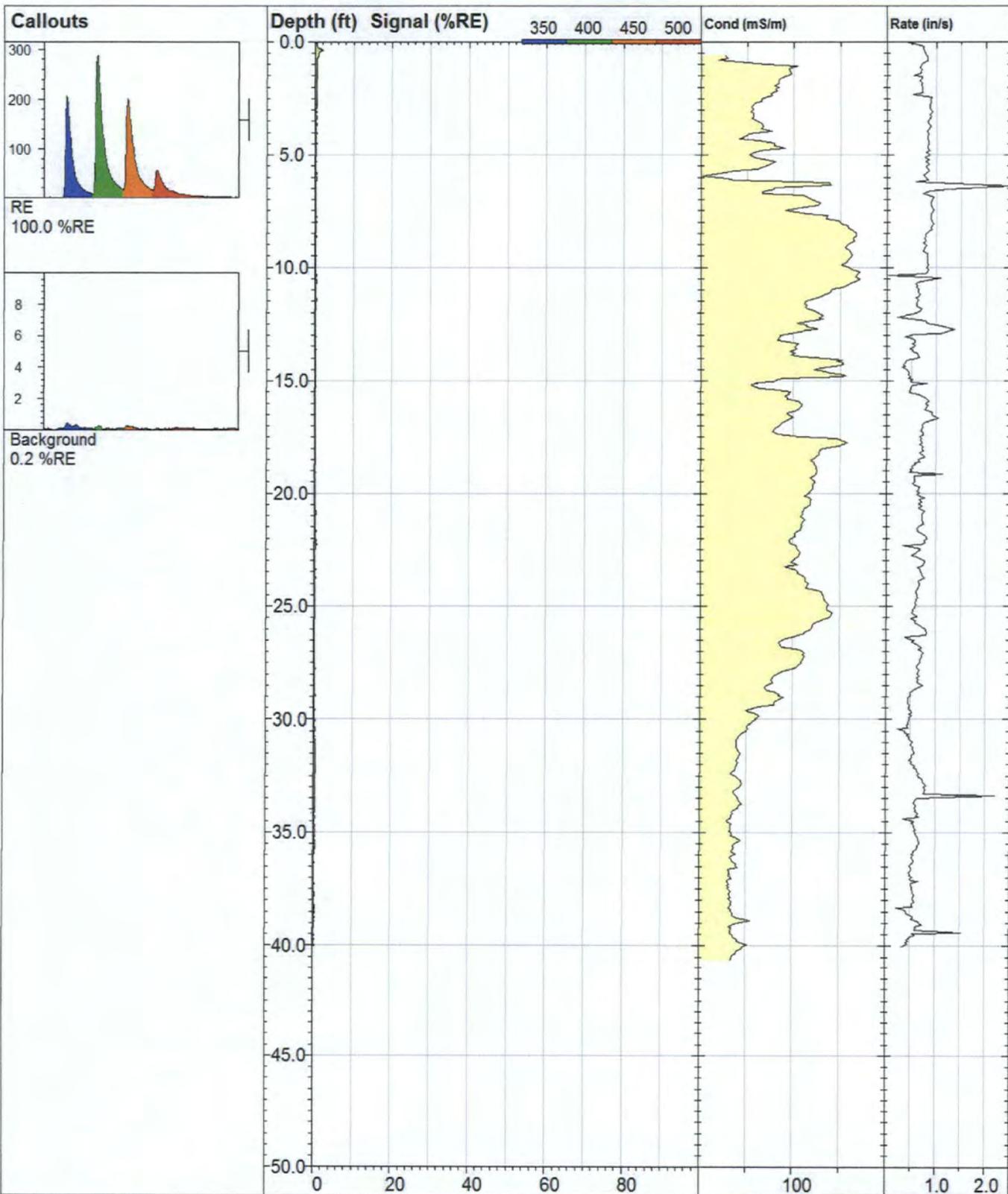
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.0 %RE @ 1.15 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 09:35 CDT



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**LIF-03**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

Elevation:  
Unavailable

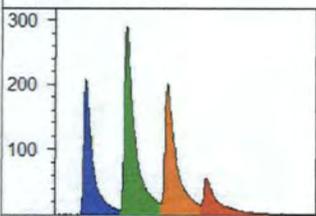
**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
40.03 ft

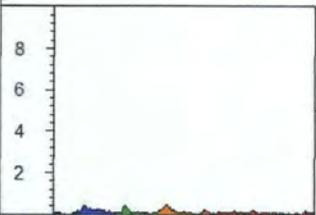
Max signal:  
1.8 %RE @ 0.37 ft

Date & Time:  
2016-09-27 10:08 CDT

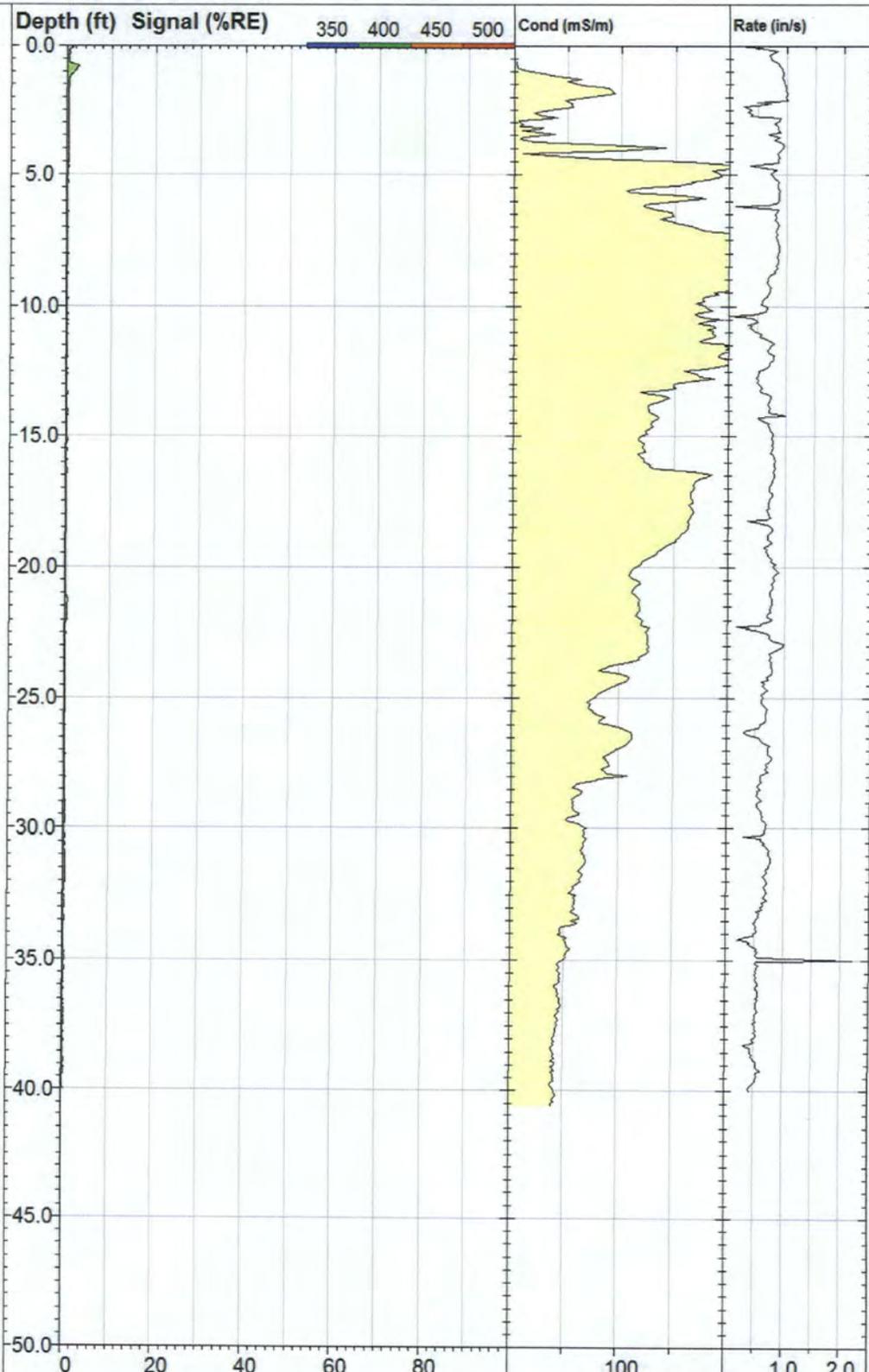
**Callouts**



RE  
100.0 %RE

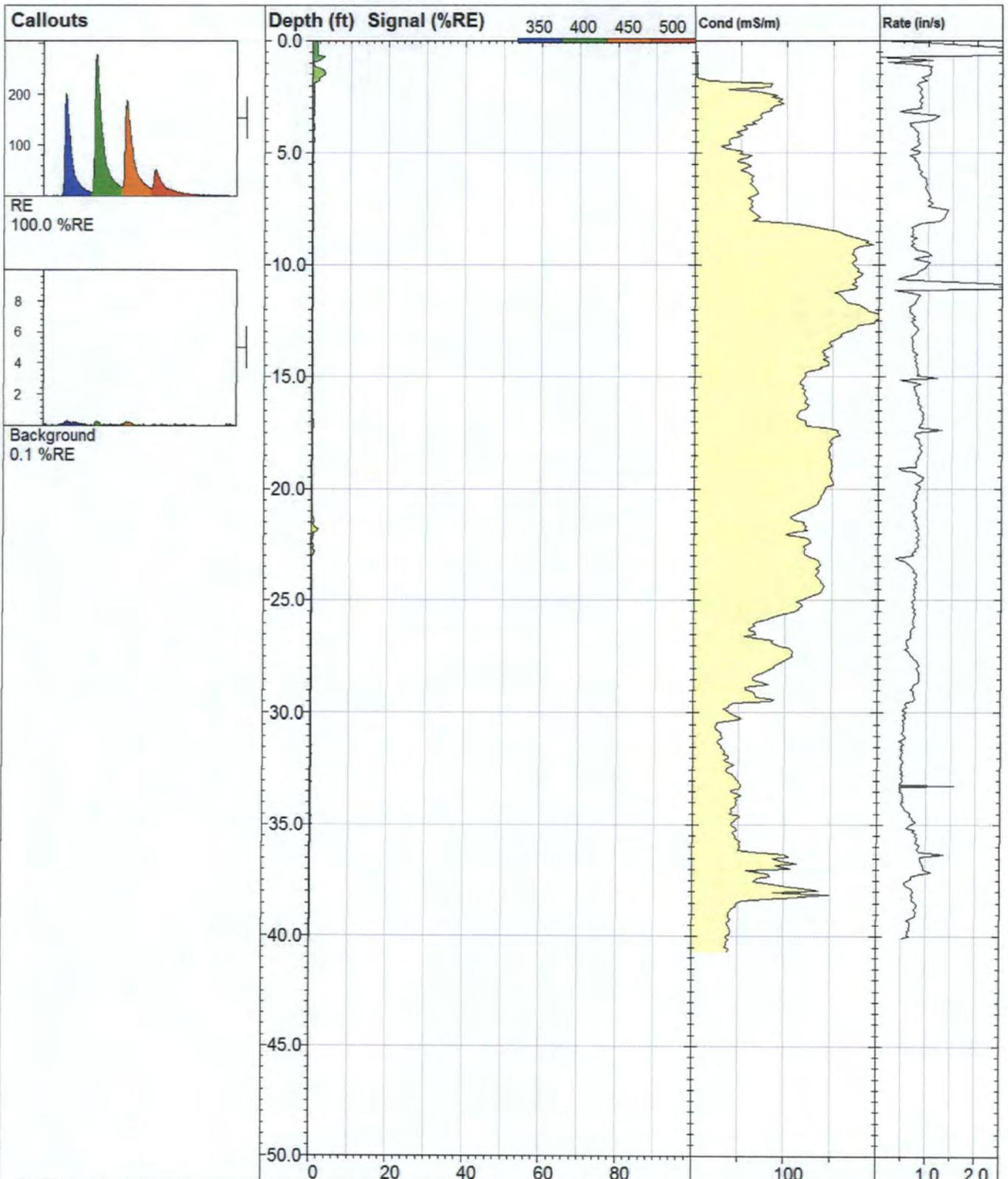


Background  
0.3 %RE



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<b>LIF-04</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 40.00 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 2.6 %RE @ 0.76 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 10:46 CDT



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**LIF-05**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
40.07 ft

Client / Job:  
Larsen & Associates / 025

X Coord.(Lng-E) / Fix:  
Unavailable / NA

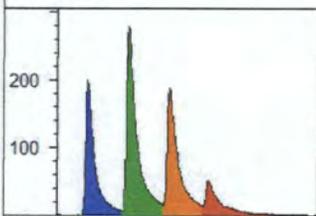
Max signal:  
3.2 %RE @ 1.41 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 11:47 CDT

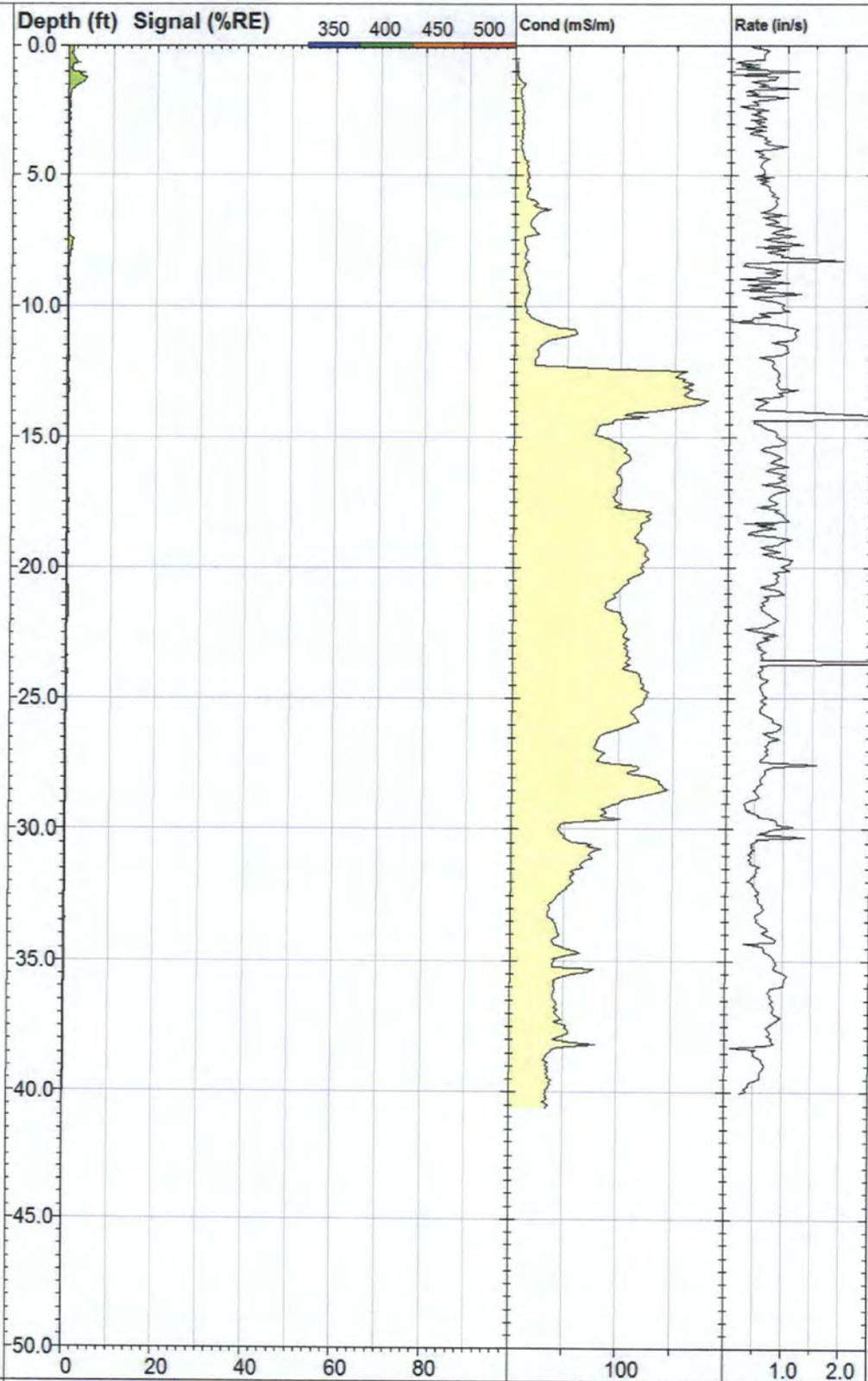
**Callouts**



RE  
100.0 %RE



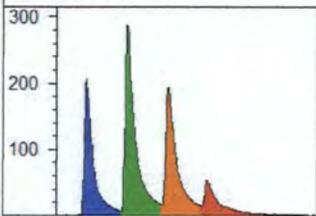
Background  
0.2 %RE



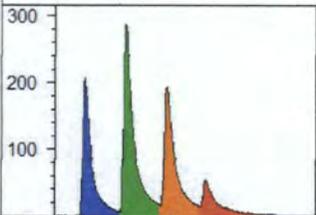
WWW.DAKOTATECHNOLOGIES.COM

<b>LIF-06</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord. (Lat-N) / System: Unavailable / NA	Final depth: 40.02 ft
Client / Job: Larsen & Associates / 025	X Coord. (Lng-E) / Fix: Unavailable / NA	Max signal: 4.2 %RE @ 1.21 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 13:27 CDT

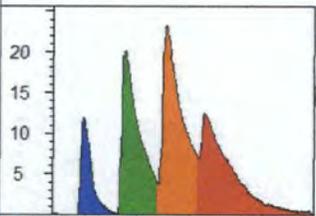
**Callouts**



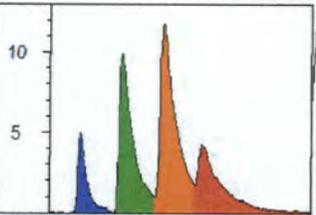
RE  
100.0 %RE



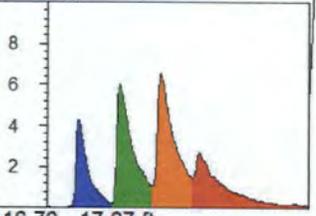
RE  
100.0 %RE



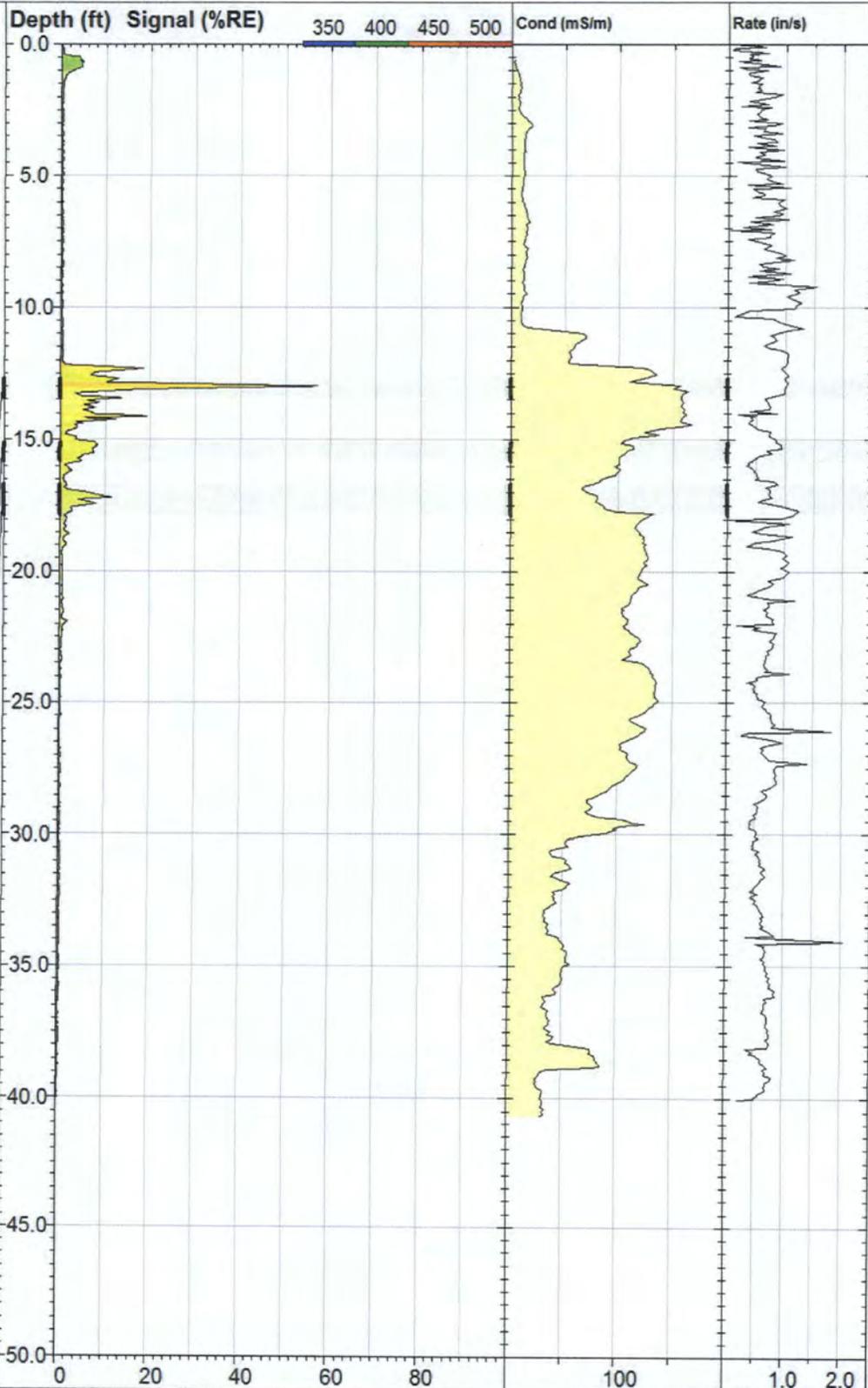
12.69 - 13.44 ft  
17.0 %RE (s 18.4)



15.09 - 15.83 ft  
6.1 %RE (s 1.6)



16.70 - 17.87 ft  
4.4 %RE (s 3.4)



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**LIF-07**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

Elevation:  
Unavailable

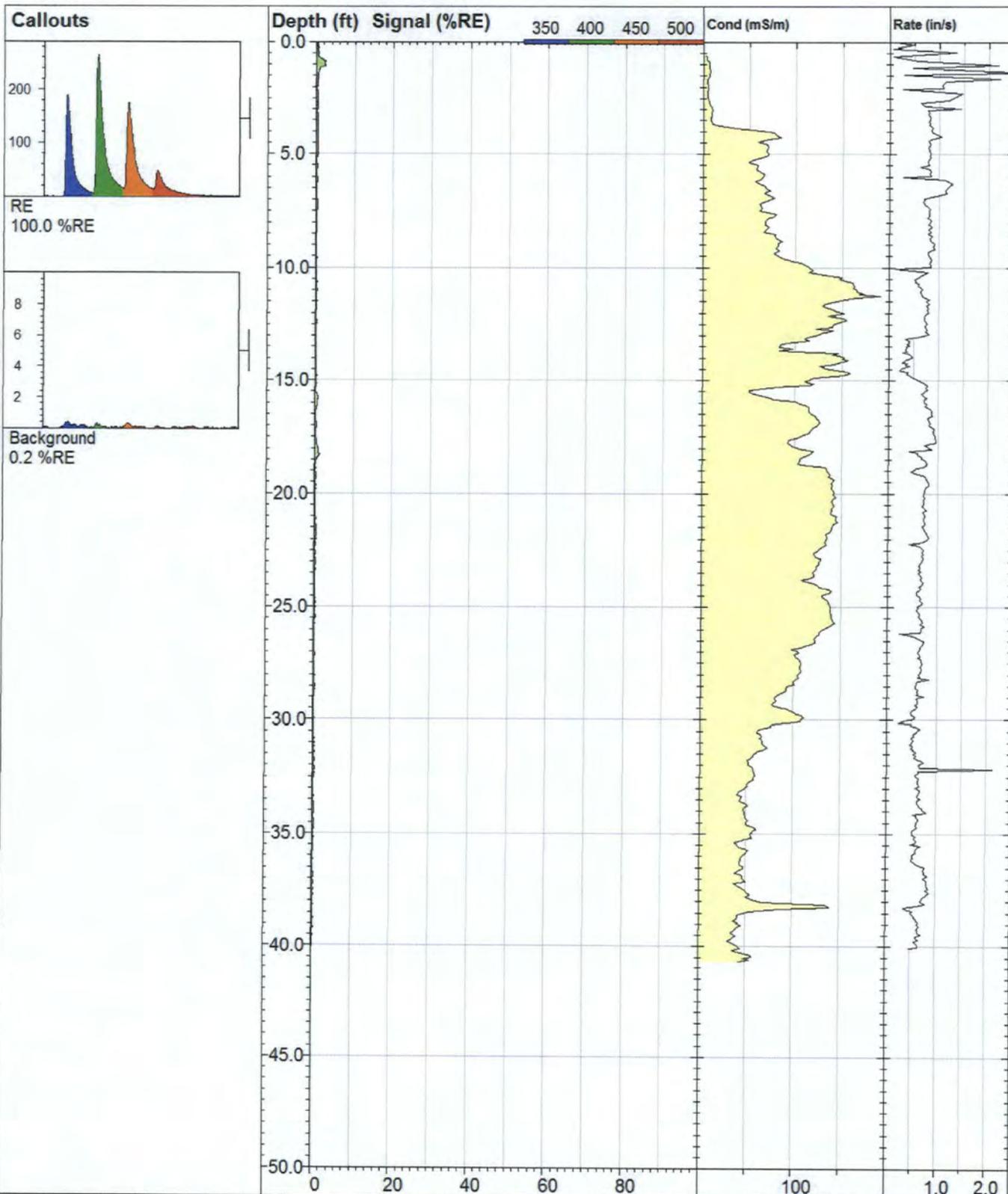
**UVOST® By Dakota**

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Final depth:  
40.04 ft

Max signal:  
57.1 %RE @ 12.97 ft

Date & Time:  
2016-09-27 14:05 CDT



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**LIF-08**

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
40.07 ft

Client / Job:  
Larsen & Associates / 025

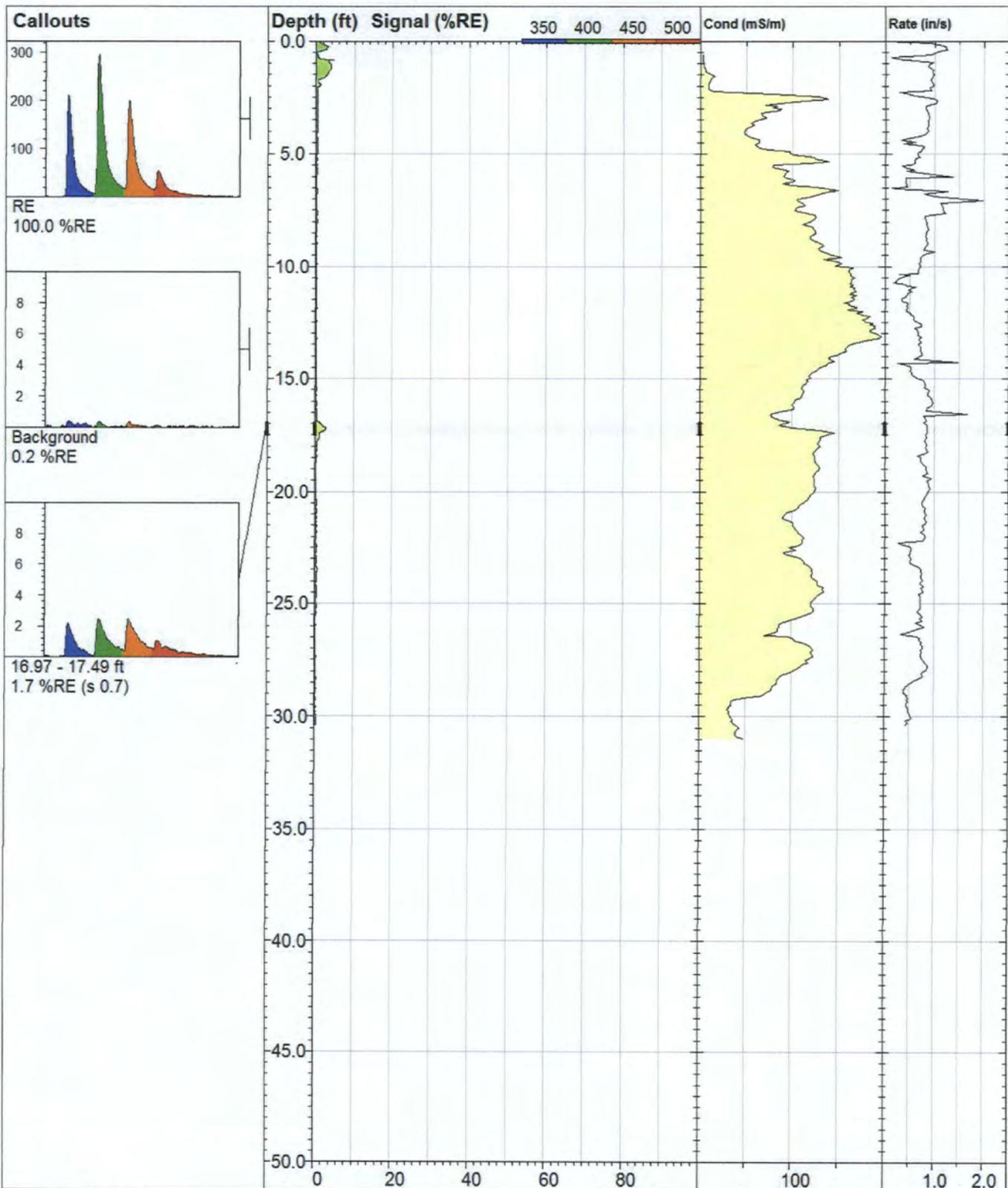
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
2.4 %RE @ 1.06 ft

Operator / Unit:  
JMBG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 14:38 CDT



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### LIF-09

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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
30.37 ft

Client / Job:  
Larsen & Associates / 025

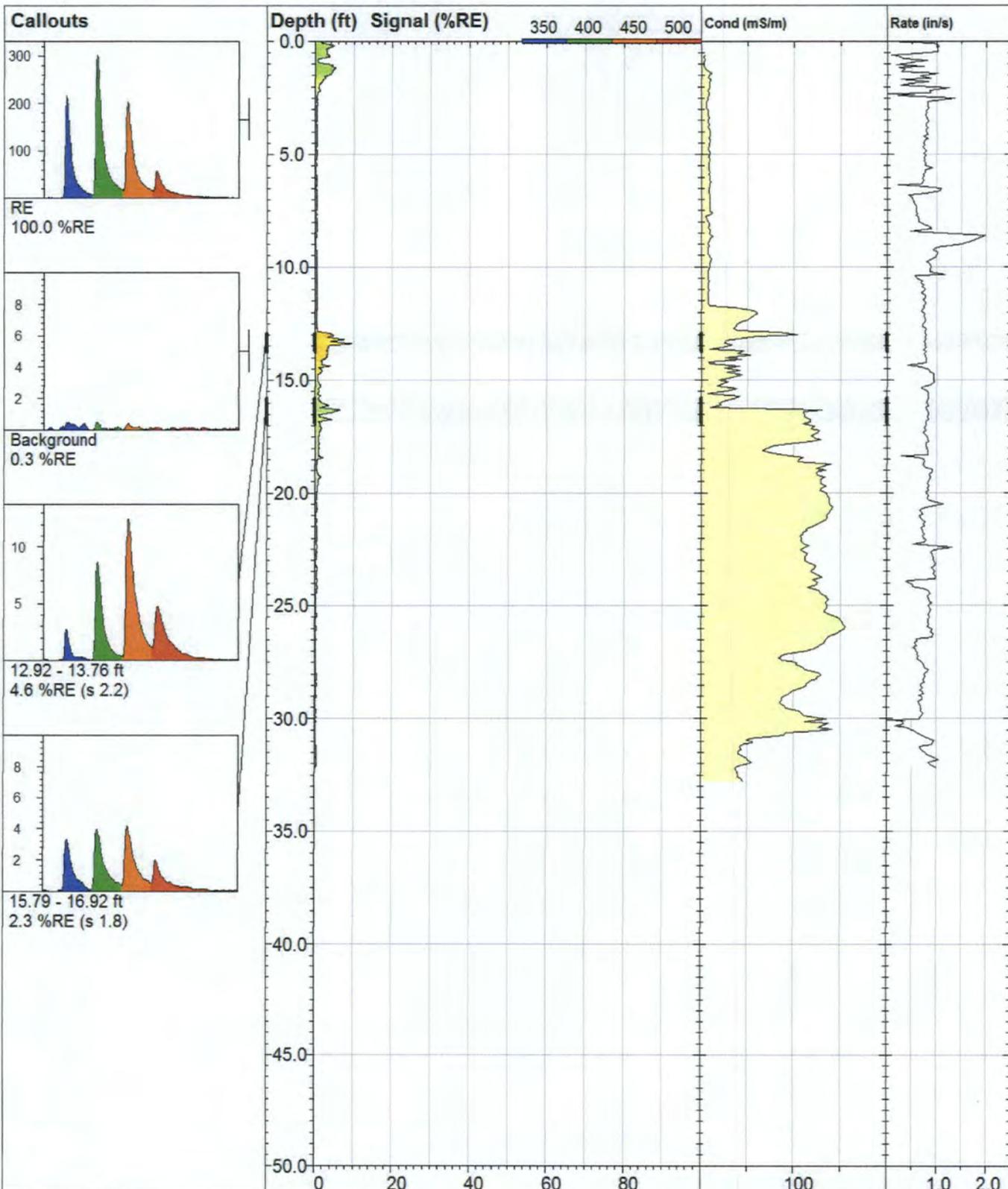
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
4.6 %RE @ 0.84 ft

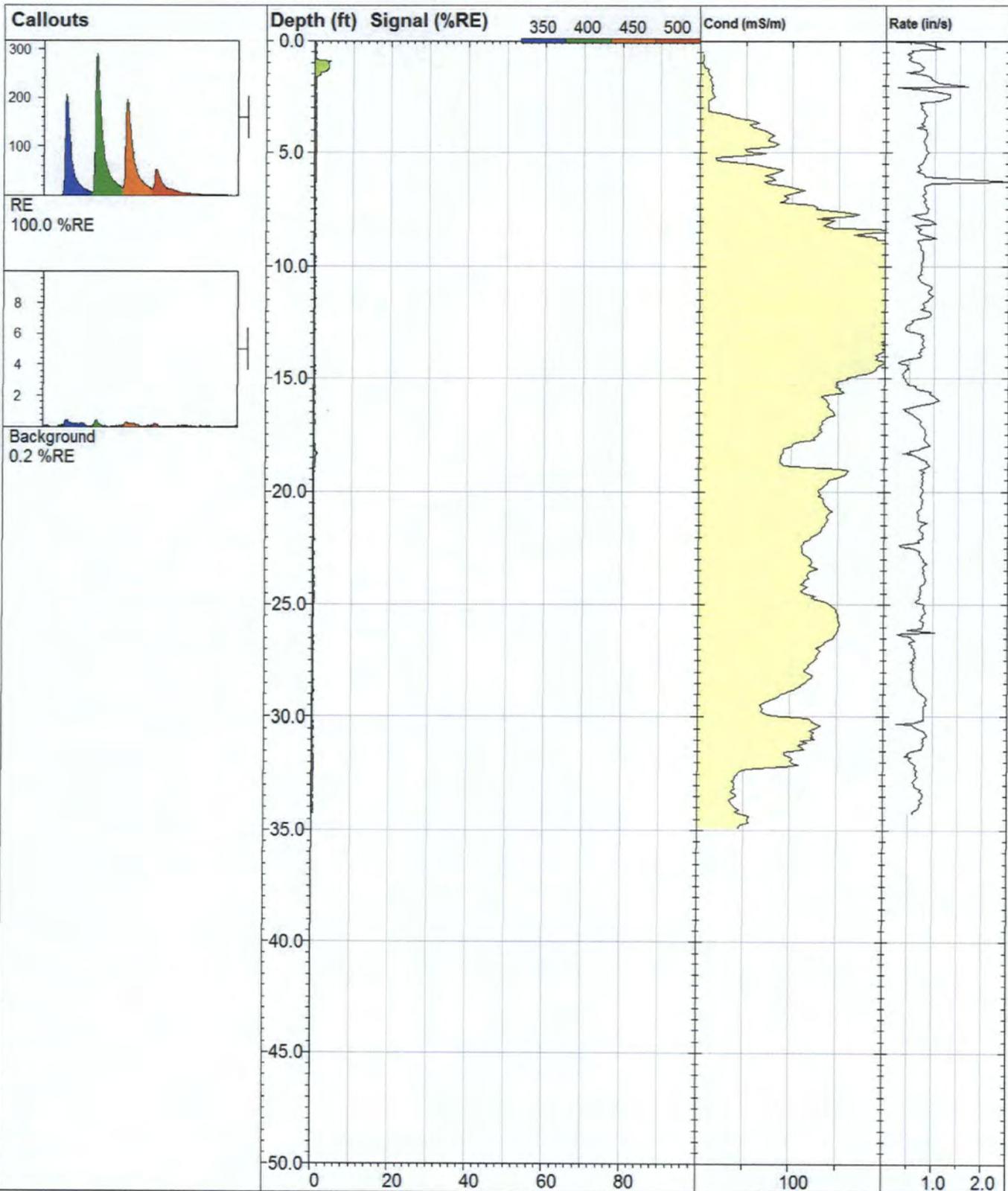
Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 15:23 CDT



 <b>DAKOTA TECHNOLOGIES</b> <small>WWW.DAKOTATECHNOLOGIES.COM</small>	<b>LIF-10</b>		<b>UVOST® By Dakota</b> <small>www.DakotaTechnologies.com</small>
	Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 32.17 ft
	Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 9.4 %RE @ 13.39 ft
	Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 16:08 CDT



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### LIF-11

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

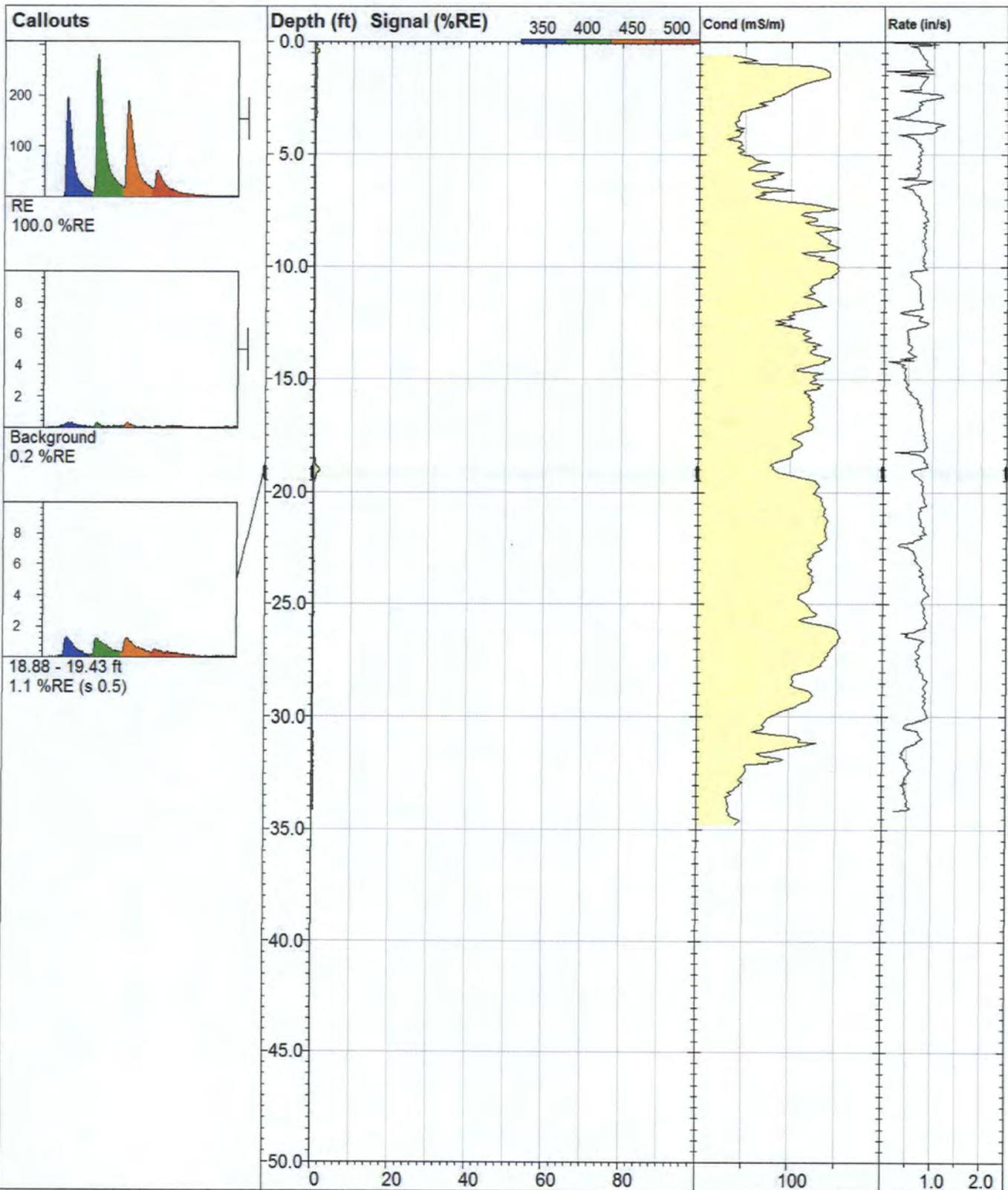
Elevation:  
Unavailable

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Final depth:  
34.27 ft

Max signal:  
4.0 %RE @ 0.93 ft

Date & Time:  
2016-09-27 16:45 CDT



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**LIF-12**

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
34.14 ft

Client / Job:  
Larsen & Associates / 025

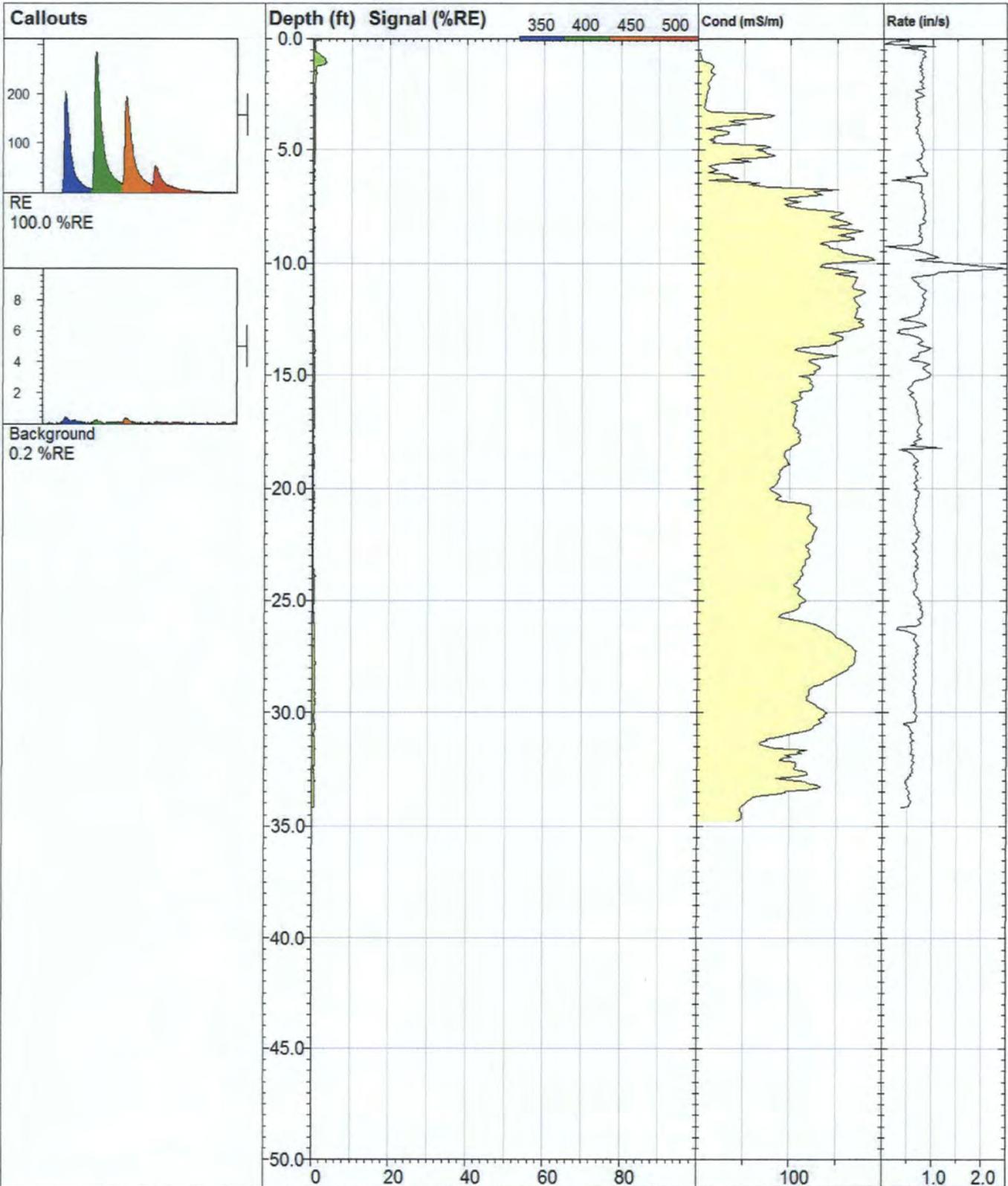
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
1.7 %RE @ 19.03 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 08:32 CDT



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**LIF-13**

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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
34.16 ft

Client / Job:  
Larsen & Associates / 025

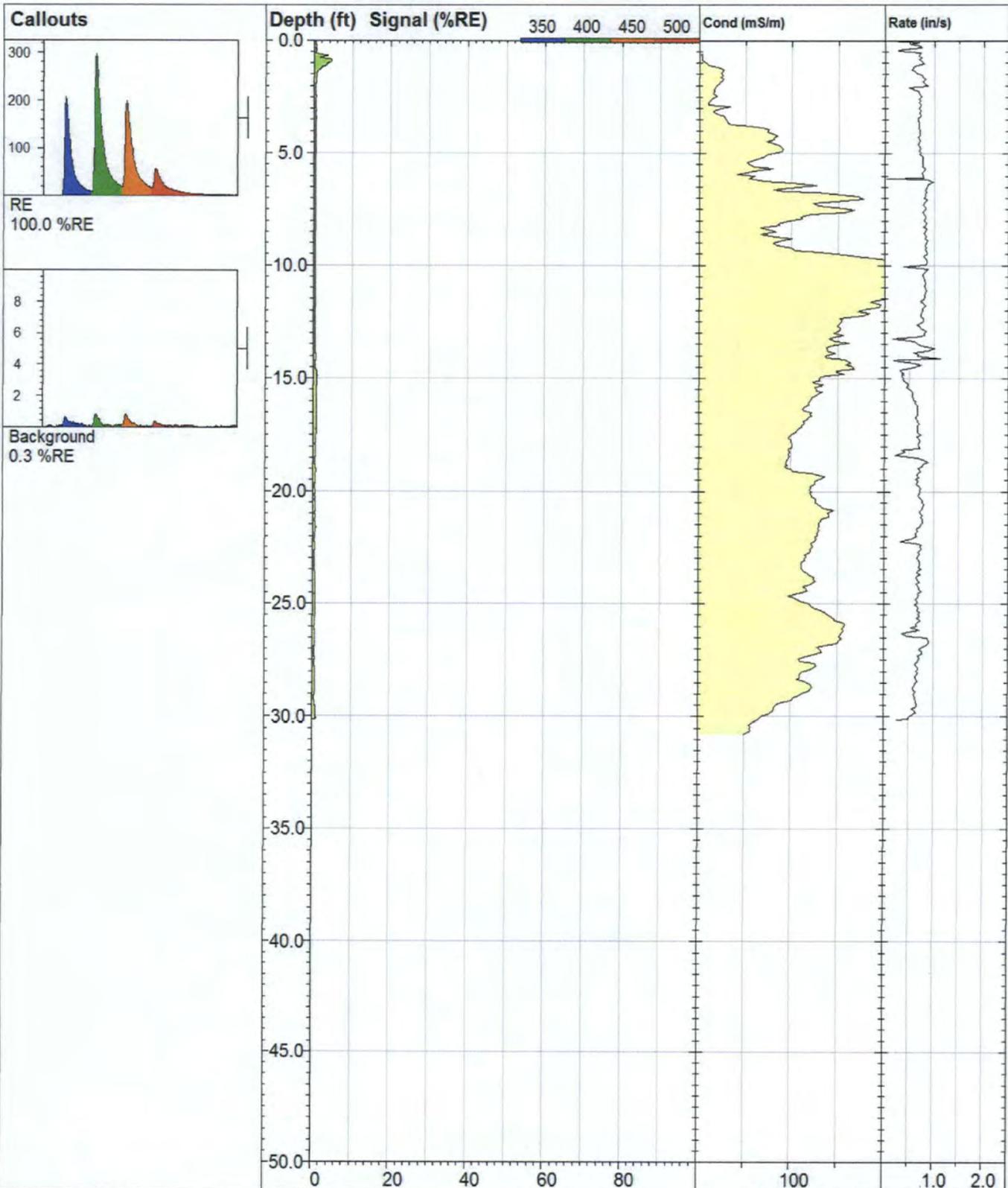
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.3 %RE @ 1.09 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 08:59 CDT



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**LIF-14**

**UVOST® By Dakota**

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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
30.13 ft

Client / Job:  
Larsen & Associates / 025

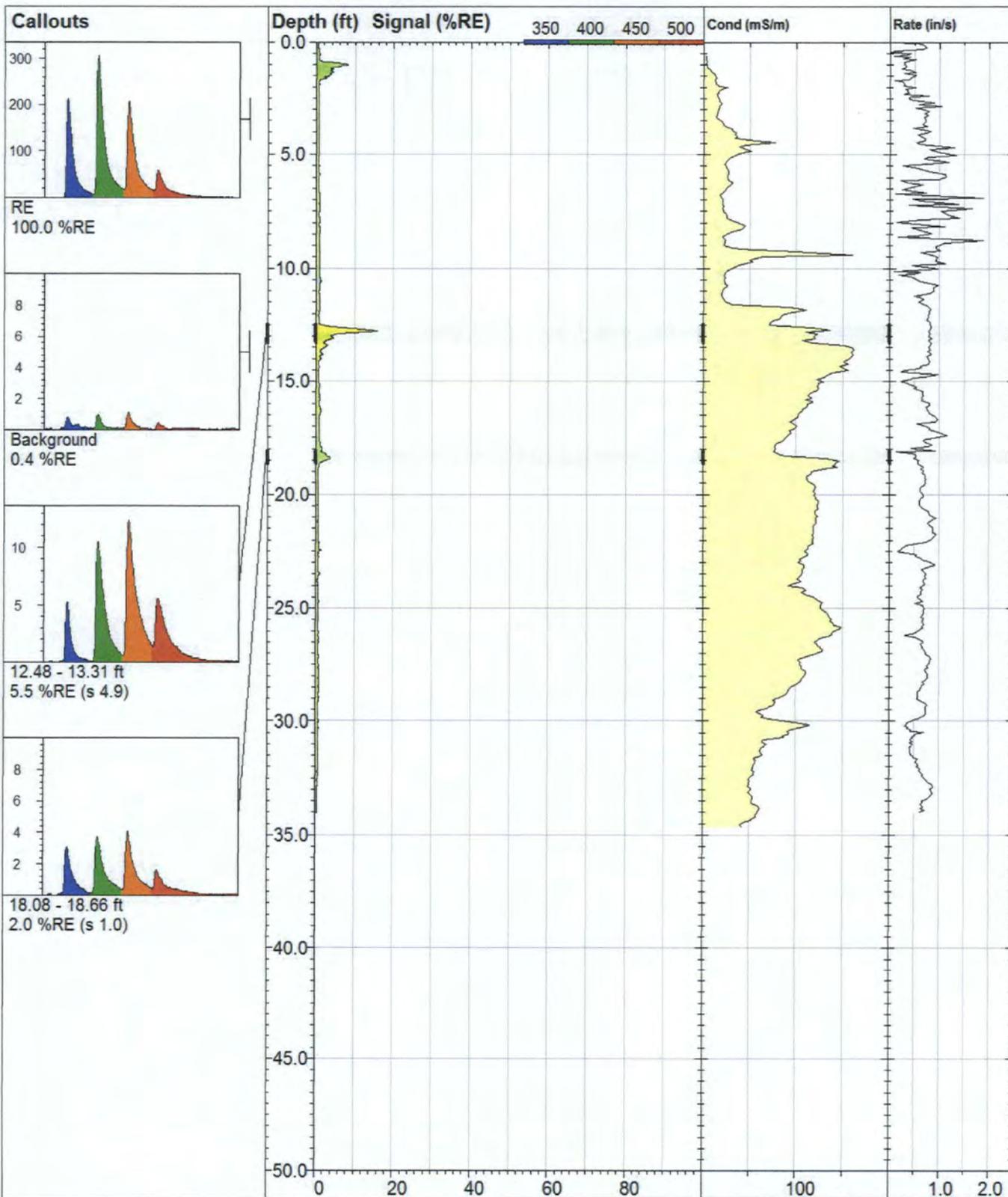
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
4.5 %RE @ 0.84 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 09:29 CDT



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**LIF-15**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

Elevation:  
Unavailable

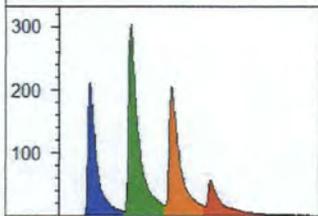
**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
**34.01 ft**

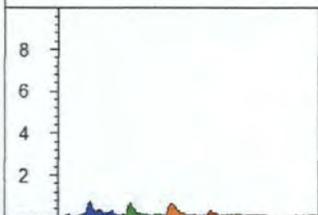
Max signal:  
**16.0 %RE @ 12.77 ft**

Date & Time:  
**2016-09-28 10:06 CDT**

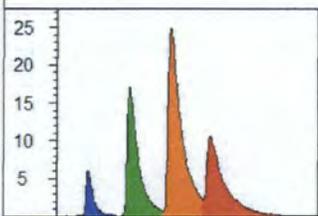
**Callouts**



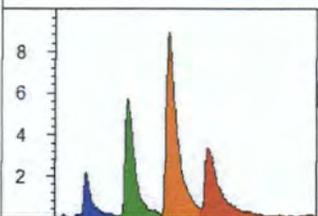
RE  
100.0 %RE



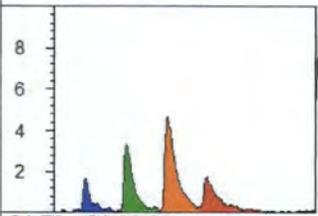
Background  
0.4 %RE



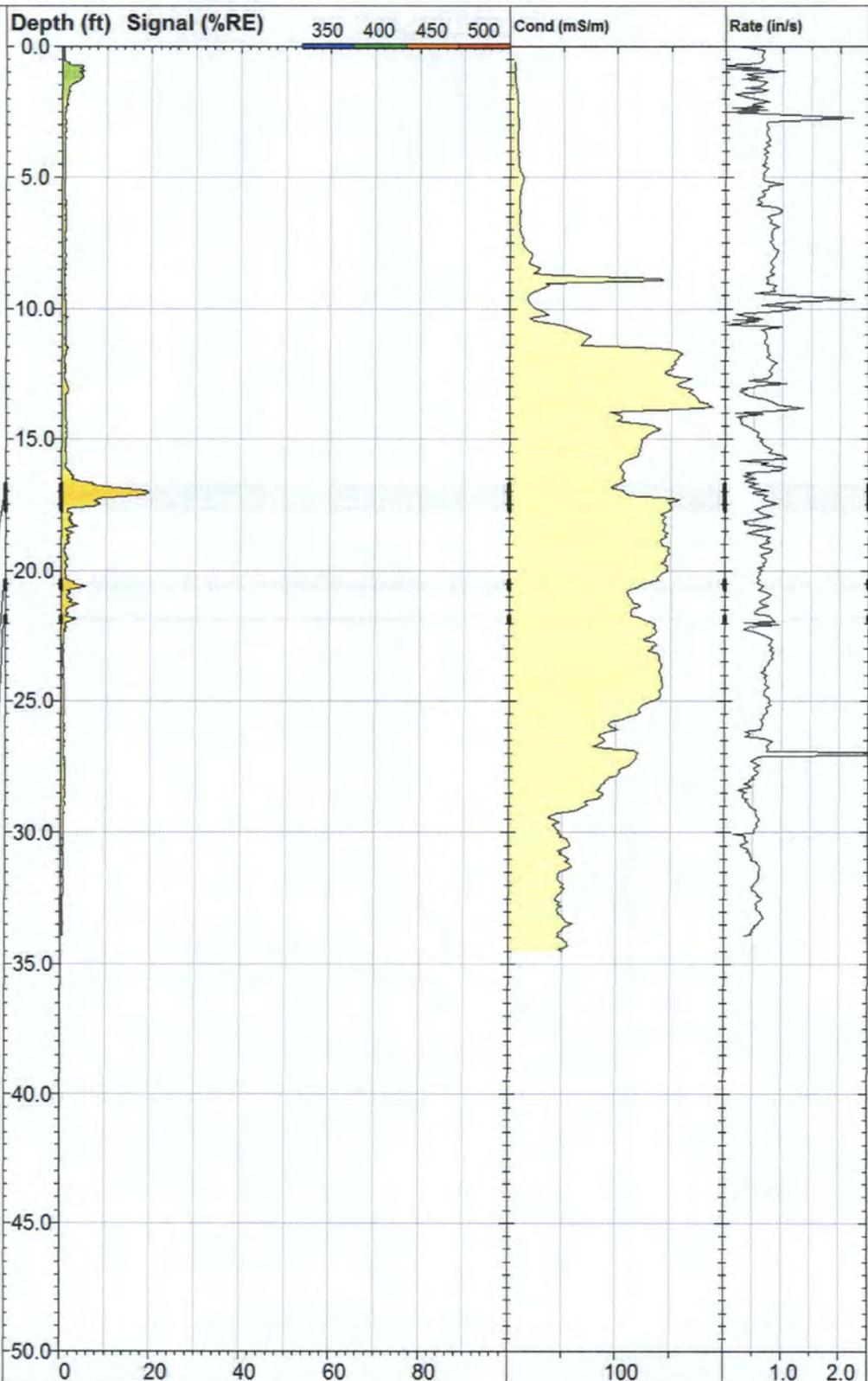
16.68 - 17.77 ft  
9.7 %RE (s 6.3)



20.35 - 20.74 ft  
2.9 %RE (s 1.6)

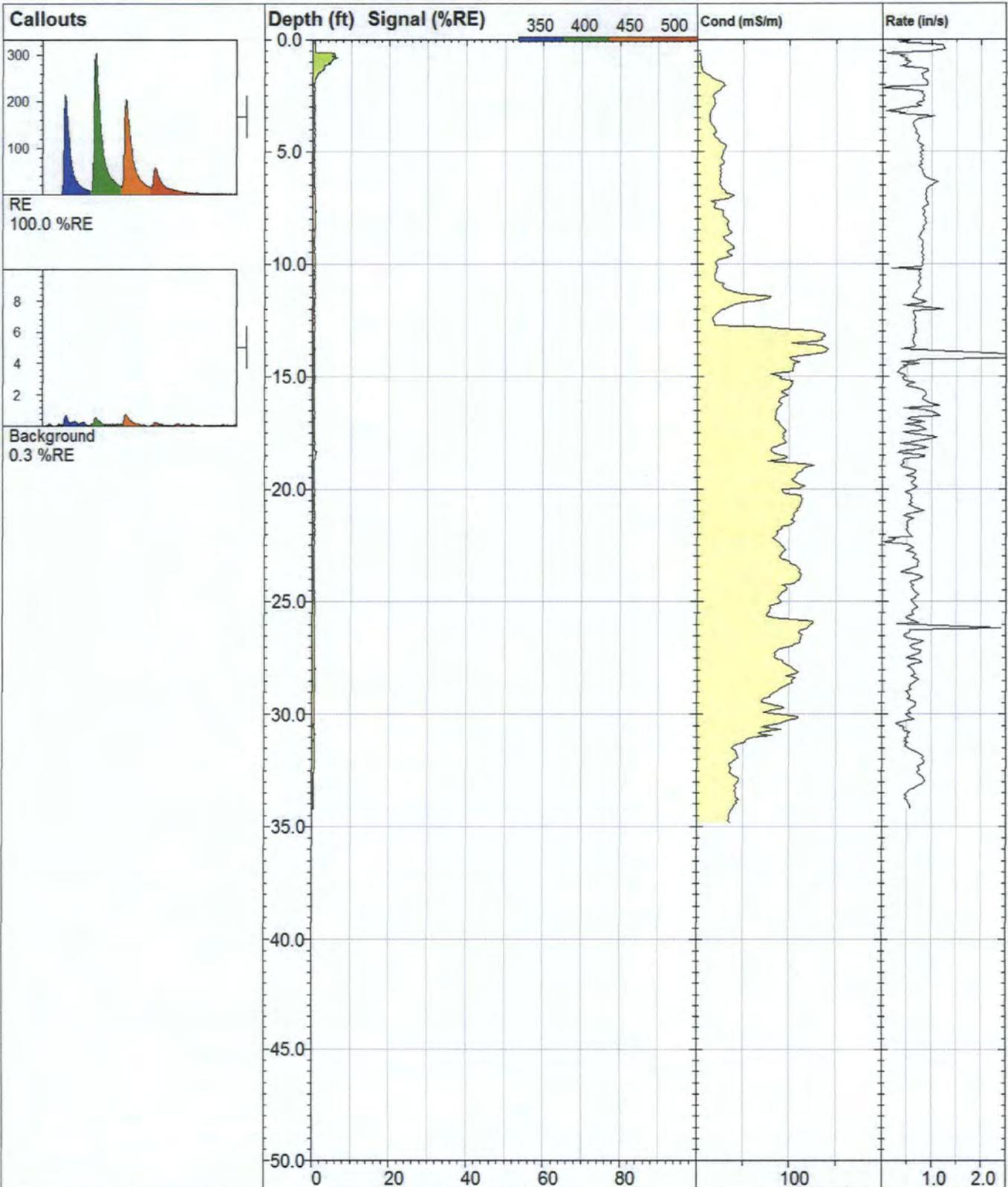


21.73 - 21.98 ft  
1.6 %RE (s 1.1)



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<b>LIF-16</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 33.90 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 19.3 %RE @ 17.01 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 10:36 CDT



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**LIF-17**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord. (Lat-N) / System:  
Unavailable / NA

Final depth:  
34.21 ft

Client / Job:  
Larsen & Associates / 025

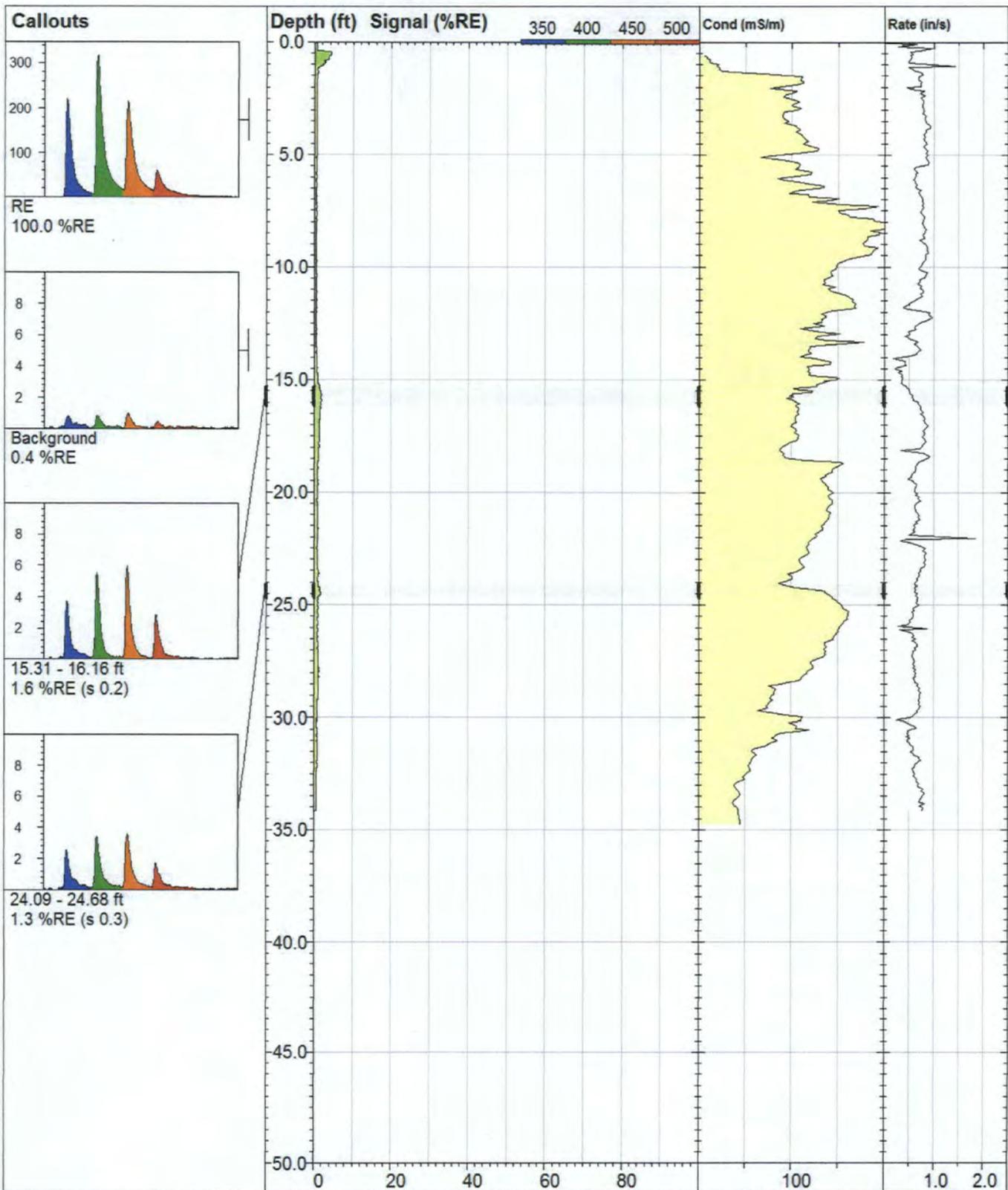
X Coord. (Lng-E) / Fix:  
Unavailable / NA

Max signal:  
6.4 %RE @ 0.81 ft

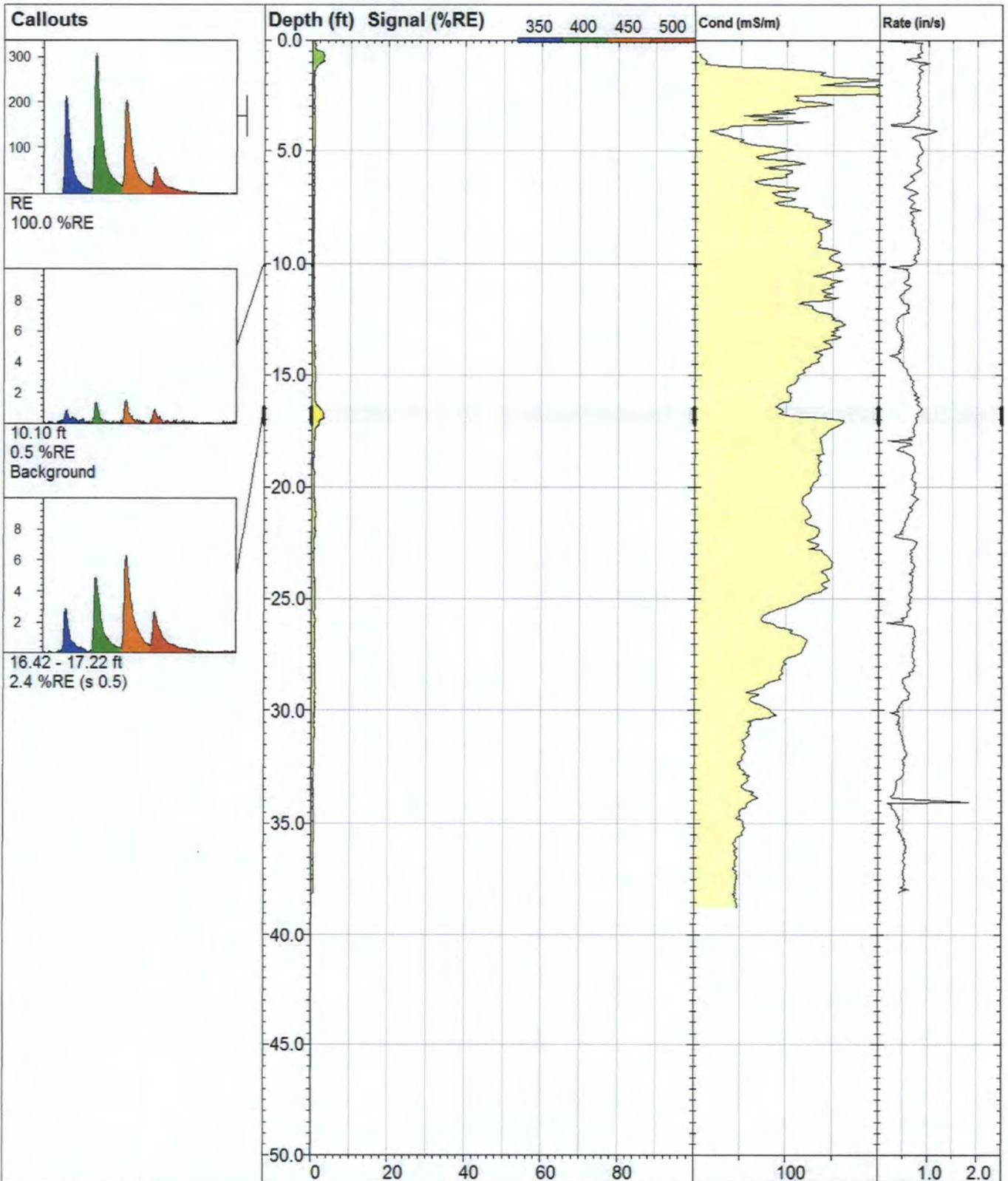
Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 11:13 CDT



 <b>DAKOTA TECHNOLOGIES</b> <small>WWW.DAKOTATECHNOLOGIES.COM</small>	<b>LIF-18</b>		<b>UVOST® By Dakota</b> <small>www.DakotaTechnologies.com</small>
	<i>Site:</i> Former Coastal Mart 7301	<i>Y Coord.(Lat-N) / System:</i> Unavailable / NA	<i>Final depth:</i> 34.15 ft
	<i>Client / Job:</i> Larsen & Associates / 025	<i>X Coord.(Lng-E) / Fix:</i> Unavailable / NA	<i>Max signal:</i> 4.3 %RE @ 0.52 ft
	<i>Operator / Unit:</i> JM/BG / UVOST1004	<i>Elevation:</i> Unavailable	<i>Date &amp; Time:</i> 2016-09-28 11:44 CDT



WWW.DAKOTATECHNOLOGIES.COM

### LIF-19\_LIF-19A

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
38.11 ft

Client / Job:  
Larsen & Associates / 025

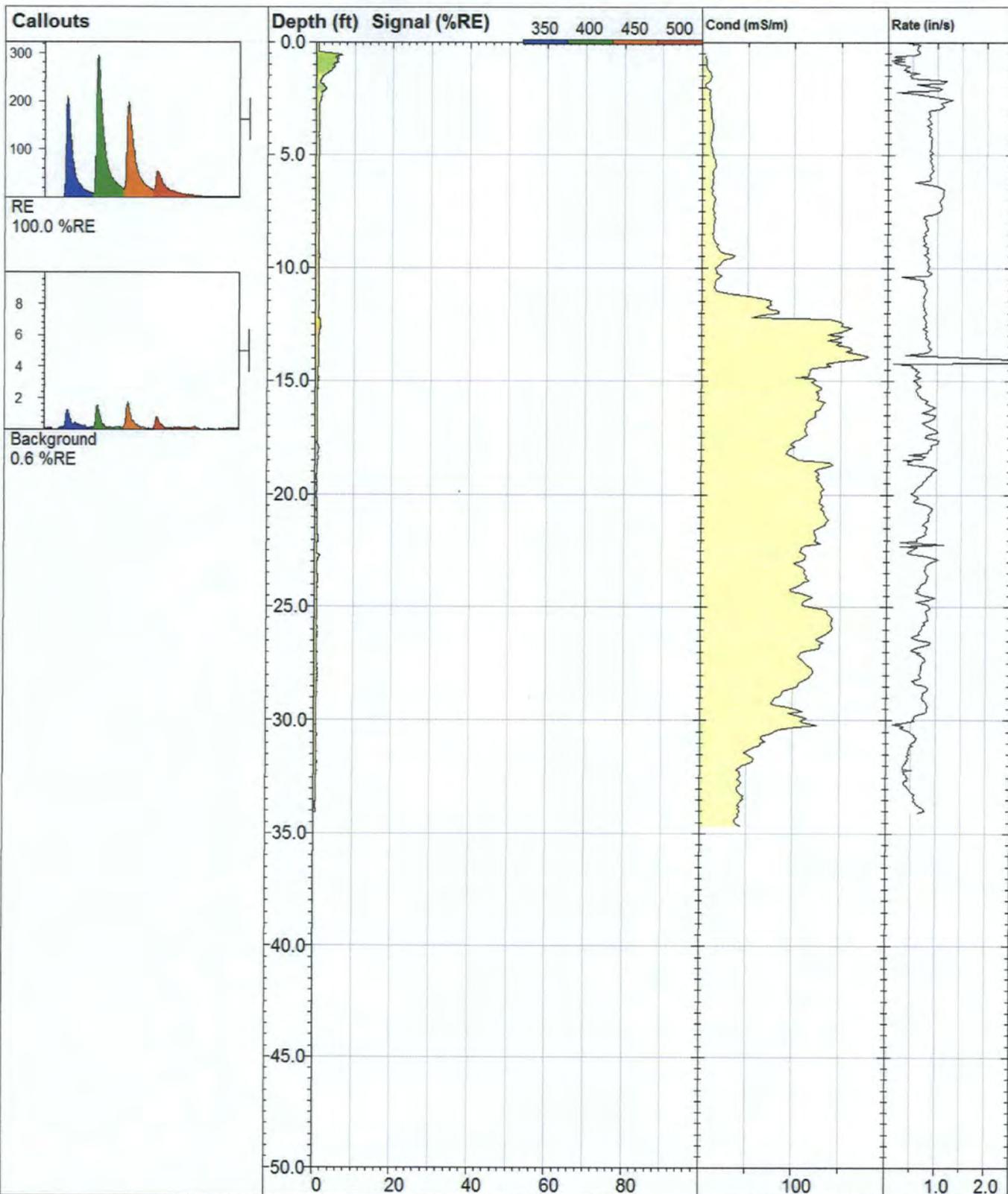
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.1 %RE @ 16.92 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 14:31 CDT



WWW.DAKOTATECHNOLOGIES.COM

**LIF-20**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
34.05 ft

Client / Job:  
Larsen & Associates / 025

X Coord.(Lng-E) / Fix:  
Unavailable / NA

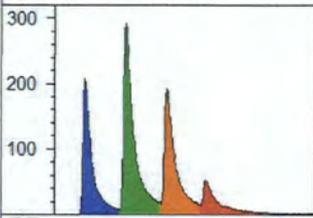
Max signal:  
6.7 %RE @ 0.58 ft

Operator / Unit:  
JM/BG / UVOST1004

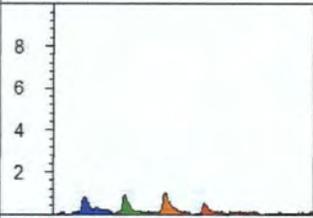
Elevation:  
Unavailable

Date & Time:  
2016-09-28 15:19 CDT

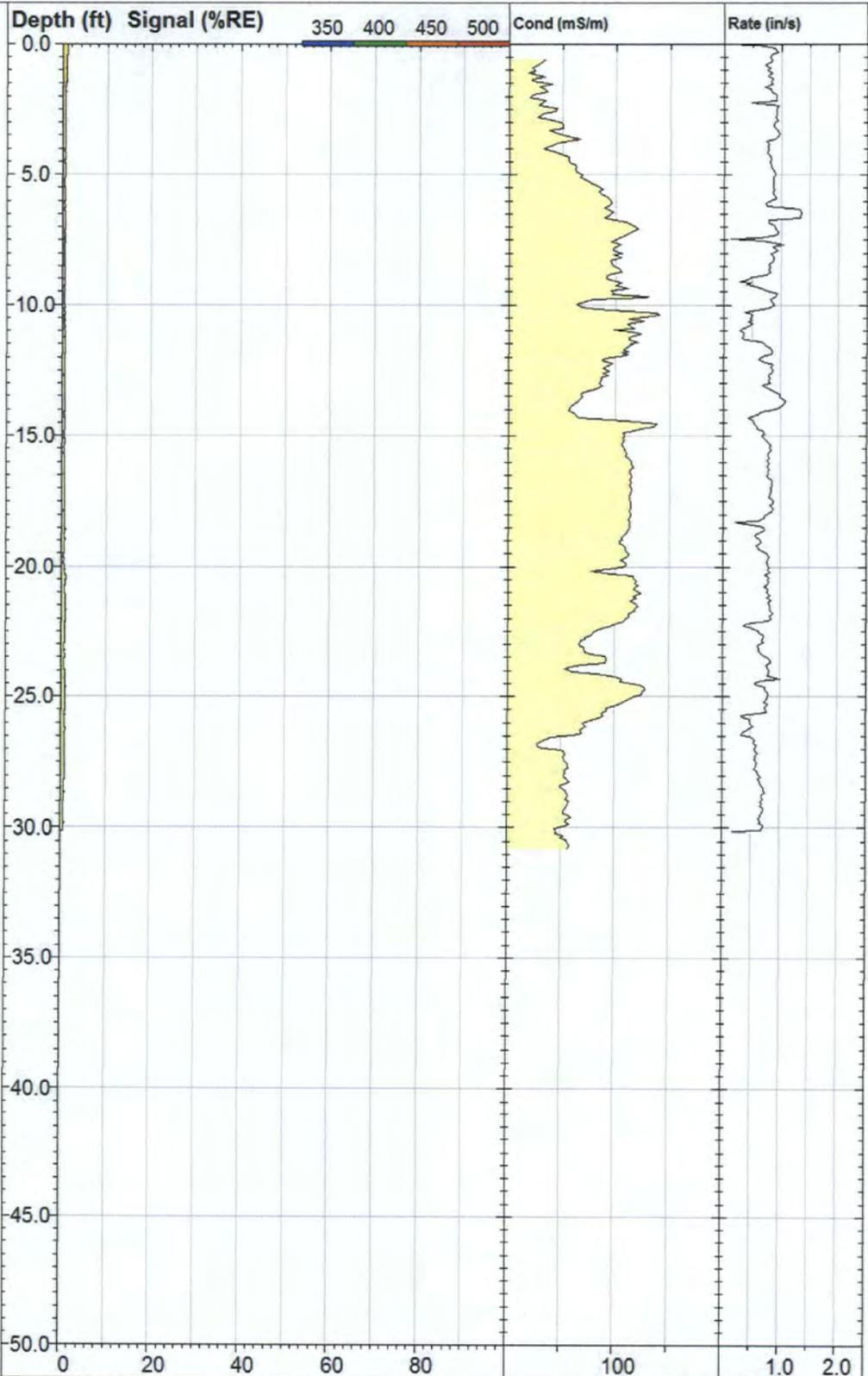
**Callouts**



RE  
100.0 %RE



Background  
0.4 %RE



WWW.DAKOTATECHNOLOGIES.COM

**LIF-21**

**UVOST® By Dakota**

www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
30.14 ft

Client / Job:  
Larsen & Associates / 025

X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
1.1 %RE @ 20.42 ft

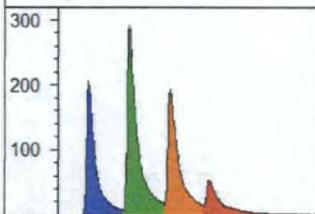
Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

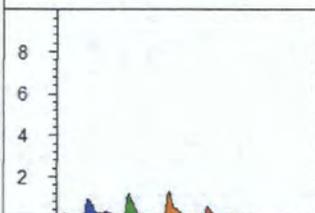
Date & Time:  
2016-09-28 15:50 CDT

## 4.0 Emulation Log

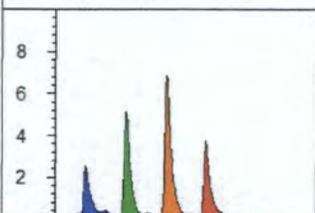
**Callouts**



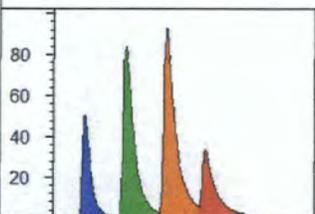
RE  
100.0 %RE



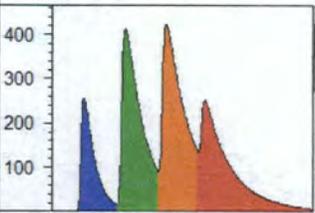
Background  
0.5 %RE



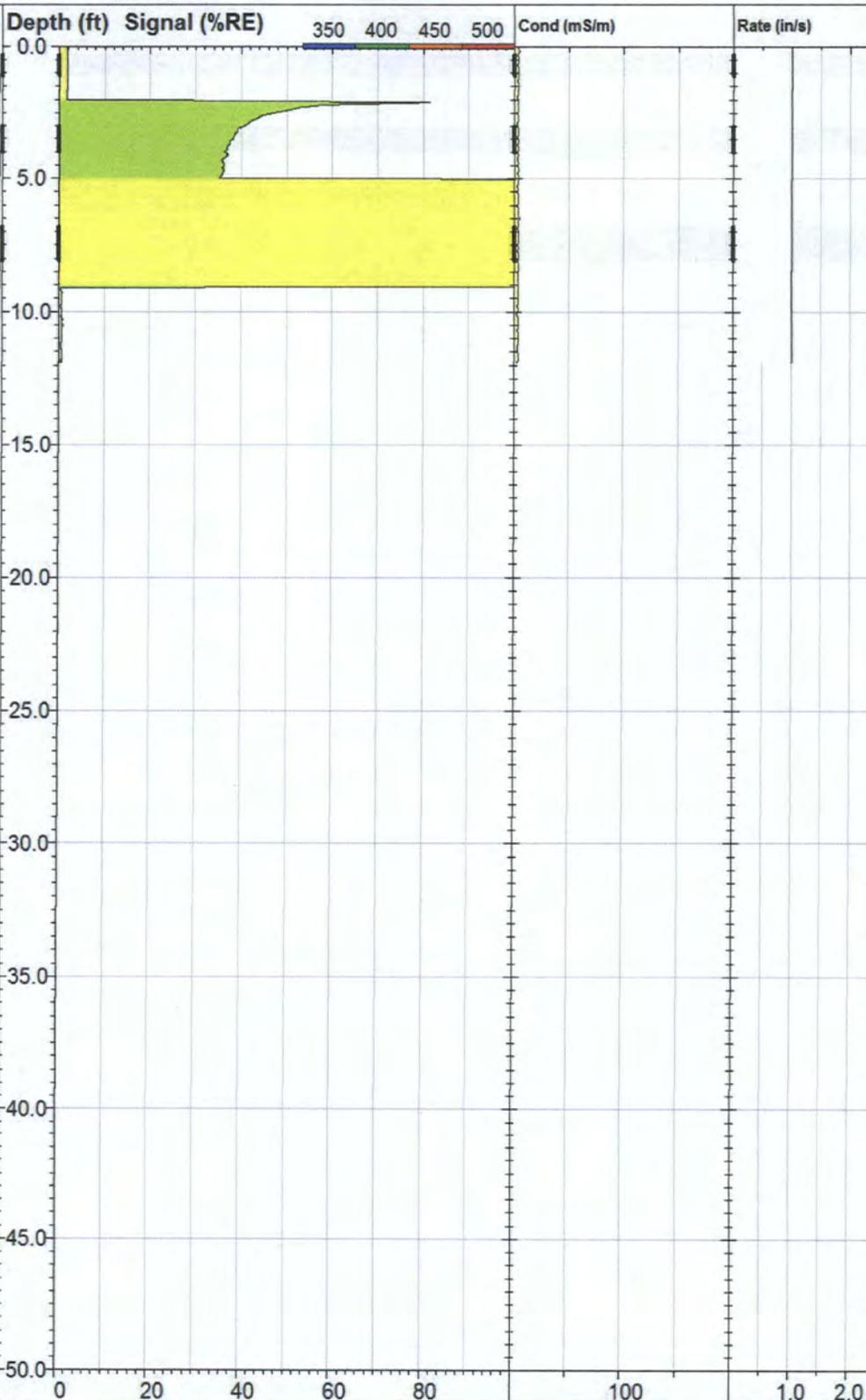
0.30 - 1.10 ft  
1.7 %RE (s 0.0)  
CLEAN SAND



3.00 - 4.00 ft  
38.1 %RE (s 1.3)  
PRODUCT ON SAND



6.80 - 8.10 ft  
352.0 %RE (s 1.4)  
PRODUCT ON WINDOW



**DAKOTA  
TECHNOLOGIES**

WWW.DAKOTATECHNOLOGIES.COM

**Emulation**

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
11.90 ft

Client / Job:  
Larsen & Associates / 025

X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
357.9 %RE @ 9.00 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 16:16 CDT

# Dakota Technologies UVOST® Reference Log

## Main Plot:

Signal (total fluorescence) versus depth where signal is relative to the Reference Emitter (RE). The total area of the waveform is divided by the total area of the Reference Emitter yielding the %RE. This %RE scales with the NAPL fluorescence. The fill color is based on relative contribution of each channel's area to the total waveform area (see callout waveform). The channel-to-color relationship and corresponding wavelengths are given in the upper right corner of the main plot.

## Callouts:

Waveforms from selected depths or depth ranges showing the multi-wavelength waveform for that depth. The four peaks are due to fluorescence at four wavelengths and referred to as "channels". Each channel is assigned a color.

Various NAPLs will have a unique waveform "fingerprint" due to the relative amplitude of the four channels and/or broadening of one or more channels. Basic waveform statistics and any operator notes are given below the callout.

## Conductivity Plot:

The Electrical Conductivity (EC) of the soil can be logged simultaneously with the UVOST data. EC often provides insight into the stratigraphy. Note the drop in EC from 10 to 13 feet, indicating a shift from finer (clay) to larger grain size (sand) stratigraphy. This correlates with the observed NAPL distribution.

## Rate:

The rate of probe advancement. Approx. 0.8 inches (2cm) per second is preferred. A noticeable decrease in the rate of advancement may be indicative of difficult probing conditions (gravel, angular sands, etc.) such as that seen here at approx. 5 ft.

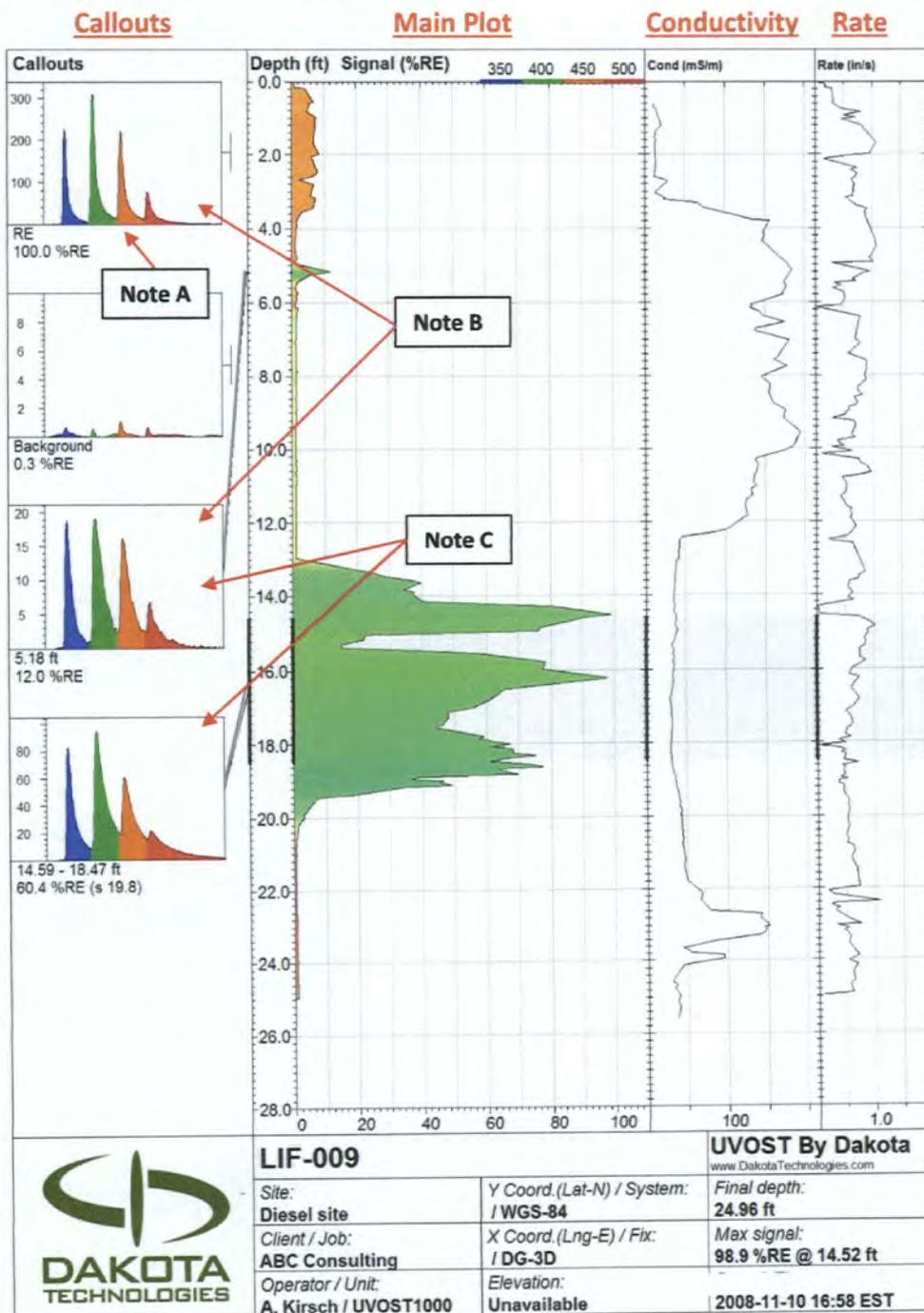
Note that this log was terminated arbitrarily, not due to "refusal," which would have been indicated by a sudden rate drop at final depth.

## Information Box:

Contains pertinent log information, including name and location.

## Note A:

Time is along the x axis. No scale is given on callouts, but it is a consistent 320ns wide. The y axis is in mV and directly corresponds to the amount of light striking the photodetector.



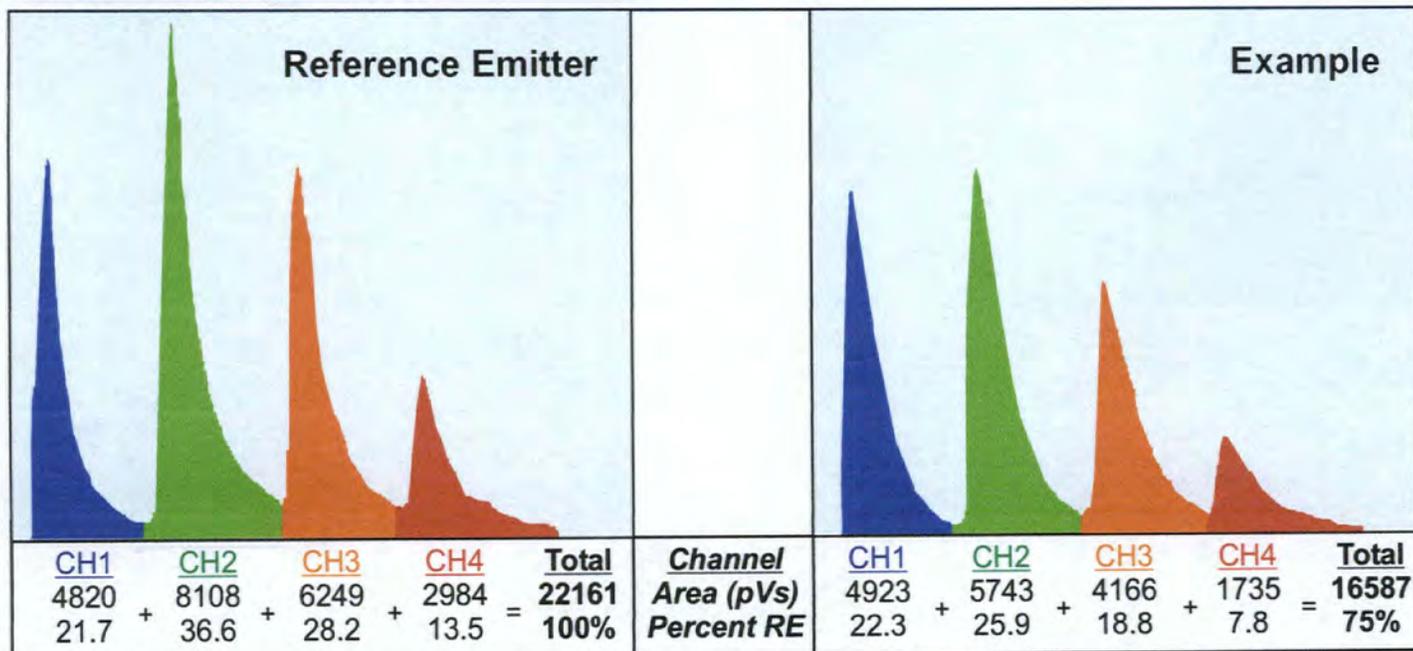
## Note B:

These two waveforms are clearly different. The top box is the Reference Emitter (a blend of NAPLs) always taken before each log for calibration, and the lower box is weathered diesel from the log itself.

## Note C:

Callouts can be a single depth (see 3rd callout) or a range (see 4th callout). The range is noted on the depth axis by a bold line. When the callout is a range, the average and standard deviation in %RE is given below the callout.

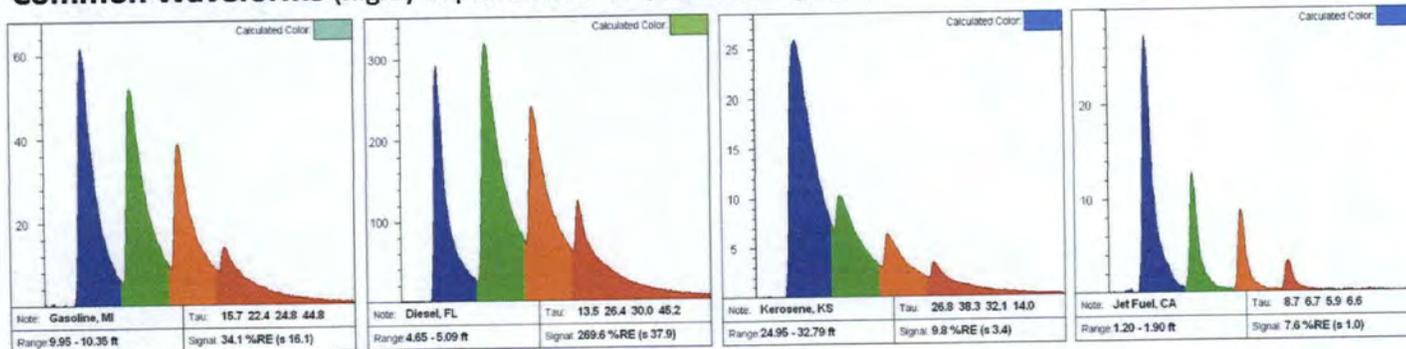
## Waveform Signal Calculation



## Data Files

<b>*.lif.raw.bin</b>	Raw data file. Header is ASCII format and contains information stored when the file was initially written (e.g. date, total depth, max signal, GPS, etc., and any information entered by the operator). All Raw waveforms are appended to the bottom of the file in a binary format.
<b>*.lif.plt</b>	Stores the plot scheme history (e.g. callout depths) for associated Raw file. Transfer along with the Raw file in order to recall previous plots.
<b>*.lif.jpg</b>	A .jpg image of the OST log including the main signal vs. depth plot, callouts, information, etc.
<b>*.lif.dat.txt</b>	Data export of a single Raw file. Tab delimited format. No string header is provided for the columns to make importing into some programs easier. Each row is a unique depth reading. The columns are: 1-Depth; 2-Total Signal (%RE); 3-CH1%; 4-Ch2%; 5-CH3%; 6-Ch4%; 7-Rate; 8-EC Depth; 9-EC Signal; 10-Hammer Rate Depth; 11-Hammer Rate; 12-Color (RRGGBB). Summing channels 1 to 4 yields the Total Signal.
<b>*.lif.sum.txt</b>	A summary file for a number of Raw files. ASCII tab delimited format. The file contains a string header. The summary includes one row for each Raw file and contains information for each file including: the file name, GPS coordinates, max depth, max signal, and depth at which the max signal occurred.
<b>*.lif.log.txt</b>	An activity log generated automatically is located in the OST application directory in the 'log' subfolder. Each OST unit the computer operates will generate a separate log file per month. A log file contains much of the header information contained within each separate Raw file, including: data rate, total depth, max signal, etc.

## Common Waveforms (highly dependent on soil, weathering, etc.)



**Tables**

## Table 2 - Groundwater Sampling Results

Sampling Date: 9/27/2016

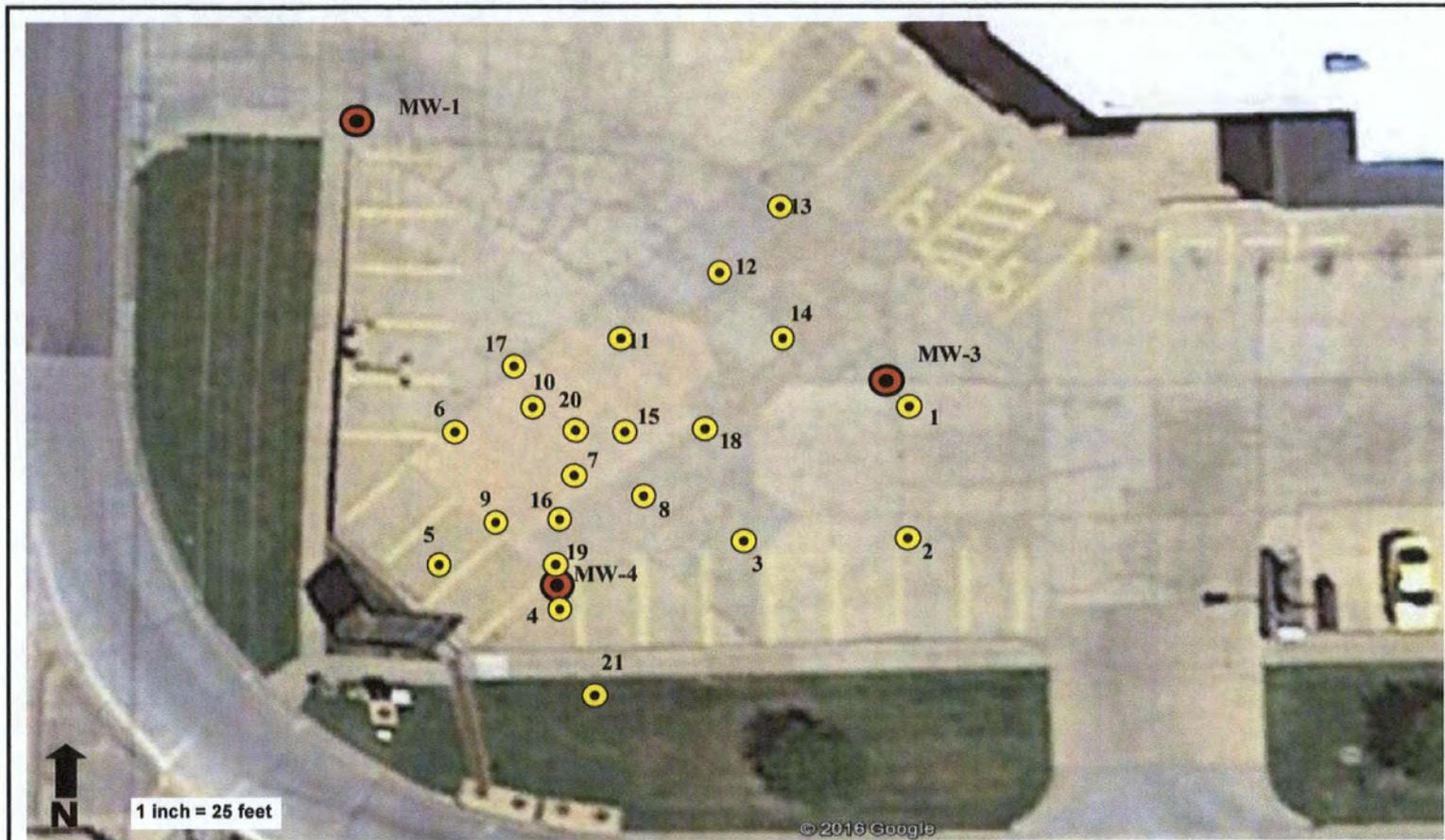
	Total BTEX µg/L	Benzene µg/L	Toluene µg/L	Ethylbenene µg/L	Xylene µg/L	MTBE µg/L	1,2 DCA µg/L	Napthalene µg/L
<b>MW-3</b>	369,100	10,300	14,600	74,200	270,000	19,600	ND	18,600
<b>MW-4</b>	146263	913	1,550	111,000	32,800	526	ND	ND

### KDHE Well Tags

<b>MW3</b>	
Removed	Installed
464143	470367

<b>MW4</b>	
Removed	Installed
464116	470251

**Figures**



**Figure 1 - LIF Boring Locations**

**LEGEND:**

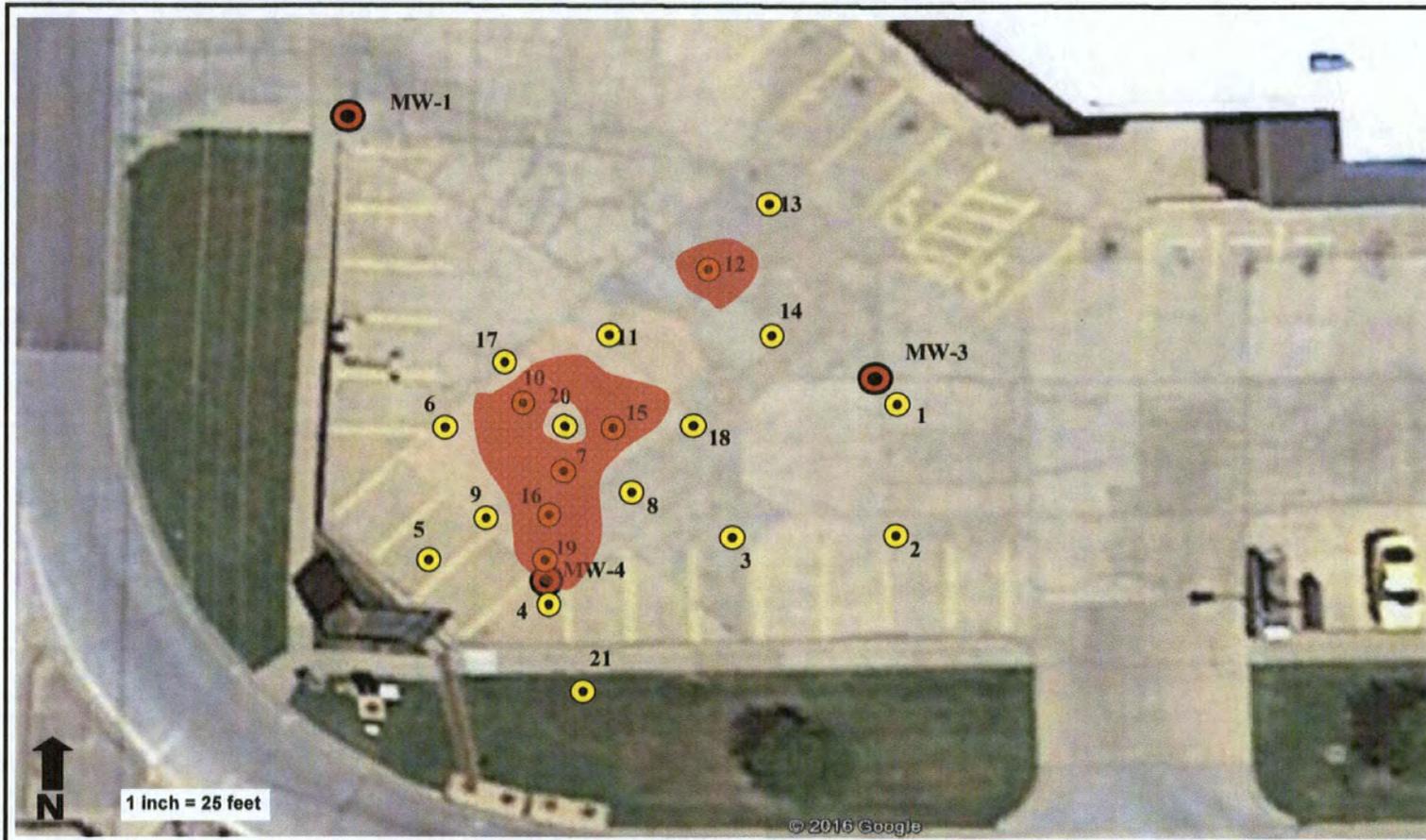
-  Monitoring Well
-  LIF Boring



1311 E 25th St., Suite B (785) 841-8707 (o)  
Lawrence, KS 66046 (785) 865-4282 (f)

**PROJECT:**

Former Coastal Mart #7301  
10330 W. Central Ave  
Wichita, KS  
KDHE ID: U2-087-13357



**Figure 2 - LNAPL Isopach**

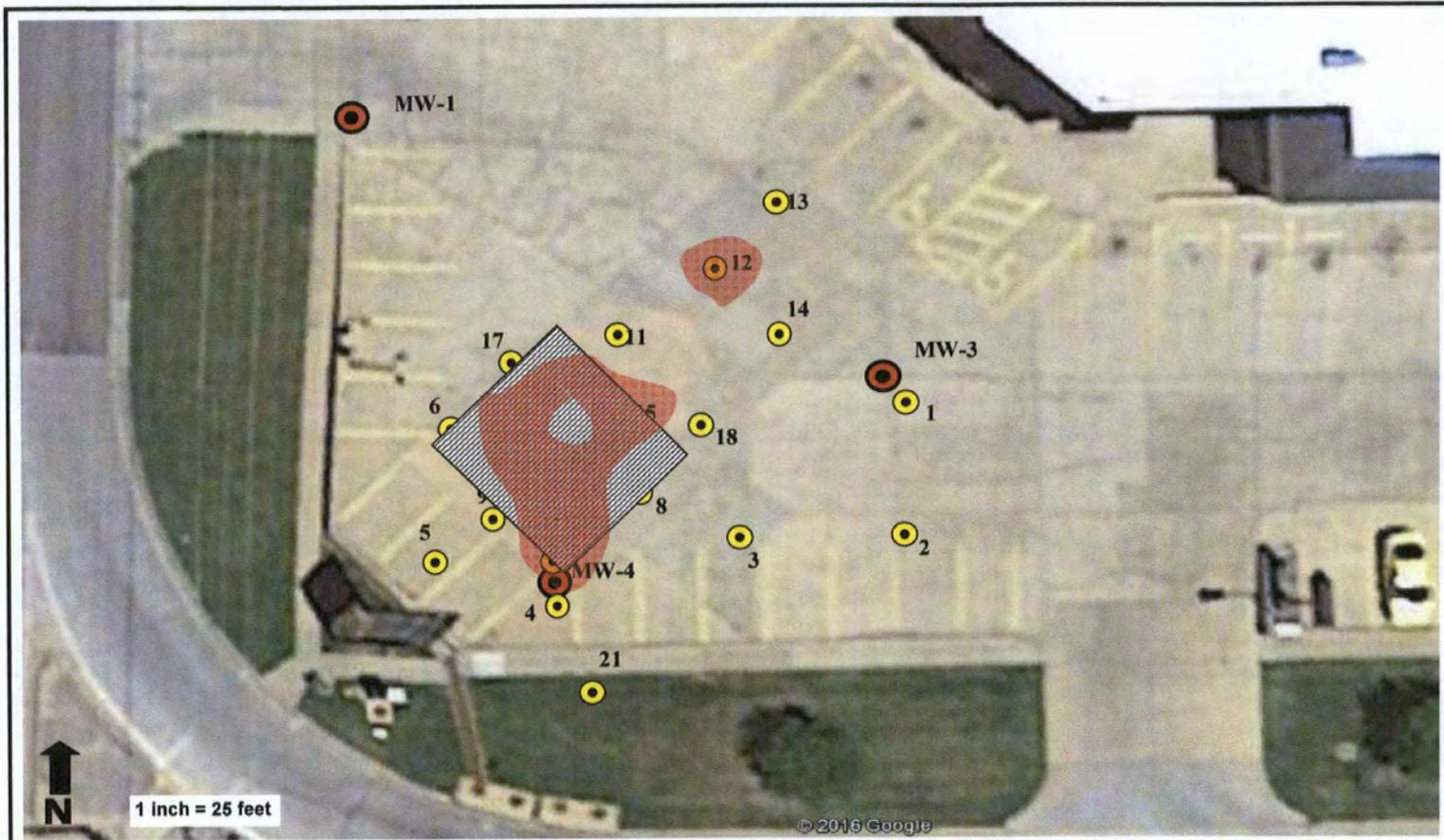
**LEGEND:**



1311 E 25th St., Suite B (785) 841-8707 (o)  
Lawrence, KS 66046 (785) 865-4282 (f)

**PROJECT:**  
Former Coastal Mart #7301  
10330 W. Central Ave  
Wichita, KS  
KDHE ID: U2-087-13357

-  **Monitoring Well**
-  **LIF Boring**
-  **LNAPL Isopach**



**Figure 3 - Former UST Basin**

**LEGEND:**

-  Monitoring Well
-  LIF Boring
-  EC delineation of Former UST Basin



1311 E 25th St., Suite B (785) 841-8707 (o)  
Lawrence, KS 66046 (785) 865-4282 (f)

**PROJECT:**

Former Coastal Mart #7301  
10330 W. Central Ave  
Wichita, KS  
KDHE ID: U2-087-13357

## **APPENDICES**

Appendix A	SMH Consultants – Professional Survey
Appendix B	Laboratory Analytical Report
Appendix C	Dakota Technologies, Inc. - Standard Report
Appendix D	Field Notes
Appendix E	Permits/Access

Appendix A SMH Consultants – Professional Survey

# SMH CONSULTANTS

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October 11, 2016

Larsen & Associates, Inc.  
 Andrew Hollenbach  
 1311 East 25<sup>th</sup> Street, Suite B  
 Lawrence, Kansas 66046  
 Email: Andrew@larsenenvironmental.com

RE: Project No. 1610MN1208

Dear Andrew:

The following is the information requested on a Monitoring Well Site, Former Coastal Mart #7301, 10330 West Central, Suite 140, Wichita, Sedgwick County, Kansas.

Point	North Coord.	East Coord.	Distance SE Cor. North	From S.17 West	Elev. Top Of Rim or PK Nail	Elev. Top of PVC Pipe	Latitude North	Longitude West
SE Corner S.17-T27S-R01W	10000	10000						
MW-1	10158.29	4763.26	158.29	5236.74	1336.71	1336.37	37.69421	97.46256
MW-2R	10128.19	4941.90	128.19	5058.10	1344.05	1343.62	37.69414	97.46194
MW-3	10113.43	4837.78	113.43	5162.22	1339.58	1339.41	37.69409	97.46230
MW-4	10083.30	4790.71	83.30	5209.29	1337.06	1336.47	37.69400	97.46246
MW-5	9904.85	4409.23	95.15 S.	5590.77	1330.29	1330.09	37.69349	97.46376
MW-6	10113.94	4503.21	113.94	5496.79	1331.59	1331.28	37.69407	97.46345
MW-7	9922.22	4939.21	77.78 S.	5060.79	1339.59	1339.18	37.69357	97.46193
MW-8	10227.84	4773.89	227.84	5226.11	1340.25	1340.04	37.69440	97.46253
Site BM	10121.85	4757.90	121.85	5242.21				BM Elevation = 1337.61

BM Description: "□" Square cut on southwest corner of concrete base of southwest light pole.

MW-1, MW-2R, MW-3, MW-4, MW-8 are in the: SW¼ SW¼ SW¼ SW¼ S.17-T27S-R01W  
 MW-6 is in the: SE¼ SE¼ SE¼ SE¼ S.18-T27S-R01W  
 MW-5 is in the: NE¼ NE¼ NE¼ NE¼ S.19-T27S-R01W  
 MW-7 is in the: NW¼ NW¼ NW¼ NW¼ S.20-T27S-R01W

Point	North Coord.	East Coord.	Distance SE Cor. North	From S.17 West	Ground Elevation	Latitude North	Longitude West
Soil Boring 1	10110.20	4838.80	110.20	5161.20	1339.4	37.69408	97.46229
Soil Boring 2	10088.50	4839.09	88.50	5160.91	1338.0	37.69402	97.46229
Soil Boring 3	10088.16	4815.08	88.16	5184.92	1337.9	37.69402	97.46237
Soil Boring 4	10079.73	4790.40	79.73	5209.60	1336.6	37.69400	97.46246
Soil Boring 5	10087.23	4771.99	87.23	5228.01	1336.4	37.69401	97.46252
Soil Boring 6	10106.47	4777.25	106.47	5222.75	1337.9	37.69407	97.46251
Soil Boring 7	10101.10	4792.07	101.10	5207.93	1338.1	37.69405	97.46245
Soil Boring 8	10097.22	4801.59	97.22	5198.41	1338.4	37.69404	97.46242
Soil Boring 9	10095.14	4780.60	95.14	5219.40	1337.3	37.69403	97.46249
Soil Boring 10	10111.29	4789.12	111.29	5210.88	1338.6	37.69408	97.46247
Soil Boring 11	10121.02	4798.28	121.02	5201.72	1339.1	37.69411	97.46243
Soil Boring 12	10132.05	4815.46	132.05	5184.54	1339.8	37.69414	97.46238
Soil Boring 13	10144.97	4824.15	144.97	5175.85	1340.7	37.69417	97.46235
Soil Boring 14	10121.34	4822.17	121.34	5177.83	1339.8	37.69411	97.46235
Soil Boring 15	10108.90	4800.83	108.90	5199.17	1338.8	37.69407	97.46243
Soil Boring 16	10093.98	4791.06	93.98	5208.94	1337.7	37.69403	97.46246
Soil Boring 17	10119.36	4786.15	119.36	5213.85	1338.8	37.69410	97.46248
Soil Boring 18	10108.93	4811.46	108.93	5188.54	1339.1	37.69407	97.46239
Soil Boring 19	10087.61	4791.15	87.61	5208.85	1337.4	37.69401	97.46246
Soil Boring 20	10109.27	4794.31	109.27	5205.69	1338.7	37.69407	97.46245
Soil Boring 21	10066.47	4796.33	66.47	5203.67	1334.5	37.69396	97.46244

Soil Boring 1-21 are in the: SW¼ SW¼ SW¼ SW¼ S.17-T27S-R01W

If you have any questions, please do not hesitate in giving us a call.

Sincerely,



Tim Sloan, L.S.  
SMH CONSULTANTS

Appendix B      Laboratory Analytical Report

October 04, 2016

Jayne Beemer  
Larsen & Associates, Inc.  
1311 E. 25th St.  
Suite B  
Lawrence, KS 66046

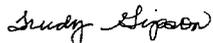
RE: Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

Dear Jayne Beemer:

Enclosed are the analytical results for sample(s) received by the laboratory on September 29, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,



Trudy Gipson  
trudy.gipson@pacelabs.com  
Project Manager

Enclosures

cc: Jess Chapman, Larsen & Associates, Inc.  
Linda Gorup, Larsen & Associates, Inc.  
Katy Nessel, Larsen & Associates, Inc.



## REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,  
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## CERTIFICATIONS

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

---

### **Kansas Certification IDs**

9608 Loiret Boulevard, Lenexa, KS 66219  
WY STR Certification #: 2456.01  
Arkansas Certification #: 15-016-0  
Illinois Certification #: 003097  
Iowa Certification #: 118  
Kansas/NELAP Certification #: E-10116

Louisiana Certification #: 03055  
Nevada Certification #: KS000212008A  
Oklahoma Certification #: 9205/9935  
Texas Certification #: T104704407  
Utah Certification #: KS00021  
Kansas Field Laboratory Accreditation: # E-92587

---

## REPORT OF LABORATORY ANALYSIS

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### SAMPLE SUMMARY

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

---

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60228879001	MW3	Water	09/27/16 16:27	09/29/16 17:35
60228879002	MW4	Water	09/27/16 15:55	09/29/16 17:35
60228879003	TB	Water	09/27/16 15:55	09/29/16 17:35

### REPORT OF LABORATORY ANALYSIS

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### SAMPLE ANALYTE COUNT

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

---

Lab ID	Sample ID	Method	Analysts	Analytes Reported
60228879001	MW3	EPA 8260	PGH	11
60228879002	MW4	EPA 8260	PGH	11
60228879003	TB	EPA 8260	PGH	8

### REPORT OF LABORATORY ANALYSIS

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### ANALYTICAL RESULTS

Project: Former Coastal Mart #7301

Pace Project No.: 60228879

Sample: MW3 Lab ID: 60228879001 Collected: 09/27/16 16:27 Received: 09/29/16 17:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
<b>8260 MSV UST, Water</b>		Analytical Method: EPA 8260						
Benzene	10300	ug/L	500	500		10/04/16 02:46	71-43-2	
1,2-Dichloroethane	ND	ug/L	250	500		10/04/16 02:46	107-06-2	
Ethylbenzene	74200	ug/L	500	500		10/04/16 02:46	100-41-4	
Methyl-tert-butyl ether	19600	ug/L	500	500		10/04/16 02:46	1634-04-4	
Naphthalene	18600	ug/L	5000	500		10/04/16 02:46	91-20-3	
Toluene	14600	ug/L	500	500		10/04/16 02:46	108-88-3	
Xylene (Total)	270000	ug/L	1500	500		10/04/16 02:46	1330-20-7	
<b>Surrogates</b>								
Toluene-d8 (S)	99	%	80-120	500		10/04/16 02:46	2037-26-5	
4-Bromofluorobenzene (S)	98	%	77-130	500		10/04/16 02:46	460-00-4	
1,2-Dichloroethane-d4 (S)	102	%	81-127	500		10/04/16 02:46	17060-07-0	
Preservation pH	1.0		1.0	500		10/04/16 02:46		

### REPORT OF LABORATORY ANALYSIS

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**ANALYTICAL RESULTS**

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

Sample: **MW4** Lab ID: **60228879002** Collected: 09/27/16 15:55 Received: 09/29/16 17:35 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
<b>8260 MSV UST, Water</b>		Analytical Method: EPA 8260						
Benzene	913	ug/L	500	500		10/04/16 03:01	71-43-2	
1,2-Dichloroethane	ND	ug/L	250	500		10/04/16 03:01	107-06-2	
Ethylbenzene	11100	ug/L	500	500		10/04/16 03:01	100-41-4	
Methyl-tert-butyl ether	526	ug/L	500	500		10/04/16 03:01	1634-04-4	
Naphthalene	ND	ug/L	5000	500		10/04/16 03:01	91-20-3	
Toluene	1550	ug/L	500	500		10/04/16 03:01	108-88-3	
Xylene (Total)	32800	ug/L	1500	500		10/04/16 03:01	1330-20-7	
<b>Surrogates</b>								
Toluene-d8 (S)	99	%	80-120	500		10/04/16 03:01	2037-26-5	
4-Bromofluorobenzene (S)	98	%	77-130	500		10/04/16 03:01	460-00-4	
1,2-Dichloroethane-d4 (S)	102	%	81-127	500		10/04/16 03:01	17060-07-0	
Preservation pH	1.0		1.0	500		10/04/16 03:01		

**REPORT OF LABORATORY ANALYSIS**

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### ANALYTICAL RESULTS

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

Sample: TB		Lab ID: 60228879003	Collected: 09/27/16 15:55	Received: 09/29/16 17:35	Matrix: Water			
Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
<b>8260 MSV UST, Water</b>		Analytical Method: EPA 8260						
Benzene	ND	ug/L	1.0	1		10/04/16 02:30	71-43-2	
Ethylbenzene	ND	ug/L	1.0	1		10/04/16 02:30	100-41-4	
Toluene	ND	ug/L	1.0	1		10/04/16 02:30	108-88-3	
Xylene (Total)	ND	ug/L	3.0	1		10/04/16 02:30	1330-20-7	
<b>Surrogates</b>								
Toluene-d8 (S)	103	%	80-120	1		10/04/16 02:30	2037-26-5	
4-Bromofluorobenzene (S)	97	%	77-130	1		10/04/16 02:30	460-00-4	
1,2-Dichloroethane-d4 (S)	104	%	81-127	1		10/04/16 02:30	17060-07-0	
Preservation pH	1.0			1		10/04/16 02:30		

### REPORT OF LABORATORY ANALYSIS

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**QUALITY CONTROL DATA**

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

QC Batch: 448965 Analysis Method: EPA 8260  
QC Batch Method: EPA 8260 Analysis Description: 8260 MSV UST-WATER  
Associated Lab Samples: 60228879001, 60228879002, 60228879003

METHOD BLANK: 1837327 Matrix: Water  
Associated Lab Samples: 60228879001, 60228879002, 60228879003

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,2-Dichloroethane	ug/L	ND	0.50	10/04/16 01:45	
Benzene	ug/L	ND	1.0	10/04/16 01:45	
Ethylbenzene	ug/L	ND	1.0	10/04/16 01:45	
Methyl-tert-butyl ether	ug/L	ND	1.0	10/04/16 01:45	
Naphthalene	ug/L	ND	10.0	10/04/16 01:45	
Toluene	ug/L	ND	1.0	10/04/16 01:45	
Xylene (Total)	ug/L	ND	3.0	10/04/16 01:45	
1,2-Dichloroethane-d4 (S)	%	103	81-127	10/04/16 01:45	
4-Bromofluorobenzene (S)	%	97	77-130	10/04/16 01:45	
Toluene-d8 (S)	%	100	80-120	10/04/16 01:45	

LABORATORY CONTROL SAMPLE: 1837328

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2-Dichloroethane	ug/L	20	21.3	106	72-116	
Benzene	ug/L	20	20.5	103	79-116	
Ethylbenzene	ug/L	20	19.0	95	81-110	
Methyl-tert-butyl ether	ug/L	20	16.3	82	79-117	
Naphthalene	ug/L	20	18.7	93	74-125	
Toluene	ug/L	20	18.9	95	82-111	
Xylene (Total)	ug/L	60	59.1	99	80-111	
1,2-Dichloroethane-d4 (S)	%			105	81-127	
4-Bromofluorobenzene (S)	%			99	77-130	
Toluene-d8 (S)	%			101	80-120	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

**REPORT OF LABORATORY ANALYSIS**

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## QUALIFIERS

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

---

### DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.  
ND - Not Detected at or above adjusted reporting limit.  
J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.  
MDL - Adjusted Method Detection Limit.  
PQL - Practical Quantitation Limit.  
RL - Reporting Limit.  
S - Surrogate  
1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.  
Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.  
LCS(D) - Laboratory Control Sample (Duplicate)  
MS(D) - Matrix Spike (Duplicate)  
DUP - Sample Duplicate  
RPD - Relative Percent Difference  
NC - Not Calculable.  
SG - Silica Gel - Clean-Up  
U - Indicates the compound was analyzed for, but not detected.  
N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.  
Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.  
TNI - The NELAC Institute.

### BATCH QUALIFIERS

Batch: 448965

[M5] A matrix spike/matrix spike duplicate was not performed for this batch due to insufficient sample volume.

## REPORT OF LABORATORY ANALYSIS

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### QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Former Coastal Mart #7301  
Pace Project No.: 60228879

---

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60228879001	MW3	EPA 8260	448965		
60228879002	MW4	EPA 8260	448965		
60228879003	TB	EPA 8260	448965		

### REPORT OF LABORATORY ANALYSIS

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Sample Condition Upon Receipt

WO#: 60228879



104

Client Name: Larsen

Courier: FedEx  UPS  VIA  Clay  PEX  ECI  Pace  Xroads  Client  Other

Tracking #: \_\_\_\_\_ Pace Shipping Label Used? Yes  No

Custody Seal on Cooler/Box Present: Yes  No  Seals intact: Yes  No

Packing Material: Bubble Wrap  Bubble Bags  Foam  None  Other  2:02

Thermometer Used: T-266  T-239  Type of Ice: Wet  Blue  None

Cooler Temperature (°C): As-read 2.0 Corr. Factor CF+1.1  CF-0.1  Corrected 1.9

Date and initials of person examining contents: 8/29/16

Temperature should be above freezing to 6°C

Chain of Custody present:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Chain of Custody relinquished:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Samples arrived within holding time:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Short Hold Time analyses (<72hr):	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
Rush Turn Around Time requested:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Sufficient volume:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Correct containers used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Pace containers used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Containers intact:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Unpreserved 5035A / TX1005/1006 soils frozen in 48hrs?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Filtered volume received for dissolved tests?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Sample labels match COC: Date / time / ID / analyses	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Samples contain multiple phases? Matrix: <u>WT</u>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Containers requiring pH preservation in compliance? (HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> , HCl<2; NaOH>9 Sulfide, NaOH>10 Cyanide) (Exceptions: VOA, Micro, O&G, KS TPH, OK-DRO)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Cyanide water sample checks: <input type="checkbox"/> N/A	
Lead acetate strip turns dark? (Record only)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Potassium iodide test strip turns blue/purple? (Preserve)	<input type="checkbox"/> Yes <input type="checkbox"/> No
Trip Blank present:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Headspace in VOA vials (>6mm):	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A
Samples from USDA Regulated Area: State:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A
Additional labels attached to 5035A / TX1005 vials in the field?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A

Client Notification/ Resolution: Copy COC to Client? Y /  N Field Data Required? Y / N

Person Contacted: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Comments/ Resolution: \_\_\_\_\_

Project Manager Review: snr Date: 8-30-16



Appendix C      Dakota Technologies, Inc. - Standard Report

# High Resolution Site Characterization Report – Ultra-Violet Optical Screening Tool

**Client: Larsen & Associates, Inc.**

**Project Name: Former Coastal Mart 7301**

**Location: Wichita, KS**

**Prepared by:**

**Dakota Technologies Company, LLC**

**11253 91<sup>st</sup> Avenue N.**

**Maple Grove, Minnesota 55369**

**763.424.4803**

**October 5, 2016**

**Project Number: 0256.16**



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National and International Services

■ High Resolution Site Characterization Specialists ■

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3.0	DISCUSSION AND COMMENTS.....	3
4.0	LIMITATIONS.....	4

## APPENDICES

Appendix A	UVOST® Field Summary Log
Appendix B	UVOST® Logs at 100% RE
Appendix C	UVOST® Logs at 10% RE
Appendix D	UVOST® Emulation
Appendix E	UVOST® Reference Log

## 1.0 ULTRA-VIOLET OPTICAL SCREENING TOOL (UVOST®) DESCRIPTION & ANALYSIS

Fluorescence is a property of some compounds where absorbed ultra-violet (UV) light stimulates the emission of photons (light) of a longer wavelength relative to the source emission. The release of the photons can be used to detect small amounts of substance (i.e., polycyclic aromatic hydrocarbons (PAHs)) in a larger matrix (soil). This method of detection has been used in laboratories for decades. With the commercial availability of lasers and optical fibers, this technology can also be applied in-situ in the field to identify the presence of light non-aqueous phase liquids (LNAPL).

The UVOST® system sends laser light (308 nanometer wavelength) through a fiber optic cable strung within probe rods on a direct push drill rig. The light, reflected by a parabolic mirror, then exits through a sapphire window in the side of the probe. As the probe is advanced, the immediately adjacent soil is exposed to the UV laser light. If PAHs (compounds in petroleum oils and lubricants that fluoresce) are present, longer wavelength light is emitted by the PAH compounds. This “signal” light is transmitted through a return fiber, back to the surface to be analyzed. Responses are indicated in real-time on a graph of signal vs. depth. The UVOST® log displays “color mixed” signal logs consisting of contributions from four wavelength channels, and waveforms (“fingerprint” of multi-wavelength) to aid in identification and relative quantity of the compound present.

Prior to every log, the UVOST® system is checked for optical quality by observing the background signal for sources of signal in the fiber, filter, mirror and sapphire window. Also, the reference emitter (a standard, proprietary LNAPL mixture called the “RE”) is placed on the window to determine the qualitative and semi-quantitative properties of the laser system. This is to assure that the RE response has the correct shape and intensity and that the UVOST® system is calibrated to log. Typically, the RE will fall between 10,000 and 12,000 picovolt-seconds (pVs), which is a measure of waveform area. The background can vary from 0.1% to 1%, which is typically an area of approximately 0 to 100 pVs. The relationship between the instrument responses from NAPL in the subsurface and the RE depends on the properties of the NAPL. The calibration of the system is not to a concentration, but to a known fluorescence signature.

## 2.0 ELECTRICAL CONDUCTIVITY (EC) DESCRIPTION

Electrical Conductivity (EC) data were collected simultaneously with the UVOST® data. EC is a measure of the soil's ability to conduct an electrical current between two dipoles on the UVOST/EC probe. Conductivity is the reciprocal of electrical resistivity and has the units (in our application) of millisiemens per meter (mS/m). Since soil is in the pathway of the charge flow, the grain size can be determined by comparing the EC log to lithology observed in a soil boring. Conductivity readings in the 100s indicate smaller grain (size such as clay). Larger grain size (sand and gravels) are typically in the 10s of mS/m range. Prior to every log, the EC point of the UVOST® probe is checked for proper operation by performing a voltage test with a voltage meter and a conductivity test with a test block.

### 3.0 DISCUSSION AND COMMENTS

Dakota Technologies completed 21 UVOST® borings on the property.

On the LIF-19 the borehole logging was accidentally stopped at 17.93 feet. A new log LIF-19A was started at 17.93 feet and advanced to 38.11 feet. These two logs were stitched together create the log LIF-19\_LIF19A.

LNAPL was observed on six logs between approximately 11 and 22 feet. No LNAPL was identified on the remaining 14 logs by UVOST®.

On all logs there is a green colored signal near the surface, this is not an LNAPL response and is probably a response to the concrete dust from the preprobing.

All QA/QC passed specifications for all UVOST® logs.

No soil sampling was completed for confirmation of EC data (soil type) and UVOST® (LNAPL) findings.

#### **4.0 LIMITATIONS**

The analysis and opinions expressed in this report are based upon data obtained from the specific test locations and from other information discussed in this report. Exceptions, if any, are discussed in the accompanying comments section of this report. This report is prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted practices. Reported results shall not be reproduced, except in full, without written approval of Dakota. No warranties, expressed or implied are intended or made.

**Appendix A**

**UVOST<sup>®</sup> Field Summary Log**

### UVOST® Field Summary Log

Former Coastal Mart 7301

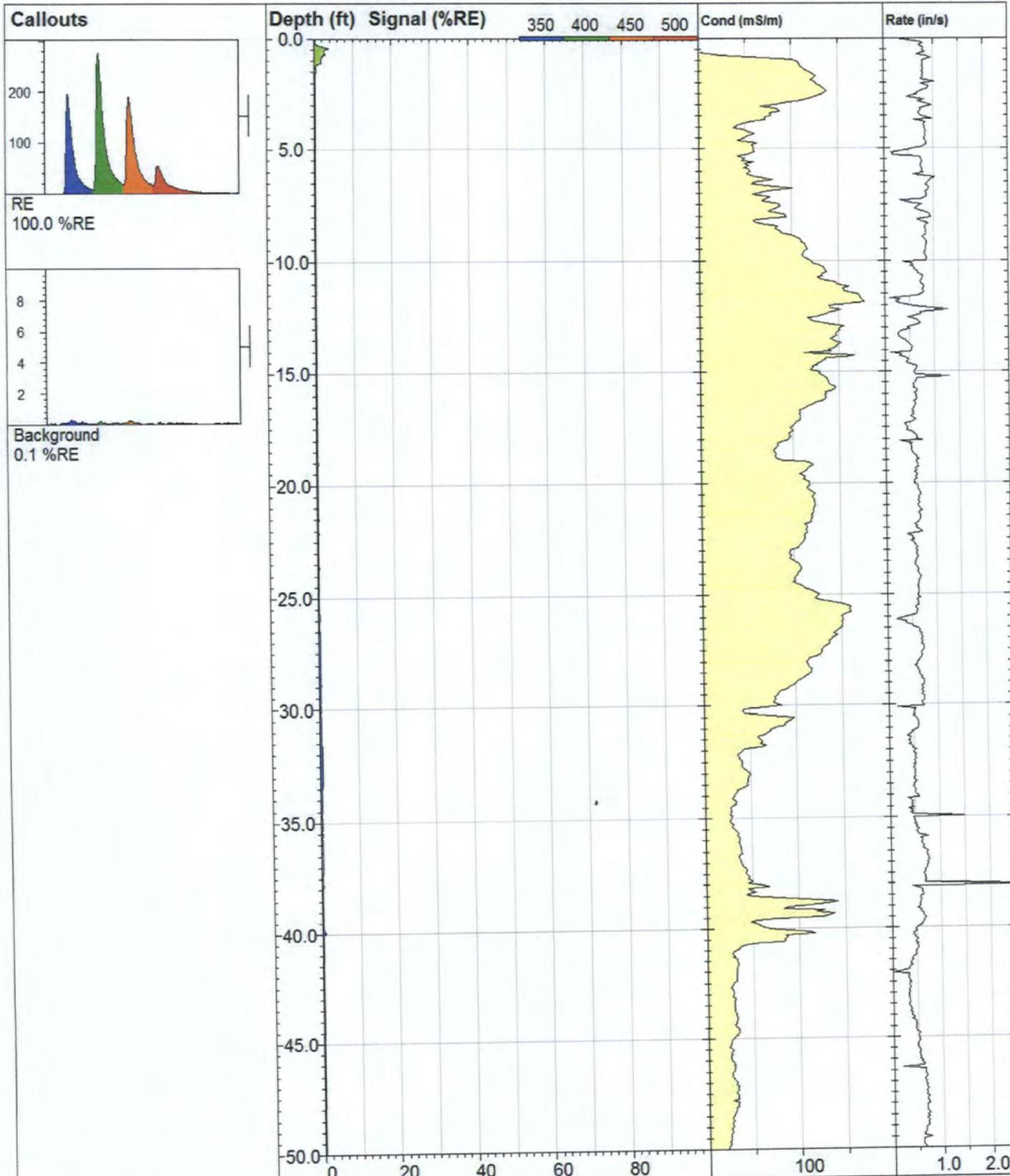
Wichita, KS

File Log ID	Date / Time	Pre-Probe (ft)	Final Depth (ft)	Max Signal (%RE)	Max Signal Depth (ft)	Initial RE Area (pVs)	Background Area (pVs)	Fluorescence <sup>(1)</sup> Top - Bottom (ft)
LIF-01	9/27/2016 8:53	1	50	4	0	11632	13	NA
LIF-02	9/27/2016 9:35	1	40	3	1	11062	19	NA
LIF-03	9/27/2016 10:08	1	40	2	0	11463	26	NA
LIF-04	9/27/2016 10:46	1	40	3	1	11594	34	NA
LIF-05	9/27/2016 11:47	1	40	3	1	10993	12	21.8
LIF-06	9/27/2016 13:27	1	40	4	1	10912	17	NA
LIF-07	9/27/2016 14:05	1	40	57	13	11005	0	12.2-22.7
LIF-08	9/27/2016 14:38	1	40	2	1	10040	21	18.3
LIF-09	9/27/2016 15:23	1	30	5	1	11191	20	NA
LIF-10	9/27/2016 16:08	1	32	9	13	11310	33	12.8-20.0
LIF-11	9/27/2016 16:45	1	34	4	1	10745	24	NA
LIF-12	9/28/2016 8:32	1	34	2	19	11484	23	18.8-19.4
LIF-13	9/28/2016 8:59	1	34	3	1	11329	24	NA
LIF-14	9/28/2016 9:29	1	30	5	1	11691	39	NA
LIF-15	9/28/2016 10:06	1	34	16	13	11647	48	12.5-18.7
LIF-16	9/28/2016 10:36	1	34	19	17	11343	43	16.2-22.2
LIF-17	9/28/2016 11:13	1	34	6	1	11470	34	NA
LIF-18	9/28/2016 11:44	1	34	4	1	11873	48	15.2-34
LIF-19_LIF-19A	9/28/2016 14:31	1	38	3	17	11648	0	16.4-17.2
LIF-20	9/28/2016 15:19	1	34	7	1	11324	67	12.3-13, 22.7
LIF-21	9/28/2016 15:50	1	30	1	20	11109	49	NA
Emulation	9/28/2016 16:16	0	12	358	9	11083	51	NA
Total Footage (this sheet)			764					

(1) Signal response from 0 to 1 feet may not be representative of actual conditions due to pre-probing.

**Appendix B**

**UVOST<sup>®</sup> Logs at 100% RE**



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**LIF-01**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

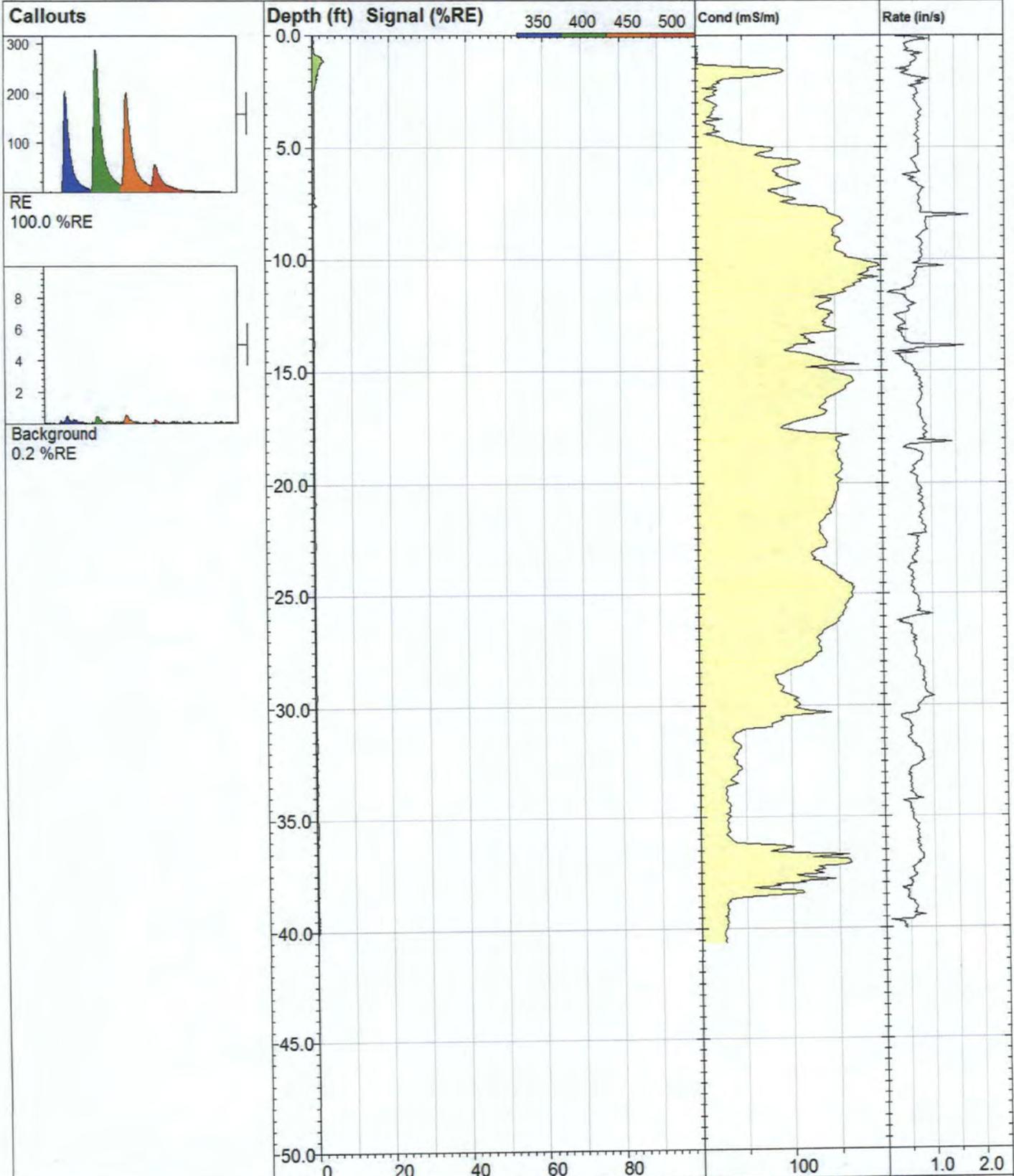
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
50.07 ft

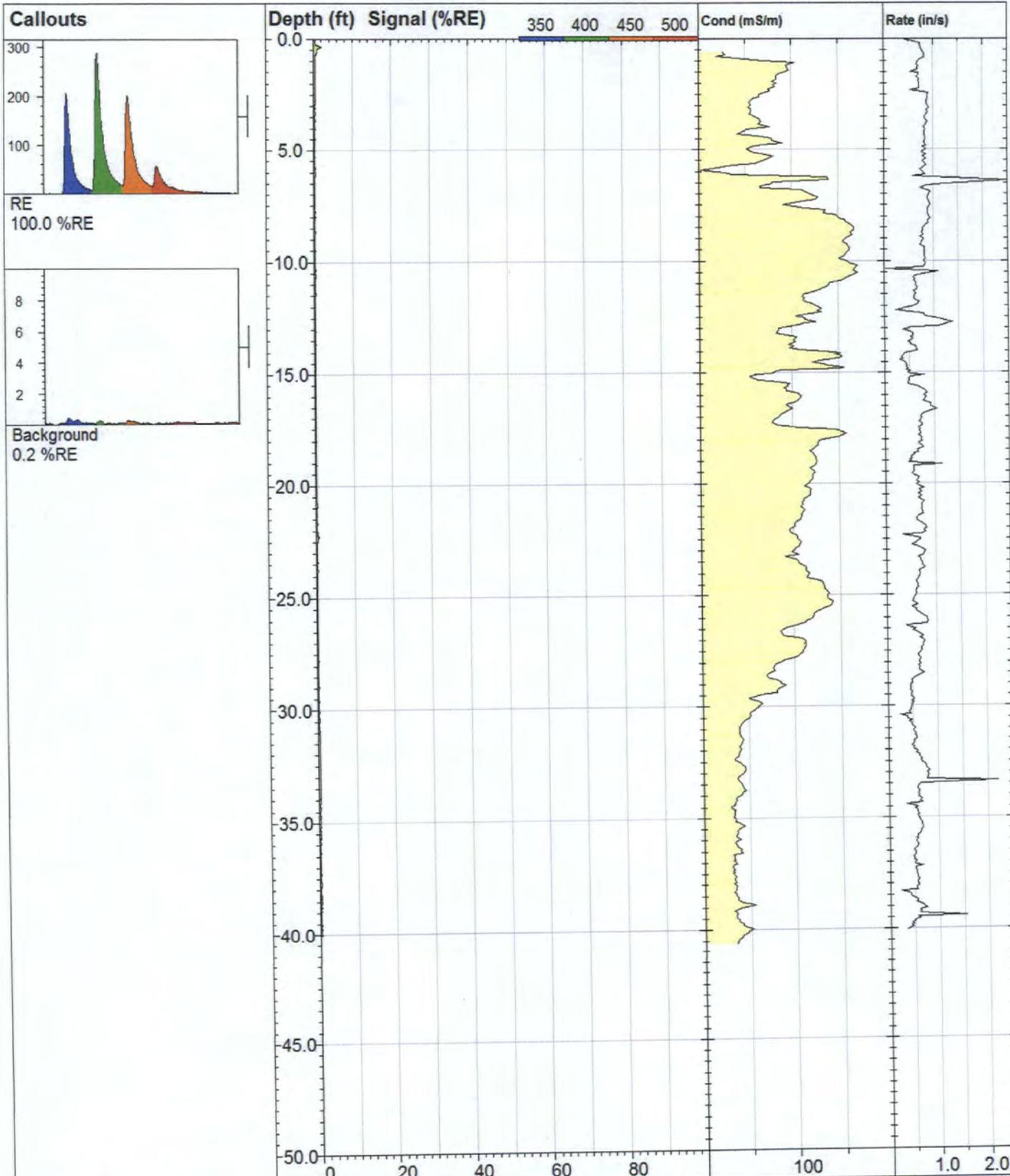
Max signal:  
3.7 %RE @ 0.44 ft

Date & Time:  
2016-09-27 08:53 CDT



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<b>LIF-02</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 40.05 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 3.0 %RE @ 1.15 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 09:35 CDT



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**LIF-03**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

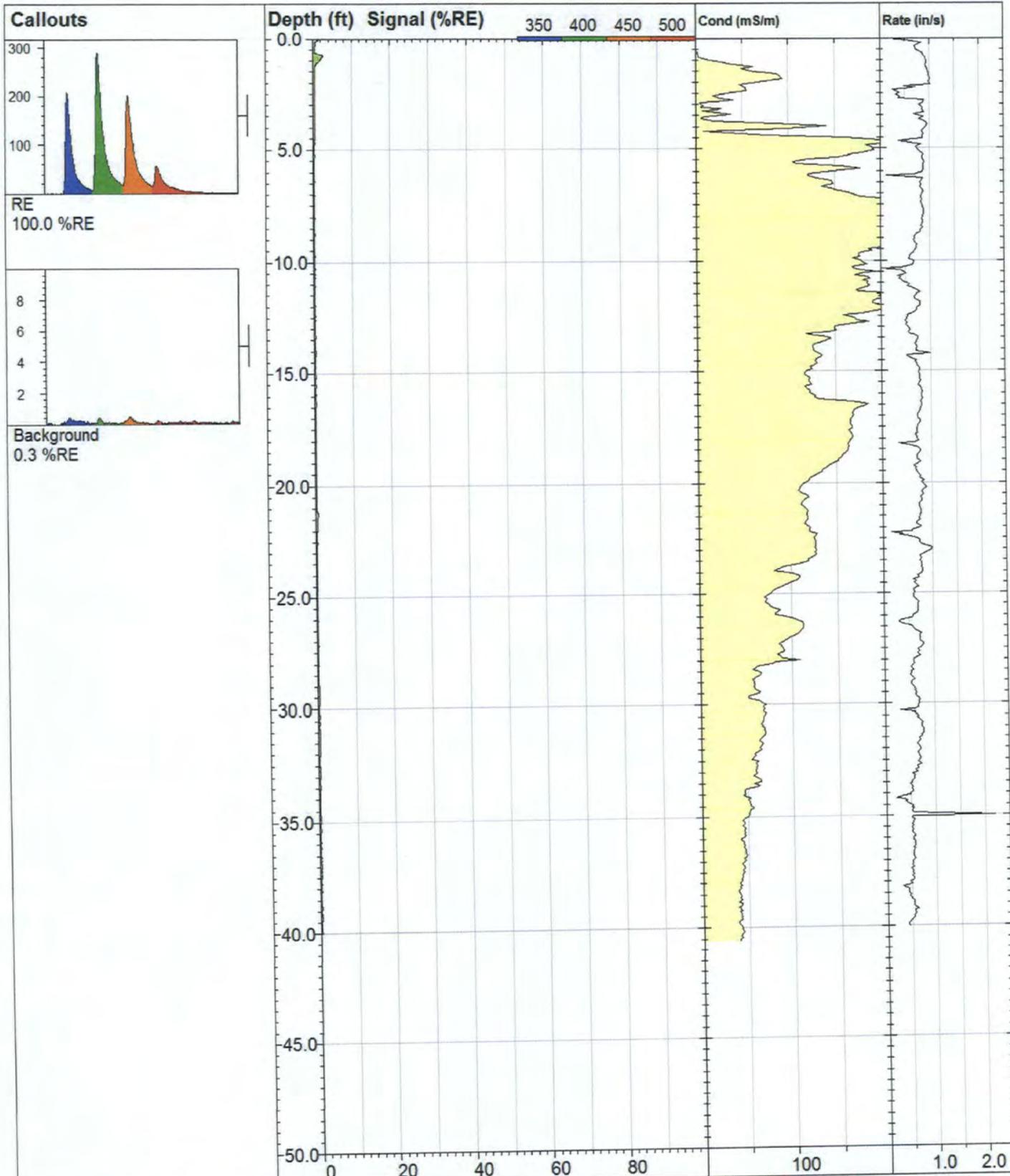
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
40.03 ft

Max signal:  
1.8 %RE @ 0.37 ft

Date & Time:  
2016-09-27 10:08 CDT



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### LIF-04

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

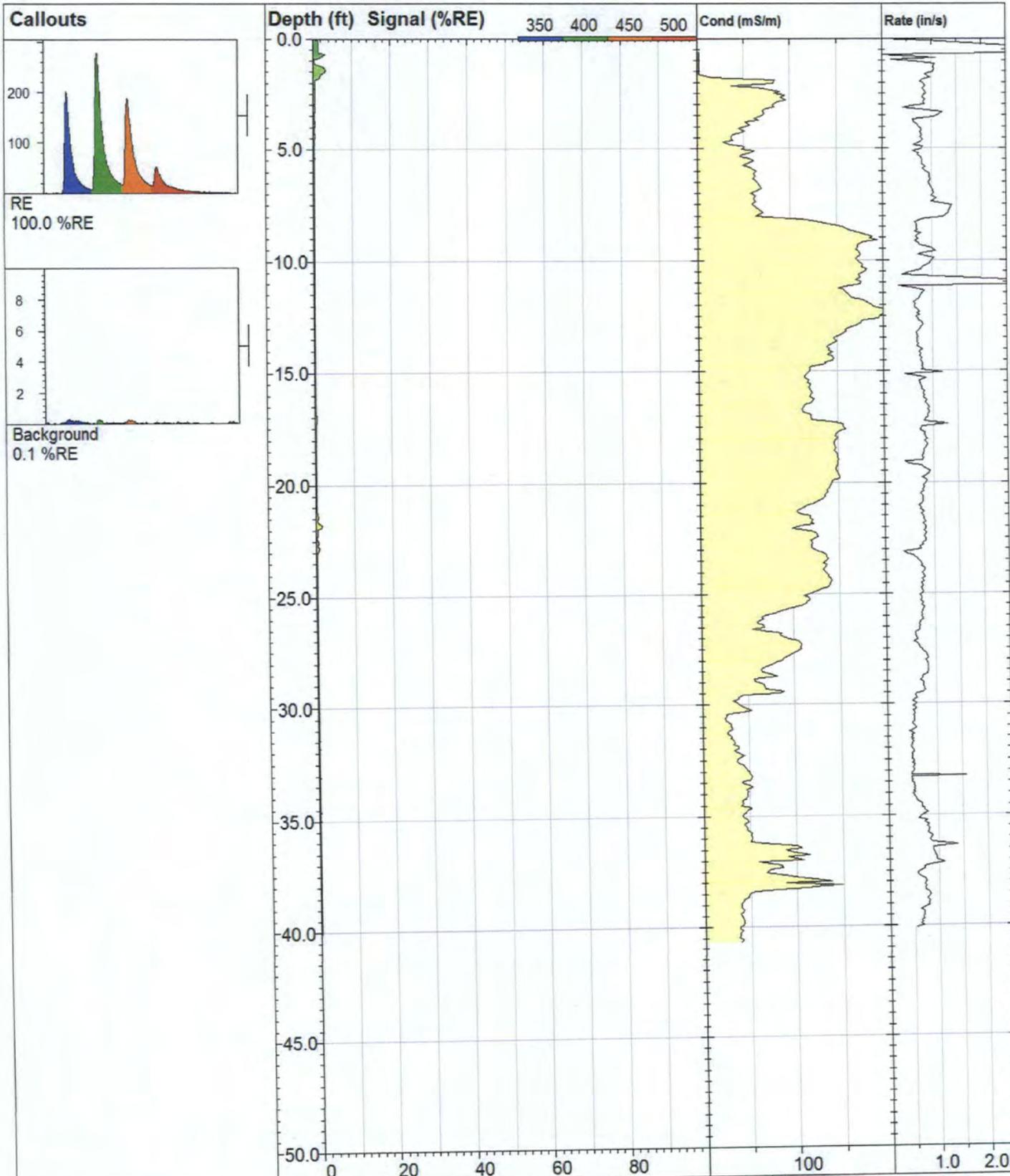
Elevation:  
Unavailable

UVOST® By Dakota  
www.DakotaTechnologies.com

Final depth:  
40.00 ft

Max signal:  
2.6 %RE @ 0.76 ft

Date & Time:  
2016-09-27 10:46 CDT



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### LIF-05

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord. (Lat-N) / System:  
Unavailable / NA

Final depth:  
40.07 ft

Client / Job:  
Larsen & Associates / 025

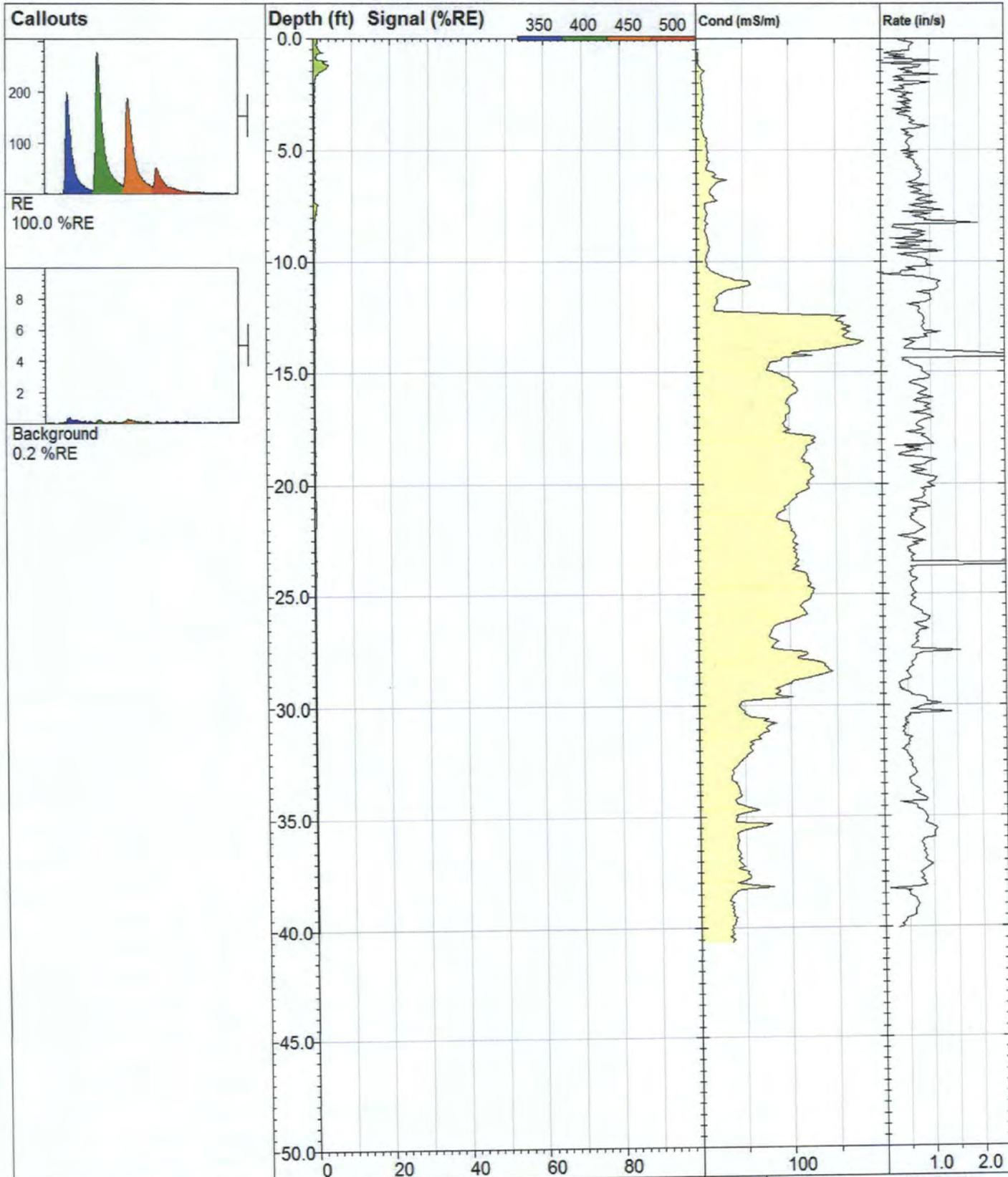
X Coord. (Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.2 %RE @ 1.41 ft

Operator / Unit:  
JMBG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 11:47 CDT



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**LIF-06**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

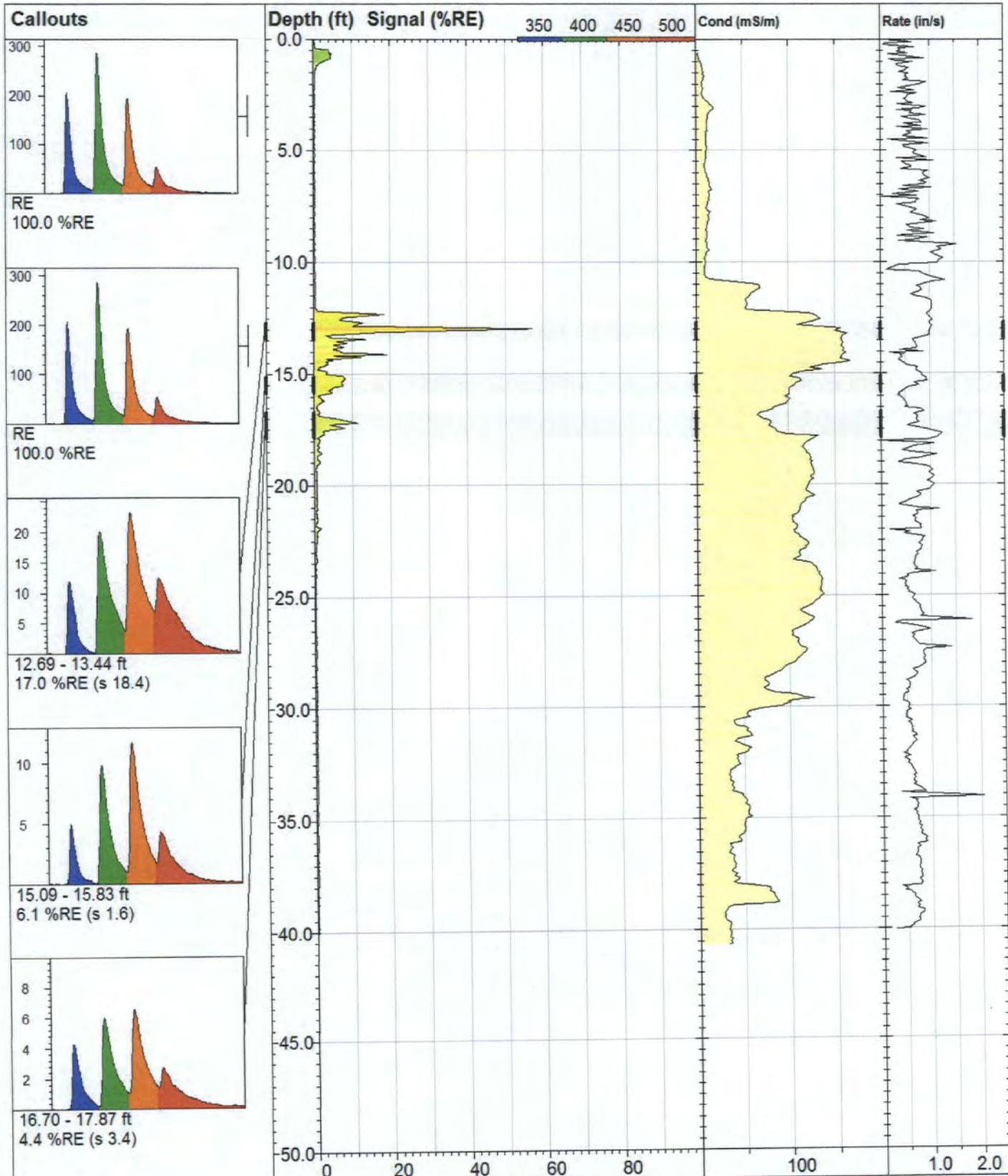
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
40.02 ft

Max signal:  
4.2 %RE @ 1.21 ft

Date & Time:  
2016-09-27 13:27 CDT



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### LIF-07

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

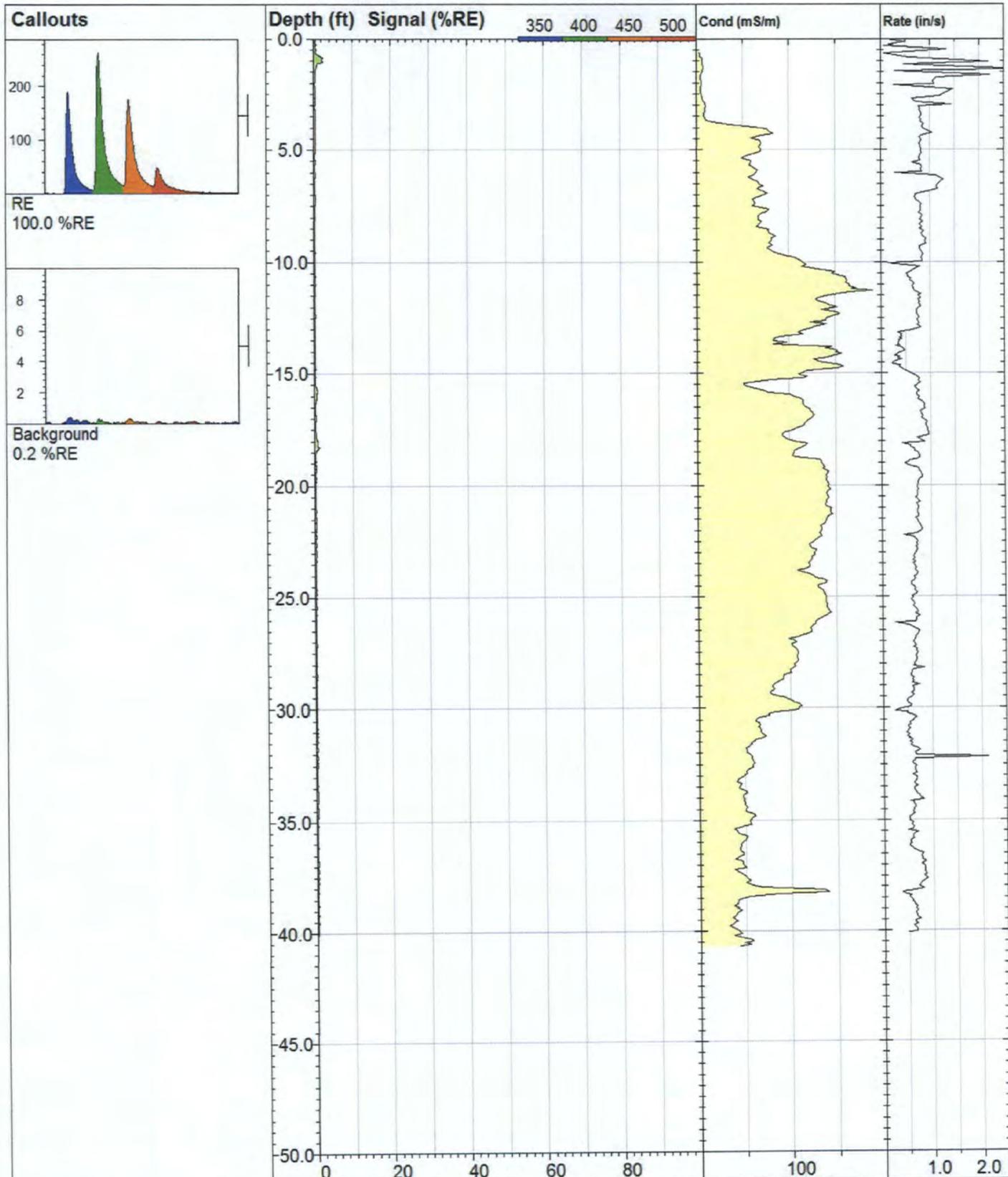
Elevation:  
Unavailable

UVOST® By Dakota  
www.DakotaTechnologies.com

Final depth:  
40.04 ft

Max signal:  
57.1 %RE @ 12.97 ft

Date & Time:  
2016-09-27 14:05 CDT



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**LIF-08**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

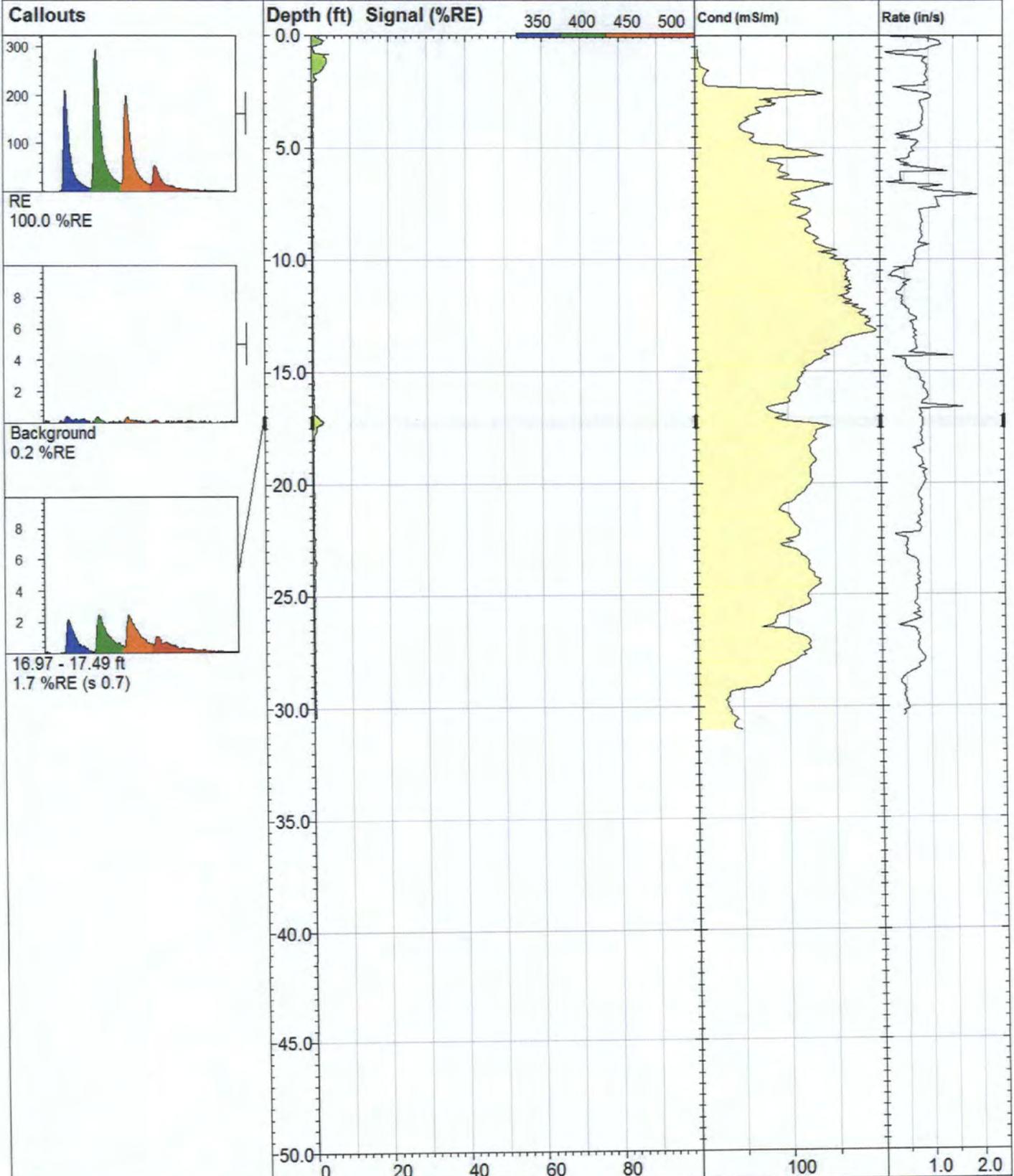
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
40.07 ft

Max signal:  
2.4 %RE @ 1.06 ft

Date & Time:  
2016-09-27 14:38 CDT



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**LIF-09**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

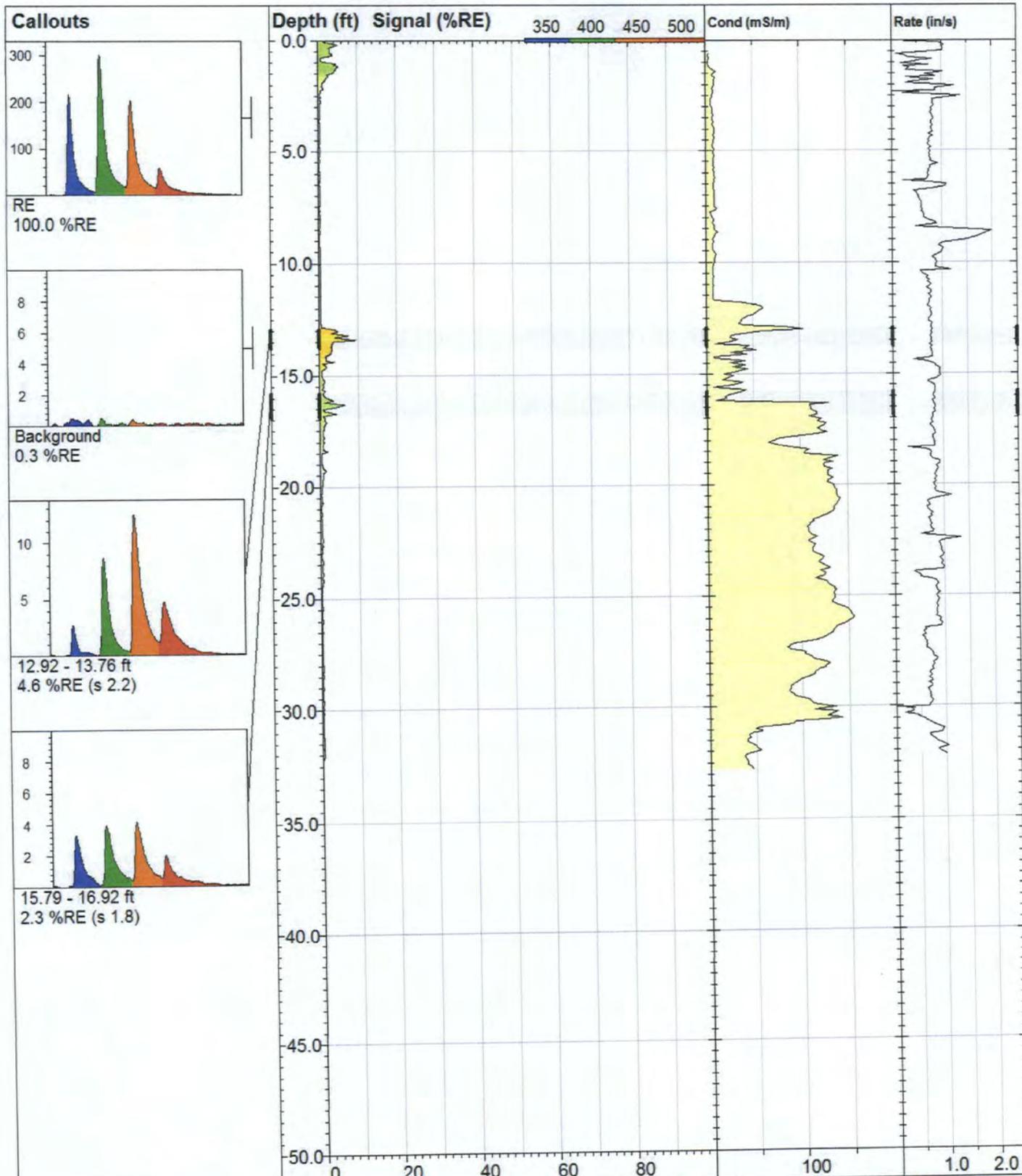
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
30.37 ft

Max signal:  
4.6 %RE @ 0.84 ft

Date & Time:  
2016-09-27 15:23 CDT



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### LIF-10

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

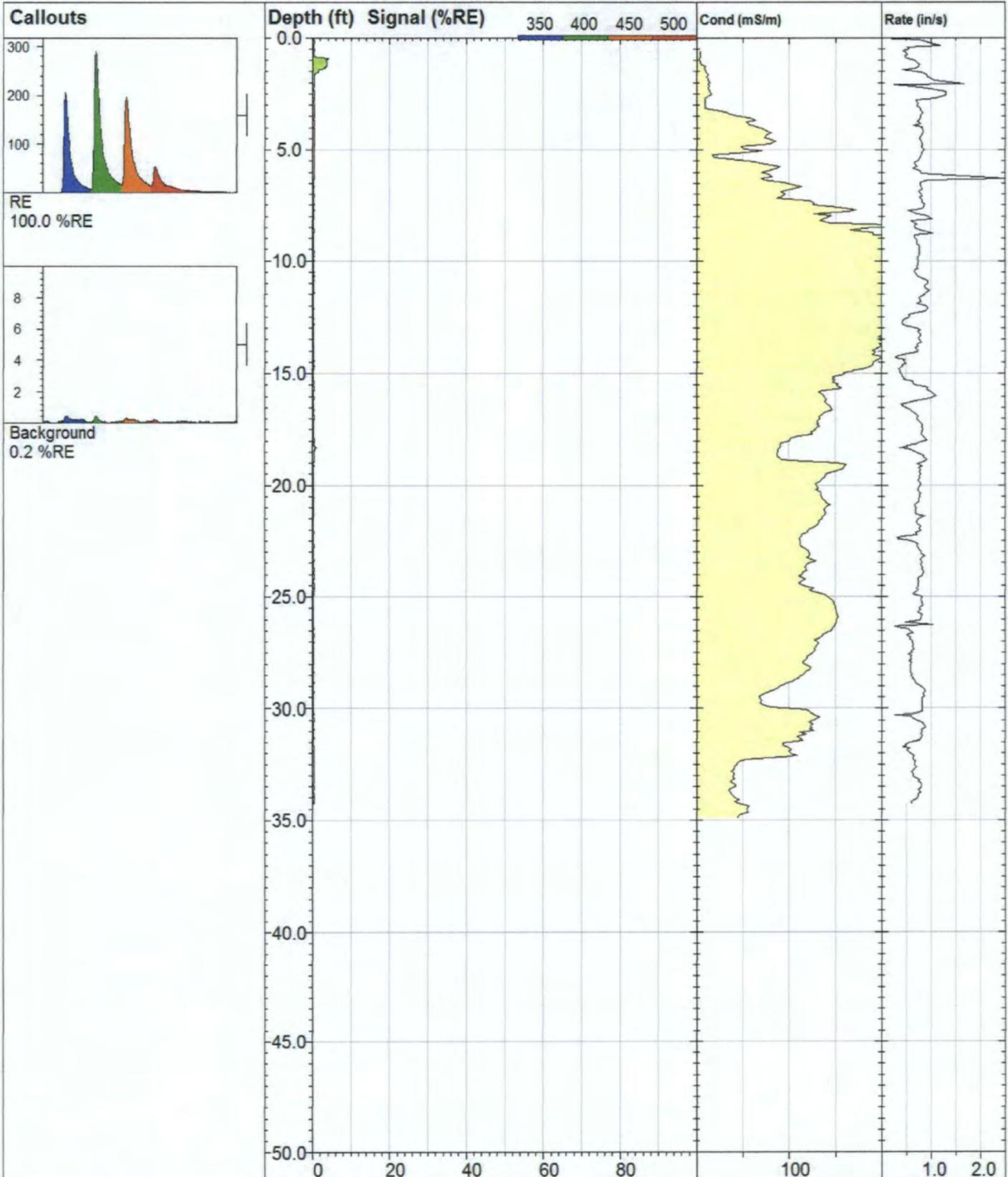
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
32.17 ft

Max signal:  
9.4 %RE @ 13.39 ft

Date & Time:  
2016-09-27 16:08 CDT



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**LIF-11**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

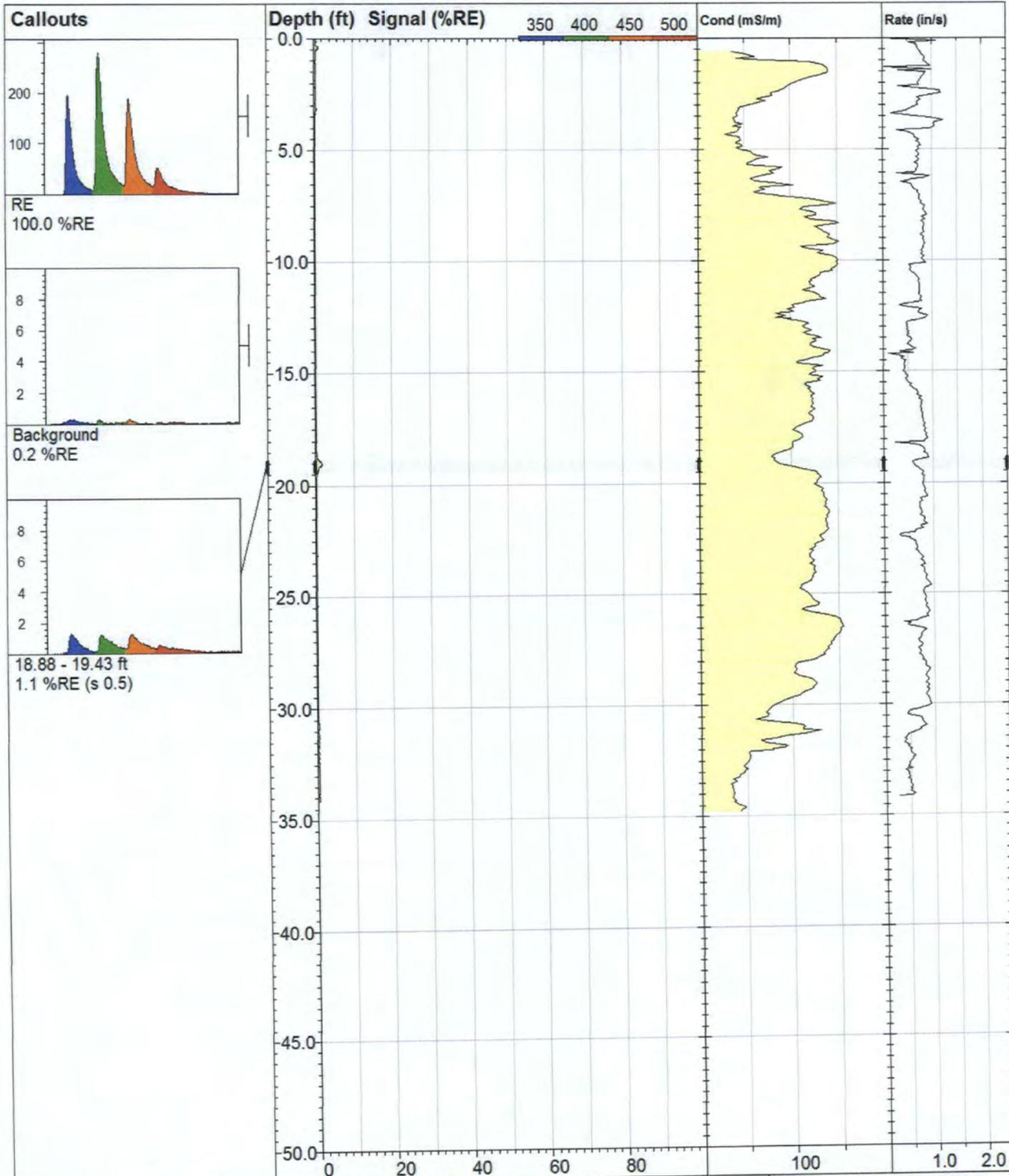
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
34.27 ft

Max signal:  
4.0 %RE @ 0.93 ft

Date & Time:  
2016-09-27 16:45 CDT



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### LIF-12

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

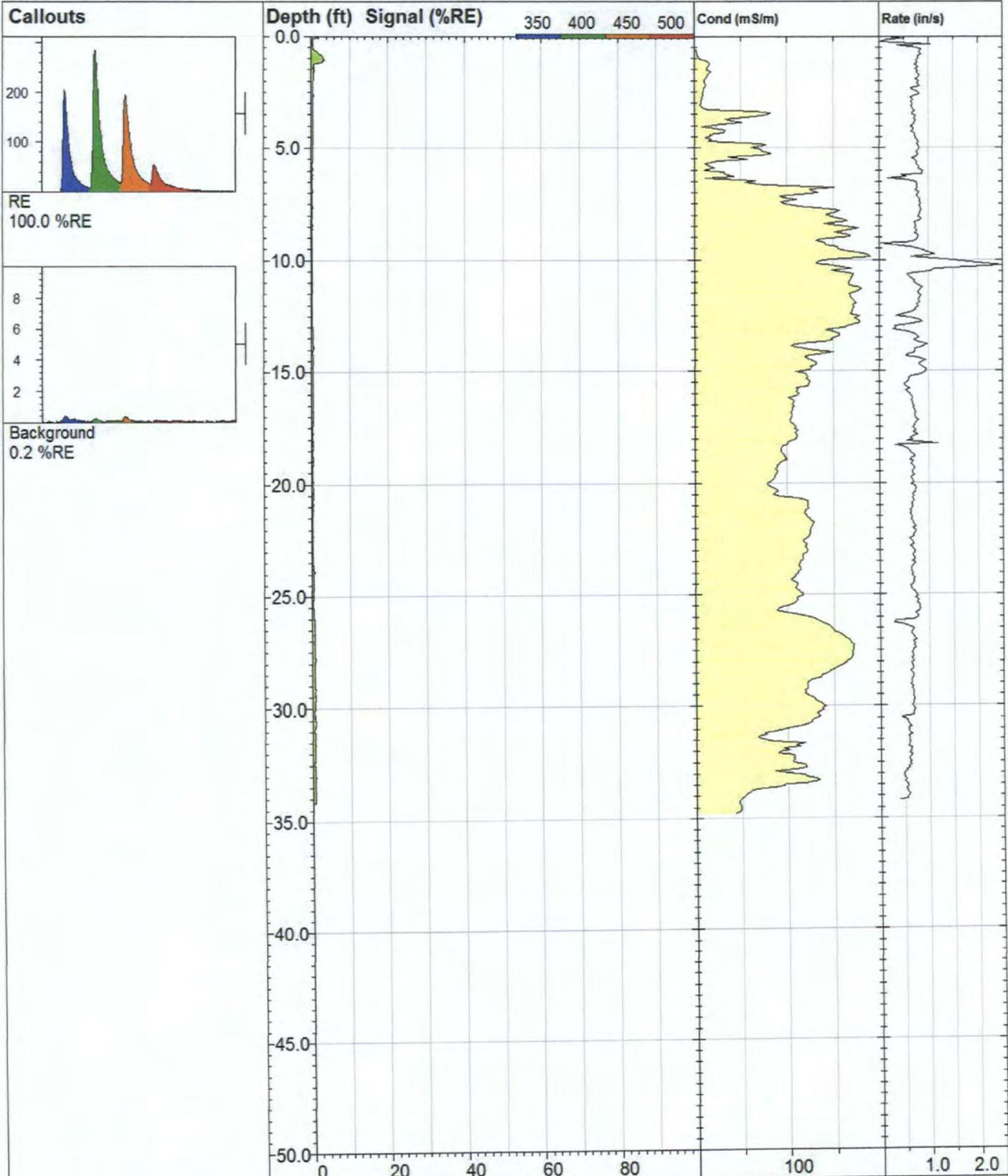
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
34.14 ft

Max signal:  
1.7 %RE @ 19.03 ft

Date & Time:  
2016-09-28 08:32 CDT



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**LIF-13**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

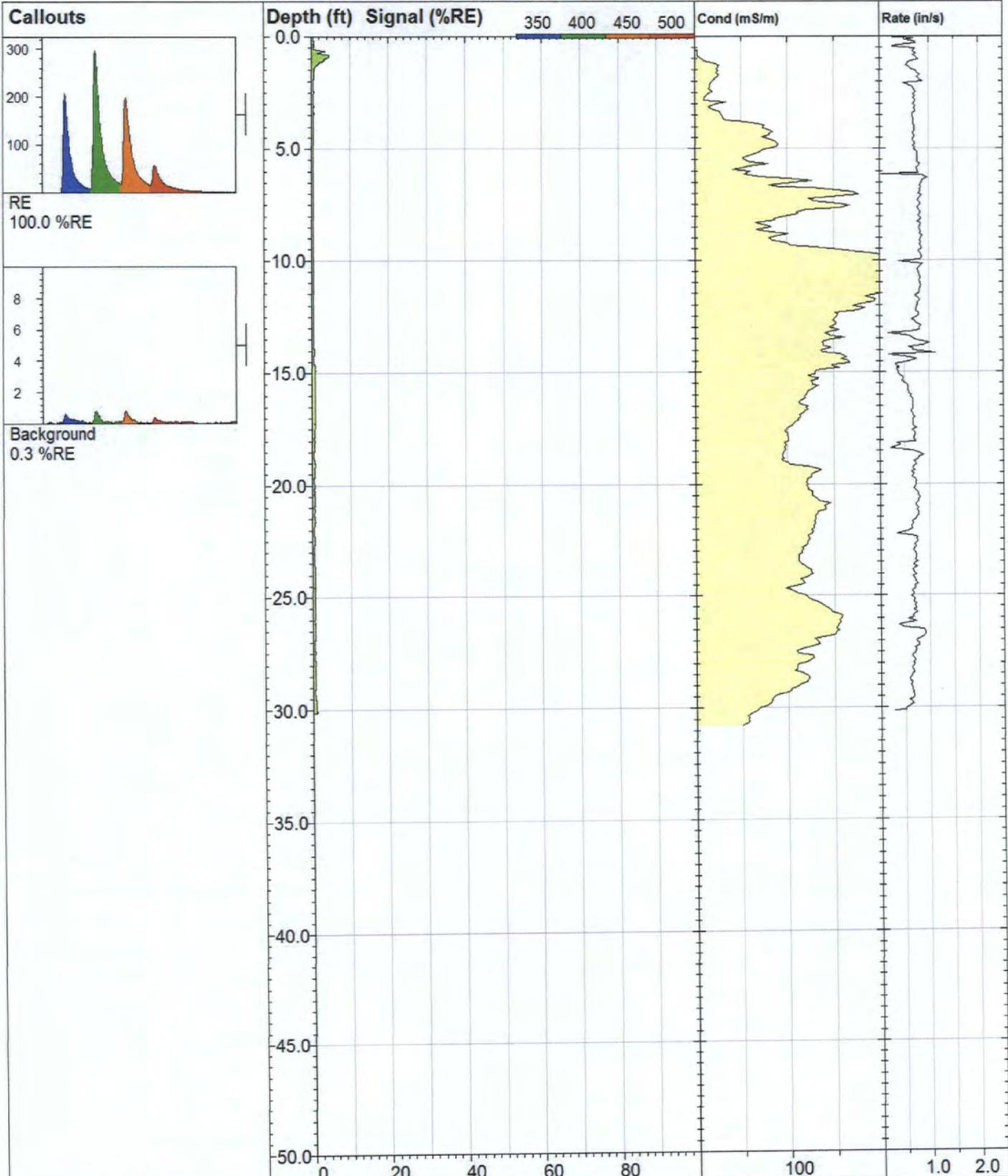
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
34.16 ft

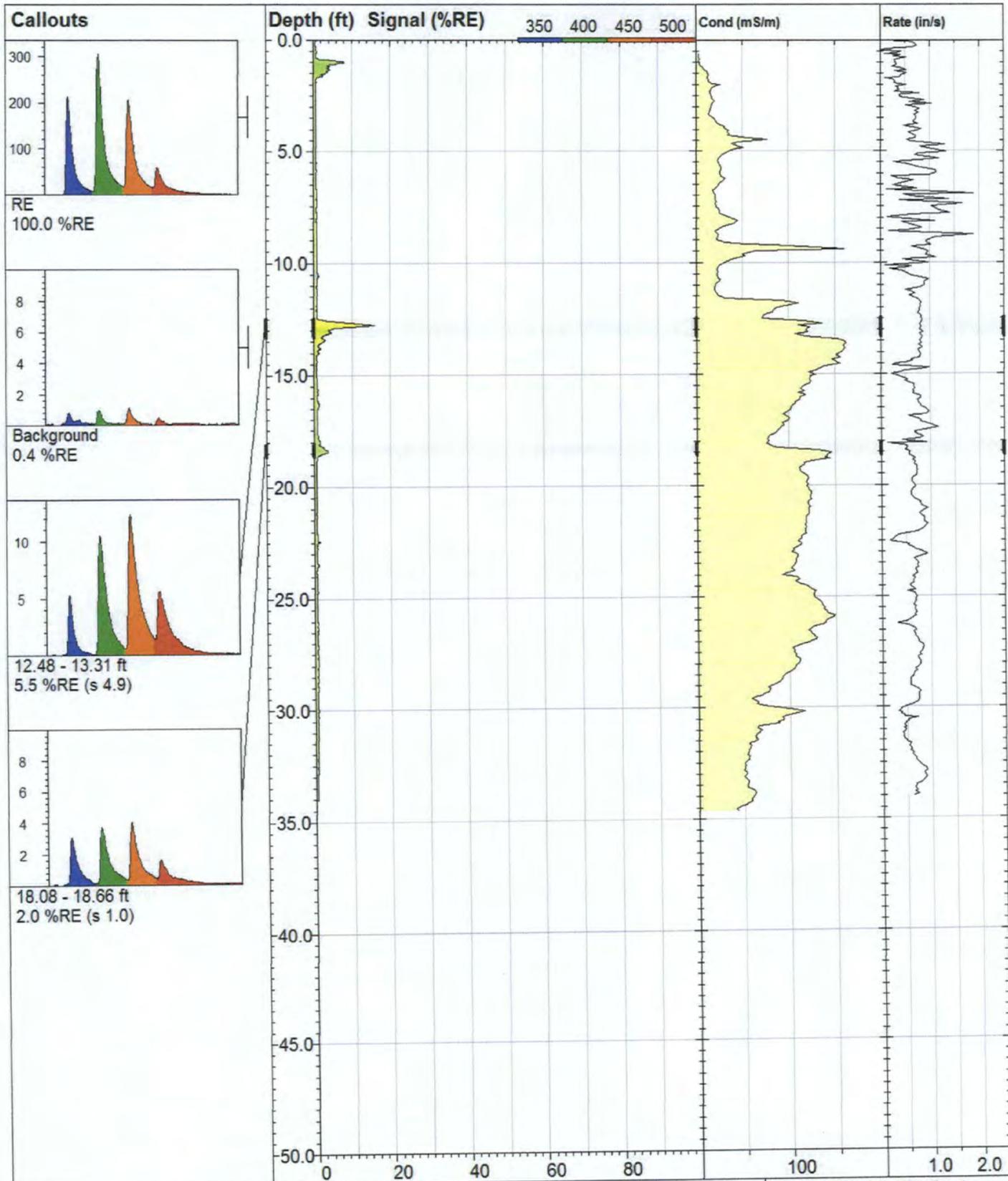
Max signal:  
3.3 %RE @ 1.09 ft

Date & Time:  
2016-09-28 08:59 CDT



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<b>LIF-14</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord. (Lat-N) / System: Unavailable / NA	Final depth: 30.13 ft
Client / Job: Larsen & Associates / 025	X Coord. (Lng-E) / Fix: Unavailable / NA	Max signal: 4.5 %RE @ 0.84 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 09:29 CDT



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### LIF-15

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

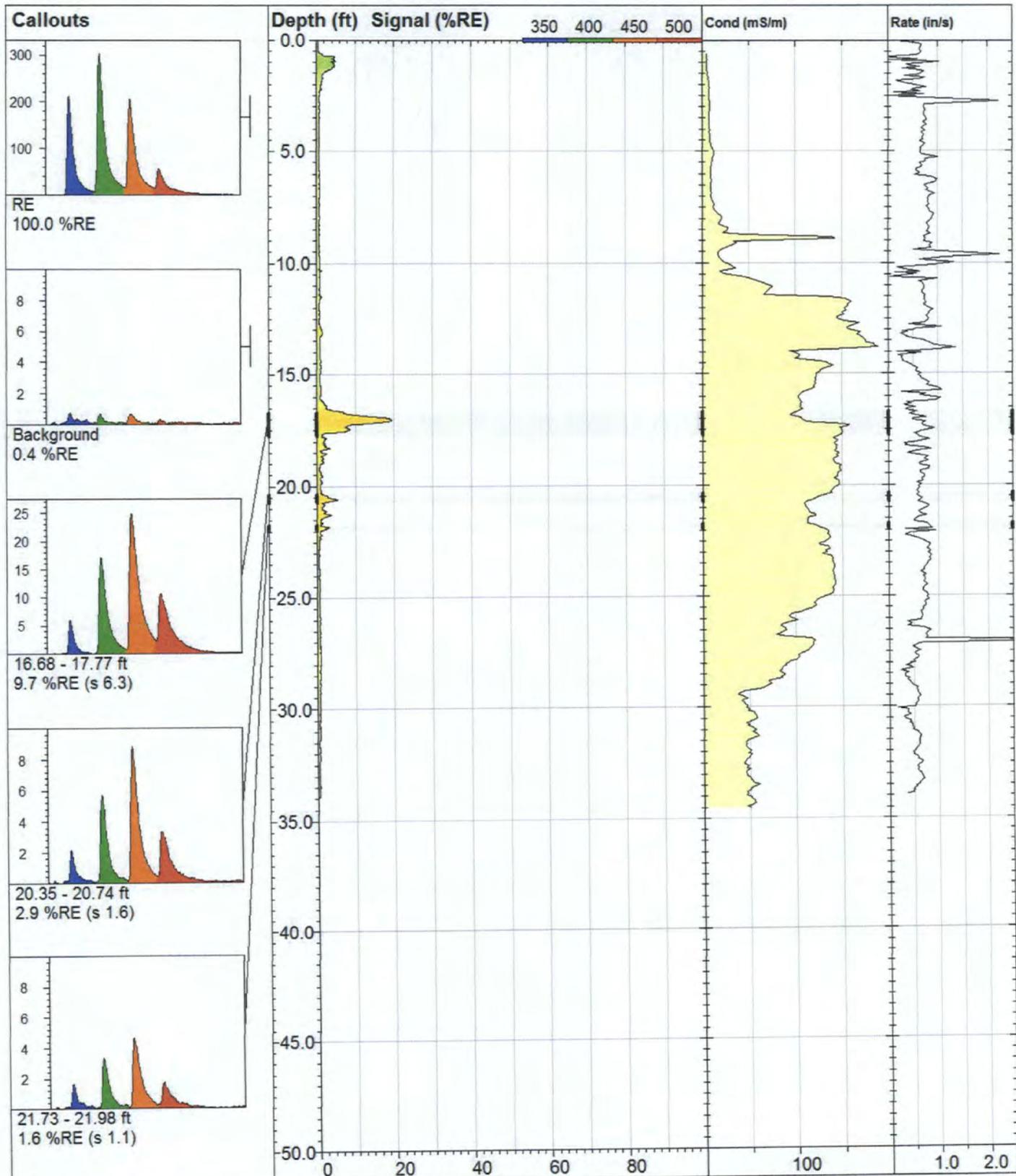
Elevation:  
Unavailable

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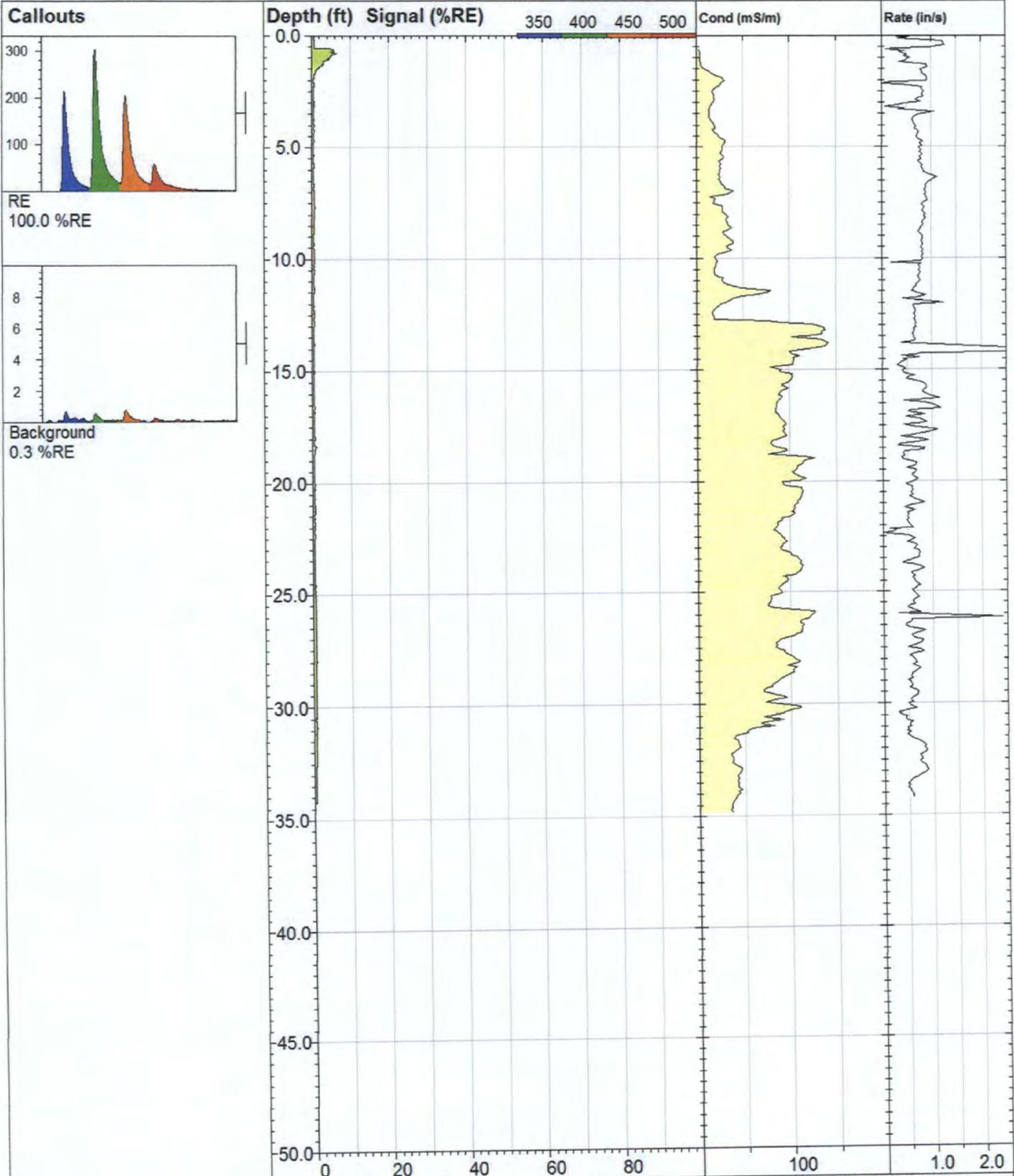
Final depth:  
34.01 ft

Max signal:  
16.0 %RE @ 12.77 ft

Date & Time:  
2016-09-28 10:06 CDT

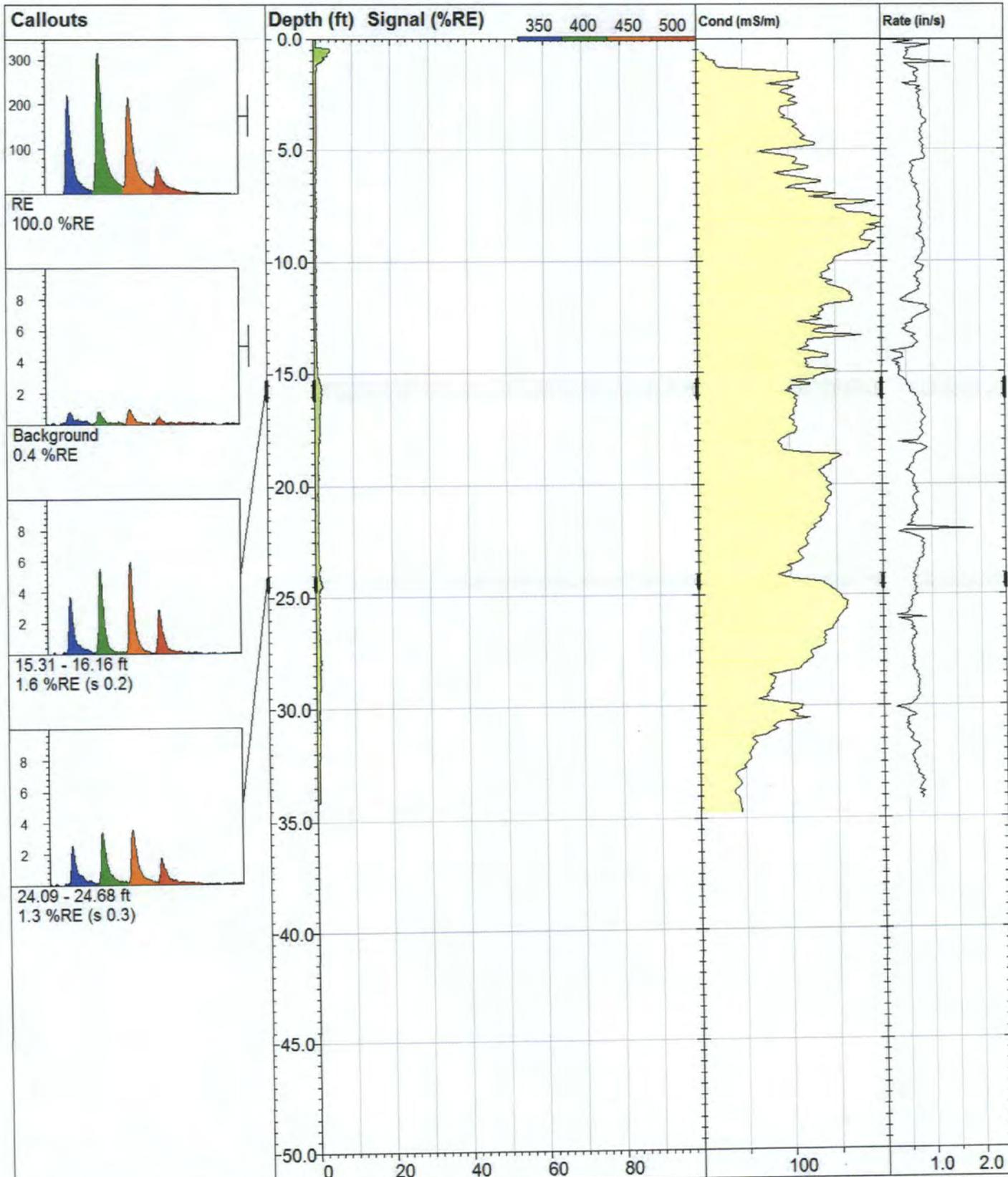


<b>LIF-16</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 33.90 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 19.3 %RE @ 17.01 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 10:36 CDT



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<b>LIF-17</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 34.21 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 6.4 %RE @ 0.81 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 11:13 CDT



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### LIF-18

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

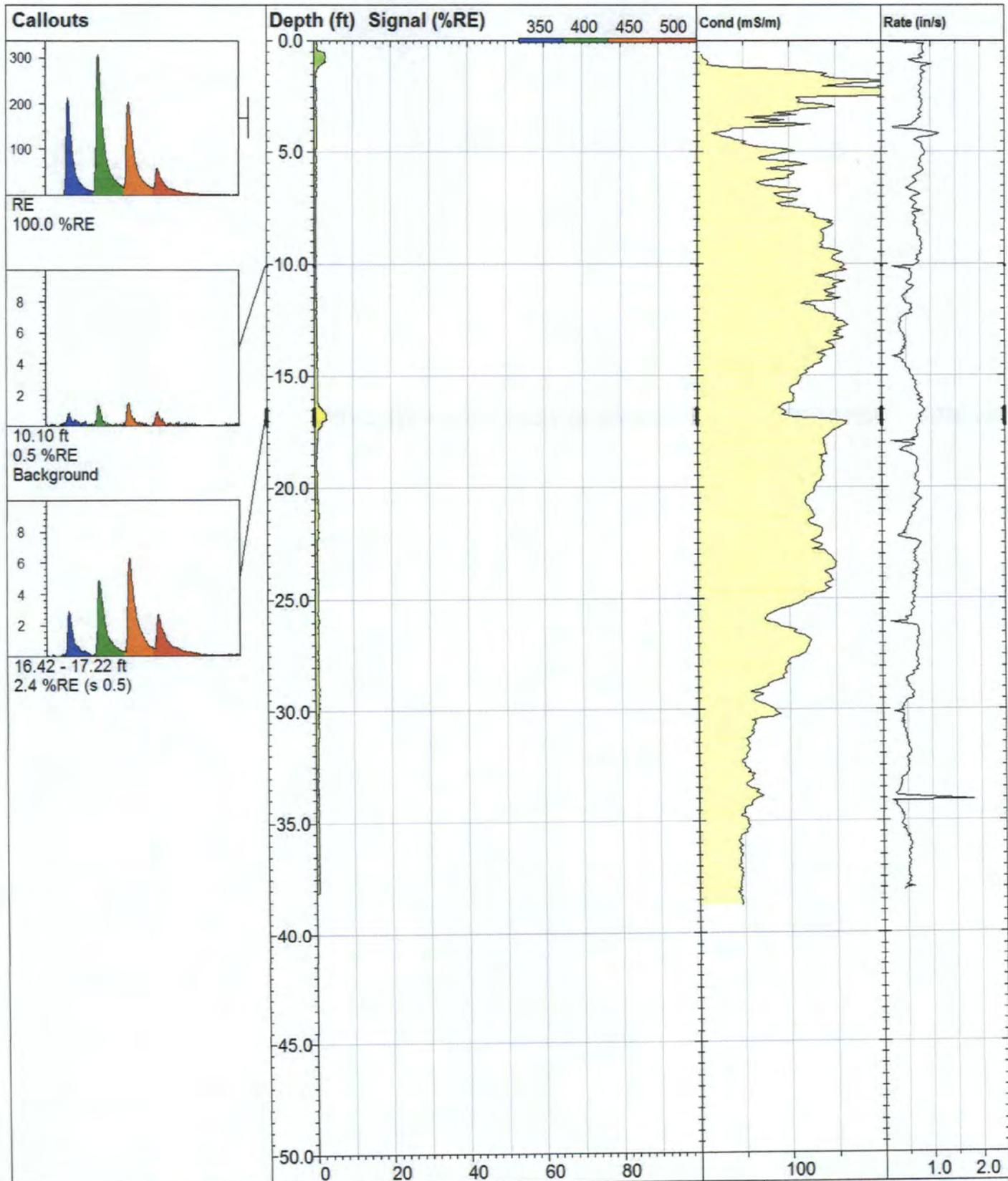
Elevation:  
Unavailable

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Final depth:  
34.15 ft

Max signal:  
4.3 %RE @ 0.52 ft

Date & Time:  
2016-09-28 11:44 CDT



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### LIF-19\_LIF-19A

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord. (Lat-N) / System:  
Unavailable / NA

Final depth:  
38.11 ft

Client / Job:  
Larsen & Associates / 025

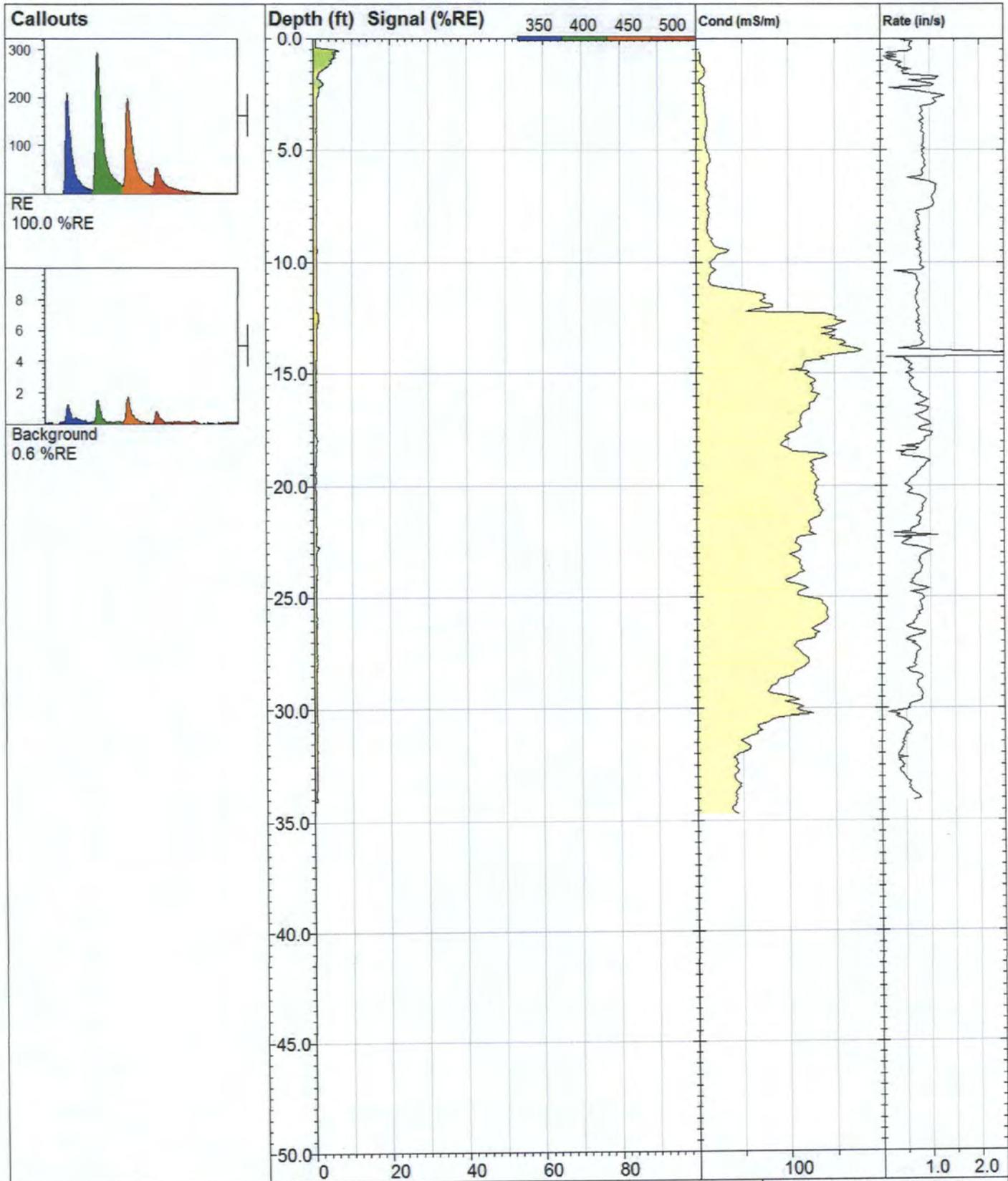
X Coord. (Lng-E) / Fix:  
Unavailable / NA

Max signal:  
3.1 %RE @ 16.92 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 14:31 CDT



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**LIF-20**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

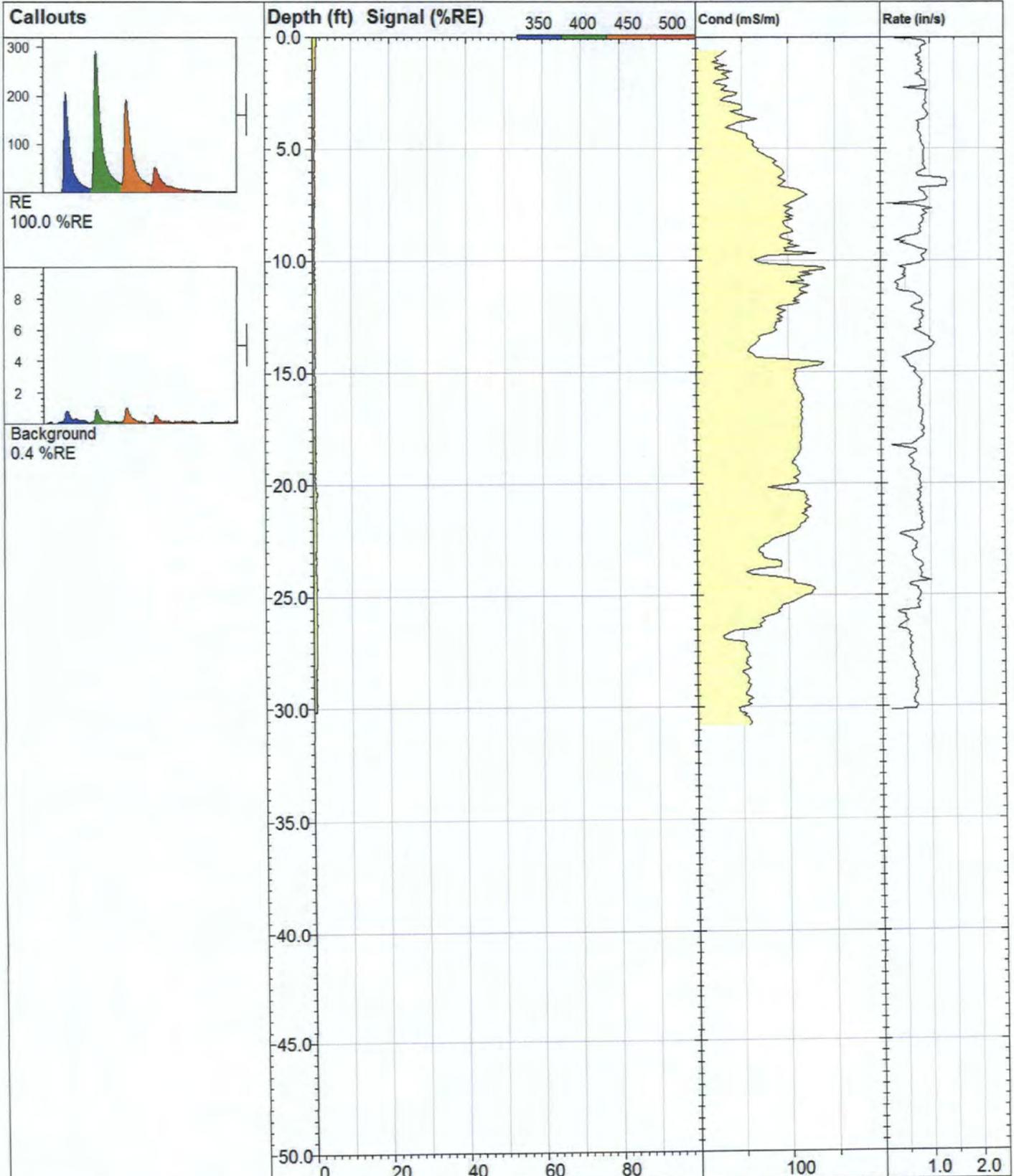
Elevation:  
Unavailable

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Final depth:  
34.05 ft

Max signal:  
6.7 %RE @ 0.58 ft

Date & Time:  
2016-09-28 15:19 CDT

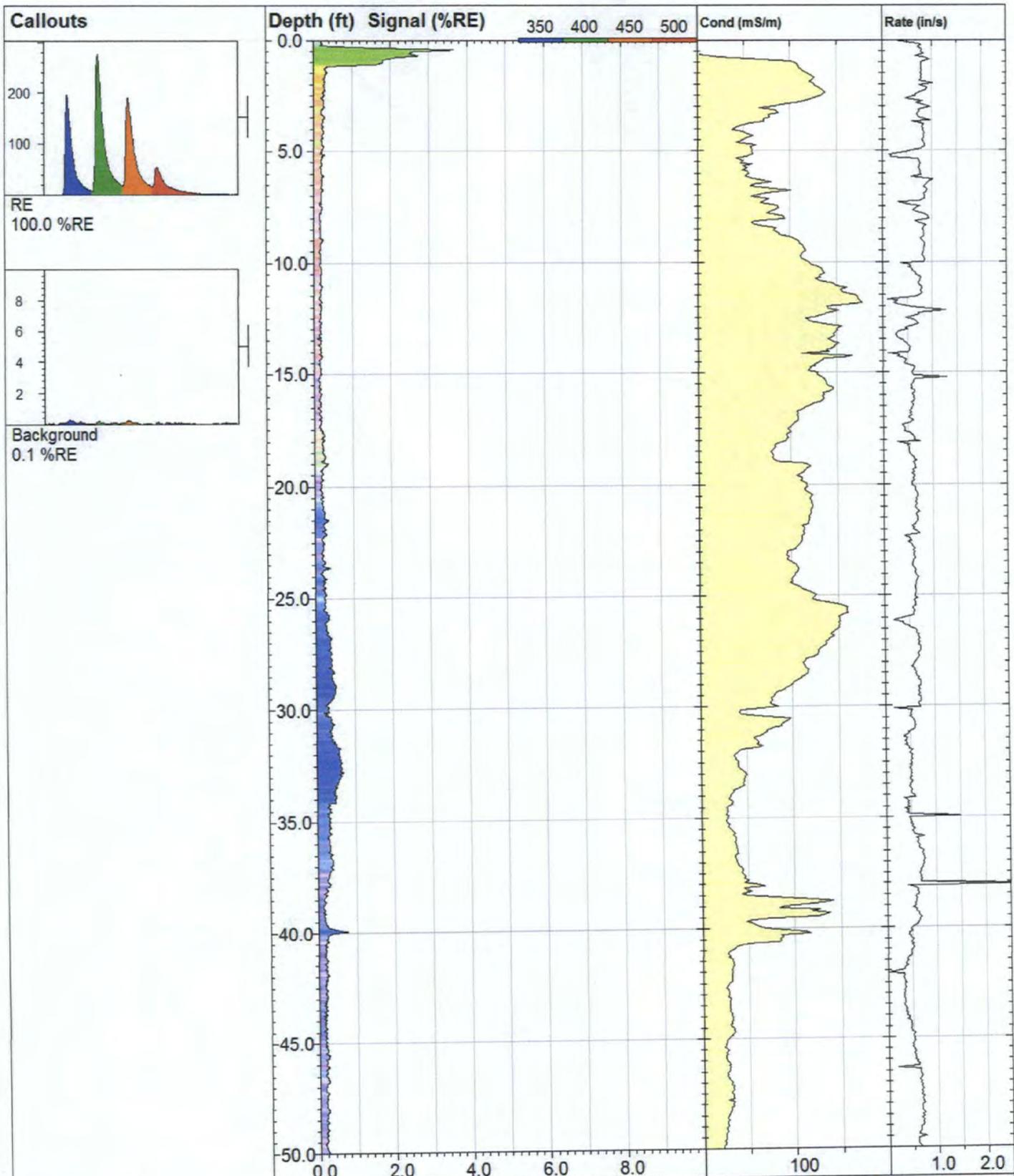


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<b>LIF-21</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord. (Lat-N) / System: Unavailable / NA	Final depth: 30.14 ft
Client / Job: Larsen & Associates / 025	X Coord. (Lng-E) / Fix: Unavailable / NA	Max signal: 1.1 %RE @ 20.42 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 15:50 CDT

**Appendix C**

**UVOST<sup>®</sup> Logs at 10% RE**



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**LIF-01**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

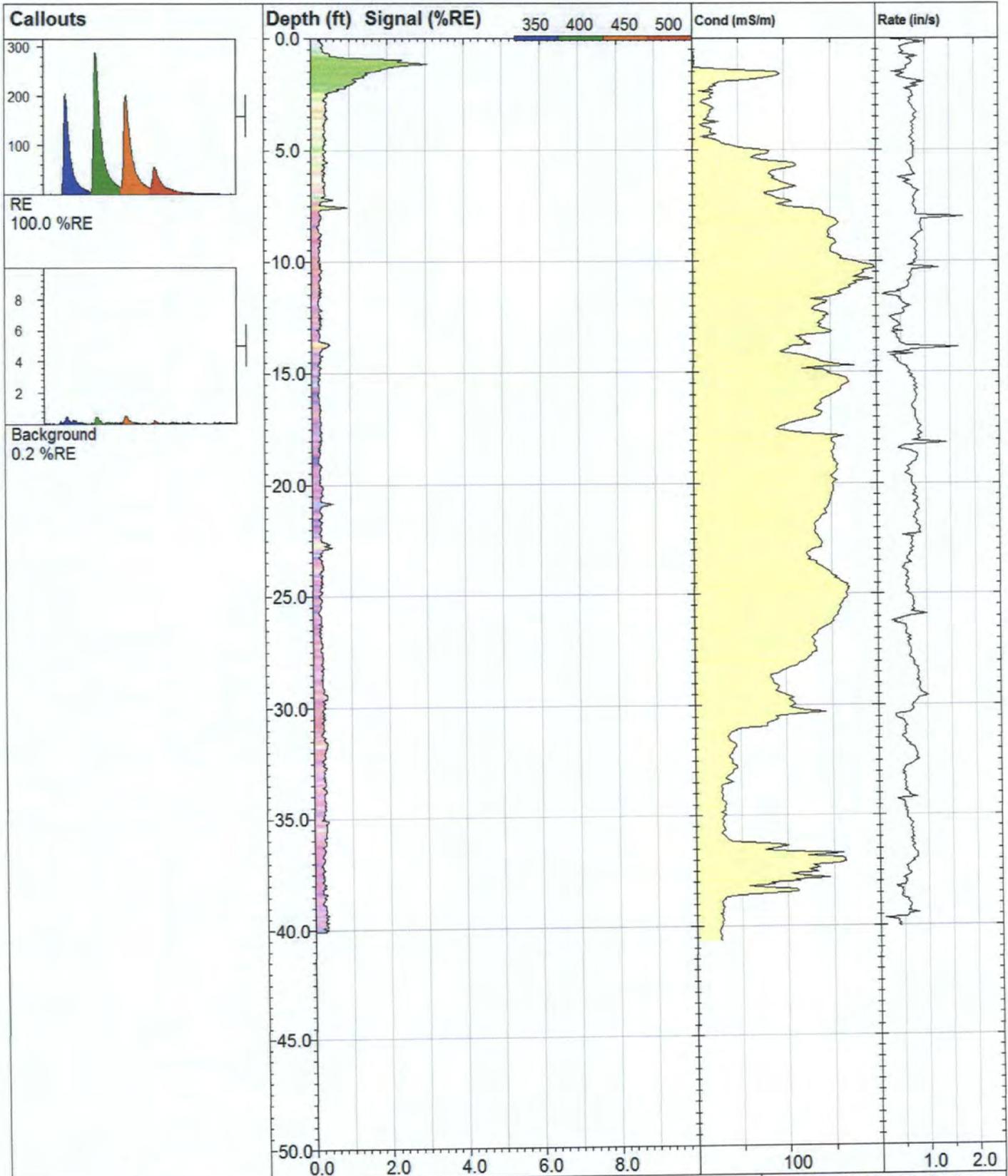
Elevation:  
Unavailable

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Final depth:  
50.07 ft

Max signal:  
3.7 %RE @ 0.44 ft

Date & Time:  
2016-09-27 08:53 CDT



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**LIF-02**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

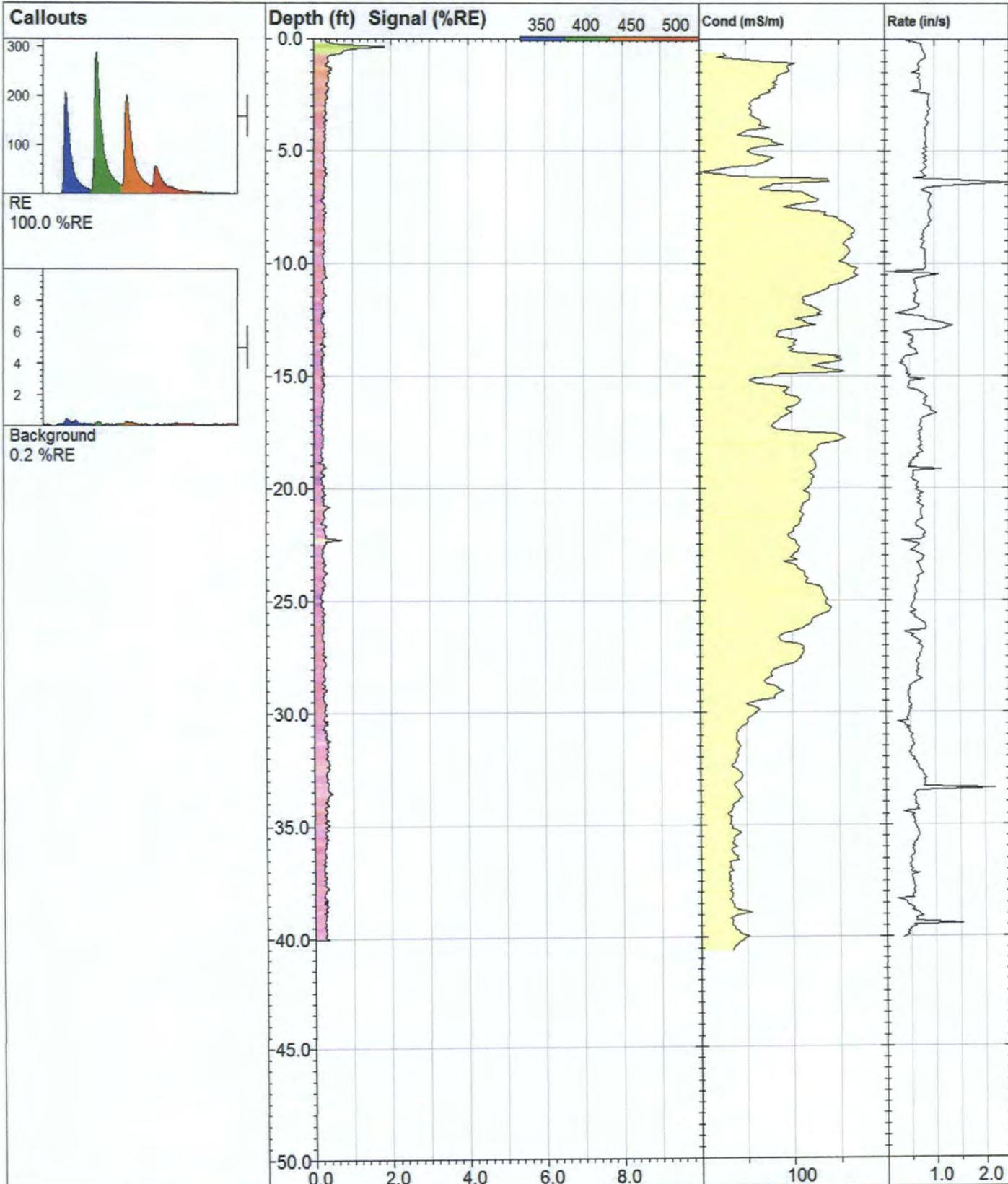
Elevation:  
Unavailable

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www.DakotaTechnologies.com

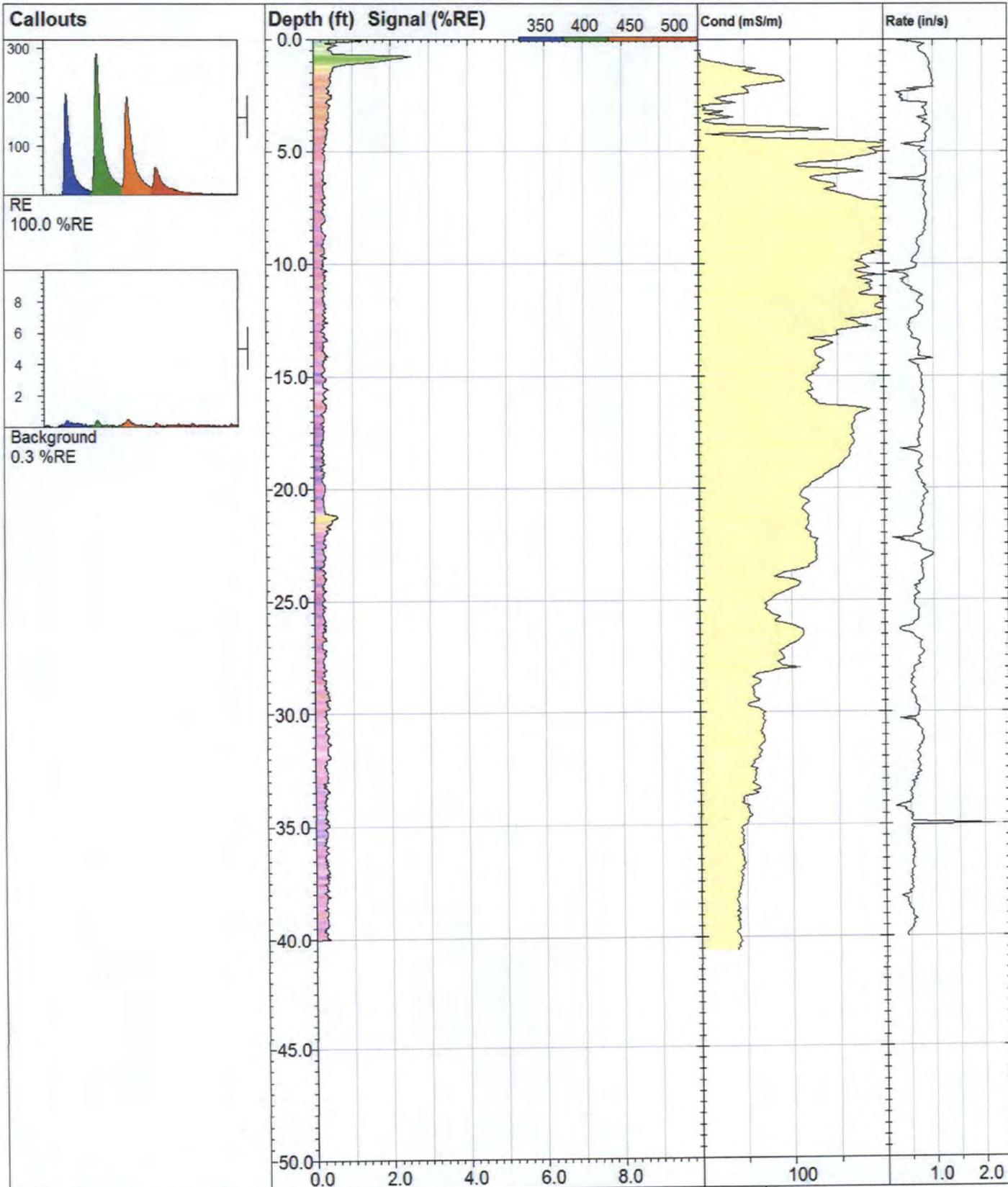
Final depth:  
40.05 ft

Max signal:  
3.0 %RE @ 1.15 ft

Date & Time:  
2016-09-27 09:35 CDT



<b>LIF-03</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord. (Lat-N) / System: Unavailable / NA	Final depth: 40.03 ft
Client / Job: Larsen & Associates / 025	X Coord. (Lng-E) / Fix: Unavailable / NA	Max signal: 1.8 %RE @ 0.37 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 10:08 CDT



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### LIF-04

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

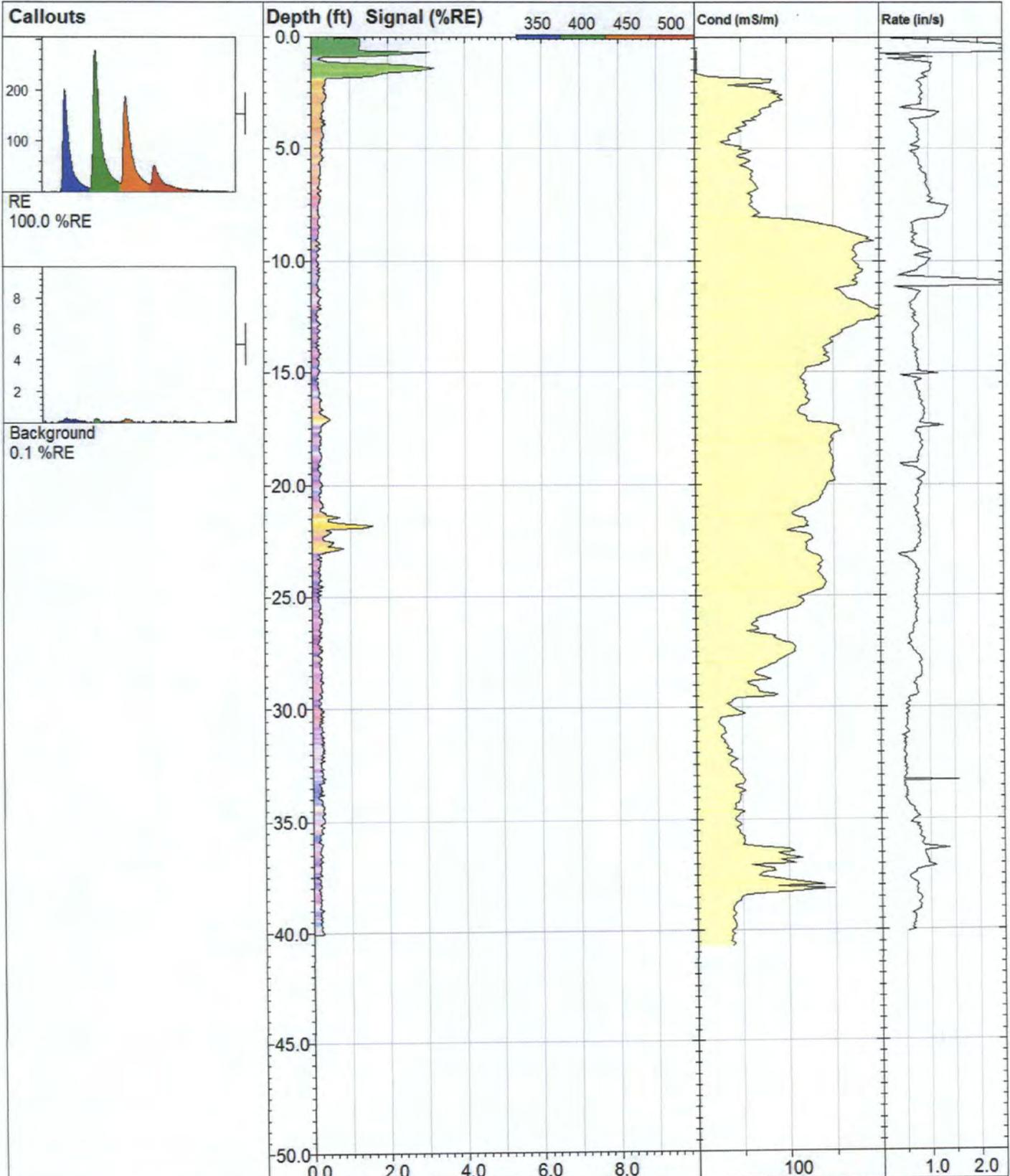
Elevation:  
Unavailable

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Final depth:  
40.00 ft

Max signal:  
2.6 %RE @ 0.76 ft

Date & Time:  
2016-09-27 10:46 CDT



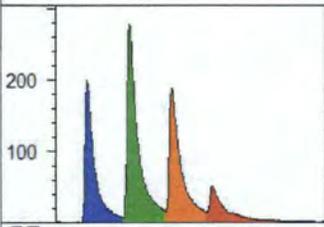
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**LIF-05**

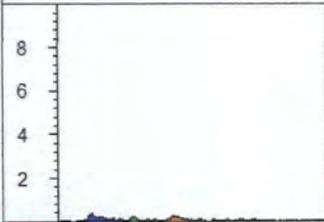
<b>Site:</b> Former Coastal Mart 7301		<b>Y Coord. (Lat-N) / System:</b> Unavailable / NA	<b>Final depth:</b> 40.07 ft
<b>Client / Job:</b> Larsen & Associates / 025		<b>X Coord. (Lng-E) / Fix:</b> Unavailable / NA	<b>Max signal:</b> 3.2 %RE @ 1.41 ft
<b>Operator / Unit:</b> JM/BG / UVOST1004		<b>Elevation:</b> Unavailable	<b>Date &amp; Time:</b> 2016-09-27 11:47 CDT

**UVOST® By Dakota**  
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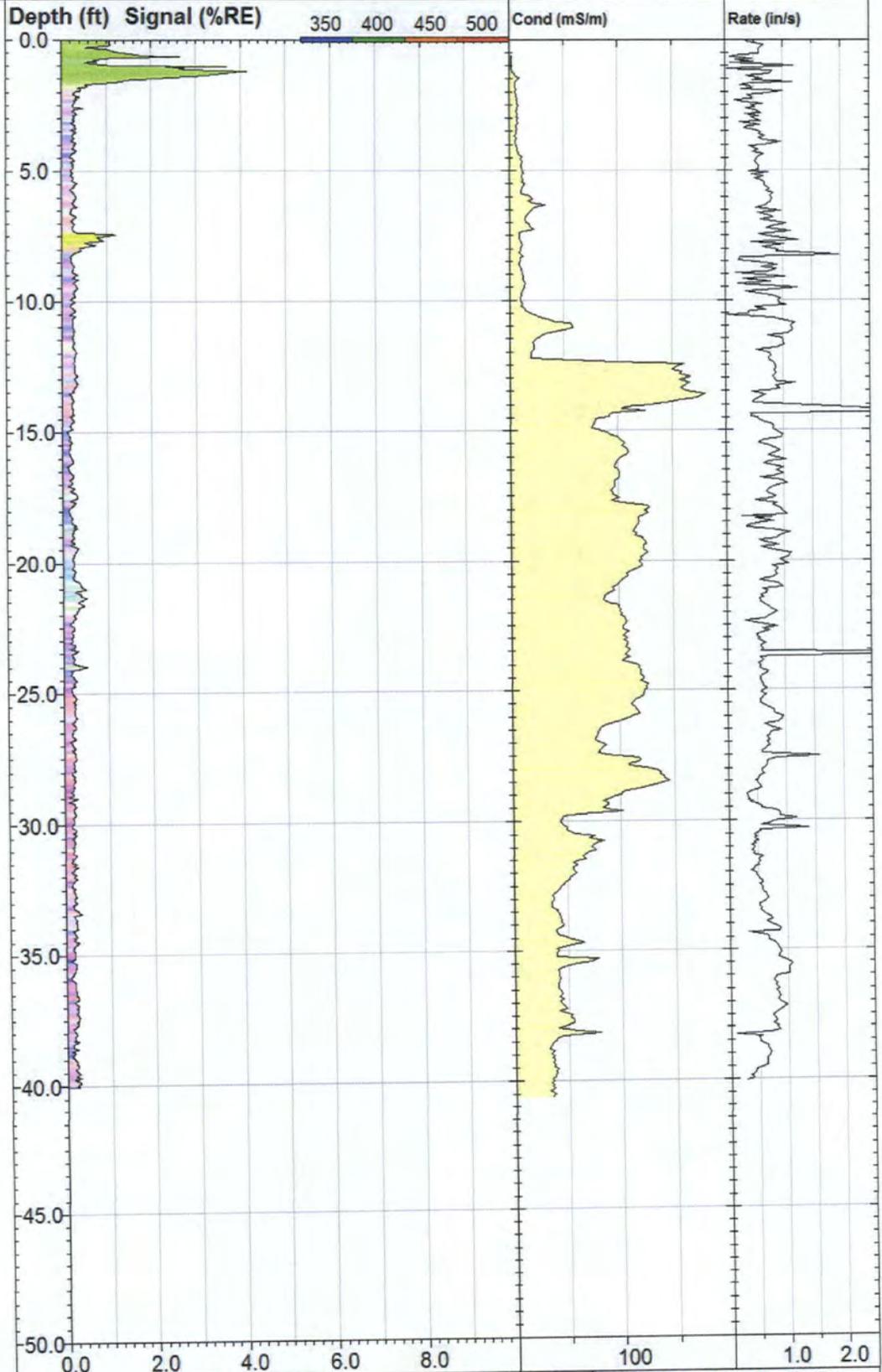
**Callouts**



RE  
100.0 %RE



Background  
0.2 %RE



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**LIF-06**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

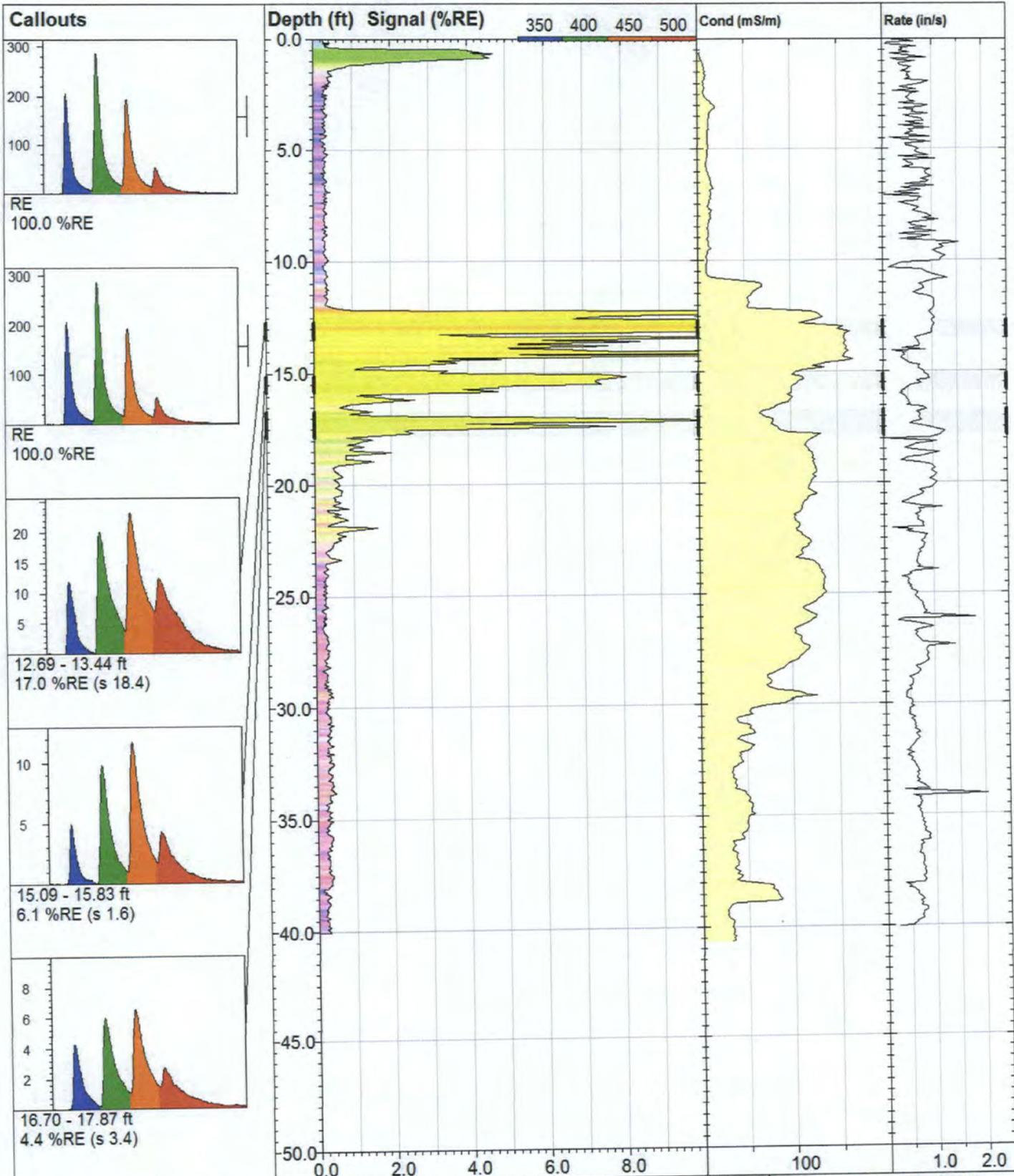
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

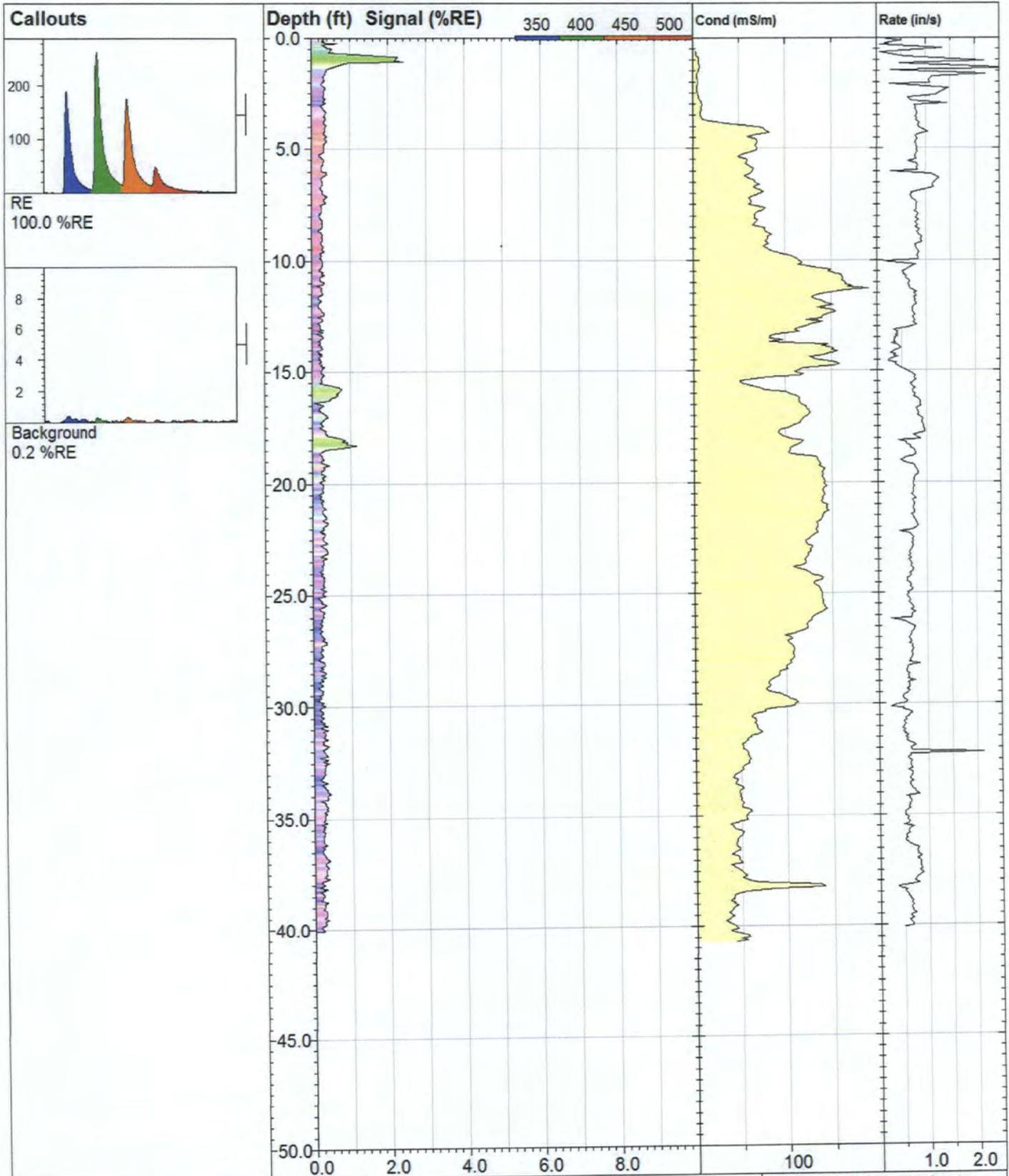
Final depth:  
40.02 ft

Max signal:  
4.2 %RE @ 1.21 ft

Date & Time:  
2016-09-27 13:27 CDT



<b>LIF-07</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 40.04 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 57.1 %RE @ 12.97 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-27 14:05 CDT



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**LIF-08**

**UVOST® By Dakota**

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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
40.07 ft

Client / Job:  
Larsen & Associates / 025

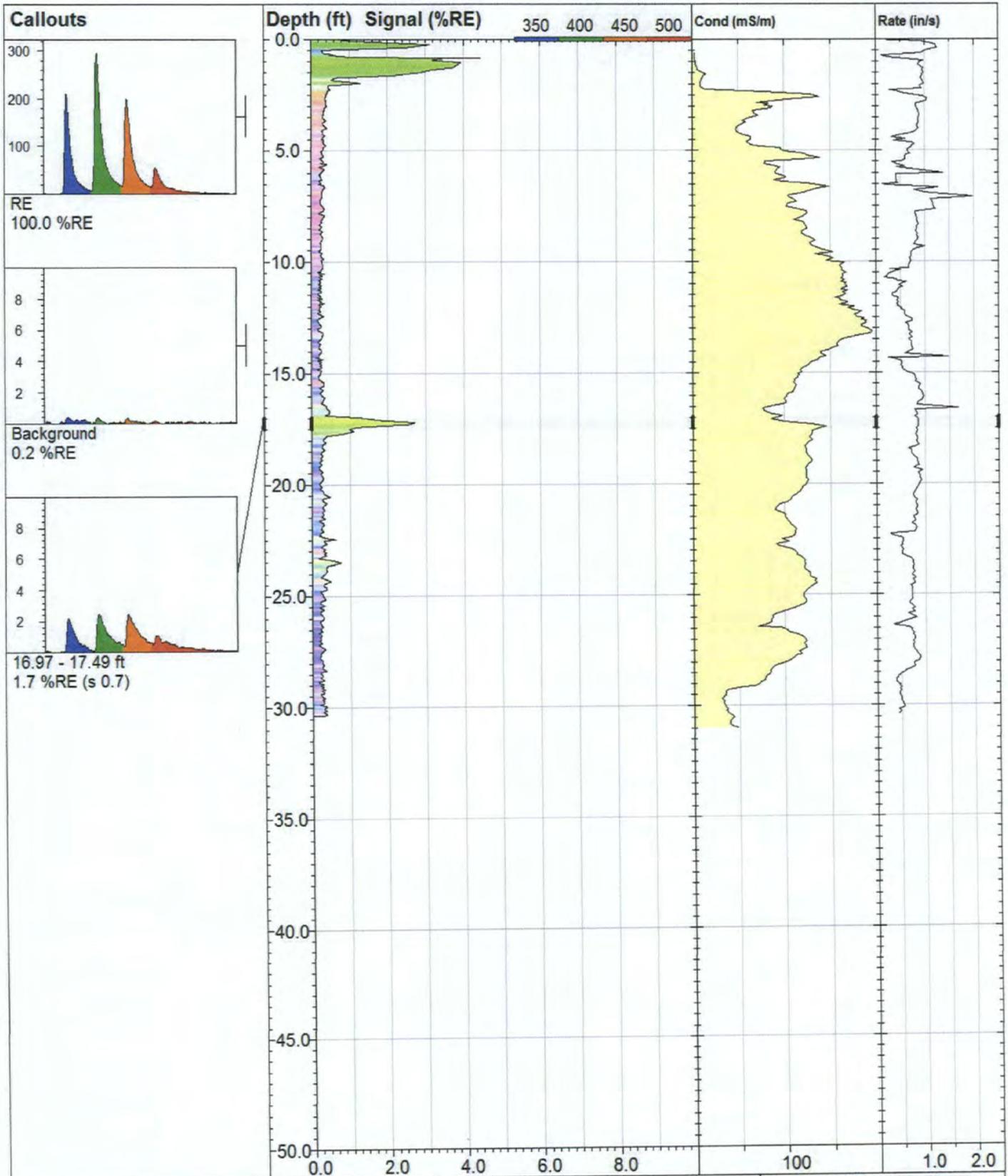
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
2.4 %RE @ 1.06 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 14:38 CDT



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**LIF-09**

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord.(Lat-N) / System:  
Unavailable / NA

Final depth:  
30.37 ft

Client / Job:  
Larsen & Associates / 025

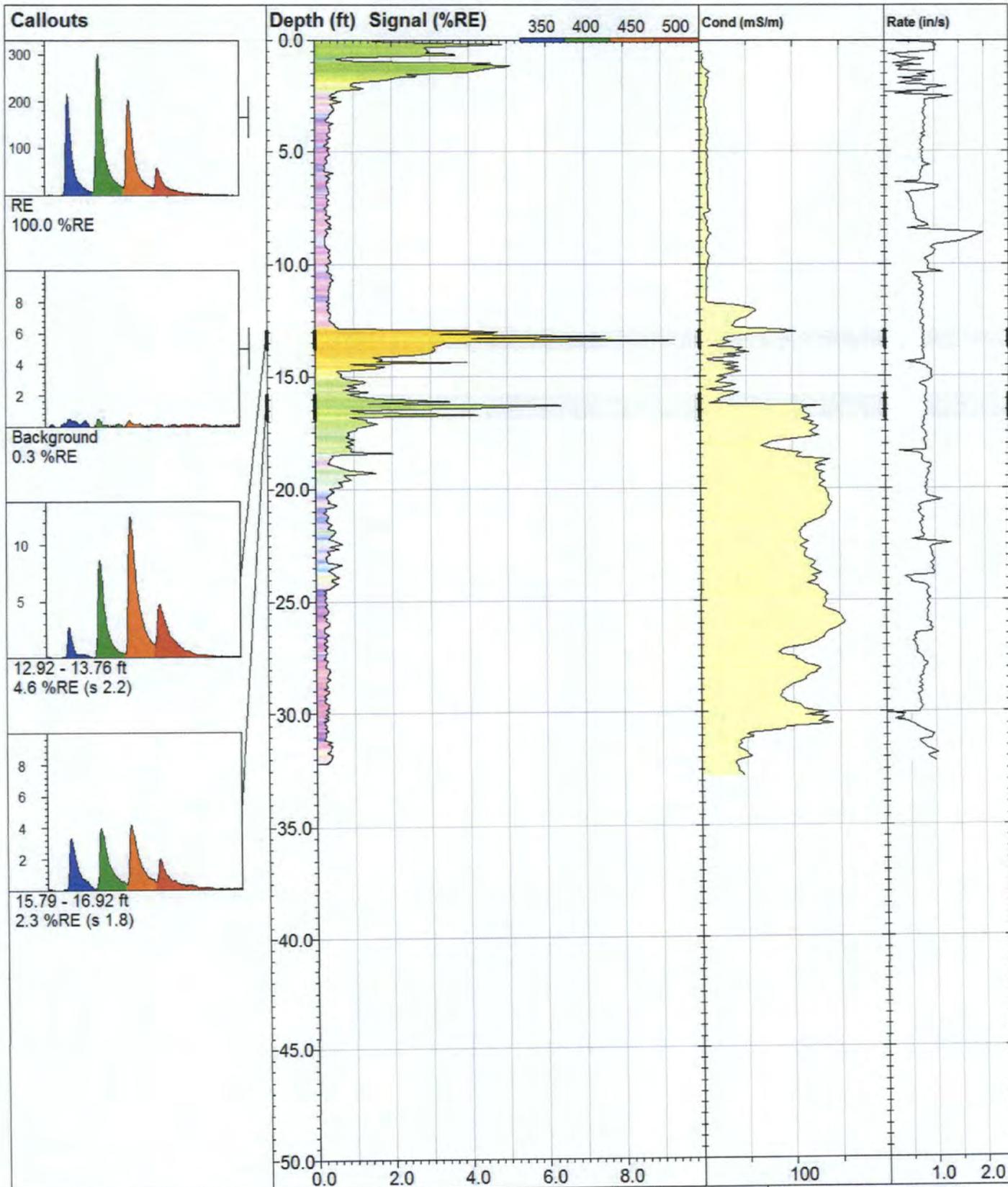
X Coord.(Lng-E) / Fix:  
Unavailable / NA

Max signal:  
4.6 %RE @ 0.84 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-27 15:23 CDT



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### LIF-10

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

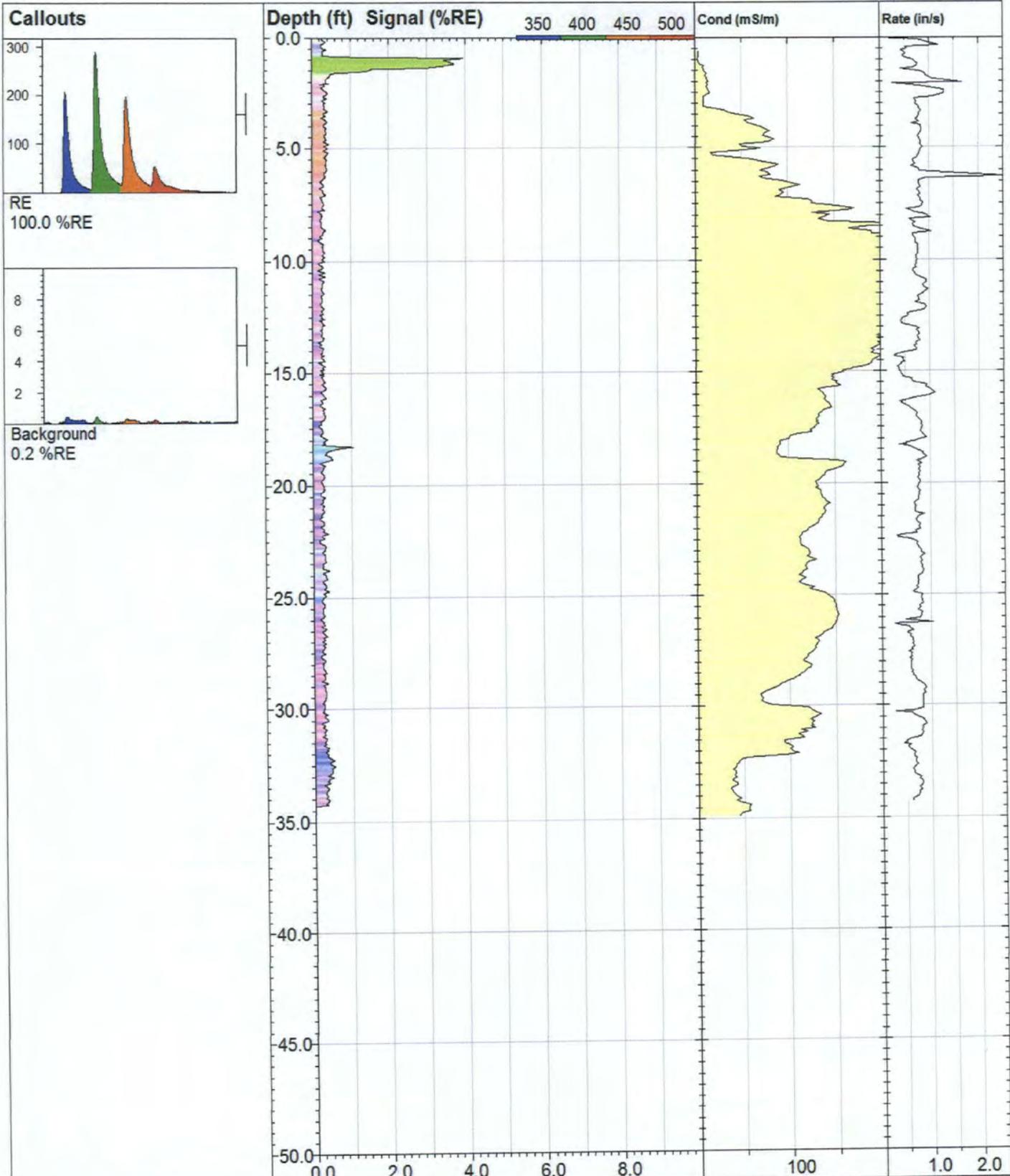
Elevation:  
Unavailable

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Final depth:  
32.17 ft

Max signal:  
9.4 %RE @ 13.39 ft

Date & Time:  
2016-09-27 16:08 CDT



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**LIF-11**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

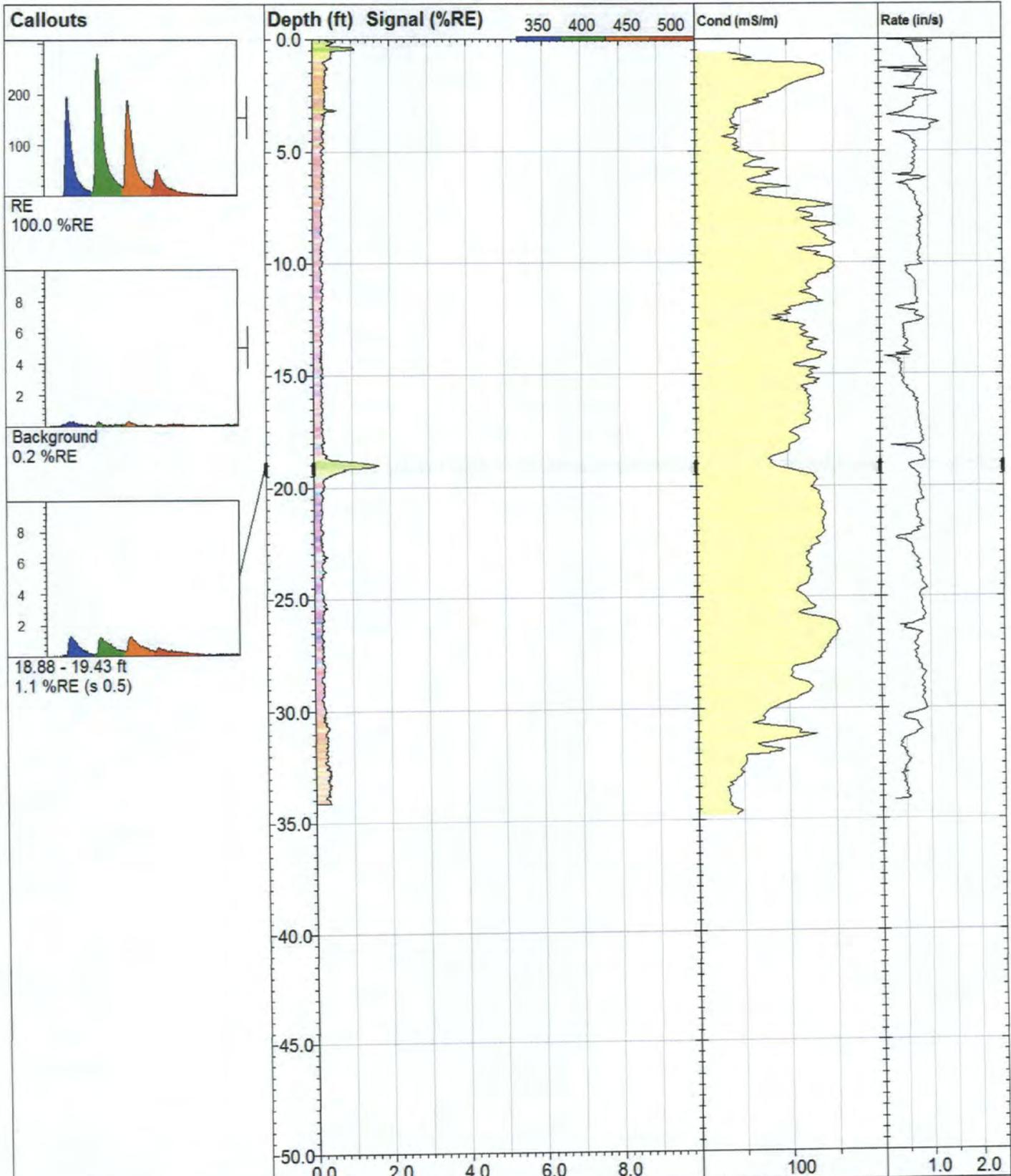
Elevation:  
Unavailable

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Final depth:  
34.27 ft

Max signal:  
4.0 %RE @ 0.93 ft

Date & Time:  
2016-09-27 16:45 CDT



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**LIF-12**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

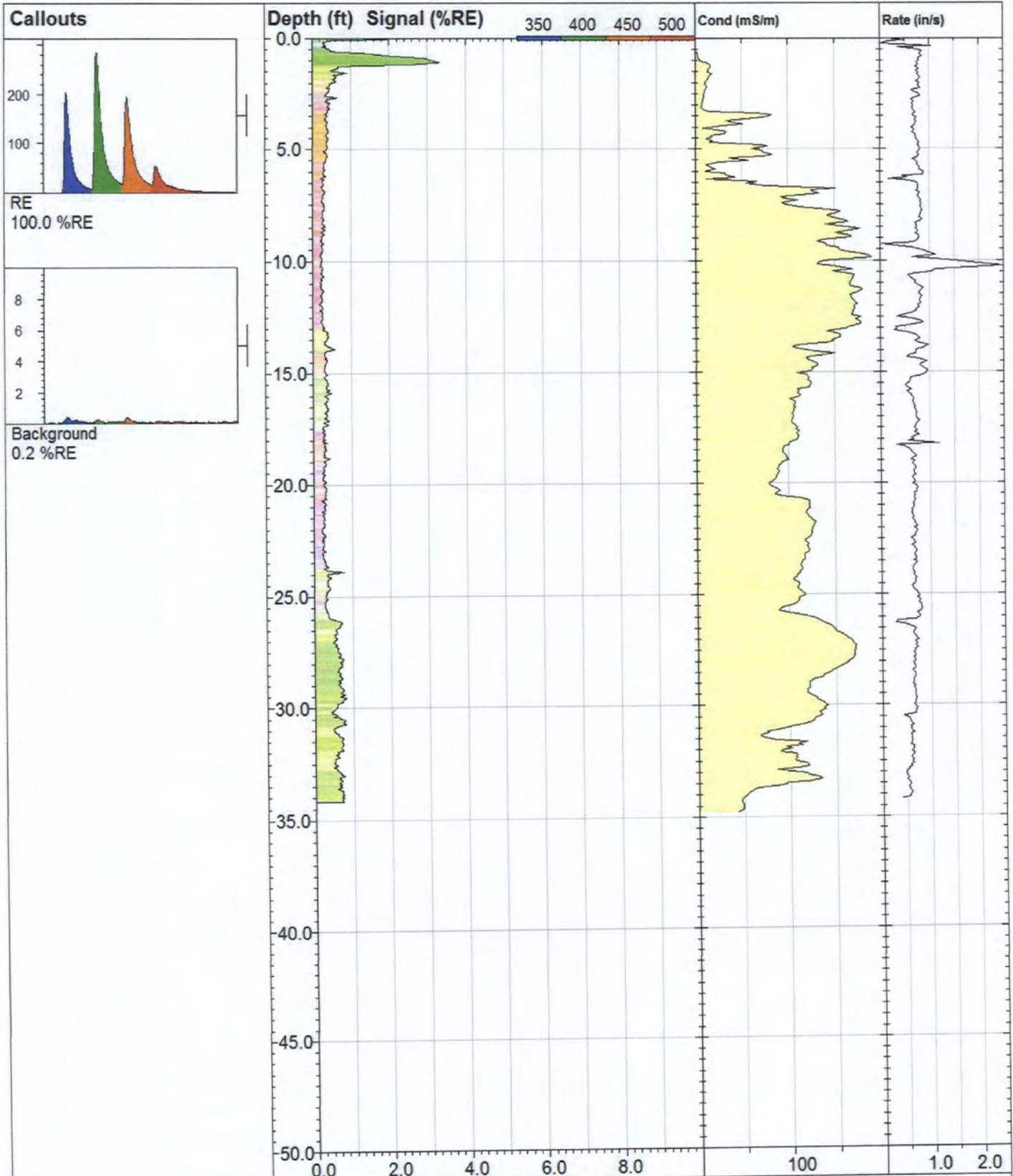
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
34.14 ft

Max signal:  
1.7 %RE @ 19.03 ft

Date & Time:  
2016-09-28 08:32 CDT



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**LIF-13**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

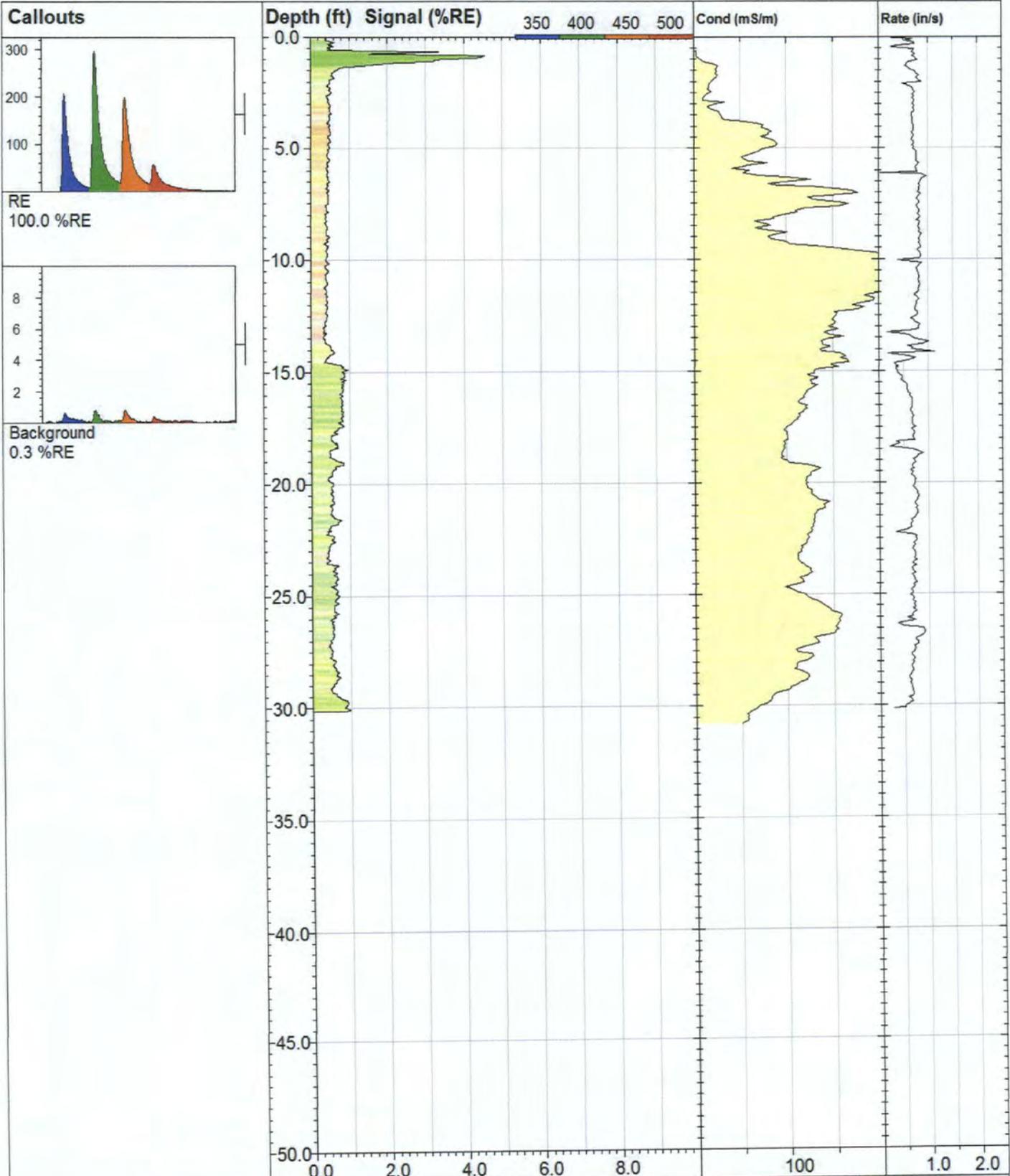
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
34.16 ft

Max signal:  
3.3 %RE @ 1.09 ft

Date & Time:  
2016-09-28 08:59 CDT



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**LIF-14**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

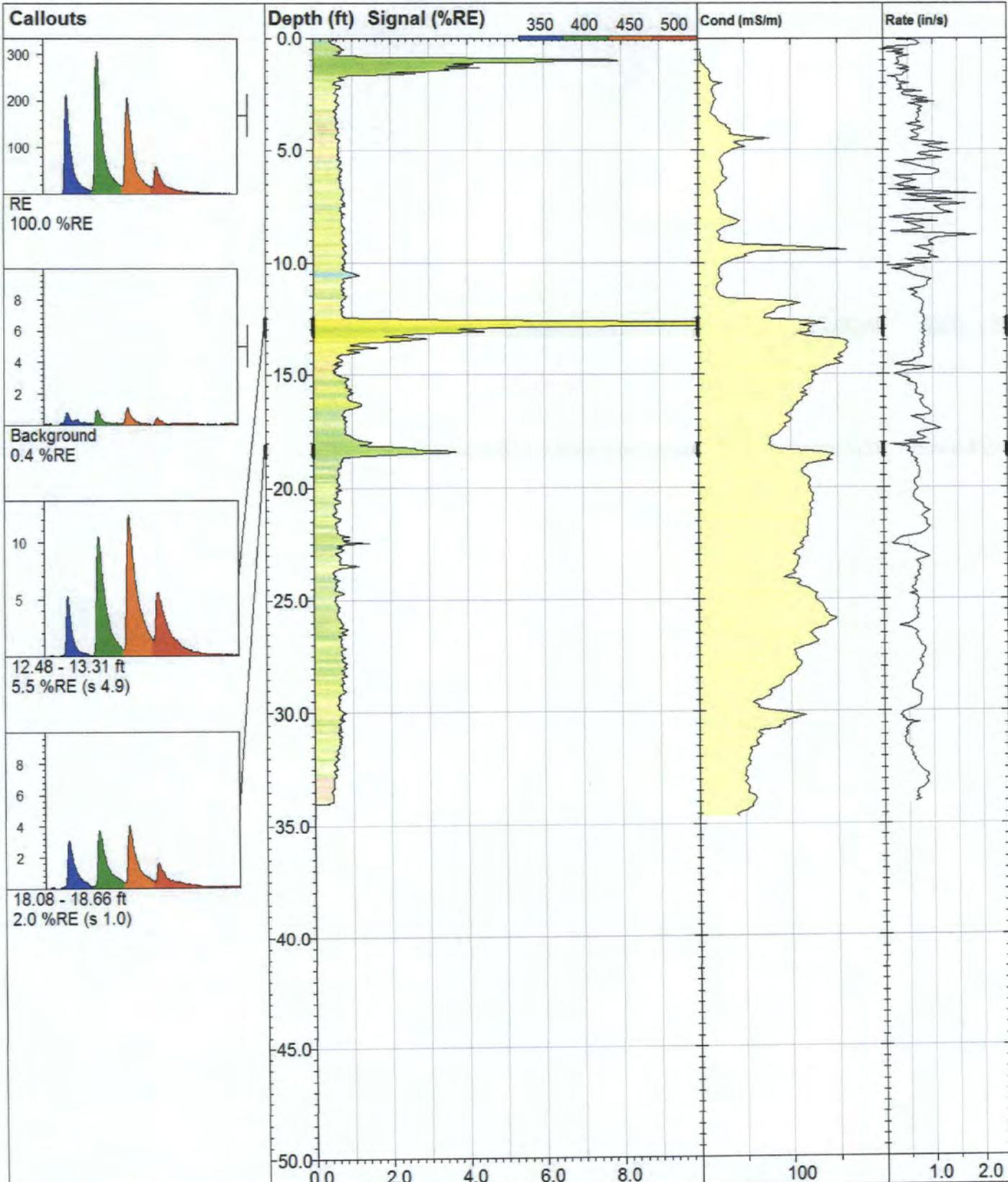
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
30.13 ft

Max signal:  
4.5 %RE @ 0.84 ft

Date & Time:  
2016-09-28 09:29 CDT



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### LIF-15

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

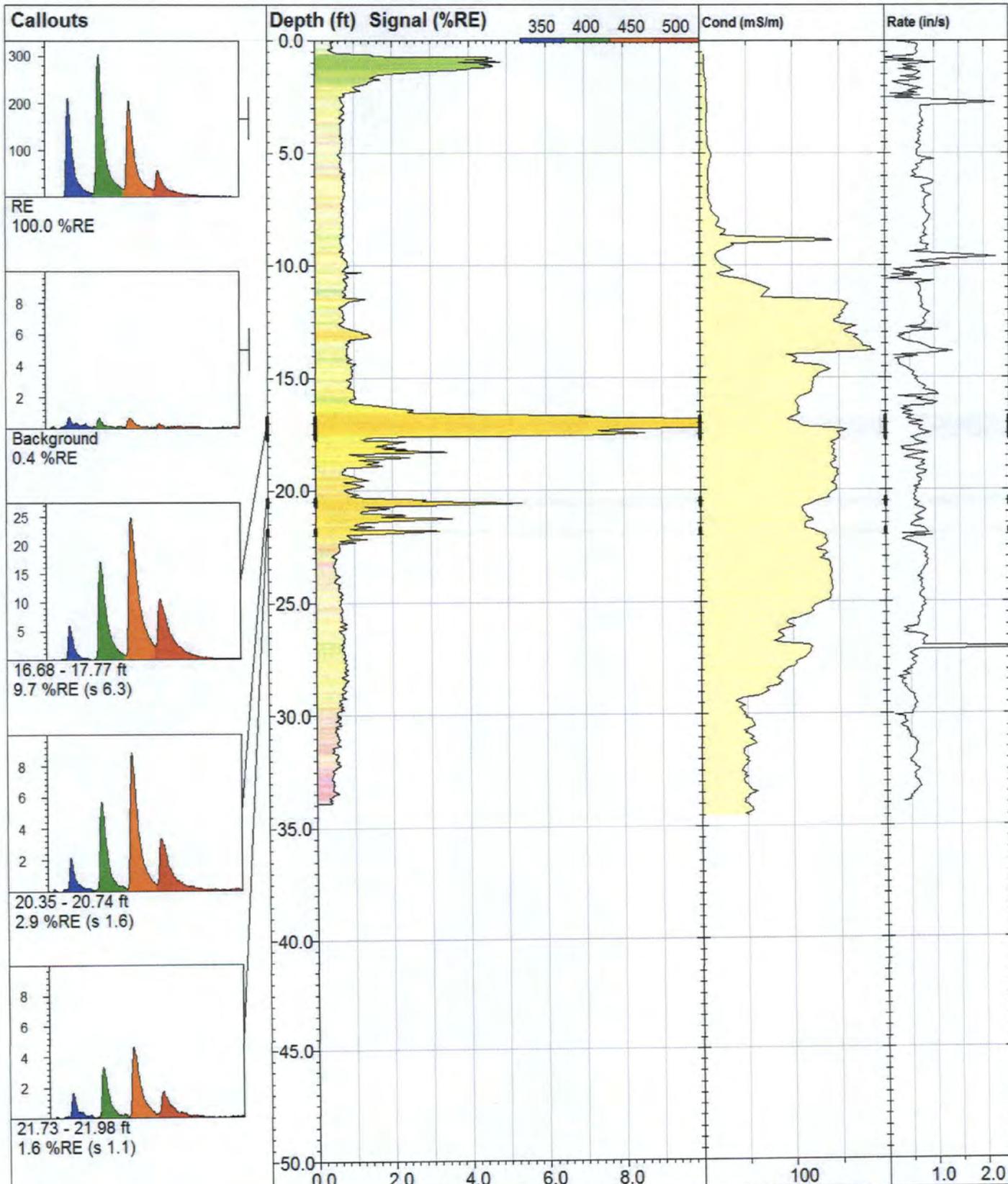
Elevation:  
Unavailable

**UVOST® By Dakota**  
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Final depth:  
34.01 ft

Max signal:  
16.0 %RE @ 12.77 ft

Date & Time:  
2016-09-28 10:06 CDT



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### LIF-16

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

Elevation:  
Unavailable

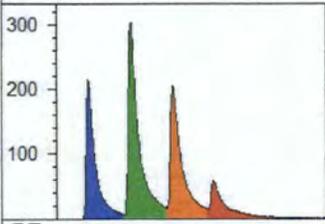
**UVOST® By Dakota**  
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Final depth:  
33.90 ft

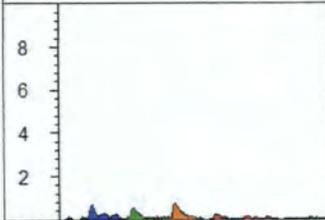
Max signal:  
19.3 %RE @ 17.01 ft

Date & Time:  
2016-09-28 10:36 CDT

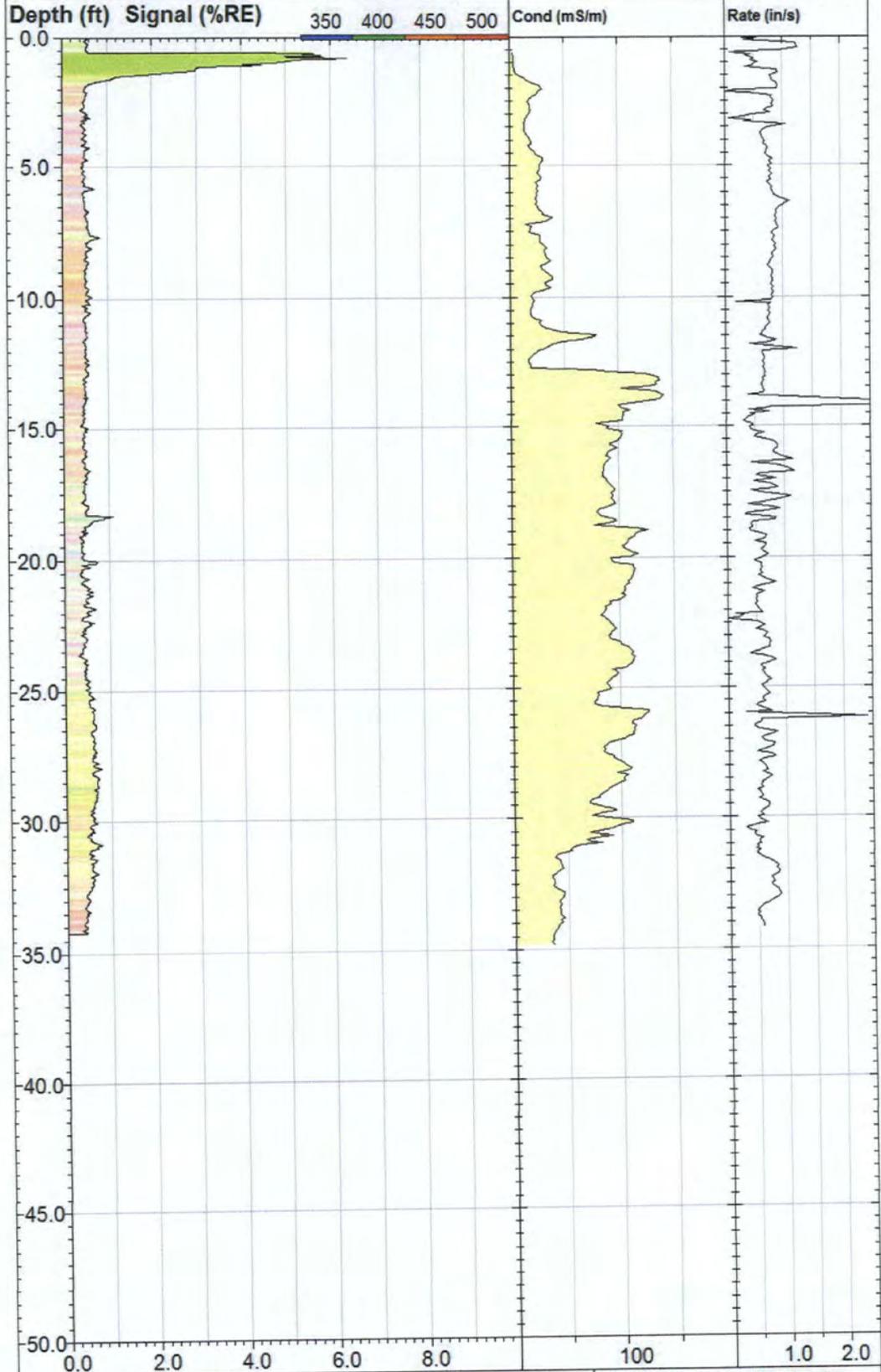
**Callouts**



RE  
100.0 %RE



Background  
0.3 %RE



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**LIF-17**

**UVOST® By Dakota**  
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Site:  
Former Coastal Mart 7301

Y Coord. (Lat-N) / System:  
Unavailable / NA

Final depth:  
34.21 ft

Client / Job:  
Larsen & Associates / 025

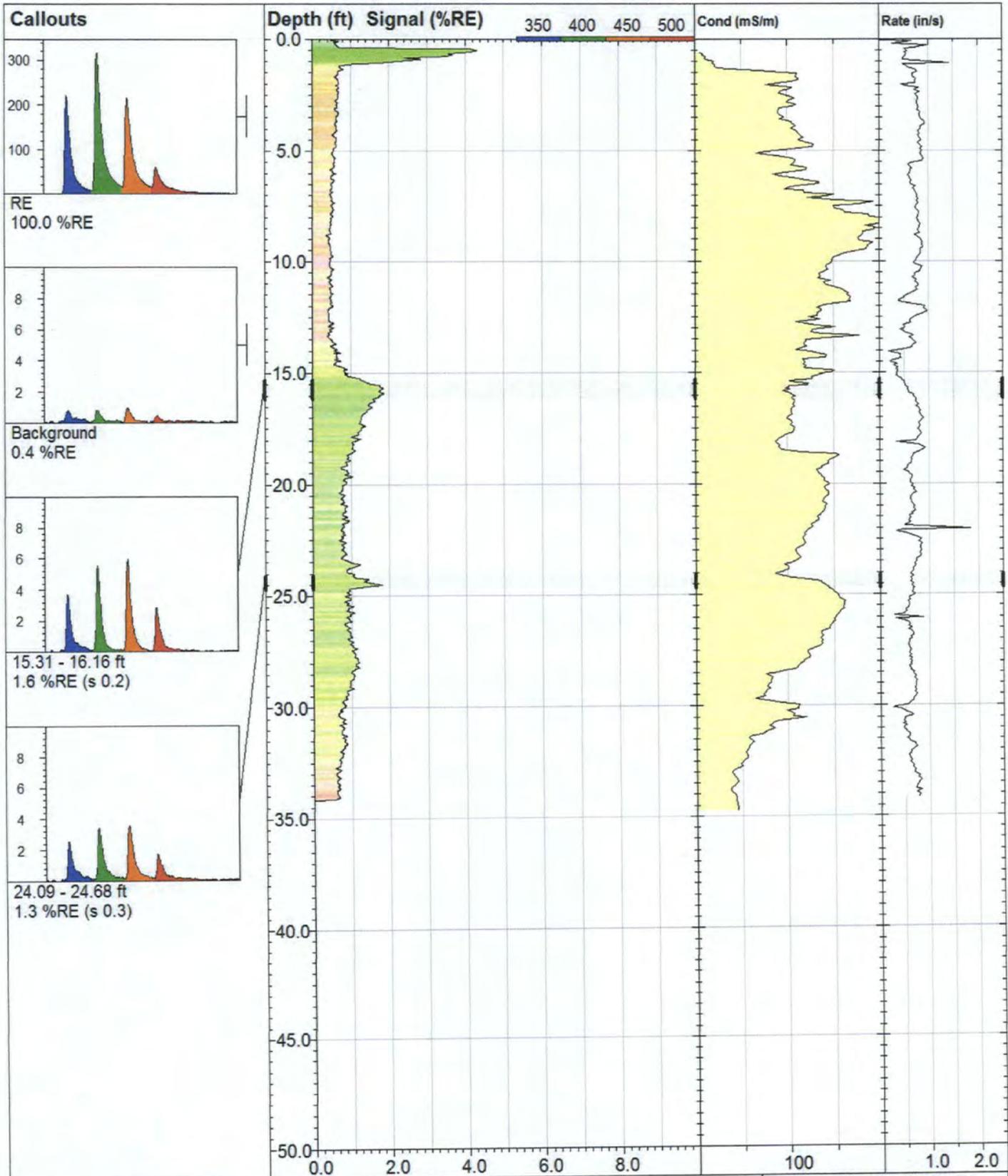
X Coord. (Lng-E) / Fix:  
Unavailable / NA

Max signal:  
6.4 %RE @ 0.81 ft

Operator / Unit:  
JM/BG / UVOST1004

Elevation:  
Unavailable

Date & Time:  
2016-09-28 11:13 CDT



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**LIF-18**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

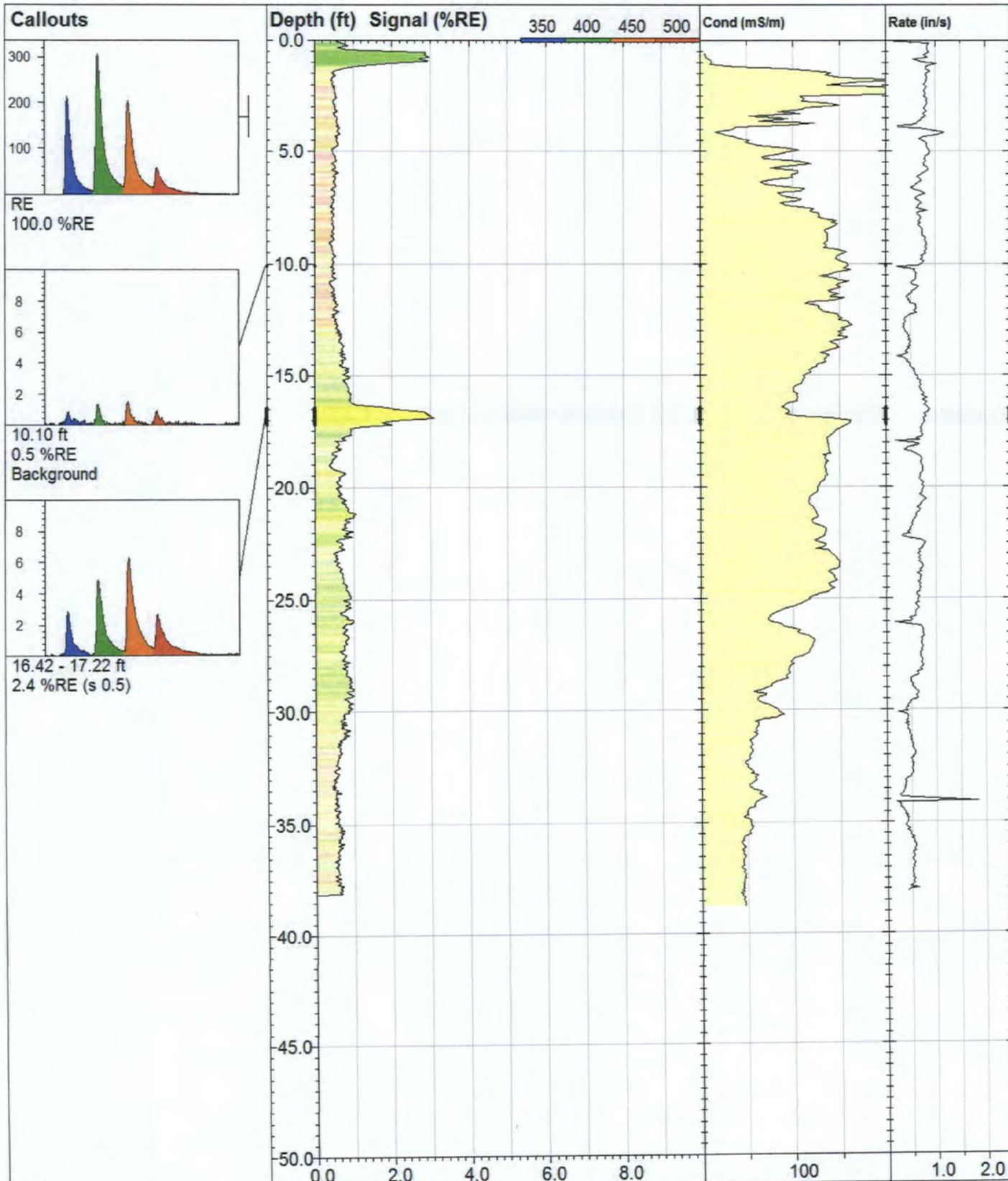
Elevation:  
Unavailable

**UVOST® By Dakota**  
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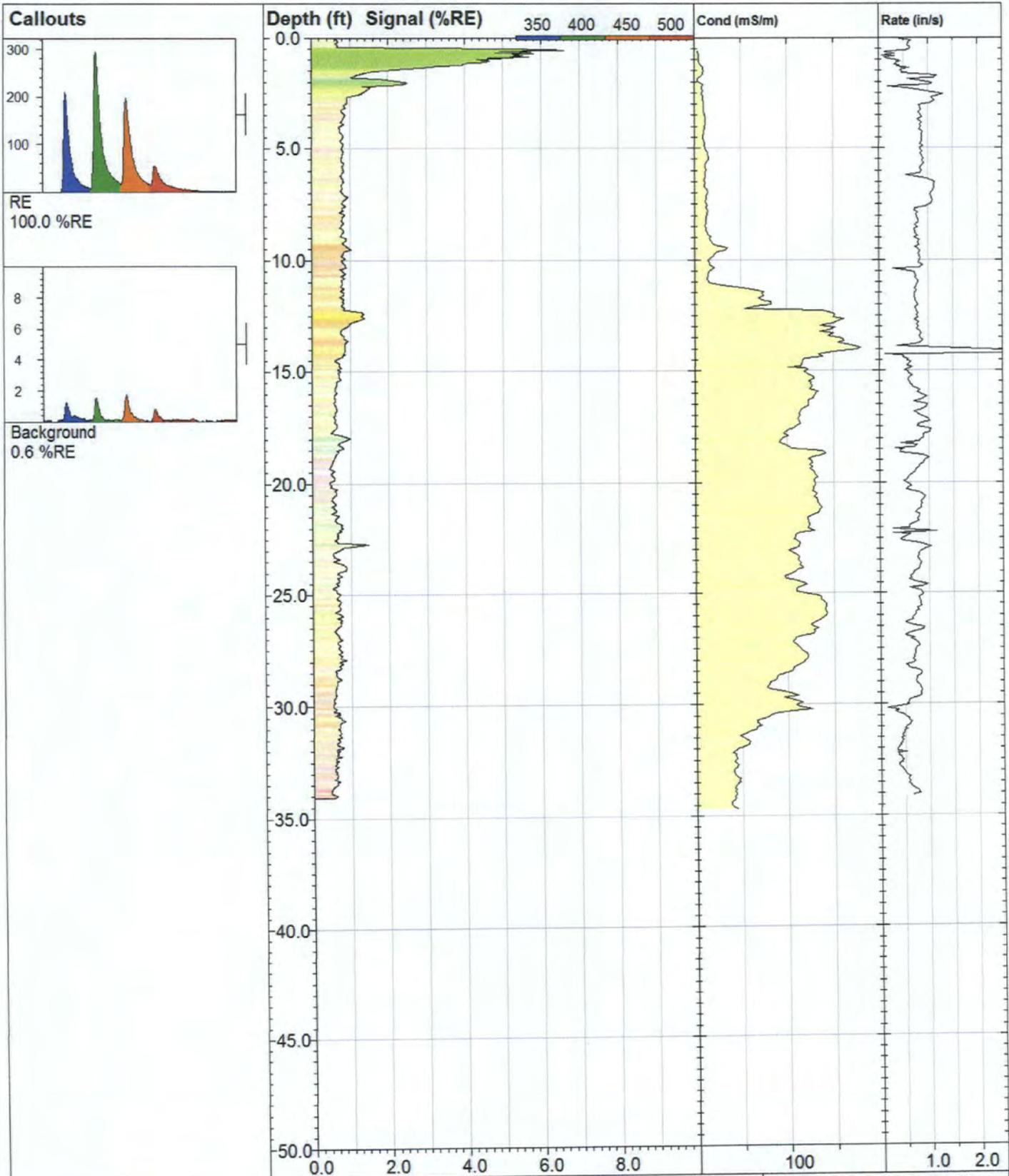
Final depth:  
34.15 ft

Max signal:  
4.3 %RE @ 0.52 ft

Date & Time:  
2016-09-28 11:44 CDT



<b>LIF-19_LIF-19A</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 38.11 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 3.1 %RE @ 16.92 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 14:31 CDT



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**LIF-20**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord.(Lat-N) / System:  
Unavailable / NA

X Coord.(Lng-E) / Fix:  
Unavailable / NA

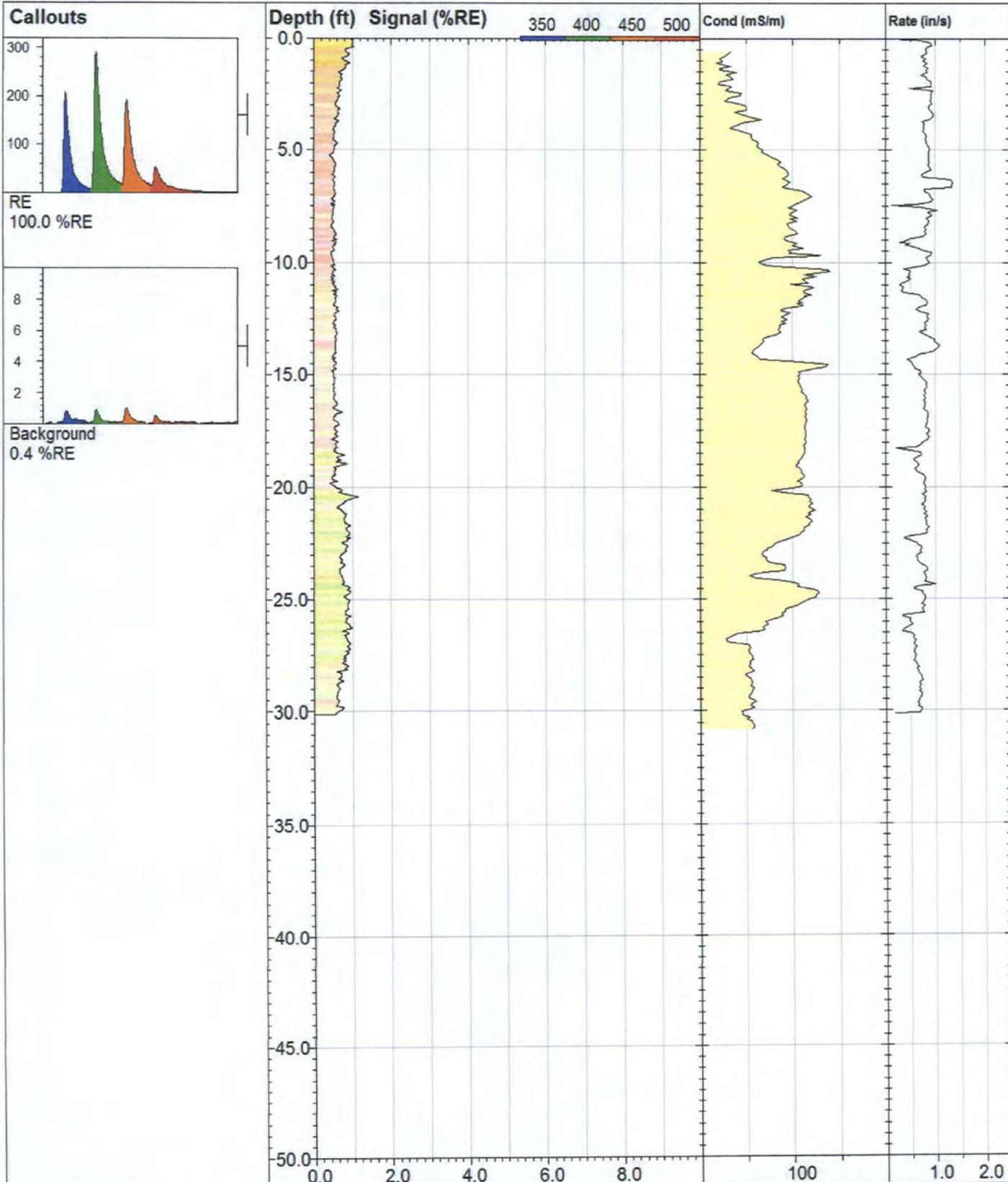
Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

Final depth:  
34.05 ft

Max signal:  
6.7 %RE @ 0.58 ft

Date & Time:  
2016-09-28 15:19 CDT



WWW.DAKOTATECHNOLOGIES.COM

**LIF-21**

Site:  
Former Coastal Mart 7301

Client / Job:  
Larsen & Associates / 025

Operator / Unit:  
JM/BG / UVOST1004

Y Coord. (Lat-N) / System:  
Unavailable / NA

X Coord. (Lng-E) / Fix:  
Unavailable / NA

Elevation:  
Unavailable

**UVOST® By Dakota**  
www.DakotaTechnologies.com

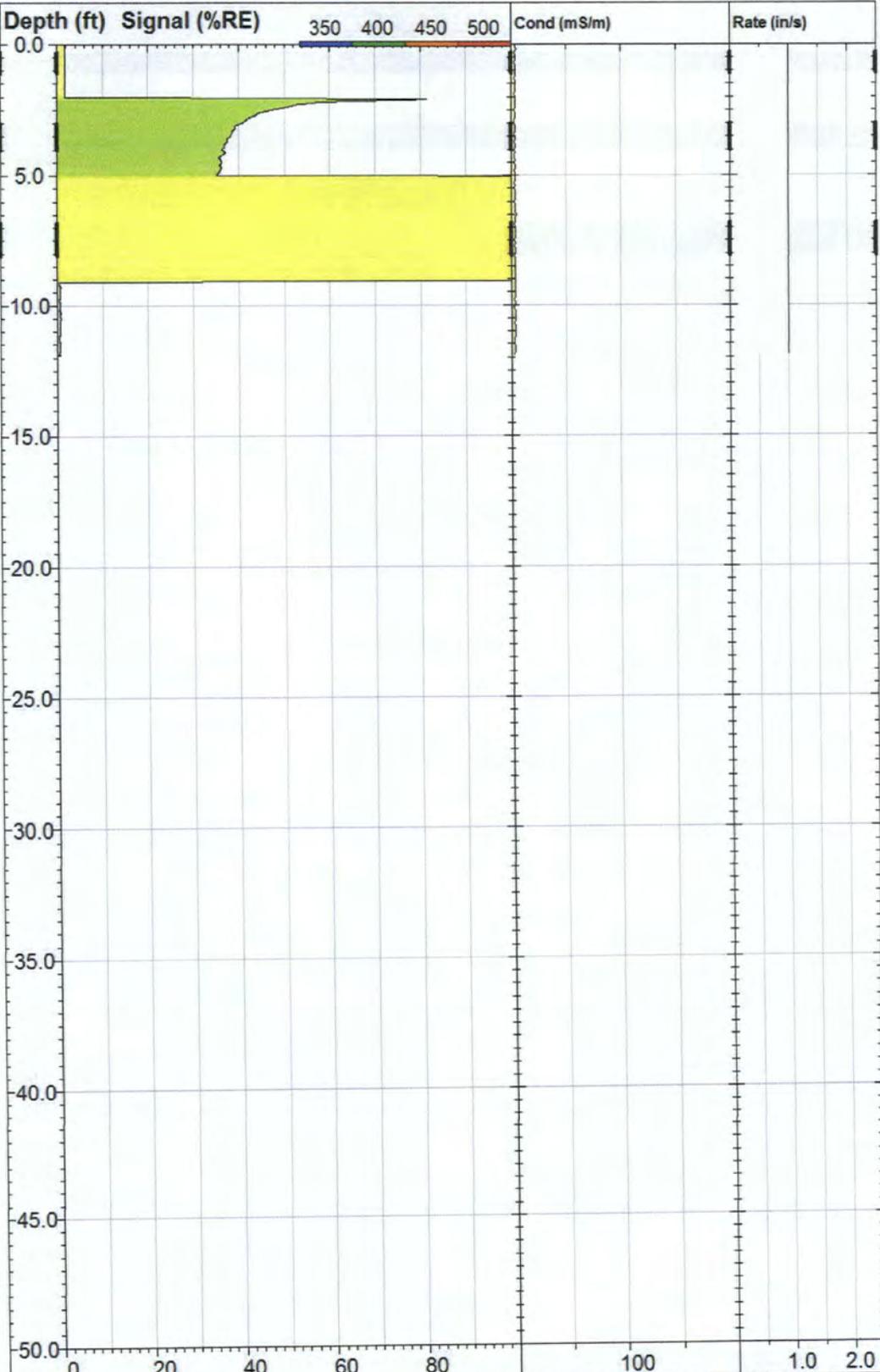
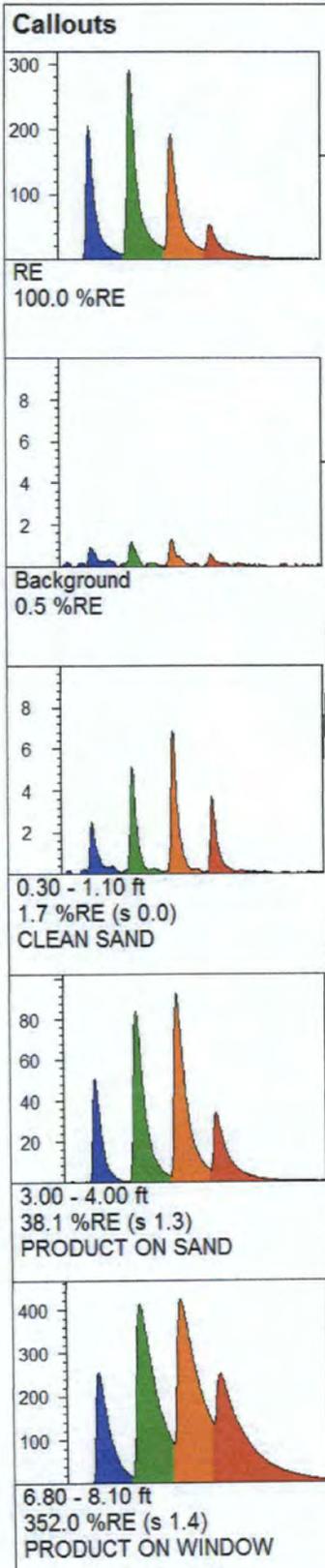
Final depth:  
30.14 ft

Max signal:  
1.1 %RE @ 20.42 ft

Date & Time:  
2016-09-28 15:50 CDT

**Appendix D**

**UVOST<sup>®</sup> Emulation**



<b>Emulation</b>		<b>UVOST® By Dakota</b> www.DakotaTechnologies.com
Site: Former Coastal Mart 7301	Y Coord.(Lat-N) / System: Unavailable / NA	Final depth: 11.90 ft
Client / Job: Larsen & Associates / 025	X Coord.(Lng-E) / Fix: Unavailable / NA	Max signal: 357.9 %RE @ 9.00 ft
Operator / Unit: JM/BG / UVOST1004	Elevation: Unavailable	Date & Time: 2016-09-28 16:16 CDT

**Appendix E**

**UVOST® Reference Log**

### Main Plot:

Signal (total fluorescence) versus depth where signal is relative to the Reference Emitter (RE). The total area of the waveform is divided by the total area of the Reference Emitter yielding the %RE. This %RE scales with the NAPL fluorescence. The fill color is based on relative contribution of each channel's area to the total waveform area (see callout waveform). The channel-to-color relationship and corresponding wavelengths are given in the upper right corner of the main plot.

### Callouts:

Waveforms from selected depths or depth ranges showing the multi-wavelength waveform for that depth. The four peaks are due to fluorescence at four wavelengths and referred to as "channels". Each channel is assigned a color.

Various NAPLs will have a unique waveform "fingerprint" due to the relative amplitude of the four channels and/or broadening of one or more channels. Basic waveform statistics and any operator notes are given below the callout.

### Conductivity Plot:

The Electrical Conductivity (EC) of the soil can be logged simultaneously with the UVOST data. EC often provides insight into the stratigraphy. Note the drop in EC from 10 to 13 feet, indicating a shift from finer (clay) to larger grain size (sand) stratigraphy. This correlates with the observed NAPL distribution.

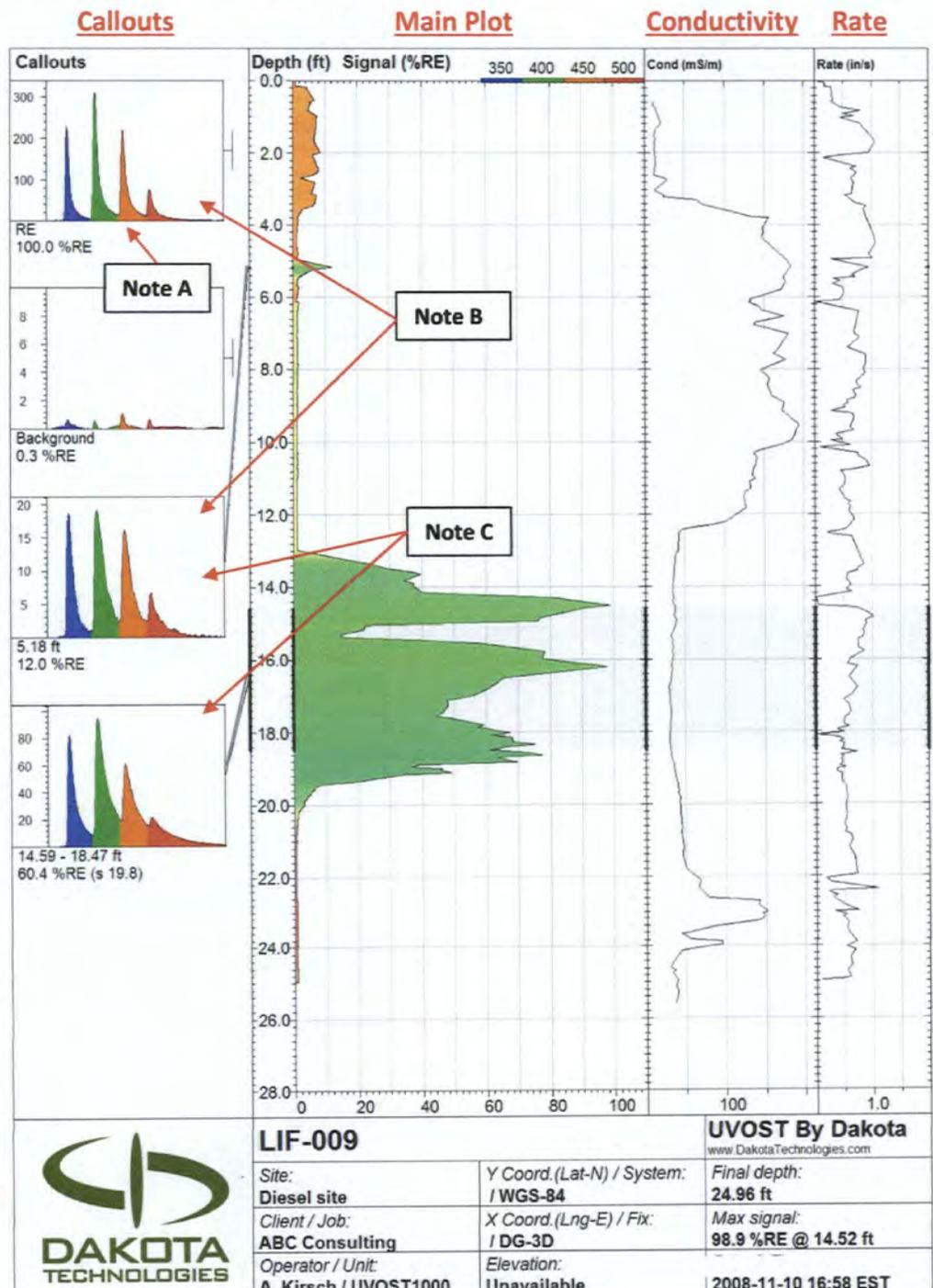
### Rate:

The rate of probe advancement. Approx. 0.8 inches (2cm) per second is preferred. A noticeable decrease in the rate of advancement may be indicative of difficult probing conditions (gravel, angular sands, etc.) such as that seen here at approx. 5 ft.

Note that this log was terminated arbitrarily, not due to "refusal," which would have been indicated by a sudden rate drop at final depth.

### Information Box:

Contains pertinent log information, including name and location.



### Note A:

Time is along the x axis. No scale is given on callouts, but it is a consistent 320ns wide. The y axis is in mV and directly corresponds to the amount of light striking the photodetector.

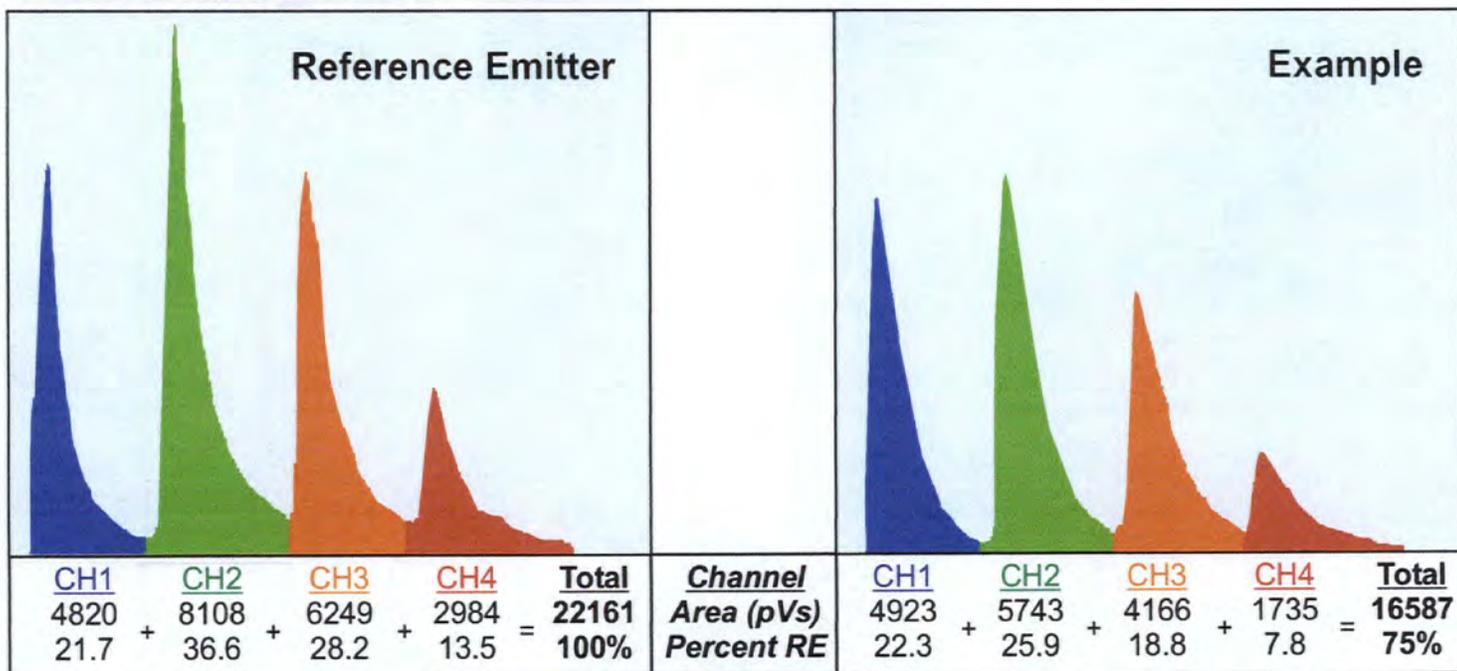
### Note B:

These two waveforms are clearly different. The top box is the Reference Emitter (a blend of NAPLs) always taken before each log for calibration, and the lower box is weathered diesel from the log itself.

### Note C:

Callouts can be a single depth (see 3rd callout) or a range (see 4th callout). The range is noted on the depth axis by a bold line. When the callout is a range, the average and standard deviation in %RE is given below the callout.

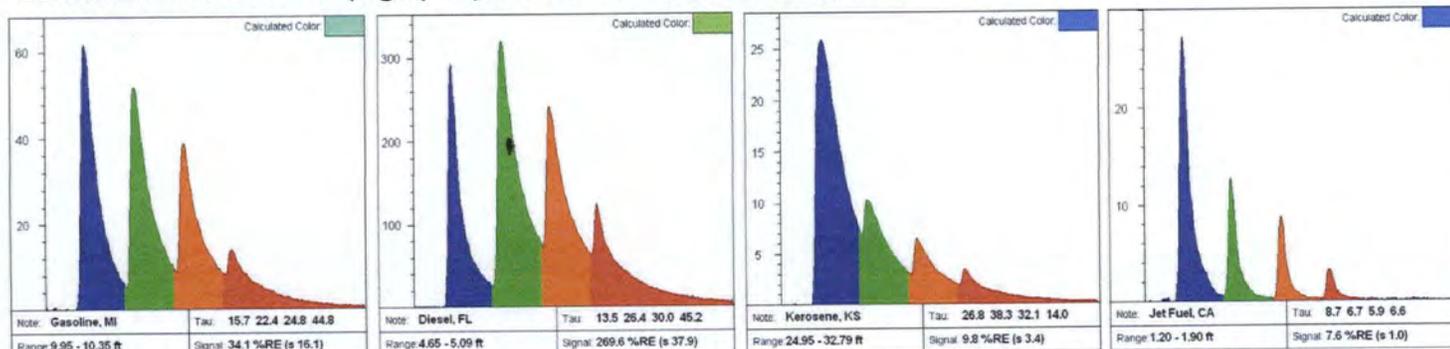
## Waveform Signal Calculation



## Data Files

<b>*.lif.raw.bin</b>	Raw data file. Header is ASCII format and contains information stored when the file was initially written (e.g. date, total depth, max signal, GPS, etc., and any information entered by the operator). All Raw waveforms are appended to the bottom of the file in a binary format.
<b>*.lif.plt</b>	Stores the plot scheme history (e.g. callout depths) for associated Raw file. Transfer along with the Raw file in order to recall previous plots.
<b>*.lif.jpg</b>	A .jpg image of the OST log including the main signal vs. depth plot, callouts, information, etc.
<b>*.lif.dat.txt</b>	Data export of a single Raw file. Tab delimited format. No string header is provided for the columns to make importing into some programs easier. Each row is a unique depth reading. The columns are: 1-Depth; 2-Total Signal (%RE); 3-CH1%; 4-Ch2%; 5-CH3%; 6-Ch4%; 7-Rate; 8-EC Depth; 9-EC Signal; 10-Hammer Rate Depth; 11-Hammer Rate; 12-Color (RRGGBB). Summing channels 1 to 4 yields the Total Signal.
<b>*.lif.sum.txt</b>	A summary file for a number of Raw files. ASCII tab delimited format. The file contains a string header. The summary includes one row for each Raw file and contains information for each file including: the file name, GPS coordinates, max depth, max signal, and depth at which the max signal occurred.
<b>*.lif.log.txt</b>	An activity log generated automatically is located in the OST application directory in the 'log' subfolder. Each OST unit the computer operates will generate a separate log file per month. A log file contains much of the header information contained within each separate Raw file, including: data rate, total depth, max signal, etc.

## Common Waveforms (highly dependent on soil, weathering, etc.)



Appendix D      Field Notes

Former Coastal Mart #7301

Andrew Hollenbach

LIF Survey

9/27/16

0445 Leave Lawrence

0730 Arrive Site

UTILITY MARKING CHECK

PHOTOS, ID monitoring well locations, etc.

REVIEW SITE DOCS

0800 Safety Meeting; calibrate before each pass

0830 Set up at MW3, just downgraded (~~SSE ← S~~)

0845 START 01 (LIF-01) (3.3'S x 1.1'E of MW3)

EC log indicates graded to sand by ~39.5'

small cyl-silt zone @ 40' but not a confining bed

no evidence of ~~most~~ LNAPL per ~~most~~ log.

0915 END LIF-01

TD = 50'

0930 START LIF-02

0940 loc picked is S ~ 26' from LIF-01

EC log indicates sand cyl zone (w/1') @ 30'

similar to LIF-01; NO LNAPL

0955 END LIF-02

TD = 40'

9/27/16

|||||

10:05 Move to LIF-03

10:07 START LIF-03

West of J ~ 25'

10:28 END-TD=40' , NO LNAPL

10:45 START @ LIF-04

West of 3 ~ 25'

11:03 End , TD=40' NO LNAPL

11:15 START @ LIF-05

11:20-11:45 Delay - Tech related issue

11:03 END @ LIF-05

TD=40'

12:05 LUNCH

13:05 Move to LIF-06 (in basin)

13:09 START @ LIF-06

bottom tank basin @ ~ 12', conductivity spike

13:55 END @ LIF-06

TD=40'

14:10 START @ LIF-07

14:30 END @ LIF-07 product ID's @ bottom of tank basin

TD=40'

on top of clay

14:35 Paul E arrives site (SHSM)

|||||

9/27/16

14:38 START LIF-08 does not appear to be in tank basin (BL)

15:00 END LIF-08

TD = ~~30.37~~ 37' 40'

15:05 STAR LIF-09 STATIC - back to 18.32 after purging

MW3, static ~~18.55~~ 18.32 TD = 30.22, 6 gal bailed  
little to no production well

MW4 static ~~21.08~~ 21.08 TD 31.4' bailed dry @ 2 gal

Paul Sampled @ MW3 and MW4

16:27

15:55

1540 END LIF-09

TD = 30.37'

MW3 0464143

1605 START LIF-10

new 0470367

1630 END LIF-10

TD = 32'

MW4 old # 0464116

1645 Paul leaves Site

new 0470251

1650 START LIF-11

1715 END LIF-11

TD = 34.27

17:30 Clean up, pack-in, Lead out.

17:50 Arrive Hotel

NOTE: GSI probing in R-O-W just west of site and North of central. They got rods stuck underground. They dug out w/ back hoe. Hit sprinkler line (PVC), and left excavation open @ end of day.

Former Coastal Mart 7301

9/22/16

LIF Survey - Day 2

Andrew Hollenbach

0630 Review Notes, logs

3' x 11'  
S E

Planned locations

0750 Arrive Site

0800 H&S Meeting

0822 Set up on LIF-12, small LNAPL @ 18'

0831 Start LIF-12

0855 END LIF-12

TD ~ 34'

0900 START LIF-13

0915 END LIF-13

TD ~ 34'

0925 START LIF-14

0955 END LIF-14

TD ~ 30.13

10:05 START LIF-15 tankbush, small LNAPL

10:25 END LIF-15 tankbush, 8 or GW

TD = 34'

10:40 START LIF-16 (zero'd out ~ 1' deeper @ ~ 2')

11:00 END LIF-16

TD = 34'

Andrew Hollenbach  
9/28/16

11:15 START LIF-17 in basin, no LMAPL

11:30 END LIF-17

TD = 34'

11:45 START LIF-18 out of basin, small LMAPL

12:00 END LIF-18

TD = 34'

12:05 Drill crew → Lunch

12:15 B. Taverner w/ KODGE left site

13:20 START LIF-19, out of basin

Some tech issues @ 15' <sup>computer</sup> stopped logging

resumed @ 14:30. comp had to be re-zeroed after fix.

2 logs will need to be combined to make LIF-19

14:45 END LIF-19

TD ≈ 38'

[CSI excavation area - clearly  
they broke a sprinkler line as  
evidenced by water.]

15:15 START LIF-20 in basin residual (very small quantity LMAPL @ bottom of  
basin)

15:40 END LIF-20

TD ≈ 34'

15:45 START LIF-21

16:05 END LIF-21

TD = 30'

16:20 Load up, patch surface, conduct emulation test

16:25 picks, measure locations

A H H H H

Andrew Hollenbeck  
9/28/16

1731 Leave Site

2009 Mine Home

~~Handwritten signature~~

Appendix E Permits/Access



1311 E 25<sup>th</sup> Street, Suite B, Lawrence, KS 66046 | 785-841-8707 | office  
 andrew@larsenenvironmental.com | 785-865-4282 | fax

## PERMISSION TO ACCESS PRIVATE PROPERTY

### General Information

As part of an environmental investigation and remediation effort at the facility known as Former Coastal Mart #7301 located at 10330 W. Central in Wichita, Kansas, it is necessary to conduct drilling (direct-push) and sampling activities on the property. The scope of work involves conducting a Laser Induced Fluorescence (LIF) Survey on the property which will provide information used to plan a full-scale remedial effort. To accomplish this goal, it is necessary to access the property. This access agreement allows us to complete the scope of work which involves drilling, sampling, and the use of the LIF technology.

The Kansas Department of Health and Environment (KDHE) requires that we obtain written authorization to access the property. Larsen & Associates, Inc. has been contracted to complete the work necessary to determine conduct the LIF survey, and sample site monitoring wells. Your assistance with this project is greatly appreciated.

If you have any questions concerning the work to be conducted please call our office at 785-841-8707.

### ACCESS AGREEMENT

As owner or owner representative of the property at the following address:

Property Address: 10330 W. Central Avenue in Wichita Kansas 67212 (Liberty Place)

Owner Name (please print): Don Zerba Phone: (316) 633-3159

(PLEASE CHECK ITEM 1 or 2)



- 1) As owner or owner legal representative I give Larsen & Associates, Inc. permission to conduct the following work on my property:
- A) Collect groundwater samples from site monitoring wells.
  - B) Drill soil borings and collect data using LIF technology.

After completion of all work, Larsen & Associates, Inc. agrees to return the property immediately surrounding the wellhead and/or soil boring to its original condition. All local and state regulations for installing wells/borings will be followed. There will be no charge to the property owner for the work conducted.

\_\_\_\_\_ 2) I deny all access to my property.

Don Zerba  
 print name (owner or owner legal representative)

Don Zerba  
 signature

9/12/16  
 date

Please complete and return.

**Andrew Hollenbach**

---

**From:** Firsching, Linda [LFirsching@wichita.gov]  
**Sent:** Monday, September 26, 2016 10:23 AM  
**To:** Andrew Hollenbach  
**Cc:** Russell, Roger  
**Subject:** FW: Dirt Cut Permit Request  
**Attachments:** Former Coastal Mart 7301\_LIF survey limits.pdf

Hi Andrew,

There will be no permit fees if you don't drill into pavement. The fees for dirt cuts are waived if they are part of KDHE Underground Storage Tank program. I am including Roger who is inspector for this area on this email.

By this email you have permission to proceed with your boring activities.

Sincerely,

Linda Firsching

**City of Wichita**  
**City Hall, 7<sup>th</sup> floor**  
**455 N. Main**  
**Wichita, KS 67202**

**Telephone #: 316-268-4418**  
**Fax # 316-858-7400**  
**Email: lfirsching@wichita.gov**

---

**From:** Andrew Hollenbach [mailto:Andrew@larsenenvironmental.com]  
**Sent:** Tuesday, September 20, 2016 12:57 PM  
**To:** Firsching, Linda <LFirsching@wichita.gov>  
**Subject:** Dirt Cut Permit Request

Linda,

I am emailing to request a permit for forthcoming boring activities on City of Wichita right-of-way property. The work will involve pushing tools into the subsurface with a direct-push rig (geoprobe). No monitoring wells will be installed, no samples will be collected, and no lasting impact will be made to right-of-way.

The Kansas Underground Storage Tank Program is conducting a Laser Induced Fluorescence Survey (LIF Survey) of contaminated property located at 10330 W Central Ave. I have attached a figure showing the extents of our survey area. There are no specific locations for our anticipated field activities, because each location is dependant upon the data that emerges from each prior location. The direct push rig will push LIF technology into the subsurface and data is collected in real-time. As part of the survey we may need to probe on right of way located adjacent to the property.

In total, we anticipate less than 5 borings to be performed on the city right-of-way; and in fact, there may ultimately be no borings on right-of-way. There will be approximately 20 borings in total (including right-of-way and private

9/26/2016

property). The work is scheduled to begin on Tuesday, 9/27. It will take 2-3 days to complete the LIF Survey.

I believe that we have an excavation bond on file in the Engineering office.

Please let me know if you have any questions, I will follow up this email with a phone call regarding permit fee payment.

Thank you for your assistance,  
Andrew Hollenbach, PG

**Larsen & Associates, Inc**  
**1311 E. 25th St.**  
**Lawrence, Ks 66046**  
**316-841-8968 (cell)**  
**785-841-8707 (office)**



**Customer**

Larsen & Associates Inc.

Job Date : 26-Sep-16

**Phone Number**

316-841-8968

**Billing Address**

1311 E 25th Street, Suite B

**City**

Lawrence

**State**

KS

**Zip**

66046

Thank you for using Ground Penetrating Radar Systems on your project. We appreciate the opportunity to work with you. If you have questions regarding the results of this scanning, please contact the lead GPRS technician on this project.

**Lead Technician :** JEFFRIES, TERRY

**Phone**

913-232-6533

**Email**

terry.jeffries@gp-radar.com

**Jobsite Location**

**Job Num:** Former Coastal Mart #7301

10330 West Central Ave

**PO Num:** U2-087-13357

The following equipment was used on this project:

- 400 MHz GPR antenna. Typically capable of detecting objects several feet deep. Maximum effective depth depends on site and soil conditions.
- At this site, the maximum effective depth of the GPR was 3 1/2
- RD 7000/8000 Radio Frequency detector. Detects electromagnetic fields. Used to actively trace metallic pipes and tracer wires, or passively detect electric, communications and other lines.

Ground Penetrating Radar Systems performed the following work on this project:

Scanning the specified area to locate underground utilities and other significant anomalies. A tracer signal was sent along any accessible metallic utility or tracer wire, and the area was scanned with GPR to locate any additional targets. The locations of any detected utilities and anomalies were marked directly at the site with paint, flags, stakes, or other appropriate means, and results were reviewed with onsite personnel.

- Scanned a large site looking for any underground utilities in the area. Any anomalies found were marked in spray paint and pin flags. Stay one foot off of all lines. Technician could not mark utilities in the alley do to limited scanning area.

**Pictures**

**TERMS & CONDITIONS**

<http://www.gp-radar.com/termsandconditions.html>

**Contact Name**

Andrew Hollanbach

**Contact Phone**

316-841-8968

**Contact Email**

Andrew@larsenenvironmental.com