GPR technology
Vol 1, No. 3
Summer 2005

Subsurface Views

Sensors & Software Inc.

Disappearing Pipes

GPR operators quickly learn that GPR penetration depth depends on the local ground conditions. If you have attended a Sensors & Software GPR training course, you will have heard us say "If the answer is not obvious, you may be far better off to move over a few inches and collect another line of data to see if the interpretation is easier". In this article, we show a dramatic example.

Data were collected running parallel to a building where at least one utility was expected to exit. To provide complete coverage, data were collected on a grid. A 16 x 30 foot grid was set up along the side of the building to investigate the area. GPR survey lines were positioned every 1 foot in both the X and Y directions.

A Noggin^{plus} 250 SmartCart system was used to conduct the survey. The 250 MHz Noggin system is optimal for investigating utilities. It has maximum depth penetration with sufficient resolution to delineate objects smaller than 2 inches in diameter. In Figure 1 (see page 2), Utility 1 can be seen on all the cross-sectional images, while Utility 2 is visible on survey lines A, B, F and G but weakly or not at all on C, D, E. The area was covered with an asphalt layer with no visible reason for the difference.

(continued on page 2)

pulseEKKO® PRO: now from 12.5 to 1000 MHz

A versatile system!

In January we introduced pulseEKKO PRO and described its basic attributes. The pulseEKKO PRO capability now has operating centre frequencies from 12.5 to 1000 MHz.

Bistatic transducers operating at 250, 500 and 1000 MHz round out the family and provide a future upgrade path for pulseEKKO 1000 owners.

The pulseEKKO PRO's versatility is clearly demonstrated by the variety of ergonomic deployment configurations for use in a wide range of applications.

Full Bistatic

in open areas to Full Bistatic for step-mode surveys in rough terrain, transillumination investigations, or CMP/WARR sounding, the pulseEKKO PRO has been designed to address all GPR needs.

Hand Tow

SmartCart

From SmartCart and One-Man configurations for efficient surveys

The 250, 500 and 1000 MHz transducers' Hand Tow configuration enable synchronized operation with odometer triggers in a highly portable package. Transducers are quickly released *(continued on page 3)*

In This Issue

Disappearing Pipes *(continued from page 1)*

The data were processed using EKKO_Mapper software to create the plan map in Figure 2. Utility 1 is visible as a continuous linear response across the map but Utility 2 exhibits a gap.

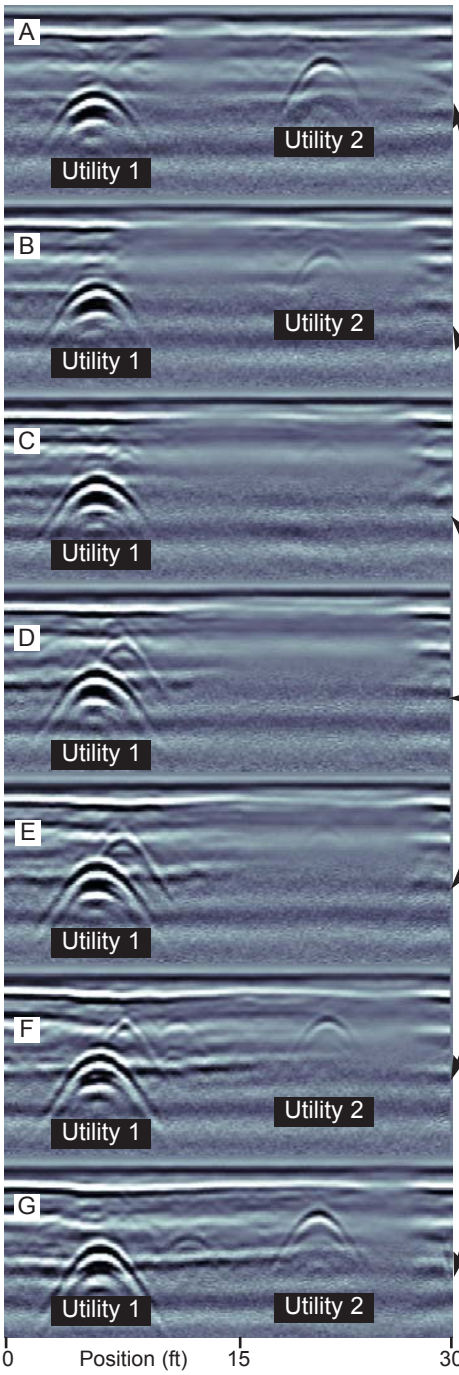

Figure 1: *Utility 1 can be seen on all cross sectional images A to G, while utility 2 is clearly visible only on A, B, F and G survey lines.*

Why does the pipe disappear? There are several explanations, some more plausible than others: 1) The soil conditions changed, 2) The utility changes direction, 3) the utility goes deeper, out of the range of the GPR signal or, 4) the material composition of the utility changes and is not detectable with GPR.

Considering most construction practices, explanations 2-4 are not likely. The data itself suggests that asphalt/soil conditions have changed because signals from the soil stratigraphy and even the direct ground wave that travels at surface directly from the GPR transmitter to receiver show reduced in signal strength. Most likely soil conditions above the pipe have changed resulting in the GPR signal absorption preventing detection of the utility pipe.

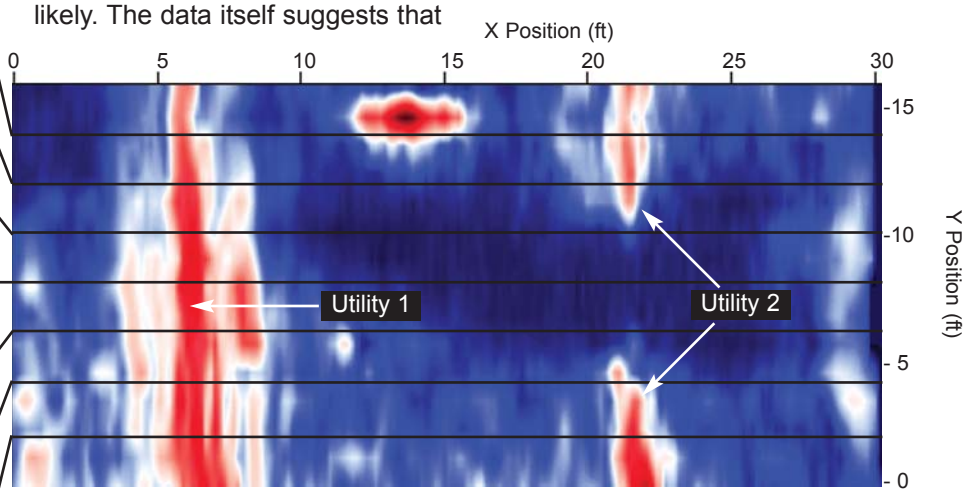

Figure 2: *Utility 1 is visible as a continuous linear response across the map but Utility 2 has a gap in the response.*

The penetration of the GPR signal is dependent on the electrical conductivity of the soil being scanned. The natural soil composition, water content, contaminants and overlying construction materials all can affect the conductivity. In this case, without testing by digging or drilling, it is difficult to determine what factor has reduced the penetration in this area.

The key points from this case study are:

1) Proper survey technique is extremely important. Without the data on a grid, we may not have collected a portion of the survey area and missed important utilities. Also, if we had only collected one or two data lines we may not have recognized the anomalous area of increased absorption.

2) Use all the knowledge available to you when making an interpretation of the data. Familiarity with local construction practices makes interpreting data easier because you will understand what objects are likely to be in the ground and how they were buried.

3) Soil conditions can change in a matter of inches. Don't give up too quickly. An adjacent survey line may be the key to understanding what is going on in the subsurface. ■

Subsurface Views
Sensors & Software Inc.

A versatile system! (continued from page 1)

for CMP or transillumination operation.

Electrical beeper trigger

Fibre optic beeper trigger

GPS Integration

Optical Encoded Odometer

Remote beeper/triggers, odometers and integrated GPS ensure accurate positioning and predictable operation in any deployment configuration. For more information visit www.sensoft.ca ■

Ask the Expert

I have been using the Noggin 250 SmartCart. There is some question as to the actual antenna separation. I thought I had read somewhere that it is 0.28 m, but it has been suggested that there is no separation because they are one. Can you clarify this for me?

Noggin systems are bistatic systems, that is, they have two antennas with a finite antenna separation. Since the system is enclosed in a single box, this separation is fixed and cannot be changed.

The number that you quoted for the antenna separation of a Noggin 250 is correct. A system with one antenna that both transmits and receives data is called a monostatic system. Sensors & Software GPR systems whether in one box like Noggins or in separate antenna boxes like the pulseEKKO PRO, are bistatic to minimize transmitter blanking inherent in monostatic systems. ■

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Upgrade your pulseEKKO 100 with a DVL & control module (rugged data logger & real time data displayer), a PRO Digital Receiver (low noise & power) and keep existing transmitters, antennas, and handles.

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250 MHz

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Recent Technical Papers

1. **Experimental Detection of Reinforcing Bar Corrosion Using Nondestructive Geophysical Techniques,** ACI Materials Journal, Vol. 100, No. 6, November-December 2003, pp. 501-510.
By: Hubbard, S.S., Zhang, J., Monteiro, P.J.M., Peterson, J.E., Rubin, Y., 2003 ***ref 306***

2. **The Early Development of TDR for Soil Measurements,** Vadose Zone Journal, Vol. 2 (2003), pp. 492-499.
By: Topp, G.C., Davis, J.L., Annan, A.P., 2003 ***ref 307***

3. **Measuring Soil Water Content with Ground Penetrating Radar:** A Review, Vadose Zone Journal, Vol. 2 (2003), pp. 476-491.
By: Huisman, J.A., Hubbard, S.S., Redman, J.D., Annan, A.P., 2003 ***ref 308***

4. **Air Distribution in the Borden Aquifer During In Situ Air Sparging,** Journal of Contaminant Hydrology, Vol. 67 (2003), pp. 113-132.
By: Tomlinson, D.W., Thomson, N.R., Johnson, R.L., Redman, J.D., 2003 ***ref 311***

Upcoming GPR courses

One Day Noggin® Short Course
September 12, 2005
November 7, 2005

Our Noggin® short courses are offered throughout the year to anyone interested in learning more about GPR and subsurface imaging.

One Day Conquest™ Course
September 13, 2005
November 8, 2005

Our Conquest™ courses are offered to anyone interested in learning more about our concrete imaging instrument.

Information Request

Please check off information required below and fax or Email back:

- ☐ pulseEKKO® PRO
- ☐ Conquest™
- ☐ OEM Noggin*plus*
- ☐ RoadMap™
- ☐ pulseEKKO® Borehole GPR
- ☐ Noggin® Systems
- ☐ Conquest3D
- ☐ EKKO Mapper
- ☐ EKKO_View
- ☐ Recent Technical Paper #1
- ☐ Recent Technical Paper #2
- ☐ Recent Technical Paper #3
- ☐ Recent Technical Paper #4
- ☐ Rental Information
- ☐ 3 Day GPR Short Course
- ☐ 1 Day Noggin® Short Course
- ☐ Other (please specify)

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Sept. 27-29, 2005
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ASCE Conference
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GPRI
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