



Case Study: Added Value of Contaminant Mapping Using Capacitively Coupled Resistivity in Pseudo- 3D form Combined with Frequency-Domain Electromagnetics

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In Collaboration With:
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Precision Drilling Corporation



Earth. Insight. Values.

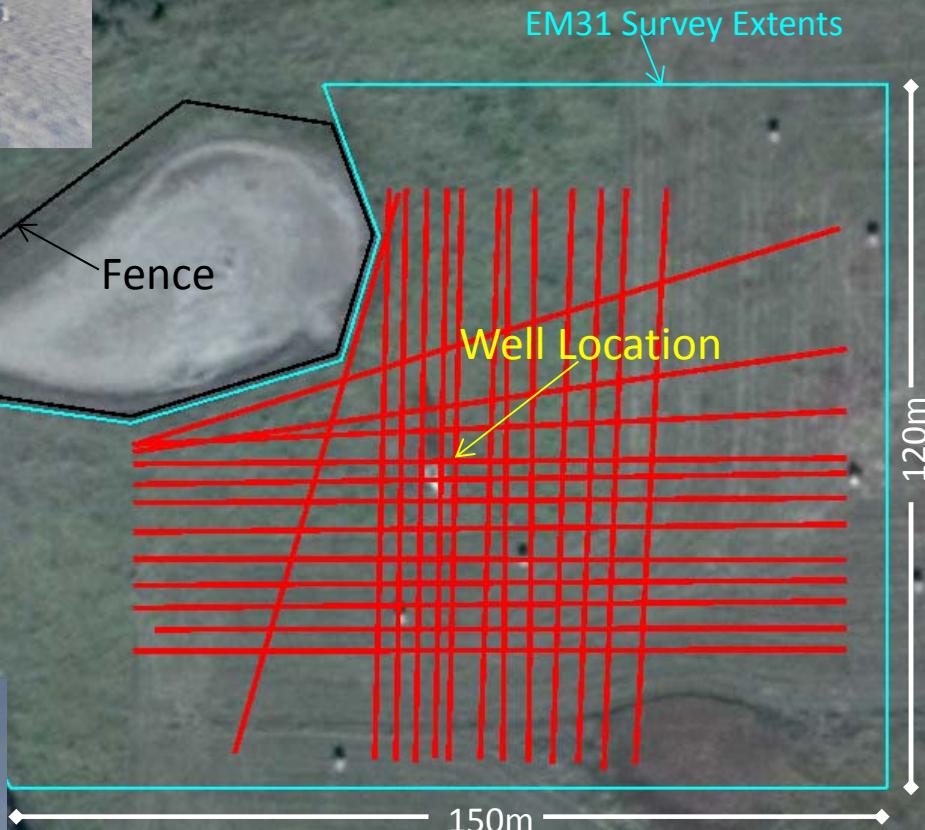
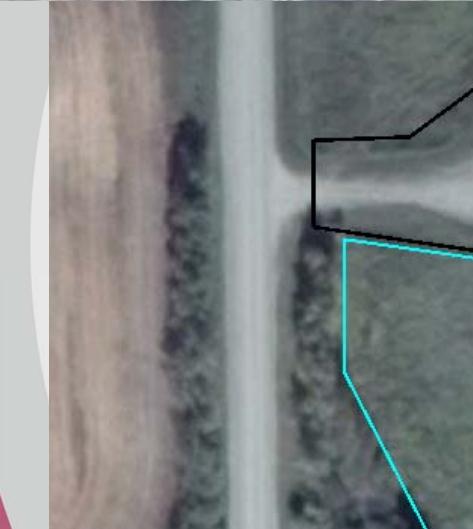
Overview



- Site Description
- Objectives
- Methods / Instruments
 - Advantages and Disadvantages
- Survey Design
- Acquisition
- Results
- Challenges
- Added Value for Client
- Conclusions



Site Description





- Objectives
 - Identify and map contaminated zone
 - EM31 and OhmMapper
 - Pseudo-3D OhmMapper data

Methods / Instruments

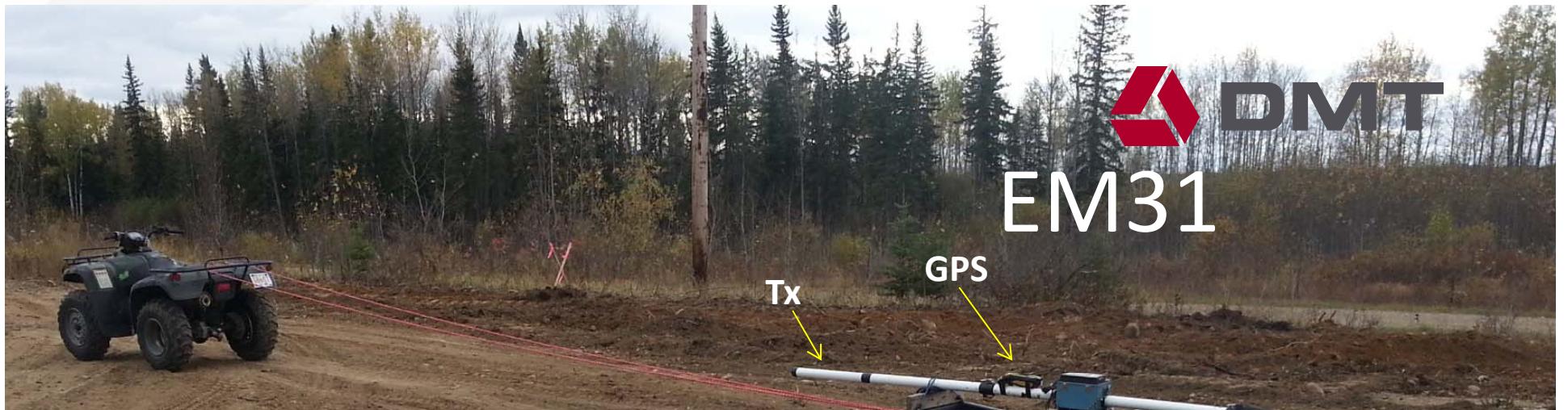


EM31

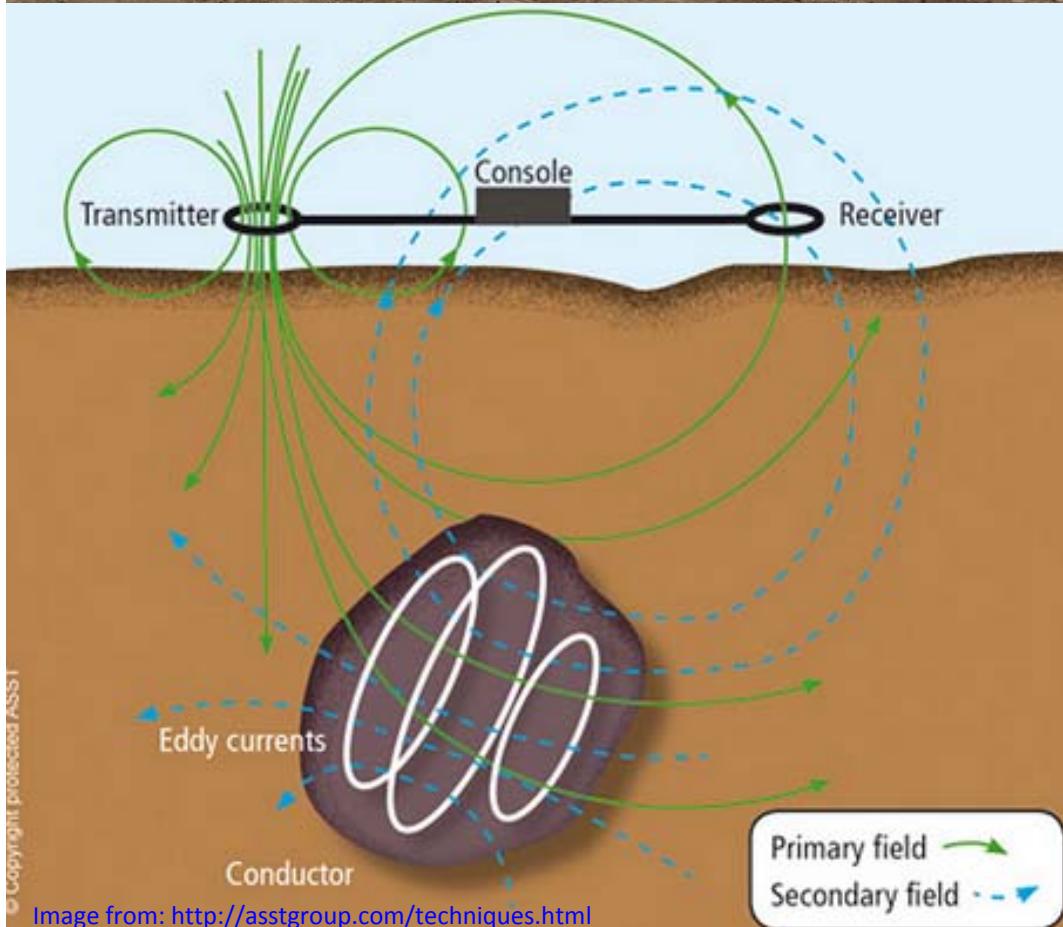
OhmMapper



Earth. Insight. Values.



DMT
EM31



- Geonics EM31 MK II Conductivity Meter
- GPS integrated in real time
- Average over exploration extents.
 - 5-6 metres
- High data density – 1 reading / second.

Earth. Insight. Values.



Advantages/Disadvantages of EM31

Advantages:

- Quick
- Ease of use
- Site overview

Disadvantages:

- Limited depth info.
- Higher conductivity reduces depth of investigation.

Conventional Resistivity



- Electrical Resistivity Imaging (ERI)

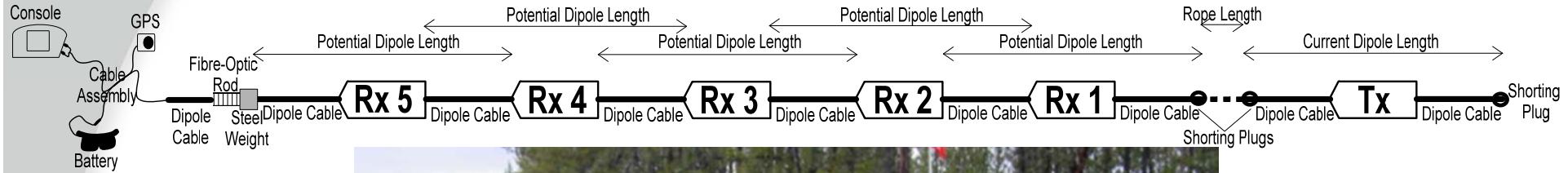


- Labour and equipment intensive.
- Stationary.
- Time intensive.

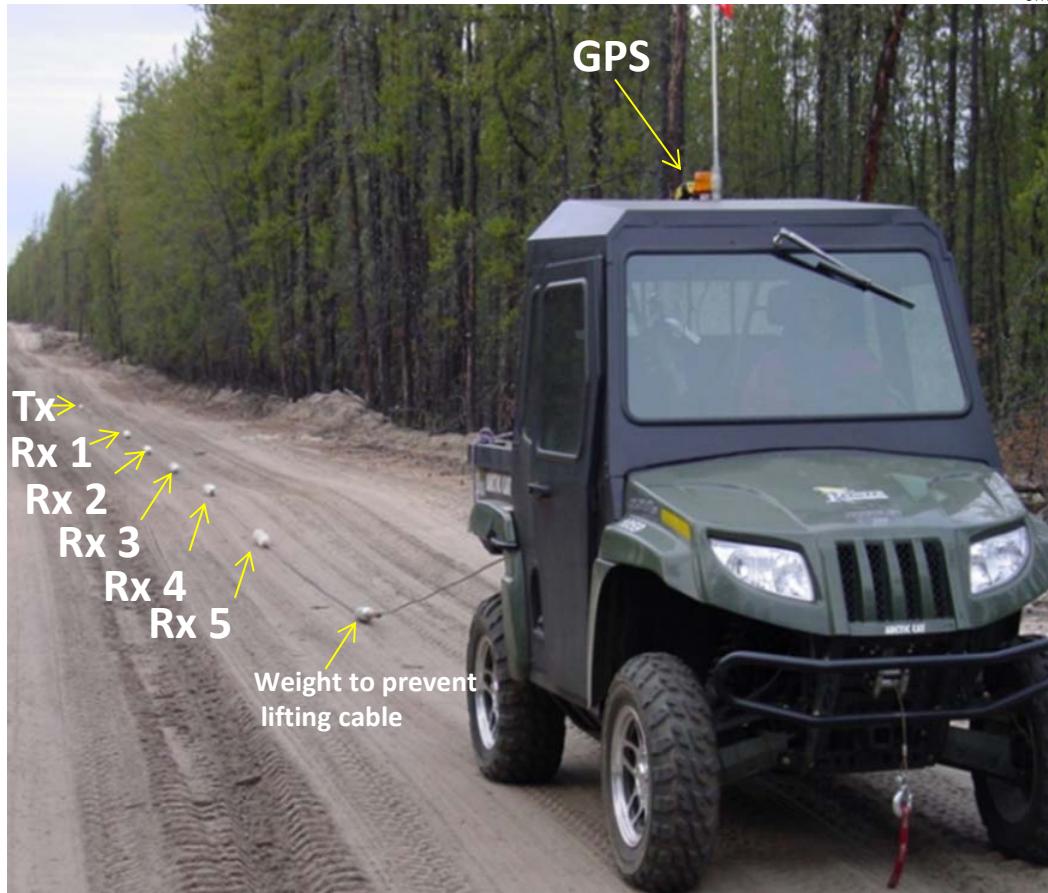
Earth. Insight. Values.

Geometrics OhmMapper

Capacitively Coupled Resistivity



Many configurations
• Cable lengths
• Rope lengths



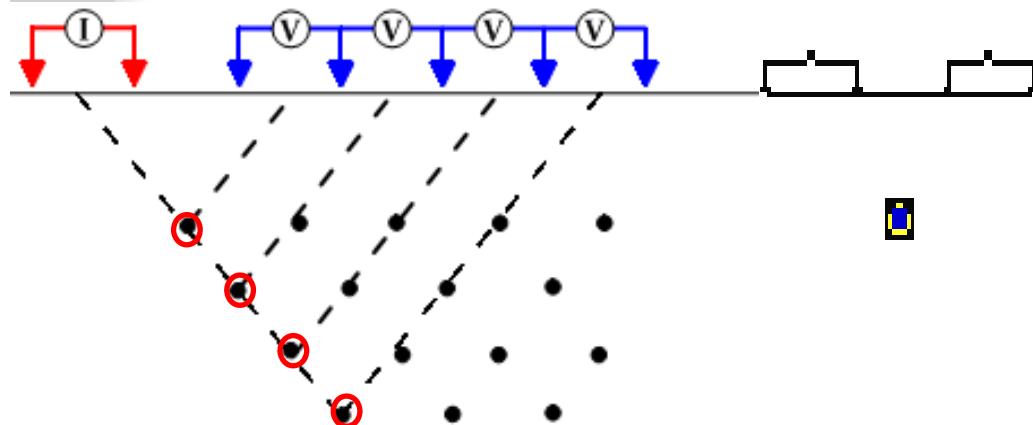
Data Acquisition
• GPS linked

Earth. Insight. Values.

OhmMapper Vs. ERI



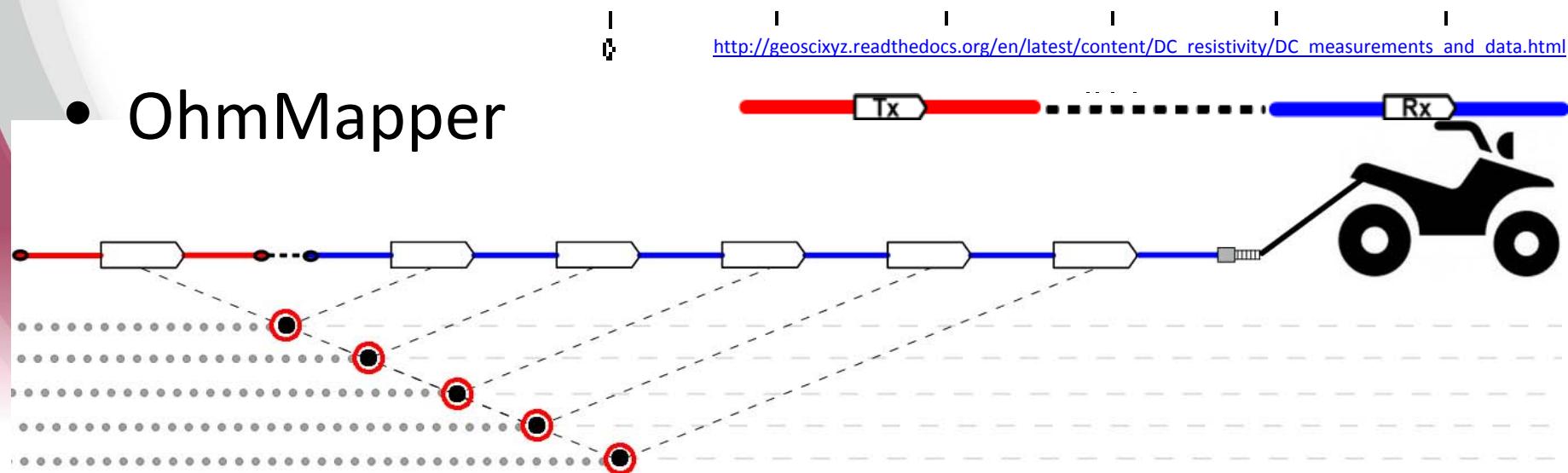
- Conventional ERI



Dipole-Dipole Array



- OhmMapper



http://geoscixyz.readthedocs.org/en/latest/content/DC_resistivity/DC_measurements_and_data.html



Advantages/Disadvantages of OhmMapper

Advantages:

- Depth information
- Quick - Dragged
- Efficient - Limited personnel
- Very high horizontal resolution
 - 2 readings/second

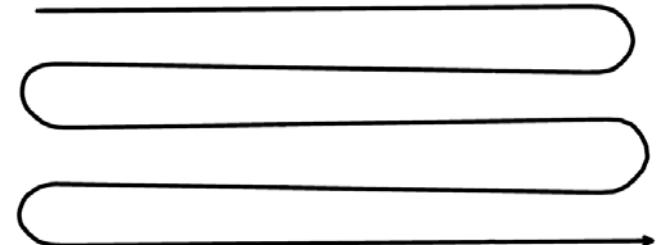
Disadvantages:

- Shallower depth than ERI
- Higher conductivity reduces ability to receive data
- Only water resistant
- Difficult to drag by hand and/or rough terrain

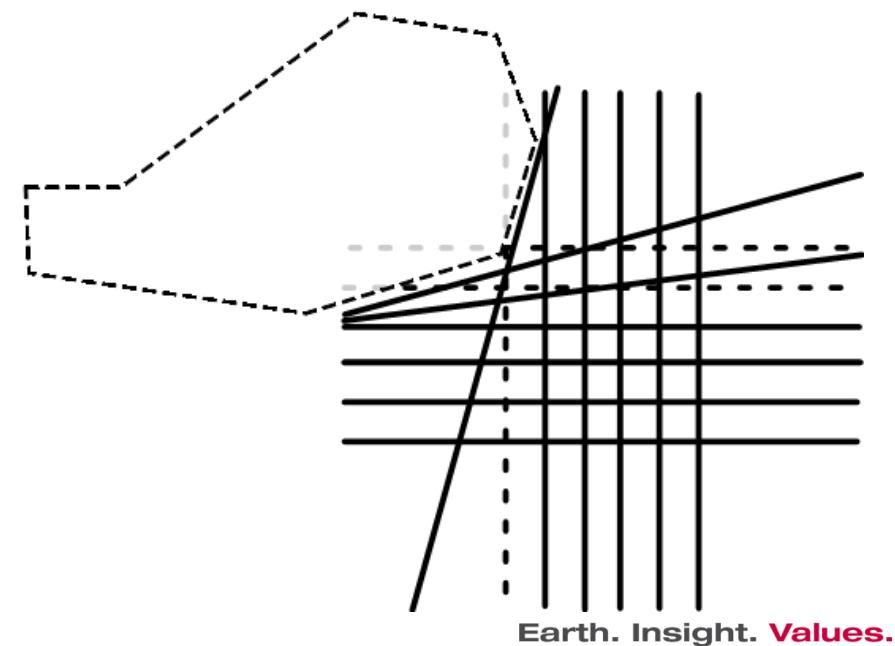
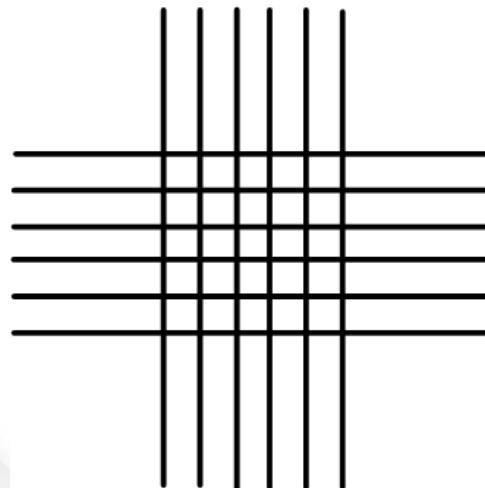
Survey design



- Reconnaissance style EM31
 - Identify targets and background



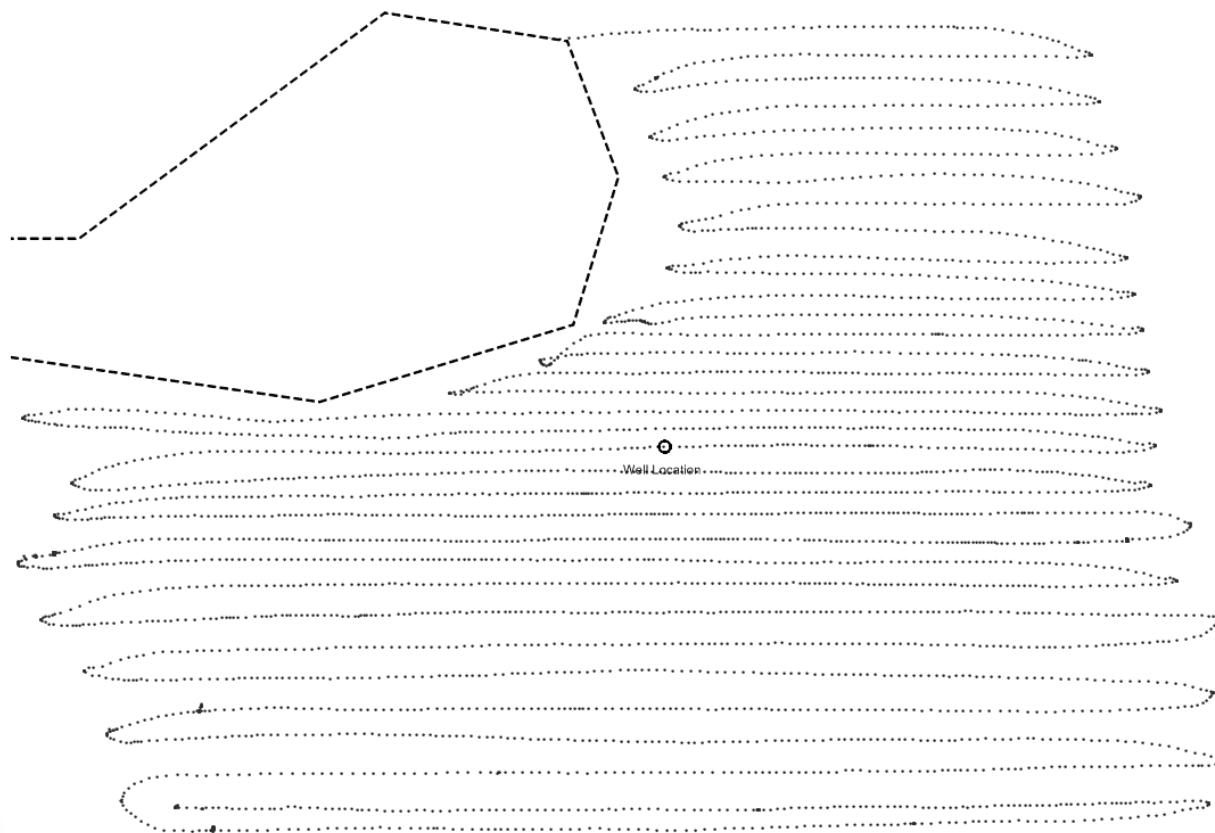
- Targeted Pseudo-3D OhmMapper survey
 - Characterize target



EM31 Acquisition



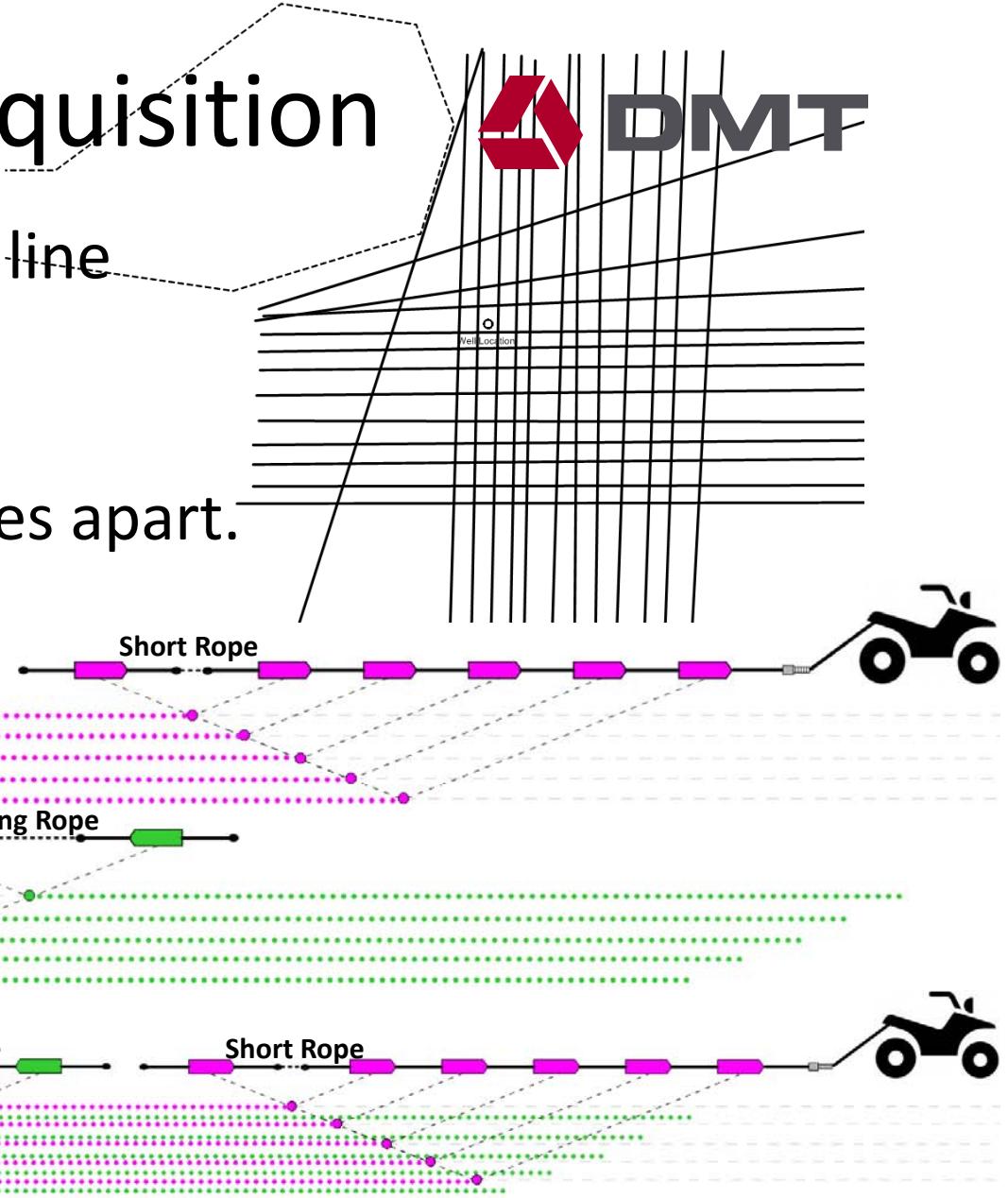
- EM31 = one continuous traverse, approx. 3m apart



OhmMapper Acquisition



- 25 Lines - 2 passes per line
 - Different rope lengths
 - 0.625m and 2.5m
- Lines approx. 3-5 metres apart.
 - Pin-flagged.



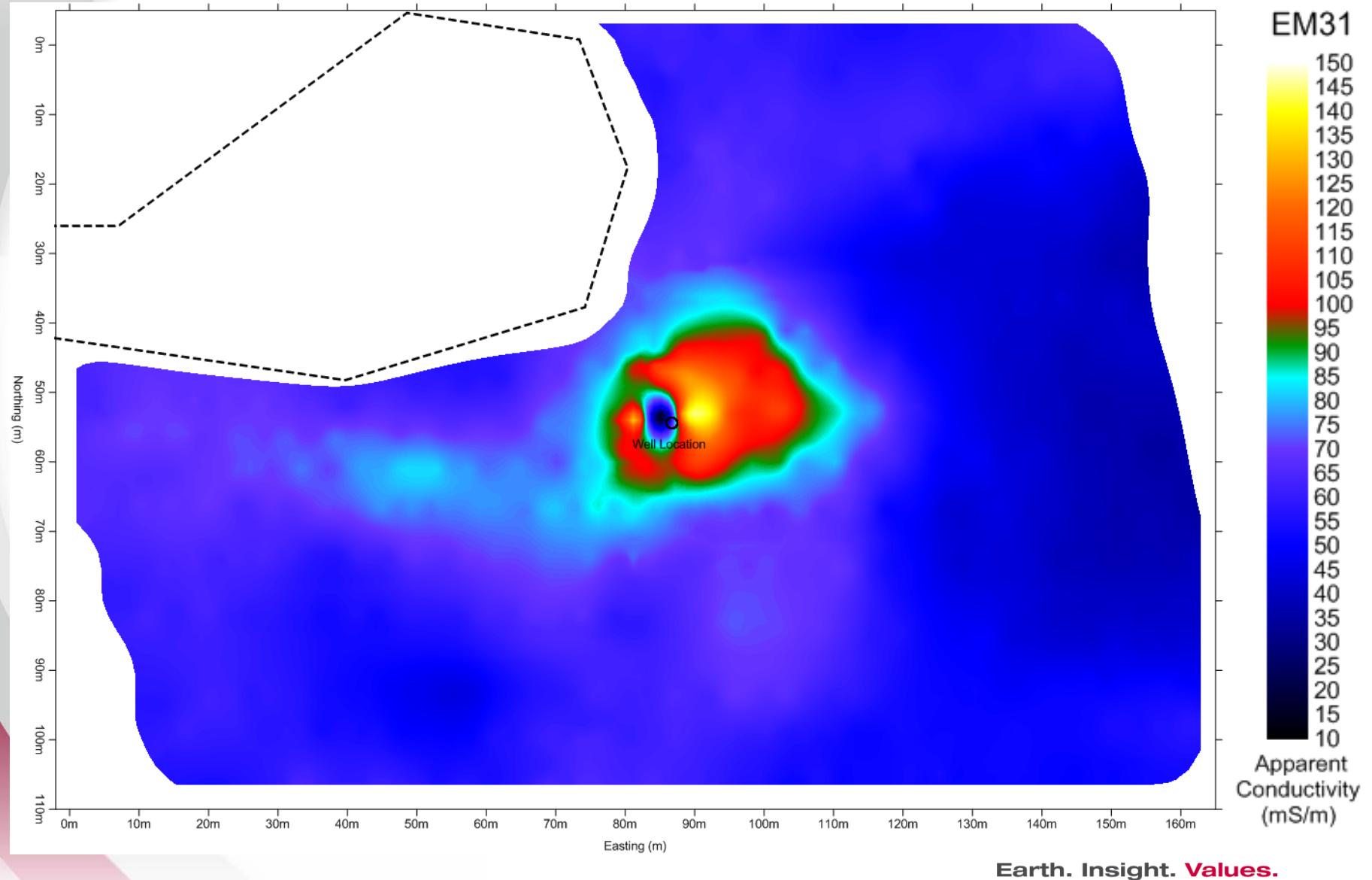
Earth. Insight. Values.

Results

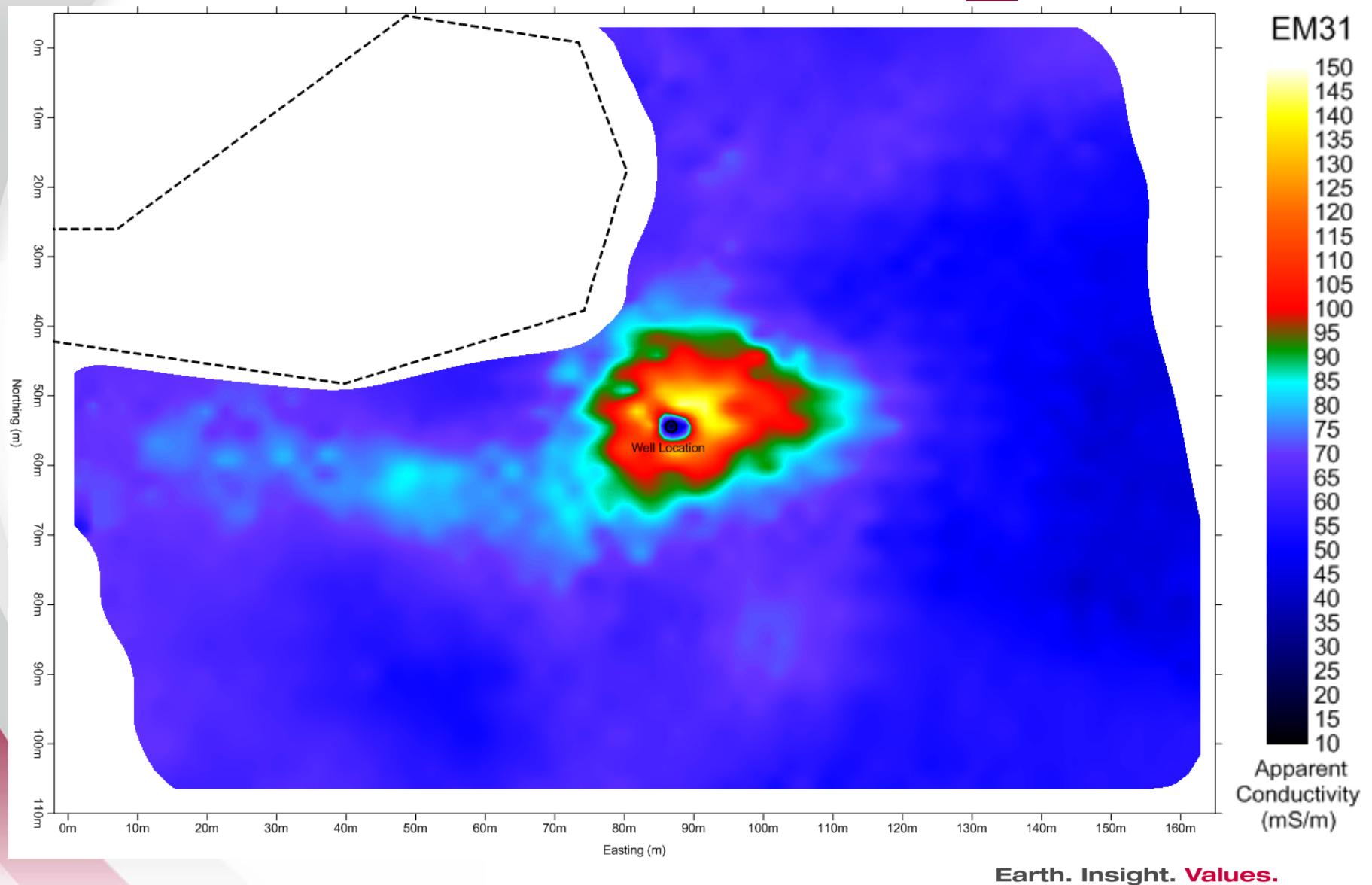


- EM31 Results
- Expectation Vs. Reality
- OhmMapper Results
 - Challenges
- Added Value for Client
- Pseudo 3D
 - Possible Subsurface Propagation

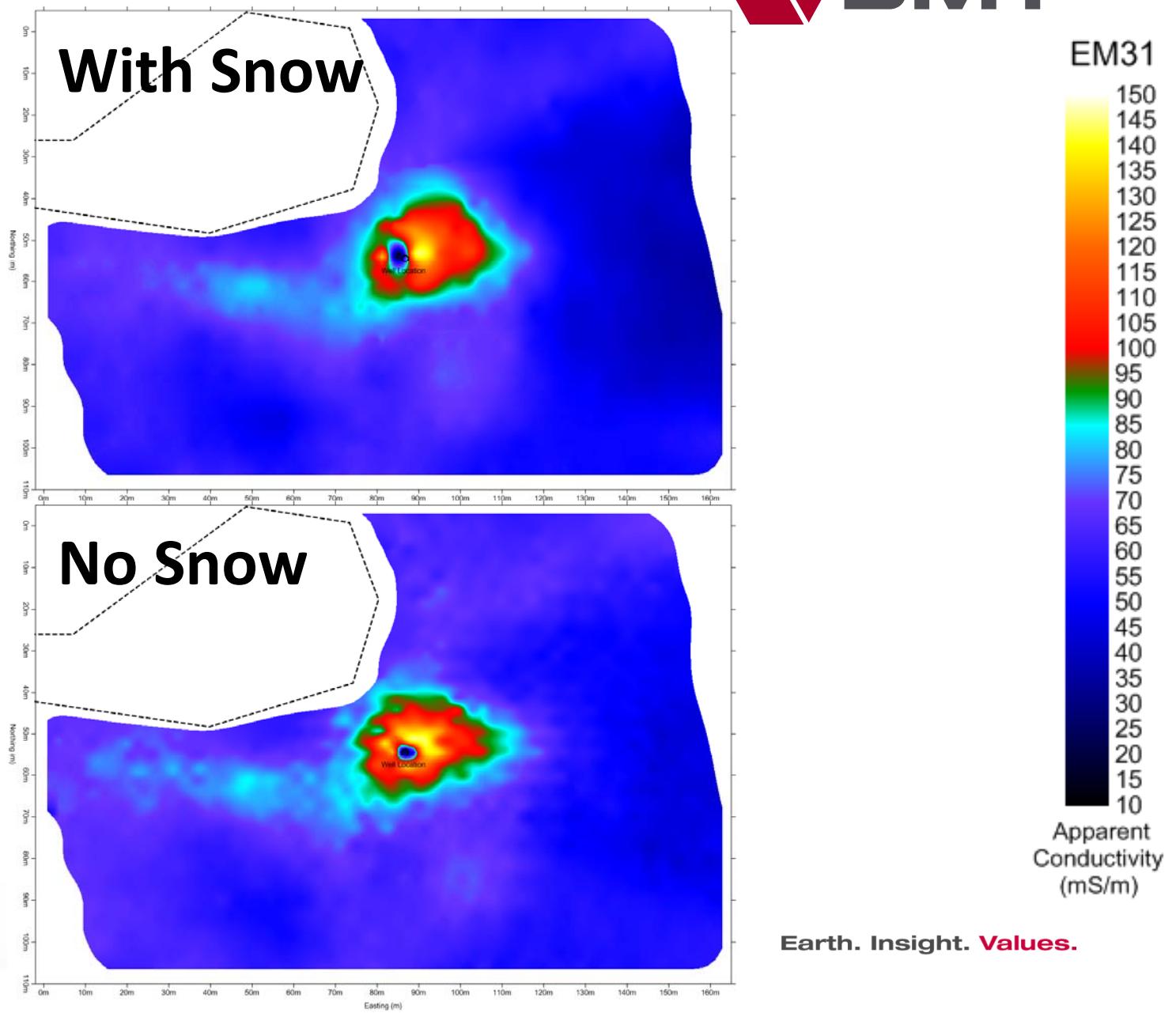
EM31 Results – With Snow DMT



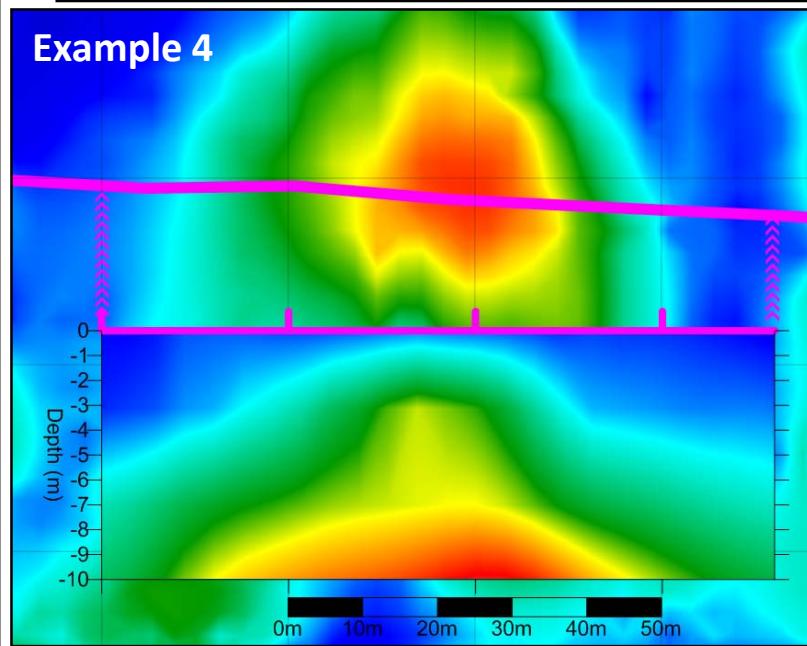
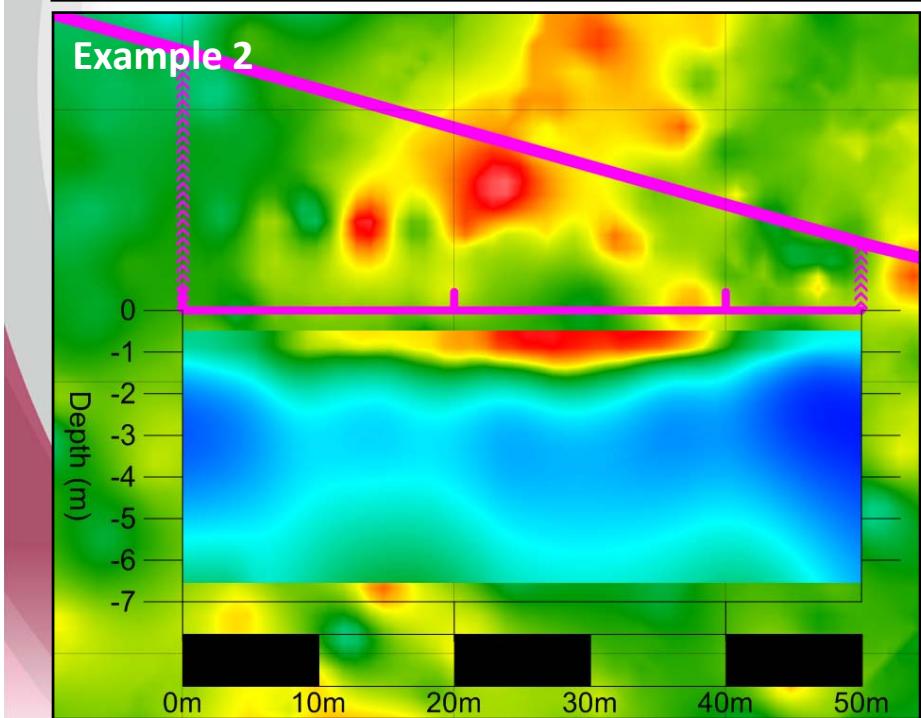
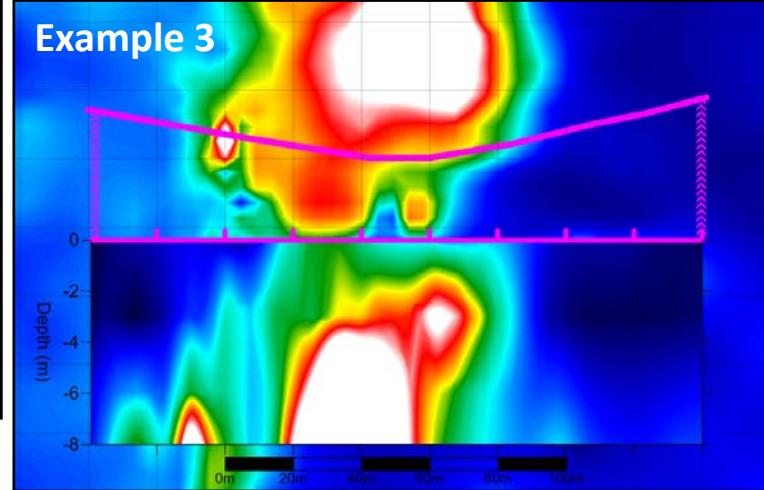
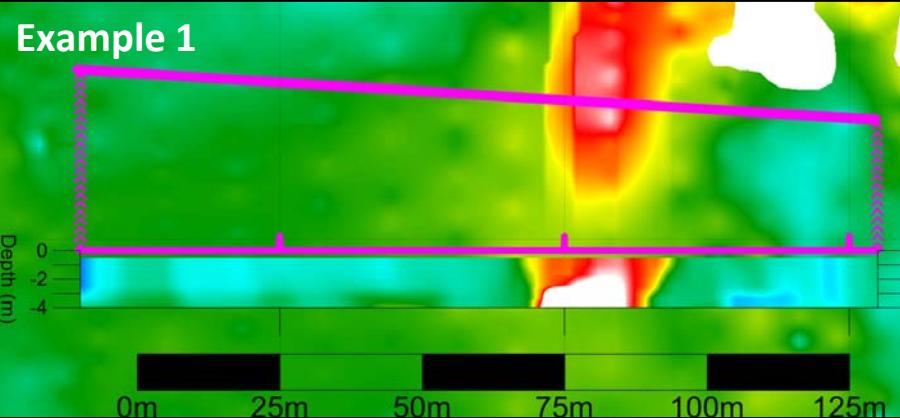
EM31 Results – No Snow



EM31 Results – Compare



Expectation vs. Reality



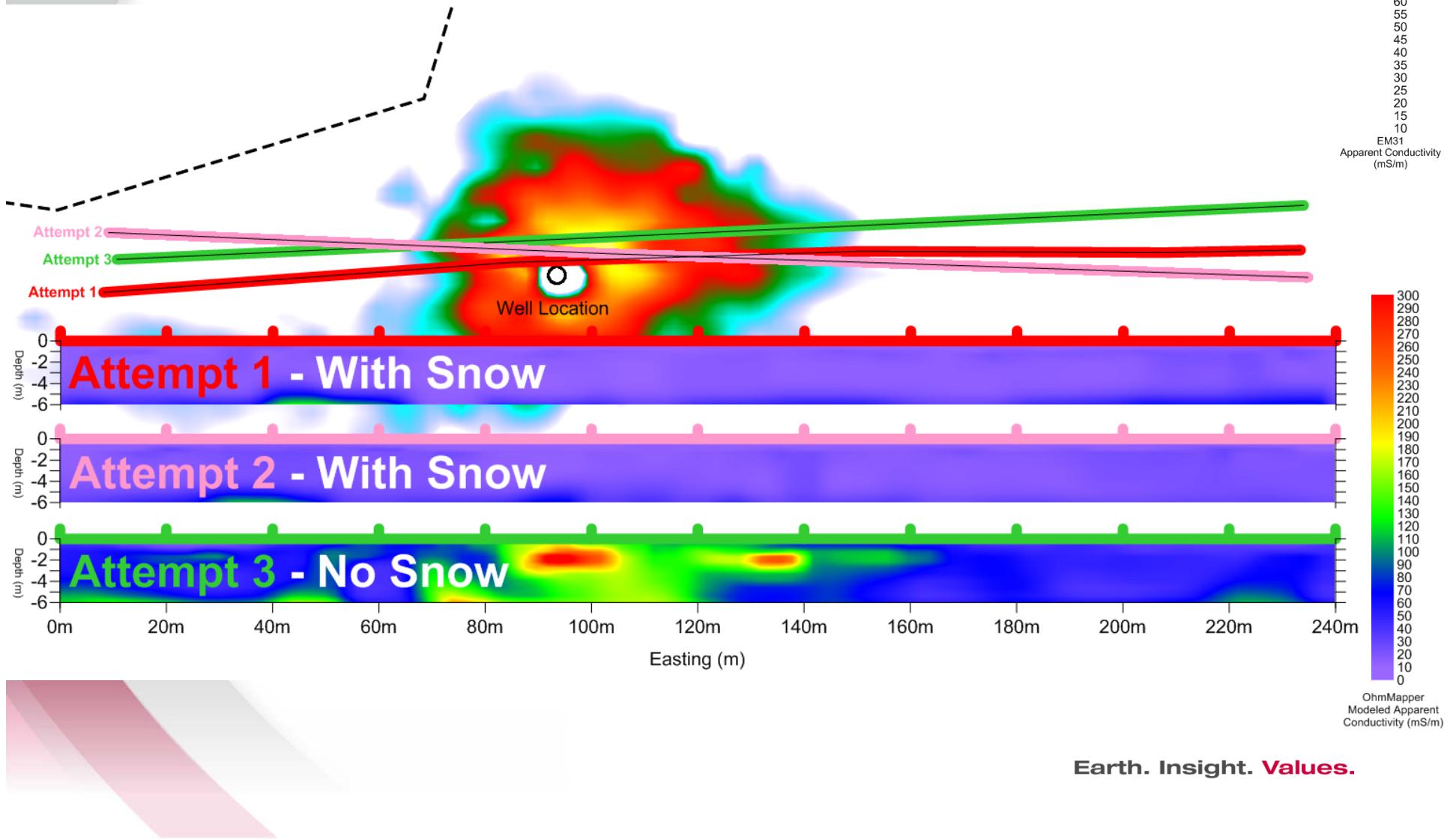
High Conductivity
Low Conductivity

Earth. Insight. Values.

OhmMapper Results



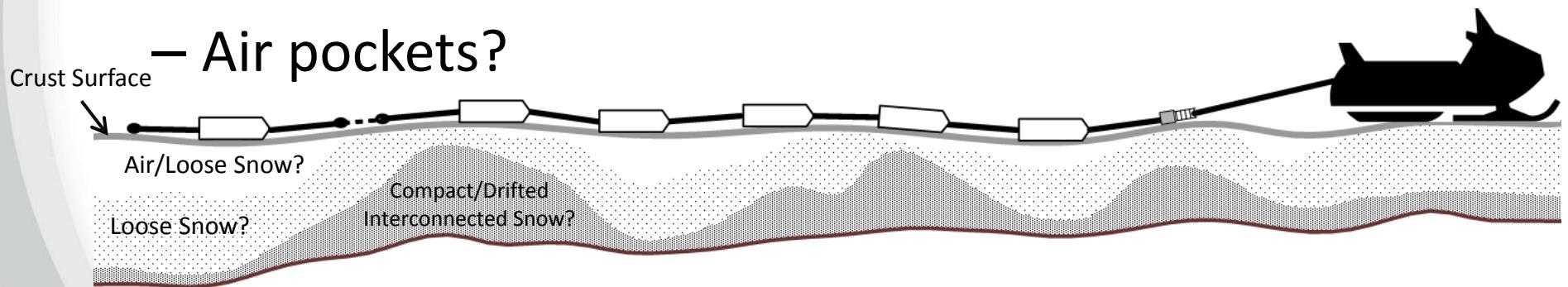
- 3 Attempts – 3rd was successful.



Challenges



- Improper coupling possibility.
 - Thick crust
 - Granular snow
 - Air pockets?



- Increased distance from ground surface
 - Capacitance inversely related to distance



Added Value for Client

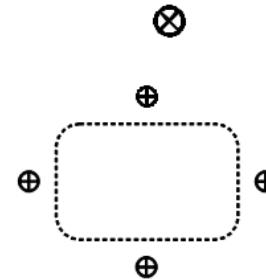
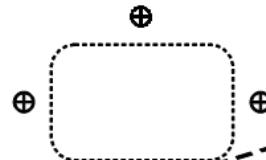
- Accurate borehole locations
- Volume estimates
- Possible subsurface propagation

Accurate Borehole Locations



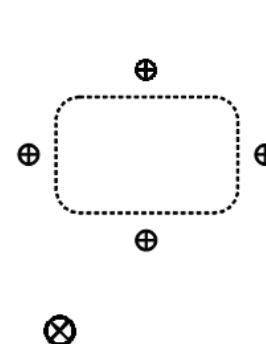
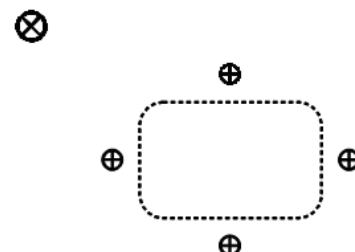
- **Before Geophysics /**

Suggested
Boreholes



- ⊕ Investigative Borehole
- ⊗ Control Borehole
- Suspected Flare Pit
- Suspected DWDA

0m 5m 10m 15m 20m 25m



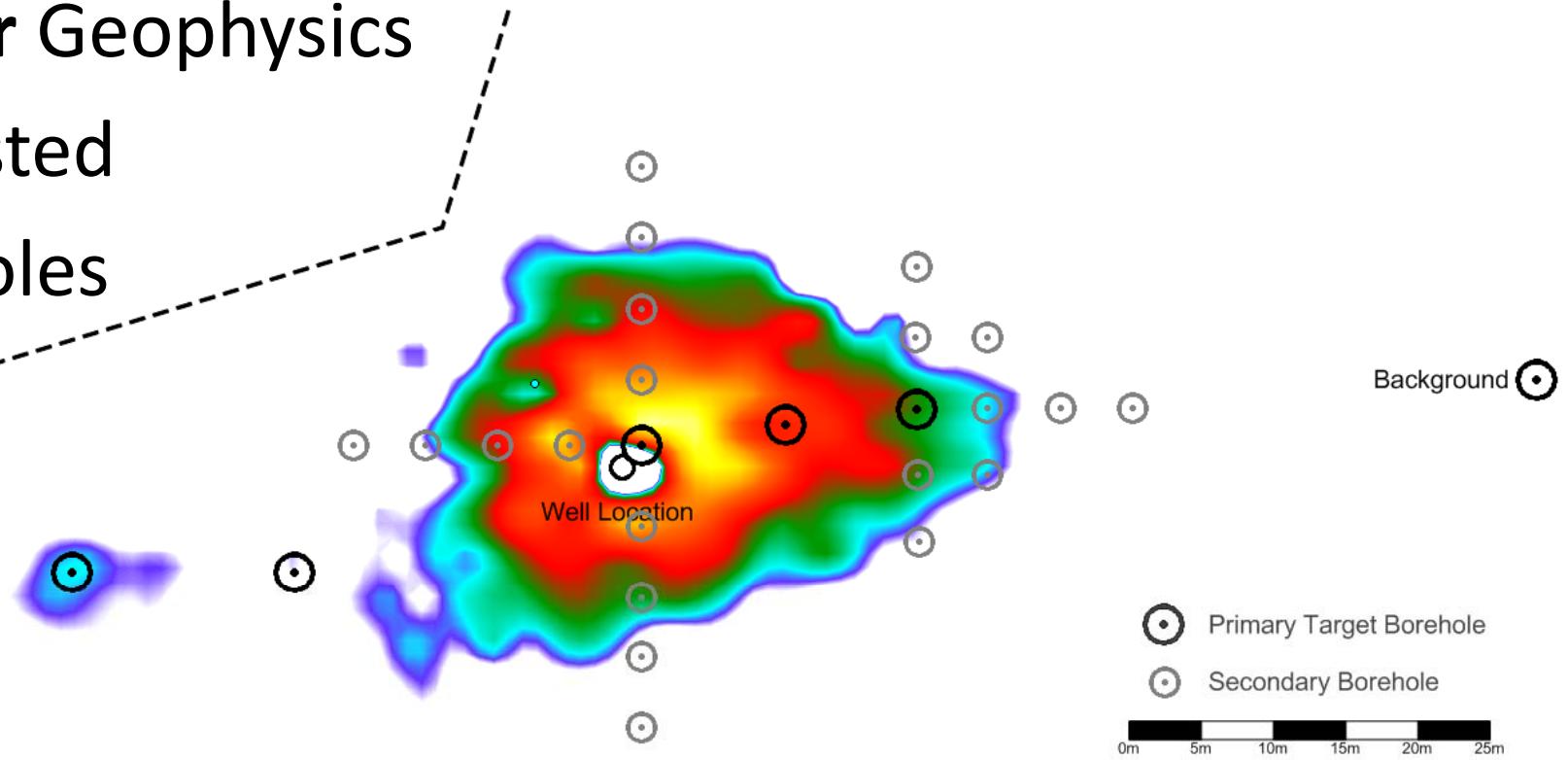
Earth. Insight. Values.

Accurate Borehole Locations



- After Geophysics

Suggested
Boreholes



Earth. Insight. Values.

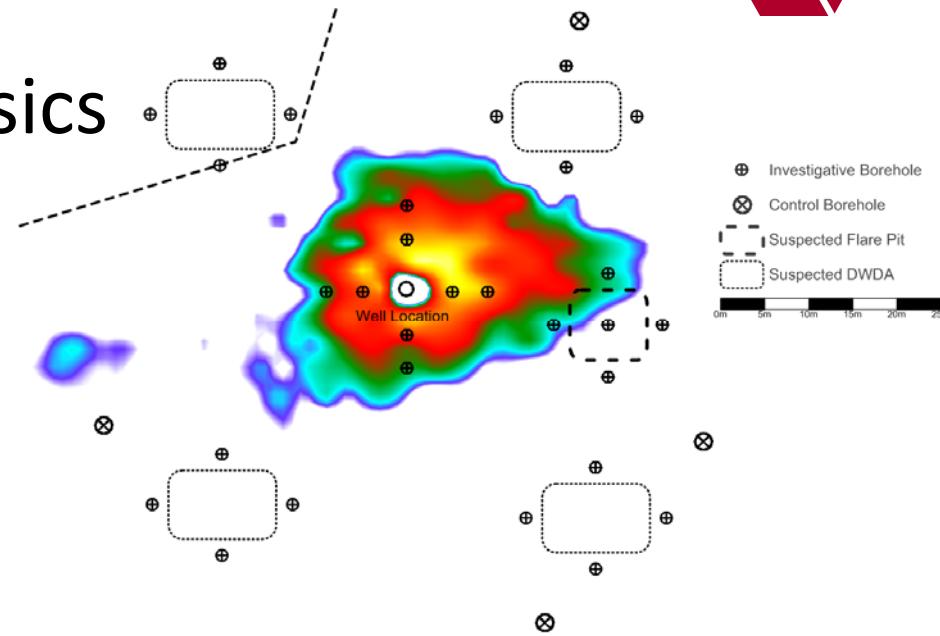


Accurate Borehole Locations



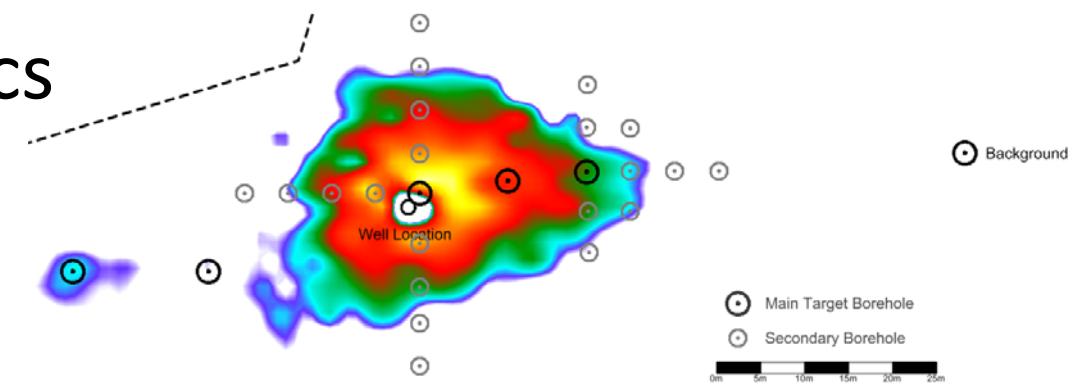
- **Before Geophysics**

Suggested
Boreholes



- **After Geophysics**

Suggested
Boreholes



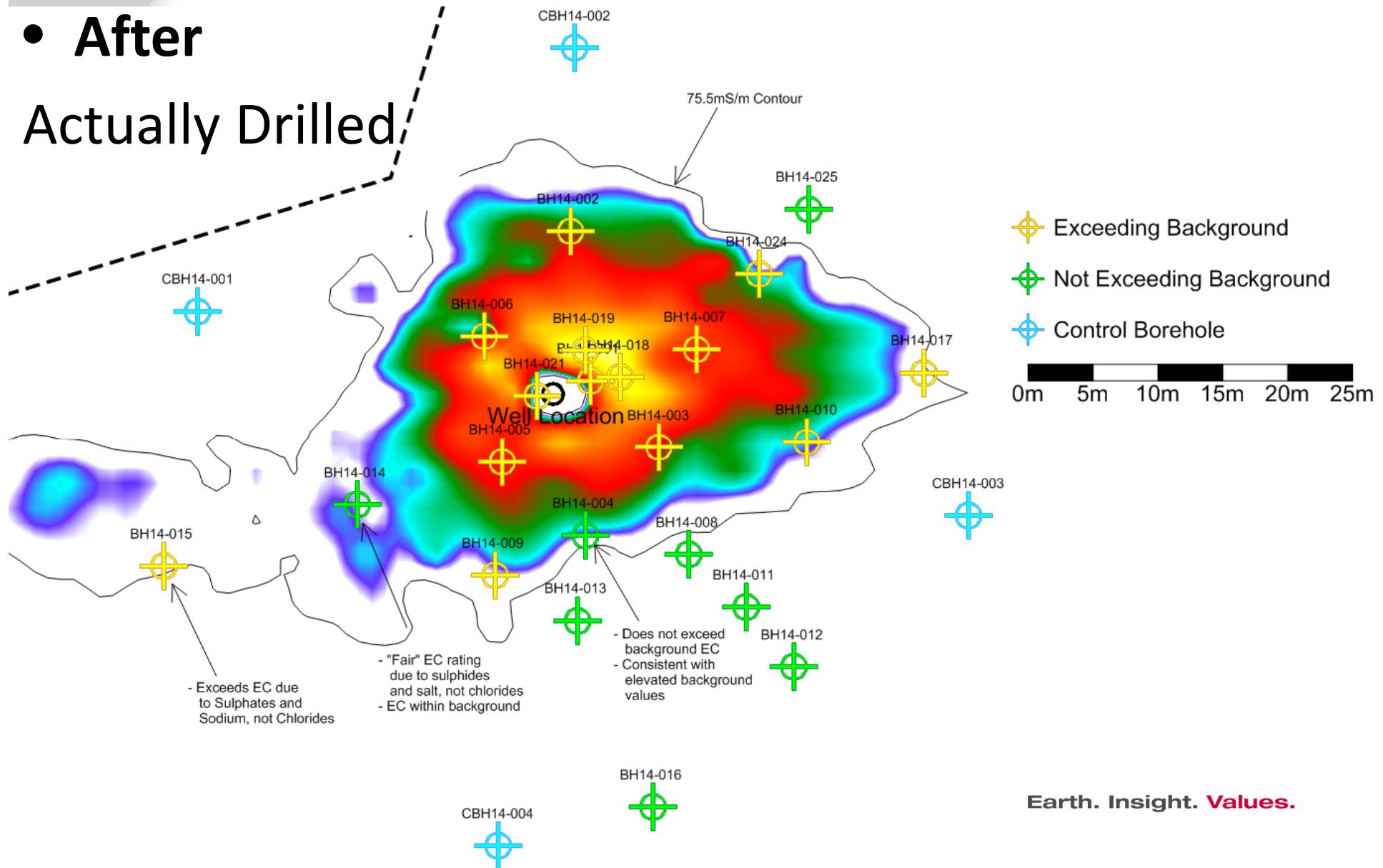
Earth. Insight. Values.

Accurate Borehole Locations



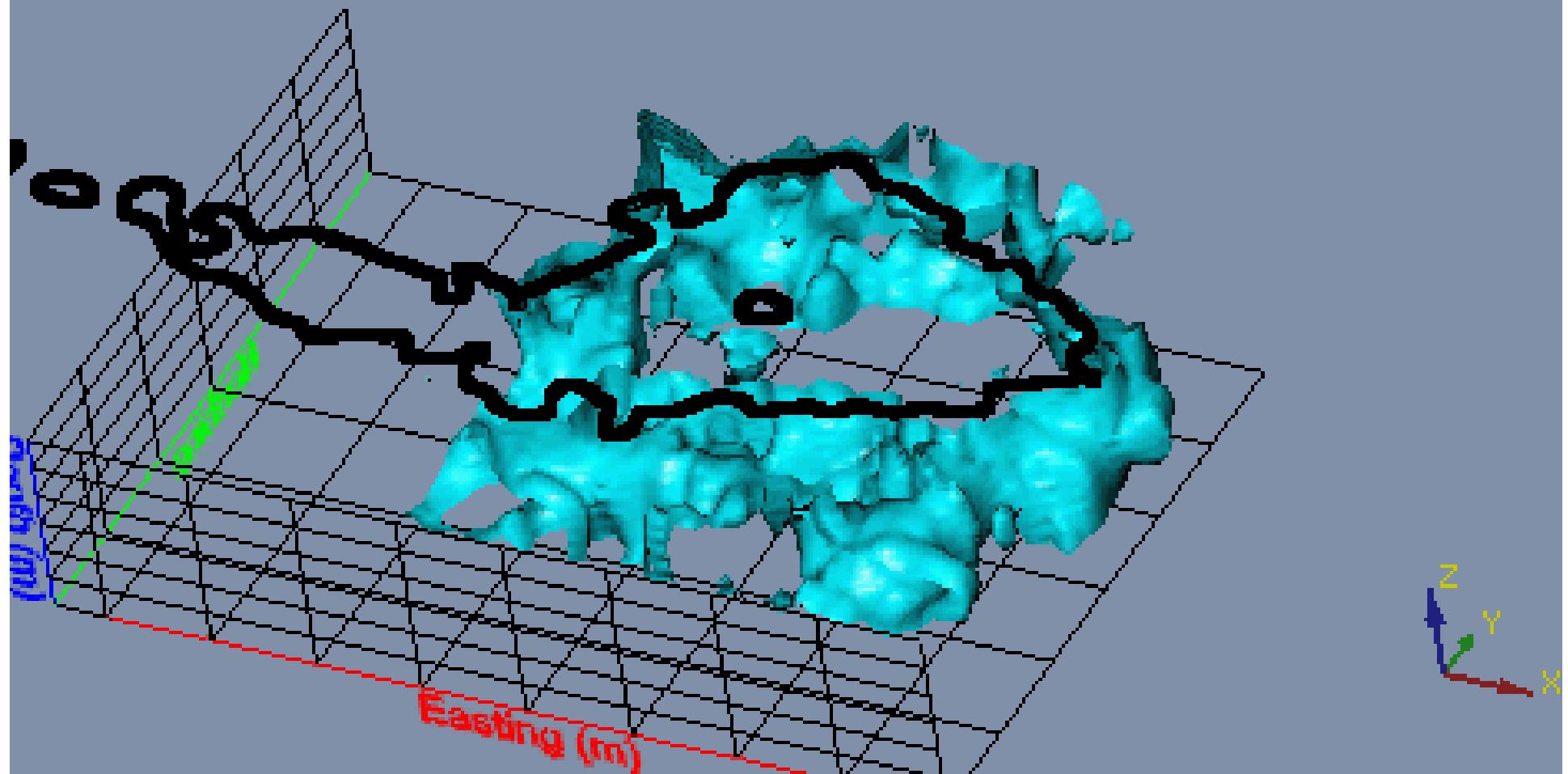
- After

Actually Drilled



Pseudo-3D

- 75 to 325mS/m
- Vertical Ex. = x3



Psuedo 3D -Volume Estimates

- Any Conductivity (Confined depth)

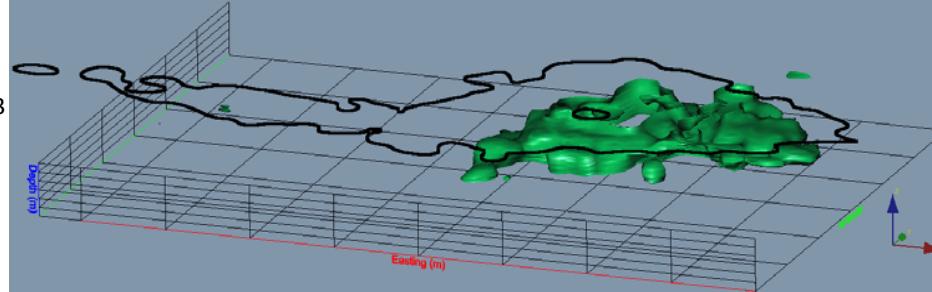


Iso-Surface Volume within Iso-Surface (m^3) – Limited to 4m depth

Value

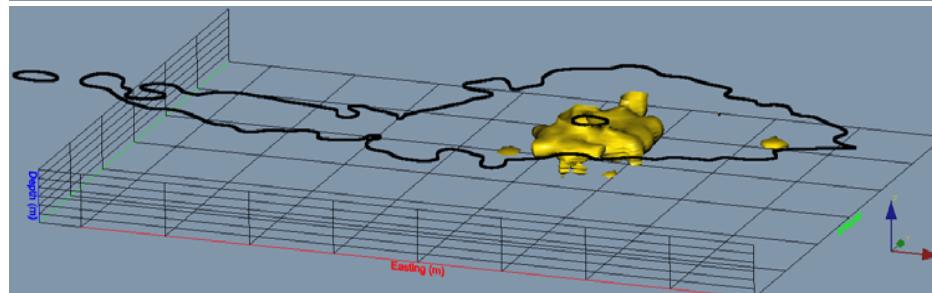
125 mS/m

1640 m^3



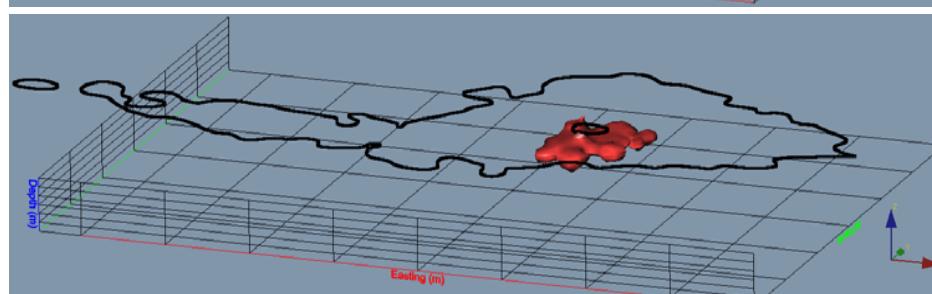
185 mS/m

350 m^3



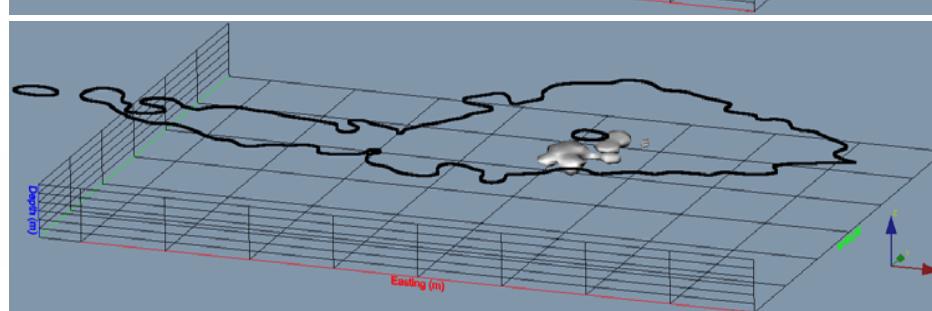
250 mS/m

129 m^3



300 mS/m

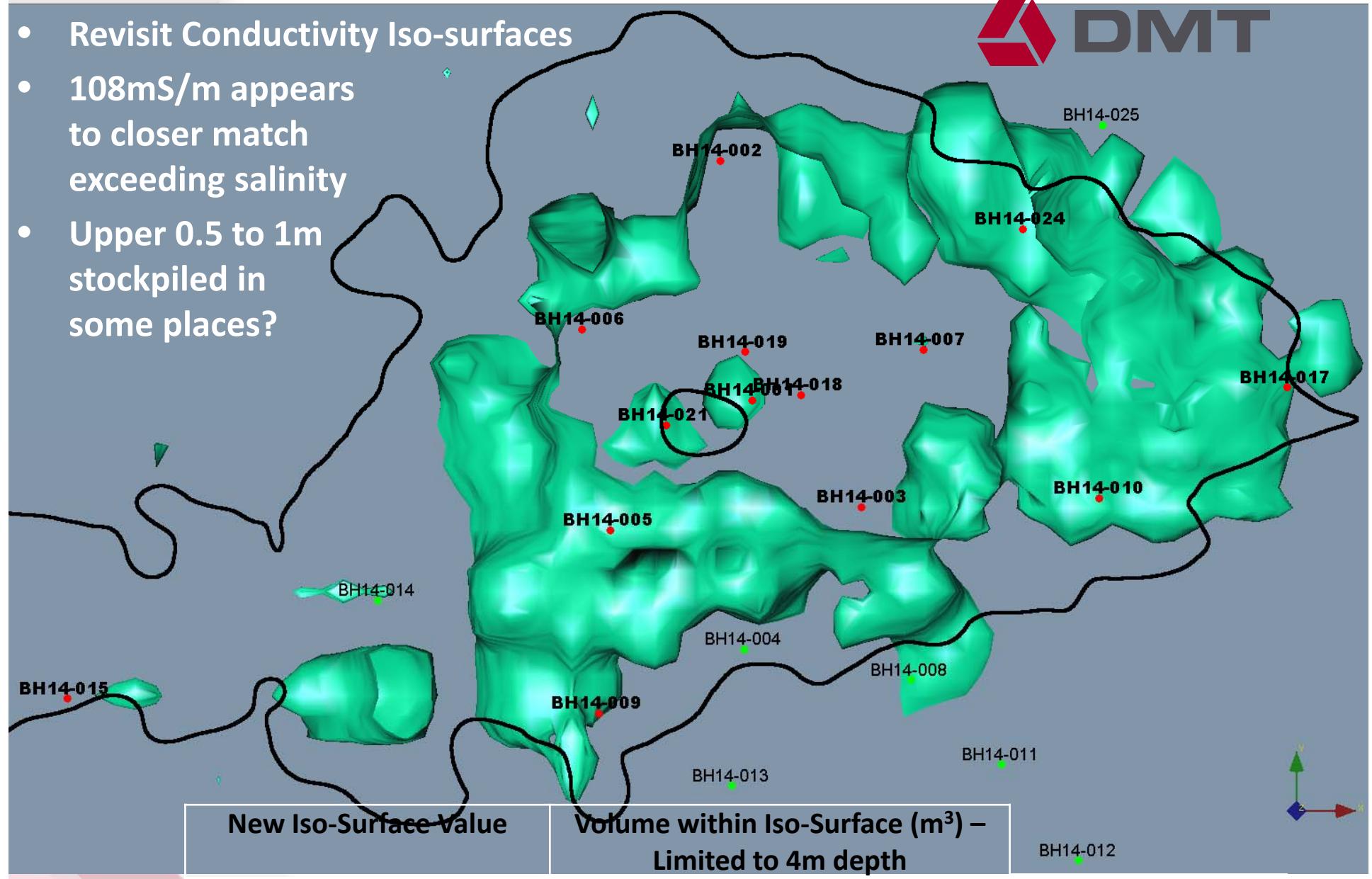
52 m^3



Earth. Insight. Values.

Evaluation

- Revisit Conductivity Iso-surfaces
- 108mS/m appears to closer match exceeding salinity
- Upper 0.5 to 1m stockpiled in some places?



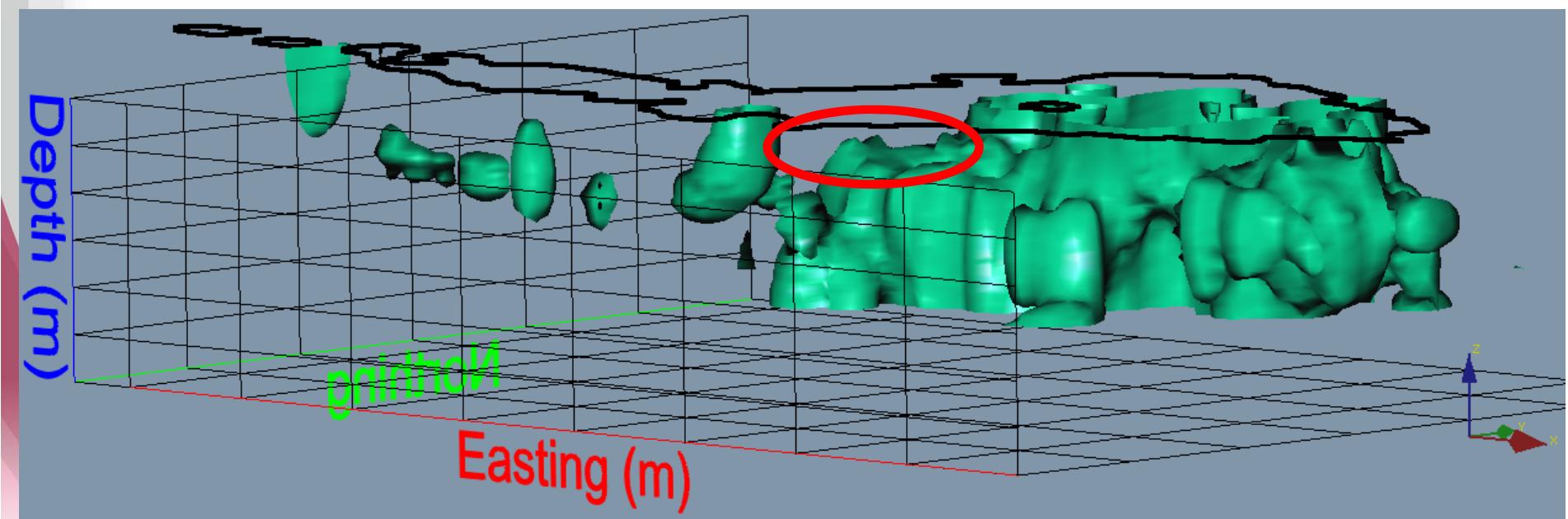
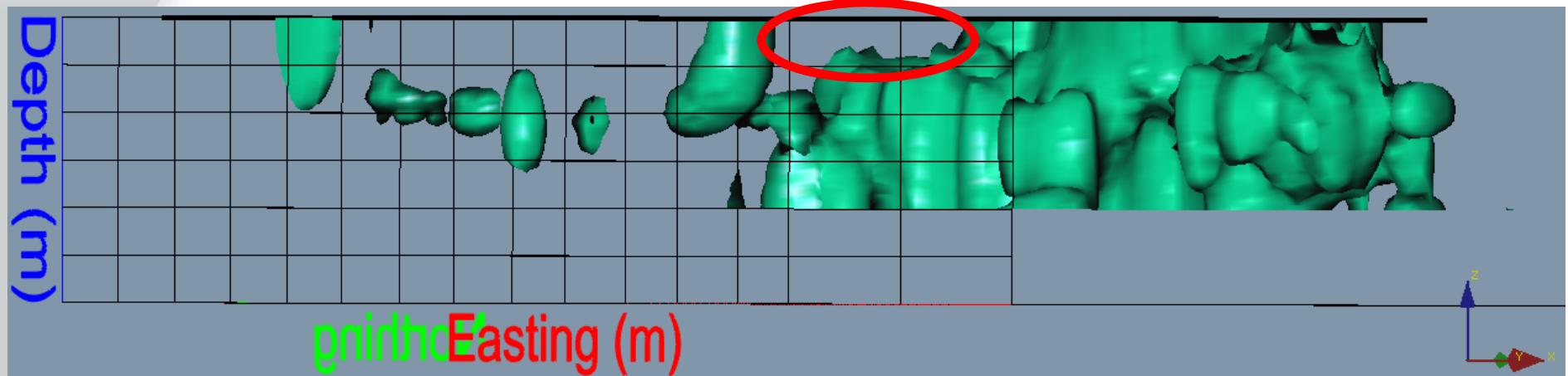
108 mS/m

3150 m^3

Evaluation

- Stockpile material?

- 108mS/m
- Vertical Ex. = x3



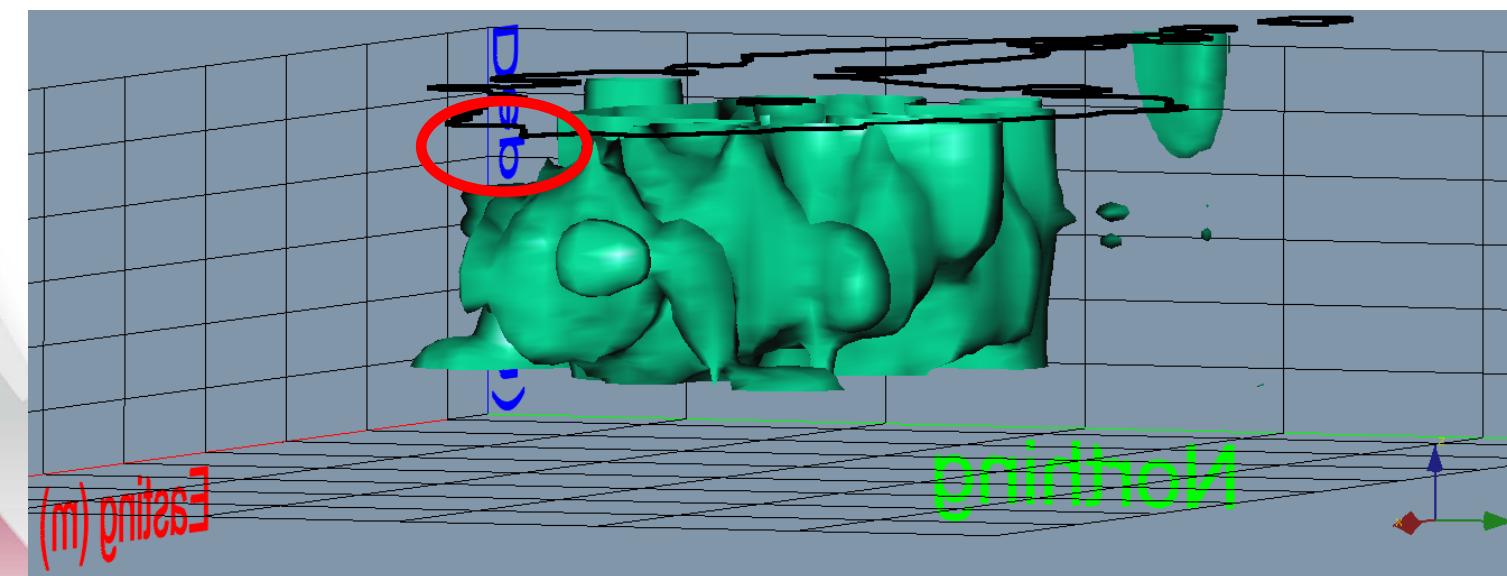
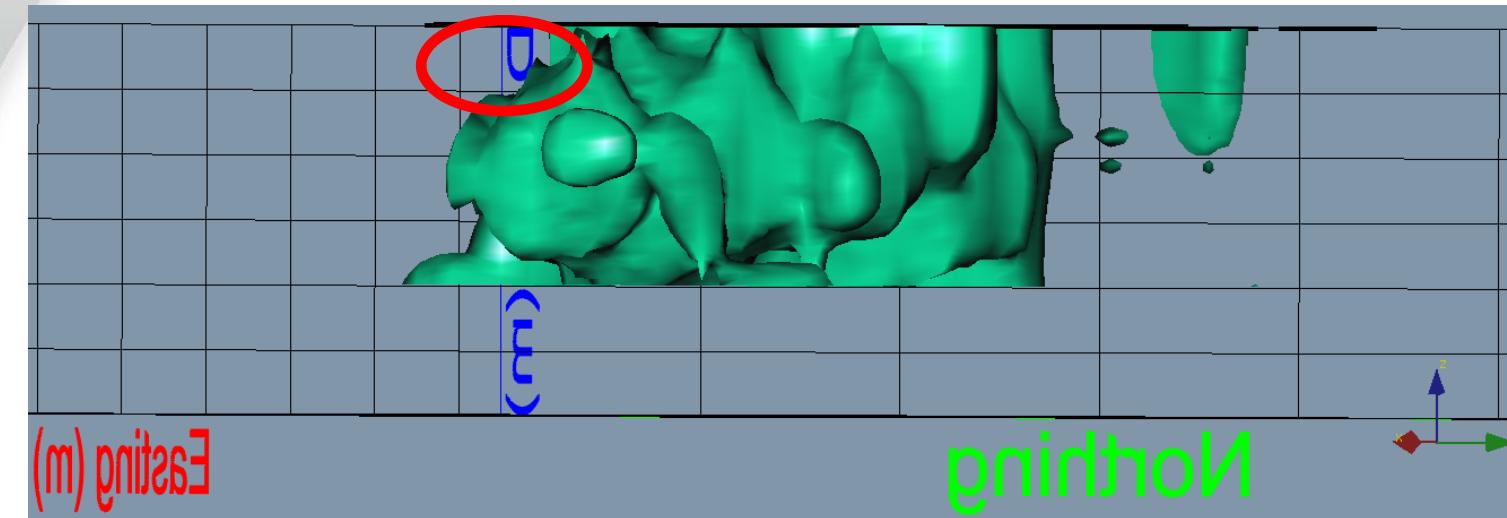
Looking Northwest

Earth. Insight. Values.

Evaluation

Rockpile material?

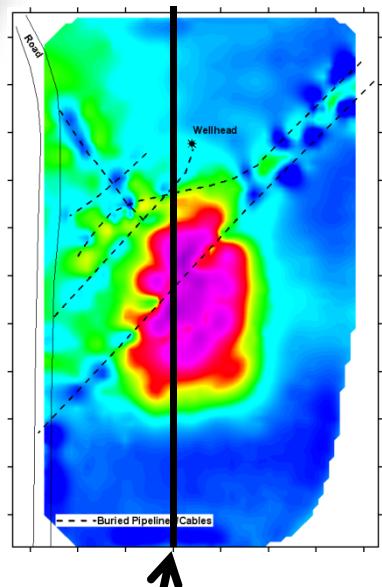
- 108mS/m
- Vertical Ex. = x3



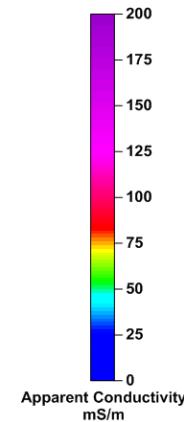
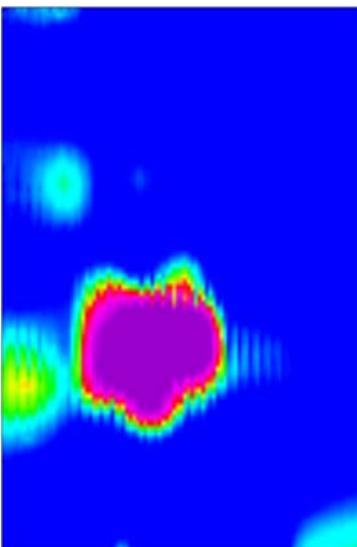
Possible Subsurface Propagation



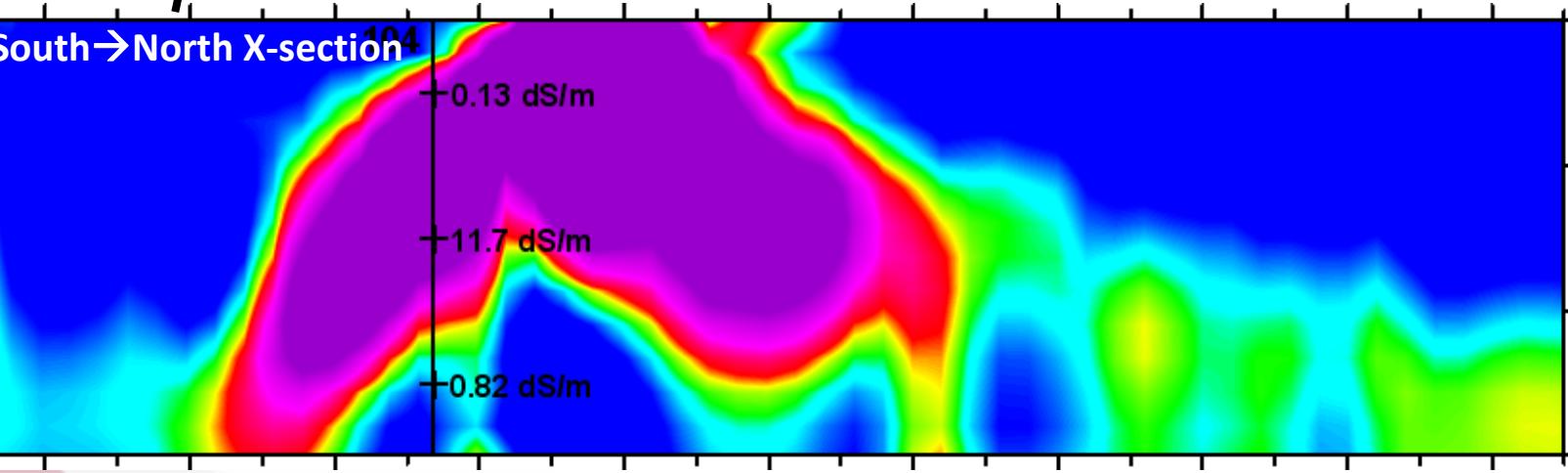
EM31



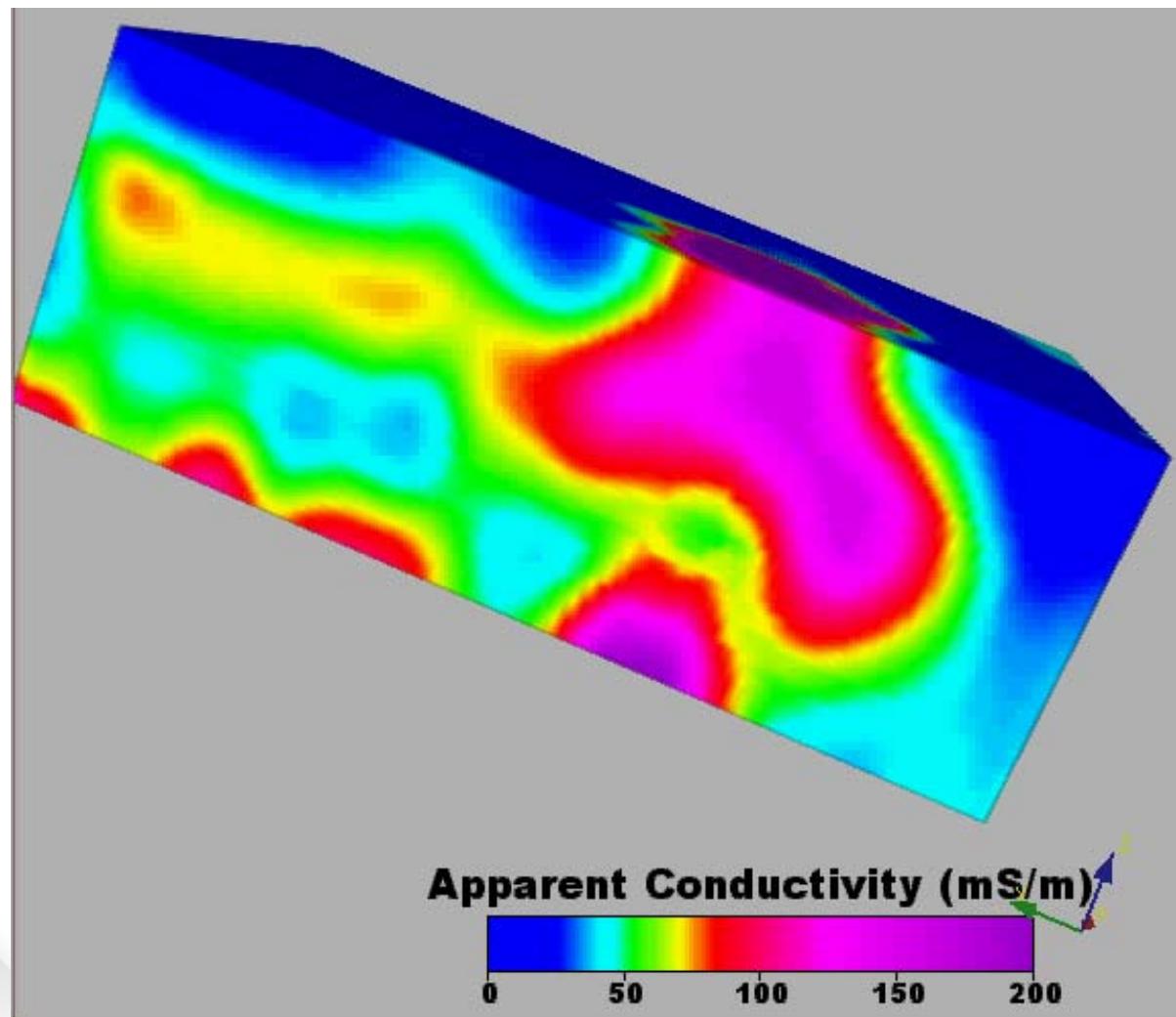
OhmMapper Depth Slice – Near Surface



South → North X-section



ossible Subsurface Propagation



Conclusion



Quick

Easy

Targeted borehole locations

Possible volume savings

Another perspective to understand all data

Might not work correctly in certain snow situations.



Thank you!

← Wolf

Rx 1 →

Rx 2 →

Rx 3 →

Rx 4 →

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