26th Colloquium of African Geology (CAG26)

Appraisal of 3D Iso -Resistivity Surfaces (Visual Rendering) in Enhancing Interpretation

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PRESENTATION OUTLINE

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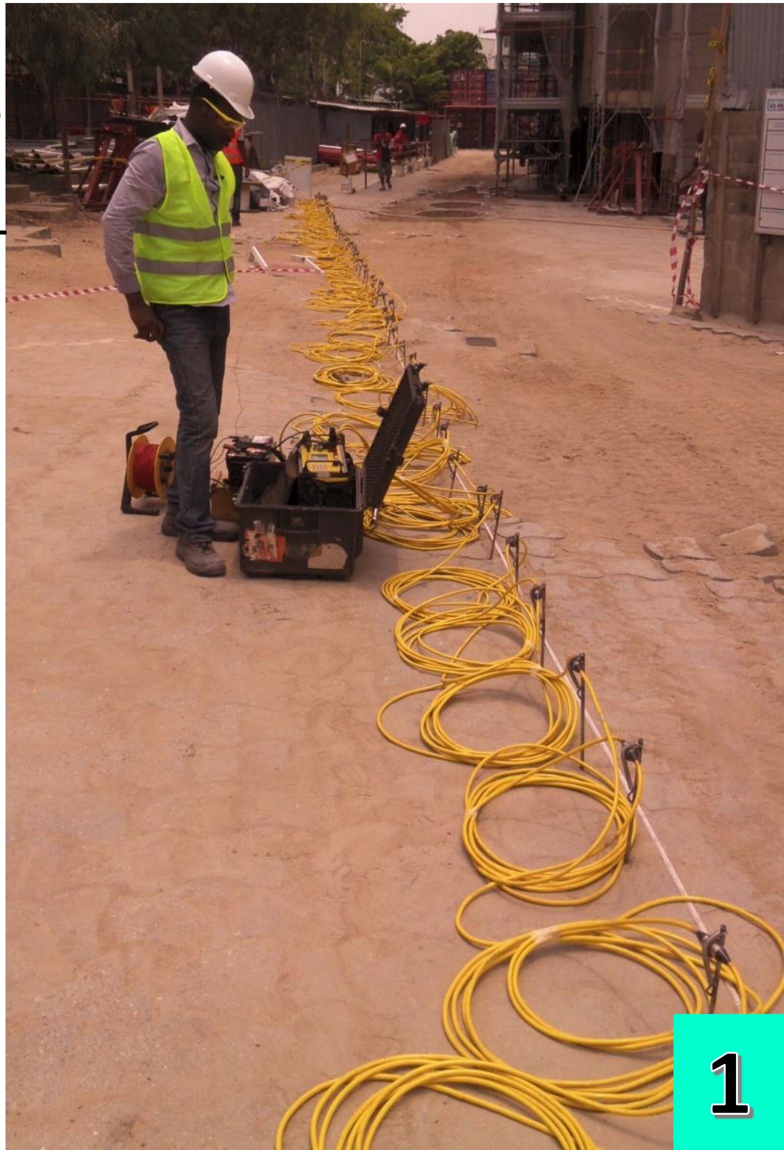
- INTRODUCTION
- STUDY OBJECTIVES
- LOCAL GEOLOGY
- LOCATION AND DATA
- METHODOLOGY
- RESULTS AND DISCUSSION
- CONCLUSION

INTRODUCTION

- Advances in instrumentation and modelling in surface electrical resistivity methods
- Multi-electrode system: improved data acquisition, speed, accuracy and reduced fatigue
- Sensitivity of equipment, improved filters, higher current injection power and multi-channel capability
- Improvement in algorithm,
- Availability of 3D interface in modern software
- Capability of filtering/extracting resistivity signatures
- Electrical Resistivity Imaging (ERI) involves 2D and 3D subsurface imaging
- The true edge in electrical resistivity imaging goes beyond speed in data acquisition but in data density which consequently affects the subsurface resolution.



INTRODUCTION

- Lagos State is a leading commercial thrive in West Africa: infrastructural decay, housing for the teeming population and need for additional offices
- Recent infrastructural challenges such as collapsed or distress in structures have necessitated exhaustive subsurface investigation leading to incorporation of geophysical survey as a tool for better subsurface disposition.
- Two case studies are discussed in order to appraise 3D Iso-Resistivity surfaces as a tool in enhancing subsurface disposition.
- The first case is that of detecting buried tanks at an engineering site undergoing renovation.
- The second case is a small piece of land, with serious engineering concern because boreholes drilled have shown unpredictability and complexity in lateral and vertical variation of subsurface layers which calls for alternatives in foundation design.

LOCATION AND GEOLOGY

The first and second locations are within Lagos Island within the coordinates of N6.436° to N6.434° & E3.438° to E3.441° and N6.430° to N6.429° & E3.414° to E3.416° respectively. Lagos belongs to the Coastal Plain Sand Formation and Recent Alluvium Deposits which is made up of loose sediment ranging from silt, clay and fine to coarse grained sand. The exposed rock unit in the study area consists of Sand, Clay, an admixture of Sand and Clay and Peat.

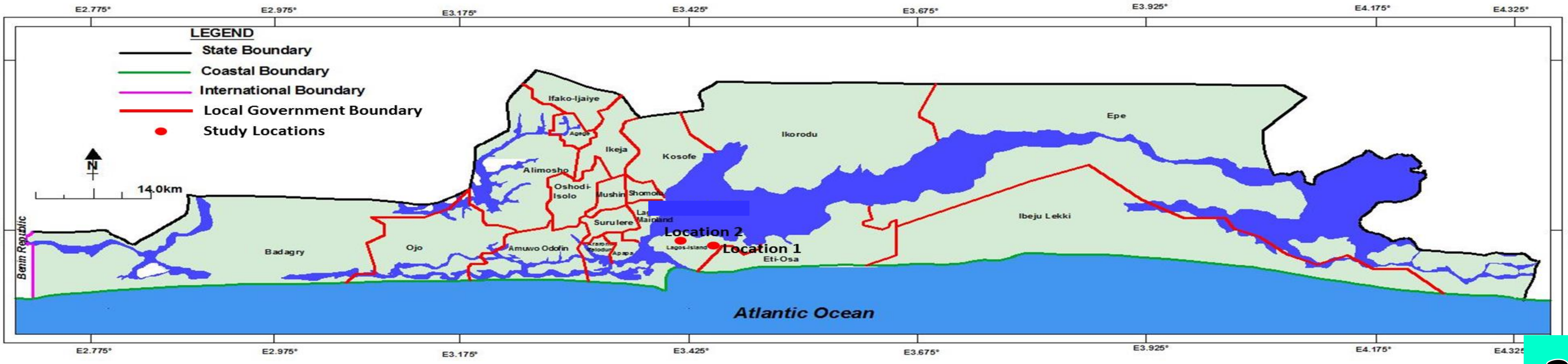


Figure 1: Map of Lagos showing the study location

METHODOLOGY

3D Electrical Resistivity Imaging involves setting out the electrodes in 3D layout for data to be acquired which differs from concatenating several 2D lines to form a 3D Image. In 3D ERI, data are acquired in between the electrode layout (both in the X, Y, XY and YX directions; see Figure 2) thereby providing a more accurate subsurface information.

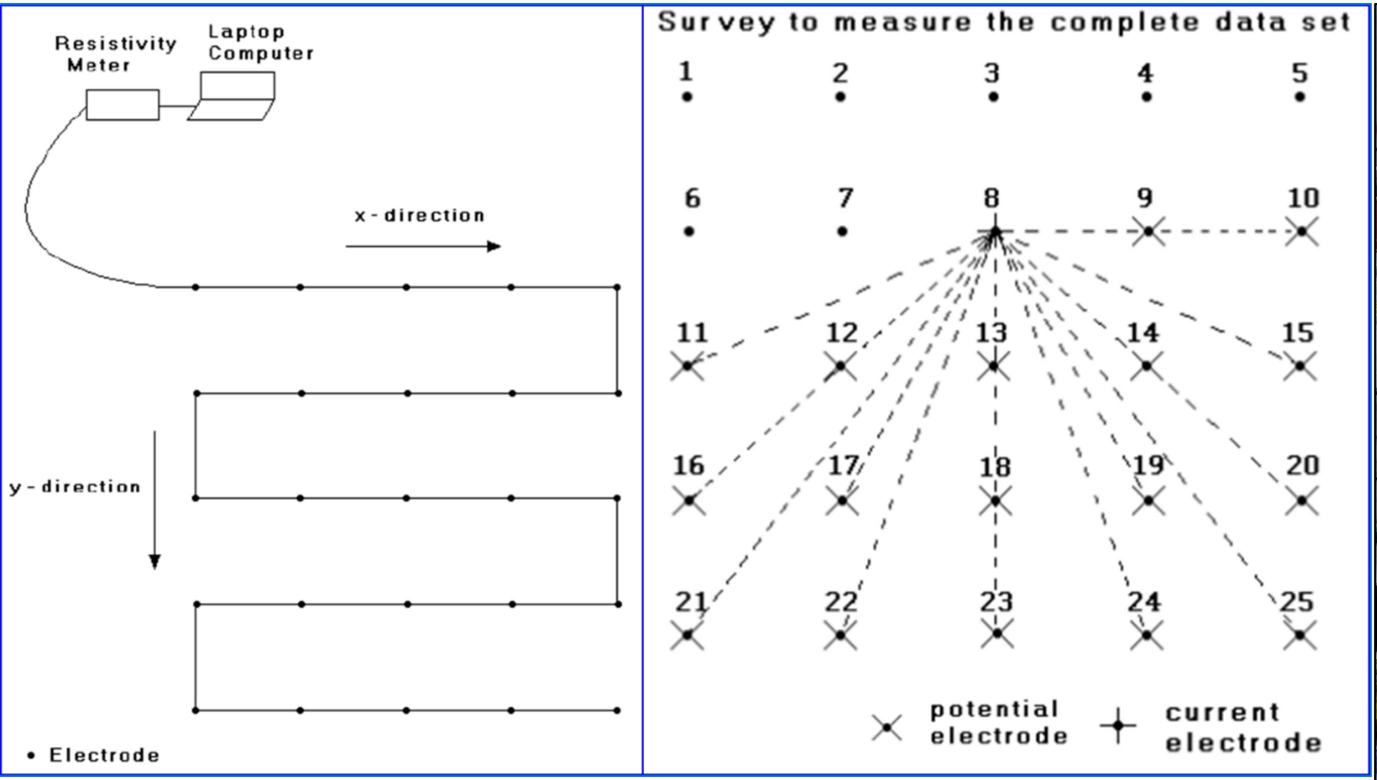


Figure 2: Electrode layout for 3D ERT (after Loke, 1999)

METHODOLOGY

Data Acquisition:

INSTRUMENT: SuperSting R8 Earth Resistivity/IP meter from AGI (Advanced Geosciences Incorporation).

ARRAY: Mixed Dipole Gradient array was used for the 3D Electrical Resistivity Imaging

SPACING: First location 2m spacing

Second 5m minimum electrode spacing

Data Processing and Inversion

EarthImager software: Smooth Model Inversion algorithm (Constable et al. 1987 and DeGroot-Hedlin and Constable, 1990).

3D Inverted Resistivity Contouring (Visual Rendering)

A tool (in EarthImager) that can be used to bring up 3D contours (isosurfaces) according to user specified number of contours and corresponding contour values.

In similitude to the geobody extraction tools in seismic interpretation.

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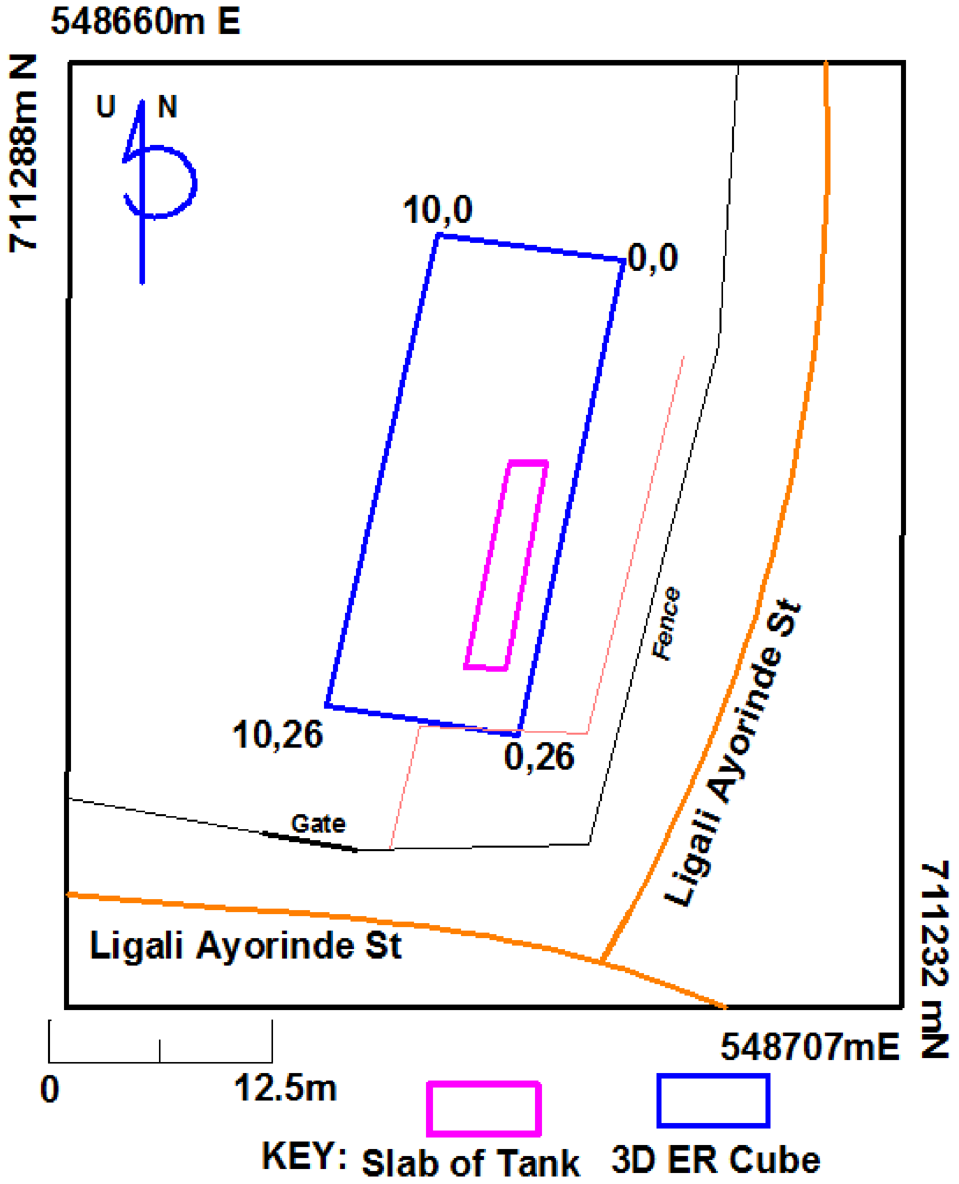
METHODOLOGY



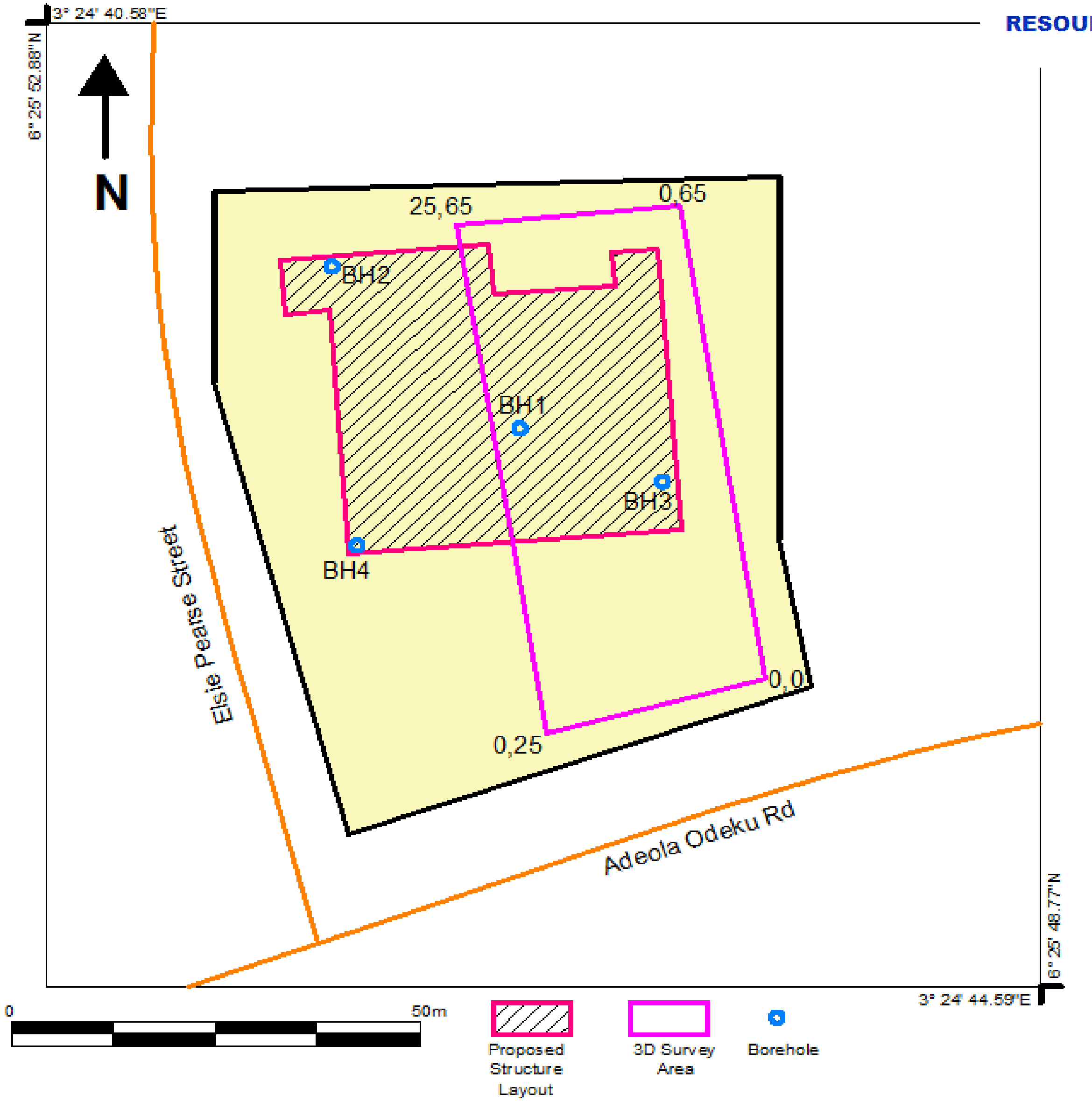
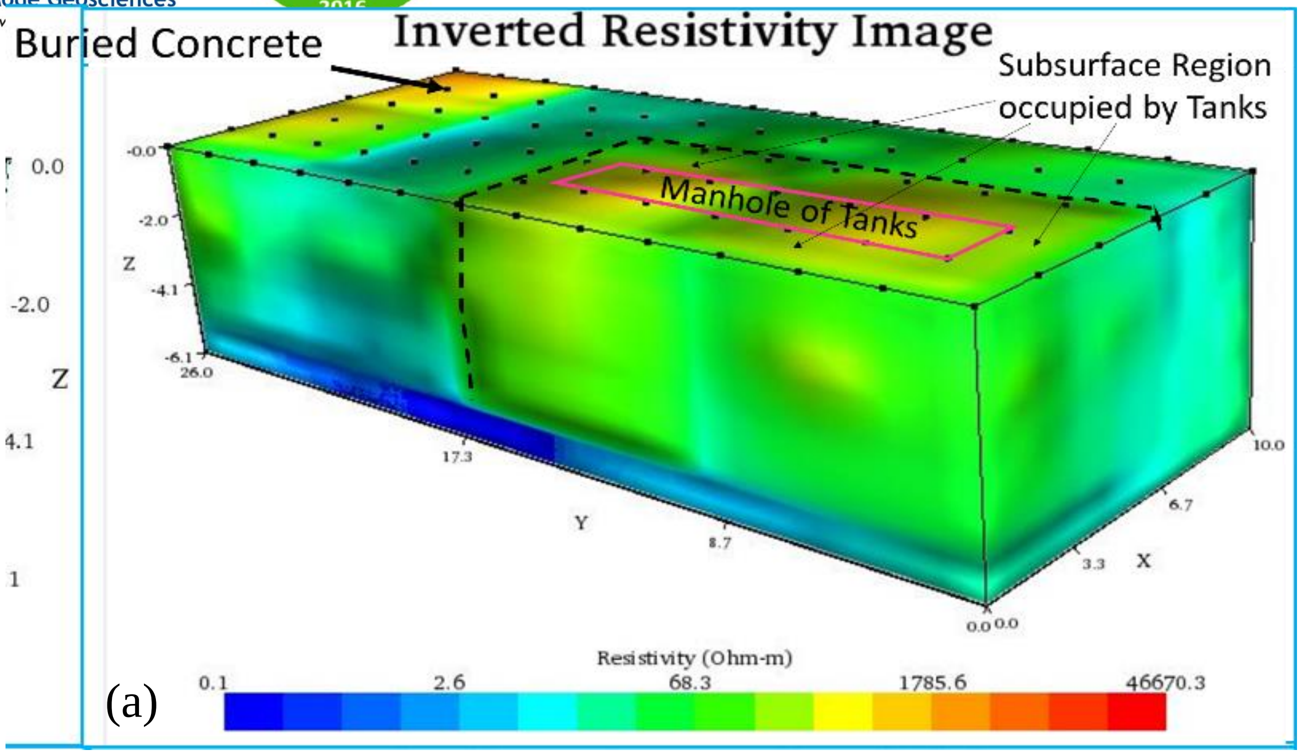


Figure 3: Acquisition Map of Location 1 and 2

RESULT AND DISCUSSION



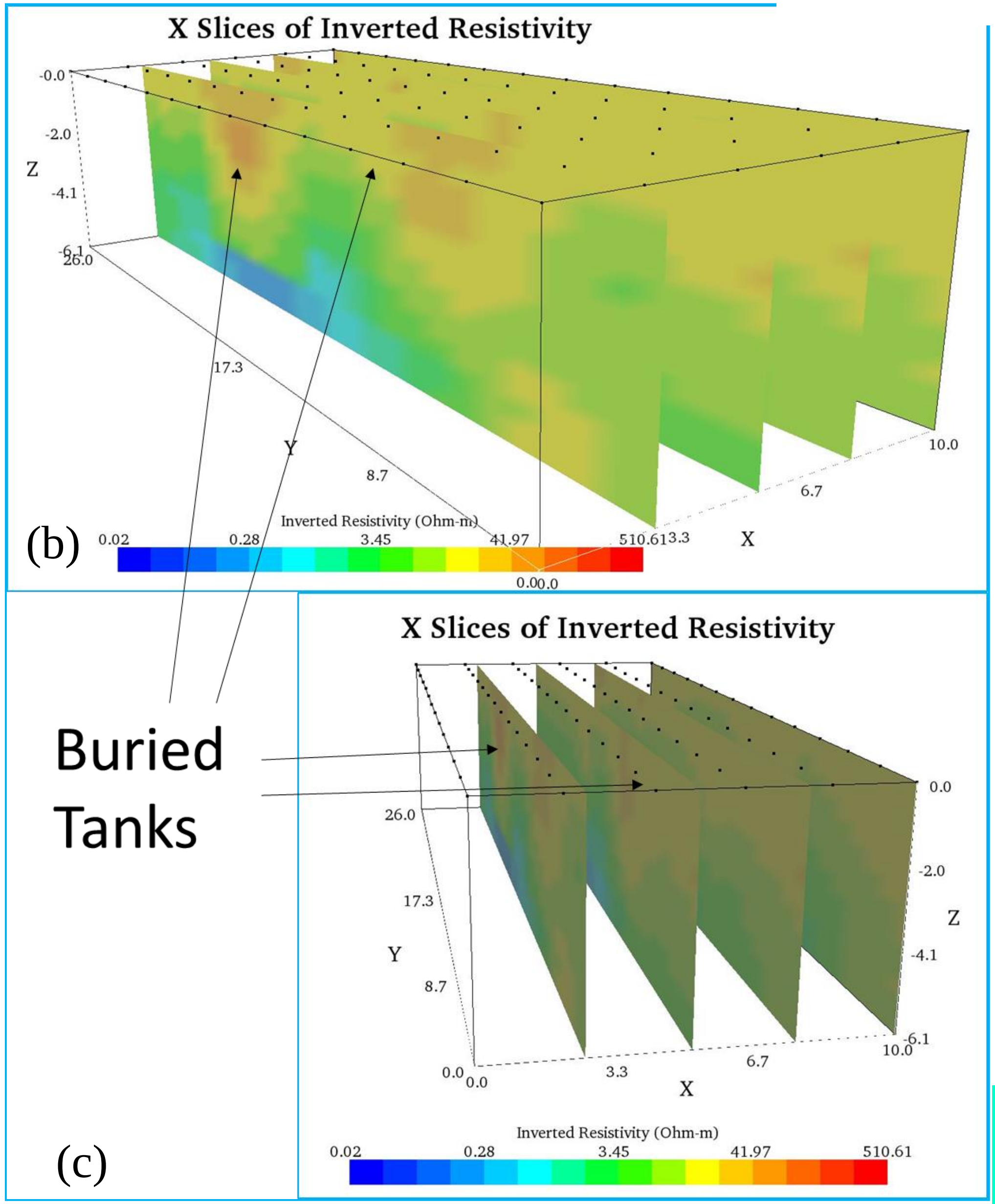


Fig 4. Interpreted 3D Inverted resistivity cubes

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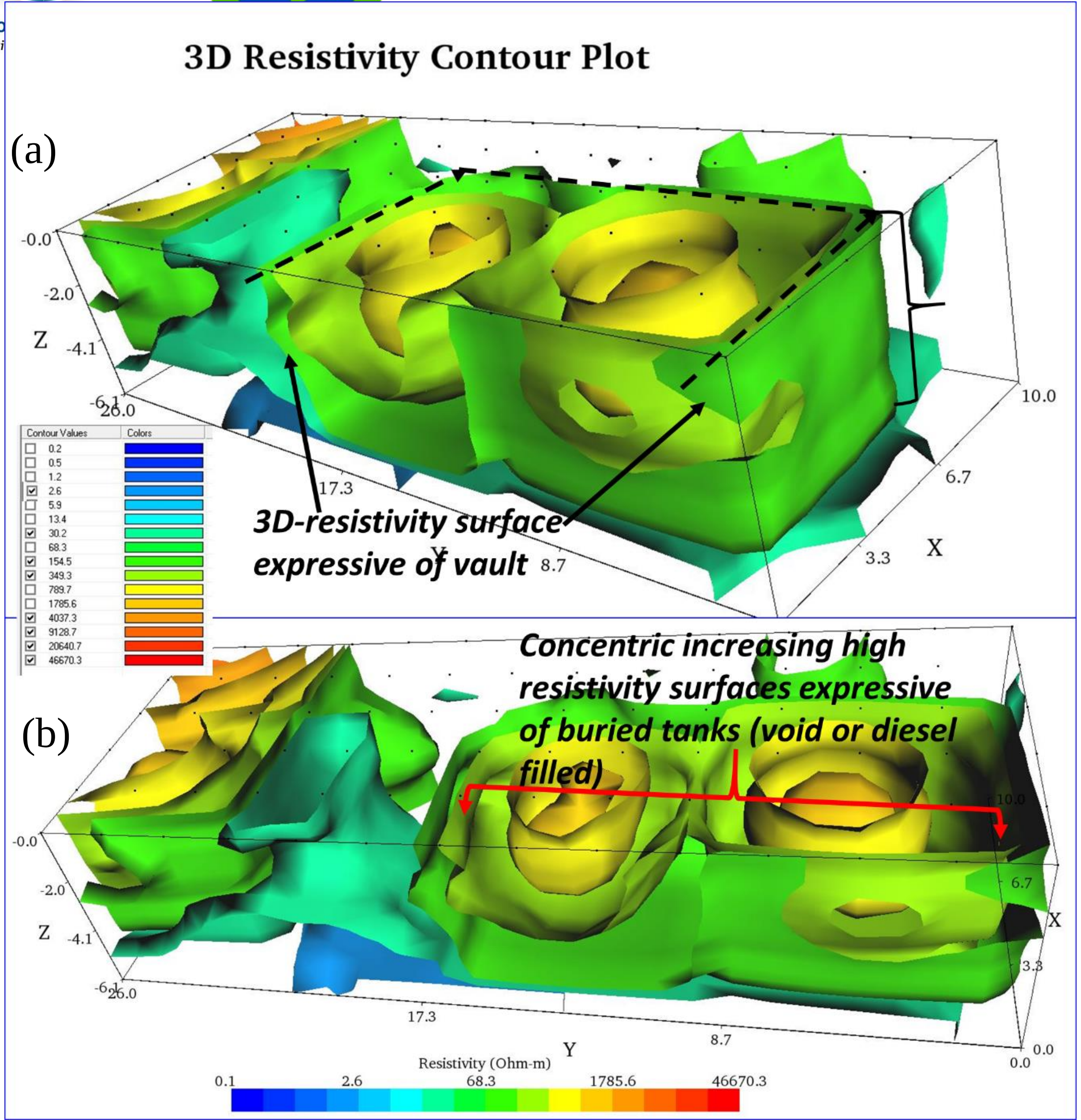

GPR IMAGE OF THE BURIED TANKS

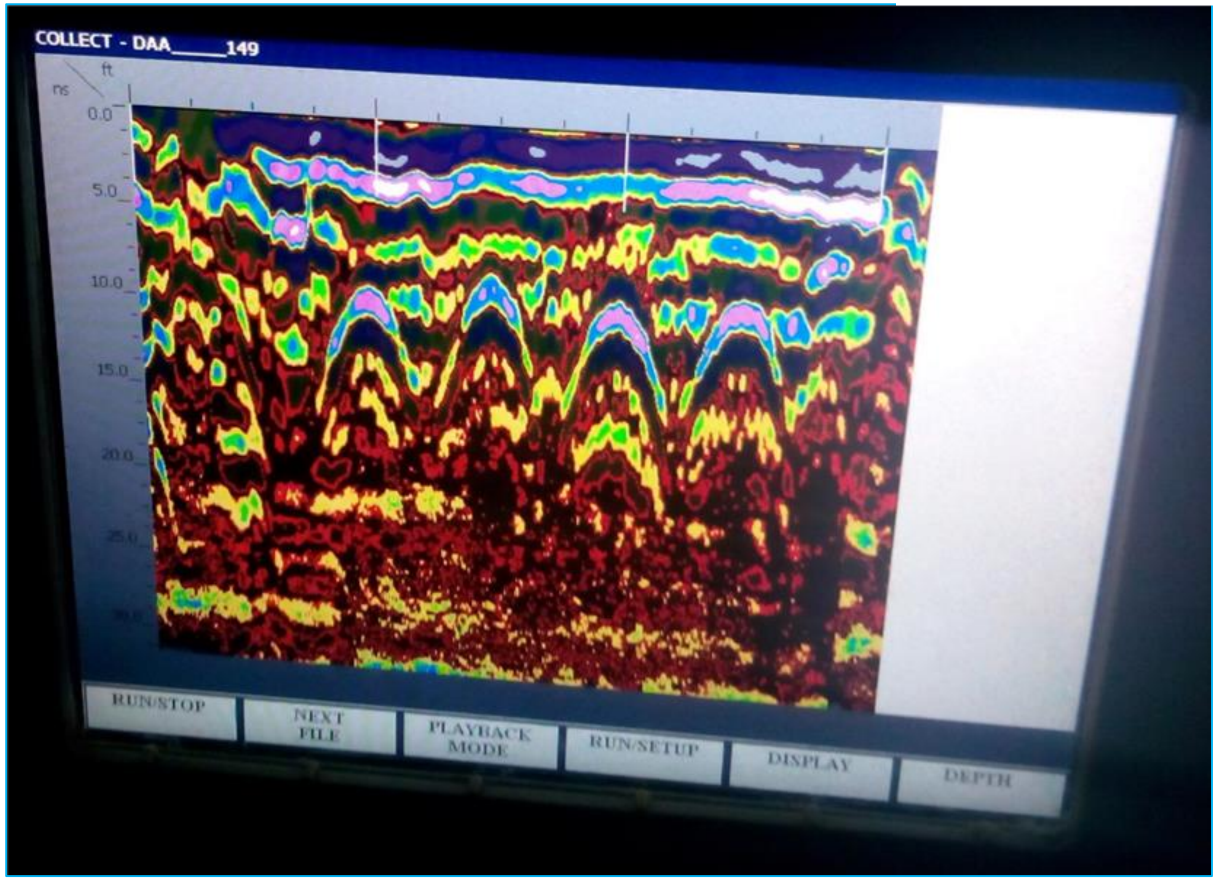

Fig 5. Interpreted 3D Resistivity contour plot showing iso-resistivity surfaces with geometry and resistivity signatures descriptive of (a) rectangular vault (b) increased resistivity value within the vault showing void or diesel

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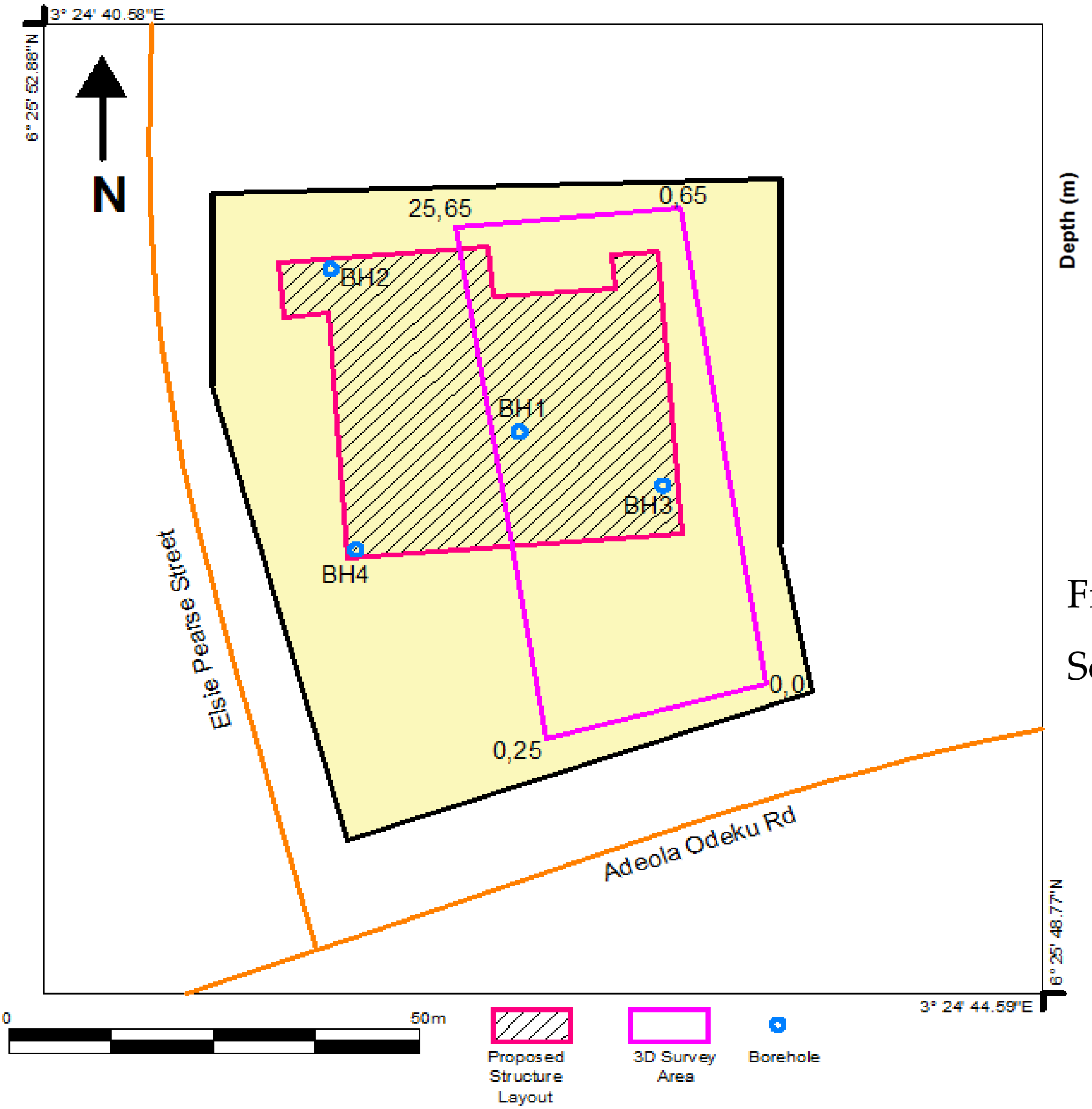

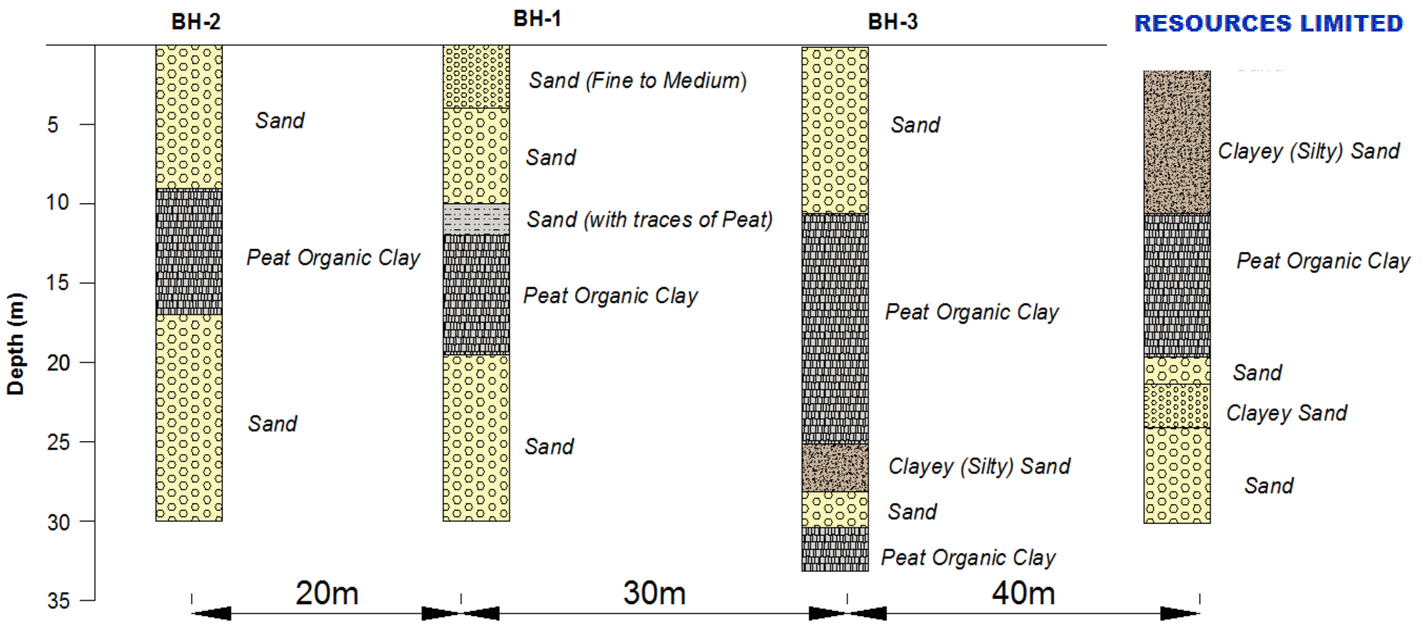

Fig 6. Lithologic cross section of boreholes 1 to 4 (North to South to South-West)

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RESULT AND DISCUSSION

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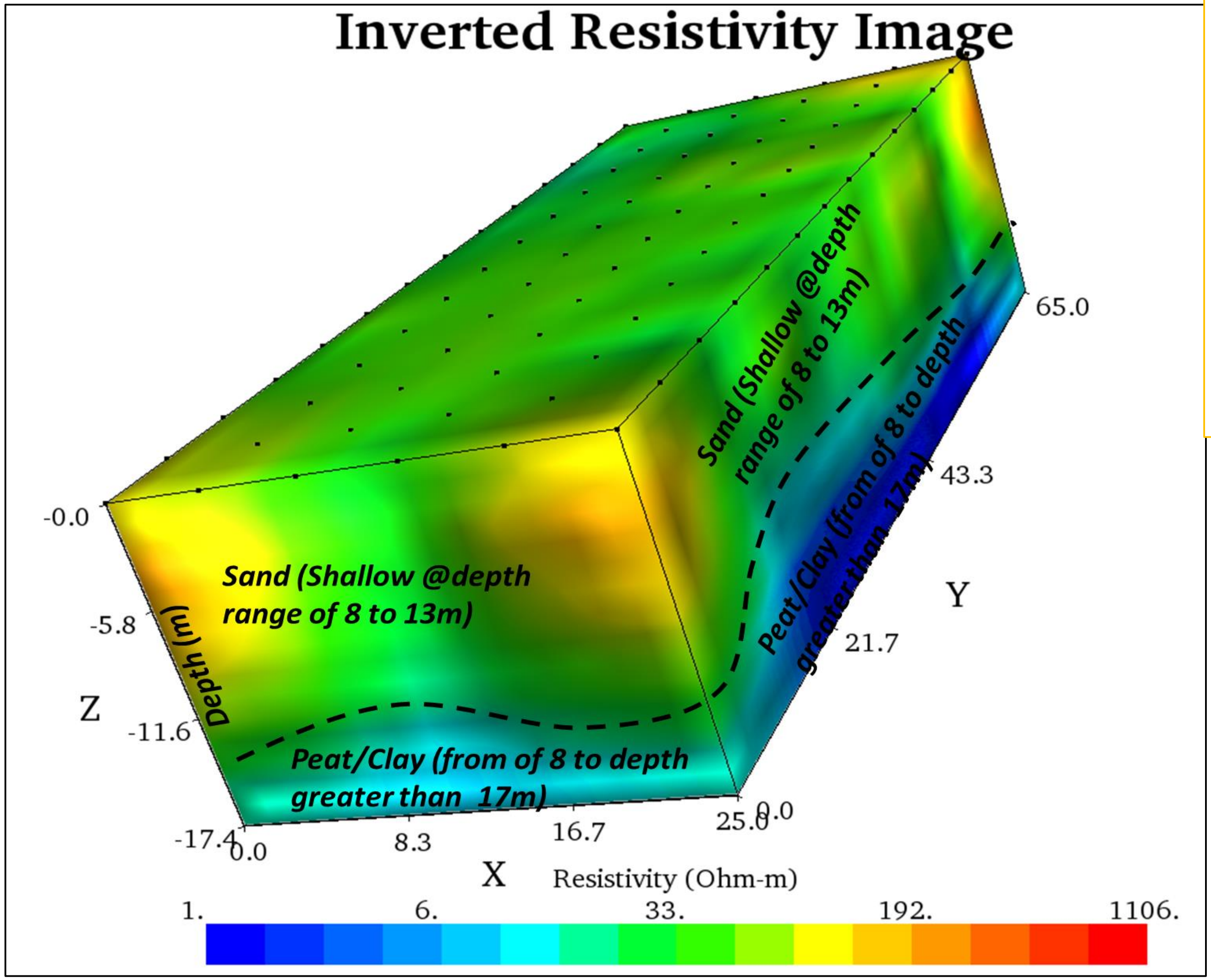
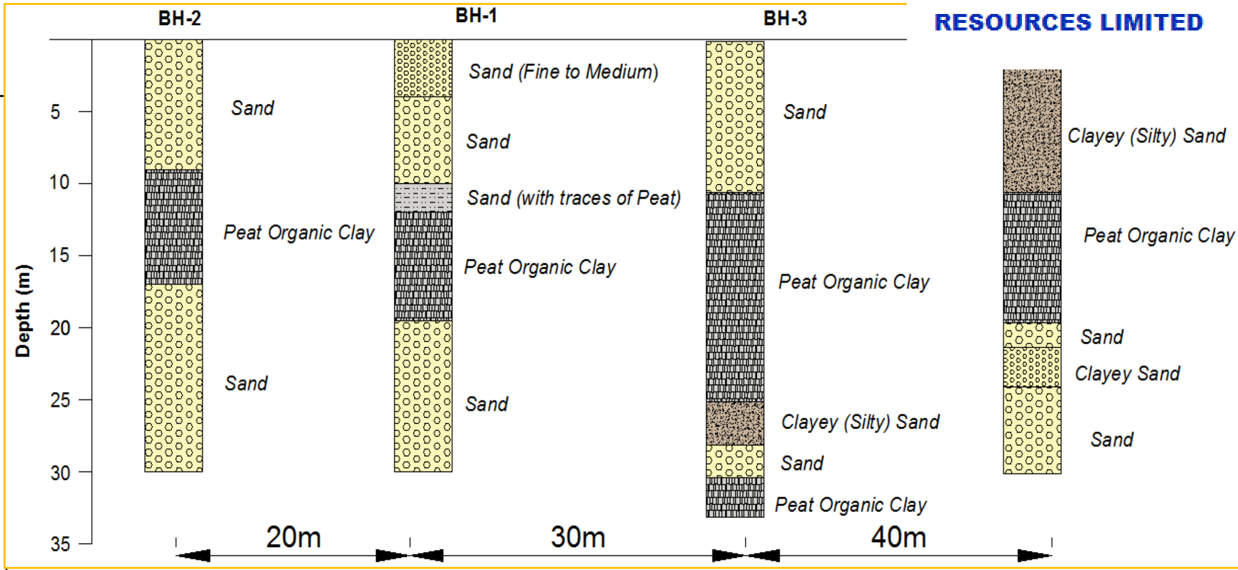
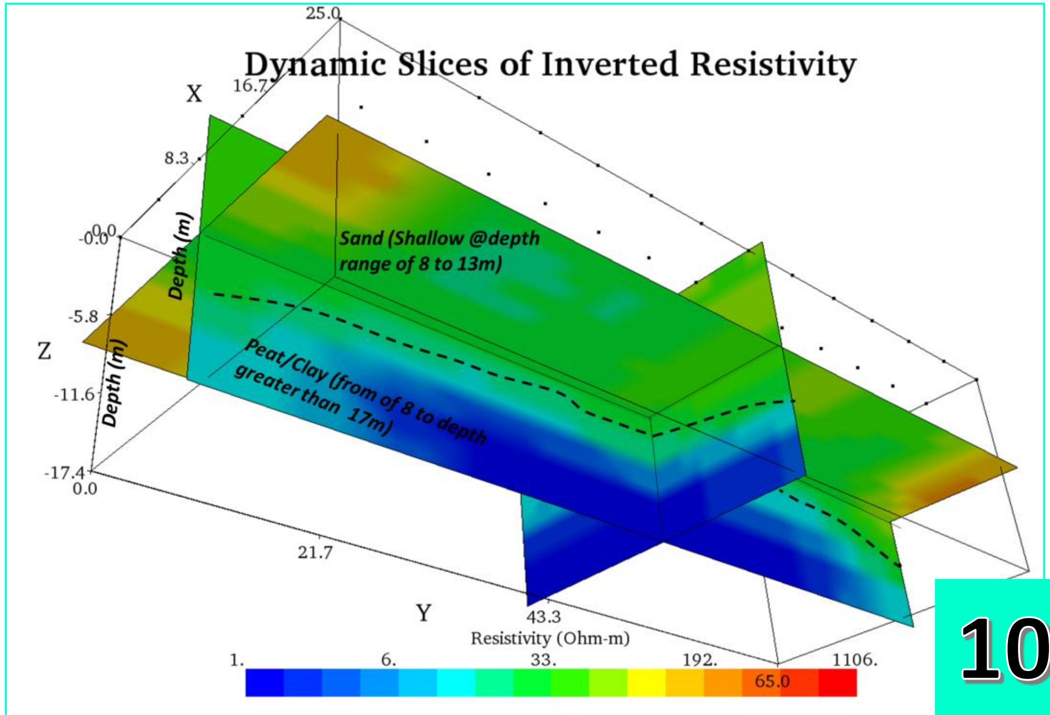


Fig 7. Interpreted 3D Resistivity Cube





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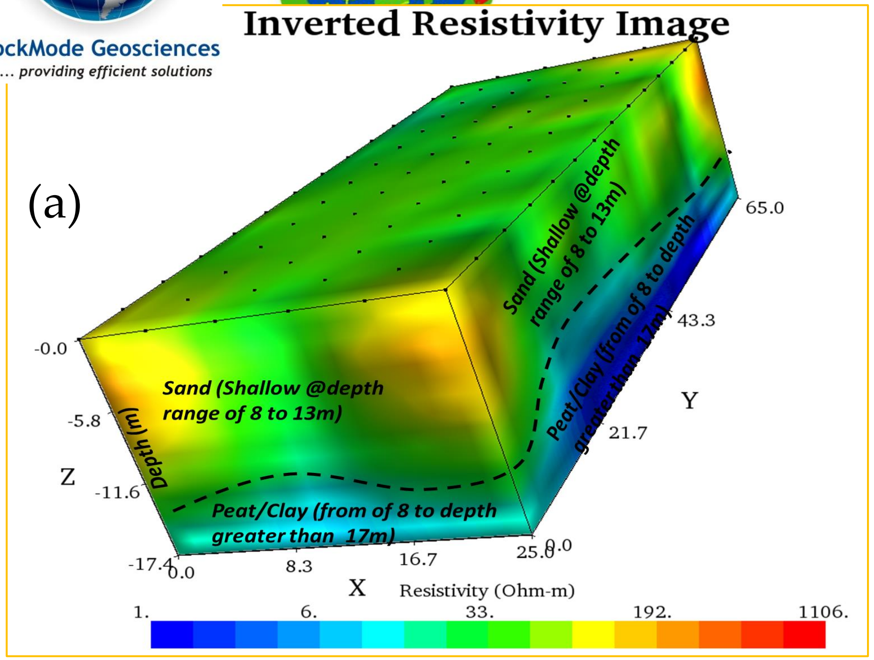
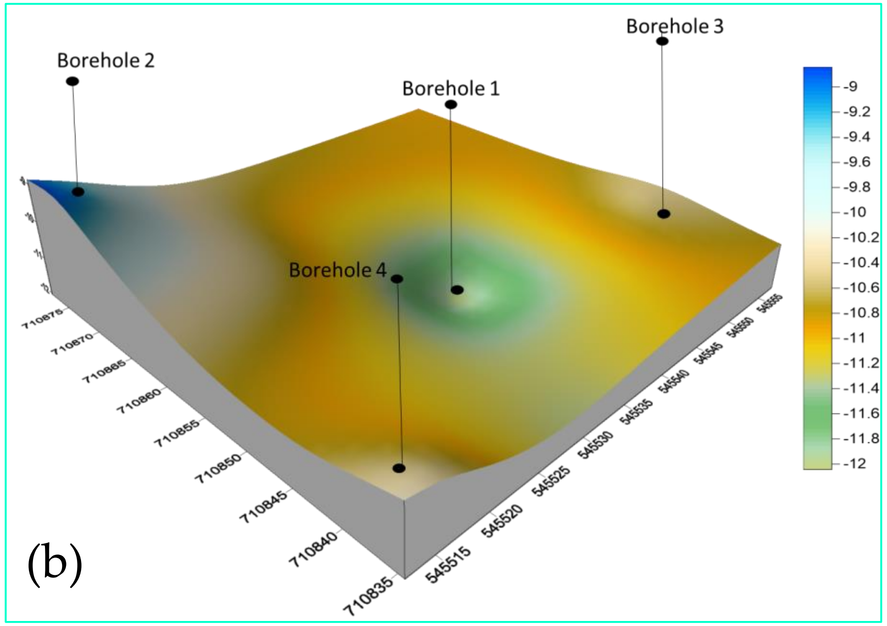




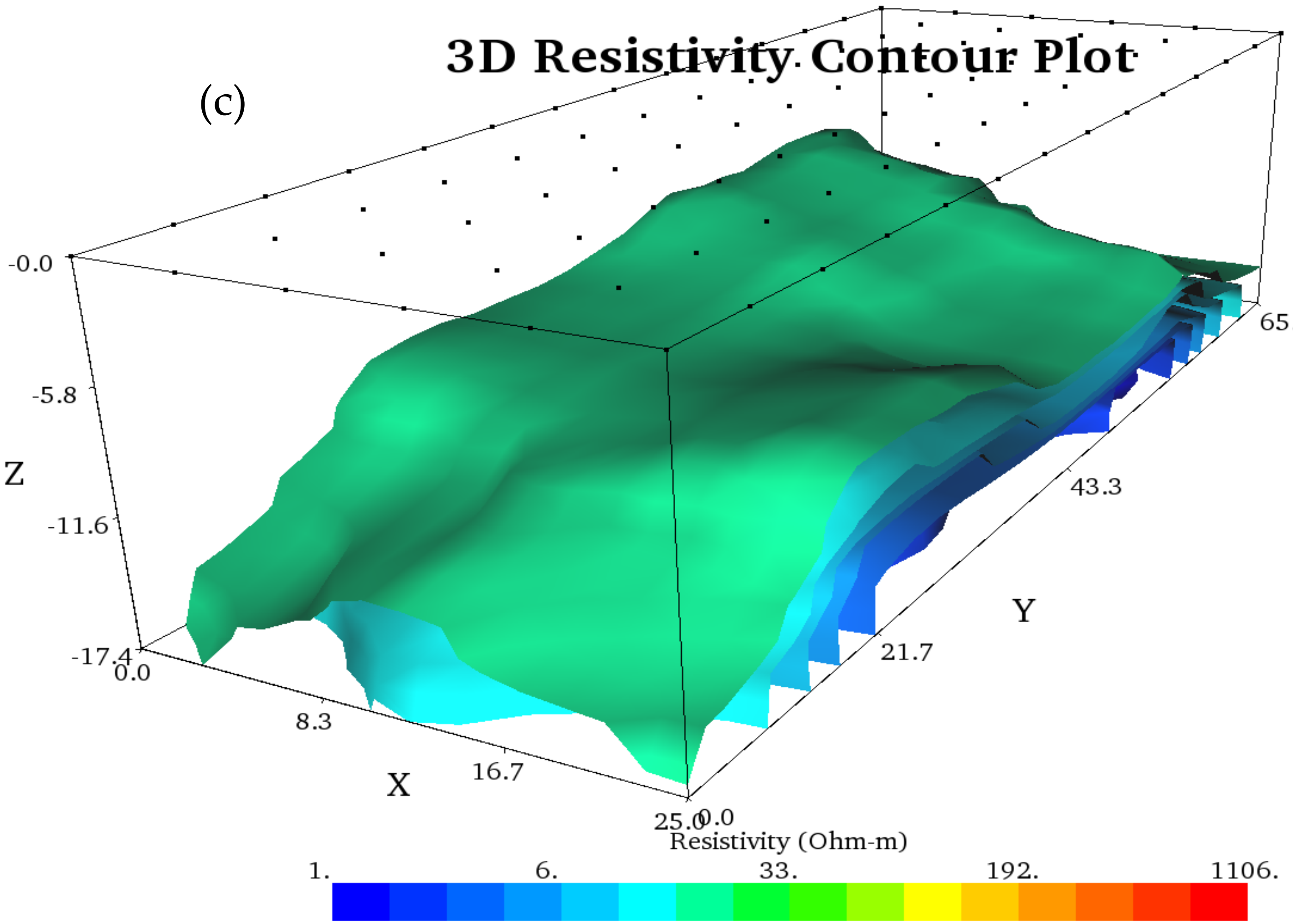
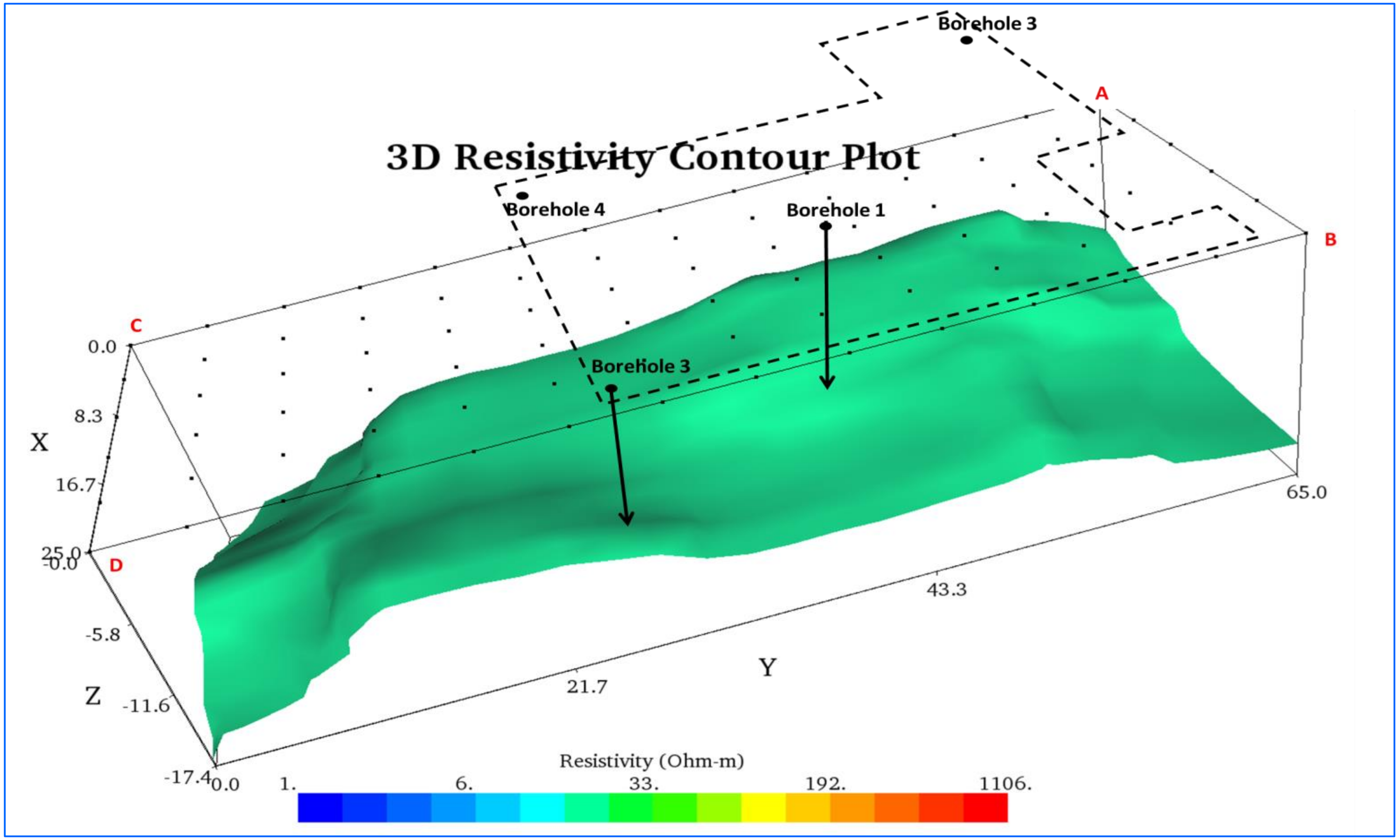


Fig 8. (a) Interpreted 3D Resistivity Cube (b) 3D Map of Depth to Clay using boreholes (c) 3D Iso-Resistivity Surface

RESULT AND DISCUSSION



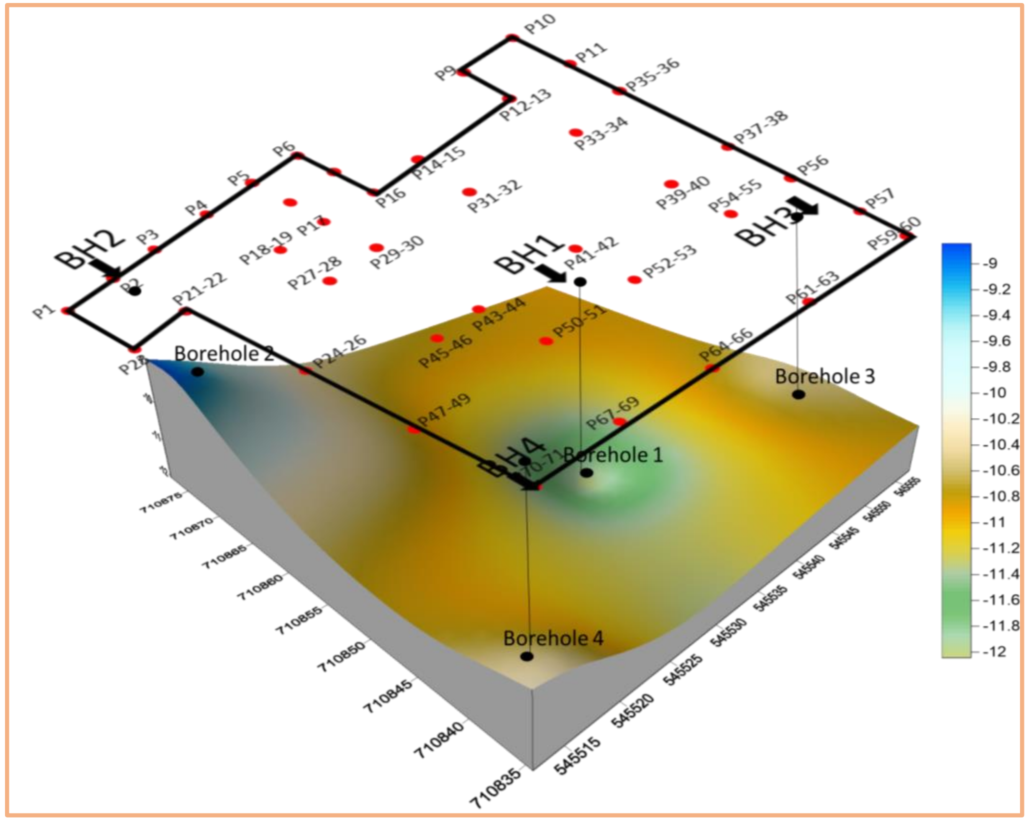


Fig 9. (a) 3D Iso-Resistivity Surface with the overlay of Site plan (b) overlay of site plan on the 3D borehole map

CONCLUSION

- 3D Electrical Resistivity Imaging provides improved imaging of the subsurface
- 3D-Iso Resistivity have shown better visuals of the buried tanks
- 3D Iso-Resistivity have enhanced visualising the depth variation of the Clay surface
- 3D Iso-Resistivity Imaging is a tool that can be used to enhance subsurface disposition

THANK YOU

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