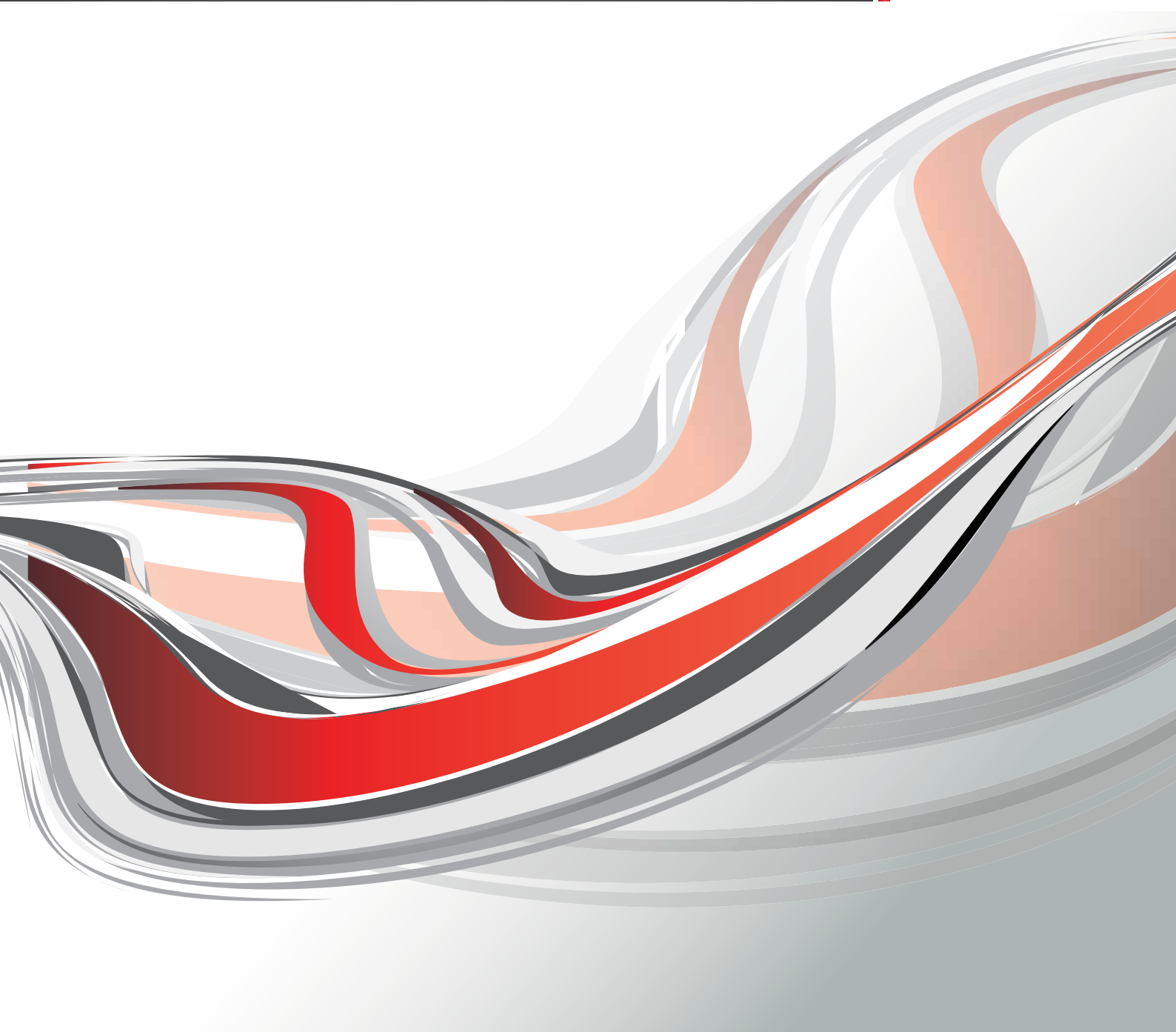




Advanced Sub-surface Investigations

Environmental and Groundwater



About Us

GBGMAPS, formed in 2008, is a joint venture between GBG Australia and McMullen Nolan Group (MNG). The partnership brings GBG's advanced subsurface investigation techniques together with MNG's industry leading survey and spatial information services.

Through a process of consultation and pre-project planning, GBGMAPS can tailor a geophysical solution to provide enhanced structural or subsurface information to add value to almost any geotechnical, engineering or remediation project including:

- **Mining and infrastructure**
- **Marine**
- **Environmental and groundwater**
- **Archaeology**
- **Structural and non-destructive testing**

The application of appropriate geophysical methods carried out by trained and experienced personnel makes GBGMAPS a leader in subsurface geophysical solutions.



Environmental and Groundwater

Environmental geophysics covers a wide of variety applications ranging from locating unexploded ordnance at former military sites to targeting geological sequences with high groundwater yields. GBGMAPS has the knowledge and experience to design geophysical surveys best suited to detect the often subtle targets during environmental investigations.

Environmental investigations where geophysical methods have proven to be invaluable include:

- **Mapping of geological sequences for groundwater**
- **Assessment of dry land salinity and soil contaminates**
- **Delineation of landfill extents, fill base and capping thickness**
- **Mapping of uncontrolled fill such as buried waste drums**
- **Location of remnant subsurface infrastructure**
- **Location of unexploded ordnance (UXOs)**
- **Detection of abandoned mine workings and mine shafts**
- **Tree root mapping**

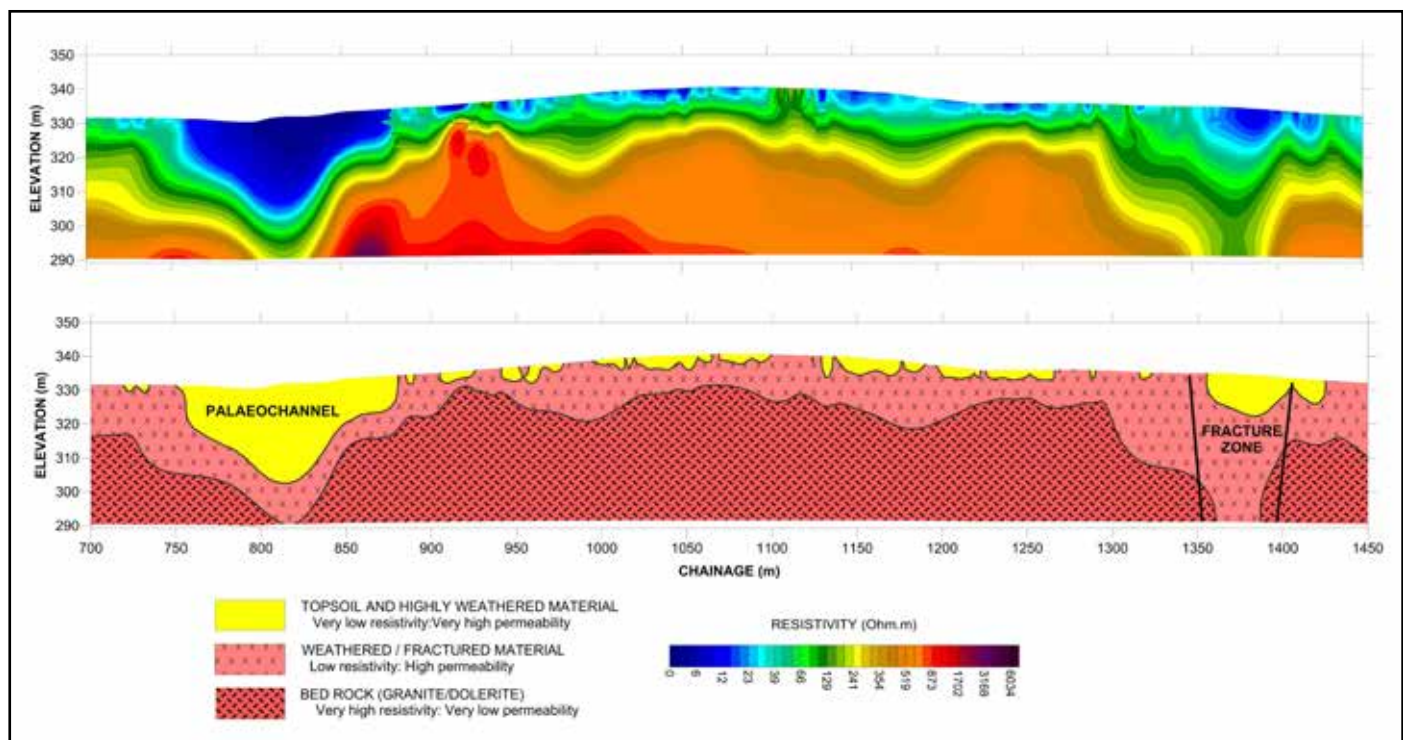


Groundwater and Hydrogeology

Using such geophysical methods as Ground Penetrating Radar (GPR), Electrical Resistivity Tomography (ERT) and Time-domain Electro-Magnetics (TEM) GBGMAPS can delineate and map the water table, hydro-geological sequences and fresh/saline groundwater interface.

Each method possesses an ability to provide subsurface information pertinent to groundwater and associated hydrogeology from the near surface to depths of over 80m.

- **GPR measures variations in the dielectric properties of subsurface materials and is typically used for near surface investigations to a maximum depth of 15m**
- **ERT method measures the variations within the electrical resistivity of the subsurface and is used for investigations requiring an exploration depth of up to 60m**
- **TEM method measures variations in subsurface electrical conductivity and is used for investigations requiring an exploration depth of greater than 60m**



Electrical Resistivity Tomography interpreted profile for hydrogeology modelling at a mine site

Assessment of Soil Contaminates

A combination of geophysical techniques can be used by GBGMAPS to map the extent and intensity of soil contamination including dry land salinity and inorganic plumes allowing for effective remediation strategies to be implemented.

Typical geophysical methods for the assessment of soil contaminants include Frequency-domain Electro-Magnetics (FEM) and Electrical Resistivity Tomography (ERT). Both methods are influenced by electrical conductivity/resistivity, which are related to porosity and permeability, degree of saturation, and fluid type including salt content.

GBGMAPS has carried out geophysical investigations targeting soil and groundwater contaminants at a number of industrial and agricultural sites which has assisted the environmental scientist, environmental engineer, and hydrogeologist in assessing the extent and implementing remediation strategies.



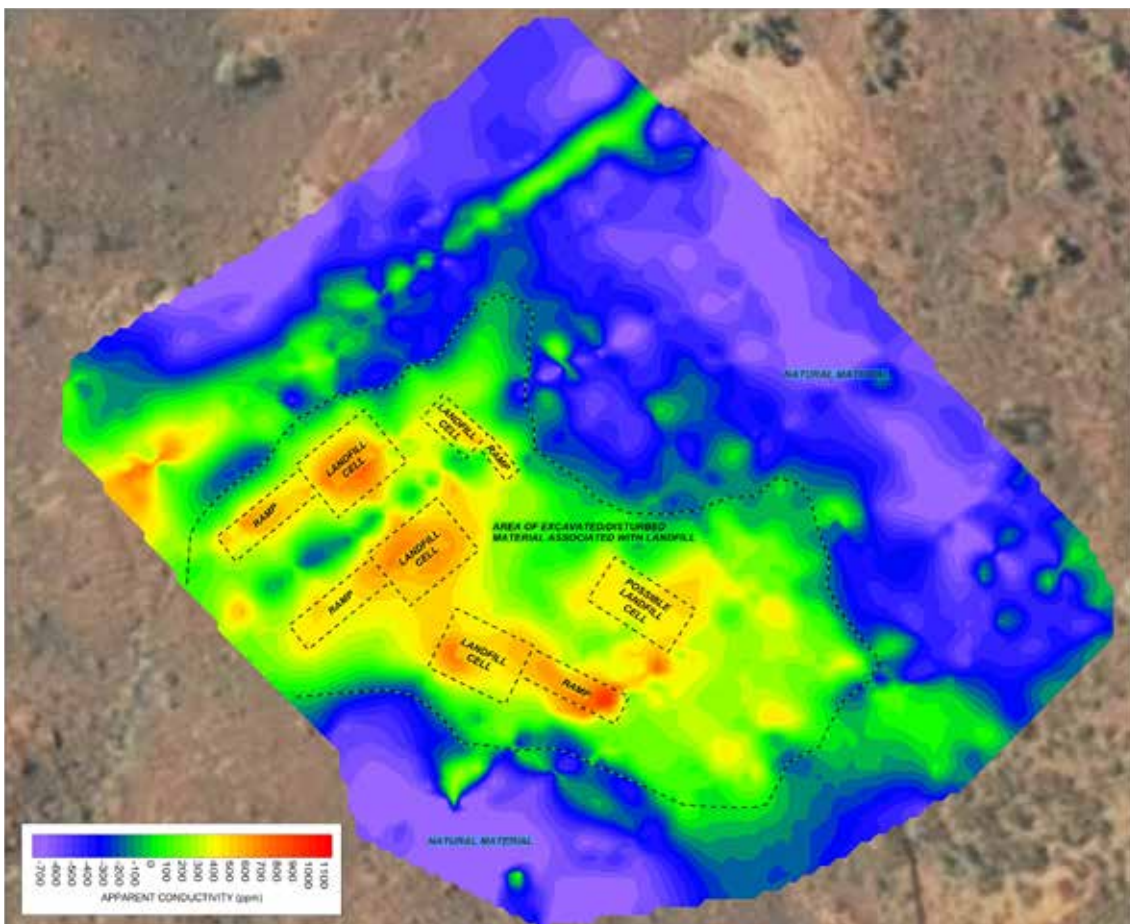
Mapping of soil contaminants at a former waste dump site using a Dual EM

Delineation of Landfill Extents and Uncontrolled Fill

The redevelopment of brownfield sites for commercial and residential projects has any number of unknown environmental risks which can have significant implications on project costs, timing and viability. This is especially the case at sites with a long history of mixed use which is often poorly documented. Together with traditional sampling methods, geophysical methods can be utilised to provide an environmental audit of brownfield sites.

Using a number of geophysical methods the following can be effectively and efficiently achieved:

- **Mapping of landfill extents and cells**
- **Thickness of landfill material and volume calculations**
- **Capping thickness**
- **Fill compaction and voiding**
- **Mapping uncontrolled fill including buried waste drums**



Conductivity map showing the extents of a landfill site

Detection of Unexploded Ordnances

The presence of unexploded ordnance (UXO) remains a hazard for development in areas that have formerly been utilised for military training or similar purposes. GBGMAPS are experienced in the detection of UXO's and are able to work in conjunction with clearance specialist to mitigate the risk associated with developing sites where UXO's are present.



UXO detection using square loop Time-domain Electro-Magnetics TEM

Tree Root Mapping

In today's environmentally conscious society trees hold a large sentimental and economic value. As a result non-invasive investigations on trees has realised a unique market ensuring their sustainability and preservation. Using geophysical methods carried out by qualified geophysicists and utilising advanced data analysis methods the following can be achieved:

- **Non-invasive and accurate generation of structural tree root maps**
- **Depth of cover, geometry and density of root systems**
- **Interaction of proposed development and roots emanating from a target tree**
- **Internal condition including trunk rot and other defects**



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