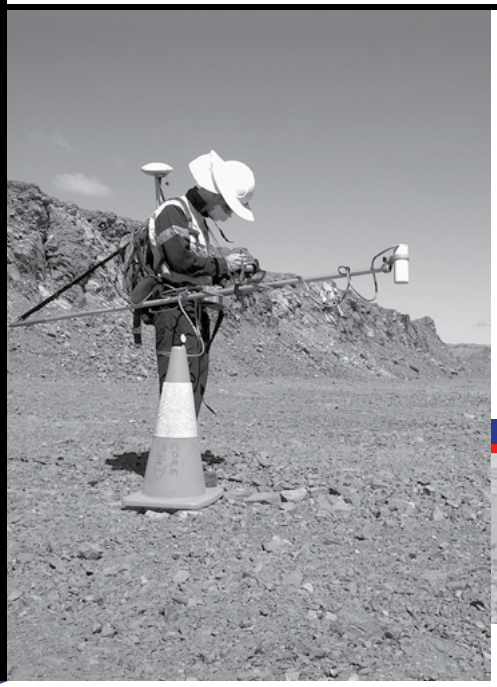
GBG Australia

Advanced Subsurface Investigations

Mining / Oil and Gas / Infrastructure



About Us

GBG Australia is a specialist consulting company providing a range of geotechnical, environmental and engineering investigation services utilising advanced subsurface imaging techniques. The comprehensive information we provide is used to minimise risk to projects. Whether these risks are from unforeseen ground conditions or limited information on how a structure is built, GBG Australia can fill in the gaps and provide extensive information that cannot be obtained from the more traditional approaches to subsurface investigations.

We provide our services for geotechnical, environmental or structural input into the following industry sectors:

- **Mining and Civil Infrastructure**
- **Marine Infrastructure**
- **Environmental and Groundwater**
- **Archaeology**
- **Structural Investigation**
- **Asset Maintenance Investigation**
- **Utilities Engineering.**

Acquisition of ERI data

Our team consists of a range of professionals that include: Geophysicists, Engineers, Geologists and NDT technicians. Our senior staff have over 20 years experience in their respective fields. They have worked on a diverse range of projects that vary in scope, size and cost from simply tracing underground utilities or buried reinforcement for excavation, to comprehensive geotechnical investigation for major infrastructure projects.

GBG Australia is a member of the GBG Group, a multi-national company providing consulting expertise in engineering investigation services since 1982. The company has offices in Cambridge, London, New York, Los Angeles, Sydney and Perth. The Sydney office has been in operation since 1993 providing services to a diverse cliental that range from Government bodies, mining companies, engineering consultancies, developers, asset managers and private owners.

Mining / Oil & Gas / Infrastructure

Accurate modelling of subsurface features is essential for ongoing development in both the resources and broader infrastructure development sectors. Subsurface information is typically modelled using traditional intrusive geotechnical methods such as borehole logging or test pitting. By utilising geophysical methods, the quality and confidence in subsurface models can be greatly improved.

Geophysical methods can be used in early stages to highlight major features that may become problematic such as faults, dykes or fracture zones, or to assist in the design of a more effective geotechnical borehole program. Geophysical methods can also be used to enhance geotechnical methods by confirming structural continuity between boreholes or allowing for less intrusive tests over a given area.

Both of these approaches allow for an overall lowering of costs while greatly reducing site uncertainty and thereby reducing the risk of build overruns.

GBG Australia have the personnel and experience to carry out a wide range of geophysical investigations in the areas of:

- **Geotechnical site assessment / Geo hazard investigation (Land & Marine)**
- **Resource sector infrastructure development**
- **Environmental and Hydro-geology**
- **Site remediation and Hazard Identification**
- **High resolution mine exploration.**

Ore body delineation using high resolution magnetometer profiling

Geotechnical Assessment / Geo-Hazard Investigations

The application of the correct geophysical techniques combined with expert analysis can add value to almost any geotechnical investigation. Whether conducting an initial site investigation to determine subsurface structure or a more detailed investigation to determine geotechnical parameters for engineering purposes, GBG Australia have the equipment and know-how to help.

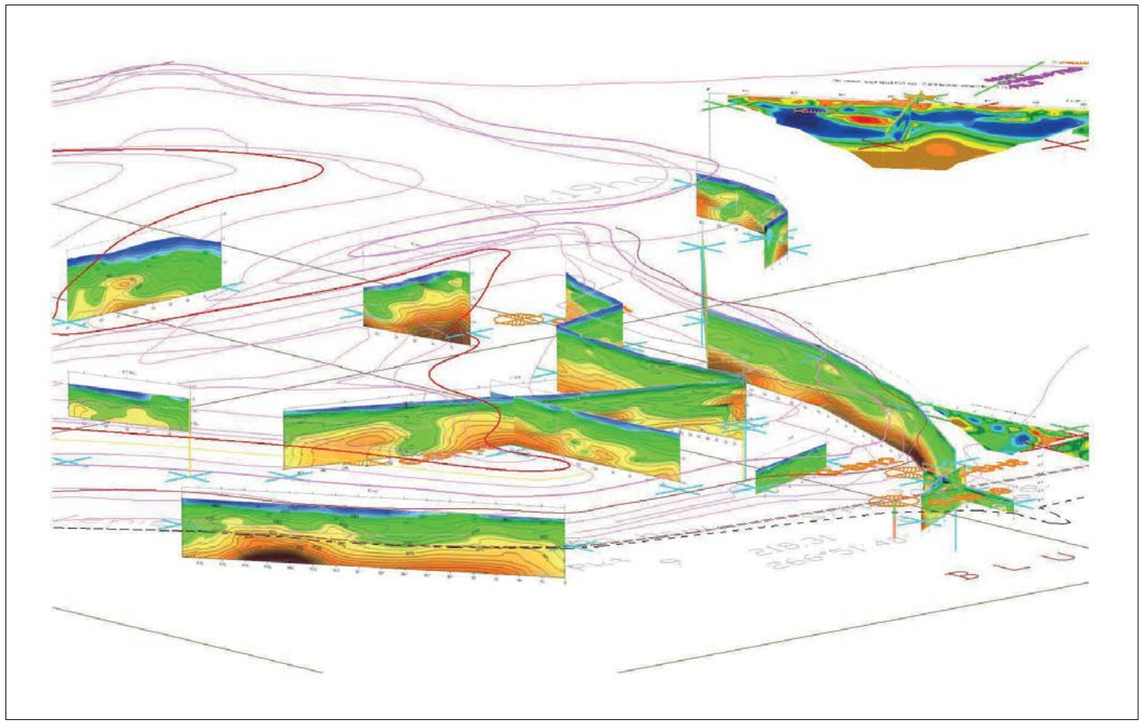
GBG Australia have the capability and experience to carry out a number of geophysical methods for common problems such as:

- **Seismic profiling between boreholes or boreholes to surface for the location of voids, cavities or mine workings**
- **EM and Earth Resistivity Profiling (ERT) to provide information on bedrock depth, location of cavities, boulder floaters, and conductive targets such as aquifers or fracture zones**
- **Subsurface profiling to locate shallow cavities, swallow holes or subsidence**
- **Shallow profiling of bedrock depth and classification for directional drilling, pipe route trenching**
- **Geomorphology – sand layer, overburden thickness, alluvial deposits.**

Seismic data collection – Kerema PNG.

Geophysical techniques can also be used to assist in the determination of subsurface parameters for geotechnical design. These may include:

- **Seismic refraction profiling of bedrock depth and material hardness for rippability, tunnelling and piling design**
- **Multichannel Analysis of Surface Waves (MASW) and Vertical Seismic Profiling (VSP) for subsurface assessment of geotechnical parameters such as material hardness and elastic moduli**
- **Vertical electrical (resistivity) soundings (VES) to provide in-situ electrical properties for earthing design.**



3 dimensional position overlay of Seismic Refraction & Resistivity profiles to ascertain bedrock depth and strength –preliminary geotechnical investigations at a proposed LNG processing facility – Kerema, gulf province, PNG.

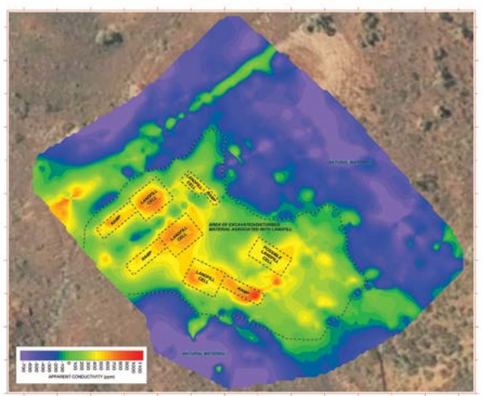
Environmental / Hydrogeology and Site remediation

Within a resources sector context, environmental investigations can be undertaken prior to development, during the life of the project and during remediation. Geophysical methods have become popular for environmental investigation work because they can cover large areas quickly to provide an overview for targeted physical investigations, or can be used to fill in the gaps between standard tests.

GBG Australia's consulting services have been used to provide a wide variety of information for sites, ranging from locating unexploded ordnance along pipe routes, base lining groundwater salinity prior to tailings dam construction and follow up monitoring, to targeting old mine workings for remediation.

Some examples of where environmental investigations have been undertaken within resource sector sites are:

- **Location of buried services, underground storage tanks and other remnant foundations on expanded brownfield sites**
- **Location of old mine shafts, addits and galleries prior to expansion of a mine**
- **Location of legacy shafts, galleries etc. within proposed housing development areas**
- **Assessment of spontaneous combustion damage within spoil heaps**
- **Assessment of geological factures affecting groundwater movement / leaching from old mine pits**
- **Delineation of landfill extents, fill base and capping thickness; and location of uncontrolled fill such as buried waste drums**
- **Location of unexploded ordnance (UXOs) within mining areas or along pipeline roots (marine and land)**
- **Delineation of inorganic contaminant plumes**
- **Delineation of hydrocarbon contaminant plumes.**

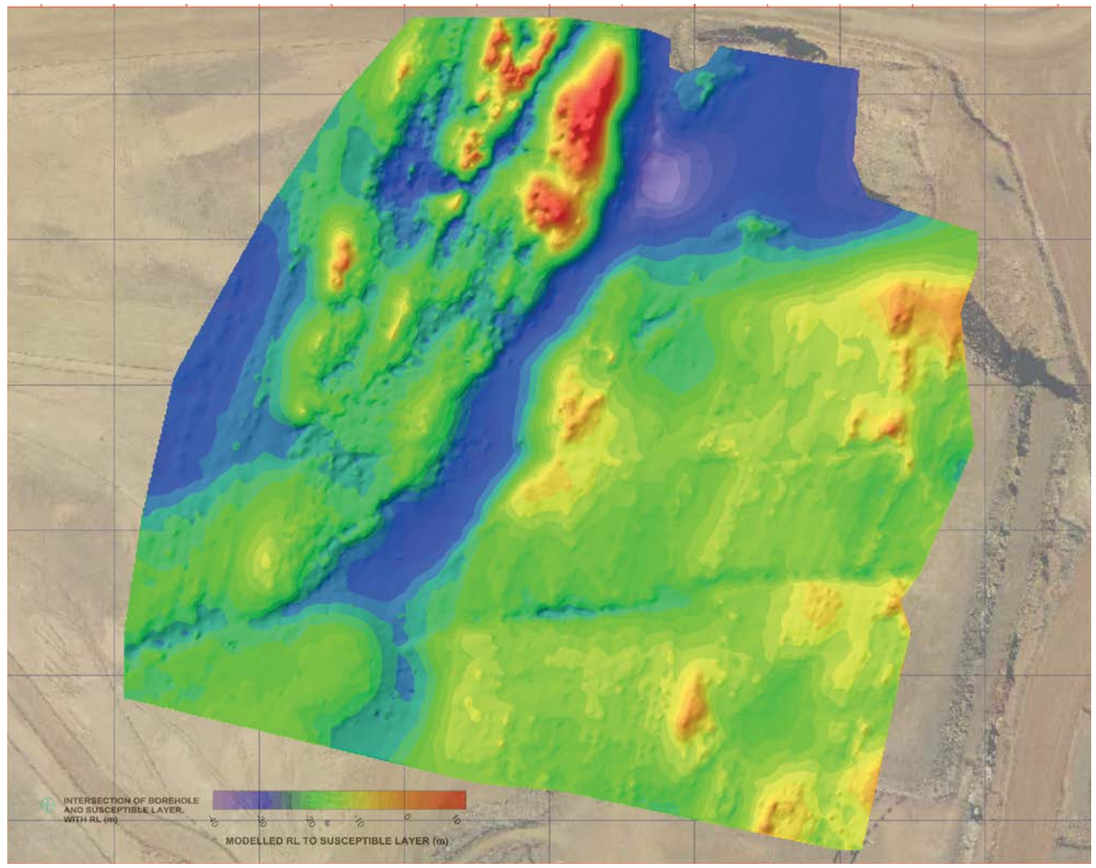


EM data showing the extents of landfill material

Exploration

Although large scale exploration projects are not GBG Australia's core business, we do have the expertise and technology to undertake mine scale exploration work. This normally entails smaller 2D seismic reflection projects for stratigraphic information, land based EM or magnetic surveys for mine lease extensions or pre planning of extraction. GPR and resistivity surveys to locate palaeo channels for mineral extraction or calculation of decayed coal in open cut pits.

GBG Australia can upscale if required to undertake larger land based exploration projects by utilising equipment and resources from our overseas offices in the UK and USA.



Map of relative level to the top of iron ore body created from high resolution surface magnetic survey combined and correlated to down hole magnetic susceptibility data. Data highlights variability in depth across this 500m x 500m section to the highest ore grade. Used to pre plan ore excavation by mine geology team.

www.gbgoz.com.au

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Some of our Clients:

RioTinto, FMG, xstrata, CITIC PACIFIC, bhpbilliton, InterOil