

## GBG Australia

### Heritage and Archaeological Investigations

Harbour Seawall—Luna Park to Jeffrey St  
Milson's Point

#### North Sydney Council

GPR Investigations of the subsurface material behind the seawall at Dawes Point & Woolloomooloo

#### Dept. Public Works & Services

Circular Quay seawall survey to locate voids

#### Syd Harbour Foreshore Auth

Plotting of metal tie location and condition in sandstone window mullions, Government House, The Domain, Sydney

#### Dept. Public Works & Services

Location of buried remains at St. Patrick's Cemetery, Parramatta

#### NSW RTA

Stan Moses Reserve San Souci, NSW  
GPR investigation to determine the extent of an Aboriginal shell midden located along a drainage reserve.

#### NSW RTA, Rockdale Council

Aboriginal grave location at Batemans Bay

#### RTA, Eurobodalla Shire Ccl

Location of unmarked graves, South Windsor Cemetery

#### NSW RTA

## Sydney

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## applications for non-destructive techniques in heritage & archaeology

LOCATION	RECOMMENDED TECHNIQUES
Stone / Brick thickness	High frequency radar
Location of internal metalwork / ties	High frequency radar metal detection
Tie condition	High frequency radar ( calibration required )
Stone delamination	Tap testing, thermal imaging, high frequency radar
Moisture variation	Moisture meter, thermal imaging, high frequency radar
Buried services	"Cat & Jenny" type service locators, Radar
Mapping flues	Radio Tracking, smoke tracking, ball tracking, Radar
Tendon Ducts	Radar, Radiography

LOCATION	RECOMMENDED TECHNIQUES
Unmarked grave location	Ground Penetrating Radar, resistivity, magnetometry ( location of metal objects buried with bodies )
Sub surface foundations	Ground Penetrating Radar, resistivity, EM systems
Aboriginal midden	Ground Penetrating Radar
Hearth / Old fire pits	Magnetometry
Old robber mines adits	Microgravity, resistivity



## Non Destructive Techniques for HERITAGE & ARCHAEOLOGICAL ASSESSMENT



### GBG Australia

GBG Australia is a specialist in applying non-destructive investigative techniques for assessment of buildings. We offer our clients innovative methods of revealing structural and condition information whilst minimizing both costs and disturbances of the site.

### Company Expertise

GBG Australia is linked with one of the United Kingdoms foremost non destructive investigation companies – GBG UK Ltd. The UK partner has pioneered the application of shallow geophysical techniques to the precision investigation environmental sites and engineered structures in UK and Europe since 1982. Having been part of CMP-GBG with CMPS&F and GHD in the last 10 years, GBG Australia is now an Independent consultant company and the Australian office of GBG UK.

# Applications for non-destructive techniques



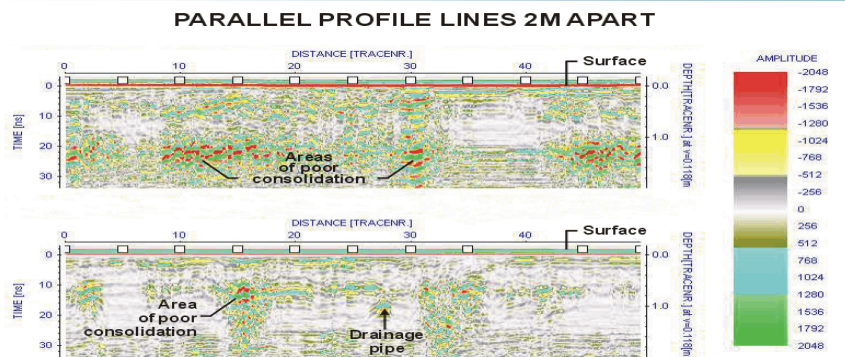
## SEA WALL INVESTIGATIONS

Shallow geophysics have been successfully used by GBG Australia to investigate the construction and condition of several Sydney Harbor seawalls. At one site, Ground Penetrating Radar (GPR) results were combined with topographic and hydrographic surveys and test pitting, to produce an assessment that was used for maintenance planning. The seawall at this location was – 100 years old, 5m high and consisted of large sandstone blocks 1-2 m long and 500 – 700 mm high. The wall had a history of subsidence, and sections of paved footpath behind it had already collapsed. These factors suggested that the subsurface material behind the seawall might be poorly consolidated or voided and possibly creeping.

GROUND PENETRATING RADAR SURVEY USING 500MHz ANTENNA

### Methodology

The site measured 4680 m<sup>2</sup> in total (main area – 360m x 10m width). Data profiles were continuously collected both parallel and perpendicular to the seawall and point measurements were taken on the seaward face. The combination of antenna frequencies ( 120 - 500 MHz) and depth settings (-4.5m) allowed for detection of smaller near- surface anomalies (e.g. voids) as well as deeper, larger anomalies such as cavities. The antennae was dragged at a slow walking pace while connected to GSSI SIR 2000 control and recording equipment. The data was downloaded off-site and processed using specialized analytical programs.



PARRALLEL PROFILE LINES 2M APART

### Results



The investigation found that behind the gravity-type structure was coarse rip-rap fill material of sandstone, which was overlain by a layer of fill material, high in fines content. There were a number of anomalous responses in the data , consistent with those expected from areas of lower material consolidation or voiding. These were believed to be related to variations in the inter-locking void spaces in the rip-rap material. No evidence was found to suggest the presence of large open voids or cavities behind the sea wall. There was both physical and geophysical evidence of fines movement in the upper layer. These anomalous areas were commonly associated with buried utilities, storm water pipes and previous repair work. Destabilisation of the upper layer allowed movement of material into the coarse rip-rap layer . This had the effect of increasing surface depressions and the risk of major collapse. From this investigation, GBG Australia were able to give recommendations to the client for repair and maintenance of the seawall.

VERTICAL CRACKING IN WALL ON CURVED EASTERN SECTION, INDICATING PAST OUTWARD MEVEMENT OF THE WALL

## GROUND PENETRATING RADAR FOR GRAVE SITE LOCATION



UNMARKED GRAVE LOCATION USING GPR

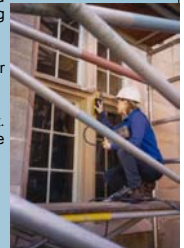
The non- destructive nature of techniques such as GPR and resistivity have proved very popular for the investigation of known and potential gravesites. To date, GBG Australia has located burials at Aboriginal, historic and contemporary sites. We are able to locate possible unmarked graves and determine the depth and orientation of these features. In some cases, metal detection is used to detect associated metal artifacts. To fully understand the stratigraphy of the site, we also plot utilities and natural geomorphological features such as the water table. All reports are strictly confidential unless otherwise requested by the client.

## SANDSTONE DETAILING ON A HERITAGE – LISTED BUILDING

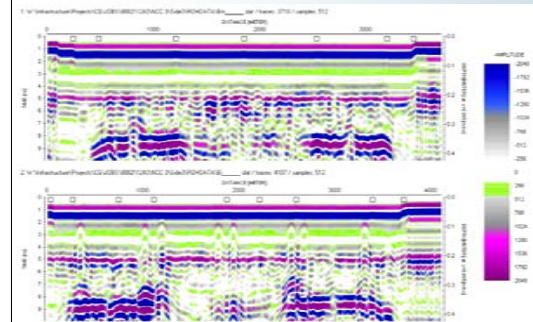
GBG Australia was commissioned to carry out a NDT of a heritage- listed public building, to detect the location and comparative condition of structural metal ties in the sandstone window mullions and surrounds. Cracking and spalling of the joint between the vertical mullions and cross – members, was thought to be caused by corroded metal pins.

Comprehensive surveys (to 350 mm depth ) were carried out using a 1.2GHz antenna, which was hand-drawn over the surface. Profiles were correlated with data from a metal detector, to confirm accurate locations of the metal pins.

The condition of the fixing pins was determined by comparing the amplitude of reflections recorded from each element. The results of this investigation enabled the Client to plan specific, and therefore economical, maintenance of these important Gothic Revival style features.



USING 1.2GHz ANTENNA TO SURVEY A WINDOW MULLION



RADAR SCAN THROUGH STONE FACADE

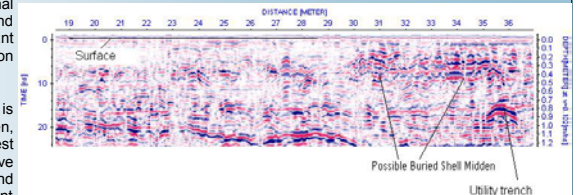
Non – Destructive Testing may also be used for the following purposes:

- Construction information: wall, slab and soffit thickness, beam placement
- Location of internal metalwork and corrosion, e.g. ties and reinforcing rods
- Detection of voiding and invisible cracking
- Assessment of stone facades: delamination, areas of high moisture content

## ARCHEOLOGICAL SITE INVESTIGATIONS

GBG Australia has used non-destructive GPR on Aboriginal archeological sites, to locate and map possible graves and shell middens. We have experience in dealing with relevant organizations and individuals such as Aboriginal Liaison Officers and NSW National Parks and Wildlife Service.

The culturally sensitive nature of these investigations is respected and confidentiality of results is observed. Often, there may be no photographs taken of the site at the request of the client. While GPR data does not give definitive answers, areas of interest within the site are mapped and recommendation given as to the location of relevant features. These results may be used to plan further physical investigation such a spitting and trench excavations. This approach saves time and is more economically viable than destructive testing of the whole site.



RADAR PROFILE OF A HOLOCENE REMNANT BEACH RIDGE