1 July 2010

CELEBRATING 50 YEARS in 2010

PENRITH NEPEAN HEALTH CAMPUS REDEVELOPMENT STAGE 3A

Geotechnical Investigation Report

Submitted to:
Health Infrastructure
c\o Aurora Projects Pty Ltd
Level 6, 650 Berry Street
North Sydney, NSW, 2060

REPORT

A world of capabilities delivered locally

Report Number. 107622059_002_R_Rev1

Distribution:

3 Copies (+ 1 electronic) Aurora Projects Pty Ltd
1 Copy (+ 1 electronic) Golder Associates

Golder Associates

Table of Contents

TABLES

APPENDICES

1.0 INTRODUCTION

Golder Associates (Golder) has been engaged by Aurora Projects Pty Ltd (Aurora) to carry out a combined geotechnical and environment investigation for the Stage 3a upgrade of the Nepean Hospital, Kingswood. The Stage 3a upgrade will include the following:

- Mental Health Patient Unit at the location of the existing maintenance depot and current car parking off Derby Street, consisting of 2 levels including excavation of up to 3 m below existing ground levels;
- Oral Health Site to be located within an existing car park to the east of the proposed East Block, consisting of a single level building and no significant cutting; and
- A new Maintenance Depot to be located within an existing car park north of the existing North Block, consisting of a 2 level building and no significant cutting.

Golder Associates carried out the work in general accordance with our proposal (ref P07622032_001_P_Rev0, dated 7 April 2010). The work was commissioned by Ed Doherty via letter of acceptance dated 12 April 2010.

The field work comprised a geotechnical investigation and environmental assessment that was carried out concurrently. This report presents the results of the geotechnical investigation. The environmental report is provided separately (ref. 107622059_003).

Based on your brief, the purpose of the geotechnical investigation was to address the following key issues:

- Depth to rock and strength of soil and rock;
- Depth to groundwater;
- Soil and rock parameters for foundation design;
- Performance of suitable founding systems;
- Soil reactivity and site classification in accordance with AS2870 "*Residential Slabs and Footings*";
- Excavation requirements;
- Earthworks and pavement earthworks;
- Retaining Structures and batter slopes;
- Reuse of excavated materials;
- Aggressivity of the soil and groundwater;
- Dispersivity of soils;
- Salinity of the soil;
- Subgrade conditions within proposed pavement areas; and
- Earthquake site factors and risks in accordance with AS1170.4 (2007) "*Structural Design Actions, Part 4: Earthquake Actions in Australia"*.

2.0 BACKGROUND

Investigations and desk top studies were carried out on the site for Stage 3 (not 3a) of the Nepean Hospital Upgrade. This included a preliminary contamination and geotechnical investigation for a development approximately between the Mental Health and Oral Health Units., which was undertaken in January 2009 for Architectus Sydney on behalf of NSW Department of Health. The findings were presented in our Preliminary Contamination and Geotechnical Investigation Report referenced 08762313 _003_Rev 1 dated 29 January 2009. Further work was A site investigation was carried out in April 2010 and reported in document ref. 107622058_002_Rev0 dated 19 May 2010.

These investigations provided findings and recommendations relating to the geotechnical conditions of the site of the demolished East building, which included the following:

- The site is underlain by typically less than 2 m of residual clay containing some ironstone gravel. The clay was inferred to be of medium to high plasticity with a stiff to very stiff clay consistency dry to moist. The underlying bedrock is of the Bringelly Shale Formation and was found to be extremely to highly weathered and typically very low to low strength, gradually decreasing in weathering and increasing in strength with depth.
- Due to the high plasticity and thickness of the clay encountered, the site was classified as a Class H site (highly reactive) in accordance with AS/NZS 2870-1996: *Residential Slabs and Footings*.
- Groundwater was measured at a depth of 5.3 metres below the ground surface level at the time of the investigation in a standpipe installed in one the boreholes.
- Soil salinity may be an issue and would require further investigation.
- Based on the Soil Landscape Series 1:100,000 Sheet Penrith 9030 maps and laboratory testing carried out on soil samples, the natural soils were assessed as a high soil erosion hazard requiring suitable stormwater management during construction.

3.0 SITE DESCRIPTION

3.1 Location

The site is located within the existing and operational Nepean Hospital compound in Kingswood, NSW, approximately 1.5km east of Penrith as shown on the site locality plan in Figure 1. The site is bounded by the Great Western Highway to the north, Somerset Street to the east, Derby Street to the south and Parker Street to the west. The proposed mental health patient unit, oral health site and maintenance depot are located in the south, east and north portions of the site respectively, as shown in Figure 2.

Land to the east, south and west beyond the adjacent roads is dominated by residential development. To the north beyond the Great Western Highway the land use comprises a mixture of railway lines, industrial / commercial units, a cemetery and residential dwellings.

3.2 Site Condition and Physical Environment

The Nepean Hospital is situated at the northern end of a north-south trending ridge. The site area slopes from the south western corner (~58m AHD) radially at an approximate 1-5^{o} gradient down towards the north and east to a low of ~52m AHD at the eastern end of the proposed development. The surrounding area is characterised by gently undulating topography ranging between 50 m and 60 m AHD.

The majority of the three proposed upgrade areas are operational car parks. These car parks are in good condition with no obvious indications of cracking or settlement. The existing maintenance depot is located to the south of the proposed mental health patient unit area. The demolished East Block is located directly adjacent to the north of the proposed mental health patient unit and west of the proposed oral health site.

3.3 Regional Geology and Soils

The Geological Series 1:100,000 Sheet Penrith 9030 maps the underlying geology as mid-Triassic Bringelly Shale which includes undifferentiated shale, carbonaceous claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

The Soil Landscape Series 1:100,000 Sheet Penrith 9030 maps the underlying soils as the Luddenham Group. They are characterised by shallow (<1m), dark podzolic soils or earthy massive clays on crests, moderately deep (0.7-1.5m) red podzolic soils on upper slopes, and moderately deep (<1.5m), yellow podzolic soils and prairie soils on lower slopes and drainage lines.

Limitations to development exhibited by the Luddenham Group soils include high soil erosion hazards, localised impermeable highly plastic and moderately reactive subsoil.

The NSW Natural Resources Atlas sourcing information from the Acid Sulfate Risk Mapping published by the Department of Infrastructure, Planning and Natural Resources (DIPNR 1994) does not indicate a risk of acid sulfate soils occurring at this site.

3.4 Salinity

The NSW Natural Resources Atlas sourcing information from the Salinity Hazard Map of Western Sydney (DIPNR 2000) does not indicate a soil salinity hazard at this site. However, review of the Department of Natural Resources (DNR), 1:100,000 Map of Salinity Potential in Western Sydney shows that across the majority of the southern part of the Nepean Hospital the land is situated in an area of moderate salinity potential. The majority of the northern portion of the Nepean Hospital is situated on land with a high potential for salinity being present. There is also one small area in the north of the Hospital which is an area of known salinity potential. Furthermore, evidence of potential salt crystals was identified in the north eastern corner of the East Block building prior to demolition as part of the July 2009 investigation.

3.5 Hydrogeology

The NSW Natural Resources Atlas sourcing information from the database of groundwater bores held by the Department of Water and Energy has identified a number of locations within relatively close proximity to the site (<3km) and with similar geological characteristics where details regarding the sub-surface geology and groundwater are available.

Bore data indicates that groundwater is found at depths in excess of 6.5 m in discrete horizons typically hosted in relatively shallow (<15m) clays and deeper fractured shale and more permeable sandstone. Groundwater is often recorded as salty or brackish. Groundwater at the site is therefore likely to occur in discrete water bearing zones within the Bringelly Shale at depths greater than 5m below surface and separated by relatively impermeable clay and shale sequences.

4.0 INVESTIGATION METHODOLOGY

4.1 Fieldwork

The geotechnical investigation for the three proposed upgrade areas was carried out over three days. Boreholes were drilled using a truck mounted drill rig, a small tracked mounted drill rig or a geoprobe drill rig. In general the boreholes were drilled using solid flight augers fitted with a V-bit until refusal. They were then advanced using a Tungsten Carbide (TC)-bit until practical refusal. Standard Penetration Tests (SPTs) were carried out at regular intervals in all of the boreholes and soil samples were collected from these tests. Several boreholes were continued into bedrock using NMLC coring techniques to obtain samples and to assess the bedrock encountered. Rock core samples that were collected were carefully boxed and photographed upon completion. Point load tests were carried out at regular intervals on the rock to assess its strength. Standpipes were installed in all of the cored holes upon completion to allow for future groundwater measurements and sampling. All boreholes were coordinated using a hand held GPS unit. Shallow hand augered boreholes (BH1 to BH16) were drilled to the top of the natural material for contamination sampling.

Borehole locations are presented on Figures 2 to 5. The borehole logs, standpipe construction details and explanatory notes are provided in Appendix A.

A more specific investigation methodology for each area is provided below.

4.1.1 Mental Health Patient Unit

- The approximate locations of these boreholes are presented on Figure 3.
- Boreholes BHA, BHB, BHD and BHE were drilled to TC-bit refusal using a small track mounted drill rig. Boreholes BHA and BHB were diatube cored to advance through the upper concrete and asphalt layer respectively. Borehole BHG advanced through the bitumen layer using a TC-bit. Boreholes were backfilled with cuttings and the top 100 mm was concrete capped.
- Borehole BHC was diatube cored to advance through the upper asphalt layer using the geoprobe drill rig. The borehole was advanced into bedrock using NMLC diamond coring.
- Borehole BHF was advanced into bedrock using a small track mounted drill rig and NMLC diamond coring.

4.1.2 Oral Health Site

- The approximate locations of these boreholes are presented in Figure 4.
- Boreholes BHG and BHH were drilled to TC-bit refusal using a small track mounted drill rig. Solid flight augers fitted with a TC-bit were used to advance through the upper bitumen and pavement layers prior to the V-bit being fitted. The boreholes were backfilled using cuttings and the upper approximately 100 mm was concrete capped.

4.1.3 Maintenance Depot

- The approximate location of borehole BHI is presented in Figure 5.
- Borehole BHI was advanced into bedrock using a truck mounted drill rig and diamond coring techniques. The upper pavement layer was penetrated using diatube coring.

4.2 Laboratory Testing

Soil samples were sent to NATA accredited soil laboratories for the following testing:

- Soil Classification Tests (Atterberg Limits and Linear shrinkage);
- California Bearing Ratio (CBR) with 4 day soak and standard compaction;
- Soil aggressivity testing (electrical conductivity, pH, Chloride content, Sulphate content);
- Emerson Crumb testing; and
- Salinity (electrical conductivity and cation exchange capacity);

Point load index strength testing was carried out at our Sydney office on representative rock core samples to assess the rock strength.

5.0 INVESTIGATION RESULTS

5.1 Subsurface Conditions

The results of the geotechnical investigation indicate that the site is covered by a layer of fill ranging from 0.6 m thick (BHE) to 2.0 m thick (BHB), underlain by a residual soil profile. The residual soil profile is a high plasticity stiff to very stiff clay in a dry to moist condition, becoming hard with depth and containing traces of ironstone gravel.

Weathered rock (Bringelly Shale Formation) was typically encountered at about 1.5 to 2 m depth, except in the proposed Maintenance Depot where it is was encountered at 4 m depth. The rock comprises interbedded sedimentary shale, sandstone, laminite and siltstone.

The subsurface conditions encountered across the three proposed development areas have been divided into subsurface Units based on their engineering properties. These Units are described below in Table 1.

Table 1: Summary of General Subsurface Conditions

Subsurface Unit	Description
Asphalt/Concrete	Fine to coarse igneous aggregate, varied strength of asphalt, with some bitumen seals.
Topsoil / Fill	Silty CLAY, medium to high plasticity, red brown and grey, with some sand and gravel. Zones of Clayey SAND and Silty SAND dark grey topsoil.
Residual Soil	Silty CLAY (and zones of Sandy Silty CLAY), high plasticity, red-brown to pale grey. Encountered generally dry to moist and stiff to hard consistency.
Class V Shale	Extremely Weathered Shale (Class V)[#] Interbedded LAMINITE and SHALE, extremely low to very low strength, pale grey/ grey and brown, with some clay.
Class IV Shale	Extremely to Highly Weathered Shale (Class IV)[#] Interbedded LAMINITE and SHALE, very low to medium strength, dark grey to grey and brown, with some clay seams and shear zones.
Class III Shale	Moderately Weathered Shale (Class IV - III)[#] Interbedded LAMINTIE, SHALE and SANDSTONE, generally low to medium strength, grey and dark grey, containing some highly weathered zones.

Inferred from Pells et al "Foundations on Sandstone and Shale in the Sydney Region" published in the Australian Geomechanics Journal, 1998.

The ground conditions encountered at each proposed development areas are described in greater detail below.

5.1.1 Mental Health Patient Unit

Five of the six boreholes drilled for the mental health patient unit indicate that the area is underlain by a layer of fill of approximately 0.8 m thickness. High plasticity dry to moist residual clay is present beneath the fill with extremely weathered shale encountered at about 2.0 m depth. The exception is at BHB, where fill was present to a depth of approximately 2 m and transitioned into weathered shale without the presence of any residual soil. Water was encountered in this borehole at a depth of approximately 1.5 m and the fill at the interface with the shale was observed as being wet. Rock recovered in BHF transitioned into Class III Shale at a shallower depth than other boreholes.

The typical depths to the base of the Units are shown in Table 2 below.

Table 2: Typical Depths to Base of Units at proposed Mental Health Patient Unit

Subsurface Unit	Typical Depth to Base of Unit (m)*
Asphalt/Concrete	0.1
Topsoil / Fill	0.8
Residual Soil	2.0
Class V Shale	2.8
Class IV Shale	4.5
Class III Shale	8.5

* Depth measured from existing ground surface levels at the time of the investigation. Specific depths of each unit encountered for individual boreholes are presented in the table in APPENDIX B.

About 10 days after the completion of the boreholes groundwater was measured in BHC and BHF at a depth of 6.94 m and 2.66 m respectively.

5.1.2 Oral Health Site

The two boreholes were drilled to TC-Bit refusal within the footprint of the proposed building. A layer of bitumen was encountered over fill to 0.7 m depth. High plasticity dry to moist residual clay is present beneath the fill with extremely weathered shale encountered at depths of approximately 1.3 m.

The typical depths to the base of the Units are shown in Table 3 below.

Table 3: Typical Depths to Base of Units at proposed Oral Health Site

Subsurface Unit	Typical Depth to Base of Unit (m)*
Asphalt/Concrete	0.03
Topsoil / Fill	0.7
Residual Soil	1.3
Class V Shale	1.8
Class IV Shale	-
Class III Shale	-

* Depth measured from existing ground surface levels at the time of the investigation. Specific depths of each unit encountered for individual boreholes are presented in the table in APPENDIX B.

Groundwater was not observed in these boreholes.

5.1.3 Maintenance Depot

The borehole drilled within the footprint of the proposed maintenance depot indicated a deeper weathering profile in this area to other areas around the site. Possible shear zones were also encountered in the cored rock. Class III Shale was not encountered in this borehole.

The typical depths to the base of the Units are shown in Table 4 below.

Table 4: Typical Depths to Base of Units at proposed Oral Health Site

Subsurface Unit	Typical Depth to Base of Unit (m)*
Asphalt/Concrete	0.05
Topsoil / Fill	0.8
Residual Soil	4.0
Class V Shale	6.6
Class IV Shale	>11.15
Class III Shale	-

* Depth measured from existing ground surface levels at the time of the investigation. Specific depths of each unit encountered for individual boreholes are presented in the table in APPENDIX B.

Groundwater was measured in BHI at a depth of 2.81 m one week after the completion of the borehole.

5.2 Laboratory Test Results

The geotechnical laboratory test results are summarised in Table 5 below. Laboratory test certificates are contained in APPENDIX C.

Table 5: Summary of Laboratory Test Results

Test ID	Depth (m)	DESCRIPTION	4-DAY SOAKED CBR (%)*	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LINEAR SHRINKAGE (%)	ELECTRCAL CONDUCTIVITY (µS/cm)	CATION EXCHANGE CAPACITY (MEQ/100g)	EMERSON CLASS NUMBER	Durability		
										pH	SO4 (mg/kg)	Chloride (mg/kg)
BHA-4	1.0-1.45	Silty Clay	-	-	-	-	-	-	1	-	-	-
BHB-5	2.0-2.44	Weathered Shale	-	-	-	-	-	-	2	-	-	-
BHD-3	0.9-1.0	Silty Clay	-	-	-	-	640	20	-	5.9	680	200
BHD-4	1.0-1.45	Silty Clay	-	50	31	9.5	-	-	-	-	-	-
BHD	0.0-0.6	Fill	9	-	-	-	-	-	-	-	-	-
BHD	0.8-1.2	Silty Clay	4.5	-	-	-	-	-	-	-	-	-
BHE-4	1.0-1.45	Silty Clay	-	-	-	-	-	-	1	-	-	-
BHF-4	1.0-1.45	Silty Clay	-	55	38	9.5	-	-	-	-	-	-
BHF	0.9-1.2	Silty Clay	4.0	-	-	-	-	-	-	-	-	-
BHG-4	1.0-1.45	Silty Clay	-	47	28	8.5	-	-	2	-	-	-
BHG	0.7-1.2	Silty Clay	3.5	-	-	-	-	-	-	-	-	-
BHI-2	0.9-1.0	Silty Clay	-	-	-	-	350	17	-	-	-	-
BHI-3	1.0-1.45	Silty Clay	-	65	46	11	-	-	-	-	-	-
BHI-5	2.5-2.95	Silty Clay	-	58	38	9.5	-	-	-	-	-	-
BH8-1	0.0-0.1	Fill	-	-	-	-	89	12	-	-	-	-
BH12-3	0.65-0.75	Silty Clay	-	-	-	-	950	21	-	4.9	500	830
		ay					-	-				

* CBR carried out at 98% MDD, standard compaction and four day soak with 9 kg surcharge.

The Atterberg Limit test results indicate the residual soils to have a Liquid Limit of typically between 50% to 60% and Plasticity Index of between 28 % and 38 %, which imply that the soils are of high plasticity.

Results from four-day soaked California Bearing Ratio (CBR) tests carried out on three natural soil samples indicate the soils to have a range CBR values between 3.5% and 4.5%. These values are upper range for the material tested as they were tested with a 9 kg surcharge and at 98% maximum dry density. The testing also indicated a high swelling potential of between 1.3% and 4.7%.

Four samples were selected for laboratory analysis of Cation Exchange Capacity and soil sodicity. The results of the analysis indicate that the natural Silty CLAY materials classed as highly sodic. This indicates past salinisation of soil strata and also indicates that the Silty CLAY may have a predisposition to waterlogging and also dispersivity if excavation exposes this strata to surface runoff. Details of how our assessment was carried out are presented in APPENDIX D.

The laboratory test results at three borehole locations (See Table 5) indicate that the natural Silty CLAY soil on the site is slightly to moderately saline. Owing to limitations regarding sampling and analytical density, there is the potential for more saline soils being present across the three proposed development areas that have not been detected during the course of this assessment.

6.0 RECOMMENDATIONS

6.1 Site Classification

The presence of fill indicates that the site should be assigned as 'Class P' in accordance with AS 2870-1996 '*Residential Slabs and Footings – Construction'.* However, if structures and slabs are founded below the existing fill, or if the fill is excavated and replaced with structural fill (or sorted to remove unsuitable materials and re-compacted as structural fill) then an alternate classification would be appropriate.

The actual site classification would depend on proposed levels of cut and fill.

The following site classifications are based on the soil profile encountered at each of the development areas, and the premise that the existing fill is excavated and replaced with predominantly cohesive fill (either imported or sourced on site) to near existing site surface levels:

- Mental Health Unit: 'Class M'
- Oral Health Unit: 'Class M'
- Maintenance Depot: 'Class H'

If the existing fill is replaced with predominantly granular fill, a lower site classification may be appropriate.

This classification is based on the assumption that only minor changes to current site levels will be required. It may be necessary to re-classify areas of the site depending on actual cut and fill levels as set out in Section 2.4 of AS 2870-1996.

For guidance on the range of potential shrink-swell movements due to wetting and drying processes the reader is referred to AS AS2870-1996. The level of site reactivity experienced by structures will also be dependent on the prevailing weather conditions at the time of construction. For example, if construction occurs during drought, the structures may experience the full range of swell following prolonged periods of rainfall. Careful consideration should also be given to site drainage, watering of any garden beds near buildings, and the proximity of trees and shrubs in the vicinity of shallow footings. The reader is referred to Appendix B of AS2870-1996 for more information.

6.2 Footing Options

Selection of footing types for individual structures will depend on the magnitude of the loading and condition of the foundation materials. Slab on ground, shallow pad or strip footings founding on residual soils near existing surface levels are considered suitable for lightly loaded structures. Depending on excavation depths

for the proposed Mental Health Unit, it may be possible to support column loads for the proposed building on pad footings bearing on weathered rock.

Alternatively, piles extending through residual soil and founding on weathered rock may be adopted. Each of these options is discussed in more detail below.

6.2.1 Shallow Foundations

Slabs and pad or strip footings may found below existing fill on stiff or better residual clay. A serviceability bearing pressure of 200 kPa may be used for the materials and should result in settlements less than 1% of the least footing dimension. Differential settlements between adjacent footings founding on these materials should be limited to about 50% of total footing settlement. To adopt this serviceability bearing pressure, the footings should have an embedment depth of at least 500 mm below finished ground surface levels.

A serviceability bearing pressure of 700 kPa may be used for shallow footings founded on Class V Shale in deeper excavations.

A serviceability bearing pressure of 130 kPa may be used for footings founding in structural fill placed in accordance with the recommendations presented in Section 6.4.2 below.

The base of all footings should be clean of loose debris and water and should be inspected prior to construction to check for the presence of localized unsuitable or soft material and to confirm anticipated foundation conditions. Subgrade for slabs should be prepared in accordance with Section 6.4.2 below.

Due to the potential variability of foundation materials we recommend that all footings of the proposed developments found on ground of similar bearing pressure to prevent differential movement resulting from the varying foundation materials. Therefore all footings should found either entirely within the residual soils or entirely within the weathered shale.

6.2.2 Pile Foundations

The use of piles founded on weathered rock may be required to support the higher loads imposed by larger buildings. We expect that bored cast-in-place piles would be suitable for this site. The piles may be designed and constructed in accordance with the recommendations and advice provided in Table 6.

Table 6: Design Serviceability End Bearing Pressure and Shaft Adhesion Values*

Soil/Rock Type[1]	Unit Weight (kN/m^3) [2]	Serviceability End Bearing Capacity (kPa)[5,6,7]	Serviceability Shaft Adhesion (kPa)[5,6,7]
Asphalt/Concrete	24	-	0
Topsoil/Fill	17	0	0
Residual Soil	19	275	15
Class V Shale[3,8]	21	700	40
Class IV Shale[4,8]	23	1000	75
Class III Shale[4,8]	24	2000	200

Notes:

1. Refer to borehole logs reported in APPENDIX A and depths in APPENDIX B for detailed subsurface information.
2. Unit weight is based on visual estimate only; order of accuracy is about 10%.
3. Strength of extremely low to low strength rock governed by extremely weathered zones.
4. Higher strength zones may be encountered.
5. Allowable end bearing pressures and side adhesions are given with an estimated factor of safety of 3 and 2 respectively. This is the factor of safety generally adopted in geotechnical practice to limit settlements to an acceptable level for conventional building structures. Assumes base of bored pier holes are clean.
6. Allowable side adhesion given assumes there is intimate contact between the pile and foundation material.
7. End bearing capacity and shaft adhesion values are to be verified by a geotechnical engineer at the time of excavation.
8. Rock strength classification based on Pells et al 1998 “Foundations on Sandstone and Shale in the Sydney Region” published in the Australian Geomechanics Journal, 1998. Zones of sandstone within the Class III Shale were not thick enough in the boreholes to warrant separate classification.

9. Where groundwater ingress is encountered during pile excavation, concrete should be placed as soon as practicable after pile excavation using a tremie system to reduce the risk of foundation material softening.

Piles designed using these parameters with good construction control are expected to have settlements less than about 0.5% of the pile diameter. Additional analysis may be required to confirm pile settlements satisfy design tolerances once configurations and design loads are finalised.

6.3 Pavement CBR

Results from four-day soaked California Bearing Ratio (CBR) tests carried out on three natural soil samples indicate the soils to have a range of CBR values between 3.5% and 4.5% and a range of swelling potential between 1.3% and 4.7%. However, due to the 9 kg surcharge these values are likely to be upper end of design values. For carparks and standard-duty pavements on residual soils we recommend a CBR of 3% for pavement design, subject to the subgrade being prepared in accordance with the recommendations below. If pavements are constructed over imported fill the actual CBR would be dependent on the nature and thickness of imported fill. The vertical subgrade modulus may be estimated from the empirical relationship E (MPa) = 10 x CBR.

6.4 Earthworks and Materials

6.4.1 Material Reuse

Excavated residual soils and weathered shale rock would be suitable for re-use as structural fill. Materials suitable for re-use in pavement layers are not expected to be sourced from site, other than existing pavement materials.

The existing fill materials observed in the boreholes were variable, and will require segregation into similar materials and inspection by a geotechnical engineer or geotechnician to confirm suitability for re-use. In general, we anticipate that silty clay, sand, or mixed sand/gravel fill would be suitable for re-use as structural fill, subject to contamination testing. The fill also includes pavement layers that would be suitable for re-use as structural fill or in new pavements (subject to verification tests during construction). Some layers of predominantly silt materials were recorded, which should be segregated for landscaping purposes or disposal off site.

Unsuitable material should be removed from stockpiles before it is used as structural fill. Unsuitable material includes oversize pieces, organic material, topsoil and silt, foreign materials and wet and/or soft cohesive materials. We recommend that a geotechnical engineer or geotechnician reassess the suitability of the stockpiled excavated materials for reuse as fill.

The laboratory test results indicate that the natural in-situ soils have an Emerson Class number of between 1 and 2. Emerson Class Numbers 1 and 2 indicate the soil to have a high potential for dispersive behaviour, in both disturbed and undisturbed states. We recommend that good erosion controls be put in place during construction, and permanent cut and fill batters will require special attention to establishing vegetation and/ or other erosion protection measures.

6.4.2 Site Preparation and Compaction

We recommend the following earthworks procedures for site preparation and filling:

- Strip existing fill from the footprint of all structures. During excavation, differing materials may be stockpiled and/or segregated for either potential re-use as structural fill, as landscaping material or for removal from site.
- If re-use as structural fill on site is proposed, stockpiles should be sorted to remove unsuitable materials (in accordance with the requirements of the AS3798-2007) as follows:
  - No oversize particles exceeding 2/3rd of loose layer thickness;
  - No material susceptible to volume change, silts and collapsible soils;

  - No peat, vegetation, timber, organic, soluble or perishable material;
  - No dangerous or toxic material; and
  - No metal, rubber, plastic or synthetic material.

- Excavate the subsurface soils in the building areas and footings to the design level of the building pads/ floor slab subgrade and stockpile materials for re-use or removal from site. A suitably qualified Geotechnical Engineer should inspect the footing excavations to confirm design bearing pressures.
- Pavement and slab areas should be excavated to subgrade level. The condition of the subgrade materials are likely to vary across the site. We therefore recommend assessment and observation of proof rolling by a geotechnical engineer or geotechnician prior to pavement construction to verify the suitability of these materials. Proof rolling should be conducted using at least 8 passes of a 10-tonne roller.
- Material within 300mm of the underside of the pavement sub-base or floor slabs should be moisture conditioned and compacted to 98% of Standard Maximum Dry Density, within -3% and +1% of Standard Optimum Moisture Content. In-situ rock in this zone should be loosened by tining/ ripping, moisture conditioned and re-compacted to the same specification.
- Wet, soft or unsuitable materials should be removed to a minimum depth of 300mm below subgrade level. The removed unsuitable material should be replaced with imported granular fill compacted in layers not greater than 250 mm loose thickness. The imported fill material should be compacted at 98% Standard Maximum Dry Density at moisture content within 2% of Standard Optimum Moisture Content.
- Excavation, processing and re-compaction of fill materials should be undertaken in accordance with AS 3798-2007 "*Guidelines on Earthworks for Commercial and Residential Developments*".

Trafficability of the site in the silty/clayey residual soils is expected to be poor during wet weather requiring a cover of crushed gravel or concrete. In addition, difficulty may be experienced when compacting or moisture conditioning the high plasticity clays to achieve compaction targets.

6.5 Excavation Conditions

Excavations are proposed for construction of the mental health unit. The deepest excavations are expected to reach about 3.0 m below existing ground level. At this depth excavations will intersect fill, minor topsoil and residual soils over the uppermost 1.4 m to 2.7 m with generally increasing proportions of ironstone gravel. Depending on the location of the excavation, extremely low to very low strength shale is likely to be encountered near the base of the excavation.

A hydraulic excavator of say 20 tonne capacity should be suitable for excavating the residual soil and extremely weathered strength shale, where encountered at depth. However, we recommend an allowance for a rock hammer to excavate higher strength sandstone layers within the shale profile, if required.

If pile footings are adopted, low and medium strength shale and sandstone may be encountered during piling operations.

Contractors should make their own contractors should make their own assessment of excavatability based on the capability of their equipment.

6.6 Groundwater Issues

At the proposed Mental Health Unit, about 10 days after the completion of the boreholes groundwater was measured in BHC and BHF at a depths of 6.94 m and 2.66 m, respectively. Seepage through existing fill was also noted at 1.5m depth in borehole BHB during drilling. Depending on the location and depth of excavation for the Mental Health Unit water seepage may flow into excavations.

Groundwater was not encountered in boreholes drilled at the proposed Oral Health Unit.

At the proposed Maintenance Depot groundwater was measured in BHI at a depth of 2.81 m one week after the completion of the borehole.

In general, groundwater may be encountered in deeper services trenches or excavations required for pile foundations. Water seepages from surface seepage or from surface flows may also occur. Water inflows into large excavations are expected to be able to be controlled using sump and pump techniques. Surface water could be controlled by diverting overland flows away from excavations.

Where groundwater ingress is encountered during pile excavation, concrete should be placed as soon as practicable after pile excavation using a tremie system to reduce the risk of foundation material softening.

6.7 Cut Slopes and Site Retention

Construction of the proposed Mental Health Unit will require excavation of greater than 1.2 m depth at locations within the development footprint. The exposed materials will need to be battered back or retained.

6.7.1 Unsupported Cut Slopes

Recommended maximum unsupported cut batters up to 4m deep in soils and weathered rock are summarised in Table 7 below:

Table 7: Recommended Cut Slope Batters

Material	Temporary Batter[1]	Permanent Batter[2]
Existing Fill	2H to 1V	3H to 1V
Residual Soils	1H:1V	2H:1V
Class V Shale	1H:1V	2H:1V
Class IV Shale	1H:1V	2H:1V

Notes:

1. Stockpiles and construction surcharges should be kept clear of the crest of excavation batters.
2. Vegetation or surface protection would be required to reduce erosion, described further below.

We note that the laboratory test results indicate that the natural in-situ soils have a high potential for dispersive behaviour, in both disturbed and undisturbed states. We recommend the use of surface protection such as a vegetation cover with the aid of vegetation matting or alternatively using shotcrete to prevent erosion of exposed dispersive high plasticity residual silty clays. If shotcrete is used for batter protection it should be provided with dowels and suitable drainage for the relief of groundwater pressures, such as weep holes and/or strip drains. We also recommend that all surface water runoff is directed away from the slopes by means of swale drains along the crest of the slopes.

6.7.2 Retaining Walls and Excavation Retention

Excavations for the Mental Health Unit that cannot be battered back / graded in accordance with the recommendations given in Section 6.7.1 above due to site boundary restrictions will need to be supported. Support may also be required if excavation extends into the zone of influence of existing structures.

Narrow excavations or trenches could be supported using bracing and shoring boxes. Support of larger excavations could be achieved using one of the following options:

- Soil nail walls with shotcrete facing. Further design of the soil nail length, layout, drainage and permissible height of each excavation bench would be required.
- Cantilevered or anchored/braced reinforced concrete soldier piles with shotcrete infill panels.
- Cantilevered or anchored/braced contiguous piles.

- Cantilevered or anchored/braced sheet piles may be feasible, but due to the stiffness of the soils would likely require heavy driving hammers, and section capacities may be a limitation for deeper excavations.

- Gravity retaining structures may be feasible where the depth of excavation is relatively low and there is room for excavation during construction.

The need for anchoring/ bracing would depend on the depth of excavation and size of structural elements. Depending on the design of the basement, it may be feasible for the structure to provide permanent bracing to the excavation. Of the options listed above, all except the sheet piles should be suitable for permanent (as well as temporary) site retention.

For design of temporary and permanent support we recommend the following earth pressure distributions:

- For flexible walls such as cantilever or for gravity walls a triangular earth pressure distribution may be used. Assuming that there are no significant constraints on tolerable ground movements, relatively flexible temporary shoring systems could be adopted, and may be designed based on active (K_a) earth pressures, using the unit weights presented in Table 6 and the following values:

  K_a = 0.35 for existing fill;

  K_a = 0.30 for residual soils; and

  K_a = 0.25 for weathered shale.

- For rigid or propped walls, a rectangular earth pressure distribution can be used with a maximum pressure of 4H or 6H (kPa), depending on the amount of movement that can be tolerated, where 'H' is the effective vertical height of the wall in metres.

The earth pressures provided above assume effective drainage is provided at the base of and behind the retaining walls. If this cannot be provided, allowance for hydrostatic pressure should also be included. Any applicable temporary or permanent surcharges should be added to the soil pressures.

Care should be taken when compacting fill behind retaining walls to ensure that walls are not subject to pressures in excess of those resulting from the earth pressures assumed in design. If compacted fill is to be placed behind walls, a minimum lateral earth pressure of 20 kPa is recommended in conjunction with the above earth pressures.

6.8 Aggressivity

With reference to AS2159-2009, '*Piling – Design and Installation'* Section 6, the laboratory test results provided in Section 5.2 of this report indicate mildly aggressive ground conditions to buried concrete, and non-aggressive conditions to buried steel.

6.9 Salinity and Sodicity

Based upon the findings of the laboratory analysis, we make the following recommendations with regards to soil salinity and sodicity:

- Saline soils were detected in soil 0.9 metres below ground level. There is a potential for shallower saline soils particularly in low lying areas. Saline soils have the potential to impact upon unprotected concrete and steel structures. It is recommended that salinity be taken into account particularly where deeper built structures are proposed; and

- Based upon assessment of soil sodicity, there is a potential for the high plasticity Silty CLAY underlying the site to present water logging and dispersive qualities. Steps should be taken to minimise exposure of these soils to surface runoff. Where exposure is unavoidable, appropriate erosion and sediment control measures are to be applied. We also recommend that approved silt fencing, drainage and settlement basins are provided at the site during construction of the East Block and that treated storm

water flows, surface run off and collected subsurface seepage flows are piped and discharged into Council's system or to an appropriate and Council approved discharge point down slope of the site.

6.10 Earthquake Site Classification

The methods of assessing the earthquake risk classification are outlined in the Australian Standard AS1170.4 (2007) Structural Design Actions, Part 4: Earthquake Actions in Australia.

The governing condition for the site subsoil class is the thickness and consistency of the subsurface materials beneath the building footings. For this site, the Australian Standard indicates an earthquake site subsoil class of class Ce – Shallow Site Soil.

The hazard factor (z) depends on the geographic location of the proposed structure. For the Sydney area, AS 1170.4 indicates a hazard factor of 0.08.

7.0 LIMITATIONS

Your attention is drawn to the document "Limitations", which is included in APPENDIX E of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

GOLDER ASSOCIATES PTY LTD

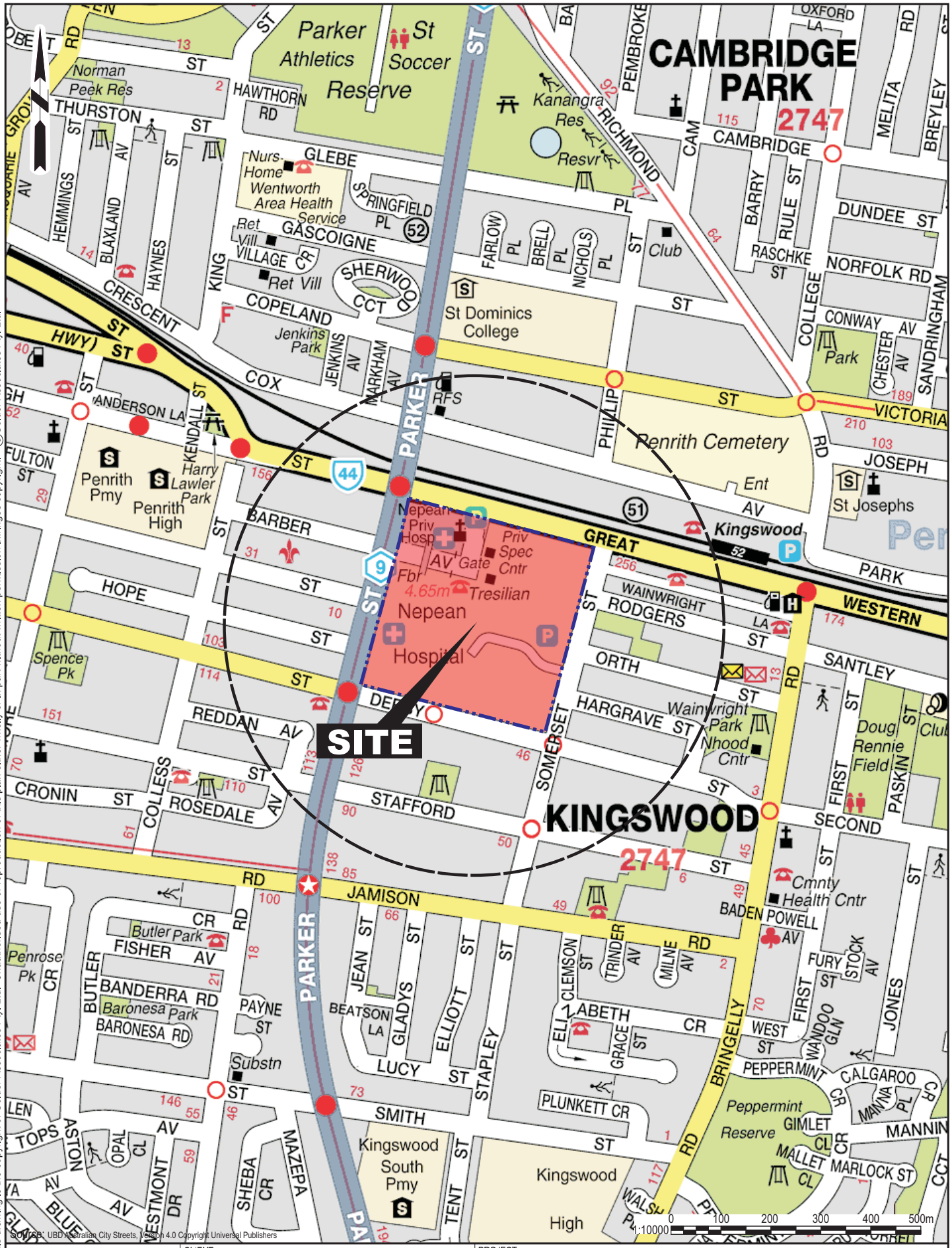
Ben Caruana
Geotechnical Engineer

Ralph Erni
Senior Geotechnical Engineer

BC/CSC/bc

A.B.N. 64 006 107 857

j:\geo\2010\107622059 health infrastructure_penrith nepean hospital 3a\correspondence out\107622059_002_r_rev1 geotechnical report_csc review.docx



Golder Associates www.golder.com GOLDER ASSOCIATES PTY LTD	CLIENT: HEALTH INFRASTRUCTURE		PROJECT: GEOTECHNICAL INVESTIGATION - PENRITH HEALTH CAMPUS NEPEAN HOSPITAL UPGRADE STAGE 3A					
	DRAWN: HC	DATE: 27.05.2010	TITLE: SITE LOCALITY PLAN					
	CHECKED: RE	DATE: 01.07.2010						
	SCALE: 1:10,000	A4	PROJECT No: 107622059	DOC No: 002	DOC TYPE: R	FIGURE No: F0001	REV No: 0	FIGURE 1

J:\geo\2010\107622059 Health Infrastructure_Penrith Nepean Hospital 3a\Technical Doc\CADD\FIGURES\107622059_002_R_F0001_REV0.CDR

LEGEND

SITE BOUNDARY

APPROXIMATE AREAS OF INVESTIGATION

1:2,000

0 40 80 120m

ADAPTED FROM DIGITAL CADASTRE DATABASE, NSW DEPARTMENT OF LANDS, 2004, ZONE 56 MGA COORDINATES

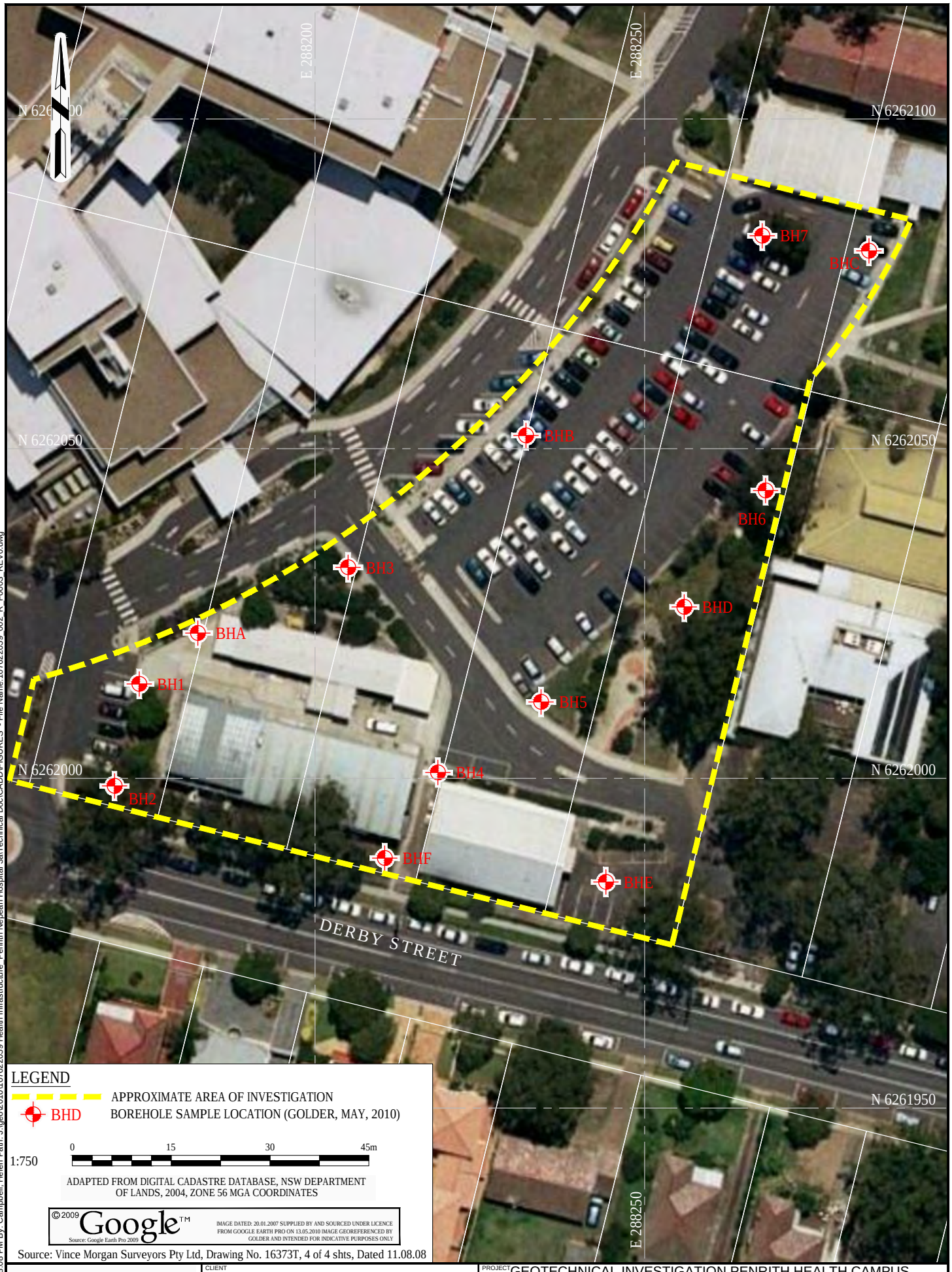
Source: Vince Morgan Surveyors Pty Ltd, Drawing No. 16373T, 4 of 4 shts, Dated 11.08.08

Golder Associates

www.golder.com
GOLDER ASSOCIATES PTY LTD

CLIENT: HEALTH INFRASTRUCTURE				PROJECT: GEOTECHNICAL INVESTIGATION - PENRITH HEALTH CAMPUS NEPEAN HOSPITAL UPGRADE: STAGE 3A				
DRAWN: HC	DATE: 13.05.2010			TITLE: SITE LAYOUT				
CHECKED: RE	DATE: 01.07.2010							
SCALE: 1:2000	A3	PROJECT No: 107622059	DOC No: 2	DOC TYPE: R	FIGURE No: F0002	REV No: 0	FIGURE 2	

Plot Date: 1 July 2010 Time:4:06:21 PM By: Campbell, Helen Path: J:\geo\2010\107622059 Health Infrastructure_Penrith Nepean Hospital 3a\Technical Doc\CADD\FIGURES - File Name:107622059_002_R_F0002_REV0.dwg



LEGEND

APPROXIMATE AREA OF INVESTIGATION

BHD BOREHOLE SAMPLE LOCATION (GOLDER, MAY, 2010)

1:750 0 15 30 45m

ADAPTED FROM DIGITAL CADASTRE DATABASE, NSW DEPARTMENT OF LANDS, 2004, ZONE 56 MGA COORDINATES

Source: Vince Morgan Surveyors Pty Ltd, Drawing No. 16373T, 4 of 4 shts, Dated 11.08.08

Golder Associates

www.golder.com

GOLDER ASSOCIATES PTY LTD

CLIENT: HEALTH INFRASTRUCTURE							
PROJECT: GEOTECHNICAL INVESTIGATION PENRITH HEALTH CAMPUS NEPEAN HOSPITAL UPGRADE: STAGE 3A							
DRAWN BY: HC	DATE: 13.05.2010	DRAWING TITLE: BOREHOLE SAMPLE LOCATIONS PROPOSED MENTAL HEALTH UNIT AREA					
CHECKED BY: RE	DATE: 01.07.2010						
SCALE: 1:750	SHEET SIZE: A4	PROJECT No: 107622059	DOC No: 002	DOC TYPE: R	FIGURE No: F0003	REVISION: 0	FIGURE 3

Xref: GAP_LOGO-A3.dwg; 107622055_google_326m jan 20 2007.jpg; Penrith Hospital - plan.jpg;
Plot Date: 1 July 2010 Time 4:08:08 PM By: Campbell, Helen Path: J:\geo\2010\107622059 Health Infrastructure_Penrith Nepean Hospital 3a\Technical Doc\CADD\FIGURES - File Name:107622059_002_R_F0003_REV0.dwg

LEGEND

APPROXIMATE AREA OF INVESTIGATION

BH9 BOREHOLE SAMPLE LOCATION (GOLDER, MAY, 2010)

1:750 0 15 30 45m

ADAPTED FROM DIGITAL CADASTRE DATABASE, NSW DEPARTMENT OF LANDS, 2004, ZONE 56 MGA COORDINATES

Source: Vince Morgan Surveyors Pty Ltd, Drawing No. 16373T, 4 of 4 shts, Dated 11.08.08

Golder Associates

www.golder.com

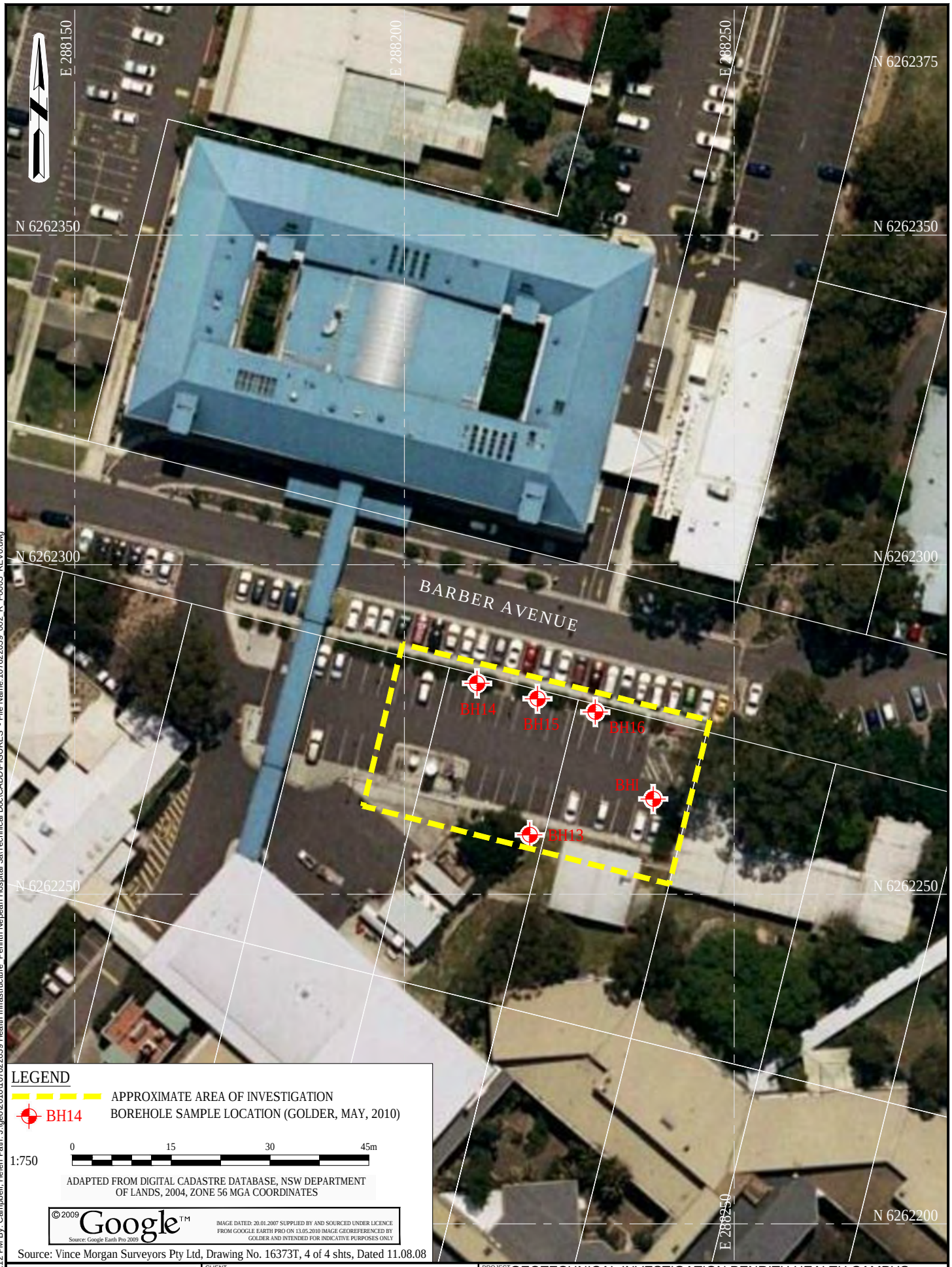
GOLDER ASSOCIATES PTY LTD

CLIENT: HEALTH INFRASTRUCTURE							
DRAWN BY: HC	DATE: 13.05.2010						
CHECKED BY: RE	DATE: 01.07.2010						
SCALE: 1:750	SHEET SIZE: A4	PROJECT No: 107622059	DOC No: 002	DOC TYPE: R	FIGURE No: F0004	REVISION: 0	FIGURE 4

PROJECT: GEOTECHNICAL INVESTIGATION PENRITH HEALTH CAMPUS NEPEAN HOSPITAL UPGRADE: STAGE 3A

DRAWING TITLE: BOREHOLE SAMPLE LOCATIONS PROPOSED ORAL HEALTH UNIT AREA

Xref: GAP_LOGO-A3.dwg; 107622055_google_326m jan 20 2007.jpg; Penrith Hospital - plan.jpg; Plot Date: 1 July 2010 Time:4:10:04 PM By: Campbell, Helen Path: J:\geo\2010\107622059 Health Infrastructure_Penrith Nepean Hospital 3a\Technical Doc\CADD\FIGURES - File Name:107622059_002_R_F0004_REV0.dwg



LEGEND

APPROXIMATE AREA OF INVESTIGATION

BH14 BOREHOLE SAMPLE LOCATION (GOLDER, MAY, 2010)

1:750

0 15 30 45m

ADAPTED FROM DIGITAL CADASTRE DATABASE, NSW DEPARTMENT OF LANDS, 2004, ZONE 56 MGA COORDINATES

Source: Vince Morgan Surveyors Pty Ltd, Drawing No. 16373T, 4 of 4 shts, Dated 11.08.08

Golder Associates

www.golder.com

GOLDER ASSOCIATES PTY LTD

CLIENT: HEALTH INFRASTRUCTURE

PROJECT: GEOTECHNICAL INVESTIGATION PENRITH HEALTH CAMPUS NEPEAN HOSPITAL UPGRADE: STAGE 3A

DRAWN BY	DATE
HC	13.05.2010
CHECKED BY	DATE
RE	01.07.2010

DRAWING TITLE: BOREHOLE SAMPLE LOCATIONS PROPOSED MAINTENANCE DEPOT AREA

SCALE	SHEET SIZE	PROJECT No	DOC No	DOC TYPE	FIGURE No	REVISION	
1:750	A4	107622059	002	R	F0005	0	FIGURE 5

Xref: GAP_LOGO-A3.dwg; 097622055_google_326m jan 20 2007.jpg; Penrith Hospital - plan.jpg;
Plot Date: 1 July 2010 Time 4:11:12 PM By: Campbell, Helen Path: J:\geo\2010\107622059 Health Infrastructure_Penrith Nepean Hospital 3a\Technical Doc\CADD\FIGURES - File Name:107622059_002_R_F0005_REV0.dwg

APPENDIX A

Borehole Logs, Well Construction Details and Explanatory Notes

REPORT OF BOREHOLE: BH01

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288170.0 m E 6262009.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 0.75 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH1/1 0.05-0.15 m R=1A PID = 1.1 ppm				FILL: Sandy SILT brown, with some medium sized gravel	M		FILL
				0.10								
	H								FILL: Road Base materials asphalt and concrete	D		asphalt, concrete
					BH1/2 0.25-0.35 m R=2A PID = 1.3 ppm							
				0.30					: as above but with some brown/light brown silt (40%) and occasional orange red clay			
	M		0.5									
				0.60								
	M-H				BH1/3 0.65-0.75 m R=0A PID = 1.5 ppm			CH	Silty CLAY high plasticity, red brown, trace of some ironstone gravel, inferred stiff	D - M		RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 0.75 m			
			1.5									
			2.0									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: BH02

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288158.0 m E 6262010.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 0.80 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L	Groundwater Not Encountered	0.0						FILL: Silty SAND brown, with some small sub-angular gravel	M		FILL asphalt at 0.05m
				0.10	BH2/1 0.05-0.15 m R=1A PID = 2.5 ppm							
	L-M								FILL: Sandy SILT pale brown, with some small sub-angular gravel			
				0.30						D - M		glass at 0.3m
	M								: as above but becoming yellow brown with some yellow clay occasional weathered shale			
				0.40								
	M-H								: as above with some coarse rounded dark grey gravel and cobbles			
				0.50								
	M		0.5		BH2/2 0.50-0.60 m R=0A PID = 1.1 ppm				FILL: Sandy SILT fine to medium, pale brown orange, with increasingly frequent brown red clay			
				0.60								
	M-H							CH	CLAY high plasticity, red brown	D		RESIDUAL SOIL
									END OF BOREHOLE @ 0.80 m			
			1.0									
			1.5									
			2.0									

REPORT OF BOREHOLE: BH03

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288205.0 m E 6262032.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 0.50 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH3/1 0.00-0.10 m R=1A PID = 0.1 ppm				FILL: Sandy SILT brown, with some yellow/grey clay, occasional gravel	M		FILL charcoal, concrete at 0.1m
				0.15								
	M				BH3/2 0.15-0.25 m R=1A PID = 0.1 ppm				FILL: : as above but lighten in colour, more clay content	M		
				0.35								
	M-H				BH3/3 0.40-0.50 m R=1A PID = 0.1 ppm				FILL: Silty CLAY high plasticity, orange brown, trace gravel	M		
			0.5						END OF BOREHOLE @ 0.50 m Refusal on inferred concrete			inferred concrete slab at 0.5m
			1.0									
			1.5									
			2.0									

REPORT OF BOREHOLE: BH04

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288214.0 m E 6262005.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 0.50 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH4/1 0.05-0.15 m R=1A PID = 0.4 ppm				FILL: Gravelly SILT brown, with some asphalt	M		FILL Plastic, glass at 0.05m
				0.10								Glass
	M								FILL: Silty CLAY high plasticity, orange brown	D		
				0.30								
	M-H				BH4/2 0.40-0.50 m R=0A PID = 0.1 ppm			CH	Silty CLAY high plasticity, red brown with grey, layering, inferred stiff			RESIDUAL SOIL
			0.5						END OF BOREHOLE @ 0.50 m REACHED TARGET DEPTH BACKFILLED			
			1.0									
			1.5									
			2.0									

REPORT OF BOREHOLE: BH05

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288239.0 m E 6262013.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 0.70 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	H	Groundwater Not Encountered	0.0		BH5/1 0.15-0.25 m R=1A - 2A PID = 0.3 ppm				FILL: Gravelly SILT pale brown grey	D - M		FILL Large fragments of concrete, asphalt and some ceramic waste
			0.5									glass, asphalt, concrete at 0.5m
				0.60								
	M-H				BH/5 0.60-0.70 m R=0A PID = 0.3 ppm			CH	Silty CLAY high plasticity, brown red, inferred stiff	D - M		RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 0.70 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH06

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288263.0 m E 6202051.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 0.65 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	H	Groundwater Not Encountered	0.0		BH6/1 0.10-0.20 m R=1A PID = 0.1 ppm				FILL: Gravelly SILT pale brown orange, with some zones of dry orange clay			FILL Fragments of concrete and asphalt
				0.40								
	M-H		0.5		BH6/2 0.55-0.65 m R=0A PID = 0.1 ppm			CH	Silty CLAY high plasticity, brown-red and grey, inferred very stiff			RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 0.65 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH07

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288264.0 m E 6262084.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 0.80 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L	Groundwater Not Encountered	0.0		BH7/1 0.05-0.15 m R=0A PID = 0.5 ppm				TOPSOIL: Gravelly SILT brown, with some clay	M		TOPSOIL
				0.20								
	M-H		0.5		BH7/2 0.50-0.60 m R=0A PID = 0.5 ppm				FILL: Silty SAND pale brown, yellow, with trace white quartz sandstone gravel	D - M		FILL
				0.60								
	M-H				BH7/3 0.70-0.80 m R=0A PID = 0.8 ppm			CH	Silty CLAY high plasticity, brown red and grey, inferred stiff	D		RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 0.80 m REACHED TARGET DEPTH BACKFILLED			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH08

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288357.0 m E 6262054.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 0.60 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M-H	Groundwater Not Encountered	0.0		BH8/1 0.00-0.10 m R=0A PID = 2.1 ppm				FILL: Clayey Sandy SILT pale brown with some red and grey clay, occasional gravel	M		FILL
				0.20								
	M				BH8/2 0.20-0.30 m R=0A PID = 2.8 ppm				FILL: : as above becoming orange and with less gravel			
				0.30								
	M-H		0.5		BH8/3 0.50-0.60 m R=0A PID = 2.5 ppm			CH	Silty CLAY high plasticity, orange brown and red, with trace fine ironstone gravel and sand, inferred stiff	D - M		RESIDUAL SOIL
									END OF BOREHOLE @ 0.60 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.0									
			1.5									
			2.0									

REPORT OF BOREHOLE: BH09

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288331.0 m E 6262062.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 0.75 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH9/1 0.05-0.15 m R=0A PID = 1.5 ppm				FILL: Clayey SILT pale brown, with some gravel, (70% silt, 30% clay)			FILL
				0.10								
	M								FILL: : as above but with asphalt and roadbase			asphalt, roadbase at 0.15m
				0.25	BH9/2 0.25-0.35 m R=1A PID = 1.5 ppm				FILL: Sandy SILT brown orange, with some clay, inclusion of purple/orange coarse gravel			asphalt at 0.3m charcoal at 0.36m
	M-H			0.40								
					BH9/3 0.45-0.55 m R=0A PID = 0.6 ppm			CH	Silty CLAY high plasticity, red brown and grey, inferred stiff			RESIDUAL SOIL
	M-H		0.5							D - M		
			1.0						END OF BOREHOLE @ 0.75 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH10

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288371.0 m E 6262053.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 0.85 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH10/1 0.05-0.15 m R=0A PID = 0.5 ppm				FILL: Sandy SILT with some red brown clay, occasional small gravel	M		FILL
	M			0.20					FILL: : as above becoming orange with some coarse orange brown gravel			
				0.30	BH10/2 0.30-0.40 m R=0A PID = 0.6 ppm				FILL: Silty CLAY high plasticity, orange brown and grey	D - M		
			0.5	0.55				CH	Silty CLAY high plasticity, brown and grey, with some sand and ironstone gravel, inferred stiff to very stiff			RESIDUAL SOIL
	M-H				BH10/3 0.70-0.80 m R=0A PID = 0.1 ppm					D - M		
									END OF BOREHOLE @ 0.85 m REACHED TARGET DEPTH BACKFILLED			
			1.0									
			1.5									
			2.0									

REPORT OF BOREHOLE: BH11

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288370.0 m E 6262071.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 0.90 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M	Groundwater Not Encountered	0.0		BH11/1 0.05-0.15 m R=1A PID = 1.2 ppm				TOPSOIL: Gravelly SILT brown and red brown grey, dry and brittle, fine to medium gravel	D		TOPSOIL occasional concrete fragment
				0.20								
	M				BH11/2 0.25-0.35 m R=0A PID = 1.3 ppm				FILL: Silty CLAY high plasticity, pale brown orange, trace ironstone, inferred stiff			FILL
				0.30					: as above becoming more silty			
				0.40				CH	Silty CLAY high plasticity, red brown and grey, with trace fine black sub-rounded ironstone gravel, inferred stiff			RESIDUAL SOIL
	M-H		0.5		BH11/3 0.80-0.90 m R=0A PID = 1.3 ppm					D - M		
			1.0						END OF BOREHOLE @ 0.90 m REACHED TARGET DEPTH BACKFILLED			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH12

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288342.0 m E 6262083.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 0.80 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0		BH12/1 0.05-0.15 m R=A PID = 1.1 ppm				FILL: Clayey SILT pale brown, orange	D - M		FILL glass
				0.10								asphalt
	M								FILL: Sandy SILT brown orange, with some clay, with some fine gravel			
				0.40	BH12/2 0.40-0.50 m R=A PID = 0.7 ppm							
	H								FILL: Silty GRAVEL fine to coarse grained, sub-angular, (road base)			
				0.50								
			0.5						Silty CLAY high plasticity, orange brown with some grey, inferred stiff			RESIDUAL SOIL
	M-H				BH12/3 0.65-0.75 m R=0A PID = 0.3 ppm					D		
				0.70					Silty CLAY high plasticity, grey red, inferred very stiff			
									END OF BOREHOLE @ 0.80 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.0									
			1.5									
			2.0									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: BH13

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288219.0 m E 6262259.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 1.10 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
	M		0.0	0.10					TOPSOIL: Gravelly CLAY high plasticity, brown, fine to medium, sub-angular, high strength gravel	D		TOPSOIL
HA	M-H	Groundwater Not Encountered	0.5	0.60	BH13/1 0.10-0.20 m R=0A PID = 0.1 ppm				FILL: Silty CLAY high plasticity, pale brown, (40% silt), some fine sand with traces of gravel	D		FILL
					BH13/2 0.60-0.70 m R=0A PID = 0.3 ppm				: as above with occasional black fractured gravel, sub-angular approx 15mm diameter, becoming darker			
	M			0.75					FILL: Silty CLAY brown with red purple, with some fine to coarse ironstone gravel			
	M			0.90					FILL: Silty SAND with gravel, with sea shells and some clay			sea shells
	M-H		1.0	1.00	BH13/3 1.00-1.10 m R=0A PID = 0 ppm			CH	Silty CLAY high plasticity, red brown and grey, inferred stiff	D - M		RESIDUAL SOIL
			1.5						END OF BOREHOLE @ 1.10 m REACHED TARGET DEPTH Backfilled with cuttings			
			2.0									

REPORT OF BOREHOLE: BH14

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288211.0 m E 6262282.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 1.00 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0						TOPSOIL: Clayey SILT high liquid limit, brown, with some gravel	M		TOPSOIL
				0.10								
HA		Groundwater Not Encountered			BH14/1 0.10-0.20 m R=1A PID = 1 ppm				FILL: Silty CLAY high plasticity, red brown with some grey, trace gravel/asphalt	D - M		FILL charcoal fragments light green tinge
				0.40								
			0.5		BH14/2 0.50-0.60 m R=0A PID = 1.5 ppm				FILL: Silty CLAY high plasticity, pale brown, inferred firm	D - M		
				0.60								
	M-H							CH	Silty CLAY high plasticity, brown red, with grey layering, occasional fine sub-angular ironstone gravel			RESIDUAL SOIL
				0.80					: as above with some red colour and occasional fine to medium red brown shale gravel			
					B14/3 0.90-1.00 m R=0A PID = 2.6 ppm							
			1.0						END OF BOREHOLE @ 1.00 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH15

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288221.0 m E 6262278.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 1.00 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	L-M	Groundwater Not Encountered	0.0	0.10	BH15/1 0.05-0.15 m R=1A PID = 1.2 ppm				TOPSOIL: Clayey SILT high liquid limit, pale brown	D - M		TOPSOIL brick fragments
	M			0.20					FILL: Silty SAND dark brown, with some gravel	D		FILL
				0.30					FILL: Silty CLAY high plasticity, brown grey, inferred firm			
	M-H			0.40	BH15/2 0.30-0.35 m R=1A PID = 0.8 ppm				FILL: Clayey SILT high liquid limit, brown, with some gravel, and roadbase			traces of charcoal
	M		0.5	0.60					FILL: Silty CLAY medium plasticity, red brown, inferred firm	D - M		
	M-H				BH15/3 0.90-1.00 m R=0A 1.1			CH	Silty CLAY high plasticity, pale brown and grey, inferred stiff, with trace roots	D - M		RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 1.00 m REACHED TARGET DEPTH Backfilled with cuttings			
			1.5									
			2.0									

REPORT OF BOREHOLE: BH16

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: Hand Auger

PROJECT: Redevelopment Stage 3A
COORDS: 288226.0 m E 6262279.0 m N MGA94 56
CONTRACTOR: Golder Associates Pty Ltd

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: MB DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 1.00 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0.0						TOPSOIL: Gravelly SILT low liquid limit, brown			TOPSOIL
				0.10								
HA	M	Groundwater Not Encountered			BH16/1 0.10-0.20 m R=1A PID = 8.5 ppm				FILL: CLAY high plasticity, brown, inferred firm			FILL domestic rubbish (metal can ring glass)
				0.40								
			0.5		BH16.2 0.45-0.55 m R1A PID = 0.6 ppm				FILL: SAND fine to medium grained, orange brown			
				0.60								
									FILL: Silty CLAY high plasticity, brown, with some gravel, inferred stiff			
				0.70								
	M-H								FILL: : as above becoming lighter in colour and higher clay content, stiffer and higher plasticity			
				0.90								
	M-H				BH16/3 0.90-1.00 m R=0A PID = 0.9 ppm				Silty CLAY high plasticity, red brown, inferred stiff	D - M		RESIDUAL SOIL
			1.0						END OF BOREHOLE @ 1.00 m REACHED TARGET DEPTH BACKFILLED			
			1.5									
			2.0									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: BHA

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288182.0 m E 6262033.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 2.75 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DTC	H	Groundwater not encountered	0	0.11					CONCRETE fine to coarse angular igneous aggregate			CONCRETE
ADV	M-H			0.40	BHA-1 DS 0.11-0.20 m R=0A PID = 1.1 ppm				FILL: Silty CLAY high plasticity, red brown and grey, inferred residual soil placed as fill	D - M		FILL
				0.80	BHA-2 DS 0.50-0.60 m R=0A PID = 0.7 ppm				FILL: Silty CLAY high plasticity, brown, with some fine to coarse sand, trace of plastic, inferred stiff	D		V-bit refusal at 0.8m
ADT	M-H		1		BHA-3 DS 0.90-1.00 m R=0A PID = 0.6 ppm SPT 1.00-1.45 m 5, 7, 11 N=18 R=0A BHA-5 DS 1.50-1.60 m R=0A PID = 2.9 ppm				Silty CLAY high plasticity, grey with red brown staining	D - M	VSt	RESIDUAL SOIL
			2	2.10								
	H-R								SHALE grey with red brown staining, laminated, extremely low strength, extremely weathered			WEATHERED ROCK TC bit refusal at 2.75m
			3						END OF BOREHOLE @ 2.75 m BACKFILLED TC BIT REFUSAL			
			4									
			5									
			6									
			7									
			8									

REPORT OF BOREHOLE: BHB

Golder Associates

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288232.0 m E 6262052.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 2.80 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DTC	H		0	0.10					ASPHALT			ASPHALT
ADV	L-M		1		BHB-1 DS 0.50-0.60 m R=0A PID = 1.1 ppm BHB-2 DS 0.90-1.00 m R=0A PID = 0.3 ppm				fine to coarse, sub-angular, igneous aggregate, dark grey binder, thin layer of gravel beneath FILL: Clayey SAND fine to coarse grained, sub-angular, low plasticity clay, with some sub-rounded and sub-angular sandstone gravel, inferred medium dense, dry to moist	D - M		FILL
	M	▽	2	1.30 2.10	BHB-3 DS 1.50-1.60 m R=0A PID = 0.4 ppm BHB-4 DS 1.90-2.00 m R=0A PID = 0.9 ppm SPT 2.00-2.44 m 4, 7, 20/140mm N>27 R=0A				FILL: Silty CLAY high plasticity, brown and red brown, with some fine gravel and sand, moist, becoming to wet near interface with shale	M		V-bit refusal at 2.1m
ADT	H-R		3						SHALE brown and red brown ironstaining, laminated at 0°, extremely low strength grading to very low strength, extremely weathered	M - W		Practical TC bit refusal at 2.8m
			4						END OF BOREHOLE @ 2.80 m TC BIT REFUSAL GROUNDWATER ENCOUNTERED @ 1.50 m DEPTH BACKFILLED WITH CONCRETE PLUG IN TOP 100mm			
			5									
			6									
			7									
			8									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: BHC

SHEET: 1 OF 3

CLIENT: Health Infrastructure
DRILL RIG: Geoprobe 66200DT

PROJECT: Redevelopment Stage 3A
COORDS: 288284.0 m E 6262080.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: TGC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 10.00 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	M-H	GROUND WATER NOT ENCOUNTERED	0	0.10					ASPHALT			CARPARK
					BHC-1 DS 0.30-0.50 m R=0A				FILL: Silty SAND fine to coarse grained, gap graded, sub-angular, with trace of clay, high plasticity, brown, trace of gravel, fine to medium grained, angular	D - M		FILL
			1	1.00	BHC-2 DS 0.90-1.00 m R=0A			CH	Silty CLAY high plasticity, brown with red and pale grey seams, trace of sand, fine to medium grained, sub-angular			RESIDUAL SOIL
	H				BHC-3 DS 1.40-1.50 m R=0A SPT 1.50-1.70 m 9, 30/50mm N>30 R=0A					M	H	
			2						For Continuation Refer to Sheet 2			
			3									
			4									
			5									
			6									
			7									
			8									

REPORT OF STANDPIPE INSTALLATION: BHC

CLIENT:	Health Infrastructure		SHEET: 1 OF 1
PROJECT:	Redevelopment Stage 3A	COORDS: 288284.0 m E 6262080.0 m N MGA94 56	DRILL RIG: Geoprobe 66200DT
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	CONTRACTOR: Terratest
JOB NO:	107622059	HOLE DEPTH: 10.00 m	LOGGED: TGC DATE: 3/5/10
			CHECKED: CSC DATE: 26/5/10

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	
ADT	GROUND WATER NOT ENCOUNTERED	0			ASPHALT	0.20 Gattic Cover
					SILTY SAND	0.50 Concrete
		1	1.00		SILTY CLAY	Backfill
		2	2.00		SHALE	2.50 Bentonite
			2.60			
			2.80		SHALE	
		3	3.85		GRAVELLY CLAY	3.50
		4	4.35		SHALE	
			4.70			
		5	5.25			
NMLC		6	6.00			2mm graded sand
		7	7.65			Slotted screen
		8	8.70		SANDSTONE	
		9	9.60		SHALE	
		10	10.00		END OF BOREHOLE @ 10.00 m REACHED TARGET DEPTH Ground monitoring well installed	10.00
		11				

This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F17
RL1

GAP 8_05A LIB.GLB Log GAP WELL 3 107622059_NEPEAN HOSPITAL.GPJ <<DrawingFile>> 01/07/2010 16:35 8.2.006

REPORT OF CORE PHOTOGRAPHS: BHC

CLIENT:	Health Infrastructure		SHEET: 1 OF 2
PROJECT:	Redevelopment Stage 3A	COORDS: 288284.0 m E 6262080.0 m N MGA94 56	DRILL RIG: Geoprobe 66200DT
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	CONTRACTOR: Terratest
JOB NO:	107622059	HOLE DEPTH: 10.00 m	LOGGED: TGC DATE: 3/5/10
			CHECKED: CSC DATE: 26/5/10

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

REPORT OF CORE PHOTOGRAPHS: BHC

CLIENT:	Health Infrastructure		SHEET: 2 OF 2
PROJECT:	Redevelopment Stage 3A	COORDS: 288284.0 m E 6262080.0 m N MGA94 56	DRILL RIG: Geoprobe 66200DT
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	CONTRACTOR: Terratest
JOB NO:	107622059	HOLE DEPTH: 10.00 m	LOGGED: TGC DATE: 3/5/10
			CHECKED: CSC DATE: 26/5/10

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F31
RL1

REPORT OF BOREHOLE: BHD

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288256.0 m E 6262026.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 2.80 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADV	L	Groundwater not encountered	0		BHD-1 BDS 0.00-0.60 m				FILL: Sandy GRAVEL fine to coarse grained, sub-angular, fine to coarse grained sub-angular sand, high strength igneous gravel, with some clay			FILL
				0.30	BHD-2 DS 0.10-0.20 m R=0,A PID = 0.9 ppm							
	M-R				BHD-3 DS 0.50-0.60 m R=0,A PID = 1 ppm				FILL: Silty CLAY medium plasticity, brown, inferred stiff	D - M		
				0.80								
ADT	M		1		BHD-4 BDS 0.80-1.20 m BHD-5 DS 0.90-1.00 m R=0,A PID = 1.3 ppm SPT 1.00-1.45 m 4, 8, 13 N=21			CH	Silty CLAY high plasticity, red brown with zones of grey	D - M	VSt	RESIDUAL SOIL
	M-H				BHD-7 DS 1.50-1.60 m R=0,A PID = 2.5 ppm							
				1.90								
	H-R		2		SPT 2.50-2.61 m 20/110mm (DB) BHD-8				SHALE brown with red ironstaining, extremely low strength, extremely weathered			WEATHERED ROCK TC bit refusal at 2.8m
									END OF BOREHOLE @ 2.80 m TC BIT REFUSAL			
			3									
			4									
			5									
			6									
			7									
			8									

REPORT OF BOREHOLE: BHE

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288248.0 m E 6261991.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 1.70 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADV	H	Groundwater not encountered	0		BHE-1 DS 0.10-0.20 m R=0A PID = 0.4 ppm				ASPHALT fine to coarse, sub-angular igneous aggregate, weak binder			ASPHALT
	M-H								FILL: Sandy GRAVEL fine to coarse grained, sub-angular, dark grey, fine to coarse grained sand			FILL/ROAD BASE
				0.60	BHE-2 DS 0.50-0.60 m R=0,A PID = 0.1 ppm				Silty CLAY high plasticity, red brown and grey			RESIDUAL SOIL
	M		1	1.10	BHE-3 DS 0.90-1.00 m R=0,A PID = 0.6 ppm SPT 1.00-1.45 m 2, 3, 4 N=7 R=0A				grading to grey	D - M	St	
	H			1.50								
ADT	H				BHE-5 DS 1.50-1.60 m R=0,A PID = 0.9 ppm				SHALE brown to red brown, extremely low strength, extremely weathered			WEATHERED ROCK TC-Bit refusal @ 1.7m
									END OF BOREHOLE @ 1.70 m REFUSAL ON SHALE			
			2									
			3									
			4									
			5									
			6									
			7									
			8									

REPORT OF BOREHOLE: BHF

SHEET: 1 OF 2

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288217.0 m E 6261988.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 7.50 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADV	M-H		0		BDS 0.00-0.60 m BHF-1 DS 0.10-0.20 m R=0,A PID = 0.7 ppm BHF-2 DS 0.50-0.60 m R=0,A PID = 0.5 ppm				FILL: Silty CLAY high plasticity, pale brown, with some fine sand, high silt content, dry, inferred stiff	D		FILL
				0.90								
ADT	M-H		1		BHF-3 DS 0.90-1.00 m PID = 0.6 ppm SPT 1.00-1.45 m 3, 4, 4 N=8 BHF-5 DS 1.50-1.60 m R=0,A PID = 0.2 ppm			CH	Silty CLAY high plasticity, red brown, with zones of grey, evidence of laminates/bedding from retict rock structure	M	St	RESIDUAL
			2	*2.10*								
	H	13/05/10			SPT 2.50-2.65 m 20/150mm N=R starting to db				SHALE brown with red ironstaining, extremely low strength, extremely weathered, laminated at o'			weathered ROCK TC bit refusal at 3.5m
			3									
									For Continuation Refer to Sheet 2			
			4									
			5									
			6									
			7									
			8									

REPORT OF STANDPIPE INSTALLATION: BHF

Golder Associates

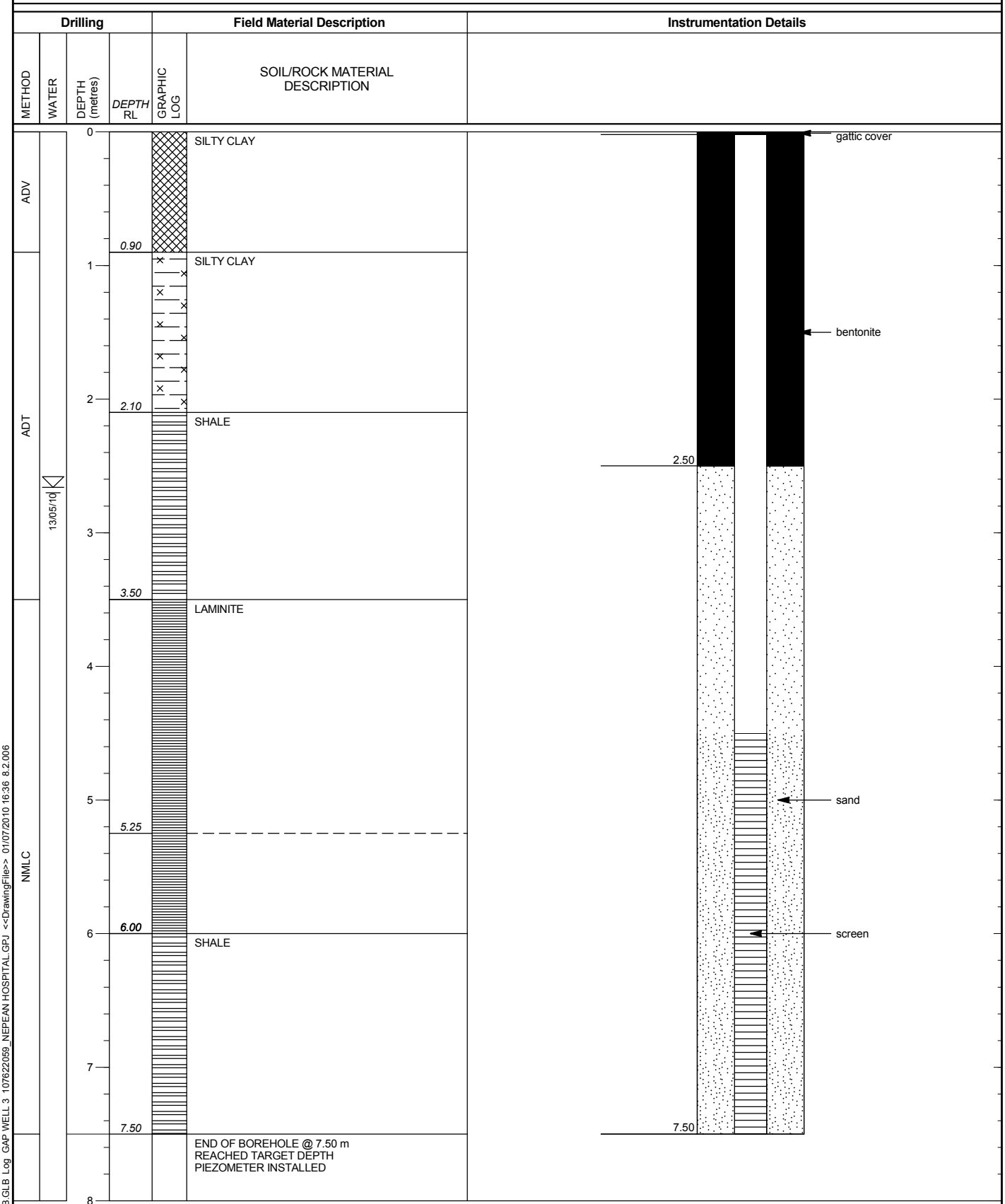
SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288217.0 m E 6261988.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 30/4/10

JOB NO: 107622059
HOLE DEPTH: 7.50 m
CHECKED: CSC DATE: 26/5/10



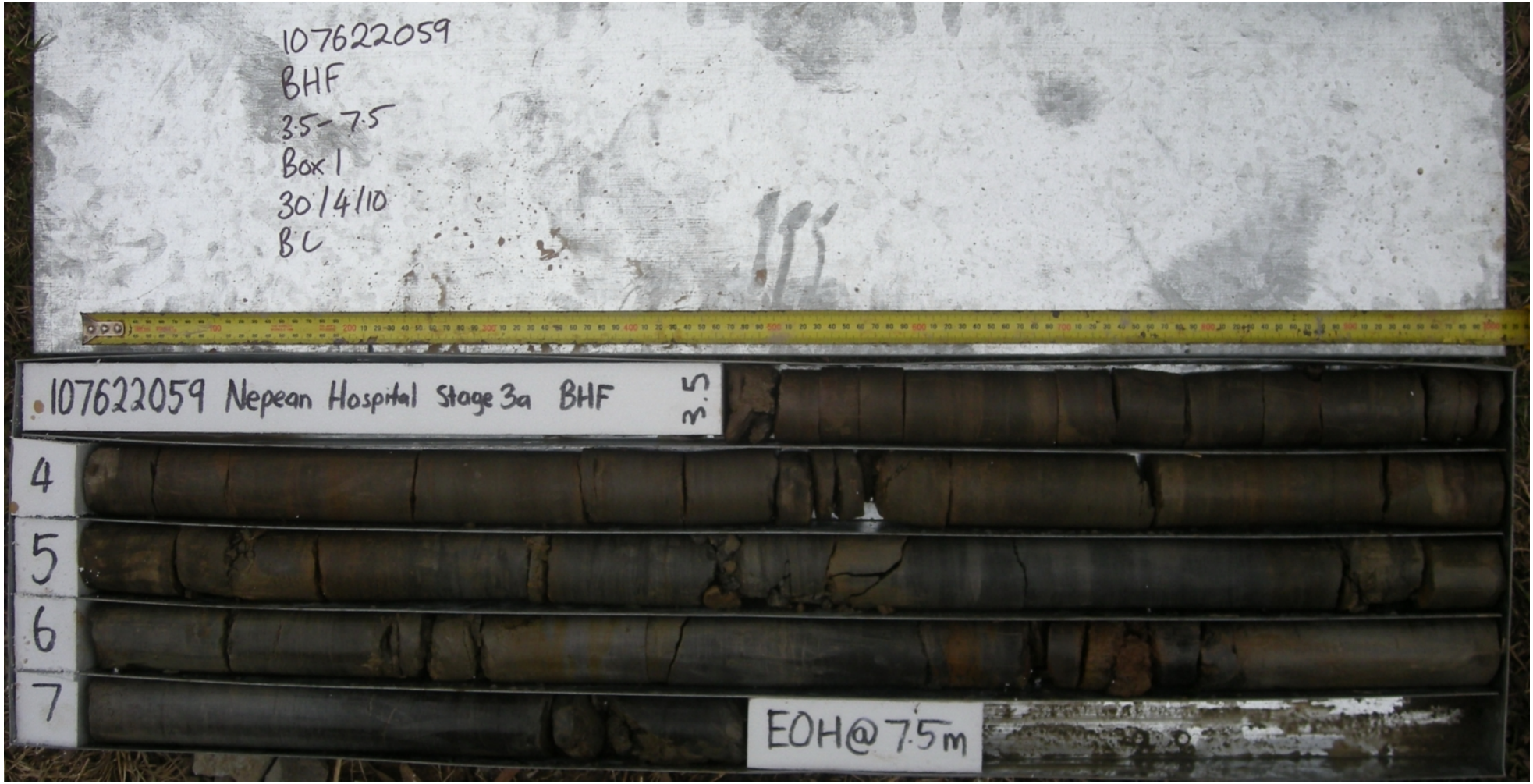
This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F17
RL1

GAP 8_05A LIB.GLB Log GAP WELL 3 107622059_NEPEAN HOSPITAL.GPJ <<DrawingFile>> 01/07/2010 16:36 8.2.006

REPORT OF CORE PHOTOGRAPHS: BHF

CLIENT:	Health Infrastructure		SHEET: 1 OF 1
PROJECT:	Redevelopment Stage 3A	COORDS: 288217.0 m E 6261988.0 m N MGA94 56	DRILL RIG: XC
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	CONTRACTOR: Terratest
JOB NO:	107622059	HOLE DEPTH: 7.50 m	LOGGED: BC DATE: 30/4/10
			CHECKED: CSC DATE: 26/5/10



This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F31
RL1

REPORT OF BOREHOLE: BHG

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288349.0 m E 62620507.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 2.00 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	H	Groundwater not encountered	0						BITUMEN fine to coarse sub-angular aggregate	D		BITUMEN ROAD BASE
ADV	M-H			0.30	BH5-1 DS 0.10-0.20 m R=0,A PID = 0.4 ppm				Road Base: Sandy GRAVEL dark grey, fine to coarse sub-angular sand, fine to coarse sub-angular igneous gravel	D		FILL
	M-R			0.70	BH5-2 DS 0.50-0.60 m R=0,A PID = 0.5 ppm			CH	FILL: Sandy CLAY high plasticity, dark grey, inferred firm to stiff			
ADT	M		1		BH5-3 DS 0.90-1.00 m R=0,A PID = 0.5 ppm SPT 1.00-1.45 m 6, 14, 18 N=32 BDS 1.00-1.20 m				Silty CLAY medium to high plasticity, grey with red ironstaining	D - M	VSt	RESIDUAL SOIL
	M-H											
	H-R			1.30					SHALE grey with red ironstaining, laminated, bedding at 0°, extremely low strength, extremely weathered			WEATHERED ROCK
			2						END OF BOREHOLE @ 2.00 m REACHED TARGET DEPTH/TC BIT REFUSAL BACKFILLED			TC-bit refusal at 2.0m
			3									
			4									
			5									
			6									
			7									
			8									

REPORT OF BOREHOLE: BHH

SHEET: 1 OF 1

CLIENT: Health Infrastructure
DRILL RIG: XC

PROJECT: Redevelopment Stage 3A
COORDS: 288369.0 m E 6262071.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 3/5/10

JOB NO: 107622059
HOLE DEPTH: 1.60 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	H	Groundwater not encountered	0	0.30	BHH-1 DS 0.10-0.20 m R=0,A PID = 0.4 ppm				BITUMEN fine to coarse sub-angular igneous gravel aggremate, dark grey	D		BITUMEN ROAD BASE
ADV	M-H				BHH-2 DS 0.50-0.60 m R=0,A PID = 0.4 ppm				Road Base: Sandy GRAVEL fine to coarse sub-angular igneous very high strength gravel, grey, fine to coarse grained sub-angular sand FILL: Silty CLAY high plasticity, red brown, trace fine to coarse sub-angular igneous gravel, inferred stiff clay	D		FILL v-bit refusal at 0.8m
ADT	M-H		1	0.80 1.30	BHH-3 DS 0.90-1.00 m R=0,A PID = 0.5 ppm SPT 1.00-1.45 m 4, 7, 16 N=23				Silty CLAY high plasticity, grey and red brown ironstaining	D - M	VSt	
	H				BHH-5 DS 1.50-1.60 m R=0,A PID = 0.7 ppm				SHALE grey with red ironstaining, laminated bedding at 0°, extremely low strength, extremely weathered, grey with red ironstaining			WEATHERED ROCK TC bit refusal at 1.6m
			2						END OF BOREHOLE @ 1.60 m REACHED TARGET DEPTH TC BIT REFUSAL BACKFILLED			
			3									
			4									
			5									
			6									
			7									
			8									

REPORT OF BOREHOLE: BHI

SHEET: 1 OF 3

CLIENT: Health Infrastructure
DRILL RIG: EXplorer

PROJECT: Redevelopment Stage 3A
COORDS: 288235.0 m E 6262268.0 m N MGA94 56
CONTRACTOR: Terratest

LOCATION: Penrith Nepean Health Campus
INCLINATION: -90°
LOGGED: BC DATE: 29/4/10

JOB NO: 107622059
HOLE DEPTH: 11.15 m
CHECKED: CSC DATE: 26/5/10

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DTC	H		0						ASPHALT fine - coarse subangular igneass gravel aggregate, dark grey binder			ASPHALT
ADV	H								FILL: Gravelly SAND fine - coarse grained, sub-angular, dark grey, fine to coarse, sub-angular, very high strength, igneous gravel, with some silt	D		
	L-M			0.80	BHI-1 DS 0.50-0.60 m R=0,A PID = 0.4 ppm							
	M		1		BHI-2 DS 0.90-1.00 m R=0,A PID = 0.3 ppm SPT 1.00-1.45 m 2, 3, 5 N=8			CH	Silty CLAY high plasticity, red brown, with zones of grey	M	St	RESIDUAL
					BHI-4 DS 1.50-1.60 m R=0,A PID = 0.1 ppm							
	M-H	13/05/10	2	2.00					zones of iron red iron cemanted clay			
					SPT 2.50-2.95 m 6, 6, 9 N=15 PP=300-400Kpa					D - M	VSt	
	H		3									V-bit refusal at 4.0m
ADT			4	4.00	SPT 4.00-4.25 m 16, 30/100mm N>30				SHALE brown, extremely low strength, extremely weathered			Weathered ROCK
	M-H		5									
	H		6									practical TC-bit refusal at 5.5m, pushed to 6.6m to allow for better setup of coring
			7						For Continuation Refer to Sheet 2			
			8									

REPORT OF STANDPIPE INSTALLATION: BHI

SHEET: 1 OF 1

CLIENT:	Health Infrastructure		DRILL RIG: EXplorer
PROJECT:	Redevelopment Stage 3A	COORDS: 288235.0 m E 6262268.0 m N MGA94 56	CONTRACTOR: Terratest
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	LOGGED: BC DATE: 29/4/10
JOB NO:	107622059	HOLE DEPTH: 11.15 m	CHECKED: CSC DATE: 26/5/10

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	
DTC			0.00		ASPHALT	gattic cover concrete
					GRAVELLY SAND	
			0.80		SILTY CLAY	
ADV			2.00			standard spoil backfill
	13/05/10					
			3.60			bentonite
			4.00		SHALE	
ADT						
			4.80			
			6.60		SHALE	
NMLC			7.80			screen
			8.30		SHALE	
						sand
			11.15		END OF BOREHOLE @ 11.15 m REACHED TARGET DEPTH PIEZOMETER INSTALLED	

This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F17
RL1

GAP 8_05A LIB.GLB Log GAP WELL 3 107622059_NEPEAN HOSPITAL.GPJ <<DrawingFile>> 01/07/2010 16:37 8.2.006

REPORT OF CORE PHOTOGRAPHS: BHI

CLIENT:	Health Infrastructure		SHEET: 1 OF 1
PROJECT:	Redevelopment Stage 3A	COORDS: 288235.0 m E 6262268.0 m N MGA94 56	DRILL RIG: EXplorer
LOCATION:	Penrith Nepean Health Campus	INCLINATION: -90°	CONTRACTOR: Terratest
JOB NO:	107622059	HOLE DEPTH: 11.15 m	LOGGED: BC DATE: 29/4/10
			CHECKED: CSC DATE: 26/5/10

This report of core photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F31
RL1

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	HQ	Diamond Core - 63 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	NQ	Diamond Core - 47 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	BH	Tractor Mounted Backhoe
HA	Hand Auger	PT	Push Tube	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	CT	Cable Tool Rig	EE	Existing Excavation
WB	Washbore or Bailer	JET	Jetting	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

⏚	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-1993
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength s_v
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\textit{Length of core recovered}}{\textit{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

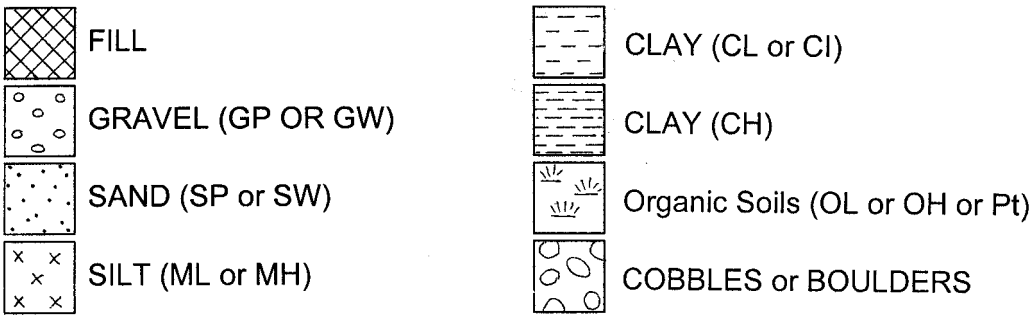
$$= \frac{\sum \textit{Length of cylindrical core recovered}}{\textit{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \textit{Axial lengths of core} > 100\ \textit{mm}}{\textit{Length of core run}} \times 100$$

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

GRAPHIC LOG - TYPICAL SYMBOLS FOR SOILS



Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

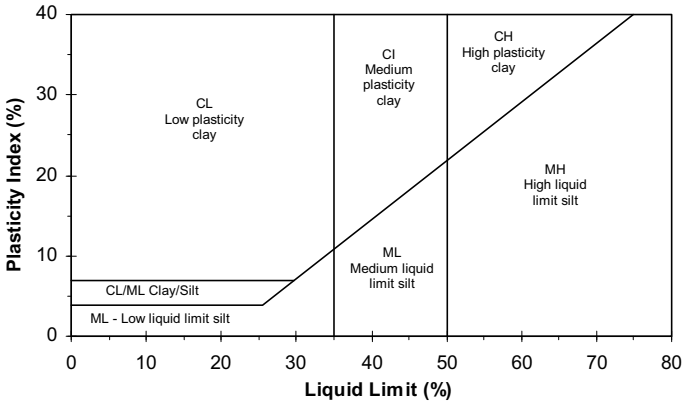
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 - 1993, Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	above 85	Above 50

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.
In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

STRENGTH

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa)	Field Guide
EL	Extremely Low	< 0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

ROCK STRENGTH TEST RESULTS

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

◀ Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

ROCK MATERIAL WEATHERING

Symbol		Term	Field Guide
RS		Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
EW		Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Distinctly Weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	MW		
SW		Slightly Weathered	Rock is slightly discoloured but shows little or no change of strength relative to fresh rock.
FR		Fresh	Rock shows no sign of decomposition or staining.

ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

Defect Type

B	Bedding parting
X	Foliation
L	Cleavage
J	Joint
SZ	Sheared zone (Fault)
CS	Crushed seam (Fault)
DS	Decomposed seam
IS	Infilled seam
S	Schistocity
V	Vein

Coating or Infilling

Cn	Clean
Sn	Stain
Vr	Veneer
Ct	Coating

Planarity

Pl	Planar
Un	Undulating
St	Stepped

Roughness

Sl	Slickensided
Sm	Smooth
Ro	Rough

Vertical Boreholes – The dip (inclination from horizontal) of the defect is given.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

APPENDIX B

Depth to Subsurface Units at Specific Borehole Locations

Summary of Unit Depth at Individual Borehole Locations

Unit	Depth to Base of (m)[1]								
	Proposed Mental Health Unit						Proposed Oral Health Unit		Proposed Maintenance Depot
	BHA	BHB	BHC	BHD	BHE	BHF	BHG	BHH	BHI
Asphalt/Concrete	0.11	0.1	0.1	-	0.06	-	0.03	0.03	0.05
Fill / Topsoil	0.8	2.1	1.0	0.8	0.6	0.9	0.7	0.8	0.8
Residual	2.1	-	2.0	1.9	1.5	2.1	1.3	1.3	4.0
Rock Unit 1 Class V	2.75	2.8	4.35	2.8	1.7	3.5	2.0	1.6	6.6
Rock Unit 2 Class IV	-	-	8.7	-	-	5.25	-	-	10.5
Rock Unit 3 Class IV-III	-	-	>10.0	-	-	>7.5	-	-	>11.15
End Depth of Borehole (m)	2.75	2.8	10.0	2.8	1.7	7.5	2.0	1.3	11.15

1 Depths are taken are referenced from the ground surface level at the time of the investigations. This level may vary due to demolition or filling processes as part of the Stage 3 construction works.

APPENDIX C

Laboratory Certificates

Resource Laboratories

ABN: 25 131 532 020

Sydney: 32/6 Abbott Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145

Ph: (02) 9674 7711 | **Fax:** (02) 9674 7755 | **Email:** info@resourcelab.com.au

Test Report

Customer: Golder Associates Pty Ltd
Project: Penrith Health Campus - Stage 3A
Location: Kingswood

Job number: 10-0009
Report number: 2
Page: 1 of 1

Soil Index Properties

Sampling method: Sample tested as received
Date sampled: 29/04/10 to 03/05/10

Test method (s): AS1289.1.1, 2.1.1, 3.1.1, 3.2.1, 3.3.1, 3.4.1.
Date tested: 12/05/10 to 18/05/10

	Results				
Laboratory sample no.	164	166	168	171	172
Customer sample no.	BHD-4 1.0m-1.45m	BHF-4 1.0m-1.45m	BHG-4 1.0m-1.45m	BHI-3 1.0m-1.45m	BHI-5 2.5m-2.95m
Material description	Silty clay, grey mottled orange	Clay, mottled grey and orange-red	Gravelly clay, grey mottled red and orange	Clay, grey mottled orange-brown	Silty clay with gravel, grey mottled red and orange-brown
Liquid limit (%)	50	55	47	65	58
Plastic limit (%)	19	17	19	19	20
Plasticity index (%)	31	38	28	46	38
Linear shrinkage (%)	9.5	9.5	8.5	11.0	9.5
Cracking / Curling / Crumbling	Curling	Curling	-	Cracking/Curling	-

*n/a - Liquid limit could not be obtained
NP - Non-plastic

Sample history: Natural state ☐ Air-dried ☐ Oven-dried ■ Unknown ☐

Preparation: Wet sieved ☐ Dry-sieved ■

Approved Signatory: E.Maldonado

Date: 18/05/2010

Resource Laboratories

ABN: 25 131 532 020

Sydney: 32/6 Abbott Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145

Ph: (02) 9674 7711 | **Fax:** (02) 9674 7755 | **Email:** info@resourcelab.com.au

Test Report

Customer: Golder Associates Pty Ltd **Job number:** 10-0009

Project: Penrith Health Campus Stage 3A **Report number:** 1

Location: Kingswood **Page:** 1 of 1

California Bearing Ratio

Sampling method: Sample tested as received **Test method (s):** AS 1289.1.1, 2.1.1, 5.1.1, 6.1.1*

Date sampled: 3/05/2010 **Date tested:** 11/05/10 to 17/05/10

	Results			
Laboratory sample no.	162	163	167	169
Customer sample no.	BHD 0.0m to 0.6m	BHD 0.8m to 1.2m	BHF 0.9m to 1.2m	BHG 0.7m to 1.2m
Material description	Silty gravelly clay, trace of organic matter, dark brown	Silty clay, orange-brown mottled grey	Silty clay, orange-red and grey	Silty clay with gravel, pale brown and grey
Maximum dry density (t/m^3)	1.84	1.68	1.72	1.80
Optimum moisture content (%)	12.3	19.4	18.5	16.3
Field moisture content (%)	n/a	n/a	n/a	n/a
Oversize retained on 19.0mm sieve (%)	3.0	0.0	0.5	1.0
Oversize included (Y/N)	N	N	N	N
Dry density before soak (t/m^3)	1.79	1.64	1.69	1.77
Dry density after soak (t/m^3)	1.77	1.63	1.65	1.73
Moisture content before soak (%)	12.2	18.7	18.9	15.6
Moisture content after soak (%)	16.6	21.4	22.1	21.4
Moisture content after test - top 30mm (%)	19.5	22.9	23.3	20.9
Moisture content after test - whole sample (%)	16.4	21.2	21.9	21.3
Density ratio before soaking (%)	97	98	98	98
Moisture ratio before soaking (%)	99	97	102	96
Period of soaking (days)	4	4	4	4
Compactive effort	Standard	Standard	Standard	Standard
Mass of surcharge applied (kg)	9	9	9	9
Swell after soaking (%)	1.0	1.0	2.5	2.0
Penetration (mm)	5.0	2.5	2.5	2.5
CBR Value (%)	**9**	**4.5**	**4.0**	**3.5**

Notes: *AS 1289.6.1.1 tested by Compaction and Soil Testing Services, NATA accredited laboratory number 15121.

Report references RES 796-2639, 2640, 2641, 2642.

Approved Signatory:  C.Greely **Date:** 19/05/2010

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: smectesting@pacific.net.au

Emerson Class No.

Project: Material Testing - Penrith Health Campus Stage 3A, Kingswood
Client: Resource Laboratories Pty Ltd
Address: P.O Box 45, Pendle Hill NSW 2145
Test Method: AS1289.3.8.1

Project No.: 17596
Report No.: 10/0576
Report Date: 19/05/2010
Page: 1 of 1

Sampling Proceedure: Samples Supplied By Client (Not covered under NATA Terms of Registration)

STS / Sample No.	7950B / 160	7950B / 161	7950B / 165	7950B / 168		
Sample Location	Borehole A-4	Borehole B-5	Borehole E-4	Borehole G-4		
Material Description	Silty Clay, grey, occassional orange-brown	Gravelly Silty Clay, grey & brown	Silty Clay, grey, occassional orange-brown	Gravelly Silty Clay, red-brown		
Depth (mm)	1.0 - 1.45	2.0 - 2.44	1.0 - 1.45	1.0 - 1.45		
Sample Date	3/05/2010	30/04/2010	3/05/2010	3/05/2010		
Date Tested	17-May-10	17-May-10	17-May-10	17-May-10		
Source of Material	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample		
Water Temperature (°)	21	21	21	21		
Emerson Class No.	**1**	**2**	**1**	**2**		

Emerson Classification

Class 1: Slaking and complete dispersion before remoulding
Class 2: Slaking and some dispersion before remoulding
Class 3: Slaking and no dispersion before remoulding, dispersion after remoulding
Class 4: Slaking and no despersion before remoulding, no dispersion after remoulding, calcite or gypsum present
Class 5: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, dispersion after slaking in a 1:5 soil / water suspension
Class 6: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, flocculation after shaking in a 1:5 soil / water suspension
Class 7: No slaking, swelling occurs
Class 8: No slaking, swelling does not occur

Remarks:

Approved Signatory.....

Technician: LC

Lincoln Coleman - Senior Geotechnician

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 40662

Client:
Golder Associates
124 Pacific Highway
St Leonards
NSW 2065

Attention: Ralph Erni

Sample log in details:

Your Reference:	**107622059, Penrith**
No. of samples:	44 Soils
Date samples received:	05/05/10
Date completed instructions received:	05/05/10

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	12/05/10
Date of Preliminary Report:	Not issued
Issue Date:	13/05/10

NATA accreditation number 2901. This document shall not be reproduced except in full.
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Rhian Morgan
Metals Supervisor

Jacinta Hurst
Laboratory Manager

Matt Mansfield
Chemist

ACCREDITED FOR TECHNICAL COMPETENCE

Miscellaneous Inorg - soil					
Our Reference:	UNITS	40662-18	40662-22	40662-30	40662-40
Your Reference	----------	BHD-3	BH8-1	BH12-3	BHI-2
Depth	----------	0.9-1.0	0.0-0.1	0.65-0.75	0.9-1.0
Date Sampled		3/05/2010	30/04/2010	3/05/2010	29/04/2010
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	7/5/10	7/5/10	7/5/10	7/5/10
Date analysed	-	7/5/10	7/5/10	7/5/10	7/5/10
pH 1:5 soil:water	pH Units	5.9	[NA]	4.9	[NA]
Electrical Conductivity 1:5 soil:water	µS/cm	640	89	950	350
Chloride, Cl 1:5 soil:water	mg/kg	200	[NA]	830	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	680	[NA]	500	[NA]

ESP/CEC Our Reference: Your Reference Depth Date Sampled Type of sample	UNITS ---------- ----------	40662-18 BHD-3 0.9-1.0 3/05/2010 Soil	40662-22 BH8-1 0.0-0.1 30/04/2010 Soil	40662-30 BH12-3 0.65-0.75 3/05/2010 Soil	40662-40 BHI-2 0.9-1.0 29/04/2010 Soil
Exchangeable Ca*	meq/100g	5.0	9.5	2.0	7.1
Exchangeable K*	meq/100g	0.42	0.41	0.49	0.33
Exchangeable Mg*	meq/100g	11	1.9	11	6.0
Exchangeable Na*	meq/100g	3.8	0.17	6.9	3.2
Cation Exchange Capacity*	meq/100g	20	12	21	17

Method ID	Methodology Summary
GC.16	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS.
GC.3	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID.
GC.12 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS.
GC-5	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
GC-6	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
LAB.2	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 20th ED and Rayment & Higginson.
LAB.81	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 21st ED, 4110-B.
Metals.20 ICP-AES	Determination of various metals by ICP-AES.
Metals.21 CV-AAS	Determination of Mercury by Cold Vapour AAS.
LAB.8	Moisture content determined by heating at 105 deg C for a minimum of 4 hours.
Metals.23	Determination of exchangeable cations and cation exchange capacity in soil.
ASB.1	Asbestos ID - Qualitative identification of asbestos type fibres in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques.

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			7/5/10	40662-1	7/5/10 || 7/5/10	LCS-2	7/5/10
Date analysed	-			11/5/10	40662-1	10/5/10 || 10/5/10	LCS-2	10/5/10
vTPH C_6 - C_9	mg/kg	25	GC.16	<25	40662-1	<25 || <25	LCS-2	122%
Benzene	mg/kg	0.5	GC.16	<0.5	40662-1	<0.5 || <0.5	LCS-2	94%
Toluene	mg/kg	0.5	GC.16	<0.5	40662-1	<0.5 || <0.5	LCS-2	129%
Ethylbenzene	mg/kg	1	GC.16	<1.0	40662-1	<1.0 || <1.0	LCS-2	113%
m+p-xylene	mg/kg	2	GC.16	<2.0	40662-1	<2.0 || <2.0	LCS-2	137%
o-Xylene	mg/kg	1	GC.16	<1.0	40662-1	<1.0 || <1.0	LCS-2	139%
Surrogate aaa-Trifluorotoluene	%		GC.16	111	40662-1	107 || 114 || RPD: 6	LCS-2	116%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Date analysed	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
TPH C_{10} - C_{14}	mg/kg	50	GC.3	<50	40662-1	<50 || <50	LCS-2	72%
TPH C_{15} - C_{28}	mg/kg	100	GC.3	<100	40662-1	<100 || <100	LCS-2	76%
TPH C_{29} - C_{36}	mg/kg	100	GC.3	<100	40662-1	<100 || <100	LCS-2	76%
Surrogate o-Terphenyl	%		GC.3	79	40662-1	79 || 76 || RPD: 4	LCS-2	86%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Date analysed	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Naphthalene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	115%
Acenaphthylene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	113%
Phenanthrene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	118%
Anthracene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	112%
Pyrene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	119%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(a)anthracene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	LCS-2	113%
Benzo(b+k)fluoranthene	mg/kg	0.2	GC.12 subset	<0.2	40662-1	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	GC.12 subset	<0.05	40662-1	<0.05 || <0.05	LCS-2	117%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	GC.12 subset	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%		GC.12 subset	84	40662-1	117 || 106 || RPD: 10	LCS-2	111%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Date analysed	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
HCB	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	116%
gamma-BHC	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	114%
Heptachlor	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	98%
delta-BHC	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	118%
Heptachlor Epoxide	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	123%
gamma-Chlordane	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	122%
Dieldrin	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	127%
Endrin	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	106%
pp-DDD	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	130%
Endosulfan II	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	LCS-2	119%
Methoxychlor	mg/kg	0.1	GC-5	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-5	95	40662-1	125 || 117 || RPD: 7	LCS-2	118%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Date analysed	-			07/05/2010	40662-1	07/05/2010 || 07/05/2010	LCS-2	07/05/2010
Arochlor 1016	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	LCS-2	102%
Arochlor 1260	mg/kg	0.1	GC-6	<0.1	40662-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		GC-6	95	40662-1	125 || 117 || RPD: 7	LCS-2	90%

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			7/5/10	[NT]	[NT]	LCS-1	7/5/10
Date analysed	-			7/5/10	[NT]	[NT]	LCS-1	7/5/10
pH 1:5 soil:water	pH Units		LAB.1	[NT]	[NT]	[NT]	LCS-1	99%
Electrical Conductivity 1:5 soil:water	µS/cm	1	LAB.2	<1.0	[NT]	[NT]	LCS-1	101%
Chloride, Cl 1:5 soil:water	mg/kg	2	LAB.81	<2.0	[NT]	[NT]	LCS-1	88%
Sulphate, SO4 1:5 soil:water	mg/kg	2	LAB.81	<2.0	[NT]	[NT]	LCS-1	93%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date digested	-			10/05/10	40662-1	10/05/10 || 10/05/10	LCS-1	10/05/10
Date analysed	-			11/05/10	40662-1	11/05/10 || 11/05/10	LCS-1	11/05/10
Arsenic	mg/kg	4	Metals.20 ICP-AES	<4	40662-1	5 || <4	LCS-1	106%
Cadmium	mg/kg	0.5	Metals.20 ICP-AES	<0.5	40662-1	<0.5 || <0.5	LCS-1	102%
Chromium	mg/kg	1	Metals.20 ICP-AES	<1	40662-1	17 || 14 || RPD: 19	LCS-1	104%
Copper	mg/kg	1	Metals.20 ICP-AES	<1	40662-1	21 || 20 || RPD: 5	LCS-1	106%
Lead	mg/kg	1	Metals.20 ICP-AES	<1	40662-1	14 || 15 || RPD: 7	LCS-1	102%
Mercury	mg/kg	0.1	Metals.21 CV-AAS	<0.1	40662-1	<0.1 || <0.1	LCS-1	100%
Nickel	mg/kg	1	Metals.20 ICP-AES	<1	40662-1	14 || 11 || RPD: 24	LCS-1	105%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Zinc	mg/kg	1	Metals.20 ICP-AES	<1	40662-1	43 || 31 || RPD: 32	LCS-1	106%

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Date prepared	-			7/5/10
Date analysed	-			7/5/10
Moisture	%	0.1	LAB.8	<0.10

QUALITY CONTROL ESP/CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Exchangeable Ca*	meq/100 g	0.01	Metals.23	<0.01	40662-18	5.0 || 5.4 || RPD: 8	LCS-1	97%
Exchangeable K*	meq/100 g	0.01	Metals.23	<0.01	40662-18	0.42 || 0.42 || RPD: 0	LCS-1	110%
Exchangeable Mg*	meq/100 g	0.01	Metals.23	<0.01	40662-18	11 || 11 || RPD: 0	LCS-1	94%
Exchangeable Na*	meq/100 g	0.01	Metals.23	<0.01	40662-18	3.8 || 3.9 || RPD: 3	LCS-1	108%
Cation Exchange Capacity*	meq/100 g	1	Metals.23	<1.0	40662-18	20 || 21 || RPD: 5	[NR]	[NR]

QUALITY CONTROL Asbestos ID - soils	UNITS	PQL	METHOD	Blank
Date analysed	-			[NT]

QUALITY CONTROL vTPH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-11	7/5/10 || 7/5/10	LCS-3	7/5/10
Date analysed	-	40662-11	10/5/10 || 10/5/10	LCS-3	11/5/10
vTPH C_6 - C_9	mg/kg	40662-11	<25 || <25	LCS-3	114%
Benzene	mg/kg	40662-11	<0.5 || <0.5	LCS-3	95%
Toluene	mg/kg	40662-11	<0.5 || <0.5	LCS-3	136%
Ethylbenzene	mg/kg	40662-11	<1.0 || <1.0	LCS-3	114%
m+p-xylene	mg/kg	40662-11	<2.0 || <2.0	LCS-3	112%
o-Xylene	mg/kg	40662-11	<1.0 || <1.0	LCS-3	113%
Surrogate aaa-Trifluorotoluene	%	40662-11	113 || 120 || RPD: 6	LCS-3	117%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Date analysed	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
TPH C_{10} - C_{14}	mg/kg	40662-11	<50 || <50	LCS-3	68%
TPH C_{15} - C_{28}	mg/kg	40662-11	<100 || <100	LCS-3	76%
TPH C_{29} - C_{36}	mg/kg	40662-11	<100 || <100	LCS-3	77%
Surrogate o-Terphenyl	%	40662-11	85 || 85 || RPD: 0	LCS-3	86%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Date analysed	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Naphthalene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	113%
Acenaphthylene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	111%
Phenanthrene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	117%
Anthracene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	110%
Pyrene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	118%
Benzo(a)anthracene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	40662-11	<0.1 || <0.1	LCS-3	112%
Benzo(b+k)fluoranthene	mg/kg	40662-11	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	40662-11	<0.05 || <0.05	LCS-3	114%
Indeno(1,2,3-c,d)pyrene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	40662-11	114 || 111 || RPD: 3	LCS-3	108%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Date analysed	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
HCB	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	40662-11	<0.1 || <0.1	LCS-3	124%
gamma-BHC	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	40662-11	<0.1 || <0.1	LCS-3	109%
Heptachlor	mg/kg	40662-11	<0.1 || <0.1	LCS-3	100%
delta-BHC	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	40662-11	<0.1 || <0.1	LCS-3	119%
Heptachlor Epoxide	mg/kg	40662-11	<0.1 || <0.1	LCS-3	109%
gamma-Chlordane	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	40662-11	<0.1 || <0.1	LCS-3	107%
Dieldrin	mg/kg	40662-11	<0.1 || <0.1	LCS-3	128%
Endrin	mg/kg	40662-11	<0.1 || <0.1	LCS-3	110%
pp-DDD	mg/kg	40662-11	<0.1 || <0.1	LCS-3	120%
Endosulfan II	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	40662-11	<0.1 || <0.1	LCS-3	111%
Methoxychlor	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-11	117 || 120 || RPD: 3	LCS-3	140%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Date analysed	-	40662-11	07/05/2010 || 07/05/2010	LCS-3	07/05/2010
Arochlor 1016	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	40662-11	<0.1 || <0.1	LCS-3	108%
Arochlor 1260	mg/kg	40662-11	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-11	117 || 120 || RPD: 3	LCS-3	88%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	40662-11	10/05/10 || 10/05/10	LCS-2	10/05/10
Date analysed	-	40662-11	11/05/10 || 11/05/10	LCS-2	11/05/10
Arsenic	mg/kg	40662-11	7 || 7 || RPD: 0	LCS-2	105%
Cadmium	mg/kg	40662-11	<0.5 || <0.5	LCS-2	105%
Chromium	mg/kg	40662-11	19 || 18 || RPD: 5	LCS-2	107%
Copper	mg/kg	40662-11	83 || 67 || RPD: 21	LCS-2	107%
Lead	mg/kg	40662-11	29 || 27 || RPD: 7	LCS-2	102%
Mercury	mg/kg	40662-11	<0.1 || <0.1	LCS-2	98%
Nickel	mg/kg	40662-11	16 || 14 || RPD: 13	LCS-2	105%
Zinc	mg/kg	40662-11	94 || 81 || RPD: 15	LCS-2	105%
QUALITY CONTROL vTPH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-21	7/5/10 || 7/5/10	40662-2	7/5/10
Date analysed	-	40662-21	10/5/10 || 10/5/10	40662-2	11/5/10
vTPH C_6 - C_9	mg/kg	40662-21	<25 || <25	40662-2	125%
Benzene	mg/kg	40662-21	<0.5 || <0.5	40662-2	101%
Toluene	mg/kg	40662-21	<0.5 || <0.5	40662-2	131%
Ethylbenzene	mg/kg	40662-21	<1.0 || <1.0	40662-2	122%
m+p-xylene	mg/kg	40662-21	<2.0 || <2.0	40662-2	136%
o-Xylene	mg/kg	40662-21	<1.0 || <1.0	40662-2	132%
Surrogate aaa-Trifluorotoluene	%	40662-21	119 || 115 || RPD: 3	40662-2	124%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Date analysed	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
TPH C_{10} - C_{14}	mg/kg	40662-21	<50 || <50	40662-2	116%
TPH C_{15} - C_{28}	mg/kg	40662-21	<100 || <100	40662-2	136%
TPH C_{29} - C_{36}	mg/kg	40662-21	<100 || <100	40662-2	136%
Surrogate o-Terphenyl	%	40662-21	94 || 96 || RPD: 2	40662-2	72%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Date analysed	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Naphthalene	mg/kg	40662-21	<0.1 || <0.1	40662-2	113%
Acenaphthylene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	40662-21	<0.1 || <0.1	40662-2	110%
Phenanthrene	mg/kg	40662-21	<0.1 || 0.1	40662-2	113%
Anthracene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	40662-21	0.1 || 0.1 || RPD: 0	40662-2	108%
Pyrene	mg/kg	40662-21	0.1 || 0.1 || RPD: 0	40662-2	114%
Benzo(a)anthracene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	40662-21	<0.1 || <0.1	40662-2	104%
Benzo(b+k)fluoranthene	mg/kg	40662-21	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	40662-21	<0.05 || <0.05	40662-2	111%
Indeno(1,2,3-c,d)pyrene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	40662-21	117 || 108 || RPD: 8	40662-2	107%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Date analysed	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
HCB	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	40662-21	<0.1 || <0.1	40662-2	114%
gamma-BHC	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	40662-21	<0.1 || <0.1	40662-2	115%
Heptachlor	mg/kg	40662-21	<0.1 || <0.1	40662-2	110%
delta-BHC	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	40662-21	<0.1 || <0.1	40662-2	116%
Heptachlor Epoxide	mg/kg	40662-21	<0.1 || <0.1	40662-2	121%
gamma-Chlordane	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	40662-21	<0.1 || <0.1	40662-2	121%
Dieldrin	mg/kg	40662-21	<0.1 || <0.1	40662-2	126%
Endrin	mg/kg	40662-21	<0.1 || <0.1	40662-2	112%
pp-DDD	mg/kg	40662-21	<0.1 || <0.1	40662-2	128%
Endosulfan II	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	40662-21	<0.1 || <0.1	40662-2	118%
Methoxychlor	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-21	130 || 133 || RPD: 2	40662-2	113%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Date analysed	-	40662-21	07/05/2010 || 07/05/2010	40662-2	07/05/2010
Arochlor 1016	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	40662-21	<0.1 || <0.1	40662-2	106%
Arochlor 1260	mg/kg	40662-21	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-21	130 || 133 || RPD: 2	40662-2	94%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	40662-21	10/05/10 || 10/05/10	LCS-3	10/05/10
Date analysed	-	40662-21	11/05/10 || 11/05/10	LCS-3	11/05/10
Arsenic	mg/kg	40662-21	9 || 9 || RPD: 0	LCS-3	105%
Cadmium	mg/kg	40662-21	<0.5 || <0.5	LCS-3	102%
Chromium	mg/kg	40662-21	18 || 18 || RPD: 0	LCS-3	104%
Copper	mg/kg	40662-21	26 || 26 || RPD: 0	LCS-3	107%
Lead	mg/kg	40662-21	20 || 20 || RPD: 0	LCS-3	102%
Mercury	mg/kg	40662-21	<0.1 || <0.1	LCS-3	96%
Nickel	mg/kg	40662-21	9 || 9 || RPD: 0	LCS-3	108%
Zinc	mg/kg	40662-21	41 || 38 || RPD: 8	LCS-3	106%
QUALITY CONTROL vTPH & BTEX in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-31	7/5/10 || 7/5/10	40662-22	7/5/10
Date analysed	-	40662-31	10/5/10 || 10/5/10	40662-22	11/5/10
vTPH C_6 - C_9	mg/kg	40662-31	<25 || <25	40662-22	115%
Benzene	mg/kg	40662-31	<0.5 || <0.5	40662-22	93%
Toluene	mg/kg	40662-31	<0.5 || <0.5	40662-22	136%
Ethylbenzene	mg/kg	40662-31	<1.0 || <1.0	40662-22	117%
m+p-xylene	mg/kg	40662-31	<2.0 || <2.0	40662-22	115%
o-Xylene	mg/kg	40662-31	<1.0 || <1.0	40662-22	112%
Surrogate aaa-Trifluorotoluene	%	40662-31	118 || 119 || RPD: 1	40662-22	133%

QUALITY CONTROL sTPH in Soil (C10-C36)	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Date analysed	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
TPH C_{10} - C_{14}	mg/kg	40662-31	<50 || <50	40662-22	69%
TPH C_{15} - C_{28}	mg/kg	40662-31	<100 || <100	40662-22	98%
TPH C_{29} - C_{36}	mg/kg	40662-31	<100 || <100	40662-22	95%
Surrogate o-Terphenyl	%	40662-31	89 || 93 || RPD: 4	40662-22	85%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Date analysed	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Naphthalene	mg/kg	40662-31	<0.1 || <0.1	40662-22	115%
Acenaphthylene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	40662-31	<0.1 || <0.1	40662-22	113%
Phenanthrene	mg/kg	40662-31	0.1 || 0.1 || RPD: 0	40662-22	116%
Anthracene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	40662-31	<0.1 || <0.1	40662-22	113%
Pyrene	mg/kg	40662-31	<0.1 || <0.1	40662-22	119%
Benzo(a)anthracene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Chrysene	mg/kg	40662-31	<0.1 || <0.1	40662-22	107%
Benzo(b+k)fluoranthene	mg/kg	40662-31	<0.2 || <0.2	[NR]	[NR]
Benzo(a)pyrene	mg/kg	40662-31	<0.05 || <0.05	40662-22	117%
Indeno(1,2,3-c,d)pyrene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Surrogate p-Terphenyl-d_{14}	%	40662-31	114 || 106 || RPD: 7	40662-22	109%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Date analysed	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
HCB	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	40662-31	<0.1 || <0.1	40662-22	108%
gamma-BHC	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	40662-31	<0.1 || <0.1	40662-22	101%
Heptachlor	mg/kg	40662-31	<0.1 || <0.1	40662-22	110%
delta-BHC	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	40662-31	<0.1 || <0.1	40662-22	108%
Heptachlor Epoxide	mg/kg	40662-31	<0.1 || <0.1	40662-22	111%
gamma-Chlordane	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	40662-31	<0.1 || <0.1	40662-22	99%
Dieldrin	mg/kg	40662-31	<0.1 || <0.1	40662-22	119%
Endrin	mg/kg	40662-31	<0.1 || <0.1	40662-22	108%
pp-DDD	mg/kg	40662-31	<0.1 || <0.1	40662-22	108%
Endosulfan II	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	40662-31	<0.1 || <0.1	40662-22	105%
Methoxychlor	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-31	122 || 129 || RPD: 6	40662-22	125%

QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Date analysed	-	40662-31	07/05/2010 || 07/05/2010	40662-22	07/05/2010
Arochlor 1016	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Arochlor 1221*	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Arochlor 1232	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Arochlor 1242	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Arochlor 1248	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Arochlor 1254	mg/kg	40662-31	<0.1 || <0.1	40662-22	100%
Arochlor 1260	mg/kg	40662-31	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%	40662-31	122 || 129 || RPD: 6	40662-22	82%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	40662-31	10/05/10 || 10/05/10	40662-2	10/05/10
Date analysed	-	40662-31	11/05/10 || 11/05/10	40662-2	11/05/10
Arsenic	mg/kg	40662-31	5 || 5 || RPD: 0	40662-2	111%
Cadmium	mg/kg	40662-31	<0.5 || <0.5	40662-2	102%
Chromium	mg/kg	40662-31	65 || 64 || RPD: 2	40662-2	100%
Copper	mg/kg	40662-31	38 || 38 || RPD: 0	40662-2	108%
Lead	mg/kg	40662-31	16 || 15 || RPD: 6	40662-2	98%
Mercury	mg/kg	40662-31	<0.1 || <0.1	40662-2	78%
Nickel	mg/kg	40662-31	73 || 71 || RPD: 3	40662-2	105%
Zinc	mg/kg	40662-31	71 || 54 || RPD: 27	40662-2	102%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	[NT]	[NT]	40662-22	10/05/10
Date analysed	-	[NT]	[NT]	40662-22	11/05/10
Arsenic	mg/kg	[NT]	[NT]	40662-22	110%
Cadmium	mg/kg	[NT]	[NT]	40662-22	104%
Chromium	mg/kg	[NT]	[NT]	40662-22	106%
Copper	mg/kg	[NT]	[NT]	40662-22	117%
Lead	mg/kg	[NT]	[NT]	40662-22	102%
Mercury	mg/kg	[NT]	[NT]	40662-22	86%
Nickel	mg/kg	[NT]	[NT]	40662-22	108%
Zinc	mg/kg	[NT]	[NT]	40662-22	109%

Report Comments:

Asbestos: A portion of the supplied sample was sub-sampled for asbestos according to Envirolab procedures. We cannot guarantee that this sub-sample is indicative of the entire sample.
Envirolab recommends supplying 30-40g of sample in it's own container.

Sample 11; Chrysotile & amosite found embedded in several fragments of fibre cement (total weight 0.031g).
It is estimated that plaster or fibre cement sheet can contain up to 15% chrysotile & amosite asbestos fibres by weight. This gives up to 0.0046g of chrysotile & amosite fibres, which in 25g of soil gives 0.185g/kg.
Asbestos was analysed by Approved Identifier: Matt Mansfield
Asbestos was authorised by Approved Signatory: Matt Mansfield
INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.
Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for

APPENDIX D

Salinity Assessment

1.0 DRYLAND SALINITY ASSESSMENT

Dryland salinity is an issue which is particularly prominent in current or historic pasture lands. It is a common problem in sub-humid areas where a landuse change and an accompanying change in vegetation type has led to excess rainfall percolating through soils on upper hill slopes and then flushing salt into lower slopes, streamlines and valley margins. The salts can come from a range of sources which include:

- Weathering processes acting upon soil and rock;
- Bedrock derived from lithified seabed deposits;
- Naturally saline soils; and
- Wind blown aerosols from the ocean deposited through wind or rain.

Salinity in soils can lead to a wide variety of problems including vegetation die-back, soil erosion, change in plant community to more salt tolerant varieties, fouling of groundwater and surface water bodies, damage to concrete and steel structures and damage to roadways.

The Golder investigation incorporates a desktop and limited field investigation to assess the presence of salinity on the Site and the likely locations where it is particularly concentrated.

1.1 Salinity Potential in Western Sydney and Urban Capability

As part of this investigation Golder has reviewed the Department of Natural Resources (DNR), 1:100,000 *Map of Salinity Potential in Western Sydney* to assess areas of potential risk on the Site. The Map shows that across the majority of the southern part of the Nepean Hospital the land is situated in an area of moderate salinity potential. The majority of the northern portion of the Nepean Hospital is situated on land with a high potential for salinity being present. There is also one small area in the north of the Hospital which is an area of known salinity potential. Due to the level of accuracy on the Map, the current location of the Penrith Health Campus in relation to this area of known salinity cannot be fully confirmed.

Based upon a review of topographic maps and other information, the northern portion of the Nepean Hospital lies roughly within the channel and floodplain of an unnamed tributary (now not visible at the surface), which formed a tributary of Werrington Creek. The presence of this historic channel within the Site is the likely cause of localised saline soils in the Site and immediate surrounds.

1.2 Soil Assessment

The analytical program for the salinity investigation was as follows:

- pH – 4 primary soil samples;

- Electrical Conductivity (EC) – 4 primary soil samples; and

- Cation Exchange Capacity (including exchangeable Ca, Mg, K and Na) – 4 primary soil samples.

Based on the EC converted into microSiemens per centimetre (µS/cm) and a multiplier which related to the soil structure, Golder calculated the salinity index (EC_e) of the 4 soil samples. Based upon the cation exchange capacity and the exchangeable sodium concentration, Golder calculated the exchangeable sodium percentage (ESP) of four selected samples.

1.2.1 Soil Salinity Classes

The EC results that were recorded by a laboratory in a 1 in 5 suspension of soil and water were used by Golder to calculate the EC_e and classify the soils for which the samples are representative into varying salinity classes. The salinity classing structure is based upon Table 6.2 from the Department of Natural Resources (2002), *Site Investigations for Urban Salinity*. The classification of the different soil samples is as follows:

- The soil for which the sample BH8-1 (0.0-0.1m) is representative, is classed as non saline (<2000 µS/cm);

- The soil for which the sample BHI-2 (0.9-1.0 m) is representative is classed as slightly saline (2000-4000 µS /cm); and

- The soil for which the samples BHD-3 (0.9-1.0 m) and BH12-3 (0.65-0.75) is representative is classed as moderately saline (4000-8000 µS /cm).

The results indicate that slightly and moderately saline soils are present on the Site. The test results indicate that within the proposed Mental Health Unit and the proposed Oral Health Unit there are areas of saline soils present. These saline soils are present throughout the residual soil. However, due to limitations regarding sampling and analytical density there is the potential for saline soils to be present at the proposed Maintenance Depot as well.

1.2.2 Cation Exchange Capacity and Soil Sodicity

The assessment of Cation Exchange Capacity (CEC) and Exchangeable Sodium Percentage (ESP) relates to the sodicity of the soils underlying the Site. Soil sodicity affects nearly a third of all soils in Australia and is known to lead to poor water infiltration, surface crusting, erosion and waterlogging.

Soil sodicity relates to soil salinity in that the sodium is believed to be derived from sodium chloride salt in groundwater and soil but much of the chloride has been washed away, leaving

behind sodium ions. These sodium ions influence behaviour of clay particles in the soil and as a result, can lead to unstable dispersive soils which may erode or become impermeable to both water and roots (e.g. crusting). They are also an indicator of past salinisation events in the soil.

The laboratory conducted analysis of cation exchange capacity on four samples collected by Golder. Based upon the results of the analysis, Golder calculated the Exchangeable Sodium Percentage (ESP) of the sample. The results of the calculations indicate that the soil analysed in three of the four samples (BHD-3 0.9-1.0 m), BH12-3 (0.65-0.75 m) and BHI (0.9-1.0 m) are highly sodic and have potential for structural instability. These results indicate that the residual silty clay encountered across the site should be regarded and treated as highly sodic.

Under certain conditions shallow sodic soils are a cause of soil erosion and deeper sodic soils can be an impediment to percolation of water and lead to saturation of overlying materials. There are a range of parameters which may affect the dispersivity of sodic soils and impacts on the landscape. These include groundwater and surface water salinity (higher salinities coagulate clays and can cancel out the impact of sodic soils), as well as contributing factors such as soil composition, gradient, vegetation cover and landuse.

1.2.3 Conclusions and Recommendations

Based upon the findings of the desktop review, fieldwork and the laboratory analysis Golder makes the following conclusions:

- Based upon the Salinity Risk Map, across the hospital property there are areas of land which are considered to be of moderate and high salinity potential and known salinity;

- Laboratory analysis of a limited number of soil samples indicates that the natural soil on the Site is classed as slightly to moderated saline; and

- Four samples were selected for laboratory analysis of Cation Exchange Capacity and soil sodicity. The results of the analysis indicate natural soils tested are highly sodic. As a result there is a potential for waterlogging and also dispersivity if excavation exposes this strata to surface runoff.

Based upon these conclusions Golder makes the following recommendations:

- Saline soils were detected in the natural Silty CLAY soil. Saline soils have the potential to impact upon unprotected concrete and steel structures. It is recommended that salinity be taken into account particularly where deeper built structures are proposed; and

- Based upon assessment of soil sodicity, there is a potential for the high plasticity Silty CLAY underlying the Site to present dispersive qualities. Steps should be taken to minimise exposure of these soils to surface runoff. Where exposure is unavoidable, appropriate erosion and sediment control measures are to be applied.

APPENDIX E

Limitations

LIMITATIONS

This Document has been provided by Golder Associates Pty Ltd ("Golder") subject to the following limitations:

This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of Golder's Services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

Golder may have retained subconsultants affiliated with Golder to provide Services for the benefit of Golder. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Golder's affiliated companies, and their employees, officers and directors.

This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

At Golder Associates we strive to be the most respected global group of companies specialising in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organisational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Pty Ltd
124 Pacific Highway
St. Leonards New South Wales 2065
Australia
T: +61 2 9478 3900

Golder Associates