ENVIRONMENTAL INVESTIGATION SERVICES

REPORT

TO

HEALTH INFRASTRUCTURE

ON

STAGE 1 ENVIRONMENTAL SITE ASSESSMENT

FOR

PROPOSED GRAYTHWAITE REHABILITATION CENTRE

AT

RYDE HOSPITAL, 1 DENISTONE ROAD, DENISTONE

MARCH 2011 **REF: E24595KHrpt**

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EXECUTIVE SUMMARY

Health Infrastructure commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake aStage 1 environmental site assessment to assess the likelihood of contamination of the subsurface soils and groundwater for the proposed Graythwaite Rehabilitation Centre at Ryde Hospital, 1 Denistone Road, Densitone. The site is identified as part of Lots 1 and 2 DP 1137800 and at the time of this investigation was occupied by hospital buildings.

The proposed development includes demolition of the existing buildings at the site and construction of a new, 'L' shaped rehabilitation centre.

This investigation included a review of historical information and soil sampling from six boreholes across the site.

At the time of the investigation the site was occupied by hospital buildings and paved carpark areas. A 'U' shaped building was located in the north-west section of the site and consisted of three metal clad buildings connected by enclosed walkways. A single storey brick building was located to the south of the 'U' shaped building and was occupied by Rotary lodges. An electrical fuse box was observed on the east wall of the Rotary lodges and the backing board appeared to be fibre-cement (potentially containing asbestos). An asphaltic concrete (AC) paved carpark was located south of the Rotary building. A single storey brick building was located east of the carpark in the south-east section of the site. The building was named The Vera Lindsay.

The search of historical information has indicated the following:

- The site was used for residential purposes or vacant since at least 1930;
- The site became part of a larger hospital in the 1940's and 1950's;
- The 'U' shaped building was constructed in stages between 1943 and 1961;
- The 'Vera Lindsay' was constructed between 1961 and 1970;
- The Rotary lodge building was constructed between 1978 and 1986;
- The carpark was partially constructed in the 1970's and extended to the current form between 1994 and 2005;
- Several buildings were demolished from the north, north-west, central and south-east sections of the site in the 1960's and 1970's;
- There are no current recorded notices listed on the NSW DECCW CLM or POEO register; and
- WorkCover have no records of underground storage tank licenses issued for the site.

Soil samples obtained for the investigation were analysed for the potential contaminants of concern identified at the site. Elevated concentrations of contaminants were not encountered in the soil samples analysed for the investigation. All results were below the site assessment criteria (SAC). Based on the results, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low.

EIS consider the potential for groundwater contamination at the site to be very low for the following reasons:

- Elevated concentrations of contaminants were not detected in the fill or natural soils at the site; and
- Groundwater is located within the shale bedrock aquifer and would, therefore, be less likely to be influenced by surficial contamination.

Based on the results of the assessment, the fill material is classified as 'General Solid Waste (non-putrescible)' according to the criteria outlined in the Waste Classification Guidelines 2009.

The natural silty clay and underlying shale bedrock at the site is considered to be virgin excavated natural material (VENM).

Based on the scope of work undertaken for this assessment EIS consider that the site can be made suitable for the proposed development provided that the site is inspected by experienced environmental personnel during demolition and excavation works to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations and to

better assess the potential for asbestos contamination beneath the existing buildings at the site. This should facilitate appropriate adjustment of the works programme and schedule in relation to the changed site conditions.

A hazardous materials assessment should be undertaken of all the buildings at the site prior to commencement of demolition works.

The conclusions presented in this report have been made within the limitations of the scope of works undertaken for the investigation. The conclusions and recommendations should be read in conjunction with the limitations presented in the body of the report.

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1 INTRODUCTION

Health Infrastructure commissioned Environmental Investigation Services (EIS), a division of Jeffery & Katauskas Pty Ltd (J&K), to undertake aStage 1 environmental site assessment to assess the likelihood of contamination of the subsurface soils and groundwater for the proposed Graythwaite Rehabilitation Centre at Ryde Hospital, 1 Denistone Road, Densitone.

The site is identified as part of Lots 1 and 2 DP 1137800 and at the time of this investigation was occupied by hospital buildings. The site location is shown on Figure 1 and the investigation was confined to the proposed development area as shown on Figure 2.

The screening was undertaken generally in accordance with an EIS proposal (Ref: EP5333KH) of 21 December 2010 and written acceptance from Health Infrastructure (contract No. HI 10121 [rev A]) of 27 January 2010.

This report describes the investigation procedures and presents the results of the environmental site assessment, together with comments, discussion and recommendations.

A geotechnical investigation was undertaken by J&K in conjunction with the environmental site screening and the results are presented in a separate report (Ref. 24595ZArpt, dated 21 March 2011).

1.1 Proposed Development Details

The proposed development includes demolition of the existing buildings at the site and construction of a new, 'L' shaped rehabilitation centre. The centre will include a lower ground floor carpark cut into the hillside with two storeys of hospital rooms and rehabilitation facilities above. An indoor swimming pool will be located in the north section of the building. A plant room will be located above the two hospital levels.

2 OBJECTIVES AND SCOPE OF WORK

2.1 Objectives

The primary objectives of the investigation were to:

- Assess the potential risk of significant widespread contamination of the site
- Assess the soil contamination conditions at the site in relation to the proposed hospital land use;
- Undertake a waste classification assessment for off-site disposal of excavated soil associated with the proposed development works; and
- Prepare a report presenting the results of the assessment/investigation generally in accordance with the *NSW EPA (now DECCW)Guidelines for Consultants Reporting on Contaminated Sites(1997[1])* and*State Environmental Planning Policy No.55 – Remediation of Land (1998[2])*.

2.2 Scope of Work

The scope of work undertaken to achieve the objective included:

1. Review of historical aerial photographs;
2. Review of historical land title records;
3. Search of the NSW DECCW notices for the site under Section 58 of the *Contaminated Land Management Act* (1997[3])[4];
4. Search of the NSW DECCW public register (POEO[5]) for licences, applications or notices for the site;
5. Search of WorkCover databases for licenses to store dangerous goods including underground fuel storage tanks (USTs);
6. Review of RydeCouncil historical development applications (DA) and building approvals (BA) records for the site;
7. Review of regional geology and groundwater conditions, including the location of registered groundwater bores and major underground services in the vicinity of the site;
8. Design and implementation of a field sampling program;
9. Laboratory analysis of selected soil samples; and
10. Preparation of a report presenting the results of the assessment together with recommendations and comments on the suitability of the site for the proposed development.

Field work for this investigation was undertaken on 21 and 22 February 2011.

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[1] *Guidelines for Consultants Reporting on Contaminated Sites,* NSW EPA (now DECCW), 1997 (Reporting Guidelines 1997)
[2] *State Environmental Planning Policy No. 55 – Remediation of Land,* NSW Government, 1998 (SEPP55)
[3] *Contaminated Land Management Act,* NSW Government Legislation, 1997 (CLM Act 1997)
[4] http://www.environment.nsw.gov.au/prclmapp/searchregister.aspx visited on 25 February 2011
[5] http://www.environment.nsw.gov.au/prpoeoapp/searchregister.aspx visited on 25 February 2011

3 SITE INFORMATION

3.1 Site Identification

The site identification details are summarised in the following table:

Site Owner:	The State Of New South Wales
Site Address:	1 Denistone Road, Denistone
Lot & Deposited Plan:	Part of Lots 1 and 2 DP 1137800
Current Land Use:	Hospital
Proposed Land Use:	Hospital/Rehabilitation Centre
Local Government Authority:	Ryde Council
Current Zoning:	SP2 Infrastructure
Area of Proposed Development:	Approximately 4,000m^2
AHD:	Approximately 95m
Geographical Location (MGA):	N: 6258930 E: 323070 (approximately)
Site Locality Plan:	Refer to Figure 1
Borehole Location Plan:	Refer to Figure 2

3.2 Site Description

The site is located to the south-east of Fourth Avenue,approximately 80m to the south-west of the intersection with Denistone Road, on the side of a hill that falls to the north and north-west at less than 5°. The crest of the hill is located immediately south of the site.

At the time of the investigation the site was occupied by hospital buildings and paved carpark areas. A 'U' shaped building was located in the north-west section of the site and consisted of three metal clad buildings connected by enclosed walkways. The building housed a drug and alcohol treatment centre. A brick and cinder block retaining wall was located along the south side of the 'U' shaped building and was up to approximately 1m high in the south section and up to 2m high in the south-west corner. The wall retained a garden area to the south and carpark to the south-west above the 'U' shaped building. A single storey brick building was located to the south of the garden area and was occupied by Rotary lodges. An electrical fuse box was observed on the east wall of the Rotary lodges and the backing board appeared to be fibre-cement (potentially containing asbestos). An asphaltic concrete (AC) paved carpark was located south of the Rotary building. A cinder block retaining wall approximately 1.5m to 2m high retained the south section of the carpark above the north section. A single storey brick building was located east of the carpark in the south-east section of the site. The building was named The Vera Lindsay and was used as a clinical resource centre – teaching hospital for the University of Sydney. A brick retaining wall up to approximately 1m high was located immediately south of the teaching building and retained part of the AC carpark.

A split level brick building was located to the east and north-east of the site that housed Ryde Community Mental Health Centre. Two storey brick buildings were located to the south and west of the site. Two buildings located to the west of the site were occupied by a medical centre. The south-most building included an undercroftcarpark. An X-ray centre was located to the south of the medical centre and south-west of the site.

The two storey building to the south of the site was occupied by 'The Chattery' and included a kitchen and kiosk. A metal clad building was located immediately south of The Chattery and was occupied by an aged care centre.

A two storey, sandstone block building was located to the east of the south section of the site and was occupied by a midwifery centre. A three storey building was located to the south-east of the site and was occupied by a maternity ward. An AC paved carpark was located east of the midwifery building and included a large liquid oxygen tank in the east section. An electrical substation was located east of the liquid oxygen store in a brick bunded area. The emergency department was located to the south-east of the maternity ward, approximately at the crest of the hill. Additional brick and metal clad buildings were located further south, within the hospital grounds.

Medium density residential premises were located to the north of the site, beyond Fourth Avenue, and typically consisted of single and double storey brick houses.

3.3 Regional Geology

The geological map of Sydney (1983[6]) indicates the site to be underlain by Ashfield Shale of the Wianamatta Group, which typically consists of black to dark grey shale and laminite.

3.4 Hydrogeology

NSW Office of Water (formerly Department of Water and Energy[7]) records were researched for the investigation and indicated that one registered groundwater bore lies within 1km of the site. The groundwater works summary and a map indicating the location of the bore in relation to the site are attached in Appendix C. The bore (ref: GW110173) was located approximately 800m to the north-west of the site, installed to approximately 48m and registered for recreation.

The stratigraphy of the site is expected to consist of residual clayey soils overlying relatively shallow bedrock. Based on these conditions and the results of the groundwater bore search groundwater is not considered to be a significant resource in the immediate area of the site.

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[6] *1:100,000 Geological Map of Sydney (Series 9130),* Department of Mineral Resources (1983) [now Department of Primary Industries]

[7] http://www.waterinfo.nsw.gov.au/gw/ visited on 2 March 2011

4 SITE HISTORY ASSESSMENT

4.1 Aerial Photographs

Aerial photographs of the site taken in 1930, 1951, 1961, 1970, 1978, 1986, 1994 and 2005 were obtained from the Department of Lands and were reviewed as part of the assessment of the site history. EIS has also reviewed the 1943 historical aerial photograph available for the site on the NSW Department of Lands SIX Viewer[8]. The information obtained from the photographs are summarised in the following table:

Year	Details
1930	A house was located in the north-west section of the site. A detached garage or shed was located adjacent to the house. A small building/shed was located in the south-east corner of the site. The remainder of the site appeared vacant and grassed except for some trees in the south section. Medium density residential premises were located to the west, north and north-east of the site. A small building was located to the east of the south section of the site and appeared similar to the existing (2011) midwifery centre; however as surrounding land did not appear to include other hospital buildings, it is considered unlikely that this building was used for midwifery at this time. Several unpaved roads/tracks were located to the south-east of the midwifery centre and two dams appeared to be located further to the south-east. The areas to the south and south-east were vacant and grassed, except for some treed areas beyond the crest of the hill.
1943	The site appeared similar to the 1930 photograph. Larger buildings were located to the south-east and south of the site and appeared to be hospital buildings. The building to the south appeared similar to the existing (2011) 'The Chattery'. Internal hospital roads had been constructed to the south-east of the site.
1951	Two buildings had been constructed in the north section of the site. The east-most building appeared similar to the east section of the existing (2011) 'U' shaped building. The immediate surrounds appeared similar to the 1943 photograph.
1961	Two additional buildings had been constructed in the north section of the site. The buildings completed the form of the existing (2011) 'U' shaped building. A third building was located immediately east of the 'U' shaped building.
1970	The building immediately south of the 'U' shaped building had been demolished and the area appeared vacant and grassed. The small building in the south-east corner of the site had been demolished and a larger building constructed that appeared similar to the existing (2011) 'Vera Lindsay'.

[8] https://six.maps.nsw.gov.au/wps/portal/SIXViewer

	The immediate surrounds appeared similar to the 1961 photograph, except that some additional small carparks and internal roads were located to the east and south-east.
1978	The house and garage/shed in the north-west section of the site had been demolished and the area appeared vacant and grassed. A paved carpark had been constructed to the west of the site.
1986	A small building had been constructed to the south of the 'U' shaped building that appeared similar to the existing (2011) Rotary lodges. Paved carparks had been constructed along the west site boundary and appeared similar to the existing (2011) carparks. A large building had been constructed to the west of the south section of the site that appeared similar to the existing (2011) medical centre. A paved carpark had been constructed to the north-west of the medical centre.
1994	The site and immediate surrounds appeared similar to the 1986 photograph, except that a new building that appeared similar to the existing (2011) maternity ward had been constructed in place of a former building to the south-east of the site.
2005	The carpark had been extended and occupied the south section of the site in a layout that appeared similar to the existing (2011) carpark. A large building had been constructed in place of previous hospital buildings to the east of the north section of the site that appeared similar to the existing (2011) Mental Health Centre. The final remaining house to the west of the site had been demolished and a building had been constructed to the west of the north section of the site that appeared similar to the existing (2011) north-most building of the medical centre. A building and associated carpark had been constructed to the south-west of the site that appeared similar to the existing (2011) x-ray centre.

4.2 Land Title Search

A limited historical land title search was performed on our behalf by Advance Legal Searchers Pty Ltd. Copies of the title records are presented in Appendix C and a summary of the relevant information is provided in the following tables:

Lot 1 DP 1137800 – majority of site

Registration Date	Proprietor
Lot 1 DP 1137800	
2010 – todate	The State of New South Wales
2009 – 2010	Health Administration Corporation
Lot 1 DP 869614	
1997 – 2009	Health Administration Corporation
(2005 – 2009)	*(commercial lease shown on Historical Search 1/869614)*
Lot 6 Section 3 DP 7997	
1989 – 1997	Health Administration Corporation
Lot 6 Section 3 DP 7997 – CTVol 2884 Fol 219	
1952 – 1989	The Ryde District Soldiers' Memorial Hospital
1938 – 1950	Pearl Porter, spinster
1920 – 1938	Mary Ann Porter
1918 – 1920	James Elton Morren, carpenter
1918 – 1918	Frank David Muller, gentleman John Edgar Terry, accountant
Portion 48, Parish of Hunters Hill – Area 128 Acres 3 Roods 4 ¼ Perches – CTVol 1115 Fol 59	
1914 – 1918	Frank David Muller, gentleman John Edgar Terry, accountant
1894 – 1914	Richard Rouse Terry
Lot 157 DP 752035	
1989 – 1997	Health Administration Corporation
Part of Portion 15, Parish of Hunter's Hill – Area 17 Acres 3 Roods 17 ¾ Perches – CTVol 4700 Fol 144	
1929 – 1989	The Ryde District Soldiers' Memorial Hospital Grantee (land as a site for hospital)

Lot 2 DP 1137800 – includes east-most section of 'U' building and Vera Lindsay

Registration Date	Proprietor
Lot 2 DP 1137800	
2009 – todate	North Sydney and Central Coast Area Health Service
(2009 – 2055)	*(lease to Energy Australia, shown on current title)*
Lot 1 DP 869614	
1997 – 2009	Health Administration Corporation
(2005 – 2009)	*(commercial lease shown on Historical Search 1/869614)*
Lot 3 Section 3 DP 7997	
1989 – 1997	Health Administration Corporation
Lot 3 Section 3 DP 7997 – Area 32 Perches – CTVol 2843 Fol 47	
1940 – 1989	The Ryde District Soldiers' Memorial Hospital
1940 – 1940	David Wild Crawley, retired blacksmith David James Crawley, engineer
1920 – 1940	Harriet Crawley
1920 – 1920	Jack Crawley, motor car trimmer
1918 – 1920	Richard Harold Gray, car builder
1918 – 1918	Frank David Muller, gentleman John Edgar Terry, accountant
Portion 48, Parish of Hunters Hill – Area 128 Acres 3 Roods 4 ¼ Perches – CTVol 1115 Fol 59	
1914 – 1918	Frank David Muller, gentleman John Edgar Terry, accountant
1894 – 1914	Richard Rouse Terry
Lot 4 Section 3 DP 7997	
1989 – 1997	Health Administration Corporation
Lot 4 Section 3 DP 7997 – Area 32 Perches – CTVol 3175 Fol 75	
1942 – 1989	The Ryde District Soldiers' Memorial Hospital
1942 – 1942	Perpetual Trustee Company (Limited), MORTGAGEE
1929 – 1942	Ada Alice Burns
1928 – 1929	Joseph Lorriman, musician
1928 – 1928	Madeline Blanche Doutty
1921 – 1928	George Henry Evans, packer
Portion 48, Parish of Hunters Hill – Area 128 Acres 3 Roods 4 ¼ Perches – CTVol 1115 Fol 59	
1914 – 1921	Frank David Muller, gentleman John Edgar Terry, accountant
1894 – 1914	Richard Rouse Terry

Lot 5 Section 3 DP 7997	
1989 – 1997	Health Administration Corporation
Lot 5 Section 3 DP 7997 – Area 32 Perches – CTVol 3596 Fol 137	
1943 – 1989	The Ryde District Soldiers' Memorial Hospital
1924 – 1943	William Whitelegg
1924 – 1924	Madeline Blanche Doutty
Part Portion 48, Parish of Hunter's Hill – Area 75 Acres 1 Rood ½ Perch – CTVol 3255 Fol 9	
1921 – 1924	Frank David Muller, gentleman John Edgar Terry, accountant
Portion 48, Parish of Hunters Hill – Area 128 Acres 3 Roods 4 ¼ Perches – CTVol 1115 Fol 59	
1914 – 1921	Frank David Muller, gentleman John Edgar Terry, accountant
1894 – 1914	Richard Rouse Terry
Lot 157 DP 752035	
1989 – 1997	Health Administration Corporation
Part of Portion 15, Parish of Hunter's Hill – Area 17 Acres 3 Roods 17 ¾ Perches – CTVol 4700 Fol 144	
1929 – 1989	The Ryde District Soldiers' Memorial Hospital

The land search has not indicated any particular land use that may be considered to have resulted in significant contamination of the soil and groundwater at the site, except for a potential car builder on part of Lot 2 DP 1137800. EIS consider this area was unlikely to have included car building operations as the lot was only owned by car builders/trimmers for approximately two years.

4.3 Council Records

A search of Development Application (DA) and Building Approval (BA) records/the property file held by Ryde Council is currently underway and the results will be forwarded when received.

4.4 WorkCover Database Records

A records search for licenses to store dangerous goods was undertaken on our behalf by WorkCover. The records indicatedseveral licences associated with storage of chemical and gases at the hospital site. None of these were in the vicinity of the proposed development area.

A letter relating to an underground storage tank dated 23 December 1996 indicated that a UST was decommissioned in 1990 by Oilsafe Pty Ltd. Although the exact location of the

UST is not included in the records, EIS consider that the likely location was either near the emergency department (for ambulances) of near the engineering building towards the south side of the hospital. Both of these locations are a significant distance from the development area.

4.5 NSW DECCW Records

A search of the NSW DECCW (EPA) on-line database did not indicate the existence of any EPA notices for the site under section 58 of the CLM Act 1997. A search of the NSW DECCW public register (POEO) indicated the existence of a former license for the hospital site for hazardous, industrial or Group A waste generation or storage. The license is no longer in force.

4.6 Assessment of Historical Information Integrity

The site history assessment has generally been obtained from: government records including the NSW land titles office, local government historical archives, historical aerial photographs and NSW WorkCover records. The veracity of the information from these sources is considered to be high, however, given the age of the development, the gap of up to 13 years between aerial photographs and the lack of information available on activities prior to 1930's, a certain degree of information loss is to be expected.

Non verifiable anecdotal information has not been relied upon during assessment of historical site use. Therefore, there is considered to be a high level of integrity associated with information obtained with respect to historical use of the site.

4.7 Summary of Historical Site Use

The search of historical information has indicated the following:

- The site was used for residential purposes or vacant since at least 1930;
- The site became part of a larger hospital in the 1940's and 1950's;
- The 'U' shaped building was constructed in stages between 1943 and 1961;
- The 'Vera Lindsay' was constructed between 1961 and 1970;
- The Rotary lodge building was constructed between 1978 and 1986;
- The carpark was partially constructed in the 1970's and extended to the current form between 1994 and 2005;
- Several buildings were demolished from the north, north-west, central and south-east sections of the site in the 1960's and 1970's;
- There are no current recorded notices listed on the NSW DECCW CLM or POEO register; and
- WorkCover have no records of underground storage tank licenses issued for the site.

5 POTENTIAL CONTAMINATION SOURCES

5.1 Potential Site Specific Contamination

Potential contamination at the site would be anticipated to be associated with:

- Potentially contaminated, imported fill material;
- Potential asbestos contamination associated with demolition of the former site buildings; and
- Historical activities such as use of pesticides.

5.1.1 Site Specific Soil Contaminants of Concern

The compounds identified as soil contaminants of concern at the site include:

- Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc;
- Total petroleum hydrocarbons (TPH);
- Monocyclic aromatic hydrocarbon compounds: benzene, toluene, ethyl benzene and xylenes (BTEX);
- Polycyclic aromatic hydrocarbons (PAHs) including benzo(a)pyrene;
- Organochlorine pesticides (OCPs) including Aldrin, dieldrin, chlordane, DDT, DDD, DDE and heptachlor;
- Organophosphorus pesticides (OPPs);
- Polychlorinated Biphenyls (PCBs); and
- Asbestos.

5.2 Potential Receptors

The main potential contamination receptors are considered to include:

- Terrys Creek located approximately 850m to the north-north-west of the site;
- Site visitors, workers and adjacent property owners, who may come into contact with contaminated soil and/or be exposed to contaminated dust arising from construction activity; and
- Future site occupants.

5.3 Contaminant Laydown and Transport Mechanisms

At this site, mobile contaminants would be expected to move down to the rock surface and migrate laterally down-slope from the source. The movement of contaminants would be expected to be associated with groundwater flow and seepage at the top of the bedrock.

6 ASSESSMENT CRITERIA DEVELOPMENT

6.1 Regulatory Background

In 1997 the NSW Government introduced the CLM Act. This Act has been amended by the *Contaminated Land Management Amendment Act* (2008[9]).

The CLMAct 1997, associated regulations, SEPP55 and NSW DECCW (EPA) guidelines, were designed to provide uniform state-wide control of the management, investigation and remediation of contaminated land.

Prior to granting consent for any proposed rezoning or development, SEPP55 requires the consent authority to:

- Consider whether the land is contaminated;
- Consider whether the site is suitable, or if contaminated, can be made suitable by remediation, for the proposed land use; and
- Be satisfied that remediation works will be undertaken prior to use of the site for the proposed use.

Should the assessment indicate that the site poses a risk to human health or the environment, remediation of the site may be required prior to occupation of the proposed development. SEPP55 requires that the relevant local council be notified of all remediation works, whether or not development consent is required. Where development consent is not required, 30 days written notice of the proposed works must be provided to council. Details of validation of remediation work must also be submitted to Council within one month of completion of remediation works.

The consent authority may request that a site audit be undertaken during, or following the completion of the site assessment process. Under the terms of the CLM Act 1997 the NSW DECCW (EPA) Site Auditor Scheme was developed to provide a system of independent review for assessment reports. An accredited Contaminated Site Auditor is engaged to review reports prepared by suitably qualified consultants to ensure that the investigation has been undertaken in accordance with the guidelines and confirm that the sites are suitable for their intended use.

Section 59(2) of the CLM Act 1997 states that specific notation relating to contaminated land issues must be included on Section149 (s149) planning certificates prepared by Council where the land to which the certificate relates is:

- Within an investigation or remediation area;
- Subject to an investigation or remediation order by the DECCW (EPA);
- The subject of a voluntary investigation or remediation proposal; and/or

- The subject of a site audit statement.

Submission of contaminated site investigation and validation reports to council as part of rezoning or development application submissions may also result in notation of actual or potential site contamination on future s149 certificates prepared for the site.

Section 60 of the CLM Amendment Act 2008 sets out a positive duty on a land owner, or person whose activities have caused contamination, to notify the DECCW if they are or become aware that contamination exists on a site that generally poses "*an unacceptable risk to human health or the environment, given the site's current or approved use*". This duty to report is based on trigger values, above which notification is required.

Off-site disposal of fill, contaminated material and excess soil/rock excavated as part of the proposed development works is regulated by the provisions of the *Protection of the Environment Operations Act*(1997[10]) and associated regulations and guidelines including the *NSW DECC (now DECCW) Waste Classification Guidelines - Part 1: Classifying Waste*(2009[11]). All materials should be classified in accordance with these guidelines prior to disposal.

Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner.

6.2 Soil Contaminant Threshold Concentrations

The soil investigation levels adopted for this investigation are derived from the NSW DEC (now DECCW) document *Guidelines for the NSW Site Auditor Scheme, 2nd Edition* (2006[12]) and the National Environmental Protection Council document *National Environmental Protection (Assessment of Site Contamination) Measure* (1999[13]). The contaminant thresholds listed below are levels at which further investigation and evaluation is required to assess whether the site is considered suitable for the proposed urban land use.

To accommodate the range of human and ecological exposure settings, a number of generic settings are used on which the Health based Investigation Levels (HILs) can be

[9] *Contaminated Land Management Amendment Act,* NSW Government Legislation, 2008 (CLM Amendment Act 2008)
[10] *Protection of Environment Operations Act,* NSW Government, 1997 (POEO Act 1997)
[11] *Waste Classification Guidelines, Part 1: Classifying Waste,* NSW DECC, 2009 (Waste Classification Guidelines 2009)
[12] *Guidelines for the NSW Site Auditor Scheme, 2nd ed.,* NSW DEC, 2006 (Site Auditor Guidelines 2006)
[13] *National Environmental Protection (Assessment of Site Contamination) Measure,* National Environment Protection Council (NEPC), 1999 (NEPM 1999)

based. Four categories of HILs are adopted for urban site assessments. Contaminant levels for a standard residential site with gardens and accessible soil (Column A) are based on protection of a young child resident at the site. The remaining categories (Columns D to F) present alternative exposure settings where there is reduced access to soil or reduced exposure time. These categories include residential land use with limited soil access, recreational and public open space and commercial/industrial use. Where the proposed land use will include more than one land use category (eg. mixed residential/commercial development) the exposure setting of the most "sensitive" land use is adopted for the site.

Threshold concentrations for petroleum hydrocarbon contaminants including total TPH and BTEX compounds have previously been established in the *NSW EPA (now DECCW) Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994[14]) publication and this document is referenced in the Site Auditor Guidelines 2006. Heavy fraction petroleum hydrocarbon aliphatic/aromatic component threshold concentrations have also been introduced in NEPM 1999.

Soil samples for this investigation have been analysed for total recoverable hydrocarbons (TRH) rather than TPH. TRH analysis is undertaken without a preliminary silica gel clean-up of the sample. Consequently the TRH result may include other compounds such as phthalates, humic acids, fatty acids and sterols (if present). For comparative purposes in relation to the threshold concentrations, we have referred to TRH as TPH within this report.

6.2.1 Provisional Phyto-toxicity Investigation Levels (PPILs)

The Provisional Phyto-toxicity Investigation Levels (PPILs) are generic values based on phytotoxicity data for plant response to specific contaminants in a sandy loam matrix and are included in the contaminated site assessment where the proposed land use includes gardens or accessible soils. The PPILs are listed in the Site Auditor Guidelines 2006. The PPILs are identical to the Ecological Investigation Levels (EILs) originally specified in NEPM 1999.

6.2.2 Asbestos in Soil

NEPM 1999 does not provide numeric guidelines for the assessment of asbestos in soil. NSW DECCW (EPA) advice (2006) has indicated that consultants should use their 'professional judgement' regarding determination of appropriate investigation and remediation levels for asbestos in soils; however the NSW DECCW (EPA) have not published numerical guidelines for the assessment of asbestos in subsurface soils.

[14] *Guidelines for Assessing Service Station Sites,* NSW EPA, 1994 (Service Station Guidelines 1994)

The WorkCover publication *Working with Asbestos Guide* (2008[15]) states that, where buried asbestos is encountered, "A competent occupational hygienist should assess the site to determine:

- If asbestos material is bonded or friable
- The extent of asbestos contamination
- Safe work procedures for the remediation of the site"

"*Any asbestos cement products that have been subjected to weathering, or damaged by hail, fire or water blasting are considered to be friable asbestos and an asbestos removal contractor with a WorkCover license for friable asbestos removal is required for its removal*". Under the *NSW Occupational Health and Safety (OHS) Regulations 2001*[16] and WorkCover requirements all necessary disturbance works associated with friable asbestos containing materials must be conducted by a licensed AS-1 Asbestos Removal Contractor.

6.2.3 Site Assessment Criteria (SAC) for Soil Contaminants

The 'open spaces' (Column E) exposure setting has been adopted for this assessment as land use at hospitals can be highly varied and generally includes some limited access to soils or landscaped areas. The appropriate soil criteria are listed in the following table:

[15] *Working with Asbestos Guide,* NSW WorkCover, 2008 (WorkCover Working with Asbestos Guide 2008)
[16] *Occupational Health and Safety Regulation,* NSW Government, 2001 (NSW OH&S Regulation 2001)

Contaminant	SAC - HILs Column E (mg/kg)	PPILs (mg/kg)
Heavy Metals		
Arsenic (total)	200	20
Cadmium	40	3
Chromium (III)	24%	400
Copper	2000	100
Lead	600	600
Mercury (inorganic)	30	1
Nickel	600	60
Zinc	14000	200
Petroleum Hydrocarbons		
TPH (C_6-C_9)	65 [a]	-
TPH (C_{10}-C_{36})	1000 [a]	-
Benzene	1 [a]	-
Toluene	1.4 [a]	-
Ethylbenzene	3.1 [a]	-
Total Xylenes	14 [a]	-
PAHs		
Total PAHs	40	-
Benzo(a)pyrene	2	-
Pesticides (OCPs & OPPs)		
Aldrin + Dieldrin	20	-
Chlordane	100	-
DDT+ DDD + DDE	400	-
Heptachlor	20	-
Total OPPs	0.1 [b]	-
Others		
PCBs (Total)	20	-
Asbestos	NDLR [c]	-

Note:

[a] Service Station Guidelines 1994

[b] Due to the absence of locally endorsed guideline criteria, the laboratory practical quantitation limit (PQL) has been adopted.

[c] Not Detected at Limit of Reporting (NDLR)

6.2.4 Waste Classification Assessment Criteria

For the purpose of off-site disposal, the classification of soil into 'General Solid Waste (non-putrescible)', 'Restricted Solid Waste (non-putrescible)' and 'Hazardous Waste (non-putrescible)' categories is defined by chemical contaminant criteria outlined in the Waste Classification Guidelines 2009. The contaminant criteria are summarised in Table A-2.

6.3 Evaluation of Soil Analysis Data and Contaminant Threshold Concentrations

Assessment of the soil analytical data using the soil contaminant threshold concentrations has been undertaken in accordance with the methodology outlined in the NEPM 1999Schedule 7(a).

The following criteria have been adopted for assessment of the analytical data:

- For a site to be considered suitable for the proposed land use each individual contaminant concentration should be less than the SAC; and
- Where the concentration of each contaminant is less than the SAC in all samples, the suitability of the site for the proposed use may be assessed based solely on individual analytical results.

Where contamination results exceed the SAC, a method of remediating the site is to physically and selectively remove the contamination hotspots from the site. This process should be continued until statistical analysis of the data meets the SAC. Validation of the remediated site is generally required to demonstrate that the site is suitable for the proposed land use.

7 ASSESSMENT PLAN

7.1 Soil Sampling Density

The *NSW EPA (now DECCW) Contaminated Sites Sampling Design Guidelines* (1995[17])for contaminated site investigations state that samples should be obtained from a minimum of eleven evenly spaced sampling points for a site of this size (approximately 4,000m^2).

Samples were obtainedfrom six sampling locations for this investigation. This density is approximately 55% of the minimum sampling density.

The boreholes were drilled on a systematic sampling plan with a spacing of up to 30m between sampling points. A systematic sampling plan was considered most appropriate for this investigation as:

- no specific potential contaminant sources were identified by the available site history; and
- the distribution of contamination is expected to be associated with imported potentially contaminated fill material and is therefore likely to be random.

Sampling was not undertaken beneath the existing buildings at the site as access was not possible during the field investigation.

7.2 Data Quality Objectives (DQOs)

The DQOs for the assessment were developed with reference to the US EPA document*Data Quality Objectives Process for Hazardous Waste Site Investigations*(2000[18]).The document includes seven steps as follows:

1. State the problem
2. Identify the decision
3. Identify inputs into the decision
4. Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Errors
7. Optimise the Design for Obtaining data

Field investigations are undertaken generally in accordance with EIS sampling protocols outlined in Appendix D.

[17]*Contaminated Sites Sampling Design Guidelines,* NSW EPA, 1995 (EPA Sampling Design Guidelines 1995)
[18]*Data Quality Objectives Process for Hazardous Waste Site Investigations,* US EPA, *2000* (US EPA 2000)

7.3 Data Quality Indicators (DQIs) and Quality Assurance

The validation, as part of the DQOs, involves the technical review of the data using defined QA Assessment Criteria. The success of theDQIs is based on assessment of the data set as a whole and not on individual acceptance or exceedance within the data set.

Review of QA criteria was based on laboratory data including surrogate recovery, laboratory control samples, duplicates, matrix spikes and method blanks.

Field QA/QC included collection and analysis of approximately 15% of field soil samples as intra-laboratory duplicates.

Success of field DQIs is based on the following criteria:

- Relative percentage differences (RPDs) were calculated for the intra-laboratory duplicates. The RPD was calculated as the absolute value of the difference between the initial and repeat result divided by the average value, expressed as a percentage. The following acceptance criteria were used to assess the RPD results:
  - For results that were greater than 10 times the Practical Quantitation Limit (PQL) RPDs less than 50% were considered acceptable.
  - For results that were between 5 and 10 times PQL RPDs less than 75% were considered acceptable.
  - For results that were less than 5 times the PQL RPDs less than 100% were considered acceptable.

8 INVESTIGATION PROCEDURE

8.1 Soil Sampling Methods

Subsurface investigation was undertaken using a truck mounted hydraulically operated drill rig equipped with spiral flight augers. Soil samples were obtained from a Standard Penetration Test (SPT) sampler or directly from the auger when conditions did not allow use of the SPT sampler.

The SPT sampler was washed with phosphate free detergent and rinsed following each sampling event. The spiral flight augers were decontaminated using a scrubbing brush and potable water and Decon 90 solution (phosphate free detergent) followed by rinsing with potable water. Details of the decontamination procedure adopted during sampling are presented in Appendix D.

Soil and rock samples were obtained at various depths, based on observations made during the field investigation. During sampling, soil at selected depths was split into initial and duplicate samples for QA/QC assessment.

All samples were placed in glass jars with plastic caps and teflon seals with minimal headspace. Samples for asbestos analysis were placed in zip-lock plastic bags. Sampling personnel used disposable nitrile gloves during sampling activities.

During the investigation, soil samples were preserved by immediate storage in an insulated sample container with ice in accordance with AS 4482.1-2005[19] and AS 4482.2-1999[20] as summarised in the following table:

Analyte	Preservation	Storage
Heavy metals	Unpreserved glass jar with Teflon lined lid	Store at <4º, analysis within 28 days (mercury and Cr[VI]) and 180 days (other metals).
VOCs (TPH/BTEX)		Store at <4º, nil headspace, extract within 14 days, analysis within forty days
PAHs, OCP, OPP & PCBs		
Asbestos	Sealed plastic bag	None

The samples were labelled with the job number, sampling location, sampling depth and date. All samples were recorded on the borehole logs presented in Appendix A and on the laboratory chain of custody (COC) record presented in Appendix B.

[19] *Guide to the Investigation and Sampling of sites with Potentially Contaminated Soil,* Standards Australia, 2005 (AS 2005)
[20] *Guide to the Sampling and Investigation of Potentially Contaminated Soil Part2: Volatile Substances,* Standards Australia, 1999 (AS 1999)

On completion of the fieldwork, the samples were delivered in the insulated sample container to a NATA registered laboratory for analysis under standard COC procedures. Detailed EIS field sampling protocols are included in Appendix D.

8.2 Photoionisation Detector (PID) Screening

A portable PID was used to screen the samples for the presence of volatile organic compounds (VOCs) and to assist with selection of samples for laboratory hydrocarbon (TPH/BTEX) analysis.

The sensitivity of the PID is dependent on the organic compound and varies for different mixtures of hydrocarbons. Some compounds give relatively high readings and some can be undetectable even though present in identical concentrations. The portable PID is best used semi-quantitatively to compare samples contaminated by the same hydrocarbon source.

The PID is calibrated before use by measurement of an isobutylene standard gas. All the PID measurements are quoted as parts per million (ppm) isobutylene equivalents.

PID screening of detectable volatile organic compounds (VOCs) was undertaken on soil samples using the soil sample headspace method. VOC data was obtained from partly filled zip-lock plastic bags following equilibration of the headspace gases. The PID headspace data is presented on the COC documents.

8.3 Laboratory Analysis

Laboratory analysis was undertaken by Envirolab Services Pty Ltd (NATA Accreditation No. 2901).

8.3.1 Soil Samples

Soil samples were analysed using the following analytical methods detailed in Schedule B(3) of NEPM (1999[21]):

- Heavy metals – Nitric acid digestion. Analysis by ICP/AES.
- Low level mercury – cold vapour AAS.
- OC and OP pesticides and PCBs – Extracted with dichloromethane/acetone. Analysis by GC/ECD.
- PAHs – Soil extracted with dichloromethane/acetone. Analysis by GC/MS.
- TPH (volatile) – Soil extracted with methanol. Analysis by P&T GC/MS.
- TPH – Soil extracted with dichloromethane/acetone. Analysis by GC/FID.
- BTEX – Soil extracted with methanol. Analysis by P&T GC/MS.

[21] *Guideline on Laboratory Analysis of Potentially Contaminated Soils*, Schedule B(3), NEMP, 1999 (Schedule B(3))

- Asbestos – Polarizing light microscopy.

9 RESULTS OF INVESTIGATION

9.1 Subsurface Conditions

Borehole locations are shown on Figure 2. Seven boreholes were drilled for the combined environmental and geotechnical investigation. For details of the subsurface soil profile reference should be made to the borehole logs in Appendix A. A summary of the subsurface conditions encountered in the boreholes is presented below:

Pavement

Asphaltic concrete, approximately 40mm thick, was encountered at the surface in BH4 to BH7, inclusive.

Fill

Silty clay fill material was encountered at the surface in BH1 to BH3 inclusive and extended to depths of approximately 0.1m to 1.7m. Sand, silty clayey sand or silty gravelly sand was encountered beneath the pavement in BH4 to BH7 inclusive and extended to depths of approximately 0.2m to 0.4m. The silty clay was typically brown and contained traces of root fibres and ash. The sand material was typically yellow-brown or brown and contained igneous or sandstone gravel.

Natural Soils

Silty clay was encountered beneath the fill material in all boreholes and extended to depths of approximately 1.8m to 3.5m in BH1 to BH3 inclusive and 0.4m to 1.2m in BH4 to BH7 inclusive. The silty clay was typically grey or red-brown and contained traces of ironstone gravel in BH4 and BH5.

Bedrock

Shale was encountered beneath the silty clay in all boreholes and extended to the termination of all boreholes at a maximum depth of approximately 11m. The shale was typically grey and red-brown with some clay and iron indurated bands.

Groundwater

Immediate groundwater seepage was encountered at a depth of approximately 6.5m in BH6. Monitoring wells were installed in BH4 and BH6 and standing water levels were measured at depths of approximately 4.6m and 3.1m, respectively, after approximately 28 and 27 hours respectively.

9.2 Laboratory Results

The laboratory reports are presented in Appendix B. The results have been assessed against the SAC adopted for this investigation.

9.2.1 Soil Samples

The soil laboratory results are presented in Table B. The results of the analyses are summarised below.

Heavy Metals

Five fill samples and one natural soil sample were analysed for heavy metals. The results of the analyses were below the SAC, except for the arsenic concentration of 22mg/kg in the BH1 (0.1-0.5m) sample which was slightly above the PPIIL of 20mg/kg.

Waste Classification:

The results of all analyses were less than the CT1 and SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Petroleum Hydrocarbons (TPH) and Monocyclic Aromatic Hydrocarbons (BTEX)

PID soil sample headspace readings were all zero ppm equivalent isobutylene. These results indicate a lack of PID detectable volatile organic contaminants.

Five fill samples and one natural soil sample were analysed for TPH and BTEX compounds. The results of the analyses were below the SAC.

Waste Classification:

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Polycyclic Aromatic Hydrocarbons (PAHs)

Five fill samples and one natural soil sample were analysed for a range of PAHs including Benzo(a)pyrene. The results of the analyses were less than the SAC.

Waste Classification:

The results of all analyses were less than the relevant CT1 and SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Organochlorine (OCPs) and Organophosphorous (OPPs) Pesticides

Five fill samples and one natural soil sample were analysed for a range of OCPs and OPPs. The results of the analyses were below the laboratory PQL and less than the SAC.

Waste Classification:

The results of all analyses were less than the SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Polychlorinated Biphenyls (PCBs)

Five fill samples and one natural soil sample were analysed for a range of PCBs. The results of the analyses were below the laboratory PQL and less than the SAC.

Waste Classification:

The results of all analyses were less than the SCC1 criteria outlined in the Waste Classification Guidelines 2009.

Asbestos

Five fill samples and one natural soil sample were screened for the presence of asbestos fibres. The results of the analyses indicated that asbestos fibres were not encountered within the samples and no respirable fibres were detected.

10 ASSESSMENT OF ANALYTICAL QA/QC

The DQOs and DQIs established for the investigation have been assessed in this section of the report. The assessment includes a review of the laboratory QA/QC procedure to assess whether the sample data is reliable.

The laboratory report for this investigation has been checked and issued as final by:

- Envirolab Services Pty Ltd
  NATA Accreditation No. 2901
  Report number: 52258

The RPD results for the field QA/QC duplicate sampls are summarised in Table C. An assessment of the DQIs adopted for this investigation is summarised in the following table. A brief explanation of the individual DQI is presented in Appendix D.

DQO	Number of Samples	DQI
Precision:		
Intra-laboratory duplicate Sample Reference: Dup 1 is a duplicate of soil sample BH1 (0.1-0.5m)	Soil: 1	The intra-laboratory RPD values indicated that field precision was acceptable.
Accuracy:		
Surrogate Spikes	All organic analytes	Laboratory accuracy was good and that no outliers were reported.
Laboratory Control Sample (LCS)	Soil: 2	Laboratory accuracy was good and that no outliers were reported.
Representativeness:		
Samples extracted and analysed within holding time	All Samples	All samples were extracted and analysed within the appropriate holding times outlined in the investigation procedure.
Analysis of Laboratory Blanks	Soil: 1	All laboratory blanks were found to be free of analyte concentrations above the PQLs.
Comparability:		
EIS sampling protocols	All Samples	Sampling was undertaken in accordance with the EIS sampling protocols outlined in Appendix D
Standard laboratory analytical methods used	All Samples	All Samples
Samples obtained by qualified staff	All Samples	All Samples
Completeness:		
Documentation (including site notes, borehole logs and COC etc) was correctly maintained	All Samples	All Samples
Samples obtained were analysed for the contaminants of concern	All Samples	All Samples
Appropriate analytical methods used by the laboratory.	All Samples	All Samples

11 DISCUSSION

The Stage 1 environmental site assessment undertaken for the proposed Graythwaite Rehabilitation Centre was designed to assess the suitability of the site for the proposed land use.

11.1 Summary of Soil Conditions

Soil samples obtained for the investigation were analysed for the potential contaminants of concern identified at the site.

Elevated concentrations of contaminants were not encountered in the soil samples analysed for the investigation. All results were below the site assessment criteria (SAC).

Based on the results, EIS are of the opinion that the potential for significant widespread soil contamination at the site is relatively low.

Access to the soils beneath the 'U' shaped building, the Rotary lodge and the 'Vera Lindsay' was not possible during this investigation. Review of historical information has indicated that former site buildings in these areas were demolished in the 1960's and 1970's. The potential for hazardous building materials beneath these buildings remains a concern. Therefore, EIS consider that the site should be inspected immediately following demolition of the existing buildings and during excavation to better assess the potential for asbestos contamination of the site.

11.1.1 PPILs

The BH1 (0.1-0.5m) natural soil sample encountered an elevated concentration of arsenic above the PPIL of 20mg/kg. A duplicate (Dup 1) was obtained of the BH1 (0.1-0.5m) sample and was found to contain an arsenic concentration of 18mg/kg, which is less than the PPIL. The PPIL criteria are principally concerned with phytotoxicity (i.e. adverse effects on plant growth in established and proposed areas of landscaping) and are described in NEPM 1999 as "*somewhat arbitrary*", as the effect of these compounds on plant growth will depend on the soil and plant type.

The arsenic elevation should be taken into consideration if the proposed development is to include landscaped areas with sensitive plant species where contaminant levels may influence plant growth.

11.1.2 Asbestos in Soil

Asbestos was not detected above the reporting limit in the soil samples analysed for the investigation; however, the areas occupied by existing buildings were inaccessible to subsurface investigations.The site should be inspected as outlined above.

11.2 Summary of Groundwater Conditions

Immediate groundwater seepage was encountered at a depth of approximately 6.5m in BH6. Monitoring wells were installed in BH4 and BH6 and standing water levels were measured at depths of approximately 4.6m and 3.1m, respectively, after approximately 28 and 27 hours respectively. EIS consider the potential for groundwater contamination at the site to be very low for the following reasons:

- Elevated concentrations of contaminants were not detected in the fill or natural soils at the site; and
- Groundwater is located within the shale bedrock aquifer and would, therefore, be less likely to be influenced by surficial contamination.

11.2.1 Dewatering During Development

In the event groundwater is intercepted during excavation works, dewatering will be required. Council and other relevant approvals will be required prior to disposal of groundwater into the stormwater system.

11.3 Waste Classification

11.3.1 Classification of Fill Soils

Based on the results of the assessment, the fill material is classified as 'General Solid Waste (non-putrescible)' according to the criteria outlined in the Waste Classification Guidelines 2009.

The material should be disposed of to a suitably licensed NSW DECCW (EPA) landfill.

11.3.2 Classification of Natural Soil and Bedrock

The natural silty clay and underlying shale bedrock at the site is considered to be virgin excavated natural material (VENM). The material is considered suitable for re-use on-site, or alternatively, the information included in this report may be used to assess whether the material is suitable for beneficial reuse at another site as fill material. Where doubt exists about the difference between fill and VENM material an environmental/geotechnical engineer should be contacted.

VENM must not be mixed with any fill material (including building rubble) as this will invalidate the VENM classification.

In the event the natural soils require disposal to a NSW DECCW (EPA) licensed landfill, the material can be disposed as 'General Solid Waste (non-putrescible)'.

11.4 Conclusion

Based on the scope of work undertaken for this assessment EIS consider that the site can be made suitable for the proposed development provided that the site is inspected by experienced environmental personnel during demolition and excavation works to assess any unexpected conditions or subsurface facilities that may be discovered between investigation locations and to better assess the potential for asbestos contamination beneath the existing buildings at the site. This should facilitate appropriate adjustment of the works programme and schedule in relation to the changed site conditions.

A hazardous materials assessment should be undertaken of all the buildings at the site prior to commencement of demolition works.

11.5 Regulatory Requirement

The requirement to report to the DECCW (EPA) under Section 60 and *Guidelines on the Duty to Report Contamination*[22] under the CLM Amendment Act 2008 should be assessed once the site has been inspected following demolition and excavation works.

[22] *Guidelines on the Duty to Report Contamination*, NSW Government Legislation, 2008 (Duty to Report Contamination 2008)

12 LIMITATIONS

The boreholes drilled for the investigation have enabled an assessment to be made of the existence of significant, large quantities of contaminated soils. The conclusions based on this investigation are that, while major contamination of the site is not apparent, problems may be encountered with smaller scale features between boreholes. EIS adopts no responsibility whatsoever for any problems such as underground storage tanks, buried items or contaminated material that may be encountered between sampling locations at the site. The proposed construction activities at the site should be planned on this basis, and any unexpected problem areas that are encountered between boreholes should be immediately inspected by experienced environmental personnel. This should ensure that such problems are dealt with in an appropriate manner, with minimal disruption to the project timetable and budget.

The conclusions developed in this report are based on site conditions which existed at the time of the site assessment and the scope of work outlined previously in this report. They are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, and visual observations of the site and vicinity, together with the interpretation of available historical information and documents reviewed as described in this report.

The investigation for this assessment and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined previously in this report.

Where information has been provided by third parties, EIS has not undertaken any verification process, except where specifically stated.

EIS has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination.

Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes.

Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work.

EIS accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site.

EIS have not and will not make any determination regarding finances associated with the site.

Changes in the proposed or current site use may result in remediation or further investigation being required at the site.

During construction at the site, soil, fill and any unsuspected materials that are encountered should be monitored by qualified environmental and geotechnical engineers to confirm assumptions made on the basis of the limited investigation data, and possible changes in site level and other conditions since the investigation. Soil materials considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of EIS. EIS has used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report.

Should you require any further information regarding the above, please do not hesitate to contact us.

Yours faithfully
For and on behalf of
ENVIRONMENTAL INVESTIGATION SERVICES

Todd Hore
Senior Environmental Engineer

Adrian Kingswell
Senior Associate

ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
AGST	Above Ground Storage Tank
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
ASS	Acid Sulfate Soil
B(a)P	Benzo(a)pyrene
BH	Borehole
BTEX	Benzene, Toluene, Ethyl benzene, Xylene
COC	Chain of Custody documentation
CLM	Contaminated Land Management
DECCW	Department of Environment, Climate Change and Water (formerly DECC, DEC and EPA)
DNR	NSW Department of Natural Resources (now split between DWE and DECCW)
DWE	NSW Department of Water and Energy
DP	Deposited Plan
DQO	Data Quality Objective
EC	Electrical Conductivity
EPA NSW	Environment Protection Authority, New South Wales (now part of DECCW)
GC-ECD	Gas Chromatograph-Electron Capture Detector
GC-FID	Gas Chromatograph-Flame Ionisation Detector
GC-MS	Gas Chromatograph-Mass Spectrometer
HIL	Health Based Investigation Level
HM	Heavy Metals
ICP-AES	Inductively Couple Plasma – Atomic Emission Spectra
NATA	National Association of Testing Authorities, Australia
NEPC	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
OCPs	Organochlorine Pesticides
OHS (OH&S)	Occupational Health and Safety
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PID	Photo-ionisation Detector
PPIL	Provisional Phyto-toxicity Investigation Levels
PQL	Practical Quantitation Limit
P&T	Purge & Trap
RAP	Remedial Action Plan
QA/QC	Quality Assurance and Quality Control
RPD	Relative Percentage Difference
SEPP	State Environmental Planning Policy
sPOCAS	suspension Peroxide Oxidation Combined Acidity and Sulfate
SPT	Standard Penetration Test
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

IMPORTANT INFORMATION ABOUT THE SITE ASSESSMENT REPORT

These notes have been prepared by EIS to assist with the assessment and interpretation of this report.

An Environmental Assessment Report is Based on a Unique Set of Project Specific Factors:

This report has been prepared in response to specific project requirements as stated in the EIS proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- the proposed land use is altered;
- the defined subject site is increased or sub-divided;
- the proposed development details including size, configuration, location, orientation of the structures are modified;
- the proposed development levels are altered, eg addition of basement levels; or
- ownership of the site changes.

EIS/J&K will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the assessment. If the subject site is sold, ownership of the assessment report should be transferred by EIS to the new site owners who will be informed of the conditions and limitations under which the assessment was undertaken. No person should apply an assessment for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions

Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (eg. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an assessment report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Assessment is Based on Professional Interpretations of Factual Data

Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn

about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Environmental Site Assessment Limitations

Although information provided by an environmental site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Environmental Site Assessments by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an environmental assessment report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Environmental Assessment Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problems, however contractors can still misinterpret the logs during bid preparation if separated from the text of the assessment. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the test of the report to obtain a proper understanding of the assessment. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site assessment is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

TABLE A - 2
CHEMICAL CONTAMINANT CRITERIA FOR WASTE CLASSIFICATION
Waste Classification Guidelines. Part 1: Classifying Waste DECC (now DECCW) NSW July 2009

GENERAL SOLID WASTE	RESTRICTED SOLID WASTE	HAZARDOUS WASTE
IF SCC ≤ CT1, TCLP NOT NEEDED TO CLASSIFY AS GENERAL SOLID WASTE	IF SCC ≤ CT2, TCLP NOT NEEDED TO CLASSIFY AS RESTRICTED SOLID WASTE	IF SCC > CT2, TCLP NOT NEEDED TO CLASSIFY AS HAZARDOUS WASTE
IF TCLP ≤ TCLP1 AND SCC ≤ SCC1 TREAT AS GENERAL SOLID WASTE	IF TCLP ≤ TCLP2 AND SCC ≤ SCC2 TREAT AS RESTRICTED SOLID WASTE	IF TCLP > TCLP2 AND/OR SCC > SCC2 TREAT AS HAZARDOUS WASTE

	GENERAL SOLID WASTE			RESTRICTED SOLID WASTE		
CONTAMINANT	CT1 (mg/kg)	TCLP1 (mg/L)	SCC1 (mg/kg)	CT2 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
Arsenic	100	5	500	400	20	2,000
Beryllium	20	1.0	100	80	4	400
Cadmium	20	1.0	100	80	4	400
Chromium VI	100	5	1,900	400	20	7,600
Cyanide (total)	320	16	5,900	1280	64	23,600
Cyanide (Amenable)	70	3.5	300	280	14	1,200
Fluoride	3,000	150	10,000	12,000	600	40,000
Lead	100	5	1,500	400	20	6,000
Mercury	4	0.2	50	16	0.8	200
Molybdenum	100	5	1,000	400	20	4,000
Nickel	40	2	1,050	160	8	4,200
Selenium	20	1	50	80	4	200
Silver	100	5.0	180	400	20	720
Benzene	10	0.5	18	40	2	72
Toluene	288	14.4	518	1,152	57.6	2,073
Ethylbenzene	600	30	1,080	2,400	120	4,320
Total xylenes	1,000	50	1,800	4,000	200	7,200
Total petroleum hydrocarbons (C6-C9)	-	-	650	-	-	2,600
Total petroleum hydrocarbons (C10-C36) (C10-C14, C15-C28, C29-C36)	-	-	10,000	-	-	40,000
Benzo(a)pyrene	0.8	0.04	10	3.2	0.16	23
Polycyclic aromatic hydrocarbons (Total)	-	-	200	-	-	800
Polychlorinated biphenyls	-	-	<50	-	-	<50
Phenol (nonhalogenated)	288	14.4	518	1,152	57.6	2,073
Scheduled chemicals	-	-	<50	-	-	<50

NOTE:
SCC – Specific Contaminant Concentration
CT – Contaminant Threshold
TCLP – Toxicity Characteristics Leaching Procedure

TABLE B
SUMMARY OF LABORATORY RESULTS
SOIL ASSESSMENT
All data in mg/kg unless stated otherwise

ANALYTE			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES				OP PESTICIDES	PCBs	PETROLEUM HYDROCARBONS									PID VALUES	ASBESTOS FIBRES
																			Petroleum Hydrocarbons					Benzene	Toluene	Ethyl benzene	Total Xylenes		
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor			C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	C_{10} - C_{36}						
PQL - Envirolab Services			4	0.5	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	0.1	25	50	100	100	250	0.5	0.5	1	3		100
Site Assessment Criteria ^			200 *	40 *	24% *	2000 *	600 *	30 *	600 *	14000 *	40 *	2 *	20 *	100 *	400 *	20 *	0.1 ^^	20 *	65 #	nsl	nsl	nsl	1000 #	1 #	1.4 #	3.1 #	14 #		100^^
PPILs			20 **	3 **	400 **	100 **	600 **	1 **	60 **	200 **	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl	nsl		-
General Solid Waste CT1+			100	20	100	nsl	100	4	40	nsl	nsl	0.8	nsl					nsl	nsl	nsl			nsl	10	288	600	1000	-	-
General Solid Waste SCC1+			500	100	1900	nsl	1500	50	1050	nsl	200	10	50					50	650	nsl			10000	18	518	1080	1800	-	-
Sample Reference	**Sample Depth**	**Sample Description**																											
BH1	0.1-0.5	Silty Clay	***22***	LPQL	18	16	47	0.1	4	50	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	LPQL
BH2	1-1.5	Fill: silty clay	9	LPQL	15	21	53	LPQL	4	72	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	LPQL
BH3	0-0.3	Fill: silty clay	6	LPQL	10	20	27	LPQL	7	44	0.49	0.09	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	LPQL
BH4	0.1-0.3	Fill: sand	LPQL	LPQL	6	2	10	LPQL	4	19	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	LPQL
BH5	0.1-0.3	Fill: silty clayey sand	6	LPQL	17	49	30	LPQL	8	34	2	0.2	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	0	LPQL
BH6	0.2-0.5	Fill: silty gravelly sand	LPQL	LPQL	14	49	37	LPQL	11	48	9.1	0.7	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	230	140	370	LPQL	LPQL	LPQL	LPQL	0	LPQL
Total Number of samples			6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Maximum Value			22	LPQL	18	49	53	0.1	11	72	9.1	0.7	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	LPQL	230	140	370	LPQL	LPQL	LPQL	LPQL	0	nc

EXPLANATION:

^ Site Assessment Criteria: Guideline concentrations adopted for the investigation as outlined below:
* National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC Guidelines)
Health Investigation Levels (HIL) - Column E, Parks, recreational open space
** Provisional Phyto-toxicity Investigation Levels (PPILs)
# NSW DECC (EPA) Guidelines for Assessing Service Station Sites (1994)
^^ In the absence of Australian guidelines, the laboratory PQL has been adopted as the site assessment criteria
+ NSW DECCW (EPA) Waste Classification Guidelines (2009)

Concentration above the Site Assessment Criteria **VALUE**
Concentration above PPILs ***VALUE***

ABBREVIATIONS:

PAHs: Polycyclic Aromatic Hydrocarbons
B(a)P: Benzo(a)Pyrene
PQL: Practical Quantitation Limit
LPQL: Less than PQL
OP: Organophosphorus Pesticides
PID: Photoionisation Detector
PCBs: Polychlorinated Biphenyls
UCL: Upper Level Confidence Limit on Mean Value
na: Not Analysed
nc: Not Calculated
nsl: No Set Limit

TABLE C
SOIL INTRA-LABORATORY DUPLICATE RESULTS
QA/QC - RELATIVE PERCENTAGE DIFFERENCES
All results in mg/kg unless stated otherwise

SAMPLE	ANALYSIS	Envirolab PQL	INITIAL	REPEAT	MEAN	RPD %
Intra-laboratory	Arsenic	4	22	18	20	20
Soil	Cadmium	0.5	LPQL	LPQL	LPQL	NC
sample ID = BH1 (0.1-0.5m)	Chromium	1	18	15	16.5	18
Dup ID = Dup 1	Copper	1	16	18	17	12
	Lead	1	47	56	51.5	17
Envirolab Report: 52258	Mercury	0.1	0.1	LPQL	0.075	67
	Nickel	1	4	4	4	0
	Zinc	1	50	59	54.5	17

EXPLANATION:

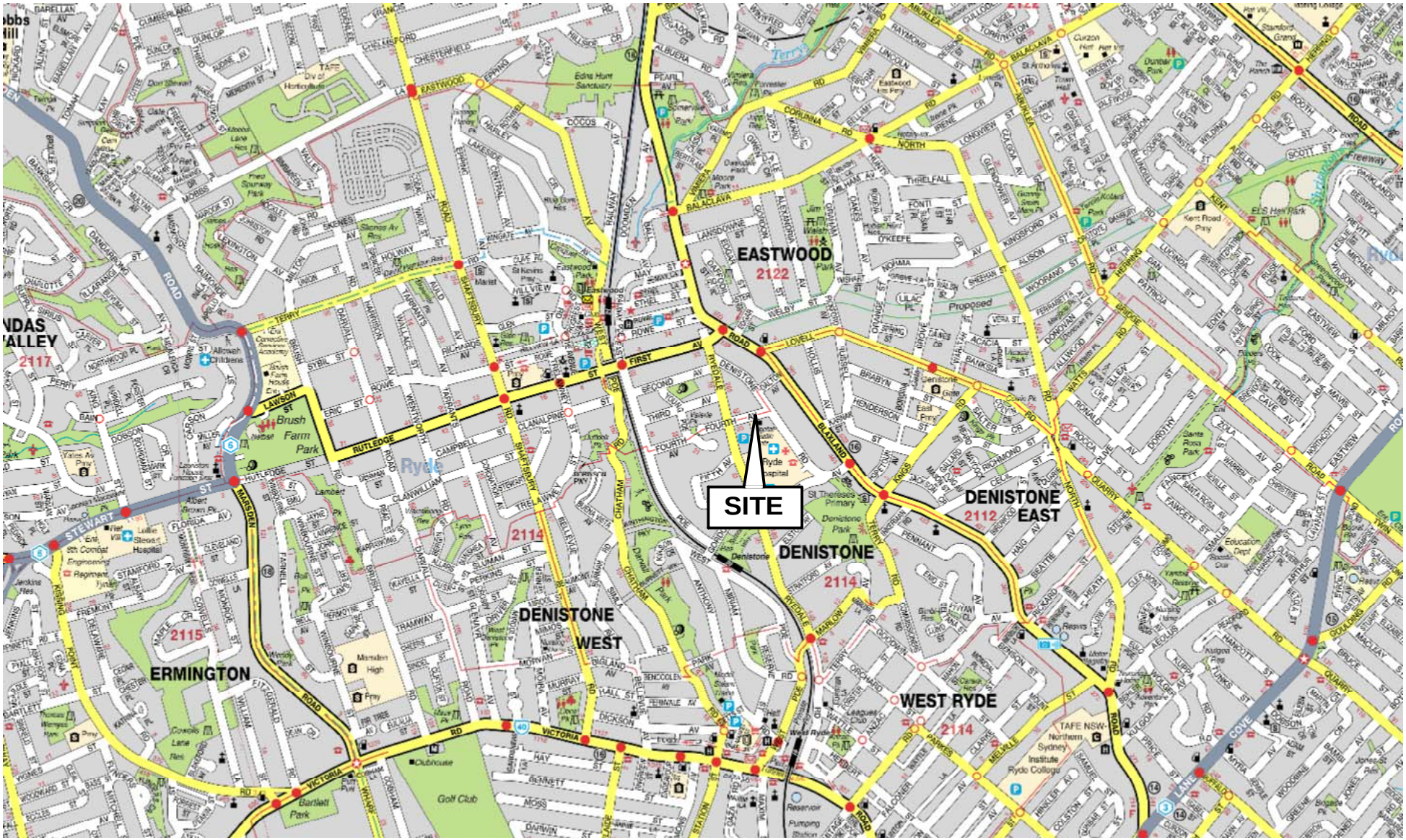
The RPD value is calculated as the absolute value of the difference between the initial and repeat results divided by the average value expressed as a percentage. The following acceptance criteria will be used to assess the RPD results:

- Results > 10 times PQL = RPD value < 50% are acceptable
- Results between 5 & 10 time PQL = RPD value < 75% are acceptable
- Results < 5 times PQL = RPD value < 100% are acceptable

RPD Results Above the Acceptance Criteria **VALUE**

ABBREVIATIONS:

PQL: Practical Quantitation Limit
LPQL: Less than PQL
NA: Not Analysed
NC: Not Calculated

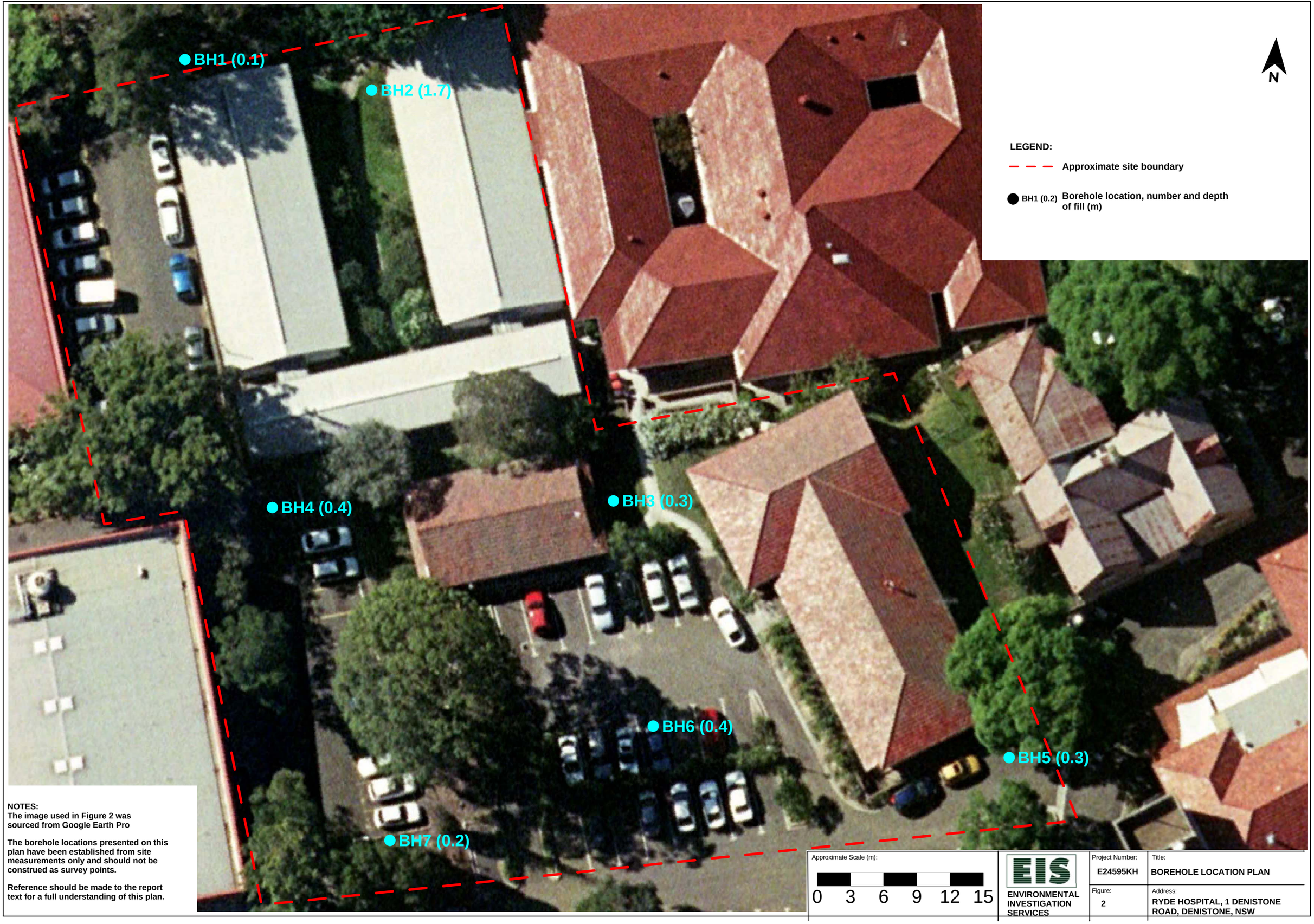


NOTES:
Figure 1 has been recreated from UBD on disc (version 5.0). Figure is not to scale.

UBD Map ref: 193 D10

Reference should be made to the report text for a full understanding of this plan.

ENVIRONMENTAL INVESTIGATION SERVICES	Project Number: **E24595KH**	Title: **SITE LOCATION PLAN**
	Figure: **1**	Address: **RYDE HOSPITAL, 1 DENISTONE ROAD, DENISTONE, NSW**



N

LEGEND:

- Approximate site boundary
- BH1 (0.2) Borehole location, number and depth of fill (m)

NOTES:
The image used in Figure 2 was sourced from Google Earth Pro

The borehole locations presented on this plan have been established from site measurements only and should not be construed as survey points.

Reference should be made to the report text for a full understanding of this plan.

Approximate Scale (m): 0 3 6 9 12 15

ENVIRONMENTAL INVESTIGATION SERVICES

Project Number: **E24595KH**	Title: **BOREHOLE LOCATION PLAN**
Figure: **2**	Address: **RYDE HOSPITAL, 1 DENISTONE ROAD, DENISTONE, NSW**

APPENDIX A

(Borehole Logs and Geotechnical Explanatory Notes)

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **JK1** 1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 89.4m

Date: 22-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION						0			FILL: Silty clay topsoil, medium plasticity, brown, with root fibres.	MC<PL			GRASS COVER
								CH	SILTY CLAY: high plasticity, red brown.	MC<PL	H	-	RESIDUAL
					N = 12 7,5,7	1						> 600 > 600 > 600	
								CL	SILTY CLAY: low plasticity, light grey mottled red brown.				
					N = 22 5,6,16	2		-	SHALE: light grey and red brown.	XW	EL		VERY LOW 'TC' BIT RESISTANCE
										DW	L-M		LOW RESISTANCE
						3							
						4							
						5			SHALE: dark grey and red brown.		M		LOW TO MODERATE RESISTANCE
						6			END OF BOREHOLE AT 6.0m				
						7							

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Borehole No. **JK2** 1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 89.5m

Date: 22-2-11 **Datum:** AHD

Logged/Checked by: D.S./AJ

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0			FILL: Silty clay topsoil, medium plasticity, brown, with root fibres.	MC < PL			GRASS COVER
					N = 10 3,5,5				FILL: Silty clay, medium plasticity, red brown, with fine to medium grained ironstone gravel and root fibres, trace of ash and fine grained sand.			> 600 > 600 > 600	APPEARS WELL COMPACTED
						1			FILL: Clayey silt, low plasticity, brown, trace of fine grained sand.				
					N = 3 2,2,1				FILL: Silty clay, high plasticity, dark grey.	MC > PL			APPEARS POORLY COMPACTED
						2		-	SHALE: light grey and red brown.	DW	VL-L		VERY LOW TO LOW 'TC' BIT RESISTANCE
						3							
						4							
						5			SHALE: dark grey and red brown.		L-M		LOW RESISTANCE WITH MODERATE BANDS
						6			END OF BOREHOLE AT 6.0m				
						7							

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Borehole No. **JK3** 1/2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 93.2m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./AG

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty clay, medium plasticity, brown, with fine to medium grained ironstone gravel and a trace of root fibres.	MC < PL			GRASS COVER
					N = 5 5,2,3			CL	SILTY CLAY: medium plasticity, light grey mottled red brown.	MC < PL	St	-	RESIDUAL
						1							
					N = 15 5,5,10						H	550 >600 >600	
						2							TOO FRIABLE FOR HAND PENETROMETER TESTING
					N > 7 11,7/ 50mm REFUSAL	3		-	SHALE: light grey, with red brown bands.	XW	EL	-	VERY LOW 'TC' BIT RESISTANCE
						4				XW-DW	EL-VL		
						5							
						6							
						7							

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Borehole No. **JK3** 2/2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 93.2m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
▼ ON COMPLE -TION						0			SHALE: dark grey and red brown.	DW	L		LOW RESISTANCE
									END OF BOREHOLE AT 8.0m				
						9							
						10							
						11							
						12							
						13							
						14							

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Borehole No. JK4 1/1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 92.5m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./AJ

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION						0		-	ASPHALTIC CONCRETE: 40mm.t.	D	-	-	
								-	FILL: Sand, fine to medium grained, yellow brown, with fine to medium grained sandstone gravel.				
					N = 13 3,6,7			CH	SILTY CLAY: high plasticity, red brown with trace of fine to medium grained ironstone gravel.	MC < PL	H	- >600 >600 >600	RESIDUAL
						1		-	SHALE: light grey.	DW	M	-	MODERATE 'TC' BIT RESISTANCE
					SPT 4/0mm REFUSAL						L-M		LOW TO MODERATE RESISTANCE
						2							
						3			SHALE: red brown.				
ON 15-3-11 ▼ AFTER 28 HRS (22-2-11) ▼						4			SHALE: red brown, with M strength bands.		VL-L		LOW RESISTANCE WITH VERY LOW AND MODERATE BANDS
						5			as above, but with clay seams.				50mm DIA. PVC STANDPIPE INSTALLED TO 6.0m DEPTH. SLOTTED BETWEEN 0.5m AND 6.0m. CAST-IRON 'GATIC' COVER CONCRETED AT SURFACE
						6			END OF BOREHOLE AT 6.0m				
						7							

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Borehole No. **JK5** 1/3

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 96.7m

Date: 22-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE -TION OF AUGER -ING						0		-	ASPHALTIC CONCRETE: 40mm.t.	M	-	-	
								-	FILL: Silty clayey sand, fine to medium grained, brown, with fine to medium grained igneous gravel.				
					N = 11 3,5,6			CH	SILTY CLAY: high plasticity, red brown, with a trace of ironstone gravel.	MC < PL	H	-	RESIDUAL
						1						> 600	
												> 600	
												> 600	
								-	SHALE: light grey and red brown.	DW	L-M		MODERATE 'TC' BIT RESISTANCE WITH LOW BANDS
						2							
						3					VL		VERY LOW RESISTANCE
						4							
▼ ON COMPLE -TION OF CORING						5							
						6			SHALE: dark grey and red brown.		L		
						7							

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Borehole No. **JK5** 2/3

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 96.7m

Date: 22-2-11 **Datum:** AHD

Logged/Checked by: D.S./AG

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								-	SHALE: dark grey and red brown.	DW	L-M		VERY LOW TO LOW RESISTANCE WITH MODERATE BANDS
									SHALE: dark grey.	SW-FR	M		MODERATE RESISTANCE
						8			REFER TO CORED BOREHOLE LOG				
						9							
						10							
						11							
						12							
						13							
						14							

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Borehole No. **JK5** 3/3

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE
Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Core Size:** NMLC **R.L. Surface:** ≅ 96.7m
Date: 22-2-11 **Inclination:** VERTICAL **Datum:** AHD
Drill Type: JK300 **Bearing:** - **Logged/Checked by:** D.S./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ (EL, VL, L, M, H, VH, EH)	DEFECT DETAILS DEFECT SPACING (mm) (500, 300, 100, 50, 30, 10)	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		8		START CORING AT 8.20m					
		9		SHALE: dark grey, with light grey laminae, bedded at 0-5°.	FR	M-H			-CS,0°,5mm.t -XWS/CS,0°,20mm.t
FULL RET-URN				CORE LOSS: 0.71m					
		10		SHALE: dark grey, with light grey laminae, bedded at 0-5°.	FR	M			J,Subvertical,Un,S,250mm long
		11		END OF BOREHOLE AT 11.00m					
		12							
		13							
		14							

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Borehole No. **JK6** 1/2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 93.6m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0		-	ASPHALTIC CONCRETE: 40mm.t.	M	-	-	
					N > 10 2,10/ 150mm REFUSAL			CH	FILL: Silty gravelly sand, fine to medium grained, brown, fine to medium grained igneous gravel.	MC > PL	St	-	
									SILTY CLAY: high plasticity, light grey mottled red brown.			180 150 200	RESIDUAL
						1		-	SHALE: light grey and red brown.	DW	L-M		LOW 'TC' BIT RESISTANCE WITH MODERATE BANDS
▼ AFTER 27 HRS (22-2-11)						2							
						3			as above, but red brown.		M		MODERATE RESISTANCE
						4			as above, but with clay seams.		L-M		LOW RESISTANCE WITH MODERATE BANDS
											M		MODERATE RESISTANCE
						5			SHALE: dark grey and red brown.				
ON COMPLE -TION ▼						6							
▶									SHALE: dark grey.	SW-FR	M-H		MODERATE TO HIGH RESISTANCE
						7							

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Borehole No. **JK6** 2/2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 93.6m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						8		-	SHALE: dark grey.	SW-FR	M-H		MODERATE TO HIGH RESISTANCE
											H		HIGH RESISTANCE
						9			END OF BOREHOLE AT 9.0m				50mm DIA. PVC STANDPIPE INSTALLED TO 9.0m DEPTH. SLOTTED BETWEEN 0.5m AND 9.0m. CAST-IRON 'GATIC' COVER CONCRETED AT SURFACE
						10							
						11							
						12							
						13							
						14							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **JK7** 1/3

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 94.6m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./AS

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
ON COMPLE-TION OF AUGER-ING AT 2.75m DEPTH					N = 16 3,6,10	0		-	ASPHALTIC CONCRETE: 40mm.t.	D	-	-	
								CH	FILL: Sand, fine to medium grained, yellow brown, with fine to medium grained sandstone gravel.	MC < PL	H	-	RESIDUAL
						1			SILTY CLAY: high plasticity, red brown and light grey, with XW shale seams.				
								-	SHALE: light grey and red brown.	DW	L	-	LOW 'TC' BIT RESISTANCE
						2							
						3		-	REFER TO CORED BOREHOLE LOG	-	-	-	INTRODUCED DRILL FLUSH WATER
						4							
						5							
						6		-	SHALE: orange brown and grey.	DW	L	-	LOW RESISTANCE
						7							

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Borehole No. **JK7** 2/3

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE

Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA **Method:** SPIRAL AUGER JK300 **R.L. Surface:** ≅ 94.6m

Date: 21-2-11 **Datum:** AHD

Logged/Checked by: D.S./

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						8		-	SHALE: orange brown and grey.	DW	L		LOW RESISTANCE
						9			as above, but with clay seams.	XW	EL		VERY LOW RESISTANCE
						10			END OF BOREHOLE AT 10.0m				
						11							
						12							
						13							
						14							

Jeffery and Katauskas Pty Ltd
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Borehole No. **JK7** 3/3

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED GRAYTHWAITE REHABILITATION CENTRE
Location: RYDE HOSPITAL, FOURTH AVENUE, DENISTONE, NSW

Job No. 24595ZA | **Core Size:** NMLC | **R.L. Surface:** ≅ 94.6m
Date: 21-2-11 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK300 | **Bearing:** - | **Logged/Checked by:** D.S./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_S(50)$ EL VL L M H VH EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
		2		START CORING AT 2.75m					
70% RET-URN		3		CORE LOSS: 1.70m					
		4							
		5		SHALE: light grey and orange brown, with clay seams (up to 20mm.t.)	DW	L	×		J,80°,P,S
				SHALE: orange brown, with grey seams, with H strength seams, bedded at 0-5°.			×		-CS,0°,10mm.t -CS,15°,15mm.t -CS,10°,15mm.t -CS,0°,20mm.t -CS,0°,3mm.t -CS,5°,5mm.t -J,subvertical,Un,healed,110mm long -CS,0°,10mm.t
				END CORING AT 5.30m REFER TO AUGERED BOERHOLE LOG					
		6							
		7							
		8							
		9							