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Project 84897.05
29 April 2016
84897.05.R.001.Rev0
DW:jlb

Attention: Drew Bagnall

Email: drew.bagnall@sydney.edu.au

Dear Sirs

Regarding SEPP55 (Contamination)
Proposed F23 Administrative Building
Eastern Avenue, The University of Sydney

Item 12 (Contamination) of the *Secretary's Environment Assessment Requirements* for the F23 Administrative Building (SSD 7055), 28 May 2015 states that it is to be demonstrated that the site is suitable for the proposed use in accordance with SEPP 55.

As part of Douglas Partners (DP) report *Geotechnical Investigation, Proposed F23 Administration Building, Eastern Avenue, The University of Sydney*, July 2015 (DP, 2015) soil sampling was undertaken from four test bores. Analytical results indicated concentrations of contaminants within the site assessment criteria. It is stated in Section 8.5 in DP (2015) that *it is considered that the site **is compatible** with the proposed development from a contamination perspective and that there is no widespread or significant contamination at the site.* We consider that this statement addresses Item 12. Recommendations in DP (2015) did not include undertaking further investigations to determine if the site is suitable, or can or will be made suitable, for the proposed development.

Recommendations made in DP (2015) included:

- Conducting further *in situ* or *ex situ* testing to confirm waste classification (for soils that are to be disposed off-site as part of the bulk excavation for the basement) and appropriate disposal of soils in accordance with the waste classification;
- Conducting inspections and validation of natural soils, following the excavation of fill soils, to determine if the natural soils can be disposed as virgin excavated natural material (VENM); and
- Prepare an unexpected finds protocol for bulk excavation and construction works to manage unexpected contamination finds.

With regards to the first two points above, waste classification and appropriate disposal of soils is typically a conditioned requirement of any development application approval where soils are to be disposed off-site.

With regards to the third point, Lend Lease Buildings Pty Ltd has prepared *University of Sydney, F23 Administration Building, Contaminated Soil and Water Management Plan*, 1 April 2016. The plan

details contingency measures for the case that unexpected contaminated soil or groundwater is encountered during the construction phase of the project, even though remediation works are not proposed for the project. DP considers that this plan acts as the recommended unexpected finds protocol.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully
Douglas Partners Pty Ltd

David Walker
Environmental Engineer

Reviewed by

Tim Wright
Senior Associate

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed F23 Administration Building
Eastern Avenue, The University of Sydney

Prepared for
The University of Sydney

Project 84897.02
July 2015

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		14/7/15
Reviewer		14/7/15
Reviewer		14/7/15

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Table of Contents

Report on Geotechnical Investigation
Proposed F23 Administration Building
Eastern Avenue, The University of Sydney

1. Introduction

This report presents the results of a geotechnical investigation undertaken for the proposed F23 Administration Building at The University of Sydney. The work was commissioned by The University of Sydney.

The project involves the construction of five storey administration building with two basement levels.

Geotechnical investigation was undertaken to provide information on the subsurface conditions on the site and included the drilling of boreholes, laboratory testing and engineering analysis. Details of the field work and comments relevant to design and construction are given in this report.

In addition, some samples were taken from the bores to provide a preliminary contamination assessment and waste classification which is described within.

The fieldwork for the F23 Administration Building investigation was carried out in conjunction with the investigation for the LEES1 Carslaw extension.

2. Site Description and Geology

The site of the proposed Administration Building is irregular in shape and is located south of the Madsen Building on Eastern Avenue, The University of Sydney. The site is currently occupied by an open car park containing small landscaped areas. Site levels tend to generally fall in a northerly direction with a difference in levels over the site of about 1.5 m.

Reference to the *Sydney 1:100 000 Geological Series Sheet* indicates that the site is underlain by Ashfield Shale of the Wianamatta Group which typically comprises black to dark grey shale and laminite.

The investigation confirmed the presence of Ashfield Shale.

3. Field Work Methods

The field work for the geotechnical investigation included the drilling of four boreholes (Bores 1 to 4) at the locations shown on Drawing No.1 in Appendix B. Three of the bores were located within the car parking areas and Bore 2 was located on a landscaped area.

The bores were drilled to depths of approximately 12 m using a truck mounted drilling rig.

The boreholes were commenced using solid flight augers then rotary wash-boring equipment inside top casing to about 4 m depth. Standard penetration tests (SPT) were undertaken within the overburden at regular depth intervals. Disturbed samples were taken in the overburden soils for identification and laboratory testing. The bores were advanced to approximately 12 m depth using NMLC-sized diamond core drilling equipment to obtain 50 mm diameter continuous samples of the rock for identification and strength testing purposes.

The ground surface levels of the bores were obtained by survey from spot levels given on the plan (The University of Sydney – City Road, Underground Utility Location, Drawing No VG1036-2D, dated 11/2/15) provided by the University.

4. Field Work Results

The subsurface conditions encountered in the boreholes are presented in the borehole logs in Appendix C. Notes defining descriptive terms and classification methods are included in Appendix C.

The subsurface conditions encountered in the boreholes can be summarised as:

- FILLING – pavement, base material and silty clay with some gravel to depths of between 0.4 and 2.5 m;
- SILTY CLAY – generally stiff silty clay to depths of between 1.0 m and 4.0 m;
- SHALY CLAY – generally very stiff to hard shaly clay to depths of between 2.0 m and 5.5 m;
- ROCK – initially extremely low and very low strength laminite or shale. The rock strength increased with depth with medium strength rock encountered at depths of between 5.5 m and 9.2 m.

Free groundwater was not observed in any of the bores while augering. The use of drilling fluid prevented groundwater observations during rotary wash-boring and coring.

5. Laboratory Testing

Thirty three samples selected from the better quality rock core were tested for axial point load strength index (Is_{50}). The results ranged from 0.1 MPa to 1.9 MPa which correspond to low to high strength. These Is_{50} results suggest an unconfined compressive strength (UCS) up to about 40 MPa for the rock encountered during the investigation.

6. Proposed Development

The project involves the construction of a new administration building to the south of the Madsen Building with approximate dimensions of 60 m by 40 m. Concept design indicate a five storey building with two basement levels whose lower level is at RL 28.0 and column loads of the order of 6000 kN.

The geotechnical issues considered relevant to the proposed development include excavation, excavation support and foundations. Excavation for the basement will be up to about 7.5 m depth.

7. Comments

7.1 Excavation

Excavation for the two basement level is expected to be in filling, clay and rock. Excavation in filling, silty clay and extremely low to very low strength rock should be readily achievable using conventional earthmoving equipment such as an excavator with bucket attachments.

Excavation in low strength and stronger rock will probably require the use of ripping equipment or rock hammers. Based on the bores, the stronger rock (mostly medium but possibly high strength) may be encountered at depths greater than about 4 m to 5 m. The use of rock hammers will cause vibration which, if not controlled, could possibly result in damage to nearby structures and disturbance to occupants. It is suggested that vibrations be provisionally limited to a peak particle velocity (PPV) of 8 mm/s at the foundation level of the Madsen Building to protect the architectural features of the building and to reduce discomfort for the occupants. The owners of any in-ground utilities on and around the property should also be consulted in regards to vibration levels. A site specific vibration monitoring trial may be required to determine vibration attenuation once excavation plant and methods have been finalised.

7.2 Excavation Support

7.2.1 General

Vertical excavations in filling, soil and weathered rock cannot be guaranteed to remain vertical. Temporary batters of 1(H):1(V) could be used to support the sides of the excavation for a maximum batter heights of 3 m increasing to 1.5H:1V for more than 3 m, but there appears to be inadequate space on the site.

Soldier piles with infill reinforced shotcrete panels are commonly used to support excavations in clay and rock. The soldier piles would generally be spaced at about 2 m to 2.5 m centres and should be founded at least two pile diameters below the lowest excavation level (both bulk and detailed) adjacent to the pile location. Shotcreting will be needed over the full excavation depth and should be undertaken in maximum 1.5 m or 2.0 m ‘drops’ as excavation proceeds in order to reduce the risk of local slippages and collapse between soldier piles. Temporary ground anchors will probably be required to prevent excessive lateral deformation of shoring/retaining walls. For the permanent

situation, the basement structure usually provides the required lateral support to the perimeter excavation once the temporary anchors are de-stressed.

7.2.2 Design

Excavation faces retained either temporarily or permanently will be subjected to earth pressures from the ground surface down to the top of medium strength rock. Table 1 outlines material and strength parameters that may be used for the preliminary design of excavation support structures.

Table 1: Typical Material and Strength Parameters for Excavation Support Structures

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure (kPa)
Filling	18	0.4	0.6	-
Soil	20	0.3	0.45	-
Extremely low to very low strength rock	22	0.2	0.3	750
Medium strength rock	24	0	0	1000

It is likely that shoring of a two basement level excavation will need to incorporate more than one row of anchors. The lateral pressure distribution on a multi-anchored or braced wall is complex and for preliminary design purposes a uniform pressure distribution with depth (i.e. rectangular) of 4 H (kPa) could be assumed where H is the height of retained material in metres. The design lateral pressure should be increased to 8H (kPa) if the shoring is to support any adjacent building, structures or in-ground utilities. It is recommended that a sophisticated software package that properly accounts for soil-structure interaction, such as WALLAP, FLAC or PLAXIS, be used to analyse the shoring system for detailed design.

Lateral pressures due to surcharge loads from the existing road corridor and construction machinery should be included where relevant. Hydrostatic pressure acting on the shoring walls should also be included in the design where adequate drainage is not provided behind the full height of the wall.

The ultimate passive pressures given in Table 1 should incorporate a suitable factor of safety to limit deflection.

The design of temporary support (and possibly permanent support) will also need to consider the possibility that moderately or steeply dipping joints which were noted in the cores, or other defects in the bedrock will 'daylight' leading to potentially unstable wedges of rock requiring support by the retention system (i.e. shoring). Sufficient anchoring of the temporary shoring wall should be undertaken to prevent movements along suck defects, even though there is a low probability that a defect would run the full length and height of the excavation.

It is suggested that preliminary design of the temporary support system be carried out such that the support system has a factor of safety of 1.1 against slippage or the mobilisation of wedges along unfavourable defects. The support system would typically comprise anchors spaced over the rock face, through the soldier piles. These anchors should have their bond lengths behind the projected

45° line from the bulk excavation level and should provide sufficient force to resist the movement of a wedge of rock projected at 45° from the bulk (or detailed) excavation level adjacent to the shoring, rising to the ground surface. The frictional resistance of the wedge along the joint may be calculated assuming an angle of friction of 25°.

Regular rock-face inspections will be required during excavation to determine whether any adverse jointing/defects that could form wedges of rock are present and will require support for the permanent condition. Additional anchors may be required to increase the factor of safety if large wedges are observed during excavation, or alternatively the basement structure (e.g. floor slabs) may need to be designed for the wedge loading for the permanent condition.

7.2.3 Ground Anchors

Where necessary, the use of declined tie-back (ground) anchors is suggested for the lateral restraint of the perimeter pile walls. Such ground anchors should be declined below the horizontal to allow anchorage into the stronger bedrock materials at depth. The design of temporary ground anchors for the support of pile wall systems may be carried out using the typical ultimate bond stresses (with an appropriate factor of safety at the grout-rock interface) given in Table 2.

Table 2: Typical Ultimate Bond Stresses for Anchor Design

Material Description	Ultimate Bond Stress (kPa)
Extremely Low to Low Strength Rock	100
Medium Strength Rock	500

Ground anchors should be designed to have a free length equal to their height above the base of the excavation and have a minimum 3 m bond length. After installation they should be proof loaded to 125% of the Design Working Load and locked-off at no higher than 80% of the Working load. Periodic checks should be carried out during the construction phase to ensure that the Lock-off Load is maintained and not lost due to creep effects or other causes.

The parameters given in Table 2 assume that the anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with good anchoring practice. Careful installation and close supervision by a geotechnical specialist may allow increased bond stresses to be adopted during construction, subject to testing.

In normal circumstances the building will restrain the basement excavation over the long term and therefore ground anchors are expected to be temporary only. The use of permanent anchors would require careful attention to corrosion protection. Further advice on design and specification should be sought if permanent anchors are to be employed at this site.

Care should be taken to avoid damaging buried services, pipes and subsurface structures during anchor installation.

7.3 Groundwater

Groundwater was not observed in any of the bores while augering. Nevertheless, it is anticipated that the groundwater ingress into the excavation will occur as seepage through and along strata boundaries on the site especially after wet weather. Based on experience, it is anticipated that any seepage through the clayey soils and rock can probably be controlled using a sub-floor drainage and collection system in the lower basement level. Seepage through shales sometimes results in iron precipitates which have the potential to block drainage material and additional maintenance precautions (e.g. wash-out points and 'rodding points', etc.) should be taken to avoid blocking of the drains over the medium to longer term.

7.4 Foundations

The proposed bulk excavation works are expected to mainly expose medium strength shale or laminite at the base of the excavation. Spread footings (i.e. pad or strip footings) within the excavation should be suitable for supporting the proposed building loads and could be designed on the basis of a typical allowable bearing pressure of 3 500 kPa for the medium strength rock. Bore 3 did not encounter consistent medium strength rock until RL 25.8 m, so some footings may have to be deepened to reach the rock quality required.

The settlement of a spread footing is dependent on the loads applied to the footing and the foundation conditions below the footing. The total settlement of a spread footing designed using the allowable parameters provided in this report should be less than 1% of the footing width upon application of the design load. That is, for a 1.5 m pad footing, settlements could be up to 15 mm. Differential settlements between adjacent shallow footings may be in the order of 50% of the value of total settlement.

All spread footings should be inspected by an experienced geotechnical professional to check the adequacy of the foundation material.

7.4.1 Piles

For higher loads or to reduce total settlements, pile foundations could be adopted. Bored piers would be expected to be a suitable pile type, however, some allowance should be made for the possibility of water seepage and collapse of any filling material into the pier hole during construction if water is encountered. Bored piles should be taken to rock and could be proportioned on the basis of the typical design parameters provided in Table 3.

Table 3: Typical Design Parameters for Bored Piles

Material Description	Ultimate Pressures (kPa)		Serviceability Pressures (kPa)	
	End-Bearing	Shaft(1)	End-Bearing	Shaft(1)
Medium Strength Rock	30 000	600	3 500	300
High Strength Rock	80 000	1 000	6 000	500

Note: (1) Provided adequate socket roughness is achieved

An appropriate geotechnical reduction factor has to be applied to the ultimate values for limit state design. The selection of the geotechnical reduction factor (Φ_g) is based on a series of individual risk ratings (IRR) which are weighted and lead to an average risk rating (ARR). The individual ratings and final value of Φ_g depend on the following factors:

- Site: the type, quantity and quality of testing
- Design: design methods and parameter selections;
- Installation: construction control and monitoring;
- Pile Testing Regime: testing benefit factor based on percentage of piles tested and the type of tests; and
- Redundancy: whether other piles can take up the load if a given pile settles or fails.

The actual value of Φ_g will have to be determined by the designer of the piles, however, it is expected to possibly be in the range of 0.4 to 0.55.

The levels of the different rock strength layers encountered in the bores are provided in Table 4.

Table 4: Levels of Depth of Typical Design Parameters for Bored Piles

Rock Strength	Level of Varying Rock Strengths (RL m)			
	Bore 1	Bore 2	Bore 3	Bore 4
Medium Strength Rock	28.3	27.9	25.8	28.7
High Strength Rock	22.6(1)	23.1(1)	24.0	25.7

Note: (1) Only bands of high strength encountered above borehole termination depth. Further drilling required if parameters for high strength rock to be adopted for design.

All bored piles should be inspected by an experienced geotechnical professional during construction to check the adequacy of the foundation material and to check the socket cleanliness and roughness.

The settlement of a pile is dependent on the loads applied to the pile and the foundation conditions in the socket zone and below the pile toe. The total settlement of a bored pile designed using the serviceability parameters provided in this report should also be less than 1% or less of the pile diameter. That is, for a 600 mm diameter pile, settlements would be expected to be less than 6 mm.

All bored piles should be inspected by an experienced geotechnical professional during construction to check the adequacy of the foundation material and to check the socket cleanliness and roughness.

7.5 Seismic Design

In accordance with the Earthquake Loading Standard, AS1170.4 - 2007 the site is assessed to have a hazard factor (z) of 0.08 and a subsoil class of “Be”.

8. Preliminary Contamination Assessment

The preliminary site (contamination) investigation (PSI) was conducted and reported with reference to the National Environment Protection Council (NEPC) National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended 2013) [NEPC, 2013] and included a review of available site history (from previous reports), a site walkover, and soil analysis from samples collected during the geotechnical investigation.

For the purpose of the PSI the site is defined as the extents of the proposed building extension.

A preliminary waste classification was also conducted and reported as part of the assessment.

8.1 Site History

DP has previously prepared a PSI for the Sydney University Site that included the current investigation area, report *Preliminary Site Investigation, Proposed Campus Improvement Program, Camperdown and Darlington Campus, University of Sydney,* Prepared for University of Sydney – Campus Infrastructure and Services, Project 73716.00 dated November 2013 (DP 2013).

Overall, based on the historical review, it was apparent that the Camperdown Campus has been used as a university since prior to the 1930s (land titles indicate since 1912), whilst the Darlington Campus comprised a large number of residential and commercial (retail) properties at least until the 1970s, from which gradual acquisition by the University appears to have taken place, culminating in the consolidation of individual lots in 1991. Site history also indicates that a large part of the Camperdown campus was previously used for farming.

Based on the site history and an inspection of then current operations, the areas of environmental concern identified were as follows:

- The University of Sydney holds chemical licenses for the storage and use of a variety of chemical, for experimental purposes. The Workcover records did not indicate that any of these chemical stores are present in the current investigation area and therefore there is a low potential for chemicals that the Site is impacted by these chemicals;
- The extent of fill across the site used for formation processes and levelling appears to be extensive. Previous investigation has identified the presence of fill across much of the site, to depths of up to 9m bgl. The fill has been found to be variable in depth and composition (including some areas containing asbestos, slag and ash);
- There is a potential for asbestos to be present in near surface soils as a result of the demolition of former structures;
- The hazardous materials registers have identified hazardous building materials (including asbestos and lead based paint) in many of the older buildings within the university grounds;
- A significant portion of the campus was previously used for farming. It is therefore possible that residual contamination from the use of pesticides and fertilisers could remain on the site; and
- The site was acquired by the University of Sydney in 1912 and has been operated as a university grounds since that time.

Based on the outcomes of this PSI, the identified contamination risks were not considered to pose a restriction on the future developments proposed by the University, subject to implementing the following recommendations:

- The storage and disposal practices for all dangerous goods within the site should be reviewed for compliance with current Dangerous Goods codes and standards. If found non-compliant, measures should be implemented to work towards compliance;
- All recommendations provided in the hazardous building materials registers existing for the University should be implemented as current management measures and/or during demolition, as appropriate. The removal of any hazardous building materials from the site must be conducted in accordance with the appropriate WorkCover codes and standards;
- A detailed site inspection (DSI) should be carried out prior to any future redevelopment works to investigate the areas of environmental concern identified in the report; and
- Any soil to be removed off site must be assessed against the NSW DECCW *Waste Classification Guidelines* (2008, now 2014) prior to disposal in order to inform disposal options.

8.2 Site Assessment Criteria

Analytical results were assessed (as a Tier 1 assessment) against the site assessment criteria (SAC) comprising the investigation and screening levels of Schedule B1, National Environment Protection Council, *National Environment Protection Measure* 1999, as amended 2013 (NEPC, 2013). The NEPM guidelines are endorsed by the NSW EPA under the CLM Act 1997.

The investigation and screening levels applied in the current investigation comprise levels adopted for a commercial/industrial land use scenario which provides the most appropriate exposure risk for a university environment where the greatest exposure risk will be staff at the university.

Petroleum based Health Screening Levels (HSLs) for direct contact at commercial and industrial site have been adopted from the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) *Technical Report no.10 Health screening levels for petroleum hydrocarbons in soil and groundwater* (2011) as referenced in NEPC (2013) in the absence of equivalent guidelines in NEPC (2013). HSLs for maintenance workers have not been considered as the HSLs for commercial and industrial landuse are considered to be protective of maintenance workers.

Management Limits to avoid or minimise the potential hazardous effects of petroleum hydrocarbons have been adopted in NEPC (2013) as interim Tier 1 guidance. The adopted Management Limits will apply to any depth in the soil profile. The management limits for commercial and industrial sites and coarse soil texture have been adopted.

A detailed asbestos assessment as outlined in NEPC (2013) was not undertaken. As such, asbestos was screened from jar samples taken for general analysis of contaminants. Therefore the presence or absence of asbestos at a limit of reporting of 0.1 g/kg has been adopted for this assessment as an initial screen.

Based on the preliminary nature of the investigation and the proposed basement excavation within the "site" as assessment of the analytical data against ecological investigation and screening levels is not considered relevant and has not been considered further in this investigation.

The adopted SAC are listed on Table 6, Appendix D.

8.3 Waste Classification

The waste classification was generally conducted in accordance with NSW EPA *Waste Classification Guidelines* 2014. Waste classification of the material was conducted with reference to the six step process as set out in the NSW EPA guideline and summarised in Table 6 below.

Table 5: Six Step Classification

Step	Classification	Rationale
1. Is it special waste?	No	Asbestos was not observed during field investigations
2. Is it liquid waste?	No	Waste composed of soil matrix (i.e. no liquids)
3. Is the waste "pre-classified"?	No	not pre-classified
4. Does the waste have hazardous waste characteristics?	No	Waste not observed to/ or considered at risk to contain explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances or corrosive substances.
5. Chemical Assessment	Undertaken	Refer to Table 5 attached.
6. Is the waste putrescible?	No	All observed components of material composed of materials pre-classified as non-putrescible (i.e. soils). Organic content is assessed to be minor.

8.4 Laboratory Results

Selected soil samples were analysed for the for a range of potential contaminants including heavy metals (HM), polycyclic aromatic hydrocarbons (PAH), total recoverable hydrocarbons (TRH), monocyclic aromatic hydrocarbons (BTEXN – benzene, toluene, naphthalene, ethyl benzene, and xylenes), organochlorine pesticides (OCP), organophosphate pesticides (OPP), polychlorinated biphynels (PCB) total phenolics and asbestos (refer to the chain of custody information, Appendix D).

Based on the initial results additional analysis was conducted for toxicity characteristic leaching procedure (TCLP) on lead and PAH. The results of the laboratory analysis are presented in Table 5, Appendix D, and discussed in the following section.

8.5 Discussion of Contamination Results

The analyte concentrations in the soil samples analysed were within the adopted SAC. No asbestos was detected in the soil samples and no significant building rubble was observed in the test bores. It is noted however that there are limitations to the test bore method with regards to detecting asbestos and therefore it is possible that asbestos may be present in the fill material.

Based on the results of the current assessment it is considered that the site is compatible with the proposed development from a contamination perspective and that there is no evidence of widespread or significant contamination at the site.

However based on the preliminary nature of the investigation it is recommended that an unexpected finds protocol be prepared and implemented during bulk earthworks and excavation to provide appropriate management procedures in the event that unexpected contamination is encountered during works.

8.6 Waste Classification

The concentrations of the contaminants analysed were generally within the General Solid Waste Guideline without TCLP (NSW EPA 2014) with the exception of the following:

- Benzo(a)pyrene in samples BH2/0.5 (2.2 mg.kg), and
- Lead in samples BH2/0.5 (130 mg.kg.

Therefore TCLP analysis was conducted for PAH and lead on the above sample. Leachable concentrations and specific contaminant concentrations were within General Solid Waste criteria and therefore the soils are preliminarily classified as General Solid Waste (non-putrescible).

8.7 Recommendations

Based on the results of the current investigation the following recommendations can be made:

- Given the limited number of samples analysed, further *in situ* or *ex situ* testing should be carried out to confirm the preliminary waste classification assigned herein;
- Once the waste classification is confirmed, the fill should be excavated and appropriately disposed off site under the assigned waste classification;
- An unexpected finds protocol should be prepared for bulk excavation and construction works to manage unexpected contamination finds; and
- Following the excavation of fill soils for the basement levels the underlying natural soil should be inspected and validated to determine if the underlying natural soil can be classified as virgin excavated natural material (VENM).

9. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for the F23 Administration Building at The University of Sydney in accordance with DP's proposal dated 18 May 2015. The report is provided for the use of The University of Sydney for these projects only and for the purpose(s) described in the report. It should not be used for other projects or by a third party.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires a risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

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Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

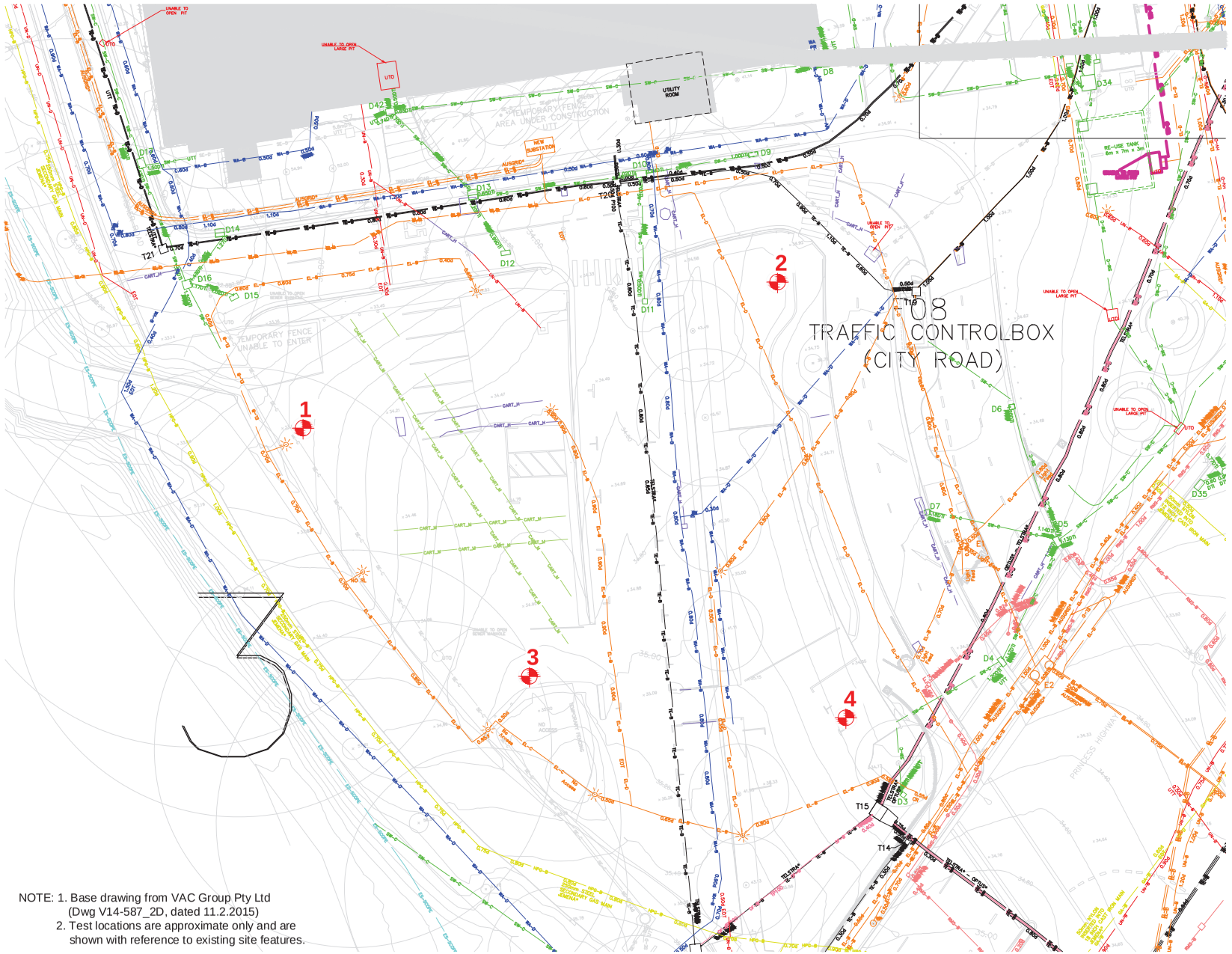
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

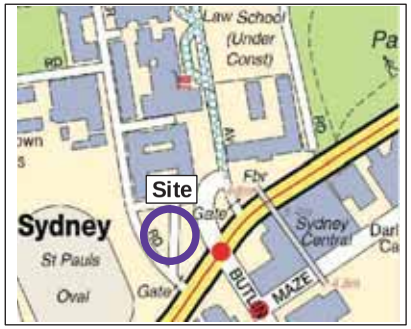
Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawing No. 1 – Location of Tests





Locality Plan

NOTE: 1. Base drawing from VAC Group Pty Ltd
(Dwg V14-587_2D, dated 11.2.2015)
2. Test locations are approximate only and are
shown with reference to existing site features.

LEGEND
Borehole location

0 1 2 3 4 5 7.5 10m
1:100 @ A3

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: The University of Sydney		TITLE: **Location of Tests**	PROJECT No: 84897
OFFICE: Sydney	DRAWN BY: PSCH	**F23 Development**	DRAWING No: 1
SCALE: 1:100 @ A3	DATE: 8.7.2015	**Eastern Avenue, THE UNIVERSITY OF SYDNEY**	REVISION: 0

P:\84897.00 - SYDNEY UNI LEES\17.0 Drawings\7.2 Out\84897-1.dwg, 10/07/2015 12:26:18 PM, DWG To PDF.pc3

Appendix C

Results of Field Work

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

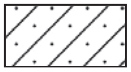
Soils


Topsoil

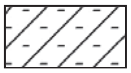

Peat


Clay


Silty clay

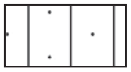

Sandy clay

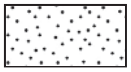

Gravelly clay

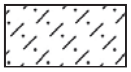

Shaly clay

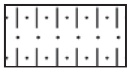

Silt


Clayey silt


Sandy silt


Sand


Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

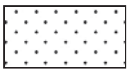

Talus

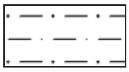
Sedimentary Rocks

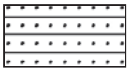

Boulder conglomerate

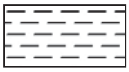

Conglomerate


Conglomeratic sandstone

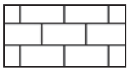

Sandstone


Siltstone

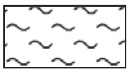

Laminite

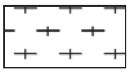

Mudstone, claystone, shale

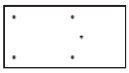

Coal


Limestone

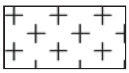
Metamorphic Rocks

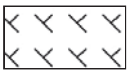

Slate, phyllite, schist

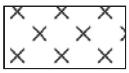

Gneiss

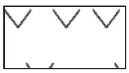

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote

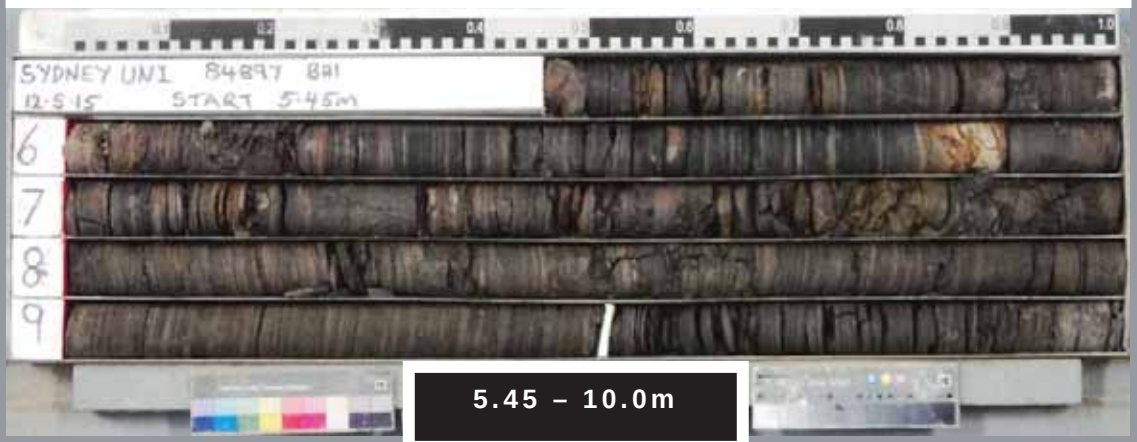

Tuff, breccia


Porphyry

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 1 PROJECT 84897–02 MAY 2015



5.45 – 10.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 1 PROJECT 84897–02 MAY 2015

10.0 – 12.08m

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 84897.02
DATE: 12/6/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
33	0.03	ASPHALTIC CONCRETE							A/E			
		FILLING - light brown, slightly gravelly, silty clayey sand filling							A/E			
	0.6	FILLING - brown coarse gravel with some clay and sand							A/E			
	0.8	FILLING - brown, slightly gravelly, slightly sandy, silty clay							A/E			
32	1								S			5,4,5 N = 9
	2											
31	2.5	SILTY CLAY - very stiff to hard, grey mottled orange, silty clay, moist							S			5,10,20 N = 30
30	3											
29	4								S			10,12,18 N = 30
	4.0	SHALY CLAY - very stiff to hard, grey mottled red and orange, shaly clay with some ironstone bands and gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	5											
28	5.5	LAMINITE - low and medium strength, slightly weathered, fractured, dark grey and grey-brown, laminite with approximately 20% fine sandstone laminations						5.5-5.63m: B (x7) 0°- 5°, sm, pl, cln 5.85-6.14m: B (x6) 0°- 5°, ir, un, fe stn 6.14-6.23m: fg 6.23-6.83m: B (x10 0°- 5°, sm, pl, cln 6.83-6.89m: fg 6.99-7.13m; B (x7) 0°- 5°, sm, pl, cln 7.13-7.98m: fg	C	100	40	PL(A) = 0.8
	6								C	100	10	PL(A) = 0.4
27	7											PL(A) = 0.9
									C	100	0	
26	8							8.29m: B2°, sm, pl, cln 8.37-8.39m: fg 8.51-8.65m: fg 8.65-9.41m: B (x7) 0°- 5°, sm, pl, cln	C	100	76	PL(A) = 0.6
	8.65	SHALE - medium and high strength, highly and slightly weathered, fractured and slightly fractured, grey shale with some fine sandstone laminations										PL(A) = 1.6
25	9											
								9.41-9.85m: B (x22) 0°- 5°, sm, pl, cln 9.85-10.0m: fg	C	100	41	PL(A) = 0.7
24												

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 5.45m; NMLC-Coring to 12.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 33.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 84897.02
DATE: 12/6/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
23	11	SHALE - medium and high strength, highly and slightly weathered, fractured and slightly fractured, grey shale with some fine sandstone laminations *(continued)*						10.06m: B5°, sm, pl, cln 10.15-10.28m: B (x6) ir, un, cln 10.28-10.32m: J45°, ir, st, cln 10.32-10.71m: B (x4) 0°-5°, sm, pl, cln 10.71-10.73m: fg 10.79-10.82m: fg 11.15m: B2°, sm, ir, cln 11.21m: B2°, sm, pl, cln 11.27-11.29m: fg 11.29-11.67m: B (x10) 0°- 5°, ir, un, cln 11.67m: CORE LOSS: 150mm 11.82-12.08m: fg	C	100	57	PL(A) = 0.8
22	11.82								C	85	15	PL(A) = 0.9 PL(A) = 1.2
	12								C	100	0	
	12.08	Bore discontinued at 12.08m										
21	13											
20	14											
19	15											
18	16											
17	17											
16	18											
15	19											
14												

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 5.45m; NMLC-Coring to 12.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

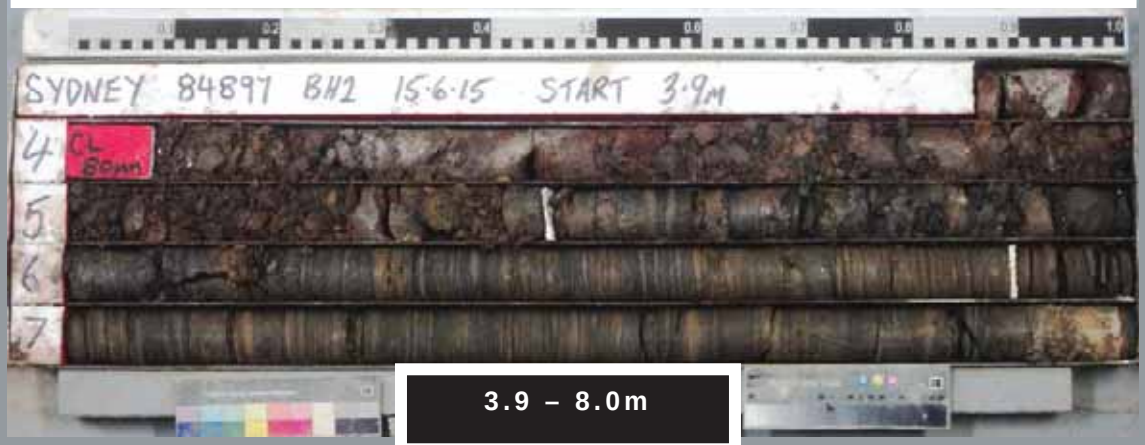
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 2 PROJECT 84897–02 JUN 2015



3.9 – 8.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 2 PROJECT 84897–02 JUN 2015

8.0 – 12.06m

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 34.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 84897.02
DATE: 12 - 15/6/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
34	0.1	TOPSOIL/FILLING - brown, silty sand filling, moist							A/E			
	0.6	FILLING - brown, silty, gravelly sand filling, gravel is coarse, igneous							A/E			
	0.8	FILLING - dark brown-grey gravel, coarse, igneous							A/E			
33	1	SILTY CLAY - stiff, orange-brown, silty clay with some grey mottles and ironstone gravel, moist							A/E			
	1.5	SILTY CLAY - stiff, grey silty clay							S			2,4,5 N = 9
32	2											
	2.7	SHALE - very low strength, highly weathered, fragmented, grey shale							S			11,25/100mm refusal
31	3							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
	3.9	SHALE - very low then low strength, extremely to highly weathered, fragmented, dark grey shale with some ironstaining						3.9-6.15m: fg (possible drilling induced)	C	100	0	
	4							4m: CORE LOSS: 80mm	C	92	0	
30	4.08											
	5								C	100	0	PL(A) = 0.1
29												PL(A) = 0.2
	6								C	100	0	
28	6.15	LAMINITE - very low to low strength, extremely to highly weathered, fragmented to fractured, dark grey and grey-brown, laminite with 25% fine sandstone laminations						6.15-6.77m: B (x8) 0°-5°, fe stn				PL(A) = 0.9
	6.85	LAMINITE - medium to high strength, highly weathered to fresh, fragmented to fractured, dark grey and grey-brown, laminite with 20-25% fine sandstone laminations						6.85m: B0°, sm, pl, cln 6.89-6.96m: B (x4) 0°, pl, cln 6.96-7.0m: fg 7.0-7.15m: B (x7) 0°, pl, cln 7.15-7.16m: fg 7.19m: B0°, sm, pl, cly vn 7.24m: B0°, sm, pl, cly vn 7.26-7.28m: fg 7.28-7.57m: B (x7) 0°, pl, cln 7.65-7.86m: J60°- 90°, ir, fe stn 7.86-7.98m: fg 7.98-8.06m: B (x2) 0°, pl, cln 8.06-8.34m: B (x5) 0°-5°, pl, cly vn 8.34-8.38m: J40°, sm, ir, 20mm wide, crushed	C	100	0	PL(A) = 0.8
27	7											PL(A) = 1.5
	8								C	100	40	
26												PL(A) = 0.6
	9								C	100	51	PL(A) = 1
25												

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.9m; NMLC-Coring to 12.06m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 34.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 84897.02
DATE: 12 - 15/6/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24	11	LAMINITE - medium to high strength, highly weathered to fresh, fragmented to fractured, dark grey and grey-brown, laminite with 20-25% fine sandstone laminations *(continued)*						shale inf 8.38-8.56m: B (x4) 0°-5°, ir, fe stn 8.56-8.6m: fg 8.6-9.17m: B (x6) 0°- 5°, ir, fe stn 9.17-9.34m: J70°- 90°, st, fe stn 9.37m: B5°, sm, pl, cly vn 9.51m: B5°, ir, un, cly vn 9.56m: B2°, sm, pl, fe stn 9.64m: B, ro, st, cln 9.66-10.0m: B (x15) 0°-5°, sm, pl, cln 10.0-10.19m: B (x5) 0°, 5°, sm, pl 10.67-10.72m: J50°-60°, ir, un, fe stn 10.73m: B5°, sm, pl, cln 10.89m: B5°, sm, pl, cln 10.89-11.71m: B (x7) 0°-5°, sm, pl, cly vn 11.71-11.74m: 35°- 40°, ir, un, fe stn 11.84-11.89m: 45°- 50°, ir, un, crushed shale inf	C	100	75	PL(A) = 0.7
23	12								C	100	92	PL(A) = 0.7 PL(A) = 1.1
22	12.06	Bore discontinued at 12.06m							C	100	100	PL(A) = 1.2
21	13											
20	14											
19	15											
18	16											
17	17											
16	18											
15	19											

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 3.9m; NMLC-Coring to 12.06m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

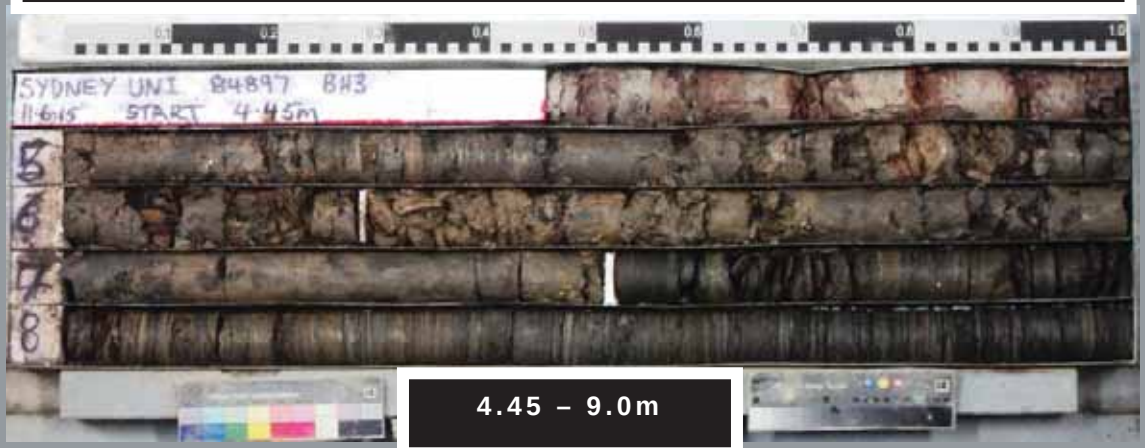
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 3 PROJECT 84897–02 JUN 2015



4.45 – 9.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 3 PROJECT 84897–02 JUN 2015

9.0 – 12.09m

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 35.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 84897.02
DATE: 11/6/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
35	0.03	ASPHALTIC CONCRETE							A/E			
	0.3	FILLING - light brown, slightly gravelly, sandy clay							A/E			
	0.7	FILLING - brown, slightly silty, slightly sandy, gravelly clay										
34	1	FILLING - brown, slightly sandy, silty clay with trace gravel							A/E			
	1.15	SILTY CLAY - very stiff to hard, grey mottled yellow-orange, silty clay with ironstone bands							S			7,8,9 N = 17
33	2											
									S			10,18,25/90mm refusal
32	3											
31	4											
	4.0	SHALY CLAY - very stiff to hard, grey, shaly clay with ironstone gravel and some bands, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	S			7,17,25/110mm refusal
30	5											
	5.0	SHALE - very low to low strength, extremely weathered, fragmented, grey to dark grey shale						5.0-7.51m: fg (possible drilling induced)	C	100	0	PL(A) = 0.1
29	6								C	100	0	
28	7								C	100	0	
	7.51	LAMINITE - low to medium strength, highly weathered, fragmented to fractured, dark grey and grey-brown, laminite with 25% fine sandstone laminations						7.51-7.62m: B (x3) 0°, sm, pl, cln 7.62-7.74m: fg 7.74-7.89m: B (x2) 0°, sm, pl, cly vn 7.89-8.06m: fg 8.06-8.33m: B (x3) 0°-5°, sm, pl, fe stn, cly vn 8.33-8.58m: B (x3) 0°-5°, sm, pl, cln 8.58m: B10°, ir, un, stn fe	C	100	0	PL(A) = 0.2
27	8								C	100	0	PL(A) = 0.4
26	9											
	9.19	LAMINITE - medium to high strength, moderately weathered to fresh, highly fractured to fractured, dark grey and grey-brown, laminite with 30% fine sandstone laminations						8.58-9.0m: B (x11) 0°-5° 9m: CORE LOSS: 190mm 9.19-9.47m: B (x4) 0°-5°, sm, pl, cln	C	81	0	PL(A) = 0.8

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 4.45m; NMLC-Coring to 12.09m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 35.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 84897.02
DATE: 11/6/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
25		LAMINITE - description next page						9.47m: B0°, ro, st, fe stn 9.52m: B0°, st, fe stn 9.52-9.86m: B (x7) sm, un, cln 9.86-10.85m: B (x7), ro, un, cln 10.85-11.03m: B (x5) ro, pl, cln 11.03-11.31m: B (x3) sm, pl, cln 11.41-11.83m: B (x3) sm, un, cln 11.83-12.09m: B (x3) sm, pl, cln	C	100	74	PL(A) = 0.6
24	11	LAMINITE - medium to high strength, moderately weathered to fresh, highly fractured to fractured, dark grey and grey-brown, laminite with 30% fine sandstone laminations *(continued)*							C	100	70	PL(A) = 1.2
23	12											PL(A) = 1.1
	12.09	Bore discontinued at 12.09m										
22	13											
21	14											
20	15											
19	16											
18	17											
17	18											
16	19											

RIG: DT-100 **DRILLER:** SM **LOGGED:** CG **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 4.45m; NMLC-Coring to 12.09m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

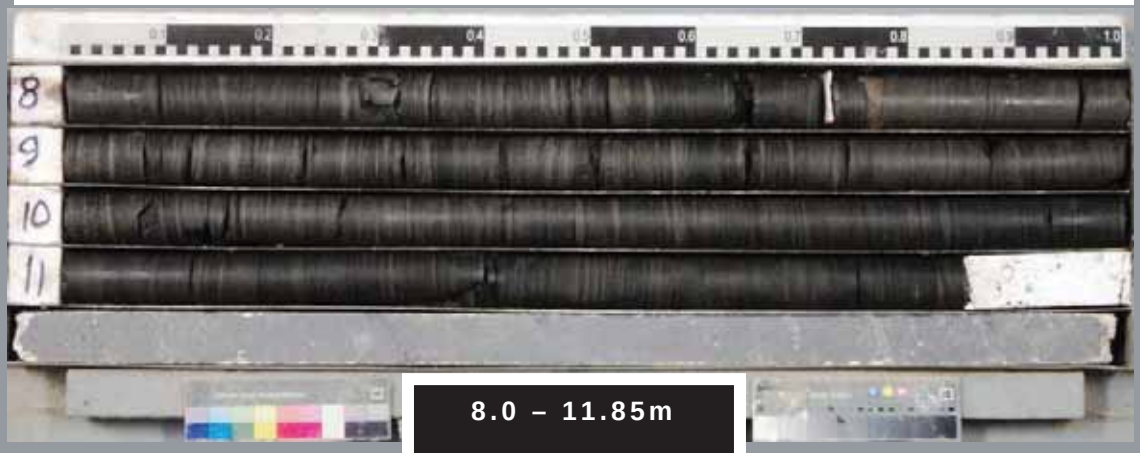
BORE 4 PROJECT 84897–02 JUL 2015

4.0 – 8.0m

DOUGLAS PARTNERS PTY LTD

PROPOSED F23 ADMIN. BUILDING – THE UNIVERSITY OF SYDNEY

BORE 4 PROJECT 84897–02 JUL 2015



8.0 – 11.85m

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 34.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 84897.02
DATE: 2/7/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low, Very Low, Low, Medium, High, Very High, Ex High		0.01, 0.05, 0.10, 0.50, 1.00	B - Bedding J - Joint S - Shear F - Fault				
34	0.1	ASPHALTIC CONCRETE							A			
	0.4	FILLING - brown, silty sand filling, humid							A/E			
		CLAY - apparently stiff, light grey mottled brown clay, moist										
33	1.0	SHALY CLAY - hard, orange-brown, shaly clay with ironstone bands, damp							A/E			
									S			9,14,19 N = 33
									E			
32	2.0	SHALE - very low strength, grey shale							E			
									S			25/100mm refusal
31	3							Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°				
30	4.0	SHALE - very low and very low to low strength, highly weathered, fragmented and slightly fractured, grey-brown shale with some low strength bands						4m: CORE LOSS: 250mm 4.3-4.35m: Cs 4.35-4.57m: fg 4.68m: B0°, cly, 10mm 4.9m: J35°, pl, ro, fe 5.07m: B5°, fe, Cz, 30mm 5.23m: J35°, pl, ro, fe	C	85	0	
29	4.25							5.7m: CORE LOSS: 300mm 6.0-6.16m: fg, fe				
28	6.0	LAMINITE - medium strength, moderately to slightly then slightly weathered, fractured and slightly fractured, grey-brown, laminite with approximately 25% fine sandstone laminations						6.25m: B5°, cly, 10mm 6.38m: J30°, pl, sm, cly, 5mm 6.45-6.65m: B's 0°, fe 6.7m: J35°, he 6.82m: J70°, he 6.9-7.25m: B's 0°, fe 7.3m: J45°, pl, ro, fe 7.48m: J20°- 45°, cu, ro, fe 7.57m: J35°, he, fe 7.82m: J60°- 80°, cu, sm, cly 7.9m: B0°, fe 8.3m: B0°, cly, sm & J, sv, un, ro, cly 8.63m: J40°, pl, ro, cln	C	90	40	PL(A) = 0.6 PL(A) = 0.8
27	8.0	LAMINITE - medium and high strength, fresh, slightly fractured and unbroken, light grey to grey, laminite with approximately 25% fine sandstone laminations										PL(A) = 1
26	9							9.5m: B5°, cly co	C	100	100	PL(A) = 1.3
25												

RIG: Bobcat **DRILLER:** SY **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 11.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: The University of Sydney
PROJECT: F23 Administration Building
LOCATION: Eastern Avenue, The University of Sydney

SURFACE LEVEL: 34.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 84897.02
DATE: 2/7/2015
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
24	11	LAMINITE - medium and high strength, fresh, slightly fractured and unbroken, light grey to grey, laminite with approximately 25% fine sandstone laminations *(continued)*						10.15m: J20°- 45°, cu, ro, cln				PL(A) = 0.8
								10.8m: J70°, he	C	100	100	
23								11.3-11.4m: J70°- 85°, st, ro, cln				PL(A) = 1.9
	11.85	Bore discontinued at 11.85m										
22	12											
	13											
21	14											
20	15											
19	16											
18	17											
17	18											
16	19											
15												

RIG: Bobcat **DRILLER:** SY **LOGGED:** SI **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger to 2.5m; Rotary to 4.0m; NMLC-Coring to 11.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix D

Results of Laboratory Testing

	Metals					TPH											BTEX					
	Lead	Lead TCLP	Mercury	Nickel	Zinc	C10-C16	C16-C34	C34-C40	F2-NAPHTHALENE	C6 - C9	C10 - C14	C15 - C28	C29-C36	>C10 - C36 (Sum of total)	C6-C10 less BTEX (F1)	C6-C10	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene Total
	mg/kg	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	1		0.1	1	1	50	100	100	50	25	50	100	100		25	25	0.2	1	0.5	2	1	
NSW 2014 General Solid Waste (No Leaching)	100		4	40						650				10000			10	600	288			1000
NSW 2014 General Solid Waste (leached)	**1500**	**5**	**50**	**1050**						**650**				**10000**			**18**	**1080**	**518**			**1800**
NSW 2014 Restricted Solid Waste (No Leaching)	*400*		*16*	*160*						*2600*				*40000*			*40*	*2400*	*1152*			*4000*
NSW 2014 Restricted Solid Waste (leached)	6000	20	200	4200						2600				40000			72	4320	2073			7200
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil	1500		730	6000	400000																	
CRC Care Direct Contact HSL-D						20000	27000	38000								26000	430	27000	99000			81000
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion, Sand 0-1m									NL						260		3	NL	NL			230
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse Soil						1000	3500	10000								700						

Field_ID	LocCode	Sample_Depth_Range																				
BH1	BH1	1	18	-	<0.1	10	41	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<25	<0.2	<1	<0.5	<2	<1	<3
BH2	BH2	0.5	130	0.05	0.2	14	140	<50	580	550	<50	<25	<50	210	540	775	<25	<25	<0.2	<1	<0.5	<2	<1	<3
BH3	BH3	1	32	-	<0.1	5	20	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<25	<0.2	<1	<0.5	<2	<1	<3
BH4	BH4	0.5	24	-	<0.1	10	11	<50	<100	<100	<50	<25	<50	<100	<100	<250	<25	<25	<0.2	<1	<0.5	<2	<1	<3

			Polycyclic aromatic hydrocarbons																		
			Total Positive PAHs	Acenaphthene	Acenaphthylene	Anthracene	Benz[a]anthracene	Benzo(a) pyrene	Benzo(a)pyrene TCLP	Benzo(a)pyrene TEQ calc(PQL)	Benzo(b)&(k)fluoranthene	Benzo(g,h,i)perylene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Phenolics Total	Pyrene
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				0.1	0.1	0.1	0.1	0.05		0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1
NSW 2014 General Solid Waste (No Leaching)			200					0.8													
NSW 2014 General Solid Waste (leached)			**200**					**10**	0.04												
NSW 2014 Restricted Solid Waste (No Leaching)			*800*					*3.2*													
NSW 2014 Restricted Solid Waste (leached)			800					23	*0.16*												
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil			4000							40											
CRC Care Direct Contact HSL-D																		11000			
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion																		NL			
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse S																					
Field_ID	**LocCode**	**Sample_Depth_Range**																			
BH1	BH1	1	2.7	<0.1	<0.1	<0.1	0.2	0.3	-	<0.5	0.5	0.2	0.2	<0.1	0.4	<0.1	0.2	<0.1	0.1	<5	0.5
BH2	BH2	0.5	22	<0.1	0.1	0.4	2.2	2.2	<0.001	3.2	3.9	0.9	2.1	0.2	3.9	<0.1	1	<0.1	1.3	<5	3.9
BH3	BH3	1	2.2	<0.1	<0.1	<0.1	0.2	0.2	-	<0.5	0.4	0.1	0.2	<0.1	0.4	<0.1	0.1	<0.1	0.2	<5	0.4
BH4	BH4	0.5	0	<0.1	<0.1	<0.1	<0.1	<0.05	-	<0.5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1

	Polychlorinated Biphenyls								Organochlorine Pesticides																										
	Arochlor 1016	Arochlor 1221	Arochlor 1232	Arochlor 1242	Arochlor 1248	Arochlor 1254	Arochlor 1260	Total PCB	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane (cis)	Chlordane (trans)	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Methoxychlor	Azinophos methyl	Bromophos-ethyl	Chlorpyrifos
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NSW 2014 General Solid Waste (No Leaching)								50																										4
NSW 2014 General Solid Waste (leached)								**50**																										**7.5**
NSW 2014 Restricted Solid Waste (No Leaching)								*50*																										*16*
NSW 2014 Restricted Solid Waste (leached)								50																										30
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil												45							3600					100			50		2500				2000
CRC Care Direct Contact HSL-D																																		
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion																																		
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse																																		

Field_ID	LocCode	Sample_Depth_Range																																	
BH1	BH1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH2	BH2	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH3	BH3	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
BH4	BH4	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

	Organophosphorous Pesticides								Pesticides		Asbestos	
	Chlorpyrifos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Ronnel	Pesticides (total, NSW Waste 2009)	Scheduled chemicals (NSW Waste 2014)	Asbestos ID in Soil	Asbestos fibres
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		g/kg	-
EQL	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.6	1.3	0.1	fibres
NSW 2014 General Solid Waste (No Leaching)									250	<50		
NSW 2014 General Solid Waste (leached)									**250**	**<50**		
NSW 2014 Restricted Solid Waste (No Leaching)									*1000*	*<50*		
NSW 2014 Restricted Solid Waste (leached)									1000	<50		
NEPM 2013 Table 1A(1) HILs Comm/Ind D Soil												
CRC Care Direct Contact HSL-D												
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intrusion												
NEPM 2013 Table 1B(7) Management Limits Comm / Ind, Coarse S												
Field_ID	**LocCode**	**Sample_Depth_Range**										
BH1	BH1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.6	<1.3	Not detected	No asbestos detected
BH2	BH2	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.6	<1.3	Not detected	No asbestos detected
BH3	BH3	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.6	<1.3	Not detected	No asbestos detected
BH4	BH4	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.6	<1.3	Not detected	No asbestos detected

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CERTIFICATE OF ANALYSIS 130575

Client:
Douglas Partners Pty Ltd
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Kelly McPhee, Geoff Young

Sample log in details:

Your Reference:	**84897, Sydney University**		
No. of samples:	9 soils		
Date samples received / completed instructions received	03/07/15	/	03/07/15

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

Report Details:

Date results requested by: / Issue Date:	8/07/15	/	7/07/15
Date of Preliminary Report:	Not Issued		

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Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	94	100	100	86	88

vTRH(C6-C10)/BTEXN in Soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1
naphthalene	mg/kg	12	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	89	82	89	86

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	07/07/2015	06/07/2015	06/07/2015	06/07/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	210	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	540	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	580	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	550	<100	<100	<100
Surrogate o-Terphenyl	%	87	86	83	83	83

svTRH (C10-C40) in Soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	07/07/2015	06/07/2015	06/07/2015	06/07/2015
TRHC$_{10}$ - C$_{14}$	mg/kg	210	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	9,800	<100	330	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	4,600	<100	180	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	720	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	710	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	13,000	<100	430	110
TRH>C$_{34}$-C$_{40}$	mg/kg	2,200	<100	<100	<100
Surrogate o-Terphenyl	%	#	85	93	89

PAHs in Soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	1.3	0.2	<0.1	0.1
Anthracene	mg/kg	<0.1	0.4	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.4	3.9	0.4	<0.1	0.2
Pyrene	mg/kg	0.5	3.9	0.4	<0.1	0.2
Benzo(a)anthracene	mg/kg	0.2	2.2	0.2	<0.1	0.1
Chrysene	mg/kg	0.2	2.1	0.2	<0.1	0.1
Benzo(b,j+k)fluoranthene	mg/kg	0.5	3.9	0.4	<0.2	0.2
Benzo(a)pyrene	mg/kg	0.3	2.2	0.2	<0.05	0.1
Indeno(1,2,3-c,d)pyrene	mg/kg	0.2	1.0	0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	0.2	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	0.2	0.9	0.1	<0.1	0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	3.2	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	3.2	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	3.2	<0.5	<0.5	<0.5
Total Positive PAHs	mg/kg	2.7	22	2.2	NIL (+)VE	1.2
Surrogate p-Terphenyl-d14	%	104	94	103	101	101

PAHs in Soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Naphthalene	mg/kg	27	<0.1	0.7	0.3
Acenaphthylene	mg/kg	70	<0.1	3.5	0.6
Acenaphthene	mg/kg	13	<0.1	0.8	0.1
Fluorene	mg/kg	48	<0.1	3.1	0.6
Phenanthrene	mg/kg	610	<0.1	24	6.9
Anthracene	mg/kg	130	<0.1	5.7	1.5
Fluoranthene	mg/kg	720	0.1	25	8.4
Pyrene	mg/kg	710	0.1	23	7.9
Benzo(a)anthracene	mg/kg	290	<0.1	10	3.5
Chrysene	mg/kg	260	<0.1	8.8	3.1
Benzo(b,j+k)fluoranthene	mg/kg	440	<0.2	14	5.1
Benzo(a)pyrene	mg/kg	290	0.05	9.0	3.1
Indeno(1,2,3-c,d)pyrene	mg/kg	150	<0.1	4.3	1.6
Dibenzo(a,h)anthracene	mg/kg	14	<0.1	1.1	0.4
Benzo(g,h,i)perylene	mg/kg	150	<0.1	4.0	1.5
Benzo(a)pyrene TEQ calc (zero)	mg/kg	400	<0.5	13	4.6
Benzo(a)pyrene TEQ calc(half)	mg/kg	400	<0.5	13	4.6
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	400	<0.5	13	4.6
Total Positive PAHs	mg/kg	3,900	0.26	140	45
Surrogate p-Terphenyl-d14	%	107	100	99	100

Organochlorine Pesticides in soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	99	102	102	99

Organochlorine Pesticides in soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
HCB	mg/kg	<1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<1	<0.1	<0.1	<0.1
Endrin	mg/kg	<1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	100	95	108

Organophosphorus Pesticides						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	102	99	102	102	99

Organophosphorus Pesticides					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Azinphos-methyl (Guthion)	mg/kg	<1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<1	<0.1	<0.1	<0.1
Ethion	mg/kg	<1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<1	<0.1	<0.1	<0.1
Malathion	mg/kg	<1	<0.1	<0.1	<0.1
Parathion	mg/kg	<1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<1	<0.1	<0.1	<0.1
Surrogate TCMX	%	100	100	95	108

PCBs in Soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCLMX	%	102	99	102	102	99

PCBs in Soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Aroclor 1016	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1221	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1232	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1242	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1248	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1254	mg/kg	<1	<0.1	<0.1	<1
Aroclor 1260	mg/kg	<1	<0.1	<0.1	<1
Surrogate TCLMX	%	100	100	95	108

Acid Extractable metals in soil						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date digested	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Arsenic	mg/kg	<4	4	4	5	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	14	11	19	12	9
Copper	mg/kg	32	84	23	19	11
Lead	mg/kg	18	130	32	24	38
Mercury	mg/kg	<0.1	0.2	<0.1	<0.1	0.2
Nickel	mg/kg	10	14	5	10	4
Zinc	mg/kg	41	140	20	11	53

Acid Extractable metals in soil					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date digested	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Arsenic	mg/kg	5	7	8	7
Cadmium	mg/kg	<0.4	<0.4	0.5	0.4
Chromium	mg/kg	9	21	17	18
Copper	mg/kg	130	16	81	93
Lead	mg/kg	170	30	150	270
Mercury	mg/kg	1	<0.1	0.4	0.4
Nickel	mg/kg	12	3	8	9
Zinc	mg/kg	200	11	150	120

Misc Soil - Inorg						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5	<5

Misc Soil - Inorg					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Date analysed	-	06/07/2015	06/07/2015	06/07/2015	06/07/2015
Total Phenolics (as Phenol)	mg/kg	<5	<5	<5	<5

Moisture						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	6/07/2015	6/07/2015	6/07/2015	6/07/2015	6/07/2015
Date analysed	-	7/07/2015	7/07/2015	7/07/2015	7/07/2015	7/07/2015
Moisture	%	6.3	8.4	16	23	12

Moisture					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	6/07/2015	6/07/2015	6/07/2015	6/07/2015
Date analysed	-	7/07/2015	7/07/2015	7/07/2015	7/07/2015
Moisture	%	11	24	21	22

Asbestos ID - soils						
Our Reference:	UNITS	130575-1	130575-2	130575-3	130575-4	130575-5
Your Reference	----------	BH1	BH2	BH3	BH4	BH5
Depth	----------	1.0	0.5	1.0	0.5	0.5
Date Sampled		12/06/2015	12/06/2015	11/06/2015	-	29/06/2015
Type of sample		Soil	Soil	Soil	Soil	Soil
Date analysed	-	7/07/2015	7/07/2015	7/07/2015	7/07/2015	7/07/2015
Sample mass tested	g	Approx. 40g	Approx. 40g	Approx. 35g	Approx. 30g	Approx. 35g
Sample Description	-	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Asbestos ID - soils					
Our Reference:	UNITS	130575-6	130575-7	130575-8	130575-9
Your Reference	----------	BH6	BH7	BH8	BH9
Depth	----------	0.5	0.5	0.5	1.0
Date Sampled		-	-	30/06/2015	29/06/2015
Type of sample		Soil	Soil	Soil	Soil
Date analysed	-	7/07/2015	7/07/2015	7/07/2015	7/07/2015
Sample mass tested	g	Approx. 35g	Approx. 30g	Approx. 35g	Approx. 35g
Sample Description	-	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks	Brown coarse grain soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-006	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-008	Moisture content determined by heating at 105+/-5 deg C for a minimum of 12 hours.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
TRH C_6 - C_9	mg/kg	25	Org-016	<25	130575-1	<25 || <25	LCS-1	101%
TRH C_6 - C_{10}	mg/kg	25	Org-016	<25	130575-1	<25 || <25	LCS-1	101%
Benzene	mg/kg	0.2	Org-016	<0.2	130575-1	<0.2 || <0.2	LCS-1	99%
Toluene	mg/kg	0.5	Org-016	<0.5	130575-1	<0.5 || <0.5	LCS-1	100%
Ethylbenzene	mg/kg	1	Org-016	<1	130575-1	<1 || <1	LCS-1	101%
m+p-xylene	mg/kg	2	Org-016	<2	130575-1	<2 || <2	LCS-1	103%
o-Xylene	mg/kg	1	Org-016	<1	130575-1	<1 || <1	LCS-1	99%
naphthalene	mg/kg	1	Org-014	<1	130575-1	<1 || <1	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	99	130575-1	94 || 95 || RPD: 1	LCS-1	99%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
TRH C_{10} - C_{14}	mg/kg	50	Org-003	<50	130575-1	<50 || <50	LCS-1	98%
TRH C_{15} - C_{28}	mg/kg	100	Org-003	<100	130575-1	<100 || <100	LCS-1	101%
TRH C_{29} - C_{36}	mg/kg	100	Org-003	<100	130575-1	<100 || <100	LCS-1	96%
TRH >C_{10}-C_{16}	mg/kg	50	Org-003	<50	130575-1	<50 || <50	LCS-1	98%
TRH >C_{16}-C_{34}	mg/kg	100	Org-003	<100	130575-1	<100 || <100	LCS-1	101%
TRH >C_{34}-C_{40}	mg/kg	100	Org-003	<100	130575-1	<100 || <100	LCS-1	96%
Surrogate o-Terphenyl	%		Org-003	85	130575-1	87 || 83 || RPD: 5	LCS-1	111%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base || Duplicate || %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Naphthalene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	LCS-1	110%
Acenaphthylene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	LCS-1	98%
Phenanthrene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.1 || 0.1 || RPD: 0	LCS-1	99%
Anthracene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.4 || 0.6 || RPD: 40	LCS-1	99%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Pyrene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.5 || 0.6 || RPD: 18	LCS-1	103%
Benzo(a)anthracene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.2 || 0.3 || RPD: 40	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.2 || 0.3 || RPD: 40	LCS-1	99%
Benzo(b,j+k) fluoranthene	mg/kg	0.2	Org-012 subset	<0.2	130575-1	0.5 || 0.6 || RPD: 18	[NR]	[NR]
Benzo(a)pyrene	mg/kg	0.05	Org-012 subset	<0.05	130575-1	0.3 || 0.3 || RPD: 0	LCS-1	98%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.2 || 0.2 || RPD: 0	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012 subset	<0.1	130575-1	0.2 || 0.2 || RPD: 0	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	90	130575-1	104 || 106 || RPD: 2	LCS-1	99%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
HCB	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	105%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	102%
Heptachlor	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	107%
delta-BHC	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	109%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	103%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	105%
Dieldrin	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	109%
Endrin	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	108%
pp-DDD	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	114%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	LCS-1	105%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	99	130575-1	102 || 100 || RPD: 2	LCS-1	99%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	102%
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	123%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	88%
Dimethoate	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	126%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	109%
Malathion	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	80%
Parathion	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	LCS-1	106%
Ronnel	mg/kg	0.1	Org-008	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-008	99	130575-1	102 || 100 || RPD: 2	LCS-1	102%

QUALITY CONTROL PCBs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Aroclor 1016	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1221	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1232	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1242	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1248	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Aroclor 1254	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	LCS-1	128%
Aroclor 1260	mg/kg	0.1	Org-006	<0.1	130575-1	<0.1 || <0.1	[NR]	[NR]
Surrogate TCLMX	%		Org-006	99	130575-1	102 || 100 || RPD: 2	LCS-1	91%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date digested	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Arsenic	mg/kg	4	Metals-020 ICP-AES	<4	130575-1	<4 || <4	LCS-1	102%
Cadmium	mg/kg	0.4	Metals-020 ICP-AES	<0.4	130575-1	<0.4 || <0.4	LCS-1	96%
Chromium	mg/kg	1	Metals-020 ICP-AES	<1	130575-1	14 || 12 || RPD: 15	LCS-1	98%
Copper	mg/kg	1	Metals-020 ICP-AES	<1	130575-1	32 || 23 || RPD: 33	LCS-1	96%
Lead	mg/kg	1	Metals-020 ICP-AES	<1	130575-1	18 || 15 || RPD: 18	LCS-1	92%
Mercury	mg/kg	0.1	Metals-021 CV-AAS	<0.1	130575-1	<0.1 || <0.1	LCS-1	76%
Nickel	mg/kg	1	Metals-020 ICP-AES	<1	130575-1	10 || 9 || RPD: 11	LCS-1	93%
Zinc	mg/kg	1	Metals-020 ICP-AES	<1	130575-1	41 || 34 || RPD: 19	LCS-1	96%

QUALITY CONTROL Misc Soil - Inorg	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Date analysed	-			06/07/2015	130575-1	06/07/2015 || 06/07/2015	LCS-1	06/07/2015
Total Phenolics (as Phenol)	mg/kg	5	Inorg-031	<5	130575-1	<5 || <5	LCS-1	101%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	06/07/2015
Date analysed	-	[NT]	[NT]	130575-2	06/07/2015
TRH C_6 - C_9	mg/kg	[NT]	[NT]	130575-2	101%
TRH C_6 - C_{10}	mg/kg	[NT]	[NT]	130575-2	101%
Benzene	mg/kg	[NT]	[NT]	130575-2	99%
Toluene	mg/kg	[NT]	[NT]	130575-2	100%
Ethylbenzene	mg/kg	[NT]	[NT]	130575-2	100%
m+p-xylene	mg/kg	[NT]	[NT]	130575-2	102%
o-Xylene	mg/kg	[NT]	[NT]	130575-2	99%
naphthalene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%	[NT]	[NT]	130575-2	93%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	07/07/2015
Date analysed	-	[NT]	[NT]	130575-2	07/07/2015
TRH C_{10} - C_{14}	mg/kg	[NT]	[NT]	130575-2	89%
TRH C_{15} - C_{28}	mg/kg	[NT]	[NT]	130575-2	#
TRH C_{29} - C_{36}	mg/kg	[NT]	[NT]	130575-2	#
TRH >C_{10}-C_{16}	mg/kg	[NT]	[NT]	130575-2	89%
TRH >C_{16}-C_{34}	mg/kg	[NT]	[NT]	130575-2	#
TRH >C_{34}-C_{40}	mg/kg	[NT]	[NT]	130575-2	#
Surrogate o-Terphenyl	%	[NT]	[NT]	130575-2	104%
QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	07/07/2015
Date analysed	-	[NT]	[NT]	130575-2	07/07/2015
Naphthalene	mg/kg	[NT]	[NT]	130575-2	105%
Acenaphthylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	[NT]	[NT]	130575-2	94%
Phenanthrene	mg/kg	[NT]	[NT]	130575-2	108%
Anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	[NT]	[NT]	130575-2	#
Pyrene	mg/kg	[NT]	[NT]	130575-2	#
Benzo(a)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	[NT]	[NT]	130575-2	133%
Benzo(b,j+k)fluoranthene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	mg/kg	[NT]	[NT]	130575-2	#
Indeno(1,2,3-c,d)pyrene	mg/kg	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%	[NT]	[NT]	130575-2	91%

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	06/07/2015
Date analysed	-	[NT]	[NT]	130575-2	06/07/2015
HCB	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-BHC	mg/kg	[NT]	[NT]	130575-2	103%
gamma-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
beta-BHC	mg/kg	[NT]	[NT]	130575-2	97%
Heptachlor	mg/kg	[NT]	[NT]	130575-2	101%
delta-BHC	mg/kg	[NT]	[NT]	[NR]	[NR]
Aldrin	mg/kg	[NT]	[NT]	130575-2	107%
Heptachlor Epoxide	mg/kg	[NT]	[NT]	130575-2	102%
gamma-Chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
alpha-chlordane	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan I	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDE	mg/kg	[NT]	[NT]	130575-2	100%
Dieldrin	mg/kg	[NT]	[NT]	130575-2	104%
Endrin	mg/kg	[NT]	[NT]	130575-2	103%
pp-DDD	mg/kg	[NT]	[NT]	130575-2	107%
Endosulfan II	mg/kg	[NT]	[NT]	[NR]	[NR]
pp-DDT	mg/kg	[NT]	[NT]	[NR]	[NR]
Endrin Aldehyde	mg/kg	[NT]	[NT]	[NR]	[NR]
Endosulfan Sulphate	mg/kg	[NT]	[NT]	130575-2	100%
Methoxychlor	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	130575-2	95%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	06/07/2015
Date analysed	-	[NT]	[NT]	130575-2	06/07/2015
Azinphos-methyl (Guthion)	mg/kg	[NT]	[NT]	130575-2	95%
Bromophos-ethyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Chlorpyriphos	mg/kg	[NT]	[NT]	130575-2	114%
Chlorpyriphos-methyl	mg/kg	[NT]	[NT]	[NR]	[NR]
Diazinon	mg/kg	[NT]	[NT]	[NR]	[NR]
Dichlorvos	mg/kg	[NT]	[NT]	130575-2	90%
Dimethoate	mg/kg	[NT]	[NT]	[NR]	[NR]
Ethion	mg/kg	[NT]	[NT]	130575-2	106%
Fenitrothion	mg/kg	[NT]	[NT]	130575-2	104%
Malathion	mg/kg	[NT]	[NT]	130575-2	77%
Parathion	mg/kg	[NT]	[NT]	130575-2	98%
Ronnel	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCMX	%	[NT]	[NT]	130575-2	99%
QUALITY CONTROL PCBs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date extracted	-	[NT]	[NT]	130575-2	06/07/2015
Date analysed	-	[NT]	[NT]	130575-2	06/07/2015
Aroclor 1016	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1221	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1232	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1242	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1248	mg/kg	[NT]	[NT]	[NR]	[NR]
Aroclor 1254	mg/kg	[NT]	[NT]	130575-2	123%
Aroclor 1260	mg/kg	[NT]	[NT]	[NR]	[NR]
Surrogate TCLMX	%	[NT]	[NT]	130575-2	93%
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date digested	-	[NT]	[NT]	130575-2	06/07/2015
Date analysed	-	[NT]	[NT]	130575-2	06/07/2015
Arsenic	mg/kg	[NT]	[NT]	130575-2	97%
Cadmium	mg/kg	[NT]	[NT]	130575-2	97%
Chromium	mg/kg	[NT]	[NT]	130575-2	97%
Copper	mg/kg	[NT]	[NT]	130575-2	125%
Lead	mg/kg	[NT]	[NT]	130575-2	96%
Mercury	mg/kg	[NT]	[NT]	130575-2	85%
Nickel	mg/kg	[NT]	[NT]	130575-2	106%
Zinc	mg/kg	[NT]	[NT]	130575-2	105%

Report Comments:

Total Recoverable Hydrocarbons in soil: # Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference.

PAH_S: # Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference.

Asbestos: A portion of the supplied samples were sub-sampled for asbestos analysis according to Envirolab procedures. We cannot guarantee that these sub-samples are indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.

OC/OP/PCB's in soil:PQL has been raised due to interference from analytes(other than those being tested) in the sample/s.

Asbestos ID was analysed by Approved Identifier: Paul Ching
Asbestos ID was authorised by Approved Signatory: Paul Ching

INS: Insufficient sample for this test
NA: Test not required
<: Less than

PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than

NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

CHAIN OF CUSTODY

Douglas Partners
Geotechnics / Environment / Groundwater

Client:	Douglas Partners	**Project Number**	84897	**To:**	Envirolab Services
Contact Person:	Kelly McPhee	**Project Name:**	Sydney University	**Contact Person:**	Aileen Hie
Project Mgr:	Geoff Young	**PO No.:**	122353	**Address:**	12 Ashley Street
Sampler:	Kelly McPhee	**lab Quote No. :**			Chatswood NSW 2068
Address:	96 Hermitage Road West Ryde NSW 2114	**Date results required:**	3 day Or choose: standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*	**Phone:**	02 9910 6200
				Fax:	02 9910 6201
				Email:	ahie@envirolab.com.au
Phone:	9809 0666 **Mob:** 0419 781 366	**Report format:** esdat / PDF / Excel		**Laboratory Report No:**	
Email:	kelly.mcphee @douglaspartners.com.au geoff.young @douglaspartners.com.au	**Comments:**		**Lab Comments:**	
Prior Storage (Fridge, Esky, Shelf)					

	Sample information					Tests Required												Comments
	Field Sample ID	Depth	Date sampled	Container Type	Type of sample	Combo 8a												
1	BH1	1.0	12/06/2015	jar	soil	X												
2	BH2	0.5	12/06/2015	jar	soil	X												
3	BH3	1.0	11/06/2015	jar	soil	X												
4	BH4	0.5		jar	soil	X												
5	BH5	0.5	29/06/2015	jar	soil	X												
6	BH6	0.5		jar	soil	X												
7	BH7	0.5		jar	soil	X												
8	BH8	0.5	30/06/2015	jar	soil	X												
9	BH9	1.0	29/06/2015	jar	soil	X												

ENVIROLAB

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 130575

Date Received: 3/7/15
Time Received: 17:40
Received by: PT
Temp: Cool/Ambient 3.6
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Douglas Partners	**Sample Receipt**	***Lab use only:***	
Hand delivered / Courier (by whom)	**Received by (Company):** ELS	**Samples Received: Cool or Ambient (circle one)**	
Condition of Sample at dispatch Cool or Ambient (circle)	**Print Name:** PTaul	**Temperature Received at:** (if applicable)	3.6°C
Temperature (if Applicable):	**Date & Time:** 3/7/15 17:40	**Transported by:** Hand delivered / courier	
Print Name: Kelly McPhee	**Signature:** PT		
Date & Time: 3/7 2.30pm			
Signature:			

13 March 2015

THE UNIVERSITY OF SYDNEY

Geotechnical Desktop Study for Proposed New Building and Extension (F07 and F23 Projects)

Submitted to:
Katie Pritchard
The University of Sydney
Campus Infrastructure and Services
Level 1, Service Building G12
Darlington Campus

REPORT

Report Number. 1520860_001_R_Rev0

Distribution:

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1.0 INTRODUCTION

Golder Associates (Golder) has been engaged by the University of Sydney - Campus Infrastructure and Services team (CIS) to undertake a geotechnical desktop study for a proposed new administrative building (F23 building) and an extension of the existing Carslaw building (F07 extension).

This desktop study was carried out in general accordance with Golder proposal Ref. P1520860_001_P_Rev 0 dated 15 January 2015.

Both projects are located within the Darlington Campus of the University of Sydney. The F23 building is being constructed to co-locate and consolidate administrative functions. It is going to be constructed on an area currently used for car parking (Figure 1) and is likely to include two basement levels.

Figure 1: The site of proposed building F23

Figure 2: The site of the F07 extension

The F07 extension will be used to co-locate the schools of Molecular Bio-Science and Biological Sciences (Figure 2). The extension to the existing Carslaw building is likely to include one basement level.

1.1 Scope of Work

The purpose of this geotechnical desktop study is to provide a review of available information relating to the existing site conditions to assist further planning and design development. The following scope of work has been completed:

- A review of available geological and topographical information for the site, including previous geotechnical reports, provided by CIS, and hydrogeological information.
- A site visit by a senior geotechnical engineer (Jamie McIlquham).
- A review of documented location of major utility services in the project area obtained from a Dial Before You Dig enquiry.
- A preliminary assessment of the potential for Acid Sulfate Soil (ASS) using ASS risk maps (ASRIS, 2015).
- A review of available groundwater bore information in the study area.
- A search of dangerous goods records through WorkCover.
- A review of the contamination land records and environmental protection licence information.
- An assessment of anticipated subsurface materials and their likely geotechnical properties.

2.0 DESK STUDY INFORMATION

2.1 Site Location and Physical Description

The F23 building and F07 extension sites are located in Camperdown, Sydney within the Darlington Campus of the University of Sydney at the intersection of City Road and Eastern Avenue (Figure 3).

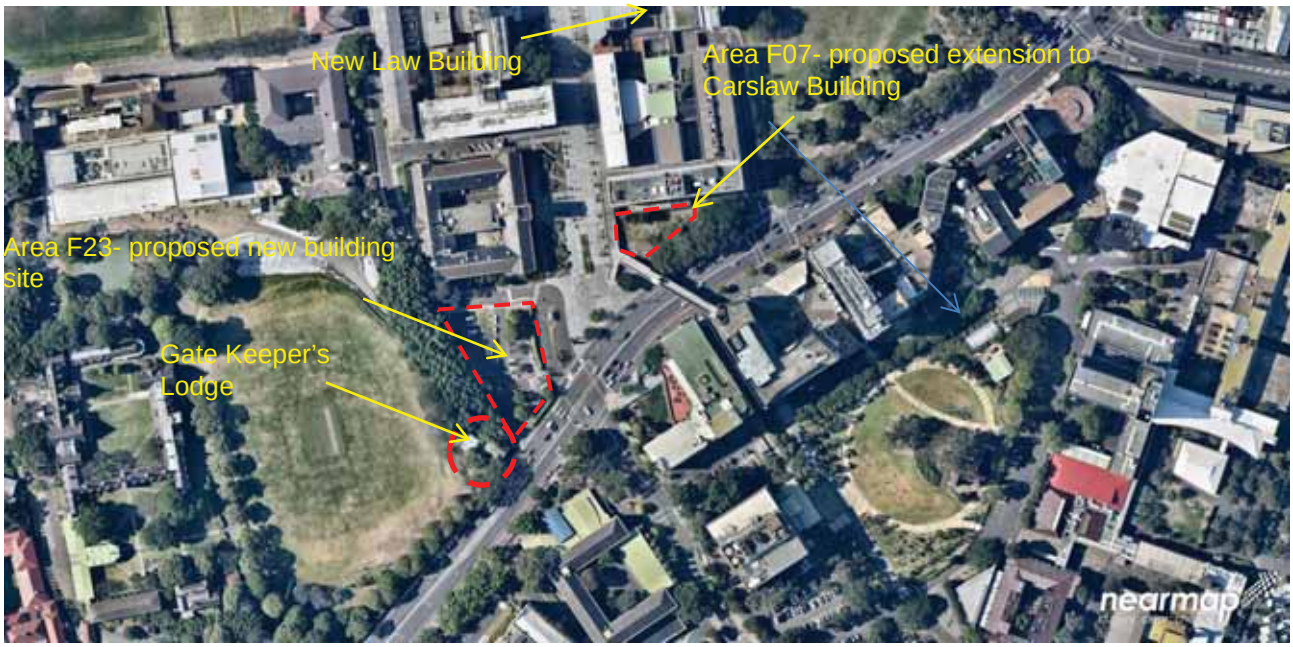

Figure 3: Locality of the study area: F07 and F23 Project sites.

The study area for the F07 extension is currently a planted area with large trees, which is bounded by the Carslaw Building to the north, City Road to the south, Barff Road to the east and Eastern Avenue to the west. The Keith Murray footbridge over City Road is located at the southwest corner of this area. The site for the F07 extension is generally flat with the ground surface generally sloping from north-west down to the south-east from approximately RL 35.5 m AHD to RL 33 m AHD over a length of about 40 m (USYD, 2013 & 2014).

The study area for the proposed F23 building is bounded by a road and the Madsen Building to the north, a vehicle access road to the east, City Road to the south, and Fisher Road and St. Paul's Oval to the west. The site for proposed building F23 is generally flat with the natural topography sloping from south-east down to the north-west from approximately RL 35 m AHD to RL 33 m AHD over a length of about 70 m (Site Survey Plan). The area is also scattered with eight medium to large trees along the walkways.

From a broader scale the study areas appear to be located on a ridge line with approximately north-south alignment.

2.2 Geology, Subsurface profile and Hydrogeology

2.2.1 Geology

The Geological Survey of NSW 1:100,000 map (Geological Series Sheet 9130, Edition 1, 1983) indicates that the site is underlain by Ashfield Shale, consisting of black to dark-grey shale and laminite with frequent sideritic clay ironstone bands. Weathering of the shale tends to produce a reddish/brown clay soil, often with poor drainage. These clay soils are usually reactive with an appreciable shrink-swell capacity when subjected to moisture variation (Howard, 1969).

Geological features in Sydney Basin typically include north-east to south-west trending faults and joint swarms that vary between about 50-80 m in width and Tertiary Age west to east oriented igneous dykes

(Och et al., 2004). The joint swarms consist of rock mass zones of relatively closer jointing than the generally widely spaced jointing of the surrounding rockmass.

The fault zones are known to comprise of much closer-jointing, shearing and measurable displacement of few metres at specific intervals resulting in fragmented, broken and clayey very poor quality rockmass.

The dykes are generally basaltic in composition and range from a few centimetres to up to 6 metres wide. Where dykes are encountered at shallow depth they are characterised by extremely weathered, low strength rock and clay together with more fractured surrounding rockmass caused by the intrusion.

No major geological structures, such as dykes, faults or folds are shown at the site. The nearest dykes recorded on the map are located over 1 km to the north east of the site trending from north-west to south-east.

The previous geotechnical investigation by JK Group (JK, 2012) and our site observations (refer Section 3) also indicate that Ashfield Shale is present at locations close to the proposed project sites.

2.2.2 Subsurface Profile

We anticipate that the site will have a relatively thin surficial fill layer associated with ground surface levelling, backfilling structures and construction of road and pavement areas. As the University has operated over a significant length of times and buildings in the area are of different ages, there may be different fills over the study area.

The fill materials may be underlain by residual soils associated with the shale. Typically fill is anticipated to comprise silty clay soils, and possibly road base materials below paved areas (JK, 2012). The shale bedrock is expected to be encountered at less than 4 m depth below ground surface, as suggested by design drawings for the footbridge over City Road (GHD, 2006). The shale encountered in previous investigations, at St Paul's College approximately 50-70 m north-west of the Area F23, showed a significant depth of weathering. Approximately the upper 5 to 10 m of the shale bedrock was recorded as extremely to distinctly weathered. The weathered shale was reported as mostly extremely low to very low strength, increasing to medium to high strength at depths of approximately 15 m below existing ground level (JK, 2012).

Based on published data, shale bedrock is anticipated to comprise near horizontal bedding planes, sub-vertical joints with at up to 90° to the horizontal, and joints with 30-60° to the horizontal with South-West or North-East dip direction (Bertuzzi & Pells, 2002). The JK Group investigation (JK, 2012) found that the structure of the shale bedrock comprised near horizontal bedding planes, joints at up to 90° to the horizontal and clay and extremely weathered seams.

The published geology and JK Group (JK, 2012) information is consistent with the records of a registered Groundwater Well (GW110247), located 250 m south-west of the site, which recorded shale bedrock at a depth of 4.5 m. Shale bedrock (Class V) was also inferred at 2 to 3 m depth at the location of the USYD footbridge (GHD, 2006).

2.2.3 Hydrogeology

The JK Group (JK, 2012) report indicates that the groundwater level around the study areas is likely to be around RL 24 m AHD (i.e. approximately 8 to 10 m below the existing ground level).

The nearest groundwater bore licensed by NSW Office of Water (GW110247) is located 250 m south-west of the site. In this bore, the upper water bearing zone was located at 22 m depth below the ground level at the well location.

2.3 Services

To assess the potential presence of services close to the site, we have completed a Dial Before You Dig enquiry. The information obtained identified the following utilities which may be affected by the proposed basement excavations:

F23 Building:

- A main Telstra cable runs across the F23 project site from Fisher Road near the Gate Keepers Lodge (see Figure 3) to the Madsen Building.
- An Ausgrid conduit has been installed along the walkway to the south of Area F23.

F07 Extension:

- Telstra and Optus fibres run along the northern boundary of Area F07 and the pedestrian walkway to the west of the area.
- Ausgrid conduits have been installed along the north-west corner of this area and the walkway to the west.

A brick sewer line is located to the south-west of Area F07, which crosses City Road and Eastern Avenue. There are also underground cables for traffic signals at the intersection of Eastern Avenue and City Road.

2.4 Acid Sulfate Soils

The Australian Soil Resource Information System (ASRIS), maintained by CSIRO, shows the ASS risk in the study areas is Class C4 'Extremely Low Probability/Low Confidence' with 'No Known Occurrence' (ASRIS 2015). This is consistent with the location of the site and the published geology of the area. ASS is usually formed within waterlogged conditions in low lying areas (typically below RL 5 m AHD).

2.5 Regulatory Agency Records Searches

2.5.1 NSW Environment Protection Authority

A search of online records held by the NSW Environment Protection Authority (EPA) was undertaken. The search findings are presented below.

2.5.2 CLM Act Notices

An on-line search on 18 February 2015 of the EPA's "Record of Notices" issued under the *Contaminated Land Management Act 1997* (the CLM Act) did not identify the project sites as being subject to current or prior notices. One premise within Camperdown was identified as having a former notice issued under the provisions of the CLM Act. The premise, located approximately 1.5 km to the west, is considered to have a low potential to impact on the project sites.

2.5.3 Notifications under Section 60 of the CLM Act

The NSW EPA maintains a "List of NSW contaminated sites notified to the EPA" under Section 60 of the *CLM Act*. Sites on this list indicate that the notifiers consider that the sites are contaminated and warrant reporting to EPA. The contamination at the site may or may not be significant enough to warrant regulation by the EPA and the EPA reviews relevant site information before making a determination as to whether or not the site warrants regulation. An online search for NSW sites near to the proposed project sites was performed on 18 February 2015.

Two premises in Camperdown and four premises in Newtown were identified as having current or former notices issued under the provisions of the CLM Act. These premises, located approximately 0.8 to 1.5 km from the project sites, are considered to have a low potential to impact on the project sites.

2.5.4 EPLs under the POEO Act

The NSW EPA maintains a public register of premises subject to an Environment Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997*. An online search for premises in the Camperdown and Darlington was performed on 18 February 2015. The result of the search, limited to premises within 1 km of the site, is presented in the table below.

Table 1: EPL Search Results

Premises	Distance and direction from site (approx.)	Licence status
Sydney South West Area Health Service, Missenden Road, Camperdown	750 m NW	No longer in force
Intec Ltd, Building J01, Maze Crescent, the University of Sydney, Darlington	150 m SW	No longer in force
John Holland Pty Ltd, Corner Codrington and Abercrombie Street, Darlington	350 m S	Surrendered

It is considered that the premises identified in the search would not impact on the site.

2.6 Notified Dangerous Goods

A search of the WorkCover NSW files for records relating to historical storage of Dangerous Goods at the site was requested by Golder on 16 February 2015. WorkCover NSW advised that a search of their Stored Chemical Information Database (SCID) and microfiche records did not locate any records relating to the site.

3.0 SITE WALKOVER

We visited the site on 26th February 2015. During the site visit, we inspected the general area of each proposed structure, as well as the basement of the Carslaw building and the car park basements below the New Law Building. Observations from the site walkover are summarised in Table 2, below.

Table 2: Site Walkover Observations

Location	Observations
Madsen Building	In general, the Madsen Building appears in good condition compared to other buildings of similar inferred age within the University, with no obvious signs of structural cracking identified during the site walkover. The building has a one level basement that in some areas has signs of groundwater having entered the building. Additional drainage has been provided in some of these areas (e.g. sump pump). The building contains vibration sensitive equipment, such as electron microscopes. During the site walkover, a University representative indicated that even low levels of vibration (i.e. doors slamming) can cause issues in the operation of this equipment.
New Law Building Car Park	The site walkover included inspections of the three level basement car park of the building. The retention system used was observed to be concrete soldier piles with shotcrete infill panels. In one part of the western wall of the 2nd basement level, shotcrete had been removed, exposing weathered shale rock, inferred to be Class IV shale (Figure 4). Groundwater inflow was observed to be occurring in some locations, this tended to be associated with joints in shotcrete infill and between shotcrete and piles (Figure 4).  *Figure 4: Observations in lower basement car park of New Law Building*
Carslaw Building	We did not enter the Carslaw Building during the walkover survey, although observations were made of an existing retaining wall at its southern end. This wall has moved slightly (up to about 10 mm at movement joints) and is approximately 4 m high. In general the Carslaw Building appeared to be in reasonable condition, with no obvious signs of structural cracking noted during the walkover survey.

4.0 DISCUSSION

Based on the available information, we present the following key geotechnical and geological issues for consideration in planning and further design development:

Excavation:

- Construction of the proposed basements may involve an excavation up to 6 to 7 m below existing ground levels. The excavation materials are likely to comprise fill, residual soil and variably weathered shale bedrock.
- Subgrade conditions may be poor, with fill materials and high plasticity clays likely to be present on the site. There may be a need for a suitable working platform to be constructed to allow construction plant to traffic the area during development.
- There is vibration sensitive equipment in the Madsen Building. The selection of excavation equipment may need to consider low vibration options. Alternatively, construction could be completed when the equipment is being maintained or is not in use.
- Excess spoil for offsite disposal will need to be classified in accordance with the *Waste Classification Guidelines Part 1: Classifying Waste* (EPA November 2014).

Groundwater Management

- Perched groundwater could potentially flow through the fill, residual or extremely weathered shale profile. This will need to be considered in design of excavations and retention systems. Dewatering may be required for both temporary and permanent excavations.
- The volume of groundwater flow depends on recent weather conditions, the nature of defects within the bedrock, topography and elevation. Groundwater level may also vary due to prevailing weather condition and rainfall, and also future development around the site.

Retention and Foundation Systems

- Temporary and permanent retention systems for excavations should be designed and constructed so that acceptable ground movements result. The retention design would need to assess impact of ground movements on nearby structures, services and roads.
- Mature trees located close to the proposed structures are to be retained. The potential impact of these trees on shallow foundations and retaining walls will need to be assessed. The potential impact of smaller trees that are removed over the footprint of the structures will also need to be assessed.
- For the F027 extension, the design of the connection between old and new structures will need to consider the potential for differential movement occurring between the structures.

Additional Geotechnical Investigation

In order to inform and optimise design development and manage geotechnical risk associated with the proposal developments construction, we recommend the following:

- The borehole information for the footbridge over City Road is found. This may well include information that will be useful in the design of the F07 extension and may reduce the cost of further geotechnical investigations.
- That additional geotechnical and environmental investigations are completed at the locations of the proposed structures. These should be used to confirm the site subsurface conditions and to enable recovery of soil and groundwater samples. Golder is available to scope and carry out a detail design intrusive geotechnical investigation, as required.

5.0 REFERENCES

ASRIS – Australian Soil Resource Information System. http://www.asris.csiro.au. Accessed February 2015.

Bertuzzi, R. and Pells, P.J.N., Sydney Sandstone and Shale, Australian Geomechancis Society, 2002.

Drawings for USYD Central Pedestrian Bridge by GHD, Drawing No: 21-1254703-S201-Rev 2, dated 9 November 2006 (GHD, 2006).

Howard, G., The Geology of New South Wales. Sydney: Geological Society of Australia edited by Peckham. November 1969, pp. 417–421.

JK Geotechnics, 'Geotechnical investigation for proposed university accommodation, St Paul's College, University of Sydney at St Paul's College University of Sydney Camperdown NSW', Ref.24782S2rptrev1, dated 20 August 2012.

NSW Office of Water, Work Summary of groundwater well GW110247, Licence No: 10BL603148, http://allwaterdata.water.nsw.gov.au/water.stm. Accessed March 2015.

Och, D, Pells, P.J.N. and Braybrooke J., Geological Faults and Dykes in Sydney CBD: Australian Geomechanics Journal, September 2004.

Pells P.J.N., Mostyn, G. and Walker B.F., Foundations on Sandstone and Shale in the Sydney Region, Australian Geomechanics Society, 1998.

The University of Sydney, topographical survey plans of Camperdown Campus, drawings No: AA-04-01 to AA-04-02, dated 30.07.2014 and No: AA-04-03 to AA-04-05, dated 04.03.2013.

6.0 LIMITATIONS

Your attention is drawn to the following limitations, which must be read in conjunction with this report.

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

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

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Report Signature Page

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SZ/JDM:SPD/sz

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UNIVERSITY OF SYDNEY F23 ADMINISTRATION BUILDING

CONTAMINATED SOIL AND WATER MANAGEMENT PLAN

1/04/2016 | REVISION No: 1

Plan Revision Status				
Date	Revision (in numbers)	Purpose and Summary of Amendments	Reviewed by	Approved by
1/04/2016	1	Initial Draft	RY	MM

*Note that all printed paper/hard copies of this document and related procedures are uncontrolled. The controlled copy of this document is found either in Project Web, within the Project Management Plan section, or other project specific database/server approved by the Regional EHS Manager.

CONTAMINATED SOIL & WATER MANAGEMENT PLAN	
Scope:	Whilst remediation of any contaminated soils and/or groundwater is outside the scope of works for this project this Contamination Soil & Water management Implementation Plan details appropriate contingency measures are in place to ensure that these materials, if encountered are managed appropriately during the construction phase. It defines mitigation measures to be implemented during relevant construction activities, a monitoring program that enables assessment of the impacts of construction activities on potentially affected areas, and contingency measures that may be implemented if exceedances are measured.
Objective:	• To identify and remove any contaminated soils and/ or groundwater within the proposed development area that may be encountered during the demolition or construction works. • To render any contaminated soils/groundwater within the footprint of the proposed redevelopment suitable for either re-use on site or for off-site in accordance with relevant state legislation, regulatory requirements and environmental guidelines. • To minimise potential future environmental and human health risks associated with any contaminated soils/ groundwater within the proposed redevelopment area.
Risks:	The potential for soil and/ or groundwater contamination at the site is low. The following activities are therefore expected to be the key risk sources during construction: • Exposure of site workers or contractors to contaminated soils, vapours or groundwater during the bulk excavation of contaminated soils or formation of service trenches. • Incorrect storage of contaminated soils or groundwater during civil works that results in either on/off-site migration of contaminants to sensitive receptors such as adjacent waterways. • Accidental creation of a contaminant migration pathway such as a service trench linking a source of contamination to a sensitive receptor. • Inappropriate disposal of contaminated soil or groundwater without appropriate documentation.
Key Legislation / Standards / Guidance	AS4482:1997 Guide to the Sampling and Investigation of Potentially Contaminated Soil – Non-volatile and Semi-volatile Compounds. NEPC (1999) National Environmental Protection (Assessment of Site Contamination) Measures ANZECC (2000) Australian and New Land Water Quality Guidelines for Fresh and Marine Water Quality
Site Control Measures:	Although not anticipated, it is possible that potentially contaminated material may be encountered during the site excavation and civil works. If encountered the following protocol must be enacted: Unexpected find protocol If suspected toxic or hazardous materials including groundwater are discovered / exposed during excavation activities in an area of the site believed to be clean of contamination, the following protocol must be followed: 1. Cease work and evacuate the area of work immediately. 2. Contact a LLB representative (EHS coordinator, General Foreman, Construction Manager, Site Manager) 3. Erect barricades to isolate the immediate areas, with 10m between the suspect material and the erected barrier if possible. Note: Evacuate the work area to the upwind side of the contamination. 4. The appropriate regulatory authorities should be notified as soon as possible if applicable. 5. No person shall enter the barricaded area unless expressly permitted by the qualified environmental specialist. A clearance certificate or approval should be given in writing prior to entry. 6. Sampling of the suspect material is to be carried out by an appropriately qualified environmental specialist (usually a consultant) as advised by the LLB construction manager. 7. The nominated Environmental Specialist (in liaison with LLB senior site personnel and/or relevant authorities) will determine if further remedial actions are necessary based on the sample test results and will nominate appropriate reuse, treatment or disposal options and procedures.

	8. All permits to carry out remedial work are to be obtained prior to the commencement of any new works and the nominated Environmental Specialist must be provided written clearance approval. 9. The barricade may then be removed and work activities may resume under the direction of the LL LLB Construction Manager. Contingency measures The first step in the sequence of operations is to plan the contaminated land contingency measures and integrate these with the construction and demolition program via a Preliminary Contamination Assessment and a Waste Classification Assessment. All controls are to comply to the LL Building Means & Methods for Physical GMRs 8.3 1. Appoint a suitable qualified consultant to conduct a Preliminary Contamination Assessment (PCA) on the proposed works areas. The PCA will determine the extent and nature of contamination (if any) and identify any associated potential for significant risk of harm to human health or the environment. A more detailed investigation may be required if information is inadequate 2. Prepare a Preliminary Waste Classification to determine the appropriate waste classification of any excavated spoil to be disposed off site. Waste soils will be classified in accordance with relevant environmental guidelines. The waste classification will include details of waste volume, type and nominated licensed landfill to receive the waste. Prepare a Contaminated Soil & Water Diagram for the site that details the contaminated areas and any designated storage locations of stockpiles and establish options for re-use on site if possible. 3. Provisions must be made on-site for the temporary stockpiling of soils pending either waste classification testing or advice from the client. The stockpile storage areas will be segregated into soils pending use (re-use on site, remediation or off-site disposal) Ensure that all the required approvals and/or permits are obtained prior to the excavation, handling, transport or disposal of contaminated soils or water. Only civil works contractor with relevant licenses for handling and transported contaminated soils and hazardous building materials (i.e. asbestos) must be used. All controls are to comply with the LL Building Means & Methods for Physical GMRs 8.3 & 8.7.

Control Measures	Timing	Methodology	Responsibility	Monitoring and Reporting	Performance Measure
Unexpected find/ Planning / General					
Suspected toxic or hazardous materials or groundwater are discovered	At all times	Unexpected find protocol enacted.			
No construction or demolition activities will be performed on the site until a PCA and Preliminary Waste Classification (if required) has been performed to identify and assess any risks associated with potential soil and/or groundwater contamination within that location. Preliminary Contamination Assessment (PCA) to be undertaken.	During design/ prior construction.	Review existing data. Additional information to be obtained by Environmental Consultant.	CM/EM	PCA prepared. Copy of Report to University of Sydney	No works performed in areas without PCA first completed. Need for remedial works identified.
Assessment of Remediation Options to be undertaken	If PCA confirms contaminated soils.	Liaison with Environmental Consultant & Lend Lease Building.	CM/EM	Feasibility assessment provided to University of Sydney	University of Sydney consent obtained prior commencing with any remediation.
Site Preparation					
Prepare designated stockpile areas (sealed & bunded) with suitable environmental controls for contaminated soil.	Prior construction work commencing.	Contractor to prepare area based on specification.	CM/SM	Inspection of stockpile area prior to works commencing	Area suitable capacity for volumes indicated in Waste Assessment Report.
Obtain relevant waste remediation/ transport/ disposal permits.	Prior construction.	Contractor to obtain relevant permits.	CM	Review permits and approvals prior works.	Copies of valid permits and approvals in site file.
Construction phase					
Specific environmental monitoring will be performed where required (i.e. VOCs, asbestos or dust) to ensure safe working conditions are maintained during the works.	Prior construction work commencing.	Consultant to identify location, level, type, duration etc.	CM	Daily to ensure it is working effectively	Daily results available and reported to LL Building.
Segregation of contaminated soils / water from other inert wastes.	At any time	Contractor to segregate. Consultant to identify level/type of contamination and place signage on stockpile.	SM/ Environmental specialist.	Routine inspection of stockpile areas.	Correct waste classification. No cross contamination of wastes. Appropriate signage present.
Minimise exposure of site workers to contaminated materials.	At all times.	Contractor to supply appropriate PPE and SWMS. Lend Lease Building to provide training and induction.	SM/ Environmental specialist.	Daily inspection of works areas.	No elevated environmental monitoring events. No notifications for incorrect/ inadequate PPE. SWMS are followed.
Safe storage of contaminated soils/ groundwater pending off-site disposal or treatment.	During construction & demolition.	Contractor to prepare designated waste storage area with environmental controls.	SM/ Environmental specialist.	Inspection of storage area prior commencement of excavation/ demolition works.	No uncontrolled runoff from stockpiles. No cross contamination of wastes.

Control Measures	Timing	Methodology	Responsibility	Monitoring and Reporting	Performance Measure
Safe transport of contaminated soils/groundwater to receiving waste facility.	During construction & demolition.	Construction traffic routes to be followed. Approved and licensed contractor used.	SM	Inspect contractor licenses and insurance.	Copies of license and insurance in site files. No use of unauthorised traffic routes.
Remediation & Pre Treatment of Waste					
Where feasible, treat contaminated groundwater/ soil for suitable re-use onsite or disposal as lower waste classification.	When required.	Environmental consultant to provide Remediation Testing Advice.	EM	Approvals for treatment obtained. Validation certificates of remediated materials.	Approvals obtained prior treatment. Validation certificate obtained at completion of treatment. No environmental incidents during treatment.
Re-use on site					
On site re-use treated soils/ groundwater that achieves acceptable clean-up targets.	When remediation successful.	Environmental consultant to confirm fit for purpose.	SM/ EM	Remediation testing report confirms materials fit for purpose. University of Sydney consent to reuse materials.	No soil/ water re-used without University of Sydney consent. Validation certificate for all re-used wastes.
Off-site Disposal					
Landfill disposal of contaminated soils.	Where remediation and reuse onsite is not feasible.	Contractor to obtain disposal approvals and permits. Environmental consultant to provide Waste Report.	SM	Inspect permits and approvals prior to loading transport vehicles. Waste report attached to waste documents.	Waste report present. Waste dockets correspond to waste volumes/types. Licensed landfill used.
Off-site disposal of contaminated groundwater.	Where remediation and reuse onsite is not feasible.	Contractor to obtain disposal approvals and permits. Licensed liquid waste contractor used.	SM	Inspect permits and approvals prior to loading transport vehicles. Waste report attached to waste documents.	Waste report present. Waste dockets correspond to waste volumes/types. Licensed liquid waste facility used.
Validation					
Validation of remediation excavations/ materials.	At completion of excavations.	Environmental consultant to perform and confirm validation.	EM	Validation report to confirm subject materials or area suitably remediated.	Remediated materials deemed suitable for re-use. Remediated areas deemed fit for purpose.
Personal decontamination					
Personal decontamination must be undertaken each time workers leave the contaminated work zone and at the completion of the contaminated material removal work. Personal decontamination should be done within the contaminated work area where re-contamination cannot occur.	At all times	When leaving the work area all site personnel must make their way to the nominated decontamination area, remove their coveralls and clean their masks and boots using the wet rags. If respirator is used, respirator must remain on during decontamination and must only be removed on completion of decontamination.	SM	As detailed in the SWMS Detailed work method statement to be prepared by sub-contractor	The environmental specialist may need to be required to carry out a full time monitoring during the work activities including visual inspection of the work area prior to the commencement of any hazardous materials removal works to ensure containment measures are satisfactory.

Control Measures	Timing	Methodology	Responsibility	Monitoring and Reporting	Performance Measure
		All equipment that is to leave the work area must also be decontaminated in the decontamination area with the use of wet rags.At completion of works all contaminated related materials including polythene coveralls, geo-fabric and rags must be disposal as contaminated waste.			
Plant decontamination					
All plant used for the removal of contaminated materials or other hazardous materials must be decontaminated.	At competition of works or if moved off site.	At the conclusion of the works the excavators/trucks shall be parked within a designated washing area. Decontamination should include removing all soil from tracks the body and bucket as far as reasonably practicable. The waste soil and water within the wash area should be removed and deposited in a truck parked outside the contaminated zone and disposed of in accordance with Waste Classification Guidelines	SM	As detailed in the SWMS Detailed work method statement to be prepared by sub-contractor	Landfill waste dockets provided. Landfill dockets correspond to removed waste volumes/types.