University of New South Wales

Remedial Action Plan

UNSW's Cliffbrook Campus Redevelopment Project
Corner of Battery and Beach Streets
Coogee, NSW

18 September 2017

54176-111021 (Rev B)

JBS&G

www.jbsg.com.au

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Executive Summary

JBS&G Australia Pty Ltd (JBS&G) was engaged by University of New South Wales (UNSW, the client) via Root Partnerships (Root) to prepare a Remedial Action Plan (RAP) for the UNSW Cliffbrook Campus Redevelopment (CCR) site, located on Battery and Beach Streets, Coogee, NSW (the site). The overall UNSW property comprises Lot 1 DP109530 (the majority) and Lots 1 and 8 DP8162, covering approximately 1.2 hectares (ha). The site location is shown on **Figure 1**.

JBS&G has previously undertaken a Preliminary Site Investigation (PSI) at the site as documented in JBS&G (2017[1]) that identified the presence of asbestos containing material (ACM) fragments and asbestos fibres within two portions of the site. ACM was reported in fill at sampling location HA02, in the southern grassed area of the site. Asbestos fibres were reported in soil at sampling location HA04 in the north of the site.

JBS&G then completed an additional investigation (JBS&G 2016[2]) targeting the southern grassed area and the area around HA04. Bonded ACM was identified at seven of the seventeen locations completed. In association with the bonded ACM three areas of asbestos fines were identified. The concentrations of the ACM and/or asbestos fines were above the adopted NEPC (2013) HSL-C recreational/secondary school land use criteria. Previous sampling locations are shown on **Figure 2**. To this extent, management of the identified asbestos impact at the site was recommended.

Based on the previous assessments of the site, the following contamination issues have been identified at the site:

- Bonded ACM and/or AF observed within the fill profile in the north and south; and
- Bonded ACM observed within the fill profile in the south.

Based on assessment of remedial options, the preferred remediation approach for the asbestos impacts identified is:

- On-site containment where feasible beneath building footprints, hardstand areas or open space areas, of asbestos impacted soils requiring disturbance during development, with ongoing management via an Environmental Management Plan (EMP); and
- Retention of asbestos impacted soils that do not require disturbance for development, with appropriate ground cover, with ongoing management via an EMP; or, contingent on the feasibility of the preferred approach:
- Off-site disposal of AF (and any coincidental ACM) impacted soils; and/or
- Picking of ACM from ACM (only) impacted soil to reduce ACM to acceptable levels and allow reuse of of the soil with management via an EMP.

Overall, it is considered that the proposed actions outlined in this RAP are: technically feasible; environmentally justifiable; and consistent with relevant laws, policies and guidelines endorsed by NSW EPA.

Subject to the successful implementation of the measures described in this RAP and the limitations in **Section 12**, it is concluded that the identified asbestos impacts can be remediated / managed in such a way to be appropriately protective of human health and the environment, such that the site can be made suitable for development and ongoing use.

[1] Preliminary Site Investigation - UNSW Cliffbrook Campus Redevelopment Project, Battery and Beach Streets, Coogee, NSW JBS&G Australia Pty Ltd 4 May 2017 (JBS&G 2017)

[2] Additional Contamination Assessment – UNSW Cliffbrook Campus Redevelopment, Battery and Beach Streets, Coogee, NSW JBS&G Australia Pty Ltd 20 October 2016 (JBS&G 2016)

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by University of New South Wales (UNSW, the client) via Root Partnerships (Root) to prepare a Remedial Action Plan (RAP) for the UNSW Cliffbrook Campus Redevelopment (CCR) site, located on Battery and Beach Streets, Coogee, NSW (the site). The overall UNSW property comprises Lot 1 DP109530 (the majority) and Lots 1 and 8 DP8162, covering approximately 1.2 hectares (ha). The site location is shown on **Figure 1**.

JBS&G has previously undertaken a Preliminary Site Investigation (PSI) at the site as documentated in JBS&G (2016) that identified the presence of asbestos containing material (ACM) fragments and asbestos fibres within two portions of the site. ACM was reported in fill at sampling location HA02, in the southern grassed area of the site. Asbestos fibres were reported in soil at sampling location HA04 in the north of the site.

JBS&G then completed an additional investigation (JBS&G 2017) targeting the southern grassed area and the area around HA04. Bonded ACM was identified at seven of the seventeen locations completed. In association with the bonded ACM three areas of asbestos fines were identified. The concentrations of the ACM and/or asbestos fines identified at three locations were above the adopted NEPC (2013) HSL-C recreational/secondary school land use criteria. Previous sampling locations are shown on **Figure 2**. To this extent, management of the identified asbestos impact at the site was recommended.

This RAP was developed in accordance with guidelines made or approved by the NSW Environment Protection Authority (EPA) and DUAP (1998) Planning Guidelines for State Environmental Planning Policy (SEPP) 55 Remediation of Land.

1.2 Objectives

The objective of this RAP is to document the procedures and standards to be followed in order to address the identified asbestos impacts at the site, ensuring the protection of human health and the surrounding environment, such that the asbestos impact is remediated / managed in such a manner as to make the site suitable for ongoing land use.

2. Site Condition

2.1 Site Identification

The site details are summarised in **Table 2.1**. A description of the site is provided in **Section 2.2**

Table 2.1: Site Details

Address	Corner of Battery and Beach Streets, Coogee, NSW
Lot and DP	Lot 1 DP 109530 and Lot 1 and 8 DP 8162
Approximate Site Area	1.2 ha
Approximate co-ordinates (MGA56) of centre of site	Easting: 339208.57 Northing: 6246013.08
Local Government Area	Randwick City Council
Current Land Use	University with open space areas
Zoning*	Zone SP2 (Infrastructure, Educational Establishment) and Zone RE2 (Private Recreation).
Environmental Info	LEP 2012 environmental info: Part of the site falls within the general heritage map

2.2 Site Description

A detailed site inspection was undertaken on 31 May 2016 by an experienced JBS&G environmental Consultant.

The site comprised an irregular parcel of land that fronted on to Battery Street to the west of the site. At the time of the inspection the site was occupied by UNSW and is home to UNSW Press Limited. The site layout and boundary is defined in **Figure 2**.

Along the northern and western boundaries of the site is a heritage listed sandstone fence. The gate opening (the main entrance to the site) has been in the same location since 1893.

The heritage listed cottage (Building CC1) was observed in the middle of the western portion of the site. It is a two storey brick building with sandstone detailing. The cottage is surrounded by a manicured hedge.

The garage (Building CC3) comprised a small two car building to the north west of the cottage, constructed out of recycled sandstone and cement mortar. The asbestos and the petrol pump noted in the historical information for this structure were not identified during this inspection. To the north of the garage there was a small pedestrian entrance through the sandstone fence.

A small building along the western boundary south of the garage was observed. This building appeared to have been built from similar brick to the main building. The former use of the building is not known, however at the time of investigation the building appeared disused, and no staining was observed on the foundations.

The carpark along the western boundary of the site is partially asphalt and bricked. Storm water drains were observed in the asphalted area.

The building to the north west of the cottage (Building CC2) was a single storey brick building, which was observed to have suspected asbestos containing material (ACM) within the eaves. Concrete stair access was observed on the southern side.

The UNSW Press Building (Building CC4) was a three storey brick building with a metal sheet roof. It is assumed again that the eaves present within this building may contain asbestos.

The residential building the north east of the site appears to be a single storey concrete rendered brick building. At the top of the northern edge of the property there is a single car garage that again appears to be concrete rendered brick. This property is completely fenced off from the university and was inaccessible at the time of the inspection.

The grassed area in southern portion of the site contained manicured gardens and lawns with pine mulch observed on some of the garden beds. The area in the southern portion of the site was fenced

off from the main university and contained a trampoline. A berm was noticed to run along the southern boundary to the east of Building CC4 to the road access in the western portion of the site.

The south east area section of the site had a gated fence that segregated it from the rest of the site. However, this area was observed to be cleared in the north western corner with a trampoline being observed. The remaining area was highly vegetated and sloped steeply towards the south east.

2.3 Surrounding Land-use

The surrounding land uses have been identified as follows:

- North – The eastern portion of the site is bound to the north by residential. The western portion of the site is bound to the north by Battery Street. Further afield are residential properties.
- East – The open space southeast portion of the site is bound to the east by a public path from Tower Street across from which are residential properties. The northeast portion of the site is bound by residential properties along Battery Street.
- South – To the west of the site is a mixture of residential properties and the reserve surrounding Gordons Bay.
- West – The site is bound to the west by Beach Street across from which are residential properties.

Based on the general observations of surrounding properties, it was considered the potential for contamination to be migrating onto the site from surrounding areas is low.

2.4 Environmental Setting

2.4.1 Topography

Review of the regional topography maps from SIX maps[3] indicates that the site has an approximate elevation of between 25 and 30 m above the Australian Height Datum (AHD).

2.4.2 Geology

Based on the Sydney 1:100,000 Geological Sheet[4] 9130 Edition 1 (1983) the site is located in an area underlain by Quaternary age sediments and Triassic age Hawkesbury Sandstone. Typical geological characteristics of the Quaternary sediment profile are medium to fine grained marine sands and/or coarse quartz sand with varying amounts of shell fragments, with Hawkesbury Sandstone typified by medium to coarse grained quartz sandstone with minor shale and laminite lenses.

Based on eSPADE[5] Soil Landscape information, soils at the site are part of the Lambert landscape characterised by undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief 20-120 m, slopes usually around 20%. Landforms can include broad ridges, gently to moderately inclined slopes, wide rock benches with low broken scarps and small hanging valleys with areas of poor drainage. Vegetation is usually open and closed heathland, scrub and occasional low eucalypt open-woodland. Limitations of this soil type include very high soil erosion hazard, rock outcrop, seasonally perched water tables, shallow, highly permeable soil and very low soil fertility.

2.4.3 Acid Sulfate Soils

Based on a review of the NSW Office of Environmental and Heritage Acid Sulphate Risk database, there is “no known occurrence” in regard to acid sulphate soils.

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3 SIX Maps http://maps.six.nsw.gov.au / (accessed 21 June 2016)
4 Sydney 1:100,000 Geological Sheet2 9130 Edition 1 (1983)
5 eSPADE http://www.environment.nsw.gov.au/eSpadeWebApp/ (accessed 21 June 2016)

Additionally a review of the Randwick LEP 2015 indicate that there are no known occurrences of acid sulfate soils (ASS) within the area of the site.

2.4.4 Hydrology

The western portion of the site is predominately sealed, precipitation falling on this portion of the site is expected to drain through the stormwater infrastructure pits observed. Run off from this portion of the site would be directed to the council stormwater infrastructure on Beach or Battery Street.

The southern portion of the site is an open space within highly vegetated areas along the southern boundary. Run-off is expected to flow south towards Gordons Bay and be diverted east by a land berm along the southern boundary.

The closest waterbody is the Gordons Bay, located approximately 50m south of the site.

2.4.5 Hydrogeology

Review of the NSW Department of Primary Industries, Office of Water's Groundwater Monitoring overview map5 revealed 7 registered groundwater wells within approximately 1 km of the site. Five of the wells were located in a cluster 1.06 km to the south west of the site. Available information for the 7 wells are summarised below in **Table 2.2**.

Table 2.2 Hydrogeological Wells within 1 km of the site

Well ID	Distance from Site	Direction from Site	Depth	Standing water level	Purpose
GW108862	0.37 km	North east	186 m	32 m	Recreation
GW042800	0.91 km	North west	14.6 m	No information provided	Recreation
GW113105	1.06 km	South west	No information provided	No information provided	Monitoring
GW113106	1.06 km	South west	No information provided	No information provided	Monitoring
GW113107	1.06 km	South west	No information provided	No information provided	Monitoring
GW113108	1.06 km	South west	No information provided	No information provided	Monitoring
GW113109	1.06 km	South west	No information provided	No information provided	Monitoring

The ground water within GW108862 was located within the sandstone bedrock. The ground water within GW042800 was within sand at 13.11 m, and the record for this well indicates three sources of ground water were crossed, the first at within sand 1.22 m, second within grey sand at 5.49 m and the third within yellow sand 8.84 m.

Based on regional topography and the geological setting of the site, there may be shallow groundwater beneath the site above sandstone bedrock which would likely follow the topography, as well as deeper aquifers in the bedrock. Based on the site's geological setting, portions in the west of the site may be located on the northeast fringe of the Botany Sands aquifer.

3. Site History and Contamination Status

3.1 Summary of Site History

A site history of the site was presented in JBS&G (2017a), including review of a full suite of available historical aerial photographs. A summary of the site history is as follows:

- 1916 – Part of the site was occupied by the Governor of the Commonwealth Bank of Australia.
- 1924-1949 – The main portion of the site was occupied by Governor of the Commonwealth Bank of Australia, an engineer, investor, grazier and a chemist.
- 1930 – The site appears to comprise one residential building in the northwestern corner, adjacent to which appears to be a structure where there currently exists Building CC2. There appears to be a rectangular feature and vacant/vegetated ground in the area currently occupied by Building CC4, although it is unclear whether the feature is a structure. A large square structure within the centre of the western portion is consistent with existing Building CC1. There appears to be a feature to the south west of the large square structure (CC1) along the southern boundary in the current grassed area. The southern portion of the site is largely vacant with some vegetation.
- 1949-1959 – The main portion of the site was acquired by The Commonwealth of Australia.
- 1970 – The roofline of Building CC4 has changed which suggests development of this building, the additional building to south of residential building in north-western corner and a track through the vegetated area to the top of the cliff above Gordons Bay.
- 1959-1990 – The main portion of the site was taken over by the Australian Atomic Energy Commission
- 1961 – The addition of Building CC4 similar to its current layout, and a building in the north-western area was observed.
- 1990-1997 – The main portion of the site was acquired by The Commonwealth of Australia again.
- 1923-2002 – Part of the site was occupied by an architect, his wife and a Bank officer.
- 2001 – The dense vegetation in the southern portion of the site has been landscaped and the buildings to the south west of the cottage (CC1) and south of Building CC4 have been removed.
- 1997 – Part of the site was acquired by the University of NSW.
- 2002 – Part of the site was acquired by the University of NSW.

3.2 Previous Investigations

Summary soil analytical tables from previous investigations are provided in **Appendix A**. Sample logs from previous investigations are provided in **Appendix B**.

3.2.1 Preliminary Site Investigation (JBS&G 2017)

JBS&G was engaged by Pells Sullivan Meynink to conduct a Preliminary Site Investigation (PSI) at the site.

Based on the site inspection and desktop review of local and regional background environmental information, and available historical information, areas of environmental concern (AEC) identified were associate with former structures at the site and potential use of fill material of unknown origin.

Associated contaminants of potential concern (COPC) at the site included Heavy metals, total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP) and asbestos.

A total of seven sampling locations, including three boreholes and four hand auger holes were completed, for a preliminary investigation of potential contamination in soil. The site surface was comprised of either pavers, road base, asphalt or grass/garden bed. Fill was encountered to depths ranging between 0.1 m to 0.7 m depth. Fill materials typically consisted of dark grey to grey gravelly or clayey with inclusions of sandstone, igneous gravels, plastic, tile and metal.

The fill material was underlain by natural grey to brown clayey sand or sand with no inclusions. Observations during geotechnical investigations indicated that the natural sand was underlain at approximately 1.6 m by brown with red and orange clayey sand (weathered sandstone).

ACM, odours or staining indicative of hydrocarbon or chemical contamination, were not observed in fill or natural materials during field works.

Concentrations of COPC in all samples analysed were reported below the adopted NEPC (2013) human health and ecological criteria, with the exception of PAH at location BH03, and ACM in fill at location HA02. While the PAH concentrations at BH03 exceeded adopted human health and ecological criteria, it is considered that the PAH is associated with bituminous fragments introduced into the samples from overlying roadbase and asphalt (bituminous concrete) pavement at this location, as no other potential source of PAH contamination was identified.

The ACM reported in the surface soil sample from HA02, was associated with the fill material within the berm constructed along the southern edge of the site. This material was heavily vegetated and therefore ACM was unlikely to be released into the air by normal surface activities. Although the material is in bonded form, and no asbestos fibres or fibrous asbestos (AF/FA) was reported in this area, if vegetated surfaces along the berm are disturbed there is the potential for small ACM fragments to be exposed. The presence of FA in fill at HA04 was identified below reporting limits and below the adopted health-based criterion and does not pose an unacceptable health risk.

3.2.2 Additional Contamination Assessment (JBS&G 2016)

JBS&G was requested by UNSW via Francis-Jones Morehen Thorp Pty Ltd (FJMT) to undertake additional contamination assessment at the site.

Based on the previous available data, including COPC identified by the historical information, a targeted systematic soil sampling pattern was considered the most appropriate approach to achieve the required outcomes for this assessment.

The program included seventeen (17) soil sampling locations (DHA01 to DHA17) targeting areas where asbestos contamination was identified previously. Soil samples were collected using hand tools, including a shovel/mattock to the base of fill between 0.2 and 0.6 m. A hand auger was used to collected deeper soils samples from 0.5 and 0.3 m into natural soils.

The fill material was underlain by natural orange to brown clayey sand or yellow, brown to grey sand with no inclusions.

It is noted that bonded ACM was identified in seven of the seventeen locations completed. Odours or staining indicative of hydrocarbon or chemical contamination, were not observed in fill or natural materials during field works.

The asbestos quantification and laboratory results are summarised as follows:

- The reported concentrations of bonded ACM presence in soil were below the adopted NEPC (2013) HSL-C criterion of 0.02%, except DHA05 at 0.0322% ACM. It is noted that bonded ACM below the criteria was identified in DHA03, DHA04, DHA06, DHA07, DHA08 and DHA10.

- The reported concentrations of asbestos fines (AF) were within the adopted 0.001% w/w NEPC (2013) HSL-C criterion, with the exception of the following results:
    - DHA03_0.0-0.6 with a reported concentration of 0.0013% w/w.
    - DHA05_0.0-0.6 with a reported concentration of 0.0033% w/w.
    - DHA06_0.0-0.4 with a reported concentration of 0.001% w/w.

Based on the findings of this investigation, the following conclusions were reached:

- The asbestos in fill soils at the site does not pose a current health risk provided the current grass cover is maintained. If the material was to be exposed/excavated there is the potential for release of asbestos fibres that could pose a risk to the users of the site.
- If management of the material in-situ is preferred, then an Asbestos Management Plan detailing the contamination and the controls that need to be in place for normal site use. It is noted that additionally this material will need to be placed on an asbestos register for the site.
- If excavation of the material is preferred, then a Remedial Action Plan will need to be developed to guide removal and validation. As noted, this approach would require disturbance of soil across a substantial area in close proximity to residential properties.

It was recommended that the asbestos in soil impact be managed without disturbance by developing and implementing a site-specific Asbestos Management Plan, and inclusion of the asbestos in soil locations on a site asbestos register.

3.3 Contamination Status

Based on the previous assessments of the site, the following contamination issues have been identified at the site:

- AF concentrations in soil above the adopted health based criteria (HIL-C) and bonded ACM impacted soils;
- AF and ACM concentrations in soil below the adopted health based criteria (HIL-C); and
- Bonded ACM concentrations in soil below the adopted health based criteria (HIL-C).

The proposed development includes the removal of some of the existing buildings in the north western portion of the site, the development of a new facility including basement parking, the removal and extension of paved/hardstand and landscaping in the south east corner of the site. It is noted that there are cut to fill activities proposed to be undertaken during the redevelopment works, plans for which have been included in **Appendix C**. Management/remediation of the above contamination issues is required during the works.

4. Remediation Options

4.1 Extent of Impact

The extent of Impact is presented on **Figure 3** and can be summarised as follows:

- AF concentrations in soil above the adopted health based criteria (HIL-C) and bonded ACM impacted soils;
- AF and ACM concentrations in soil below the adopted health based criteria (HIL-C); and
- Bonded ACM concentrations in soil below the adopted health based criteria (HIL-C).

4.2 Remediation Objectives

The goal for the remediation of environmental impacts is to remove unacceptable risks to human health posed by the asbestos impacted fill materials.

This RAP has been prepared with reference to the following guidelines and legislation:

- Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land; (DUAP 1998).
- Contaminated Sites: Sampling Design Guidelines, September 1995 (EPA 1995).
- Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, August 2011 (OEH 2011).
- Contaminated Sites: Guidelines for NSW Site Auditor Scheme, April 2006 (DEC 2006).
- National Environment Protection (Assessment of Site Contamination Measure) Measure 1999, as amended 2013, National Environment Protection council (NEPC 2013);
- Work Health and Safety Act 2011.
- How to safely remove asbestos - Code of Practice, Safe Work Australia, 2011 (SWA 2011a).
- How to manage and control asbestos in the workplace - Code of Practice, Safe Work Australia, 2011 (SWA 2011b).
- Management of asbestos in the non-occupational environment, enHealth Council, 2005 (enHealth 2005).
- Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia, WA Department of Health, 2009 (WA DoH 2009).

4.3 Remedial Options

Consideration of the available remedial options in accordance with relevant guidance is presented in Table 4.1. The hierarchy of remediation/management adopted by EPA and reference in the NEPC (2013) ASC NEPM are outlined below.

4.3.1 DEC 2006 Guidance

DEC (2006)[6] lists the following order of preference for soil remediation and management:

1. On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;

[6] *Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (2nd edition),* DEC NSW, 2006 (DEC 2006).

2. Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
3. Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill; and
4. Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

NEPC (2013) indicates that when considering remediation and management, options 1 and 2 mentioned above are preferred. However, if these are not practicable, then options 4 then 3, or an appropriate management strategy where remediation has no net benefit, should be considered. It is noted that the draft revised site auditor guidelines (currently pending release) make reference to the NEPC (2013) hierarchy being followed in NSW.

4.3.2 WA DoH 2009 Guidance

WA DoH (2009)[7] provides specific guidance in the remediation and management of asbestos. The following considerations are important when assessing the acceptability of any remediation:

- Minimisation of public risk;
- Minimisation of contaminated soil disturbance; and
- Minimisation of contaminated material/soil moved to landfill.

[7] *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia,* WA Department of Health, 2009 (WA DoH 2009).

Table 4.1: Remedial Options Matrix

Remedial Option	Discussion	Conclusion
Option 1: On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level.	<u>Bonded ACM and AF impacted soils</u> FA / AF are typically heterogeneously distributed throughout impacted soils and are not readily visible to the naked eye. On this basis, there is no option considered appropriate to remove AF from impacted soils on site.	Not a suitable option.
	<u>Bonded ACM only impacted soils</u> Within the bonded ACM impacted soils (**Figure 2**): - Bonded ACM only was observed within the fill profile greater than 10mm below surface; and - The natural soil is sandy which enables effective raking. Based on this, if bonded ACM impacted soils are exposed within the top 10 mm of the surface the soil is considered to be suitable for hand-picking of bonded ACM. Furthermore, hand-picking of bonded ACM from the soil minimises the volume of material requiring transport and off-site disposal. Furthermore, this method reduces the amount of soil to be removed from the site which could be detrimental to the local ecology.	An option in areas of bonded ACM only impact.
Option 2: Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site.	<u>Bonded ACM and AF impacted soils</u> As with Option 1, treatment of these materials is not a viable option.	Not a suitable option.
	<u>Bonded ACM only impacted soils</u> There are currently no facilities licensed to accept asbestos impacted material for offsite treatment.	Not a suitable option.
Option 3: Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill.	<u>Bonded ACM and AF impacted soils</u> Given that AF cannot be treated onsite or off-site and that containment may not be possible on the site due to cut-fill requirements of the development, an alternate option for remediation of AF impacted soils is excavation and off-site disposal. There are currently suitably licensed waste facilities in the Sydney region capable of accepting asbestos contaminated soils.	An option for bonded ACM and FA jointly impacted soils, if unable to be contained/managed on site.
	<u>Bonded ACM only impacted soils</u> Offsite disposal is a suitable remedial option for areas where bonded ACM impact may not be able to me remediated for onsite reuse. This may be due to an inability to effectively remove bonded ACM due to soil type or due to a high concentration of ACM within a localised area.	A suitable option if unable to remediate or manage onsite.

Remedial Option	Discussion	Conclusion
Option 4: Consolidation and isolation of the soil on-site by containment within a properly designed barrier.	<u>Bonded ACM and FA impacted soils</u> Given the limited excavation works within the impacted area in situ management of the AF and bonded asbestos is a valid option. Additionally, there is the option of containment of the AF and bonded asbestos impact underneath the proposed building with a long term EMP managed for the site, if feasible within the development cut-fill requirements. Where development works do not require disturbance of AF/ACM impacted soil, such impacts can be managed in-situ subject to an appropriate environmental/asbestos management plan.	Preferred option where feasible within the development.

4.4 Preferred Remedial Strategy

A number of potential remedial options have been outlined in **Table 4.1**.

The preferred remedial strategy for the site is cap and contain ACM/AF impacted materials beneath appropriate capping/structures where these impacted soils are required to be disturbed during development. With reference to ANZECC (1999) and WA DOH (2009) on-site containment and management of asbestos impacted materials is considered appropriate to mitigate potentially unacceptable risks from asbestos impacted soils for the intended ongoing land use.

The impacted materials can be contained beneath capping in an open space area on site. This includes the importation and placement of a marker layer and at least 0.1 m up to 0.3 m of clean capping material to be used for recreational/park land purpose.

A suitable maker layer will be placed between the clean material/hard surface to allow easy identification of the presence of contaminated material.

Where asbestos impacted soils in grassed areas do not require disturbance for the development, these materials could remain in place subject to appropriate management.

The presence of impacted material will be managed by implementation of a long term Environmental Management Plan (EMP).

4.4.1 Contingency Remedial Approaches

Contingent on the feasibility of on-site containment and management as above, the following remedial strategies can be implemented:

- Reducing ACM content in ACM impacted soils to acceptable levels and reuse of remediated soils beneath hardstand or >0.1 m beneath surface in landscaped areas with management; and/or
- Removing and disposing ACM and AF impacted soils at an offsite landfill.

5. Remediation Plan

5.1 Approvals, Licences and Notifications

The *Randwick Local Environmental Plan (2012)* (LEP) applies to the site. LEP stated that the site falls within a heritage protection area and therefore consent for Category 1 remediation works would be required consistent with SEPP 55 (refer **Section 10.2**). It is understood remediation will be completed ancillary to proposed development works, which is understood to be State Significant Development (SSD), and therefore will be subject to development consent.

Given the proposed remedial works include the removal of friable asbestos impacted soils, SafeWork NSW must be notified by the licensed asbestos removalist at least five workings days prior to the commencement of the removal work. The presence of friable asbestos means that the works must be managed as friable asbestos removal works with removal conducted by a Class A Licensed Contractor.

Owners and/or occupiers of premises adjoining or across the road from the site shall be notified at least seven days prior to the commencement of remediation works.

5.2 Site Establishment

The boundary of the extent of remediation will be defined by the Remediation Consultant (JBS&G). The Remediation Contractor (herein referred to as the "Contractor") shall secure these areas to ensure that all safety and environmental controls are implemented. These controls will include, but not be limited to:

- Locate and isolate all required utilities in the proximity of the works;
- Assess need for and implement any necessary traffic controls;
- Work area security fencing;
- Site signage and contact numbers;
- Stabilised site entry gate;
- Appropriate decontamination areas for personnel and plant;
- Sediment fencing (attached to security fencing) where necessary; and
- Stormwater runoff and sediment controls (e.g. silt fences) where necessary.

5.3 Remedial Works

The remedial works below are based on containment and ongoing management of disturbed soils beneath an appropriate capping layer and in-situ management of impacted soils that are not required to be disturbed.

5.3.1 AF and Bonded Impact to be disturbed

The following remediation works shall be undertaken on the bonded ACM and AF (friable) impacted soils indicated on **Figure 3**:

- The asbestos removal works shall be conducted by a Class A Licensed Asbestos Removalist.
- During all asbestos works, air monitoring shall be carried out as per **Section 8.8.1**.
- Excavation of impacted fill materials to the lateral and vertical extent required, guided by the Environmental Consultant.

- Placement of the excavated material beneath an appropriate capping layer, being either beneath a building slab, hardstand area, or landscaped area, as described below.

Over excavation of natural soils may be required to facilitate placement of impacted soils beneath the proposed building areas.

5.3.2 Installation of a Marker Layer and Placement of the Cap

A maker layer will be placed across the impacted areas prior to the placement of the cap. A site survey shall be undertaken at this time to identify the levels of the marker layer, and the extent of remedial excavations.

The marker layer shall consist of a brightly coloured (or at least a colour contrasting to the soil) nonwoven geotextile (such as bidim). The marker layer must:

- Be easily recognisable within soils;
- Be durable as a long-term marker layer;
- Not prevent surface water infiltration through the soil profile; and
- Maintain integrity during capping layer installation and any subsequent construction.

Where materials are placed underneath the proposed buildings or hard surfaces, the marker layer will be installed as the only capping requirement beneath the slab/hardstand (and any drainage/bedding layers and services required for slab/hardstand construction. A site survey shall be undertaken to confirm successful capping.

Where asbestos impacted soil is to be contained beneath landscaped areas, a minimum of 0.1 m bgs, up to 0.3 m, of suitable material is to be placed above the marker layer. Survey will be required to confirm successful capping.

Where asbestos impacted soils are not disturbed during the proposed development current grass cover should be maintained and the area noted on the Long Term Management Plan.

5.4 Validation

Validation data will be required to support the appropriate selection and placement of the cap as consistent with **Section 6**. The validation of the works will be completed by the Remediation Consultant and will comprise:

- Documentation of final excavation/remediated areas and placement of the marker layer;
- The chemical analysis of the capping material and any other imported soil materials to demonstrate that it is compliant with published guidelines and protective of human health (refer **Sections 6.3.3 and 6.3.4**);
- Compilation of waste classification and disposal documentation, including waste tracking and disposal documentation to be provided by the Remediation Contractor: and
- Survey data to demonstrate the depth of the marker layer and that sufficient extent of the cap was installed to prevent potential direct contact of normal site users to underlying fill based soils.

A long term EMP will be prepared to manage potential exposures to impacted soils that will remain at depth on the site (refer **Section 6.7.2**).

5.5 Waste Classification

Classification of ACM and other waste materials/soil will be completed in accordance with *Waste Classification Guidelines Part 1: Classifying Waste,* NSW EPA (2014) and relevant waste regulations by the Remediation Consultant. Disposal of waste to licensed waste facilities in accordance with

relevant waste regulations will be undertaken by the Contractor. All waste tracking documentation including disposal dockets must be maintained by the Contractor and must be provided to the Principal and the Remediation Consultant for inclusion in the validation report.

Based on the previous samples collected the material is likely to be classified as *General Solid Waste – Special Waste Asbestos*.

5.6 Offsite Disposal

As of 1 July 2015, it will be required under the *Protection of the Environment Operations (Waste) Regulations 2014* (POEO 2014) to record the movement of all loads of more than 100 kg of asbestos waste or more than 10 m^2 of asbestos sheeting from the place of generation to its final destination. Each load will be assigned a unique consignment code via the online WasteLocate portal[8] to allow NSW EPA to monitor their movement from site of generation to disposal.

It is noted that there is current exemption (EPA 2016)[9] to the tracking requirements of asbestos contaminated soil waste solely within NSW.

The *proximity principle*, under POEO 2014, makes it an offence to transport waste generated in NSW by motor vehicle for disposal more than 150 kilometres from the place of generation, unless the waste is transported to one of the two nearest lawful disposal facilities to the place of generation

The Contractor must be aware of and conduct all waste disposal in accordance all relevant regulations.

5.7 Contingency Remedial Actions

If the in situ management of the impacted soils on site is considered not to be feasible the following contiengency remedial options are presented. Contingency Scenarios are further discussed in **Section 7.2**.

5.7.1 Remediation and Reuse of ACM Impacted Soils

The following methodology is to be employed for the remediation of bonded (non-friable) ACM contaminated stockpiled material that have been disturbed:

- An area of the site will be prepared to enable to remediation of the soil - i.e. a solid foundation for the laying of the material;
- Bonded impacted materials will be spread in 'pads', no more than 100 mm in thickness, and should constitute no more than approximately 40 m^3 each. Each pad will be assigned a unique identifier for material tracking purposes;
- The remedial contractor will then proceed to undertake systematic raking and emu-picking on crossing 1m transects until three consecutive passes have reduced visible asbestos to acceptable levels, as validated by the environmental consultant. The personnel conducting the raking/picking and inspections should be appropriately trained in the identification of potential asbestos containing materials;
- The JBS&G field scientist will then be required to 'walkover' the pad in 1 metre spaced transects to ensure the concentration of visible fragments of bonded asbestos are not present above the adopted HSL. Following the completion of a successful validation 'walkover', the field scientist will be required to complete one asbestos quantification (AQ) per pad to provide field-quantitative data for the validation of the pad in accordance with published NEPC HSLs for bonded ACM in commercial/industrial land uses (HSL-D);

[8] https://wastelocate.epa.nsw.gov.au/.

[9] *Protection of the Environment Operations (Waste) Regulation 2014 - Notice of Exemption from Clause 79: Reporting on transportation of asbestos waste solely within New South Wales*, Environmental Protection Authority, 2016 (EPA 2016).

- If bonded asbestos is identified above the applicable HSL (NEPC 2013), the remedial and validation process will be repeated until such time that validation is achieved;
- Following the completion of a successful walkover and AQ, the pad will be considered validated and suitable for reuse in the burrow-pit; and
- This process will be repeated until such time that all bonded ACM impacted soils at the site, as identified by the AQ investigation, have been successfully remediated and validated and will be suitable for placement.

Following the above process a JBS&G field scientist will then be required to 'walkover' the pad footprint in 1 metre spaced transects to ensure no visible fragments of bonded asbestos are present. If ACM is identified the area will be scraped back 100mm and the process repeated until the completion of a successful walkover.

All collected non-friable (bonded) ACM fragments will be weighed in-house by JBS&G personnel using an externally calibrated scale with an accuracy of 1 g with the mass of ACM fragments in each increment sample recorded.

The Guidelines for the Management of Asbestos in the Non-Occupational Environment (enHealth, 2005) prescribe an approach whereby the concentration of asbestos in soil attributable to ACM contamination may be estimated. Given that the application of the HSL (NEPM 2013) for non-friable asbestos criterion relates to ACM, the asbestos calculation formula for the purposes of this assessment is:

$$\%\ Soil\ ACM\ = \frac{ACM\ (kg)}{Soil\ volume\ (m^3) \times Soil\ density\ (kg/m^3)}$$

The soil volume will be calculated via field measurement of the excavation to verify each sample is based on a sample of approximately 10 L volume. For soil density, reference is made to User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings. US EPA Office of Emergency and Remedial Response (US EPA 2003) to derive a suitable average density based on the predominant soil type of each sample such that volumes may be calculated (e.g. 1.63 g/cm3 for silty clay). The ACM (kg) is the addition of the weight of ACM fragments collected during the quantification.

5.7.2 Removal and Offsite Disposal of All Asbestos Impacted Soils

As discussed in **Section 4.3** if on site management of ACM and/or AF impacted soils is not considered feasible removal of these soils is the only other option.

The following remediation works shall be undertaken if all of the impacted soils as shown on **Figure 3** are to be removed from site:

- The asbestos removal works shall be conducted by a Class A Licensed Asbestos Removalist.
- Excavation of impacted fill material and impacted natural soils within the area delineated on Figure 3, to be guided by the Environmental Consultant.
- Disposal of the material to an appropriately licensed waste facility with appropriate waste classification documentation.
- Remediated areas are to be validated as per **Section 6**. Should validation fail, excavation shall continue within the failed location and the validation process repeated until validation is achieved.
- Reinstatement of the excavations with approved soils.

6. Validation Plan

6.1 Overview

Validation data are required to be collected to verify the effectiveness of the remediation works and document the condition of the site as being suitable for the permissible uses.

Validation activities will be required for the following:

- Management of the identified bonded ACM and FA impact;
- Air quality during and subsequent to remedial works;
- Waste materials requiring offsite disposal; and
- Importation of materials to site.

6.2 Data Quality Objectives

Data Quality Objectives (DQOs) were developed for the validation program, as discussed in the following sections.

6.2.1 State the Problem

Asbestos impact in the form of bonded ACM and/or FA has been identified on the site and requires remediation in order to make the site suitable for recreational/secondary school land uses.

6.2.2 Identify the Decision

The following decisions are required to be made during the validation works:

- Have marker and capping layers been installed appropriately and in accordance with RAP requirements?
- Are imported soils environmentally suitable for their proposed use?
- Have waste materials been suitability classified and lawfully disposed?
- Are analytical data generated by the validation works reliable?
- Is a Long Term Environmental Management Plan required?
- Is the site suitable for ongoing use?

6.2.3 Identify Inputs to the Decision

The inputs to the decision are:

- Observation and photographic log of marker and capping layer installation;
- Survey of maker and capping layer vertical and lateral extents;
- Field observations, sampling and analytical data for imported materials;
- Field observations, sampling and analytical data for off-site disposal of waste materials;
- Field observations, sampling and analytical data of any unexpected finds;
- Documentation of appropriate classification of imported materials;
- Documentation of appropriate classification and disposal of exported waste materials;
- Environmental monitoring data to demonstrate that potential airborne pollutants as generated by the handling of environmentally impacted materials on the site has not impacted off-site locations; and
- Data quality indicators as assessed by quality assurance/quality control (QA/QC).

6.2.4 Define the Study Boundaries

The study boundaries of the site are defined as follows:

- The lateral extent of the works relevant to this RAP as defined impacted areas on **Figure 6**;
- The vertical extent of the works is defined as the depth of asbestos impacted soils, which is anticipated to be a maximum of 0.6 m bgs.

6.2.5 Decision Rules

The decision rules adopted to answer the decisions identified in **Section 6.2.2** are discussed below.

Have marker and capping layers been installed appropriately and in accordance with RAP requirements?

The marker and capping layers must be installed across the extent of any contained impacted soils. The maker layer must be installed to the RAP requirements, as well as the manufacturer's installation requirements. The vertical and lateral extents of the maker layer should be surveyed along with consistent and comprehensive photographic evidence.

Where soil based material is to be used as a capping layer, placed above the marker layer and readily accessible to human users, this material is required to be validated as meeting the health and ecological validation requirements for the site in addition to aesthetic requirements.

All imported materials to be used as the capping layer must be environmentally suitable, as identified below.

Are imported soils environmentally suitable for their proposed use?

Material required to be imported onto the site as capping, are required to be demonstrated to be Virgin Excavated Natural Material (VENM).

Excavated natural materials (ENM) or other exempt waste including recycled products should not be used for reinstating remedial excavations or as capping material.

All imported materials will be assessed to ensure the entirety of the capping layer from surface to the marker layer is validated upon conclusion of remedial works.

VENM

Laboratory analysis results will be compared to published background levels (metals) and nominated laboratory LORs (for all man-made chemical constituents) to assess VENM. The Remediation Consultant will conduct a site inspection of all VENM source sites and approve any VENM Certificates prior to importation of material. If either the source site or supporting documentation is unsatisfactory in regards to certainty of the material comprising VENM, the Remediation Consultant will undertake additional sampling to confirm chemical characterisation of VENM material and prepare any required documentation.

Have waste materials been suitability classified and lawfully disposed?

All waste requiring off-site disposal must be suitably characterised and classified in accordance with Waste Classification Guidelines (EPA 2014), and disposed to appropriately licensed waste disposal facilities. The Remediation Contractor will be required to provide all waste tracking and disposal documentation for wastes removed from the site, including individual tipping dockets.

Are analytical data generated by the validation works reliable?

If the analytical data meets the Data Quality Indicators established in **Section 6.2.8**, then the analytical data are considered to be reliable.

All other data, such as visual observations, photographic logs and surveys will be qualitatively assessed to ensure they contain sufficient information to inform the validation report.

Is a Long Term Environmental Management Plan required?

A suitable Long Term Environmental Management Plan (LTEMP) is required at the site due to the containment and management strategy of residual asbestos impacted fill materials beneath the proposed capping layer. A LTEMP will detail the management strategies required to ensure the longterm integrity of the marker and capping layers, such as inspection timetables, accidental penetrations of the marker layer and required controls for scheduled works below the marker layer.

Is the site suitable for ongoing use?

The site will be considered suitable for ongoing use if the following conditions are met:

- Remediation works have been completed in accordance with this RAP;
- Marker and capping layers have been appropriately installed and documented;
- Imported soils are considered to be environmentally suitable;
- Waste materials have been suitably characterised and lawfully disposed;
- Analytical data generated is considered reliable; and
- A suitable Long Term Environmental Management Plan will be implemented at the site.

6.2.6 Specify Limits of Decision Error

This step seeks to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting inherent uncertainty in the data. Data generated during this project needs to robust and reliable to facilitate decisions to be made with confidence.

Specific limits for this project were adopted in accordance with the appropriate guidance from the NSW EPA, NEPC (2013), appropriate indicators of data quality indicators (DQIs) used to assess QA/QC and standard JBS&G procedures for field sampling and handling.

To assess the useability of the data prior to making decisions, the data were assessed against pre-determined DQIs to assess precision, accuracy, representativeness, comparability, completeness and sensitivity (PARCCS parameters). The acceptable limit on decision error was 95% compliance with DQIs.

The QA/QC program is documented in **Section 6.7**.

6.2.7 Optimise the Design for Obtaining Data

The validation sampling design for each specific type of validation works anticipated is discussed in detail in **Section 6.3**. The general sampling methodologies are discussed below.

6.3 Validation Inspection and Sampling Plan

6.3.1.1 Soil Sampling Methodology

Soil sampling will be conducted by the Remediation Consultant. The soil sampling method shall be determined by the Remediation Consultant as consistent with the observations of the site sub-surface and appropriate to generate representative samples. The soil sampling method shall be consistent with the data quality indicators in **Section 6.2.8**.

All asbestos quantifications and samples will be recovered using hand tools, via test pitting or from a solid flight auger with a diameter of at least 200 mm. Re-usable equipment, if used, will be decontaminated between sampling locations.

6.3.1.2 Soil Sample Containers

During the collection of soil samples, features such as seepage, discolouration, staining, odours and other indications of contamination shall be noted on field reporting sheets / field logs.

Collected soil samples shall be immediately transferred to sample containers of appropriate composition (glass jars) fitted with Teflon sealed lids. Minimum 500 mL samples shall be additionally collected and placed in new zip lock bags where asbestos analysis is required. Sample labels shall record sample identification number and date and time of sampling. Sample containers shall be transferred to a chilled ice box for sample preservation prior to and during shipment to the testing laboratory. A chain-of-custody form shall be completed and forwarded with the samples to the testing laboratory.

6.3.2 Off-site Disposal

All wastes requiring off-site disposal must be classified in accordance with *Waste Classification Guidelines* (EPA 2014). The Contractor is responsible for the lawful disposal of the classified waste to a licensed waste disposal facility lawfully able to accept the waste.

Disposal dockets for each individual off-site waste disposal load must be provided to the Principal and to the Remediation Consultant by the Contractor to demonstrate appropriate off-site disposal of waste occurred for site validation purposes.

6.3.3 Imported Materials

The following shall be implemented if imported materials are required to reinstate remedial excavations.

Material to be imported onto the site for remedial works are required to be demonstrated to be Virgin Excavated Natural Material (VENM). Furthermore, any validated VENM for importation should have soil characteristics consistent with the natural sandy soils at the site.

All imported material must not contain asbestos.

Imported material source sites will be visited by the Remediation Consultant. Supporting documentation must be provided by the Contractor for imported materials to be assessed against the validation plan, relevant guidelines/exemptions and adopted site criteria. The Remediation Consultant will collect additional samples and prepare appropriate documentation for imported materials in lieu of inadequate information provided by the Contractor to ensure all material imported to site is validated.

6.4 Validation Analytical Plan

The proposed soil and air validation sampling and analytical program is outlined below.

Table 6.2: Validation Analytical Schedule

Validation Purpose	Sampling Frequency	Analytes
Bonded ACM and FA Excavation Remedial Area (Sydney Water property)	Field visual validation + 1 per 25m^2	Field visual validation + Asbestos (500mL)
Bonded ACM Remedial Areas	Field visual validation + 1 per 100m^2	Field visual validation + Asbestos (500mL)
VENM	3 per source site if no documentation provided	As a minimum: Heavy metals TPH/BTEX PAHs OCPs/PCBs Asbestos (500mL)

Waste Classification Stockpiles	1 per 25m^3 up to 200m^3, minimum of 3. Relevant historical soil data to be considered.	Heavy metals TPH/BTEX OCPs/PCBs PAHs Asbestos TCLP Metals and PAHs (if required)

6.5 Soil Validation Criteria

Health Screening Level Residential A (HSL A) from NEPC 2013 were adopted as the site validation criteria. HSL A are the most conservative assessment criteria for asbestos contamination in soil within NEPC 2013. The HSL A criteria applies to a residential land use scenario with garden/accessible soils. As such, these criteria are considered to be appropriate for the site, given the current partial residential land use at the site.

The adopted site validation criteria for asbestos in soils is presented in **Table 6.3** below.

Table 6.3: Site Validation Criteria for Asbestos in Soil (% w/w)

	Health Screening Level (% w/w)
Form of Asbestos	**Residential A[10]**
FA / AF within soils	0.001% w/w[11]
Bonded ACM within soils	0.01% w/w
All forms of asbestos within surface soils (i.e. <0.1 m)	No visible asbestos for surface soils.

6.5.1 Marker Layer Inspection and Survey

Visual inspection will be undertaken by the Remediation Consultant to verify the installation of the marker layer across the site. Photographic records and a survey of the marker layer installation, including vertical and lateral extents by the Contractor, will be retained for inclusion in the validation report.

6.5.2 Capping Layer Validation

Material to be used as a capping layer must be validated by the Remediation Consultant to be environmentally suitable, consisting of VENM . Additionally, any capping layer material must not exceed the adopted site validation criteria for soils, and must not contain asbestos.

Photographic records and a survey of the capping layer installation, which details the final thicknesses of the capping layer, including the surveyed vertical and lateral extents by the Contractor, will be retained for inclusion in the validation report.

Sufficient time must be allowed prior to importation to enable the Remediation Consultant to verify documentation, inspect source sites and if necessary undertake additional sampling and analysis.

6.6 Air Quality Validation Criterion

For airborne asbestos fibre monitoring, a limit of 0.01 fibres per millilitre (f/mL) is adopted as the air quality validation criterion (guideline value), in accordance with guidance in WA DoH (2009). It is noted that the 0.01 f/mL is also the limit of detection of the membrane filter method as detailed within NOHSC: 3003(2005).

6.7 Quality Assurance / Quality Control

The objective of the project is to remediate the site to a standard suitable for the permissible uses. To demonstrate the effectiveness of the remedial works, validation sampling, inspections and analysis will be conducted. The quality of the validation data must be sufficient to draw conclusions regarding the suitability of the site. Hence, the quality assurance / quality control (QA/QC) program

[10] Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.

[11] The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

employed as part of the remediation works will involve pre-determined data quality indicators (DQIs).

The DQIs are summarised following and in **Table 6.4:**

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is normally assessed by calculating the Relative Percent Difference (RPD) [12] of duplicate samples. However, this calculation is not applicable due to the presence / absence nature of asbestos, and as such, the agreement between the sample pairs will be assessed instead.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- **Representativeness** –expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples, ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.
- **Sensitivity** - expresses the appropriateness of the chosen field and laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.

Table 6.4: Summary of QA/QC Control Program

Data Quality Indicator	Frequency	Data Quality Acceptance Criteria
Precision		
Blind duplicates (intra laboratory)	1 / 20 samples	<50% RPD or agreement between asbestos presence/absence
Blind duplicates (inter laboratory)	1 / 20 samples	<50% RPD or agreement between asbestos presence/absence
Accuracy		
Surrogate spikes	All organic samples	70-130% recovery
Matrix spikes	NA for asbestos analysis. Otherwise 1 per lab batch.	70-130% recovery
Laboratory control samples	1 per lab batch (exc. asbestos)	70-130% recovery
Representativeness		
Sampling appropriate for media and analytes	All samples	All samples

[12]

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where C_0 is the analyte concentration of the original sample
C_d is the analyte concentration of the duplicate sample

Data Quality Indicator	Frequency	Data Quality Acceptance Criteria
Samples extracted and analysed within holding times.	-	NA for asbestos, organics (14 days), inorganics (6 months)
Laboratory Blanks	1 per lab batch (exc. asbestos)	<LOR
Trip spike	1 per sampling event targeting volatiles	70-130% recovery
Trip blank	1 per sampling event targeting volatiles	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All samples	All samples
Standard analytical methods used for all analyses	All samples	All samples
Consistent field conditions, sampling staff and laboratory analysis	All samples	All samples
Limits of reporting appropriate and consistent	All samples	All samples
Completeness		
Soil description and COCs completed and appropriate	All samples	All samples
Appropriate documentation	All samples	All samples
Satisfactory frequency and result for QC samples	All QA/QC samples	-
Data from critical samples is considered valid	-	Field and laboratory data is complete and satisfactory for critical samples
Sensitivity		
Field and analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All samples	LOR < site validation criteria (where possible)

If the RPD between duplicates is greater that the pre-determined DQI, a judgement will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field. For asbestos agreement, the highest concentration of the primary, duplicate or triplicate samples will be recorded as the result for that sample location, thus eliminating any non-conformance between primary, duplicate and triplicate samples.

6.8 Validation Reporting

6.8.1 Validation Report

The validation report shall be prepared by the Remediation Consultant written in general accordance with *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, NSW Office of Environment and Heritage (OEH 2011).

The validation report should contain information including:

- Results of previous investigations conducted at the site;
- Details of the remediation works conducted;
- Information demonstrating that the objectives of the RAP have been achieved, in particular the validation data and assessment of the data against both the pre-defined data quality objectives and the remediation acceptance (validation) criteria;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents; and

- Other information as appropriate, including any requirements for ongoing monitoring / management.

6.8.2 Long Term Environmental Management Plan

In addition to the requirements of the validation plan, the proposed containment strategy will require long term management following completion of the redevelopment.

The LTEMP is required to document the following elements:

- A statement of the objectives of the LTEMP – i.e., to ensure continued suitability of the site following remediation.
- Identification of residual environmental contamination issues at the site that require ongoing management/monitoring to meet the LTEMP objectives, including the type of contamination and location within the site (including a survey plan prepared by a registered surveyor).
- Documentation of environmental management measures which have been implemented to address the identified environmental issues at the site, including appropriate asbestos management plan.
- Description of management controls to limit the exposure of site users to known areas of contamination to acceptable levels.
- Description of responsibilities for implementing various elements of the provisions contained in the LTEMP.
- Timeframes for implementing the various control/monitoring, etc. elements outlined in the LTEMP.
- Environmental monitoring and reporting requirements (if required) for the future management of environmental impact underlying the site
- Health and safety requirements for particular activities;
- A program of review and audits;
- The provisions in the LTEMP are feasible (i.e., able to be implemented) and able to be legally enforceable (i.e., a mechanism exists, such as development consent conditions, to give the plan a basis in law); and
- The relevant consent authority is satisfied that the inclusion of a development consent condition relating to the implementation of the LTEMP is acceptable.

Corrective action procedures to be implemented where LTEMP assessment criteria are breached.

7. Contingency Plan

A review of remediation works has been undertaken to identify potential risks to meeting the specified site validation criteria. A number of potential risks have been identified. These are listed following with contingencies that will be implemented to ensure that validation criteria are met.

Additionally, the associated remedial works health and environmental risks/hazards and their minimisation/mitigation are further discussed in **Sections 8** and **9**.

7.1 Unexpected Finds Protocol

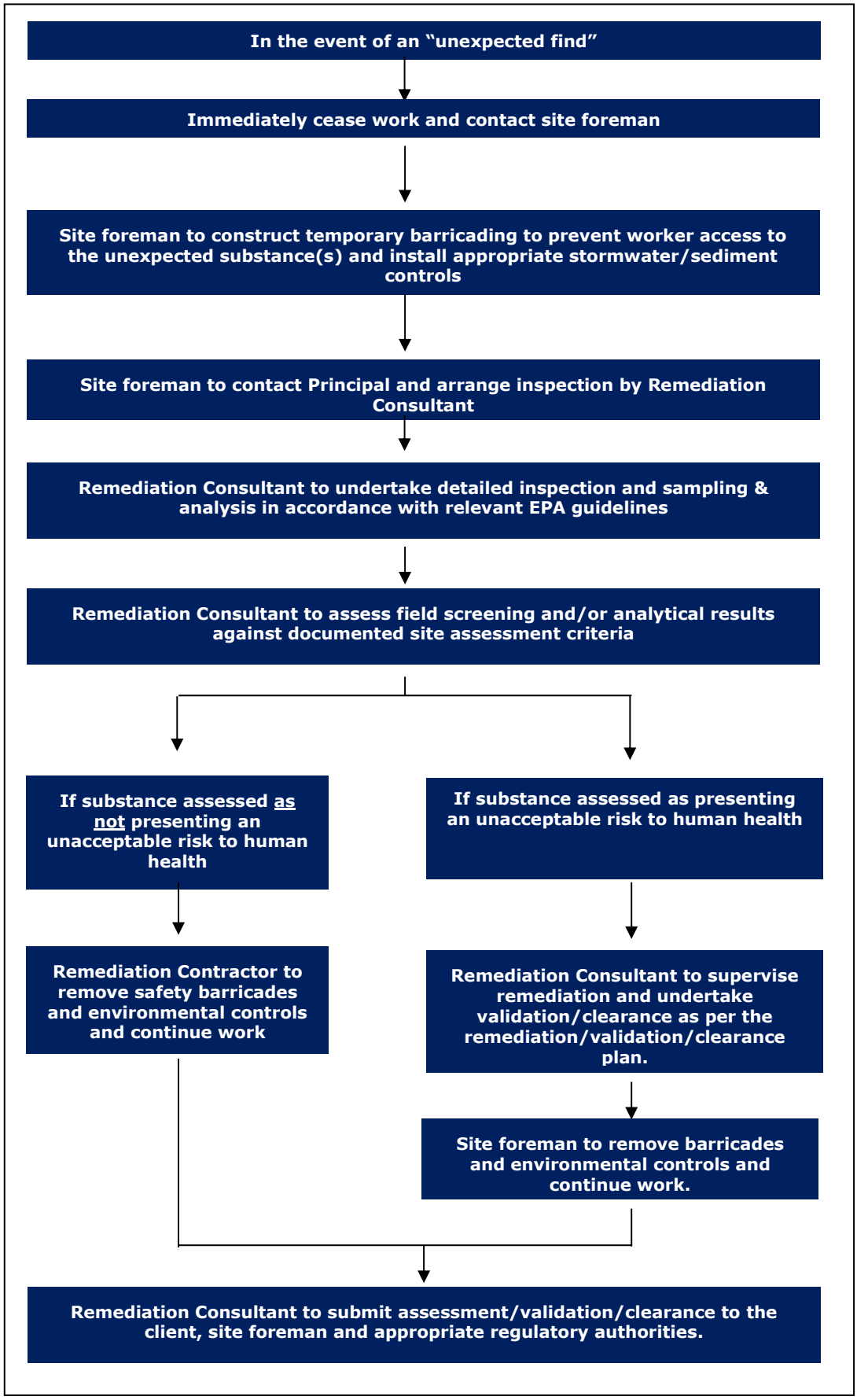
It is acknowledged that previous investigations of the site have been undertaken to assess the identified contaminants of potential concern in selected parts of the site. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations during remediation. The nature of any residual hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- Bonded ACM or FA encountered outside the extent of known asbestos impacted fill materials;
- bottles / containers of chemicals (visible);
- construction / demolition waste (visible);
- ash and/or slag contaminated soils / fill materials (visible); and
- unexpected petroleum or volatile organic compound contaminated soils (odorous, staining / discolouration visible).

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances be identified (or any other unexpected potentially hazardous substance), the procedure summarised in **Flowchart 7.1** is to be followed.

An enlarged version of the unexpected finds protocol, suitable for use on-site, should be posted in the Site Office and referred to during the site specific induction by the Contractor.

Flowchart 7.1: Unexpected Finds Protocol



7.2 Contingency Scenarios

7.2.1 Remedial Strategy Constraints

In the event that the proposed remedial works do not meet the validation criteria, or if the selected remedial strategy is not able to proceed, the following actions will be considered to ensure, firstly, the safety and health of people and the environment and, secondly, that the overall project objectives are achieved:

- Reassessment of remedial and validation options for asbestos impacted soils, giving consideration to the contingency remediation approaches described in **Sections 4.4 and 5.7**; and
- Continued controlled excavation of potential impacted soils.

7.2.2 Extended Remedial Area

Given the known distribution of asbestos impact at the site, any observed or detected asbestos contaminated soils outside of the area of known or suspected distribution will constitute an unexpected find to be managed under the procedure detailed in **Section 7.1**.

7.2.3 Material Storage Breach

In the event any stockpiled materials escape (or have the potential to escape), then the management controls shall be rectified and investigations undertaken to review the adequacy of the controls and any improvements implemented.

7.2.4 Complaints

There is a potential for complaints to be received from residents / members of the public relating to environmental emissions including:

- Dust emissions arising from soil excavation, material handling and transport; and
- Noise and vibration from excavation.

Monitoring of all environmental emissions shall be undertaken as detailed in **Section 8** and appropriate actions taken to further control emissions following receipt of a complaint. Such additional controls may include the following actions:

- Earthworks during meteorologically favourable periods only; and/or
- covering and/or wetting down soils which are generating dust.

7.2.5 Severe Weather

Weather will be monitored on a daily basis via checking an internet based weather service provider. Should severe weather be forecast, especially strong winds, works will stop until safe to re-commence. All site management and dust controls will be implemented to the extent practicable prior to any severe weather events.

7.2.6 Odours from Works

Based on the nature of the identified contaminants, off-site odour complaints are considered unlikely. Where complaints of odours relating to remedial works occur, the following will be undertaken:

- Installation of an odour screening / masking system at the remediation area boundaries; and/or
- Earthworks during meteorologically favourable periods only; and/or

- The use of odour suppressant additives to water used to keep impact soils/ stockpiles moist; and/or
- Covering of impacted soils.

8. Site Management Plan

8.1 Overview

The site management plan is largely based on the BMCC *Contaminated and Potentially Contaminated Land Policy* (BMCC 2000)[13]. This section contains procedures and requirement that are to be implemented as minimum requirement during the remedial works at the site.

8.2 Hours of Operation

All remediation works shall be conducted within the following hours:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sunday and public holidays: No work permitted.

8.3 Erosion and Sediment Control Policy

All works shall be conducted in general accordance with *Managing Urban Stormwater: Soil and Conservation* – Volume 1 (4th ed. Landcom 2004), which outlines the general requirements for the preparation of a soil and water management plan.

8.3.1 Nature and Extent of Remedial Works

The areas of asbestos impacts identified during previous investigations are presented on **Figure 3** and is estimated to be approximately 980 m^2.

The depth of disturbance will be generally equal to or less than 0.4 m bgs with a probable maximum depth of disturbance of 0.6 m bgs.

The extent of disturbance of impacted materials will be determined ultimately by the proposed development requirements including extent and depth of excavations required and the feasibility of containing impacted soils beneath building slabs, hardstand areas or landscaping, and efficacy of managing undisturbed impacted soils in place.

8.3.2 Areas of Specific Planning

Additional sediment controls will be installed at the down-gradient boundary of remedial areas which contain sloped areas.

8.3.3 Potential Sediment Sources

Any stockpiles created will be temporary (prior to offsite disposal) and will be managed in accordance with the requirements detailed in **Section 8.4**.

8.3.4 Sediment Management

All erosion and sediment measures must be maintained in a functional condition through the remediation works by the Contractor.

To prevent the migration of impacted (or other) sediment, silt fences shall be constructed (where practicable) at the down-gradient boundary of the remedial areas or site. Any material collected behind the sediment control structures will require characterisation.

In storm or extended rainfall event, the structures located on site for sediment control shall be monitored and replaced or altered if necessary by the contractor. Collected material shall be managed in accordance with remediation works by the contractor.

[13] *Contaminated and Potentially Contaminated Land Policy*, Blue Mountains City Council, 22 August 2000 (BMCC 2000).

8.4 Stockpile Management

All materials stockpiled onsite will be managed by the Contractor. Unique numbers will be provided for each stockpile, the source of the stockpile, its estimated volume, material characterisation and its location onsite will also be recorded.

The following procedures will be implemented by the Contractor:

- No stockpiles of soil or other materials shall be placed on footpaths or road reserves unless prior Council approval has been obtained;
- All stockpiles of soil or other materials shall be placed away from drainage lines gutters or stormwater pits or inlets;
- All stockpiles of soil or other materials likely to generate dust or odours shall be covered (where practical);
- All stockpiles of chemically contaminated soil shall be stored in a secure area and be covered if remaining more than 24 hours (where practical); and
- All stockpiles of asbestos contaminated soils shall be kept damp and covered to minimise potential fibre release, and if left for more than 24 hours, be stored in a secure area (where practical).

8.5 Site Access

All vehicle access to the site shall be stabilised to prevent the tracking of sediment onto the roads and footpaths. All materials must be removed from the roadway on a daily or as required basis. Soil washings from wheels shall be collected and disposed of in a manner that does not pollute waters. Any personnel, equipment, plant or vehicles that enter an asbestos works zone must be appropriately decontaminated prior to exiting.

8.6 Excavation Pump-out

It is very unlikely that any excavation pump-out will be required for remediation actions given the required remedial works are shallow in nature.

8.7 Noise

Remediation work shall not give rise to 'offensive noise' as defined in the *Protection of the Environment Operations* (POEO) Act 1997. All equipment and machinery associated with the remediation work shall be operated by the Contractor in accordance with the POEO Act 1997 and its *Noise Control Regulations 2000*.

Noise generated should be managed so as not to adversely impact the amenity or residents / business adjoining or nearby the site.

All machinery and equipment used on site will be in good working order and with the fitted with appropriate silencers when necessary.

8.8 Vibration

Vibration generated should be managed so as not to adversely impact the amenity or residents / business adjoining or nearby the site.

8.9 Air Quality

During remedial works, dust emissions and any odours will be confined within the site boundary. This will be assessed by a program of air monitoring undertaken by the consultant for all remediation works and implemented by air emission controls as required by the Contractor. Air quality requirements are summarised in this section. General procedures to be considered as a

minimum by the Contractor to reduce levels of airborne dusts / fibres and odours are discussed henceforth.

8.9.1 Dust Tracking / Real-time Exposure Monitoring

Preference is given for all environmental monitoring to be undertaken using real time methods. To this extent, the Remediation Consultant shall monitor works on the site by the use of a dust-trak real-time monitor. A minimum of six locations will be monitored daily for ten minutes per location.

The Remediation Consultant will advise the client and Contractor when the time averaged particulate measurement exceeds 0.05 mg/m^3. WA DoH (2009) reports that this level is protective of potential asbestos fibre exposures. Further, this level is well below the inspirable dust inhalation standard, and is further protective of potential respirable dust impacts at the site boundary. The remediation works shall not comprise excavation / handling of silica rich materials, and maintenance of particulates at this level is considered to be similarly protective of potential silica exposures.

If dust levels exceed the adopted criteria of 0.05 mg/m^3, the client and Contractor will be notified, and works will require to be modified to reduce dust emissions to below the adopted criteria. All exceedances will be required to be "closed-out" by re-sampling at the exceedance location subsequent to implementation of modified work routines (such as increased dust controls).

8.9.2 Airborne Asbestos Fibre Monitoring

Airborne asbestos fibre monitoring will be conducted by an independent (i.e., not the remediation contractor) Licensed Asbestos Assessor (LAA, as per WorkCover NSW requirements) in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC*) Asbestos Code of Practice and Guidance Notes*, in particular the Guidance note for the estimation of airborne asbestos dust [NOHSC 3002:2005]. The LAA shall undertake airborne asbestos fibres monitoring at a minimum of five static locations daily during remediation works that will disturb asbestos impacted materials. Monitoring locations will include site perimeter locations targeting nearby receptors including the adjacent homestead and downwind locations. Wind Rose information available from the Bureau of Meteorology (BOM) for the nearest weather stations or onsite observations will be used to determine common prevailing winds in the area.

Air filters shall be analysed by a NATA accredited laboratory and results shall be required to be below 0.01 fibres/ml. Detections of fibres may be further analysed by scanning electron microscope (SEM) to confirm the fibres are asbestos.

If respirable asbestos fibres are confirmed and present between 0.01 and 0.02 fibres/ml, the following controls must be implemented by the licensed asbestos removalist, in accordance with SWA (2011b);

- Review control measures;
- Investigate the cause; and
- Implement controls to eliminate or minimise exposure and prevent further release.

If respirable asbestos fibres are confirmed and present above 0.02 fibres/ml, the following controls must be implemented by the licensed asbestos removalist, in accordance with (SWA 2011b);

- Stop removal work;
- Notify WorkCover NSW by phone, then by fax or written statement that work has ceased;
- Investigate the cause;
- Implement controls to eliminate or minimise exposure and prevent further release; and
- Do not recommence removal work until further air monitoring is conducted and fibre levels are detected below 0.01 fibres/ml.

A daily report air monitoring report will be prepared documenting the previous/same days airborne asbestos fibre air monitoring results. This report will be made available to all relevant stakeholders, including but not limited to:

- Site workers; and
- Neighbouring facilities.

8.9.3 Dust Control

During the remedial works, as necessary, excavation areas will be wetted down using a water spray to minimise the potential for dust to be generated by the Contractor. A wetting or bonding agent may be used to further bind the soil to minimise asbestos fibre release.

All asbestos impacted soils must be moistened (but not flooded) prior to and during excavation and movement of the soils.

Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access, all equipment have dust suppressors fitted by the Contractor and all loads entering or exiting the site are securely covered.

Given the rough and sloped terrain, it is not practicable to erect dust screens around the perimeter of the site.

Meteorological conditions will be monitored by the Remediation Consultant and Contractor. Remedial work will be stopped or modified where meteorological conditions are adverse (i.e., dry conditions and strong winds towards sensitive receptors).

Plant and vehicles should limit their speed when working within asbestos exclusion zones and only designated paths. Only essential vehicles are permitted to traverse the asbestos exclusion zone.

8.9.4 Odour / Volatile Emissions Control

No odours should be detectable at the site boundary and volatile emissions of other potentially volatile substances shall be controlled. Appropriate actions will be taken by the Contractor to reduce the odours, which may include: increasing the amount of covering of excavations / stockpiles; mist sprays; odour suppressants; and maintenance of equipment.

Records of volatile emissions and odours shall be kept by the Contractor. Equipment and machinery will be adequately maintained to minimise exhaust emissions. No materials shall be burnt on the site.

8.10 Transport of Material Offsite

Trucks will be loaded in a designated areas. The Contractor shall ensure that there is no material tracked out onto the street and that the load is securely covered. In addition, all site vehicles must leave the site in a forward direction.

The Contractor shall also log truck movements and approximate volume, via registration number and consignment number (where applicable), into and out of the site.

All appropriate road rules shall be observed and state roads will be selected as far as practicable over local roads when deciding on the transport route to the off-site material disposal location.

Plant and vehicles should limit their speed when working within asbestos exclusion zones and only traverse designated paths.

The nearest appropriately licensed landfill, Blaxland Waste Management Facility, is located 16km to the south-south west of the site via Hawkesbury Road and the Great Western Highway.

8.11 Hazardous Materials

Hazardous and / or intractable wastes arising from the remediation work shall be removed and disposed of in accordance with the requirements of NSW EPA, WorkCover NSW and the relevant regulations by the Contractor.

In particular, any hazardous wastes will be transported by a NSW EPA licensed transporter.

8.12 Disposal of Contaminated Soil

All soils will be classified, managed and disposed in accordance with the *Waste Classification Guidelines* (EPA 2014). Documentary evidence for all soil disposal shall be kept for inclusion in the Validation Report/s.

Additional requirements for offsite disposal of soils are presented in **Section 5.6**.

8.13 Imported Fill

Any materials imported on site by the Contractor to re-establish ground levels or to be applied as a capping layer must be validated, environmentally suitable material (i.e. VENM, as described in **Section 6.3.3**). Additionally, the imported fill should also be compatible with required geotechnical constraints and the existing soils characteristic for site drainage purposes.

8.14 Groundwater

It is anticipated no dewatering will be required for the remediation works. If dewatering is required as part of the remediation works, a licence shall be applied for from the Office of Water for approval to extract groundwater.

8.15 Site Signage and Contact Numbers

A sign/s shall be displayed adjacent to the site access point/s throughout the duration of the works with the contact details of the Contractor and project manager as provided and maintained by the Contractor.

8.16 Site Security

The remedial areas shall be secured against unauthorised access by means of an appropriate fence or barricade or other means by the Contractor. All persons working in asbestos remedial areas must be inducted, have undertaken required training and don appropriate PPE. The access gates to the site will be locked at all times when remedial works are not occurring.

8.17 Community Consultation

Owners and / or occupants of adjacent premises and across the road from the site will be notified at least seven days prior to the commencement of preparation for the remediation works. As a minimum the notification shall include the details of an appropriate contact person.

9. Health and Safety Management Plan

9.1 Overview

This health and safety plan contains procedures and requirements that are to be implemented as a minimum during the remediation works.

The objectives of the health and safety plan are:

- To apply standard procedures that reduce risks to acceptable levels resulting from the remedial works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards and mandatory safety practices and procedures; and
- Provision for contingencies that may arise while operations are being conducted at the site.

This health and safety plan does not provide safety information specific to construction and other demolition or excavation activities carried out by contractors, such as the safe operation, maintenance and inspection of plant, etc. Contractors will be required to prepare their own Safe Work Method Statements for their work activities. All parties working on the site shall comply with all applicable Health and Safety legislation, regulations, codes and guidelines.

9.2 Responsibilities

Remediation Supervisor

The remediation supervisor is responsible for ensuring that the work is carried out in accordance with the health and safety plan. This will include:

- Ensuring a copy of the health and safety plan is available at the site during the remediation/validation activities;
- Confirming individuals are competent in performing allotted tasks;
- Liaison with the contractor representatives, as appropriate, regarding safety matters; and
- Investigation and reporting of incidents and accidents.

Other Members of the Site Workforce

Every individual worker is responsible for conducting their allocated tasks in a safe manner and in accordance with their training and experience. They must give due consideration to the safety of all others in their proximity and cooperate in matters of health and safety. All workers must leave their work areas in such a condition that the location will not be hazardous to others at any time.

9.3 Hazards

The known or potential hazards associated with the remedial work activities are listed below:

- inhalation hazards associated with the presence of asbestos.
- physical hazards, including:

- work in or near excavations;
- operating machinery;
- heat stress and UV exposure;
- underground or overhead services;
- manual handling; and
- noise.

In the event of the discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, or of any new hazard that could potentially cause serious harm to personnel or the environment, work will be suspended until the client, Remediation Contractor and Remediation Consultant have been notified and appropriate instructions have been provided to field personnel.

9.3.1 Inhalation Hazards

The main inhalation hazards from the remediation/validation works are consequent of the presence of asbestos. Measures are required to be put in place to prevent/ minimise the generation of airborne fibres. These have been described in the environmental controls for the works. Where there is a potential for airborne emissions to be generated, PPE shall be required to be worn to prevent potential exposure, as described in **Section 9.4**.

9.3.2 Physical Hazards

Operating Machinery

Heavy plant and equipment operating in the vicinity of field personnel presents a risk of physical injury. Personnel should be cognisant of their position in relation to operating machinery at all times.

Never walk behind or to the side of any operating equipment without the operator's knowledge. Do not assume that the operator knows your position. Personnel should stay at least 1 m from the operational area of heavy equipment and should not stand directly below any load or piece of equipment (e.g. excavators).

All persons onsite are to wear high-visibility upper body clothing at all times.

Work In or Near Excavations

All excavations greater than 1.5m in depth shall be shored, sloped or otherwise constructed so as to minimise the potential for collapse. No excavation of this depth are proposed during the remedial works.

Cuts and Abrasions

The manual work associated with the remediation works may give rise to the risk of cuts and abrasions to personnel working in the area. As well as the direct consequences of any cut or abrasion, such injuries can lead to the possibility of exposure to contaminants through the wound as well as diseases such as tetanus. To minimise the risk of direct or indirect injury, personnel will wear the personal protective equipment (PPE) described in **Section 9.3**.

Heat Stress and UV Exposure

Site personnel may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the type of work and the time of year.

In addition to heat stress, overexposure to UV radiation in sunlight can result in sunburn to exposed skin. The use of a high protection sunscreen (SPF30+ or greater) on all exposed skin is recommended. Sunscreen should be applied at least 20 minutes prior to the commencement of work and re-applied at least every two hours or more frequently if perspiring.

Hats (including hard hats in specified areas) will also provide additional sun protection during the peak (i.e. 10:00 am to 3:00 PM) sun period. Sunglasses should be worn (where appropriate) to protect eyes from effects of UV exposure.

Underground Services

There is the potential for underground services (electricity, natural gas lines, water, telephone, sewer, and stormwater) to be present beneath the work area. The Contractor shall ensure that appropriate procedures will be taken to minimise the risk associated with excavation near services.

Aboveground Electrical Hazards

All electrical plant and equipment must comply with the requirements of Australian Standard AS 3000. Hand held portable tools shall comply with *AS/NZS 3160 "hand-held portable electric tools"* and shall be double insulated. Cord connected portable hand lamps shall comply with AS/NZS 3118. A Residual Current Device (RCD) shall protect plug-in portable equipment, which is connected to a supply above Extra Low Voltage - 12-24volts (including equipment supplied from a generator or welding set). RCD protection shall be provided during maintenance of portable electrical equipment at all times while the equipment is connected to a power supply above Extra Low Voltage, irrespective of whether power is switched ON or OFF. RCD's shall comply with AS 3190 and shall be type II units, rated to trip at or below 30 milliamps within 40 milliseconds.

No excavator, drill rig or crane may work within 6 m of overhead distribution power lines.

Manual Handling

When lifting or handling heavy objects, use correct lifting techniques, bending the knees not the back. If the item to be lifted is too heavy or awkward for one person to lift, seek assistance from other company employees or use mechanical help.

Noise

Long-term exposure to high levels of noise is unlikely. However, operating machinery may cause significant noise exposures for short periods. Earplugs or earmuffs should be worn in any situation where noise levels make normal conversation difficult.

9.4 Personal Protective Equipment (PPE)

9.4.1 General Site Works PPE

All workers who may come into direct contact with contaminated soil will wear the following personal protective equipment:

- High visibility long sleeved collared shirt;
- Long pants;
- Heavy duty outer gloves (e.g. leather) where there is a risk of cuts or abrasions, otherwise PVC outer gloves if in direct contact with contaminated soil;
- Steel capped boots;
- Safety glasses;
- High visibility vest or jacket (not required if shirt is high-visibility); and

- Hard hat when working near mechanical plant.

9.4.2 PPE for Asbestos Removal Works

During any asbestos removal/management works, excavation, transport or placement asbestos impacted materials, the following items of PPE are required in addition to any standard PPE required for the specific task, and applies for any ground workers within the asbestos work zone:

- Disposable coveralls must be worn (Type 5, Category 3 or better);
- Disposable gloves – non disposable gloves must be cleaned within the decontamination unit in accordance with SWA (2011b);
- P2 class respirator or higher – non disposable respirators must be cleaned in the decontamination unit in accordance with SWA (2011b); and
- Laceless steel capped rubber soled work shoes or gumboots.

Plant operators undertaking sub-surface intrusive works must close cabin doors and windows and set air conditioning to re circulate when operating within the asbestos work zone or wear PPE as listed above.

Further information on PPE requirements for asbestos removal works is provided in SWA (2011b).

The contractor shall supply and keep in good order, two complete sets of protective clothing and respirators for authorised inspection personnel. These will remain the property of the contractor at the end of the contract.

Employees must receive instruction in the correct method of using the respirator and on the importance of correct facial fit and maintenance. No person with a beard shall be allowed within the asbestos work area except using an approved positive pressure continuous airflow hood.

It is further noted that, as part of the WorkCover permitting process, additional PPE may be required. If this occurs, then the above PPE requirements will be upgraded to reflect WorkCover's requirements.

9.4.3 Decontamination Procedures

The decontamination procedures specified below will be followed whenever personnel, plant or equipment leave the site.

Personnel

The following steps should be taken to ensure personnel do not leave the site with potentially contaminated clothing:

- Wash boots in clean water;
- Remove outer gloves and store for reuse;
- Remove overalls and store for reuse (during the day) or place in the skip for the asbestos wastes for disposal;
- Remove respirator and goggles (if used) and store clean for reuse or decontamination, as appropriate; and
- Thoroughly wash hands and face.

If any part of a worker's body comes into direct contact with any potentially contaminated material, the affected part(s) should be immediately washed with clean water.

Vehicle, Plant and Equipment

All equipment, including personal protective equipment, will be washed or otherwise cleaned to ensure that contaminated soil, water or dust is removed before it leaves the site. All plant and equipment will have their outer bodies thoroughly cleaned of soil and sediment before moving off the site.

9.5 Emergency Response

The remediation contractor will be responsible for preparing an emergency response plan, which will provide details on appropriate action and evacuation procedures in the event of an emergency.

In the event of an emergency arising on the site, appropriate action should be taken. Site evacuation procedures should be followed, as necessary.

In the event of an accident:

- evaluate the seriousness of the injury, and contact emergency services, if necessary;
- provide first aid, as appropriate;
- if working within a Decontamination Zone and it is safe to do so, evacuate the injured person via the Decontamination Zone; and
- make the area as safe as possible without jeopardising safety.

If a serious accident occurs, do not disturb the scene, except to make safe and prevent further injury or damage, and keep all unauthorised people out, and report all accidents to the Project Manager and relevant emergency services and authorities.

10. Regulatory Approvals / Licensing

10.1 Randwick Local Environmental Plan (2012) (LEP)

The site falls within the heritage boundary of LEP, which dictates that all works within the area heritage item instrument require development consent.

10.2 State Environmental Planning Policy No. 55 – Remediation of Land (SEPP55)

The proposed remediation works are considered Category 1 remediation works, i.e., requiring development consent, as noted above.

It is understood remediation will be ancillary to the development, which is SSD, and as such subject to the relevant planning assessment, approval and notification requirements as the development.

10.3 Protection of the Environment Operations Act 1997

The proposed remediation/validation activities are not required to be licensed under the *Protection of the Environment Operation Act 1997* since the works do not involve:

- treatment otherwise than by incineration and storage of more than 30 000 cubic metres of contaminated soil originating exclusively from the site, or
- disturbance of more than an aggregate area of 3 hectares of contaminated soil originating exclusively from the site.

10.4 Protection of The Environment Operations (Waste) Regulation 2014

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works on the site will not require to be licensed.

Section 42 of the Regulation stipulates special transportation, reporting, re-use and recycling requirements relating to asbestos waste and must be complied with regardless whether the activity is licensed.

The requirements for the transportation of asbestos waste include:

- bonded asbestos material must be securely packaged at all times,
- friable asbestos material must be kept in a sealed container,
- asbestos-contaminated soils must be wetted down,
- all asbestos waste must be transported in a covered, leak-proof vehicle.

The transporter of asbestos waste must cause the following information to be given to the EPA prior to the transportation of asbestos waste loads:

- source site details including address, name and contact details;
- date of proposed transportation commencement;
- name, address and contact details of disposal site; and
- approximate weight of each class of asbestos in each load;

The transporter of asbestos waste must ensure the following information is given to the disposal site before or at delivery:

- unique consignment code issued by EPA in relation to that load; and
- any other information specified in the Asbestos and Waste Tyres Guidelines.

The requirements relating to the off-site disposal of asbestos waste are as follows:

- asbestos waste in any form must be disposed of only at a landfill site that may lawfully receive the waste,
- when asbestos waste is delivered to a landfill site, the occupier of the landfill site must be informed by the person delivering the waste that the waste contains asbestos,
- when unloading and disposing of asbestos waste at a landfill site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust,
- asbestos waste disposed of at a landfill site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence.
- Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded.

10.5 Waste Classification Guidelines (EPA 2014)

All wastes generated and proposed to be disposed off-site shall be assessed, classified and managed in accordance with this guideline.

10.6 Asbestos Removal Regulations and Code of Practice

The removal and disposal of asbestos will be managed in accordance with the Work Health and Safety Act (2011) and Work Health and Safety Regulation (2011), *How to Management and Control Asbestos in the Workplace: Code of Practice* (SWA 2011a), "*How to Safely Remove Asbestos: Code of Practice* (SWA 2011b), *Managing Asbestos in or on Soil* (WorkCover 2014) and the NSW EPA Waste Classification Guidelines 2014.

Excavation and removal of friable asbestos contaminated soils are required to be conducted by a Class A licensed contractor. Excavation, onsite remediation and offsite removal of bonded ACM only contaminated soils are to be conducted by the same Class A licensed contractor.

Before starting any affected works, the appointed contractor is required to obtain a site-specific permit approving the asbestos works from NSW WorkCover. A permit will not be granted without a current licence and the permit application must be made at least seven days before the work is due to commence.

11. Conclusions

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of the *Contaminated Sites Guidelines for the NSW Site Auditor Scheme (2nd Edition)* (DEC 2006) because they are: technically feasible; environmentally justifiable; and consistent with relevant laws, policies and guidelines endorsed by NSW EPA.

Subject to the successful implementation of the measures described in this RAP and the limitations in **Section 12**, it is concluded that the identified asbestos impacts can be remediated / managed in such a way to be appropriately protective of human health and the environment, such that the site can be made suitable for the development and ongoing land use.

12. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

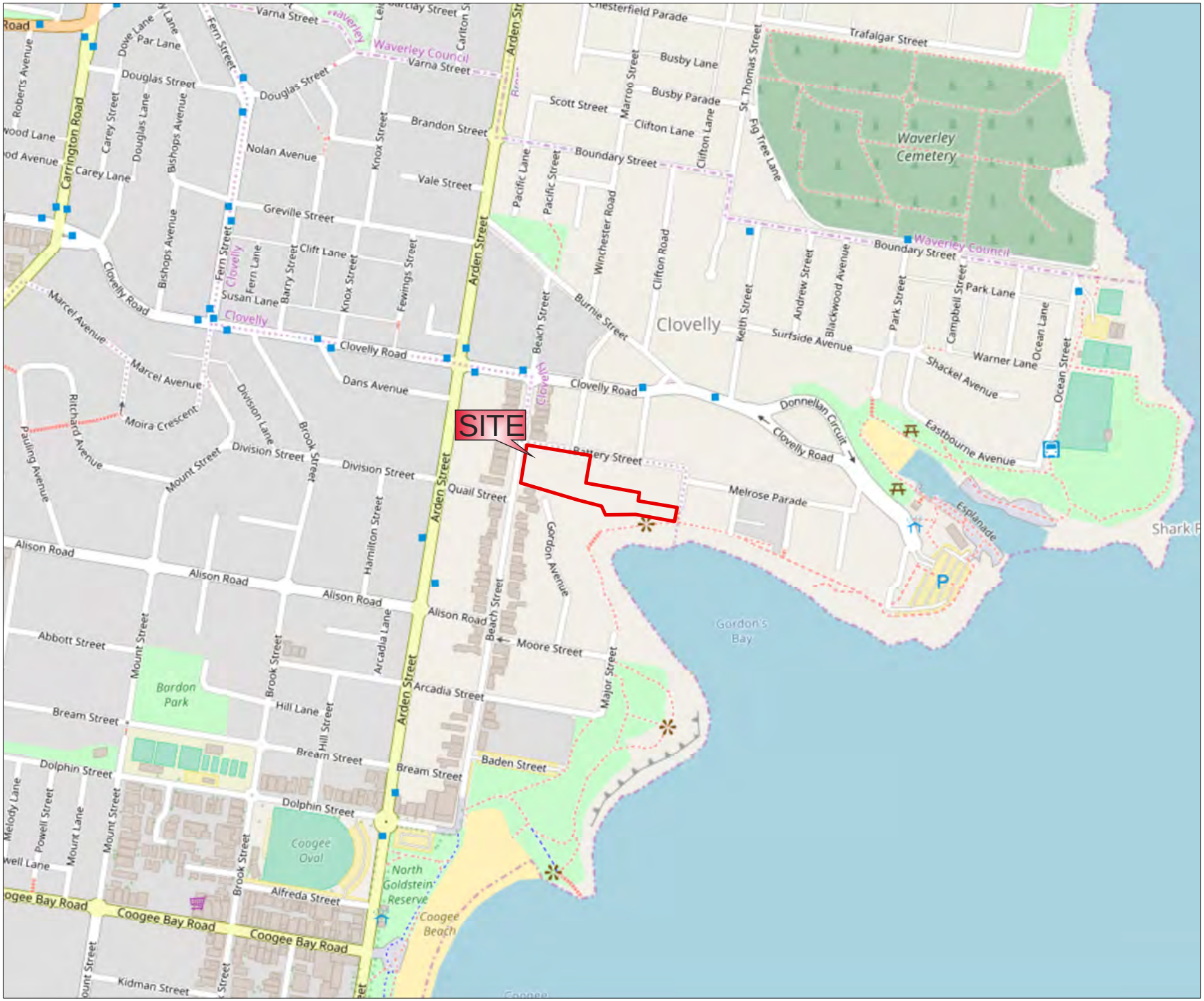
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Figures



Legend:

Approximate Site Boundary

JBS&G

Job No: 54176

Client: University of New South Wales

Version: R01 Rev A	Date: 14-Sep-2017
Drawn By: BC	Checked By: KS

Scale 1:8,500

0 100 200

metres

Coor. Sys. GDA 1994 MGA Zone 56

UNSW Cliffbrook Campus
Coogee, NSW

SITE LOCATION

FIGURE 1

File Name: 52166_01

Legend:

- Approximate Site Boundary
- Hand Auger Location
- Previous Borehole Location
- Previous Hand Auger Location

JBS&G

Job No: 54176

Client: University of New South Wales

Version: R01 Rev A	Date: 15-Sep-2017
Drawn By: SE	Checked By: KS

Scale 1:1,250

0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

UNSW Cliffbrook Campus
Coogee, NSW

SAMPLE LOCATIONS

FIGURE 2

File Name: 52166_02
Reference: SIX Maps www.maps.six.nsw.gov.au, imagery date 06-01-2014, accessed 03-06-2016

Legend:

- Approximate Site Boundary
- Soil with ACM Below HILC Criteria
- Soil with AF and ACM Below HILC Criteria
- Soil with AF and ACM Above HILC Criteria
- Hand Auger Location
- Previous Borehole Location
- Previous Hand Auger Location

JBS&G

Job No: 54176

Client: University of New South Wales

Version: R01 Rev A	Date: 15-Sep-2017
Drawn By: BC	Checked By: KS

Scale 1:1,250

0 10 20
metres

Coor. Sys. GDA 1994 MGA Zone 56

UNSW Cliffbrook Campus
Coogee, NSW

AREAS OF IMPACT

FIGURE 3

File Name: 52166_02
Reference: SIX Maps www.maps.six.nsw.gov.au, imagery date 06-01-2014, accessed 03-06-2016

Appendix A Summary Tables

Table A
Project Number: 51707
Project Name: UNSW Cliffbrook Campus PSI

					Metals & Metalloids									TPHs (NEPC 1999)					TRHs (NEPC 2013)						BTEX					
					Arsenic (Total)	Cadmium	Chromium (Total)	Copper	Iron	Lead	Mercury (Inorganic)	Nickel	Zinc	C6-C9 Fraction	C10-C14 Fraction	C15-C28 Fraction	C29-C36 Fraction	C10-C36 Fraction (Total)	>C10-C16 Fraction	>C16-C34 Fraction	>C34-C40 Fraction	C6-C10 Fraction	C6 - C10 less BTEX (F1)	>C10 - C16 less Naphthalene (F2)	Benzene	Ethylbenzene	Toluene	Xylene (m & p)	Xylene (o)	Xylene (Total)
					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					2.00	0.40	1.00	1.00	5.00	1.00	0.05	1.00	1.00	20.00	20.00	50.00	50.00	50.00	50.00	100.00	100.00	20.00	20.00	50.00	0.10	0.10	0.10	0.20	0.10	0.30
NEPC 2013 EIL, EILs Aged Sediment					100			110		1100		400	330																	
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil																			120[#1]	300[#2]	2800[#2]	180[#3]	180[#1]	120[#1]	50[#2]	70[#2]	85[#2]			105[#2]
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL B																														
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																														
NEPM 2013 Soil HIL B					500[#6]	150	500[#7]	30000		1200[#8]	120[#9]	1200	60000																	
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																							45[#12]	110[#13]	0.5	55	160			40
NSW EPA 2014 General Solid Waste (No Leaching)					100	20				100	4	40		650				10000							10	600	288			1000
LocCode	Depth (m)	Sampled_Date-Time	Sample Code	Lab #																										
BH01 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00241	502667	<2	<0.4	<5	5.8	-	43	0.08	<5	100	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
BH02 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00242	502667	<2	<0.4	8.1	25	-	6.1	<0.05	21	25	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
BH03 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00243	502667	<2	<0.4	5.8	<5	-	18	<0.05	<5	28	<20	<20	170	77	247	<50	250	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
BH03 0.90-1.0	0.9-1	31/05/2016	S16-Jn00244	502667	-	-	-	-	5600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.9-1.0	0.9-1	31/05/2016	S16-Jn07502	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA01 0.00-0.10	0-1	31/05/2016	S16-Jn00245	502667	2.5	<0.4	<5	8.9	-	57	0.05	<5	70	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00246	502667	3.5	<0.4	<5	15	-	89	0.09	<5	110	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
HA02 0.2-0.3	0.2-0.3	31/05/2016	S16-Jn07504	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00247	502667	3.5	<0.4	<5	21	-	86	0.09	<5	99	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
HA03 0.0-0.10	0-0.1	31/05/2016	S16-Jn00248	502667	2.1	<0.4	<5	12	3400	41	<0.05	<5	160	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
HA04 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00249	502667	5.3	<0.4	<5	7.6	-	31	<0.05	<5	71	<20	<20	<50	<50	<50	<50	<100	<100	<20	<20	<50	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3
QC01/A		31/05/2016	147764-1	147764	<4	<0.4	6	17	-	73	<0.1	2	99	<25	<50	<100	<100	-	<50	<100	<100	<25	<25	<50	<0.2	<1	<0.5	<2	<1	-

Env Stds Comments

#1:ESLs are of moderate reliability.
#2:ESLs are of low reliability.
#3:ESLs are of moderate reliability. To obtain F1 subtract the sum of BTEX from C6-C10.
#4:Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
#5:The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures (refer Section 4.10). This screening level is not applicable to free fibres.
#6:Key limitations of HSL should be referred to prior to application in Friebel and Nadebaum (2011b and 2011d).
#7:TV adopted from Chromium (VI)
#8:Assumptions of HSL are presented in Friebel and Nadebaum (2011a and 2011b).
#9:Refer to HSL and soil saturation concentration limit.
#10:TV maybe be multiplied by a factor to account for biodegradation of vapour
#11:HIL relates to non-dioxin-like PCBs only. If PCB source is suspected a site-specific assessment should be untertaken
#12:To obtain F1 subtract the sum of BTEX from C6-C10.
#13:To obtain F2 subtract naohthalene from >C10-C16.
#14:TV adopted from Endosulfan

Data Comments

#1 ESDAT Combined with Non-Detect Multiplier of 0.5. Some Analytes are missing from this Combined Compound.
#2 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#3 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 No respirable fibres detected
#5 Chrysotile asbestos detected
#6 Organic fibres detected.
#7 ESDAT Combined.
#8 ACM:
#9 Nil
#10 FA:

Table A
Project Number: 51707
Project Name: UNSW Cliffbrook Campus PSI

	Polycyclic Aromatic Hydrocarbons																							Chlorinated Benzenes
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (lower bound)*	Benzo(a)pyrene TEQ (medium bound)*	Benzo(a)pyrene TEQ (upper bound)*	Benzo(b,j)fluoranthene	Benzo(b,k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Carcinogenic PAHs as B(a)P TPE	Phenanthrene	Pyrene	PAHs (Total)	Total Positive PAHs	Hexachlorobenzene
	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	0.10	0.10	0.10	0.10	0.05	0.50	0.50	0.50	0.50		0.10	0.50	0.10	0.10	0.10	0.10	0.10	0.10		0.10	0.10	0.50		0.05
NEPC 2013 EIL, EILs Aged Sediment																		170						
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil					0.7[#2]																			
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL B																								
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																								
NEPM 2013 Soil HIL B																			4			400[#10]		15
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																		3						
NSW EPA 2014 General Solid Waste (No Leaching)					0.8																			

LocCode	Depth (m)	Sampled_Date-Time	Sample Code	Lab #																					
BH01 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00241	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	-
BH02 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00242	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	-
BH03 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00243	502667	<0.5	<0.5	1.1	3.1	3.7	5.4	5.4	5.4	2.7	-	2.3	2.6	3.1	0.6	7.6	<0.5	1.6	<0.5	5.354[#3]	5.8	7.9	42.1	-	-
BH03 0.90-1.0	0.9-1	31/05/2016	S16-Jn00244	502667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.9-1.0	0.9-1	31/05/2016	S16-Jn07502	503683	<0.5	<0.5	<0.5	0.9	1.1	1.4	1.7	1.9	0.8	-	0.7	0.9	1.1	<0.5	2.4	<0.5	<0.5	<0.5	1.653[#3]	1.6	2.6	12.1	-	-
HA01 0.00-0.10	0-1	31/05/2016	S16-Jn00245	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	<0.05
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00246	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	<0.05
HA02 0.2-0.3	0.2-0.3	31/05/2016	S16-Jn07504	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00247	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	<0.05
HA03 0.0-0.10	0-0.1	31/05/2016	S16-Jn00248	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	<0.05
HA04 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00249	502667	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.21[#7]	<0.5	<0.5	<0.5	-	<0.05
QC01/A		31/05/2016	147764-1	147764	<0.1	0.1	<0.1	0.3	0.3	<0.5	<0.5	<0.5	-	0.5	0.2	-	0.3	<0.1	0.5	<0.1	0.2	<0.1	0.405[#1]	0.2	0.5	-	3.1	<0.1

Env Stds Comments

#1:ESLs are of moderate reliability.
#2:ESLs are of low reliability.
#3:ESLs are of moderate reliability. To obtain F1 subtract the sum of BTEX from C6-C10.
#4:Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently
#5:The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) onl
#6:Key limitations of HSL should be referred to prior to application in Friebel and Nadebaum (2011b and 2
#7:TV adopted from Chromium (VI)
#8:Assumptions of HSL are presented in Friebel and Nadebaum (2011a and 2011b).
#9:Refer to HSL and soil saturation concentration limit.
#10:TV maybe be multiplied by a factor to account for biodegradation of vapour
#11:HIL relates to non-dioxin-like PCBs only. If PCB source is suspected a site-specific assessment should be
#12:To obtain F1 subtract the sum of BTEX from C6-C10.
#13:To obtain F2 subtract naohthalene from >C10-C16.
#14:TV adopted from Endosulfan

Data Comments

#1 ESDAT Combined with Non-Detect Multiplier of 0.5. Some Analytes are missing from this Combined Co
#2 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#3 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 No respirable fibres detected
#5 Chrysotile asbestos detected
#6 Organic fibres detected.
#7 ESDAT Combined.
#8 ACM:
#9 Nil
#10 FA:

Table A
Project Number: 51707
Project Name: UNSW Cliffbrook Campus PSI

	Polychlorinated Biphenyls								Organochlorine Pesticides																								
	Arodor 1016	Arodor 1221	Arodor 1232	Arodor 1242	Arodor 1248	Arodor 1254	Arodor 1260	PCBs (Total)	Aldrin	4,4-DDE	Aldrin + Dieldrin (Sum of Total)	Dieldrin	DDD	alpha-BHC	DDT	beta-BHC	DDT+DDE+DDD (Sum of Total)	alpha-Chlordane	Chlordane	delta-BHC	gamma-Chlordane	Endosulfan alpha	Endosulfan beta	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	Heptachlor	Heptachlor Epoxide	Lindane	Methoxychlor	Toxaphene
	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	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.05	0.05		0.05	0.05	0.05	0.05	0.05			0.10	0.05		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.10	1.00
NEPC 2013 EIL, EILs Aged Sediment															180																	
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil																																
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL B																																
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL																																
NEPM 2013 Soil HIL B								1[#11]			10						600		90						20			10			500	30
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																																
NSW EPA 2014 General Solid Waste (No Leaching)								50-0														60[#14]	60[#14]	60[#14]								
LocCode	**Depth (m)**	**Sampled_Date-Time**	**Sample Code**	**Lab #**																														
BH01 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00241	502667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH02 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00242	502667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00243	502667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.90-1.0	0.9-1	31/05/2016	S16-Jn00244	502667	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BH03 0.9-1.0	0.9-1	31/05/2016	S16-Jn07502	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA01 0.00-0.10	0-1	31/05/2016	S16-Jn00245	502667	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.1[#7]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.15[#2]	-	<0.1	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00246	502667	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.1[#7]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.15[#2]	-	<0.1	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1
HA02 0.2-0.3	0.2-0.3	31/05/2016	S16-Jn07504	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00247	502667	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.1[#7]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.15[#2]	-	<0.1	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1
HA03 0.0-0.10	0-0.1	31/05/2016	S16-Jn00248	502667	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	<0.05	<0.1[#7]	<0.05	<0.05	<0.05	<0.05	<0.05	<0.15[#2]	-	<0.1	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1
HA04 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00249	502667	<0.5	<0.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.09	<0.05	0.36[#3]	0.27	<0.05	<0.05	<0.05	<0.05	<0.15[#2]	-	0.2	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.2	<1
QC01/A		31/05/2016	147764-1	147764	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.2[#7]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3[#2]	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Env Stds Comments

#1:ESLs are of moderate reliability.
#2:ESLs are of low reliability.
#3:ESLs are of moderate reliability. To obtain F1 subtract the sum of BTEX from C6-C10.
#4:Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently
#5:The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) onl
#6:Key limitations of HSL should be referred to prior to application in Friebel and Nadebaum (2011b and 2
#7:TV adopted from Chromium (VI)
#8:Assumptions of HSL are presented in Friebel and Nadebaum (2011a and 2011b).
#9:Refer to HSL and soil saturation concentration limit.
#10:TV maybe be multiplied by a factor to account for biodegradation of vapour
#11:HIL relates to non-dioxin-like PCBs only. If PCB source is suspected a site-specific assessment should be
#12:To obtain F1 subtract the sum of BTEX from C6-C10.
#13:To obtain F2 subtract naohthalene from >C10-C16.
#14:TV adopted from Endosulfan

Data Comments

#1 ESDAT Combined with Non-Detect Multiplier of 0.5. Some Analytes are missing from this Combined Co
#2 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#3 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 No respirable fibres detected
#5 Chrysotile asbestos detected
#6 Organic fibres detected.
#7 ESDAT Combined.
#8 ACM:
#9 Nil
#10 FA:

Table A
Project Number: 51707
Project Name: UNSW Cliffbrook Campus PSI

				Ionic Balance			Asbestos											Asbestos - Trace Analysis					Asbestos ID - soils NEPM		Other	
				Cation Exchange Capacity	EC 1:5 soil:water	pH 1:5 soil:water	Approx. Sample Mass	Asbestos from ACM in Soil	Mass ACM	Mass Asbestos in ACM	Asbestos from FA & AF in Soil	Mass FA	Mass Asbestos in FA	Mass AF	Mass Asbestos in AF	Mass Asbestos in FA & AF	Synthetic Fibres - Comment	ACM - Comment	AF - Comment	FA - Comment	Organic Fibres - Comment	Respirable Fibres - Comment	FA and AF Estimation*#2	Total Asbestos#1	% Clay	% Moisture 103oC
				meq/100g	US/CM	ph Units	g	%w/w	g	g	%w/w	g	g	g	g	g	Comment	Comment	Comment	Comment	Comment	Comment	%(w/w)	g/kg	%	%
EQL				0.05	10.00	0.10																			1.00	1.00
NEPC 2013 EIL, EILs Aged Sediment																										
NEPM 2013 ESL Urban Residential and Public Open Space, Coarse Soil																										
NEPM 2013 HSL Asbestos in Soil - Bonded ACM - Residential - HSL B								0.04#4																		
NEPM 2013 HSL Asbestos in Soil - FA & AF - HSL											0.001#5															
NEPM 2013 Soil HIL B																										
NEPM 2013 Soil HSL A & HSL B for Vapour Intrusion - Sand 0 to <1m																										
NSW EPA 2014 General Solid Waste (No Leaching)																										
LocCode	**Depth (m)**	**Sampled_Date-Time**	**Sample Code**	**Lab #**																						
BH01 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00241	502667	-	-	-	501	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	6.6
BH02 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00242	502667	-	-	-	553	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	5.7
BH03 0.40-0.50	0.4-0.5	31/05/2016	S16-Jn00243	502667	-	-	-	908	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	6.1
BH03 0.90-1.0	0.9-1	31/05/2016	S16-Jn00244	502667	4.4	25	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5	12
BH03 0.9-1.0	0.9-1	31/05/2016	S16-Jn07502	503683	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.4
HA01 0.00-0.10	0-1	31/05/2016	S16-Jn00245	502667	-	-	-	435	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	14
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00246	502667	-	-	-	534	0.0657	2.339	0.3508	0	0	0	0	0	0	1#9	1#8	1#9	1#9	1#6	1#4	-	-	-	8.5
HA02 0.2-0.3	0.2-0.3	31/05/2016	S16-Jn07504	503683	-	-	-	606	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	-
HA02 0.00-0.10	0-1	31/05/2016	S16-Jn00247	502667	-	-	-	568	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	-	13
HA03 0.0-0.10	0-0.1	31/05/2016	S16-Jn00248	502667	8.1	37	6.4	648	0	0	0	0	0	0	0	0	0	1#9	1#9	1#9	1#9	1#6	1#4	-	-	2.5	13
HA04 0.20-0.30	0.2-0.3	31/05/2016	S16-Jn00249	502667	-	-	-	925	0	0	0	0.0008	0.0111	0.0078	0	0	0.0078	1#9	1#9	1#9	1#10	1#6	1#4	-	-	-	3.4
QC01/A		31/05/2016	147764-1	147764	-	-	-	601.8	0.097	0.98	0.68	0	0	0	0	0	0	-	-	-	-	-	-	<0.001	0.9696	-	-

Env Stds Comments

#1:ESLs are of moderate reliability.
#2:ESLs are of low reliability.
#3:ESLs are of moderate reliability. To obtain F1 subtract the sum of BTEX from C6-C10.
#4:Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently
#5:The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) onl
#6:Key limitations of HSL should be referred to prior to application in Friebel and Nadebaum (2011b and 2
#7:TV adopted from Chromium (VI)
#8:Assumptions of HSL are presented in Friebel and Nadebaum (2011a and 2011b).
#9:Refer to HSL and soil saturation concentration limit.
#10:TV maybe be multiplied by a factor to account for biodegradation of vapour
#11:HIL relates to non-dioxin-like PCBs only. If PCB source is suspected a site-specific assessment should be
#12:To obtain F1 subtract the sum of BTEX from C6-C10.
#13:To obtain F2 subtract naohthalene from >C10-C16.
#14:TV adopted from Endosulfan

Data Comments

#1 ESDAT Combined with Non-Detect Multiplier of 0.5. Some Analytes are missing from this Combined Co
#2 ESDAT Combined. Some Analytes are missing from this Combined Compound.
#3 ESDAT Combined with Non-Detect Multiplier of 0.5.
#4 No respirable fibres detected
#5 Chrysotile asbestos detected
#6 Organic fibres detected.
#7 ESDAT Combined.
#8 ACM:
#9 Nil
#10 FA:

Table A: Asbestos Quantification Summary Table
Job #: 52166
Client: University of NSW
Name: Additional Investigation UNSW Cliffbrook

Asbestos Concentration in Soils (NEPC 2013 HIL-C)		
Category	**Criteria**	**Exceedance**
Visible Surface Asbestos	No Visible ACM	**Number**
Bonded ACM in soils	0.02% w/w	**Number**
FA and AF in soils	0.001% w/w	**Number**

Sample Information				Field Asbestos Quantification								Laboratory Analysis							
Sample ID	Soil Desciption	Date	Lab Report Number	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Sample Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	AF Mass (g)	Mass Asbestos in AF (g)	Mass Asbestos in FA & AF (g)	[Asbestos from FA & AF in soil] (%w/w)	Trace Analysis
DHA01_0.0-0.6	FL	6/10/2016	518881	10.00	16300.00	-	-	-	508	-	-	<LOR	-	-	-	-	-	-	Organic Fibre Detected Synthetic Mineral Fibre Detected
DHA02_0.0-0.5	FL	6/10/2016	518881	10.00	16300.00	-	-	-	641	-	-	<LOR	-	-	-	-	-	-	Organic Fibre Detected Synthetic Mineral Fibre Detected
DHA03_0.0-0.6	FL	6/10/2016	518881	10.00	16300.00	6.00	0.9000	0.0055	518	-	-	<LOR	0.0163	0.0065	-	-	0.0065	**0.0013**	Chrysotile asbestos detected in weathered fibre cement fragments Organic Fibres Detected
DHA04_0.0-0.4	FL	6/10/2016	518881	10.00	16300.00	8.00	1.2000	0.0074	615	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA05_0.0-0.6	FL	6/10/2016	518881	10.00	16300.00	35.00	5.2500	**0.032**	467	-	-	<LOR	0.0389	0.0156	-	-	0.0156	**0.0033**	Chrysotile asbestos detected in weathered fibre cement fragments Organic Fibres Detected
DHA06_0.0-0.4	FL	6/10/2016	518881	10.00	16300.00	14.00	2.1000	0.013	665	-	-	<LOR	0.0019	0.0156	-	-	0.0156	**0.0010**	Chrysotile asbestos detected in weathered fibre cement fragments Organic Fibres Detected
DHA07_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	7.00	1.0500	0.0064	608	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA08_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	14.00	2.1000	0.013	501	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA09_0.0-0.3	FL	6/10/2016	518881	10.00	16300.00	-	-	-	504	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA10_0.0-0.3	FL	6/10/2016	518881	10.00	16300.00	2.00	0.3000	0.0018	629	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA11_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	-	-	-	796	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA12_0.0-0.4	FL	6/10/2016	518881	10.00	16300.00	-	-	-	547	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA13_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	-	-	-	575	-	-	<LOR	-	-	-	-	-	-	Organic Fibre Detected Synthetic Mineral Fibre Detected
DHA14_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	-	-	-	682	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA15_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	-	-	-	504	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA16_0.0-0.4	FL	6/10/2016	518881	10.00	16300.00	-	-	-	757	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected
DHA17_0.0-0.2	FL	6/10/2016	518881	10.00	16300.00	-	-	-	504	-	-	<LOR	-	-	-	-	-	-	Organic Fibres Detected

Appendix B Sample Location Logs

Borehole No: BH01

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Solid Flight Auger
Total Hole Depth (mbgs): 3.8

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Pavers	BH01_0.05-0.15	-	D	No odours, stains or ACM observed
		Fill (FL) Roadbase - igneous gravel, dark grey, moist, loose.	BH01_0.2-0.3	-	D	
		Sand (SP) Sand, dark grey, homogeneous, coarse, loose, moist.	BH01_0.4-0.5	-	D	
						No odours, stains or ACM observed
1.0			BH01_0.9-1.0	-	D	
		Sand (SP) Sand, light grey, homogeneous, coarse, medium dense, moist.				No odours, stains or ACM observed
2.0		**Clayey Sand (SC)** Clayey SAND, orange - brown, homogeneous, loose to medium dense, moist.				No odours, stains or ACM observed
3.0		**Clayey Sand (SC)** Clayey SAND, orange - brown, red mottles, loose to medium dense, moist.				No odours, stains or ACM observed
4.0		**End of hole @ 3.80 mbgs** Continued by Geotech - not logged				

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: BH02

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Solid Flight Auger
Total Hole Depth (mbgs): 1.5

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Roadbase.	BH02_0.0-0.1	-	D	No odours, stains or ACM observed
		Fill (FL) Clayey SAND, heterogeneous, orange - brown, coarse, damp, inclusions of sandstone cobbles and igneous gravels.	BH02_0.2-0.3	-	D	
			BH02_0.4-0.5	-	D	No odours, stains or ACM observed
		Sand (SP) Sand, grey - brown, homogeneous, coarse, damp, inclusions of sandstone and gravels.				
1.0			BH02_0.9-1.0	-	D	No odours, stains or ACM observed
		Sand (SP) Sand, light grey, homogeneous, coarse, loose, damp.				No odours, stains or ACM observed
		End of hole @ 1.50 mbgs Continued by Geotech - not logged				
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: BH03

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Solid Flight Auger
Total Hole Depth (mbgs): 1.1

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Ashphalt	BH03_0.05-0.15	-	D	No odours, stains or ACM observed
		Fill (FL) Roadbase / coarse ashphalt gravels, grey - black, dense.	BH03_0.2-0.3	-	D	No odours, stains or ACM observed
		Fill (FL) Sand, heterogeneous, dark grey, coarse, loose, damp, inclusions of igeneous gravels and sandstone gravels.	BH03_0.4-0.5	-	D	No odours, stains or ACM observed
		Sand (SP) Sand, light grey, homogeneous, coarse, loose, damp.				No odours, stains or ACM observed
1.0		**Clayey Sand (SC)** Clayey sand, orange - brown, coarse, medium dense, damp - moist.	BH03_0.9-1.0	-	D	No odours, stains or ACM observed
		End of hole @ 1.10 mbgs Continued by Geotech - not logged				
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: HA01

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Hand Auger
Total Hole Depth (mbgs): 0.5

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Sand, heterogeneous, grey - brown, coarse, medium dense, damp, inclusions of sandstone gravels and trace plastic.	HA01_0.0-0.1	-	D	No odours, stains or ACM observed
		Sand (SP) Sand, homogeneous, grey, coarse, medium dense, damp.	HA01_0.2-0.3	-	D	No odours, stains or ACM observed
		Refusal @ 0.5mbgs Refusal on sandstone bedrock				
1.0						
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: HA02

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Hand Auger
Total Hole Depth (mbgs): 1.0

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Sand, heterogeneous, grey, coarse, medium dense, damp, inclusions of tile, sandstone cobbles and igneous gravels.	HA02_0.0-0.1	-	D	QC01 and QC01/A collected Geofabric
			HA02_0.2-0.3	-	D	No odours, stains or ACM observed
			HA02_0.4-0.5	-	D	
		Sand (SP) Sand, homgeneous, light grey, coarse, medium dense, moist, inclusions of roots.				Geofabric No odours, stains or ACM observed
1.0			HA02_0.9-1.0	-	D	
		End of hole @ 1.0mbgs Natural				
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: HA03

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Hand Auger
Total Hole Depth (mbgs): 0.6

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Sand, heterogeneous, dark grey, coarse, loose, damp, inclusions of clayey sand (orange - brown), sandstone cobbles, igneous gravels and roots. Service encountered at 0.35 (casted pipe).	HA03_0.0-0.1	-	D	No odours, stains or ACM observed
			HA03_0.2-0.3	-	D	
		Clayey Sand (SC) Clayey sand, homogeneous, orange - brown, coarse, medium dense.	HA03_0.4-0.5	-	D	No odours, stains or ACM observed
		End of hole @ 0.6mbgs Natural				
1.0						
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

Borehole No: HA04

Project No: 51707
Client: Pells Sullivan Meynink
Project Name: UNSW Cliffbrook Campus PSI
Site Address: UNSW Cliffbrook Campus

Date: 31/05/2016
Contractor:
Drill Rig:
Method: Hand Auger
Total Hole Depth (mbgs): 0.65

Eastings (MGA): -
Northings (MGA): -
Reference Level: Ground Surface
Elevation - Surface (m): -
Bore Diameter (mm): -

SUBSURFACE PROFILE			SAMPLE			
Depth	Graphic Log	Lithologic Description	Sample ID	PID (ppm)	Sample Type	Comments
0.0		Ground Surface				
		Fill (FL) Gravelly sand, heterogeneous, grey, fine to medium grained, loose, inclusions of gravels, roots.	HA04_0.0-0.1	-	D	
		Fill (FL) Gravelly sand, heterogeneous, grey, fine to medium grained, loose, inclusions of gravels, roots and rusted tin (paint or similar)	HA04_0.2-0.3	-	D	No odours, stains or ACM observed
		Fill (FL) Gravelly sand, heterogeneous, grey, fine to medium grained, loose, inclusions of gravels, roots.	HA04_0.4-0.5	-	D	No odours, stains or ACM observed
		Clayey Sand (SC) Clayey sand, homogeneous, orange - brown, medium dense, moist.				
1.0		**End of hole @ 0.65mbgs** Natural				
2.0						
3.0						
4.0						

Drilling Method	*Sample Type*	*Reference Level*	*Log Details*
HA - Hand Auger	*U - Undisturbed tube sample*	*AHD - Australian Height Datum*	*Logged By:* Lindsey Blecher
SFA - Solid Flight Auger	*D - Disturbed sample*	*BGS - Below Ground Surface*	*Project Manager:* Matthew Bennett
HFA - Hollow Flight Auger	*CS - Core sample*		
PT - Push Tube			
AH - Air Hammer			

NOTE: This bore log is for environmental assessment purposes only and is not intended to provide geotechnical information

DHA01

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.9
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger	0.5			Fill	SAND, grey, heterogeneous, dry, coarse grained, loose with trace inclusions of gravel, charcoal and brick	DHA01_0.0-0.6	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.60		SW	SAND, grey, heterogeneous, dry to damp, coarse grained, angular		
		0.90			Borehole DHA01 terminated at 0.9m		
	1.0						
	1.5						
	2.0						

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 18/10/16

DHA02

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.8
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger	0.5			Fill	SAND grey, heterogeneous, dry, loose, angular with trace inclusions of brick and concrete	DHA02_0.0-0.5	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.50		SW	SAND, grey, homogeneous, damp, coarse grained, loose		
	1.0	0.80			Borehole DHA02 terminated at 0.8m		
	1.5						
	2.0						

DHA03

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.7
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, coarse grained, angular with inclusions of tile, brick, concrete gravels and bonded ACM fragments		No odours or staining observed
						DHA03_0.0-0.6	10L Asbestos quantification completed, ACM fragments identifed
		0.40		SW	SAND, grey, homogeneous, damp, coarse grained, angular		
	0.5						
		0.70			Borehole DHA03 terminated at 0.7m		
	1.0						
	1.5						
	2.0						

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 18/10/16

DHA04

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.7
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, coarse grained, loose with trace inclusions of gravel, tile, brick, concrete and bonded ACM fragments	DHA04_0.0-0.4	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
	0.5	0.40		SW	SAND, grey, homogeneous, damp, coarse grained, angular, loose		
	1.0	0.70			Borehole DHA04 terminated at 0.7m		
	1.5						
	2.0						

DHA05

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.9
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger	0.5			Fill	Gravelly SAND, grey, heterogeneous, dry, angular within inclusions of igneous gravels, tile, brick and bonded ACM fragments	DHA05_0.0-0.6	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
		0.60		SW	SAND, grey to brown, homogeneous, damp, coarse grained		
		0.90			Borehole DHA05 terminated at 0.9m		
	1.0						
	1.5						
	2.0						

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 18/10/16

DHA06

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.7
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, coarse grained with inclusions of bonded ACM	DHA06_0.0-0.4	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
	0.5	0.40		SW	Sand, grey, homogeneous, damp, loose with inclusions of sandstone cobbles		
	1.0	0.70			Borehole DHA06 terminated at 0.7m		
	1.5						
	2.0						

DHA07

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.4
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	SAND, grey, heterogeneous, damp, coarse with inclusions of brick, concrete, steel, circuit board and bonded ACM fragment	DHA07_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
		0.20		SW	SAND, grey, homogeneous, coarse with inclusions of sandstone cobbles		
		0.40			Borehole DHA07 terminated at 0.4m		
	0.5						
	1.0						
	1.5						
	2.0						

DHA08

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.2
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, loose with inclusions of igneous gravels, tile, brick, glass and bonded ACM fragments	DHA08_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
		0.20			Borehole DHA08 terminated at 0.2m		
	0.5						
	1.0						
	1.5						
	2.0						

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 18/10/16

DHA09

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.6
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, loose with inclusions of brick, gravels, glass	DHA09_0.0-0.3	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.30		SW	SAND, grey, homogeneous, damp, loose		
	0.5						
		0.60			Borehole DHA09 terminated at 0.6m		
	1.0						
	1.5						
	2.0						

DHA10

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.6
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, damp, coarse grained with inclusions of brick, tile, glass and bonded ACM fragment	DHA10_0.0-0.3	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identifed
		0.30		SW	SAND, grey, homogeneous, damp, coarse		
	0.5						
		0.60			Borehole DHA10 terminated at 0.6m		
	1.0						
	1.5						
	2.0						

DHA11

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.5
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, damp, coarse grained with inclusions of tile and glass	DHA11_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.20		SW	SAND, grey to brown, homogeneous, damp, loose		
	0.5						
		0.50			Borehole DHA11 terminated at 0.5m		
	1.0						
	1.5						
	2.0						

DHA12

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.4
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Gravelly SAND, grey, heterogeneous, dry, fine to medium grained, very loose with trace inclusions of timber	DHA12_0.0-0.4	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
	0.5	0.40			Borehole DHA12 terminated at 0.4m		
	1.0						
	1.5						
	2.0						

DHA13

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.5
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	Clayey SAND, orange to brown, heterogeneous, damp, loose, coarse to angular grains with inclusions of tile and roots	DHA13_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.20		SC	Clayey SAND, orange to brown, heterogeneous, damp, loose, coarse to angular grains with inclusions of tile and roots		
	0.5						
		0.50			Borehole DHA13 terminated at 0.5m		
	1.0						
	1.5						
	2.0						

BOREHOLE JBSG BOREHOLE.GPJ GINT STD AUSTRALIA.GDT 18/10/16

DHA14

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.2
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				SM	Silty SAND, grey, homogeneous, damp, coarse grained	DHA14_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.20			Borehole DHA14 terminated at 0.2m		
	0.5						
	1.0						
	1.5						
	2.0						

DHA15

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.5
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	SAND, grey, heterogeneous, dry, coarse grained with inclusions of roots and trace gravels	DHA15_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.20		SW	SAND, yellow to grey, homogeneous, dry, coarse gained, loose		
	0.5						
		0.50			Borehole DHA15 terminated at 0.5m		
	1.0						
	1.5						
	2.0						

DHA16

Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.7
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	SAND, grey, heterogeneous, dry, coarse grained, loose with trace glass	DHA16_0.0-0.4	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
	0.5	0.40		SW	SAND, yellow to grey, homogeneous, dry, coarse gained, loose		
	1.0 1.5 2.0	0.70			Borehole DHA16 terminated at 0.7m		

DHA17

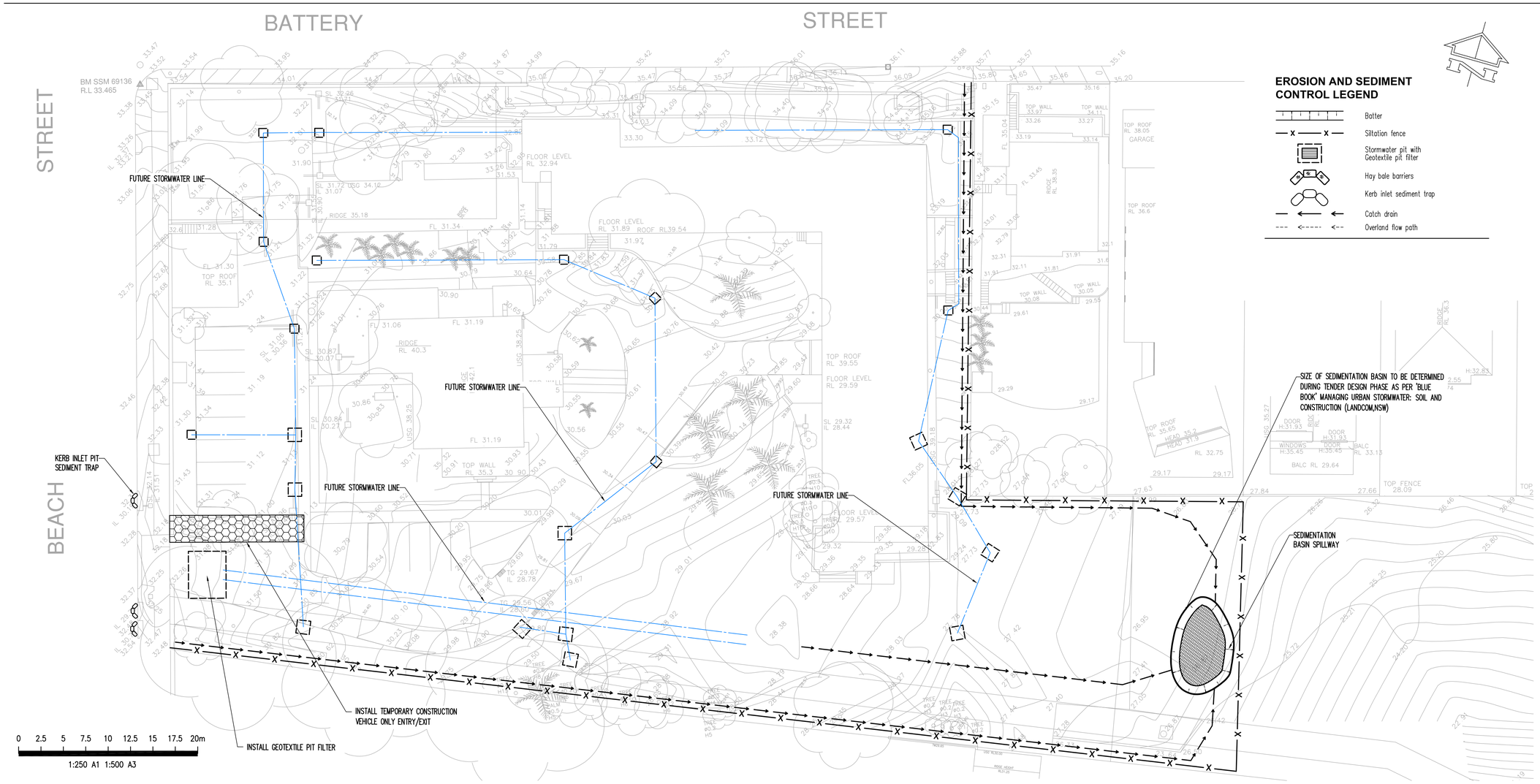
Project Number: 52166_Logs
Client: University of NSW
Project Name: Additional Investigation
Site Address: Battery and Beach Streets Coogee

Date: 8/10/2016
Logged By: L. Blecher
Contractor: NA
Total Hole Depth (mbgs): 0.5
Bore Diameter (mm):

Eastings (GDA 94):
Northings (GDA 94):
Zone/Area:
Reference Level:
Elevation (m):

Method	Depth (mbgs)	Contact (mbgs)	Graphic Log	Lithological Class	Lithological Description	Samples Tests Remarks	Additional Observations
Hand Auger				Fill	SAND, dark brown, heterogeneous, dry, coarse grained, loose with inclusions of organic matter and roots	DHA17_0.0-0.2	No odours or staining observed 10L Asbestos quantification completed, no ACM fragments identifed
		0.20		SW	SAND, yellow to grey, homogeneous, damp, coarse gained, loose		
	0.5						
		0.50			Borehole DHA17 terminated at 0.5m		
	1.0						
	1.5						
	2.0						

Appendix C Development/Landscape Plans



EROSION AND SEDIMENT CONTROL LEGEND

- Batter
- Siltation fence
- Stormwater pit with Geotextile pit filter
- Hay bale barriers
- Kerb inlet sediment trap
- Catch drain
- Overland flow path

EROSION AND SEDIMENT CONTROL NOTES

1. All work shall be generally carried out in accordance with
   (A) Local authority requirements,
   (B) EPA – Pollution control manual for urban stormwater,
   (C) LANDCOM NSW – Managing Urban Stormwater: Soils and Construction ("Blue Book").
2. Erosion and sediment control drawings and notes are provided for the whole of the works. Should the Contractor stage these works then the design may be required to be modified. Variation to these details may require approval by the relevant authorities.
   The erosion and sediment control plan shall be implemented and adopted to meet the varying situations as work on site progresses.
3. Maintain all erosion and sediment control devices to the satisfaction of the superintendent and the local authority.
4. When stormwater pits are constructed prevent site runoff entering the pits unless silt fences are erected around pits.
5. Minimise the area of site being disturbed at any one time.
6. Protect all stockpiles of materials from scour and erosion. Do not stockpile loose material in roadways, near drainage pits or in watercourses.
7. All soil and water control measures are to be put back in place at the end of each working day, and modified to best suit site conditions.
8. Control water from upstream of the site such that it does not enter the disturbed site.
9. All construction vehicles shall enter and exit the site via the temporary construction entry/exit.
10. All vehicles leaving the site shall be cleaned and inspected before leaving.
11. Maintain all stormwater pipes and pits clear of debris and sediment. Inspect stormwater system and clean out after each storm event.
12. Clean out all erosion and sediment control devices after each storm event.

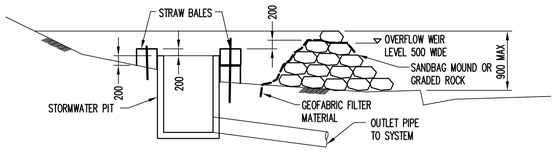
Sequence Of Works

1. Prior to commencement of excavation the following soil management devices must be installed.
1.1. Construct silt fences below the site and across all potential runoff sites.
1.2. Construct temporary construction entry/exit and divert runoff to suitable control systems.
1.3. Construct measures to divert upstream flows into existing stormwater system.
1.4. Provide sandbag sediment traps upstream of existing pits.
2. Construct geotextile filter pit surround around all proposed pits as they are constructed.
3. On completion of pavement provide sand bag kerb inlet sediment traps around pits.

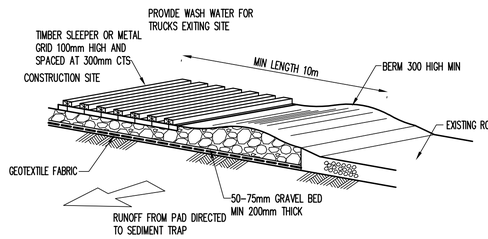
WATER QUALITY TESTING REQUIREMENTS

Prior to discharge of site stormwater, groundwater and seepage water into council's stormwater system, contractors must undertake water quality tests in conjunction with a suitably qualified environment consultant outlining the following:

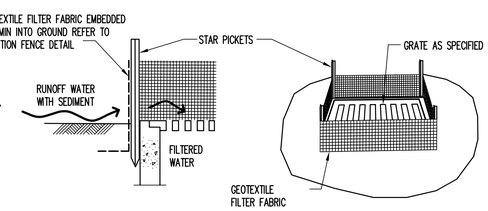
- Compliance with the criteria of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- If required subject to the environmental consultants advice, provide remedial measures to improve the quality of water that is to be discharged into Councils storm water drainage system.This should include comments from a suitably qualified environmental consultant confirming the suitability of these remedial measures to manage the water discharged from the site into Councils storm water drainage system. Outlining the proposed, ongoing monitoring, contingency plans and validation program that will be in place to continually monitor the quality of water discharged from this site. This should outline the frequency of water quality testing that will be undertaken by a suitably qualified environmental consultant.



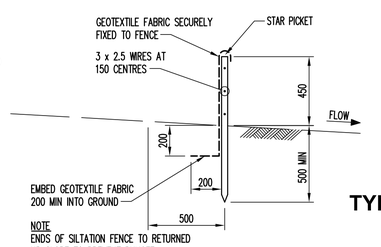
SEDIMENTATION TRAP
NTS



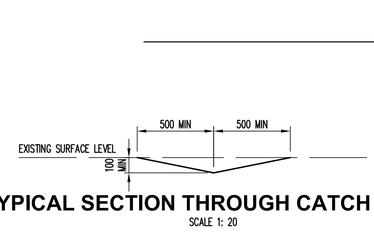
TEMPORARY CONSTRUCTION VEHICLE ENTRY / EXIT
NTS



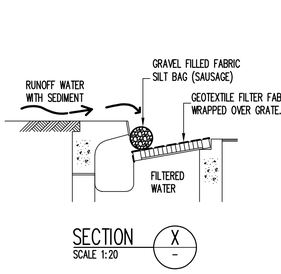
GEOTEXTILE FILTER PIT SURROUND
NTS

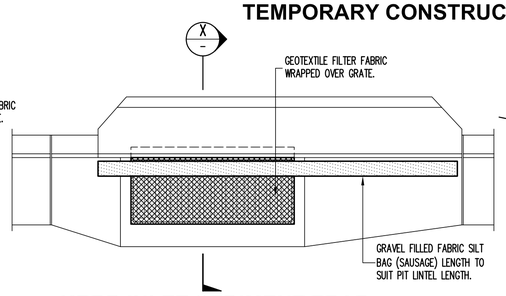


SILTATION FENCE DETAIL
SCALE 1: 20

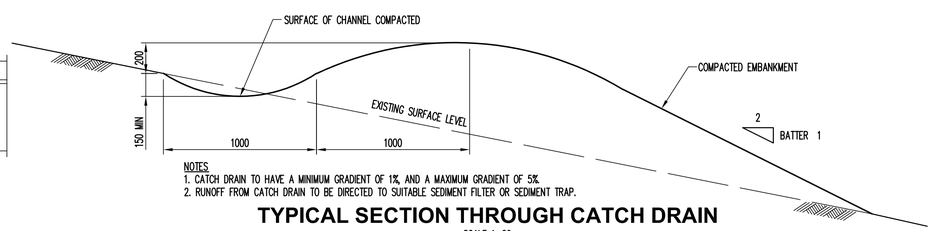


TYPICAL SECTION THROUGH CATCH DRAIN
SCALE 1: 20



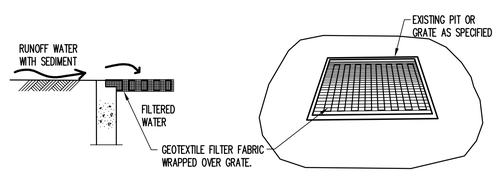


KERB INLET SEDIMENT TRAP
SCALE 1: 20



NOTES
1. CATCH DRAIN TO HAVE A MINIMUM GRADIENT OF 1%, AND A MAXIMUM GRADIENT OF 5%
2. RUNOFF FROM CATCH DRAIN TO BE DIRECTED TO SUITABLE SEDIMENT FILTER OR SEDIMENT TRAP.

TYPICAL SECTION THROUGH CATCH DRAIN
SCALE 1: 20



GEOTEXTILE PIT FILTER
NTS

PRELIMINARY

FileName: C01.dwg – USER: williamw – Plot File Created: Sep 06, 2017 - 12:55pm

Rev	Description	Eng	Draft	Date
C	100% DESIGN DOCUMENTATION – REISSUE	WW	PW	06.09.17
B	100% DESIGN DOCUMENTATION	WW	PW	19.06.17
A	ISSUE FOR SSD APPLICATION	WW	RG	13.04.17

Architect: fjmt, francis-jones morehen thorp, Level 5/70 King St, Sydney NSW 2000

Structural Engineer: TTW Taylor Thomson Whitting, 612 9439 7288 | 48 Chandos Street St Leonards NSW 2065

Project: UNSW CLIFFBROOK CAMPUS REDEVELOPMENT, COOGEE

Sheet Subject: EROSION & SEDIMENT CONTROL PLAN AND DETAILS

Scale : A1	Drawn	Authorised
1:250	RG	PY

Job No	Drawing No	Revision
161031	C01	B

Plot File Created: Sep 06, 2017 - 12:55pm

NOTES:
1) FREEBOARD PROVISIONS, FLOOD CRESTS, OVERLAND FLOW ROUTES AND PIPED FLOOD DIVERSION NETWORK AS PER FLOOD ENGINEERS ADVICE. REFER TO FLOOR REPORT BY KUSTOM ENGINEERING PTY LTD.
2) ALL GRATED SERVICE INLET PITS DRAINING PAVED AREAS ARE TO INCORPORATE STORMWATER 360 ENVIROPOD BASKET INSERTS OR SIMILAR PROPRIETARY PRODUCT.
3) AS PER RANDWICK COUNCIL'S DCP REQUIREMTENTS, A MINIMUM OF ONE POLLUTANT TRAP IS TO BE LOCATED BETWEEN THE LAST DOWNSTREAM STORMWATER PIT PRIOR TO DISCHARGE FROM THE SITE.

BATTERY

STREET

STREET

BEACH

CONSTRUCT NEW CONCRETE INSITU RETAINING WALL (RW3). REFER TO SHEET C11 FOR DETAILS.

EXISTING STORMWATER PIPE TO BE RETAINED.

PROPOSED #150 STORMWATER PIPE

PROPOSED #150 STORMWATER PIPE

BM SSM 69136 R.L 33.465

IL31.19 150ø 'PVC' 7.80% IL30.75

CAP EXISTING PIPES AND SEAL PITS.

IL30.72 225ø 'PVC' 2.90% IL30.38

FFL 31.30 STORMWATER LINES TO BE REDIRECTED OUTSIDE OF BUILDING EXTENTS.

IL30.40 225ø 'PVC' 1.20% IL30.03

TYPICAL CONNECTION TO BUILDING DRAINAGE. DOWNPIPE LOCATIONS TO BE COORDINATED WITH HYDRAULIC SERVICES DURING TENDER DOCUMENTATION.

IL32.61 150ø 'PVC' 29.00% IL26.22

IL30.35 225ø 'S' 2.80% IL30.08

RECONSTRUCT EXISTING PIT AND GRATE TO SUIT NEW LEVELS.

IL30.30 225ø 'PVC' 1.20% IL29.87

150mm KERB ONLY

IL30.05 225ø 'S' 1.30% IL29.91

IL30.55 225ø 'S' 5.90% IL29.91

IL29.84 300ø 'S' 1.10% IL29.64

150mm KERB ONLY

REFER TO STRUCTURAL ENGINEERS PLANS FOR SUBSTATION SLAB AND RAMPS.

3x165mm RISER STAIRS. REFER TO SHEET C11 FOR TYPICAL DETAILS.

SUBSTATION PAD RL 31.65

IL29.88 300ø 'S' 1.50% IL29.80

IL29.77 300ø 'S' 1.00% IL29.62

IL29.61 300ø 'S' 2.80% IL29.27

200mm KERB ONLY TOWARDS PRAM RAMP.

150mm KERB ONLY

SW360 VORTCAPTURE VC40 OR SIMILAR GPT.

200mm KO WITH BALUSTRADE.

IL29.24 375ø 'S' 1.60% IL29.07

MINIMUM 600MM HIGH FLOOD PROOF WALL ADJACENT TO STAIRCASE & BASEMENT CARPARK RAMP.

BASEMENT RAMP CREST RL 30.15

PROPOSED GRATED INLET STRUCTURE TO CAPTURE MINIMUM 3.06m³/s. 4.5m x 3.5m HEELPROOF GRATE TO FUTURE DETAIL.

CULVERT OBVERT RL 29.16

CULVERT OBVERT RL 28.90

IL29.04 375ø 'S' 1.00% IL29.02

IL29.15 225ø 'S' 1.80% IL29.07

200mm KERB ONLY TOWARDS BASEMENT RAMP CREST.

CONSTRUCT JUNCTION PIT OVER EXISTING 1200mm PIPE.

TWIN 0.9m WIDE x 0.6m HIGH REINFORCED CONCRETE BOX CULVERT @ MIN 1.0% FALL.

REFER TO ARCHITECTS SPECIFICATION FOR PAVING BANDS WITHIN ASPHALTIC CONCRETE PAVEMENT.

CONSTRUCT JUNCTION PIT OVER EXISTING 1200mm PIPE.

RESULTING OVERLAND FLOW 2.0m³/s.

ENERGY DISSIPATER TO FUTURE DESIGN IL 27.90

EXISTING ø1.2M STORMWATER PIPE

EXISTING CONCRETE CRIB RETAINING WALL TO BE DEMOLISHED AND RECONSTRUCTED (RW2). REFER TO SHEET C11 FOR DETAILS.

PROPOSED BUILDING'S DRAINAGE POINT OF CONNECTION (TYPICAL)

OVERLAND FLOW PATH

EXISTING STORMWATER PIPE TO BE REMOVED

IL26.19 225ø 'PVC' 1.20% IL26.02

EXISTING STORMWATER PIPE TO BE REMOVED

IL25.99 225ø 'PVC' 1.50% IL25.89

IL25.86 225ø 'PVC' 1.30% IL25.77

CONSTRUCT NEW CONCRETE BLOCK RETAINING WALL (RW1). REFER TO SHEET C11 FOR DETAILS.

LEVELS TO BE COORDINATED WITH LANDSCAPE ARCHITECT.

IL25.74 225ø 'PVC' 1.20% IL25.63

CONSTRUCT NEW CONCRETE BLOCK RETAINING WALL (RW1). REFER TO SHEET C11 FOR DETAILS.

STAIRS TO LANDSCAPE ARCHITECTS DETAILS.

IL 25.60 300ø 'RCP' MIN 1.0% IL 25.35

EXISTING JUNCTION PIT RL:26.87

EXISTING STORMWATER PIPE TO BE REMOVED

FOR CONTINUATION REFER TO DRAWING No C03

1

2

0 2 4 6 8 10 12 14 16m

1:200 A1 1:400 A3

PRELIMINARY

Rev	Description	Eng	Draft	Date
C	100% DESIGN DOCUMENTATION – REISSUE	WW	PW	06.09.17
B	100% DESIGN DOCUMENTATION	WW	PW	19.06.17
A	ISSUE FOR SSD APLICATION	WW	RG	13.04.17

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Structural Engineer: TTW Taylor Thomson Whitting, 612 9439 7288 | 48 Chandos Street St Leonards NSW 2065

Project: UNSW CLIFFBROOK CAMPUS REDEVELOPMENT, COOGEE

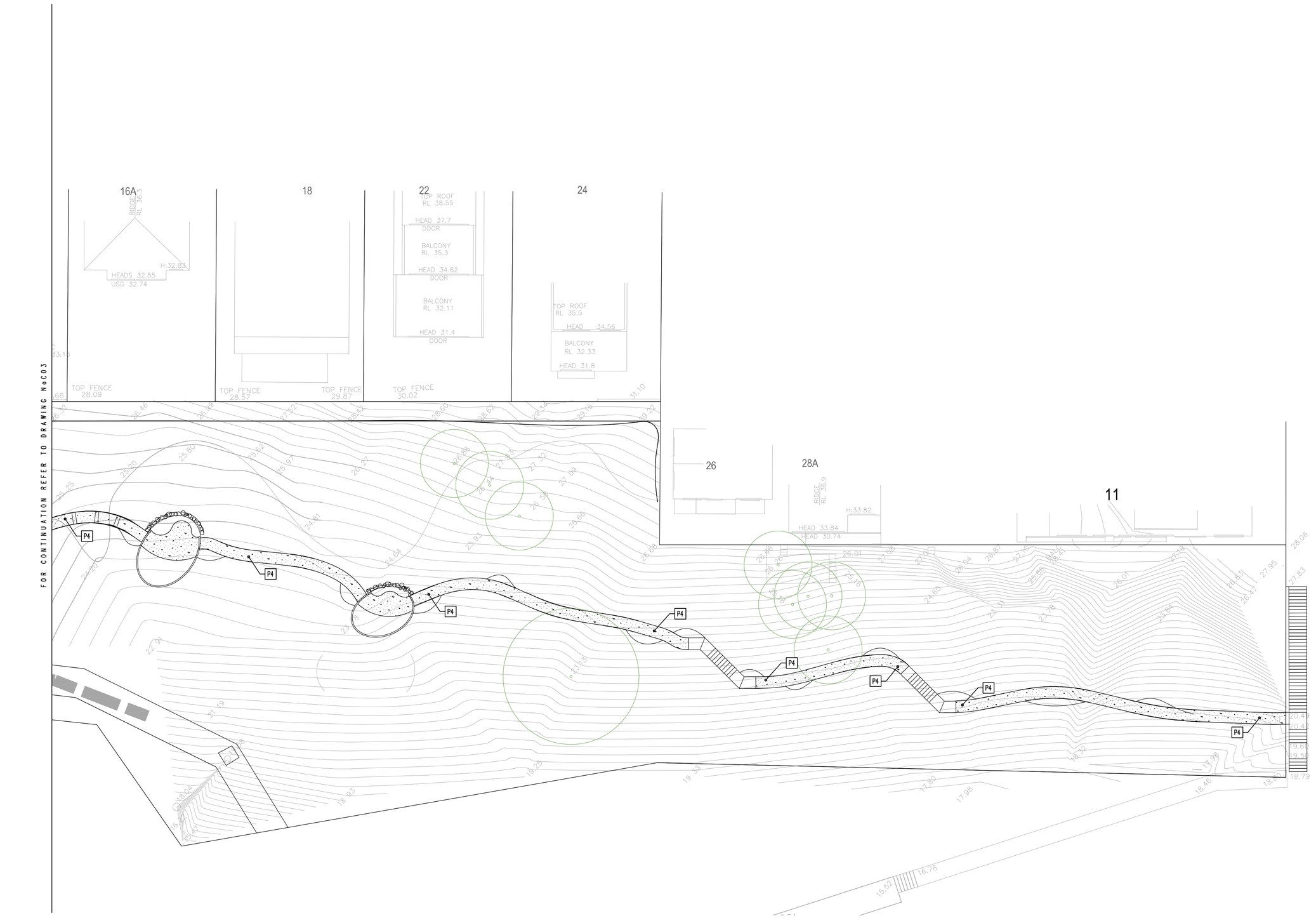
Sheet Subject: STORMWATER MANAGEMENT PLAN

Scale : A1 1:200 | Drawn RG | Authorised PY

Job No 161031 | Drawing No C02 | Revision B

Plot File Created: Sep 06, 2017 - 12:56pm

FileName: C02.dwg - USER: williamw - Plot File Created: Sep 06, 2017 - 12:56pm



PAVEMENT LEGEND

VEHICULAR PAVEMENT

P1

50mm Asphaltic concrete AC10 on
125mm Compacted thickness of fine crushed rock (DGB20) on
compacted subgrade min CBR 20%

PEDESTRIAN PAVEMENT

P2

Pavers to landscape architects specification on
30mm mortar on
100mm thickness concrete (f'c=25MPa) with SL62 with 6m joints cetres on
compacted subgrade

PEDESTRIAN PAVEMENT

P3

Pavers to landscape architects specification on
30mm mortar on
100mm thickness concrete (f'c=25MPa) with SL62 with 6m joints cetres on
compacted subgrade

PEDESTRIAN PAVEMENT

P4

100mm Thickness concrete (f'c=25MPa) with SL62 with 6m centres on
Compacted subgrade

0 2 4 6 8 10 12 14 16m

1:200 A1 1:400 A3

PRELIMINARY

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Rev	Description	Eng	Draft	Date
A	100% DESIGN DOCUMENTATION	WW	PW	19.06.17

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Project
UNSW CLIFFBROOK CAMPUS REDEVELOPMENT, COOGEE

Sheet Subject
SITE WORKS PLAN SHEET 2 OF 2

Scale : A1	Drawn	Authorised
1:200	PW	PY

Job No	Drawing No	Revision
161031	C04	A

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