

20 October 2016

University of New South Wales
Elisabeth Carpenter
C/o Francis-Jones Morehen Thorp Pty Ltd
Via email: ecarpenter@fjmtstudio.com

Additional Contamination Assessment – UNSW Cliffbrook Campus Redevelopment, Battery and Beach Streets Coogee, NSW

Dear Elisabeth,

1. Introduction and Background

JBS&G Australia Pty Ltd (JBS&G) was requested by University of New South Wales (UNSW, the client) via Francis-Jones Morehen Thorp Pty Ltd (FJMT) to undertake an additional contamination assessment at the UNSW Cliffbrook Campus Redevelopment (CCR) site, located on Battery and Beach Streets, Coogee, NSW (the site). The overall UNSW property comprises Lot 1 DP 109530 (the majority) and Lots 1 and 8 DP 8162, 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 (2016¹) 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 previous 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. Previous sampling locations are shown on **Figure 2**.

The scope of the proposed additional assessment work has been developed to assess the areas surrounding the identified contamination to ascertain its extent.

The completed works were developed in general accordance with relevant guidelines made or approved by the NSW Environment Protection Authority (EPA).

2. Objective and Scope of works

The objective of the additional investigation was to assess the areas surrounding the identified asbestos contamination to ascertain its extent.

The scope of work undertaken for this additional assessment comprised:

- Installation and quantification of asbestos in fill for an additional 17 locations;
- Laboratory analysis of representative fill samples from the 17 locations;
- Assessment of field observations and laboratory analysis results with site assessment criteria; and

¹ Preliminary Site Investigation UNSW's JBS&G (2016)

- Preparation of this letter report presenting the findings of the additional assessment activities and providing recommendations on the extent of contaminated material identified at the site.

3. Soil Sampling Methodology

Various strategies for developing a statistically based sampling plan are identified in EPA (1995), including judgmental, random, systematic and stratified sampling patterns.

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

The program included seventeen (17) locations (DHA01 to DHA17) targeting areas where asbestos contamination was identified previously. Sampling locations are shown on **Figure 2**.

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 collect deeper soils samples from 0.5 and 0.3 m into natural soils.

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

Ten litres of the collected soil samples were placed onto contrasting plastic to inspect the soil for visible ACM, and quantify the mass of visible ACM. The type of ACM (i.e. non-friable (bonded) or friable) was noted. A 500 mL soil sample was then collected from each interval, for laboratory analysis consistent with NEPC (2013) National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) requirements.

4. Quality Assurance / Quality Control

An assessment of Quality Assurance / Quality Control (QA/QC) of the works has been undertaken in **Attachment 6**. The results of the field and laboratory QA/QC program indicates that the data obtained from the sampling and analysis can be considered appropriately accurate for the objectives of the assessment. However it should be noted that there is potential heterogeneity of contaminant distributions throughout fill based materials.

5. Results

A table summarising the field and laboratory results is presented in **Attachment 3**. Additionally, the detailed laboratory reports and chain of custody documentation are presented in **Attachment 5**.

Soil analytical data was assessed against EPA endorsed criteria including the National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1), National Environment Protection Council (NEPC 2013), and EPA (2014) Waste Classification Guidelines. For human health considerations, results were compared with NEPC (2013) health-based investigation or screening levels and secondary schools (HIL/HSL-C). These levels have been adopted as most consistent with the ongoing use of the land and given the area of the site where the asbestos has been identified is largely open space that is likely to remain such.

5.1 Observations

Soil sampling was conducted on the 8 October 2016 at the sampling locations shown on **Figure 2** in **Attachment 2**. Bore logs are included in **Appendix 4**.

Within the additional investigation areas, the site surface was encountered to be either grass/garden bed. Fill was encountered to depths ranging between surface to 0.6 m depth. Fill materials typically consisted of grey gravelly or clayey sand with inclusions of gravel, brick, charcoal, concrete, igneous gravels, glass, tile and metal.

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 asbestos was identified in seven of the seventeen location completed. Odours or staining indicative of hydrocarbon or chemical contamination, were not observed in fill or natural materials during field works.

5.2 Asbestos results

The asbestos quantification and laboratory results are summarised as follows:

- The reported concentrations of bonded ACM presence in soil were all 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.

6. Discussion of the results

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. However, the risk of potential exposure to asbestos fibres in soil is limited as the material is currently covered with grass.

If the fill material in this area were exposed through removal of grass and/or excavation, there would be a potential risk of exposure to asbestos fibres released from soil to users of the site.

Removal of asbestos impacted fill would remove potential risks, however as the fill is widespread it may not be feasible or even achievable to remove all potential asbestos impacted material. Such action would pose a short term public risk through disturbance of impacted soils in proximity to residential properties, and considerable management controls would be required during the process.

Consistent with NEPC (2013) guidance, management actions that minimise soil disturbance and therefore public risk, are preferred.

Implementation of a site-specific Asbestos Management Plan would enable appropriate ongoing risk mitigation to protect users of the site and maintenance workers during normal use of the site without disturbing the ground surface, and the plan could include controls for any future works that may involve ground disturbance.

7. Conclusions

Based on the findings of this investigation and subsequent to the limitations in **Attachment 1**, the following conclusions have been 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 is 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.

Should you require clarification, please contact the undersigned on 02 8245 0300 or by email ksharp@jbsg.com.au.

Yours sincerely:



Kate Sharp
Environmental Consultant
JBS&G Australia Pty Ltd

Reviewed/Approved by:



Matthew Bennett
Principal Contaminated land
JBS&G Australia Pty Ltd

Attachments:

- 1) Limitations
- 2) Figures
- 3) Table
- 4) Logs
- 5) QA/QC Assessment
- 6) RPD Table

Attachment 1 – 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.

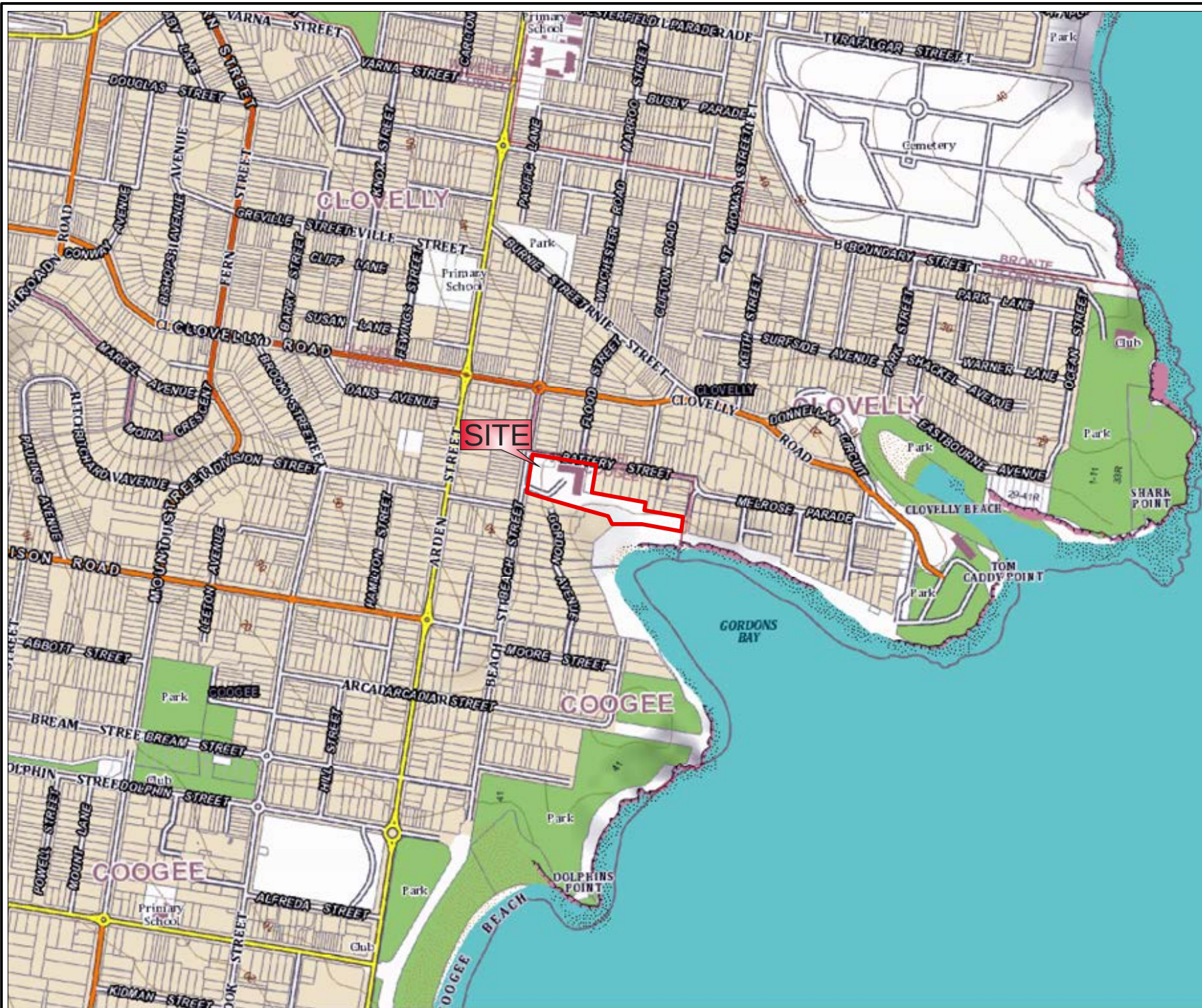
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the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

Attachment 2 – Figures



Legend:

Approximate Site Boundary



Job No: 52166

Client: University of New South Wales

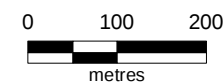
Version: R01 Rev A

Date: 18-Oct-2016

Drawn By: SE

Checked By: KS

Scale 1:8,500

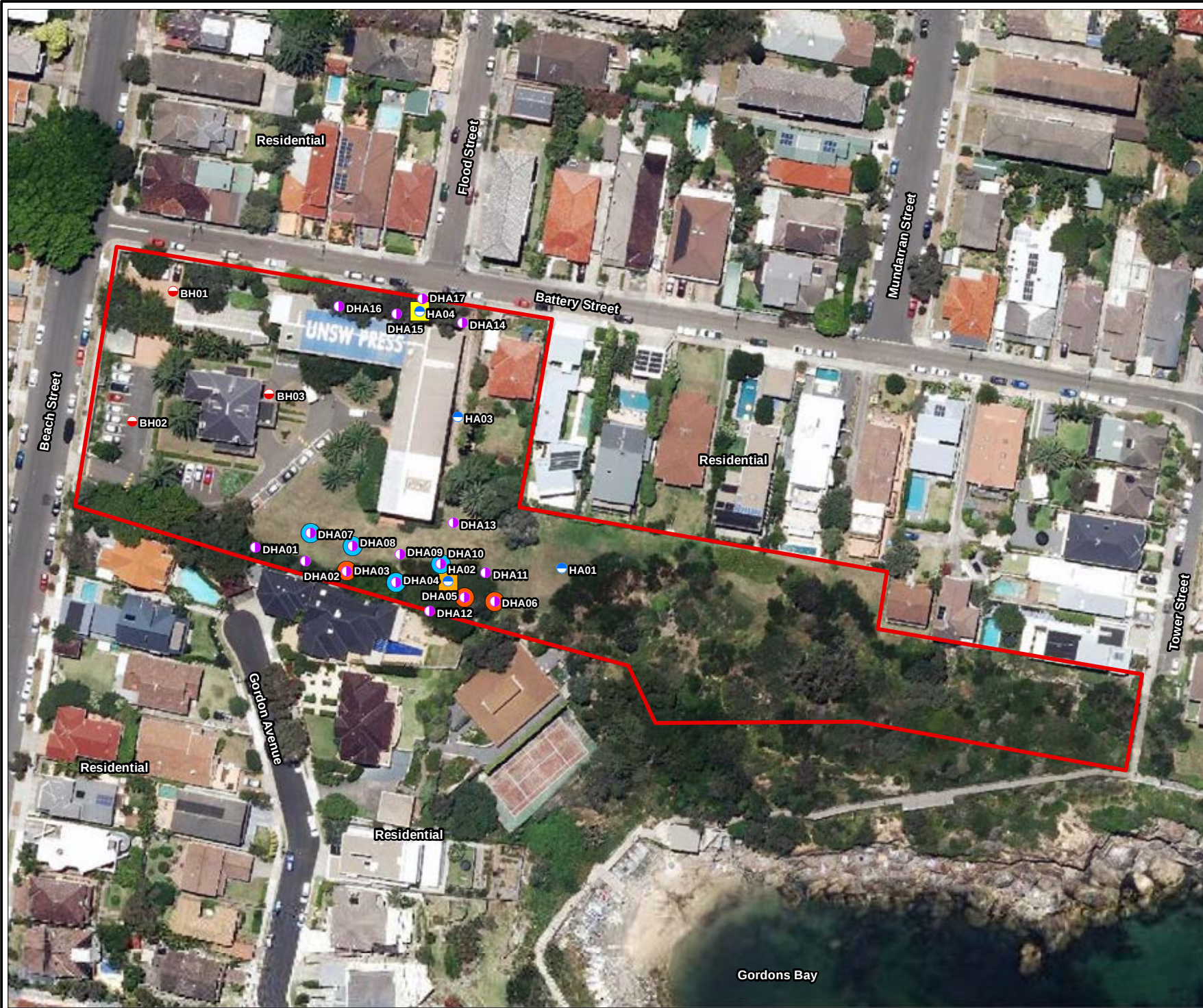


Coor. Sys. GDA 1994 MGA Zone 56

**UNSW Cliffbrook Campus
Coogee, NSW**

SITE LOCATION

FIGURE 1



Legend:

- Approximate Site Boundary
- Hand Auger Location
- Previous Borehole Location
- Previous Hand Auger Location
- Hand Auger Location with ACM Below HIL-C Criteria
- Hand Auger Location with AF Above HIL-C Criteria + ACM
- Previous Hand Auger Location with AF + ACM Below HIL-C Criteria
- Previous Hand Auger Location with AF Below HIL-C Criteria



Job No: 52166

Client: University of New South Wales

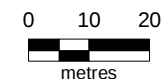
Version: R01 Rev A

Date: 20-Oct-2016

Drawn By: SE

Checked By: KS

Scale 1:1,250



Coor. Sys. GDA 1994 MGA Zone 56

**UNSW Cliffbrook Campus
Coogee, NSW**

SAMPLE LOCATIONS

FIGURE 2

Attachment 3 – Table

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 Description	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

Attachment 4 – Borelogs



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 identified
	0.60			SW	SAND, grey, heterogeneous, dry to damp, coarse grained, angular		
	0.90				Borehole DHA01 terminated at 0.9m		



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				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 identified
	0.5	0.50		SW	SAND, grey, homogeneous, damp, coarse grained, loose		
		0.80			Borehole DHA02 terminated at 0.8m		
	1.0						
	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	DHA03_0.0-0.6	No odours or staining observed 10L Asbestos quantification completed, ACM fragments identified
		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						



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
	0.40			SW	SAND, grey, homogeneous, damp, coarse grained, angular, loose		10L Asbestos quantification completed, ACM fragments identified
	0.70				Borehole DHA04 terminated at 0.7m		



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				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 identified
	0.5						
	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						



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 identified
	0.40			SW	Sand, grey, homogeneous, damp, loose with inclusions of sandstone cobbles		
	0.5						
	0.70				Borehole DHA06 terminated at 0.7m		
	1.0						
	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
	0.20			SW	SAND, grey, homogeneous, coarse with inclusions of sandstone cobbles		10L Asbestos quantification completed, ACM fragments identified
	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 identified
	0.20				Borehole DHA08 terminated at 0.2m		
	0.5						
	1.0						
	1.5						
	2.0						



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 identified
		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 identified
	0.30			SW	SAND, grey, homogeneous, damp, coarse		
	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
	0.20			SW	SAND, grey to brown, homogeneous, damp, loose		10L Asbestos quantification completed, no ACM fragments identified
	0.5				Borehole DHA11 terminated at 0.5m		
	0.50						
	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 identified
	0.40				Borehole DHA12 terminated at 0.4m		
	0.5						
	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
	0.20			SC	Clayey SAND, orange to brown, heterogeneous, damp, loose, coarse to angular grains with inclusions of tile and roots		10L Asbestos quantification completed, no ACM fragments identified
	0.5				Borehole DHA13 terminated at 0.5m		
	0.50						
	1.0						
	1.5						
	2.0						



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 identified
	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
	0.20			SW	SAND, yellow to grey, homogeneous, dry, coarse grained, loose		10L Asbestos quantification completed, no ACM fragments identified
	0.5				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 identified
	0.40			SW	SAND, yellow to grey, homogeneous, dry, coarse grained, loose		
	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
	0.20			SW	SAND, yellow to grey, homogeneous, damp, coarse grained, loose		10L Asbestos quantification completed, no ACM fragments identified
	0.5				Borehole DHA17 terminated at 0.5m		
	1.0						
	1.5						
	2.0						

Attachment 5 - Laboratory Reports and Chain of Custody Documentation

Attachment 6 – Assessment of Quality Assurance/Quality Control

The pre-determined data quality indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness (**Table A6.1**).

- Precision - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- Accuracy - measures the bias in a measurement system. The accuracy of the laboratory data that is 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 represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and 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.

Table A6.1: Summary of Quality Assurance / Quality Control Program

Data Quality Indicators	Frequency	Data Quality Criteria
Precision		
Split duplicates (intra laboratory)	1 / 20 samples	<50% RPD ¹
Blind duplicates (inter laboratory)	1 / 20 samples	<50% RPD ¹
Laboratory Duplicates	1 / 20 samples	<50% RPD ¹
Accuracy		
Surrogate spikes	All organic samples	70-130%
	Phenols	30-130%
Laboratory control samples	1 per lab batch	70-130%
Matrix spikes	1 per lab batch	70-130% (phenols 30-130%)
Representativeness		
Sampling appropriate for media and analytes	All samples	- ²
Samples extracted and analysed within holding times.	-	Soil: organics (14 days), inorganics (6 months)
Laboratory Blanks	1 per lab batch	<LOR
Trip spike	1 per lab batch	70-130% recovery
Storage blank	1 per lab batch	<LOR
Rinsate sample	1 per sampling event/media	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All Samples
Standard analytical methods used for all analyses	All Samples	NATA accreditation
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples ²
Limits of reporting appropriate and consistent	All Samples	All samples ²
Completeness		

Sample description and Chain of Custody (COCs) completed and appropriate	All Samples	All samples ²
Appropriate documentation	All Samples	All samples ²
Satisfactory frequency and result for QC samples		95% compliance
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All samples	LOR<= site assessment criteria

If the RPD between duplicates is greater than the pre-determined data quality indicator, 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.

Lower recoveries may be recorded for some semi-volatile organic analyses particularly including phenols

DQIs have been calculated as per Table A3.1 and are summarised in Table A3.2 and discussed below.

Table A3.2: Data Quality Indicators

Data Quality Indicators	Frequency	Data Quality Criteria
Precision		
Split duplicates (intra laboratory)	1 / 17 samples	Asbestos results match
Blind duplicates (inter laboratory)	1 / 17 samples	Asbestos results match
Laboratory Duplicates	NA	
Accuracy		
Surrogate spikes	NA	
Laboratory control samples		
Matrix spikes		
Representativeness		
Sampling appropriate for media and analytes	All samples	- ²
Samples extracted and analysed within holding times.	-	Soil: 6 months
Laboratory Blanks	NA	
Trip spike		
Storage blank		
Rinsate sample		
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All Samples
Standard analytical methods used for all analyses	All Samples	NATA accreditation
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples ²
Limits of reporting appropriate and consistent	All Samples	All samples ²
Completeness		
Sample description and Chain of Custody (COCs) completed and appropriate	All Samples	All samples ²
Appropriate documentation	All Samples	All samples ²
Satisfactory frequency and result for QC samples		95% compliance
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted site assessment criteria	All samples	LOR<= site assessment criteria

Discussion of QA/QC Results**Precision**

The split and the blind duplicate soil sample was in agreement with the duplicate sample for all analytes. The RPDs for intra-laboratory duplicates as presented in **Attachment 7**.

RepresentativenessSampling appropriate for media and analytes

All sampling works completed during the investigation were conducted in accordance with JBS&G standard operating procedures. Sampling was conducted as described in **Section 3**.

Holding Times

The extraction and analysis of selected samples was completed within the recommended holding times for all selected analytes.

Comparability

An experienced JBS&G field scientist undertook all sampling in accordance with standard JBS&G sampling methods. Field works and sampling were undertaken by the same JBS&G field scientist for each medium type throughout the duration of works.

All field documentation was appropriately completed. The nominated laboratories undertook all analysis in accordance with the relevant National Association of Testing Authorities (NATA) accredited methods.

Completeness

Samples were transported under full COC documentation. The COC documentation was completed correctly and the selected analyses were correctly conducted.

All field documentation was completed appropriately including borehole logs, decontamination sheets, COCs and daily field logs.

The frequency of analysis and result for all QC samples were appropriate.

Assessment of QA/QC

The field sampling and handling procedures across the site produced QA/QC results which indicate that soil data collected is of an acceptable quality.

The NATA certified laboratory results sheets from contracted laboratories indicate that the project laboratory was achieving levels of performance within its recommended control limits during the period when the samples of this program were analysed.

On the basis of the results of the field and laboratory QA/QC program, the soil data is of an acceptable quality upon which to draw conclusions regarding the PSI for the site.

Attachment 7 – RPD Table

Table B: Duplicate and Triplicate RPD

Job #: 52166

Client: Univerity of NSW

Name: Additional Investigation UNSW Cliffbrook



Primary Sample ID	AF/FA Detected	Duplicate ID	AF/FA Detected	Detections in Agreement	Triplicate ID	AF/FA Detected	Detections in Agreement
DHA01_0-0.6	No	QC20161006_1	No	Yes	QC20161006_1/A	No	Yes