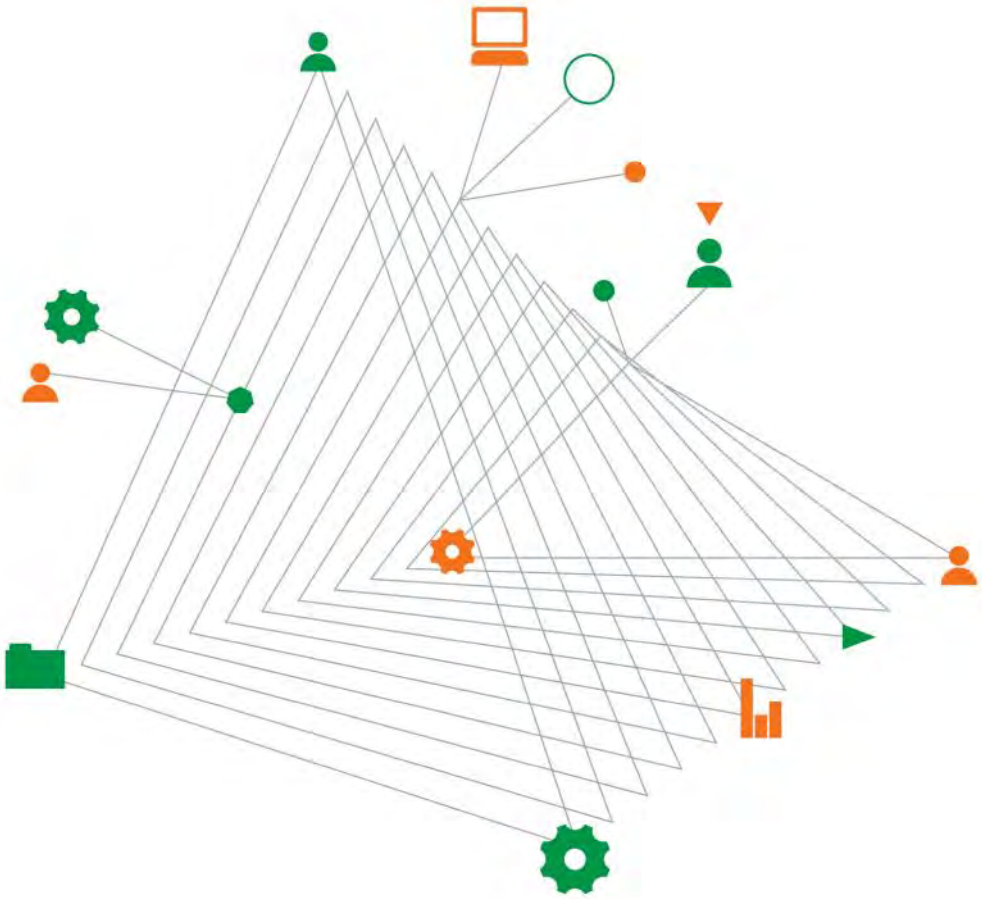
The University of Sydney

Remediation Action Plan

Regiment Mixed Use Redevelopment
Cnr City and Darlington Road, Darlington, NSW

18 February 2017



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Remediation Action Plan

Prepared for
The University of Sydney

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18 February 2017

754-SYDEN201550-R01

Quality information

Revision history

Revision	Description	Date	Author	Reviewer
R01a	Draft Remediation Action Plan	17/2/2017	Colee Quayle	Manuel Fernandez
R01	Final Remediation Action Plan	18/2/2018	Colee Quayle	N/A

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Draft	1	pdf	The University of Sydney	17/2/2017
Final	1	pdf	The University of Sydney	18/2/2017

Executive summary

The University of Sydney's (USYD) Campus Infrastructure and Services (CIS) has recently received approval from the Department of Planning to undertake the Campus Improvement Programme (CIP) at its Darlington Campus, located on corner of City and Darlington Roads, Darlington, NSW (the 'site').

The CIP includes changes to infrastructure, redevelopments and refurbishments of facilities within the USYD including accommodation precincts, the promotion of key gateways into the University, the location of principle service hubs and a transport access strategy.

As part of the planning process, Coffey completed a geotechnical investigation and a Phase 1 and 2 Contamination Assessment. The contamination assessment identified asbestos (friable) and lead contamination within soils at two areas of the site, which require further assessment and remediation. The contamination was associated with weathering of hazardous building materials from nearby structures. Benzo(a)pyrene reported concentrations exceeding ecological screening levels indicating potential unacceptable risk posed to ecological receptors. The source of the benzo(a)pyrene was potentially associated with asphalt pavement (but not confirmed).

In summary, the preferred remedial option will comprise:

- Additional investigation to assess the extent of potentially contaminated areas, along with pre-validation and in situ waste classified. Once the extent of contamination is known, it will then be excavated and disposed offsite to a licenced waste facility. The excavation will be checked by an environmental consultant / licensed asbestos assessor.
- The remedial excavations will be visually checked to confirm the excavation extended to the pre-validated extent and that subsurface conditions are consistent with those encountered during the additional investigation/pre-validation phase. Additional validation samples may be collected from the walls and base of the excavations should new conditions be encountered or if managing an unexpected find is required. If assessment criteria are met, then construction can continue.
- A validation report will be written with reference to NEPM (2013). The report will detail site activities, validation results, waste tracking, imported material dockets and figures showing remediation areas, and make a clear statement of suitability with respect to remediation goals.

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Abbreviations

ACM	Asbestos Containing Material
AHD	Australian Height Datum
AMP	Asbestos Management Plan
C6-C36	Hydrocarbon chainlength fraction
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
COPC	Chemical of potential concern
DQO	Data Quality Objective
DQI	Data Quality Indicator
EIL	Ecological Investigation Levels
ESL	Ecological Screening Levels
HIL	Health Investigation Level
HSL	Health Screening Level
LOR	Limit of Reporting
mg/kg	milligrams per kilogram
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPM	National Environment Protection (Assessment of Site Contamination) Measure
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionisation Detector
ppm	parts per million
QA / QC	Quality Assurance / Quality Control
RAP	Remedial Action Plan
RPD	Relative Percent Difference
SAS	Site Auditor Statement
SOP	Standard Operating Procedures
TPH / TRH	Total Petroleum Hydrocarbon / Total Recoverable Hydrocarbons
UFP	Unexpected Finds Procedure
VENM	Virgin Excavated Natural Material
VOC	Volatile Organic Compound

1. Introduction

The University of Sydney's (USYD) Campus Infrastructure and Services (CIS) has recently received approval from the Department of Planning to undertake the Campus Improvement Programme (CIP) at its Darlington Campus, located on the corner City and Darlington Roads, Darlington, NSW (the 'site'). The site is shown on Figures 1 and 2.

The CIP includes changes to infrastructure, redevelopments and refurbishments of facilities within the USYD including accommodation precincts, the promotion of key gateways into the University, the location of principle service hubs and a transport access strategy. The development details are further discussed in Section 3.

As part of the planning process, Coffey completed a geotechnical investigation and a Phase 1 and 2 Contamination Assessment. The contamination assessment identified asbestos (friable) and lead contamination within soils at two areas of the site, which require further assessment and remediation. The contamination was associated with weathering of hazardous building materials from nearby structures. Benzo(a)pyrene reported concentrations exceeding ecological screening levels indicating potential unacceptable risk posed to ecological receptors. The source of the benzo(a)pyrene was potentially associated with asphalt pavement (but not confirmed). It is noted that since the investigation phase, the site boundary has changed and is now smaller.

To progress the development, USYD engaged Coffey to assist with preparation of necessary planning documents to appropriately manage contamination and unexpected occurrences of contamination during construction. The planning documents required for this site include:

- Remediation Action Plan (RAP);
- Unexpected Finds Procedure (UFP);
- Asbestos Management Plan (AMP).

The UFP has been included in Appendix A of this RAP for convenience. However, this can be removed and used independently of the RAP, as required. It is recommended that an AMP is prepared once the nature of asbestos contamination is understood and prior to remediation. It is understood that a hazardous building material survey has already been undertaken on site structures. In addition to these documents an Asbestos Removal Control Plan is required but this is prepared by the Class A licensed asbestos removal contractor.

Because the extent of identified contamination requires further assessment, this document is a RAP and will require revision following additional investigation outcomes.

It is understood that a Site Auditor Statement (SAS) is required to satisfy relevant development consent conditions. It is recommended that the Site Auditor is appointed early in the process and prior to any further investigation or remediation works are undertaken at the site.

This RAP does not provide guidance for demolition of site structures.

2. Objectives and scope of the RAP

The objective of the RAP is to identify appropriate measures by which the site contamination can be remediated and/or adequately managed (including appropriate validation) so that there is a low likelihood of contamination being a risk to human health or the environment and the site is suitable for the proposed industrial land use development, in accordance with guidelines endorsed by NSW EPA.

The RAP aims to:

- Set the remediation goals;
- Review the available remedial options;
- Select the preferred remedial option;
- Outline the procedures and activities associated with implementation of the preferred remediation option;
- Outline the requirements for the contractor to prepare environmental and occupational health and safety plans for the remediation;
- Outline the requirements for a contingency plan to be prepared for the remediation;
- Outline the regulatory compliance requirements for the remedial works;
- Provide details of contacts for the period of remediation works; and
- Provide a framework for the environmental management plan for the site during remediation.

This plan addresses the following:

- Further assessment of identified contamination to better assess the extent of remediation areas;
- Remediation and management of contaminated soil arising from the historical use of the site;
- Preliminary asbestos management protocols (this is to be supplemented with an AMP);
- Appropriate unexpected finds procedures;
- Validation of the remediated areas; and
- Health and safety and site control during remediation.

3. Proposed development and land use

The proposed development is outlined by the red boundary and shown in Figure A below. The University proposes to redevelop the site as part of the CIP by demolishing the existing buildings or part thereof and constructing student accommodation. The proposed redevelopment will include:

- Demolition of the existing Regiment Building (H01) structure and the Darlington Centre (H02), excluding the heritage-listed brick wall which is to be retained.
- Construction of an eight storey building with a one level basement to about RL39.3. The southeastern part of the basement will be used as a loading area, bike storage area. The northeastern portion of the basement will be used for associated laundry and toilet facilities.
- Works to the heritage wall within the site and on Darlington Road; and
- Associated architectural design and heritage works.

Outside of the building footprint there will be a combination of landscape areas and pavements. The landscaped areas appear to include improvements to existing landscaping along with new areas.

The proposed site layout plan following development is shown in Appendix B.

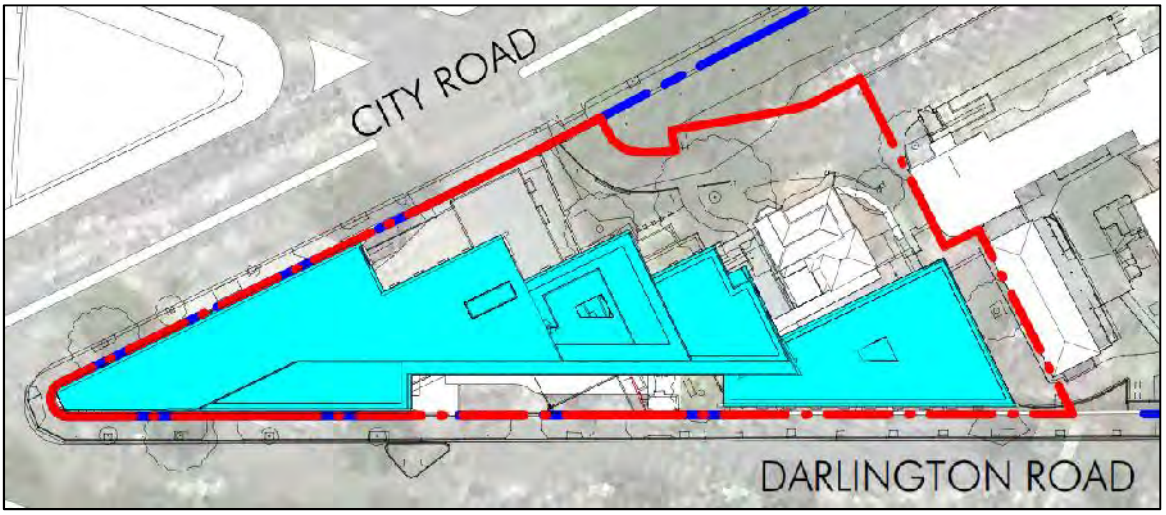


Figure A: Site Layout Plan Showing Proposed Development Area and Building Footprint in Aqua

4. Summary of site details and previous investigations

4.1. General

We reviewed the following available environmental reports for this site:

- Coffey Geotechnics Pty Ltd (2015) Stage 1 Contamination Assessment, The Campus Improvement Program: The Regiment Student Accommodation Project, The University of Sydney (Ref: GEOTLCOV25409AA-AC v2, dated 11 December 2016); and
- Coffey Geotechnics Pty Ltd (2016) Stage 2 Contamination Investigation, The Campus Improvement Program: Regiment Student Accommodation Project, The University of Sydney, Darlington (Ref: GEOTLCOV25409AA-AE Rev 2, dated 15 December 2016).

4.2. Site identification

Site identification details and surrounding land uses are summarised in **Table 1**. The site layout and surrounding areas are shown on Figures 1 and 2.

Table 1: Site Identification Details

Address:	96 to 148 City Road, Darlington
Site title identification:	Part of Lot 1 in DP 790620
Area:	Approximately 5,500m^2
Dimensions:	The site is generally triangular in shape with the apex at the corner of City and Darlington Road intersection. Southern side of the site approximately 180m. Northwestern side approximately 130m. The northernmost section of the site runs in a south-eastern direction for approximately 50m then northeasterly for approximately 30m, then back in a southeasterly direction for around 50m.
Local government area:	City of Sydney
Current Zoning:	Zone SP2 Infrastructure under the Sydney Local Environmental Plan 2012
Current land use:	Two to three storey buildings used for a mixture of commercial and educational uses.
Future land use:	High density residential – student accommodation
Adjoining land uses:	• **North/northwest:** City Road with USYD Camperdown Campus precinct and residential land use beyond. • **East:** 3 level Institute Building (H03) (excluding the Western Wing) and other buildings occupied by the Business School with Butlin Avenue beyond. • **South:** Darlington Road with other buildings within the USYD Darlington Campus and residential land use beyond. • **West:** City Road, then residential properties, Newtown North Primary School and other buildings within the USYD Darlington Campus beyond.
Site coordinates:	33°53’29.17"S 151°11’19.65"E (based on the central location of the site. Source: Google Earth)

4.3. Topography, drainage, geology and hydrogeology

Table 2 summarises topography, drainage, geology and hydrogeology associated with the site.

Table 2: Topography, drainage, geology and hydrogeology

Elevation:	Review of the elevation profile (Google Earth, 2015) indicates that the site lies at elevations between approximately 43m and 45m Australian Height Datum (AHD)
General slope direction:	Slopes gently down towards the north east and south.
Closest surface water body:	The closest surface water body is Lake Northam, located within Victoria Park, approximately 800m north east of the site. Another surface water body named Orphan School Creek and associated stormwater channel are located approximately 900m north west of site.
Drainage:	It is expected that site surface water would either percolate into sub-surface soils (where permeability allows) or enter the stormwater drainage services via off-site kerbside drains along City Road and Darlington Road.
Regional geology:	The site is underlain by Middle Triassic Bringelly shale and Ashfield shale, including Minchinbury sandstone (Wianamatta Group). Bringelly shale comprises of shale, carbonaceous claystone, laminate, fine to medium grained lithic sandstone and rare coal. Ashfield shale is made up of black to dark grey shale and laminite and Minchinbury sandstone is fine to medium grained lithic sandstone.
Site specific soil and rock:	• **Fill:** Materials typically comprised a Sandy Gravel pavement subgrade over orange brown to pale grey, medium to high plasticity, stiff to very stiff gravelly Clay or Clay or silty Clay to depths between 0.55m and 1.1m. Foreign materials including brick fragments and geofabric were observed at some locations. A concrete subslab was encountered at BH04 at 1m bgs. • **Residual:** Typically comprised high plasticity, grey mottled red brown, very stiff to hard Clay to medium to high plasticity, orange brown to red brown to dark brown to pale grey silty Clay, with some gravel. • **Bedrock:** Encountered in boreholes at depths of 1.1m bgs to 5.6m bgs and comprised extremely to highly weathered, pale grey mottled red brown, yellow brown Shale underlain by grey, dark grey, red brown, orange brown distinctly laminated Siltstone
Groundwater bores:	One groundwater bore was registered within 500m of the site. The bore is located approximately 120m to the west of the site, within the Moore Theological College, and is registered for domestic use. The bore was installed to a final depth of 210m below ground surface (bgs) and recorded a standing water level of 31m bgs.
Depth to groundwater:	Three groundwater monitoring wells (MW01 to MW03) were installed onsite in 2015. Standing water levels on December 2015 were measured between 3.89m and 5.28m bgs. Groundwater elevation ranged between 35.52m and 38.71m AHD.
Inferred groundwater flow direction:	Based on groundwater elevation measured at onsite wells, groundwater was assessed to flow in an easterly direction. Groundwater flow contours and direction are shown in Figure 3.

4.4. Results of desktop study

A review of the historical uses of the site is presented within the Stage 1 Contamination Assessment (Coffey, Dec 2016; Ref: GEOTLCOV25409AA-ACv2). The information has been summarised below:

- The Institute Building (H03), including its separate auxiliary structures i.e. The Western Wing of the Institute Building (H03) on site appears to be present from as far as potentially 1885. Historic parish maps and aerial photographs indicate that this building has remained on site and to the east of the site since that time, in a relatively unaltered configuration. The use of the site appears to be a Deaf and Dumb and Blind Asylum at that time.
- Land surrounding the site prior to and during 1930 appeared to be used predominantly for residential uses (terrace housing) with an oval and some larger buildings (possibly university residential uses) noted to the north (i.e. where the St. Pauls College Oval and the current St. Pauls College within the USYD Camperdown campus was established) and the University Reserve to the north west. Land to the south appeared to be occupied by the former Eveleigh carriage works and locomotive workshops (railway workshops) and the main Sydney Trains railway line running from Redfern to Macdonaldtown and Erskineville stations. A creek known as Blackwattle Swamp Creek was also formerly located to the south of the site.
- Land within the site and surrounding the site underwent some changes during the period between 1930 and 1950. The Superintendent's Residence structure was established at the central eastern estimated boundary of the site and potentially the heritage wall which is presently located between the Regiment Building (H01) and the Darlington Centre (H02) in c.1943. The part of land to the north of the site was developed further, with several buildings, during this period, which is currently the USYD Camperdown Campus.
- From early to mid-1960's onwards, a number of buildings and structures within and around the site had been demolished including one small building or structure that had been located on the western-most corner of the site, some of the elongated structures present south west of The Superintendent's Residence and a circular garden type of structure that had previously been located adjacent south east of the current Institute Building (H03). One large building shaped in three distinct parts had been built within much of the western part of the site, taking the shape of the current Sydney University Regiment Building (H01). The Superintendent's Residence and the Institute Building (H03), including the Western Wing building remained within the central eastern and eastern estimated site boundary and to the east of the site. A large building was built further east of the site and some residential buildings demolished to the east. New buildings were erected further north of the site and most likely associated with the University.
- Between 1970 and 2000, several additional buildings were established within the surrounding land by demolishing mostly terrace style residential buildings to the east, south east and south of the site. The new buildings are most likely associated with the University. Minor changes of structures had taken place around The Superintendent's Residence within the site during this period. Landscaping, driveways and car parking areas were well defined within the site and surrounding area east of the imaginary eastern boundary.
- Around early 2000's, a new large building had been built within the southern central part of the site, adjacent south of The Superintendent's Residence. This new building is the current restaurant and bar and conference rooms ground floor building within the Darlington Centre (H02) present on site. The Superintendent's Residence also forms part of the current The Darlington Centre (H02) on site. A small structure was established within the building complex to the north east of the site around this time as well.

Some buildings within land to the southeast of the site within the present day USYD's Darlington campus were demolished prior to 2014 and the land potentially redeveloped.

Table 3: Areas of Environmental Concern and Contaminants of Potential Concern

AEC	Potential Contaminating Activity	Potential Area of impact	COPC	Likelihood of Impact*	Media	Comments
1	Fill of Unknown Origin and Quality	Entire site	Heavy metals, PAH,TRH & BTEX, OCP, PCB and Asbestos	Low to moderate	Soil & ground water	The origin of fill within the site is unknown and may contain a broad range of chemicals of potential concern (COPCs). Fill materials in this area of Sydney may have had industrial origin, particularly given proximity to the former railway workshops. However, Coffey have not observed that the site would contain significant quantities of fill and therefore fill may be limited to minor quantities used as levelling or base course for building slabs or pavements.
2	Pesticides/ herbicides residue	Surrounding buildings and pavement edges	PAH,TRH & BTEX, OCP	Low to moderate	Soil	Residues associated with the historic use of pesticides/herbicides on site.
3	Lead paint or asbestos discharge from buildings	Surrounding buildings	Heavy metals & asbestos	Low to moderate	Soil	Lead paint or asbestos discharge from weathered materials in current or former site structures.
4	Aerial deposition from historical Railway workshops	Entire site	Heavy metals & PAH	Low	Soil	Aerial deposition of contaminants associated with the former railway workshops and railway, located approximately 300m south of the site.

Notes:

TRH: Total Recoverable Hydrocarbon

OCP: Organochlorine Pesticides

PAH: Polycyclic Aromatic Hydrocarbon

Heavy metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc

ACM: Asbestos Containing Material, also commonly referred to as fibro or bonded asbestos

4.5. Results of subsurface investigation

Targeted soil sampling was used to assess AECs at a preliminary level for this site. A schematic cross section was developed and included in Figure 4. The key findings of the assessment are summarised below:

- **Asbestos:**
  - Amosite asbestos was detected as loose fibre bundles in sample BH01_0.05-0.2m via laboratory analysis.
  - BH01 is adjacent to the Regiment Building (H01) in which asbestos has been observed during previous asbestos risk assessment studies conducted on site (refer to section 4.1). It is assessed that the asbestos fines identified in the surface sample at BH01 location is likely to be attributable to the weathering of building materials within the Regiment Building (H01) that contains asbestos.
- **Lead:**
  - Lead impacted material was reported in shallow soils in one of the sample locations (SS01). The elevated levels of lead in the soils are considered likely to be attributed to the weathering and subsequent deposition of lead based paint residues from the Darlington Centre (H02) on site. The reported concentrations of lead in soil exceed the residential and commercial/industrial health criteria indicating these materials pose potential risks to future occupants of the site and workers involved in the construction of the proposed development.
- **PAH and TRH:**
  - Concentrations of benzo(a)pyrene TEQ of 4.9mg/kg exceeding HIL B (human health residential) were reported at sample locations BH03/0.05-0. The samples represented shallow fill material within the central and eastern parts of the site.
  - Benzo(a)pyrene also exceeded ecological screening levels (ESL) for residential/open space land use. The laboratory reported concentrations ranging between 1.4mg/kg and 3.4mg/kg within shallow fill materials at locations BH02, BH03 and BH04.
  - Samples collected from deeper fill materials and residual soils reported significantly lower concentrations of these constituents. For these samples, it is noted that the ratio of Benzo(a)pyrene to Total PAH ranged between 12% and 16%. Given the absence of other volatile PAH compounds, suggests that the likely source of PAH detected in these samples possibly small fragments of asphalt mixed with shallow fill rather than another source of hydrocarbon (e.g. oil, diesel fuel etc.).

Analysis of groundwater samples collected from three wells installed on site did not report concentrations above the adopted Groundwater HSL for Vapour intrusion. Elevated heavy metals and TRH concentrations were reported and exceeded adopted ecological trigger values. The source of TRH was unknown and the heavy metals are likely to be from diffuse sources representative of the urbanised environment.

The report concluded that the presence of Asbestos, Lead and PAH compound Benzo(a)pyrene TEQ within shallow soils require further consideration during site redevelopment. The report recommended a RAP and UFP be prepared to facilitate remediation of impacted areas.

Based on the above information, in light of the proposed development the above contamination sources could pose a risk to workers during development, future users or future maintenance workers (through direct contact, ingestion and/or inhalation).

5. Optimisation of remediation

The Phase 2 Contamination Assessment was preliminary due to access constraints posed by existing structures. Additionally, it was outside the scope of the Phase 2 Contamination Assessment to assess the extent of contamination identified. Therefore, prior to the remediation phase, it is considered prudent to further assess areas where contamination has been identified and undertaking sampling and analysis within previously inaccessible areas to satisfy at a minimum the NSW EPA (1995) Sampling Design Guidelines. Additional investigation should be undertaken following removal of pavements and demolition of relevant buildings but prior to the remediation phase.

The additional investigations will also provide information concerning waste classification of materials requiring removal offsite, in particular natural soils. For natural soils to satisfy the definition of Virgin Excavated Natural Material (VENM), they must not have been exposed to contaminants. In situ waste classification undertaken prior to remediation activities will allow excavated material to be loaded directly into waiting trucks and reducing double handling costs.

Resource Recovery Exemption – Excavated Natural Material (ENM) Exemption (2014) assessment criteria was compared to laboratory results from the Phase 2 Contamination Assessment. Based on this comparison, it is considered that there is a low likelihood that fill material would meet the ENM Exemption requirements based on account of lead and benzo(a)pyrene. Therefore, a resource recovery assessment is not recommended. A copy of the ENM Exemption has been included in Appendix C for reference.

Once the extents of impacted areas are assessed, the extents will be surveyed so that a clear remediation area is defined and allow efficient removal to be undertaken.

Five areas of the site have been identified as requiring further investigation and discussed in Table 4. A remediation area will be based on the results of this additional investigation phase.

Sampling methodologies and validation procedures required for remediation of contaminated soils will be applied to additional investigation processes. These methodologies and procedures are discussed in Sections 8 and 9.

Table 4: Additional investigation areas

Area	Description	Proposed sampling plan	Analysis
SS01, Building H02	Hazardous building material survey indicated lead based paint has been in Building H02. Therefore, it is likely that similar lead concentrations will exist within near surface soils surrounding this entire building. Typically impacted soils will extend about 2m from the building to depths between 0.3m and 0.5m, depending on the soil type. The Superintendence residence will be retained and the ground surface surrounding the western portion of Building H02 may be retained. Therefore, the extent of lead contamination will need to be further assessed in these areas. Based on the age of Building H01, lead based paint may also have used. However, these buildings will be demolished and excavated soil will be disposed offsite. Because lead pre-classifies as General Solid Waste, no further investigation is required in areas to be excavated as part of development.	The sampling will include assessing the depth at SS01 where lead contamination was previously identified then positioning samples that step out from SS01 to assess the horizontal extent. Additional sampling will also take place along the western side of Building H02 and the Residence. The proposed sampling plan is as follows: • SS01: ▪ samples will be collected at the same location as SS01 but at depth targeting soils between 0.3m and 0.5m to assess the vertical extent ▪ Stepping out from SS01 in northeasterly direction by about 2m. Samples will be collected at the near surface and at depth between 0.3m and 0.5m. • Western side of Building H02 and Residence: ▪ Samples will be collected every 10m along the western edge of these structures. Samples will be collected adjacent to the structure then 2m step out from the structure. Samples will be collected at the near surface and at depth between 0.3m and 0.5m. ▪ Surface samples will be analysed first and based on results step-out and samples collected at depth with then be analysed.	Lead
BH01	ACM was identified as materials used in Building H01 and may have been the source of asbestos fibre bundles at this location. Site history information also indicated that another building c. 1951 was located at the southwestern apex of the site. Given the age of this building, it is likely to have also contained asbestos and possibly lead based paints. Lead has not been previously assessed within this area of the site. Because this area of the site will be excavated to accommodate the basement, it is proposed that the further investigation attempts to assess the extent of asbestos impacted material from a waste classification perspective.	To further assess the extent of asbestos impacted soils, soil samples will be collected on an approximate 10m x 10m grid. At this stage, the grid will extend to the southwestern tip of the site which was previously occupied by a structure, then extend northwest by approximately 20m. The proposed sampling area may extend following demolition of Building H01.	Asbestos Lead
BH02 to BH04	Benzo(a)pyrene TEQ and benzo(a)exceeding HSL and ESL criterion. The source of the PAH was potentially associated with asphalt fragments that may have been present in the samples (but cannot be confirmed). If asphalt is found to be the source of benzo(a)pyrene then it is not considered to pose and unacceptable risk to human health and the environment.	Identify the location of BH02 to BH04 and re-sample soils from these locations. The primary purpose of this is to assess the waste classification of soils with respect to benzo(a)pyrene within the proposed excavation area and at BH03 further assess the source and risk benzo(a)pyrene will pose to ecological receptors, as BH03 will be in an area retained for landscaping purposes. The proposed sampling plan includes: • One sample per location (3 samples) will be selected for PAH analysis at BH02 to BH04 targeting soils in the upper 0.3m of the soil profile. Based on those results, leachability (Toxicity Characteristic Leaching Procedure (TCLP)) testing the waste classification will be reassessed. • At location BH03, three step out samples will be collected (north, west, east of BH03) and also at depth between 0.3m and 0.5m to assess the potential source of PAHs. At these 6 samples will be considered for laboratory analysis.	PAH
Entire site	Additional investigation is required to satisfy the NSW EPA (1995) Sampling Design Guidelines and provide adequate assessment of the identified AEC's. The guidelines recommend 14 sampling locations to assess of site that occupies an area of 5,500m^2. The previous investigation used 5 sampling locations to assess the site at a preliminary level. Areas beneath building footprints and other previously inaccessible areas have not been assessed. This assessment should be undertaken following demolition of Buildings H01 and H02. Information from this assessment will be used to waste classify materials and assess VENM.	At this stage, samples will be collected from 9 test pit locations where samples will target fill materials and natural soils. The test pits will extend to approximately 0.5m into natural.	TRH, BTEX, PAH, heavy metals, OCP, asbestos

6. Remediation plan

This concept remediation plan assumes the following outcomes from the additional investigations:

- Asbestos impacted soils are located in a proposed basement area and will be disposed offsite. Asbestos will require appropriate management to ensure it is safely removed and disposed to an appropriately licenced was facility.
- Lead contamination is identified in soils surrounding the perimeter of the Residence building and western side of Building H02.
- PAH exceedences are found to be associated with asphalt and no longer considered to pose an unacceptable risk to ecological receptors. Benzo(a)pyrene within the excavation area meets General Solid Waste criteria.

6.1. Remediation goals

The broad remediation goal is to remediate/manage the contamination at the site to a level where there is a low risk of adverse impact to human health or the environment and the site is made suitable for the proposed high density residential land use in accordance with relevant legislation and guidelines, taking into consideration the protection of the broader community and environment.

6.2. Remediation options

6.2.1. Remediation hierarchy

DEC, 2006 provides a preferred hierarchy of options for site clean-up and/or management, which was originally developed in ANZECC and NHMRC (1992). The hierarchy is outlined as follows:

- Onsite treatment of the contamination so that is it destroyed and the associated risk is reduced to an acceptable level;
- Offsite treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which the soil is returned to the site.

If the above is not practicable:

- Removal of contaminated material to an approved facility, followed, where necessary, by replacement with appropriate material;
- Consolidation and isolation of the soil on site by containment with a properly designed barrier.

Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy can be considered.

6.2.2. Preferred of remediation option

The contamination identified at the site is potentially friable asbestos, lead and possibly benzo(a)pyrene, which appear to be associated with a point source (e.g. weathering of hazardous building materials from former/existing structures and asphalt). The extent of contamination is undefined but expected to be in the vicinity of these point sources. Based on the type of contamination and the proposed development, which includes a basement, and discussions with University of Sydney, excavation and offsite disposal of impacted areas, has been adopted as the preferred remediation option.

University of Sydney also preferred where possible to pre-validate remedial excavation extents to improve more efficiency of the remediation process in both time and cost.

This method involves the excavation of the identified areas of contaminated material requiring remediation and disposal of the excavated material offsite to an appropriate landfill licensed by NSW EPA. Prior to offsite disposal, excavated contaminated soil requires waste classification where the results of samples collected from the material are compared to the NSW EPA (2014) Waste Classification Guidelines. As discussed in Section 5, waste classification can also be undertaken prior to commencing remediation activities.

Based on Coffey's understanding of the proposed development, relatively small volumes of imported material is required. It is expected that engineered fill for pavements and growing medium for landscaping areas will be the main materials imported to the site.

If site levels need to be restored following the offsite disposal of contaminated soil, suitable fill which has been adequately validated (refer to Section 9.3.1 - such as Virgin Excavated Natural Material (VENM)) may need to be imported to the site.

It is noted that due to the presence of asbestos, the relevant requirements/provisions of the Protection of the Environment Operations (Waste) regulation 2005, Workplace Health and Safety Act 2011 and SafeWork Codes of Practice apply.

7. Proposed remediation activities

The following sections outline the remediation work that will be required within the site based on currently available information provided by University of Sydney, from previous investigations and assumed outcomes of the additional investigations outlined in Section 5.

The standard environmental control and mitigation measures required for similar construction works would still need to be in place for the remediation work, including those described in the development consent conditions. Information on controls and mitigation measures are further discussed in Section 10.

Unless otherwise identified, activities discussed below will be the responsibility of the contractor or its representative.

7.1. Remediation activities

The proposed sequence for remediation activities is as follows:

1. Planning documents and asbestos licensing;
2. Notifications to regulatory authorities;
3. Site establishment;
4. Demolition of existing site structures and hazardous building material clearance;
5. Pre-validation sampling of site to optimise remediation;
6. Remediation and management of contaminated areas;
7. Waste classification and offsite disposal;
8. Preparation of validation report (Refer to Section 9.5).

These are discussed further in the following subsections below and Section 9.

7.2. Planning documents and asbestos licensing

It is understood that University of Sydney or Richard Crookes Construction will prepare a construction and environmental management plan (CEMP) which will provide control measures to managing safety and environmental aspects associated with the overall construction project. The CEMP will need to make reference to safety and environmental control measures associated with remediation.

Because the excavation involves the removal and offsite disposal of potentially friable asbestos impacted soils, a Class A licensed asbestos removal contractor will need to be engaged to manage onsite safety of workers.

A suitably qualified consultant is responsible to:

- Prepare of an Asbestos Management Plan (AMP);
- Guide remediation excavation and provide a clearance certificate following effective removal of asbestos impacted soils.

The Class A contractor is responsible for:

- Preparation of an Asbestos Removal Control Plan (based on AMP requirements);
- Lodging a “Friable Works Permit” with SafeWork NSW (formerly NSW WorkCover) (refer to Section 7.3.2);
- Supervision of all asbestos removal work.

A Class A asbestos removal contractor is only required to supervise works when the asbestos impacted material that is deemed friable will be removed from site. If the asbestos is deemed bonded (e.g. within the building) or with further quantitative assessment asbestos fibres in soil does not exceed friable asbestos criterion, a Class A removalist and asbestos assessor will not be required.

7.3. Notifications to regulatory authorities

The follow sections describe relevant notifications under NSW regulations.

7.3.1. Notification to regulatory authority

State Environmental Planning Policy No 55 - Remediation of Land under the Environmental Planning and Assessment Act 1979 (EP&A Act) applies to works involving remediation or management of contaminated land in NSW. Remediation can be Category 1 requiring consent of the relevant planning authority or Category 2 not requiring consent.

It is understood that the RAP forms part of documentation to be submitted as part of the State Significant Development Application (SSDA) and lodged with the Department of Planning and Environment.

7.3.2. Notification to SafeWork NSW

Friable – notification to SafeWork NSW IS required

Free asbestos fibres in soil were identified. Asbestos removal works undertaken in this area must be supervised by a Class A licensed asbestos removalist. The Class A asbestos removalist must notify WorkCover 7 days prior to removal works being undertaken.

Bonded – notification to SafeWork NOT required

Bonded asbestos is likely to exist in buildings, which can be removed by a Class B licensed asbestos removalist if greater than 10m^2. SafeWork NSW does not require notification for Class B asbestos removal works. If degraded fragments of ACM are encountered during site works, these fragments will be handled as friable asbestos. Associated asbestos removal works would need to be continued by a Class A asbestos removalist rather than a Class B.

Given that potentially friable asbestos is present, both bonded and friable asbestos removal work can form part of the one notification for Class A.

7.3.3. Transportation of waste

The receiving waste facility is still to be confirmed by University of Sydney / Richard Crookes Construction. University of Sydney and its contractors should note the following with respect to soil and liquid (if any) waste generated as part of site remediation:

- The waste must be disposed offsite to an appropriately licenced waste facility and prior approval sought from this facility before transporting offsite. Depending on the facility, University of Sydney / Richard Crookes Construction should allow up to 7 days for this approval process.
- All impacted soil and water requiring offsite disposal will be transported and disposed of to either a licensed landfill or liquid waste facility. Prior to waste leaving the site, a written approval from the receiver will be obtained and included in the site validation report. All material leaving the site will be tracked and documented.
- The waste generator should carefully consider its obligations with respect to managing asbestos waste and follow asbestos management protocols. These protocols are typically outlined in an Asbestos Management Plan (AMP).
- From 1 July 2015 asbestos loads greater than 100kg, or more than 10 square metres of asbestos sheeting will require special monitoring requirements. The NSW EPA requires the waste generator use the “WasteLocate” system which is described at this link

http://www.epa.nsw.gov.au/wasteregulation/transport-asbestos-tyres.htm. Failure to do so will result in prosecution.

- Any waste leaving the site that classified as “restricted solid waste” or “asbestos waste” will need to be transported by an appropriately licensed contractor.
- The Protection of the Environment Operations (Waste) Regulation 2014 (the Waste Regulation) 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 (even if that facility is located more than 150 kilometres from its place of generation).

Handling and transporting asbestos waste is outlined in Section 10.2.4.

7.4. Site establishment

It is expected that permanent and temporary fencing will be erected and maintained to designate the construction site. Additional fencing may be required to designate remediation areas, particularly if construction works will be undertaken currently with remediation. The purpose of the fencing is to restrict access to authorised personnel only and minimising inadvertent exposure of contaminants to other site personnel and instance of cross contamination.

University of Sydney / Richard Crookes Construction will need to nominate:

- Temporary stockpiling areas along with sediment and erosion control structures;
- Equipment and truck decontamination areas (i.e. wash down bays);
- Truck load out areas relative to excavation activity.

7.5. Remediation and management of contamination

Excavation works must be programmed in such a way to lower the potential for contamination of soils in other areas of the site or cross-contamination of remediated areas. A construction staging plan has been developed by Richard Crookes Construction indicating the general sequence of earthworks activities. A construction staging plan can be developed by the construction contractor to help facilitate this approach allowing works to progress from one area to the next without inadvertently spreading impacted materials into clean areas, should remediation be undertaken concurrently with other construction activities.

The following key principals must be adopted in the construction program:

- Where practicable, excavation works should progress from one end of the site to the other, avoiding machinery tracking back into remediated areas. If this needs to occur, machinery must be decontaminated before entering clean areas.
- Temporary fencing can be used to cordon off areas of the site (or create exclusion zones) so that specific work practices involving handling of contaminated soils remain in designated areas. Hold points should be incorporated into the staging to validate areas prior to removal of fencing;
- Transport of impacted soils will only occur over areas yet to be remediated to reduce the potential for cross contamination or a designated loading zone that can be remediated at conclusion of earthworks;
- Clean imported fill soils will be transported into the site only via areas already deemed to have been remediated; and

- Works involving contact with contaminated soils will utilise a separate set of earthmoving equipment to those involving placing and compacting clean fill.

Adequate protection will be provided around the perimeter of the excavations that are left open such as temporary fencing or barriers, as the change in ground level may pose a hazard to other site personnel working within the remediation area.

7.5.1. Excavation of impacted areas

The results of additional investigations will provide the remediation extents of contaminated areas. The samples which defined the extents will be used as final validation samples.

An experienced environmental consultant will be present on site to guide the excavation and ensure that the excavation extends to the validated extent. The extent may be adjusted based on potential evidence of contamination such as oil staining at the time of remediation excavation and will be managed as an unexpected find.

If material is required to be stockpiled onsite then this material should be stockpiled as per the recommendations in Section 10.2.3.

7.6. Waste classification and offsite disposal of soil

7.6.1. Waste classification

Soils that classify as general solid waste (and/or asbestos waste) will be disposed directly offsite to an appropriately licensed landfill which will accept the waste. However, if soils classify as restricted solid waste or hazardous waste, alternative disposal or treatment options will be considered.

Waste classification will be assessed prior to offsite disposal in general accordance with the NSW EPA (2014) Waste Classification Guidelines: Part 1: Classifying Waste. The waste classification will be undertaken as part of additional investigations proposed in Section 5.

Should additional waste classification be required during constructions, for example, as a result of an unexpected find, then the following process will be undertaken:

- Collecting representative samples from stockpiled soils. The frequency of sampling is largely dependent on volumes and heterogeneity. For small volumes (<250m^3) samples will be collected at a rate of 1 sample per 25m^3. For larger volumes (say >250m^3 to 2,500m^3) and assuming low heterogeneity, a minimum of 10 samples will be collected to statistically assess the stockpile.
- Each sample will be screened with a PID.
- Laboratory analysis may will include:
  - TRH, BTEX, PAH, asbestos, phenols and heavy metals.
  - Leachability testing using the Toxicity Characteristic Leaching Procedure (TCLP) for heavy metals and PAH to further assess waste classification, if required.
- Disposal dockets will be retained for waste tracking purposes and inclusion in validation report.

7.6.2. Virgin Excavated Natural Material (VENM)

As the proposed development indicates a basement will form part of this construction and thus resulting in relatively large volumes of excess soil and rock requiring offsite disposal. It is important to keep non-impacted natural materials separated from fill and/or contaminated soils.

The underlying natural soil and rock at this site may satisfy the definition of Virgin Excavated Natural Material (VENM). Additional investigations will provided information on the depth VENM is expected to be encountered at the site. An experienced environmental consultant will then assess the top of VENM following removal of fill and other contaminated material and provide a VENM certificate to facilitate its lawful offsite disposal. Once natural soil and rock is assessed as VENM, it must be kept separate from other material that may be stockpiled onsite. Inadvertent mixing of material types will void VENM certificates issued for that material.

Validation procedures for potential re-use onsite are discussed in Section 9.3.

7.7. Backfilling of remedial excavations

Based on the proposed development, backfilling of remedial excavations will not be required. If temporary backfilling is required, appropriately validated fill should be used. If fill cannot be sourced from site, imported material will need to be assessed for suitability from a contamination perspective, prior to use onsite. Validation of imported material is further discussed in Section 9.3.1.

Copies of dockets pertaining to imported materials will be retained to confirm the source, type and quantities of materials for inclusion in validation report.

Because remedial excavations are expected to be less than 0.3m, accumulation of rain water and groundwater is unlikely to require management. If these shallow excavations fill with water, it is expected that excess water can be accommodated onsite.

7.8. Contingency plan

The following contingency plans have been considered:

- If unacceptable levels of contamination are identified within remediation excavations, University of Sydney / Richard Crookes Construction project manager will be contacted to discuss options of further assessment, excavation and/or management.
- If excavated materials have a higher classification than general solid waste managed as asbestos waste, alternative management strategy could be consider or onsite treatment.

An addendum to this RAP would be provided should an unexpected occurrence take place resulting in remediation objectives not being able to be met.

7.9. Managing unexpected occurrences

An unexpected find can be broadly defined as:

- Encountering ‘suspicious” material such as, but is not limited to the following, oily materials or materials with unusual odours, drums, metal or plastic chemical containers, buried solid waste, ash, slag, coke or brightly coloured material, etc.

An unexpected finds procedure has been developed to manage such occurrences and is included in Appendix A.

8. Quality control plan

The quality assurance/quality control plan described in the following subsections is designed to achieve the predetermined Data Quality Objectives (DQOs) that will demonstrate accuracy, precision, comparability, representativeness and completeness of the data generated and the procedures for assessing the DQOs are met (refer to Appendix D).

8.1. Soil sampling methodology

A new pair of disposable nitrile gloves will be used for handling each sample.

Sample collection will be undertaken with the assistance of an excavator or as a manual grab sample from directly from the excavation. Where an excavator is used, samples will be collected as manual grab samples from the centre of the excavator bucket to avoid potential cross-contamination.

Soil samples from the stockpiles will be collected by hand at least 0.3m below the surface of the stockpile to obtain a representative sample.

Soil samples will be placed in clean, laboratory prepared and supplied 250mL glass jars, which will be filled to minimise headspace and immediately sealed with Teflon lined caps to reduce the loss of volatiles. Samples will be then labelled and placed directly into ice filled cooler boxes for temporary storage and then later transport to the laboratory. Samples for asbestos analysis will be placed in plastic zip-lock bags as required by WA DOH (2009) guidelines. Asbestos validation sampling procedure is further discussed in Section 9.3.1.

Samples will be transported in secure containers (e.g. ice chests or sealed cardboard boxes) to a NATA accredited laboratory under chain of custody control.

For areas of possible hydrocarbon contamination only, a portion of each soil sample will be placed inside a sealed plastic bag for field headspace screening for volatile organic compounds (VOCs). Samples will be screened using a PID which will be calibrated using 100ppm isobutylene calibration gas prior to use.

8.2. Field quality control procedures

For each sampling event, field quality control will include the following:

- Environmental sampling and field testing will be performed in accordance with procedures listed in Schedule B (2) of the National Environment Protection Measure (NEPM) 1999 amended 2013 and industry accepted protocols for environmental sampling;
- Where non-disposable sampling equipment is used (e.g. stainless trowel), it will be decontaminated with Decon-90 and rinsed with deionised water between sampling locations. Rinsate samples will be collected when sampling equipment is used to assess the adequacy of the decontamination of sampling equipment.
- Using appropriate sample preservation methods as recommended by the laboratory;
- Duplicate/triplicate samples[1] will be collected at a frequency of 5% duplicates and 5% triplicates and assessed by calculating the Relative Percentage Differences (RPDs) between primary and duplicate laboratory samples using a control limit of:
  - When the result is less than 5 times the laboratory reporting limit then there is no limit;
  - When the result is between 5 and 10 times the laboratory reporting limit then the control limit is 50%; and
  - When the result is greater than 10 times the laboratory reporting limit then the control limit is 30%.
- One rinsate blank sample will be collected per batch of samples or from different pieces of sampling equipment such as the stainless steel trowel. The rinsate blanks will be used to check the efficacy of decontamination procedures and the potential for cross contamination; and
- One laboratory prepared trip spike and blank water samples will be transported into the field with the laboratory samples and despatched to the laboratory for analysis of volatile contaminants. The purpose of the trip spike and blank samples will be to check that there is no cross contamination of volatile contaminants during transport and sample preparation at the laboratory and that concentration of volatiles in the trip spike samples are within acceptable control limits (between 60% and 110%). Trip spike and blank samples will only be used when petroleum hydrocarbons are a contaminant of concern. For this site, a trip spike and blank sample will be transported with samples associated with additional investigations for PAHs, within building footprints and waste classifications.

8.3. Laboratory quality control and procedures for checking control data

- NATA accredited laboratories will be used for laboratory analysis. The laboratory will implement a quality control plan conforming to the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) Schedule B (3) Guidelines for Analysis of Potentially Contaminated Soils;

[1] Duplicate, triplicates, rinsate blanks, trip spike and trip blank samples are not required for asbestos assessments/validations and these will only apply to other areas.

- The laboratory will analyse reagent blanks, spike samples, duplicate spikes, matrix spikes, and surrogates spikes and duplicates for quality control.

Coffey will assess laboratory quality control data by:

- Checking that the results reported are consistent with field observations;
- Checking that the reporting limits and procedures are satisfactory;
- Checking that the samples are analysed within holding times and that NATA accredited methods were used to determine the result;
- Checking that laboratory blanks/reagent blanks are less than the laboratory reporting limits;
- Checking the reproducibility of samples by calculating the RPDs between primary and duplicate laboratory samples using the laboratory control limit;
- Checking that laboratory spikes, surrogate spikes, matrix spikes and duplicate matrix spike recoveries are within acceptable control limits; and
- Where data quality indicators are not met, the data and quality control measures will be reviewed to assess whether this was due to field procedures, laboratory procedures, sample heterogeneity or other reasons.

9. Validation plan

9.1. General

The objective of the validation plan is to provide a program of work that is adequate to check whether the remediation goals discussed in Section 6.1 have been met.

9.2. Validation methodology

Validation soil sampling will be completed with reference to the following guidelines (as applicable for the respective remedial area and contaminants):

- National Environment Protection (Assessment of Site Contamination) 1999 (April 2013), NEPC 2013, Canberra.
- NSW EPA (1995) Sampling Design Guidelines.
- WA DOH (2009) Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.

The validation methodology uses a combination of field observations and field screening to assess effective removal of impacted soils. Samples will be collected prior to remedial excavations and will represent the future walls and base of the excavation. The extent will be guided and confirmed by an environmental consultant. If subsurface conditions within the resulting remedial excavation vary from those observed during the additional investigation phase, additional validation samples may be required to ensure adequate removal of contaminated soil has occurred.

Similarly for assessing imported materials for suitability for use onsite, should this be required. Field observations and field screening will be used to assess residual impacts and laboratory analysis of representative samples will be used to verify these observations.

Once the excavation is pre-validated, a qualified surveyor will record the extent of the excavation required and following final excavation. The survey will also record general site features including site boundary, topography, pavement, etc. The survey plan will be included in the validation report.

Validation procedures, quality control and assessment criteria are described in the following sections.

9.3. Validation procedures

9.3.1. Validation sampling – Asbestos

At this stage, asbestos remediation is not required from a human health perspective as BH01 is located in an area designated to be excavated as part of the development. However, from a waste classification perspective, the extent of asbestos will be assessed as part of the additional investigations. These results will be confirmed with a visual inspection as described below.

If asbestos contamination is identified within other areas of the site, a new remediation area will be designated for removal. Validation sampling of the remedial excavation will depend on the following:

- The excavation extent and depth;
- If the excavation is terminated within fill material;
- If the excavation is terminated within natural soils.

Upon completion of excavation works, if excavation walls and base are within natural soils, a visual inspection of the walls and base should be undertaken by a licensed assessor.

If the excavation extents are confidently pre-validated and the exaction is terminated in fill, then the base of the excavation will be validated by visual observation followed by sampling.

For the purposes of waste classification, samples will be collected for asbestos identification only rather than a quantitative sampling and analysis. However, should conditions change, quantitative sampling and analysis may be beneficial in validating the site. This method is described below:

- Validation sampling will be carried out in general accordance with the Western Australia Department of Health: Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia (WA DOH, 2009) and comprise the following:
  - Visually checking the base of the excavation to confirm absence of ACM;
  - Collection of either one sample from the base, or one sample per every 25m^2 of the base, whichever is greater.
  - Per sample location, 10 litres of material will be spread out for inspection on a contrasting colour material, or sieved through a 7mm sieve, and any ACM picked out and placed into a labelled zip lock bag for later weighing by a contract laboratory;
  - One wetted 500ml sub sample will be collected for laboratory analysis for asbestos identification (AS4964-2004); and
  - Where asbestos is detected in any sample, the concentration of asbestos as fragments (ACM) and as loose fibres (FA or AF) will be compared with the validation assessment criteria.
- This validation process is considered to be consistent with Table 8 of the WA DOH (2009) guidelines.

9.3.2. Validation sampling – other contaminants

Pre-validation sampling and analysis described in Section 5 will be undertaken in general accordance with NEPM (1999, amended 2013) and NSW EPA (1995) guidelines. The sampling and analysis has been developed to validate the walls and base of the resulting excavation.

New excavations, as a result of unexpected finds, will also follow the same guidelines for validation sampling and analysis. The excavator or hand tools will be used to facilitate collection of soil validation samples from the walls and the base of the excavation. The number of samples will depend on the final shape and size of the excavation. Validation samples are positioned along the walls and base of the excavation to confirm effective removal of the identified contamination.

Where petroleum hydrocarbons are a COPC, each sample will be screened with a PID. Additional samples will be collected for field screening purposes.

9.3.3. Validation of imported materials

Based on the proposed development, it is unlikely imported materials will be required as part of reinstatement of remedial excavations. However, if temporary backfill is required the following validation process is required for imported materials.

The validation of imported materials requires a two-step process. The first step is to establish if the material can be accepted at the site in compliance with the Protection of the Environment Operations (POEO) Act. The second step is to assess if the material is suitable for the future proposed use of the site. The material must be able firstly to be placed on the site without triggering the requirement for an environmental protection licence for disposal of waste. Secondly, the material is assessed for compatibility with the proposed use of the site, as are other materials on the site once the issue of importing material is addressed satisfactorily.

Step 1 – Is the material compliant with POEO Act provisions?

Any imported material used as construction fill will be required to meet the definition of VENM or to meet the requirements of an acceptable resource recovery order such as Excavated Natural Material (ENM) as defined in the POEO Act 1997 and POEO Amendment (Waste) Regulation 2014. If the proposed material is VENM (e.g. sourced from a local quarry), then a certificate from the source site will be requested describing the material and confirming that this material meets the definition of VENM. If validation samples are collected, then typical results should report no detectable organic compounds and concentrations of heavy metals indicative of natural background levels. If the material is ENM, a “statement of compliance” must be provided by the generator. If the material is a manufactured material such as topsoil, then it must be commercially available to the public, produced to a specification and a copy of the specification stating its composition is to be provided.

Step 2 – Is the material consistent with the proposed future use of the site?

The material will be assessed in accordance with the NSW EPA (1995) Sampling Design Guidelines which requires assessment of the source of the material to check for activities that could have given rise to contamination in the soils. If the material is VENM, then at least two samples of the material will be collected and analysed. If the material is ENM, then the ENM statement of compliance (e.g. a consultant's report) will be reviewed to ensure that the sampling density and suite of analysis are in accordance with the Protection of the Environment Operations (Waste) Regulation 2014 – Resource recovery exemption Under Part 9, Clauses 91, 92 and 93 - The excavated natural material exemption and order 2014. The sampling rate and suite of analyses will depend on the information presented in the ENM statement of compliance associated analytical data and the source of the material. Samples will be tested for a suite of potential chemicals of concern which may include TRH, BTEX, PAH, OCP, OPP, PCB and heavy metals. Asbestos will only be analysed if there is evidence to suspect it may be present in materials, such as, fibre cement fragments.

Observations will be made by the environmental consultant of the material(s) as it is delivered to site, to check that the material appears consistent with the source and what is described on the VENM certificate, and that there is no obvious visual evidence of potential contamination such as suspicious staining, odours or anthropogenic materials. Coffey will be responsible for tracking of materials that are imported to the site. Copies of all dockets pertaining to imported material soils will be retained by the environmental consultant to confirm the source, type and quantities of materials.

The results will be compared to relevant validation criteria listed in

Table 5 and published background concentrations as discussed in Section 9.4

9.4. Validation assessment criteria

The proposed development is consistent with Residential B as described in Schedule B7 of National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 1999 (2013 Amendment).

For Asbestos, the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (NEPC, 1999 (2013 Amendment)) provides guidance on assessment of asbestos in soil. The NEPM 1999 (2013) amendment also references the Western Australian Department of Health (WA DOH) guidelines (2009).

The NEPM 1999 (2013) amendment will be used to assess risks posed by asbestos if identified. Based on the above guidelines, Coffey proposes to adopt the following as the acceptance criteria for assessment:

- No apparent visible fragments of asbestos containing material (ACM) present at the surface (surface defined as the upper 0.1m);
- No respirable fibres of asbestos identified in soil validation samples;
- The concentration of asbestos fines (AF) and/or friable asbestos (FA) should not exceed 0.001% w/w; and
- If one or more fragments of bonded ACM are found in validation samples, then the concentration of bonded ACM should not exceed 0.04% w/w.

For remaining COPCs, the rationale has been outlined in the previous report (Coffey, 2016) for selection of validation criteria. Based on this rationale, the selected validation criteria have been deemed appropriate to assess effectiveness of remediation activities, the potential for re-use of excavated materials and use of imported material onsite. HSL do not apply within proposed basement areas of the site. The validation assessment criteria for human health and management limits, selected for the site, are listed in **Table 5**.

The proposed development has indicated approximately one-third of the site will be landscaped, thus providing a complete exposure pathway for onsite ecological receptors. Therefore, ecological screening and investigation are considered applicable validation criteria.

The validation assessment criteria for ecological receptors, selected for the site, are listed in **Table 6**.

Table 5: Validation assessment criteria for human health and management limits

Contaminant of Concern	Published background range (mg/kg)	Human Health Investigation and Screening Levels (mg/kg)	HSL-B Direct Contact[4] (mg/kg)	Intrusive Maintenance Worker[4/5] (mg/kg)	Management Limits[6] (mg/kg)
Arsenic	5 to 11[1]	500[2]	-	-	N/A
Cadmium	0.25[1]	150[2]	-	-	N/A
Chromium	6 to 21[1]	500[2]	-	-	N/A
Copper	6 to 32[1]	30,000[2]	-	-	N/A
Lead	13 to 44[1]	1,200[2]	-	-	N/A
Nickel	5 to 50[1]	1,200[2]	-	-	N/A
Mercury	0.05[1]	120[2]	-	-	N/A
Zinc	17 to 77[1]	60,000[2]	-	-	N/A
F1 (TPH C_6-C_9)	< LOR	-	-	-	700 / 800[8]
F1 (TPH C_6-C_9 less BTEX)	< LOR	45 [3]	5,600	82,000 / NL	-
F2 (TPH C_{10}-C_{16})	< LOR	-	-	-	1,000
F2 (TPH C_{10}-C_{16} less Naphthalene)	< LOR	110 [3]	4,200	62,000 / NL	-
F3 (TPH C_{16}-C_{34})	< LOR	NL[3]	5,800	85,000 / NL	2,500 / 3,500[8]
F4 (TPH C_{34}-C_{40})	< LOR	NL[3]	8,100	120,000 / NL	10,000
Benzene	< LOR	0.5 [3]	140	1,100 / 77	-
Toluene	< LOR	480 [3]	21,000	120,000 / NL	-
Ethylbenzene	< LOR	55 [3]	5,900	85,000 / NL	-
Total Xylene	< LOR	40 [3]	17,000	130,000 / NL	-
Naphthalene	< LOR	3 [3]	2,200	29,000 / NL	-
Carcinogenic PAH as Benzo(a)pyrene TEQ	< LOR	4 [2]	-	-	-
Total PAHs	< LOR	400 [2]	-	-	-

Contaminant of Concern	Published background range (mg/kg)	Human Health Investigation and Screening Levels (mg/kg)	HSL-B Direct Contact[4] (mg/kg)	Intrusive Maintenance Worker[4/5] (mg/kg)	Management Limits[6] (mg/kg)
VHCs	< LOR	-	-	-	-
OCP	< LOR	10 to 600 [2]	-	-	-
OPP	< LOR	-	-	-	-
PCBs	< LOR	1 [2]	-	-	-
Phenols	< LOR	130 to 45,000 [2]			
Asbestos	< LOR	Not detected or 0.001% - FA and AF[7] 0.04% - ACM [7]	-	-	-

Table 5 notes:

1. NSW soils for new suburbs in low traffic areas listed on page 17 (South Australian Health Commission (1995)). Only adopted for imported materials as a general reference. Depending on source of material, other reference data may be adopted.
2. Table 1A(1) – Schedule B(1), Guideline on the Investigation Levels for Soil and Groundwater (NEPC, 2013)
3. Table 1A(3) – Soil Health Screening Levels for Vapour Intrusion (NEPC, 2013) for Sand, depth 0 to <1m
4. Table B4 - Soil Health Screening levels for Direct Contact and Intrusive Maintenance Worker (CRC Care, 2011)
5. Table B3 – Soil Health Screening Levels for Vapour Intrusion (Intrusive Maintenance Worker) (CRC Care, 2011) – Sand, depth 0 to <2m.
6. NEPM (2013) - Table 1B(7) – Management Limits for TPH Fractions F1 to F4 in soils
7. NEPM (2013) Schedule B(1) Investigation Levels. (Residential B).
8. Management limits guidelines for “coarse”/”fine” soil textures.

NL = HSL’s are non-limiting
TEQ = Toxicity Equivalent Quotient
LOR = Laboratory reporting limit

Table 6: Validation assessment criteria for ecological receptors

Chemical Constituent	Ecological Investigation Levels Urban Residential/Public Open Space (mg/kg)
Arsenic	100 [1]
Chromium (III)	190 [2]
Copper	220 [3]
Nickel	190 [4]
Lead	1100 [5]
Zinc	590 [6]
F1 (TPH C_6-C_9 – BTEX)[7]	180
F2 (TPH C_{10}-C_{16} – Naphthalene) [7]	120
F3 (TPH C_{16}-C_{34}) [7]	300
F4 (TPH C_{34}-C_{40}) [7]	2800
Benzene[7]	50
Toluene[7]	85
Ethylbenzene[7]	70
Xylenes[7]	105
Naphthalene	170
Benzo(a)pyrene[7]	0.7
DDT	180

Table 6 Notes:

1. Table 1B(5) - Schedule B(1), Guideline on the Investigation Levels for Soil and Groundwater (NEPC, 2013)
2. The Added Contaminant Limit (ACL) selected for Chromium III conservatively assumes a clay content of 1%.
3. The ACL selected for Copper uses the mean soil pH value of 7.6, mean CEC of 12cmol$_c$/kg and Total Organic Carbon of 1%.
4. The ACL selected for Nickel uses the mean CEC of 12cmol$_c$/kg.
5. Table 1B(4) - Schedule B(1), Guideline on the Investigation Levels for Soil and Groundwater (NEPC, 2013)
6. The ACL selected for Zinc uses the mean soil pH of 7.6 and CEC of 12cmol$_c$/kg.
7. EIL for TPH F1 to F4, BTEX and Benzo(a)pyrene compounds assume soils are coarse grained.
8. ABC were adopted for NSW assuming high traffic volume, where relevant.

9.5. Validation report

The laboratory data will be reviewed and assessed by applying general chemical data validation guidelines. The data that is accepted will be compared to the validation assessment criteria. Statistical interpretation of validation data may be used. Based on the comparison, the areas that have been satisfactorily remediated will be identified and will be flagged as “No Further Action Required”. Where the remediation objectives have not been met, environmental consultant and/or licensed assessor will communicate to University of Sydney which areas are requiring further remediation and/or management.

Upon completion of the remediation and validation activities, a report will be prepared and include the following information:

- Summary of previous investigations and desktop study;
- Summary of validation results and field observations;
- Waste classification;
- Disposal and imported materials dockets;
- Figures and photos showing remediation and validation activities and sampling locations;
- Site survey plan.

The validation report will be written with reference to the NEPM (2013). The report will provide a statement as whether the objectives of the remediation have been met.

10. Environmental management plan for remediation

The main environmental impact associated with the proposed remedial works will be associated with the removal of contaminated soil. Soil removed during the excavation works is likely to be loaded directly into trucks however if temporary storage is required on site, it will be stockpiled in a secure area on an impervious surface until laboratory results are received. The soils will then be classified and disposed offsite to a licensed landfill facility.

Stockpiled material will be enclosed by silt-trapping barriers for the control of silt and surface water runoff. Sediment erosion control devices shall be installed and will be maintained throughout the remediation process. We understand that a CEMP will be developed by University of Sydney for the construction works and the relevant elements of the items below should be covered off by the CEMP.

10.1. Air emissions

The main type and source of air emissions from the site during remedial works are anticipated to be odours released from the walls and base of the open excavation and from the stockpiled/transported soil prior to final disposal. Dust and particulates are discussed in the following section. The actual concentrations of the air emissions will vary depending on weather conditions and the composition of the impacted soils.

Air emission and odour controls will endeavour to control odours so that no offensive odours will be detected at the site boundary. During removal of asbestos impacted material, air monitoring will be undertaken by an occupational hygienist. Air monitoring requirements will be described in an AMP to be prepared prior to asbestos remediation.

Although not anticipated, should hydrocarbon odours be noted at the site boundaries, the following odour management procedures will be adopted:

- Undertaking the excavation works in a staged manner to limit the surface area of odorous material exposed;
- Application of odour suppressants (such as Anotec 0307®) via spray applicator; and

- Covering of the stockpiled and transported soil, to suppress the release of the odours.

In addition, as a precautionary management measure, air monitoring will be carried out during the Area 4 excavation works using a PID that measures VOCs. Air quality within the work area and within workers' breathing zones will be monitored during the site activities using a PID. All workers will immediately withdraw from the work area if VOCs are greater than 10ppm in the workers' breathing zone. A range of actions including the use of respirators by site personnel, watering or covering of stockpiles, and suspension of site works will be assigned to different PID action levels.

Records of air monitoring conducted during excavation works will be made available to relevant regulatory officers upon request.

10.2. Dust

The remedial works will involve excavation of the subsurface, stockpiling, transportation and placement of soil, and general movement of vehicles across the site. As such, dust generation is considered a potential environmental impact to the surrounding environment and the public.

The following management measures will be implemented to prevent dust impacts:

10.2.1. General work area

- High density weave shade cloth will be placed around the remediation work zone; and
- A communication and complaints register will be operated on site to ensure that any concerns of local residences and businesses are recorded and addressed.

10.2.2. Excavation areas

- Shade cloth will be used around the perimeter of the excavation areas to prevent dust from migrating laterally from the areas;
- Regular application of water across exposed soil areas; and
- If dust migration from excavation areas is considered excessive due to high winds and cannot be controlled with water, the works will be delayed or limited during these periods.

10.2.3. Stockpile areas

- Temporary stockpiling of the impacted soils may result in dust generation. The material will be covered by a high density polyethylene (HDPE) sheet which will aid in minimising the off-site movement of dust;
- Silt fencing and/or hay bales should be placed around stockpiled soils to filter runoff;
- Stockpiles will be positioned where erosion of the stockpile will be minimised and/or securely covered with tarpaulin where this is not possible;
- Regular dampening of stockpiles with water mist may be carried out to minimise dust generation. Note that the amount of water used for dust suppression needs to be minimal in order to prevent runoff;

- Stockpiles will not exceed the height of the fencing in order to reduce dust and odours spreading to the surrounding environment; and
- Impervious polyethylene sheeting (2-ply HDPE) will be placed under stockpiles to prevent contaminants from seeping into uncontaminated soils.

10.2.4. Haulage of soils

- All trucks transporting contaminated soil or imported fill to and from the site must be covered in order to minimise dust generation;
- Consideration for a tyre grid/wash may be required to prevent soil being transported off site via vehicular movement to and from the site. The following procedures will be followed on site to limit the potential for transport of soil/dust off site via vehicular movement:
  - Vehicles on site will remain on paved areas where possible;
  - Minimal vehicular traffic will be entering and exiting the site;
  - The excavator will be taken to and from the site on a float;
  - The excavator will be brushed down before leaving the site; and
  - All contractors working on site will be apprised of the need to keep dust generation to a minimum. Note that where a visual assessment of the dust levels indicates that unacceptable levels are being generated, work will cease until measures have been undertaken to reduce the dust, or until weather conditions are more suitable. This may involve an alteration of the work plan or the use of water sprays.
- Excavated asbestos contaminated soil should be covered by plastic sheeting (and weighed down using sandbags) whilst awaiting transport to a licensed waste facility. Alternatively, the soil can be placed on into an appropriately covered leak proof vehicles so that no spillage or dispersal of the waste to the atmosphere occurs.
- Separate ACM (or suspected ACM) fragments should be placed in appropriately sized waste bin pre-lined with plastic sheeting. The bins should be suitably marked and held in a secured area displaying appropriate warning signs.
- Controlled wetting of waste shall be employed, where practicable, to reduce dust emission. Excessive waterlogging shall be avoided as the excess of contaminated water may leak out of the stockpile or trucks, thereby creating a future source of airborne dust.

10.3. Noise controls

Any noise impact associated with the site works is acknowledged as an important environmental issue. Some noise will be generated during the excavation activities when using machinery such as excavators, backhoes and soil screening equipment.

Contractors are bound to comply with the statutory regulations regarding noise limitations in rural residential areas, and hours as restricted by Council.

In the event that these measures are not sufficient to reduce noise levels, a noise monitoring program may be implemented. This program would involve short term operator attended noise surveys at the noise source, as well as at surrounding properties to quantify the contribution of noise levels from the site to the ambient background levels.

10.4. Stormwater and sediment control

At this stage we anticipate excavated soils will be stockpiled on either high density plastic sheeting or directly on the ground. The stockpiled soils will be required to be bunded with adequate provision for offsite stormwater control. This can include providing silt fencing and hay bales around the stockpiled soils. The following general soil erosion and sedimentation control measures will be implemented for the proposed works:

- Controls for stockpiles are discussed in Section 10.2.3;
- Ensuring silt fencing and hay bales will cope with high rainfall events particularly on the down gradient sides of each stockpile;
- Have additional sediment erosion and control structures readily available on site in case installed controls fail;
- The grated drains on access roads adjoining the site will be bunded on the upslope side of the drain through a combination of sandbags, hay bales and silt screen material to minimise sediment entry into the stormwater system, if this is not possible then the drains will be blocked off permanently. An inspection of all vehicles leaving site will be completed to ensure soil is not transported off site in tyre wheel treads;
- Vehicles leaving the site should be adequately cleaned to remove any excess soil and should ensure that soil does not reach the road, any soil carried to the road should be removed by sweeping, not hosing; and
- Regular routine maintenance will be undertaken to replace damaged sediment control structures and maintain and improve other temporary measures as required.

10.5. Water management

Based on the level of contamination present and shallow remedial excavations, any accumulated water will be managed onsite. As required, water will be pumped out of excavations and allowed to soak into the ground within an appropriate area of the site, away from any stormwater drainage system.

Surface water runoff must be controlled on the site to ensure that potentially impacted material and/or water is not discharged to the surrounding area. Surface water runoff must also be directed away from the excavations such as through use of bunding or sand bags.

10.6. Waste disposal

Soil wastes and liquid (e.g. from septic tanks) that need to be disposed offsite will be stored, transported and disposed in accordance with the relevant sections of the POEO (Waste Regulation) Clause 42. The general waste generated from remedial activities may include domestic rubbish, disposable PPE and disused sediment and erosion control structures. The domestic rubbish and disposable PPE will be collected and disposed of appropriately at regular intervals (say weekly). Disposal of disused sediment and erosion control structures used at the site for this project will be disposed of site to landfill. General waste potentially containing asbestos should be handled and disposed of according to protocols outlined in an AMP to be prepared for this site.

A relatively small volume of water used in the decontamination of sampling equipment will also require disposal at the end of each day. It is proposed that this water will be spread over stockpiled soils which will be removed off site.

10.7. Traffic

Excavation and other equipment will be transported to the area in accordance with standard regulatory requirements. The need for traffic controls will be assessed based on the number of truck movements, proximity of excavation to the western boundary and in consultation with the relevant authorities.

10.8. Working hours

Working hours for on-site remedial works will be completed in accordance with Council DA requirements. These working hours include:

- 7am to 6pm Monday to Friday (inclusive);
- 7am to 3pm Saturdays; and
- No construction or demolition activity on Sundays and Public Holidays.

10.9. Access restriction

Access to the remediation areas will be restricted solely to authorised staff and contractors who have appropriate levels of personal protective equipment and have been inducted. Temporary and permanent fencing will be used to limit unauthorised access.

Signage, including contractor details and contact numbers, place near site entrance or at site office. The signage will remain displayed on the site entrance throughout the duration of the remediation works.

The site supervisor shall control site access and shall authorise visitors on an “as needed” basis.

11. Occupational health and safety

The environmental consultant will prepare a safety plan prior to the commencement of the remedial and validation works in order to protect workers at the site as well as people in the surrounding areas. The Site Safety Plan (SSP) would consider the following.

- Hazard Identification and Control;
- Air monitoring during earthworks;
- Chemical Hazard Control;
- Handling Procedures;
- Personal Protective Equipment;
- Work Zones;
- Decontamination procedures;
- Contingency Plans; and
- Incident Reporting.

The SSP will be periodically reviewed and updated prior to various project tasks being conducted. It will be specifically written for all onsite tasks relating to guiding remedial earthworks, air monitoring and validating resulting excavation. The environmental consultant will be required to work strictly to this plan. Daily sign off is required by all project staff.

All staff will require inductions by the ASA licensed contractor prior to entering the designated work area.

12. Incident response procedures

In the event of a major environmental incident, University of Sydney will contact:

- The fire brigade/ambulance/police on 000;
- University of Sydney project manager: M +61 430 310 397 (Georgia Kalavritinos)
- Richard Crookes Construction project manager: TBA
- NSW EPA on 131 555
- SafeWork NSW on 131 050
- City of Council on (02) 9265 9333 where applicable

Other useful contact numbers are:

- Royal Prince Alfred Hospital: Missenden Road, Camperdown, NSW, 2050; Phone: (02) 9515 6111
- Redfern Police Station: 1 Lawson Street, Redfern, NSW; (02) 8303 5199
- Other emergency numbers will be included in the SSP.

An example of a major incident would include significant spillage of hazardous or toxic liquids to stormwater or sewer.

In the case of minor incidents (such as an oil spillage), University of Sydney should respond to the incident (such as contain a minor oil spillage). Site workers are required to report any accidents or incidents to Richard Crookes Construction at the work site. Richard Crookes Construction will forward any accidents or incidents to University of Sydney.

Civil contractor will bring to site a "spill kit" which includes absorbents (such as socks, mats, pillows saw dust or equivalent) capable of containing up to 10L of hydrocarbons. These will be applied by the civil contractor immediately in the event of a spill.

13. Community relations

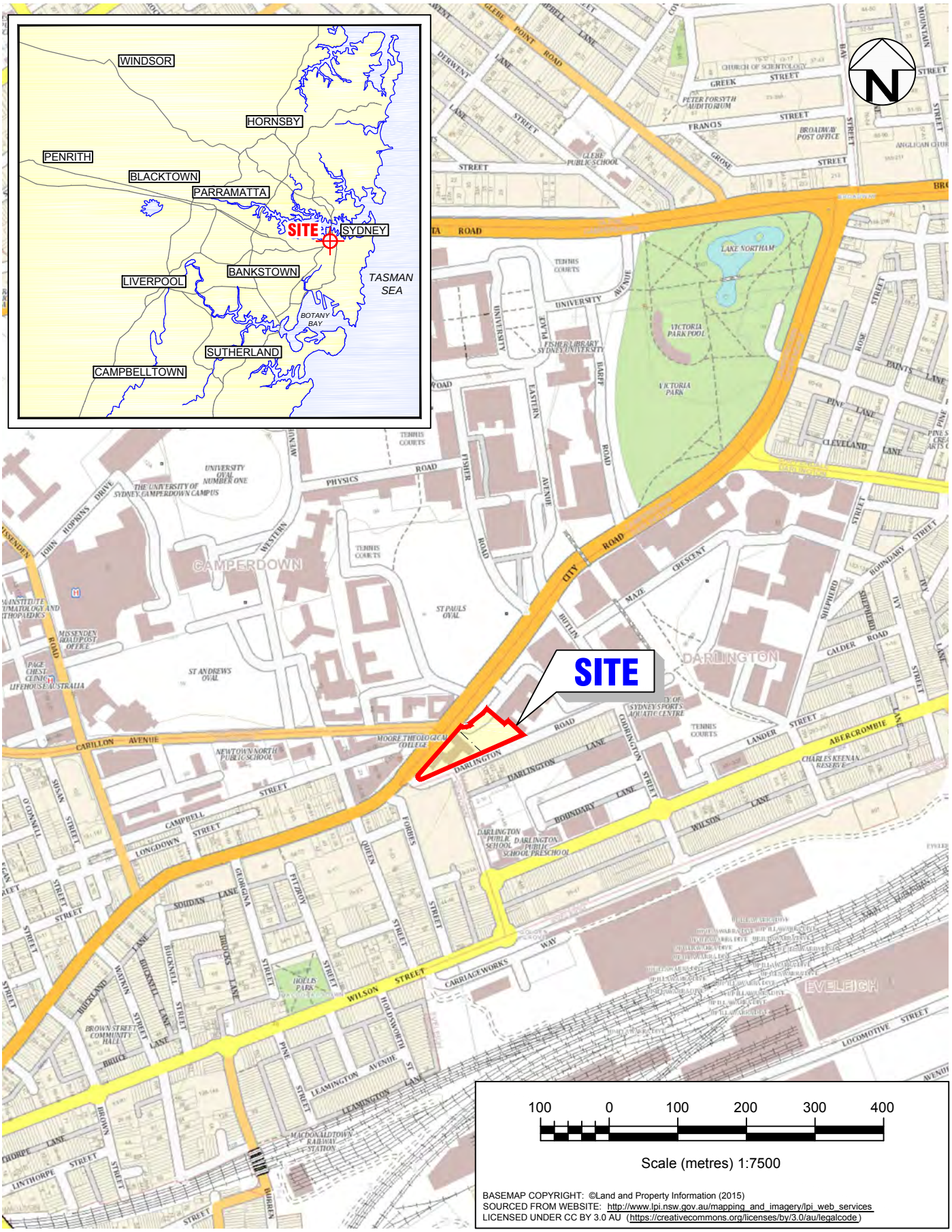
The procedures outlined in the RAP will ensure that the impact on the surrounding community from the site works will be minimal. Inquiries regarding environmental and contamination issues from members of the local community and neighbouring properties will be documented and referred to University of Sydney.

14. Complaints

Any complaints received shall be recorded and attended to promptly in consultation with University of Sydney Property or the appointed construction contractor. On receiving a complaint, works will be reviewed to determine whether issues relating to the complaint can be avoided or minimised. Proposed feedback to the complainant will be reviewed by the University of Sydney prior to explaining what outcomes have resulted.

15. References

1. **Coffey Geotechnics Pty Ltd (2015)** Stage 1 Contamination Assessment, The Campus Improvement Program: The Regiment Student Accommodation Project, The University of Sydney (Ref: GEOTLCOV25409AA-AC v2, dated 11 December 2016);
2. **Coffey Geotechnics Pty Ltd (2016)** Stage 2 Contamination Investigation, The Campus Improvement Program: Regiment Student Accommodation Project, The University of Sydney, Darlington (Ref: GEOTLCOV25409AA-AE Rev 2, dated 15 December 2016);
3. **Friebel & Nadebaum (2011)** Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater (technical paper No.10) Guidelines, CRC for Contamination Assessment and Remediation of the Environment (CRC CARE);
4. **NEPC (2013)** National Environmental Protection (Assessment of Site Contamination) Measure 1999, as amended in 2013, National Environment Protection Council;
5. **NSW DEC (2006)** Guidelines for the NSW Auditor Scheme 2nd Edition;
6. **NSW EPA (1995)** Sampling Design Guidelines;
7. **NSW EPA (2014)** Waste Classification Guidelines: Part 1: Classifying Waste;
8. **NSW EPA (2014)** Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 - The excavated natural material order 2014;
9. **NSW OEH (2011)** Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, OEH 2011/0650, ISBN 0 7310 3892 4, Office of Environment and Heritage, Sydney;
10. **South Australian Health Commission (1995)** Trace Element Concentrations in Soils from Rural and Urban Areas of Australia - Contaminated sites Monograph Series No. 4;
11. **WA DOH (2009)** Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.



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date	17 / 02 / 17
scale	AS SHOWN
original size	A4

coffey
A TETRA TECH COMPANY

client: THE UNIVERSITY OF SYDNEY

project: REGIMENT MIXED USE REDEVELOPMENT
REMEDIATION ACTION PLAN
CNR CITY AND DARLINGTON ROAD, DARLINGTON, NSW

title: SITE LOCATION PLAN

project no: 754-SYDEN201550-R01 | figure no: FIGURE 1 | rev: A

PLOT DATE: 17/02/2017 5:04:43 PM DWG FILE: \\CHATF-S01.CORP.COFFEY.COM.AU\DATA\S1_PROJECTS\1_SYDENENV\2017\SYDEN201550 - REMEDIATION ACTION PLAN FOR US\DWG\12. CAD\754-SYDEN201550-R01.DWG

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	JM	CCQ	17/02/17

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Scale (metres) 1:1000

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: 2015 AEROMETREX

drawn	JM / AW
approved	CCQ
date	17 / 02 / 17
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client: THE UNIVERSITY OF SYDNEY

project: REGIMENT MIXED USE REDEVELOPMENT
REMEDIATION ACTION PLAN
CNR CITY AND DARLINGTON ROAD, DARLINGTON, NSW

title: SITE LAYOUT, BOUNDARY PLAN & SAMPLING LOCATIONS

project no: 754-SYDEN201550-R01 | figure no: FIGURE 2 | rev: A

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CITY ROAD

CARILLON AVENUE

BUTLIN AVENUE

DARLINGTON ROAD

DTSWL	3.64
SWL mAHD	38.66

DTSWL	5.28
SWL mAHD	35.52

DTSWL	3.59
SWL mAHD	38.71

BH01/MW01

BH02

BH03/MW02

BH04

BH05/MW03

BH06

38.6 38.4 38.2 38 37.8 37.6 37.4 37.2 37 36.8 36.6 36.4

LEGEND

- BORE HOLE LOCATIONS
- APPROXIMATE SITE BOUNDARY
- INFERRED GROUNDWATER FLOW DIRECTION
- 37 — INFERRED GROUNDWATER ELEVATION CONTOUR (mAHD)
- DTSWL — GAUGED DEPTH TO WATER (metres)
- SWL mAHD — GROUNDWATER ELEVATION (mAHD)

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	JM	CCQ	17/02/17

10 0 10 30 50

Scale (metres) 1:1000

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
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drawn	JM / AW
approved	CCQ
date	17 / 02 / 17
scale	AS SHOWN
original size	A3

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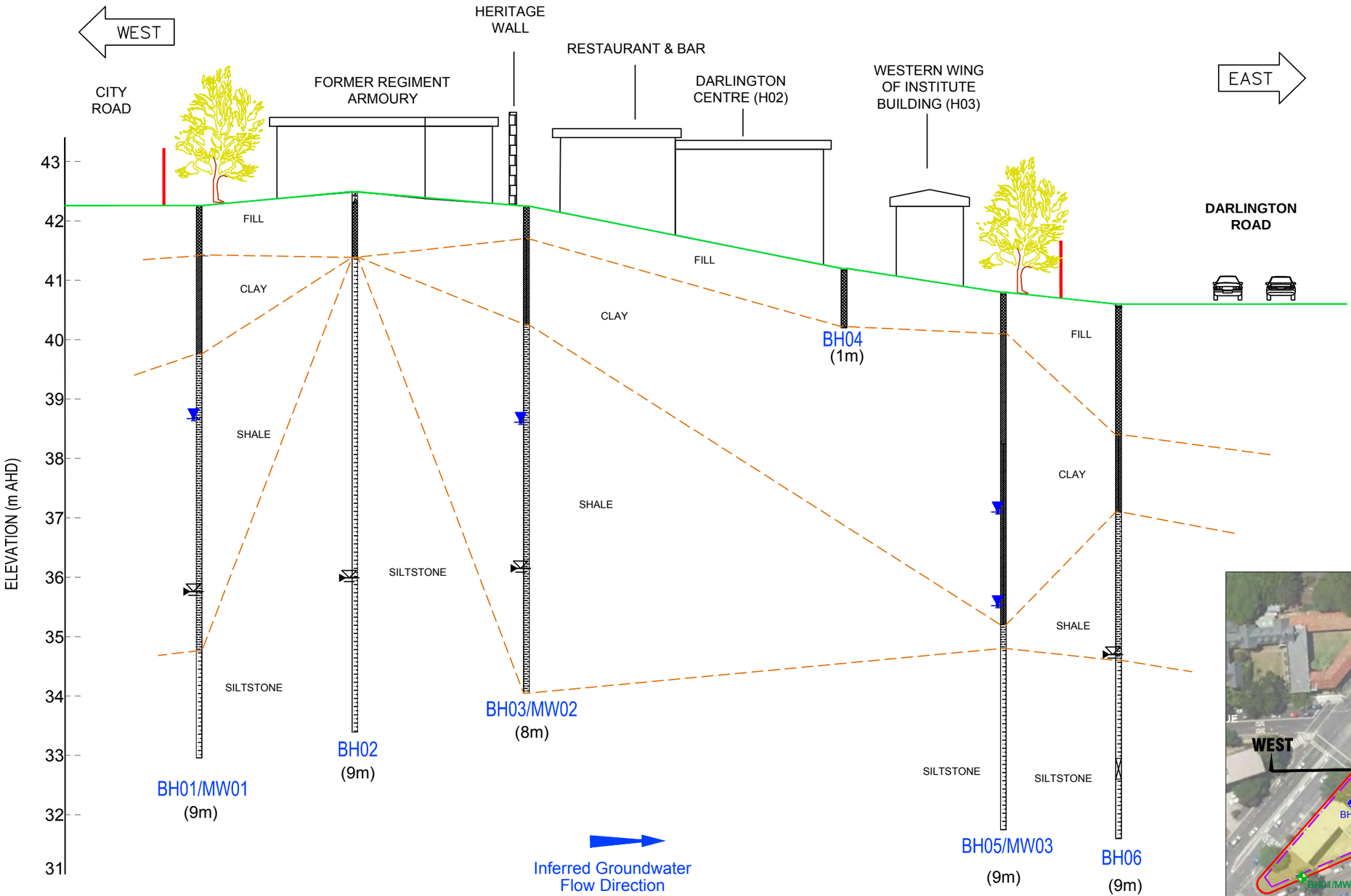
A TETRA TECH COMPANY

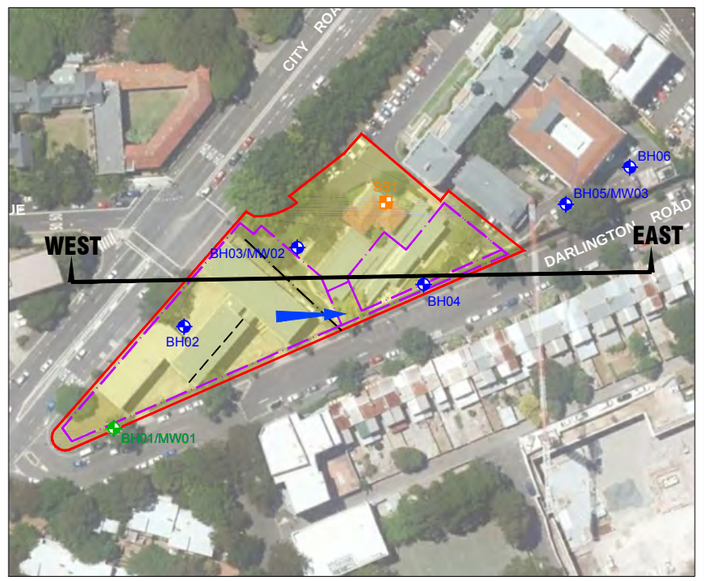
client: THE UNIVERSITY OF SYDNEY

project: REGIMENT MIXED USE REDEVELOPMENT
REMEDIATION ACTION PLAN
CNR CITY AND DARLINGTON ROAD, DARLINGTON, NSW

title: GROUNDWATER CONTOUR PLAN - DECEMBER 2015

project no: 754-SYDEN201550-R01 | figure no: FIGURE 3 | rev: A





revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	JM	CCQ	17/02/17

drawn	JM / AW
approved	CCQ
date	17 / 02 / 17
scale	NTS
original size	A3

coffey
A TETRA TECH COMPANY

client: THE UNIVERSITY OF SYDNEY

project: REGIMENT MIXED USE REDEVELOPMENT
REMEDIATION ACTION PLAN
CNR CITY AND DARLINGTON ROAD, DARLINGTON, NSW

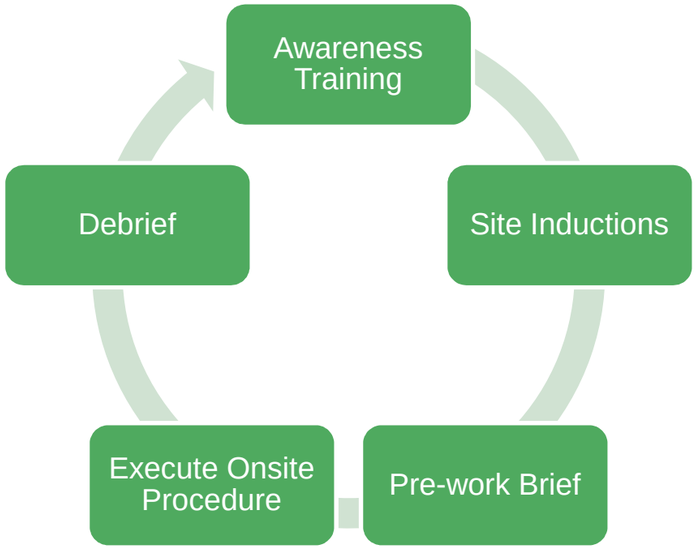
title: CONCEPTUAL SITE MODEL

project no: 754-SYDEN201550-R01 | figure no: FIGURE 4 | rev: A

Appendix A – Unexpected Finds Procedure

Unexpected Finds Procedure

Process



Contractor to ensure this process is followed and all site personnel that are involved with penetrating the subsurface undergo awareness training and inductions.

What is an unexpected find?

Unexpected finds may include:

- Contamination
- Buried waste
- Unusual ground conditions – ash, slag, etc
- Brightly coloured material – green, blue, etc
- Unusual odours – petroleum, sulphur, etc

Common contaminants of concern:

- Asbestos
- Petroleum hydrocarbons
- Heavy metals
- Pesticides

Limitations:

- Always use the precautionary principal if ever in doubt
- Unexpected finds are not always identifiable by sight and smell

Examples of unexpected finds are illustrated in the following photographs.

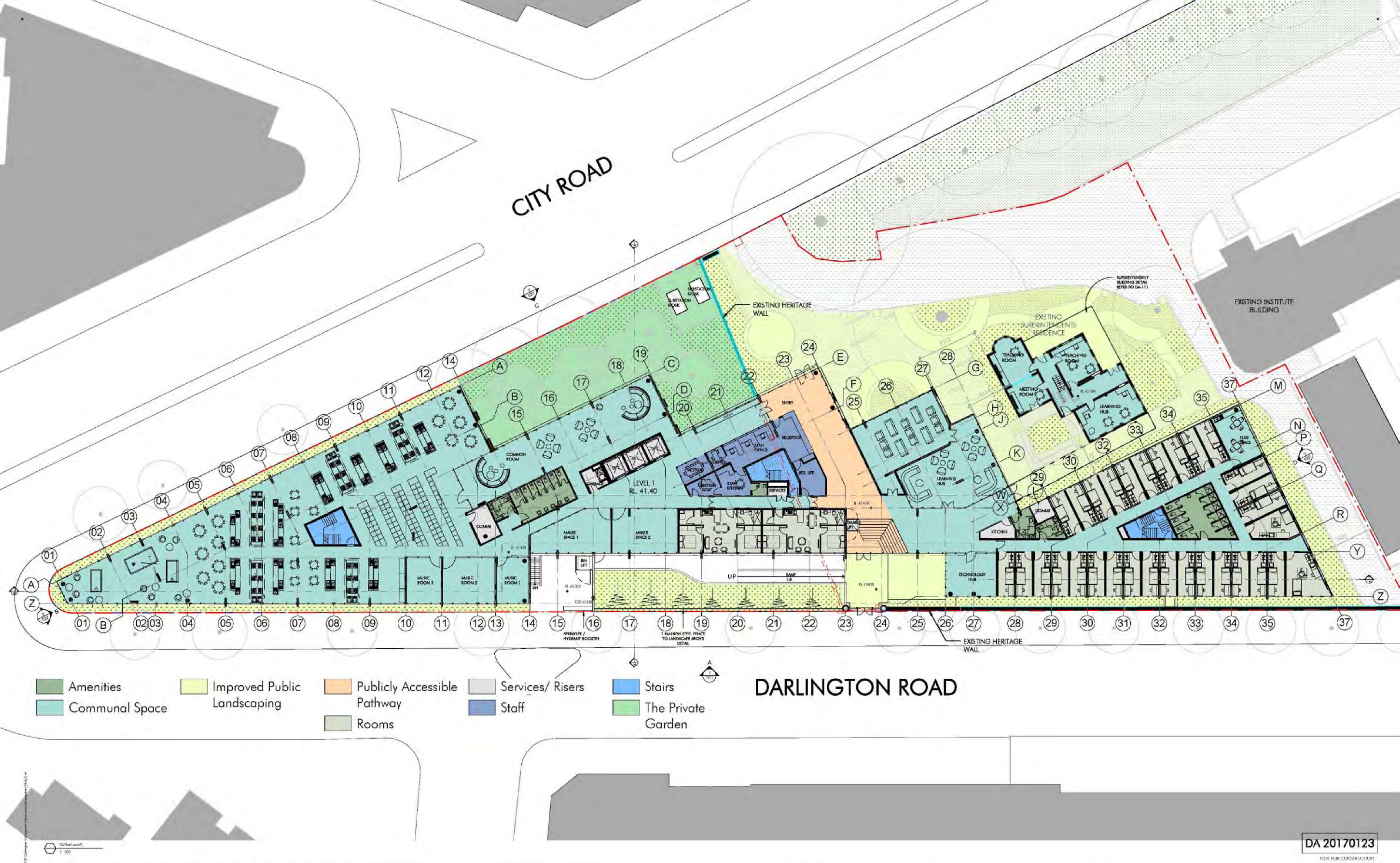
Onsite procedure

Stop Work
- Inform site foreman/site manager
- Assess safety risk
- Quarantine area

Manage
- Contact specialist consultant
- Further investigation
- Remediate and validate

Clearance
- Receipt of written clearance
- Recommence work

Appendix B – Proposed Site Layout



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NOT FOR CONSTRUCTION

Builders and/or subcontractors shall verify all project dimensions before commencing on-site work or off-site fabrication. Figured dimensions shall take precedence over scaled dimensions. This drawing is copyright and cannot be reproduced in whole or in part or by any medium without the written permission of Nettleton Tribe Partnership Pty Ltd.

Key Plan / North

Issue	Description	Date

LEGEND

Building Contractor: - Address: -

Traffic Consultant: - Address: -

Acoustic: Acoustic Logic Address: 9 Sarah St, Mascot, NSW 2020

Fire: JHA Services Address: L23 101 Miller St, North Sydney, NSW 2060

BIM Consultant: - Address: -

Developer: - Address: -

Project Manager: - Address: -

Town Planner: Urbis Address: Tower 2, Level 23, Darling Park, 201 Sussex St, Sydney, NSW 2000

Surveyor: Frank M Mason & Co Address: 2 Winslow St, Milsons Point

Civil: SCP Consulting Pty Ltd Address: Level 2, Dorchester house, 507 Kent St, Sydney, NSW 2000

Mechanical: JHA Services Address: L23 101 Miller St, North Sydney, NSW 2060

Builder: Richard Crookes Constructions Address: 214 Willoughby Road, Naremburn, NSW 2065

BCA Certifier: Blackett Maguire + Goldsmith Address: Suite 2.01, 22-36 Mountain St, Ultimo, NSW 2007

Landscape: Oculus Address: Level 1, 5 Wilson St, Newtown, NSW 2042

Structural: SCP Consulting Pty Ltd Address: Level 2, Dorchester house, 507 Kent St, Sydney, NSW 2000

Hydraulic: JHA Services Address: L23 101 Miller St, North Sydney, NSW 2060

Electrical: JHA Services Address: L23 101 Miller St, North Sydney, NSW 2060

Client: **University of Sydney**

Project: **University of Sydney - H01 Mixed Use Redevelopment**

City Road, Darlington NSW 2006, Australia

Title: **Level 01 Floor Plan**

Drawn	Scale	Checked	Sheet Size
AK	1:200	ML	A1

Number: 10107_DA011

Issue:

Architectural Consultant
nettleton tribe partnership pty ltd ABN 58 161 683 122
117 Willoughby Road, Crows Nest, NSW 2065
t +61 2 9431 6131
e sydney@nettletontribe.com.au w nettletontribe.com.au

nettletontribe

Appendix C – ENM General Exemption 2014

Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014

The excavated natural material order 2014

Introduction

This order, issued by the Environment Protection Authority (EPA) under clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 (Waste Regulation), imposes the requirements that must be met by suppliers of excavated natural material to which 'the excavated natural material exemption 2014' applies. The requirements in this order apply in relation to the supply of excavated natural material for application to land as engineering fill or for use in earthworks.

1. Waste to which this order applies

1.1. This order applies to excavated natural material. In this order, excavated natural material means naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

a) been excavated from the ground, and
b) contains at least 98% (by weight) natural material, and
c) does not meet the definition of Virgin Excavated Natural Material in the Act.

Excavated natural material does not include material located in a hotspot; that has been processed; or that contains asbestos, Acid Sulfate Soils (ASS), Potential Acid Sulfate soils (PASS) or sulfidic ores.

2. Persons to whom this order applies

2.1. The requirements in this order apply, as relevant, to any person who supplies excavated natural material, that has been generated, processed or recovered by the person.

2.2. This order does not apply to the supply of excavated natural material to a consumer for land application at a premises for which the consumer holds a licence under the POEO Act that authorises the carrying out of the scheduled activities on the premises under clause 39 'waste disposal (application to land)' or clause 40 'waste disposal (thermal treatment)' of Schedule 1 of the POEO Act.

3. Duration

3.1. This order commences on 24 November 2014 and is valid until revoked by the EPA by notice published in the Government Gazette.

4. Generator requirements

The EPA imposes the following requirements on any generator who supplies excavated natural material.

Sampling requirements

4.1. On or before supplying excavated natural material, the generator must:

4.1.1. Prepare a written sampling plan which includes a description of sample preparation and storage procedures for the excavated natural material.

4.1.2. Undertake sampling and testing of the excavated natural material as required under clauses 4.2, 4.3, and 4.4 below. The sampling must be carried out in accordance with the written sampling plan.

4.2. The generator must undertake sampling and analysis of the material for ASS and PASS, in accordance with the NSW Acid Sulfate Soil Manual, Acid Sulfate Soils Management Advisory Council, 1998 and the updated Laboratory Methods Guidelines version 2.1 – June 2004 where:

4.2.1. the pH measured in the material is below 5, and/or

4.2.2. the review of the applicable Acid Sulfate Soil Risk Maps (published by the former Department of Land and Water Conservation and available at http://www.environment.nsw.gov.au/acidsulfatesoil/riskmaps.htm) indicates the potential presence of ASS.

4.3. For stockpiled material, the generator must:

4.3.1. undertake sampling in accordance with Australian Standard 1141.3.1-2012 Methods for sampling and testing aggregates – Sampling – Aggregates (or equivalent);

4.3.2. undertake characterisation sampling by collecting the number of samples listed in Column 2 of Table 1 with respect to the quantity of the waste listed in Column 1 of Table 1 and testing each sample for the chemicals and other attributes listed in Column 1 of Table 4. For the purposes of characterisation sampling the generator must collect:

4.3.2.1. composite samples for attributes 1 to 10 and 18 in Column 1 of Table 4.

4.3.2.2. discrete samples for attributes 11 to 17 in Column 1 of Table 4.

4.3.2.3. The generator must carry out sampling in a way that ensures that the samples taken are representative of the material from the entire stockpile. All parts of the stockpile must be equally accessible for sampling.

4.3.2.4. for stockpiles greater than 4,000 tonnes the number of samples described in Table 1 must be repeated.

4.3.3. store the excavated natural material appropriately until the characterisation test results are validated as compliant with the maximum average concentration or other value listed in Column 2 of Table 4 and the absolute maximum concentration or other value listed in Column 3 of Table 4.

Table 1

Sampling of Stockpiled Material		
Column 1	**Column 2**	**Column 3**
Quantity (tonnes)	**Number of samples**	**Validation**
<500	3	Required
500 – 1,000	4	
1,000 – 2,000	5	
2,000 – 3,000	7	
3,000 – 4,000	10	

4.4. For in situ material, the generator must:

4.4.1. undertake sampling by collecting discrete samples. Compositing of samples is not permitted for in-situ materials.

4.4.2. undertake characterisation sampling for the range of chemicals and other attributes listed in Column 1 of Table 4 according to the requirements listed in Columns 1, 2 and 3 of Table 2. When the ground surface is not comprised of soil (e.g. concrete slab), samples must be taken at the depth at which the soil commences.

4.4.3. undertake sampling at depth according to Column 1 of Table 3.

4.4.4. collect additional soil samples (and analyse them for the range of chemicals and other attributes listed in Column 1 of Table 4), at any depth exhibiting discolouration, staining, odour or other indicators of contamination inconsistent with soil samples collected at the depth intervals indicated in Table 3.

4.4.5. segregate and exclude hotspots identified in accordance with Table 2, from material excavated for reuse.

4.4.6. subdivide sites larger than 50,000 m² into smaller areas and sample each area as per Table 2.

4.4.7. store the excavated natural material appropriately until the characterisation test results are validated as compliant with the maximum average concentration or other value listed in Column 2 of Table 4 and the absolute maximum concentration or other value listed in Column 3 of Table 4.

Table 2

***In Situ* Sampling at surface**				
Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**
Size of *in situ* area (m^2)	**Number of systematic sampling points recommended**	**Distance between two sampling points** (m)	**Diameter of the hot spot that can be detected with 95% confidence** (m)	**Validation**
500	5	10.0	11.8	Required
1000	6	12.9	15.2	
2000	7	16.9	19.9	
3000	9	18.2	21.5	
4000	11	19.1	22.5	
5000	13	19.6	23.1	
6000	15	20.0	23.6	
7000	17	20.3	23.9	
8000	19	20.5	24.2	
9000	20	21.2	25.0	
10,000	21	21.8	25.7	
15,000	25	25.0	28.9	
20,000	30	25.8	30.5	
25,000	35	26.7	31.5	
30,000	40	27.5	32.4	
35,000	45	27.9	32.9	
40,000	50	28.3	33.4	
45,000	52	29.3	34.6	
50,000	55	30.2	35.6	

Table 2 has been taken from NSW EPA 1995, *Contaminated Sites Sampling Design Guidelines*, NSW Environment Protection Authority.

Table 3

***In Situ* Sampling at Depth**	
Column 1	**Column 2**
Sampling Requirements *	**Validation**
1 soil sample at 1.0 m bgl from each surface sampling point followed by 1 soil sample for every metre thereafter. From 1.0 m bgl, sample at the next metre interval until the proposed depth of excavation of the material is reached. If the proposed depth of excavation is between 0.5 to 0.9 m after the last metre interval, sample at the base of the proposed depth of excavation.	Required if the depth of excavation is equal to or greater than 1.0 m bgl

* Refer to Notes for examples

Chemical and other material requirements

4.5. The generator must not supply excavated natural material waste to any person if, in relation to any of the chemical and other attributes of the excavated natural material:

4.5.1. The chemical concentration or other attribute of any sample collected and tested as part of the characterisation of the excavated natural material exceeds the absolute maximum concentration or other value listed in Column 3 of Table 4:

4.5.2. The average concentration or other value of that attribute from the characterisation of the excavated natural material (based on the arithmetic mean) exceeds the maximum average concentration or other value listed in Column 2 of Table 4.

4.6. The absolute maximum concentration or other value of that attribute in any excavated natural material supplied under this order must not exceed the absolute maximum concentration or other value listed in Column 3 of Table 4.

Table 4

Column 1	Column 2	Column 3
Chemicals and other attributes	**Maximum average concentration for characterisation** (mg/kg 'dry weight' unless otherwise specified)	**Absolute maximum concentration** (mg/kg 'dry weight' unless otherwise specified)
1. Mercury	0.5	1
2. Cadmium	0.5	1
3. Lead	50	100
4. Arsenic	20	40
5. Chromium (total)	75	150
6. Copper	100	200
7. Nickel	30	60
8. Zinc	150	300
9. Electrical Conductivity	1.5 dS/m	3 dS/m
10. pH *	5 to 9	4.5 to 10
11. Total Polycyclic Aromatic Hydrocarbons (PAHs)	20	40
12. Benzo(a)pyrene	0.5	1
13. Benzene	NA	0.5
14. Toluene	NA	65
15. Ethyl-benzene	NA	25
16. Xylene	NA	15
17. Total Petroleum Hydrocarbons C_{10}-C_{36}	250	500
18. Rubber, plastic, bitumen, paper, cloth, paint and wood	0.05%	0.10%

* The ranges given for pH are for the minimum and maximum acceptable pH values in the excavated natural material.

Test methods

4.7. The generator must ensure that any testing of samples required by this order is undertaken by analytical laboratories accredited by the National Association of Testing Authorities (NATA), or equivalent.

4.8. The generator must ensure that the chemicals and other attributes (listed in Column 1 of Table 4) in the excavated natural material it supplies are tested in accordance with the test methods specified below or other equivalent analytical methods. Where an equivalent analytical method is used the detection limit must be equal to or less than that nominated for the given method below.

4.8.1. Test methods for measuring the mercury concentration.

4.8.1.1. Analysis using USEPA SW-846 Method 7471B Mercury in solid or semisolid waste (manual cold vapour technique), or an equivalent analytical method with a detection limit < 20% of the stated absolute maximum concentration in Column 3 of Table 2 (i.e. < 0.20 mg/kg dry weight).

4.8.1.2. Report as mg/kg dry weight.

4.8.2. Test methods for measuring chemicals 2 to 8.

4.8.2.1. Sample preparation by digesting using USEPA SW-846 Method 3051A Microwave assisted acid digestion of sediments, sludges, soils, and oils (or an equivalent analytical method).

4.8.2.2. Analysis using USEPA SW-846 Method 6010C Inductively coupled plasma - atomic emission spectrometry, or an equivalent analytical method with a detection limit < 10% of the stated absolute maximum concentration in Column 3 of Table 2, (e.g. 10 mg/kg dry weight for lead).

4.8.2.3. Report as mg/kg dry weight.

4.8.3. Test methods for measuring electrical conductivity and pH.

4.8.3.1. Sample preparation by mixing 1 part excavated natural material with 5 parts distilled water.

4.8.3.2. Analysis using Method 103 (pH) and 104 (Electrical Conductivity) in Schedule B (3): Guideline on Laboratory Analysis of Potentially Contaminated Soils, National Environment Protection (Assessment of Site Contamination) Measure 1999 (or an equivalent analytical method).

4.8.3.3. Report electrical conductivity in deciSiemens per metre (dS/m).

4.8.4. Test method for measuring Polynuclear Aromatic Hydrocarbons (PAHs) and benzo(a)pyrene.

4.8.4.1. Analysis using USEPA SW-846 Method 8100 Polynuclear Aromatic Hydrocarbons (or an equivalent analytical method).

4.8.4.2. Calculate the sum of all 16 PAHs for total PAHs.

4.8.4.3. Report total PAHs as mg/kg dry weight.

4.8.4.4. Report benzo(a)pyrene as mg/kg.

4.8.5. Test method for measuring benzene, toluene, ethylbenzene and xylenes (BTEX).

4.8.5.1. Method 501 (Volatile Alkanes and Monocyclic Aromatic Hydrocarbons) in Schedule B (3): Guideline on Laboratory Analysis of Potentially Contaminated Soils, National Environment Protection (Assessment of Site Contamination) Measure 1999 (or an equivalent analytical method).

4.8.5.2. Report BTEX as mg/kg.

4.8.6. Test method for measuring Total Petroleum Hydrocarbons (TPH).

4.8.6.1. Method 506 (Petroleum Hydrocarbons) in Schedule B (3): Guideline on Laboratory Analysis of Potentially Contaminated Soils, National Environment Protection (Assessment of Site Contamination) Measure 1999 (or an equivalent analytical method).

4.8.6.2. Report as mg/kg dry weight.

4.8.7. Test method for measuring rubber, plastic, bitumen, paper, cloth, paint and wood.

4.8.7.1. NSW Roads & Traffic Authority Test Method T276 Foreign Materials Content of Recycled Crushed Concrete (or an equivalent method).

4.8.7.2. Report as percent.

Notification

4.9. On or before each transaction, the generator must provide the following to each person to whom the generator supplies the excavated natural material:

- a written statement of compliance certifying that all the requirements set out in this order have been met;
- a copy of the excavated natural material exemption, or a link to the EPA website where the excavated natural material exemption can be found; and
- a copy of the excavated natural material order, or a link to the EPA website where the excavated natural material order can be found.

Record keeping and reporting

4.10. The generator must keep a written record of the following for a period of six years:

- the sampling plan required to be prepared under clause 4.1.1;
- all characterisation sampling results in relation to the excavated natural material supplied;
- the volume of detected hotspot material and the location;
- the quantity of the excavated natural material supplied; and
- the name and address of each person to whom the generator supplied the excavated natural material.

4.11. The generator must provide, on request, the characterisation and sampling results for that excavated natural material supplied to the consumer of the excavated natural material.

5. Definitions

In this order:

application or apply to land means applying to land by:

- spraying, spreading or depositing on the land; or
- ploughing, injecting or mixing into the land; or
- filling, raising, reclaiming or contouring the land.

Bgl means below ground level, referring to soil at depth beneath the ground surface.

composite sample means a sample that combines five discrete sub-samples of equal size into a single sample for the purpose of analysis.

consumer means a person who applies, or intends to apply excavated natural material to land.

discrete sample means a sample collected and analysed individually that will not be composited.

generator means a person who generates excavated natural material for supply to a consumer.

hotspot means a cylindrical volume which extends through the soil profile from the ground surface to the proposed depth of excavation, where the level of any contaminant listed in Column 1 of Table 2 is greater than the absolute maximum concentration in Column 3 of Table 2.

***in situ* material** means material that exists on or below the ground level. It does not include stockpiled material.

***in situ* sampling** means sampling undertaken on *in situ* material.

N/A means not applicable.

stockpiled material means material that has been excavated from the ground and temporarily stored on the ground prior to use.

systematic sampling means sampling at points that are selected at even intervals and are statistically unbiased.

transaction means:

- in the case of a one-off supply, the supply of a batch, truckload or stockpile of excavated natural material that is not repeated.
- in the case where the supplier has an arrangement with the recipient for more than one supply of excavated natural material, the first supply of excavated natural material as required under the arrangement.

Manager Waste Strategy and Innovation

Environment Protection Authority

(by delegation)

Notes

The EPA may amend or revoke this order at any time. It is the responsibility of each of the generator and processor to ensure it complies with all relevant requirements of the most current order. The current version of this order will be available on ' www.epa.nsw.gov.au

In gazetting or otherwise issuing this order, the EPA is not in any way endorsing the supply or use of this substance or guaranteeing that the substance will confer benefit.

The conditions set out in this order are designed to minimise the risk of potential harm to the environment, human health or agriculture, although neither this order nor the accompanying exemption guarantee that the environment, human health or agriculture will not be harmed.

Any person or entity which supplies excavated natural material should assess whether the material is fit for the purpose the material is proposed to be used for, and whether this use may cause harm. The supplier may need to seek expert engineering or technical advice.

Regardless of any exemption or order provided by the EPA, the person who causes or permits the application of the substance to land must ensure that the action is lawful and consistent with any other legislative requirements including, if applicable, any development consent(s) for managing operations on the site(s).

The supply of excavated natural material remains subject to other relevant environmental regulations in the POEO Act and Waste Regulation. For example, a person who pollutes land (s. 142A) or water (s. 120), or causes air pollution through the emission of odours (s. 126), or does not meet the special requirements for asbestos waste (Part 7 of the Waste Regulation), regardless of this order, is guilty of an offence and subject to prosecution.

This order does not alter the requirements of any other relevant legislation that must be met in supplying this material, including for example, the need to prepare a Safety Data Sheet. Failure to comply with the conditions of this order constitutes an offence under clause 93 of the Waste Regulation.

Examples

In situ sampling at depth

Example 1.

If the proposed depth of ENM excavation is between 1 m bgl and 1.4 m bgl, then:

- 1 sample on surface (as per the requirements of Table 2).
- 1 sample at 1 m bgl.
- No further depth sampling after 1 m bgl, unless required under section 4.4.4.

Example 2.

If the proposed depth of ENM excavation is at 1.75 m bgl, then:

- 1 sample on surface (as per the requirements of Table 2).
- 1 sample at 1 m bgl.
- 1 sample at 1.75 m bgl.
- No further depth sampling after 1.75 m bgl, unless required under section 4.4.4.

Example 3.

If the proposed depth of ENM excavation is at 2.25 m bgl, then:

- 1 sample on surface (as per the requirements of Table 2).
- 1 sample at 1 m bgl.
- 1 sample at 2 m bgl.
- No further depth sampling after 2 m bgl, unless required under section 4.4.4.

Appendix D – Data Quality Objectives

DATA QUALITY OBJECTIVES

The following data quality objectives (DQO) are based on the requirements detailed in Appendix IV of the *Guidelines for the NSW Site Auditor Scheme (2nd edition)* (NSW DEC, 2006).

Step 1: State the problem	The primary objective of the remediation and validation program is to: • The broad remediation goal is to remediate/manage the contamination at the site to a level where there is a low risk of adverse impact to human health or the environment and the site is made suitable for the proposed high density residential land use in accordance with relevant legislation and guidelines, taking into consideration the protection of the broader community and environment. The main problems are: • What is the extent of contamination • How many soil samples should be collected? • What sample layout should be used to achieve the above objectives? • What analytes should be tested?
Step 2: Identify the decision	• Following remediation, is the Site suitable for the proposed land use? • Based on the outcome of the remedial works, will other media (groundwater, surface water, vapour) require assessment? • If fill is brought to the site, is it suitable for use? • What is the waste classification of material designated for offsite disposal?
Step 3: Identify inputs to the decision	• A review of a previous environmental assessment undertaken at the site; • Field observations, PID screening results, soil laboratory results; • Applicable NSW EPA/DEC/DECC/DECCW/OEH/WA DOH/NEPC and CRC Care guidelines.
Step 4: Define the boundaries of the study	The study boundaries are defined by in Figures 1 to 3. Remediation excavation areas are yet to be defined. Vertically, the remediation extent is expected to be up to 0.3m and/or to the base of fill. Based on previous investigation, remediation of groundwater was not required.
Step 5: Develop a decision rule	The decision rule for soil for each identified contaminant/layer to assess the suitability of the site will be as follows: • QA/QC assessment indicates that the data is usable; • Where contaminant concentrations for each sample are below the validation acceptance criteria then no further assessment/remediation is required with respect to that contaminant/soil unit/area; • Where contaminant concentrations are reported to exceed the validation acceptance criteria, additional excavation and validation works will be carried out to ensure complete removal of the identified impact.
Step 6: Acceptable limits on decision error	There are two types of decision errors: • Sampling errors, which occur when the samples collected are not representative of the conditions within the remediation area; and • Measurement errors, which occur during sample collection, handling, preparation, analysis and data reduction.

	The null hypothesis for this study is: • Contaminant concentrations within the subsurface of the site are less than the proposed validation criteria. These errors may lead the decision maker to make the following errors: 1. Deciding that the Site has been validated when it has actually not; and 2. Deciding that the Site has not been validated when it actually is. The validation will aim with 95% probability to conclude that the site is suitable for the proposed use (i.e. the acceptable error limit for the type 1 error is 5%). For this reason, the 95% UCL will be used to assess the true mean. The consequences of a type 2 error are less than a type 1 error and therefore we propose a greater limit on the type 2 error (say 80% probability).
Step 7: Optimise the design for obtaining data.	The methodology for validation and numbers of validation samples/ locations selected will be based on the RAP as described in Section 9.3.

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