REPORT TO

HEALTH INFRASTRUCTURE NSW

ON

REMEDIATION ACTION PLAN

FOR

PROPOSED OPERATING THEATRE UPGRADE

AT

SUTHERLAND HOSPITAL

CORNER OF KINGSWAY & KAREENA ROAD

CARINGBAH, NSW

Date: 8 February 2021

Ref: E33141PArpt-RAP

JKEnvironments

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Executive Summary

Health Infrastructure NSW ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed operating theatre upgrade at Sutherland Hospital on the corner of Kingsway & Kareena Road, Caringbah, NSW. The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in the appendices.

We understand that this RAP will support the lodgement of a State Significant Development Application (SSDA) to the Department of Planning and Environment (DPE).

JKE has previously undertaken an Environmental Site Assessment (ESA) for the proposed development. The ESA included a review of historical information and soil sampling from four borehole locations. The desktop review and inspection indicated that the site area formed part of the wider Sutherland Hospital premises since at least 1956 and was used predominantly as a carpark/accessway since at least 2005. Prior to this time, the site was used for rural/agricultural purposes. A Woolworths service station was identified 150m to the north/north-west (up-gradient) of the site which had been notified to the NSW Environment Protection Authority (EPA). Historical business directory records also identified a number of mechanics in the general surrounds between the 1950s and 1990s.

The limited sampling and analysis undertaken for the ESA identified Polycyclic Aromatic Hydrocarbons (PAHs), nickel and Total Recoverable Hydrocarbons (TRH F3) in fill/soil that was assessed to pose a potential risk. Additionally, data gaps were identified in the ESA that requires further investigation when the site is accessible. The ESA recommended preparation of a RAP.

The goal of the remediation is to reduce human health and environmental risks associated with actual and potential site contamination to an acceptable level, in order to render the site suitable for the proposed development from a contamination viewpoint. The primary aims of the remediation are to manage risks associated with contamination and to remediate any contamination that is assessed to pose a risk to the receptors. The objectives of this RAP are to:

- Provide a rationale to support the extent of the proposed remediation and the remedial/site validation approach;
- Document a methodology that is to be implemented to remediate and validate the site; and
- Document a strategy that can be implemented in the event of uncovering any unexpected, contamination-related finds.

This RAP includes requirements to complete the data gap investigation and confirm the extent of remediation. Once this occurs, a Remedial Works Plan (RWP) is to be prepared. The RAP proposes two options for remediation, including 'cap and contain and management' and 'excavation and off-site disposal'. Either option, or a combination of the two options, is considered to be appropriate to mitigate the risks posed by the contaminants identified during the ESA.

A validation report is to be prepared on completion of remediation to demonstrate that the remediation was successful and to confirm that the site is suitable for the proposed development from a contamination viewpoint. An Environmental Management Plan (EMP) will also be prepared for those areas where contaminated soil is capped as these areas will be managed over the long-term so that risks remain low and acceptable.

We have assessed that the remediation falls within Category 1 under State Environmental Planning Policy No.55 – Remediation of Land (1998). This should be confirmed by the client's planning expert. JKE is of the opinion that the site can be made suitable for the proposed development provided this RAP is implemented.

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Abbreviations

Asbestos Fines/Fibrous Asbestos	**AF/FA**
Asbestos Management Plan	**AMP**
Ambient Background Concentrations	**ABC**
Asbestos Containing Material	**ACM**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Below Ground Level	**BGL**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Contaminated Land Management	**CLM**
Contaminant(s) of Potential Concern	**CoPC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Dial Before You Dig	**DBYD**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Department of Planning and Environment	**DPE**
Environmental Investigation Services	**EIS**
Environmental Management Plan	**EMP**
Excavated Natural Material	**ENM**
Environment Protection Authority	**EPA**
Environmental Site Assessment	**ESA**
Health Investigation Level	**HILs**
Health Screening Level	**HSL**
JK Environments	**JKE**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
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Photo-ionisation Detector	**PID**
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Relative Percentage Difference	**RPD**
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State Significant Development Application	**SSDA**
Total Recoverable Hydrocarbons	**TRH**
United States Environmental Protection Agency	**USEPA**
Virgin Excavated Natural Material	**VENM**
Validation Assessment Criteria	**VAC**

Volatile Organic Compounds	**VOC**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millilitres	**ml or mL**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Percentage	**%**
Percentage weight for weight	**%w/w**

1 INTRODUCTION

Health Infrastructure NSW ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed operating theatre upgrade at Sutherland Hospital on the corner of Kingsway & Kareena Road, Caringbah, NSW. The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in the appendices.

We understand that this RAP will support the lodgement of a State Significant Development Application (SSDA) to the Department of Planning and Environment (DPE).

1.1 Proposed Development Details

Based on the information provided, we understand the operating theatre upgrade includes a three-storey extension to the western side of the main existing hospital building, and minimal refurbishment works. No new basement levels are proposed as part of the upgrades. Minor alterations are also proposed to sections of the existing 'Carpark 3'.

1.2 Previous investigations

JKE has previously undertaken an Environmental Site Assessment (ESA)[1] for the proposed development. Summary information from the ESA is included in Section 2. The ESA should be read in conjunction with this report.

This RAP is also to be read in conjunction with the JK Geotechnics (JKG) Geotechnical Investigation report[2].

1.3 Remedial Goal, Aims and Objectives

The goal of the remediation is to reduce human health and environmental risks associated with actual and potential site contamination to an acceptable level, in order to render the site suitable for the proposed development from a contamination viewpoint.

The primary aims of the remediation are to manage risks associated with contamination and to remediate any contamination that is assessed to pose a risk to the receptors. The objectives of this RAP are to:

- Provide a rationale to support the extent of the proposed remediation and the remedial/site validation approach;
- Document a methodology that is to be implemented to remediate and validate the site; and
- Document a strategy that can be implemented in the event of uncovering any unexpected, contamination-related finds.

[1] JKE, (2021a). *Report to Health Infrastructure NSW on Environmental Site Assessment for Proposed Operating Theatre Upgrade at Sutherland Hospital Corner of Kingsway & Kareena Roads, Caringbah, NSW.* (Ref: E33141PArptRev1, dated 2 February 2021) (referred to as the ESA)

[2] JKG (2020). *Report to Health Infrastructure NSW on Geotechnical Investigation for Proposed Operating Theatre Upgrade at Sutherland Hospital Corner of Kingsway & Kareena Roads, Caringbah, NSW.* (Ref: 33141LXrpt, dated 9 June 2020) (referred to as the JKG report)

1.4 Scope of Work

The RAP was prepared in accordance with a JKE proposal (Ref: EP51464P3) of 18 January 2021 and was commissioned by the client via a Letter of Award (Contract No. HI20115) dated 18 January 2021. The scope of work included review of the ESA, consultation with the client's project manager (CBRE) in relation to the remediation strategy, and preparation of a RAP.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[3], other guidelines made under or with regards to the Contaminated Land Management Act (1997)[4] and State Environmental Planning Policy No.55 – Remediation of Land (1998)[5]. A list of reference documents/guidelines is included in the appendices.

[3] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)

[4] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

[5] *State Environmental Planning Policy No. 55 – Remediation of Land 1998* (NSW) (referred to as SEPP55)

2 SITE INFORMATION

2.1 Background and Summary of Site History

The ESA included a review of historical information and soil sampling from four borehole locations. The desktop review and site inspection indicated that the site area formed part of a wider Sutherland Hospital premises since at least 1956 and was used predominantly as a carpark/accessway since at least 2005. Prior to this time, the site was used for rural/agricultural purposes. A Woolworths service station was identified 150m to the north/north-west (up-gradient) of the site which had been notified to the EPA and is currently regulated under the CLM Act. Historical business directory records also identified a number of mechanics in the general surrounds between the 1950s and 1990s.

2.2 Site Identification

Table 2-1: Site Identification

Current Site Owner:	The Minister of Health
Site Address:	Corner of Kingsway & Kareena Road, Caringbah, NSW
Lot & Deposited Plan:	Part of Lot 1 in DP432283 Part of Lot 1 in DP398975 Part of Lot 1 in DP119519
Current Land Use:	Hospital (carpark/driveway)
Proposed Land Use:	Hospital (operating theatre and car park)
Local Government Authority:	Sutherland Shire Council
Current Zoning:	SP1 – Special Activities – Health Services Facilities
Site Area (m^2) (approx.):	1,900
RL (AHD in m) (approx.):	40-42
Geographical Location (decimal degrees) (approx.):	Latitude: -34.036829 Longitude: 151.114518
Site Location Plan:	Figure 1
Sample Location Plan:	Figure 2
Site Contamination Plan:	Figure 3

2.3 Site Location and Regional Setting

The wider hospital site is located in a predominantly residential and commercial area of Caringbah and is bound by Kareena Road to the west, Kingsway to the north, railway corridor (Eastern Suburbs and Illawarra Line) to the south and residential properties to the east. Predominantly residential type properties were also

located further to the north and to the west across the bounding streets, with some commercial land uses (including a private hospital) identified further to the north-west. The site is located approximately 650m to the north of Yowie Bay.

2.4 Topography

The regional topography is characterised by a gently sloping hillside that falls southwards towards Yowie Bay. The site is located mid-slope and falls to the south at approximately 3˚. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

2.5 Site Inspection

A walkover inspection of the site was undertaken by JKE on 7 May 2020 for the ESA. The inspection was limited to accessible areas of the site and immediate surrounds. A summary of the inspection findings is as follows:

- At the time of the inspection, the site comprised a relatively flat area at the western end of the wider Sutherland Hospital;
- The site included eastern part of Carpark 3 and surrounds, western parts of the main hospital building, access roads and a foot path. The carpark was retained by a concrete block masonry wall which was approximately 0.5m to 0.9m high and these changes in surface elevation were indicative of historical filling/levelling;
- Stormwater drainage infrastructure appeared to be present along the access roads through the site, with stormwater collection pit and underground overflow detection tank/s noted to be situated beneath the access road in the central part of the site. Numerous services were also noted to be present beneath the access roads through the site;
- A vegetated area was located immediately south of Carpark 3 and was overgrown with grasses containing a number of scattered medium to large trees and a fill embankment as described above. No obvious signs of vegetation stress or grass dieback were observed anywhere on site; and
- A visual hazardous building material inspection was limited to accessible external areas associated with the western façade of Main Building A where refurbishment and additions are proposed as part of the upgrades. JKE's inspection confirmed (with the existing asbestos register) the presence of non-friable asbestos containing materials associated with this part of the main building.

2.5.1 Surrounding Land Use

During the site inspection, JKE observed the following land uses in the immediate surrounds:

- North – Carpark 2, NSW Pathology Health and Administration building, accessing roads and footpath;
- North-west – Ambulance Bay and Emergency Department of Sutherland hospital;
- South / south-east – Accessing Road and Ambulance Station;
- East – Carpark 3 beyond which was Kareena Road; and
- West / south-west – Main Hospital Building.

2.5.2 Underground Services

The 'Dial Before You Dig' (DBYD) plans were reviewed for the ESA in order to establish whether any major underground services exist at the site or in the immediate vicinity that could act as a preferential pathway for contamination migration. The DBYD plans indicated that a number of services ran beneath the access road through the middle of the site (i.e. Telstra, NBN, Optus fibre optic). These were considered to be potential migration pathways for contamination. However, it is noted that the potential for such migration would depend on the fate and transport properties of the contaminants.

2.6 Summary of Geology and Hydrogeology

2.6.1 Geology and Acid Sulfate Soil (ASS)

Regional geological information reviewed for the ESA indicated that the site is underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses. The boreholes drilled for the ESA (see Figure 2 in the appendices) identified relatively shallow fill (i.e. historically imported soil or re-worked soil placed during earthworks) underlain by residual silty clay soil and siltstone and sandstone bedrock. A summary of the subsurface conditions is provided in the following table:

Table 2-2: Summary of Subsurface Conditions

Profile	Description
Pavement	Asphaltic concrete (AC)/concrete pavements were encountered at the surface in BH1, BH2 and BH3. A concrete pavement (150mm thick) was encountered at the surface in BH1 underlain by 200mm of sand gravel roadbase. AC pavement (60mm thick) was encountered at surface in BH2 and BH3 and was underlain by 50mm to 440mm of sandy gravel roadbase.
Fill	Fill was encountered at the surface or beneath the pavement in all boreholes and extended to depths of approximately 0.8 to 1.4m below ground level (BGL). The fill typically comprised sandy gravel and silty clay, with inclusions of igneous and ironstone gravel, fine to medium grained sand and brick fragments.
Natural Soil	Residual silty clay was encountered beneath the fill in each borehole and extended to depths ranging between 2.1mBGL (BH1) and 3.05mBGL (BH3).
Bedrock	Bedrock underlying the soil profile comprised siltstone overlying sandstone. The siltstone extended to depths ranging from approximately 5.8mBGL (BH3) to 7.3mBGL (BH2).
Groundwater	Groundwater seepage was not encountered in the boreholes during drilling. All boreholes remained dry on completion of auguring. On 1 June 2020 (approximately one month after drilling), groundwater levels were measured at depths of approximately 4.15mBGL, 3.15mBGL and 3.9mBGL within the monitoring wells installed (for the JKG investigation) within BH2, BH3 and BH4, respectively.

The site is not located in an acid sulfate soil (ASS) risk area according to the risk maps prepared by the Department of Land and Water Conservation.

2.6.2 Hydrogeology

Hydrogeological information reviewed for the ESA indicated that the regional aquifer on-site and, in the areas, immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were no registered groundwater bores within 500m of the site that were used for irrigation/recreation or drinking water purposes.

Considering the local topography and surrounding land features, JKE expected groundwater to flow south towards Yowie Bay.

2.6.3 Receiving Water Bodies

Excess surface water flows through the site were expected to eventuate in the on-site stormwater drains. It was expected that these would connect to municipal stormwater drainage along the main streets and eventually discharge into Yowie Bay located approximately 650m south of the site. This water body is considered to be the closest receiving water body and was identified in the ESA as a potential receptor.

3 CONCEPTUAL SITE MODEL / SITE CHARACTERISATION

NEPM (2013) defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. An iteration of the CSM and the site characterisation details based on the findings of the ESA are presented in the following sub-sections.

3.1 Contamination Sources and Contaminants of Concern/Potential Concern

The ESA identified a range of potential contamination sources and AEC. These have been refined in the table below based on a review of the ESA and the sampling and analysis that occurred for that assessment:

Table 3-1: Known and Potential Contamination Sources

Source / AEC	Contaminants of Concern and Contaminants of Potential Concern (CoPC)
Fill material – The site has been historically filled to achieve the existing levels. The boreholes drilled for the ESA encountered fill ranging in depth from approximately 0.8mBGL to 1.4mBGL.	Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), petroleum hydrocarbons (referred to as total recoverable hydrocarbons – TRHs), polycyclic aromatic hydrocarbons (PAHs) and asbestos. Concentrations of nickel, polycyclic aromatic hydrocarbons (PAHs) and total recoverable hydrocarbons (TRHs) were encountered in fill above the site assessment criteria (SAC) adopted for the ESA. Some of the fill contained inclusions of demolition rubble (brick fragments) which is a potential indicator/pre-cursor for other demolition waste such as fibre cement containing asbestos.
Parked Vehicles –Vehicles parking across the site may have resulted in spills and/or leaks of fuels/oils over a period of time in various parts of the site.	Heavy metals, TRHs, PAHs and benzene, toluene, ethylbenzene and xylene (BTEX).
Hazardous Building Material – Hazardous building materials may be present as a result of former building and demolition activities. There is a potential for these materials to have been mixed in with soil and used as fill during previous earthworks. These materials are also present in the existing buildings.	Asbestos and lead.
Off-site Land Uses (potential groundwater impacts) – Up-gradient land uses include/included service stations and mechanics. Records relating to an underground storage tank (UST) for petrol and diesel in the ambulance station to the south/south-west of the site were also identified.	Heavy metals, TRHs, naphthalene, phenols and BTEX.

We have considered the potential for the occurrence of per- and polyfluoroalkyl substances (PFAS) at the site with regards to the activities described in Table B2 in the Heads of EPAs Australia and New Zealand (HEPA) PFAS National Environmental Management Plan (2020)[6]. It is noted that agriculture is listed as an activity

[6] HEPA, (2020). *PFAS National Environmental Management Plan*. Version 2.0 dated January 2020 (referred to as NEMP 2020)

potentially associated with PFAS contamination where PFAS can be used as an adjuvant or active ingredient in fertilisers and pesticides, or in firefighting foam used in the poultry industry to destroy infected flocks. The historical aerial photographs did not indicate that any intensive agriculture/cultivation occurred on site and there was no evidence of poultry farming. On this basis PFAS is not considered to be a CoPC.

A copy of the laboratory results summary tables from the ESA is included in the appendices. The following exceedances of the SAC were reported during the ESA (see also Figure 3):

- BH3 (0.06-0.3m) – PAHs and Carcinogenic PAHs of 580mg/kg and 57mg/kg respectively, above the Health Investigation Level (HIL) B SAC;
- BH3 (0.06-0.2m) – TRH (F3) of 1,100mg/kg, above the Ecological Screening Level (ESL) SAC; and
- BH2 (0.06-0.1m) – nickel up to 80mg/kg, above the Ecological Investigation Level (EIL) SAC.

The above exceedances are considered to be associated with imported fill.

3.2 Mechanism for Contamination, Affected Media, Receptors and Exposure Pathways

The mechanisms for contamination, affected media, receptors and exposure pathways relevant to the contamination sources/AEC are outlined in the following CSM table:

Table 3-2: CSM

Mechanism for contamination	The mechanism for soil contamination includes fill placement and 'top down' impacts. The potential mechanisms for groundwater contamination are associated with off-site sources and are unknown. However, impacts to the site could occur via migration of contaminated groundwater from these areas.
Affected media	Soil has been identified as an affected medium. However, it is noted that asbestos fibres can also affect the air. Groundwater is a potentially affected medium. Both require further characterisation.
Receptor identification	Human receptors include site users (including adults and children), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users, and recreational water users within Yowie Bay. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas), and marine ecology in Yowie Bay.
Exposure pathways and mechanism	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRH, naphthalene and BTEX). The potential for exposure would typically be associated with the construction and excavation works, and future use of the site. Potential exposure pathways for ecological receptors include primary/direct contact and ingestion. The following have been identified as potential exposure mechanisms for site contamination: • Vapour intrusion into the proposed building (either from soil contamination or volatilisation of contaminants from groundwater); • Contact (dermal, ingestion or inhalation) with exposed soils in landscaped areas and/or unpaved areas, or during construction; and • Migration of groundwater off-site and into the down-gradient water body (Yowie Bay), including aquatic ecosystems and those being used for recreation.

3.3 Data Gaps

The primary data gaps include:

- Absence of groundwater data;
- Limited sample density for the ESA due to site access constraints/underground services;
- Lack of delineation of the impacted soil identified during the ESA; and
- Preliminary nature of the soil waste classification provided in the ESA.

Section 4 of this RAP outlines requirements for a data gap investigation following site establishment so that these gaps are sufficiently addressed.

4 DATA GAP INVESTIGATION REQUIREMENTS

A data gap investigation must occur when adequate site access becomes available (e.g. following site establishment and the erection of hoarding). Based on typical turnaround times, the data gap investigation and finalisation of the associated report may take approximately 3-4 weeks. The client and project manager are to factor this into the project timeline.

A Sampling, Analysis and Quality Plan (SAQP) must be prepared for the data gap investigation in accordance with NEPM 2013 and the NSW EPA Consultants reporting on contaminated land, Contaminated Land Guidelines (2020)[7]. The SAQP is to account for the following:

- The site/investigation area is to be confirmed in order to justify the sampling density/number of sample locations;
- The sampling density for asbestos is to meet the minimum requirements for sites where asbestos is "suspect", in accordance with NEPM 2013 and the Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (2009)[8] (endorsed in NEPM 2013). It is noted that this density is consistent with the number of locations for hotspot identification as outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)[9];
- Soil sampling is to occur from test pits. The test pits are to be excavated to the base of the fill and approximately 0.5m into the natural soil/bedrock. If the use of test pits is not possible, asbestos sampling is to occur from boreholes drilled using an auger with a minimum diameter of 0.2m and samples for other contaminants are to be collected using push tubes;
- Bulk (10L) samples are to be screened in the field for asbestos and 500ml samples are also to be submitted for gravimetric analysis of asbestos at the laboratory in accordance with the WA DoH 2009 and NEPM 2013 methods;
- Where required, additional sampling, analysis and reporting is to occur to provide a waste classification;
- One sample per fill profile, per location, is to be analysed for the contaminants of concern/CoPC in fill. Analysis of the underlying soils is also to occur if elevated concentrations of contaminants (above the SAC) are identified in fill;
- Analysis of soil physiochemical parameters to generate site-specific EILs;
- Groundwater sampling is to occur from three locations. This could include the existing JKG wells if these are assessed to be suitable, or alternatively, new wells must be installed;
- Groundwater samples are to be analysed for the CoPC associated with the off-site land uses;
- The groundwater flow direction is to be confirmed via a survey of the well heights and modelling; and
- Quality Control/Quality Assurance (QA/QC) sampling/analysis.

[7] NSW EPA, (2020). *Consultants reporting on contaminated land, Contaminated Land Guidelines.* (referred to as Reporting Guidelines)

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

[9] NSW EPA, (1995), *Contaminated Sites Sampling Design Guidelines.* (referred to as EPA Sampling Design Guidelines 1995)

5 EXTENT OF REMEDIATION

The extent of remediation is to be confirmed following the data gap investigation described in Section 4. Once this occurs, a Remedial Works Plan (RWP) is to be prepared to outline the remediation and validation requirements.

For the purpose of this RAP, it is assumed that the contamination impacts in fill could be delineated as 'hotspots' during the data gap investigation. However, in our opinion, it is considered more likely that the fill is heterogeneous and the delineation and remediation of 'hotspots' will not be achievable.

The final extent of remediation will be confirmed via the site validation process.

6 REMEDIATION OPTIONS

6.1 Soil Remediation

The NSW EPA follows the hierarchy set out in NEPM 2013 for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

1. On-site treatment of soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated material so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;

Or if the above are not practicable:

3. Consolidation and isolation of the soil by on-site containment within a properly designed barrier; and
4. Removal of contaminated material to an approved site or facility, followed where necessary by replacement with clean material; or
5. Where the assessment indicates that remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

For simplicity herein, the above hierarchy are respectively referred to as Option 1, Option 2, Option 3 etc.

In addition to the above, important considerations in assessing the acceptability of an asbestos remediation proposal includes the following (based on WA DoH 2009 which is endorsed under the NEPM 2013):

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

6.2 Consideration of Remediation Options

The table below discusses a range of remediation options:

Table 6-1: Consideration of Remediation Options

Option	Discussion	Applicability
Option 1 **On-site treatment of contaminated soil**	On-site treatment can provide a mechanism to reuse the processed material, and in some instances, avoid the need for large scale earthworks. Treatment options are contaminant-specific and can include bio-remediation, soil washing, air sparging and soil vapour extraction, thermal desorption and physical removal of fibre cement fragments containing asbestos. Depending on the treatment option, licenses may be necessary for specific individual waste streams due to the potential for air pollution and the formation of harmful by-products during incineration processes. Licences for re-use of treated material/waste may also be required.	Not technically achievable or economically viable for small quantities of soil contaminated with PAHs, mid to heavy-fraction TRHs and heavy metals. Applicable for asbestos if found in non-friable asbestos containing material (ACM) at the ground surface.

Option	Discussion	Applicability
Option 2 **Off-site treatment of contaminated soil**	Contaminated soils are excavated, transported to an approved/licensed treatment facility, treated to remove/stabilise the contaminants then returned to the subject site, transported to an alternative site or disposed to an approved landfill facility. This option is also contaminant-specific. The cost per tonne for transport to and from the site and for treatment is considered to be relatively high. The material would also have to be assessed in terms of suitability for reuse as part of the proposed development works under the waste and resource recovery regulatory framework.	Not technically achievable or economically viable for small quantities of soil contaminated with PAHs, mid to heavy-fraction TRHs and heavy metals.
Option 3 **Consolidation and isolation of impacted soil by cap and containment**	This would include capping material in-situ beneath appropriate barriers, or the consolidation of contaminated soil within an appropriately designed cell, followed by the placement of an appropriate barrier over the material to reduce the potential for future disturbance. The capping and/or containment must be appropriate for the specific contaminants of concern. Depending on the concentrations of contaminants being encapsulated, a long-term Environmental Management Plan (EMP) may be required and an EMP would need to be publicly notified and made to be legally enforceable (e.g. via listings in the Section 10.7 planning certificate and on the land title).	Applicable and an appropriate option to easily mitigate risks associated with non-volatile contamination.
Option 4 **Removal of contaminated material (excavation and disposal) to an appropriate facility and reinstatement with clean material**	Contaminated soils would be classified in accordance with NSW EPA guidelines for waste disposal, excavated and disposed of off-site to a licensed landfill. The material would have to meet the requirements for landfill disposal. Landfill gate fees (which may be significant) would apply in addition to transport costs.	Applicable. However, the approach is not environmentally sustainable and is unlikely to be economically viable in the event that large quantities of soil are contaminated.
Option 5 **Implementation of management strategy**	Contaminated soils would be managed in such a way to reduce risks to the receptors and monitor the conditions over time so that there is an on-going minimisation of risk. This may occur via the implementation of monitoring programs, potentially also involving capping systems.	Applicable, concurrently with Option 3.

6.3 Rationale for the Preferred Option for Remediation

6.3.1 Preferred Options

The preferred options for remediation are summarised in the following table:

Table 6-2: Preferred Options for Remediation

Preferred Options	Rationale
Options 3 and 5 – cap and contain and manage via an EMP	The soil contaminants found to date (heavy metals, mid to heavy fraction TRHs and PAHs) do not pose a risk via the vapour inhalation pathway and are well suited to capping/long-term management. As the site will be predominantly covered in hardstand (i.e. concrete beneath the building and throughout the car park), implementing this strategy is not expected to require a significant alteration to the development proposal. Eliminating access/exposure to the soil will adequately mitigate the risks posed by heavy metals, mid to heavy fraction TRHs and PAHs during future use of the site. This approach also reduces unnecessary costs associated with excavation and disposal of materials to landfill, and is considered to be environmentally sustainable.
Option 4 – excavation and off-site disposal	Excavation and disposal is considered to be appropriate in the event that contamination impacts in soil are localised and not widespread, or in the event that the client does not wish to implement a long-term EMP. Removal of contaminated material will eliminate the need for capping/management, however the potential costs associated with this option may be significant in the event large quantities of soil are found to be contaminated.

7 REMEDIATION DETAILS

7.1 Roles and Responsibilities

Table 7-1: Roles and Responsibilities

Role	Responsibility
Client/Developer and Project Manager	Health Infrastructure NSW and CBRE The client/project manager is required to appoint the project team for the remediation and must provide all assessment/investigation reports and this RAP to the remediation contractor, consent authority and any other relevant parties involved in the project. The project manager is required to review all documents prepared for the project and manage the implementation of the procedures outlined in this RAP. The project manager is to take reasonable steps so that the remediation contractor and others have understood the RAP and will implement it in its totality. The project manager will review the RAP and other documents and will update the parties involved of any changes to the development or remediation sequence (in consultation with the validation consultant). Further details are outlined in the sections below.
Remediation Contractor	To be appointed. The remediation contractor is required to review all documents prepared for the project, apply for any relevant removal licences or permits and implement the remediation requirements outlined in this RAP. The remediation contractor is required to collect all necessary documentation associated with the remediation activities and forward this documentation onto the client and project manager as they become available. Further details are outlined in the sections below.
Validation Consultant	To be appointed The validation consultant[10] provides consulting advice and validation services in relation to the remediation, and is to complete the data gap investigation and preparation of the RWP. The validation consultant is required to review any deviation to this RAP or in the event of unexpected finds if and when encountered during the site work. The validation consultant is required to liaise with the client, project manager and remediation contractor on all matters pertaining to the site contamination, remediation and validation.

7.2 Pre-commencement

The project team is to have a pre-commencement meeting to discuss the sequence of remediation, and the remediation and validation tasks. The site management plan for remediation works (see Section 10) is to be reviewed by project manager and remediation contractor, and appropriate steps are to be taken to ensure the adequate implementation of the plan.

[10] The consultant must be a certified practitioner (specialising in site contamination), under one of the NSW EPA endorsed certification schemes

7.3 Remediation and Associated Tasks

The following general sequence of works is anticipated:

- Site establishment;
- Demolition of structures (where required);
- Data gap investigation (Section 4); and
- Remediation and validation.

7.3.1 Site Establishment and Demolition

The remediation contractor is to establish on site as required to facilitate the remediation. Consideration must be given to the work sequence and extent of remediation so that the site establishment (e.g. site sheds, fencing, access points etc) does not inhibit the works. Any materials imported onto site during the site establishment (e.g. 40/70 or DGB gravels for driveways and site shed areas etc) must be validated in Accordance with Section 8.

The buildings are to be demolished with regards to the hazardous building materials survey/register and in accordance with the relevant codes and standards. All demolition waste from the buildings/structures are to be disposed off-site to facilities that are appropriately licensed to receive the waste. A clearance certificate is to be obtained by the demolition contractor following the removal of any hazardous materials.

All waste from the demolition is to be disposed to facilities that are licenced by the NSW EPA to accept the waste. The demolition contractor is to maintain adequate records and retain all documentation for such activities including:

- A summary register including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with waste disposal docket numbers;
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations, e.g. WasteLocate for asbestos); and
- Disposal dockets for the waste.

The above information is to be supplied to the validation consultant for assessment and inclusion in the site validation report.

7.3.2 Remediation – Cap and Contain

This section of the RAP outlines the generalised approach for capping and containing contaminated soil on site. Where necessary, the RWP can further refine this approach. The procedure relates to in-situ capping (i.e. where soils are left in-situ) rather than construction of a specific ‘cell’ to contain the contaminated material. The detailed validation plan relevant to this aspect of the remediation is provided in Section 8. In the event that construction of a cell is preferred as an alternative to in-situ capping, or if a cell is required in conjunction with in-situ capping, referenced should be made to the contingency option in Section 9.

The premise for implementing this option is based around capping the fill/soil beneath appropriate (clean) capping layers in order to eliminate exposure to the fill/soil. The proposed capping system requires consideration during the detailed design process so that the minimum capping requirements are achieved.

A summary of the proposed capping strategy is provided in the following table. These requirements must be reviewed by the project team prior to finalising the design, and all relevant design drawings must include the capping specification details.

Table 7-2: In-situ Capping Specification

Area	Capping Specification^
Areas of continuous pavement/hardstand (e.g. new buildings, concrete footpaths, carparks etc)	Installation of: • Geotextile marker layer over the contaminated fill; and • Overlain by any required (validated) basecourse materials and the pavement/floor slab.
Unpaved areas or areas of non-continuous pavement (e.g. landscaped zones, brick pavers etc)	Installation of: • Geotextile marker layer over the contaminated fill; and • Minimum of 500mm of clean (validated) material.
New plantings (trees, shrubs etc) and underground services	All new plantings and underground services are to be placed above (not within) the contaminated fill (i.e. must be above the marker layer). Depending on the service depths and tree planting depths, this may require excavation and the placement of additional clean (validated) material to depths of >500mm. Not required for existing services.
Tree Protections Zones (TPZs)	In the event that TPZs are identified on site. an appropriate capping procedure for TPZs is to be developed by the validation in consultant with the project arborist.

^ The capping specification relates to the remediation only and has not considered engineering design requirements for the site.

The remediation procedure is provided below:

Table 7-3: Remediation – In-situ Capping

Step	Procedure
1.	<u>Bulk earthworks/site preparations:</u> The remediation contractor is to complete the earthworks required to facilitate the proposed capping of the site. Where piling is required, piling is to occur prior to capping to minimise the potential for cross-contamination. Any imported materials used are to be validated by the validation consultant in accordance with Section 8. This may include but is not limited to coarse gravels (e.g. 40/70) for driveways, DGB, material used to create a piling platform etc.
2.	<u>Survey of site levels:</u> A pre-capping levels survey is to be completed by the remediation contractor. This must occur after the installation of the geotextile marker layer, but before the installation of any overlying capping layers. The purpose of the survey is to provide a record of the site levels across the top of the geotextile marker layer.

Step	Procedure
	Survey points are to be recorded with a spacing of not more than 10m between adjacent points. Additional survey points will be required in the vicinity of changes in surface slope.
3.	Capping: The cap is to be constructed in accordance with the capping specification (Table 7-2). A post-capping levels survey is to be completed by the remediation contractor. This must occur after the installation of the capping layers. The purpose of the survey is to provide a record of the site levels across the top of the cap and allow calculation of the thickness of capping layer. This survey can be supplemented by as built drawings if the drawings provide details of the finished levels. Survey points are to be recorded with a spacing of not more than 10m between adjacent points. Additional survey points will be required in the vicinity of changes in surface slope. Any imported materials used are to be validated by the validation consultant in accordance with Section 8. The validation consultant is required to inspect the capping works and imported materials in accordance with the validation plan.

7.3.3 Remediation – Excavation and off-site Disposal

This section of the RAP outlines the generalised approach for the excavation and off-site disposal of contaminated soil. The extent of excavation is to be confirmed by the data gap investigation and documented in the RWP. The detailed validation plan relevant to this aspect of the remediation is provided in Section 8.

The remediation procedure is outlined below:

Table 7-4: Remediation Details – Excavation and disposal of contaminated fill

Step	Procedure
1.	Personal Protective Equipment (PPE) and Work Health and Safety (WHS): The minimum PPE required for the remediation includes covered clothing, gloves and steel cap boots. Other site/project specific PPE may be required including hard hat, eye protection etc and will be dependent on the requirements of the remediation contractor.
2.	Removal of contaminated fill: Excavation of the remediation area will be undertaken as follows: • The remediation area will be market out using pegs or marking paint; • Prepare waste classification documentation for the material in accordance with the NSW EPA guidelines; • Submit an application to dispose the fill (in accordance with the assigned waste classification) to a landfill licensed by the NSW EPA to receive the waste and obtain authorisation to dispose; • A water system will need to be in place to spray the excavated soil during excavation. The general site area should be kept damp during remediation works to minimise the generation of dust; • The remediation area is to be excavated to the base of the fill and down to the surface of the underlying natural soil; • Load the fill onto trucks and dispose in accordance with the assigned waste classification to the receiving landfill facility; and • All documents including landfill dockets must be retained and forwarded to the client and validation consultant for inclusion into the validation report.

Step	Procedure
3.	Validation of Excavation Base and Walls: • Once all fill is removed, the base and walls of the excavation are to be validated (by the validation consultant) in accordance with Section 8; • If the validation fails, the contaminated area must be chased out (under the guidance of the validation consultant) and re-validated until the validation is successful; and • If the validation is successful, the excavation can be continued to achieve the finished levels, or reinstated with clean (validated) imported or site-won material.

7.4 Remediation Documentation

The remediation contractor must retain all documentation associated with the remediation, including but not limited to:

- Waste/surplus soil disposal dockets (see additional details below);
- Waste disposal dockets and tracking documentation (see additional details below in Section 7.4.1 and Appendix C);
- Imported materials information (see additional details below in Section 7.4.2 and Appendix C);
- Asbestos management documentation (where asbestos removal occurs), including all relevant notifications, monitoring reports and asbestos clearance certificates; and
- Photographs of remediation works;

Copies of these documents must be forwarded to the validation consultant for inclusion in the validation report.

7.4.1 Waste

All waste removed from the site is to be appropriately tracked and managed in accordance with the relevant regulations. The remediation contractor (and/or their nominated construction contractor) is to maintain adequate records and retain all documentation for waste disposal activities including:

- A summary register (in Microsoft Excel format) including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with the associated waste classification documentation and the waste disposal docket numbers; and
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste.

Any soil waste classification documentation is to be prepared in accordance with the reporting requirements specified by the NSW EPA as outlined in the Reporting Guidelines.

Waste information is to be reviewed by the validation consultant on completion of the works and an assessment of the quantities of soil disposed off-site (e.g. comparison with the estimated and actual volumes) is to occur. A review of the disposal facility's Environment Protection Licence (EPL) issued under the

Protection of the Environment Operations (POEO) Act (1997)[11] is to be undertaken to assess whether the facility is appropriately licensed to receive the waste.

7.4.2 Imported Materials

The remediation contractor (and/or their nominated construction contractor) is to maintain for the duration of the project an imported material register. This must include a register (in Microsoft Excel format) with details of each imported material type, supplier details, summary record of where the imported materials were placed on site, and importation docket numbers and a tally of quantities (separated for each import stream). Dockets for imported materials are to be provided electronically so these can be reconciled with the register.

The above information is to be provided to the validation consultant for inclusion in the validation report. It is recommended that the register be set up at the beginning of the project and provided to the validation consultant regularly (say on a bi-monthly basis) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

[11]NSW Government, (1997)). *Protection of Environment Operations Act.* (referred to as POEO Act 1997)

8 VALIDATION PLAN

Validation is necessary to demonstrate that remedial measures described in the RAP have been successful and that the site is suitable for the intended land use. The sampling program for the validation is outlined in Section 8.1. This is the minimum requirement based on the remedial strategies provided.

8.1 Validation Sampling and Documentation

The table below outlines the validation requirements for the site:

Table 8-1: Validation Requirements

Aspect	Sampling	Analysis	Observations and Documentation
Cap and Contain (Section 7.3.2)			
Survey of site levels	Not required	Not required	**Remediation contractor** to obtain the survey information. It is also expected that the remediation contractor will provide design/as-built drawings for the project which document the capping layers.
Inspections	Not required	Not required	**Validation consultant** to carry out inspections to document the installation of the cap. Key hold points for inspections include: - Geotextile marker installation; - During importation of materials used to construct the cap; and - Finished surface levels. A photographic record is to be maintained by the **remediation contractor** and **validation consultant**.
Validation of imported materials	As indicated below	As indicated below	As indicated below
Excavation and Off-site Disposal (Section 7.3.3)			
Validation sampling after fill removal	One sample per 100m^2 at the base of the excavation (i.e. on a 10m by 10m grid) and one sample per 5m lineal along the excavation walls. Wall samples are to target all fill profiles/stratum changes and the depth of the original soil exceedance/s that triggered the remediation at that location.	Contaminants of concern for remediation, as identified during the data gap investigation.	**Validation consultant** is to: - Document observations to confirm fill removal is acceptable; - Photograph the excavation; and - Evaluate waste disposal information. **Remediation contractor** to provide documentation relating to waste disposal.

Aspect	Sampling	Analysis	Observations and Documentation
Imported Materials – validation of imported materials is required for any materials imported onto the site during the remediation and to the point in time that the site validation report is prepared (e.g. general fill to raise the site levels, imported materials to create piling platform, gravels for site preparation, material used for capping layers etc).			
Imported Virgin Excavated Natural Material (VENM) backfill	Minimum of three samples per source. One additional sample per 100m^3 for quantities in excess of 300m^3.	Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc), TRHs, BTEX, PAHs, Organochlorine pesticides (OCPs), polychlorinated biphenyls and asbestos. Additional analysis may be required depending on the site history of the source property.	**Remediation contractor** to supply existing VENM documentation/report (report to be prepared in accordance with the NSW EPA waste classification reporting requirements). A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Material is to be inspected upon importation by the **validation consultant** to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Photographic documentation and an inspection log are to be maintained. Where check sampling occurs by the **validation consultant** due to deficiencies or irregularities in existing VENM documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the Validation Assessment Criteria (VAC).
Imported engineering materials such as recycled aggregate, road base etc or Excavated Natural Material (ENM)	Minimum of three samples per source. One additional sample per 100m^3 for quantities in excess of 300m^3. Additional testing may be required for ENM to meet the specification within the ENM Order.	Heavy metals (as above), TRHs, BTEX, PAHs, OCPs, PCBs and asbestos. Additional testing may be required for ENM (e.g. foreign materials, pH and electrical conductivity) depending on available documentation.	**Remediation contractor** to provide product specification and documentation to confirm the material has been classified with reference to a relevant Resource Recovery Order/Exemption. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the facility's EPL. Material is to be inspected by the **validation consultant** upon importation to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Where check sampling occurs by the **validation consultant** due to deficiencies or

Aspect	Sampling	Analysis	Observations and Documentation
			irregularities in existing documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the VAC.
Imported engineering materials comprising only natural quarried products.	At the validation consultant's discretion based on robustness of supplier documentation and the initial inspection.	At the validation consultant's discretion based on robustness of supplier documentation and the initial inspection.	**Remediation contractor** to provide documentation from the supplier confirming the material is a product produced using only virgin natural soil or rock (i.e. natural quarried product). A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Review of the quarry's EPL. Material is to be inspected by the **validation consultant** upon importation to confirm it is free of anthropogenic materials, visible and olfactory indicators of contamination, and is consistent with documentation. Where check sampling occurs by the **validation consultant** due to deficiencies or irregularities in existing documentation, the following is required: - Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; - Sample location plan; and - Analytical reports and tabulated results with comparison to the VAC.
Landscaping materials	Minimum of three samples per source.	Asbestos.	**Remediation contractor** to provide product specification and documentation to detail the material types being imported. A hold point remains until the **validation consultant** approves the material for importation or advises on the next steps. Material is to be inspected by the **validation consultant** upon importation to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Where check sampling occurs by the **validation consultant** for asbestos, the following is required:

Aspect	Sampling	Analysis	Observations and Documentation
			- Date of sampling and description of material sampled; - An estimate of the volume of material imported at the time of sampling; and - Analytical reports and tabulated results with comparison to the VAC.

8.2 Validation Assessment Criteria and Data Assessment

The VAC to be adopted for the validation assessment are outlined in the table below:

Table 8-2: VAC

Validation Aspect	VAC
Data Gap Investigation (Section 4)	Soil VAC are to include the land use 'B' criteria, the commercial/industrial criteria for ecological assessment, and the direct contact and management limits based on Schedule B1 of NEPM 2013. Groundwater VAC are to include: • The land use 'B' criteria for vapour intrusion based on Schedule B1 of NEPM 2013; • The Australian Drinking Water Guidelines 2011 (updated 2018)[12] multiplied by a factor of 10 to assess potential risks associated with incidental/recreational-type exposure to groundwater (e.g. within down-gradient water bodies); and • Groundwater Investigation Levels (GILs) for 95% protection of marine species based on the Default Guideline Values in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)[13]. The 99% trigger values are to adopted where required to account for bioaccumulation and low and moderate reliability trigger values are to be adopted where high-reliability trigger values don't exist.
Cap and Contain (Section 7.3.2)	Survey and inspections to confirm that the minimum capping requirements have been achieved. Minimum 500mm clean cap required in unpaved areas.
Excavation and Off-site Disposal (Section 7.3.3)	Concentrations in the base and wall samples are to be below the land use 'B' criteria, the commercial/industrial criteria for ecological assessment and the direct contact and management limits, as applicable based on the contaminant(s) being remediated. These criteria are derived from Schedule B1 of NEPM 2013.
Imported materials	All results for imported materials are to be compared to the HIL/HSL-B criteria to check they do not pose a risk to human health in the proposed land use scenario. Results for VENM and other imported materials will need to be consistent with expectations for those materials. VENM must meet the definition presented in the waste classification guidelines and the POEO Act 1997. The following VAC also apply: - Asbestos not detected; - Heavy metal concentrations are to be less than the most conservative Added Contaminant Limit (ACL) concentrations for a commercial/industrial exposure setting presented in Schedule B1 of the NEPM 2013; and

[12] National Health and Medical Research Council (NHMRC), (2018). *National Water Quality Management Strategy, Australian Drinking Water Guidelines 2011* (referred to as ADWG 2011)

[13] Australian and New Zealand Governments (ANZG), (2018). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (referred to as ANZG 2018)

Validation Aspect	VAC
	- Organic compounds are to be less than the laboratory Practical Quantitation Limits (PQLs) and asbestos is to be absent. Recycled materials are to meet the criteria of the relevant exemption/order under which they are produced. Aesthetics: soils to be free of staining and odours.

Laboratory data should initially be assessed as above or below the VAC. Statistical analysis may be applied if deemed appropriate by the consultant and undertaken in accordance with the NEPM 2013.

8.3 Validation Report

As part of the validation process, a site validation report will be prepared by the validation consultant. The report will present the results of the validation assessment and will be prepared in accordance with the Reporting Guidelines.

An EMP will be required to manage contamination that is capped at the site and the EMP will be documented as part of the overall validation process. Public notification and enforcement mechanisms for the EMP are to be arranged and the consent authority and the local council are to be provided with a draft copy of the EMP for consultation prior to finalisation of the document.

The notification and enforcement mechanisms are to include notation on the planning certificate under Section 10.7 of the Environmental Planning and Assessment Act (1979) and a covenant registered on the title to land under Section 88B of the Conveyancing Act (1919).

The EMP will include requirements for passive management of the capping system that will focus on maintaining the capping layers to minimise the potential of exposure to the underlying fill. The EMP will also include contingencies for managing intrusive works in the event that the capping system is breached.

8.4 Data Quality

Appropriate QA/QC samples are to be obtained during the validation (where applicable) and analysed for the same suite of contaminants as the primary samples. As a minimum, QA/QC sampling should include duplicates (5% inter-laboratory and 5% intra-laboratory), trip spikes and trip blanks. Rinsate samples are to be obtained if re-usable sampling equipment is utilised.

Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) should be clearly outlined and assessed as part of the validation process. A framework for the DQO and DQI process is outlined below and should be reflected in the validation report. DQOs have been broadly established for the validation with regards to the seven-step process outlined NEPM (2013), noting that these will be documented separately for the data gap investigation outlined in Section 4. The seven steps include the following which are detailed further in the following subsections:

- State the problem;
- Identify the decisions/goal of the study;
- Identify information inputs;
- Define the study boundary;
- Develop the analytical approach/decision rule;
- Specify the performance/acceptance criteria; and
- Optimise the design for obtaining the data.

DQIs are to be assessed based on field and laboratory considerations for precision, accuracy, representativeness, completeness and comparability.

8.4.1 Step 1 - State the Problem

Validation data is required to demonstrate that the remediation is successful and that the site is suitable for the proposed land use.

8.4.2 Step 2 - Identify the Decisions of the Study

The remediation goal, aims and objectives are defined in Section 1.3. The decisions to be made reflect these objectives and are as follows:

- Was the remediation undertaken in accordance with the RAP?
- If there were any deviations, what were these and how do they impact the outcome of the validation?
- Are any of the validation results above the VAC?
- Is the site suitable for the proposed development from a contamination viewpoint?

8.4.3 Step 3 - Identify Information Inputs

The primary information inputs required to address the decisions outlined in Step 2 include the following:

- Existing relevant data from previous reports;
- Site information, including site observations, inspections, survey information, as-built drawings, waste and imported materials registers;
- Validation sampling of remedial excavations where excavation and disposal methods are utilised;
- Validation of capping procedures where capping occurs;
- Validation sampling of imported materials; and
- Field and laboratory QA/QC data.

8.4.4 Step 4 - Define the Study Boundary

The remediation and validation will be confined to the site boundaries as shown in Figure 2 in the appendices and will be limited vertically to the depth of the contaminated soil. This is to be confirmed following the data gap investigation within the RWP.

8.4.5 Step 5 - Develop an Analytical Approach (or Decision Rule)

8.4.5.1 VAC

The validation data will be assessed in accordance with the requirements outlined in Section 8.2.

8.4.5.2 Field and Laboratory QA/QC

Field QA/QC is to include analysis of inter-laboratory duplicates (5% frequency), intra-laboratory duplicates (5% frequency), trip spike, trip blank and rinsate samples (one each for the assessment to demonstrate adequacy of standard sampling/handling procedures). Field QA/QC samples are to be analysed for the contaminants of concern, except asbestos. Trip spikes will only be analysed for BTEX.

DQIs for field and laboratory QA/QC samples are defined below:

Field Duplicates

Acceptable targets for precision of field duplicates will be 30% or less, consistent with NEPM (2013). RPD failures will be considered qualitatively on a case-by-case basis taking into account factors such as the concentrations used to calculate the RPD (i.e. RPD exceedance where concentrations are close to the PQL are typically not as significant as those where concentrations are reported at least five or 10 times the PQL), sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Trip Blanks

Acceptable targets for trip blank samples will be less than the PQL for organic analytes. Metals will be considered on a case-by-case basis with regards to the reference material used as the blank medium.

Trip Spikes

Acceptable targets for trip spike samples will be 70% to 130%.

Laboratory QA/QC

The suitability of the laboratory data will be assessed against the laboratory QA/QC criteria. These criteria are developed and implemented in accordance with the laboratory's NATA accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.

A summary of the typical limits is provided below:

RPDs

- Results that are <5 times the PQL, any RPD is acceptable; and
- Results >5 times the PQL, RPDs between 0-50% are acceptable.

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics; and
- 60-140% recovery acceptable for organics.

Surrogate Spikes

- 60-140% recovery acceptable for general organics.

Method Blanks

- All results less than PQL.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence will be reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation with the laboratory is to be undertaken in an effort to establish the cause of the non-conformance. Where uncertainty exists, the validation consultant is to adopt the most conservative concentration reported.

8.4.5.3 Appropriateness of PQLs

The PQLs of the analytical methods are to be considered in relation to the VAC to confirm that the PQLs are less than the VAC. In cases where the PQLs are greater than the VAC, a discussion of this is to be provided.

8.4.6 Step 6 – Specify Limits on Decision Errors

To limit the potential for decision errors, a range of quality assurance processes are adopted. A quantitative assessment of the potential for false positives and false negatives in the analytical results is to be undertaken with reference to Schedule B(3) of NEPM (2013) using the data quality assurance information collected.

8.4.7 Step 7 - Optimise the Design for Obtaining Data

The design is to be optimised via the collection of validation data to demonstrate the success of the key aspects of the remediation. Data collection will be via various methods including inspections and sampling.

8.4.8 Sampling Plan

The proposed sampling plan for the validation is described in Section 8.1.

9 CONTINGENCY PLAN

The following subsections include contingencies for remediation that are to be implemented in the event that the proposed remediation strategies are not preferred or are unachievable based on the final design of the project. An unexpected finds protocol is also included.

9.1 Containment Cell

The RAP acknowledges that in-situ capping may not be achievable in all areas and the ability to cap contaminated soil in situ will depend largely on the depths of contaminated soil and the proposed design levels for the site. This contingency plan is to be implemented if a containment cell is to be constructed for contaminated soil, as an alternative to or in conjunction with the in-situ capping.

An appropriate area is to be identified for the location of the containment cell. If there is no available information on the subsurface conditions in this area, an investigation must occur to establish the depth of fill, natural soil and bedrock, and the potential occurrence of groundwater. It is noted that any constructed cell must be above the groundwater table and must not be regularly/permanently inundated with water.

Once the preferred location of the cell is established, the remediation contractor is to prepare a RWP to the satisfaction of the project manager/client and the validation consultant. The RWP is to include, as a minimum:

- Survey plans indicating the nominated area for the cell, including survey coordinates for the horizontal extent of the cell;
- Design details including relative levels (RLs) for the base of the cell, top of the contaminated soil to be placed within it, RLs to the top of the clean soil cap, and details regarding the site features and surface finishes to be constructed over the cell as part of the proposed development (e.g. pavements etc);
- Details for the earthworks, including geotechnical requirements (including but not limited to compaction of the cell contents and capping layers, batter requirements, and consideration of root-affected/organic content in root-affected soils to be excavated), locations of access ramps, temporary stockpiling locations for material excavated from the cell area during its construction, and materials management practices to minimise the potential for cross contamination with the remediation areas;
- A process so that some of the virgin excavated natural material (VENM) excavated to create the cell is preferably re-used to cap the cell;
- A specification for a clean soil cap over the cell to reflect the capping requirements specified in Section 7.3.2; and
- A contingency plan in the event that additional capacity is required, including the location of secondary cells or areas where the original cell could be expanded.

The containment cell is to be constructed as outlined in the following table. A detailed validation plan is to be established by the validation consultant based on the requirements of the RWP. The generalised remediation steps for the cell are outlined in the following table:

Table 9-1: Remediation – Construction of Containment Cell

Step	Procedure
1.	Waste Classification: Prior to commencement of excavation, the validation consultant is to undertake a waste classification assessment for any surplus materials to be excavated and disposed off-site during the cell construction. Preferably, site-won VENM (i.e. excavated to construct the cell) is to be used to cap the cell to reduce the off-site disposal of waste.
2.	Implementation of RWP to construct the cell: The cell is to be excavated/constructed in accordance with the RWP. As-built details for the cell are to be documented on construction drawings by the remediation contractor.

9.2 Unexpected Finds

Residual hazards that may exist at the site would generally be expected to be detectable through visual or olfactory means. At this site, these types of hazards may include: sub-surface infrastructure made from ACM; odorous or stained hydrocarbon impacted soils; or unexpected inclusions in fill such as fibre cement/ACM, or gravelly slag etc. The procedure to be followed in the event of an unexpected find is presented below:

- In the event of an unexpected find, all work in the immediate vicinity should cease and the contractor should contact the validation consultant and the project manager;
- Temporary barricades should be erected to isolate the area from access to workers;
- The validation consultant is to attend the site, adequately characterise the contamination and provide advice in relation to remediation. In the event that remediation differs from that outlined in this RAP, an addendum RAP or RWP must be prepared in consultation with the project stakeholders and submitted to the consent authority; and
- Contamination should be remediated and validated in accordance with the advice provided, and the results should be included in the validation report.

9.3 Importation Failure for VENM or other Imported Materials

Where material to be imported onto the site does not meet the importation VAC detailed in Section 8.2, the material should not be imported. Alternative material must be sourced that meets the importation requirements.

10 SITE MANAGEMENT PLAN FOR REMEDIATION WORKS

The information outlined in this section of the RAP is for the remediation work only. The client should make reference to the development consent for specific site management requirements for the overall development of the site.

10.1 Interim Site Management

No interim site management measures are considered necessary.

10.2 Project Contacts

Emergency procedures and contact telephone numbers should be displayed in a prominent position at the site entrance gate and within the main site working areas. The contact details of key project personnel are summarised in the following table:

Table 10-1: Project Contacts

Role	Company	Contact Details
Project Manager	CBRE	Gavin Statham Gavin.Statham@cbre.com M: 0413 104 045
Remediation Contractor	To be appointed	-
Validation Consultant	To be appointed	-
Certifier	To be appointed	-
NSW EPA	Pollution Line	131 555
Emergency Services	Ambulance, Police, Fire	000

10.3 Security

Appropriate fencing should be installed as required to secure the site and to isolate the remediation areas. Warning signs should be erected, which outline the PPE required for remediation work.

10.4 Timing and Sequencing of Remediation Works

The anticipated sequence of remediation works is outlined in Section 7.3. Where capping occurs, remediation will take place concurrently with the proposed development as the proposed development features such as the landscaping, building slabs/pavement etc will for part of the cap.

10.5 Site Soil and Water Management Plan

The remediation contractor is to prepare a detailed soil and water management plan prior to the commencement of site works. Silt fences should be used to control the surface water runoff at all appropriate locations of the site and appropriate measures are to be implemented to manage soil/water disturbance to the satisfaction of the regulator/consent authority. Reference should be made to the consent conditions for further details.

All stockpiled materials should be placed within an erosion containment boundary with silt fences and sandbags employed to limit sediment movement. The containment area should be located away from drainage lines/low-points, gutters, stormwater pits and inlets and the site boundary. No liquid waste or runoff should be discharged to the stormwater or sewerage system without the approval of the appropriate authorities.

10.6 Noise and Vibration Control Plan

The guidelines for minimisation of noise on construction sites outlined in AS-2460 (2002)[14] should be adopted. Other measures specified in the consent conditions should also be complied with. Noise producing machinery and equipment should only be operated between the hours approved by the consent authority (refer to consent documents).

All practicable measures should be taken to reduce the generation of noise and vibration to within acceptable limits. In the event that short-term noisy operations are necessary, and where these are likely to affect residences, notifications should be provided to the relevant authorities and the residents by the project manager, specifying the expected duration of the noisy works.

10.7 Dust Control Plan

All practicable measures should be taken to reduce dust emanating from the site. Factors that contribute to dust production are:

- Wind over a cleared surface;
- Wind over stockpiled material; and
- Movement of machinery in unpaved areas.

Visible dust should not be present at the site boundary. Measures to minimise the potential for dust generation include:

- Use of water sprays on unsealed or exposed soil surfaces;
- Covering of stockpiled materials and excavation faces (particularly during periods of site inactivity and/or during windy conditions) or alternatively the erection of hessian fences around stockpiled soil or large exposed areas of soil;
- Establishment of dust screens consisting of a 2m high shade cloth or similar material secured to a chain wire fence;

[14] Australian Standard, (2002). *AS2460: Acoustics - Measurement of the Reverberation Time in Rooms.*

- Maintenance of dust control measures to keep the facilities in good operating condition;
- Stopping work during strong winds;
- Loading or unloading of dry soil as close as possible to stockpiles to prevent spreading of loose material around the development area; and
- The expanse of cleared land should be kept to a minimum to achieve a clean and economical working environment. Geofabric is to be placed over exposed soils in the event that excavation is staged.

If stockpiles are to remain on-site or soil remains exposed for a period of longer than several days, dust monitoring should be undertaken at the site. If excessive dust is generated all site activities should cease until either wind conditions are more acceptable or a revised method of excavation/remediation is developed.

Dust is also produced during the transfer of material to and from the site. All material should be covered during transport and should be properly disposed of on delivery. No material is to be left in an exposed, un-monitored condition.

All equipment and machinery should be brushed down before leaving the site to limit dust and sediment movement off-site.

10.8 Dewatering

Temporary dewatering is not anticipated to be required as part of the remediation works. If a rain event occurs during the construction of a containment cell, this water should be managed appropriately on site in accordance with the remediation contractor's soil and water management plan. This water should not be pumped to stormwater or sewer unless a prior application is made and this is approved by the relevant authorities.

10.9 Odour Control Plan

All activities undertaken at the site are to be completed in a manner that minimises emissions of smoke, fumes and vapour into the atmosphere and any odours arising from the works or stockpiled material should be controlled. Control measures may include:

- Maintenance of construction equipment so that exhaust emissions comply with the Clean Air Regulations issued under the POEO Act 1997;
- Demolition materials and other combustible waste should not be burnt on site;
- The spraying of a suitable proprietary product to suppress any odours that may be generated by excavated materials; and
- Use of protective covers (e.g. builder's plastic).

All practicable measures should be taken to reduce fugitive emissions emanating from the site so that associated odours do not constitute a nuisance and that the ambient air quality is not adversely impacted.

The following odour management plan should be implemented to limit the exposure of site personnel and surrounding residents to unpleasant odours:

- Excavation and stockpiling of material should be scheduled during periods with low winds if possible;
- A suitable proprietary product could be sprayed on material during excavation and following stockpiling to reduce odours (subject to an appropriate assessment of the product by the validation consultant);
- All complaints from workers and neighbours should be logged and a response provided. Work should be rescheduled as necessary to minimise odour problems;
- The site foreman should consider the following odour control measures as outlined in NEPM:
  - reduce the exposed surface of the odorous materials;
  - time excavation activities to reduce off-site nuisance (particularly during strong winds); and
  - cover exposed excavation faces overnight or during periods of low excavation activity.
- If continued complaints are received, alternative odour management strategies should be considered and implemented.

10.10 WHS Plan

A site specific WHS plan is to be prepared by the remediation contractor for all work to be undertaken at the site. The WHS plan should meet all the requirements outlined in SafeWork NSW WHS regulations.

As a minimum requirement, personnel must wear appropriate protective clothing, including long sleeve shirts, long trousers, steel cap boots and hard hats. Additional asbestos-related PPE will be required in the event that asbestos remediation occurs or in the event of an asbestos-related unexpected find. Washroom and lunchroom facilities should also be provided to allow workers to remove potential contamination from their hands and clothing prior to eating or drinking.

10.11 Waste Management

Prior to commencement of remedial works and excavation for the proposed development, the remediation contractor should develop a waste management or recycling plan to minimise the amount of waste produced by the site. This should, as a minimum, include measures to recycle and re-use natural excavated material wherever possible.

10.12 Incident Management Contingency

The validation consultant should be contacted if any unexpected conditions are encountered at the site. This should enable the scope of remedial/validation works to be adjusted as required. Similarly, if any incident occurs at the site, the validation consultant should be advised to assess potential impacts on contamination conditions and the remediation/validation timetable.

10.13 Hours of Operation

Hours of operation should be between those approved by the consent authority under the development approval process.

10.14 Community Consultation and Complaints

The remediation contractor should provide details for managing community consultation and complaints within their site management plans.

11 CONCLUSION

The ESA identified PAHs, nickel and TRH (F3) in fill that was assessed to pose a potential risk. Additionally, data gaps were identified in the ESA that require further investigation. This RAP includes requirements to complete the data gap investigation and confirm the extent of remediation. Once this occurs, a RWP is to be prepared.

The RAP proposes two options for remediation, including 'cap and contain and management under an EMP' and 'excavation and off-site disposal'. Either option, or a combination of the two options, is considered to be appropriate to mitigate the risks posed by the contaminants identified during the ESA.

A validation report is to be prepared on completion of remediation to demonstrate that the remediation was successful and to confirm that the site is suitable for the proposed development from a contamination viewpoint. An EMP will also be prepared for those areas where contaminated soil is capped as these areas will be managed over the long-term so that risks remain low and acceptable.

JKE are of the opinion that the site can be made suitable for the proposed development provided this RAP is implemented.

11.1 Regulatory Requirements

The regulatory requirements applicable for the remediation are discussed in the following table:

Table 11-1: Regulatory Requirement

Guideline / Legislation / Policy	Applicability
SEPP55	We have assessed that the remediation falls within Category 1 under Clause 9(d) of SEPP55 as State Environmental Planning Policy (State and Regional Development) 2011 applies. This should be confirmed by the client's planning expert. Under Clause 17 of SEPP55, a notice of completion of remediation work is to be given to council and DPE within 30 days of completion of the work. The notice of completion of remediation works must be in accordance with Clause 18 of SEPP55.
POEO Act 1997	Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. Appropriate waste tracking is required for all waste that is disposed off-site. Activities should be carried out in a manner which does not result in the pollution of waters.
POEO (Waste) Regulation 2014	Part 7 of the POEO Waste Regulation 2014 set outs the requirements for the transportation and management of asbestos waste and Clause 79 of the POEO Waste Regulation requires waste transporters to provide information to the NSW EPA regarding the movement of any load in NSW of more than 10 square meters of asbestos sheeting, or 100 kilograms of asbestos waste. To fulfil these legal obligations, asbestos waste transporters must use WasteLocate.

Guideline / Legislation / Policy	Applicability
	Clause 78 of the POEO Waste Regulation requires that a person who transport asbestos waste must ensure that: • Any part of any vehicle in which the person transports the waste is covered, and leak-proof, during the transportation; and • If the waste consists of bonded asbestos material—it is securely packaged during the transportation; and • If the waste consists of friable asbestos material—it is kept in a sealed container during transportation; and • If the waste consists of asbestos-contaminated soils—it is wetted down. Asbestos waste in any form cannot be re-used or recycled.
SafeWork NSW Code of Practice: How to manage and control asbestos in the workplace (2019)	Sites with asbestos become a 'workplace' when work is carried out there and require a register and AMP. Appropriate SafeWork NSW notification will be required for asbestos removal works or handling. Contractors are also required to be appropriately licensed for asbestos-related remediation works undertaken.

12 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Important Information About This Report

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

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

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

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

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

This Report is based on Professional Interpretations of Factual Data
Site assessments identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

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

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

Misinterpretation of Site Assessments by Design Professionals

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

Logs Should not be Separated from the Assessment Report

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

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

Read Responsibility Clauses Closely

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

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title: **SITE LOCATION PLAN**

Location: CNR KINGSWAY AND KAREENA ROAD, CARINGBAH, NSW

Project No: E33141PA

Figure No: 1

JKEnvironments

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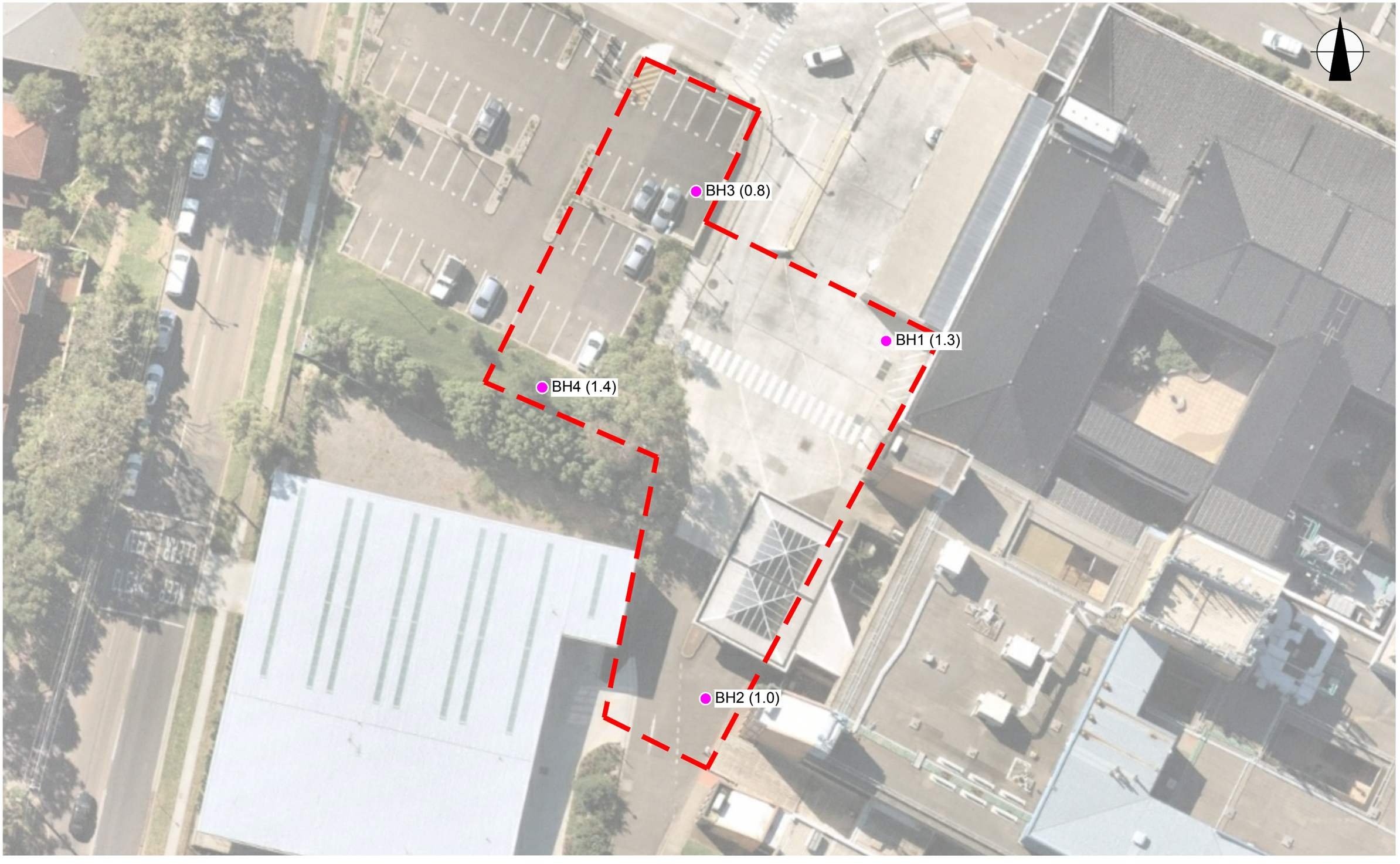

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

0 4 8 12 16 20

SCALE 1:400 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **SAMPLE LOCATION PLAN**

Location: CNR KINGSWAY AND KAREENA ROAD, CARINGBAH, NSW

Project No: E33141PA

Figure No: 2

JKEnvironments

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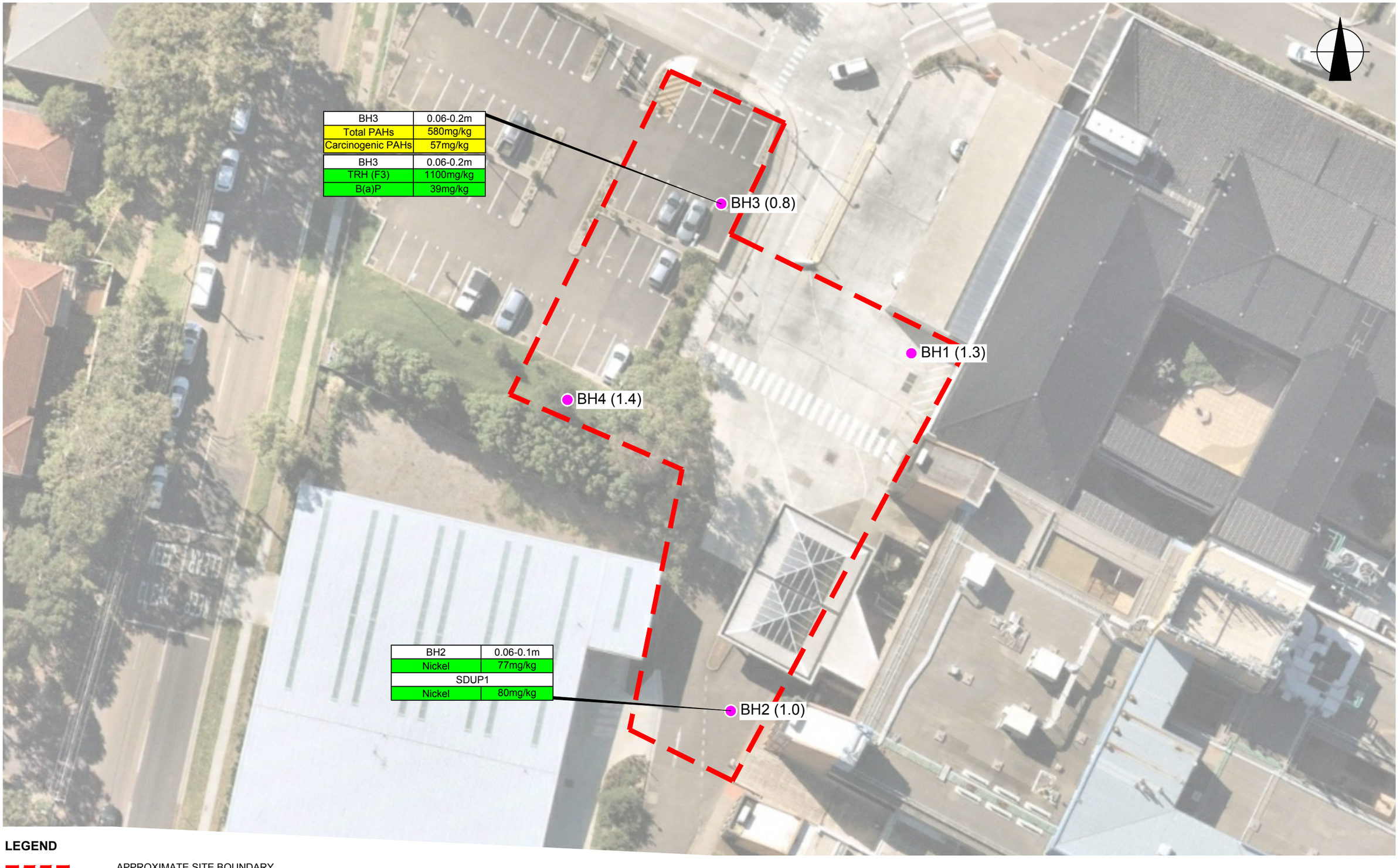

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

- SOIL/SURFACE CONTAMINATION ABOVE SAC FOR HUMAN HEALTH RISK
- SOIL CONTAMINATION ABOVE SAC FOR ECOLOGICAL RISK

0 4 8 12 16 20

SCALE 1:400 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **CONTAMINATION LOCATION PLAN**

Location: CNR KINGSWAY AND KAREENA ROAD, CARINGBAH, NSW

Project No: E33141PA

Figure No: 3

JKEnvironments

PLOT DATE: 5/06/2020 12:47:00 PM DWG FILE: L:\5C EIS JOBS\33000'S\E33141PA CARINGBAH (SUTHERLAND HOSPITAL)\CAD\E33141PA.DWG

Appendix B: ESA Data Summary Tables

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZG	Australian and New Zealand Guidelines
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
GSW:	General Solid Waste
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
kg/L	kilograms per litre
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
%w/w:	weight per weight
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} :	pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} :	pH of filtered 1:20 1M KCl after peroxide digestion
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
RSW:	Restricted Solid Waste
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
S_{Cr}:	Chromium reducible sulfur
S_{POS}:	Peroxide oxidisable Sulfur
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
UCL:	Upper Level Confidence Limit on Mean Value
USEPA	United States Environmental Protection Agency
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-B: 'Residential with minimal opportunities for soil access; including dwellings with fully/permanently paved yards like high-rise buildings'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PHENOLICS (as Phenol)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos			
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	5	0.1	100
Site Assessment Criteria (SAC)			500	150	500	30000	1200	120	1200	60000	400	4	15	400	500	10	90	600	10	340	50000	1	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																					
BH1	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**22**	**19**	**20**	<0.1	**9**	**46**	**3.8**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**12**	**17**	**22**	<0.1	**9**	**110**	**0.5**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	NA
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**10**	**15**	**18**	<0.1	**10**	**48**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.5-0.6	Fill: Silty Clay	**5**	<0.4	**15**	**21**	**31**	<0.1	**24**	**49**	**1.6**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0.06-0.1	Fill: Sandy Gravel	<4	<0.4	**22**	**39**	**7**	<0.1	**77**	**33**	**0.1**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0.1-0.2	Fill: Silty Clay	**7**	<0.4	**15**	**12**	**30**	<0.1	**6**	**24**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH3	0.06-0.2	Fill: Sandy Gravel	<4	<0.4	**25**	**36**	**14**	<0.1	**5**	**32**	**580**	**57**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH3	0.5-0.6	Fill: Sandy Gravel	**4**	<0.4	**28**	**31**	**16**	<0.1	**11**	**34**	**0.3**	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH4	0.1-0.2	Fill: Silty Clay	**7**	<0.4	**11**	**21**	**49**	<0.1	**6**	**78**	**1.6**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<5	<0.1	Not Detected
BH4	0.5-0.6	Fill: Silty Clay	**10**	<0.4	**19**	**28**	**25**	<0.1	**6**	**36**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SDUP-1	-		<4	<0.4	**22**	**41**	**4**	<0.1	**80**	**35**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			11	11	11	11	11	11	11	11	10	10	5	5	5	5	5	5	5	5	4	5	4
Maximum Value			10	<PQL	28	41	49	<PQL	80	110	580	57	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Not Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					**HSL-A/B:LOW/HIGH DENSITY RESIDENTIAL**							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH1	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA	0
BH1	0.5-0.6	Fill: Silty Clay	0m to <1m	Clay	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH2	0.06-0.1	Fill: Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH2	0.1-0.2	Fill: Silty Clay	0m to <1m	Clay	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH3	0.06-0.2	Fill: Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH3	0.5-0.6	Fill: Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH4	0.1-0.2	Fill: Silty Clay	0m to <1m	Clay	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH4	0.5-0.6	Fill: Silty Clay	0m to <1m	Clay	<25	<50	<0.2	<0.5	<1	<3	<1	0
SDUP-1	-		0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	NA
Total Number of Samples					10	10	10	10	10	10	10	10
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH1	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA
BH1	0.5-0.6	Fill: Silty Clay	0m to <1m	Clay	50	280	0.7	480	NL	110	5
BH2	0.06-0.1	Fill: Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH2	0.1-0.2	Fill: Silty Clay	0m to <1m	Clay	50	280	0.7	480	NL	110	5
BH3	0.06-0.2	Fill: Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH3	0.5-0.6	Fill: Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH4	0.1-0.2	Fill: Silty Clay	0m to <1m	Clay	50	280	0.7	480	NL	110	5
BH4	0.5-0.6	Fill: Silty Clay	0m to <1m	Clay	50	280	0.7	480	NL	110	5
SDUP-1	-		0m to <1m	Sand	45	110	0.5	160	55	40	3

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	$>C_{10}$-C_{16} (F2) plus napthalene	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**RESIDENTIAL, PARKLAND & PUBLIC OPEN SPACE**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH1	0.15-0.25	Coarse	<25	<50	<100	<100
BH1 - [LAB_DUP]	0.15-0.25	Coarse	<25	<50	<100	<100
BH1 - [TRIPLICATE]	0.15-0.25	Coarse	NA	NA	NA	NA
BH1	0.5-0.6	Fine	<25	<50	<100	<100
BH2	0.06-0.1	Coarse	<25	<50	<100	**200**
BH2	0.1-0.2	Fine	<25	<50	<100	<100
BH3	0.06-0.2	Coarse	<25	<50	**1100**	**420**
BH3	0.5-0.6	Coarse	<25	<50	**140**	**210**
BH4	0.1-0.2	Fine	<25	<50	**120**	**120**
BH4	0.5-0.6	Fine	<25	<50	**130**	**180**
SDUP-1	-	Coarse	<25	<50	<100	**190**
Total Number of Samples			10	10	10	10
Maximum Value			<PQL	<PQL	1100	420

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	$>C_{10}$-C_{16} (F2) plus napthalene	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)
BH1	0.15-0.25	Coarse	700	1000	2500	10000
BH1 - [LAB_DUP]	0.15-0.25	Coarse	700	1000	2500	10000
BH1 - [TRIPLICATE]	0.15-0.25	Coarse	--	--	--	--
BH1	0.5-0.6	Fine	800	1000	3500	10000
BH2	0.06-0.1	Coarse	700	1000	2500	10000
BH2	0.1-0.2	Fine	800	1000	3500	10000
BH3	0.06-0.2	Coarse	700	1000	2500	10000
BH3	0.5-0.6	Coarse	700	1000	2500	10000
BH4	0.1-0.2	Fine	800	1000	3500	10000
BH4	0.5-0.6	Fine	800	1000	3500	10000
SDUP-1	-	Coarse	700	1000	2500	10000

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		5,600	4,200	5,800	8,100	140	21,000	5,900	17,000	2,200	
Site Use		**HIGH DENSITY RESIDENTIAL - DIRECT SOIL CONTACT**									
Sample Reference	**Sample Depth**										
BH1	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH1 - [LAB_DUP]	0.15-0.25	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH1 - [TRIPLICATE]	0.15-0.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	0
BH1	0.5-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH2	0.06-0.1	<25	<50	<100	**200**	<0.2	<0.5	<1	<3	<1	0
BH2	0.1-0.2	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	0
BH3	0.06-0.2	<25	<50	**1100**	**420**	<0.2	<0.5	<1	<3	<1	0
BH3	0.5-0.6	<25	<50	**140**	**210**	<0.2	<0.5	<1	<3	<1	0
BH4	0.1-0.2	<25	<50	**120**	**120**	<0.2	<0.5	<1	<3	<1	0
BH4	0.5-0.6	<25	<50	**130**	**180**	<0.2	<0.5	<1	<3	<1	0
SDUP-1	-	<25	<50	<100	**190**	<0.2	<0.5	<1	<3	<1	NA
Total Number of Samples		10	10	10	10	10	10	10	10	10	10
Maximum Value		<PQL	<PQL	1100	420	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS TESTING - LABORATORY RESULTS
HSL-B: Residential with minimal opportunities for soil access

FIELD DATA															LABORATORY DATA											
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.04**			**0.001**			**0.001**											**0.04**	**0.001**
															242632	BH1	0.15-0.25	65	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected						
															242632	BH2	0.1-0.2	70	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected						
	No Field Screening														242632	BH3	0.06-0.2	60	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected						
															242632	BH4	0.1-0.2	45	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected						
															242632	B1	-	798.5	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
															242632	B2	-	815.45	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
															242632	B3	-	942.85	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
															242632	B4	-	748.57	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001

Concentration above the SAC **VALUE**

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TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																		
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																			
BH1	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	<4	**22**	**19**	**20**	**9**	**46**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.2**
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	<4	**12**	**17**	**22**	**9**	**110**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	<4	**10**	**15**	**18**	**10**	**48**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.5-0.6	Fill: Silty Clay	Fine	NA	NA	NA	**5**	**15**	**21**	**31**	**24**	**49**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH2	0.06-0.1	Fill: Sandy Gravel	Coarse	NA	NA	NA	<4	**22**	**39**	**7**	**77**	**33**	<1	NA	<25	<50	<100	**200**	<0.2	<0.5	<1	<3	<0.05
BH2	0.1-0.2	Fill: Silty Clay	Fine	NA	NA	NA	**7**	**15**	**12**	**30**	**6**	**24**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH3	0.06-0.2	Fill: Sandy Gravel	Coarse	NA	NA	NA	<4	**25**	**36**	**14**	**5**	**32**	<1	<0.1	<25	<50	**1100**	**420**	<0.2	<0.5	<1	<3	**39**
BH3	0.5-0.6	Fill: Sandy Gravel	Coarse	NA	NA	NA	**4**	**28**	**31**	**16**	**11**	**34**	<1	NA	<25	<50	**140**	**210**	<0.2	<0.5	<1	<3	<0.05
BH4	0.1-0.2	Fill: Silty Clay	Fine	NA	NA	NA	**7**	**11**	**21**	**49**	**6**	**78**	<1	<0.1	<25	<50	**120**	**120**	<0.2	<0.5	<1	<3	**0.2**
BH4	0.5-0.6	Fill: Silty Clay	Fine	NA	NA	NA	**10**	**19**	**28**	**25**	**6**	**36**	<1	NA	<25	<50	**130**	**180**	<0.2	<0.5	<1	<3	<0.05
SDUP-1	-		Coarse	NA	NA	NA	<4	**22**	**41**	**4**	**80**	**35**	<1	NA	<25	<50	<100	**190**	<0.2	<0.5	<1	<3	<0.05
Total Number of Samples				0	0	0	11	11	11	11	11	11	10	5	10	10	10	10	10	10	10	10	10
Maximum Value				NA	NA	NA	10	28	41	49	80	110	<PQL	<PQL	<PQL	<PQL	1100	420	<PQL	<PQL	<PQL	<PQL	39

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH1	0.5-0.6	Fill: Silty Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	1300	5600	65	105	125	45	20
BH2	0.06-0.1	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH2	0.1-0.2	Fill: Silty Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH3	0.06-0.2	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH3	0.5-0.6	Fill: Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH4	0.1-0.2	Fill: Silty Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH4	0.5-0.6	Fill: Silty Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	1300	5600	65	105	125	45	20
SDUP-1	-		Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20

TABLE S7
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH1	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**22**	**19**	**20**	<0.1	**9**	**46**	**3.8**	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH1 - [LAB_DUP]	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**12**	**17**	**22**	<0.1	**9**	**110**	**0.5**	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH1 - [TRIPLICATE]	0.15-0.25	Fill: Sandy Gravel	<4	<0.4	**10**	**15**	**18**	<0.1	**10**	**48**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.5-0.6	Fill: Silty Clay	**5**	<0.4	**15**	**21**	**31**	<0.1	**24**	**49**	**1.6**	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH2	0.06-0.1	Fill: Sandy Gravel	<4	<0.4	**22**	**39**	**7**	<0.1	**77**	**33**	**0.1**	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	**120**	**120**	<0.2	<0.5	<1	<3	NA
BH2	0.1-0.2	Fill: Silty Clay	**7**	<0.4	**15**	**12**	**30**	<0.1	**6**	**24**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH3	0.06-0.2	Fill: Sandy Gravel	<4	<0.4	**25**	**36**	**14**	<0.1	**5**	**32**	**580**	**39**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**740**	**570**	**1310**	<0.2	<0.5	<1	<3	Not Detected
BH3	0.5-0.6	Fill: Sandy Gravel	**4**	<0.4	**28**	**31**	**16**	<0.1	**11**	**34**	**0.3**	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	**150**	**150**	<0.2	<0.5	<1	<3	NA
BH4	0.1-0.2	Fill: Silty Clay	**7**	<0.4	**11**	**21**	**49**	<0.1	**6**	**78**	**1.6**	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	**160**	**160**	<0.2	<0.5	<1	<3	Not Detected
BH4	0.5-0.6	Fill: Silty Clay	**10**	<0.4	**19**	**28**	**25**	<0.1	**6**	**36**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	**150**	**150**	<0.2	<0.5	<1	<3	NA
SDUP-1	-		<4	<0.4	**22**	**41**	**4**	<0.1	**80**	**35**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	**110**	**110**	<0.2	<0.5	<1	<3	NA
Total Number of Samples			11	11	11	11	11	11	11	11	10	10	5	5	5	5	5	10	10	10	10	10	10	10	10	10	4
Maximum Value			10	<PQL	28	41	49	<PQL	80	110	580	39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	740	570	1310	<PQL	<PQL	<PQL	<PQL	Not Detected

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**

TABLE S8
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Arsenic	Cadmium	Chromium	Lead	Mercury	Nickel	B(a)P
PQL - Envirolab Services			0.05	0.01	0.01	0.03	0.0005	0.02	0.001
TCLP1 - General Solid Waste			5	1	5	5	0.2	2	0.04
TCLP2 - Restricted Solid Waste			20	4	20	20	0.8	8	0.16
TCLP3 - Hazardous Waste			>20	>4	>20	>20	>0.8	>8	>0.16
Sample Reference	**Sample Depth**	**Sample Description**							
BH3	0.06-0.2		NA	NA	NA	NA	NA	NA	<0.001
BH3 - [LAB_DUP]	0.06-0.2		NA	NA	NA	NA	NA	NA	<0.001
SDUP-1	-	Duplicate of BH2 (0.06-0.1)	<0.05	<0.01	<0.01	<0.03	<0.0005	**0.08**	NA
Total Number of samples			1	1	1	1	1	1	2
Maximum Value			<PQL	<PQL	<PQL	<PQL	<PQL	0.08	<PQL

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

TABLE S9
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*
Intra	BH2	0.06-0.1	<25	<50	<100	200	<0.2	<0.5	<1	<2	<1
laboratory	SDUP-1	-	<25	<50	<100	190	<0.2	<0.5	<1	<2	<1
duplicate	MEAN		nc	nc	nc	195	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	5%	nc	nc	nc	nc	nc
Field	TB-S1	-	NA	NA	NA	NA	<0.2	<0.5	<1	<2	<1
Blank	11/05/20										

			Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH2	0.06-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
laboratory	SDUP-1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	0.075	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	67%	nc	nc	nc	nc	nc	nc	nc
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	11/05/20																

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH2	0.06-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
laboratory	SDUP-1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	11/05/20																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra	BH2	0.06-0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	22	39	7	<0.1	77	33
laboratory	SDUP-1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	22	41	4	<0.1	80	35
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	22	40	5.5	nc	78.5	34
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	5%	55%	nc	4%	6%
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	11/05/20																						

Result outside of QA/QC acceptance criteria (highlighted: Pyrene RPD 67%, Lead RPD 55%)

Appendix C: Imported Materials and Waste Registers

Imported Materials Register

Supplier	Date	Docket/Invoice #	Product Type	Quantity (specify m3 or tonnes)	Area where Material was Placed

Exported (Waste) Materials Register

Load	Date	Material Type / Classification	Site Area where Waste was Generated	Waste Classification Report Reference	Disposal Facility	Tipping Receipt/Docket Number	Tracking Number (where relevant)	Tonnage

Appendix D: Guidelines and Reference Documents

Contaminated Land Management Act 1997 (NSW)

Managing Land Contamination, Planning Guidelines SEPP55 – Remediation of Land (1998)

NSW EPA, (1995). Contaminated Sites Sampling Design Guidelines

NSW EPA, (2014). Waste Classification Guidelines - Part 1: Classifying Waste

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

NSW EPA, (2020). Consultants Reporting on Contaminated Land, Contaminated Land Guidelines

NSW SafeWork, (2019). Code of Practice: How to Safely Remove Asbestos.

NSW SafeWork, (2019). Code of Practice: How to Manage and Control Asbestos in the Workplace.

National Environment Protection Council (NEPC), (2013). National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

Protection of the Environment Operations Act 1997 (NSW)

Protection of the Environment Operations (Waste) Regulation 2014 (NSW)

State Environmental Planning Policy No.55 – Remediation of Land 1998 (NSW)