CONSULTING EARTH SCIENTISTS

REMEDIAL ACTION PLAN
10 NELSON SHORT STREET, POTTS HILL, NEW SOUTH WALES
CES DOCUMENT REFERENCE: CES170303-SD-AE

Written by: J. Johnston

Reviewed by: D. Johnson

Authorised by: D. Lowe

Client: Mushan Pty Limited
Suite 2, Level 33
1 Macquarie Place,
Sydney 2000

Date: 18 July 2018

Suite 3, Level 1 • 55-65 Grandview Street • Pymble, NSW 2073 • Australia
Telephone: 02 8569 2200 • Fax: 02 9983 0582 0 • ABN 67 151 524 757

Document Control

REMEDIAL ACTION PLAN
10 NELSON SHORT STREET, POTTS HILL, NEW SOUTH WALES
PREPARED FOR MUSHAN GROUP PTY LTD

CES DOCUMENT REFERENCE: CES170303-SD-AE

Distribution Register

Hard Copy	Digital copy	Recipient	Location
	1	Shener Dursun	Mushan Group Pty Ltd
	1	CES Library	CES Pty Ltd

The Distribution Register identifies the recipients of issued copies of this report.

Revision Register

Revision Number	Revision Date	Description
0.0	18/07/2018	Original Report: CES170303-SD-AE Remedial Action Plan

The revision register tracks changes to the document.

The latest revision of this document supersedes all previous revisions. It is the responsibility of the recipient to ensure that superseded revisions of this document are removed from circulation.

Documents are only valid if they are signed, original documents issued by CES Pty Ltd. CES Pty Ltd does not accept any liability for actions taken based upon incomplete copies of this document.

EXECUTIVE SUMMARY

The site (10 Nelson Short Street, Potts Hill) (Lot 104 in Deposited Plan (DP) 1149790) covering an area of approximately 1.9 hectares is currently zoned as commercial/ industrial (business park) land use. The site was previously owned by Sydney Water Corporation and is situated within the former Sydney Water Potts Hill Reservoir Site.

The objective of the Remedial Action Plan (RAP) is to set remediation goals which will assist in making the site suitable for the proposed residential use and will pose no unacceptable risk to human health or to the environment. The site has previously had a Site Audit Report (SAR) (Environ, 2010), an Environmental Management Plan (EMP) put into effect (AECOM, 2010) and a Stage 1 – Preliminary Site Investigation (PSI) (CES, 2017) undertaken, in which the finding are the basis for this RAP.

Previous environmental reports provided to CES included a Site Audit Report and Environmental Management Plan (EMP). The Audit completed by Environ considered the review of twenty-five reports prepared between 1996 and 2010. The key sources of contaminants identified at the site were filling of unknown origin, storage activities and a former Underground Storage Tank (UST). The contaminants of concern therefore were considered as asbestos containing materials (ACM), heavy metals, TPH, BTEX, PAHs, OCPs, OPP and phenols. The main contaminants identified in the samples submitted for laboratory analysis included PAH, mainly identified in samples collected from the shallow fill of the northern portion of the Main Area but also identified in the embankment fill material (possibly due to the presence of ash, coal, slag, and bitumen/asphalt in the fill materials), TPH C10-C36 from five samples collected from the Main Area, and some heavy metals, primarily arsenic, lead and zinc. Additionally, one small fragment of cement bonded sheeting identified within a sample collected from the surface on the eastern embankment was identified as asbestos containing. It was considered by the Auditor that the remedial works and validation sampling was adequate to demonstrate the Main Area of the site suitable for commercial/industrial use. The Embankment area however was deemed not suitable for commercial/industrial use but could be maintained in a condition suitable for commercial/industrial use with the provision of an Environmental Management Plan.

In 2017 CES undertook a Stage 1 – Preliminary Site Investigation (CES, 2017), to investigate data gaps that were deemed areas of concern regarding the site. The scope of works during this investigation included:

- Desktop study;
- Site inspection;
- Soil and groundwater sampling programme; and
- Preparation of this Stage I – Preliminary Site Investigation report.

No exceedance of human health criteria was identified in the analysis results for the fill samples from the fifteen borehole locations. One location exceeded the ecological criteria for benzo(a)pyrene, however this was not considered significant as the entire footprint of the proposed development will be excavated for the construction of a basement carpark, thus removing the fill material from site. Additionally, results of fill from the top three metres were compared to NSW EPA waste classification criteria for a preliminary waste classification and were within the criteria for classification as general solid waste.

Groundwater results were below the SAC for all analytes tested with the exception of copper, nickel, and zinc. These concentrations exceeded the groundwater investigation levels (GIL) – marine waters criteria, however it is likely that these concentrations are background concentrations and unlikely to impact the receiving natural water body of Cooks River.

The Total Organic Carbon (TOC) content of fill and natural soil samples below three metres indicates a "Characteristic Situation 1" in accordance with CL:AIRE - *A Pragmatic Approach to Ground Gas Risk Assessment* (CL:AIRE, 2012) and therefore a very low ground gas risk.

As there were no analysed fill samples that exceeded the human health based SAC, it is unlikely that site soils located within the main flat area of the site pose a potential risk to human health or the environment for the proposed high density residential development. However, the investigation was limited in spatial scope, with the embankment area of the site not investigated.

Previous investigations detected PAH and asbestos impacts within the embankment, therefore the embankment requires further investigation and may require remediation to make the site suitable for the proposed use. Additional investigation work should consist of 13 sample locations as required to meet the NSW EPA minimum sample density requirement for a site of 1.8 ha. The further investigations should be targeted to investigate the area of the site which has the highest risk of unsuitable contamination, the embankment which is currently subject to an EMP.

This RAP has been prepared to further assess the contamination status of the site. The results of previous investigations at the site are discussed and data gaps and further investigations identified (Section 5.5).

Remediation, if required following the further investigations, should be carried out in accordance with Sections 8-11.

This RAP is considered suitable to confirm whether or not the site is suitable for the proposed high density residential use. If the additional investigations identify impacts which pose an unacceptable risk to human health or the environment, implementation of the remedial actions detailed in Sections 6-11 is considered suitable to make the site suitable for the proposed high-density land use.

This RAP should be revised following further investigation detailed in Section 5.5 if required based on the investigation results.

REMEDIAL ACTION PLAN
10 NELSON SHORT STREET, POTTS HILL, NEW SOUTH WALES
PREPARED FOR MUSHAN GROUP PTY LTD

CES DOCUMENT REFERENCE: CES170303-SD-AE

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ACM	Asbestos Containing Material
AHD	Australian Height Datum
ASS	Acid Sulfate Soil
BTEX	Benzene, Toluene, Ethylbenzene and Total Xylenes
CES	Consulting Earth Scientists Pty Ltd
CLM	Contaminated Land Management
COPC	Contaminants of Potential Concern
DECCW	Department of Environment and Climate Change and Water
DLWC	Department of Land and Water Conservation
EMP	Environmental Management Plan
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
km	Kilometre
LGA	Local Government Area
LPI	Land and Property Information Division
LEP	Local Environmental Plan
m	Metre
mbgl	metres Below Ground Level
NEPM	National Environment Protection Measure
NSW	New South Wales
OCP	Organochlorine Pesticide
PAH	Polycyclic Aromatic Hydrocarbon
PSI	Preliminary Site Investigation
PSP	Project Safety Plan
RAP	Redial Action Plan
TRH	Total Recoverable Hydrocarbons
UST	Underground Storage Tank
VOC	Volatile Organic Compounds

REMEDIAL ACTION PLAN

10 NELSON SHORT STREET, POTTS HILL, NEW SOUTH WALES
PREPARED FOR MUSHAN GROUP PTY LTD

CES DOCUMENT REFERENCE: CES170303-SD-AE

1 INTRODUCTION

1.1 *BACKGROUND*

Consulting Earth Scientists Pty Ltd (CES) was commissioned by Mushan Group Pty Ltd (Mushan, the Client) to prepare a Remedial Action Plan (RAP) for the property located at 10 Nelson Short Street, Potts Hill, New South Wales (NSW) (the site). A site location plan is presented as Figure 1.

It has also been prepared in general accordance with the requirements specified for a Stage 3 – Site Remedial Action Plan as published by the NSW Environment Protection Authority (EPA) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA), 2011 and the National Environmental Protection Measure (NEPM) *Guidelines on Site Characterisation* (Schedule B2) 1999, as amended 2013.

CES understands previous investigations by various consultants have been undertaken at the site and the site has been subject to remediation to make the site suitable for commercial/industrial land use.

The proposed development consists of a high density residential development designed for seniors living. The development includes the construction of four-storey apartment blocks above a single level underground car park which would extend over the majority of the site footprint.

1.2 *OBJECTIVES*

The principal objectives of this RAP are as follows:

- Set remediation goals which will assist in making the site suitable for the proposed residential use and will pose no unacceptable risk to human health or to the environment;
- Document all procedures and plans to be implemented to reduce risks to acceptable levels for the proposed high density residential land use; and
- Establish the environmental safeguards required to complete the remediation in an environmentally acceptable manner.

1.3 *SCOPE OF WORK*

The scope of works for the preparation of this RAP included:

- a review and summary of the previous environmental site assessment report;
- identification of data gaps and areas that require further investigation;
- identification of reported impacts and the extent of remediation required;
- preparation of site conceptual model characterising the known contamination sources, pathways and (current and future) receptors;
- evaluation of remediation options and rationale for the recommended remedial option including contingency plan, if the selected remedial strategy fails;
- setting of remediation goals and acceptance criteria based on environmental legislation;
- preparation of validation procedures for the site;
- setting of Construction Site Management Plan requirements for stormwater, soil management, noise control, dust control, odour control and WHS plan for the operational phase of remediation;
- preparation of Contingency Plans to respond to site incidents that may affect site workers or surrounding site environments or communities;
- identification of regulatory compliance requirements such as licences or approvals;
- identification of a remediation timeline and schedule and hours of remedial work operations;
- identification of appropriate personnel to contact during remediation;
- identification of reporting requirements; and,
- identification of long-term site management plan requirements.

This RAP and the information summarised within has been prepared on the basis of information provided in existing reports which should be read in conjunction with this RAP. No further verification of the information provided in the previous third party reports has been undertaken, however, in some cases, additional information has been provided by CES or the Client to meet reporting requirements.

1.4 *REVISION OF THIS RAP*

This RAP is applicable for the duration of the construction works at the site. It may be necessary to revise and re-issue the RAP in order to reflect changes in project objectives; parties responsible for implementation of the RAP and development; unexpected finds; or changes to planning or statutory requirements.

If revision of the RAP is necessary, the following procedure should be followed:

- Review of the RAP by an experienced environmental consultant with reference to the changes requiring the revision. This review should also be done in consultation with the Site Auditor and, where necessary, the Local Council, particularly if the updated report varies or is inconsistent with any condition of consent imposed by Council which could require a Section 4.55 (Modification of Consent) application under the Environmental Planning and Assessment Act 1979 to be submitted to modify the consent;
- Update the RAP, including the document register revision number information, to address the requirements of the changed conditions;
- The updated RAP should be provided to the Site Auditor for review and endorsement prior to re-issue; and
- Re-issue the RAP and provide notice to the key stakeholders that previous versions have been superseded.

2 SITE INFORMATION

The site information presented below is based on a review of government and publicly available information sources.

2.1 *SITE IDENTIFICATION*

The site is located at 10 Nelson Short Street, Potts Hill, New South Wales (NSW) 2143, within the Local Government Area (LGA) of Canterbury-Bankstown. The site covers an area of approximately 1.9 hectares, and is legally identified as a single lot, Lot 104 in Deposited Plan (DP) 1149790 (Figure 1). The geographical extent of the site is presented in Table 1 below.

Table 1: Geographical extent of site

Corner/point of site	Eastings	Northings
Southeast corner of site	318312.909mE	6247341.275mN
Northeast corner of site	318238.208mE	6247538.055mN
Southwest corner of site	318169.819mE	6247364.917mN
Northwest corner of site	318337.351mE	6247524.576mN
Centre of site	318272.834mE	6247433.492mN

2.2 *SITE ZONING*

Bankstown Local Environmental Plan (LEP) 2015 indicates that the site is currently zoned "B7 – Business Park".

2.3 *SITE DESCRIPTION*

The subject site is located within a mixed public recreation and residential district of Potts Hill. It was formally part of the Sydney Water Potts Hill reservoir complex. The site is accessed via Nelson Short Street and is largely trapezoidal in shape. At the time of the site inspection, the property included:

- Two conjoined areas of vegetated open space. No buildings were observed on site at the time of the site inspection.

During the site inspection there were signs of dry and browned vegetation, however the vegetation was not considered distressed (an indication of potential environmental impacts) and in the accessible areas observed, there was no surface staining indicative of surface spills that could have impacted underlying soil and groundwater.

There was no evidence of above ground or below ground fuel storage tanks on the site.

Based on observations from the site inspection, the surrounding land use comprised the following:

- **North** – immediately bordering the northern boundary of the site is the Potts Hill NSW Police Facility located within the Potts Hill Business Park, further north of which lies residential areas including the Carnarvon Golf Club (1.3km North-northeast), Sydney University (Cumberland Campus) (2km northeast) and Rookwood Cemetery (2.5km northeast);
- **East** – Graf Avenue borders the eastern boundary of the site, beyond which are low density single and double storey residential properties of Yagoona. Beyond this lies an industrial area of Chullora, the Hume Highway separates the industrial area from the residential area of Greenacre;
- **South** – Brunker Road immediately borders the southern boundary of the site, beyond which are low density single and double storey residential properties of Yagoona stretching far south; and
- **West** –Immediately bordered by Nelson Short Street and further west is the Sydney Water reservoir site. Further west lies residential areas of Birrong and Sefton.

2.4 *TOPOGRAPHY*

The site was observed during the site inspection to have no preferential slope, however steep fill embankments were observed along the eastern and southern boundaries of the site.

2.5 *SURFACE WATER*

The nearest surface water features are the Cooks River, located approximately 262 m northeast of the site boundary. The likely discharge point for groundwater / surface water run-off, based on local topography is the Cooks River.

2.6 *GEOLOGY*

Reference to the Sydney 1:100 000 Geological Series Sheet 9130 (1983) indicates that the majority of the site is underlain by Bringelly Shale of the Wianamatta Group, of Triassic Age. This formation typically comprises shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff. The nature of the formation is considered alluvial and estuarine.

2.7 *HYDROGEOLOGY*

It is expected that groundwater would flow away from the Reservoirs 1 and 2 to the southeast, towards the Cooks River.

A search of the Department of Primary Industries Office of Water database (http://allwaterdata.water.nsw.gov.au/water.stm, accessed 27 July 2016) indicates there are nine registered groundwater abstraction wells located between 941 and 972 m from the site boundary. All nine wells are used for monitoring and extend between 3.7 and 13 m below ground level. The

groundwater standing water levels recorded is range of between 1.80 and 9.10 m below the ground surface.

2.8 *SENSITIVE LOCAL ENVIRONMENTS*

The site is not located within an Underground Petroleum Storage System (UPSS) environmentally sensitive zone. UPSS environmentally sensitive zones represent areas that are likely to be vulnerable to the contamination from leaking UPSS due to geology or groundwater properties.

2.9 *ACID SULFATE SOILS*

The classification of acid sulphate soils (ASS) is based on the likelihood that these soils will be present in particular areas at specific depths. Soils are classed from 1 (high probability presence) to 5 (low probability presence).

There is no acid sulfate soil risk mapped for the site in the Bankstown LEP (2015) Acid sulfate soils map (sheet: ASS-004).

2.10 *METEOROLOGY*

Information on meteorology recorded from the Bankstown Airport AWS has been obtained from the Bureau of Meteorology website (http://www.bom.gov.au/ accessed 27 July 2017).

- Mean annual temperature – 23.3 degrees Celsius;
- Mean annual lowest temperature – 12.0 degrees Celsius; and
- Mean annual rainfall – 996.7 millimetres (mm).

2.11 *NSW CONTAMINATED SITE REGISTER*

The site is located within proximity to six sites on the List of NSW contaminated sites notified to EPA:

- Shell Coles Express Service Station located 165m east;
- Galserv Galvanising Services located 259m northeast;
- Former Plating Works located 336m southeast;
- Sydney Water Potts Hill Complex located 336 west;
- BP Potts Hill Service Station and Truckstop located 470m northeast; and
- 7-Eleven (former Mobil) Service Station located 930m southeast.

3 SITE HISTORY

Information pertaining to the history of the site was obtained through a review of information available from external sources including historical title searches, aerial photographs and council records and the WorkCover NSW Dangerous Goods search (detailed documents contained within the appendices of the *Stage 1 – Preliminary Site Investigation* report (CES, 2017)).

3.1 *PROPERTY TITLE INFORMATION*

A title deeds search was conducted by Lot Search. Where available, the original title and lease documents are outlined within the *Stage 1 – Preliminary Site Investigation* report (CES, 2017).

A review of the past owner of the site, Sydney Water Corporation (SWC) indicates the site would have been highly utilised for works and operations of the reservoirs. It is likely that activities relating to the construction, ongoing use and maintenance of the reservoirs would have occurred at the site between the dates of 1911 and 2016. This is supported by the review of previous environmental reports in section 3.6 outlining the contaminating sources that may be associated with such works and operations as identified previously by consultants.

3.2 *HISTORICAL AERIAL PHOTOGRAPH INTERPRETATION*

Aerial photography viewed on Nearmap in addition to photographs taken from 1943 to 2015 obtained from Lot Search were reviewed to assess the history of development of the site and indications of potential sources of contamination. The photographs are outlined within the *Stage 1 – Preliminary Site Investigation* report (CES, 2017).

The historical aerial photographs obtained from Lot Search revealed that the site has been in use as a storage yard for the associated works of the Sydney Water reservoir for the majority of the time between 1943 and 2014. The review of the historical aerial photographs also indicates that the surrounding areas of the site did not undergo any significant changes other than that of gradual residential development.

3.3 *SAFEWORK NSW RECORDS*

A search of SafeWork NSW Stored Chemical Information Database and microfiche records has been undertaken. Records pertaining to the site have not been located.

3.4 *PLANNING CERTIFICATES*

Review of Planning Certificates under Section 149 of the Environmental Planning and Assessment Act (1979) indicates the following for the subject site:

- The land has not been proclaimed as within a Mine Subsidence District;
- The land is not biodiversity certified land;
- The land does not include or comprise critical habitat;
- The land is not in a conservation area;
- The land has not been identified as bush fire prone land; and
- Development on the land is not subject to flood related development controls.

The following matters are prescribed under section 59 (2) of the Contaminated Land Management Act (1997):

- The land is not significantly contaminated;
- The land is not subject to a management order;
- The land is not subject of an approved voluntary management proposal;
- The land is not subject to an on-going maintenance order; and
- The land is not subject to an audit statement.

A copy of the Section 149 certificates is outlined within the *Stage 1 – Preliminary Site Investigation* report (CES, 2017).

3.5 *SITE WALKOVER*

CES carried out a site walkover as part of the Preliminary Site Investigation on 13 July 2017. Photographs taken during the site walkover are presented within the *Stage 1 – Preliminary Site Investigation* report (CES, 2017). The following was identified:

- No buildings were observed on-site.
- No evidence of below or above ground fuel storage tanks were observed (e.g. manhole covers, vent stacks, fill points or bowsers);
- No significant odours were detected;
- No evidence of chemical storage was observed;
- Vegetation across the site appeared dry and brown in some areas, however, it did not appear stressed; and
- Two large (2m by 2m) concrete pits covered by metal grates were identified in the north-eastern and south-eastern corners of the main investigation area. It is expected that these concrete pits are connected by means of concrete cased conduits.

3.6 *PREVIOUS ENVIRONMENTAL REPORTS*

CES had previously written the most current report regarding the site, *Stage 1 – Preliminary Site Investigation (CES, 2018)*. Prior to this, CES had been provided reports of investigations and remediation works previously undertaken by consultants. A summary of information pertaining to the site from each of the reports has been provided below.

3.6.1 *ENVIRON, MAY 2010, SITE AUDIT REPORT, PROPOSED LOT 104, POTTS HILL*

The Audit completed by Environ was conducted to provide an independent review by an EPA NSW Accredited Auditor to determine the suitability of the site for commercial/industrial land use. The Site Audit Report (SAR) considered the review of twenty-five reports prepared between 1996 and 2010.

Key observations during the various investigations undertaken between 2003 and 2009 at the site prior to demolition and remediation included a former underground storage tank (UST) present in the southwest portion of the site. The south and south-eastern yard areas were surfaced by asphalt

in poor condition and were used for the storage of shipping containers and drums with no evidence of bulk chemical storage noted in the area, Coffey noted a small above ground fuel storage area in the northwest corner of the site and some rusted drums on the middle of the eastern boundary of the Main Area (developable land), directly south of an equipment wash down area. AECOM also noted observations of potential building waste materials such as concrete, bitumen, ballast gravels, and terracotta pipe in the accessible areas of the southern embankment. The eastern embankment was inaccessible at the time of inspection however it was noted that steel and concrete wastes were commonly encountered during test pitting.

A history of the site indicated distribution of excavated reservoir spoil across the Potts Hill reservoir area which could have potentially contained ash waste, fly ash and waste associated with the removal of bitumen-based pipe linings. Significant placement of the spoil is believed to have occurred at the site creating the steep embankments in the south and east. The 45,000 L petrol UST identified in the southwest portion of the site was decommissioned in 1996 by Fluor Daniel GTI (GTI). It was reported at the time of decommissioning that the UST was in "very good condition" with no significant corrosion or visible leaks, however petrol contamination was noted. The remaining pit was backfilled with sand originally surrounding the UST and topped with imported fill.

The key sources of contaminants identified at the site were filling of fill of unknown origin, storage activities and the former UST. The contaminants of concern therefore were considered as asbestos containing materials (ACM), heavy metals, TPH, BTEX, PAHs, OCPs, OPP and phenols. The main contaminants identified in the samples submitted for laboratory analysis included PAH, mainly identified in samples collected from the shallow fill of the northern portion of the Main Area but also identified in the embankment fill material (possibly due to the presence of ash, coal, slag, bitumen/asphalt in the fill materials), TPH C10-C36 from five samples collected from the Main Area, and some heavy metals, primarily arsenic, lead and zinc. Additionally, one small fragment of cement bonded sheeting identified within a sample collected from the surface on the eastern embankment was identified as asbestos containing. No specific contaminant concentration information or sample location information (for both investigation works and validation works) is contained within the SAR.

Remediation works undertaken at the site in response to the results of the environmental investigations undertaken included the re-excavation and validation of the UST pit area by AECOM, the excavation and offsite disposal of the PAH impacted fill from five locations, the screening and removal of the top one metre of surface material (identified by Coffey as Unit 1A) from a portion of the Main Area with the screened soil validated for re-use to backfill remediation excavations at the site and adjoining sites, and the excavation, screening and re-emplacement of soils for the stabilisation of the Embankment.

It was considered by the Auditor that the remedial works and validation sampling was adequate to demonstrate the Main Area of the site suitable for commercial/industrial use. The Embankment area however was deemed not suitable for commercial/industrial use but could be maintained in a

condition suitable for commercial/ industrial use with the provision of an Environmental Management Plan (EMP).

3.6.2 *AECOM, May 2010, Environ: Site Audit Report, Proposed Lot 104, Potts Hill, Appendix E: Environmental Management Plan*

AECOM Australia prepared an Environmental Management Plan (EMP) to address and manage the PAH contamination risks of the contaminated fill materials identified within the Environmental Site Assessments (ESAs) undertaken by URS Corporation (URS) and Coffey Environmental (Coffey) and the Supplementary Contamination Assessment (SCA) completed by AECOM, following the development of the site for commercial/industrial land use.

The EMP applies to construction (applicable upon initiation of the construction works) and operational phase (after development has completed) of the Management Area. The EMP is applicable to, but not limited to, the excavations of the Management Area, stockpiling, storage, movement and handling of excavated materials, on-site reuse or off-site disposal of excavated materials, general disturbance of the Maintenance Area, importation and use of fill materials, and routine inspections of the Management Area.

The EMP outlines the Occupational Health and Safety (OH&S) considerations and requirements for works of the Maintenance Area including an overview of site induction requirements, prevention of potential hazards and personal protective equipment. Additionally, the EMP outlines site management procedures including the consideration of water management, soil management, odour and dust control, excavation reinstatement, disposal of excavated materials, and importation of fill materials. Furthermore, the EMP details the requirement for inspection and monitoring of the Management Area. No reports detailing the implementation of the EMP have been provided to CES.

3.6.3 *Consulting Earth Scientists Pty Ltd, August 2017, Stage 1 – Preliminary Site Investigation, 10 Nelson Short Street, Potts Hill, New South Wales*

The objective of the Preliminary Site Investigation was to determine whether the site is likely to be suitable for the future proposed residential seniors living development, or whether further investigation is required. In order to meet the objectives of the investigation, CES completed the following scope of works:

- Desktop study;
- Site inspection;
- Soil and groundwater sampling programme; and
- Preparation of a Preliminary Site Investigation report.

No exceedance of human health criteria was identified in the analysis results for the fill samples from the fifteen borehole locations. One location exceeded the ecological criteria for

benzo(a)pyrene however this was not considered significant as the entire footprint of the proposed development will be excavated for the construction of a basement carpark, thus removing the fill material from site. Additionally, results of fill from the top three metres were compared to NSW EPA waste classification criteria for a preliminary waste classification and were within the criteria for classification as general solid waste.

Groundwater results were below the SAC for all analytes tested with the exception of copper, nickel, and zinc. These concentrations exceeded the groundwater investigation levels (GIL) – marine waters criteria, however it is likely that these concentrations are background concentrations and unlikely to impact the receiving natural water body of Cooks River.

The total Organic Carbon (TOC) content of fill and natural soil samples below three metres indicates a "Characteristic Situation 1" in accordance with CL:AIRE - *A Pragmatic Approach to Ground Gas Risk Assessment* (CL:AIRE, 2012) and therefore a very low ground gas risk.

As there were no analysed fill samples that exceeded the human health based SAC, it is unlikely that site soils located with the main flat area of the site pose a potential risk to human health or the environment for the proposed high density residential development. However, the investigation was limited in spatial scope, with the embankment area of the site not investigated.

Previous investigations detected PAH and asbestos impacts within the embankment therefore the embankment requires further investigation and may require remediation to make the site suitable for the proposed use. Additional investigation work should consist of 13 sample locations as required to meet the NSW EPA minimum sample density requirement for a site 1.8 ha. The further investigations should be targeted to investigate the area of the site which has the highest risk of unsuitable contamination, the embankment which is currently subject to an EMP.

4 SITE ASSESSMENT CRITERIA

The selection of the most appropriate investigation levels for use with a site specific environmental setting and land use scenario should consider factors including the protection of human health and ecosystems.

Investigation and screening levels are provided in *Guideline on Investigation Levels for Soil and Groundwater* (Schedule B1, NEPC, 2013) for commonly encountered contaminants which are applicable to generic land use scenarios and include consideration of, where possible, the soil type and the depth of contamination. Investigation levels and screening levels are the concentrations of a contaminant above which further appropriate investigation and evaluation will be required. Investigation and screening levels provide the basis of Tier 1 risk assessment.

In the absence of a site specific risk assessment these Tier 1 screening criteria could be used as remediation acceptance criteria.

4.1 *SOIL*

4.1.1 *HUMAN HEALTH ASSESSMENT*

To address potential health impacts at the site, CES compared the analytical testing results against a set of health based soil investigation criteria appropriate for the proposed land-use. That is, the HIL has been set at a level that provides confidence that contaminant concentrations below the HIL will not adversely affect human health. As described in Section 1.1, the future site land-use is proposed high density residential seniors living development; however, as CES is not in possession of development plans and as such cannot confirm the development to take place at the site, the NEPM (2013) HIL B (residential with minimal opportunities for soil access includes dwellings with fully permanently paved yard space such as high rise buildings and flats) criteria has been adopted as a conservative approach for the assessment of human health. Additionally, NEPM (2013) HSL A & HSL B (low-high density residential for clay) criteria have been selected for the assessment of human health.

4.1.2 *ECOLOGICAL ASSESSMENT*

NEPC (1999) indicates that while protection of human health often drives the first stages of assessment, protection of the environment (terrestrial and aquatic) should be a consideration for all site assessments. The closest waterbody, Georges River, is approximately 1.5 km east of the site and may be considered a sensitive ecological receptor.

To address the potential ecological impacts at the site, CES compared the analytical testing results against a set of ecological investigation and screening levels appropriate for the proposed land use of mixed use and aged care development. The NEPM (2013) EIL criteria adopted were generated using the CSIRO for *NEPM Ecological Investigation Level Calculation Spreadshee*t (CSIRO, 2010). Conservative values for pH (7.0 pH), cation exchange capacity (CEC) (20 cmolc/kg),

organic content (1%) and clay content (>10%) were used in the absence of available data. Additionally, the NEPM (2013) ESL (fine soil texture) was adopted for the ecological assessment.

4.1.3 *ASBESTOS*

Health screening levels for asbestos in soils, which are based on scenario-specific likely exposure levels, are adopted from the Western Australia, Department of Health (WA DoH) guidelines as outlined in Table 7 of Schedule B1, NEPC, 2013. Based on the proposed seniors living development, the Residential B exposure setting has been selected. As such, the HSL for bonded asbestos containing materials (ACM) is 0.04% w/w and 0.001% w/w for asbestos fines and fibrous asbestos.

4.1.4 *GROUND GAS RISK*

Total Organic Carbon (TOC) provides an assessment of the proportion of organic materials present in the soil and thus provides an indication of the amount of methane and carbon dioxide potentially produced by the decomposition of the materials. The data can be used to determine the gas generation risk against screening values such as those included in Table 1 of CL:AIRE Research Bulletin: *A Pragmatic Approach to Ground Gas Risk Assessment* (CL:AIRE, 2012).

4.2 *GROUNDWATER*

To address the data gap of groundwater characterisation at the site, CES compared results of samples of groundwater to the NEPM (2013) GIL criteria for Marine Waters and Fresh Waters.

4.3 *WASTE CLASSIFICATION*

For off-site disposal of soils, the assessment should be undertaken in accordance with the NSW EPA (2014) *Waste Classification Guidelines: Part 1 Classifying Waste*.

5 CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) has been developed in consideration of the findings of the preliminary investigation taking into account the proposed future high density residential redevelopment.

5.1 *POTENTIAL SOURCES OF CONTAMINATION*

Uncontrolled fill has been identified as a potential source of contamination on the main area and the embankment area due to the historical cut and fill activities that may have occurred during development at the reservoir site. In consideration of the previous environmental investigations the fill materials in the 'main area' of the site are unlikely to be significantly contaminated and therefore are unlikely to pose a risk to the environment or human health. As such the identified COPC considered likely to be remaining on site are:

- PAHs; and
- Asbestos.

Additional COPC associated with uncontrolled fill, which are considered unlikely to contribute significant contamination risk at the site are:

- TRH and BTEX; and
- Heavy Metals.

5.2 *POTENTIAL OFF-SITE SOURCES OF CONTAMINATION*

There have been no potential off-site sources of contamination identified within the surrounds of the site.

5.3 *POTENTIAL PATHWAYS*

The pathways through which contaminants may reach receptors are in part dependent on the nature and behaviour of the contaminant. The following potential pathways have been identified:

- Ingestion / dermal contact during construction;
- Inhalation of contaminants in the particulate form (dust);
- Leaching of contaminants from site soils into groundwater; and
- Lateral migration of contaminants in groundwater (dissolved and immiscible phases) to surface waters.

5.4 *RECEPTORS*

Potential sensitive receptors (on and off-site) are listed below:

- Future construction workers during the construction of the proposed redevelopment;

- Future residents and employees;
- Groundwater beneath the site; and
- Neighbouring residents.

5.5 *DATA GAPS AND FURTHER ASSESSMENT*

Based on the previous investigation undertaken by CES (2017) the main area of the site is considered to be adequately characterised in terms of risk to future users of the proposed development, however additional assessment is required for soils to be disposed of off site in accordance with the NSW EPA (2014) *Waste Classification Guidelines: Part 1 Classifying Waste*.

Further investigation of the embankment area of the site should be carried out to characterise the soils which were not assessed as part of the PSI. The assessment should consist of 13 locations, with soils assessed for PAH and asbestos. 13 further sample locations were recommended by the PSI (CES 2017).

The proposed further investigation locations are presented on Figure 3. The investigation should address the COPC identified in the CSM detailed in Section 5.1.

Due to site specific constraints (the slope of the embankment, and the condition of the slope), the further investigation would be most suitably carried out during the construction phase.

5.6 *REMEDIATION*

Based on the previous investigation, the main area of the site is suitable for the proposed high density residential use, with no further assessment, remediation or management required.

Based on the embankment area being subject to an EMP to make the site suitable for commercial/industrial use, it is likely that remediation or management will be required to make this area of the site suitable for the proposed high density residential land use. The following sections (6-11) present a Remediation Action Plan (RAP) which could be implemented to make the site suitable for use should remediation be required based on the results of the further assessment detailed in Section 5.5.

6 REMEDIAL ACTION PLAN

The NSW Environmental Planning and Assessment Regulation (2000), under the Environmental Planning and Assessment Act (EP&A) 1979 (NSW Government, 1979), provides the legislative framework within which notifications and approvals must be made for redevelopment of the site. The remediation works (involving potential exposure to contaminated materials and handling potential contaminated waste materials) to be undertaken must comply with the applicable environmental legislative requirements. Table 2 provides a summary of the applicable legislation and regulations for the proposed remediation works.

Table 2: Applicable Legislation / Regulation

Legislation / Regulation	Applicability
Contaminated Land Management Act 1997	Establishes the process for investigating and remediating land.
Protection of the Environment Operations Act 1997 (POEO Act)	Framework to minimise harm to the environment (in particular pollution of air and water and noise emissions) and not cause an offence under the Act. Discharge to stormwater may require a licence under the Act if required.
Protection of the Environment Operations (Waste) Regulation 2005	Transporters of waste (including Restricted Solid Waste and Hazardous Waste) are required to be licensed under the Act. Some waste disposal / processing facilities are required to be licensed under the Act. Requirements in relation to transportation, collection, storage or disposal of waste.
State Environment Planning Policy No 55 – Remediation of Land	SEPP 55 specifies consent requirements for remediation, specifies certain considerations that are relevant for rezoning land, and requiring that remediation is conducted to meet certain standards and notification requirements.
Work Health and Safety Act 2011	All works to be conducted in accordance with WHS Act.
Work Health and Safety Regulation 2011	All works to be conducted in accordance with WHS Regulations.
SafeWork NSW	Notifications required for asbestos removal, hazardous chemicals, lead, and demolition.

The site remediation process, validation works, and reporting prescribed within this document should be conducted with reference to the following industry standards, guidelines, and codes of practice:

i. National Environment Protection (Assessment of Contamination) Measure, 1999, as amended;

ii. NSW EPA (1997) *Guidelines on Assessing Banana Plantation Sites*

iii. NSW EPA (2003) *Guidelines for the Vertical mixing of Soil on Former Broad-Acre Agricultural Land*

iv. Australian Standard AS 4482.1 Part 1 – Non-volatile and Semi-Volatile Compounds;

v. Australian Standard AS 4482.2 Part 2 – Volatile Compounds;

vi. NSW Government, Managing asbestos in or on soil, March 2014;

vii. How to safely remove asbestos code of practice, Safe Work Australia (2011) workcover.nsw.gov.au;

viii. Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres, 2nd Edition, April 2005;

ix. National Environment Protection Council (1998): NEPM on Ambient Air Quality;

x. NSW Office of Environment and Heritage (March 2004): Managing Urban Stormwater – Soils and Construction;

xi. NSW EPA (2014): Waste Classification Guidelines. Part 1: Classifying Waste;

xii. NSW DECCW (2005): Approved Methods for the Modelling and Assessment of Air Pollutants in NSW; and,

xiii. NSW DECCW (2007): Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.

6.1 *NOTIFICATIONS AND PERMIT REQUIREMENTS*

All works related to the site remediation must be undertaken with the appropriate notifications and permits in place. A summary of the key notifications and permits which will be required prior to initiating works are listed below:

- Development consent for remediation works from the Department of Planning and Infrastructure.
- Any other relevant approvals should be submitted and approved before any works are carried out.

7 REMEDIATION OPTIONS AND STRATEGY

7.1 *REMEDIATION GOAL*

The site is proposed to be redeveloped with the construction of residential seniors living apartments. The goal of remedial works is to provide sufficient engineering and management controls to make the site suitable (with respect to soil contamination) for the proposed development with accessible soils, to ensure protection of human health and the environment during and post remediation works, and to manage soils in a cost-effective manner.

7.2 *EXTENT OF REMEDIATION REQUIRED*

In regards to the Main Area of the site (Figure 2), one location exceeded the ecological criteria for benzo(a)pyrene, however this was not considered significant as the entire footprint of the proposed development will be excavated for the construction of a basement carpark, thus removing the fill material from site. Additionally, results of fill from the top three metres were compared to NSW EPA waste classification criteria for a preliminary waste classification and were within the criteria for classification as general solid waste.

Further investigation of the embankment area is required, as detailed in Section 5.5. Based on the site history, and the embankment area being subject to an EMP, remediation of PAH and Asbestos impacts is considered to likely be required. The RAP details the potential remedial solutions to be implemented should remediation be required following the results of the further investigations. Based on the site history and the CSM, PAH and asbestos were considered to be the likely COPC.

7.3 *REMEDIATION OPTIONS ASSESSMENT AND RATIONALE FOR SELECTION*

In accordance with the ANZECC / NHMRC (1992) Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, the preferred order of options for site remediation and management are:

1. On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2. Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
3. Removal of any contaminated soil to an approved site or facility, followed, where necessary, by replacement with clean fill (in this case there is no requirement for the importation of clean fill due to the excavation of the underground carpark); and
4. Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

The guidance also considers that:

- If remediation is likely to cause a greater adverse effect than leaving the site undisturbed, then remediation should not proceed.

- In cases where it is not viable to remediate large quantities of soil with low level of contamination, alternative strategies should be considered or developed.
- On-site containment and capping may be considered where appropriate. In general, leaving contaminated material in-situ requires acceptable rationale that there is no immediate danger to the environment or community, the site has appropriate controls in place, the capping or containment has long-term stability, and does not include erection of a structure that may result in a risk of harm to public health or the environment.

A brief description of remedial methods is provided below.

7.3.1 *TREATMENT TECHNOLOGIES*

Treatment technologies are used to permanently and significantly reduce the toxicity, mobility or volume of contaminated wastes. Treatment technologies may be targeted towards in situ or ex situ remediation and may include biological, thermal, separation, and physical/chemical treatment and containment. Treatment technologies require various levels of assessment and approval prior to implementation.

7.3.2 *REMOVAL TO LANDFILL*

Removal to landfill involves physically moving impacted soil to an off-site location for storage, treatment or disposal. Waste must be assessed and managed in accordance with NSW EPA (2014) Waste Classification Guidelines. In some instances, waste soils must be treated and re-assessed prior to disposal. Waste soils must be disposed at licensed landfill premises that have the appropriate licence and is capable of accepting the waste.

7.3.3 *PHYSICAL BARRIER SYSTEMS (CAPPING)*

Physical barrier systems (or capping) limit access to the impacted material, mitigate surface water infiltration through the underlying material and control or reduce migration of the substances into the surrounding environment. This option can include creating horizontal or vertical barriers around and on top of the impacted material in place or relocating the impacted material to a constructed encapsulation area. In addition, the barrier may also be used to control the emission of odours and gases/vapours, reduce erosion and improve aesthetics.

7.3.4 *INSTITUTIONAL CONTROLS*

Institutional controls include measures such as land use restriction through zoning, site management (e.g. Environmental Management Plans) and access restrictions, restrictions on intrusive works and relocation of receptors. Although exposure can be reduced by these means, the impacted media are not directly remediated. Institutional controls can restrict design elements of a re-development.

7.4 *REMEDIAL OPTIONS ASSESSMENT*

A remedial options assessment for the site contamination is outlined in Table 3.

Table 3: Remedial Options Assessment

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
Polycyclic Aromatic Hydrocarbons (PAH)					
On-site treatment of PAH impacted soils and re-use on-site	• Yes	• On-site in-situ or ex-situ biological, chemical, or thermal treatment (Enhanced soil washing with surfactants, bio-stimulation/bio-augmentation, landfarming, bio-pile, chemox, thermal desorption)	• Reduced disposal volume and cost. • Soils can be re-used on-site. • If successful, no Environment Management Plan on property title required.	• Requires bench scale, pilot trial studies to determine effectiveness and potential impact on site and site surroundings. • Requires impact and geo-chemical assessment. • Requires long-contact time with impacted soil. • May not be suitable if other contaminants are found in the soil. • Nature of remediation method may require Regulatory approval.	• No
Off-site treatment of PAH impacted soils and return to the site	• Yes	• Off-site biological, chemical, or thermal treatment (Enhanced soil washing with surfactants, bio-stimulation/bio-augmentation, landfarming, bio-pile, chemox, thermal desorption.	• Reduction of waste to landfill. Reduced disposal volume and cost.	• Requires bench scale, pilot trial studies to determine effectiveness and potential impact on site and site surroundings. • Requires impact and geo-chemical assessment. • Requires long-contact time with impacted soil.	• No

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
				• May not be suitable if other contaminants are found in the soil. • Nature of remediation method will require Regulatory approval. • Double handling of soils. • Requires strict monitoring and tracking of soils and remedial method off-site. • Requires verification testing of returned soils and subject to ENM Order requirements. • May hold up construction if soils are not returned to site in a timely manner.	
Excavation, transport, and disposal of PAH impacted soils at licensed facility	• Yes	• Excavate and transport soils off-site (Waste Classification is subject to further sampling and analysis).	• Fast and effective. • Removes impacted material and subsequently any ongoing liability or need for any long-term management. • If successful, no Environment Management Plan on property title required.	• Increased disposal volume and cost. • Imported VENM/ENM and geotechnical considerations required to replace lost soil volume. • Additional site testing to determine extent and validation upon removal.	• Yes

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
				• Requires excavation in accordance with CEMP.	
On-site Containment of PAHP impacted soils	• Yes	• Determine extent and concentration of PAH, survey location with coordinates and elevation. Contain PAH under hard-stand, cover with marker tape, and clean soil buffer.	• No excavations for off-site disposal required. • Reduced disposal volume and cost. • Soils can be left in-place on-site. • Reduction of waste to landfill.	• Potential reduction in land value. • Subject to further leachability testing for on-site re-use. • Requires long-term management - Environmental Management Plan (EMP) on property title required. • PAH soils to managed and handled via Construction Environment Management Plan (CEMP). CEMP would require site induction requirement's, control measures, and monitoring measures, and quality control measures to ensure that environmental controls are being implemented and are effective. • EMP/CEMP must be administered until PAH removal is confirmed. • May limit design elements of development.	• No

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
On-site relocation of PAH impacted soils to an are of less sensitive land use	• Yes	• Determine extent and concentration of PAH, relocate PAH impacted soils to areas of less sensitive land use such as roadways.	• No off-site disposal required. • Reduced disposal volume and cost. • Soils can be beneficially re-used on-site. • Reduction of waste to landfill. • No EMP required.	• Subject to further leachability testing for on-site re-use. • PAH soils to managed and handled via Construction Environment Management Plan (CEMP). CEMP would require site induction requirement's, control measures, and monitoring measures, and quality control measures to ensure that environmental controls are being implemented and are effective. • EMP/CEMP must be administered until PAH removal is confirmed. • May limit design elements of development.	• Yes
Asbestos					
On-site containment of Asbestos	• Yes	• Determine extent of asbestos, survey location with coordinates and elevation. Contain asbestos beneath clean soil cover (1.0 m) under hard-stand, cover with marker tape, and clean soil buffer.	• No excavations for off-site disposal required. • Reduced disposal volume and cost. • Soils can be left in-place on-site if no human health risk. • Reduction of waste to landfill.	• Potential reduction in land value. • Requires long-term management - Environmental Management Plan (EMP) on property title. • Asbestos soils to managed and handled via Asbestos	• No

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
				Management Plan and Asbestos Register. AMP requires site induction requirement's, control measures, monitoring measures, and quality control measures to ensure that environmental controls are being implemented and are effective. • AMP and Asbestos Register must be administered until asbestos removal is confirmed. • May limit design elements of development.	
Excavation, transport, and disposal of Asbestos impacted soils at licensed facility	• Yes	• Excavate and transport soils off-site.	• Fast and effective. • Removes impacted material and subsequently any ongoing liability or need for any long-term management. • If successful, no Asbestos Management Plan or Asbestos register on property title required.	• Increased disposal volume and cost. • Imported VENM/ENM and geotechnical considerations required to replace lost soil volume. • Additional site testing to determine extent and validation upon removal.	• Yes

Remedial Method	Applicability	Method	Advantage	Disadvantage	Further Consider?
				• Requires excavation in accordance with environmental controls. • Requires clearance and site air monitoring (if fibrous asbestos) by Occupational Hygienist.	

Based on the remedial options assessment, the applicable and preferred remedial option for the COPCs is likely to be a combination of excavation, transportation and disposal to a licensed facility.

Excavation, transportation and reuse of impacted soils in an area of the site which has a less sensitive land and onsite encapsulation of impacted materials are also discussed.

These options however, will need to be re-evaluated based on the outcomes of additional assessment of soil at the site which are proposed to characterise soils.

It is noted that all remediation works at the site must be undertaken in accordance with a Construction Environment Management Plan to mitigate risks to workers and the public during earthworks at the site.

8 REMEDIATION METHODS

8.1 *OFFSITE DISPOSAL*

Excavation and offsite disposal at a suitably licenced waste disposal facility consists of physically removing the contaminated medium and therefore the contamination from the site. This method is considered likely to be the most suitable remediation approach as this approach has low technological risk and provides a fast, effective remediation methodology. This remediation method is considered suitable for both asbestos and PAH impacts.

The procedure for excavation and offsite disposal is as follows:

- The targeted area for remediation is set out onsite;
- The area is excavated to the target depth, with soils either excavated directly to trucks for offsite disposal at a suitably licenced waste facility capable of accepting the waste, or stockpiled onsite for offsite disposal at a later date;
- Waste classification of the material for offsite disposal is required prior to offsite disposal. Waste classification can be carried out insitu or following stockpiling of the material, in accordance with Section 9;
- Following excavation of the impacted soils, validation of the excavation should be carried out in accordance with Section 9.

8.2 *RETENTION OF IMPACTED MATERIALS ONSITE*

Onsite treatment of impacted soils by excavation, transport and placement of materials in an area of the site which has a less sensitive proposed land use is another option and is considered to be relatively low cost, has low technological risk and provides a fast, effective remediation methodology.

The reuse of impacted soils on an area of the site with a less sensitive land use is therefore considered suitable for remediation of PAH impacted soils. This methodology is not considered likely to be suitable for asbestos impacted soils.

The procedure for excavation and reuse onsite is as follows:

- The targeted area for remediation is set out onsite;
- The area is excavated to the target depth, with soils either excavated directly to trucks for transport to the designated reuse area, or stockpiled near the remediation area for transport at a later date;
- Following transport to the reuse area, the soils are then placed either in stockpile or by spreading and compaction to an engineering standard (if required);
- Following excavation of the impacted soils, validation of the excavation should be carried out in accordance with Section 9.

If required in order to meet design final contours for the site, uncontaminated material may be excavated from the less sensitive areas in order to create suitable void space in the areas of less sensitive land use, for the impacted materials which are to be relocated. If this is required the excavated uncontaminated materials could be used to backfill the excavated hotspots (once validation of remediation has been confirmed), be used beneficially on other areas of the site requiring fill materials or alternatively be suitable waste classified and disposed of at an offsite location, capable of accepting the waste materials (most likely to be classified as VENM).

8.3 *ONSITE ENCAPSULATION*

Onsite encapsulation of the impacted material consists of excavation of the impacted soil and placement of the soil at a suitable location onsite, for example under a proposed roadway. Onsite encapsulation will require specific design in consultation with the site auditor, Council and other stakeholders, and may require an Environmental Management Plan to be prepared for the site.

The impacted soil excavation will require validation in accordance with the validation requirements outlined in Section 9 and the impacted soils may require further assessment.

Onsite encapsulation is considered to likely be suitable for the PAH and/or asbestos impacted soils.

8.4 *REMEDIATION SEQUENCING*

The sequencing and timing of remediation at the site will be under control of the Site Manager who will have control of all aspects of the construction (i.e. timing, stakeholder engagement, permits, technical, plant and site management, waste management, environmental controls and subcontractor management). It is noted that at this time the site staging plan has not been finalised. Following finalisation of the construction staging plan the RAP should be reviewed and updated if required to suit the proposed staging plan. An indicative sequence of site construction and remediation is provided below:

1. Notifications given, and permit requirements obtained;

2. Installation of environmental, safety, traffic management, construction utilities, site boundary, and waste management controls;
3. Mobilisation of site amenities;
4. Investigation of areas identified for further assessment in the RAP;
5. Update of the RAP;
6. Remediation works executed in accordance with the RAP and the preferred remediation approach; and
7. Validation sampling and analyses remediated areas.

8.5 *PRELIMINARIES*

Prior to undertaking any works, the nominated remediation contractor should prepare health, safety and environment plans (HESPs) to ensure that potential hazards related to the work are identified and control measures are implemented. Safe work method statements should be prepared for tasks required to be undertaken by both the environmental consultant and the remediation contractor to complete their respective scopes of work.

The remediation contractor is to confirm that all necessary environmental management, notifications, permits and safety controls are in place.

Service plans will be requested from the Dial Before You Dig service and from the Council as necessary to identify the location of underground services at the site.

8.6 *SITE PREPARATION*

The following Table 4 summarises the measures that should be implemented prior to remediation works at the site.

Table 4: Site Preparation

Item	Description
Site Access	Access to the site remediation area will be controlled by the remediation contractor performing the works and the site will be off limits to all non-essential personnel. The public will not have access to this area of the site.
Site Signage	Signage will be installed on the site, with direction to key areas (including to decontamination units, wash down areas, exits, etc.) and traffic restrictions. Signage at the main access points will include after-hours contact details.
Fencing or Hoarding	The site is to be secured with perimeter security fencing which must be maintained around the site and internal excavation areas if physical barriers are not already in place. Shade cloth should be installed on fences and hoardings. Additional fencing should be erected where required to secure work areas and exclusion zones. Regular maintenance and repair of all retained fences and hoardings within and surrounding the site will be undertaken during the period of the remediation work.

Item	Description
Traffic Management	It is the remediation contractor's responsibility to liaise with others on the property outside the designated site works boundary, and adjacent to the site, to ensure works are completed in accordance with directions from the Site Manager. The remediation contractor may need to excavate, and transport impacted soils off-site. Driving through the impacted areas is to be avoided and dust suppression is to be undertaken where trafficking is unavoidable. Transport of materials to and from site will need to consider traffic management options which take into account the size of the site and any access restrictions to the site. The site access and exit roads are to be monitored for spillage and tracking from the site and are to be kept clean with street sweeper following waste removal off-site.
Decontamination Facilities	The remediation contractor shall isolate or eliminate the risk of cross-contamination or off-site transport of hazardous or contaminated materials via the vehicle tyres by manual removal and wheel washing facility. A wheel washing facility will be required for vehicles leaving the remediation area of the site, either for waste disposal or other activities, based on site conditions, to minimise dust and soil emitting off-site. A decontamination facility for workers (hand and eye washing facilities etc.) should be installed for use during the works. These facilities should be clearly signposted and indicated to site workers during site inductions.
Supply of Utilities	The installation and commissioning of all temporary site services (e.g. electricity, water, sewerage and telecommunications) required for the duration of the works should be installed to the requirements of the appropriate regulatory authorities and should be installed outside areas of proposed excavations. All approvals in respect to the installation, operation and eventual removal of temporary services shall be obtained.
Site Contractor's Facilities	All site accommodation and facilities required for the remediation works will be established in conformance with relevant regulations and authority's requirements. Existing site infrastructure may be utilised for this purpose (if present). Licensed persons in accordance with statutory requirements will carry out all connections. The following facilities may need to be established adjacent to or in close proximity to the site for the site works: • site offices; • amenities; • work sheds (including decontamination facilities) and changing areas for the use of the remediation contractor, subcontractors and consultants; • temporary site sheds; • bins for rubbish generated by personnel.
Waste Management	Unless materials are removed from site upon excavation, designated waste management areas are to be set up on or near to the site to manage impacted excavated soil for disposal or impacted soils stored on the site are to be managed in accordance with approved environmental controls.

8.7 *SOIL STOCKPILE MANAGEMENT*

In the occurrence of soil stockpiling onsite, stockpile management procedures, soil erosion and sedimentation controls, and procedures to manage contamination must be applied to all stockpiled material.

The location of the stockpiles should be selected to fit with the expected stages of the project. In addition to the general requirements and assumptions for excavations noted above, these additional requirements apply to stockpiled soils:

- The remediation contractor is responsible for the selection, location and preparation of surfaces for the placement of stockpiles. Stockpiles will only be placed at approved locations.
- Stockpiles will be strategically located to mitigate environmental impacts while facilitating material handling requirements.
- The remediation contractor is responsible for tracking the movement of materials between excavations and stockpiles.
- Stockpiles must be managed by the remediation contractor to mitigate the effects of dust, odour, vapours, and liquid run-off.
- During excavation, soils must be characterised by visual and olfactory means, and placed in segregated stockpiles based on field screening methods described below.
- The remediation contractor must excavate soils to minimise cross-contamination of soil types, contamination, and liquids.
- Contaminated materials will only be stockpiled in locations that do not pose any risk of environmental impairment of the stockpile area or surrounding areas (i.e. sealed surfaces such as sealed concrete, asphalt, high density polyethylene or a combination of these).
- Stockpiles will only be constructed in areas of the site that have been located and prepared in accordance with the requirements of this RAP.
- All such preparatory works will be undertaken prior to the placement of material in the stockpile.
- Access routes will be established around the material stockpiles to enable access from adjoining traffic routes.

8.7.1 *STOCKPILE WASTE CLASSIFICATION*

Classification of stockpiled materials to be removed from the site will be undertaken in accordance with the NSW EPA Waste Classification Guidelines (2014).

8.7.2 *STOCKPILE ASSESSMENT AND SAMPLING METHODOLOGY*

Stockpile assessment and sampling methodology should be in general conformance with the referenced regulatory and guidance documents within this RAP and as directed by the environmental consultant. In addition, reference is made to the following document for general guidance on stockpile sampling methodology:

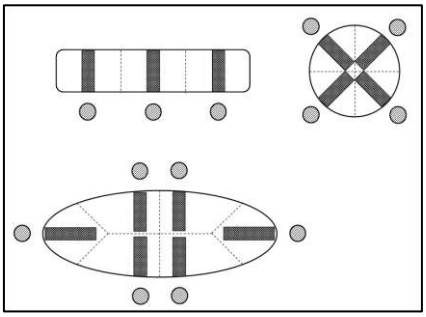
- AS1141.3.1-2012, Methods for sampling and testing aggregates, Method 3.1: Sampling - Aggregates
- Cement Concrete & Aggregates Australia, Guideline to Sampling for the Extractive Industry, August 2006
- ASTM D6009-12, Standard Guide for Sampling Waste Piles

The method of stockpile field screening assessment and sampling shall consider the size of the stockpile, the expected degree of homogeneity, the known history, the expected contaminant distribution, contaminant volatility and physical characteristics, the space availability needed to interrogate the contents of a stockpile, the qualifications of the sampling environmental consultant and equipment operator, the quality of sampling equipment, and the environmental controls in-place.

8.7.3 *GENERAL GUIDANCE FOR FIELD SCREENING STOCKPILES OF VOLUME UP TO 200M^3*

- Sketch and measure the stockpile dimensions, location, and immediate vicinity impediments and record this information on the Field Inspection Form.
- Collect minimum 10 field screening samples from the stockpile for visual, olfactory and/or PID measurement (where volatile contaminants are present). The screening samples should be discrete and collected evenly throughout the stockpile via a systematic grid.
- The 10 samples should be collected in both bag for PID measurement and clean glass jar(s) for laboratory analyses and be of suitable volume for analyses.
- Screening samples should be collected by opening the stockpile using mechanical means (i.e. backhoe) or penetrating the stockpile using hand auger or push tube. Examples of stockpile partitioning are shown in Figure 4 below as reproduced from AS11413.1-2012.
- Sampling should penetrate the entire depth of the stockpile.
- Samples should be handled with appropriate personal protective equipment.
- The samples should be collected using decontaminated equipment.
- Samples should be taken a minimum 200 mm from the soil exposed surface.

Figure 4 Example Stockpile Partitioning (Source: Reproduced from AS11413.1-2012).



8.7.4 *GENERAL GUIDANCE FOR FIELD SCREENING STOCKPILES OF VOLUME GREATER THAN 200M³:*

For stockpiles greater than 200 m^3, the minimum number of field screening PID samples should include 10 samples for the first 200 m^3 and then 1 sample per 25 m^3. Example: a stockpile of 350 m^3 should include a minimum of 16 field screening samples.

8.7.5 *LABORATORY ANALYTICAL FREQUENCY*

The minimum number of soil samples required for analytical testing will be based on the NSW EPA Sampling Design Guidelines, Schedule B2, Table 4, NEPM 2013, and the Victorian EPA Publication IWRG 702.

The number of samples for analytical purposes is primarily based on the soil volume (e.g. either less or greater than 200 m^3) and the method of assessment as either:

Method 1: Highest individual measured concentration; or,

Method 2: Comparison of the calculated 95% Upper Confidence Limit of the Average Concentration against the adopted criteria.

Stockpiles Less than 200m³

For stockpiles less than 200 m^3, the minimum number of samples for analyses utilising assessment Method 1 is reproduced from Table 4 Schedule B2, NEPM 2013 and IWRG702 in Table 5 below:

Table 5: Minimum number of samples for stockpile 200 m^3 or less (minimum of 3 then 1:25m^3)

Soil Volume, m^3	Minimum Number of Samples for Analyses
<75	3
75 - <100	4
100 - <125	5
125 - <150	6
150 - <175	7
175 - <200	8
>200	1:25

Where assessment Method 2 is required for stockpiles less than 200 m^3, a recommended minimum number of ten samples should be analysed.

Stockpiles Greater than 200m^3

For stockpiles greater than 200 m^3, the minimum number of samples for analyses utilising assessment Method 1 or Method 2 is reproduced from IWRG702 in Table 6 below:

Table 6: Minimum number of samples for stockpile soil volumes greater than 200 m^3

Soil Volume, m^3	Minimum Number of Samples at 1:25 m^3	Minimum number of samples to calculate 95%UCL of the Average Concentration
300	12	10
400	16	10
500	20	10
600	24	10
700	28	10
800	32	10
900	36	10
1000	40	10
1500	60	10
2000	80	10
2500	100	10
3000	120	12 (1:250)
4000	160	16 (1:250)
4500	180	18 (1:250)
5000	200	20 (1:250)
>5000	1:25 m^3	1:250 m^3

*: Taken from Table 3 of EPA Publication IWRG 702

8.8 *CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN REQUIREMENTS*

The Remediation contractor shall develop a Construction Environmental Management Plan (CEMP) that describes the measures to reduce adverse impact of the construction activities on the environment and sensitive receptors (e.g. residential properties to the south). The CEMP is to include, as a minimum:

- placement of site accommodation, toilets, storage compounds and personal decontamination units;
- vehicle access and areas where access is to be restricted;
- enclosure or delineation of the site for safety;
- protection of existing vegetation;
- methods of odour, dust, and vapour control;
- dust and asbestos trigger levels for action;

- noise mitigation and monitoring methods;
- site drainage management measures;
- control of discharges from and within the site;
- methods of control of erosion on the site;
- methods of controlling surface run off from the site;
- methods of controlling discharges to watercourses or drains so that they comply with EPA and Sydney Water requirements;
- location and procedures (including spill contingencies) for refuelling and chemical storage on site; and
- material stockpile areas and sediment control.

8.9 *WASTE MATERIALS TRACKING*

Materials excavated or removed from the site should be tracked in order to provide detailed and accurate information about the location and quantity of all materials both on- and off-site from the time of their excavation until their disposal. The disposal locations will be determined by the remediation contractor. Over and above waste dockets supplied by the receiving landfill, the following information is to be documented by the remediation contractor:

- Origin of material on the site;
- material type and description;
- approximate volume (m^3);
- time and date of excavation and transport;
- truck licence and registration number.

This information, along with the landfill docket number, is to be provided to the environmental consultant so as to be included in the validation report.

As per the Protection of the Environment Operations (Waste) Regulations 2014, as at 1 July 2015, it is required that transport of more than 100 kg of asbestos waste or more than 10 m^2 of asbestos sheeting is recorded with a unique code to allow NSW EPA to monitor their movement from site of generation to disposal. An exemption for excavated soil contaminated with asbestos waste and soil contaminated with asbestos waste prior to excavation was available until 28 February 2017.

8.10 *SOIL OFF-SITE DISPOSAL*

Following receipt of waste classification results, the total volumes of stockpiled material for offsite disposal will be transported by a licenced transporter to an appropriately licensed facility for disposal. Prior to the disposal of waste materials from the site, the remediation contractor will seek written approval from the receiving facility to accept the waste.

8.11 *ONGOING MONITORING/ MANAGEMENT*

The preferred remediation approaches are designed to treat contaminated material, remove contaminated materials from the site and dispose at a licenced facility or contain contaminated materials to prevent exposure of future site users to the contaminants, such that there remains no risk to human health. If this approach is validated as successful, the requirement for on-going monitoring or management to ensure continued protection of human health and the environment will not be required.

8.12 *SITE REINSTATEMENT*

Imported materials may be required to reinstate some of the excavated areas, excavations will be backfilled with imported virgin excavated natural material (VENM) or Excavated Natural Material (ENM) as defined in the NSW EPA general resource recovery order "The Excavated Natural Material Order 2014". All material must be certified as suitable for the intended use.

VENM/ENM sourced from a quarry or other supplier, should either be accompanied by a certified letter stating that the material is VENM/ENM or ideally come with chemical certification by means of confirmatory validation data from the source site. It may also be prudent for the environmental consultant supervising the works to visit the source site to assess the potential for contamination. Observations will be made by the consultant during importation/use to confirm that the material is consistent with the documentation. Geotechnical considerations with respect to backfilling (drainage of the material, compaction, density) should be taken into account by the remediation contractor (with the possibility of engaging a suitably qualified geotechnical consultant to provide advice on backfilling specifications).

During the importation of validated fill material for site reinstatement, if needed, receipts and dockets will be provided by the supplier of the material for every truck or load of material that is trucked into site. These dockets will also need to be kept on file as part of the remediation documentation.

Landscaping soil and garden mixes are an exception to the requirement of VENM due to their processed nature. This material would need to be approved on a case by case basis prior to being used on site and provision of any compliance certificates, product information sheets and the preparation by a reputable landscape supplier. Laboratory testing will be required at the discretion of the Site Auditor and environmental consultant on site.

8.13 *REMEDIAL CONTINGENCIES*

The proposed remedial option should be effective in dealing with the identified impacts, however contingency strategies may be required in the event of certain scenarios.
Anticipated potential remedial contingencies are detailed in Table 7.

Table 7: Remedial Contingencies

Potential issues	Proposed Corrective Actions	Responsible Person	Communication and Additional Sampling/Monitoring
Excavation becomes unmanageable due to mud	Improve drainage collection system; add geotextile/gravel in problem areas; strip off mud/slurry materials. Drains, gutters, roads and access ways shall be maintained free of sediment. Site personnel or dedicated site manager to remain vigilant of breaches of sediment controls.	Remediation contractor	Advise site manager of potential breaches. Breaches are to be recorded in the daily site log and provided to the Client and the appointed environmental consultant or site environmental officer. No additional monitoring/sampling required unless stormwater drains are inundated with evidence of contaminated materials from site.
Excessive stormwater runoff in drains or excavation areas	Minimise active contaminated work area; improve stormwater diversion. Check control measures are adequate to prevent surface water runoff entering and leaving excavation and stockpile areas. Temporary bunding or diversion drain, impermeable sheeting placed under stockpiles, silt fences/hay bales surrounding stockpiles and protect existing drains with silt/sediment mats or bunds. Regularly inspect drains to ensure that they are protected from runoff.	Remediation contractor to contact Environmental consultant to test any accumulated water.	Breaches are to be recorded in the daily site log and provided to the Client and the appointed environmental consultant. No additional monitoring/sampling required unless stormwater drains are inundated with evidence of contaminated materials from site. Water accumulated in excavations to be sampled by environmental consultant for applicable contaminants of concern. Management/disposal options to be formulated based on analytical results.
Excessive dust	Use water sprays or water fogging equipment; stop dust-generating activity until better dust control can be achieved or apply interim capping systems on stockpiles or exposed material. Stop work in high wind conditions.	Remediation contractor	Breaches are to be recorded in the daily site log. Monitoring/sampling required where removal of asbestos is occurring in accordance with licenced asbestos removalist's asbestos control plan.
Heavy rain, wind, or inclement weather	Temporarily stop work. Ensure site security is stable. Ensure sediment and surface water controls are operating correctly. If possible, divert surface water away from active work areas or excavations. Cover stockpiles with tarp and weights.	Remediation contractor	None.
Equipment failures	Maintain spare equipment or parts; keep rental options available or shut down affected	Remediation contractor	Sample any impacted stockpiled materials (TRH, BTEX compounds and PAHs) and determine appropriate

Potential issues	Proposed Corrective Actions	Responsible Person	Communication and Additional Sampling/Monitoring
	operations until repairs are made. Clean up the spill with absorbent material. Stockpile the impacted material in a secure location.		disposal/treatment option based on an assessment of analytical results.
Unexpected contamination findings (such as areas of fly tipping or potentially contaminated fill)	Stop work immediately and consult with a specialist as to appropriate management options. Further details are included in Unexpected Finds Management Plan Appendix A.	Remediation contractor	Sampling and laboratory testing of potentially contaminated material to determine appropriate management options based on an assessment of analytical results. Analyses may include heavy metals, TRH, BTEX compounds, PAHs, and asbestos (as required).
Neighbour or community complaints	Stop works and implement control measures to address complaint (if possible).	Remediation contractor	Coordinate a community consultation process prior to and during the works. Notify relevant Project Managers following complaint. Report complaint as per Client management procedures.
Selected remedial options are not effective	It is anticipated that the proposed RAP will be effective in dealing with the on-site impact, however, alternative remedial methods will be identified and applied, in consultation with the Client and other stakeholders, as appropriate.	Remediation contractor	Unidentified impacts at the site will need additional sampling to assess appropriate remedial action.

9 VALIDATION PLAN

Validation sampling will be undertaken following removal of impacted or contaminated soils during the site works to ensure that the horizontal and vertical extent of impacts are removed. Sampling will be conducted in accordance with relevant NSW EPA guidance to confirm whether the identified contamination has been adequately removed from the excavated areas and whether any further remediation is required.

Based on the soil results to date for the site, the contaminants of potential concern (COPC) are identified as:

- PAH and asbestos located on the eastern embankment.

All validation samples collected from the remediation areas will also be analysed for the identified COPC.

Where other COPCs are identified during site works or additional investigations, these COPCs will be added to the validation suite where necessary.

Soils at the base and walls of excavations will be assessed against the site criteria outlined in Section 5 as well as consideration for statistical analyses of results where appropriate in accordance with NEPM 2013.

9.1 *VALIDATION SAMPLING*

Validation sampling should be carried out as required, as outlined below.

9.1.1 *EXCAVATED AREAS*

A systematic and judgemental sampling regime will be adopted for validation of areas where impacted soils have been removed by excavation.

Following excavation of impacted areas, the walls and base of each excavation area will be field screened and documented for the following characteristics:

- visual and olfactory evidence of impact;
- spatial relationship to known impacts; and,
- geologic or hydrogeological evidence of preferential pathways.

Systematic grid-based samples retrieved in-situ will be collected from the walls and base of excavations and analysed at a frequency of one sample per 25 m^2 and increased depending on field observations. Judgemental samples will also be collected where distinct soil differences occur.

If validation samples detect contaminants in excess of the site assessment criteria, additional material will be excavated and treated, until the area can be successfully validated.

9.1.2 *FILL STOCKPILE AREAS*

If the material from excavated areas is stockpiled onsite, and the stockpiled material is assessed to have the potential to leach in excess of the stipulated criteria, validation of the footprint of the stockpiled material will be required. Validation should be undertaken in a similar manner to excavated areas, as detailed in Section 11.1.1.

9.1.3 *VALIDATION PLAN SUMMARY*

The validation plan will be proposed once further sampling at the site has been carried out. This will ensure that sufficient and effective validation of the areas of concern is carried out. This RAP will be amended as further sampling results are received and assessed.

9.1.4 *WASTE CLASSIFICATION*

For remediation areas requiring off-site disposal of soils the following chemical contaminants should be analysed in accordance with the NSW EPA (2014) Waste Classification Guidelines: Part 1 Classifying Waste, November 2014:

- Heavy Metals;
- PAH;
- Moderately harmful pesticides list in table 1 of waste classification guidelines;
- TRH;
- BTEX; and
- Scheduled chemicals list in table 1 of waste classification guidelines.

9.1.5 *IMPORTED VENM*

VENM, sourced from a quarry or other supplier, should either be accompanied by a certified letter stating that the material is VENM, and ideally be accompanied by analytical data from the source site.

CES will undertake an inspection of the source of the material, and if necessary complete sampling of the material, to assess potential for contamination. Observations will be made by the consultant during importation/use to confirm that the material is consistent with the documentation.

Geotechnical considerations with respect to backfilling (drainage of the material, compaction, density) should be taken into account by the remediation contractor (with the possibility of engaging a suitably qualified geotechnical consultant to provide advice on backfilling specifications).

During the importation of validated fill material for site reinstatement, receipts and dockets are to be provided by the supplier of the material for every truck or load of material that is trucked into the site. These dockets will also be required to be kept on file as part of the site reinstatement documentation.

9.1.6 *IMPORTED ENM*

Where ENM is to be imported to the site for use as backfill, the material should be sampled and assessed in accordance with the NSW EPA Resource Recovery Order, ENM Order 2014 prior to being imported to the site.

9.1.7 *IMPORTED MATERIAL VALIDATION*

Any VENM or ENM imported to site for use must be accompanied by suitable documentation to demonstrate that the material meets with the classification of VENM or the ENM General Resource Recovery exemption issued by the NSW EPA. Fill that is not accompanied by adequate certification shall be rejected from Site.

Prior to and following placement, the imported material will be inspected for any visual signs of contamination, foreign material or variations in material type to that expected from the source site. The inspection will include:

- Inspection for obvious sign of contamination or unacceptable characteristics including odours, discolouration, waste materials (slag, ash, building wastes, containers, rubbish) and potential asbestos containing materials (including fibro, cement pipes and compressed cement sheeting); and
- Confirmation that the material is what is expected from the source site (e.g. ripped sandstone, shale, clay soil etc).

Any material exhibiting signs of contamination or that is not the expected material will be rejected. To confirm the suitability of the material for use on-site from a contamination perspective, ongoing validation testing of the material imported to the site will be undertaken.

The validation testing will involve as a minimum:

- Collection of a minimum of three samples per VENM source site under 15,000m^3 or one sample per 5,000m^3 for source sites where greater than 15,000m^3 will be sourced of VENM imported to the site; and
- Laboratory analysis of the material at a NATA registered laboratory for a suite of common contaminants including heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn); Total Petroleum Hydrocarbons (TPH); Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX), Polycyclic Aromatic Hydrocarbons (PAH), Organochlorine Pesticides (OCP), and asbestos.

The results will be compared to the SAC applicable to the area of the site where the material is to be placed as detailed below:

- HIL A, HSL A – Residential areas;
- HIL B, HSL B – Low-high density residential

Where an imported material does not meet the SAC, the material should be considered unsuitable and rejected from site.

9.1.8 *METHOD OF SAMPLE COLLECTION*

Care will be taken to ensure that representative samples are obtained and that the integrity is maintained, particularly when dealing with potentially volatile or semi-volatile compounds. Specific sampling procedures for each method of collection are provided below in following sections.

9.1.9 *SAMPLE COLLECTION*

Samples will be collected using either a decontaminated stainless steel trowel or by using new nitrile gloves for each sample and placing the soil directly into laboratory supplied containers.

9.1.10 *DECONTAMINATION PROCEDURES*

The following decontamination procedures will be adopted for sampling equipment.

9.1.11 *SAMPLING EQUIPMENT*

Sampling equipment, such as trowels, will be washed between sampling events using Decon 90 (or similar laboratory grade detergent) initially followed by adequate rinsing with clean potable and de-ionised water. To check the adequacy of the decontamination protocol, rinsate samples will be collected for analysis.

9.1.12 *SAMPLE CONTAINERS*

Soil and groundwater sample containers will comprise glass or plastic containers, as required, supplied by either the primary or secondary laboratory. The containers will be completely filled leaving no headspace, labelled with the job number, date, unique sampling point identification and initials of the project environmental scientist/engineer.

9.1.13 *METHOD OF SAMPLE STORAGE AND HANDLING*

The samples will immediately be placed in an esky / cool box in which ice has been added, to keep the samples below a temperature of approximately 4^{o}C. At the end of each day, the samples in the cool box will be transported to laboratory (within holding times).

9.1.14 *SAMPLE LOGGING*

A log of excavation works and soil/groundwater samples collected will be completed during fieldwork by a qualified environmental engineer/scientist. The log records the following data:

- Sample number and depth;
- Soil classification, colour, consistency or density, odour and moisture content;
- Groundwater colour, odour, suspensions;
- Depth of excavation;
- Excavator bucket refusal;
- Method of excavation; and

- The depth of first encountered free water.

9.1.15 *QA / QC DOCUMENTATION*

While on site, the supervising engineer/scientist will be required to fill out a copy of a 'sample register', which documents:

- Time of sample collection;
- Weather;
- Unique sample identification number; and
- Sample location and depth.

All samples will be classified in the field based on soil/fill/groundwater characteristics and obvious signs of contamination such as discolouration or odour will be noted on a log.

All samples, including QC samples, will be transported to the primary and check laboratories under Chain-of Custody (COC) procedures and maintained in an ice-filled cooler. The following details will be recorded on the COC form:

- Site identification;
- The sampler;
- Nature of the sample;
- Collection time and date;
- Analyses to be performed;
- Sample preservation method;
- Departure time from site; and
- Dispatch courier(s).

9.2 *FIELD SCREENING*

Although not anticipated, where volatile contaminants are encountered, field screening will be undertaken to screen potentially contaminated material being removed from the excavations for the presence of volatile compounds. Field screening will be conducted using a Photo-Ionisation Detector (PID) or similar instrument capable of measuring Volatile Organic Compounds (VOCs) in air.

The instrument will be operated using the controlled headspace method in accordance with a documented procedure by appropriately trained persons. Full documentation will be provided relating to the calibration of the instrument, the samples analysed, gas screening results and site observations. These results will be compiled and presented in the validation report.

The presence of elevated levels of VOCs in imported material will result in that batch of material being rejected.

9.3 *QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM (QA/QC)*

The proposed field and laboratory QA/QC programme for this project is consistent with National Environmental Protection Council (NEPC, 1999 as amended 2013) requirements. The programme consists of the following:

- Laboratory blind replicates at 1 in 20 (5 %) samples or one per batch; and
- Split samples (intra-lab duplicates) at 1 in 20 (5 %) samples or one per batch.

9.3.1 *FIELD QA/QC PROGRAMME*

Field QA/QC consists of the application of documented quality work procedures and the collection of field QC samples listed above.

9.3.1.1 *Environmental Samples*

The environmental samples collected for the validation programme are representative samples of soil/groundwater collected for analysis. Environmental samples are the original samples taken from a particular location and other samples are blind replicates or split samples of the original.

9.3.1.2 *Blind Replicate Samples*

Blind replicate samples are provided by the collection of two similar samples from the same location or successively from the same monitoring bore. These samples are preserved, stored, transported, prepared and analysed in an identical manner to environmental samples.

9.3.1.3 *Split Samples*

Split samples provide a check on the analytical proficiency of the laboratories. Split samples are collected from the same location or successively from the same monitoring bore. Split samples must be taken from the same location as the blind replicate, thus becoming a triplicate sample. However, split samples are not taken as often as blind replicates. Spilt samples (triplicates) are preserved, stored, transported, prepared and analysed in an identical manner to environmental samples, but are sent for testing to a different laboratory.

9.3.1.4 *Trip Spike*

Laboratory-prepared VOC spikes consisting of distilled, de-ionised water or sand spiked with known concentrations of BTEX should be included in QA/QC programmes where light fraction TPH, BTEX and other VOCs concentrations are being measured. Laboratory-prepared VOC spikes should be included at a rate of one per sample batch submitted for VOC analysis. These samples are to be submitted for BTEX analysis with resulting concentrations compared with the concentrations of the known additions. Generally, samples are spiked with concentrations of 10,

10, 10 and 30 ppm of benzene, toluene, ethylbenzene and total xylenes, respectively. The purpose of these samples is to monitor VOC losses during transit.

9.3.1.5 *Trip Blank*

Trip blanks consisting of pre-washed bottles containing distilled or de-ionised water and appropriate preservatives or laboratory-prepared sand blank containing acid-washed quartz sand will be supplied by the analytical laboratory. The role of trip blanks is to detect potential contamination during sample transport. These samples reside in transport vessels during sampling activities and are not opened in the field. Typically, one trip blank is submitted with each batch of samples for VOC analysis. Trip blanks are analysed at the laboratory as regular samples or only for volatile organic compounds, as deemed appropriate.

9.4 *VALIDATION REPORTING*

Following the remediation and validation works, a validation report will be prepared in accordance with the NSW EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The validation report will detail the extent and nature of the remedial works undertaken, characterisation and disposal of contaminated soils, the validation of imported clean fill and topsoil (if any) and will consider the overall status of the site.

The report will include the following sections:

- executive summary;
- scope of works and objectives;
- site identification;
- site history;
- site conditions and surrounding environment;
- geology and hydrogeology;
- previous investigation results;
- summary of the RAP;
- validation criteria;
- nature and extent of the remediation undertaken;
- sampling and analysis plan and sampling methodology;
- field and laboratory QA/QC;
- results of the validation sampling and sampling of imported fill materials;
- information supplied by the remediation contractor (such as waste disposal documentation);
- discussion of the land use suitability at the completion of remedial works; and,

- conclusions.

It should be noted that to enable the validation report to be produced, the remediation contractor will be required to supply the following to the environmental consultant:

- the quantities and types of waste disposed;
- details of the receiving facility/facilities accepting waste from the site;
- disposal dockets for the waste disposed;
- details of any imported materials (including VENM certification, laboratory results, origin and supplier, exemption details, quantities and areas of placement), survey data (including surveys of excavations and following backfilling works).

10 WORK HEALTH AND SAFETY

All works conducted at the site as part of the remediation or site excavation process will comply with the Work Health and Safety Act 2011 and associated Regulations.

The remediation contractor will prepare a work health and safety (WHS) plan that outlines the risks and control measures of site remedial works. The plan should cover site specific requirements associated with the asbestos and PAH's contamination known to be present within fill and natural soils at the site.

The environmental consultant will prepare a WHS Plan for the sampling works it will undertake.

Typically, the WHS plan should address the following issues:

- regulatory requirements;
- responsibilities hazard identification and control;
- air monitoring (including action levels) during excavation and construction (if necessary);
- noise;
- odours;
- chemical hazard control;
- handling procedures;
- personal protective equipment (PPE);
- work zones;
- decontamination procedures;
- emergency response plans;
- contingency plans; and
- incident reporting.

The plan should include emergency contact numbers such as police, fire brigade, hospital and contact details for all relevant personnel. Response to any incidents occurring on site should be in accordance with the plan. The plan should include an Induction and Tool Box Discussion Register.

A hazardous material survey should be completed by a suitably qualified person to inform demolition works.

All those working or visiting the site should be inducted into the plan.

11 SITE MANAGEMENT PLAN

11.1 *HOURS OF OPERATION*

Remediation work hours will only be permitted during the following times, subject to Council approval:

- Monday to Friday: 7:00 am to 6:00 pm
- Saturday: 8:00 am to 1:00 pm.
- Sundays or Public holidays: No work permitted.

Emergency work is permitted outside of these hours.

11.2 *SITE SIGNAGE AND CONTACTS*

Signage will be installed on the site, with direction to key areas (including to decontamination units, wash down areas, exits, etc.) and traffic restrictions. Signage at the main access points will include after-hours contact details of the remediation contractor and site manager.

11.3 *SITE ACCESS*

Transport of materials to and from site will need to consider traffic management options which take into account the size of the site and any access restrictions to the site. The site access and exit roads are to be monitored for spillage and tracking from the site and are to be kept clean with street sweeper following waste removal off-site.

During the remediation works, perimeter fencing will be erected to restrict public access to the work area. Only authorised personnel will be permitted to enter the remediation works area.

Vehicle access will be managed at the entry access point to the site to reduce the tracking of potential contaminated soils around and off-site. This shall be achieved by sweeping the entry on an as-needed basis. Any collected material shall be treated as contaminated material and will be disposed of as required.

11.4 *SEDIMENT AND RUNOFF MANAGEMENT*

A soil and water management plan must be implemented for the control of sediments and runoff leaving or entering the site. All control measures must be installed in accordance with Managing Urban Stormwater: Soil and Construction Volume 1, 4th Edition, NSW Government, March 2004. In the event excavated materials may be required to be stockpiled on site, the material will be required to be stockpiled in a designated location and covered to prevent dust emissions or wash-out during potential rainfall events. Methodology for stockpiling of materials on-site is provided in this RAP.

Drainage and sediment erosion control is required to mitigate the potential for:

- Migration of clean and impacted soil off-site and across the site itself; and

- Migration of clean and impacted surface water and groundwater off-site and across the site itself.

Migration of clean or impacted soil off-site can increase the sediment load in receiving waters and storm water drains, while impacted soils may also release contaminants into these environments. Migration of impacted surface and/or groundwater off-site may result in the release of contaminants into sensitive receiving waters or public utilities (sewer or storm water). Migration of impacted soil, surface water or groundwater across the site may also lead to re-contamination of remediated portions of the site.

Uncontrolled migration of clean surface water across the site may cause erosion and result in transport of soil and sediment off-site. Drainage and erosion controls to be implemented may include the following:

- Hay-bale and geofabric fences to control soil erosion;
- The use of silt/sediment mesh to control surface water run-on or run-off. Where possible, clean run-off should be diverted around the site to minimise the volume of water requiring management; and
- Temporary bunding.

These sediment control features may be placed around:

- The individual site boundaries (up, across and down gradient);
- Soil stockpiles (if created);
- Excavation areas; and
- Stormwater drains.

Appropriate regulatory and utility permits will be required to allow disposal of run-off to either the stormwater or the sewer. Review of the permitting regulations will need to be done with the local authority and/or water authority managing the sewer (storm and sewerage) network.

11.5 *AIR QUALITY*

11.5.1 *DUST CONTROL*

The greatest potential for dust generation may occur during soil treatment or excavation, stockpiling and reinstatement works. Control procedures for the site should be implemented on an as needed basis and could include the following:

- Use of hand held water sprays or hoses to dampen exposed soil and fill surfaces. However, it is important to recognise that there is an environmental risk associated with the generation of excessive and / or contaminated run-off and this should be managed accordingly;
- Stockpiling material in small stockpiles;
- Covering stockpiles; and
- Staging works to take advantage of the prevailing winds to minimise the impact of dusts.

11.5.2 *ODOUR*

Odour is not anticipated be an issue at the site during the excavation and remediation works however if required odour issues can be mitigated by covering of soils, and mist sprays/odour suppressants at site boundaries.

The following measures are generally used to mitigate odour, if generated:

- Minimise working area within odorous soils;
- All stockpiles will be covered to prevent odour dispersion and potential off gassing;
- Excavation works should take advantage of the prevailing winds to minimise the dispersal of nuisance odours to any neighbouring properties; and
- Use of odour suppressant such as Biosolve or suitable alternative may be applied to stockpiled excavated material to reduce odour.

11.5.3 *POTENTIAL VAPOUR EXPOSURE IN SUBSURFACE AREAS*

Occupational health and safety requirements must be met to prevent exposure from impacted soil and / or groundwater during excavation and soil management works. It is not anticipated that soils impacted by volatile contaminants will be encountered, however if encountered the risks to site workers should be managed as outlined below.

Prior to excavation works, or access to utility pits, control measures to protect against exposure to vapour inhalation should be implemented. These measures might include but are not limited to:

- Using a photo-ionisation detector (PID) in the operator breathing zone;
- Setting PID action levels;
- Using respirators or implementing ventilation measures if action levels are exceeded; and
- Stopping work and accessing methods of eliminating vapour exposure.
- Assessment of confined spaces on-site and in nearby off-site utility pits or other sub-surface structures is to be done only by appropriately trained and accredited confined space personnel.

Occupational health and safety requirements under NSW legislation or industry codes of practice must be met for entry into confined spaces such as trenches during future building works.

11.5.4 *NOISE*

The remediation works shall comply with the NSW EPA Interim Construction Noise Guideline, NSW Department of Environment and Climate Change, July 2009.

12 SUMMARY AND RECOMMENDATIONS

This RAP has been prepared to further assess the contamination status of the site. The results of previous investigations at the site are discussed and data gaps and further investigations identified (Section 5.5).

Remediation, if required following the further investigations, should be carried out in accordance with Sections 8-11.

This RAP is considered suitable to confirm or otherwise that the site is suitable for the proposed high density residential use. If the additional investigations identify impacts which pose an unacceptable risk to human health or the environment, implementation of the remedial actions detailed in Sections 6-11 is considered suitable to make the site suitable for the proposed high-density land use.

This RAP should be revised following further investigation detailed in Section 5.5 if required based on the investigation results. Revision of the RAP should be carried out in accordance with the process detailed in Section 1.4.

13 LIMITATIONS OF THIS REPORT

This report has been prepared for use by the client who commissioned the works in accordance with the project brief and based on information provided by the client. The advice contained in this report relates only to the current project and all results, conclusions and recommendations should be reviewed by a competent person with experience in geotechnical and environmental investigations before being used for any other purpose. CES accepts no liability for use or interpretation by any person or body other than the client. This report must not be reproduced except in full and must not be amended in any way without prior approval by the client and CES.

This report does not provide a complete assessment of the environmental status of the site and is limited to the scope defined therein. It is noted that areas of the site could not be investigated due to the presence of structures including the residential property and presence of ponds. Should information become available regarding conditions at the site including previously unknown sources of contamination, CES reserves the right to review the report in the context of the additional information.

14 REFERENCES

Bureau of Meteorology (2016) http://www.bom.gov.au. Accessed 4 August 2017.

Card G, Wilson S, Mortimer S.2012. A Pragmatic Approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin RB17. CL:AIRE, London, UK. ISSN 2047-6450 (Online)

Consulting Earth Scientists, 2017: *Stage 1 – Preliminary Site Investigation, 10 Nelson Short Street, Potts Hill, New South Wales*. Prepared for Mushan Pty Limited, Report ID: CES170303-SD-AB

Dial Before You Dig (2015) http://www.1100.com.au/default.aspx. Accessed 11 July 2017.

Environment Protection Authority NSW (2011): *Guidelines for Consultants Reporting on Contaminated Sites*. EPA 97/104, Environment Protection Authority of New South Wales.

Environment Protection Authority NSW (2014): *Waste Classification Guidelines, Part 1: Classifying Waste*. EPA 2014, Environment Protection Authority of New South Wales.

Environment Protection Authority NSW (2016) List of Contaminated Sites Notified to EPA as of 4 August 2017. NSW Government.

Geological Survey of New South Wales (1991), Penrith 1:100 Geological Sheet Series 9030. Edition I, New South Wales Department of Mineral Resources, Sydney.

NEPC, 2013: National Environment Protection Council (2013). National Environment Protection (Assessment of Site Contamination) Measure. *Schedule B(1) Guideline on Investigation Levels For Soil and Groundwater.*

NEPC, 2013: National Environment Protection Council (2013). National Environment Protection (Assessment of Site Contamination) Measure. *Schedule B(2) Guideline on Site Characterisation.*

The Department of Primary Industries Office of Water Groundwater Bore Search http://allwaterdata.water.nsw.gov.au/water.stm. Accessed 3 August 2017.

Figures

CONSULTING EARTH SCIENTISTS
Suite 3, Level 1
55 Grandview Street, Pymble, NSW, 2073
ph 8569 2200 fax 9983 0582

Title:

Figure 1: Site Location Plan

CES Project ID:	Date:
CES170303-SD	09/08//2017
Prepared By:	Checked By:
I. Wong	D. Lowe

CONSULTING EARTH SCIENTISTS
Suite 3, Level 1
55 Grandview Street, Pymble, NSW, 2073
ph 8569 2200 fax 9983 0582

Title:

Figure 2: Site Layout Plan

CES Project ID:	Date:
CES170303-SD	18/07/2018
Prepared By: S. Inameti	Checked By: D. Johnson

CONSULTING EARTH SCIENTISTS
Suite 3, Level 1
55 Grandview Street, Pymble, NSW, 2073
ph 8569 2200 fax 9983 0582

Title:

Figure 3: Borehole Location Plan

CES Project ID:	Date:
CES170303-SD	09/07/2018
Prepared By: B. Ren	Checked By: D. Johnson