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Engineering | Environmental | Testing

Report Type:
Remedial Action Plan

Project Address:
4 Pennant Avenue, Gordon NSW
Lot X DP387680 and Lot Y DP387680

Client Name:
Ku-ring-gai Council

20 November 2020
Report No: 6839-ER-1-3

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Document Control

Revision	Report Date	Author	Reviewer	Commissioned by	Comment
1	21 November 2020	O. Yan	N. Foster	Ku-ring-gai Council	Issued to Client for Review

		**Reviewer Signature**	
Name	Oliver Yan	**Name**	Nathan Foster
Title	Senior Environmental Scientist	**Title**	Principal Environmental Scientist

Executive Summary

Alliance Geotechnical Pty Ltd (AG) was engaged by Ku-ring-gai Council, to prepare a remedial action plan (RAP) for 4 Pennant Avenue, Gordon, NSW (refer **Figure 1** with the 'site' boundaries outlined in **Figure 2**).

AG has the following project appreciation:

- The site covers an area of approximately 1.3 hectares over ten (10) separate properties/lots;
- A contamination assessment of the site is required to inform future land use planning decisions and development;
- Previous contamination assessments were completed by AG in 2018; and
- A RAP is required to address the findings of the previous contamination assessments, in accordance with site-specific conditions of approval.

The objectives of this project were to prepare a RAP to provide:

- Prepare a RAP to address potentially unacceptable land contamination exposure risks on the site identified in the stage 1 PSI and stage 2 DSI in the context of informing future land use planning
- A strategy to mitigate these potential exposure risks, by exploring available remediation options that will effectively and efficiently provide this outcome; and
- A risk-based clean-up strategy to achieve an acceptable outcome that is technically, logistically, and financially feasible.

The scope of the RAP has been established on the basis of the findings of the previous investigation, with the RAP aimed at providing:

- A desktop review of the previous contamination assessments;
- Outline key roles and responsibilities for implementation of the works;
- Define the appropriate remedial works strategy required, assess the options available, and plan a strategy to achieve site suitability for the proposed use;
- Appropriate requirements for the validation and verification of the remediation strategy, including soil and groundwater criteria to measure the success of the remediation;
- Appropriate procedures to manage any unexpected finds throughout construction of the development.
- Appropriate requirements for the validation and verification of the successful implementation of the remediation strategy and the remediation acceptance criteria to be adopted;
- Details of the appropriate environmental measures to be implemented to mitigate any adverse effects that may occur because of the remediation; and
- WH&S procedures required to conduct the remediation works in a manner that will not pose a threat to the health of site workers or users.

The site history data collected was assessed within the objectives of this project and in the context of the proposed development works. That assessment identified the following areas of environmental concern (AEC) and contaminants of potential concern (COPC) which either require assessment, further assessment, and/or remediation. The AEC identified are presented in attached **Figure 3** and **Figure 4**, and associated COPC are presented in the **Table A.1** below.

Table A.1. Areas of Environmental Concerns and Contaminants of Potential Concerns

AEC	COPC	Media	Potential Receptor	Potential Exposure Pathway	Validated
AEC02	Asbestos Aesthetics (ACM)	Soil	Recreational site users Workers.	Dermal contact, ingestion and inhalation of dust	No – unacceptable asbestos risks require management / remediation.
AEC04	Asbestos Aesthetics (ACM)	Soil	Recreational site users Workers.	Dermal contact, ingestion and inhalation of dust	No – unacceptable asbestos risks require management / remediation.
AEC06	TRH, BTEX, VOCs, Metals, PAHs, PCBs, Asbestos	Soil	Recreational site users Workers.	Dermal contact, ingestion and inhalation of dust/vapour	No – unknown/ unacceptable COPC risks require investigation/ management/ remediation.

The remedial goal for this site is to remediate potential soil contamination (where identified) to a level that does not present an unacceptable human health exposure risk, based on the proposed land use setting.

AG notes that the clients preferred remedial method may result in the need for:

- notation on a planning certificate for the site;
- a covenant registered on the title to the land;
- a long-term environmental management plan (EMP).

The lateral extent of remediation on the site is considered to be, as a minimum, the following:

- AEC02 – asbestos impacted soils (fragments of material suspected to contain asbestos) within the vicinity of TP08 (Frag-1);
- AEC04 –asbestos containing material detected in fill material at sampling points TP16 and TP17;
- AEC06 – concentrations of COPC within the footprint or underlying existing club house have not been assessed due to access.

Refer to **Figure 4**, which indicate the areas which will be subject to remediation and the remedial strategy for each area to mitigate the risks to human health and the wider environment.
The potential list of remediation options associated with impacted soil is extensive.

Consequently, only relevant remediation strategies that have been considered which include the following:

- Institutional controls / do nothing;
- Capping and Isolation/on-site treatment; and
- Excavation and off-site disposal

Taking into consideration the client's objectives for the site, and the nature and extent of the proposed site redevelopment works, the preferred remedial option for the site is:

- Excavation and offsite disposal of contaminated soil.

Conclusions and Recommendations

Based on the information presented in the historical contamination assessment reports and AG's observations on site, AG concludes that the remedial strategies and goals can be achieved and the site made suitable in informing future land use planning and rendering the site suitable for proposed land use, subject to:

- Implementation of the strategies, methodologies and measures set out in this RAP;
- Should newly identified unacceptable land contamination risks be identified during supplementary assessment works (specifically AEC06 and in addition, AEC02 (in the vicinity of TP08) and AEC04), an addendum to this RAP may be required. The addendum should be prepared by a suitably experienced environmental consultant;
- Prior to any removal of soils from site for offsite disposal during remedial works, waste classification for those soils should be prepared by a suitably experienced environmental consultant. Residual impacted fill materials must also be appropriately characterised as per the strategy outlined in this RAP; and
- All remedial works should be monitored and validated by a suitably experienced environmental consultant; and

AG recommends that any waste classifications, remediation monitoring and validation works be undertaken by a suitably experienced environmental consultant.

This report must be read in conjunction with the limitations set out in **Section 14**.

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ABBREVIATIONS

AAM	Airborne Asbestos Monitoring
ACM	Asbestos Containing Material
AEC	Areas of Environmental Concern
AF	Asbestos fragment
AG	Alliance Geotechnical Pty Ltd
AHD	Australian Height Datum
ASS	Acid Sulfate Soils
B(α)P	Benzo(α)pyrene
BTEXN	Benzene, toluene, ethylbenzene, xylene, naphthalene
COC	Chain-of-custody
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
DP	Deposited Plan
DQI	Data quality indicators
DSI	Detailed Site Investigation
ENM	Excavated natural material
EPA	Environmental Protection Authority
FA	Friable asbestos
HIL	Health Investigation Levels
HSL	Health Screening Levels
L	litre
LAA	Licensed Asbestos Assessor
LOR	Limit of Reporting
m AHD	metres Australian Height Datum
m bgl	metres below ground level
µg/L	micrograms per litre
µm	micrometres
m^2	square metres
m^3	cubic metres
mg/kg	milligrams per kilogram
mg/L	milligrams per litre

mL	millilitre
NATA	National Association of Testing Authorities
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NSW	New South Wales
NSW DEC	New South Wales Department of Environment and Conservation
NSW EPA	New South Wales Environmental Protection Authority
OCP	Organochlorine Pesticides
OPP	Organophosphorous Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PPE	Personal protective equipment
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance / Quality Control
RAP	Remedial Action Plan
RPD	Relative percentage difference
SAQP	Sampling, Analysis, and Quality Plan
SEPP	State Environmental Protection Plan
SWMW	Safe Work Method Statements
TEQ	Toxicity Equivalent Quotient
TPH	Total Petroleum Hydrocarbon
TRH	Total Recoverable Hydrocarbons
UCL	Upper confidence limit
USEPA	United States Environmental Protection Agency
VENM	Virgin excavated natural material
VOC	Volatile Organic Compounds
WA DOH	Western Australian Department of Health

1. Introduction

1.1. Background

Alliance Geotechnical Pty Ltd (AG) was engaged by Ku-ring-gai Council to undertake a Remedial Action Plan (RAP) at 4 Pennant Avenue, Gordon NSW (refer **Figure 1,** with the 'site' boundaries outlined in **Figure 2**)**.**

AG has the following project appreciation:

- The site is defined as Lot X DP387680 and Lot Y DP387680, and covers an area of approximately 1.3 hectares;
- A contamination assessment of the site is required to inform future land use planning decisions relating to possible redevelopment of the site;
- Previous contamination assessments were completed by AG in 2018; and
- A RAP is required to address the findings of the previous contamination assessments, in accordance with site-specific conditions of approval.

1.2. Objectives

The objective of this project was to prepare a RAP to address potentially unacceptable land contamination exposure risks identified for the site during the Stage 1 Preliminary Site Investigation (PSI) and Stage 2 Detailed Site Investigation (DSI), previous completed at the site. The goal is to provide a strategy to mitigate potential exposure risks, with consideration of a strategy to achieve an acceptable outcome that is technically, logistically, and financially feasible.

1.3. Scope of Work

The scope of work undertaken to address the project objective included:

- A desktop review of the previous contamination assessments;
- Preparation of a RAP with reference to the relevant sections of NSW EPA (2020a), including the following:
  - Outline key roles and responsibilities for implementation of the works;
  - Define the appropriate remedial works strategy required, assess the options available, and plan a strategy to achieve site suitability for the proposed use;
  - Appropriate requirements for the validation and verification of the remediation strategy, including soil and groundwater criteria to measure the success of the remediation;
  - Appropriate procedures to manage any unexpected finds throughout construction of the development.
  - Appropriate requirements for the validation and verification of the successful implementation of the remediation strategy and the remediation acceptance criteria to be adopted;
  - Details of the appropriate environmental measures to be implemented to mitigate any adverse effects that may occur because of the remediation; and
  - Work Health and Safety (WH&S) procedures required to conduct the remediation works in a manner that will not pose a threat to the health of site workers or users.

2. Site Setting

2.1. Site Identification

Site identification details and associated information is present in **Table 2-1**. The locality of the site is presented in **Figure 1**, with the general layout and site boundaries depicted in **Figure 2**.

Table 2-1 Site Identification Information

Site Address	4 Pennant Avenue, Gordon NSW
Cadastral Identification	Lot X DP387680 and Lot Y DP387680
Geographical Coordinates	33°45'38" S 151°09'05" E (Source: Six Maps - https://maps.six.nsw.gov.au/)
Site Area	1.3 hectare (Source: Six Maps - https://maps.six.nsw.gov.au/)
Zoning	RE1 – Public Recreation (Ku-ring-gai Local Environmental Plan 2015)
Current Land Use	Unused Bowling Green and Clubhouse
Proposed Land Use	Low-density Residential (consideration given to the most sensitive land use possible at the site)
Local Government Area	Ku-ring-gai Council

2.2. Ground Conditions and Surrounding Environment

A summary of available site and local data identifying topography, geology, soils, and hydrology is provided in **Table 2-2**.

Table 2-2 Summary of Ground Conditions and Surrounding Environment

Geology	A review of the Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1) 1983, indicated that the site is likely to be underlain by Ashfield Shale (a formation of the Wianamatta Group), defined as black to dark-grey shale and laminite.
Soil Landscape	Moderately deep (50-150 cm), hard-setting yellow podzolic soils and yellow soloths; yellow earths on outer edges. The easternmost portion of the site is underlain by the shallow to moderately deep (<100 cm) red podzolic soils on crests; moderately deep (70–150 cm) red and brown podzolic soils on upper slopes; deep (>200 cm) yellow podzolic soils and gleyed podzolic soils along drainage lines. (Source: https://www.environment.nsw.gov.au/eSpade2WebApp)

Topography	The overall site topography is generally flat, with some steeper gradients on the perimeter of bowling greens. Gradients in the western and north-western areas of the site descend to the north-west. Local topography consists of gently undulating crests and ridges on plateau surfaces. Gently undulating plateau areas are 200-1000 m in width, with level to gently inclined slope gradients of <10%. Local relief is <30 m. Rock outcrop is absent. (Source: https://www.environment.nsw.gov.au/eSpade2WebApp)
Site Elevation	AG understands that the site is located at an elevation of 95-100 m Australian Height Datum (mAHD)
Acid Sulfate Soil (ASS) Risk	A review of the Department of Land and Water Conservation NSW Acid Sulfate Soil Risk Map (1997) for Prospect/Parramatta River indicates that the site lies in an area mapped as *No Known Occurrence* with respect to ASS. This infers that land management activities are not likely to be affected by ASS materials. Further assessment of acid sulfate soils, in the context of this investigation, is not considered to be warranted. (Source: https://www.environment.nsw.gov.au/eSpade2WebApp)
Potential Depth of Site Filling	Observed filling during the DSI (AD, 2018b) ranged between 0.25 to 1.0 m in thickness.
Site Drainage	Drainage in hardstand areas is likely to be collected and discharged to the municipal stormwater system. Drainage in unsealed areas in likely to consist of direct soil infiltration and overland flow.
Nearest Surface Waterbody	Surface water courses proximal to the site included Falls Creek, approximately 660 m to the south-west, Blackbutt Creek, approximately 800 m to the west, and Links Creek, approximately 820 m to the south.

2.3. Hydrogeology and Groundwater Use

Available hydrogeological data and records of groundwater use, obtained for this investigation, are summarised below in **Table 2-3**.

Table 2-3 Background Hydrogeological Information

Depth to Watertable[1]	> 3.0 m
Inferred Groundwater Flow Direction	Based on prevailing site topography, groundwater flow direction in the vicinity of the site is inferred to be towards the west or south-west.
Local Groundwater Bore Records (≤ 500 m of site)	Review of the Water NSW groundwater database identified six (6) registered groundwater bores within a 500 m radius of the site. The registered bores are: ▪ GW024606 – irrigation – standing water level (SWL): unknown ▪ GW023699 – general use – SWL: 2.70 m ▪ GW107984 – domestic (rainwater catchment runoff) ▪ GW104670 – monitoring bore – SWL: unknown ▪ GW104669 – monitoring bore – SWL: unknown ▪ GW104668 – monitoring bore – SWL: unknown The Water NSW search records are presented in **Appendix A**. (Source: www.realtimedata.waternsw.com.au/water.stm, accessed 28 October 2020)

Potential Groundwater Receptors (including vapour flux receptors)	Potential groundwater receptors include: ▪ Proposed users of the site (vapour). ▪ Neighbouring residential properties and schools (vapour). ▪ Basement users.

Notes:
[1] Sourced from https://www.environment.nsw.gov.au/eSpade2WebApp and www.realtimedata.waternsw.com.au/water.stm

3. Previous Contamination Assessments

It is noted that various typographical updates of contamination assessment reports have been undertaken to date. For the purposes of this RAP, the following reports, with the original investigation dates referenced, were considered during the development of this plan:

- AG 2018a, *Preliminary Site Investigation, 4 Pennant Avenue, Gordon NSW*, dated 23 March 2018, ref: 6839-ER-1-1.
- AG 2018b, *Stage 2 Detailed Site Investigation, 4 Pennant Avenue, Gordon NSW*, dated 3 July 2018, ref: 6839-ER-1-2.

The reports itemised above are discussed in the sections below.

3.1. AG (2018a) Preliminary Site Investigation

Initial investigation at the site completed by AG (2018a) consisted of a review of available records relating to historical and current land uses, and completion of a site inspection to assess site features, layout, and existing activities.

Evaluation of the findings of the investigation identified a variety of areas of environmental concern (AEC) and contaminants of potential concern (COPC) which had the potential to be present on the site. The AEC identified are tabulated below.

Area of Environmental Concern (AEC)	Land Use Activity	Contaminants of Potential Concern (COPC)
AEC01 - South-western bowling green AEC02 - Northern bowling green AEC03 - South eastern bowling green	▪ Uncontrolled filling ▪ Application of herbicides and/or pesticides	Hydrocarbons, herbicides, pesticides, polychlorinated biphenyls, metals, and asbestos
AEC04 - Grassed open space area, north eastern corner	Uncontrolled filling	Hydrocarbons, herbicides, pesticides, polychlorinated biphenyls, metals, and asbestos
AEC05 - Greenkeepers shed / storage area	Historical chemical / fuel storage	Hydrocarbons, pesticides, and metals
AEC06 - Former/current clubhouse building	Uncontrolled demolition and additions / modifications	Metals and asbestos

Based on the findings of the investigation, AG considered that the identified AECs and associated COPCs may present an unacceptable exposure risk (in the context of land contamination) as part of the future land use scenario. A Detailed Site Investigation (DSI) was recommended to evaluate potential contamination in AEC identified by the PSI.

3.2. AG (2018b) Detailed Site Investigation

The Detailed Site Investigation (DSI) was completed by ADE (2018b) at the site to characterise possible contamination with respect to AECs identified by the previously completed PSI (AG, 2018a).

Intrusive investigation was conducted at 19 test pit locations (TP01 to TP19), with the intrusive investigation targeting AECs identified by the PSI. Sampling identified fill soils across the site, with fill ranging between 0.25 to 1.0 m in thickness, overlying natural residual clay soils. Anthropogenic materials observed in fill material encountered included, aggregate gravels, concrete of cobble and

boulder size, wood, glass, plastic, terracotta tile, tailings from coal processing, and brick. Visual evidence of potential asbestos containing materials (ACM) was noted in fill soils from test locations TP16 and TP17 during intrusive investigation. Due to access limitations encountered during execution of the works, soils underlying the existing clubhouse could not be investigated, and this area constituted an investigation data gap. It is noted that investigation of car park areas was not included in the investigation.

AG (2018b) identified lead exceeding the Health Investigation Level (HIL) for residential land use with accessible soil (HIL-A) in fill soil at test location TP12 (AEC03). Asbestos exceeding investigation criteria was also reported from test locations TP16 and TP17, within AEC04. Asbestos was also reported in one cement-fibre sheeting fragment collected from the soil surface in proximity to TP08 (AEC02).

AG (2018b) recommended that a RAP be prepared outlining the requirements for remediating and managing the contamination identified during the DSI. AG (2018b) also noted that the RAP should include assessment requirements for data gap closure associated with areas inaccessible during the DSI.

4. Remediation Criteria

Taking into consideration the objectives of this project, and the conceptual site model and land use setting, the following remediation criteria are set out in **Table 4-1** and will be adopted based on the proposed land use scenario[1] and identified receptors.

Table 4-1 Remediation Criteria

Exposure Pathway	Land Use Setting[2]	Reference
Dermal contact and ingestion	HIL-A	Table 1A(1) in ASC NEPM (2013a) Table B4 in Friebel, E & Nadebaum P (2011) Table 2 in DoEE (2018)
Inhalation of dust	HIL-A	Table 1A(2) in ASC NEPM (2013a)[3] Table 1A(3) in ASC NEPM (2013a) Table 1A(4) in ASC NEPM (2013a) Table 1A(5) in ASC NEPM (2013a)
Inhalation via release of airborne fibres	HIL-A	Table 7 in ASC NEPM (2013a)[4]
Inhalation of vapour	HSL-A & B	Table 1A(5) in ASC NEPM (2013a)
Human health (aesthetics)	All land use scenarios	Characteristics and processes in Section 3.6.2 and 3.6.3 in ASC NEPM (2013a)
Uptake by plants and terrestrial organisms in root zones.	EIL and ESL - Urban residential / public open space	Table 1B(6) in ASC NEPM (2013a)[1,2] Table 3 in DoEE (2018) Table 11 in CRC CARE (2017)

[1] The land use scenarios in Section 2.2 of ASC NEPM (2013a) will be considered when adopting human health assessment criteria. The land use scenarios in Section 2.5 of ASC NEPM 2013a will be considered when adopting ecological assessment criteria.

[2] Consideration will be given to soil type, soil texture, soil depth, groundwater depth and appropriate species protection levels.

[3] School buildings to be assessed using the Residential A HSLs for vapour intrusion purposes.

[4] A depth of up to 10cm below ground level is adopted to define 'surface soil'.

5. Data Gap Closure Assessment

5.1. Data Gap Closure Outline

The previous assessment completed by AG reported an investigation data gap in the assessment of contamination within AEC06, which is based on known historical use of the site and demolition or modification of structures present within the AEC. AG consider further assessment is required to characterise soil quality within this area following the demolition of the existing structure, as access constraints inhibited sampling during the DSI.

Further to the above, assessment was not previously conducted within the car parking area of the site (north-western corner of Lot Y and entirety of Lot X). Available survey and topographical information indicate that this area of the site was likely part of a pre-existing drainage prior to development of the site. Review of land title records and dial before you dig (DBYD) information also indicates the presence of a stormwater easement in this area of the site. In light of the above information, potential for filling in this area of the site has been considered, and the conceptual site model developed for the investigation has been updated to reflect this finding. Intrusive investigation and soil sampling is required in this area to evaluate the existing soil conditions and establish if any potential risks from contaminated soil are present

Should contamination be identified in soils within the above locations during data gap closure investigations, a RAP addendum will require preparation to outline requirements for either further investigation, remediation, or management. Data gap closure investigations should be conducted prior to proceeding with any remediation strategy detailed in this RAP.

5.2. Sampling Method and Laboratory Analysis

The sampling method set out in **Table 5-1** will be used for data closure purposes. Based on the area requiring characterisation, it is considered reasonable to adopt a sampling plan comprising of four (4) additional test pits, which are presented in **Figure 5**:

Table 5-1 Soil Sampling and Analysis Plan

AEC ID	Location	Sampling Point ID	Target Depth (mBGL)	Laboratory Analysis
AEC06	Northern-central portion of the site, beneath the existing clubhouse	Four locations (TP20 to TP23) to be conducted by excavator / backhoe or hydraulic drilling rig. Sampling points are present in Figure 4.	Target depth of 1.5 m or minimum of 0.5 m into natural soil materials.	TRH/BTEX, PAH, metals, PCBs, PAHs, pesticides, and asbestos.
-	Site car parking area (north-western corner of Lot Y and entirety of Lot X)	Three locations (TP24 to TP26) to be conducted by excavator / backhoe or hydraulic drilling rig. Sampling points are present in Figure 4.	Target depth of 1.5 m (assuming a maximum fill depth of 1.0 m) or minimum of 0.5 m into natural soil materials.	TRH/BTEX, PAH, metals, PCBs, PAHs, pesticides, and asbestos.

6. Remedial Strategy Options Discussion

A range of soil remediation options have been considered for the site. The options considered include only those which are proven to be effective on past remediation or related projects. The following sections review each of the soil remediation option considered and outline the selection process used.

6.1. Remediation Strategy Development Rationale

Given the distribution of contamination has been defined, it is recommended that various remediation options be considered.

Due to the nature and distribution of the contaminant in the underlying soil matrix, an effective remediation approach for the site must be tailored towards the key impacted source material which is the impacted reworked imported fill material. A discussion of remediation options for impacted soil is provided in the below sections.

6.2. Remediation Options for Impacted Soil

The potential list of remediation options associated with impacted soil is extensive.

Consequently, only relevant remediation strategies that have been considered which include the following:

- Institutional controls / do nothing;
- Capping and Isolation/on-site treatment; and
- Excavation and off-site disposal.

A discussion on the merits and disadvantages of each option is discussed in **Table 6-1**.

Table 6-1 Remediation Options Assessment

Treatment Option	Description	Advantages			Disadvantages		
		Technical	Financial	Logistical	Technical	Financial	Logistical
Do Nothing Scenario	No remedial action taken. Impacted soil left in-situ.	Lowest greenhouse emissions. Not considered a significant human health risk as long as the site is not disturbed.	No short-term remedial costs incurred. No operation and maintenance required.	No disturbance to site required. Existing landscape can be retained. No odour or dust management is required.	As the site is to be developed for 'education' purposes, direct access to soil will not be restricted. This option is not protective of human health including site development workers and future tenants of the site in the long term, given increased likelihood for adverse effects with prolonged exposure. On-going liabilities including human health and the environment would remain.	Potential for future liability (e.g. EPA notices and potential health impacts to site users if exposed to unsafe levels for a long period of time.)	A long-term environmental management plan will need to be developed for site users and potential future excavation or maintenance requirements. Impacted material would remain on-site indefinitely.
Capping and Isolation of impacted soils	Soil removal, capping and isolation to restrict direct access to soil. Some impacted soil left in-situ.	Protective of human health including construction/ maintenance workers. Direct access to soil will be restricted and can be isolated with the appropriate mitigation measures.	Potentially lower costs through greater confidence of delivery through strategic planning (no time delays).	Moderate excavation is required to remove all the identified AECs across the entire site. Limited environmental management required during the works (e.g. dust, noise).	Some impacted material would remain on-site indefinitely. A notation would be placed on the planning certificate. Consideration must be given to the existing drainage easement on site and the area will be required to be designed and constructed to a standard that satisfies Sydney Water/ Council development standards. Ecological impacts from loss of existing trees on the site.	Moderate disposal costs incurred in addition to the cost of importing clean soil material.	A long-term environmental management plan will need to be developed for site users and potential future excavation or maintenance requirements. Impacted material would remain on-site indefinitely.

Treatment Option	Description	Advantages			Disadvantages		
		Technical	**Financial**	**Logistical**	**Technical**	**Financial**	**Logistical**
Excavation & Offsite Disposal	Removal of all identified contaminated soil to an EPA licensed waste facility. Validation sampling to demonstrate the conditions of the residual soil impact. Reinstatement of excavated areas with material validated as suitable for the intended land use.	Protective of human health including future tenants and construction workers. Facilitate future development of the entire site. No long-term EMP will be required.	No onsite operation and maintenance required.	No ongoing management required as the impacted soil will have been removed offsite.	Based on the soil investigation results, for off-site disposal purposes, the impacted soil to be excavated and removed offsite would require waste classification in accordance with the NSW EPA *Waste Classification Guidelines 2014.*	Very high remedial cost incurred to remediate and backfill the entire site.	Major excavation works is required. Odour, vapour and dust management required during the excavation works. May increase truck traffic in area to transport contaminated soil for a short period of time.

6.3. Selected Remediation Strategy

Based on AG's assessment detailed above, the most suitable remedial strategy will comprise ***off-site removal and disposal*** as it will be consistent with any future land use scenario.

Taking into consideration the Client's objectives for the site, the nature and extent of the proposed site redevelopment and identified contamination issues at the site, the preferred remedial option for the site is *excavation and off-site disposal* of contaminated soil. Waste classification analysis will be required to be carried out on all soil materials to facilitate off-site disposal in accordance with the NSW EPA (2014) Waste Classification Guidelines.

Figure 4 indicates the areas which will be subject to remediation to mitigate the risks to human health and the wider environment.

7. Remedial Contingency Plan

7.1. Contingency Measures

It is possible that during works, unexpected conditions may be encountered, such as the discovery of different types of filling, aesthetic impacts, or soil conditions different to those currently understood. If encountered, it may be necessary to stop work and re-consider the proposed approach before continuing. **Table 7-1** presents a contingency plan for contamination related scenarios.

Table 7-1 Remediation Contingences

Scenario	Remedial Contingencies/Corrective Action
Contamination not identified during previous investigation is encountered.	Isolate material and classify for offsite disposal. Ensure no risk of residual contamination exists.
Chemical spill / exposure	Stop work, refer to Health and Safety Plan and immediately contact the Site Supervisor.
Excessive Rain	Cover those working areas not located under cover, where possible, with plastic during off-shifts. Inspect and maintain sediment controls.
Excessive Dust	Use water sprays, biodegradable dust sprays, cease dust-generating activity until better dust control is achieved, or apply interim capping systems. If necessary, install dust deposition gauges prior to and during works to monitor the effectiveness of dust controls implemented on-site.
Release of fuel/oil from machinery	Remove source, use spill kit to absorb oil and make any repairs as required. If necessary, implement temporary measures until booms can be deployed; (e.g. earth embankments) to prevent movement of spill into water courses.
Complaint Management	Notify site management and owners (if required) following complaint and record details as per management procedures. Implement control measures to address reason of complaint (if possible) and advise complainant of results.
Unexpected potential contamination or underground structures encountered during remediation (e.g. underground storage tank, underground pit)	Consider excavation of test pits / trenches to assess potential for contamination to be present. Remove underground structures (if required) and associated soil contamination (if required). Consider groundwater assessment, subject to nature and extent of identified contamination. Amendment to the preferred remedial strategy (if required), pending the outcomes of the assessment of the unidentified contamination.

8. Remedial Action Plan

8.1. Remedial Goal

The remedial goal for this site is to remediate potential soil contamination (where identified) to a level that does not present an unacceptable human health exposure risk, based on a potential sensitive land use scenario, being residential land use (with accessible soil).

8.2. Remediation Extent

The extent of contamination on the site is considered to be the following:

- AEC02 – Asbestos impacted soils delineated around TP08 – central western portion of AEC02.
- AEC03 – Lead contamination at TP12.
- AEC04 – Asbestos impacted soils within AEC04 (TP16 and TP17)..

Refer to **Figure 4**, which indicates the areas which will be subject to remediation and the remedial strategy for each area to mitigate the risks to human health and the wider environment.

It is noted that the lateral extent of remediation may be altered, during remedial works based on site observations and validation soil sample analytical laboratory results.

8.3. Sequence of Works for Remediation

8.3.1. Remediation Schedule & Staging

Remediation works will likely be completed within 1 to 3 months from council approval. It is expected that remediation timeframes will be further refined following appointment of the remediation contractor, and the staging of the remediation tasks in the contractor's works program. Further, the schedule described herein assumes that the existing clubhouse building overlying AEC06 has been decommissioned and proposed data gap closure investigation can commence as soon as approval is received.

8.3.2. Notification and Approvals

The proposed remediation works would likely be classified as Category 2 under SEPP 55, which does not require consent from Ku-ring-gai Council, but notification to Council must still be made. The Council will then review proposed remediation and considers whether approval is required. Consideration should be given to informing the Council of the proposed commencement date.

The following information will also be required to be provided to the Ku-ring-gai Council as part of the remediation works:

- copies of any updated contamination assessment reports and updated RAP;
- contact details of the contractor appointed to undertake the remediation works (when appointed);
- contact details of the parties responsible (if not the remediation contractor) for ensuring remediation works comply with relevant regulatory requirements.

A notification will be submitted to SafeWork NSW prior to undertaking asbestos removal works (where applicable). The removal works will be undertaken by a suitably licensed contractor.

Within 30 days of completion of remediation and validation works, notification and copies of relevant validation and contamination reports will be submitted to the planning consent authority.

8.3.3. Remediation Works

The following remediation works, is based on data available at the time of preparing this RAP.

Remedial works will be guided and monitored by the environmental consultant. The environmental consultant will assist the remediation contractor in setting out the inferred lateral extent of the identified AEC. The environmental consultant will monitor remedial works and provide guidance to the remedial contractor on:

- When to pause remedial works in an AEC, to allow validation works to be undertaken; and
- Where to extend remedial works in an AEC beyond the inferred extent (if observations indicate a need for 'chasing out' additional contamination).

8.3.4. AEC02 – Asbestos/Aesthetics Impacted Soils

A 10 m x 10 m area will be marked out surrounding the contamination point. Impacted soils will be excavated to a level below the known depth of contamination removed from site, for offsite disposal, in accordance with the relevant waste classification, and under the direction of a suitably licenced asbestos removalist contractor.

The remediation contractor will retain transport and disposal records for all wastes removed off site.

The validation strategy for the residual soils is set out in **Section 9**.

8.3.5. AEC03 – Lead Impacted Soils

A 10 m x 10 m area will be marked out surrounding the contamination point. Impacted soils will be excavated to a level below the known depth of contamination removed from site, for offsite disposal, in accordance with the relevant waste classification.

The remediation contractor will retain transport and disposal records for all wastes removed off site.

The validation strategy for the residual soils is set out in **Section 9**.

8.3.6. AEC04 – Asbestos/Aesthetics Impacted Soils

A 10 m x 10 m area will be marked out surrounding the contamination point. Impacted soils will be excavated to a level below the known depth of contamination removed from site, for offsite disposal, in accordance with the relevant waste classification, and under the direction of a suitably licenced asbestos removalist contractor.

The remediation contractor will retain transport and disposal records for all wastes removed off site.

The validation strategy for the residual soils is set out in **Section 9**.

8.3.7. Backfilling

Should remedial excavations require backfilling, then backfill soils will be limited to:

- Virgin excavated natural material (VENM);
- Excavated natural material (ENM);
- Other material that is the subject of a resource recovery exemption and the placement of that material is within the lawful constraints of the resource recovery exemption (and does not present an unacceptable exposure risk to human health or the environment, within the context of the proposed land use setting); or

Consideration will be given to geotechnical engineering requirements associated with backfilling; however, those requirements will be specified by others elsewhere.

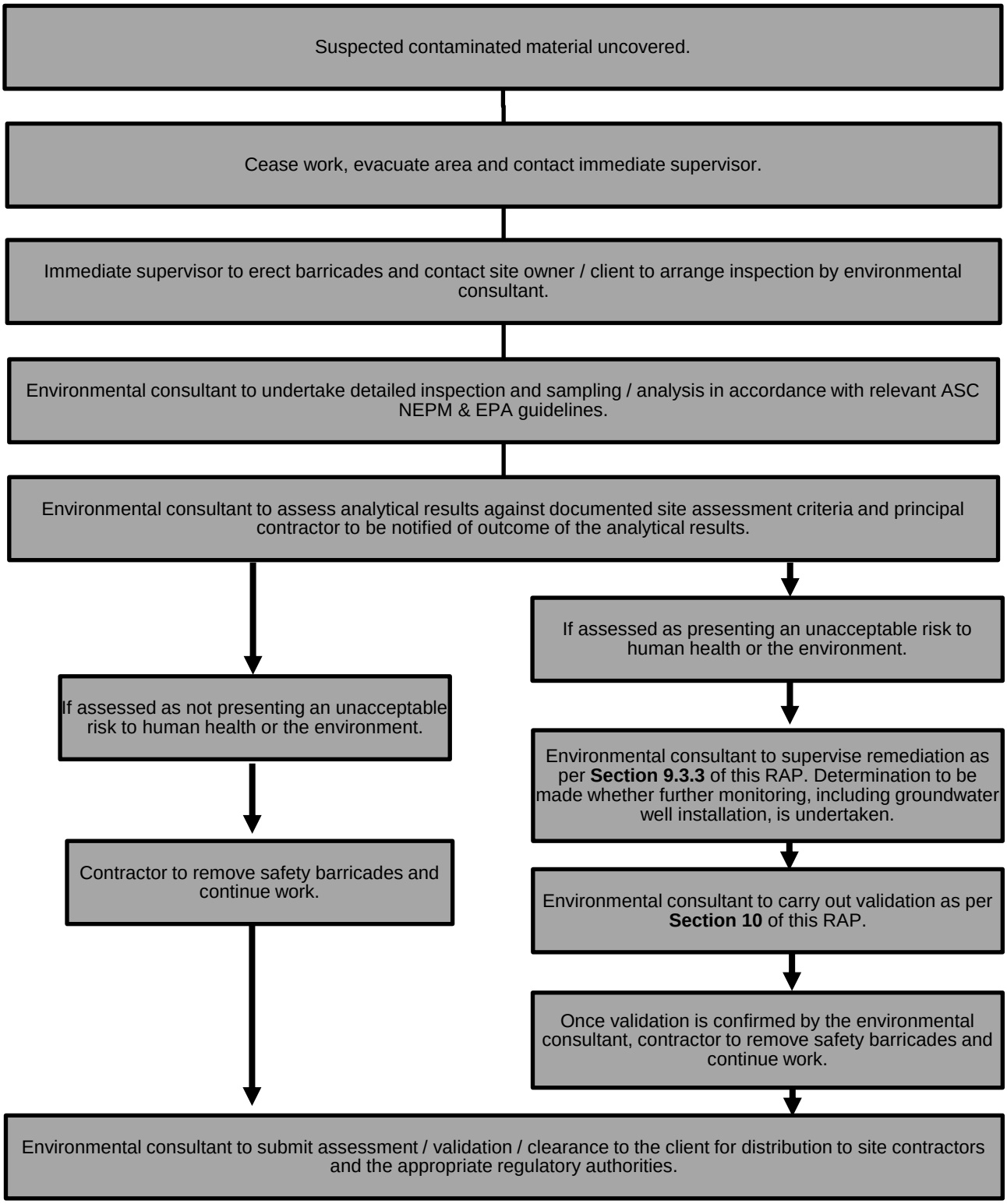
8.3.8. Unexpected Finds Protocol

The contamination assessments to date have not indicated the presence of significant soil contamination that is unacceptable for the proposed land use beyond the area of remediation described in this RAP. However, it is possible that unexpected finds may be present within the fill material. To this end, an unexpected finds protocol has been compiled, and is summarised herein. Unexpected finds could include, but are not limited to:

- Other underground storage tanks that are previously not identified;
- Buried containers and drums;
- Phase separated hydrocarbons;
- Powders and other suspicious buried material;
- Potentially hazardous materials; and
- Evidence of contamination including significant staining, odours and discolouration.

In the event that any material suspected of containing potentially hazardous substances is found during remediation works, the following unexpected finds protocol is to be followed:

UNEXPECTED FINDS PROTOCOL



9. Validation Data Quality Objectives

Appendix B of ASC NEPM (2013b) provides guidance on the development of data quality objectives (DQO) using a seven-step process.

The DQO for this project are set out in **Sections 9.1** to **9.7** of this report.

9.1. Step 1: State the problem

The first step involves summarising the contamination problem that will require new data and identifying the resources available to resolve the problem.

The objective of this project is to assess whether the remedial goal has been achieved, and whether the site presents an unacceptable human health exposure risk, for the proposed land use setting.

This project is being undertaken because:

- the site may be the subject of redevelopment works; and
- historically identified areas of environmental concern on the site, have the potential to present an unacceptable human health exposure risk in the context of the proposed land use setting.

The project team identified for this project includes AG, the Principal Contractor, the Remediation Contractor, and the planning consent authority.

The regulatory authorities identified for this investigation include NSW EPA, SafeWork NSW and the Ku-ring-gai Council.

9.2. Step 2: Identify the decision/goal of the study

The second step involves identifying decisions that need to be made about the contamination problem and the new environmental data required to make them.

The decisions that need to be made during this investigation include:

- Is the environmental data collected for the project, suitable for assessing relevant land contamination exposure risks?
- Do the concentrations of identified COPC present an unacceptable exposure risk to identified receptors, for the proposed land use setting?
- Is the site suitable for the proposed land use setting, in the context of land contamination?

9.3. Step 3: Identify the information inputs

The third step involves identifying the information needed to support decisions and whether new environmental data will be needed.

The inputs required to make the decisions set out in **Section 9.2** for this investigation, will include:

- data obtained during searches of the site's history;
- the nature and extent of sampling at the site, including both density and distribution;
- samples of relevant site media;
- the measured physical and/or chemical parameters of the site media samples (including field screening and laboratory analysis, where relevant); and
- assessment criteria adopted for each of the media sampled.

Taking into consideration the objectives of this investigation, and the conceptual site model and land use setting presented in AG (2018b), the assessment criteria relevant to the proposed land use setting adopted for this investigation is summarised in **Section 4**.

9.4. Step 4: Define the boundaries of the study

The fourth step involves specifying the spatial and temporal aspects of the environmental media that the data must represent to support decisions.

The spatial extent of the project will be limited to the site as defined by its boundaries.

The temporal boundaries of the project include:

- the project timeframes presented in the AG proposal for this project, and subsequent remediation contractor works program;
- unacceptable weather conditions at the time of undertaking fieldwork, including rainfall, cold and/or heat;
- access availability of the site (to be defined by the site owner/representative); and
- availability of AG field staff (typically normal daylight working hours, Monday to Friday).

The lateral extent that contamination is expected to be distributed across, based on the CSM, is defined by the inferred boundaries of the AEC.

The vertical extent that contamination is expected to be distributed across, based on the conceptual site model and the project scope, is limited to fill material.

The scale of the decisions required will be based on the entire site.

Constraints which may affect the carrying out of this investigation may include access limitations, presence of above and below ground infrastructure, and hazards creating health and safety risks.

9.5. Step 5: Develop the analytical approach (or decision rule)

The fifth step involves defining the parameter of interest, specifying the action level, and integrating information from Steps 1 to 4 into a single statement that gives a logical basis for choosing between alternative actions.

9.5.1. Rinsate Blanks

One rinsate blank will be collected and scheduled for analysis, for each day of sampling undertaken, if non-disposable sampling equipment was used on that day. The rinsate blank will be analysed for at least one of the analytes the sample/s collected that day are being scheduled for analysis for (with the exception of asbestos).

9.5.2. Trip Spikes and Trip Blank Samples

One trip spike and trip blank sample will be used and scheduled for analysis, for each day of sampling undertaken, if site samples being collected that day are being analysed for volatile contaminants of concern (typically BTEX and/or TRH C_6-C_{10}).

9.5.3. Field Duplicates and Field Triplicates

Field duplicate and Field triplicates will be collected at a rate of one per twenty (5%) site samples collected. The duplicates and triplicates collected will be analysed for at least one of the analytes that the parent sample of the duplicate/triplicate is being scheduled for analysis for (with the exception of asbestos).

The relevant percent difference (RPD) of concentrations of relevant analytes, between the parent sample and the duplicate/triplicate will be calculated.

9.5.4. Laboratory Analysis Quality Assurance (QA) / Quality Control (QC)

The analytical laboratory QA/QC program will typically include laboratory method blank samples, matrix spike samples, surrogate spike samples, laboratory control samples, and laboratory duplicate samples.

9.5.5. If/Then Decision Rules

AG has adopted the following 'if/then' decision rules for this investigation:

- If the result of the assessment of field data and laboratory analytical data is considered acceptable, then that field data and laboratory analytical data is suitable for interpretation within the scope of this investigation; and
- If the field data and laboratory analytical data is within the constraints of the assessment criteria adopted for this investigation (refer **Section 9.3**), then the contamination exposure risks to identified receptors, are considered acceptable.

In the event the assessment of field data and/or laboratory analytical data results in the data being not suitable for interpretation, then AG will determine if additional data is required to allow interpretation to be undertaken.

In the event that field data and/or laboratory analytical data exceeds the assessment criteria adopted for this investigation (refer **Section 9.3**), AG will undertake an assessment of the exceedance in the context of the project objectives to determine if additional data is required and whether management and/or remediation is required.

9.6. Step 6: Specify the performance or acceptance criteria

The sixth step involves specifying the decision maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainties in the data. When assessing contaminated land, there are generally two types of errors in decision making:

- Contamination exposure risks for a specific land use setting are acceptable, when they are not; and
- Contamination exposure risks for a specific land use setting are not acceptable, when they are.

AG will mitigate the risk of decision error by:

- Calculation of the 95% upper confidence limit (UCL) statistic to assess the mean concentration of relevant contaminants of potential concern;
- Assignment of fieldwork tasks to suitably experienced AG consulting staff, and suitably experienced contractors;
- Assignment of laboratory analytical tasks to reputable NATA accredited laboratories;
- Assignment of data interpretation tasks to suitably experienced AG consulting staff, and outsourcing to technical experts where required.

AG will also adopt a range of data quality indicators (DQI) as presented in **Table 9-1**, to facilitate assessment of the completeness, comparability, representativeness, precision, and accuracy (bias).

Table 9-1 Data quality indicators

Completeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Critical locations sampled	Refer **Section 9.7.1**	Critical samples analysed according to DQO	Refer **Section 9.7.7**
Critical samples collected	Refer **Section 9.7.1**	Analytes analysed according to DQO	Refer **Section 9.7.7**
SOPs appropriate and complied with	100%	Appropriate laboratory analytical methods and LORs	Refer **Section 9.7.7**
Field documentation complete	All sampling point logs, calibration logs and chain of custody forms	Sample documentation complete	All sample receipt advices, all certificates of analysis
		Sample extraction and holding times complied with	Refer **Section 9.7.7**
Comparability			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Same SOPs used on each occasion	100%	Same analytical methods used by primary laboratory	Refer **Section 9.7.7**
Climatic conditions	Samples stored in insulated containers with ice, immediately after collection	Same LORs at primary laboratory	Refer **Section 9.7.7**
Same types of samples collected, and handled/preserved in same manner	All soil samples same size, all stored in insulated containers with ice	Same laboratory for primary sample analysis	All primary samples to Eurofins Environmental
		Same analytical measurement units	Refer **Section 9.7.7**
Representativeness			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Appropriate media sampled according to SAQP	Refer **Section 9.4**	Samples analysed according to SAQP	Refer **Section 9.7.7**

Media identified in SAQP sampled	Refer Section 10.4

Precision			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Field duplicate / triplicate RPD	Minimum 5% duplicates and triplicates No limit for analytical results <10 times LOR 50% for analytical results 10-20 times LOR 30% for analytical results >20 times LOR	Laboratory duplicates	No exceedances of laboratory acceptance criteria
SOPs appropriate and complied with	100%	-	-
Accuracy (bias)			
Field Considerations	**Assessment Criterion**	**Laboratory Considerations**	**Assessment Criterion**
Rinsate blanks	Less than laboratory limit of reporting	Laboratory method blank	No exceedances of laboratory acceptance criteria
Field trip spikes	Recoveries between 60% and 140%	Matrix spike recovery	No exceedances of laboratory acceptance criteria
Field trip blanks	Analyte concentration <LOR	Surrogate spike recovery	No exceedances of laboratory acceptance criteria
		Laboratory control sample recovery	No exceedances of laboratory acceptance criteria

9.7. Step 7: Develop the plan for obtaining data

The seventh step involves identifying the most resource effective sampling and analysis design for generating the data that is required to satisfy the DQOs.

9.7.1. Validation Sampling

Review of the draft NSW EPA (2020) – Section 5.2.1 states that judgemental sampling is recommended for validation of the remediation of solid media and the removal of infrastructure. Further, Section 6.2.1 of NEPM ASC (2013) states that the number and location or sampling points is based on the knowledge of the site and professional judgement. Sampling should be localised to known or potentially contaminated areas identified from knowledge of the site either from the site history or an earlier phase of site investigation. Judgemental sampling can be used to investigate sub-surface contamination assessment issues in site assessment.

As this investigation has included reviewing data which provides a reasonable understanding of site history (in context of potential areas of environmental concern of the site), and taking into consideration Table 1 in WA DOH (2009), as well as the conclusions outlined in AG (2018b), it is considered reasonable to adopt a judgemental sampling pattern, where necessary, for each AEC.

Validation should focus on collecting clear evidence to assess whether the key objectives have been met. Validation sampling programs should identify and delineate the lateral and vertical extent of contamination (if any) and arrive at a scientifically defensible and statistically valid data set which characterises the chemical concentrations and human health risk present at the site.

An appropriately experienced environmental consultant will be present onsite at all stages of the remediation works, to assess the extent of remediation required to render the site suitable for the proposed development. Site observations and field screening equipment can be used to assist in decision-making in relation to:

- The location and extent of any excavations to trace contamination or whether to remove additional soil;
- Create a more focused sample collection (number and location) and laboratory analysis; and
- The need to consider (or implement) any specific health and safety measures.

The validation sampling arrangements for this project are presented in **Table 9-2.**

Table 9-2 Applicable Validation Sampling

Area of Environmental Concern	Validation Scenario	Validation Sampling
AEC02 and AEC04 – Asbestos in soil	Excavation and removal of contaminated fill material and validation of excavation base and walls.	A systematic visual assessment of the base and walls of the excavation will be undertaken by an environmental consultant. All fill material within the AEC will be excavated down to inferred natural material. Collect one 250 mL jar soil sample per 25 m^2 from the base of the excavation footprint. Collect one 250 mL jar soil samples per 5 linear meters of excavation wall (minimum one per wall). Samples are to be analysed for asbestos quantification by a NATA accredited lab.
AEC03 – Lead in soil	Excavation and removal of contaminated fill material and validation of excavation base and walls.	A systematic visual assessment of the base and walls of the excavation will be undertaken by an environmental consultant. All fill material within the AEC will be excavated down to inferred natural material. Collect one 250 mL jar soil sample per 25 m^2 from the base of the excavation footprint. Collect one 250 mL jar soil samples per 5 linear meters of excavation wall (minimum one per wall). Samples are to be analysed for asbestos quantification by a NATA accredited lab.

Area of Environmental Concern	Validation Scenario	Validation Sampling
Contingency Areas	Excavation and removal of contaminated fill material and validation of excavation base and walls.	A systematic visual assessment of the base and walls of the excavation will be undertaken by an environmental consultant. All fill material within the AEC will be excavated down to inferred natural material. PID screening will be conducted on samples collected on areas of potential impact. Collect one 250 ml jar soil sample per 25 m^2 from the base of the excavation footprint. Collect one 250 ml jar soil samples per 5 linear metre of excavation wall (minimum one per wall). Samples are to be analysed for TRH, BTEXN, PAHs, Metals, PCBs, OCP, and Asbestos by a NATA accredited lab.
Unexpected Finds (On-site treatment of Non-friable Asbestos)	-	Visual inspection of at least two manual rake passes in perpendicular direction of treated material, using a manual rake with teeth spaced <7 mm apart and >10 cm long, will be carried out by a licensed asbestos assessor (LAA) or competent person (as per definition in SafeWork NSW 2019) Photographic record of treated soils If any fragments of non-friable ACM are identified within the remediated material during the validation process, remedial contractor will restart remedial strategy. This process is to continue until remedial goal is achieved. One (1) 10 L sample collected and assessed for fragments of ACM >7 mm One (1) 500 mL NEPM asbestos quantification (0.001%) (sealable plastic bag) sample per 25 m^3 of treated material or at least one (1) per stockpile. Soil samples will be analysed for friable asbestos (FA)/asbestos fibres (AF).
Unexpected Finds (Off-site disposal of Friable Asbestos)	-	Visual inspection of stockpile footprint to confirm removal. One (1) 500 mL NEPM asbestos quantification (0.001%) (sealable plastic bag) sample per 25 m^2 of footprint (minimum 3 samples) Soil samples will be analysed for FA/AF. Photographic record of treated soils.
Waste Classification	-	Quantity dependent – refer to NSW EPA *Waste Classification Guidelines (2014),* sample density based on Section 7.5.2 in Schedule B2 of NEPM (2013).
Imported Fill – VENM	-	One (1) per 100 m^3 or at least 3 samples per stockpile / site.
Imported Fill - ENM	-	Quantity dependent – refer to the ENM order for further details.

Note:
If the validation testing identifies contamination outside of the known AEC extent (lateral and vertical), AG will conduct delineation testing (targeting the depth of newly identified contamination) in order to identify the contamination extent (lateral and vertical).

The quantity and movement of all waste materials excavated and removed offsite will be closely tracked by the remedial contractor under the supervision of AG. This will include internal tracking of material for reuse on the site. All waste disposal dockets issued by the suitably licensed waste receiving facility will be retained by the remedial contractor for reconciliation against the material tracking records, and for inclusion in the final site validation report. This will demonstrate that the waste was appropriately disposed to licensed facilities.

The site validation report will be issued by a suitably experienced environmental consultant.

If visual or olfactory observations indicated a potential for soil contamination to be present, then collection of additional validation samples will be considered.

The location of each sampling point will be marked on a site plan.

9.7.2. Soil Sampling Methodology

Grab soil samples will be collected at each required sampling point directly from the base and walls (where appropriate) of the excavation, however for asbestos sampling of fill material (should fill materials remain) a 10 L (bucket sample for bonded ACM) and a 500 mL (quantification AF/FA) samples are required.

The asbestos sampling and analysis for assessment and validation of fill materials will be conducted in accordance with WA DOH (2009), and involves:

- Collection of a 10 L sample from each test location;
- The 10 L sample will be weighed and recorded;
- Samples shall be screened through a 7 mm sieve or spread out on a contrasting colour fabric/ tarp;
- Observable ACM and FA weighed and calculated for asbestos soil concentration;
- One wetted 500 mL sample will be collected from each test location; and
- Samples will be sent to the laboratory for asbestos quantification (AF/FA) testing.

Depending on the depth of the excavation footprint, an excavator may be required to obtain samples. In these instances, samples will be collected from soils in the centre of the excavator bucket, to avoid cross contamination from the excavator bucket.

For soil sampling in areas where COPCs include volatiles (e.g. TRH, BTEX), project soil samples will be subjected to field screening for ionisable VOCs, using a PID, fitted with a 10.9 eV lamp. The PID will be used to screen selected discrete soil samples (collected at every 0.5 m intervals) for the presence of potential VOCs. Soil vapour field screening results will be utilised for the selection of samples for laboratory analysis. Dedicated nitrile gloves were used for the collection of each soil sample.

Sampling will be guided by a combination of visual evidence (ACM) and olfactory evidence.

Observations of the materials encountered during sampling will be recorded on the relevant field observation log with photographic record.

9.7.3. Identification, Storage and Handling of Samples

Sample identifiers will be used for each sample collected, based on the sampling point number and the depth/interval the sample was collected from, e.g. a sample collected from test pit TP20 at a depth of 0.2 to 0.4 mBGL, would be identified as TP20/0.2-0.4.

Project samples will be stored in laboratory prepared glass jars or zip-lock bags if collected for asbestos).

Reference will also be made to Table 5 in WA DOH (2009) for the sampling and screening of fill soils for the presence of asbestos, where practical. Subsequently, application of asbestos screening criteria published in NEPM (2013) may be limited.

Soil samples in glass jars will be placed in insulated container/s with ice.

Samples will be transported to the relevant analytical laboratory, with chain of custody (COC) documentation that includes the following information:

- AG project identification number;
- Each sample identifier;
- Date each sample was collected;
- Sample type (e.g. soil or water);
- Container type/s for each sample collected;
- Preservation method used for each sample (e.g. ice);
- Analytical requirements for each sample and turnaround times; and
- Date and time of dispatch and receipt of samples (including signatures).

9.7.4. Decontamination

In the event that non-disposable sampling equipment is used, that equipment will be decontaminated before and in between sampling events, to mitigate potential for cross contamination between samples collected. The decontamination methodology to be adopted for this project will include:

- Washing relevant sampling equipment using potable water with a phosphate free detergent (i.e. Decon 90 or similar) mixed into the water;
- Rinsing the washed non-disposable sampling equipment with distilled or de-ionised water; and
- Air drying as required.

9.7.5. Laboratory Selection

The analytical laboratories used for this project will be NATA accredited for the analysis undertaken.

9.7.6. Laboratory Analytical Schedule

Project samples will be scheduled for NATA accredited laboratory analysis, using a combination of:

- Observations made in the field of the media sampled;
- Headspace screening results (where available);
- The COPCs identified for the area of environmental concern that the sample was collected from.

Based on site history, AG has adopted the laboratory analytical schedule presented in **Table 9-3** for the RAP portion of this project.

Table 9-3 Laboratory Analytical Schedule

AEC	Analytical Schedule
AEC02	Asbestos and Aesthetics
AEC03	Lead

AEC	Analytical Schedule
AEC04	Asbestos and Aesthetics

9.7.7. Laboratory Holding Times, Analytical Methods and Limits of Reporting

The laboratory holding times, analytical methods and LOR being used for this project, are presented in **Table 9-4.**

Table 9-4 Laboratory Holding Times, Analytical Methods and LOR

Analyte	Holding Time	Analytical Method	LOR (mg/kg)
TRH	14 days	USEPA 8015B & C	50-200
BTEX	14 days	USEPA 5030, 8260B and 8020	0.2-0.5
Metals	6 months	USEPA 8015B & C	0.05 – 2
OCP	14 days	USEPA 8081	0.2
PCB	28 days	USEPA 8270	0.2
PAH	14 days	USEPA 8270	0.1-0.5
Asbestos NEPM	No Limit	Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia May 2009 Western Australian (WA) Department of Health (DOH)	0.001%

10. Site Validation Reporting

Interim site validation reports if required, will be prepared by AG as per the needs of the project and the client. At the completion of all remedial works for the site, a final site validation report will be prepared with reference to the relevant sections of NSW EPA (2020) in order to satisfy the requirement from Council prior to occupation of the site. The final site validation report will include:

- Document status;
- Executive summary;
- Objectives;
- Scope of work;
- Site identification;
- Site history;
- Site condition and surrounding environment;
- Previous results;
- Conceptual site model;
- Implementation of remedial action plan;
- Sampling and analysis plan and sampling methodology;
- Validation results and discussion
- Field quality assurance/ quality control;
- Laboratory quality assurance/ quality control;
- Quality assurance/ quality control data evaluation;
- Waste management; and
- Conclusions and recommendations.

11. Site Management Plan

The following site management plan will apply during undertaking of the remediation tasks.

11.1. Asbestos Management & Controls

11.1.1. Equipment

The following is an equipment register of required materials in preparation for works:

- Appropriate personal protective equipment; disposable suits, P2 and P3 respirators, disposable gloves and disposable boot covers;
- Asbestos warning signage and barricade taping;
- 200 micrometre (µm) thick polyethylene asbestos waste bags;
- Black 200 µm plastic lining;
- Water system capable of generating a light mist at low pressure;
- General personal hygiene equipment (e.g. wipes, brushes etc);
- Airborne Asbestos Monitoring (AAM) equipment (provided by the qualified occupational hygienist); and
- Waste transport system.

11.1.2. Personal Protective Equipment

The following personal protective equipment (PPE) is required on the project:

- Steel capped safety boots / steel capped gum boots.
- Disposable gloves.
- Disposable boot covers (if required).
- Safety Hard Hat.
- Disposable coveralls (type 5, category 3 (EN ISO 13982–1) or equivalent that would meet this standard (if required).
- Coveralls worn should be made from either 100% synthetic material or a mixed natural / synthetic fabric capable of providing adequate protection against fibre penetration. All fabrics must be capable of preventing the penetration of asbestos fibres down to a diameter of 0.5µm and to a maximum 1% penetration of all airborne asbestos fibres. Once worn, disposable overalls are not to be reused or laundered.
- Disposable half-face particulate respirator (P2 or P3 rated dependant on type of removal): The respirator must conform to the requirements of AS/NZS 1716:2009 Selection, Use and Maintenance of Respiratory Protective Devices or its equivalent. These disposable respirators must be replaced at each decontamination event.

11.1.3. Bulk Excavation Works

In regards to excavation, soil movement and placement of asbestos contaminated soil within the site, AG recommends the following:

- At least 5 days prior to commencing works, a SafeWork NSW Notification for Friable Asbestos Removal Works will be lodged by the appointed Licensed Asbestos Removalist;

- All excavation, soil movement and capping of the asbestos contaminated soil should be carried out under the supervision of a LAA or suitably qualified occupational hygienist and Class A or Class B licensed removalist contractor team;
- The LAA or qualified occupational hygienist will supervise the removal works to ensure that all removal procedures are implemented in accordance with the NSW Code of Practice: *How to Safely Remove Asbestos* (2019) and requirements set out in this document;
- Asbestos Air Monitoring will be carried out for the entirety of the works to ensure adequacy of control measures within the work site;
- A nominated decontamination area for plant and machinery will be erected outside the boundary of the removal areas during any friable asbestos removal / handling works;
- At the end of each shift, the source area and any temporary placement will be made safe using geofabric or appropriate plastic sheeting;
- At the end of each shift, the LAA or qualified occupational hygienist shall undertake an asbestos clearance / make-safe inspection to ensure that each area has been made safe. Records of these inspections will be provided to Spaceframe Constructions by the LAA / qualified occupational hygienist once completed;
- Following the removal of all asbestos contaminated soil, interim validation inspections and sampling of the source area will be carried out by a LAA, qualified occupational hygienist and / or Environmental Consultant;
- At the completion of asbestos works, all plant and machinery used during the works are to be decontaminated by the licensed removalist contractor;
- At the completion of the works, a validation report will then be prepared and issued in accordance with the appropriate legislation and guidelines (where required).

AG anticipates that areas validated will be fenced off from the remaining areas to be remediated, in order to reduce the risk of contaminated materials being tracked onto validated areas.

11.2. Soil and Stormwater Management

11.2.1. Site Access/Egress

Vehicle access and egress to the site will be stabilised to prevent tracking of sediment onto roads and footpaths. Soil, mud and other similar materials will be removed from the roadway adjacent the access/egress point by sweeping, shovelling or a means other than washing, on a daily basis, or as required.

Trucks will be loaded adjacent to the nominated waste dispatch area or to the remediation excavation (where practical). Spills of excavated soil will be scraped / swept up and combined with the soil being disposed offsite.

Soil and sediment will be broomed or washed off vehicle/plant tyres and tracks, prior to vehicles/plant leaving the remediation works zone. This soil and sediment will be scraped / swept up and managed onsite or disposed of, depending on its contamination status.

As per DA condition 12, a site-specific sediment and erosion control plan will be prepared and maintained by the remediation contractor, to suit staging of the remediation works. Erosion and sediment control measures will be maintained in a functional condition. Sediment laden stormwater runoff will be controlled using measures outlined in Landcom (2004) *Managing Urban Stormwater - Soils and Construction*.

11.2.2. Stockpiles

Stockpiles of soil or other materials:

- will not be placed on footpaths or nature strips, unless approved by Council;
- will be placed away from gutters, stormwater pits and other drainage lines;
- will be kept moist at all time;
- will be stored in a secure area and be covered if remaining on site for more than 24 hours; and
- will generally be constructed as low elongated mounds on level surfaces.

The **remediation contractor** will retain following material tracking information in relation to stockpiles onsite. A stockpile register should be implanted which will include the following minimum information:

- stockpile identification (i.e. stockpile number);
- estimated volume of stockpile;
- tracking of materials source; and
- fate of stockpile (i.e. tipping facility it will be sent to).

For materials that are proposed for reuse on site, internal material movement and stockpile tracking shall be undertaken.

11.2.3. Excavation Pump Out

Should excavations require pumping out, water will be analysed for total suspended solids, pH, metals and petroleum hydrocarbons. Should analytical results be less than relevant marine water ecosystem groundwater investigation levels in ANZG 2018, and meets Ku-Ring-Gai Council requirements for stormwater discharge (Refer to Ku-Ring-Gai Council 'Water Management Development Control Plan – DCP 47, Chapter 5') then the excavation water (if any) may be discharged to stormwater.

Should analytical results exceed ANZG 2018 criteria, other options for disposal will be considered, including:

- discharge to sewer (with prior approval from Sydney Water with a Trade Waste Agreement);
- removal and offsite disposal by a liquid waste contractor.

11.2.4. Rehabilitation and Landscaping

Stabilisation of exposed areas on the site, where required, will be undertaken in a progressive manner, as stages of remediation works are completed. Stabilisation will be maintained until such time as site redevelopment works commence.

As site redevelopment works are expected to be undertaken in conjunction with remediation works, revegetation of the site is considered unlikely to be required.

11.3. Waste Management

Removal of materials from site for recycling and/or disposal, will be undertaken with reference to the relevant provisions of the *Protection of the Environment Operations Act 1997,* SafeWork NSW (2019) and NSW EPA (2014).

The **remediation contractor** will maintain detailed records of materials removed from the site, including date/time of removal, quantities of materials, transport company details and vehicle registration details.

The **remediation contractor** will retain records verifying lawful disposal of the materials, including weighbridge / tipping dockets from the waste receiver.

The **remediation contractor** will retain following material tracking information, they are as follows.

For waste classification:

- Waste classification document;
- Material source and description;
- Sampling density, pattern, COPC;
- Result summary, including appropriate table with comparison to acceptance criteria; and
- Waste classification.

For offsite disposal works:

- Source location;
- Estimated volume (based on excavation size);
- Actual volume of disposal;
- Waste classification;
- Transporter;
- Final destination, POEO licence;
- Reconciliation of waste dockets with actual disposal volume; and
- Reconciliation of actual disposal volume and the estimated volume of disposal (based on excavation size).

For imported material:

- Volume of imported material;
- Source site;
- VENM certificate or certificate applicable for NSW EPA exemptions (e.g. ENM certificate);
- Placement location; and
- Transporter.

11.4. Groundwater Management

Should dewatering of true groundwater be required, development consent may be required from the planning consent authority. Dewatering may also require approvals from the NSW Department of Primary Industry – Water and Water NSW.

11.5. Noise Control

Noise levels from the site during the project will not exceed the limits indicated in AS2436-2010.

No ‘offensive noise’ as defined under the *Protection of the Environment Operations Act 1997* will be created during remediation works/activities.

Plant and equipment will be fitted with noise attenuation devices (e.g. mufflers on exhausts). Consideration will be given to use of reversing alarms other than the standard pulsed tonal alarms.

Vehicle access roads will be designed in such a way to minimise the need for plant and vehicles to reverse (e.g. provision of a turning circle adjacent to the remediation works zone).

11.6. Dust Control

Dust may be generated during remediation works and associated tasks. To mitigate risk of dust emissions migrating beyond the site boundary, consideration will be given to implementing the following procedures:

- erection of dust screens around the perimeter of the site (e.g. fencing with shade cloth attached);
- securely covering all loads entering or exiting the site;
- use of water sprays across the site to suppress dust;
- covering stockpiles of contaminated soil remaining on site for more than 24 hours;
- keeping excavation surfaces moist;
- wetting down of placed fill material during spreading;
- sweeping of hardstand surfaces;
- minimising soil disturbance works during windy days; and
- retaining stabilised site access/egress points for vehicles.

Any remedial works associated with asbestos are to be carried out in accordance with SafeWork NSW (2019) *Code of Practice – How to Safety Remove Asbestos*.

11.7. Odour Control

Generation of significant odours during the remediation works is considered to be unlikely.

If odours are generated, odours will be monitored at the site boundary. Should unacceptable odours be detected at the site boundary, consideration will be given to implementing the following procedures:

- use of appropriate covering techniques such as plastic sheeting to cover excavation faces or stockpiles;
- use of fine mist sprays (which may incorporate deodorizing agents);
- use of hydrocarbon mitigating agents on impacted areas/materials; and
- adequate maintenance of equipment and machinery to minimise exhaust emissions.

A record of unacceptable odours and corrective/preventative action taken, will be maintained by the remediation contractor.

11.8. Traffic Management

Haulage routes for trucks transporting soil, materials, equipment or machinery to and from the site will be selected by the remediation contractor and will meet the following objectives:

- compliance with all traffic road rules;
- minimisation of noise, vibration and odour to adjacent premises; and
- utilisation of state roads and minimisation of use of local roads.

The remediation contractor will ensure that site vehicles:

- conduct deliveries of soil, materials, equipment or machinery during the hours of remediation work identified in **Section 11.14**;
- securely cover all loads to prevent dust or odour emissions during transportation;
- exit the site in a forward direction; and

- do not track soil, mud or sediment onto the road.

11.9. Vibration Management

Vibration emissions during remediation works will be controlled to mitigate risk of potential damage to assets on adjacent properties, and to mitigate unreasonable loss of amenity to nearby residents.

11.10. Fill Importation

Material proposed to be imported to site as engineered fill, will be limited to materials certified as:

- VENM; or
- ENM

VENM certification will be undertaken with reference to NSW EPA (1995). ENM certification will be undertaken with reference to NSW EPA Excavated Natural Material Exemption.

The concentrations of potential contaminants in VENM and ENM proposed to be imported to site, will be compared against NSW EPA Waste Classification Guidelines 2014 and NSW EPA Excavated Natural Material Order 2014.

Imported fill will be compatible with existing soil characteristics for site drainage purposes.

The remediation contractor will maintain detailed records of all fill imported to the site, including details of the supplier, the source of the fill, the quantities of the fill, vehicle registration numbers and the dates/times the fill was received on site.

11.11. Work Health and Safety

11.11.1. Safe Work Method Statement

Each contractor and sub-contractor undertaking remediation works, or working within a remediation works zone, will prepare a project specific safe work method statement (SWMS), which will include, but not be limited to:

- the tasks to be undertaken;
- hazards identified for each of the tasks to be undertaken;
- an assessment of risk for each hazard, considering likelihood and consequence;
- control measures to eliminate or mitigate risks associated with each identified hazard.

11.11.2. Personal Protective Equipment

As the majority of the site is impacted by asbestos, the following minimum PPE should be worn by all persons working in or visiting the remediation works zone:

- long sleeves and long pants or overalls (when required);
- high visibility vests (or clothing);
- a dust mask or respirator (depending on the hazard) must be worn when hazardous substances are present;
- safety boots and boot covers (when required);
- hard hats
- gloves; and

- eye protection (e.g. safety glasses).

Additional PPE may be required in accordance with task specific control measures in SWMS (refer **Section 11.11.1**).

11.11.3. Decontamination of Personnel

Personnel undertaking remediation tasks, or entering the remediation works zone, be required to decontaminate upon exiting the remediation works zone. Decontamination procedures will include:

- cleaning down of protective footwear (including removal of soil from the soles); and
- washing of hands.

The following minimum PPE should be worn by any persons the remediation works zone:

- gloves;
- safety boots;
- hard hats;
- high visibility vests or clothing; and
- safety glasses.

11.12. Site Signage

A sign will be posted on the boundary of the site, adjacent to the site access point, which will include 24-hour contact details of the remediation contractor. This sign will be maintained onsite until all remediation works are complete.

11.13. Site Security

Site security will be maintained throughout the duration of the remediation works, with appropriate boundary fencing and gate locks. This will include areas/ stages that are awaiting validation sign-off or have previously been validated.

Other security measures may be implemented, if the need arises.

11.14. Site Hours of Operation

Remediation works will be undertaken on Monday to Friday between the hours of 7:00am to 5:00pm, and Saturday between the hours of 8:00am and 1:00pm.

Remediation works will not be undertaken outside the hours stated above, or on Sundays or public holidays.

11.15. Community Relations and Complaints

Owners, occupants, and tenants of properties adjoining the site and across the road from the site, will be provided with notification of remediation works, at least two days prior to those works commencing.

Personnel undertaking remediation works on the site, will direct all third-party communications and/or complaints to the Project Manager. The Project Manager will arrange for the communication/complaint to be assessed, a response prepared, corrective/preventative actions implemented (if necessary).

A register will be maintained on site for the recording of communications / complaints from third parties, including but not limited to, local residents and local businesses.

11.16. Emergency Preparedness

An emergency assembly point will be established at the site egress point. This point will be communicated to all site workers and visitors, during relevant site induction processes.

In the event of an emergency, site workers and visitors will assemble here and await further instructions from the site supervisor, project manager or emergency services.

In the event of soil and/or groundwater contamination as a result of a spill and/or fire, the steps described in **Section 8.3.8** 'Unexpected Finds Protocol' Should be followed and implemented.

Spill control kits and fire extinguishers will be located on site, as and where required.

Contact details to be used in the event of an emergency, are presented in **Section 11.17**.

11.17. Register of Contacts

A register of contacts for the project is presented in **Table 11-1**.

Table 11-1 Register of Contacts

Project Role	Person	Organisation	Contact
Emergency Services	-	Fire / Police / Ambulance	000
Principal Contractor	-	Appointed Principal Contractor	To be advised
Planning Consent Authority	-	Ku-Ring-Gai (via NSW DA)	1300 305 695
WHS Regulatory Authority	-	SafeWork NSW	131 050
Environment Protection Authority	-	NSW EPA	131 500
Remediation Contractor	-	To be advised	To be advised
Environmental Consultant	-	Alliance Geotechnical	1800 288 188

This report, including its conclusions and recommendations, must be read in conjunction with the statement of limitations presented in **Section 13**.

12. Conclusions

Based on the information presented in the historical contamination assessment reports and AG's observations on site, AG concludes that the remedial strategies and goals can be achieved and the site made suitable in informing future land use planning and rendering the site suitable for proposed land use, subject to:

- Implementation of the strategies, methodologies and measures set out in this RAP;
- Should newly identified unacceptable land contamination risks be identified during supplementary assessment works (specifically AEC06 and in addition, AEC02 (in the vicinity of TP08) and AEC04), an addendum to this RAP may be required. The addendum should be prepared by a suitably experienced environmental consultant;
- Prior to any removal of soils from site for offsite disposal during remedial works, waste classification for those soils should be prepared by a suitably experienced environmental consultant. Residual impacted fill materials must also be appropriately characterised as per the strategy outlined in this RAP; and
- All remedial works should be monitored and validated by a suitably experienced environmental consultant; and

AG recommends that any waste classifications, remediation monitoring and validation works be undertaken by a suitably experienced environmental consultant.

This report must be read in conjunction with the limitations set out in **Section 13**.

13. Statement of Limitations

The findings presented in this report are based on specific searches of relevant, government historical databases and anecdotal information that were made available during the course of this investigation. To the best of our knowledge, these observations represent a reasonable interpretation of the general condition of the site at the time of report completion.

This report has been prepared solely for the use of the client to whom it is addressed and no other party is entitled to rely on its findings.

No warranties are made as to the information provided in this report. All conclusions and recommendations made in this report are of the professional opinions of personnel involved with the project and while normal checking of the accuracy of data has been conducted, any circumstances outside the scope of this report or which are not made known to personnel and which may impact on those opinions is not the responsibility of Alliance Geotechnical Pty Ltd. Should information become available regarding conditions at the site including previously unknown sources of contamination, AG reserves the right to review the report in the context of the additional information.

This report must be reviewed in its entirety and in conjunction with the objectives, scope and terms applicable to AG's engagement. The report must not be used for any purpose other than the purpose specified at the time AG was engaged to prepare the report.

Logs, figures, and drawings are generated for this report based on individual AG consultant interpretations of nominated data, as well as observations made at the time site walkover/s were completed.

Data and/or information presented in this report must not be redrawn for its inclusion in other reports, plans or documents, nor should that data and/or information be separated from this report in any way.

Should additional information that may impact on the findings of this report be encountered or site conditions change, AG reserves the right to review and amend this report.

14. References

AG 2018a, '*Stage 1 Preliminary Site Investigation, Lot X in DP38760 & Lot Y in DP387680, 4 Pennant Avenue, Gordon, NSW*', dated 23 March 2018, ref: 6839-ER-1-1;

AG 2018b, '*Stage 2 Detailed Site Investigation, 4 Pennant Avenue, Gordon, NSW*', dated 03 July 2018, ref: 6838-ER-1-2;

National Environment Protection Council (NEPC) 1999a, '*Schedule B(1) Guideline on Investigation Levels for Soil and Groundwater, National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM)* as amended in May 2013';

CRC CARE 2017, '*Risk-based management and remediation guidance for benzo(a)pyrene, CRC CARE Technical Report no. 39, CRC for Contamination Assessment and Remediation of the Environment, Newcastle, Australia;'*

NEPC 1999b, '*Schedule B(2) Guideline on Site Characterisation, National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM)'* as amended in May 2013;

NSW EPA 1995, '*Contaminated Sites: Sampling Design Guidelines;'*

NSW EPA 2017, '*Contaminated Sites: Guidelines for the NSW Site Auditor Scheme (3rd edition);'*

NSW EPA 2020a, '*Guidelines for consultants reporting on contaminated land; Contaminated Land Guidelines*;'

NSW EPA 2020b, draft '*Sampling design part 1 – application, Contaminated Land Guidelines*', dated August 2020;

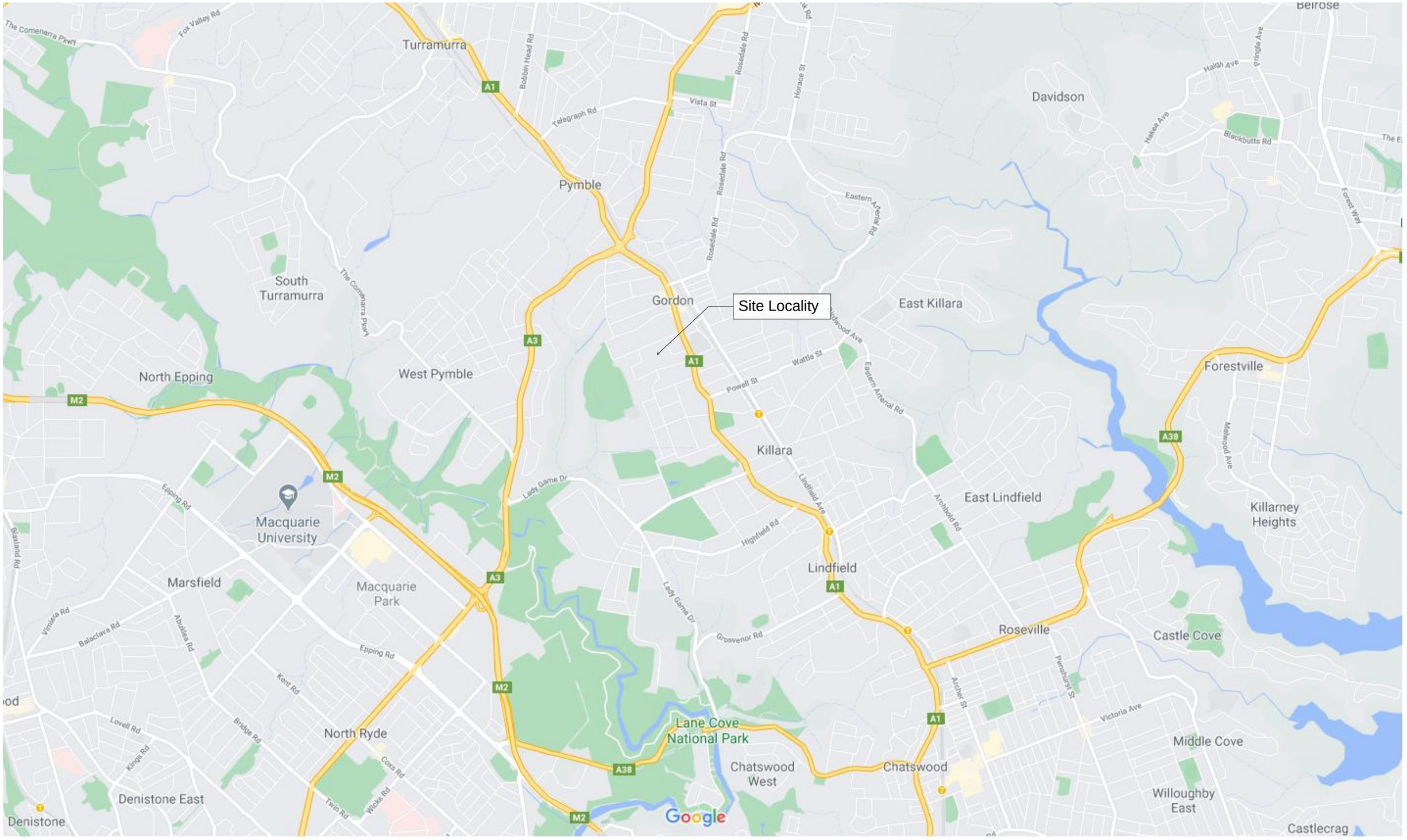
WA DOH 2009, '*Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*' dated May 2009;

NSW Aquifer Interference Policy 201*2, 'NSW Government policy for the licensing and assessment of aquifer interference activities;'*

NSW EPA 1998, '*Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land;'*

Landcom 2004, '*Managing Urban Stormwater - Soils and Construction'* (the Blue Book).

SITE FIGURES



Source: *Google Maps (google.com/maps) – accessed 28 October 2020*

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Site Locality

Client Name:	Ku-ring-gai Council	Figure Number:	1
Project Name:	Remedial Action Plan	Figure Date:	28 October 2020
Project Location:	4 Pennant Avenue, Gordon, NSW	Report Number:	6839-ER-1-3

Source: *NearMap (Nearmap.com) – accessed 28 October 2020*

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Site Layout

Client Name:	Ku-ring-gai Council	Figure Number:	2
Project Name:	Remedial Action Plan	Figure Date:	28 October 2020
Project Location:	4 Pennant Avenue, Gordon, NSW	Report Number:	6839-ER-1-3

Source: *NearMap (Nearmap.com) – accessed 28 October 2020*

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AEC and Approximate Extent of Contamination

Client Name:	Ku-ring-gai Council	Figure Number:	3
Project Name:	Remedial Action Plan	Figure Date:	28 October 2020
Project Location:	4 Pennant Avenue, Gordon, NSW	Report Number:	6839-ER-1-3

Source: *NearMap (Nearmap.com) – accessed 28 October 2020*

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Inferred Extent of Remediation

Client Name:	Ku-ring-gai Council	Figure Number:	4
Project Name:	Remedial Action Plan	Figure Date:	28 October 2020
Project Location:	4 Pennant Avenue, Gordon, NSW	Report Number:	6839-ER-1-3

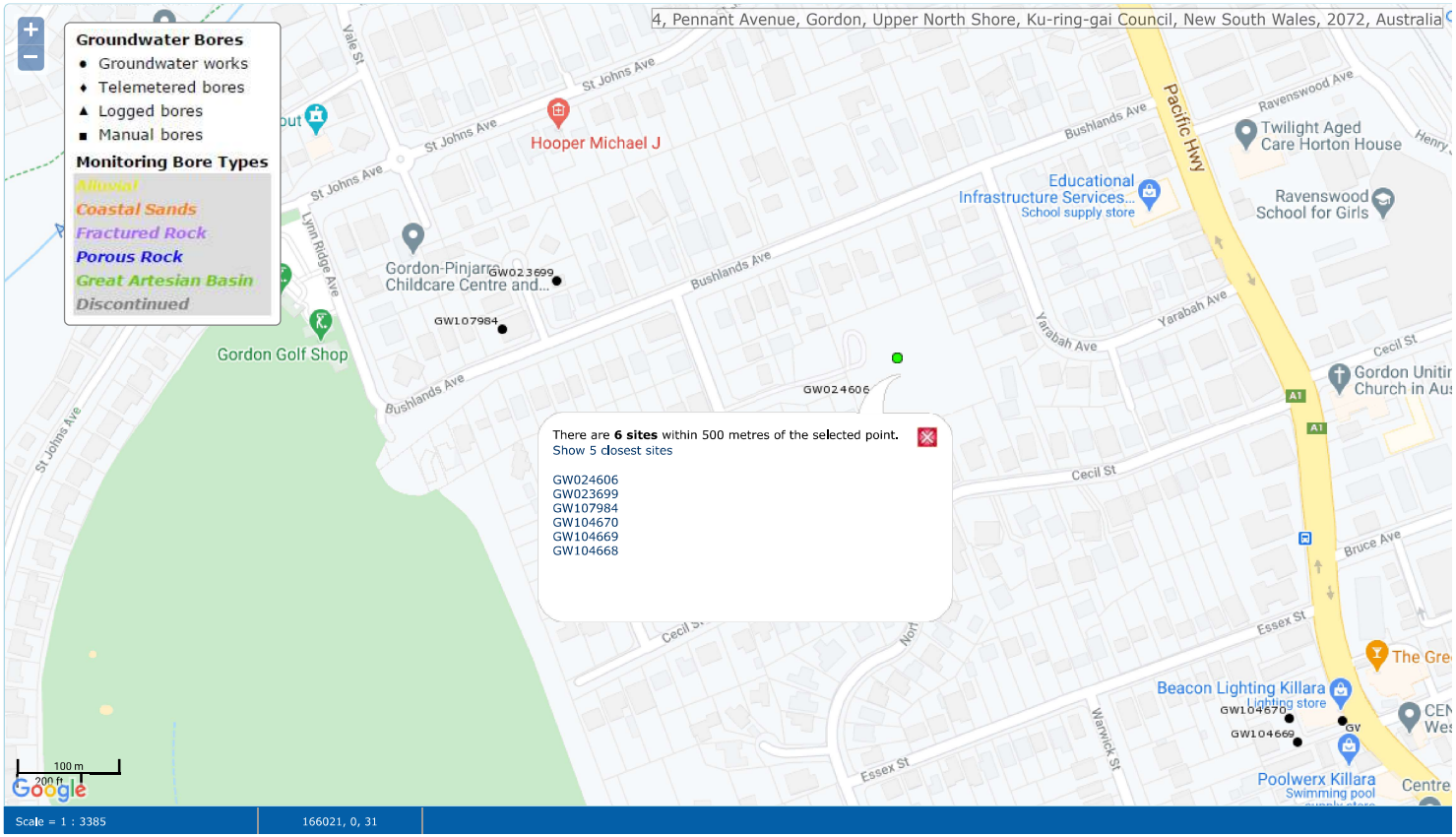
APPENDIX A

WATER NSW RECORDS

ALL GROUNDWATER MAP

All data times are Eastern Standard Time

Map Info



APPENDIX B

CONCEPTUAL SITE MODEL

Conceptual Site Model

In accordance with NEPM (2013) *Schedule B2,* AG developed a CSM to provide a framework for the review of the reliability and useability of the data collected, and to identify data gaps in existing site characterisation. Source – pathway – receptor linkages associated with the revised CSM presented in the DSI (AG, 2020) is summarised below.

Sources of Contamination

Potential sources of contamination identified during review of site history records include:

- AEC02 – Uncontrolled filling.
- AEC03 – Uncontrolled filling.
- AEC04 – Uncontrolled filling.
- AEC06 – Uncontrolled demolition and additions/modifications.
- Site car parking area (north-western corner of Lot Y and entirety of Lot X).

Contaminants of Potential Concern

Potential sources of contamination were revealed, with potential to contaminate the site. Given the above sources, the COPC are:

- AEC02 – Asbestos in the central western portion of AEC02; within the vicinity of TP08.
- AEC03 – Lead (TP12)
- AEC04 – Asbestos in soil, across AEC04 (TP16 and TP17).
- AEC06 – TRH, BTEX, metals, PAH, PCB, pesticide, and asbestos.
- Site car parking area - TRH, BTEX, metals, PAH, PCB, pesticide, and asbestos.

Source – Pathway – Receptor Linkages

A summary of potential source – pathway – receptor linkages identified for the site and proposed redevelopment is presented in **Table B-1**.

Table B-1 Source – Pathway – Receptor Linkages

Media	Areas of Environmental Concern	Contaminants of Potential Concern	Potential Exposure Pathway	Potential Receptor
Soil	AEC02	Aesthetics (asbestos)	▪ Ingestion ▪ Dermal contact ▪ Inhalation of dust particulates ▪ Uptake	▪ Construction and maintenance workers ▪ End users of the site post-redevelopment ▪ Ecological receptors
	AEC03	Lead		
	AEC04	▪ Asbestos in soil ▪ Aesthetics (asbestos)		
	AEC09	TRH, BTEX, PAHs, PCBs, metals, pesticides, and asbestos		
	Site car parking area	TRH, BTEX, PAHs, PCBs, metals, pesticides, and asbestos		