

CONTAMINATED SITE AUDIT

165 Milton Street, Ashbury, NSW

08 MAY 2019



CONTACT



TIM CHAMBERS
NSW EPA Accredited Site
Auditor 1004

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T 02 8907 3983
M +61 458 888 033
E tim.chambers@arcadis.com

Arcadis Australia Pacific Pty Ltd

Level 16, 580 George Street
Sydney NSW 2000
Tel No: +61 2 8907 9000
www.arcadis.com/au

ASHBURY DEVELOPMENTS CONTAMINATED SITE AUDIT REPORT

165 Milton Street, Ashbury, NSW

Site Audit Report to support Site Audit Statement TNC118

Author Tim Chambers



Checker Natasha Pasley



Approver Tim Chambers



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LIMITATIONS

This Site Audit relates only to those matters relevant to the Contaminated Land Management Act 1997, which describes that "The general object of this Act is to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3." The SAS and SAR do not seek to provide an opinion regarding other aspects of the environment not related to site contamination, to the suitability of the site in regard to the occupational health and safety legislation, or in regards to the suitability of the engineering design.

By definition, Auditing involves the review and critique of Consultants' and Contractors' work, including site histories, site surveys, subsurface investigations, chemical and physical analyses, risk assessments and modelling. Accordingly, the Auditor relies on the experience, expertise and integrity of the relevant organisations. The information sources referenced have been used to determine site history and local subsurface conditions. While the Auditor has used reasonable care to avoid reliance on data and information that is inaccurate or unsuitable, the Auditor is not able to verify the accuracy or completeness of all information and data made available.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

Limited environmental sampling and laboratory analyses were undertaken as part of the investigations reviewed by the Auditor, as described herein. Ground conditions between sampling locations may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site which was not identified in the site history and which may not be expected at the site.

Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this site audit are based on the information provided at the time of the investigations.

AUDIT REPORT REQUIREMENTS

The following items are listed in section 3.3 of NSW EPA (2017) *Contaminated Site Management: Guidelines for the NSW Site Auditor Scheme, 3rd Edition* as being required to be addressed in a Site Audit Report:

NSW DEC Reporting Requirement	Section in this Report
a) site location details, including maps giving details of potential receptors	Section 3
b) site history including past, current and proposed zoning and approved use, describing all potentially contaminating activities on the site and adjoining land.	Section 5
c) a clear outline of the actual or potential contamination of the land	Section 7
d) potential contaminants of concern from both on-site and off-site sources, listing each specific contaminant – where the auditor considers that a contaminant that would usually be expected to be of concern is not in this case, the auditor must state this and give reasons for this conclusion	Section 7
e) soil stratigraphy and hydrogeology	Section 4
f) a conceptual site model	Section 7.3
g) a clear statement of the investigation and remediation that has taken place	Section 8
h) evaluation of quality assurance and quality control plans, including appropriate implementation of sampling plan(s), sample handling, collection and transport processes	Sections 10.4 and 12.2
i) a summary of all analytical results and an evaluation of those results	Sections 10, 12.1
j) a summary and justification of environmental quality criteria used by the auditor in assessing the reports of consultants	Section 9
k) assessment of risks to human health, structures and the environment arising from the actual or potential contamination of land	Section 11
l) the need for any ongoing management of residual contamination and how that management should be achieved	Section 15
m) requirements relevant to the audit imposed by the planning consent authority, EPA or any other public authority and documented evidence that these requirements have been met	Section 16.3
n) any evidence of, or potential for, migration of contaminants from the site including odour, air quality, stormwater, sedimentation and groundwater issues – where the auditor considers that off-site migration is not a potential issue, the auditor must say this and give reasons for this conclusion	Section 14
o) an assessment of aesthetic issues, odours and background soil concentrations where these are required by these guidelines or other guidelines made or approved by the EPA	Section 16.6
p) conclusions and recommendations, and details of how they have been reached	Section 18
q) any other information relevant to the site audit, including copies of correspondence between the auditor and consultant(s) relevant to the outcome of the assessment, remediation and validation works	Section 2.8 and Appendix B
r) the auditor's opinion of the adequacy of the work of each consultant in relation to all of the above areas	Section 17
s) documentation of all cases where the consultants have departed from applicable guidelines with appropriate comment on whether these departures are acceptable.	Section 11, Section 12.1

EXECUTIVE SUMMARY

Background

Ashbury Developments have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped and comprises one lot (Lot A DP 30778), with an area of 1.4 ha. It is proposed to redevelop the site for mixed use (residential and commercial). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

This Site Audit Report (SAR) and has been developed to document the information reviewed as part of a site audit of contamination assessment and remediation, and to form the basis and rationale for the conclusions contained in the associated Site Audit Statement (SAS) No. **TNC118**.

Environmental Investigations and Remediation

Site assessment incorporated soil, ground gas and groundwater assessment. No unacceptable contamination and no impact from the adjacent landfill was identified. Some areas of elevated carbon dioxide content were apparent, but do not appear to be related to landfill gas. The location of underground fuel storage tanks in the north of the site was identified as requiring remediation since no record of tank removal and validation was identified.

Remediation proposed for the site includes the confirmatory monitoring of ground gas using continuous methods to ensure robust measurements.

Audit Conclusions

The Auditor has reviewed the remedial action plan (EI (May 2019) *Remediation Action Plan, 165 Milton Street, Ashbury, NSW*. Reference E24185.E06_Rev0) and is satisfied that it meets NSW EPA reporting requirements, and presents a suitable method to remediate and validate the site for ongoing high density residential or mixed commercial/residential use.

1 INTRODUCTION

1.1 Background to this Site Audit Report

Ashbury Developments have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped and comprises one lot (Lot A DP 30778), with an area of 1.4 ha. It is proposed to redevelop the site for mixed use (commercial and residential). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

This Site Audit Report (SAR) and has been developed to document the information reviewed as part of a site audit of contamination assessment and remediation, and to form the basis and rationale for the conclusions contained in the associated Site Audit Statement (SAS) No. **TNC118**.

The location of the site is shown in Figure 1, Appendix A. The layout and site features are shown in Figure 2, Appendix A.

Details of Arcadis' Contaminated Land Accredited Site Auditor (accredited by the NSW Environment Protection Authority (EPA)) and the scope of the Audit are contained in Section 2. The SAS and SAR relate to the property identified in Section 3.

1.2 Overview of the Site Audit Process

The Site Audit has been conducted in accordance with the requirements of the Contaminated Land Management (CLM) Act 1997. The CLM Act (Part 1, Section 4) describes a site audit as an independent review:

- a. that relates to management (whether under this Act or otherwise) of the actual or possible contamination of land, and
- b. that is conducted for the purpose of determining any one or more of the following matters:
 - i. the nature and extent of any contamination of the land,
 - ii. the nature and extent of any management of actual or possible contamination of the land,
 - iii. whether the land is suitable for any specified use or range of uses
 - iv. what management remains necessary before the land is suitable for any specified use or range of uses,
 - v. the suitability and appropriateness of a plan of management, long-term management plan or a voluntary management proposal.

NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, describes the site assessment and Audit process:

- i. The **'first tier' is the work of a contaminated site consultant**, generally engaged by the site owner or developer. The contaminated site consultant designs and conducts a site assessment and any necessary remediation and validation, and documents the processes and information in reports.

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- ii. The **'second tier' is the site audit**, which involves a site auditor independently and at arm's length reviewing, for one of the audit purposes stated in the CLM Act, the consultant's assessment, remediation, validation and management plans or reports. The material outcomes of a site audit are a site audit report and a site audit statement.

Section 53B(6) of the CLM Act describes that site audits conducted by EPA accredited site Auditors must take the following matters into account:

- the provisions of the CLM Act and the CLM Regulations;
- the guidelines made or approved by the EPA; and
- the provisions of any environmental planning instruments applying to the site;

Guidelines made and approved by NSW Environment Protection Authority (EPA) are listed in Section 16 of this document.

2 AUDIT DETAILS

2.1 Site Auditor

The NSW EPA Accredited Site Auditor who conducted this site audit was Mr Tim Chambers (NSW EPA Accreditation Number 1004).

Formal engagement of the site Auditor on this project occurred on the 26th March 2019 with formal Site Audit Notification submitted to NSW EPA on the 26th March 2019 (EPA Reference DOC19/287690).

2.2 Site Audit Statement

This SAR relates to Site Audit Statement (SAS) Number **TNC118**.

2.3 Input to this Report by Auditor's Support Team

The Auditor did not rely on any members of his support team during this Audit. Assistance in tabulation and report review was provided by Natasha Pasley and Doug Craven of Arcadis under the direction and supervision of the Auditor.

2.4 Type of Audit

A statutory site audit is one that is required by:

- a regulatory instrument issued under the *Contaminated Land Management Act 1997* (CLM Act), including EPA agreements issued by EPA to voluntary proposals
- the *Environmental Planning and Assessment Act 1979*, including an environmental planning instrument or development consent condition
- any other Act.

The Audit is required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Audit is a Statutory Audit under the Contaminated Land Management Act 1997.

This Site Audit Report has been written in accordance with NSW EPA (2017) *Contaminated Site Management: Guidelines for the NSW Site Auditor Scheme* (3rd edition).

2.5 Proposed Development

The development of the site is currently at planning stage and may include five residential buildings of varying heights from two to six storeys with one basement level. Excavation for the basement is anticipated to a depth of 3m below ground level (BGL).

2.6 Potential for Conflict of Interest

Under the provisions for the Site Auditor Scheme laid out in the Contaminated Land Management Act 1997, section 54 deals with the potential for conflict of interest in conducting contaminated Site Audits. Section 54 of the Contaminated Land Management Act 1997 states:

1. A site auditor must not carry out a site audit of land:
 - a. if he or she is or is related to a person by whom any part of the land is owned or occupied, or

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- b. if he or she has a pecuniary interest in any part of the land or any activity carried out on any part of the land, or
 - c. if it involves the site auditor reviewing any aspect of work carried out by, or a report written by, the site auditor or a person to whom the site auditor is related.
2. A site auditor has a pecuniary interest for the purposes of this section if there is a reasonable likelihood or expectation of appreciable financial gain or loss to the site auditor, or to a person to whom he or she is related, from the relevant part or activity, but does not have such an interest if the interest is so remote or insignificant that it could not reasonably be regarded as likely to influence any decision that the site auditor might make in relation to a site audit of the land.
3. A site auditor is related to a person for the purposes of this section if the site auditor:
 - a. is an employer, partner or employee of the person, or
 - b. is a spouse, de facto partner, sibling, parent or child of the person, or
 - c. has a contractual arrangement with the person that might reasonably be seen to give rise to a conflict between the site auditor's duties as a site auditor and the site auditor's interests under the arrangement, or
 - d. is employed by the same employer as the person.

The Auditor confirms that none of the above conditions apply with regard to this Audit as the Auditor:

- Within the meaning given in S 54(3) of the Contaminated Land Management Act 1997 is not related to the site owners or occupiers;
- Does not have a pecuniary interest in the land or any activity carried out on the land; and
- The Auditor has not reviewed work conducted by himself or any persons to whom he is related.

2.7 Objectives of Audit

The objectives of this Site Audit Report are to confirm that:

- the site is sufficiently free of contamination, or that residual contamination is managed, to ensure that it is protective of human health and the environment under the proposed land use;
- the site is suitable for the intended land use (mixed use with six, three to eight storey buildings over a basement carpark); and
- that contamination has been assessed and managed in a manner consistent with NSW EPA requirements.

2.8 Documents Reviewed

This SAR has relied on data collected and reported by the following consultancies:

- Eiaustralia, formerly Environmental Investigations Australia (EI)
- Environmental Investigation Services (EIS)

The Auditor has been provided with the following documents detailing the environmental investigations conducted at the site.

- EI (14 August 2014 *Preliminary Environmental Site Assessment Report*, 165 Milton Street, Ashbury, NSW. Reference E22232 AA Rev0.

- EIS (8 November 2018) *Stage 2 Environmental Site Assessment For Proposed Re-Zoning For Future Development 165 Milton Street, Ashbury, NSW*, Reference E31803KBrpt-rev1.
- EI (03 May 2019) *Remediation Action Plan, 165 Milton Street, Ashbury, NSW*. Reference E24185.E06_Rwv0

Report summaries are presented in Section 8.2 below (Page 19). The key aspects of the reports are assessed in the relevant sections of this audit report.

2.9 Audit Meetings and Site Inspection

Audit meetings and site inspections are summarised Table 1 below.

Table 1: Audit Meetings and Site Inspection

Date	Purpose	Comments
2 nd May 2019	Site meeting	The Auditor met representatives of consultant (Mr Tony Guirguis of Eiaustralia) at the site. The site infrastructure (buildings) were intact and partially occupied (some were for lease). The site was used as office space and for warehousing and open-air storage of manufactured goods including scaffolding and machinery. Buildings appeared in good condition although hardstand and asphalt paving was cracked and damaged in places. No evidence of ongoing presence of USTs was apparent, although removal of the UST was not confirmed. No vent pipes were apparent, the bowser had been removed (but the bowser stand remains) and concrete repair at the location of the UST was evident. The site level is clearly several metres above the finished cap level of the adjacent former landfill (playing field), and the local topography continues to dip away from the site to the north west. Site photos are presented in Appendix D.

2.10 Audit Correspondence

The Site Auditor provided feedback during the course of the audit on reports provided for review, documented as Interim Audit Advice letters.

Copies of letters of Interim Advice are presented in Appendix B.

3 SITE IDENTIFICATION & SURROUNDS

This section provides details of the site and its land use, it describes the surrounding land uses and summarises the potentially sensitive human health and environmental receptors. This information has been sourced primarily from the consultants' reports (EI, 2018), the Auditor's observations of the site and, where required, from referenced published literature.

3.1 Site Identification and Land use

The site location is shown in Figure 1, Appendix A. The layout of the site is shown on Figure 2 Appendix A.

The site identification and land use details are included in Table 2 below.

Table 2: Site Identification

Descriptor	Value
Street Address	165 Milton Street, Ashbury NSW
Property Description	Lot A DP30778
Geographic Coordinates	Latitude: -33.897311326 Longitude: 151.119706206
Property Size	15,000m ² (1.5 ha)
Local Government Area	Canterbury-Bankstown City Council
Subdivision	Subdivision is not known to be planned at this stage of the redevelopment.
Land use – Previous	Commercial / Industrial
Land use – Proposed	Mixed-use development. Demolition of existing structures and the construction of six, three to eight storey buildings over a basement car park.
Zoning – Existing	IN2 - Light Industrial
Zoning – Proposed	High density residential

3.2 Surrounding Land Use

The surrounding land use described in EI (2018) as follows:

- **North:** Existing commercial buildings;
- **East:** Low density residential buildings;
- **South:** Low density residential buildings; and
- **West:** Whitfield Reserve and W H Wagener Oval.

3.3 Audit Discussion

The Auditor is satisfied that the site identification details provided are an accurate representation of the area and are generally consistent with the Auditor's observations and knowledge of the area.

4 ENVIRONMENTAL SETTING

The EI (2018) detailed site investigation provides a concise summary of the environmental setting prior to remedial works and has been used as the source for the Auditor's description of the site below, supplemented by published data and the Auditor's observations of the site as required.

4.1 Topography and Hydrology

EI (2018) describe the site topography as follows:

The site is located on a ridgeline that falls to the north-west towards the oval and south-east towards Peace Park. The site has been cut into the ridge with localised ramps and retaining walls that fall to the west and south-west. Parts of the site appear to have been levelled to account for the slope and accommodate the existing development.

The Auditor is satisfied that this description is accurate.

4.2 Soils and Geology

4.2.1 Regional Geology

EI (2014) describe the regional geology as:

With reference to the 1:100,000 scale Geological Series Sheet 9130 (Sydney) the site is likely to be underlain by Ashfield Shale of the Wianamatta Group, which typically comprises black to dark grey shale and laminite. Ashfield Shale generally weathers into silty clay of medium to high plasticity (Ref. 1:100,000 Geological Series Sheet 9130 – Sydney, NSW DMR).

The Auditor is satisfied that this description is accurate.

4.2.2 Site Soil Profile and Geology

The site geology is detailed in EI (2016) section 10.2 as reproduced by the Auditor in Table 3 below.

Table 3: Site Geology, after EI (2018)

Layer	Description	Depth to Top of layer (m BGL)
FILL	Fill comprised of silty sand, clayey sand, gravelly sand and silty clay with inclusions of clay fines, ash, root fibres, ironstone, igneous, sandstone and shale gravel, slag and building rubble (bricks and concrete). Deeper fill was noted in the central and west sections of the site.	0.5 – 2.80
Natural Soils	Silty clay, low to medium plasticity and contained inclusions of ironstone gravel.	0.3 – 4.1
Bedrock	Shale, extremely weathered, light brown.	0.4 – 4.1

4.2.3 Acid Sulphate Soils

EI (2014) discuss acid sulphate soil potential as follows:

With reference to the Prospect Paramatta Acid Sulphate Soil Risk Map (1:25,000 scale; Murphy, 1997), the subject land lies within the map class description of No Known Occurrence. In such cases, acid sulphate soils

(ASS) are not known or expected to occur and "land management activities are not likely to be affected by ASS materials". The Canterbury City Council Local Environmental Plan 2012 – Acid Sulphate Soils Risk Class 1:10,000 scale Map does not indicate the Acid Sulphate Soil Risk Class of the site. Taking into account the above information, the need for further Acid Sulphate Soil management was considered unwarranted and the risks associated with Acid Sulphate Soils was considered negligible.

The Auditor is satisfied that no acid sulphate soil has been encountered on site and that further consideration of acid sulphate soils is not required in relation to this site audit.

4.3 Hydrogeology

4.3.1 Regional

EI (2018) mention the following regarding the local hydrogeology:

A review of the hydrogeological information presented in the Lotsearch report indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were a total of sixteen (16) registered bores within the report buffer of 2,000m. The information reviewed for this assessment indicated that the subsurface conditions at the site are likely to consist of relatively low permeability (residual) soils overlying shallow bedrock. The potential for viable groundwater abstraction and use of groundwater under these conditions is considered to be low. Use of the groundwater is not proposed as part of the development. Considering the local topography and surrounding land features, EIS would generally expect groundwater to flow towards the west and north west.

The Auditor is satisfied that the local hydrogeology is adequately described and concurs with the suggestion that the former landfill will have a distinct local effect on groundwater.

The Auditor notes that the former landfill will have a significant effect on local groundwater flow direction and is likely to distort the natural flow regime.

4.3.2 Site Hydrogeology

The site hydrogeology is best presented in the detailed site investigation report (EI, 2018). The Auditor notes that three previously installed monitoring wells (MW1, MW4 and MW5) and one newly installed monitoring well (MW105) was sampled. MW1 was installed in shale and laminite, MW4 in sandy clay and shale, MW5 in laminite and MW105 in shale. The wells were screened between 3.0 – 9.0m bgl.

The Auditor notes that monitoring wells MW110, MW111, MW112, MW113, MW114, MW115 and MW116 were installed for ground gas sampling and were not used to assess groundwater during the investigation.

The site hydrogeology is consistent with the mapped geology and the Auditor's professional experience.

4.4 Audit Discussion

4.4.1 Soils and Geology

The Auditor is satisfied that the consultants have adequately documented the soils and geology of the site from a regional and site perspective.

4.4.2 Acid Sulphate Soil

The Auditor is satisfied that potential acid sulphate soils have not been identified at the site and that management of acid sulphate soil is not required in relation to the current site remediation.

4.4.3 Hydrogeology

The Auditor is satisfied that the hydrogeological behaviour at the site is adequately documented.

5 SITE HISTORY

5.1 Auditor's Summary of Site History

The site history is summarised in EI (2014) based on source document review.

The key historical uses of the site and associated aspects affecting the site contamination were identified to be:

- Historical use of the site as part of the Ashfield Brick Company;
- Historical use of the site as a workshop for motor vehicle maintenance and repair;
- Fill material placed onsite prior to the construction of the current facility; and
- Former underground storage tank pit and former fuel pumps.

5.2 Audit Discussion

The Auditor is satisfied that the site history identified by the consultants is adequate given the site location and usage, although no synthesis of site history is presented.

6 SITE CONDITION

The site condition prior to remediation is summarised below based on the EI (2018) site assessment, augmented by the Auditor's observations where required.

6.1 Site Layout

EI (2018) described the following site features:

The majority of the site was occupied by a large warehouse (2 storey) that was used for stocking, distribution and fabrication of doors, door frames and related products. The northeast section of the site was occupied by a three-storey office building. A large workshop was located in the south-west corner of the site. The workshop was suspended on piles with an undercroft used for the storage of excess supplies. Signage was observed in the façade of the buildings ('Tyres 4U' and 'Stylewise Doors') that indicated the type of commercial land uses.

The Auditor is satisfied that this description is accurate.

6.2 Visible and Olfactory Signs of Contamination

No visual indication of contamination (filming, ACM fragments, or similar) was apparent although EIS noted staining on concrete within the warehouse. No odours were noted during site assessment.

The former bowser stand remains adjacent to the access road along the northern site boundary and shows some staining (See photograph 1 in Appendix D)

6.3 Audit Discussion

The site condition described by the consultants is generally consistent with the Auditor's observations of the site and review of historical documentation.

7 CONTAMINANTS AND MEDIA

The potential contaminants of concern are related to the historical commercial/industrial activities such as historical use of the site as part of a quarry, fuel storage on site and manufacturing of doors, frames and other products.

7.1 Potential Contaminants of Concern

The site history review identified the following contaminants as being of potential concern at the site:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury);
- Total Recoverable Hydrocarbons (TRH);
- Benzene, toluene, ethylbenzene, total xylenes (BTEX);
- Polycyclic aromatic hydrocarbon (PAH);
- Organochlorine- and organophosphate pesticides (OCP/OPP)
- Polychlorinated Biphenyls (PCB);
- Asbestos; and
- Landfill gases (methane, carbon dioxide, carbon monoxide and hydrogen sulphide).

The Auditor is satisfied that this suite of potential contaminants addresses the identified potential sources – uncontrolled fill and general industrial use including potential fuel storage.

The assessment of ammonia and other nitrogen compounds in groundwater would be a useful preliminary indicator of leachate impact from the landfill which was not included in the initial assessments.

7.1.1 PFAS

PFAS (polyfluorinated alkyl substances) have become of increasing concern to regulators and the public in recent years. NSW EPA (2017) *Contaminated Site Management: Guidelines for the NSW Site Auditor Scheme, 3rd Edition*, require that PFAS assessment be considered in all Site Audit Reports and states that “*The auditor must check that contamination by per- and poly-fluoroalkyl substances (PFAS) has been considered in the assessment of contamination*”.

Potential for PFAS impact at the site is not discussed in the EI 2018 ESA report.

The Auditor notes that PFAS use in manufacturing is known to occur in galvanising and metal plating works, as well as in textile manufacture. Neither use has been documented at the site.

7.2 Media Assessed

Intrusive sampling included soil, ground gas and groundwater sampling.

The Auditor is satisfied that all required media have been sampled.

7.3 Conceptual Site Model

Schedule B2 of NEPC (2013) states that the essential elements of conceptual site models include:

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- known and potential sources of contamination and contaminants of concern including the mechanism(s) of contamination (e.g. 'top down' spill or sub-surface release from corroded tank or pipe)
- potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air)
- human and ecological receptors
- potential and complete exposure pathways.

NEPC (2013) provide an example conceptual site model in flow diagram format and state that:

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments and provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or the future.

Typically, the CSM should be presented in written format and illustrated with suitable graphics and flow diagrams.

A formal conceptual site model for the site was first presented for the site in the EI (2014) Preliminary ESA report. The CSM includes detailed text addressing the groundwater and soil issues, and potential exposure pathways. This CSM is formulated from data included in the previous reports.

The Auditor is satisfied that an adequate understanding of the conceptual site model was present in the remediation of the site.

7.4 Audit Discussion

The potential contaminants identified are consistent with the known site history. The Auditor is satisfied that the contaminant suite identified is appropriate.

The Auditor is satisfied that soil, ground gas and groundwater have been assessed and therefore that all required media have been addressed.

8 STAGES OF SITE INVESTIGATIONS AND MILESTONES

8.1 Chronology

A summary of key stages of the investigations is presented in Table 4.

Table 4: Key Stages of the Investigation and remediation

Date	Investigation or Milestone
15 th August 2014	EI issue Preliminary Site Assessment Report
8 th November 2018	EIS issue Stage 2 Environmental Site Assessment Report
26th March 2019	Auditor appointed
April 2019	EI issue draft RAP
2nd May 2019	Auditor site inspection
3 rd May 2019	EI issue final RAP

8.2 Summary of Reports

An overview of the investigation reports provided by the consultants is provided by the Auditor below to allow a sound understanding of the assessment, remediation and validation processes undertaken at the site.

Detailed examinations of key parts of the documents are provided elsewhere in the relevant sections of this Audit Report.

8.2.1 EI (2014) Environmental Site Assessment

EI conducted the following site assessment works:

- Review of background information relating to the site, including:
 - Historical aerial photographs;
 - Historical title deed information and development application records from council;
 - Groundwater bore information;
 - Relevant government databases;
 - Published soil, geology and topographic maps.
- Inspection of the site;
- Historical industrial use of the site was documented:
 - The site was part of the Ashfield Brick Company between 1913 to 1960, then was developed and used as grocery warehouse a until 1987.
 - From 1987 to 1991 the site was an automotive air conditioning business and from 1911 to the time of reporting (2014) the site was used a tyre warehouse.
- Potential contamination sources were limited to:
 - Historical use of the site as part of the Ashfield Brick Company;
 - Historical use of the site as a workshop for motor vehicle maintenance and repair.
 - Fill material placed onsite prior to the construction of the current facility;

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- Former underground storage tank pit and former fuel pumps;
- Soil Sampling
 - 14 soil bores were installed at the site and extended to a maximum depth of 14.6m below ground level.
 - The sub-surface layers comprised of fill materials averaging 1-2m thick and consisting of various constituents including bricks and gravels, overlying residual clays overlying and weathered Ashfield shale.

Sample analysis included the following target contaminants:

- Heavy metals,
- PAH,
- TRH,
- BTEX,
- OCP/OPP,
- PCB,
- VOC's and
- Asbestos.
- Groundwater Sampling
 - Conversion of five soil bores (BH1M, BH3M, BH4M, BH7M and BH8M) to groundwater monitoring wells.
 - Groundwater was encountered at depths ranging between 31.14 and 37.7 mAHN (2.2 and 5.1 metres below ground surface) across the site.
 - Gauging and sampling of five groundwater monitoring wells. Samples were analysed for:
 - Heavy Metals
 - BTEX
 - TRH
 - PAH and VOC

The following findings were made:

- Results of soil samples collected from test bores were generally below adopted health based and ecological based soil investigation levels, with the exception of BH4, BH7 and BH8 where reported zinc concentrations exceeded adopted ecological based SILs (soil investigation levels) but not health based criteria.
- Groundwater samples collected at MW1, MW2 and MW5 reported concentrations of nickel and zinc above the adopted groundwater investigation level. MW1, MW2 and MW3 reported concentrations of cadmium above the adopted groundwater investigation level.
- Several data gaps were identified by the consultants and require closure by further investigation:
 - To adequately characterise environmental conditions of the site (in accord with NSW EPA (1995) *Contaminated Sites: Sampling Design Guidelines*), and to delineate the profile of zinc impacted soil at the southwest portion of the site, additional soil investigations shall be conducted after demolition of site structures;
 - The potential presence of explosive and/or asphyxiation hazards posed by gases generated from the adjacent landfill (now known as WH Wagener Oval)

will need to be addressed with a detailed landfill gas assessment (and possible risk assessment based on the findings of the investigation);

- Identification of sources of hydrocarbon odours and sheens noted in groundwater monitoring wells; and
- Environmental conditions in the vicinity of former USTs remain inconclusive; further assessment, including laboratory testing of field samples shall be performed.

8.2.2 EIS (2018) Stage 2 Environmental Site Assessment

Detailed site assessment was conducted by Environmental Investigation Services (EIS) in 2018, to provide intrusive site data. EIS (2018) documents the following site assessment works, as summarised by the Auditor. Note that in this summary the Auditor has presented the Consultants' conclusions and observations and not their own:

- Review of background information relating to the site, including:
 - Historical aerial photographs;
 - Historical title deed information and development application records from council;
 - Groundwater bore information;
 - Relevant government databases;
 - Published soil, geology and topographic maps.

- Inspection of the site;

The Auditor summarises the key findings of the assessment as follows:

- Historical use summary consistent with previous reporting (EIA, 2014), as reviewed separately in Interim Advice 1.
- Soil Sampling
 - 16 soil bores were installed in 2018 at the site and extended to a maximum depth of 9mbgs below ground level. combined with the fourteen (14) locations previously completed by EIA in 2014 is a total of thirty (30) sampling points.
 - The total number of locations met the minimum sampling density of twenty-five (25) recommended for hotspot identification outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)⁹. Based on the above density, the hotspot diameter with a 95% confidence level is 26m.
 - The sub-surface layers comprised of fill materials averaging 1-2m thick and consisting of various constituents including bricks and gravels, overlying residual clays overlying and weathered Ashfield shale.
 - Sample analysis included the following target contaminants:
 - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn)
 - Polycyclic Aromatic Hydrocarbons (PAH)
 - TRH (total Recoverable Hydrocarbons)
 - BTEX (benzene, toluene, ethylbenzene and xylenes)
 - Pesticides (organo-chlorine and organo-phosphate pesticides, OCP/OPP)
 - Polychlorinated Biphenyl (PCB),
 - Volatile Organic compounds (VOC's) and
 - Asbestos.

- Groundwater Sampling
 - Conversion of five soil bores (BH105, BH110, BH111, BH112, BH114 and BH116) to groundwater monitoring wells.
 - Groundwater was encountered at depths ranging between and 1.56 and 6.7 mbgs across the site.
 - Gauging and sampling of five groundwater monitoring wells. Samples were analysed for:
 - Heavy Metals
 - BTEX
 - TRH
 - PAH and VOC
- Positive identification of underground services to identify UST (underground storage tank) and infrastructure locations.
- Hazardous Ground Gas (HGG) sampling utilising the existing groundwater monitoring well network.
- Ground Gas sampling: Gauging and sampling of nine groundwater monitoring wells for HGG in the headspace. Samples were analysed for:
 - CH₄ (methane)
 - CO₂
 - O₂
 - CH₄ LEL
 - H₂S
 - CO and
 - Standing Water Level (SWL)

The following findings were made, as summarised by the Auditor:

- The soil analytical results were below the SAC adopted for the ESA. Additional waste classification
- Marginal elevations of copper, nickel and zinc were detected in the groundwater. The source of this contaminant could be associated with the leaching of metals from the fill inclusions. The report assumes that groundwater will not be used as a resource at the site.
- Considering the proximity of the former quarry to the subject site, there is potential for on-site migration of HGG through the subsurface profile. Gas movement will be influenced by a number of factors the most important of which is the method of filling and any voids in the fill.
- The study has identified hazardous ground gases at concentrations above the site assessment criteria (SAC). The maximum concentrations above the SAC for carbon dioxide (CO₂) – 12.2 %v/v. No methane was detected.
- Data gaps in the assessment were identified as
 - Long term gas data has not been obtained for the site. The monitoring rounds have not coincided with a low atmospheric pressure event (below 1000 hPa) therefore there is the potential for higher gas and flow rate measurements at this site; and
 - Additional waste classification analysis should be undertaken to assign a final waste classification to the fill material that will be excavated as part of the development.

- Recommendations from the report include
 - Undertake a Level 3 HGG risk assessment with additional HGG monitoring to meet NSW EPA guidelines
 - Prepare a Remediation Action Plan (RAP) on completion of the Level 3 risk assessment; and
 - Prepare a Validation Assessment for the remediation works undertaken at the site.

8.2.3 EI (May 2019) Remedial Action Plan

The Auditor summarises the proposed remedial works as follows:

- Ground gas monitoring will be conducted to extend confidence in the current data set. Whilst it is not anticipated that hazardous ground gas will present an issue requiring particular management as the existing data indicates no impact from the adjacent landfill, variation in atmospheric pressures can result in changes in gas behaviour and need to be covered as part of the works.
- Excavation, removal and validation of underground storage tanks.

Detailed summary of the proposed remediation is presented in Section 0 below.

8.3 Auditor Comment

The Auditor is satisfied that the works conducted were adequate to identify and delineate contaminants at the site based on the known site history to allow derivation of an appropriate remedial action plan.

Final reports satisfactorily adhered to NSW OEH (2011) reporting requirements subject to minor amendments. For detailed review see the letters of Interim Advice in Appendix B of this report, and the reporting checklists in Appendix C.

The works are discussed in detail in the remaining sections of this Site Audit Report.

9 SITE ASSESSMENT CRITERIA

The selected criteria and data evaluation methods adopted for the various investigation and validation phases of works conducted by the consultants are detailed and discussed in this section.

9.1 Assessment Criteria for Soil

Assessment criteria adopted by EI were consistent with the NEPC (2013) guidelines, based on HIL B/HSL B (residential with minimal access to soil). The Auditor notes that as a basement carpark is present beneath the building footprint, HSL D can be applied to residential settings with basement carparks (NEPC (2013) Table 1(A)4 footnote 1).

The consultants assumed a SAND soil profile in the selection of HSL values. Environmental Investigation Levels (EILs) were relied on by the consultant and were applied to the top 2m of soil as outlined in NEPM (2013).

The Auditor does not consider EIL exceedances, if and where present at the site, to be drivers of remediation because the landscaped area will be managed and maintained to a degree sufficient to mitigate the effects of any detected impact above EIL concentrations.

The relevant criteria have been reproduced in Table 5 below, as summarised by the Auditor.

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Table 5: Assessment Criteria for Soil (mg/kg)

Contaminant	Criteria			LOR*	
	Human Health (HIL B)		Ecological (EIL)		
METALS					
Arsenic	500		n/a	3	
Cadmium	150		n/a	0.3	
Chromium (VI)	500		13	0.3	
Copper	30,000		28	0.5	
Lead	1,200		163	1	
Nickel	1,200		5	0.5	
Mercury	120		n/a	0.01	
Zinc	60,000		122	0.5	
PAH					
BaP TEQ	4		n/a	0.3	
Total PAH	400		n/a	0.8	
OCP/OPP					
multiple compounds	10 – 6,600		n/a	0.1 – 0.5 per compound	
PCB					
Total PCB	1		n/a	1	
SOIL HSLs FOR VAPOUR INTRUSION, HSL-D (SAND)					
TRH and BTEXN	0-<1m	1m-<2m	2m-<4m	EIL	
TRH F1+	260	370	630	180	25
TRH F2+	NL	NL	NL	120	50
Benzene	3	3	3	50	0.2
Toluene	NL	NL	NL	85	0.5
Ethylbenzene	NL	NL	NL	70	1
Total Xylenes	230	NL	NL	105	1
Naphthalene"	NL	NL	NL	170	1
ASBESTOS					
All forms of asbestos	None visible in surface soil (0.0 – 0.1m) and no asbestos fibres in soil			visual	

* LOR achieved in validation works. LOR values exceeding criteria are highlighted in red.

** Naphthalene is included in the HSLs as a potentially volatile contaminant.

+ The Management Limit for TRH F2 in coarse grained soils at residential and commercial sites is 1,000 mg/kg. For TRH F1, the management limit is 700 mg/kg. These values are both greater than their respective HSL counterparts.

The Auditor is satisfied that the assessment criteria adopted for site soil validation were appropriate to the site history at the time of assessment. The Auditor's opinion on site suitability is based on currently applicable guidelines.

9.2 Assessment Criteria for Groundwater

The NEPC (2013) criteria were used during the investigation and collate the relevant HSLs, ANZECC (2000) (now ANZG 2018) and NHMRC Australian Drinking Water Guidelines as groundwater investigation levels.

Health Screening Levels (HSLs) are not relevant as the groundwater depths were recorded at depths of less than 2m and the proposed 1 level basement will intersect the groundwater table. To assess the risk to site occupants from volatile contaminants, EI have used alternative Tier 1 criteria which are based on drinking water guidelines including:

- Australian Drinking Water Guidelines (2011) for BTEX compounds and selected VOCs;
- World Health Organisation (WHO) document titled Petroleum Products in Drinking-water, Background document for the development of WHO Guidelines for Drinking Water Quality (2008) for petroleum hydrocarbons;
- USEPA Region 9 screening levels for naphthalene (threshold value for tap water); and
- The use of the laboratory PQLs for other contaminants where there were no Australian guidelines.

The relevant criteria have been reproduced in Table 6, as summarised by the Auditor. Whilst the full list is comprehensive, only compounds identified as potential contaminants of concern in the assessment in the investigation are listed here.

Table 6: Assessment Criteria for Groundwater (µg/L)

Contaminant	NHMRC ADWG 2011	WHO 2008	USEPA RSL Tap water 2017	GIL*	LOR**
METALS					
Arsenic	-	-	-	24	1
Cadmium	-	-	-	0.2	0.1
Chromium (VI)	-	-	-	3.3	1
Copper	-	-	-	1.4	1
Lead	-	-	-	3.4	1
Nickel	-	-	-	7	1
Mercury	-	-	-	0.06	0.05
Zinc	-	-	-	8	1
PAH*					
Naphthalene	NL	-	6.1	16	0.2
Benzo[a]pyrene	-	-	-	0.1	0.1
TRH and BTEXN					
TRH F1	-	15,000	-	-	10
TRH F2	-	100	-	-	50
Benzene	1	-	-	950	1
Toluene	800	-	-	180	1
Ethylbenzene	300	-	-	80	1
Xylene	600	-	-	350 o-xylene 70 m+p-xylene	2
VOCs					
Vinyl Chloride	0.3	-	-	100	10
1,1-Dichloroethene	30	-	-	700	1
Chloroform	250	-	-	370	1
Bromodichloromethane	250	-	-	-	1
1,2-dichloroethane	3	-	-	1,900	1
Chlorobenzene	300	-	-	55	1
1,3-dichlorobenzene	300	-	-	-	1
1,4-dichlorobenzene	40	-	-	60	1
1,2-dichlorobenzene	1500	-	-	160	1

* NEPC (2013) GIL for marine water, based on ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, Canberra, as referenced in NEPC (2013). Selected for protection of 95% of marine water species.

**LOR achieved in assessment report. LOR values exceeding criteria are highlighted in red.

The Auditor does not consider the USEPA RSL quoted by the consultants to be a relevant criteria without detailed discussion of the applicability of acceptable risk

levels and differences in exposure pathways between Australian and US usage patterns. For the purposes of the Audit, the Auditor has not relied on this criteria.

The Auditor is satisfied that the assessment criteria adopted for site groundwater validation were appropriate to the site history and ongoing high density residential site use. Note that the HSL values can not be relied on where groundwater is within 2 m of the design level and therefore an increased potential for vapour transport to the site structures is present where volatile contaminants occur in that situation.

9.3 Assessment Criteria for Hazardous Ground Gas

Contaminated soil vapour was not assessed at the site so soil vapour criteria are not presented here.

Ground gasses were assessed against the criteria presented in NSW EPA (2012) *Contaminated Sites: Guidelines for the Assessment and Management of Sites impacted by Hazardous Ground Gases*. These guidelines are focussed on impacts from degradation of organic matter, with a particular focus on impacts from landfill sites. These guidelines address the concerns related to potential gas migration from the former landfill adjacent to the site.

The approach adopted in these guidelines is that carbon dioxide (CO₂) and methane (CH₄) are measured in ground gas as both a concentration and a flow rate. The concentration and flow are combined to provide a Gas Screening Value (GSV):

$$GSV = \text{Flow Rate (L/hr)} \times \text{Concentration (\%)}$$

GSV are grouped in the guidance to provide a Characteristic Gas Situation (CS) ranging from 1 to 6. CS values of 1 and 2 are considered *Very Low Risk* and *Low Risk* respectively, and are typical of natural soils and filled areas. Higher values are indicative of *Moderate Risk* to *Very High Risk* and are indicative of putrescible waste landfill and flooded mine workings.

The guidelines provide protection requirements for buildings based on the CS value for a site. The Auditor notes that for CS 1 no protective measures are required, and for CS 2 three points of protection are required. The recommended protective measures in the guidance include basement car parks which provide four points of protection.

Eiaustralia have presented these criteria in the RAP.

9.4 Data Evaluation

The consultants adopted a direct comparison approach to use of the guidelines. Statistical analysis was not relied upon.

9.5 Audit Discussion

9.5.1 Appropriateness of Criteria

The Auditor is satisfied that the criteria adopted for soil, ground gas and groundwater are appropriate to the proposed site use.

9.5.2 Criteria and PQLs

The laboratory limits of reporting were generally below the adopted site assessment criteria and the Auditor is satisfied that sufficiently sensitive assessment was conducted.

The limit of reporting for benzo[a]pyrene in groundwater was an order of magnitude higher than the drinking water criteria. Whilst benzo[a]pyrene was not reported in the groundwater at the site, the potential remains for concentrations above the drinking water criteria (0.01 µg/L) but below the laboratory limit of reporting (0.1 µg/L) to exist

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at the site. Should groundwater from the site be intended to be used for potable purposes, analysis of the water for all relevant compounds should be conducted at a suitable sensitivity prior to use.

10 SUMMARY OF INVESTIGATION RESULTS

This section provides an overview of the sampling results obtained from the environmental investigations conducted at the site.

Figure 3, Appendix A shows the sampling locations.

10.1 Soil

A summary of the primary soil sample results from the EI (2014) and EI (2018) site investigation are reproduced by the Auditor in Table 7 below. The Auditor has summarised all relevant data from the assessment report irrespective of geological strata with the intent of identifying those contaminants which were identified at the site as requiring remediation.

Concentrations exceeding human health criteria are highlighted in **red**. Concentrations below human health criteria but exceeding environmental investigation levels are highlighted in **green**.

Resolution by strata, where required, is discussed in Section 10.5 below.

The Auditor has not referred to statistical analysis of the data as the diverse sources of the data mean that the data sets are not sufficiently consistent to make statistical summary of the data unreliable.

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Table 7: Summary Soil Results – Site Assessment (mg/kg)

Contaminant	Criteria		LOR*	No Samples	Min	Max	Acceptable
	Human Health (HIL B)	Ecologic al (EIL)					
METALS							
Arsenic	500	n/a	4	19	<4	13	YES
Cadmium	150	n/a	0.4	19	<0.4	0.6	YES
Chromium	500	13	1	19	2	66	NO
Copper	30,000	28	1	19	2	56	NO
Lead	1,200	163	1	29	2	54	YES
Nickel	1,200	5	1	19	<1	50	NO
Mercury	120	n/a	0.1	19	<0.1	<0.1	YES
Zinc	60,000	122	1	19	2	210	NO
PAH							
BaP TEQ	4	n/a	0.5	29	<0.5	<0.5	YES
Total PAH	400	n/a	0.8	29	<0.8	5.5	YES
OCP/OPP							
multiple compounds	10 – 6,600	n/a	0.1 – 0.5	9	<LOR	<LOR	YES
PCB							
Total PCB	1	n/a	0.1	9	<0.1	<0.1	YES
	SOIL HEALTH SCREENING LEVELS FOR VAPOUR INTRUSION HSL-A/B (SAND)						
TRH and BTEX	0-<1m	EIL					
TRH F1*	260	180	25	29	<25	<25	YES
TRH F2*	NL	120	50	29	<50	<50	YES
TRH F3	2,500	300	90	29	<90	<90	YES
TRH F4	10,000	2800	120	29	<120	<120	YES
Benzene	3	50	0.2	29	<0.2	<0.2	YES
Toluene	NL	85	0.5	29	<0.5	<0.5	YES
Ethylbenzene	NL	70	1	29	<1	<1	YES
Total Xylenes	230	105	1	29	<1	<1	YES
Naphthalene	NL	170	1	29	<1	<1	YES
ASBESTOS							
Bonded ACM	0.04 %w/w		0.01	-	-	-	-
FA and AF	0.001 % w/w		0.01	-	-	-	-
All forms of asbestos	None visible in surface soil (0.0 – 0.1m) and no asbestos fibres in soil		n/a	15	not detected	not detected	YES

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* LOR achieved in EIS (2018) DSI. Values exceeding health based criteria are highlighted in **red**, those exceeding ecological but not health based criteria are highlighted in **green**.

** Naphthalene is included in the HSLs as a potentially volatile contaminant.

+ The Management Limit for TRH F2 in coarse and fine grained soils at residential and commercial sites is 1,000 mg/kg. For TRH F1, the management limit is 700 mg/kg (fine) and 800 mg/kg (coarse), which are respectively greater than the HSL values.

Soil samples were assessed for asbestos fibres but were not sampled using a method allowing comparison to NEPC (2013) acceptability limits for asbestos in soil. Although there has been no indication that asbestos is present, it will need to be considered as a potential contaminant in fill at the time of excavation.

10.2 Groundwater

Results of the groundwater sampling are summarised by the Auditor in Table 8 below.

Table 8: Assessment Criteria for Groundwater (µg/L)

Contaminant	NHMRC ADWG 2011	WHO 2008	GIL*	LOR**	No Samples	Min	Max	Acceptable?
METALS								
Arsenic	-	-	24	1	4	<1	1	YES
Cadmium	-	-	0.2	0.1	4	<0.1	<0.1	YES
Chromium (VI)	-	-	3.3	1	4	<1	<1	YES
Copper	-	-	1.4	1	4	<1	20	NO
Lead	-	-	3.4	1	4	<1	<1	YES
Nickel	-	-	7	1	4	1	47	NO
Mercury	-	-	0.06	0.05	4	<0.05	<0.05	YES
Zinc	-	-	8	1	4	15	250	NO
PAH*								
Naphthalene	NL	-	16	0.2	4	<0.2	<0.2	YES
Benzo[a]pyrene	-	-	0.1	0.1	4	<0.1	<0.1	YES
TRH and BTEXN								
TRH F1	-	15,000	-	10	4	<10	<10	YES
TRH F2	-	100	-	50	4	<50	<50	YES
Benzene	1	-	950	1	4	<1	<1	YES
Toluene	800	-	180	1	4	<1	<1	YES
Ethylbenzene	300	-	80	1	4	<1	<1	YES
Xylene	600	-	350 o-xylene 70 m+p-xylene	2	4	<2	<2	YES
VOCs								
Vinyl Chloride	0.3	-	100	10	4	<10	<10	NO
1,1-Dichloroethene	30	-	700	1	4	<1	<1	YES
Chloroform	250	-	370	1	4	<1	<1	YES
Bromodichloromethane	250	-	-	1	4	<1	<1	YES
1,2-dichloroethane	3	-	1,900	1	4	<1	<1	YES
Chlorobenzene	300	-	55	1	4	<1	<1	YES
1,3-dichlorobenzene	300	-	-	1	4	<1	<1	YES
1,4-dichlorobenzene	40	-	60	1	4	<1	<1	YES
1,2-dichlorobenzene	1500	-	160	1	4	<1	<1	YES

* NEPC (2013) GIL for marine water, based on ANZECC & ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand gEnvironment and Conservation Council and Agriculture and Resource Management Council of

Australia and New Zealand, Paper No 4, Canberra, as referenced in NEPC (2013). Selected for protection of 95% of marine water species.

**LOR achieved in initial assessment. LOR values exceeding human health criteria are highlighted in red. LOR values exceeding ecological criteria are highlighted in green.

The Auditor notes that the limit of reporting was above the screening criteria for vinyl chloride. Accordingly, dissolved vinyl chloride may be present in groundwater at concentrations above the screening criteria but below the laboratory limit of reporting. The Auditor notes that this is extremely unlikely as vinyl chloride is a degradation product of chlorinated solvents (tri- and per-chloroethene) and neither these compounds, nor dichloroethene were reported as being present, or used, at the site.

Ammonia and methane were analysed in groundwater. Ammonia was reported in all four wells at concentrations of 32 – 130 mg/L, with the highest in MW1 and MW105, close to the former UST locations. No methane was reported in groundwater. The Auditor suspects the ammonia is related to the local geology, or site activity, and is unrelated to the adjacent former landfill. There is a steep hydraulic gradient from the site to the landfill which would make migration of ammonia in leachate unlikely, and the absence of dissolved methane is inconsistent with a landfill signature.

10.3 Hazardous Ground Gas

Ground gas was assessed for landfill gas impact by EIS in nine wells across the site on three occasions (see Section 8.2.2). The following findings were made, as summarised by the Auditor:

- No methane concentration greater than 0.1 % v/v was detected, giving maximum methane characteristic situation of 1, indicating no measurable landfill impact.
- Carbon dioxide, which can provide an asphyxiation risk if it collects in enclosed spaces, was present in all wells with a characteristic situation of 2, indicating very low to low risk.

EIS made no interpretation of the ground gas data and recommended further assessment and risk review.

The Auditor notes the following in relation to this data:

- There is no indication from the data that the site is affected by the adjacent landfill because there was no detection of methane.
- Degradation of organic matter will result in the generation of carbon dioxide. It is feasible that there is generation from organic matter within the shale.
- Protective measures to address the carbon dioxide would be limited to the installation of a ventilated carpark basement (4 points of protection) to meet the required three points for residential or commercial use.
- The Auditor does not consider this data to be definitive because:
 - It is accompanied by high oxygen concentrations (18 – 20 ppm) consistent with short circuiting from atmosphere (21 ppm) and inconsistent with the consumption of oxygen during the degradation of organic matter.
 - Monitoring was conducted in groundwater wells not designed for gas sampling and not screened in zones representative of exposure pathways to users of the site.
 - Sampling of well headspace can produce result biased by off-gassing from the groundwater system on exposure to atmospheric conditions. This can also result in increased carbon dioxide concentrations relative to dedicated soil gas measurements.

The Auditor is satisfied that the ground gas measurements demonstrate an absence of impact from the adjacent landfill, but further monitoring is required to confirm the results. The RAP (see Section 0 below) includes a suitable ground gas monitoring programme.

10.4 Quality Assurance/Quality Control

This section of the SAR discusses both QA/QC sampling in the assessment stage as well as the adequacy of the sampling methods and sampling densities adopted and other similar aspects of the site assessment requiring appropriate documentation.

Field quality control sampling was conducted in both the groundwater and soil assessments and is discussed below.

10.4.1 Field QC – Soil and Groundwater

EIS (2018) included the following quality control sampling for field data for 29 primary soil and four primary groundwater samples collected:

- Soil (QC samples analysed for TRH, BTEX and metals only, with OCP/OPP and PCB also analysed in duplicate pair DUPAM6/BH106 0.17-0.3m)
 - Four duplicate (intra-laboratory duplicate) samples
 - DUPAM2/BH111 0.21-0.35
 - DUPAM4/BH105 0.14-0.2
 - DUPAM5/BH108 0.16-0.3
 - DUPAM6/BH106 0.17-0.3
 - **No triplicate (intra-laboratory duplicate) samples**
 - Two trip blank samples with acceptable results.
 - One rinsate blank with acceptable results.
 - Two trip spike with acceptable results.
- Groundwater
 - One duplicate (intra-laboratory duplicate) sample pair DUPWAM1/MW5 analysed for TRH, BTEX, metals, PAH, VOC, methane.
 - Raised RPD for nickel and zinc
 - One triplicate (inter-laboratory duplicate) sample pair DUPWAM2/MW1 analysed for TRH, metals, PAH, only.
 - Raised RPD for nickel and zinc
 - One trip blank sample with acceptable results.
 - One trip spike with acceptable results.

The Auditor notes that multiple raised RPD values were reported due to low (within ten times laboratory limit of reporting) concentrations in either the primary or duplicate sample for both soil and groundwater. These results are considered acceptable. The Raised RPD values noted by the Auditor above suggest some variability in site soils, and that nickel and zinc both occur naturally in the shale. This variation should be considered when evaluating site data, but it is noted that results for these compounds in soil did not exceed health based criteria. The Auditor is satisfied that the metals identified in groundwater at concentrations above the EILs are naturally occurring and not indicative of site contamination.

Hazardous ground gas was measured directly using a landfill gas meter so field QC samples were not required. Calibration certificates were included in the report, confirming that the equipment was appropriately calibrated.

The Auditor is satisfied that the field data is of adequate quality to identify the presence and nature of contamination at the site.

10.4.2 Laboratory QC

The Auditor has reviewed the following laboratory reports included in EI (2016). QC issues identified are noted beneath each report identification. Acceptable data quality is to be assumed where no issues are listed.

- Envirolab 200540 Primary Soil
 - Minor RPD issues with laboratory duplicates due to sample heterogeneity.
- Envirolab 200540-A Primary Soil TCLP
 - pH was analysed outside holding time and may not be reliable..
- Envirolab 201070 Primary Water
 - Sample turbidity could not be measured in two samples due to high sediment load
- Envirolab 14901 Secondary Water
 - Acceptable QC

The Auditor is satisfied that the laboratory QC is acceptable for site assessment purposes and that the QC non-compliances identified by the laboratory are typical of urban fill soils which are heterogenous.

It is noted that high sediment load in groundwater samples can result in increased colloidal material being entrained in the analysis, providing artificially high measurements of dissolved metals. This may be a contributing factor in the raised metals concentrations reported in groundwater samples from the site.

The Auditor notes that the water triplicate sample was conducted in a second laboratory operated by the same company as the primary laboratory. This is acceptable as differences in results due to variation in calibration, equipment and local methodologies are accounted for.

10.4.3 General Requirements

Table 9 and Table 10 below provide summaries of general requirements and field methods adopted in the assessment of the site. The Auditor's discussion is presented in Section 10.5 below.

Table 9: Summary of General Reporting Requirements

General Reporting Requirement	EIS (2018)	Auditor Comment
Figures showing sample locations	✓	Acceptable
Sampling density appropriate – soil	✓	Acceptable – approximate grid of 30 locations for an area of 1.5 ha (25 required by NSW EPA 1995).
Sampling locations adequate – groundwater and vapour	Nine groundwater wells, five sampled in current assessment.	Acceptable
Borehole logs recording sample locations	✓	Acceptable
Laboratory reports and discussion of rationale	✓	Acceptable
Presentation of results	Tabulated and figures	Acceptable
Identification of fill and natural materials	Discussion and bore logs	Acceptable
Groundwater and vapour well construction	✓	Groundwater wells used to sample ground gas. Not ideal but acceptable for screening measurements – see Section 10.3 above

Table 10: Summary of Field Methods and QA/QC

Field Methods and QA/QC	EIS (2018)	Auditor Comment
Method of Soil Sampling	Solid flight auger plus SPT	Acceptable. Push tube is preferable but may not be suitable in fill soils due to obstruction by solid matter
Decontamination between Samples	✓	Acceptable
Use of PID	✓	Acceptable
Use of laboratory prepared/preserved containers as required	✓	Acceptable
Unique sample identification	✓	Acceptable
Storing of samples in eskies	✓	Acceptable
Chain of custody documentation	✓	Acceptable
Details of well construction provided	✓	Acceptable
Purging of wells appropriately prior to sampling	✓	Acceptable
Groundwater and soil vapour sampling method	✓	Acceptable – see discussion in Section 10.5 below

10.5 Audit Discussion on Contamination Status

10.5.1 Soil

The Auditor is satisfied that the soil sampling was adequate to identify the presence of unacceptable concentrations of contaminants in the fill material. Historical site assessment has resulted in sound understanding of the site geological profile. Sampling has been conducted in a grid-based manner, biased by site access restrictions, with the sampling locations targeted to appropriate locations.

10.5.1.1 Asbestos

Asbestos fibres were not identified in site soils and ACM was not observed in samples. Assessment was not conducted to current NEPC (2013) reporting limits and quantified asbestos concentrations were not available.

The Auditor notes that sampling using augers may not recover ACM fragments, which can be pushed aside during the drilling process and it remains possible that ACM fragments are present at the site, although they do not appear to be wide spread. This should be considered during future site works.

10.5.2 Groundwater and Surface Water

Surface water was not relevant to the site assessment and was not assessed.

Groundwater assessment was conducted at four targeted locations. The monitoring network is adequate to delineate the groundwater flow direction and impact on site.

10.5.3 Ground Gas

Soil vapour contaminant impacts were not assessed as no source for such impacts was suspected or identified at the site. The Auditor is satisfied that this is appropriate.

Potential landfill gas impact was assessed through three rounds of landfill gas sampling at the site using the existing groundwater monitoring network. This revealed no indication of methane impact from the landfill, and some location with a carbon dioxide source apparently unrelated to the landfill. The maximum CS value was 2, based on the carbon dioxide measurement. The Auditor notes that there are deficiencies in the method used to sample the ground gas at the site, but is confident that the results do not indicate impact from the adjacent landfill.

The Auditor is satisfied that the sampling was conducted appropriately, but notes that the single round of sampling was not able to account for potential variation in ground gas conditions over time. Additional validation sampling in this regard is included in the RAP (see Section 0 below).

11 ASSESSMENT OF RISK

Assessment of risk through comparison to guideline criteria (tier 1 risk assessment) resulted in the identification of potential risks to site occupants from asbestos in soil. No site specific risk assessment was conducted.

The risk was managed by the development and implementation of a remedial action plan (RAP). Uncertainty in the ground gas measurements was identified due to the need to include measurement over variable climatic conditions, and this uncertainty is addressed in the RAP.

12 REMEDIAL ACTION PLAN

12.1 Summary of proposed remediation

The Auditor summarises the proposed remedial works as follows:

- Ground gas monitoring will be conducted to extend confidence in the current data set. Whilst it is not anticipated that hazardous ground gas will present an issue requiring particular management as the existing data indicates no impact from the adjacent landfill, variation in atmospheric pressures can result in changes in gas behaviour and need to be covered as part of the works.
 - Sampling to be conducted in the nine existing monitoring wells, allowing the data set to build from the EIS data.
 - It is understood that continuous monitoring would be conducted to ensure that site conditions are captured under a range of atmospheric conditions including a drop in pressure in the order of 2.5-3.5 hPa/hour over three hours. At times when atmospheric pressure drops, residual pressure in the ground gas can result in increased migration and represents the typical worst case conditions for the site.
 - A contingency measure to provide additional building protection is included in the RAP if the ground gas validation identifies a ground gas CS of four or above. Lower ground gas CS values will be adequately protected by the ventilated basement carpark.
- Removal of any remaining tanks, fuel infrastructure and soils with unacceptable residual impact in the former UST area in the north of the site.
- Excavated soils will be classified for off-site waste disposal prior to leaving site.

12.2 Validation Sampling

El propose the following validation works for the site, as summarised by the Auditor:

- Validation sampling of the former UST area at
 - one sample per ten lineal meters of excavation wall, with a minimum of one per wall.
 - Sampling from the excavation base on a 7.5m grid with a minimum of one sample.
 - Analysis for TRH, BTEX, PAH, VOC and lead.
- Any material imported to site as part of the remedial works is to be validated by analysis of one sample per 100m³ for TRH, BTEX, PAH, heavy metals, PFAS, pesticides, PCB and asbestos.

12.3 Guideline Compliance

The Auditor reviewed the draft RAP against NSW EPA reporting requirements and identified several minor non-compliances. The Auditor has reviewed the final RAP and is satisfied that it adequately meets NSW EPA reporting requirements. See Interim Advice 6, in Appendix B, for the Auditor's initial comments.

12.4 Audit Discussion on Remedial Action Plan

The Auditor's review of the draft RAP identified several technical points requiring clarification. The Auditor has reviewed the final RAP and is satisfied that it adequately

Contaminated Site Audit

addresses the Auditor's concerns. See Interim Advice 6, in Appendix B, for the Auditor's initial comments.

The Auditor is satisfied that the RAP presents a reasonable method to treat identified impacts at the site and, when implemented by a suitable experienced and qualified consultancy, will render the site suitable for the proposed development.

13 REMEDIATION AND VALIDATION

The Auditor notes that remediation has not yet been conducted and no validation report has been prepared.

14 POTENTIAL FOR OFF-SITE MIGRATION

As the site will be fully sealed apart from a managed landscaped area along the southern site boundary there is no realistic mechanism for migration of contaminated dusts from the site.

No contamination was identified in groundwater and there is therefore no identified potential for off-site migration in groundwater.

Soil impact was limited to asbestos, which is not mobile in the subsurface and will be removed from the site under appropriate management to prevent dust generation.

The Auditor is therefore satisfied that there is no appreciable potential for off-site migration of contamination from the site.

15 LONG TERM MANAGEMENT

Long term management is not anticipated to be required for the site based on the available data.

16 REGULATORY REQUIREMENTS

The following regulatory aspects are considered to relate to the investigations, remediation and validation works conducted at the site.

16.1 Protection of the Environment Operations Act, 1997

Activities governed by the Protection of the Environment Operations Act 1997 (PoEO Act 1997) and associated regulations include waste disposal.

Requirements for waste soil to be disposed from site in accordance with the PoEO Act 1997 and associated regulations are included in the RAP.

16.2 Duty to Report under Contaminated Land Management Act 1997

Under Section 60 of the CLM Act 1997, and in accordance with NSW EPA (2015) Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, the owner of a site is obligated to report that site to NSW EPA where:

the level of the contaminant in, or on, soil is equal to or above a level of contamination set out in Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 2013) or other approved guideline value with respect to a current or approved use of the land, and people have been, or foreseeably will be, exposed to the contaminant

OR

the contamination meets a criterion prescribed by the regulations

OR

the contaminant or a by-product has entered, or will foreseeably enter, neighbouring land, the atmosphere, groundwater or surface water, and is above, or will foreseeably be above, a level of contamination set out in National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 2013) or other approved guidelines and will foreseeably continue to remain equal to or above that level.

The Auditor notes that no contamination was identified in soil at the site, and the first clause is not triggered.

There are currently no criteria prescribed by the regulations, so the second clause is not triggered.

Groundwater quality includes naturally occurring metals but no evidence of contamination from the site. Ground gas presents no indication of impact from the adjacent site. Accordingly the third clause is not triggered.

The Auditor is satisfied that there is no duty to report contamination at the site.

16.3 Site Specific Requirements

The Audit is understood to be required to satisfy planning requirements, although no formal application has been presented and requirements from council have only been presented in email. Council's requirements are presented here in Table 11 below, where it is demonstrated that they have been addressed

Table 11: Site Specific Audit Requirements

Requirement	Met?	Auditor Comment
The EPA advice recommended that Council require under conditions of consent, that a NSW EPA accredited site auditor be engaged in order to review and endorse the proposed additional contaminated site and hazardous ground gas assessments and the proposed remedial action plan, and to issue a 'Section B' Site Audit Statement and Report to indicate suitability of the site for the proposed use, subject to a specific remedial action plan.	✓	Site Audit Statement TNC118 addresses this condition.
Both the auditor and proponent must also consider the duty to notify the site to the EPA under Section 60 of the CLM Act.	✓	See Section 16.2
Council does not have the in-house expertise to review the issues raised in the Phase 2 report, and prepare a site audit statement. While there is no statutory mechanism to require engagement of a site auditor as a condition of consent as suggested by the EPA, we however will require that you engage a site auditor and meet the other requirements outlined above before the Planning Proposal may be further progressed. This is to ensure Council can be satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for all the purposes permitted in the zone as required by SEPP 55. The engagement of a site auditor and Site Audit Statement and Report is necessary for Council to be satisfied of this or provide a clear decision otherwise depending on the auditor's outcomes.	✓	Site Audit Statement TNC118 addresses this condition.
Council also requires that the site auditor contact Council after engagement to discuss issues that may arise from the adjacent former land fill site.	✓	Correspondence demonstrating this is included in Appendix B. Initial contact by email with Allan Shooter, and subsequent phone discussion with Jeff Senior.

16.4 Guidelines made by the NSW EPA

EPA (1995a) *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-acre Agricultural Land*. NSW EPA, Sydney;

EPA (1995b) *Contaminated Sites: Sampling Design Guidelines*. NSW EPA, Sydney;

EPA (1997a) *Contaminated Sites: Guidelines for Assessing Banana Plantation Sites*. NSW EPA, Sydney;

DEC (2005) *Contaminated Sites: Guidelines for Assessing Former Orchards and Market Gardens*. DEC, Sydney;

DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination*. NSW EPA, Sydney

OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. NSW EPA, Sydney;

EPA (2012) *Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*, NSW EPA Sydney.

NSW EPA (2014) *Waste Classification Guidelines*. NSW DECC, NSW EPA Sydney

NSW EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. NSW EPA Sydney.

NSW EPA (2017) *Contaminated Site Management: Guidelines for the NSW Site Auditor Scheme – 3rd Edition*. NSW EPA, Sydney;

16.5 Guidelines approved by the EPA

ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Paper No 4, Canberra;

ANZECC/NHMRC (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*. Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council, Canberra;

ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

Department of Health and Ageing and EnHealth Council (2002) *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards*. Commonwealth of Australia, Canberra;

Lock, W. H., (1996) *Composite Sampling*, National Environmental Health Forum Monographs, Soil Series No. 3, National Environmental Health Forum, SA Health Commission, Adelaide;

NEPC (1999) *National Environment Protection (Assessment of Site Contamination) Measure, Schedule A and Schedules B(1)-B(10)*. National Environment Protection Council, Adelaide;

NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Amendment Measure No 1, Schedule A and Schedules B(1)-B(9)*. National Environment Protection Council, Adelaide;

NHMRC, NRMCC (2011) *Australian Drinking Water Guidelines* Paper 6 National Water Quality Management Strategy; and

NSW Agricultural/CMPS&F (1996) *Guidelines for the Assessment and Clean Up of Cattle Tick Dip Sites for Residential Purposes*, NSW Agricultural and CMPS&F Environmental, Canberra.

16.6 Guidelines from International Sources

International guidelines were used by the consultants as screening criteria but were not relied on by the Auditor in forming his opinion of the site due to the site-specific risk assessment conducted at the site.

16.7 NSW EPA (2017) Appendix A: Decision-making process for assessing urban redevelopment sites

The site is to be used as a residential development. As such, the decision making process for assessing this site is described in Appendix A, NSW EPA (2017) as follows:

1. all site assessment, remediation and validation reports follow applicable guidelines
2. any aesthetic issues relating to site soils have been adequately addressed

3. soils have been assessed against relevant health-based investigation levels and potential for migration of contamination from soils to groundwater has been considered
4. groundwater (where relevant) has been assessed against relevant health-based investigation levels and, if required, any potential impacts to buildings and structures from the presence of contaminants considered
5. hazardous ground gases (where relevant) have been assessed against relevant health-based investigation levels and screening values the site management strategy is appropriate
6. any issues relating to local area background soil concentrations that exceed relevant investigation levels have been adequately addressed in the site assessment report(s)
7. the impacts of chemical mixtures have been assessed
8. any potential ecological risks have been assessed
9. any evidence of, or potential for, migration of contaminants from the site has been appropriately addressed, including potential risks to off-site receptors, and reported to the site owner or occupier
10. the site management strategy (where relevant) is appropriate including post-remediation environmental plans.

These points are discussed below. Where relevant, reference is also made to other sections of this document.

16.7.1 OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites

The investigation and validation reports compiled for the site generally comply with the guideline requirements (see Appendix C). Where non-compliance has been noted, the Auditor's review has indicated that the non-compliances do not materially affect the required technical approach or conclusions able to be drawn from the reports and as such are considered acceptable.

The Auditor's review of these reports is presented throughout this document and in particular, in Sections 8.2, 10, and 11 above, and in Appendix C.

16.7.2 Aesthetic Issues

No aesthetic issues were identified during the site assessment works. The Auditor notes that disturbance of soils containing residual hydrocarbon impact, such as where USTs had been removed, may release odours on a temporary basis. It is anticipated that odorous soils would be removed if encountered.

16.7.3 Soil Investigation Levels

Appropriate investigation levels were adopted for the site. See Section 9 of this report for detailed discussion.

16.7.4 Groundwater Investigation Levels

Appropriate investigation levels were adopted for the site. See Section 9 of this report for detailed discussion.

16.7.5 Hazardous Ground Gas (including contaminated soil vapour)

Appropriate investigation levels were adopted for the site. See Section 9 of this report for detailed discussion.

16.7.6 Background Soil Concentrations

Contamination within the site was adequately delineated without the need to reference background concentrations. The Auditor is satisfied that background soil concentrations are not required to be considered in this case.

16.7.7 Assessment of Chemical Mixtures

Chemical mixtures were not assessed as part of the investigations.

The suspected contaminant compounds do not degrade to more toxic products and have no known synergistic toxicity effects with each other. It is noted that no chemical contamination was identified.

Accordingly, the Auditor is satisfied that assessment of chemical mixtures would not have a bearing on the results of the remediation or validation work and that in this case the absence of assessment of mixtures is acceptable.

16.7.8 Ecological Risks

Ecological investigation levels for soil were marginally exceeded in fill soils at one location. The Auditor is satisfied that this is a minor issue, is unlikely to have any noticeable impact on site redevelopment, and will not require direct remediation.

Groundwater impact exceeded ecological screening levels but is consistent with the local groundwater quality.

16.7.9 Migration of Contaminants

The migration of contaminants is discussed in Section 14 above.

16.7.10 Site Management Strategy

The long term management of the site is discussed in Section 0 above.

16.8 Audit Discussion

The Auditor is satisfied that the assessment and remedial action plan have adequately complied with the appropriate guidelines and are consistent with current industry standards. Some non-compliance with individual guideline recommendations was identified, but these were considered by the Auditor to be either minor and not to materially affect the conclusions able to be drawn from the reports, or to have been adequately addressed in revised versions of reports.

The Auditor is satisfied that other regulatory requirements and EPA guidelines have been adequately met.

17 ADEQUACY OF CONSULTANTS' WORK

17.1 Eiaustralia (EI)

EI conducted work consistent with industry standard at the time the works were conducted. Only minor non-compliance with reporting requirements was identified, and the non-compliance was not material to the technical aspects of the reports.

17.2 Environmental Investigation Services (EIS)

The EIS reports were generally of a good standard and commensurate with industry practice at the time the works were conducted.

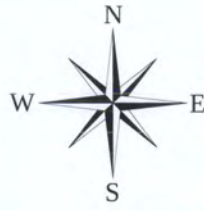
18 AUDIT CONCLUSIONS

Site assessment identified the presence of USTs in the northern part of the site. Ground gas assessment did not indicate impact from the adjacent landfill but requires additional confirmatory sampling to ensure that an adequate range of atmospheric conditions are incorporated in the results.

The Auditor has reviewed the remedial action plan (EI (May 2019) *Remediation Action Plan, 165 Milton Street, Ashbury, NSW*. Reference E24185.E06_Rev0) and is satisfied that it meets NSW EPA reporting requirements, and presents a suitable method to remediate and validate the site for ongoing high density residential or mixed commercial/residential use.

Appendix A

Figures



Maps sourced from the NSW
Department of Finance and
Services Spatial Information
eXchange
(maps.six.nsw.gov.au) on
06/05/2019.

Aerial photography from
June 2018

SITE





UST area and electrical substation area marked based on Auditor's site observations and consultant's reports, particularly EI, May 2019.



Appendix B

Letters of Interim Advice and Supporting Documentation

Ashbury Developments
C/- Mr Aras Labutis
Coronation
Level 2 66 Wentworth Ave
Surry Hills NSW 2010

Arcadis Australia Pacific Pty Ltd
Level 16, 580 George Street
Sydney NSW 2000
Tel No: +61 2 8907 9000
www.arcadis.com/au

5/04/2019

165 Milton Street, Ashbury, Interim Advice 1 - Review of Phase 1 Environmental Audit

This letter is provided as Interim Advice and does not constitute a Site Audit Report or Site Audit Statement. This letter does not pre-empt the findings of the site Audit. A Site Audit Statement and Site Audit Report will be issued at the completion of the Audit.

Where required for clarity, the Auditor's opinion in this letter is enclosed in a box to separate the Auditor's opinion from quoted opinions from Consultants' reports or other sources.

Dear Mr Labutis

1 INTRODUCTION

1.1 Audit Background

Ashbury Developments have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped and comprises one lot (Lot A DP 30778), with an area of 1.4 ha. It is proposed to redevelop the site for mixed use (commercial and residential). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

1.2 Site Background

The site is understood to have been used for commercial and industrial purposes since the 1930s, with potentially contaminating uses including brick making, vehicle refuelling and maintenance.

The sports field adjacent to the west (W.H. Wagener Oval) is known to be a former putrescible waste landfill and may pose a hazardous ground gas risk to site development, as well as potentially adversely influencing groundwater quality.

Eiaustralia are understood to be preparing a remedial action plan (RAP) for the site. Council require a Site Audit Statement endorsing the RAP prior to allowing the development planning to proceed.

2 SCOPE OF AUDITS

Whereas interim audit advice is provided to assist in the assessment and management of contamination issues at the site, interim audit advice should not be regarded as 'approval' of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, describes the site assessment and audit process as:

- i. The **'first tier' is the work of a contaminated site Consultant**, generally engaged by the site owner or developer. The contaminated site Consultant designs and conducts a site assessment and any necessary remediation and validation, and documents the processes and information in reports.
- ii. The **'second tier' is the site audit** which involves a site auditor independently and at arm's length reviewing, for one of the audit purposes stated in the CLM Act, the Consultant's assessment, remediation, validation and management plans or reports. The material outcomes of a site audit are a site audit report and site audit statement.

Section 53B of the CLM Act describes that site audits conducted by EPA accredited site auditors must take the following matters into account:

- the provisions of the CLM Act and the CLM Regulations;
- the provisions of any environmental planning instruments applying to the site; and
- the guidelines made or approved by the EPA.

Therefore, the contaminated land Consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

3 CURRENT INTERIM ADVICE

The current Interim Advice is presented as a summary of the following documents which has been provided for review:

- Environmental Investigation Australia, EI (14 August 2014 *Preliminary Environmental Site Assessment Report*, 165 Milton Street, Ashbury, NSW. Reference E22232 AA Rev0.

The review of this document has been in general accordance with the requirements in the NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)* and the NSW OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. The primary focus of the review documented here has been to assess the adequacy of the assessment to identify and

delineate contamination sufficiently to allow determination of whether or not remediation is required, and if so to identify suitable remediation methods for the site.

The overall objective of this audit is to provide comment on whether the land at the site is suitable for the proposed uses with respect to contamination.

4 ENVIRONMENTAL INVESTIGATIONS AUSTRALIA (2014) ENVIRONMENTAL SITE ASSESSMENT

4.1 Auditor's Summary of the Assessment Works

Environmental site assessment was conducted by Environmental Investigations Australia (EIA) in 2014, to provide Preliminary Environmental site investigation. EIA (2016) documents the following site assessment works, as summarised by the Auditor. Note that in this summary the Auditor has presented the Consultants' conclusions and observations and not their own:

- Review of background information relating to the site, including:
 - Historical aerial photographs;
 - Historical title deed information and development application records from council;
 - Groundwater bore information;
 - Relevant government databases;
 - Published soil, geology and topographic maps.
- Inspection of the site;

The Auditor summarises the key findings of the assessment as follows:

- Historical industrial use of the site was documented:
 - The site was part of the Ashfield Brick Company between 1913 to 1960, then was developed and used as grocery warehouse until 1987.
 - From 1987 to 1991 the site was an automotive air conditioning business and from 1911 to the time of reporting (2014) the site was used as a tyre warehouse.
- Potential contamination sources were limited to:
 - Historical use of the site as part of the Ashfield Brick Company;
 - Historical use of the site as a workshop for motor vehicle maintenance and repair.
 - Fill material placed onsite prior to the construction of the current facility;
 - Former underground storage tank pit and former fuel pumps;
- Soil Sampling
 - 14 soil bores were installed at the site and extended to a maximum depth of 14.6m below ground level.
 - The sub-surface layers comprised of fill materials averaging 1-2m thick and consisting of various constituents including bricks and gravels, overlying residual clays overlying and weathered Ashfield shale.
 - Sample analysis included the following target contaminants:
 - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn)

- Polycyclic Aromatic Hydrocarbons (PAH)
- TRH (total Recoverable Hydrocarbons)
- BTEX (benzene, toluene, ethylbenzene and xylenes)
- Pesticides (organo-chlorine and organo-phosphate pesticides, OCP/OPP)
- Polychlorinated Biphenyl (PCB),
- Volatile Organic compounds (VOC's) and
- Asbestos.
- Groundwater Sampling
 - Conversion of five soil bores (BH1M, BH3M, BH4M, BH7M and BH8M) to groundwater monitoring wells.
 - Groundwater was encountered at depths ranging between 31.14 and 37.7 mAHD (2.2 and 5.1 metres below ground surface) across the site.
 - Gauging and sampling of five groundwater monitoring wells. Samples were analysed for:
 - Heavy Metals
 - BTEX
 - TRH
 - PAH and VOC

The following findings were made, as summarised by the Auditor:

- Results of soil samples collected from test bores were generally below adopted health based and ecological based soil investigation levels, with the exception of BH4, BH7 and BH8 where reported zinc concentrations exceeded adopted ecological based SILs (soil investigation levels) but not health based criteria.
- Groundwater samples collected at MW1, MW2 and MW5 reported concentrations of nickel and zinc above the adopted groundwater investigation level. MW1, MW2 and MW3 reported concentrations of cadmium above the adopted groundwater investigation level.
- Several data gaps were identified by the consultants and require closure by further investigation:
 - To adequately characterise environmental conditions of the site (in accord with NSW EPA (1995) *Contaminated Sites: Sampling Design Guidelines*), and to delineate the profile of zinc impacted soil at the southwest portion of the site, additional soil investigations shall be conducted after demolition of site structures;
 - The potential presence of explosive and/or asphyxiation hazards posed by gases generated from the adjacent landfill (now known as WH Wagener Oval) will need to be addressed with a detailed landfill gas assessment (and possible risk assessment based on the findings of the investigation);
 - Identification of sources of hydrocarbon odours and sheens noted in groundwater monitoring wells; and
 - Environmental conditions in the vicinity of former USTs remain inconclusive; further assessment, including laboratory testing of field samples shall be performed.

4.2 Guideline Compliance

The Auditor has assessed EIA 2014 PSA against the reporting criteria for Preliminary Site Assessment Reports listed in NSW EPA (2011) *Contaminated Sites: Guideline for Consultants Reporting on Contaminated Sites*.

Section 2.1 of NSW OEH (2011) states that:

The preliminary site investigation report should:

- *identify all past and present potentially contaminating activities*
- *identify potential contamination types*
- *discuss the site condition*
- *provide a preliminary assessment of site contamination*
- *assess the need for further investigations.*

An appraisal of the site history is fundamental to the preliminary assessment and may be used to assess potential site contamination. It is important to review and assess all relevant information about the site, including information obtained during a site inspection.

The Auditor is satisfied that these broad requirements have been met.

The Auditor's comparison of EIS (2014) to the reporting criteria is appended to this advice (Table 1).

The report was found to satisfactorily meet the reporting guidelines with the following minor non-conformances noted which do not materially detract from the conclusions able to be drawn from the report.

1. No soil or groundwater SIL or GIL exceedances were presented with in figures to better identify areas of concern on the site. This would be highly beneficial in determination of remediation requirements.

5 AUDITOR'S CONCLUSIONS

The Auditor is satisfied that the assessment work as conducted was of reasonable quality and that the data is adequately reliable for the identification of potential contaminant sources at the site despite the minor omissions discussed above. The Auditor concurs with the identified potential sources of contamination identified at the site.

The Auditor is not satisfied that the data in this report is sufficient to derive a reliable remediation strategy for the site without supplementary assessment.

Yours sincerely

A handwritten signature in black ink, appearing to be 'Tim Chambers', with a stylized, flowing script.

Tim Chambers
NSW EPA Accredited Site Auditor 1004
0458 888 033

ATTACHMENT 1

COMPARISON TO NSW EPA REPORTING REQUIREMENTS

Ashbury Developments
C/- Mr Aras Labutis
Coronation
Level 2 66 Wentworth Ave
Surry Hills NSW 2010

Arcadis Australia Pacific Pty Ltd
Level 16, 580 George Street
Sydney NSW 2000
Tel No: +61 2 8907 9000
www.arcadis.com/au

5/04/2019

L02 165 Milton Street, Ashbury, Interim Advice 2 - Review of Stage 2 Environmental Site Assessment

This letter is provided as Interim Advice and does not constitute a Site Audit Report or Site Audit Statement. This letter does not pre-empt the findings of the site Audit. A Site Audit Statement and Site Audit Report will be issued at the completion of the Audit.

Where required for clarity, the Auditor's opinion in this letter is enclosed in a box to separate the Auditor's opinion from quoted opinions from Consultants' reports or other sources.

Dear Mr Labutis

1 INTRODUCTION

1.1 Audit Background

Ashbury FMBM have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped block (Lot A DP 30778), with a combined area of 1.49 ha. It is proposed to redevelop the site for mixed use (commercial and residential). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

1.2 Site Background

The site is understood to have been used for commercial and industrial purposes since the 1930s, with potentially contaminating uses including brick making, vehicle refuelling and maintenance.

The sports field adjacent to the west (W.H. Wagener Oval) is known to be a former putrescible waste landfill and may pose a hazardous ground gas risk to site development, as well as potentially adversely influencing groundwater quality.

Eiaustralia are understood to be preparing a remedial action plan (RAP) for the site. Council require a Site Audit Statement endorsing the RAP prior to allowing the development planning to proceed.

2 SCOPE OF AUDITS

Whereas interim audit advice is provided to assist in the assessment and management of contamination issues at the site, interim audit advice should not be regarded as 'approval' of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, describes the site assessment and audit process as:

- i. The **'first tier' is the work of a contaminated site Consultant**, generally engaged by the site owner or developer. The contaminated site Consultant designs and conducts a site assessment and any necessary remediation and validation, and documents the processes and information in reports.
- ii. The **'second tier' is the site audit** which involves a site auditor independently and at arm's length reviewing, for one of the audit purposes stated in the CLM Act, the Consultant's assessment, remediation, validation and management plans or reports. The material outcomes of a site audit are a site audit report and site audit statement.

Section 53B of the CLM Act describes that site audits conducted by EPA accredited site auditors must take the following matters into account:

- the provisions of the CLM Act and the CLM Regulations;
- the provisions of any environmental planning instruments applying to the site; and
- the guidelines made or approved by the EPA.

Therefore, the contaminated land Consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

3 CURRENT INTERIM ADVICE

The current Interim Advice is presented as a summary of the following documents which has been provided for review:

- Environmental investigation Australia, EI (8 November 2018) *Stage 2 Environmental Site Assessment For Proposed Re-Zoning For Future Development 165 Milton Street, Ashbury, NSW*, Reference E31803KBprt-rev1.

The review of this document has been in general accordance with the requirements in the NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)* and the NSW OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. The primary focus of the review documented here has been to assess the adequacy of the assessment to identify and

delineate contamination sufficiently to allow determination of whether or not remediation is required, and if so to identify suitable remediation methods for the site.

The overall objective of this audit is to provide comment on whether the land at the site is suitable for the proposed uses with respect to contamination.

4 ENVIRONMENTAL INVESTIGATION AUSTRALIA, STAGE 2 ENVIRONMENTAL SITE ASSESSMENT ENVIRONMENTAL AUDIT

4.1 Auditor's Summary of the Assessment Works

Detailed site assessment was conducted by Environmental Investigations Australia (EIS) in 2018, to provide Preliminary Environmental site investigation. EI (2018) documents the following site assessment works, as summarised by the Auditor. Note that in this summary the Auditor has presented the Consultants' conclusions and observations and not their own:

- Review of background information relating to the site, including:
 - Historical aerial photographs;
 - Historical title deed information and development application records from council;
 - Groundwater bore information;
 - Relevant government databases;
 - Published soil, geology and topographic maps.
- Inspection of the site;

The Auditor summarises the key findings of the assessment as follows:

- Historical use summary consistent with previous reporting (EIA, 2014), as reviewed separately in Interim Advice 1.
- Soil Sampling
 - 16 soil bores were installed in 2018 at the site and extended to a maximum depth of 9mbgs below ground level. combined with the fourteen (14) locations previously completed by EIA in 2014 is a total of thirty (30) sampling points.
 - The total number of locations met the minimum sampling density of twenty-five (25) recommended for hotspot identification outlined in the NSW EPA Contaminated Sites Sampling Design Guidelines (1995)⁹. Based on the above density, the hotspot diameter with a 95% confidence level is 26m.
 - The sub-surface layers comprised of fill materials averaging 1-2m thick and consisting of various constituents including bricks and gravels, overlying residual clays overlying and weathered Ashfield shale.
 - Sample analysis included the following target contaminants:
 - Heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn)
 - Polycyclic Aromatic Hydrocarbons (PAH)
 - TRH (total Recoverable Hydrocarbons)
 - BTEX (benzene, toluene, ethylbenzene and xylenes)

- Pesticides (organo-chlorine and organo-phosphate pesticides, OCP/OPP)
- Polychlorinated Biphenyl (PCB),
- Volatile Organic compounds (VOC's) and
- Asbestos.
- Groundwater Sampling
 - Conversion of five soil bores (BH105, BH110, BH111, BH112, BH114 and BH116) to groundwater monitoring wells.
 - Groundwater was encountered at depths ranging between and 1.56 and 6.7 mbgs across the site.
 - Gauging and sampling of five groundwater monitoring wells. Samples were analysed for:
 - Heavy Metals
 - BTEX
 - TRH
 - PAH and VOC
- Positive identification of underground services to identify UST (underground storage tank) and infrastructure locations.
- Hazardous Ground Gas (HGG) sampling utilising the existing groundwater monitoring well network.
- Gauging and sampling of nine groundwater monitoring wells for HGG. Samples were analysed for:
 - CH₄ (methane)
 - CO₂
 - O₂
 - CH₄ LEL
 - H₂S
 - CO and
 - Standing Water Level (SWL)

The following findings were made, as summarised by the Auditor:

- The soil analytical results were below the SAC adopted for the ESA. Additional waste classification
- Marginal elevations of copper, nickel and zinc were detected in the groundwater. The source of this contaminant could be associated with the leaching of metals from the fill inclusions. The report assumes that groundwater will not be used as a resource at the site.
- Considering the proximity of the former quarry to the subject site, there is potential for on-site migration of HGG through the subsurface profile. Gas movement will be influenced by a number of factors the most important of which is the method of filling and any voids in the fill.

- The study has identified hazardous ground gases at concentrations above the site assessment criteria (SAC). The maximum concentrations above the SAC for carbon dioxide (CO₂) – 12.2 %v/v. No methane was detected.
- Data gaps in the assessment were identified as
 - Long term gas data has not been obtained for the site. The monitoring rounds have not coincided with a low atmospheric pressure event (below 1000 hPa) therefore there is the potential for higher gas and flow rate measurements at this site; and
 - Additional waste classification analysis should be undertaken to assign a final waste classification to the fill material that will be excavated as part of the development.
- Recommendations from the report include
 - Undertake a Level 3 HGG risk assessment with additional HGG monitoring to meet NSW EPA guidelines
 - Prepare a Remediation Action Plan (RAP) on completion of the Level 3 risk assessment; and
 - Prepare a Validation Assessment for the remediation works undertaken at the site.

4.2 Guideline Compliance

The Auditor has assessed EIA 2014 PSA against the reporting criteria for Preliminary Site Assessment Reports listed in NSW EPA (2011) *Contaminated Sites: Guideline for Consultants Reporting on Contaminated Sites*.

Section 2.1 of NSW OEH (2011) states that:

The detailed site investigation report should:

- *identify all past and present potentially contaminating activities*
- *identify potential contamination types*
- *discuss the site condition*
- *provide a preliminary assessment of site contamination*
- *assess the need for further investigations.*

An appraisal of the site history is fundamental to the preliminary assessment and may be used to assess potential site contamination. It is important to review and assess all relevant information about the site, including information obtained during a site inspection.

The Auditor is satisfied that these broad requirements have been met.

The Auditor's comparison of EIS (2018) to the reporting criteria is appended to this advice (Table 1).

The report was found to satisfactorily meet the reporting guidelines with the following minor non-conformances noted which do not materially detract from the conclusions able to be drawn from the report.

1. No HGG exceedances were presented with in figures to better identify areas of concern on the site.

2. CSM cross reference marked A:A on figure 2
3. DTSTL and mAHD in wrong order on figure 3
4. No table of SWL in text, SWL provide on Table M (HGG results and on figure 3)

5 AUDITOR'S TECHNICAL COMMENT

The Auditor's review of the report resulted in the following technical comments in addition to the reporting requirement deficiencies identified above.

- Bore logs were missing well construction details including screen intervals for MW111 and MW112;
- No graphical presentation of well construction was presented on the bore logs
- The Auditor's review of standing water levels and screen intervals identified that the screens of some of the wells used to test for HGG were submerged during gauging and HGG sampling. Submersion of the well screen provides a barrier which prevents HGG in the surrounding formation from entering the well and therefore wells with submerged screens do not provide reliable measurement of the presence of HGG in the formation.

Table 1: Auditor's summary of Screen Positions and Standing Water Levels

Well ID	Screen top (mbgs)	Screen bottom (mbgs)	HGG Submerged Well Sampling event	SWL (mbgs)
MW1	4.55	7.55	#2 and #3	2.29, 1.56
MW5	6.0	9.0	#2 and #3	3.26, 2.90
MW105	3.0	6.0	All	1.63, 1.63, 1.28
MW111	?	?	Unknown	6.7, 6.74, 6.59
MW112	?	?	Unknown	5.49, 6.47, 6.27
MW116	0.5	3.0	Unknown	No SWL recorded in table M

- MW110, MW114 and MW115 results are considered acceptable for HGG sampling.
- MW111 and MW112 can not be relied on to provide useful HGG data as confirmation of the screen positioning was not provided.
- HGG data and assumptions made for all three sampling events may underestimate the concentrations present in the subsurface. The majority of wells used for HGG analysis either have submerged screens or provide data with low confidence HGG measurements due to unknown factors around the well construction. It is also noted that these wells were targeted at groundwater and may not provide relevant measurement of HGG present in parts of the formation above the well screen.
- The Consultant advised progression to a Tier II or Tier III risk assessment for HGG. Given that the Auditor is not satisfied that the existing HGG data is reliable it is recommended that further data be obtained before proceeding to risk assessment.

- Data gaps exist in the information provided for review. These include but are not necessarily limited to:
 - Well construction details for all wells, including graphical presentation of well construction in bore logs.
 - Gauging data for MW116.

6 AUDITOR'S CONCLUSIONS

The Auditor is satisfied that the assessment work as conducted was of reasonable quality and that the soil and groundwater data is adequately reliable for the identification of potential contaminant presence at the site despite the minor omissions discussed above. The Auditor concurs with the identified potential sources of contamination identified at the site.

The Auditor is not confident that the measurements of hazardous ground gas obtained from the monitoring wells are sufficiently reliable or that they provide adequate understanding of the presence of hazardous ground gases between the water table and the ground surface.

Certainty in the remedial approach required for the development will not be obtained without understanding the ground gas component in detail. If hazardous ground gas is reliably found to be present at sufficient concentration and pressure, it will be necessary to include gas mitigation measures in the remediation works and/or building structure.

Yours sincerely



Tim Chambers
Site Auditor
0458 888 033

ATTACHMENT 1

COMPARISON TO NSW EPA REPORTING REQUIREMENTS

Ashbury Developments
C/- Mr Aras Labutis
Coronation
Level 2 66 Wentworth Ave
Surry Hills NSW 2010

Arcadis Australia Pacific Pty Ltd
Level 16, 580 George Street
Sydney NSW 2000
Tel No: +61 2 8907 9000
www.arcadis.com/au

9/04/2019

165 Milton Street, Ashbury, NSW, Interim Advice 3 – Comment on Remedial Requirements

This letter is provided as Interim Advice and does not constitute a Site Audit Report or Site Audit Statement. This letter does not pre-empt the findings of the site Audit. A Site Audit Statement and Site Audit Report will be issued at the completion of the Audit.

Where required for clarity, the Auditor's opinion in this letter is enclosed in a box to separate the Auditor's opinion from quoted opinions from Consultants' reports or other sources.

Dear Mr Labutis

1 INTRODUCTION

1.1 Audit Background

Ashbury Developments have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped and comprises one lot (Lot A DP 30778), with an area of 1.4 ha. It is proposed to redevelop the site for mixed use (commercial and residential). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

1.2 Site Background

The site is understood to have been used for commercial and industrial purposes since the 1930s (or earlier), with potentially contaminating uses including brick making, vehicle refuelling and maintenance, and electrical substations.

The sports field adjacent to the west (W.H. Wagener Oval) is known to be a former putrescible waste landfill and may pose a hazardous ground gas risk to site development, as well as potentially adversely influencing groundwater quality.

Eiaustralia are understood to be preparing a remedial action plan (RAP) for the site. Council require a Site Audit Statement endorsing the RAP prior to allowing the development planning to proceed.

2 SCOPE OF AUDITS

Whereas interim audit advice is provided to assist in the assessment and management of contamination issues at the site, interim audit advice should not be regarded as 'approval' of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, describes the site assessment and audit process as:

- i. The **'first tier' is the work of a contaminated site Consultant**, generally engaged by the site owner or developer. The contaminated site Consultant designs and conducts a site assessment and any necessary remediation and validation, and documents the processes and information in reports.
- ii. The **'second tier' is the site audit** which involves a site auditor independently and at arm's length reviewing, for one of the audit purposes stated in the CLM Act, the Consultant's assessment, remediation, validation and management plans or reports. The material outcomes of a site audit are a site audit report and site audit statement.

Section 53B of the CLM Act describes that site audits conducted by EPA accredited site auditors must take the following matters into account:

- the provisions of the CLM Act and the CLM Regulations;
- the provisions of any environmental planning instruments applying to the site; and
- the guidelines made or approved by the EPA.

Therefore, the contaminated land Consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

3 CURRENT INTERIM ADVICE

The Auditor has provided review of existing site assessment work in previous letters of interim advice, and has not repeated that review here. This letter provides a summary of site contamination issues and the remedial strategy proposed by Eiaustralia (Tony Guirguis, pers. comm, 9/4/19).

In summary, the data obtained from ground gas monitoring, whilst requiring additional work to confirm the results, does not show an indication of landfill gas, as methane was not detected above concentrations typical in any soil profile.

There is no indication from the preliminary ground gas sampling that site conditions are significantly different to other sites in the area and there is no requirement for the management of landfill gas from the adjacent site based on current data. Some additional monitoring to confirm these results is required.

4 AUDITOR'S CONCLUSIONS

The Auditor is satisfied that the remediation requirements for the site are not out of the ordinary or complex and will not require management of gas emanating from the adjacent former landfill.

Yours sincerely



Tim Chambers
NSW EPA Accredited Site Auditor 1004
0458 888 033

Ashbury Developments
C/- Mr Aras Labutis
Coronation
Level 2 66 Wentworth Ave
Surry Hills NSW 2010

Arcadis Australia Pacific Pty Ltd
Level 16, 580 George Street
Sydney NSW 2000
Tel No: +61 2 8907 9000
www.arcadis.com/au

1/05/2019

165 Milton Street, Ashbury, NSW, Interim Advice 4 – Comment on Remedial Action Plan

This letter is provided as Interim Advice and does not constitute a Site Audit Report or Site Audit Statement. This letter does not pre-empt the findings of the site Audit. A Site Audit Statement and Site Audit Report will be issued at the completion of the Audit.

Where required for clarity, the Auditor's opinion in this letter is enclosed in a box to separate the Auditor's opinion from quoted opinions from Consultants' reports or other sources.

Dear Mr Labutis

1 INTRODUCTION

1.1 Audit Background

Ashbury Developments have engaged Tim Chambers of Arcadis to conduct a Site Audit, resulting in a Site Audit Statement and Site Audit Report, in relation to assessment and remediation of contamination at 165 Milton Street, Ashbury, NSW. The site is irregularly shaped and comprises one lot (Lot A DP 30778), with an area of 1.4 ha. It is proposed to redevelop the site for mixed use (commercial and residential). The site is zoned *IN2 – Light Industrial*.

The Audit is understood to be required to satisfy Canterbury-Bankstown Council requirements for approval of the planning proposal for the development. Accordingly, the Site Audit Statement will be considered statutory under the *Contaminated Land Management Act 1997* and will be issued to the client, the consent Authority, and the NSW EPA simultaneously.

1.2 Site Background

The site is understood to have been used for commercial and industrial purposes since the 1930s (or earlier), with potentially contaminating uses including brick making, vehicle refuelling and maintenance, and electrical substations.

The sports field adjacent to the west (W.H. Wagener Oval) is known to be a former putrescible waste landfill and may pose a hazardous ground gas risk to site development, as well as potentially adversely influencing groundwater quality.

Eiaustralia are understood to be preparing a remedial action plan (RAP) for the site. Council require a Site Audit Statement endorsing the RAP prior to allowing the development planning to proceed.

2 SCOPE OF AUDITS

Whereas interim audit advice is provided to assist in the assessment and management of contamination issues at the site, interim audit advice should not be regarded as 'approval' of any proposed investigations or remedial activities, as any such approval is beyond the scope of an independent review.

NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, describes the site assessment and audit process as:

- i. The **'first tier' is the work of a contaminated site Consultant**, generally engaged by the site owner or developer. The contaminated site Consultant designs and conducts a site assessment and any necessary remediation and validation, and documents the processes and information in reports.
- ii. The **'second tier' is the site audit** which involves a site auditor independently and at arm's length reviewing, for one of the audit purposes stated in the CLM Act, the Consultant's assessment, remediation, validation and management plans or reports. The material outcomes of a site audit are a site audit report and site audit statement.

Section 53B of the CLM Act describes that site audits conducted by EPA accredited site auditors must take the following matters into account:

- the provisions of the CLM Act and the CLM Regulations;
- the provisions of any environmental planning instruments applying to the site; and
- the guidelines made or approved by the EPA.

Therefore, the contaminated land Consultant and other relevant parties should be satisfied that the work to be conducted conforms to all appropriate regulations, standards and guidelines and is suitable based on the site history and the proposed land use.

3 CURRENT INTERIM ADVICE

The current Interim Advice is presented as a summary of the following document which has been provided for review:

- Eiaustralia, EI (29 April 2019) *DRAFT Remediation Action Plan, 165 Milton Street, Ashbury, NSW*. Reference E24185.E06_DRAFT.

The review of this document has been in general accordance with the requirements in the NSW EPA (2017) *Contaminated Land Management: Guidelines for the NSW Site*

Auditor Scheme (3rd Edition) and the NSW OEH (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. The primary focus of the review documented here has been to assess the adequacy of the plan to identify suitable remediation methods for the site.

The overall objective of this audit is to provide comment on whether the land at the site is suitable for the proposed uses with respect to contamination.

4 EI (APRIL 2019) REMEDIAL ACTION PLAN

4.1 Auditor's Summary of Proposed Remediation

The summarises the proposed remedial works as follows:

- Ground gas monitoring will be conducted to extend confidence in the current data set. Whilst it is not anticipated that hazardous ground gas will present an issue requiring particular management as the existing data indicates no impact from the adjacent landfill, variation in atmospheric pressures can result in changes in gas behaviour and need to be covered as part of the works.
- Excavation, removal and validation of underground storage tanks.

4.2 Guideline Compliance

The Auditor has assessed EI (2019) against the reporting criteria for Remedial Action Plans listed in NSW EPA (2011) *Contaminated Sites: Guideline for Consultants Reporting on Contaminated Sites*.

Section 2.3 of NSW OEH (2011) states that:

The RAP should:

- *set remediation goals that ensure the remediated site will be suitable for the proposed use and will pose no unacceptable risk to human health or to the environment*
- *document in detail all procedures and plans to be implemented to reduce risks to acceptable levels for the proposed site use*
- *establish the environmental safeguards required to complete the remediation in an environmentally acceptable manner*
- *identify and include proof of the necessary approvals and licences required by regulatory authorities.*

Once remedial work is complete, a report should be prepared detailing the site work conducted and regulatory decisions made.

The Auditor is satisfied that these objectives have been adequately met.
--

The Auditor's comparison to specific NSW EPA reporting requirements (NSW EPA (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*) is presented in Table 1 (appended). The report was found to satisfactorily meet the reporting guidelines with the following exceptions. These items need to be addressed before the data can be relied on for this Audit.

1. The report lacks an executive summary. Whilst this does not affect the technical merit of the proposed remediation it may adversely affect stakeholder communication.
2. The extent of remediation required is not clearly stated.
3. The review of possible remediation methods is not presented.
4. Remediation contingencies are not presented (i.e. backup methods of remediation should the preferred method fail validation). This is particularly relevant to the proposed ground gas validation measurements.
5. Although relevant legislation and policies are listed, the requirements relevant to this work are not explicitly mentioned.
6. The conclusions section requires a discussion of relevant assumptions in reaching the conclusions and uncertainties in the results relied on to reach the conclusions.

4.3 Auditor's Technical Comment

The Auditor's review of the report resulted in the following technical comments in addition to those identified above.

1. Whilst the Auditor considers the likelihood of occurrence low, the potential ventilation requirements for management of higher gas characteristic situations mentioned in the report should be presented as contingency measures to be adopted in the RAP if the ground gas validation monitoring identifies raised gas screening values.
2. Table 2-1 should flag the particular requirements under SEPP55 for notification of Council regarding commencement and completion of remediation, and requirements for waste classification and disposal documentation under the PoEO Act.
3. Section 5.3. The Auditor notes that in accordance with Table 8 of EPA (2012), a ventilated carpark basement provides four points of protection and is likely to be sufficient to manage ground gas at the site without additional measures. It is noted that the preliminary ground gas measurements, whilst not considered comprehensive by the Auditor, did not suggest the presence of ground gas requiring management.
4. Section 7.3.1. Please indicate what atmospheric pressure change over what period would be sufficient to meet the conditions of the third data point. The Auditor notes that pressure changes of more than 20 MPa over 24 hours are rare in Sydney.
5. Table 7-3,
 - a. sample collection. How is the potential loss of volatile contaminants managed using this sampling method?
 - b. Field QAQC. Has Eiaustralia considered using a trip spike sample for soil as volatile hydrocarbons are target contaminants?

5 AUDITOR'S CONCLUSIONS

The Auditor is satisfied that the RAP presents a reasonable method to treat identified impacts at the site and, when implanted by a suitable experienced and qualified consultancy, will render the site suitable for the proposed mixed-use development.

In order for the Auditor to be in a position to issue a Site Audit Statement endorsing the RAP, the Auditor's comments in sections 4.2 and 4.3 above must be addressed to the Auditor's satisfaction.

Yours sincerely



Tim Chambers
NSW EPA Accredited Site Auditor 1004
0458 888 033

Appendix C

Reporting Requirements Checklists

Comparison of reviewed reports to requirements in NSW EPA (2011) *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*. Applies to review of draft reports. Material deficiencies have been rectified in the final report versions prior to issue of the Site Audit Report

Table 1: NSW OEH (2011) Reporting Requirements - Phase 1 Assessment

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Executive Summary			
Background			
Investigation Objectives			Objectives, scope of work and findings were summarized
Scope of Work	✓	Page 1	Tabulation of data not presented but provided in body of report
A summary of sampling results in tabulated format containing minimum, maximum, arithmetic average and 95% upper confidence limit on arithmetic average for each analyte			
Summary of conclusions and recommendations			
Scope of Work			
A clear statement of the scope of work	✓	Section 1.5	
Site Identification			
Street number, street name and suburb	✓	Section 2.1	
Lot number and Deposited Plan number	✓	Section 2.1	
Geographic coordinates related to a nearby cadastral corner of a State Survey Control Mark	✓	Section 2.1	
Locality Map	✓	Figure 1	
Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features.	✓	Figure 2-3	
Site History			
Zoning	✓	Section 2.1	
Land Use	✓	Section 2.2	
Summary of Council rezoning and DA records	✓	Section 1.1	
Chronological list of site uses	✓	Section 3.1 and 3.2	
Review of aerial photographs	✓	Section 3.2	
Site photographs	✓	Appendix C	
Inventory of chemicals and wastes	x	Section 3.6	Hazardous chemicals reviewed, no specific inventory
Possible contaminant sources and potential off-site effects	✓	Section 4.1	
Site layout plans showing past and present industrial processes	✓	Figure 2-5	No historical process presented
Sewer and service plans	n/a		
Description of manufacturing processes	x		
Details and locations of USTs and ASTs	✓	Section 3.4	

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Product spill and loss history	x		
Discharges to land, water and air	✓	Section 3.5	
Disposal locations	✓	Section 3.5	
Relevant complaint history	x		
Local site knowledge of residents and staff	✓	Section 3.5	
Summary of local literature about the site	x		
Details of building and related permits, licences, approvals and trade waste agreements	x		
Historical use of adjacent land	✓	Section 3.5	
Local usage of ground/surface waters	✓	Section 2.4	
Integrity assessment of information	x		
Site Conditions and Surrounding Environment			
Topography	✓	Section 2.3	
Boundary conditions	✓	Section 2.5	
Visible signs of contamination	✓	Section 2.5	
Presence of drums, wastes and fill materials	✓	Section 3.2	
Odours	n/a		None noted
Condition of buildings and roads	✓	Section 2.5	
Quality of surface water	n/a		
Flood potential	n/a		None noted
Local sensitive environments	✓	Section 2.3	
Geology and Hydrogeology (as readily available)			
Soil stratigraphy using recognised classification	✓	Section 2.3	
Location and extent of imported and locally derived fill	✓	Section 3.2	Acknowledged but not defined
Bore logs	✓	Appendix F	
Details of design and location of wells	✓	Appendix F	
Description and location of springs and wells in the vicinity	✓	Section 2.4	
Depth to groundwater	✓	Section 2.3	
Direction and rate of groundwater flow	✓	Section 2.3 Figure 3	
Direction of surface-water runoff	x		Minor omission
Background water quality	n/a		
Preferential water courses	✓	Section 2.3	
Summary of local meteorology	x		Minor omission

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Sampling and Analysis Plan and Sampling Methodology (as readily available)	✓	Section 5.1	
Sampling, analysis and data quality objectives (DQOs)	✓	Section 5	
Rationale for selection of:			
Sampling Pattern	✓	Section 5.1	
Sampling density and potential residual hotspot size	✓	Section 5.1	
Sampling locations including map	✓	Figure 2-3	
Sampling depths	✓	Tables	
Samples for analysis and samples not analysed	✓	Tables	
Analytical methods	x		Minor omission
Analytes for samples	✓	Section 7.31	
Detailed description of the sampling methods including:			
Sample containers and type of seal used	x		Minor omission
Sampling devices and equipment e.g. auger type	✓	Section 6.4	
Equipment decontamination procedures	✓	Section 6.4	
Sample handling procedures	✓	Section 6.4	
Sample preservation methods with reference to recognised protocols	✓	Section 6.4	
Detailed description of field screening protocols	✓	Section 6.4	
Basis for Assessment Criteria			
Table listing all selected assessment criteria and references	✓	Section 6.3	
Rationale for and appropriateness of the selection of criteria	✓	Section 6.3	
Assumptions and limitations of criteria	✓	Section 6.3	
Results			
Summary of previous results, if appropriate	✓	Section 7.3	
Summary of all results in a table that: -shows all essential details such as sample numbers and sampling depth -shows assessment criteria -highlights all results exceeding the assessment criteria	✓	Tables	
Site plan showing all sample locations, sample identification numbers and sampling depths	✓	Figure 2-3	

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth	x		
Site Characterisation			
Assessment of type of all environmental contamination, particularly soil and groundwater	✓	Section 4	
Assessment of extent of soil and groundwater contamination, including off-site effects	✓	Section 4	
Assessment of the chemical degradation products	n/a		
Assessment of possible exposure routes and exposed populations (human, ecological)	✓	Section 4	
Conclusions and Recommendations			
Brief summary of all findings	✓	Section 10	
Assumptions used in reaching the conclusions	✓	Section 10	
Extent of uncertainties in the results	x		
Where remedial action has been taken, a list summarising the activities and physical changes to the site	n/a		
A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable)	✓	Section 10	
A statement detailing all limitations and constraints on the use of the site (where applicable)	✓	Section 12	
Recommendations for further work, if appropriate	✓	Section 11	

Table 2: NSW OEH (2011) Reporting Requirements - Phase 1 Assessment

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Executive Summary			
Background			
Investigation Objectives			
Scope of Work	✓	Page 1	No tables or statistical summaries provided in Executive summary- provide in main report body
A summary of sampling results in tabulated format containing minimum, maximum, arithmetic average and 95% upper confidence limit on arithmetic average for each analyte			
Summary of conclusions and recommendations			
Scope of Work	x		
A clear statement of the scope of work	✓	Section 1.4	
Site Identification			
Street number, street name and suburb	✓	Section 2.1	
Lot number and Deposited Plan number	✓	Section 2.1	
Geographic coordinates related to a nearby cadastral corner of a State Survey Control Mark	✓	Section 2.1	
Locality Map			
Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features.	✓	Figure 1	
Site History			
(summary only required if provided in previous reports)	✓	Section 5	
Site Conditions and Surrounding Environment			
(summary only required if provided in previous reports)	✓	Section 5	
Geology and Hydrogeology			
Soil stratigraphy using recognised classification			
Location and extent of imported and locally derived fill			
Bore logs	✓	Appendix D	Note well construction on MW111 and MW112 is not defined, screen elevation not determined in these wells. Well construction details not graphically included on all bore logs.

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Details of design and location of wells	✓	Appendix D, Figure 2-3	
Description and location of springs and wells in the vicinity	x		
Depth to groundwater	✓	Figure 3	
Direction and rate of groundwater flow	✓	Figure 3	
Direction of surface-water runoff	x		
Background water quality	x		
Preferential water courses	n/a		
Summary of local meteorology	n/a		
Sampling and Analysis Plan and Sampling Methodology			
Sampling, analysis and data quality objectives (DQOs)	✓	Section 7	
Rationale for selection of:			
Sampling Pattern	✓	Section 8.1 and 8.2	
Sampling density and potential residual hotspot size	✓	Section 8.1 and 8.2	
Sampling locations including map	✓	Figure 2 and 3	
Sampling depths	✓	Table A	
Samples for analysis and samples not analysed	x		
Analytical methods	✓	Appendix F	
Analytes for samples	✓	Section 11	
Detailed description of the sampling methods including:			
Sample containers and type of seal used	✓	Section 8.1	
Sampling devices and equipment e.g. auger type	✓	Section 8.1	
Equipment decontamination procedures	✓	Section 8.1	
Sample handling procedures	✓	Section 8.1	
Sample preservation methods with reference to recognised protocols	✓	Section 8.1	
Detailed description of field screening protocols	✓	Section 8.1	
Field Quality Assurance and Quality Control (QA/QC)			
Details of sampling team	x		
Decontamination procedures during sampling	✓	Section 8.1	

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Logs for each sample collected	✓	Groundwater sampling Records, HGG records and Bore logs	
Chain of custody documentation	✓	Appendix F	
Sample splitting techniques	✓	Appendix F	
Field blank results	✓	Appendix F	
Rinsate sample results	✓	Appendix F	
Laboratory prepared trip spike results for volatile analyses	✓	Appendix F	
Trip blank results	✓	Appendix F	
Field instrument calibrations	✓	Equipment calibration records	
Laboratory QA/QC			
Copies of signed chain of custody forms	✓	Appendix E	
Record of holding times and a comparison with method specifications	✓	Appendix E	
Analytical methods used	✓	Appendix E	
Laboratory accreditation for analytical methods used	✓	Appendix E	
Laboratory performance in inter-laboratory trials, where available	✓	Appendix E	
Description of surrogates and spikes used	✓	Appendix E	
Percent recoveries of spikes and surrogates	✓	Appendix E	
Instrument detection limit	✓	Appendix E	
Method detection limit	✓	Appendix E	
Matrix or practical quantification limits	✓	Appendix E	
Standard solution results	✓	Appendix E	
Reference sample results	✓	Appendix E	
Reference check sample results	✓	Appendix E	
Daily check sample results	✓	Appendix E	
Laboratory duplicate results	✓	Appendix E	
Laboratory blank results	✓	Appendix E	
Laboratory standard charts	✓	Appendix E	
QA/QC Data Evaluation			
Evaluation of all QA/QC information listed above against stated DQOs including:			

Requirement in NSW OEH (2011)	Present	Location in Document	Auditor Comment
Documentation completeness	✓	Appendix F	
Data completeness	✓	Appendix F	
Data comparability	✓	Appendix F	
Data representativeness	✓	Appendix F	
Precision and accuracy for sampling and analysis for each analyte and media.	✓	Appendix F	
Data comparability checks including bias assessment including:	✓	Appendix F	
Collection and analysis of samples by different personnel	x		Not specified
Use of different methodologies	x		Not specified
Collection and analysis by the same personnel using the same methods but at different times	x		Not specified
Spatial and temporal changes due to environmental dynamics	x		Not specified
Relative percent differences for intra- and inter-laboratory duplicates	✓	Appendix F	
Basis for Assessment Criteria			
Table listing all selected assessment criteria and references	✓	Appendix B	
Rationale for and appropriateness of the selection of criteria	✓	Section 9	
Assumptions and limitations of criteria	✓	Section 9	
Results			
Summary of previous results, if appropriate	✓	Section 3.1.2	
Summary of all results in a table that: -shows all essential details such as sample numbers and sampling depth -shows assessment criteria -highlights all results exceeding the assessment criteria	✓	Appendix B	
Site plan showing all sample locations, sample identification numbers and sampling depths	✓	Figure 2-3	
Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth	n/a	Minor Exceedances of groundwater only	
Site Characterisation			
Assessment of type of all environmental contamination, particularly soil and groundwater			

Table 1 NSW OEH (2011) Reporting Requirements - Remedial Action Plan

Requirement in NSW OEH (2011)	Present	Location in document	Auditor Comment
Executive Summary			
Background	x		No executive summary is provided. This may adversely affect stakeholder communication
Investigation Objectives	x		
Scope of Work	x		
A summary of sampling results in tabulated format containing minimum, maximum, arithmetic average and 95% upper confidence limit on arithmetic average for each analyte	x		
Summary of conclusions and recommendations	x		
Scope of Work			
A clear statement of the scope of work	✓	Section 1.3	
Site Identification			
Street number, street name and suburb	✓	Section 3.2	
Lot number and Deposited Plan number	✓	Section 3.2	
Geographic coordinates related to a nearby cadastral corner of a State Survey Control Mark	✓	Section 3.2	
Locality Map	✓	Figure 1	
Current site plan with scale bar, showing north, local water drainage and other local environmentally significant features.	✓	Figure 2	
Site History			
(summary only required in RAP if provided in previous reports)	✓	Section 3.3	
Site Conditions and Surrounding Environment			
(summary only required in RAP if provided in previous reports)	✓	Section 3.2	
Geology and Hydrogeology			
(summary only required in RAP if provided in previous reports)	✓	Section 4.1	
Basis for Assessment Criteria			
Table listing all selected assessment criteria and references	x		Acceptable as reference to applicable criteria may vary with development specifics
Rationale for and appropriateness of the selection of criteria	✓	Section 2	
Assumptions and limitations of criteria	✓	Section 2	

Requirement in NSW OEH (2011)	Present	Location in document	Auditor Comment
Results			
Summary of previous results, if appropriate	✓	Section 3.1	
Summary of all results in a table that: -shows all essential details such as sample numbers and sampling depth -shows assessment criteria -highlights all results exceeding the assessment criteria	x		acceptable as target areas defined
Site plan showing all sample locations, sample identification numbers and sampling depths	✓	Figure 2	
Site plan showing the extent of soil and groundwater contamination exceeding selected assessment criteria for each sampling depth	✓	Figure 2	
Site Characterisation			
Assessment of type of all environmental contamination, particularly soil and groundwater	✓		
Assessment of extent of soil and groundwater contamination, including off-site effects	✓		
Assessment of the chemical degradation products	✓		
Assessment of possible exposure routes and exposed populations (human, ecological)	✓	Section 4.2	
Remedial action plan			
Remediation goal	✓	Section 5	
Discussion of the extent of remediation required	x		Required
Discussion of the possible remediation options and how risk can be reduced	x		Required
Rationale for selection of recommended remedial option	✓	Section 5	
Proposed testing to validate the site after remediation	✓	Sections 7 & 8	
Contingency plan if the selected remedial strategy fails	x		Remedial contingencies Required
Interim site management plan (before remediation), including e.g. fencing, erection of warning signs, stormwater diversion	n/a		
Site management plan (operation phase): -site stormwater management plan -soil management plan -noise control plan	✓	Section 5	

Requirement in NSW OEH (2011)	Present	Location in document	Auditor Comment
-dust control plan, including wheel wash (where applicable) -odour control plan -occupational health and safety plan			
Remediation schedule	n/a		
Hours of operation	✓	Section 5	
Contingency plans to respond to site incidents, to obviate potential effects on surrounding environment and community	✓	Section 5	
Identification of regulatory compliance requirements such as licences and approvals	×	Section 2	Requires specifics
Names and phone numbers of appropriate personnel to contact during remediation	TBC		
Community relation plans, where applicable	n/a		
Staged progress reporting, where appropriate	n/a		
Long-term site management plan	n/a		
Conclusions and Recommendations			
Brief summary of all findings	✓	Section 9	
Assumptions used in reaching the conclusions	×		Required
Extent of uncertainties in the results	×		Required
Where remedial action has been taken, a list summarising the activities and physical changes to the site	n/a		
A clear statement that the consultant considers the subject site to be suitable for the proposed use (where applicable)	n/a		
A statement detailing all limitations and constraints on the use of the site (where applicable)	n/a		
Recommendations for further work, if appropriate	✓	Section 9	

Appendix D

Site Photographs

SITE PHOTOGRAPHS

Project 10031134, Site Audit, 165 Milton Street, Ashbury, NSW
Client: Ashbury Developments

Photograph 1

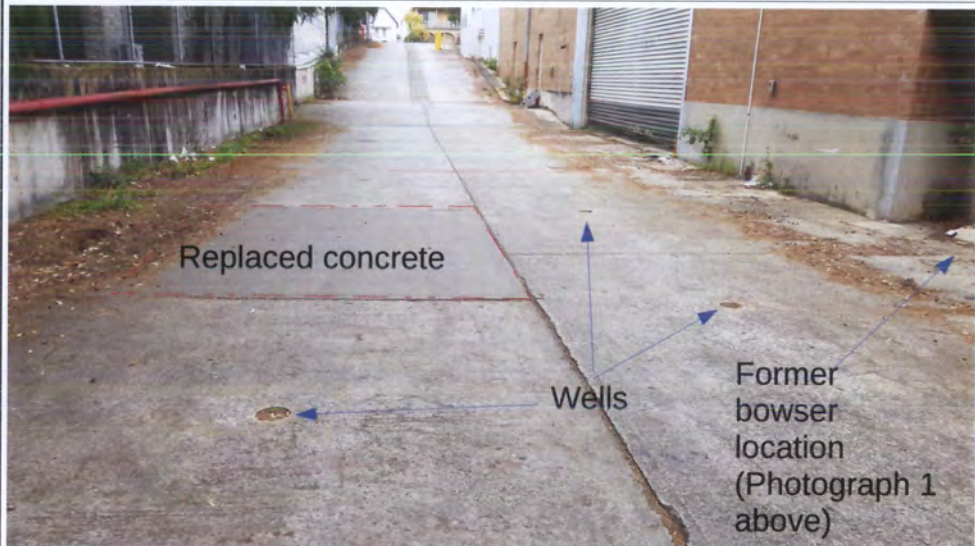
Date: 02/05/2019



Former bowser location along northern driveway. Some staining evident.

Photograph 2

Date: 02/05/2019



Replaced concrete indicating potential UST removal, with monitoring wells

SITE PHOTOGRAPHS

Project 10031134, Site Audit, 165 Milton Street, Ashbury, NSW
Client: Ashbury Developments

Photograph 3

Date: 02/05/2019



Driveway on northern boundary, facing west.

Photograph 4

Date: 02/05/2019



View across the western boundary, illustrating topographic drop to the adjacent playing field/former landfill.

SITE PHOTOGRAPHS

Project 10031134, Site Audit, 165 Milton Street, Ashbury, NSW
Client: Ashbury Developments

Photograph 5

Date: 02/05/2019



Interior of warehouse. Concrete appears in good condition.

Photograph 6

Date: 02/05/2019



Miscellaneous storage in the undercroft of the southwestern building. Used to store building materials and scaffolding.

Appendix E

Site Audit Statement



NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. TNC118

This site audit is a:

☒ statutory audit

☐ ~~non-statutory audit~~

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name Tim Chambers

Company Arcadis

Address Level 16, 580 George Street, Sydney, NSW

Postcode 2000

Phone 02 8907 3983

Email tim.chambers@arcadis.com

Site details

Address 165 Milton Street, Ashbury, NSW

Postcode 2193

Property description

(Attach a separate list if several properties are included in the site audit.)

Lot A DP 30778

Local government area	Canterbury-Bankstown
Area of site (include units, e.g. hectares)	1.5 ha
Current zoning	IN2 – Light Industrial

Regulation and notification

To the best of my knowledge:

☐ ~~the site is~~ the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*, as follows: (provide the no. if applicable)

☐ Declaration no.:

☐ Order no.:

☐ Proposal no.:

☐ Notice no.:

☒ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

☐ ~~the site has~~ been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☒ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

Site audit commissioned by

Name	Aras Labutis			
Company	Ashbury Developments Pty Ltd			
Address	Level 2, 66 Wentworth Avenue, Surry Hills, NSW		Postcode	2010
Phone	02 8316 9100			
Email	al@coronation.com.au			

Contact details for contact person (if different from above)

Name

Phone

Email

Nature of statutory requirements (not applicable for non-statutory audits)

☐ ~~Requirements under the *Contaminated Land Management Act 1997*
(e.g. management order; please specify, including date of issue)~~

☒ Requirements imposed by an environmental planning instrument
(please specify, including date of issue)

Requirement to satisfy Canterbury-Bankstown Council with regard to re-zoning of the
site in preparation for redevelopment for mixed commercial and residential use

☐ ~~Development consent requirements under the *Environmental Planning and
Assessment Act 1979* (please specify consent authority and date of issue)~~

☐ ~~Requirements under other legislation (please specify, including date of issue)~~

Purpose of site audit

☐ ~~A1 To determine land use suitability~~

~~Intended uses of the land: _____~~

OR

☐ ~~A2 To determine land use suitability subject to compliance with either an active or passive environmental management plan~~

~~Intended uses of the land: _____~~

OR

(Tick all that apply)

☒ **B1** To determine the nature and extent of contamination

☒ **B2** To determine the appropriateness of:

☐ ~~an investigation plan~~

☒ a remediation plan

☐ ~~a management plan~~

☐ ~~B3 To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

☐ ~~B4 To determine the compliance with an approved:~~

☐ ~~**voluntary management proposal** or~~

☐ ~~**management order** under the *Contaminated Land Management Act 1997*~~

☒ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land:

Mixed commercial and high density residential redevelopment

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Eiaustralia, formerly Environmental Investigations Australia (EI)

Environmental Investigation Services (EIS)

Titles of reports reviewed:

EI (14 August 2014 Preliminary Environmental Site Assessment Report, 165 Milton Street, Ashbury, NSW. Reference E22232 AA Rev0.

EIS (8 November 2018) Stage 2 Environmental Site Assessment For Proposed Re-Zoning For Future Development 165 Milton Street, Ashbury, NSW, Reference E31803KB rpt-rev1.

Site Audit Statement

EI (03 May 2019) Remediation Action Plan, 165 Milton Street, Ashbury, NSW. Reference E24185.E06_Rev0

Other information reviewed, including previous site audit reports and statements relating to the site:

none

Site audit report details

Title	Contaminated Site Audit 165 Milton Street Ashbury NSW		
Report no.	10031134 SAR	Date	08/05/2019

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section.
(Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
 - (B1) the nature and extent of contamination, and/or
 - (B2) the appropriateness of an investigation, remediation or management plan¹, and/or
 - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
 - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
 - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

¹For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The ~~site is suitable~~ for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
 - ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
 - ☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
 - ☐ ~~Day care centre, preschool, primary school~~
 - ☐ ~~Residential with minimal opportunity for soil access, including units~~
 - ☐ ~~Secondary school~~
 - ☐ ~~Park, recreational open space, playing field~~
 - ☐ ~~Commercial/industrial~~
 - ☐ ~~Other (please specify):~~
-

OR

- ☐ ~~I certify that, in my opinion, the site is not suitable for any use due to the risk of harm from contamination.~~

Overall comments:

Section A2

~~I certify that, in my opinion:~~

Subject to compliance with the ~~attached~~ environmental management plan² (EMP),
the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
 - ☐ Residential, including substantial vegetable garden, excluding poultry
 - ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
 - ☐ Day care centre, preschool, primary school
 - ☐ Residential with minimal opportunity for soil access, including units
 - ☐ Secondary school
 - ☐ Park, recreational open space, playing field
 - ☐ Commercial/industrial
 - ☐ Other (please specify):
-

EMP details

Title —

Author —

Date _____ No. of pages _____

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ☐ requires operation and/or maintenance of **active** control systems³
- ☐ requires maintenance of **passive** control systems only³.

²Refer to Part IV for an explanation of an environmental management plan.

³Refer to Part IV for definitions of active and passive control systems.

Site Audit Statement

Purpose of the EMP:

Description of the nature of the residual contamination:

Summary of the actions required by the EMP:

How the EMP can reasonably be made to be legally enforceable:

How there will be appropriate public notification:

Overall comments:

Section B

Purpose of the plan⁴ which is the subject of this audit:

Remediation of the site to make the site suitable for proposed commercial and/or high density residential site use

I certify that, in my opinion:

(B1)

- ☒ The nature and extent of the contamination **has** been appropriately determined
- ☐ ~~The nature and extent of the contamination **has not** been appropriately determined~~

AND/OR (B2)

- ☒ The investigation, remediation or management plan **is** appropriate for the purpose stated above
- ☐ ~~The investigation, remediation or management plan **is not** appropriate for the purpose stated above~~

AND/OR (B3)

- ☐ ~~The site testing plan:-~~
- ☐ ~~is appropriate to determine-~~
- ☐ ~~is not appropriate to determine-~~
- ~~if groundwater is safe and suitable for its intended use as required by the Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017~~

AND/OR (B4)

- ☐ ~~The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):-~~
- ☐ ~~have been complied with-~~
- ☐ ~~have not been complied with-~~
- ~~*voluntary management proposal no.~~
- ~~**management order no.~~
-

AND/OR (B5)

- ☒ The site **can be made suitable** for the following uses:
- (Tick all appropriate uses and strike out those not applicable.)
- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~

⁴For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Site Audit Statement

- ☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
- ☐ Day care centre, preschool, primary school
- ☒ Residential with minimal opportunity for soil access, including units
- ☐ Secondary school
- ☒ Park, recreational open space, playing field
- ☒ Commercial/industrial
- ☐ Other (please specify):

IF the site is remediated/~~managed~~* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title *Remediation Action Plan, 165 Milton Street, Ashbury, NSW*

Plan author Eiaustralia

Plan date 03 May 2019

No. of pages 51

SUBJECT to compliance with the following condition(s):

Overall comments:

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997*.

Accreditation no. 1004

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997*, and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed

Date



08th May 2019

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997* (CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of the *Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**:
nswauditors@epa.nsw.gov.au or as specified by the EPA
- AND
- the **local council** for the land which is the subject of the audit.

CORONATION PROPERTY CO. PTY LTD



Remediation Action Plan

165 Milton Street, Ashbury NSW

Document Control

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Copies		Recipient	
1	Soft Copy (PDF – Secured, issued by email)	Coronation Property Co. Pty Ltd 9-25 Coronation Street, Sydney NSW 2000	
2	Original (Saved to Digital Archives)	EI Australia Suite 6.01, 55 Miller Street, PYRMONT NSW 2009	
			
Author		Technical Reviewer	
SARI ERU Senior Environmental Scientist		MALCOLM DALE Senior Principal – Contaminated Land	
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Executive Summary

Coronation Property Co. Pty Ltd (the client) engaged Environmental Investigations (EI) to prepare a Remediation Action Plan (RAP) for the properties located at 165 - 171 Milton Street, Ashbury NSW (the site). The client proposes to redevelop the land for residential land use and EI understands preparation of this document will support the application for land rezoning to Canterbury - Bankstown council.

Preliminary contamination investigations were completed by earlier consultants and reported the historic use of the site to be commercial / industrial in nature and included the significant storage of petroleum chemicals within two underground storage tanks (USTs) and remain in-situ at the site. Hazardous building materials were identified within onsite structures, and a former brick-pit now landfill was identified at the western boundary of the land.

This RAP was developed to ensure the site can be made suitable for the proposed residential land use, by guiding site remediation, validation and additional investigation work. The required remediation includes:

Decommissioning of the in-situ USTs including excavation and removal of the tanks and 'chasing out' of any impacted material surrounding, methods for the classification and offsite disposal of all excavated material, and details the required validation of the resulting excavation to confirm effective removal of all potential risks posed to the end users of the site by these features;

Further assessment of soil in landscaping areas to be retained; and

Further ground gas sampling, using continuous sampling, to better assess the potential risks posed by ground gas migration at the site.

This will be achieved by:

- Detailing the additional investigation works required;
- Providing details on how to carry out remediation works in a safe and environmentally friendly manner, while minimising impacts; and
- Providing a sampling and quality plan (SAQP) to be used for site validation.
- Excavation of the in-situ USTs including stockpiling of the excavated material for offsite disposal;
- Soil sampling and classification of any excavated material for off-site disposal in accordance with NSW EPA guidelines;
- Classification of any remaining natural soils and/or bedrock as virgin excavated natural material (VENM), if appropriate, for the remainder of excess soils designated for basement excavation; and
- Validation of any remedial excavations involving the collection of soil validation samples and analysis for contaminants of concern. This includes preliminary indications of likely ground gas mitigation systems required.

Following completion of these works a Site Validation Report will be prepared in accordance with the OEH (2011) Guidelines for Consultants Reporting on Contaminated Sites stating that the results of remediation and site validation assessment meet the criteria for the proposed residential use.

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1. Introduction

1.1 Background

Coronation Property Co. Pty Ltd (the 'client') EI Australia (EI) to prepare this remedial action plan to assist the client with a land use rezoning application for residential activities to occur at 165 Milton Street, Ashbury NSW (the 'site'). As shown in **A.1, Appendix A**, the site is located within the local government area (LGA) of Canterbury - Bankstown Council.

EI understands that as well as the current site, the application for rezoning includes land at 149 – 163 Milton Street, however this RAP was developed for land at 165 Milton Street only, and the sites will be managed as separate development projects. Furthermore, EI understands a site auditor, accredited under the NSW EPA *Contaminated Land Management Act 1997* (The CLM Act) has been engaged, and this RAP will require approval from the site auditor, being Tim Chambers of Arcadis Australia Pacific Pty Ltd (Arcadis).

1.2 Proposed Development

Land within the site was zoned IN2, light industrial under the Canterbury Local Environment Plan (2012), however the client desires to re-develop land for high density residential use. Development plans were still in progress, however for development of the RAP, EI relied on the proposed vision for the development as drawn by SJB Architects (undated) and presented in **A.2, Appendix A**.

The plans indicate the complete demolition of all onsite structures will be required, to allow for the construction of a multi-level basement car park, with multi-storey residential properties overlying. A 500 m² deep soil landscaping area was proposed for the centre of the building and is expected along the boundaries of the site also, outside of the basement excavation.

1.3 Remedial Objective and Scope

The objective of this remedial action plan (RAP) was to assist the client in making the site suitable for residential use. The RAP will guide the additional works required, so they may occur in a safe and acceptable manner which comply with relevant guidelines while preventing adverse effects on receptors of the site, using the following scope of works:

- Detail the legislative framework governing the remedial works and identify key roles and responsibilities required to complete the remediation;
- Review all available data relevant to the remediation, including details of the site history, regional setting and previous investigations to identify the areas requiring remediation;
- Develop a remedial strategy for the site, including a review of all remediation technologies available and provision of the methods and procedures required in accordance with the relevant environmental legislation; and
- Provision of a validation strategy to evaluate the effectiveness of the remedial works and provide conclusions regarding site suitability.

2. Regulatory Framework

This RAP was prepared with consideration of various acts, standards and guidelines, and those of significance are presented below.

Table 2-1 Regulatory Framework for Remediation

NSW Regulation	Requirements
Environmental Planning and Assessment Act 1979 (EP&A Act)	The EP&A Act stipulates the regulations and gives rise to state environmental planning policy (SEPP) to assist regulators with the protection of human and environmental health.
Contaminated Land Management Act 1997 (CLM Act)	Promotes the effective management of contaminated land in NSW by setting out the roles and responsibilities of the EPA and the rules they use.
Protection of the Environment Operations Act 1997 (POEO Act)	The objective of the POEO Act is to achieve the protection, restoration and enhancement of the quality of the environment.
Environmentally Hazardous Chemicals Act 1985 (EHC Act)	Primary legislation for management and regulation of environmentally hazardous chemicals.
Work Health and Safety Act 2011 (WHS Act)	Primary legislation for management and regulation of work health and safety, including the management of hazardous building materials. Gives rise to the NSW Government Work Health and Safety Regulation, 2017.
State Environmental Protection Policies (SEPPs)	Assists the regulator with their responsibilities under the EP&A Act by detailing the indicators and objectives for the protection and preservation of the environment. For development of the RAP, the SEPP55 Remediation of Land (1998) was referred to. EI assumes the site will be a "Major Project" and therefore classifies as Category 1 Remedial work and requires consent.
National Protection (Assessment of Site Contamination) Measures, 1999, Amendment 2013 (NEPM)	Outlines methodology for contaminated land assessment and provides risk-based criteria for ecological and human health receptors of site contamination.
Local Government	The client was preparing for an application to Canterbury - Bankstown Council for land rezoning and no details of these conditions were known by EI at the preparation of this RAP. Consideration is required for the requirements of Canterbury - Bankstown's Local Environmental Plan (LEP) 2012 and Development Control Plan (DCP)
Australian Standards	Standards relevant to the RAP include, but are not limited to: AS 4482.1 (2005). Guide to the Sampling and Investigation of Potentially Contaminated Soil Part 1: Non-volatile and Semi-volatile Compounds; Table E1.
Relevant Guidelines	Guidelines relevant to the RAP include, but are not limited to: - ANZAST (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality; - CIRIA (2007), <i>Assessing Risks posed by Hazardous ground gasses to buildings</i>. Construction Industry Research and Information Association CIRIA C665 - DOP (2011) The Assessment Guideline – Multi-Level Risk Assessment (Ground Gas)

NSW Regulation	Requirements
	▪ HEPA, 2018 The PFAS National Environmental Management Plan; ▪ NSW EPA, 2012 Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases; ▪ NSW EPA, 2014. Waste Classification Guidelines. ▪ NSW EPA, 2017. Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme (3rd Edition); ▪ NSW OEH, 2011. Guidelines for Consultants Reporting on Contaminated Sites; and ▪ WA DoH, 2009. Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia.

2.1 Site Acceptance Criteria

Site acceptance criteria were developed as a benchmark to decide if soil or groundwater sampled during the additional works will pose an unacceptable risk to future users of the site. Much of the criteria was sourced from NEPM Schedule B (1), *Guideline on the Investigation Levels for Soil and Groundwater* as presented below.

Table 2-2 Site Acceptance Criteria

Target Medium	Criteria Applied
Soil for offsite disposal	Soil results for material designated for offsite disposal will be classified using the criteria presented in Tables 1 and 2 of the NSW EPA <i>Waste Classification Guidelines</i> , 2014. No ecological screening required.
Soil beneath basement structure	Material to be retained beneath the basement will be assessed against: ▪ NEPM Residential B Health-based Investigation Levels (HILs) for residential with minimal access to soil (HIL B); ▪ NEPM Soil Health Screening Levels (HSLs) for vapour intrusion (HSL-D) for commercial / industrial settings, for fine-textured (clay) soil; and ▪ NEPM HSL B for asbestos, for residential settings. No ecological screening is required.
Deep Soil / landscaping material.	All material to be retained in areas of landscaping and/or open space will require additional characterisation, to be assessed against NEPM Residential B Health-based Investigation Levels (HILs) for residential with minimal access to soil (HIL B); and NEPM Soil Health Screening Levels (HSLs) for vapour intrusion (HSL-B) for residential settings using values for fine-textured (clay) soil. Site specific ecological criteria will be derived using physicochemical properties of onsite soil, to incorporate any ambient background concentrations of contaminants within the site, as described in NEPM Schedule B1.
Groundwater	If required, groundwater results will be assessed against ANZAST (2018) criteria specific to protection of (marine) aquatic ecosystems, aesthetics as well as buildings and structures. Analysis should include determination of water hardness (as CaCO₂) and pH to adapt the criteria to the physiochemical properties of the waterbody. In addition to NEPM (2013) <i>Groundwater Investigation Levels</i> (GILs) for the protection of marine waters will be conferred with.

Target Medium	Criteria Applied
	Potential vapour intrusion from groundwater to users of the basement will be assessed using NEPM (2013) for vapour intrusion using commercial / industrial land use scenario (HSL D). Fine-textured (clay) soil strata values will represent strata of the site.

2.2 Ground Gas Assessment Approach

As defined in NSW EPA (2012), gas mitigation measures will be established by determining the gas screening value (GSV) threshold for raw landfill gas results using the following formula:

$$GSV (L/hr) = \text{maximum borehole flow rate (L/hr)} \times \text{maximum gas concentration (\%)}$$

The calculation is carried out for both methane and carbon dioxide, with the worst-case value adopted. The GSV is then compared to the GSV thresholds below, as reproduced from EPA (2012), to establish the characteristic gas situation (CS) for the site.

Table 2-3 Gas Screening Value Thresholds

Gas Screening Value Threshold (L/hr)	Characteristic gas situation	Risk Classification	Additional factors	Typical Sources
<0.007	1	Very low risk	Typical methane <1% v/v and/or carbon dioxide <5% v/v, otherwise Situation 2.	Natural soil with low organic content. Typical fill
<0.7	2	Low risk	Flow rate not to exceed 70 L/hr otherwise Situation .3.	Natural soil with high organic content. Fill
<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
<15	4	Moderate to high risk	Consider need for Level 3 Risk Assessment	Mine workings prone to flooding Closed putrescible waste landfill
<70	5	High risk	Level 3 Risk Assessment required	Shallow, un-flooded abandoned mine workings
>70	6	Very high risk		Recent putrescible waste landfill

- NOTE
1. Site characterisation should be based on data gained from an appropriate ground gas investigation as defined in Section 3.4 of the guidance.
 2. Source of gas and generation potential must be identified in the conceptual site model (CSM)
 3. Where there is no detectable flow, the lower measurement limit of the instrument will be used
 4. To determine a GSV of <0.07, instruments capable of making accurate concentration measurements to 0.5% v/v and flow to 0.1L/hr are recommended.

The gas protection guidance value for determining gas protection measures is established by comparing the CS calculated for the site against the proposed development scenario. The table for determining gas protection measures is presented in **Table 2-3 below**.

Table 2-4 Guidance values for Gas Protection

Characteristic Gas Situation	Required gas protection guidance value				
	Low Density Residential	Medium-High Density Residential	Public Buildings, Schools, Hospitals, Shopping Centres	Standard Commercial Buildings (offices etc.)	Large Commercial Buildings (Warehouses) and Industrial Buildings
1	0	0	0	0	0
2	3	3	3	2	1 ²
3	4	3	3	2	2
4	6 ³	5	5	4	3
5	6 ³	6 ³	6 ⁴	5	4
6	6 ³	6 ³	6 ⁴	6	6

Note 1 If maximum measured methane concentration exceeds 20%, increase to CS3.

Note 2 Residential development not recommended at CS4 and above without pathway intervention and high level of management.

Note 3 Consideration of evacuation issues and social risks required.

The remediation requirements necessary to allow the site to be suitable for the proposed development require ground gas mitigation measure to meet a gas protection guidance value of 2, using a combination of protection measures appropriate to the prevailing site conditions so that the combined score equals or exceeds the required guidance value. Table 8 of the guidance provides a score table for selecting the most appropriate gas protection measure to mitigate any potential LFG ingress, and is reproduced below.

Table 8: Scores for protection measures

Measure or system element	Score	Comments
Venting and dilution measures		
Passive sub-floor ventilation with very good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 0.3 m/s)	2.5	
Passive sub-floor ventilation with good performance (steady state concentration of methane over 100% of ventilation layer remains below 1% v/v at a wind speed of 1 m/s and below 2.5% v/v at a wind speed of 0.3 m/s)	1	If passive ventilation cannot meet this requirement an active system will be required.
Subfloor ventilation with active abstraction or pressurisation	2.5	Robust management systems must be in place to ensure long-term operation and maintenance.
Ventilated car park (basement or undercroft)	4	Assumes that car park is vented to deal with exhaust fumes in accordance with BCA ^(a) requirements.
Floor slabs		
Reinforced concrete ground bearing floor slab	0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations cast into slab	1	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain these performances.
Reinforced concrete cast in situ or post-tensioned slab with minimal service penetrations and water bars around all penetrations and at joints	1.5	
Fully tanked basement	2	
Membranes		
Taped and sealed membrane to reasonable levels of workmanship with inspection and validation	0.5	The performance of membranes is dependent upon the design and quality of the installation, protection from and resistance to damage post installation and the integrity of joints in membranes that require joints. Materials that offer some degree of self-sealing and repair are preferred.
Proprietary gas-resistant membrane to reasonable levels of workmanship under independent construction quality assurance (CQA)	1	
Proprietary gas resistant membrane to reasonable levels of workmanship under independent CQA with integrity testing and independent validation	2	
Monitoring and detection (alarms)		
Intermittent monitoring using hand-held equipment	0.5	Monitoring and alarm systems are only valid as part of a combined gas protection system. Where fitted, permanent systems should be installed in the underfloor venting system but can also be provided in the occupied space as a back-up.
Permanent monitoring system installed in the occupied space of the building	1	
Permanent monitoring system installed in the underfloor venting / dilution system	2	
Pathway intervention		
Vertical barriers	–	Required for residential and public buildings at CS4 and above.
Vertical venting systems	–	

^(a) Building Code of Australia

3. Site Setting

The site was an irregularly shaped land block referred to as lots B & C in deposited plan (DP) 30778 and covers approximately 1.654 hectares (ha). Current zoning is IN2 – *Light Industrial* and was understood to have been used for commercial / industrial purposes since at least the 1930's. The investigation revealed minor impacts to surface fill resulting from the weathering of hazardous building material and identified the presence of a former brick pit turned landfill, (W H Wagner Oval) directly to the west. Further environmental works are required to manage the risks identified, and development of this RAP was required to guide these works and assist the client in making the land suitable for the intended use.

3.1 Previous Reports

Previous environmental assessments completed at the site were relied on for development of this RAP, being:

- EI (2014) *Coronation Property Co Pty Ltd Preliminary Environmental Site Assessment Report, 165 Milton Street Ashbury NSW* Report No. E22232 AA Rev0, dated 15 August 2014 (referred to as the PSI); and
- Environmental Investigation Services (EIS) (2018) *Report to Coronation Property Co Pty Ltd on Stage 2 Environmental Site Assessment for proposed rezoning for future development at 165 Milton Street Ashbury NSW* Report Ref. E31803KBrpt-rev1, dated 8 November 2018 (referred to as the DSI).

The DSI reviewed the data presented by the PSI and no comments from the auditor were received during development of this RAP. Details of the site setting were collated using the above reports, as follows.

3.2 Site Description

Pertinent information regarding the site setting were:

Table 3-1 Site Setting

Relevant Info	Summary
Site Address and zoning	165 Milton Street, Ashbury NSW, being Lot A of DP 30778. GDA94-MGA55 site descriptor: Easting: 881083.686, Northing: 6241669.007 (Source: http://maps.six.nsw.gov.au). The land is currently zoned IN2 – light industrial use however a proposal for re-zoning has been submitted, to allow for R4 – high density residential use.
Site Topography & drainage	An irregular shaped land parcel covering approximately 1.49 hectares (14,870 m ²), the site topography was sloping west from an approximate elevation of 40 meters Australian height datum (mAHD) in the north east, reducing to 36.2 mAHD in the south west. Consistent with the general slope of the site, stormwater is assumed to flow west via drainage systems discharging to various stormwater easements and the municipal stormwater system.
Current Setting	The site was occupied by a warehouse, with concrete hardstand across much of the land.
Sensitive receptors to site	Ashbury public school (330 m south), Woodstock childcare centre (320 m northwest) and St. Francis Xavier's primary school (450 m west) were considered sensitive human receptors of the site.

Relevant Info	Summary
Regional Setting	The Soil Conservation Service of NSW Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman and Murphy, 2002) indicates that the site overlies an <i>Erosional Landscape – Blacktown (Bt)</i>. The 1:100,000 scale Geological Series Sheet 9130 (Sydney) indicated the site was underlain by Ashfield Shale of the Wianamatta Group, which typically comprises black to dark grey shale and laminite. The upper zones of Ashfield Shale generally consist of weathered silty clay of medium to high plasticity. The Botany Bay Acid Sulfate Soil Risk Map (1:25,000 scale; Murphy, 1997) and the Canterbury City Council LEP 2012- Acid Sulfate Soils Risk Map indicated that the site lies within an area of no known occurrences, and as such, acid sulphate soils (ASS) are not known or expected to occur and "land management activities are not likely to be affected by ASS materials".
Groundwater	The DSI reported standing water levels (SWL) beneath the site as 2.27 to 5.15 meters below ground level (mBGL). Aquifer confinement is likely, and groundwater was observed to be slightly acidic (pH of 5-6) and brackish (EC range 340µs/cm to 5,400 µs/cm) and was hard (14 – 340 mg CaCO₃). Groundwater migration occurred through flow paths of least resistance within the rock mass (i.e. joints and bedding planes) in a generally southwest direction. Cooks river, a marine feature (1 km south west) and an artificial pond within the grounds of Canterbury Park Racecourse were the likely receptors of the waterbody migrating from site, however given the distance were not considered as sensitive.

3.3 Site History

The PSI and DSI completed in depth desktop studies of the historic activities that have occurred at the site and revealed the land to have been part of a larger land parcel operated by the Ashfield Brickworks until at least 1961. The site was then developed into a large commercial warehouse by Moran and Cato (NSW) Pty Ltd, being a large chain of grocery stores. Two underground storage tanks (UST's) were installed within the northern driveway. Land use activities remained commercial in nature from 1960 to date, with the most recent activity noted as being a tyre repair warehouse.

No significantly contaminated land was identified in the vicinity of the site that presented a significant risk of harm to the current site.

3.4 Soil Investigations

Soil was assessed by previous investigations using thirty (30) soil sampling locations, meeting the minimum sampling density requirements. The sampling density provides for the detection of a hotspot diameter of 26m or greater, with 95% confidence. The soil sampling events included field screening of soil for visual and olfactory signs of contamination and included field screening of volatiles using a photoionisation device (PID). All PID readings recorded volatile organic compounds (VOCs) less than 10 parts per million (PPM) and volatile contaminants were not considered to be of concern to the site. Laboratory analysis of soil included analysis of the eight priority heavy metals, being arsenic (As) cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni) and zinc (Zn), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) organochlorine and organophosphorus pesticides (OCP and OPP), polychlorinated biphenyls (PCBs) and asbestos (qualitative) The sampling was completed as follows:

- EI (2014) sampled fill and natural soil from 14 locations distributed in a grid-based sampling pattern with allowance given to onsite obstructions and areas of environmental concern. No significant contamination was identified, and sampling did not indicate residual impacts to soil from the in-situ USTs. Analytical results of 22 soil samples indicated elevated

concentrations of heavy metals in fill, exceeding ecological criteria however no contaminants of concern were found to report concentrations in excess of the adopted human health criteria. Furthermore, seventeen surface samples were collected and evaluated for the presence of asbestos, and no asbestos was detected. A single fibrous cement sheeting fragment was identified near BH14, however the laboratory analysis did not report asbestos as present within the soil or the fragment submitted from this part of the site.

- EIS (2018) collected samples from sixteen sample locations in an approximate 25m grid-based sampling pattern. Samples BH105 to BH108 targeted the in-situ USTs and no impacts to soil were revealed.

3.5 Groundwater Investigations

Groundwater beneath the site was assessed using newly installed groundwater wells, and samples analysed for heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), TRH, BTEX, PAH, and volatile organic compounds (VOCs) with the findings being:

- EI (2014) installed five groundwater monitoring wells (MW1 – MW5), in July 2014. Hydrocarbon odours were recorded at locations MW1 and MW5 and TRH F3 was detected in groundwater from an unknown source. Long chained hydrocarbons (F3 fraction) are commonly known to be of low / no mobility, therefore the risk posed by the reported concentrations was considered low. Naphthalene was reported in groundwater sampled at MW1, MW3 and MW5 however were below the adopted criteria, and chloroform was detected in sample MW5-1 however was not considered to be of concern.
- EIS (2018) utilised three monitoring wells installed by EI (MW1, MW4 and MW5) and a newly installed well (MW105) and standing water levels (SWL) observed groundwater at 1.28 to 6.59 mBGL. MW105 was positioned down gradient of the USTs. No hydrocarbon odours were detected and the elevated heavy metal concentrations reported were considered representative of groundwater within an urban environment. Groundwater did not exceed the criteria for residential use, however given the below ground excavation required for the basement, further assessment of the data may be required once the final basement design is completed, to assess the potential direct contact risk of the waterbody to the basement structure.

3.6 Potential sources of contamination

Based on the findings of previous reports, the following sources of contamination were identified, and were considered relevant to the RAP.

3.6.1 Vehicle refuelling and in-situ USTs

Moran & Cato occupied the site from 1961 and WorkCover records indicate that two 1,000-gallon USTs were installed to store mineral spirits, and no documentation regarding decommissioning were included. The EIS (2018) assessment included a survey of the former UST location using ground penetrating radar (GPR) and found the USTs to remain in-situ within the site. The survey indicated the USTs to be present 1 – 2 mBGL, positioned side by side, within the northern driveway. The position of the tanks is indicated on the site plan, **A-2 Appendix A**.

3.6.2 Brick Pit / Former Landfill

The PSI indicated an area of interest to the west of site, being the former quarry excavation pit, now reinstated and used as the W H Wagner Oval. WH Wagner Oval was formerly used as an extraction pit and the natural material was extracted for the manufacture of bricks. The operation included land of the current site until the 1960's and the use of glazes in kilns were considered a potential source of heavy metal (HM) contaminants (being arsenic, cadmium, chromium, copper, lead, mercury nickel and zinc) and polycyclic aromatic hydrocarbons (PAH).

3.6.3 Ground Gas

Filling of the quarry pit occurred from 1961 to 1965 with the oval appearing as it is today, in the 1970 aerial photographs. A preliminary ground gas assessment was completed by EIS (2018) which determined a characteristic gas situation (CS) of 3. Ground gas was considered a moderate risk for the site. Elevated carbon dioxide (CO₂) was revealed however sampling did not occur during the worst-case meteorological conditions as required by the guidance. The assessment did not define the source of CO₂ which may include

- The adjoining former landfill (now WH Wagner Oval). The current site and is approximately 50-55 m from the edge former brickpit. The landfill is now considered mature being 49 years old and probably in the aerobic phase where methane is reducing and is probably of limited source potential. The former brickpit was up to 15 m deep (GSNSW, 1976) and comprised grey shale with 4 thin siltstone beds interspersed unevenly throughout the face;
- The adjacent in-situ USTs which may have resulted in soil impacts surrounding the tanks. The DSI included soil and groundwater sampling of material surrounding the tanks and no significant contamination was revealed. However, some residual contamination (below sensitive land-use criteria) is possible and if present, the natural bacterial degradation of the hydrocarbon compounds produces methane (in anaerobic conditions) and carbon dioxide (in aerobic conditions);
- Degradation of the natural organic matter in the Ashfield Shales. The Ashfield Shales generally contain <1.5% carbon (Herbert, 1979) which is well below the 3% total organic carbon required to be a concern for the generation of ground gas (EPA, 2012) and would therefore be considered a low risk site. CO₂ measured in samples of shale ranged from 2.72 to 6.8% (Herbert, 1979 however the method to determine the concentration is unknown);
- The degradation of carbonate materials in the Ashfield Shale. Calcite (CaCO₃) is relatively insignificant in the Ashfield Shale (<1%, Herbert, 1979), however siderite (FeCO₃) is finely disseminated throughout the shales and may be up to 10 – 12% of the shale (Herbert, 1979). The CO₂ would be released in the weathering process and with contact with acidic groundwater (pH 5-6 measured wells in EI, 2016),
- Gassing from the dissolved gases in the groundwater, and
- Known or unknown services (sewer or gas pipes) in the vicinity of the monitoring locations.

A tier three assessment is recommended to determine the actual risk of ground gas to the future users of the site.

4. Conceptual Site Model

A conceptual site model (CSM) was maintained by EI throughout the environmental works to assist with collection of data. Key features are described below.

4.1 Site Strata

Current site was described as a layer of fill overlying residual soil with Ashfield shale bedrock. Fill across the site was generally found to be 0.5 – 1.0 m thick, with greater lenses of filling observed in the west. Residual soil was fine grained and of moderate plasticity, and shale bedrock was encountered at depths ranging from 0.4 to 4.1 mBGL.

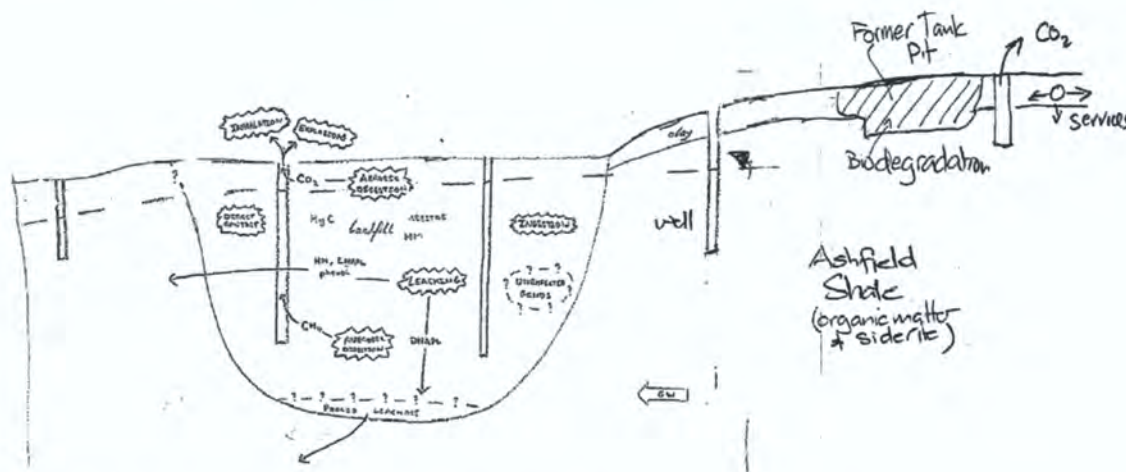
4.2 Contamination Pathways

The primary sources of contamination identified for the site were defined using the findings of previous investigations (Section 3) and an updated likelihood of exposure was derived for each of the source – receptor pathways applicable to the remedial works, as presented in **Table 4-1**.

Table 4-1 Receptor and Exposure Pathways

Media	Exposure Pathway	Potential Receptor	Likelihood of Exposure
Material surrounding in-situ USTs	Dermal contact Ingestion Inhalation Vapour intrusion	Construction and Maintenance Workers Groundwater Users of basement (if residual contamination is identified at end use)	Exposure potential considered minimal based on the minor contaminant concentrations reported. Validation sampling of volatile concentrations should confirm no residual migration to soil vapour exists and should significant impacts to soil be identified, further groundwater characterisation may be required.
Fill within ecological / landscaping areas	Bioaccumulation Sediment migration	Ecological communities	Elevated concentrations of heavy metals were identified and a site-specific ecological assessment of all retained fill will be required to confirm suitability of the material for use.
Groundwater	Vapour intrusion Offsite migration to Cooks River / artificial pond	Users of basement Offsite residents and receiving waterbodies	Exposure potential low based on contaminant concentrations identified however should significant impacts to soil be revealed, further assessment may be required.
Air	Vapour intrusion to basement Ground Gas Migration to indoor air and crawl space via diffusion, advection and solubility	Future site occupants Construction and Maintenance Workers Offsite residents	The preliminary ground gas assessment derived a Characteristic Gas Situation (CS) of CS3. Ground gas migration was therefore considered a moderate risk (EPA, 2012).

To further assist in understanding the ground gas conditions of the site, a schematic conceptual site model (CSM) was sketched and is presented below, with an updated CSM for ground gas presented in detail within EI (2019), applicable to remedial stages of the work.



4.3 Data Gaps

- The quality of material surrounding the in-situ USTs;
- The worst – case ground gas scenario posed by the presence of the historic landfill, west of site. EI (2019) involved a preliminary assessment and potentially underestimates the likelihood of risk as the time period of sampling was minimal and did not consider the effects of seasonal weather conditions;
- The development design has yet to be completed, and current plans were conceptual only. The basement levels (one or multiple), location and basement excavation level are unknown.
- The source of the CO₂ is postulated only and may not be able to be fully identified even with considerable further investigation.

The preliminary risk characterisation could be modified (up or down) with further investigation but as noted above some uncertainties may remain.

5. Remedial Strategy

5.1 Remediation Required

Preliminary assessments found groundwater at the site to be suitable for rezoning to residential use, however assessment of the site surface, post demolition, was required for soil to be deemed as suitable. Should any unsuitable impacts to soil be found from the additional works, either by asbestos or chemical contaminants, procedures to remove these impacts will be implemented, and the area validated.

- Decommissioning, removal and validation of the in-situ UPSS;
- Assessment and remediation of asbestos impacts in fill at former EI sampling locations BH19 and BH4m (See A.2, Appendix A); and
- Onsite ground gas sampling using continuous sampling, to assess worst case scenario and derive a site-specific characteristic gas situation (CS) and will conclude on any mitigation measures required for implementation to the final design;

EI understands the current purpose of this document is for rezoning consideration, final design of the development has yet to be completed. Inclusion of the design requirements for ground gas mitigation will be essential to ensuring the site achieves suitability for the proposed end use of the site.

5.2 Remediation Goals

The main objective of this RAP is to make the site suitable for high density residential use. Remediation goals were developed in line with relevant legislation and include:

- Selection of a suitable strategy which contributes positively to the future condition of the area;
- Define site acceptance criteria, to be applied as a benchmark to assess the suitability of material to remain at the end use of the site;
- Detail any site-specific contaminant specifications to be considered during the development of site-specific construction and environmental management plans, including material handling and management requirements, contingency measures and waste minimisation requirements as required by the *Waste Avoidance and Resource Recovery Act 2001*;
- Detail the methods and procedures to be implemented for site remediation, to guide the earthworks and assist the client in meeting the required objectives of the work; and
- Provision of a sampling and quality plan (SAQP) for site validation which will demonstrate the effectiveness of the remedial works and provide conclusions regarding the suitability of land for the intended use.

The remediation required for the site is the removal and validation of the in-situ UST's. Additional ground gas characterisation is also necessary, to adequately define the ground gas control requirements that require inclusion to the development design.

As no exceedances were identified in soil at the site, further sampling for waste classification is not considered a remediation activity as the soil is not unsuitable for use. Waste assessment works are required for offsite disposal of the material and will be completed separately from the remediation. However, data collected from the waste assessment may be required for

validation purposes. Should significant contamination be identified during the additional sampling events, the unexpected finds protocol as presented in **Appendix C** of this RAP will be initiated, and significant contamination may be addressed via an addendum.

5.3 Technology Review / Preferred Remedial Option

Exact details of the development are yet to be defined; however, the client has confirmed the need for significant soil excavation and removal for basement construction. Based on the identified areas requiring remediation and the contaminants of concern, development design and the likelihood of risk remedial techniques were evaluated, and selected on consideration of practicality, cost and long-term management requirements.

NEPM 2013 guidelines (Volume 1 Section 16) details the preferred hierarchy of remedial technologies available for land contamination. Site specific consideration was given to:

- Requirements of the proposed development including future conditions of consent;
- The nature and behaviour of the contaminants identified;
- Effectiveness of the remedial method within site setting with respect to material and infrastructure limitations;
- Development project timeline and budget constraints;
- Consideration of the adverse effects resulting from the remediation, to ensure these effects do not outweigh the benefit gained from completing the works; and
- The ability to achieve regulatory compliance.

A number of soil and groundwater remediation technologies were also reviewed as part of the remedial options review process, using the following primary information sources:

- US EPA CLU-IN website (<https://clu-in.org/remediation/>); and
- Recent experience with landfills in the Sydney Metropolitan area (including site auditor review and sign-off).

Discussion on the various remediation technology options is provided in **Appendix B**. Each of the available remediation technologies except ones that are not commonly used in Australia (like in-situ thermal or steam injection) are summarised and ranked in terms of their suitability for treatment of soil and ground gas and the ranking process is further discussed in **Appendix B** and included the following site specific considerations:

- Basement excavation will likely cover much of the site area, resulting in the bulk removal of much of the site soil currently in-situ.
- Deep soil areas will be present and will retain the natural strata of the site (and fill if deemed suitable);
- Avoidance of long-term management was preferred by the client,
- Demolition of above ground structures is required to gain access to the site surface.

Given the above, and the identified contamination requiring remediation, excavation of impacted material was selected to best fit the contamination identified at the site, and either offsite disposal and/or onsite containment will be adopted to manage the excavated spoil, once the contamination status of the site is adequately quantified.

5.4 Ground Gas Management Strategy

To make the site suitable for residential use, mitigation and/ or management elements will be required within the final design of structures to reduce the risk posed by ground gas migration to

an acceptable level. A site-specific CS has yet to be defined, however given the preliminary indications reported for surrounding land, did not suggest the presence of ground gas requiring management. EI considers it likely that at vented basement would be the likely mitigation strategy, should management be required (i.e. for a CS of 3 or less). Key Stakeholders

The roles and responsibilities of key stakeholders involved with the remedial works are presented in the table below.

Table 5-1 Roles and Responsibilities

Role	Key stakeholder
Client Representative – Management of development works on behalf of site owner, superintendent.	Coronation Property Co. Pty Ltd
Remediation Contractor – responsible for earthworks, construction and site preparation works including notification to council and waste disposal documentation / tracking. Development of management plans and systems and establishment of mitigation / control measures required during remedial works.	Coronation Property Co. Pty Ltd
Environmental Consultant – Responsible for preparation of the RAP and assistance with implementation. Collection of validation samples and evaluate the effectiveness of remediation to conclude on site suitability.	EI Australia
Regulating Authority – Responsible for award of consent and regulator of consent conditions	Director General of the NSW Department of Planning and Canterbury - Bankstown Council

5.5 Deviations from RAP

While it may be possible to vary the sequence and/or details of the remediation and validation works to meet site constraints, a qualified Environmental Scientist should be appointed to the project to ensure:

- Critical stages of the site remediation/validation process are appropriately supervised, implemented and documented, with the relevant data collected for environmental reporting purposes; and
- Any deviations from the works specified in this RAP are properly documented and approved, as required under the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*.

Performing remedial and validation works without the presence of a qualified environmental engineer/scientist when necessary may lead to project delays and extra costs due to additional environmental requirements imposed by regulatory authorities. Furthermore, spoil removed from the site without proper waste classification may lead to regulatory action and potential penalties under the POEO and CLM Acts.

5.6 Work Health Safety

The site owner / developer responsible for implementing health and safety procedures should induct all site personnel so that they are aware of and comply with, the requirements of this document. It is the contractor's responsibility, with assistance from client/owner(s) of the site to ensure that all other permits, approvals, consents or licences are current. The following hazards and relevant to the remedial works are presented below.

Table 5-2 Remedial Hazards & Mitigation

Potential Hazards / Issues	Mitigation Measures	Risk Rating
Physical Hazards	The following hazards are associated with conditions that may be created during site works: - Heat exposure; - Buried services; - Noise, vibration and dust; - Electrical equipment; and - The operation of heavy plant equipment	Moderate during site preparation and construction
Discovery of hazardous wastes (lead batteries / corrosive waste)	Use Unexpected Finds Protocol (Appendix C)	Low
Potential for explosive or toxic atmosphere, particularly during excavation	- During excavation activities continually monitor for explosive atmospheres with a Combustible Gas Detector. - Record LEL readings at pre-determined time intervals. This is to be agreed by Environmental Consultant and Site Contractor prior to works commencing on site. - Works must cease if LEL readings exceed action levels specified in the WHS plan (Chemical Hazard Action Levels) and can only recommence after a gas test has been completed of the site, and the site has been re-cleared for explosive gases. - No ignition sources to be used within defined work area (mobile phones, cigarettes, etc.); - Keep fire extinguishers (2 x 9 kg) within easy reach of personnel (i.e. within 10 m of the work area and outside of the field vehicle).	Moderate for CO ₂ , low for all other ground gas compounds.
Exposure to ground gas contaminants during excavation Unnecessary contact with contaminated substances or materials is to be avoided	- Use of PID to monitor chemical concentrations in operator breathing zone during excavation works. Action to be set based on NIOSH levels. - If monitoring alarm sounds, stop work, move upwind and contact PM for further advice. - Respirators only to be used if user is correctly fit tested and appropriate filters are available. - Use a half-face respirator (with appropriate organic filter) if PID action level is reached. - Ensure appropriate PPE is used (e.g. nitrile gloves, respirator, etc.).	Low given lack of significant contamination identified.
Exposure to asbestos during excavation / Asbestos Hazards	A licenced contractor shall prepare an asbestos management plan (AMP) prior to the excavation of asbestos impacted soils. The AMP shall detail methods for preventing the migration of asbestos impacted soils and dusts. Asbestos-soils to be managed in accordance with WorkCover/EPA requirements (Ref. NSW WorkCover Publication Cat No. WC01253, March 2014).	Moderate given identification of ACM at surface.
Exposure to contaminants in soil (contaminated land) during sampling	Contaminated sites have chemical compounds, substances or materials that may present a risk to human health and the environment. Chemicals of concern and associated risks are as detailed within the Conceptual Site Model, Section 4 . The site specific WHS plan should set out controls to mitigate any potential risks. Should significantly impacted / odorous soil be encountered then the following will be required: Use PID/LEL to monitor air quality in operator breathing zone.	Low – no significant contamination identified.

	- Ensure appropriate PPE is used (e.g. nitrile gloves, respirator, etc.) - Eating, drinking, smoking, and chewing gum are strictly prohibited during field work involving potential exposure to hazardous substances. - Unnecessary contact with contaminated substances or materials is to be avoided. - Personnel should thoroughly wash their hands and face following field activities before eating, drinking or smoking	
Sediment migration and erosion due to ponding, flooding and excessive runoff	Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures may include: - construction of diversion channels and linear drainage sumps with catch pits in the remediation area to divert stormwater; - provision of sediment traps, including geo-textiles or hay bales; and - only discharging water that meets the appropriate effluent discharge consent condition under the Protection of the Environmental Operations Act. Onsite surface water shall be managed in accordance with Council's Design Specifications and relevant codes of practice. The design should allow for surface water flows and groundwater seepage.	Moderate given removal of hardstand required to inspect surface.
During Remediation: Generation of dust and air pollution from excavation activities and through wind erosion, including vapours, odours and airborne, solid particulate matter	Appropriate measures shall be taken to ensure that no nuisance emissions leave the site boundary. Measures include: - Working in favourable, low wind weather conditions. Wind speed and direction will be considered during all site works; - Periodic atmospheric monitoring will be completed in the vicinity of the works using a photo-ionisation detector (PID) and LEL to detect the presence of organic chemicals; - Appropriate action levels for the PID readings (refer to the CEMP) will be developed to protect site personnel. - If odorous material is encountered during excavation works and the site supervisor believes that the odour may impact on neighbouring properties, work shall stop until the HSE representative is contacted and appropriate engineering controls are implemented. The offending material will be stored in a separate stockpile, if necessary, it may be covered with a plastic sheet (tarpaulin) to minimise the odour emission; and - The presence and movement of dust will be monitored during any works that disturb earth (in-situ or already excavated). If the level of dust becomes excessive or if dust begins to migrate off-site, dust generating work will cease until dust suppression equipment (water spray) is utilised or dust generating conditions abate. Dust suppression measures should be appropriate for the specific works and should aim to prevent dust from leaving the site. These may include: - use of water carts or dust suppression sprays, - provision of screens, and - work restrictions during windy periods.	Low for concentrations of contaminants identified.
Vehicle movement and earthworks	Cover loads of excavated material and other erodible materials that are transported to or from the work site.	Moderate given

generating dust	Avoid work in windy periods	earthworks required
Wind erosion of exposed soil surfaces	Keep areas adjacent to the work sites, including roadways, free of construction soil or dust. Monitor all work sites, general work areas, stockpiles and skip bins for dust generation and water down or cover affected areas. Minimise soil and vegetation disturbance, in order to minimise erosion.	Moderate (as above)
Public complaints regarding odours / dust	Sign to identify the site manager's number. The contact number is to be available 24hrs a day / 7 days a week to receive comments and complaints, including emergencies.	Moderate

5.7 Materials Handling

During remedial and bulk excavation works, material handling and management measures will be required to reduce the risk of cross contamination and to ensure contamination does not migrate beyond the site boundary in an unauthorised manner. **Table 5-3** presents items which require consideration.

Table 5-3 Materials Handling and Management Requirements

Item	Description/ Requirements
Excavation Contractors	Excavation should be completed by a suitably qualified contractor to ensure staff are aware of the sites environmental, health and safety requirements, that all adverse effects are either mitigated, isolated or reduced, no nuisance effects or uncontrolled discharge occurs because of the works and any pollution incidents, health impacts or complaints are appropriately managed.
Stockpiling of Materials	All stockpiles will be maintained as follows: ▪ Present on sealed surfaces such as concrete, asphalt, or high-density polyethylene. If placed on bare soil, the land will be over-excavated to ensure adequate removal of all impacted material and located in areas of the site which do not pose environmental risk (e.g. sheltered areas). ▪ No greater than 2m in height, be appropriately battered and sediment measures surrounding each base to manage stormwater runoff. Material will either be covered or kept moist to prevent dust blow. ▪ Stockpiles will be in approved locations of the site, selected to mitigate environmental impacts while facilitating material handling requirements. Any contaminated material will only be stockpiled in non-remediated areas of the site or at locations that do not pose any risk (e.g. sheltered areas). Should the stockpile remain in-situ for over 24 hours, silt fences or hay bales should be erected around each stockpile to prevent losses from surface erosion (runoff)

Item	Description/ Requirements
Loading / Transport of Material (off-site)	Material shall be transported via a clearly distinguished haul route defined within construction management plans. All haulage routes for trucks transporting soil, materials, equipment and machinery shall comply with all road traffic rules, minimise noise, vibration and odour to adjacent premises, utilise state roads and minimise use of local road. Implementation of sediment measures to reduce the mechanical movement of soil onto public roadways or vehicle wheels is required, such as wheel washing/cleaning facilities placed at each site entry/exit. Any residue from the cleaning facility will be collected and deemed contaminated unless proven otherwise. Spool material will require offsite disposal. Trucks transporting soils from the site are to be covered with tarpaulins (or equivalent). All deliveries of soil, materials equipment or machinery should be completed during the approved hours of remediation and exit the site in a forward direction. Removal of waste materials from the site shall only be carried out by a recognised contractor holding the appropriate EPA NSW licenses, consents and approvals.
Soil Management	Appropriate measures shall be taken to ensure soils are excavated using a methodology appropriate to reduce nuisance dust and odours from leaving the boundary and are disposed of in accordance with the NSW Government <i>Protection of the Environment Operations (Waste) Regulation</i> (2014). Materials excavated from the site should be tracked from the time of their excavation until their disposal ("cradle to grave"). Tracking of the excavated materials should be completed by recording the following: ▪ Origin of material; ▪ Material type; ▪ Approximate volume; and ▪ Truck registration number. Disposal locations will be determined by the remediation contractor and the receiving facility, weighbridge dockets and waste certification information should be provided to the environmental consultant for validation reporting.

5.8 Operational Measures

All work should be undertaken with due regard to the minimisation of environmental effects and to meet all statutory environmental and safety requirements. A CEMP should be developed for the site works by the site contractor/builder, which considers relevant guidance including, but not limited to:

- DA Conditions of Consent;
- Canterbury - Bankstown Development Control Plan; and
- Managing Urban Stormwater, Soils and Construction, Volume 1: 4th edition (March 2004) – often referred to as the 'blue book'.

Site management requirements for the remediation are presented in **Table 5-4**.

Table 5-4 Site Management Measures

Category	Measure
Demolition (including Asbestos Management)	Appropriate measures shall be taken to ensure that demolition works are completed in accordance with WorkCover Standards and Codes of Practice. Any asbestos identified within building materials should be managed in accordance with WorkCover Codes of Practice and Australian Standards, and should be detailed within the EMP.
Site Stormwater Management and	Appropriate measures shall be taken to ensure that potentially contaminated water does not leave the site. Such measures should include, but not be limited

Category	Measure
Control	to: ▪ Diversion and isolation of any stormwater from any contaminated areas; ▪ Provision of sediment traps including geotextiles or hay bales; and ▪ Discharge of any water to drains and water bodies must meet the appropriate effluent discharge consent condition under the <i>Protection of the Environmental Operations Act</i>.
Dust and Odour	Control of dust and odour during the course of the remediation works shall be maintained by the contractor to ensure no nuisance dust or odours are received at the site boundary according to requirements of Canterbury - Bankstown DCP. Action levels and specific control measures would be described in the site construction phase environmental management plan (CEMP) and may include, but will not be limited to the following: ▪ Site wide water spraying, as and when appropriate, to eliminate wind-blown dust; ▪ Use of mist sprays, and/or sprinklers on stockpiles, fill screening areas and loaded fill to lightly condition the material; ▪ Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; ▪ Covering of stockpiles or loads with polythene or geotextile membranes; ▪ Restriction of stockpile heights to 2.0 m above surrounding site level; ▪ Ceasing works during periods of inclement weather such as high winds or heavy rain; and ▪ Regular checking of the fugitive dust and odour issues to ensure compliance with the CEMP requirements, undertaking immediate remedial measures to rectify any cases of excessive dust or odour (e.g. use of misting sprays or odour masking agent). EI notes the Council Contaminated Land Policy requires that "No odours shall be detected at any boundary of the site during remediation works by a Council officer who is authorized under the POEO Act and who is relying solely on their sense of smell." Should significant odours be detected, additional control measures for odour control may be required under the Canterbury - Bankstown contaminated land policy, being: ▪ Use of appropriate covering techniques such as plastic sheeting to cover excavation faces; ▪ Use of fine mist sprays / mitigation agent on the impacted areas/materials (Examples of mitigation agents include BioSolve® Pinkwater®, or Anotech, however a similar product may be selected by the contractor); and ▪ Adequate maintenance of equipment and machinery to minimize exhaust emissions.
Noise and Vibration	Noise and vibration will be restricted to reasonable levels. All plant and machinery used on site will be noise muffled to ensure that noise emissions do not breach statutory levels as defined within the Canterbury - Bankstown DCP (2011).
Hours of Operation	Working hours will be restricted to those specified by Council, which are defined as being 7am to 7pm weekdays and 7am to 5pm Saturdays; no Sunday work permitted. These hours may differ from DA conditions, and DA conditions specified for the site must be adhered to.

Category	Measure
Community Engagement	Community engagement should be carried out in accordance with Schedule B (8) of NEPM (2013). Prior to the commencement of any remediation works at the site, every owner and occupier of any land located either wholly or partly within 100 m of the boundary of the premises (including local council and the RMS) should be notified at least 30 days in advance. The notice should include: ▪ Advice of demolition & excavation work to be carried out on the premises; ▪ State the time and date such work is to commence; ▪ Indicate that the works are being conducted to minimise any risk of site contamination impacting on off-site receptors; ▪ Provide appropriate site signage at an easily readable location on the site fencing, including site contact name and phone number to be contacted should any matter arise; provide the phone number of a person present on the premises whilst remediation works are being undertaken; and ▪ Provide contact information and procedure for registering any complaints.
Incident Management and Community Relations	While various environmental management and occupational safety plans will be developed to protect human health and the environment, incidents may occur which pose a risk to the various stakeholders. To mitigate these risks and ensure that a suitable response is carried out quickly, a response plan to any incident that may occur on site should be prepared and various responsibilities assigned. The site health and safety plan and environmental management plan should document these procedures and responsibilities, and incident contact numbers should be maintained in an on-site register. All other relevant emergency contact numbers such as Police, Fire Brigade, and Hospital should be listed in the Health and Safety Plan and posted on-site for easy access.

5.9 Contingency Management

Contingency plans for anticipated problems that may arise on-site during the course of the site preparation works comprising demolition and remediation are presented below.

Table 5-5 Contingency Management Requirements

Anticipated Problems	Corrective Actions
Chemical/ fuel spill	Stop work, notify above site project manager. Use accessible soil or appropriate absorbent material on site to absorb the spill (if practicable). Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Excessive Dust	Use water sprays to suppress the dust or stop site activities generating the dust until it abates.
Excessive Noise	Identify the source, isolate the source if possible, modify the actions of the source or erect temporary noise barriers if required.
Excessive Odours	Stage works to minimise odours. If excessive organic odours are being generated, stop works and monitor ambient air across site for LFG with a landfill gas meter at site boundaries. Implement control measures including use of odour suppressants, wetting down of excavated material.

Anticipated Problems	Corrective Actions
Excessive rainfall	Ensure sediment and surface water controls are operating correctly. If possible, divert surface water away from active work areas or excavations.
Water in excavations	Collect samples and assess against relevant EPA (2014) Waste Classification Guidelines assessment criteria, to enable disposal options to be formulated.
Leaking machinery or equipment	Stop the identified leak (if possible). Clean up the spill with absorbent material. Stockpile the impacted material in a secure location, sample and determine the appropriate disposal/treatment option.
Failure of erosion or sedimentation control measures	Stop work, repair failed control measure.
Unearthing unexpected materials, fill or waste	Stop activities, contact the site project manager. Follow the unexpected finds protocol as detailed in Section 8.6 of this RAP. Prepare a management plan if required, to address the issue.
Identification of cultural or building heritage items	Stop work and notify site project manager. Follow the unexpected finds protocol as detailed in Appendix C of this RAP. Prepare action or conservation plan as required.
Equipment failures	Ensure that spare equipment is on hand at site, or that the failed equipment can be serviced by site personnel or a local contractor.
Complaint Management	Notify Client, Project Managers and Environmental Consultant (if required) following complaint. Report complaint as per management procedures. Implement control measures to address reason of complaint (if possible). Notify complainant of results of remedial actions.
Large volume of asbestos wastes encountered.	Work to be suspended and asbestos work removed by a suitably qualified contractor, in accordance with WorkCover regulations.
Changes in proposed future land uses at the site.	Review of the remediation works completed for the site.
A higher gas characteristic situation is calculated for the site (>3)	As a contingency a site-specific risk assessment would be undertaken that provides more optimal criteria to mitigate any potential risk to human and environmental health. Should this assessment identify a risk greater than CS of 3, an addendum to the RAP will be required, outlining all additional design measures to mitigate the identified risk, and will require approval from the Site Auditor prior to implementation. These measures may include additional measures described in Table 8, EPA (2012).

6. Remedial Works

Site characterisations revealed the presence of two, in-situ USTs which required removal, and further characterisation of ground gas risks were required to confirm the suitability of land at the site.

6.1 Remediation Sequence

The sequence of required remedial tasks and a brief description of each is summarised in the following table. Further detail is provided in the sections below.

Task	Description of Work
Site Establishment	Development of work health and safety plans (construction environmental management plan, occupational health and safety plan, hazardous material survey) approvals and permits to commence work. Establishment of site pollution monitoring and control measures to be maintained for the duration of the works as outlined in the I management plans.
Demolition	Identify, remove, disconnect, and manage existing services as required. Ensure all USTs are empty and engage liquid waste management should any aqueous material remain.
UST Removal	The in-situ USTs and any associated infrastructure (bowzers, fuel lines etc.) will require removal from site and any impacted material surrounding would be 'chased out' until no further impacts are observed.
Waste Management	Provide a method for management of waste classification of soil for offsite disposal
Ground Gas Assessment	The ground gas monitoring programme established by EI (2019) will be continued using continuous sampling methods to confirm the characteristic gas situation until minimum duration and worst-case meteorological conditions occur as defined in EPA (2012)
Validation	Implement the sampling and validation plan to detailing the remedial works and provide conclusions on site suitability.

6.2 Site Establishment

6.2.1 Work Health and Safety Plans

As required by the *Work Health and Safety Act 2011* and associated Regulations, a Work Health and Safety (WHS) Plan should be prepared by the Principal Contractor which mitigates the hazards identified in Table 5.2 and includes the site management requirements detailed in **Table 5.4** of this RAP.

6.2.2 Preliminaries

As the proposed development is subject to planning approvals, EI considers that the remedial works would be considered Category 1 under State Environmental Planning Policy (*Major Projects*). Category 1 works require development consent and include provision of this RAP. Site specific management plans will require implementation under the supervision of site contractors, and should include mitigation for the hazards described in **Section 5.2**

6.2.3 Environmental Monitoring

Environmental monitoring (including air quality assessment) will be conducted to demonstrate that workers at the site and members of the general public are being protected from odour,

fugitive emissions, dust, noise, vibrations, and ground gas generation during both the remediation works and during piling activities. Monitoring requirements are to be outlined in the Construction Environmental Management Plan to be prepared for the site.

All open excavations and treated soils are to be monitored during the remediation works with a landfill gas meter to ensure ambient air concentrations of ground gases (i.e. methane, carbon dioxide) are within acceptable safe work limits. Similarly, methane levels are to also be monitored during piling rig advancement at 1.0 m intervals to identify any potential explosive atmospheres that may be generated.

Action levels and specific control measures are to be prescribed in the CEMP and may include, but will not be limited to the following:

- Establishment of monitoring points;
- Action levels and control measure for potential explosive atmospheres;
- Use of masks or respirators for works in some areas of the site;
- Wetting down the excavated material with the use of water sprays;
- Covering of all contaminated material loaded onto trucks for off-site disposal;
- Reduction of the volume of soils excavated, and
- Use of odour suppressant sprays, particularly at locations where odorous soil is excavated / disturbed.

The environmental monitoring is to continue during all stages of excavation.

6.3 Demolition

Removal of onsite structures is required, and is considered a separate task to the remediation, to be completed under the direction of site management. The identification and removal of hazardous materials will be documented as part of that process. Removal of any material required in accordance with NSW *Work Health and Safety Act, 2011* will be completed prior to demolition and once complete, will provide access to all soil present across the site.

6.4 Removal of the USTs

All infrastructure will require removal to achieve access to underlying strata and a staged approach should be implemented which limits the size and extent of excavations, to minimise any aesthetic impact to adjacent properties. WorkSafe records indicate two 1,000 gallon underground storage tanks (USTs) remain within the northern part of site, formerly used to store mineral spirits. The location of the tanks is presented in **A2, Appendix A**. Prior to removal:

- A licensed liquid waste transporter will be required to remove any liquid contents from the UST and UPSS infrastructure (including silt UST) and dispose of any liquid waste to a suitably licensed liquid waste facility. The contractor must provide appropriate documentation for the waste disposal, and copies given to the Environmental Consultant.

Supervision of the UST remedial works will be required by a suitably qualified environmental professional to reduce volatilisation risks and ensure the remedial works are completed in accordance with the DECC (2010) UPSS Technical Note: Decommissioning, abandonment and removal of UPSS and AS4976-2008 (R2016) *The removal and disposal of underground petroleum storage systems*. The works should occur as follows:

- Remove all above ground infrastructure including bowzers, fuel lines and vent lines, followed by decommissioning of the USTs.

- Excavation of material to remove the USTs will begin. Any soil showing signs of contamination will be screened using a photoionisation device (PID) and all soil producing readings greater than 20 parts per million (ppm) will be excavated, segregated and stockpiled awaiting further classification. Any impacted soil will be 'chased' and removed until no further signs of contamination are present and PID readings are <20 ppm.
- Excavated soil is to be managed in accordance with the methodologies presented in **Section 6.6** and remain segregated from clean soil awaiting waste classification. Should significant volumes of material or contaminant concentrations be identified, bioremediation of the contaminated material may be suited, and samples will be collected to evaluate the suitability of this method. Once classified, material will be transported to an off-site waste disposal facility to minimise dust and odour issues
- Validation of excavations will be required as described in **Section 8** of this report.

No soil impacts were detected during previous investigations however should heavily impacted soils may be detected below the tanks, bowzers and other fuel infrastructure, they should be segregated during excavation works and classified in accordance with the Waste Guidelines (EPA, 2014) before being removed from site to an approved disposal facility.

Previous investigations did not identify significantly impacted groundwater resulting from the UPSS and off-site migration of groundwater contamination is therefore unlikely, however should significant impacts be identified, consideration to further assessments of groundwater quality should be given.

6.5 Waste Management

Waste classifications for individual, excavated fill stockpiles that have been determined to be surplus to the development, may be determined from previous investigation results and additional sampling to confirm the waste material classification. The procedure for the assessment and offsite disposal of fill will be as follows:

- Any material containing ACM surplus to the development works will be disposal by a licensed asbestos contractor as *Special Waste – Asbestos Waste*.
- Unclassified fill materials should be stored on impermeable surfaces (such as a plastic liners) to allow sampling and classification, to enable any surplus material to be taken to the appropriately licensed waste landfill facility to receive the materials.
- Any fill exhibiting heavy staining, organic matter and/or odours are to be isolated from other excavated materials, for separate waste classification sampling and testing.

Fill within the basement excavation and any fill within the UST and/or deep soil landscaping area deemed unsuitable for the proposed use will be considered as contaminated and excavated separately. Any excavation of contaminated material should occur under supervision of the Environmental Consultant. Excavation of fill material shall occur as follows:

- 1 Carefully excavate fill using appropriate equipment (e.g. excavators / backhoes) from the designated area. All earthworks and material handling will be conducted in accordance with management requirements presented in **Section 5.4**. To reduce the area of disturbed material, the number of areas subject to impacted fill excavation at any one time should be minimised;
- 2 EI recommend over-excavating the fill by approximately 0.1 m into natural soils to allow for the removal of any residual impacts from the overlying fill at the top of natural material. The effectiveness of these works will be confirmed via validation, completed once soil has been excavated and managed in accordance with **Section 5.5**.

- 3 Prior to any soil material being removed from the site, a formal waste classification certificate shall be completed, in accordance with the EPA (2014a) *Waste Classification Guidelines*.

Procedures for waste classification are below.

6.5.1 Waste classification

Waste classification of all material to be disposed offsite is required, to be completed by the Environmental Consultant. Procedure for classification was:

A waste classification assessment will be performed on each fill stockpile using the following procedure:

- Collect one sample per 25 m³ (min 3 sampling for stockpiles < 75 m³) of stockpiled material for the fill/soils excavation, or 10 samples for stockpiles >2,500 m³.
- Collect one intra-laboratory duplicate for every 10 primary samples collected and one inter-laboratory duplicate for every 20 primary samples collected.
- Collect one rinsate blank per sampling round.
- Using NATA-registered laboratory methods, analyse each sample for eight heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, BTEX, PCBs, OC/Ops, PAHs and Asbestos identification, with TCLP testing of elevated metals and PAH results for leachability assessment; and
- Where stockpiles exceed 2,500 m³, waste classification will require a 95% UCL mean of contaminant concentrations;
- Prepare a Waste Classification Certificate for each category of soil waste, to enable appropriate off-site disposal of all fill stockpiles.

Any asbestos identified will be treated as an unexpected find and in accordance with the *POEO (Waste) Regulation 2014*, waste movements will be tracked and disposal receipts (dockets) will be maintained by the site manager. Copies of all waste documentation will be required for final validation reporting purposes.

6.6 Ground Gas Assessment

EIs (2018) developed a monitoring programme to assess the potential presence of ground gas. The assessment was suitable for preliminary assessment purposes and revealed the presence of CO₂ at elevated levels within ground gas at the site. The data obtained was used to calculate a characteristic gas situation of 3 for the site, however the duration of monitoring was insufficient and did not include worst-case meteorological conditions. Further assessment will occur as follows:

- 1 Continue the ground gas monitoring programme as detailed by EIS (2018). The additional works will utilise on-site monitoring wells and should be completed prior to bulk excavation. **DO NOT DAMAGE EXISTING WELLS**, so that an adequate continuation of the dataset may be achieved.
- 2 Sampling of ground gas will collect continuous ground gas data during worst-case conditions. In Australia, a worst-case meteorological scenario can be estimated from the fifth percentile three-hour pressure decrease rate for the site, based on a two-year data set for the nearest Bureau of Meteorology site with continuous pressure recording.
- 3 In accordance with EPA (2012) compare the data with respect to the specific design of structures, assessing the likelihood of risk posed to future users of the site. Specific ground floor and/or basement depths of the final design will be required to confirm the suitability of

the structure for residential use and to ensure no unacceptable risk is present within the land; and

- 4 Re-evaluate the gas risk based on the findings of investigations noted above and in light of a more detailed site development and infrastructure plan.

As part of the construction and installation of the ground gas control measures, detailed design plans of the as built control measures will require preparation. Due to the incorporation of the control measures within the construction of the development, detailed design plans should be prepared in consultation with the relevant parties (including the site auditor and environmental consultant) associated with the development design. Construction and Quality Assurance (CQA) plans are to be prepared by contractors responsible for the construction and installation of the ground gas controls and are to be provided to the environmental consultant for review prior to proceeding with the works. Additionally, CQA reports documenting the installation of each stage of the works are to be prepared and provided to the environmental consultant following the completion of each item. CQA plans and reports are to be prepared in accordance with the requirements of Section 11 of EPA (2016) *Environmental Guidelines: Solid Waste Landfills*.

6.7 Validation

Validation sampling will be completed in accordance with the sampling and quality plan provided in **Section 7**. Analytical results, investigation methodologies and findings of the additional investigations related to ground gas may be reported via an investigation update letter, and should significant contamination be identified, further works will be addressed via an addendum to this RAP.

The site validation report will provide descriptions of the remedial works undertaken at the site, provide methodologies for sampling and a comparison of validation results to the site acceptance criteria, to make conclusions on the suitability of the land for the proposed residential use.

7. Sampling, Analytical and Quality Plan

The sampling, analytical and quality plan (SAQP) plays a crucial role in ensuring that the data collected are representative and provide a robust basis for site assessment decisions.

7.1 Data Quality Objectives

In accordance with the NEPM and the Australian Standard AS4482.1 *Guide to the Sampling and Investigation of Potentially Contaminated Soil*, Data Quality Objectives (DQO) were developed in a sequential manner as documented below.

Table 7-1 Data Quality Objectives

Step	Description
State the Problem	Two, in-situ USTs and ground gas CO ₂ were considered to present unacceptable risks to the re-zoning of land for residential purposes. Remediation is required to remove the risk and make the land suitable for the proposed use.
Identify the Decision	No significant contamination was identified and decisions that need to be made are: - Has the nature and extent of soil and ground gas contamination onsite been adequately defined? - Can the identified areas of unacceptable risk be remediated in a sustainable manner, making the land suitable for the proposed use; and - Will further remediation and/or special management be required before the site is suitable?
Identify Inputs to the Decision	Inputs to the decision process include: - Previous investigation works; - Details of the proposed site use; - Understanding of current site use and historic activities that have occurred, including potential offsite sources of contamination; - Geological and hydrogeological data relevant to the area, including physicochemical parameters for calculating ecological criteria; - Field screening data and site observations for the presence of visual/olfactory contamination indicators; - Contaminant concentrations in soil validation samples confirming effective removal of identified impacts; and - Further input to the decision will be sample collection and handling, field and laboratory QAQC and confirmation that data quality indicators (DQIs) were achieved.
Define the Boundary of the Assessment	Spatial – Works are limited to the site boundaries (A.2, Appendix A) Temporal – The results will be valid on the day samples are collected and will remain valid if no changes to site use occur, and contamination (if present) does not migrate from off-site sources. Constraints of sampling requiring consideration include access restrictions (due to site operations and/or conditions) and presence of both above and underground services / structures.

Step	Description
Develop a Decision Rule	The decision rules for validation are: - Is the site suitable for the proposed land use? <i>If the concentrations of contaminants in site strata that remains are below the relevant criteria for the intended land use; then the site will be deemed suitable for the proposed development.</i> - Is additional information required to determine the suitability of the site for its proposed use? <i>Should additional information be required as determined by the conceptual site model (CSM), then appropriate recommendations will be provided.</i> Decision criteria for analytical data are defined by the Data Quality Indicators (DQI) in Table 7-2.
Specify Acceptable Limits on Decision Errors	Specific limits for this project are to be in accordance with NEPM, appropriate data quality indicators (DQIs) for assessing the useability of the data, and EI standard procedures for field sampling and handling. To assess the useability of the data, pre-determined DQIs for completeness, comparability, representativeness, precision and accuracy, as presented below in Table 7-2. If any of the DQIs are not met, further assessment will be necessary to determine whether the non-conformance will significantly affect the useability of the data. Corrective actions may include requesting further information from samplers and/or analytical laboratories, downgrading of the quality of the data or alternatively, re-collection of samples.
Optimise the Design for Obtaining Data	- Written instructions will be issued to guide field personnel in the required fieldwork activities. - Soil excavation is to be performed as per Section 5.8. Soil validation sampling is to be completed as per the methodology prescribed in Table 7-3. - Validation sampling procedures that would be implemented to optimise data collection for achieving the DQOs. - Review of the results will be undertaken to determine if further excavation and additional sampling is warranted. Additional investigations would be warranted where soil concentrations are found to exceed remediation criteria endorsed by the NSW EPA, relevant to the proposed land use(s).

7.2 Data Quality Indicators

To ensure that the data collected is of an acceptable quality, the data set will be evaluated against the data quality indicators (DQI) outlined in **Table 7-2**, which related to both field and laboratory-based procedures.

Table 7-2 Data Quality Indicators

Data Quality Objective	Data Quality Indicator	Acceptable Range
Accuracy	Field – Laboratory trip blank) / Laboratory – control spike and matrix spike analysis	< laboratory limit of reporting LOR / laboratory defined in accordance with NATA accreditation
Precision	Field – Blind replicate and spilt duplicate	< 30 % relative percentage difference (RPD [%]) / defined in accordance with NATA accreditation
Representativeness	Laboratory – Laboratory duplicate and matrix spike duplicate	defined in accordance with NATA accreditation

Data Quality Objective	Data Quality Indicator	Acceptable Range
Completeness	Completion (%)	-

7.3 Sampling Methodology

7.3.1 Ground Gas

Continued collection of ground gas samples will mimic the procedures and sampling methodology of EI (2019).

- Utilising onsite wells, ground gas data will be collected continuously using a calibrated landfill gas meter (such as the Gas Clam) that allows direct measurement of gas from the well head. If required, a PID may be used to assess trace gas.
- The ground gas concentrations for contaminants of concern, being methane (CH₄), carbon dioxide (CO₂), hydrogen sulfide (H₂S), carbon monoxide (CO), and oxygen (O₂) will be collected via peak and stable concentrations collected from within the well. The individual flow rate and barometric pressure observed during the collection of data will be recorded, along with the total well depth and the observed standing water level (SWL) within each well.
- Data from the Bureau of Meteorology (BOM) detailing the barometric pressure and temperature for the nearest BOM monitoring station will require routine collection from online sources (BOM website) and will address worst case meteorological conditions. For Australian conditions, a worst-case meteorological scenario can be estimated from the fifth percentile three-hour pressure decrease rate for the site, based on a two-year data set for the nearest Bureau of Meteorology site with continuous pressure recording.
- Gas readings recorded will be evaluated and a final level of protection for the site applied and will include the results obtained from additional soil characterisation within the former UPSS area and will conclude on the actual risk posed to future users of the site, based on the development design.

A final characteristic gas situation will be calculated for the site and confirm the required ground gas protection measures to be included within the final design (if any). The findings of the additional ground gas assessment will be required prior to site validation and may be reported as a standalone event. Should measures be required, as-built details of the design will be required as part of the site validation works and will require confirmation that the measures implemented are effective in mitigating the risk posed by the contaminant.

7.3.2 Soil

Future sampling of soil is expected, and the collection of material will include field screening for signs of contamination and a field assessment of VOCs using a photo-ionisation detector (PID). Sampling will be completed in accordance with the methodology detailed in **Table 7.3**, below.

Table 7-3 Sampling Procedure for Soil

Action	Description
Sample Collection	Soil will be collected from directly beneath the exposed surface of excavation, or from the centre part of the material brought to the surface by the backhoe/excavator bucket to ensure the retention of volatiles within the sample. Direct transfer of the sample into new glass jars from material just beneath the surface will then be filled reducing the presence of air pockets as far as practical to reduce the loss of volatiles Soil samples will be field screened for the presence of volatiles on site using a PID. Analysis of the head-space within a snap lock bag filled with sampled soil (at an

Action	Description
	approximate 1:5 soil to air ratio) and left to equilibrate. A small hole is made through the snap lock seal and the probe of the PID inserted. The VOC reading for the sample is recorded and provides information as a guide to vapour impacts to site. Sampling data shall be recorded to comply with routine chain of custody requirements. Collection of soil for bulk asbestos sampling may be required
Sampling Frequency	As specified in Table 8.1
Sampling, handling, transport and tracking	The use of stainless-steel sampling equipment or dedicated gloves. All sampling equipment (including hand tools or excavator parts) to be washed in a 3% solution of phosphate free detergent (Decon 90), followed by a rinse with potable water prior to each sample being collected. Direct transfer of the sample into new glass jars or plastic bags is preferred, with each plastic bag individually sealed to eliminate cross contamination during transportation to the laboratory; Label sample containers with individual and unique identification including Project No., Sample No., Sampling depth, date and time of sampling; Place sample containers into a chilled, enclosed and secure container for transport to the laboratory; and Provide chain of custody documentation to ensure that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to the environmental laboratory.
Sample Containers & Holding Times	Metals - 250g glass jar / refrigeration 4°C / 6 months (maximum holding period); TRH/BTEX - 250g glass jar / refrigeration 4°C / 14 days (maximum holding period); PAH - 250g glass jar / refrigeration 4°C / 14 days (maximum holding period); and Asbestos – up to a 10 Litre resealable plastic (polyethylene) bag / no refrigeration / indefinite holding time.
Field QA/QC	Quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme to ensure sampling precision and accuracy, which will be assessed through the analysis of 10% field duplicate/replicate samples. Appropriate sampling procedures will be undertaken to prevent cross contamination, in accordance with EI's Standard Operating Procedures Manual. This will ensure the DQIs are met. One in 10 samples will be analysed as blind field duplicates and one in 20 samples to be tested as inter-laboratory duplicates (ILD).as well as one VOC trip blank/spike set (intra-lab) samples and one equipment wash blank sample per sample batch. No QAQC samples will be collected for asbestos sampling.
Laboratory Quality Assurance and Quality Control	The contract laboratory will conduct in-house QA/QC procedures involving the routine analysis of: Reagent blanks; Spike recoveries; Laboratory duplicates; Calibration standards and blanks; QC statistical data; and Control standards and recovery plots.
Achievement of Data Quality Objectives	Based on the analysis of quality control samples (i.e. duplicates/replicates and in-house laboratory QA/QC procedures), the following data quality objectives are required: ▪ conformance with specified holding times; ▪ accuracy of spiked samples will be in the range of 70-130%; and ▪ field and laboratory duplicates and replicates samples will have a precision average of +/- 30% relative percent difference (RPD). An assessment of the overall data quality is required for the validation report, in accordance with the NSW EPA (2017) <i>Guidelines for the NSW Site Auditor Scheme</i>.

8. Validation Strategy

8.1 Validation sampling

To achieve site validation, the calculated value, known as the '95% upper confidence limit' (95% UCL), of the average concentration for each analyte will be less than relevant residential land use scenario values. Where the 95% UCL is less than the relevant threshold value but one or more individual sample measurements are more than 250% above the criteria, the corresponding area of site should be re-investigated to determine whether it constitutes a 'hot spot'. Should backfilling be required, validation of imported fill materials used for the backfilling of remediated areas would be required to verify their suitability for the proposed land use.

The recommended methodology for sample collection is presented in **Section 7.3**

8.2 Validation Required

Table 8.1 below details the sampling required to show the remedial works were effective in removing the contamination identified within the site.

Table 8-1 Validation Sampling Requirements

Remedial Area	Validation Required
UST Remediation Excavation	Residual soil impacts (if encountered) will be excavated and the resulting excavation will be validated to confirm the effective removal of the material. Samples will be collected from the base using a 7.5 m square grid (minimum of one base sample per excavation pit) and on the walls of the excavation every 10 m (with a minimum of one sample per excavation pit wall), in accordance with NSW EPA <i>Technical Note: Assessment of Service Station Sites</i> . Samples will be analysed for TRH, BTEX, PAH, VOCs and lead.
Stockpiled / Waste Materials	Sampling of stockpiles at a rate of 1 sample per 25m ³ , with a minimum of 3 samples per stockpile. Stockpiles exceeding 200m ³ but not exceeding 2,000m ³ may be sampled in accordance with NEPM (2013) – which allows characterisation according to 95%UCL of the mean concentration of an analyte provided a minimum of 10 representative samples are assessed.
Landscaping	1. Collecting one soil sample per 100m³ of imported soil in deposited areas. 2. Analysis of samples for contaminants of concern, including TRH, BTEX, PAH, HMs, PFAS, OCP / OPP, PCBs and asbestos (at least). 3. Acceptance will be achieved once all contaminant concentrations are reported to be below the site criteria. 4. Analysis results should be presented to the Environmental Consultant for inclusion in the site validation report.

8.3 Reporting

All fieldwork, chemical analyses, discussions, conclusions and recommendations will be documented in a validation report for the site. The validation report will be prepared in general accordance with requirements of the EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* and EPA (2017) *Guidelines for the NSW Site Auditor Scheme* and will confirm that the site has been remediated to a suitable standard for the proposed development.

The Site Validation Report will be submitted for Council and/or Site Auditor review at the completion of the remediation works program.

9. Conclusions

Based on the information available from previous investigations at the site, this RAP has been prepared to inform the remediation works at 165 Milton Street, Ashbury NSW. Historic site use was described by earlier investigations to be primarily commercial / industrial and two in-situ underground storage tanks (USTs) remain within the northern part of site. Asbestos impacts to fill and the chemical storage that occurred within the UST's were considered to represent sources of unacceptable risk at the site and required remediation. A former non-putrescible landfill was also identified at the western boundary of the land, and the migration of ground gas contaminants to the site requires assessment.

The RAP requires the following works to be completed to prepare the site for residential land use:

- Demolition of site structures to allow for site surface inspection for asbestos;
- Decommissioning, excavation and removal of the in-situ USTs and any impacted material surrounding the tanks, including methods for stockpiling and offsite disposal of the spool, and the required validation to confirm the effectiveness of the remediation; and
- An assessment of hazardous ground gas migration to the site, from the historic land fill. This requires collection of data over worst case conditions to adequately assess the risk posed and will include details of the required mitigation management (if required).

Currently, the preferred approach involves excavation and offsite disposal of impacted fill materials, with ground gas mitigating requirements yet to be defined. Groundwater beneath the site was previously assessed and concentrations of contaminants were considered suitable for residential land use, with no unacceptable risk posed to the receiving environment. The status of groundwater quality may require additional assessment once the underground storage tank remediation is complete.

It is envisaged that the remediation works will be implemented in stages, as follows:

- Site Establishment;
- Demolition;
- UST removal;
- Waste Management;
- Ground Gas Assessment; and
- Validation.

Material management procedures are provided to characterise soil for offsite disposal, and contingency measures are provided for any unexpected finds. In summary, EI considers that the site can be made suitable for residential land uses through the implementation of the works described in this RAP.

10. Limitations

This report has been prepared for the exclusive use of Coronation Property Co. Pty Ltd (the client), being the only intended beneficiary of our work. The scope of the RAP is limited to that agreed with our client.

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The methods and conclusions presented in this report are based on a limited investigation of conditions, with specific sampling locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during remedial activities. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

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Appendix A –Figures

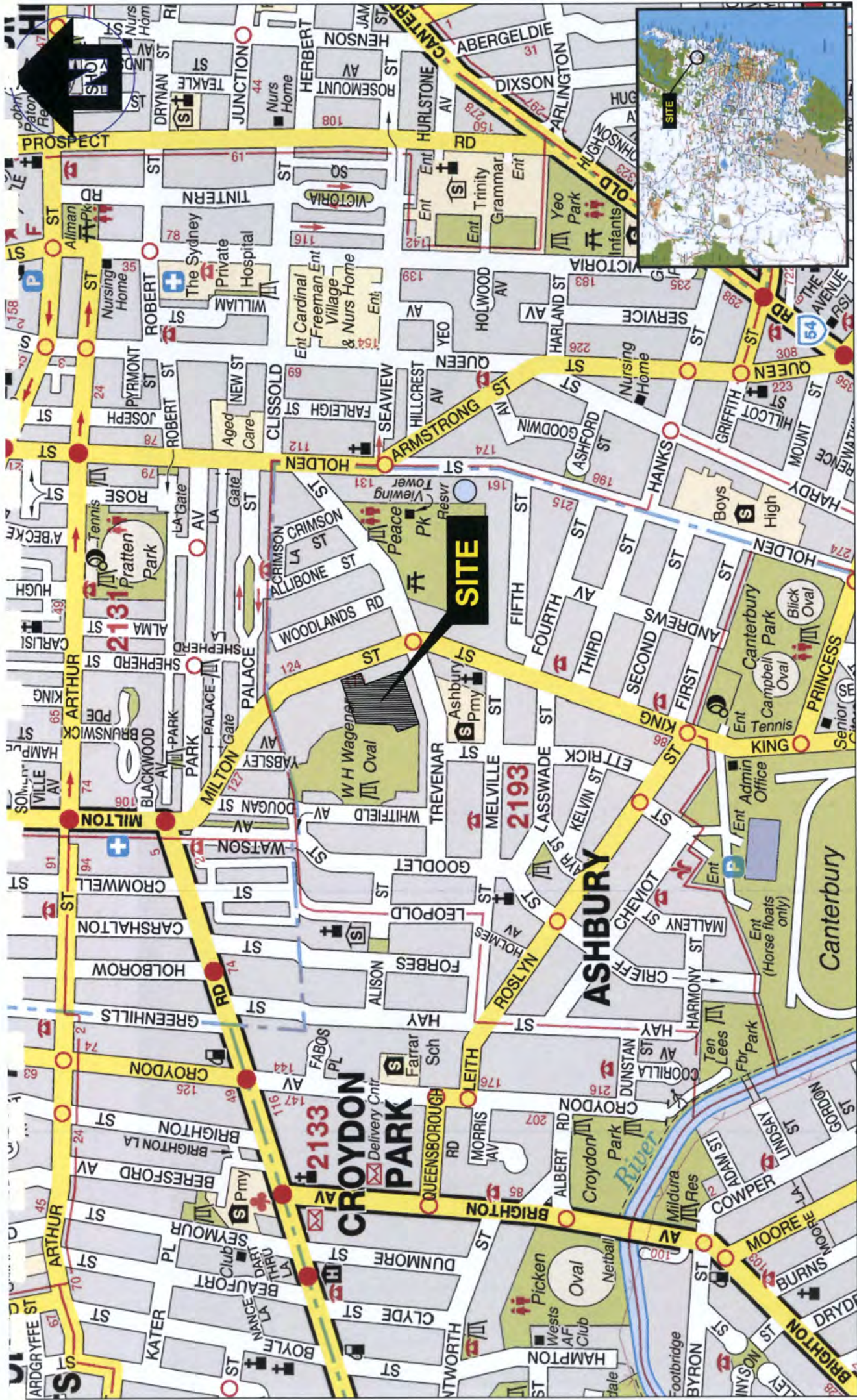


Figure: 1

Coronation Property Co. Pty Ltd
Remediation Action Plan
165 Milton Street, Ashbury NSW
Site Locality Plan

Drawn:	C.S.
Approved:	T.G.
Date:	29-04-19
Scale:	Not To



Map Source: NearMaps, imagery dated 04 March 2019

LEGEND

- Approximate site boundary
- Approximate location of USTs



Suite 6.01, 55 Miller Street, PYRMONT 2009
1518 5081

Drawn: C.S.

Approved: T.G.

Date: 29-04-19

Coronation Property Co. Pty Ltd

Remediation Action Plan

165 Milton Street, Ashbury NSW

Tank Location Plan

Figure:

2

Project: E24185 E06

Appendix B – Review of Remedial Technology

B.1 Remedial Technology Options and Ranking

The various remediation options were reviewed in a technology matrix (**Table B-1**) to assess whether their suitability against the various subsurface materials at the site and the primary objectives of the remediation works program. The ranking of the remedial options identifies the following options to remediate the Narellan site including:

- Ground Gas Management; and
- Soil excavation with segregation for on-site reuse and off-site disposal

The ranking of the remediation options is based on:

- The suitability of the method for each of the materials or chemicals of concern with the following scoring applied – Not applicable = 0, Not suitable = 1, Possible = 2, Suitable (Yes) = 3.
- The options also consider the need for longer term monitoring and/or the requirements that an EMP is prepared to cover residual contamination; these aspects are ranked as N/A = 0, requires EMP/monitoring (Yes) = 1, possibly requires EMP/monitoring = 2, does not require an EMP/monitoring = 3.

The scores are added to give the individual score for each of the soil and ground gas media and these individual scores are added to give the overall rating or ranking of the remediation option. The preferred option is arbitrarily selected as above 30 points option is suitable below or equal to 30 option is not suitable.

The preferred remedial option(s) is discussed further in **Section 5.3**

Table B-1: Review of Remediation Technologies

Technology	Matrix	Asbestos	Heavy metals	TPH	VOC	Landfill Gas	Long Term Monitoring	EMP	Individual Scores	Preferred Option
Bioventing	Soil	N/A	0 No	1 Yes	3 Yes	3 Yes	3 N/A	0 No	3 13	No
	Ground gas	N/A	0 No	1 Yes	3 Yes	3 Yes	3 Yes	1 Possible	2 13	No
Enhanced Bioremediation	Soil	N/A	0 No	1 Yes	3 Yes	3 Yes	3 N/A	0 No	3 13	No
	Ground Gas	N/A	0 No	1 Yes	3 Yes	3 Yes	3 Possible	2 Possible	2 14	No
Capping and Containment	Soil	Yes	3 Yes	2 Yes	3 No	1 Yes	3 Yes	1 Yes	0 13	Possible
	Ground Gas	Yes	3 Yes	3 No	1 No	1 Yes	3 Yes	1 No	3 15	Possible
Chemical Oxidation	Soil	N/A	0 No	1 Yes	2 Yes	3 Yes	2 N/A	0 No	3 11	No
	Ground Gas	N/A	0 Yes	3 Yes	3 Yes	3 Yes	3 Possible	2 Yes	0 14	No
Excavation Reuse & Disposal	Soil	Yes	3 Yes	3 Yes	3 Yes	3 Yes	3 No	3 No	3 21	Yes
	Ground Gas	Yes	3 Yes	3 Yes	3 Yes	3 Yes	3 Possible	2 Possible	2 19	Yes
Land Farming	Soil	N/A	0 No	1 Yes	3 Yes	3 Yes	3 N/A	0 No	3 13	No
	Ground Gas	N/A	0 No	1 Possible	2 Possible	2 Possible	2 N/A	0 Possible	2 9	No
Air Sparging	Soil	N/A	0 No	1 Yes	3 Yes	3 Yes	3 N/A	0 No	3 13	No
	Ground Gas	N/A	0 No	1 No	1 No	1 Yes	3 Possible	2 Possible	2 10	No
Reactive Barrier Wall	Soil	N/A	0 N/A	0 Yes	3 Yes	3 Yes	3 No	3 No	3 15	No
	Ground Gas	N/A	0 N/A	0 No	1 No	1 No	1 Yes	1 Yes	1 5	No
Pump and Treat	Soil	N/A	0 No	1 No	1 No	1 No	1 N/A	0 No	3 5	No
	Ground Gas	N/A	0 Possible	2 Yes	3 Yes	3 Yes	3 Yes	1 Possible	2 14	No

Appendix C – Unexpected Finds Protocol

Unexpected Finds Protocol

