Remediation Action Plan

Shoalhaven Hospital Redevelopment

8202118201

Prepared for
Johnstaff

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Cardno

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1 Introduction

Cardno now Stantec (Cardno) were engaged by Johnstaff on behalf of Health Infrastructure NSW to prepare a Remediation Action Plan (RAP) for the site located on, Shoalhaven St and North Street, Nowra, NSW (the site). Health Infrastructure NSW intends to redevelop the site from the current mix of public open space land, a pre-school and amenities for Shoalhaven Hospital to a new facility for the Shoalhaven Hospital which will occupy a large portion of the centre and north east of the site.

Numerous assessments have been completed at the site with the most recent Environmental Site Assessment (ESA) (Cardno, 2022a) prepared by Cardno identified total recoverable hydrocarbon (TRH), toxaphene and possible polycyclic aromatic hydrocarbon (PAH) contamination at borehole BH01 exceeding the adopted criteria within a carpark at Shoalhaven Hospital. The identified contamination meets the definition of a hotspot at >2.5x the adopted assessment criteria. Further delineation sampling undertaken as part of a Data Gap Investigation (DGI) (Cardno, 2022b) delineated the extent of impact to an area 2 m x 2 m with a depth of 0.5 m below ground level (m bgl) and an estimated volume of 2 m^3.

Based on the status as a hotspot, the DGI concluded that while the contamination was not considered to impact suitability of remainder of the site for the intended use, identified impacts will require management as part of the proposed development.

1.1 Purpose and objectives

The purpose of this RAP is to identify and outline methodologies to appropriately manage the identified impacts in the vicinity of borehole BH01 to enable redevelopment of the site.

The objective of this RAP is to set remediation objectives and document the process to remediate the site.

1.2 Scope of work

The preparation of this RAP included the following scope of work:

- Review of previously prepared site reports to review and identify:
  - Site features and extents;
  - A conceptual site model (CSM); and
  - What further assessment, if any, is required.
- Propose and evaluate options for remediation of the identified soil contamination and recommend the preferred remediation strategy;
- Detail the implementation of the preferred remediation strategy including:
  - Identifying legislative, planning and permitting requirements;
  - Develop a Construction and Waste Management Plan outlining environmental controls required for the duration of the remediation works and to be implemented alongside the existing Construction Environmental Management Plan (CEMP);
  - Identify environmental, site, occupational health and safety (OHS) control measures and community consultation requirements associated with implementation of the preferred remedial strategy;
- Preparation of this RAP document outlining the above in accordance with the (NSW EPA, 2020) *Consultants reporting on contaminated land: Contaminated land guidelines*.

1.3 Guidelines and Legislation

This RAP and the remediation and validation requirements were completed in accordance with the requirements included in the following guidelines and legislation:

- National Environment Protection (Assessment of Site Contamination) Measure (NEPM). National Environment Protection Council (NEPC) 1999, Amendment 2013;
- State Environmental Planning Policy (Resilience and Hazards) 2021;

> NSW EPA (1995) *Contaminated Sites Sampling Design Guidelines*. New South Wales Environment Protection Authority, September 1995;

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

> NSW EPA (2017) *Guidelines for the NSW Auditor Scheme (3rd edition)*. New South Wales Environment Protection Authority, September 2017;

> NSW EPA (2020) *Consultants reporting on contaminated land; Contaminated land guidelines*. New South Wales Environment Protection Authority;

> Standards Australia (2005) *Australian Standard AS 4482.1-2005 – Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds*. Standards Australia, Homebush, NSW;

> Standards Australia (1999) *Australian Standard AS 4482.2-1999 - Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances*. Standards Australia, Homebush, NSW;

2 Site identification

2.1 Site details

Details related to the site are included in **Table 2-1** below whilst **Figure 1** and **2**, **Appendix A** shows the site locality and Site plan.

Table 2-1 Site Details

Details	Comments
Site address	Shoalhaven Street, Nowra, NSW, 2541
Lot and Deposited Plan	Lot 104 DP1165533 Part-lot Lot 373 DP755952 Lot 7034 DP1031852
Current land use	▪ Hospital and associated infrastructure (including roads and car parks) ▪ Pre-school ▪ Public recreation (Nowra Recreation Park).
Proposed land use	Redevelopment, expansion and/or rezoning of land to accommodate upgraded and new hospital facilities and associated infrastructure.
Local Government Authority (LGA)	Shoalhaven City Council
Current zoning (Shoalhaven LEP, 2014)	SP2 - Infrastructure RE1 - Public Recreation
Site area	27,704.5 m^2
Site coordinates GDA1994 MGA56	South-east corner of the site: 280282.0273, 6138563.938
Surrounding land use	**North**: Shoalhaven Memorial District Hospital facilities and associated infrastructure, Scenic Drive, public recreation, coastal walking tracks and Shoalhaven River **East**: Shoalhaven Street and low-density residential housing **South**: North Street and low-density residential housing **West**: Shoalhaven Cancer Care Centre, Shoalhaven Hospital parking, Scenic Drive, coastal walking tracks (Bens Walk) and Shoalhaven River

2.2 Site description

The site and regional context are summarised in detail in the previous DGI (Cardno, 2022b) however key features and observations are summarised below.

> Site slope is towards the east with an approximate fall of 9 m from west to east.

> The site surface is currently predominately unsealed outside hardstand areas and structures predominately in the north of the site associated with the pre-school and hospital. Precipitation and surface run-off anticipated to either penetrate ground surfaces at a rate reflective of soil permeability or enter installed stormwater systems and move as surface runoff, ultimately flowing into regional stormwater on North Street or Shoalhaven Street. Surface waters will then be managed by stormwater systems and / or enter tributaries of Shoalhaven River.

> Site soils are a mixture fill materials and residual soils grading to the underlying Nowra Sandstone bedrock.

> No permanent groundwater table was encounter during site investigations, which were limited to refusal on underlying bedrock with the exception of geotechnical testing locations. Limited seepage was identified at the soil rock interface suggesting ephemeral perched water at the soil-rock interface. A permanent groundwater table was not encountered to a maximum depth of 7m bgl but is anticipated to exist within underlying bedrock.

> No evidence of acid sulphate soil (ASS) or soil salinity risk has been identified in public registers or during site works.

3 Previous reports

Cardno is aware of the following environmental assessments historically undertaken within the site footprint:

> *Shoalhaven Hospital Redevelopment, Preliminary Site Investigation*, Cardno, November 2021 (Cardno, 2021)

> *Shoalhaven Hospital Redevelopment, Environmental Site Assessment*, Cardno, February 2022 (Cardno, 2022a)

> *Shoalhaven Hospital Redevelopment, Data Gap Investigation*, Cardno, May 2022 (Cardno, 2022b)

3.1 Preliminary site investigation (Cardno, 2021)

Cardno undertook the investigation to provide preliminary advice on the contamination status of the site and consequent implications for the concept design process for the site redevelopment. Cardno understand that this includes the expansion of the existing hospital and rezoning of land to accommodate upgraded and new hospital facilities and associated infrastructure. Revision 0 was issued 14 July 2021 before being updated using existing information to include the entirety of the Nowra Recreation Park and issued as Revision 1 on 23 November 2021.

The stated purpose of this report was to undertake a PSI to identify potential contaminants sources and contaminated materials at and surrounding the site, and to identify constraints that may require consideration during the concept design process. The objective of the PSI is to assess whether contamination has the potential to exist on the site and whether further investigation is needed to confirm the nature and extent of potential contamination.

The assessment included a history review which indicated the site has historically been used for public recreation / parkland in the southern portion and hospital facilities as well as a pre-school centre in the northern portion. The PSI report identified the following AEC summarised below in **Table 3-1**.

Table 3-1 AEC identified within Cardno (2021) PSI

AEC Identification	Description	Contaminants of Interest
AEC 1: Filling / Mounding / Tipping within the site	Fill areas along the western ridge line, surrounding the helicopter pad and the turning circle at the northern extent of the site were observed but the quality, quantity or origin of fill was difficult to determine due to vegetation, grass cover and hardstands without an intrusive assessment. The amount of filling is considered to be minor based upon site observations such as the inferred shallow depth to rock and site history, however while there was an absence of anthropogenic material in surface material, there is potential for unidentified contamination and these materials should be assessed further	Total recoverable hydrocarbons (TRH); benzene, toluene, ethylbenzene, xylene (BTEX), polycyclic aromatic hydrocarbons (PAH); Metals; Phenol; organochlorine pesticides (OCP); organophosphate pesticides (OPP); polychlorinated biphenyls (PCB); Asbestos
AEC 2: Soils surrounding maintenance shed	The maintenance shed was inaccessible at the time of the walkover; however, it may contain chemicals and fuels typical of general maintenance and landscaping. Housekeeping and ground surfaces within the shed were unable to be observed and it is unknown if potential uncontrolled spills and releases have occurred.	TRH; PAH; BTEX; metals; OCP/ OPP, other pesticides

AEC Identification	Description	Contaminants of Interest
AEC 3: Structures constructed pre-1990	The only structure established pre-1990 within the site is the Shoalhaven Community Pre-school main building. However, the date of construction of the toilets at the south of Nowra Park is unknown as the area is obscured by tree cover in aerial photography. In addition to the above existing structures a was present in the south-west corner of Nowra Park for a period between 1949 and 1969 (visible only in 1961 imagery). The above noted current and historical structures, and the soils surrounding them may contain potentially hazardous building materials as a result of weathering or poor demolition practices.	Asbestos; lead and zinc

Based upon the findings of the PSI Cardno made the following recommendations:

- Conduct a Preliminary Environmental Site Assessment (PESA) (named Environmental Site Assessment and summarised in **Section 3.2**) to confirm the presence of contaminant sources and contaminated materials within the identified sources in **Table 3-1**. The PESA would seek to determine if a risk to human and ecological receptors exists, whether there is the potential for off-site migration of any identified contamination and/or if management and consideration is required during construction.
- Locate existing wells BH104 and BH105 to assess groundwater conditions.
- Undertake a hazardous building materials assessment of structures within the site to identify materials which may be disturbed as part of the proposed site redevelopment.
- In the event the PESA identifies contamination above the permissible investigation levels, the site may require further investigation in the form of a Data Gap Investigation (DGI) [this report] or a Detailed Site Investigation (DSI), which would further clarify the risk to human and ecological receptors and/or recommend management and consideration required during construction.
- If any earthworks or disturbance occurs prior to preparation of the PESA, a suitably qualified environmental consultant must be engaged to undertake an assessment for contamination and provide guidance on appropriate material management, if required.

3.2 Environmental site assessment (Cardno, 2022a)

Cardno undertook this Environmental Site Assessment (ESA) to provide the client with advice on the contamination status of the site and the resulting implications for the suitability of the site for its proposed future land use. The primary objective of the ESA was to undertake an intrusive sampling investigation in order to assess the previously identified areas of environmental concern based on Revision 0 of the PSI report which excluded southern areas of Nowra Recreation Park (Cardno, 2021).

Intrusive soil sampling was undertaken including general site coverage sample locations and sample locations targeting at the identified AECs. In total, 19 locations were sampled and assessed with 18 of these located within the current site boundary, TP09 is now located within the proposed Shoalhaven Pre-school relocation site. The fill layers observed on site showed no obvious indicators of contamination (odour, staining or discolouration) and anthropogenic materials were only observed in trace quantities at select sample locations. Asbestos containing materials were not observed within fill or on visible ground surfaces.

BH01 was identified as having the following concentrations of contaminants of concern to human health:

- TRH F2 (>C10 – C16 less naphthalene) - <500 mg/kg;
- Benzo(α)pyrene Toxic Equivalence Quotient (B(α)P TEQ) - <5 mg/kg; and
- Toxaphene - <100 mg/kg.

Due to interference from hydrocarbon impacts in the sample the laboratory was unable to resolve the results to a firm concentration however during follow-up indicated that results were the result of actual concentrations. The following conclusions were drawn with respect to soils assessed within the site:

- **Human Health**
  - The location of BH01 and unassessed areas require further investigation to make a statement on contamination and Site suitability, and the requirement, if any, for remediation. The requirement for

further assessment at BH01_0.1 should be considered in the context of the project design and the proposed construction activities at that specific location.

> **Ecological**

- Exceedances of the applicable ecological screening criteria in soil were limited to four samples that contained TRH, benzo(α)pyrene, toxaphene and copper above the criteria. Under the current and proposed land use these exceedances are not considered to present an unacceptable risk as no biota will be reliant on the root zone (upper 2 m) under the future land use, i.e. the source-receptor-pathway linkage is currently incomplete.
- Whilst ecological receptors were not identified under the current Site use / configuration, during redevelopment soil from BH01, BH02 and BH05 should not be placed near sensitive ecological receptors / remnant vegetation, or the upper 2 m of the soil profile within landscaped areas or surrounding remnant vegetation. Ideally the material would be placed beneath hardstand surfaces with minimal interaction with ecological receptors, surface water or groundwater.

Based upon the findings of the ESA and with reference to the proposed future land use of the site, the following recommendations were made:

> If soils in the vicinity of BH01_0.1 are to be disturbed, further assessment should be undertaken to confirm the nature and extent of potential impact. The assessment should include:

  - Vertical and lateral delineation of contaminant impact;
  - Silica-gel clean-up and leachability testing on soil samples to reduce interference and determine the toxicity and contaminant risk;
  - Consideration of the fate of the soils during the proposed redevelopment and refinement of the conceptual site model; and
  - Consideration of any design features.

> Upon completion of characterisation and delineation sampling around BH01, remediation should be considered if an unacceptable risk to human health and/or the environment is confirmed.

> Upon completion of a detailed design the findings of this assessment must be revisited and any outstanding data gaps assessed prior to earthworks.

> If the site is deemed suitable for the proposed development, the following should be considered:

- Future ground disturbance works should be undertaken in accordance with a Construction Environmental Management Plan (CEMP) with an Unexpected Finds Protocol that outlines appropriate actions in the event that potentially contaminated materials are identified. If potentially contaminated materials are identified then a more detailed assessment for will be required as detailed in the ASC NEPM (NEPC, 2013).
- Any waste generated during the redevelopment, including demolition materials and excavated soil, must be assessed for potential offsite reuse / disposal opportunities in accordance with the NSW EPA *Waste Classification* Guidelines (2014) and current resource recovery exemptions / orders.

3.3 Data gap investigation (Cardno, 2022b)

The DGI was undertaken to address information gaps following the completion of the ESA report. The stated purpose of this investigation was to provide the client (Johnstaff) with updated advice on the contamination status of the site and the resulting implications for the suitability of the site for its proposed future land use. Objectives included targeting previously unassessed soils and making a revised statement on site suitability with the additional data.

Areas assessed by the investigation included:

> Southern portions of Nowra Recreation Park which were outside the ESA study area;

> The current Shoalhaven Pre-school grounds in the north-east of the site where access was not available previously; and

> Within the carpark of Shoalhaven Hospital in the vicinity of BH01 to allow for delineation and follow-up sampling.

From the findings of the investigation no new contamination or potential contamination was identified in any of the additional sampling locations and the previously identified contamination at BH01 was constrained to

an area between sampling locations BH01E1, BH01S1, BH01W1 and BH01N1. Results for BH01 and delineation locations are presented in **Appendix C**.

Based on the findings of the DGI and ESA, with the exception of the area located between sampling locations BH01E1, BH01S1, BH01W1 and BH01N1, the site was considered suitable for the intended land use as a hospital. The unsuitable area can be made suitable following management of the identified contamination through the implementation of recommendations which included:

- Preparation of a Remediation Action Plan (this report) to manage impacts in the vicinity of BH01. Based on the small volume of material excavation and off-site disposal is likely to be the most time and cost-effective approach however other treatment options may be considered.
- Future ground disturbance works should be undertaken in accordance with a Construction Environmental Management Plan (CEMP) with an Unexpected Finds Protocol that outlines appropriate actions in the event that potentially contaminated materials are identified. If potentially contaminated materials are identified then a more detailed assessment for will be required as detailed in the ASC NEPM (NEPC, 2013).
- Any waste generated during the redevelopment, including demolition materials and excavated soil, must be assessed for potential offsite reuse / disposal opportunities in accordance with the NSW EPA *Waste Classification Guidelines* (2014) and current resource recovery exemptions / orders.

3.4 Extent of contamination

Under the current understanding of the site, the extent of material requiring management has been delineated to an approximately 2 m x 2 m area within the carpark area delineated by BH01E1, BH01S1, BH01W1 and BH01N1. Vertically contaminants of concern are below the laboratory limit of reporting by BH01_0.5 collected from 0.5 m bgl. Based on these measurements total volume requiring management is estimated, to be 2 m^3 in-situ with for potential to bulk during removal up to approximately 4 m^3.

4 Conceptual site model

A conceptual site model (CSM) provides an assessment of the fate and transport of contaminants of potential concern (COPC) within the context of site-specific subsurface conditions with regard to their potential risk to human health and the environment. Risk to human health and the environment is identified through complete Source – Pathway – Receptor (SPR) linkages. In order to identify SPR linkages the CSM considers site specific factors, including:

- Source(s) of contamination;
- Identification of contaminants of concern associated with past (and present) source(s);
- Site specific information including soil type(s), inferred depth to groundwater, inferred permeability, inferred groundwater flow direction and surface water bodies and interactions;
- Location of any identified sources relative to the proposed site development; and
- Actual or potential receptors considering both current and future land use both for the site, adjacent properties and any sensitive ecological receptors.

Table 4-1 summarises the CSM for the site following completion of all assessments summarised in **Section 3**. Based on the findings of these reports no complete SPR linkage was identified for ecological receptors however a residual risk remains for human site users under both the current and future land uses.

Data gaps and uncertainties surrounding this CSM are detailed in the DGI report (Cardno, 2022b).

Table 4-1 Conceptual Site Model

Source	Potential Contaminants	Encountered Contaminants	Impacted media	Pathway	Receptor	Completeness
Filling of unknown origin and quantity along western ridgeline and surrounding helicopter pad and beneath the hardstands in the northern portion of the site.	Asbestos; metals; PAH; TRH; BTEX; Phenols; OCP; OPP; PCB	TRH; Potential B(α)P TEQ; OPP (toxaphene)	Soils including fill through direct application Surface water through runoff	Direct contact including ingestion of, impacted media Inhalation of asbestos fibres Surface water infiltration	Ecological receptors: - Site biota dependent on site soils Human: - Current Site workers (hospital, pre-school) - Future Site workers (hospital) - Workers during construction - Individuals undertaking installation and maintenance of subsurface utilities - Current recreational land users	Potentially complete at BH01, in the event of any direct interaction with impacted media (i.e. excavations, use as growth medium or mobilisation as run-off)
Structures constructed pre-1990	Asbestos; lead and zinc	No contaminants above adopted criteria encountered.	Soils beneath and surrounding potentially hazardous building materials	Direct contact including ingestion of, impacted media Inhalation of asbestos fibres Surface water infiltration		Incomplete as site observations and analytical results indicated no potential or actual contamination is present.
Maintenance shed	TRH; PAH; BTEX; metals; OCP/ OPP, other pesticides		Soils surrounding maintenance shed (particularly downgradient) Surface water through runoff	Direct contact including ingestion of, impacted media Surface water infiltration		

5 Remediation objectives and criteria

The purpose of the proposed remediation activities is to eliminate any potential risk of exposure to impacted soils within the identified site boundary to current site users and future site users under the proposed development.

The remediation objectives are:

- To ensure the identified contaminated material is managed in accordance with best and most sustainable practices to reduce health risk to site users to an acceptable level; and,
- Following management, to demonstrate via validation sampling, any potential health risk to site users has been reduced to an acceptable level.

5.1 Soil validation targets

The soil validation targets for the proposed remediation are based on the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPM) 1999*, as amended* 2013, in relation to investigation levels for soil in the assessment of site contamination (NEPC, 2013).

Validation targets will be adopted based on the Health Investigation Level (HIL) Recreational C and Health Screening Level (HSL) A & B – Residential, guideline criteria tabulated within Section 6, Schedule B1 of the NEPM (NEPC, 2013). Relevant criteria for known contaminants are presented in **Table 5-1**. Criteria have been adopted to allow the greatest flexibility in design and design change under the current and proposed future land use.

Table 5-1 Validation criteria for identified contaminants

Contaminant	Source	Value (mg/kg)
TRH F2	HSL A & B, Sand, 0 m to <1m, Table 1A(3), Section 6, Schedule B1	110
B(α)P TEQ	HIL C, Table 1A(1), Section 6, Schedule B1	30
Toxaphene		3

5.2 Aesthetics

Soils remaining onsite must also comply with the aesthetic requirements provided in Section 3.6, Schedule B1 of the NEPM (NEPC, 2013). The general assessment considerations include:

- The risk for a person to be injured by metal, glass or other sharp objects;
- That chemically discoloured soils or large quantities of various types of inert refuse, particularly if unsightly, may cause ongoing concerns to site users;
- The depth of any residue in relation to the final surface of the site; and
- The need for and practicality of any long-term management of foreign material.

Soils remaining within the site should be such that at surface there is no detectable odour, identifiable staining or large quantities of inert waste.

5.3 Imported materials

It must be demonstrated that any soil materials imported to the site during the proposed development must do not contain any asbestos in any form, meet aesthetic criteria, and must also meet the criteria of a NSW EPA Resource Recovery Exemption / Order (such as Excavated Natural Material (ENM)) or meet the definition of Virgin Excavated Natural Material (VENM).

5.4 Exported materials

Waste classification assessment will be required for any soil materials that need to be exported or disposed off-site during the development in accordance with the NSW EPA (2014) *Waste Classification Guidelines*. Based on the presence of asbestos, the material onsite is not suitable for off-site beneficial re-use under a Resource Recover Exemption / Order or under legislation.

For waste materials characterised through chemical analyses, the analyte concentrations are to be assessed against the criteria outlined in Table 1 and Table 2 of the Waste Classification Guidelines (NSW EPA, 2014). As long as assessment results from the DGI (Cardno, 2022b) remain current (i.e. no changes occur to the site which may impact the contamination status) these results may be used to support the preparation of a waste classification however further assessment of excavated and stockpiled soils with specific volume is to be undertaken.

All materials are to be disposed of at a landfill appropriately licenced to accept the final material waste classification provided.

6 Remediation options

6.1 Remediation options hierarchy

The potentially applicable soil remedial strategies were evaluated in accordance with the remediation hierarchy, which is based on Section 6(16) of the NEPM (NEPC, 2013) and endorsed by the NSW EPA.

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

   If the above is not practical then,

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

6.2 Remedial options evaluation

The remedial options listed above are evaluated below in **Table 6-1** which consider the available remedial options for the impacted soil identified on the site.

Table 6-1 Remediation option evaluation

Remedial Option	Discussion	Acceptable yes / no
Option 1: On-site treatment of soil	This option includes on-site treatment of soil, such as bioremediation or thermal treatment of soils. While the TRH F2 impact is considered suitable for both treatment approaches, impacts such as B(α)P TEQ and toxaphene are appropriate for bioremediation. In addition to varying suitability the costs of establishing and undertaking treatment of soils is likely to be prohibitive compared to other management options for a small volume of soil	Potentially acceptable.
Option 2 Off-site treatment of excavated soil	This option includes off-site treatment of soil, such as bioremediation or thermal treatment of soils. Similar limitations to on-site treatment exist with regards to this approach with the additional cost and challenge of identifying an appropriate facility for treatment.	Potentially acceptable
Option 3 Isolation of the soil on-site by containment	This option includes the encapsulation of impacted soils within the site with marker and capping layers designed to be appropriate to the contaminant, this may include soil or concrete. This remedial strategy relies on removing the completed receptor pathways to impacted soils. This strategy would necessitate leaving quantities of impacted soil at the site and will require a long-term, though generally passive, legally enforceable environmental management plan (EMP). Additional testing of impacted materials will be necessary to establish contaminant mobility. Appropriate location/s will need to be identified within the site for material storage and emplacement during and following construction. While this could be undertaken the contamination will remain onsite and ongoing management, even if passive, may not be a palatable approach for the land owner.	Potentially Acceptable.

Remedial Option	Discussion	Acceptable yes / no
Option 4 Excavation and off-site disposal of impacted soil	This option includes the excavation and transportation of soil to an off-site facility licensed to accept the waste. The volume of material is tracked through waste dockets and weight tickets at the receiving facility. This approach will be effective in removing the contaminants from the site and based on the identified volume, of approximately 2 m^3 is unlikely to be cost prohibitive. This approach would likely be the fastest to undertake, and require no ongoing management limiting impacts to construction and ongoing site management. Further assessment would be required as based on current measured concentrations of B(α)P the material would be classified as Hazardous Waste under Contaminant Threshold (CT) criteria within Table 1 of the Waste Classification Guidelines (NSW EPA, 2014). Leachability analysis of the specific volume to be disposed would likely reduce this classification to General Solid Waste.	Acceptable.
Option 5 Do-nothing with Environmental Management Plan	This option would involve leaving identified contamination in-situ and implementing an Environmental Management Plan (EMP). This approach would only be acceptable in the event that the proposed redevelopment does not proceed and the site remains as a car park with the material encapsulated beneath the asphalt surface. Prior to implementation of this approach further risk-based assessment of impacted soils considering the intended land use should be undertaken. This approach is not compatible with the current intended redevelopment.	Not acceptable. The do-nothing option will not reduce COPC concentrations to an appropriate level for the proposed development under the current concept design and would continue to allow risk of exposure impacted soils.

Based on the evaluation above, implementation of a combination of Remedial Options 1, 2, 3 and 4 could mitigate the potential risks with the identified COPCs in a timely and cost-efficient manner. The advantages and disadvantages of these options are compared below.

6.3 Remedial option comparison

Options available for the remediation of impacted soils are assessed in **Table 6-2** below.

Table 6-2 Remediation option comparison

Option	Description	Advantages	Disadvantages
1	On-site treatment of soils	Minimises potential risk to human health and the environment. Suitable long-term remediation option Potential minimisation of need to export import soil for construction purposes.	Time investment required to undertake remediation works. Cost prohibitive for small volumes of material. Not all contaminants may be suitable for treatment.
2	Off-site treatment of soils	Minimises potential risk to human health and the environment. Suitable long-term remediation option Potential minimisation of need to export import soil for construction purposes.	Time investment required to undertake remediation works. Cost prohibitive for small volumes of material. Not all contaminants may be suitable for treatment. Additional handling of materials. Additional approvals potentially required from NSW EPA with associated costs and delays

Option	Description	Advantages	Disadvantages
3	Consolidation and isolation of the soil on-site by containment	Minimises potential risks to human health and environment More economically viable for larger volumes of material. Suitable long-term remediation option Potential minimisation of need to export import soil for construction purposes.	Ongoing management required to ensure continuing successful encapsulation. Additional engineering of containment within final design and construction. The containment cell must be registered on the S.10 certificate and therefore become legally enforceable. Ongoing enforcement of management to ensure maintenance of containment. Contamination to remain on a site with a sensitive proposed land-use with high potential for public concern.
4	Excavation and offsite disposal of impacted soils	Minimises potential risks to human health and environment More economically viable for smaller, localised areas of contamination with soils classified as General Solid Waste. Suitable long-term remediation option Removes liability for ongoing management Fast and effective at managing small volumes of material.	Costs of offsite disposal at a licensed facility in the event that materials beyond those identified require management. Potential for larger quantities of material than expected to require disposal. Prohibitive waste classifications, such as current Hazardous Waste classification, limiting options and increasing costs for disposal facilities. Costs to import soil for construction purposes (if required) Not a sustainable approach to the management of the contamination on the site as it involves high energy cost to excavate, transport, and deposit in landfill thereby using valuable space.

6.4 Preferred remediation option

Based on the analysis included in **Table 6-1** and **Table 6-2**, our understanding of the proposed site works and final land-use, Cardno recommends Option 4: Excavation and off-site disposal of impacted soil. This option is considered the most suitable reducing contamination risks to an acceptable level as well as working within site constraints (short time frames, limited usable areas for treatment, etc), being cost effective (cheapest approach) and managing potential sensitivities (low appetite for ongoing management or cost of treatment to retain soils) associated with the intended redevelopment.

7 Remediation strategy

The preferred remediation option, as outlined in **Section 6**, is the offsite disposal of impacted soils. The following outlines the broad stages of the remediation approach:

1. Remediation contractor is selected;
2. Impacted soil excavation and removal to an appropriately licenced premises;
3. Validation of remedial excavations and waste classification following the removal of contaminated materials;
4. Validation of imported soils (if any).

Details on each remediation stage are outlined in **Section 7.1** to **Section 7.5**, below with and contingency planning is included in **Section 7.6**. A Remediation Environmental and Waste Management Plan is included in **Section 8**. Potential risks to site workers during construction can be managed through OHS practices which are detailed in **Section 9**.

7.1 Remediation contractor selection

For the purposes of this remediation activity the remedial contractor is only required to be an appropriately experienced and licenced civil contractor. Removal will require an excavator or equivalent machine and a truck for transport to the appropriate facility.

An independent environmental consultant (such as Cardno) must be appointed to provide guidance on the implementation of this RAP and undertake validation sampling and reporting following completion of remediation works.

7.2 Impacted soil removal

The soils onsite, identified as impacted by contamination will be subject to excavation and offsite disposal in accordance with the NSW legislation and the NSW EPA (2014) *Waste Classification Guidelines*.

Based on the volume of material to be removed, the size of the site and the need for further assessment to provide waste classification Cardno recommends an approach of excavation, stockpiling, assessment, and then transport for disposal. The removal process will be undertaken through the following process:

- Establish the area as a civil works zone, with appropriate controls, barricades and signage.
- Excavate impacted material onto an impermeable surface with appropriate sediment and erosion controls (suitable) or into a suitably sized bin (preferred option). Excavation will be no smaller than the volume between BH01E1, BH01S1, BH01W1 and BH01N1 and to a depth of 0.5 m bgl.
  - Definition of the excavation area should be undertaken via survey and / or mark out onsite prior to the removal of any asphalt as there is potential for the existing investigation points used to delineate contamination to be lost in this process. The appropriate definition approach should consider site activities prior to remediation works and potential for the markers of extent to be obscured (i.e. removal of car park surface destroying surface markings).
- The nominated environmental consultant will attend site and undertake a visual assessment of the residual surfaces of the excavation. The remedial contractor may be instructed at this point to excavate further material that contains visual or olfactory indicators of contamination. Sampling of both the stockpiled material and residual surfaces will be undertaken to provide a waste classification for disposal and confirm that all material impacted by contamination has been successfully removed.
- Following laboratory analysis confirmation that results from residual surfaces are below the adopted remediation objectives in **Section 5.1** and provision of a waste classification certificate by the nominated environmental consultant, the stockpiled material can be loaded out for transport and disposal at a facility appropriately licenced to handle the final classification.

Where the above approach is determined to not be suitable due to site and project constraints variations to the approach may be adopted in consultation with the nominated environmental consultant. Acceptable variations would include in-situ waste classification to allow direct load out and disposal, though this has not been recommended due to potential changes between the proposed material for disposal and final material invalidating any pre-excavation waste classification.

7.3 Validation of remediation and waste classification

Following removal of the asbestos impacted soils, remediation works will require validation to confirm that all impacted materials have been removed, at the same time removed material will require further assessment to provide a waste classification. Validation will include the following stages:

- Assessment of the residual surfaces of the remedial excavation for visual or olfactory indicators of further contamination. Any indicators of contamination should be removed and placed in the impacted material stockpile before undertaking validation sampling.
- Following a successful inspection, the nominated environmental consultant must undertake sampling of residual surface to confirm via laboratory analysis that the impacted soil has been removed. Analysis must be undertaken at a NATA-accredited laboratory.
- Stockpiled material should be assessed for offsite disposal through laboratory analysis as per the NSW EPA (2014) Waste Classification Guidelines. Based on the identified potential B(α)P impact above CT2 Restricted Waste criteria PAH should be assessed for toxicity characteristic leaching procedure (TCLP) leachability results to allow comparison against specific contaminant concentration (SCC) and TCLP criteria from Table 2 of the Waste Classification Guidelines (NSW EPA, 2014).
- Sampling methodology must be undertaken at the rates outlined in **Table 7-1** with reference to the Data Quality Objectives (DQO) and Data Quality Indicators (DQI) summarised in **Appendix D.**
- The environmental consultant is to be made aware of any indicators of other potential contamination identified during remediation works. These can include but are not necessarily limited to, odours, staining, unexpected waste finds and illegal tipping before and during site works. Where these are identified then the remediation and validation sampling method are to be updated as appropriate.

Table 7-1 Validation Soil Sample Criteria

Item	Sample Location	Sample Frequency	Laboratory Analyses	Relevant Criteria
Soil validation primary sample	Base of excavation	1 sample per 25 m^2	TRH, PAH, OPP	Table 5-1 or HSL A&B / HIL C
	Wall of excavation	1 sample per 10 lineal metres and (where deeper than 1 m) per 1 vertical metre (10 m2)		
Waste classification	Stockpiled material	Minimum 3 samples 1 per 25 m^3 up to 2,500 m^3	TRH, BTEX, PAH, Metals, OCP, OPP and TCLP PAH	NSW EPA (2014) Waste Classification Criteria

The remediation will be considered successful only when analysed samples confirm that contamination impacts to soil are below the adopted remediation objectives. Only following confirmation that all impacted material has been removed by visual inspection and sample analysis will the nominated environmental consultant provide advice that further works can proceed in the remediation area.

7.4 Validation of imported soils

Should any soil materials be imported onto the site for the proposed development then they will need to have supporting classification documentation and be validated to meet the site validation criteria outlined in **Section 5.3** and meet the definition and requirements of assessment for a NSW EPA Resource Recovery Order or VENM.

Classification documentation must include material source, volume and descriptions, sampling methodology and laboratory analysis results and certificates. All documentation should be verified by the nominated environmental consultant.

Each load of approved imported material must be inspected by an appropriately experienced and qualified individual to confirm the material is consistent with the description of the accompanying classification certificate and meet the definitions of relevant classification. In addition to the importers documentation, imported materials must also be sampled and analysed at a minimum rate of one sample per 1,000 m^3 with at least three samples per source. Sampling should be conducted in a manner consistent with the DQO and DQI outlined in **Appendix D**. Material must also be considered geotechnically and aesthetically suitable by the environmental consultant and project geotechnical engineer.

A register of imported material is to be maintained and reconciled by the site manager and supplied to the environmental consultant which will include the origin of the material, classification type, volumes, date of importation, haulage contractor name, photographs and a description of imported material. This register is to be supplied to the environmental consultant and is to form part of the site remediation and validation report. Analysis should include the following common contaminant analytes as a minimum in addition to any analytes specified in the relevant Resource Recover Order (if applicable); total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), metals and asbestos. All results should be below the guidelines provided within the relevant RRO.

For VENM materials, metals should be below the applicable NSW background levels as published in *Trace Element Concentrations in Soils from Rural and Urban Areas of Australia*, Contaminated Sites Monograph Series No. 4, 1995, Olszowy et al, and organic compounds should be non-detect at the standard laboratory method via a NATA-accredited laboratory certificate.

7.5 Reporting

The remediation of the site should be documented by the environmental consultant in the form of the following:

- A Waste Classification Certificate, to be prepared consistent with the NSW EPA (2014) *Waste classification guidelines, Part 1: Classifying waste*; and
- A Validation Report, to be prepared consistent with the *Consultants Reporting on Contaminated Lands: Contaminated Land Guidelines* (NSW EPA, 2020)

In addition to the above documentation the following should also be captured.

7.5.1 Waste classification and waste tracking

All waste classification and waste tracking documentation compiled during the site remediation works will be prepared in accordance with relevant NSW EPA regulatory guidelines. All waste classification certificates, waste tracking and disposal records will be included within the relevant validation report for each remediation zone.

7.5.2 Other documentation

Any information relating to site preparation and development, unexpected finds, and remediation validation should be collated for summary and inclusion with in the final Validation report. Such information may include photographs, survey records, design and as-builts.

7.6 Remediation contingency plan

As with any remedial scope of work, unanticipated events or outcomes may be encountered during the remedial program. Cardno has developed contingencies throughout the RAP to mitigate risks associated with potential issues that may arise during the remedial works. Contingency items considered for the current remediation are summarised in **Table 7-2** noting that there may be other unforeseen circumstances that may arise during the course of the works.

Any variation from the remedial methodology noted above is to be approved by the nominated environmental consultant prior to implementation.

Table 7-2 Remedial Works Contingency Plan

Potential Issue	Contingency Measures
Additional potential sources of impact are discovered during establishment of site levels or validation	Additional sampling will target the location of the potential sources (if identified) The analytical suite may be adjusted based on the nature of the potential source. The Unexpected Finds Protocol summarized in **Section 8.5** will be communicated to the remedial / construction contractor and followed during the construction phase of the project
Potential contamination continues past the remediation boundary.	While results to date demonstrate that the contamination is not gross or widespread within the carpark potential exists for indicators of contamination to continue past the proposed remediation extents. Additional sampling may be necessary to delineate the extent of impacted materials if remediation works identify impacted material extends beyond the remediation boundary
Unintentional release of impacted soils	Construction of appropriate erosion and sedimentation controls around any excavations and stockpiles or use of bins of appropriate volume. Weather forecasts must be monitored throughout the course of the remedial works to anticipate any significant storm events. Works may be suspended if large volumes of rain are anticipated. Soil stockpiles and excavations must be sufficiently covered prior to any storm event.
Imported material is determined unsuitable	If identified prior to entry onto site material is to be stopped at the site gate and returned to the point of origin. If emplaced prior to being determined unsuitable, material is to be isolated and demarcated. If stockpiled prior to removal offsite the stockpile should be lined to avoid contact with unimpacted ground surfaces. Any material leaving site must undergo waste classification to allow for appropriate disposal offsite.

8 Remediation environmental and waste management plan

The following sections include a Remediation Environmental and Waste Management Plan which provides measures required to minimise the potential impact of works on the local environment, site workers and third parties. In all cases, environmental issues must be managed by the Principal Contractor in accordance with good environmental management practices with periodic supervision and documentation by the appointed environmental consultant. The purpose of these measures is to prevent site workers, the public and environmental exposure to potential health risks associated with these works.

8.1 Heritage constraints

Areas and objects of heritage significance are not known to exist at the site however an assessment of these items is beyond the scope of assessments completed by Cardno to date. Despite the absence of known areas and objects, the remedial and validation works will need to be considerate of unexpected finds.

8.2 Stockpile management

Soil may require stockpiling during the remediation, stockpiles must be tracked according to the origin and storage of the stockpile. Stockpiles to be in place longer than 24 hours are to be contained and covered and placed on an impervious base.

The stockpile(s) should be clearly labelled, with stockpiles known or suspected of containing contaminated material, appropriately identified with warning signage. Stockpiles of contaminated material should be placed on an impervious membrane, kept less than 2 m in height, and covered to prevent mobility of airborne dust and particulate. Any stockpiled asbestos contaminated material generated following unexpected finds should be dampened and covered with either geofabric layer or equivalent, which is to be disposed of as asbestos waste after completion of asbestos works.

Stockpiles are to be contoured to minimise the loss of material during rainfall, with upgradient drainage and levee banks installed to divert water flows around the stockpile. Silt fencing, silt fabric drain covers, and hay-bales are to be appropriately placed and installed to avoid sediment loading of stormwater drains and pipes. The installation of these controls is to be undertaken in accordance with the Landcom (2004) “Blue Book” and the site stockpile, erosion and sediment management plans. Stockpiles should be monitored for evidence of failure, run-off, erosion, and dust generation and mitigated appropriately.

8.2.1 Waste disposal tracking

Tracking of waste movements around the site and material transported off-site for disposal is a critical component to demonstrate that the remedial strategy is being implemented appropriately. Waste tracking will be achieved through use of waste disposal dockets, survey of stockpiled materials or excavations and photographic documentation of movements of soil around and off-site. An environmental scientist should be on-site to monitor the remedial works and to check with the site manager that appropriate waste tracking procedures are being employed.

8.3 Excavation water management

As a groundwater aquifer was not encountered during investigation works a groundwater aquifer is not expected to be contacted as part of remedial site excavations. Potential exists for groundwater to be encountered in some deeper excavations into bedrock or for rain to accumulate in excavations, and minor seepages. Excavations should be designed to minimise the inflow of water as much as is practicable to minimise volumes requiring management.

If accumulated water (either groundwater or rainfall) is to be extracted from excavations, then it is to be managed in accordance with applicable guidelines and criteria including those set-out by the local water authority. This may include assessment by a suitably qualified environmental consultant to determine suitability for discharge and re-use onsite or extraction and disposal offsite at an appropriately licensed liquid waste facility as per the NSW EPA (2014) *Waste Classification Guidelines*.

8.4 Air and dust

8.4.1 Odours

Due to the nature of contamination identified on site, it is not anticipated that nuisance odours will be generated. Should odour be generated that is likely to impact sensitive receptors, such as neighbouring residents, on-site spraying of the excavated material with a suitable odour suppressant (i.e. Anotec) will be undertaken to minimise any odour. Other options that may also be employed are:

- A reduction in the size of the excavation face that is open at any one time to reduce the surface area generating the odour;
- Location of any temporary stockpiles of impacted soil as far as possible (and in the predominant down wind direction) from sensitive receptors;
- Smothering of the odours by covering the portion of the site that is generating the odour; and
- Watering the stockpiles and excavations to minimise volatile emissions.

8.4.2 Dust control

The Principal contractor will be responsible for ensuring that excavation, loading, carting, and stockpiling operations are dust free. This may include (but is not limited to):

- Stockpile protection;
- Water application on stockpiles and access roads;
- Limiting the area of exposed excavations and surfaces; and
- Wind fences around earthworks areas.

In the event that excessive dust is generated during any operations on-site, the works will cease and modifications to the process will be made before the operation is resumed. There must be no observable dust transported off-site.

8.5 Unexpected finds

Site workers (including remedial contractors and the nominated environmental consultant) must be vigilant for materials that may impact the soil suitability for the proposed land use, particularly for soils intended to remain following remediation works. Unexpected finds include, but are not limited to, odour, visual contamination, anthropogenic materials (i.e. large quantities of building materials), asbestos containing material, underground storage tanks (UST), or any other suspect materials. Any unexpected finds will be reported to the Site Manager immediately. Additionally, the site owner/occupier should be informed as soon as practical following an unexpected find.

If an unexpected find is discovered during excavations the Contractor shall:

- Cease all work in that vicinity
- Remove workers from the vicinity and limit access to the area (i.e. fencing, bunting or signage)
- An experienced environmental consultant should be contacted to assess the potential risks associated with the Unexpected Finds and provide appropriate management options
- Investigate the nature of the risk of the materials, determine the appropriate response and document the actions in accordance with contractual obligations.

In the event of a serious unexpected find, which could cause immediate harm to human health and/or the environment, Shoalhaven City Council, Health Infrastructure NSW, and the NSW EPA may need to be informed.

In the event potential heritage items are encountered during excavations, works will cease and the Site Manager notified.

8.6 Stormwater

8.6.1 Erosion and sediment control

Cleared areas and exposed excavations may promote erosion. The following erosion and sediment controls will be implemented:

- Limiting the extent of cleared areas and exposed excavations;
- Backfilling of excavated areas as soon as practicable;
- Diversion of stormwater from active areas using hay bales or sediment fences;
- Covering of temporary stockpiles with plastic (HDPE) and placement of silt socks around excavations when necessary;
- Covering open stormwater grates in the vicinity of stormwater pits and excavations with silt fences or other appropriate materials;
- Placement of stockpiles away from footpaths, roadways, kerbs, access ways, drainage lines, and slopes;
- Minimising translocation of contaminated soils throughout the site by ensuring excavator operators do not track over contaminated areas;
- If possible, a single vehicle entry and exit to minimise translocating soil;
- Depending on the volume of soil to be excavated, rumble strips may be required at the site access in order to prevent contaminated soil being transported off-site.

The installation of these controls is to be undertaken in accordance with the Landcom (2004) “Blue Book”.

8.7 Noise

The hours of operation will comply with Council requirements to control noise from site works, typically:

- 7am and 5pm Monday through Friday
- 8am to 1pm Saturdays.
- No work is permitted on Sundays or public holidays.

8.8 Land disturbance

Works include excavation, loading, carting and stockpiling operations of associated soils. These works shall be carried out in an orderly manner to minimise impact to the surrounding residences.

- Excavation - the removal of soil shall be performed by the appointed excavation contractor using an excavator. If a transport truck is not on-site during excavation and soil will need to be temporarily stockpiled, no contaminated soils should be placed on areas validated as suitable for the proposed land use. In these locations, soils shall be excavated and placed on a suitable plastic liner or on concrete surfaces in discrete stockpiles prior to off-site disposal. Stockpiles should be segregated for each potential contamination source.
- Loading and Carting – the loading of the stockpile material shall occur with an appropriately sized loader. The trucks and trailers shall be covered for transport as deemed necessary, and shall meet any other statutory requirements.

8.9 General

The appointed Principal Contractor shall ensure compliance with relevant Safework NSW guidelines and Occupational Health and Safety Regulations. The Principal Contractor shall also ensure compliance with any amendments to the Act or Regulations during the project duration.

The Principal Contractor shall monitor and control the access of all persons to the site and ensure that no unauthorised persons enter the site during remedial works (wherever practicable). All site personnel and visitors will be inducted and shall wear appropriate personal protective equipment (PPE).

The appointed Principal Contractor shall undertake additional underground and overhead service location specifically in areas surrounding the remediation location.

Any open excavation(s) are to be barricaded in accordance with the NSW Occupational Health and Safety Act; Clause 16 (1) and the Construction Safety Regulation Section 73, as administered by Safework NSW.

The appointed Principal Contractor shall install warning signs on the barricades surrounding any open excavations or active work areas with machine interactions.

8.9.1 Vehicles

The appointed Principal Contractor shall ensure all vehicles are suitably contained and covered in the transport of all debris, spoil, rubbish and materials to or from the site, such that spillage or contamination of adjoining and other areas or property shall be prevented.

Vehicles shall also be maintained to prevent the transfer of mud or wastes onto adjacent streets or other areas. If wheel treads contain significant quantities of site soils the contractor will manually remove and appropriately dispose. A cattle grid, tyre wash or similar removal method should be considered at the site entrance / exit.

8.9.2 Traffic control

The Principal Contractor shall supply signs and safety cones; erect at the appropriate entry and exit points; and maintain these devices in good condition. Excavation works, stockpiles and other hazards, shall be individually barricaded at all times. The site will be fully fenced to exclude public.

8.9.3 Refuse disposal

All site refuse, including food, equipment wrappings, unused materials, etc. shall be handled and disposed of appropriately into a skip.

8.9.4 Site security

The site shall be secured by a lockable fence around the perimeter of the site and access to the site is to be restricted. All excavations and above-ground remediation equipment will be barricaded with reflective barricades, with pertinent reflective signage. Keys to the gate will be restricted to approved personnel.

Fencing should be sufficient to prevent unauthorised access including illegal tipping and dumping by the public which may exacerbate site contamination issues.

8.9.5 Training

Low environmental awareness of site workers may result in environmental impact including cross contamination of soil layers and off-site movement of contaminated soil. Accordingly, staff awareness training, inductions and daily toolbox meetings shall be conducted by the Principal Contractor with assistance from the Proponent and Site Supervisor.

8.9.6 Roles and responsibilities

8.9.6.1 Proponent/Land Owner

A summary of the proponent's role and responsibilities includes:

- Overall responsibility for the project development and outcomes of the RAP;
- Becomes the Principal Contractor unless assigned to an appropriate Third Party;
- Liaison with neighbours and other stakeholders;
- Engagement and/or approval of Site Manager, Site Remediation Contractor, and environmental consultant to oversee, implement, and monitor progression of the RAP;
- Engagement of contractors to perform further investigation works, and any subsequent contaminated soil disposal and site rehabilitation works as required;
- Provision of health and safety measures for site personnel and the works area; and
- Maintain relevant records associated with the RAP.

8.9.6.2 Site Manager

A Site Manager, who is an individual familiar with the site development construction and implementation of environmental controls, is to be appointed to take responsibility for implementation of this RAP at the site during excavation of impacted soils. The Site Manager's duties include:

- Complete control of all site activities;
- Workplace health and safety Induction for all site attendees;
- Regular inspection of the site and site activities;

- Maintenance of a daily activities record;
- Implementation and compliance with the RAP;
- Maintaining routine correspondence with the site owner, remediation contractor and environmental consultant on progress of site remediation;
- Liaison with site personnel/contractors and the proponent regarding progress of works;
- Provide and maintain a photographic record of works and results; and
- Identification, reporting and management of the rectification of any non-conformances with the RAP.

8.9.6.3 Remediation contractor

The remediation contractor is to be engaged for the remediation works and must:

- Undertake all works in compliance with the provisions of the RAP;
- Liaison with Site Manager and environmental consultant regarding progress of works;
- Report any environmental incidents and unexpected finds to the Site Manager;
- Collate all project documentation including landfill disposal dockets (where relevant); and
- Conduct works in accordance with the Site OH&S plan.

8.9.6.4 Environmental Consultant

An environmental consultant knowledgeable with the RAP, the NSW EPA and legislative framework should be appointed by the client and involved in providing contaminated land advice through the project.

The Environmental Consultant's duties are to include:

- Regular inspection of the site and site activities as requested by the Client or Site Manager;
- Undertake validation inspections, sampling and prepare validation reports;
- Completion of daily field notes when requested to attend the site;
- Provision of on-site advice with regard to implementation and compliance with the RAP;
- Liaison with site personnel/contractors and the client regarding progress of works;
- Provide and maintain a photographic record of works and results when attending the site; and
- Documenting, reporting and advice on the rectification of any RAP non-conformances.

9 Occupational health and safety

9.1 OHS planning and preparation

Prior to mobilising to complete the remedial works, the Principal Contractor and appointed remedial contractor will develop site and project specific Health and Safety Plans (HSPs), Safe Work Method Statements and Job Safety Analyses for the scope of works to be undertaken. The OHS documentation will detail measures to mitigate potential risks to site workers, third parties and the local environment during the remedial works. General, minimal OHS procedures to be implemented during the remedial works are outlined as follows:

- The identified contamination can present a risk to human health during construction primarily through dermal contact and ingestion. Controls to minimise this can include dust suppression, good hygiene practices (i.e. washing hands before meals and smoke breaks), and use of gloves and other personal protective equipment (PPE)
- Protective footwear (steel capped boots) to be worn on site at all times;
- Hearing protection should be worn during soil removal activities (or when working in the vicinity of heavy plant/machinery);
- Unauthorised access should be limited by ensuring that security gates are locked at the completion of each day's work;
- Personnel are not to enter excavations (>1m depth) at any time; and
- PPE shall be provided in sufficient quantities to provide for the duties of each on-site individual.

9.2 Incident management plan

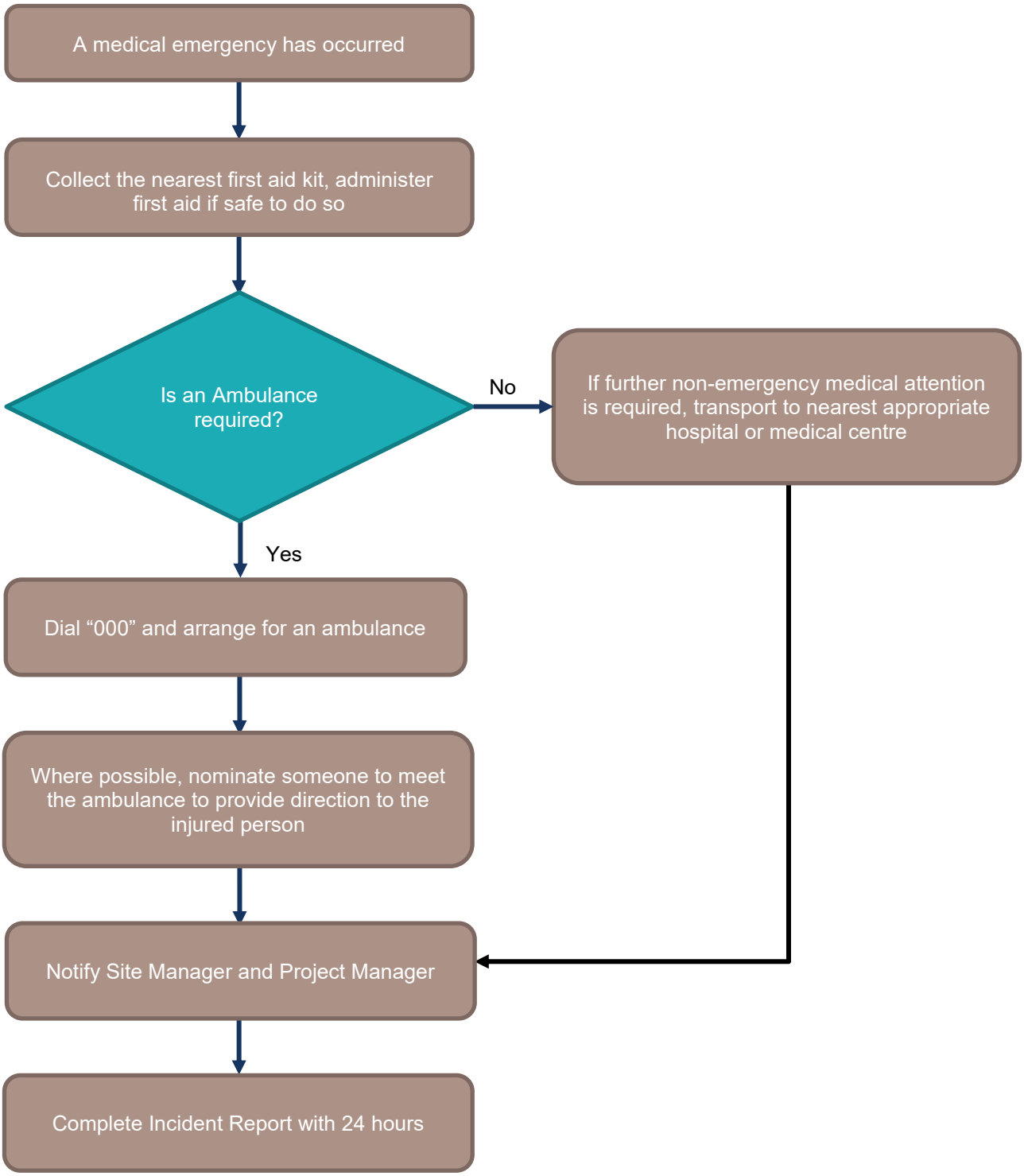
Emergency response includes pre-emergency planning, lines of authority and communication, emergency recognition and prevention, site control, evacuation routes, decontamination and first aid.

9.2.1 Medical emergency / serious injury

In the event of an accident or an emergency situation involving a serious injury or medical emergency, immediate action must be taken by the first person to recognise the event (refer to flowchart below).

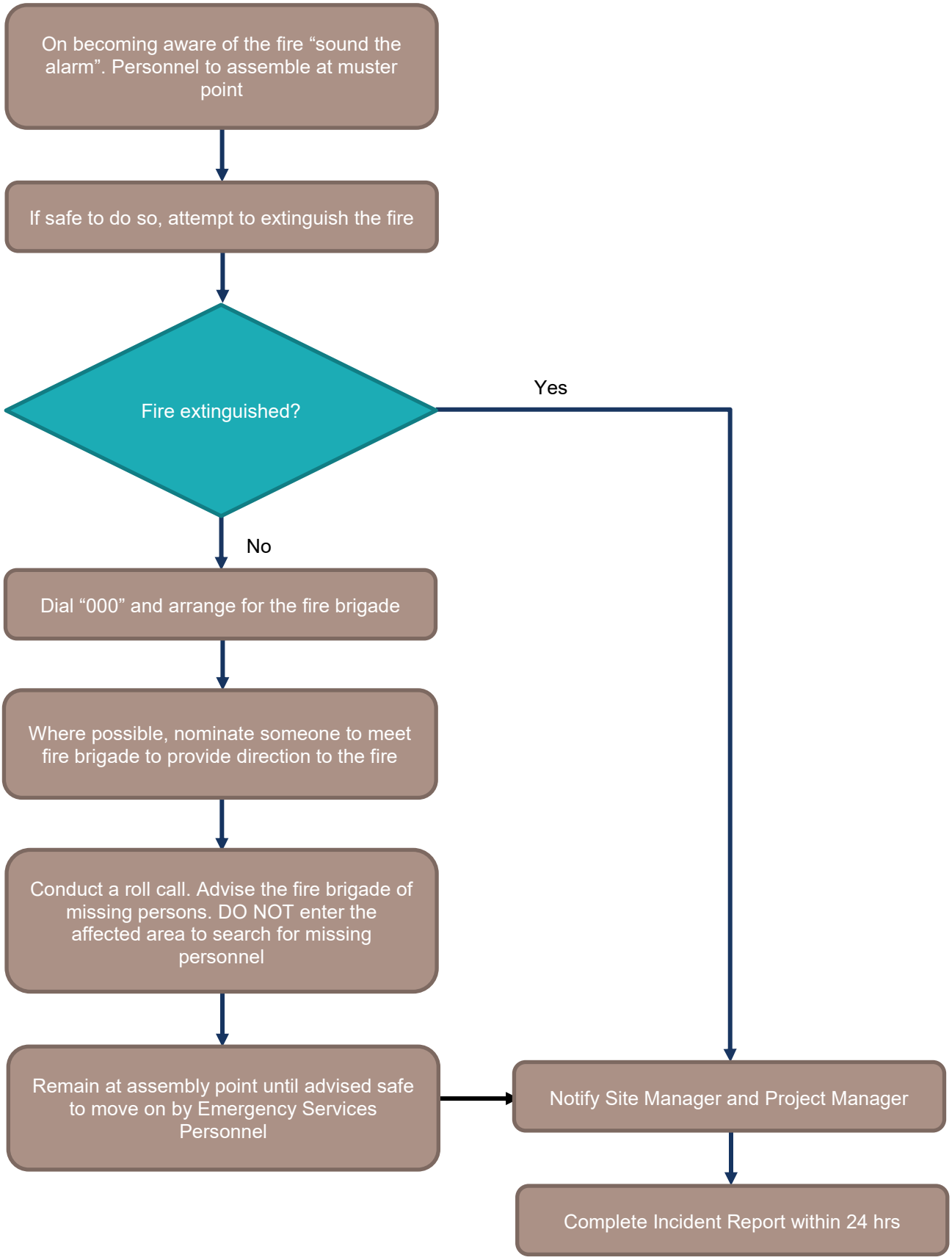
A portable and fully-stocked first aid kit shall be retained on site at all times.

In the event of a fatality, the Police, Site Manager, and Project Manager shall be notified immediately.



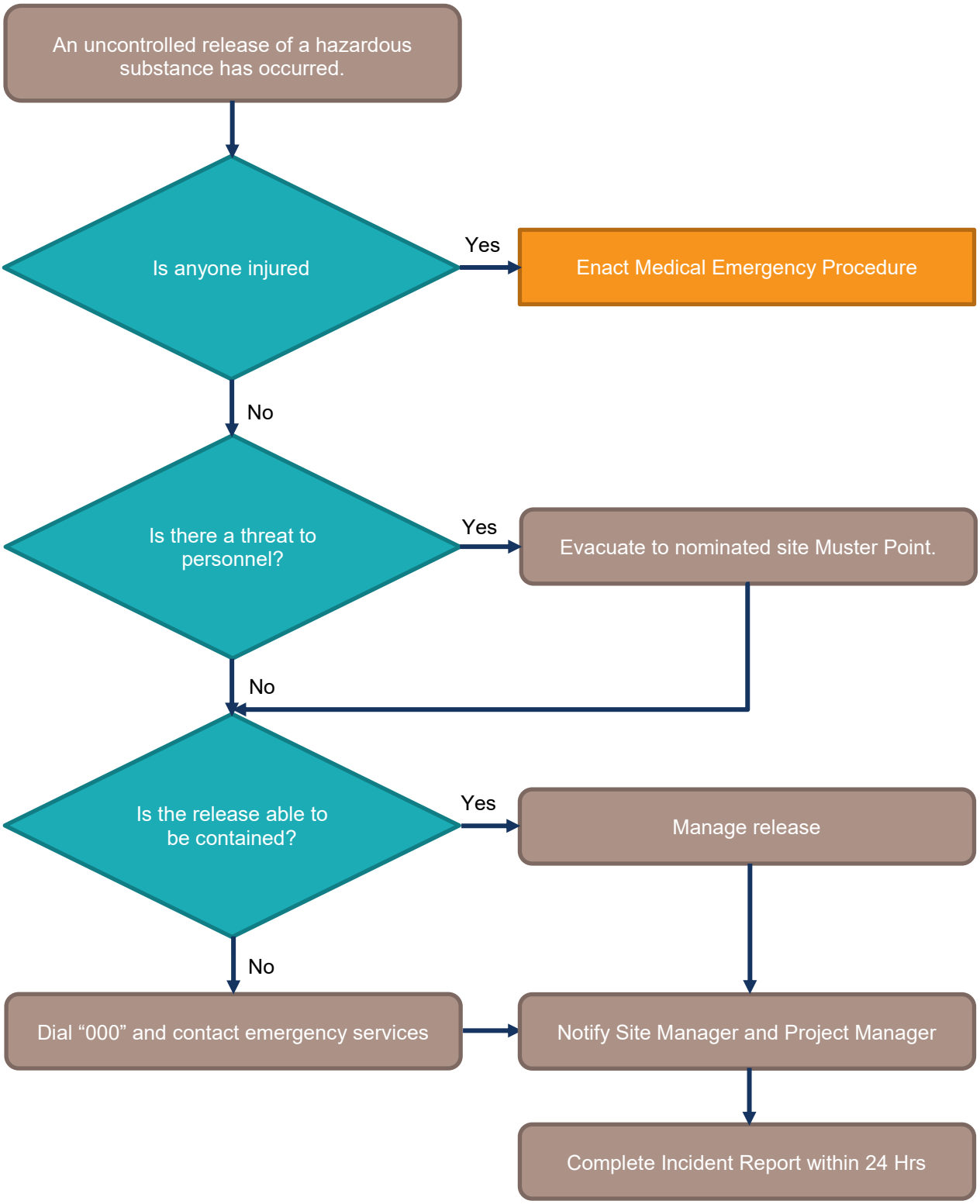
9.2.2 Fire

In the event of a fire, the actions outlined in below shall be taken:



9.2.3 Environmental incident

In the event of an environmental incident, the actions outlined below shall be taken:



9.3 Incident reporting

All site workers and attendees are required to verbally report incidents, accidents and near-misses to the Site Manager and Project Manager immediately after an event has occurred. It is the responsibility of the Site Manager to notify the Proponent immediately after the occurrence of an incident and to complete a written incident report within 24 hours including notification to appropriate individuals and authorities (i.e. HSE and Management teams, Safework NSW and NSW EPA). Additional investigations may be necessary should a serious incident occur.

9.4 Community consultation

Cardno does not anticipate that significant community consultation will be required during the course of the remedial and validation works. Should this assumption change, a detailed Community Consultation Plan may be developed to manage communications with third parties.

10 Regulatory approvals / licences

10.1 Regulatory compliance requirements

Regulations and sources of regulatory guidance relevant to this remediation programme relate to waste management, environment protection and occupational health and safety.

10.1.1 Waste management

The remediation program must comply with the following legislation and policies

- *Waste Avoidance and Resource Recovery Act 2001*
- *Protection of the Environment Operations (waste) Regulation 2005*
- NSW EPA (2014) *Waste Classification Guidelines*

10.1.2 Planning controls

Planning controls applicable to the proposed remediation are provided in the following:

- Shoalhaven Local Environmental Plan 2014
- State Environmental Planning Policy (Resilience and Hazards) 2021

The proposed remedial works are to be managed as Category 2 remediation as per the State Environmental Planning Policy (Resilience and Hazards) 2021 definition as the works are to be undertaken under existing approvals for the site development, with no specific development application required.

11 Conclusions

Cardno was engaged by John staff on behalf of Health Infrastructure NSW to prepare this Remediation Action Plan to guide the remediation of identified TRH, B(α)P TEQ and toxaphene soil impacts at the site of the proposed Shoalhaven Hospital Redevelopment. Based on time to complete, volume of material requiring management and the relative cost, both immediate and ongoing, of the various management options, the remediation methodology identified as most suitable was one of off-site disposal of impacted materials.

This approach was determined the most appropriate to make the site suitable for workers during construction and for the future land use which includes hospital facilities and ancillary landscaped areas.

12 Limitations

This assessment report is not any of the following:

- A Site Audit Report or Site Audit Statement as defined under the *Contaminated Land Management Act 1997* (CLM Act).
- A hazardous building material survey that will identify any specific building materials on site, which may pose a risk to human health or the environment.
- The agreed scope of this Plan has been limited for the current purposes of the Client and does not identify contamination occurring in all areas of the site.

This Document has been provided by Cardno subject to the following limitations:

- This Document has been prepared for the particular purpose outlined in Cardno's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.
- The scope and the period of Cardno's services are as described in Cardno's proposal, and are subject to restrictions and limitations. Cardno did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Cardno in regards to it.
- Conditions may exist which were undetectable given the limited nature of the enquiry Cardno was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.
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- Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Cardno for incomplete or inaccurate data supplied by others.

13 References

Cardno. (2021). *Preliminary Site Investigation - Shoalhaven Hospital Redevelopment.* Report Ref: 8202118201_R001_PSI_Rev1: Cardno (NSW/ACT) Pty Ltd.

Cardno. (2022a). *Environmental Site Assessment - Shoalhaven Hospital Redevelopment.* Report Ref: 8202118201_R003_ESA_Rev0: Cardno (NSW/ACT) Pty Ltd.

Cardno. (2022b). *Data Gap Investigation - Shoalhaven Hospital Redevelopment.* Report Ref: 8202118201-R006-DGI-Rev1: Stantec Australia Pty Ltd.

Landcom. (2004). *Managing Urban Stormwater: Soils and construction - Volume 1.* Landcom.

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure (NEPM), As amended 2013.* National Environment Protection Council (NEPC).

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

NSW EPA. (2020). *Consultants reporting on contaminated land; Contaminated land guidelines.* NSW Environment Protection Authority.

NSW EPA. (2022, 04 14). *NSW Environment Protection Authority*. Retrieved from Position statement — WA guidelines for asbestos contaminated sites: https://www.epa.nsw.gov.au/your-environment/contaminated-land/other-contamination-issues/managing-asbestos-in-and-on-land/position-statement-wa-managment-of-asbestos-sites

Safework NSW. (2019). *Code of Practice: How to Safely Remove Asbestos.* Safework NSW.

APPENDIX

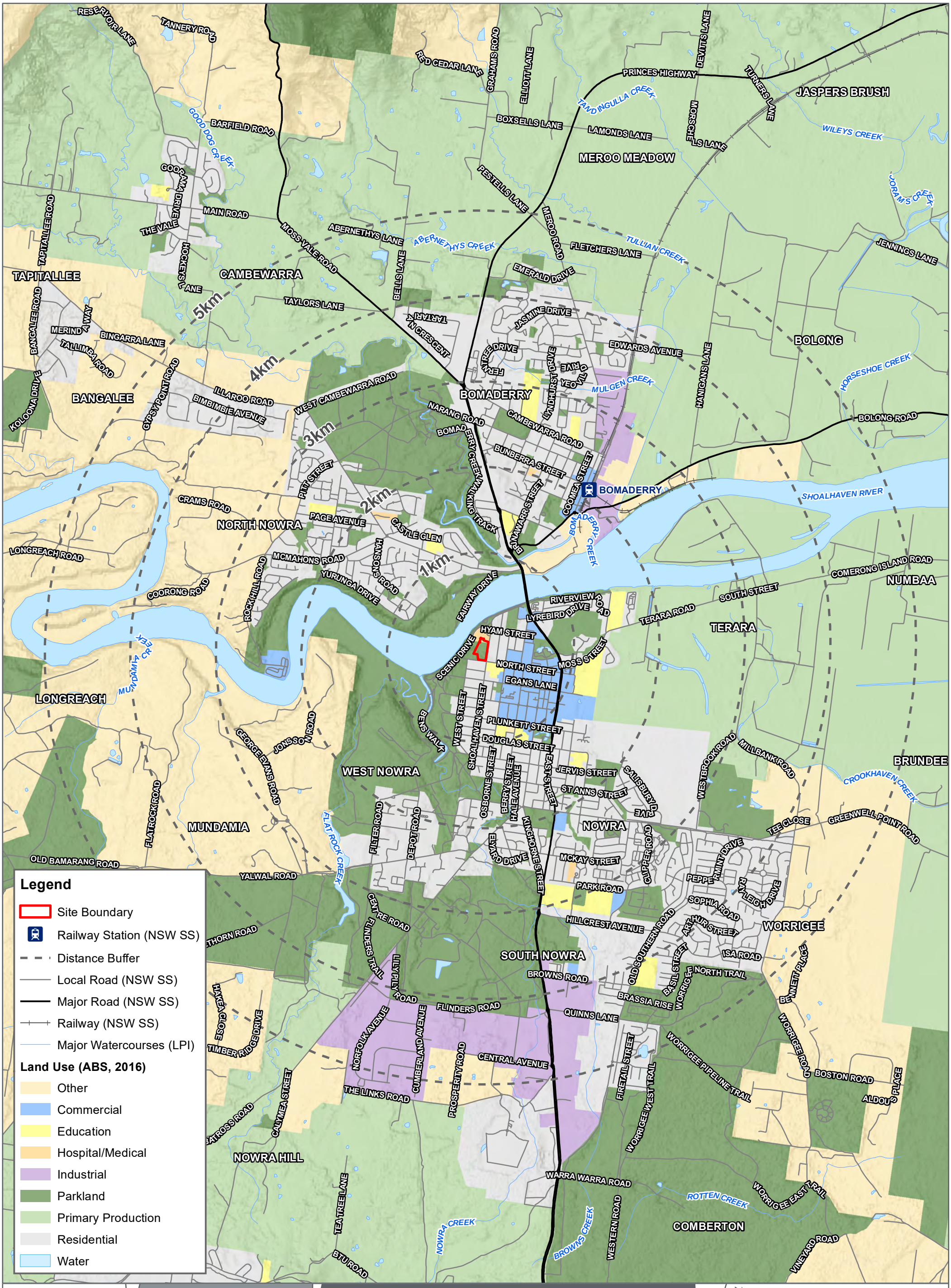
A

FIGURES

Cardno

now

Stantec



NSW GOVERNMENT Health Infrastructure

FIGURE 1

1:40,000 Scale at A3

km

0 0.5 1 1.5

Location Plan

SHOALHAVEN HOSPITAL REDEVELOPMENT

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (MNL)
Date: 2022-05-06 | Project: 8202118201
Coordinate System: GDA 1994 MGA Zone 56
Map: 8202118201-GS-013-NewSiteBoundary_LocationPlan.mxd 01
Basemap supplied by Esri and other third party suppliers

Legend

Site Boundary

Cadastre (NSW SS, 2019)

Previous Sample Location (Cardno, 2021)

Borehole

Hand Auger

Test Pit

DSI Sample Location

Borehole

Hand Auger

Test Pit

BH01N2
BH01N1
BH01W2
BH01W1
BH01
BH01E1
BH01S1
BH01E2
BH01S2
BH05
BH06
HA04
BH08
BH01N1
HA09
BH07
BH01S2
HA07
HA02
HA01
HA03
HA06
TP02
HA08
HA05
BH02
TP04
TP03
BH03
TP06
TP05
TP24
SHOALHAVEN STREET
TP07
TP25
TP26
BH04
TP08
TP27
TP10
TP28
TP30
TP29
TP31
NORTH STREET

FIGURE 3

1:1,000 Scale at A3

m
0 10 20 30 40

Sample Location Plan

SHOALHAVEN HOSPITAL REDEVELOPMENT

NSW GOVERNMENT Health Infrastructure

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (MNL)
Date: 2022-05-06 | Project: 8202118201
Coordinate System: GDA 1994 MGA Zone 56
Map: 8202118201-GS-010-AllSamplingPlan.mxd 02
Aerial imagery supplied by Metromap (November, 2020)

APPENDIX

B

CONCEPT DESIGN

Cardno

now

Stantec

Conrad Gargett

Legend

- NEW BUILD
- EXISTING BUILDINGS
- BUILDING LINKS
- LANDSCAPING
- EXISTING ROADS
- NEW ROADS
- PAVED AREAS

Revision

REV	DESCRIPTION	DATE	INT.
0	ISSUED FOR INFORMATION	11.11.21	JZ
1	ISSUED FOR INFORMATION	17.11.21	JZ
2	ISSUED FOR INFORMATION	07.12.21	JZ
3	ISSUED FOR INFORMATION	20.12.21	JZ
4	ISSUED FOR 80% SD	04.02.22	CL
5	ISSUED FOR INFORMATION	11.02.22	JZ
6	ISSUED FOR INFORMATION	18.02.22	CL
7	ISSUED FOR INFORMATION	25.02.22	JZ

KEY PLAN

Project

SDMH Shoalhaven District Memorial Hospital
Scenic Dr, Nowra NSW 2541

Client

NSW GOVERNMENT Health
Illawarra Shoalhaven Local Health District

Project Manager / Contract Administrator

JOHNSTAFF

Managing Contractor

NSW GOVERNMENT Health Infrastructure

PRELIMINARY

Building

ASB

Drawing

Site Plan - Proposed

A1 Scale 1 : 1000
Project No. 20278
Issue 7

Drawing No.
ASB-SD-DR-AR-1000

Details

Nominated Architect : Lawrence Toaldo NSW Reg. 10255.

10 0 10 20 30 40 50 60 70
SCALE 1: 1000 m
Scale at A1

APPENDIX

C

ANALYSIS RESULTS SUMMARY

Cardno

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Stantec

				TPH					TRH Fractions							BTEX							Metals								PAH						
				C6 - C9	C10 - C14	C15 - C28	C29-C36	>C10 - C36 (Sum of total)	C6-C10	C10-C16	C16-C34	C34-C40	C10 - C40 (Sum of total)	F1: C6-C10 less BTEX	F2: >C10-C16 less NAPHTHALENE	Naphthalene (VOC)	Benzene	Toluene	Ethylbenzene	Xylene (m & p)	Xylene (o)	Xylene Total	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				20	20	50	50	50	20	50	100	100	100	20	50	0.5	0.1	0.1	0.1	0.2	0.1	0.3	2	0.4	5	5	5	0.1	5	5	0.5	0.5	0.5	0.5	0.5	0.5
NSW 2014 General Solid Waste CT1 (No Leaching)				650				10000									10	288	600			1000	100	20	100		100	4	40							
NSW 2014 General Solid Waste SCC1 (With Leached)				650|6500				10000									18	518	1080			1800	500	100	1900		1500	50	1050							
NSW 2014 Restricted Solid Waste CT2 (No Leaching)				2600				40000									40	1152	2400			4000	400	80	400		400	16	160							
NEPM 2013 HIL, Recreational C																							300	90		17000	600	80	1200	30000						
NEPM 2013 Soil HSL Residential A&B, for Vapour Intrusion, Sand																																				
0-1m														45	110		0.5	160	55			40								3						
Field ID	**Location ID**	**Sample Depth**	**Sample Date**																																		
BH01_0.1	BH01	0.1	22/06/2021	<20	<200	<500	<500	<500	<20	<500	<1000	1300	1300	<20	<500	-	<0.1	<0.1	0.3	1.5	0.7	2.2	2.1	<0.4	7.1	160	6.4	<0.1	12	63	<0.5	<5	<5	<5	<5	<5
BH01_0.5	BH01	0.5	22/06/2021	<20	<20	51	220	271	<20	<50	160	660	820	<20	<50	-	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	6.9	<0.4	42	<5	7.9	<0.1	12	13	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01E1_0.1	BH01E1	0.1	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	14	<0.4	39	31	13	<0.1	17	52	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01E1_0.5	BH01E1	0.5	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	4.6	<0.4	26	<5	6.3	<0.1	5.4	6.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01N1_0.1	BH01N1	0.1	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	10	<0.4	24	110	12	<0.1	16	65	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01N1_0.5	BH01N1	0.5	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	22	<0.4	100	13	17	<0.1	12	23	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01S1_0.1	BH01S1	0.1	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	7.8	<0.4	15	130	13	<0.1	16	73	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01S1_0.5	BH01S1	0.5	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	5.7	<0.4	34	<5	6.4	<0.1	6.3	5.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01W1_0.1	BH01W1	0.1	21/03/2022	<20	<40	<100	160	160	<20	<100	<200	220	220	<20	<100	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	8	<0.4	20	56	8.7	<0.1	15	64	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01W1_0.5	BH01W1	0.5	21/03/2022	<20	<20	<50	<50	<50	<20	<50	<100	<100	<100	<20	<50	<0.5	<0.1	<0.1	<0.1	<0.2	<0.1	<0.3	6.4	<0.4	31	<5	6.6	<0.1	6.8	8.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

				PAH													OCP																				
				Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(k)fluoranthene	Benzo(b+j)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenz(a,h)anthracene	Benzo(g,h,i)perylene	Benzo(a)pyrene TEQ (Zero LOR)	Benzo(a)pyrene TEQ (Half LOR)	Benzo(a)pyrene TEQ (Full LOR)	PAHs (Sum of total)	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	d-BHC	DDD	DDT	DDT+DDE+DDD	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
NSW 2014 General Solid Waste CT1 (No Leaching)										0.8							200											60	60	60						
NSW 2014 General Solid Waste SCC1 (With Leached)										10																		108	108	108						
NSW 2014 Restricted Solid Waste CT2 (No Leaching)										3.2																		240	240	240						
NEPM 2013 HIL, Recreational C																3						300									20					10
NEPM 2013 Soil HSL Residential A&B, for Vapour Intrusion, Sand																																				
0-1m																																				
Field ID	**Location ID**	**Sample Depth**	**Sample Date**																																		
BH01_0.1	BH01	0.1	22/06/2021	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	6.1	12	<5	<5	<5	<5	<5	<5	<10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
BH01_0.5	BH01	0.5	22/06/2021	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01E1_0.1	BH01E1	0.1	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01E1_0.5	BH01E1	0.5	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01N1_0.1	BH01N1	0.1	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01N1_0.5	BH01N1	0.5	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01S1_0.1	BH01S1	0.1	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01S1_0.5	BH01S1	0.5	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
BH01W1_0.1	BH01W1	0.1	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
BH01W1_0.5	BH01W1	0.5	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	1.2	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

	OCP				OPP																																
	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Azinophos methyl	Bolstar (Sulprofos)	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Coumaphos	Demeton-O	Demeton-S	Diazinon	Dichlorvos	Dimethoate	Disulfoton	Ethion	Ethoprop	Fenitrothion	Fensulfothion	Fenthion	Malathion	Merphos	Methyl parathion	Mevinphos (Phosdrin)	Monocrotophos	Naled (Dibrom)	Omethoate	Phorate	Pyrazophos	Ronnel	Terbufos	Trichloronate
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.05	0.05	0.05	0.1	0.2	0.2	0.2	0.2	0.2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2	0.2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
NSW 2014 General Solid Waste CT1 (No Leaching)								4																													
NSW 2014 General Solid Waste SCC1 (With Leached)								7.5																													
NSW 2014 Restricted Solid Waste CT2 (No Leaching)								16																													
NEPM 2013 HIL, Recreational C		10	400	30				250																													
NEPM 2013 Soil HSL Residential A&B, for Vapour Intrusion, Sand																																					
0-1m																																					
Field ID	**Location ID**	**Sample Depth**	**Sample Date**																																			
BH01_0.1	BH01	0.1	22/06/2021	<5	<5	<5	<100	<5	<5	<5	<5	<5	<50	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<50	<5	<50	<5	<5	<5	<5	<5
BH01_0.5	BH01	0.5	22/06/2021	<0.05	<0.05	<0.2	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01E1_0.1	BH01E1	0.1	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01E1_0.5	BH01E1	0.5	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01N1_0.1	BH01N1	0.1	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01N1_0.5	BH01N1	0.5	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01S1_0.1	BH01S1	0.1	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01S1_0.5	BH01S1	0.5	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2
BH01W1_0.1	BH01W1	0.1	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5
BH01W1_0.5	BH01W1	0.5	21/03/2022	<0.05	<0.05	<0.05	<0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<2	<0.2	<2	<0.2	<0.2	<0.2	<0.2	<0.2

	OPP	Insecticides	Pesticides		SVOCs
	Tetrachlorvinphos	Tokuthion	Parathion	Pirimiphos-methyl	EPN
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.2	0.2	0.2	0.2	0.2
NSW 2014 General Solid Waste CT1 (No Leaching)					
NSW 2014 General Solid Waste SCC1 (With Leached)					
NSW 2014 Restricted Solid Waste CT2 (No Leaching)					
NEPM 2013 HIL, Recreational C					
NEPM 2013 Soil HSL Residential A&B, for Vapour Intrusion, Sand					
0-1m					
Field ID	**Location ID**	**Sample Depth**	**Sample Date**					
BH01_0.1	BH01	0.1	22/06/2021	<5	<5	<5	<5	<5
BH01_0.5	BH01	0.5	22/06/2021	<0.2	<0.2	<0.2	<0.2	<0.2
BH01E1_0.1	BH01E1	0.1	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01E1_0.5	BH01E1	0.5	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01N1_0.1	BH01N1	0.1	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01N1_0.5	BH01N1	0.5	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01S1_0.1	BH01S1	0.1	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01S1_0.5	BH01S1	0.5	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2
BH01W1_0.1	BH01W1	0.1	21/03/2022	<0.5	<0.5	<0.5	<0.5	<0.5
BH01W1_0.5	BH01W1	0.5	21/03/2022	<0.2	<0.2	<0.2	<0.2	<0.2

APPENDIX

D

SAMPLING DQO AND DQI

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Data Quality Indicators

The following Data Quality Indicators (DQIs), are to be adopted in accordance with the requirement of the *Schedule B2 Guideline on Site Characterisation* of the ASC NEPM (2013). The DQIs outlined in the table below assist with decisions regarding the contamination status of the site, including the quality of the laboratory data obtained.

Summary of Data Quality Indicators

QAQC Measure	Field Quality Indicator	Laboratory Quality Indicator
Precision: A quantitative measure of the variability (or reproducibility) of data,	SOPs are appropriate and complied with. Field duplicates and Blind field duplicates are collected and analysed at a rate of 5% (1 per 20 samples). Use of calibrated equipment.	Laboratory analyses of laboratory and inter-laboratory duplicates, field duplicates, laboratory prepared volatile trip spiles. Relative Percent Difference (RPD) calculation results: <30% Relative Percentage Difference (RPD). The RPD values are calculated using the following equation: $RPD = \frac{I\ C_O - C_R\ I}{[(C_O + C_R) / 2]} \times 100$ Where, C_O = Analyte concentration of the original sample C_R = Analyte concertation of the duplicate sample
Accuracy: A quantitative measure of the closeness of reported data to the “true” value	SOPs are appropriate and complied with. Use of calibrated equipment. Field interlaboratory duplicates sampled and analysed at a rate of 1 per 20 samples. <50% Relative Percentage Difference (RPD) for volatile contaminants. Analysis of rinsate sample collected at rate of 1 per day.	Laboratory holds NATA-accreditation for the analyses. Laboratory holds ANSI accreditation for isotope analysis. Laboratory limit of reporting is below the adopted investigation level. Laboratory analysis of: field blanks, rinsate blank, reagent blank, method blank, matrix spike, matrix spike duplicate, surrogate spike, reference material, laboratory control sample, laboratory-prepared spikes. The nominal acceptance limits on laboratory control samples are: Laboratory spikes: ▪ 70-130% recovery for metals ▪ 60-140% for organics ▪ Laboratory duplicates. If contaminant concentration is: - < 10 x PQL, no RPD limit - 10-20 x PQL, RPD is 0% to 50% - >20 x PQL, RPD is 0% to 20% Laboratory surrogates: 60-140% recovery. Laboratory blanks: <PQL Laboratory control samples, 70-130% recovery

QAQC Measure	Field Quality Indicator	Laboratory Quality Indicator
Representativeness: The confidence (expressed qualitatively) that data are representative of each media present on site and the conditions encountered in the field	Appropriate media sampled. Preservation and storage of samples upon collection and during transport to the laboratory occurs. Sampling is undertaken by an experienced sampler.	Blank samples run in parallel with field samples to confirm there are no unacceptable instances of laboratory artefacts. Review of RPD values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods). Rinsate samples used when sampling equipment is reused have analytical results <LOR.
Completeness: A measure of the amount of useable data from the data collected during the fieldwork program	All critical locations sampled. All samples collected (from grid and at depth). Standard operating practices (SOPs) appropriate and complied with. Sampling is undertaken by an experienced sampler. Suitable records of field work are documented. Completed laboratory sample chain-of-custody and documentation.	All critical samples are analysed according to the SAQP. All COPC are analysed. Appropriate methods and PQLs are implemented. Sample documentation is complete. Samples are analysed within holding times.
Comparability: The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event	Same SOP is used on each field occasion. Climatic conditions are documented. Experienced sampler Sample type, preservation and handling are consistent at sampling events. Use of calibrated equipment.	Sample analytical methods used (including clean-up) Sample PQLs (justify/quantify if different) Same laboratories are used and justification is given where differences occur. Same analytical methods, Practical Quantification Limits (PQLs), and units of measurement are used.

Quality Assurance / Quality Control

To meet the DQIs outlined above, the following additional Quality Assurance / Quality Control (QA/QC) procedures are to be undertaken.

Summary of QA/QC Processes

Requirement	Comments
Equipment calibration	Provision of calibration certificates. The scientific instruments that are used for the site are to be calibrated by the manufacturer.
Equipment decontamination	Decontamination of sampling equipment where needed. Sampling equipment that is not disposable, such as hand tools, is to undergo the following decontamination process: Wash equipment in soapy water that contains a mixture of water and Decon 90, with the objective to remove sediments and particulate from the equipment. Rinse decontaminated equipment with potable or deionised water.
Soil logging	Logging soils in general accordance with AS1726 including sample information recorded on the sampling sheets.
Sample media identification	Samples marked with a unique identifier including project number, sample location, depth and date.
QA/QC Field duplicates/triplicates/field blanks and trip spikes	Duplicate samples collected at a rate of 1 every 20 primary samples completed at the primary intra-laboratory; and triplicate samples at a rate of 1 every 20 samples to be analysed at the secondary inter-laboratory. One laboratory provided trip blank and trip spike is to be submitted at a rate of 1 per sample dispatch.
Sample preservation	Collected soil and water samples are to be placed in a chilled icebox with ice for storage and transport to the laboratory.
Chain of Custody (COC documentation	COC forms detailing sample identification, collection date, sampler and laboratory analysis required. The COC form is to be signed off and returned to Cardno by the laboratory staff upon receipt of all the samples.
NATA accredited methods	NATA accredited laboratories are to be used for analysis of samples in accordance with NATA accredited methods where applicable.
Trip blank / spike	A laboratory supplied trip blank and trip spike is to be submitted for analysis at a rate of at least one per sample dispatch.

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs.

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