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REMEDIATION ACTION PLAN

5-9 Cowan Road, St Ives NSW

Prepared for:

Prosper 5-9 Cowan Road St Ives Pty Limited

29th January 2026

Document Number: ES9614/9

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ABBREVIATIONS

AIP	Australian Institute of Petroleum Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council
AST	Aboveground Storage Tank
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethyl benzene and Xylene
COC	Chain of Custody
DQOs	Data Quality Objectives
DSI	Detailed Site Investigation
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESL	Ecological Screening Level
HIL	Health-Based Soil Investigation Level
HSL	Health Screening Level
LGA	Local Government Area
NEHF	National Environmental Health Forum
NEPC	National Environmental Protection Council
NHMRC	National Health and Medical Research Council
OCP	Organochlorine Pesticides
OPP	Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photo Ionisation Detector
PQL	Practical Quantitation Limit
PSI	Preliminary Site Investigation
QA/QC	Quality Assurance / Quality Control
RAC	Remediation Acceptance Criteria
RAP	Remediation Action Plan
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SMP	Site Management Plan
SVC	Site Validation Criteria
TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
VHC	Volatile Halogenated Compounds

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EXECUTIVE SUMMARY

GSNE Services Pty Ltd ("GSNE Services") was appointed by Prosper 5-9 Cowan Road St Ives Pty Limited (the "Client") to prepare a Remediation Action Plan (RAP) for the property located at 5-9 Cowan Road, St Ives NSW (the "site").

The proposed works include demolition of existing structures, site preparation works, excavation and construction of the building and associated landscaping works. Specifically, the SSDA seeks development consent for:

- Demolition of the existing row of 10 attached townhouses at the site;
- Construction of an 9-storey residential flat building comprising:
    - 77 new dwellings (64 market residential units and 13 affordable housing units)
    - 3 basement levels for car parking
    - Communal open space at Ground Level and Level 7 and Level 8
- landscaping; and
- associated site works.

A site investigation was requested by the Client to accompany a detailed State Significant Development Application (SSDA) for a residential development (including in-fill affordable housing) at 5-9 Cowan Road, St Ives within the Ku-ring-gai Local Government Area (LGA).

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-88948458) on 25 July 2025, in particular *Section 13 - Contamination and Remediation*.

Based on the findings of the *""Detailed Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/8, dated 23rd January 2026), a number of data gaps and two hotspots of zinc contaminated topsoils in BH9 & BH11 were identified. It was recommended that these concerns be addressed through an additional soil investigation, and preparation of a RAP to manage the zinc impacted topsoils in BH9 & BH11.

Additional site works are required as outlined in Section 6.0 of this RAP.

The removal of fill material to a licensed landfill (off-site disposal) is the preferred remediation strategy.

Assuming appropriate permits have been granted, the remediation of the site is to take place in the following stages:

- Prepare the site with fences, erosion controls, signage and environmental controls.
- Demolish site structures and concrete slabs to make way for remedial works and under slab observations.
- Undertake the ASI as per Section 6.0.
- Following the completion of the ASI, a revised RAP may be required should additional contamination be identified within the site.
- The topsoils within Hotspot BH9 will be excavated approximately 140m^2 x 0.3m vertically deep and placed into the one stockpile, SP1.
- The topsoils within Hotspot BH11 will be excavated approximately 140m^2 x 0.3m vertically deep and placed into the one stockpile, SP1.
- The stockpile SP1, with an approximate volume of 84m^3, will be sampled by recovering 5 samples to allow for an appropriate waste classification report to be prepared.
- Upon classification, the stockpile SP1 will be appropriately disposed of at EPA licenced facility that can accept the classified waste.
- The floor and walls of the Hotspot BH9 will be validated by taking 3 floor samples and 5 wall samples plus QA/QC samples. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.
- The floor and walls of the Hotspot BH11 will be validated by taking 6 floor samples and 5 wall samples plus QA/QC samples. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.
- Remediation will occur by managing soil for offsite disposal to landfill for contaminated soils and for soil to an offsite soil recycling facility for reuse in the case of clean soil.

With reference to Clause 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021, the site will be considered to be rendered suitable subject to the implementation of remediation and validation works in accordance with this RAP, for the proposed eight-storey residential building including three levels of basement car parking and deep soil landscaping areas development.

1 INTRODUCTION

1.1 Background

GSNE Services Pty Ltd ("GSNE Services") was appointed by Prosper 5-9 Cowan Road St Ives Pty Limited (the "Client") to prepare a Remediation Action Plan (RAP) for the property located at 5-9 Cowan Road, St Ives NSW (the "site"). The location of the property is presented in Figure 1 of Appendix A.

The proposed works include demolition of existing structures, site preparation works, excavation and construction of the building and associated landscaping works. Specifically, the SSDA seeks development consent for:

- Demolition of the existing row of 10 attached townhouses at the site;
- Construction of an 9-storey residential flat building comprising:
  - 77 new dwellings (64 market residential units and 13 affordable housing units)
  - 3 basement levels for car parking
  - Communal open space at Ground Level and Level 7 and Level 8
- landscaping; and
- associated site works.

The proposed development plans can be found in Appendix B.

A site investigation was requested by the Client to accompany a detailed State Significant Development Application (SSDA) for a residential development (including in-fill affordable housing) at 5-9 Cowan Road, St Ives within the Ku-ring-gai Local Government Area (LGA).

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued for the project (SSD-88948458) on 25 July 2025, in particular *Section 13 - Contamination and Remediation*.

Based on the findings of the *""Detailed Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/8, dated 23rd January 2026), a number of data gaps and two hotspots of zinc contaminated topsoils in BH9 & BH11 were identified. It was recommended that these concerns be addressed through an additional soil investigation, and preparation of a RAP to manage the zinc impacted topsoils in BH9 & BH11.

This RAP has been prepared to support the Development Application (DA) for this site with reference to the following (but not limited to) guidelines:

- NSW EPA (2020) "*Guidelines for Consultants Reporting on Contaminated Sites*".
- NSW EPA (2017, 3rd Edition) "*Guidelines for the NSW Site Auditor Scheme*".

1.2 RAP Objectives and Roles

The primary objective of the RAP is to provide a detailed list of objectives, planned activities and procedures to ensure the effective and controlled remediation and validation of the site to manage the contamination identified in previous investigations.

However, should the additional soil investigation indicate other areas of concern and the requirement for additional remediation, an addendum or revision to this RAP is required to address these concerns.

It is the responsibility of the remediation contractor to implement all the remediation requirements prescribed in the RAP. The site manager/foreman of the remediation contractor should have a thorough understanding of the contents of the RAP and should ensure that each employee or sub-contractor is familiar with the requirements of the RAP. All works undertaken during the remediation program must be monitored by a suitably qualified person experienced in the assessment and remediation of contaminated sites.

Validation works and additional investigations or field monitoring shall be carried out by a suitably qualified and experienced environmental consultant either engaged directly by the Client or by the remediation contractor.

1.3 Scope

The scope of the RAP comprises the following:

- Provide a summary of site conditions and the surrounding environment;
- Summarise the findings of the previous investigation and the current contamination status of the site;
- Provide an outline of the additional investigations to be carried out in order to address the data gaps identified in the previous investigation;
- Set remediation goals, strategies and methods to ensure that the remediated site will be suitable for the proposed development and will pose no unacceptable risk to human health or the environment;
- Establish appropriate site validation criteria and a validation works programme to ensure that the remediation works carried out meet the remediation goals of the project; and
- Establish a Site Management Plan (SMP), Environmental Management Plan (EMP) and Work Health & Safety Plan (WHSP) to be implemented during remediation and validation works to ensure that statutory requirements for the environment and work health safety are complied with.

It should be noted that the RAP may need to be revised in the event that additional contamination is identified during the additional investigation works to be carried out.

1.4 Roles and Responsibilities

The following roles and responsibilities have been identified:

Table 1: Roles and Responsibilities

Role	Contact	Responsibility
Project Manager	Serghei Bolgarschii	The client and principal
Accredited Site Auditor	Kylie Lloyd	The Auditor will prepare a Site Audit Report (SAR). The Site Auditor will undertake an independent review of the works in accordance with the *Contaminated Land Management Act*.
Remediation Contractor	TBA	The contractor will be responsible for undertaking the remedial works and obtaining and complying with all relevant approvals such as those required to undertake these works.
Environmental Consultant	GSNE Services	Will be required to liaise with the Client, Site Auditor Project Manager and Contractor, and provide an independent compliance inspection with the RAP, review and validation of the remedial works / management measures

2 SUMMARY OF SITE CONDITIONS

2.1 Site Identification and Zoning

Site identification information is summarised in the table below.

Table 2: Site Identification

Lot and DP Number (Address)	SP30097 (5-9 Cowan Road, St Ives NSW)
Coordinates (SE corner) *	Latitude: -33.730459, Longitude: 151.157080
Approx. Site Area	3,467.7m^2
Local Government Area	Ku-Ring-Gai
Parish	Gordon
County	Cumberland
Current Land Zoning**	R3- Medium Density Residential
Proposed Land Use	Medium Density Residential
Site End Users	Residents (adults & children), workers and visitors

Notes: * refer to http://maps.six.nsw.gov.au/

** refer to https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address

The site boundary and Lot and DP numbers are presented in Figure 2 of Appendix A. A survey plan provided by the client is included in Appendix B.

2.2 Site Description

An GSNE Services field scientist/engineer made the following observations during the site inspection carried out on Wednesday 10th December 2025:

- The site was trapezoidal in shape with an approximately 78m long western frontage to Cowan Road and used for residential purposes.
- The site boundaries were defined by metal fences along the northern, southern and eastern boundaries.
- The site comprised of ten identical double-storey residential buildings with tile roofs.
- A concrete driveway was observed adjacent to the southern perimeter of the site extending towards the north at the back of the residential building. The sealed surfaces within the driveway were observed to be in a generally good condition.
- A garage was observed at the back of each residential building. Staining was not observed at the sealed surfaces around the garage.
- A concrete parking area was observed at the back of units 1, 2 and 3. The sealed surface within the parking area was observed to be in a generally good condition.
- A metal shed was observed towards the northern site boundary.
- Trees and grass covered backyard was observed at the back of each residential building. No sign of stress was observed within the vegetation.
- No surface standing water was noticed at the site.

The site features are presented in Figure 3 of Appendix A.

2.3 Topography and Surface Water Drainage

The following observations were made during the site inspection carried out on the Wednesday 10th December 2025:

- The site topography is slightly sloping towards the southeast, with Cowan Road (along the western perimeter) slightly sloping to the southwest at approximately 5% slope.
- Stormwater runoff from the site is expected to flow across the site towards Mona Vale Road, southeast from the site.

Copies of the topographical survey provided by the client, including existing stormwater and sewer drainage plans can be found in Appendix B.

2.4 Surrounding Land Uses

The surrounding land uses identified are described in the table below:

Table 3: Surrounding Land Uses

Orientation	Description
North	Commercial (Parking lot)
East	Commercial (St Ives Shopping Village)
South	Low density residential and Caltex Service Station (50m towards the south)
West	Street then low and medium density residential.

3 LOCAL SOIL, GEOLOGY AND HYDROGEOLOGY

3.1 Soil

The Soil Landscape Map of Sydney (soil Landscape Series Sheet 9130, Scale 1:100,000, 2002), prepared by the Soil Conservation Service of NSW, indicates that the site is located within the Glenorie landscape area and typically consists of highly plastic and impermeable residual soil.

Based on the *Preliminary Geotechnical Investigation* performed by GSNE Services Pty Ltd (Ref: GS9614, dated July 2025), the soil profile at the site comprised of topsoil and/or fill materials up to 1.5m below ground level (BGL).

3.2 Geology

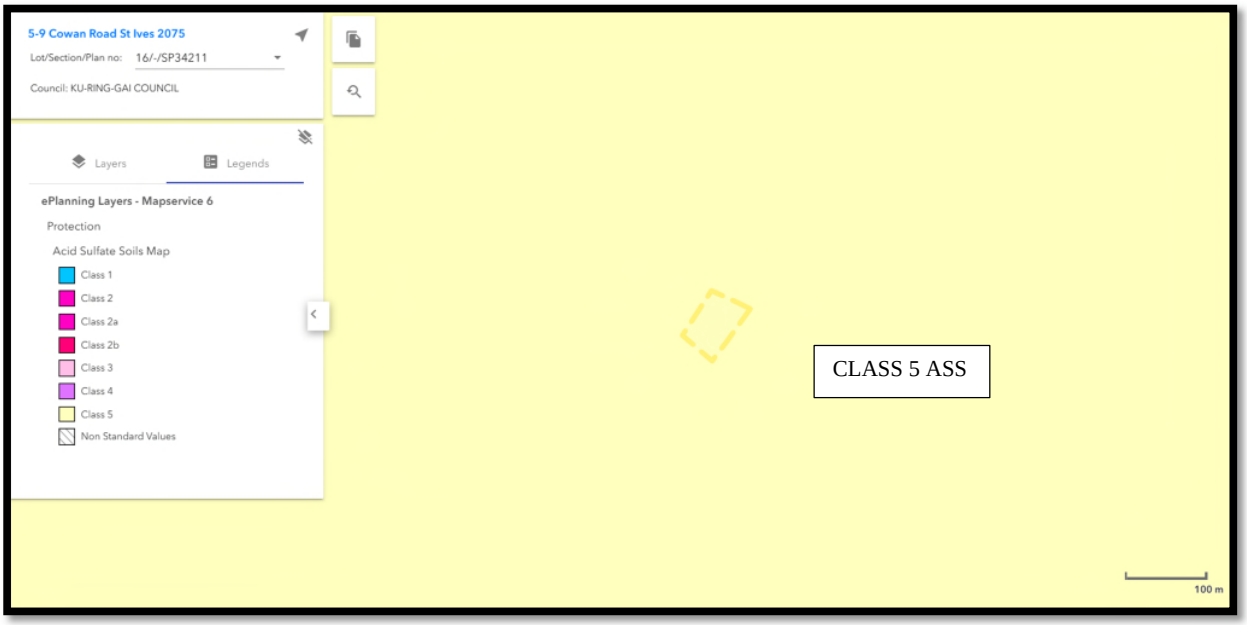
The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by Triassic Age Shale of the Wianamatta Group, comprising black to dark grey shale and laminite.

Based on the *Preliminary Geotechnical Investigation* performed by GSNE Services Pty Ltd (Ref: GS9614, dated July 2025), the geological profile at the site comprised of residual Silty CLAY underlain by SHALE bedrock.

3.3 Acid Sulphate Soils

To determine whether there is a potential for acid sulphate soils to be present at the site, reference was made to the NSW Department of Land & Water Conservation (DLWC) *Acid Sulphate Soil Risk Maps* (Edition Two, December 1997, Scale 1:250,000), specifically Map No. 89 – "Hornsby/Mona Vale". A review of the map indicated that there is a no probability of occurrence of acid sulphate soil materials at the site, and the presence of acid sulphate soils was considered to be unlikely.

A review of NSW Planning and Environment website revealed that the site is situated in the region designated as “Class 5” for acid sulfate soil (ASS) as shown in the enclosed extracted map.



3.4 Hydrogeology

3.4.1 Desktop

Based on available information, our desktop study indicates that groundwater from site is likely to be flowing towards the southeast as shown in Figure 4 in Appendix A.

A search of the Department of Natural Resources (DNR) borehole database information revealed twenty-seven (27) groundwater bores within a 500m radius of the site, with the nearest ten (10) registered groundwater bores used for monitoring purposes, installed to depths between 0.5m and 7.0m BGL.

Based on the single bore record with data on the water bearing zone (GW110700), groundwater is likely to be present at shallow depths above or within the less permeable clay soils/Shale in the area. Groundwater present within the clay soils/Shale is likely to be under semi-confined conditions with low recharge rates during heavy rainfall events.

No information was provided regarding salinity records; however, groundwater is likely to be fresh or brackish based on other site investigations conducted by GSNE Services in the area.

3.4.2 Standing Water Levels

During the *Detailed Site Investigation*, the standing water levels measured in the three monitoring wells installed within the site were at depths of 8.5m (163.5m AHD), 7.9m (163.1m AHD), and 7.5m (163.5m AHD), respectively.

3.5 Local Meteorology

The monthly rainfall of the local area can be represented by the data collected by Bureau of Meteorology (BOM) from the rainfall gauge located Gordon Golf Club, which is located approximately 3.3km away from the site. Records indicate that the mean annual rainfall calculated over all the years of data is 1327.6mm.

3.6 Sensitive Receptors

The nearest sensitive environmental receptors to the site are:

- Pymble Golf Club located approximately 160m to the south west.
- St Ives Playground located approximately 220m to the north.
- St Ives Village Green located approximately 310m to the north.
- Dalrymple-Hay Nature Reserve located approximately 740m to the south.
- High Ridge Gully located approximately 970m to the south.
- Friars Field located approximately 950m to the south west.
- Cowan Creek located approximately 800m to the west.

4 SUMMARY OF SITE HISTORY

4.1 Land Titles Review

The land title information provided suggests that the site was owned by private individuals from 1924 to 1970. In 1970, the site was bought by David Jones Limited. From 1972 to 1985, the site was owned by G. & R. Investments Pty Limited. In 1985, ownership transferred back to a private individual, John Patrick Grogan, who held the site until 1989. During 1989 the site was developed into a Strata Plan and was transferred to various private individuals since then.

4.2 Aerial Photography Review

The land use of the site appeared to have comprised vacant land and low-density residential in the northern portion from at least 1943 to 1964 and subsequently developed for residential use across the site between 1964 and 1970. From 1970 to 1978, the site became vacant following demolition of the residential structures. Between 1978 and 1989, the site was redeveloped with five residential buildings, which remained generally unchanged through to 2013.

The general land use of the immediate site vicinity appears to have been predominantly rural residential and vacant land from 1943 to 1964, with increasing residential development in all directions by 1964. From 1970 onwards, gradual commercial development occurred to the east and south of the site, with additional parking areas developed to the north by 1989, and redevelopment of surrounding residential and commercial properties observed between 2005 and 2013.

4.3 NSW EPA Records

4.3.1 Section 58, CLM Act 1997

A search of the EPA database revealed that the subject site is not listed; however, the following sites were listed within the suburb of St Ives.

Table 4: Summary of sites listed under Section 58, CLM Act 1997

Site name	Location	Type	Notices	Distance from site
Shell Service Station	179-181 Mona Vale Road, St Ives NSW	Notice to End Remediation Declaration	4 former (20194436, 21075, 19010 & GN93B)	Approx 110m SE

In 2001, the NSW EPA determined that 179-181 Mona Vale Road, St Ives along with 4 Shinfield Avenue, St Ives was contaminated to a degree that presented a significant risk of harm. The contaminants of concern were Total Petroleum Hydrocarbons (TPH) and Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), which were found in both soil and groundwater.

On October 11, 2019, the EPA declared that 179-181 Mona Vale Road, St Ives had been remediated under the Contaminated Land Management Act 1997. Remediation works were undertaken at the property to remove the primary sources of contamination, remediate off-site impacted land, and to prevent further off-site migration.

4.3.2 POEO Register

A search of the POEO Register revealed that the site was not listed. No other sites were listed within the suburb of St Ives.

4.3.3 Unlicensed Premises Regulated by the NSW EPA

A search of the NSW EPA Records revealed that the site is not listed. No other sites were listed within the suburb of St Ives.

4.3.4 Section 60, CLM Act

The published document as of the 10th June 2025 revealed that the site was not listed; however, the following sites were notified within the suburb of St Ives.

Table 5: List of sites notified under Section 60, CLM Act

Site name	Location	Type	Distance from site
7-Eleven	157 – 159 Mona Vale Road, St Ives NSW	Service Station	Approx. 260m S
Caltex Service Station	452 Mona Vale Road, St Ives NSW	Service Station	Approx. 3.9km NE
Caltex Service Station	164 Mona Vale Road, St Ives NSW	Service Station	Approx. 50m SE
Caltex Service Station	363 Mona Vale Road, St Ives NSW	Service Station	Approx. 2.2km NE
Shell Service Station	179-181 Mona Vale Road, St Ives NSW	Service Station	Approx 110m SE

4.4 NSW Government PFAS Investigation Program

A search of the EPA database revealed that the site is not listed on the NSW Government PFAS Investigation Program and/or the Contaminated Land Database.

The nearest PFAS investigation is the Westleigh Rural Fire Brigade located approximately 8.1km west of the site.

4.5 Unexploded Ordnance

A review of the Department of Defence website for Unexploded Ordnance showed no records for the site.

4.6 Naturally Occurring Asbestos

A review of the SafeWork NSW website showed that the site was not located in an area where naturally occurring asbestos might be located.

4.7 10.7 Planning Certificates

The 10.7 Planning Certificates of the Environmental Planning & Assessment Act 1979 for the site was obtained by the client and provided to GSNE Services for review. A summary of the information pertaining to the site is provided below:

- The site is zoned R3 – Medium Density Residential under the provision of the *Ku-ring-gai Local Environmental Plan 2015*.
- Complying Developments under the Container Recycling Facilities Code, Commercial and Industrial Alteration Code, Commercial and Industrial (New Buildings and Additions) Code, Demolition Code, Fire Safety Code, General Development Code, Housing Code, Housing Alteration Code, Low Rise Housing Diversity Code, Subdivision Code may be carried out.
- The land does not include or comprise conservation areas, or environmental heritage items.
- The property is not affected by a road widening or road realignment under the Roads Act.
- The land is not listed on the loose-fill asbestos insulation register.
- The land is not within a proclaimed mine subsidence district.
- The land is not affected by a policy that restricts the development of the land because of the likelihood of land slip, bush fire, tidal inundation, subsidence, acid sulphate soils or flooding.
- The land is not affected by one of the matters prescribed by Section 59 (2) of the *Contaminated Land Management Act 1997*.

4.8 Industrial Processes and Products Manufactured

A review of the industrial processes and/or products manufactured at the site was conducted, with these activities are unlikely having taken place within the site.

4.9 Former Chemical Storage and Transfer Areas

A review of the former chemical storage and transfer areas and/or products manufactured at the site was conducted. No evidence of such storage was found within the site.

4.10 Product Spill & Loss History

It was indicated by the client, that to their knowledge no serious land or water contamination had occurred.

4.11 Discharges to Land, Water and Air

No discharges to land, water and air were observed within the site.

4.12 Complaints History

There were no complaints registered for the site.

4.13 Historical Use of Adjacent Land

It was indicated by the client that to their knowledge, the adjacent lands to the site have been used primarily for residential and commercial / industrial developments. The adjacent land towards the southeast of the site has been used as a service station.

5 SUMMARY OF PREVIOUS ENVIRONMENTAL REPORTS

5.1 General

The following previous site investigations were undertaken for the site and are summarised in the following sub-sections:

- GSNE Services Pty Ltd (2025) – *"Preliminary Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/6, dated 25th August 2025).
- GSNE Services Pty Ltd (2026) – *"Detailed Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/8, dated 23rd January 2026).

5.2 GSNE Services PSI (August 2025)

The scope of works for the PSI included a site inspection, a desktop and historical document review, preparation of a CSM and preparation of a report.

At the time of the inspection (24th June 2024), the site was used for residential purposes and comprised of ten identical double-storey residential buildings with a garage at the back of each residential building.

Historical information indicated that the site was owned and used by private individuals from the early 1920s through to the present date.

A service station located at 179-181 Mona Vale Road, St Ives was noted on the EPA website to be contaminated to a degree that presented a significant risk of harm. The contaminants of concern were TPH and BTEX, which were found in both soil and groundwater.

The findings of the assessment indicated the following areas of potential environmental concern; those being potential importation of uncontrolled fill, pesticides use, onsite migration, leaks from vehicles, metal degradation, and asbestos based building materials.

Based on the CSM, the following data gaps were identified with respect to the pollution linkages identified:

- Confirmation if contamination has occurred from current and historical site activities through collection and laboratory analysis of soil.
- The presence and quality of groundwater is currently unknown and may be impacted by contaminated fill and historical leakages from the adjacent service station to the south east.

The contaminants that may be present in some of these areas were considered to be of low significance in terms of risk to the human and environmental receptors identified. Therefore, it is recommended that a Detailed Site Investigation (DSI) is to be undertaken during design development phase, to provide further confirmation of the presence and extent of contamination on site prior to construction.

Based on the information collected during this investigation and in reference Clause 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021, the site will be suitable subject to the completion of a Detailed Site Investigation (and after remediation and validation, if required), for the proposed eight-storey residential building including three levels of basement car parking and deep soil landscaping areas.

5.3 GSNE Services DSI (January 2026)

Eleven boreholes (BH1 to BH11) were drilled by adopting a near systematic grid and targeted sampling pattern across the site to provide general site coverage with consideration given to accessibility, site features and the proposed development zones.

Three (3) groundwater monitoring wells (GW1 to GW3) were installed during the GSNE Services Geotechnical Site Investigation on the 11th & 12th June 2025 and were utilised to undertake a groundwater investigation within the site.

The soil assessment revealed the following:

- Heavy metals concentrations were below the HIL 'B', EILs and site derived EILs, with the exception of:
    - Zinc concentrations in the samples BH9 (0-0.1m) and BH11 (0-0.1m) which exceeded the site derived EIL.
- TRH and/or BTEXN concentrations were below the HSL "A&B", HSL "D", ESLs and/or Management Limits.
- PAH, OC, PCB, Phenols and/or Cyanide concentrations were below the HIL 'B', ESLs and/or EILs.
- Asbestos was not detected int the recovered samples analysed.

The groundwater assessment revealed the following:

- Heavy metals concentrations were below the SAC, with the exception of the following which exceeded the freshwater criteria:
    - A cadmium concentration in sample GW1.
    - A chromium concentration in sample GWSS1 (a triplicate of GW2).
    - Copper concentrations in samples GW1, GW2, GWD1 (a replicate of GW2) and GWSS1 (a triplicate of GW2).
    - A lead concentration in sample GWSS1 (a triplicate of GW2).
    - A mercury concentration in sample GW1.
    - Nickel concentrations in samples GW1 and GWSS1 (a triplicate of GW2).
    - Zinc concentrations in samples GW1, GW2, GW3, GWD1 (a replicate of GW2) and GWSS1 (a triplicate of GW2).
- TRH, BTEX and/or PAH concentrations were below the SAC.

The heavy metal concentrations can be considered to be background levels are do not warrant any further investigation.

Based on the results of this investigation, it is considered that the risks to human health and the environment associated with soil and groundwater contamination at the site are low within the context of the proposed use of the site for a medium density residential development.

With reference to Clause 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021, the site will be considered to be rendered suitable subject to the completion of a Remedial Action Plan (and after remediation and validation), for the proposed an eight-storey residential building including three levels of basement car parking and deep soil landscaping areas development.

No investigation was conducted within the existing building footprints across the site, leaving potential contamination in these areas unassessed. Additionally, the vertical and/or lateral extents of the impacted soils at locations BH9 & BH11 have not been fully delineated. To address these concerns, it is recommended to conduct subsurface investigations within the building footprints after the demolition of the buildings, and to further characterize the impacted soils at BH9 & BH11 to determine the full extent of contamination.

6 ADDITIONAL INVESTIGATION

Prior to the commencement of any remediation works other than removing the current infrastructure, additional investigation as indicated hereafter are required to adequately characterise the soil impacts in the context of human health and/or the environment.

A summary of the works required to be undertaken is provided in the table below and showed in Figure 9 in Appendix A:

Table 6: Soil Sampling

Borehole	Depth (mBGL)	Contaminants of Potential Concern	Rationality
BH12 to BH20	Near surface (0.1)	Heavy Metals, TPH, BTEX, PAH, OC, PCB and %w/w asbestos.	Characterisation of soil previously inaccessible and/or waste classification of soils within the proposed basement area.
	Natural	Heavy Metals.	

The results of the supplementary investigations will be included as part of the validation program for the site. Should the additional soil investigation indicate other areas of concern and the requirement for further remediation, an addendum or revision to this RAP will be required to amend the remediation strategy.

These works should be conducted once the structures have been demolished from the site and concrete slabs have been removed to better target potential AECs that could not be accessed during the DSI.

7 SOIL REMEDIATION STRATEGY

7.1 Remediation Goals

The remediation goal is to render the site suitable for the proposed development upon completion of the remediation, validation and additional investigation works.

7.2 Extent of Remediation Works

Soil remediation is currently limited to the zinc impacted hotspots at boreholes BH9 and BH11.

At this stage, the extent of remediation would be as follows:

- Hotspot BH9 – it is intended to initially excavate the Hotspot area, that being approximately 140m^2 x 0.3m into natural ground vertically deep. The topsoils in this area will be classified and then appropriately disposed of at EPA licenced facility that can accept the classified waste. The approximate volume of topsoils to be disposed of off-site is 42m^3.
- Hotspot BH11 – it is intended to initially excavate the Hotspot area, that being approximately 140m^2 x 0.3m into natural ground vertically deep. The topsoils in this area will be classified and then appropriately disposed of at EPA licenced facility that can accept the classified waste. The approximate volume of topsoils to be disposed of off-site is 42m^3.

Should the additional soil investigations indicate other areas of concern and the requirement for further remediation, an addendum or revision to this RAP is required to amend the remediation strategy.

If additional contaminated material is found during the remediation works, these materials will be chased up and removed.

7.3 Soil Remediation Options Review

7.3.1 NSW EPA Preferred Hierarchy Of Options

The NSW EPA publication Guidelines for the NSW Site Auditor Scheme (3rd Edition) (NSW EPA, 2017) outlines the preferred hierarchy of options for site remediation and/or management as is set out in s.6(16) Assessment of Site Contamination Policy Framework of Schedules A and B of the NEPM.

The preferred order of options for soil remediation and management outlined in these guidelines are:

1) On site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
2) Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site;
3) Removal of contaminated soil to an approved site or facility followed, where necessary, by replacement with clean fill; and
4) Consolidation and isolation of the soil on the site by containing with a properly designed barrier.

7.3.2 On-Site and Off-Site Treatment

There is a range of soil treatment technologies available depending on the type of contaminant including in-situ and ex-situ remediation methods. Most commonly, for contamination, the technologies adopted are ex-situ, requiring excavation of the contaminated material. In-situ remediation technologies generally require a longer timeframe for completion than ex-situ technologies. Most of the treatment technologies that require excavation of the contaminated material could be undertaken on or off-site, subject to obtaining licences.

7.3.3 Excavation and Off-site disposal

This method involves the excavation of contaminated materials and disposal of the materials off-site to a landfill licensed by the NSW EPA.

Excavated soils must be classified before disposal to an appropriate landfill. Depending on the levels of contamination, soil may require pre-treatment (to reduce contaminant levels or immobilise contaminants) prior to off-site disposal to the licensed landfill.

7.3.4 Containment of Contaminated Soils

On-site capping is used to isolate areas in the subsurface from the surrounding uncontaminated environment. A physical barrier such as a layer of clean soil, synthetic material liners, asphalt and concrete layers may be installed to cap the contaminated material. A cap is typically used where it is required to remove exposure to the contaminated soils and where the contaminated soils are not mobile or there is no contact with groundwater and / or groundwater is not contaminated.

A site management plan is required with any cap and contain strategy. The site management plan identifies the party responsible for adhering to the plan, and includes commitments for ongoing monitoring and maintenance of the cap as well as control of future excavations, which must be minimised or if required, the appropriate occupational health and safety procedures are adopted and permits acquired before work is carried out.

7.4 Preferred Remedial Option

The following factors were considered in selecting the most feasible remediation method:

- **Proven technology**: the remediation method should have a proven track record of success/failure;
- **Reliability**: this is a measure of the degree of certainty that the remediation method will succeed in meeting the site remediation goals in the short and long term;
- **Regulatory approvals**: the remediation method needs to be endorsed by the relevant regulatory authorities. The difficulty in obtaining regulatory approvals will be largely dependent upon the nature of the remediation method proposed;
- **Cost**: provides an indication as to the likely costs involved in implementing each type of remediation method;
- **Implementation time:** provides an indication as to the likely time frame involved in implementing each type of remediation strategy;
- **Land use restrictions:** if contaminated material is left on-site, the regulatory authority may place restrictions on the land use and/or require notification of the contamination on the property title;
- **Ongoing liabilities (maintenance and monitoring requirements):** a remediation strategy that does not involve the complete removal of all contaminants from the site will necessitate some form of ongoing maintenance and/or monitoring to ensure the longer term integrity of the remediation strategy adopted;
- **Future liability:** any remediation strategy that does not involve the complete removal of all contaminants from the site will result in future liability for the contamination;
- **Local contractor experience:** the success and cost effectiveness of any remediation method will be at least partially dependent upon the experience local contractors have in undertaking the type of remediation works proposed;
- **On-site space requirements:** some remediation techniques (e.g. landfarming) require relatively large amounts of space to spread soil and will only be feasible if sufficient land is available;
- **Disruptions to site structures and activities:** remediation of the site is likely to create some disturbance, both to the existing site operations and structures, as well as to underground services which may pass through the remediation area (e.g. any work

involving excavation of the contaminated soil mass will involve the removal of any structures located atop the excavation zone);

- **Human health risks during remediation:** the remediation workers, site users and the general public may be exposed to hazards posed by contamination during the remediation (eg significant levels of vapours may be released when disturbing soil contaminated with volatile organic compounds); and
- **Availability of appropriate disposal sites (for remediation techniques involving excavation and off-site disposal)**: landfill disposal of contaminated soil will only be feasible if a landfill licensed to accept the contaminated soils excavated from the site is available at a reasonable distance from the site.

The table below presents an evaluation of the various options for soil remediation within the site. The table also includes a number of limitations and risks associated with each method.

Table 7: Remediation Options – Soil

Technical Characteristics	Option 1 (Treatment) Bioremediation	Option 2 (Treatment) Thermal	Option 3 Excavation and Off-Site Disposal	Option 4 Containment
Cost	Not Applicable	Not Applicable	Low- Medium The costs of off-site disposal to landfill are considerably less than treatment costs.	Low
Technical feasibility	Not possible for heavy metal contaminated material	Not possible for heavy metal contaminated material	Possible for a range of contaminants including those encountered at the site during the investigations The 'excavate and dispose' remediation method is a proven technology for the type of contaminants identified at the site, likely to be approved by the regulatory bodies	Possible for a wide range of contaminants including those encountered at the site
Human Health Risks	Not Applicable	Not Applicable	Relatively low – excavation and direct off-site disposal will minimise personal contact	Relatively low – only minimal soil disturbance involved
Reliability	Not Applicable	Not Applicable	Excellent – system ensures the removal of all contaminated materials	Moderate – some potential may exist for contaminant breakthrough if containment cell not properly constructed

Technical Characteristics	Option 1 (Treatment) Bioremediation	Option 2 (Treatment) Thermal	Option 3 Excavation and Off-Site Disposal	Option 4 Containment
Regulatory Approval	Not Applicable	Not Applicable	Satisfactory – Compliance with Regulatory Authorities. Licensed landfills available for day cover	Generally satisfactory – whilst on-site containment is not the EPA's preferred option, it is often accepted as a feasible option
Disruption to Site Structures and Activities	Not Applicable	Not Applicable	Significant – all existing site structures need to be demolished or relocated to allow excavation of contaminated soils	Moderate – some disruption likely to proposed underground services
Ongoing Liabilities	Not Applicable	Not Applicable	Minimal – all heavily contaminated materials removed. After completion of the remediation works by the 'excavate and dispose' remediation method, the site would continue to be suitable for the residential use with minimal access to soils, and there would be no ongoing liabilities, and very limited (if any) ongoing maintenance / monitoring required	Moderate to high – capping system need to be maintained, and ongoing monitoring necessary to ensure the integrity of the cap
Contractor Experience	Not Applicable	Not Applicable	Good – relatively simple strategy involving only basic technologies	Moderate – contractors available with experience in the implementation of cap and contain systems
Availability of Disposal Sites	Not Applicable	Not Applicable	Good – landfills available to accept solid waste	Not Applicable

Technical Characteristics	Option 1 (Treatment) Bioremediation	Option 2 (Treatment) Thermal	Option 3 Excavation and Off-Site Disposal	Option 4 Containment
Implementation Time Frame	Not Applicable	Not Applicable	Short The timeframe for implementation of the 'excavate and dispose' remediation method is relatively short compared to other possible remediation methods.	Short to Moderate
PREFERENCE	**No**	**No**	**1**	**No**

7.5 Available Soil Remediation / Management Technologies

7.5.1 General

There is a range of different remediation technologies that are available for remediation of contaminated sites. Some of these technologies are proven while others have not been successfully implemented, particularly in Australia and / or there is limited local expertise for implementation.

Based on review of the possible remediation options, the preferred options were primarily ranked according to the following rationale:

1. Option 3 (Preferred) – based upon the proposed development and the client's preferences, all contaminated material exceeding the remediation/validation criteria will be disposed off-site.
2. Option 4 – Does not fit in with the proposed development and the client's preference to have all contaminated material removed from the site.
3. Options 1 and 2 – Not technically feasible for the contaminants to be remediated.

8 REMEDIATION PROGRAMME

8.1 General

All works undertaken during the remediation program must be monitored by a suitably qualified person experienced in the assessment and remediation of contaminated sites. The RAP must be adhered to by all personnel and sub-contractors involved in the remediation program.

8.2 Soils

Assuming appropriate permits have been granted, the remediation of the site is to take place in the following stages:

- Prepare the site with fences, erosion controls, signage and environmental controls.
- Demolish site structures and concrete slabs to make way for remedial works and under slab observations.
- Undertake the ASI as per Section 6.0.
- Following the completion of the ASI, a revised RAP may be required should additional contamination be identified within the site.
- The topsoils within Hotspot BH9 will be excavated approximately 140m^2 x 0.3m vertically deep and placed into the one stockpile, SP1.
- The topsoils within Hotspot BH11 will be excavated approximately 140m^2 x 0.3m vertically deep and placed into the one stockpile, SP1.
- The stockpile SP1, with an approximate volume of 84m^3, will be sampled by recovering 5 samples to allow for an appropriate waste classification report to be prepared.
- Upon classification, the stockpile SP1 will be appropriately disposed of at EPA licenced facility that can accept the classified waste.
- The floor and walls of the Hotspot BH9 will be validated by taking 3 floor samples and 5 wall samples plus QA/QC samples. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.

- The floor and walls of the Hotspot BH11 will be validated by taking 6 floor samples and 5 wall samples plus QA/QC samples. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.
- Remediation will occur by managing soil for offsite disposal to landfill for contaminated soils and for soil to an offsite soil recycling facility for reuse in the case of clean soil.

8.3 Duration of Remediation and Validation Works

Based on the proposed scope of the remediation and validation works, it is expected that the works should be completed within approximately two to four weeks following receipt of the regulatory approvals. This timeframe does not include reporting which should be completed approximately one to two months after completion of the remediation and validation works.

9 REGULATORY COMPLIANCE

9.1 General

Regulatory requirements that must be addressed for the remedial program are described in the following sub-sections.

9.2 State Environmental Protection Policy (SEPP) - Resilience and Hazards

The State Environmental Planning Policy (Resilience and Hazards) 2021: "Chapter 4 – Remediation of Land" defines the regulations for Category 1 and Category 2 remediation works. The remedial works to be undertaken at the site constitute Category 1 works based on the Councils requirement for a RAP to be submitted with the DA. Remedial works may only commence upon approval of the RAP by the Council.

9.3 EPA and Waste Disposal Approvals

Approval will be sought from an NSW EPA licensed waste facility prior to the disposal of wastes to that facility. Waste should be classified with reference to the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste"* and waste disposal shall be conducted as per POEO (Waste) Regulation 2014.

Approval will be sought from the NSW EPA prior to the discharge of potentially contaminated water to surface water bodies or stormwater drains.

The waste shall be transported and tracked waste under Schedule 1, Part 1 and Part 2 of the POEO Act 1997 and as discussed in the following link:

https://www.epa.nsw.gov.au/your-environment/waste/tracking-transporting-hazardous-waste/industry-responsibilities-tracking-waste/waste-transporter-tracking-responsibilities

9.4 Council Regulations

Site works will occur only in designated hours in accordance with Council policy. Wastes will be managed in accordance with this RAP to ensure compliance with Council requirements and that the environment is protected. It is possible that Council may have additional DA requirements and the RAP should be amended accordingly to ensure compliance.

Approval will be sought from the local Council prior to the discharge of potentially contaminated water to surface water bodies or stormwater drains.

9.5 Government Departments

Approval will be sought from the relevant NSW Government departments, such as Water NSW and Sydney Water for licensing requirements, prior to the discharge of potentially contaminated water to sewers and/or for groundwater re-injection approvals.

9.6 WHS Regulations

Any asbestos removal shall be conducted as per the WHS Regulations 2017 and Safe Work Australia (2022) How to Safely Remove Asbestos Code of Practice.

10 SITE MANAGEMENT PLAN

10.1 General

The Site Management Plan (SMP) shall be implemented by the principal remediation contractor during remediation works to ensure that statutory requirements have been met and that the following issues have been addressed (where applicable):

- Site access;
- Working hours;
- Stormwater management;
- Soil management;
- Traffic management;
- Noise, dust and odour control; and
- Work Health Safety.

The site manager/foreman of the principal remediation contractor should have a thorough understanding of the contents of the RAP, including the Site Management Plan (SMP) and should ensure that each employee or sub-contractor is familiar with the requirements of these plans.

Adherence to the SMP will be monitored by a suitably qualified and experienced Environmental Scientist/Engineer who will be present during all critical remediation / validation works.

Each of the issues to be addressed in the site management plan is briefly discussed in the following sub-sections.

10.2 Site Access

The contractor will ensure that adequate barriers have been placed around the site to prevent access of unauthorised personnel to areas where contaminated material is exposed. The contractor will also place adequate warning signs around the site.

10.3 Working Hours

The working hours for the remediation / validation works will be in accordance with Council requirements as stated in the approved Development Application and/or with the Council DCP/LEP.

10.4 Stormwater Management

The contractor will put in place adequate stormwater runoff, run-on and sediment control measures for the remedial works.

These include stockpiling excavated soil in a manner that will prevent contamination from being transported off-site by stormwater, and include the following measures:

- Divert stormwater runoff outside the site so that it does not flow through the site;
- Control drainage on the site by intercepting and redirecting runoff in a controlled manner;
- Stormwater collected at the site in trenches and sumps should be appropriately managed; and
- Silt stop fences should be erected at locations where stormwater may flow outside the site.

The presence of sediment in surface water or runoff must be minimised by the use of sediment controls such as diversion drains, hay bales and silt fencing.

10.5 Soil Management

Soils that require stockpiling must be managed in such a manner that these materials remain well contained and easily identifiable and that the effects of wind and rain have minimal impact on their integrity. Subsequently, if adverse weather conditions are anticipated, or if the stockpile is to remain on-site for an extended period, stockpiles must be protected and covered. Stockpile records must be maintained to track the re-use of soils at the site (if any). The following procedures will be implemented should it be necessary to stockpile soil at the site prior to off-site disposal:

- Material tracking records will be completed on a daily basis by the contractor to document the origin, quantities and fate of contaminated soil excavated, stockpiled on-site and transported off-site.
- The stockpiles of waste material to be transported off site will be labelled appropriately to enable easy assignment to landfill or re-use facility. No stockpile should be allowed to be transported until it has been appropriately classified for off-site disposal/reuse.

Any materials available to be re-used at a licensed resource recovery facility must meet the Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption Under Part 6, Clause 51 and 51A.

Any plant or equipment that comes into contact with soils must be inspected prior to leaving the site and cleaned as necessary.

10.6 Groundwater Management

Groundwater may be intercepted during the construction of the proposed development. Any groundwater encountered during excavation works should be directed to and collected in a sump. No discharge of groundwater will occur without approval of appropriate regulatory bodies. In addition, any contaminated groundwater intercepted should be collected and disposed of by an appropriately licensed contractor.

10.7 Traffic Management

Vehicular movement is to be conducted in accordance with Council requirements. The principal contractor will manage all vehicles as indicated by the principal's environmental representative to minimise tracking of any materials onto public roads. The wheels of the vehicles will be washed and brushed prior to leaving the site. If applicable, a vehicle wheel washing or shaking facility will be installed. Loads leaving the site should be maintained moist and must be covered to prevent materials from the site being spilled or left on public or private roadway or adjacent areas.

10.8 Noise Control

The contractor should keep noise levels to a minimum, and levels should not exceed limits indicated in AS 2436 1981. Noise levels must also comply with Council and NSW EPA requirements. It is expected that the equipment to be used in the remediation works will not generate noise levels above these requirements.

10.9 Dust control

The dust generated during remedial activities must be monitored and local Council and NSW EPA requirements must be complied with.

The generation of dust should be kept to a minimum. Stockpiled contaminated material should be bunded and covered. Water sprays may be used to minimise dust. Water used for this purpose should not be allowed to flow off-site through the stormwater system, sewer, or any other way.

10.10 Odour control

The level of odours generated during remedial activities must be monitored and local Council and NSW EPA requirements must be complied with.

Should odorous compounds be encountered, the remediation contractor should take measures to mitigate them and to prevent their migration outside the site boundaries. This may involve placing the odorous materials as soon as possible in a bunded area, covered with plastic membrane, and spraying with an odour suppressant approved by the environmental consultant.

10.11 Work Health Safety

As personnel on-site may be exposed to potentially toxic or hazardous compounds, a site-specific Work Health Safety Plan (WHSP) was prepared for implementation prior to commencement of remediation and validation work in accordance with relevant legislation. The WHSP identifies hazards, assesses the risks posed by the hazards and recommends measures to control the hazards. This includes detailed descriptions of vehicle decontamination, protective clothing, equipment and appropriate safety controls to be adopted during remediation and validation works carried out at the site.

If hydrocarbon odours are detected at areas around the site PID measurements will be collected by the on-site Environmental Scientist. If PID readings >30 ppm are recorded breathing masks should be worn by workers in the vicinity of the odour and >300 ppm hydrocarbon odour suppressants as well as controlled excavations should be applied.

Personnel working on the site are required to read, understand and apply the requirements of the WHSP. All staff working on the site must be inducted by an authorised induction trainer and must sign the relevant induction form. A copy of the WHSP prepared for the site is included in Appendix C.

All contractors working on the site will be required to provide their own site-specific safety plan for the relevant site works.

11 OPERATIONAL CONTROLS

11.1 Fire And Explosion Hazard

Explosive atmospheres may be present where any petroleum products or other potentially flammable or explosive substance is encountered / used, including machinery. Therefore, the contractor will put into place measures to prevent fires and explosions, which include:

- preventing access to the site by unauthorised persons;
- forbidding smoking or using naked flame at the site;
- cutting of concrete to be carried out under a blanket of water in proximity to any underground storage tanks;
- approved fire extinguishers to be maintained in proximity to excavations;
- ensuring that no free product or fuel used for refuelling equipment enters a confined space or drainage/sewer system; and
- using only certified flameproof equipment in proximity to locations where free petroleum fuel is present or is expected to be present.

11.2 Public Complaints Registry

Given the nature of the remediation and validation works, it is considered that a community relations plan is not required.

11.3 Duties of the on-site Environmental Scientist

The duties of the on-site environmental scientist include:

- ensure adherence to the Remediation Action Plan, the Work Health and Safety Plan and other plans applicable to the site;
- monitor the excavation of contaminated material undertaken at the site;
- ensure environmental compliance of contractors;

- monitoring with a PID the areas adjacent to open excavated pits at least three times throughout the day, and at additional times if strong or unusual odours or if unusual substances are encountered during the excavations part of the remediation works;
- inspection of the integrity of the sediment controls placed around the site;
- inspection at approximately two hourly intervals of the roadway in the vicinity of the site used by the vehicles leaving the site to ensure that no significant amounts of materials have been tracked off-site by vehicles;
- immediately report actual or potential non-compliances to the principal's environmental representative who will report those to appropriate regulatory bodies ;
- note weather conditions, approximate temperature, direction and velocity of the wind, and rainfall at the commencement of work, at about midday and at the end of the day;
- collect samples for validation or other purposes as required by the principal's environmental representative;
- maintain a site diary which will record the following information:
  - date
  - weather conditions
  - presence of odours at the site and at the site boundaries
  - PID measurements
  - details of materials excavated during the remediation works, and details of actions taken if unexpected materials are encountered
  - details of accidents, near misses or incidents, which may have resulted in injury, and the actions taken to prevent their recurrence
  - details of environmental issues, which may result in environmental incidents and measures taken to correct them
  - details of visitors to the site or other matters relating to environmental or health issues

11.4 Unexpected Occurrences

If during remediation works, significant odours and/or evidence of gross contamination not previously detected are encountered, or any other significant unexpected occurrence, site works should cease in that area, and a suitably qualified and experienced environmental consultant should be contacted to assess the potential risks. If required, the administering authority will be notified in writing within two working days of significant unexpected occurrence and informed of the remediation actions implemented. Reference should be made to Section 12.2 for further information.

11.5 Non-compliances

If the on-site environmental scientist suspects that some works carried out at the site do not comply with the requirements of the RAP, the WH&SP or other plans applicable to the site, this should be reported immediately to the principal's environmental representative. If the principal's environmental representative cannot be contacted or if immediate action is required, the on-site environmental scientist has authority to stop the work or request appropriate action to be taken. This is particularly the case under the following circumstances:

- injury to person due to exposure to materials excavated from the site;
- spillage of materials at the site or on areas adjacent to the site; and
- other events that the environmental scientist believes could give rise to unacceptable risk to human health or to adverse impact to the site or to areas adjacent to the site.

12 CONTINGENCY PLANNING

12.1 Excavation Contingency Planning

The conditions that may be encountered when excavating are uncertain. As unknown and variable subsurface conditions impose a degree of uncertainty for the project a set of anticipated conditions has been assumed in developing the excavation plan. However, because field conditions vary, flexibility has been built into the excavation plan to adapt to differing conditions.

The table below summarises conditions that can be reasonably expected and the resulting problems they may cause and how these problems may be resolved within the context of the excavation program.

Table 8: Excavation Contingency Planning

Anticipated Problem	**Corrective Action By Contractor**
Chemical spill / exposure	Stop work, refer to Occupational Health, Safety and Rehabilitation Plan and immediately contact GSNE Services.
Excessive rain	Maintain access roads, cover high-traffic areas with gravel; or cover working areas/stockpiles with plastic during off-shifts; or shut down operations until runoff is more manageable. Inspect & maintain sediment control pond & filter fences.
Unmanageable mud in excavation zone	Improve drainage collection system; add geotextile/gravel in problem areas; or strip off mud/slurry materials; or excavate from the top of the fill.
Excessive drainage	Minimise active/contaminated work area; or improve diversion clean run-on; or maintain sufficient on-site wastewater storage capacity; or mobilise additional storage and/or treatment systems as needed.
Excessive dust	Use water sprays or biodegradable dust sprays, or cease dust-generating activity until better dust control can be achieved, or apply interim capping systems.
Sediment pond water for discharge – analytical results exceed site response levels	Perform in-situ treatment, e.g. flocculant dosing, until response levels are met. Alternatively arrange off-site disposal by a licensed Contractor.
Excessively wet materials	Stockpile and dewater on-site; or add absorbents.
Equipment failures	Maintain spare equipment or parts; or maintain alternate rental options; or shut down affected operations until repairs are made.
Release of fuel/oil from machinery	Remove source, use absorbent booms to remove oil and make any repairs as required.
Silt fence fails	Stop work and repair fence to specifications.
Excessive noise	Identify source and review noise attenuation equipment and as necessary provide silencers on noisy equipment.
Unexpected Problem	**Corrective Action By Contractor**

Asbestos cement sheeting, lagging, pipping etc	Stop excavations if there is the potential for people to inhale airborne asbestos fibres. Contact GSNE Services immediately to assess whether the material is asbestos. Cover the area with plastic and suppress dust by wetting down if needed. Place a warning sign at the entrance to the site where asbestos removal or site remediation is taking place.
Discovery of USTs	Stop excavations, contact GSNE Services immediately.
Discoloured soil	Stop excavations, contact GSNE Services immediately
Excessive odours	Monitor for volatiles using PID and upgrade PPE if necessary. Use odour and volatile suppressing agents to eliminate or reduce odours as required and/or cover odorous material if practicable.
Unearthing drummed material	Isolate and contact Superintendent. Arrange temporary storage in a secure part of the remediation site (to be nominated).

In addition to the above listed contingencies, the following steps may need to be undertaken should non-spadeable sludges or buried drums be discovered during the remediation works:

- upgrade of personal protective equipment (PPE), for workers within the active work zone, in accordance with the site Occupational Health, Safety and Rehabilitation Plan;
- segregation and bunding of discovered material;
- use of odour suppressants (where appropriate);
- cover the discovered material with plastic sheeting;
- appropriate sampling and analysis to assess potential contaminants; and
- appropriate off-site disposal of the materials following receipt of analytical results and any associated regulatory approvals required.

12.2 Unexpected Finds Protocol

The possibility exists for residual hazards to be present at the site. Environmental sampling is based on chemical analytes identified as a potential concern during a documented process of reviewing historical site activities. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations.

The nature of any residual hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- Fragments of asbestos-containing materials (visible)
- Construction / Demolition Waste (visible)
- Hydrocarbon impacted materials (visible / odourous)
- Ash and/or slag contaminated soils / fill materials (visible)

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances be identified (or any other unexpected potentially hazardous substance), the procedure summarised in *Appendix G* is to be followed.

An enlarged version of the unexpected finds protocol, suitable for use on site, should be posted in the Site Office and referred to during the Site-Specific Induction by the Principal Contractor.

The sampling strategy for each "unexpected find" shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance / materials across the site and at former drainage / buried utility infrastructure shall meet the following minimum requirements:

- *In-situ* Sampling
  - At least 1 wall sample per 10 linear metre.
  - At least 1 wall sample per 1m depth along wall of excavation.
  - At least 1 base sample per 25m^2.

Lower sampling rates may be derived for soil quantities greater than 200m^3 by applying statistical analysis, such as 95% UCL.

- Stockpile Sampling
  - Samples should be analysed for the chemicals of concern <75m^3 = 3 samples
  - 75 m^3 to <100 m^3 = 4 samples
  - 100 m^3 to <125 m^3 = 5 samples
  - 125 m^3 to <150 m^3 = 6 samples
  - 150 m^3 to <175 m^3 = 7 samples
  - 175 m^3 to <200 m^3 = 8 samples
  - >200 m^3 = 1 sample every 25 m^3

Lower sampling rates may be derived for soil quantities greater than 200m^3 by applying statistical analysis, such as 95% UCL.

The following analytical suite should include heavy metals, TPH, BTEX, PAH, OC, PCB, Phenols, Cyanides, VOCs, PFAS, Solvents and/or asbestos %w/w, and is dependent on the type of the waste encountered.

All additional works should be documented by the use of field notes, site photographs, site plans and reporting.

Any proposed community relations plan should be updated if any unexpected find are encountered.

13 DATA QUALITY OBJECTIVES

13.1 General

The Data Quality Objectives (DQOs) have been set to ensure that the data collected is sufficiently reliable for validation purposes.

The QA/QC should be in accordance with the National Environment Protection Council (NEPC) (2013) *National Environmental Protection (Assessment of Site Contamination) Measure* and with the Australian Standard AS4482.1-1997.

13.2 Step 1 - State the Problem

The site is proposed to be developed into an eight-storey residential building including three levels of basement car parking and deep soil landscaping areas. However, previous investigations identified the following concerns:

- Zinc contaminated topsoils in locations BH9 and BH11.
- Further soil characterisation is required within the building footprint (previously inaccessible).

Further assessments are required to address the data gaps above and to formulate an appropriate remediation strategy as prescribed in this RAP. These works are required to confirm the suitability of the site for the proposed development.

13.2.1 Conceptual Site Model

The CSM, based on the DSI, is summarised in the table below.

Table 9: Conceptual Site Model

Potential Sources	Potential Receptor	Potential Exposure Pathways	Complete Linkages	Risk	Justification
Zinc in BH9 & BH11	Site users or the general public	Dermal contact, inhalation or ingestion of exposed impacted soils	Limited (Current)	Low	Direct contact with impacted soils is limited to the grassed areas.
			No (Future)	Negligible	If present, contaminated soils are likely to be remediated and removed for off-site disposal.
Asbestos in buildings	Site user or visitors	Inhalation of airborne fibres	Limited (Current)	Low	If present, asbestos material is likely to be limited to the building fabric and would be in bonded form.
			No (Future)	Negligible	A hazardous materials survey is likely to be required prior to the demolition of the existing buildings for the proposed development and licensed contractors would have to remove any asbestos likely to be present.

13.3 Step 2 - Identify the Decisions of the Study

The following information is required to identify the decisions of the study:

- What is the nature and extent of the impacted soils within the site.
- What is the soil quality beneath the existing site features.
- Upon validation works and adopting the preferred remediation strategy, would the site be rendered suitable for the proposed development.

13.4 Step 3 - Identify Information Inputs

The following information is required for input into the decisions identified in Step 2:

- Findings from previous contaminated land reports prepared for the site;
- Selection of soil investigation and screening levels from the NEPM 2013 guidelines;
- Collection and laboratory analysis of soil samples for additional site characterisation and validation purposes;
- Headspace analysis for screening of VOCs present within soils using a PID; and
- Comparison and interpretation of results again the adopted soil investigation and screening levels as prescribed in the NEPM 2013 guidelines.

13.5 Step 4 - Define the Study Boundaries

The spatial and temporal aspects of the investigation area that the data must represent to support the decisions identified in Step 2 are as follows:

- The lateral extent of the study boundary is defined by the site boundaries as shown in the Site Location Plan (refer to Figure 1).
- The vertical extent of the soil removal is up to clean underlying material.
- Additional soil sampling.

13.6 Step 5 - Develop the Analytical Approach

The acceptable limits for laboratory QA/QC parameters are shown in the table below and are based upon the laboratory reported acceptable limits and those stated within the NEPM 2013 Guidelines.

Table 10: Acceptable Limits for QC Samples

Type of QC Sample	Control Limit
FIELD	
Rinsate Blanks	Analytes <LOR
Intra-Laboratory Duplicates	RPD's <50%
Inter-Laboratory Duplicates	RPD's <50%
Trip Blanks	Volatiles <LOR
Trip Spike Recovery	>70%
LABORATORY	
Method Blanks	< Laboratory LOR
Matrix Spike	Recovery targets: • Metals: 70% to 130% • Organics: 60% to 140%
Laboratory Duplicate	RPD's <30%
Laboratory Control Samples	Recovery targets: 60% to 140%
Surrogate Spike	Recovery targets: 60% to 140%

The following conditions should be adopted:

- If the control limits are exceeded, then an assessment of the significance of the results should be carried out;
- If the results of the DQI assessment indicate that the data set is reliable, then the data set will be deemed to be acceptable for the purposes of the additional investigation and validation works; and
- If the measured concentrations of soil samples analysed meet their respective validation criteria, then no additional assessment is required is required.

13.7 Step 6 - Specify Limits on Decision Errors

There are two types of decision errors:

- **Sampling errors**, which occur when the samples collected are not representative of the conditions within the investigation area; and
- **Measurement errors**, which occur during sample collection, handling, preparation, analysis and data reduction.

These errors may lead to following (null hypothesis):

- Deciding that the site is not suitable for the proposed development when it actually is (Type I error); and
- Deciding that the site is suitable for the proposed development when it is actually not (Type II error).

A 5% significance level has been selected for Type I errors on the basis that 95% of the data set will satisfy the DQIs. Therefore, the acceptable limit of the decision errors is based on a 5% probability of the hypothesis being incorrect.

An assessment will be made as to the likelihood of a decision error being made based on:

- The acceptable limits for inter/intra laboratory duplicate sample comparisons as specified in Step 5 of the DQOs; and
- The acceptable limits for laboratory QA/QC parameters are based upon the laboratory reported acceptable limits and those stated within the NEPM Guidelines.

If the concentration of a particular contaminant of concern exceeds its assessment criteria, then a further assessment is required to address the significance of the result.

Statistical analysis based on 95% UCL may be used to assess the significance of the data provided the following conditions are met:

- the arithmetic mean of the data set must be less than its respective threshold level; that is, it is acceptable for individual results to exceed its respective threshold level, but the cumulative mean of the data set of soil sample results must not exceed the threshold level;
- the standard deviation of the data set is less than 50% of the relevant threshold level; and
- no individual sample result should be greater than 250% of the relevant threshold level.

Ecological data is not included in this assessment process as ecological results cannot be statistically interpreted.

13.8 Step 7 - Optimise the Design for Obtaining Data

The optimum design for obtaining data in order to achieve the Data Quality Objectives is as follows:

- Only NATA-accredited environmental testing laboratories will be commissioned to analyse soil samples and will implement a quality control plan conforming to the NEPM (Assessment of Site Contamination) Measure Schedule B(3) Guidelines for Analysis of Potentially Contaminated Soils;
- Review of previous contaminated land reports relevant to the Site;
- An assessment of the Data Quality Indicators to determine if the field procedures and laboratory analytical results are reliable;
- The investigation will be carried out by an experienced and qualified Environmental Scientist, who is trained in sampling at contaminated sites in accordance with GSNE Services protocols based on best practice industry standards; and
- Collection of QA/QC samples at frequencies prescribed in the NEPM 2013 Guidelines.

14 VALIDATION CRITERIA

14.1 General

The selection of appropriate human health and ecological site validation criteria were based on the "National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)", NEPC (2013).

It is acknowledged that the guideline values adopted are generally intended for application as investigation and screening levels and are based on a conservative approach. However, the guidelines do not necessarily preclude their use in determining the suitability of a site for its proposed land use in the absence of remediation guideline values. Therefore, should the validation samples be at concentrations below their respective adopted criterion, they are considered to render the site suitable for the proposed use.

It should be noted that should validation samples fail their respective validation criteria, a justifiable decision should be made to determine whether a quantitative risk assessment would be warranted, based on the likelihood that it would result in a beneficial outcome in avoiding further unnecessary remediation costs.

Full details of the validation criteria for each contaminant of concern are presented below.

14.2 Soils

14.2.1 Health Investigation Levels (HILs)

The NEPM presents Tier 1 Health Investigation Levels (HILs) for a broad range of chemicals such as metals, inorganics, PAHs, phenols, pesticides and other organics. The HILs are applicable to generic land uses such as residential, commercial/industrial or public open space and all soil types, generally within the first 3 metres of soil below ground level. The HILs have been applied to assess human health risks via all relevant pathways of exposure.

Based on the proposed development, soil investigation results within the site will be assessed against the **HIL 'B' –** *Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.*

14.2.2 Health Screening Levels (HSLs)

The NEPM presents Tier 1 Health Screening Levels (HSLs) for the following petroleum compounds and fractions:

- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX);
- Naphthalene; and
- TPH C_6-C_{10} and TPH >C_{10}-C_{16} fractions

The HSLs are applicable to generic land uses such as residential, commercial/industrial or recreational/public open space and different soil types between the ground surface and soils >4 metres below ground level. The HILs have been applied to assess human health risks via the inhalation and direct contact pathways of exposure.

Based on the proposed redevelopment plans for the site which includes basements for car parking and ground floor for residential and deep planting areas, soil investigation results within the site will be assessed against the HSL "A&B" on residual soil in the deep planting areas and HSL "D" within the basement footprint.

14.2.3 Petroleum Hydrocarbon Management Limits

Table 1B (7) of the NEPM presents petroleum hydrocarbon management limits for application to TPH fractions C_6-C_{10}, >C_{10}-C_{16}, >C_{16}-C_{34} and >C_{34}-C_{40}. The management limits are applicable for coarse or fine soils in residential, parkland, public open space or commercial/industrial land uses following consideration of relevant ESLs and HSLs.

The Management Limits for urban residential areas and public open space will be utilised across the site.

14.2.4 Ecological Investigation Levels (EILs)

Validation samples to be taken from the deep soil area in the future will be assessed against the following site derived EILs determined from the GSNE Services DSI investigation:

Table 11: Site Derived EILs

Analyte / Sample Location / Depth (m)	HEAVY METALS (mg/kg)			
	COPPER	LEAD	NICKEL	ZINC
Site Derived Ecological Investigation Levels (EIL)	60	1100	30	100

14.2.5 Ecological Screening Levels (ESLs)

Table 1B (6) of the NEPM presents Ecological Screening Levels (ESLs) for TPH C_6-C_{40} fractions, BTEX and benzo(a)pyrene.

The ESLs are applicable to generic land uses such as areas of ecological significance, urban residential areas and public open space, and commercial/industrial land uses. The ESLs have been applied to assess risks to terrestrial ecosystems, generally, within the top 2 metres of coarse or fine soil at the final surface/ground level.

The ESL for urban residential areas and public open space will be utilised across the site.

14.3 Asbestos in Soils

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1.

Table 12: Health screening levels for asbestos contamination in soil

	Health Screening Level (w/w)			
Form of asbestos	**Residential A[1]**	**Residential B[2]**	**Recreational C[3]**	**Commercial/ Industrial D[4]**
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF[5] (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

1. Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.
2. Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
3. Recreational C includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths.
4. Commercial/industrial D includes premises such as shops, offices, factories and industrial sites.
5. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures (refer Section 4.10). This screening level is not applicable to free fibres.

14.4 Export of Waste

To assess the waste classification of materials to be disposed of off-site, the NSW EPA refers to the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste*".

15 VALIDATION SAMPLING AND ANALYSIS QUALITY PLAN

15.1 Objectives

The objective of the Validation Sampling and Analysis Quality Plan (VSAQP) is to ensure that at completion of the remediation works, the site is suitable for its proposed redevelopment. The validation programme for each area to be remediated is detailed in the following sub-sections and the summary table of validation sampling is shown in the table below.

Table 13: Validation Programme

Area of Concern	Minimum Number of samples	Analytes to be tested
Stockpile SP1 excavated soils from Hotspots BH9 & BH11	5 samples	Heavy Metals, TPH, BTEX, PAHs, OCP, PCB, asbestos plus TCLP metals & PAH, if required
Validation Hotspot BH9 QA/QC	3 floor samples and 5 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate 1 rinsate	Heavy Metals Heavy Metals
Validation Hotspot BH11 QA/QC	6 floor samples and 5 wall samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate 1 rinsate	Heavy Metals Heavy Metals
Unexpected Finds In-situ Sampling	At least 1 wall sample per 10 linear metre. At least 1 wall sample per 1m depth along wall of excavation. At least 1 base sample per $25m^2$.	HM, TPH, BTEX, PAH, OCP, PCB, Phenol, Cyanide, VOCs, PFAS &/or Asbestos, dependent on the type of the waste encountered.
Unexpected Finds Stockpile Sampling	In accordance with Soil Sampling from EPA Victoria: $<25m^3$ = 3 samples $<50m^3$ = 3 samples $75m^3$= 4 samples $100m^3$ = 5 samples $125m^3$ = 7 samples $150m^3$ = 8 samples $175m^3$ = 9 samples $200m^3$ = 10 samples $>200m^3$ = 1 samples per $25m^3$ Lower sampling rates may be derived for soil quantities greater than $200m^3$ by applying statistical analysis, such as 95% UCL.	HM, TPH, BTEX, PAH, OCP, PCB, Phenol, Cyanide, VOCs, PFAS &/or Asbestos, dependent on the type of the waste encountered.

15.2 Waste classification of Stockpile SP1

The Hotspots BH9 & BH11 will each be excavated 140m^2 x 0.3m deep and placed into the one stockpile SP1, with an approximate total volume of 84m^3.

A total of 5 samples will be recovered from the stockpile SP1 and analysed for metals, TPH, BTEX, PAH, OC, PCB and asbestos plus TCLP metals & PAH if required.

The stockpile SP1 will then be classified according to the NSW EPA *"Waste Classification Guidelines, Part 1: Classifying Waste"* and the contaminated soils from stockpile SP1 disposed of an EPA licensed facility that can accept the classified waste.

A Waste Classification Report must be prepared for all soils to be disposed off-site.

15.3 Validation of Hotspot BH9

Following removal of soils from Hotspot BH9, photographic records of the floor and walls of the excavation will be taken for reference in the Validation Report.

The minimum sampling protocols to be used for Hotspot BH9 include 3 floor samples and 5 wall samples. Soil validation samples will be collected and analysed for Heavy Metals.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

At a minimum, further excavations will occur 1m in a lateral direction either direction of the soil exceedance and at least 0.2m in depth. The minimum validation sampling will be the recovery of 1 base sample at the former soil exceedance location and 1 wall sample in either lateral direction excavated as part of the additional remediation works.

15.4 Validation of Hotspot BH11

Following removal of soils from Hotspot BH11, photographic records of the floor and walls of the excavation will be taken for reference in the Validation Report.

The minimum sampling protocols to be used for Hotspot BH11 include 6 floor samples and 5 wall samples. Soil validation samples will be collected and analysed for Heavy Metals.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

At a minimum, further excavations will occur 1m in a lateral direction either direction of the soil exceedance and at least 0.2m in depth. The minimum validation sampling will be the recovery of 1 base sample at the former soil exceedance location and 1 wall sample in either lateral direction excavated as part of the additional remediation works.

15.5 Waste Classification of Soils for Disposal

Any excavated material to be disposed off-site will be temporarily stockpiled on a heavy-duty plastic sheet or a sealed surface such as concrete and covered with an impermeable plastic sheet to prevent rain infiltration.

Soils will be classified in accordance with the NSW EPA Waste Classification Guidelines (2014) and disposed of to an appropriately licensed facility. A Waste Classification Report must be prepared for all soils to be disposed off-site.

The sampling frequency shall meet the following minimum requirements:

- Samples should be analysed for the chemicals of concern <75m^3 = 3 samples
- 75 m^3 to <100 m^3 = 4 samples
- 100 m^3 to <125 m^3 = 5 samples

- 125 m^3 to <150 m^3 = 6 samples
- 150 m^3 to <175 m^3 = 7 samples
- 175 m^3 to <200 m^3 = 8 samples
- >200 m^3 = 1 sample every 25 m^3

Lower sampling rates may be derived for soil quantities greater than 200m^3 by applying statistical analysis, such as 95% UCL.

The following analytical suite should include heavy metals, TPH, BTEX, PAH, OC, PCB, Phenols, Cyanides, VOCs, PFAS, Solvents and/or asbestos %w/w, and is dependent on the type of the waste encountered.

A Waste Classification Report must be prepared for all soils to be disposed off-site.

15.6 Disposal of Excavated Material

The NSW EPA (2017) Guidelines for the Site Auditor Scheme require that the complete waste disposal information is provided, as such the following are minimum requirements to be included:

Waste Classification

- Waste classification document
- Material source and description
- Sampling density, pattern, COPCs
- Results summary including appropriate table with comparison to acceptance criteria
- Waste classification

Offsite Disposal

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

15.7 Field Measurements

A sub-sample should be taken from each soil sampling location and placed in zip-lock bags for headspace analysis using a calibrated PID meter.

15.8 Field QA/QC

15.8.1 Sample Collection Methodology

All samples must be collected by a suitably qualified person, collected in the appropriate containers and labelled to identify their origins.

The soil samples will be collected from between 0-100 mm depth from freshly excavated surfaces. The sample density must be in accordance with the requirements of the NSW EPA guidelines, particularly the NSW EPA (2022) "*Sampling Design Guidelines*".

Primary and QA/QC samples should be placed in clean laboratory-supplied containers appropriate for each suite of analysis required, leaving no headspace, and closed using Teflon-coated lids.

Soil sampling for asbestos will be carried out in general accordance with the following protocols as outlined in the NEPM 2013 guidelines:

- A minimum 10L sample from each sample location will be recovered.
- Each sample (minimum of 10 L) will be screened through a 7mm sieve and the material retained on the sieve examined for any bonded ACM and / or suspect material and forwarded to the laboratory for analysis if any suspected ACM is encountered.
- If visible FA material is present or suspected, the soil should be wetted to minimise the release of fibres.
- Identified bonded ACM and FA should be weighed for each sample.
- One wetted 500ml sample from each sampling location will be submitted for laboratory analysis.
- %w/w will be quantified in the laboratory results and reported in the subsequent validation report.

15.8.2 Sample Preservation

Samples should be stored in an ice brick-cooled esky or similar and transported to the laboratory. The samples should be sent to the laboratory for analysis within 24 hours of collection. Chain of Custody documentation and handling protocols must be in accordance with the guidelines particularly the Australian Standard AS4482.1 (2005) and the NEPM (2013).

15.8.3 Decontamination Procedures

As a minimum standard, decontamination of non-dedicated sampling equipment should be achieved by washing the equipment with phosphate-free detergent and tap water, followed by a final rinse with distilled water. Decontamination should be conducted after the collection of samples at each sample location.

15.8.4 QA/QC Samples

The minimum target frequency for each type of QA/QC sample should be carried out in accordance with the following table:

Table 14: QA/QC Requirements

Field QA/QC Sample	Frequency (Soil)
Intra-Laboratory Duplicate	1 in 10 samples
Inter-Laboratory Duplicate	1 in 20 samples
Field Blanks	1 per day (rinsate)
Trip Blank	1 per sample batch
Trip Spike	1 per sample batch

15.8.5 DQIs

The five Data Quality Indicators (DQIs) comprising completeness; comparability; representativeness; precision and accuracy provide an assessment of the reliability of field procedures and laboratory analytical results in accordance with the 'Guidelines for the NSW Site Auditor Scheme (3rd Edition), 2017. These are addressed in the following tables.

Table 15: Data Completeness

Field	Laboratory
• All critical locations are sampled; • All samples collected from critical grids and depths; • Consistency in the use of standard operating procedures, equipment, sampler; • Completion and correctness of field documentation.	• All critical samples and analytes are analysed in accordance with the DQOs; • Appropriateness of laboratory methods and PQLs.

Table 16: Data Comparability

Field	Laboratory
• Consistency in the use of standard operating procedures, equipment, sampler • Consistency in the method of sample collection for each media • Quantification of influence by climatic conditions	• Consistency of analytical methods and limits of reporting (LOR) for each analyte • Whether laboratory limits of reporting are set at < 20% of the adopted site criteria value for each analyte • Consistent use of one primary and one secondary laboratory

Table 17: Data Representativeness

Field	Laboratory
• Samples are collected in accordance with the proposal • Receipt of samples within holding times • Receipt of intact samples • Receipt of adequately preserved samples	• All samples are extracted and analysed within their respective holding times

Table 18: Data Precision

Type of QC Sample	Control Limit
Field Intra-Laboratory Duplicate (Blind)	RPD < +/- 50%
Field Inter-Laboratory Duplicate (Split)	RPD < +/- 50%

Table 19: Data Accuracy

Laboratory QA/QC Sample	Frequency
Method Blank	1 per 20 samples
Matrix Spike	1 per 20 samples
Laboratory Duplicate	Laboratory defined
Laboratory Control	Laboratory defined
Surrogate Spike	All organic samples

16 CONCLUSIONS

With reference to Clause 4.6 of the State Environmental Planning Policy (Resilience and Hazards) 2021, the site will be considered to be rendered suitable subject to the implementation of remediation and validation works in accordance with this RAP, for the proposed eight-storey residential building including three levels of basement car parking and deep soil landscaping areas development.

We would be pleased to provide further information on any aspects of this report.

For and on behalf of

GSNE Services Pty Ltd

Mark Kelly
Principal Environmental Consultant

Reviewed by

Nick Kariotoglou
Senior Principal

17 LIMITATIONS

The GSNE Services assessment is based on the result of limited site investigations and sample testing. Neither GSNE Services, nor any other reputable consultant, can provide unqualified warranties nor does GSNE Services assume any liability for site conditions not observed or accessible during the time of the investigations.

Despite all reasonable care and diligence, the materials encountered and concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. In addition, site characteristics may change at any time in response to variations in natural conditions, chemical reactions and other events, e.g. groundwater movement and or spillages of contaminating substances. These changes may occur subsequent to GSNE Services investigations and assessment.

This report and associated documentation and the information herein have been prepared solely for the use of the client at the time and is valid (for the purposes of transport of material) for a period of one month only from the date of issue. Any other reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to GSNE Services.

Please note that Part 5.6, Section 143 of the Protection of the Environment Operations (POEO) Act 1997 states that is an offence for waste to be transported to a place that cannot lawfully be used as a facility to accept that waste. It is the duty of the owner and transporter of the waste to ensure that the waste is disposed of appropriately. GSNE Services accepts no liability for the unlawful disposal of waste materials from any site. GSNE Services does not accept any responsibility for the material tracking, loading, management, transport or disposal of waste from the site. Before disposal of the material to a licensed landfill is undertaken, the waste producer will need to obtain prior consent from the landfill. The receiving site should check to ensure that the material received matches the description provided in the report.

Opinions are judgements, which are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions.

REFERENCES

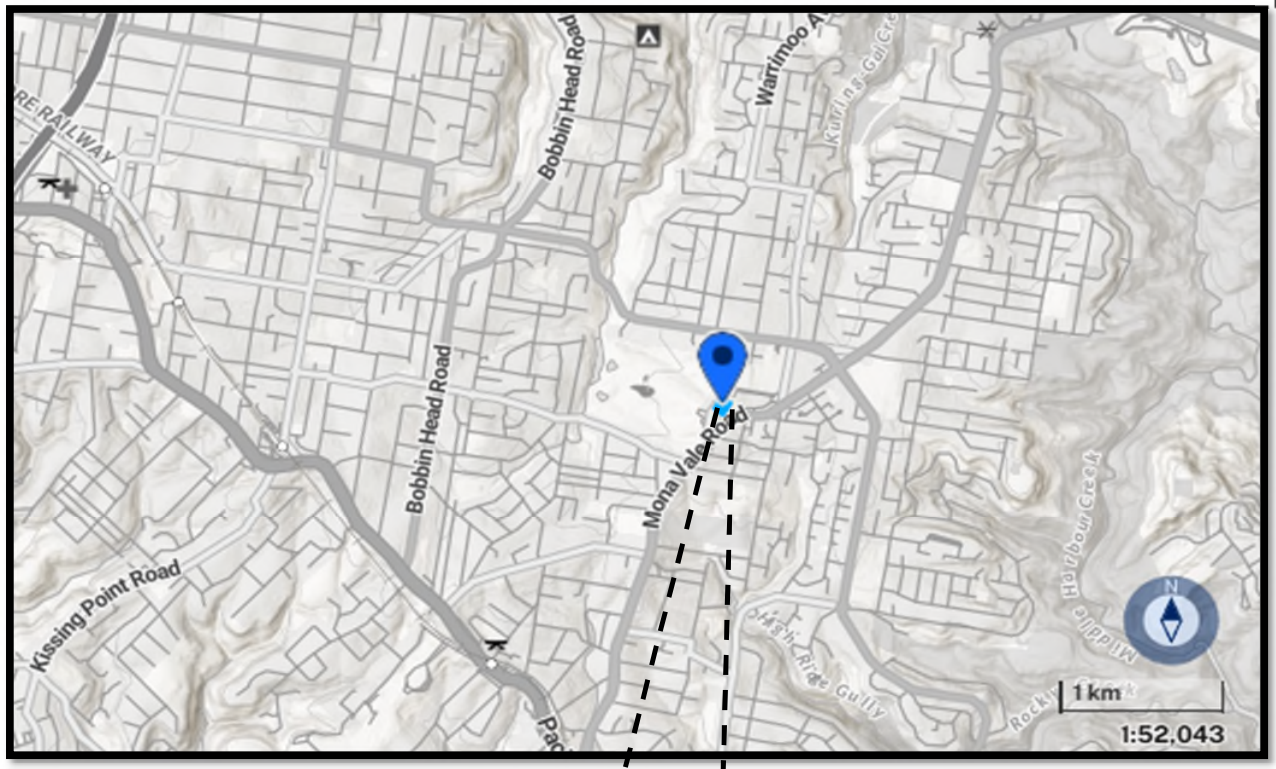
This report was prepared with reference to the following guiding documents:

- "*National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)*", NEPC (2013).
- NSW EPA (2014) – "*Waste Classification Guidelines, Part 1: Classifying Waste*".
- NSW EPA "*Guidelines for the NSW Site Auditor Scheme*" (2017, 3rd edition).
- NSW EPA "*Guidelines for Consultants Reporting on Contaminated Sites*" (2020).
- NSW EPA "*Sampling Design Guidelines*" (2022).
- NSW Department of Planning and Environment (2022) – The State Environmental Planning Policy (Resilience and Hazards) 2021: "*Chapter 4 – Remediation of Land*".
- GSNE Services Pty Ltd (2025) – *"Preliminary Geotechnical Investigation, 5-9 Cowan Road, St Ives NSW"* (Ref: GS9614, dated July 2025).
- GSNE Services Pty Ltd (2025) – *"Preliminary Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/6, dated 25th August 2025).
- GSNE Services Pty Ltd (2026) – *"Detailed Site Investigation, 5-9 Cowan Road, St Ives NSW"* (Report no. ES9614/8, dated 23rd January 2026).

APPENDIX A

SITE PLANS

SITE LOCALITY MAP



Legend	Locality map
	Boundary of the site

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	1	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	02.07.2025
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

SITE PLAN – LOT & DEPOSITED PLAN

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	2	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	02.07.2025
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

SITE FEATURES

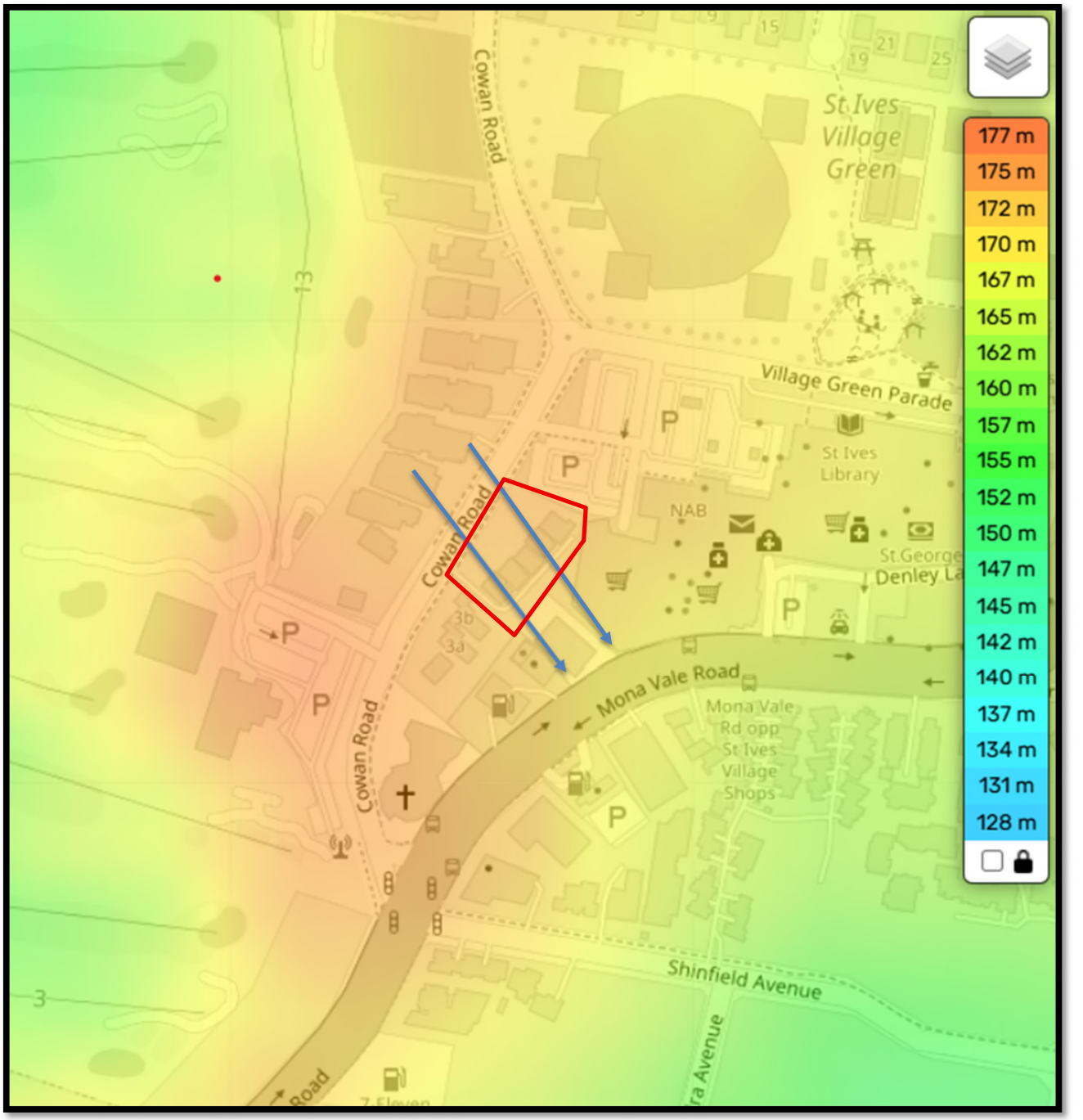
Source: http://maps.six.nsw.gov.au/

SITE FEATURES - LEGEND

1. Double-storey residential building with tile roof and brick walls
2. Concrete driveway
3. Garage with brick walls and metal gate
4. Metal fence
5. Visitor car park - Concrete
6. Garden and open areas
7. Metal shed
8. Walkway paved in brick/concrete
9. Timber Pergola

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	3	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	02.07.2025
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

INFERRED GROUNDWATER FLOW DIRECTION



LEGEND

Groundwater Flow Direction

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	4	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	02.07.2025
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

BOREHOLE LOCATIONS ON AERIAL VIEW

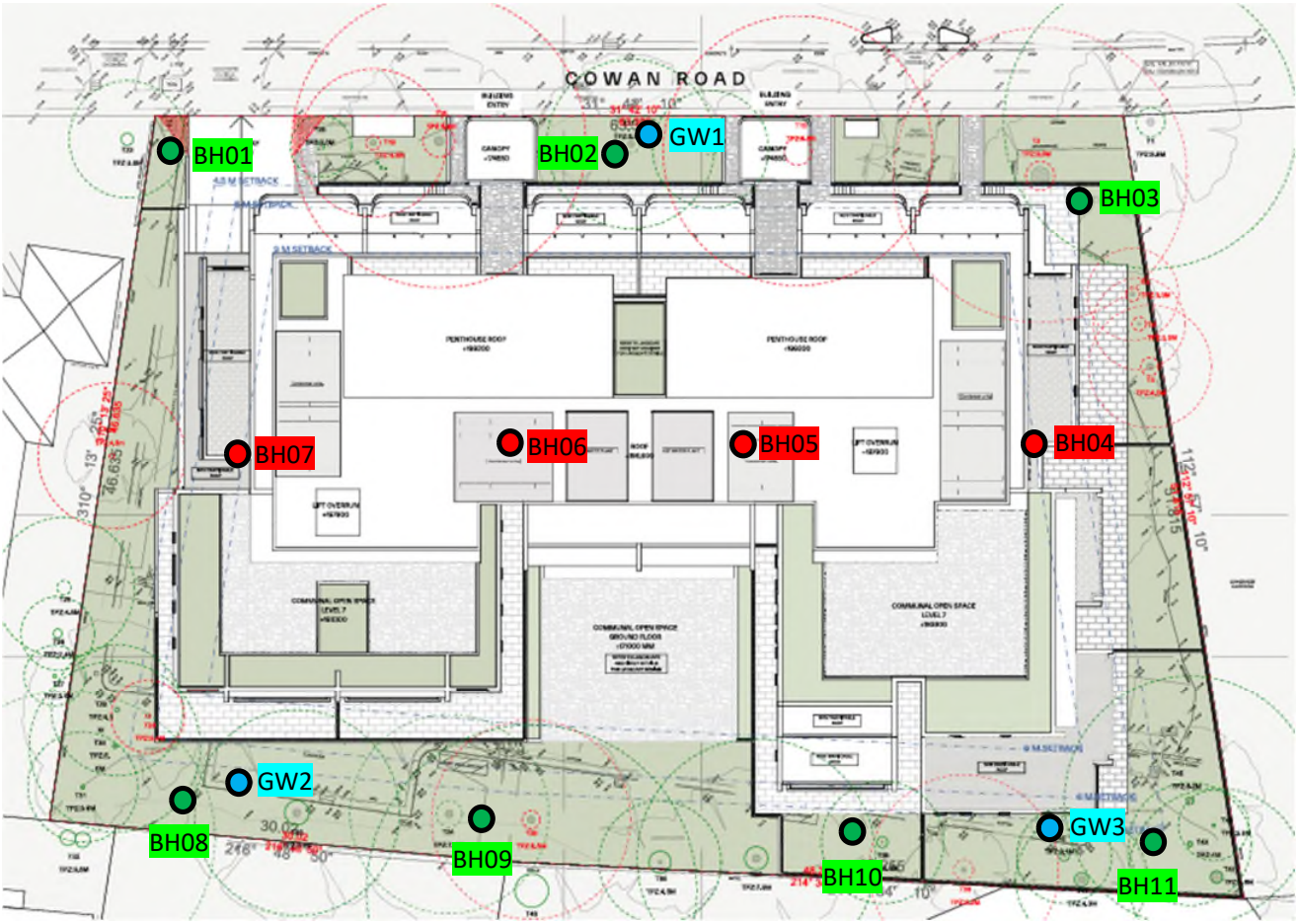
Source: http://maps.six.nsw.gov.au/

LEGEND

Borehole Monitoring Well / Borehole

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	5	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

BOREHOLE LOCATIONS ON PROPOSED DEVELOPMENT LAYOUT



LEGEND

- Proposed Basement Areas
- Proposed Deep Soil Landscaping areas
- Groundwater monitoring wells

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	6	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

HOTSPOT LOCATIONS ON AERIAL VIEW

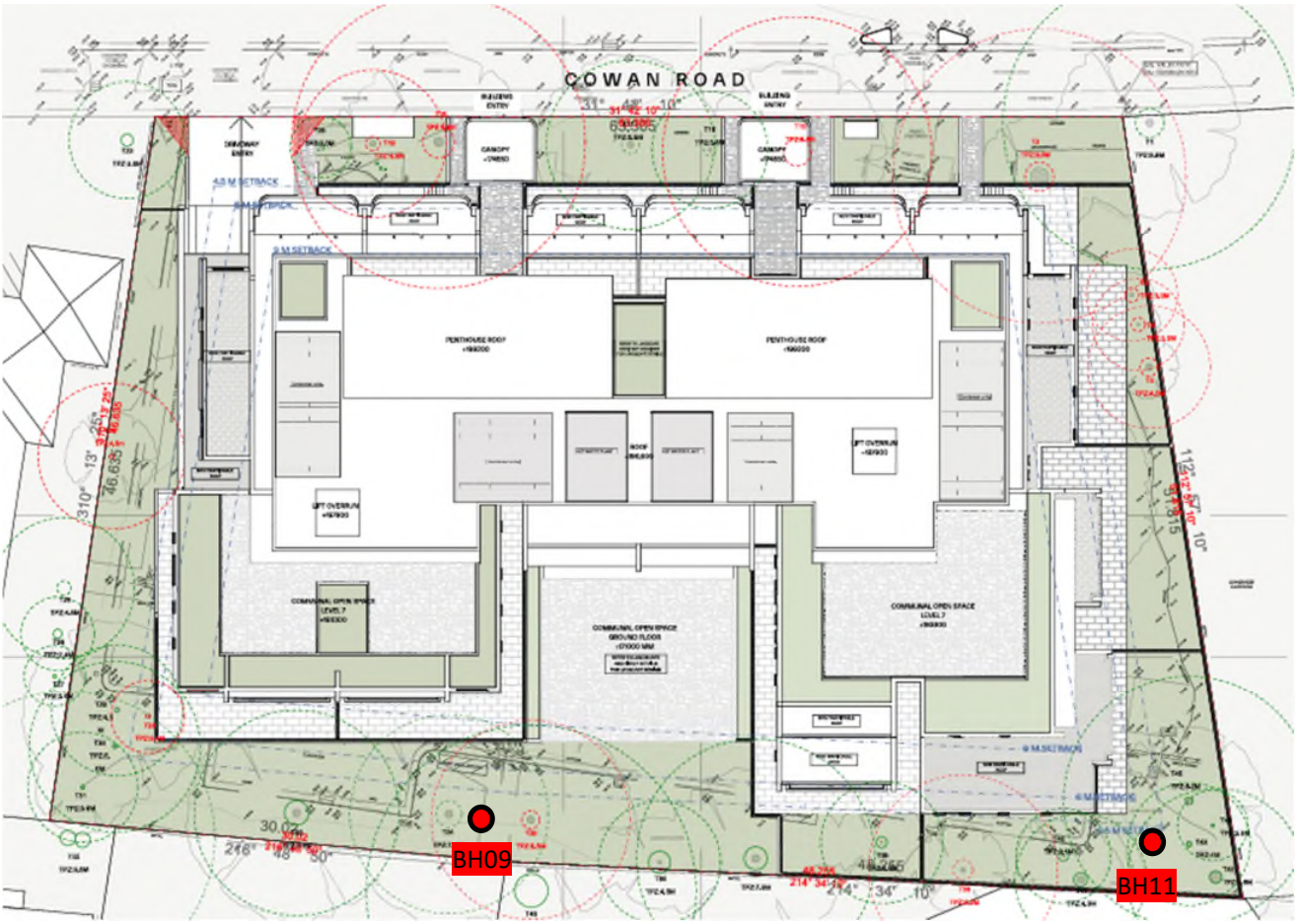
Source: http://maps.six.nsw.gov.au/

LEGEND

Hotspot Location

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	7	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

HOTSPOT LOCATIONS ON PROPOSED DEVELOPMENT LAYOUT



LEGEND

Hotspot Locations

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	8	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

ADDITIONAL LOCATIONS ON AERIAL VIEW

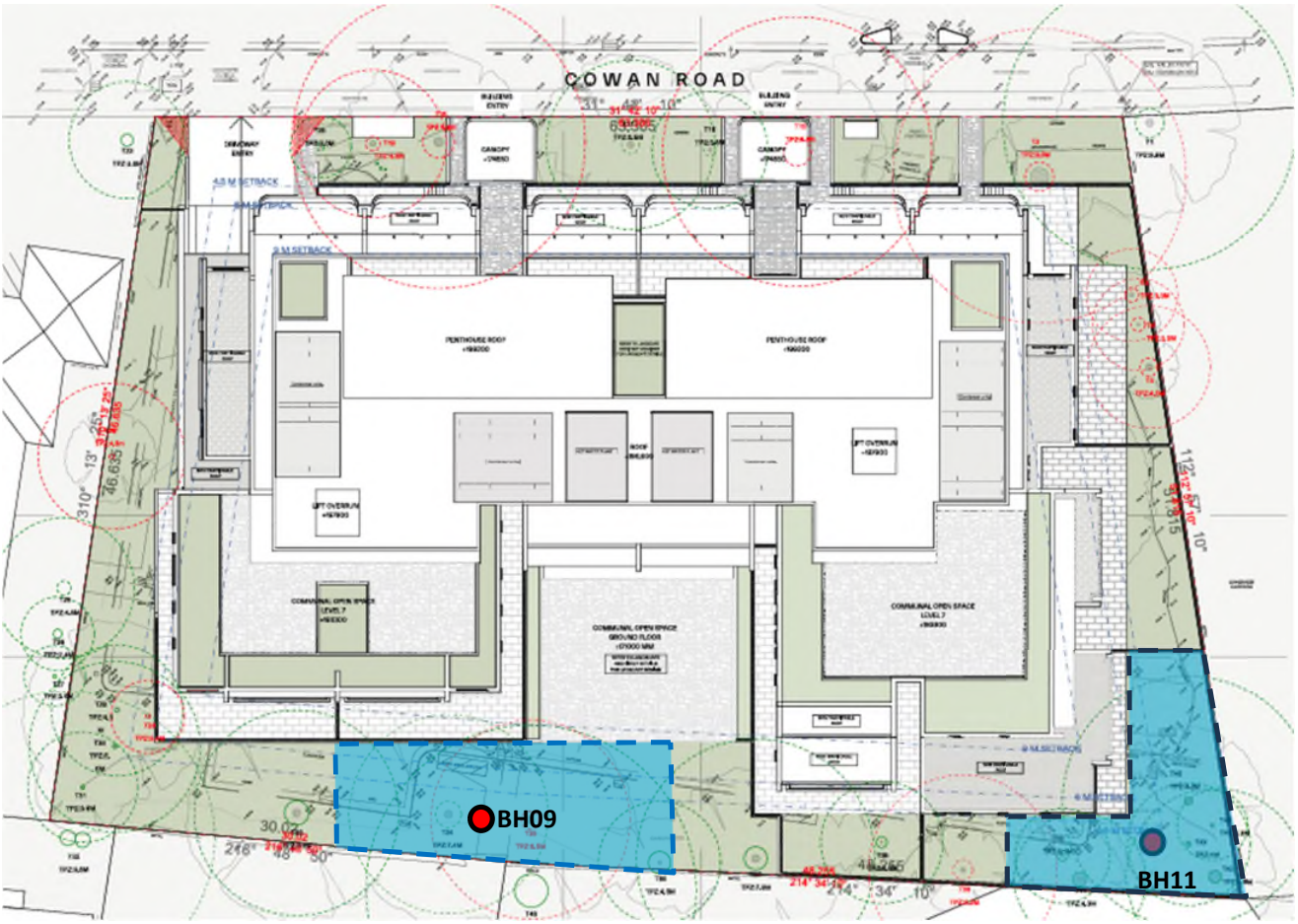
Source: http://maps.six.nsw.gov.au/

LEGEND

Borehole | Monitoring Well / Borehole | Additional Locations

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	9	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

HOTSPOT LOCATIONS ON PROPOSED DEVELOPMENT LAYOUT



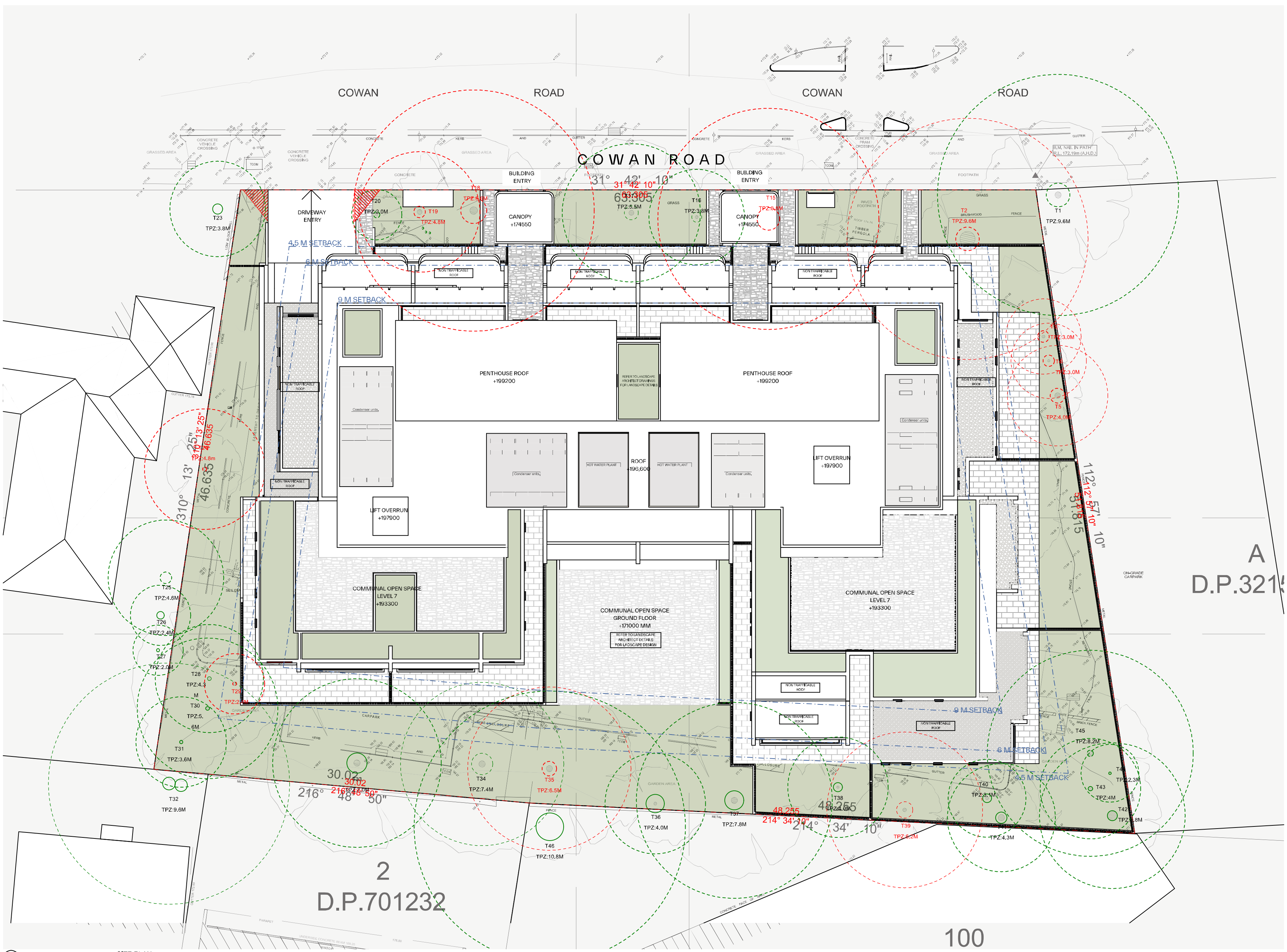
LEGEND

Hotspot Locations

PROJECT DETAILS		DRAWING DETAILS			
Project Title	Remediation Action Plan	**Figure No.**	8	**Rev No.**	0
Project No.	ES9614/9	**Scale**	As above	**Size**	A4
Client	Prosper 5-9 Cowan Road St Ives Pty Limited	**Drawn by**	SK	**Date**	22.01.2026
Site Address	5-9 Cowan Road, St Ives NSW	**Approved by**	MK	**Date**	29.01.2026

APPENDIX B

PROPOSED DEVELOPMENT PLANS


COWAN
ROAD
COWAN
ROAD
COWAN ROAD
BUILDING ENTRY
BUILDING ENTRY
DRIVEWAY ENTRY
CANOPY
+174550
CANOPY
+174550
4.5 M SETBACK
6 M SETBACK
9 M SETBACK
PENTHOUSE ROOF
+199200
PENTHOUSE ROOF
+199200
ROOF
+196,600
LIFT OVERRUN
+197900
LIFT OVERRUN
+197900
HOT WATER PLANT
HOT WATER PLANT
COMMUNAL OPEN SPACE
LEVEL 7
+193300
COMMUNAL OPEN SPACE
GROUND FLOOR
+171000 MM
REFER TO LANDSCAPE ARCHITECT DETAILS FOR LANDSCAPE DESIGN
COMMUNAL OPEN SPACE
LEVEL 7
+193300
NON TRAFFICABLE ROOF
9 M SETBACK
6 M SETBACK
4.5 M SETBACK
A
D.P.3215
2
D.P.701232
100
T1
TPZ:9.6M
T2
TPZ:9.6M
T16
TPZ:3.8M
T19
TPZ:4.8M
T23
TPZ:3.8M
T25
TPZ:4.8M
T26
TPZ:2.4M
T28
T31
TPZ:3.6M
T32
TPZ:9.6M
T34
TPZ:7.4M
T35
TPZ:6.5M
T36
TPZ:4.0M
T37
TPZ:7.8M
T38
T39
TPZ:6.2M
T40
T42
T43
TPZ:4M
T45
TPZ:8.2M
T46
TPZ:10.8M
30.02
216° 48' 50"
48.255
214° 34' 10"
46.635
310° 13' 25"
51.815
112° 57' 10"
31° 42' 10"
63.305
TREES LEGEND
EXISTING TREES TO BE RETAINED
EXISTING TREES TO BE REMOVED

SITE PLAN
1:100

Scale Bar 1 : 100 @ A1

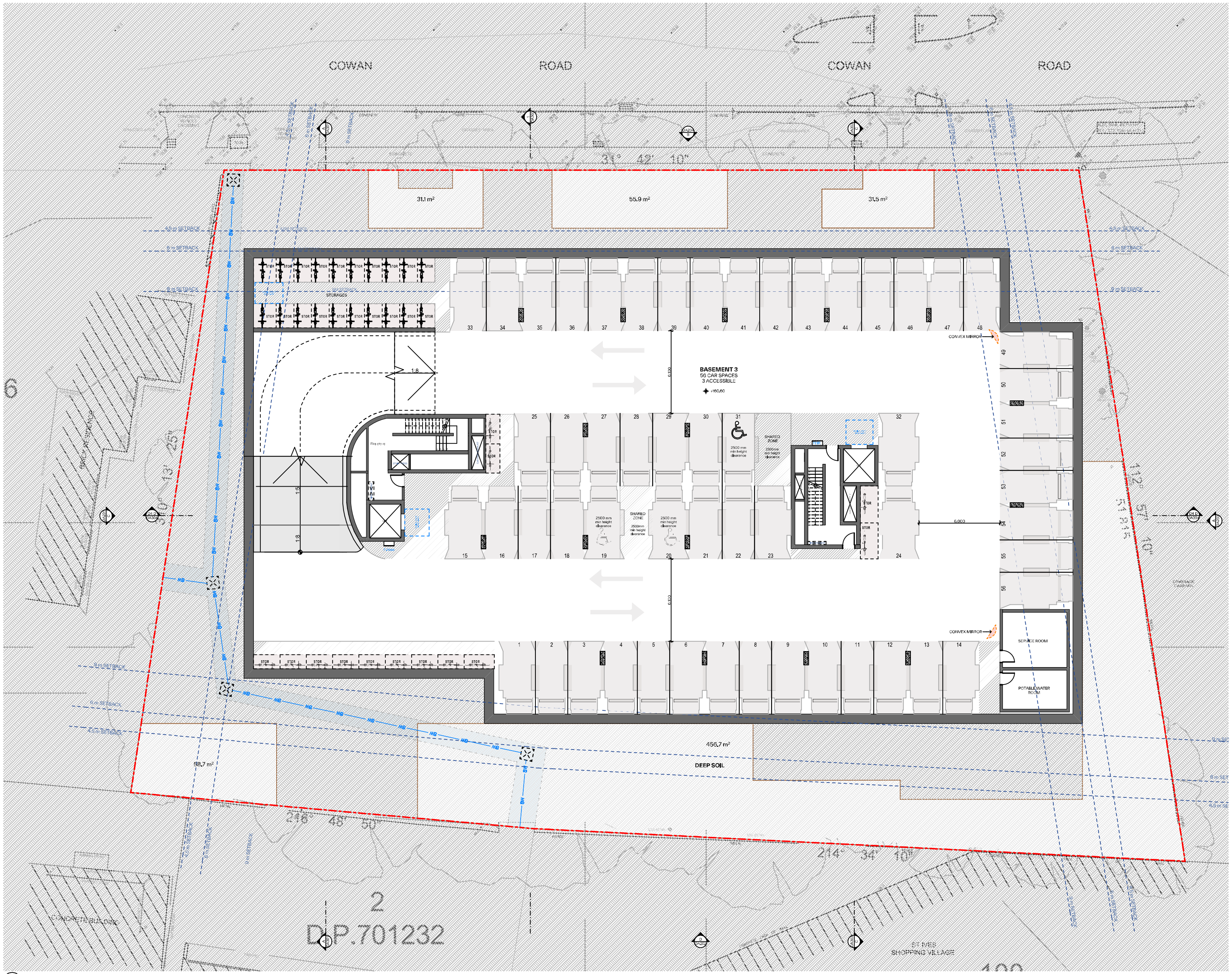
CLIENT:
PROSPER

pbd architects

PROJECT:
RESIDENTIAL FLAT BUILDING
5-9 COWAN ROAD ST IVES NSW 2075

DRAWING TITLE:
Site Plan

DRAWING BY:	CHECKED BY:	
CAD Technician XX	Checked by XX	
SCALE: 1:100@A0	DRAWING NO: **DA004**	ISSUE: **P5**
PROJECT NO: 2518		



1 Basement 3
1:100

GENERAL NOTES:

- ALL WORKS TO COMPLY WITH BUILDING CODE OF AUSTRALIA, REQUIREMENTS OF RELEVENT STATUTORY AUTHORITIES/ LOCAL GOVERNMENT & RELEVENT AUSTRALIAN BUILDING STANDARDS
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- AREA SCHEDULES SUPPLIED ARE APPROXIMATE ONLY - FUTURE ALLOWANCE FOR VERTICAL SERVICE DUCTS, STRUCTURAL WALL SYSTEMS AND CONSULTANT INPUT WILL BE REQUIRED

LEGEND:

AW	AWNING
AH	ACCESS HATCH
AC	A/C CONDENSER UNITS
FH	FIRE HYDRANT
FHR	FIRE HOSE REEL
FS	FIRE STAIRS
GC	GARBAGE CHUTE
HW	HIGHLIGHT WINDOW
MV	MECHANICAL RISER TO FUTURE DETAIL
MB	MAILBOX TO FUTURE DETAIL
R	240L RECYCLING BIN
SK	SKYLIGHT
ST	STORAGE
HWU	HOT WATER UNITS

MATERIALS LEGEND:

AFG	ALUMINIUM FRAMED GLAZING
LV	ALUMINIUM ELLIPTICAL FIXED LOUVERS
AW	AWNING (TO FUTURE DETAIL)
CONC	CONCRETE
FB	FACE BRICK
GB	FRAMELESS TOUGHENED GLASS BALUSTRADE (TO BCA/AUS STANDARDS)
MB	METAL BALUSTRADE
MC	METAL CLADDING
FCL	METAL FENCING (TO FUTURE SELECTION)
PC	COMPOSITE PANEL CLADDING
PSx	PRIVACY SCREEN (TO FUTURE SELECTION)
PTx	PAINT FINISH TYPEx
RD	ROLLER DOOR
RP	RIVER PEBBLES
RW	RENDERED FINISH/SELECTED PAINT FINISH
TC	TIMBER CLADDING
VB	EXTERNAL VENETIAN BLINDS

TREES LEGEND

EXISTING TREES TO BE RETAINED

EXISTING TREES TO BE REMOVED

Issue	Date	Description
P1	15/07/2025	For Review
P2	5/08/2025	For Review
P3	15/08/2025	For Review
P4	20/08/2025	Draft Development Application
P5	25/08/2025	Draft Development Application

Scale Bar 1 : 100 @ A1
0 1 2 3 4 5m

N

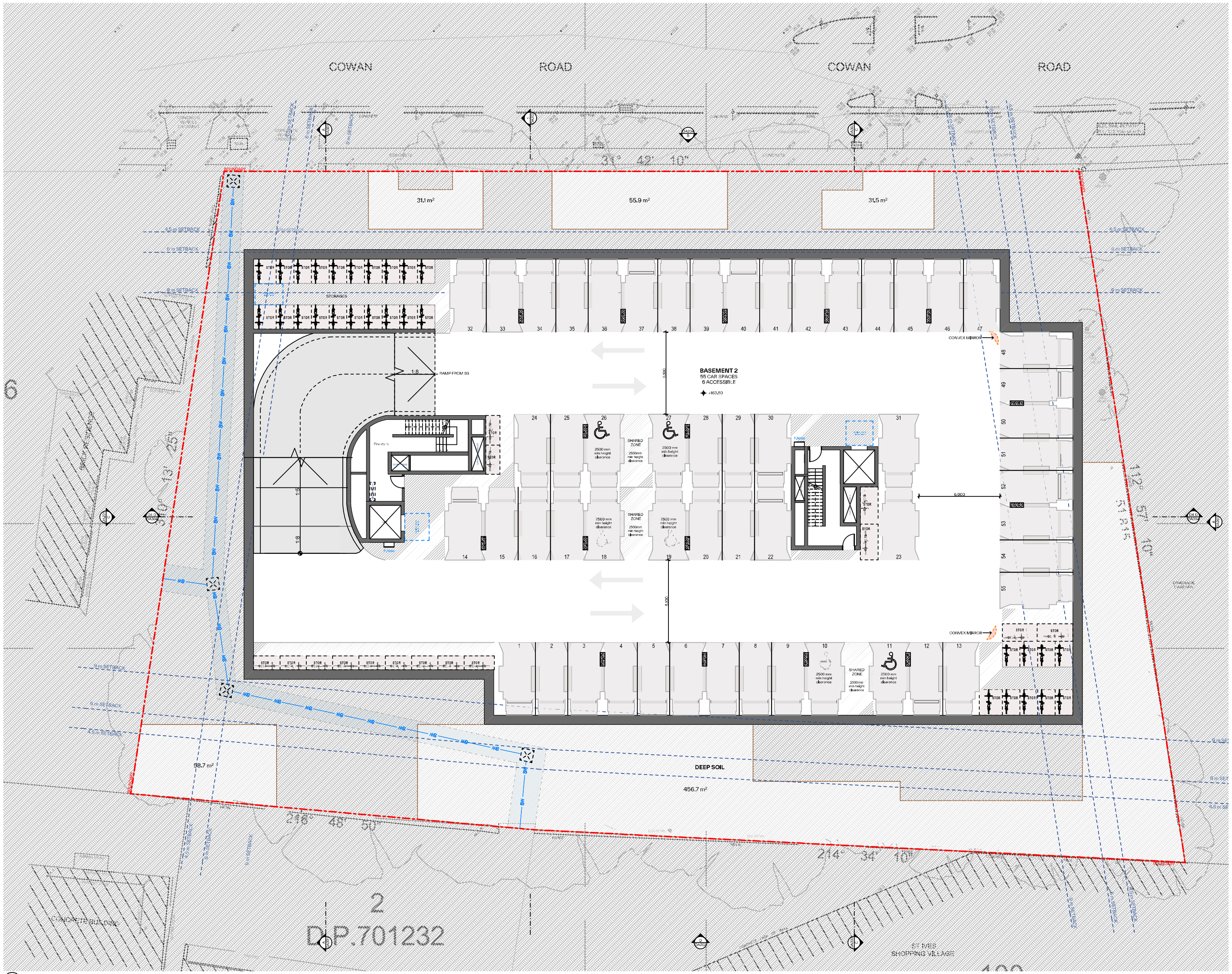
CLIENT:
PROSPER

pbd architects

PROJECT:
RESIDENTIAL FLAT BUILDING
5-9 COWAN ROAD ST IVES NSW 2075

DRAWING TITLE:
Basement 3 plan

DRAWING BY: CAD Technician XX	CHECKED BY: Checked by XX	
SCALE: 1:100@A0	DRAWING NO: DA100	ISSUE: P5
PROJECT NO: 2518		



1 Basement 2
1:100

GENERAL NOTES:

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LEGEND:

AW	AWNING
AH	ACCESS HATCH
AC	A/C CONDENSER UNITS
FH	FIRE HYDRANT
FHR	FIRE HOSE REEL
FS	FIRE STAIRS
GC	GARBAGE CHUTE
HW	HIGHLIGHT WINDOW
MV	MECHANICAL RISER TO FUTURE DETAIL
MB	MAILBOX TO FUTURE DETAIL
R	240L RECYCLING BIN
SK	SKYLIGHT
ST	STORAGE
HWU	HOT WATER UNITS

MATERIALS LEGEND:

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CONC	CONCRETE
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MC	METAL CLADDING
FCL	METAL FENCING (TO FUTURE SELECTION)
PC	COMPOSITE PANEL CLADDING
PSx	PRIVACY SCREEN (TO FUTURE SELECTION)
PTx	PAINT FINISH TYPEx
RD	ROLLER DOOR
RP	RIVER PEBBLES
RW	RENDERED FINISH/SELECTED PAINT FINISH
TC	TIMBER CLADDING
VB	EXTERNAL VENETIAN BLINDS

TREES LEGEND

EXISTING TREES TO BE RETAINED

EXISTING TREES TO BE REMOVED

Issue	Date	Description
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P2	5/08/2025	For Review
P3	15/08/2025	For Review
P4	20/08/2025	Draft Development Application
P5	25/08/2025	Draft Development Application

Scale Bar 1 : 100 @ A1

0 1 2 3 4 5m

N

CLIENT:
PROSPER

pbd architects

P = 02 9698 8140
E = info@pbdarchitects.com.au
W = pbdarchitects.com.au

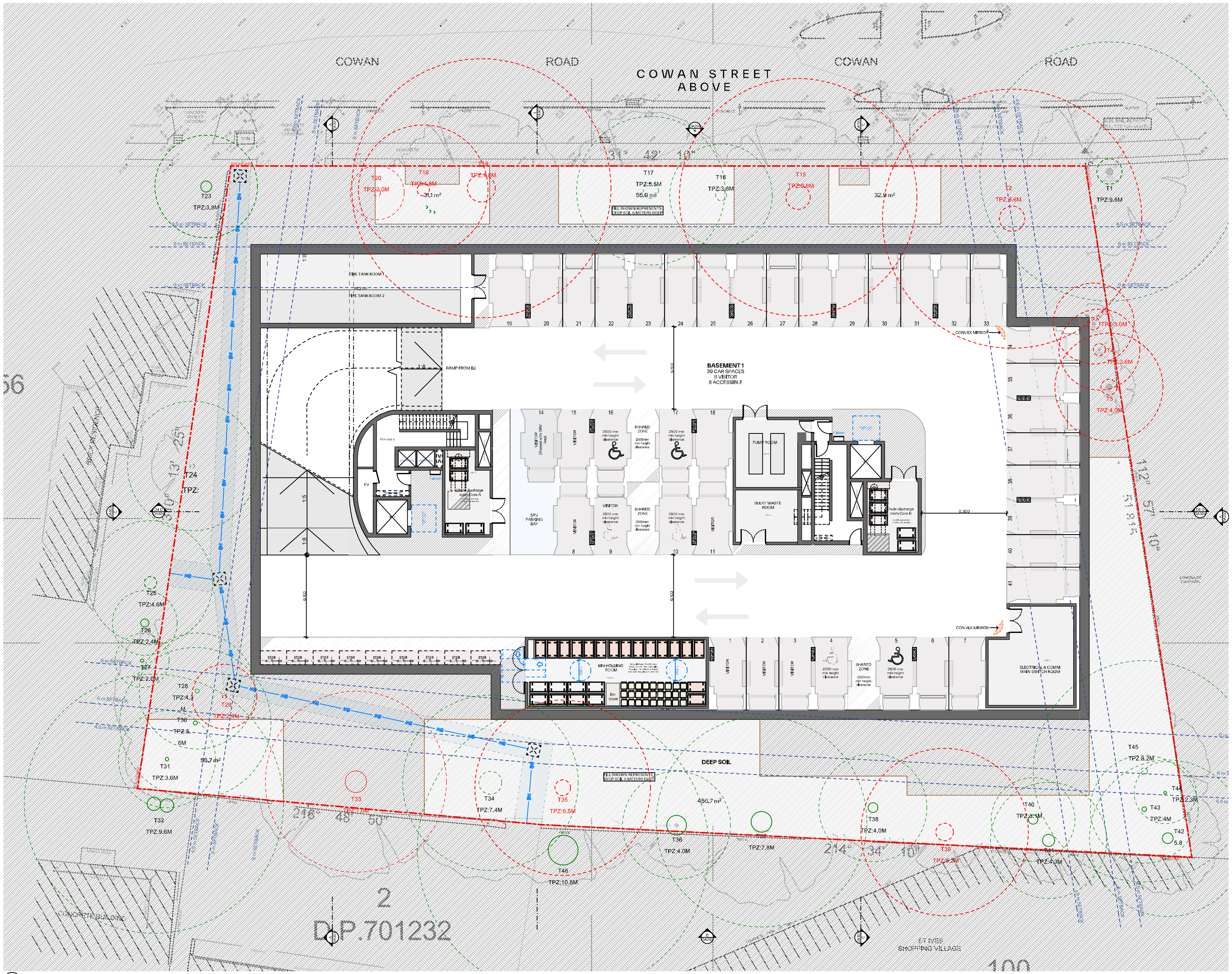
Level 2, 52 Albion Street,
Surry Hills NSW 2010

ABN 36 147 035 550
Nominated Architect:
Paul Buljevic NSW 7768

PROJECT:
RESIDENTIAL FLAT BUILDING
5-9 COWAN ROAD ST IVES NSW 2075

DRAWING TITLE:
Basement 2 plan

DRAWING BY: CAD Technician XX	CHECKED BY: Checked by XX	
SCALE: 1:100@A0 / PROJECT NO: 2518	DRAWING NO: **DA101**	ISSUE: **P5**



1 Basement 1
1:100

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LEGEND:

AW	AWNING
AH	ACCESS HATCH
AC	A/C CONDENSER UNITS
FH	FIRE HYDRANT
FHR	FIRE HOSE REEL
FS	FIRE STAIRS
GC	GARBAGE CHUTE
HW	HIGHLIGHT WINDOW
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MB	MAILBOX TO FUTURE DETAIL
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SK	SKYLIGHT
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P5	25/08/2025	Draft Development Application

Scale Bar 1 : 100 @ A1

0 1 2 3 4 5m

N

CLIENT:
PROSPER

pbd architects

P - 02 9698 8140
E - info@pbdarchitects.com.au
W - pbdarchitects.com.au

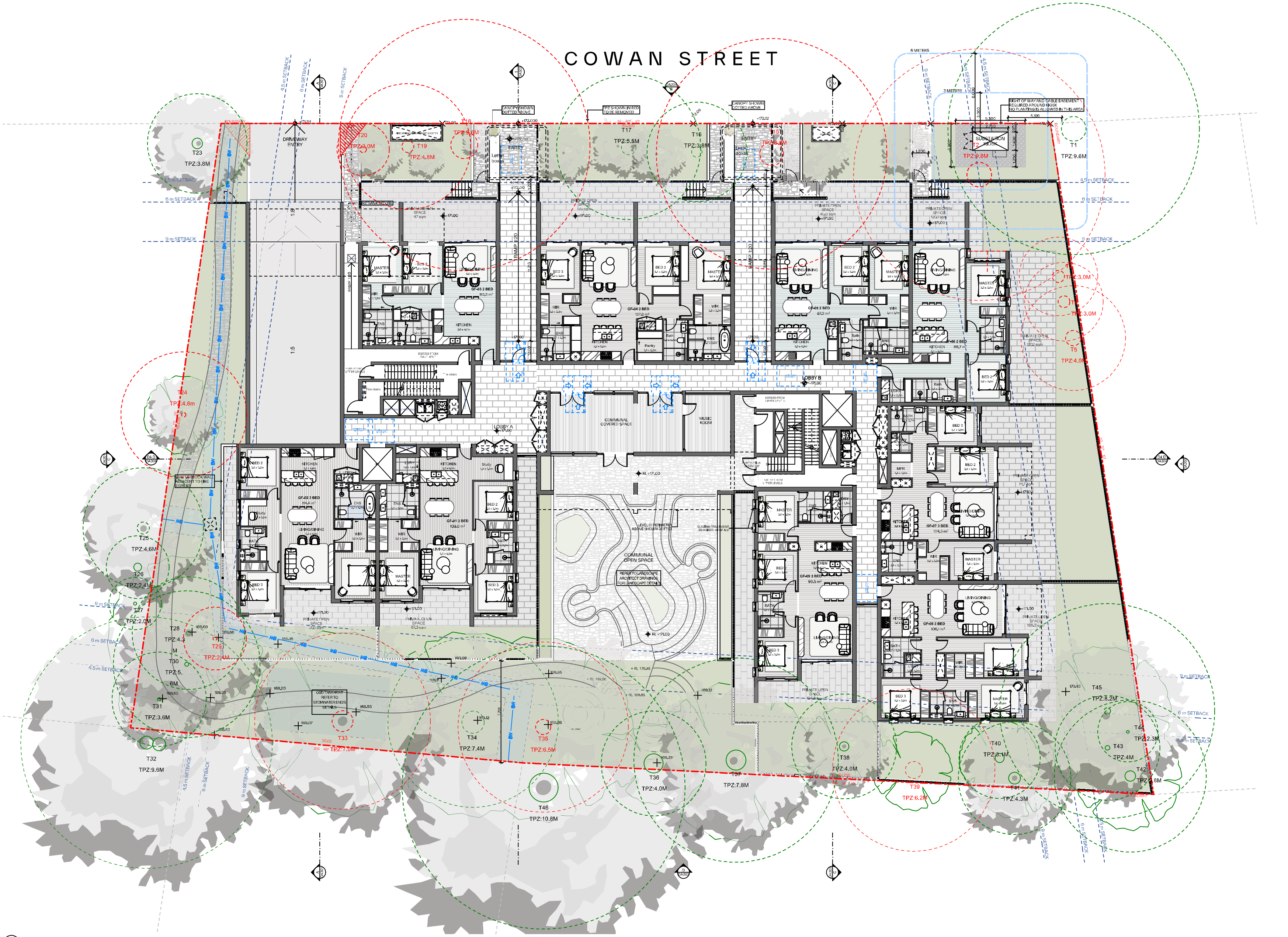
Level 2, 52 Albion Street,
Surry Hills NSW 2010

ABN 36 147 035 550
Nominated Architect:
Paul Buljevic NSW 7768

PROJECT:
RESIDENTIAL FLAT BUILDING
5-9 COWAN ROAD ST IVES NSW 2075

DRAWING TITLE:
Basement 1 plan

DRAWING BY: CAD Technician XX	CHECKED BY: Checked by XX	
SCALE: 1:100@A0	DRAWING NO: DA102	ISSUE: P5
PROJECT NO: 2518		



1 Ground 1:100

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LEGEND:

AW	AWNING
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FHR	FIRE HOSE REEL
FS	FIRE STAIRS
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MB	MAILBOX TO FUTURE DETAIL
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SK	SKYLIGHT
ST	STORAGE
HWU	HOT WATER UNITS

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EXISTING TREES TO BE RETAINED

EXISTING TREES TO BE REMOVED

Issue	Date	Description
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P2	5/08/2025	For Review
P3	15/08/2025	For Review
P4	20/08/2025	Draft Development Application
P5	25/08/2025	Draft Development Application

Scale Bar 1 : 100 @ A1

0 1 2 3 4 5m

N

CLIENT:
PROSPER

pbd architects

P - 02 [illegible]
E - info@pbdarchitects.com.au
W - pbdarchitects.com.au

Level 2, 52 Albion Street,
Surry Hills NSW 2010

ABN [illegible]
Nominated Architect:
Paul Buljevic NSW 7768

PROJECT:
RESIDENTIAL FLAT BUILDING
5-9 COWAN ROAD ST IVES NSW 2075

DRAWING TITLE:
Ground floor plan

DRAWING BY: CAD Technician XX	CHECKED BY: Checked by XX	
SCALE: 1:100@A0	DRAWING NO: **DA103**	ISSUE: **P5**
PROJECT NO: 2518		

MGA2020

Sheet 2

Sheet 3

TRUE NORTH
M.G.A. NORTH

COWAN ROAD

B.M. NAIL IN PATH
R.L. 172.19m (A.H.D.)

31° 42' 10"
63.305

112° 57' 10"
51.815

310° 13' 25"
46.635

S.P.30097
3468 m²

EASEMENT TO DRAIN WATER 1 WIDE

30.02
216° 48' 50"

48.255
214° 34' 10"

UNDERSLAB CONCRETE BEAM 1.69.20

2
D.P.10256

A
D.P.321567

2
D.P.701232

1
D.P.701232

100
D.P.838008

Sheet 4

Sheet 5

NOTES:

IF ACCURATE LOCATION OF SERVICES IS REQUIRED SERVICE TRACE IS RECOMMENDED.

INFORMATION SHOWN ON PLAN AND ELEVATIONS OF ADJOINING PROPERTIES HAS BEEN OBTAINED BY REMOTE SURVEY METHODS FROM WITHIN SUBJECT LAND AND STREET.

RESTRICTED VISIBILITY ALONG THE WESTERN, EASTERN AND SOUTHERN BOUNDARIES OF THE SUBJECT LAND HAS PREVENTED DIRECT MEASUREMENTS TO THE ADJOINING BUILDINGS.

SYMBOLS REPRESENTING SERVICE PITS, POLES AND STREET FURNITURE ARE NOT TO SCALE.

TREE SPREADS AND TRUNK DIAMETERS SHOWN ARE DIAGRAMMATIC ONLY AND TREE HEIGHTS ARE ESTIMATED. IF ANY OF THESE ELEMENTS ARE CRITICAL TO DESIGN (IN PARTICULAR DRIPLINES) MORE SPECIFIC DETAILS SHOULD BE REQUESTED FOR ACCURATE LOCATION.

BEARINGS SHOWN RELATE TO M.G.A. NORTH.

VISIBLE SURFACE PITS ONLY SHOWN.
THE EXISTENCE AND POSITION OF UNDERGROUND SERVICES HAS NOT BEEN INVESTIGATED.

PIT SIZE IS SHOWN AT GROUND LEVEL. PITS MAY BE LARGER BELOW THE SURFACE.

CONSTRUCTION WORKS MUST BE RELATED TO THE SITE BENCH MARK AND NOT LEVELS OF STRUCTURES SHOWN ON THE PLAN.

IT IS THE RESPONSIBILITY OF EACH CONTRACTOR AND/OR CONSULTANT TO CONTACT THE RELEVANT AUTHORITY AND/OR "Before You Dig Australia" (Phone 1100) BEFORE COMMENCING ANY EXCAVATION.

THIS PLAN HAS BEEN CREATED AT A SCALE OF 1:100 AND MAY NOT BE SATISFACTORY FOR OTHER PURPOSES. THE ACCURACY OF ANY ENLARGEMENT OR OTHER REPRODUCTION MAY BE LESS THAN THAT OF THE ORIGINAL.

BOUNDARIES HAVE BEEN SURVEYED IN ACCORDANCE WITH THE SURVEYING & SPATIAL INFORMATION REGULATION 2024.

G.J. FRITH, B.Surv. F.I.S.
Registered Land Surveyor
Surveyor ID: SU001066

LEGEND

ELECTRICITY PIT	WATER METER	BENCHMARK
ELEC POLE WITH LIGHT	WATER TAP	GROUND CONTROL POINT
ELECTRICITY POLE	STOP VALVE	PERMANENT MARK
LIGHT POLE	HYDRANT	STATE SURVEY MARK
TRAFFIC SIGNAL	STORM WATER GRATE	REFERENCE MARK
ELECTRICITY PILLAR	STORMWATER GRATE	BIN
MULTI FUNCTION POLE	STORM WATER MANHOLE	CAMERA
GAS METER	STORM WATER PIT	HILLS HOIST
GAS VALVE	DOWNPIPE	MAILBOX
POLE (UNSPECIFIED)	SEWER INSPECTION POINT	SIGN
PIT (UNSPECIFIED)	MANHOLE SEWER	PARKING METER
MANHOLE (UNSPECIFIED)	MANHOLE SEWER	FIRE HYDRANT
TELECOM PIT	BOLLARD	GATE
TELECOM PILLAR		STORMWATER
RTA PIT		TOP OF BANK
T.W. TOP OF WALL		BOTTOM OF BANK
B.W. BOTTOM OF WALL		OVERHEAD POWER LINES

REV.	DATE	AMENDMENTS
A	16/04/2025	ISSUED FOR INFORMATION

RYGATE SURVEYORS
SURVEYING SINCE 1893

Rygate & Company Pty Limited
P.W. Rygate & West
ABN 61 001 204 897

a Suite 903 Level 9, 171 Clarence St. Sydney NSW 2000
p +61 2 9262 6800
f +61 2 9262 6843
e surveyors@rygate.com.au
w rygate.com.au

SUBDIVISION | STRATA PLANS | STRATUM SUBDIVISION | LEASE PLANS | TOPOGRAPHIC SURVEYS | GPS SURVEYS | 3D MODELLING | RACECOURSE DESIGN | PROJECT MANAGEMENT | SUN SHADOW DIAGRAMS

SURVEYOR	DRAWN	CHECKED	APPROVED
A.C.	T.O.	A.C.	G.J.F.

0 — 10m
REDUCTION RATIO 1:200 @ A1

DATUM : AUSTRALIAN HEIGHT DATUM
CONTOUR INTERVAL :0.5m
ORIGIN OF LEVELS : S.S.M.153117 R.L.172.65m (A.H.D.)

THIS TITLE BLOCK AND NOTES FORM AN INTEGRAL PART OF THE PLAN AND MUST BE REPRODUCED IN ANY USE, DUPLICATION OR AMENDMENT.

CLIENT
GROWTH BUILT

LOCALITY
ST IVES

L.G.A.
KU-RING-GAI

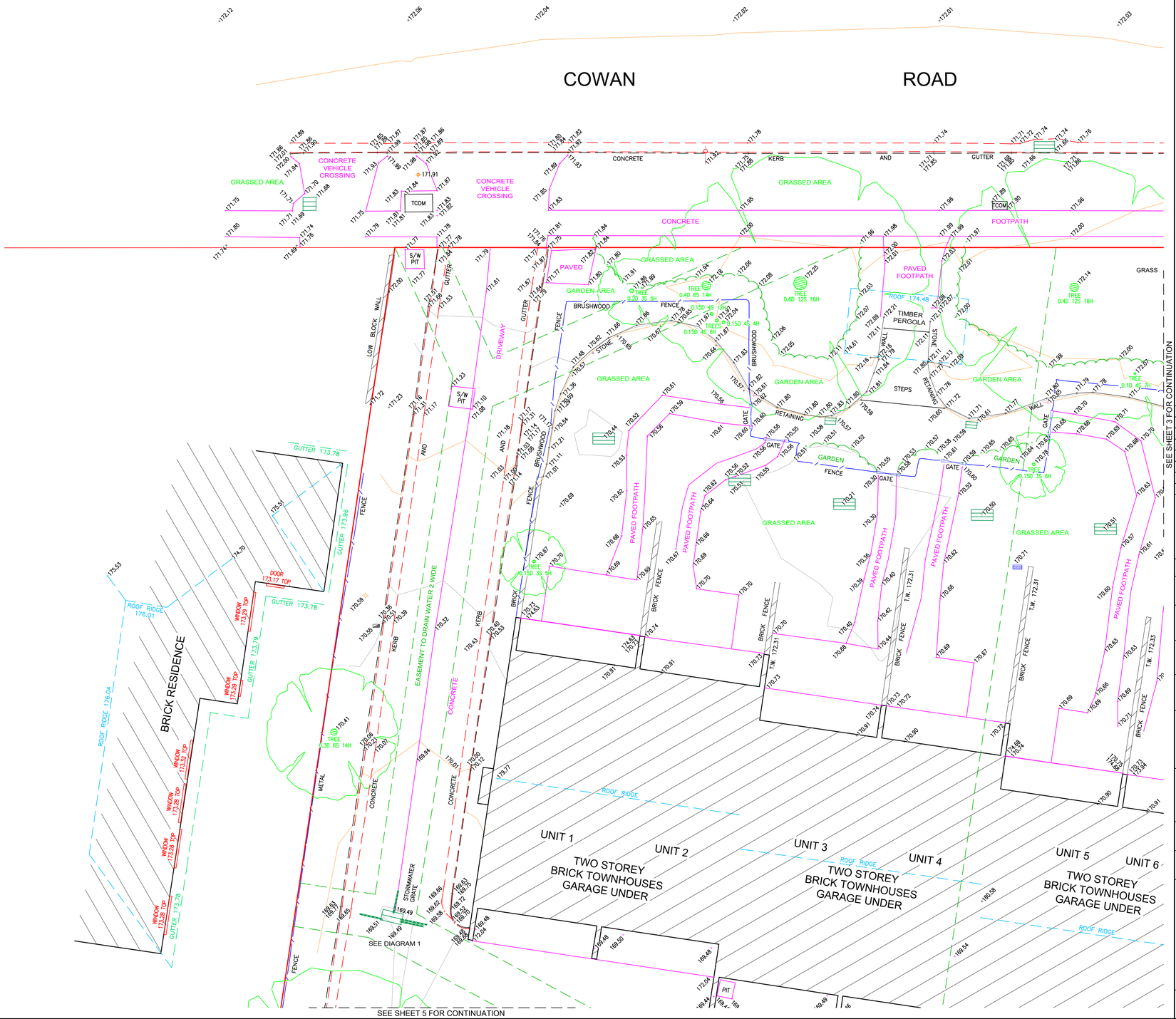
PLAN
SHOWING DETAIL & LEVELS
No. 5-9 COWAN ROAD
S.P.30097

REFERENCE No.	PLAN No.	DATE	SHEET NO
80743	80743-D.DWG	16/04/2025	1 OF 5 SHEETS

MGA2020

TRUE NORTH
M.G.A. NORTH

COWAN ROAD



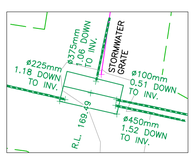


DIAGRAM 1
NOT TO SCALE

NOTES:

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G.J. FRITH, B.Surv. F.I.S.
Registered Land Surveyor
Surveyor ID: SU001066

LEGEND

- ELECTRICITY PIT
- ELEC POLE WITH LIGHT
- ELECTRICITY POLE
- LIGHT POLE
- TRAFFIC SIGNAL
- ELECTRICITY PILLAR
- MULTI FUNCTION POLE
- GAS METER
- GAS VALVE
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- GROUND CONTROL POINT
- PERMANENT MARK
- STATE SURVEY MARK
- REFERENCE MARK
- BIN
- CAMERA
- HILLS HOIST
- MAILBOX
- SIGN
- PARKING METER
- FIRE HYDRANT
- GATE
- TOP OF BANK
- BOTTOM OF BANK
- OVERHEAD POWER LINES

SEE SHEET 3 FOR CONTINUATION

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RYGATE SURVEYORS
SURVEYING SINCE 1893

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SURVEYOR	DRAWN	CHECKED	APPROVED
A.C.	T.O.	A.C.	G.J.F.

0 — 10m
REDUCTION RATIO 1:100 @ A1

DATUM : AUSTRALIAN HEIGHT DATUM
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CLIENT
GROWTH BUILT

LOCALITY
ST IVES

L.G.A.
KU-RING-GAI

PLAN
SHOWING DETAIL & LEVELS
No. 5-9 COWAN ROAD
S.P.30097

REFERENCE No.	PLAN No.	DATE	SHEET NO
80743	80743-D.DWG	16/04/2025	2 OF 5 SHEETS

MGA2020

TRUE NORTH
M.G.A. NORTH

COWAN ROAD

CONCRETE
KERB
AND
GUTTER
CONCRETE PRAM CROSSING
B.M. NAIL IN PATH
R.L. 172.19m (A.H.D.)
GRASSED AREA
FOOTPATH
CONCRETE
PAVED FOOTPATH
TIMBER PERGOLA
ROOF 174.74
ROOF 174.78
GRASS
BRUSHWOOD
FENCE
METAL
GARDEN AREA
STEPS
WALL
STONE
RETAINING
GRATE
GATE
GARDEN
BRICK FENCE
T.W. 172.31
T.W. 172.33
T.W. 172.32
ROOF RIDGE 179.78
ROOF RIDGE 180.64
UNIT 5
UNIT 6
UNIT 7
UNIT 8
UNIT 9
UNIT 10
TWO STOREY BRICK TOWNHOUSES GARAGE UNDER
ON-GRADE CARPARK
SEE SHEET 2 FOR CONTINUATION
SEE SHEET 6 FOR CONTINUATION

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G.J. FRITH, B.Surv. F.I.S.
Registered Land Surveyor
Surveyor ID: SU001066

LEGEND

ELECTRICITY PIT	WATER METER	BENCHMARK
ELEC POLE WITH LIGHT	WATER TAP	GROUND CONTROL POINT
ELECTRICITY POLE	STOP VALVE	PERMANENT MARK
LIGHT POLE	HYDRANT	STATE SURVEY MARK
TRAFFIC SIGNAL	STORM WATER GRATE	REFERENCE MARK
ELECTRICITY PILLAR	STORMWATER GRATE	BIN
MULTI FUNCTION POLE	STORM WATER MANHOLE	CAMERA
GAS METER	STORM WATER PIT	HILLS HOIST
GAS VALVE	DOWNPIPE	MAILBOX
POLE (UNSPECIFIED)	SEWER INSPECTION POINT	SIGN
PIT (UNSPECIFIED)	MANHOLE SEWER	PARKING METER
MANHOLE (UNSPECIFIED)	MANHOLE SEWER	FIRE HYDRANT
TELECOM PIT	BOLLARD	GATE
TELECOM PILLAR		STORMWATER
RTA PIT		TOP OF BANK
T.W. TOP OF WALL		BOTTOM OF BANK
B.W. BOTTOM OF WALL		OVERHEAD POWER LINES

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A.C.	T.O.	A.C.	G.J.F.

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ST IVES

L.G.A.
KU-RING-GAI

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SHOWING DETAIL & LEVELS
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REFERENCE No.	PLAN No.	DATE	SHEET NO 3
80743	80743-D.DWG	16/04/2025	OF 5 SHEETS

MGA2020

TRUE NORTH
M.G.A. NORTH

SEE SHEET 2 FOR CONTINUATION

UNIT 1 — TWO STOREY BRICK TOWNHOUSES GARAGE UNDER
UNIT 2
UNIT 3 — TWO STOREY BRICK TOWNHOUSES GARAGE UNDER
UNIT 4
UNIT 5
UNIT 6 — TWO STOREY BRICK TOWNHOUSES GARAGE UNDER

ROOF RIDGE
SEE DIAGRAM 1
SEE DIAGRAM 2
STORMWATER GRATE
PIT
FENCE
METAL
CONCRETE
EASEMENT TO DRAIN WATER 2 WIDE
GARDEN AREA
CARPARK
KERB
AND
GUTTER
BINS ENCLOSURE
TCOM
TREE 0.30 6S 6H
TREE 0.30 12S 14H
TREE 0.30 6S 14H
TREE 0.25D 6S 8H
TREE 0.50 14S 16H
TREE 0.25D 6S 14H
WINDOW 172.28 TOP
GUTTER 172.29
AWNING 170.90
PARAPET 172.33
PARAPET 174.28
CONCRETE BUILDING
PARAPET 174.29
GUTTER 172.00
PARAPET
UNDERSIDE CONCRETE BEAM 169.20
176.80
WINDOW 175.61 TOP 173.78 SILL 172.16 TOP 170.36 SILL
TWO STOREY BRICK OFFICE BUILDING CARPARK UNDER
ST IVES SHOPPING VILLAGE
CONCRETE FACE OF WALL
PARAPET 175.14

SEE SHEET 6 FOR CONTINUATION

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L.G.A.
KU-RING-GAI

PLAN
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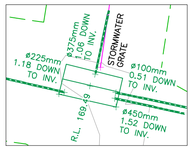


DIAGRAM 1
NOT TO SCALE

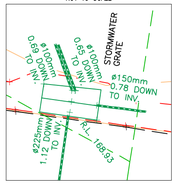
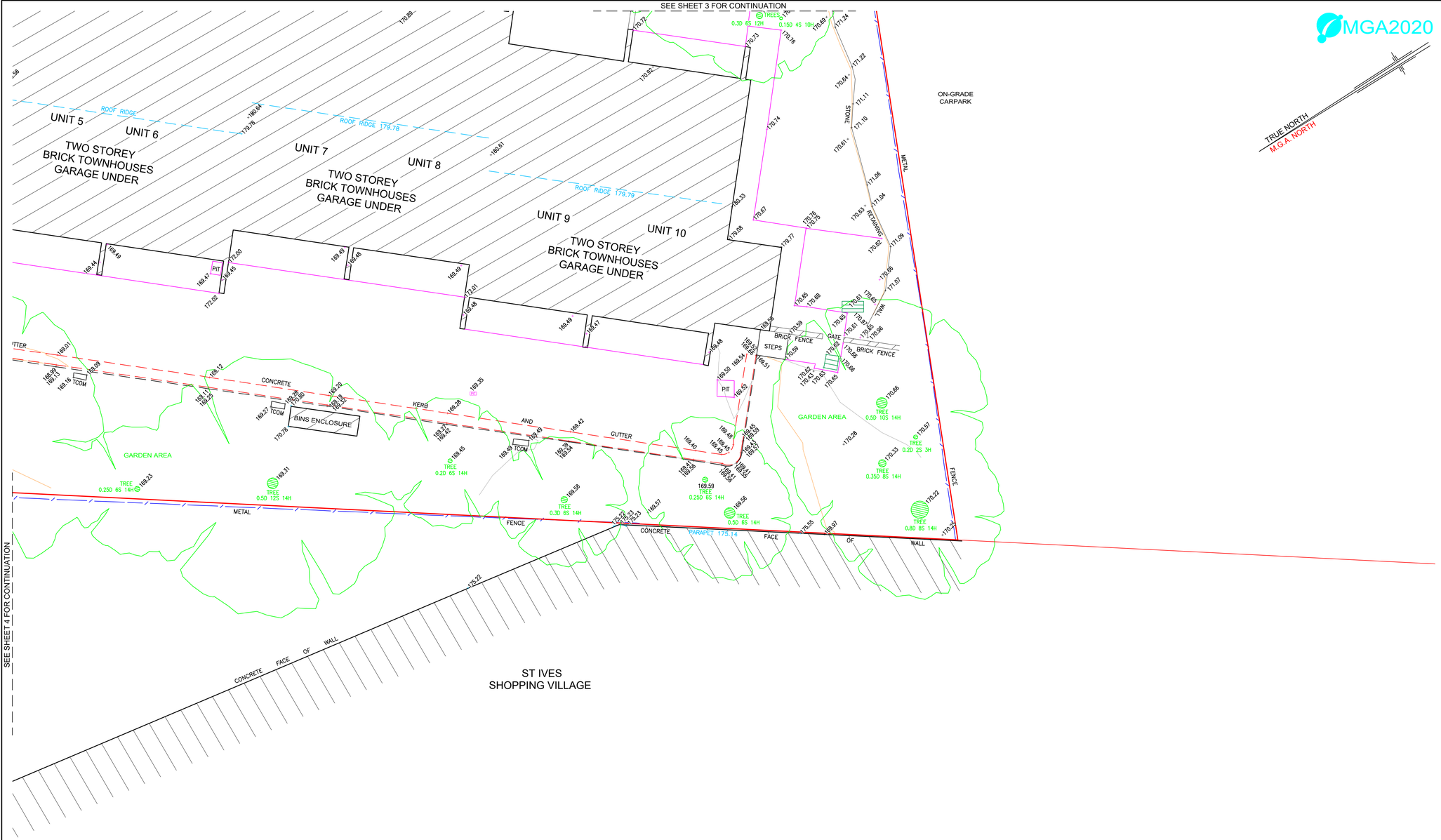


DIAGRAM 2
NOT TO SCALE



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APPENDIX C

WORK HEALTH SAFETY PLAN

GSNE SERVICES PTY LTD

SOLUTIONS THAT LAST

ENGINEERING ● RESEARCH ● ENVIRONMENTAL ● HAZMAT ● CONSTRUCTION MATERIAL LABS ● EXCAVATION ● DRILLING ● ASBESTOS LABS ● DEMOLITION ● REHABILITATION ● CIVIL WORKS ● RECYCLING ● ENERGY ● MINING

WORK HEALTH AND SAFETY PLAN

For

5-9 Cowan Road, St Ives NSW

Prepared for

Prosper 5-9 Cowan Road St Ives Pty Limited

29th January 2026

GSNE Services Pty Ltd: ABN 71 387 576 812
Toll Free: 1300 137 038
Email: admin@gsne.com.au
Offices: Gipps Road Smithfield NSW 2164 – 93 Eastwood Road Leppington NSW 2179 – 12/1 Bounty Close Tuggerah NSW 2259

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

GSNE Services Pty Ltd ("GSNE Services") has been engaged to undertake a remediation and validation program on behalf of our client. Project specific details are provided in Appendix 1.

Personnel engaged on the project will be provided with a copy of this plan. When you have read the Work Health and Safety Plan you are asked to sign a Statement of Compliance and Confidentiality. You will also be asked to complete and sign a Safe Work Method Statement (provided in Appendix 2) prior to works commencing.

2.0 OBJECTIVES

The objective of the plan is to protect the health and safety of workers on the project. This document will also serve to familiarise workers with good work practices, which should be followed during on- site activities. It also identifies those people who should follow the guidelines set out in the plan.

3.0 KEY PEOPLE AND THEIR RESPONSIBILITIES

The Project Manager has overall responsibility for Work Health and Safety on the Project. The responsibilities of the Project Manager include:

- Developing and reviewing health and safety site specific requirements;
- Identifying, assessing and controlling hazards;
- Ensuring the Site Coordinator is fully conversant with their responsibilities;
- Inspecting the site on a random basis, to ensure health and safety requirements are followed; and
- Reviewing all accident and non-conformance forms forwarded by the Site Coordinator.

The Site Coordinator is responsible for Work Health and Safety on the site itself. Personnel, visitors and sub-contractors must follow his/her directions and adhere to the requirements of the Work Health and Safety Plan. Specific responsibilities include:

- Advising personnel of the health and safety requirements and procedures;
- Implementing health and safety requirements and procedures;
- Maintaining health and safety and first aid equipment;
- Providing First Aid assistance whenever necessary;
- Inspecting the site to ensure all equipment is in order and that work procedures are followed;
- Completing all accident and non-conformance forms when required, forwarding such forms to the Project Manager;
- Informing the client of any hazardous and emergency conditions; and
- In the event of an emergency, informing other Authorities as required.

4.0 SITE DESCRIPTION

The address of the site and a site plan are provided in Appendix 1.

5.0 PROPOSED SITE ACTIVITIES

This health and safety plan describes precautionary measures to be carried out in relation to site work to be conducted by and on behalf of GSNE Services. It also presents procedures for responding to emergencies and other incidents.

Site work may comprise of any of the following:

- Use of a drill rig, concrete coring, excavators, backhoes, cranes, trucks, vehicles, hand augers, geoprobes and electronic equipment;
- Collection of soil samples for analysis;
- Removal of concrete slabs;
- Excavation of contaminated soil;
- Treatment of contaminated soil;
- Storage and disposal of treated soil;
- Collection of contaminated water;
- Backfilling of excavations with approved material;
- Paving or reinstatement of surfaces; and
- Erection of fences, site accommodation facilities and facilities for collecting or treating environmental contaminants (including plumbing or electrical connections thereto).

The specific site activities to be undertaken for this project are listed in Appendix 1 and can be referred to within the contractors Construction Management Program.

6.0 PROJECT HAZARDS

A number of hazards are likely to be present on this project. Some of these are common to many types of industrial work, some are specific to this project. Please observe the following safety guidelines.

6.1 Potential Hazards

The most common physical hazards are described in the table below. Personnel must be aware of hazards and exercise care in minimising the risks associated with these hazards.

POTENTIAL HAZARD & PRECAUTIONS

Pit Excavations

- **Barricade** excavations and open boreholes
- Works in excavations need to be performed in compliance with the WHSA *Code of Practice for Safety Precautions in Trenching Operations*. In particular, **do not enter** an unshored or unbattered trench which is greater than 1.5 m in depth.
- Excavated areas can be soft or slippery, especially the sloped ramps or batters of pits and trenches. **Test for surface stability and traction** before entering pits or trenches.
- **Use the length of the ramp** to enter pits or trenches. Do not step down into an excavation from the side of the pit or trench.
- **Chemical vapours** given off by contaminated soil or water can be flammable, intoxicating or suffocating. Heavier-than-air vapours can accumulate in depressions. Use respiratory equipment as necessary.
- Be mindful of the possibilities of **falling objects**.

Confined spaces (i.e. in basements of buildings, storage rooms, below platforms etc.)

- No confined space work is permitted on the site

Hot work

- **"Hot work"** is any work which can produce a source of ignition eg. sparks, hot surfaces or flames. Examples are cutting or grinding, welding or brazing, cutting with a flame (oxy torch), some electrical equipment, hammering, chiselling, chipping and use of internal combustion engines.
- The Site Co-ordinator will check whether the area is free of potentially harmful vapours and a **Hot Work Permit** must be issued by the Site Co-ordinator.

Trafficked Areas

- Place **warning signs** in visible locations where they provide sufficient notice to traffic of works ahead.
- Wear **safety vests** and other personal protective equipment.
- **Barricade** the workplace.

Mobile equipment

- Operators must use **care** when moving equipment especially when reversing and other people on-site should be aware of traffic.
- An assistant must **guide** a heavy vehicle when it is reversing unless it has a reversing buzzer and adequate clearance behind it.
- Flashing warning light should be used on the roof in areas where heavy vehicles frequent.

Underground services

- The Site Coordinator will be responsible for ensuring **sample locations are cleared with site employees** so as not to interfere with underground piping or services.
- A **search for underground services** may also be performed, by engaging a specialist contractor.
- Personnel should be aware of **bunting and markers** which may indicate services (such as electrical cables or sewers) buried in the ground.

Electricity

- **Check for overhead electricity wires** before raising any extended equipment (eg. drill rigs, augers). A minimum distance of 3 metres must be kept from overhead power lines of less than 330 kV, unless it is otherwise shown to be safe. A minimum of 8 metres clearance must be kept from overhead power lines of more than 330 kV.
- **Check for underground services** prior to drilling or excavating. Ensure mains electrical connections and switches are **kept dry**, and do not operate with wet hands.

Gas

- Gas lines should **not be disturbed**. Alert the Site Co-ordinator.

Compressed Air

- Ensure that the air supply valve is closed and the pressure is released before any air hose is disconnected. Never direct a stream of compressed air at yourself or another person.

Explosive Hazards

- The use of naked flames will only be allowed if a **Hot Work Permit** has been obtained. Smoking will not be allowed in the work area.

Manual Handling

- Do not attempt to lift **large or bulky items** without assistance. **Lifting assistance** may be in the form of a lifting or carrying device (eg. trolley) or with the aid of one or more co-workers.

Trips and Falls

- Ensure footwear is **appropriate** for the surface.
- **Do not run** on-site, and exercise caution when near trip hazards.
- Keep the workplace **tidy**, do not leave tools, equipment or materials where they could be a hazard.
- Use **handrails** on stairways.

Sunlight

- Wear shade hats, sunscreen and sunglasses as necessary.

Noise

- Works causing elevated noise will not occur outside of 7 am to 6 pm
- Monday to Friday, and 8 am to 4 pm on Saturday. **Use earplugs or earmuffs** as necessary, and when in designated hearing protection areas.

Heat Stress

- Each worker should **monitor colleagues** for signs of heat stress (loss of concentration, profuse sweating, dizziness, lethargy etc).
- **Consume sufficient fluids** to remain adequately hydrated and implement **rest** regimes.

Dust Generation

- Light watering of exposed soil in excavation areas and stockpiles wll be undertaken as needed to suppress the generation of dust.
- Each worker should be supplied with and wear an appropriate particulates rated respirator where necessary.

Odour Control

- To suppress any offensive odours encountered during the excavation and stockpiling of hydrocarbon impacted soil, a liquid odour suppressant (such as Biosolve) should be used as required.

Air

- Ambient air monitoring will be undertaken once a day during the remediation works using a photoionisation detector (PID) in three locations. One reading should be taken in the active work zone surrounding the excavation, one to the south of the excavation in the vicinity of the railway station building and one to the north of the excavation, towards the site boundary with neighbouring residential properties

- If the PID measures volatile vapours within ambient air concentrations exceeding 50 ppm, excavation works should cease and the source of the vapours should be investigated.
- Each worker should be supplied with and wear an appropriate combined particulates, organic vapours and acid gases rated respirator where necessary.

6.2 Site Specific Chemical Hazards

Chemical contaminants may be present on a site in:

- Soil;
- Groundwater;
- Waste;
- Dust;
- Surface water; and
- Air.

Specific **Work Health and Safety information** on the hazardous chemicals listed above is presented in Appendix 1. Where possible, the chemical data sheets provided are Material Safety Data Sheets (MSDSs) prepared by a manufacturer. However, this is not always possible, as chemical contaminants are rarely pure, manufactured products. As chemical contaminants are usually present in a mixture with soil, water or waste, they are likely to be present at lower concentrations than is assumed in the chemical data sheets or MSDSs. Compliance with the health and safety requirements of the chemical data sheets or MSDSs should therefore be a conservative approach.

Relevant **airborne concentrations** of the contaminants at which no adverse health effects occur or undue discomfort is caused (exposure standards) are listed in Appendix 1. These exposure standards have been prepared by the National Occupational Health and Safety Commission, Australia.

Relevant airborne concentrations of the contaminants at which no adverse health effects occur or undue discomfort is caused (exposure standards) are listed in Appendix 1. These exposure standards have been prepared by the National Occupational Health and Safety Commission, Australia.

Personnel should be aware of these potential risks to health and safety. Safety precautions are detailed in Section 7 and 8 of this Health and Safety Plan.

7.0 HEALTH AND SAFETY EQUIPMENT

The health and safety equipment on-site consists of the following:

- Personal protective equipment;
- First aid equipment; and
- Fire extinguishers suitable for ordinary combustibles, flammable liquids and electrical fires.

The Site Co-ordinator will be responsible for instruction of personnel in the use and maintenance of health and safety equipment.

7.1 Personal Protection

The personal protection regimes which apply on work sites follow the modified OSHA/NIOSH (USA) classifications, namely:

Level A Full chemical suit with self-contained breathing apparatus (SCBA) using tanks or airline.

Level B Use of SCBA with lesser protective suits.

Level C2 Use of full-face cartridge respirators.

Level C1 Use of half-face respirators.

Level D Use of minimal level of protection. This includes:

- Long sleeved shirt and trousers;
- Gloves (for protection against dermal (skin) contact);
- Eye protection;
- Safety boots; and
- Hard hats.

The general store of specific personal safety equipment will comprise:

- Disposable plastic gloves suitable for general use and nitrite gloves suitable for media with high concentrations of hydrocarbon;
- Steel cap boots (waterproof and chemically resistant);
- Tyvek or similar disposable overalls;
- Safety glasses and dust proof goggles;
- Hard hats / head gear;
- Ear plugs or ear muffs;
- Half-face piece respirators which combined particulate and chemical fitter cartridges suitable for organic vapours, pesticides, herbicides etc (Class AUSP1, (AS1716));
- Full face respirator with combined particulate and organic vapour filter cartridge (Class A2 P2);
- Supply of clean water and towels;
- Mobile telephone; and
- First aid kit

7.2 First Aid Equipment

The First Aid equipment available on-site will include:

- A fully supplied first aid kit;
- Eye washing equipment;
- Facilities for washing skin exposed to contaminants; and
- Emergency shower.

If a medical emergency occurs the Site Co-ordinator will administer first aid. The Site Coordinator will be responsible for organising conveyance of an injured person in order to seek medical assistance. Emergency contact numbers specific to the project are included in Appendix 3. General first aid procedures are presented on the following table

General Emergency First Aid Procedures

UNCONSCIOUS:
• Turn onto side and clear airway.
• Check for breathing (look, listen and feel).
• If breathing, leave on side and observe continuously.
• If not breathing:
  • roll onto back;
  • support jaw by lifting it up and forward;
  • give five breaths;
  • feel for pulse. If pulse present continue expired air resuscitation at the rate of 15 breaths per minute; and
  • If no pulse, perform cardio-pulmonary resuscitation if trained.
• Send for help.
• Control serious bleeding as soon as possible.

INGESTION: • Do not induce vomiting. • Wash with water or wipe away if substance is corrosive. • Give nothing by mouth. • Seek medical attention.
INHALATION: • If necessary, move casualty to fresh air, taking care not to become the next casualty. • Loosen clothing. • If casualty has difficulty breathing or shows signs of intoxication,
EYE CONTAMINATION: • Immediately rinse the eyes with the saline eyewash in the first aid kit. • Rinse for 15 minutes. • Be sure to lift the eyelids during rinsing. • Inform the Site Co-ordinator, and obtain assistance in seeking medical attention.
SKIN CONTAMINATION: • Immediately wash the affected area with water and detergent, rinse thoroughly and remove contaminated clothing. • If any symptoms or signs of poisoning are observed, seek medical attention.

BURNS: • Remove casualty from danger. • Hold burnt area under cold, gently running water for up to 10 minutes. • Remove jewellery and clothing, but leave any that is stuck. • Cover burn with a sterile, non stick dressing. • Seek medical attention. • Do not apply lotions, ointments, prick/ break blisters or give alcohol to drink.
BLEEDING: • Apply direct pressure to the wound. Use gloves if available. • As soon as possible, place a clean dressing over the wound and firmly bandage. • Loosen tight clothing and give nothing by mouth. • Seek medical attention if bleeding is severe or persistent.

7.3 Fire Extinguishers

Appropriate fire extinguishers for the expected fire hazards will be available on-site and kept in serviceable condition. A Class BE extinguisher, suitable for fire involving flammable liquids and electrical equipment is provided in serviceable condition.

7.4 Health and Safety Requirements

During the site work, site personnel are to comply with following requirements. This will ensure that exposure to the contaminants is minimised and the safety at the site is guaranteed.

- Eating or drinking is not permitted during excavating, drilling or sampling. Site personnel need to decontaminate before eating or drinking;
- Consumption of alcohol or non-prescribed drugs or any illegal substance is prohibited on-site;
- Smoking is not permitted;

- Avoid agitation or splashing of contaminated soil and water;
- Contact with potentially contaminated substances is to be avoided;
- No one may enter a tank or vessel unless specific prearranged precautions have been taken and approved by the Site Co-ordinator;
- No naked flames or heat sources that emit sparks are permitted;
- Areas are to be kept tidy and "good housekeeping" policies maintained;
- Equipment and materials are to be maintained in good and safe condition, and the work area is to be cleaned up upon completion of the program;
- Personnel collecting or handling environmental samples must wear protective overalls/ long trousers, safety boots and gloves;
- All site personnel must be equipped with and fit-tested for appropriate respirators, if required. Appropriate respiratory protection will be determined by air monitoring;
- Personnel should use their senses to alert them to potentially dangerous situations (eg. odours, noise, vibration); and
- Each employee has to work with at least one other member of the team.

All gloves and overalls used are to be consistent with the requirements listed in the chemical data sheets/MSDSs. Any additional, project specific health and safety instructions and equipment requirements for site workers are provided in Appendix 4.

7.5 Vehicles On-Site

The following requirements are to be followed for vehicles in use on the site:

- Vehicles are to be driven with extreme care and at a speed not greater than 5 km/h;
- Personnel driving vehicles must possess a current driving licence;
- Vehicles should be parked in positions that will not obstruct site work activities. Keys should be left in the ignition where appropriate; and
- A decontamination station will be installed at the property for the purpose of removing contaminated soil from vehicles leaving the site. Waste wash water will be temporarily stored on-site and periodically disposed of off-site by a liquid waste contractor, or by addition to soil to assist the treatment process.

7.6 Air Monitoring

If site conditions are not expected to present elevated levels of airborne contaminants once asbestos types of materials are removed, there will not be a monitoring program for air quality. However, the need for air monitoring will be reviewed throughout the duration of the project by the Site Co-ordinator and is proposed for the duration of the asbestos removal process. Appendix 1 shows if air monitoring is included in the health and safety program for this project.

If necessary, airborne concentrations will be monitored during site work activities and compared to national workplace exposure limits. Details of exposure limits are contained in Appendix 1.

Where hydrocarbon type contaminants may be encountered, air quality will be monitored by use of a PID. Appendix 1 indicates if a PID will be used for the project. In such cases, the health and safety precautions to be taken will depend on the readings obtained by the PID:

PID Reading	**Personal Protective Equipment to be Used**
PID readings less than the EXCEEDANCE VALUE listed in Appendix 1.	**Level D**
PID readings in excess of the EXCEEDANCE VALUE but below the UPPER LIMIT VALUE listed in Appendix 1.	**Level C1**
PID readings in excess of the UPPER LIMIT VALUE but below the MAXIMUM PERMITTED VALUE listed in Appendix 1.	**Level C2**
PID readings above the MAXIMUM PERMITTED VALUE listed in Appendix 1	**Work must cease or Independent Respiratory Device must be used**

7.7 Respirators

Note that the half face respirators are fitted with Class AUS P2 filters and the full-face respirator is fitted with Class 2 P2 filters. These are combined chemical and particulate filters suitable for **organic vapours** (to a maximum of 1 000 ppm) and **particulates** (including dust, mist and fumes). These are the common types of chemical hazards at contaminated sites. However, they are **not suitable** for many inorganic gases and vapours including:

- Halogens;
- Hydrogen sulphide;
- Carbon monoxide and dioxide;
- Sulphur dioxide;
- Hydrogen cyanide/hydrocyanic acids;
- Acid mists and vapours;
- Ammonia; and
- Mercury gases, vapours and particulates.

Also, independent respiratory devices (SCBA) must be used in the following situations:

- Toxic inorganic gases (eg. H2S, SO2, CO etc) are present at concentrations above their respective exposure standards; and
- Oxygen levels are less than 17% vol%.

7.7 Decontamination

The Site Co-ordinator will instruct personnel in the appropriate procedures for decontaminating personal protective equipment and work equipment. The decontamination procedures are to be followed prior to leaving the site or when entering the lunch room at the site. Personal decontamination procedures include:

- Washing all dirt off work boots;
- Removing contaminated clothing and disposing of it in bins provided;
- Washing of hands and other parts of the body having had contact with the contamination; and
- Personal protective equipment should either be cleaned or disposed of.

Disposable protective equipment must not be removed from the site. Personal protective wear must be cleaned or disposed of appropriately before completion of work. In addition equipment used on-site that may be potentially contaminated will not leave the site unless it has been thoroughly cleaned and inspected by the Site Co-ordinator prior to leaving the site.

8.0 ENVIRONMENTAL RISKS

Assessment or remediation of site contamination presents risks to the environment as well as to site personnel. The most common environmental risks are described in the table below. Personnel must be aware of these risks and exercise care in minimising their potential.

Environmental Risk	Precautions
Migration of Contamination and/or Contamination of Groundwater Resources	• Care should be taken to avoid drilling or excavating through a contaminated aquifer into an uncontaminated underlying aquifer therefore creating a conduit through which contamination may migrate. • During backfilling, test pit soil should be returned to the test pit at roughly the same depth from which it was excavated to avoid introducing contamination to an otherwise clean soil stratum. • Barriers on diversion channels maybe required to prevent contaminated surface run off from impacting on adjacent sites, water courses or stormwater drainage systems. • Sampling should never take place during periods of heavy rain. • Contaminated drill cuttings and flush water from borehole purging should be collected in lined drums or tanks for appropriate treatment or disposal. • Dust suppression measures should be taken to prevent windblown contamination from being spread to other parts of the site or to adjacent sites. • Decontamination of vehicles, clothing or plant and equipment should be carried our before leaving the site as per Section 7.7.
Degradation of Heritage Sites	• Care should be taken to ensure that work on the site will not have an adverse impact on any sites of cultural of natural heritage significance. Heritage places may include buildings, structures, archaeological remains or landscaped or natural areas of aesthetic, historic, scientific or social value.
Degradation of Natural Habitats	• Care should be taken to ensure that any remediation works activities will have limited impact to the surrounding flora and fauna. Special care should be taken where rare natural habitats or any endangered species may be at risk.

9.0 UNEXPECTED SITE CONDITIONS

If during the course of subsurface investigations, unexpected or perceived hazardous conditions are encountered:

- All works will be stopped;
- The Site Co-ordinator should be informed immediately;
- If it is considered necessary, backfilling of test holes/ pits/ excavated areas will occur;
- The Site Co-ordinator will undertake appropriate measures to determine how best to characterise the unexpected conditions and how to proceed with the project. If necessary a new or revised work procedure will be prepared; and
- All personnel will be notified of the changed procedures by the Site Co-ordinator, and the client will also be advised of the changes.

10.0 INCIDENT REPORTING AND EMERGENCY PROCEDURES

In the event of an incident or emergency, the following procedures should be followed:

10.1 Reporting of Incidents and Record Keeping

- An incident is any event in which people or the environment are injured or damaged, or a near- miss event where these could have occurred but did not.
- Any accident, injury, or near-miss events experienced by personnel whilst on the site are to be reported to the Site Co-ordinator immediately;
- In the case of an accident, the Site Co-ordinator will take appropriate first aid measures or will direct a responsible person to take such measures on his behalf;
- The Site Co-ordinator will be responsible for organising conveyance of an injured person to medical aid where necessary. A list of emergency contact telephone numbers is attached in Appendix 3;
- The Site Co-ordinator will record details of the incident on the form provided in Appendix 5 (PR321);
- All hazardous conditions and emergencies will be reported to the client by the Site Co-ordinator;
- The Site Co-ordinator will initiate an investigation into the cause of the incident. Adequate corrective action will be taken;
- The Site Co-ordinator will maintain records of daily activities and also keep records of any incidents on-site (Appendix 5); and
- If the incident is a Notifiable Incident, WorkCover is to be notified immediately, and provided with follow-up. Notifiable Incidents are listed below.

Types of Incidents to be Notified

Notification is required where an incident at a workplace or equipment site results in death or specified serious injury. That is, if an injured person requires:

- Medical treatment within 48 hours of being exposed to a substance;
- Immediate hospital treatment as an in-patient and/or
- Immediate medical treatment for:
  - Amputation;
  - Serious head injury;
  - Serious eye injury;
  - Separation of skin from underlying tissue (for example de-gloving or scalping);
  - Electric shock;
  - Spinal injury;
  - Loss of bodily function; and
  - Serious laceration.

Notification is also required of dangerous occurrences which seriously endanger the lives or the health and safety of people in the immediate vicinity. Such dangerous occurrences include:

- Collapse, overturning, failure or malfunction of, or damage to, certain items of major plant;
- Collapse or failure of an excavation or the shoring support of an excavation;
- Collapse or part of a building or structure;
- Implosion, explosion or fire;
- Escape, spillage or leakage of substances;
- The fall from a height of dangerous or heavy object(s).

Source: Work Health and Safety (Incident Notification) Regulations 2011. Work Health and Safety Act 2011.

At the conclusion of the project, the Project Manager will complete the Project Review Report (PR322), a copy of which is provided in **Appendix 5**. The completed form is to be filed in the job file held by GSNE Services.

10.2 Emergency Contact

The Site Co-ordinator should immediately be informed of any incidents and emergencies which may arise during site work. He/she will then initiate any emergency procedures. Should contacting the Site Co-ordinator be impossible or impractical, appropriate external assistance in management of the emergency should be sought (eg. call 000).

Contact telephone numbers and locations for emergency and medical services are given in the list of emergency contact numbers in Appendix 3. The site Coordinator will hold a copy of these details at the site.

10.3 Emergency Procedures

Fire:

- Personnel who have been instructed on extinguishing fires may attempt to put out a fire if it is small and you are not at risk. Otherwise, inform the Site Co-ordinator of the fire or other relevant personnel; and
- If the fire cannot be easily extinguished and/or the premises are unattended, use the 000 emergency procedures to call the fire brigade.

Note that only personnel trained in extinguishing fires are advised to do so.

Injuries:

- Provide first aid, if possible;
- Inform the Site Co-ordinator; and
- Use the **000 emergency procedure** if injuries are severe; otherwise evacuate the casualty to hospital. A listing of the nearest hospital and emergency co-ordinators is given in **Appendix 3**.

Evacuation:

If a major emergency occurs such as a fire, explosion, or toxic vapour release:

- Sound the vehicle horn to gain attention of on-site personnel requiring evacuation;
- Call the Site Co-ordinator;
- Evacuate the work area to a designated area, in an upwind location;
- Evaluate potential dangers to persons in a down wind direction. All personnel should evacuate to an upwind location;
- Shut off or remove any inflammable materials from danger (if it is safe to do so);
- Notify Emergency Services, phone 000;
- A head count will be performed by the site co-ordinator to make sure that everybody is accounted for. Search for any unaccounted persons; and
- Wait for the all clear from the Site Co-ordinator before returning to the work area.

11.0 STATEMENT OF COMPLIANCE AND CONFIDENTIALITY

When you have read and understood this document, please sign the *Statement of Compliance and Confidentiality* provided in Appendix 6. Please seek clarification on any matter you are unclear of from the Site Co-ordinator, before signing the form. If, during the period you are working on the site you require assistance or further information, please speak to the Site Co-ordinator.

APPENDIX 1

Appendix 1

Project Details

Client:	Prosper 5-9 Cowan Road St Ives Pty Limited
Purpose:	Remediation and Validation Program
Site Address:	5-9 Cowan Road, St Ives
Project Manager:	TBC
Contractor Representative:	TBC

Site work specific to small jobs can include:

- Sampling and analysis of the soil for classification for off-site disposal.
- Coordination of excavation of zinc impacted soil.
- Collection of validation samples from the floors and walls of the excavated areas.

Chemical hazards specific to this site are expected to exist in the form of contamination of:

- Soil
- Dust

Chemical species likely to be present include:

- Zinc

Chemicals toxic to humans and which are likely to be present include:

- Zinc

AIR MONITORING

Exposure standards for Petrol (TWA) is 193 (based upon an average molecular weight of petrol of 114. For this reason, GSNE Services takes the most significant carcinogen in fuel being benzene that has a TWA of 5ppm (1.6mg/m^3) and uses this for its PID monitoring screening level.

PID exceedance value is 9.2 (say 10ppm) based on the TWA for benzene and a conversion factor of 0.54 for a minirae 2000PID.

PID upper limit value of 100ppm (lesser of 1000ppm and 10 times the exceedence value)

PID maximum permitable value is 500ppm (lesser of 1000ppm and 50 times the exceedence value with a class AUS or class 1 filter cartridge)

PID maximum permitable value is 1000ppm (lesser of 5000ppm and 100 times the exceedence value with a class 2 filter cartridge)

PID maximum permitable value is 1000ppm (lesser of 10000ppm and 100 times the exceedence value with a class 3 filter cartridge)

Prior to use the PID is calibrated to read 102ppm laboratory grade isobutylene (refer to AS/NZS 1715:1994 for further guidance).

HEALTH ASPECTS AND EXPOSURE STANDARDS OF ASBESTOS

Inhalation of high concentrations of asbestos may result in asbestosis, a progressive scarring of lung tissue and lung cancer, or mesothelioma, a form of lung cancer. The destructive nature on lung tissues of asbestos fibres below 3 microns (3□m) in diameter has been well documented, especially that of blue and brown forms of asbestos. Common latency periods for associated diseases to develop are within 10 to 50 years, which emphasizes the need to minimize potential exposure pathways and maximizing control measures and monitoring procedures.

Any admissible exposure to airborne asbestos should be kept as low as achievable and in any case below the specified exposure standards. These standards are determined by the *National Commission for Occupational Exposures*. Below is a summary of the threshold limits for airborne concentrations measured as a time-weighted average (TWA) fibre concentration.

Exposure Standards – TWA Fibre Concentration Limits

Asbestos Species	Concentration (fibres/mL)
Chrysotile	0.1
Crocidolite	0.1
Amosite	0.1
Other forms	0.1
Other mixtures of species	0.1

APPENDIX 2

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

ORGANISATION NAME: GSNE Services Pty Ltd	**PHONE: 1300 137 038**
BUSINESS ADDRESS: Gipps Road, Smithfield NSW 2164	**PROJECT NAME: 5-9 Cowan Road, St Ives NSW**
ABN NUMBER: 71 387 576 812	**REVISION # & DATE: Rev 0, 29th January 2026**

This SWMS was prepared by: (inert name, signature, position and date below)

NAME	POSITION	SIGNATURE	DATE
Nick Kariotoglou	Project Manager and WHS Consultant	Nick Kariotoglou	29.01.2026

This SWMS was approved by: (inert name, signature, position and date of **senior management representative** of the organization below)

NAME	POSITION	SIGNATURE	DATE
Mark Kelly	National Environmental Manager	Mark Kelly	29.01.2026

The names and positions of personnel assigned the responsibility for supervising this work and their qualifications are as follows:

NAME	POSITION	QUALIFICATIONS	DATE
Nick Kariotoglou	Project Manager and WHS Consultant	BSc	29.01.2026

The names of workers or their nominated safety representatives who were consulted and involved in the development of this SWMS are as follows:	
Nick Kariotoglou	
Mark Kelly	

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

NSW and National Occupational Health & Safety Commission – Hierarchy of Control Definitions
Controlling the health and safety risks in a workplace is necessary to prevent injury and illness. First, identify and assess the risks, then decide on the best way to control them by applying the Hierarchy of Controls as follows: 1. **Elimination** - controlling the hazard at source 2. **Substitution** - replacing one substance or activity with a less hazardous one 3. **Isolation** – separating the hazard from the person 4. **Engineering** - installing guards on machinery 5. **Administration** - implementing policies and procedures for safe work practices 6. **Personal Protective Equipment** - use of goggles, respirators, and ear plugs etc. When deciding on the best way to control a risk, start at the top of the hierarchy of controls, i.e. investigate if the risk can be eliminated first, for example by changing the way the work is done, or by using safer substances or equipment. This is the most effective way to control a hazard. If these methods are not possible, use engineering, isolation or administrative controls to reduce or minimise the risk.

Risk Assessment Matrix

		Likelihood				
		Almost certain	Likely	Possible	Unlikely	Rare
Consequence	Extraordinary	1	2	4	7	11
	Major	3	5	8	12	16
	Moderate	6	9	13	17	20
	Minor	10	14	18	21	23
	Insignificant	15	19	22	24	25

Risk Class

High / 1-6	Those risks with a relatively high likelihood and large impact
Medium / 7-15	Risks with a medium likelihood or impact.
Low / 16-25	Those risks with a relatively low likelihood and impact.

Consequence	Description	Likelihood	Description
Extraordinary	Catastrophic impact on project. Major incident involving fatalities or permanent disability.	Almost Certain	The event/impact is common and expected to occur in most circumstances *(will occur regularly / 10 times for year)*
Major	Major negative impact on project. Serious injury or disease to staff or subcontractors or the general public.	Likely	The event/impact has happened before and will probably occur again *(will occur often / 5-10 times per year)*
Moderate	Significant negative impact on project. Medical treatment required loss of production capability.	Possible	This event/impact could occur at some time *(is likely to occur few / 2-3 times per year)*
Minor	Minor negative impact on project. First aid treatment required.	Unlikely	This event/impact is not likely to occur *(is unlikely to occur more than once per year)*
Insignificant	Insignificant negative impact on project. No injuries.	Rare	This event/impact may occur in exceptional circumstances only *(is unlikely to occur during a year)*

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

ACTIVITY	POSSIBLE HAZARDS	RISK RATING	POSSIBLE CAUSES	POSSIBLE RISKS	POTENTIAL OUTCOMES	CONTROL MEASURES	CHECKED BY
Establishment Disestablishment Moving About Site	On-Site traffic accidents On-Site accidents Impact by site machinery Noise	2-4 2-4 2-4 2-4	Lack of concentration Lack of communication Lack of traffic control measures	Injury to person(s) Damage to machinery Damage to utilities	Death/serious/minor injury Costly repairs/delays	Coordinating activities with drillers, spotter and other personnel on site Clear direction to personnel of site duties All drilling staff complete necessary site inductions PPE Erect Signage and Barricades around work area	Drillers Spotter Contractor Inductor
Drilling activities	Services contact Being struck by tools, equipment, objects Being caught in core drill Slipping on wet ground Mishandling equipment, tools Exposure to contaminated materials	2-4 2-4 4-7 4-7 4-7 4-7	Lack of concentration Lack of observation Lack of communication Poorly coordinated works Insufficient information provided on services drawings Set up too close to services Being too close to works Unclean work area Incorrect use of tools Lack of traffic control measures	Injury to person(s) Damage to machinery Damage to utilities	Death/serious/minor injury Costly repairs/delays	Service location/identification prior to Excavation by 'Dial Before You Dig' services and by services search sub-contractor. Coordinating activities with drillers, spotter and other personnel on site Maintaining equipment; checking for potential damage to equipment Correct use of tools and equipment Maintain safe distance from machinery and vehicular pathways Maintain safe distance (3metres) for overhead electrical wiring Wearing appropriate safety gear	Drillers Spotter Engineer Services search Sub-contractors. Client Representative
Logging of Drilling activities	Being struck by tools, equipment, objects Being caught in drill rods Slipping on wet ground Being struck by objects	4-7 4-7 4-7 4-7	Lack of concentration Lack of observation Lack of communication Poorly coordinated works Being too close to works Unclean work area Incorrect use of tools	Injury to person(s)	Death/serious/minor injury	Coordinating site activities Maintain safe distance from machinery and vehicular pathways Wearing appropriate safety gear	Engineer
DCP Equipment	Contact with underground services Equipment breakdown Equipment malfunction Improper use of equipment	9-13 9-13 9-13 9-13	Lack of concentration Lack of observation Lack of communication Poor training with equipment Poorly coordinated works Insufficient information Insufficient use of PPE Unserviced & old equipment	Injury to person(s) Damage to machinery Damage to utilities	Time delays to project Minor Injury , First Aid needed	Regular servicing of the equipment Update materials/equipment when required Correct procedures must be followed as per the Aargus Fieldwork Protocols. Services Search DBYD Pot Holing	Geotechnician Engineer

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

ACTIVITY	POSSIBLE HAZARDS	RISK RATING	POSSIBLE CAUSES	POSSIBLE RISKS	POTENTIAL OUTCOMES	CONTROL MEASURES	CHECKED BY
Hand drilled boreholes Hand Auger	Contact with underground services UV Exposure/dehydration Equipment breakdown Equipment malfunction Improper use of equipment	14-18 14-18 14-18 14-18 14-18	Lack of concentration Lack of observation Lack of communication Poor training with equipment Poorly coordinated works Insufficient information Insufficient use of PPE Unserviced & old equipment	Injury to person(s) Damage to machinery Damage to utilities	Minor injury, Costly repairs, delays	Dial before you dig plans & service locator Correct use of tools and equipment Wearing appropriate PPE (gloves, hard hat, long sleeves, safety boots, high-visible vest). Regular servicing of the equipment Correct procedures must be followed	Supervisor Contractor Drillers Sub-contractors
Sample Collection	Lifting injuries Contaminated materials Being struck by tools, equipment, objects Slipping on wet ground Being struck by objects Odours and damage to olfactory system Exposure to contaminated materials	14-18 14-18 9-13 4-7 4-7 14-18 14-18	Manual handling Contact with contaminated soils Lack of concentration Lack of observation Lack of communication Lack of correct PPE Poorly coordinated works Being too close to works Unclean work area Incorrect use of tools	Injury to person(s) Disease	Serious/minor injury Time loss due to sick leave	Restricting lifting loads Maintain safe distance from machinery and vehicular pathways Wearing appropriate safety gear (gloves, hard hat, long sleeves, safety boots, hi-visible vest). Applying appropriate odour spraying methodology for the entire length of works Placing contaminated material on a plastic membrane in a designated area	Engineer Scientist
Asbestos impacted materials and soils	Uncontrolled release of Asbestos fibres	3-8	Lack of concentration Lack of observation Lack of correct PPE Lack of dampening control measures Manual handling Contact with contaminated soils	Injury to person(s) Disease	Serious/minor injury Time loss due to sick leave	Restricting lifting loads Maintain safe distance from machinery and vehicular pathways Wearing appropriate safety gear Applying appropriate water spraying methodology for the entire length of works Placing contaminated material on a plastic membrane or bags in a designated area Maintain safe distance from drilling equipment	Supervisor Scientist Client Representative
Site Clean Up	Lifting injuries Being struck by tools, equipment, objects Services contact Slipping on wet ground Odours and damage to olfactory system Exposure to contaminated materials	4-7 4-7 2-4 4-7 14-18 14-18	Manual handling Poorly stored equipment Lack of observation Poorly coordinated works Set up too close to services	Injury to person(s) Damage to utilities	Death/serious/minor injury Costly repairs/delays	Coordinating site activities Restricting lifting loads Materials to be correctly stored/used Maintain safe distance from machinery and vehicular pathways Applying appropriate odour spraying methodology for the entire length of works Placing contaminated material on a plastic membrane in a designated area	Engineer Drillers Spotter

General	Tripping Dust/flying objects Noise	4-7 4-7 2-4	Lines, hoses and tools on ground Drilling activities Machinery motors	Smaller injuries/discomfort Partial/complete blindness Eye irritations Ear irritation/damage	Serious/minor injury Time loss due to sick leave	Wearing appropriate safety gear, including boots, hard hats, eye protection, ear plugs etc Training of site personnel Completion of Workcover induction course	Engineer Drillers Spotter
Equipment	Equipment breakdown Equipment malfunction Explosions	8-18 14-18 4-7	Unserviced, old equipment Ignition of Fuel	Small injuries/ discomfort Burns	Serious to minor injury Time loss due to sick leave Time delays to project	Regular servicing of the equipment Update materials/equipment when required No smoking on site	Fleet Manager Engineer Drillers Spotter
Transport of Materials	Impact with truck Odours and damage to olfactory system Exposure to contaminated materials	2-4 14-18 14-18	Lack of traffic control measures Contact with contaminated soils Lack of concentration Lack of observation Lack of communication Lack of correct PPE	Injury to person(s) Disease	Serious/minor injury Time loss due to sick leave	Coordinating site activities Maintain safe distance from machinery and vehicular pathways Wearing appropriate safety gear Clear direction to personnel of site duties All drilling staff complete necessary site inductions Applying appropriate odour spraying methodology for the entire length of works	

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

PERSONNEL COMPETENCY AND TRAINING:	
Nick Kariotoglou	OH&S training,
	General Induction (White Card) Training

LIST OF PPE:	
Hard hat (dated) with slots for ear muffs & face shield	Required
Lace up steel capped ankle fit safety boots	Required
Long trousers - company issue	Required
High visibility Orange, long sleeved shirt or vest closed at front	Required
AS1270 Hearing Protection	Required
AS1337 Safety Glasses	Required
AS4150 Gloves - rated 3 minimum for cut resistance	Required
Rubber or PVC gloves	Not Required
Dust Masks	Required
Face shield for Hard Hat	Not Required
AS1891.1 Safety Harness	Not Required
Disposable Coveralls	Not Required
Night Reflective Coveralls	Not Required
Type B First Aid Kit	Required
AS1841 Type A Dry Powder Fire Extinguisher: 6 month tagged	Not Required

PLANT AND EQUIPMENT:	
GENERIC – Sampling Containers, Esky, Ice Bricks, Trowel	

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

HAZARDOUS SUBSTANCES AND DANGEROUS GOODS USED:	
N/A	

EMERGENCY PROCEDURES OR RESCUE PLANS RELEVANT TO THE ACTIVITY:	
Emergency Department - Tel: 000, Mobile 121	Evacuation Area: 5 Cowan Road, St Ives
Nearest Hospital: Sydney Adventist Hospital - Clifford Tower, Level 3/185 Fox Valley Rd, Wahroonga NSW 2076; Tel: 02 9487 9111	
WHS Consultant – Nick Kariotoglou – Tel: 1300 137 038	
Poisons Information Centre (National) - Tel: 02 9998 0333	

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

HEALTH AND SAFETY LEGISLATION:
Work Health and Safety Act 2011 and Work Health and Safety Regulation 2017
APPLICABLE AUSTRALIAN STANDARDS:
AS2210 Safety Boots
AS1801 Hard Hat
AS2162 Gloves
AS1270 Hearing Protection
AS4150 Safety Glasses
AS/NZS 1715:1994 Respiratory Protection
prEN ISO13982-1 Disposable Tyvec Suits rated Type 5
APPLICABLE INDUSTRY CODES OF PRACTICE:
NSW SafeWork Codes of Practice: How to Manage Work Health and Safety Risks, Construction Works, Hazardous Materials Tasks,
Managing Noise and Preventing Hearing Loss at Work
MANUFACTURERS / SUPPLIERS SPECIFICATIONS:
N/A

SAFE WORK METHOD STATEMENT OF ENVIRONMENTALSITE INVESTIGATION

NAME AND SIGNATURE OF PERSON(S) CARRYING OUT THE TRAINING:	
NAME	**SIGNATURE**
Mark Kelly	

SWMS INDUCTION STATEMENT - The following persons have been inducted into the work activities described in this SWMS.		
• I have read and understood the content of this SWMS.		
• I will work in accordance with this SWMS.		
• If deemed necessary to amend this SWMS I will consult with my immediate supervisor and assist where required in reviewing this SWMS.		
PRINT NAME	**SIGNATURE**	**DATE**
Nick Kariotoglou		29.01.2026
Mark Kelly		29.01.2026

APPENDIX 3

Appendix 3

EMERGENCY CONTACT NUMBERS

Ambulance Fire Brigade	000
Police	000
Poisons Information Centre	13 11 26
Sydney Adventist Hospital	(02) 9487 9111
Sydney Water Corporation (repairs)	13 20 90

GSNE Services Pty Ltd

Project Director	Mark Kelly 0425 344 389
Project Manager	TBC
Field Environmental Scientist	TBC
Environmental Representative Head Office	1300 137 038

Contractor	TBC
Project Manager	TBC
Foreman	TBC

APPENDIX 4

Appendix 4

PROJECT SPECIFIC HEALTH AND SAFETY INSTRUCTIONS

Project Health & Safety Instructions are:

1. A Health and Safety induction must be attended prior to commencing work on the site.
2. Follow the work instructions exactly as specified in the Work Health and Safety Plan.
3. An Asbestos Removal Control Plan must be prepared to excavate, transport and dispose of the underlying asbestos impacted soils.
4. Do not start work until the site coordinator has stated that all the necessary work permits have been obtained.
5. Appropriate Personal Protective Equipment must be worn whenever physically handling asbestos containing materials and asbestos impacted soils.
6. Control Asbestos Air Monitoring maybe recommended around site boundaries during excavation of asbestos impacted soils.
7. A particulates and organic vapours rated respirator must be worn at all times whilst working in the vicinity of odorous hydrocarbon impacts soil or in areas where dust is generated.
8. Only intrinsically safe electrical equipment approved by the site manager can be used on site.

APPENDIX 5

Environment Health and Safety Incident Report

(To be completed by Project Manager)

Job No. .....
Project: .....
Client: .....
Site Address: .....
.....
Project Manager: .....
Site Co-ordinator: .....

Date of Incident: .....
Time of Incident: .....
Type of Incident or Near Incident .....

Description of Incident:.....
.....
.....
Persons Involved:.....
.....
Type of Involvement:.....
.....
Witnesses (not involved in incident):.....
.....
Immediate Actions Taken: .....
.....
.....
Cause of Incident: .....
.....
If near-miss, what might have happened: .....
.....
.....
Corrective Action Implemented/Proposed: .....
.....
.....

Is this a notifiable incident (see List of Notifiable Incidents in Section 9.1 of the Health and Safety Plan)

If Yes: Call WorkCover immediately on 132 360 Date: .....
Send written notification within 48 hours Date: .....
Signature: ....
Aargus Pty Ltd Project Manager

Filing Instructions

1. Original in Job File.
2. Copy to Techfile 7.3.2.1 Health and Safety Incidents

EHS Project Review Report

(To be completed by Project Manager)

Job No. .....

Project: .....

Client: .....

Site Address: .....

.....

Project Manager: .....

Site Co-ordinator: .....

Date(s) of Site Work: .....

Did any Notifiable Incidents occur during site work:

☐ Yes See Incident Report No. .....

☐ No

Signature: ....

Aargus Pty Ltd Project Manager

Filing Instructions

1. Original in Job File.
2. Copy to Techfile 7.3.2.1 Health and Safety Incidents

APPENDIX 6

Appendix 6

STATEMENT OF COMPLIANCE AND CONFIDENTIALITY

GSNE SERVICES - HEALTH AND SAFETY PLAN

- I have read and understood the attached Work Health and Safety Plan;
- I have been informed of the potential hazards associated with work on the site;
- I have been instructed in the use of all safety equipment on the site:
- I agree to comply with the safety procedures detailed in the attached Health and Safety Plan;
- I agree to keep confidential all information supplied to me or information of which I become aware of in the course of carrying out any work on the site.

Name:_____ Name:_____

Company:_____ Company:_____

Signature:_____ Signature:_____

Date:_____ Date:_____

Name:_____ Name:_____

Company:_____ Company:_____

Signature:_____ Signature:_____

Date:_____ Date:_____

APPENDIX D

ENVIRONMENTAL WORKSHEETS

Site Assessment
Daily Worksheet Record

PROJECT NAME:	**PROJECT NO:**
CLIENT:	**DATE:**
SITE ADDRESS:	
SITE CONTACT:	**PHONE:**
AARGUS REPRESENTATIVE:	
TITLE:	**PHONE:**
FIELD NOTES:	

Start Time	Finish Time .....
Weather	Rainfall (mm) .....
Wind Direction	Wind Speed .....
Humidity	
Odours Present	Staining Present .....

Environmental and Safety Concerns

.....

.....

.....

Actions

.....

Site Safety Induction	Stormwater Control .....
Dust Suppression	Traffic Control .....
Machinery onsite	Equipment onsite .....
.....	.....

Description of Site Activities

SKETCH OF SITE PLAN

(include north, street boundaries & surrounding land uses)

SOIL PROFILE

LEGEND / NOTES

Soil Sampling

SOIL ASSESSMENT AND SAMPLING			
Sample No. (show on site plan)	**Depth** (m)	**Material Description** Fill / Natural	**PID** (ppm)

PID Measurements

PID Monitor Description……………………………...………………………………

Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID level
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)
Location	PID (ppm)	Location	PID (ppm)	Location	PID (ppm)

Groundwater Field Measurements

GROUNDWATER	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
INITIAL										
Well Depth (m)										
Time										
SWL (m)										
PID (ppm)										
Round 1 - Measurements										
degrees ^{o}C										
mmHg										
DO										
CO2										
pH										
Ec										
ORP										
Round 2 - Measurements										
degrees ^{o}C										
mmHg										
DO										
CO2										
pH										
Ec										
ORP										

Round 3 - Measurements										
degrees °C										
mmHg										
DO										
CO2										
pH										
Ec										
ORP										
Round 4 - Measurements										
degrees °C										
mmHg										
DO										
CO2										
pH										
Ec										
ORP										
Samples Collected										
Duplicates										
Splits										
Rinsate										
END										
Time										
SWL (m)										

APPENDIX E

SAMPLING QUALITY AND FIELDWORK ASSURANCE PLAN

GSNE SERVICES PTY LTD

SOLUTIONS THAT LAST

ENGINEERING ● RESEARCH ● ENVIRONMENTAL ● HAZMAT ● CONSTRUCTION MATERIAL LABS ● EXCAVATION ● DRILLING ● ASBESTOS LABS ● DEMOLITION ● REHABILITATION ● CIVIL WORKS ● RECYCLING ● ENERGY ● MINING

Sampling Quality & Fieldwork Assurance Protocols

NOTE: Whilst these protocols are based upon standard industry best practice, since preparing this document, the new recently released NEPM 2013 Guidelines may provide more updated methodologies used in sampling, quality and fieldwork procedures. This document therefore is in the process of being updated.

January 2025

GSNE Services Pty Ltd: ABN 71 387 576 812

Toll Free: 1300 137 038

Email: admin@aargus.net

Offices: Gipps Road Smithfield NSW 2164 – 93 Eastwood Road Leppington NSW 2179 – 12/1 Bounty Close Tuggerah NSW 2259

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OBJECTIVE AND SCOPE

The objective of GSNE Services Pty Ltd (GSNE Services) Protocols is to ensure that the methodology followed during fieldworks is adequate to provide data which is usable, and representative of the conditions actually encountered at the site.

The scope of these protocols is to:

- Outline the methods and procedures for the field investigations during an engineering, laboratory or environmental assessment or remediation and validation program; and

- Specify methods and procedures which ensure that soil and groundwater samples recovered are representative of the actual subsurface or surface conditions at the site, as well as ensuring that the risk of introducing external contamination to samples and to the environment is minimised.

These protocols must be adhered to by GSNE Services personnel and by sub-contractors involved in field investigations under GSNE Services Management. Any deviations from these protocols should be explained within the GSNE Services Report to which they are attached.

1 SOIL SAMPLING

1.1 Collection methods

Possible collection methods

Soil samples are generally collected by drilling or excavating the subsurface, using one of the following drilling / excavating technique:

- Rotary air hammer
- Hand auger, trowel or manual handling (shovel)
- Solid or hollow auger
- Backhoe or Excavator

Rotary Air Hammer

The air hammer technique requires the use of synthetic blend lubricants to prevent potential contamination of the borehole if a leak were to occur. In addition, micro-filters are installed into the drilling airline to avoid contamination by hydrocarbons present in the compressed air.

Samples of rock are generally not collected. Where rock samples are needed, specialised techniques are used.

Hand auger, trowel or manual

A hand auger or trowel is generally used to investigate subsurface conditions of unconsolidated materials at shallow depths or in areas difficult to access with other equipment. Samples are recovered from the hand auger, taking care to avoid cross contamination, especially between samples from the same hole but at different depths.

Sampling equipment is to be thoroughly cleaned between sampling events, in accordance with the procedures outlined in Section 1.5 Equipment decontamination. In the case of laboratory sampling, a pick and shovel can be used to gather adequate sample size as cross contamination is not considered an issue.

Solid or Hollow auger

Solid and hollow auger drilling techniques are well suited to unconsolidated materials. The main advantage of the hollow auger technique is that the drill rods allow access of sampling equipment at specified depths within the annulus of the drill rods.

Samples of soil are recovered using a split spoon sampler at specific depth intervals. The split spoon sampler is driven into the soil by the drill rig whilst attached to the end of the drill rods. The retrieved sample is then split lengthways into two halves when duplicate samples are required. A few centimetres of soil from the top of the split spoon sampler is discarded. Samples for volatile analysis are collected first, without mixing.

Test pits and trenches excavated with a backhoe or an excavator

Test Pit and Trenches excavated with a backhoe/excavator are used to collect relatively shallow (i.e. less than 3.5m depth) soil samples on occasions where:

- Access multiple sample locations at a site are needed;
- A description of the subsurface soil profile to approximately 3.5 m depth is required (generally in unsaturated conditions);
- The investigated site is free from known underground services and access problems;

- The investigated site is free from impenetrable surface or near surface layers including concrete and asphalt pavements; and
- Undisturbed soil samples are required, usually at multiple depths.

Backfilling

On completion of drilling / test pitting, the investigated locations are backfilled with cuttings and compacted. Excess drill cuttings are disposed of appropriately. If the sampling location is located in an area used for the circulation of people or vehicles, the top of the sampling location should be sealed with mortar.

1.2 Soil logging

The lithological logging of soil samples and subsurface conditions is undertaken by GSNE Services personnel. The soil characteristics are logged in accordance with the Australian Standard *AS1726-1993 Geotechnical Site Investigations.* This includes description of grain size, visible staining, odour and colour, and of the clues which may suggest that the soil may be contaminated. Descriptions of soils are made using the Northcote method.

1.3 Collecting soil samples

The soil sample is collected using a stainless steel trowel, split tube sampler, or directly with the hand if the sampler wears disposable gloves. Soils are quickly transferred into 250g clean amber glass jars, which have been acid washed and solvent rinsed. The jars are sealed with a screw-on teflon lined plastic lid, labelled, and placed for storage in

an ice filled chest. Alternatively for engineering and laboratory sampling, 20kg plastic bulk bags are used and appropriately labelled.

1.4 Labelling of soil samples

Samples are labelled with the following information:

- Job number;
- Date of sample collection;
- Name of the GSNE Services professional who collected the sample; and
- Sample number: the letters used to label the samples are BH, C, SS, SP, TP and V which refer respectively to borehole samples, composite samples, surface samples, stockpile samples, test pit samples and validation samples. For borehole samples, BH3.1.0 is the sample taken from borehole 3 at 1.0m below ground level. For stockpile samples, SP1/1 is the first sample from stockpile 1. TP1.2.5 is the sample taken from testpit 1 at a depth of 2.5 metres below ground level. V3/F is the validation sample taken from location V3, the letters F N, S, E and W refer to the floor, north, south, east and west walls of an excavation; if some contamination is found in the validation sample, then chasing out of the contamination is required and in this case, the label of the sample is changed by adding /1 or /2 according to the number of times the contamination has been chased out. B stands for blind and could be B1, B2 etc. dependant on how many blind samples were taken.

1.5 Equipment decontamination

The drilling and sampling equipment are cleaned using an appropriate surfactant (e.g. phosphate-free detergent or Decon 90), then rinsed with tap water prior to final rinsing with distilled water.

The following procedures shall be followed for decontamination of drilling and sampling equipment where required:

- buckets or tubs used for decontamination shall be cleaned with tap water and detergent and rinsed with tap water before sampling commences;
- fill first bucket or tub with tap water, and phosphate free detergent;
- fill second bucket or tub with tap water;
- clean equipment thoroughly in detergent water, using a stiff brush; rinse equipment in tap water;
- dry equipment with disposable towels;
- rinse equipment by thoroughly spraying with tap water, then final rinse with distilled water;
- allow equipment to dry; and
- change water and detergent solution between sampling event where required or when water is dirty.

Sampling decontaminated equipment should be kept in a clean area to prevent cross-contamination. Equipment that cannot be thoroughly decontaminated using the detergent wash and water rinse should be cleaned with steam or high pressure water or if a cleaner is not available, not used for further sampling (and labelled clearly "not

decontaminated") or discarded. Equipment decontaminated using the high pressure steam cleaner will be treated as described above. Any equipment that cannot be thoroughly decontaminated shall be discarded and replaced.

A new pair of latex gloves is used to handle each sample. Contaminated materials such as disposable clothing should be disposed of in accordance with environmental best practice.

1.6 Surveying of sampling locations

Sampling locations are generally located by measured reference to existing ground and site features, e.g. fences, buildings.

If the survey for location and elevation is required, it should be done by a licensed surveyor, or alternatively by an GSNE Services environmental engineer / scientist using proprietary laser dumpies and theodolites required can be obtained by the use of GSNE Services field equipment. GSNE Services also has GPS equipment and level meters.

If the location is given by a licensed surveyor, it is generally given to the nearest 0.1m and referenced to the Australian Map Grid (AMG) coordinates.

2 GROUNDWATER SAMPLING

2.1 Groundwater Sampling Objectives

The primary objective of any groundwater (quality) sampling is to produce groundwater samples that are representative of groundwater in the aquifer and will remain representative until analytical determination or measurements are made.

2.2 Groundwater well construction

Typically wells are installed to gain access to the groundwater to be sampled. Well construction details will depend on hydrogeological setting of the site, for example the depth to groundwater strata present. Relevant information regarding the hydrogeological setting will have been obtained prior the development of any groundwater sampling program.

The preferred drilling methods will depend on the hydrogeological setting of the site and the objectives of the groundwater sampling program. For example, shallow wells in unconsolidated materials, such as sand, may be drilled using a hand auger. Drill rigs using solid of hollow flight augers may be used to drill deeper wells or through semi consolidated materials, such as stiff clay. Rotary air hammer drilling may be used were well is to be drilled through consolidated materials, such as rock. Soil samples may also be collected during drilling (see Section 1 SOIL SAMPLING).

Drilling methods and materials must not have an unacceptable impact on the groundwater to be sampled. For example, if groundwater from the wells is to be tested for organic analytes, petroleum-based lubricants are not to be used and oil traps must be

installed on compressed air lines. Drilling techniques should also minimise compaction or smearing of the boreholes wells and transport of material into different zones, in particular, when drilling through potentially contaminated material to access groundwater.

Drill cuttings accumulated over a hole are to be removed as drilling progresses so as to prevent fallback of cuttings into the hole. Samples may be collected at a range of depths in the borehole profile during drilling.

The depth of groundwater well depends of the purpose of the investigation on the soil profile and the regional geology of the area. If the borehole location is covered by concrete, coring of the superficial hard layer is undertaken first.

Petroleum based lubricants are not used on drilling and sampling equipment, instead, Teflon based greases are used where appropriate. An GSNE Services professional monitors and records drilling activities, procedures adopted, materials used, progress of the stages of well construction, screen location, standpipe lens, placement, of sand filters and well seals, and general completion details, as well as the lithology of the subsurface, visible staining, unusual odours and colours (if any).

The use of a rotary air hammer rig has many advantages for consolidated material (e.g. rock), including:

- Large diameter to allow precise placement of groundwater monitoring equipment;

- No injection of drilling fluids into the formation with resulting benefits in ensuring integrity of recovered samples, and therefore no need to dispose off-site drilling fluids;
- Rapid penetration in consolidated material; and
- Provision of reliable indications of saturated conditions whilst drilling.

Drill cuttings accumulated over a hole are removed as drilling progresses so as to prevent fallback of cuttings into the hole. Samples are taken at a range of depths in the borehole profile.

Construction of the monitoring well may be carried out by the GSNE Services professional or the drilling contractor under the direct supervision of the GSNE Services environmental scientist/engineer. Typically on completion of drilling, slotted heavy duty PVC pipe (generally 50mm in diameter for the installation of monitoring well) is inserted into the drilled hole. The base of the pipe is capped prior to insertion in order to prevent natural soils entering the well from below. The drilled area surrounding the pipe screen is filled with coarse-grained sand. Bentonite or cement grout seal plugs may be placed above the screen depending on the hydrogeological setting of the site and sand cement mix. Excess drill cuttings are disposed of in accordance with environmental best practice.

The GSNE Services professional will monitor and record drilling activities, and materials encountered during drilling (including visible staining, unusual odours and colours (if any)). They will log the procedures adopted, materials used, and well

construction (i.e. location of the screen, placement of sand packs and well seals and general completion details).

2.3 Development of monitoring wells

Development is the process of removing fine sand silt and clay from the aquifer around the well screen in order to maximise the hydraulic connection between the bore and the formation.

Development involves removal of fluids that may have been introduced during drilling operations as well as fines from the sand filter and screens. Well development generally involves actively agitating the water column in the well then pumping water out until, ideally, water pumped comes out visibly clean and of constant quality. Development can be undertaken immediately after installation of the groundwater well or after sufficient time has been allowed for bentonite / grout seals to consolidate.
Bores used for groundwater quality monitoring should be developed after drilling, then left for a period until bore chemistry can be demonstrated to have stabilised, anywhere between 24 hours and 7 days.

2.4 Purging of monitoring well

In most groundwater monitoring wells, there is a column of stagnant water above the screen that remains standing in the bore between sampling rounds. Stagnant water is generally not representative of formation water because it is in contact with bore construction materials for extended periods, is in direct contact with the atmosphere and is subject to different chemical equilibrium.

Purging is the process of removing this water from the well prior to sampling. In newly installed wells, the disturbance cause by drilling may also affect water present in the well, and purging may be carried out concurrently with well development. Ideally wells should be purged at the lowest rate practicable until stable water chemistry is achieved.

Purging is to be performed less than 24 hours before sample collection, but usually it is performed just before sampling. The default procedure for purging a groundwater monitoring well is as follows:

- If required, measure the concentration of volatile organic vapours in the well standpipe headspace.
- Measure the depth to the standing water level in the well standpipe and the total depth of the well relative to a reference mark (generally the top of the groundwater pipe). The depth of any light non-aqueous phase liquids (LNAPL) floating on the standing water should be recorded if present using an interface probe or other suitable device.
- Calculate the volume of the groundwater in the well standpipe. The internal diameter of the well casing and the diameter of the drill hole are used to calculate the volume of water to be removed during development (nominally a minimum of three well volumes, including water present in the sand pack, should be abstracted during purging).
- Samples of water are collected generally following development/purging of each well volume. The samples are measured immediately in the field for water quality parameters, pH, electrical conductivity, redox potential and temperature. Water quality measurement probes are to be calibrated against stock standards on regular basis and decontaminated between wells.

- Pump/bail groundwater from the well until the water quality parameters have stabilised (i.e. within 10% of the previous reading) or the well is pumped/bailed dry. Collect all purged water into an appropriate volume measurement vessel. Purged water is disposed of appropriately.
- Record all appropriate development details on the well development and sampling sheet.
- Decontaminate all equipment used in the purging procedure.

2.5 Groundwater sampling

For each sampling event, starting water levels, purging times and volumes, water quality parameters and sample details are recorded on well development and sampling sheets.

At each groundwater monitoring well, a polyethylene sheet or Eski lid is placed beside the well head and firmly fixed into position. Sampling equipment is placed onto the sheet to avoid cross contamination between the ground surface and the groundwater in the well.

Groundwater samples are collected in a bailer (Stainless Steel or disposable polymer) fitted with an emptying device. The bailer is decontaminated prior to use. All groundwater samples are retrieved at an appropriate rate in order for turbulence (which leads to cloudy samples) to be minimised.

When collecting a water sample the bailer is lowered gently into the well, until it is within the screened interval. The bailer is then steadily withdrawn, to minimise agitation of water in the well and disturbance of the surrounding sand filter material.

The procedure for using the bailer is:

- Slowly lower the bailer into the water and allow it to sink and fill with a minimum of disturbance;
- Empty the first bailer sample into a container in order to measure the volume of bailed water and to rinse the bailer with well water;
- Emptying the bailer through the bottom-emptying device (BED) collects the samples. The sample is discharged down the side of the sample bottle to minimise entry turbulence;
- Collect samples for volatile organics first, followed by semi-volatiles, other organics and then inorganics;
- The flow from the BED is adjusted so that a relatively low flow rate is maintained.

2.6 Low flow purging

Purging large volumes of water can be impractical, hazardous or may adversely affect the contaminant distribution in the sub-surface (e.g. through dilution). Low-flow purging involves minimal disturbance of the water column and aquifer and is preferable to the removal of a number of bore volumes. This method removes only small volumes of water, typically at rates of 0.1 to 1.0L/min, at a discrete depth within the bore.

Low-flow purging consists essentially of the following steps:

- The pump inlet is carefully and slowly placed in the middle or slightly above the middle of the screened interval at the point where the contaminant concentration is required (dedicated pumps, such as bladder pumps, are ideal for low-flow

sampling). Placement of the pump inlet too close to the bottom of the bore can cause increased entrainment of solids, which have collected in the bore over time.

- Purging begins, typically at a rate of 0.1 to 1.0L/min, although higher rates may be possible provident the rate of purging does not cause significant draw down in the bore.
- During purging, groundwater stabilisation parameters should be measured and recorded to determine when they stabilise.
- When parameters have stabilised, the sample may be collected, at a rate slower or equal to purge rate.

2.7 Labelling of water samples

The water samples are identified with the same information than soil samples. GW4/2 is the sample collected from well GW4, and 2 refers to the sample number from this well, i.e. second time the well is sampled.

2.8 Sampling containers

Water samples are generally collected in bottles and containers provided by the laboratory who will analyse the samples. These are generally plastic bottles for inorganic analysis, and amber glass bottles for organic analysis. Vials are used to collect samples to be analysed for volatile organics. Sampling containers have appropriate preservatives added.

The bottles are filled to overflowing so as to remove air bubbles as much as possible prior to firmly screwing on the container cap. When performing purge and trap analyses, the vials are filled to 100% of their capacity. For headspace analyses, the vials are filled to approximately 75% of their capacity.

2.9 Well surveying

If the survey for location and elevation of a groundwater well is required, it should be done by a licensed surveyor, or alternatively by an GSNE Services environmental engineer / scientist if the level of precision required can be obtained by the use of GSNE Services field equipment.

If the location is given by a licensed surveyor, it is generally given to the nearest 0.1m and referenced to the Australian Map Grid (AMG) coordinates.

If the elevation is given by a licensed surveyor, the top of the standpipe and the ground surface adjacent to the standpipe are generally given to the nearest 0.01m and may be referenced to the Australian Height Datum (AHD). Relative levels (RLs) can be used if general contours are required.

3 SURFACE WATERS AND STORMWATER SAMPLING

3.1 Surface waters

Surface water samples are collected by hand, using automatic samplers, batch samplers or continuous samplers which can be installed to take samples at discrete time intervals or continuously.

For well mixed surface water samples (up to 1m depth) a sample bottle is immersed by hand covered by a glove below the surface. Samples are also taken with sample poles that have extension arms so that more representative samples can be taken.

For areas where access is difficult, samples can be collected using a retractable sample extension pole (sample bottle on the end) or in a bucket and transferred to sample bottles immediately following collection.

Other methods such as pumping systems, depth samplers, automatic samplers, and integrating systems are all relatively similar with water samples being supplied to a discharge point where samples can be collected in appropriate bottles.

3.2 Stormwater

The monitoring of stormwater quality is generally required prior to reject waters into stormwater drains. Field measurements are generally carried out using a Hanna Multiprobe prior to the discharge of the water to stormwater. The water parameters measured include pH, electrical conductivity (EC, in mS/cm) and Total Dissolved Solids (TDS).

If sampling is required, samples to be analysed for inorganic compounds are collected in plastic bottles, and samples to be analysed for organic compounds are collected in amber glass bottles. The bottles are filled to overflowing so as to remove air bubbles as much as possible prior to firmly screwing on the container cap. Sample containers may have preservatives added, in accordance with the laboratory recommendations.

Vials are used for volatile organic analysis. When performing purge and trap analysis, the vials should be filled to 100% of their capacity, whereas for headspace measurements, the vials should be filled to approximately 75% of their capacity.

3.3 Filtration devices

Water filtration devices may be required to filter surface water before it is discharged to the stormwater network, in order to remove suspended solids in water. One of the most simple and commonly used filtration device consists of between two to four retention sedimentation bays with a geotextile covering the inlet and outlet hoses.

Litter traps (wire or plastic grids or netting) may also be used to remove larger particles or debris. Other techniques to reduce the amount of suspended matter in water include wet basins, artificial wetlands, infiltration trenches and basins, sand filters and porous pavements. Some of these latter methods are also likely to reduce the bacterial levels in water.

The use of these filtration devices does not preclude carrying out monitoring of water quality following treatment and prior to discharge, particularly to the stormwater system.

4 FIELD TESTING

4.1 Field measurements

Field measurement of soils and groundwater parameters provides a rapid means of assessing certain aspects of soil and water quality. They are generally taken to:

- Ensure that formation water is being sampled
- Ensure screening of soils prepares samples for laboratory testing
- Provide on-site measurements for soil and water quality parameters that are sensitive to sampling and may change rapidly (e.g. temperature, pH, redox and dissolved oxygen (DO)).
- Compare with laboratory measurements of these parameters to assist in the interpretation of analytical results of other parameters (e.g. check for chemical changes due to holding time, preservation and transport).

Field measurements may be taken either in-situ or after groundwater has been extracted from a bore. Field measurements should be taken immediately before collecting each sample.

pH and dissolved oxygen meters need to be calibrated before every use, in accordance with the manufacturer's instructions. If field meters are to be used over several hours, periodic readings of a reference solution must be made to ensure calibration is stable.

4.2 PID Photo Ionisation Detector

Photo Ionisation Detector (PID) measurements are used to provide indicative field measurements of the amount of ionisable vapours released from a soil or water sample into the head space above the sample.

The procedure for field screening of samples using the PID is as follows:

- Prior to testing commencing, the PID is calibrated using standard laboratory calibration gas. The battery of the PID should also be sufficiently charged for the duration of the testing;
- The background concentrations of total ionisable compounds in the ambient air in the vicinity of the work area are established prior to the commencement of site activities. Background measurements are normally taken approximately 5 to 10m upwind of the work area. The readings are observed before and after each measurement of a sample to ensure that the PID is operating correctly. The maximums, fluctuations and other relevant comments are recorded.
- A glass sample jar is filled with the soil sample to be tested. The jar should not be filled more than 3/4 full;
- The jar is sealed with aluminium foil or plastic wrap and the lid is screwed;
- At least 20 minutes after placing the sample into the sampling jar, check that the PID reading is constant and similar to the background. Insert the top of the PID through the foil or plastic wrap in order to measure the ionisable vapour concentrations in the airspace above the sample;
- Monitor and record the PID readings noting fluctuations and maximum readings;
- Monitor the readings after returning the PID to a location with background concentrations. Interchangeable, clean, in-line filters for the PID probe are available to allow rapid decontamination of the unit in the field if background

readings measured by the instrument are significantly greater than the background air concentration initially established;

- If perforations are present in the aluminium foil prior to analysis reseal the jar and test after having waited again for at least 20minutes.

An alternative acceptable method is to place the soil to be tested in a disposable zip loc plastic bag and test the sample by punching a hole in the bag with the PID tube to sample the gas from the bag.

5 ACID SULFATE SOILS

5.1 Desktop Classification

An initial review of Acid Sulphate Soils (ASS) Planning Maps is undertaken to identify the likelihood and risk of ASS being present at the site. The following geomorphic conditions of the site are also checked as an indication of the presence of ASS: sediments of recent geological age (Holocene) ~ 6000 to 10 000 years old; soil horizons less than 5m AHD (Australian Height Datum); marine or estuarine sediments and tidal lakes; coastal wetlands or back swamp areas; waterlogged or scalded areas; inter-dune swales or coastal sand dunes; areas where the dominant vegetation is mangroves, reeds, rushes and other swamp tolerant and marine vegetation; areas identified in geological descriptions or in maps bearing sulfide minerals, coal deposits or former marine shales/sediments; and deeper older estuarine sediments >10m below the ground surface.

5.2 Site Walkover

The presence on site of hydrogen sulphide odours, acid scalds, flocculated iron, monosulfidic sludges, salt crusts, stressed vegetation, corrosion of concrete and/or steel structures and water logged soils are noted as cues for the presence of ASS.

5.3 Visual Classification

Visual indicators taken into account for the presence of ASS are the presence of jarosite (pale yellow colour) horizons or mottling, unripe muds (waterlogged, soft, blue grey or dark greenish grey in colour), silty sands and sands (mid to dark grey in colour) and the presence of shells.

5.4 Sample Collection

Samples are collected to at least one metre below the depth of the proposed excavation or estimated drop in the water table, or two metres below ground level, whichever is deepest. Samples are collected from every soil horizon or every 0.25m. Large shells, stones and fragments of wood, charcoal and other matter are noted, but removed from the sample. Small roots are not removed from the sample. If laboratory analysis is required, samples are sent for laboratory testing within 24 hours of sampling.

5.5 Field Testing

The field pH peroxide test (pH_{FOX}) is used to obtain an indication of the presence of oxidisable sulphur in the soil. The procedure for this test is as follows:

- A small sample of soil (<100g) is collected in a glass jar and split into two sub-samples. One sub-sample is made into a 1:5 (soil : deionised water) solution in order to measure field soil pH and electrical conductivity (EC) analysis. If the resulting pH is less than 4 (pH_F<4), the sample is identified as actual acid sulphate soil (AASS)
- The second sub-sample is made into a 1:5 (soil : Hydrogen Peroxide) solution to measure pH of oxidised soil. Sodium Hydroxide (NaOH)-adjusted analytical (30%) grade Hydrogen Peroxide (H_2O_2) is used as the soil oxidising agent. A mobile electronic pH/EC probe is used to measure soil pH.
- The presence of oxidisable sulphides, organic matter or manganese in the sample, will trigger a chemical reaction. The type of effervescence and any colour change is noted with the final pH measured to give an indication of the potential change in pH should the soil remain exposed to oxygen. If the resulting pH is less than 3 (pH_{FOX}<3) or if pH_{FOX} is at least one unit less than the pH_F, this suggests that the soil tested is potential acid sulfate soil (PASS).

5.6 Laboratory Testing

When the field test suggests that the material tested contains ASS or PASS, this should be confirmed by laboratory analysis (POCAS/SPOCAS or TOS testing).

6 NOISE MONITORING

Measurements are taken at a range of times during the day in order to assess the trends in noise emission over time. Noise is measured using a hand-held Rion NA-29 Sound Level Meter with digital microphone. Some noise meters change and appropriate equipment which is calibrated is used for all monitoring. The reference level of the meter is checked before and after the measurements using a Rion NC-73 Sound Level Calibrator to ensure there is no significant drift. Noise measurements are made over a 15-minute interval using the "fast" response of the sound level meter. 5dB would be added if the noise is substantially tonal or impulsive in character. Measurements should be adapted to the type of noise being measured i.e. construction, occupation, club, etc.

7 DUST MONITORING

Sampling is conducted at locations of potential concern. The deposit gauge static sampler contains a glass funnel measuring approximately 150mm with the angle of the cones sides being 60 degrees, placed into a rubber stoppers in the mouth of a five-litre glass receptacle. The deposit gauge is placed in a stand so that the height of the funnel of the deposit gauge is between 1.8 and 2.2m above ground level. A quantity of 7.8g copper sulfate pentahydrate dissolved in water is placed in the glass receptacle in order to prevent algal growth.

Exposure periods vary depending on the purpose of the investigation but typically the period is 30 ±2 days. Samples are usually analysed for measured soils: total solids, insoluble solids, ash and combustible solids.

Dust can also be measured using a High Volume Air Sampler. Such sampler should be located at least 2 metre away from any structures so that an undisturbed sample can be collected. HVASs can be used indoors or outdoors.

8 ASBESTOS INSPECTION, FIELDWORK AND SAMPLING

9.1 Assessment of soils that may contain asbestos contamination

Soils that are assessed as part of an environmental site assessment may be in-situ fill soils or stockpiled soils. The site/area-specific assessment for asbestos should be made in accordance with standard site investigation procedures with care taken during the site inspection stage. Details regarding assessment for asbestos are found within the WA Department of Health guidance guidelines and NEPM 2013 guidelines. The assessment process may move from a preliminary site investigation to a more comprehensive detailed site investigation where required and indicators for asbestos are present. For most cases, a detailed environmental site assessment may not be needed if no soil contamination is found other than asbestos as a management approach will be preferred and qualitative assessment of the lateral extent of soil contamination will be sufficient. The severity of Asbestos risk can be calculated using the GSNE Services Asbestos Risk Assessment Hazard Level sheet found in the attachments of this document.

Assessment would normally require a sampling and analysis plan (SAP) to support the investigations and also any validation sampling that occurs. A site asbestos management plan (AMP) may be required to protect the public and workers during the assessment phase, as well as long term users of the site.

Initial inspections during site and soil assessments should be grid-based as far as practical in the first instance to detect any visible asbestos. The identified areas should then be surveyed in more detail along with suspect locations indicated as a result of the desktop study. enHealth 2005 *(Appendix V: Sample inspection and investigation form)*

provides an asbestos visual inspection checklist. Relevant guidelines recommend that such an approach be used to assist the systematic collection of relevant data.

Site inspection methods should be adopted to prevent further degradation or distribution of asbestos. This may include: restricted on-site use of vehicles and equipment; minimal disturbance of stockpiled or discarded materials; and the use of equipment and footwear scrub-down areas.

The most likely presence of asbestos, if present, will be visible on the surface and in significant quantities. The main exception is free fibre which will be hard to identify unless in bulk. An experienced inspector (GSNE Services OH&S scientist or experienced senior) is likely to identify asbestos as such, but confirmation of representative samples by analysis is appropriate if there is any uncertainty.

If the surface is heavily vegetated, then confidence in the visual inspection will be lessened. Some careful vegetation clearance may help to clarify the situation.
The inspection should also include any asbestos-containing structures, especially if in poor repair, footprints of demolished structures, and debris that has been dumped on the site, particularly demolition waste.

The condition, quantities and location of the asbestos should be evaluated in general terms to inform initial remediation and management decisions. The following basic approach is generally appropriate:

- Where there is good historic information on the sources of the asbestos contamination, the estimated surface area of contamination can be considered

equivalent to the visually delineated area of impact, and up to 1 m in all directions to account for uncertainty;

- The depth of contamination may be inferred from the desktop investigation, or later informed by targeted sampling. In either case, an additional 30 cm should be incorporated to account for uncertainty;
- The condition of ACM (Asbestos Cement Material) should be considered equivalent to the most degraded samples found in an area, noting that this may vary across different areas;
- Where significant amounts of free asbestos fibres may have been exposed over time, the immediate surrounding area should also be considered contaminated.

9.2 Preliminary Site Investigation

Sampling during the PSI is not normally recommended, since either a management strategy may be adequately defined based on other PSI investigation findings or because it is evident that a detailed site investigation (DSI) will be necessary anyway. Limited PSI sampling may be appropriate for the following reasons:

- To form part of the initial site or soil assessment;
- To confirm that asbestos is present/absent, including as free fibre;
- To roughly delineate the contamination's lateral and vertical extent;
- To inform the Sampling and Analysis Plan for the Detailed Site Investigation;
- To obtain a preliminary idea of appropriate management options;
- For air sampling, to ascertain what additional site-control measures are warranted or if immediate response actions are required.

PSI sampling would most likely be surface hand-picking or targeted sampling (also in accordance with general site/area soil assessment requirements as part of standard site assessments). Any sampling should be based on a Sampling and Analysis Program.

Fragments if found must be inspected by an appropriately qualified and experienced asbestos consultant (GSNE Services OH&S scientist or experienced senior). The default assumption should be that any suspect material does contain asbestos and appropriate management action should be initiated. Where confirmation is required regarding the nature of the fibre in the ACM, identification by transmission electron microscopy is the favoured method to determine if the suspect material in the cement matrix is asbestos.

9.3 Detailed Site Investigation

A DSI is an investigation which confirms and delineates potential or actual contamination through a comprehensive sampling program. These form part of the standard GSNE Services sampling protocols for site and soil assessments and elements specific to asbestos are provided below as additional items to review when taking asbestos into consideration.

A DSI is not usually required if the contamination is demonstrated to be ACM in limited quantities sitting on the soil surface (simple surface impact). Hand-picking as outlined below may be sufficient to manage this type of contamination. The AMP can be used instead for management purposes just for asbestos, although this will depend on site-specific circumstances, especially the remediation approach proposed.

A DSI should only be undertaken when delineation of asbestos impacts must be accurate, such as if:

- The remediation or management approach requires asbestos to be removed or relocated from an area;
- Asbestos contamination is due to friable or free-fibre generating material;
- Land uses are to be determined and delineated according to the extent and nature of asbestos contamination.

A DSI may also help resolve uncertain findings from the PSI, or to help assess the likely effectiveness of alternative remediation and management strategies.

Care is necessary during the DSI to ensure that sampling and monitoring results are not compromised due to poor site management practices, specifically:

- Sampling should follow removal of any asbestos material that may be actively generating asbestos free fibres, such as exposed ACM products in poor condition;
- Investigations should follow any planned demolition of asbestos-containing structures or buildings, or removal of asbestos from within them, unless the demolition is closely monitored and the associated removal site is professionally validated;
- All equipment operation, vehicle movements and dust during the sampling and monitoring regime need to be carefully managed.

Qualitative assessment may be sufficient to determine that the distribution of ACM is limited and that no further action, or limited action such as removal of minor surface material, is all that is required. Where there is a concern (and a need to determine) that the level of ACM may exceed the screening criterion, quantitative assessment using a graivimetric approach may be undertaken to assess the site-specific risk. This more detailed assessment may also be carried out when ongoing management of the site under regulatory controls is a potential requirement. This approach should be checked first as in general a zero tolerance of asbestos is the preferred regulatory approach at the moment.

Detailed site assessment should be undertaken for sensitive land uses where asbestos contamination (using a gravimetric approach) is likely to approach or exceed screening criteria. This may involve a quantitative, thorough; and well-argued risk assessment involving a detailed test pit and trenching program based on site history where it is available, and appraisal of the relevant site7specific risk issues.

9.4 Sampling of Asbestos

Surface distribution - ACM fragments are often present as surface deposits on sites from past poor demolition and building practices. While isolated fragments across the surface of a site are usually of low concern, any surface material may present a risk of exposure over time from decay through corrosive weathering or abrasion by vehicle traffic and other activities. There should be no visible ACM fragments greater than 7mm x 7mm on the surface or in the top 10cm of soil, which can be achieved by multi-directional raking or tilling and hand picking (as described below). When cohesive soils or a large surface area is involved it may be more practical to skim the top 10cm of soil for disposal in accordance with regulatory requirements. The exposed surface of the site can then be further visually assessed by an appropriately qualified and experienced professional on a systematic basis where some localised hand picking or additional earthworks may be required.

ACM through a soil profile, test pits or boreholes may reveal the presence of ACM in fill through a soil profile. This can be quantified on a gravimetric basis and compared to the screening criteria in Schedule B1 of the NEPM.

Judgmental sampling targets particular areas of a site based on known or likely contamination, which is the preferred approach. It depends heavily on a thorough PSI and should reflect the state of the site at that time. Judgmental sampling can help avoid unnecessary broad area sampling. Judgmental sampling may need to be augmented or substituted by grid sampling.

Grid sampling is most appropriate when asbestos contamination is widespread or may be present at unknown locations. If the contamination is buried then test pits in particular and/or boreholes are used for either the judgmental or grid-based regimes.

The following situations are especially relevant to judgmental sampling:

- If contamination 'hot spots' are identified by the PSI, a sampling strategy is required to confirm their extent, which if indicated to be sub-surface should include test pits and stratified sampling methods;
- The SAP provides for opportunistic (discretionary) sampling to be conducted as necessary, for example, when unexpected suspect asbestos products or unusual soil strata are encountered;
- Areas that will remain covered by hardstand do not require sampling. However, if asbestos is likely, its presence will be assumed unless sampling indicates otherwise. If sampling cannot readily meet the recommended density because of hardstands, targeted sampling in key locations is suitable to allow limited characterisation of sub-surface contamination;
- If structures containing asbestos have been removed, the former 'footprint' should be investigated, unless the removal was properly managed and documented. In addition to a visual inspection, sub-surface sampling should only be necessary if the structure was partially buried, for instance, asbestos fencing, or subsequent soil disturbance has occurred. Sampling below 30 cm depth is not generally warranted. Sampling should extend laterally up to 50 cm outside the footprint perimeter, and include soak-wells. A sampling interval of 5-10 m along and within the footprint perimeter is recommended, aligned with any adjacent grid sampling pattern;

- Disused sub-surface asbestos structures and products, such as former service trenches or piping, may be localised areas of potential contamination. If not properly documented, these should be delineated by sampling, although validation sampling would suffice if structure removal is undertaken.

Hand-picking (Emu bob) primarily refers to the visual inspection of the soil surface and manual collection of ACM, as outlined below.

Process

- Can use a rake to sample down to a depth of 10cm;
- Most suitable for ACM, and possibly for low levels of FA (Friable Asbestos);
- Relevant where contamination is known or considered only to be on or near the soil surface and may be attributed to a defined event;
- Limited application for deeper contamination or if there is surface vegetation or debris. Raking may be difficult except in sand or loose fill;
- Used to characterise the extent and level of contamination, whilst concurrently reducing its impact.

Method

- Locations and weights of asbestos material should be recorded;
- Rake teeth should be <7mm spaced apart and >10 cm long;
- At least 2 passes of picking (and of raking if appropriate) made with 90^{o} direction change between each and using a grid pattern;
- Material should not be further damaged or buried by the process;
- % contamination may be calculated, using 1 cm as soil depth for handpicking or using the rake teeth length as appropriate;
- Final visual inspection of the area should not detect surface ACM.

Tilling refers to a process of mechanically turning over surface soils to facilitate the presentation and collection of asbestos fragments. The process and its implementation are outlined below.

Process

- Most suitable for ACM, not for fibre-generating materials;
- Generally conducted across the entire zone of suspected impact;
- Relevant for contamination within top 30cm of soil;
- Limited application for deeper contamination or if there is surface vegetation or debris;
- Used to characterise the extent and level of contamination, whilst concurrently reducing ACM impact.

Method

- Usually preceded by hand-picking;
- Locations and weights of asbestos material should be recorded;
- Soils should be pre-wet to the tilling depth, and the dust controlled;
- Rotor blades should present ACM optimally for 1 or 2 spotters closely following depending on speed, till breadth and contamination level;
- At least 2 passes with 90^{o} direction change using a grid pattern;
- Material should not be further damaged or buried from the process;
- Evaluated areas normally cannot be considered representative of other locations;
- Percentage contamination may be calculated using an estimate of the average impact depth as well as the area involved;
- Final visual inspection of the area should not detect surface ACM.

Screening is applied to both the small-scale separation of ACM fragments from localised soil samples and the large-scale treatment of an area to detect and quantify asbestos contamination, with concomitant remediation. This Section deals with large-scale mechanical screening. The process and its implementation are outlined below.

Process

- Most suitable for minor ACM impact, not for fibre-generating materials;
- Other sampling methods are preferable because of potential dust/fibre generation;
- Generally conducted across the entire zone of suspected impact;
- Relevant for larger volumes of reasonably accessible and delineated contamination;
- Used to effectively characterise the extent and level of contamination, whilst concurrently reducing ACM impact.

Method

- May be preceded by hand-picking if appropriate;
- Oversized ACM may be removed by 'screening down' from larger mesh sizes to the final screening mesh;
- Final mesh size of <7mm is recommended. Anything larger will require validation sampling;
- ACM weights/concentrations should be closely correlated to locations or stockpiles to allow re-sampling or segregation if required;
- Impacted soil should not be mixed with other soil in a way that might compromise the concentration calculations;
- Soils should be pre-wet and procedure subject to strong dust/fibre control and monitoring measures as outlined in a Dust Management Plan;
- Evaluated areas normally cannot be considered representative of other locations;

- Percentage contamination may be calculated using the weight of ACM found for a particular strata, area or volume;
- Final visual inspection of the stockpile surface should not detect ACM.

Test Pits and Trenching is used if asbestos extends below surface soils (>30cm), especially if contamination distribution is uncertain. GSNE Services recommends use of test pits instead of boreholes (where machines are available) because buried ACM and FA can be more readily identified, differing strata distinguished and there is more sampling flexibility. Specified large sample sizes should be used for both methods with reliance put on visual methods of asbestos detection and concentration calculation wherever possible. The process and its implementation are outlined below.

Process

- Suitable for all asbestos types, but especially ACM, and FA if fibre disturbance is manageable;
- Relevant if contamination is buried and of unknown location and depth.

Method

- Sampling should be conducted to 30cm below the likely lower limit of potential contamination unless this is greater than 3m;
- Suspect asbestos material or construction debris should be targeted and all sample locations noted;
- Precautions are necessary to protect workers and public from wall collapse or hole hazards, and potential fibre release from excavation/sampling.

ACM & FA

- At least one 10L sample from each relevant stratum (or per 1m depth) of one wall, and discretionary samples from other suspect spots;

- Sample screened manually on-site through a <7mm sieve or spread out for inspection on a contrasting colour material (recommended for FA);
- Identified ACM and FA weighed to calculate asbestos soil concentration for individual samples.

AF (Asbestos Fines)

- At least one wetted 500ml sample from each relevant stratum or 1m depth (if thick) of one wall, and discretionary samples from other suspect spots;
- May be done with ACM/FA sampling, or at another wall position; Whole sample submitted for laboratory analysis.

Boreholes are used generally during the site sampling process but where suspect asbestos is present and if equipment is available, TPs are recommended. Borehole sampling may be appropriate where physical obstructions may limit soil access or generation of asbestos contaminated dust is a potential problem. The sample taking and assessment is similar to that for TPs. The process and its implementation are outlined below.

Process

- Suitable for all asbestos types;
- Relevant if contamination is buried and of unknown location and depth

Method

- Sampling should be conducted to 30cm below the likely lower limit of potential contamination unless this is greater than 3m;
- Suspect asbestos material or construction debris should be targeted and all sample locations/ depths noted.

ACM & FA

- Corer diameter should be at least 15cm;
- At least one 10L sample if practical from each relevant stratum (or per 1m depth) of core. Cross-strata samples are permissible provided that asbestos detections are further investigated;
- Sample screened manually on-site through a <7mm sieve or spread out for inspection on a contrasting colour material (recommended for FA);
- Identified ACM and FA weighed to calculate asbestos soil concentration for individual samples.

AF

- At least one wetted 500ml sample from each relevant stratum (or per 1m depth);
- May be done with ACM/FA sampling;
- Whole sample submitted for laboratory analysis.

Soil stockpiles intended for use on-site and of unknown quality should be assessed for asbestos contamination. GSNE Services intends to adopt a conservative approach to stockpile assessment and use because of associated uncertainties and risks.

If the stockpiles originated on the site from areas not likely to be contaminated, for instance, no indication of building activity or waste, the assessment can consist of a close visual examination and hand-picking over the whole stockpile surface. If any asbestos is found or the soil came from asbestos suspect areas on site, then the stockpiles should normally be considered contaminated. These stockpiles and any imported soil, aggregate or crushed material of unknown quality should not be used as “clean” fill without further investigation and management if necessary.

The sampling regime outlined below can be used to assess better the level and nature of contamination. This is designed to be consistent with the sampling density included in standard site and soil assessments for an area likely to be contaminated.

Process

- Suitable for all asbestos types;
- Confidence in results is not as high as with other sampling procedures.

Method

- Sampling should be spread over the whole stockpile surface at a minimum rate of 14 locations per 1,000 m^3;
- If soil is subject to a conveyor process (not recommended for FA or AF) then a minimum of 1 sample should be taken per 70m^3 of material;
- Suspect asbestos material or construction debris should be targeted and all sample locations noted.

ACM and FA

- At least one 10L sample from each location;
- Sample screened manually on-site through a <7mm sieve or spread out inspection on a contrasting colour fabric (recommended for FA);
- Identified ACM and FA weighed to calculate asbestos soil concentration for individual samples.

AF

- At least one wetted 500ml sample from each location;
- May be done with ACM/FA sampling, or at another spot;
- Whole sample submitted for laboratory analysis.

For ACM, if the contamination is below the investigation criteria then the stockpile may be used on the site as non-contaminated fill, subject to suitable controls. Controls should include closely monitoring the installation process for asbestos and visual inspection and hand-pick sampling of the new soil surface and also the stockpile footprint. It may also be appropriate to undertake test pit sampling of the installed material. Depending on the results, it may be necessary to remediate the installed soil and stockpile footprint.

If any free fibre or FA is found in the stockpile, it would not normally be useable as "clean" fill and would be regarded as contaminated unless extensive sampling demonstrates otherwise.

Air quality monitoring (AQM) for asbestos fibre, dust and other contaminant emissions should be considered during the DSI, remediation and site development processes. Asbestos fibre and dust (as a surrogate for asbestos fibre) are of particular interest.

9 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

9.1 Introduction

Inaccuracies in sampling and analytical programs can result from many causes, including collection of unrepresentative samples, unanticipated interferences between elements during laboratory analyses, equipment malfunctions and operator error. Inappropriate sampling, preservation, handling, storage and analytical techniques can also reduce the precision and accuracy of results.

The Australian Standard AS4482.1-2005 *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-Volatile and Semi-Volatile Compounds* has documented procedures for quality assurance (QA) and quality control (QC) for sampling and analysis to ensure that the required degree of accuracy and precision is obtained. The Australian Standard also recommends the use of two laboratories for the implementation of a QA program for the analyses in addition to the QC procedures followed by the primary laboratory.

9.2 Field QAQC samples

General

Procedures for duplicate sampling should be identical to those used for routine sampling and duplicate samples will be despatched for analysis for the same parameters using the same methods as the routine samples. No homogenisation of samples which may induce the loss of volatile compounds (such as BTEX) should occur. Whenever possible, the selection of samples for duplicate analyses should be biased towards samples believed to contain the contaminant of concern.

Intra-laboratory duplicates

Intra-laboratory duplicate samples, also referred to as Blind duplicates, are used to assess the variation in analyte concentration between samples collected from the same sampling point and / or also the repeatability of the laboratory analyses. Samples are split in the field to form a primary sample and a QC duplicate (intra-laboratory replicate) sample. The intra-laboratory duplicates are taken from a larger than normal quantity of soil collected from the same sampling point, removed from the ground in a single action, and divided into two vessels. These samples are submitted to the laboratory as two individual samples without any indication to the laboratory that they have been duplicated.

Intra-laboratory duplicate samples should be collected at a rate of approximately 1 in 20 soil samples and analysed for the full suite of analytes. At least one intra-laboratory duplicate sample should be included in each batch of samples.

Inter-laboratory duplicates

Inter-laboratory duplicate samples, also referred to as Split duplicates, provide a check on the analytical proficiency of the laboratories. The samples are taken from a larger than normal quantity of soil collected from the same sampling point, removed from the ground in a single action, and divided into two vessels. One sample from each set is submitted to a different laboratory for analysis. The same analytes should be determined by both laboratories using the same analytical methods.

Inter-laboratory duplicates should be collected at a rate of approximately 1 in 20 soil samples and analysed for the full suite of analytes. At least one inter-laboratory duplicate sample should be included in each batch of samples.

Blanks

Rinsate Blanks

Rinsate blank samples provide information on the potential for cross-contamination of substances from the sampling equipment used. Rinsate blanks are collected where cross-contamination of samples is likely to impact on the validity of the sampling and assessment process (e.g. when the investigation level of a contaminant is close to the detection limit for this contaminant). They are prepared in the field using empty bottles and the distilled water used during the final rinse of sampling equipment. After completion of the decontamination process, fresh distilled water is poured over the sampling equipment and collected. The distilled water is exposed to the air for approximately the same time the sample would be exposed. The collected water is then transferred to an appropriate sample bottle and the proper preservative added, if required.

One rinsate blank par day and / or one per piece of sampling equipment are collected during the decontamination process and analysed for the analytes of interest. At least one rinsate blank should be included in each batch of samples. One rinsate blank should be collected for every 50 samples collected and analysed for the full suite of analytes.

Trip Blanks / Spikes

Trip blanks / spikes are a check on the sample contamination originating or lost from sample transport, handling, and shipping. These are samples of soil or water prepared by the laboratory with a zero or known concentration of analytes.

Field Blanks

Field blanks are a check on sample contamination originating from sample transport, handling, shipping, site conditions or sample containers. These are similar to trip blanks except the water is transferred to sample containers on site.

9.3 Laboratory quality assurance / quality control

The laboratories undertake the analyses utilising their own internal procedures and their test methods (for which they are NATA, or equivalent, accredited) and in accordance with their own quality assurance system which forms part of their accreditation.

Laboratory duplicate samples

Laboratory duplicate samples measure precision. These samples are taken from one sample submitted for analytical testing in a batch. The rate of duplicate analysis will be according to the requirements of the laboratory's accreditation but should be at least one per batch.

Precision is reported as standard deviation SD or Relative Percent Difference %RPD, being:

$$\%RPD = \frac{(D1 - D2)}{(D1 + D2)} \times 200$$

where: D1: sample concentration and D2: duplicate sample concentration

Replicate data for precision is expected to be less than 30% RPD at concentration levels greater than ten times the EQL, or less than 50% RPD at concentration levels less than ten times the EQL. Sample results with a RPD exceeding 100% require specific discussion. Note that certain methods may allow for threshold limits outside of these limits.

Matrix Spiked Samples

Matrix spiked samples are used to monitor the performance of the analytical methods used, and to assess whether the sample matrix has an effect of on the extraction and analytical techniques. A sample is spiked by adding an aliquot of known concentration of the target analyte(s) to the sample matrix prior to sample extraction and analysis. These samples should be analysed at a rate of approximately 5% of all analyses, or at least one per batch.

Matrix spikes are reported as a percent recovery %R, being:

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

where: SSR: spiked sample result, SR: sample result (blank) and SA: spike added

Recovery data for accuracy is described by control limits specified by the laboratory (generally ranging between 70% and 130%) and referenced to US EPA SW-846 method guidelines values.

Laboratory Blank

Laboratory blanks are used to correct for possible contamination resulting from the preparation or processing of the samples. These are usually an organic or aqueous solution that is as free as possible of analyte and contains all the reagents in the same volume as used in the processing of the samples. Laboratory blanks must be carried through the complete sample preparation procedure and contain the same reagent concentrations in the final solution as in the sample solution used for analysis. Laboratory blanks should be analysed at a rate of once per process batch, and typically at a rate of 5% of all analyses.

Laboratory Control Samples

Laboratory Control Samples, also referred to as Quality Control Check Samples, are used to assess the repeatability and long term accuracy of the laboratory analysis. These are externally prepared and supplied reference material containing representative analytes under investigation. Recovery check portions should be fortified at concentrations that are easily quantified but within the range of concentrations expected for real samples. Laboratory Control samples should be analysed at a rate of one per process batch, and typically at a rate of 5% of analyses.

Laboratory control samples are reported as a percent recovery %R, being:

$$\%R = \frac{(SSR-SR)}{SA} \times 100$$

where: SSR: spiked sample result, SR: sample result (blank) and SA: spike added

Recovery data for accuracy is described by control limits specified by the laboratory and referenced to US EPA SW-846 method guidelines values. Ideally, all calculated recovery values should be within the acceptable limits. However, in the event that control limit outliers are reported, professional judgement is used to assess the extent to which such results may affect the overall usability of data.

Surrogates

Surrogates are used to provide a means of checking, for every analysis, that no gross errors have occurred at any stage of the procedure leading to significant analyte losses. Surrogate are quality control monitoring spikes, which are added to all fields and QAQC samples at the beginning of the sample extraction process in the laboratory. Surrogates are closely related to the sample analytes being measured (particularly with regard to extraction, recovery through clean-up procedures and response to chromatography) and are not normally found in the natural environment.

Surrogate spikes will not interfere with quantification of any analytes of interest and may be separately and independently quantified by virtue of, for example, chromatographic separation or production of different mass ions in a GC/MS system.

Surrogates are measured as Percent Recovery %R expressed as:

$$\%R = \frac{(SSR)}{SA} \times 100$$

where: SSR: spiked sample result and SA: spike added

Recovery data for accuracy is described by control limits specified by the laboratory and referenced to US EPA SW-846 method guidelines values.

10 DATA QUALITY OBJECTIVES

10.1 General

Data Quality Objectives (DQOs) are defined to ensure that the data is sufficiently accurate and precise to be used for the purpose of the project works. DQOs are defined for a number of areas including:

- sampling methods;
- decontamination procedures;
- sample storage (including nature of the containers) and preservation;
- laboratory analysis, including PQL, recoveries (surrogates, spikes), duplicates;
- preparation of CoC forms;
- document and data completeness; and
- data comparability.

The NSW EPA Contaminated Sites Guidelines for the NSW Site Auditor Scheme (3rd Ed) 2017 also provide a seven-step process for Data Quality Objectives (DQOs). These are as follows:

- State the problem
- Identify the decisions
- Identify inputs to the decision
- Define the study boundaries
- Develop a decision rule
- Specify limits on decision errors
- Optimise the design for obtaining data

DQOs must be adopted for all assessments and remediation programmes. The DQO process must be commenced before any investigative works begin on a project.

10.2 Field DQOs

The DQOs for sampling methods, decontamination procedures, sample storage (including nature of the containers) and preservation, preparation of CoC forms, and document and data completeness are the GSNE Services protocols which have been described in the previous sections of this document.

10.3 Assessment of RPD values for field duplicate samples

The criteria used to assess RPD values for field duplicate samples is based on discussion reported in AS4482.1 1997, a summary of which is presented below:

Table 1: RPD acceptance criteria

Sample type	Typical acceptable RPD
Intra-laboratory duplicate (blind duplicate)	30-50°% (*)
Inter-laboratory duplicate (split duplicate)	30-50% (*)

It is noted that other factors such as sampling technique, sample variability, absolute concentration relative to criteria and laboratory performance should also be considered when evaluating RPD values.

The Australian Standard also states that the variation can be expected to be higher for organic analytes than for inorganics, and for low concentrations of analytes (lower than five times the detection limit). Based on GSNE Services Pty Ltd experience, RPD up to 70% are considered to be acceptable for organic species. RPD of 100% or more are generally considered to demonstrate poor correlation and should be discussed.

10.4 Laboratory Data Quality Objectives (DQO)

General

GSNE Services also provides internal laboratory testing for a range of physical parameters. GSNE Services is NATA certified to conduct these tests.

SGS Environmental is the GSNE Services -preferred laboratory for the chemical analysis of primary samples. SGS Environmental is accredited by the National Association of Testing Authorities (NATA).

The laboratory generally used by GSNE Services for analysing inter-duplicate samples is SGS Environmental.

Analytical methods including detection limits are provided on each laboratory report and are checked as part of the data review process.

Laboratory QA/QC

Specific to SGS Environmental, standard QA/QC data includes LCS, MB, CRM (CRM metals only), Laboratory Duplicate (1 in first 5-10 samples, then every tenth sample) and Spike sample (1 in first 5-20 samples, then every 20th sample), and surrogate recovery's (target organics). All QA/QC is reviewed by a senior chemist prior to customer release and includes a DQO comment on final report. Additional QA/QC maybe performed on batches less than 10 samples; however additional charges shall apply at the appropriate analytical rate/sample.

Laboratory analyses DQOs

The following table summarises laboratory analyses DQOs.

Table 2: Laboratory Data Quality Objectives (DQOs)

Laboratory QA/QC Testing	Laboratory QA/QC Acceptance Criteria
Method Blanks	For all inorganic analytes the Method Blanks must be less than the LOR. For organics Method Blanks must contain levels less than or equal to LOR.
Surrogate Spikes	At least two of three routine level soil sample Surrogate Spike recoveries are to be within 70-130% where control charts have not been developed and within the estimated control limited for charted surrogates. Matrix effects may void this as an acceptance criteria. Any recoveries outside these limits will have comment. Water sample Surrogates Spike recoveries are to within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criteria. Any recoveries outside these limits will have comment.
Matrix Spikes	Sample Matrix Spike duplicate recovery RPD to be <30%. In the event that the matrix spike has been applied to samples whose matrix or contamination is problematic to the method then these acceptance criteria apply to the Control Matrix Spike.
Laboratory Control Samples	Control standards must be 80-120% of the accepted value. Control standard recoveries are to be within established control limits or as a default 60-140% unless compound specific limits apply.

Laboratory QA/QC Testing	**Laboratory QA/QC Acceptance Criteria**
Laboratory Duplicate Samples	For Inorganics laboratory duplicates RPD to be <15%. For Organics Laboratory duplicates must have a RPD <30%.
Calibration of Chromatography Equipment	The calibration check standards must be within +/-15%. The calibration check blanks must be less than the LOR.

Non-compliances

Exceedances of QAQC results outside the DQO should be thoroughly investigated and discussed with the laboratories concerned, and the outcomes of these investigations should be recorded in the project files.

11 Use and calculation of the 95% UCL for site validation purpose

For environmental services, statistical analysis is performed on data. Validation of a site at the completion of remediation works should comply with the recommendations of the applicable guidelines.

For a site to be considered uncontaminated or successfully remediated, the typical minimum requirement is that the 95% upper confidence limit (UCL) of the arithmetic average concentration of the contaminant(s) is less than an acceptable limit, eg the threshold value of an health-based investigation level.

The calculation of the 95% UCL of the arithmetic average concentration method requires that the probable average concentration and standard deviation of the contaminant be known. This method is most applicable for validation sampling, where the mean concentration and the standard deviation can be estimated from sampling results.

The 95% UCL is calculated as follows:

$$\textbf{95\% UCL} = \textbf{mean} + t_{\alpha,n-1} \frac{STDEV}{\sqrt{n}}$$

where:

mean	arithmetic average of all sample measurements
$t_{\alpha,n-1}$	A test statistic (Student's t at an α level of significance and n-1 degrees of freedom)

$\propto$	The probability (in that case chosen to be 0.05) that the 'true' average concentration of the sampling area might exceed the UCL average determined by the above equation
STDEV	Standard deviation of the sample measurements
n	number of samples measurements

12 COPYRIGHT

13 ABBREVIATIONS

ANZECC	Australian and New Zealand Environment and Conservation Council
ASS	Acid Sulfate Soil
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethyl benzene and Xylene
CoC	Chain of Custody
DEC	Department of Conservation (formerly EPA)
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
HIL	Health-Based Soil Investigation Level
LGA	Local Government Area
NEHF	National Environmental Health Forum
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
NSL	No Set Limit
OCP/OPP	Organochlorine Pesticides /Organophosphate Pesticides
PAH	Polycyclic Aromatic Hydrocarbon
PASS	Potential Acid Sulfate Soil
PCB	Polychlorinated Biphenyl
PID	Photo Ionisation Detector
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance, Quality Control
RAC	Remediation Acceptance Criteria
RAP	Remediation Action Plan
RPD	Relative Percentage Difference
SAC	Site Assessment Criteria
SVC	Site Validation Criteria
SWL	Standing Water Level
TCLP	Toxicity Characteristics Leaching Procedure
TESA	Targeted Environmental Site Assessment
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit
VHC	Volatile Halogenated Compounds
VOC	Volatile Organic Compounds

14 REFERENCES

- Standards Australia AS1726-1993 (1993) – *Geotechnical Site Investigations.*
- Standards Australia AS4482.1-1997 (1997) – *Guide to the Sampling and Investigation of Potentially Contaminated Soil, Part 1: Non-Volatile and Semi-Volatile Compounds.*
- Standards Australia AS5667.11-1998 (1998) – *Water Quality Sampling: Guidance on the Sampling of Groundwaters.*
- NSW Acid Sulphate Soil Management Advisory Committee – August 1998 (ASSMAC) manual.
- "Environmental Guidelines: Use and Disposal of Biosolids Products, 2000" NSW EPA.
- NSW EPA (2003) – *Guidelines for Assessing Service Station Sites.*
- Land and Biodiversity committee (2003) – *Minimum Construction requirements for water bores in Australia.*
- "*Guidelines for Managing Risk to Recreational Waters 2008"* (GMRRW).
- CRC Care Technical Report No. 13 – Soil Vapour Assessment (August 2009).
- NSW DECCW, "Vapour Intrusion: Technical Practice Note", (September 2010).
- "*National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)*", NEPC (2013).
- NSW EPA (2014) – "*Waste Classification Guidelines, Part 1: Classifying Waste*".
- NSW EPA "*Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*" (2015).
- NSW EPA "*Guidelines for the NSW Site Auditor Scheme*" (2017, 3rd edition).
- "*Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018*" (ANZECC).

- Commonwealth 2018 – National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods (NASSG) manual.
- NSW EPA "*Guidelines for Consultants Reporting on Contaminated Sites*" (2020).
- NSW EPA "*Sampling Design Guidelines*" (2022).
- NSW EPA (2023) – *Contamination assessment of service station sites.*

APPENDIX F

IMPORTANT INFO ABOUT ENVIRONMENTAL REPORTS

IMPORTANT INFORMATION ABOUT YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by GSNE Services Pty Ltd and its associated companies using guidelines prepared by ASFE (The Association) of Engineering Firms Practicing in the Geo-sciences. They are offered to help you in the interpretation of your Environmental Site Assessment (ESA) reports.

REASONS FOR CONDUCTING AN ESA

ESA's are typically, though not exclusively, carried out in the following circumstances:

- as pre-acquisition assessments, on behalf of either purchaser or vender, when a property is to be sold;
- as pre-development assessments, when a property or area of land is to be redeveloped or have its use changed for example, from a factory to a residential subdivision;
- as pre-development assessments of greenfield sites, to establish "baseline" conditions and assess environmental, geological and hydrological constraints to the development of, for example, a landfill; and
- as audits of the environmental effects of an ongoing operation.

Each of these circumstances requires a specific approach to the assessment of soil and groundwater contamination. In all cases however, the objective is to identify and if possible quantify the risks that unrecognised **c**ontamination poses to the proposed activity. Such risks may be both financial, for example, cleanup costs or limitations on site use, and physical, for example, health risks to site users or the public.

THE LIMITATIONS OF AN ESA

Although the information provided by an ESA could reduce exposure to such risks, no ESA, however, diligently carried out can eliminate them. Even a rigorous professional assessment may fail to detect all contamination on a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which showed no signs of contamination when sampled.

AN ESA REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental report should not be used:

- when the nature of the proposed development is changed, for example, if a residential development is proposed instead of a commercial one;
- when the size or configuration of the proposed development is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership
- or for application to an adjacent site.

To help avoid costly problems, refer to your consultant to determine how any factors, which have changed subsequent to the date of the report, may affect its recommendations.

ESA "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to help minimise its impact. For this reason owners should retain the services of their consultants

through the development stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Natural processes and the activity of man change subsurface conditions. As an ESA report is based on conditions, which existed at the time of subsurface exploration, decisions should not be based on an ESA report whose adequacy may have been affected by time. Speak with the consultant to learn if additional tests are advisable.

ESA SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Every study and ESA report is prepared in response to a specific brief to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Other persons should not use a report for any purpose, or by the client for a different purpose. No individual other than the client should apply a report even apparently for its intended purpose without first conferring with the consultant. No person should apply a report for any purpose other than that originally contemplated without first conferring with the consultant.

AN ESA REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when design professionals develop their plans based on misinterpretations of an ESA. To help avoid these problems, the environmental consultant should be retained to work with appropriate design professionals to explain relevant findings and to review the adequacy of their plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final borehole or test pit logs are developed by environmental scientists, engineers or geologists based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final logs customarily included in our reports. These logs should not under any circumstances be redrawn for inclusion in site remediation or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimise the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To reduce the likelihood of boring log misinterpretation, the complete report must be available to persons or organisations involved in the project, such as contractors, for their use. Those who o not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing all the available information to persons and organisations such as contractors helps prevent costly construction problems and the adversarial attitudes that may aggravate them to disproportionate scale.

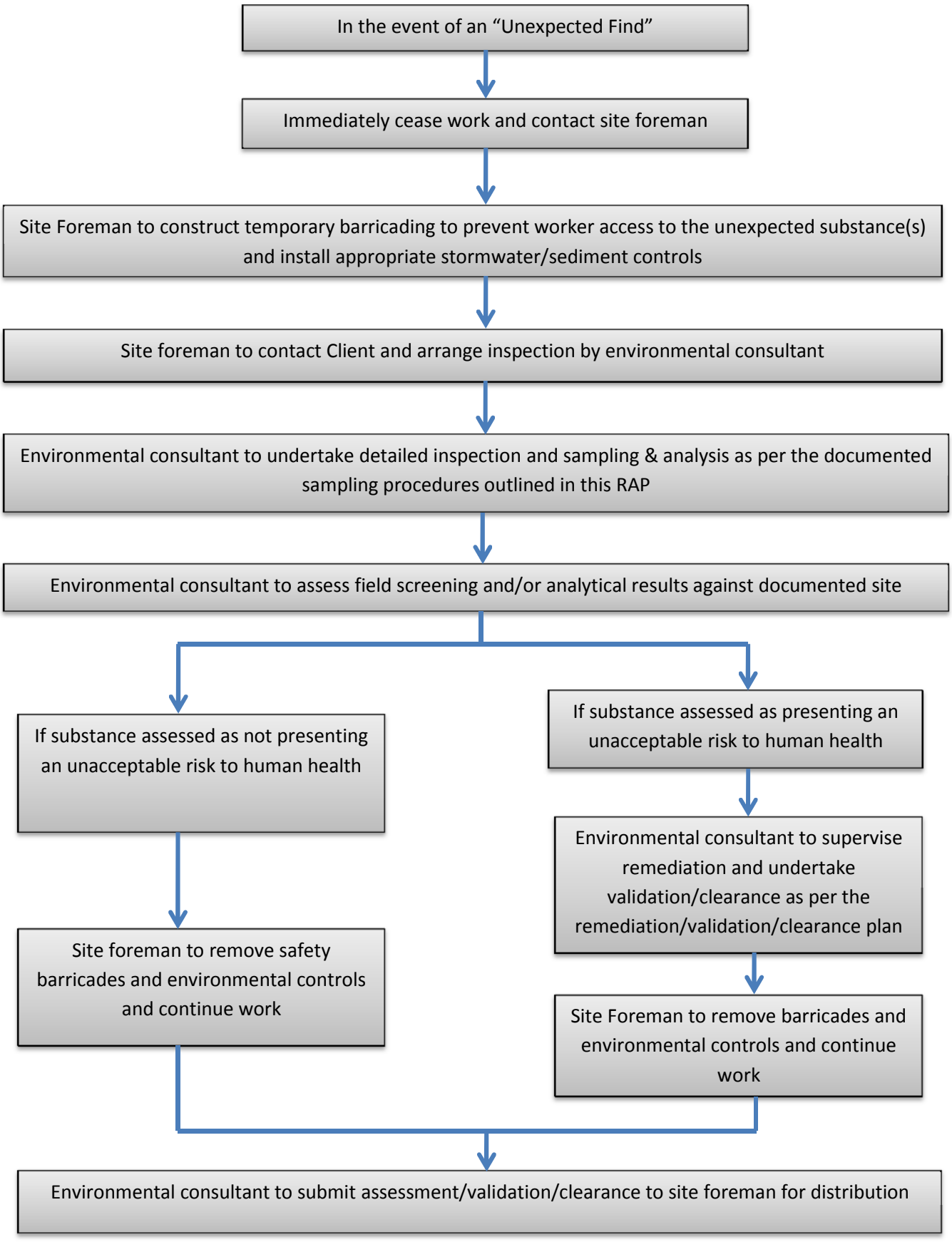
READ RESPONSIBILITY CLAUSES CLOSELY

Because an ESA is based extensively on judgement and opinion, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, model clauses have been developed for use in transmittals. These are not exculpatory clauses designed to foist liabilities onto some other party. Rather, they are definitive clauses that identify where your consultant's responsibilities begin and end. Their use helps all parties involved recognise their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your ESA report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

APPENDIX G

UNEXPECTED FINDS PROTOCOL

Unexpected Finds Protocol



APPENDIX H

VALIDATION CRITERIA

Table 1: CT1 & CT2 values for classifying waste by chemical assessment without the TCLP test

For disposal requirements for organic and inorganic chemical contaminants not listed below, contact the EPA. Aluminium, barium, boron, chromium (0 and III oxidation states), cobalt, copper, iron, manganese, vanadium and zinc have not been listed with values in this table and need not be tested for.

	Maximum values of *specific contaminant concentration* (SCC) for classification without TCLP		
	General solid waste[1]	Restricted solid waste	
Contaminant	**CT1 (mg/kg)**	**CT2 (mg/kg)**	**CAS Registry Number**
Arsenic	100	400	
Benzene	10	40	71-43-2
Benzo(a)pyrene[2]	0.8	3.2	50-32-8
Beryllium	20	80	
Cadmium	20	80	
Carbon tetrachloride	10	40	56-23-5
Chlorobenzene	2,000	8,000	108-90-7
Chloroform	120	480	67-66-3
Chlorpyrifos	4	16	2921-88-2
Chromium (VI)[3]	100	400	
m-Cresol	4,000	16,000	108-39-4
o-Cresol	4,000	16,000	95-48-7
p-Cresol	4,000	16,000	106-44-5
Cresol (total)	4,000	16,000	1319-77-3
Cyanide (amenable)[4]	70	280	
Cyanide (total)	320	1,280	
2,4-D	200	800	94-75-7
1,2-Dichlorobenzene	86	344	95-50-1
1,4-Dichlorobenzene	150	600	106-46-7
1,2-Dichloroethane	10	40	107-06-2
1,1-Dichloroethylene	14	56	75-35-4
Dichloromethane	172	688	75-09-2
2,4-Dinitrotoluene	2.6	10.4	121-14-2
Endosulfan[5]	60	240	See below[5]
Ethylbenzene	600	2,400	100-41-4
Fluoride	3,000	12,000	
Fluroxypyr	40	160	69377-81-7
Lead	100	400	

Contaminant	Maximum values of *specific contaminant concentration* (SCC) for classification without TCLP		CAS Registry Number
	General solid waste[1]	Restricted solid waste	
	CT1 (mg/kg)	CT2 (mg/kg)	
Mercury	4	16	
Methyl ethyl ketone	4,000	16,000	78-93-3
Moderately harmful pesticides[6] (total)	250	1,000	See below[6]
Molybdenum	100	400	
Nickel	40	160	
Nitrobenzene	40	160	98-95-3
C6–C9 petroleum hydrocarbons[7]	650	2,600	
C10–C36 petroleum hydrocarbons[7]	10,000	40,000	
Phenol (non-halogenated)	288	1,152	108-95-2
Picloram	60	240	1918-02-1
Plasticiser compounds[8]	20	80	See below[8]
Polychlorinated biphenyls[9]	<50	<50	1336-36-3
Polycyclic aromatic hydrocarbons (total)[10]	200	800	
Scheduled chemicals[11]	<50	<50	
Selenium	20	80	
Silver	100	400	
Styrene (vinyl benzene)	60	240	100-42-5
Tebuconazole	128	512	107534-96-3
1,2,3,4-Tetrachlorobenzene	10	40	634-66-2
1,1,1,2-Tetrachloroethane	200	800	630-20-6
1,1,2,2-Tetrachloroethane	26	104	79-34-5
Tetrachloroethylene	14	56	127-18-4
Toluene	288	1,152	108-88-3
1,1,1-Trichloroethane	600	2,400	71-55-6
1,1,2-Trichloroethane	24	96	79-00-5
Trichloroethylene	10	40	79-01-6
2,4,5-Trichlorophenol	8,000	32,000	95-95-4
2,4,6-Trichlorophenol	40	160	88-06-2
Triclopyr	40	160	55335-06-3

Contaminant	Maximum values of *specific contaminant concentration* (SCC) for classification without TCLP		CAS Registry Number
	General solid waste[1]	Restricted solid waste	
	CT1 (mg/kg)	CT2 (mg/kg)	
Vinyl chloride	4	16	75-01-4
Xylenes (total)	1,000	4,000	1330-20-7

Notes

1. Values are the same for general solid waste (putrescible) and general solid waste (non-putrescible).
2. There may be a need for the laboratory to concentrate the sample to achieve the TCLP limit value for benzo(a)pyrene with confidence.
3. These limits apply to chromium in the +6 oxidation state only.
4. Analysis for cyanide (amenable) is the established method for assessing potentially leachable cyanide. The EPA may consider other methods if it can be demonstrated that these methods yield the same information.
5. Endosulfan (CAS Registry Number 115-29-7) means the total of Endosulfan I (CAS Registry Number 959-98-8), Endosulfan II (CAS Registry Number 891-86-1) and Endosulfan sulfate (CAS Registry Number 1031-07-8).
6. The following moderately harmful pesticides are to be included in the total values specified:

Moderately harmful pesticides (total)			
Name	CAS Registry Number	Name	CAS Registry Number
Atrazine	1912-24-9	Imidacloprid	138261-41-3
Azoxystrobin	131860-33-8	Indoxacarb	173584-44-6
Bifenthrin	82657-04-3	Malathion (Maldison)	121-75-5
Brodifacoum	56073-10-0	Metalaxyl	57837-19-1
Carboxin	5234-68-4	Metalaxyl-M	70630-17-0
Copper naphthenate	1338-02-9	Methidathion	950-37-8
Cyfluthrin	68359-37-5	3-Methyl-4-chlorophenol	59-50-7
Cyhalothrin	68085-85-8	Methyl chlorpyrifos	5598-13-0
Cypermethrin	52315-07-08	N-Methyl pyrrolidone	872-50-4
Deltamethrin	52918-63-5	2-octylthiazol-3-one	26530-20-1
Dichlofluanid	1085-98-9	Oxyfluorfen	42874-03-3
Dichlorvos	62-73-7	Paraquat dichloride	1910-42-5
Difenoconazole	119446-68-3	Parathion methyl	298-00-0
Dimethoate	60-51-5	Permethrin	52645-53-1
Diquat dibromide	85-00-7	Profenofos	41198-08-7
Emamectin benzoate	137515-75-4 & 155569-91-8	Prometryn	7287-19-6
Ethion	563-12-2	Propargite	2312-35-8
Fenthion	55-38-9	Pentachloronitrobenzene (Quintozene)	82-68-8
Fenitrothion	122-14-5	Simazine	122-34-9
Fipronil	120068-37-3	Thiabendazole	148-79-8

Moderately harmful pesticides (total)			
Name	**CAS Registry Number**	**Name**	**CAS Registry Number**
Fluazifop-P-butyl	79241-46-6	Thiamethoxam	153719-23-4
Fludioxonil	131341-86-1	Thiodicarb	59669-26-0
Glyphosate	1071-83-6	Thiram	137-26-8

7. Approximate range of petroleum hydrocarbon fractions: petrol C6–C9, kerosene C10–C18, diesel C12–C18, and lubricating oils above C18. Laboratory results are reported as four different fractions: C6–C9, C10–C14, C15–C28 and C29–C36. The results of total petroleum hydrocarbons (TPH) (C10–C36) analyses are reported as a sum of the relevant three fractions. Please note that hydrocarbons are defined as molecules that only contain carbon and hydrogen atoms. Prior to TPH (C10–C36) analysis, clean-up may be necessary to remove non-petroleum hydrocarbon compounds. Where the presence of other materials that will interfere with the analysis may be present, such as oils and fats from food sources, you are advised to treat the extract that has been solvent exchanged to hexane with silica gel as described in *USEPA Method 1664A* (USEPA 2000).
8. Plasticiser compounds means the total of di-2-ethyl hexyl phthalate (CAS Registry Number 117-81-7) and di-2-ethyl hexyl adipate (CAS Registry Number 103-23-1) contained within a waste.
9. Polychlorinated biphenyls must be managed in accordance with the EPA's polychlorinated biphenyl (PCB) chemical control order 1997, which is available on the EPA website at www.epa.nsw.gov.au/resources/pesticides/pcbcco1997.pdf.
10. The following polycyclic aromatic hydrocarbons (PAHs) are assessed as the total concentration of 16 USEPA Priority Pollutant PAHs, as follows:

Polycyclic aromatic hydrocarbons (total)			
PAH name	**CAS Registry Number**	**PAH name**	**CAS Registry Number**
Acenaphthene	83-32-9	Chrysene	218-01-9
Acenaphthylene	208-96-8	Dibenzo(a,h)anthracene	53-70-3
Anthracene	120-12-7	Fluoranthene	206-44-0
Benzo(a)anthracene	56-55-3	Fluorene	86-73-7
Benzo(a)pyrene	50-32-8	Indeno(1,2,3-cd)pyrene	193-39-5
Benzo(b)fluoranthene	205-99-2	Naphthalene	91-20-3
Benzo(ghi)perylene	191-24-2	Phenanthrene	85-01-8
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0

11. Scheduled chemicals must be managed in accordance with the EPA's scheduled chemical wastes chemical control order 2004, which is available on the EPA website at www.epa.nsw.gov.au/resources/pesticides/scwcco2004.pdf.

    The following scheduled chemicals are to be included in the total values specified:

Scheduled chemicals (total)			
Name	**CAS Registry Number**	**Name**	**CAS Registry Number**
Aldrin	309-00-2	Heptachlor	76-44-8
Alpha-BHC	319-84-6	Heptachlor epoxide	1024-57-3
Beta-BHC	319-85-7	Hexachlorobenzene	118-74-1
Gamma-BHC (Lindane)	58-89-9	Hexachlorophene	70-30-4
Delta-BHC	319-86-8	Isodrin	465-73-6

Scheduled chemicals (total)			
Name	**CAS Registry Number**	**Name**	**CAS Registry Number**
Chlordane	57-74-9	Pentachlorobenzene	608-93-5
DDD	72-54-8	Pentachloronitrobenzene	82-68-8
DDE	72-55-9	Pentachlorophenol	87-86-5
DDT	50-29-3	1,2,4,5-Tetrachlorobenzene	95-94-3
Dieldrin	60-57-1	2,3,4,6-Tetrachlorophenol	58-90-2
Endrin	72-20-8	1,2,4-Trichlorobenzene	120-82-1
Endrin aldehyde	7421-93-4	2,4,5-Trichlorophenoxyacetic acid, salts and esters	93-76-5

Table 2: TCLP and SCC values for classifying waste by chemical assessment

For disposal requirements for organic and inorganic chemical contaminants not listed below, contact the EPA. Aluminium, barium, boron, chromium (0 and III oxidation states), cobalt, copper, iron, manganese, vanadium and zinc have not been listed with values in this table and need not be tested for.

Contaminant	Maximum values for *leachable concentration* and *specific contaminant concentration* when used together				CAS Registry Number
	General solid waste[1]		Restricted solid waste		
	Leachable concentration	Specific contaminant concentration	Leachable concentration	Specific contaminant concentration	
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)	
Arsenic	5.0[2]	500	20	2,000	
Benzene	0.5[2]	18	2	72	71-43-2
Benzo(a)pyrene[3]	0.04[4]	10	0.16	23	50-32-8
Beryllium	1.0[5]	100	4	400	
Cadmium	1.0[2]	100	4	400	
Carbon tetrachloride	0.5[2]	18	2	72	56-23-5
Chlorobenzene	100[2]	3,600	400	14,400	108-90-7
Chloroform	6[2]	216	24	864	67-66-3
Chlorpyrifos	0.2	7.5	0.8	30	2921-88-2
Chromium (VI)[6]	5[2]	1,900	20	7,600	
m-Cresol	200[2]	7,200	800	28,800	108-39-4
o-Cresol	200[2]	7,200	800	28,800	95-48-7
p-Cresol	200[2]	7,200	800	28,800	106-44-5
Cresol (total)	200[2]	7,200	800	28,800	1319-77-3
Cyanide (amenable)[7, 8]	3.5[7]	300	14	1,200	
Cyanide (total)[7]	16[7]	5,900	64	23,600	
2,4-D	10[2]	360	40	1,440	94-75-7
1,2-Dichlorobenzene	4.3[2]	155	17.2	620	95-50-1
1,4-Dichlorobenzene	7.5[2]	270	30	1,080	106-46-7
1,2-Dichloroethane	0.5[2]	18	2	72	107-06-2
1,1-Dichloroethylene	0.7[2]	25	2.8	100	75-35-4
Dichloromethane	8.6[2]	310	34.4	1,240	75-09-2
2,4-Dinitrotoluene	0.13[2]	4.68	0.52	18.7	121-14-2
Endosulfan[9]	3	108	12	432	See below[9]

Contaminant	Maximum values for *leachable concentration* and *specific contaminant concentration* when used together				CAS Registry Number
	General solid waste[1]		Restricted solid waste		
	Leachable concentration	Specific contaminant concentration	Leachable concentration	Specific contaminant concentration	
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)	
Ethylbenzene	30[10]	1,080	120	4,320	100-41-4
Fluoride	150[10]	10,000	600	40,000	
Fluroxypyr	2	75	8	300	69377-81-7
Lead	5[2]	1,500	20	6,000	
Mercury	0.2[2]	50	0.8	200	
Methyl ethyl ketone	200[2]	7,200	800	28,800	78-93-3
Moderately harmful pesticides[11](total)	N/A[12]	250	N/A[12]	1,000	See below[11]
Molybdenum	5[10]	1,000	20	4,000	
Nickel	2[10]	1,050	8	4,200	
Nitrobenzene	2[2]	72	8	288	98-95-3
C6–C9 petroleum hydrocarbons[13]	N/A[12]	650	N/A[12]	2,600	
C10–C36 petroleum hydrocarbons[13]	N/A[12]	10,000	N/A[12]	40,000	
Phenol (non-halogenated)	14.4[14]	518	57.6	2,073	108-95-2
Picloram	3	110	12	440	1918-02-1
Plasticiser compounds[15]	1	600	4	2,400	See below[15]
Polychlorinated biphenyls[12]	N/A[12]	< 50	N/A[12]	< 50	1336-36-3
Polycyclic aromatic hydrocarbons (total)[16]	N/A[12]	200	N/A[12]	800	
Scheduled chemicals[17]	N/A[12]	< 50	N/A[12]	< 50	See below[17]
Selenium	1[2]	50	4	200	
Silver	5.0[2]	180	20	720	
Styrene (vinyl benzene)	3[10]	108	12	432	100-42-5
Tebuconazole	6.4	230	25.6	920	107534-96-3
1,2,3,4-Tetrachlorobenzene	0.5	18	2	72	634-66-2

Contaminant	Maximum values for *leachable concentration* and *specific contaminant concentration* when used together				CAS Registry Number
	General solid waste[1]		Restricted solid waste		
	Leachable concentration	Specific contaminant concentration	Leachable concentration	Specific contaminant concentration	
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)	
1,1,1,2-Tetrachloroethane	10[2]	360	40	1,440	630-20-6
1,1,2,2-Tetrachloroethane	1.3[2]	46.8	5.2	187.2	79-34-5
Tetrachloroethylene	0.7[2]	25.2	2.8	100.8	127-18-4
Toluene	14.4[14]	518	57.6	2,073	108-88-3
1,1,1-Trichloroethane	30[2]	1,080	120	4,320	71-55-6
1,1,2-Trichloroethane	1.2[2]	43.2	4.8	172.8	79-00-5
Trichloroethylene	0.5[2]	18	2	72	79-01-6
2,4,5-Trichlorophenol	400[2]	14,400	1,600	57,600	95-95-4
2,4,6-Trichlorophenol	2[2]	72	8	288	88-06-2
Triclopyr	2	75	8	300	55335-06-3
Vinyl chloride	0.2[2]	7.2	0.8	28.8	75-01-4
Xylenes (total)	50[18]	1,800	200	7,200	1330-20-7

Notes

1. Values are the same for general solid waste (putrescible) and general solid waste (non- putrescible).
2. See *Hazardous Waste Management System: Identification and Listing of Hazardous Waste – Toxicity Characteristics Revisions, Final Rule* (USEPA 2012b) for TCLP levels.
3. There may be a need for the laboratory to concentrate the sample to achieve the TCLP limit value for benzo(a)pyrene with confidence.
4. Calculated from *Hazardous Waste: Identification and Listing* (USEPA 2012a).
5. Calculated from 'Beryllium' in *The Health Risk Assessment and Management of Contaminated Sites* (DiMarco & Buckett 1996).
6. These limits apply to chromium in the +6 oxidation state only.
7. Taken from the *Land Disposal Restrictions for Newly Identified and Listed Hazardous Wastes and Hazardous Soil: Proposed Rule* (USEPA 1993).
8. Analysis for cyanide (amenable) is the established method used to assess the potentially leachable cyanide. The EPA may consider other methods if it can be demonstrated that these methods yield the same information.
9. Endosulfan (CAS Registry Number 115-29-7) means the total of endosulfan I (CAS Registry Number 959-98-8), endosulfan II (CAS Registry Number 891-86-1) and endosulfan sulfate (CAS Registry Number 1031-07-8).
10. Calculated from *Australian Drinking Water Guidelines* (NHMRC 2011).
11. The following moderately harmful pesticides are to be included in the total values specified:

Moderately harmful pesticides (total)			
Name	**CAS Registry Number**	**Name**	**CAS Registry Number**
Atrazine	1912-24-9	Imidacloprid	138261-41-3
Azoxystrobin	131860-33-8	Indoxacarb	173584-44-6
Bifenthrin	82657-04-3	Malathion (Maldison)	121-75-5
Brodifacoum	56073-10-0	Metalaxyl	57837-19-1
Carboxin	5234-68-4	Metalaxyl-M	70630-17-0
Copper naphthenate	1338-02-9	Methidathion	950-37-8
Cyfluthrin	68359-37-5	3-Methyl-4-chlorophenol	59-50-7
Cyhalothrin	68085-85-8	Methyl chlorpyrifos	5598-13-0
Cypermethrin	52315-07-08	N-Methyl pyrrolidone	872-50-4
Deltamethrin	52918-63-5	2-octylthiazol-3-one	26530-20-1
Dichlofluanid	1085-98-9	Oxyfluorfen	42874-03-3
Dichlorvos	62-73-7	Paraquat dichloride	1910-42-5
Difenoconazole	119446-68-3	Parathion methyl	298-00-0
Dimethoate	60-51-5	Permethrin	52645-53-1
Diquat dibromide	85-00-7	Profenofos	41198-08-7
Emamectin benzoate	137515-75-4 & 155569-91-8	Prometryn	7287-19-6
Ethion	563-12-2	Propargite	2312-35-8
Fenthion	55-38-9	Pentachloronitrobenzene (Quintozene)	82-68-8
Fenitrothion	122-14-5	Simazine	122-34-9
Fipronil	120068-37-3	Thiabendazole	148-79-8
Fluazifop-P-butyl	79241-46-6	Thiamethoxam	153719-23-4
Fludioxonil	131341-86-1	Thiodicarb	59669-26-0
Glyphosate	1071-83-6	Thiram	137-26-8

12. No TCLP analysis is required. Moderately harmful pesticides, petroleum hydrocarbons, polychlorinated biphenyls, polycyclic aromatic hydrocarbons and scheduled chemicals are assessed using SCC1 and SCC2.

    Polychlorinated biphenyls must be managed in accordance with the EPA's polychlorinated biphenyl (PCB) chemical control order 1997, which is available on the EPA website at www.epa.nsw.gov.au/resources/pesticides/pcbcco1997.pdf.

13. Approximate range of petroleum hydrocarbon fractions: petrol C6–C9, kerosene C10–C18, diesel C12–C18, and lubricating oils above C18. Laboratory results are reported as four different fractions: C6–C9, C10–C14, C15–C28 and C29–C36. The results of total petroleum hydrocarbons (C10–C36) analyses are reported as a sum of the relevant three fractions. Please note that hydrocarbons are defined as molecules that only contain carbon and hydrogen atoms. Prior to TPH (C10–C36) analysis, clean-up may be necessary to remove non-petroleum hydrocarbon compounds. Where the presence of other materials that will interfere with the analysis may be present, such as oils and fats from food sources, you are advised to treat the extract that has been solvent exchanged to hexane with silica gel as described in USEPA *Method 1664A* (USEPA 2000).

14. Proposed level for phenol and toluene in *Hazardous Waste Management System: Identification and Listing of Hazardous Waste – Toxicity Characteristics Revisions, Final Rule* (USEPA 2012b).

15. Plasticiser compounds means the total of di-2-ethyl hexyl phthalate (CAS Registry Number 117-81-7) and di-2-ethyl hexyl adipate (CAS Registry Number 103-23-1) contained within a waste.
16. The following polycyclic aromatic hydrocarbons are assessed as the total concentration of 16 USEPA Priority Pollutant PAHs, as follows:

Polycyclic aromatic hydrocarbons (total)			
PAH name	**CAS Registry Number**	**PAH name**	**CAS Registry Number**
Acenaphthene	83-32-9	Chrysene	218-01-9
Acenaphthylene	208-96-8	Dibenzo(a,h)anthracene	53-70-3
Anthracene	120-12-7	Fluoranthene	206-44-0
Benzo(a)anthracene	56-55-3	Fluorene	86-73-7
Benzo(a)pyrene	50-32-8	Indeno(1,2,3-cd)pyrene	193-39-5
Benzo(b)fluoranthene	205-99-2	Naphthalene	91-20-3
Benzo(ghi)perylene	191-24-2	Phenanthrene	85-01-8
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0

17. Scheduled chemicals must be managed in accordance with the EPA's scheduled chemical wastes chemical control order 2004, which is available on the EPA website at www.epa.nsw.gov.au/resources/pesticides/scwcco2004.pdf.

    The following scheduled chemicals are to be included in the total values specified:

Scheduled chemicals (total)			
Name	**CAS Registry Number**	**Name**	**CAS Registry Number**
Aldrin	309-00-2	Heptachlor	76-44-8
Alpha-BHC	319-84-6	Heptachlor epoxide	1024-57-3
Beta-BHC	319-85-7	Hexachlorobenzene	118-74-1
Gamma-BHC (Lindane)	58-89-9	Hexachlorophene	70-30-4
Delta-BHC	319-86-8	Isodrin	465-73-6
Chlordane	57-74-9	Pentachlorobenzene	608-93-5
DDD	72-54-8	Pentachloronitrobenzene	82-68-8
DDE	72-55-9	Pentachlorophenol	87-86-5
DDT	50-29-3	1,2,4,5-Tetrachlorobenzene	95-94-3
Dieldrin	60-57-1	2,3,4,6-Tetrachlorophenol	58-90-2
Endrin	72-20-8	1,2,4-Trichlorobenzene	120-82-1
Endrin aldehyde	7421-93-4	2,4,5-Trichlorophenoxyacetic acid, salts and esters	93-76-5

18. Calculated from *Guidelines for Drinking Water Quality* (WHO 2011).

Table 1A(1) Health investigation levels for soil contaminants (including PFAS)

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Metals and Inorganics				
Arsenic[2]	100	500	300	3 000
Beryllium	60	90	90	500
Boron	4500	40 000	20 000	300 000
Cadmium	20	150	90	900
Chromium (VI)	100	500	300	3600
Cobalt	100	600	300	4000
Copper	6000	30 000	17 000	240 000
Lead[3]	300	1200	600	1 500
Manganese	3800	14 000	19 000	60 000
Mercury (inorganic)[5]	40	120	80	730
Methyl mercury[4]	10	30	13	180
Nickel	400	1200	1200	6 000
Selenium	200	1400	700	10 000
Zinc	7400	60 000	30 000	400 000
Cyanide (free)	250	300	240	1 500
Polycyclic Aromatic Hydrocarbons (PAHs)				
Carcinogenic PAHs (as BaP TEQ)[6]	3	4	3	40
Total PAHs[7]	300	400	300	4000
Phenols				
Phenol	3000	45 000	40 000	240 000
Pentachlorophenol	100	130	120	660
Cresols	400	4 700	4 000	25 000
Organochlorine Pesticides				
DDT+DDE+DDD	240	600	400	3600
Aldrin and dieldrin	6	10	10	45
Chlordane	50	90	70	530
Endosulfan	270	400	340	2000
Endrin	10	20	20	100

Table 1A(1) Health investigation levels for soil contaminants (including PFAS)

Chemical	Health-based investigation levels (mg/kg)			
	Residential[1] A	Residential[1] B	Recreational[1] C	Commercial/ industrial[1] D
Heptachlor	6	10	10	50
HCB	10	15	10	80
Methoxychlor	300	500	400	2500
Mirex	10	20	20	100
Toxaphene	20	30	30	160
Herbicides				
2,4,5-T	600	900	800	5000
2,4-D	900	1600	1300	9000
MCPA	600	900	800	5000
MCPB	600	900	800	5000
Mecoprop	600	900	800	5000
Picloram	4500	6600	5700	35000
Other Pesticides				
Atrazine	320	470	400	2500
Chlorpyrifos	160	340	250	2000
Bifenthrin	600	840	730	4500
Other Organics				
PCBs[8]	1	1	1	7
PBDE Flame Retardants (Br1–Br9)	1	2	2	10
PFAS[9]				
PFOS/PFHxS	0.009	2	1	20
PFOA	0.1	20	10	50

Notes:

(1) Generic land uses are described in detail in Schedule B7 Section 3

HIL A – Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.

HIL B – Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.

HIL C – Public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and footpaths. This does not include undeveloped public open space where the potential for exposure is lower and where a site-specific assessment may be more appropriate.

HIL D – Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.

(2) Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7).

(3) Lead: HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.

(4) Methyl mercury: assessment of methyl mercury should only occur where there is evidence of its potential source. It may be associated with inorganic mercury and anaerobic microorganism activity in aquatic environments. In addition the reliability and quality of sampling/analysis should be considered.

(5) Elemental mercury: HIL does not address elemental mercury. A site-specific assessment should be considered if elemental mercury is present, or suspected to be present,

(6) Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.

PAH species	TEF	PAH species	TEF
Benzo(a)anthracene	0.1	Benzo(g,h,i)perylene	0.01
Benzo(a)pyrene	1	Chrysene	0.01
Benzo(b+j)fluoranthene	0.1	Dibenz(a,h)anthracene	1
Benzo(k)fluoranthene	0.1	Indeno(1,2,3-c,d)pyrene	0.1

Where the B(a)P occurs in bitumen fragments it is relatively immobile and does not represent a significant health risk.

(7) Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (WHO 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant HSL.

(8) PCBs: HIL relates to non-dioxin-like PCBs only. Where a PCB source is known, or suspected, to be present at a site, a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) should be undertaken.

(9) Heads of EPAs Australia and New Zealand (HEPA) and the Australian Government Department of the Environment and Energy (DoEE) – "PFAS National Environmental Management Plan – January 2018"

Table 1A(3) Soil HSLs for vapour intrusion (mg/kg)

CHEMICAL	HSL A & HSL B Low – high density residential				HSL C recreational / open space				HSL D Commercial / Industrial				Soil saturation concentration (Cast)
	0 m to <1 m	1 m to <2 m	2 m to <4m	4 m+	0 m to <1 m	1 m to <2 m	2 m to <4m	4 m+	0 m to <1 m	1 m to <2 m	2 m to <4m	4 m+	
SAND													
Toluene	160	220	310	540	NL	NL	NL	NL	NL	NL	NL	NL	560
Ethylbenzene	55	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	64
Xylenes	40	60	95	170	NL	NL	NL	NL	230	NL	NL	NL	300
Naphthalene	3	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	9
Benzene	0.5	0.5	0.5	0.5	NL	NL	NL	NL	3	3	3	3	360
F1	45	70	110	200	NL	NL	NL	NL	260	370	630	NL	950
F2	110	240	440	NL	NL	NL	NL	NL	NL	NL	NL	NL	560
SILT													
Toluene	390	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	640
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	69
Xylenes	95	210	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	4	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.6	0.7	1	2	NL	NL	NL	NL	4	4	6	10	440
F1	40	65	100	190	NL	NL	NL	NL	250	360	590	NL	910
F2	230	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	570
CLAY													
Toluene	480	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	630
Ethylbenzene	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	68
Xylenes	110	310	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	330
Naphthalene	5	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	10
Benzene	0.7	1	2	3	NL	NL	NL	NL	4	6	9	20	430
F1	50	90	150	290	NL	NL	NL	NL	310	480	NL	NL	850
F2	280	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	560

Table 1 B(7): Management Limits for TPH fractions F1 - F4 in soil

TPH fraction	Soil texture	Management Limits1 (mg/kg dry soil)	
		Residential, parkland and public open space	Commercial and industrial
F1[2] C6- C10	Coarse	700	700
	Fine	800	800
F2[2] >C10-C16	Coarse	1000	1000
	Fine	1000	1000
F3 >C16-C34	Coarse	2500	3500
	Fine	3500	5000
F4 >C34-C40	Coarse	10 000	10 000
	Fine	10 000	10 000

Table 7: Health screening levels for asbestos contamination in soil

Form of asbestos	Health Screening Level (w/w)			
	Residential A[1]	Residential B[2]	Recreational C[3]	Commercial/ Industrial D[4]
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

Notes:

1. Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.
2. Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.
3. Recreational C includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths.
4. Commercial/industrial D includes premises such as shops, offices, factories and industrial sites.
5. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures (refer Section 4.10). This screening level is not applicable to free fibres.