REPORT TO

HELM PTY LTD

ON

REMEDIATION ACTION PLAN

FOR

PROPOSED RESIDENTIAL DEVELOPMENT

AT

118, 120, 122, & 124 BENELONG ROAD AND 72 GERARD STREET, CREMORNE, NSW

Date: 7 February 2025
Ref: E36901Prpt3-RAP

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Executive Summary

HELM Pty Ltd ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed residential development at 118, 120, 122, & 124 Benelong Road and 72 Gerard Street, Cremorne, NSW ('the site'). The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in Appendix A.

Previous investigations at the site identified historically imported fill soils impacted by heavy metals and hydrocarbons, which are primarily suspected to be associated with ash and slag within the fill/soil matrix. A localised area of soil impacted by asbestos was also identified. Remediation of the site is required to mitigate potential risks associated with these contaminants. A summary of the previous investigation findings is provided in Section 2.

This RAP has been prepared to support the lodgement of a Development Application (DA) to North Sydney Council, with regards to Chapter 4 (Clause 4.6) of State Environmental Planning Policy (Resilience and Hazards) 2021. It is understood that the proposed development includes the demolition/removal of the existing buildings/structures, followed by construction of a residential apartment building over three basement levels. From the proposed development plans provided, it appears that excavation to a depth of approximately 14-15m may occur at the high end of the site, and the excavation depth at the low end of the site may be in the order of 9-10m to construct the basements. The basement excavation will be set back from the northern, eastern, southern and western site boundaries by approximately 7m, 5m, 6m and 7m, respectively. It is understood that there will be ground level landscaping in common areas and accessible soils within the yards of the ground floor apartments.

The goal of the remediation is to reduce contamination-related risks to human health and the environment, and to render the site suitable for the proposed development from a contamination viewpoint. The primary aim of the remediation at the site is to mitigate risks from heavy metals, hydrocarbons and asbestos in fill/soil. The objectives of this RAP are to:

- Provide a framework to address the data gaps;
- Provide a rationale to support the extent of proposed remediation and the remedial/validation approach;
- Provide a methodology to remediate and validate the site;
- Provide a contingency plan for the remediation works;
- Outline site management procedures to be implemented during remediation work; and
- Provide an unexpected finds protocol to be implemented during the development works.

The proposed remediation strategy includes 'excavation and off-site disposal' of contaminated fill/soil to a suitably licensed landfill. This process aligns closely with the proposed development works which include excavation for a proposed basement. The strategy is therefore easy to implement and is expected to be effective and successful to mitigate contamination risks.

The RAP also includes requirements for an additional round of groundwater sampling, and also for additional soil sampling (in previously inaccessible areas) which is to occur following demolition in order to confirm the waste classification for the soils.

The anticipated sequence of remediation works is outlined in Section 5.3 of this RAP. Remediation will occur prior to the commencement of the built form of the development. The validation report is expected to be prepared prior to the commencement of construction.

We are of the opinion that the site can be made suitable for the proposed development via remediation and the implementation of this RAP. A site validation report is to be prepared on completion of remediation activities and submitted to the consent authority to demonstrate that the site is suitable for the proposed development following completion of remediation/validation.

The conclusions and recommendations should be read in conjunction with the limitations presented in the body of this report.

Table of Contents

List of Tables

Attachments

Abbreviations

Asbestos Containing Material	**ACM**
Asbestos Fines/Fibrous Asbestos	**AF/FA**
Asbestos Management Plan	**AMP**
Area of Environmental Concern	**AEC**
Australian Height Datum	**AHD**
Acid Sulfate Soil	**ASS**
Below Ground Level	**BGL**
Benzene, Toluene, Ethylbenzene, Xylene	**BTEX**
Contaminated Land Management	**CLM**
Construction Environmental Management Plan	**CEMP**
Contaminant(s) of Potential Concern	**CoPC**
Chain of Custody	**COC**
Conceptual Site Model	**CSM**
Development Application	**DA**
Data Quality Indicator	**DQI**
Data Quality Objective	**DQO**
Detailed Site Investigation	**DSI**
Ecological Investigation Level	**EIL**
Ecological Screening Level	**ESL**
Environmental Management Plan	**EMP**
Environment Protection Authority	**EPA**
Fibre Cement Fragment(s)	**FCF**
General Approval of Immobilisation	**GAI**
Health Investigation Level	**HIL**
Health Screening Level	**HSL**
International Organisation of Standardisation	**ISO**
JK Environments	**JKE**
Lab Control Spike	**LCS**
Map Grid of Australia	**MGA**
National Association of Testing Authorities	**NATA**
National Environmental Protection Measure	**NEPM**
Organochlorine Pesticides	**OCP**
Organophosphate Pesticides	**OPP**
Polycyclic Aromatic Hydrocarbons	**PAH**
Polychlorinated Biphenyls	**PCB**
Photo-ionisation Detector	**PID**
Protection of the Environment Operations	**POEO**
Practical Quantitation Limit	**PQL**
Quality Assurance	**QA**
Quality Control	**QC**
Residential Aged Care	**RAC**
Remediation Action Plan	**RAP**
Remedial Works Plan	**RWP**
Relative Percentage Difference	**RPD**
Site Assessment Criteria	**SAC**
Sampling, Analysis and Quality Plan	**SAQP**
State Environmental Planning Policy	**SEPP**
Source, Pathway, Receptor	**SPR**
Standing Water Level	**SWL**
Toxicity Characteristic Leaching Procedure	**TCLP**
Total Recoverable Hydrocarbons	**TRH**
Upper Confidence Limit	**UCL**
United States Environmental Protection Agency	**USEPA**

Virgin Excavated Natural Material	**VENM**
Volatile Organic Compounds	**VOC**
Work Health and Safety	**WHS**

Units

Litres	**L**
Metres BGL	**mBGL**
Metres	**m**
Millilitres	**ml or mL**
Milligrams per Kilogram	**mg/kg**
Milligrams per Litre	**mg/L**
Parts Per Million	**ppm**
Percentage	**%**
Percentage weight for weight	**%w/w**

1 INTRODUCTION

HELM Pty Ltd ('the client') commissioned JK Environments (JKE) to prepare a Remediation Action Plan (RAP) for the proposed residential development at 118, 120, 122, & 124 Benelong Road and 72 Gerard Street, Cremorne, NSW ('the site'). The site location is shown on Figure 1 and the RAP applies to the land within the site boundaries as shown on Figure 2 attached in Appendix A.

This RAP has been prepared to support the lodgement of a Development Application (DA) to North Sydney Council, with regards to Chapter 4 (Clause 4.6) of State Environmental Planning Policy (Resilience and Hazards) 2021[1] (formerly known as SEPP55).

Previous investigations at the site identified historically imported fill soils impacted by heavy metals and hydrocarbons, which are primarily suspected to be associated with ash and slag within the fill/soil matrix. A localised area of soil impacted by asbestos was also identified. Remediation of the site is required to mitigate potential risks associated with these contaminants. A summary of the previous investigation findings is provided in Section 2.

The RAP includes a methodology to remediate and validate the site, to demonstrate that the site can be made suitable for the proposed development from a contamination viewpoint.

This RAP must be read and implemented in conjunction with the recommendations of the geotechnical investigation report prepared by our geotechnical division, JK Geotechnics (JKG) (project Ref: 36901SF).

1.1 Proposed Development Details

It is understood that the proposed development includes the demolition/removal of the existing buildings/structures, followed by construction of a residential apartment building over three basement levels. From the proposed development plans provided, it appears that excavation to a depth of approximately 14-15m may occur at the high end of the site, and the excavation depth at the low end of the site may be in the order of 9-10m to construct the basements. The basement excavation will be set back from the northern, eastern, southern and western site boundaries by approximately 7m, 5m, 6m and 7m, respectively.

It is understood that there will be ground level landscaping in common areas and accessible soils within the yards of the ground floor apartments.

The indicative basement footprint is shown on Figure 2 in Appendix A. A selection of supplied proposed development plans is included in Appendix B.

1.2 Remediation Goal, Aims and Objectives

The goal of the remediation is to reduce contamination-related risks to human health and the environment, and to render the site suitable for the proposed development from a contamination viewpoint. The primary

[1] *State Environmental Planning Policy (Resilience and Hazards) 2021* (NSW) (referred to as SEPP Resilience and Hazards 2021)

aim of the remediation at the site is to mitigate risks from heavy metals, hydrocarbons and asbestos in fill/soil. The objectives of this RAP are to:

- Provide a framework to address the data gaps;
- Provide a rationale to support the extent of proposed remediation and the remedial/validation approach;
- Provide a methodology to remediate and validate the site;
- Provide a contingency plan for the remediation works;
- Outline site management procedures to be implemented during remediation work; and
- Provide an unexpected finds protocol to be implemented during the development works.

1.3 Scope of Work

The RAP was prepared generally in accordance with a JKE proposal (Ref: EP61075P2) of 20 September 2024 and written acceptance from the client of 23 September 2024. The scope of work included review of the previous reports and preparation of a RAP.

The scope of work was undertaken with reference to the National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)[2], Consultants Reporting on Contaminated Land (2020)[3] guidelines, other guidelines made under or with regards to the Contaminated Land Management Act (1997)[4] and SEPP Resilience and Hazards 2021. A list of reference documents/guidelines is included in the appendices.

[2] National Environment Protection Council (NEPC), (2013). *National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013).* (referred to as NEPM 2013)
[3] NSW EPA, (2020). *Consultants reporting on contaminated land, Contaminated Land Guidelines.* (referred to as Consultants Reporting Guidelines)
[4] Contaminated Land Management Act 1997 (NSW) (referred to as CLM Act 1997)

2 SITE INFORMATION

2.1 Summary of Previous Investigations

JKE has previously undertaken a Preliminary Site Investigation (PSI)[5] for the proposed development at the site. The scope of works for the PSI included: a review of site history and other site information; a site walkover inspection; and soil sampling from seven boreholes. A time line summary of the historical land uses and activities is presented in the following table:

Table 2-1: Summary of Historical Land Uses / Activities

Year(s)	On-site - Potential Land Use / Activities	Off-site - Potential Land Use / Activities
1930-Present	Residential: • Cut and fill works to generate required levels across the site during construction of the existing and former structures, and for levelling of yard areas; • Filling around local services; • Buildings and structures (original and existing) of an age indicative of containing hazardous building materials. Possible historical demolition of former outbuildings/sheds in the rear yards of each property; and • Use of pesticides beneath structures and around site.	Residential and commercial (including dry cleaners and service stations/motor garages), upgradient of the site.

The following potential contamination sources/areas of environmental concern (AEC) were identified: imported fill material; use of pesticides; hazardous building materials; and off-site land uses (including dry cleaners and motor garages/service stations).

The boreholes encountered fill materials (i.e. historically imported soils) to depths of approximately 0.2m below ground level (BGL) to 0.8mBGL, underlain by clayey and sandy residual soils and sandstone bedrock. The fill typically comprised silty sandy clay and silty clayey sand with inclusions of sandstone cobbles, igneous and ironstone gravel, brick, concrete, ceramic, tile, glass and metal fragments, ash and slag. No odours or staining were recorded in the fill material during field work. No fibre cement fragments (FCF)/asbestos containing material (ACM) was encountered in the fill material during fieldwork.

Carcinogenic polycyclic aromatic hydrocarbons (PAHs) and lead were identified in fill soils at concentrations that exceeded the health-based Site Assessment Criteria (SAC), and zinc was identified in fill soils at concentrations that exceeded the ecological SAC. The fill depths and SAC exceedances are shown on Figure 3 in Appendix A. A copy of the PSI laboratory results summary tables is also attached in Appendix C.

The PSI did not identify contamination that would preclude the proposed development/use of the site. However, additional investigation was considered to be required to facilitate development of a RAP, and we anticipated that remediation would be required to render the site suitable for the proposed development. A Detailed Site Investigation (DSI) was recommended.

[5] JKE, (2024a). *Report to HELM Pty Ltd on Preliminary Site Investigation for Proposed Residential Development at 118, 120, 122, & 124 Benelong Road and 72 Gerard Street, Cremorne, NSW*. (Ref: E36901Prpt , dated 7 February 2025) (referred to as PSI).

The DSI[6] included a review of existing project information, a site inspection, soil sampling from six boreholes and groundwater sampling from three monitoring wells. The DSI sample locations are also shown on Figure 3 in Appendix A.

The boreholes generally encountered fill materials to depths of approximately 0.2m to 0.9mBGL, underlain by natural residual sandy soils and sandstone bedrock. Multiple fragments of bonded ACM/FCF were encountered in BH103 which was drilled in the rear yard of the 118 Benelong Road property. The soil sample collected at this location also encountered asbestos fines/fibrous asbestos (AF/FA), however, we considered this was associated with the co-located ACM. The asbestos concentrations in soil at this location were above the SAC.

Elevated concentrations of PAHs and lead were identified in the soil samples more broadly across the site, above the health-based SAC. The occurrence of lead, PAHs and asbestos in fill/soil at concentrations that exceeded the SAC confirmed the need for remediation.

Copper, zinc and total recoverable hydrocarbons (TRHs) were also encountered in soil at concentrations that exceeded the ecological SAC. Risks were assessed to be low, however, this is discussed further in Section 3 of this RAP.

Elevated concentrations of cadmium, copper, lead and zinc above the ecological SAC were encountered in the groundwater sampled from MW2, and elevated concentrations of copper were encountered in MW4. We considered that the heavy metals exceedances were likely to be indicative of regional groundwater background concentrations rather than on on-site contamination source. pH levels in all three samples were outside (below) the acceptable range and this too was considered likely to be a regional issue.

TRH F2 was also encountered in the groundwater sample from MW2 at a concentration that exceeded the adopted health-based SAC for vapour intrusion. The occurrence of TRH F2 in one of the three groundwater samples was considered to be anomalous and the DSI noted this could have been attributed to silt in the groundwater. Notwithstanding, the TRH F2 SAC adopted for the DSI was conservative based on site specific assessment criteria (the NEPM 2013 SAC for TRH F2 in groundwater is 1,000µg/L and the concentration reported was 340µg/L) and we were of the opinion that unacceptable groundwater risks from vapour intrusion were unlikely. The DSI stated that another round of groundwater sampling should occur to verify this assessment of risk and this could be undertaken under the purview of the RAP.

Overall, risks from groundwater were expected to be low and acceptable on the provision that any groundwater during construction dewatering is appropriately treated and managed for off-site disposal.

The laboratory results summary tables and borehole logs from the PSI and DSI are attached in Appendix C and the SAC exceedances from the PSI and DSI are shown on Figure 3 in Appendix A.

[6] JKE, (2024b). *Report to HELM Pty Ltd on Detailed Site Investigation for Proposed Residential Development at 118, 120, 122, & 124 Benelong Road and 72 Gerard Street, Cremorne, NSW*. (Ref: E36901Prpt2 , dated 7 February 2025) (referred to as DSI).

2.2 Site Identification

Table 2-2: Site Identification

Current Site Owner (certificate of title):	Michael Cresswell O'Reilly (Lot 1 in DP 932946) Eric Graham Wrigglesworth & Pauline Maria Bramwell (Lot 1 in DP 932513) Leah Cleary (Lot 1 in DP 171543) Regal Benelong Pty Ltd (Lot 1 in DP 169417) Blagoy Stoyanoff & Vera Stoyanoff (Lot 1 in DP 791296)
Site Address, Lot & Deposited Plan:	118 Benelong Road, Cremorne - Lot 1 in DP 932946 120 Benelong Road, Cremorne - Lot 1 in DP 932513 122 Benelong Road, Cremorne - Lot 1 in DP 171543 124 Benelong Road, Cremorne - Lot 1 in DP 169417 72 Gerard Street, Cremorne - Lot 1 in DP 791296
Current Land Use:	Residential
Proposed Land Use:	Residential
Local Government Area:	North Sydney Council
Current Zoning:	R4
Site Area (m^2) (approx.):	2,082m^2
RL (AHD in m) (approx.):	65-66
Geographical Location (decimal degrees) (approx.):	Latitude: -33.826458 Longitude: 151.2298
Site Plans:	Appendix A

2.3 Summary of Site Setting and Description

The site is located in a predominantly residential area of Cremorne and is bound by Gerard Lane to the north, Benelong Road to the west and Gerard Street to the south. The site is located approximately 550m to the south-east of Willoughby Creek which forms part of Middle Harbour.

The regional topography is characterised by a north facing hillside that falls towards Middle Harbour. The site is located towards the crest of the hillside and falls towards the north-west at approximately 5-6°. The ridgeline is located approximately 150m to the south-east of the site, along Military Road.

A walkover inspection of the site was undertaken by JKE for the PSI, and then again on 1 October 2024 for the DSI. At the time of the inspections, the site was occupied by residential properties. Parts of the site appeared to have been levelled to account for the slope and accommodate the existing developments. There were no obvious indicators of contamination on site or in the immediate surrounds.

2.4 Summary of Geology and Hydrogeology

2.4.1 Regional Geology and Subsurface Conditions

Regional geological information was reviewed for the PSI. The information was sourced from the Lotsearch report attached in the appendices. The report indicated that the site is underlain by Hawkesbury Sandstone, which typically consists of medium to coarse grained quartz sandstone with minor shale and laminite lenses.

The boreholes drilled for the PSI/DSI generally encountered shallow fill over residual soil and sandstone. The approximate fill depths at the borehole locations are shown on Figures 2 and 3 in Appendix A.

2.4.2 Hydrogeology and Groundwater

Hydrogeological information presented in the PSI indicated that the regional aquifer on-site and in the areas immediately surrounding the site includes porous, extensive aquifers of low to moderate productivity. There were no nearby registered bores.

Standing water levels (SWLs) measured in the groundwater wells during the DSI ranged from 3.33mBGL to 4.98mBGL (approximately equivalent to RL68.4m to 70.7m).

2.4.3 Water Bodies

Surface water bodies were not identified in the immediate vicinity of the site. The closest surface water body is Willoughby Creek which forms part of Middle Harbour, located approximately 550m to the north-west of the site.

3 SITE CHARACTERISATION AND CONCEPTUAL SITE MODEL

NEPM 2013 defines a CSM as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM for the site is presented in the following sub-sections and is based on the site information and investigation data to date. Reference should also be made to the figures attached in the appendices.

3.1 Summary of Contamination (Site Characterisation)

Based on a review of the proposed development details and future use of the site, potential risks from contaminated soil in the basement/building footprint will be negligible as the basement construction will remove all fill, thus eliminating the risk. Therefore, risks are primarily associated with soil disturbance during the proposed development works, and the contaminated soils in the setback areas that fall outside the basement footprint.

Whilst the occurrence of copper, zinc and TRHs in the fill are unlikely to pose an unacceptable ecological risk in the proposed land use setting given that new landscaping involving the importation of suitable garden mixes, topsoils and mulches etc. will occur, these contaminants will still be considered in the context of the RAP given they are co-located with elevated PAHs, lead and asbestos above the human health-based SAC.

The lead, PAHs and asbestos in fill are the primary risk drivers for remediation. The maximum reported concentrations in fill which exceeded the SAC are as follows:

- Carcinogenic PAHs up to 10mg/kg which exceeded the human health-based SAC of 3mg/kg;
- Lead up to 1,000mg/kg which exceeded the human health-based SAC of 300mg/kg;
- TRH F2 up to 140mg/kg which exceeded the human health-based SAC of 110mg/kg;
- Asbestos as ACM 0.32%w/w and as AF/FA 0.46%w/w which exceeded the health-based SAC of 0.01%w/w and 0.001%w/w respectively;
- TRH F2 and F3 of up to 140mg/kg and 550mg/kg respectively, which exceeded the respective ecological SAC of 120mg/kg and 300mg/kg;
- Copper up to 5,500mg/kg which exceeded the ecological SAC of 90mg/kg; and
- Zinc of up to 770mg/kg which exceeded the ecological SAC of 190mg/kg.

An assessment of data gaps from the DSI is provided in the following table:

Table 3-1: Data Gap Assessment

Data Gap	Assessment
Soil sampling undertaken within building footprint	No soil sampling was undertaken within the building footprints due to access constraints. Sampling must occur in these areas after demolition and this data must also be considered from a waste classification perspective. The RAP includes provisions for this to occur.
Groundwater	Only one groundwater sampling event has occurred. The potentially anomalous TRH result requires further consideration via another round of groundwater sampling/analysis. It is also noted that the addition of another basement level, which we were advised of only at the time of finalising the DSI and this report, warrants further consideration of deeper groundwater. The RAP includes provisions for this to occur.

3.2 CSM

The table below includes a review of the CSM which has been used to design the remediation strategy. The CSM will require further review if additional site data becomes available.

Table 3-2: CSM

Contaminant source(s) and contaminants of concern	**Contamination source:** fill material. **Contaminants of concern for remediation include:** Lead, copper, zinc, PAHs, TRHs, and asbestos. **Potential contamination sources:** use of pesticides (most notably beneath the residential buildings in areas not yet sampled); and hazardous building materials. **Contaminants of potential concern (CoPC)** requiring further investigation/consideration under the RAP framework due to data gap identification in the building footprints include: heavy metals (arsenic, cadmium, chromium, copper, mercury, nickel and zinc); TRHs; benzene, toluene, ethylbenzene and xylenes (BTEX); organochlorine and organophosphate pesticides (OCPs/OPPs); polychlorinated biphenyls (PCBs); and asbestos.
Affected media	**Affected medium for remediation:** fill/soil. Remediation of groundwater is not proposed at this stage in the context of rendering the site suitable for the proposed development. However, it is noted that groundwater requires further investigation (via the pre-remediation validation sampling process) to address the data gaps and this will result in groundwater risks being further assessed.
Receptor identification	Human receptors include site occupants/users (including adults and children), construction workers and intrusive maintenance workers. Off-site human receptors include adjacent land users. Ecological receptors include terrestrial organisms and plants within unpaved areas (including the proposed landscaped areas).
Exposure pathways and mechanisms	Potential exposure pathways relevant to the human receptors include ingestion, dermal absorption and inhalation of dust (all contaminants) and vapours (volatile TRHs, the PAH compound naphthalene, and BTEX). The potential for exposure would typically be associated with the construction and excavation works, and future use of the site. Potential exposure pathways for ecological receptors include primary/direct contact and ingestion. If remediation does not occur, exposure during future site use could occur via direct contact with soil in unpaved areas such as gardens, inhalation of airborne asbestos fibres during soil disturbance, or inhalation of vapours within enclosed spaces such as the building and basement. Exposure to groundwater is unlikely to occur in Middle Harbour through direct migration, however groundwater has the potential to enter the harbour via the stormwater system (which is expected to discharge into the river) in a drained basement scenario, or during temporary construction dewatering. These risks will be managed with regards to the typical regulatory requirements during construction and this does not form part of the RAP.

Evaluation of data gaps	See Table 3-1. A pre-remediation investigation framework is provided in Section 5.3.3 to address these gaps.

3.3 Remediation Extent

Remediation of fill will extend horizontally to the site boundaries (see Figure 4 in Appendix A) and down to the top of the underlying natural soil or sandstone bedrock (whichever is encountered first). The extent of remediation will be confirmed via the validation process.

The fill depths are typically expected to be in the order of approximately 0.2m to 0.5m below the existing ground levels. However, some areas reported slightly deeper fill to a depth of 0.9m in the basement footprint and we note that some boreholes for the PSI and DSI terminated in the fill so there is some uncertainty around fill depths in some areas (although it is noted that these boreholes were largely suspected to have terminated on sandstone bedrock).

The PSI/DSI only encountered asbestos in one location (BH103) and the fill in this borehole was distinct from all other boreholes as it contained large amounts of bonded ACM in the form of FCF. The extent of the asbestos impacts associated with the BH103 area is uncertain and the associated remediation area has been nominally defined at this point in time as shown on Figure 4 in Appendix A. The rationale for defining the asbestos remediation area is based on the assumption that the impacts may be limited to the rear corner of 118 Benelong Road and associated with a localised, historical waste burial event. If this is the case, it is reasonable to expect that the impacts do not extend beyond the fence line into the 72 Gerard Street property to the east or into the 120 Benelong Road property to the south. The southern extent is supported to some degree by the lack of any asbestos in BH102 and BH2.

The fill depths at the previous investigation locations are shown on Figure 4 in Appendix A. Copies of the previous borehole logs are included in Appendix C.

4 REMEDIATION OPTIONS AND PREFERRED REMEDIATION STRATEGY

4.1 Soil Remediation

The NSW EPA follows the hierarchy set out in NEPM 2013 for the remediation of contaminated sites. The preferred order for soil remediation and management is as follows:

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

Or if the above are not practicable:

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

For simplicity herein, the above hierarchy are respectively referred to as Option 1, Option 2, Option 3 etc.

The NSW EPA Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd Edition) (2017)[7] provides the following additional requirements to be taken into consideration:

- Remediation should not proceed in the event that it is likely to cause a greater adverse effect than leaving the site undisturbed; and
- Where there are large quantities of soil with low levels of contamination, alternative strategies should be considered or developed.

The following table discusses and assesses a range of soil remediation options.

4.2 Remediation Options Assessment

The table below discusses and assesses a range of remediation options:

Table 4-1: Consideration of Soil Remediation Options

Option	Discussion	Assessment/Applicability
Option 1 **On-site treatment of contaminated soil**	On-site treatment can provide a mechanism to reuse the processed material, and in some instances, avoid the need for large scale earthworks. Treatment options are contaminant-specific and can include bio-remediation, soil washing, air sparging and soil vapour extraction, and thermal desorption. Physical removal of fibre cement fragment containing asbestos (i.e. ACM) is also possible in some situations.	Not applicable for this site based on the combination of contaminants of concern present in fill (i.e. asbestos, heavy metals and organic compounds). Notwithstanding this constraint, treatment options would not likely be economically viable for the relatively small quantities of soil requiring remediation, nor would they be appropriate given the extent of the proposed basement and the

[7] NSW EPA, (2017). *Contaminated land Management, Guidelines for the NSW Site Auditor Scheme (3rd ed.).* (referred to as Site Auditor Guidelines 2017)

Option	Discussion	Assessment/Applicability
	Depending on the treatment option, licences may be necessary for specific individual waste streams due to the potential for air pollution and the formation of harmful by-products during incineration processes. Licences for re-use of treated material/waste may also be required.	surplus of materials expected to be generated during construction.
Option 2 **Off-site treatment of contaminated soil**	Contaminated soils are excavated, transported to an approved/licensed treatment facility, treated to remove/stabilise the contaminants then returned to the subject site, transported to an alternative site or disposed to an approved landfill facility. This option is also contaminant-specific. The cost per tonne for transport to and from the site and for treatment is considered to be relatively high. The material would also have to be assessed in terms of suitability for reuse as part of the proposed development works under the waste and resource recovery regulatory framework.	Not applicable as noted above.
Option 3 **Consolidation and isolation of impacted soil by cap and containment**	This would include the consolidation of contaminated soil within an appropriately designed cell, followed by the placement of an appropriate barrier over the material to reduce the potential for future disturbance (or capping in-situ beneath appropriate capping layers). The capping and/or containment must be appropriate for the specific contaminants of concern. An ongoing environmental management plan (EMP) would be required and this would need to be publicly notified and made to be legally enforceable (e.g. via listings in the Section 10.7 planning certificate and on the land title).	Not suitable considering the extent of the proposed basement/the need for bulk excavation, and considering the challenges associated with capping fill in landscaped zones when the existing site areas are not intended to be raised substantially above existing levels.
Option 4 **Removal of contaminated material (excavation and disposal) to an appropriate facility and reinstatement with clean material**	Contaminated soils would be classified in accordance with NSW EPA guidelines for waste disposal, excavated and disposed of off-site to a licensed landfill. The material would have to meet the requirements for landfill disposal. Landfill gate/tipping fees would apply in addition to transport costs.	This option is the most applicable for remediation as a majority of the fill at the site will require excavation/disposal to construct the basement. Excavating and disposing of all contaminated fill will eliminate the need for long-term management of the site via an EMP.
Option 5 **Implementation of management strategy**	Contaminated soils would be managed in such a way to reduce risks to the receptors and monitor the conditions over time so that there is an on-going minimisation of risk. This may occur via the implementation of monitoring programs.	Not applicable considering the extent of the proposed development works.

4.3 Rationale for the Preferred Option for Remediation

The preferred option for remediation of the fill is Option 4 (excavation and off-site disposal). This option is considered to be most appropriate for the proposed development based on the following:

- The proposed development includes substantial excavation of the site which will result in the removal of all fill from the basement footprint and beneath the associated shoring wall by default;
- The remaining fill outside the basement footprint is relatively shallow and removing this material concurrently will provide a simple strategy that avoids the need for on-going management of the site via an EMP;
- Excavation of a fill from the entire site/remediation area will require the shortest timeframe for the remedial works and will minimise the potential for cross contamination or validation failure to occur; and
- On and off-site treatment technologies are not considered to be economically viable or technically achievable.

5 REMEDIATION DETAILS

5.1 Roles and Responsibilities

Table 5-1: Roles and Responsibilities

Role	Responsibility
Developer and Project Manager	HELM Pty Ltd The developer is required to appoint the project team for the remediation/validation and must provide all investigation reports including this RAP to the project manager, remediation contractor/principal contractor, consent authority and any other relevant parties involved in the project. The project manager is required to review all documents prepared for the project and manage the implementation of the procedures outlined in this RAP. The project manager is to take reasonable steps so that the remediation contractor and others have understood the RAP and will implement it in its totality. The project manager will review the RAP and other associated documents and will update the parties involved of any changes to the development or remediation sequence (in consultation with the validation consultant).
Principal Contractor	To be confirmed The principal contractor is required to review all documents prepared for the project and manage the implementation of the procedures outlined in this RAP. The principal contractor is to take reasonable steps so that the remediation contractor and others have understood the RAP and will implement it in its totality. The principal contractor will review the RAP and other documents and will update the parties involved of any changes to the development or remediation sequence (in consultation with the validation consultant).
Remediation Contractor	To be confirmed The remediation contractor (this may be the same entity as the principal contractor) is required to review all relevant documents prepared for the project, liaise with the validation consultant so that the pre-remediation investigation and validation tasks are integrated into the project timeline, apply for any relevant removal licences or permits and implement the remediation requirements and relevant validation requirements (that are the remediation contractor's responsibility) outlined in this RAP. The remediation contractor is required to collect all documentation associated with the remediation activities and forward this documentation onto the principal contractor, client and project manager as they become available. The remediation contractor must be (or must subcontract) a Class A licensed asbestos removalist for the remediation activities associated with removal of the asbestos in soil. Whilst the asbestos appeared to be associated with bonded ACM, NEPM 2013 defines asbestos in the form of AF/FA as 'friable', therefore the associated remediation works will also be deemed as friable asbestos removal.

Role	Responsibility
Validation Consultant	To be confirmed The validation consultant[8] provides consulting advice and validation services in relation to the remediation. The validation consultant undertakes the pre-remediation investigation and associated reporting, and prepares the validation report. The validation consultant is required to review any deviation to this RAP or any unexpected finds if and when encountered during the site work. The validation consultant is required to liaise with the principal contractor, client, project manager and remediation contractor on all matters pertaining to the site contamination, remediation and validation, and carry out the required pre-remediation investigation, validation sampling and inspections. The validation consultant must have a Licensed Asbestos Assessor (LAA) on staff to carry out the required asbestos clearance(s).

5.2 Pre-commencement Meeting and Arrangements

The project team is to have a pre-commencement meeting to discuss the sequence of remediation and the remediation and validation tasks. The site management plan for remediation works (see Section 8) must be reviewed by the project manager and remediation contractor, and appropriate steps are to be taken to ensure the adequate implementation of the plan.

5.3 Remediation and Associated Tasks

The following general sequence of works is anticipated:

- Site establishment;
- Demolition/removal of structures;
- Pre-remediation investigation and associated reporting (note: the groundwater sampling aspect of this work could occur prior to demolition); and
- Remediation (and validation) of the site via excavation and off-site disposal of fill, and validation of this process. The excavation of fill will occur over two steps, with the first step removing the asbestos contaminated fill, followed by the second step of removing the remaining fill.

Remediation will occur following demolition. Remediation will be deemed complete following the successful removal of contaminated fill, reinstatement of the remedial excavations as necessary, and validation/documentation of this process.

5.3.1 Site Establishment

The remediation contractor is to establish on site as required to facilitate the remediation. Consideration must be given to the work sequence and extent of remediation so that the site establishment (e.g. site sheds,

[8] The validation consultant should be a certified practitioner (specialising in site contamination), under one of the NSW EPA endorsed certification schemes, i.e. CEnvP SC or equivalent

fencing, access points etc) does not inhibit the remediation works which will involve the removal of all fill across the entire site footprint.

The validation consultant must be advised (by the principal/remediation contractor) if any soil, gravel or engineering materials (e.g. DGB, roadbase etc) are to be imported for the site establishment works. These materials must be validated by the validation consultant in accordance with Section 6 of this RAP to confirm they are suitable to be imported to site.

5.3.2 Demolition of Structures

A suitably qualified consultant is to undertake a hazardous building materials survey and prepare a report for the structures at the site, prior to the commencement of any demolition activities. The demolition of buildings/structures is to occur with regards to the findings of the hazardous building materials consultant's advice/report(s) and must be undertaken in accordance with the relevant codes, standards, guidelines and regulations. All structures and materials are to be removed from the site and clearance certificates are to be provided for the removal of all hazardous materials.

All demolition waste is to be segregated in accordance with AS2601-2017 and disposed of to facilities that are licenced by the NSW EPA to accept the waste. The demolition contractor is to maintain adequate records and retain all documentation for such activities including:

- A summary register including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with waste disposal docket numbers;
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste. Legible dockets are to be provided for all waste materials so they can be reconciled with the register.

The above information is to be supplied to the validation consultant for assessment and inclusion in the site validation report.

5.3.3 Pre-remediation Investigation and Reporting

Prior to the commencement of the pre-remediation investigation, the validation consultant must prepare a detailed Sampling, Analysis and Quality Plan (SAQP) in accordance with the Consultants Reporting Guidelines and NEPM 2013. The investigation must include the following as a minimum:

- An inspection of the site to assess whether there are any unexpected finds or indicators of contamination that required additional investigation;
- Inspection and soil sampling from a minimum of one test pit in each of the building footprints (this includes the main residences, as well as any garages, outbuildings or sheds etc. The following soil sampling and analysis is to occur:
    - Bulk (10L) field asbestos quantification sampling must occur in accordance with the endorsed methods in the NEPM 2013. Any identified FCF are to be weighed/recorded and analysed for asbestos. If any of the FCF are assessed to be in poor condition and can be easily crushed or

pulverised to powder using hand pressure in the field, a separate 500ml soil sample must be collected from the soil at the location/fill profile where such FCF is identified and must be analysed for asbestos using the NEPM 2013 quantification method;

- Samples are to be collected from the surficial soils (including those beneath the slabs/pavements if these have been removed beforehand) and all observed fill profiles, and analysed for: heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, BTEX, PAHs, OCPs and PCBs;

- Leachate (TCLP) analysis is to occur for waste classification purposes and in accordance with the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014)[9] and with regards to the requirements of any applicable General Approval of Immobilisation (GAI);
- An additional round of groundwater sampling is to occur from the existing MW2, and from at least one additional well in the upgradient area of the site installed to an appropriate depth to assess deeper groundwater. This could (and preferably should) occur prior to demolition just in case the wells are damaged during the demolition works. The well must be developed prior to sampling, then sampled using low-flow methods (e.g. peristaltic pump). If MW2 is damaged and cannot be sampled, a replacement well must be reinstalled to facilitate the required sampling;
- The groundwater sample is to be analysed for TRH/BTEX; and
- Appropriate QA/QC samples are to be obtained and analysed for soil and groundwater, with regards to the NEPM 2013 requirements.

On completion of the investigation, a report is to be prepared by the validation consultant in accordance with the Consultants Reporting Guidelines and is to include a Tier 1 risk assessment, review of the CSM and confirmation of the waste classification for the fill. Appropriate site assessment criteria must be applied with regards to Schedule B1 of the NEPM (2013), based on 'residential' with accessible soils (Type A) exposure scenario and consistent with the criteria applied during the DSI for soils and groundwater. The final waste classification must consider all applicable soil data from the PSI and DSI.

The report must include commentary and must draw conclusions regarding the applicability/suitability of the remediation strategy outlined in this RAP. If the remedial approach requires substantial alteration beyond the scope of this RAP, then a Remedial Works Plan (RWP) or revised RAP must be prepared by the validation consultant and submitted to the client/developer, project manager and consent authority (as applicable). The client/developer and project manager must then establish the appropriate course of action in relation to any additional planning/consent requirements prior to making arrangements to carry out the additional works. If deemed necessary, a specialist consultant must be engaged to undertake a site-specific (Tier 2) risk assessment.

The investigation is expected to take approximately 2-3 weeks to complete. This work must be adequately considered in the project timeline and the investigation should be planned then initiated as soon as possible to avoid delays.

[9] NSW EPA, (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* (referred to as Waste Classification Guidelines 2014)

5.3.4 Remediation Details – Excavation/Fill Removal Step 1 (Asbestos Contamination)

The procedure for excavation and disposal of asbestos-contaminated fill in the BH103 remediation area is outlined in the following table:

Table 5-2: Remediation Details – Asbestos-Contaminated Fill

Step	Primary Role/ Responsibility	Procedure
1.	Remediation contractor	Address Stability Issues and Underground Services: Geotechnical advice must be sought regarding the stability of adjacent structures and/or adjacent areas prior to commencing remediation (as required). Stability issues are to be addressed to the satisfaction of a suitably qualified geotechnical engineer. All underground services are to be appropriately disconnected or rerouted to facilitate the works.
2.	Remediation contractor (or nominated Class A licensed sub-contractor)	Establish Asbestos Related Controls and Arrange Licenses and Tracking Requirements: Prior to the commencement of excavation, asbestos related controls, licences and tracking requirements are to be implemented as outlined in the AMP (refer to Section 8.2 of this RAP). The remediation contractor is to take steps to ensure the site management plan in this RAP is implemented for the remediation works.
3.	Remediation contractor (or nominated Class A licensed sub-contractor) Validation consultant/LAA (inspections)	Excavation and Disposal of Asbestos-Contaminated Fill: Remediation will be undertaken as follows: • Submit an application to dispose of the fill (in accordance with the assigned waste classification) to a facility that is appropriately licensed by the NSW EPA to receive the waste, and obtain authorisation to dispose. Establish the required waste tracking using the NSW EPA-endorsed asbestos waste tracking system; • Contact the validation consultant to arrange for the consultant's LAA to be present to witness the remedial excavation works; • The excavation and removal of asbestos-contaminated soil must be completed in accordance with the remediation-phase AMP; • The asbestos remediation area must be marked out using an appropriate method (i.e. star pickets or spray paint), so the extent of remediation is clear to the excavator operator and other relevant parties; • Excavate the fill from the remediation area, down to the surface of the underlying soil/bedrock (whichever is shallower); • Load the fill directly into trucks and dispose of the soil to a facility licensed by the NSW EPA to receive the waste; and • All documents including landfill disposal dockets must be retained by the remediation contractor/asbestos removal contractor and forwarded to the client and validation consultant. This documentation forms a key part of the validation process and is to be included in the validation report.
4.	Validation consultant/LAA	Validation of Excavation: Once all fill is removed to required levels, the base and walls of the excavation are to be validated in accordance with the validation plan outlined in Section 6, which includes bulk field screening and completion of a surface asbestos clearance by a LAA. It is noted that this validation sampling must occur under asbestos-related controls with appropriate personal protective equipment (PPE). In the event of a validation failure, reference must be made to the contingency plan in Section 7.3.

Step	Primary Role/ Responsibility	Procedure
5.	Remediation contractor	Make Safe following Successful Validation: Considering that the fill surrounding the asbestos remediation area will be removed subsequently, the asbestos remediation area is to be made safe via the installation of suitable fencing or an exclusion zone around the excavation, until excavation of the remaining fill occurs. The excavation and immediate surrounds (say 1-2m beyond the excavation footprint) should be covered by plastic or geofabric until the validation is successful.

5.3.5 Remediation Details – Excavation/Fill Removal Step 2 (Remaining Fill)

Following the remediation and successful validation of the asbestos remediation area, the remaining fill at the site is to be remediated. The procedure for excavation of the remaining contaminated fill soil from the site is outlined in the table below:

Table 5-3: Remediation Details – Contaminated Fill

Step	Primary Role/ Responsibility	Procedure
1.	Remediation contractor	Site Management and Geotechnical/Stability: Geotechnical advice must be sought regarding the stability of adjacent structures and/or adjacent areas prior to commencing remediation (as required). Stability issues are to be addressed to the satisfaction of a suitably qualified geotechnical engineer. All underground services are to be appropriately disconnected or rerouted to facilitate the works. The remediation contractor is to take steps to ensure the site management plan in this RAP is implemented for the remediation works.
2.	Remediation contractor and validation consultant	Excavation and Disposal of Fill, Followed by Validation: Remediation will be undertaken as follows: • Submit an application to dispose of the fill (in accordance with the assigned waste classification) to a facility that is appropriately licensed by the NSW EPA to receive the waste, and obtain authorisation to dispose; • Contact the validation consultant to arrange for the consultant's LAA to be present to regularly inspect the remedial excavations; • Excavate the fill from the site, down to the surface of the underlying soil/bedrock (whichever is shallower); • Load the fill directly into trucks and dispose of the soil to a facility licensed by the NSW EPA to receive the waste; and • All documents including landfill disposal dockets must be retained by the remediation contractor/asbestos removal contractor and forwarded to the client and validation consultant. This documentation forms a key part of the validation process and is to be included in the validation report.
3.	Validation consultant	Validation of remedial excavation: Following completion of the fill excavation/removal from the site, the validation consultant is to obtain validation samples in accordance with the validation plan in Section 6 of this RAP. Interim advice is to be provided regarding whether or not the validation has passed or failed prior to proceeding any further.

Step	Primary Role/ Responsibility	Procedure
		In the event of a validation failure, reference must be made to the contingency plan in Section 7.3.
4.	Remediation contractor	Reinstatement of remedial excavations: In the event that any parts of the site need to be filled or levelled following the remedial excavations, this can occur using clean site-won material where appropriate. Attentively, clean imported material can be for the reinstatement, however, this must be validated in accordance with Section 6.

5.4 Remediation Documentation

The remediation contractor must retain all documentation associated with the remediation, including but not limited to:

- Asbestos management documentation, including all relevant notifications and monitoring reports, and clearance certificates where applicable (additional details in this regard are to be outlined in the remediation-phase AMP);
- Waste disposal dockets;
- Photographs of remediation works;
- Waste tracking documentation (see below and the example waste tracking form in Appendix D); and
- Imported materials documentation (see below and the example imported material tracking form in Appendix D).

Copies of these documents must be forwarded to the project manager and the validation consultant for assessment and inclusion in the validation report.

5.4.1 Waste Register

All waste removed from the site is to be appropriately classified, tracked and managed in accordance with the relevant guidelines and regulations. The remediation contractor is to maintain adequate records and retain all documentation for waste disposal activities including:

- A summary register (in Microsoft Excel format) including details such as waste disposal dates, waste materials descriptions, disposal locations (i.e. facility details) and reconciliation of this information with the associated waste classification documentation and the waste disposal docket numbers;
- Waste tracking records and transport certificates (where waste is required to be tracked/transported in accordance with the regulations); and
- Disposal dockets for the waste (i.e. weighbridge dockets for each load).

Any soil waste classification documentation is to be prepared in accordance with the reporting requirements specified by the NSW EPA as outlined in the Consultants Reporting Guidelines and the NSW EPA Waste Classification Guidelines (2014). The documentation must be reviewed by the validation consultant (if the documentation is prepared by others) prior to the waste leaving the site.

A review of the disposal facility's Environment Protection Licence (EPL) issued under the Protection of the Environment Operations (POEO) Act (1997)[10] is to be undertaken to assess whether the facility is appropriately licensed to receive the waste.

The above information is to be provided to the validation consultant for inclusion in the validation report. The register must be set up at the beginning of the project and provided to the validation consultant regularly (i.e. weekly) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

5.4.2 Imported Materials Register

The remediation contractor is to maintain, for the duration of the project, an imported material register. This must include a register (in Microsoft Excel format) with details of each imported material type, supplier details, summary record of where the imported materials were placed on site, and importation docket numbers and a tally of quantities (separated for each import stream). Dockets for imported materials are to be provided electronically so these can be reconciled with the register.

Examples of imported materials for this project may include but would not be limited to site preparation materials (e.g. DGB, 40/70 etc) and potentially materials to reinstate remedial excavations (although use of clean site-won material is preferred). Landscaping materials such as topsoil garden mixes, mulches etc are not expected to be imported within the timeframe of the remediation/validation exercise, however, these materials have still been considered in the validation process for completeness.

The above information is to be provided to the validation consultant for inclusion in the validation report. The register be set up at the beginning of the project and provided to the validation consultant regularly (i.e. weekly) so the details can be checked and any rectification of the record keeping process can occur in a timely manner.

[10]NSW Government, (1997)). *Protection of Environment Operations Act.* (referred to as POEO Act 1997)

6 VALIDATION PLAN

Validation is necessary to demonstrate that remedial measures described in the RAP have been successful and that the site is suitable for the intended land use. The sampling program for the validation is outlined in Section 6.1. This is the minimum requirement based on the remedial strategy proposed in this RAP. Additional validation sampling may be required based on the outcome of the pre-remediation investigation and/or observations made during remediation, however, that detail would be reflected in the RWP/revised RAP where necessary.

6.1 Validation Sampling and Documentation

The following subsections outline the validation requirements for the site:

6.1.1 Excavation/Fill Removal

Table 6-1: Validation Requirements – BH12 Remediation Area

Aspect	Sampling	Analysis	Observations and Documentation
Validation sampling of BH103 asbestos remediation area (Step 1)	Base of excavation: No sampling for visible ACM/FCF (this is to be validated via the visual asbestos clearance process). Base samples are to be collected at a minimum rate of one sample per 25m^2 for AF/FA analysis (500ml samples). Walls of excavation: The excavation is expected to expose fill at the walls. The excavation walls must be sampled every 5m lineal, with samples collected from each distinct fill profile at each location, with a minimum of one sample per distinct wall. The fill is expected to be shallower than 1m, however, if deeper fill is encountered, the fill on the excavation walls must have at least one sample per fill profile collected and per vertical metre on the wall (whichever is the greater). Based on the current extent of remediation at BH103 as shown on Figure 4, it is expected that each wall will have one sample location positioned centrally along each wall. Wall sampling is to included bulk sampling (10L field screening) for asbestos in accordance with the NEPM 2013 procedures and sampling/analysis of fill soils for AF/FA (500ml samples).	Any FCF identified in the validation samples is to be analysed for asbestos. All samples collected for AF/FA analysis are to be analysed for AF/FA at the laboratory.	Observations to be recorded by the **validation consultant/LAA** to document fill/soil lithology on the base and walls of the excavation. Each bulk sample is to be weighed (in kg) using an accurate scale to two decimal places. A sample location plan is to be prepared by the **validation consultant**, documenting the sample locations and final extent of the remediation area. Photographs are to be taken by the **validation consultant/LAA**. **LAA** to provide asbestos surface clearance for the base and walls of the asbestos remedial excavation. Air monitoring results to be reviewed. Disposal dockets to be retained by the **remediation contractor** and forwarded to validation consultant for inclusion in the validation report.

Aspect	Sampling	Analysis	Observations and Documentation
Validation sampling of remaining fill removal (Step 2)	Base of excavation: Base samples are to be collected at a minimum rate of one sample per 225m^2, on a 15m by 15m grid based sampling plan. Walls of excavation: Wall sampling is not proposed as the northern, western and southern extents of the excavation are formed by the site boundaries and there will be no 'wall' remaining. The eastern boundary/extent of the remediation area will be defined by the neighbouring property boundary and won't be representative of the site conditions.	Lead, copper, zinc, TRH (F2 and F3) and PAHs.	Observations to be recorded by the **validation consultant** to document soil/bedrock lithology on the base of the excavation, and to confirm that excavation of the fill has occurred to the full extent of the site boundaries. A sample location plan is to be prepared by the **validation consultant**, documenting the sample locations. Photographs are to be taken by the **validation consultant**. Disposal dockets to be retained by the **remediation contractor** and forwarded to validation consultant for inclusion in the validation report.

6.1.2 Imported Materials

A minimum of three samples from each imported material type/source (up to 75m^3 or approximately 120 tonnes) must be collected and analysed for heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), TRHs, BTEX, PAHs, OCP/OPPs, PCBs and asbestos (500ml NEPM 2013 analysis). Additional analysis may be required depending on the material type and/or history of the material/source site, at the validation consultant's discretion. For quantities of imported material greater than 75m^3, additional samples must be collected and analysed at a rate of one sample per additional 50m^3.

Material is to be inspected upon importation by the validation consultant to confirm it is free of visible/olfactory indicators of contamination and is consistent with documentation. Photographic documentation and an inspection log are to be maintained. A minimum of one inspection must occur for each imported material type from each different source.

Where applicable (e.g. where the imported material is a waste or recycled product), documentation must be supplied to the validation consultant to confirm the material has been classified with reference to a relevant Resource Recovery Order/Exemption and/or the NSW EPA waste classification guidelines.

6.2 Validation Assessment Criteria and Data Assessment

The Validation Assessment Criteria (VAC) to be adopted for the validation assessment are outlined in the table below:

Table 6-2: VAC

Validation Aspect	VAC
Validation sampling of BH103 asbestos remediation area (Step 1)	The qualitative VAC for soil validation of the asbestos remediation area are as follows: • Visual confirmation of complete fill removal so that no fill remains at the base of the remedial excavation; and • Visual confirmation of no visible FCF/ACM at the base and walls of the excavation, by the LAA. The quantitative VAC for soil/bedrock sample analysis are as follows: • No asbestos detected in bulk samples. This VAC is being used rather than the asbestos health screening level (HSL) as it is intended to demonstrate that there is no asbestos remaining. This aligns with the current CSM that implies the asbestos impact is localised; and • No asbestos detected (ACM or AF/FA) in laboratory analysis samples. As noted above, this is intended to demonstrate there is no asbestos remaining, to align with the CSM.
Validation sampling of remaining fill removal (Step 2)	The qualitative VAC for soil validation are as follows: • Visual confirmation of complete fill removal from the site so that no fill remains at the base of the remedial excavation. The quantitative VAC for soil/bedrock validation are as follows: • Analytical results for lead, copper and zinc are to be nominally less than 90mg/kg. This concentration is well below the level at which unacceptable human health or ecological risks would be expected to occur, and is considered reasonable to demonstrate that the overlying contaminated fill has been adequately removed; and • Analytical results for PAHs and TRHs are to be below the laboratory practical quantitation limits (PQLs). The PQLs have been nominated as VAC as these compounds are not expected to be detected in the natural soil/bedrock if the overlying fill is adequately removed. Data will be assessed as above or below the VAC. Statistical analysis is not proposed. The above VAC are not intended to be applied for waste classification purposes and any waste classification of the natural soil/bedrock must occur in accordance with the NSW EPA waste classification or resource recovery framework.
Imported materials	All results for imported materials are to be compared to the HIL/HSL-A criteria in Schedule B1 of NEPM 2013 to confirm they do not pose a risk to human health even in a sensitive land use scenario. Landscaping materials must also be assessed against the urban residential and public open space ecological criteria to check they do not pose a risk to ecological receptors. Discretion can be used in assessing TRH data in landscaping materials as such materials often include high organic content which can interfere with the TRH analysis. The land use Type A health-based criteria have been proposed along with the urban residential ecological criteria for imported landscaping materials as they are commensurate with the proposed land use scenario.

Validation Aspect	VAC
	Results for VENM and other imported materials will need to be consistent with expectations for those materials. VENM must meet the definition presented in the waste classification guidelines and the POEO Act 1997. Recycled materials are to meet the criteria of the relevant exemption/order under which they are produced. Aesthetics: soils to be free of staining and odours.

6.3 Validation Sampling, Analysis and Quality Plan (SAQP)

Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) should be clearly outlined and assessed as part of the validation process. A framework for the DQO and DQI process is outlined below and are to be reflected in the validation report.

DQOs have been broadly established for the validation with regards to the seven-step process outlined NEPM (2013). The seven steps include the following which are detailed further in the following subsections:

- State the problem;
- Identify the decisions/goal of the study;
- Identify information inputs;
- Define the study boundary;
- Develop the analytical approach/decision rule;
- Specify the performance/acceptance criteria; and
- Optimise the design for obtaining the data.

DQIs are to be assessed based on field and laboratory considerations for precision, accuracy, representativeness, completeness and comparability.

6.3.1 Step 1 - State the Problem

Validation data is required to demonstrate that the remediation is successful and that the site is suitable for the proposed land use/development described in Section 1.1.

6.3.2 Step 2 - Identify the Decisions of the Study

The remediation goal, aims and objectives are defined in Section 1.2. The decisions to be made reflect these objectives and are as follows:

- Was the remediation undertaken in accordance with the RAP?
- If there were any deviations, what were these and how do they impact the outcome of the validation?
- Are any of the validation results above the VAC?
- Was the remediation successful and is the site suitable for the proposed development from a contamination viewpoint?

6.3.3 Step 3 - Identify Information Inputs

The primary information inputs required to address the decisions outlined in Step 2 include the following:

- Existing relevant data from previous reports;
- Pre-remediation investigation sampling results and any associated reports;
- Site information, including site observations, inspections, asbestos clearance certificates, waste and imported materials registers;
- Validation sampling and analysis;
- Field and laboratory QA/QC data; and
- Records relating to unexpected finds (where applicable).

6.3.4 Step 4 - Define the Study Boundary

The remediation and validation will be confined to the land within the site boundaries, as indicated in the figures in Appendix A. The vertical study boundary is expected to be limited to the depth of fill/surface of the underlying natural soil/bedrock (~0.2-0.9m below existing levels), however, this will be confirmed via the validation process.

6.3.5 Step 5 - Develop an Analytical Approach (or Decision Rule)

6.3.5.1 VAC

The validation data will be assessed in accordance with the requirements outlined in Section 6.1 and 0. The data will be assessed as either above (fail) or below (pass) the VAC. Failures will be further assessed using a multiple lines of evidence, risk-based approach in relation to complete source-pathway-receptor (SPR) linkages.

For the validation of the base of the remedial excavation, the nominated VAC are relatively conservative in comparison to the associated contaminant concentrations that could pose a potential risk in the context of the proposed development. With the exception of asbestos, if the VAC are exceeded in a sample collected from the natural soil/bedrock at the base of the excavation, this may not necessarily imply that there is an unacceptable human health or ecological risk associated with the natural soil/bedrock. So should a VAC failure occur, then the concentration is also to be evaluated against the NEPM (2013) (Schedule B1) health-based investigation/screening levels for a residential (Type A) land use setting, whilst also considering the location of the failed sample relative to the proposed development layout, to assess whether unacceptable risks exist. The potential source of the impact is also to be assessed. If the reported concentrations are below these criteria, then the validation will be deemed to have passed.

Notwithstanding the above, we note that the presence of organic compounds in samples collected from the base of the remedial excavation would compromise any attempted VENM classification for the natural soil/bedrock if the impacted material were not removed. Therefore, the validation results from the base of the remedial excavation must also be considered in the context of the waste classification process for the bulk excavation of natural soil/bedrock being removed from the site to construct the basement. This waste classification requirement does not form part of the remediation requirements for the site.

6.3.5.2 Field and Laboratory QA/QC

Field QA/QC is to include analysis of inter-laboratory duplicates (5% frequency), intra-laboratory duplicates (5% frequency), trip blank (one per daily sampling event) and rinsate samples (one per sampling event, only where re-usable equipment is utilised). Field QA/QC samples are to be analysed for the contaminants of concern, except asbestos. Trip spikes are not proposed as the contaminants of concern are not volatile.

DQIs for field and laboratory QA/QC samples are defined below:

Field Duplicates

Acceptable targets for precision of field duplicates will be 30% or less, consistent with NEPM (2013). RPD failures will be considered qualitatively on a case-by-case basis taking into account factors such as the concentrations used to calculate the RPD (i.e. RPD exceedance where concentrations are close to the PQL are typically not as significant as those where concentrations are reported at least five or 10 times the PQL), sample type, collection methods and the specific analyte where the RPD exceedance was reported.

Trip Blanks and Rinsates

Acceptable targets for trip blank and rinsate samples will be less than the PQL for organic analytes. Metals will be considered on a case-by-case basis with regards to the reference material used as the blank medium.

Acceptable targets for trip spike samples will be 70% to 130%.

Laboratory QA/QC

The suitability of the laboratory data will be assessed against the laboratory QA/QC criteria. These criteria are developed and implemented in accordance with the laboratory's NATA accreditation and align with the acceptable limits for QA/QC samples as outlined in NEPM (2013) and other relevant guidelines.
A summary of the typical limits is provided below:

RPDs

- Results that are <5 times the PQL, any RPD is acceptable; and
- Results >5 times the PQL, RPDs between 0-50% are acceptable.

Laboratory Control Samples (LCS) and Matrix Spikes

- 70-130% recovery acceptable for metals and inorganics; and
- 60-140% recovery acceptable for organics.

Surrogate Spikes

- 60-140% recovery acceptable for general organics.

Method Blanks

- All results less than PQL.

In the event that acceptable limits are not met by the laboratory analysis, other lines of evidence will be reviewed (e.g. field observations of samples, preservation, handling etc) and, where required, consultation

with the laboratory is to be undertaken in an effort to establish the cause of the non-conformance. Where uncertainty exists, the validation consultant is to adopt the most conservative concentration reported.

6.3.5.3 Appropriateness of PQLs

The PQLs of the analytical methods are to be considered in relation to the VAC to confirm that the PQLs are less than the VAC. In cases where the PQLs are greater than the VAC, a discussion of this is to be provided.

6.3.6 Step 6 – Specify Limits on Decision Errors

To limit the potential for decision errors, a range of quality assurance processes are adopted. A quantitative assessment of the potential for false positives and false negatives in the analytical results is to be undertaken with reference to Schedule B(3) of NEPM (2013) using the data quality assurance information collected.

Decision errors can be controlled through the use of hypothesis testing. The test can be used to show either that the baseline condition is false or that there is insufficient evidence to indicate that the baseline condition is false. The null hypothesis is an assumption that is assumed to be true in the absence of contrary evidence. For the application of statistical analysis to data sets, the null hypothesis (H_0) is that the 95% UCL for the contaminant of concern is greater than the VAC. The alternative hypothesis (H_A) is that the 95% UCL for the contaminant of concern is less than the VAC. Potential outcomes include Type I and Type II errors as follows:

- Type I error of determining that the soil is acceptable for the proposed land use when it is not (wrongly rejects true H_0), includes an alpha (α) risk of 0.05; and
- Type II error of determining that the soil is unacceptable for the proposed land use when it is (wrongly accepts false H_0), includes beta (β) risk of 0.2.

Notwithstanding the above, statistical analysis is not proposed for this project and results will be assessed as pass or fail as documented previously.

6.3.7 Step 7 - Optimise the Design for Obtaining Data

The design is to be optimised via the collection of validation data to demonstrate the success of the key aspects of the remediation.

6.3.8 Sampling Plan

The proposed sampling plan is described in Section 6.1.

6.4 Validation Report

As part of the site validation process, a site validation report will be prepared by the validation consultant. The report will present the results of the validation assessment and will be prepared in accordance with the Consultants Reporting Guidelines. The report must clearly state whether or not the site has been adequately remediated and validated, and whether or not the site is suitable for the proposed development from a contamination viewpoint.

Validation of imported materials must occur until the point that the remediation is complete and the validation report is issued. However, it is recommended that the framework for validating imported materials occurs throughout the remainder of the construction works.

7 CONTINGENCY PLAN

A review of the proposed remediation works has indicated that the greatest risks that may affect the success of the remediation include unexpected finds or validation failure. A contingency plan for the remediation is provided below:

7.1 Unexpected Finds

Residual hazards that may exist at the site would generally be expected to be detectable through visual or olfactory means. At this site, these types of hazards may include odorous or stained hydrocarbon impacted soils, underground infrastructure such as tanks or separator pits, asbestos or suspected asbestos/FCF etc beyond the currently nominated asbestos remediation area. The procedure to be followed in the event of an unexpected find is presented below:

- In the event of an unexpected find, all work in the immediate vicinity must cease (provided it is safe to do so) and the remediation contractor must contact the validation consultant and the client/project manager;
- Temporary barricades should be erected to isolate the area from access to workers;
- The validation consultant is to attend the site, adequately characterise the contamination and provide advice in relation to site management and remediation. In the event that remediation differs from that outlined in this RAP, a RWP or addendum RAP must be prepared in consultation with the project stakeholders and the client's expert planner is to advise whether the document is to be submitted to the consent authority to facilitate any modification to the consent; and
- Contamination must be remediated and validated in accordance with the advice provided (subject to any additional approval/s), and the results must be included in the validation report.

7.2 Importation Failure for VENM or other Imported Materials

Where material to be imported onto the site does not meet the importation VAC, the material should not be imported. Alternative material must be sourced that meets the importation requirements.

7.3 Validation Failure

In the event that a validation sample from the base of the remedial excavation exceeds the VAC and is assessed to pose an unacceptable risk, additional material is to be 'chased out' and disposed off-site, then the area re-validated. However, prior to the chase out of additional material, the remediation contractor/principal contractor must advise the project manager and client, and seek approval.

7.4 Remediation Strategy Changes

Any material change to the proposed remediation strategy will require revision of the RAP or preparation of an addendum RAP or RWP. This must not occur without appropriate consultation and approvals from the client, consent authority and other relevant parties.

8 SITE MANAGEMENT PLAN FOR REMEDIATION WORKS

The information outlined in this section of the RAP is for the remediation work only. The client should make reference to the development consent for specific site management requirements for the overall development of the site.

8.1 Interim Management

As recommended in the DSI, and interim management plan is to be prepared interim management plan to manage potential risks from lead, PAHs and asbestos contamination in fill until the time the site is developed.

8.2 Asbestos Management Plan (AMP)

A remediation-phase AMP must be prepared for the site by a suitably qualified consultant, and implemented for the site remediation works. The AMP must include the minimum personal protective equipment (PPE), work health and safety (WHS) and other requirements outlined in the documents published by Safe Work Australia, WorkCover Authority of NSW, National Occupational Health and Safety Commission, and other relevant authorities as applicable. An asbestos removal control plan (ARCP) must be prepared by the remediation contractor and issued to SafeWork, and notification of asbestos removal is to be provided to SafeWork at least five days prior to commencement of works. Based on the current data, the asbestos is bonded/non-friable.

Although the asbestos found to date is bonded/non-friable ACM, we recommend that air monitoring be included in the AMP due to the close proximity of adjoining residential properties. Air monitoring must only be carried out by personnel registered and accredited by NATA (National Association of Testing Authorities). Filter analysis must only be carried out within a NATA certified laboratory. The monitoring results must conform to the requirements of the NOHSC Guidance note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC:3003 (2005)].

A monitoring program will be used to assess whether the control procedures being applied are satisfactory and that criteria for airborne asbestos fibre levels are not being exceeded. The following levels will be used as action criteria during the air monitoring:

- <0.01 Fibres/ml: Work procedures deemed to be successful;
- 0.01 to 0.02 Fibres/ml: Inspection of the site and review of procedures; and
- >0.02 Fibres/ml: Stop work, inspection of the site, review of procedures, clean-up, rectification works where required and notify the relevant regulator.

It is noted that the DSI also recommended the preparation of an interim AMP.

8.3 Project Contacts

Emergency procedures and contact telephone numbers should be displayed in a prominent position at the site entrance gate and within the main site working areas. The available contact details are summarised in the following table:

Table 8-1: Project Contacts

Role	Company	Contact Details
Developer/Project Manager	HELM Pty Ltd	Kit Cunningham-Reid E: kcunninghamreid@helmproperties.com.au P: 8036 7400
Remediation Contractor	To be appointed	-
Validation Consultant	To be appointed	-
Certifier	To be appointed	-
NSW EPA	Pollution Line	131 555
Emergency Services	Ambulance, Police, Fire	000

8.4 Security

Appropriate fencing should be installed as required to secure the site. Warning signs should be erected, which outline the personal PPE required for remediation work.

8.5 Timing and Sequencing of Remediation Works

The anticipated sequence of remediation works is outlined in Section 5.3. Remediation will occur concurrently with the development works as we expect that the built form of the development will need to commence in order to construct the shoring system to facilitate the basement excavation and associated fill remediation.

This must be considered by the consent authority in the context of when remediation is deemed to be complete and the validation report can be prepared. The validation report is expected to be prepared following commencement of construction, but prior to the issue of any occupation certificate or use of the site for the intended purpose.

8.6 Site Soil and Water Management Plan

The remediation contractor must prepare a detailed soil and water management plan prior to the commencement of site works and this should consider the requirements of the remediation-phase AMP, as applicable. Silt fences must be used to control the surface water runoff at all appropriate locations of the site

and appropriate measures are to be implemented to manage soil/water disturbance to the satisfaction of the regulator/consent authority. Reference should be made to the consent conditions for further details.

All stockpiled materials must be placed within an erosion containment boundary with silt fences and sandbags employed to limit sediment movement. The containment area should be located away from drainage lines/low-points, gutters, stormwater pits and inlets and the site boundary. No liquid waste or runoff can be discharged to the stormwater or sewerage system without the approval of the appropriate authorities.

8.7 Noise and Vibration Control Plan

The guidelines for minimisation of noise on construction sites outlined in AS-2460 (2002)[11] should be adopted. Other measures specified in the consent conditions should also be complied with. Noise producing machinery and equipment should only be operated between the hours approved by the consent authority (refer to consent documents).

All practicable measures should be taken to reduce the generation of noise and vibration to within acceptable limits. In the event that short-term noisy operations are necessary, and where these are likely to affect residences, notifications should be provided to the relevant authorities and the residents by the project manager, specifying the expected duration of the noisy works.

8.8 Dust Control Plan

All practicable measures must be taken to reduce dust emanating from the site. Factors that contribute to dust production are:

- Wind over a cleared surface;
- Wind over stockpiled material; and
- Movement of machinery in unpaved areas.

Visible dust should not be present at the site boundary. Measures to minimise the potential for dust generation include:

- Use of water sprays on unsealed or exposed soil surfaces;
- Covering of stockpiled materials and excavation faces (particularly during periods of site inactivity and/or during windy conditions) or alternatively the erection of hessian fences around stockpiled soil or large exposed areas of soil;
- Establishment of dust screens consisting of a 2m high shade cloth or similar material secured to a chain wire fence;
- Maintenance of dust control measures to keep the facilities in good operating condition;
- Stopping work during strong winds;
- Loading or unloading of dry soil as close as possible to stockpiles to prevent spreading of loose material around the development area; and
- Geofabric/geotextile could be placed over exposed soils in the event that excavation is staged.

[11] Australian Standard, (2002). *AS2460: Acoustics - Measurement of the Reverberation Time in Rooms.*

If stockpiles are to remain on-site or soil remains exposed for a period of longer than several days, dust monitoring should be undertaken at the site. If excessive dust is generated all site activities should cease until either wind conditions are more acceptable or a revised method of excavation/remediation is developed.

Dust is also produced during the transfer of material to and from the site. All material must be covered during transport and should be properly disposed of on delivery. No material is to be left in an exposed, un-monitored condition.

All equipment and machinery must be brushed or washed down before leaving the site to limit dust and sediment movement off-site. In the event of prolonged rain and lack of paved areas all vehicles should be washed down prior to exit from the site, and any soil or dirt on the wheels of the vehicles removed. Water used to clean the vehicles should be collected and tested prior to appropriate disposal under the relevant waste classification guidelines.

Reference is also to be made to the remediation-phase AMP in this regard.

8.9 Dewatering

Based on the fill depths encountered, and the previously observed depths to groundwater, dewatering is not anticipated to be required during the remediation processes associated with the excavation and off-site disposal of fill from the site.

Standard regulatory requirements would apply to any discharge of groundwater during the proposed construction works. This does not fall under the purview of the RAP at this stage.

8.10 Odour Control Plan

All activities undertaken at the site should be completed in a manner that minimises emissions of smoke, fumes and vapour into the atmosphere and any odours arising from the works or stockpiled material should be controlled. Control measures may include:

- Maintenance of construction equipment so that exhaust emissions comply with the Clean Air Regulations issued under the Protection of the Environment Operations Act (1997) (POEO);
- Demolition materials and other combustible waste should not be burnt on site;
- The spraying of a suitable proprietary product to suppress any odours that may be generated by excavated materials; and
- Use of protective covers (e.g. builder's plastic).

All practicable measures must be taken to reduce fugitive emissions emanating from the site so that associated odours do not constitute a nuisance and that the ambient air quality is not adversely impacted.

The following odour management plan should be implemented to limit the exposure of site personnel and surrounding neighbours to unpleasant odours:

- Excavation and stockpiling of odorous material must be scheduled during periods with low winds if possible;

- Where necessary, a suitable proprietary product could be sprayed on material during excavation and following stockpiling to reduce odours (subject to an appropriate assessment of the product by the validation consultant);
- All complaints from workers and neighbours should be logged and a response provided. Work should be rescheduled as necessary to minimise odour problems;
- The site foreman should consider the following odour control measures:
  - reduce the exposed surface of the odorous materials;
  - time excavation activities to reduce off-site nuisance (particularly during strong winds); and
  - cover exposed excavation faces overnight or during periods of low excavation activity.
- If continued complaints are received, alternative odour management strategies should be considered and implemented.

8.11 Work Health and Safety (WHS) Plan

A site specific WHS plan must be prepared by the remediation contractor for all work to be undertaken at the site. The WHS plan must meet all the requirements outlined in SafeWork NSW WHS regulations.

As a minimum requirement, personnel must wear appropriate protective clothing, including long sleeve shirts, long trousers, steel cap boots and hard hats. Additional asbestos-related PPE will be required for the remedial works involving asbestos (Reference is also to be made to the remediation-phase AMP in this regard). Washroom and lunchroom facilities must also be provided to allow workers to remove potential contamination from their hands and clothing prior to eating or drinking.

8.12 Waste Management

Prior to commencement of remedial works and excavation for the proposed development, the remediation contractor should develop a waste management or recycling plan to minimise the amount of waste produced by the site. Consideration should be given to re-use material wherever possible.

8.13 Incident Management Contingency

The validation consultant must be contacted if any unexpected conditions are encountered at the site. This should enable the scope of remedial/validation works to be adjusted as required. Similarly, if any incident occurs at the site, the validation consultant must be advised to assess potential impacts on contamination conditions and the remediation/validation timetable.

8.14 Hours of Operation

Hours of operation should be between those approved by the consent authority under the development approval process.

8.15 Community Consultation and Complaints

The remediation contractor should provide details for managing community consultation and complaints within their Construction Environmental Management Plan (CEMP).

9 CONCLUSIONS

Previous investigations at the site identified historically imported fill soils impacted by heavy metals and hydrocarbons which are primarily suspected to be associated with ash and slag within the fill/soil matrix. Asbestos was also identified in one location. Remediation of the site is required to mitigate potential risks associated with these contaminants.

The proposed remediation strategy includes 'excavation and off-site disposal' of contaminated fill/soil to a suitably licensed landfill. This process aligns closely with the proposed development works which include excavation for a proposed basement. The strategy is therefore easy to implement and is expected to be effective and successful to mitigate contamination risks.

The RAP also includes requirements for an additional round of groundwater sampling, and also for additional soil sampling (in previously inaccessible areas) which is to occur following demolition in order to confirm the waste classification for the soils.

The anticipated sequence of remediation works is outlined in Section 5.3 of this RAP. Remediation will occur prior to the commencement of the built form of the development. The validation report is expected to be prepared prior to the commencement of construction.

We are of the opinion that the site can be made suitable for the proposed development via remediation and the implementation of this RAP. A site validation report is to be prepared on completion of remediation activities and submitted to the consent authority to demonstrate that the site is suitable for the proposed development following completion of remediation/validation.

JKE is of the opinion that the RAP has met the objectives outlined in Section 1.2.

The regulatory requirements applicable for the site are outlined in Section 9.1.

9.1 Regulatory Requirements

The regulatory requirements applicable for the remediation are discussed in the following table:

Table 9-1: Regulatory Requirement

Guideline / Legislation / Policy	Applicability
SEPP Resilience and Hazards 2021	We have assessed the remediation to be Category 2 with regards to SEPP Resilience and Hazards 2021. Prior notice of Category 2 remediation work is required with regards to Clauses 4.13 at least 30 days before the commencement of work. A notice of completion of remediation work is to be given to the local council within 30 days of completion of the work, in accordance with Clauses 4.14 and 4.15 of SEPP Resilience and Hazards 2021. A notice of completion of remediation work is to be provided in accordance with Clauses 14.14 and 14.15 of SEPP Resilience and Hazards 2021.

Guideline / Legislation / Policy	Applicability
POEO Act 1997 (and associated regulations)	Section 143 of the POEO Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have a duty to ensure that the waste is disposed of in an appropriate manner. Appropriate waste tracking must occur for all waste that is disposed off-site, where required. Activities must be carried out in a manner which does not result in the pollution of waters.
POEO (Waste) Regulation 2014	Part 7 of the POEO Waste Regulation 2014 set outs the requirements for the transportation and management of asbestos waste and Clause 79 of the POEO Waste Regulation requires waste transporters to provide information to the NSW EPA regarding the movement of any load in NSW of more than 10 square meters of asbestos sheeting, or 100 kilograms of asbestos waste. To fulfil these legal obligations, asbestos waste transporters must use the NSW EPA-endorsed asbestos waste tracking system. Appropriate waste tracking is required for all waste that is disposed off-site, in accordance with the regulations.
Work Health and Safety Regulation (2017) SafeWork NSW Code of Practice: How to manage and control asbestos in the workplace (2022)	Sites with asbestos become a 'workplace' when work is carried out there and require a register and AMP. Appropriate SafeWork NSW notification will be required for licensed asbestos removal works or handling. These requirements must be evaluated following the hazardous building materials survey and on completion of the additional soil sampling associated with the pre-remediation investigation.
NSW EPA Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997	The requirement to notify the NSW EPA should be assessed as part of the site validation process. The need to notify will be largely dependent on the asbestos air monitoring results during the remediation. In our opinion the results obtained by JKE to date do not trigger a need to notify the EPA.

10 LIMITATIONS

The report limitations are outlined below:

- JKE accepts no responsibility for any unidentified contamination issues at the site. Any unexpected problems/subsurface features that may be encountered during development works should be inspected by an environmental consultant as soon as possible;
- Previous use of this site may have involved excavation for the foundations of buildings, services, and similar facilities. In addition, unrecorded excavation and burial of material may have occurred on the site. Backfilling of excavations could have been undertaken with potentially contaminated material that may be discovered in discrete, isolated locations across the site during construction work;
- This report has been prepared based on site conditions which existed at the time of the investigation; scope of work and limitation outlined in the JKE proposal; and terms of contract between JKE and the client (as applicable);
- The conclusions presented in this report are based on investigation of conditions at specific locations, chosen to be as representative as possible under the given circumstances, visual observations of the site and immediate surrounds and documents reviewed as described in the report;
- Subsurface soil and rock conditions encountered between investigation locations may be found to be different from those expected. Groundwater conditions may also vary, especially after climatic changes;
- The investigation and preparation of this report have been undertaken in accordance with accepted practice for environmental consultants, with reference to applicable environmental regulatory authority and industry standards, guidelines and the assessment criteria outlined in the report;
- Where information has been provided by third parties, JKE has not undertaken any verification process, except where specifically stated in the report;
- JKE has not undertaken any assessment of off-site areas that may be potential contamination sources or may have been impacted by site contamination, except where specifically stated in the report;
- JKE accept no responsibility for potentially asbestos containing materials that may exist at the site. These materials may be associated with demolition of pre-1990 constructed buildings or fill material at the site;
- JKE have not and will not make any determination regarding finances associated with the site;
- Additional investigation work may be required in the event of changes to the proposed development or landuse. JKE should be contacted immediately in such circumstances;
- Material considered to be suitable from a geotechnical point of view may be unsatisfactory from a soil contamination viewpoint, and vice versa; and
- This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Important Information About This Report

These notes have been prepared by JKE to assist with the assessment and interpretation of this report.

The Report is based on a Unique Set of Project Specific Factors
This report has been prepared in response to specific project requirements as stated in the JKE proposal document which may have been limited by instructions from the client. This report should be reviewed, and if necessary, revised if any of the following occur:

- The proposed land use is altered;
- The defined subject site is increased or sub-divided;
- The proposed development details including size, configuration, location, orientation of the structures or landscaped areas are modified;
- The proposed development levels are altered, eg addition of basement levels; or
- Ownership of the site changes.

JKE will not accept any responsibility whatsoever for situations where one or more of the above factors have changed since completion of the investigation. If the subject site is sold, ownership of the investigation report should be transferred by JKE to the new site owners who will be informed of the conditions and limitations under which the investigation was undertaken. No person should apply an investigation for any purpose other than that originally intended without first conferring with the consultant.

Changes in Subsurface Conditions
Subsurface conditions are influenced by natural geological and hydrogeological process and human activities. Groundwater conditions are likely to vary over time with changes in climatic conditions and human activities within the catchment (e.g. water extraction for irrigation or industrial uses, subsurface waste water disposal, construction related dewatering). Soil and groundwater contaminant concentrations may also vary over time through contaminant migration, natural attenuation of organic contaminants, ongoing contaminating activities and placement or removal of fill material. The conclusions of an investigation report may have been affected by the above factors if a significant period of time has elapsed prior to commencement of the proposed development.

This Report is based on Professional Interpretations of Factual Data
Site investigations identify actual subsurface conditions at the actual sampling locations at the time of the investigation. Data obtained from the sampling and subsequent laboratory analyses, available site history information and published regional information is interpreted by geologists, engineers or environmental scientists and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on the proposed development and appropriate remediation measures.

Actual conditions may differ from those inferred, 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 an investigation indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimise the impact. For this reason, site owners should retain the services of their consultants throughout the development stage of the project, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

Investigation Limitations
Although information provided by a site investigation can reduce exposure to the risk of the presence of contamination, no environmental site investigation can eliminate the risk. Even a rigorous professional investigation may not 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. Contaminant analysis cannot possibly cover every type of contaminant which may occur; only the most likely contaminants are screened.

Misinterpretation of Site Investigations by Design Professionals

Costly problems can occur when other design professionals develop plans based on misinterpretation of an investigation report. To minimise problems associated with misinterpretations, the environmental consultant should be retained to work with appropriate professionals to explain relevant findings and to review the adequacy of plans and specifications relevant to contamination issues.

Logs Should not be Separated from the Investigation Report

Borehole and test pit logs are prepared by environmental scientists, engineers or geologists based upon interpretation of field conditions and laboratory evaluation of field samples. Logs are normally provided in our reports and these should not be re-drawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however contractors can still misinterpret the logs during bid preparation if separated from the text of the investigation. If this occurs, delays, disputes and unanticipated costs may result. In all cases it is necessary to refer to the rest of the report to obtain a proper understanding of the investigation. Please note that logs with the 'Environmental Log' header are not suitable for geotechnical purposes as they have not been peer reviewed by a Senior Geotechnical Engineer.

To reduce the likelihood of borehole and test pit log misinterpretation, the complete investigation should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of subsurface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations such as contractors.

Read Responsibility Clauses Closely

Because an environmental site investigation 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 written transmittals. These are definitive clauses designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site investigation, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to any questions.

Appendix A: Report Figures

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the Environmental report.

Title: **SITE LOCATION PLAN**

Location: 118, 120, 122 AND 124 BENELONG ROAD AND 72 GERARD STREET, CREMORNE, NSW

Project No: E36901P

Figure No: 1

JKEnvironments

PLOT DATE: 16/08/2024 9:26:36 AM DWG FILE: K:\SC EIS \JOBS\36000\SIE36901P CREMORNE\CAD\E36901P.DWG

LEGEND

APPROXIMATE SITE BOUNDARY	
BH(Fill Depth)	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
BH/MW(Fill Depth)	BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
BH101	BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI 2024)

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **PREVIOUS INVESTIGATION LOCATIONS**

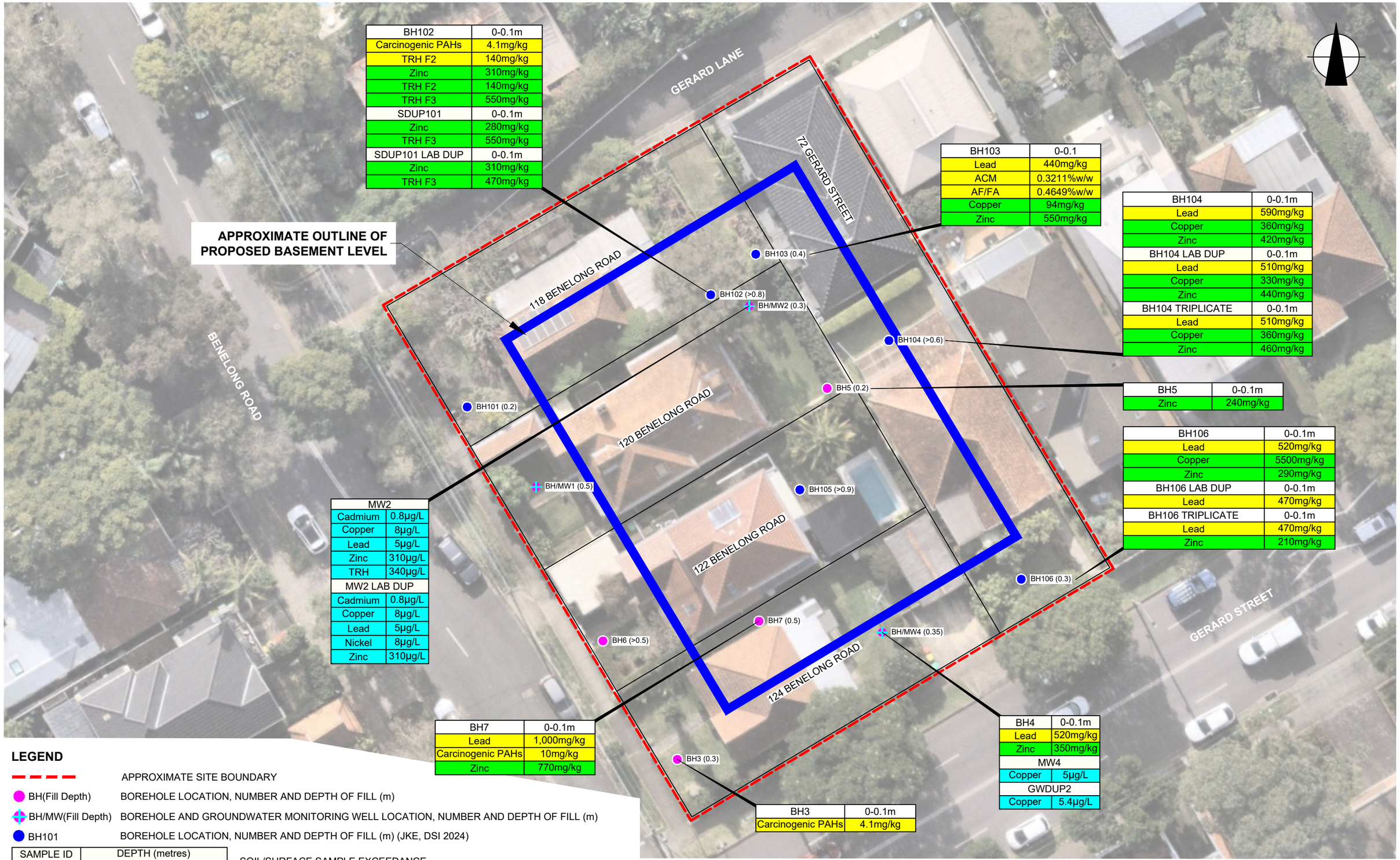
Location: 118, 120, 122 AND 124 BENELONG ROAD AND 72 GERARD STREET, CREMORNE, NSW

Project No: E36901P

Figure No: 2

JKEnvironments

PLOT DATE: 7/02/2025 9:03:56 AM DWG FILE: K:\5C EIS JOBS\36000'S\E36901P CREMORNE\CAD\E36901P.DWG



BH102	0-0.1m
Carcinogenic PAHs	4.1mg/kg
TRH F2	140mg/kg
Zinc	310mg/kg
TRH F2	140mg/kg
TRH F3	550mg/kg
SDUP101	0-0.1m
Zinc	280mg/kg
TRH F3	550mg/kg
SDUP101 LAB DUP	0-0.1m
Zinc	310mg/kg
TRH F3	470mg/kg

BH103	0-0.1
Lead	440mg/kg
ACM	0.3211%w/w
AF/FA	0.4649%w/w
Copper	94mg/kg
Zinc	550mg/kg

BH104	0-0.1m
Lead	590mg/kg
Copper	360mg/kg
Zinc	420mg/kg
BH104 LAB DUP	0-0.1m
Lead	510mg/kg
Copper	330mg/kg
Zinc	440mg/kg
BH104 TRIPLICATE	0-0.1m
Lead	510mg/kg
Copper	360mg/kg
Zinc	460mg/kg

BH5	0-0.1m
Zinc	240mg/kg

BH106	0-0.1m
Lead	520mg/kg
Copper	5500mg/kg
Zinc	290mg/kg
BH106 LAB DUP	0-0.1m
Lead	470mg/kg
BH106 TRIPLICATE	0-0.1m
Lead	470mg/kg
Zinc	210mg/kg

MW2	
Cadmium	0.8µg/L
Copper	8µg/L
Lead	5µg/L
Zinc	310µg/L
TRH	340µg/L
MW2 LAB DUP	
Cadmium	0.8µg/L
Copper	8µg/L
Lead	5µg/L
Nickel	8µg/L
Zinc	310µg/L

BH7	0-0.1m
Lead	1,000mg/kg
Carcinogenic PAHs	10mg/kg
Zinc	770mg/kg

BH4	0-0.1m
Lead	520mg/kg
Zinc	350mg/kg
MW4	
Copper	5µg/L
GWDUP2	
Copper	5.4µg/L

BH3	0-0.1m
Carcinogenic PAHs	4.1mg/kg

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
- BH/MW(Fill Depth) — BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
- BH101 — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI 2024)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

SAMPLE ID	-
CHEMICAL	CONCENTRATION (µg/L)

GROUNDWATER SAMPLE EXCEEDANCE

- SOIL/SURFACE CONTAMINATION ABOVE SAC FOR HUMAN HEALTH RISK
- SOIL/SURFACE CONTAMINATION ABOVE SAC FOR ECOLOGICAL RISK
- GROUNDWATER CONTAMINATION ABOVE SAC

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **SAC EXCEEDANCE PLAN**

Location: 118, 120, 122 AND 124 BENELONG ROAD AND 72 GERARD STREET, CREMORNE, NSW

Project No: E36901P

Figure No: 3

JKEnvironments

PLOT DATE: 7/02/2025 9:16:23 AM DWG FILE: K:\5C EIS JOBS\36000'S\E36901P CREMORNE\CAD\E36901P.DWG

BH102	0-0.1m
Carcinogenic PAHs	4.1mg/kg
TRH F2	140mg/kg
Zinc	310mg/kg
TRH F2	140mg/kg
TRH F3	550mg/kg
SDUP101	0-0.1m
Zinc	280mg/kg
TRH F3	550mg/kg
SDUP101 LAB DUP	0-0.1m
Zinc	310mg/kg
TRH F3	470mg/kg

BH103	0-0.1
Lead	440mg/kg
ACM	0.3211%w/w
AF/FA	0.4649%w/w
Copper	94mg/kg
Zinc	550mg/kg

BH104	0-0.1m
Lead	590mg/kg
Copper	360mg/kg
Zinc	420mg/kg
BH104 LAB DUP	0-0.1m
Lead	510mg/kg
Copper	330mg/kg
Zinc	440mg/kg
BH104 TRIPLICATE	0-0.1m
Lead	510mg/kg
Copper	360mg/kg
Zinc	460mg/kg

BH5	0-0.1m
Zinc	240mg/kg

BH106	0-0.1m
Lead	520mg/kg
Copper	5500mg/kg
Zinc	290mg/kg
BH106 LAB DUP	0-0.1m
Lead	470mg/kg
BH106 TRIPLICATE	0-0.1m
Lead	470mg/kg
Zinc	210mg/kg

BH7	0-0.1m
Lead	1,000mg/kg
Carcinogenic PAHs	10mg/kg
Zinc	770mg/kg

BH4	0-0.1m
Lead	520mg/kg
Zinc	350mg/kg

BH3	0-0.1m
Carcinogenic PAHs	4.1mg/kg

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)
- BH/MW(Fill Depth) — BOREHOLE AND GROUNDWATER MONITORING WELL LOCATION, NUMBER AND DEPTH OF FILL (m)
- BH101 — BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m) (JKE, DSI 2024)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

- SOIL/SURFACE CONTAMINATION ABOVE SAC FOR HUMAN HEALTH RISK
- SOIL/SURFACE CONTAMINATION ABOVE SAC FOR ECOLOGICAL RISK
- SITE-WIDE REMEDIATION AREA
- INDICATIVE ASBESTOS REMEDIATION AREA

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

0 3 6 9 12 15

SCALE 1:300 @A3 METRES

This plan should be read in conjunction with the Environmental report.

Title: **REMEDIATION PLAN**

Location: 118, 120, 122 AND 124 BENELONG ROAD AND 72 GERARD STREET, CREMORNE, NSW

Project No: E36901P

Figure No: 4

JKEnvironments

PLOT DATE: 7/02/2025 9:16:34 AM DWG FILE: K:\5C EIS JOBS\36000\SITE\36901P CREMORNE\CAD\E36901P.DWG

Appendix B: Selection of Proposed Development Plans

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DEVELOPMENT APPLICATION

PROPOSED APARTMENT DEVELOPMENT
118-124 BENELONG RD & 72 GERARD ST • CREMORNE • NSW
CLIENT : HELM PTY LIMITED

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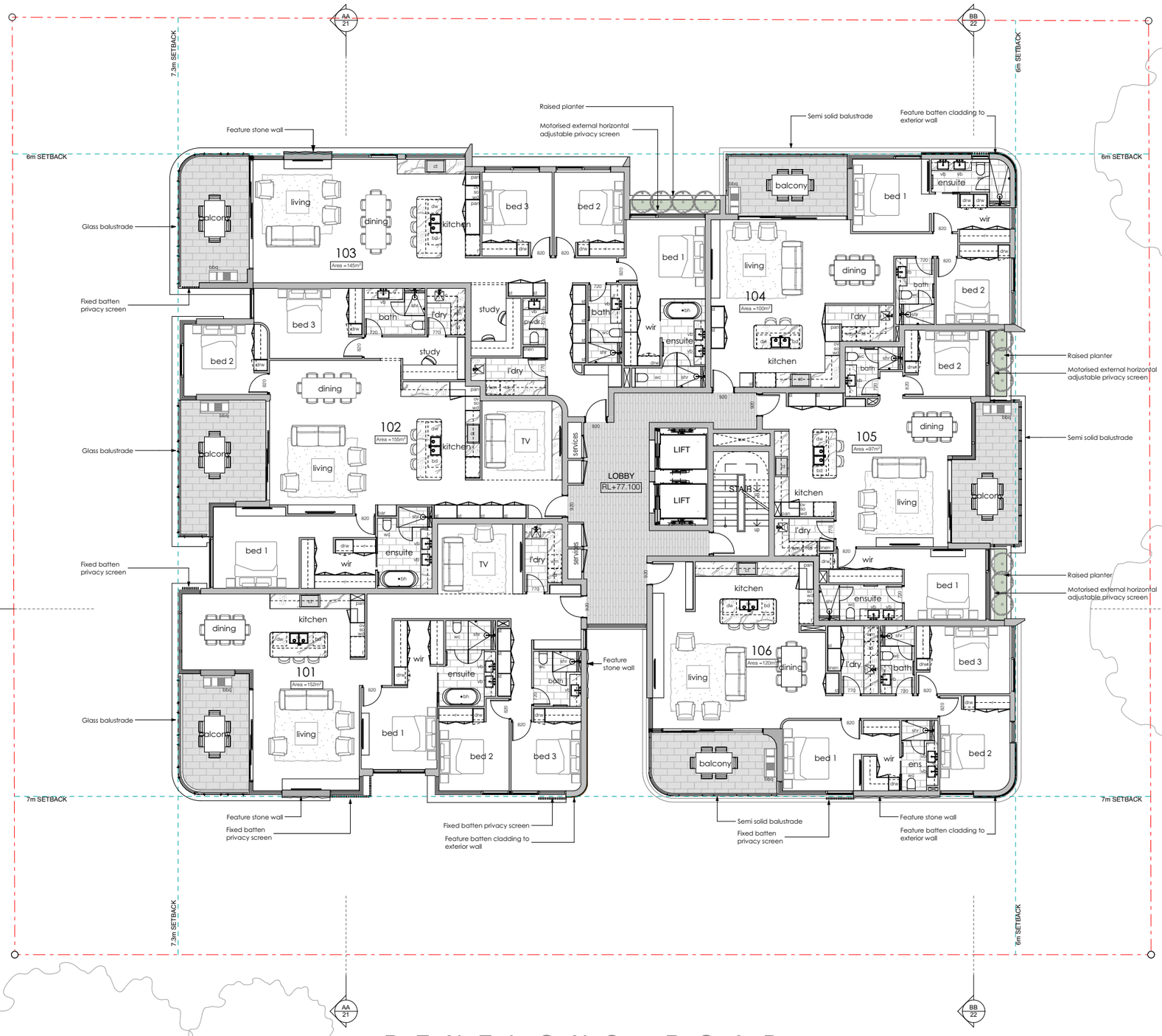
DRAWING SCHEDULE

HELM®

REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Level 1				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



LEVEL 1

0 1 2 3 4 5

Minor changes to building form and configuration may be required when drawings are subsequently prepared for construction purposes after the grant of development consent.

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118 - 124 BENELONG RD & 72 GERARD ST, CREMORNE
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CLIENT : HELM PTY LIMITED DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Level 1	JOB No. NL2433	DWG. No. DA.10	Rev. A

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REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Lower Ground Level				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

GERARD LANE

GERARD STREET

BENELONG ROAD

Bin holding area below

Hydrant and sprinkler booster with louvred doors

Existing Building No. 72

existing driveway location

Fixed batten privacy screen

Driveway Below

Line of balcony above

Feature fence to detail

Fixed batten privacy screen

Feature fence to detail

Soft landscape planting zone at grade

Existing Building No. 118

Soft landscape planting zone in front of fence

Existing trees to be removed shown dashed

Line of balcony above

Fixed batten privacy screen

Existing tree to be removed shown dashed

Feature fence to detail

gate

Soft landscape planting zone in front of wall

Existing tree to be retained

Existing tree to be retained

Existing Building No. 120

footpath

Feature fence and wall as detail

Soft landscape planting zone in front of wall

Proposed new street tree

line of existing driveway to be removed

Existing Building No. 122

line of existing driveway to be removed

DA Approved Building DA 323/21 No. 124

Existing tree to be retained

Existing Building No. 124

OSD Tank to hydraulic eng details shown dashed

LOWER GROUND LEVEL

0 1 2 3 4 5

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03.02.25	A	Development Application Issue	
DATE	ISSUE	AMENDMENTS	

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PROPOSED APARTMENT DEVELOPMENT • CREMORNE • NSW

CLIENT : HELM PTY LIMITED — DEVELOPMENT APPLICATION

DRAWING	JOB No.	DWG. No.	Rev.
Lower Ground Level	NL2433	DA.08	A

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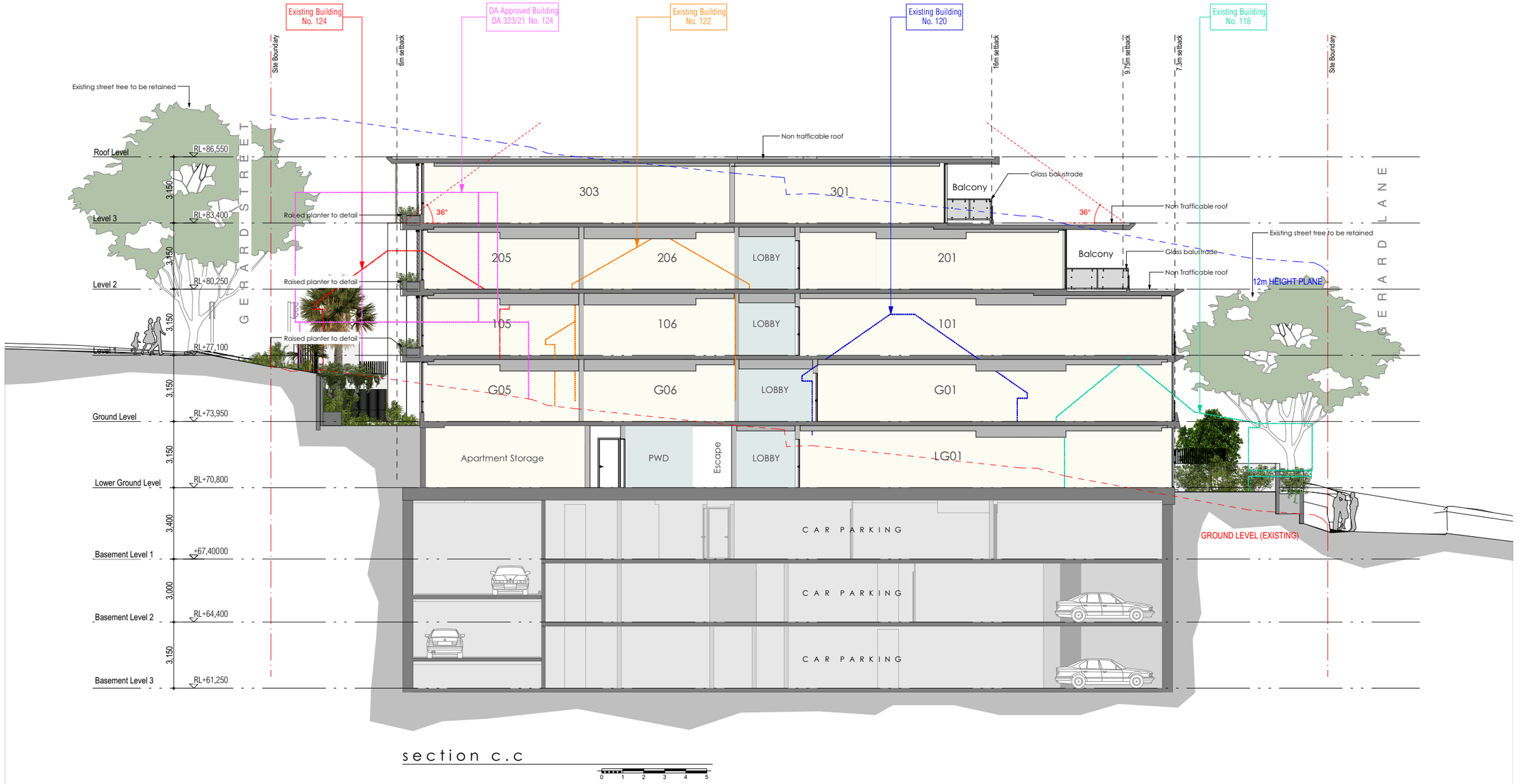
REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Section C				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



section c.c

0 1 2 3 4 5

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PROPOSED APARTMENT DEVELOPMENT • CREMORNE • NSW
CLIENT : HELM PTY LIMITED DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Section C	JOB No. NL2433	DWG. No. DA.23	Rev. A

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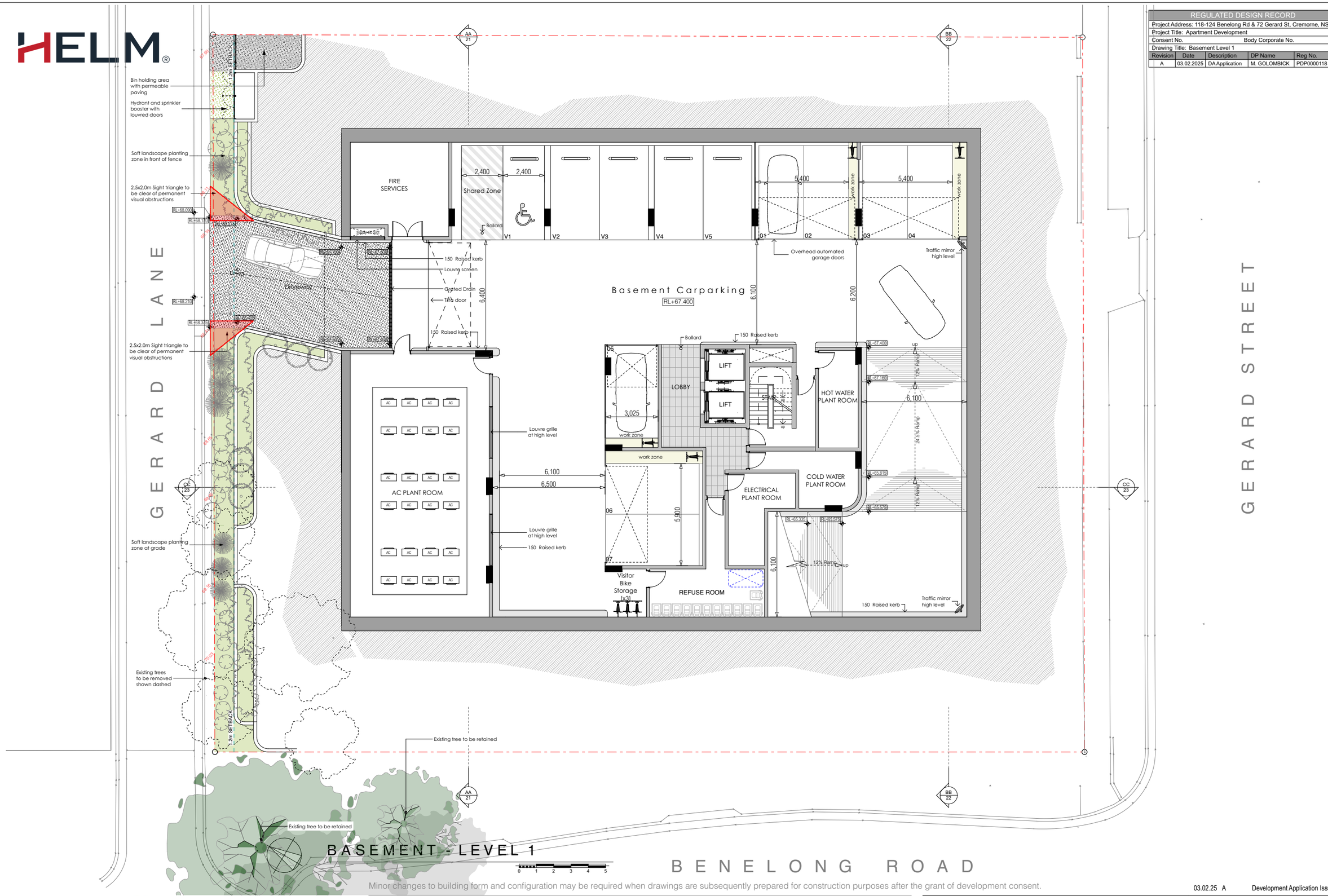
REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Basement Level 1				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



BASEMENT - LEVEL 1

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CLIENT : HELM PTY LIMITED
DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
Basement Level 1	03.02.25	A	Development Application Issue

JOB No.	DWG. No.	Rev.
NL2433	DA.14	A

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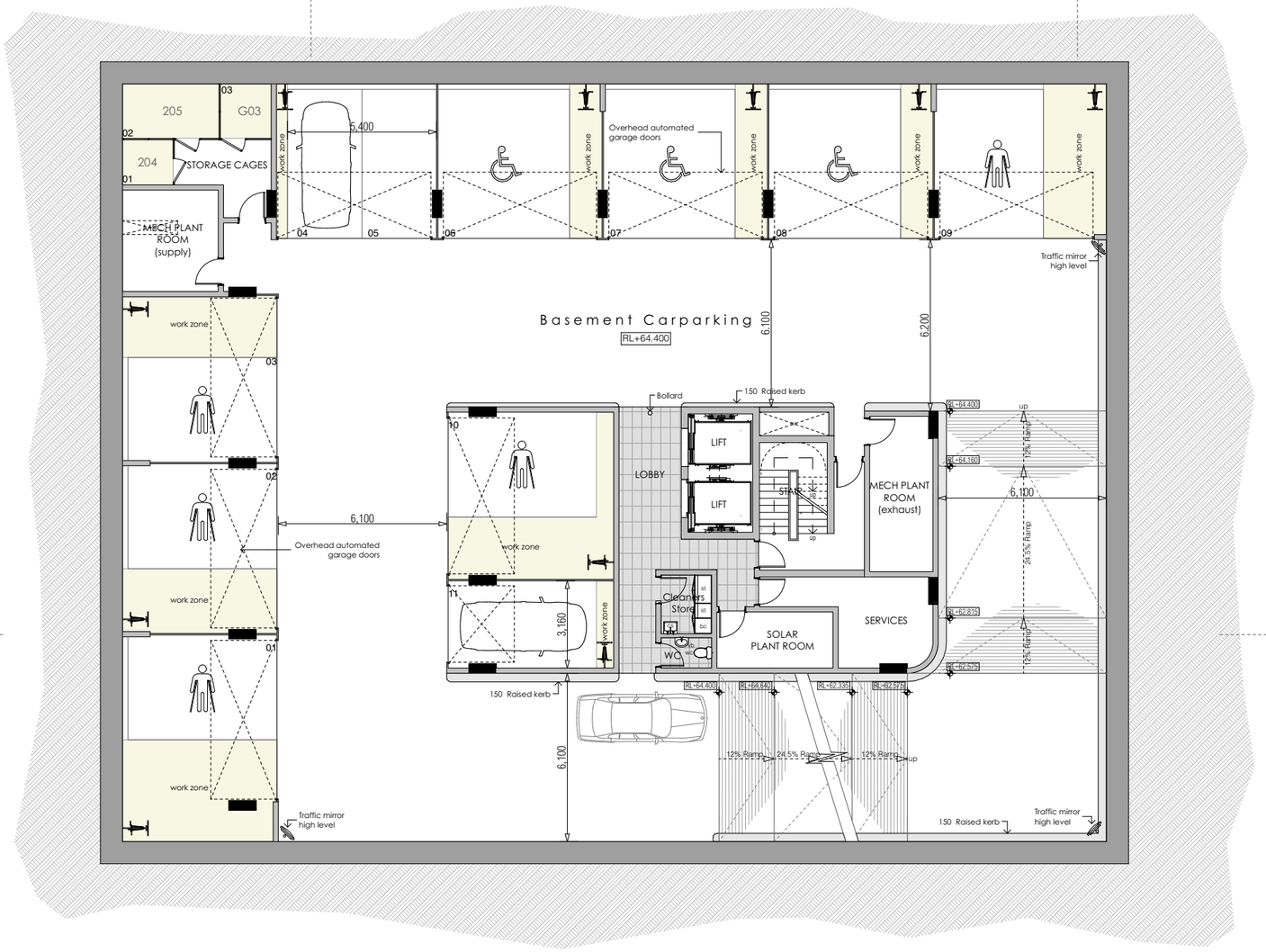
REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Basement Level 2				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



BASEMENT - LEVEL 2

0 1 2 3 4 5

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CLIENT : HELM PTY LIMITED
DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Basement Level 2	JOB No. NL2433	DWG. No. DA.15	Rev. A

REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Basement Level 3				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

BASEMENT - LEVEL 3

0 1 2 3 4 5

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CLIENT : HELM PTY LIMITED
DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Basement Level 3	JOB No. NL2433	DWG. No. DA.16	Rev. A

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REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Ground Level				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

GERARD LANE

GERARD STREET

BENELONG ROAD

GROUND LEVEL

Existing Building No. 72

Existing Building No. 118

Existing Building No. 120

Existing Building No. 122

DA Approved Building DA 323/21 No. 124

Existing Building No. 124

7.3m SETBACK

6m SETBACK

7m SETBACK

LG03 Court yard below

LG02 Court yard below

LG01 Court yard below

Semi solid balustrade

Raised planter

Motorised external horizontal adjustable privacy screen

Feature stone wall

Fixed batten privacy screen

Feature batten cladding to exterior wall

G01 Area = 152m²

G02 Area = 155m²

G03 Area = 145m²

G04 Area = 100m²

G05 Area = 97m²

G06 Area = 120m²

LOBBY RL+73.950

ENTRY RL+73.750

Piazza (void above)

court yard grass FGL+73.800

retaining wall to detail

garden store

Existing tree to be retained

Existing driveway to be removed

1500H Feature fence and wall to detail

Soft landscape planting zone in front of wall

1500H timber fence

Existing traffic light

Feature tree

Proposed new street tree

line of existing driveway to be removed

Minor changes to building form and configuration may be required when drawings are subsequently prepared for construction purposes after the grant of development consent.

03.02.25 A Development Application Issue

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118 - 124 BENELONG RD & 72 GERARD ST, CREMORNE

PROPOSED APARTMENT DEVELOPMENT • CREMORNE • NSW

CLIENT : HELM PTY LIMITED — DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
Ground Level	JOB No. NL2433	DWG. No. DA.09	Rev. A

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REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Elevation (South)				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

south elevation
gerard street view

0 1 2 3 4 5

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DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Elevation (South)	JOB No. NL2433	DWG. No. DA.17	Rev. A

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REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Elevation (West)				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

west elevation
benelong road view

0 1 2 3 4 5

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03.02.25 A Development Application Issue

DRAWING	DATE ISSUE AMENDMENTS		
Elevation (West)	JOB No. NL2433	DWG. No. DA.18	Rev. A

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REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Elevation (North)				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

north elevation
gerard lane view

0 1 2 3 4 5

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CLIENT : HELM PTY LIMITED
DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue

Elevation (North)

JOB No.	DWG. No.	Rev.
NL2433	DA.19	A

HELM®

REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Elevation (East)				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118

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118 - 124 BENELONG RD & 72 GERARD ST, CREMORNE
PROPOSED APARTMENT DEVELOPMENT • CREMORNE • NSW
CLIENT : HELM PTY LIMITED — DEVELOPMENT APPLICATION

03.02.25 A Development Application Issue

DRAWING	DATE ISSUE AMENDMENTS		
Elevation (East)	JOB No. NL2433	DWG. No. DA.20	Rev. A

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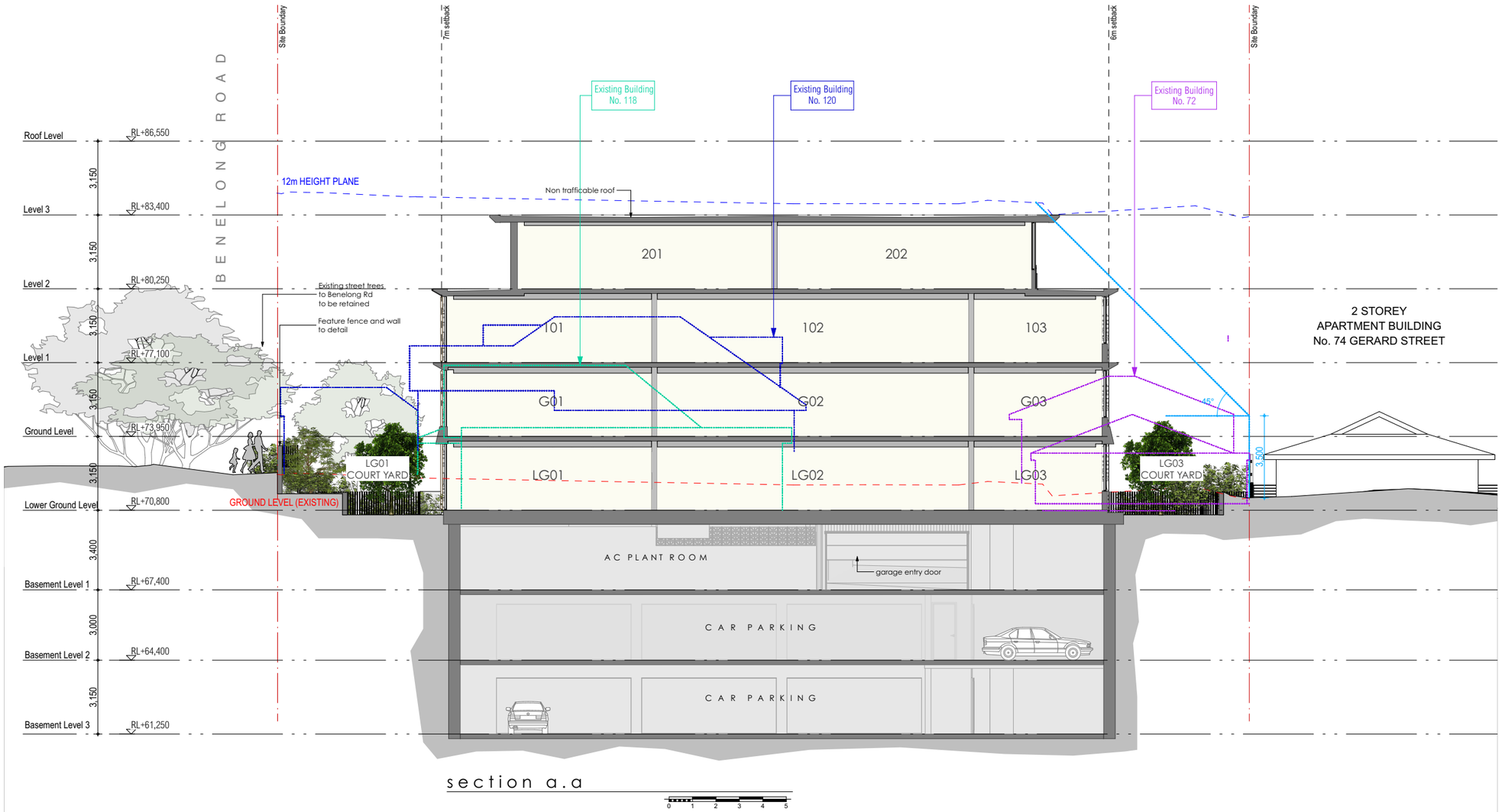
REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Section A				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



section a.a

0 1 2 3 4 5

Minor changes to building form and configuration may be required when drawings are subsequently prepared for construction purposes after the grant of development consent.

03.02.25 A Development Application Issue

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DRAWING	DATE	ISSUE	AMENDMENTS
Section A	JOB No. NL2433	DWG. No. DA.21	Rev. A

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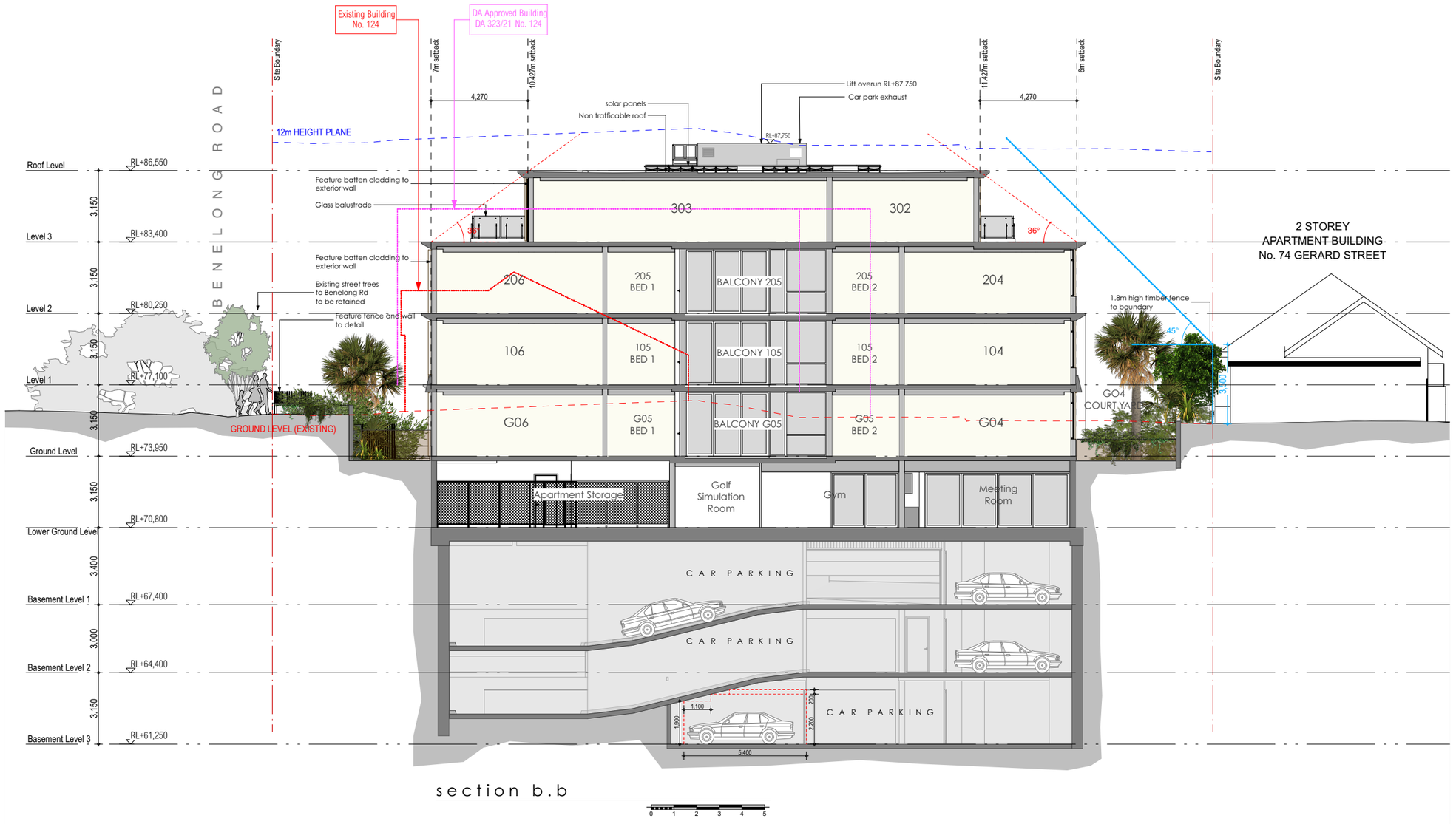
REGULATED DESIGN RECORD				
Project Address: 118-124 Benelong Rd & 72 Gerard St, Cremorne, NSW				
Project Title: Apartment Development				
Consent No.		Body Corporate No.		
Drawing Title: Section B				
Revision	Date	Description	DP Name	Reg No.
A	03.02.2025	DA Application	M. GOLOMBICK	PDP0000118



section b.b

0 1 2 3 4 5

Minor changes to building form and configuration may be required when drawings are subsequently prepared for construction purposes after the grant of development consent.

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PROPOSED APARTMENT DEVELOPMENT • CREMORNE • NSW
CLIENT : HELM PTY LIMITED
DEVELOPMENT APPLICATION

DRAWING	DATE	ISSUE	AMENDMENTS
	03.02.25	A	Development Application Issue
Section B	JOB No. NL2433	DWG. No. DA.22	Rev. A

Appendix C: Previous Investigation Borehole Logs and Data Summary Tables

PSI Laboratory Results Tables and Borehole Logs

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZG	Australian and New Zealand Guidelines
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
GSW:	General Solid Waste
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
kg/L	kilograms per litre
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
%w/w:	weight per weight
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
pH_{KCL} :	pH of filtered 1:20, 1M KCL extract, shaken overnight
pH_{ox} :	pH of filtered 1:20 1M KCl after peroxide digestion
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
RSW:	Restricted Solid Waste
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
S_{POS}:	Peroxide oxidisable Sulfur
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
USEPA	United States Environmental Protection Agency
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

TABLE S1

SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.

HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			100	20	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH1	0-0.1	F: Silty Sand	**4**	<0.4	**22**	**38**	**250**	**0.1**	**6**	**170**	**9.8**	**1.9**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH1 - [LAB_DUP]	0-0.1	F: Silty Sand	<4	<0.4	**16**	**37**	**230**	**0.1**	**6**	**170**	**13**	**2.6**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH2	0-0.1	F: Silty Clayey Sand	**4**	<0.4	**18**	**34**	**240**	**0.6**	**5**	**91**	**5.5**	**1.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH3	0-0.1	F: Silty Sandy Clay	<4	<0.4	**10**	**21**	**180**	**0.1**	**3**	**91**	**22**	**4.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH4	0-0.1	F: Silty Clayey Sand	<4	<0.4	**33**	**25**	**520**	**0.4**	**4**	**350**	**13**	**2.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH5	0-0.1	F: Silty Sandy Clay	**4**	<0.4	**17**	**27**	**190**	**0.7**	**6**	**240**	**5.8**	**1.3**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH6	0-0.1	F: Silty Clayey Sand	**12**	<0.4	**21**	**32**	**130**	**0.2**	**4**	**160**	**5.9**	**1**	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	Not Detected
BH7	0-0.1	F: Silty Sandy Clay	**7**	**0.7**	**24**	**62**	**1000**	**0.3**	**20**	**770**	**61**	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH7	0.5-0.8	Sandy Clay	**5**	<0.4	**45**	<1	**12**	<0.1	**2**	**9**	**0.09**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
SDUP1	0-0.1	Duplicate	**5**	<0.4	**16**	**28**	**190**	**0.7**	**6**	**170**	**5.6**	**0.9**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Number of Samples			10	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9	9	9	7
Maximum Value			12	0.7	45	62	1000	0.7	20	770	61	10	<PQL	<PQL	<PQL	<PQL	<PQL	0.1	<PQL	<PQL	<PQL	Not Detected

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
Asbestos Detected **Detected**

TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					**HSL-A/B: LOW/HIGH DENSITY RESIDENTIAL**							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH1	0-0.1	F: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.3
BH1 - [LAB_DUP]	0-0.1	F: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.3
BH2	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1
BH3	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.5
BH4	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.1
BH5	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.3
BH6	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.9
BH7	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.8
BH7	0.5-0.8	Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	2.8
SDUP1	0-0.1	Duplicate	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	NA
Total Number of Samples					10	10	10	10	10	10	10	9
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	2.9

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH1	0-0.1	F: Silty Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1 - [LAB_DUP]	0-0.1	F: Silty Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH2	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH3	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH4	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH5	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH6	0-0.1	F: Silty Clayey Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH7	0-0.1	F: Silty Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH7	0.5-0.8	Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
SDUP1	0-0.1	Duplicate	0m to <1m	Sand	45	110	0.5	160	55	40	3

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**RESIDENTIAL, PARKLAND & PUBLIC OPEN SPACE**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH1	0-0.1	Coarse	<25	<50	<100	<100
BH1 - [LAB_DUP]	0-0.1	Coarse	<25	<50	**220**	<100
BH2	0-0.1	Coarse	<25	<50	**110**	<100
BH3	0-0.1	Fine	<25	<50	**160**	<100
BH4	0-0.1	Coarse	<25	<50	**110**	<100
BH5	0-0.1	Fine	<25	<50	**150**	<100
BH6	0-0.1	Coarse	<25	<50	**190**	<100
BH7	0-0.1	Fine	<25	<50	**400**	**180**
BH7	0.5-0.8	Fine	<25	<50	<100	<100
SDUP1	0-0.1	Fine	<25	<50	<100	<100
Total Number of Samples			10	10	10	10
Maximum Value			<PQL	<PQL	400	180

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH1	0-0.1	Coarse	700	1000	2500	10000
BH1 - [LAB_DUP]	0-0.1	Coarse	700	1000	2500	10000
BH2	0-0.1	Coarse	700	1000	2500	10000
BH3	0-0.1	Fine	800	1000	3500	10000
BH4	0-0.1	Coarse	700	1000	2500	10000
BH5	0-0.1	Fine	800	1000	3500	10000
BH6	0-0.1	Coarse	700	1000	2500	10000
BH7	0-0.1	Fine	800	1000	3500	10000
BH7	0.5-0.8	Fine	800	1000	3500	10000
SDUP1	0-0.1	Fine	800	1000	3500	10000

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		4,400	3,300	4,500	6,300	100	14,000	4,500	12,000	1,400	
Site Use		RESIDENTIAL WITH ACCESSIBLE SOIL- DIRECT SOIL CONTACT									
Sample Reference	**Sample Depth**										
BH1	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**1.3**
BH1 - [LAB_DUP]	0-0.1	<25	<50	**220**	<100	<0.2	<0.5	<1	<1	<1	**1.3**
BH2	0-0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	<1	**1**
BH3	0-0.1	<25	<50	**160**	<100	<0.2	<0.5	<1	<1	<1	**1.5**
BH4	0-0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	<1	**1.1**
BH5	0-0.1	<25	<50	**150**	<100	<0.2	<0.5	<1	<1	<1	**1.3**
BH6	0-0.1	<25	<50	**190**	<100	<0.2	<0.5	<1	<1	<1	**2.9**
BH7	0-0.1	<25	<50	**400**	**180**	<0.2	<0.5	<1	<1	<1	**2.8**
BH7	0.5-0.8	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**2.8**
SDUP1	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	NA
Total Number of Samples		10	10	10	10	10	10	10	10	10	9
Maximum Value		<PQL	<PQL	400	180	<PQL	<PQL	<PQL	<PQL	<PQL	2.9

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HSL-A: Residential with garden/accessible soils; children's day care centers; preschools; and primary schools

FIELD DATA															LABORATORY DATA											
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.01**			**0.001**			**0.001**											**0.01**	**0.001**
13/08/2024	BH1	0-0.1	No	10	12,010	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH1	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
12/08/2024	BH2	0-0.1	No	10	11,900	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH2	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
12/08/2024	BH2	0.1-0.3	No	<10	5,410	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
13/08/2024	BH3	0-0.1	No	10	10,200	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH3	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
13/08/2024	BH3	0.1-0.3	No	<10	6,450	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
13/08/2024	BH4	0-0.1	No	10	11,100	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH4	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
12/08/2024	BH5	0-0.2	No	10	11,410	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024-A	BH5	0-0.2		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
12/08/2024	BH6	0-0.1	No	10	10,110	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH6	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
12/08/2024	BH6	0.1-0.3	No	<10	8,100	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12/08/2024	BH7	0-0.1	No	10	10,580	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	359024	BH7	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.01
12/08/2024	BH7	0.1-0.5	No	<10	7,100	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concentration above the SAC **VALUE**

TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																			
BH1	0-0.1	F: Silty Sand	Coarse	NA	NA	NA	**4**	**22**	**38**	**250**	**6**	**170**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**1.4**
BH1 - [LAB_DUP]	0-0.1	F: Silty Sand	Coarse	NA	NA	NA	<4	**16**	**37**	**230**	**6**	**170**	<1	<0.1	<25	<50	**220**	<100	<0.2	<0.5	<1	<1	**2**
BH2	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	**4**	**18**	**34**	**240**	**5**	**91**	<1	<0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	**0.8**
BH3	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	<4	**10**	**21**	**180**	**3**	**91**	<1	<0.1	<25	<50	**160**	<100	<0.2	<0.5	<1	<1	**3.1**
BH4	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	<4	**33**	**25**	**520**	**4**	**350**	<1	<0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	**1.8**
BH5	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	**4**	**17**	**27**	**190**	**6**	**240**	<1	<0.1	<25	<50	**150**	<100	<0.2	<0.5	<1	<1	**0.94**
BH6	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	**12**	**21**	**32**	**130**	**4**	**160**	<1	<0.1	<25	<50	**190**	<100	<0.2	<0.5	<1	<1	**0.67**
BH7	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	**7**	**24**	**62**	**1000**	**20**	**770**	<1	<0.1	<25	<50	**400**	**180**	<0.2	<0.5	<1	<1	**7**
BH7	0.5-0.8	Sandy Clay	Fine	NA	NA	NA	**5**	**45**	<1	**12**	**2**	**9**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.09**
SDUP1	0-0.1	Duplicate	Fine	NA	NA	NA	**5**	**16**	**28**	**190**	**6**	**170**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.64**
Total Number of Samples				0	0	0	10	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10	10
Maximum Value				NA	NA	NA	12	45	62	1000	20	770	<PQL	<PQL	<PQL	<PQL	400	180	<PQL	<PQL	<PQL	<PQL	7

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0-0.1	F: Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 -	0-0.1	F: Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH2	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH3	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH4	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH5	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH6	0-0.1	F: Silty Clayey Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH7	0-0.1	F: Silty Sandy Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH7	0.5-0.8	Sandy Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
SDUP1	0-0.1	Duplicate	Fine	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	1300	5600	65	105	125	45	20

TABLE S7
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled	PCBs	C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH1	0-0.1	F: Silty Sand	**4**	<0.4	**22**	**38**	**250**	**0.1**	**6**	**170**	**9.8**	**1.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH1 - [LAB_DU	0-0.1	F: Silty Sand	<4	<0.4	**16**	**37**	**230**	**0.1**	**6**	**170**	**13**	**2**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**130**	**110**	**240**	<0.2	<0.5	<1	<1	NA
BH2	0-0.1	F: Silty Clayey Sand	**4**	<0.4	**18**	**34**	**240**	**0.6**	**5**	**91**	**5.5**	**0.8**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH3	0-0.1	F: Silty Sandy Clay	<4	<0.4	**10**	**21**	**180**	**0.1**	**3**	**91**	**22**	**3.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	**120**	**120**	<0.2	<0.5	<1	<1	Not Detected
BH4	0-0.1	F: Silty Clayey Sand	<4	<0.4	**33**	**25**	**520**	**0.4**	**4**	**350**	**13**	**1.8**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH5	0-0.1	F: Silty Sandy Clay	**4**	<0.4	**17**	**27**	**190**	**0.7**	**6**	**240**	**5.8**	**0.94**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	**150**	**150**	<0.2	<0.5	<1	<1	Not Detected
BH6	0-0.1	F: Silty Clayey Sand	**12**	<0.4	**21**	**32**	**130**	**0.2**	**4**	**160**	**5.9**	**0.67**	<0.1	<0.1	<0.1	**0.1**	<0.1	<25	<50	<100	**150**	**150**	<0.2	<0.5	<1	<1	Not Detected
BH7	0-0.1	F: Silty Sandy Clay	**7**	**0.7**	**24**	**62**	**1000**	**0.3**	**20**	**770**	**61**	**7**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**230**	**240**	**470**	<0.2	<0.5	<1	<1	Not Detected
BH7	0.5-0.8	Sandy Clay	**5**	<0.4	**45**	<1	**12**	<0.1	**2**	**9**	**0.09**	**0.09**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
SDUP1	0-0.1	Duplicate	**5**	<0.4	**16**	**28**	**190**	**0.7**	**6**	**170**	**5.6**	**0.64**	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
Total Number of Samples			10	10	10	10	10	10	10	10	10	10	9	9	9	9	9	10	10	10	10	10	10	10	10	10	7
Maximum Value			12	0.7	45	62	1000	0.7	20	770	61	7	<PQL	<PQL	<PQL	0.1	<PQL	<PQL	<PQL	230	240	470	<PQL	<PQL	<PQL	<PQL	Not Detected

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**
Asbestos Detected > Special Waste (asbestos) — **Detected**

TABLE S8
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Lead	B(a)P
PQL - Envirolab Services			0.03	0.001
TCLP1 - General Solid Waste			5	0.04
TCLP2 - Restricted Solid Waste			20	0.16
TCLP3 - Hazardous Waste			>20	>0.16
Sample Reference	**Sample Depth**	**Sample Description**		
BH1	0-0.1	F: Silty Sand	**0.06**	<0.0001
BH3	0-0.1	F: Silty Sandy Clay	**0.1**	<0.0001
BH7	0-0.1	F: Silty Sandy Clay	**0.3**	<0.0001
Total Number of samples			3	3
Maximum Value			0.30	<PQL

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

Preliminary Site Investigation
118, 120, 122 & 124 Benelong Road and 72 Gerard Street, Cremorne, NSW
E36901P

JKEnvironments

TABLE Q1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*
Intra	BH5	0-0.1	<25	<50	150	<100	<0.2	<0.5	<1	<2	<1
laboratory	SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1
duplicate	MEAN		nc	nc	100	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	100%	nc	nc	nc	nc	nc	nc
Field	FR1-HA	µg/L	92	<50	<100	<100	<1	<1	<1	<2	<1
Rinsate	12/08/24										
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	12/08/24										
Trip	TS		-	-	-	-	97%	98%	96%	97%	97%
Spike	12/08/24										

			Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH5	0-0.1	<0.1	0.1	<0.1	<0.1	0.2	0.1	0.7	0.7	0.5	0.4	1	0.94	0.4	<0.1	0.4
laboratory	SDUP1	-	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	0.8	0.9	0.6	0.4	1	0.64	0.3	0.1	0.4
duplicate	MEAN		nc	0.075	nc	nc	0.25	0.075	0.75	0.8	0.55	0.4	1	0.79	0.35	0.075	0.4
	RPD %		nc	67%	nc	nc	40%	67%	13%	25%	18%	0%	0%	38%	29%	67%	0%
Field	FR1-HA	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1
Rinsate	12/08/24																
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	12/08/24																
Trip	TS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	12/08/24																

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH5	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Field	FR1-HA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	12/08/24																					
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	12/08/24																					
Trip	TS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	12/08/24																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra	BH5	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	4	<0.4	17	27	190	0.7	6	240
laboratory	SDUP1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	<0.4	16	28	190	0.7	6	170
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	4.5	nc	16.5	27.5	190	0.7	6	205
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	22%	nc	6%	4%	0%	0%	0%	34%
Field	FR1-HA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	<0.01	<0.01	0.02	<0.03	<0.0005	<0.02	<0.02
Rinsate	12/08/24																						
Field	TB	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	12/08/24																						
Trip	TS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	12/08/24																						

Result outside of QA/QC acceptance criteria

Rinsate metals results in mg/L

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BOREHOLE LOG

Borehole No. 1

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■			■	REFER TO DCP TEST RESULTS SHEET					FILL: Silty sand, fine to medium grained, grey, trace of fine to coarse grained ironstone gravel.	M			APPEARS POORLY COMPACTED
										FILL: Silty sandy clay, low plasticity, grey, trace of fine to medium grained sand, and root fibres .	w>PL			SCREEN: 12.01kg 0-0.1m, NO FCF
	■								CL		w>PL	St		INSUFFICIENT RETURN FOR BULK SCREEN
				■		72	1		CH	Sandy CLAY: low plasticity, light brown, fine to medium grained sand.			140 160 180	RESIDUAL
										Silty CLAY: high plasticity, orange brown, trace of fine to coarse grained ironstone gravel.				
										REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 9.43m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 9.43m TO 5.93m. CASING 5.93m TO 0.1m. 2mm SAND FILTER PACK 9.43m TO 5.5m. BENTONITE SEAL 5.5m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						71	2							
						70	3							
						69	4							
						68	5							
						67	6							
						66								

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CORED BOREHOLE LOG

Borehole No. 1 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.10m						
0% RETURN		71	2		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°. NO CORE 1.20m	MW	VL - L				
ON 9/9/24		70	3		SANDSTONE: fine to medium grained, red brown, with occasional grey laminae, bedded at 0-10°.	SW	M - H	1.2, 0.70			Hawkesbury Sandstone
100% RETURN		69	4		SANDSTONE: fine to medium grained, light grey, orange brown and red brown, with grey laminae, bedded at 0-15°.			1.3, 1.7, 0.80		(3.75m) Be, 10°, Ir, R, Cn	
		68	5							(5.09m) Be, 10°, Ir, R, Fe Sn	
		67	6					1.0, 1.1			
					NO CORE 0.20m						
		66	7		SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-15°.	SW	M - H	0.70, 1.3, 2.2			Hawkesbury Sandstone
					NO CORE 0.19m						
		65			SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°.	SW	M - H	0.60			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No. 1

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
100% RETURN					SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°. *(continued)*	SW	M - H			(8.15m) J, 70°, P, R, Cn	
							VL	0.070			
					NO CORE 0.28m						
		64	9		SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°.	SW	L - M	0.20			
								0.30		(9.30m) XWS, 0°, 40 mm.t	
					END OF BOREHOLE AT 9.43 m						
		63	10								
		62	11								
		61	12								
		60	13								
		59	14								
		58									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET					FILL: Silty clayey sand, fine to medium grained, brown, trace of root fibres.	M			APPEARS POORLY COMPACTED
										FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, trace of root fibres.	w>PL		150 130 120	SCREEN: 11.90kg, 0-0.1m, NO FCF SCREEN: 5.41kg (<10L), 0.1-0.3m, NO FCF
						71	1		CL	Sandy CLAY: low plasticity, orange brown, fine to medium grained sand, trace of fine to coarse grained ironstone gravel.	w>PL	St	180 200 160 190	INSUFFICIENT RETURN FOR BULK SAMPLE RESIDUAL
										Casing Washed in to 1.52m.				HAND AUGER REFUSAL AT 1.2m DEPTH
						70	2			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 8.63m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 8.63m TO 5.13m. CASING 5.13m TO 0.1m. 2mm SAND FILTER PACK 8.63m TO 5.0m. BENTONITE SEAL 5.0m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						69	3							
						68	4							
						67	5							
						66	6							
						65								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.52m						
60% RETURN		70	2		SANDSTONE: fine to medium grained, red brown.	SW	M				
					NO CORE 0.65m						
					SANDSTONE: fine to medium grained, orange brown and red brown.	HW	VL	0.060			
					Extremely Weathered sandstone: clayey SAND, fine to coarse grained, orange brown.	XW	Hd				Hawkesbury Sandstone
ON 9/9/24		69	3		SANDSTONE: fine to medium grained, light grey, red brown and orange brown, with grey and orange brown laminae, bedded at 0-10°.	SW	L - M	0.60 0.10 0.20 0.30			
		68	4		NO CORE 0.10m						
95% RETURN					SANDSTONE: fine to medium grained, light grey and orange brown, with grey laminae, bedded at 0-15°.	SW	L - M	0.30 0.20 0.40	600 200 60 20	(4.35m) Be, 0°, Ir, R, Cn (4.51m) Be, 15°, P, R, Clay Vn (4.85m) Be, 10°, P, R, Clay Vn (5.23m) CS, 0°, 15 mm.t (5.25m) CS, 0°, 5 mm.t	
		67	5		NO CORE 0.22m						
					SANDSTONE: fine to medium grained, light grey and grey, with grey laminae, bedded at 0-15°.	SW	L				
		66	6		NO CORE 0.17m	SW	M	0.40		(5.84m) Be, 15°, Ir, R, Fe Sn	
					SANDSTONE: fine to medium grained, light grey and brown, with occasional grey laminae, bedded at 0-15°.					(6.42m) Be, 0°, P, R, Fe Sn	Hawkesbury Sandstone
		65	7					0.50 0.20			
					NO CORE 0.10m					(7.27m) CS, 0°, 45 mm.t	
					SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°.	SW	VL - L	0.040			
		64				FR	M - H		200 60 20	(7.73m) XWS, 0°, 45 mm.t	

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
95% RETURN					SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°. *(continued)*	FR	L - M	0.20 – 1.0		(8.04m) XWS, 0°, 10 mm.t (8.10m) Be, 0°, P, R, Fe Sn (8.42m) CS, 0°, 20 mm.t	
		63	9		END OF BOREHOLE AT 8.63 m						
		62	10								
		61	11								
		60	12								
		59	13								
		58	14								
		57									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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BOREHOLE LOG

Borehole No. 3

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET	76				FILL: Silty sandy clay, low plasticity, brown and grey, fine to medium grained sand, trace of ironstone gravel, roots and root fibres.	w>PL			APPEARS POORLY COMPACTED
									SC		M	(St)		SCREEN: 10.20kg, 0-0.1m, NO FCF
									CL-CI	Clayey SAND: fine to medium grained, light brown, trace of fine to coarse grained ironstone gravel.	w>PL			SCREEN: 6.45kg <10L), 0.1-0.3m, NO FCF
							1			Sandy CLAY: low to medium plasticity, light brown and red brown, fine to medium grained sand, trace of fine to coarse grained ironstone gravel.				RESIDUAL
						75				Casing Washed in to 1.1m.				HAND AUGER REFUSAL AT 0.8m DEPTH
										REFER TO CORED BOREHOLE LOG				
						74	2							
						73	3							
						72	4							
						71	5							
						70	6							

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CORED BOREHOLE LOG

Borehole No. 3 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		75			START CORING AT 1.10m						
					NO CORE 0.90m						
		74	2		SANDSTONE: fine to medium grained, red brown, massive.	MW	M - H	1.0			
					NO CORE 0.23m						
					SANDSTONE: fine to medium grained, light grey, massive.	SW	VL - L				Hawkesbury Sandstone
		73	3		SANDSTONE: fine to medium grained, red brown, with occasional grey laminae, bedded at 0-15°.		L - M	0.40 0.20 0.30			
80% RETURN					NO CORE 1.01m						
		72	4								
			5		SANDSTONE: fine to medium grained, red brown and orange brown.	SW	L - M	0.50		(5.08m) XWS, 0°, 30 mm,t	
		71			NO CORE 0.12m						
					SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	SW	M	0.30 0.60 1.0 0.70 0.70			Hawkesbury Sandstone
		70	6								
90% RETURN		69	7					0.90		(7.47m) Be, 15°, P, R, Fe Sn	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No. 3

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1 L 0.3 M 1 H 3 VH 10 EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
90% RETURN		68			SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	SW	M				Hawkesbury Sandstone
					SANDSTONE: fine to medium grained, light grey, with occasional grey laminae, bedded at 0-15°.	FR	M - H	0.70			
		67	9					0.80 0.50		(9.50m) XWS, 0°, 45 mm.t	
		66	10					0.90 1.3			
		65	11					0.70 0.90			
		64	12					1.4 1.1			
		63	13		END OF BOREHOLE AT 12.26 m						
		62	14								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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BOREHOLE LOG

Borehole No. 4

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET	75	1		CL	FILL: Silty clayey sand, fine to medium grained, grey and brown, trace of fine to coarse grained ironstone gravel, glass and metal fragments, ash and root fibres.	M			APPEARS POORLY COMPACTED
											w>PL	St	150 180	SCREEN: 11.1kg, 0-0.1m, NO FCF
									CI-CH	Silty sandy CLAY: low plasticity, orange brown and brown, trace of fine to coarse grained ironstone gravel, and ash.				INSUFFICIENT RETURN FOR BILK SCREEN
												VSt - Hd		RESIDUAL
										Silty CLAY: medium to high plasticity, orange brown, with fine to coarse grained ironstone gravel.			280 260 240	ASH LAYER (INFERRED DECOMPOSED TREE ROOT)
										Silty CLAY: medium to high plasticity, grey, trace of fine to coarse grained ironstone gravel.			>600 580	
									CL-CI				590	
						74							280	
							2			Silty CLAY: low to medium plasticity, light grey, with fine to medium grained sand.			250 230	GROUNDWATER MONITORING WELL INSTALLED TO 11.96m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 11.96m TO 8.96m. CASING 8.96m TO 0.1m. 2mm SAND FILTER PACK 11.96m TO 8.5m. BENTONITE SEAL 8.5m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
										REFER TO CORED BOREHOLE LOG				
						73	3							
						72	4							
						71	5							
						70	6							
						69								

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CORED BOREHOLE LOG

Borehole No. 4 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.70m						
	90% RETURN	74	1		SANDSTONE: fine to medium grained, red brown, massive.	MW	H				
			2		NO CORE 0.22m	MW	M	0.50		(2.12m) Be, 0°, Ir, R, Clay Vn	Hawkesbury Sandstone
	95% RETURN	73			SANDSTONE: fine to medium grained, red brown and orange brown, massive.			0.50			
			3		SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.		VL - L	0.020		(3.03m) XWS, 0°, 20 mm.t (3.10m) XWS, 0°, 15 mm.t (3.24m) XWS, 45°, 15 mm.t	
		72			Extremely Weathered sandstone: sandy CLAY, low plasticity, light grey, fine to coarse grained sand.	XW	Hd				
			4		SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	MW	L - M	0.90 0.010		(3.80m) Be, 0°, P, R, Clay Vn (4.06m) XWS, 0°, 50 mm.t	
					NO CORE 0.34m						
	85% RETURN ON 9/9/24	71	5		SANDSTONE: fine to medium grained, red brown, massive.	SW	L - M	0.60 0.20		(5.05m) Be, 0°, P, R, Clay Vn (5.52m) Be, 0°, P, R, Fe Sn	
		70	6					0.40 0.60		(6.36m) Be, 0°, P, R, Fe Sn	Hawkesbury Sandstone
		69	7					0.70 0.30		(6.81m) Be, 0°, P, R, Clay Vn	
	80% RETURN	68						0.20			

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No. 4 **3 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
80% RETURN		67	9		SANDSTONE: fine to medium grained, red brown, massive. *(continued)*	SW	L - M	0.40; 0.20		(8.33m) XWS, 0°, 15 mm.t; (8.64m) Be, 10°, P, R, Fe Sn; (8.78m) J, 85°, Ir, R, Fe Sn	
					NO CORE 0.02m	XW	Hd				
					Extremely Weathered sandstone: silty CLAY, medium to high plasticity, red brown.	SW	M	0.20		(9.07m) Be, 0°, Ir, R, Fe Sn; (9.15m) J, 30°, Ir, R, Fe Sn; (9.21m) J, 30°, Ir, R, Fe Sn	
		66	10		NO CORE 0.08m SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.			0.30; 0.40			Hawkesbury Sandstone
		65	11					0.80			
		64						0.80; 1.2			
			12		END OF BOREHOLE AT 11.96 m						
		63	13								
		62	14								
		61									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH5 **1/1**

SDUP1: 0-0.1m

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, trace of concrete and ceramic fragments, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 11.41kg 0-0.2m, NO FCF
	■		■						SC	Clayey SAND: fine to medium grained, light grey.	M			RESIDUAL
							0.5							
										END OF BOREHOLE AT 0.6m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH6** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty clayey sand, fine to medium grained, brown, trace of igneous gravel, bark fragments, roots and root fibres.	D			MULCH COVER SCREEN 10.11kg 0-0.1m, NO FCF
	■		■		■					FILL: Silty clay, medium to high plasticity, light brown and brown, trace of ironstone and igneous gravel, sand and root fibres.	w≈PL			SCREEN: 8.10kg (<10L) 0.1-0.3m, NO FCF
							0.5			END OF BOREHOLE AT 0.5m				INSUFFICIENT RETURN FOR BULK SCREEN HAND AUGER REFUSAL ON OBSTRUCTION IN FILL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH7** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty sandy clay, low to medium plasticity, brown, fine to medium grained sand, trace of sandstone cobbles, ironstone and igneous gravel, brick, tile, glass and metal fragments, slag, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 10.58kg 0-0.1m, NO FCF SCREEN: 7.10kg (<10L) 0.1-0.5m, NO FCF
							0.5		CI-CH	Sandy CLAY: medium to high plasticity, light brown, fine to medium grained sand, trace of ironstone gravel.	w≈PL			RESIDUAL
							1			END OF BOREHOLE AT 0.9m				
							1.5							
							2							
							2.5							
							3							
							3.5							

ENVIRONMENTAL LOGS EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the environmental report in regard to classification methods, field procedures and certain matters relating to the logging of soil and rock. Not all notes are necessarily relevant to all reports.

Where geotechnical borehole logs are utilised for environmental purpose, reference should also be made to the explanatory notes included in the geotechnical report. Environmental logs are not suitable for geotechnical purposes.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Environmental studies include gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geoenvironmental practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) are referred to as 'laminite'.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the

structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

LOGS

The borehole or test pit logs presented herein are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse environmental characteristics or behaviour. If the volume and nature of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing has not been undertaken to confirm the soil classification and rock strengths indicated on the environmental logs unless noted in the report.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

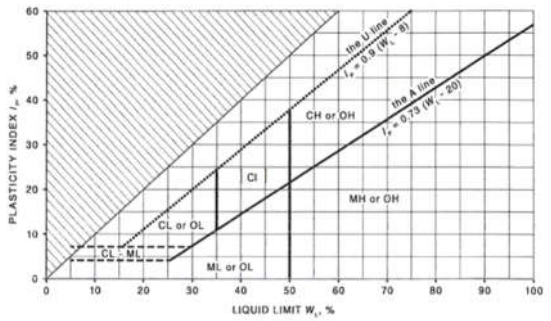
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
	PFAS	Soil sample taken over depth indicated, for analysis of Per- and Polyfluoroalkyl Substances.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL $w \approx$ PL w < PL $w \approx$ LL w > LL	Moisture content estimated to be greater than plastic limit. Moisture content estimated to be approximately equal to plastic limit. Moisture content estimated to be less than plastic limit. Moisture content estimated to be near liquid limit. Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D M W	DRY – runs freely through fingers. MOIST – does not run freely but no free water visible on soil surface. WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS S F St VSt Hd Fr ( )	VERY SOFT – unconfined compressive strength ≤ 25kPa. SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa. FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa. STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa. VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa. HARD – unconfined compressive strength > 400kPa. FRIABLE – strength not attainable, soil crumbles. Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)	VL L MD D VD ( )	**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)** VERY LOOSE ≤ 15 / 0 – 4 LOOSE > 15 and ≤ 35 / 4 – 10 MEDIUM DENSE > 35 and ≤ 65 / 10 – 30 DENSE > 65 and ≤ 85 / 30 – 50 VERY DENSE > 85 / > 50 Bracketed symbol indicates estimated density based on ease of drilling or other assessment.

Log Column	Symbol	Definition
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

DSI Laboratory Results Tables and Borehole Logs

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ABC:	Ambient Background Concentration
ACM:	Asbestos Containing Material
ADWG:	AustralianDrinking Water Guidelines
AF:	Asbestos Fines
ANZG	Australian and New Zealand Guidelines
B(a)P:	Benzo(a)pyrene
CEC:	Cation Exchange Capacity
CRC:	Cooperative Research Centre
CT:	Contaminant Threshold
EILs:	Ecological Investigation Levels
ESLs:	Ecological Screening Levels
FA:	Fibrous Asbestos
GIL:	Groundwater Investigation Levels
GSW:	General Solid Waste
HILs:	Health Investigation Levels
HSLs:	Health Screening Levels
HSL-SSA:	Health Screening Level-SiteSpecific Assessment
kg/L	kilograms per litre
NA:	Not Analysed
NC:	Not Calculated
NEPM:	National Environmental Protection Measure
NHMRC:	National Health and Medical Research Council
NL:	Not Limiting
NSL:	No Set Limit
OCP:	Organochlorine Pesticides
OPP:	Organophosphorus Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
%w/w:	weight per weight
ppm:	Parts per million
PCBs:	Polychlorinated Biphenyls
PCE:	Perchloroethylene (Tetrachloroethylene or Teterachloroethene)
PQL:	Practical Quantitation Limit
RS:	Rinsate Sample
RSL:	Regional Screening Levels
RSW:	Restricted Solid Waste
SAC:	Site Assessment Criteria
SCC:	Specific Contaminant Concentration
SSA:	Site Specific Assessment
SSHSLs:	Site Specific Health Screening Levels
TAA:	Total Actual Acidity in 1M KCL extract titrated to pH6.5
TB:	Trip Blank
TCA:	1,1,1 Trichloroethane (methyl chloroform)
TCE:	Trichloroethylene (Trichloroethene)
TCLP:	Toxicity Characteristics Leaching Procedure
TPA:	Total Potential Acidity, 1M KCL peroxide digest
TS:	Trip Spike
TRH:	Total Recoverable Hydrocarbons
TSA:	Total Sulfide Acidity (TPA-TAA)
UCL:	Upper Level Confidence Limit on Mean Value
USEPA	United States Environmental Protection Agency
VOCC:	Volatile Organic Chlorinated Compounds
WHO:	World Health Organisation

Table Specific Explanations:

HIL Tables:

- The chromium results are for Total Chromium which includes Chromium III and VI. For initial screening purposes, we have assumed that the samples contain only Chromium VI unless demonstrated otherwise by additional analysis.
- Carcinogenic PAHs is a toxicity weighted sum of analyte concentrations for a specific list of PAH compounds relative to B(a)P. It is also refered to as the B(a)P Toxic Equivalence Quotient (TEQ).

EIL/ESL Table:

- ABC Values for selected metals have been adopted from the published background concentrations presented in Olszowy et. al., (1995), Trace Element Concentrations in Soils from Rural and Urban New South Wales (the 25th percentile values for old suburbs with high traffic have been quoted).

Waste Classification and TCLP Table:

- Data assessed using the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (2014).
- The assessment of Total Moderately Harmful pesticides includes: Dichlorovos, Dimethoate, Fenitrothion, Ethion, Malathion and Parathion.
- Assessment of Total Scheduled pesticides include: HBC, alpha-BHC, gamma-BHC, beta-BHC, Heptachlor, Aldrin, Heptachlor Epoxide, gamma-Chlordane, alpha-chlordane, pp-DDE, Dieldrin, Endrin, pp-DDD, pp-DDT, Endrin Aldehyde.

QA/QC Table:

- Field/trip blank, Inter and Intra laboratory duplicate results are reported in mg/kg.
- Trip spike results are reported as percentage recovery.
- Field rinsate results are reported in µg/L.

TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-A: 'Residential with garden/accessible soils; children's day care centers; preschools; and primary schools'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	Carcinogenic PAHs	HCB	Endosulfan	Methoxychlor	Aldrin & Dieldrin	Chlordane	DDT, DDD & DDE	Heptachlor	Chlorpyrifos		
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100
Site Assessment Criteria (SAC)			100	20	100	6000	300	40	400	7400	300	3	10	270	300	6	50	240	6	160	1	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH101	0-0.1	Fill: clayey silty sand	**6**	<0.4	**22**	**40**	**180**	<0.1	**4**	**130**	**8.3**	**1.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	**5**	<0.4	**17**	**48**	**160**	<0.1	**4**	**120**	**10**	**1.6**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
BH102	0-0.1	Fill: silty sand	**11**	**0.6**	**18**	**60**	**290**	**0.3**	**6**	**310**	**25**	**4.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH102	0.6-0.8	Fill: silty sand	**5**	<0.4	**48**	**5**	**49**	**0.7**	**9**	**120**	**0.3**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH103	0-0.1	Fill: silty sandy clay	**8**	**1**	**19**	**94**	**440**	**0.2**	**6**	**550**	**7.8**	**1.3**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Detected
BH103	0.4-0.6	Sandy Clay	<4	<0.4	**32**	**12**	**52**	<0.1	**3**	**190**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NA
BH104	0-0.1	Fill: silty sandy clay	**6**	**4.5**	**66**	**360**	**590**	**0.7**	**24**	**420**	**13**	**2.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH104 - [LAB_DUP]	0-0.1	Lab duplicate	**5**	**2**	**54**	**330**	**510**	**0.7**	**20**	**440**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104 - [TRIPLICATE]	0-0.1	Lab triplicate	**6**	**3**	**38**	**360**	**510**	**0.5**	**14**	**460**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	0.4-0.6	Fill: sandy clay	<4	<0.4	**29**	**11**	**29**	<0.1	**2**	**33**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH105	0-0.1	Fill: silty sand	<4	<0.4	**10**	**12**	**23**	<0.1	**3**	**57**	**0.06**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH105	0.4-0.6	Fill: silty sand	<4	<0.4	**6**	**11**	**23**	<0.1	**3**	**37**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH106	0-0.1	Fill: silty clay	**5**	<0.4	**24**	**5500**	**520**	**0.4**	**9**	**290**	**8.2**	**1.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Not Detected
BH106 - [LAB_DUP]	0-0.1	Lab duplicate	**6**	**0.4**	**36**	**88**	**470**	**0.3**	**12**	**180**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106 - [TRIPLICATE]	0-0.1	Lab triplicate	**4**	<0.4	**19**	**83**	**470**	**0.4**	**5**	**210**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0.4-0.6	Silty Clay	**6**	<0.4	**64**	**4**	**14**	<0.1	**3**	**20**	**0.05**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NA
SDUP101	-	Intra-lab dup BH102 0-0.1m	**10**	**0.6**	**15**	**54**	**250**	**0.3**	**5**	**280**	**7.8**	**1.3**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
SDUP101 - [LAB_DUP]	-	Lab duplicate	**12**	**0.6**	**18**	**63**	**290**	**0.3**	**6**	**310**	**5.1**	**0.9**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA
SDUP102	-	Inter-lab dup BH105 0-0.1m	<4.0	<0.40	**10**	**12**	**33**	<0.10	**3.5**	**59**	**0.38**	<0.50	<0.10	**0.14**	<0.10	<0.1	<0.1	<0.10	<0.10	<0.1	NA	NA
F3	0-0.1	Fibre cement fragment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
Total Number of Samples			19	19	19	19	19	19	19	19	15	15	15	15	15	15	15	13	15	15	14	10
Maximum Value			12	4.5	66	5500	590	0.7	24	550	25	4.1	<PQL	0.14	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Detected

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
Asbestos Detected — **Detected**

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TABLE S2
SOIL LABORATORY RESULTS COMPARED TO HSLs
All data in mg/kg unless stated otherwise

					C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Field PID Measurement
PQL - Envirolab Services					25	50	0.2	0.5	1	1	1	ppm
NEPM 2013 HSL Land Use Category					HSL-A/B: LOW/HIGH DENSITY RESIDENTIAL							
Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**								
BH101	0-0.1	Fill: clayey silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.3
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	-
BH102	0-0.1	Fill: silty sand	0m to <1m	Sand	<25	**140**	<0.2	<0.5	<1	<1	<1	0.7
BH102	0.6-0.8	Fill: silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.7
BH103	0-0.1	Fill: silty sandy clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.4
BH103	0.4-0.6	Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	1.3
BH104	0-0.1	Fill: silty sandy clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.3
BH104	0.4-0.6	Fill: sandy clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.2
BH105	0-0.1	Fill: silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.4
BH105	0.4-0.6	Fill: silty sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.5
BH106	0-0.1	Fill: silty clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.3
BH106	0.4-0.6	Silty Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<1	<1	0.3
SDUP101	0-0.1	Intra-lab dup BH102 0-0.1m	0m to <1m	Sand	<25	**110**	<0.2	<0.5	<1	<1	<1	-
SDUP101 - [LAB_DUP]	0-0.1	Lab duplicate	0m to <1m	Sand	<25	**76**	<0.2	<0.5	<1	<1	<1	-
SDUP102	0-0.1	Inter-lab dup BH105 0-0.1m	0m to <1m	Sand	<25	<50	<0.20	<0.50	<1.0	<1.0	<3.0	-
Total Number of Samples					15	15	15	15	15	15	15	11
Maximum Value					<PQL	140	<PQL	<PQL	<PQL	<PQL	<PQL	1.3

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the concentration above the SAC is highlighted in grey in the Site Assessment Criteria Table below

HSL SOIL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
BH101	0-0.1	Fill: clayey silty sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH102	0-0.1	Fill: silty sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH102	0.6-0.8	Fill: silty sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH103	0-0.1	Fill: silty sandy clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH103	0.4-0.6	Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH104	0-0.1	Fill: silty sandy clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH104 - [TRIPLICATE]	0-0.1	Lab triplicate	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA
BH104	0.4-0.6	Fill: sandy clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH105	0-0.1	Fill: silty sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH105	0.4-0.6	Fill: silty sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH106	0-0.1	Fill: silty clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH106 - [TRIPLICATE]	0-0.1	Lab triplicate	0m to <1m	Sand	NA	NA	NA	NA	NA	NA	NA
BH106	0.4-0.6	Silty Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
SDUP101	0-0.1	Intra-lab dup BH102 0-0.1m	0m to <1m	Sand	45	110	0.5	160	55	40	3
SDUP101 - [LAB_DUP]	0-0.1	Lab duplicate	0m to <1m	Sand	45	110	0.5	160	55	40	3
SDUP102	0-0.1	Inter-lab dup BH105 0-0.1m	0m to <1m	Sand	45	110	0.5	160	55	40	3

TABLE S3
SOIL LABORATORY RESULTS COMPARED TO MANAGEMENT LIMITS
All data in mg/kg unless stated otherwise

			C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
PQL - Envirolab Services			25	50	100	100
NEPM 2013 Land Use Category			**RESIDENTIAL, PARKLAND & PUBLIC OPEN SPACE**			
Sample Reference	**Sample Depth**	**Soil Texture**				
BH101	0-0.1	Coarse	<25	<50	**110**	<100
BH101 -	0-0.1	Coarse	<25	<50	**100**	<100
BH102	0-0.1	Coarse	<25	**140**	**550**	**300**
BH102	0.6-0.8	Coarse	<25	<50	<100	<100
BH103	0-0.1	Fine	<25	<50	**140**	<100
BH103	0.4-0.6	Fine	<25	<50	<100	<100
BH104	0-0.1	Fine	<25	<50	**110**	<100
BH104	0.4-0.6	Fine	<25	<50	<100	<100
BH105	0-0.1	Coarse	<25	<50	<100	<100
BH105	0.4-0.6	Coarse	<25	<50	<100	<100
BH106	0-0.1	Fine	<25	<50	<100	<100
BH106	0.4-0.6	Fine	<25	<50	<100	<100
SDUP101	0-0.1	Coarse	<25	**110**	**550**	**490**
SDUP101 - [LAB_DUP]	0-0.1	Coarse	<25	**76**	**470**	**410**
SDUP102	0-0.1	Coarse	<25	<50	<100	<100
Total Number of Samples			15	15	15	15
Maximum Value			<PQL	140	550	490

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

MANAGEMENT LIMIT ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Soil Texture**	C_6-C_{10} (F1) plus BTEX	>C_{10}-C_{16} (F2) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)
BH101	0-0.1	Coarse	700	1000	2500	10000
BH101 -	0-0.1	Coarse	700	1000	2500	10000
BH102	0-0.1	Coarse	700	1000	2500	10000
BH102	0.6-0.8	Coarse	700	1000	2500	10000
BH103	0-0.1	Fine	800	1000	3500	10000
BH103	0.4-0.6	Fine	800	1000	3500	10000
BH104	0-0.1	Fine	800	1000	3500	10000
BH104	0.4-0.6	Fine	800	1000	3500	10000
BH105	0-0.1	Coarse	700	1000	2500	10000
BH105	0.4-0.6	Coarse	700	1000	2500	10000
BH106	0-0.1	Fine	800	1000	3500	10000
BH106	0.4-0.6	Fine	800	1000	3500	10000
SDUP101	0-0.1	Coarse	700	1000	2500	10000
SDUP101 - [LAB_DUP]	0-0.1	Coarse	700	1000	2500	10000
SDUP102	0-0.1	Coarse	700	1000	2500	10000

TABLE S4
SOIL LABORATORY RESULTS COMPARED T0 DIRECT CONTACT CRITERIA
All data in mg/kg unless stated otherwise

Analyte		C_6-C_{10}	>C_{10}-C_{16}	>C_{16}-C_{34}	>C_{34}-C_{40}	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services		25	50	100	100	0.2	0.5	1	1	1	
CRC 2011 -Direct contact Criteria		4,400	3,300	4,500	6,300	100	14,000	4,500	12,000	1,400	
Site Use		**RESIDENTIAL WITH ACCESSIBLE SOIL- DIRECT SOIL CONTACT**									
Sample Reference	**Sample Depth**										
BH101	0-0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	<1	**0.3**
BH101 - [LAB_DUP]	0-0.1	<25	<50	**100**	<100	<0.2	<0.5	<1	<1	<1	-
BH102	0-0.1	<25	**140**	**550**	**300**	<0.2	<0.5	<1	<1	<1	**0.7**
BH102	0.6-0.8	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.7**
BH103	0-0.1	<25	<50	**140**	<100	<0.2	<0.5	<1	<1	<1	**0.4**
BH103	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**1.3**
BH104	0-0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	<1	**0.3**
BH104	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.2**
BH105	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.4**
BH105	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.5**
BH106	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.3**
BH106	0.4-0.6	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	**0.3**
SDUP101	0-0.1	<25	**110**	**550**	**490**	<0.2	<0.5	<1	<1	<1	-
SDUP101 - [LAB_DUP]	0-0.1	<25	**76**	**470**	**410**	<0.2	<0.5	<1	<1	<1	-
SDUP102	0-0.1	<25	<50	<100	<100	<0.20	<0.50	<1.0	<1.0	<3.0	-
Total Number of Samples		15	15	15	15	15	15	15	15	15	11
Maximum Value		<PQL	140	550	490	<PQL	<PQL	<PQL	<PQL	<PQL	1.3

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**

TABLE S5
ASBESTOS QUANTIFICATION - FIELD OBSERVATIONS AND LABORATORY RESULTS
HSL-A: Residential with garden/accessible soils; children's day care centers; preschools; and primary schools

FIELD DATA															LABORATORY DATA											
Date Sampled	Sample reference	Sample Depth	Visible ACM in top 100mm	Approx. Volume of Soil (L)	Soil Mass (g)	Mass ACM (g)	Mass Asbestos in ACM (g)	[Asbestos from ACM in soil] (%w/w)	Mass ACM <7mm (g)	Mass Asbestos in ACM <7mm (g)	[Asbestos from ACM <7mm in soil] (%w/w)	Mass FA (g)	Mass Asbestos in FA (g)	[Asbestos from FA in soil] (%w/w)	Lab Report Number	Sample refeference	Sample Depth	Sample Mass (g)	Asbestos ID in soil (AS4964) >0.1g/kg	Trace Analysis	Total Asbestos (g/kg)	Asbestos ID in soil <0.1g/kg	ACM >7mm Estimation (g)	FA and AF Estimation (g)	ACM >7mm Estimation %(w/w)	FA and AF Estimation %(w/w)
SAC			**No**					**0.01**			**0.001**			**0.001**											**0.01**	**0.001**
1/10/2024	BH101	0-0.2	No	10	10,200	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH101	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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1/10/2024	BH102	0-0.1	No	10	10,010	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH102	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		BH102	0.6-0.8		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
1/10/2024	BH103	0-0.1	Yes	10	12,100	259.0	38.85	0.3211	No ACM <7mm observed	--	--	No FA observed	--	--		BH103	0-0.1		Chrysotile asbestos detected: Amosite asbestos detected: Organic fibres detected	No asbestos detected	4.6486	See Above	–	2.7928	<0.01	0.4649
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4/10/2024	BH104	0-0.1	No	10	11,100	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH104	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
4/10/2024	BH104	0.1-0.3	No	<10	6,220	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		BH104	0.4-0.6		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
1/10/2024	BH105	0-0.1	No	10	13,950	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH105	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
1/10/2024	BH105	0.1-0.4	No	<10	6,890	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1/10/2024	BH105	0.4-0.9	No	<10	2,600	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH105	0.4-0.6		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
4/10/2024	BH106	0-0.1	No	10	10,980	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--		BH106	0-0.1		No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected	<0.1	No visible asbestos detected	–	–	<0.01	<0.001
4/10/2024	BH106	0.1-0.3	No	<10	4,110	No ACM observed	--	--	No ACM <7mm observed	--	--	No FA observed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Concentration above the SAC **VALUE**

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TABLE S6
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013 EILs AND ESLs
All data in mg/kg unless stated otherwise

Land Use Category				URBAN RESIDENTIAL AND PUBLIC OPEN SPACE																	
							AGED HEAVY METALS-EILs						EILs		ESLs							
				pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
PQL - Envirolab Services				-	1	-	4	1	1	1	1	1	1	0.1	25	50	100	100	0.2	0.5	1	1	0.05
Ambient Background Concentration (ABC)				-	-	-	NSL	13	28	163	5	122	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL	NSL
Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**																				
BH101	0-0.1	Fill: clayey silty sand	Coarse	NA	NA	NA	**6**	**22**	**40**	**180**	**4**	**130**	<1	<0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	**0.96**
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	Coarse	NA	NA	NA	**5**	**17**	**48**	**160**	**4**	**120**	<1	<0.1	<25	<50	**100**	<100	<0.2	<0.5	<1	<1	**1.1**
BH102	0-0.1	Fill: silty sand	Coarse	NA	NA	NA	**11**	**18**	**60**	**290**	**6**	**310**	<1	<0.1	<25	**140**	**550**	**300**	<0.2	<0.5	<1	<1	**2.8**
BH102	0.6-0.8	Fill: silty sand	Coarse	NA	NA	NA	**5**	**48**	**5**	**49**	**9**	**120**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.06**
BH103	0-0.1	Fill: silty sandy clay	Fine	NA	NA	NA	**8**	**19**	**94**	**440**	**6**	**550**	<1	<0.1	<25	<50	**140**	<100	<0.2	<0.5	<1	<1	**0.89**
BH103	0.4-0.6	Sandy Clay	Fine	NA	NA	NA	<4	**32**	**12**	**52**	**3**	**190**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH104	0-0.1	Fill: silty sandy clay	Fine	NA	NA	NA	**6**	**66**	**360**	**590**	**24**	**420**	<1	<0.1	<25	<50	**110**	<100	<0.2	<0.5	<1	<1	**1.4**
BH104 - [LAB_DUP]	0-0.1	Lab duplicate	Fine	NA	NA	NA	**5**	**54**	**330**	**510**	**20**	**440**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104 - [TRIPLICATE]	0-0.1	Lab triplicate	Fine	NA	NA	NA	**6**	**38**	**360**	**510**	**14**	**460**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	0.4-0.6	Fill: sandy clay	Fine	NA	NA	NA	<4	**29**	**11**	**29**	**2**	**33**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH105	0-0.1	Fill: silty sand	Coarse	NA	NA	NA	<4	**10**	**12**	**23**	**3**	**57**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.06**
BH105	0.4-0.6	Fill: silty sand	Coarse	NA	NA	NA	<4	**6**	**11**	**23**	**3**	**37**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.05
BH106	0-0.1	Fill: silty clay	Fine	NA	NA	NA	**5**	**24**	**5500**	**520**	**9**	**290**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.94**
BH106 - [LAB_DUP]	0-0.1	Lab duplicate	Fine	NA	NA	NA	**6**	**36**	**88**	**470**	**12**	**180**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106 - [TRIPLICATE]	0-0.1	Lab triplicate	Fine	NA	NA	NA	**4**	**19**	**83**	**470**	**5**	**210**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0.4-0.6	Silty Clay	Fine	NA	NA	NA	**6**	**64**	**4**	**14**	**3**	**20**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<1	**0.05**
SDUP101	0-0.1	Intra-lab dup BH102 0-0.1m	Coarse	NA	NA	NA	**10**	**15**	**54**	**250**	**5**	**280**	<1	<0.1	<25	**110**	**550**	**490**	<0.2	<0.5	<1	<1	**0.86**
SDUP101 - [LAB_DUP]	0-0.1	Lab duplicate	Coarse	NA	NA	NA	**12**	**18**	**63**	**290**	**6**	**310**	<1	<0.1	<25	**76**	**470**	**410**	<0.2	<0.5	<1	<1	**0.6**
SDUP102	0-0.1	Inter-lab dup BH105 0-0.1m	Coarse	NA	NA	NA	<4.0	**10**	**12**	**33**	**3.5**	**59**	<3.0	<0.10	<25	<50	<100	<100	<0.20	<0.50	<1.0	<1.0	**0.13**
Total Number of Samples				0	0	0	19	19	19	19	19	19	15	15	15	15	15	15	15	15	15	15	15
Maximum Value				NA	NA	NA	12	66	5500	590	24	550	<PQL	<PQL	<PQL	140	550	490	<PQL	<PQL	<PQL	<PQL	2.8

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the EIL and ESL Assessment Criteria Table below

EIL AND ESL ASSESSMENT CRITERIA

Sample Reference	**Sample Depth**	**Sample Description**	**Soil Texture**	pH	CEC (cmolc/kg)	Clay Content (% clay)	Arsenic	Chromium	Copper	Lead	Nickel	Zinc	Naphthalene	DDT	C_6-C_{10} (F1)	$>C_{10}$-C_{16} (F2)	$>C_{16}$-C_{34} (F3)	$>C_{34}$-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH101	0-0.1	Fill: clayey silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH102	0-0.1	Fill: silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH102	0.6-0.8	Fill: silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH103	0-0.1	Fill: silty sandy clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH103	0.4-0.6	Sandy Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH104	0-0.1	Fill: silty sandy clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH104 - [LAB_DUP]	0-0.1	Lab duplicate	Fine	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH104 - [TRIPLICATE]	0-0.1	Lab triplicate	Fine	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH104	0.4-0.6	Fill: sandy clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH105	0-0.1	Fill: silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH105	0.4-0.6	Fill: silty sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH106	0-0.1	Fill: silty clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
BH106 - [LAB_DUP]	0-0.1	Lab duplicate	Fine	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH106 - [TRIPLICATE]	0-0.1	Lab triplicate	Fine	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH106	0.4-0.6	Silty Clay	Fine	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	1300	5600	65	105	125	45	20
SDUP101	0-0.1	Intra-lab dup BH102 0-0.1m	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
SDUP101 - [LAB_DUP]	0-0.1	Lab duplicate	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
SDUP102	0-0.1	Inter-lab dup BH105 0-0.1m	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20

TABLE S7
SOIL LABORATORY RESULTS COMPARED TO WASTE CLASSIFICATION GUIDELINES
All data in mg/kg unless stated otherwise

			HEAVY METALS								PAHs		OC/OP PESTICIDES				Total PCBs	TRH					BTEX COMPOUNDS				ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Total PAHs	B(a)P	Total Endosulfans	Chloropyrifos	Total Moderately Harmful	Total Scheduled		C_6-C_9	C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	Total C_{10}-C_{36}	Benzene	Toluene	Ethyl benzene	Total Xylenes	
PQL - Envirolab Services			4	0.4	1	1	1	0.1	1	1	-	0.05	0.1	0.1	0.1	0.1	0.1	25	50	100	100	50	0.2	0.5	1	1	100
General Solid Waste CT1			100	20	100	NSL	100	4	40	NSL	200	0.8	60	4	250	50	50	650		NSL		10,000	10	288	600	1,000	-
General Solid Waste SCC1			500	100	1900	NSL	1500	50	1050	NSL	200	10	108	7.5	250	50	50	650		NSL		10,000	18	518	1,080	1,800	-
Restricted Solid Waste CT2			400	80	400	NSL	400	16	160	NSL	800	3.2	240	16	1000	50	50	2600		NSL		40,000	40	1,152	2,400	4,000	-
Restricted Solid Waste SCC2			2000	400	7600	NSL	6000	200	4200	NSL	800	23	432	30	1000	50	50	2600		NSL		40,000	72	2,073	4,320	7,200	-
Sample Reference	**Sample Depth**	**Sample Description**																									
BH101	0-0.1	Fill: clayey silty sand	**6**	<0.4	**22**	**40**	**180**	<0.1	**4**	**130**	**8.3**	**0.96**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	**100**	**100**	<0.2	<0.5	<1	<1	Not Detected
BH101 - [LAB_DUP]	0-0.1	Lab duplicate	**5**	<0.4	**17**	**48**	**160**	<0.1	**4**	**120**	**10**	**1.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	**100**	**100**	<0.2	<0.5	<1	<1	NA
BH102	0-0.1	Fill: silty sand	**11**	**0.6**	**18**	**60**	**290**	**0.3**	**6**	**310**	**25**	**2.8**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**440**	**350**	**790**	<0.2	<0.5	<1	<1	Not Detected
BH102	0.6-0.8	Fill: silty sand	**5**	<0.4	**48**	**5**	**49**	**0.7**	**9**	**120**	**0.3**	**0.06**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH103	0-0.1	Fill: silty sandy clay	**8**	**1**	**19**	**94**	**440**	**0.2**	**6**	**550**	**7.8**	**0.89**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**100**	<100	**100**	<0.2	<0.5	<1	<1	Detected
BH103	0.4-0.6	Sandy Clay	<4	<0.4	**32**	**12**	**52**	<0.1	**3**	**190**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
BH104	0-0.1	Fill: silty sandy clay	**6**	**4.5**	**66**	**360**	**590**	**0.7**	**24**	**420**	**13**	**1.4**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH104 - [LAB_DUP]	0-0.1	Lab duplicate	**5**	**2**	**54**	**330**	**510**	**0.7**	**20**	**440**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104 - [TRIPLICATE]	0-0.1	Lab triplicate	**6**	**3**	**38**	**360**	**510**	**0.5**	**14**	**460**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH104	0.4-0.6	Fill: sandy clay	<4	<0.4	**29**	**11**	**29**	<0.1	**2**	**33**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH105	0-0.1	Fill: silty sand	<4	<0.4	**10**	**12**	**23**	<0.1	**3**	**57**	**0.06**	**0.06**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH105	0.4-0.6	Fill: silty sand	<4	<0.4	**6**	**11**	**23**	<0.1	**3**	**37**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH106	0-0.1	Fill: silty clay	**5**	<0.4	**24**	**5500**	**520**	**0.4**	**9**	**290**	**8.2**	**0.94**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	Not Detected
BH106 - [LAB_DUP]	0-0.1	Lab duplicate	**6**	**0.4**	**36**	**88**	**470**	**0.3**	**12**	**180**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106 - [TRIPLICATE]	0-0.1	Lab triplicate	**4**	<0.4	**19**	**83**	**470**	**0.4**	**5**	**210**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH106	0.4-0.6	Silty Clay	**6**	<0.4	**64**	**4**	**14**	<0.1	**3**	**20**	**0.05**	**0.05**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	NA
SDUP101	-	Intra-lab dup BH102 0-0.1m	**10**	**0.6**	**15**	**54**	**250**	**0.3**	**5**	**280**	**7.8**	**0.86**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**370**	**430**	**800**	<0.2	<0.5	<1	<1	NA
SDUP101 - [LAB_DUP]	-	Lab duplicate	**12**	**0.6**	**18**	**63**	**290**	**0.3**	**6**	**310**	**5.1**	**0.6**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	**280**	**380**	**660**	<0.2	<0.5	<1	<1	NA
SDUP102	-	Inter-lab dup BH105 0-0.1m	<4.0	<0.40	**10**	**12**	**33**	<0.10	**3.5**	**59**	**0.38**	**0.13**	**0.14**	<0.1	<0.1	<0.1	NA	<25	<50	<100	<100	<50	<0.20	<0.50	<1.0	<1.0	NA
F3	0-0.1	Fibre cement fragment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
Total Number of Samples			19	19	19	19	19	19	19	19	15	15	15	15	15	15	14	15	15	15	15	15	15	15	15	15	10
Maximum Value			12	4.5	66	5500	590	0.7	24	550	25	2.8	0.14	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	440	430	800	<PQL	<PQL	<PQL	<PQL	Detected

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**
Asbestos Detected > Special Waste (asbestos) — **Detected**

JKEnvironments

TABLE S8
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Lead	B(a)P
PQL - Envirolab Services			0.03	0.001
TCLP1 - General Solid Waste			5	0.04
TCLP2 - Restricted Solid Waste			20	0.16
TCLP3 - Hazardous Waste			>20	>0.16
Sample Reference	**Sample Depth**	**Sample Description**		
BH102	0-0.1	Fill: silty sand	**0.05**	<0.0001
BH103	0-0.2	Fill: silty sandy clay	**0.1**	<0.0001
BH104	0-0.3	Fill: silty sandy clay	**0.31**	<0.0001
BH106	0-0.4	Fill: silty clay	**0.3**	<0.0001
Total Number of samples			4	4
Maximum Value			0.31	<PQL

General Solid Waste	**VALUE**
Restricted Solid Waste	**VALUE**
Hazardous Waste	**VALUE**
Concentration above PQL	**Bold**

TABLE Q1
SOIL QA/QC SUMMARY

			TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene
	PQL Envirolab SYD		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1*	*2*	*1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.05*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*25*	*50*	*100*	*100*	*0.2*	*0.5*	*1.0*	*2.0*	*1.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH102	0-0.1	<25	140	550	300	<0.2	<0.5	<1	<2	<1	<0.1	0.5	<0.1	<0.1	0.6	0.3	3.5	4	2.9	2.9	4.2	2.8	1.3	0.5	1.5
laboratory	SDUP101	-	<25	110	550	490	<0.2	<0.5	<1	<2	<1	<0.1	0.1	<0.1	<0.1	0.3	0.1	1.2	1.3	0.8	0.8	1	0.86	0.4	0.1	0.5
duplicate	MEAN		nc	125	550	395	nc	nc	nc	nc	nc	nc	0.3	nc	nc	0.45	0.2	2.35	2.65	1.85	1.85	2.6	1.83	0.85	0.3	1
	RPD %		nc	24%	0%	48%	nc	nc	nc	nc	nc	nc	133%	nc	nc	67%	100%	98%	102%	114%	114%	123%	106%	106%	133%	100%
Inter	BH105	0-0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	0.06	<0.1	<0.1	<0.1
laboratory	SDUP102	-	<25	<50	<100	<100	<0.20	<0.50	<1.0	<2.0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	0.13	<0.10	<0.10	<0.20	0.13	<0.10	<0.10	<0.10
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.085	0.09	nc	nc	nc	0.095	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	82%	89%	nc	nc	nc	74%	nc	nc	nc
Trip	TB101	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.05	<0.1	<0.1	<0.1
Blank	27/09/24																									
Trip	TS101		-	-	-	-	103%	102%	102%	102%	101%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	27/09/24																									
Field	FR101-HA	µg/L	44	<50	<100	<100	<1	<1	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	4/10/24																									

			HCB	alpha- BHC	gamma- BHC	beta- BHC	Heptachlor	delta- BHC	Aldrin	Heptachlor Epoxide	Gamma- Chlordane	alpha- chlordane	Endosulfan I	pp- DDE	Dieldrin	Endrin	pp- DDD	Endosulfan II	pp- DDT	Endrin Aldehyde	Endosulfan Sulphate	Methoxychlor
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Intra	BH102	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP101	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Inter	BH105	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
laboratory	SDUP102	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.095	nc	nc	nc	nc
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	95%	nc	nc	nc	nc
Trip	TB101	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	27/09/24																					
Trip	TS101		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	27/09/24																					
Field	FR101-HA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rinsate	4/10/24																					

			Azinphos-methyl (Guthion)	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4*	*0.4*	*1*	*1*	*1*	*0.1*	*1*	*1*
	PQL Envirolab VIC		*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*4.0*	*0.4*	*1.0*	*1.0*	*1.0*	*0.1*	*1.0*	*1.0*
Intra	BH102	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11	0.6	18	60	290	0.3	6	310
laboratory	SDUP101	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	10	0.6	15	54	250	0.3	5	280
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	10.5	0.6	16.5	57	270	0.3	5.5	295
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	10%	0%	18%	11%	15%	0%	18%	10%
Inter	BH105	0-0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<4	<0.4	10	12	23	<0.1	3	57
laboratory	SDUP102	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<4.0	<0.40	10	12	33	<0.10	3.5	59
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	10	12	28	nc	3.25	58
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	0%	36%	nc	15%	3%
Trip	TB101	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<4	<0.4	<1	<1	<1	<0.1	<1	<1
Blank	27/09/24																						
Trip	TS101		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spike	27/09/24																						
Field	FR101-HA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	<0.01	<0.01	0.4	<0.03	<0.0005	<0.02	<0.02
Rinsate	4/10/24																						

Result outside of QA/QC acceptance criteria

Rinsate metals results in mg/L

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

ADWG: AustralianDrinking Water Guidelines
ANZG Australian and New Zealand Guidelines
B(a)P: Benzo(a)pyrene
CRC: Cooperative Research Centre
ESLs: Ecological Screening Levels
GIL: Groundwater Investigation Levels
HILs: Health Investigation Levels
HSLs: Health Screening Levels
HSL-SSA: Health Screening Level-SiteSpecific Assessment
NA: Not Analysed
NC: Not Calculated
NEPM: National Environmental Protection Measure
NHMRC: National Health and Medical Research Council
NL: Not Limiting
NSL: No Set Limit
OCP: Organochlorine Pesticides
OPP: Organophosphorus Pesticides
PAHs: Polycyclic Aromatic Hydrocarbons
ppm: Parts per million
PCBs: Polychlorinated Biphenyls
PCE: Perchloroethylene (Tetrachloroethylene or Tetrachloroethene)
PQL: Practical Quantitation Limit
RS: Rinsate Sample
RSL: Regional Screening Levels
SAC: Site Assessment Criteria
SSA: Site Specific Assessment
SSHSLs: Site Specific Health Screening Levels
TB: Trip Blank
TCA: 1,1,1 Trichloroethane (methyl chloroform)
TCE: Trichloroethylene (Trichloroethene)
TS: Trip Spike
TRH: Total Recoverable Hydrocarbons
UCL: Upper Level Confidence Limit on Mean Value
USEPA United States Environmental Protection Agency
VOCC: Volatile Organic Chlorinated Compounds
WHO: World Health Organisation

TABLE G1
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO ECOLOGICAL GILs SAC
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	ANZG 2018 Marine Waters	SAMPLES						
			MW1	MW1 - [LAB_DUP]	MW2	MW2 - [LAB_DUP]	MW4	GWDUP1	GWDUP2
Inorganic Compounds and Parameters									
pH		7 - 8.5	5.8	NA	**5.1**	NA	**3.8**	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**360**	NA	410	NA	560	NA	NA
Turbidity (NTU)		NSL	NA	NA	NA	NA	NA	NA	NA
Metals and Metalloids									
Arsenic (As III)	1	2.3	<1	[NT]	<1	<1	<1	<1	<1.0
Cadmium	0.1	0.7	<0.1	[NT]	**0.8**	**0.8**	<0.1	<0.1	<0.10
Chromium (SAC for Cr III adopted)	1	27	<1	[NT]	<1	<1	**1**	<1	<1.0
Copper	1	1.3	**1**	[NT]	**8**	**8**	**5**	**1**	**5.4**
Lead	1	4.4	<1	[NT]	**5**	**5**	**1**	<1	**1.6**
Total Mercury (inorganic)	0.05	0.1	<0.05	<0.05	<0.05	[NT]	<0.05	<0.05	<0.050
Nickel	1	7	**1**	[NT]	**7**	**8**	<1	**1**	<1.0
Zinc	1	15	**8**	[NT]	**310**	**310**	**12**	**7**	**15**
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)									
Benzene	1	500	<1	<1	<1	NA	<1	<1	<1.0
Toluene	1	180	<1	<1	<1	NA	<1	<1	<1.0
Ethylbenzene	1	5	<1	<1	<1	NA	<1	<1	<1.0
m+p-xylene	2	75	<2	<2	<2	NA	<2	<2	<2.0
o-xylene	1	350	<1	<1	<1	NA	<1	<1	<1.0
Total xylenes	2	NSL	<2	<2	<2	NA	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs									
Dichlorodifluoromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Chloromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Vinyl Chloride	10	100	<10	<10	<10	NA	<10	NA	NA
Bromomethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Chloroethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
1,1-Dichloroethene	1	700	<1	<1	<1	NA	<1	NA	NA
Trans-1,2-dichloroethene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,1-dichloroethane	1	250	<1	<1	<1	NA	<1	NA	NA
Cis-1,2-dichloroethene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Bromochloromethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Chloroform	1	370	**1**	**1**	**2**	NA	<1	NA	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichloroethane	1	1900	<1	<1	<1	NA	<1	NA	NA
1,1,1-trichloroethane	1	270	<1	<1	<1	NA	<1	NA	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Cyclohexane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Carbon tetrachloride	1	240	<1	<1	<1	NA	<1	NA	NA
Benzene	1	500	<1	<1	<1	NA	<1	NA	NA
Dibromomethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichloropropane	1	900	<1	<1	<1	NA	<1	NA	NA
Trichloroethene	1	330	<1	<1	<1	NA	<1	NA	NA
Bromodichloromethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
trans-1,3-dichloropropene	1	NSL	<1	<1	<1	NA	<1	NA	NA
cis-1,3-dichloropropene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,1,2-trichloroethane	1	1900	<1	<1	<1	NA	<1	NA	NA
Toluene	1	180	<1	<1	<1	NA	<1	NA	NA
1,3-dichloropropane	1	1100	<1	<1	<1	NA	<1	NA	NA
Dibromochloromethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Tetrachloroethene	1	70	<1	<1	<1	NA	<1	NA	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Chlorobenzene	1	55	<1	<1	<1	NA	<1	NA	NA
Ethylbenzene	1	5	<1	<1	<1	NA	<1	NA	NA
Bromoform	1	NSL	<1	<1	<1	NA	<1	NA	NA
m+p-xylene	2	75	<2	<2	<2	NA	<2	NA	NA
Styrene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,1,2,2-tetrachloroethane	1	400	<1	<1	<1	NA	<1	NA	NA
o-xylene	1	350	<1	<1	<1	NA	<1	NA	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Isopropylbenzene	1	30	<1	<1	<1	NA	<1	NA	NA
Bromobenzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
n-propyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
2-chlorotoluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
4-chlorotoluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,3-dichlorobenzene	1	260	<1	<1	<1	NA	<1	NA	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,4-dichlorobenzene	1	60	<1	<1	<1	NA	<1	NA	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichlorobenzene	1	160	<1	<1	<1	NA	<1	NA	NA
n-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,4-trichlorobenzene	1	20	<1	<1	<1	NA	<1	NA	NA
Hexachlorobutadiene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,3-trichlorobenzene	1	3	<1	<1	<1	NA	<1	NA	NA
Polycyclic Aromatic Hydrocarbons (PAHs)									
Naphthalene	0.2	50	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Phenanthrene	0.1	0.6	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Anthracene	0.1	0.01	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Fluoranthene	0.1	1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	NA	<0.2	<0.2	<0.20
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G2
SUMMARY OF GROUNDWATER LABORATORY RESULTS COMPARED TO HUMAN CONTACT GILs
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	Recreational (10 x NHMRC ADWG)	SAMPLES						
			MW1	MW1 - [LAB_DUP]	MW2	MW2 - [LAB_DUP]	MW4	GWDUP1	GWDUP2
Inorganic Compounds and Parameters									
pH		6.5 - 8.5	**5.8**	NA	**5.1**	NA	**3.8**	NA	NA
Electrical Conductivity (µS/cm)	1	NSL	**360**	NA	**410**	NA	**560**	NA	NA
Turbidity (NTU)		NSL	NA	NA	NA	NA	NA	NA	NA
Metals and Metalloids									
Arsenic (As III)	1	100	<1	[NT]	<1	<1	<1	<1	<1.0
Cadmium	0.1	20	<0.1	[NT]	**0.8**	**0.8**	<0.1	<0.1	<0.10
Chromium (total)	1	500	<1	[NT]	<1	<1	**1**	<1	<1.0
Copper	1	20000	**1**	[NT]	**8**	**8**	**5**	**1**	**5.4**
Lead	1	100	<1	[NT]	**5**	**5**	**1**	<1	**1.6**
Total Mercury (inorganic)	0.05	10	<0.05	<0.05	<0.05	[NT]	<0.05	<0.05	<0.050
Nickel	1	200	**1**	[NT]	**7**	**8**	<1	**1**	<1.0
Zinc	1	30000	**8**	[NT]	**310**	**310**	**12**	**7**	**15**
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)									
Benzene	1	10	<1	<1	<1	NA	<1	<1	<1.0
Toluene	1	8000	<1	<1	<1	NA	<1	<1	<1.0
Ethylbenzene	1	3000	<1	<1	<1	NA	<1	<1	<1.0
m+p-xylene	2	NSL	<2	<2	<2	NA	<2	<2	<2.0
o-xylene	1	NSL	<1	<1	<1	NA	<1	<1	<1.0
Total xylenes	2	6000	<2	<2	<2	NA	<2	<2	<2
Volatile Organic Compounds (VOCs), including chlorinated VOCs									
Dichlorodifluoromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Chloromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Vinyl Chloride	10	3	<10	<10	<10	NA	<10	NA	NA
Bromomethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Chloroethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
Trichlorofluoromethane	10	NSL	<10	<10	<10	NA	<10	NA	NA
1,1-Dichloroethene	1	300	<1	<1	<1	NA	<1	NA	NA
Trans-1,2-dichloroethene	1	600	<1	<1	<1	NA	<1	NA	NA
1,1-dichloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Cis-1,2-dichloroethene	1	600	<1	<1	<1	NA	<1	NA	NA
Bromochloromethane	1	2500	<1	<1	<1	NA	<1	NA	NA
Chloroform	1		**1**	**1**	**2**	NA	<1	NA	NA
2,2-dichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichloroethane	1	30	<1	<1	<1	NA	<1	NA	NA
1,1,1-trichloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,1-dichloropropene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Cyclohexane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Carbon tetrachloride	1	30	<1	<1	<1	NA	<1	NA	NA
Benzene	1	10	<1	<1	<1	NA	<1	NA	NA
Dibromomethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Trichloroethene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Bromodichloromethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
trans-1,3-dichloropropene	1	1000	<1	<1	<1	NA	<1	NA	NA
cis-1,3-dichloropropene	1	1000	<1	<1	<1	NA	<1	NA	NA
1,1,2-trichloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Toluene	1	8000	<1	<1	<1	NA	<1	NA	NA
1,3-dichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Dibromochloromethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dibromoethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Tetrachloroethene	1	500	<1	<1	<1	NA	<1	NA	NA
1,1,1,2-tetrachloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Chlorobenzene	1	3000	<1	<1	<1	NA	<1	NA	NA
Ethylbenzene	1	3000	<1	<1	<1	NA	<1	NA	NA
Bromoform	1	NSL	<1	<1	<1	NA	<1	NA	NA
m+p-xylene	2	NSL	<2	<2	<2	NA	<2	NA	NA
Styrene	1	300	<1	<1	<1	NA	<1	NA	NA
1,1,2,2-tetrachloroethane	1	NSL	<1	<1	<1	NA	<1	NA	NA
o-xylene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,3-trichloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
Isopropylbenzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Bromobenzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
n-propyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
2-chlorotoluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
4-chlorotoluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,3,5-trimethyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
Tert-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,4-trimethyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,3-dichlorobenzene	1	200	<1	<1	<1	NA	<1	NA	NA
Sec-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,4-dichlorobenzene	1	400	<1	<1	<1	NA	<1	NA	NA
4-isopropyl toluene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dichlorobenzene	1	15000	<1	<1	<1	NA	<1	NA	NA
n-butyl benzene	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2-dibromo-3-chloropropane	1	NSL	<1	<1	<1	NA	<1	NA	NA
1,2,4-trichlorobenzene	1	300	<1	<1	<1	NA	<1	NA	NA
1,2,3-trichlorobenzene	1		<1	<1	<1	NA	<1	NA	NA
Hexachlorobutadiene	1	7	<1	<1	<1	NA	<1	NA	NA
Polycyclic Aromatic Hydrocarbons (PAHs)									
Naphthalene	0.2	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Acenaphthylene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Acenaphthene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Fluorene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Phenanthrene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Anthracene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Fluoranthene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Pyrene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(a)anthracene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Chrysene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(b,j+k)fluoranthene	0.2	NSL	<0.2	<0.2	<0.2	NA	<0.2	<0.2	<0.20
Benzo(a)pyrene	0.1	0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Indeno(1,2,3-c,d)pyrene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Dibenzo(a,h)anthracene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10
Benzo(g,h,i)perylene	0.1	NSL	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.10

Concentration above the SAC	**VALUE**
Concentration above the PQL	**Bold**
GIL >PQL	Red

TABLE G3
GROUNDWATER LABORATORY RESULTS COMPARED TO HSLs
All data in µg/L unless stated otherwise

				C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	PID
PQL - Envirolab Services				10	50	1	1	1	2	1	
NEPM 2013 - Land Use Category				**HSL-A/B: LOW/HIGH DENSITY RESIDENTIAL**							
Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**								
MW1	3.33	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0.1
MW1 - [LAB_DUP]	-	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	NA
MW2	3.35	0m to <2m	Sand	<10	**340**	<1	<1	<1	<2	<1	0.1
MW4	4.98	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	0.1
GWDUP1	-	0m to <2m	Sand	<10	<50	<1	<1	<1	<2	<1	NA
GWDUP2	-	0m to <2m	Sand	<10	<50	<1.0	<1.0	<1.0	<2	<1.0	NA
Total Number of Samples				6	6	6	6	6	6	6	3
Maximum Value				<PQL	340	<PQL	<PQL	<PQL	<PQL	<PQL	0.1

Concentration above the SAC **VALUE**
Concentration above the PQL **Bold**
The guideline corresponding to the elevated value is highlighted in grey in the Groundwater Assessment Criteria Table below

HSL GROUNDWATER ASSESSMENT CRITERIA (based on 2-4m groundwater depth)

Sample Reference	**Water Depth**	**Depth Category**	**Soil Category**	C_6-C_{10} (F1)	>C_{10}-C_{16} (F2)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
MW1	3.33	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL
MW1 - [LAB_DUP]	-	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL
MW2	3.35	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL
MW4	4.98	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL
GWDUP1	-	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL
GWDUP2	-	2m to <4m	Sand	1000	1000	800	NL	NL	NL	NL

TABLE G4
GROUNDWATER LABORATORY RESULTS COMPARED TO SITE SPECIFIC HSLs - RISK ASSESSMENT
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NHMRC ADWG 2011	WHO 2008	USEPA RSL Tapwater 2017	SAMPLES MW1	MW1 - [LAB_DUP]	MW2	MW4	GWDUP1	GWDUP2
Total Recoverable Hydrocarbons (TRH)										
C_6-C_9 Aliphatics (assessed using F1)	10	-	100	-	<10	<10	<10	<10	<10	<10
>C_9-C_{14} Aliphatics (assessed using F2)	50	-	100	-	<50	<50	**340**	<50	<50	<50
Monocyclic Aromatic Hydrocarbons (BTEX Compounds)										
Benzene	1	1	-	-	<1	<1	<1	<1	<1	<1.0
Toluene	1	800	-	-	<1	<1	<1	<1	<1	<1.0
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	<1	<1.0
Total xylenes	2	600	-	-	<2	<2	<2	<2	<2	<2
Polycyclic Aromatic Hydrocarbons (PAHs)										
Naphthalene	1	-	-	6.1	<1	<1	<1	<1	<1	<1.0
Volatile Organic Compounds (VOCs), including chlorinated VOCs										
Dichlorodifluoromethane	10	-	-	-	<10	<10	<10	<10	NA	NA
Chloromethane	10	-	-	-	<10	<10	<10	<10	NA	NA
Vinyl Chloride	10	0.3	-	-	<10	<10	<10	<10	NA	NA
Bromomethane	10	-	-	-	<10	<10	<10	<10	NA	NA
Chloroethane	10	-	-	-	<10	<10	<10	<10	NA	NA
Trichlorofluoromethane	10	-	-	-	<10	<10	<10	<10	NA	NA
1,1-Dichloroethene	1	30	-	-	<1	<1	<1	<1	NA	NA
Trans-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	NA	NA
1,1-dichloroethane	1	-	-	-	<1	<1	<1	<1	NA	NA
Cis-1,2-dichloroethene	1	60	-	-	<1	<1	<1	<1	NA	NA
Bromochloromethane	1	250	-	-	<1	<1	<1	<1	NA	NA
Chloroform	1		-	-	**1**	**1**	**2**	<1	NA	NA
2,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2-dichloroethane	1	3	-	-	<1	<1	<1	<1	NA	NA
1,1,1-trichloroethane	1	-	-	-	<1	<1	<1	<1	NA	NA
1,1-dichloropropene	1	-	-	-	<1	<1	<1	<1	NA	NA
Cyclohexane	1	-	-	-	<1	<1	<1	<1	NA	NA
Carbon tetrachloride	1	3	-	-	<1	<1	<1	<1	NA	NA
Benzene	1	1	-	-	<1	<1	<1	<1	NA	NA
Dibromomethane	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2-dichloropropane	1	-	-	-	<1	<1	<1	<1	NA	NA
Trichloroethene	1	-	-	-	<1	<1	<1	<1	NA	NA
Bromodichloromethane	1	-	-	-	<1	<1	<1	<1	NA	NA
trans-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	NA	NA
cis-1,3-dichloropropene	1	100	-	-	<1	<1	<1	<1	NA	NA
1,1,2-trichloroethane	1	-	-	-	<1	<1	<1	<1	NA	NA
Toluene	1	800	-	-	<1	<1	<1	<1	NA	NA
1,3-dichloropropane	1	-	-	-	<1	<1	<1	<1	NA	NA
Dibromochloromethane	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2-dibromoethane	1	-	-	-	<1	<1	<1	<1	NA	NA
Tetrachloroethene	1	50	-	-	<1	<1	<1	<1	NA	NA
1,1,1,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	NA	NA
Chlorobenzene	1	300	-	-	<1	<1	<1	<1	NA	NA
Ethylbenzene	1	300	-	-	<1	<1	<1	<1	NA	NA
Bromoform	1	-	-	-	<1	<1	<1	<1	NA	NA
m+p-xylene	2	-	-	-	<2	<2	<2	<2	NA	NA
Styrene	1	30	-	-	<1	<1	<1	<1	NA	NA
1,1,2,2-tetrachloroethane	1	-	-	-	<1	<1	<1	<1	NA	NA
o-xylene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2,3-trichloropropane	1	-	-	-	<1	<1	<1	<1	NA	NA
Isopropylbenzene	1	-	-	-	<1	<1	<1	<1	NA	NA
Bromobenzene	1	-	-	-	<1	<1	<1	<1	NA	NA
n-propyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
2-chlorotoluene	1	-	-	-	<1	<1	<1	<1	NA	NA
4-chlorotoluene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,3,5-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
Tert-butyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2,4-trimethyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,3-dichlorobenzene	1	20	-	-	<1	<1	<1	<1	NA	NA
Sec-butyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,4-dichlorobenzene	1	40	-	-	<1	<1	<1	<1	NA	NA
4-isopropyl toluene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2-dichlorobenzene	1	1500	-	-	<1	<1	<1	<1	NA	NA
n-butyl benzene	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2-dibromo-3-chloropropane	1	-	-	-	<1	<1	<1	<1	NA	NA
1,2,4-trichlorobenzene	1	30	-	-	<1	<1	<1	<1	NA	NA
1,2,3-trichlorobenzene	1		-	-	<1	<1	<1	<1	NA	NA
Hexachlorobutadiene	1	7	-	-	<1	<1	<1	<1	NA	NA

Concentration above the SAC — **VALUE**
Concentration above the PQL — **Bold**
GIL >PQL — Red

TABLE Q2
GROUNDWATER QA/QC SUMMARY

		TRH C6 - C10	TRH >C10-C16	TRH >C16-C34	TRH >C34-C40	Benzene	Toluene	Ethylbenzene	m+p-xylene	o-Xylene	Naphthalene	Acenaphthylene	Acenaph-thene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b,j+k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cene	Benzo(g,h,i)perylene	Arsenic	Cadmium	Chromium VI	Copper	Lead	Mercury	Nickel	Zinc
	PQL Envirolab SYD	*10*	*50*	*100*	*100*	*1*	*1*	*1*	*2*	*1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
	PQL Envirolab VIC	*10*	*50*	*100*	*100*	*1.0*	*1.0*	*1.0*	*2.0*	*1.0*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*0.1*	*1*	*1*	*1*	*0.05*	*1*	*1*
Intra	MW1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<1	1	<1	<0.05	1	8
laboratory	GWDUP1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<1	1	<1	<0.05	1	7
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	1	nc	nc	1	7.5
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	nc	nc	0%	13%
Inter	MW4	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<1	<0.1	1	5	1	<0.05	<1	12
laboratory	GWDUP2	<10	<50	<100	<100	<1.0	<1.0	<1.0	<2.0	<1.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.20	<0.10	<0.10	<0.10	<0.10	<1.0	<0.10	<1.0	5.4	1.6	<0.050	<1.0	15
duplicate	MEAN	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.75	5.2	1.3	nc	nc	13.5
	RPD %	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	67%	8%	46%	nc	nc	22%
Trip	TS-W1	-	-	-	-	109%	111%	105%	101%	105%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Spike	4/10/2024																																
Field	TB-W1	<10	<50	<100	<100	<1	<1	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	<1	<0.05	<1	<1
Blank	4/10/2024																																

Result outside of QA/QC acceptance criteria — Value

ABBREVIATIONS AND EXPLANATIONS

Abbreviations used in the Tables:

CT: Contaminant Threshold
FTS: Fluorotelomer sulfonic acid
NA: Not Analysed
NC: Not Calculated
NEMP National Environmental Management Plan
NSL: No Set Limit
PFAS Per- and polyfluoroalkyl substances
PFHxS Perfluorohexanesulfonic acid
PFOA Perfluorooctanoic acid
PFOS Perfluorooctanesulfonic acid
PQL: Practical Quantitation Limit
RS: Rinsate Sample
SAC: Site Assessment Criteria
SCC: Specific Contaminant Concentration
TB: Trip Blank
TCLP: Toxicity Characteristics Leaching Procedure
TS: Trip Spike
UCL: Upper Level Confidence Limit on Mean Value

Table Specific Explanations:

Groundwater Ecology Tables:

- 95% refers to a concentration that has been derived to protect 95% of aquatic species
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

TABLE GP1
SUMMARY OF PFAS CONCENTRATIONS IN GROUNDWATER - ECOLOGY
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NEMP 2018 Interim 95% Marine	SAMPLES			
			MW1	MW2	MW4	GWDUP1
PFAS Compound						
Perfluorobutanesulfonic acid	0.0004	NSL	**0.0043**	**0.004**	**0.0094**	**0.0044**
Perfluoropentanesulfonic acid	0.001	NSL	**0.002**	<0.001	**0.003**	**0.002**
Perfluorohexanesulfonic acid - PFHxS	0.0002	NSL	**0.026**	**0.0041**	**0.023**	**0.028**
Perfluoroheptanesulfonic acid	0.001	NSL	<0.001	<0.001	<0.001	<0.001
Perfluorooctanesulfonic acid PFOS	0.0002	0.13	**0.0097**	**0.0053**	**0.0029**	**0.0099**
Perfluorodecanesulfonic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorobutanoic acid	0.002	NSL	<0.01	<0.01	<0.01	<0.01
Perfluoropentanoic acid	0.002	NSL	**0.009**	**0.008**	**0.007**	**0.008**
Perfluorohexanoic acid	0.0004	NSL	**0.011**	**0.011**	**0.0075**	**0.012**
Perfluoroheptanoic acid	0.0004	NSL	**0.0098**	**0.018**	**0.0043**	**0.01**
Perfluorooctanoic acid PFOA	0.0002	220	**0.016**	**0.072**	**0.0066**	**0.015**
Perfluorononanoic acid	0.001	NSL	**0.001**	**0.027**	<0.001	**0.001**
Perfluorodecanoic acid	0.002	NSL	<0.002	**0.009**	<0.002	<0.002
Perfluoroundecanoic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid	0.005	NSL	<0.005	<0.005	<0.005	<0.005
Perfluorotridecanoic acid	0.01	NSL	<0.01	<0.01	<0.01	<0.01
Perfluorotetradecanoic acid	0.05	NSL	<0.05	<0.05	<0.05	<0.05
4:2 FTS	0.001	NSL	<0.001	<0.001	<0.001	<0.001
6:2 FTS	0.0004	NSL	<0.0004	<0.0004	**0.0009**	<0.0004
8:2 FTS	0.0004	NSL	<0.0004	<0.0004	<0.0004	<0.0004
10:2 FTS	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonamide	0.01	NSL	<0.01	<0.01	<0.01	<0.01
N-Methyl perfluorooctane sulfonamide	0.05	NSL	<0.05	<0.05	<0.05	<0.05
N-Ethyl perfluorooctanesulfon amide	0.1	NSL	<0.1	<0.1	<0.1	<0.1
N-Me perfluorooctanesulfonamid oethanol	0.05	NSL	<0.05	<0.05	<0.05	<0.05
N-Et perfluorooctanesulfonamid oethanol	0.5	NSL	<0.5	<0.5	<0.5	<0.5
MePerfluorooctanesulf-amid oacetic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
EtPerfluorooctanesulf-amid oacetic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Total Positive PFHxS & PFOS	0.0002	NSL	**0.036**	**0.0094**	**0.026**	**0.038**
Total Positive PFOS & PFOA	0.0002	NSL	**0.026**	**0.077**	**0.0095**	**0.025**
Total Positive PFAS	0.0002	NSL	**0.09**	**0.16**	**0.065**	**0.091**

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE GP2
SUMMARY OF PFAS CONCENTRATIONS IN GROUNDWATER - HUMAN HEALTH
All results in µg/L unless stated otherwise.

	PQL Envirolab Services	NEMP 2020 Recreational	SAMPLES MW1	MW2	MW4	GWDUP1
PFAS Compound						
Perfluorobutanesulfonic acid	0.0004	NSL	**0.0043**	**0.004**	**0.0094**	**0.0044**
Perfluoropentanesulfonic acid	0.001	NSL	**0.002**	<0.001	**0.003**	**0.002**
Perfluorohexanesulfonic acid - PFHxS	0.0002	NSL	**0.026**	**0.0041**	**0.023**	**0.028**
Perfluoroheptanesulfonic acid	0.001	NSL	<0.001	<0.001	<0.001	<0.001
Perfluorooctanesulfonic acid PFOS	0.0002	NSL	**0.0097**	**0.0053**	**0.0029**	**0.0099**
Perfluorodecanesulfonic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorobutanoic acid	0.002	NSL	<0.01	<0.01	<0.01	<0.01
Perfluoropentanoic acid	0.002	NSL	**0.009**	**0.008**	**0.007**	**0.008**
Perfluorohexanoic acid	0.0004	NSL	**0.011**	**0.011**	**0.0075**	**0.012**
Perfluoroheptanoic acid	0.0004	NSL	**0.0098**	**0.018**	**0.0043**	**0.01**
Perfluorooctanoic acid PFOA	0.0002	10	**0.016**	**0.072**	**0.0066**	**0.015**
Perfluorononanoic acid	0.001	NSL	**0.001**	**0.027**	<0.001	**0.001**
Perfluorodecanoic acid	0.002	NSL	<0.002	**0.009**	<0.002	<0.002
Perfluoroundecanoic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorododecanoic acid	0.005	NSL	<0.005	<0.005	<0.005	<0.005
Perfluorotridecanoic acid	0.01	NSL	<0.01	<0.01	<0.01	<0.01
Perfluorotetradecanoic acid	0.05	NSL	<0.05	<0.05	<0.05	<0.05
4:2 FTS	0.001	NSL	<0.001	<0.001	<0.001	<0.001
6:2 FTS	0.0004	NSL	<0.0004	<0.0004	**0.0009**	<0.0004
8:2 FTS	0.0004	NSL	<0.0004	<0.0004	<0.0004	<0.0004
10:2 FTS	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Perfluorooctane sulfonamide	0.01	NSL	<0.01	<0.01	<0.01	<0.01
N-Methyl perfluorooctane sulfonamide	0.05	NSL	<0.05	<0.05	<0.05	<0.05
N-Ethyl perfluorooctanesulfon amide	0.1	NSL	<0.1	<0.1	<0.1	<0.1
N-Me perfluorooctanesulfonamid oethanol	0.05	NSL	<0.05	<0.05	<0.05	<0.05
N-Et perfluorooctanesulfonamid oethanol	0.5	NSL	<0.5	<0.5	<0.5	<0.5
MePerfluorooctanesulf-amid oacetic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
EtPerfluorooctanesulf-amid oacetic acid	0.002	NSL	<0.002	<0.002	<0.002	<0.002
Total Positive PFHxS & PFOS	0.0002	2	**0.036**	**0.0094**	**0.026**	**0.038**
Total Positive PFOS & PFOA	0.0002	NSL	**0.026**	**0.077**	**0.0095**	**0.025**
Total Positive PFAS	0.0002	NSL	**0.09**	**0.16**	**0.065**	**0.091**

Positive PFAS result **Bold**
PFAS result above the SAC **Bold**

TABLE Q3
SUMMARY OF PFAS FIELD QA/QC IN GROUNDWATER
Units are µg/L unless stated otherwise.

		Perfluorobutanesulfonic acid	Perfluoropentanesulfonic acid	Perfluorohexanesulfonic acid - PFHxS	Perfluoroheptanesulfonic acid	Perfluorooctanesulfonic acid PFOS	Perfluorodecanesulfonic acid	Perfluorobutanoic acid	Perfluoropentanoic acid	Perfluorohexanoic acid	Perfluoroheptanoic acid	Perfluorooctanoic acid PFOA	Perfluorononanoic acid	Perfluorodecanoic acid	Perfluoroundecanoic acid	Perfluorododecanoic acid	Perfluorotridecanoic acid	Perfluorotetradecanoic acid	4:2 FTS	6:2 FTS	8:2 FTS	10:2 FTS	Perfluorooctane sulfonamide	N-Methyl perfluorooctane sulfonamide	N-Ethyl perfluorooctanesulfon amide	N-Me perfluorooctanesulfonamid oethanol	N-Et perfluorooctanesulfonamid oethanol	MePerfluorooctanesulf-amid oacetic acid	EtPerfluorooctanesulf-amid oacetic acid	Total Positive PFHxS & PFOS	Total Positive PFOS & PFOA	Total Positive PFAS
PQL Envirolab		*0.0004*	*0.001*	*0.0002*	*0.0010*	*0.0002*	*0.002*	*0.002*	*0.002*	*0.000*	*0.000*	*0.000*	*0.001*	*0.002*	*0.002*	*0.005*	*0.01*	*0.05*	*0.001*	*0.0004*	*0.0004*	*0.002*	*0.01*	*0.05*	*0.1*	*0.05*	*0.5*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*
Intra laboratory duplicate	MW1	0.0043	0.002	0.026	<0.001	0.0097	<0.002	<0.01	0.009	0.011	0.0098	0.016	0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.05	<0.1	<0.05	<0.5	<0.002	<0.002	0.036	0.026	0.09
	GWDUP1	0.0044	0.002	0.028	<0.001	0.0099	<0.002	<0.01	0.008	0.012	0.01	0.015	0.001	<0.002	<0.002	<0.005	<0.01	<0.05	<0.001	<0.0004	<0.0004	<0.002	<0.01	<0.05	<0.1	<0.05	<0.5	<0.002	<0.002	0.038	0.025	0.091
	MEAN	0.00435	0.002	0.027	nc	0.0098	nc	nc	0.0085	0.0115	0.0099	0.0155	0.001	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.037	0.0255	0.0905
	RPD %	2%	0%	7%	nc	2%	nc	nc	12%	9%	2%	6%	0%	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	5%	4%	1%
Trip Blank	TB-W1 4/10/2024	NA	NA	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.01	<0.02	NA	NA	NA	NA	NA	NA	NA	NA	<0.01	<0.01	<0.01

Result outside of QA/QC acceptance criteria Value

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH101** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 1/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Clayey silty sand, fine to medium grained, brown, trace of ironstone gravel, ash, roots and root fibres.	D			GRASS COVER SCREEN: 10.20kg 0-0.2m, NO FCF
	■		■						CI	Sandy CLAY: medium plasticity, light brown, fine to medium grained sand, with ironstone gravel.	w≈PL			RESIDUAL
							0.5			END OF BOREHOLE AT 0.5m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH102 **1/1**

SDUP101: 0-0.1m

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 1/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sand, fine to medium grained, brown, trace of ironstone and sandstone gravel, roots and root fibres.	D			GRASS COVER SCREEN: 10.01kg 0-0.1m, NO FCF INSUFFICIENT RETURN FOR BULK SCREEN
							0.5			FILL: Silty sand, fine to medium grained, light brown and brown, trace of ironstone gravel and ash.				INSUFFICIENT RETURN FOR BULK SCREEN
										END OF BOREHOLE AT 0.8m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH103** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 1/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sandy clay, medium plasticity, brown, fine to medium grained sand, trace of ironstone gravel, tile fragments, fibre cement fragments, slag, ash, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 12.10kg 0-0.1m, F1, F2, F3, F4, F5
▶	■		■				0.5		CL-CI	Sandy CLAY: low to medium plasticity, light brown, fine to medium grained sand, trace of ironstone gravel.	w>PL			INSUFFICIENT RETURN FOR BULK SCREEN RESIDUAL
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH104** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sandy clay, low to medium plasticity, brown, fine to medium grained sand, trace of ironstone gravel, slag, ash, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 11.10kg 0-0.1m, NO FCF
	■		■				0.5			FILL: Sandy clay, medium plasticity, light brown and brown, fine to medium grained sand, trace of sandstone gravel and ash.	w>PL			SCREEN: 6.22kg 0.1-0.3m, NO FCF INSUFFICIENT RETURN FOR BULK SCREEN
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH105 **1/1**

SDUP102: 0-0.1m

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 1/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sand, fine to medium grained, brown, trace of igneous and ironstone gravel, roots and root fibres.	D			GRASS COVER SCREEN: 13.95kg 0-0.1m, NO FCF SCREEN: 6.89kg 0.1-0.4m, NO FCF
	■		■		■		0.5			FILL: Silty sand, fine to medium grained, brown mottled grey.				SCREEN: 2.60kg 0.4-0.9m, NO FCF
							1			END OF BOREHOLE AT 0.9m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1.5							
							2							
							2.5							
							3							
							3.5							

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ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH106** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 4/10/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty clay, medium plasticity, brown, with sand, trace of ironstone gravel, slag, ash, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 10.98kg 0-0.1m, NO FCF
							0.5		CH	Silty CLAY: high plasticity, light brown mottled red brown, trace of ironstone gravel.	w≈PL			SCREEN: 4.11kg 0.1-0.3m, NO FCF RESIDUAL
										END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL ON INFERRED BEDROCK
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

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BOREHOLE LOG

Borehole No. 1

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■			■	REFER TO DCP TEST RESULTS SHEET					FILL: Silty sand, fine to medium grained, grey, trace of fine to coarse grained ironstone gravel.	M			APPEARS POORLY COMPACTED
										FILL: Silty sandy clay, low plasticity, grey, trace of fine to medium grained sand, and root fibres .	w>PL			SCREEN: 12.01kg 0-0.1m, NO FCF
	■								CL		w>PL	St		INSUFFICIENT RETURN FOR BULK SCREEN
				■		72	1		CH	Sandy CLAY: low plasticity, light brown, fine to medium grained sand.			140 160 180	RESIDUAL
										Silty CLAY: high plasticity, orange brown, trace of fine to coarse grained ironstone gravel.				
										REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 9.43m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 9.43m TO 5.93m. CASING 5.93m TO 0.1m. 2mm SAND FILTER PACK 9.43m TO 5.5m. BENTONITE SEAL 5.5m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						71	2							
						70	3							
						69	4							
						68	5							
						67	6							
						66								

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CORED BOREHOLE LOG

Borehole No. 1 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.10m						
0% RETURN		71	2		SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-10°. NO CORE 1.20m	MW	VL - L				
ON 9/9/24		70	3		SANDSTONE: fine to medium grained, red brown, with occasional grey laminae, bedded at 0-10°.	SW	M - H	1.2, 0.70			Hawkesbury Sandstone
100% RETURN		69	4		SANDSTONE: fine to medium grained, light grey, orange brown and red brown, with grey laminae, bedded at 0-15°.			1.3, 1.7, 0.80		(3.75m) Be, 10°, Ir, R, Cn	
		68	5							(5.09m) Be, 10°, Ir, R, Fe Sn	
		67	6					1.0, 1.1			
					NO CORE 0.20m						
		66	7		SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-15°.	SW	M - H	0.70, 1.3, 2.2			Hawkesbury Sandstone
					NO CORE 0.19m						
		65			SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°.	SW	M - H	0.60			

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No. 1

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~72.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
100% RETURN					SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°. *(continued)*	SW	M - H			(8.15m) J, 70°, P, R, Cn	
							VL	0.070			
					NO CORE 0.28m						
		64	9		SANDSTONE: fine to medium grained, light grey and red brown, with occasional grey laminae, bedded at 0-10°.	SW	L - M	0.20			
								0.30		(9.30m) XWS, 0°, 40 mm.t	
					END OF BOREHOLE AT 9.43 m						
		63	10								
		62	11								
		61	12								
		60	13								
		59	14								
		58									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET					FILL: Silty clayey sand, fine to medium grained, brown, trace of root fibres.	M			APPEARS POORLY COMPACTED
										FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, trace of root fibres.	w>PL		150 130 120	SCREEN: 11.90kg, 0-0.1m, NO FCF SCREEN: 5.41kg (<10L), 0.1-0.3m, NO FCF
						71	1		CL	Sandy CLAY: low plasticity, orange brown, fine to medium grained sand, trace of fine to coarse grained ironstone gravel.	w>PL	St	180 200 160 190	INSUFFICIENT RETURN FOR BULK SAMPLE RESIDUAL
										Casing Washed in to 1.52m.				HAND AUGER REFUSAL AT 1.2m DEPTH
						70	2			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 8.63m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 8.63m TO 5.13m. CASING 5.13m TO 0.1m. 2mm SAND FILTER PACK 8.63m TO 5.0m. BENTONITE SEAL 5.0m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
						69	3							
						68	4							
						67	5							
						66	6							
						65								

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CORED BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.52m						
60% RETURN		70	2		SANDSTONE: fine to medium grained, red brown.	SW	M				
					NO CORE 0.65m						
					SANDSTONE: fine to medium grained, orange brown and red brown.	HW	VL	0.060			
					Extremely Weathered sandstone: clayey SAND, fine to coarse grained, orange brown.	XW	Hd				Hawkesbury Sandstone
ON 9/9/24		69	3		SANDSTONE: fine to medium grained, light grey, red brown and orange brown, with grey and orange brown laminae, bedded at 0-10°.	SW	L - M	0.60 0.10 0.20 0.30			
		68	4		NO CORE 0.10m						
95% RETURN					SANDSTONE: fine to medium grained, light grey and orange brown, with grey laminae, bedded at 0-15°.	SW	L - M	0.30 0.20 0.40	600 200 60 20	(4.35m) Be, 0°, Ir, R, Cn (4.51m) Be, 15°, P, R, Clay Vn (4.85m) Be, 10°, P, R, Clay Vn (5.23m) CS, 0°, 15 mm.t (5.25m) CS, 0°, 5 mm.t	
		67	5		NO CORE 0.22m						
					SANDSTONE: fine to medium grained, light grey and grey, with grey laminae, bedded at 0-15°.	SW	L				
		66	6		NO CORE 0.17m	SW	M	0.40		(5.84m) Be, 15°, Ir, R, Fe Sn	
					SANDSTONE: fine to medium grained, light grey and brown, with occasional grey laminae, bedded at 0-15°.					(6.42m) Be, 0°, P, R, Fe Sn	Hawkesbury Sandstone
		65	7					0.50 0.20			
					NO CORE 0.10m					(7.27m) CS, 0°, 45 mm.t	
					SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°.	SW	VL - L	0.040			
		64				FR	M - H		200 60 20	(7.73m) XWS, 0°, 45 mm.t	

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 36901SF CREMORNE.GPJ <<DrawingFile>> 18/09/2024 09:56 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 2

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~71.8 m

Date: 12/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
95% RETURN					SANDSTONE: fine to medium grained, light grey, with grey laminae, bedded at 0-15°. *(continued)*	FR	L - M	0.20 – 1.0		(8.04m) XWS, 0°, 10 mm.t (8.10m) Be, 0°, P, R, Fe Sn (8.42m) CS, 0°, 20 mm.t	
		63	9		END OF BOREHOLE AT 8.63 m						
		62	10								
		61	11								
		60	12								
		59	13								
		58	14								
		57									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

BOREHOLE LOG

Borehole No. 3

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET	76				FILL: Silty sandy clay, low plasticity, brown and grey, fine to medium grained sand, trace of ironstone gravel, roots and root fibres.	w>PL			APPEARS POORLY COMPACTED
									SC		M	(St)		SCREEN: 10.20kg, 0-0.1m, NO FCF
									CL-CI	Clayey SAND: fine to medium grained, light brown, trace of fine to coarse grained ironstone gravel.	w>PL			SCREEN: 6.45kg <10L), 0.1-0.3m, NO FCF
							1			Sandy CLAY: low to medium plasticity, light brown and red brown, fine to medium grained sand, trace of fine to coarse grained ironstone gravel.				RESIDUAL
						75				Casing Washed in to 1.1m.				HAND AUGER REFUSAL AT 0.8m DEPTH
										REFER TO CORED BOREHOLE LOG				
						74	2							
						73	3							
						72	4							
						71	5							
						70	6							

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CORED BOREHOLE LOG

Borehole No. 3 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		75			START CORING AT 1.10m						
					NO CORE 0.90m						
		74	2		SANDSTONE: fine to medium grained, red brown, massive.	MW	M - H	1.0			
					NO CORE 0.23m						
					SANDSTONE: fine to medium grained, light grey, massive.	SW	VL - L				Hawkesbury Sandstone
		73	3		SANDSTONE: fine to medium grained, red brown, with occasional grey laminae, bedded at 0-15°.		L - M	0.40 0.20 0.30			
80% RETURN					NO CORE 1.01m						
		72	4								
			5		SANDSTONE: fine to medium grained, red brown and orange brown.	SW	L - M	0.50		(5.08m) XWS, 0°, 30 mm,t	
		71			NO CORE 0.12m						
					SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	SW	M	0.30 0.60 1.0 0.70 0.70			Hawkesbury Sandstone
		70	6								
90% RETURN		69	7					0.90		(7.47m) Be, 15°, P, R, Fe Sn	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No. 3

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~76.1 m

Date: 14/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ VL 0.1 L 0.3 M 1 H 3 VH 10 EH	DEFECT DETAILS SPACING (mm) 600 200 60 20	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
90% RETURN		68			SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	SW	M				Hawkesbury Sandstone
					SANDSTONE: fine to medium grained, light grey, with occasional grey laminae, bedded at 0-15°.	FR	M - H	0.70			
		67	9					0.80 0.50		(9.50m) XWS, 0°, 45 mm.t	
		66	10					0.90 1.3			
		65	11					0.70 0.90			
		64	12					1.4 1.1			
		63	13		END OF BOREHOLE AT 12.26 m						
		62	14								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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BOREHOLE LOG

Borehole No. 4

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Method:** HAND AUGER **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Datum:** AHD

Plant Type: **Logged/Checked By:** T.F./O.F.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING					REFER TO DCP TEST RESULTS SHEET	75	1		CL	FILL: Silty clayey sand, fine to medium grained, grey and brown, trace of fine to coarse grained ironstone gravel, glass and metal fragments, ash and root fibres.	M			APPEARS POORLY COMPACTED
											w>PL	St	150 180	SCREEN: 11.1kg, 0-0.1m, NO FCF
									CI-CH	Silty sandy CLAY: low plasticity, orange brown and brown, trace of fine to coarse grained ironstone gravel, and ash.				INSUFFICIENT RETURN FOR BILK SCREEN
												VSt - Hd		RESIDUAL
										Silty CLAY: medium to high plasticity, orange brown, with fine to coarse grained ironstone gravel.			280 260 240	ASH LAYER (INFERRED DECOMPOSED TREE ROOT)
										Silty CLAY: medium to high plasticity, grey, trace of fine to coarse grained ironstone gravel.			>600 580	
									CL-CI				590	
						74							280	
							2			Silty CLAY: low to medium plasticity, light grey, with fine to medium grained sand.			250 230	GROUNDWATER MONITORING WELL INSTALLED TO 11.96m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 11.96m TO 8.96m. CASING 8.96m TO 0.1m. 2mm SAND FILTER PACK 11.96m TO 8.5m. BENTONITE SEAL 8.5m TO 0.5m. BACKFILLED WITH SAND TO THE SURFACE. COMPLETED WITH A CONCRETED GATIC COVER.
										REFER TO CORED BOREHOLE LOG				
						73	3							
						72	4							
						71	5							
						70	6							
						69								

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CORED BOREHOLE LOG

Borehole No. 4 **2 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.70m						
	90% RETURN	74	1		SANDSTONE: fine to medium grained, red brown, massive.	MW	H				
			2		NO CORE 0.22m	MW	M	0.50		(2.12m) Be, 0°, Ir, R, Clay Vn	Hawkesbury Sandstone
	95% RETURN	73			SANDSTONE: fine to medium grained, red brown and orange brown, massive.			0.50			
			3		SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.		VL - L	0.020		(3.03m) XWS, 0°, 20 mm.t (3.10m) XWS, 0°, 15 mm.t (3.24m) XWS, 45°, 15 mm.t	
		72			Extremely Weathered sandstone: sandy CLAY, low plasticity, light grey, fine to coarse grained sand.	XW	Hd				
			4		SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.	MW	L - M	0.90 0.010		(3.80m) Be, 0°, P, R, Clay Vn (4.06m) XWS, 0°, 50 mm.t	
					NO CORE 0.34m						
	85% RETURN ON 9/9/24	71	5		SANDSTONE: fine to medium grained, red brown, massive.	SW	L - M	0.60 0.20		(5.05m) Be, 0°, P, R, Clay Vn (5.52m) Be, 0°, P, R, Fe Sn	
		70	6					0.40 0.60		(6.36m) Be, 0°, P, R, Fe Sn	Hawkesbury Sandstone
		69	7					0.70 0.30		(6.81m) Be, 0°, P, R, Clay Vn	
	80% RETURN	68						0.20			

JK 9.02.4 LIB:GLB Log JK CORED BOREHOLE - MASTER 36901SF CREMORNE.GPJ <<DrawingFile>> 18/09/2024 09:56 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 4 **3 / 3**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: 36901SF **Core Size:** TT56 **R.L. Surface:** ~75.7 m

Date: 13/8/24 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** T.F./O.F.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
80% RETURN		67	9		SANDSTONE: fine to medium grained, red brown, massive. *(continued)*	SW	L - M	0.40; 0.20		(8.33m) XWS, 0°, 15 mm.t; (8.64m) Be, 10°, P, R, Fe Sn; (8.78m) J, 85°, Ir, R, Fe Sn	
					NO CORE 0.02m	XW	Hd				
					Extremely Weathered sandstone: silty CLAY, medium to high plasticity, red brown.	SW	M	0.20		(9.07m) Be, 0°, Ir, R, Fe Sn; (9.15m) J, 30°, Ir, R, Fe Sn; (9.21m) J, 30°, Ir, R, Fe Sn	
		66	10		NO CORE 0.08m SANDSTONE: fine to medium grained, red brown and light grey, with occasional grey laminae, bedded at 0-15°.			0.30; 0.40			Hawkesbury Sandstone
		65	11					0.80			
		64						0.80; 1.2			
			12		END OF BOREHOLE AT 11.96 m						
		63	13								
		62	14								
		61									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. BH5 **1/1**

SDUP1: 0-0.1m

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty sandy clay, low plasticity, brown, fine to medium grained sand, trace of concrete and ceramic fragments, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 11.41kg 0-0.2m, NO FCF
	■		■						SC	Clayey SAND: fine to medium grained, light grey.	M			RESIDUAL
							0.5							
										END OF BOREHOLE AT 0.6m				
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH6** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION	■		■		■		0			FILL: Silty clayey sand, fine to medium grained, brown, trace of igneous gravel, bark fragments, roots and root fibres.	D			MULCH COVER SCREEN 10.11kg 0-0.1m, NO FCF
	■		■		■					FILL: Silty clay, medium to high plasticity, light brown and brown, trace of ironstone and igneous gravel, sand and root fibres.	w≈PL			SCREEN: 8.10kg (<10L) 0.1-0.3m, NO FCF
							0.5			END OF BOREHOLE AT 0.5m				INSUFFICIENT RETURN FOR BULK SCREEN HAND AUGER REFUSAL ON OBSTRUCTION IN FILL
							1							
							1.5							
							2							
							2.5							
							3							
							3.5							

JKEnvironments

ENVIRONMENTAL LOG

Environmental logs are not to be used for geotechnical purposes

Log No. **BH7** **1/1**

Client: HELM PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 118-124 BENELONG ROAD & 72 GERARD STREET, CREMORNE, NSW

Job No.: E36901P **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 12/8/24 **Datum:** -

Plant Type: - **Logged/Checked by:** O.B./B.P.

Groundwater Record	SAMPLES ES	SAMPLES ASS	SAMPLES ASB	SAMPLES SAL	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLE-TION							0			FILL: Silty sandy clay, low to medium plasticity, brown, fine to medium grained sand, trace of sandstone cobbles, ironstone and igneous gravel, brick, tile, glass and metal fragments, slag, roots and root fibres.	w≈PL			GRASS COVER SCREEN: 10.58kg 0-0.1m, NO FCF SCREEN: 7.10kg (<10L) 0.1-0.5m, NO FCF
							0.5		CI-CH	Sandy CLAY: medium to high plasticity, light brown, fine to medium grained sand, trace of ironstone gravel.	w≈PL			RESIDUAL
							1			END OF BOREHOLE AT 0.9m				
							1.5							
							2							
							2.5							
							3							
							3.5							

Appendix D: Examples of Imported Materials and Waste Tracking Registers

Exported (Waste) Materials Register

Load	Date	Material Type / Classification	Site Area where Waste was Generated	Waste Classification Report Reference	Disposal Facility	Tipping Receipt/Docket Number	Tracking Number (where relevant)	Tonnage

Imported Materials Register

Supplier	Date	Docket/Invoice #	Product Type	Quantity (specify m3 or tonnes)	Area where Material was Placed

Appendix E: Report Explanatory Notes

QA/QC Definitions

The QA/QC terms used in this report are defined below. The definitions are in accordance with US EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (1994)[12] methods and those described in *Environmental Sampling and Analysis, A Practical Guide,* (1991)[13]. The NEPM (2013) is consistent with these documents.

A. Practical Quantitation Limit (PQL), Limit of Reporting (LOR) & Estimated Quantitation Limit (EQL)

These terms all refer to the concentration above which results can be expressed with a minimum 95% confidence level. The laboratory reporting limits are generally set at ten times the standard deviation for the Method Detection Limit for each specific analyte. For the purposes of this report the LOR, PQL, and EQL are considered to be equivalent.

When assessing laboratory data it should be borne in mind that values at or near the PQL have two important limitations: *"The uncertainty of the measurement value can approach, and even equal, the reported value. Secondly, confirmation of the analytes reported is virtually impossible unless identification uses highly selective methods. These issues diminish when reliably measurable amounts of analytes are present. Accordingly, legal and regulatory actions should be limited to data at or above the reliable detection limit*" (Keith, 1991).

B. Precision

The degree to which data generated from repeated measurements differ from one another due to random errors. Precision is measured using the standard deviation or Relative Percent Difference (RPD).

C. Accuracy

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter being measured (i.e. the proximity of an averaged result to the true value, where all random errors have been statistically removed). The assessment of accuracy for an analysis can be achieved through the analysis of known reference materials or assessed by the analysis of surrogates, field blanks, trip spikes and matrix spikes. Accuracy is typically reported as percent recovery.

D. Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is primarily dependent upon the design and implementation of the sampling program. Representativeness of the data is partially ensured by the avoidance of contamination, adherence to sample handing and analysis protocols and use of proper chain-of-custody and documentation procedures.

E. Completeness

Completeness is a measure of the number of valid measurements in a data set compared to the total number of measurements made and overall performance against DQIs. The following information is assessed for completeness:

- Chain-of-custody forms;
- Sample receipt form;
- All sample results reported;
- All blank data reported;

[12] US EPA, (1994). *SW-846: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* (US EPA SW-846)

[13] Keith., H, (1991). *Environmental Sampling and Analysis, A Practical Guide*

- All laboratory duplicate and RPDs calculated;
- All surrogate spike data reported;
- All matrix spike and lab control spike (LCS) data reported and RPDs calculated;
- Spike recovery acceptable limits reported; and
- NATA stamp on reports.

F. Comparability

Comparability is the evaluation of the similarity of conditions (e.g. sample depth, sample homogeneity) under which separate sets of data are produced. Data comparability checks include a bias assessment that may arise from the following sources:

- Collection and analysis of samples by different personnel; Use of different techniques;
- Collection and analysis by the same personnel using the same methods but at different times; and
- Spatial and temporal changes (due to environmental dynamics).

G. Blanks

The purpose of laboratory and field blanks is to check for artefacts and interferences that may arise during sampling, transport and analysis.

H. Matrix Spikes

Samples are spiked with laboratory grade standards to detect interactive effects between the sample matrix and the analytes being measured. Matrix Spikes are reported as a percent recovery and are prepared for 1 in every 20 samples. Sample batches that contain less than 20 samples may be reported with a Matrix Spike from another batch. The percent recovery is calculated using the formula below. Acceptable recovery limits are 70% to 130%.

$$\frac{\text{(Spike Sample Result – Sample Result) x 100}}{\text{Concentration of Spike Added}}$$

I. Surrogate Spikes

Samples are spiked with a known concentration of compounds that are chemically related to the analyte being investigated but unlikely to be detected in the environment. The purpose of the Surrogate Spikes is to check the accuracy of the analytical technique. Surrogate Spikes are reported as percent recovery.

J. Duplicates

Laboratory duplicates measure precision, expressed as Relative Percent Difference. Duplicates are prepared from a single field sample and analysed as two separate extraction procedures in the laboratory. The RPD is calculated using the formula where D1 is the sample concentration and D2 is the duplicate sample concentration:

$$\frac{(D1 - D2) \times 100}{\{(D1 + D2)/2\}}$$

Appendix F: Guidelines and Reference Documents

Contaminated Land Management Act 1997 (NSW)

NSW EPA, (2014). Waste Classification Guidelines - Part 1: Classifying Waste

NSW EPA, (2015). Guidelines on the Duty to Report Contamination under Section 60 of the CLM Act 1997

NSW EPA, (2017). Guidelines for the NSW Site Auditor Scheme, 3rd Edition

NSW EPA, (2020). Consultants Reporting on Contaminated Land, Contaminated Land Guidelines

National Environment Protection Council (NEPC), (2013). National Environmental Protection (Assessment of Site Contamination) Measure 1999 as amended (2013)

Protection of the Environment Operations Act 1997 (NSW)

Protection of the Environment Operations (waste) Regulation 2014 (NSW)

SafeWork NSW, (202022). Code of Practice: How to manage and control asbestos in the workplace

State Environmental Planning Policy (Resilience and Hazards) 2021 (NSW)

Western Australia Department of Health, (2009/2021). Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia

Work Health and Safety Regulation 2017 (NSW)