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contaminated sites

FINAL REPORT

Remediation Action Plan

3 Wiston Gardens, Double Bay NSW

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Executive Summary

Merman Investments Pty Ltd (Merman Investments) are proposing the redevelopment of a property located at 3 Wiston Gardens, Double Bay NSW (the Site) for a medium density residential apartment building. The development comprises a multi-storey building, basement levels for parking and plant rooms and landscaping at the frontage and rear of the building.

The Site currently contains a multi-storey residential apartment building that was constructed with no basements at sometime between the 1920s and 1930s. A steeply terraced sandstone ridge is present across the north-western area of the Site and the ground floor of the building sits at the base of this cliff face which then slopes down to the road. Garages are present at the road level with the frontage of the building located ontop of the garages. The building footprint together with the sandstone cliff occupies the majority of the area of the Site. Some minimal garden beds and landscaping areas are present at the northern side and frontage of the current building above the garages and some of the higher sandstone terraces contain some vegetation.

Recent investigations have identified the presence of shallow fill materials within the landscaped areas present above the garages at the front the Site that contained asbestos containing materials (ACM) and concentrations of polycyclic aromatic hydrocarbons (PAHs) that were greater than the criteria for medium density residential land use. The investigation works indicated the potential for these fill materials to extend beneath the existing building to depths of up to 2 to 3 m beneath the building.

The previously identified presence of contaminated fill materials and the potential for contaminated fill materials to be present beneath the building has been determined to render the Site not suitable for medium density residential land use and that as part of the redevelopment of the Site, in order to ensure that the Site is suitable for ongoing medium density residential land use, remediation is required.

This Remediation Action Plan (RAP) has been prepared to document the remediation strategy to be adopted on the Site due to the presence and potential presence of fill materials in the surface and shallow sub-surface that contain asbestos and PAHs that are greater than the criteria for residential land use with minimal opportunities for access to soils.

The proposed redevelopment of the Site will comprise the demolition of the existing building and all associated structures and then the excavation and off-site disposal of fill materials, natural soils and bedrock across the majority of the Site to depths of up to 20 metres below the current ground level. The most significant excavation works will be the removal of approximately half of the existing terraced sandstone ridge and then further in-ground excavation works beneath this existing terraced ridge and across the east and south-eastern areas of the Site. This excavation work will remove all existing fill materials and natural soils that overlay the natural sandstone bedrock on the Site and then the underlying sandstone bedrock. It is expected that the excavated materials will comprise 5-10% fill materials and natural soils with the remainder being sandstone.

Given that the redevelopment of the Site requires large scale excavation and removal off-site of surface and sub-surface materials present across the Site to the required lateral and vertical extent of the proposed basement levels, remediation of contaminated and potentially contaminated fill materials at the Site will be achieved by these works. As such the approach to the remediation and validation works on the Site is via excavation, off-site disposal of excavated materials and the adoption of a validation plan to demonstrate that the Site is suitable for medium density residential land use.

The requirements of this RAP are required to be implemented during the redevelopment of the Site for a new residential apartment building in order to ensure that the Site is made suitable for residential land use with minimal opportunities for access to soils.

1 Introduction

CONSARA Pty Ltd (CONSARA) has been commissioned by Merman Investments Pty Ltd (Merman Investments) to prepare this Remediation Action Plan (RAP) for a property located at 3 Wiston Gardens, Double Bay NSW (the Site). The location of the Site is presented in Figure 1 and the layout of the Site is presented on Figure 2.

Merman Investments are proposing the redevelopment of the Site into a medium density residential apartment building. The development comprises a multi-storey building, basement levels for parking and plant rooms and landscaping at the frontage and rear of the building. The Site currently contains a multi-storey residential apartment building that was constructed with no basements at sometime between the 1920s and 1930s. A steeply terraced sandstone ridge is present across the north-western area of the Site and the ground floor of the building sits at the base of this cliff face which then slopes down to the road. Garages are present at the road level with the frontage of the building located on top of the garages. The building footprint together with the sandstone cliff occupies the majority of the area of the Site. Some minimal garden beds and landscaping areas are present at the northern side and frontage of the current building above the garages and some of the higher sandstone terraces contain some vegetation. The current layout of the Site is shown on Figure 2.

The redevelopment of the Site will comprise the demolition of the existing building and all associated structures and then the excavation across the majority of the Site to depths of up to 20 metres below the current ground level. The most significant excavation works will be the removal of approximately half of the existing terraced sandstone ridge and then further in-ground excavation works beneath this existing terraced ridge and across the east and south-eastern areas of the Site. This excavation work will remove all existing fill materials and natural soils that overlay the natural sandstone bedrock on the Site and then the underlying sandstone bedrock. It is expected that the excavated materials will comprise 5-10% fill materials and natural soils with the remainder being sandstone.

Recent investigations have identified the presence of shallow fill materials within the landscaped areas present above the garages at the front the Site that contained asbestos containing materials (ACM) and concentrations of polycyclic aromatic hydrocarbons (PAHs) that were greater than the criteria for medium density residential land use. The investigation works indicated the potential for these fill materials to extend beneath the existing building to depths of up to 1 to 2 m beneath the building. However, it is noted that as the majority of the Site area is occupied by the terraced sandstone ridge and the building footprint, areas in which intrusive investigations could be completed were limited.

The previously identified presence of contaminated fill materials and the potential for contaminated fill materials to be present beneath the building has rendered the Site not suitable for medium density residential land use. As such as part of the redevelopment of the Site, in order to ensure that the Site is suitable for ongoing medium density residential land use, remediation is required.

Given that the redevelopment of the Site requires large scale excavation and removal off-site of surface and sub-surface materials present across the Site to the required lateral and vertical extent of the proposed basement levels, remediation of contaminated and potentially contaminated fill materials at the Site will be achieved by these works. As such the approach to the remediation and validation works on the Site is via excavation, off-site disposal of excavated materials and the adoption of a validation plan to demonstrate that the Site is suitable for medium density residential land use.

Given the above, this RAP documents the remediation and validation works that will be required to be undertaken during the redevelopment works to ensure that the Site is suitable for its proposed use. This RAP has been prepared, where possible and relevant, with reference to the relevant requirements of the *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) – Schedule B 1999 as Amended 2013* (ASC NEPM) National Environment Protection Council (NEPC) and the NSW Environment Protection Authority (NSW EPA, 2020) *Contaminated Land Guidelines - Consultants Reporting on Contaminated Sites* and other relevant guidance made or endorsed by NSW EPA.

It is noted that this RAP has been prepared as part of the development application to be lodged with the relevant planning authority to achieve development consent for the proposed redevelopment of the Site. The RAP has been prepared to ensure that the requirements of State Environment Planning Policy 55 (SEPP 55) in relation to the redevelopment have been appropriately addressed. The implementation of this RAP will ensure that the Site is made suitable for the proposed land use.

1.1 Objective

The objective of this RAP is to describe the redevelopment plans for the Site and the approach to the remediation and validation of the Site that will be implemented as part of the excavation works required for the redevelopment of the Site.

1.2 Objective of the Remediation

The objective of the remediation works on the Site is to ensure that it is made suitable for medium density residential land use with minimal opportunities for access to soils.

1.3 Scope of Works

The scope of works undertaken to achieve the objectives set out above is as follows:

- Detail the current redevelopment plans for the Site, as set out in the plans provided in Appendix A;
- Detail the approach to the remediation and validation of the Site resulting from the current redevelopment plans for the Site; and
- Preparation of this RAP that confirms that the remediation approach can be implemented under the current redevelopment plans such that successful remediation and validation can be achieved, and, if implemented the Site can be made suitable for the proposed residential land use with minimal opportunities for access to soils.

1.4 Persons referred to in this RAP

Within this RAP the following persons are referred to:

- Site Owner – Merman Investments Pty Ltd (Merman Investments)
- Proponent – Persons or Entity responsible for the development of the Site and implementation of this RAP
- Construction Contractor – the Construction Company contracted by Merman Investments to undertake the redevelopment works on the Site, including all excavation, building and landscaping works;
- Environmental Consultant – CONSARA - the Contaminated Site Consultant contracted by the Proponent to undertake the works of the Environmental Consultant as specified in this RAP.

2 Conceptual Site Model

2.1 Site Condition and Surrounding Environment

2.1.1 Site Identification

The Site is located at 3 Wiston Gardens, Double Bay NSW (the Site) within the Woollahra Municipal Council (the Council) area. The Site is identified as Lot 4 in Deposited Plan (DP) 15968. The Site has an area of approximately 830 m^2. The Site is zoned R3 Medium Density Residential under the Woollahra Local Environment Plan 2014.

2.1.2 Current and Proposed Use

The Site is located across a steeply terraced and sloping sandstone ridge, with the lowest area of the Site in the south-east, near level with the road at 2.49 metres Australian Height Datum (m AHD) and the highest area in the north-west on top of the sandstone ridge at 21.49 m AHD. The Site is occupied by a multi-storey residential apartment building that has four storeys across the lower south-eastern areas of the Site but then only two storeys further to the central to north-western parts of the Site. It appears the building construction was terraced to match the sandstone ridge. Garages are located on the lower levels in the south-eastern area of the Site, beneath the building with a short sloping concrete driveway providing access to the road.

Concrete footpaths and stairs and sandstone retaining walls are located on either side of the building and around the rear of the building. Some small gardens beds are located on the sides of the buildings and a courtyard is present at the rear that is surrounded by sandstone retaining walls, batters and terraced sandstone bedrock. Vegetation was present on some terraced areas of the sandstone bedrock. The frontage of the building, located above the garages, also has some limited landscaping that appears to have been formed as part of the construction of the building.

The Site is proposed to developed, with all existing buildings and structures and much of the existing sandstone ridge to be removed and replaced with a seven storey building with a number of basement levels to depths of between 2.7 to 3.5 metres below the RL of Wiston Gardens. Due to the slope of the Site, excavation will be required to a depths of up to 20 metres below the current ground surface levels, particularly in the north-western areas of the Site. After completion of demolition of the existing building and in order to achieve the required RLs on which to commence construction a program of stripping of fill materials and any underlying natural soils will be undertaken followed by the excavation of the sandstone bedrock. Once complete this will create the sub-grade levels that are required for the commencement of the construction of the building. The demolition plans and construction plans for the redevelopment are provided in Appendix A.

2.1.3 Surrounding Land Use

At the time of preparation of this RAP the Site was bound by:

- A mix of low and medium density residential property to the north, south, east and west;
- Wiston Garden, which is an open space park, is located at the end of the Wiston Garden road to the south and south-east of the Site;
- Double Bay, which is located on the southern extent of the larger Sydney Harbour, is located 50 m to the east to south east of the Site.

2.1.4 Topography and Soils

The Site is located across a south-east facing sandstone ridgeline that runs along a north/south alignment and that slopes down to Double Bay. The Site is located across part of the ridge that then steeply terraces down to the

more gentle slope of the toe of the ridge. Overall, the Site has a grade of approximately 10° to 15° down to Double Bay.

The soils present beneath the Site are likely to be minimal and are likely to primarily comprise fill materials that may have been historically placed to achieve the current RLs. Given that sandstone ridge outcrops within the Site and that the existing building has been constructed to step down with the slope and then toe of the rock face, it likely that any filling that has occurred across the toe of the ridge on which the current building has been constructed would be minimal and it is expected that sandstone bedrock will be encountered either directly beneath the building or up to 1 to 2 metres below the lower levels of the building. Some natural sands or sandy clays may also be present, though it would expected that such soils would be limited to terraced areas of sandstone given the steepness of the sandstone ridge.

The 1:25 000 Botany Bay Acid Sulfate Soil Risk Map (DLWC, 1997) indicates that the Site is located on area which is noted to have disturbed terrain to depths of up to 4 metres below existing ground levels and that assessment is required in order to determine the potential for acid sulphate soils to be present. However, given that the Site and surrounding areas are located on and across a sandstone ridge and toe that sits higher than the waters of Double Bay the conditions required for acid sulphate soils to be present does not exist. The excavation works to be completed on the Site will be well into and within sandstone bedrock and any soils or fill materials present are present above the sandstone bedrock and above any groundwater that may be present at depth in the bedrock. As such there is no potential for acid sulphate soils to be present or able to be formed on the Site.

2.1.5 Surface Water, Drainage and Flood Potential

A constructed surface water drainage system is present along Wiston Gardens roadway and outside of the boundaries of the Site which drains surface water flows to the south-east to Double Bay. However, there appears to be no constructed surface water drainage system on the Site and it is likely that all surface water drains with the sloping topography down to Wiston Gardens roadway and then to Double Bay.

The potential for localised flooding across the Site under high rainfall conditions is considered to be low given the steeply sloping topography and that the Site is located proximal to Double Bay. Double Bay is located on Sydney Harbour proximal to the harbour's connection with the Pacific Ocean. The Double Bay is tidal and any risk of flooding is likely to be primarily related to extreme high tide events rather than being related to rainfall.

The redevelopment of the Site will involve the construction of a building and associated utilities that will include a constructed stormwater system that will discharge to the local stormwater system on Wiston Garden.

2.1.6 Geology and Hydrogeology

The Site and surrounding area is underlain by Middle Triassic aged Hawkesbury Sandstone of the Wianamatta Group (DMR, 1991). The Hawkesbury Sandstone consists of medium to coarse-grained quartz sandstone, very minor shale, siltstone and laminite lenses.

Prior to any historical filling that may have occurred to achieve the current surface RLs, the soil landscape of the Site is likely to have been comprised of a sandstone rocky outcrops dominated by shallow lithosols and siliceous sands with some podzolic soils present in less exposed areas (SCS, 2009). It is well known that this foreshore area of Double Bay, was historically dominated by areas of sandstone outcrops and cliffs that continue to despite extensive development, to govern the local landscape and topography.

Regional groundwater is expected to be present at depth within the Hawkesbury Sandstone underlying the Site and areas to the north-west and is likely to be present as flow through fractures such as joints and bedding plane partings or via permeable lenses of siltstone or laminate. Thus, the transmissivity of the sandstone aquifer is dependent on the frequency, openness and orientation of the fracturing present. Groundwater present in sandstone is expected to be generally of reasonable quality with low salinity, whilst groundwater present in any

siltstone and laminite lenses is expected to be of higher salinity (Pells 1985). Based on local topography and surface drainage, groundwater in the bedrock is expected to flow to the east to south-east toward Double Bay.

Locally, it is considered unlikely that perched groundwater is present in any underlying fill materials or natural sandy soils such that it would be present as a groundwater system or would be require consideration in assessing the environmental condition of the Site. However, it is noted that should perched groundwaters be present in the fill materials or natural soils that any lateral or vertical migration would be primarily influenced by the permeability of the surrounding materials and the topography of the surface of the bedrock.

It is noted that regional or local groundwater in the region of the Site is not known to be used for any beneficial purpose.

2.2 Previous Investigations

2.2.1 Preliminary Site Investigation

In mid 2020, as part of planning for the redevelopment of the Site a Stage 1 environmental site assessment was completed on the Site by JK Environments Pty Ltd as documented in '*Report to Merman Investment Pty Ltd on Preliminary (Stage 1) Site Investigation for Proposed Residential Development at 3 Wiston Gardens, Double Bay NSW*" dated 17 July 2020 (the PSI). The PSI comprised the completion of desktop and background searches and intrusive investigations at two locations on the Site, one in a landscaped area located at the front of the building above the garages and one on the upper terraced sandstone ridge where some vegetation was growing. The locations are shown in the figure provided in Appendix B. The limited nature of the intrusive investigations was due to the fact that the building and sandstone ridge occupied the majority of the Site area, with only small areas able to accessed.

The results of the background searches identified that the residential apartment building that is currently present on the Site was present on the Site in the early 1940s so was likely to have been constructed prior to this, likely in the 1930s. No changes appeared to have occurred to the building or the Site since this time. The Site appears to have only been historically occupied by residential land use, with the surrounding local region also occupied by low density residential land uses, with increasing residential density apartments occurring on adjacent and surrounding sites since the mid 1960s. There was no evidence of any commercial or industrial activities having been historically undertaken on or near the Site. Review of publicly available contaminated land records held by the NSW EPA did not identify any contaminated sites that are located within 500 m of the Site nor in locations that are up-hydraulic gradient such that the Site could be affected by migration of potentially contaminated groundwater.

The results of the intrusive investigation identified the presence of fill materials from the surface or beneath concrete hardstand and into the sub-surface to depths of between 0.4 and 0.7 m bgs. The fill materials were reported to comprise silty sands, gravels and some sandy clays with inclusions of sandstone and igneous gravels, ash and building and demolition wastes such as brick and concrete. No perched or other groundwaters were observed to be present. Fragments of asbestos containing materials (ACM) were identified to be present in the fill materials present at depths between 0.4 and 0.6 m bgs in the landscaped area at the front of the building above the garages. Fill materials from this same location reported concentrations of carcinogenic polycyclic aromatic hydrocarbons (PAHs) that were greater than the relevant residential land use criteria. Concentrations of metals, total petroleum hydrocarbons, benzene, toluene, ethylbenzenes, xylenes, organochlorine and organophosphorus pesticides and polychlorinated biphenyls were either less than the laboratory detection limits or less than the relevant criteria in all other samples that were analysed. Based on the concentrations reported the PSI provided a preliminary waste classification for these fill materials as General Solid Waste (non-putrescible) and Special Waste-Asbestos.

Based on the results of the works completed the PSI identified that the Site did not have any history of contaminating activity and that the contamination on the Site was limited to the presence of shallow fill materials

of unknown origin. It was stated that it was likely that the fill materials extend beneath the building. Given the limited accessible areas on the Site the PSI stated that the extent of the contaminated fill materials had not been able to be assessed and would require further assessment if delineation was required. In addition the PSI noted the investigations did not include an assessment of groundwater conditions, however, given the historical use of the Site and the surrounding areas that the potential for groundwater contamination to be low and that the groundwater conditions could be assessed as part of the excavation works for the redevelopment.

Results of chemical analysis of samples of topsoils, fill materials and natural clays across the Site did not identify the presence of contamination. The PSI recommended that once the demolition of the residential dwellings had been undertaken that further investigations be completed on the central to eastern part of the Site to assess for the presence of contamination and to determine the requirements for remediation.

The PSI concluded that the presence of asbestos and PAH contaminated fill materials and that the contamination had not been delineated rendered the Site not suitable for residential land use with minimal opportunities for access to soils. Due to the nature of the redevelopment on the Site which required major excavation works across the Site, the PSI considered that the Site could be suitable for residential land use with minimal opportunities for access to soils if remediation and validation works were undertaken.

2.2.2 Detailed Site Investigation

In early 2021, in response to the conclusions and recommendations made in the PSI for the requirement for further investigations, CONSARA were engaged by Merman to complete a detailed site investigation. The results of this investigation were documented in a report '*Detailed Site Investigation, 3 Wiston Gardens Double Bay NSW*' prepared by CONSARA and dated 1 April 2021. It is noted that whilst it is usual for DSI's to include intrusive investigation works, given that access on the Site remained unchanged since the completion of the PSI, further intrusive investigations were not undertaken. Instead, the DSI provided a more complete and definitive assessment on the matters raised in the PSI through the completion of a detailed review of the PSI, the development of a detailed conceptual model of the Site, an assessment of adequacy and completeness of all information available for use in the assessment of risk and for the identification of remaining data gaps and uncertainties and demonstration that further intrusive investigations, as recommended by the PSI, were not required in order to determine how suitability of the Site can be achieved as part of the redevelopment on the Site.

The DSI considered that whilst the intrusive investigations on the Site have been limited to accessible areas the front and rear of the building and that there are some data gaps in relation to the sub-surface conditions beneath the building, given the historical use of the Site and the nature of the identified contamination, there is considered to be a low likelihood of gross or significant contamination or point source contamination being present on the Site. Rather the contamination is likely to be limited to the presence of asbestos and PAHs or similar as part of building and demolition waste in fill materials that are likely to be present to shallow depths beneath the building and its surrounding narrow footpaths and limited courtyard areas. Given that it is expected that any fill materials present beneath the building will be limited in their vertical extent it is considered likely that any contamination present in these fill materials will be similar to that identified at the frontage of the Site. Such contamination likely to be present as diffuse contamination, directly associated with the presence of fill materials with the nature and distribution of any contamination likely to be variable within these materials.

In addition, the absence of any potential point sources of chemical contamination on the Site or from the surrounding land uses or gross chemical contamination in the fill materials, indicates there is a negligible potential for contaminated groundwater to be sourced from the Site.

As such the DSI considered that there was no requirement to assess groundwater for the presence of contamination nor for further soil investigations and that the information available for the Site, as presented in the PSI and in the DSI, was sufficiently adequate and complete for a reliable assessment of suitability to be made and for any remediation works to be adequately planned to be completed as part of the redevelopment works.

The DSI concluded that the Site is considered to not be suitable for the proposed redevelopment and remediation works will be required in order to ensure that the Site is made suitable for medium density residential land use with minimal access to soils. This RAP has been prepared to document the remediation and validation works that will be required to be undertaken during the redevelopment works to ensure that the Site is suitable for its proposed use.

2.3 Areas and Contaminants of Concern

The results of the previous investigations identified the presence of asbestos and PAH contaminated shallow fill materials in landscaped areas located on the south-eastern part of the Site, in front of the building above the existing garages. Given the location of the fill materials it is clear that these materials were placed as part of the establishment of the landscaped areas or to achieve surface levels required for the construction of the building. Whilst investigations were not able to extend beneath the existing building it is conservatively assumed that the fill materials present in the south-eastern areas outside the building continue beneath the building. Given the terraced sandstone ridge that dominates the north-western part of the Site and the stepped nature of the building down the toe of the ridge, that it is likely that the sandstone bedrock is present at depths not greater than 2 to 3 metres beneath the building with the garages likely to have been founded directly on sandstone.

Based on these results it is considered that there is a low likelihood of gross or significant contamination or point source contamination being present on the Site, rather the contamination is likely to be limited to the presence of asbestos and PAHs as part of building and demolition waste in fill materials and as such is likely to be present as diffuse contamination, directly related to the presence of fill materials with the nature and distribution of any asbestos and PAH contamination likely to be variable within these materials. In addition, it is considered that the presence of such fill materials is likely to have been historically placed to establish surface levels or landscaping on the Site prior to or as part of the construction of the building. In addition, given the absence of any potential point sources of chemical contamination on the Site or from the surrounding land uses or gross chemical contamination in the fill materials, it is considered that that there is a negligible potential for contaminated groundwater to be present.

2.4 Potential Receptors

The proposed redevelopment of the Site will not change the use of the Site with the Site continuing to be occupied by medium density residential use in which there will be minimal opportunity to access soils. As such the potential receptors for potential contaminants sourced from the redeveloped Site are considered below.

2.4.1 Human Receptors

Given that the Site will be used for medium density residential use in which there will be minimal opportunity to access soils, with respect to human use the potential future receptors (and the associated exposure pathways) for potential contaminants sourced from the Site include the following:

- Occupiers and users (Children through to Adults) of the Site who have access to the Site's outdoor areas – inhalation of dusts generated from surface soils; ingestion from surface soils or dusts generated from surface soils; and
- Workers involved in intrusive maintenance works on the Site– inhalation of dusts generated from surface soils, ingestion from surface soils or dusts generated from surface/sub-surface soils or from perched groundwaters.

It is noted that currently and under the future use of the Site that the nearest off-site human receptors would be in residential properties located directly to the north, east and west.

2.4.2 Environmental Receptors

Given the location of the Site the environmental receptors (aquatic and terrestrial) for potential contaminants sourced from the Site are windblow dust or the physical movement of asbestos and PAH containing fill materials to Double Bay.

It is considered that the local area is within a highly disturbed environment and the waters of Double Bay and the greater Sydney Harbour have been the receiving body for historical wastes, wastewaters and discharges from domestic and industrial sources that historically occupied and currently occupy the catchment of Sydney Harbour. Whilst the quality of the waters and sediments in such catchments have been demonstrated to have improved over the past few decades, mainly due to increased regulation around discharges from industrial sites and urban areas, the harbour still receives significant flows of stormwater and surface water runoff from the surrounding urban areas. In addition, with respect to human use, groundwater beneath and in the local region surrounding the Site is known to be unsuitable for any beneficial purpose and is not accessed for beneficial use. The value of this groundwater resource is considered to be low.

2.5 Requirement for Remediation

The results of the previous investigations have identified the presence of fill materials in the surface and sub-surface on the Site that contain asbestos and PAHs at concentrations that render the Site not suitable for the proposed residential use with minimal opportunities for access to soils. In order to render the Site suitable for residential land use with minimal opportunities for access to soils a remediation strategy is required to address the presence of the asbestos and PAH contaminated fill materials.

3 Remediation and Validation

3.1 Remediation Objective

The objective of the remediation works on the Site is to ensure that it is made suitable for residential land use with minimal opportunities for access to soils.

3.2 Extent of Remediation

Given the nature and extent of the asbestos and PAH contamination on the Site, the extent of remediation works must address the lateral extent of the Site and the vertical extent being the current surface to the vertical extent or base of the fill materials where they overlay the natural soils and/or sandstone bedrock.

The previous investigations did not identify the presence of gross chemical contamination in the fill materials and did not identify the presence of groundwater perched in the fill materials. There was also no evidence of a history of contaminating activities having been conducted on the Site or within the local area. As such there was considered to be negligible risk of contaminated groundwater being present on the Site. Consequently, there is no need to consider remediation options for groundwater at the Site.

3.3 Remediation Options

An evaluation of remediation options for the Site has been completed in accordance with the NSW EPA's policy for site remediation as set out in the ASC NEPM Toolbox *Key Principals for remediation and management of contaminated sites* and the NSW EPA (2017) *Guidelines for the Site Auditor Scheme – 3rd Edition*.

In considering the remediation options and the proposed redevelopment of the Site it was identified that there was only one option available for the remediation of the Site being excavation for disposal off-site.

3.3.1 Preferred Remediation Option

The proposed redevelopment of the Site for a new multi-storey residential apartment building comprises the demolition of the existing building and associated hardstands on the Site, the excavation and removal off-site of all existing materials to depths up to 20 m bgs, including the excavation of part of the sandstone ridge that is present across the north-western area of the Site, then the construction of new multi-storey building with basement level carparking, plant rooms and lift wells and new landscaping and outdoor areas surrounding the building, as set out in the plans provided in Appendix A.

Given the vertical and lateral extent of excavation and construction works required on the Site, all existing fill materials and any overlying natural soils will be removed and disposed off-site to enable the continued excavation into the underlying sandstone bedrock Given that the contamination has been and potentially is present in fill materials on the Site, the process of excavation and off-site disposal of these materials as part of the redevelopment will result in the remediation of the Site. The adoption of a remediation strategy that is commensurate with the redevelopment requirements on the Site, being excavation and off-site disposal, is the preferred remedial option as it is technically justifiable, commercially feasible and environmentally sustainable.

It is also noted the requirements to make the Site suitable for the redevelopment is a requirement of SEPP55.

3.4 Approach to the Remediation and Validation Works

Given that the nature and extent of the redevelopment works on the Site comprises excavation works to achieve the required levels, construction of a multi-storey building and the construction of new landscaping and outdoor areas surrounding the building it is considered that once developed the Site will be suitable for residential use with minimal opportunities for access to soils. In addition, it is noted that as the excavation works on the Site will remove all existing fill materials and natural soils on the Site, any soils present on the Site at the time of

completion of the redevelopment will have been imported to the Site, nominally as growing medium for landscaping. As such the approach to the remediation and validation works on the Site is via the implementation of an excavation and off-site disposal and validation works to ensure that the resultant excavation surfaces and retained bedrock and any imported materials are suitable for residential land use with minimal opportunities for soil access.

In adopting this approach for the Site consideration has been provided to the program of works required on the Site and the likely condition of the materials generated from these works. The excavation program on the Site will not commence until demolition of the existing building and associated pavements and structures is completed. After the completion of the demolition works and prior to the commencement of excavation works, assessment works will be undertaken to inform the requirements for waste classification and for segregation of materials during excavation (if required). It is expected that given the space constraints on the Site, waste classifications will be provided either prior to the commencement of excavation works or at a stage in excavation works where all fill materials have been excavated and placed to stockpile for classification. Excavation of all fill materials and any natural soils will be completed and will be followed by the excavation of the sandstone ridge and bedrock.

All earthworks methodologies will adopt a program of segregation to ensure that no mixing or cross contamination of fill material with other materials occurs.

The approach to the validation works to be undertaken to demonstrate the success of the remediation works on the Site and to confirm the achievement of the objectives of the remediation works will comprise the following:

- At the completion of the demolition of the buildings and other structures, a program of inspections and sampling for waste classification;
- The completion of the excavation of fill materials and natural soils to expose sandstone bedrock and then the excavation of the sandstone ridge and bedrock in accordance with the plans provided in Appendix A and the requirements of this RAP;
- A program of inspections, during and after the completion of the excavation of fill materials and natural soils and prior to the commencement of excavation of sandstone bedrock;
- A program of inspections and sampling and analysis (if required) of resultant finished excavated surfaces and any groundwater seepage into the resultant excavation prior to the commencement of in-ground or above-ground constructions, to achieve validation of the resultant surfaces and to confirm the condition of groundwater seepage;
- The completion of a program of inspections and recording of the condition of the resultant excavation surfaces and the construction works on the Site by an appropriately qualified Environmental Consultant;
- A program of validation/certification of imported materials required for the construction works;
- A program of sampling and analysis of soil and/liquid materials that require disposal off-site; and
- The compilation of Registered Survey, inspection results and records, materials tracking and as-constructed plans for the construction works completed.

3.5 Remediation Acceptance Criteria

The Remediation Acceptance Criteria (RAC) adopted for the remediation and validation works for the Site are provided below.

3.5.1 RAC for Validation of Resultant Excavation Surfaces

Validation inspections will be undertaken of the final excavation surfaces created from the program of excavation works to achieve the required relative levels to enable the construction of the building. These excavated surfaces

will be comprised of sandstone bedrock. The inspections will be undertaken to confirm that all fill materials have been removed and that there is no visual evidence of potential contamination such as retained fill materials, potential asbestos containing materials, building wastes, other wastes, staining, odours, sheens or non-aqueous phase liquids. If inspections confirm no evidence of potential for contamination to be present then the surfaces will be confirmed to be validated and no further works will be required.

However, if the resultant surfaces do contain evidence of potential for contamination to be present then sampling of the materials on these surfaces will be undertaken. The guidelines to evaluate soil analytical results currently applied in NSW (NEPM, 2013; NSW EPA, 2017) presents a range of Health-Based Investigation Levels (HILs), Health-based Screening Levels (HSLs) and Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for urban redevelopment sites in NSW.

It is noted that EILs and ESLs apply principally to contaminants in the top 2 m of soil at the finished surface/ground level which corresponds to the root zone and habitation zone of many species (NEPC, 2013). Given that any landscaping on the Site will be established in imported growing medium topsoils the EILs and ESLs are not considered to be relevant and will not be applied to soil analytical results for samples collected from the Site.

Given that the redevelopment comprises the construction of new buildings and associated external pavements, basement carparking, outdoor features and the construction of new outdoor landscaped areas the analytical results for materials that are required to be sampled from resultant excavation surfaces created from the program of excavation works will be compared against the following criteria to allow for validation of areas of the Site

- Metals, Total PAH and Benzo(a)pyrene, PCBs, OCPs/OPPs results:
    - Heath-based Investigation Level (HIL) B (Residential B with minimal opportunities for access to soils) (NEPC, 2013);
- TPH, BTEX and Naphthalene results:
    - Health-based Screening Level (HSL) B (Clay and Depth range dependant) (Residential B with minimal opportunities for access to soils) (NEPC, 2013);
- Asbestos results:
    - FA and AF: 0.001 % w/w and no visible FA and/or AF in surface soils (top 100 mm of soils) (NEPC, 2013);
    - Residential B land uses –ACM: 0.04 % w/w and no visible ACM in surface soils (top 100 mm of soils) (NEPC, 2013).

3.5.2 RAC for Imported Materials

The RAC for imported materials and the procedure for ensuring the suitability of materials for importation onto the Site is detailed below. For clarity it is noted that materials to be imported onto the Site by the Construction Contractor for the purposes of achieving RLs, re-instatement, establishing a suitable sub-grade for pavement or landscaping or similar must be subject to assessment by the Environmental Consultant to determine whether certification documentation supplied with the materials is deemed to appropriate or whether confirmation sampling and analysis is required.

Materials to be imported on the Site must satisfy the following criteria:

- Virgin excavated natural materials (VENM) must satisfy the criteria stated in NSW EPA (2014) and NSW EPA (2017) guidelines and be demonstrated to be:
    - Natural material (such as clay, gravel, sand, soil or rock fines);

- Materials that have been excavated or quarried from areas that are not contaminated with manufactured chemicals or process residues, as a result of industrial, commercial, mining or agricultural activities; and
- Materials that do not contain any sulfidic ores or soils or any other waste;

- Topsoils, growing media, mulch etc. for landscaping purposes must be visually inspected (at source and upon delivery at the Site) for foreign substances, suspicious staining and/or odours;
- Materials that are permitted to be brought onto the Site via an exemption issued under the POEO Act. The requirements of any such exemption, prior to, during and/or after importation of materials must be fully complied with;
- Any materials proposed to be imported to the Site must not contain any of the following:
  - Marine mud, peat, vegetation, timber, organic, soluble or perishable materials,
  - Dangerous or toxic material or material susceptible to combustion;
  - Metal, rubber, plastic or synthetic material or other forms of general rubbish; and/or
  - Construction/demolition debris.

Materials are not to be imported onto the Site until the Environmental Consultant has provided to the Construction Contractor approval. If materials are imported on the Site then their use and placement is to be recorded by the Construction Contractor.

In addition, it is noted that should a recycled product, such as crushed concrete or similar, be imported, then the Environmental Consultant must review the supplier documentation and determine whether sampling of this material is required to be undertaken to confirm its suitability, either at the supplier's site or once it is imported to the Site. Decisions regarding sampling will be made based on the type of product, the supplier and the supplier documentation. Such materials are not be placed onto the Site until the Environmental Consultant has provided to the Construction Contractor approval.

3.5.3 RAC for Off-site Disposal

The RAC applied to materials requiring off-site disposal is that the materials must be classified in accordance with NSW EPA (2014) *Waste Classification Guidelines. Part 1 to Part 4*

3.5.4 RAC for Groundwater Seepage

In the event that groundwaters present in joints, fissures or bedding planes in the sandstone bedrock seeps through the walls and enters such that it accumulates in the resultant excavation, samples will be taken to confirm the condition of the groundwaters. The analytical results of any groundwater seepage sampled will be assessed against the guidelines currently endorsed by NSW EPA.

The guidelines currently endorsed by NSW EPA to assess the quality of groundwater require that in assessing groundwater contamination all environmental values of the groundwater need to be identified and their relevance considered such that appropriate groundwater criteria are selected to assess groundwater quality at a site. NSW DEC (2007) *Guidelines for the Assessment and Management of Groundwater Contamination* states that concentrations of potential contaminants of concern in groundwater at a site must be compared in the first instance against existing generic criteria, if available, which protect environmental values such as drinking water (provided in NHMRC & NRMMC (2013) *Australian Drinking Water Guidelines*) and aquatic ecosystems (provided in ANZG (2018) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*).

Given that the Site is located within a highly urbanised area and that ready access is available to a reticulated, potable water supply system, the potential for groundwater to be used for drinking water or for other beneficial

purposes is currently considered to be negligible. Consequently, the NHMRC & NRMMC (2011) guidelines for drinking water are not considered applicable to the Site and with respect to human use, groundwater immediately down-gradient of the Site is known to be unsuitable for any beneficial purpose. Whilst the waters of the catchment of Double Bay are known to be used for any recreational purposes such as fishing, boating and kayaking, it is likely that any groundwater present would discharge to sandstone aquifers present beneath the waters of Double Bay and as such consideration of groundwater quality with respect to recreational waters and the NHMRC (2008) guidelines for recreational waters are not considered applicable.

The nearest receiver of groundwater discharge that may come from the Site is the deeper areas of Sydney Harbour beyond Double Bay which is a marine environment and as such the groundwater results from this assessment will be compared to the ANZG (2018) Trigger Levels for Fresh Waters. Trigger Levels with a 95% level of species protection are to be adopted. Although a higher level of protection (99%) is recommended for several analytes, the 95% Trigger Level has been adopted due to the highly disturbed nature of the regional groundwater and the waters of Sydney Harbour.

It is noted that the high-reliability trigger level for some analytes for marine environments presented in ANZG (2018) are currently less than the detection limits that can be provided by the analytical laboratories. Consequently, in these instances the laboratory Estimated Quantitation Level (EQL), which is the lowest level of detection that can be routinely achieved by the laboratory and which is sometimes referred to as the "detection limit" of the analytical method is suitable for use as a screening value for concentrations of analytes in groundwater where trigger values provided in ANZG (2018) cannot be applied.

With respect to hydrocarbons neither the ANZG (2018) or the ASC NEPM (2013) provide criteria relevant for the purpose of this assessment. However, the ASC NEPM (2013) does provide groundwater health based screening levels (HSLs) for BTEX, the light to medium fraction TPH compounds and naphthalene, that are applicable to determine the likelihood of vapour intrusion. Similarly, the solubility limits for BTEX and some TPH fractions in groundwater are provided in the ASC NEPM (2013). Both these criteria will be included for the purposes of comparison only.

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4 Remediation Works Contingency Plan (RWCP)

The purpose of the Remediation Works Contingency Plan (RWCP) is to outline procedures for the identification and management of unexpected issues or events that may occur during the remediation works.

4.1 Key Risks

The key risks that have the potential to arise during the remediation works include:

- Unexpected finds; and
- Construction works fail to achieve the remediation criteria and goals.

The contingency measures that will be required to be implemented to ensure that the remediation criteria are met are discussed below.

4.2 Unexpected Finds

The approach for the remediation works set out in this RAP has been developed through a review of the previous investigations and historical activities that have been undertaken on the Site to determine the potential contaminants of concern. However, the possibility remains, albeit low, for unanticipated contamination (i.e. contaminated soil, water or debris) to be encountered.

The nature of residual material and the associated hazards are generally detectable through visual or olfactory means such as:

- Ash or slag contaminated soils not previously identified through visual observation;
- Hydrocarbon impacted materials through staining and odours;
- Construction /demolition associated waste not previously identified through visual observation; and
- Waste material associated with illegal dumping through visual observation.

In the event that one or more of the above mentioned substances are encountered, the following steps should be undertaken:

STEP 1: Immediately cease work and contact the Environmental Consultant.

STEP 2: Construction Contractor personnel to form an exclusion zone through the use of barricading or similar to prevent access and exposure by workers.

STEP 3: Construction Contractor to contact Environmental Consultant (if not already on-site) to arrange for inspection of encountered material.

STEP 4: Environmental Consultant to undertake detailed inspection and sampling and analysis of unexpected material. The sampling density requirements will be determined on-site in accordance with the requirements of the NSW EPA (1995) *Sampling Design Guidelines* and other guidelines endorsed by NSW EPA

STEP 5: Environmental Consultant to assess analytical results against assessment criteria for residential land use with minimal opportunities for access to soils as set out in the ASC NEPM and other relevant guidelines;

STEP 6: Where results exceed the assessment criteria the Environmental Consultant must assess the requirement for further investigation, remediation and/or management and document the outcomes of this assessment in a report.

STEP 7: Where the unexpected material are considered suitable for adopted remediation approach, the material should be managed in accordance with the requirements of this RAP.

STEP 8: Where the unexpected material is not able to be appropriately remediated in accordance with this RAP undertake an assessment of potential remediation options and develop a separate remediation plan to address the requirements of remediation for material.

STEP 9 If deemed required, Environmental Consultant to supervise any active 'remediation' or other rectification/management works if they are required.

STEP 10: Once any rectification/management works are completed Construction Contractor to remove barricades for exclusion zone.

STEP 11: Where required Environmental Consultant to prepare a report to provide to the Proponent on the unexpected find and the works undertaken to rectify/manage the conditions encountered.

4.3 Remediation Works Fail to Achieve Validation Criteria

Where the remediation works and the contingency remediation works result in the objectives of the RAP not being met, the following contingency measures should be implemented:

- Review the results of the validation works;
- Determine the lateral and vertical extent of the failure of the installed remediation measures;
- Determine the requirements for rectification or replacement of the remediation measures in order to achieve the RAC and remediation objectives;
- Document these requirements in a report;
- Mark out the spatial boundaries on-site and communicate the rectification requirements to the Construction Contractor;
- Upon completion of the additional works, undertake validation works in accordance with this RAP or subsequent plan; and
- Where the validation works returns successful results, remediation is considered to have been completed.

4.4 Heritage Items

Cultural heritage sites are easily damaged or destroyed by natural processes such as erosion, as well as disturbance. While it is not possible to prevent the slow destruction of cultural heritage sites, it is possible to prevent unnecessary damage by the implementation of careful work practices.

Due to the location and nature of the Site, there is considered to be low potential for heritage items, to be encountered during the works. However, should potential heritage items be encountered unexpectedly, the following contingency measures should be implemented:

STEP 1: Immediately cease all activities that could in any way interfere with or disturb the encountered site and/or object(s).

STEP 2: Promptly report the discovery to the Proponent who will in turn notify the relevant regulatory authorities. Until further instructions are received:

- DO NOT disturb the Site;
- DO NOT collect any artefacts as this may alter the scientific value;

- DO NOT touch or interfere with painted art as this may cause the pigmentation to deteriorate, and similarly;
- DO NOT touch up painted art or enhance engravings for the purposes of photographs.

STEP 3: Details of the find should be documented by the Construction Contractor including:

- Location of find;
- Person(s) whom encountered the find;
- Time and date of find;
- Description of find including number of objects, shape, colour etc;
- Actions taken; and
- Without touching or interfering with the site and/or objects, obtain photograph for record of find.

5 Remediation Works Environmental Management Plan (RWEMP)

Disturbance of sub-surface environments for the purpose of remediation brings with it the potential of risk to the surrounding environment, associated with migration of contamination off-site or within a site, as well as to site personnel. To ensure the protection of the environment, measures need to be implemented during the remediation of a contaminated site.

The RWEMP to be implemented on the Site during the remediation works is presented in detail below. Where conditions required by Proponent or any development consent contradict what is set out below, the Proponent or the development consent conditions take precedent.

5.1 Site Access and Protection

During the construction works effective site signage and security that will prevent the exposure of the users of the Site to potentially contaminated materials and/or to hazards that may exist during the course of the works and prevent damage to environmental control structures is to be established and maintained by the Construction Contractor. During works, barriers will be installed which will restrict access to the designated works area. Only authorised persons will be able to enter the work area.

5.2 Soil, Sediment and Water Management

The remediation works required to be undertaken on the Site must implement the following general measures:

- Prevent migration of any waters generated during the works, geosocks or similar will be placed around any newly disturbed surfaces/excavated areas where soils are exposed and stockpiled material to prevent sediment and contaminant laden runoff into nearby stormwater drains or surface water bodies;
- Any material which is collected behind the sediment control structures shall be either placed into a designated stockpile or incorporated back into the stockpiled material from which it was generated;
- Storage and stockpiling during construction works must not be located outside the boundaries of the Site;
- Any materials that require disposal off-site will require the Environmental Consultant to conduct appropriate sampling and analysis to determine the requirements for off-site disposal in accordance with NSW EPA (2014) "*Waste Classification Guidelines*" or equivalent. Waste Classification information must be obtained by the Construction Contractor from the Environmental Consultant prior to any soil material or waters being disposed off-site. In addition, the Construction Contractor must provide details of the waste facility where they intend on disposing of the material to the Environmental Consultant for their approval prior to undertaking any disposal works;
- Any excess materials shall be treated and handled as per the requirements outlined in this RAP.

5.2.1 Handling of Contaminated and Potentially Contaminated Materials

The results of previous investigations have identified the presence of fill materials in the surface and sub-surface of the Site that contain and potentially contain asbestos-containing materials (ACM) and PAH compounds.

Any solid or liquid materials excavated from the surface and sub-surface of the Site must be handled with care and in accordance with the requirements set out below. In the event of unexpected contamination, the requirements of Section 4.2 of this RAP are required to be implemented and must be consistent with the guidance provided in this section.

Asbestos Management

Given the presence of asbestos contaminated fill materials in the surface and sub-surface of the Site the Construction Contractor must be appropriately licenced and shall prepare and implement an Asbestos Management Plan (AMP) and/or an Asbestos Removal Control Plan (ARCP) in accordance with the requirements of the Work Health and Safety Act 2011 (WH&S Act) and Safe Work NSW guidelines and codes of practice. NSW Work Health and Safety Regulation 2011 sets out the requirements for working with and removing asbestos. Additional guidance is found in the NSW Government *How to manage and control asbestos in the workplace*. Code of Practice. 2019 and in the NSW Government *How to safely remove asbestos* Code of Practice 2019. Works on the Site must not commence until the AMP and/or ARCP is prepared and provided to Proponent for review and approval.

The AMP and/or ARCP must contain the following:

- Determination of whether the works to be undertaken that involve the disturbance, excavation, transportation, stockpiling and/or placement of materials containing or potentially containing ACM are deemed to be "non-friable" or "friable" works;
- The steps to be undertaken when ground disturbance or excavation works uncover the presence of or potential presence of ACM on the Site and the control measures that will be implemented to prevent release of asbestos fibres and to ensure:
    - The health of neighbouring occupants is being protected;
    - The health of workers are being protected.
    - Health, safety and environmental management controls during excavation, transportation, stockpiling and off-site disposal of materials containing or potentially containing ACM;
    - Waste management practices for asbestos materials;
- An asbestos air monitoring program and dust monitoring program designed to meet the following objectives:
    - Determine if the health of occupants and workers are being protected;
    - Determine if control measures and preventative actions are effective;
    - Determine changes in airborne asbestos fibre levels;
    - Determine if changes to work practices and procedures result in increased levels of airborne asbestos fibre;
    - Promote the implementation of more effective preventative measures; and
    - Assess compliance with workplace and environmental goals.
- It is noted that the AMP and/or ARCP must also contain the following provisions:
    - Water blasting of asbestos-containing material is prohibited;
    - Excavated soils containing or suspected of containing potentially asbestos must not be left unattended. If it is necessary to leave the Site unattended, the fill materials or soils are required to be dampened to prevent generation of dust, and covered or reinstated so that exposure to these materials cannot be gained by casual users of the Site or by neighbouring properties;
    - Any placement and compaction of soils containing or potentially containing asbestos must be undertaken in a manner that mitigates the potential release of fibres. Those contracted to carry out the work must be informed of the dangers involved and the precautions that should be taken. It is the Construction Contractor's responsibility to determine the protocols to be undertaken during placement and compaction

works are appropriate to protect worker health. Such measures must include appropriate dust control, suppression and monitoring; and

5.2.2 Excavation and Stockpiling

Excavation Works

Excavation works are any works that involve the disturbance of the current surface and/or sub-surface of the Site and includes disturbance of fill materials, natural soils and/or sandstone bedrock. It is noted that the works on the Site will involve an extensive excavation program and all resultant excavated materials will require disposal off-site.

Care should be taken by the Construction Contractor during excavation and stockpiling to ensure that soil materials from distinctly different horizons are not mixed and that different types of materials are stockpiled separate from each other in order to maximise the potential beneficial re-use and/or minimise the volumes requiring off-site disposal.

Excavation works will require the Construction Contractor to ensure the following:

- Implementation of necessary environmental protection measures in accordance with the requirements of this RAP; and
- Documenting and recording the works.

Stockpiling Works

During the excavation works on the Site, stockpiles are required to be established in designated areas, to be nominated by the Construction Contractor. All stockpiles will be maintained in an orderly and safe condition according to the requirements of this RAP. The movement of stockpiles will need to be undertaken in accordance with the materials tracking requirements of this RAP.

Care should be taken during excavation and stockpiling to ensure that soil materials from distinctly different horizons are not mixed and that different types of materials are stockpiled separate from each other in order to ensure the most appropriate waste classification of each material type for off-site disposal.

Where stockpiling is required the stockpiling of excavated material will comprise the following:

- Establishment of stockpiles in designated areas;
- Implementation of necessary environmental protection measures in accordance with the requirements of this RAP;
- Documenting the location and observations of stockpiles and any other activities relevant to the works such as:
  - Following the implementation of any environmental control measures; and
  - Following storm/rainfall events to assess the potential for sediment (and contaminant) laden run-off.

5.2.3 Generation of Excess Soils and Waters

The construction works will require excavation of the surface and sub-surface of the Site and all materials generated will require disposal off-site.

It is expected that the excavation works into the sandstone bedrock may intersect jointing planes or fractures in the sandstone and seepage of groundwaters present in these features may enter and accumulate in the resultant excavation. As such it is expected that dewatering of the excavation will be required once the excavation is

advanced well into the bedrock. In addition, any rainfall during excavation and construction works is likely to accumulate at the base of the excavation.

Where excess/accumulated waters are generated on the Site then they will be required to be handled with appropriate PPE as set out in Section 6.5 of this RAP. Large volumes of excess waters are not to be disposed onto unsealed areas of the Site or elsewhere without the Environmental Consultant providing confirmation that the waters are of an appropriate quality for this activity to be acceptable. Any excess waters deemed not appropriate to be disposed onto unsealed areas of the Site or elsewhere must be disposed off-site. Any liquids that require disposal off-site will require the Environmental Consultant to conduct appropriate sampling and analysis to determine the requirements for off-site disposal in accordance with NSW EPA (2014) guidelines or equivalent.

5.2.4 Generation of Acid Sulphate Soils

The Site is located within a local region which is noted to have disturbed terrain to depths of up to 4 metres below existing ground levels. However, given that the Site and surrounding areas are located on and across a sandstone ridge and toe that sits higher than the waters of Double Bay the conditions required for acid sulphate soils to be present on the Site do not exist. The excavation works to be completed on the Site will be well into and within sandstone bedrock and any soils or fill materials present are present above the sandstone bedrock and above any groundwater that may be present at depth in the bedrock. As such there is no potential for acid sulphate soils to be present or able to be formed on the Site.

As such, an acid sulphate soils management plan is not required for the construction works. However, if during construction works, potential acid sulphate soils are encountered then the Construction Contractor is required to notify Proponent to seek advice on how to proceed.

5.2.5 Stormwater and Sediment Control

Stormwater and sediment control is needed to prevent flows of surface water and/or deposition of sediments off-site either onto neighbouring properties and must include the following:

- Installation and maintenance of perimeter control barrier measures along the boundary of the Site. These control measures must be constructed to minimise migration of sediment and waters, primarily as a component of surface run-off into surrounding areas and roadways and to other parts of the Site. These measures should be constructed as silt fences constructed of filter fabric or mesh. Should conditions require it, straw bales may also be needed;
- Installation and maintenance of perimeter control barrier measures around designated stockpile areas and water retention areas for the duration of the works. These control measures must be constructed to minimise migration of soils as sediment and waters, primarily as a component of run-off from the surface of the stockpiles to the surrounding areas of the Site. These measures should be constructed as silt fences constructed of filter fabric or mesh. Should conditions require it, straw bales may also be needed surrounding the stockpiles;
- Perimeter control barriers may require scour protection or similar to divert surface runoff away from the boundaries of the Site. The requirement for such measures is to be determined by the Construction Contractor. Surface run-off generated within the Site will be diverted by a series of bunds into temporary stormwater retention areas to be constructed by the Construction Contractor. These retention areas will be located away from the boundaries of the Site and must be constructed with a minimum storage capacity to contain a 10 year ARI storm event of 6 hours duration, as per the recommendation in the CALM *Urban Erosion and Sediment Control Guideline* (1992) and the '*Blue Book - Managing Urban Stormwater: Soils and Construction*, Landcom (2004). Following completion of the earthworks, the retention areas and associated bund structures are to be assessed by the Environmental Consultant. The Environmental Consultant will collect samples from the floor and walls of the pond and analyse samples for the chemicals of concern.

- All stormwater and sediment control should be checked for damage, regularly and immediately after periods of significant rainfall to ensure their effective functioning. Deposited sediments must be removed by the Construction Contractor and transferred to the designated stockpile area and retained within a separate stockpile to allow for the Environmental Consultant to determine the options for disposal off-site. Accumulated waters outside of the designated stormwater retention areas must be transferred by the Construction Contractor to the retention areas to allow for the Environmental Consultant to determine options for disposal (see Section 5.2.3)

5.2.6 Erosion Prevention and Control

It is noted that the construction works on the Site are assessed as being of low erosion hazard as the majority of the excavation work will be completed into sandstone bedrock. As such general erosion control measures are considered to be adequate to prevent erosion during construction works as follows:

- Where possible ensure that only minimum areas of land are disturbed at any one time and where disturbed surfaces remain unsealed during the works, ensure that they are left with a scarified surface to inhibit soil erosion;
- Ensuring that during periods of high wind, to prevent wind blown soils and dust, that all disturbed areas and stockpiled materials that may create dust are wetted down or covered;
- Ensure stockpiles are:
    - Located only within the designated stockpile area away from the boundaries of the Site;
    - Located on liners or hardstand and any bunding must also be located either within the liner footprint or on hardstand;
    - Formed to be protected from run-on water upslope and with sediment filters immediately downslope to protect areas from runoff from the stockpiles; and
    - Not greater than 3 metres in height and stabilised by covering or hyrdro seeding or spraying if retained for longer than 10 days to minmise runoff and sediment transportation.

All erosion prevention and control measures should be implemented for the duration of the works and where physical controls are installed, they need to be regularly checked and immediately after periods of significant rainfall to ensure their effective functioning.

5.2.7 Dust Control

The Construction Contractor is required to ensure that adequate measures are undertaken to prevent dust from affecting the amenity of the neighbourhood during construction. In particular, the following measures must be adopted:

- Physical barriers to be erected at right angles to the prevailing wind direction or being placed around or over dust sources to prevent wind or activity from generating dust emissions;
- Earthworks and scheduling activities shall be managed to ensure that only minimum areas of land are disturbed at any one time and where disturbed surfaces remain unsealed during the works , ensure that they are left with a scarified surface to inhibit soil erosion;
- Ensuring that during periods of high wind, to prevent wind blown soils and dust, that all disturbed areas and stockpiled materials that may create dust are wetted down or covered;
- Vehicles carrying spoil or rubble to or from the Site shall at all times be covered to prevent the escape of dust or other materials;

- All equipment wheels shall be washed before exiting the Site using manual or automated sprayers and drive through washing bays (if applicable);
- Gates shall be closed between vehicle movements and shall be fitted with shade cloth; and
- Cleaning of footpaths and roadways shall be carried out regularly by manual dry sweep or by use of a cleaning vehicle.

5.2.8 Odour Control

The objective of odour control measures implemented on the Site is to take all practicable measures to ensure that odours emanating from within the Site are minimised such that nuisance odours cannot be detected outside the Site boundaries and the ambient air quality is not adversely impacted.

Odour and air quality is to be managed by the Construction Contractor adopting the following procedures:

- If during excavation works odours are noted to be present the Construction Contractor must notify the Environmental Consultant for an assessment to be undertaken and to determine the response measures which may include the following:
    - Minimising the areas of exposed materials within excavations and covering excavated materials with plastic sheeting, etc;
    - Securely covering loads of contaminated or waste materials leaving the Site ;
    - Where excavations are open to the environment and odours are being generated such that controls are required, setting the area under direct supervision, with mist sprays and where (and if) required movable mist sprays to be set up on the Site boundary fences to provide additional odour suppression;
    - Undertaking excavation activities in favourable weather conditions; and
    - Adequate maintenance of equipment and machinery to minimise exhaust emissions.
- Excavations and stockpiled materials that have been confirmed by the Environmental Consultant to have the potential to emit odour must be monitored with a PID unit (equipped with high intensity lamp) on a regular basis. Section 6.5 of this RAP specifies the PID criteria that would require work to cease and additional protective measures to be implemented.

5.3 Materials Handling and Tracking

The movement of materials within the Site must be tracked and the Construction Contractor is required to prepare a Materials Tracking Plan, in which records of the following must be kept and maintained:

- Any materials imported onto the Site;
- Any movement and placement of materials within the Site; and
- Any materials disposed off-site.

All loading and unloading associated with the construction activity must be accommodated on the Site, unless relevant approvals have been sought by the Construction Contractor from the local council or other relevant authorities.

Transfer of excess materials to the designated stockpiling areas for off-site disposal will occur via the use of an excavator or other appropriate equipment nominated by the Construction Contractor. During the transfer of the materials due care will be taken to ensure that the loads do not exceed the capacity of the vehicles, and that spillages of materials are prevented.

All appropriate site rules shall be observed during the transfer of material including obeying restricted speed limits, vehicles to proceed in a forward direction only (i.e. reversing to be avoided where practicable) and trucks to remain on designated site routes where possible.

Any soils, sediments and excess/accumulated waters encountered during construction works require handling with appropriate Personal Protection Equipment (PPE) as set out in Section 6.5 of this RAP.

The Environmental Consultant will determine the options for either beneficial re-use or disposal off-site of stockpiled materials. Materials sourced from different areas of the Site or from different sources on the Site must be subject to segregated stockpiling to ensure that contaminated materials are not mixed with uncontaminated materials. The segregation of stockpiled materials is to be managed by the Construction Contractor and assessed by the Environmental Consultant. Where sediments are required to be stockpiled, these materials must be kept separate from materials generated from land-based works and are to be classified by the Environmental Consultant for the purpose of off-site disposal

Any excess/accumulated waters are not to be disposed onto unsealed areas of the Site or elsewhere without the Environmental Consultant providing confirmation that the waters are of an appropriate quality for this activity to be acceptable. Any excess/accumulated waters deemed not appropriate to be disposed onto unsealed areas of the Site must be disposed off-site.

Any materials (solid or liquid) that require disposal off-site will require the Environmental Consultant to conduct appropriate sampling and analysis to determine the requirements for off-site disposal in accordance with NSW EPA (2014) guidelines or equivalent. Waste Classification information must be obtained by the Construction Contractor from the Environmental Consultant prior to any material being disposed off-site. In addition, the Construction Contractor must provide details of the waste facility where they intend on disposing of the material to the Environmental Consultant for their approval prior to undertaking any disposal works.

Details of any off-site disposal of soil or other materials from the Site during the construction works, including disposal dockets and consignment information, will be required to be recorded by the Construction Contractor in the Materials Tracking Plan and must be provided to the Environmental Consultant and PHF.

5.4 Waste Management

5.4.1 Waste Stream Management and Handling

The Construction Contractor is responsible for the management and handling of the different waste streams that may be generated during the works on the Site.

Materials sourced from different areas of the Site or from different sources on the Site must be subject to segregated stockpiling to ensure that contaminated materials are not mixed with uncontaminated materials. The segregation of stockpiled materials is to be managed by the Construction Contractor and assessed by the Environmental Consultant.

5.4.2 Waste Classification and Disposal

As detailed in previous sections, materials excavated from the Site will require disposal off-site. In addition any materials (solid or liquid) that are deemed by the Environmental Consultant to require disposal off-site must be disposed off-site. The Environmental Consultant mustconduct appropriate sampling and analysis to determine the requirements for off-site disposal in accordance with NSW EPA (2014) guidelines or equivalent.

Any materials (solid or liquid) that require disposal off-site will require the Environmental Consultant to conduct appropriate sampling and analysis to determine the requirements for off-site disposal in accordance with NSW EPA (2014) guidelines or equivalent. Waste Classification information must be obtained by the Construction Contractor from the Environmental Consultant prior to any material being disposed off-site. In addition, the

Construction Contractor must provide details of the waste facility where they intend on disposing of the material to the Environmental Consultant for their approval prior to undertaking any disposal works.

Details of any off-site disposal of soil or other materials from the Site during the construction works, including disposal dockets and consignment information, will be required to be recorded by the Construction Contractor in the Materials Tracking Plan and must be provided to the Environmental Consultant and Proponent.

5.5 Imported Materials

Materials to be imported onto the Site by the Construction Contractor for the purposes of achieving RLs, re-instatement, establishing a suitable sub-grade for pavement or landscaping or similar must be subject to assessment by the Environmental Consultant to determine whether certification documentation supplied with the materials is deemed to appropriate or whether confirmation sampling and analysis is required in accordance with the RAC set out in Section 3.5.2.

Materials are not to be imported onto the Site until the Environmental Consultant has provided to the Construction Contractor approval. If materials are imported on the e Site then their use and placement is to be recorded in the Materials Tracking Plan.

5.6 Complaint Reporting and Resolution

Complaints from any parties will be directed initially to the Construction Contractor. Following that, discussion with PHF and the complainant will investigate the issue and remedy it as required or applicable. The Construction Contractor is required to keep a detailed record of any complaints received and their resolution.

6 Work Health and Safety Plan

The Construction Contractor is required to prepare a Work Health and Safety Plan for the works on the Site, including the remediation works, in accordance with the relevant requirements of the Work Health and Safety Act 2011 (WH&S Act), its associated regulations and Safe Work NSW guidelines and codes of practice.

The Work Health and Safety Plan (WHS Plan) to be implemented by the Construction Contractor during the works must, at a minimum, contain the procedures and requirements set out below to ensure that all workers on the Site perform their duties in a safe manner.

Given that the works on the Site will require the disturbance and handling of asbestos contaminated fill materials, the WHS Plan must refer and include, where necessary, the requirements of the Asbestos Management Plan (AMP) and/or Asbestos Removal Control Plan (ARCP).

6.1 Objectives

The objectives of the WHS Plan is to ensure that all workers on the Site are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner.

These objectives will be achieved by the WHS Plan being prepared to include:

- Assignment of responsibilities;
- An evaluation of hazards;
- Establishment of personal protection standards and mandatory safety practices and procedures; and
- Provision for contingencies that may arise while operations are being conducted at the Site.

All parties working on the Site shall comply with all applicable Work Health and Safety legislation, regulations, codes and guidelines.

6.2 Responsibilities

Roles and responsibilities during the construction and remediation works on the Site are described in the table below.

Table 1: Roles and Responsibilities

Role	Responsibilities
Construction Contractor	Responsible for preparation of the WHS Plan Responsible for ensuring that the Asbestos Management Plan (AMP) and/or Asbestos Removal Control Plan (ARCP) is prepared in accordance with the relevant regulations. Responsible for the day to day implementation of the WHS Plan in all phases of work. Responsible for the day to day implementation of the AMP and/or ARCP during the phases of works that involve ground surface disturbance works or handling of excavated materials that contain or potentially contain asbestos.

Role	Responsibilities
	Ensure that any required modifications to the WHS Plan are noted, communicated to all project staff and are implemented. Ensure contractors are suitably qualified and safe work method statements have been supplied and approved prior to commencing works on the Site. Inductions for personnel and contractors in accordance with the Site-specific Induction requirements. Provision of copy of the WHS Plan and AMP and/or ARCP to relevant stakeholders Ensure that appropriate Personal Protective Equipment (PPE) is worn. Report any incidents or accidents as soon as possible.
Sub-contractors/Environmental Consultant	Ensure they are familiar with the requirements of the e Site-specific Induction and WHS Plan before commencing works on the Site Responsible for abiding by the WHS Plan. Provide SWMS's for work to be undertaken as required by the WHS Plan Ensure they are suitably qualified and trained to complete the tasks required including operation of equipment. Ensure the on-site activities and deliverables conform to the WHS Plan. Ensure that appropriate PPE is worn. Report any incidents or accidents to Construction Contractor as soon as possible. Sub-Contractors should demonstrate to the Construction Contractor appropriate WHS knowledge and performance, be able to identify risks associated with the work they are doing and provide suitable work methods to minimise the risks to themselves and others.

6.3 Anticipated Hazards

The anticipated onsite hazards are provided in the table below:

Table 2: Anticipated On-Site Hazards

	Chemical		Physical		Biological
✔	Dusts		Pressure		Rats, rodents, dogs
	Mists	✔	Temperature		Poisonous plants
	Fumes	✔	Heat Stress	✔	Insects
	Gases		Cold Stress		Microbes, viruses, bacteria
	Vapours	✔	Noise+Vibration		Snakes
	Liquids		Oxygen deficiency		Sanitation
	Sludge	✔	Fire	✔	Other
✔	Solids		Engulfment		
✔	Unspecified materials	✔	Crushed/run over		
✔	Other: Asbestos contamination in soils comprised of ACM and FA/AF				

	Ergonomic		General Safety
✔	Stress	✔	First aid
✔	Fatigue	✔	Access / egress
	Driver Fatigue	✔	Trenching / shoring
✔	Biomechanics (i.e., pushing, pulling, carrying, hand tools)		Services not cleared
	Work place design	✔	Walking surfaces (uneven ground, holes, ditches)
	Other		Unstable stacking or storage
		✔	Sharp objects (i.e., nails, glass, metal, etc.)
		✔	Slippery surfaces (trips)
		✔	Wet surfaces (trips and falls)
		✔	Electrical (underground/overhead)
		✔	Materials handling (manual handling)
		✔	Heavy equipment
		✔	Machinery (moving parts)
		✔	Moving Plant Equipment
		✔	Poorly visible supports
		✔	Underground utility services
		✔	Other (fire extinguisher)

6.4 Potential Hazards and Prevention

The anticipated hazard prevention is provided in the table below. Any accidents or near misses will be reported in accordance with the WHS Plan.

Table 3: Potential Hazards and Prevention

Hazard	Prevention
Use of mobile phone whilst driving	Personnel will be prohibited from using a mobile phone or hands free device whilst driving and/or operating machinery.
Potentially contaminated soil or surface water coming into contact with skin	Wear gloves and long sleeve clothing. Wash hands before eating, smoking, drinking and leaving Site.
Inhalation and/or ingestion of contaminated soil or surface water.	Undertake all works in accordance with AMP and/or ARCP requirements including use of PPE Wear gloves when sampling. Wash hands after sampling complete and/or before handling food. If odours are significant but not dangerous for comfort use appropriate PPE – half face respirators with organic filters – see Section 6.5
Heavy Machinery and Plant	See Sub- Contractors Safe Work Method Statements
Site Traffic (Movement of Plant/Equipment)	An exclusion zone will be set up around any sedentary work area to protect the safety of the work party.
Noise	Use noise attenuation equipment and as necessary provide silencers on noisy equipment. All Site personnel will carry earmuffs or plugs for use during excessive noise.
Manual Handling and Lifting	Heavy loads are not to be lifted alone. If possible use mechanical aids. When handling rough jagged or sharp objects use gloves or hand tools.
Fatigue	Regular breaks, use equipment where possible to reduce heavy physical labour.
Contact with contaminated soils	Undertake all works in accordance with AMP and/or ARCP requirements including use of PPE Environmental Consultant working at the Site must have training in handling asbestos contaminated soil samples. All staff are aware about the human health and ecological risks posed by the contaminants. Appropriate PPE will be worn while in contact with contaminants.
Contact with fire and explosion	Access to fire fighting equipment at the e Site will be identified during the Site-specific induction to be provided by the Construction Contractor. All field staff PPE is rated for fire protection.

6.5 Personal Protective Equipment

Personnel working on the Site must wear PPE that is specified by the Construction Contractor in their WHS documentation and as specified in the AMP and/or ARCP when works are being undertaken that involve the disturbance or handling of asbestos containing soils.

In addition, the following PPE is required to be worn when in the vicinity of operational machinery or when in contact with soil/water:

- Long Sleeved shirt and Long Pants;
- Safety glasses;

- Gloves.

If during works, particularly during excavation works, unusual or unexpected odours are noted by any personnel, the Environmental Consultant must be notified and a PID monitor must be made available on-site to monitor the breathing zone of site personnel. Should the results of monitoring indicate a potential issue a half–face respirator fitted with relevant organic chemical filters and coveralls/tyvex (chemical resistant) must be made available for use in the event that significant contamination/odours are encountered. If the MUL Action levels and PPE requirements for benzene (most conservative and PID measures benzene equivalents) as presented in the table below are to be applied as a minimum within the breathing zone during the works.

Table 4: MUL Action Levels for Benzene Equivalents

Chemical Hazards:	Risk: H - High M - Med L - Low	TWA (ppm)	STEL (ppm)	MUL Action levels (75% safety margin worked into MUL)				LEL (%)
				No APR	½ face APR	full face APR	IDLH reached	
☒ Benzene	L	0.7	2.5[(a)]	3	26	53	1000	5
Max Use Limit (MUL) = (Protection Factor x Exposure Limit) x 75% ** PF= 10 for ½ face, 50 for full face, 10000 for SCBA (a). No Occupational Exposure Standard exists as an STEL. This is calculated to be a maximum of 2.5 times the unadjusted TWA of 1 TWA Concentrations are based on a maximum 10 hr day								

6.6 Emergency Response

The WHS Plan shall detail the emergency response procedures and will be restated prior to commencing works. In addition to the procedures outlined in the WHS Plan in the event of an emergency personnel will follow the emergency response procedures described below:

- Remain calm;
- Assist persons in immediate danger if safe to do so;
- Retreat to a safe distance;
- Raise the alarm – call '000' in the event of fire, spill or medical emergency;
- Shut down ignition sources / remove power supply if safe to do so;
- Provide first aid to injured parties if trained and safe to do so;
- In the event of fire, use fire extinguisher if trained and safe to do so; and
- Notify project manager / director, client and complete incident report form.

7 Validation Plan

The purpose of the Validation Plan is to develop a framework for the validation of the remediation works completed on the Site and includes the data quality objectives, sampling and analytical plan, sampling methodology and quality control/quality assurance procedures to be adopted for the validation works.

7.1 Data Quality Objectives

In determining the type, quantity and quality of data needed to support decisions relating to the validation of the works completed on the Site, the seven-step DQO approach has been undertaken in accordance with Appendix B of Schedule B2 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC, 2013) (the NEPM). The DQO's are presented below.

7.1.1 Step 1 State the Problem

Merman Investments are proposing the redevelopment of the Site for a medium density residential apartment building. The development comprises a multi-storey building, basement levels for parking and plant rooms and landscaping at the frontage and rear of the building. The Site currently contains a multi-storey residential apartment building that was constructed with no basements at sometime between the 1920s and 1930s. A steeply terraced sandstone ridge is present across the north-western area of the Site and the ground floor of the building sits at the base of this cliff face which then slopes down to the road. Garages are present at the road level with the frontage of the building located on top of the garages. The building footprint together with the sandstone cliff occupies the majority of the area of the Site. Some minimal garden beds and landscaping areas are present at the northern side and frontage of the current building above the garages and some of the higher sandstone terraces contain some vegetation. The current layout of the Site is shown on Figure 2.

Recent investigations have identified the presence of shallow fill materials within the landscaped areas present above the garages at the front the Site that contained asbestos containing materials (ACM) and concentrations of polycyclic aromatic hydrocarbons (PAHs) that were greater than the criteria for medium density residential land use. The investigation works indicated the potential for these fill materials to extend beneath the existing building to depths of up to 2 to 3 m beneath the building. However, it is noted that as the majority of the Site area is occupied by the terraced sandstone ridge and the building footprint, areas in which intrusive investigations could be completed were limited and that these physical constraints preclude the opportunity for further investigations to be conducted.

The previously identified presence of contaminated fill materials and the potential for contaminated fill materials to be present beneath the building maybe likely to render the Site not suitable for medium density residential land use. The physical constraints that preclude further investigations at this time, means that the results of the limited investigation have been relied upon to provide an assessment that, as part of the redevelopment of the Site, in order to ensure that the Site is suitable for ongoing medium density residential land use, remediation is required.

Given that the redevelopment of the Site requires large scale excavation and removal off-site of surface and sub-surface materials present across the Site to the required lateral and vertical extent of the proposed basement levels, remediation of contaminated and potentially contaminated fill materials at the Site will be achieved by these works. As such the approach to the remediation and validation works on the Site is via excavation, off-site disposal of excavated materials and the adoption of a validation plan to demonstrate that the Site is suitable for medium density residential land use.

Validation is required to confirm that the excavation works have removed all contaminated and potentially contaminated fill materials and that the resultant excavation surfaces are not contaminated or potentially contaminated. The purpose of this validation plan is to set out the requirements to validate the successful implementation of the remediation strategy for the Site.

7.1.2 Step 2 Identify the Decisions

The decisions to be made in order to validate the works on the Site are as follows:

- Confirm that the works have been undertaken in accordance with this RAP;
- Confirm the requirement, if any, for additional data to determine and support validation;
- Assess the success of the remediation works, including the validation of the resultant excavation surfaces;
- Assess the condition of any groundwater seepage into the resultant excavation to confirm the conditions and confirm that no groundwater remediation is required; and
- Confirm whether the validation field and analytical results meet the validation criteria (RAC), where required.

7.1.3 Step 3 Identify Inputs to the Decisions

The inputs required to make the above decisions are as follows:

- Appropriate guidelines endorsed by NSW EPA or as set out in the RAP;
- Land use;
- Remediation objectives;
- Records of inspections conducted during the works;
- Collection and analysis of soil samples to determine waste classification of the different soil and rock types that will require off-site disposal;
- Records of validation inspections of resultant excavation surfaces;
- If validation inspections identify visual evidence of potential contamination such as retained fill materials, potential asbestos containing materials, building wastes, other wastes, staining, odours, sheens or non-aqueous phase liquids the collection of samples of resultant excavation surfaces will be undertaken to provide validation or to inform the requirement for further remediation excavation;
- If groundwater seepage enters the resultant excavation then collection of groundwater seepage samples will be undertaken to confirm groundwater conditions and that no remediation is required;
- Collection of soil samples from any imported materials for analysis to determine suitability for importation and use on the Site;
- Results of Registered Survey works;
- As-built descriptions and drawings; and
- Determination of whether the remediation works have been successfully completed by demonstrated satisfaction of the remediation objectives.

7.1.4 Step 4 Define the boundaries

The boundaries of the validation works have been identified as follows:

- Spatial boundaries –the boundary of the Site as set out in the plans in Appendix A;
- Vertical boundaries –the depth of the resultant excavation for the construction of the building;

- Temporal boundaries – the temporal boundary is limited to the data collected during the remediation works and validation works, however, the results of the previous investigations will be referred to and utilised where relevant; and
- Constraints within the study boundaries – The following issues present limitations upon the validation strategy for the Site:
    - Unexpected finds during the remediation works.

7.1.5 Step 5 Develop a Decision Rule

The decision rules for the validation of the remediation works are as follows:

a. The as-built descriptions, drawings and survey plans of the completed Site are required to meet the specifications set out in the plans provided as Appendix A and the requirements of this RAP;

b. The results of any sampling, analysis, monitoring and/or other data collection must meet the requirements of this RAP;

c. If the validation works do not meet the criteria set out in this RAP, the requirement for contingency works will be considered in accordance with the requirements of the RAP.

7.1.6 Step 6 Specify Limits on Decision Errors

The minimum acceptable limits on decision errors to be applied in the validation works and the manner of addressing possible decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness and are presented in Section 7.5.6 of this RAP.

The potential for significant decision errors are to be minimised by:

- Completing an assessment of the constructed development to determine whether the decisions set out in Step 3 for these measures have been met;
- Completing a robust QA/QC assessment of the validation data and application of the probability that 95% of data will satisfy the DQIs, therefore a limit on the decision error will be 5% that a conclusive statement may be incorrect;
- Ensuring that, where required, an appropriate inspection, monitoring, sampling and analytical density is applied for the purposes of demonstrating required outcomes; and
- Ensuring that the criteria set for the validation works are appropriate.

The potential for significant decision errors are to be minimised by completing a robust QA/QC program and by completing a validation program that has an appropriate inspection, monitoring and sampling and analytical frequency for the purposes of the validation works.

7.1.7 Step 7 Develop the Plan for Validation

The design of the validation plan is based on satisfying the remediation objectives. The validation works are required to confirm that the remediation works set out in this RAP have been completed successfully. The sections below set out the works to be undertake in order to demonstrate satisfaction of the remediation objectives.

7.2 Validation Approach

Validation works are required to demonstrate the success of the remediation works completed on the Site and to confirm the achievement of the objectives of the remediation works. As such the validation approach for the Site will involve the following:

- The excavation works required for the construction of the redevelopment in accordance with the detailed plans provided as Appendix A to this RAP and the requirements of this RAP;
- The completion of a program of inspections and recording of the excavation and construction works on the Site by the Environmental Consultant;
- The completion of a program of validation inspections of the resultant excavation surfaces by the Environmental Consultant prior to the commencement of construction works on the Site;
- A program of sampling and analysis of materials (liquid and/or non-liquid) that require disposal off-site;
- If required, a program of sampling and analysis of materials at the resultant excavation surfaces if validation inspections identify potential for contamination to be present;
- If required, a program of sampling and analysis of groundwater seepage into the resultant excavation to provide an assessment of groundwater conditions and confirm no requirement for remediation;
- A program of validation/certification of imported materials required for the construction works;
- The compilation of Registered Survey, inspection results and records, materials tracking and as-built plans for the construction works completed.

7.3 Validation Criteria

The validation criteria to be applied in set out as the RAC as presented in Section 3.5 and is summarised in the table below.

Table 5: Summary of Validation Criteria – Remediation Acceptance Criteria

Works	Validation Criteria		Detail Information
Validation Inspections	Visual Evidence of the absence of potential for contamination such as retained fill materials, potential asbestos containing materials, building wastes, other wastes, staining, odours, sheens or non-aqueous phase liquids	Registered Survey of lateral and vertical extent of resultant excavation Material tracking register to document off-site disposal of materials Photographic evidence	Section 3.5.1
Where Validation Inspections cannot confirm successful remediation Validation Samples collected.	ASC NEPM -HIL B	Arsenic – 500 mg/kg Cadmium – 150 mg/kg Chromium (VI) – 500 mg/kg Copper – 30 000 mg/kg Lead – 1200 mg/kg Mercury – 120 mg/kg Nickel – 1200 mg/kg	Section 3.5.1

Works	Validation Criteria		Detail Information
		Zinc – 60 000 mg/kg Carcinogenic PAHs – 4 mg/kg Total PAHs – 400 mg/kg DDT+DDE+DDD – 600 mg/kg Aldrin and Dieldrin – 10 mg/kg Chlordane – 90 mg/kg Endosulfan – 400 mg/kg Endrin – 20 mg/kg Heptachlor – 10 mg/kg HCB – 15 mg/kg PCBs – 1 mg/kg	
	ASC NEPM – HSL B CLAY - 0m- <1 m	Toluene – 480 mg/kg Ethylbenzene – Not Limiting Xylenes – 110 mg/kg Naphthalene – 5 mg/kg Benzene – 0.7 mg/kg F1 – 50 mg/kg F2 – 280 mg/kg	
	CLAY - 1m- <2 m	Toluene – Not Limiting Ethylbenzene – Not Limiting Xylenes – 310 mg/kg Naphthalene – Not Limiting Benzene – 1 mg/kg F1 – 90 mg/kg F2 – Not Limiting	
	ASC NEPM – HSL for Asbestos – Residential B	Bonded ACM – 0.04% FA and AF – 0.001% All Asbestos – No visable asbestos for surface soils	
Imported Materials	VENM	Must satisfy the criteria stated in NSW EPA (2014) and NSW EPA (2017) guidelines and be demonstrated to be: • Natural material (such as clay, gravel, sand, soil or rock fines); • Materials that has been excavated or quarried from areas that are not contaminated with manufactured chemicals or process residues, as a result of industrial,	Section 3.5.2

Works	Validation Criteria		Detail Information
		commercial, mining or agricultural activities; and • Materials that do not contain any sulfidic ores or soils or any other waste.	
	Topsoils, growing media, mulch etc for landscaping	Must be visually inspected (at source if required and upon delivery at the Site) for foreign substances, suspicious staining and/or odours.	
	Exemption under POEO Act	Materials that are permitted to be brought onto the Site via an exemption issued under the POEO Act. The requirements of any such exemption, prior to, during and/or after importation of materials must be fully complied with	
	All Imported Materials	Must not contain any of the following: • Marine mud, peat, vegetation, timber, organic, soluble or perishable materials, • Dangerous or toxic material or material susceptible to combustion; • Metal, rubber, plastic or synthetic material or other forms of general rubbish; and/or • Construction/demolition debris.	
Where groundwater seepage enters resultant excavation in bedrock then samples collected	ANZG (2018)	Arsenic – 24 µg/L Cadmium – 0.2 µg/L Chromium– 3.3 (CrIII) µg/L Copper – 1.4 µg/L Lead – 3.4 µg/L Mercury – 0.06 µg/L Nickel – 11 µg/L Zinc – 8 µg/L Carcinogenic PAHs – 0.1 µg/L (Benzo (a) pyrene)	Section 3.5.4

Works	Validation Criteria		Detail Information
		PAHs – 0.01 µg/L (Anthracene) 1 µg/L (Fluroanthene) 1 µg/L (Fluroanthene) 0.6 µg/L (Phenathrene) DDT– 0.006 µg/L Endosulfan – 0.03 µg/L Endrin – 0.01 µg/L Xylenes – 200 µg/L (m&p) 200 µg/L (o) Naphthalene – 16 µg/L Benzene – 950 µg/L	

7.4 Scope of Validation Works

The scope of work that is required to be undertaken during validation of the remediation work comprises the following:

- Inspection and recording of the excavation and construction works on the Site;
- Completion of waste classification assessments for all materials requiring disposal off-site and provision of approval of designated waste facilities for disposal of materials from the Site prior to the commencement of disposal works;
- Validation inspections and sampling (if required) of resultant excavation surfaces and any groundwater seepage waters prior to commencement of construction works on the Site;
- Documentation of resultant excavation vertical and lateral extent via Registered Survey;
- Assessment of the suitability of materials to be imported onto the Site for use during construction works;
- Receipt and review of materials tracking and off-site disposal documentation, detail design drawings of the works completed from the Construction Contractor;
- Preparation of a Validation Report

7.5 Validation Sampling, Analytical and Quality Plan

The Validation Sampling, Analytical and Quality Plan (VSAQP) for the remediation and validation works has been developed based on the objectives of the remediation and with respect to the DQOs, the surface and sub-surface conditions on the Site and the requirements of the remediation works set out in this RAP. The VSAQP will be implemented by the Environmental Consultant.

The VSAQP includes the inspection program, the validation sampling and analytical plan and the specific quality assurance and quality control measures to be undertaken during the works is presented in detail below.

7.5.1 Inspection Program

Periodic inspections are required to be undertaken by the Environmental Consultant after completion of the demolition works and prior to the commencement of any excavation works and then during all stages of the excavation and constructions works, with higher frequency inspections to be undertaken during the initial stages

of the excavation works to undertake any required waste classification works and to provide confirmation that the works are being undertaken in accordance with the requirements of this RAP.

Validation inspections will then be required to be completed once the excavation works are completed and the resultant excavation surfaces are available for thorough visual inspections, including the walls and base of the excavation.

Record of the inspections will be via the completion of field notes and a photographic record.

7.5.2 Sampling Plan

The validation monitoring and sampling program will be applied to the following media during the works:

- Materials (liquid and non-liquid) to be disposed off-site;
- Materials that are present on the resultant excavation surfaces of the Site that are considered to potentially contain contamination;
- Groundwater seepage waters that may enter the resultant excavation through the walls or base of the exposed sandstone bedrock; and
- Materials to be imported onto the Site.

7.5.3 Validation Sampling Plan Works

Materials to be disposed off-site

Materials generated during the excavations across the Site will require disposal off-site. Fill materials and natural soils must be sampled and analysed at a rate of one per 50 m^3 or as appropriately justified by the Environmental Consultant. The results must be compared to the criteria presented in Section 3.5.3 to determine the waste classification for off-site disposal.

Sandstone bedrock materials to be generated will at a minimum require visual inspections to determine if the materials can be pre-classified as VENM or whether sampling will be required in order to achieve a VENM classification or to achieve a classification under an appropriate and applicable NSW EPA Resource Recovery Exemption. The sampling and analytical density to be applied to the sandstone bedrock would be determined by the results of visual inspections or the requirements of the relevant exemption.

Excess waters generated during the works that are determined require disposal off-site as liquid waste must be sampled and analysed in accordance with the requirements of the liquid waste receiving facility to be determined by the Environmental Consultant during the works.

Materials present on the resultant excavation surfaces on the Site

Materials present on the resultant excavation surfaces of the Site that have been deemed by the Validation Inspections to potentially contain contaminated materials will be subject to sampling by the Environmental Consultant. The sampling is required to be undertaken to ensure that representative samples of the potentially contaminated materials present are collected such that validation of these materials can be achieved. Given the history of the Site it is considered unlikely that any sampling will be required, however, if it is required the Environmental Consultant will complete sampling on a general grid based pattern across the area which is potentially affected and the density applied will provide a higher level of confidence for detection of hot-spots than required under the NSW EPA (1995) *Sampling Design Guidelines* for an 800 m^2 site. It is noted that if wall or base samples are collected the area of the wall or base will also be utilised to determine the required sampling density. Samples will be collected on the surface and near surface of the area or as determined by the Environmental Consultant.

Groundwater Seepage present on resultant excavation surfaces on the Site

If groundwater seepage is present and able to be collected as a discrete sample then this will be undertaken by the Environmental Consultant during and/or at the completion of the excavation into the sandstone bedrock. If multiple seepage points are present and generating sufficient waters for sampling then the Environmental Consultant will make an assessment and determine the number of seeps required to be sampled to be representative of the groundwaters entering the Site.

Materials Imported onto the Site

Materials proposed to be imported onto the Site must be subject to assessment by the Environmental Consultant to determine whether confirmation sampling and analysis is required or whether documentation supplied with the materials is deemed to appropriate. If confirmation sampling is required it would be conducted as follows:

- VENM proposed to be imported will be sampled and analysed a rate of 1 per 250 m^3;
- Recovered Aggregates proposed to be imported will be sampled and analysed at the frequency and for the suite of analytes required by the specific resource recovery exemptions that apply to that material; and
- Non-VENM material (such as topsoils, growing media, mulch etc.) will be sampled and analysed at a rate of 1 per 250 m^3.

The materials imported to the Site must meet the validation criteria presented in Section 3.5.2. If the results of sampling and analysis indicate that the materials are suitable for importation onto the Site then the Environmental Consultant is to provide this information to the Construction Contractor. If materials are imported on the Site then their use and placement is to be recorded by the Construction Contractor.

As stated in above, if the imported material sampling/analyses has not been conducted by the Environmental Consultant or in strict accordance with the requirements set out above then documentation that verifies the suitability of the materials as they are received at the Site must be provided to the Environmental Consultant to accept as appropriate prior to their placement on the Site.

7.5.4 Field Methodology

Inspections

The program of inspections will be conducted by the Environmental Consultant and records must be kept to document the supervision and inspection works undertaken. These records must include the following:

- Purpose of the Inspection and Scope of Works completed during the inspection;
- Photographs of the works being conducted and/or the area or subject of the inspection;
- Description of the conditions of the sub-surface (where exposed);
- Detailed description of works being conducted and/or the area or subject of the inspection;
- Detailed description of any identified unexpected contamination or degraded conditions; and
- Field personnel, date, time, weather conditions.

The results of this program of inspections and the records kept will be included in the Validation Report. If the results of the inspections identify unexpected conditions then the requirements of the contingency plan in this RAP will be implemented.

Sampling

Sampling conducted as part of the validation works will be undertaken in accordance with the methodology set out in the table below.

Table 6: Sampling Methodology

Activity	Details
Soil/Rock Sampling for Validation	Sampling locations will be completed via a hand trowel or similar. Samples will be collected from the surface at 0-0.1 m bgs and then, if required, at regular intervals to the base of any potential contamination. Samples will be collected by a hand protected by nitrile gloves. A clean pair of disposable gloves will be worn to collect each sample. The samples will be collected into containers as follows: - Samples for chemical analysis in laboratory-supplied 150 mL glass jars with lids, which will be carefully filled to minimise the amount of headspace in the sample jars; - Samples for asbestos field screening and/or analysis, one 10 L and one 0.5L samples shall be placed into clean buckets.
Soil Sampling for Importation	Imported material samples will be collected directly from the source/supplier of the material (either from the near-surface or from stockpiles or similar, but at a minimum of 10 cm below the surface) by hand protected by a disposable nitrile glove or as required by the applicable resource recovery exemption. A clean pair of disposable gloves will be worn to collect each sample. The samples will be collected into containers as follows: - Samples for chemical analysis in laboratory-supplied 150 mL glass jars with lids, which will be carefully filled to minimise the amount of headspace in the sample jars; - Samples for asbestos analysis -one 0.5L samples shall be placed into single use laboratory supplied snap locked bags
Soil Sampling for Off-site disposal	Samples will be collected directly from the stockpile of the material (either from the near-surface or from stockpiles or similar, but at a minimum of 10 cm below the surface) by hand protected by a disposable nitrile glove. A clean pair of disposable gloves will be worn to collect each sample. The samples will be collected into containers as follows: - Samples for chemical analysis in laboratory-supplied 150 mL glass jars with lids, which will be carefully filled to minimise the amount of headspace in the sample jars; - Samples for asbestos field screening and/or analysis, one 10 L and one 0.5L samples shall be placed into clean buckets.
Field Screening	**Asbestos Screening** Soil samples collected for asbestos screening and analysis must include the collection of a 0.5 L and 10L sample from each sampling location. In accordance with the WA DoH (2009), the 10 L sample shall be screened manually on-site through a < 7 mm sieve or spread out for inspection on a contrasting colour material (recommended for FA) and: - If ACM is identified at greater than 7 x 7 mm the pieces from each 10 L sample will be placed in a sealed plastic bag and sent to a laboratory NATA accredited

Activity	Details
	for weighing and asbestos analysis. Where the soils are being assessed for suitability for use on the Site, the remaining 10L sample will also be sent to a laboratory NATA accredited for weighing and asbestos analysis; - If ACM is not identified at greater than 7 x 7 mm but where observations during screening identify potential ACM (<7mm) and FA the 10L sample shall be sent to a laboratory NATA accredited for weighing and asbestos analysis; - If ACM is not identified at greater than 7 x 7 mm and where observations during screening do not identify the potential for ACM (<7mm) and FA to be present the 10 L sample shall be retained and not analysed, however, the 0.5 L sample for this location will be sent to a laboratory NATA accredited for weighing and asbestos analysis. If the results of the analysis of the 0.5 L sample identify the presence of asbestos, consideration must be given to conducting analysis of the 10L sample for asbestos.
Groundwater seepage samples	Sampling of groundwater seepage will be collected directly from the seepage point on the sandstone face using laboratory supplied unpreserved plastic bottle attached to an extendable pole or direct by hand protected by nitrile gloves using a dedicated unpreserved bottle. Samples will be collected into the following laboratory prepared and supplied bottles: 2 x 40mL glass vials preserved with HCl; 1 x 250 mL unpreserved plastic bottle; 1 x100mL plastic bottle preserved with HNO3; 1 x 100mL plastic bottle preserved with NaOH; 1x 100ml plastic bottle preserved with H2SO4; 1 x 500mL amber glass bottle, unpreserved. Samples for dissolved heavy metal analysis (100mL plastic bottle preserved with HNO3) will first be field filtered through 0.45 µm filters and then transferred directly into appropriately preserved laboratory supplied bottles. New single-use nitrile gloves will be used at each well.
Sample Labelling, Storage and Transport	Sample jars and bottles will be clearly labelled with unique identification numbers consisting of the date, sample location, depth of sample (for soil samples only) and sampler's initials. In the case of field intra-laboratory and inter-laboratory duplicates, sample containers will be labelled so as to not reveal their purpose or sample location to the laboratory. Samples for chemical analysis will be kept chilled in an ice-filled esky prior to dispatch and during transport to the NATA registered laboratory under chain-of-custody procedures. Samples for analysis for asbestos will be kept in an esky or other secure container prior to dispatch and during transport to the NATA registered laboratory under chain-of-custody procedures.
Decontamination	During the soil sampling works the following equipment may need to be decontaminated: - Stainless steel trowel or similar; and/or - Excavator bucket No other re-useable sampling equipment is proposed to be used during the soil sampling. Decontamination procedures will be performed before initial use and after each subsequent use. The stainless steel trowel and other re-useable sampling equipment

Activity	Details
	will be decontaminated using pressurised water cleaner between each well location. Re-usable sampling equipment will be decontaminated between each sample location by scrubbing with a solution of Decon 90 (a phosphate-free detergent) followed by a rinse in potable water. For each day of sampling, following decontamination procedures, a rinsate blank will be collected by running laboratory prepared deionised water over the equipment directly into laboratory prepared sampling containers for analysis for the suite of analytes applied to the primary samples

7.5.5 Analytical Plan

Analytical Schedule

The following sample analysis schedule will be adopted for the validation works:

- Materials for off-site disposal:
  - Samples of material to be disposed offsite shall be submitted for analysis of metals (Arsenic, Cadmium, Copper, Chromium, Nickel, Lead, Zinc and Mercury), TPH, BTEX, PAHs, OCPs, PCBs, asbestos and Toxicity Characteristic Leachate Procedures (TCLPs) as required;
- Validation Samples
  - Validation samples will be analysed for metals (Arsenic, Cadmium, Copper, Chromium, Nickel, Lead, Zinc and Mercury), TPH, BTEX, PAHs, OCPs, OPPs and PCBs and asbestos (if deemed to be required);
- Groundwater Seepage Samples
  - Samples of groundwater seepage will be metals (Arsenic, Cadmium, Copper, Chromium, Nickel, Lead, Zinc and Mercury), TPH, BTEX, PAHs, OCPs and OPPs;
- Imported Material samples:
  - Samples of material to be imported to the Site shall be submitted for analysis of metals (Arsenic, Cadmium, Copper, Chromium, Nickel, Lead, Zinc and Mercury), TPH, BTEX, PAHs, OCPs, PCBs, asbestos and any other analytes that may be specifically required depending on the source of the materials;
- Field Quality Control Samples for soil sampling program:
  - Intra-laboratory duplicate samples will be analysed at a rate of one per ten primary samples (10%) for the suite of analytes applied to the primary samples (excludes asbestos);
  - Inter-laboratory duplicates samples will be analysed at a rate of one per twenty primary samples (5%) for the suite of analytes applied to the primary samples (excludes asbestos);
  - Rinsate blank samples or other field quality control samples will be analysed at a rate of one per piece of reusable sampling equipment per day for the suite of analytes applied to the primary samples.

Analytical Laboratory Methodology

Samples must be submitted for analysis to a laboratory certified by NATA for the analysis required. Primary, intra-laboratory duplicate and rinsate samples must be submitted to the nominated primary laboratory and inter-laboratory duplicate samples must be submitted to the nominated secondary laboratory.

Laboratory analysis will be conducted in accordance with the requirements of NEPM and are referenced to USEPA and APHA methods. The analytical schedule, laboratory methods, laboratory detection limits and reference methods to be applied for the validation works must be appropriate to meet the project DQOs and DQIs.

7.5.6 Quality Assurance and Quality Control Plan

The field and laboratory quality assurance and quality control plan to be adopted for the remediation and validation works has been designed to achieve pre-determined data quality indicators that will demonstrate the precision, accuracy, representativeness, completeness and comparability of the data set and that the data set is of acceptable quality to meet the objectives of the works.

The specific quality assurance and quality control plan for the field and laboratory components of the validation works have been developed based on Appendix B of Schedule B2 of the NEPM and are detailed below.

Field QA/QC

The field quality assurance procedures to be adopted and the field quality control samples to be collected during the remediation and validation works and the corresponding acceptable control limits are presented in the table below.

Table 7: Validation Field QA/QC

Data Type	Comments and Acceptable Control Limits
Field personnel	Use appropriately trained field personnel employing procedures listed in this RAP.
Field data collection	All data collection to be undertaken in accordance with the methods set out in in this RAP. Site conditions properly described and documented by collection of adequate photographs and other information such as survey or other documentation Materials sampled properly described Information to be recorded in field notes. Field notes are appropriately completed and included in the report on the works.
Sample handling (storage and transport)	Soil samples will be collected into the sample jars/bottles supplied by the analytical laboratory and each sample will be characterised by a unique number. Samples for chemical analysis will be kept chilled in an ice-filled esky prior to dispatch and during transport to the NATA registered laboratory under chain-of-custody procedures. Samples for analysis for asbestos will be kept in an esky or secure container prior to dispatch and during transport to the NATA registered laboratory under chain-of-custody procedures. Sample numbers, dates, preservation and analytical requirements will be recorded on COC documentation, which will also be delivered to the analytical laboratory. All samples are required to be documented as received by the laboratory chilled (where required) and intact.
Field Intra-laboratory Duplicates Field Inter-laboratory Duplicates	Intra-laboratory duplicates will be collected and analysed at a rate of 1 in every 10 primary samples. Inter-laboratory duplicates will be collected and analysed at a rate of 1 in every 20 primary samples.

Data Type	Comments and Acceptable Control Limits
	Duplicate samples will be labelled so as to conceal their relationship to the primary sample from the laboratory. RPD of < 50% Organics & <30% Inorganics and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.
Rinsate Blanks	Rinsate blank samples (from an item of sampling equipment) will be collected and analysed at a rate of one per piece of re-useable equipment per day of sampling. Concentrations of analytes to be less than the laboratory detection limits.

Laboratory QA/QC

The laboratory quality assurance procedures to be adopted and the internal laboratory quality control samples to be analysed and the corresponding acceptable control limits are presented in the following table.

Table 8: Validation Laboratory QA/QC

Data Type	Comments and Acceptable Control Limits
Sample Analysis	All sample analyses to be conducted using NATA certified methods by laboratories which will implement a quality control plan in accordance with NEPM (2013).
Holding times	Standard holding times for analysis as set out by the laboratory
Laboratory Detection Limits	Where possible, laboratory detection limits to be less than the adopted validation criteria.
Laboratory Blanks	Laboratory blanks to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch. Concentration of analytes to be less than the laboratory detection limits.
Laboratory Duplicates	Laboratory duplicates to be analysed at a rate of 1 in 20, with a minimum of one analysed per batch. RPDs to be less than 50% and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.
Laboratory Control Samples (LCS)	LCSs to be analysed at a rate of 1 in 20, with a minimum of one analysed per analytical batch. Control limits: 70 to 130 % Acceptable Recovery and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.
Matrix Spikes	Matrix spikes and matrix spike duplicates prepared by dividing a field sample into two aliquots, then spiking each with identical concentrations of the analytes at a rate of 1 in 20. Matrix spike control limits: 70–130 % Acceptable recovery and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required. Matrix spike duplicates: RPDs <50% and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.

Data Type	Comments and Acceptable Control Limits
Surrogates	Surrogates are generally spiked into all sample aliquots prior to preparation and analysis by chromatographic methods. Percent recoveries are calculated for each surrogate, providing an indication of analytical accuracy. Surrogate Recovery limits: 70-130% Acceptable recovery and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required

Data Quality Indicators

The acceptance limits on field and laboratory data collected for the remediation and validation works have been set out in the tables above. A summary of the data quality indicators (DQIs) and the corresponding measures to be applied for the validation are presented in the table below.

Table 9: Summary of DQIs for Validation

DQI	Field	Laboratory	Acceptability Limits
Precision	Sampling methodologies appropriate and complied with. Collection of intra-laboratory duplicate and inter-laboratory duplicate samples	Analysis of: Field intra-laboratory duplicate samples (1 in 10 samples) Field inter-laboratory duplicate samples (1 in 20 samples) Laboratory duplicate samples	 RPD of < 50% Organics & <30% Inorganics RPD of < 50% Organics & <30% Inorganics RPD of < 50%
Accuracy	Sampling methodologies appropriate and complied with. Collection of rinsate blanks	Analysis of: Rinsate Blanks Method blanks Matrix spikes Matrix spike duplicates Surrogates/surrogate spikes Laboratory control samples Reagent blanks	 Non-detect for CoC Non-detect for CoC 70 to 130% RPD of <50% 70 to 130 % RPD of <50% Non-detect for CoC
Representativeness	Appropriate media sampled according to RAP All media identified in RAP sampled.	All samples analysed according to RAP	All samples analysed according to RAP and in accordance with laboratory methodologies

DQI	Field	Laboratory	Acceptability Limits
Comparability	Same sampling methodologies used on each day of sampling Experienced sampler Climatic conditions Same types of samples collected	Same analytical methods used (including clean-up) Sample laboratory detection limits (justify/quantify if different) Same laboratories (NATA accredited) Same units	As per NEPC (2013) < nominated criteria (where applicable)
Completeness	All critical locations and media sampled All samples collected Sampling methodologies appropriate and complied with Experienced sampler Documentation correct	All critical samples analysed and all analytes analysed according to RAP Appropriate methods Appropriate laboratory detection limits Sample documentation complete Sample holding times complied with	 As per NEPC (2013) < nominated criteria (where applicable) As per NEPC (2013)

In the event that a DQI is not met by laboratory analyses, the field observations relating to the nature of the samples will be reviewed and if no obvious source for the non-conformance is identified, such as an error in sampling, preservation of sample/s or heterogeneity of sample/s, liaison with the laboratories will be undertaken in an effort to identify the issue that has given rise to the non-conformance and additional analyses will be undertaken on the original sample/s, on duplicate samples or on other samples, if required.

If no explanation for the non-conformance is identified, the concentrations for the affected samples will be marked as estimates.

7.6 Validation Report

At the completion of the construction works on the Site a Validation Report will be prepared by the Environmental Consultant. For clarity the Validation Report will be prepared in general compliance with the relevant requirements of the NSW EPA (2020) and NSW EPA (2017) and other applicable guidelines endorsed by NSW EPA.

The Validation Report must contain information including, but not limited, to the following:

- Details of the works conducted on the Site;
- Information demonstrating that the objectives of the remediation and validation works have been achieved, in particular the validation results and assessment of the data against both the pre-defined data quality objectives and the validation criteria;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the construction works and justification for the variation to the strategy, where it affects the outcomes of the remediation and validation works;

- Description of the results of the inspections;
- Details on materials disposed off-site;
- Details of any environmental incidents occurring during the course of the works and the actions undertaken in response to these incidents;
- Description of the works undertaken, with drawings showing the locations of all significant works;
- Descriptions, supported by relevant drawings, cross-sections, etc, of the as-built of the Site;
- Details on material tracking and placement;
- Details on materials imported to the Site;
- A Registered Survey plan at A3 scale in hard copy and CAD formats showing the locations of:
    - The cadastral boundaries of the Site;
    - The survey of the resultant excavation prior to construction including the RLs and lateral extents of the marker layer as installed;
    - The RL of the finished surfaces on the Site;
    - The buildings and other relevant features constructed on the Site;
- Other information as appropriate, that will apply to the Site;
- A statement that the Site is suitable for residential land use with minimal opportunities for access to soils.

Each of the relevant matters listed in NSW EPA (2017) and NSW EPA (2020) guidelines is required to be addressed in the Validation Report.

Assessment of the reliability of the field and laboratory programs is required to be addressed in accordance with Appendix B of Schedule B2 of the NEPM and in accordance with the requirements of the RAP.

8 Conclusions

Merman Investments are proposing the redevelopment of the Site for a medium density residential apartment building. The development comprises a multi-storey building, basement levels for parking and plant rooms and landscaping at the frontage and rear of the building. The Site currently contains a multi-storey residential apartment building that was constructed with no basements at sometime between the 1920s and 1930s. A steeply terraced sandstone ridge is present across the north-western area of the Site and the ground floor of the building sits at the base of this cliff face which then slopes down to the road. Garages are present at the road level with the frontage of the building located ontop of the garages. The building footprint together with the sandstone cliff occupies the majority of the area of the Site. Some minimal garden beds and landscaping areas are present at the northern side and frontage of the current building above the garages and some of the higher sandstone terraces contain some vegetation. The current layout of the Site is shown on Figure 2.

Recent investigations have identified the presence of shallow fill materials within the landscaped areas present above the garages at the front the Site that contained asbestos containing materials (ACM) and concentrations of polycyclic aromatic hydrocarbons (PAHs) that were greater than the criteria for medium density residential land use. The investigation works indicated the potential for these fill materials to extend beneath the existing building to depths of up to 2 to 3 m beneath the building. However, it is noted that as the majority of the Site area is occupied by the terraced sandstone ridge and the building footprint, areas in which intrusive investigations could be completed were limited and that these physical constraints preclude the opportunity for further investigations to be conducted.

The previously identified presence of contaminated fill materials and the potential for contaminated fill materials to be present beneath the building render the Site not suitable for medium density residential land use. Given this, as part of the redevelopment of the Site, in order to ensure that the Site is suitable for ongoing medium density residential land use, remediation is required.

This RAP has been prepared to document the remediation strategy to be adopted on the Site due to the presence and potential presence of fill materials in the surface and shallow sub-surface that contain asbestos and PAHs that are greater than the criteria for residential land use with minimal opportunities for access to soils.

Given that the redevelopment of the Site will comprise the demolition of the existing building and all associated structures and then the excavation and off-site disposal of fill materials, natural soils and bedrock across the majority of the Site to depths of up to 20 metres below the current ground level, it is considered that once developed the Site will be suitable for residential land use with minimal opportunities for access to soils.

The most significant excavation works will be the removal of approximately half of the existing terraced sandstone ridge and then further in-ground excavation works beneath this existing terraced ridge and across the east and south-eastern areas of the Site. This excavation work will remove all existing fill materials and natural soils that overlay the natural sandstone bedrock on the Site and then the underlying sandstone bedrock. It is expected that the excavated materials will comprise 5-10% fill materials and natural soils with the remainder being sandstone.

Given that the redevelopment of the Site requires large scale excavation and removal off-site of surface and sub-surface materials present across the Site to the required lateral and vertical extent of the proposed basement levels, remediation of contaminated and potentially contaminated fill materials at the Site will be achieved by these works. As such the approach to the remediation and validation works on the Site is via excavation, off-site disposal of excavated materials and the adoption of a validation plan to demonstrate that the Site is suitable for medium density residential land use.

The requirements of this RAP are required to be implemented during the redevelopment of the Site for a new residential apartment building in order to ensure that the Site is made suitable for residential land use with minimal opportunities for access to soils.

9 Limitations

This report has been prepared for the sole purpose of documenting the Remediation Action Plan that is required to be implemented on the Site as part of the redevelopment of the Site for a new multi-storey residential apartment building, in accordance with generally accepted consulting practice. No other warranty or guarantee expressed or implied is made as to the advice indicated in this report.

This report should not be used for any other purpose without our prior written consent. Accordingly, neither CONSARA nor any member or employee of CONSARA accepts responsibility or liability in any way whatsoever for the use of this report for any purpose other than that for which it has been prepared.

This report should not be released to any other party, in whole or in part, without the express written consent of CONSARA. CONSARA accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

CONSARA has relied upon and presumed accurate information provided by Merman Investments Pty Ltd and/or any third party (or absence thereof) in making the assumptions made in this report. Nothing in this report should be taken to imply that CONSARA has verified or audited any of the information supplied to us other than as expressly stated in this report. We have assumed this information to be both adequate and accurate for the purposes of this report.

Where findings, observations and conclusions are based solely upon information provided by Merman Investments Pty Ltd and/or a third party and CONSARA do not accept, to the maximum extent permitted by law, any liability for any losses, claims, costs, expenses, damages (whether in statute, in contract or tort for negligence or otherwise) suffered or incurred by Merman Investments Pty Ltd or any third party as a result of or in connection with CONSARA's reliance on any such the information to the extent that such information is false, misleading or incomplete and CONSARA give no warranty or guarantee, express or implied as to such findings, observations and conclusions.

If further information becomes available, or additional assumptions need to be made, CONSARA reserves its right to amend any statements or opinions made in this report.

10 References

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Figures

Figure 1: Site Location

Figure 2: Site Layout

A4

PROJECT No.	**C201009**
FILE NAME	**F001**
DATE	**30.03.21**
DRAWN	**RR**
APPROVED	**RO**

SOURCE: NEARMAP

LEGEND

APPROXIMATE SITE BOUNDARY

CLIENT
MERMAN INVESTMENTS PTY LTD

PROJECT
REMEDIATION ACTION PLAN
3 WISTON GARDENS
DOUBLE BAY, NSW

TITLE
SITE LOCATION

FIGURE No.
1

CONSARA

A4

PROJECT No.	**C201009**
FILE NAME	**F002**
DATE	**30.03.21**
DRAWN	**RR**
APPROVED	**RO**

SOURCE: NEARMAP

LEGEND

APPROXIMATE SITE BOUNDARY

CLIENT
MERMAN INVESTMENTS PTY LTD

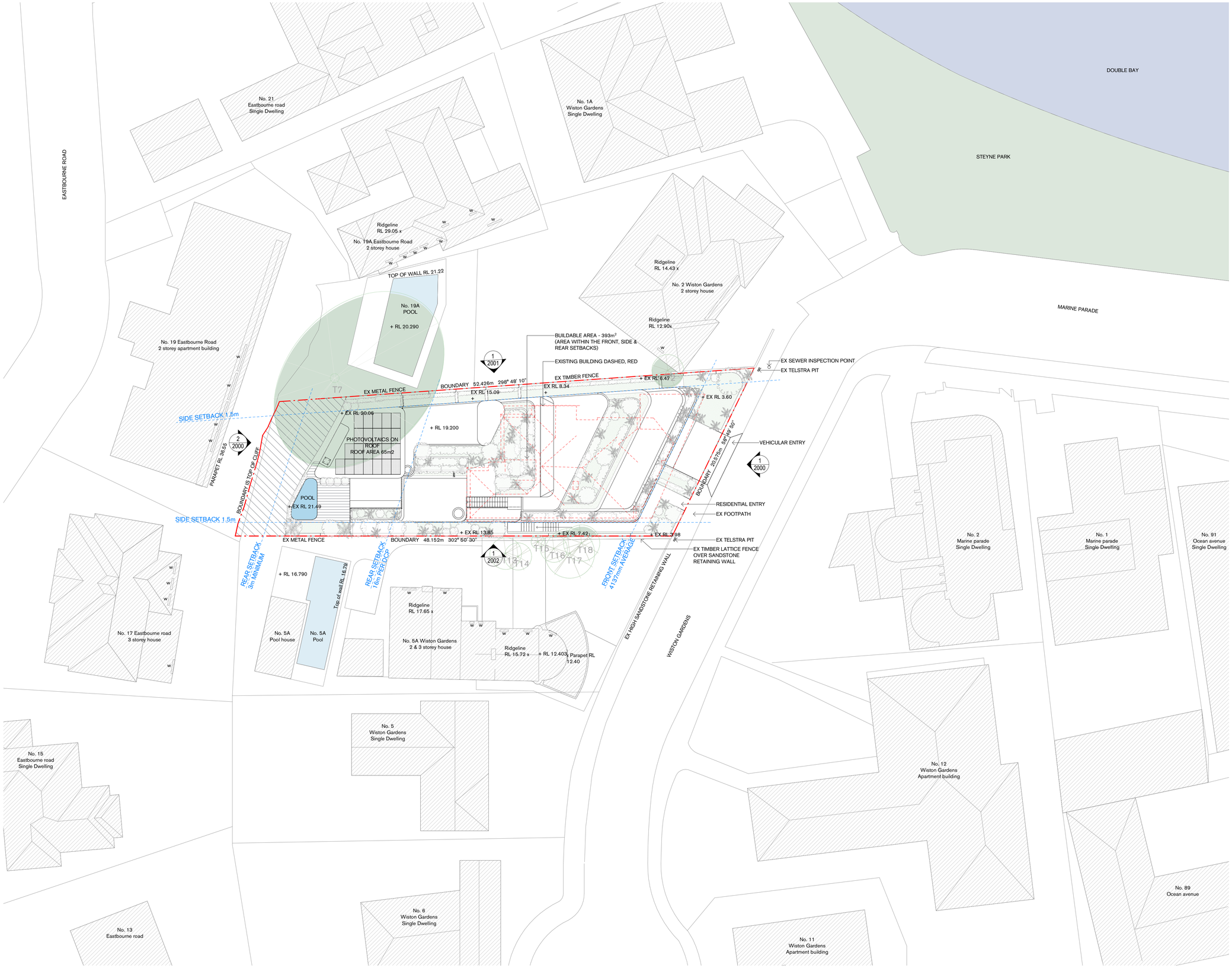
PROJECT
REMEDIATION ACTION PLAN
3 WISTON GARDENS
DOUBLE BAY, NSW

TITLE
SITE LOCATION

FIGURE No.
2

CONSARA

Appendix A: Detailed Plans for Multi-storey Residential Apartment Building



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Mladen Pmjatovic 7468
Ben Green 7066
Chi Melhem 7754

Notes Regarding "Development Application Drawings"

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

Refer to arborist Andrew Morton's report for further information regarding the labelled trees.

Site Area: 828m²
Zone: R3 Medium Density Residential
Building Height: 10.5m maximum
Acid Sulfate: Class 5

Rev	Date	For
A	11.03.20	For client review
B	07.04.20	For legal advice
C	14.04.20	For legal advice
D	12.06.20	For consultant information
E	10.07.20	For consultant information
F	29.07.20	For Development Application

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Legend

Existing tree retained

Proposed tree

Proposed planting

Tzannes

Scale **North**

1 : 200 @ A1 (Double @ A3)

0 2 4 6 8 10 m

Project
Wiston Gardens Double Bay

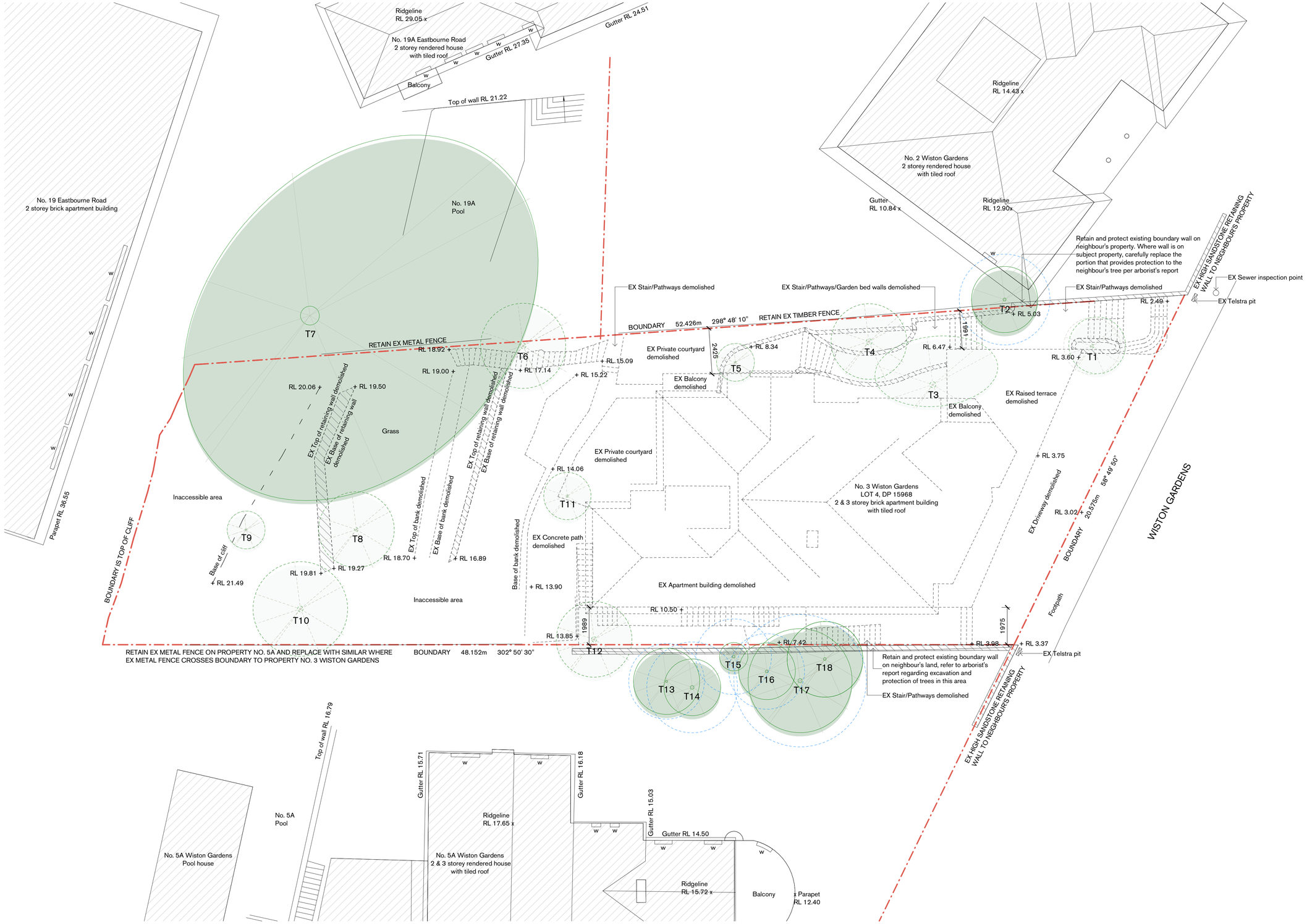
Address
3 Wiston Gardens
Double Bay, NSW 2028

Status
FOR DEVELOPMENT APPLICATION

Drawing
Site and Roof Plan

Date Created	Drawn	Checked
10/03/20	CD	TZ

Project No.	Drawing No.	Revision
19029	0001	F



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Rev	Date	For
A	12.06.20	For consultant information
B	10.07.20	For consultant information
C	29.07.20	For Development Application

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Heritage
Stephen Davies, Urbis
0438 029 797 sdavies@urbis.com.au

Legend

Existing tree retained

Existing tree removed

Tzannes

Scale 1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

North

Project
Wiston Gardens Double Bay

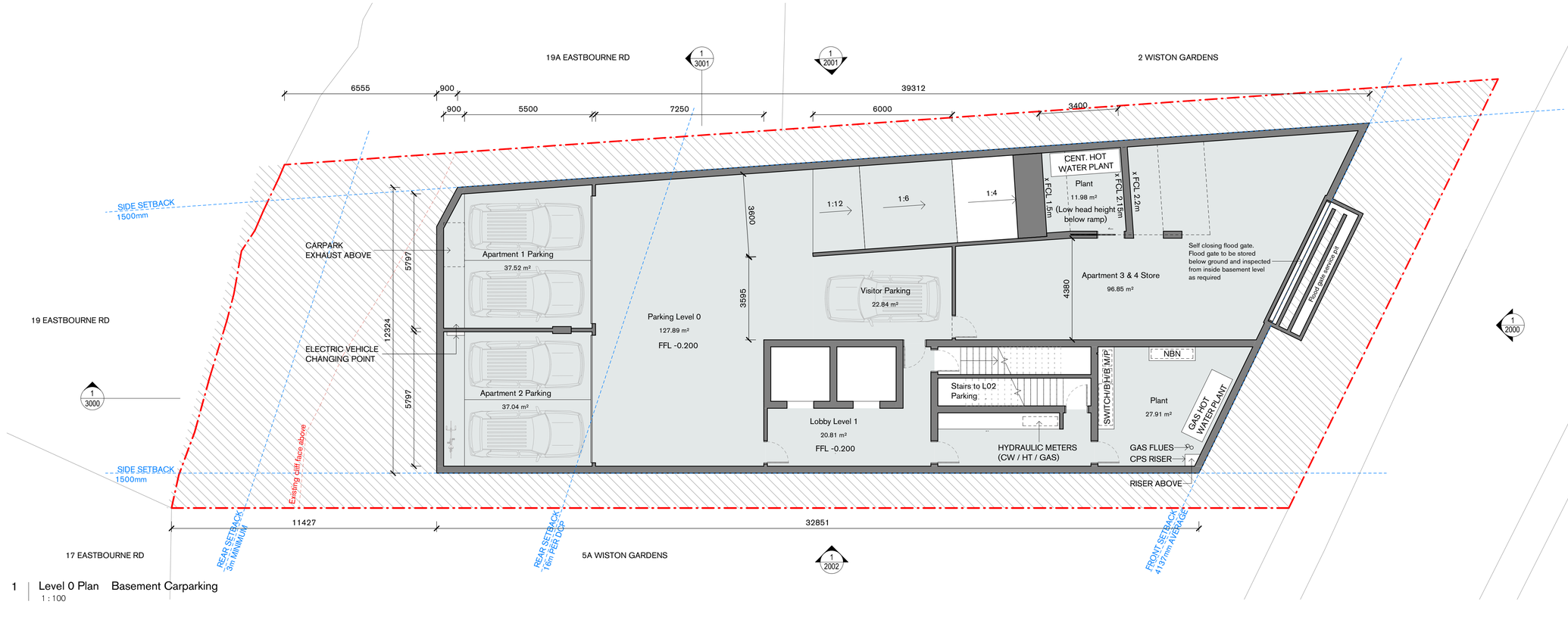
Address
3 Wiston Gardens
Double Bay, NSW 2028

Status
FOR DEVELOPMENT APPLICATION

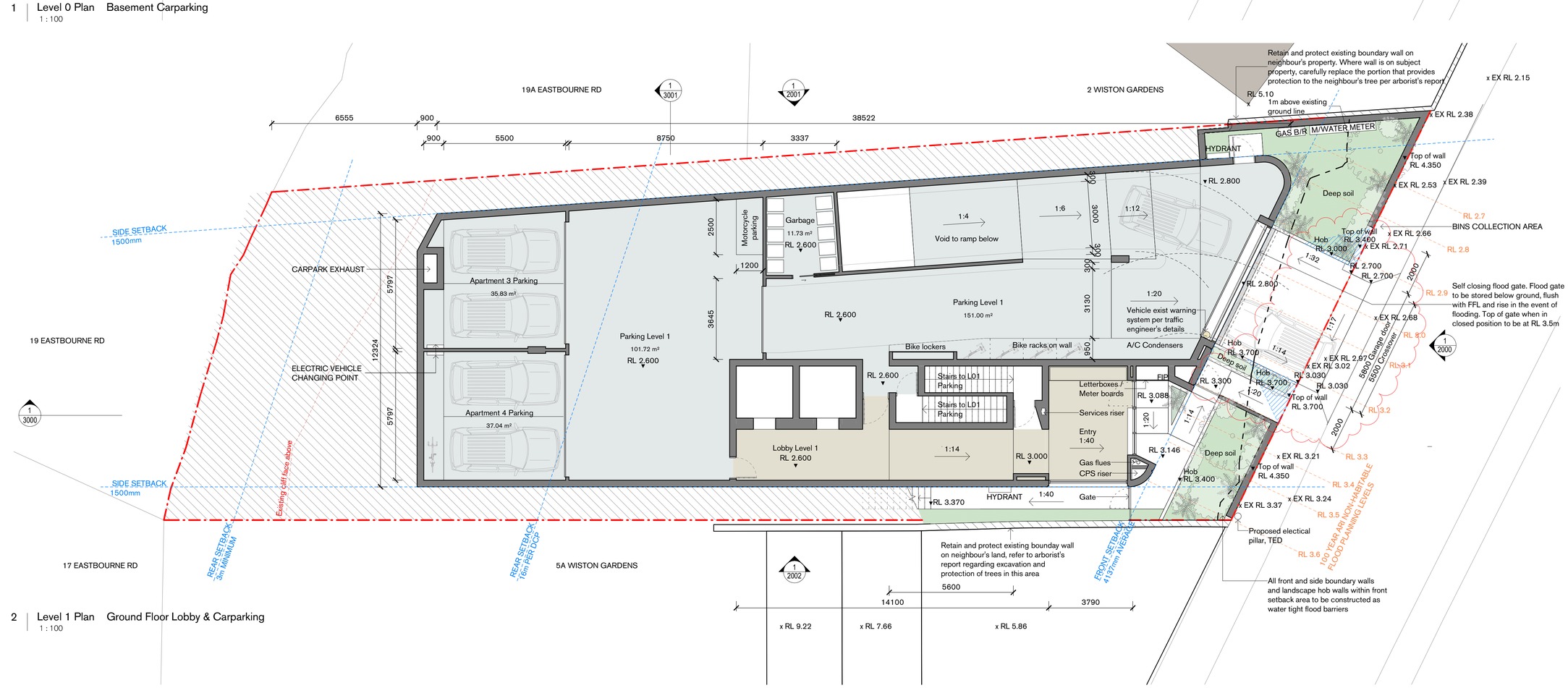
Drawing
Demolition Plan

Date Created	Drawn	Checked
05/05/20	SR	TZ

Project No.	Drawing No.	Revision
19029	0500	C



1 | Level 0 Plan Basement Carparking
1 : 100



2 | Level 1 Plan Ground Floor Lobby & Carparking
1 : 100

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Mladen Pmjatovic 7468
Ben Green 7066
Chi Melhem 7754

Notes Regarding "Development Application Drawings"

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

Note

Landscaping per landscape architect's report

Rev	Date	For
F	31.07.20	For Development Application
G	19.11.20	Flood Plane Updates
H	23.11.20	Flood Plane Updates
I	24.11.20	Flood Plane Updates
J	02.12.20	Flood Plane Updates
K	12.03.21	For Comment
L	15.03.21	WMC Requested Amendments

Client

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Heritage

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Legend

ALV	Aluminium Louvres
BZ	Bronze Finish Metal
CON	Concrete
GLC	Glass - Clear
MDR	Metal Deck Roof
MSR	Masonry
SST	Sandstone Block

Tzannes

Scale **North**

1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

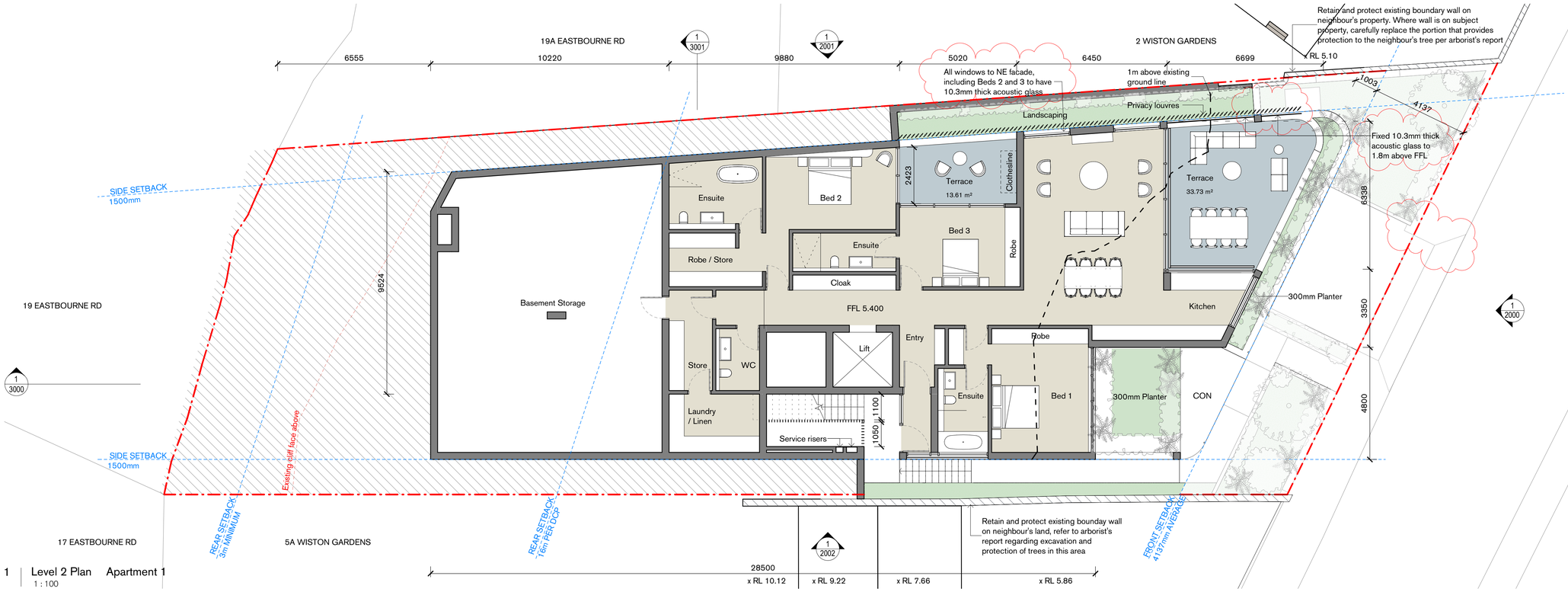
FOR DEVELOPMENT APPLICATION

Drawing

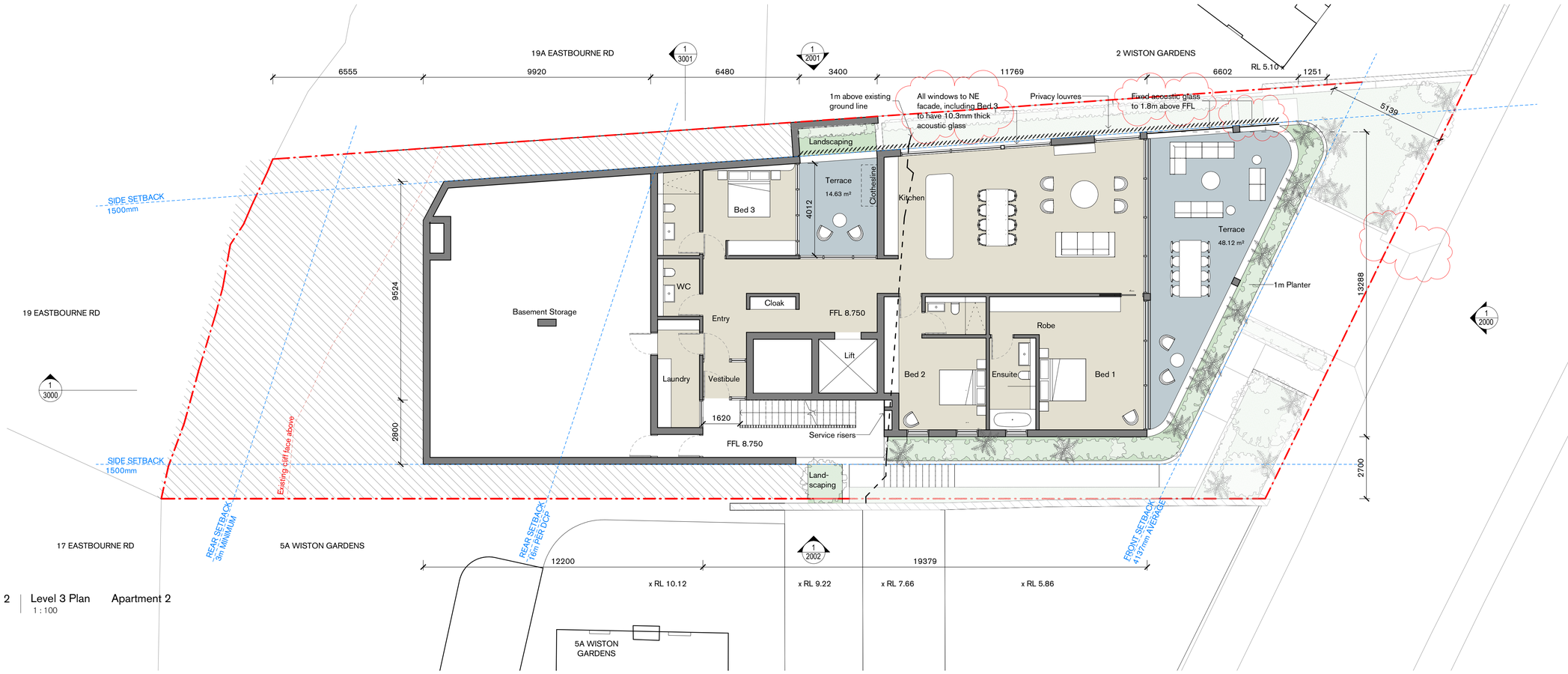
Level 0 and Level 1 Plans

Date Created	Drawn	Checked
13/12/19	CD	TZ

Project No.	Drawing No.	Revision
19029	1000	L



1 | Level 2 Plan Apartment 1
1 : 100



2 | Level 3 Plan Apartment 2
1 : 100

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Note

Landscaping per landscape architect's report

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C	10.07.20	For consultant information
D	29.07.20	For Development Application
E	19.11.20	Flood Plane Updates
F	23.11.20	Flood Plane Updates
G	02.12.20	Flood Plane Updates
H	12.03.21	For Comment
I	15.03.21	WMC Requested Amendments

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GLC	Glass - Clear
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MSR	Masonry
SST	Sandstone Block

Tzannes

Scale **North**

1 : 100 @ A1 (Double @ A3)
0 1000 2000 3000 4000 5000 mm

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

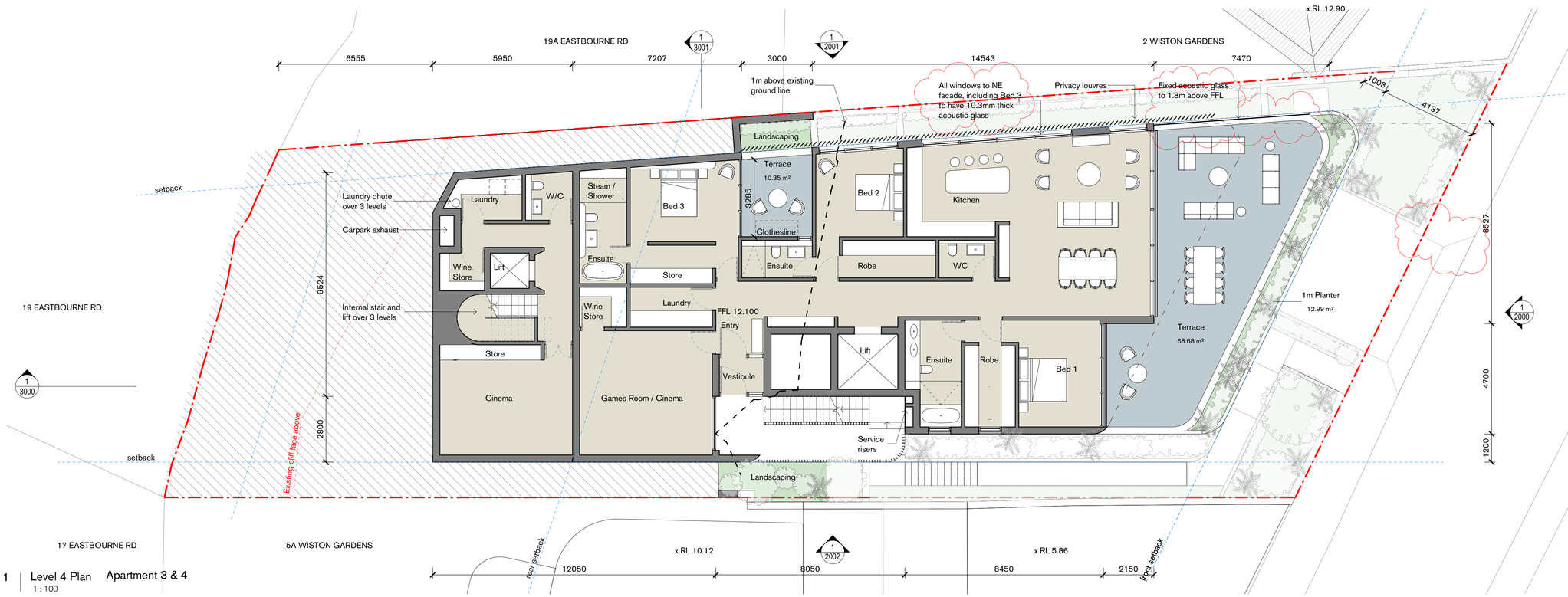
FOR DEVELOPMENT APPLICATION

Drawing

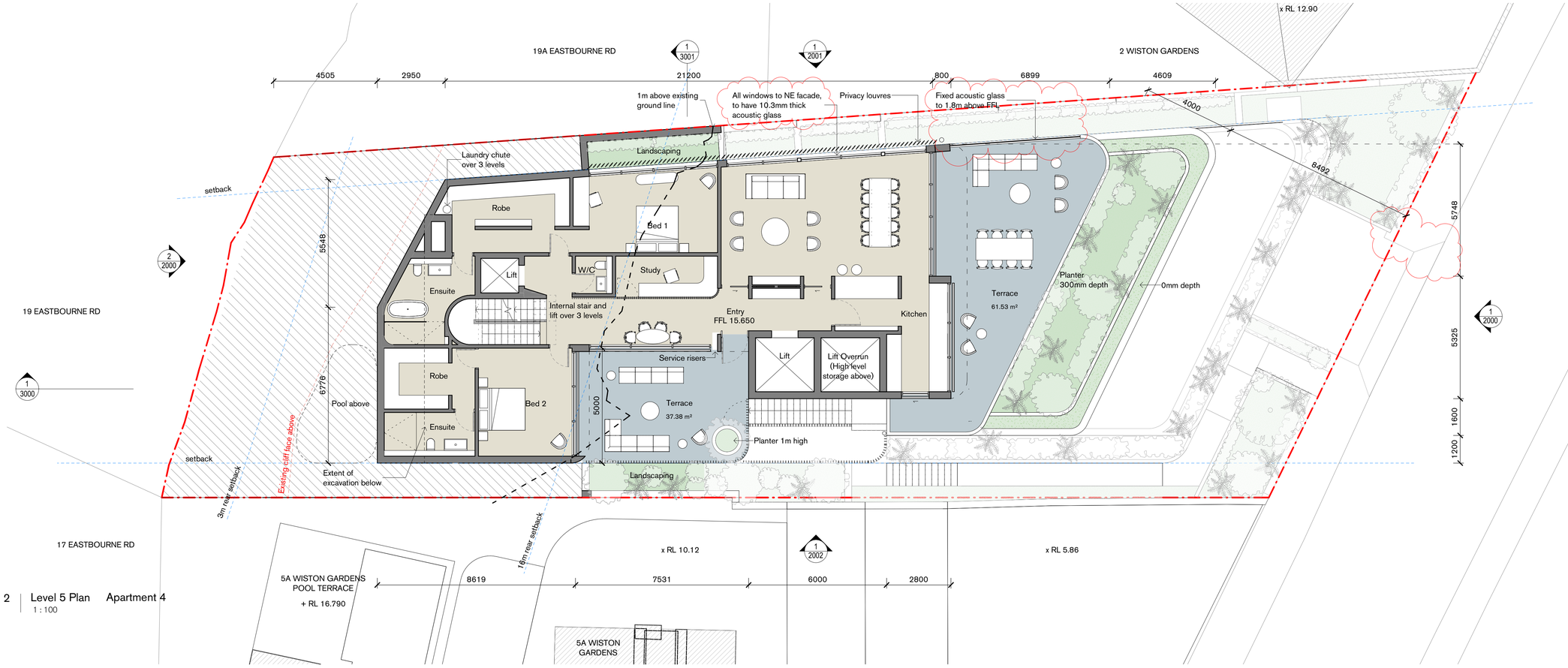
Level 2 and Level 3 Plans

Date Created	Drawn	Checked
13/12/19	CD	TZ

Project No.	Drawing No.	Revision
19029	1001	I



1 | Level 4 Plan Apartment 3 & 4
1 : 100



2 | Level 5 Plan Apartment 4
1 : 100

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Notes Regarding "Development Application Drawings"

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Note

Landscaping per landscape architect's report

Rev	Date	For
C	08.07.20	For information
D	10.07.20	For consultant information
E	21.07.20	For consultant information
F	29.07.20	For Development Application
G	10.12.20	Flood Plane Updates
H	12.03.21	For Comment
I	15.03.21	WMC Requested Amendments

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Legend

ALV	Aluminium Louvres
BZ	Bronze Finish Metal
CON	Concrete
GLC	Glass - Clear
MDR	Metal Deck Roof
MSR	Masonry
SST	Sandstone Block

Tzannes

Scale 1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

North

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

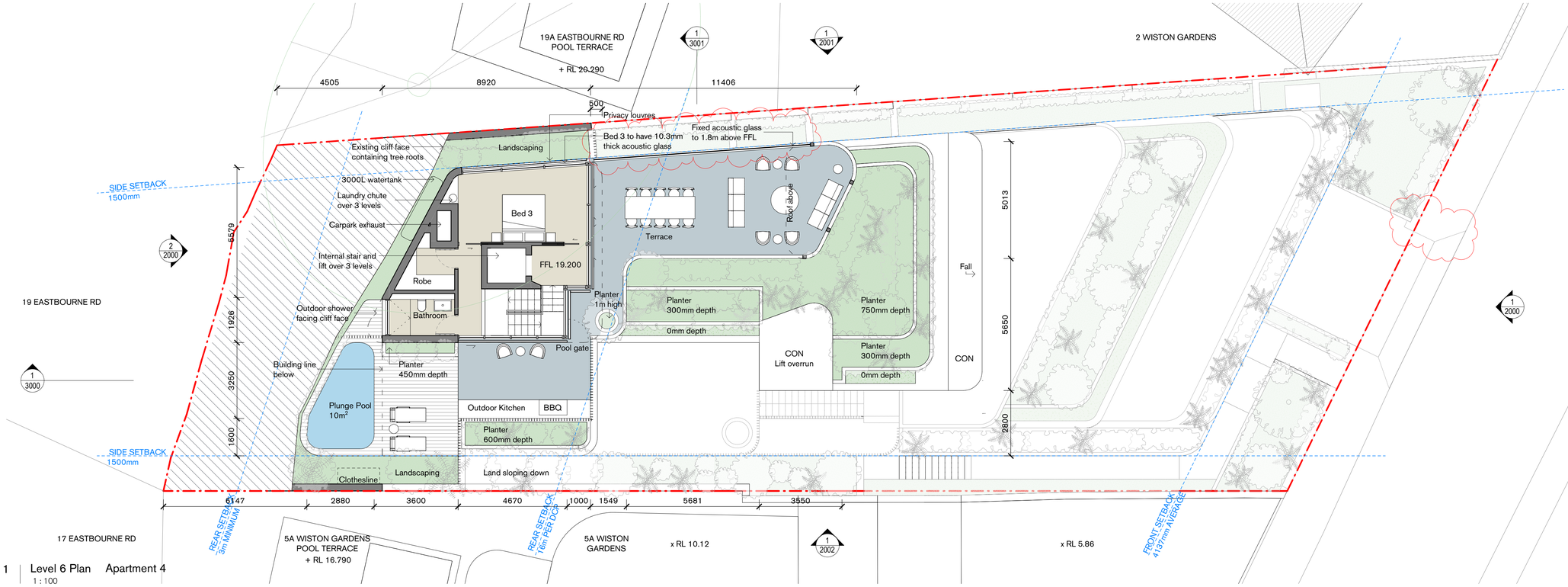
FOR DEVELOPMENT APPLICATION

Drawing

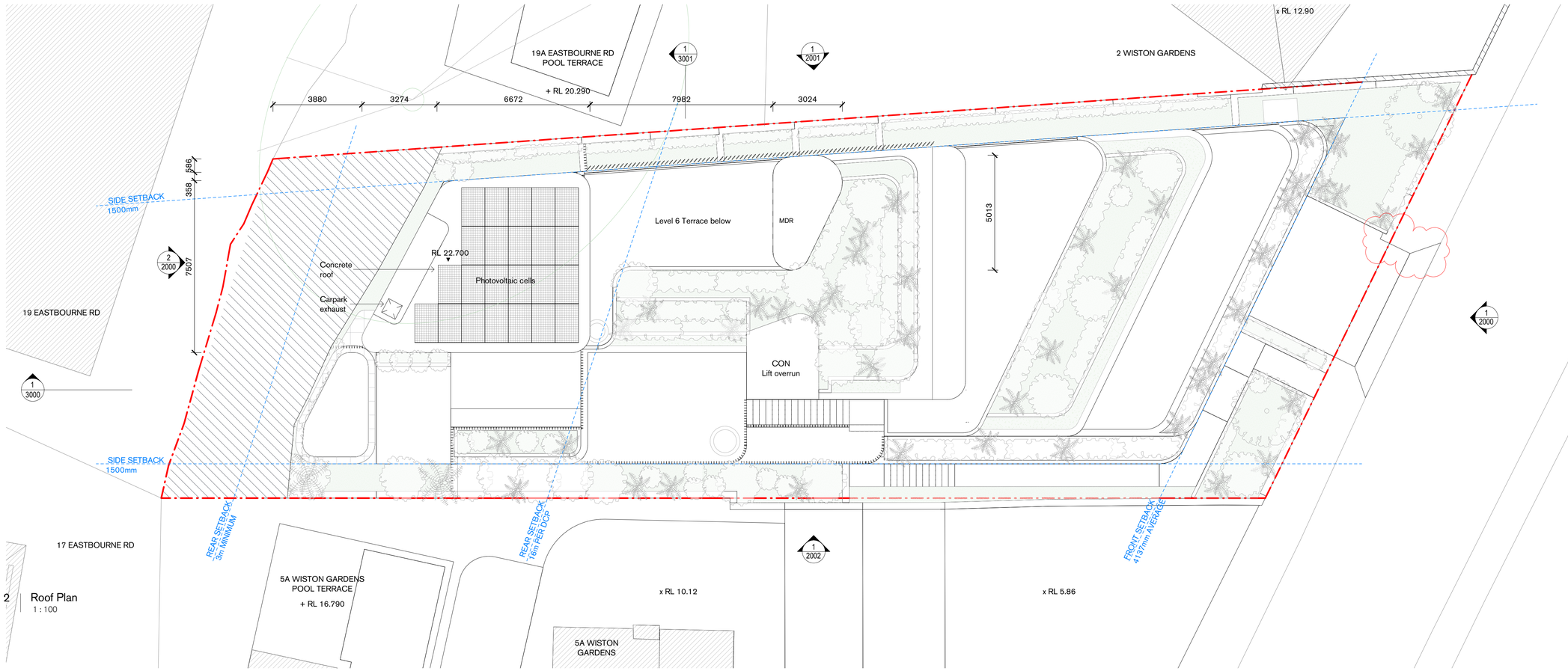
Level 4 and Level 5 Plans

Date Created	Drawn	Checked
18/12/19	CD	TZ

Project No.	Drawing No.	Revision
19029	1002	I



1 | Level 6 Plan Apartment 4
1 : 100



2 | Roof Plan
1 : 100

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Notes Regarding "Development Application Drawings"

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Note

Landscaping per report by landscape architect, Oculus

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C	08.07.20	For information
D	10.07.20	For consultant information
E	21.07.20	For consultant information
F	29.07.20	For Development Application
G	10.12.20	Flood Plane Updates
H	12.03.21	For Comment
I	15.03.21	WMC Requested Amendments

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GLC	Glass - Clear
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MSR	Masonry
SST	Sandstone Block

Tzannes

Scale 1 : 100 @ A1 (Double @ A3)
0 1000 2000 3000 4000 5000 mm

North

Project
Wiston Gardens Double Bay

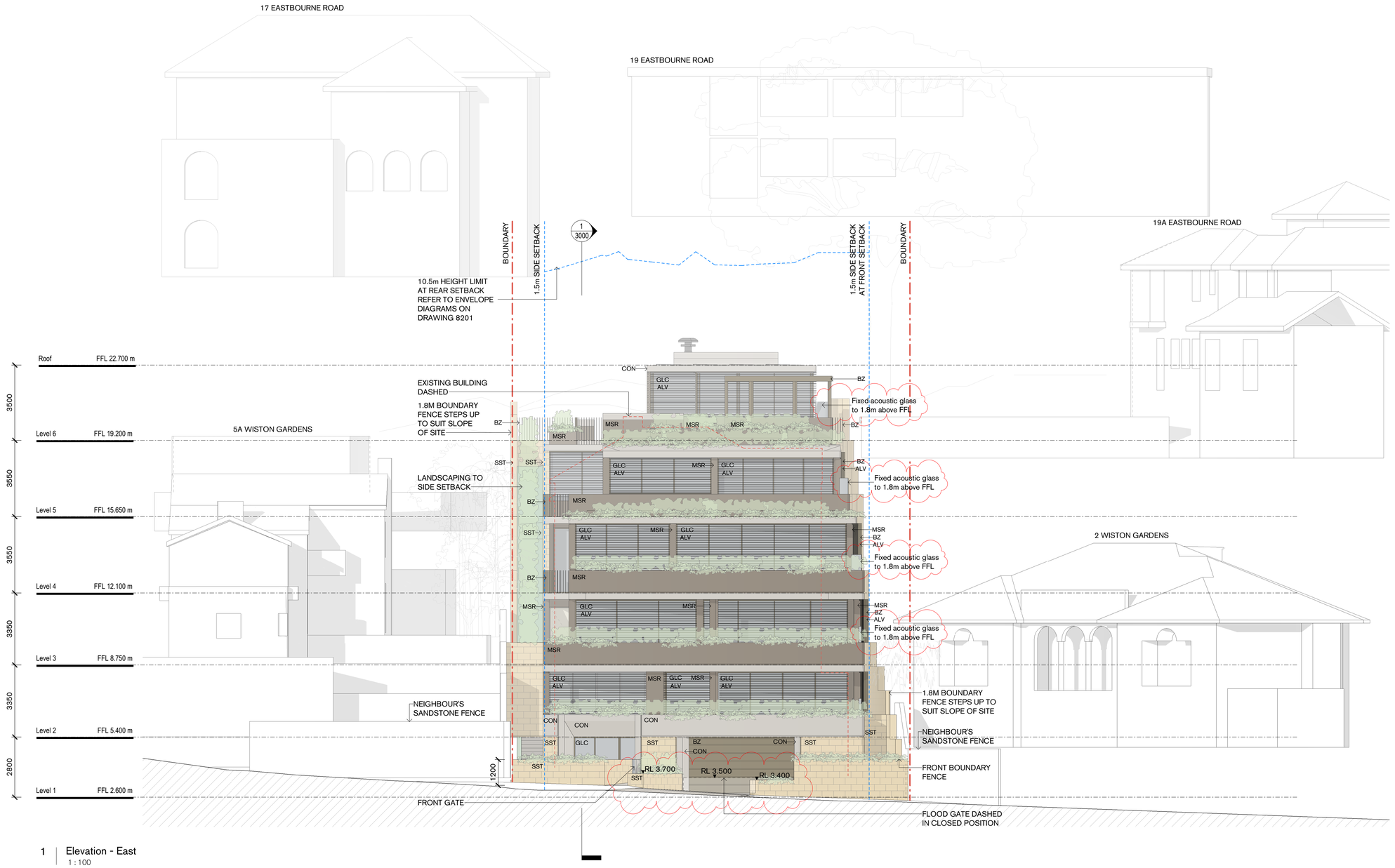
Address
3 Wiston Gardens
Double Bay, NSW 2028

Status
FOR DEVELOPMENT APPLICATION

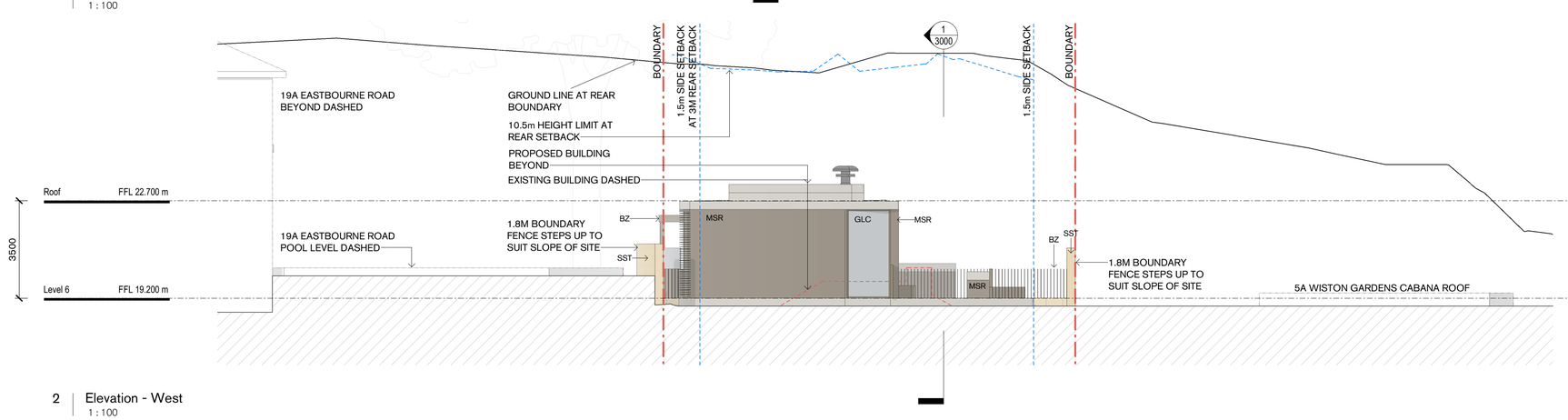
Drawing
Level 6 and Roof Plans

Date Created	Drawn	Checked
01/08/20	CD	TZ

Project No.	Drawing No.	Revision
19029	1003	I



1 | Elevation - East
1 : 100



2 | Elevation - West
1 : 100

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Legend

ALV	Aluminium Louvres
BZ	Bronze Finish Metal
CON	Concrete
GLC	Glass - Clear
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MSR	Masonry
SST	Sandstone Block

Tzannes

Scale 1 : 100 @ A1 (Double @ A3)
0 1000 2000 3000 4000 5000 mm

North

Project
Wiston Gardens Double Bay

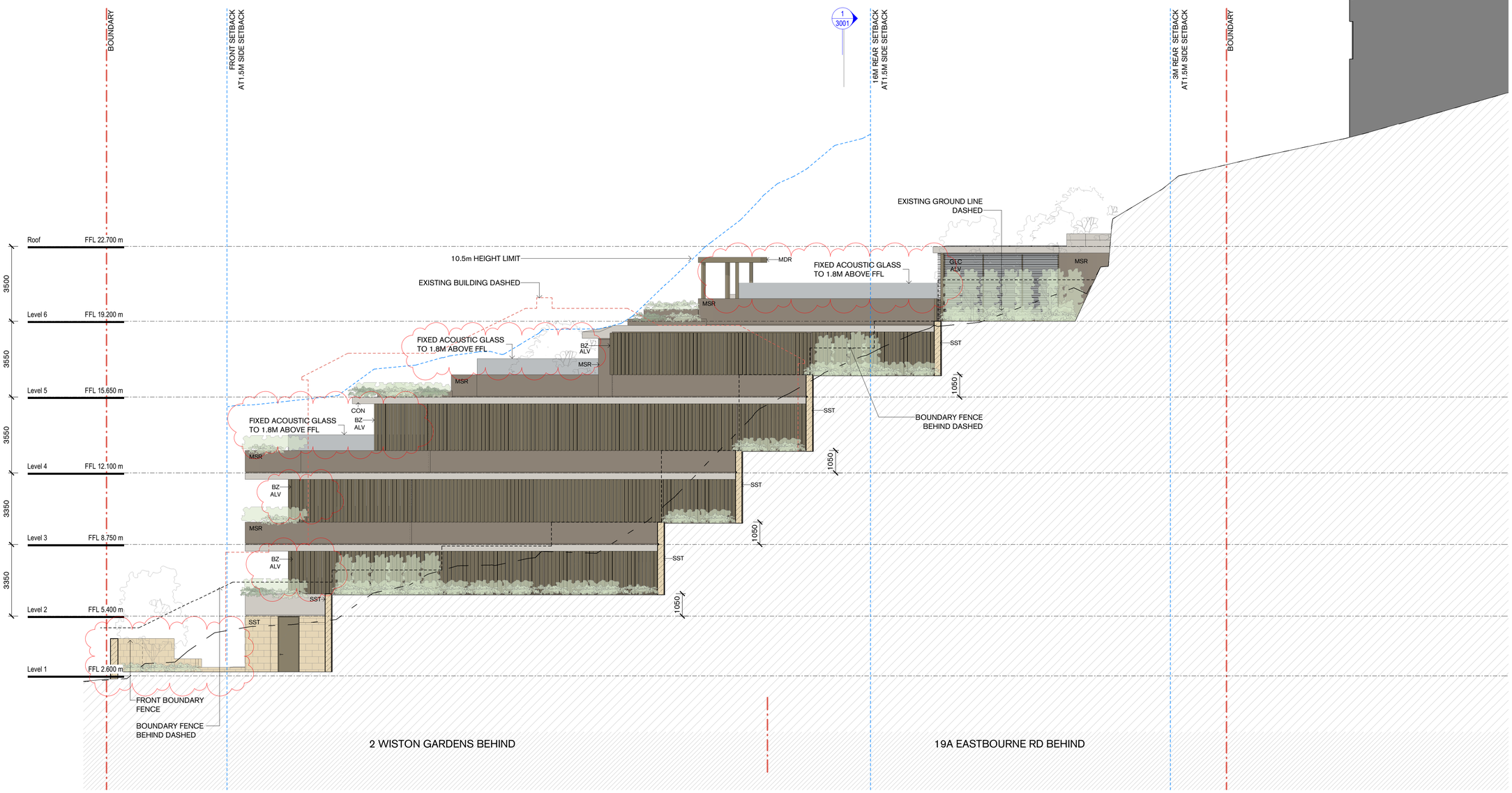
Address
3 Wiston Gardens
Double Bay, NSW 2028

Status
FOR DEVELOPMENT APPLICATION

Drawing
Elevations - East & West

Date Created	Drawn	Checked
20/12/19	RW	TZ

Project No.	Drawing No.	Revision
19029	2000	G



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Tzannes

Scale **North**

1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000
mm

Project
Wiston Gardens Double Bay

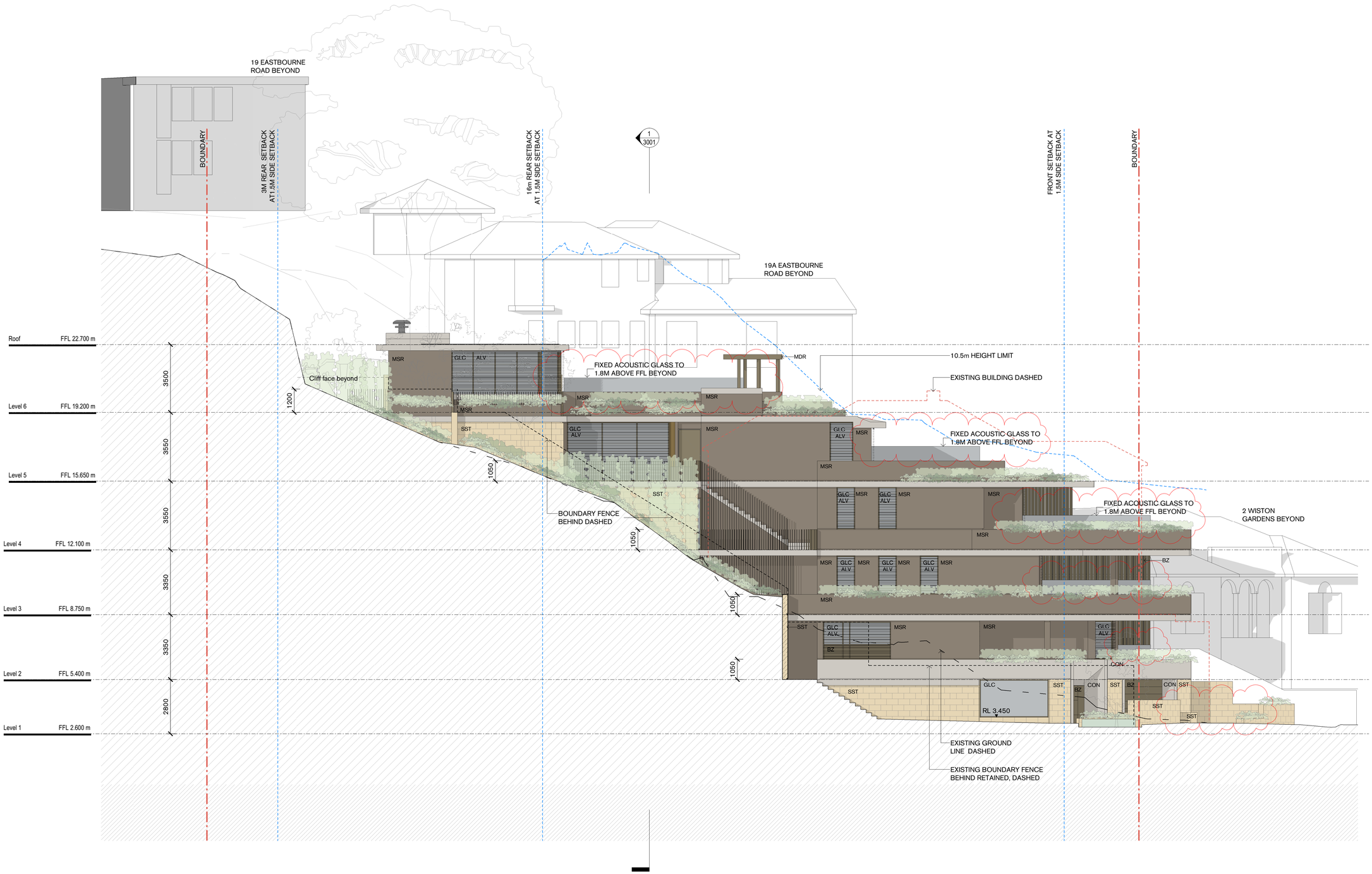
Address
3 Wiston Gardens
Double Bay, NSW 2028

Status
FOR DEVELOPMENT APPLICATION

Drawing
Elevation - North

Date Created	Drawn	Checked
20/12/19	RW	TZ

Project No.	Drawing No.	Revision
19029	2001	G



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Tzannes

Scale **North**

1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

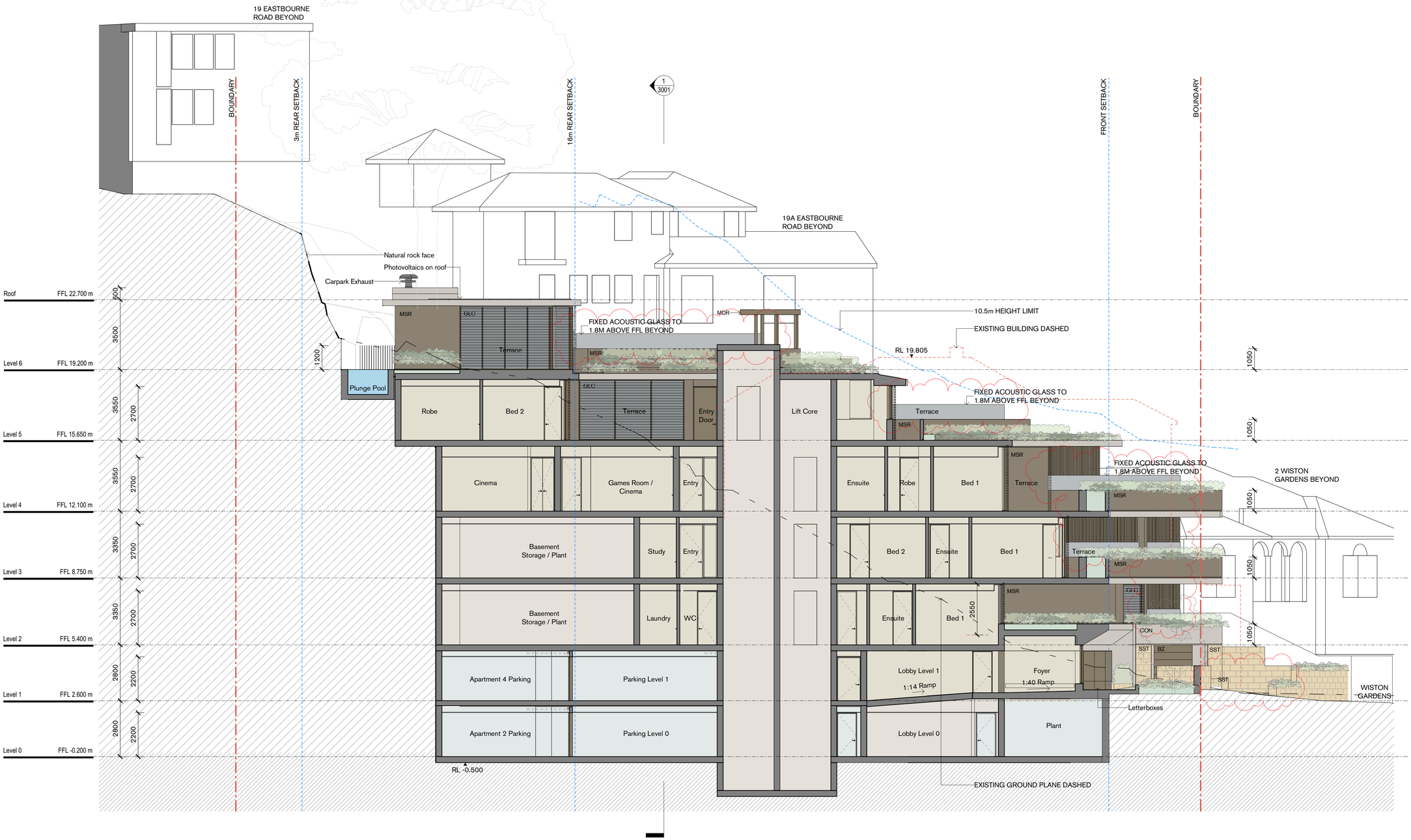
FOR DEVELOPMENT APPLICATION

Drawing

Elevation - South

Date Created	Drawn	Checked
20/12/19	RW	TZ

Project No.	Drawing No.	Revision
19029	2002	G



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Scale **North**

1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

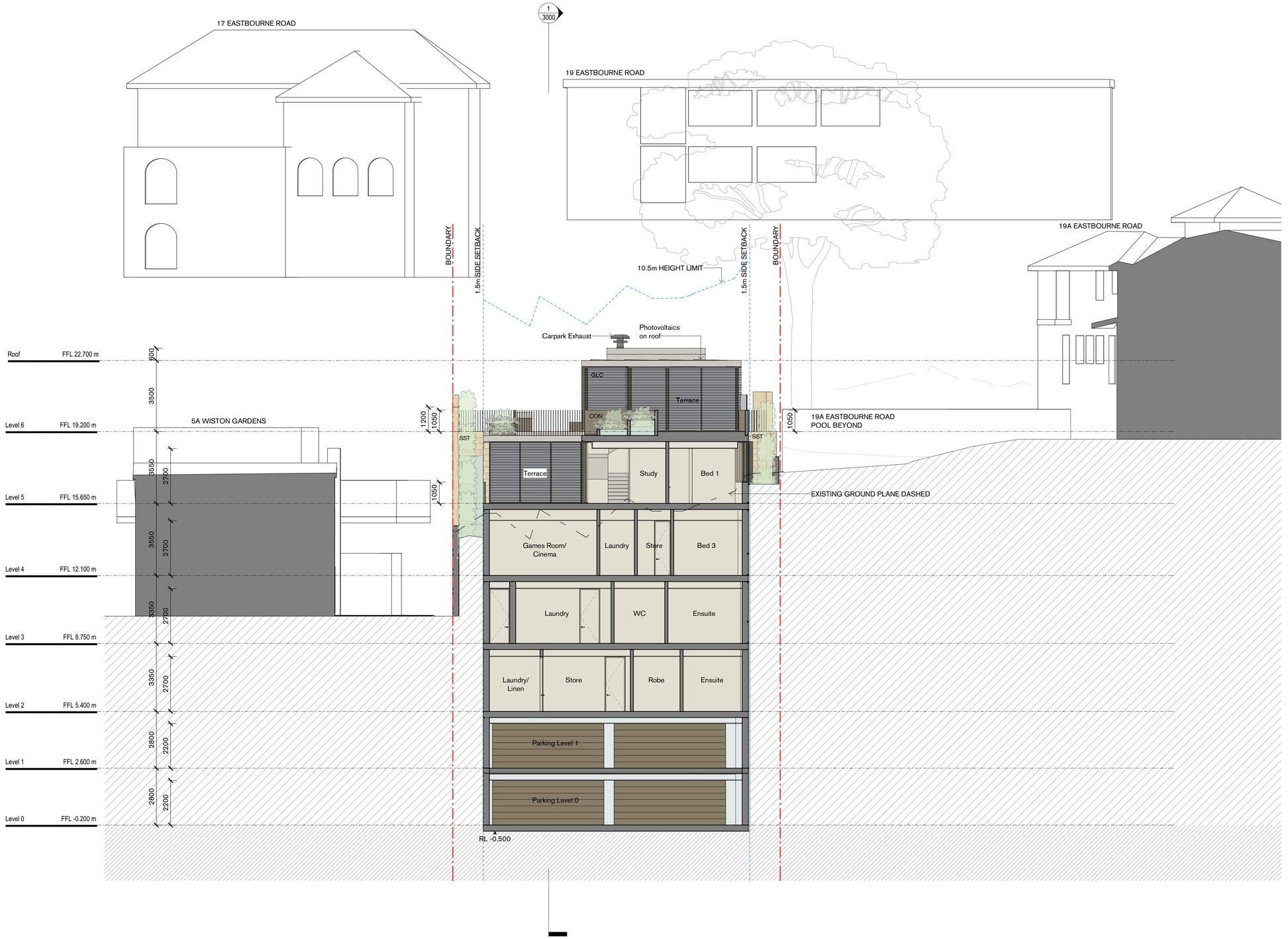
FOR DEVELOPMENT APPLICATION

Drawing

Section 1

Date Created	Drawn	Checked
20/12/19	RW	TZ

Project No.	Drawing No.	Revision
19029	3000	H



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Tzannes

Scale **North**

1 : 100 @ A1 (Double @ A3)

0 1000 2000 3000 4000 5000 mm

Project

Wiston Gardens Double Bay

Address

3 Wiston Gardens
Double Bay, NSW 2028

Status

FOR DEVELOPMENT APPLICATION

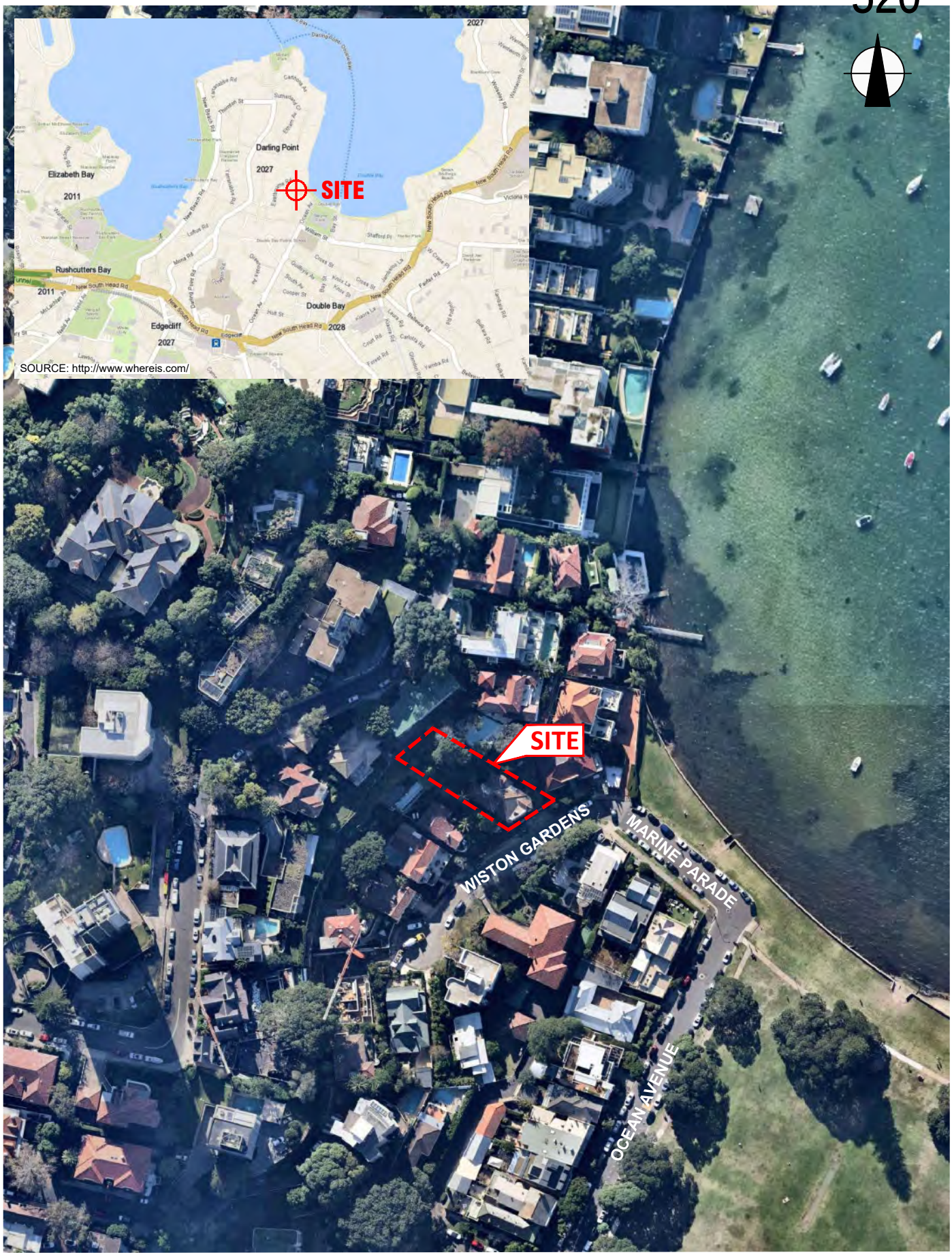
Drawing

Section 2

Date Created	Drawn	Checked
18/12/19	RW	TZ

Project No.	Drawing No.	Revision
19029	3001	E

Appendix B: Results of PSI



AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

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

Title: **SITE LOCATION PLAN**

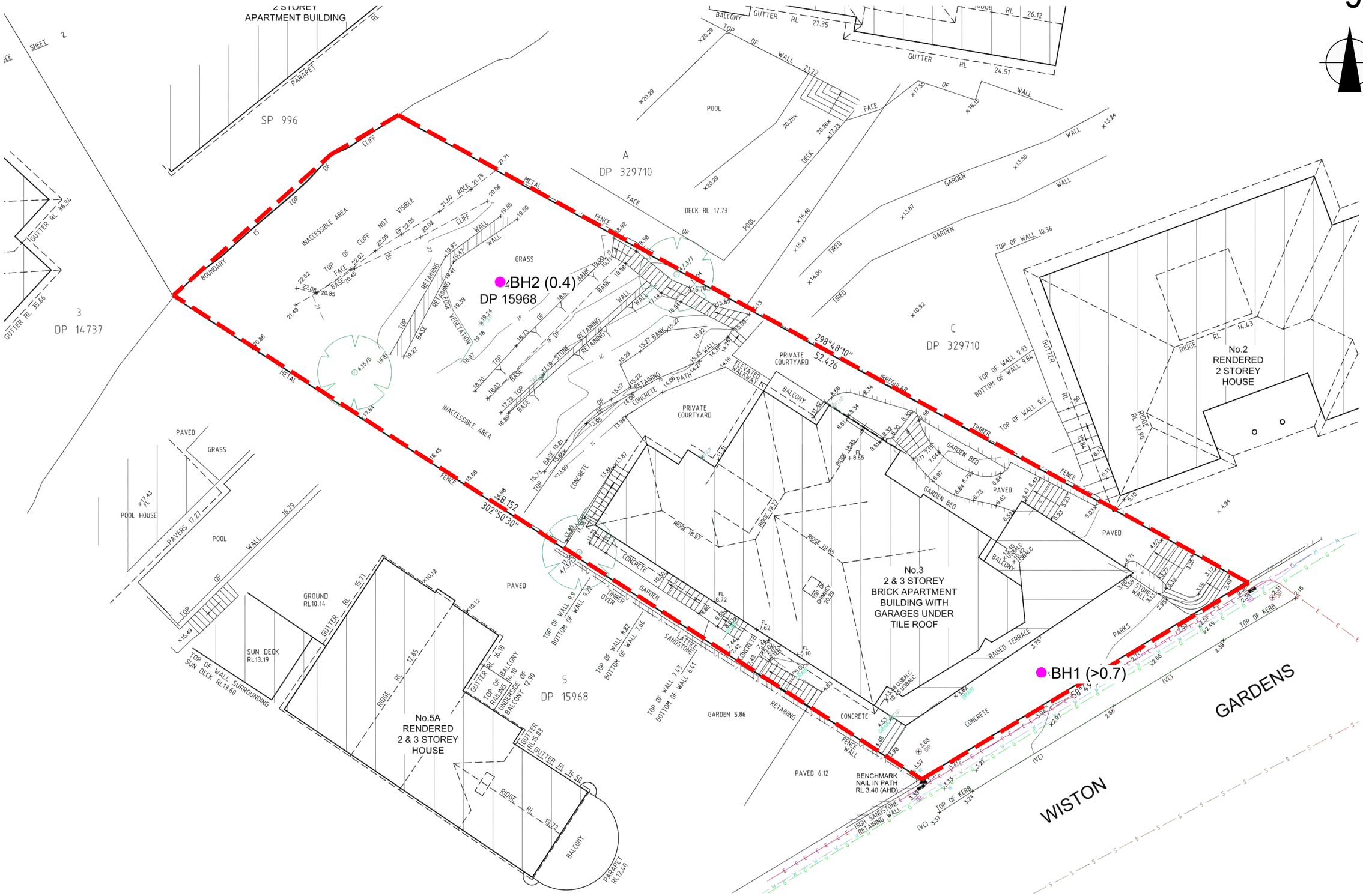
Location: 3 WISTON GARDENS, DOUBLE BAY, NSW

Project No: E33308BT

Figure No: 1

JKEnvironments

PLOT DATE: 14/07/2020 2:32:13 PM DWG FILE: Z:\5 EIS\5C EIS JOBS\33000'S\E33308BT DOUBLE BAY\CAD\E33308BT.DWG



LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

0 2 4 6 8 10
SCALE 1:200 @A3 METRES

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

Title: **SAMPLE LOCATION PLAN**

Location: 3 WISTON GARDENS, DOUBLE BAY, NSW

Project No: E33308BT

Figure No: 2

JKEnvironments

PLOT DATE: 17/07/2020 10:37:27 AM DWG FILE: Z:\5 EIS\SC EIS JOBS\33000'S\E33308BT DOUBLE BAY\CAD\E33308BT.DWG

2 STOREY APARTMENT BUILDING

SP 996

3 DP 14737

A DP 329710

C DP 329710

5 DP 15968

BH2 (0.4)

BH1 (>0.7)

No.2 RENDERED 2 STOREY HOUSE

No.3 2 & 3 STOREY BRICK APARTMENT BUILDING WITH GARAGES UNDER TILE ROOF

No.5A RENDERED 2 & 3 STOREY HOUSE

INACCESSIBLE AREA

POOL

POOL HOUSE

PAVED

GRASS

GARDEN

GARDEN BED

PRIVATE COURTYARD

BALCONY

SUN DECK RL13.19

GROUND RL10.14

DECK RL 17.73

BENCHMARK NAIL IN PATH RL 3.40 (AHD)

298°48'10" 52.426

302°50'30" 18.152

WISTON GARDENS

BH1	0.4-0.6m
Carcinogenic PAHs	5.6mg/kg
Asbestos	Detected

LEGEND

- APPROXIMATE SITE BOUNDARY
- BH(Fill Depth) BOREHOLE LOCATION, NUMBER AND DEPTH OF FILL (m)

SAMPLE ID	DEPTH (metres)
CHEMICAL	CONCENTRATION

SOIL/SURFACE SAMPLE EXCEEDANCE

SOIL/SURFACE CONTAMINATION ABOVE SAC FOR HUMAN HEALTH RISK

ASBESTOS DETECTED

0 2 4 6 8 10

SCALE 1:200 @A3 METRES

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

Title: **CONTAMINATION LOCATION PLAN**

Location: 3 WISTON GARDENS, DOUBLE BAY, NSW

Project No: E33308BT

Figure No: 3

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PLOT DATE: 17/07/2020 10:37:45 AM DWG FILE: Z:\5 EIS\5C EIS JOBS\33000'S\E33308BT DOUBLE BAY\CADE33308BT.DWG

Appendix B: Laboratory Results Summary Tables

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_{Cr}:	Chromium reducible sulfur
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)
UCL:	Upper Level Confidence Limit on Mean Valu
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).
- Statistical calculations are undertaken using ProUCL (USEPA). Statistical calculation is usually undertaken using data from fill samples.

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.

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TABLE S1
SOIL LABORATORY RESULTS COMPARED TO NEPM 2013.
HIL-B: 'Residential with minimal opportunities for soil access; including dwellings with fully/permanently paved yards like high-rise buildings'

All data in mg/kg unless stated otherwise			HEAVY METALS								PAHs		ORGANOCHLORINE PESTICIDES (OCPs)							OP PESTICIDES (OPPs)	TOTAL PCBs	ASBESTOS FIBRES
			Arsenic	Cadmium	Chromium VI	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)			500	150	500	30000	1200	120	1200	60000	400	4	15	400	500	10	90	600	10	340	1	Detected/Not Detected
Sample Reference	**Sample Depth**	**Sample Description**																				
BH1	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**6**	**4**	**19**	<0.1	**3**	**18**	**0.8**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	Not Detected
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**6**	**7**	**18**	<0.1	**3**	**15**	<0.05	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NA
BH1 (Triplicate)	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**7**	**5**	**21**	<0.1	**3**	**15**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.4-0.6	Fill: Silty Sandy Clay	<4	<0.4	**8**	**6**	**27**	**0.2**	<1	**19**	**50**	**5.6**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH2	0-0.2	Fill: Silty Sand	<4	<0.4	**7**	**15**	**80**	**0.2**	**5**	**83**	**0.58**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	Not Detected
BH2	0.4-0.5	Clayey Silty Sand	**10**	<0.4	**67**	**4**	**11**	<0.1	**1**	**41**	<0.05	<0.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FCF1 - BH1	0.4-0.6	Fragment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Detected
SDUP1	-	Fill: Silty Sand	<4	<0.4	**8**	**14**	**82**	**0.2**	**3**	**75**	**1.2**	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1	<0.1	<0.1	NA
Total Number of Samples			7	7	7	7	7	7	7	7	6	6	4	4	4	4	4	0	4	4	4	3
Maximum Value			10	<PQL	67	15	82	0.2	5	83	50	5.6	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	Detected

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

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	0.13-0.3	Fill: Silty Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.5
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.5
BH1	0.4-0.6	Fill: Silty Sandy Clay	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0
BH2	0-0.2	Fill: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	3
BH2	0.4-0.5	Clayey Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	0.4
SDUP1	-	Fill: Silty Sand	0m to <1m	Sand	<25	<50	<0.2	<0.5	<1	<3	<1	-
Total Number of Samples					6	6	7	7	7	7	7	6
Maximum Value					<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	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
BH1	0.13-0.3	Fill: Silty Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH1	0.4-0.6	Fill: Silty Sandy Clay	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH2	0-0.2	Fill: Silty Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
BH2	0.4-0.5	Clayey Silty Sand	0m to <1m	Sand	45	110	0.5	160	55	40	3
SDUP1	-	Fill: Silty Sand	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	0.13-0.3	Coarse	<25	<50	<100	<100
BH1 (Duplicate)	0.13-0.3	Coarse	<25	<50	<100	<100
BH1	0.4-0.6	Coarse	<25	<50	**220**	<100
BH2	0-0.2	Coarse	<25	<50	<100	<100
BH2	0.4-0.5	Coarse	<25	<50	<100	<100
SDUP1	-	Coarse	<25	<50	<100	<100
Total Number of Samples			6	6	6	6
Maximum Value			<PQL	<PQL	220	<PQL

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	0.13-0.3	Coarse	700	1000	2500	10000
BH1 (Duplicate)	0.13-0.3	Coarse	700	1000	2500	10000
BH1	0.4-0.6	Coarse	700	1000	2500	10000
BH2	0-0.2	Coarse	700	1000	2500	10000
BH2	0.4-0.5	Coarse	700	1000	2500	10000
SDUP1	-	Coarse	700	1000	2500	10000

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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	0.13-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**0.5**
BH1 (Duplicate)	0.13-0.3	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**0.5**
BH1	0.4-0.6	<25	<50	**220**	<100	<0.2	<0.5	<1	<3	<1	0
BH2	0-0.2	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**3**
BH2	0.4-0.5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	**0.4**
SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<1	-
Total Number of Samples		6	6	6	6	6	6	6	6	6	5
Maximum Value		<PQL	<PQL	220	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	3

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

TABLE S5
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) plus napthalene	>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	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	<4	**6**	**4**	**19**	**3**	**18**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.09**
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	<4	**6**	**7**	**18**	**3**	**15**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
BH1 (Triplicate)	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	<4	**7**	**5**	**21**	**3**	**15**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.4-0.6	Fill: Silty Sandy Clay	Coarse	NA	NA	NA	<4	**8**	**6**	**27**	<1	**19**	<1	NA	<25	<50	**220**	<100	<0.2	<0.5	<1	<3	**3.9**
BH2	0-0.2	Fill: Silty Sand	Coarse	NA	NA	NA	<4	**7**	**15**	**80**	**5**	**83**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
BH2	0.4-0.5	Clayey Silty Sand	Coarse	NA	NA	NA	**10**	**67**	**4**	**11**	**1**	**41**	<1	NA	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.05
SDUP1	-	Fill: Silty Sand	Coarse	NA	NA	NA	<4	**8**	**14**	**82**	**3**	**75**	<1	<0.1	<25	<50	<100	<100	<0.2	<0.5	<1	<3	**0.1**
Total Number of Samples				0	0	0	7	7	7	7	7	7	7	4	6	6	6	6	7	7	7	7	6
Maximum Value				NA	NA	NA	10	67	15	82	5	83	<PQL	<PQL	<PQL	<PQL	220	<PQL	<PQL	<PQL	<PQL	<PQL	3.9

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) plus napthalene	>C_{16}-C_{34} (F3)	>C_{34}-C_{40} (F4)	Benzene	Toluene	Ethylbenzene	Total Xylenes	B(a)P
BH1	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH1 (Triplicate)	0.13-0.3	Fill: Silty Sandy Gravel	Coarse	NA	NA	NA	100	200	90	1300	35	190	--	--	--	--	--	--	--	--	--	--	--
BH1	0.4-0.6	Fill: Silty Sandy Clay	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
BH2	0-0.2	Fill: Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20
BH2	0.4-0.5	Clayey Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	--	180	120	300	2800	50	85	70	105	20
SDUP1	-	Fill: Silty Sand	Coarse	NA	NA	NA	100	200	90	1300	35	190	170	180	180	120	300	2800	50	85	70	105	20

TABLE S6
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	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**6**	**4**	**19**	<0.1	**3**	**18**	**0.8**	**0.09**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**6**	**7**	**18**	<0.1	**3**	**15**	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
BH1 (Triplicate)	0.13-0.3	Fill: Silty Sandy Gravel	<4	<0.4	**7**	**5**	**21**	<0.1	**3**	**15**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BH1	0.4-0.6	Fill: Silty Sandy Clay	<4	<0.4	**8**	**6**	**27**	**0.2**	<1	**19**	**50**	**3.9**	NA	NA	NA	NA	NA	<25	<50	**160**	**120**	**280**	<0.2	<0.5	<1	<3	NA
BH2	0-0.2	Fill: Silty Sand	<4	<0.4	**7**	**15**	**80**	**0.2**	**5**	**83**	**0.58**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	Not Detected
BH2	0.4-0.5	Clayey Silty Sand	**10**	<0.4	**67**	**4**	**11**	<0.1	**1**	**41**	<0.05	<0.05	NA	NA	NA	NA	NA	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
FCF1 - BH1	0.4-0.6	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
SDUP1	-	Fill: Silty Sand	<4	<0.4	**8**	**14**	**82**	**0.2**	**3**	**75**	**1.2**	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<3	NA
Total Number of Samples			7	7	7	7	7	7	7	7	6	6	4	4	4	4	4	6	6	6	6	6	6	6	6	6	3
Maximum Value			10	<PQL	67	15	82	0.2	5	83	50	3.9	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	160	120	280	<PQL	<PQL	<PQL	<PQL	Not Detected

Concentration above the CT1 — **VALUE**
Concentration above SCC1 — **VALUE**
Concentration above the SCC2 — **VALUE**
Concentration above PQL — **Bold**

TABLE S7
SOIL LABORATORY TCLP RESULTS
All data in mg/L unless stated otherwise

			Arsenic	Cadmium	Chromium	Lead	Mercury	Nickel	B(a)P
PQL - Envirolab Services			0.05	0.01	0.01	0.03	0.0005	0.02	0.001
TCLP1 - General Solid Waste			5	1	5	5	0.2	2	0.04
TCLP2 - Restricted Solid Waste			20	4	20	20	0.8	8	0.16
TCLP3 - Hazardous Waste			>20	>4	>20	>20	>0.8	>8	>0.16
Sample Reference	**Sample Depth**	**Sample Description**							
BH1	0.13-0.3	Fill: Silty Sandy Gravel	<0.05	<0.01	<0.01	<0.03	<0.0005	<0.02	<0.001
BH1 (Duplicate)	0.13-0.3	Fill: Silty Sandy Gravel	<0.05	<0.01	<0.01	<0.03	<0.0005	<0.02	<0.001
BH2	0-0.2	Fill: Silty Sand	<0.05	<0.01	<0.01	<0.03	<0.0005	<0.02	<0.001
Total Number of samples			3	3	3	3	3	3	3
Maximum Value			<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

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

Preliminary (Stage 1) Site Investigation
3 Wiston Gardens, Double bay, NSW
E33334B

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)fluoranthen	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthra-cen	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	BH2	0-0.2	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1	0.1	<0.2	0.1	<0.1	<0.1	<0.1
laboratory	SDUP1	-	<25	<50	<100	<100	<0.2	<0.5	<1	<2	<1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.1	0.1	0.2	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	0.2	0.2	0.075	0.1	0.15	0.1	nc	nc	0.075
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0%	0%	67%	0%	67%	0%	nc	nc	67%
Field	TB-S1	-	NA	NA	NA	NA	<0.2	<0.5	<1	<2	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	29/06/20																									

			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	BH2	0-0.2	<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	-	<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
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	29/06/20																					

			Azinphos-methyl (Guthi	Bromophos-ethyl	Chlorpyriphos	Chlorpyriphos-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenitrothion	Malathion	Parathion	Ronnel	Total PCBS	Arsenic	Cadmium	Chromium VI	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	BH2	0-0.2	<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	7	15	80	0.2	5	83
laboratory	SDUP1	-	<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	8	14	82	0.2	3	75
duplicate	MEAN		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	7.5	14.5	81	0.2	4	79
	RPD %		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	13%	7%	2%	0%	50%	10%
Field	TB-S1	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Blank	29/06/20																						

Result outside of QA/QC acceptance criteria

Appendix D: Borehole Logs

JKGeotechnics

BOREHOLE LOG

Borehole No. 1
1/1

Client: MERMAN INVESTMENTS PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 3 WISTON GARDENS, DOUBLE BAY, NSW

Job No.: 33308B **Method:** HAND AUGER **R.L. Surface:** ≈ 3.4m

Date: 29/6/20 **Datum:** AHD

Plant Type: - **Logged/Checked by:** S.D./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION	■			■	REFER TO DCP TEST RESULTS	0			CONCRETE: 130mm.t				NO OBSERVED REINFORCEMENT
	■			■				-	FILL: Silty sandy gravel, fine to coarse grained igneous and sandstone gravel, light brown, fine to coarse grained sand, with brick and concrete fragments.	W M w>PL		50 50	APPEARS POORLY TO MODERATELY COMPACTED 0.4-0.6m FCF1
	■			■		0.5			FILL: Silty sand, fine to coarse grained, light brown and light grey, trace of fine to medium grained sandstone gravel.	M			
						1			FILL: Silty sandy clay, low to medium plasticity, light grey and grey, fine to medium grained sand, trace of fine to medium grained sandstone gravel.				HAND AUGER REFUSAL ON OBSTRUCTION IN FILL
									FILL: Silty sand, fine to medium grained, grey, trace of fine to medium grained sandstone gravel.				
						1.5			END OF BOREHOLE AT 0.7m				
						2							
						2.5							
						3							
						3.5							

JKGeotechnics

BOREHOLE LOG

Borehole No. 2
1/1

Client: MERMAN INVESTMENTS PTY LTD

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Location: 3 WISTON GARDENS, DOUBLE BAY, NSW

Job No.: 33308B **Method:** HAND AUGER **R.L. Surface:** ≈ 19.2m

Date: 29/6/20 **Datum:** AHD

Plant Type: - **Logged/Checked by:** S.D./D.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION AND AFTER 1 HR	■			■	REFER TO DCP TEST RESULTS	0			FILL: Silty sand, fine to medium grained, dark grey, trace of clay, fine to medium gained sandstone gravel and ash.	M			GRASS COVER APPEARS POORLY COMPACTED
	■			■		0.5		SM	Clayey silty SAND: fine to medium grained, orange brown.	M	L		RESIDUAL
									END OF BOREHOLE AT 0.6m				HAND AUGER REFUSAL ON INFERRED SANDSTONE
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							