57-69 Strathallen Avenue, Northbridge NSW

SJD NB Pty Ltd

Remedial Action Plan

JBS&G 65963| 156,347

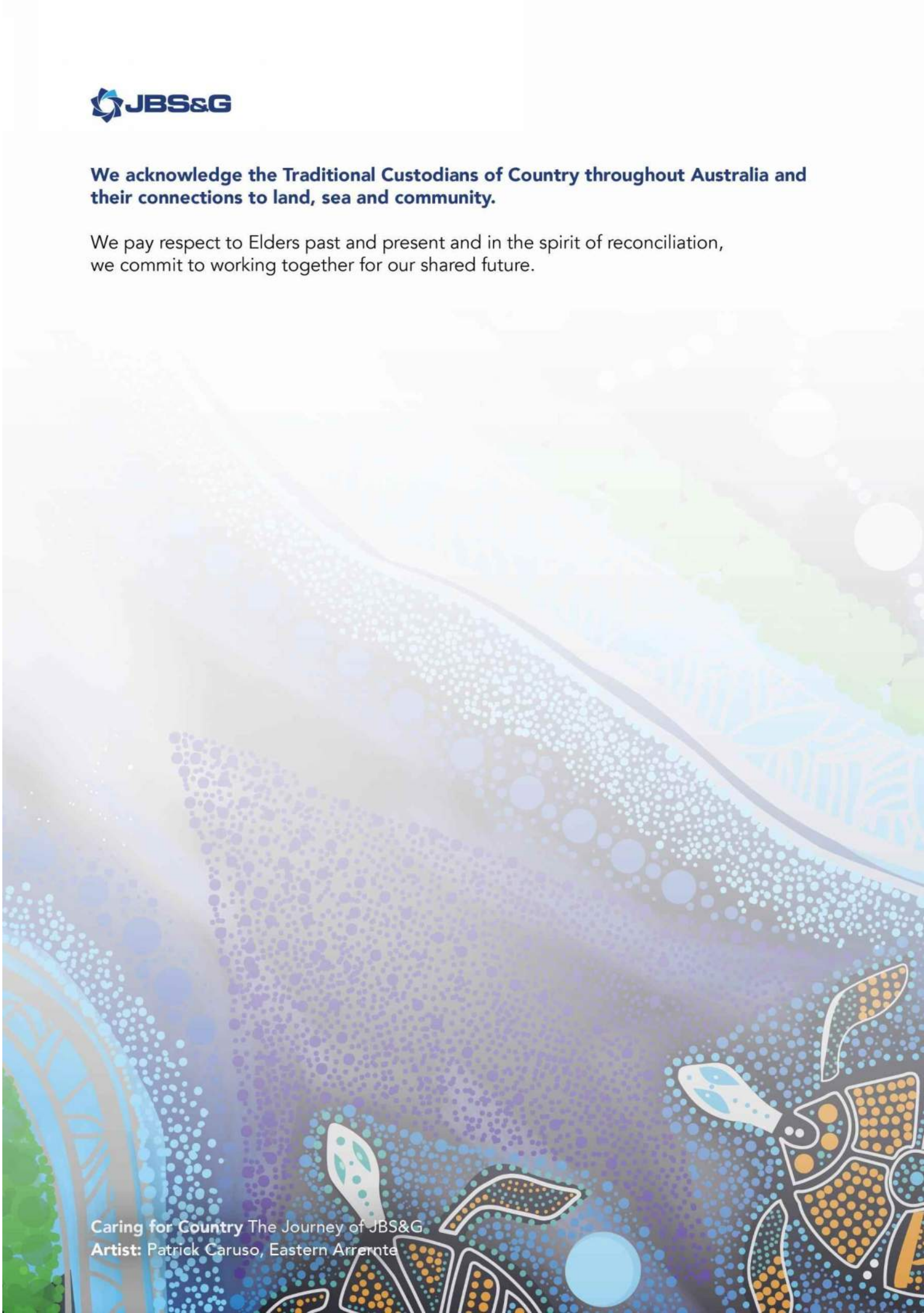
2 July 2024



JBS&G

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.



Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

Abbreviations ..... **v**

1. Introduction **1**

1.1 Background 1

1.2 Objectives 1

2. Site Condition and Surrounding Environment **2**

2.1 Site Identification 2

2.2 Site Description 2

2.3 Surrounding Land-use 3

2.4 Topography 3

2.5 Geology and Soils 3

2.6 Hydrology 3

2.7 Acid Sulfate Soils 3

2.8 Hydrogeology 4

2.9 Meteorology 4

3. Previous Investigations and Summary Site History **5**

3.1 Contamination Investigation – Douglas Partners (DP 2023) 5

3.2 Detailed Site Investigation (JBS&G 2023a) 6

3.3 Human Health Risk Assessment (JBS&G 2023b) 8

3.4 Summary Site History 8

4. Conceptual Site Model **9**

5. Remediation Options **11**

5.1 Guidelines and Legislation 11

5.2 Extent of Remediation 11

5.3 Remediation Objectives 12

5.4 Remedial Options 12

6. Remediation Action Plan **15**

6.1 Approvals, licences and notifications 15

6.2 Site Establishment 15

6.3 Remediation Works 15

6.3.1 Pre-Remediation Activities 15

6.3.2 Excavation of Asbestos Impacted Fill 16

6.3.3 Removal of Sewer Infrastructure and Excavation of CE Impacted Soils 16

6.3.4 Removal of Potential UPSS/USTs and Associated Petroleum Hydrocarbon Impacted Soils (IF ENCOUNTERED) 17

6.3.5 Constraints on Excavation and Stockpiling 17

6.3.6 Bulk Excavation for Basement Construction....17
6.4 Material Importation....18
6.5 Validation....18
6.6 Site Dis-establishment....18
6.7 Contingency Plan....18
7. Validation Plan....19
7.1 General....19
7.2 Data Quality Objectives....19
7.2.1 State the Problem....19
7.2.2 Identify the Decision....19
7.2.3 Identify Inputs to the Decision....20
7.2.4 Define the Study Boundaries....20
7.2.5 Develop a Decision Rule....20
7.2.6 Specify the Limits on Decision Error....22
7.2.7 Validation Inspections and Sampling....24
7.2.8 Excavation of Chlorinated Hydrocarbon Impacted Soil....25
7.2.9 Removal of Asbestos Impacted Soils....26
7.2.10 Removal of Residual UPSS/USTs and Operational Infrastructure (If encountered)....26
7.3 Validation Criteria....26
7.3.1 Soil....26
7.3.2 Soil Vapour....27
7.3.3 Waste Disposal Off-site....27
7.3.4 Transport of Asbestos Impacted Materials....27
7.4 Validation Reporting....28
8. Unexpected Finds....29
9. Site Management Plan....31
9.1 Contact Persons....31
9.2 Hours of Operation....31
9.3 Soil and Water Management....31
9.3.1 Stockpiles....32
9.3.2 Site Access....32
9.3.3 Excavation Pump-out....32
9.4 Noise....33
9.5 Vibration....33
9.6 Air Quality....33
9.6.1 Dust Control....33
9.6.2 Occupational Asbestos Air Monitoring....33

©JBS&G Australia Pty Ltd

9.6.3 Odour 35
9.7 Groundwater 35
9.8 Material Transport 35
9.9 Hazardous Materials 35
9.10 Disposal of Contaminated Soil 35
9.11 Site Signage and Contact Numbers 36
9.12 Community Relations 36
9.13 Site Security 36
9.14 Occupational Health and Safety 36
10. Health and Safety 37
10.1 Responsibilities 37
10.2 Hazards 38
10.3 Chemical Hazards 38
10.4 Physical Hazards 38
10.5 Personal Protective Equipment 40
10.6 Emergency Response 41
11. Regulatory Approvals / Licencing 42
11.1 Protection of the Environment Operations Act 1997 (POEO 1997) 42
11.2 State Environment Planning Policy (Resilience and Hazards) 2021 42
11.3 Protection of the Environment Operations (Waste) Regulation 2014 43
11.4 Waste Classification Guidelines (EPA 2014a) 43
11.5 Asbestos Removal Regulations and Code of Practice 43
11.6 Willoughby Council (2023) 'Development Control Plan' 43
12. Conclusions 44
13. Limitations 45

List of Figures

Figure 1: Site Location

Figure 2: Site Layout

Figure 3: Historical Sample Locations

Figure 4: Sample Locations

Figure 5: Soil Exceedances

Figure 6: Groundwater Exceedances

Figure 7: Sub-slab Vapour Exceedances

Figure 8: Inferred Remedial Extent

Appendices

Appendix A **Historical Datasets**

Appendix B **Development Plans**

Appendix C **Human Health Risk Assessment**

©JBS&G Australia Pty Ltd

Abbreviations

Term	Definition
ACM	Asbestos Containing Material
AEC	Area of Environmental Concern
AHD	Australian Height Datum
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure
ASS	Acid Sulfate Soils
AST	Aboveground Storage Tank
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CLM Act	Contaminated Land Management Act 1997
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DLWC	NSW Department of Land and Water Conservation
DP	Deposited Plan
DSI	Detailed Site Investigation
EPA	NSW Environment Protection Authority
ESG	Environmental Services Group
ha	Hectare
JBS&G	JBS&G Australia Pty Ltd
LEP	Local Environmental Plan
LGA	Local Government Area
LPG	Liquified Petroleum Gas
NEPC	National Environment Protection Council
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
PAHs	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PDNSW	Property & Development New South Wales
POEO Act	Protection of the Environment Operations Act 1997
PSI	Preliminary Site Investigation
PFAS	Per- and Poly-fluoroalkyl Substances
RAP	Remedial Action Plan
SAQP	Sampling Analysis and Quality Plan
TCE	Trichloroethene
TRH	Total Recoverable Hydrocarbons
UST	Underground Storage Tank

©JBS&G Australia Pty Ltd

1. Introduction

1.1 Background

JBS&G Australia Pty Ltd (JBS&G) was engaged by SJD NB Pty Ltd (the client) to prepare a Remedial Action Plan (RAP) for the property located at 57-69 Strathallen Avenue, Northbridge, NSW (the site). The site location and site layout are presented on **Figure 1** and **Figure 2**, respectively.

The site is currently occupied by existing commercial buildings and associated carpark areas. At the time of recent assessments, the buildings were partially operational and used for commercial purposes that included a restaurant and Public House. It is understood that the client intends to demolish the existing structures and construct a multi-level building that will accommodate a two-level tanked basement, with ground-level commercial retail floor and residential apartments in overlying floors (refer to design plans in **Appendix B**). This RAP is required to document the required measures in order to make the site suitable (from a contamination perspective) for the proposed use in order to assist development planning and meet the requirements under SEPP (Resilience and Hazards) 2021 for the development application to be submitted to Council.

The RAP documents remedial works required to address potential contamination issues identified during previous investigations (refer to **Sections 3** and **4**). Specifically, remedial works are required to remove potential on-going sources of contamination as associated chlorinated hydrocarbon impacts predominantly inclusive of trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE) in soil vapour which pose a potentially unacceptable health risk to occupants of the future building. In addition, bonded asbestos impacts have been identified in site soils which require to be removed during site development.

This RAP has been developed in general accordance with NEPC (2013[1]) and guidelines made or approved by the NSW Environment Protection Authority (EPA) and relevant Australian Standards.

1.2 Objectives

The objective of this RAP is to document the procedures and standards to be followed in order to remove the risks posed by the identified potential contamination issues, to make the site suitable for the proposed development while ensuring the protection of human health and the surrounding environment.

[1] *National Environmental Protection (Assessment of Site Contamination) Measure 2013*. National Environment Protection Council, 2013 (NEPC 2013).

2. Site Condition and Surrounding Environment

2.1 Site Identification

The site location and layout are shown on **Figure 1** and **Figure 2**, respectively. The site details are summarised in **Table 2.1** below and described in detail within the following sections.

Table 2.1 – Summary Site Details

Item	Details
Site Area	Approximately 0.24 ha
Address	57-69 Strathallen Avenue, Northbridge NSW
Lot and DP	Lot 1 DP 726736 Lot 1 DP172561 Lot 4B DP305190 Lot 4A DP305190 Lot 5 Section 3 DP7122 Lot 6 Section 3 DP7122
LGA	Willoughby Council
Approximate Coordinates - GDA2020-MGA56	E: 334419.4 N: 6257311.5
Land Zoning	Local Centre (B2)
Previous Use	Commercial / Industrial (including dry cleaner and service station)
Proposed Use	Ground-level retail with residential apartments in overlying floors

2.2 Site Description

A detailed site inspection was conducted on 1 December 2023 by an appropriately qualified and experienced JBS&G environmental consultant. Key site features displayed on **Figure 2** and summarised following:

- The site was a rectangular shaped parcel of land and accessed via Strathallen Avenue into a carpark area in the western portion of the site.
- The ground surface in the carpark area comprised of asphalt in which there was no evidence of disused underground storage tanks (USTs) and related infrastructure as associated with the former service station in this area.
- The dry-cleaning operation in the northern portion was no longer operational. The building was vacant and all infrastructure removed. However, based on the layout it appeared the dry-cleaning machines would have been located in the eastern portion of the building. A sewer pit was present at the backdoor (eastern side of the building) in which pooled water with sewage smell was observed. Staining was observed on the ground surface surrounding the pit.
- The commercial spaces on the eastern portion of the site (adjacent to the carpark) were largely vacant with the exception of a restaurant (inaccessible for investigations). No chemical storage or surface staining as associated with potential contamination was observed on the commercial ground floor building spaces in this portion.
- The Northbridge Hotel occupied the southern portion of the site. The Hotel contained a cellar that was approximately 1.5 m below the ground level of surrounding footpaths on Strathallen Avenue and Baringa Road.
- The ground sloped to the south-west as consistent with surrounding land.
- No vegetation was present on the site.

2.3 Surrounding Land-use

Surrounding land-uses at the time of the site inspection are described following:

- **North:** The site is bound to the north by commercial properties and Sailors Bay Road beyond.
- **East:** The site is bound to the east by residential properties comprising Torrens title dwellings with garden accessible soils.
- **South:** The site is bound to the south by Baringa Road with residential properties that are Torrens title dwellings with garden accessible soils beyond.
- **West:** The is bound to the west by Strathallen Avenue with the land beyond, comprising ground-level commercial and residential apartments.

2.4 Topography

The site is situated at approximately 88 m Australian Height Datum (AHD) and was observed to slope to the south-west during the site inspection as consistent with surrounding land.

2.5 Geology and Soils

According to the Sydney 1:100 000 Geological Sheet (1983), the site is underlain by Triassic aged Hawkesbury Sandstone, generally comprising medium to coarse grained quartz sandstone with minor shale and laminite lenses.

Review of eSPADE[2] indicates the site is underlain by residual soils of the Lucas Heights soil Landscape. This is typically characterised by shallow to moderately deep yellow residual clays and sandy clays.

Previous investigations (refer to **Section 3)** reported site soils to comprise of shallow gravelly sandy fill (0.6-0.9 m depth) overlying natural sandy clay and sandstone as consistent with the geological mapping of the site.

2.6 Hydrology

The site is predominantly covered by a building or concrete hardstand. On this basis, the majority of rainwater is expected to be captured within the drainage infrastructure on site and then enter local stormwater infrastructure. Minimal infiltration is expected to occur at the site given the minimal exposed soil.

The nearest surface water receptor is Flat Rock Creek, located approximately 400 m to the south-west, which drains into Middle Harbour.

2.7 Acid Sulfate Soils

Review of map provided by the Atlas of Australia Acid Sulfate Soils indicates the site is mapped as extremely low (1-5 %) probability for the occurrence of acid sulfate soils (ASS). The Willoughby LEP (2012) notes the site is located within Class 5 land, which is defined as an area that is within 500 m of adjacent Class 1-4 land or presents an environmental risk in instances where works extend below 5 m AHD and where the watertable is likely to be lowered below 1 m AHD. Noting that the site has an elevation of > 80 m AHD, ASS are unlikely to be encountered as part of site redevelopment works and as such, further assessment and/or management of ASS is not considered warranted.

[2] *eSPADE v2.2, Environment and Heritage Division – NSW Department of Planning and Environment.* NSW Government, April 2022. www.environment.nsw.gov.au/eSpade2Webapp/# accessed 7 December 2023.

2.8 Hydrogeology

A search for registered groundwater bore information was undertaken on the Water NSW website[3] and no registered bores were noted within a 1 kilometre (km) radius of the site. Previous investigations (**Section 3**) reported site groundwater to be present within sandstone rock (potentially as semi-confined/confined system) and inferred to flow to the south-west in line with regional topography. In addition, site groundwater was reported to be aerobic, fresh and acidic pH.

2.9 Meteorology

A review of average climatic data from nearby Bureau of Meteorology monitoring location (Sydney Airport AMO 066037 – AWS[4]) indicates the site is located approximately within the following meteorological setting:

- Mean minimum temperatures vary from 7.4°C in July to 19.2°C in February;
- Mean maximum temperatures vary from 17.2°C in July to 26.7°C in January;
- The mean annual rainfall is approximately 1092 mm, with rainfall greater than 1 mm occurring on an average of 96 days per year; and
- Monthly average rainfall varies from 59.8 mm in September to 123.7 mm in March with the wettest periods occurring on average in February through to June.

3 http://allwaterdata.water.nsw.gov.au/water.stm accessed 7 December 2023.

4 http://www.bom.gov.au/climate/averages/tables/cw_059006.shtml, Bureau of Meteorology, prepared and accessed 7 .

3. Previous Investigations and Summary Site History

A detailed account of the site history is provided in the historical reports completed at the site which are summarised below. Sampling locations from historical investigations are presented in **Figures 3** and **4** respectively. In addition, historical datasets are summarised in analytical tables presented in **Appendix A**.

3.1 Contamination Investigation – Douglas Partners (DP 2023)[5]

Douglas Partners (DP) completed a pre-purchase due diligence investigation in April 2023. The scope of works included a limited desktop review and intrusive investigations comprising limited soil, groundwater and vapour sampling.

DP reported that the site operated as commercial real estate since the 1940s. Between 1951 and 1986, it was reported that the site accommodated a service station and/or motor mechanic. An operational dry-cleaner was further reported in the northern portion of the site in which the following was noted:

- The dry-cleaning machine and associated solvents were located in the back (eastern portion) of the building.
- The dry-cleaning machine comprised a third-generation closed loop machine (which recaptures the drycleaning solvent). The volume of drycleaning solvent observed to be stored on-site amounted to less than 500 L.
- A sewer line ran parallel to the rear of the dry cleaner. A number of washing machines were present in the rear corridor adjacent to the sewer line. Chemical staining was observed on the carpet in this section suggesting the potential for spills or leaks in the area that could impact the sewer.

An interview was conducted with the existing tenants, in which the following was communicated:

- The site operated as a service station in the past.
- The underground storage tanks may still be present beneath the car park.
- Restaurant operations along Sailors Bay Road, discharge large volumes of waste (oil and grease) directly into the sewer lines, causing blockages every 6 month or so.

The general subsurface conditions encountered during the investigation were reported as follows:

- Asphaltic Concrete: in boreholes BH1 and BH2, of approximately 50 mm in thickness.
- Fill: in all boreholes comprising a sandy gravel matrix of igneous (roadbase) and sandstone gravels, with clay nodules mixed-in to a depth of between 0.6 to 0.9 m bgl.
- Natural (residual): natural soils beneath the site comprise residual sandy clays to a depth of 1.38 m bgl.
- Hawkesbury sandstone: the bedrock beneath the site comprised Hawkesbury sandstone interbedded with siltstone lenses of the Mittagong formation.

Select soil samples were analysed for heavy metals, polycyclic aromatic hydrocarbons (PAHs), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylenes (BTEX), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), asbestos and Per- and polyfluoroalkyl substances

[5] *Contamination Investigation*, Pre-purchase Due Diligence, 57-69 Strathallen Avenue, Northbridge, Douglas Partners, April 2023 (DP 2023).

(PFAS). No exceedance of health based criteria (residential for minimal access to soils – HIL-B) were reported within site soils.

It was reported that site groundwater had been impacted by contaminants associated with historical on-site and potentially nearby off-site activities as summarised following:

- Elevated concentrations of chlorinated VOCs, particularly Tetrachloroethene (PCE) and Cis-1,2-dichloroethene (cis-DCE) were detected in BH2 and exceeded adopted Marine default guideline value (DGV).
- Elevated TRH, particularly fractions 1 (F1) and 2 (F2) were recorded in both samples.
- Dissolved copper, nickel and zinc exceeded the screening criteria assuming a slightly / moderately disturbed marine aquatic ecosystem. This was attributed to the regional groundwater quality.
- Dissolved lead exceeded the adopted criteria in BH2. Based on the anecdotal evidence outlined in previous sections, it is considered that lead concentrations may be associated with the historical use of the site as a service station and/or mechanical workshop.

Elevated concentrations of chlorinated VOCs in soil vapour, as summarised following:

- Vinyl Chloride (VC) with highest recorded concentration of 280 µg/m^3.
- Trans-1,2-dichloroethene (trans-DCE) with highest recorded concentration of 200 µg/m^3.
- Cis-DCE with highest recorded concentration of 3500 µg/m^3.
- Chloroform with highest recorded concentration of 420 µg/m^3.
- Trichloroethene (TCE) with highest recorded concentration of 4800 µg/m^3.
- PCE with highest recorded concentration of 37000 µg/m3.

It was recommended that further intrusive testing and investigation be completed to adequately characterise the potential contamination risks as associated with the groundwater and soil vapour impacts reported above.

3.2 Detailed Site Investigation (JBS&G 2023a)[6]

JBS&G recently completed a DSI to assess the suitability of the site for the proposed use in order to assist development planning and meet the requirements under SEPP (Resilience and Hazards) 2021 for the development application to be submitted to Council. The scope of works included a desktop assessment and program of soil, groundwater and soil vapour sampling and analysis. The following provides a summary of the investigation findings/conclusions:

- Desktop information indicate the site was largely used for commercial / industrial purposes that have included a dry-cleaning operation in the northern portion (since the 1950s until recently), a service station and motor garage in the central portion (from approximately the 1950s until at least 1981) and Public House / Hotel in the southern portion (likely from the 1940s until present).
- The potential sources of contamination identified at the site included; anthropogenic fill materials of unknown origin used to create existing/current site levels, former structures potentially containing hazardous materials and historical industrial activities (including dry-cleaning, service station and motor garage). As part of former site operations, liquid chemicals (dry-cleaning fluids) were likely disposed in a sewer pit within the northern portion which has resulted in impacts to

[6] *Detailed Site Investigation*, 57-69 Strathallen Avenue, JBS&G Australia Pty Ltd, 14 December 2023 (JBS&G 2023a).

site media. In addition, there is potential disused underground storage tanks (USTs) as associated with the former station still present within the central portion of the site.

- Representative samples of fill material and natural soils within the site (at 6 locations) were analysed for a range of identified potential contaminants of concern including heavy metals, PAHs, TRH, BTEX, VOCs, OCP/PCBs, PFAS and asbestos. With the exception of asbestos and volatile impacts (causing impacts to soil vapour as discussed below), the concentration of COPCs were all below the health based criteria. Bonded asbestos impacts were identified by laboratory analysis in sample BH104 0.5-0.6 with an estimated concentration of 0.036% w/w which exceeds the adopted health criterion. Whilst the presence of hardstand across the majority of the site will preclude exposures to shallow soils for current / future users of the site, the asbestos impacts will require management/remediation in order to make the site suitable for the proposed use (particularly in instances where the impacted soils are relocated to landscaped areas etc). It is also acknowledged that the advancement of boreholes is not the preferred method for the investigation of asbestos in soils (due to the limited volume of material able to be inspected). However, given the existing pavement and operational nature of the site, pavement removal and subsequent test pitting was not feasible. As such, considering the observation of varying levels of building and demolition wastes in site fill, there is the potential for additional fill materials at the site to contain asbestos.
- Similar to the soil assessment, representative samples of groundwater from 7 locations were analysed for a range of identified potential contaminants of concern including heavy metals, PAHs, TRH, OCPs, VOCs, phenols, phthalates and PFAS. Elevated levels of heavy metals and PFOS were reported in site groundwater but not considered to be sourced from historical activities at the site and are indicative of background conditions within the surrounding environment. As such, these impacts do not require further assessment or remediation.

  Consistent with previous investigations, petroleum and chlorinated hydrocarbon impacts were reported in shallow groundwater at the site. The areas of greatest groundwater impact were downgradient of the former dry-cleaner and require further assessment / remediation to address potential vapour intrusion risks to future occupants of the proposed building.
- The TRH impacts primarily comprise petroleum hydrocarbons as light (TRH C_6-C_{10}) and medium-heavy chain (TRH >C_{10}-C_{40}) compounds that were encountered in the central portion of the site (adjacent to the UST). Whilst the impacts appear confined to the site and not likely to pose a risk to future on or off-site receptors (given the results of sub-slab vapour investigation), the degradation of these constituents is potentially resulting in the generation of methane gas and therefore requires management.
- A sub-slab vapour assessment was completed at 23 locations across the site. Elevated levels of 1,2-dichloropropane, cis-1,2-DCE, PCE, TCE, VC, chloroform and bromodichloromethane were reported in sub-slab vapour at various locations across the site (refer to **Figure 7**). The impact appears largely related to the former dry-cleaning operation given the highest level of impact were reported in the footprint of the building and downgradient areas. It appears the former operator disposed of dry-cleaning fluids down the sewer pit at the rear of the building which has caused impact to soils and groundwater. The elevated pose a potential unacceptable health risk to occupants of the future building and will require further assessment and potential remediation to address health risks (via vapour intrusion) to occupants of the building.
- It is considered that further assessment in the form of human health risk assessment (HHRA) will be required to determine if hydrocarbon (both petroleum and chlorinated) impacts in site soils, groundwater and soil vapour will pose a risk to future site users under the proposed development and downgradient receptors. The HHRA will develop site-specific risk-based criteria that will inform the extent of required remediation at the site to be documented in a Remedial Action Plan

(RAP). The RAP will further provide an appropriate framework and procedure for managing the following issues:

- The extent of required remediation to address petroleum and chlorinated hydrocarbon impacts in site media.
- Asbestos impacts in shallow fill based soils.

How to appropriately decommission any underground storage tanks (USTs) and associated infrastructure that may be encountered in the central portion of the site within the former service station area (**Figure 2b**) in accordance with the UPSS Regulation (2020)[7].

3.3 Human Health Risk Assessment (JBS&G 2023b)

A human health risk assessment (HHRA) was completed to determine constituents and associated site media that required remediation (JBS&G 2023b)[8] and provided in **Appendix C**. Based on the outcomes of the assessment, the following was noted as require to be adopted in the preparation of the RAP for the site:

- Basements designed and operated to mitigate potential inflow of groundwater and/or potential accumulation of standing water as puddles etc within the basement; and
- Remediation of chlorinated ethene impacted soils within site unsaturated zones to achieve soil vapour validation criteria of 7.6 and 29 mg/m^3 respectively for TCE and cis-1,2-DCE.

3.4 Summary Site History

The site was largely used for commercial / industrial purposes that have included a dry-cleaning operation in the northern portion (since the 1950s until recently), a service station and motor garage in the central portion (from approximately the 1950s until at least 1981) and Public House / Hotel in the southern portion (likely from the 1940s until present). Based on the range of sources and the general consistency of the historical information, it is considered that the historical assessment has an acceptable level of accuracy with respect to identifying potential contaminating activities historically occurring at the site.

[7] *Guidelines for implementing the POEO (Underground Petroleum Storage Systems) Regulation 2019* (December 2020) (UPSS Regulation)
[8] *Human Health Risk Assessment*, 57-69 Strathallen Avenue, JBS&G Australia Pty Ltd, 14 December 2023 (JBS&G 2023b).

4. Conceptual Site Model

National Environment Protection (Assessment of Site Contamination) Measure, NEPC, 1999 (as amended 2013, NEPC 2013) identifies a conceptual site model (CSM) as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments.

NEPC (2013) identified the essential elements of a CSM as including:

- Known and potential sources of contamination and contaminants of concern including the mechanism(s) of contamination;
- Potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air);
- Human and ecological receptors;
- Potential and complete exposure pathways; and
- Any potential preferential pathways for vapour migration (if potential for vapours identified).

Each of these elements is discussed in **Table 4.1** following as relevant to the scope of this risk assessment.

Table 4.1: Conceptual Site Model

CSM Element	Description
Contamination Source(s)	Historical aerial images (JBS&G 2023) indicate the site was largely used for commercial / industrial purposes that have included a dry-cleaning operation in the northern portion (since the 1950s until recently), a service station and motor garage in the central portion (from approximately the 1950s until at least 1981) and Public House / Hotel in the southern portion (likely from the 1940s until present). Chlorinated hydrocarbon impact at the site has likely resulted from the historical use (including potential leaks and spills) of tetrachloroethene (PCE) as part of dry-cleaning operations and likely uncontrolled disposal of dry cleaning solvent. Potential discharges of PCE may have occurred to site sewer services, which can contaminate soil and groundwater where leaks subsequently occur from the sewer pipes.
Affected Media	Chlorinated ethene contaminated soils, groundwater and soil vapour have been found at the highest levels in proximity of a sewer easement and in proximity of the location of the former dry cleaner. Levels of chlorinated ethenes as reported in soils and groundwater are not indicative of the occurrence of NAPL. The highest levels of soil vapours are present in proximity of the former dry cleaner and a sewer easement within the site, with lower though still significantly elevated levels extending laterally away as consistent with increased potential migration distances of soil vapour based contamination.
Human Receptors	The risk assessment is specific to the redeveloped site. Potential human receptors are identified as: • Future site residents with buildings / basements to be constructed on the site. This is inclusive of buildings as constructed overlying the proposed basement; • Recreational users of the areas of proposed landscaped / courtyard areas as located on the eastern boundary of the site; • Gardeners / landscapers as engaged in the unpaved areas of the site. This will include surface activities associated with maintenance of site landscaping as well as occasional deep works / works within excavations; • Commercial / industrial workers as potentially engaged within buildings / basements and further within outdoor areas of the site; • Sub-surface excavation / intrusive / maintenance workers as required to undertake sub-surface works as associated with the maintenance of site services; and • Potential lift maintenance workers whom will be engaged in potential lift pits as constructed within site basements or otherwise other maintenance works within the site basement.
Ecological Receptors	Ecological receptors refer to potential flora communities as may be established on the site with the site landscaping. Potentially sensitive receptors of groundwater are associated with Flat Rock Creek located a substantial distance hydrogeologically downgradient of the site. Direct exposures of on-site ecological receptors will be typically restricted to the media as used n site landscaping / growing zones.
Exposure Pathways	All users will be potentially exposed to volatile constituents by inhalation pathways. For surface receptors this will be by formation of soil vapour and diffusion of soil vapour to the site surface. For basement / building users this will be potential vapour intrusion to basements through unsaturated horizons and potential volatilisation of

CSM Element	Description
	constituents from wet walls as caused by seepage to the basement. Groundwater is potentially present from as shallow a depth as 3.5 m below ground surface (bgs) with depths ranging to 9.9 m bgs. It is likely that the basement will extend below the depth of groundwater on the site. Basement users will further be potentially exposed by direct exposure pathways to constituents present in infiltrating groundwater and present on wet walls. This will be by direct contact to wet walls, or otherwise puddles of pooled infiltrating seepage water. Potential direct and inhalation exposure pathways will occur to constituents present in soils in landscaped portions of the site. Inhalation exposures would be inclusive of vapours (for volatile constituents) as well as particulates.
Preferential Pathways	There is a potential for future preferential pathways to be formed on the site with the future installation of services and construction of a basement that intersects the migration of groundwater contamination. The preferential pathways of their own would not cause the maximum levels of groundwater impact to increase, but may potentially redistribute groundwater contamination. The basement may cause a redistribution of groundwater contaminants within the site. With respect to vapour migration, *Vapor Intrusion Pathway: A Practical Guideline*, 2007, ITRC reports that lift shafts in multi-storey buildings may be a potential source of vapour intrusion into overlying floors, acting as a preferential pathway.

5. Remediation Options

5.1 Guidelines and Legislation

The RAP has been prepared with reference to the following guidelines and legislation:

- DECC (2007) Guidelines for the Assessment and Management of Groundwater Contamination, DECC March 2007;
- EPA (2014a) Waste Classification Guidelines – Part 1: Classifying Waste. NSW Environment Protection Authority dated 2014;
- EPA (2017) Contaminated Land Management Guidelines for the NSW Site Auditor Scheme (3rd edition). NSW Environment Protection Authority dated October 2017;
- Work Health and Safety Regulation 2017;
- SWA (2020a) How to safely remove asbestos - Code of Practice. Safe Work Australia, 2020;
- SWA (2020b) How to manage and control asbestos in the workplace - Code of Practice. Safe Work Australia, 2020;
- EPA (2020a) Consultants Reporting on Contaminated Land Contaminated Land Guidelines, NSW Environment Protection Authority dated April 2020;
- Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2020 under the Protection of Environment Operations Act 1997 (UPSS Regulation 2020);
- State Environment Planning Policy (Resilience and Hazards) 2021 (SEPP-RH); and
- (EPA 2022) Contaminated Land Guidelines: Sampling design part 1 – application.

5.2 Extent of Remediation

Remediation works are required to address unacceptable health risk to potential occupants of the site and include:

- Decommission and remove historical petroleum infrastructure as related to the former operation of a service station on the site at least inclusive of historical underground storage tanks;
- Remediation of bonded asbestos impacted soils in the central portion of the site. The asbestos hotspot is estimated at comprising up to 100 m^3 of soils. However, the asbestos impacts are not yet delineated and the remedial extent will be informed by observations during remediation. As such, the excavation will proceed until validation is achieved, however a nominal extent is shown on **Figure 8;**
- Basements designed and operated to mitigate potential inflow of groundwater and/or potential accumulation of standing water as puddles etc within the basement. It is noted that the basement design is proposed to be tanked to preclude ingress of groundwater, which exceeds the standard nominated in response to site contamination. The extent of proposed basement is shown on **Figure 8**; and
- Remediation of chlorinated ethene impacted soils within site unsaturated zones to achieve soil vapour validation criteria of 7.6 and 29 mg/m^3 respectively for TCE and cis-1,2-DCE. This will require excavations beyond the basement footprint in the northern portion of the site as shown on **Figure 8**. In this portion, excavations will proceed to a depth until results of validation sampling meet the remediation criteria or to a maximum depth of groundwater (approximately 3-5 m below ground surface, bgs).

©JBS&G Australia Pty Ltd

As noted, though not confirmed as present, there is potential that disused USTs may be encountered in the former service station footprint during remediation activities or during bulk excavation of the basement. If encountered, the USTs will require decommissioning in accordance with the UPSS Regulation (2020).

5.3 Remediation Objectives

The objectives of the remediation are:

- To make the site suitable from a human health perspective for the proposed development; and
- To cause effective removal of chlorinated hydrocarbon source material and allow for the restoration of groundwater quality to the extent practicable

In summary, the objective of the remediation is to remove/manage potential risks posed by the identified contamination issues, such that the site is made suitable for the proposed development. It is a further objective to undertake works, in accordance with applicable guidelines and legislation, in a manner which is consistent with the principles of ecologically sustainable development (ESD).

5.4 Remedial Options

The preferred hierarchy of options for remediation (clean up) and/or management adopted by NSW EPA has been established within the NEPC (2013) Assessment of Site Contamination Policy Framework as follows:

- On-site treatment so that the contaminant is either destroyed or the associated risk is reduced to an acceptable level; and
- Off-site treatment so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site; or

If the above options are not practicable:

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

In addition, when deciding which option to choose, consideration is also required to be given to the sustainability (environmental, economic and social) aspects of each option to ensure an appropriate balance between the benefits and effects of undertaking remedial/management options.

In cases where no readily available or economically feasible method is available for remediation, it may be possible to adopt appropriate regulatory controls or develop other forms of remediation.

Consideration of each of the approaches (EPA 2017), is presented in **Table 5.1**.

Table 5.1: Remedial Options Screening Matrix

Remedial Option	Applicability	Assessment
1. On-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level.	Chlorinated Hydrocarbon Impacted Soils Treatment of chlorinated hydrocarbons is most commonly undertaken by a process to cause volatilisation of chlorinated hydrocarbon from the soils, and capture and treatment / destruction of the volatilised chlorinated hydrocarbons.	Not appropriate. Based on similar projects undertaken by JBS&G, the space required to treat the chlorinated hydrocarbon impacted soils to cause the volatilisation of the sorbed constituents and capture and treat the emissions is not available on the site. The treatment of a substantial quantity of contaminated soils on the site within an established residential precinct is further likely not aligned with community expectations of the project.
	Asbestos Impacted soils Not an applicable option for asbestos as there are no treatment options for bonded ACM in soils (i.e. it is not longer aligned with EPA policy to remediate bonded asbestos impacted soils via emu-picking).	Not appropriate.
	USTs (if encountered) The UPSS Regulation requires any disused petroleum storage infrastructure to be removed from the site where it is possible to do so. Given that if a UST is present, it will most likely be in the basement footprint, it will require removal to facilitate the construction of the basement.	Not appropriate.
2. Off-site treatment so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level, after which the soil is returned to the site.	Chlorinated Hydrocarbon Impacted Soils Facilities are available at Altona (Vic) and Dandenong (Vic) to treat chlorinated hydrocarbon impacted soils by thermal processes.	Not appropriate. The environmental impacts of the cartage of a large volume of soils to Victoria for treatment is not a preferred remedial method compared to the options considered following. Previous recent experience of JBS&G further indicates that the transport would require to occur over several weeks due to the absence of available road tippers that are appropriate to cart contaminated soils over interstate distances. Vic EPA permits are also unlikely as disposal facilities are available in NSW for the materials.
	Asbestos Impacted soils As above (Option 1).	Not appropriate.
	USTs (if encountered) Not an applicable option with respect to any potential USTs.	Not applicable.
3. On-site *in-situ* management of the contaminant by capping and cover, and ongoing management.	Chlorinated Hydrocarbon Impacted Soils Where management is adopted for the chlorinated hydrocarbon impacted soils there will require to be an appropriate location on the site where the soils can be retained, and will further require construction / preparation to eliminate the potential for leaching of impacts and/or release of vapours.	Not appropriate. The extent of monitoring that would be required for a site containment of chlorinated hydrocarbon impacted soils is not consistent with the expectations of a substantially residential development. With the extent of basements proposed there is insufficient space to retain the soils in an unsaturated horizon. This would potentially lead to soils currently present in the unsaturated zone being transferred to the saturated zone.

Remedial Option	Applicability	Assessment
	Asbestos Impacted soils Noting that the identified bonded asbestos impacts are within the basement footprint, this is not the preferred option. However, in instances where more widespread impacts are identified, the impacted materials could be contained in an area that precludes future site users to exposures (i.e. by placement under hardstand etc). Under such a scenario, an asbestos register/asbestos management plan would be required at the site to document the presence/location of bonded asbestos materials.	Not the preferred option.
	USTs (if encountered) Not an applicable option with respect to any potential USTs given location within basement footprint.	Not applicable.
4. Excavation and off-site removal of the impacted material.	Chlorinated Hydrocarbon Impacted Soils Chlorinated hydrocarbon impacted soils are able to be classified as NSW EPA waste classification guidelines and disposed at EPA licensed waste facilities typically located within 70 km of the site..	**The preferred option.** This is the preferred option for the chlorinated hydrocarbon impacted soils as it results in the removal of the contamination from the site and has the lowest environmental impacts within the extent of the site location within an area of potentially sensitive human receptors. The option is further readily able to be implemented with availability resources in the Sydney region and can be combined with the proposed substantial extent of excavations already proposed for the placement of the basement on the site.
	Asbestos Impacted soils As consistent with chlorinated hydrocarbon impacted soils, these materials are able to be classified for off-site disposal in Sydney. It further removes all asbestos impacts from the site with no requirement for on-going management.	**The preferred option**
	USTs (if encountered) The preferred option in accordance with the UPSS Regulation as it will result in the removal of the primary source of potential contamination and allow for the remediation of any associated impacts in surrounding soils.	**The preferred option**

Should further impacted material (i.e. not previously identified in historical investigations) be identified as part of an unexpected find during construction works or as part of pre-remediation activities, the remedial options screening matrix in **Table 5.1** will be required to be reviewed. Notwithstanding, it is anticipated that any impacts will be relatively isolated and could be appropriately managed through controlled excavation and off-site disposal or on-site containment (where contaminants are relatively inert and do not pose a risk to groundwater or at significant levels within soil vapour).

6. Remediation Action Plan

6.1 Approvals, licences and notifications

State Environment Planning Policy (Resilience and Hazards) 2021

From review of the site location and proposed activities, the remediation works are classified as Category 2 Remediation Works (**Section 11.2**) as per the meaning provided in *State Environment Planning Policy (Resilience and Hazards) 2021* (SEPP-RH) and will not require specific development consent under the *Environmental Planning and Assessment Act 1997*.

Notification of remediation works will be required to be given to Council at least 30 days prior to commencement, and Council requires notification within 30 days from completion of remediation works, consistent with SEPP-RH requirements and Council's Contaminated Land Policy.

Remediation works shall not commence until all required approvals, licences and notifications have been granted and/or received.

6.2 Site Establishment

All safety and environmental controls are to be implemented as the first stage of remediation works. These controls will include, but not be limited to:

- Locate and isolate all required underground utilities within the site such that excavation works can safely proceed;
- Assess the potential impacts of the excavation works to neighbouring properties. It is recommended that a suitably qualified engineer be consulted prior to any excavation works, such that appropriate controls (if required) can be implemented;
- Assess need for traffic controls;
- Work area security fencing;
- Site signage and contact numbers; and
- Sediment fencing as appropriate to mitigate sediment laden runoff from the site.

6.3 Remediation Works

6.3.1 Pre-Remediation Activities

Hardstand Removal and Surface Inspection

All existing hardstand surfaces shall be removed as part of site works, in which the materials will require inspection (by the environmental consultant and remedial contractor) for the potential presence of adhered asbestos (that may be encountered on the underside of the slabs) prior to potential crushing and off-site disposal in accordance with the requirements of NSW EPA (2014a).

Following the complete removal of all hardstand surfaces, the environmental consultant shall undertake a walkover (in a 2 m by 2 m grid) to identify any additional potential sources of contamination (such as surface staining, unidentified infrastructure etc) that may require remediation. Should surface staining or additional infrastructure be identified, then the underlying materials / features will be required to assessed or managed in accordance with **Section 6.3.2** to **Section 6.3.4**. Should a unique source of contamination be identified (i.e. different from that identified as part of the site history in **Sections 3** and **4**) then the unexpected find protocol (**Section 8**) will be required to be implemented.

GPR Survey

Following the demolition and removal of all above ground structures and hardstand surfaces, a ground penetrating radar (GPR) survey will be required to be conducted by an appropriate professional (under the supervision of the environmental consultant) on an approximate 2 m grid over the former service station area. The survey will attempt to identify any underground anomalies which may be indicative of a UST or other potential source of hydrocarbon contamination (sump, pit etc).

Where potential USTs, sumps or pits are identified, then test pitting will be required to be conducted until the infrastructure is positively identified or confirmed to be absent.

6.3.2 Excavation of Asbestos Impacted Fill

The localised instance of asbestos impacted soil requires to be excavated and disposed from the site. Asbestos impacted soils require to be separated from residual soils in the central portion of site (if possible) prior to commencement of CE impacted soil remediation (see **Section 6.3.3**).

The following work procedures are to be followed:

- Fill-based soil shall be excavated over an approximate area of 10 m x 10 m up to a depth of 0.9 m (i.e. extent of fill material) over former sample location BH105;
- Where this area coincides with soils to be remediated as part of **Section 6.3.3,** the asbestos impacted soils shall be separately stockpiled/managed so as to minimise the required controls for handling asbestos contaminated soils;
- The resulting excavation will require validation in accordance with **Section 7.2.8**; and
- The excavated impacted soils shall be placed in stockpile and sampled for waste classification purposes in accordance with **Section 7.3** prior to off-site disposal.

Should more widespread bonded asbestos impacts be observed on the ground surface of exposed soils following hardstand removal (**Section 6.3.1**), then all fill based soils at the site shall be assumed to be impacted with bonded asbestos and require excavation and off-site disposal. Where it is not possible / desirable to excavate asbestos impacted fill, a contingency option of on-site containment (**Section 6.7**) and on-going management can be implemented.

6.3.3 Removal of Sewer Infrastructure and Excavation of CE Impacted Soils

The primary source of CE impacted soils and groundwater at the site appears to be the former dry-cleaner where solvents were likely disposed to sewer. As such, prior to any bulk excavations for basement construction, all highly impacted materials acting as on-going source to soil and groundwater impact will require excavation and off-site disposal. The following general work methodology shall be followed:

- The first step will comprise decommissioning of all underground utilities within the remediation area which is anticipated to comprise the northern portion of the site beyond the basement footprint as shown on **Figure 8**;
- The most highly impacted soils are noted to be present adjoining the sewer pipe at the rear of the former dry-cleaner. The excavation is proposed to be undertaken in an 'inside-out' manner as starting at the most highly impacted location and extending vertically and laterally for the extent of impacted soils as instructed by validation sampling
- Impacted soils shall be progressively excavated under the supervision of the Environmental Consultant until all grossly impacted soils have been removed from the excavation to the practical extent. The resulting excavation will require validation in accordance with **Section 7.3.2**. Where possible, fill and natural soils (that require excavation for remedial purposes) should be segregated, handled and managed separately to minimise the extent of asbestos related management controls; and

- The excavated impacted soils shall be placed in stockpile and sampled for waste classification purposes in accordance with **Section 7.3** prior to off-site disposal.

6.3.4 Removal of Potential UPSS/USTs and Associated Petroleum Hydrocarbon Impacted Soils (IF ENCOUNTERED)

Any residual UPSS/USTs encountered as part of pre-remediation activities (**Section 6.3.1**) and/or during bulk excavation of the basement will require decommissioning in accordance with relevant Australian Standards. In general, the following work procedures are to be followed:

- The USTs should be emptied of all dangerous goods and made gas-free. Any contents of the tank will be disposed off-site in accordance with EPA (2014a);
- Where possible, all associated piping should be disconnected and made safe so that no flammable or combustible liquid remain;
- UPSS/USTs will be excavated for off-site disposal in accordance with EPA (2014a); and
- It is anticipated that soil impacts will be present proximal to the UPSS/USTs. Impacted soils shall be progressively excavated under the supervision of the Environmental Consultant until all grossly impacted soils have been removed from the excavation to the practical extent. The resulting excavation will require validation in accordance with **Section 7.2.9**. Where possible, fill and natural soils (that require excavation for remedial purposes) should be segregated, handled and managed separately.

6.3.5 Constraints on Excavation and Stockpiling

The practicable limits of excavation include the consideration of the following:

- Physical limitations of available equipment;
- Geotechnical constraints associated with excavation safety and excavation stabilisation requirements (e.g. benching) and / or potential effects on nearby infrastructure. As such, specialist geotechnical and/or structural engineering advice will be required to inform safe excavation requirements, noting that excavations will only proceed to the extent that they do not undermine the structural integrity of any neighbouring structures as informed by the specialist's recommendations; and
- Structural constraints should the excavation extend to a close proximity to roadways, footpaths, building and underground conduits.

Site won fill obtained from areas of the site not impacted by asbestos or hydrocarbons and / or validated, stockpiled soils will be used to partially backfill the open excavations, battering the excavation edges to minimise fall hazards if required.

6.3.6 Bulk Excavation for Basement Construction

Only following completion of remedial steps as outlined in preceding sections (i.e. **Section 6.3.1 to Section 6.3.4**) where the results of validation sampling (as conducted by the Environmental Consultant) demonstrate that the remedial objectives have been met, can bulk excavations for basement construction proceed. It is anticipated that residual hydrocarbon impact will remain in natural soil / sandstone bedrock during bulk excavation works and as such, materials will require to be placed in stockpile and sampled (in accordance with **Section 7.3)** to inform off-site disposal or beneficial re-use options of the materials.

6.4 Material Importation

Based on the scope of remedial works described herein, it is anticipated that if materials are required to be imported to site, it will generally be as a result of construction requirements or otherwise to ensure appropriate growing media are established within the landscaped areas as proposed in the north-eastern portion of the site.

Prior to importation of all material, appropriate assessment of such materials must be completed to demonstrate the material is both fit for purpose and suitable from a contamination view point. In accordance with EPA requirements, the extent of assessment will be determined by the type of material proposed to be imported.

Where material proposed to be imported is Virgin Excavated Natural Material (VENM), an assessment must demonstrate that the material is compliant with the definition of VENM as presented in the POEO Act 1997, adopting in the minimum requirements for characterisation of fill material as presented in EPA (2022).

Where material proposed to be imported has been characterised under the Resource Recovery Framework (Order/Exemption), the material must firstly be demonstrated by the supplier as suitable for use in accordance with the requirements of the Order via provision of a statement of compliance. Suitable materials are anticipated to comprise but will not necessarily be limited to: excavated natural material – ENM, recycled aggregate, basalt fines, compost, mixed organic waste, pasteurised garden organics and recovered fines, with reference to the list of current orders and exemptions on the NSW EPA website.

In addition to the testing completed by the supplier, given the low frequency of compliance testing required under these Exemptions, the specific material proposed to be imported will require an additional compliance assessment prior to approval to import. The additional assessment is required to ensure that the incoming material does not pose an unacceptable risk to human health and/or environment at the placement site and is therefore suitable for use. It is anticipated that such assessment activities will include visual inspections, representative sampling and laboratory analysis of material to demonstrate the material meets the requirements of this RAP. As for VENM assessments, it is considered suitable to define such requirements on a specific site basis given the potential variability of project site requirements.

Material tracking records in addition to the import assessment report are required to be included in the final validation report for the site.

6.5 Validation

Validation of the remedial works will be conducted by the Environmental Consultant to demonstrate the remediation/management objectives have been achieved and to document the final condition of the site at the completion of works such that conclusions may be drawn on the end use suitability of the site for the proposed development. Details of the validation program are provided in **Section 7.**

6.6 Site Dis-establishment

On completion of the remediation works all plant/equipment and safety/environmental controls shall be removed from the site. Details are provided in the Site Management Plan in **Section 9.**

6.7 Contingency Plan

Given the available site history information, consideration has been given to the potential for additional small scale issues that may arise during works (from a contamination viewpoint). Should further impacted material (i.e. not previously identified in historical investigations) be identified as part of an unexpected find during construction works, the remedial options screening matrix in **Section 5.4** will be required to be reviewed. Notwithstanding, due to the site history and relatively shallow depth of fill it is anticipated that any impacts (not identified herein) will be relatively isolated and could be appropriately managed through either on-site in-situ management (i.e. option 3) or controlled excavation and off-site disposal.

7. Validation Plan

7.1 General

Data will be required to be collected during remediation/management and construction works to assess the effectiveness of the implemented management actions and document the final condition of the site at the completion of all works. Such information will allow conclusions to be drawn on the end suitability of the site for the proposed use. The general principles to be implemented with regard to the validation assessment are discussed in accordance with EPA (2017) requirements in the following sections.

It is anticipated that the validation assessment will be required to address the following broad issues:

- Confirm the site conditions are consistent with those identified during previous site investigation activities as documented herein;
- Validation that soil remediation works has reduced the level of hydrocarbon (primarily CE) impacts in soils such that potential for ongoing contribution of hydrocarbon impacts to soil vapour is minimised; and
- Validation that soil remediation works has removed asbestos contaminated soils from the site.

7.2 Data Quality Objectives

Data quality objectives (DQOs) have been developed for the validation assessment, as discussed in the following sections.

7.2.1 State the Problem

JBS&G (2023a and 2023b) has identified the presence of contaminated site media that require to be remediated to make the site suitable for the proposed development.

A set of environmental data are required to verify that remediation works as documented in **Section 6** have been implemented in a manner which causes potential risks associated with contaminated site media to reduce to low and acceptable levels.

7.2.2 Identify the Decision

The following decisions are required to be made during the validation works:

- Have chlorinated hydrocarbon impacted soils been removed to mitigate the potential for vapour intrusion to future site buildings?
- Are there any unacceptable risks to future human site receptors, associated with asbestos in soil, following the remediation of soils?
- Is any disused infrastructure remaining at the site which represents a potential contamination risk?
- Has all material imported to site to achieve development objectives been demonstrated as suitable for use?
- Were surplus materials classified and disposed off-site to a facility licensed to accept the classified waste, or where relevant, appropriately recycled for beneficial re-use?
- Have the works been completed in accordance with the RAP, or where variations to the works were required, have these met the objectives of the RAP?
- Is the site suitable for the proposed land uses?

7.2.3 Identify Inputs to the Decision

The inputs to the decisions are:

- Previous investigation results as discussed in **Section 3**;
- The proposed development and final proposed land form and site features;
- Field observations in relation to inspection of all excavation bases, walls, stockpiles and final site surfaces for signs of potential contamination;
- Environmental data as collected from the validation of remedial excavations;
- Material characterisation data obtained during assessment of surplus material prior to off-site beneficial re-use or disposal;
- Disposal dockets and relevant documents in relation to appropriate disposal of material (if required) to be removed from site as part of the remediation works (landfill dockets, beneficial reuse / recycling dockets, trade waste disposal, etc.);
- Material characterisation data (including field observations, sampling and analytical data) obtained during assessment of material proposed to be imported to the site;
- Relevant guideline criteria for validation and waste classification; and
- Data quality indicators (DQIs) as assessed by quality assurance / quality control (QA/QC).

7.2.4 Define the Study Boundaries

The study boundaries are defined as the lateral site extent (**Section 2.1**) and the vertical extent of remediation works is estimated as the depth of sandstone underlying the basement.

Ultimately the study boundaries will comprise the lateral and vertical extent of the site successfully validated in accordance with the requirements of this plan. The temporal limits of the assessment will comprise the duration of the remedial works and validation program.

7.2.5 Develop a Decision Rule

The decision rules adopted to answer the decisions identified in **Section 6.1.2** are summarised in **Table 7.1**.

Table 7.1: Summary of Decision Rules

Decision Required to be Made	Decision Rule
1. Have chlorinated hydrocarbon impacted soils been removed to mitigate the potential for vapour intrusion to future site buildings?	Soil vapour validation data shall be collected of the walls and base of remedial excavations. If the soils validation results meet the adopted validation criteria then the answer is Yes. If the soil validation results fail the adopted validation criteria then the answer is No.
2. Are there any unacceptable risks to future human site receptors, associated with asbestos in soil, following the remediation of soils?	Soil validation data shall be collected of the walls and base of remedial excavations to remove asbestos impacted soils. If the soils validation results meet the adopted validation criteria then the answer is Yes. If the soil validation results fail the adopted validation criteria then the answer is No.

Decision Required to be Made	Decision Rule
3. Is any disused infrastructure remaining at the site which represents a potential contamination risk?	Where any UPSS/USTs or operational infrastructure are encountered and observed to be removed from the site and the associated sample results (from walls and base of excavaiton) meet the validation criteria, then the answer is Yes. Otherwise the answer is No.
4. Were surplus materials classified and disposed off-site to a facility licensed to accept the classified waste, or where relevant, appropriately recycled for beneficial re-use?	**Waste Materials** Soil analytical data will be compared against EPA (2014a) or applicable EPA endorsed criteria as relevant to resource recovery exemptions. Statistical analysis (comprising a review of 95% UCL of the mean, standard deviation and maximum values of dataset) of the data in accordance with relevant guidance documents will be undertaken, where appropriate, to facilitate the decisions (as detailed above). Documentation from the operation receiving the material including the dates, tonnage and classification of the accepted material will be required to facilitate the decision. If the statistical criteria stated above are satisfied, the decision is Yes, and if receipts are provided recording the disposal of material to an off-site licensed facility (waste) or appropriate destination (for materials subject to resource recovery exemptions), the decision is Yes. If the material exceeds the criteria, and no disposal receipts are provided, the answer is No.
5. Where material is imported to site for development purposes is it considered environmentally suitability for use?	Analytical data sets and inspection data will be reviewed for each proposed material type/source against established definitions for acceptable material (i.e. VENM, resource recovery exemptions, etc) and EPA endorsed criteria as established in the RAP as validation criteria. If the complete data set for the applicable material meet the requirements relevant to the material type, the answer to the decision is Yes and material may be imported to site. If the data set exceeds the adopted criterion, the answer to the decision is No and the material cannot be imported to site for use in development activities.
6. Have remedial and validation works met the requirements of the RAP?	If the answer to Questions 1-3 is Yes and/or an answer to Questions 4-5 No, the answer to the decision is No. Further assessment is required to establish the nature and extent of additional remediation/management as may be required. If the RAP requirements were addressed, and there are no outstanding issues, the answer to the decision is Yes.
7. Is the site suitable for the proposed land use?	If the answer to Question 6 is Yes, then the answer to the decision is also Yes. Otherwise, the answer to the decision is No. In this instance further remediation/ management actions will require to be implemented and appropriately documented such that a future review of the above decisions may result in a different decision outcome.

7.2.6 Specify the Limits on Decision Error

This step is to establish the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits for this project have been adopted in accordance with the appropriate guidance from the NSW EPA, NEPC (2013), appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard JBS&G procedures for field sampling and handling.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined DQI) established for the project as discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters). The acceptable limit on decision error is 95% compliance with DQIs.

The DQIs and data assessment criteria are summarised as presented in **Table 7.2**.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- **Representativeness** – expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.
- **Sensitivity** – expresses the appropriateness of the chosen field and laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.

Table 7.2 Summary of Data Quality Indicators

Data Quality Objectives	Frequency	Data Quality Indicator
Precision		
Blind duplicates (intra laboratory)	1 / 20 primary samples	1-10x LOR – no limit; 10x-30x LOR - <50 % relative percent difference (RPD)[1] >30x LOR - <30 % RPD
Blind duplicates (inter laboratory)	1 / 20 primary samples	
Laboratory duplicates	1 / 20 primary samples	
Accuracy		
Surrogate spikes	All organic samples	70-130 %
Laboratory control samples	1 per lab batch	70-130 %
Matrix spikes	1 per lab batch	70-130 %
Representativeness		
Sampling appropriate for media and analytes	All samples	-[2]
Samples extracted within holding times.	All samples	TRHs, VOCs and SVOCs – 14 days Asbestos – no limit
Trip spike (BTEX only)	1 per sampling event	70-130% recovery
Rinsate blank	1 per sampling event	<LOR
Method blank	1 per lab batch	<LOR
Comparability		
Standard operating procedures for sample collection & handling	All Samples	All samples
Standard analytical methods used for all analyses	All Samples	NATA accredited methods
Consistent field conditions, sampling staff and laboratory analysis	All Samples	All samples[2]
Limits of reporting appropriate and consistent	All Samples	All samples[2]
Completeness		
Sample description and COCs completed and appropriate	All Samples	All samples[2]
Appropriate documentation	All Samples	All samples[2]
Satisfactory frequency and result for QC samples	All QA/QC samples	95% compliance
Data from critical samples is considered valid	-	Critical samples valid
Sensitivity		
Analytical methods and limits of recovery appropriate for media and adopted Site assessment criteria	All samples	LOR ≤ site assessment criteria

[1] If the RPD between duplicates is greater than the pre-determined data quality indicator, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

[2] A qualitative assessment of compliance with standard procedures and appropriate sample collection methods will be completed during the DQI compliance assessment.

7.2.7 Validation Inspections and Sampling

The validation inspections, sampling and analysis required for remediation areas are summarised in **Table 7.3** and detailed in the following sections.

Table 7.3 Validation Inspection and Sampling Program

Item	RAP Sampling Density			Analytical Suite
Source Removal Excavation Validation				
	Excavation Floors	Excavation Walls	Materials	
Excavations formed by the removal of chlorinated hydrocarbon contaminated soils	1 / 100 m^2 (10 m grid) Minimum 2 samples per excavation where the excavation is terminated above groundwater	1 / 4 m (from each distinct horizon or material type or 1 m vertical soil profile)	N/A	VOCs (TO-15) in soil vapour samples
Excavations formed by the removal of asbestos contaminated soils	1 / 100 m^2 (10 m grid)	1 / 4 m (from each distinct horizon or material type or 1 m vertical soil profile)	N/A	Asbestos (500 mL)
Excavations formed by the removal of UST (if encountered)	1 / 100 m^2 (10 m grid) Minimum 2 samples per excavation. Minimum 2 samples per UST removed.	1 / 4 m (from each distinct horizon or material type or 1 m vertical soil profile)	N/A	TRHs and BTEXN (all excavations) in soil samples
Excavations formed by the removal of impacted materials (if identified as part of an unexpected find)	1 / 100 m^2 (10 m grid) Minimum 2 samples	1 / 10 m (from each distinct horizon or material type or 1 m vertical soil profile) Minimum 4 samples	N/A	As determined by the nature of the impact
Materials Importation				
Imported VENM	Minimum of 3 samples per source site / material type to 500 m^3 then 1 sample per 500 m^3 thereafter			TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos (500 ml)
Quarry VENM Materials (e.g. blue metal, sandstone, shale)	Confirmation that the material is quarried rock (VENM) prior to importation, and visual confirmation.			Site Inspection required.
Material subject to a NSW EPA Resource Recovery Order/Exemption	Confirmation by the supplier that the material meets the terms of the order. Then environmental consultant sampling at a minimum of 3 samples per source site / material type to 500 m^3 then 1 sample per 500 m^3 thereafter, prior to importation			TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos (500 ml)
Export of Materials				
Surplus waste materials for off-site disposal are to be classified in accordance with EPA (2014b).	Stockpiled materials for off-site disposal require a minimum of 5 samples (up to 75 m^3) or a sample density of 1/25 m^3 to 200 m^3 (whichever is greater) Decreased sampling frequency to be justified on basis of stockpile homogeneity and risk of contaminants present.			Heavy metals TRH/BTEXN PAHs OCP/PCBs Asbestos Spocas (ASS) TCLP (Heavy metals and PAHs) at the Environmental Consultant's discretion.

7.2.8 Excavation of Chlorinated Hydrocarbon Impacted Soil

The validation program for the removal of the chlorinated hydrocarbon impacted soils comprises:

- Inspection of the excavated areas by a suitably trained and experienced environmental consultant to confirm the extent of potentially impacted materials have been removed. This inspection shall be cognisant of aesthetic indicators of CH impact (i.e. odours, etc.) and elevated PID measurements. If additional potentially impacted material is identified, further excavation will be conducted and the affected area will be re-inspected until such time as visual, olfactory and field screening validation is obtained;
- Following field screening validation, soil vapour (as appropriate to the nature of the impact) samples will be collected from the remediation area walls at a rate of 1 sample per 10 linear m, and from the excavation bases at a rate of 1 sample per 100 m^2 (minimum 2 samples per base and one sample from each wall). The methodology to collect soil vapour samples is provided following:
    - The excavation is likely to consist of sandstone base and walls. Soil vapour probes are proposed to be installed to a 0.5 m depth within the base and the walls. This will require to be implemented using a drill with a preferred cutting head diameter of at least 25 mm. Holes as drilled into the base of the excavation shall be vertical, while holes drilled into walls shall be horizontal.
    - Soil vapour probes shall be constructed at each location by use of 6 mm diameter LDPE tubing as inserted into the hole. A stainless steel gauze shall be placed around the base of the tube, and lower depth of the borehole filled using 2 mm sand. The upper depth / portion of each borehole shall be completed using modelling clay, grout or similar as considered appropriate to cause an air tight seal around the top of the tube with the top of the borehole and be suitably robust to be adapted for sampling.
    - It is likely, as consistent with the impermeable nature of the sandstone geology, that vapours will not readily flow into the soil vapour probes. A sampling methodology has been adapted as cognisant of this and is outlined following:
    - At a minimum period of 24 hours subsequent to installation and setting of sealant material used to construct the probe, a three way valve and syringe shall be connected to the probe. By activation of the three-way valve, the syringe shall be used to purge the probe. Based on a 50 ml syringe being used for sampling, a maximum of four syringe volume shall be removed, or otherwise until significant resistance is felt to the withdrawal of air through the syringe;
    - At the cessation of purging, the syringe shall be left in a depressed state and connected to the three way valve and vapour probe;
    - At a minimum duration of 24 hours subsequent to purging, a soil vapour sample shall be collected by the use of the syringe and transfer of the sample to a tedlar bag. A tedlar bag has been nominated as there is a high likelihood that a low sample volume only will be able to be collected. A tedlar bag has no minimum sample volume, and further has a low detection limit when analysed by a TO-15 sample method, that where insufficient sample is available to implement the laboratory analysis, the addition of make-up air to meet the minimum sample volume will not cause the detection limits to be raised to a level beyond the adopted assessment criteria; and
    - Leak detection shall be undertaken with all sampling by the placement of an isopropanol soaked rag around the top of the soil vapour probe and the use of a sheath to ensure an isopropanol rich atmosphere around relevant sample connections.
    - Notwithstanding the methodology described, tedlar bags shall be attempted to be filled with as much sample as available to inflate the bag. Soil vapour probes which are found to flow more easily shall be further selected for the collection of duplicate samples.
    - It is noted that no field parameters / fixed gases are proposed to be assessed during validation sampling. It is considered highly unlikely that sufficient soil vapour sample will be able to be

collected to allow analysis of these constituents. It is further noted that no remedial criteria are provided on the basis of levels of fixed gases in soil vapour.

- Excavation validation samples will be analysed at a laboratory NATA accredited for the required analyses on an accelerated turnaround time (i.e. 24 hr) to allow for excavations to be backfilled as soon as possible. If the concentration of COPCs are identified in any of the excavation validation samples exceeding criteria, then the soils will be excavated 0.3 m deeper or otherwise 1 m further in the lateral direction of failure and the validation process repeated. Alternatively, where impact exceeding criteria is not identified by the laboratory, the remedial areas will be deemed to have been successfully remediated and validated.

7.2.9 Removal of Asbestos Impacted Soils

The absence of asbestos impacts shall be confirmed visually prior to the completion of soil sampling and analysis. This may be assisted by the collection of bulk samples and field sieving to allow closer examination of any anthropogenic materials as present in the soils.

7.2.10 Removal of Residual UPSS/USTs and Operational Infrastructure (If encountered)

The validation program for the removal of any UPSS/USTs and associated impacted soils comprise:

- Inspection of the excavated areas by a suitably trained and experienced environmental consultant to confirm the extent of potentially impacted materials have been removed. This inspection shall be cognisant of aesthetic indicators of petroleum hydrocarbon impact. The potential presence of petroleum hydrocarbons should be further assessed by the use of a PID. If additional potentially impacted material is identified, further excavation will be conducted and the affected area will be re-inspected until such time as visual and olfactory validation is obtained;
- Following visual and olfactory validation, soil (as appropriate to the nature of the impact) samples will be collected from the remediation area walls at a rate of 1 sample per 4 linear m, and from the excavation bases at a rate of 1 sample per 100 m^2 (minimum 2 samples per excavation base or UST removed and two samples from each wall); and
- Excavation validation samples will be analysed at a laboratory NATA accredited for the required analyses. If the concentration of COPCs are identified in any of the excavation validation samples exceeding criteria, then the soils will be excavated 0.3 m deeper or otherwise 1 m in a further lateral extent in the direction of failure and the validation process repeated. Alternatively, where impact exceeding criteria is not identified by the laboratory, the remedial areas will be deemed to have been successfully remediated and validated.

7.3 Validation Criteria

7.3.1 Soil

Soil validation data collected on site will be compared to the most conservative asbestos and/or petroleum hydrocarbon (in instances where a UST are encountered) in soil criteria as advised to NEPC (2013) for the protection of human health.

Aesthetic impacts of soils will be interpreted by on-site observations of indicators of soil staining and/or ACM and/or odours and/or other anthropogenic materials. The soil validation criteria are nominated in **Table 7.4** following.

Table 7.4: Soil Validation Criteria

Constituent	Health Screening Levels (% w/w)	Health Screening Level for Vapour Intrusion (mg/kg)	Management Limits – Coarse Soil
Asbestos (bonded ACM)	0.01		
Asbestos (friable)	0.001		
TRH C_{6-10} Less BTEX (F1)	-	45	700
TRH $C_{>10-C16}$ Less naphthalene (F2)	-	110	1000
TRH $C_{>16-34}$	-	-	3500
TRH $C_{>34-40}$	-	-	10 000
Benzene	-	0.5	-
Toluene	-	160	-
Ethylbenzene	-	55	-
Xylenes	-	40	-
Naphthalene	-	3	-

7.3.2 Soil Vapour

Soil vapour validation data collected on site will be compared to the site specific risk criteria to be established from the human health risk assessment (HHRA JBS&G 2023b) provided in **Appendix C**. This includes validation criteria of 7.6 and 29 mg/m^3 respectively for TCE and cis-1,2-DCE.

Site contaminants occur in combinations, and other constituents will occur with the nominated TCE and cis-1,2-DCE. However it is considered that where these constituents can be remediated to an appropriate level that the levels of the co-occurring constituents will be below a level that may pose a potential health risk.

7.3.3 Waste Disposal Off-site

All wastes requiring off-site disposal must be classified in accordance with *Waste Classification Guidelines* (EPA 2014a). The Remedial Contractor is responsible for the lawful disposal of the classified waste to a licensed waste disposal facility lawfully able to accept the waste.

Disposal dockets for each individual off-site waste disposal load must be provided to the Principal and to the Remediation Consultant by the Contractor to demonstrate appropriate off-site disposal of waste occurred for site validation purposes.

7.3.4 Transport of Asbestos Impacted Materials

As further required to be considered in the requirements of material tracking, transport of materials affected by asbestos will require to be further cognisant of the requirements of *Work Health and Safety Act (2011)* and *Work Health and Safety Regulation (2017)*, *How to Manage and Control Asbestos in the Workplace: Code of Practice*, October 2018, Safe Work Australia, *Managing Asbestos in or on Soil*, 2014, WorkCover and the EPA (2014a).

The details of the relevant contractor shall be further advised to the relevant parts of the materials tracking form(s).

7.4 Validation Reporting

At the completion of the remedial works, a validation report will be prepared in general accordance with the *Consultants Reporting on Contaminated Land Contaminated Land Guidelines* (EPA 2020), documenting the works as completed. The report will contain information including:

- Details of the remediation works conducted;
- Information demonstrating that the objectives of this RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined DQO and the remediation acceptance (validation) criteria;
- Information demonstrating compliance with appropriate regulations and guidelines including UPSS infrastructure destruction/disposal documentation;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Results of all environmental monitoring undertaken during the course of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents;
- Verification of regulatory compliance;
- Details on waste classification, tracking and off-site disposal including landfill dockets;
- Photographic records of applicable remediation works; and
- Clear statement of the suitability of the site with respect to permissible land uses with references for ongoing management (if applicable).

The report will serve to document the remediation works for future reference. It is noted that due to site access and/or construction constraints, that the remediation and validation works may occur in stages.

©JBS&G Australia Pty Ltd

8. Unexpected Finds

The possibility exists for hazards to be present at the site other than those identified and expected based on previous investigations.

Environmental sampling is based on chemical analytes identified as a potential concern during a documented process of reviewing historical site activities. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations. The nature of any additional hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- Areas of previously unidentified ACM on the ground surface or within fill material;
- Uncontrolled filling, such as in eroded drainage lines;
- Drums or underground tanks;
- Chemical bottles; and
- Odorous or unusual coloured soils;

As a precautionary measure to ensure the protection of the workforce and surrounding community, if any of the abovementioned substances be identified (or any other unexpected potentially hazardous substance), the procedure summarised in **Flowchart 8.1** and detailed in the following sections is to be followed.

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

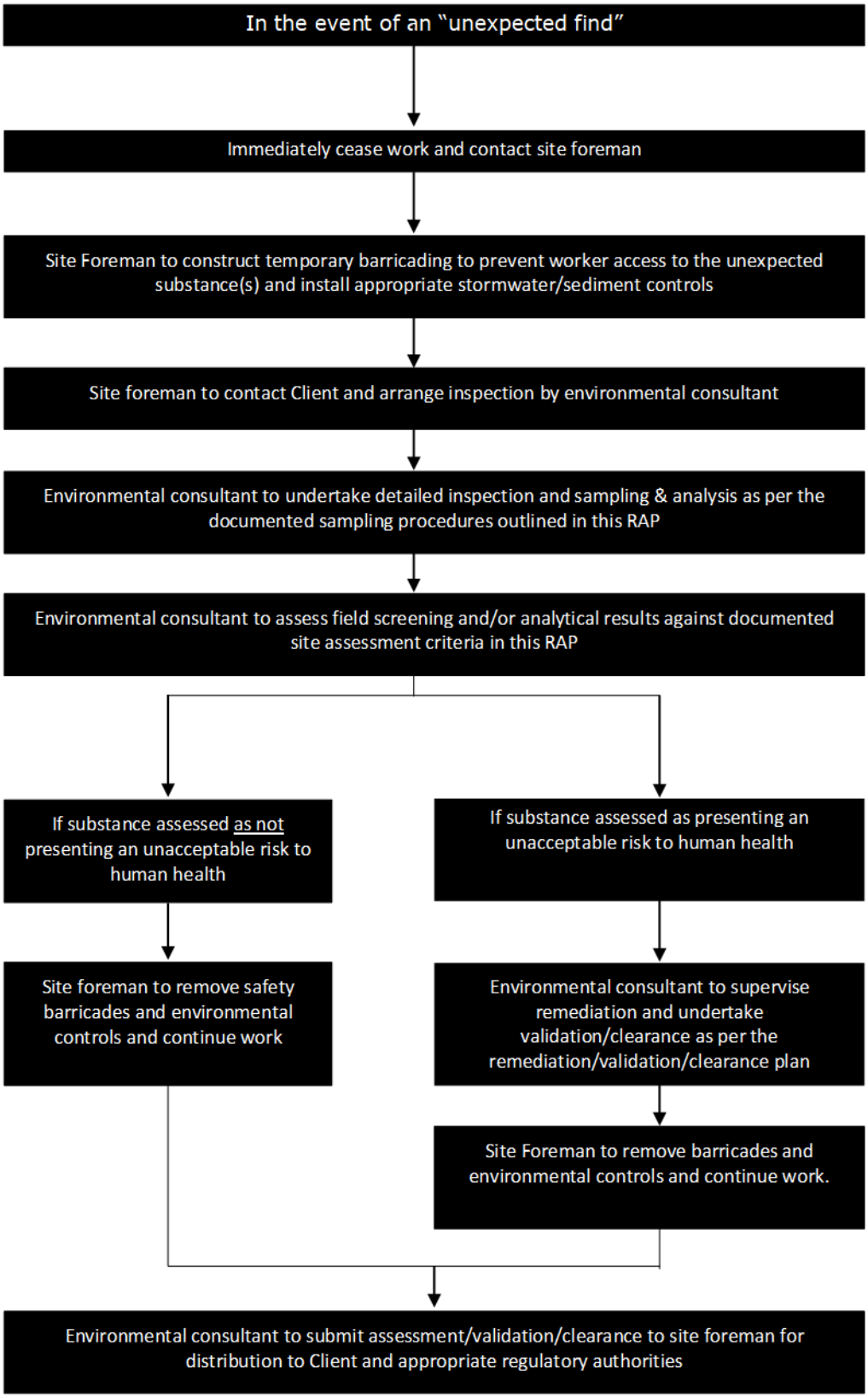
The sampling strategy for each 'unexpected find' shall be designed by a suitably qualified environmental consultant, in accordance with guidelines made or endorsed by EPA. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations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

The sampling frequency of the identified substance / materials shall meet the requirements the NSW EPA (2022).

The assessment criteria shall be determined by the Environmental Consultant, with the subject material to at least meet the criteria nominated in **Section 7.3**, and additional criteria (as necessary) obtained from published national guidance documents.

©JBS&G Australia Pty Ltd

Flowchart 8.1: Unexpected Find Protocol



9. Site Management Plan

This section contains procedures and requirements that are to be implemented as a minimum requirement during the remedial works at the site.

9.1 Contact Persons

Contact details for key personnel involved in remediation and validation works are summarised in **Table 9.1**.

Table 9.1: Contact Details

Client's Supervisor/Manager	Details
Name	To be advised
Company	To be advised
Address	To be advised
Contact Phone	To be advised
Remediation Contractor	**Details**
Name	To be advised
Company	To be advised
Contact Phone	To be advised
Environmental Consultant	**Details**
Name	To be advised
Company	To be advised
Address	To be advised
Contact Phone	To be advised

9.2 Hours of Operation

It is understood that the hours of operation for remedial works will be conducted in accordance with the recommended site hours suggested by the EPA[9], however, works hours will be subject to requirements of any development approval conditions provided by the consent authority.

Typical hours of operation for remedial works are:

- Monday to Friday: 7am to 6pm.
- Saturday: 8 am to 1 pm.
- Sunday and public holidays: No work permitted.

Emergency work is permitted to be completed outside of these hours.

9.3 Soil and Water Management

All works shall be conducted in general accordance with Landcom (2004)[10] guidance (the Blue Book), which outlines the general requirements for the preparation of a soil and water management plan.

All remedial works shall be conducted in accordance with a soil and water management plan, which is to be kept onsite and made available to council officers on request. All erosion and sediment measures must be maintained in a functional condition through the remediation works by the remedial contractor.

9 *Interim Construction Noise Guideline.* Department of Environment & Climate Change NSW. DECC 2009/265. July 2009.

10 *Managing Urban Stormwater: Soils and Construction*, Landcom 4th Edition, March 2004.

To prevent the migration of impacted soil off site, silt fences shall be constructed at the down-gradient site boundaries by the remedial contractor. Any material which is collected behind the sediment control structures shall be removed off site to a licensed waste facility after waste classification.

In storm or extended rainfall event, the structures located on site for sediment control shall be monitored and replaced or altered if necessary by the contractor. Collected material shall be managed in accordance with remediation works by the contractor.

9.3.1 Stockpiles

All materials stockpiled onsitewill be managed by the remedial contractor. Unique numbers will be provided for each stockpile, the source of the stockpile, its volume, material characterisation and its location onsite (via GPS) recorded.

The following procedures will be implemented by the remedial contractor:

- No stockpiles of soil or other materials shall be placed on footpaths or nature strips unless prior Council approval has been obtained;
- All stockpiles of soil or other materials shall be placed away from drainage lines gutters or stormwater pits or inlets;
- All stockpiles of soil or other materials likely to generate dust or odours shall be covered (where practical); and
- All stockpiles of contaminated soil shall be placed on plastic sheeting to limit cross contamination of the underlying soils and stored in a secure area.

9.3.2 Site Access

During remediation works, temporary fencing will be installed which will restrict access to remedial areas on the site. Only authorised persons will be permitted to enter the remedial areas.

Vehicle access to the site shall be stabilised to prevent the tracking of materials from the site and the adjoining driveway/access point to the road will be swept or cleaned on an as-needed basis. Any collected materials shall be treated as potentially contaminated and handled as per the classification/reuse/disposal requirements outlined in this RAP.

9.3.3 Excavation Pump-out

Any excavation pump-out water shall be sampled by the environmental consultant for analysis for total suspended solid concentrations, turbidity, pH and the identified contaminants of concern prior to release to stormwater with appropriate documentation indicating that the discharged water is compliant with the ANZG (2018[11]) default guideline values (DGVs) for the 95 % Protection of Fresh Water Ecosystems. If not, the water may be disposed off-site to a licenced facility lawfully able to accept the waste.

[11] *Australian and New Zealand Guidelines for Fresh an Marine Water Quality*, August 2018, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (ANZG 2018)

9.4 Noise

Remediation work shall not give rise to 'offensive noise' as defined in the POEO Act *1997*. All equipment and machinery associated with the remediation work shall be operated by the Contractor in accordance with *the POEO Act 1997* and the *Noise Control Regulations 2000*.

All machinery and equipment used on site will be in good working order and fitted with appropriate silencers when necessary.

Louder equipment shall be located away from noise sensitive areas. Works shall be staged as required to avoid concurrent operation of multiple pieces of noisy equipment. Works outside of normal hours of operation (**Section 9.2**) shall be avoided.

9.5 Vibration

The use of plant and machinery shall not cause vibrations to be felt or capable to be measured at neighbouring premises.

9.6 Air Quality

During remedial works, dust emissions and any odours will be confined within the site boundary.

9.6.1 Dust Control

During the remedial works, as necessary, excavation areas will be wetted down using a water spray to minimise the potential for dust to be generated by the remedial contractor.

Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access and all equipment have dust suppressors fitted by the remedial contractor.

During all remedial works, dust screens will be erected around the perimeter of the site by the remedial contractor. Where significant fugitive emissions are observed from specific site areas, these areas shall be wetted and/or covered by the remedial contractor.

Meteorological conditions will be monitored by the environmental consultant and remedial contractor. Remedial work will be stopped or modified where meteorological conditions are adverse (i.e., dry conditions and strong winds towards sensitive receptors).

Plant and vehicles should limit their speed when working within asbestos exclusion zones and only traverse wetted haul roads.

9.6.2 Occupational Asbestos Air Monitoring

Where asbestos and/or contaminated soil is being disturbed during the proposed works, applicable air monitoring activities will be employed on a daily basis at relevant locations to demonstrate the suitable application of contaminant migration control measures. Monitoring activities as may be employed are discussed following.

During the remedial works, perimeter asbestos in air monitoring will be conducted at each applicable remedial works area boundary when soils impacted with asbestos are being disturbed.

Air monitoring will be conducted on a daily basis at relevant locations during any ground disturbance activities within impacted soil within the Site to verify that implementation of appropriate control measures have been successful at managing the risk of air borne fibre generation.

Air monitoring will be undertaken in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes, in particular the Guidance note for the estimation of airborne asbestos dust [NOHSC 3002:2005]. Air filters shall be analysed by a NATA

accredited laboratory and results shall be required to be below 0.01 fibres/mL. All detections of fibres shall be further analysed by scanning electron microscope (SEM) to confirm the fibres are asbestos.

Should friable asbestos be identified, air monitoring will be conducted by Licensed Asbestos Assessor (LAA, as per Safe Work NSW requirements). All removal works will further be required to be completed by a Class A Asbestos licenced removalist.

In establishing site trigger levels for evaluation of the monitoring results, reference is made to the appropriate TWA (Workplace Exposure Standards for Airborne Contaminants, 17 December 2019 – SafeWork Australia) levels:

- Amosite - 0.1 fibre/mL;
- Chrysotile – 0.1 fibre/mL;
- Crocidolite - 0.1 fibre/mL;
- Other forms of asbestos - 0.1 fibre/mL; and
- Any mixture of these, or where the composition is unknown - 0.1 fibre/mL.

With consideration to these levels the following trigger levels have been developed:

- If airborne fibre levels reach 0.01 fibres/mL the source of fibre release is to be found and rectified. Work in the affected area does not have to stop; and
- If airborne fibre levels reach 0.02 fibres/mL work in the work area should stop and additional controls measures employed. This will involve additional water spraying during excavations.

Air monitoring results will be obtained within 24 hours of sample collection on week days. While this precludes “real time” monitoring, inspections will be made during all excavation works and, if there are any visible dusts, light water sprays will be used to wet the excavation and prevent the release of any airborne asbestos fibres.

If respirable asbestos fibres are confirmed and present between 0.01 and 0.02 fibres/mL, the following controls must be implemented by the Class A licensed asbestos removalist, in accordance with NSW (2019);

- Review control measures;
- Investigate the cause; and
- Implement controls to eliminate or minimise exposure and prevent further release.

If respirable asbestos fibres are confirmed and present above 0.02 fibres/mL, the following controls must be implemented by the licensed asbestos removalist, in accordance with SWA 2011;

- Stop removal work;
- Notify Safe Work NSW by phone, then by fax or written statement that work has ceased;
- Investigate the cause;
- Implement controls to eliminate or minimise exposure and prevent further release; and
- Do not recommence removal work until further air monitoring is conducted and fibre levels are detected below 0.01 fibres/mL.

A daily report air monitoring report will be prepared documenting the previous/same days airborne asbestos fibre air monitoring results. This report will be made available to all relevant stakeholders, upon request, including but not limited to:

- Site workers;
- Council and, WorkSafe NSW and/or EPA officers;

- Neighbouring facilities; and
- Unions.

9.6.3 Odour

Given the nature of some of the material being excavated at the site, namely hydrocarbon impacted soils, there may be some odour issues at the site boundaries.

If odours are detectable at the site boundaries, then appropriate actions will be taken to reduce the odours, which may include: increasing the amount of covering of excavations / stockpiles; mist sprays; odour suppressants; or maintenance of equipment.

Records of volatile emissions and odours shall be kept by the remediation manager. Equipment and machinery will be adequately maintained to minimise exhaust emissions. No materials shall be burnt on the site.

9.7 Groundwater

No groundwater remediation or dewatering is proposed as part of site remediation works. No approvals are required under the *Water Management Act 2000*.

9.8 Material Transport

Trucks will be loaded in a designated area in a manner designed to minimise noise, vibrations and odour to adjoining premises. The transportation contractor shall ensure that there is no material tracked out onto public roads and that each load is securely covered. Removal and deliveries of soils and materials, equipment and machinery will only occur during the hours of remediation works unless specific approvals are obtained.

All appropriate road rules shall be observed and state roads will be selected as far as practicable over local roads when deciding on the transport route to the off-site material disposal location. In addition, the transport contractor will be required to be appropriately licensed to transport and dispose of the waste identified as requiring removal from the site.

As of 1 July 2015, it will be required under the *Protection of the Environment Operations (Waste) Regulations 2014* (POEO 2014) to record the movement of all loads of more than 100 kg of asbestos waste or more than 10 m^2 of asbestos sheeting. Each load will be assigned a unique consignment code to allow NSW EPA to monitor their movement from site of generation to disposal.

In addition, the proximity principle, under POEO 2014, makes it an offence to transport waste generated in NSW by motor vehicle for disposal more than 150 kilometres from the place of generation, unless the is waste is transported to one of the two nearest lawful disposal facilities to the place of generation.

9.9 Hazardous Materials

Hazardous and / or intractable wastes arising from the remediation work shall be removed and disposed of in accordance with the requirements of NSW EPA, SafeWork NSW and the relevant regulations by the Contractor.

Any hazardous wastes will be transported by a NSW EPA licensed transporter.

9.10 Disposal of Contaminated Soil

All soil will be classified, managed and disposed in accordance with the *Waste Classification Guidelines* (EPA 2014). Documentary evidence for all soil disposal shall be kept for inclusion in the Validation Report.

9.11 Site Signage and Contact Numbers

A sign shall be displayed adjacent to the site access throughout the duration of the works with the contact details of the remediation contractor and project manager.

9.12 Community Relations

Owners and/or occupants of premises adjoining the site will be notified at least seven days prior to the commencement of remedial works.

Any community concerns or queries should be directed to the site manager. The site manager will notify the site owner of any community queries or concerns so that the site owner will direct an appropriate person to address the community query or concern.

9.13 Site Security

The remedial areas shall be secured against unauthorised access by means of an appropriate fence.

9.14 Occupational Health and Safety

It is the employer's responsibility to ensure that all site remediation works comply with all Work Health and Safety and Construction Safety Regulations of NSW SafeWork.

©JBS&G Australia Pty Ltd

10. Health and Safety

This health and safety plan contains procedures and requirements that are to be implemented as a minimum during the remediation works.

The objectives of the health and safety plan are:

- To apply standard procedures that reduce risks resulting from the above works;
- To ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- To have procedures to protect other site workers and the general public.
- These objectives will be achieved by:
- 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.

This health and safety plan does not provide safety information specific to construction and other demolition or excavation activities carried out by contractors, such as the safe operation, maintenance and inspection of plant, etc. Contractors will be required to prepare their own Safe Work Method Statements for their work activities. All parties working on the site shall comply with all applicable Health and Safety legislation, regulations, codes and guidelines.

10.1 Responsibilities

Remediation Supervisor

The remediation supervisor is responsible for ensuring that the work is carried out in accordance with the health and safety plan. This will include:

- Ensuring a copy of the health and safety plan is available at the site during the remediation/validation activities;
- Ensuring all works are undertaken in accordance with appropriate regulations and standards;
- Confirming individuals are competent in performing allotted tasks;
- Liaison with the contractor representatives, as appropriate, regarding safety matters; and
- Investigation and reporting of incidents and accidents.

Every individual worker is responsible for conducting their allocated tasks in a safe manner and in accordance with their training and experience. They must give due consideration to the safety of all others in their proximity and cooperate in matters of health and safety. All workers must leave their work areas in such a condition that the location will not be hazardous to others at any time.

10.2 Hazards

The known or potential hazards associated with the work activities described in **Section 6** and are listed below:

- Chemical hazards associated with the presence of potentially contaminated soil and groundwater inclusive of elevated levels of hydrocarbons;
- Inhalation hazards associated with the potential presence of bonded ACM in soils;
- Physical hazards, including:
    - work in or near excavations;
    - operating machinery;
    - heat stress and UV exposure;
    - underground (particularly with the presence of UST(s)) or overhead services;
    - manual handling; and
    - noise.

In the event of the discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, or of any new hazard that could potentially cause serious harm to personnel or the environment, work will be suspended until the Project Manager has been notified and appropriate instructions have been provided to field personnel.

10.3 Chemical Hazards

When working with potentially contaminated materials in general, care must be taken to ensure that the contamination is not introduced to the worker via ingestion, inhalation or absorption. PPE and decontamination requirements related to the remedial works are summarised in **Section 10.5**.

10.4 Physical Hazards

Operating Machinery

Heavy plant and equipment operating in the vicinity of field personnel presents a risk of physical injury. Personnel should be cognisant of their position in relation to operating machinery at all times.

Never walk behind or to the side of any operating equipment without the operator's knowledge. Do not assume that the operator knows your position. Personnel should stay at least 1 m from the operational area of heavy equipment and should not stand directly below any load or piece of equipment (e.g. backhoes).

Work in or Near Excavations

All excavations shall be shored, sloped or otherwise constructed so as to minimise the potential for collapse. No excavations greater than 1.5 m depth are anticipated to be created.

Cuts and Abrasions

The manual work associated with the remediation works gives rise to the risk of cuts and abrasions to personnel working in the area. As well as the direct consequences of any cut or abrasion, such injuries can lead to the possibility of exposure to contaminants through the wound as well as diseases such as tetanus. To minimise the risk of direct or indirect injury, personnel will wear the personal protective equipment described in **Section 0**.

Heat Stress and UV Exposure

Site personnel may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the type of work and the time of year.

In addition to heat stress, overexposure to UV radiation in sunlight can result in sunburn to exposed skin. The use of a high protection sunscreen (SPF15 or greater) on all exposed skin is recommended. Hats (including hard hats in specified areas) will also provide additional sun protection during the peak (i.e. 10:00 am to 3:00 PM) sun period. Sunglasses should be worn (where appropriate) to protect eyes from effects of UV exposure.

Underground Services

There is the potential for underground services (electricity, natural gas lines, water, telephone, sewer, and stormwater) to be present beneath the work area. The remediation contractor shall ensure that appropriate procedures will be taken to minimise the risk associated with excavation near services.

It is further noted that the presence of UST(S) will require appropriate decommissioning in which the Remedial Contractor shall ensure that appropriate procedures will be taken to minimise the risk associated with the works.

Aboveground Electrical Hazards

All electrical plant and equipment must comply with the requirements of Australian Standard AS 3000. Hand held portable tools shall comply with AS/NZS 3160 Hand-held Portable Electric Tools and shall be double insulated. Cord connected portable hand lamps shall comply with AS/NZS 3118. A Residual Current Device (RCD) shall protect plug-in portable equipment, which is connected to a supply above Extra Low Voltage - 12-24volts (including equipment supplied from a generator or welding set). RCD protection shall be provided during use of portable electrical equipment at all times while the equipment is connected to a power supply above Extra Low Voltage, irrespective of whether power is switched ON or OFF. RCD's shall comply with AS 3190 and shall be type II units, rated to trip at or below 30 milliamps within 40 milliseconds.

All equipment shall be operated in compliance with the NSW WorkCover (2006) Work Near Overhead Power Lines: Code of Practice. Minimum approach distances for all equipment should exceed:

- 3.0 m for nominal phase to phase ac voltage lines up to 132,000 Volts;
- 6.0 m for 132 000 to 330 000 Volts;
- 8.0 m for greater than 330 000 Volts; and
- 3.0 m for nominal pole to earth dc voltage up to and including 1500 +/- volts.

Manual Handling

When lifting or handling heavy objects, use correct lifting techniques, bending the knees not the back. If the item to be lifted is too heavy or awkward for one person to lift, seek assistance from other company employees or use mechanical help.

Noise

Long-term exposure to high levels of noise is unlikely. However, operating machinery may cause significant noise exposures for short periods. Earplugs or earmuffs should be worn in any situation where noise levels make normal conversation difficult.

©JBS&G Australia Pty Ltd

10.5 Personal Protective Equipment

All workers who may come into direct contact with contaminated soil will wear the following PPE:

- Overalls or long sleeved collared shirt;
- Heavy duty outer gloves (eg. leather) where there is a risk of cuts or abrasions, otherwise PVC outer gloves if in direct contact with contaminated soil;
- Steel capped boots;
- Safety glasses;
- High visibility vest or jacket; and
- Hard hat.

In addition to the above, the following PPE will be worn by the personnel responsible for handling of fill materials within the extent of the site where asbestos impacted soils are encountered:

- During any work in which direct contact of personnel to asbestos impacted soils may occur and prior to final clearance – overalls, gloves, rubber soled work shoes or gum boots should be work by personnel involved in the work. These shoes will remain inside the work area for the duration of the work.
- Approved respirators shall be worn during direct handling of asbestos impacted soils at all times to provide respiratory protection. The minimum protection is an approved properly fitting P2 disposable respirator or half faced respirator fitted with a particulate cartridge. However, it is expected that the remediation contractor will conduct a risk assessment in relation to the works and should consider the requirement for positive pressure, hood or full-face powered air-purifying respirator fitted with an approved Class M filter.
- The remediation contractor shall supply and keep in good order, two complete sets of protective clothing and respirators for authorised inspection personnel. These will remain the property of the contractor at the end of the contract.
- Respirators should be issued for personal use only and shall be kept in a clean condition. Alcohol based antiseptic swabs should be made available for the cleaning of respirators.
- Any respirator defects should be reported for subsequent repair. They should be maintained in a clean and safe working condition.
- Employees must receive instruction in the correct method of using the respirator and on the importance of correct facial fit and maintenance. No person with a beard shall be allowed within the asbestos work area except using an approved positive pressure continuous airflow hood.

In the event that the PPE detailed above differs from that required by the Class B licensed contractor, the requirements of the licensed contractor will prevail.

Vehicle, Plant and Equipment

All equipment, including personal protective equipment, will be washed or otherwise cleaned to ensure that contaminated soil, water or dust is removed before it leaves the Site. All plant and equipment will have their outer bodies thoroughly cleaned of soil and sediment before moving off the site.

10.6 Emergency Response

The remediation contractor will be responsible for preparing an emergency response plan, which will provide details on appropriate action and evacuation procedures in the event of an emergency.

In the event of an emergency arising on the site, appropriate action should be taken. Site evacuation procedures should be followed, as necessary.

In the event of an accident: evaluate the seriousness of the injury, and contact emergency services, if necessary; provide first aid, as appropriate, and if safe to do so evacuate the injured person via the Decontamination Zone; make the area as safe as possible without jeopardising safety.

If a serious accident occurs, do not disturb the scene, except to make safe and prevent further injury or damage, and keep all unauthorised people out, and report all accidents to the Project Manager.

©JBS&G Australia Pty Ltd

11. Regulatory Approvals / Licencing

11.1 Protection of the Environment Operations Act 1997 (POEO 1997)

The proposed remediation/validation activities are not required to be licensed under the *Protection of the Environment Operation Act 1997*, which is based on the following:

- The proposed remediation works will not treat more than 1000 m^3 per year of contaminated soil received from off-site.
- The proposed remediation works will not involve the treatment of contaminated soil originating on-site with the capacity: (i) to incinerate more than 1000 m^3 per year of contaminated soil, or (ii) to treat (otherwise than by incineration) and store more than 30 000 m^3 of contaminated soil, or (iii) disturb an aggregate area of 3 hectares of contaminated soil.

11.2 State Environment Planning Policy (Resilience and Hazards) 2021

Development consent for remediation works is addressed by reference to State Environmental Planning Policy 55 – Remediation of Land (SEPP-RH) and associated Planning Guidelines (DUAP 1998).

The proposed remediation works are classified as 'Category 2' Remediation Works – i.e. not requiring consent. The notification requirements include notification to council 30 days before Category 2 remediation works commence. The proposed works do not constitute Category 1 works because it is understood that:

- The work is not Designated Development under Schedule 3 of the EPA&A Regulation or under a planning instrument.
- The work proposed is not on land identified as critical habitat under the *Threatened Species Conservation Act 1995*.
- Consideration of s.5A of the EP&A Act indicates the remediation work is not likely to have a significant effect on threatened species, populations, ecological communities or their habitats.
- The work is not proposed in an area or zone to which any classifications to the following effect apply under an environmental planning instrument:
    - coastal protection;
    - conservation or heritage conservation;
    - habitat area, habitat protection area, habitat or wildlife corridor;
    - environmental protection;
    - escarpment, escarpment protection or escarpment preservation;
    - floodway;
    - littoral rainforest;
    - nature reserve;
    - scenic area or scenic protection;
    - wetland, or
    - carried out or to be carried out on any land in a manner that does not comply with a policy made under the contaminated land planning guidelines by the council for any local government area in which the land is situated (or if the land is within the unincorporated area, the Western Lands Commissioner).

©JBS&G Australia Pty Ltd

- The work does not require consent under another SEPP or regional environmental plan.

In addition, the notification will also include relevant contact details and a proposed remediation schedule. Notice is also required to be given to Council within 30 days of remediation works completion.

11.3 Protection of the Environment Operations (Waste) Regulation 2014

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works on the site will not require to be licensed. Section 48 of the Reg. requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded.

It will be required under the *Protection of the Environment Operations (Waste) Regulations 2014* (POEO 2014) to record the movement of all loads of more than 100 kg of asbestos waste or more than 10 m^2 of asbestos sheeting. Each load will be assigned a unique consignment code to allow NSW EPA to monitor their movement from site of generation to disposal. However, at this stage no asbestos impacts have been identified within site soils.

In addition, the proximity principle, under POEO 2014, makes it an offence to transport waste generated in NSW by motor vehicle for disposal more than 150 kilometres from the place of generation, unless the waste is transported to one of the two nearest lawful disposal facilities to the place of generation.

11.4 Waste Classification Guidelines (EPA 2014a)

All wastes generated and proposed to be disposed off-site shall be assessed, classified and managed in accordance with this guideline.

11.5 Asbestos Removal Regulations and Code of Practice

The removal and disposal of asbestos will be managed in accordance with the Work Health and Safety Act (2011) and Work Health and Safety Regulation (2017), Code of Practice How to Safely Remove Asbestos (NSW Government 2019), Code of Practice How to Manage and Control Asbestos in the Workplace (NSW Government 2019), NSW SafeWork Guidelines, the NSW EPA (2014) Waste Classification Guidelines, and requirements under the Protection of the Environment Operations (Waste) Regulation (2014) for asbestos waste monitoring (NSW EPA 2015).

Excavation, onsite remediation and removal of asbestos impacted soils are required to be conducted by a Class A (Friable) or B (Bonded) Asbestos Removal licensed contractor.

11.6 Willoughby Council (2023) 'Development Control Plan'

The Council DCP provides a number of environmental and site management provisions required to be employed during remediation works. These will require to be adopted as minimum standards for the environmental management of remediation works.

12. Conclusions

Overall, it is considered that the proposed actions outlined in this RAP conform to the requirements of the *Contaminated Sites Guidelines for the NSW Site Auditor Scheme (3rd Edition)* (EPA 2017) because they are: technically feasible; environmentally justifiable; and consistent with relevant laws policies and guidelines endorsed by NSW EPA.

Subject to the successful implementation of the measures detailed in this RAP and subject to the limitations in **Section 13**, it is considered that the risks posed by the identified impacts at the site can be appropriately addressed and that the site can be made suitable for the proposed land-use associated with the proposed development. As such, having regard to Clause 4.6(1)(b) of SEPP (Resilience and Hazards) 2021, the land will be/can be made suitable after remediation for the purpose for which the development is proposed to be carried out subject to the actions recommended in this RAP.

13. Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquiries.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

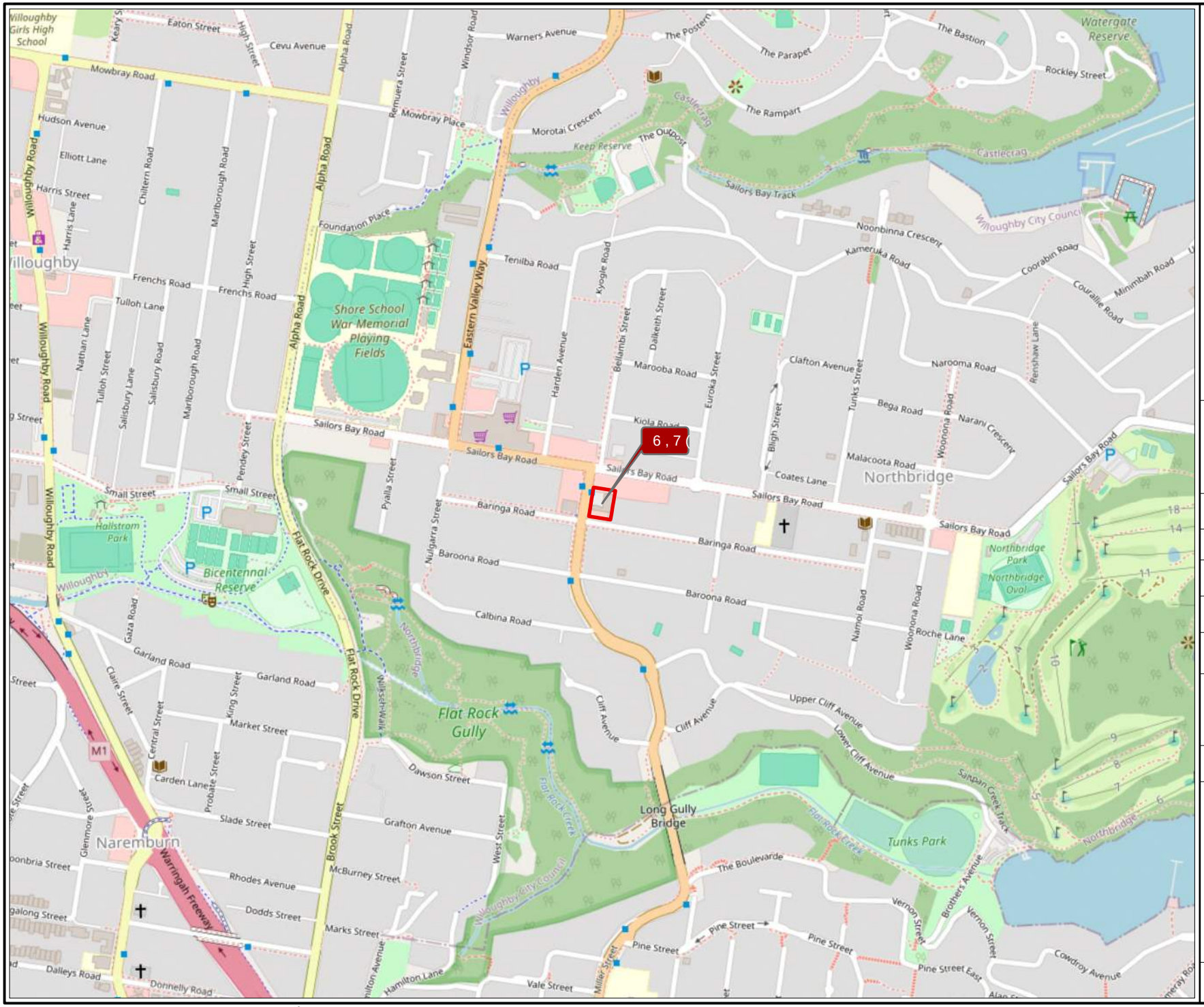
Limited sampling and laboratory analyses were undertaken as part of the investigations undertaken, as described herein. Ground conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information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

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

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

©JBS&G Australia Pty Ltd

Figures



> P v
‰‰Œ}Æ]u š ^]š }µv ŒÇ

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ßà ólíîlîìîï

Œ Áv ÇW W Z l ÇW ^

^ o íWíìUìì 9

ì õì íôì

u šŒ •

}}Œ X ^Ç•X ' îìîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu E}ŒšZ Œ] P U E^t

^/d >K d/KE

&/'hZ í



> P v
‰‰Œ}Æ]u š ^]š }µv ŒÇ
E^t •šŒ
^]š & šµŒ •
&}Œu Œ ŒÇr o v]vP K‰ Œ
&}Œu Œ D}š}Œ ' Œ P Œ
&}Œu Œ ^ ŒÀ] ^š Ÿ}v Œ
E}ŒšZ Œ] P ,}š o
‰‰Œ}Æ]u š ^ Á Œ }v µ]š
‰‰Œ}Æ]u š ‹µ µ š >} Ÿ}v

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ÎîÎíîÎìîï

Œ Áv ÇW W Z I ÇW ^

^ o íWðñì 9

ì ðXñ õ

u šŒ •

}}Œ X ^Ç•X ' îìîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu
E}ŒšZ Œ] P U E^t

^/d > zKhd

&/'hZ î



> P v

‰‰Œ}Æ]u š ^]š }µv ŒÇ

E^t •šŒ

‰‰Œ}Æ]u š • u vš Æš vš

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ïìlìðlîìîð

Œ Áv ÇW WlZ^ l ÇW ^

^ o íWðñì 9

ì ñ íì

u šŒ •

}}Œ X ^Ç•X ' îìîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu E}ŒšZ Œ] P U E^t

WZKWK^ ^/d > zKhd

&/'hZ î



> P v
‰‰Œ}Æ]u š ^]š }µv ŒÇ
E^t •šŒ
,]•š}Œ] o ^ u‰o >} Ÿ}v•
~ }µPo • W Œšv Œ•U ìÌîî•
" ^}]o s ‰}µŒ
}Œ Z}o lD}v]š}Œ]vP t oo

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ó lííîlîÌîî

Œ Áv ÇW W Z l ÇW ^

^ o íWðñì 9

ì ðXñ õ

u šŒ •

}}Œ X ^Ç•X ' îÌîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu
E}ŒšZ Œ] P U E^t

,/^dKZ/ > ^ DW> >K d/KE^

&/'hZ ï

&]o E u W òñõòïzE}ŒšZ Œ] P ^/rZ WzZìízZ À
Z (Œ v W E Œu ‰ r ÁÀÁXv Œu ‰X }u ~ ‰šµŒ š W ìÌlíìlîÌîî•



> P v

‰‰Œ}Æ]u š ^]š }µv ŒÇ

E^t •šŒ

,]•š}Œ] o ^ u‰o >} Ÿ}v•

~ }µPo • W Œšv Œ•U ìÌíî•

" ^}]o s ‰}µŒ

}Œ Z}o lD}v]š}Œ]vP t oo

^ u‰o >} Ÿ}v• ~: ^˜'U îìíî•

}Œ Z}o

" ^}]o s ‰}µŒ

}Œ Z}o lD}v]š}Œ]vP t oo

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ó lííîlîìîïî

Œ Áv ÇW W Z l ÇW ^

^ o íWðñì 9

ì ðXñ õ

u šŒ •

}}Œ X ^Ç•X ' îìîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu

E}ŒšZ Œ] P U E^t

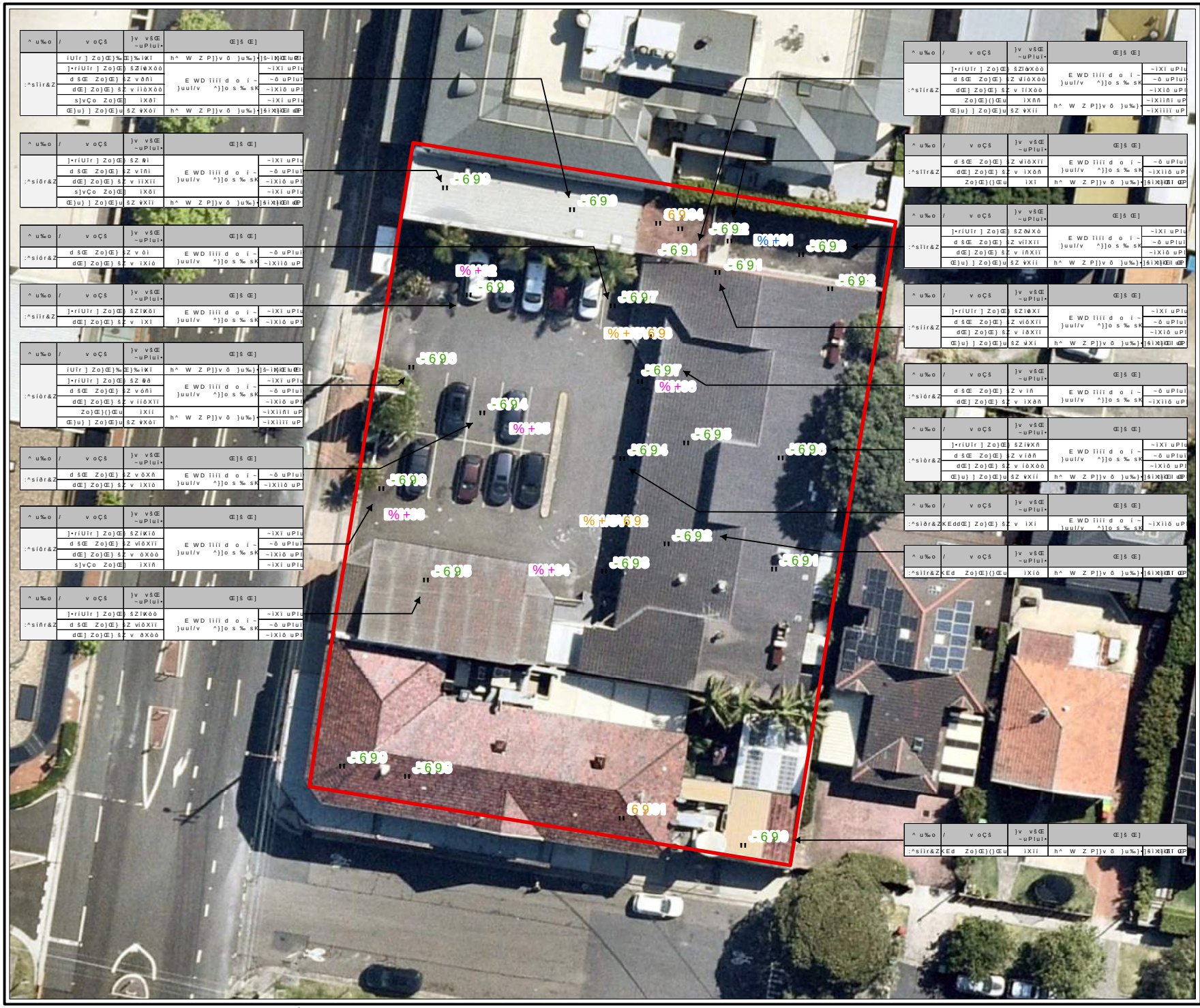
^ DW> >K d/KE^

&/'hZ ð

&]o E u W òñõòïzE}ŒšZ Œ] P ^/rZ WzZìízZ À
Z (Œ v W E Œu ‰ r ÁÀÁXv Œu ‰X }u ~ ‰šµŒ š W ìïlíìlîìîï•


(675$7+$//(1 $9(
%$5,1*$5'
-69.
%+69.
%+69.
%+


-69
%+
-69
%+
-69
%+



> P v
‰‰Œ}Æ]u š ^]š }µv ŒÇ
,]•š}Œ] o ^ u‰o >} Ÿ}v•
~ }µPo • W Œšv Œ•U ÎÌÎÎ•
" ^}]o s ‰}µŒ
}Œ Z}o lD}v]š}Œ]vP t oo
^ u‰o >} Ÿ}v• ~: ^˜'U ÎÌÎÎ•
}Œ Z}o
" ^}]o s ‰}µŒ
}Œ Z}o lD}v]š}Œ]vP t oo

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ÎÎlíÎlÎìÎÎï

Œ Áv ÇW W Z l ÇW ^

^ o íWðñì 9

ì ðXñ õ

u šŒ •

}}Œ X ^Ç•X ' ÎìÎì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu
E}ŒšZ Œ] P U E^t

^K/> s WKhZ y E ^

&/'hZ ó



> P v

‰‰Œ}Æ]u š ^]š }µv ŒÇ

‰‰Œ}Æ]u š ^]š & šµŒ •

&}Œu Œ ŒÇr o v]vP K‰ Œ

&}Œu Œ D}š}Œ ' Œ P Œ

&}Œu Œ ^ ŒÀ] ^š Ÿ}v Œ

E}ŒšZ Œ] P ,}š o

‰‰Œ}Æ]u š • u vš Æš vš

^ Á Œ

/v(ŒŒ Z u] o Æš vš•

/u‰ š D š Œ] o•

Ç}v • u vš &}}š‰Œ]vš

• •š}• /u‰ š &]oo

^ u‰o >} Ÿ}v• ~: ^˜'U îìîï•

}Œ Z}o lD}v]š}Œ]vP t oo

JBS&G

:} E}W òñõòï

o] všW ^: WšÇ >š X

s Œ•]}vW Zìí Z ïìlìðlîìîð

Œ Áv ÇW WlZ^ l ÇW ^

^ o íWðñì 9

ì ñ íì

u šŒ •

}}Œ X ^Ç•X ' îìîì D' •}v ñò

ñórñõ ^šŒ šZ oo v À vu

E}ŒšZ Œ] P U E^t

/E& ZZ Z D / > yd Ed

&/'hZ ô

&]o E u W òñõòïzE}ŒšZ Œ] P ^/rZ WzZìízZ À
Z (Œ v W E Œu ‰ r ÁÁÁXv Œu ‰X }u ~ ‰šµŒ š W ìïlíìlîìîï•

Appendix A Historical Datasets

TABLE A: SOIL ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

| | Metals & Metalloids | | | | | | | | TPHs (NEPC 1999) | | | | | TRHs (NEPC 2013) | | | | | | | BTEXN | | | | | | | PAH | | | | | | | | | | | | | | | | | | Organochlorine Pesticide | | | | | | | | | | | | | | | | | |

TABLE A: SOIL ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

| | | |

TABLE A: SOIL ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

			PFAS																													MAH						Miscellaneous Hydrocarbons						Chlorinated Benzenes					Trihalomethanes				Organic Sulfur Compounds	EPA VIC - IWRG621					
			Perfluorotetradecanoic acid (PFTeDA)	Perfluorooctane sulfonamide (FOSA)	N-Methyl perfluorooctane sulfonamide (NMeFOSA)	N-Ethyl perfluorooctane sulfonamide (NEtFOSA)	N-Methylperfluorooctanesulfonamidoethanol (N-MeFOSE)	N-ethylperfluorooctanesulfonamidoethanol (NEtFOSE)	N-methylperfluorooctane sulfonamidoacetic acid (NMeFOSAA)	N-ethyl-perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	Perfluoropropanesulfonic acid (PFPrS)	Perfluorobutanesulfonic acid (PFBS)	Perfluoropentanesulfonic acid (PFPeS)	Perfluorohexanesulfonic acid (PFHxS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorooctanesulfonic acid (PFOS)	Perfluorodecanesulfonic acid (PFDS)	1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2 FTSA)	1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2 FTSA)	1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2 FTSA)	1H,1H,2H,2H-perfluorododecanesulfonic acid (10:2 FTSA)	Sum of PFHxS and PFOS	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)*	Sum of US EPA PFAS (PFOS + PFOA)*	Sum of WA DWER PFAS (n=10)*	Sum of PFAS	Perfluorononanesulfonic acid ion	1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	Styrene	Total MAH	Bromobenzene	Isopropylbenzene	1,2-dibromoethane	Bromomethane	Dibromomethane	Iodomethane	4-Methyl-2-pentanone	Methyl Ethyl Ketone	1,2-Dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	Hexachlorobenzene	Dibromochloromethane	Chloroform	Tribromomethane	Bromodichloromethane	Carbon disulfide	Chlorinated Hydrocarbons EPAVic	Other Chlorinated Hydrocarbons EPAVic	Organochlorine Pesticides EPAVic	Other Organochlorine Pesticides EPAVic	Approximate Sample Mass	Mass ACM
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kG	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g	g
EQL			0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.005	0.005	0.005	0.005	0.005	0.01	0.05	0.005	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1		
NEPM 2013 Table 1A(1) HILs Res A Soil																		

TABLE A: SOIL ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

			Asbestos - Eurofins																Asbestos - Envirolab				Moisture Content	Other
			Mass Asbestos in ACM	Asbestos from ACM in Soil	Mass FA	Mass Asbestos in FA	Mass AF	Mass asbestos in AF	Asbestos from FA & AF in Soil	Mass Asbestos in FA & AF	ACM - Comment	FA- Comment	AF - Comment	Organic Fibres - Comment	Respirable Fibres - Comment	Synthetic Fibres - Comment	Asbestos Reported Result	Asbestos ID in Soil	Total Asbestos	Asbestos (ACM >7mm) Estimation	Asbestos in soil (<2mm AF/FA) [%w/w]	Moisture Content	Moisture Content (dried @ 103°C)
			g	% (w/w)	g	g	g	g	% (w/w)	g	Comment	Comment	Comment	Comment	Comment	Comment	Comment	g/kg	g/kg	% (w/w)	% (w/w)	%	%
EQL																			0.1	0.01	0	0.1	1
NEPM 2013 Table 1A(1) HILs Res A Soil																							
NEPM 2013 Table 1A(3) Comm/Ind D Soil HSL for Vapour Intru																							
NEPM 2013 Table 1B(1-5) Generic EIL - Urban Residential and																							
NEPM 2013 Table 1B(6) ESLs for Urban Res, Coarse Soil																							
PFAS NEMP 2020 Table 2 Health Residential accessible soil																							
PFAS NEMP 2020 Table 2 Health Residential min soil access																							
Field_ID	**Sampled_Date_Time**	**Lab_Report_Number**																						
BH101_0.1-0.2	4/12/2023	1050325	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	7.9
BH101_0.2-0.3	1/12/2023	1050325	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	6.8
BH102-0.2-0.3	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	10
BH102-04-0.5	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.9
BH102-2.5-2.6	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.7
BH103-0.2-0.3	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	9.1
BH103-1.0-1.1	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.7
BH103-2.0-2.1	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8
BH104-0.2-0.3	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	9.1
QA_041223	4/12/2023	339497	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	<0.1	<0.01	<0.001 - 0[#7]	5.5	-
QC-041223	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	-	1[#6]	1[#2]	-	-	-	-	-	8.9
BH104-0.5-0.6	4/12/2023	1050302	0.16023	0.0359421265	0	0	0	0	0	0	1[#3]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#3]Approximate raw weight of ACM = 1.6gTotal estimated asbestos content in ACM = 0.16g*Total estimated asbestos concentration in ACM = 0.036% w/w*Organic fibre detected.No trace asbestos detected.	-	-	-	-	-	9.9
BH104-1.5-1.6	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6
BH104-2.0-2.1	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.3
BH105-0.2-0.3	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	7.6
BH105-0.5-0.6	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	11
BH105-1.0-1.1	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.3
BH105-2.4-2.5	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8
BH106-0.2-0.3	4/12/2023	1050302	0	0	0	0	0	0	0	0	1[#6]	1[#6]	1[#6]	1[#5]	1[#4]	1[#6]	1[#2]	-	-	-	-	-	7.2
BH106-0.5-0.6	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.8
BH106-2.0-2.1	4/12/2023	1050302	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.1
DP 2023																							0
BH01 0.3-0.6	14/04/2023																No asbestos detected						
BH01 0.7-1.0	14/04/2023																No asbestos detected						

Table B: GROUNDWATER ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

	Metals & Metalloids								TRH				BTEXN						PAH																								Organochlo
	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	TRH C6-C10 (F1)	TRH C10-C16 (F2)	TRH C160C34 (F3)	TRH c34-C40 (F4)	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	2-Methylnaphthalene	3-Methylcholanthrene	7,12-Dimethylbenz(a)anthracene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b+j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Naphthalene	Phenanthrene	Pyrene	PAHs (Sum of total)	Pentachlorophenol	4,4-DDE	a-BHC	b-BHC	d-BHC	g-BHC (Lindane)	Aldrin	Dieldrin	Aldrin + Dieldrin	DDT
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	0.001	0.0002	0.001	0.001	0.001	0.0001	0.001	0.005	0.01	0.05	0.1	0.1	0.001	0.001	0.001	0.001	0.002	0.003	0.005	0.005	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0001	0.005
ADWG (2011) Health x 10 (Recreational) - Updated March-2021	0.1	0.02	0.5 [#1]	20	0.1	0.01	0.2	[#2]					0.01	8	3	6 [#3]	6 [#3]	6								0.0001 [#4]													0.1					0.1	0.003 [#5]	0.003 [#5]	0.003	0.09
ANZG (2018) Freshwater 95% toxicant DGVs	0.013 [#10]	0.0002 [#11]	0.001 [#12]	0.0014 [#11]	0.0034 [#13]	0.0006 [#14]	0.011 [#15]	0.008 [#16]					0.95 [#13]	0.18 [#17]	0.08 [#17]	0.35 [#15]	0.075 [#18]							0.0004 [#19]		0.0002 [#19]						0.0014 [#19]			0.016 [#15]	0.002 [#19]			0.01 [#14]					0.0002 [#13]				0.00001 [#14]
ANZG (2018) Freshwater 99% toxicant DGVs	0.0008 [#25]	0.00006 [#26]	0.00001 [#27]	0.001 [#26]	0.001 [#14]	0.00006 [#28]	0.008 [#20]	0.0024 [#26]					0.6 [#14]	0.11 [#19]	0.05 [#19]	0.2 [#20]	0.05 [#18]							0.00001 [#29]		0.0001 [#30]						0.001 [#29]			0.0025 [#20]	0.0006 [#29]			0.0036 [#28]					0.00007 [#14]				0.000006 [#28]
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion, Sand 2-4m									6	NL			5																																	
PFAS NEMP 2020 Table 5 Freshwater 95%																																														
PFAS NEMP 2020 Table 1 Health Recreational Water																																													

Field_ID	Sampled_Date_Time	Lab_Report_Number																																													
BH01	6/12/2023	1051812	<0.001	<0.0002	<0.001	0.005	<0.001	<0.0001	0.003	0.063	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
BH02	6/12/2023	1051812	<0.001	<0.0002	<0.001	0.019	0.007	<0.0001	0.042	0.28	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW103	6/12/2023	1051812	0.002	<0.0002	<0.001	0.016	<0.001	<0.0001	0.027	0.15	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW104-D	6/12/2023	1051812	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW104-S	6/12/2023	1051812	0.002	<0.0002	<0.001	0.007	<0.001	<0.0001	0.013	0.057	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MW105	6/12/2023	1051812	0.009	<0.0002	<0.001	0.014	<0.001	<0.0001	0.037	0.14	-	-	-	-	0.011	<0.001	<0.001	0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
MW106	6/12/2023	1051812	0.002	<0.0002	<0.001	0.005	<0.001	<0.0001	0.01	0.05	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
QC01	6/12/2023	1051812	0.002	<0.0002	<0.001	0.007	<0.001	<0.0001	0.01	0.051	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003	<0.005	<0.005	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

DP 2023																																														
BH1	21/04/2023		<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0005	0.001	0.011	0.16	0.15	<0.1	<0.1	0.025	<0.001	<0.001	<0.001	<0.002	<0.003																													
BH2	21/04/2023		<0.001	<0.0002	<0.001	0.018	0.015	<0.0005	0.007	0.076	1.3	<0.05	<0.1	<0.1	<0.001	<0.001	<0.001	<0.001	<0.002	<0.003																													

Table B: GROUNDWATER ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

| | rine Pesticides | | | | | | | | | | | Chlorinated Alkanes | | | | | | | | | | | | | | | | | | | | Chlorinated Alkenes | | | | | | | | | Semivolatile Organic Compounds | | | | | | | | | | | | | | | | | | |

Table B: GROUNDWATER ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

| | Solvents | | | | Phenols | | | |

Table B: GROUNDWATER ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

	Miscellaneous Hydrocarbons					Chlorinated Benzenes											Trihalomethanes				bicides & Fungici		Phthalates					Nitrobenzenes		Nitrotoluenes	Anilines		Organic Sulfur Compounds	PA VIC - IWRG6		inated Hydroca	
	Bromomethane	Dibromomethane	Iodomethane	4-Methyl-2-pentanone	Methyl Ethyl Ketone	1,2,3,4-tetrachlorobenzene	1,2,3,5-tetrachlorobenzene	1,2,3-trichlorobenzene	1,2,4,5-tetrachlorobenzene	1,2,4-trichlorobenzene	1,2-Dichlorobenzene	1,3,5-trichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	Hexachlorobenzene	Pentachlorobenzene	Dibromochloromethane	Chloroform	Tribromomethane	Bromodichloromethane	Pronamide	Trifluralin	Bis(2-ethylhexyl) phthalate	Diethylphthalate	Dimethyl phthalate	Di-n-butyl phthalate	Di-n-octyl phthalate	Nitrobenzene	Pentachloronitrobenzene	2,4-dinitrotoluene	2-Nitroaniline	Aniline	Carbon disulfide	Chlorinated Hydrocarbons EPAVic	Other Chlorinated Hydrocarbons EPAVic	Hexachlorocyclopentadiene	Hexachlorobutadiene
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL	0.005	0.001	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.001	0.005	0.001	0.001	0.001	0.005	0.005	0.001	0.005	0.001	0.001	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.001	0.005	0.005	0.005	0.005
ADWG (2011) Health x 10 (Recreational) - Updated March-2021	0.01										15		#2	0.4	3							0.7	0.9	0.1						0.3								0.007
ANZG (2018) Freshwater 95% toxicant DGVs						0.004 #19	0.005 #19	0.01 #20	0.007 #19	0.17 #21	0.16 #15	0.013 #19	0.26 #15	0.06 #13	0.055 #17	0.0001 #19	0.002 #19		0.77 #19				0.0044 #14		1 #23	3.7 #15	0.026 #20		0.55 #15		0.065 #22		0.25 #24					
ANZG (2018) Freshwater 99% toxicant DGVs						0.002 #30	0.003 #30	0.003 #36	0.005 #30	0.085 #37	0.12 #20	0.008 #30	0.16 #20	0.04 #14	0.005 #19	0.00005 #30	0.0015 #30		0.37 #38				0.0026 #28		0.9 #39	3 #20	0.01 #32		0.23 #20		0.016 #40		0.008 #41					
NEPM 2013 Table 1A(4) Comm/Ind HSL D GW for Vapour Intrusion,																																					
PFAS NEMP 2020 Table 5 Freshwater 95%																																					
PFAS NEMP 2020 Table 1 Health Recreational Water																																					

Field_ID	Sampled_Date_Time	Lab_Report_Number																																			
BH01	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.056	0.056	<0.005	<0.005
BH02	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.335	0.335	<0.005	<0.005
MW103	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.034	0.034	<0.005	<0.005
MW104-D	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	-	-	-	-	-	<0.001	-	<0.001	<0.001	<0.001	-	-	<0.001	<0.005	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	<0.001	<0.005	<0.005	-	-
MW104-S	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	-	-	-	-	-	<0.001	-	<0.001	<0.001	<0.001	-	-	<0.001	<0.005	<0.001	<0.001	<0.001	-	-	-	-	-	-	-	-	-	-	-	<0.001	0.106	0.106	-	-
MW105	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.193	0.193	<0.005	<0.005
MW106	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.369	0.349	<0.005	<0.005
QC01	6/12/2023	1051812	<0.005	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.001	<0.005	<0.001	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.352	0.334	<0.005	<0.005

DP 2023																																					
BH1	21/04/2023																		0.019																			
BH2	21/04/2023																		<0.001																			

SOIL VAPOUR ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

			BTEXN				PAH	Chlorinated Alkanes														Chlorinated Alkenes									
			Benzene	Toluene	Ethylbenzene	Xylene Total	Naphthalene	1,1,1,2-tetrachloroethane	1,1,1-trichloroethane	1,1,2,2-tetrachloroethane	1,1,2-trichloroethane	1,1-dichloroethane	1,2,3-trichloropropane	1,2-dibromo-3-chloropropane	1,2-dichloroethane	1,2-dichloropropane	1,3-dichloropropane	2,2-dichloropropane	Bromochloromethane	Carbon tetrachloride	Trichlorofluoromethane	1,1-dichloroethene	1,1-dichloropropene	2-chlorotoluene	4-chlorotoluene	cis-1,2-dichloroethene	cis-1,3-dichloropropene	Tetrachloroethene	trans-1,3-dichloropropene	Trichloroethene	Vinyl Chloride
			mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
EQL			0.08	0.08	0.08	0.2500005	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
NEPM 2013 Table 1A(2) Comm/Ind D Soil Vap VOCC HILs									230																			8		0.08	0.1
NEPM 2013 Table 1A(5) Comm/Ind D Soil Vapour HSL for Va			4	4800	1300	840	3																			0.3					
US EPA Region 9 Composite Worker																0.03						8.8									
Field_ID	**Sampled_Date_Time**	**Lab_Report_Number**																														
JSV01-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.55	<0.08	<0.08	<0.08	<0.08
JSV02-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	1.83	<0.08	<0.08	<0.08	<0.08
JSV03-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.60	<0.08	<0.08	<0.08	<0.08
JSV04-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	3.33	<0.08	0.10	<0.08	<0.08
JSV05-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	3.00	<0.08	<0.08	<0.08	<0.08
QC-01-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	3.00	<0.08	<0.08	<0.08	<0.08
JSV06-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	10.50	<0.08	145.00	<0.08	16.66	<0.08
JSV07-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	35.00	<0.08	0.45	<0.08
JSV09-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
JSV10-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
JSV11-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	38.30	<0.08	18.33	<0.08	14.33	<0.08
JSV12-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.36	<0.08	<0.08	<0.08	<0.08
JSV13-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	2.83	<0.08	0.11	<0.08	0.20	<0.08
JSV14-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	8.50	<0.08	0.36	<0.08	<0.08
JSV15-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	2.66	<0.08	18.33	<0.08	4.66	<0.08
JSV16-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.20	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.18	<0.08	<0.08	<0.08	94.00	<0.08	750.00	<0.08	118.33	<0.08
JSV17-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.20	<0.08	60.00	<0.08	3.16	<0.08
JSV18-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	1.38	<0.08	28.33	<0.08	6.66	0.35
JSV19-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.16	<0.08	<0.08	<0.08	50.00	<0.08	250.00	<0.08	33.33	0.93
JSV20-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.20	0.11	<0.08	<0.08	<0.08	<0.08	<0.08	1.10	<0.08	<0.08	<0.08	216.66	<0.08	450.00	<0.08	106.66	0.42
JSV21-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.10	<0.08	<0.08	<0.08	26.66	<0.08	216.66	<0.08	21.66	<0.08
JSV22-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.10	<0.08	108.33	<0.08	0.85	<0.08
JSV23-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.25	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	40.60	<0.08	12.33	<0.08	15.33	<0.08

SOIL VAPOUR ANALYTICAL RESULTS
Project Number: 65963
Project Name: Northbridge DSI

			MAH										Miscellaneous Hydrocarbo		Chlorinated Benzenes						Trihalomethanes				Organic Alcohols	Chlorinated Hydrocarbons
			1,2,4-trimethylbenzene	1,3,5-trimethylbenzene	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-butylbenzene	isopropylbenzene	1,2-dibromoethane	Dibromomethane	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-Dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	Dibromochloromethane	Chloroform	Tribromomethane	Bromodichloromethane	2-Propanol	Hexachlorobutadiene
			mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3	mg/m3
EQL			0.08	0.08	0.08	0.08	0.08	0.08	0.833335	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	1.66667	0.08
NEPM 2013 Table 1A(2) Comm/Ind D Soil Vap VOCC HILs																										
NEPM 2013 Table 1A(5) Comm/Ind D Soil Vapour HSL for Va																										
US EPA Region 9 Composite Worker																					0.0053		0.0033			
Field_ID	**Sampled_Date_Time**	**Lab_Report_Number**																								
JSV01-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV02-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.16	<0.08	<0.08	<1.6	<0.08
JSV03-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV04-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV05-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
QC-01-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV06-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.11	<1.6	<0.08
JSV07-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV09-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV10-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.31	<0.08	<0.08	<1.6	<0.08
JSV11-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.10	<1.6	<0.08
JSV12-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV13-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV14-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV15-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV16-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.11	<0.08	0.63	<1.6	<0.08
JSV17-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV18-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<1.6	<0.08
JSV19-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.23	<1.6	<0.08
JSV20-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.63	<1.6	<0.08
JSV21-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.55	<0.08	0.11	<1.6	<0.08
JSV22-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.20	<0.08	<0.08	<1.6	<0.08
JSV23-FRONT	1/12/2023	1050392	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.83	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.11	<1.6	<0.08

Appendix B Development Plans

57-69 Strathallen Ave, Northbridge

Architectural Development Application Drawings

Drawing List					
Drawing Number	Drawing Series	Drawing Name	Status	Revision	Date
A00.000		Cover Sheet & Drawing List	Development Application	2	28.06.24
A01.001	Site & Existing Conditions	Site Plan (Existing)	Development Application	2	28.06.24
A01.002	Site & Existing Conditions	Demolition Plan	Development Application	2	28.06.24
A01.003	Site & Existing Conditions	Site Plan (Proposed)	Development Application	2	28.06.24
A03.001	General Arrangement Plan	Basement Level 01	Development Application	3	28.06.24
A03.002	General Arrangement Plan	Basement Level 02	Development Application	3	28.06.24
A03.100	General Arrangement Plan	Ground Level	Development Application	3	28.06.24
A03.101	General Arrangement Plan	Level 01	Development Application	3	28.06.24
A03.102	General Arrangement Plan	Level 02 & 03	Development Application	3	28.06.24
A03.104	General Arrangement Plan	Level 04	Development Application	2	28.06.24
A03.105	General Arrangement Plan	Roof Level	Development Application	2	28.06.24
A09.001	External Elevations	North Elevation	Development Application	3	28.06.24
A09.002	External Elevations	East Elevation	Development Application	3	28.06.24
A09.003	External Elevations	South Elevation	Development Application	3	28.06.24
A09.004	External Elevations	West Elevation	Development Application	3	28.06.24
A10.001	Building Sections	Section A	Development Application	2	28.06.24
A10.002	Building Sections	Section B	Development Application	2	28.06.24
A13.001	Apartment Types	3B_A	Development Application	3	28.06.24
A13.002	Apartment Types	3B_B	Development Application	3	28.06.24
A13.003	Apartment Types	3B_C	Development Application	3	28.06.24
A13.004	Apartment Types	3B_D	Development Application	3	28.06.24
A13.101	Apartment Types	4B_A	Development Application	3	28.06.24
A13.102	Apartment Types	4B_B	Development Application	3	28.06.24
A21.001	Shadow Analysis Diagrams	Shadow Plans	Development Application	2	28.06.24
A21.002	Shadow Analysis Diagrams	Views From The Sun	Development Application	2	28.06.24
A22.001	Area Calculation Plans	GFA	Development Application	2	28.06.24



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Cover Sheet & Drawing List

Status	DEVELOPMENT APPLICATION
Scale	@ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:50 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A00.000
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

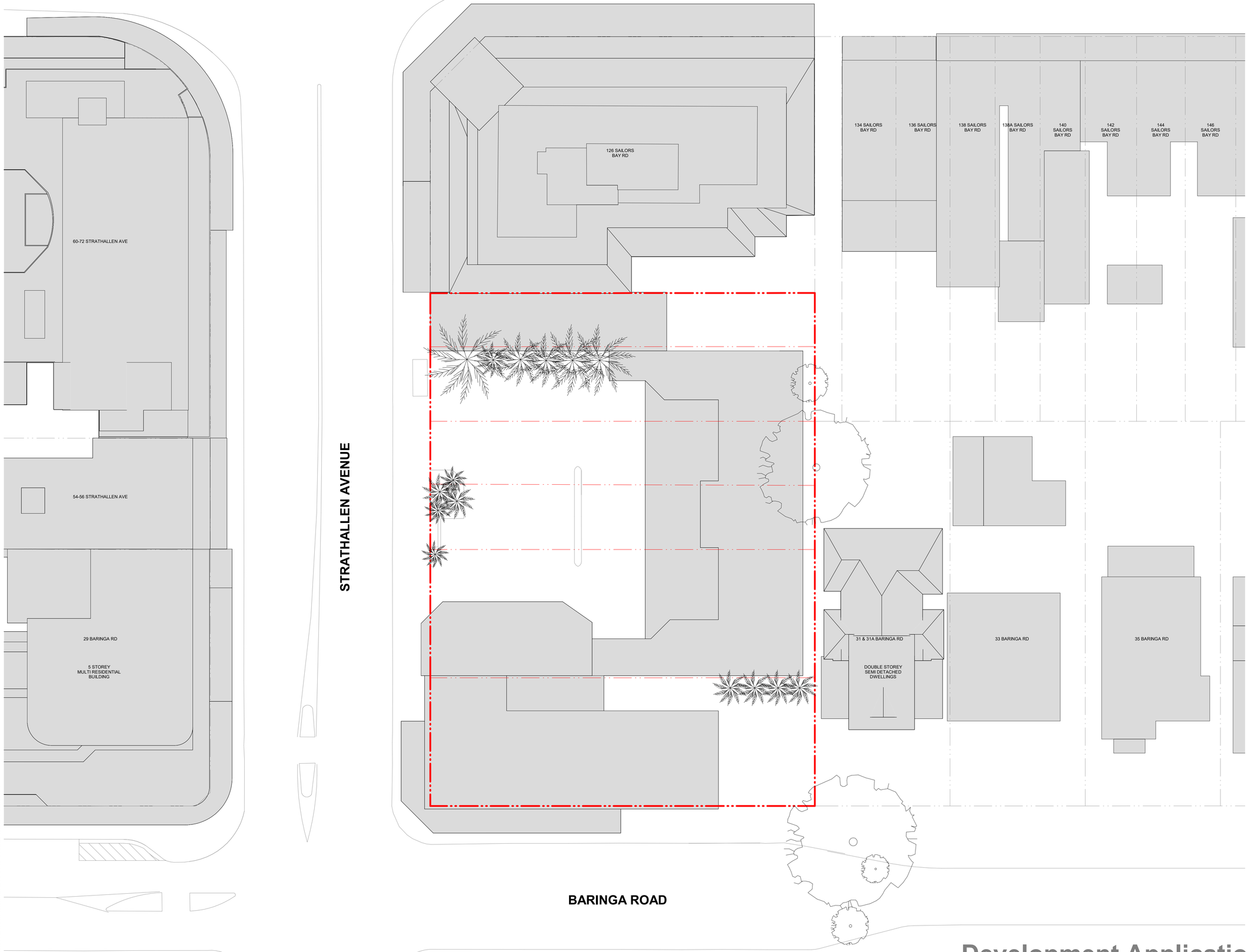
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Site Plan (Existing)

Status	DEVELOPMENT APPLICATION
Scale	1 : 200 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:56 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.001
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

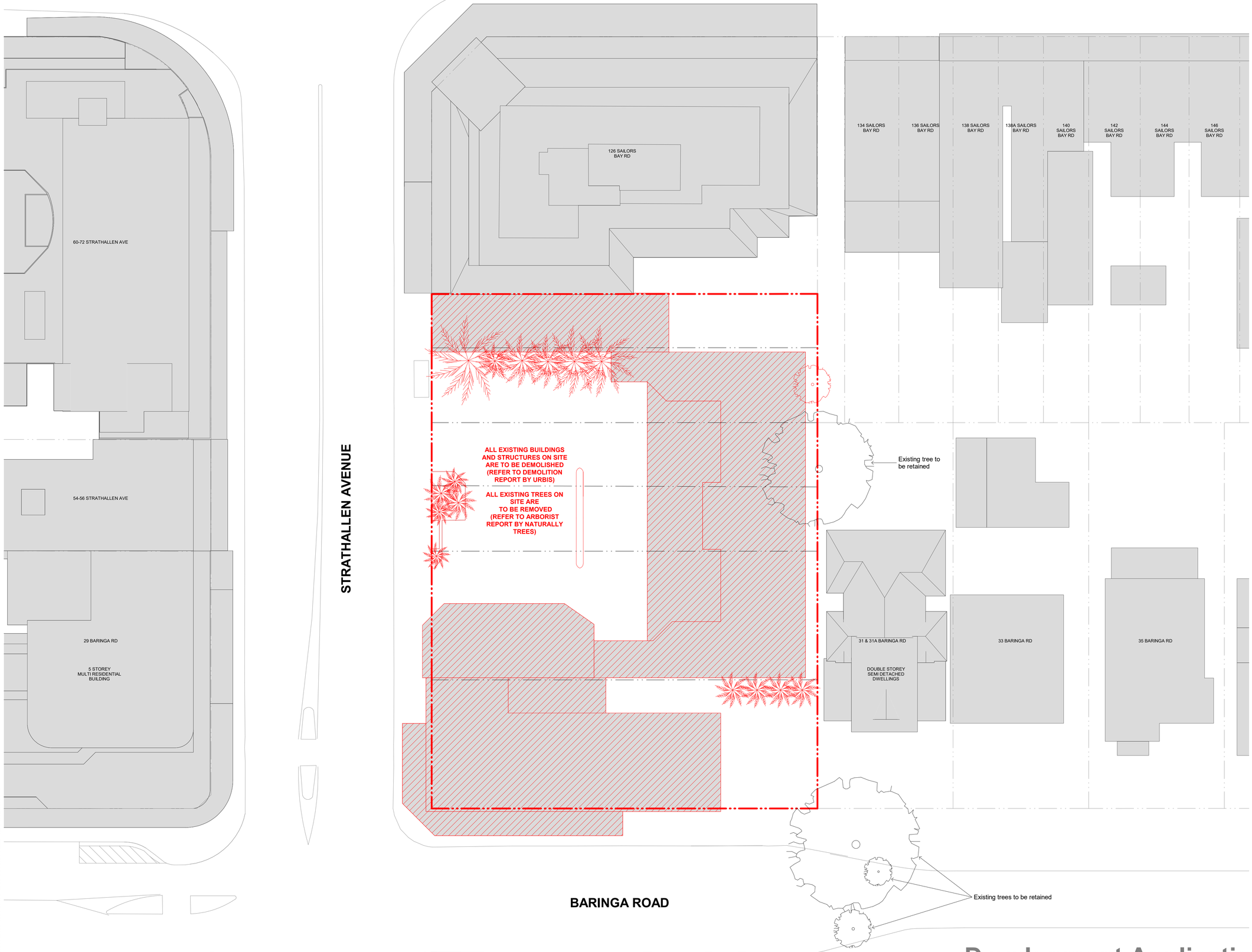
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Phillip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

To be demolished

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Demolition Plan

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:55:59 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

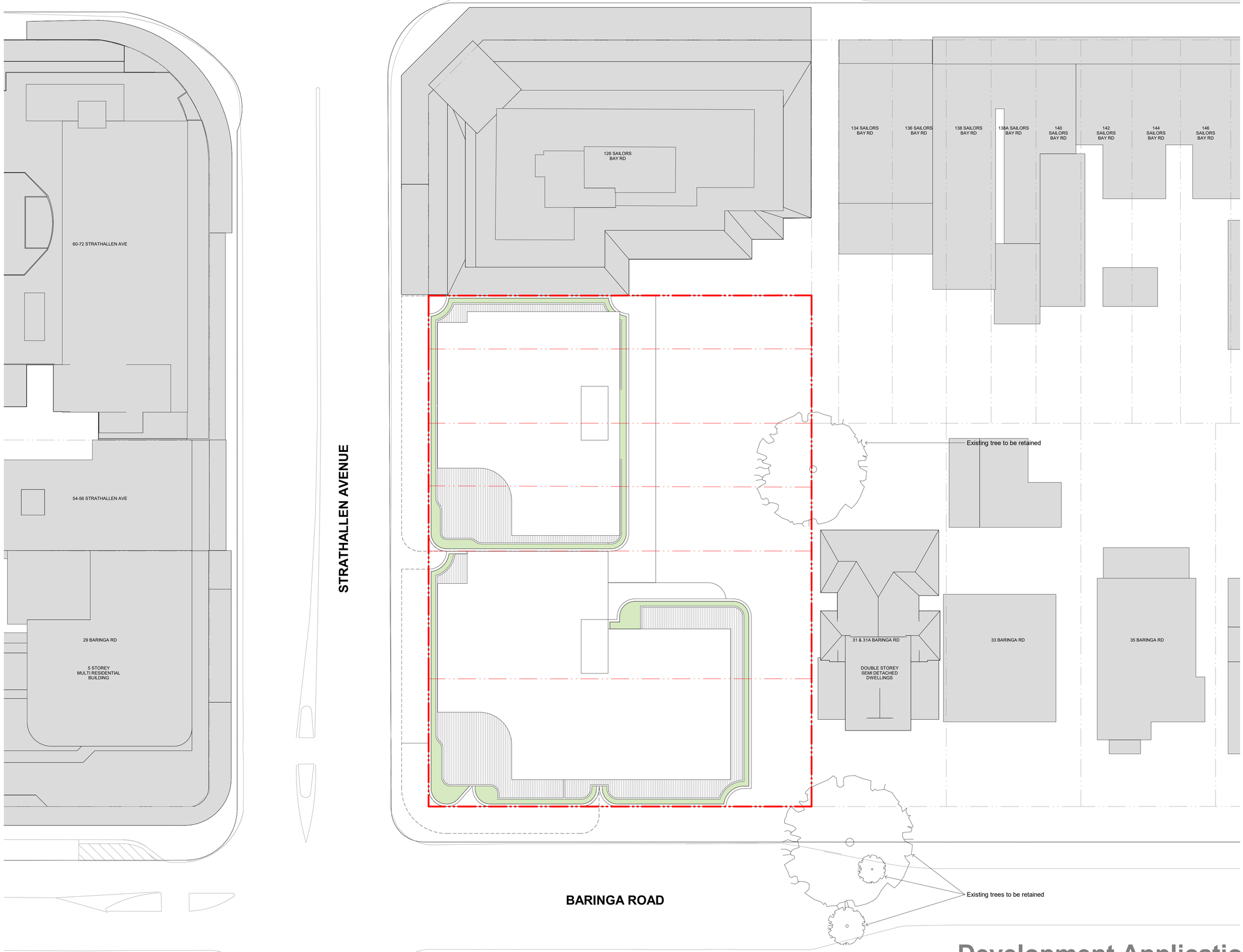
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Site Plan (Proposed)

Status	DEVELOPMENT APPLICATION
Scale	1 : 200 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:03 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.003
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

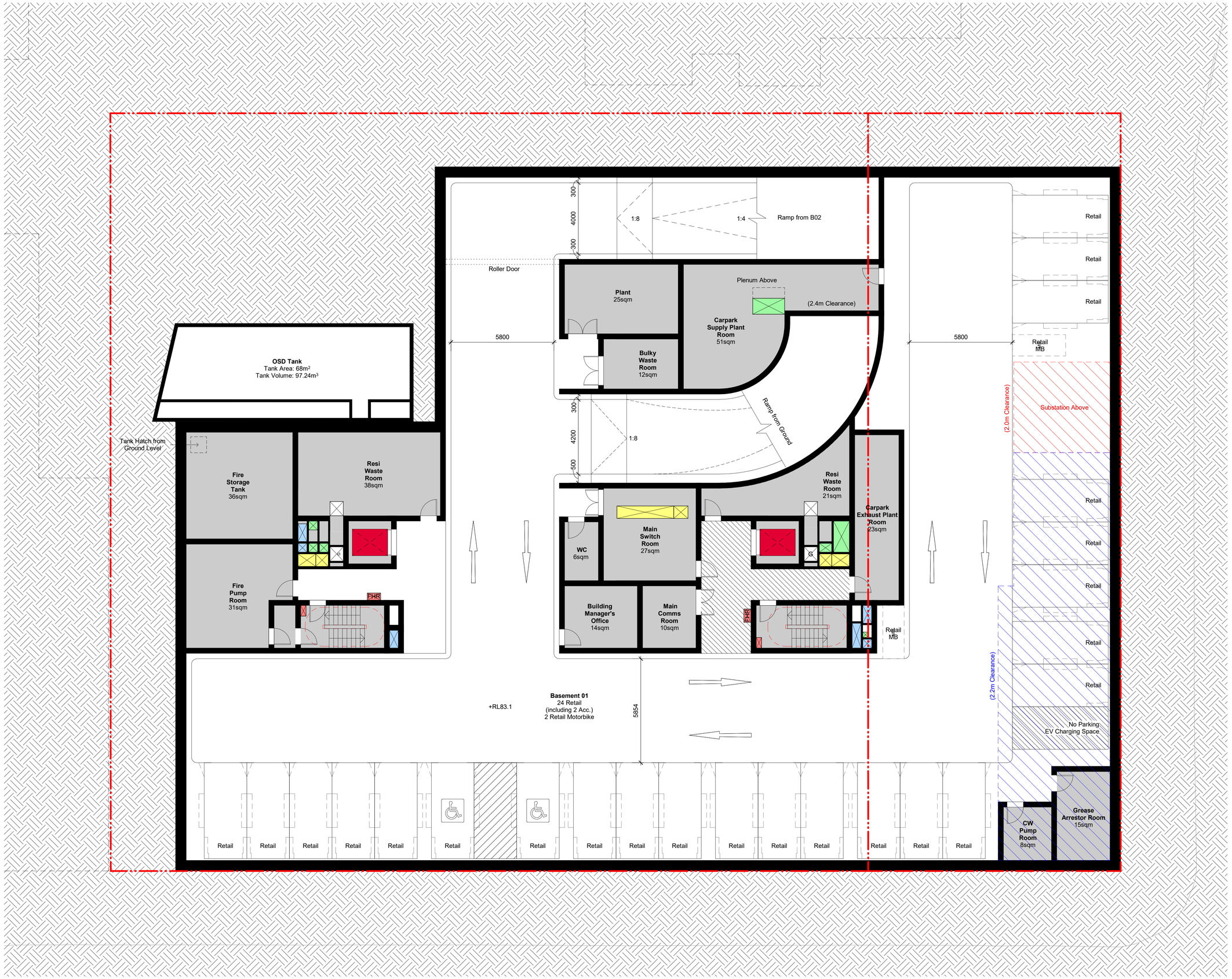
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Basement Level 01

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:06 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt
Drawing no.	A03.001
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

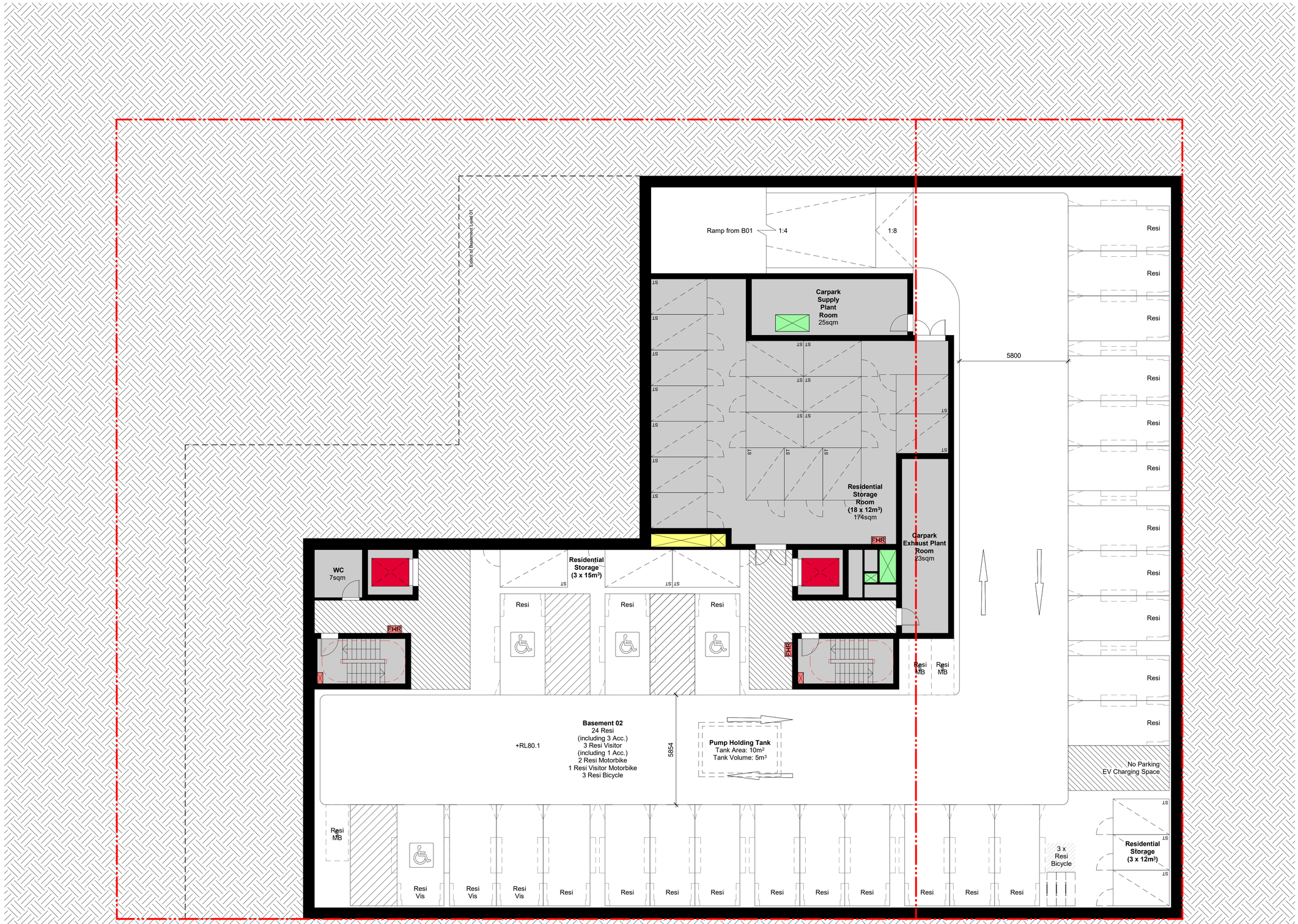
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Basement Level 02

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:09 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.002
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

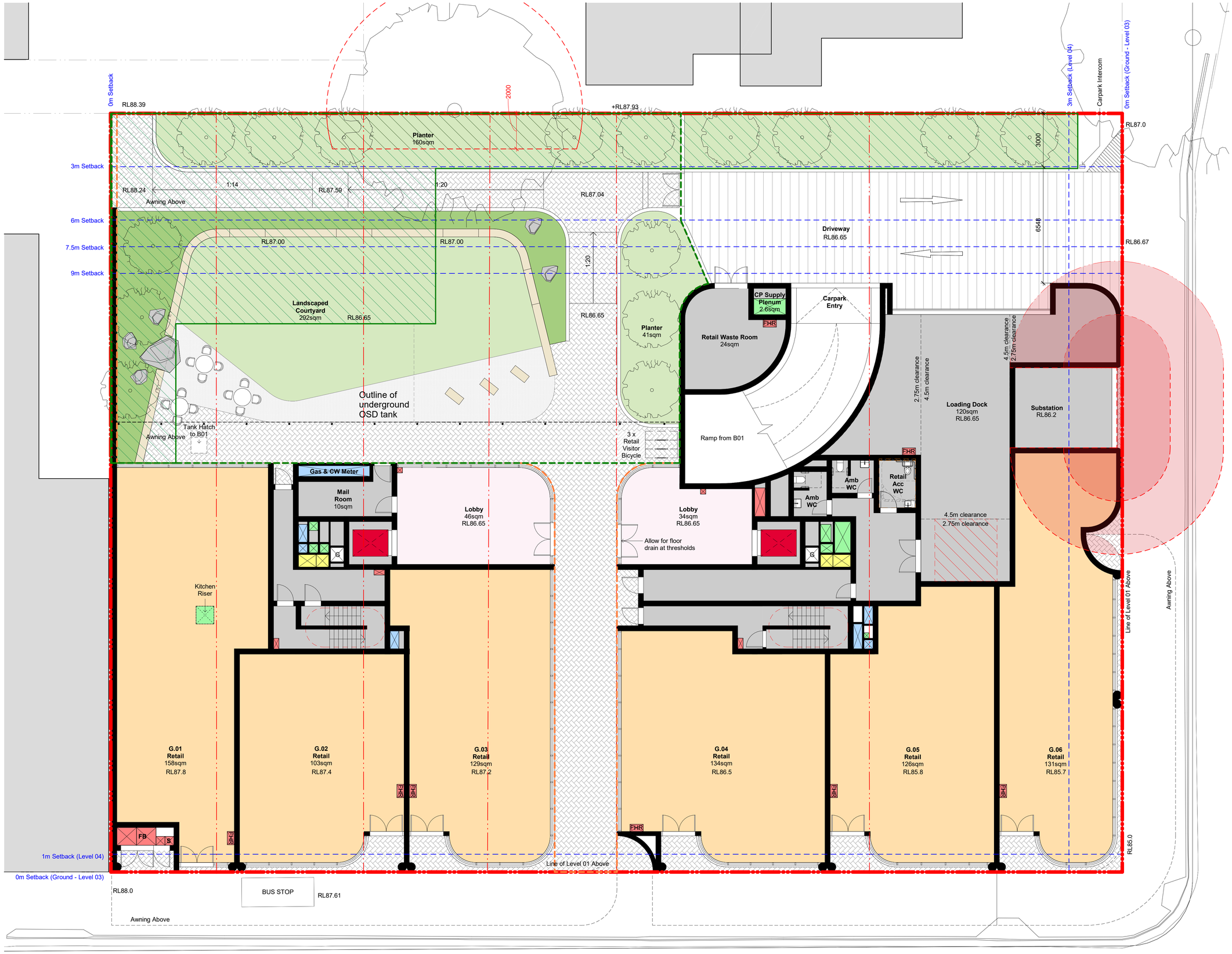
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Legend

- Deep soil extent
- Outline of communal open space
- Outline of public open space

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Ground Level

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:13 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt
Drawing no.	A03.100
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

0m Setback

3m Setback

6m Setback

7.5m Setback

9m Setback

1m Setback (Level 04)

0m Setback (Ground - Level 03)

3m Setback (Level 04)

0m Setback (Ground - Level 03)

Line of Level 02 Above

Awning Below

Awning Below

Awning Below

1.01 - Balcony 11m²

1.03 - Balcony 10m²

1.04 - Balcony 5m²

1.06 - Balcony 16m²

1.06 - Balcony 26m²

1.01 - Balcony 17m²

1.02 - Balcony 17m²

1.03 - Balcony 15m²

1.04 - Balcony 15m²

1.05 - Balcony 48m²

1.01
3B
165sqm

1.02
2B+
109sqm

1.03
3B+
145sqm

1.04
3B+
152sqm

1.05
4B
167sqm

1.06
4B+
198sqm

Master
Bed
Bath
Ens.
Study
L'dry
St
Living
Dining
Kitchen
B. Pantry
Loading Below

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 01

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:16 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraysm
Drawing no.	A03.101
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

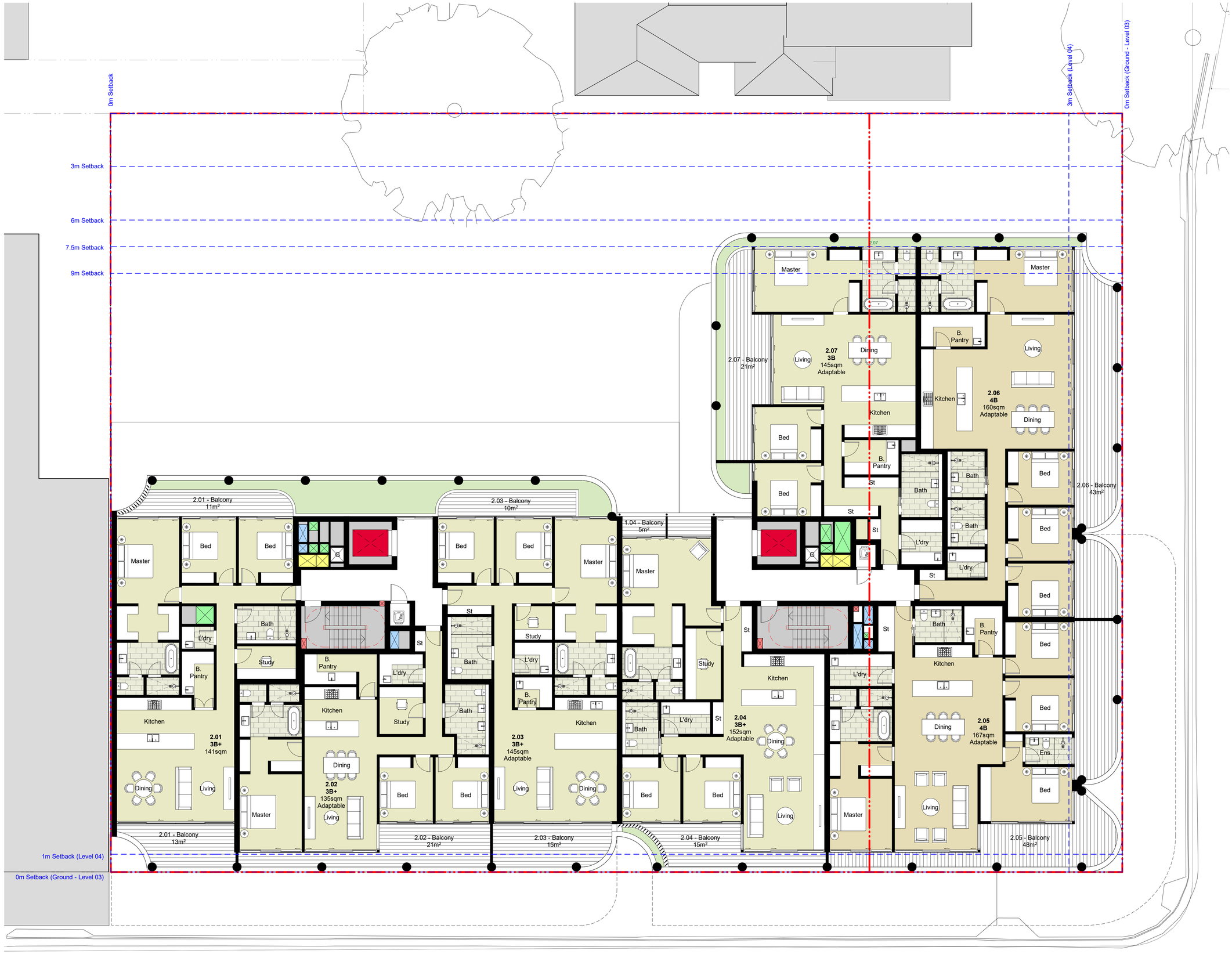
Development Application

BATESSMART

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 02 & 03

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:20 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.102
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 04

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:24 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.104
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

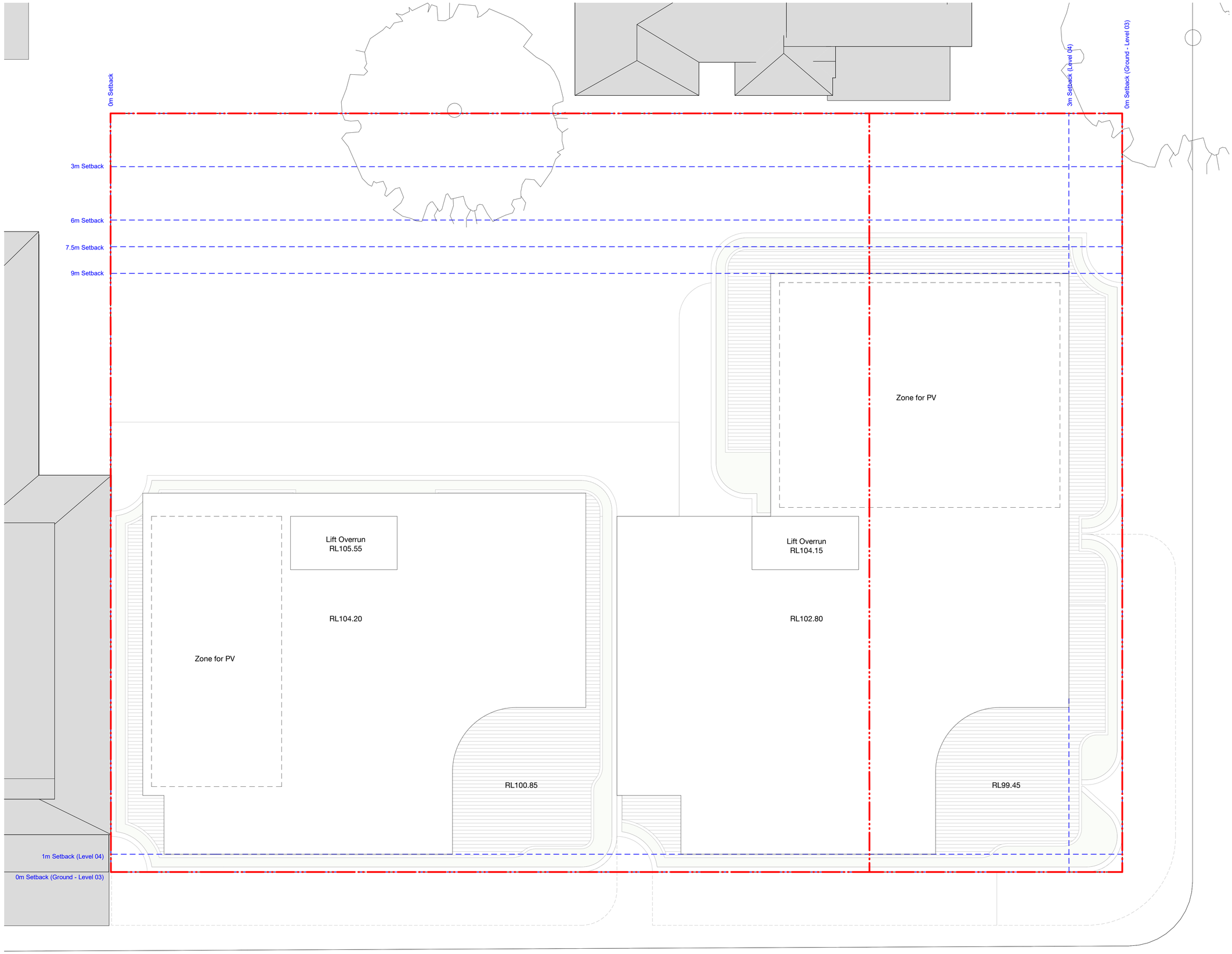
Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Roof Level

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:53 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt
Drawing no.	A03.105
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

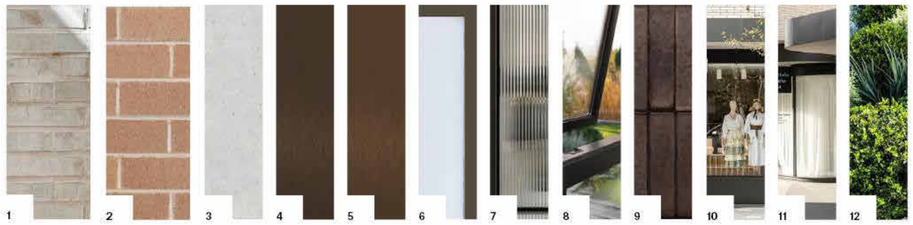
Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
North Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:57:32 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt		
Drawing no.	A09.001	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
East Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:58:07 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymi		
Drawing no.	A09.002	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

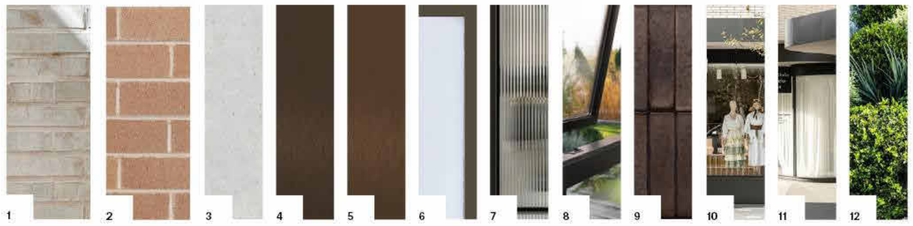
Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
South Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:58:41 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymi		
Drawing no.	A09.003	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
West Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:59:16 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt		
Drawing no.	A09.004	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

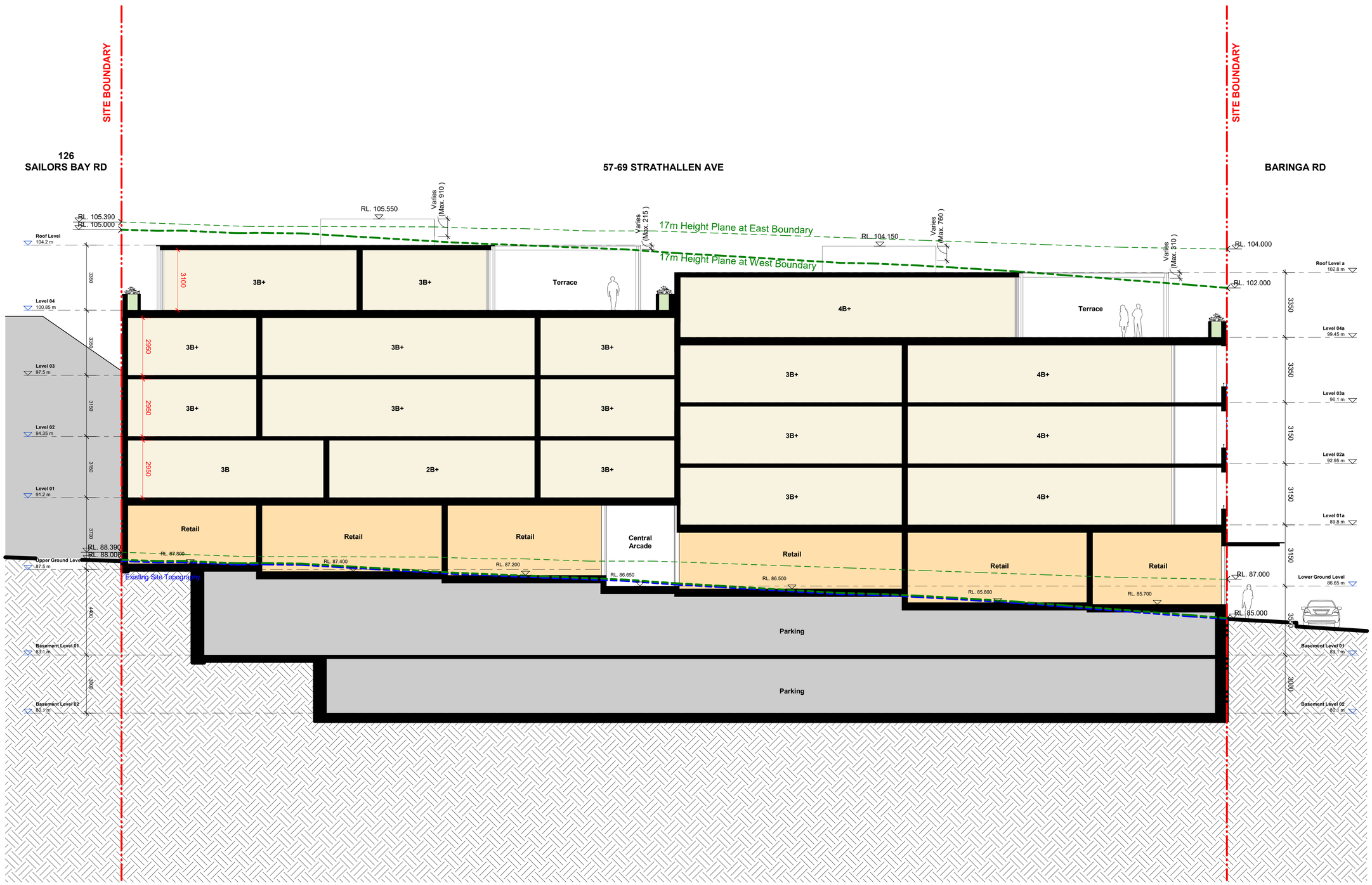
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Building Sections
Section A

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 10:58:05 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt		
Drawing no.	A10.001	Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

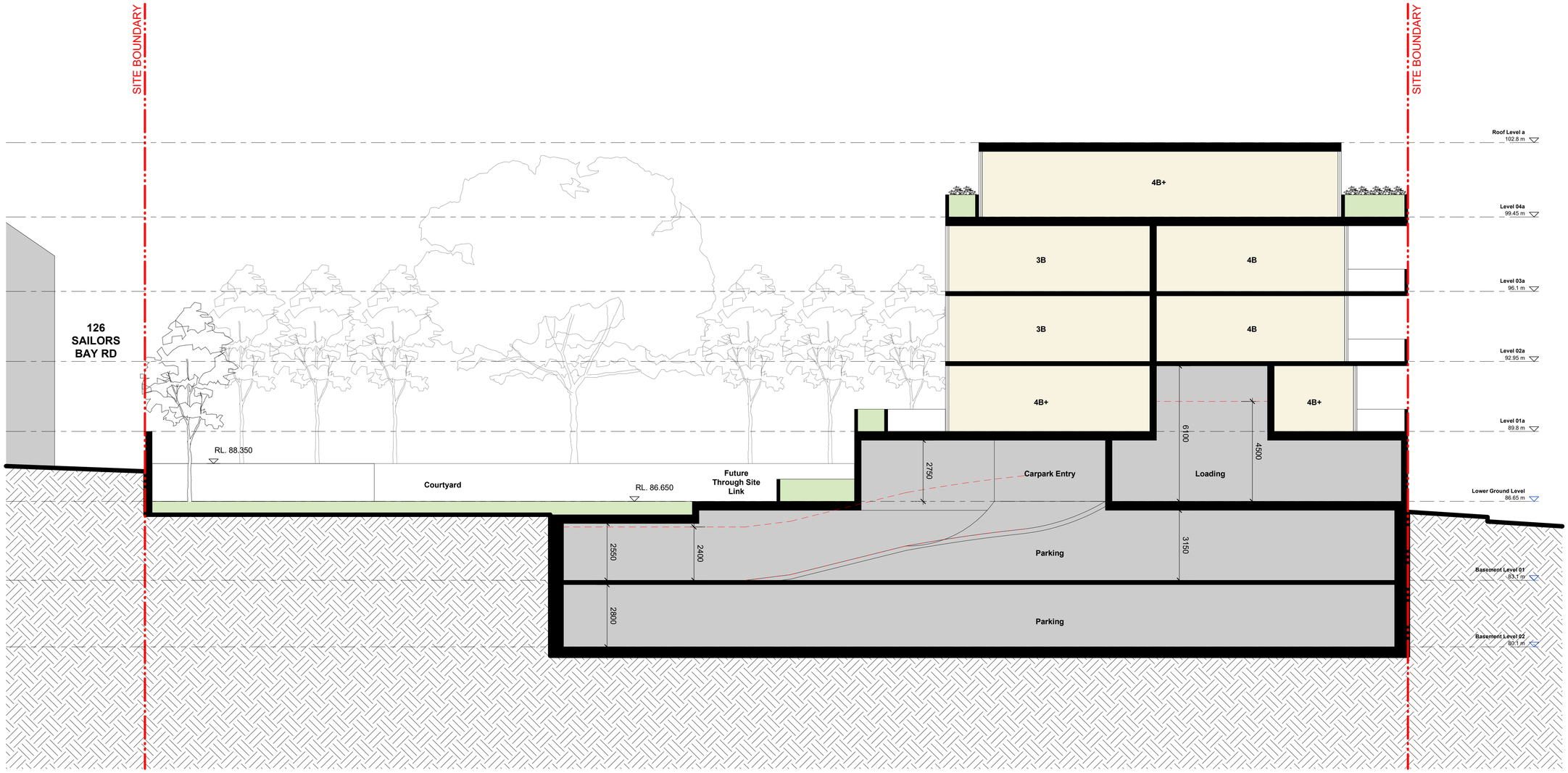
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Building Sections
Section B

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:47 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A10.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

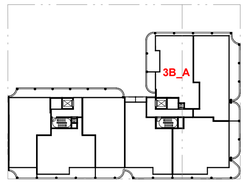
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

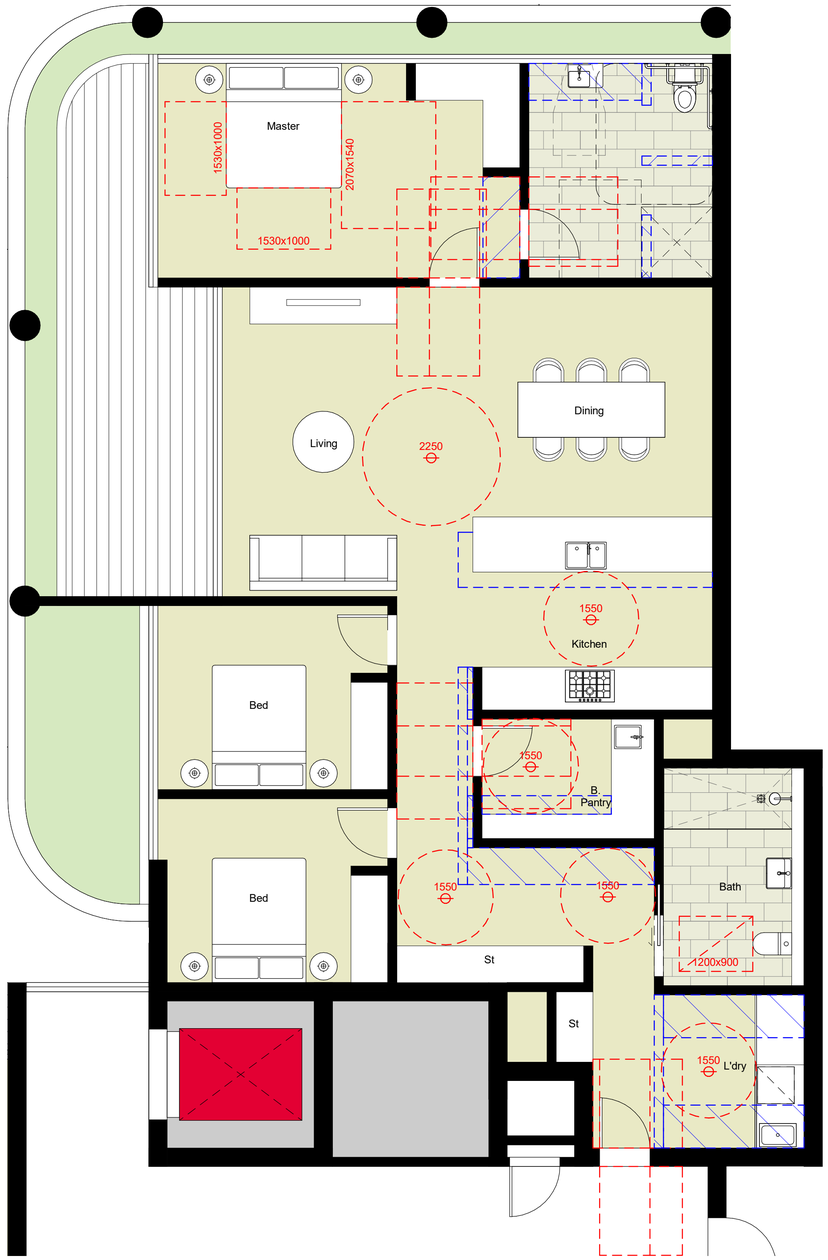
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_A - Pre Adaptation
Plan 1 : 50



2 3B_A - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_A

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:25 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.001
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

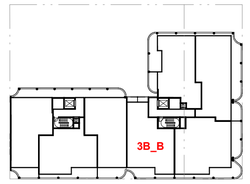
BATESSMART

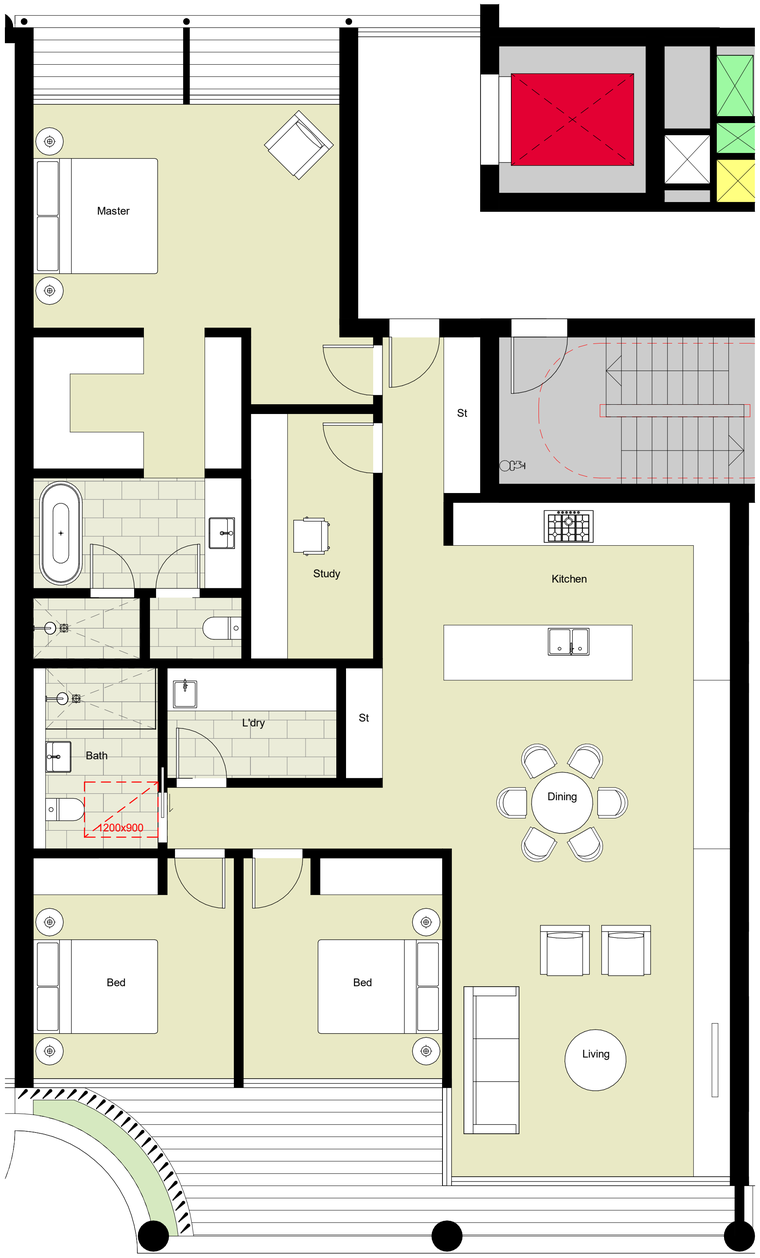
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

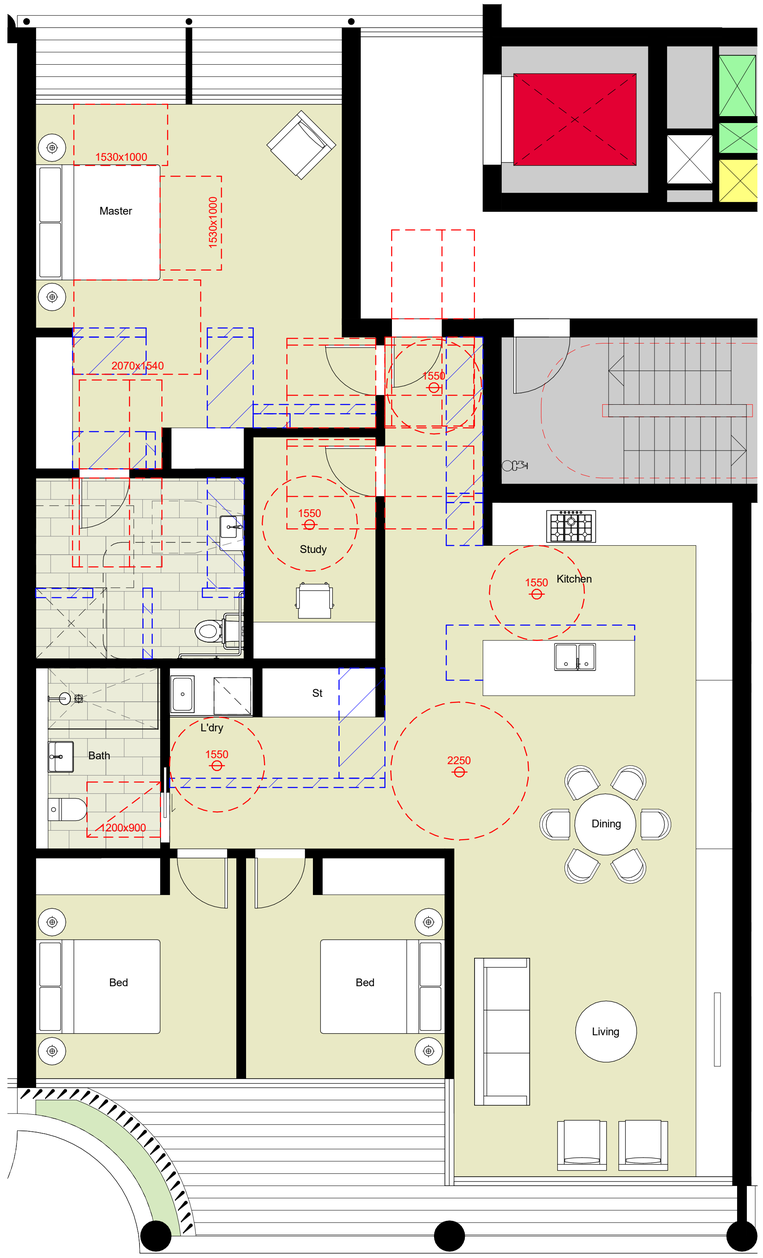
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_B - Pre Adaptation
Plan 1 : 50



2 3B_B - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_B

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:29 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.002
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Phillip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

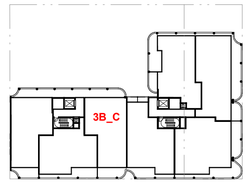
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiwHANB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

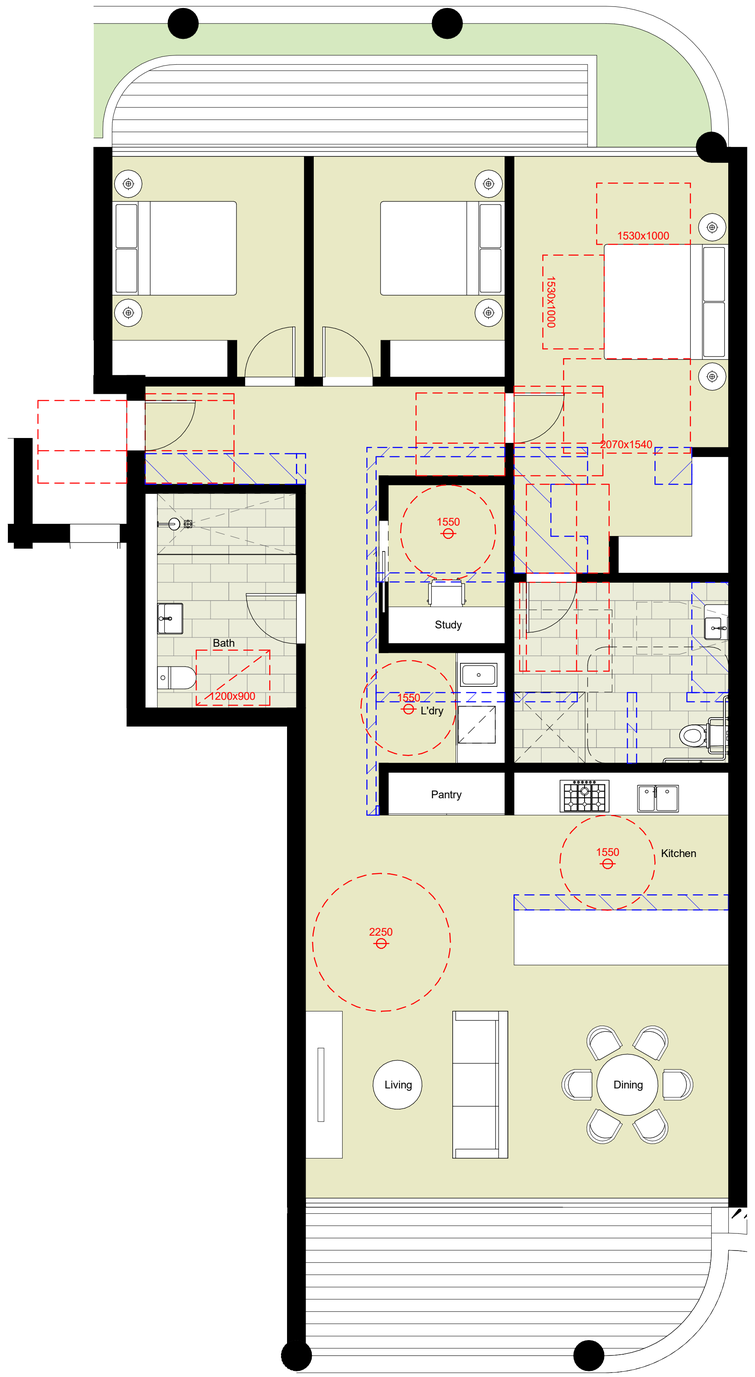
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_C - Pre Adaptation
Plan 1 : 50



2 3B_C - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_C

Status	DEVELOPMENT APPLICATION		
Scale	As indicated @ A1		
Drawn	Author	Checked	Checker
Project No.	S12751		
Plot Date	28/06/2024 9:55:33 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A13.003	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

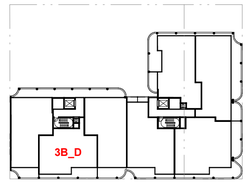
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

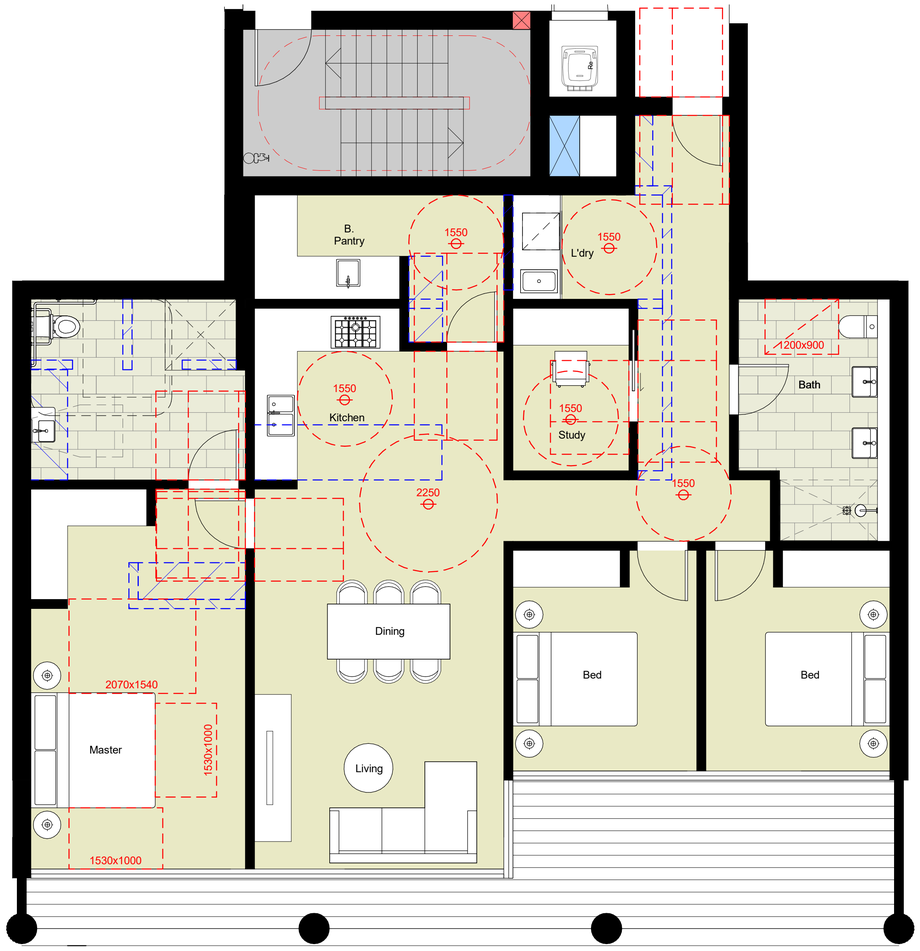
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_D - Pre Adaptation
Plan 1 : 50



2 3B_D - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_D

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author
Checked	Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:37 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.004
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

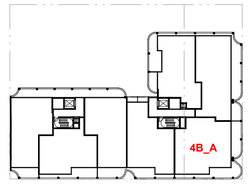
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

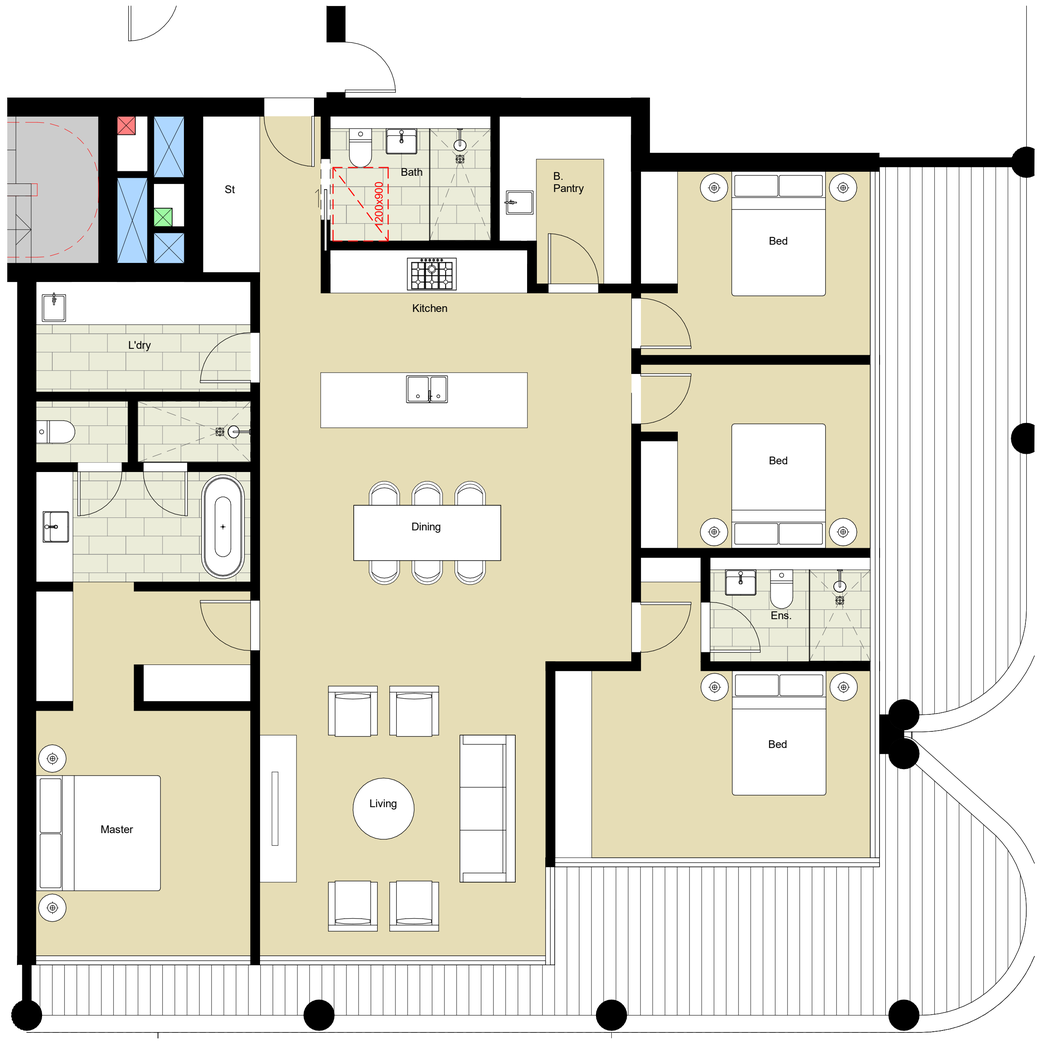
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

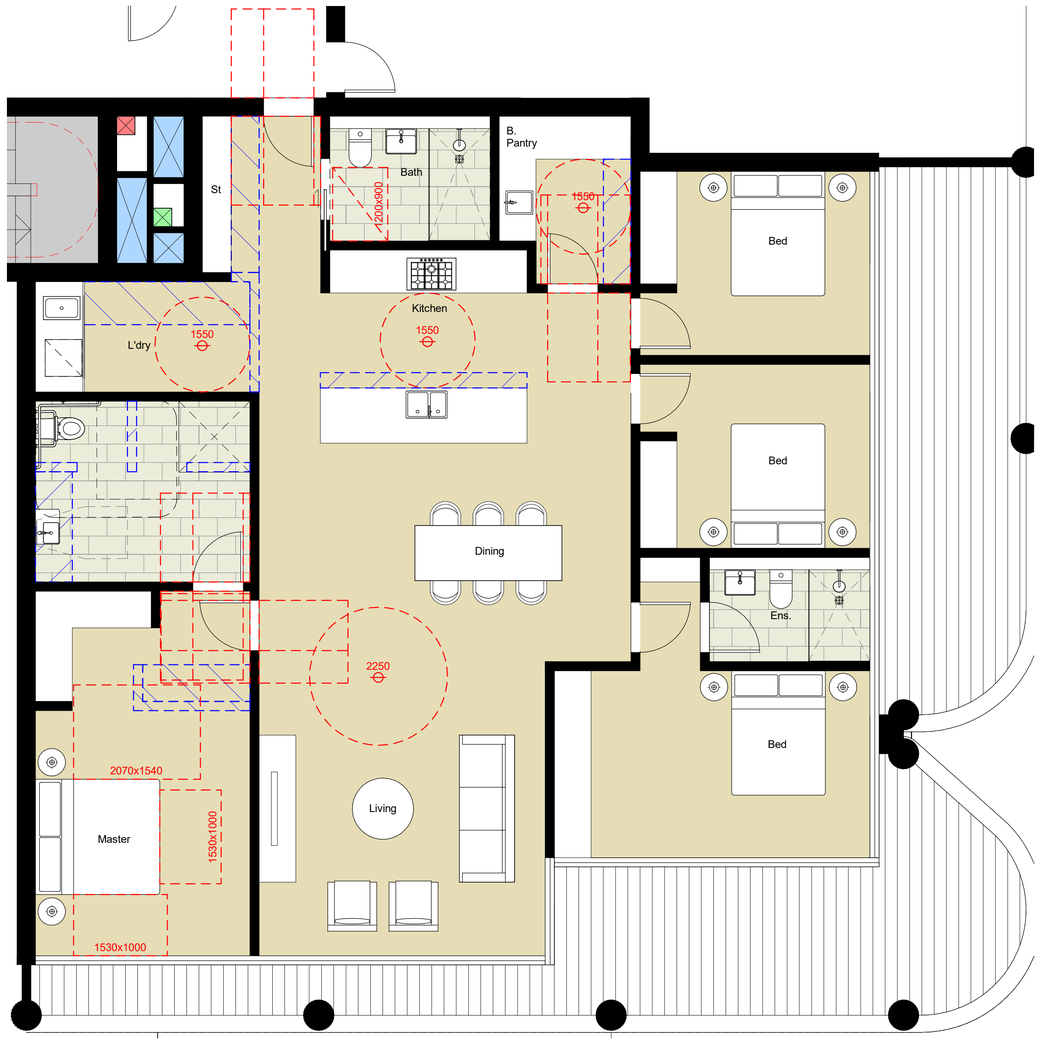
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 4B_A - Pre Adaptation
Plan 1 : 50



2 4B_A - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
4B_A

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:42 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.101
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

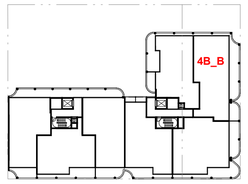
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM65.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

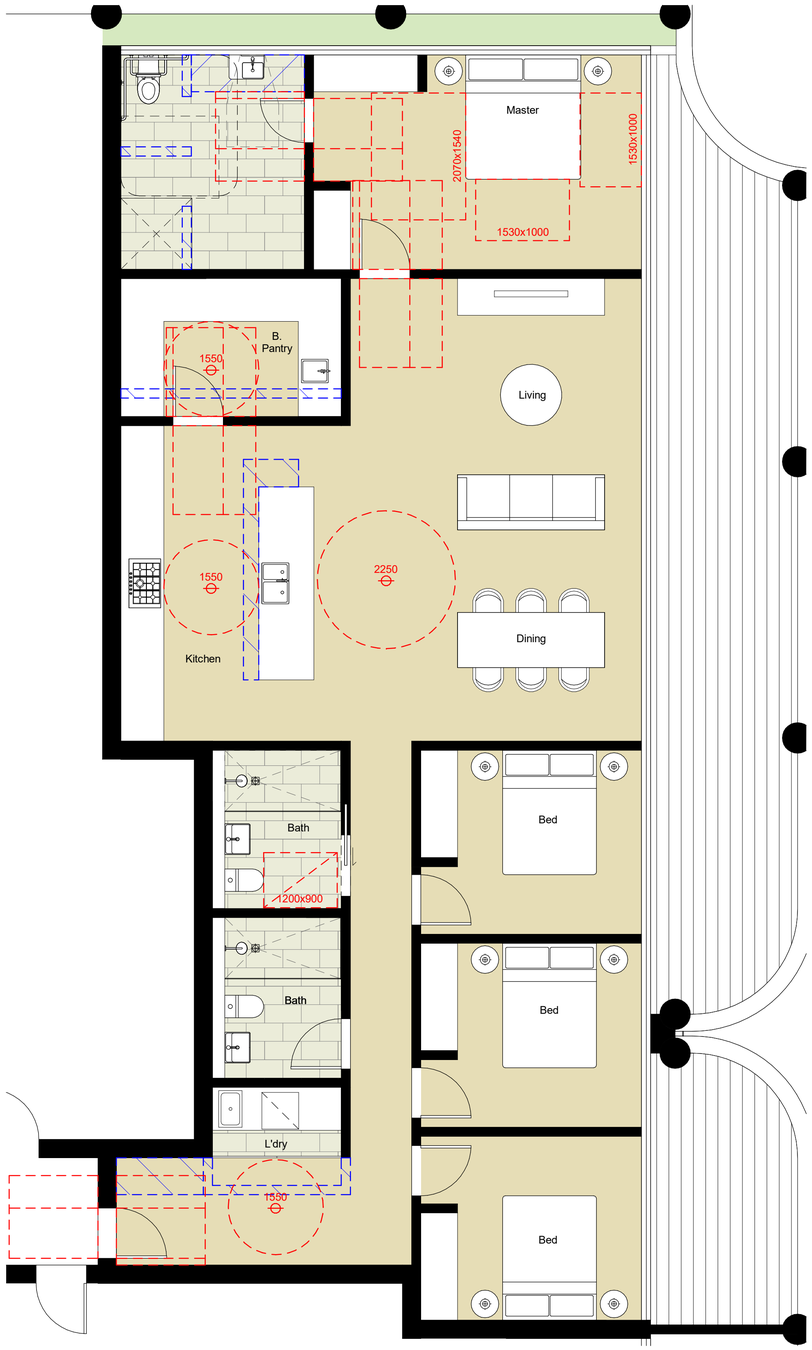
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 4B_B - Pre Adaptation
Plan 1 : 50



2 4B_B - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
4B_B

Status	DEVELOPMENT APPLICATION		
Scale	As indicated @ A1		
Drawn	Author	Checked	Checker
Project No.	S12751		
Plot Date	28/06/2024 9:55:20 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A13.102	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt



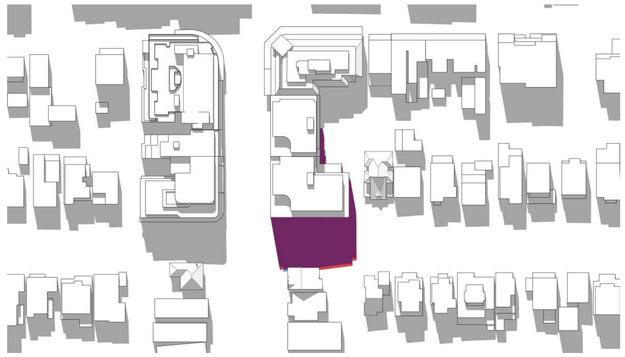
9am



10am



11am



12pm



1pm



2pm



3pm

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM85.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

- Height Compliant Scheme
- Proposed Scheme
- Overlap

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Shadow Analysis Diagrams
Shadow Plans

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:55:11 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A21.001	Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

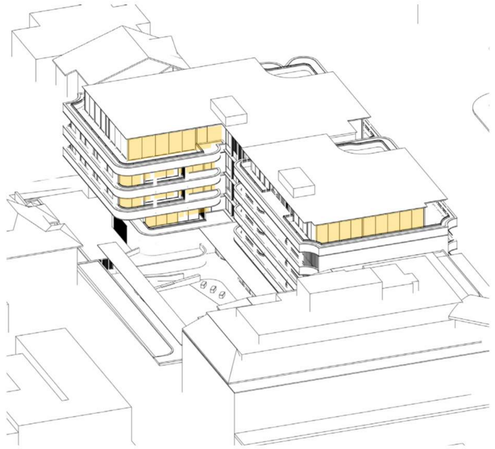
Winter Solstice (21st June)

KEY

2 hours of solar access



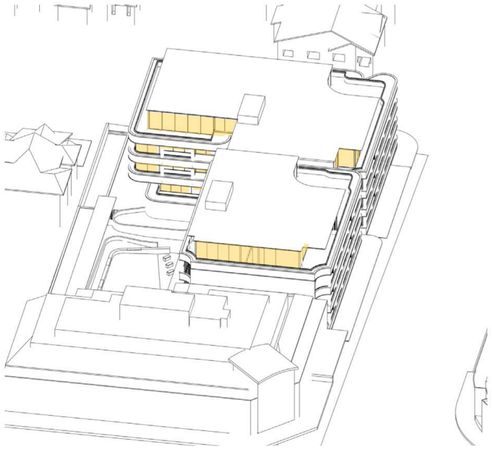
9am



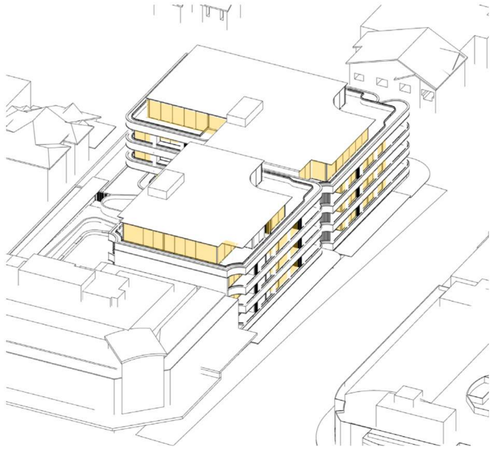
10am



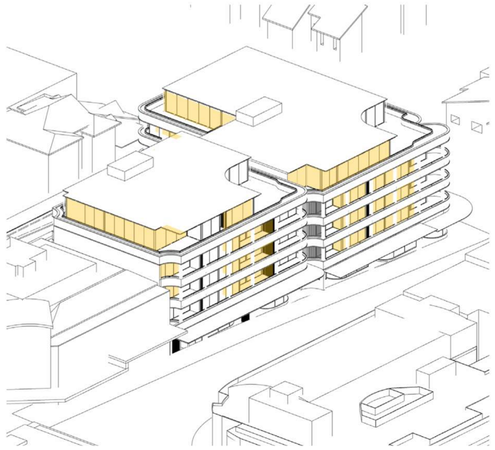
11am



12pm



1pm



2pm



3pm

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Shadow Analysis Diagrams
Views From The Sun

Status	DEVELOPMENT APPLICATION
Scale	1 : 60 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:16 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A21.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM65.rvt

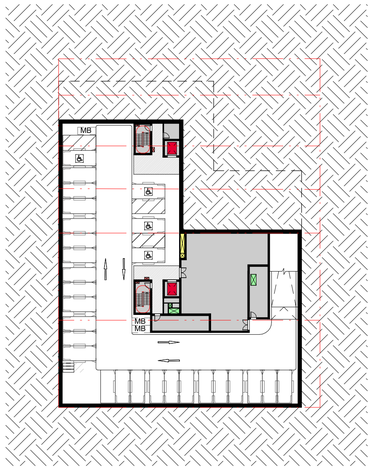
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

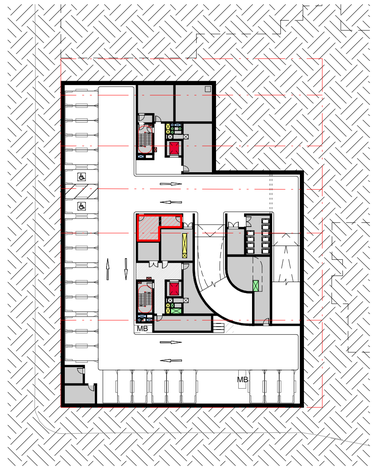
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

- GFA (Retail)
- GFA (Residential)
- GFA (Retail Amenity)

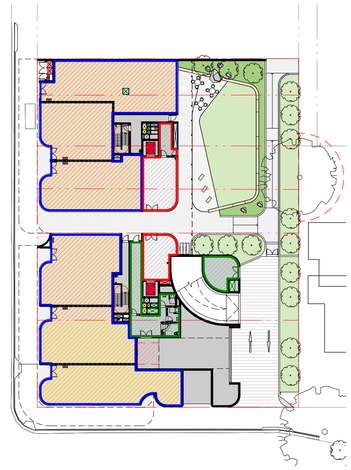


1 GFA Plan - Basement Level 02
Plan 1 : 500



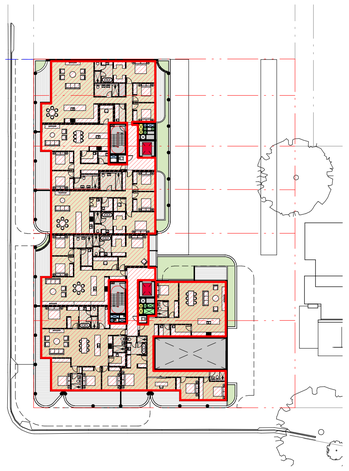
2 GFA Plan - Basement Level 01
Plan 1 : 500

Residential GFA: 21sqm



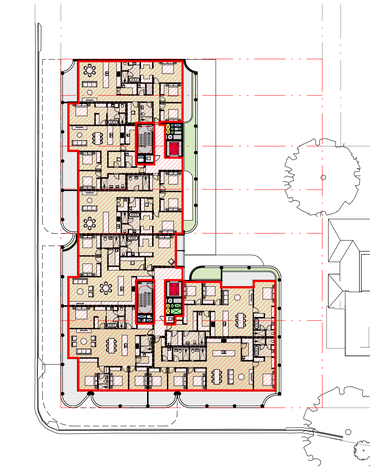
3 GFA Plan - Ground Level
Plan 1 : 500

Residential GFA: 93sqm
Retail GFA: 797sqm
Retail Amenity GFA: 82sqm



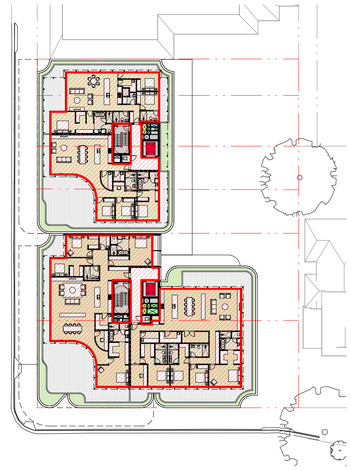
4 GFA Plan - Level 01
Plan 1 : 500

Residential GFA: 1010sqm



5 GFA Plan - Level 02 & 03
Plan 1 : 500

Residential GFA: 1125sqm



6 GFA Plan - Level 04
Plan 1 : 500

Residential GFA: 863sqm

GFA Calculations (Total)

Level	Area
Basement Level 02	-
Basement Level 01	21sqm
Ground Level	972sqm
Level 01	1010sqm
Level 02	1125sqm
Level 03	1125sqm
Level 04	863sqm
Total GFA	**5116sqm**

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Area Calculation Plans
GFA

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:07 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraszmuk
Drawing no.	A22.001
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraszmukLNM85.rvt

Appendix C Human Health Risk Assessment

JBS&G65963-156377 rev A
L01 (HHRA - SJD Northbridge) rev A

13 December 2023

ATT: Alex Zhao
Director & General Manager
SJD NB Pty Ltd
Via email: Alex Zhao - SJD Group <alexzhao@sjdpg.com>

Assessment of Potential Health Risk to Proposed Combined Residential / Commercial Development
57-69 Strathallen Avenue, Northbridge NSW

Dear Mr Zhao,

1. Introduction and Background

JBS&G Australia Pty Ltd (JBS&G) has been previously engaged by SJD NB Pty Ltd (SJD, the client) to undertake a detailed site investigation at the property located at 57-69 Strathallen Avenue, Northbridge, NSW (the site). The assessment has been prepared concurrently with this assessment and issued as *57-69 Strathallen Avenue, Northbridge NSW SJD NB Pty Ltd Detailed Site Investigation*, 14 December 2023, JBS&G Australia Pty Ltd (JBS&G 2023).

Elevated levels of volatile organic compounds (VOCs) inclusive of trihalomethanes and chlorinated ethenes were reported in soils, groundwater and/or soil vapour. Levels of chlorinated ethenes in particular were found to significantly exceed generic investigation levels as issued or endorsed by the NSW EPA.

The site is proposed for a substantial redevelopment comprising excavation and construction of a basement over the majority of the site, commercial and residential occupancies overlying and potential landscaped areas adjoining the basement. The generic investigation levels as available from published guidelines are not necessarily applicable to the potential exposure scenarios and/or constituents identified on the site. Remedial works will be required on the site to reduce levels of chlorinated ethenes to levels that do not pose a potential health risk to future site users. A site-specific human health risk assessment (HHRA) has been identified as being required to determine levels of site contaminants that can be present on the site to not pose a potential risk to future site users, or to otherwise identified required remedial extents and standards.

The risk assessment has been prepared here and as based on environmental data as presented in JBS&G (2023). The risk assessment has been prepared in accordance with guidelines made or approved by the NSW EPA.

1.1 Objectives

To determine whether levels of environmental contaminants as measured on site pose a potential health risk to future site users of a redeveloped site. To derive site specific criteria as specific to constituent and media for constituents which are found to pose a potential unacceptable health risk.

2. Site Identification

A detailed site description has been provided to JBS&G (2023). The risk assessment has considered the extent of the site present at 57-69 Strathallen Avenue, Northbridge NSW inclusive of Lot 1 DP 726736, Lot 1 DP172561, Lot 4B DP305190, Lot 4A DP305190, Lot 5 Section 3 DP7122 and Lot 6 Section 3 DP7122

The site is present over an area of approximately 2400 m^2.

2.1 Proposed Redevelopment

Conceptual development plans are provided in **Attachment 2**. Key features of the proposed development that will require to be considered in the completion of the health risk assessment include:

- Two storey deep basement as constructed over the majority of the site with a maximum lateral extent of 1960 m^2;
- Overlying floor levels as consistent of commercial / retail building uses on the ground floor and residential apartments overlying;
- A deep soil planting / recreational zone adjoining the east of the basement of a lateral extent of approximately 330 m^2; and
- Use of the basement for car parking only, with lift wells and stair wells extending from the basement through the extent of the building.

3. Conceptual Site Model

National Environment Protection (Assessment of Site Contamination) Measure, NEPC, 1999 (as amended 2013, NEPC 2013) identifies a conceptual site model (CSM) as a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments.

NEPC (2013) identified the essential elements of a CSM as including:

- Known and potential sources of contamination and contaminants of concern including the mechanism(s) of contamination;
- Potentially affected media (soil, sediment, groundwater, surface water, indoor and ambient air);
- Human and ecological receptors;
- Potential and complete exposure pathways; and
- Any potential preferential pathways for vapour migration (if potential for vapours identified).

Each of these elements is discussed in **Table 1** following as relevant to the scope of this risk assessment.

Table 1: Conceptual Site Model

CSM Element	Description
Contamination Source(s)	Historical aerial images (JBS&G 2023) indicate the site was largely used for commercial / industrial purposes that have included a dry-cleaning operation in the northern portion (since the 1950s until recently), a service station and motor garage in the central portion (from approximately the 1950s until at least 1981) and Public House / Hotel in the southern portion (likely from the 1940s until present). Chlorinated hydrocarbon impact at the site has likely resulted from the historical use (including potential leaks and spills) of tetrachloroethene (PCE) as part of dry-cleaning operations and likely uncontrolled disposal of dry cleaning solvent. Potential discharges of PCE may have occurred to site sewer services, which can contaminate soil and groundwater where leaks subsequently occur from the sewer pipes.
Affected Media	Chlorinated ethene contaminated soils, groundwater and soil vapour have been found at the highest levels in proximity of a sewer easement and in proximity of the location of the former dry cleaner. Levels of chlorinated ethenes as reported in soils and groundwater are not indicative of the occurrence of NAPL. The highest levels of soil vapours are present in proximity of the former dry cleaner and a sewer easement within the site, with lower though still significantly elevated levels extending laterally away as consistent with increased potential migration distances of soil vapour based contamination.
Human Receptors	The risk assessment is specific to the redeveloped site. Potential human receptors are identified as: • Future site residents with buildings / basements to be constructed on the site. This is inclusive of buildings as constructed overlying the proposed basement; • Recreational users of the areas of proposed landscaped / courtyard areas as located on the eastern boundary of the site; • Gardeners / landscapers as engaged in the unpaved areas of the site. This will include surface activities associated with maintenance of site landscaping as well as occasional deep works / works within excavations; • Commercial / industrial workers as potentially engaged within buildings / basements and further within outdoor areas of the site; • Sub-surface excavation / intrusive / maintenance workers as required to undertake sub-surface works as associated with the maintenance of site services; and • Potential lift maintenance workers whom will be engaged in potential lift pits as constructed within site basements or otherwise other maintenance works within the site basement.
Ecological Receptors	Ecological receptors refer to potential flora communities as may be established on the site with the site landscaping. Potentially sensitive receptors of groundwater are associated with Flat Rock Creek located a substantial distance hydrogeologically downgradient of the site. Direct exposures of on-site ecological receptors will be typically restricted to the media as used n site landscaping / growing zones.
Exposure Pathways	All users will be potentially exposed to volatile constituents by inhalation pathways. For surface receptors this will be by formation of soil vapour and diffusion of soil vapour to the site surface. For basement / building users this will be potential vapour intrusion to basements through unsaturated horizons and potential volatilisation of constituents from wet walls as caused by seepage to the basement. Groundwater is potentially present from as shallow a depth as 3.5 m below ground surface (bgs) with depths ranging to 9.9 m bgs. It is likely that the basement will extend below the depth of groundwater on the site. Basement users will further be potentially exposed by direct exposure pathways to constituents present in infiltrating groundwater and present on wet walls. This will be by direct contact to wet walls, or otherwise puddles of pooled infiltrating seepage water. Potential direct and inhalation exposure pathways will occur to constituents present in soils in landscaped portions of the site. Inhalation exposures would be inclusive of vapours (for volatile constituents) as well as particulates.
Preferential Pathways	There is a potential for future preferential pathways to be formed on the site with the future installation of services and construction of a basement that intersects the migration of groundwater contamination. The preferential pathways of their own would not cause the maximum levels of groundwater impact to increase, but may potentially redistribute groundwater contamination. The basement may cause a redistribution of groundwater contaminants within the site. With respect to vapour migration, *Vapor Intrusion Pathway: A Practical Guideline*, 2007, ITRC reports that lift shafts in multi-storey buildings may be a potential source of vapour intrusion into overlying floors, acting as a preferential pathway.

4. Summary of Environmental Data

Soil, groundwater and soil vapour data was summarised in JBS&G (2023). This was inclusive of historical data and more recent data as collected by JBS&G to address data gaps in the historical dataset. The maximum level of each constituent within the full data set as available is summarised in **Tables 2** to **4** following as specific for soil, groundwater and soil vapour respectively. Only constituents which have been reported above detection limits are summarised in **Tables 2** to **4**. Health based criteria have also been included for each of the constituents to assist with the assessment undertaken in **Section 4.1**.

The health based criteria have been selected from NEPC (2013), *PFAS National Environmental Management Plan Version 2.0*, January 2020, HEPA (HEPA 2020), *Petroleum Products in Drinking Water*, 2008, World Health Organisation (WHO 2008), *CRCCARE Technical Report No. 10 Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater*, 2011, CRCCARE (CRCCARE 2011) and *US EPA Region 9 Regional Screening Levels*, November 2023, US EPA (US EPA 2023) as adjusted for a target risk of $1*10^{-5}$ (if appropriate).

Criteria used to assess groundw3ater based constituents have been further adjusted by an order of magnitude to be protective of a recreational exposure as consistent with the guidance in *Guidelines for Managing Risks in Recreational Water*, 2008, NHMRC (NHMRC 2008) if not otherwise provided for recreational exposures. Groundwater on the site is not proposed for potable uses and the most sensitive potential exposure to groundwater impact can be conservatively assessed as a recreational exposure.

Criteria for residential land-uses have been adopted in each instance apart from PFOS noting the absence of home-grown produce being generated on the site. The criteria for a residential land-ise with minimal access to soils has been adopted here.

Table 2: Summary of Maximum Levels of Constituents in Soils (mg/kg)

Constituent	Maximum Level	Health Criteria	Criteria Source
Arsenic	31	100	NEPC (2013)
Chromium	100	100	NEPC (2013)
Copper	120	6000	NEPC (2013)
Lead	45	300	NEPC (2013)
Nickel	160	400	NEPC (2013)
Zinc	150	7400	NEPC (2013)
Benzo(a)pyrene TEQ	0.2	3	NEPC (2013)
Tetrachloroethene	1.2	81	US EPA (2023)
PFOS	0.0001	1	HEPA (2020), recreational

Table 3: Summary of Maximum Levels of Constituents in Groundwater (mg/L)

Constituent	Maximum Level	Health Criteria	Criteria Source
Arsenic	0.009	0.1	NEPC (2013) * 10
Copper	0.019	20	NEPC (2013) * 10
Lead	0.007	0.1	NEPC (2013) * 10
Nickel	0.042	0.2	NEPC (2013) * 10
Zinc	0.28	6.0	US EPA (2021)
Benzene	0.025	0.01	NEPC (2013) * 10
Xylene	0.001	6	NEPC (2013) * 10
Naphthalene	0.002	0.012	US EPA (2023) * 10
Chloroform	0.019	0.03	NEPC (2013) * 10
1,1-dichloroethene	0.001	2.8	US EPA (2023) * 10
cis-1,2-dichloroethene	0.47	0.6	NEPC (2013) * 10
Tetrachloroethene	0.32	0.5	NEPC (2013) * 10
Trichloroethene	0.22	0.028	US EPA (2023) * 10

Constituent	Maximum Level	Health Criteria	Criteria Source
Vinyl chloride	0.02	0.003	NEPC (2013) * 10
PFHxS + PFOS	0.00006	0.002	HEPA (2020) recreational
PFOA	0.00003	0.01	HEPA (2020) recreational

Some low-level TRH impacts have also been reported in groundwater. These generally co-occur with speciated aromatic compounds and consistent with advice on TRH assessment, assessment has been restricted to the speciated compounds which will be protective of the co-occurring detections of TPH/TRH.

Table 4: Summary of Maximum Levels of Constituents in Soil Vapour (mg/m³)

Constituent	Maximum Level	Health Criteria	Criteria Source
Chloroform	0.55	0.0012	US EPA (2023) correct to target risk $1*10^{-5}$
1,2-dichloropropane	0.2	0.0042	US EPA (2023)
1,3-dichloropropane	0.11	-	No criteria
1,1-dichloroethene	1.1	0.21	US EPA (2023)
Cis-1,2-dichloroethene	220	0.08	NEPC (2013)
Tetrachloroethene	750	2	NEPC (2013)
Trichloroethene	120	0.02	NEPC (2013)
Vinyl chloride	0.93	0.03	NEPC (2013)
Bromodichloromethane	0.63	0.00076	US EPA (2023)

Asbestos has also been detected on the site – however remediation is already proposed irrespective of the findings of the HHRA.

4.1 Selection of Constituents of Potential Concern

Constituents of potential concern (COPCs) require to be assessed and selected to ensure that the ensuing risk calculations are undertaken only for those constituents which are most likely to pose a risk. This has been undertaken by a comparison of the maximum level of each constituent to the health screening criteria as summarised in **Tables 2** to **4**. The health based criteria are based on a potential residential exposure for soils and soil vapour, and a recreational exposure for groundwater (noting no potable use of groundwater within the site) which are considered suitably protective of the range of potential human exposure scenarios identified in **Table 1**.

On the basis of this assessment, the following COPCs and associated site media are nominated as requiring risk assessment:

- Bromodichloromethane in soil vapour;
- Chloroform in soil vapour;
- Cis-1,2-dichloroethene in soil vapour;
- Tetrachloroethene in soil vapour;
- Trichloroethene in groundwater and soil vapour;
- Vinyl chloride in groundwater and soil vapour.

It is noted that some other constituents in soil vapour samples have been reported slightly exceeding the US EPA (2023) ambient air criterion inclusive of dichloropropanes. These constituents have not been selected as COPCs as the screening criteria do not include the attenuation that will occur in the levels of these constituents between soil vapour and building intrusion. Where this factor is included the level of the dichloropropane constituents is found to be below a screening criteria.

Benzene is also noted to have slightly exceed the groundwater screening criteria. Benzene has been selected as a COPC as the exceedance is slight, and levels of benzene in all other monitoring wells

are below detection limits. Benzene impact is likely to be highly localised and will not pose a potential health risk.

5. Toxicological Assessment

A toxicological review has been undertaken of the COPCs and is detailed in **Attachment 4**. On this basis, the adopted toxicological data for the COPCs is summarised in **Tables 5** and **6** following for non-threshold and threshold effects.

Table 5: Toxicity Values for Carcinogenic / Non-Threshold Effects $(mg/m^3)^{-1}$ or $(mg/kg/day)^{-1}$

Constituent	Unit Risk $(mg/m^3)^{-1}$	Slope factor $(mg/kg/day)^{-1}$	Oral Bioavailability	Dermal Absorption	Source
PCE	0.00026	0.0021	1.0	0.1	Based on US EPA. PCE assessed for threshold and non-threshold effects. Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.
TCE	0.004	0.00078	1.0	0.1	Inhalation unit risk based on US EPA, consistent with selection in NEPC (2013). Oral slope factor based on WHO (2005). TCE assessed for threshold and non-threshold effects. Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.
VC	0.0044 (adult) 0.0088 (resident)	0.75	1.0	0.1	Inhalation unit risk and slope factor based on US EPA (2000), consistent with selection of inhalation values in NEPC (2013). Adult value adopted for commercial worker and maintenance worker exposure scenarios noting most significant exposures occur to excavation workers. More conservative value adopted for residential exposures. Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.

Table 6: Toxicity Values for Threshold Effects (mg/m^3) or (mg/kg/day)

Constituent	RfC (mg/m^3)	RfD (mg/kg/day)	Oral Bioavailability	Dermal Absorption	Source
PCE	0.2	0.014	1.0	0.1	RFC as per WHO TDI. Oral reference dose per NHRMC. Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.
TCE	0.002	0.00146	1.0	0.1	Inhalation reference concentration based on US EPA, consistent with selection of toxicity values in NEPC (2013). Oral and dermal reference dose as per WHO (2005). Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.
Cis-1,2-DCE	0.007	0.017	1.0	0.1	Inhalation reference concentration based on US EPA, consistent with selection of toxicity values in NEPC (2013). Oral / dermal values (RfD) as per NHMRC/NRMMC (2011). Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.
VC	0.1	0.003	1.0	0.1	US EPA (2000) RfC and RfD adopted. RfD further consistent with guidance in ATSDR (2006). Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.

Constituent	RfC (mg/m³)	RfD (mg/kg/day)	Oral Bioavailability	Dermal Absorption	Source
Trihalomethanes (Chloroform and bromo-dichloro-methane)	0.25	0.07	1.0	0.1	NHMRC TDI guidance adopted for inhalation and direct exposure pathways. Dermal absorption factor as US EPA RAGS E recommended value for organic compounds.

NEPC (2013) further advises that a background dose of PCE and TCE as equal to 10% of the RfC should be adopted. This has been included in the risk calculations. Background doses are not advised for other constituents assessed.

Odour thresholds of the COPCs have been further reviewed and are summarised in **Table 7** following to allow an assessment of potential aesthetic impacts within a future basement / building.

Table 7: Odour Thresholds for Potentially Malodorous COPCs (mg/m³)

Constituent	Odour Threshold	Source
PCE	5.2	Nagata, 1990 'Measurement of Odor Threshold by Triangle Odor Bag Method'
TCE	21	Nagata, 1990 'Measurement of Odor Threshold by Triangle Odor Bag Method' Trichloroethylene
Cis-1,2-DCE	68	WHO (2003) '1,2-Dichloroethene in Drinking Water'
VC	7670	ATSDR (2006) 'Toxicological Profile for Vinyl Chloride'
Chloroform	415	US EPA (2000) 'Chloroform Hazard Summary'
Bromodichloromethane	1680	National Library of Medicine (2023) 'Bromodichloromethane Compound Summary'

6. Exposure Assessment

Exposure assessment involves the determination of the magnitude, frequency, extent, character and duration of exposures currently and into the future. This includes the identification of exposed populations and potentially complete exposure pathways.

The potentially exposed human receptors and associated potentially complete exposure pathways were identified in **Section 3** and include:

- Residents and commercial workers within basements as proposed to be constructed on the site. Potential exposures can occur by inhalation and direct (oral and dermal) exposure pathways;
- Residents and commercial workers within buildings as constructed overlying basements;
- Potential maintenance workers within the areas of the site outside of the extent of site basements; and
- Potential maintenance workers within site basements. This will be inclusive of lift maintenance workers.

6.1 Exposure Factors

Exposure factors have been required for a residential occupant of a building, a commercial occupant of a building, sub-surface maintenance workers and potential basement / lift maintenance workers. The exposure factors adopted are summarised in **Tables 8** to **10** following. The exposure factors have anticipated a basement construction as designed to mitigate (though not eliminate) potential seepage water ingress.

Table 8: Exposure Parameters – Residential

Exposure Parameter	Units	Factor	Reference
Exposure frequency, Basement / Building	Days/year	365	NEPC (2013)
Exposure frequency, direct contact to pooled seepage water / wet walls within basement	Days/year	24	Assumption of twice per moth
Exposure time (building)	Hours/day	20	*Australian Exposure Factor Guidance: Guidelines for assessing human health risks from environmental hazards*, 2012, enHealth (enHealth 2012)
Exposure time (basement / car park)	Hours/day	0.5 1	Child <15 years, assumption Adult, assumption
Exposure duration	Years	35	enHealth (2012). 95% RME time at single residence.
Averaging time – non threshold	Years	70	NEPC (2013)
Averaging time – threshold	Years	35	Equal to exposure duration
Body weight	kg kg kg	15 56 70	Child 2-4 years, enHealth (2012) Child 12-15 years, enHealth (2012) Adult, enHealth (2012)
Water ingestion	mL/day	5 5 negligible	Child 2-4 years, assumption Child 12-15 years, assumption Adult, assumption
Exposed skin surface	cm^2 cm^2 cm^2	400 1100 1300	Child 0-5 years, hands only, enHealth (2012), based on 2-<3 years 95th percentile Child 6-15 years, hands only, enHealth (2012), based on 11-<16 years 95th percentile Adult, hands only, enHealth (2012) Likely to be insufficient water to premise additional body areas being exposed

Table 9: Exposure Parameters – Commercial / Retail Worker

Exposure Parameter	Units	Factor	Reference
Exposure frequency, Basement / Building	Days/year	240	NEPC (2013)
Exposure frequency, direct contact to pooled seepage water / wet walls within basement	Days/year	24	Assumption of twice per moth
Exposure time (building)	Hours/day	8	NEPC (2013)
Exposure time (basement / car park)	Hours/day	0.5	Assumption
Exposure duration	Years	30	NEPC (2013)
Averaging time – non threshold	Years	70	NEPC (2013)
Averaging time – threshold	Years	30	Equal to exposure duration
Body weight	kg	70	Adult, enHealth (2012)
Water ingestion	mL/day	negligible	Assumption
Exposed skin surface	cm^2	1300	Adult, hands only, enHealth (2012) Likely to be insufficient water to premise additional body areas being exposed

Table 10: Exposure Parameters – Maintenance Worker / Lift Maintenance

Exposure Parameter	Units	Factor	Reference
Exposure frequency, Basement / Building	Days/year	20	CRCCARE Technical Report No. 10 Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater Part 1: Technical Development Document, 2011, Friebel and Nadebaum CRCCARE (2011) sub-surface maintenance worker exposure frequency. Adopted for basement / lift maintenance frequency.
Exposure time	Hours/day	8	NEPC (2013)
Exposure duration	Years	30	NEPC (2013)
Averaging time – non threshold	Years	70	NEPC (2013)
Averaging time – threshold	Years	30	Equal to exposure duration
Body weight	kg	70	Adult, enHealth (2012)
Water ingestion	mL/day	5	Assumption
Exposed skin surface	cm^2	6300	NEPC (2013) as adopted for dermal exposure calculations. Potential substantial water pooled within lift pits, as likely to be present at lowest point of basement or otherwise in basement drainage. Similarly potential for standing water in excavations following dewatering to allow worker ingress. Maintenance works potentially undertaken in these areas.

Inhalation exposures have been estimated by the approach in *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*, January 2009, US EPA. An airborne concentration adjustment factor is derived here as specific to non-threshold and threshold assessments on the basis of exposure duration. Estimation of exposure adjustment factors for each inhalation scenario are summarised in risk calculations provided as **Attachment 5**.

6.2 Vapour Levels in Buildings

By review of the development plans to **Attachment 2** and the summary provided to **Section 2.1** a basement is proposed to be constructed across the majority of the site which will potentially be in proximity of known site contamination.

Vapours will potentially occur in the basement by:

- Vapour intrusion of soil vapours present overlying impacted groundwater (i.e. unsaturated horizons) and/or associated with impacted soils by potential advective and diffusive migration processes into the basement; and
- Volatilisation of volatile constituents from wet walls / pooled seepage water as will potentially occur within the basement by groundwater infiltration into the basement.

Potentially localised exposures to higher levels of impact may occur within lift pits / lift shafts as associated with the construction of lift pits to deeper depths below the basement and the potential localised accumulation of seepage water within the pits. Separate modelling scenarios have also been undertaken for lift shafts / lift pit exposures.

Fate and transport modelling has been completed in **Attachment 5** for each scenario.

The maximum levels of each constituent have been used in the risk assessment calculations. Exceedances of acceptable levels of risk and hazard will necessitate derivation of risk based criteria which will be used to instruct the scope of remediation works prior to site development.

6.3 Vapour Levels in Excavations

Potential deep excavations may be excavated on-site in the future as associated with potential maintenance of services.

Fate and transport modelling has been completed in **Attachment 5** to estimate potential vapour intrusion into an excavation by adjoining / underlying soil vapour impacts. Excavations for service maintenance are not anticipated to extend below the depth of groundwater. Excavations have been assumed to be placed to a maximum depth of 2 m below ground surface (bgs), and of lateral dimensions 10- m by 2 m. Excavations have further been assumed to be ventilated by a wind speed equal to an assumed outdoor wind speed of 2 m/s, as adjusted by an order of magnitude (0.2 m/s adopted).

6.4 Oral and Dermal Doses

Oral and/or dermal doses of the selected COPCs have also been required to be estimated for the following exposure scenarios:

- Resident use of the site basement, including child and adult exposures to infiltrating seepage water based impact;
- Commercial worker use of the site basement, to infiltrating seepage water based impact; and
- Lift maintenance worker occupational engagement within Lift Pits to the site, to infiltrating seepage water based impact that may potentially accumulate / pool within a lift pit.

Oral and dermal doses have been estimated by modelling undertaken using the RISC package and on the basis of the potential maximum levels of groundwater impact. Risk outputs and estimated doses are provided in **Attachment 5**.

6.5 Summary of Risk Assessment

Table 10 following provides a summary of the each of the exposure scenarios assessed, environmental data considered and particular fate and transport calculations performed.

Table 10: Summary of Risk Assessment Calculations

Location	Receptor	Exposure Pathway	Source of Data	Fate and Transport Modelling / Risk Assessment
Basement	Resident Commercial Worker	Inhalation	Groundwater (maximum levels)	Direct volatilisation / wet walls Vapour intrusion from adjoining groundwater and/or impacted soils
			Soil vapour (maximum levels)	Vapour intrusion from adjoining impacted soils
		Oral / dermal	Groundwater (maximum levels)	Direct exposure to wet walls
Basement	Lift Maintenance Worker	Inhalation	Groundwater (maximum levels)	Direct volatilisation / wet walls
			Soil vapour (maximum levels)	Vapour intrusion from adjoining impacted soils
		Oral / dermal	Groundwater (maximum levels)	Direct exposure to wet walls / pooled seepage in lift pit
Residential dwelling / apartment over basement	Resident	Inhalation	Maximum airborne level in basement as estimated	Adjustment by division by 10.
		Oral / dermal	Incomplete pathway	
Commercial suite / retail tenancy over basement	Commercial worker	Inhalation	Maximum airborne level in basement as estimated	Adjustment by division by 10.
		Oral / dermal	Incomplete pathway	

Location	Receptor	Exposure Pathway	Source of Data	Fate and Transport Modelling / Risk Assessment
Future excavation on site	Sub-surface maintenance worker	Inhalation	Groundwater (maximum levels)	Vapour intrusion from adjoining groundwater and/or impacted soils
			Soil vapour (maximum levels)	
		Oral / dermal	Incomplete pathway, excavation above depth to groundwater	

7. Risk Estimates

Incremental risks and threshold hazard have been estimated as consistent with the guidance in NEPC (2013). Estimated incremental risk levels have been compared to a criterion of $1*10^{-5}$ and the summed hazard index has been compared to a criterion of 1.0 as consistent with the same criterion adopted in NEPC (2013). Summed risk estimated are summarised in **Table 11** following. Calculations are provided as **Attachment 5**.

Table 11: Summary of Risk and Hazard Estimates

Site Area	Receptor	Risk	Hazard
Building / Basement	Residential	$3.5*10^{-5}$	12
	Commercial	$1.0*10^{-5}$	3.5
	Lift Maintenance Worker	$5.2*10^{-7}$	0.1
Excavation	Sub-Surface Maintenance Worker	$6.2*10^{-7}$	0.3

Substantial exceedances of risk and hazard criteria have been reported for potential residential and commercial worker exposures within a future basement and building constructed on the site. By review of the risk calculations, the exceedance of the risk and hazard criteria is attributable to potential exposures to TCE and cis-1,2-DCE in soil vapour. Constituent levels in groundwater are not found to pose an unacceptable risk or hazard.

Remediation works will be required to address potential TCE and cis-1,2-DCE impacted soils as likely present in the unsaturated zone and causing elevated levels of soil vapours to be present. Further back calculation of risk outcomes has been undertaken to a target hazard of 0.5 for each of these constituents to derive a site-specific remediation criterion. A lower target risk of 0.5 has been adopted to be protective of potential additive effects of COPCs. Risk based criteria to be applied to the remediation of the site are summarised following:

- cis-1,2-DCE – 29 mg/m^3; and
- TCE – 7.6 mg/m^3.

Other constituents and/or media are not found to pose a potentially unacceptable risk or hazard to the proposed redevelopment of the site.

7.1 Sensitivity Analysis

A review of the risk estimates has been undertaken to assess the potential sensitivity of the risk outcomes to each of the factors adopted in the risk calculations and/or assumptions of the conceptual site model. This is summarised in **Table 12** following.

Table 12: Sensitivity Analysis

Factor	Discussion
Constituent Levels	The principal factor affecting the calculations here is the selection of data point(s) to characterise the levels of COPCs in soil vapour and groundwater. The most conservative approach available here was adopted, which included adopting the maximum concentrations as measured in soil vapour and groundwater across the site for the past four years. Estimates of risk and hazard vary in a linearly proportional manner to the level that is adopted. For the case of soil vapour data – which is the measure of impact present in unsaturated soils – this will not affect the assessment outcomes as risk based validation criteria have been derived.
Toxicological Parameters	Toxicological data are generally derived by the conversion of dose factors as developed based on animal studies to appropriate levels for human exposure. The conservatism of these values is achieved through the use of uncertainty factors. An uncertainty factor of 100 is commonly applied in converting measured animal toxicity data for use for humans, comprising: • A factor of 10 to allow for differences that affect the way a chemical behaves in humans rather than the animal species tested; and • Another factor of 10 adequate to allow for differences in the way the chemical might affect different people, to allow for the most sensitive individuals. Though the two processes most likely act in two separate ways, indicating a summed factor of 20 should be used, the factors are multiplied to generate an uncertainty factor of 100. It is also noted that most agencies will incorporate an additional factor of 10 where long term toxicity data are not available for a particular constituent, resulting in a total factor of 1000. Published toxicity data from agencies cited in Australian guideline publications have only been used by the risk assessment. Toxicological data used in the risk assessment has incorporated these uncertainty factors. This is considered an appropriately conservative process for the site.
Exposure Parameters	Exposure parameters have been adopted for an anticipated conservative characterisation of residential, commercial and potential lift maintenance worker receptors. Of most relevance to the risk assessment outcomes and the acceptability of the proposed basement / management design are the risk estimates for the residential receptor. These are discussed further following: • A constant exposure to site conditions for a 35 year period has been adopted. This has further assumed exposure from birth (as relevant to VC calculations). A lifetime exposure could have been adopted here, however this would of only adjusted the risk estimate by a factor of two; • Risk based criteria are provided for soil vapour to be complied with now. In the case of the COPC that will likely control the extent of remedial works – TCE – this is based on managing a level of lifetime risk. The level of risk is based on a 35 year exposure. However contaminant levels will continue to reduce by in-situ degradation processes following collection of the validation data. The adoption of the maximum level of the carcinogenic constituents for the entire exposure duration is highly conservative; • It has been assumed that levels of vapours in the building overlying the basement are 1/10th of the basement level. CRCCARE (2013) indicates that this may be as high as ¼ for buildings where this is significant connectivity between the dwelling and the basement. Adopting this alternate building concentration does affect the risk estimates by a factor about equal to the adjusted exposure in the building. It is noted however that a similar level of safety as incorporated into the reduced factor used to set the soil vapour validation criteria. It is further noted that the basement / building will be of modern construction – and the exclusion of dwellings from car park basement areas to ensure that vehicle exhaust emissions do not migrate into the overlying building will be similarly effective for ensuring that trace levels of chlorinated ethene vapours do not pass form the basement to the building; and • Relatively minor skin surface areas have been used for dermal exposure calculations. Similarly reduced incidence of dermal exposure events have also been adopted. Risk estimates will be linearly proportional to the skin surface area and the skin surface exposure event frequency. Noting that the basement will be designed and operated to mitigate the potential of significant standing water, the adopted parameters are considered to be highly conservative. Basement activities are further limited to parking of motor vehicles only – which are typically undertaken wearing shoes, again making the inclusion of feet surface area a conservative approach. It would have been a reasonable assumption to estimate that direct exposures to infiltrating

Factor	Discussion
	seepage water do not occur to normal basement users and excluded this exposure pathway. It is further noted that risk outcomes are not controlled by the basement direct exposure estimates.
Basement Parameters	A significant component of the risk assessment has been the characterisation of potential vapour levels as will occur in the basement and associated potential vapour exposure. The assumptions as adopted in these calculations are discussed following: • The basement has been assumed to be ventilated at a rate of four times per day. Vapour level estimates are linearly proportional to this rate. As ventilation rates increase, levels of vapour decrease. The ventilation rate adopted is well below that otherwise nominated for commercial or residential buildings in CRCCARE (2011); • Even though the basement is present over a substantial area, the ventilation has been assumed to be uniform over the area of the basement. This will be achieved in practice by the use of mechanical ventilation equipment to push exhaust air to a point of discharge. These works are otherwise undertaken to manage the far more substantial hazard associated with the build up of vehicle exhaust emissions; • A significant wind speed, when compared to the ventilation estimate, was adopted for the typical wind speed through the basement. This estimate was based on an assumption that ventilation air was drawn in at one end of the basement only and removed at the opposite end at the furthest distance for the inlet. In a more likely scenario, where multiple inlet and exhaust points are present, a lower wind speed would be estimated. Risk estimates are not overly sensitive to this parameter; • The modelling results have little sensitivity to the dimensions / extent of the basement consequent of a range of other factors varying at the same rate that the basement extent varies. However the model does vary approximately by the ratio of the lateral extent of the basement to the volume of the basement. To this extent, increased / deeper levels of the basement will typically cause reduced estimated levels of vapour. This variation is approximately linear – and can be observed with the comparison of the results of the southern basement to the northern basement. It is noted that risk based criteria for site validation of vapours have been set as per the most conservative basement scenario assessed; • A volume of water of 5 L/day entering the northern basement has been estimated. This estimate is substantially based on a mid range estimate of concrete permeability as per published values from CSIRO (1993). Where the highest concrete permeability is adopted of 10^{-10} m/s then the rate of inflow would increase by an order of magnitude. This would not affect risk estimates however as the conservatism of the groundwater derived vapour intrusion scenario has resulted in estimates that are generally two orders of magnitude higher than the wet walls scenario; and • It has been assumed that maximum levels of groundwater impact are present adjoining the base and all sides of the basement. In practice the highest levels of groundwater impact adjoin a portion of the basement wall only and it is over conservative to assume this level across the basement. Levels of groundwater impact at the eastern and southern side of the southern basement for example are likely to be non-detect, noting the absence of groundwater impact here, the groundwater migration direction and the source of groundwater impact being the sewer present at the west of the site.
Modelling Equations	Appropriately conservative modelling approaches have been used to estimate doses and levels of COPCs. Typically US EPA issued or endorsed approaches have been adopted, as consistent with the guidance in NEPC (2013). The sensitivity of the basement vapour scenario has been assessed further in the fourth row of this table. It is noted that RISC adopts an approach of using historical US EPA methods to estimate dermal doses. Further calculations were undertaken to confirm that the estimated dermal doses are similar to those that may be derived using *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment*), July 2004, US EPA (US EPA 2004) and presented in JBS&G (2021). The estimated doses were observed to be very similar (less than 5% difference). The use of one approach to estimate dermal doses over an alternate approach is not considered to significantly affect the outcomes of the risk assessment. The method used to estimate dermal doses with this assessment are considered reliable.

In consideration of the highly conservative characterisation of the levels of chlorinated ethenes in soil vapour and groundwater and noting the likely future attenuation of these constituents, it is considered that the risk calculations have been provided with a sufficient basis of conservatism to be considered reliable for future decision making on the site.

8. Conclusions and Recommendations

A human health risk assessment (HHRA) has been undertaken for the proposed residential and commercial development of the 57-69 Strathallen Avenue Northbridge redevelopment site.

Recent environmental assessments have comprised the sampling and analysis of site soils, soil vapour and groundwater on and in proximity of the site. Environmental impact has been reported on the site consisting of trihalomethanes and chlorinated ethenes present in soils, soil vapour and/or groundwater.

A number of potential human receptors were identified for health risk assessment, including residents (both children and adults), commercial tenants of buildings, basement maintenance workers and potential future sub-surface / excavation maintenance workers. The risk assessment has considered potential exposures associated with a commercial / residential building overlying a basement extending to below the depth of groundwater and potential excavations on the site in the future to maintain / repair site services.

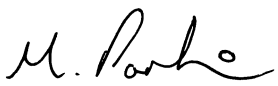
A sensitivity analysis has been undertaken of the risk assessment process, including consideration of environmental data, toxicological data, assumed exposure factors and future land use scenarios. It was concluded that whilst the risk estimates generated may have potentially overestimated exposures, the risk outcomes are suitably conservative to be used to support decision making for the site going forward.

Based on the outcomes of the risk assessment, and in accordance with **Attachment 1**, the following will require to be adopted in the preparation of the Remedial Action Plan for the site:

- Basements designed and operated to mitigate potential inflow of groundwater and/or potential accumulation of standing water as puddles etc within the basement; and
- Remediation of chlorinated ethene impacted soils within site unsaturated zones to achieve soil vapour validation criteria of 7.6 and 29 mg/m^3 respectively for TCE and cis-1,2-DCE.

Should you require clarification, please contact the undersigned on 02 8245 0300 or by email mparkinson@jbsg.com.au.

Yours sincerely:



Matthew Parkinson
Senior Principal Environmental Consultant
JBS&G Australia Pty Ltd

Attachments: 1. Limitations
2. Proposed Development Plans
3. Toxicity Review
4. Fate and Transport Modelling and Risk Calculations

Attachment 1 – Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G, and should not be relied upon by other parties, who should make their own enquires.

Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements.

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

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

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS&G reserves the right to review the report in the context of the additional information.

Attachment 2 – Proposed Development Plans

57-69 Strathallen Ave, Northbridge

Architectural Development Application Drawings

Drawing List					
Drawing Number	Drawing Series	Drawing Name	Status	Revision	Date
A00.000		Cover Sheet & Drawing List	Development Application	2	28.06.24
A01.001	Site & Existing Conditions	Site Plan (Existing)	Development Application	2	28.06.24
A01.002	Site & Existing Conditions	Demolition Plan	Development Application	2	28.06.24
A01.003	Site & Existing Conditions	Site Plan (Proposed)	Development Application	2	28.06.24
A03.001	General Arrangement Plan	Basement Level 01	Development Application	3	28.06.24
A03.002	General Arrangement Plan	Basement Level 02	Development Application	3	28.06.24
A03.100	General Arrangement Plan	Ground Level	Development Application	3	28.06.24
A03.101	General Arrangement Plan	Level 01	Development Application	3	28.06.24
A03.102	General Arrangement Plan	Level 02 & 03	Development Application	3	28.06.24
A03.104	General Arrangement Plan	Level 04	Development Application	2	28.06.24
A03.105	General Arrangement Plan	Roof Level	Development Application	2	28.06.24
A09.001	External Elevations	North Elevation	Development Application	3	28.06.24
A09.002	External Elevations	East Elevation	Development Application	3	28.06.24
A09.003	External Elevations	South Elevation	Development Application	3	28.06.24
A09.004	External Elevations	West Elevation	Development Application	3	28.06.24
A10.001	Building Sections	Section A	Development Application	2	28.06.24
A10.002	Building Sections	Section B	Development Application	2	28.06.24
A13.001	Apartment Types	3B_A	Development Application	3	28.06.24
A13.002	Apartment Types	3B_B	Development Application	3	28.06.24
A13.003	Apartment Types	3B_C	Development Application	3	28.06.24
A13.004	Apartment Types	3B_D	Development Application	3	28.06.24
A13.101	Apartment Types	4B_A	Development Application	3	28.06.24
A13.102	Apartment Types	4B_B	Development Application	3	28.06.24
A21.001	Shadow Analysis Diagrams	Shadow Plans	Development Application	2	28.06.24
A21.002	Shadow Analysis Diagrams	Views From The Sun	Development Application	2	28.06.24
A22.001	Area Calculation Plans	GFA	Development Application	2	28.06.24



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Cover Sheet & Drawing List

Status	DEVELOPMENT APPLICATION
Scale	@ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:50 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A00.000
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

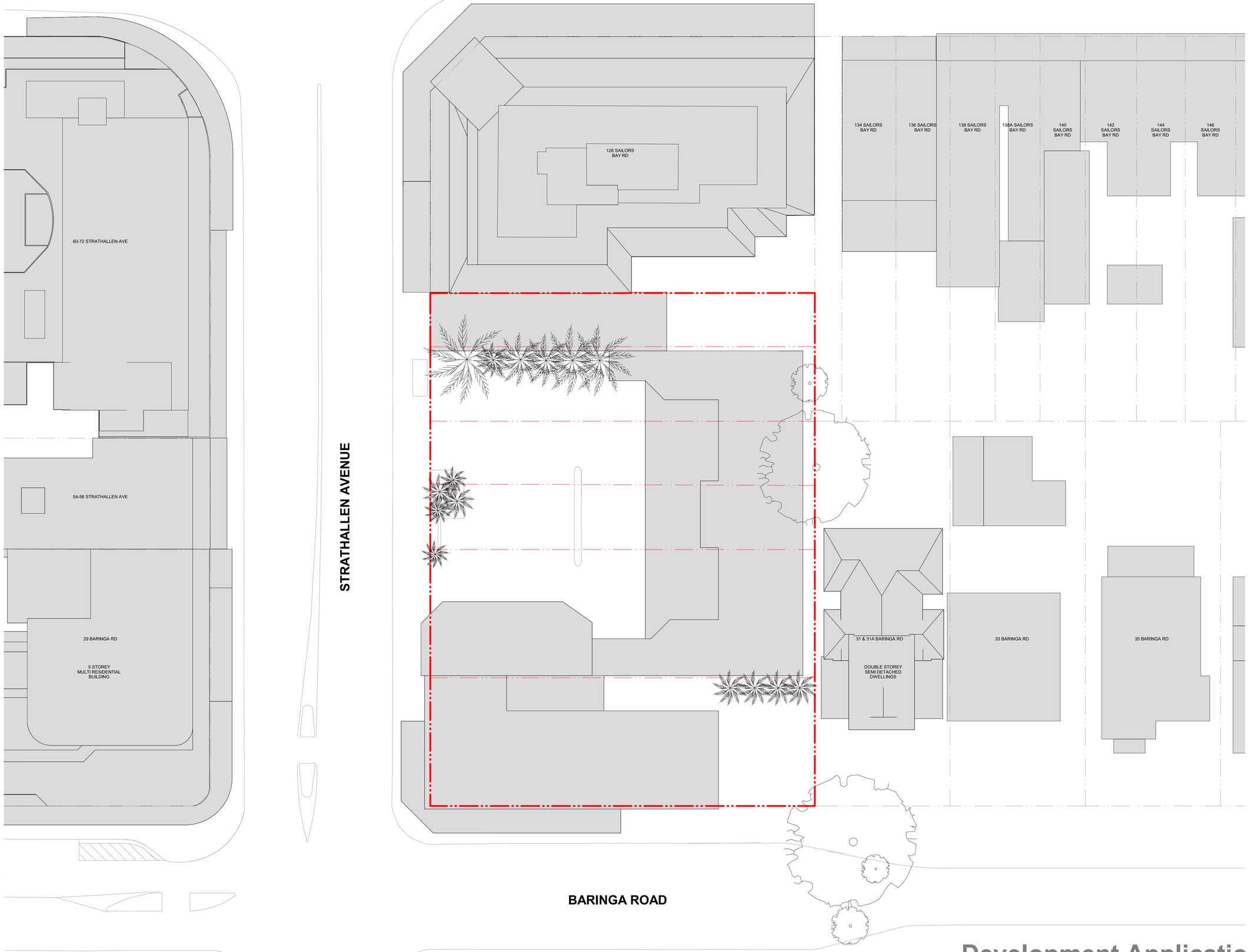
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Site Plan (Existing)

Status	DEVELOPMENT APPLICATION
Scale	1 : 200 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:56 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.001
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

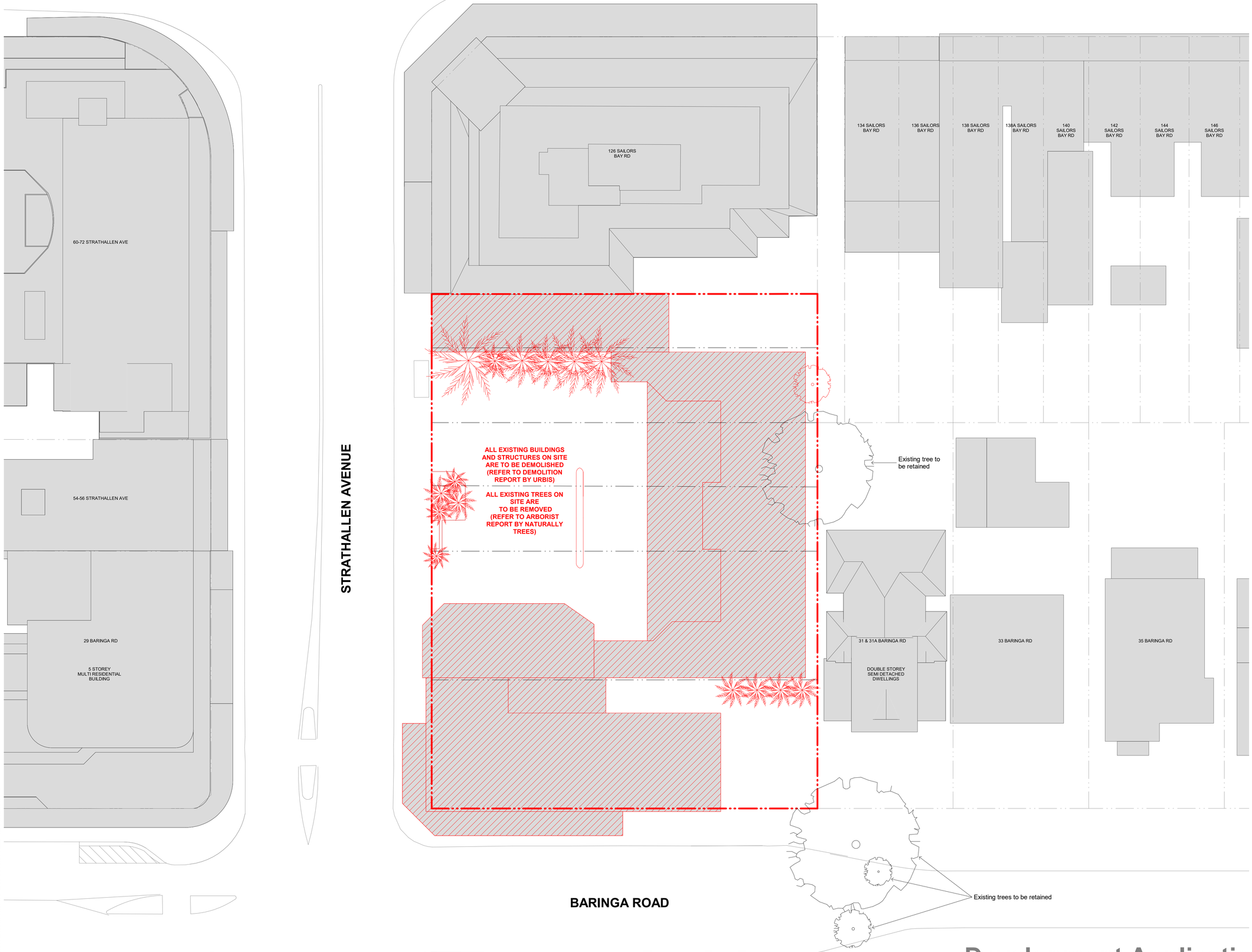
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Phillip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

To be demolished

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Demolition Plan

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:55:59 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

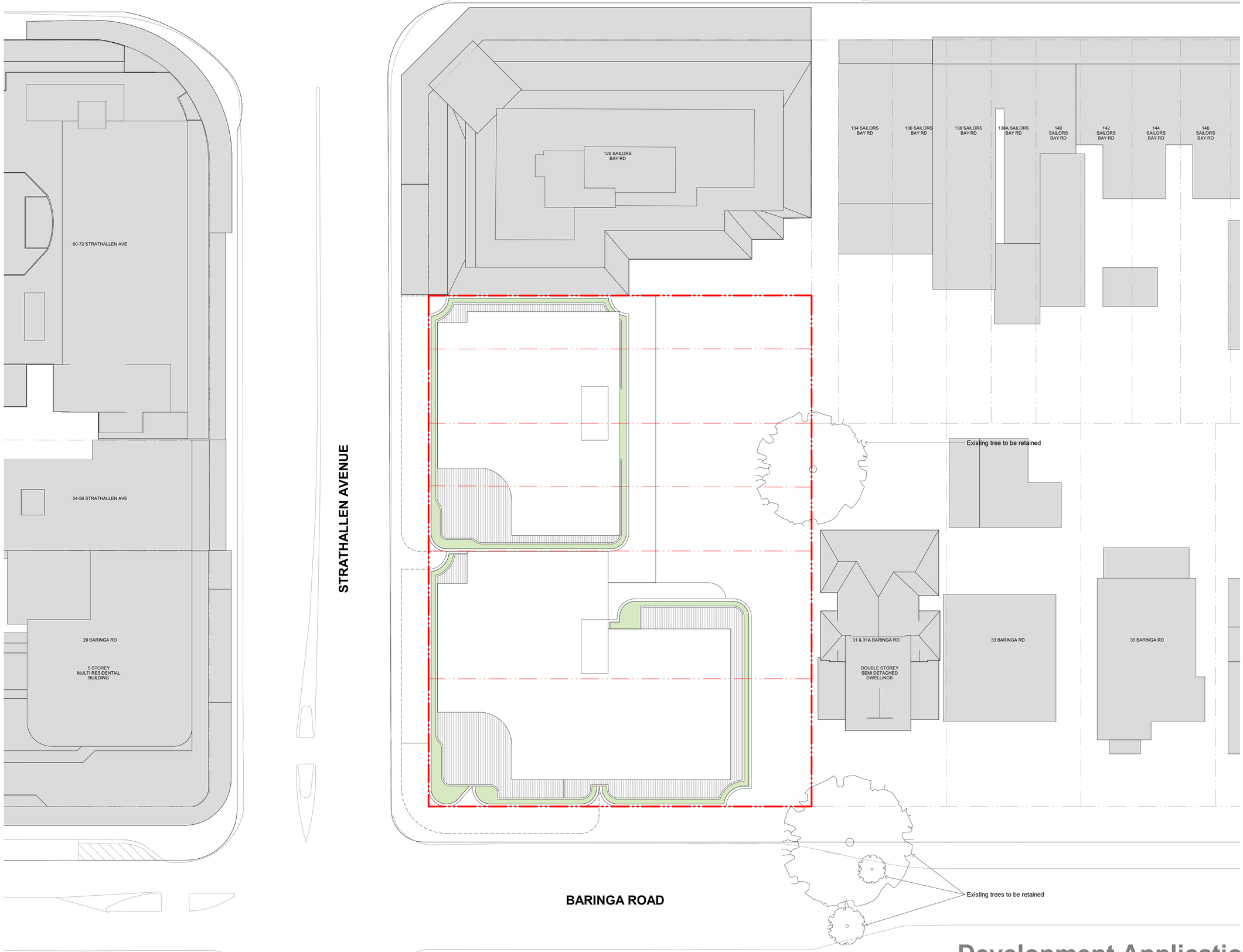
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Site & Existing Conditions
Site Plan (Proposed)

Status	DEVELOPMENT APPLICATION
Scale	1 : 200 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:03 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A01.003
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

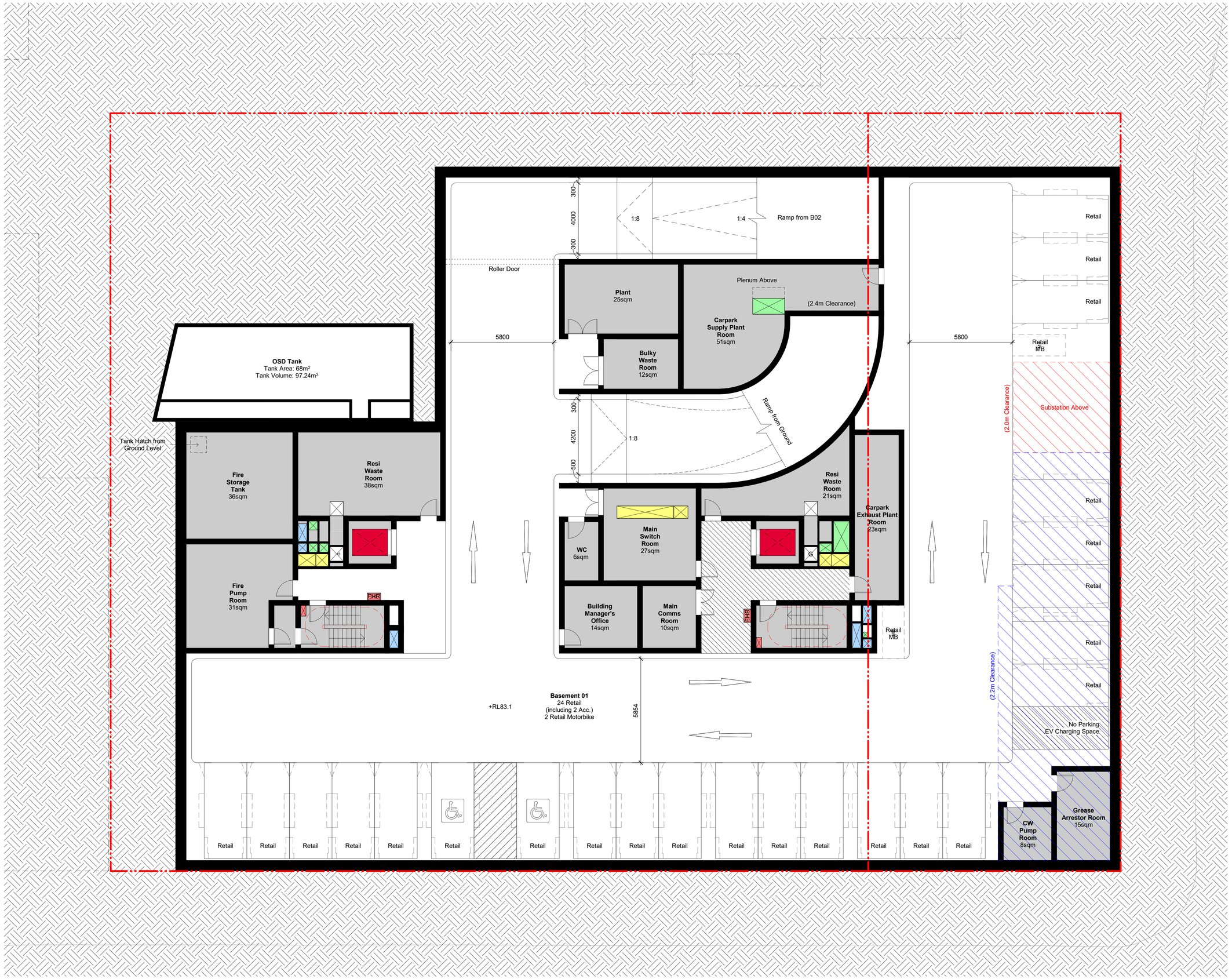
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Basement Level 01

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:06 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt
Drawing no.	A03.001
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

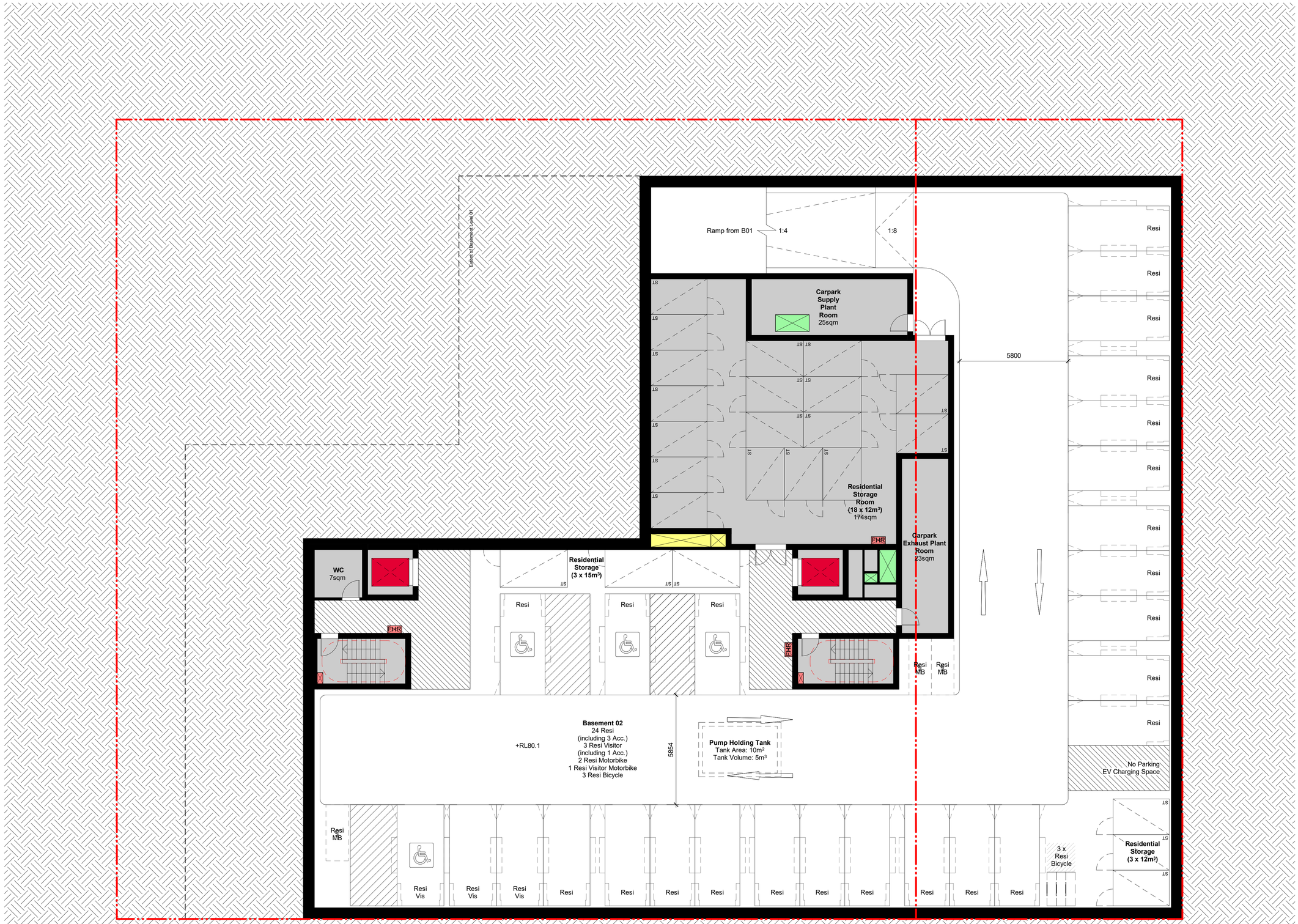
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Basement Level 02

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:09 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.002
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

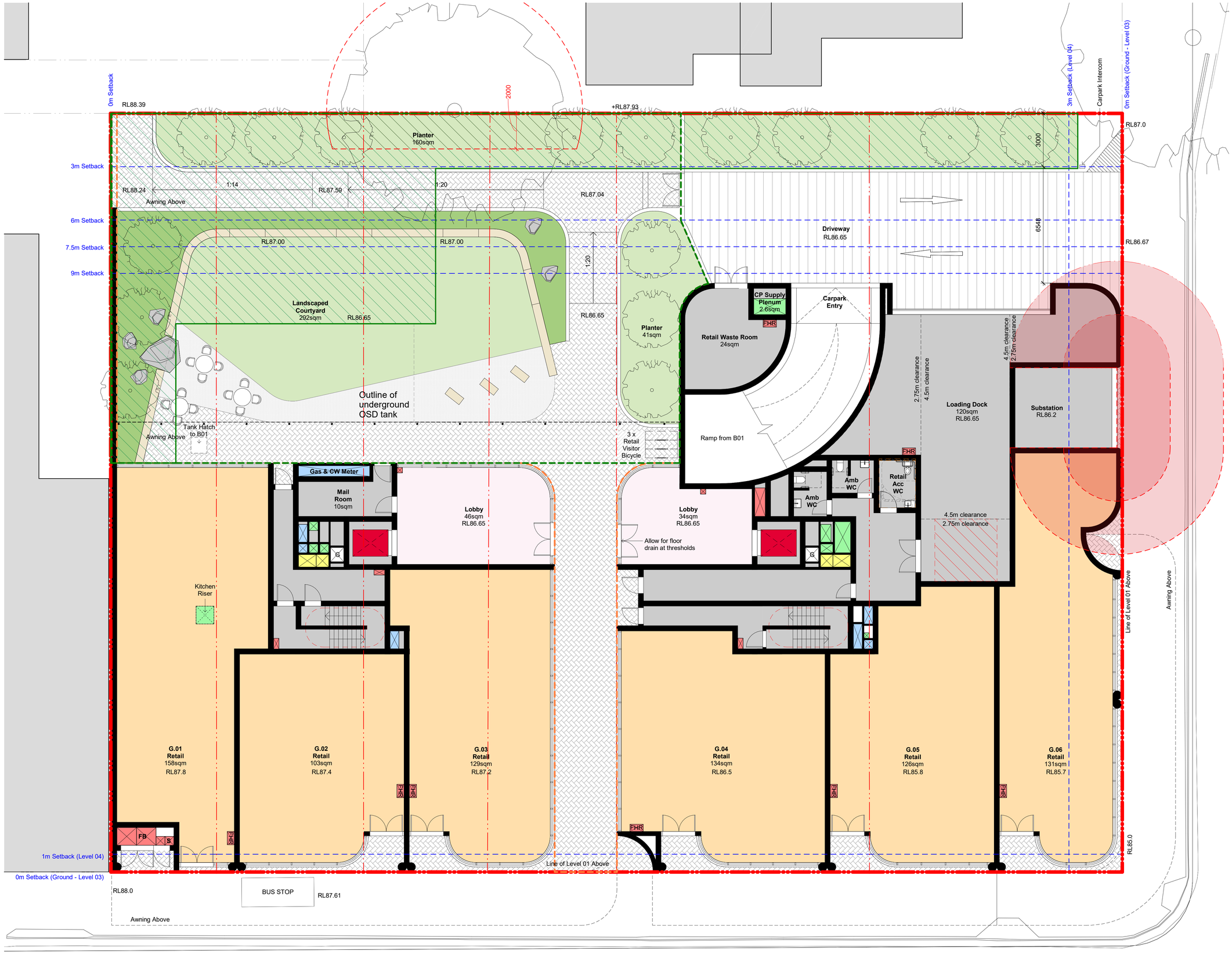
Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Legend

- Deep soil extent
- Outline of communal open space
- Outline of public open space

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Ground Level

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:13 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt
Drawing no.	A03.100
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

0m Setback

3m Setback

6m Setback

7.5m Setback

9m Setback

1m Setback (Level 04)

0m Setback (Ground - Level 03)

3m Setback (Level 04)

0m Setback (Ground - Level 03)

Line of Level 02 Above

Awning Below

Awning Below

Awning Below

1.01 - Balcony 11m²

1.03 - Balcony 10m²

1.04 - Balcony 5m²

1.06 - Balcony 16m²

1.06 - Balcony 26m²

1.01 - Balcony 17m²

1.02 - Balcony 17m²

1.03 - Balcony 15m²

1.04 - Balcony 15m²

1.05 - Balcony 48m²

1.01
3B
165sqm

1.02
2B+
109sqm

1.03
3B+
145sqm

1.04
3B+
152sqm

1.05
4B
167sqm

1.06
4B+
198sqm

Master
Bed
Bath
Ens.
Study
L'dry
St
Living
Dining
Kitchen
B. Pantry
Loading Below

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 01

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:16 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraysm
Drawing no.	A03.101
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

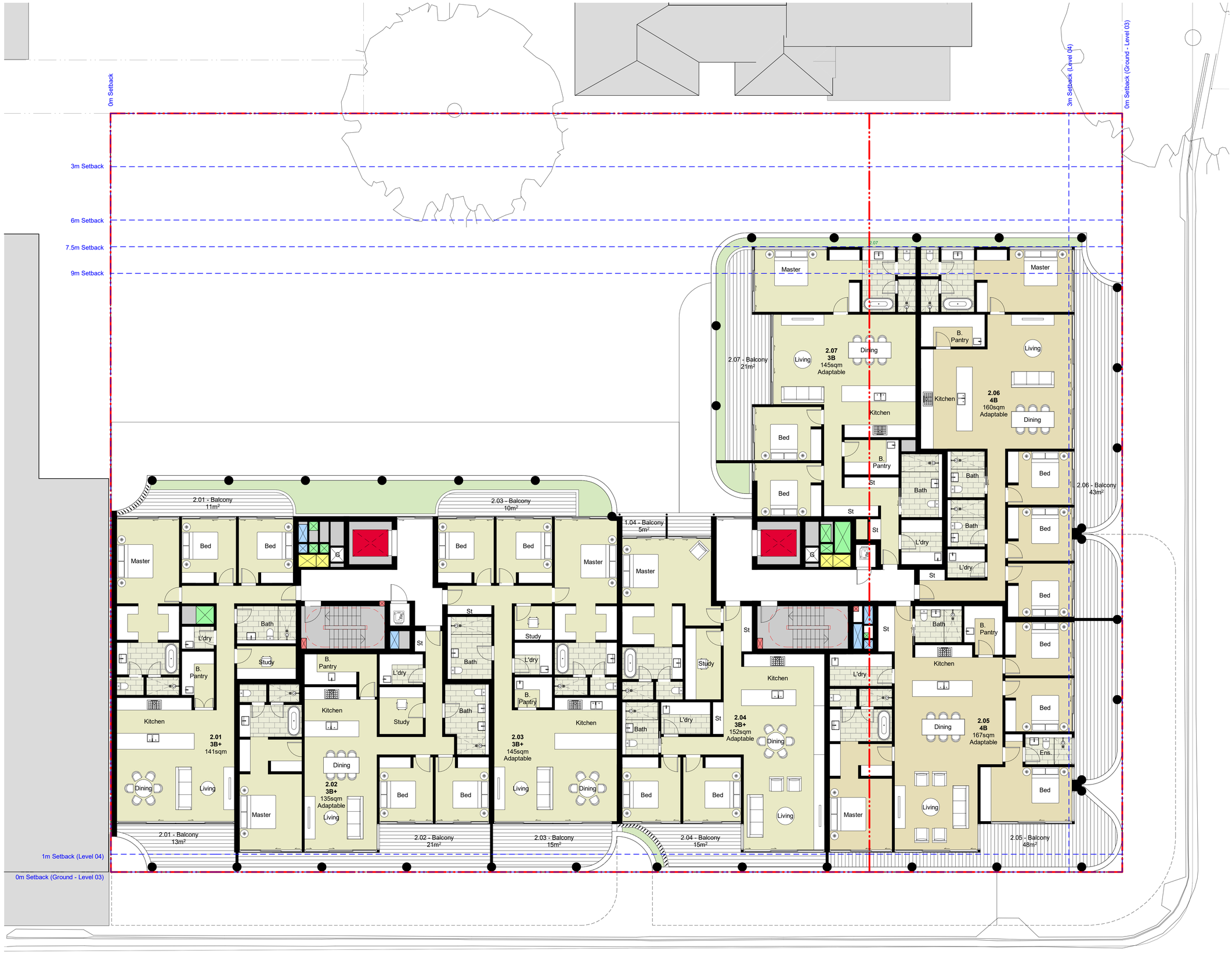
Development Application

BATESSMART

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 02 & 03

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS Checked BS
Project No.	S12751
Plot Date	28/06/2024 9:56:20 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.102
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Level 04

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:56:24 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A03.104
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

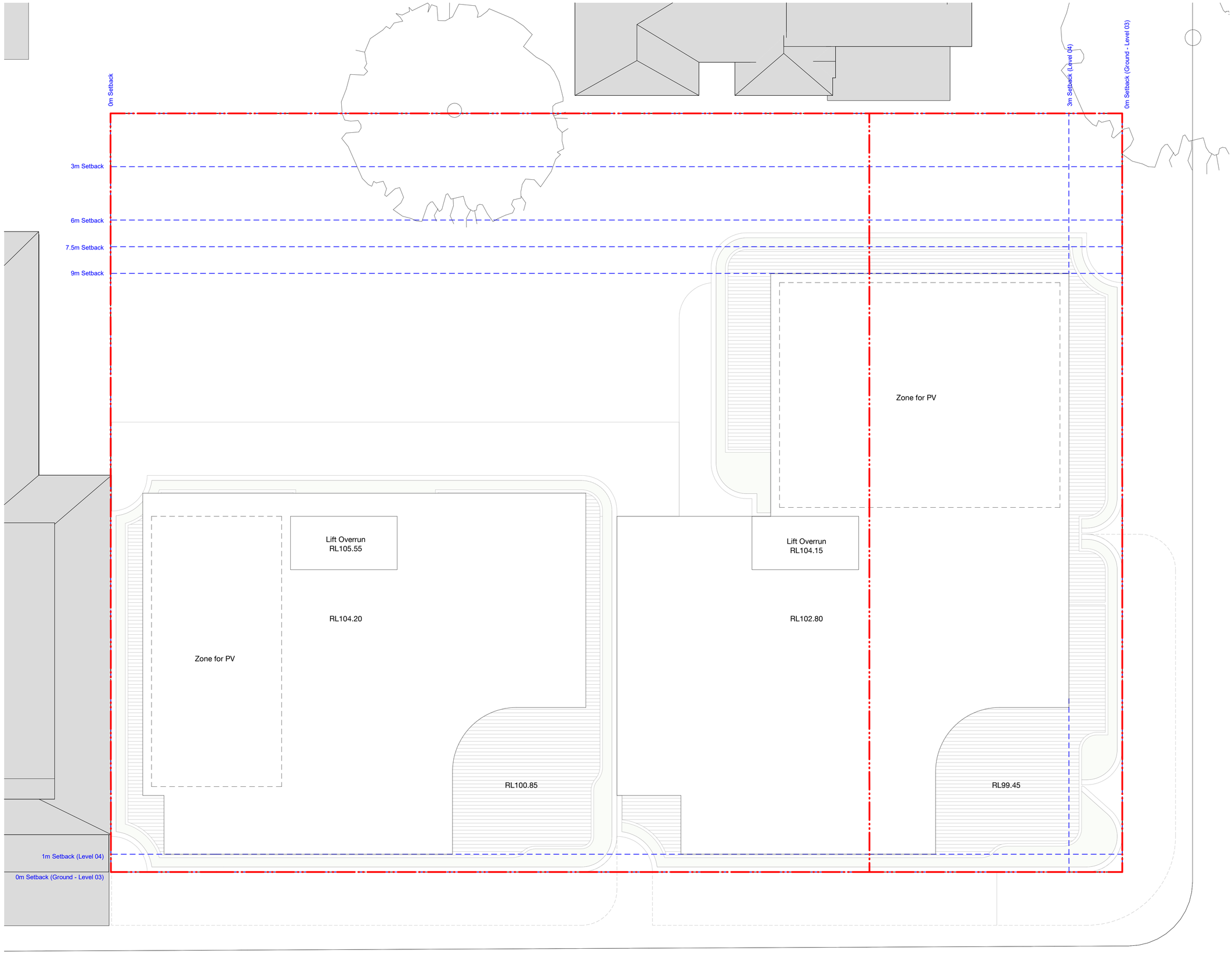
Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt



Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

General Arrangement Plan
Roof Level

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:53 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt
Drawing no.	A03.105
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

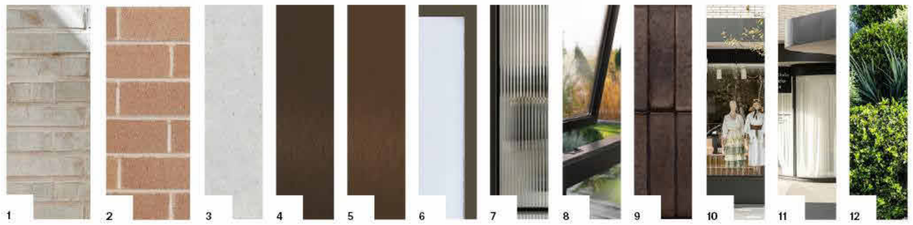
Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
North Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:57:32 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt		
Drawing no.	A09.001	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
East Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:58:07 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymi		
Drawing no.	A09.002	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

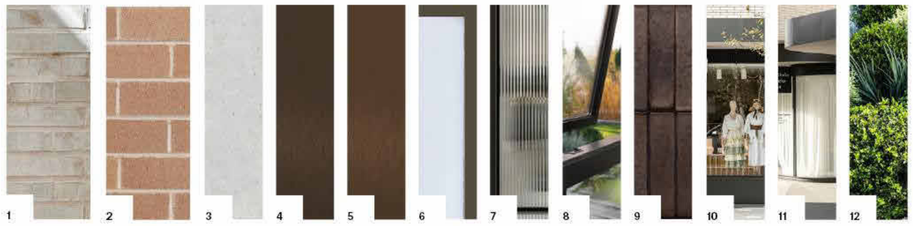
Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
South Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:58:41 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymi		
Drawing no.	A09.003	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.LNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Pictured

1. Feature Brickwork to Spandrel & Round Columns - Warm, light grey
2. Podium Brickwork - Mid brown/red
3. Concrete Capping to Spandrel
4. Aluminium Window Framing - Dark Bronze
5. Metal Handrail, Louvres & Awnings - Medium Bronze
6. Glazing - Flat, Clear
7. Glazing - Fluted
8. Glazing - Operable
9. Tile - Dark
10. Steel Shopfront Framing - Dark Bronze
11. Curved Shopfront Glazing - Clear
12. Planting



Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

External Elevations
West Elevation

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:59:16 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiuk.rvt		
Drawing no.	A09.004	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

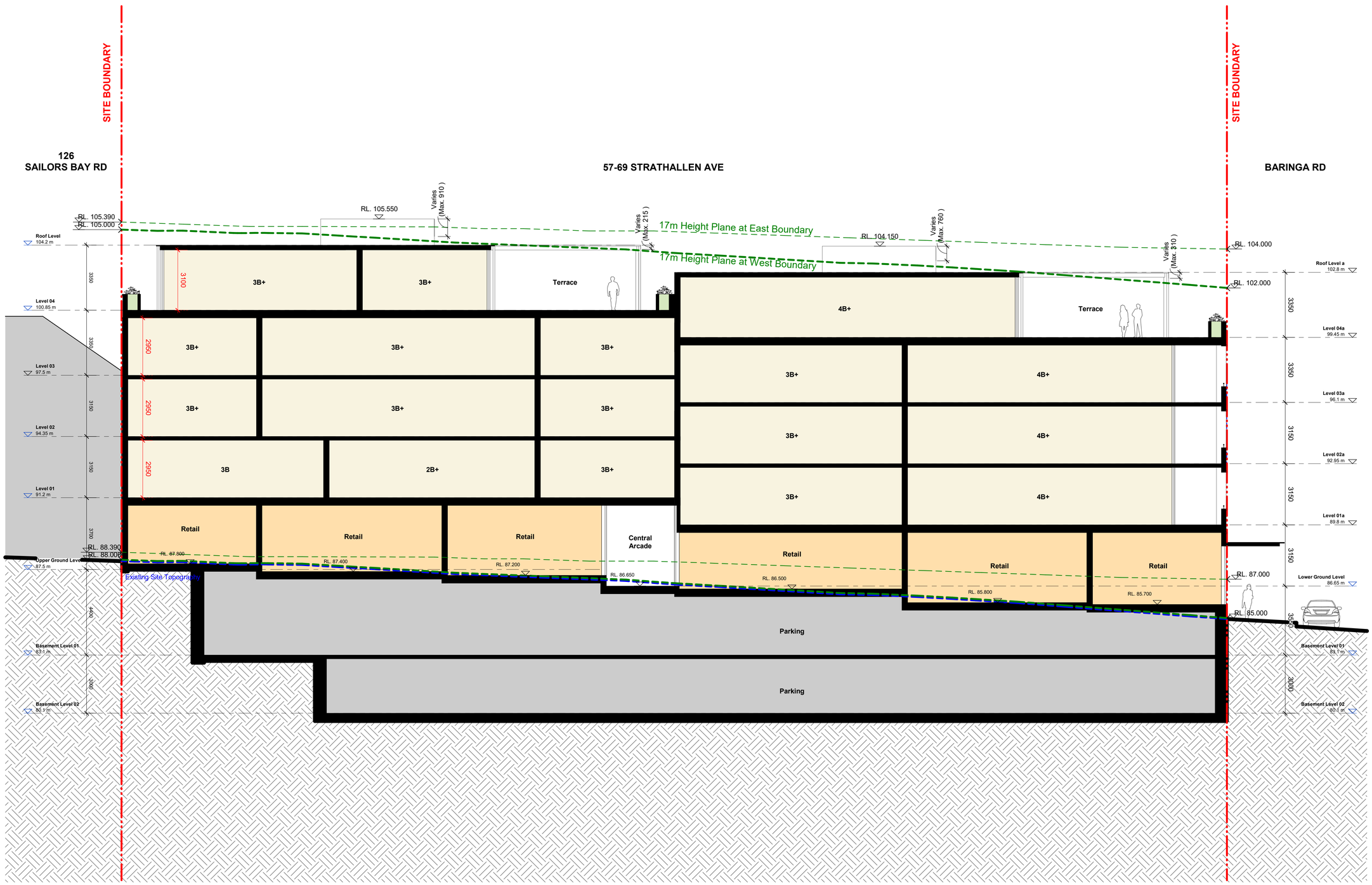
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Building Sections
Section A

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 10:58:05 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiak.rvt		
Drawing no.	A10.001	Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

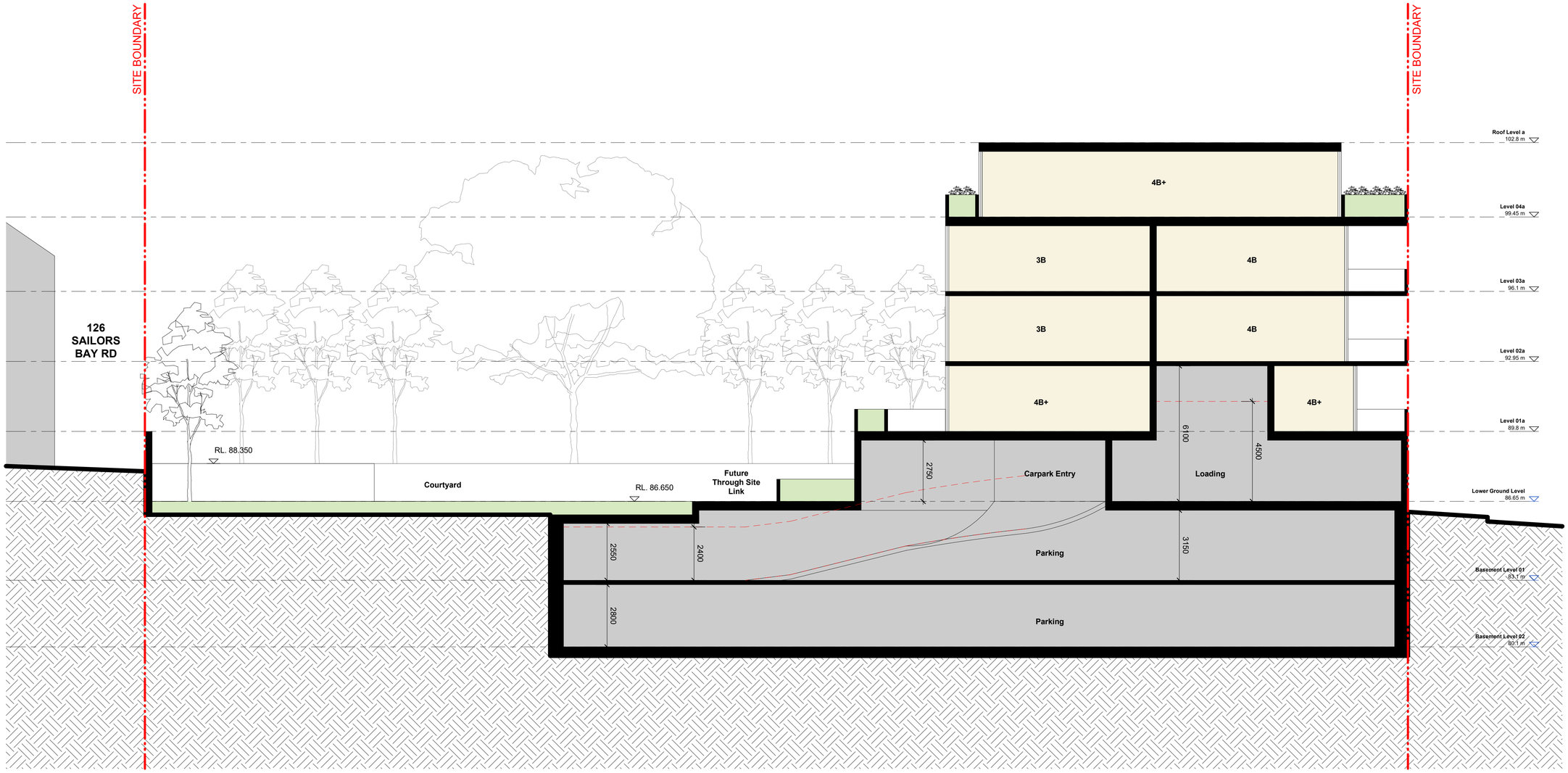
BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.



Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Building Sections
Section B

Status	DEVELOPMENT APPLICATION
Scale	1 : 100 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:47 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A10.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

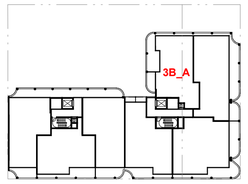
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

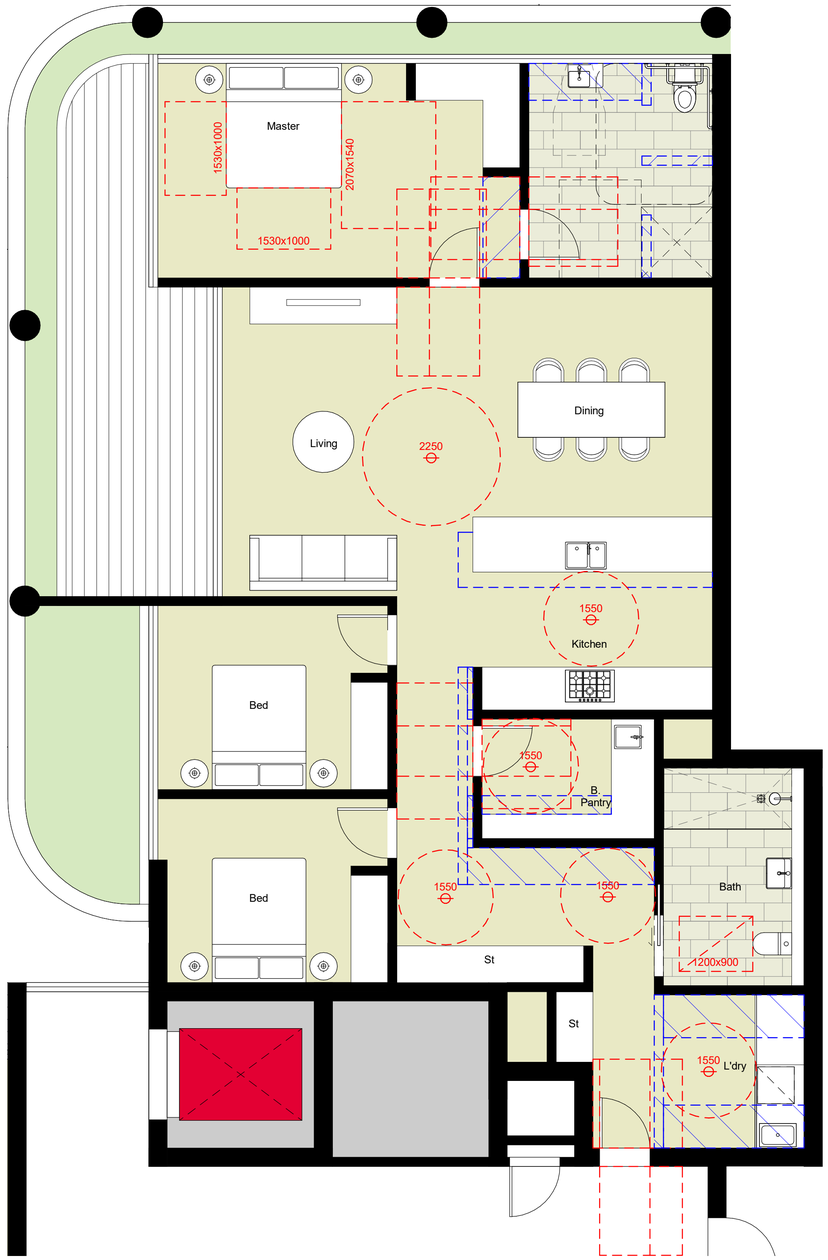
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_A - Pre Adaptation
Plan 1 : 50



2 3B_A - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_A

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:25 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.001
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

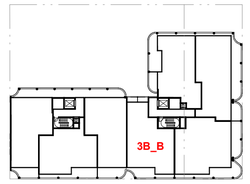
BATESSMART

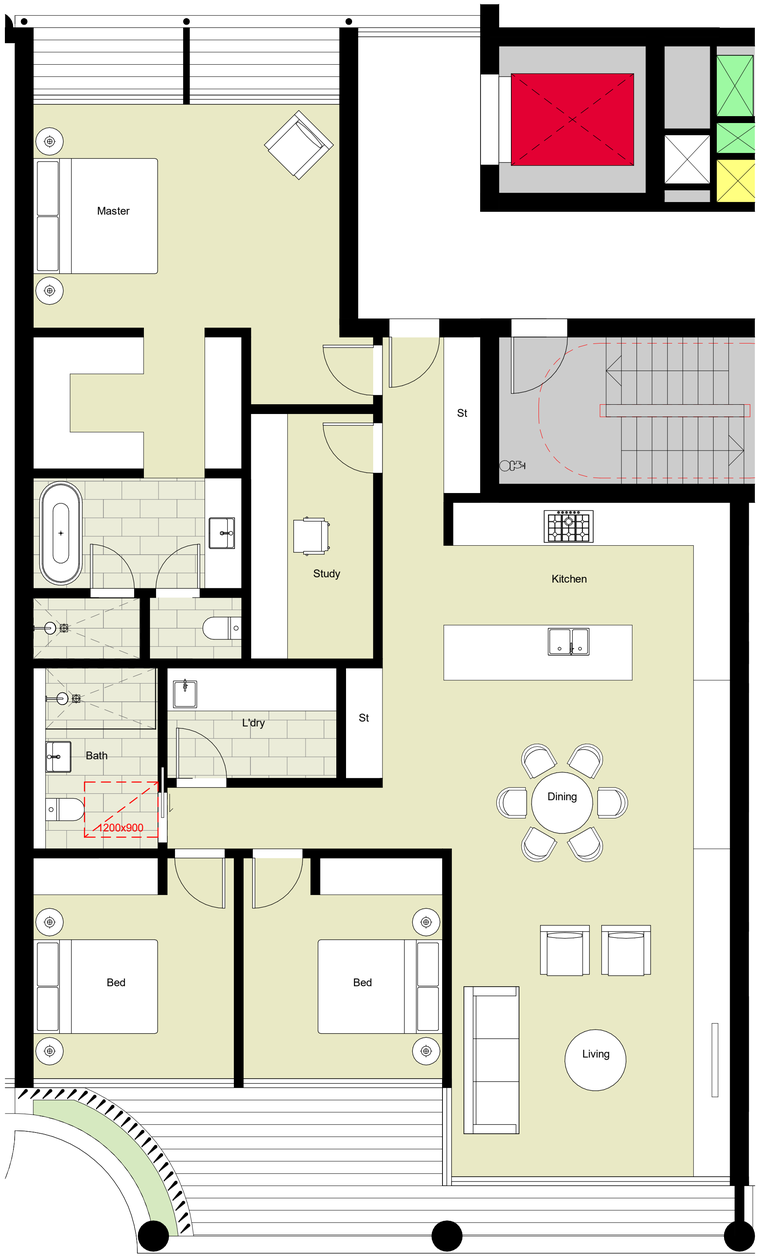
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

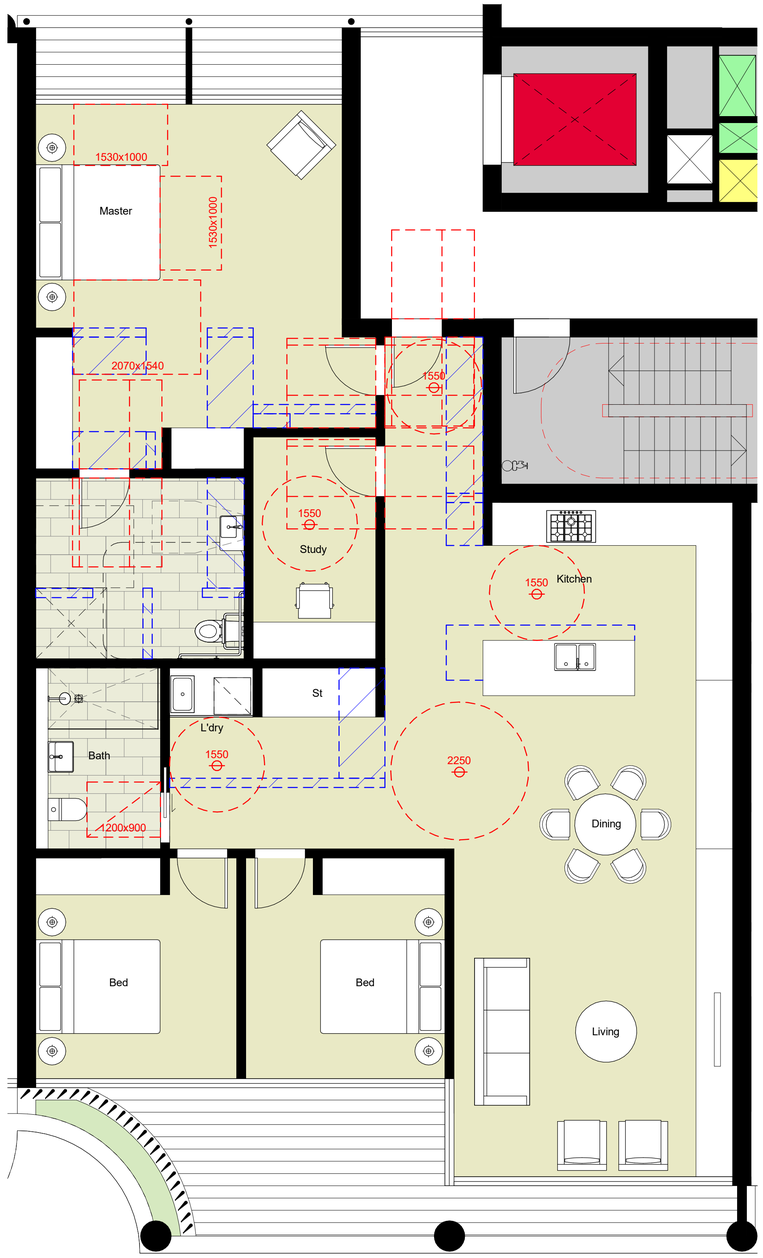
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_B - Pre Adaptation
Plan 1 : 50



2 3B_B - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_B

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:29 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.002
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Phillip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

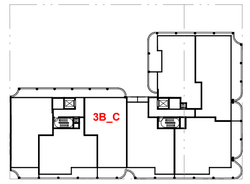
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiwHANB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

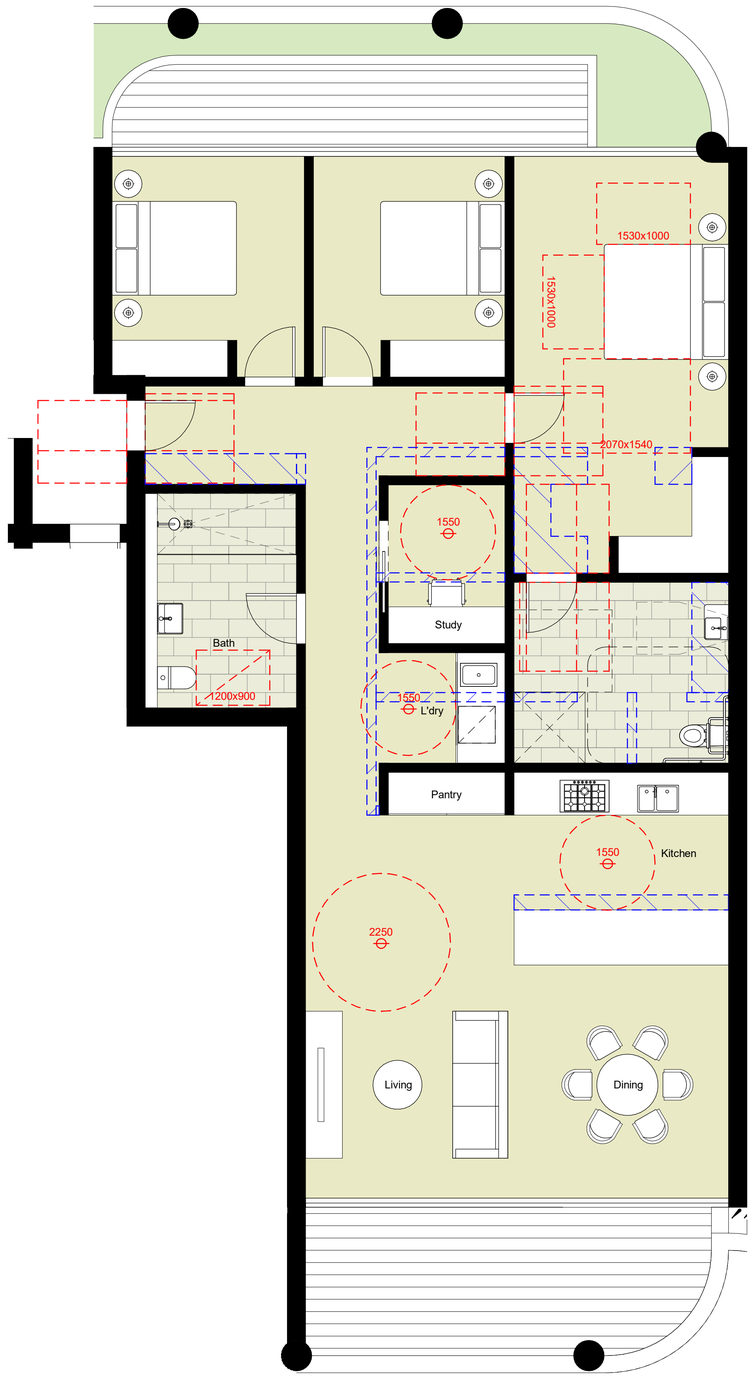
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_C - Pre Adaptation
Plan 1 : 50



2 3B_C - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_C

Status	DEVELOPMENT APPLICATION		
Scale	As indicated @ A1		
Drawn	Author	Checked	Checker
Project No.	S12751		
Plot Date	28/06/2024 9:55:33 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A13.003	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

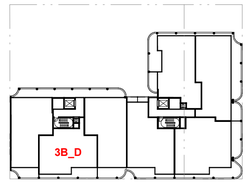
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

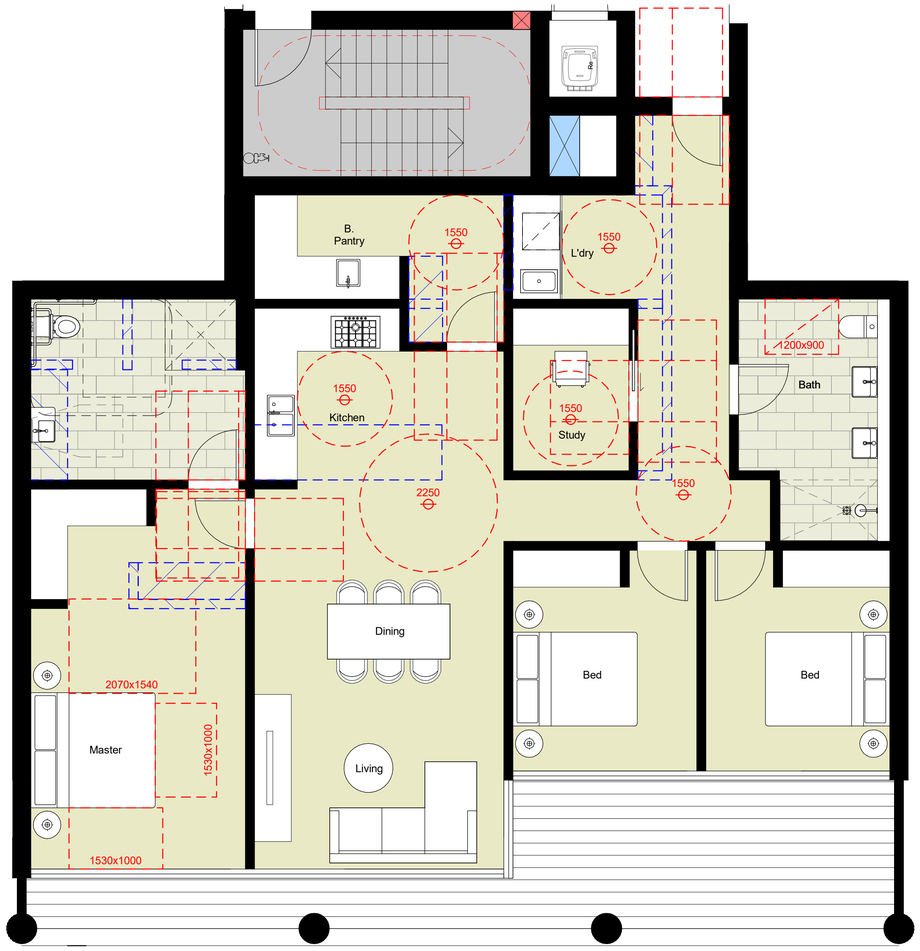
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 3B_D - Pre Adaptation
Plan 1 : 50



2 3B_D - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
3B_D

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author
Checked	Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:37 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.004
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

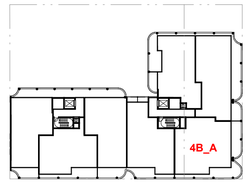
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNMB5.rvt

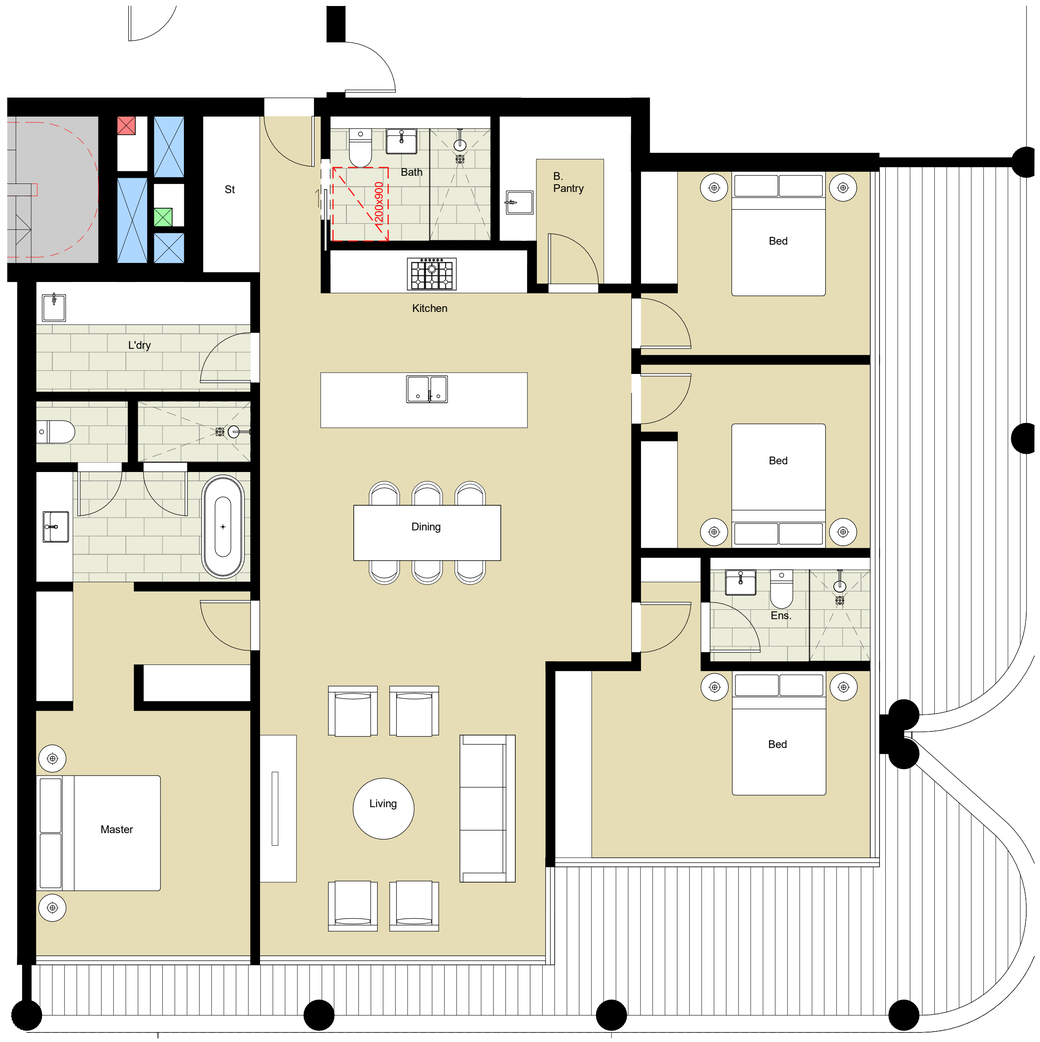
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

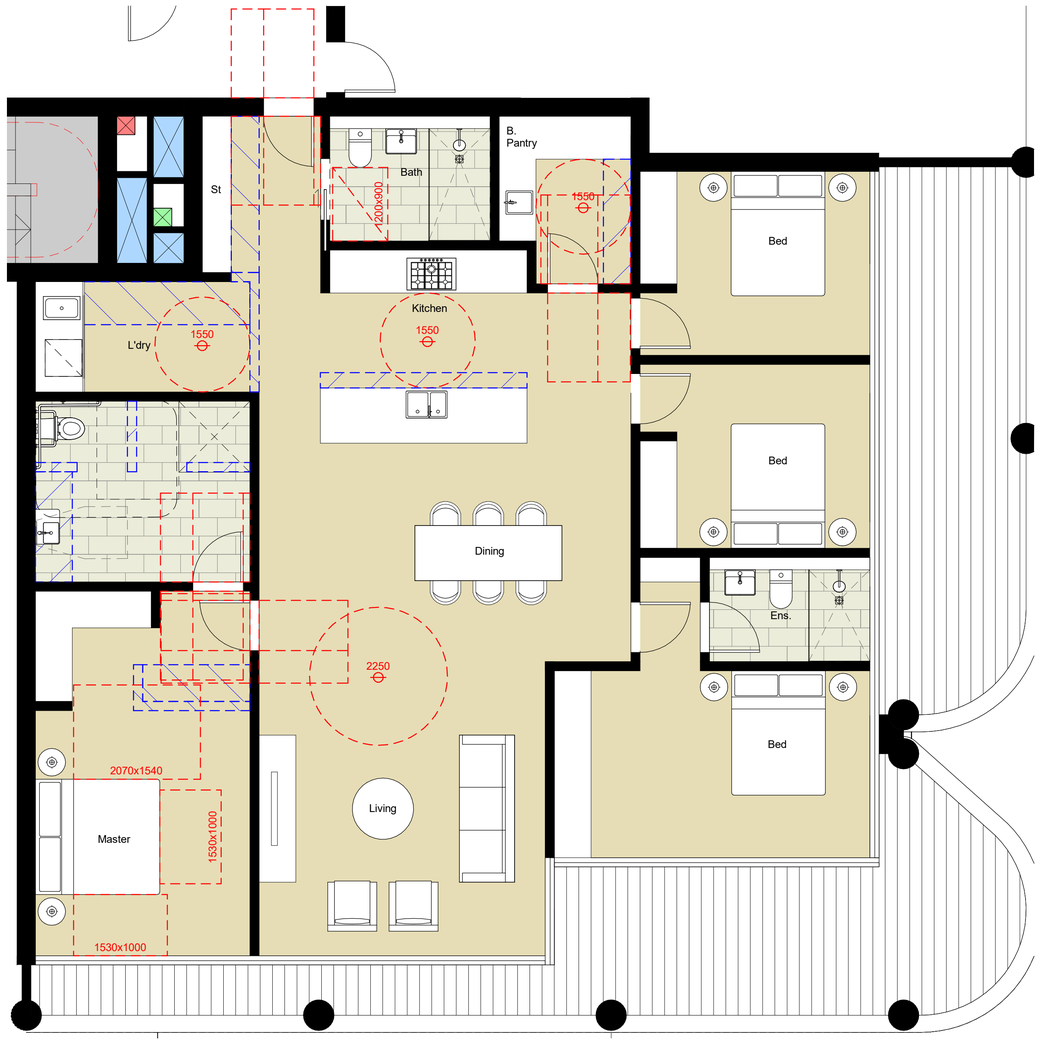
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 4B_A - Pre Adaptation
Plan 1 : 50



2 4B_A - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
4B_A

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:42 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A13.101
Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

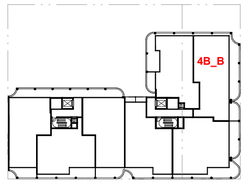
C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM65.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

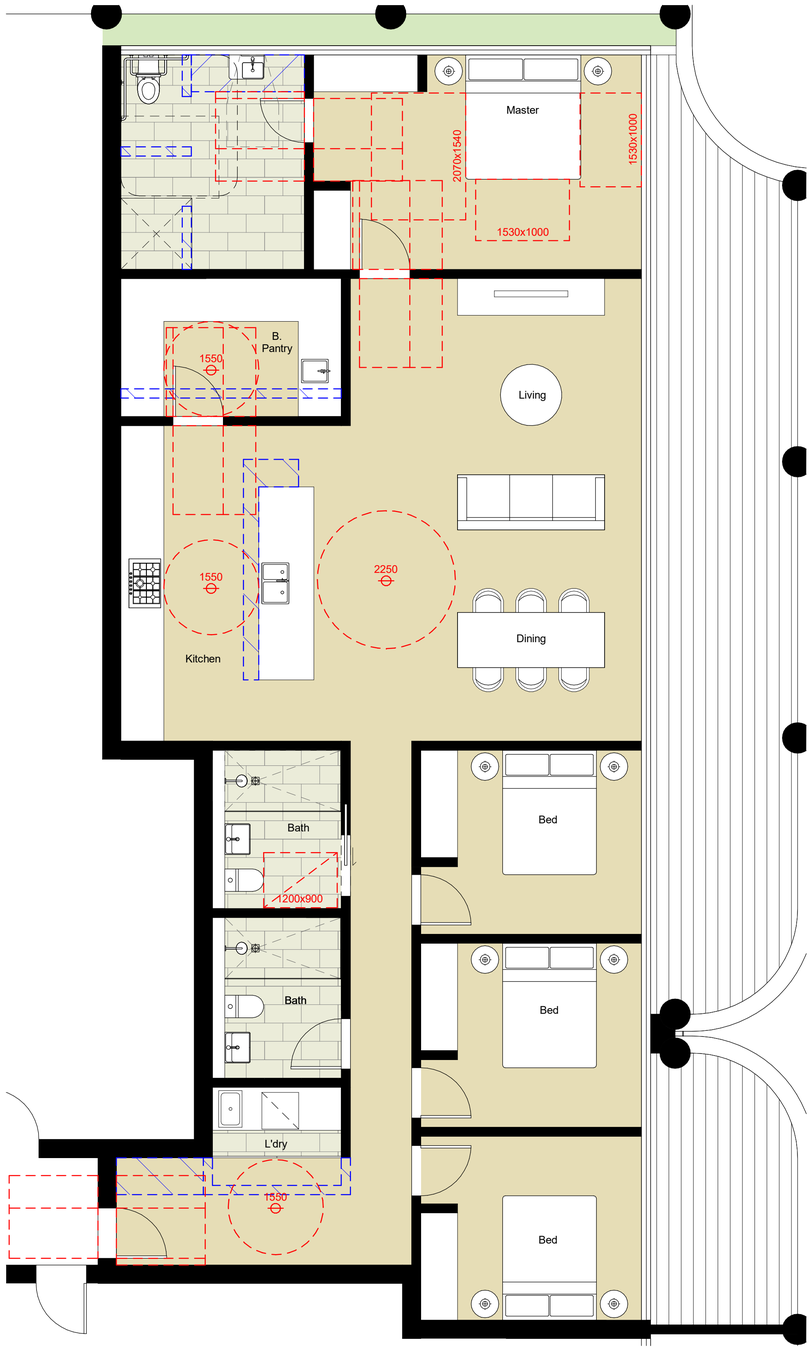
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY PLAN
Level 02-03





1 4B_B - Pre Adaptation
Plan 1 : 50



2 4B_B - Post Adaptation
Plan 1 : 50

Rev	Date	Description	Initial	Checked
3	28.06.24	Post Lodgement Amendments	NH	TG
2	02.05.24	Development Application	EYB	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Apartment Types
4B_B

Status	DEVELOPMENT APPLICATION		
Scale	As indicated @ A1		
Drawn	Author	Checked	Checker
Project No.	S12751		
Plot Date	28/06/2024 9:55:20 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A13.102	Revision	3

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiukLNMB5.rvt



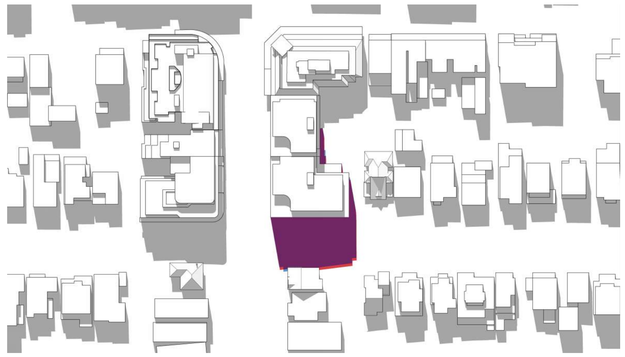
9am



10am



11am



12pm



1pm



2pm



3pm

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM85.rvt

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

- Height Compliant Scheme
- Proposed Scheme
- Overlap

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Shadow Analysis Diagrams
Shadow Plans

Status	DEVELOPMENT APPLICATION		
Scale	1 : 100	@ A1	
Drawn	BS	Checked	BS
Project No.	S12751		
Plot Date	28/06/2024 9:55:11 AM		
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym		
Drawing no.	A21.001	Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART™

Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

All drawings may not be reproduced or distributed without prior permission from the architect.

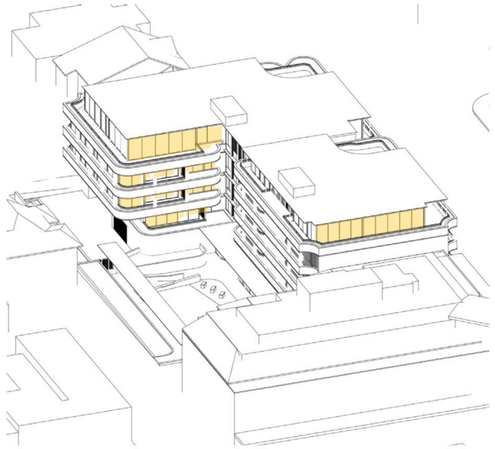
Winter Solstice (21st June)

KEY

2 hours of solar access



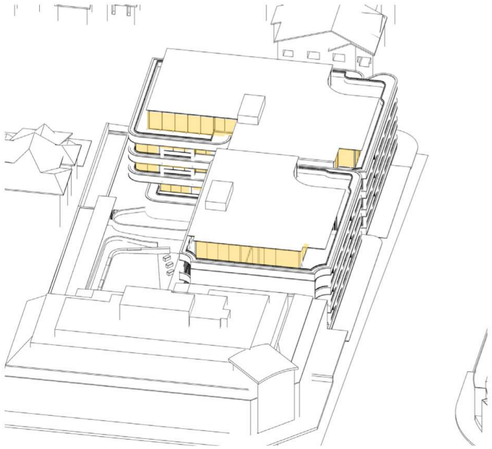
9am



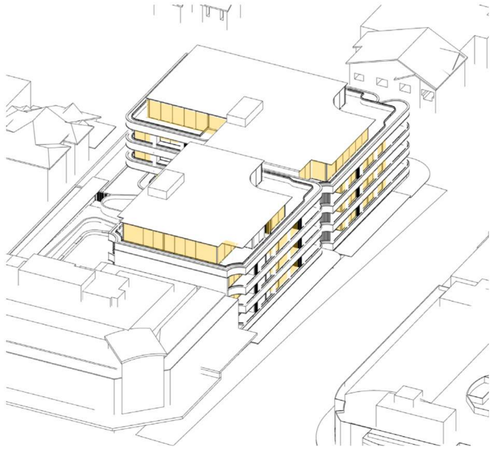
10am



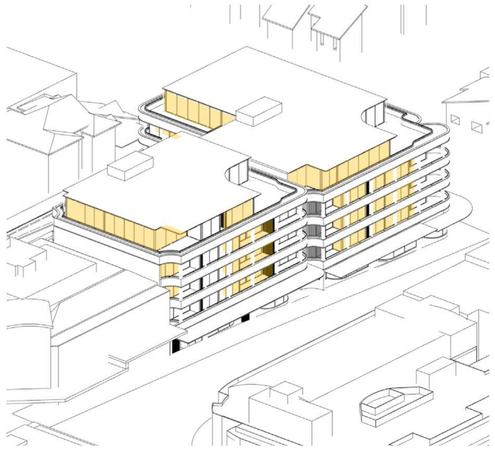
11am



12pm



1pm



2pm



3pm

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Shadow Analysis Diagrams
Views From The Sun

Status	DEVELOPMENT APPLICATION
Scale	1 : 60 @ A1
Drawn	BS
Checked	BS
Project No.	S12751
Plot Date	28/06/2024 9:55:16 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasym
Drawing no.	A21.002
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986

NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHarasymiakLNM65.rvt

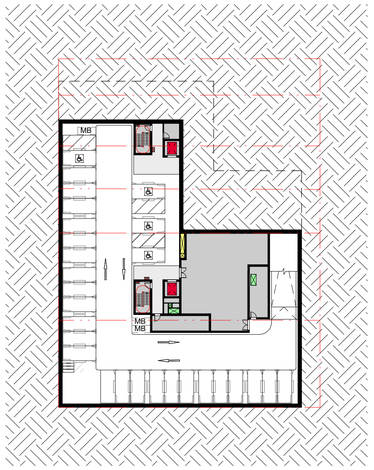
Check all dimensions and site conditions prior to commencement of any work, the purchase or ordering of any materials, fittings, plant, services or equipment and the preparation of shop drawings and or the fabrication of any components.

Do not scale drawings - refer to figured dimensions only. Any discrepancies shall immediately be referred to the architect for clarification.

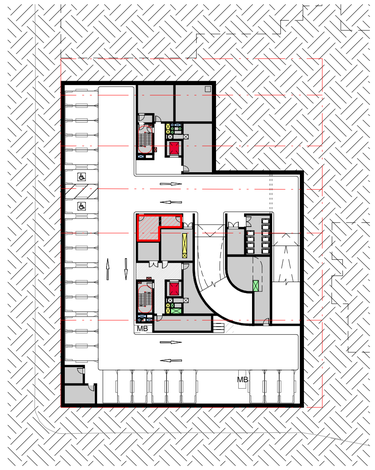
All drawings may not be reproduced or distributed without prior permission from the architect.

KEY

- GFA (Retail)
- GFA (Residential)
- GFA (Retail Amenity)

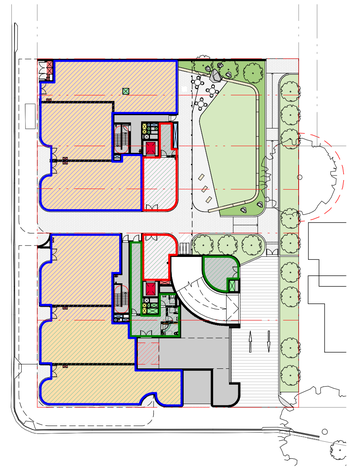


1 GFA Plan - Basement Level 02
Plan 1 : 500



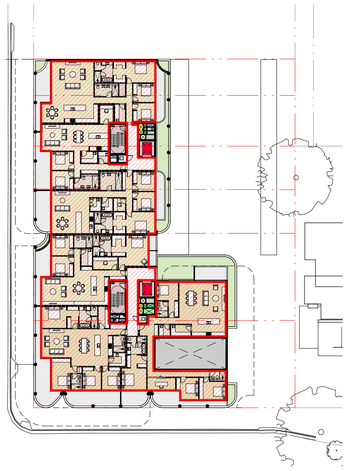
2 GFA Plan - Basement Level 01
Plan 1 : 500

Residential GFA: 21sqm



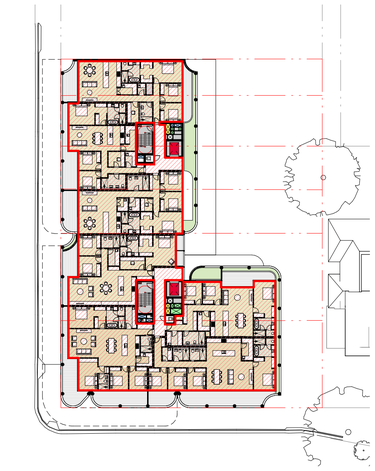
3 GFA Plan - Ground Level
Plan 1 : 500

Residential GFA: 93sqm
Retail GFA: 797sqm
Retail Amenity GFA: 82sqm



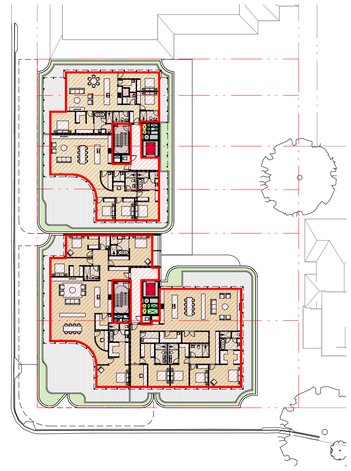
4 GFA Plan - Level 01
Plan 1 : 500

Residential GFA: 1010sqm



5 GFA Plan - Level 02 & 03
Plan 1 : 500

Residential GFA: 1125sqm



6 GFA Plan - Level 04
Plan 1 : 500

Residential GFA: 863sqm

GFA Calculations (Total)

Level	Area
Basement Level 02	-
Basement Level 01	21sqm
Ground Level	972sqm
Level 01	1010sqm
Level 02	1125sqm
Level 03	1125sqm
Level 04	863sqm
Total GFA	**5116sqm**

Rev	Date	Description	Initial	Checked
2	28.06.24	Post Lodgement Amendments	NH	TG
1	13.03.24	Development Application	EYB	TG

NORTHBRIDGE

57-69 Strathallen Ave

Area Calculation Plans
GFA

Status	DEVELOPMENT APPLICATION
Scale	As indicated @ A1
Drawn	Author Checked Checker
Project No.	S12751
Plot Date	28/06/2024 9:55:07 AM
BIM	C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraszmuk
Drawing no.	A22.001
Revision	2

Melbourne 1 Nicholson Street
Melbourne VIC 3000 Australia
T 03 8664 6200 F 03 8664 6300
email mel@batessmart.com.au
http://www.batessmart.com.au

Sydney 43 Brisbane Street
Surry Hills NSW 2010 Australia
T 02 8354 5100 F 02 8354 5199
email syd@batessmart.com.au
http://www.batessmart.com.au

Bates Smart Architects Pty Ltd ABN 68 094 740 986
NSW Nominated Responsible Architects: Kellie Payne Reg. 6454 / Philip Vivian Reg. 6696 / Guy Lake Reg. 7119 / Matthew Allen Reg. 8498

Development Application

BATESSMART

C:\Users\HANA\Documents\NORTHBRIDGE_BS_ARCH_R2023_nHaraszmukLNM85.rvt

Attachment 3 – Toxicological Review

There are two elements to the toxicological review for the human health risk assessment: hazard identification (using toxicological studies) and dose-response assessment. The Australian approach to each is discussed in detail below.

A3.1 Hazard Identification

Hazard identification examines the capacity of an agent to cause adverse health effects in humans and other animals. The dose-response assessment examines the quantitative relationships between exposure and the effects of concern.

Hazard identification uses:

- Animal data. This is usually assessed by toxicological methods;
- Human data. This usually assessed by epidemiological methods when groups of people are involved, or by toxicological methods when using case studies and acute chamber studies; and
- Other data. This includes structure data such as structure activity data or in vitro data assessed by toxicologists.

Hazard identification mostly relies on the results of in vitro toxicity studies conducted according to standard protocols (e.g. OECD Test Guidelines). The following types of studies are defined:

- Acute toxicity studies are studies which investigate the effects of single doses of a substance. The standard acute toxicity studies include tests for: acute, oral, dermal and inhalational toxicity, eye irritation, skin irritation and skin sensitisation;
- Sub-chronic toxicity studies are short term repeat-dose studies. The main purpose of sub-chronic testing is to identify any target organs and to establish dose levels for chronic exposure studies;
- Chronic toxicity studies, or long-term studies, are defined as studies lasting for the greater part of the lifespan of the test animals. The protocol for these studies may cover the investigation of chronic toxicity or carcinogenicity, or both;
- Reproductive toxicity studies are studies designed to provide general information about the effects of a test substance on reproductive performance in both male and female animals;
- Developmental toxicity studies are studies which examine the spectrum of possible in utero outcomes for the conceptus, including death, malformations, functional deficits and developmental delays; and
- Genotoxicity studies are designed to determine whether test chemicals can perturb genetic material to cause gene or chromosomal mutations.

The essential purpose of toxicity studies is the detection of valid biological evidence of the hazard potential of the substance being investigated. The evaluation of the weight of evidence produced by toxicity studies is that process which considers the cumulative data pertinent to arriving at a level of concern about the potential adverse effects of a substance. In assessing toxicological studies and hazard analysis, judgement and supporting rationale are provided for:

- The acceptability of the study and its database;
- The existence of biologically important adverse effects;
- The relevance of any factors noted during the evaluation which might have had some bearing on the outcomes of the study and modified the findings in some way; and

- The likelihood that any of the observed effects were induced by the administered substance.

Toxicology assessments are often complemented with epidemiological studies in hazard assessment. Epidemiology is the direct human evidence component of the assessment. Epidemiological studies are used to investigate the cause of adverse health effects; the natural history of health conditions; the description of the health status of populations; and to evaluate the health status of populations; and to evaluate health related interventions.

A3.2 Dose-Response Assessment

There are different ways of characterising dose-response relationships including:

- Effect levels (e.g. LD50, LC50, ED10) and no observed adverse effect levels (NOELs);
- Margins of safety;
- Therapeutic indices; and
- Models to interpolate high dose experimental data to the low doses likely to be experienced in the environment.

There are often limited human exposure data available and, on this basis, animal bio-assay data are most often used for dose-response assessment. The use of these data requires extrapolations from animals to humans and interpolations from high doses to low doses.

Dose-response assessments and calculations are generally undertaken by either a threshold approach or a non-threshold approach. Each is described in further detail below.

A3.2.1 Threshold Approaches

A threshold is considered to occur because of biological mechanisms such as the ability to metabolise or excrete a toxin to repair damage up to a certain dose.

The approach with these models is to derive exposure limits such as an ADI, Tolerable Daily Intake (TDI) or RfD. This approach makes no attempt to calculate a level of risk at low exposures. Rather, it derives a dose which is apparently without effect in a human population or suitable animal model, and then applies a factor to derive an exposure which has a high likelihood that no effect will occur in the general human population.

These exposure limits are derived by first determining the No Observed Adverse Effect Level (NOAEL) or, if the NOAEL cannot be determined, the Lowest Observed Adverse Effect Level (LOAEL) and dividing the value by factors to account for:

- Interspecies differences (extrapolating from animals to humans);
- Intraspecies differences (differing sensitivities between individuals);
- The severity of the adverse effect; and
- The quantity and quality of the scientific data.

Traditionally, safety factors for intraspecies and interspecies differences have each been assigned values of ten, and the other two have been assigned values between 1 and 10. An additional factor of ten is sometimes used if the NOAEL was not established in the study. The individual factors are then multiplied to determine an overall safety factor by which the NOAEL is divided to give the ADI, TDI or RfD.

Historically, the most common overall factor used by a number of regulatory bodies is 100, if a large toxicological database has been assessed, although the overall factor can range from 10 to 10,000. From the data available on humans and experimental animals, it appears that interspecies and

intraspecies differences are in general less than 10, hence the often used safety factor of 100 for these two factors is conservative and adequately protective of public health.

A3.2.2 Non-Threshold Approaches

These approaches do not recognise the possibility of a threshold effect and are appropriate for radiation and some genotoxic carcinogens. It is, as a science policy decision, applied to all carcinogens by the US EPA.

Non-threshold models assume linearity between the lowest experimentally derived dose and the zero dose (the origin). This implies that there is a calculable probability of an adverse effect (risk) no matter how small the dose. This does not mean that there is no dose that could be considered safe unless safety must be equated with zero risk.

Numerical estimates of risk probabilities are generated by fitting one or more mathematical models to the data in the experimental dose range and extrapolating to the low environmental exposure doses. For example, low-dose extrapolation using a linear model is a default approach for cancer risk assessment in the USA and is one approach which has been used by the WHO for genotoxic carcinogens in deriving water quality guidelines.

The outcomes are estimates of either:

- The dose at a predetermined acceptable risk level (note that this requires some judgement on what constitutes an acceptable level of risk); or
- The estimated risk level at any particular dose.

It has been recognised by IARC and other European based agencies that not all carcinogens have genotoxicity as their prime mode of action, the dose-response curve is assumed to be non-threshold for genotoxic carcinogens and threshold for non-genotoxic carcinogens. Accordingly, the Australian approach is to apply non-threshold and threshold models to genotoxic and non-genotoxic carcinogens respectively.

A3.3 Sources of Toxicological and Tolerable Intake Data

NEPC (2013) provides toxicological data sources that are considered to provide information that is compliant with Australian requirements for setting public health standards in the context of assessing potential human health risks. These sources include:

1. National Health and Medical Research Council documents (e.g. Australian Drinking Water Guidelines);
2. National Environmental Protection Council documents (e.g. NEPM Air Toxics, NEPM Ambient Air Quality and Air Quality Standard Setting Methodology);
3. Other Australian government sources of toxicity data (e.g. ADI list from the Therapeutic Goods Administration, enHealth Council documents and National Environmental Health Forum documents distributed by the Commonwealth Department of Health and Ageing);
4. South Australian Health which has published a series of workshops on risk assessment of contaminated land;
5. World Health Organisation (WHO) documents. Australia is a party to the WHO process and has incorporated their material in a variety of environmental health criteria. A range of documents include those from the WHO/ILO/UNEP International Programme on Chemical Safety (IPCS) which produces Environmental Health Criteria monographs and Concise International Chemical Assessment documents (CICADs). Documents detailing international Acceptable Daily Intakes (ADI's), Tolerable Daily Intakes (TDI) or Tolerable Weekly Intakes (TWI) may be found in

evaluations by the WHO/FAO Joint Meeting on Pesticide Residues (JMPR) and by the Joint FAO/WHO Expert Committee on Food Additives (JECFA);

6. International Agency for Research on Cancer (IARC) documents;
7. US Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels and toxicological reviews;
8. Other Governmental sources of information (e.g. NICNAS, USEPA IRIS database and European Government Guidance);
9. Other sources of peer reviewed toxicity criteria (US EPA's PPRTV/HEAST, Cal EPA toxicity values and OEHHA); and
10. Peer reviewed journals for which robust justification is required if information is to be sourced as they generally are not compliant with the requirement for having carried out an extensive literature review.

Where physical and chemical data are necessary requirements in the risk assessment process, the following sources, in order, are recommended:

1. ORNL (Oak Ridge National Laboratory) Risk Assessment Information System (RAIS);
2. ATSDR toxicological profiles; and
3. Peer reviewed journals.

A3.4 Review of Published Hazard Data

Available toxicological, epidemiological studies and dose-response studies have been reviewed for each of the COPC's (identified in **Section 4.1**) by the protocols established in the preceding sections. Consequently, citing the relevant agencies, there has been no requirement in this risk assessment to further review and comment upon the hazard studies reviewed by each organisation, or those that may be available elsewhere that are not endorsed by these organisations.

Instead, the pertinent toxicological effects identified for each of the COPC's by the agencies has been reviewed and summarised for each identified COPC. Risk / hazard factors and guideline values have also been identified from these sources.

A brief summary of the toxicological endpoints of each of the identified COPC's is provided in the following sections. The summaries have been generated by a review of the available data held by the toxicological data source agencies.

A3.4.1 Tetrachloroethene

Trichloroethene (TCE) has been selected as a COPC for the assessment of potential human health impacts. A brief summary of the toxicological data available for TCE has been provided following. The summary has been generated by a review of the available data held by the agencies outlined preceding, as summarised in **Table A3.1** following.

Table A3.1: Summary of Published Hazard Data for PCE

Organisation	Availability	Reference
NHMRC	YES	NHMRC/NRMMC (2011) 'Australian Drinking Water Guidelines'
NEPC	YES	NEPC (2013) 'Schedule B7: The Derivation of Interim HILs for Volatile Organic Chlorinated Compounds'
Therapeutic Goods Administration	No	Full review of safety alerts and advisory statements, no information
WHO	YES	WHO (2009) 'Tetrachloroethene in Drinking Water' WHO (2000) 'Air Quality Guidelines' WHO (2006) 'Air Quality Guidelines'
enHealth	No	
NEHF	YES	See NICNAS
S.A Health	No	
IARC	YES	IARC (1995)'Tetrachloroethene'
WHO/FAO JMPR	No	
NICNAS PEC	YES	NICNAS (2001) 'Tetrachloroethylene: Priority Existing Chemical Assessment Report No 15'
ATSDR	YES	ATSDR (1997) 'Toxicological Profile for Tetrachloroethylene'
NTP	YES	NTP (1977) 'Bioassay of Tetrachloroethylene for Possible Carcinogenicity'
OECD SIDS SIAR	YES	OECD SIDS (1996) 'SIDS Initial Assessment Report'
US EPA	YES	IRIS database (2012)

NHMRC

NHMRC/NRMMC (2011) has recommended a daily intake of 14mg/kg body weight per day based on the no effect level from a 90 day drinking water study using rats and mice. A safety factor of 1000 was recommended based on interspecies and intraspecies variation, and possible carcinogenicity.

Exposure to tetrachloroethene was reported to depress the nervous system. Short term studies found some evidence of liver and kidney toxicity at high doses. Inhaling at high air concentrations was found to increase the incidence of hepatocellular carcinomas in mice and leukaemia in rats.

A background exposure to PCE was not reported in NHMRC/NRMMC (2011).

NEPC

NEPC (2013) provides a review of toxicological data for PCE. It is recommended that potential inhalation effects of PCE are assessed by the WHO threshold concentration of 0.2 mg/m^3. This is reported to have been based on a 10 year occupational exposure study.

WHO

WHO has concluded that tetrachloroethene caused hepatoxicity in laboratory animals, with some evidence for carcinogenicity. It has been classified by IARC as Group 2B: possible human carcinogen.

WHO reports a tetrachloroethane dose of 14 mg/kg body weight per day as NOAEL. This includes an uncertainty factor of 1000 for intra and interspecies diversity, and for carcinogenic potential. The given guideline value is 40 µg/litre (rounded figure) for a drinking-water contribution of 10%.

WHO (2000) provides a guideline value of 260 µg/m^3 for tetrachloroethene based on a LOAEL for 102 mg/m^3 derived for kidney effects in occupationally exposed workers. WHO (2006) provides an updated threshold concentration of 0.2 mg/m^3 as reported to have been based on a mean LOAEC as measured from a 10 year occupational exposure study and adjusted by an uncertainty factor of 100.

NEHF/NICNAS

The NEHF finds that acute toxicity of tetrachloroethene in humans and animals is low following ingestion and inhalation. High acute exposure levels results in central nervous system effects in animals and central nervous system effects and respiratory irritation in humans. Repeat exposures are considered to be carcinogenic in animals, with limited evidence for their effect in humans. Tetrachloroethene is classed a carcinogen category 3, carrying a possible risk of adverse effects.

IARC

The IARC has found that there is limited evidence for carcinogenicity from tetrachloroethene in humans. However, there is sufficient evidence for carcinogenicity in animals. Therefore, the IARC has concluded that tetrachloroethene is probably carcinogenic to humans (Group 2A). (http://monographs.iarc.fr/ENG/Monographs/vol63/mono63-7.pdf).

ATSDR

ATSDR identified that exposure to tetrachloroethene can be through inhalation, ingestion, and dermal contact. They identify that the likely ingestion for the majority of the population, as present in drinking water, would range from 0.0001 to 0.002 milligrams per day. They identify the potential results of high level single exposures to tetrachloroethene as dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Nervous system effects are also identified in people with longer term exposures. Epidemiological studies have identified increased mortality from cancers of the lungs, cervix, uterus, and skin.

An acute-duration inhalation of 0.2 ppm was calculated, based on neurological studies of volunteers. This result was reported as being based on the NOAEL of 10 ppm, while uncertainty factors were not reported.

A chronic-duration inhalation MRL of 0.04 ppm was calculated based on epidemiological studies of individuals occupationally exposed. This result was based on a LOAEL of 15 ppm, while the uncertainty factor was not reported.

An acute oral MRL of 0.05 mg/kg/day was calculated, from a study on mouse pups observing development neurotoxicity. This result was reportedly derived from a LOAEL of 5 mg/kg/day, and the uncertainty factor was not reported. Intermediate- and chronic-duration oral MRLs were not derived.

No dermal exposure MRLs were provided.

NTP

The NTP found that administration of tetrachloroethene was associated with a significantly increased incidence of hepatocellular carcinoma, toxic nephropathy and respiratory disease in mice. Tetrachloroethene was consider to be a liver carcinogen in mice of both sexes.

OECD SIDS/SIAR

The OECD SIDS report identifies that tetrachloroethene is clearly carcinogenic in standard animal studies, producing liver tumours in mice and kidney tumours in rats. However, it is considered that the mechanisms underlying the appearance of these tumours indicates that they are highly unlikely to be of any significance in relation to human health. There is no convincing evidence for any increased risk of cancer in humans resulting from exposure to tetrachloroethene.

The chemical is considered to be a candidate for further work.

US EPA

The US EPA has evaluated the carcinogenicity of tetrachloroethene and reported that is likely to be carcinogenic to humans, on the basis of observations of hepatocellular adenomas or carcinomas in mice. An oral slope factor of $2.1*10^{-3}$ $(mg/kg/day)^{-1}$ and an inhalation unit risk of $2.6*10^{-7}$ $(\mu g/m^3)^{-1}$ is recommended by the US EPA.

An oral RfD of $6 * 10^{-3}$ mg/kg/day is given, based on observations of neurotoxicity in a 10 year occupational exposure study. This has been derived by the mean of LOAEC's derived for reaction time effects and colour vision effects and adjusted by an uncertainty factor of 1000. An inhalation reference concentration of $4 * 10^{-2}$ mg/m^3 has been derived from the same occupational study.

A3.4.2 Trichloroethene

Trichloroethene (TCE) has been selected as a COPC for the assessment of potential human health impacts. A brief summary of the toxicological data available for TCE has been provided following. The summary has been generated by a review of the available data held by the agencies outlined preceding, as summarised in **Table A3.2** following.

Table A3.2: Summary of Published Hazard Data for TCE

Organisation	Availability	Reference
NHMRC	YES	NHMRC/NRMMC (2011) 'Australian Drinking Water Guidelines'
NEPC	YES	NEPC (2013) 'Schedule B7: The Derivation of Interim HILs for Volatile Organic Chlorinated Compounds'
Therapeutic Goods Administration	No	Full review of safety alerts and advisory statements, no information
WHO	YES	WHO (2011) 'Guidelines for Drinking Water Quality, 4th Edition' WHO (2010) 'Guidelines for Indoor Air Quality, Selected Pollutants' WHO (2005) 'Trichloroethene in Drinking Water' WHO (2000) ' Air Quality Guidelines for Europe'
enHealth	No	
NEHF	YES	See NICNAS
S.A Health	No	
IARC	YES	IARC (1995) 'Trichloroethylene'
WHO/FAO JMPR	No	
NICNAS PEC	YES	NICNAS (2008) 'Priority Existing Chemical Reports – Trichloroethylene'
ATSDR	YES	ATSDR (1997) 'Toxicological Profile for Trichloroethylene'
NTP	YES	US Department of Health and Human Services (2000) 'Final Report on Carcinogen'
OECD SIDS SIAR	YES	OECD SIDS (1996) 'SIDS Initial Assessment Report'
US EPA	YES	IRIS database (2010) US EPA (2011) 'Toxicological Review of Trichloroethylene

NHMRC

NHMRC/NRMMC (2011) reports that trichloroethene (TCE) is readily absorbed by all routes of exposure and distributed to all tissues. It is metabolised to reactive epoxides and the trichloro derivatives of acetaldehyde, ethanol and acetic acid.

In humans, TCE is a known central nervous system depressant and has been used as a general anaesthetic. Liver damage has been reported in people occupationally exposed to high concentrations.

There is some evidence that TCE induces liver and lung tumours in various strains of mice. It is also a weakly acting mutagen in bacteria and yeast.

The NHMRC determined that there was insufficient data to set a guideline value for TCE.

NEPC

NEPC (2013) provides interim soil vapour investigation levels for TCE based on various land uses for inhalation pathways. An inhalation toxicity unit risk value of 0.004 $(mg/m^3)^{-1}$ is recommended for carcinogenic endpoints and 0.002 mg/m^3 for non-carcinogenic endpoints based on US EPA (2011).

It is recommended that a background exposure of 10% of the relevant inhalation reference concentration be adopted.

NEPC (2013) also provides guidance for investigation levels in groundwater based on NHMRC (2011).

WHO

WHO (2005) reports that trichloroethene causes neurotoxicity, hepatotoxicity, nephrotoxicity and pulmonary toxicity in laboratory animals. It is also carcinogenic in rats and mice. It is considered likely to be a human carcinogen and is classified by IARC in Group 2A.

WHO gives a recommended drinking water guideline of 20 µg/litre based on a risk assessment for cancer based on kidney tumors, and for non-cancer based upon developmental studies.

WHO also recommends a unit risk of $4.3 * 10^{-7}$ $(\mu g/m^3)^{-1}$ for inhalation exposure to trichloroethene. This is based on the occurrence of cell tumours in the testes of exposed rats.

NEHF/NICNAS

The NEHF reports that the predominant effect of acute exposure to trichloroethene in humans is CNS depression. It is a skin and eye irritant but not a skin or respiratory sensitiser. Kidney toxicity may occur with repeat exposure. In animal reproductive toxicity studies, adverse effects were only observed at maternally toxic doses, while it is weakly mutagenic in vitro.

The NEHF found that trichloroethene is absorbed via inhalational, dermal and oral routes, with the most significant uptake being through inhalation of the vapour. Absorbed trichloroethene is distributed throughout the body and is deposited mainly in adipose tissue and liver. It readily crosses the placental and blood brain barriers.

IARC

The IARC has found that there is limited evidence in humans for the carcinogenicity of trichloroethene. However, there is sufficient evidence in experimental animals. Therefore the IARC has concluded that trichloroethene is probably carcinogenic to humans (Group 2A). (http://monographs.iarc.fr/ENG/Monographs/vol63/mono63-6.pdf)

ATSDR

ATSDR provides an acute duration inhalation exposure MRL of 2 ppm. The MRL is reported to have been derived from a LOAEL value of 200 ppm for fatigue and drowsiness in humans.

An intermediate duration inhalation exposure MRL of 0.1 ppm has been reported. This is reported to have been derived from a LOAEL of 50 ppm for decreased wakefulness, decreased heart rate and slow wave sleep in rats.

No chronic inhalation exposure (365 or more days) MRL was derived for trichloroethene because insufficient studies were available.

An acute oral exposure MRL of 0.2 mg/kg/day was reported, based on a study with mice showing behavioural changes.

No intermediate or chronic oral exposure MRLs were derived for trichloroethene because of a lack of adequately designed studies examining suitable end points.

NTP

Trichloroethene is reported to be a known human carcinogen based on sufficient evidence in humans. These findings are supported by evidence of malignant tumour formation in experimental animals, and convincing relevant information that TCE acts through mechanisms indicating that it would likely cause cancer in humans. Mice were found to develop cancers of the liver, lung and blood following exposure, while rats developed cancers of the kidney and testis, with possible leukaemia.

OECD SIDS/SIAR

The SIDS assessment identified that trichloroethene is an animal carcinogen but there was no agreement as to whether this was due to a genotoxic mechanism.

US EPA

US EPA (2011) as accessed via https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=199 derived an inhalation unit risk of $4 * 10^{-6}$ $(mg/m^3)^{-1}$ based on non-Hodgkins lymphoma, renal cell carcinoma and liver tumours from a number of epidemiological studies, and adjusted to account for potential risk of tumours at multiple sites. It is noted that even with the consideration of adjustment factors, the unit risk derived is within the range of values derived in other studies. An RfC of 0.002 mg/m^3 was derived based on the route-extrapolation from oral studies for the critical effects of heart malformations in rats and immunotoxicity in mice, and incorporating uncertainty factors ranging from 10 to 100.

Summary and Use

For the purposes of the risk assessment completed:

- Inhalation values have been selected as per US EPA guidance. Though these are lower in the preferred hierarchy of use of toxicological sources they have been selected as consistent with the results of a similar review completed in NEPC (2013);
- Oral / dermal risk factors have been adopted as per WHO guidance as most preferred source of toxicity data with available values; and
- Rate of dermal absorption / oral bioavailability based on general US EPA guidance in lieu of specific guidance.

A3.4.3 cis-1,2-dichloroethene

Cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-dichloroethene has been selected as a COPC for the assessment of potential human health impacts. A brief summary of the toxicological data available for cis-1,2-DCE and trans-1,2-DCE has been provided following. The summary has been generated by a review of the available data held by the agencies outlined preceding, as summarised in **Table A3.3** following.

Table A3.3: Summary of Published Hazard Data for DCE

Organisation	Availability	Reference
NHMRC	YES	NHMRC/NRMMC (2011) 'Australian Drinking Water Guidelines'
NEPC	YES	NEPC (2013) 'Schedule B7: The Derivation of Interim HILs for Volatile Organic Chlorinated Compounds'
Therapeutic Goods Administration	No	Full review of safety alerts and advisory statements, no information
WHO	YES	WHO (2011) 'Guidelines for Drinking Water Quality, 4th Edition' WHO (2005) '1,1-Dichloroethene in Drinking Water' WHO (2003b) '1,2-Dichloroethene in Drinking Water'
enHealth	No	
NEHF	No	
IARC	No	
WHO/FAO JMPR	No	
NICNAS PEC	No	
ATSDR	YES	ATSDR (1994) 'Toxicological Profile for 1,1-Dichloroethene' ATSDR (1996) 'Toxicological Profile for 1,2-Dichloroethene'
NTP	No	
OECD SIDS SIAR	No	
EPA	YES	IRIS Database (2010), 1,1-dichloroethene US EPA (2010) 'Toxicological Review of cis-1,2-Dichloroethylene and trans-1,2-Dichloroethylene'

NHMRC

For 1,1-dichloroethene, NHMRC/NRMMC (2011) has recommended a daily intake of 9mg/kg body weight per day based on the lowest level effect from a 2 year drinking water study using rats. A safety factor of 1000 was recommended based on interspecies and intraspecies variation, and because a lowest level study was used.

For 1,2-dichloroethene, NHMRC/NRMMC (2011) has recommended a daily intake of 17 mg/kg body weight per day based on the no effect level from a 90 day drinking water study using mice. A safety factor of 1000 was recommended based on interspecies and intraspecies variation, and the below lifetime study

The NHMRC/NRMMC has determined that dichloroethenes can be readily absorbed through the lungs and the gastrointestinal tract. They are distributed primarily to the liver and kidneys, and are metabolised to chloroacetic acid, chloroacetyl chloride, dichloroacetaldehyde and reactive epoxides.

In humans, exposure to high concentrations in air can lead to central nervous system depression. The DCEs have been used as anaesthetics.

A long-term study where rats were exposed to 1,1-DCE in their drinking water for 2 years reported minimal swelling to liver cells but no other adverse effects. No changes were observed in tissues taken from dogs after 97 days of exposure. 1,1-DCE induced tumours in mice in one inhalation study, but was not carcinogenic in other studies, including one drinking water study. It has exhibited some mutagenic activity in tests with bacteria but not with cultured mammalian cells.

NEPC

NEPC (2013) provides interim soil vapour investigation levels for cis-1,2-DCE based on various land uses for inhalation pathways. An inhalation toxicity reference value of 0.007 mg/m^3 is recommended for threshold effects as reported to be based on US EPA (2011).

It is recommended that no background exposure be considered.

NEPC (2013) also provides guidance for investigation levels in groundwater based on NHMRC (2011).

WHO

WHO has found that high concentrations of dichloroethenes in air cause central nervous system depression in humans. There is some evidence for the carcinogenicity of 1,1-DCE by inhalation in mice.

The IARC groups 1,1-DCE in Group 3: not classifiable as to its carcinogenicity to humans. There is no grouping given for 1,2-DCE.

WHO (2011) derived a drinking water guideline based on a TDI of 0.017 mg/kd/day associated with a NOAEL of 17 mg/kg/day from a 90 day study in mice administered with trans-1,2-DCE in drinking water including uncertainty factors.

WHO does not provide any recommended values for exposure to dichloroethenes by inhalation.

ATSDR

For 1,1-dichloroethene, ATSDR provides an intermediate duration inhalation exposure MRL of 0.02 ppm. This MRL is based on a NOAEL of 5 ppm for hepatic effects in guinea pigs continuously exposed to 1,1-dichloroethene. MRLs were not derived for acute or chronic inhalation exposures.

An MRL of 0.009 mg/kg/day has been derived for chronic-duration oral exposure. This MRL is based on the development of hepatocellular changes observed in rats exposed to 50 ppm. An MRL has not been developed for acute or intermediate oral exposure.

For 1,2-dichloroethene, MRLs have been divided by the isomer type, trans- and cis-.

An MRL of 0.2 ppm has been derived for acute- and intermediate-duration inhalation exposure to trans- 1,2-dichloroethene. The MRL is based on a LOAEL of 200 ppm for trans-1,2-dichloroethene over an 8-hour period that caused fatty degeneration of the liver.

No chronic inhalation MRL was derived for cis-1,2-dichloroethene due to lack of data.

An MRL of 1 mg/kg/day has been derived for acute-duration oral exposure to cis- 1.2-dichloroethene. An uncertainty factor of 100 is used: 10 for extrapolation from animals to humans, and 10 for human variability. The MRL is based on a study that found hematological effects at 290 mg/kg/day and reported a NOAEL of 97 mg/kg/day.

An MRL for intermediate duration oral exposure was derived for the cis-1,2-dichloroethene isomer as 0.3 mg/kg/day based on a hematological study.

No acute-duration oral exposure MRL was derived for trans-1,2-dichloroethene. For intermediate duration exposure, the MRL is 0.2 mg/kg/day, based on hepatic effects.

US EPA

US EPA (2011) as summarised in https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=418 derived an RfD for cis-1,2-dichloroethene of 0.002 mg/kg/day based on a BMDL10 of 5.1 mg/kg/day associated with increased kidney weight in male rats and an uncertainty factor of 3000. An RfD was similarly derived for the trans-isomer of 0.02 mg/kg/day. No inhalation RfCs were derived.

For 1,1-dichloroethene, an RfD for chronic oral exposure of $5*10^{-2}$ mg/kg/day was derived based upon fatty changes to the liver. This included an uncertainty factor of 100 and a modifying factor of 1. An RfC for chronic inhalation was given as $2*10^{-1}$ mg/mg^3, based upon fatty changes to the liver. This included an uncertainty factor of 30 and a modifying factor of 1. For lifetime exposure, 1,1-DCE is assigned to Group C, possible human carcinogen.

No IRIS statement was available for 1,2-dichloroethene.

Summary and Use

For the purposes of the risk assessment completed:

- Common toxicity values have been used to characterise cis-1,2-DCE and trans-1,2-DCE. The constituents have been assessed as simply 1,2-DCE;
- Inhalation values have been selected as per US EPA guidance. Though these are lower in the preferred hierarchy of use of toxicological sources they have been selected as consistent with the results of a similar review completed in NEPC (2013);
- Oral / dermal risk factors have been adopted as per NHMRC guidance as most preferred source of toxicity data; and
- Rate of dermal absorption / oral bioavailability based on general US EPA guidance in lieu of specific guidance.

A3.4.4 Vinyl Chloride

Vinyl Chloride (VC) has been selected as a COPC for the assessment of potential human health impacts. A brief summary of the toxicological data available for VC has been provided following. The summary has been generated by a review of the available data held by the agencies outlined preceding, as summarised in **Table A3.4** following.

Table A3.4: Summary of Published Hazard Data for VC

Organisation	Availability	Reference
NHMRC	YES	NHMRC/NRMMC (2011) 'Australian Drinking Water Guidelines'
NEPC	YES	NEPC (2013) 'Schedule B7: The Derivation of Interim HILs for Volatile Organic Chlorinated Compounds'
Therapeutic Goods Administration	No	Full review of safety alerts and advisory statements, no information
WHO	YES	WHO (2011) 'Guidelines for Drinking Water Quality, 4th Edition' WHO (2004b) 'Vinyl-chloride in Drinking Water' WHO (2000) ' Air Quality Guidelines for Europe'
enHealth	No	
NEHF	YES	See NICNAS
S.A Health	YES	IARC (2008) 'Vinyl Chloride'
IARC	No	
WHO/FAO JMPR	No	
NICNAS PEC	YES	NICNAS (2003) 'Existing Chemicals Information Sheet – Ethene, chloro-'
ATSDR	YES	ATSDR (2006) 'Toxicological Profile for Vinyl Chloride'
NTP	YES	US Department of Health and Human Services (2009) 'Substance Profiles: Vinyl Chloride'
OECD SIDS SIAR	YES	OECD SIDS (2001), 'SIDS Initial Assessment Profile'

Organisation	Availability	Reference
US EPA	YES	US EPA (2000) 'Toxicological Review of Vinyl Chloride In Support of Summary Information on the Integrated Risk Information System (IRIS)'

NHMRC

The NHMRC/NRMMC has recommended a daily maximum intake of 0.13 mg/kg body weight per day based on the no adverse effect level from a lifetime study using rats. A safety factor of 1000 was used, for intraspecies and interspecies diversity, and because of evidence of carcinogenicity.

VC is readily absorbed following ingestion. It is metabolised to chloroethylene oxide, which can rearrange spontaneously to chloroacetaldehyde. Both substances are highly reactive and mutagenic. In humans, VC is a narcotic agent, and occupational exposure to high doses causes a number of symptoms including Raynaud's phenomenon, a painful disorder of the hands. It is also a well-documented human carcinogen, with inhalation of high concentrations causing tumours in the liver, particularly angiosarcoma. Tumours in the brain and lung and malignancies of the lymphatic and haematopoietic tissues have also been reported.

VC has exhibited mutagenic activity in a variety of tests on bacteria and mammalian cells.

NEPC

NEPC (2013) provides interim soil vapour investigation levels for VC based on various land uses for inhalation pathways. An inhalation toxicity reference value of 0.0088 $(mg/m^3)^{-1}$ is recommended for non-threshold effects and 0.0044 mg/m^3 for threshold effects as based on US EPA (2010).

It is recommended that a no background exposure be adopted.

NEPC (2013) also provides guidance for investigation levels in groundwater based on NHMRC (2011).

WHO

WHO identifies VC as a carcinogen in both humans and animals. In animals, it induced angiosarcomas of the liver in rats, mice and hamsters, Zymbal gland tumours in rats and hamsters, nephroblastomas in rats, pulmonary and mammary gland tumours in mice and forestomach papillomas in hamsters when administered by inhalation. Further carcinogenicity was reported when administered orally or in drinking water.

WHO also reports that VC is mutagenic and clastogenic in humans. There is strong and consistent evidence from epidemiological studies that VC exposure causes the rare tumour angiosarcoma of the liver. Brain tumours and hepatocellular carcinoma may also be associated with VC. Other cancer sites reported to be in excess, but less consistently, include lung, lymphatic and haematopoietic tissue and skin.

IARC (1979, 1987) has classified VC in Group 1, a known human carcinogen. It is recommended that exposure to the chemical should be avoided as far as is possible, and sets a drinking water guideline of 0.5 µg/litre.

WHO provide a unit risk for inhalation exposure to VC of $1*10^{-6}$ $\mu g/m^3$ based on carcinoma in occupationally exposed workers and liver cancer in occupationally exposed workers. WHO also provide oral slope factors of 0.7 and 1.15 $(mg/kg/day)^{-1}$ for exposures in adulthood and exposures from birth respectively as based on the liver tumours observed from an oral exposure study of rats and assuming a doubling of the risk of exposure from birth.

NEHF/NICNAS

NICNAS reports that VC appears to be of low acute toxicity in various species when administered orally or by inhalation. Liver toxicity is observed with repeated exposures, and it induces liver cancer in animals.

For humans, the primary route of uptake is inhalation. It is reported that chromosomal aberrations have been observed in peripheral lymphocytes of exposed workers in some studies. Liver cancer (angiosarcoma) is reported repeatedly in occupational studies of VC exposure.

IARC

The IARC finds that there is sufficient evidence in humans for the carcinogenicity of VC. VC is found to cause angiosarcomas of the liver and hepatocellular carcinomas. It is classified as Group 1, carcinogenic to humans.

ATSDR

An MRL of 0.5 ppm has been derived for acute duration inhalation exposure, based upon narcosis and severe lung, liver and kidney damage in animals. A NOAEL of 15 ppm was used, with an uncertainty factor of 30; 3 for interspecies variability and 10 for interhuman variability. An MRL of 0.03 ppm was derived for intermediate duration exposure, based on studies in male rats showing decreased fertility, decreased weight and epithelial necrosis.

An MRL of 0.003 mg/kg/day has been derived for chronic oral exposure, based on animal studies showing hepatic necrosis, early mortality, and liver cell polymorphisms. The MRL was based on a NOAEL of 0.17 mg/kg/day, with an uncertainty factor of 30; 3 for interspecies variability and 10 for interhuman variability. No acute or intermediate MRLs were developed based on a lack of appropriate data.

NTP

The NTP states that VC is a known human carcinogen based on sufficient evidence of carcinogenicity in humans. The strongest evidence for VC causing cancer in humans is based on epidemiological studies and case reports showing an association with angiosarcoma of the liver, and possibly cancers of the brain, lung, lymphatic system, and hematopoietic system.

OECD SIDS

The SIDS report finds that VC is a known human carcinogen. The primary route of exposure is inhalation, and is well absorbed. Chronic exposure will cause damage to the liver, and possibly cancers of the lymphopoietic system, connective and soft tissues, although studies vary.

It is currently of low priority in the SIDS system as it is considered to be well controlled.

US EPA

US EPA (200) as accessed via https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=1001, gives slope factors of 1.5 mg/kg/day^{-1} (for exposures over a lifetime) and 0.75 mg/kg/day^{-1} (for exposures as an adult only) as derived on the basis of hepatocellular carcinomas, angiosarcomas and neoplastic nodules in female rats as markers for carcinogenic response. Based on animal evidence an age-dependant sensitivity uncertainty factor of 2 has been adopted to account for early life sensitivity. Inhalation unit risks of $8.8*10^{-6}$ $(mg/m^3)^{-1}$ (for exposures over a lifetime) and $(4.4*10^{-6}$ $mg/m^3)^{-1}$ (for exposures as an adult only) have been derived on the basis of liver angiosarcomas, angiomas, hepatomas and neoplastic nodules in an inhalation study on female rats and mice and an extrapolated model.

The US EPA gives an RFD for chronic oral exposure as $3*10^{-3}$ mg/kg/day, with an uncertainty factor of 30 and a modifying factor of 1. This is based on a NOAEL of 0.09 mg/kg/day.

An RfC is given for chronic inhalation exposure as $1*10^{-1}$ mg/m^3. This includes an uncertainty factor of 30 and a modifying factor of 1.

On the weight of evidence, it is considered category "A", a known human carcinogen, based on human epidemiological data.

Summary and Use

For the purposes of the risk assessment completed:

- Inhalation values have been selected as per US EPA guidance. Though these are lower in the preferred hierarchy of use of toxicological sources they have been selected as consistent with the results of a similar review completed in NEPC (2013);
- Oral / dermal risk factors have been adopted as per US EPA guidance as these are relatively similar to the WHO nominated values for non-threshold effects. The US EPA / ATSDR guidance has been adopted for threshold effects of vinyl chloride. Though the NHMRC/NRMMC (2011) criterion cited an acceptable dose, this is based on non-threshold effects; and
- Rate of dermal absorption / oral bioavailability based on general US EPA guidance in lieu of specific guidance.
- specific guidance.

A3.4.5 Trihalomethanes

Trihalomethanes including chloroform and bromodichloromethane have been selected as COPC's for the assessment of potential human health impacts. A brief summary of the toxicological data available for trihalomethanes has been provided following. The summary has been generated by a review of the available data held by the agencies outlined preceding, as summarised in **Table A3.5** following.

Table A3.5: Summary of Published Hazard Data for Trihalomethanes Chloroform and Bromodichloromethane

Organisation	Availability	Reference
NHMRC	YES	NHMRC/NRMMC (2011) 'Australian Drinking Water Guidelines'
NEPC	No	
Therapeutic Goods Administration	No	
WHO	YES	World Health Organisation (2002) 'Concise International Chemical Assessment Document 58 'Chloroform'. WHO (2005) 'Summary Statement Trihalomethanes (bromoform, bromodichloromethane, dibromochloromethane, chloroform)
enHealth	No	
NEHF	No	
S.A Health	No	
IARC	YES	IARC Monographs
WHO/FAO JMPR	No	
NICNAS PEC	No	
ATSDR	YES	ATSDR (September 1997) 'Toxicological Profile for Chloroform' ATSDR (March 2020) 'Toxicological Profile for Bromodichloromethane'
NTP	No	
OECD SIDS SIAR	No	
US EPA	YES	US EPA (1987, 1993 and 2001) IRIS Database

NHMRC

Chloroform and bromodichloromethane are assessed with trihalomethanes in NHMRC (2011). It has been found that trihalomethanes are central nervous system depressants, liver and kidney toxicants. Long-term carcinogenicity bioassays with animals have shown that trihalomethanes can produce tumours in rats and mice, but only at doses that are toxic to the animals. Chloroform increased the incidence of liver tumours in mice when administered in food at doses from 25 mg/kg body weight per day, but not in drinking water at the same doses, and has induced kidney tumours in male rats at doses from 263 mg/kg body weight per day.

NHMRC (2011) provides a no Effect Level of 7 mg/kg body weight per day for trihalomethanes. It is recommended that this is used with a safety factor of 100 (10 for interspecies variations and 10 for intraspecies variations).

WHO

WHO (2002) reports that chloroform toxicity data in humans are extremely limited but suggest that chloroform elicits the same symptoms of toxicity in humans as in laboratory animals. Liver and kidney toxicity have been reported.

Acute oral toxicity in rats is moderate. Single gavage administration to rats and mice resulted in central nervous system depression and nasal lesions in rats and liver damage in both species. Short-term oral exposure caused nasal lesions in rats and tissue changes in the liver and kidneys of mice. Exposure by inhalation for up to 7 days resulted in a proliferative response in the nasal tissues of rats and mice.

When chloroform was administered to mice by gavage or in the drinking-water for 90 days, liver effects (increases in weight and microsomal enzyme activity, lipid accumulation and vacuolation) were observed.

In chronic toxicity/carcinogenicity studies, chloroform induced liver tumours in mice (both sexes) when given by gavage in a corn oil vehicle.

A tolerable concentration for inhalation exposure of 0.14 mg/m^3 has been recommended by WHO (2000) based on a study in which fatty cysts developed in the liver of dogs. Toxicological values are not provided for oral and dermal exposures.

A tolerable daily intake of 15 µg/kg of body weight is recommended by WHO (2005), derived from the lower 95% confidence limit for the 5% incidence of hepatic cysts, generated by PBPK modelling, in beagle dogs that ingested chloroform in toothpaste for 7.5 years, using an uncertainty factor of 25 (10 for intraspecies differences and toxicodynamics and 2.5 for differences in interspecies toxicodynamics).

IARC

The International Agency for Research on Cancer has concluded that chloroform is possibly carcinogenic to humans (Group 2B, inadequate evidence in humans but sufficient evidence in animals).

IARC reports that there is no epidemiological data relevant to the carcinogenicity of bromodichloromethane were available. There is sufficient evidence in experimental animals for the carcinogenicity of bromodichloromethane. Bromodichloromethane is possibly carcinogenic to humans (Group 2B).

ATSDR

An MRL of 0.1 ppm has been derived for acute-duration inhalation exposure to chloroform. The MRL is reported to be based on a NOAEL of 3 ppm for hepatic effects in mice.

An MRL of 0.05 ppm has been derived for intermediate-duration inhalation exposure to chloroform. The MRL is based on a LOAEL of 14 ppm for toxic hepatitis in workers exposed to up to 400 ppm for less than 6 months.

An MRL of 0.02 ppm has been derived for chronic-duration inhalation exposure to chloroform. The MRL was based on a LOAEL of 2 ppm for hepatic effects in workers exposed to concentrations of chloroform ranging from 2 to 205 ppm for l-4 years.

An MRL of 0.3 mg/kg/day has been derived for acute-duration oral exposure to chloroform. The MRL is based on a NOAEL of 26.4 mg/kg/day for hepatic effects in mice.

An MRL of 0.1 mg/kg/day has been derived for intermediate-duration oral exposure to chloroform. The MRL is based on a NOAEL of 15 mg/kg/day for liver effects (increased SGPT) in dogs exposed to chloroform in toothpaste for ≥6 weeks.

An MRL of 0.01 mg/kg/day has been derived for chronic-duration oral exposure to chloroform based on a LOAEL for liver effects (increased SGPT) in dogs administered 15 mg/kg/day chloroform in toothpaste in capsules for 7.5 years.

The chronic-duration oral reference dose (RfD) for chloroform is also 0.01 mg/kg/day, based on the LOAEL for liver effects in dogs administered 15 mg/kg/day chloroform.

An acute duration MRL of 0.07 mg/kg/day is provided by ATSDR (2020) for bromodichloromethane on the basis of full-litter resorption in rats. This incorporates an uncertainty factor of 100.

A chronic duration MRL of 0.008 mg/kg/day is provided by ATSDR (2020) for bromodichloromethane on the basis of hepatocellular fatty degeneration in rats, and incorporates an uncertainty factor of 100.

US EPA

An oral RfD of 0.01 mg/kg/day is provided by US EPA for chloroform on the basis of moderate / marked fatty cyst formation in the lever and serum glutamate-pyruvate transaminase (SGPT) in beagle dogs. Groups of eight male and eight female beagle dogs to doses of 15 or 30 mg chloroform/kg/day given orally in a toothpaste base in gelatin capsules. A LOAEL of 15 mg/kg/day was identified in the study, based on elevated SGPT levels and increased incidence and severity of fatty cysts.

An inhalation unit risk of $2.3*10^{-5}$ $(\mu g/m^3)^{-1}$ is provided by US EPA for chloroform. This is based on the occurrence of hepatocellular carcinoma in female mice exposed by gavage. At high doses, chloroform has been reported to be carcinogenic in several chronic animal bioassays, with significant increases in the incidence of liver tumours in male and female mice and significant increases in the incidence of kidney tumours in male rats and mice.

There are some equivocal epidemiological data relating a weak association of human drinking water exposures to bladder, rectal and colon cancer. Chloroform is classified as a Class B2, probably human carcinogen based on sufficient evidence of carcinogenicity in animals.

US EPA (1987) provided a reference dose of 0.02 mg/kg/day for bromodichloromethane on the basis of renal cytomegaly as based on a LOAEL 17.9 mg/kg/day and an uncertainty factor of 1000.

US EPA (1993) characterises bromodichloromethane as a probable human carcinogen. US EPA provides an oral slope factor of 0.062 $(mg/kg/day)^{-1}$ as based on urinary tract tumours / kidney tumours (tubular cell adenoma and tubular cell adenocarcinoma).

Summary and Use

For the purposes of the risk assessment completed:

- Trihalomethanes have been summed and assessed as a single constituent;
- The NHMRC guidance has been adopted of a tolerable daily intake (TDI) of 0.07 mg/kg/day;
- A reference concentration of 0.25 mg/m^3 has been derived from the TDI and adopted for the assessment of inhalation exposures; and
- Assessment has been undertaken for potential threshold effects only as consistent with the approach adopted by NHMRC.

Attachment 4 – Fate and Transport Modelling and Risk Calculations

Fate and transport modelling has been undertaken for each of the basements as proposed to be constructed on the site. Potential vapour ingress to each basement has been assumed to occur by two processes inclusive of:

- Diffusive / advective movement of soil vapour as present within the unsaturated soil profile overlying the depth of groundwater into the basement. Vapour has been measured as soil vapour, or can otherwise be estimated as volatilising from groundwater; and
- Volatilisation of constituents from COPCs as present in basement wet walls / pooled seepage water.

The approach to assess each, and the parameters adopted to characterise basements, lift shafts and overlying buildings, are detailed following.

Fate and transport modelling has also been required to estimate potential vapour intrusion to a deep excavation. Potential vapour ingress to the excavation has been assumed to occur by two processes inclusive of:

- Diffusive / advective movement of soil vapour as present within the unsaturated soil profile overlying the depth of groundwater into the excavation (again vapour has been assessed as soil vapour and as levels of vapours estimated overlying groundwater); and
- Volatilisation of constituents from COPCs as present in pooled seepage water at the base of the excavation.

Building Parameters for Basements

Table A4-1 following summarises the physical characterisation of the basement for the purposes of the assessments completed. Where noted, building parameters have been determined from the plans provided as **Attachment 2**.

Table A4-1: Summary of Adopted Building Parameters for Basement

Parameter	Northern Basement	
	Adopted Value	Reference
Building volume	11 760 m^3	Floor area of 1960 m^2 Two storey basement assumed internal height of 6 m
Building cross sectional area	1960 m^2	Extent of floor area as per development plans
Saturated wall height	2.5 m	Minimum depth to groundwater of 3.5 m bgs
Dry wall height	3.5 m	Applies substantially to upper depth basement level. On assumption of shallowest depth to groundwater of 3.5 m bgs.
Portion of basement adjoining contamination	0.5	Factor account for absence of significant levels of chlorinated ethene impact adjoining / underlying western portion of basement.
Foundation thickness	0.15 m	CRC CARE (2011)
Ventilation / air exchanges (building)	0.17 h^{-1}	Based on assumption of four volume changes per day, well below CRC CARE (2011) default values. Consistent with advice received on similar developments.
Fraction of foundation present as cracks	0.001	CRC CARE (2011), basement constructed with no controls.
Porosity in foundation cracks	0.38	CRC CARE (2011) , basement constructed with no controls.
Water content in foundation cracks	0.12	CRC CARE (2011) , basement constructed with no controls.

Lifts and Stair Wells

Elevator shafts and associated stair wells are proposed to be constructed from basement levels into the overlying commercial building and residential apartments. Lift shafts are anticipated underlying each of the buildings constructed within the site. Lift shafts and stairwells present a unique vapour transport environment when compared with the balance of the building floors and basements. These are a potential preferential pathway of vapour migration within buildings. Each of the unique factors are discussed following.

Pressure Differentials

Movement of lifts within the lift shafts interferes with internal atmospheric conditions; this effect is known as the 'piston effect'. During standard operations of lift cars, the piston effect incurs intermittent pressure differentials above and below the lift cars; temporarily increasing gaseous pressure in the direction of travel, and reducing it in the opposite direction. Readily available technical guidance and academic literature is limited pertaining to the characterisation of pressure differentials incurred by the piston effect, though review of *Elevator Piston Effect and the Smoke Problem*. John H. Klote and George Tamura, Fire Safety Journal, 11(1986), PP. 227-233 (Klote and Tamura 1986) and AS/NZS 1668.1:1998 provided the following relevant details.

Klote and Tamura (1986) experimentally measured differential pressure resulting from vertical movement of both cars in a two car shaft of 19 Pa at a velocity of 1.68 m/s and 53 Pa at a velocity of 2.52 m/s. The reported pressure differential rapidly crescendos (2-3 seconds following commencement of the car movement) and decreases down to baseline levels less than 20 seconds from the peak. The maximum pressure differential as estimated in Klote and Tamura (1986) is consistent with guidance provided to *AS/NZS 1668.1:1998 The use of ventilation and air-conditioning in buildings Part 1: Fire and smoke control in multicompartment buildings*. AS/NZS 1668.1:1998 requires that a pressurisation system that is provided to a lift shaft to prevent smoke infiltration during a fire event requires to be sufficient to develop a pressure differential of between 20 and 50 Pa between the lift shaft and the occupied space of the building. The range of 20 and 50 Pa is consistent with the range of maximum pressure differentials as measured by Klote and Tamura (1986), with the higher pressure differential being measured in a lift shaft with a lift car speed of 2.52 m/s. The referenced pressure differentials are based on a worst-case scenario, whereby all lift cars within a shaft are vertically ascending at the same time.

In typical operation, lift cars will travel down as often as they travel up, resulting in a positive overburden pressure (i.e. reduced vapour emissions) as often as there is an reduced one. Additionally, lift shafts complying with AS/NZS 1668.1:1998 will be over pressurised, to minimise smoke transport during a fire. This is considered likely to reduce temporarily decreased overburden pressure to negligible levels.

Advective and liquid surface emission vapour kinetics are dependent on pressure of the receiving gaseous environment, and therefore potential influences of pressure require specific consideration. Though, for the reasons mentioned above, are considered unlikely to result in significantly increased vapour intrusion.

Shaft Characteristics

Detailed lift design documentation is not available in the development plans available for the site. However the following characteristics are anticipated based on typical commercial industrial and residential building design characteristics. Lift wells are likely to be advanced slightly below the surrounding basement floor, increasing penetration into the underlying groundwater. There is elevated potential, given the limited areal footprint of the lift wells, for seepage water to accumulate and pool within at the base of the shaft.

Lift shafts are anticipated to extend from lowest level to ground surface and extending throughout the height of the buildings. Extended vertical spaces present a greater mixing volume per wall/base area in contact with contaminated media than is present within other building/basement areas.

Lift shaft locations have been specified in the development plans provided as **Attachment 2**. Review of these plans indicates that the extent of lift shafts will be less than 1.5% of the floor space of the respective basements / overlying buildings.

Parameters to characterise a typical lift shaft to the northern and southern basement / building are summarised in **Tables A4-2** following respectively for each of the buildings.

Table A4-2: Summary of Adopted Lift Shaft Parameters for Basement

Parameter	Typical Lift Shaft	
	Adopted Value	Reference
Building volume	150 m^3	Based on cross sectional area of 5 m^2 and a minimum lift shaft height of 30 m.
Shaft cross sectional area	5 m^2	Estimated based on one car lift car shaft as shown in **Attachment 2**. Considered appropriate in lieu of current design plans.
Saturated wall height	3 m	Based on depth to groundwater of 3.5 m and lift sump which is below basement.
Number of basement walls in contact with retained site media	None	Lift sumps only will be in contact with water, lifts are shown within the footprint of the basement
Wet wall area	40 m^2	Lift sump in contact with groundwater on all four sides. 2 m depth.
Ventilation / air exchanges (building)	0.83 h^{-1}	Consistent with CRC CARE (2011) default value for commercial buildings in lieu of specific published guidance
Fraction of foundation present as cracks	0.001	CRCCARE (2011)
Advective pressure differential	50 Pa	Klote and Tamura (1986) – values for two car lift shaft adopted to be conservative.

Shaft to Building Dilution

The vapours within the lift shaft will potentially mix with the adjoining / surrounding building into which the lift shaft is constructed. Although lift shafts / lift cars are likely to be ventilated independently of the buildings (i.e. naturally ventilated), it has been assumed that perfect mixing will occur between the lift shaft and the adjoining building / surrounding floor space. The resulting air concentration is calculated by adopting a factor of 1.5% as based on the maximum extent of the area of the lift shafts to the area of the overall building / basement

It required to be ensured that lift cars do not increase levels of vapours within overlying buildings that potentially exceed vapour levels as estimated within buildings otherwise.

Vapour Fate and Transport Modelling from Underlying and Adjoining Soil / Groundwater Source

The RISC V.5.03 modelling package has been used for risk modelling undertaken to assess human health effects. RISC uses risk equations based on those provided in US EPA Risk Assessment guidance (RAGS Guidelines). These are noted in NEPC (2013) as being appropriate for use in human health risk assessment. Chemical parameters provided to the RISC model have been updated to comply with NEPC (2013) or site specific data where available (i.e. use of sub-slab to building attenuation rations to characterise advective movement of vapours into the basement). Updated parameters are detailed throughout this risk assessment document. Other parameters as provided within the RISC package (i.e. physical properties of modelled constituents) have not been altered in use of RISC.

The RISC model uses Johnson & Ettinger relationships in estimating transport of volatile constituents into human breathing zones. CRCCARE (2011) reports that the use of Johnson & Ettinger relationships is appropriate in undertaking human health risk assessments. The amendments to the RISC model described above ensure that RISC is behaving as closely as possible to the most recent guidance for the use of the Johnson & Ettinger relationships.

Basement

RISC has been used to estimate potential vapour levels within potential future basements / buildings including an assessment as specific to lift shafts / lift cars. It has been assumed that mixing occurs throughout the basement levels – as consistent with the assessment of potential chronic effects of exposures to the contaminants. Model outputs are provided attached. Key parameters as adopted in the model have included:

- Assumption of vapour source present 0.1 m away from basement, with separate calculations as undertaken for a soil vapour source and a groundwater based source (with estimation of vapours overlying groundwater);
- For each of the basement scenarios, enclosed space floor length as set equal to the basement perimeter (180 m), enclosed space floor length set equal to the height of wall above the depth of groundwater (2.5 m) and the enclosed space height set equal to 6 m. Vapours enter the basement through unsaturated horizons only;
- Characterisation of soils between basement and groundwater source using parameters for sand as provided to CRCCARE (2013). This is consistent with potential vapour migration through interstitial materials to sandstone which will consist of sandy soils; and
- Characterisation of advective movement between soils and the basement using a $Q_{soil}/Q_{building}$ attenuation factor of 0.001 as per CRCCARE (2011) and recommended for large buildings.

Soils Properties

Geological parameters provided to CRCCARE (2011) for sands have been adopted to characterise the soils for the purposes of fate and transport modelling as summarised following:

- Air filled porosity – 0.257; and
- Water filled porosity – 0.13.

The following parameters have been adopted for the characterisation of a capillary fringe overlying groundwater as adopted in the assessment of groundwater based constituents:

- Water filled porosity in capillary fringe – 0.348;
- Air filled porosity in capillary fringe – 0.039; and
- Height of capillary fringe – 20 cm (though restricted to 10 cm as consistent with minimum vapour transport distance).

Seepage Water Infiltration to Basement / COPC Volatilisation Calculations

The following equations have been used to predict the airborne concentration of each constituent within the basements as consequent of infiltrating seepage water / volatilisation from pooled seepage / wet walls. The equations are based on those provided for quiescent surfaces with flow in *Air Emissions Models for Waste and Wastewater,* U.S. Environmental Protection Agency, November 1994 (USEPA 1994) and are considered appropriately conservative to assess the processes within the northern basement.

A site specific relationship has been derived for the purposes of estimating the potential airborne levels of vapours on the basis of US EPA (1994) model predicted vapour emission rates. The concentration of the constituent as specific to each assessed basement is:

$$AC_b = \frac{\sum_{a,b1,b2} E_i}{V * ER}$$

Where: AC_b – air concentration of constituent in basement floor 'i'

E_i – air emission rate for a specific wall section being assessed (g/sec)

V – volume of basement (m^3)

ER – air exchange rate (/s)

Undertaking this calculation, it is assumed that perfect mixing occurs within the extent of the basement assessed. This is considered appropriate as constituents are being assessed on chronic timescales.

The mass transfer of the volatilised constituent from the open liquid surface is defined by:

$$E = K * A * C_l$$

Where: E = Air emissions from the liquid surface (g/sec)

K = Overall mass transfer coefficient (m/sec)

A = Liquid surface area (m^2)

Cl = Concentration of constituent in the liquid phase (g/m^3)

The overall mass transfer coefficient (K) is calculated as:

$$\frac{1}{K} = \frac{1}{K_l} + \frac{1}{K_g * K_{eq}}$$

Where: K_l = Liquid phase transfer coefficient (m/sec)

K_g = Gas phase transfer coefficient (m/sec)

K_{eq} = Equilibrium constant concentration in gas phase / concentration in liquid phase

The equilibrium constant (K_{eq}) is calculated as:

$$K_{eq} = \frac{H}{R * T}$$

Where: H = Henrys Law Constant (atm.m^3/g.mol)

R = Universal Gas Constant (8.21*10^{-5} atm.m^3/g.mol.K)

T = Temperature, assumed to be 20°C/293K.

To convert unitless Henry's Law values into values as per the nominated units

$$Henrys\ Law \left(\frac{atm.m^3}{g.mol}\right) = \left(\frac{T}{12186}\right) * HL\ (unitless)$$

Where: 12186 is a conversion factor to adjust untiless Henry's Law to (atm.m^3/g.mol);

T – Temperature of water (degrees Kelvin), assumed to be 20°C / 293 K;

H_L – unitless Henry's Law constant

The liquid phase mass transfer coefficient (K_l), assuming the windspeed in the basement will be less than 3.5m/sec, is calculated as:

$$K_l = 2.78 * 10^{-6} * (\frac{D_w}{D_{ether}})^{\frac{2}{3}}$$

Where: D_w = Diffusivity in Water (cm^2/sec)

D_{ether} = Diffusivity of Ether in Water (8.5*10^{-6} cm^2/sec)

The gas phase mass transfer coefficient (K_g) is calculated as:

$$K_g = 4.82 * 10^{-3} * U^{0.78} * S_{cg}^{-0.67} * D_e^{-0.11}$$

Where: U = Windspeed (m/sec)

S_{cg} = Schmidt Number

D_e = Effective Diameter

The Schmidt Number (S_{cg}) is calculated as:

$$S_{cg} = \frac{\mu G}{\rho G * D_a}$$

Where: μG = Viscosity of Air (1.86*10^{-4} g/cm.sec)

ρG = Density of Air (1.29*10^{-3} g/cm^3)

D_a = Diffusivity in Air (cm^2/sec)

The Effective Diameter of the wetted area (D_e) is calculated as:

$$D_e = \left|\frac{4 * A}{\pi}\right|^{0.5}$$

Where: A = Wetted Area (m^2)

π = Pi Constant (3.14592)

The bulk concentration of each constituent the liquid phase (C_l) is calculated as:

$$C_l = \frac{Q * C_i}{(K * A) + Q}$$

Where: Q = Volumetric Flow Rate (m^3/sec)

C_i = Concentration in Water (g/m^3)

C_l = Equilibrium of Bulk Concentration (g/m^3)

The volumetric flow rate (Q) for water entering the wetted surface can be calculated using Darcy's Law:

$$Q = k * i * A_w$$

Where: k = Hydraulic Conductive of Soil Profile (m/sec)

I = Hydraulic Gradient

A_w = Area of Wetted Surface (m^2)

However, little information is available for hydraulic conductivity of the saturated soil types adjoining the basement and future hydraulic gradients, particularly noting the potential effects of the placemen t of a basement within saturated horizons is unknown.

Instead, an alternate approach has been used to estimate water inflow for the basements. The basement seepage rate has been estimated based on calculation of seepage through the walls and the foundation slab / basement walls as follows:

$$Q\left(\frac{m^3}{day}\right) = \frac{K_{Concrete}(A_{Walls} * H_{Walls} + A_{Base} * H_{Base})}{T_{Concrete}};$$

Where: $K_{Concrete}$ = Permeability Conductivity of Concrete ($8.64 * 10^{-7}$) (m/day)

A_{Walls} = Area of seepage through walls (m^2)

A_{Base} = Area of seepage through base (m^2)

H_{Walls} = Average Hydraulic Pressure head perpendicular to wall face (m)

A_{Base} = Average Hydraulic Pressure head perpendicular to base (m)

$T_{Concrete}$ = Thickness of the concrete (0.3 m assumed)

The estimate of the permeability of water through concrete has been derived from a value of 10^{-11} as provided with the range of values nominated in *Permeability of Concrete from Proceedings of the Cement and Concrete Association of Australia Seminar on Waterproofing Concrete*, 9 November 1993, CSIRO Division of Building, Construction and Engineering (CSIRO 1993).

The calculation has been undertaken and parameters used are summarised in **Table A4-3** following.

Table A4-3: Estimation of Potential Seepage Water Flow into Basements

Basement Parameter	Basement
A_{walls}	450
A_{base}	1960
H_{walls}	1.25
H_{base}	2.5
Flow	5 L/day

Each of the parameters adopted in the model to estimate the potential vapour level in the basement from seepage water / wet walls are summarised in **Table A4-4** following, and can be observed in calculation spreadsheets attached.

Table A4-4: Summary of Parameters Adopted to Estimate Airborne Levels of Constituents in Basement and Lift Shafts

Parameter	Value	Reference / Source
A, Potential liquid surface area for basement	2400 m^2	Development plans, Attachment 2. Based on 1960 m^2 floor area, 180 m perimeter and 2.5 m saturated wall height
A, Potential liquid surface area for lift shaft	20 m^2	Single car lift shaft, amount of sump immersed below basement
H, Henrys Law Constant	As per **Table A5-5**, converted to atm.m^3/g.mol	RAIS
R, universal gas constant	8.21*10^{-5} atm.m^3/g.mol.K	US EPA 1994
T, temperature	293 K	Assume, 20°C basement temperature
D_w, diffusivity of constituent in water	As per **Table A5-5**, cm^2/s	RAIS
D_{ether}, diffusivity of ether in water	8.5*10^{-6} cm^2/s	US EPA 1994
U, windspeed basement	Calculated from basement length (55 m), ventilation of four volume changes per day. 1.0 * 10^{-2} m/s.	**Attachment 2**, client advice, similar developments, estimate across extent of basement typical wind travel distance.
U, windspeed lift shaft	floor area (5 m^2) and ventilation of 0.87 volume changes per hour. 3.0 * 10^{-4} m/s.	Based on CRC CARE 2011 volume exchange rate and assumed lift characteristics. Calculated from lift floor area
µG, viscosity of air	1.86*10^{-4} g/cm.s	US EPA 1994
ρG, density of air	1.29*10^{-3} g/cm^3	US EPA 1994
D_a, diffusivity of constituent in air	As per **Table A5-5**, cm^2/s	RAIS
A, wetted area of basement (for estimating effective diameter of wetted area)	120 m^2	5% of potential extent of wetted area consistent with CRCCARE (2013). 2400 m^2 * 0.05 = 135 m^2
A, wetted area of lift shaft (for estimating effective diameter of wetted area)	6 m^2	Whole lift sump floor area and 5% of wall area as per CRCCARE (2013)
Q, volumetric flow rate	0.005 m^3/day – basement 7.5*10^{-5} m^3/day – lift shaft	Calculated. Lift shaft values set as 1.5% of overall values, conservative noting that a single lift shaft is 0.4% of the basement area.
C_i, concentration in water	As per **Table 2**	Maximum level of groundwater constituents in groundwater proximal to the basement
V, volume of basement	11 760 m^3	Calculated in **Table A5-1**
V, volume of lift shaft	150 m^3	Calculated in **Table A5-2**
ER, building exchange rate	4 per day – basement 0.87/h – Lift car / lift shaft	Advice and CRCCARE (2011)

Physical properties of the COPCs as adopted for fate and transport modelling are summarised in **Table A4-5**. Values have been taken from the US Department of Energy RAIS Database.

Table A4-5: Summary of Physical Properties of COPCs

Constituent	Henrys Law Constant (unitless)	Diffusivity in Air, D_a (cm^2/s)	Diffusivity in Water, D_w (cm^2/s)	Skin Permeability Constant, K_p (cm/h)
PCE	0.724	0.0505	$9.46*10^{-6}$	0.0334
TCE	0.403	0.0687	$1.02*10^{-5}$	0.0116
Cis-1,2-DCE	0.167	0.0884	$1.13*10^{-5}$	0.011
VC	1.14	0.107	$1.02*10^{-5}$	0.00838
Chloroform[1]	0.15	0.0769	$1.09*10^{-5}$	0.00683

Note: 1. Trihalomethanes assessed as chloroform

Modelling Results

The estimated vapour levels in the basement as estimated on the basis of potential volatilisation of infiltrating seepage water and by vapour intrusion from overlying impact groundwater horizons and unsaturated zone measurements of soil vapour are summarised in **Table A4-6** following. Model outputs are provided following.

Table A4-6: Summary of Estimated Levels of COPCs in Basement from Groundwater Source (mg/m^3)

Constituent	Groundwater Source	
	Vapour Intrusion	Volatilisation (wet wall)
Chloroform	2.40E-04	2.02E-06
Cis-1,2-DCE	6.68E-03	4.99E-05
PCE	7.80E-03	3.40E-05
TCE	4.43E-03	2.34E-05
VC	1.34E-03	2.13E-06

The estimated vapour levels in each of the basements as estimated on the basis of a soil vapour source are summarised in **Table A4-7** following. Model outputs are provided following.

Table A4-7: Summary of Estimated Levels of COPCs in Basement from Soil Vapour Source (mg/m^3)

Constituent	Soil Vapour Source
Chloroform	1.12E-03
Cis-1,2-DCE	2.11E-01
PCE	6.96E-01
TCE	1.14E-01
VC	8.98E-04

The results for the same assessments for the lift shaft are summarised in **Table A4-8** following on the basis of groundwater source. The modelling scenarios here have considered infiltrating seepage water and volatilisation from pooled seepage water / wet walls only.

Table A4-8: Summary of Estimated Levels of COPCs in Lift Shafts to Basements (mg/m^3)

Constituent	Lift Shafts
	Seepage Water Accumulation / Volatilisation
Chloroform	1.09E-05
Cis-1,2-DCE	2.70E-04
PCE	1.84E-04
TCE	1.26E-04
VC	1.15E-05

Levels of COPCs as estimated in an excavation as consequent of lateral migration of vapours from adjoining impacted soils and/or accumulation of infiltrating seepage water and direct volatilisation are summarised in **Table A4-9** following.

Table A4-9: Summary of Estimated Levels of COPCs in Excavations (mg/m³)

Constituent	Excavation	
	Migration of Vapours	Vapour from Groundwater
Chloroform	1.63E-04	8.60E-07
Cis-1,2-DCE	3.49E-02	2.40E-05
PCE	6.89E-02	2.68E-05
TCE	1.49E-02	1.54E-05
VC	1.84E-04	4.74E-06

Note cis-1,2-DCE and VC modelling results adjusted as concentration less than maximum used in fate and transport modelling.

CRCCARE Technical Report No. 23 Petroleum Hydrocarbon Vapour Intrusion Assessment: Australian Guidance, July 2013, EnRiskS (CRCCARE 2013) reports that for buildings where there is a good separation between the basement and upper floors the concentration of volatile constituents on the floors above the basement(s) are 1/10th of the basement concentrations. With the size of the buildings provided as shown on the redevelopment plans as **Attachment 2**, there will be good separation between the basement / car park and the overlying commercial tenancies and residential dwellings.

It was noted in **Section 3** that potentially increased levels of vapours may be caused inside a building by a preferential pathways as associated with a lift shaft. On the basis of a lift shaft representing up to 1.5% of the building volume and similar levels of vapours in lift shafts as estimated in the basement, the factor of 1/10th is considered more than sufficient to account for potential vapour movement into the building by this pathway.

Oral and dermal doses, as based on a 12 month averaging time, are summarised in **Table A4-10** following for each receptor, as based on the potential incidental contact to groundwater scenarios.

Table A4-10: Summary of Estimated Oral and Dermal Exposures to COPCs (mg/kg/day)

Constituent	Pathway	Child 0-5 years	Child 6-15 years	Adult Resident	Commercial / Industrial Worker	Lift Maintenance Worker
Chloroform	Oral	6.33E-06	1.70E-06	0.00E+00	0.00E+00	7.44E-08
	Dermal	1.73E-06	1.27E-06	2.41E-06	1.58E-06	5.12E-06
Cis-1,2-DCE	Oral	1.57E-04	4.20E-05	0.00E+00	0.00E+00	1.84E-06
	Dermal	6.89E-05	5.08E-05	9.60E-05	6.31E-05	2.04E-04
PCE	Oral	1.07E-04	2.86E-05	0.00E+00	0.00E+00	1.25E-06
	Dermal	1.43E-04	1.05E-04	1.98E-04	1.31E-04	4.22E-04
TCE	Oral	7.33E-05	1.96E-05	0.00E+00	0.00E+00	8.61E-07
	Dermal	3.40E-05	2.51E-05	4.74E-05	3.12E-05	1.01E-04
VC	Oral	6.67E-06	1.79E-06	0.00E+00	0.00E+00	7.83E-08
	Dermal	2.23E-06	1.65E-06	3.11E-06	2.05E-06	6.61E-06

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	1.3E-01
Air content	cm3/cm3	2.6E-01
Distance from groundwater to building	m	1.0E-01
Bioattenuation factor	-	1.0E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	2.0E+01
Air content	-	3.9E-02
Water content	-	3.5E-01

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	3.8E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	5.5E+01
Enclosed space floor width	m	3.5E+01
Enclosed space height	m	6.0E+00
Volume of building	m3	1.2E+04
Number of air changes per hour	1/hr	1.7E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	1.0E-03

Dissolved Source for Groundwater Model [mg/l]		
Chloroform	mg/l	1.9E-02
Dichloroethylene (cis 1,2)	mg/l	4.7E-01
Tetrachloroethylene (PCE)	mg/l	3.2E-01
Trichloroethylene (TCE)	mg/l	2.2E-01
Vinyl Chloride	mg/l	2.0E-02

Chemical Properties	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride

Diffusion coefficient in air	cm2/s	7.7E-02	8.8E-02	5.1E-02	6.9E-02	1.1E-01
Diffusion coefficient in water	cm2/s	1.1E-05	1.1E-05	9.5E-06	1.0E-05	1.2E-05
Solubility	mg/l	7.9E+03	3.5E+03	2.0E+02	1.1E+03	2.8E+03
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	3.2E+01	3.6E+01	9.5E+01	6.1E+01	2.2E+01
Henry's Law coefficient	m3-H2O)/(m3-air	1.5E-01	1.7E-01	7.2E-01	4.0E-01	1.1E+00
Molecular weight	g/mol	1.2E+02	9.7E+01	1.7E+02	1.3E+02	6.3E+01

Well -- groundwater concentration (mg/l)

Time (year)	Chloroform (mg/l)	Dichloroethylene (cis 1,2) (mg/l)	Tetrachloroethylene (PCE) (mg/l)	Trichloroethylene (TCE) (mg/l)	Vinyl Chloride (mg/l)
0	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
1	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
2	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
3	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
4	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
5	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
6	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
7	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
8	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
9	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
10	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
11	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
12	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
13	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
14	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
15	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
16	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
17	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
18	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
19	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
20	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
21	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
22	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
23	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
24	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
25	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
26	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
27	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
28	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
29	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
30	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02

Vapor flux into building (g/s)

Time (year)	Chloroform (g/s)	Dichloroethylene (cis 1,2) (g/s)	Tetrachloroethylene (PCE) (g/s)	Trichloroethylene (TCE) (g/s)	Vinyl Chloride (g/s)
0	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
1	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
2	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
3	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
4	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
5	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
6	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
7	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
8	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
9	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
10	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
11	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
12	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
13	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
14	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
15	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
16	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
17	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
18	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
19	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
20	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
21	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
22	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
23	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
24	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
25	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
26	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
27	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
28	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
29	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07
30	1.3E-07	3.6E-06	4.3E-06	2.4E-06	7.3E-07

Vapor conc. above groundwater (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
1	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
2	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
3	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
4	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
5	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
6	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
7	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
8	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
9	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
10	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
11	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
12	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
13	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
14	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
15	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
16	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
17	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
18	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
19	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
20	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
21	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
22	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
23	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
24	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
25	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
26	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
27	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
28	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
29	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
30	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01

Indoor air concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
1	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
2	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
3	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
4	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
5	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
6	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
7	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
8	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
9	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
10	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
11	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
12	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
13	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
14	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
15	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
16	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
17	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
18	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
19	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
20	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
21	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
22	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
23	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
24	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
25	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
26	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
27	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
28	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
29	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03
30	2.4E-04	6.7E-03	7.8E-03	4.4E-03	1.3E-03

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Soil Gas
Johnson and Ettinger Indoor air model
Volatilization from soil gas source to indoor air (onsite)

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	1.3E-01
Air content	cm3/cm3	2.6E-01
Distance from source to building	m	1.0E-01
Bioattenuation factor	-	1.0E+00

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	3.8E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	5.5E+01
Enclosed space floor width	m	3.5E+01
Enclosed space height	m	6.0E+00
Volume of building	m3	1.2E+04
Number of air changes per hour	1/hr	1.7E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	1.0E-03

Soil Gas Source Concentration for Vapor Model Chemical	Units	Concentration
Chloroform	mg/m3	1.2E+00
Dichloroethylene (cis 1,2)	mg/m3	2.2E+02
Tetrachloroethylene (PCE)	mg/m3	7.5E+02
Trichloroethylene (TCE)	mg/m3	1.2E+02
Vinyl Chloride	mg/m3	9.3E-01

Chemical Properties	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Diffusion coefficient in air	cm2/s	7.7E-02	8.8E-02	5.1E-02	6.9E-02	1.1E-01
Diffusion coefficient in water	cm2/s	1.1E-05	1.1E-05	9.5E-06	1.0E-05	1.2E-05
Solubility	mg/l	7.9E+03	3.5E+03	2.0E+02	1.1E+03	2.8E+03

Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	3.2E+01	3.6E+01	9.5E+01	6.1E+01	2.2E+01
Henry's Law coefficient	m3-H2O)/(m3-air	1.5E-01	1.7E-01	7.2E-01	4.0E-01	1.1E+00
Molecular weight	g/mol	1.2E+02	9.7E+01	1.7E+02	1.3E+02	6.3E+01

Vapor flux into building (g/s)

Time (year)	Chloroform (g/s)	Dichloroethylene (cis 1,2) (g/s)	Tetrachloroethylene (PCE) (g/s)	Trichloroethylene (TCE) (g/s)	Vinyl Chloride (g/s)
0	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
1	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
2	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
3	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
4	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
5	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
6	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
7	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
8	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
9	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
10	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
11	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
12	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
13	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
14	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
15	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
16	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
17	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
18	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
19	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
20	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
21	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
22	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
23	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
24	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
25	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
26	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
27	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
28	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
29	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07
30	6.1E-07	1.1E-04	3.8E-04	6.2E-05	4.9E-07

Source -- vapor concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
1	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
2	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
3	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
4	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
5	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
6	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
7	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
8	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
9	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
10	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
11	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
12	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
13	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
14	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
15	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
16	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
17	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
18	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
19	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
20	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
21	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
22	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
23	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
24	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
25	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
26	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
27	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
28	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
29	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
30	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01

Indoor air concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
1	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
2	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
3	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
4	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
5	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
6	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
7	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
8	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
9	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
10	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
11	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
12	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
13	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
14	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
15	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
16	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
17	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
18	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
19	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
20	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
21	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
22	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
23	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
24	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
25	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
26	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
27	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
28	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
29	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04
30	1.1E-03	2.1E-01	7.0E-01	1.1E-01	9.0E-04

Basement Calculations

All Basement Area, Maximum GW concentrations, for assessment of heal

Basement Seepage Rate

Walls

Area (A)	m2	
Hydraulic Gradient (H)	m	
Hydraulic Conductivity (K)	m/day	
Q (walls)	m3/day	

Base

Area (A)	m2	
Hydraulic Gradient (H)	m	
Hydraulic Conductivity (K)	m/day	
Q (walls)	m3/day	
Vol of Water Entering (Q) (m3/sec)	m3/second	
(m3/day)	5.00E-03	m3/day

Params

Temp ('C)	20
Temp (K)	293
Visc of Air (g/cm sec)	1.86E-04
Dens of Air (g/cm3)	1.29E-03

Basement Dimens.

Vol. (m3) (B1)	11760
X-Sectional Area (m2)	1960
H of Basement	6

Wet Basement Sect.

L (m)	
H (m)	
D of Water (m)- assumed	0.001
Vol. of Wet Basement Sect (m3)	0.12
Wet Area (m2)	120
Effect Diam Wetted Area (De) (m)	12.35227015
Vol of Water Entering (Q) (m3/sec)	5.79E-08
(m3/day)	5.00E-03

Ventilation (L/sec)	544.4444444
Air exch (vol/day)=	4
U (m/sec)=	1.00E-02

U <3.5 m/sec

COPC	GW Conc.	MW	Vap. P	Vap. P	H	H	Da	Dw	D ether in water	Eq. Coeff	Sch. No.	Gas Trans Coeff. (Kg)	Liq Trans Coeff. (Kl)	Overall Trans Coeff. (K)	Equil. Conc. Of W in Basement (Cl)	Air Emission for L Surface (E)	Air Emission for L Surface (E)	Adjusted Conc. In Basement Air (ACb)
	mg/L	g/mol	mmHG	atm	-	atm.m3/g.mol	cm2/sec	cm2/sec	cm2/sec	Keq	SCg	m/sec	m/sec	m/sec	g/m3	g/sec	mg/day	mg/m3
cis-1,2-DCE	4.70E-01	9.69E+01	2.00E+02	2.63E-01	1.67E-01	4.02E-03	8.84E-02	1.13E-05	8.50E-06	1.67E-01	1.63E+00	7.25E-05	3.36E-06	2.63E-06	8.61E-05	2.72E-08	2.35E+00	4.99E-05
PCE	3.20E-01	1.66E+02	1.85E+01	2.43E-02	7.24E-01	1.74E-02	5.05E-02	9.46E-06	8.50E-06	7.24E-01	2.86E+00	4.99E-05	2.99E-06	2.76E-06	5.60E-05	1.85E-08	1.60E+00	3.40E-05
TCE	2.20E-01	1.33E+02	6.90E+01	9.08E-02	4.03E-01	9.69E-03	6.87E-02	1.02E-05	8.50E-06	4.03E-01	2.10E+00	6.13E-05	3.14E-06	2.79E-06	3.81E-05	1.27E-08	1.10E+00	2.34E-05
VC	2.00E-02	6.25E+01	2.98E+03	3.92E+00	1.14E+00	2.74E-02	1.07E-01	1.20E-05	8.50E-06	1.14E+00	1.35E+00	8.24E-05	3.50E-06	3.37E-06	2.86E-06	1.16E-09	1.00E-01	2.13E-06
Chloroform	1.90E-02	1.19E+02	1.97E+02	2.59E-01	1.50E-01	3.61E-03	7.69E-02	1.09E-05	8.50E-06	1.50E-01	1.87E+00	6.61E-05	3.28E-06	2.46E-06	3.72E-06	1.10E-09	9.50E-02	2.02E-06

Basement Lift Shaft Calculations

All Basement Area, Maximum GW concentrations, for assessment of heal

Basement Seepage Rate

Walls

Area (A)	m2	
Hydraulic Gradient (H)	m	
Hydraulic Conductivity (K)	m/day	
Q (walls)	m3/day	

Base

Area (A)	m2	
Hydraulic Gradient (H)	m	
Hydraulic Conductivity (K)	m/day	
Q (walls)	m3/day	
Vol of Water Entering (Q) (m3/sec)	m3/second	
(m3/day)	7.50E-05	m3/day

Params

Temp ('C)	20
Temp (K)	293
Visc of Air (g/cm sec)	1.86E-04
Dens of Air (g/cm3)	1.29E-03

Basement Dimens.

Vol. (m3) (B1)	150
X-Sectional Area (m2)	5
H of Basement	30

Wet Basement Sect.

L (m)	
H (m)	
D of Water (m)- assumed	0.001
Vol. of Wet Basement Sect (m3)	0.006
Wet Area (m2)	6
Effect Diam Wetted Area (De) (m)	2.762051574
Vol of Water Entering (Q) (m3/sec)	8.68E-10
(m3/day)	7.50E-05

Ventilation (L/sec)	1.510416667
Air exch (vol/h)=	0.87
U (m/sec)=	3.00E-04

U <3.5 m/sec

COPC	GW Conc.	MW	Vap. P	Vap. P	H	H	Da	Dw	D ether in water	Eq. Coeff	Sch. No.	Gas Trans Coeff. (Kg)	Liq Trans Coeff. (Kl)	Overall Trans Coeff. (K)	Equil. Conc. Of W in Basement (Cl)	Air Emission for L Surface (E)	Air Emission for L Surface (E)	Adjusted Conc. In Basement Air (ACb)
	mg/L	g/mol	mmHG	atm	-	atm.m3/g.mol	cm2/sec	cm2/sec	cm2/sec	Keq	SCg	m/sec	m/sec	m/sec	g/m3	g/sec	mg/day	mg/m3
cis-1,2-DCE	4.70E-01	9.69E+01	2.00E+02	2.63E-01	1.67E-01	4.02E-03	8.84E-02	1.13E-05	8.50E-06	1.67E-01	1.63E+00	5.55E-06	3.36E-06	7.26E-07	9.36E-05	4.08E-10	3.52E-02	2.70E-04
PCE	3.20E-01	1.66E+02	1.85E+01	2.43E-02	7.24E-01	1.74E-02	5.05E-02	9.46E-06	8.50E-06	7.24E-01	2.86E+00	3.81E-06	2.99E-06	1.43E-06	3.23E-05	2.78E-10	2.40E-02	1.84E-04
TCE	2.20E-01	1.33E+02	6.90E+01	9.08E-02	4.03E-01	9.69E-03	6.87E-02	1.02E-05	8.50E-06	4.03E-01	2.10E+00	4.69E-06	3.14E-06	1.18E-06	2.70E-05	1.91E-10	1.65E-02	1.26E-04
VC	2.00E-02	6.25E+01	2.98E+03	3.92E+00	1.14E+00	2.74E-02	1.07E-01	1.20E-05	8.50E-06	1.14E+00	1.35E+00	6.31E-06	3.50E-06	2.35E-06	1.23E-06	1.74E-11	1.50E-03	1.15E-05
Chloroform	1.90E-02	1.19E+02	1.97E+02	2.59E-01	1.50E-01	3.61E-03	7.69E-02	1.09E-05	8.50E-06	1.50E-01	1.87E+00	5.06E-06	3.28E-06	6.16E-07	4.46E-06	1.65E-11	1.42E-03	1.09E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Soil Gas
Johnson and Ettinger Indoor air model
Volatilization from soil gas source to indoor air (onsite)

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	1.3E-01
Air content	cm3/cm3	2.6E-01
Distance from source to building	m	1.0E-01
Bioattenuation factor	-	1.0E+00

Building Parameters		
Diffusion only case		
Foundation thickness	cm	0.0E+00
Fraction of cracks	-	1.0E+00
Porosity in cracks	cm3/cm3	1.0E+00
Water content in cracks	cm3/cm3	0.0E+00
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	2.0E+00
Enclosed space height	m	2.0E+00
Volume of building	m3	4.0E+01
Number of air changes per hour	1/hr	7.2E+01

Soil Gas Source Concentration for Vapor Model Chemical	Units	Concentration
Chloroform	mg/m3	1.2E+00
Dichloroethylene (cis 1,2)	mg/m3	2.2E+02
Tetrachloroethylene (PCE)	mg/m3	7.5E+02
Trichloroethylene (TCE)	mg/m3	1.2E+02
Vinyl Chloride	mg/m3	9.3E-01

Chemical Properties	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Diffusion coefficient in air	cm2/s	7.7E-02	8.8E-02	5.1E-02	6.9E-02	1.1E-01
Diffusion coefficient in water	cm2/s	1.1E-05	1.1E-05	9.5E-06	1.0E-05	1.2E-05
Solubility	mg/l	7.9E+03	3.5E+03	2.0E+02	1.1E+03	2.8E+03
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND

KOC (organiChem carbon partition coefficient	L/kg	3.2E+01	3.6E+01	9.5E+01	6.1E+01	2.2E+01
Henry's Law coefficient	m3-H2O)/(m3-air	1.5E-01	1.7E-01	7.2E-01	4.0E-01	1.1E+00
Molecular weight	g/mol	1.2E+02	9.7E+01	1.7E+02	1.3E+02	6.3E+01

Vapor flux into building (g/s)

Time (year)	Chloroform (g/s)	Dichloroethylene (cis 1,2) (g/s)	Tetrachloroethylene (PCE) (g/s)	Trichloroethylene (TCE) (g/s)	Vinyl Chloride (g/s)
0	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
1	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
2	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
3	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
4	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
5	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
6	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
7	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
8	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
9	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
10	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
11	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
12	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
13	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
14	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
15	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
16	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
17	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
18	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
19	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
20	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
21	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
22	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
23	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
24	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
25	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
26	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
27	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
28	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
29	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07
30	1.3E-07	2.8E-05	5.5E-05	1.2E-05	1.5E-07

Source -- vapor concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
1	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
2	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
3	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
4	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
5	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
6	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
7	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
8	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
9	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
10	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
11	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
12	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
13	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
14	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
15	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
16	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
17	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
18	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
19	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
20	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
21	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
22	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
23	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
24	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
25	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
26	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
27	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
28	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
29	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01
30	1.2E+00	2.2E+02	7.5E+02	1.2E+02	9.3E-01

Indoor air concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
1	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
2	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
3	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
4	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
5	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
6	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
7	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
8	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
9	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
10	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
11	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
12	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
13	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
14	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
15	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
16	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
17	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
18	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
19	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
20	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
21	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
22	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
23	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
24	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
25	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
26	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
27	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
28	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
29	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04
30	1.6E-04	3.5E-02	6.9E-02	1.5E-02	1.8E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	1.3E-01
Air content	cm3/cm3	2.6E-01
Distance from groundwater to building	m	1.5E+00
Bioattenuation factor	-	1.0E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	2.0E+01
Air content	-	3.9E-02
Water content	-	3.5E-01

Building Parameters		
Diffusion only case		
Foundation thickness	cm	0.0E+00
Fraction of cracks	-	1.0E+00
Porosity in cracks	cm3/cm3	1.0E+00
Water content in cracks	cm3/cm3	0.0E+00
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	2.0E+00
Enclosed space height	m	2.0E+00
Volume of building	m3	4.0E+01
Number of air changes per hour	1/hr	7.2E+01

Dissolved Source for Groundwater Model [mg/l]		
Chloroform	mg/l	1.9E-02
Dichloroethylene (cis 1,2)	mg/l	4.7E-01
Tetrachloroethylene (PCE)	mg/l	3.2E-01
Trichloroethylene (TCE)	mg/l	2.2E-01
Vinyl Chloride	mg/l	2.0E-02

Chemical Properties	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Diffusion coefficient in air	cm2/s	7.7E-02	8.8E-02	5.1E-02	6.9E-02	1.1E-01

Diffusion coefficient in water	cm2/s	1.1E-05	1.1E-05	9.5E-06	1.0E-05	1.2E-05
Solubility	mg/l	7.9E+03	3.5E+03	2.0E+02	1.1E+03	2.8E+03
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	3.2E+01	3.6E+01	9.5E+01	6.1E+01	2.2E+01
Henry's Law coefficient	m3-H2O)/(m3-air	1.5E-01	1.7E-01	7.2E-01	4.0E-01	1.1E+00
Molecular weight	g/mol	1.2E+02	9.7E+01	1.7E+02	1.3E+02	6.3E+01

Well -- groundwater concentration (mg/l)

Time (year)	Chloroform (mg/l)	Dichloroethylene (cis 1,2) (mg/l)	Tetrachloroethylene (PCE) (mg/l)	Trichloroethylene (TCE) (mg/l)	Vinyl Chloride (mg/l)
0	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
1	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
2	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
3	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
4	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
5	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
6	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
7	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
8	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
9	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
10	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
11	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
12	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
13	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
14	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
15	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
16	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
17	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
18	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
19	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
20	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
21	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
22	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
23	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
24	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
25	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
26	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
27	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
28	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
29	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02
30	1.9E-02	4.7E-01	3.2E-01	2.2E-01	2.0E-02

Vapor flux into building (g/s)

Time (year)	Chloroform (g/s)	Dichloroethylene (cis 1,2) (g/s)	Tetrachloroethylene (PCE) (g/s)	Trichloroethylene (TCE) (g/s)	Vinyl Chloride (g/s)
0	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
1	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
2	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
3	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
4	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
5	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
6	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
7	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
8	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
9	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
10	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
11	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
12	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
13	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
14	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
15	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
16	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
17	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
18	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
19	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
20	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
21	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
22	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
23	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
24	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
25	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
26	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
27	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
28	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
29	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09
30	6.9E-10	1.9E-08	2.1E-08	1.2E-08	3.8E-09

Vapor conc. above groundwater (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
1	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
2	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
3	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
4	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
5	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
6	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
7	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
8	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
9	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
10	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
11	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
12	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
13	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
14	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
15	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
16	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
17	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
18	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
19	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
20	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
21	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
22	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
23	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
24	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
25	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
26	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
27	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
28	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
29	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01
30	2.9E+00	8.0E+01	2.3E+02	8.9E+01	2.3E+01

Indoor air concentration (mg/m3)

Time (year)	Chloroform (mg/m3)	Dichloroethylene (cis 1,2) (mg/m3)	Tetrachloroethylene (PCE) (mg/m3)	Trichloroethylene (TCE) (mg/m3)	Vinyl Chloride (mg/m3)
0	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
1	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
2	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
3	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
4	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
5	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
6	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
7	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
8	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
9	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
10	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
11	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
12	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
13	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
14	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
15	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
16	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
17	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
18	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
19	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
20	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
21	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
22	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
23	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
24	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
25	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
26	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
27	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
28	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
29	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06
30	8.6E-07	2.4E-05	2.7E-05	1.5E-05	4.7E-06

Summary of Input Data for Risk Calculation

Description:	**Basement - Direct Contacxt to Water - Child Receptors**
Date:	**12-12-2023 15:49:57**

Receptors:
Child 0-5 yrs
Child 6-15 yrs
Risk results ARE NOT added for carcinogens

Routes:
Ingestion of Surface Water
Dermal Contact with Surface Water

Chemicals:
Chloroform
Dichloroethylene (cis 1,2)
Tetrachloroethylene (PCE)
Trichloroethylene (TCE)
Vinyl Chloride

Exposure Parameters

Exposure Pathway	**Units**	**Child 0-5 yrs**	**Child 6-15 yrs**
Body weight	kg	15	56
Averaging time for carcinogens	yr	70	70
Exposure duration	yr	6	10

Ingestion of Surface Water	**Units**	**Child 0-5 yrs**	**Child 6-15 yrs**
Exposure frequency for surface water/sediment	events/yr	365	365
Time spent swimming or in contact with surface wat	hr/d	0.5	0.5
Ingestion rate of surface water	ml/hr	10	10

Dermal Contact with Surface Water	**Units**	**Child 0-5 yrs**	**Child 6-15 yrs**
Exposure frequency for surface water/sediment	events/yr	365	365
Time spent swimming or in contact with surface wat	hr/d	0.5	0.5
Skin surface area exposed to surface water	cm2	400	1.10E+03

Absorption Adjustment Factors	Dermal Permeability Coefficient cm/hour
Chloroform	6.83E-03
Dichloroethylene (cis 1,2)	1.10E-02
Tetrachloroethylene (PCE)	3.34E-02
Trichloroethylene (TCE)	1.16E-02
Vinyl Chloride	8.38E-03

Slope Factors and Reference Doses

Chemical	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Ingestion Slope Factor	1/(mg/kg-day)	3.10E-02	ND	0.54	5.90E-03	1.5
Ingestion Reference Dose	mg/kg-day	1.00E-02	1.00E-02	1.00E-02	ND	3.00E-03

Exposure Point Concentrations

--- Used to calculate risk and hazard index.

Concentrations in Surface Water (mg/L)	
Chloroform	1.90E-02
Dichloroethylene (cis 1,2)	0.47
Tetrachloroethylene (PCE)	0.32
Trichloroethylene (TCE)	0.22
Vinyl Chloride	2.00E-02

Summary of Daily Doses (Intake) for Risk Calculation

Description:	**Basement - Direct Contacxt to Water - Child Receptors**
Date:	**12-12-2023 15:49:57**

Daily Dose and Risk for: Chloroform Ingestion of Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	6.3E-06	1.7E-06
LADD (mg/kd-d)	5.4E-07	2.4E-07
Cancer Risk (-)	1.7E-08	7.5E-09
Hazard Index (-)	6.3E-04	1.7E-04

Daily Dose and Risk for: Chloroform Dermal Contact with Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	1.7E-06	1.3E-06
LADD (mg/kd-d)	1.5E-07	1.8E-07
Cancer Risk (-)	4.6E-09	5.6E-09
Hazard Index (-)	1.7E-04	1.3E-04

Daily Dose and Risk for: Dichloroethylene (cis 1,2) Ingestion of Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	1.6E-04	4.2E-05
LADD (mg/kd-d)	1.3E-05	6.0E-06
Cancer Risk (-)	ND	ND
Hazard Index (-)	1.6E-02	4.2E-03

Daily Dose and Risk for: Dichloroethylene (cis 1,2) Dermal Contact with Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	6.9E-05	5.1E-05
LADD (mg/kd-d)	5.9E-06	7.3E-06
Cancer Risk (-)	ND	ND
Hazard Index (-)	6.9E-03	5.1E-03

Daily Dose and Risk for: Tetrachloroethylene (PCE) Ingestion of Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	1.1E-04	2.9E-05
LADD (mg/kd-d)	9.1E-06	4.1E-06
Cancer Risk (-)	4.9E-06	2.2E-06
Hazard Index (-)	1.1E-02	2.9E-03

Daily Dose and Risk for: Tetrachloroethylene (PCE) Dermal Contact with Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	1.4E-04	1.1E-04
LADD (mg/kd-d)	1.2E-05	1.5E-05
Cancer Risk (-)	6.6E-06	8.1E-06
Hazard Index (-)	1.4E-02	1.1E-02

Daily Dose and Risk for: Trichloroethylene (TCE) Ingestion of Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	7.3E-05	2.0E-05
LADD (mg/kd-d)	6.3E-06	2.8E-06
Cancer Risk (-)	3.7E-08	1.7E-08
Hazard Index (-)	ND	ND

Daily Dose and Risk for: Trichloroethylene (TCE) Dermal Contact with Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**

CADD (mg/kd-d)	3.4E-05	2.5E-05
LADD (mg/kd-d)	2.9E-06	3.6E-06
Cancer Risk (-)	1.7E-08	2.1E-08
Hazard Index (-)	ND	ND

Daily Dose and Risk for: Vinyl Chloride Ingestion of Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	6.7E-06	1.8E-06
LADD (mg/kd-d)	5.7E-07	2.6E-07
Cancer Risk (-)	8.6E-07	3.8E-07
Hazard Index (-)	2.2E-03	6.0E-04

Daily Dose and Risk for: Vinyl Chloride Dermal Contact with Surface Water	**Child 0-5 yrs**	**Child 6-15 yrs**
CADD (mg/kd-d)	2.2E-06	1.7E-06
LADD (mg/kd-d)	1.9E-07	2.4E-07
Cancer Risk (-)	2.9E-07	3.5E-07
Hazard Index (-)	7.5E-04	5.5E-04

Summary of Input Data for Risk Calculation

Description:	**Basement - Direct Contact to Water - Adult Resident and Commercial Worker Receptors**
Date:	**12-12-2023 15:58:26**

Receptors:
Adult Resident
Worker
Risk results ARE NOT added for carcinogens

Routes:
Ingestion of Surface Water
Dermal Contact with Surface Water

Chemicals:
Chloroform
Dichloroethylene (cis 1,2)
Tetrachloroethylene (PCE)
Trichloroethylene (TCE)
Vinyl Chloride

Exposure Parameters

Exposure Pathway	**Units**	**Adult Resident**	**Worker**
Body weight	kg	70	70
Averaging time for carcinogens	yr	70	70
Exposure duration	yr	19	30

Ingestion of Surface Water	**Units**	**Adult Resident**	**Worker**
Exposure frequency for surface water/sediment	events/yr	365	240
Time spent swimming or in contact with surface wat	hr/d	1	1
Ingestion rate of surface water	ml/hr	0	0

Dermal Contact with Surface Water	**Units**	**Adult Resident**	**Worker**
Exposure frequency for surface water/sediment	events/yr	365	240
Time spent swimming or in contact with surface wat	hr/d	1	1

Skin surface area exposed to surface water	cm2	1.30E+03	1.30E+03

Absorption Adjustment Factors	Dermal Permeability Coefficient cm/hour
Chloroform	6.83E-03
Dichloroethylene (cis 1,2)	1.10E-02
Tetrachloroethylene (PCE)	3.34E-02
Trichloroethylene (TCE)	1.16E-02
Vinyl Chloride	8.38E-03

Slope Factors and Reference Doses

Chemical	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Ingestion Slope Factor	1/(mg/kg-day)	3.10E-02	ND	0.54	5.90E-03	1.5
Ingestion Reference Dose	mg/kg-day	1.00E-02	1.00E-02	1.00E-02	ND	3.00E-03

Exposure Point Concentrations

--- Used to calculate risk and hazard index.

Concentrations in Surface Water (mg/L)	
Chloroform	1.90E-02
Dichloroethylene (cis 1,2)	0.47
Tetrachloroethylene (PCE)	0.32
Trichloroethylene (TCE)	0.22
Vinyl Chloride	2.00E-02

Summary of Daily Doses (Intake) for Risk Calculation

Description:	**Basement - Direct Contact to Water - Adult Resident and Commercial Worker Receptors**
Date:	**12-12-2023 15:58:26**

Daily Dose and Risk for: Chloroform **Ingestion of Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	0.0E+00	0.0E+00
LADD (mg/kd-d)	0.0E+00	0.0E+00
Cancer Risk (-)	0.0E+00	0.0E+00
Hazard Index (-)	0.0E+00	0.0E+00

Daily Dose and Risk for: Chloroform **Dermal Contact with Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	2.4E-06	1.6E-06
LADD (mg/kd-d)	6.5E-07	6.8E-07
Cancer Risk (-)	2.0E-08	2.1E-08
Hazard Index (-)	2.4E-04	1.6E-04

Daily Dose and Risk for: Dichloroethylene (cis 1,2) **Ingestion of Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	0.0E+00	0.0E+00
LADD (mg/kd-d)	0.0E+00	0.0E+00
Cancer Risk (-)	ND	ND
Hazard Index (-)	0.0E+00	0.0E+00

Daily Dose and Risk for: Dichloroethylene (cis 1,2) **Dermal Contact with Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	9.6E-05	6.3E-05
LADD (mg/kd-d)	2.6E-05	2.7E-05
Cancer Risk (-)	ND	ND
Hazard Index (-)	9.6E-03	6.3E-03

Daily Dose and Risk for: Tetrachloroethylene (PCE) **Ingestion of Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	0.0E+00	0.0E+00
LADD (mg/kd-d)	0.0E+00	0.0E+00
Cancer Risk (-)	0.0E+00	0.0E+00
Hazard Index (-)	0.0E+00	0.0E+00

Daily Dose and Risk for: Tetrachloroethylene (PCE) **Dermal Contact with Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	2.0E-04	1.3E-04
LADD (mg/kd-d)	5.4E-05	5.6E-05
Cancer Risk (-)	2.9E-05	3.0E-05
Hazard Index (-)	2.0E-02	1.3E-02

Daily Dose and Risk for: Trichloroethylene (TCE) **Ingestion of Surface Water**	**Adult Resident**	**Worker**
CADD (mg/kd-d)	0.0E+00	0.0E+00
LADD (mg/kd-d)	0.0E+00	0.0E+00
Cancer Risk (-)	0.0E+00	0.0E+00
Hazard Index (-)	ND	ND

Daily Dose and Risk for: Trichloroethylene (TCE) Dermal Contact with Surface Water	Adult Resident	Worker
CADD (mg/kd-d)	4.7E-05	3.1E-05
LADD (mg/kd-d)	1.3E-05	1.3E-05
Cancer Risk (-)	7.6E-08	7.9E-08
Hazard Index (-)	ND	ND

Daily Dose and Risk for: Vinyl Chloride Ingestion of Surface Water	Adult Resident	Worker
CADD (mg/kd-d)	0.0E+00	0.0E+00
LADD (mg/kd-d)	0.0E+00	0.0E+00
Cancer Risk (-)	0.0E+00	0.0E+00
Hazard Index (-)	0.0E+00	0.0E+00

Daily Dose and Risk for: Vinyl Chloride Dermal Contact with Surface Water	Adult Resident	Worker
CADD (mg/kd-d)	3.1E-06	2.1E-06
LADD (mg/kd-d)	8.5E-07	8.8E-07
Cancer Risk (-)	1.3E-06	1.3E-06
Hazard Index (-)	1.0E-03	6.8E-04

Summary of Input Data for Risk Calculation

Description:	**Basement - Direct Contact to Water - Lift Maintenance Worker**
Date:	**12-12-2023 16:05:58**

Receptors:
Lift Maintenance Worker

Routes:
Ingestion of Surface Water
Dermal Contact with Surface Water

Chemicals:
Chloroform
Dichloroethylene (cis 1,2)
Tetrachloroethylene (PCE)
Trichloroethylene (TCE)
Vinyl Chloride

Exposure Parameters

Exposure Pathway	**Units**	**Lift Maintenance Worker**
Body weight	kg	70
Averaging time for carcinogens	yr	70
Exposure duration	yr	30

Ingestion of Surface Water	**Units**	**Lift Maintenance Worker**
Exposure frequency for surface water/sediment	events/yr	20
Time spent swimming or in contact with surface wat	hr/d	8
Ingestion rate of surface water	ml/hr	0.625

Dermal Contact with Surface Water	**Units**	**Lift Maintenance Worker**
Exposure frequency for surface water/sediment	events/yr	20

Time spent swimming or in contact with surface wat	hr/d	8
Skin surface area exposed to surface water	cm2	6.30E+03

Absorption Adjustment Factors	Dermal Permeability Coefficient cm/hour
Chloroform	6.83E-03
Dichloroethylene (cis 1,2)	1.10E-02
Tetrachloroethylene (PCE)	3.34E-02
Trichloroethylene (TCE)	1.16E-02
Vinyl Chloride	8.38E-03

Slope Factors and Reference Doses

Chemical	Units	Chloroform	Dichloroethylene (cis 1,2)	Tetrachloroethylene (PCE)	Trichloroethylene (TCE)	Vinyl Chloride
Ingestion Slope Factor	1/(mg/kg-day)	3.10E-02	ND	0.54	5.90E-03	1.5
Ingestion Reference Dose	mg/kg-day	1.00E-02	1.00E-02	1.00E-02	ND	3.00E-03

Exposure Point Concentrations

--- Used to calculate risk and hazard index.

Concentrations in Surface Water (mg/L)	
Chloroform	1.90E-02
Dichloroethylene (cis 1,2)	0.47
Tetrachloroethylene (PCE)	0.32
Trichloroethylene (TCE)	0.22
Vinyl Chloride	2.00E-02

Summary of Daily Doses (Intake) for Risk Calculation

Description:	**Basement - Direct Contact to Water - Lift Maintenance Worker**
Date:	**12-12-2023 16:05:58**

Daily Dose and Risk for: Chloroform **Ingestion of Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	7.4E-08
LADD (mg/kd-d)	3.2E-08
Cancer Risk (-)	9.9E-10
Hazard Index (-)	7.4E-06

Daily Dose and Risk for: Chloroform **Dermal Contact with Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	5.1E-06
LADD (mg/kd-d)	2.2E-06
Cancer Risk (-)	6.8E-08
Hazard Index (-)	5.1E-04

Daily Dose and Risk for: Dichloroethylene (cis 1,2) **Ingestion of Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	1.8E-06
LADD (mg/kd-d)	7.9E-07
Cancer Risk (-)	ND
Hazard Index (-)	1.8E-04

Daily Dose and Risk for: Dichloroethylene (cis 1,2) **Dermal Contact with Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	2.0E-04
LADD (mg/kd-d)	8.7E-05
Cancer Risk (-)	ND
Hazard Index (-)	2.0E-02

Daily Dose and Risk for: Tetrachloroethylene (PCE) **Ingestion of Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	1.3E-06
LADD (mg/kd-d)	5.4E-07
Cancer Risk (-)	2.9E-07
Hazard Index (-)	1.3E-04

Daily Dose and Risk for: Tetrachloroethylene (PCE) **Dermal Contact with Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	4.2E-04
LADD (mg/kd-d)	1.8E-04

Cancer Risk (-)	9.8E-05
Hazard Index (-)	4.2E-02

Daily Dose and Risk for: Trichloroethylene (TCE) **Ingestion of Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	8.6E-07
LADD (mg/kd-d)	3.7E-07
Cancer Risk (-)	2.2E-09
Hazard Index (-)	ND

Daily Dose and Risk for: Trichloroethylene (TCE) **Dermal Contact with Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	1.0E-04
LADD (mg/kd-d)	4.3E-05
Cancer Risk (-)	2.6E-07
Hazard Index (-)	ND

Daily Dose and Risk for: Vinyl Chloride **Ingestion of Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	7.8E-08
LADD (mg/kd-d)	3.4E-08
Cancer Risk (-)	5.0E-08
Hazard Index (-)	2.6E-05

Daily Dose and Risk for: Vinyl Chloride **Dermal Contact with Surface Water**	**Lift Maintenance Worker**
CADD (mg/kd-d)	6.6E-06
LADD (mg/kd-d)	2.8E-06
Cancer Risk (-)	4.3E-06
Hazard Index (-)	2.2E-03

Risk Calculations

Resident (0-5 years) - Building - Soil Vapour

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.1E-03	7.0E-01	7.0E-01	1.1E-01	1.1E-01	2.1E-01	9.0E-04	9.0E-04
Oral dose (mg/kg/day)	6.3E-06	1.1E-04	1.1E-04	7.3E-05	7.3E-05	1.6E-04	6.7E-06	6.7E-06
Dermal dose (mg/kg/day)	1.7E-06	1.4E-04	1.4E-04	3.4E-05	3.4E-05	6.9E-05	2.2E-06	2.2E-06
RAGS F Basement adjust	2.1E-02	1.8E-03	2.1E-02	1.8E-03	2.1E-02	2.1E-02	1.8E-03	2.1E-02
RAGS F Building adjust	8.3E-01	7.1E-02	8.3E-01	7.1E-02	8.3E-01	8.3E-01	7.1E-02	8.3E-01
Background	0.0E+00		1.0E-01		1.0E-01			
Inhalation Risk/Hazard	4.7E-04	1.6E-06	4.0E-01	4.1E-06	6.6E+00	3.1E+00	7.1E-08	9.4E-04
Direct Risk/Hazard	1.2E-04	4.5E-08	1.8E-02	7.2E-09	7.3E-02	1.3E-02	5.7E-07	3.0E-03
Sum Risk		6.4E-06						
Sum Hazard		1.0E+01						

Resident (5-16 years) - Building - Soil Vapour

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.1E-03	7.0E-01	7.0E-01	1.1E-01	1.1E-01	2.1E-01	9.0E-04	9.0E-04
Oral dose (mg/kg/day)	1.7E-06	2.9E-05	2.9E-05	2.0E-05	2.0E-05	4.2E-05	1.8E-06	1.8E-06
Dermal dose (mg/kg/day)	1.3E-06	1.1E-04	1.1E-04	2.5E-05	2.5E-05	5.1E-05	1.7E-06	1.7E-06
RAGS F Basement adjust	2.1E-02	3.0E-03	2.1E-02	3.0E-03	2.1E-02	2.1E-02	3.0E-03	2.1E-02
RAGS F Building adjust	8.3E-01	1.2E-01	8.3E-01	1.2E-01	8.3E-01	8.3E-01	1.2E-01	8.3E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	4.7E-04	2.7E-06	4.0E-01	6.8E-06	6.6E+00	3.1E+00	1.2E-07	9.4E-04
Direct Risk/Hazard	4.2E-05	4.0E-08	9.5E-03	5.0E-09	3.1E-02	5.5E-03	3.7E-07	1.1E-03
Sum Risk		1.0E-05						
Sum Hazard		1.0E+01						

Resident (>16 years) - Building - Soil Vapour

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.1E-03	7.0E-01	7.0E-01	1.1E-01	1.1E-01	2.1E-01	9.0E-04	9.0E-04
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	2.4E-06	2.0E-04	2.0E-04	4.7E-05	4.7E-05	9.6E-05	3.1E-06	3.1E-06
RAGS F Basement adjust	4.2E-02	6.0E-03	4.2E-02	6.0E-03	4.2E-02	4.2E-02	6.0E-03	4.2E-02
RAGS F Building adjust	8.3E-01	2.3E-01	8.3E-01	2.3E-01	8.3E-01	8.3E-01	2.3E-01	8.3E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	5.6E-04	5.2E-06	4.8E-01	1.3E-05	7.9E+00	3.8E+00	2.3E-07	1.1E-03
Direct Risk/Hazard	3.4E-05	5.9E-08	1.4E-02	5.3E-09	3.2E-02	5.6E-03	3.3E-07	1.0E-03
Sum Risk		1.9E-05			3.5E-05	all resident exposures		

Sum Hazard		1.2E+01						

Resident (0-5 years) - Building - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	2.4E-04	7.8E-03	7.8E-03	4.4E-03	4.4E-03	6.7E-03	1.3E-03	1.3E-03
Oral dose (mg/kg/day)	6.3E-06	1.1E-04	1.1E-04	7.3E-05	7.3E-05	1.6E-04	6.7E-06	6.7E-06
Dermal dose (mg/kg/day)	1.7E-06	1.4E-04	1.4E-04	3.4E-05	3.4E-05	6.9E-05	2.2E-06	2.2E-06
RAGS F Basement adjust	2.1E-02	1.8E-03	2.1E-02	1.8E-03	2.1E-02	2.1E-02	1.8E-03	2.1E-02
RAGS F Building adjust	8.3E-01	7.1E-02	8.3E-01	7.1E-02	8.3E-01	8.3E-01	7.1E-02	8.3E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	1.0E-04	1.8E-08	4.5E-03	1.6E-07	2.6E-01	9.9E-02	1.1E-07	1.4E-03
Direct Risk/Hazard	1.2E-04	4.5E-08	1.8E-02	7.2E-09	7.3E-02	1.3E-02	5.7E-07	3.0E-03
Sum Risk		9.1E-07						
Sum Hazard		4.7E-01						

Resident (5-16 years) - Building - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	2.4E-04	7.8E-03	7.8E-03	4.4E-03	4.4E-03	6.7E-03	1.3E-03	1.3E-03
Oral dose (mg/kg/day)	1.7E-06	2.9E-05	2.9E-05	2.0E-05	2.0E-05	4.2E-05	1.8E-06	1.8E-06
Dermal dose (mg/kg/day)	1.3E-06	1.1E-04	1.1E-04	2.5E-05	2.5E-05	5.1E-05	1.7E-06	1.7E-06
RAGS F Basement adjust	2.1E-02	3.0E-03	2.1E-02	3.0E-03	2.1E-02	2.1E-02	3.0E-03	2.1E-02
RAGS F Building adjust	8.3E-01	1.2E-01	8.3E-01	1.2E-01	8.3E-01	8.3E-01	1.2E-01	8.3E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	1.0E-04	3.0E-08	4.5E-03	2.6E-07	2.6E-01	9.9E-02	1.8E-07	1.4E-03
Direct Risk/Hazard	4.2E-05	4.0E-08	9.5E-03	5.0E-09	3.1E-02	5.5E-03	3.7E-07	1.1E-03
Sum Risk		8.8E-07						
Sum Hazard		4.1E-01						

Resident (>16 years) - Building - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	2.4E-04	7.8E-03	7.8E-03	4.4E-03	4.4E-03	6.7E-03	1.3E-03	1.3E-03
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	2.4E-06	2.0E-04	2.0E-04	4.7E-05	4.7E-05	9.6E-05	3.1E-06	3.1E-06
RAGS F Basement adjust	4.2E-02	6.0E-03	4.2E-02	6.0E-03	4.2E-02	4.2E-02	6.0E-03	4.2E-02
RAGS F Building adjust	8.3E-01	2.3E-01	8.3E-01	2.3E-01	8.3E-01	8.3E-01	2.3E-01	8.3E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	1.2E-04	5.8E-08	5.4E-03	5.1E-07	3.1E-01	1.2E-01	3.4E-07	1.7E-03
Direct Risk/Hazard	3.4E-05	5.9E-08	1.4E-02	5.3E-09	3.2E-02	5.6E-03	3.3E-07	1.0E-03
Sum Risk		1.3E-06			3.1E-06	all resident exposures		

Sum Hazard		4.9E-01						

Commercial Worker - Building - Soil Vapour

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.1E-03	7.0E-01	7.0E-01	1.1E-01	1.1E-01	2.1E-01	9.0E-04	9.0E-04
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	1.6E-06	1.3E-04	1.3E-04	3.1E-05	3.1E-05	6.3E-05	2.1E-06	2.1E-06
RAGS F Basement adjust	1.4E-02	5.9E-03	1.4E-02	5.9E-03	1.4E-02	1.4E-02	5.9E-03	1.4E-02
RAGS F Building adjust	2.2E-01	9.4E-02	2.2E-01	9.4E-02	2.2E-01	2.2E-01	9.4E-02	2.2E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	1.6E-04	2.8E-06	1.4E-01	7.0E-06	2.3E+00	1.1E+00	1.2E-07	3.2E-04
Direct Risk/Hazard	2.3E-05	2.4E-08	9.4E-03	2.1E-09	2.1E-02	3.7E-03	1.3E-07	6.8E-04
Sum Risk		1.0E-05						
Sum Hazard		3.5E+00						

Commercial Worker - Building - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	2.4E-04	7.8E-03	7.8E-03	4.4E-03	4.4E-03	6.7E-03	1.3E-03	1.3E-03
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	1.6E-06	1.3E-04	1.3E-04	3.1E-05	3.1E-05	6.3E-05	2.1E-06	2.1E-06
RAGS F Basement adjust	1.4E-02	5.9E-03	1.4E-02	5.9E-03	1.4E-02	1.4E-02	5.9E-03	1.4E-02
RAGS F Building adjust	2.2E-01	9.4E-02	2.2E-01	9.4E-02	2.2E-01	2.2E-01	9.4E-02	2.2E-01
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	3.4E-05	3.1E-08	1.5E-03	2.7E-07	8.8E-02	3.4E-02	1.8E-07	4.8E-04
Direct Risk/Hazard	2.3E-05	2.4E-08	9.4E-03	2.1E-09	2.1E-02	3.7E-03	1.3E-07	6.8E-04
Sum Risk		6.4E-07						
Sum Hazard		1.6E-01						

Lift Maintenance Worker - Building - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.1E-05	1.8E-04	1.8E-04	1.3E-04	1.3E-04	2.7E-04	1.2E-05	1.2E-05
Oral dose (mg/kg/day)	7.4E-08	1.3E-06	1.3E-06	8.6E-07	8.6E-07	1.8E-06	7.8E-08	7.8E-08
Dermal dose (mg/kg/day)	5.1E-06	4.2E-04	4.2E-04	1.0E-04	1.0E-04	2.0E-04	6.6E-06	6.6E-06
RAGS F Basement adjust	1.8E-02	7.8E-03	1.8E-02	7.8E-03	1.8E-02	1.8E-02	7.8E-03	1.8E-02
RAGS F Building adjust	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	8.0E-07	3.7E-10	1.9E-05	3.9E-09	1.3E-03	7.0E-04	7.9E-10	2.1E-06
Direct Risk/Hazard	7.4E-05	7.6E-08	3.0E-02	6.8E-09	7.0E-02	1.2E-02	4.3E-07	2.2E-03
Sum Risk		5.2E-07						

Sum Hazard		1.2E-01						

Excavation Worker - Soil Vapour

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	1.6E-04	6.9E-02	6.9E-02	1.5E-02	1.5E-02	3.5E-02	1.8E-04	1.8E-04
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RAGS F Excavation adjust	1.8E-02	7.8E-03	1.8E-02	7.8E-03	1.8E-02	1.8E-02	7.8E-03	1.8E-02
RAGS F Building adjust	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	1.2E-05	1.4E-07	7.0E-03	4.7E-07	1.5E-01	9.1E-02	1.3E-08	3.4E-05
Direct Risk/Hazard	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Risk		6.2E-07						
Sum Hazard		2.5E-01						

Excavation Worker - Groundwater

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	VC
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
UR (mg/m3)-1		2.6E-04		4.0E-03			8.8E-03	
SF (mg/kg/day)-1		2.1E-03		7.8E-04			7.5E-01	
RfC (mg/m3)	2.5E-01		2.0E-01		2.0E-03	7.0E-03		1.0E-01
RfD (mg/m3)	7.0E-02		1.4E-02		1.5E-03	1.7E-02		3.0E-03
Conc (mg/m3)	8.6E-07	2.7E-05	2.7E-05	1.5E-05	1.5E-05	2.4E-05	4.7E-06	4.7E-06
Oral dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Dermal dose (mg/kg/day)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
RAGS F Excavation adjust	1.8E-02	7.8E-03	1.8E-02	7.8E-03	1.8E-02	1.8E-02	7.8E-03	1.8E-02
RAGS F Building adjust	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Background			1.0E-01		1.0E-01			
Inhalation Risk/Hazard	6.3E-08	5.5E-11	2.7E-06	4.8E-10	1.6E-04	6.3E-05	3.3E-10	8.7E-07
Direct Risk/Hazard	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Sum Risk		8.6E-10						
Sum Hazard		2.2E-04						

Maximum Risk / Hazard Attributable to Vapour Source

COPC	THM (CF/BDCM)	PCE		TCE		cis-1,2-DCE	VC	
Measure	Hazard	Risk	Hazard	Risk	Hazard	Hazard	Risk	Hazard
Max risk / hazard								
Soil Vapour Conc.								
Risk Based Criterion								
Inc. addive effects								

© JBS&G
This document is and shall remain the property of JBS&G. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited

Document Distribution

Rev No.	Copies	Recipient	Date
A	1 x electronic	Alex Zhao (alexzhao@sjdpg.com)	14/12/2023
0	1 x electronic	Alex Zhao (alexzhao@sjdpg.com)	10/04/2024
1	1 x electronic	Alex Zhao (alexzhao@sjdpg.com)	30/04/2024
2	1 x electronic	Alex Zhao (alexzhao@sjdpg.com)	2/07/2024

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Chris Bielby	Matthew Parkinson		Initial draft for client comments	14/12/2023
0	Chris Bielby	Matthew Parkinson			10/04/2024
1	Chris Bielby	Matthew Parkinson			30/04/2024
2	Chris Bielby	Matthew Parkinson			2/07/2024

www.jbsg.com.au

JBS&G

Adelaide
Kaurna Country | 100 Hutt St,
Adelaide, SA 5000
T: 08 8431 7113

Brisbane
Turrbal/Yuggera Country | Level 37, 123
Eagle Street, Brisbane, QLD 4000
T: 07 3211 5350

Bunbury
Wardandi Noongar Country | 177
Spencer Street Bunbury, WA 6230
T: 08 9792 4797

Canberra
Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
T: 02 6198 3278

Darwin
Larrakia Country | Suite G1, Level 1
48-50 Smith Street, Darwin NT 0800
T: 08 8943 0600

Hobart
Muwununa/Nuenon Country | Level 6,
111 Macquarie Street Hobart, TAS 7000
T: 03 6108 9054

Melbourne
Kulin Country | Level 5, 10 Queen
Street, Melbourne, VIC 3000
T: 03 9642 0599

Newcastle
Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

Perth
Whadjuk Nyoongar Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney
Gadigal Country | Level 1, 50
Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong
Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
T: 02 4225 2647