

Smith Street, Highgate – Build to Rent

Acoustic Services

Design Development Report



27/06/2024

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PREPARED FOR:

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Tetris Capital

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1. Introduction

Stantec has been commissioned by Tetris Capital to undertake acoustic design of proposed residential development at Lot 501 Smith Street, Highgate. The project will see the development of a multi-storey residential development that consists of apartments, located at the above address in Highgate, WA.

This **Design Development** acoustic report covers the acoustic design aspects relating to the project:

- Acoustic privacy between apartments
- The control of building services noise including mechanical plant, lifts and hydraulics.
- Reverberation control within common areas.
- Internal noise from mechanical plant
- The control of noise emission from mechanical plant to nearest noise sensitive receivers.

Each acoustical aspect identified above has been addressed in this report with recommendations provided that aims to achieve a consistent acoustical outcome for the project. All advice provided in this report is for coordination with the project team and implementation by the respective disciplines.

A glossary of acoustic terms used in this report is included in Appendix A

The recommendations made in this report are specific to the building design at the date of issue of this report. The building design is subject to change during the following design stages. Where this occurs, the assumptions made to inform the recommendations in the report may no longer be valid; therefore, further advice should be sought to ensure that the acoustic outcomes presented in this report are achieved.

The performance of products referred to in this report are made to meet the acoustic requirements only. It does not consider other aspects including, but not limited to, thermal, wind, impact, structural, mechanical, national construction code, security and fire requirements. Relevant discipline reports, drawings and specifications should be referred to for conformance.

This report relates to this specific project and must not be applied to any other project without prior consultation with Stantec. Designs and conditions can vary between projects causing significant variations in acoustic performance requirements and relevant subsequent advice to one project may not apply to another.

This report shall not be relied upon as providing any warranties or guarantees of construction quality regarding acoustics.



2. Referenced Documentation

2.1 Regulations, Policies, Standards and Guidelines

The following documents detailed in Table 1 are relevant to the project and are referred to throughout this report.

Table 1: Applicable regulations, policies, standards and guidelines referenced in this report

Title	Abbreviation
REGULATIONS AND LOCAL COUNCIL POLICIES	
Western Australian Environmental Protection (Noise) Regulation 1997	EPNR 1997
City of Vincent Planning Policy No. 7.5.21, "Sound Attenuation"	
Western Australian Planning Commission – State Planning Policy 5.4 (2019)	SPP5.4 2019
BUILDING CODES, STANDARDS AND DESIGN GUIDELINES	
National Construction Code 2019 – Volume 1, <i>Building Code of Australia Class 2 to Class 9 Buildings</i>	NCC 2019
AUSTRALIAN AND INTERNATIONAL STANDARDS	
Australian / New Zealand Standard AS/NZS 2107:2016 – <i>Acoustics – Recommended design sound levels and reverberation times for building interiors</i>	AS 2107:2016

2.2 Project Location

2.2.1 Development Description

The project primarily consists of a Four (4) storey multi-residential development, in addition to the following architectural volumes:

- Basement – enclosed carpark and engineering services room;
- Ground Floor - Sole-occupancy units, communal area and lobby;
- Level 1 - 2 - Sole-occupancy units;
- Level 3 - Sole-occupancy units and communal garden

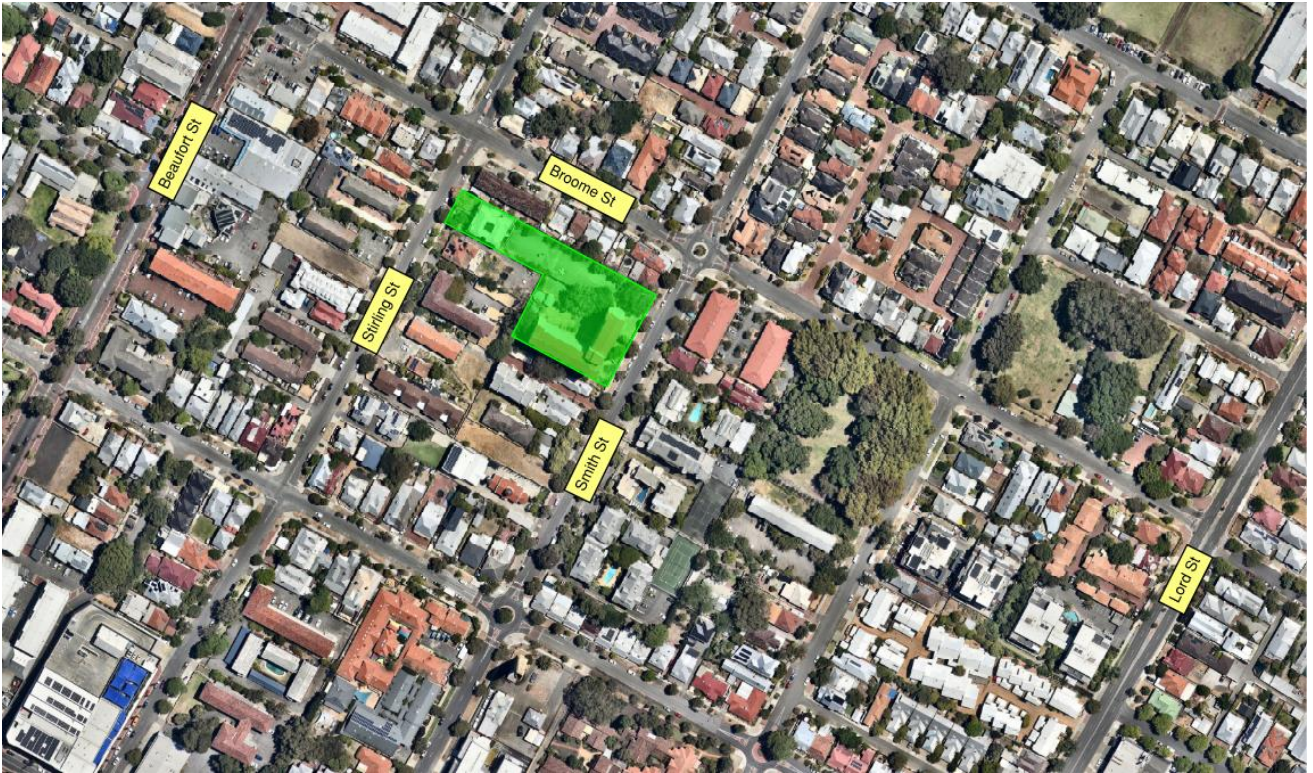
2.2.2 Site Description

The development is proposed at Lot 501 Smith Street, WA 6003. The surrounding area is primarily residentially zoned developments with sparse commercial and mixed-used developments within a 450m radius.

The Beaufort Street and Lord Street are identified as the major road surrounding the project site forming a major part of the acoustic environment.

The project site and other areas identified above have been provided in Figure 1





Source: NearMaps

Figure 1: Site location and surrounding area



3. Acoustic Criteria

The acoustic criteria presented in this Development Application report are derived from the following documentation;

- City of Vincent Planning Policy No. 7.5.21, "Sound Attenuation"
- *Western Australian Environmental Protection (Noise) Regulation 1997 (EPNR)*;
- *Australian and New Zealand Standard AS/NZS 2107:2016 - Acoustics – Recommended design sound levels and reverberation times for building interiors (AS2107)*;
- *State Planning Policy 5.4 – Road and Rail Noise 2019 (SPP 5.4)*;
- *National Construction Code 2019 Volume 1, Building Code of Australia Class 2, 3 Buildings (NCC 2019)*;

3.1 City of Vincent Planning Policy No. 7.5.21

The acoustic assessment has been undertaken in accordance with the City of Vincent Planning Policy No. 7.5.21, "Sound Attenuation Policy", herein referred to as the Policy.

Section 3.2 of the Policy states that an Acoustic Report must be submitted where the development is a residential development of six (6) or more dwellings, mixed-use residential/commercial buildings containing (1) residential dwelling or more, and any residential building located within or adjacent to the District Centre, Local Centre, Commercial and Commercial/Residential and Regional Town Centre zones.

The Sections of the Policy relevant to the proposed mixed-use development are:

- **Section 3.3.2**, regarding the content of the Report and Acoustic Criteria:
 - Part a) Inbound noise (Residential Development).
 - i. Residential buildings are to be designed to achieve the following sound levels:
 - a. Leq 35 dB(A) in sleeping areas (bedrooms); and
 - b. Leq 40 dB(A) in living/work areas and other habitable rooms.
- IMPORTANT NOTE:**
- The Leq level should not be unduly biased toward the lower frequencies of the octave band spectrum. If lower frequencies are dominant in sound levels taken during the sampling phase of reporting (between 31.5-125Hz), the Acoustic Consultant/Engineer shall discuss the findings with the City's Senior Environmental Health Officer or Manager Health Services in developing solutions*
- ii. Residential developments are to be constructed to meet the requirements of the National Construction Code Series 2012 Building Code of Australia Part F5.
 - Part b) Outbound noise (All Developments).
- Noise Emissions from all the development are to comply with the 'assigned levels' detailed in the *Environmental Protection (Noise) Regulations 1997*.
 - **Section 4**, regarding Noise Source Identification and assessment methodology:
 - **Section 4.1** – Traffic Noise, Outcome 2.

The Applicant is to:

- Detail sound levels recorded at the property of contributories (motor cars, trains) on a Weekday, during the period 7.00am-9.00am; or at a period of the day that is representative of the normal peak traffic conditions for the area). Sound monitoring shall not be conducted on a public holiday or during school holidays



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- **Section 4.2** – Residual Breakout Noise from Lifestyle uses and Entertainment Venues, Outcome 3.

The Applicant is to:

- Identify all breakout noise sources that have a noticeable impact on sound levels received at the subject property, and in particular, those noise sources within a 100m radius;
 - Specify sound levels recorded at the property during time periods that correspond to related breakout noise sources; for example:
- Nightclubs to be monitored during hours of operation after 10.00pm at night on a Friday or Saturday;
 - Cafes and Outdoor Eating Areas to be monitored during peak trade periods; and
 - Locations near sports grounds and stadiums to be monitored during periods of normal use; particularly when used at capacity (where practicable)

IMPORTANT NOTE:

Standardised theoretical sound level limits should not be used for calculation purposes, unless such use is absolutely necessary due to noise sources (to be modelled), occurring so infrequently, that performing measurements on-site are impractical.

- **Section 4.3** – Street Noise, Outcome 4.

The Applicant is to:

- Provide comment on the likely impact of all localised street noise sources (factors such as proximity to local business districts, late night venues, schools and setbacks from footpaths shall be considered); and
- Thereafter, comment on practical building design solutions to minimise the impact of such noise sources (i.e. acoustic barriers, separation of noise sensitive parts of the development from the noise transmission path).

- **Section 4.4** – Mechanical Plant and Equipment, Outcome 5.

The Applicant is to:

- Provide comment on the likely impact of all existing mechanical plant and equipment noise sources surrounding the proposed development site (air conditioners, traffic gates etc);
- Comment on practical building design solutions that could be implemented to minimise the impact of existing mechanical plant and equipment noise sources; and
- Comment on the proposed location of all mechanical plant and equipment at the development site; and provide details of how noise emissions from these sources will be contained, so as not to create unwanted sound at nearby properties.

Section 5, which elaborates acoustic treatment and noise mitigation measures, as required.

In line with the requirements outlined above, the following scope has been covered in this Acoustic Assessment:

- Conducting sound measurements at the proposed site in order to quantify noise from the adjacent entertainment venue and from road traffic;
- Assessing noise intrusion into the proposed development to recommend practical noise control measures into the building design;
- Identifying noise sensitive receivers in the surroundings of the proposed development and potential sources of noise from the development; and
- Assessing environmental noise emissions from the proposed development.



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3.2 Environmental Protection (Noise) Regulation 1997

Environmental noise impacts resulting from the noise emissions from the project are addressed through the Environmental Protection Act 1986, with the regulatory requirements detailed in the Environmental Protection (Noise) Regulations 1997 (EPNR).

The EPNR establishes the maximum permissible noise emission levels (assigned levels) to be received at all adjacent noise-sensitive premises during specific periods of the day as a result of the cumulative noise emissions from all sources proposed for the project site. Compliance to relevant noise limits outlined in the EPNR is compulsory.

The EPNR states noise emissions from any premises are considered not to *significantly contribute to* the noise at a receiver if the noise emissions are 5 dB or below the assigned levels.

In brief, the assigned levels are determined by considering of the amount of commercial and industrial zones, as well as main transport corridors and sporting venues surrounding the noise sensitive premises. The assigned levels apply at premises receiving the noise (noise sensitive receiver) and not to areas within the project site or lot. In addition, the Environmental Protection (Noise) Regulations 1997 identify the following in Schedule 3, clause 2A.

“If the land within either of the circles is categorised on the land use map as land in respect of which mixed uses are permitted, the use of that land that results in the highest influencing factor is to be used in the determination of the influencing factor.”

The nearest noise sensitive receivers to the project site have been identified as residential premises located at 342 Stirling St and 47 Smith St. The Local Planning Scheme 2 (LPS2) for the City of Vincent were used to determine the influencing factor.

Traffic data for roads surrounding the nearest noise sensitive receiver were provided by Main Roads Western Australia (MRWA) on 08 April 2024. The available traffic data has been presented in Table 2.

Table 2: Traffic count data (MRWA)

Transport Corridors	EPNR Classification ¹⁾	Average Daily Traffic Volumes					
		2018/19	2019/20	2020/21	2021/22	2022/23	2023/24
Beaufort St (North of Harold St)	Major Rd	-	-	15105	-	-	-
Lord St (North of Bulwer St)	Major Rd	-	-	20336	-	-	-

1) As defined by the EPNR. Secondary roads have between 6,000-15,000 vehicles per day. Major roads have greater than 15,000 vehicles per day.

3.2.1 Influencing Factor

The influencing factor for 342 Stirling St and 47 Smith St from identifying major roads, commercial and industrial areas for all nearest noise sensitive receivers is 3 dB, as summarised in Table 3.



Table 3: Influencing factor (IF) at noise sensitive receivers

Noise Sensitive Premises	Commercial Zones	Industrial Zones	Transport Corridors	Influencing Factor
342 Stirling St	0 % within a 100 m radius 11 % within a 450 m radius	0 % within a 450 m radius	Beaufort St and Lord St (major road) in a 450m radius	3 dB
47 Smith St	0 % within a 100 m radius 14 % within a 450 m radius	0 % within a 450 m radius	Beaufort St and Lord St (major road) in a 450m radius	3 dB

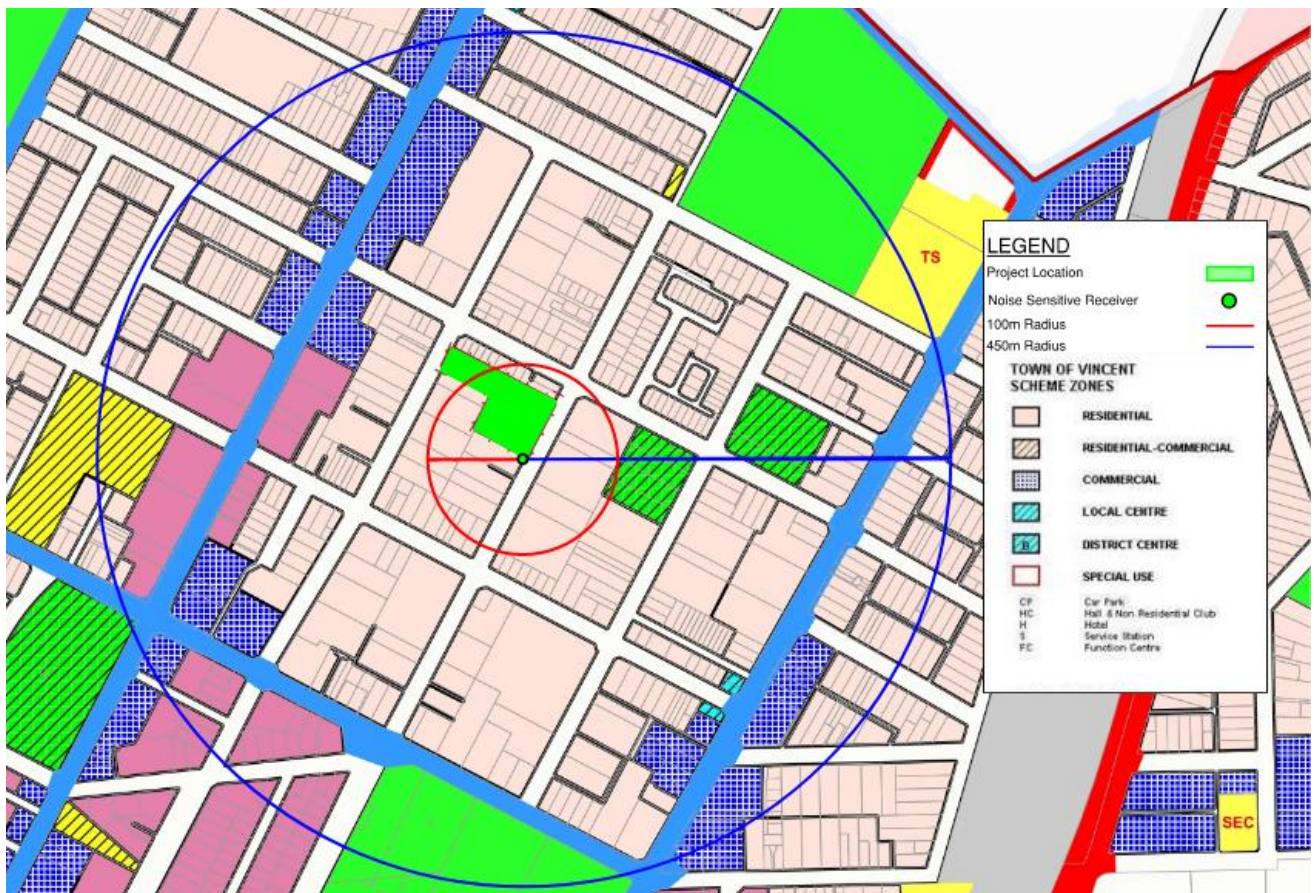


Figure 2: Zoning map of areas surrounding 47 Smith St



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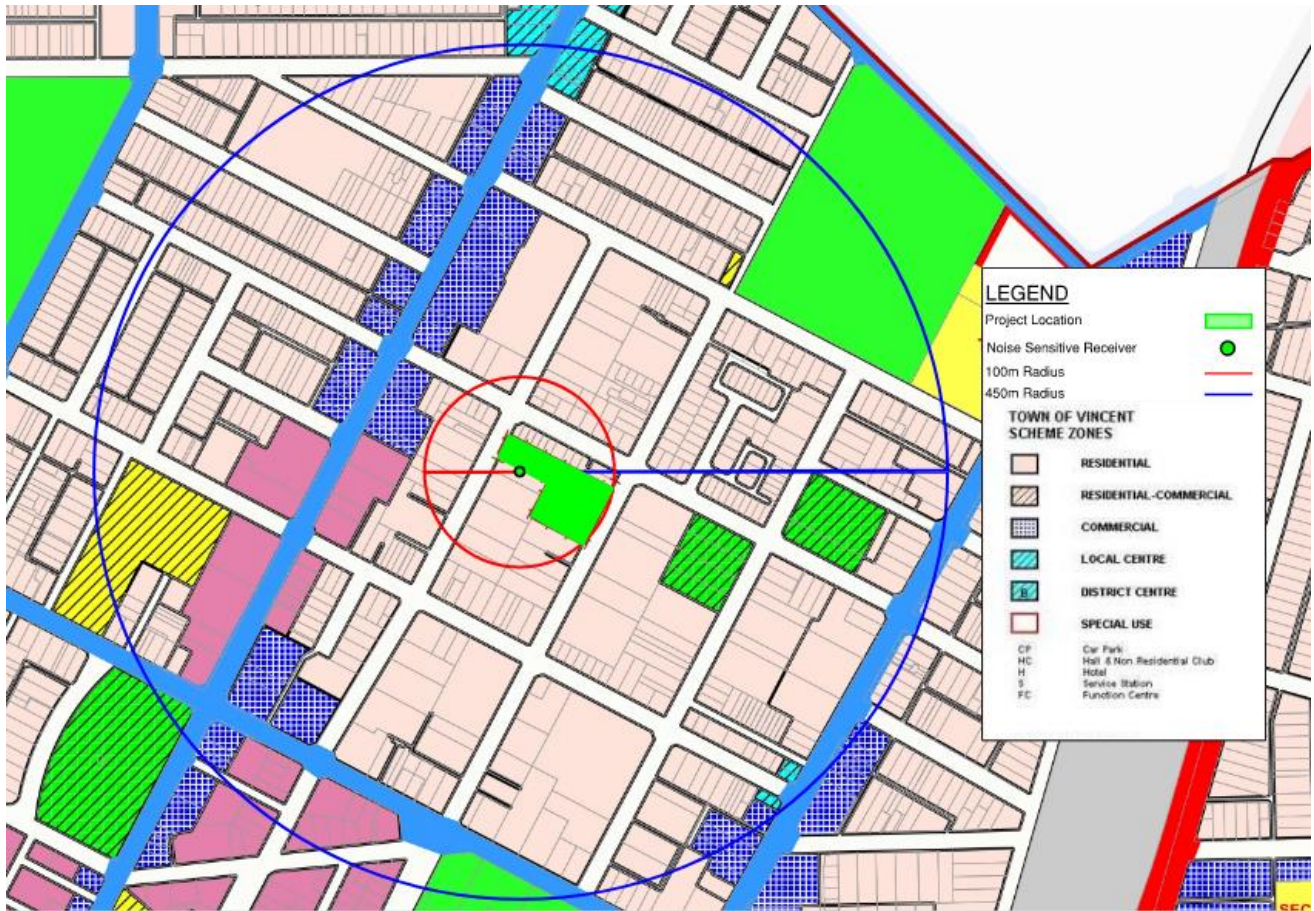


Figure 3: Zoning map of areas surrounding 342 Stirling St

Source: City of Vincent online mapping system

3.2.2 Assigned Noise Levels for Nearest Sensitive Receiver

Table 4 summarizes the assigned levels at the nearest noise sensitive premises. It is required that all noise emissions from the development are below the assigned level for all defined periods of the day and at the lot boundary of the receiver or 15m from any associated building. It is noted that the EPNR assigned levels only apply at the premises receiving the noise only and not to noise within the site.



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Table 4: Assigned levels for 342 Stirling St and 47 Smith St

Type of premises receiving noise	Time of day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Noise sensitive premises: Highly sensitive area	0700 to 1900 hours Monday to Saturday	48	58	68
	0900 to 1900 hours Sunday & public holidays	43	53	68
	1900 to 2200 hours all days	43	53	58
	2200 hours on any day to 0700 hours Monday to Saturday, and 0900 hours Sunday & public holidays	38	48	58
Noise sensitive premises: any area other than highly sensitive areas	All Hours	60	75	80
Commercial premises	All Hours	60	75	80
Industrial and utility premises	All Hours	65	80	90

3.2.3 Noise Character Adjustments

Regulation 7 states that the noise character must be “free” of annoying characteristics, namely —

- Tonality, e.g. whining, droning;
- Modulation, e.g. like a siren; and
- Impulsiveness, e.g. banging, thumping.

Regulation 9 (1) establishes the methodology for determining noise characteristics. If these characteristics cannot be reasonably and practicably removed, a series of adjustments to the measured levels are required, indicated in Table 5.

Table 5: Noise character adjustment

Adjustment where noise emission is not music these adjustments are cumulative to a maximum of 15 dB		Adjustment where noise emission is music		
Where tonality is present	Where modulation is present	Where impulsiveness is present	Where impulsiveness is not present	Where impulsiveness is present
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

3.2.4 Noise Emissions - Mechanical services

At this stage no information is available on mechanical equipment. Typically, projects of this type involve noise emissions from mechanical services such as air conditioning units and condensers and exhaust fans.

It is important that noise emissions from the site do not present any form of tonality, modulation or impulsiveness (as defined by the EPNR).



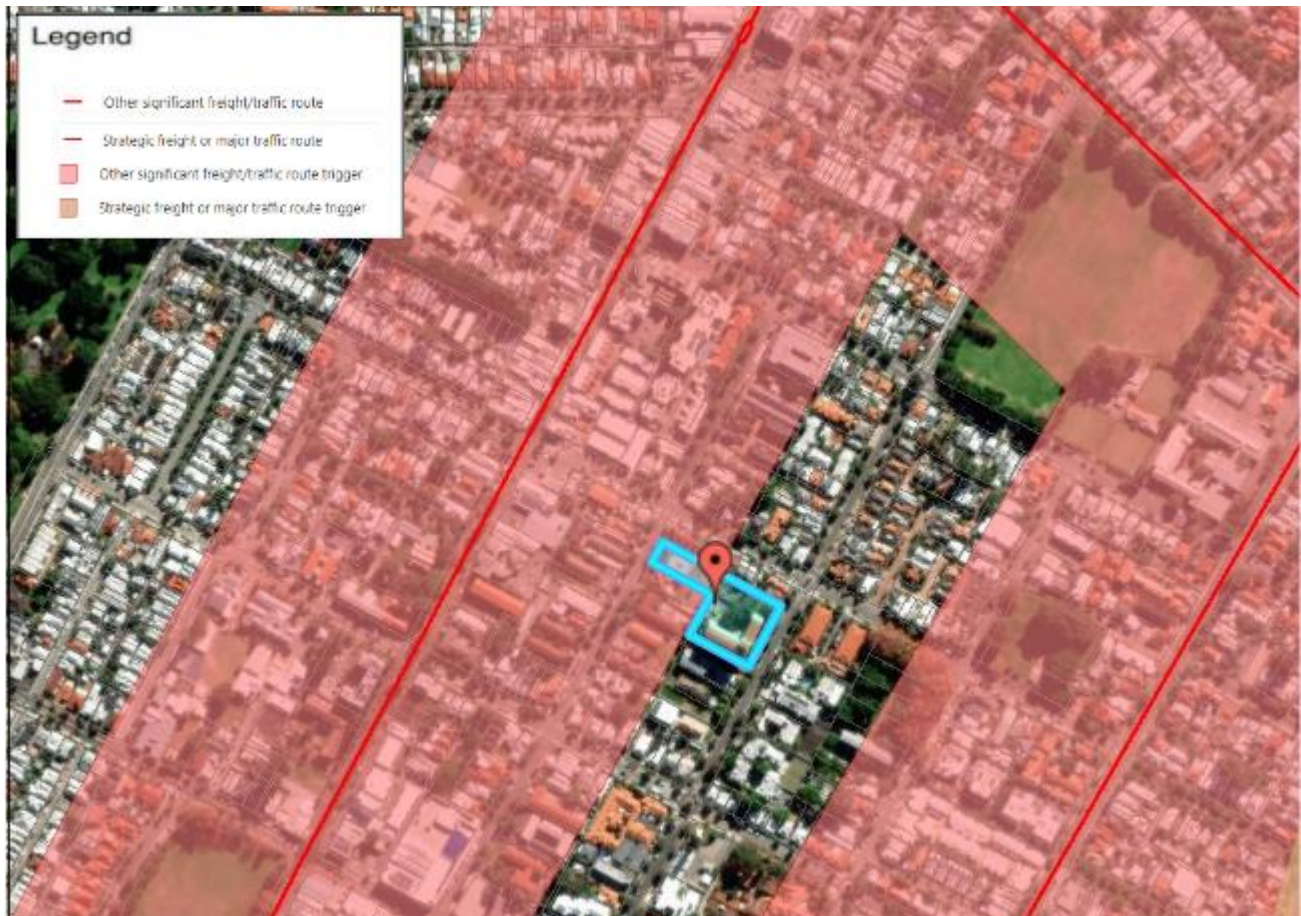
Given that data from mechanical plant manufacturers is generally limited to broadband data or in 1/1 octave band value, it is not possible to objectively determine tonality, as it is described in the EPNR. 1/3 octave band data is required yet is typically unavailable.

Therefore, a +5 dB correction shall be conservatively assigned when assessing noise emissions from mechanical equipment. In summary, Noise emissions from mechanical equipment shall comply with L_{A10} 38 dB at the nearest noise sensitive receiver.

3.3 State Planning Policy 5.4

The project is also required to comply with the State Planning Policy 5.4 – Road and Rail Noise (SPP 5.4).

The SPP 5.4 establishes the outdoor noise criteria that apply to a noise sensitive land use due to noise emissions from road and rail transport. As indicated in Figure 4, the project location is within the SPP 5.4 trigger zone.



Source: Department of Planning, Lands and Heritage <https://espatial.dplh.wa.gov.au/planwa/index.html?viewer=planwa>

Figure 4: SPP 5.4 Zone (Department of Planning, Lands and Heritage)

The noise criteria provided in Table 6 applies to new noise-sensitive development proposals at 1 m from the most exposed, habitable façade.



Table 6: Noise target criteria for SPP5.4

Proposal	New/Upgrade	Noise Targets		
		Outdoor		Indoor
		Day (L_{Aeq} (Day) dB) (6am - 10 pm)	Night (L_{Aeq} (Night) dB) (10pm - 6am)	L_{Aeq} dB
Noise-Sensitive land-use and/or development	New noise-sensitive land-use and/or development within the trigger distance of an existing/proposed transport corridor	55	50	Day: L_{Aeq} 40 (living and work areas) Night: L_{Aeq} 35 (Bedrooms)

The policy requires outdoor targets are to be met at all outdoor areas as far as is reasonable and practical to do so using the various noise mitigation measures outlined in the guidelines.

3.4 Internal Noise Levels and Reverberation Times

The criteria recommended below are based on the limits presented in Australian Standard 'Acoustics – Recommended design sound levels and reverberation times for building interiors' (AS 2107:2016). The levels stated in AS 2107:2016 apply to the combined internal noise levels from building services and external sources. The internal noise level criteria in AS2107 recommend continuous equivalent (L_{Aeq}) levels for background noise. This document is a common reference for establishing satisfactory goals for quasi-static mechanical and external traffic noise ingress.

Table 7: Design internal noise levels (AS2107)

Type of Occupancy	Recommended design sound level, L_{eq} dB(A)	Recommended design sound level, L_{eq} dB(A)
RESIDENTIAL BUILDINGS – Houses and apartments near major roads		
Living areas	35 - 45	-
Sleeping areas	35 - 40	-
Work areas	35 – 40	-
Apartment common areas (e.g. foyer, lift lobby)	45 - 50	See note 1
Enclosed Carpark	< 65	-

1) Reverberation time should be minimised as far as practicable for noise control.

The internal noise level criteria in AS2107 refer to the continuous equivalent (L_{Aeq}) levels for background noise. This document is a common reference for establishing satisfactory goals for quasi-static mechanical and external traffic noise ingress.



3.5 Sound Transmissions and Insulation — National Construction Code 2019

The acoustic requirements for inter-tenancy walls, floors etc. in residential buildings are outlined in the National Construction Code 2019 Volume 1, Building Code of Australia Class 2 and 3 Buildings (NCC 2019). The acoustic requirements outlined in NCC 2019 are summarised in Table 8.

Table 8: Sound insulation requirements in accordance with NCC 2019

Construction	Condition	Deemed-to-Satisfy Requirements	Verification Requirements
Walls	<u>Airborne Sound Insulation</u>		
	Between sole-occupancy units	Minimum $R_w + C_{tr}$ 50	Minimum $D_{nT,w} + C_{tr}$ 45
	Between a sole-occupancy unit and a plant room, lift shaft, stairway corridor, public corridor or the like	Minimum R_w 50	Minimum $D_{nT,w}$ 45
	<u>Impact Sound Insulation</u>		
	Between a laundry, kitchen, bathroom or sanitary compartment in a sole-occupancy unit, and a habitable room in an adjoining unit	Discontinuous construction ¹⁾	As deemed to satisfy
	Between a sole-occupancy unit and a plant room or lift shaft	Discontinuous construction ¹⁾	As deemed to satisfy
Floor	<u>Airborne Sound Insulation</u>		
	Between sole-occupancy units and between sole occupancy unit and lift shaft, stairway or public corridor	Minimum $R_w + C_{tr}$ 50	Minimum $D_{nT,w} + C_{tr}$ 45
	<u>Impact Sound Insulation</u>		
	Between sole-occupancy units and between sole occupancy unit and lift shaft, stairway or public corridor	Maximum $L_{n,w}$ 62	Maximum $L_{nT,w}$ 62
Services	<u>Airborne Sound Insulation</u>		
	Between a habitable room (other than a kitchen) in a sole-occupancy unit and a duct, soil, waste or water supply pipe duct (if the duct or pipe is located in a wall or floor cavity and serves or passes through more than one sole-occupancy unit)	Minimum $R_w + C_{tr}$ 40	N/A
	Between a kitchen or non-habitable room in a sole-occupancy unit and a duct, soil, waste or water supply pipe duct (if the duct or pipe is located in a wall or floor cavity and serves or passes through more than one sole-occupancy unit)	Minimum $R_w + C_{tr}$ 25	N/A



	If a storm water pipe passes through a sole-occupancy unit (habitable room other than kitchen)	Minimum $R_w + C_{tr}$ 40	N/A
	If a storm water pipe passes through a sole-occupancy unit (kitchen or non-habitable room)	Minimum $R_w + C_{tr}$ 25	N/A

- 1) For the purposes of this Part, "discontinuous construction" means a wall having a minimum 20 mm cavity between two separate leaves.



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4. Noise Intrusion Assessment

A previous acoustic assessment as part of development application was conducted to determine the noise impact from the external traffic noise source. This was detailed in the acoustic report issued by Stantec 'AC-RP-301251813-STN-XX-XXX-RE_AC-000001_C01' issued 05th May 2024.

The road traffic noise impact for the future year (2044) predicted the highest external noise levels for the day and night-time periods to be at the following façade location(s):

- North-Western Façade, Day-time scenario: **48 dB(A)**
- North-Western Façade, Night-time scenario: **41 dB(A)**

4.1 External Envelope

Noise intrusion calculations were undertaken following the methodology described in British Standard BS EN 12354:2000 and by utilizing the worst case (i.e. highest predicted) noise levels predicted at each façade to determine suitable glazing to achieve the required internal noise levels. Appropriate corrections were applied to the linear spectral noise levels to compensate for potential losses due to flanking paths and façade correction.

4.1.1 External Wall

The noise intrusion has been calculated for all façade elements, which is relative to their surface area.

Stantec recommends solid wall elements have a minimum performance of $R_w + C_{tr}$ 40 - 45.

Architectural wall types have been reviewed and the proposed configurations presented in Table 9 are acceptable to meet the nominated acoustic criteria. The cavity within the furring channels is required to be filled in with glasswool insulation (Min. Density 14kg/m³).

Table 9: Façade wall element configuration

Configuration	Wall Performance $R_w + C_{tr}$
Option 1 13mm plasterboard + furring channel, cavity filled with insulation + 110mm brick (internal)+ 50mm cavity (insulation/ sarking TBC) + 110mm brick (external)	> 45
Option 2 13mm plasterboard + furring channel, cavity filled with insulation + 162 AFS (internal)+ (insulation/ sarking only TBC) + 110mm brick (external) – tied into AFS with brick ties	

4.1.2 External Glazing

Glazing systems and entryway elements typically provide lower airborne sound insulation performance than external walls, forming weak acoustic links in the building envelope.

To satisfy internal noise level design targets, glazed elements located at the façades are determined based on the composite sound reduction index (i.e., the combined sound insulation performance of all façade elements relative to their surface area).



Glazing types for each noise sensitive space located at each façade of the proposed development have been comparatively assessed against the noise levels detailed in this report. The table below provides the glazing performance and proposed locations required to satisfy internal noise level design targets. The performance ratings outlined below are required for compliance to internal noise level design targets and apply to the glazing system as a whole (i.e., frame, seals and window hardware), with a maximum allowable deviation of 2-3dB only.

Table 10: External Glazing Configurations

Glazing Configuration	$R_w + C_{tr}$	Spectrum Sound Transmission Loss (dB)						
		63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz
<u>SG Option</u>								
6.38mm laminated glass	29 (32; -3)	15	19	24	29	33	35	41
<u>DG Option</u>								
6mm glass + 12mm air gap + 6mm glass	29 (36; -7)	22	23	19	36	45	41	43

Note: Glazing performance provided for glass only. Overall performance of the glazing system including the frames and seals shall not degrade by more than 3 dB as per the performance requirement stated.

Please note that all the bedrooms and living rooms facing the central common area (resident outdoor area) can be constructed with either:

- 6.38mm laminated glass or
- 6mm glass + 12mm air gap + 6mm glass.

4.1.3 Roof Construction

Roof construction should be adequately designed to control external noise intrusion from noise sources identified in this report to satisfactorily provide internal noise levels which are compliant with the criteria.

The following roof configuration is expected to achieve the above objectives:

One layer of Colorbond sheet metal or similar (0.42 mm); and

- 75 mm thick high-density Anticon insulation hard fixed to the underside of roof and over steel purlins;
- Suspended light weight steel framing system; and
- Min. 50 mm thick glass wool insulation (min. 14kg/m³) one layer of 13 mm standard plasterboard.

Refer Section 6.3.2 for roof construction requirements to control noise intrusion from mechanical plant deck.



5. Architectural Acoustics

5.1 Internal Partitions

Minimum partition construction types required to satisfy the relevant acoustic separation targets nominated by NCC 2019 for intertenancy partitions have been provided in Table 11. This table shall be read in conjunction with the colour-coded partition mark ups provided in Appendix B.



Table 11: Wall Constructions

Colour code	Type	Proposed Configuration	Expected Performance
 PT - 1	Sole-occupancy wall (Room to Room)	162 AFS Wall Where furring channel + plasterboard is being applied to the AFS wall the cavity within the furring channel is filled with glasswool insulation (Min. Density 14kg/m ³)	R _w + C _{tr} ≥ 50
 PT - 1	Sole-occupancy wall (Habitable to wet area)	162 AFS wall with <ul style="list-style-type: none">20mm air gap64mm steel stud filled with min.75mm glass wool insulation (Min. Density 14kg/m³)1 layer of 13mm plasterboard	
 PT - 2	Bounding walls (Room to corridor)	150 AFS Wall	R _w ≥ 50
 PT - 3	Bounding walls (SOU to lift riser or plant room)	200 AFS wall with <ul style="list-style-type: none">One row of 64 mm steel studs at 600 mm centres, <u>spaced 20 mm from the AFS wall</u>; and75 mm glass wool insulation with a density of 14 kg/m³, positioned between studs; andOne layer of 13 mm plasterboard fixed to the outside face of the studs.	R _w ≥ 50 (discontinuous)
 PT - 4	Habitable room (including open plan kitchen) to services that passes through more than one sole occupancy unit	AFS 150 or 2 layers of 13mm plasterboard Services within the riser to be installed with 20mm air gap Acoustic rate pipe Rehau Rupiano plus or acoustically lag with min 25 mm glasswool or foam bonded to a loaded vinyl noise barrier layer (min. mass per unit area of 4.5kg/m ² , Pyrotek 4525C or equivalent). Risers to be closed off at each floor level.	R _w + C _{tr} 40
 PT - 5	Non-habitable room (excluding open plan kitchen) to services that passes through more than one sole occupancy unit	AFS 150 or 1 layer of 13mm moisture resistant plasterboard Services within the riser to be installed with 20mm air gap Acoustic rate pipe Rehau Rupiano plus or acoustically lag with min 25 mm glasswool or foam bonded to a loaded vinyl noise barrier layer (min. mass per unit area of 4.5kg/m ² , Pyrotek 4525C or equivalent). Risers to be closed off at each floor level.	R _w + C _{tr} 25

5.1.1 Party Walls to Roof Over

NCC Part 5.5 (f) states 'where a separating wall that is required to have a minimum sound insulation performance has a floor or roof above, then that wall must continue to the underside of the floor/roof above, or, the roof or ceiling must have an equal sound insulation performance as the wall.

5.1.2 Intra-tenancy Walls

All intra-tenancy walls constructed around bathrooms, laundry, kitchens and any other room or riser containing soil, waste and storm water pipes serving a different tenancy in the ceiling space or riser shall be constructed to be full height to the soffit slab above. Where full height walls are not practical, lagging of pipes in combination with insulation on plasterboard ceiling shall be considered to comply with the NCC requirements.

5.1.3 Technical Recommendations for Drywall Partitions / Linings

- Preserve the sound reduction properties of sound rated partitions by sealing flanking sound transmission paths during installation including but not necessarily limited to junctions between partitions and other building surfaces, air gaps around door sets, cut-outs for services and the like.
- Install fibreglass or polyester insulation of minimum density 14 kg/m^3 in the partition cavities as specified or as shown on the Contract drawings. Ensure the insulation does sag or fall down post installation.
- Tightly butt joint inner sheets for multiple layer plasterboard walls. Stagger joints between adjacent sheets. At corners or at locations where coinciding alignment of joints between sheets for cavity side, inner and face sheet linings cannot be avoided fully fill joints during each sheet fixing. Tape and set joints in face sheets.
- Ensure that all full height walls presented in Table 11 extend from the slab to the underside of the soffit. All partitions are to be sealed in accordance with manufacturers recommendations to maintain the acoustic performance requirements.
- Where discontinuous construction partition is required, studs to be separated by at least 20 mm cavity.
- Acoustically lag the service pipes or install acoustic bulkheads surrounding service pipes located in habitable areas of offices as specified and seal with an approved acoustic sealant at the junction with walls and soffit.
- All electrical GPO's and data sockets must be offset by at least 300 mm in acoustically rated partitions.

5.1.4 Acoustic Treatment of Services – Ceilings / Risers

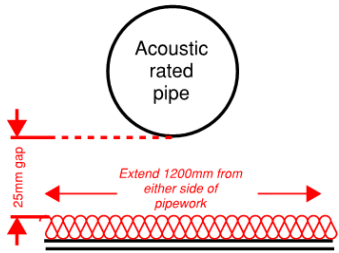
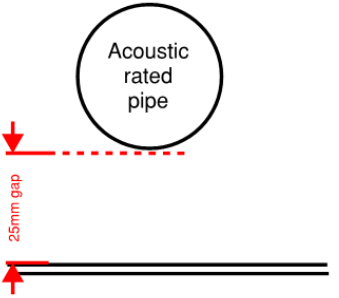
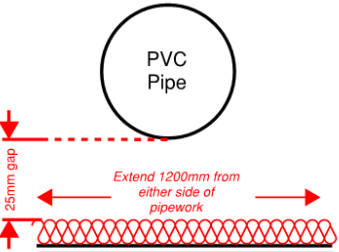
In addition to minimum airborne sound insulation performance parameters as specified for separating walls, the NCC also prescribes minimum airborne sound insulation parameters for services which separate building services from residential spaces, in order to preserve a minimum level of acoustic amenity for building occupants.

Where a duct, soil, waste or hydraulic service pipe passes through more than one sole occupancy unit they must be located within a construction capable of minimum $R_w + C_{tr}$ 40 if they pass through a habitable room (other than a kitchen), or minimum $R_w + C_{tr}$ 25 if they pass through a kitchen or a non-habitable room. For the purposes of this report, hydraulic services refer to all concealed piping installations relating to sewerage, storm water, hot and cold-water supply and gas.

The maximum numbers of down lights per 5m^2 area as per Table 12.



Table 12: Ceiling constructions for hydraulic services noise

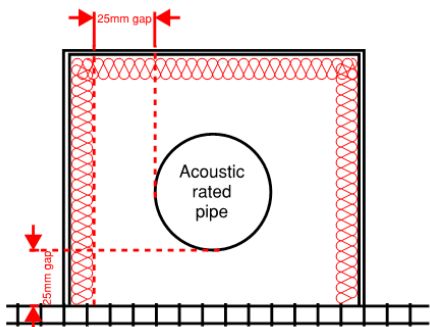
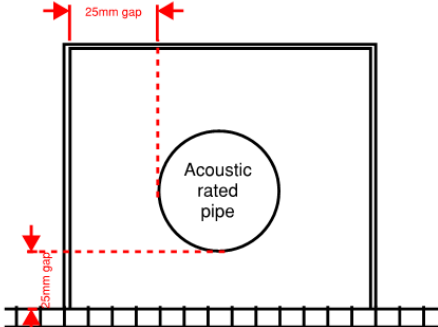
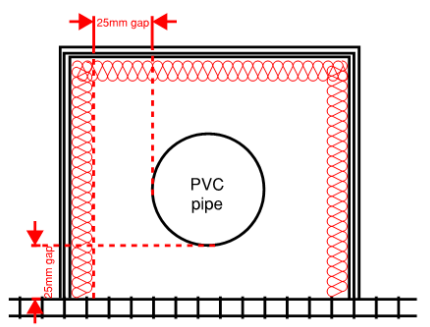
Services Concealment Treatment	Ceiling Lining	Insulation	Pipe/Pipe Lagging	Max No. of Downlights per 5m ²	R _w + C _{tr}
	<p>1 layer of 13mm standard plasterboard</p> <p>25mm air gap to be provided between the pipework and ceiling/insulation.</p>	<p>Min 75mm thick Earth wool batts, min. density of 14kg/m³. Installed to a min. distance of 1200mm either side of pipe.</p>	<p>Acoustic rated pipe- Rehau Rqupiano Plus , Valsir Triplus or similar ⁽¹⁾.</p> <p>Alternatively, where PVC pipes are being used, provide min. 25 mm glasswool or foam bonded to a loaded vinyl noise barrier layer (min. mass per unit area of 4.5kg/m², Pyrotek Soundlag 4525C or equivalent).</p>	5	≥ 40 (Habitable Rooms)
	<p>1 layer of 13mm standard plasterboard</p>	Not required.	Acoustic rated pipe- Rehau Raupiano Plus , Valsir Triplus or similar ⁽¹⁾ .	2	≥ 25 (Non-Habitable Rooms)
	<p>25mm air gap to be provided between pipework and ceiling/insulation</p>	<p>Min. 75mm thick Earth wool batts, of min. density 14kg/m³. Installed to a min. distance of 1200mm either side of pipe.</p>	PVC pipes (Alternative)		

Note: 1) Installation of acoustic rated pipe work must be in strict accordance to manufacturers recommendations.



Refer to Table 11 for wall constructions to achieve the acoustic performance of the riser construction.

Table 13: Riser constructions for services noise

Services Concealment Treatment	Insulation	Pipe/Pipe Lagging	$R_w + C_{tr}$
	<p>Min. 75mm thick Earth wool batts, min. density 14kg/m³.</p> <p>25mm air gap to be provided between the pipework and riser wall/insulation.</p>	<p>Acoustic rated pipe- Rehau Raupiano Plus , Valsir Triplus or similar ⁽¹⁾.</p> <p>Alternatively, where PVC pipes are being used, provide min. 25mm glasswool or foam bonded to a loaded vinyl noise barrier layer (min. mass per unit area of 4.5kg/m², Pyrotek Soundlag 4525C or equivalent).</p>	<p>≥ 40 (Habitable Rooms)</p>
	<p>Not required.</p> <p>25mm air gap to be provided between the pipework and riser wall.</p>	<p>Acoustic rated pipe- Rehau Raupiano Plus , Valsir Triplus or similar⁽¹⁾.</p>	<p>≥ 25 (Non-Habitable Rooms)</p>
	<p>Min. 75mm thick Earth wool batts, min density 14kg/m³. Installed to a min. distance of 1200mm either side of pipe.</p> <p>25mm air gap to be provided between the pipework and riser wall/insulation.</p>	<p>PVC pipes (Alternative)</p>	<p>≥ 25 (Non-Habitable Rooms)</p>

Note: 1) Installation of acoustic rated pipe work must be in strict accordance to manufacturers recommendations.

All pipes should be secured in cavities, voids or service risers using resilient pipe clip connections which incorporate an isolating rubber or neoprene collar, to avoid introducing pipe-borne noise into the surrounding structural elements.

Furthermore, all pipe runs connected to hydraulic circulation pumps or similar plant equipment must be connected via flexible couplings to avoid the introduction of structure borne noise through rigid connections.



5.2 Separating Floors

The NCC requires floor constructions to be treated or engineered to provide resistance to both airborne and impact sound transmission. Construction details are provided in Table 14.

Floor Mark-ups are provided in Appendix C showing the areas that require treatment.

Table 14: Floor construction

Type	$L_{n,w} \leq 62$ and $R_w + C_{tr} \geq 50$
 <p>SOU or public corridor over SOU (NCC requirement)</p>	<p>Floor finish</p> <ul style="list-style-type: none"> • Carpet with foam underlay <p>Slab thickness:</p> <ul style="list-style-type: none"> • 200mm thick <p>Ceiling Treatment:</p> <ul style="list-style-type: none"> • None
	<p>Floor finish:</p> <ul style="list-style-type: none"> • Timber or Vinyl planks with acoustic underlay. • Tiles with 4.5mm 4515 Regupol underlay; <p>Slab thickness:</p> <ul style="list-style-type: none"> • 200mm thick <p>Ceiling Treatment:</p> <ul style="list-style-type: none"> • Minimum 10mm thick plasterboard ceiling suspended on light steel grid
$R_w + C_{tr} \geq 50$	
 <p>SOU over enclosed carpark/services room (NCC requirement)</p>	<p>Floor finish:</p> <ul style="list-style-type: none"> • Carpet with foam underlay • Tiles • Timber <p>Slab thickness:</p> <ul style="list-style-type: none"> • 200mm thick <p>Ceiling Treatment:</p> <ul style="list-style-type: none"> • None Required



5.2.1 Resilient Underlays

Where a carpet on a foam underlay is proposed no further treatment to control impact sound insulation is required. However, where carpet tiles, vinyl, linoleum, ceramic or wooden flooring finishes are proposed, a resilient floor underlay treatment will be required.

Where internal kitchen and living areas have timber or tiled finish, a layer of acoustic resilient layer (4.5 - 5 mm thick) beneath the floor finish will be required.

Vinyl planks with integrated acoustic underlay are required to meet compliance with the NCC requirements and have a weighted reduction in impact sound pressure level (ΔL_w) of not less than 18 dB when measured in accordance with AS ISO 140-8: 2006.

Where a habitable space is located above an office area, impact isolation treatment to the floor is recommended in order to mitigate any potential impact noise into the office space below.

The resilient underlay treatment shall have a weighted reduction in impact sound pressure level (ΔL_w) of not less than 18 dB when measured in accordance with AS ISO 140-8: 2006 – Measurement of sound insulation of buildings and of building elements – laboratory measurements of the reduction of transmitted impact noise by floor coverings on a heavyweight standard floor and rated in accordance with AS ISO 717-2: 2004 – Acoustics – Rating of sound insulation in buildings and of building elements – Part 2: Impact Sound Insulation.

Resilient isolation layers must be installed in strict accordance with manufacturer's details with appropriate edge detailing applied to avoid 'shorting' the resilient layer at perimeter junctions.

Approved Suppliers / Product Examples

Approved suppliers for impact isolation underlays include:

- Regupol / Damtec / Dunlop

Any alternative product shall be submitted to the acoustic engineer for approval along with acoustic test data confirming compliance to the criteria.



5.3 Doors

Table 15 describe the door constructions required to achieve the stated acoustic performance. Refer to mark-ups in Appendix B for locations of door types. Where doors are present in enclosed corridors in close proximity, we recommend the doors to be upgraded (refer Appendix B)

Table 15: Recommended door construction details

Airborne Sound Insulation Performance (R_w)	Configuration
 <p>D - 1</p> <p>R_w 30</p>	<p>45mm solid core door leaf with particle cores or laminated softwood cores, with a minimum mass per unit area of 27 kg/m²</p> <p>Frames for these doors have a minimum recommended section of 90 mm x 40 mm with a stop of at least 15 mm.</p> <p>Compression or wipe seals should be used around the door's perimeter, with a threshold seal beneath. A drop-down or wipe type threshold seal is suitable.</p> <p>Example seals: Raven RP10 for the perimeter and RP38 for the bottom seal.</p>
 <p>D - 2</p> <p>R_w 35</p>	<p>54mm solid core door with a minimum mass per unit area of 29 kg/m². Frames for these doors to be of steel and must be filled with insulation (min. density 32 kg/m³) have a minimum recommended section of 90 mm x 40 mm with a stop of at least 15 mm.</p> <p>Compression or wipe seals should be used around the door's perimeter, with a threshold seal beneath. A drop-down or wipe type threshold seal is suitable.</p> <p>Example seals: Raven RP10 for the perimeter and RP38 for the bottom seal.</p>



6. Building Services

6.1 NCC Construction Requirements for Building Services

Summary of Specific Requirements

The NCC makes provision of criteria specific to the placement and function of mechanical building services. To be deemed to satisfy, provisions must be made such that;

- i) Services must not be chased into concrete or masonry elements
- ii) Access doors/panels required to have a certain $R_w + C_{tr}$ that provides access to a duct, pipe or other service must –
 - a) not open into any **habitable** room
 - b) be firmly fixed such that the rebate or frame is overlapped by the access panel by not less than 10mm, and be fitted with a sealing gasket along all edges. And be constructed of;
 - wood, particleboard or block board >33mm thick
 - compressed fibre reinforced cement sheeting >9mm thick
 - *Other suitable material with mass per unit area > 24.4 kgm⁻²*
- iii) A water supply pipe must –
 - a) Only be installed in the cavity of a discontinuous construction; and
 - b) In the case of a pipe that serves only one sole-occupancy unit, not be fixed to the wall leaf on the side adjoining any other sole-occupancy unit, and have a clearance of at least 10mm to the other leaf
- iv) Electrical outlets must be offset from each other –
 - a) In masonry walling, not less than 100mm; and
 - b) In timber or steel framed walling, not less than 300mm

6.2 Fire Pump Room

At this stage no selection of the fire pump is available. When the full equipment schedule has been provided, specific acoustic treatments will be provided to achieve compliance to the relevant EPNR assigned noise levels at nearest noise sensitive receivers.

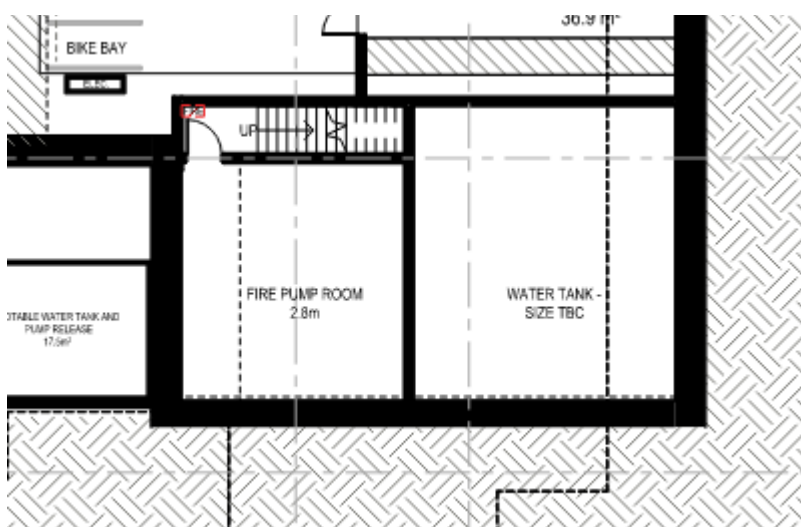


Figure 5: Location of Fire Pump Room



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The following general treatments will be required:

- design the air distribution system to minimise flow resistance and turbulence
- balance systems with minimum throttling
- design fans to run generally at low speed
- use acoustic flexible duct where flexible duct is required
- No air relief door grilles are to be located in acoustically rated doors, where ventilation is required between spaces, transfer grilles with cushion heads are to be used. Transfer grille cushion heads are to be specified -with a minimum internal lining of 25mm.

Duct Lining

All rigid duct work from to have acoustic lining (internal) to the extent indicated by the mechanical engineer's drawings.

Internal insulation to be, at minimum, 50mm thick and shall be "Bradford Supertel" semi-rigid fibreglass batt of 32 kg/m³ density or approved equivalent. The insulation shall be placed on the inside of the duct with adjacent sides overlapping at all corners and with all joints tightly butted. All joints in insulation panels shall be made with a minimum 50 mm lap of foil in the direction of air flow to prevent the air stream lifting the leading edge. Acoustic properties of the insulation systems shall be as detailed in Table 17.

All subsequent flexible duct work branches from FCU supply to have acoustic lining as per the mechanical engineer's specification.

Table 17: Minimum required attenuation static insertion losses (dB), for each frequency band (Hz)

Insulation	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Perforated foil faced – 50mm	0.23	0.71	0.99	1.09	0.97	0.97

Return Air Ceiling Penetrations

If fan coil units (FCU) are not ducted to the return air grille, return air penetrations can degrade the acoustic performance of the ceiling system, especially where FCUs are located near critical areas, such as bedrooms. Generally, return air penetrations should not be located within a 2 m radius of a fan coil unit location.

Return air ducts to be treated with, at minimum, 25 mm thick internal acoustic lining. Return air outlets to all ducted fan coil units which have a rated capacity of 8 kW or more are to be fitted with internally lined ducts with a minimum length of 3000mm and with at least one 90° bend.

Casing Breakout

Case radiated breakout noise from fan coil units and VAV's located in the roof subspace, above the sensitive spaces will require to be mitigated by acoustically lagging the units. This is only applicable when the casing breakout from the selected units exceeds the internal noise level criteria.

The acoustic lagging to be constructed of the following:

The acoustic lagging to consist of 50mm thick convoluted foam externally finished with a flexible loaded vinyl wrapping material having a surface mass not less than 6 kg/m². Seal all joints and junctions within or at the edges of the wrapping with an adhesive tape approved by the vinyl material supplier.

Noise Control Measures

Coordinate ductwork so as to minimise penetrations through sound rated partitions.

- Where ductwork penetrates sound rated partitions install acoustic treatment to ensure the sound insulation rating is not downgraded.



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- Where services carry vibration or noise, provide an oversized penetration which shall be packed with fibreglass and sealed using a silicone or similar flexible sealant to both finished faces of the penetration, installed in accordance with the sealant manufacturers' recommendations. Where the gap between the service and the surrounding structure is larger than 15 mm, provide a metal flashing cover over the fibreglass filler and seal using a flexible sealant. Ensure that the metal flashing does not transfer vibration into the adjacent structure.
- Supply and install acoustic treatment (attenuators, lined ducts, acoustic louvres etc.) to mechanical equipment where required to comply with specified background noise levels.
- Low noise supply air diffusers and return air registers shall be selected to prevent excessive regenerated noise.
- Externally insulate ductwork, pipework and equipment where required to comply with specific background noise levels.
- Selection of vibration isolation systems shall be made based on the rotational/reciprocating speeds and power requirements, design minimum isolation efficiency, floor static deflection and plant/equipment mass etc.
- Provide a clearance of minimum 50 mm between vibrating equipment and nearby building structure.
- Flexible connections shall be provided before the first rigid connection to the building structure.

Services Penetrations

Penetrations through acoustic rated walls shall be sealed to ensure that the sound insulation and noise criteria performance requirements of this specification are not compromised.

Holes in walls, ceilings, floors, façades or roofs etc. for penetrations shall be sized to accommodate ducts with the minimum clearance that is practicable.

Once ductwork or pipework is installed, the hole around it shall be sealed according to the details shown on the building services contract drawings (or equivalent detail agreed in writing by the client's representative).

Acoustic lagging shall be absent as ducts and pipes pass through the thickness of the wall, ceiling, floor, façade or roof, and, where permissible, thermal lagging shall also be removed.

Treating Penetrations

Ensure that all penetrations through building elements are made in such a way that the sound insulation and noise criteria performance requirements of this specification are not compromised.

Holes made in building elements shall be made good. This shall be done by filling or covering the hole with a material of the same mass per unit area as the Building Element through which the penetration has been made, using a method that ensures that no material can fall into cavities or bridge Isolation Boundaries

6.4 Hydraulic Services

The noise from hydraulic services is generally attributed to structure-borne rather than an airborne noise issue. This is caused due to direct coupling of services pipework that allows noise from fluid flow and/or water hammer to transmit through structural elements and radiate noise.

It is highly recommended not to chase hydraulic services into concrete or masonry elements of sound rated walls as it can compromise acoustic separation performance. Refer to Section 5.1.4 for construction details for hydraulic services within vertical risers and ceiling voids. Additionally, the following general recommendations are provided for fixing of hydraulic services:

- All penetrations are to be sealed with a flexible caulking compound to ensure no gaps
- Pipework/ including soil waste is to be acoustically isolated at mounting points and penetrations—pipe insulation (Bradflex), 6 mm thick neoprene, closed cell foam or 'unicushion' is required between all pipes and pipe clamps; alternatively provide neoprene element vibration isolation hangers to pipe supports or mounting points.
- Where possible, waste pipes shall not be fixed to the walls of the riser shaft. Fixing shall occur only at slab edges.
- Pipes must not be supported by wall lining sheets.



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- Pipework is to be supported from the 'wet' side of the isolated partition studwork.
- Pipes/taps may penetrate only one face of the wall between any two studs.
- Ensure there is no direct contact between waste pipes and surrounding elements a 50 mm clearance to all other building elements is recommended where possible.

6.5 Electrical Services

The following general recommendations are provided for electrical services:

- It is important that penetrations for electrical services through inter-tenancy walls and corridor walls are not downgrading the acoustic performance. These penetrations should be avoided where possible and switches and outlets should ideally be surface mounted.
- If electrical services are not surface mounted, switches and outlets must be offset;
 - in concrete walls not less than 100 mm; and
 - in brick walls and stud frame walls, not less than 300 mm. Outlets installed in walls rated $R_w \geq 50$ shall be installed with acoustic/fire rated wall boxes rated R_w 50 or above.
- Electrical outlets include general power and telecommunication outlets, television and internet outlets, light switches and wall mounted lights.
- It is highly recommended not to chase electrical services into concrete or masonry elements of sound rated walls as it can compromise acoustic separation performance.
- Where electrical services penetrate plant room walls or floors, an inter-tenancy wall or floor/ceiling or a riser shaft wall, the penetration shall be acoustically treated so that it does not degrade the sound isolation rating of the subject partition.
- Penetrations shall be sized for cables and conduits passing through building slabs, plasterboard or masonry walls to allow a uniform clearance of 10 mm around the item and this gap shall be sealed using an approved acoustic sealant.



Appendix A Glossary of Acoustic Terms

NOISE	
Acceptable Noise Level:	The acceptable LAeq noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
LAm _{ax}	The maximum A-weighted sound pressure level measured over a period.
LAm _{in}	The minimum A-weighted sound pressure level measured over a period.
LA ₁	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
LA ₁₀	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
LA ₉₀	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq	The A-weighted "equivalent noise level" is the summation of noise events and integrated over a selected period of time.



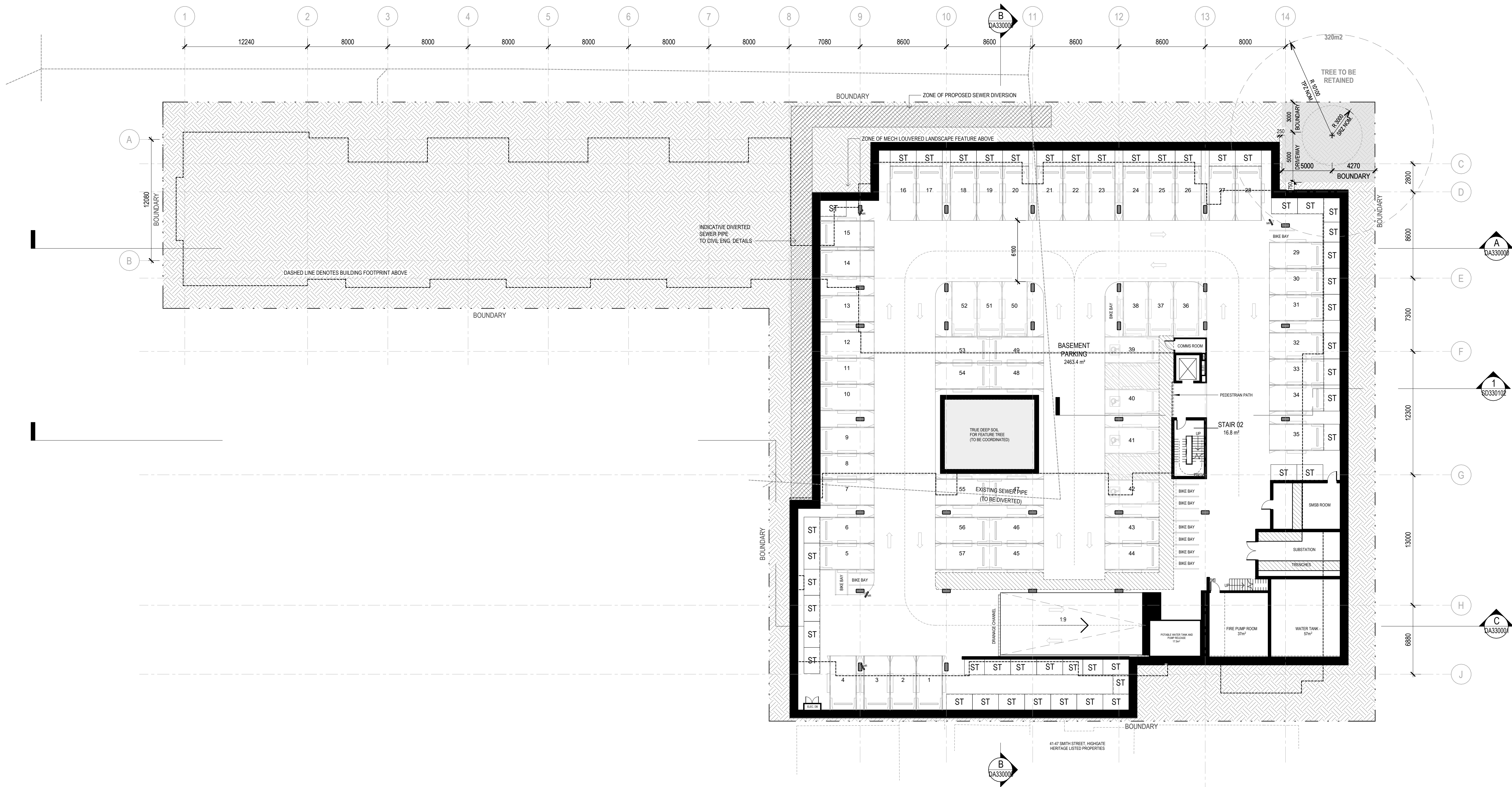
LAeqT	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R-w:	The Sound Insulation Rating R-w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.



Appendix B Wall Mark Ups



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project

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BASEMENT

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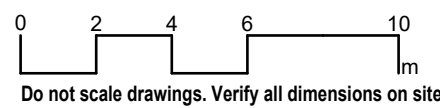
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Nominated Architect
Ray Brown, NSWARB 6359

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EXCAVATION DRAWING NOTES

- REFER TO STRUCTURAL ENGINEERS DRAWINGS FOR SIZE OF FOOTINGS AND CONCRETE PILESPICE CAPS.
- ANY EXISTING STRUCTURES AND/OR SERVICES THAT ARE NOT IDENTIFIED ON THE DOCUMENTS ARE TO BE REPORTED TO THE SUPERINTENDENT IMMEDIATELY.
- EXCAVATED ROCK SHELF BENCH LEVELS MAY VARY AND ARE SUBJECT TO EXISTING FOOTING LEVELS. ALL BENCH LEVELS ARE TO BE CONFIRMED ON SITE BY THE STRUCTURAL ENGINEER.
- PRIOR TO COMMENCING EXCAVATION, ALL PLANS, METHODOLOGIES, STAGING AND CONSTRUCTION PROCEDURES ARE TO BE APPROVED BY THE GEOTECHNICAL AND/OR STRUCTURAL ENGINEER AND RELEVANT AUTHORITIES. REFER TO THE STRUCTURAL AND/OR CIVIL DRAWINGS FOR EXCAVATION DETAILS, SEQUENCING, TEMPORARY WORKS AND OTHER SPECIFIC REQUIREMENTS.
- ARCHITECTURAL DRAWINGS MUST BE READ IN CONJUNCTION WITH THE STRUCTURAL AND/OR CIVIL ENGINEERING DRAWINGS.
- IF DISCREPANCIES ARE FOUND BETWEEN THE ARCHITECTURAL AND STRUCTURAL/CIVIL ENGINEERS DRAWINGS



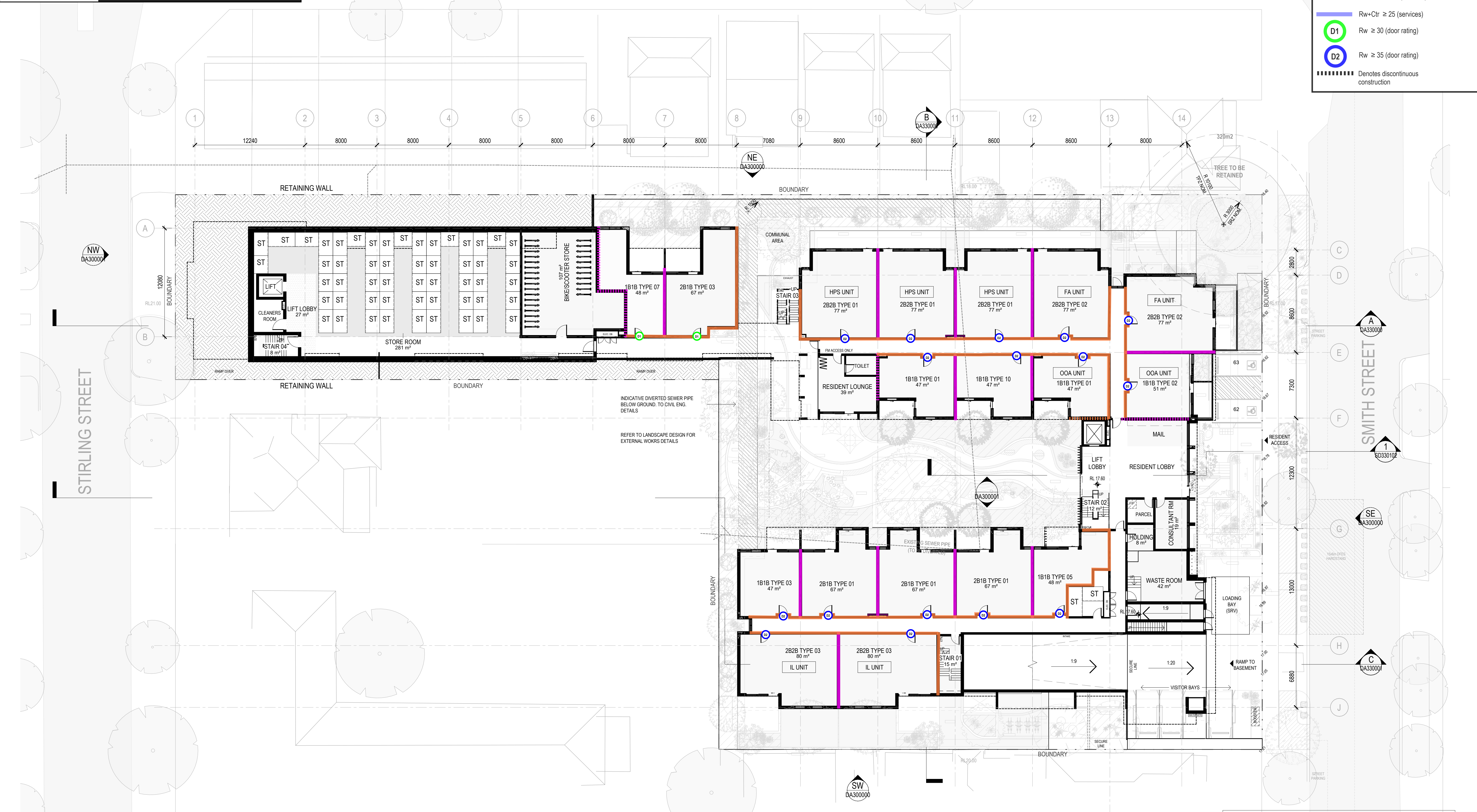
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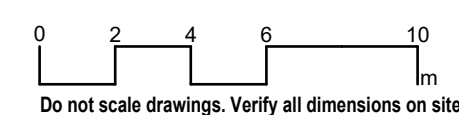


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Nominated Architect
Ray Brown, NSWARB 6359

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SMITH STREET, HIGHGATE

LOT 501 SMITH STREET, PERTH

drawing

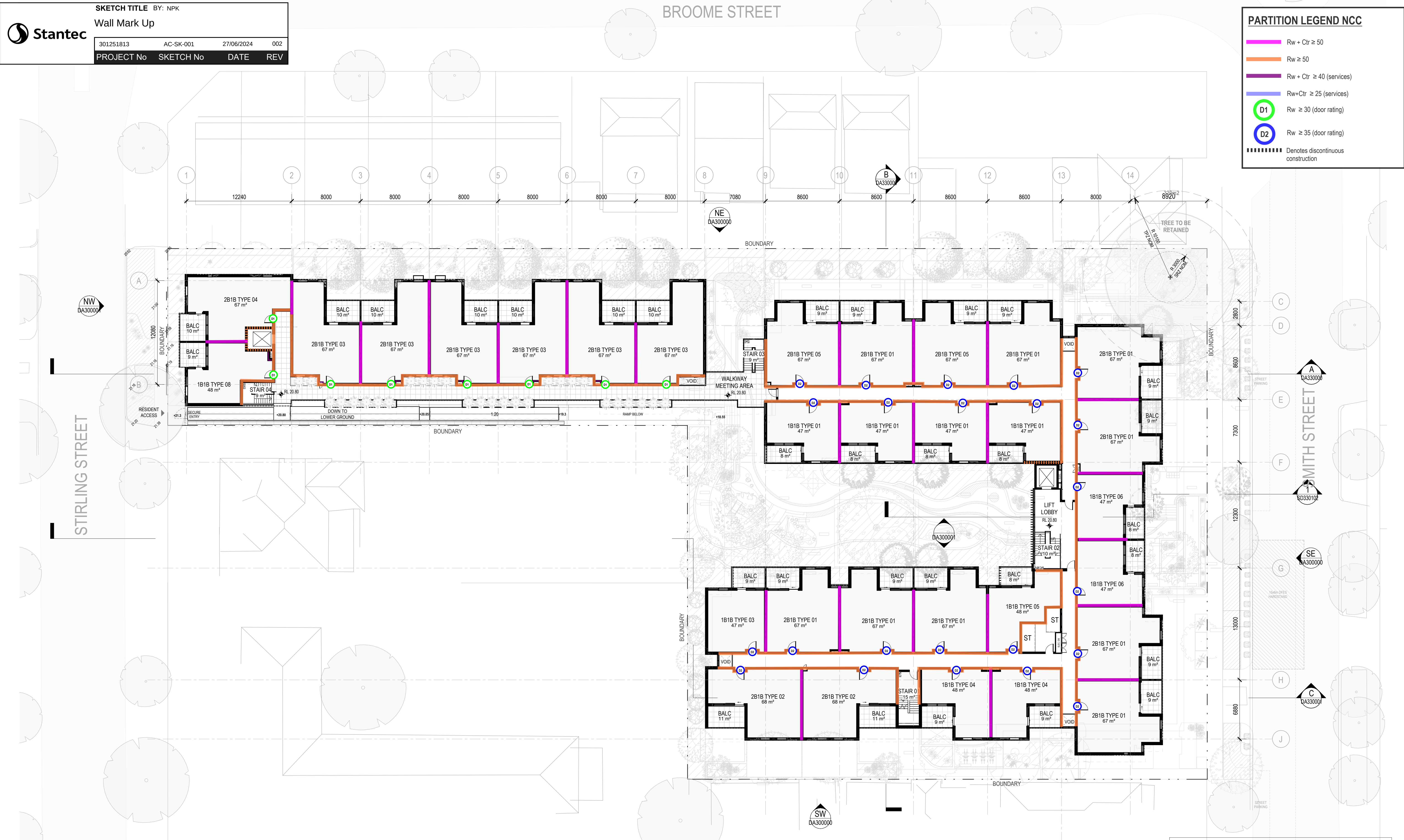
GROUND - LOWER

drawing no.

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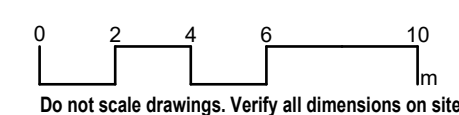


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SMITH STREET, HIGHGATE

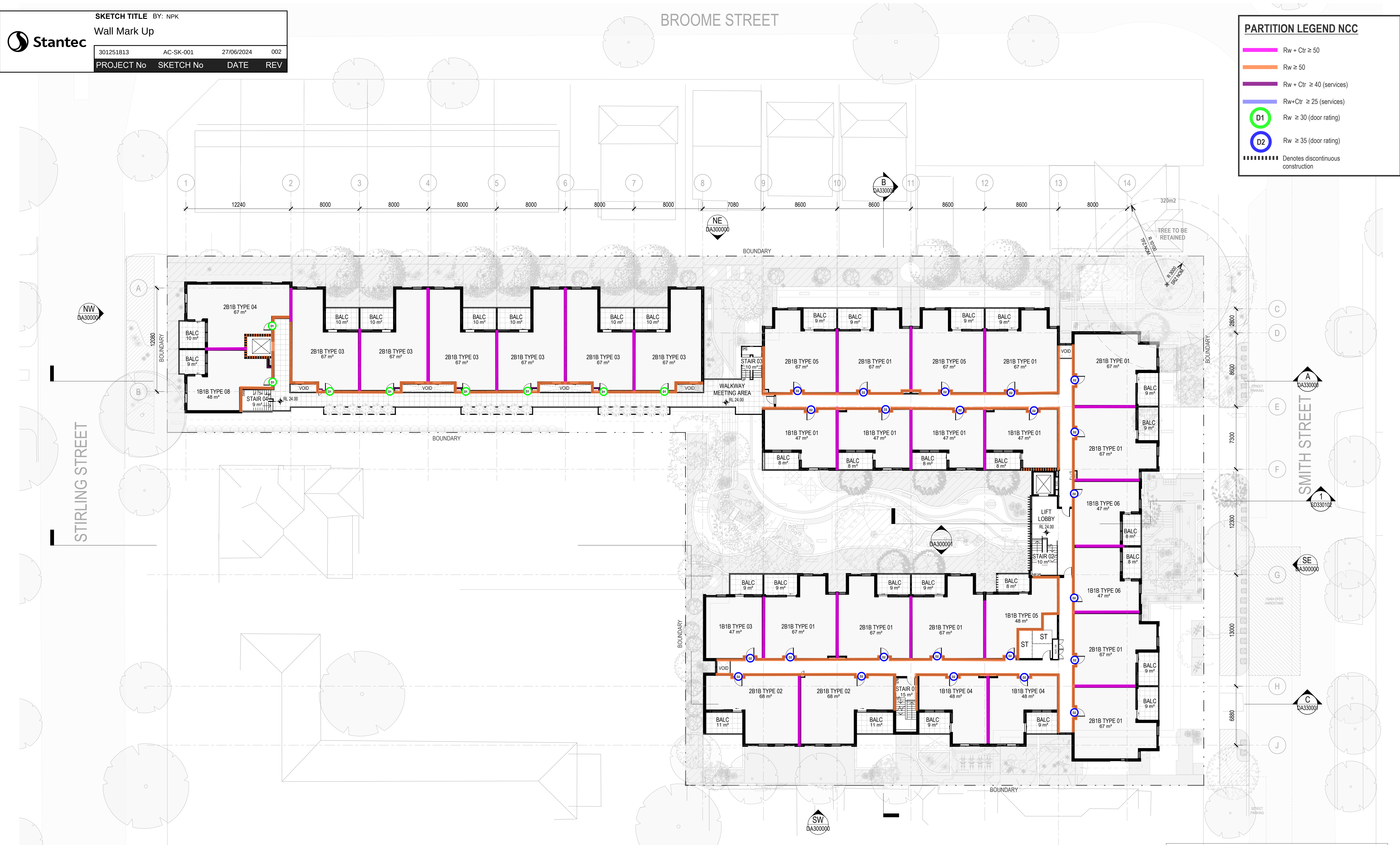
LOT 501 SMITH STREET, PERTH

GROUND - UPPER / LEVEL 01

drawing no.

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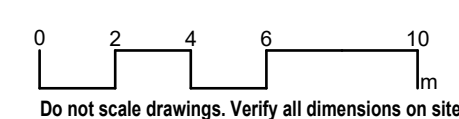


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Nominated Architect
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SMITH STREET, HIGHGATE

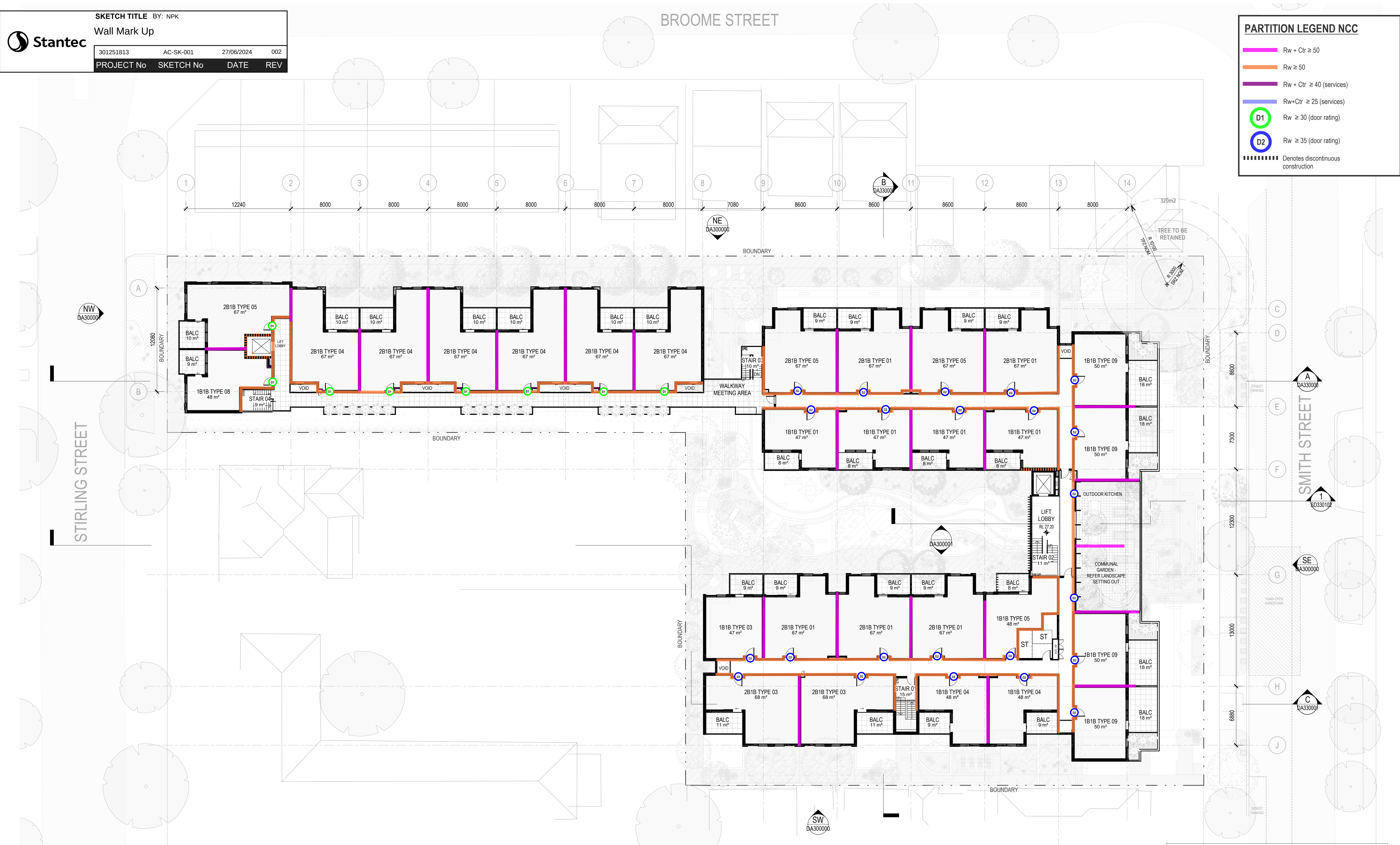
LOT 501 SMITH STREET, PERTH

LEVEL 02

drawing no.	revision
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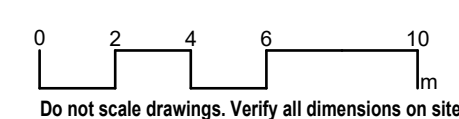


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Nominated Architect
Ray Brown, NSWARB 6359

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 - 4. DIMENSIONS TO FACE UNLESS OTHERWISE STATED.
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prepared	project no	230010.0

SMITH STREET, HIGHGATE

LOT 501 SMITH STREET, PERTH

LEVEL 03

drawing no.	revision
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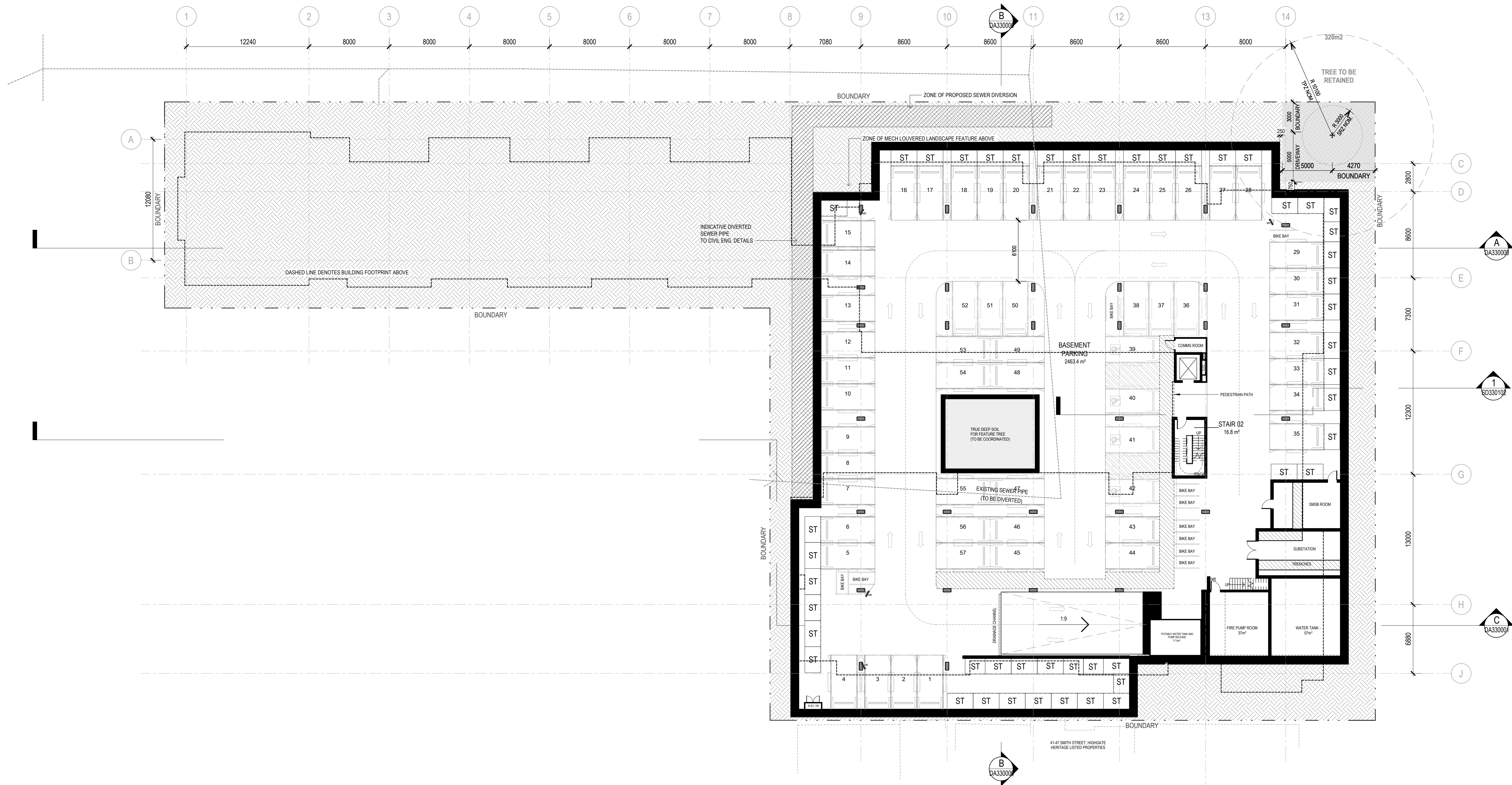
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Appendix C Floor Mark Ups



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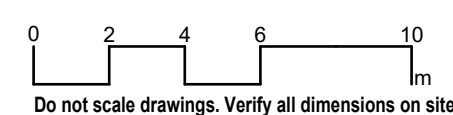


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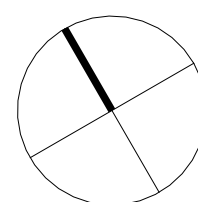
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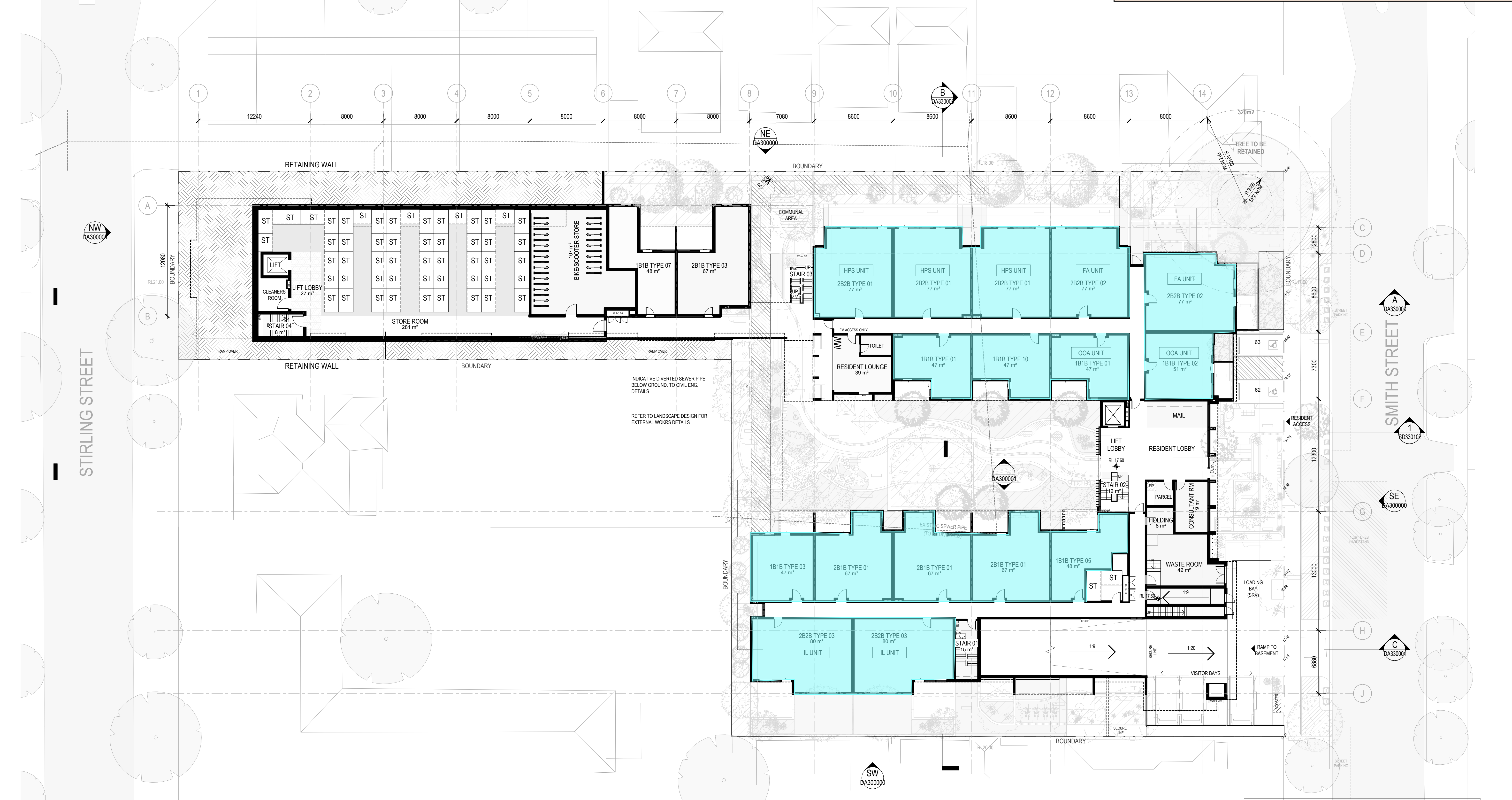
revision	Purpose of issue	checked	date
A	ISSUED FOR INFORMATION		28.03.24
B	ISSUED FOR INFORMATION		04.04.24
C	ISSUED FOR INFORMATION		22.04.24
D	ISSUED FOR INFORMATION		25.04.24
E	ISSUED FOR INFORMATION		02.05.24
F	ISSUED FOR INFORMATION		13.05.24
G	DA SUBMISSION		31.05.24
H	DA SUBMISSION		07.06.24

- **EXCAVATION DRAWING NOTES:**
 - REFER TO STRUCTURAL ENGINEER'S DRAWINGS FOR SIZE OF FOOTINGS AND CONCRETE PILE/SLAB CAPS
 - ANY EXISTING STRUCTURES AND/OR SERVICES THAT ARE NOT IDENTIFIED ON THE DOCUMENTS ARE TO BE REPORTED TO THE SUPERINTENDENT IMMEDIATELY.
 - EXCAVATED ROCK SHEET BENCH LEVELS MAY VARY AND ARE SUBJECT TO EXISTING FOOTING LEVELS. ALL BENCH LEVELS ARE TO BE CONFIRMED ON THE EXISTING STRUCTURAL DRAWINGS.
 - PRIOR TO COMMENCING EXCAVATION, ALL PLANS, METHODOLOGIES, STAGING AND EXCAVATION PROCEDURES ARE TO BE APPROVED BY THE GEOTECHNICAL AND/OR STRUCTURAL ENGINEER AND RELEVANT AUTHORITIES. REFER TO THE STRUCTURAL AND/OR GEOTECHNICAL DRAWINGS FOR EXCAVATION SEQUENCING, TEMPORARY WORKS AND OTHER SPECIFIC REQUIREMENTS.
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GROUND - LOWER

drawing no.	revision
AR-DA210000	H

SKETCH TITLE

BY: NPK

Floor Mark Up

301251813

AC-SK-001

27/06/2024

002

PROJECT No

SKETCH No

DATE

REV

Stantec

Legend / Notes

$R_w + C_v$ (airborne) no less than 50 and an $L_{n,w}$ (impact) not more than 62 between this level and the level below. (NCC Requirement)

$R_w + C_v$ (airborne) no less than 50 between this level and the level below.

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GROUND - UPPER / LEVEL 01

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SKETCH TITLE

BY: NPK

Floor Mark Up

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AC-SK-001

27/06/2024

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PROJECT No

SKETCH No

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$R_w + C_v$ (airborne) no less than 50 between this level and the level below.

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1 : 200 @A1

prepared

project no

230010.00

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project

SMITH STREET, HIGHGATE

LOT 501 SMITH STREET, PERTH

drawing

LEVEL 02

drawing no.

revision

AR-DA210002

G

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Stantec

SKETCH TITLE BY: NPK

Floor Mark Up

301251813AC-SK-00127/06/2024002

PROJECT NoSKETCH NoDATEREV

Legend / Notes

$R_w + C_v$ (airborne) no less than 50 and an $L_{n,w}$ (impact) not more than 62 between this level and the level below. (NCC Requirement)

$R_w + C_v$ (airborne) no less than 50 between this level and the level below.

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Nominated Architect
Ray Brown, NSWARB 6359

024610m

Do not scale drawings. Verify all dimensions on site

revision	purpose of issue	checked	date
A	ISSUED FOR INFORMATION		28.03.24
B	ISSUED FOR INFORMATION		04.04.24
C	ISSUED FOR INFORMATION		25.04.24
D	ISSUED FOR INFORMATION		02.05.24
E	ISSUED FOR INFORMATION		13.05.24
F	DA SUBMISSION		31.05.24
G	DA SUBMISSION		07.06.24

GENERAL NOTES:

•

DO NOT SCALE FROM THE DRAWINGS. USE ONLY FIGURED DIMENSIONS. IF IN DOUBT OBTAIN WRITTEN ADVICE FROM THE SUPERINTENDENT.

•

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.

•

REDUCED LEVELS (RL) ARE TO AUSTRALIAN HEIGHT DATUM (AHD). COORDINATES ARE TO MAP GRID AUSTRALIA (MGA).

•

DESIGN DRAWINGS ARE BASED ON 3RD PARTY SURVEY INFORMATION. PRIOR TO CONSTRUCTION ALL SET-OUT DIMENSIONS, SITE AND PROPERTY BOUNDARIES, EXISTING LEVELS, STRUCTURE, SERVICES, BUILDING FABRIC AND SITE FEATURES ARE TO BE VERIFIED ON SITE BY A REGISTERED SURVEYOR - INFORMATION PERTAINING TO EXISTING BUILDING FABRIC AND SITE FEATURES, INDICATED WITHIN THE DOCUMENTATION IS NOT GUARANTEED AS COMPLETE OR CORRECT. NOTIFY THE SUPERINTENDENT IN WRITING OF COMPLIANCE TO THE DRAWINGS AND OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.

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SMITH STREET, HIGHGATE

LOT 501 SMITH STREET, PERTH

project

drawing

LEVEL 03

revision

AR-DA210003

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