Road and Rail Noise Impact Assessment

990 Hunter Street Newcastle NSW

Prepared for : KDC Pty Limited

August 2017

Muller Acoustic Consulting

Document Information

Road and Rail Noise Impact Assessment

Proposed Residential Development, 990 Hunter Street, Newcastle, NSW.

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by KDC Pty Ltd (KDC) to complete a road and rail traffic noise impact assessment for the proposed multi-storey apartment block to be constructed at 990 Hunter Street, Newcastle, NSW (the 'project').

This report presents the results, findings and recommendations of the road and rail traffic noise impact assessment and has been prepared to accompany the project's Development Application (DA) being prepared by KDC for submission to The City of Newcastle Council (TCONC).

This report addresses several noise related aspects pertaining to the residential apartments including:

- quantifying the existing ambient noise environment adjacent to the project;
- quantifying the impacts of road traffic noise from Hunter Street at the potentially most affected facades of the project;
- quantifying rail noise and vibration emissions from the Great Northern Railway to the project;
- quantifying maximum noise levels from road and rail passbys; and
- comparison of predicted noise levels against relevant design noise levels and determination of noise control treatments required to achieve internal criteria.

The assessment has been undertaken in general accordance with the following policies and guidelines:

- Environment Protection Authority (EPA) 2000, NSW Industrial Noise Policy (INP);
- Department of Planning (DPI) 2008, Development Near Rail Corridors and Busy Roads - Interim Guideline;
- The City of Newcastle Council (TCONC) 2012, Development Control Plan (DCP), Section 7.01 Building Design Criteria;
- Environment Protection Authority (EPA) 2011, NSW Road Noise Policy (RNP);
- Standards Australia AS 1055.1:1997, Acoustics - Description and measurement of environmental noise - General Procedures;
- Department of Environment, Climate Change and Water (DECCW) 2009, Assessing Vibration: A Technical Guideline;

- Australian Standard AS 3671-1989, Acoustics - road traffic noise intrusion - building site and construction; and
- Standards Australia AS 2107:2016, Acoustics - Recommended design sound levels and reverberation times for building interiors.

A glossary of terms, definitions and abbreviations used in this report is provided in Appendix A.

1.1 Background

The project involves the construction of a 13 storey residential apartment block, with basement level parking and commercial tenancies situated on the ground floor. Appendix B provides the site drawings for the building. From the first floor to the ninth floor, the units will consist of either studio, single or double bedroom apartments. From the 10th floor, there will be a mixture of three and four bedroom apartments.

Mechanical ventilation and lift motors are to be installed either on the rooftop or within the basement. Both areas would be situated within acoustic enclosures hence are not deemed acoustically significant sources. Therefore, mechanical plant and the lift motors have not been included in this assessment.

Furthermore, it is anticipated that material used in construction are sufficient in attenuating internal noise transmission to satisfy the Building Code of Australia part F5 – Sound transmission and insulation. A review of internal construction materials is premature for this stage of the development and hence outside the scope of this assessment report.

2 Existing Environment

One unattended logger was installed at 849 Hunter Street from Wednesday 10 February 2016 to Thursday 18 February 2016 to quantify the influence of road noise. The logger location was selected considering security, and exposure to road traffic. Data from the logger was used to calibrate the noise model.

Logging instrumentation consisted of a SVANTEK 977 Type 1 octave sound analyser, programmed to collect samples at 15 minute intervals with 'Fast' time weighting and 'A' frequency weighting. The analyser was calibrated before and after the monitoring period with no drift in calibration noted. Monitoring was conducted in general accordance with the procedures described in Australian Standard AS 1055, 1997 Acoustics - Description and Measurement of Environmental Noise. Data affected by adverse meteorological conditions has been excluded from the results in accordance with methodologies provided in the INP.

The results of long-term unattended monitoring are provided in Table 1. Appendix C presents the noise logging charts for the assessment period.

Table 1 Noise Logging Results

Measurement Location	Measured Background Noise Level, LA90, dBA			Measured LAeq, dBA[1]	
	Day	Evening	Night	Day	Night
L1	53	48	46	69	64

Note 1 : LAeq (period) is the average for the week of data collected.

Note : Road traffic is assessed over two periods, Day 7am to 10pm and Night 10pm to 7am (ie no evening).

The unattended monitoring confirms that the ambient noise environment surrounding the south-western side of the project is dominated by road traffic.

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3 Noise and Vibration Screening Tests

3.1 Development Near Rail Corridors and Busy Roads – Interim Guidelines

Guidance for the specification of internal noise levels of habitable rooms is prescribed in Department of Planning's (DoP) Development near Rail Corridors and Busy Roads – Interim Guidelines (2008) ('the guideline'). The guideline provides several screening tests for developments. The screening tests identify the likely level of noise control treatments required for developments adjacent to busy roads. Furthermore, the guideline also provides screening test relating to developments adjacent to rail lines.

3.1.1 Road Noise Screening Test

Section 5.3.2 of the guideline provides screening tests for single and dual occupancy dwellings. The screening tests provide varying categories of noise control treatments for dwellings taking into consideration distance to the road and amount of traffic. The guideline presents two screen tests for a 60/70 km/hr zone and 100/110 km/hr zone that are reproduced in Figure 1 and Figure 2 respectively. The screening tests have been adopted in this assessment to provide guidance on building categories for the project.

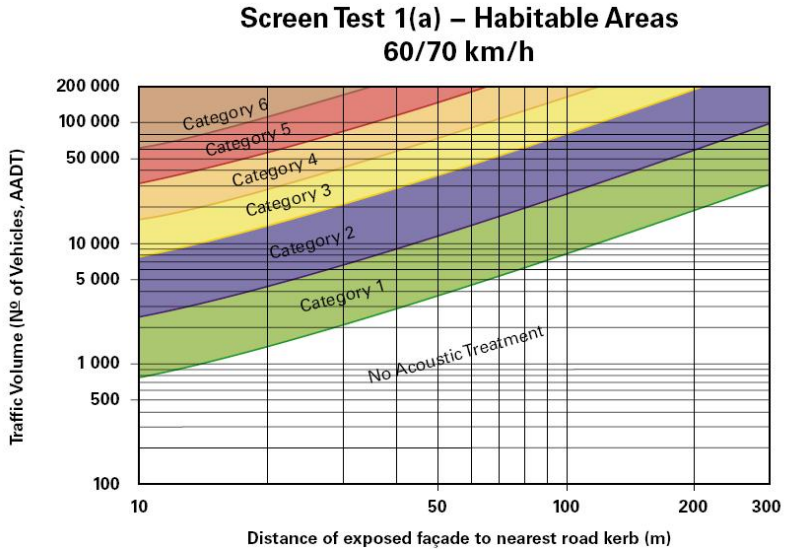

Figure 1 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 60/70 km/hr zones.

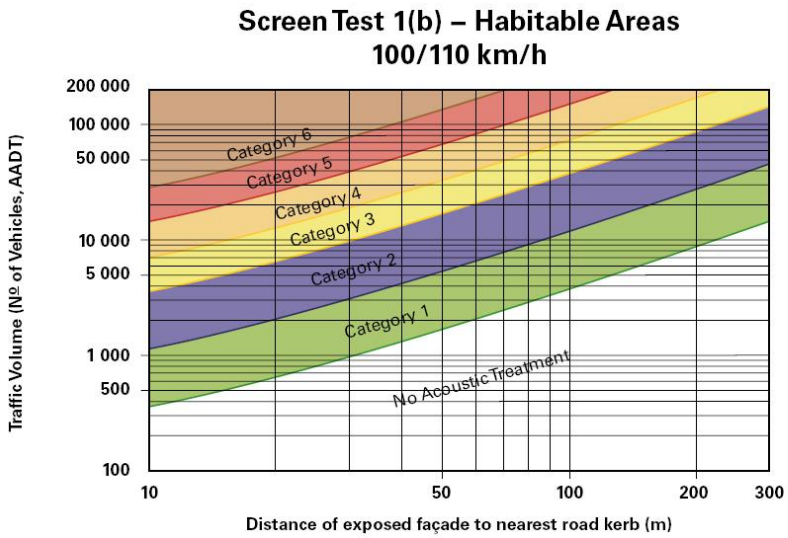

Figure 2 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 100/110 km/hr zones.

The guideline assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads and supports the Infrastructure SEPP. The guidelines are mandatory for residential developments proposed adjacent to busy roads with an Annual Average Daily Traffic (AADT) of greater than 40,000 vehicles or for projects within 10m of a rail corridor where passenger trains are travelling at speeds of <80km/hr.

Traffic volumes for Maitland Road were sourced from the Roads and Maritime Services (RMS) traffic counting station (#05202) Tighes Hill, approximately 2 kilometres north-west of the project. The station identifies an Annual Average Daily Traffic (AADT) of up to 21,400 vehicles for 2012. It is estimated that current (2016) traffic flows along Maitland Road/Hunter Street would be in the order of 30,987 AADT assuming a 2% traffic growth since 2012. This data was found to be consistent with RMS traffic volume maps for Maitland Road.

3.1.2 Rail Noise Screening Test

Section 5.3.1 of the guideline provides Acoustic Assessment Zones for rail corridors. The Assessment Zones provide offset distances for developments from an operational rail track where a detailed noise impact assessment is required.

Figure 3 reproduces the Acoustic Assessment Zones as presented in the guideline.

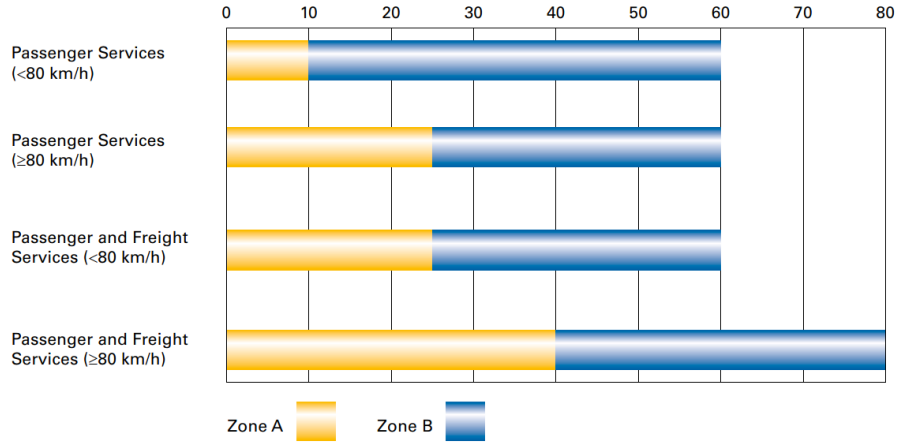

Figure 3 Acoustic Assessment Zones.

The section of rail adjacent to the project is anticipated to accommodate passenger trains to the Wickham Transport Interchange. The distance to the proposed interchange from the project site is approximately 500m, hence rail traffic would be slowing and be at speeds of less than 80km/hr. It is noted that the project will be established approximately 14m from the Great Northern Railway and outside the buffer zone required for a detailed acoustic assessment. Notwithstanding, rail noise has been considered in this assessment as a good practice measure and commensurate to this size of development.

3.1.3 Rail Vibration Screening Test

Section 5.3.1 of the guideline provides guidance on the Vibration Assessment Zone for development sites adjacent to rail corridors. As per Figure 4 reproduced below (from the guideline), the project site is within 25m from the existing rail track, hence an assessment of rail vibration is included in this assessment.

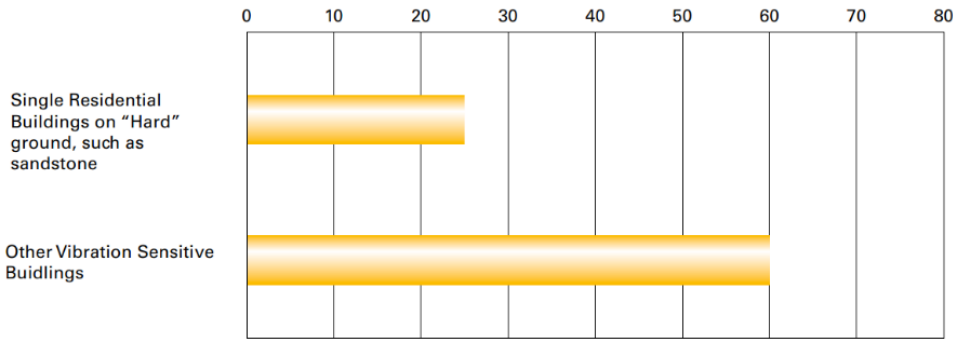

Figure 4 Rail Vibration Assessment Zone (distance (m) to operational track)

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4 Project Noise and Vibration Criteria

4.1 The City of Newcastle Council Development Control Plan

Section 7.01.09 of the TCONC DCP, 2012 provides general objectives and development controls for building developments. The objectives are reproduced below:

4.1.1 Views and Privacy

- Ensure adequate visual and acoustic privacy for proposed and existing dwellings.
- Parking areas, shared driveways, streets, active recreational areas and service equipment have a minimum line of sight separation of 3m from bedroom windows.
- Living area windows have a minimum line of sight separation of 3m from bedroom windows of adjacent dwellings.
- Shared walls and floors between dwellings are constructed to limit noise transmission.
- Dwellings adjacent to higher levels of external noise minimise the entry of that noise.
- Mechanical plant or equipment designed and located to minimise noise nuisance.

4.1.2 Fencing and Walls

- Ensure front and side fences and walls provide privacy, security and noise attenuation without having a detrimental impact upon the streetscape and adjacent buildings.
- Front fences and walls have a maximum height of 1.2m high if solid. For residential development the height may be increased to 1.8m if:
  - (a) the main private open space is in the front of the dwelling, and
  - (b) the fence has openings which make it not less than 50% transparent, or
  - (c) traffic volumes and/or noise exceed 6000 vehicles per day and/or 60 dB(A), and
  - (d) the development site is not located within a heritage conservation area.
- Front fences and walls complement the existing streetscape in relation to scale and materials and use similar or compatible materials to those used in attractive buildings within the locality.
- The use of sheet-metal fencing is avoided adjacent to public places, unless the visual impact is softened by landscaping.
- Front fences are compatible with facilities in the street frontage area, such as mail boxes and garbage collection areas.
- Front fences highlight entrances to buildings.

4.2 Residential Road and Rail Noise Criteria

The guideline outlines internal criterion levels for Clause 102 (Road) of the State Environmental Planning Policy (SEPP) for Infrastructure (Infrastructure SEPP):

"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- in any bedroom in the building : 35dBA at any time 10pm–7am; and
- anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dBA at any time."

Table 3.1 of the guideline clarifies that the above noise criteria are to be determined as an $LA_{eq(15hr)}$ for the daytime and $LA_{eq(9hr)}$ for the night time period. It should be noted that the noise goals outlined in SEPP (Infrastructure) (2007) are identical to those of AS/NZS 2107:2016.

4.3 Private Open Space Areas Criteria

For residential developments, internal noise levels are the key parameter to be considered with respect to noise emissions from road or rail sources. Assignment of an external criteria would make the feasibility of construction near transport corridors unfeasible and contrary to the State Governments initiative with respect to the integration of land uses and transport. The key principles of this initiative include intentionally locating housing, activities jobs and services in accessible areas close to public transport hubs (Department of Planning, 2008).

In summary, there are no discrete external noise criteria that are specifically assigned road/rail noise and private open spaces. Notwithstanding, the Environment Protection Authority (EPA) 2011, NSW Road Noise Policy (RNP) prescribes at facade (ie external) noise criteria for residential premises. It is noted, that these criteria are for road traffic noise emissions and primarily are adopted when considering noise emissions from redevelopment of roads or land use developments that may generate additional traffic on the road network. Notwithstanding, the RNP criteria for sub-arterial roads is 60dBA, LAeq15hr (day) and 55dBA, LAeq9hr (night) have been considered in this assessment.

4.4 Sleep Disturbance Criterion

The most important aspect of intermittent noise would be the potential to disturb the sleep of nearby residents. The EPA provides guidance on assessing sleep disturbance for industrial and commercial sites. The EPA nominates that a screening criterion of background noise level (L_{A90}) plus 15 dB shall apply to maximum noise level events from the site which are to be calculated at one metre from the bedroom facade at the nearest residential properties. Where noise levels have been calculated above the screening criterion, additional analysis should be undertaken, referencing guidance on maximum noise levels and sleep disturbance listed in the Road Noise Policy (RNP) (Department of Environment, Climate Change and Water, DECCW, 2011).

This guidance states:

- maximum internal noise levels below 50 to 55 dB are unlikely to wake sleeping occupants; and
- one or two noise events per night, with maximum internal noise levels of 65 to 70 dBA, are not likely to affect the health and wellbeing of occupants significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies that a partially open window will reduce external noise levels by 10 dBA. Therefore, external noise levels in the order of 60 to 65 dBA calculated at the facade of a residence are unlikely to cause sleep disturbance impacts under a worst case situation (ie with windows open). Similarly, the World Health Organisation (WHO, 1999) suggests that levels below 45 dBA inside homes are unlikely to wake sleeping occupants. The descriptors LAmax and LA1 are considered interchangeable by the EPA. If noise levels over the screening criteria were identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur (between 10:00pm and 7:00am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Table 2 provides the sleep disturbance criterion for the project and is based on the night RBL+15dB.

Table 2 Sleep Disturbance Noise Criterion

Location	Rating Background Level (RBL), L_{A90} dBA	Sleep Disturbance Noise Criterion L_{Amax}, dBA
Residential receptors	46	61

4.4.1 Noise Criteria for Commercial Premises

Noise goals at commercial tenancies for this project have been derived in accordance with AS/NZS 2107:2016. Table 1 of AS/NZS 2107:2016 specifies that the 'recommended satisfactory design' internal sound level of LAeq for general retail stores is 45 dBA. Table 3 reproduces the recommended design noise levels from AS/NZS 2107.

Table 3 Recommended Design Noise Levels (AS/NZS 2107)

Type of occupancy/activity	Recommended design sound level LAeq, dB(A)	
	Satisfactory	Maximum
Small Retail Stores (general)	45	55

4.5 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques.

At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria and include continuous vibration, impulsive vibration and intermittent vibration. The guideline states that intermittent train passbys should be classed as intermittent sources of vibration.

Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square)

acceleration levels over the frequency range 1 Hz to 80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted rms of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in Table 4.

Table 4 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration ($m/s^{1.75}$)

Receiver	Daytime		Night-time	
	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$
Residences	0.20	0.4	0.13	0.26

Note : Daytime is 7am to 10pm and Night-time is 10pm to 7am

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

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5 Noise Assessment Methodology and Results

5.1 Calculation of Road Traffic Noise

A theoretical assessment of road traffic noise was carried out to predict levels at the façade of each level of the project using the Calculation of Road Traffic Noise (CORTN) algorithm, as developed by the UK Department of Transport. This method incorporates flow volumes, average speed, percentage of heavy vehicles, road gradient and includes attenuation via spherical spreading (or cylindrical in the case of a line source such as a road), soft ground, atmospheric absorption and screening from buildings or barriers. Hourly AADT distributions are required for modelling, however were not available for this assessment. Therefore, hourly flow distributions of the available AADT were assumed as 80% for day and 20% for night. These are typical industry accepted proportions. Table 5 summarises the calculation parameters adopted for this assessment.

Table 5 Calculation Parameters

Assessment Period	Traffic Volume[1]	% Heavy Vehicles	Speed Limit (km/hr)
Day	24,789	5	60
Night	6,197	10	60

Note 1: Sourced from RMS traffic counting station #05202 and extrapolated to 2016 using 2% growth.

5.2 Indicative Attenuation Levels

The Environmental Noise Management Manual (ENMM) (2001) provides a summary of indicative attenuation from standard building types. The indicative attenuation levels are summarised in Table 6, which provides typical performance of buildings with respect to noise reduction. A light frame residence with single 3mm glazing would be expected to provide a reduction of approximately 20dBA from external to internal with windows closed. Where windows are closed, the fresh air requirements outlined in the Building Code of Australia are to be satisfied.

Table 6 Indicative Building Noise Attenuation

Building Type	Windows	Internal noise reduction, dBA
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	30

Note : Sourced from ENMM, 2001.

5.3 Noise Assessment Validation

Road noise predictions for the project were compared against measured levels at logging location (L1). This is considered a good practice technique to validate the assumptions made in the assessment. Results of the validation are presented in Table 7. Noise predictions demonstrate a consistent correlation (±<2dB tolerance) when compared against measured levels.

Table 7 Noise Assessment Validation Results

Measurement Location	Predicted level, LAeq, dBA		Measured LAeq, dBA		Difference, dB	
	Day	Night	Day	Night	Day	Night
849 Hunter Street	69.1	63.9	68.8	63.9	0.3	0.0

5.4 Road Noise Prediction Results

A review of floor plans (Michael Carr Architects Pty Ltd, 2017) (Appendix B) for the project have been completed as part of the assessment. Noise level calculations of road traffic emissions have been made to habitable spaces of each floor of the project for the north-east, south-east and south-west facades of the development. From review of the plans lower levels (Level 1 to Level 3) fronting Hunter Street will be slightly shielded to road noise by the presence of the store awning of the commercial tenancies below. Additionally, Level 4 would be somewhat shielded to Hunter Street from the podium of the level below, especially the south-west facade. Notwithstanding, Levels 5 to 12 will have an increased line of site to Hunter Street traffic as the height of the building increases, essentially reducing the noise attenuation afforded by the podium. The attenuation effects of the podium can be readily observed via noise prediction results for each level of the project. The south east façade will contain units that are potentially exposed to both road and rail traffic, although these units are from the fourth floor and above, it is noted that the glazing designs for these units primarily face the Great Northern Railway.

Table 8 presents a comparison of predicted road traffic noise for day LAeq(15hr) and night LAeq(9hr) assessment periods against the respective day and night internal criteria.

Table 8 Road Noise Prediction Results – 990 Hunter Street					
Facade	Receptor Room Category[1]	Predicted level, LAeq, dBA[2] (internal)		Internal Criteria LAeq, dBA	
		Day	Night	Day	Night
		Ground			
SW	Retail	47	N/A	45	N/A
		Level 1			
SW	Bedroom	49	44	40	35
SW	Living	49	44	40	40
		Level 2			
SW	Bedroom	49	44	40	35
SW	Living	49	44	40	40
		Level 3			
SW	Bedroom	49	44	40	35
SW	Living	49	44	40	40
		Level 4			
SW	Bedroom	43	38	40	35
SW	Living	43	38	40	40
SE	Bedroom	<35	<35	40	35
SE	Living	<35	<35	40	40
		Level 5			
SW	Bedroom	43	38	40	35
SW	Living	43	38	40	40
SE	Bedroom	<35	<35	40	35
SE	Living	<35	<35	40	40
		Level 6			
SW	Bedroom	46	41	40	35
SW	Living	46	41	40	40
SE	Bedroom	37	<35	40	35
SE	Living	37	<35	40	40
		Level 7			
SW	Bedroom	45	41	40	35
SW	Living	45	41	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40
		Level 8			
SW	Bedroom	45	40	40	35
SW	Living	45	40	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40

Table 8 Road Noise Prediction Results – 990 Hunter Street					
Facade	Receptor Room Category[1]	Predicted level, LAeq, dBA[2] (internal)		Internal Criteria LAeq, dBA	
		Day	Night	Day	Night
Level 9					
SW	Bedroom	44	40	40	35
SW	Living	44	40	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40
Level 10					
SW	Bedroom	44	39	40	35
SW	Living	44	39	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40
Level 11					
SW	Bedroom	43	39	40	35
SW	Living	43	39	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40
Level 12					
SW	Bedroom	43	38	40	35
SW	Living	43	38	40	40
SE	Bedroom	36	<35	40	35
SE	Living	36	<35	40	40

Note 1 : Determined from proposed site drawing plans (Michael Carr Architect Pty Ltd, 2017).

Note 2 : Internally predicted to habitable rooms. Adjustments made assuming attenuation (20dB) for a light framed structure with windows closed and includes +2.5dB façade correction.

Results of the noise assessment demonstrate that internal noise criteria for some habitable rooms associated with the project would be exceeded if standard construction materials were used. Therefore, noise control recommendations are required to satisfy internal noise criteria.

5.5 Rail Noise Results

Passenger train timetables from Transport NSW were reviewed to quantify the number of passenger movements along the Central Coast to Newcastle Line and the Hunter Line to the proposed interchange at Wickham. The analysis identified that the approximate number of passenger trains to Wickham is 136 per day and 43 per night. This volume is not anticipated to alter dramatically in the future considering the current available paths on the rail network. Therefore, these volumes have been adopted for this assessment and are considered realistic of representing potential noise impacts to the project.

Historic noise emission data for the project was sourced from the 'Wickham Transport Interchange Noise and Vibration Assessment' (the 'WTINVA') (GHD, July 2014). Noise data for the WTINVA were obtained for 28 train passbys, approximately 35 metres north of the 990 Hunter Street project site. The measurements were undertaken 11.5 metres from the Great Northern Railway track and hence are relevant to this project.

Additionally, MAC conducted in-field noise and vibration measurements of up to 20 train passbys at Broadmeadow and Mayfield, on 24 February 2016. Results of the MAC measurements returned results consistent, albeit slightly lower than levels reported in the WTINVA. Notwithstanding, this assessment has adopted the more conservative levels presented in the WTINVA. Table 9 presents the average LAmax and maximum sound exposure level (SEL) adopted for this project.

Table 9 Rail Passby Noise Levels

Distance to track (m)	Average LAmax, dBA[1]	SEL, dBA
11.5	78	90

Note 1 : equates to a sound power level of 108dBA.

A combination of train movements and sound exposure levels have been used to calculate the $LA_{eq(15hr)}$ and $LA_{eq(9hr)}$ at the façade of each level of the project. Table 10 presents a comparison of predicted rail traffic noise for day $LA_{eq(15hr)}$ and night $LA_{eq(9hr)}$ assessment periods against the respective day and night internal criteria. Rail noise calculations do not include attenuation afforded by the podium.

Table 10 Rail Noise Prediction Results – 990 Hunter Street					
Facade	Receptor Room Category[1]	Predicted level, LAeq, dBA[2] (internal)		Internal Criteria LAeq, dBA	
		Day	Night	Day	Night
		Level 1			
NE	Bedroom	43	40	40	35
NE	Living	43	40	40	40
		Level 2			
NE	Bedroom	42	39	40	35
NE	Living	42	39	40	40
		Level 3			
NE	Bedroom	41	38	40	35
NE	Living	41	38	40	40
		Level 4			
NE	Bedroom	39	36	40	35
NE	Living	39	36	40	40
SE	Bedroom	39	36	40	35
SE	Living	39	36	40	40
		Level 5			
NE	Bedroom	41	38	40	35
NE	Living	41	38	40	40
SE	Bedroom	41	38	40	35
SE	Living	41	38	40	40
		Level 6			
NE	Bedroom	40	37	40	35
NE	Living	40	37	40	40
SE	Bedroom	40	37	40	35
SE	Living	40	37	40	40
		Level 7			
NE	Bedroom	40	37	40	35
NE	Living	40	37	40	40
SE	Bedroom	40	37	40	35
SE	Living	40	37	40	40
		Level 8			
NE	Bedroom	40	37	40	35
NE	Living	40	37	40	40
SE	Bedroom	40	37	40	35
SE	Living	40	37	40	40
		Level 9			
NE	Bedroom	40	37	40	35

Table 10 Rail Noise Prediction Results – 990 Hunter Street					
Facade	Receptor Room Category[1]	Predicted level, LAeq, dBA[2] (internal)		Internal Criteria LAeq, dBA	
		Day	Night	Day	Night
NE	Living	40	37	40	40
SE	Bedroom	40	37	40	35
SE	Living	40	37	40	40
		Level 10			
NE	Bedroom	39	37	40	35
NE	Living	39	37	40	40
SE	Bedroom	39	37	40	35
SE	Living	39	37	40	40
		Level 11			
NE	Bedroom	38	36	40	35
NE	Living	38	36	40	40
SE	Bedroom	38	36	40	35
SE	Living	38	36	40	40
		Level 12			
NE	Bedroom	37	34	40	35
NE	Living	37	34	40	40
SE	Bedroom	37	34	40	35
SE	Living	37	34	40	40

Note 1 : Determined from proposed site drawing plans (Michael Carr Architect Pty Ltd, 2017).

Note 2 : Internally predicted to habitable rooms. Adjustments made assuming attenuation (20dB) for a light framed structure with windows closed and includes +2.5dB façade correction.

5.6 Private Open Space Areas Assessment

A review of transport noise has been completed for several private open space areas at the development. Noise predictions identify that generally for open spaces adjacent to the rail corridor will be at or below the external criteria, assuming some moderate levels of attenuation from the solid 1.2m high balcony balustrade and even less taking into account the attenuation afforded by the balconies timber shutters.

For units facing Hunter Street, road noise levels are anticipated to be above the road noise criteria. Notwithstanding, with the inclusion of the proposed timber shutters that will be installed on each balcony, levels would expected to be reduced to at or below the relevant criteria within the balcony/private open space.

Notwithstanding, to improve the amenity of the privates open spaces further the following is recommended:

- Consider upgrading the timber shutters to acoustic timber shutters (ie to include acoustic seals and the shutters to have a density of at least 10kg/m^3;
- Ensure that when closed, the shutters do not contain any spaces or gaps; and
- Consider applying sound absorbing materials to the ceiling area of the balcony fronting the road and rail corridors.

It is reiterated that transportation noise impacts on residential developments are assessed against internal criteria and rely on architectural treatments (usually glazing upgrades) to achieve internal criteria and improve internal acoustic amenity.

5.7 Sleep Disturbance Impacts

Maximum noise emission events from road vehicles and passenger trains have been quantified to the nearest façade of the proposed development. Generally, lower level floors of the project have a greater exposure to maximum noise events from transportation noise. Notwithstanding, noise recommendations in this report have taken into account the minimum required Rw to attenuate maximum transportation noise events to satisfy the relevant internal noise criterion.

5.8 Rail Vibration Results

A combination of in-field vibration monitoring data from passenger train passbys and historic vibration emission data have been reviewed. The 'Wickham Transport Interchange Noise and Vibration Assessment' (the 'WTINVA') (GHD, July 2014) provides a summary of vibration data obtained for 28 train passbys, approximately 35 metres north of the 990 Hunter Street project site.

The measurements were undertaken 11.5 metres from Great Northern Railway track and hence are relevant to this project. Additionally, MAC conducted in-field vibration measurements of up to 20 train passbys at Broadmeadow and Mayfield, on the 24 February 2016. Results of the MAC measurements returned results consistent, albeit slightly lower than levels reported in the WTINVA. Historic results identify received VDV (vibration dose) levels of 0.11m/$s^{1.75}$ and 0.08 m/$s^{1.75}$ for day and night train passbys respectively, 5m from the Great Northern Railway track.

These levels are significantly below preferred dose values (see Table 4). Therefore, as the proposal is situated at 11.5m from the track, rail vibration are below levels that would generate a low probability of adverse comment or disturbance to building occupants.

6 Discussion and Summary of Recommendations

Standard domestic glass is usually inadequate acoustically and can reduce the attenuation performance of the overall building facade. Upgrade options include thicker laminated glass or double-glazed laminated windows with an air gap between panels. The frames and air gaps should be adequately sealed to optimise noise reduction. As windows must remain closed for effective noise reduction, alternative means of internal ventilation (eg air conditioning or wall ventilators) must be considered to allow windows to remain fully closed (refer to BCA requirements).

Table 11 provides a summary of the facades where windows will require glazing upgrades, the minimum Rw to achieve internal criteria and the recommended minimum glazing Category as per the guideline (see Appendix D) for the south-west and north-west facades exposed to Hunter Street. To protect the acoustic amenity of occupants within bedrooms, in most cases recommendations have adopted a category a level higher than the minimum to achieve compliance. Additionally, alternative glazing systems may be adopted as long they meet or exceed the minimum recommended category treatments. It is noted that the south-east façade is potentially more impacted by rail noise. Hence, noise attenuation recommendations for the south-eastern façade are provide in Table 12.

Table 11 Noise Attenuation Recommendations – Road Noise (SW and NW Facades)

Facade	Receptor Room Category[1]	Minimum Required Rw to Achieve Internal Criteria	Recommended Minimum Guideline Category for Glazing Treatments
		Ground	
SW	Retail	21	Cat 2
		Level 1	
SW	Bedroom	29	Cat 3
SW	Living	29	Cat 3
		Level 2	
SW	Bedroom	29	Cat 3
SW	Living	29	Cat 3
		Level 3	
SW	Bedroom	29	Cat 3
SW	Living	29	Cat 3
		Level 4	
SW	Bedroom	23	Cat 3
SW	Living	23	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	15	Cat 2

Table 11 Noise Attenuation Recommendations – Road Noise (SW and NW Facades)

Facade	Receptor Room Category[1]	Minimum Required Rw to Achieve Internal Criteria	Recommended Minimum Guideline Category for Glazing Treatments
		Level 5	
SW	Bedroom	23	Cat 3
SW	Living	23	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	15	Cat 2
		Level 6	
SW	Bedroom	26	Cat 3
SW	Living	26	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	17	Cat 2
		Level 7	
SW	Bedroom	26	Cat 3
SW	Living	25	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2
		Level 8	
SW	Bedroom	25	Cat 3
SW	Living	25	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2
		Level 9	
SW	Bedroom	25	Cat 3
SW	Living	24	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2
		Level 10	
SW	Bedroom	24	Cat 3
SW	Living	24	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2
		Level 11	
SW	Bedroom	24	Cat 3
SW	Living	23	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2

Table 11 Noise Attenuation Recommendations – Road Noise (SW and NW Facades)			
Facade	Receptor Room Category[1]	Minimum Required Rw to Achieve Internal Criteria	Recommended Minimum Guideline Category for Glazing Treatments
		Level 12	
SW	Bedroom	23	Cat 3
SW	Living	23	Cat 2
SE	Bedroom	20	Cat 2
SE	Living	16	Cat 2

Note 1 : Determined from proposed site drawing plans (Michael Carr Architect Pty Ltd, 2017).

Table 12 provides a summary of the facades that will require glazing upgrades, the minimum Rw to achieve internal criteria and the recommended minimum glazing Category as per the guideline (see Appendix D) for the north-east and south-east facades exposed to the Great Northern Railway. Note alternative glazing systems may be adopted as long they meet or exceed the minimum recommended category treatments.

Table 12 Noise Attenuation Recommendations – Rail Noise (NE and SE Facades)			
Facade	Receptor Room Category[1]	Minimum Required Rw to Achieve Internal Criteria	Recommended Minimum Guideline Category for Glazing Treatments
		Level 1	
NE	Bedroom	26	Cat 3
NE	Living	23	Cat 3
		Level 2	
NE	Bedroom	25	Cat 3
NE	Living	22	Cat 2
		Level 3	
NE	Bedroom	24	Cat 3
NE	Living	21	Cat 2
		Level 4	
NE	Bedroom	24	Cat 3
NE	Living	21	Cat 2
SE	Bedroom	24	Cat 3
SE	Living	21	Cat 2
		Level 5	
NE	Bedroom	23	Cat 3
NE	Living	21	Cat 2

Table 12 Noise Attenuation Recommendations – Rail Noise (NE and SE Facades)

Facade	Receptor Room Category[1]	Minimum Required Rw to Achieve Internal Criteria	Recommended Minimum Guideline Category for Glazing Treatments
SE	Bedroom	23	Cat 3
SE	Living	21	Cat 2
		Level 6 to Level 10	
NE	Bedroom	22	Cat 3
NE	Living	20	Cat 2
SE	Bedroom	22	Cat 3
SE	Living	20	Cat 2
		Level 11	
NE	Bedroom	21	Cat 3
NE	Living	18	Cat 2
SE	Bedroom	21	Cat 3
SE	Living	18	Cat 2
		Level 12	
NE	Bedroom	19	Cat 2
NE	Living	17	Cat 2
SE	Bedroom	19	Cat 2
SE	Living	17	Cat 2

Note 1 : Determined from proposed site drawing plans (Michael Carr Architect Pty Ltd, 2017).

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed an assessment of potential road and rail noise impacts for a proposed multi storey residential development to be established at 990 Hunter Street, Newcastle, NSW.

The assessment has qualified the existing ambient environment with respect to road noise, using measured levels to calibrate predictions. Noise predictions identified that standard glazing on some windows would not be adequate to attenuate internal levels to satisfy relevant criteria.

It is recommended that noise control measures outlined in Section 6 of this report be implemented to reduce road and rail noise emissions to satisfy relevant internal criteria.

Additionally, vibration emissions from rail traffic are demonstrated to satisfy recommended levels that may generate a low probability of adverse comment or disturbance to building occupants.

Following the findings of the noise assessment, it is recommended Council approve the development based on noise control assumptions/recommendations and referenced architectural plans provided in this report.

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Appendix A – Glossary of Terms

Table A1 provides a number of technical terms have been used in this report.

Table 1A Glossary of Terms

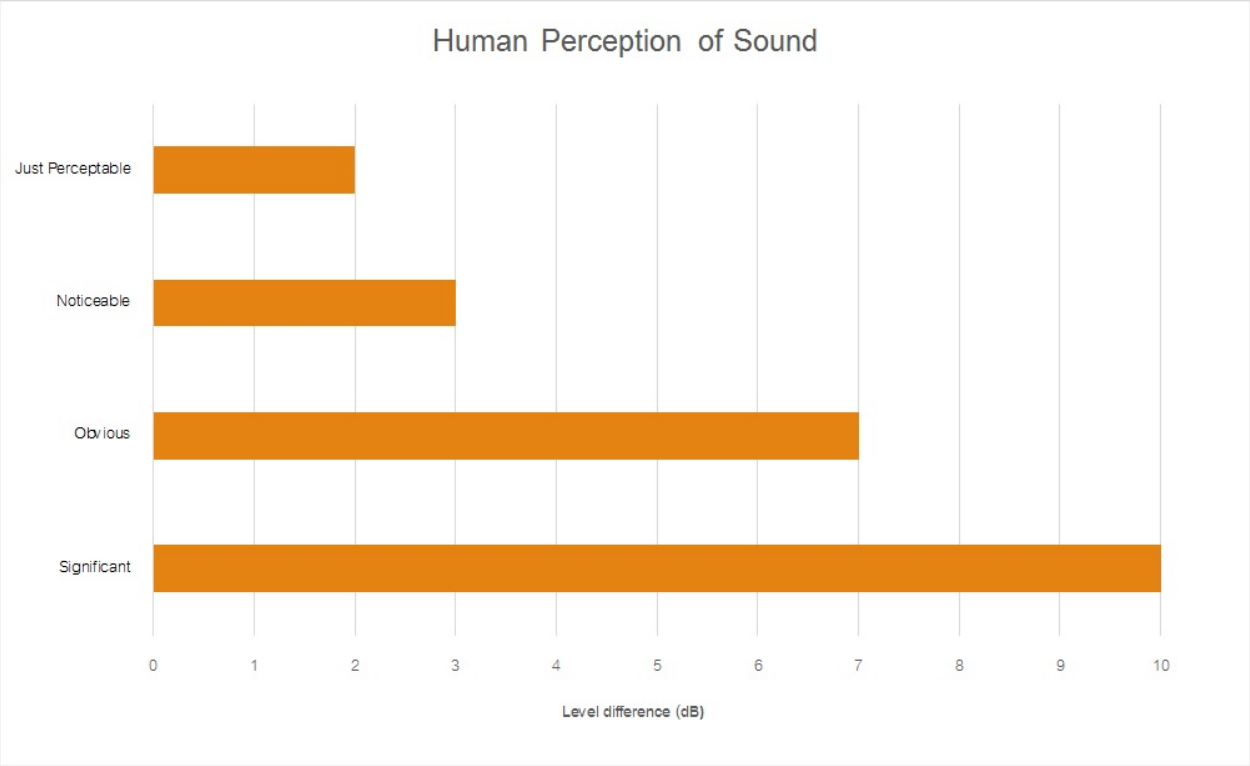
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Appendix B – Site Plans

GENERAL NOTE:

DIMENSIONS HAVE BEEN ROUNDED TO THE NEAREST 5mm
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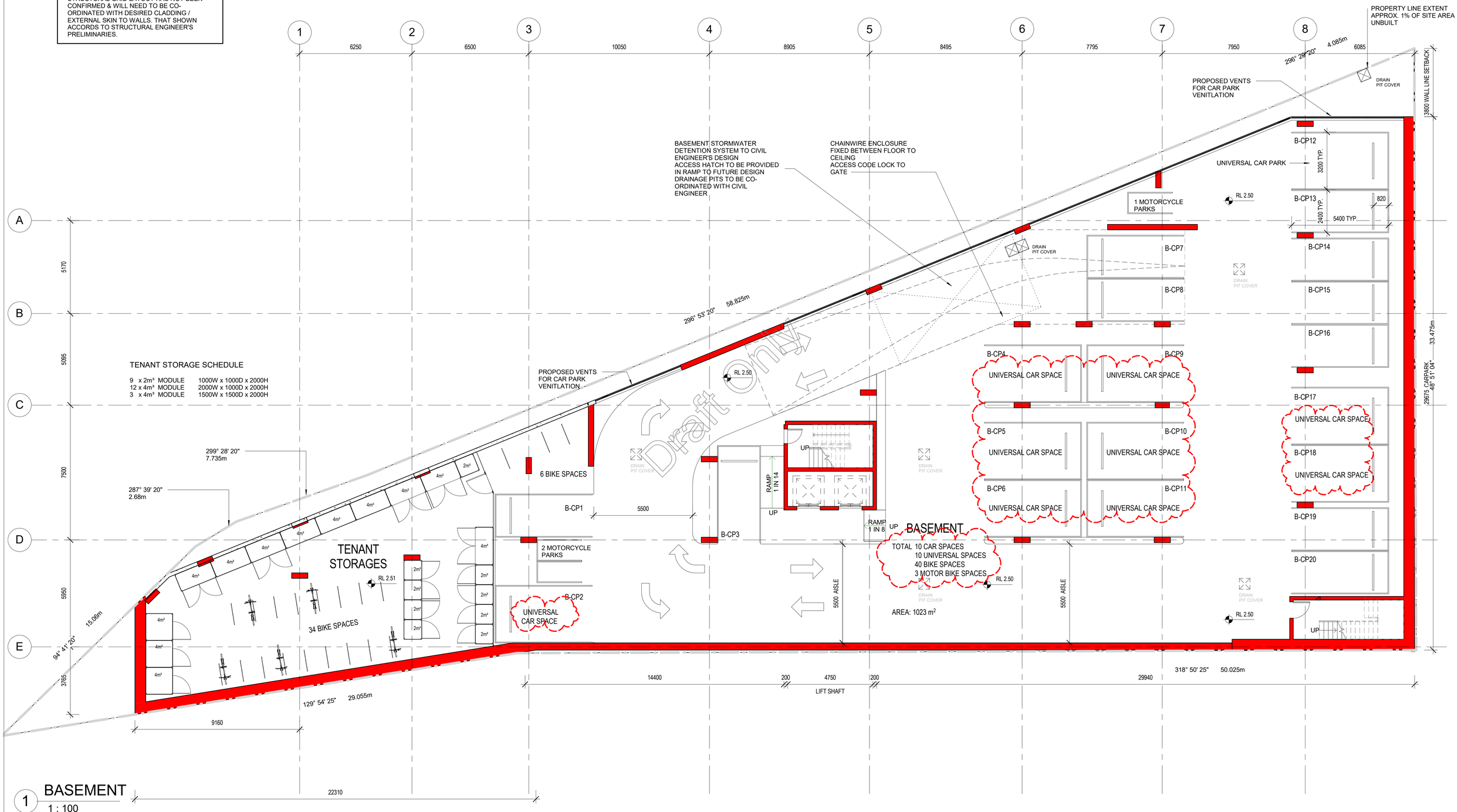
STRUCTURAL GRID LAYOUT HAS NOT BEEN CONFIRMED & WILL NEED TO BE CO-ORDINATED WITH DESIRED CLADDING / EXTERNAL SKIN TO WALLS. THAT SHOWN ACCORDS TO STRUCTURAL ENGINEER'S PRELIMINARIES.

TENANT STORAGE SCHEDULE

9 x 2m³	MODULE	1000W x 1000D x 2000H
12 x 4m³	MODULE	2000W x 1000D x 2000H
3 x 4m³	MODULE	1500W x 1500D x 2000H



1 BASEMENT
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DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA8	02/07/17	PLANNING AMENDMENTS	AD
DA7	28/07/17	PLANNING AMENDMENTS	AD/EM
DA6	21/07/17	PLANNING AMENDMENTS	AD/EM
DA5	26/05/17	SETBACK REVISED, NOTES ADDED	PC/TV/KW
DA4	03/05/17	APARTMENTS AND CARPARKS REVISED WITH NEW SETBACK	TV/PC
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

DRAWING TITLE:
BASEMENT

SCALE: 1 : 100
DRAWN BY: TV/MI/DS/EE
DATE: 17.07.17
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PROJECT NUMBER: 14067
DRAWING No: A2-01
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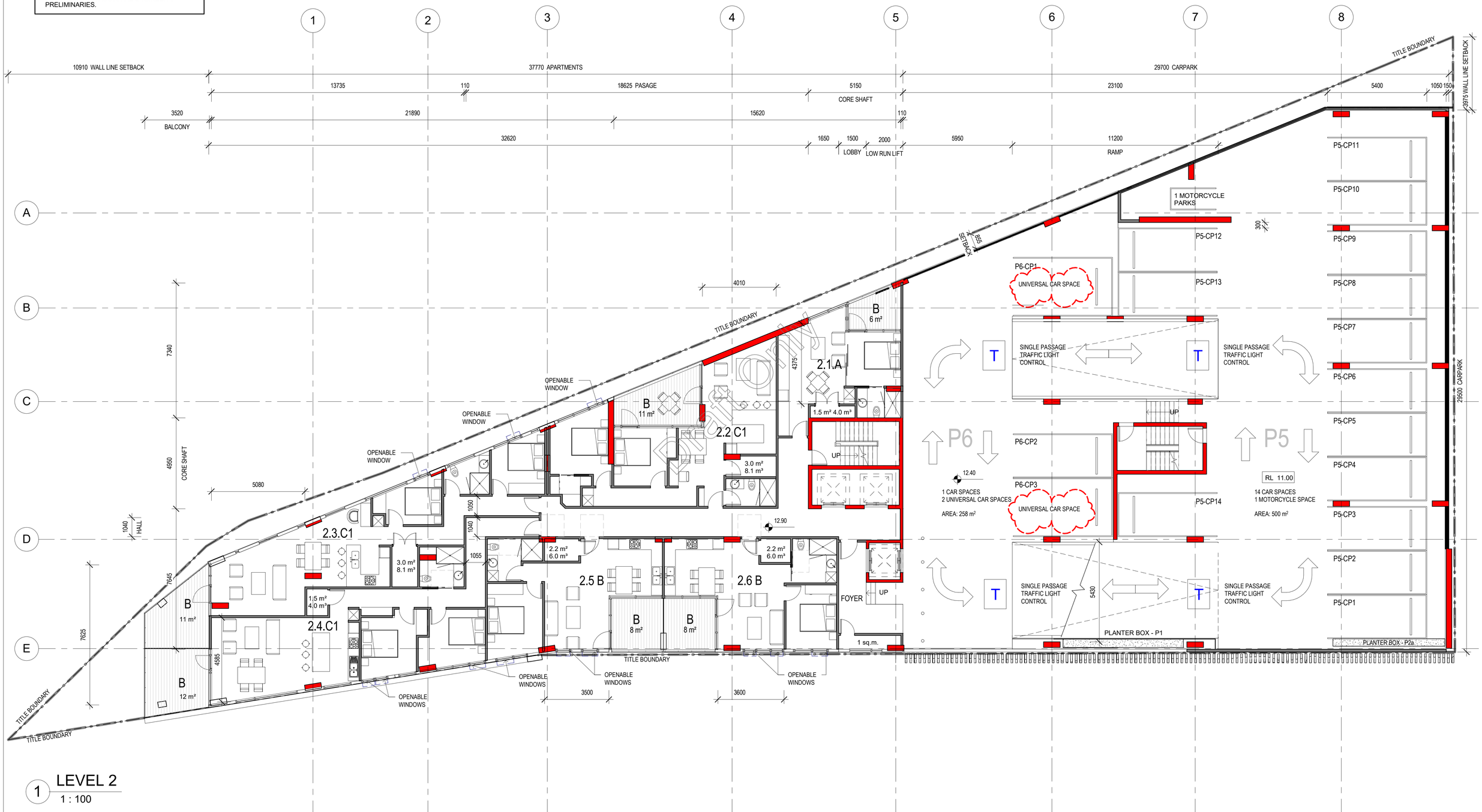

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DA7	28/07/17	PLANNING AMENDMENTS	AD/EM
DA6	21/07/17	PLANNING AMENDMENTS	AD/EM
DA5	26/05/17	APARTMENTS AND ELEVATIONS REVISED	PC/TV/KW
DA4	22/11/16	REVISED APARTMENT LAYOUT WITH RECESSED BUILDING BOUNDARY	KW
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT: BRANCOURT NOMINEES P/L

PROJECT: 990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

PROPOSED MIXED USE DEVELOPMENT

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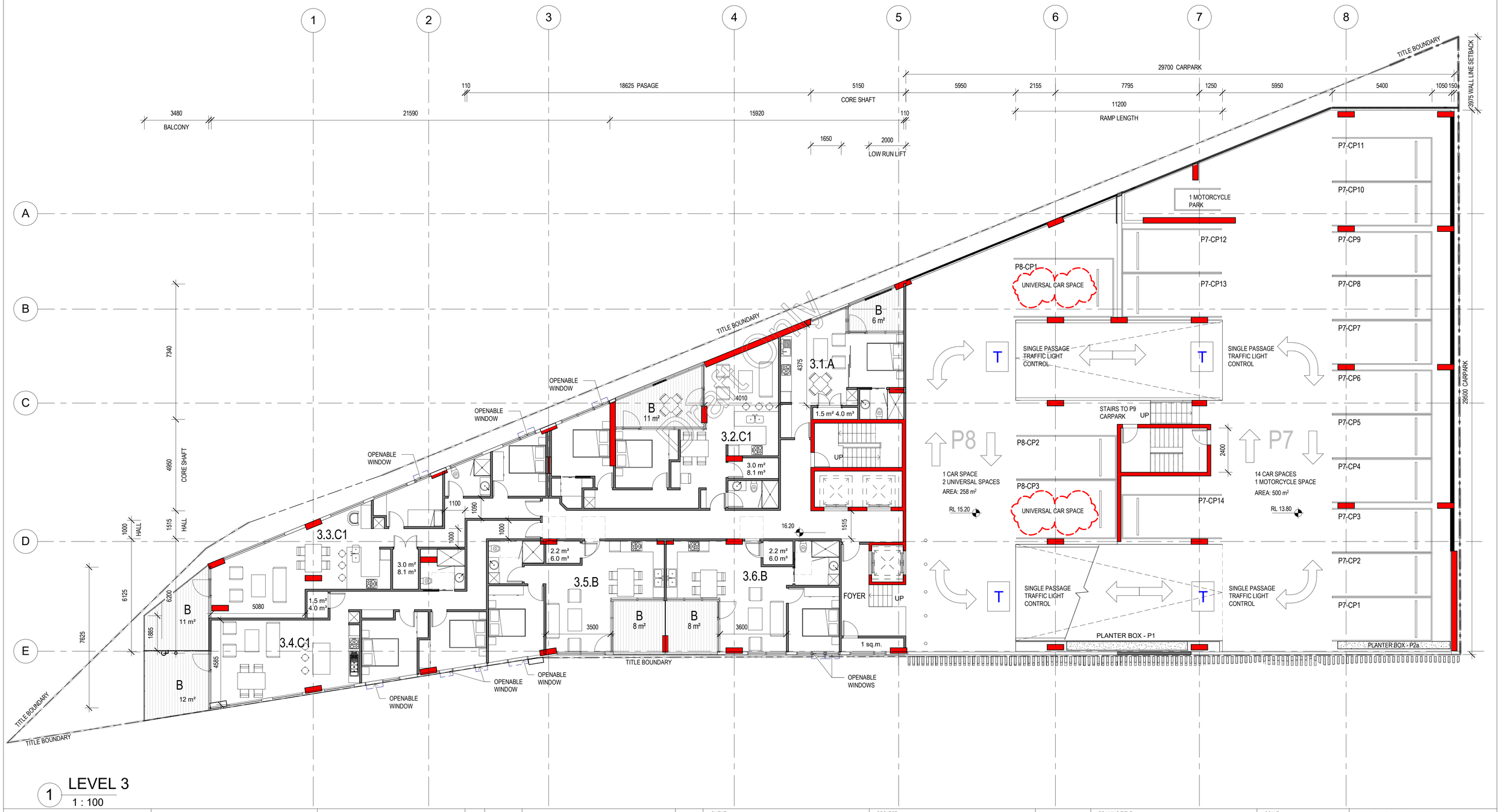

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DA7	28/07/17	PLANNING AMENDMENTS	AD/EM
DA6	21/07/17	PLANNING AMENDMENTS	AD/EM
DA5	26/05/17	APARTMENTS AND ELEVATIONS REVISED	PC/TV/KW
DA4	03/05/17	APARTMENTS AND CARPARKS REVISED WITH NEW SETBACK	TV/PC
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES
P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

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THIRD FLOOR PLAN

SCALE: 1 : 100
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DATE: 17.07.17
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PROJECT NUMBER: 14067
DRAWING No: A2-05
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April 2016 **BSA Reference: 10779**

Building Sustainability Assessments **Ph: (02) 4962 3439**
enquiries@buildingsustainability.net.au **www. buildingsustainability.net.au**

Important Note for Development Applicants

The following specification was used to achieve the thermal performance values indicated on the Assessor Certificate. If they vary from drawings or other specifications this Specification shall take precedence. If only one specification option is detailed for a building element, that specification must apply to all instances of that element for the whole project. If alternate specifications are detailed, the location and extent of the alternate specification must be detailed below and / or clearly indicated on referenced documentation.

Once the development is approved by the consent authority, these specifications will become a condition of consent and must be included in the built works. If you do not want to include these requirements, the proposed construction varies to those detailed or need further information, please contact Building Sustainability Assessments.

This assessment has assumed that the BCA provisions for building sealing will be complied with at construction. No loss of insulation arising from ceiling penetrations has been simulated.

Thermal Performance Specifications

External Wall Construction	*Insulation*	*Colour (Solar Absorptance)*	*Detail*
Concrete	R1.0	Any	
Lightweight	R2.0	Any	
Internal Wall Construction	*Insulation*	*Detail*	
Plasterboard on studs & Concrete	none		
Plasterboard on studs	R2.0 to walls adjacent to carpark, lobbies, starwells and liftwells		
Ceiling Construction	*Insulation*	*Detail*	
Plasterboard	R3.0 to ceilings adjacent to roof and decks above		
Roof Construction	*Insulation*	*Colour (Solar Absorptance)*	*Detail*
Concrete	none	Any	
Floor Construction	*Insulation*	*Covering*	*Detail*
Concrete	none	As drawn (if not noted default values used)	
Concrete	R1.0 to floors adjacent to carparks below		

Windows	*Glass and frame type*	*U*	*SHGC*	*Area sq m*	*Detail*
Performance glazing with the following values		3.74	0.47	As drawn	

Skylights	*Glass and frame type*	*U*	*SHGC*	*Area sq m*	*Detail*

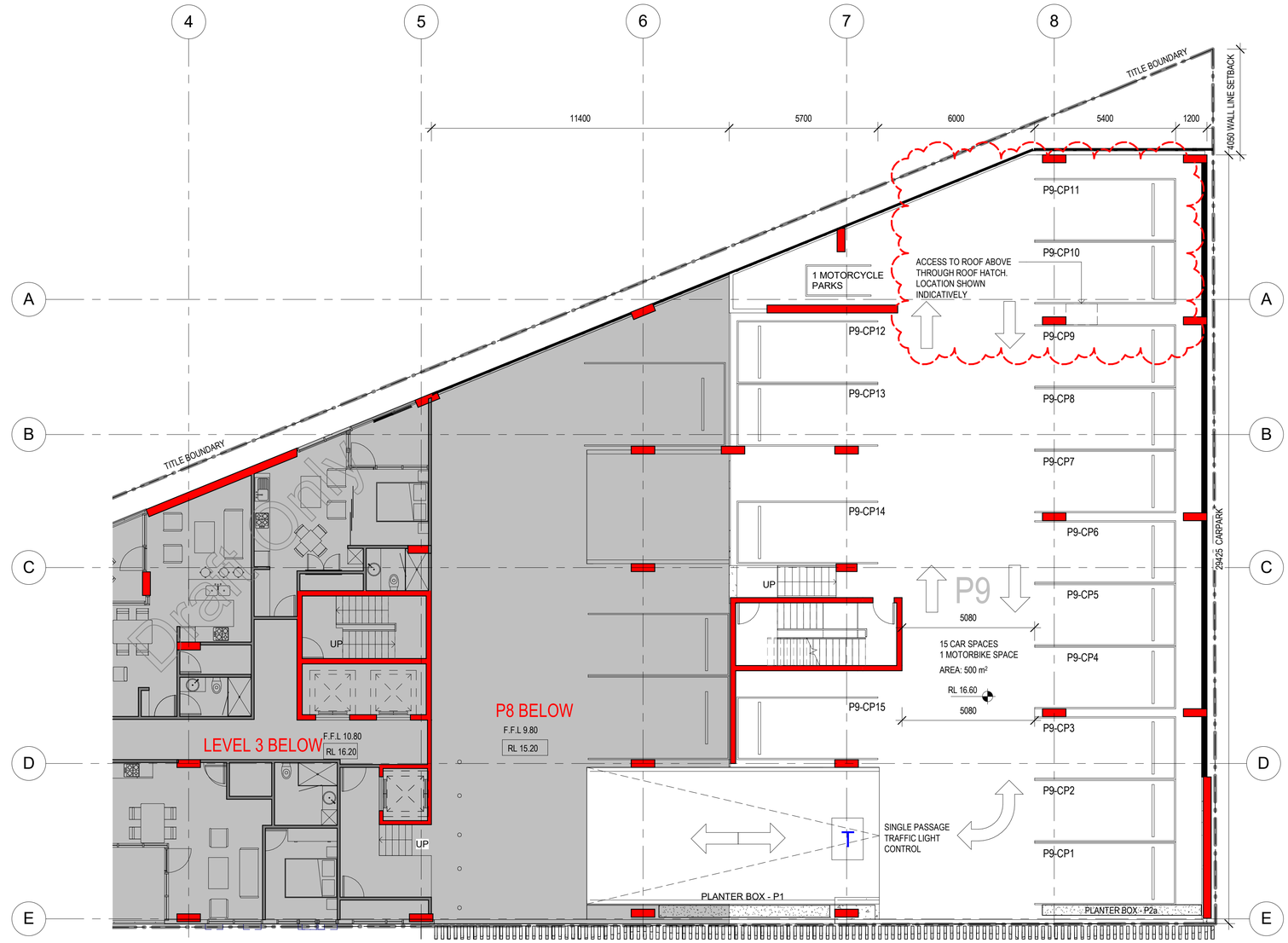
U and SHGC values are according to NFRC. Alternate products may be used if the U value is lower and the SHGC is less than 10% higher or lower than the above figures.

External Window Cover	*Detail*
As drawn	
Fixed shading - Eaves	*Width includes guttering, offset is distance above windows*
Width: as drawn Offset: as drawn	Nominal only, refer to plan for detail
Fixed shading - Other	*Verandahs, Pergolas (type and description)*
Shaded areas and shade devices as drawn	

For construction in NSW the BCA Vol 1 or 2 must be complied with, in particular the following:

- *Thermal construction in accordance with Vol 1 Section J1.2 or Vol 2 Part 3.12.1.1*
- *Thermal breaks in accordance with Section J1.3(d) & 1.5(c) or Part 3.12.1.2(c) & 3.12.1.4(b)*
- *Compensating for loss of ceiling insulation in accordance with Section J1.3(c) or Part 3.12.1.2(e)*
- *Floor insulation in accordance with Section J1.6(c) & (d) or Part 3.12.1.5(a)(iii) or (c) & (d)*
- *Building sealing in accordance with Section J3 or Part 3.12.3.1 to 3.12.3.6.*

HOT WATER SUPPLY
EACH UNIT IS TO BE PROVIDED WITH AN INDIVIDUALLY METERED ELECTRIC INSTANTANEOUS HOT WATER SERVICE



1 CARPARK LEVEL 4 P9
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DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA8	02/07/17	PLANNING AMENDMENTS	AD
DA7	28/07/17	PLANNING AMENDMENTS	AD/EM
DA6	21/07/17	PLANNING AMENDMENTS	AD/EM
DA5	26/05/17	PRELIMINARY	PC/TV/KW
DA4	03/05/17	APARTMENTS AND CARPARKS REVISED WITH NEW SETBACK	TV/PC
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT: BRANCOURT NOMINEES P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT: 990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

DRAWING TITLE: P9 CAR PARK

SCALE: As indicated
DRAWN BY: TV/MI/DS/EE
DATE: 17.07.17
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PROJECT NUMBER: 14067
DRAWING No: A2-06
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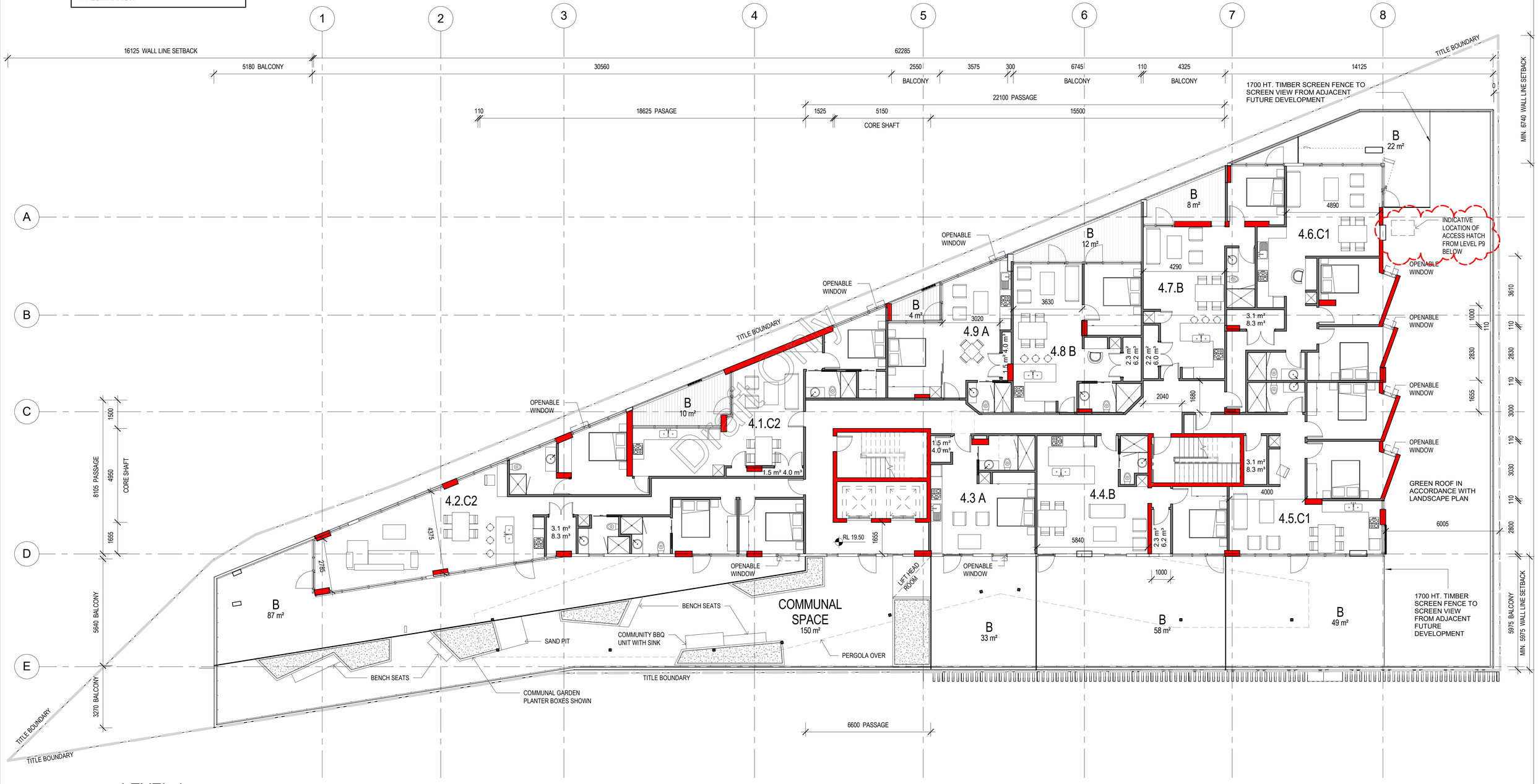

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DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA9	02/07/17	PLANNING AMENDMENTS	AD
DA8	28/07/17	PLANNING AMENDMENTS	AD/EM
DA7	21/07/17	PLANNING AMENDMENTS	AD/EM
DA6	26/05/17	APARTMENTS AND ELEVATIONS REVISED	PC/TV/KW
DA5	03/05/17	APARTMENTS REVISED WITH NEW SETBACK	TV/PC
DA4	28/10/16	COMMUNAL BALCONIES, APARTMENTS UPDATED	KW
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

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FOURTH FLOOR PLAN

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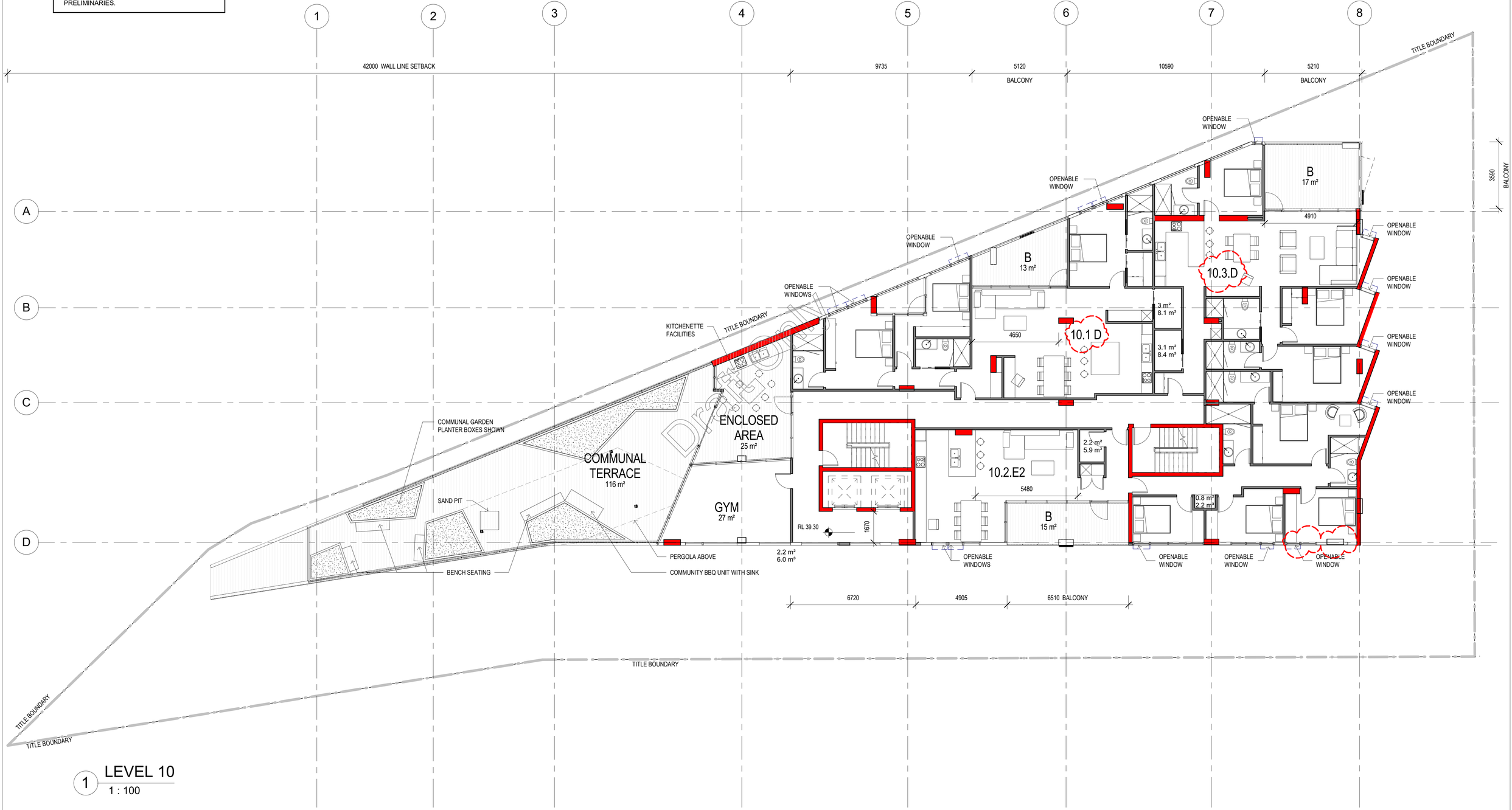

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DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA8	28/04/17	PLANNING AMENDMENTS	AD/EM
DA7	21/07/17	PLANNING AMENDMENTS	AD/EM
DA6	26/05/17	APARTMENTS AND ELEVATIONS REVISED	PC/TV/KW
DA5	03/05/17	APARTMENTS REVISED WITH NEW SETBACK	TV/PC
DA4	28/10/16	COMMUNAL BALCONIES, APARTMENTS UPDATED	KW
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

DRAWING TITLE:
TENTH FLOOR PLAN

SCALE: 1 : 100
DRAWN BY: TV/MI/DS/EE
DATE: 17.07.17
CHECKED BY: MC

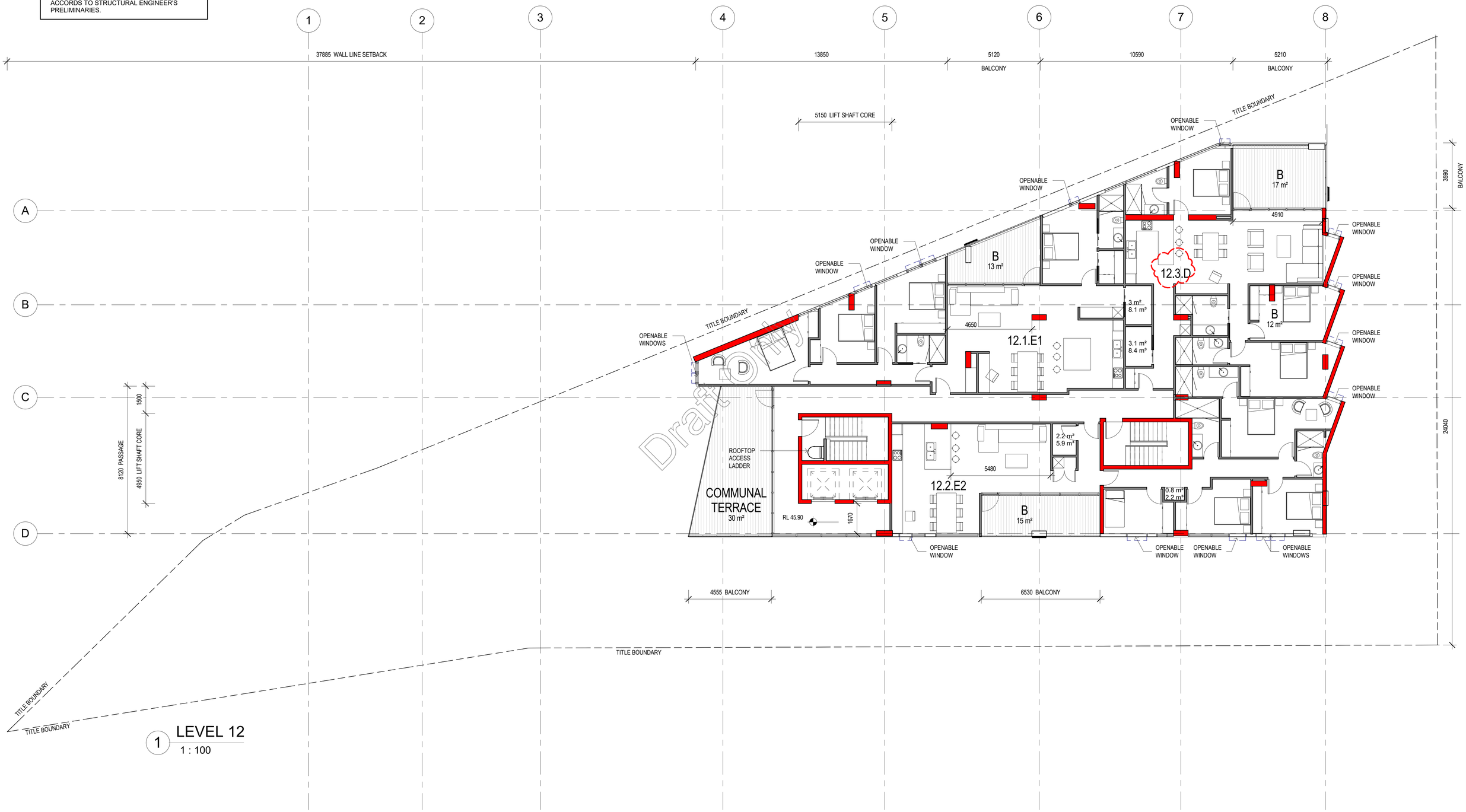
PROJECT NUMBER: 14067
DRAWING No: A2-09
REV: DA8

28/07/2017 1:10:49 PM

GENERAL NOTE:

DIMENSIONS HAVE BEEN ROUNDED TO THE NEAREST 5mm
WHERE THEY ARE TO BE ABSOLUTE "MIN" OR "MAX" HAS BEEN NOTED TO CONFER THAT THE VALUE IS A MINIMUM OR MAXIMUM VALUE

STRUCTURAL GRID LAYOUT HAS NOT BEEN CONFIRMED & WILL NEED TO BE CO-ORDINATED WITH DESIRED CLADDING / EXTERNAL SKIN TO WALLS. THAT SHOWN ACCORDS TO STRUCTURAL ENGINEER'S PRELIMINARIES.



1 LEVEL 12
1 : 100

MEMBER THE ROYAL AUSTRALIAN INSTITUTE OF ARCHITECTS

Michael Carr Architect Pty. Ltd.
ACN 005 121 219

88 Tope Street, South Melbourne 3205
Ph 03 9645 5635 Fax 03 9686 4084
Email admin@mcarchitect.com.au

DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA8	28/04/17	PLANNING AMENDMENTS	AD/EM
DA7	21/07/17	PLANNING AMENDMENTS	AD/EM
DA6	26/05/17	APARTMENTS AND ELEVATIONS REVISED	PC/TV/KW
DA5	03/05/17	APARTMENTS REVISED WITH NEW SETBACK	TV/PC
DA4	31/10/16	REVISED BUILDING FACADE AND APARTMENTS	KW
DA3	06/10/16	ADDITIONAL STAIRS, CARPARK AND APARTMENT ADJUSTMENTS	KW
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET, NEWCASTLE WEST, 2302, N.S.W.

APPROVED: DATE:

DRAWING TITLE:
TWELFTH FLOOR PLAN

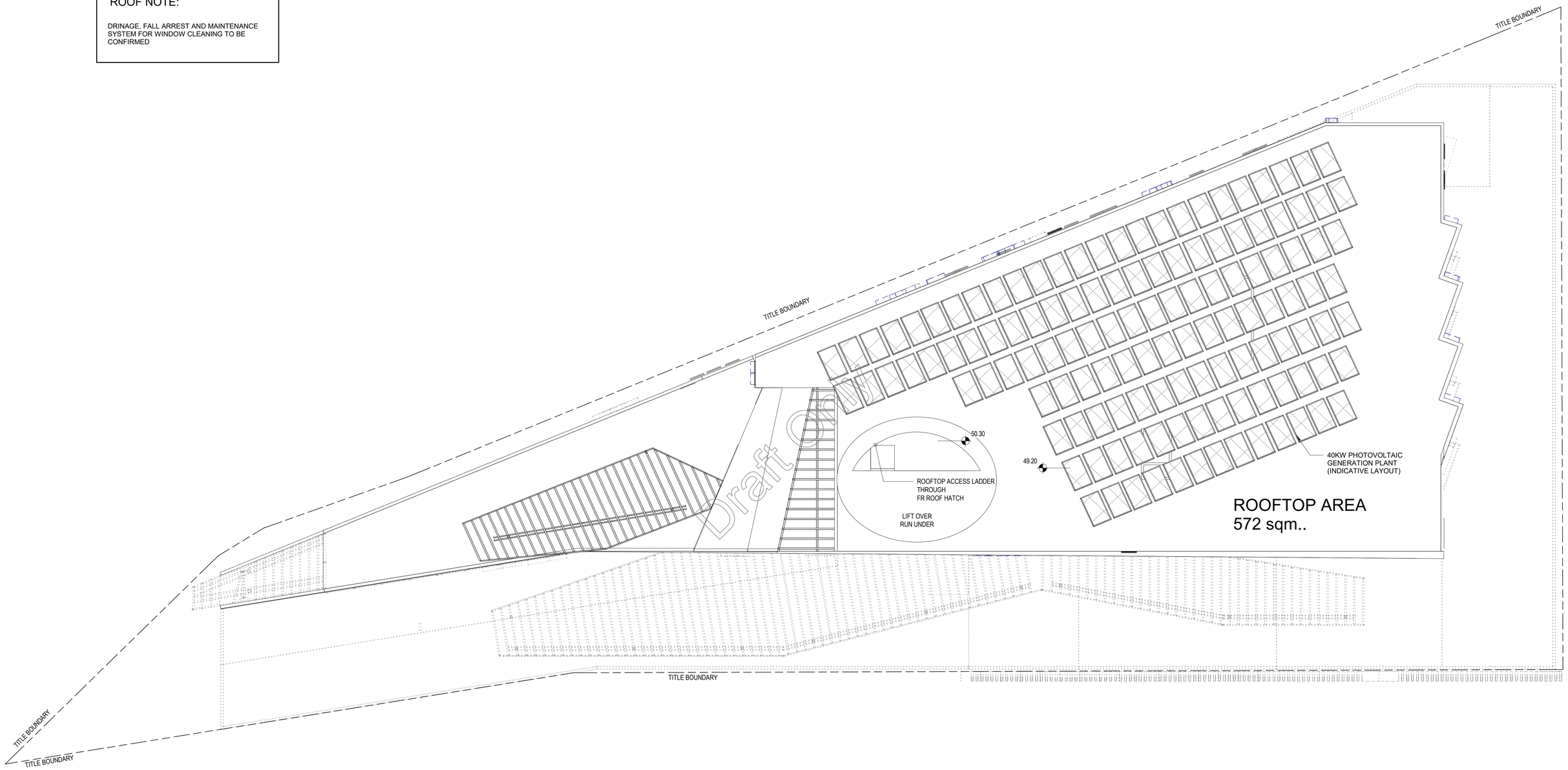
SCALE: 1 : 100
DRAWN BY: TV/MI/DS/EE
DATE: 17.07.17
CHECKED BY: MC

PROJECT NUMBER: 14067
DRAWING No: A2-11
REV: DA8

28/07/2017 1:11:40 PM

ROOF NOTE:

DRINAGE, FALL ARREST AND MAINTENANCE SYSTEM FOR WINDOW CLEANING TO BE CONFIRMED



1 ROOF PLAN
1 : 100

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DEVELOPMENT APPLICATION

REV	DATE	AMENDMENT	BY
DA4	26/05/17	PRELIMINARY	PC/TV/KW
DA3	03/05/17	APARTMENTS REVISED WITH NEW SETBACK	TV/PC
DA2	27/04/16	Screen & spandrels	EE
DA1	08/04/16	Amendments to design	EE

CLIENT:
BRANCOURT NOMINEES
P/L PROPOSED MIXED USE DEVELOPMENT

PROJECT:
990 HUNTER STREET,
NEWCASTLE WEST, 2302,
N.S.W.

APPROVED: DATE:

DRAWING TITLE:
ROOF PLAN

SCALE: 1 : 100
DRAWN BY: TV/MI/DS/EE
DATE: 17.07.17
CHECKED BY: MC

PROJECT NUMBER: 14067

DRAWING No: A2-12

REV: DA4

28/07/2017 1:12:38 PM

Appendix C – Noise Logging Data

Measured Ambient Noise Levels

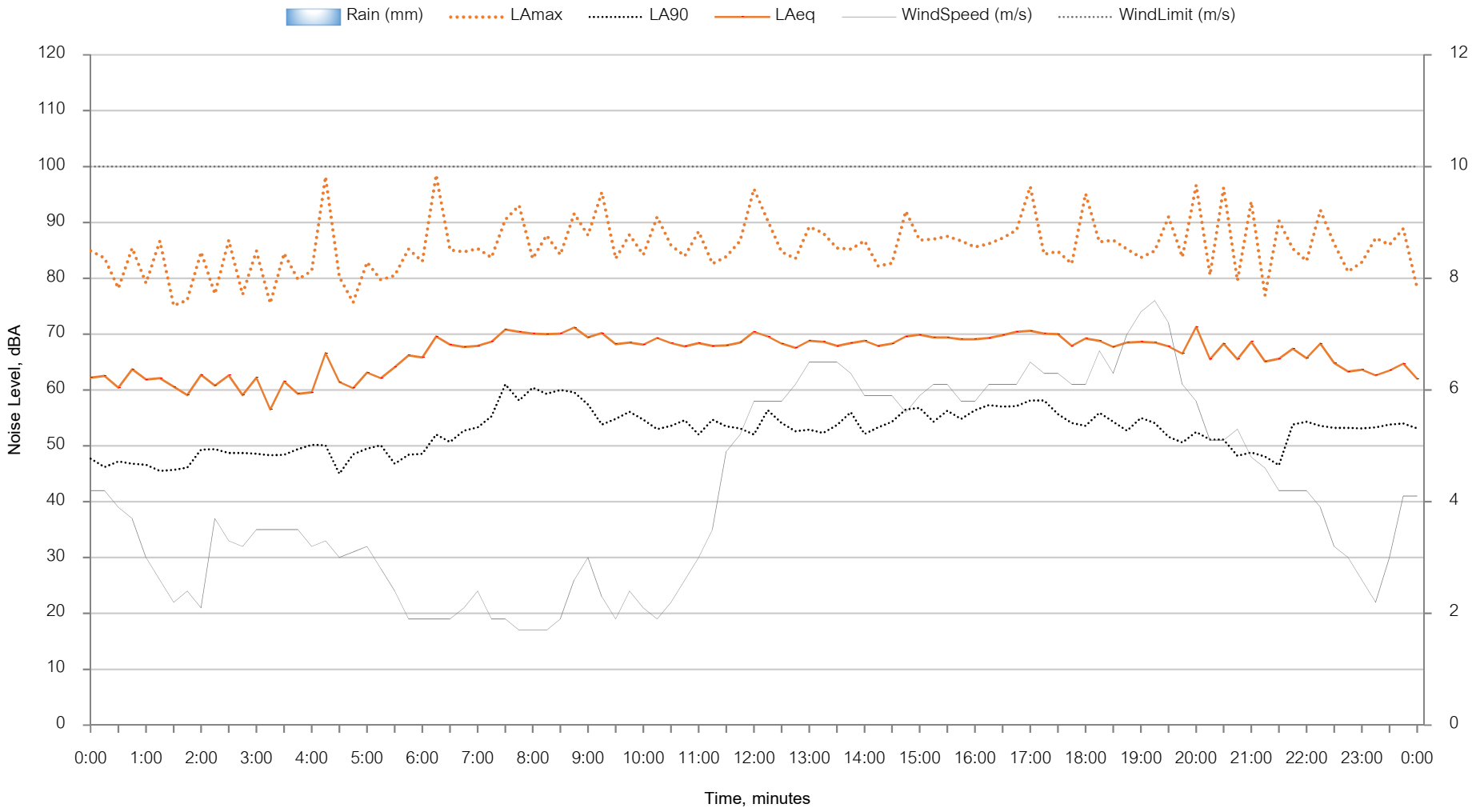
990 Hunter Street

Wednesday, 10-02-16

Measured Ambient Noise Levels

990 Hunter Street

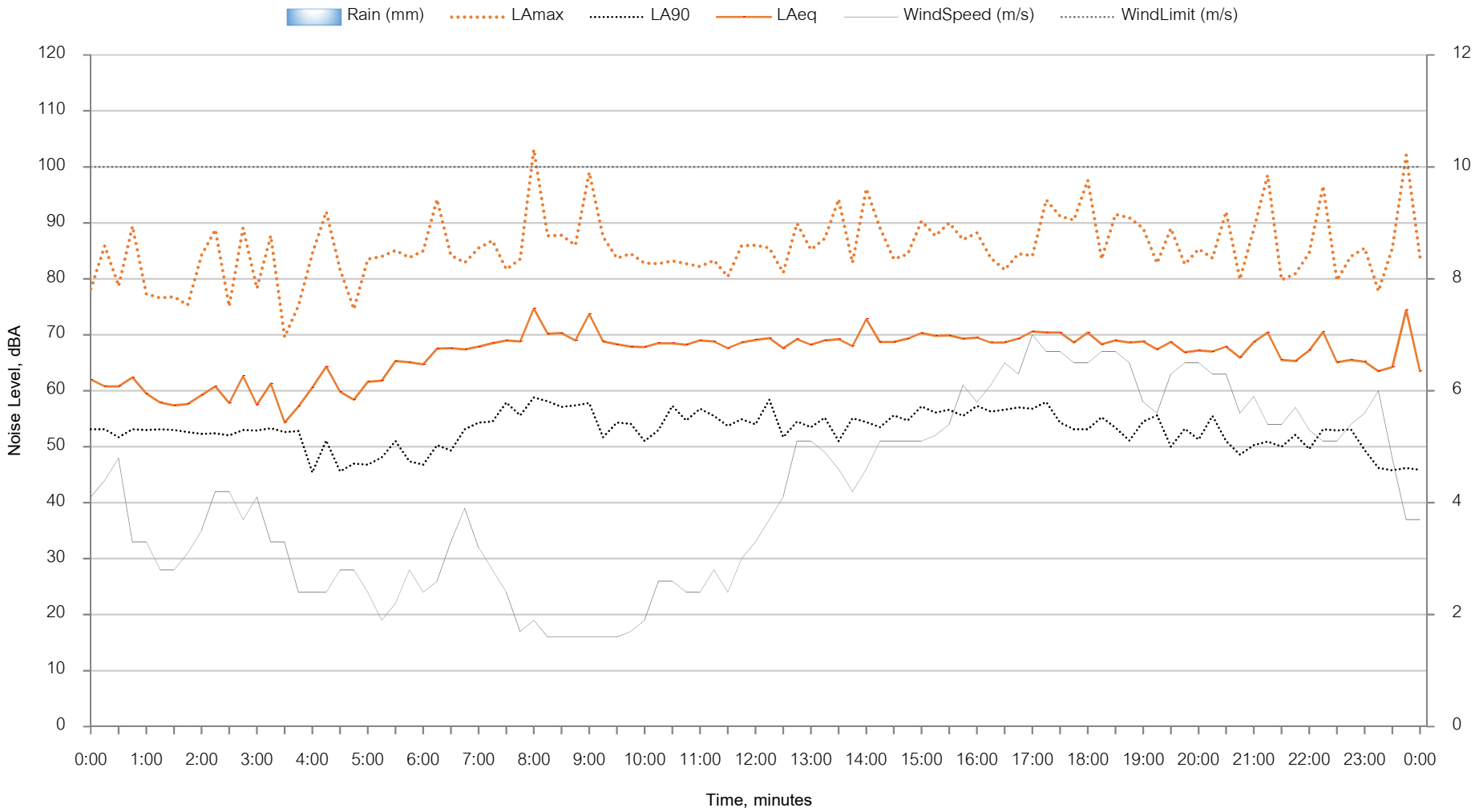
Thursday, 11-02-16



Measured Ambient Noise Levels

990 Hunter Street

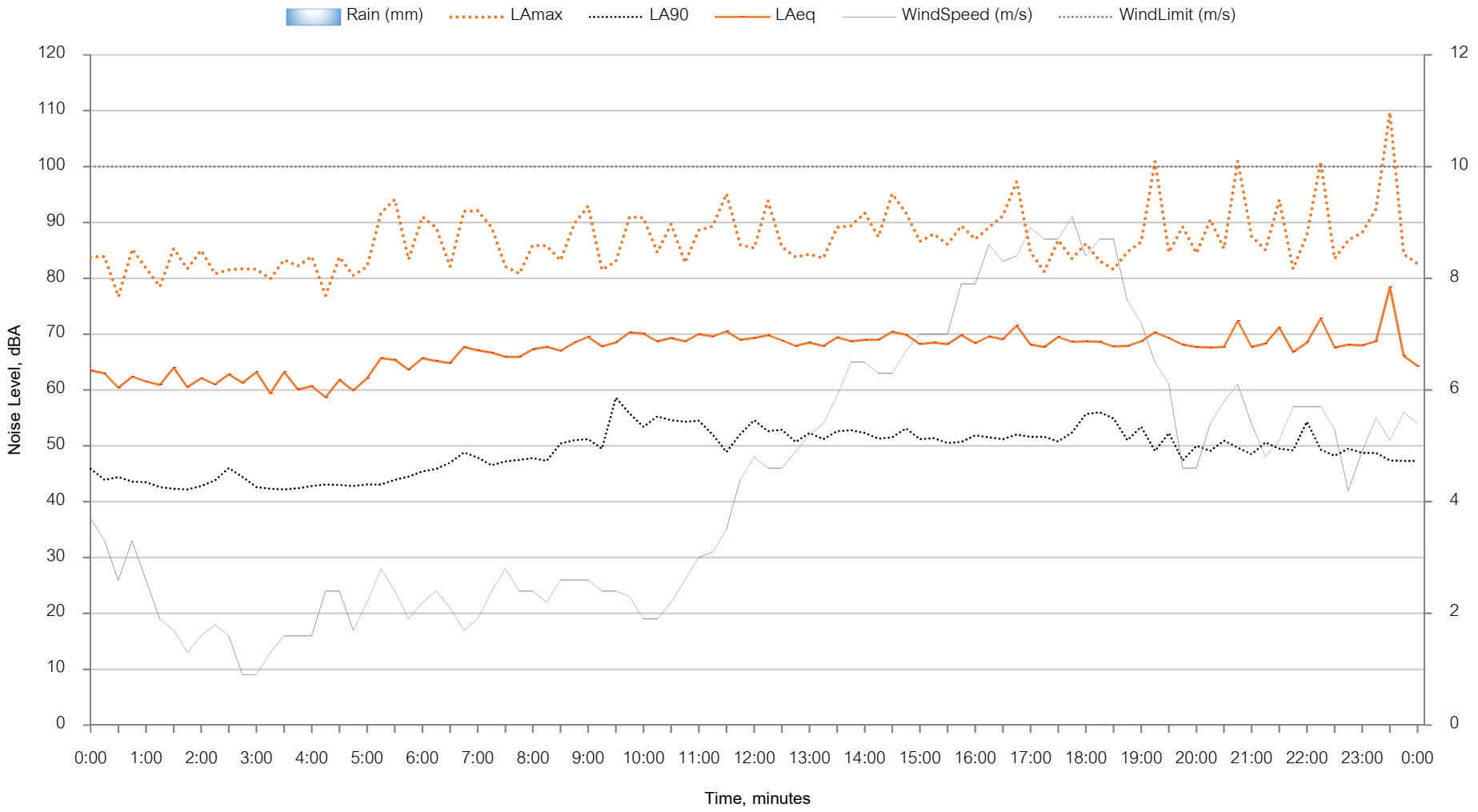
Friday, 12-02-16



Measured Ambient Noise Levels

990 Hunter Street

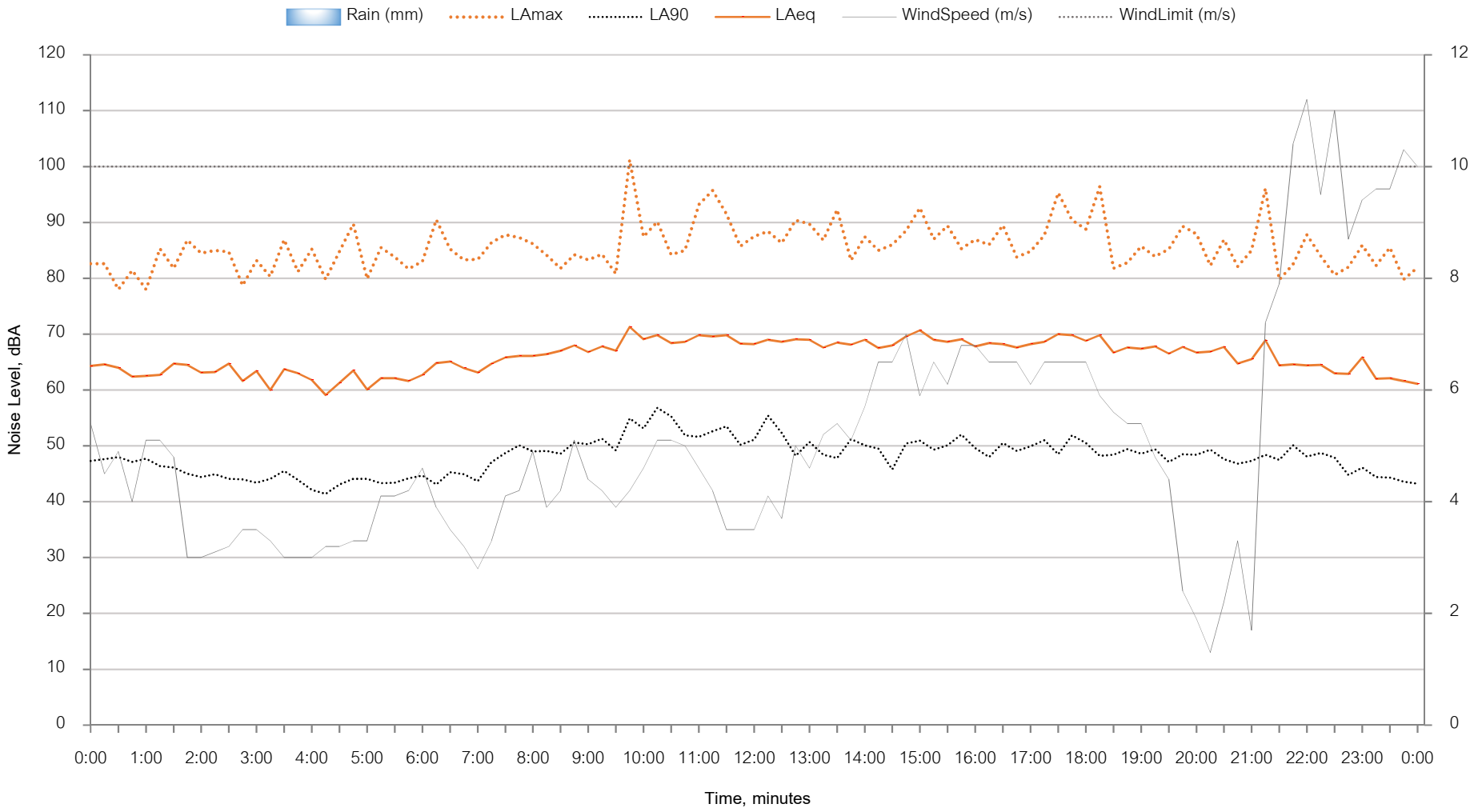
Saturday, 13-02-16



Measured Ambient Noise Levels

990 Hunter Street

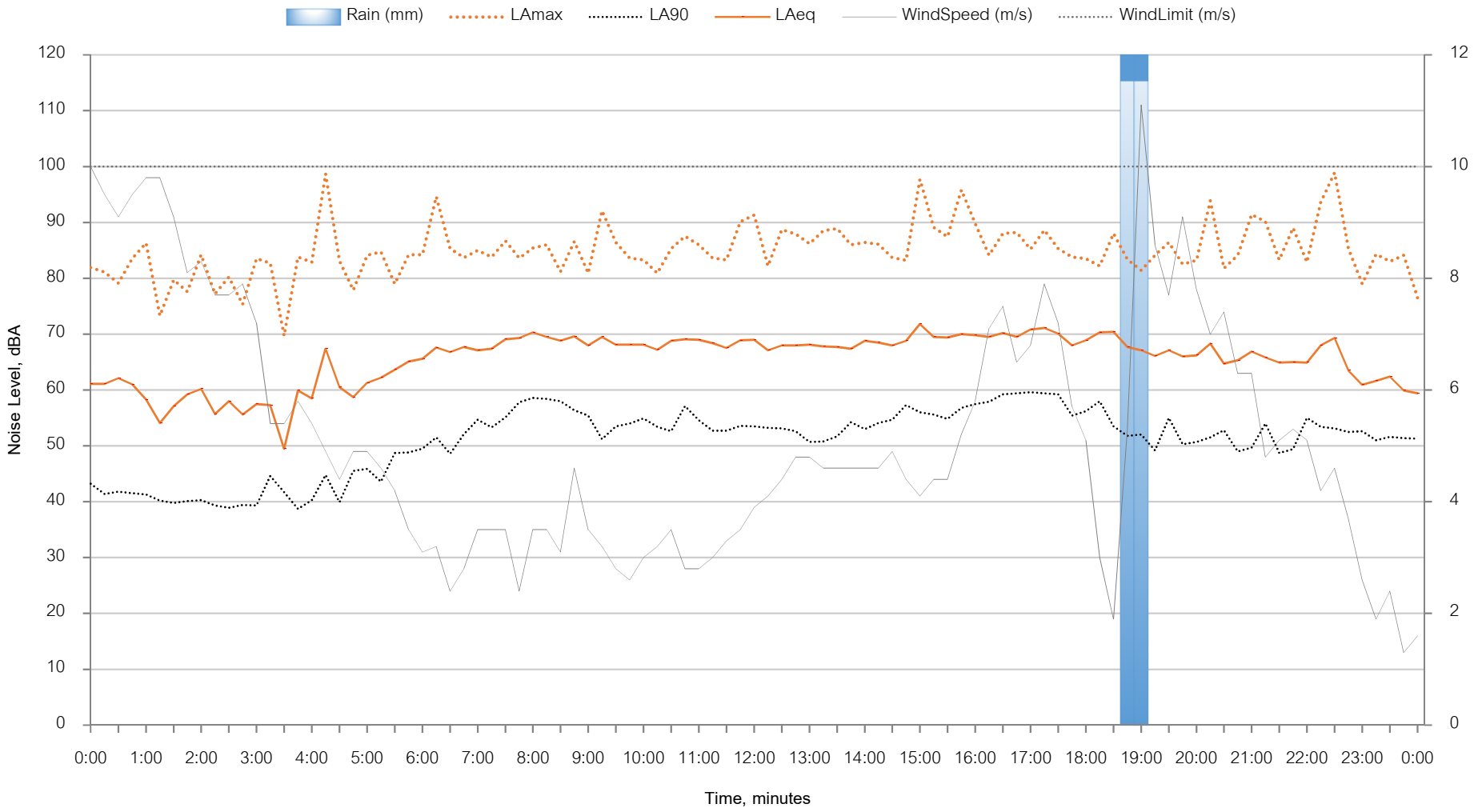
Sunday, 14-02-16



Measured Ambient Noise Levels

990 Hunter Street

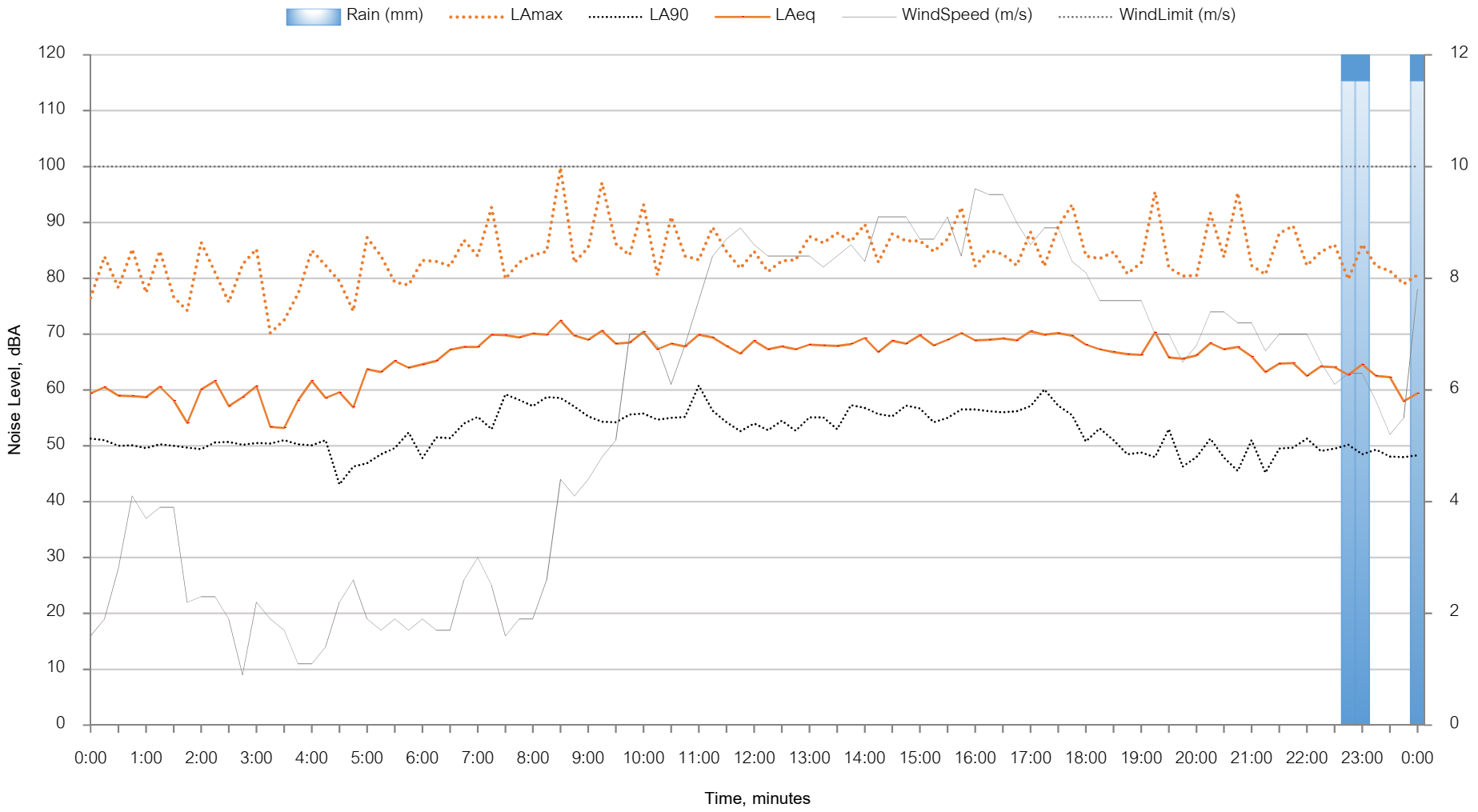
Monday, 15-02-16



Measured Ambient Noise Levels

990 Hunter Street

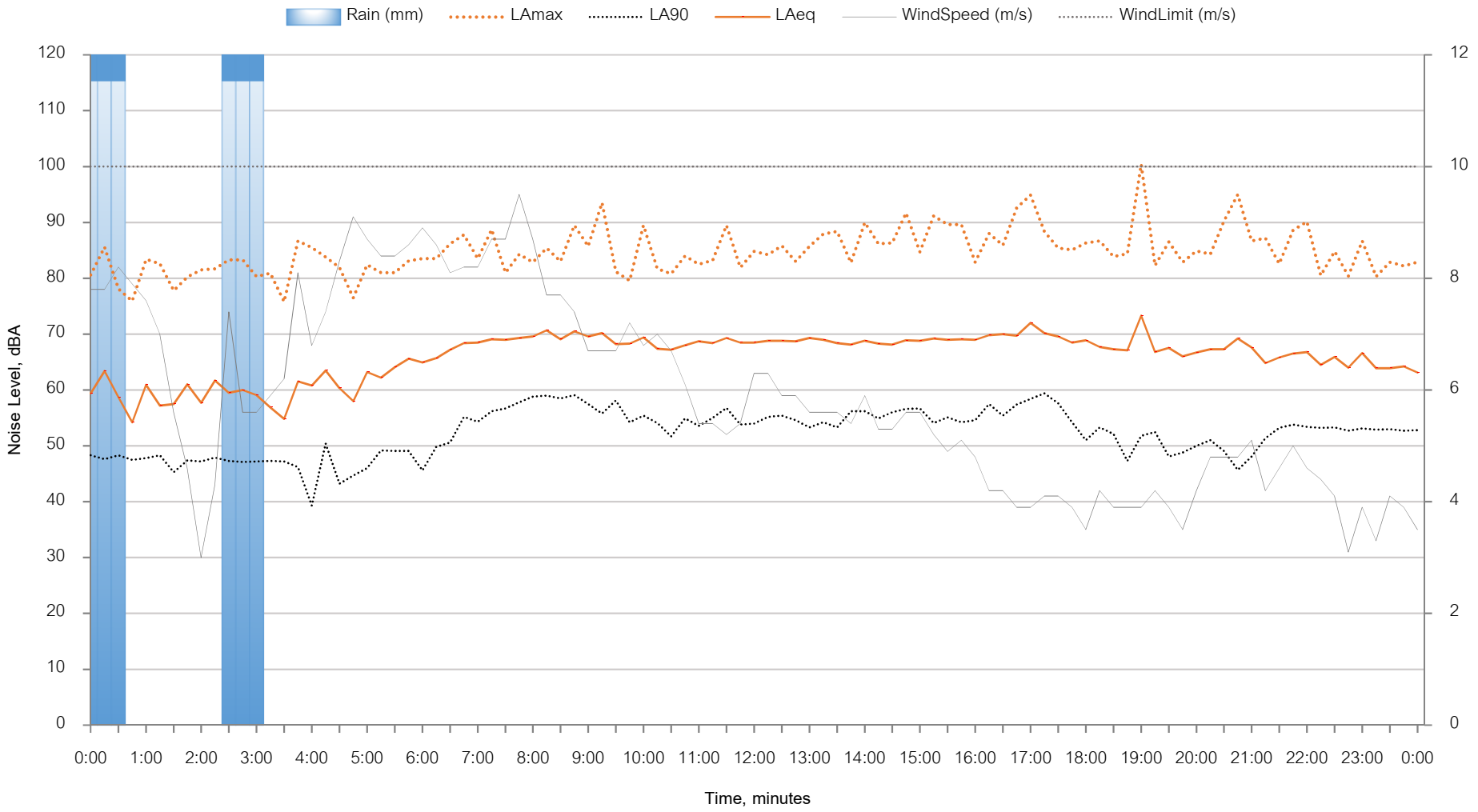
Tuesday, 16-02-16



Measured Ambient Noise Levels

990 Hunter Street

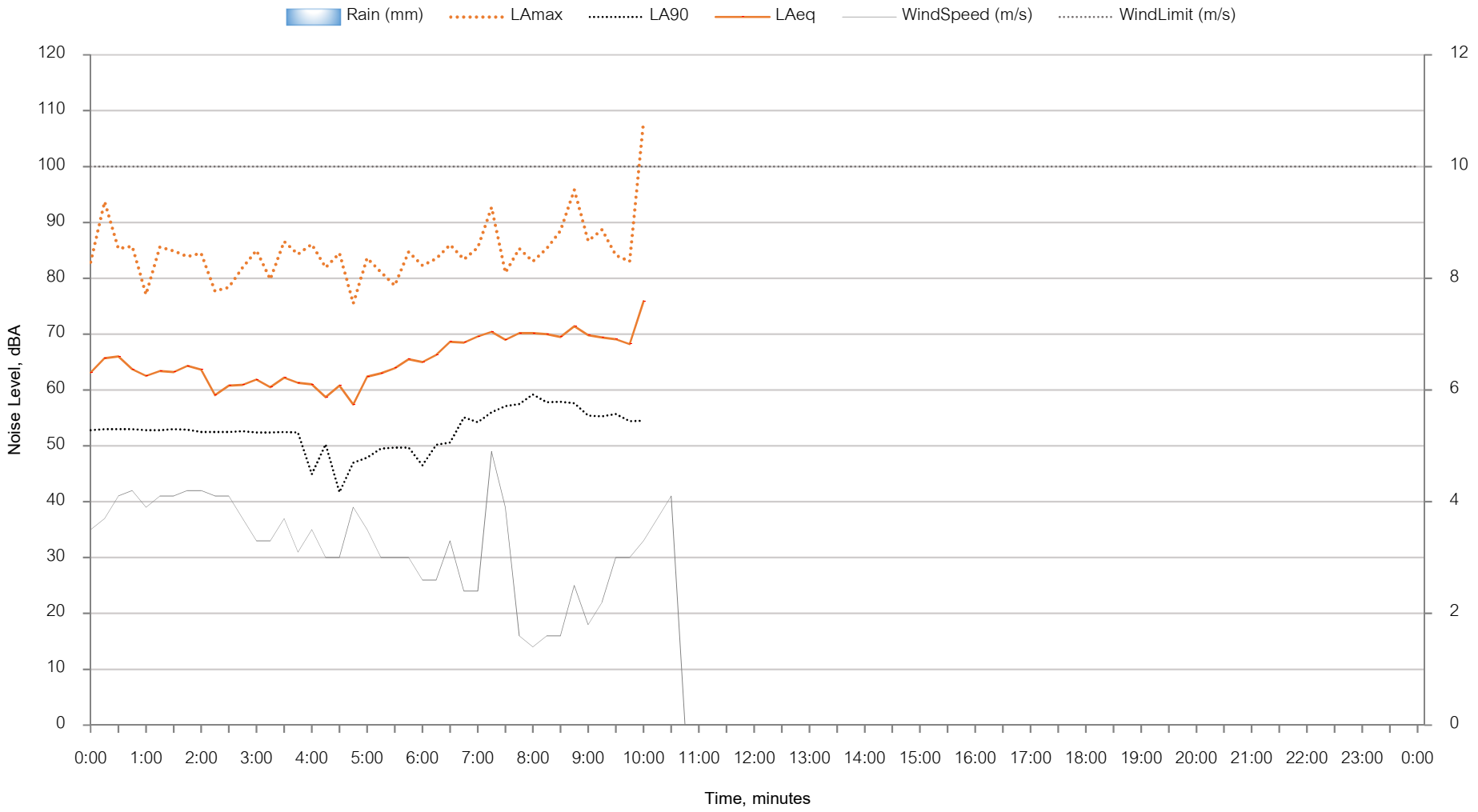
Wednesday, 17-02-16



Measured Ambient Noise Levels

990 Hunter Street

Thursday, 18-02-16



Appendix D – Guideline Treatment Categories

Appendix C – Acoustic Treatment of Residences

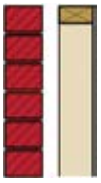
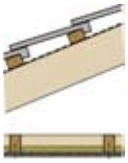
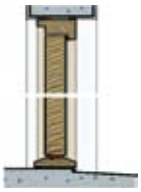
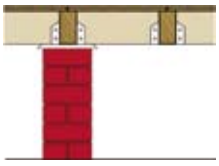
The following table sets out standard (or deemed-to-satisfy) constructions for each category of noise control treatment for the sleeping areas and other habitable areas of single / dual occupancy residential developments only. The assumptions made in the noise modelling are as follows:

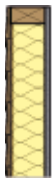
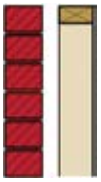
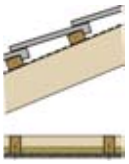
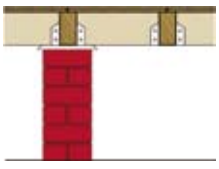
- Typical layout of a modern dwelling taken from a recent large residential development in an outer Sydney suburb
- Bedrooms and other habitable rooms are exposed to road noise

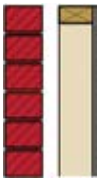
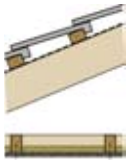
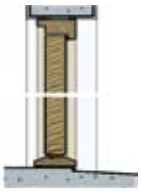
ACOUSTIC PERFORMANCE OF BUILDING ELEMENTS

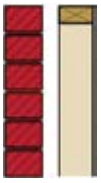
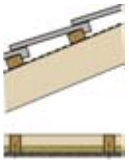
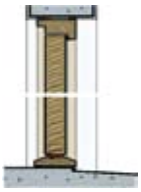
The acoustic performances assumed of each building element in deriving the Standard Constructions for each category of noise control treatment presented in the preceding Table, are presented below in terms of Weighted Sound Reduction Index (Rw) values, which can be used to find alternatives to the standard constructions presented in this Appendix:

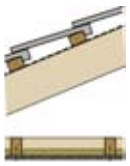
Category of Noise Control Treatment	R_w of Building Elements (minimum assumed)				
	Windows/Sliding Doors	Frontage Facade	Roof	Entry Door	Floor
Category 1	24	38	40	28	29
Category 2	27	45	43	30	29
Category 3	32	52	48	33	50
Category 4	35	55	52	33	50
Category 5	43	55	55	40	50

Category No.	Building Element	Standard Constructions	sample
1	**Windows/Sliding Doors**	Openable with minimum 4mm monolithic glass and standard weather seals	
	Frontage Facade	**Timber Frame or Cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally	
		Brick Veneer: 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally	
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R1.5 insulation batts in roof cavity.	
	Entry Door	35mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
2	**Windows/Sliding Doors**	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals	
	Frontage Facade	**Timber Frame or Cladding Construction:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally with R2 insulation in wall cavity.	
		Brick Veneer Construction: 110mm brick, 90mm timber stud frame or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	40mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
3	**Windows/Sliding Doors**	Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals	
	Frontage Facade	**Brick Veneer Construction:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 1 layer of 13mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	45mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
4	**Windows/Sliding Doors**	Openable with minimum 10.38mm laminated glass and full perimeter acoustic seals	
	Frontage Facade	**Brick Veneer Construction:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, R2 insulation batts in wall cavity, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	45mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
5	**Windows/Sliding Doors**	Openable Double Glazing with separate panes: 5mm monolithic glass, 100mm air gap, 5mm monolithic glass with full perimeter acoustic seals.	
	Frontage Facade	**Double Brick Cavity Construction:** 2 leaves of 110mm brickwork separated by 50mm gap with cement render to the external face of the wall and cement render or 13mm plasterboard direct fixed to internal faces of the wall.	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joist using resilient mounts, R2 insulation batts in roof cavity	
	Entry Door	Special high performance acoustic door required - Consult an Acoustic Engineer	*Door to acoustic consultant's specifications*
	Floor	Concrete slab floor on ground	
6	**All**	Consult an Acoustic Engineer	

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