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1 INTRODUCTION

This report presents an analysis of acoustic impacts associated with the proposed residential apartment development at 90 Cartwright Avenue, Miller.

In this report we will conduct an external noise impact assessment (primarily traffic noise) and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future tenants.

This report is conducted in reference to;

- Liverpool Council DCP 2008
- Australian Standard AS-2107:2000

The analysis will be undertaken with reference to the architectural drawing set provided by Architex, of Job Number 2038, Sheets DA02-DA13 and dated November 2014.

2 SITE DESCRIPTION

The development consists of an 8 level residential apartment building with 1 additional basement level for car-parking, located at 90 Cartwright Avenue, Miller. The site is bounded as follows;

- To the north by Cartwright Avenue, carrying low-to-medium volumes of traffic flow
- To the east by Woodward Crescent, carrying low-to-medium volumes of traffic flow, with residential properties further to the east
- To the west by Miller Shopping Centre
- To the south by Green Valley Hotel, with an external courtyard facing the proposed development, operating 7 days a week, and open after 10pm Monday-Saturday.

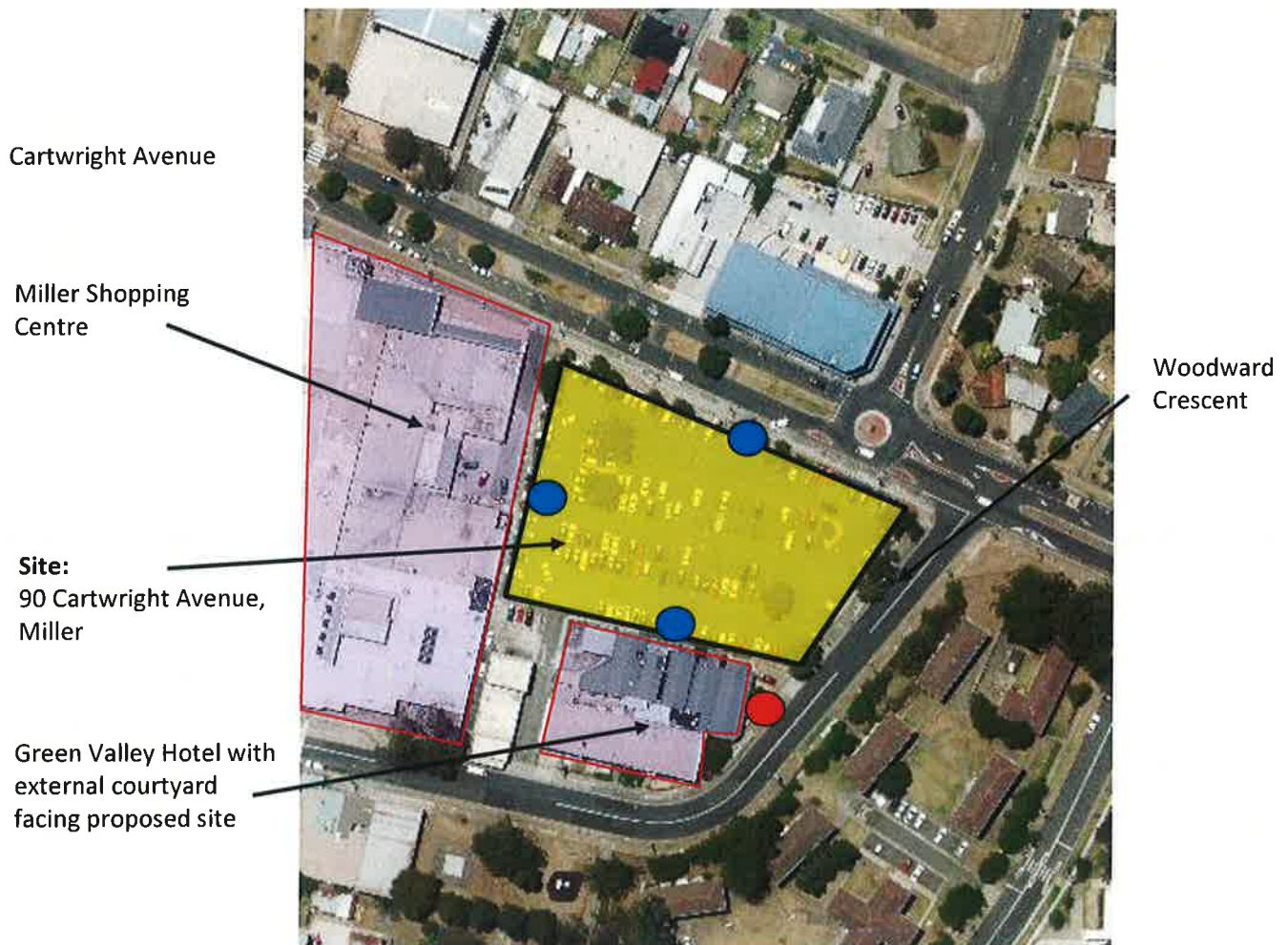


Figure 1 – Proposed Development Site

- Attended Noise Monitoring Locations
- Unattended Noise Monitoring Locations

3 NOISE DESCRIPTORS

Traffic noise constantly varies in level, due to fluctuations in traffic speed, vehicle types, road conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of environmental noise, three principle measurement parameters are used, namely L_{10} , L_{90} and L_{eq} .

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced at the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

Current practice favours the L_{eq} parameter as a means of measuring traffic noise, whereas the L_{10} parameter has been used in the past and is still incorporated in some codes. For the reasons outlined above, the L_{90} parameter is not used to assess traffic noise intrusion.

4 NOISE INTRUSION CRITERIA

The most significant traffic noise from within the vicinity of the site is caused by road traffic along Cartwright and Woodward Crescent, along the north and east of the project, respectively. Both roadways carry low-to-medium volumes of traffic flow. Noise impacts from the road traffic noise should comply with both the requirements of the Liverpool City Council DCP 2008, and AS-2107:2000.

Noise from the rooftop mechanical plant of Miller Shopping Centre to the west of the site, and noise from the courtyard of the Green Valley Hotel to the South of the site have also been assessed to the recommended internal noise levels of AS2107:2000.

4.1 ACOUSTIC OBJECTIVES

4.1.1 Liverpool City Council DCP 2008

There are no specific criteria stated in the Liverpool City Council DCP relating to acoustic amenity, therefore criteria will be set from the AS2107, as presented below.

4.1.2 Australian Standard AS2107

The following criteria is set for internal noise goals of habitable spaces, based on AS2107;

Table 1 –AS2107 Noise Criteria

Room Type	Criteria
Bedroom	$\leq 35 \text{ dB(A) } L_{eq} (9 \text{ hour})$
Living Room	$\leq 40 \text{ dB(A) } L_{eq} (15 \text{ hour})$

5 MEASUREMENTS

Traffic noise measurements were taken at the site of the proposed development. Measurements were performed generally in accordance with the Australian Standard AS1055 – “Description and measurement of environmental noise – General Procedures”.

5.1 UNATTENDED NOISE MEASUREMENTS

A long term noise monitor was installed to the south of the proposed site, between the 8th and 15th December 2014. See Figure 1 above for location. Refer Appendix 1 for unattended noise data.

The long term monitoring was conducted using two Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted.

5.2 ATTENDED NOISE MEASUREMENTS

Attended noise measurements were undertaken to compliment long term monitoring on the 8th and 12th December 2014, between the hours of 3:00pm and 5:00pm. Attended noise measurements were undertaken at the following locations;

- At the northern property boundary of the proposed development, facing Cartwright Avenue to measure traffic noise.
- At the southern property boundary of the proposed development, facing the courtyard of the Green Valley Hotel during an function within the external courtyard.
- At the western property boundary, facing Miller Shopping Centre, to measure rooftop mechanical plant

Measurements were undertaken using a Norsonics Type 140 precision sound level analyser, set to A-weighted fast response. The precision sound level analyser was calibrated before and after the measurements using a Norsonics 1251 precision sound level calibrator. No significant drift was recorded.

5.3 MEASUREMENT RESULTS

The traffic noise levels listed in the table below were determined based on the testing done on site. In determination of acoustic treatments at each façade, the measured level is adjusted for distance and orientation.

Table 2 - External Noise Level (Traffic Noise)

Location	Time Period	Noise Level dB(A)
Northern Façade (Cartwright Avenue)	Day (7am – 10pm)	63 dB(A) L_{Aeq} (15hour)
	Night (10pm – 7am)	60 dB(A) L_{Aeq} (9 hour)
Eastern Façade (Woodward Crescent)	Day (7am – 10pm)	59 dB(A) L_{Aeq} (15hour)
	Night (10pm – 7am)	56 dB(A) L_{Aeq} (9 hour)

The noise levels listed below in the following table were determined from testing done on site, from the mechanical plant noise from Miller Shopping Centre and the external courtyard of the licensed venue at Green Valley Hotel. In determination of acoustic treatments at each façade, the measured level is adjusted for distance and orientation.

Table 3 – Measured External Noise Levels

Location	Noise Level dB(A)
3m from the external wall of the Green Valley Hotel Courtyard	67dB(A) L_{Aeq} , measured behind a masonry screen (74 dB(A) L_{Aeq} at southern façade of Building A overlooking the screen)
Western Façade Ground Level Miller Shopping Centre	<50dB(A) L_{Aeq} measured at ground level (57dB(A) at façade overlooking shopping centre roof)

6 EVALUATION OF NOISE INTRUSION

Internal noise levels will primarily be as a result of noise transfer through the windows and doors and roof, as these are relatively light building elements that offer less resistance to the transmission of sound.

The predicted noise levels through the windows, doors and roof are discussed below. The predicted noise levels have been based on the measured level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

In all cases, the recommended constructions (refer below) reduces internal noise levels to within the nominated criteria for the various space types.

Recommended treatments are provided to address both road traffic and noise from the adjacent commercial/hotel development.

6.1 RECOMMENDED GLAZING

Appendix 2 details the recommended glazing assemblies for this project to achieve the internal traffic noise requirements. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals.

The glazing thicknesses recommended are those needed to satisfy acoustic requirements and do not take into account other requirements such as thermal, structural, safety or other considerations. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement. In such cases, thicker window glazing will be acoustically acceptable.

In addition to complying with the minimum scheduled glazing thickness, the STC rating of the glazing fitted into operable frames and fixed into the building opening should not be lower than the values listed in Table 4 for all rooms. Where nominated, this will require the use of acoustic seals around the full perimeter of operable frames and the frame will need to be sealed into the building opening using a flexible sealant. **Note that mohair seals in windows and doors are not acceptable where acoustic seals are required.**

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed STC requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 4 - Minimum STC/Rw of Glazing Requirements

Glazing Assembly	Acoustic Seals	Minimum STC/Rw of Installed Window
6.38m laminated	Yes	31
10.38mm laminated	Yes	35
Double Glazing – 6mm float / 150mm air-gap / 150mm float	Yes	42

6.2 EXTERNAL WALLS

Proposed external wall cladding consists of Alucabond panel with fc sheet backing/min 90mm cavity with 75mm thick insulation to cavity/plasterboard internal lining.

Recommended wall building up is presented below:

Table 5 –External Wall Constructions

Block	Facade	Room Type	External Wall Construction	Internal Wall Construction
A	North/East/West	Living Room	Alucabond + 1x9mm fibrous cement	1x13mm plasterboard
	South		Alucabond + 1x9mm fibrous cement	2x16mm plasterboard
	North	Bedroom	Alucabond + 1x9mm fibrous cement	2x13mm plasterboard
	East/West		Alucabond + 1x9mm fibrous cement	1x13mm plasterboard
	South (below level 4)		Alucabond + 1x9mm fibrous cement	2x16mm plasterboard
	South (level 4 and above)		Alucabond + 1x9mm fibrous cement	2x13mm plasterboard
B	All	Living Room	Alucabond + 1x9mm fibrous cement	1x13mm plasterboard
	North	Bedroom	Alucabond + 1x9mm fibrous cement	2x13mm plasterboard
	South-East Corner Apartments (below level 4)		Alucabond + 1x9mm fibrous cement	2x13mm plasterboard
	Remaining		Alucabond + 1x9mm fibrous cement	1x13mm plasterboard

6.3 ROOF / CEILING CONSTRUCTION

Noise intrusion through concrete roofing will not require acoustic treatment.

6.4 VENTILATION REQUIREMENTS

With respect to natural ventilation of the dwelling, the NSW Department of Planning document "Development near Busy Roads and Rail Corridors - Interim Guideline" dictates that:

- *"If internal noise levels with windows or doors open exceed the criteria by more than 10dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."*

With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (ie – allowable level in bedrooms becomes 45dB(A), and 50dBA() in living rooms).

Within Block A, these internal noise goals may be achieved only within windows closed.

Within Block B, these internal noise levels can be achieved only within living rooms on the western eastern facade. All remaining rooms will require their windows to be closed to achieve the recommended noise levels.

Supplementary fresh air (using either mechanical ventilation or fresh air through one of the other facades) is recommended to ensure ventilation requirements of AS1668 are achieved.

The mechanical ventilation system should be acoustically designed to ensure that the acoustic performance of the acoustic treatments outlined above is not reduced and does not exceed Council criteria for noise emission to nearby properties.

7 NOISE EMISSION ASSESSMENT

Noise emissions from the site should be assessed to ensure that the amenity of nearby land users is not adversely affected. Noise generated by mechanical plant servicing the development has been identified as the only source of potential noise emission from the development.

A long term noise monitor was installed to the south of the proposed site, between the 8th and 15th December 2014. See Figure 1 above for location. Refer Appendix 1 for unattended noise data.

The long term monitoring was conducted using two Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted.

Table 6 - Measured Background Noise Levels

Location	Period/Time	Background Noise Level dB(A) L ₉₀ (period)
Proposed Development Site	Day (7am-6pm)	50
	Evening(6pm-10pm)	47
	Night(10pm-7am)	39

7.1 ACOUSTIC OBJECTIVES

Acoustic objectives will be based on;

- Liverpool Council DCP 2008
- The EPA Industrial Noise Policy
- The Protection of the Environment Operations Regulation Act 2000

7.1.1 Liverpool Council DCP 2008

There are no specific criteria stated in the Liverpool Council DCP relating to acoustic noise amenity from mechanical plant, therefore criteria will be from the EPA Industrial Noise Policy and The Protection of the Environment Operations Regulation Act 2000, as described below.

7.1.2 EPA Industrial Noise Policy

The EPA Industrial Noise Policy has two criteria which need to be satisfied namely Intrusiveness and Amenity. These are described below:

- *Intrusiveness Criteria* - This guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.
- *Amenity Criteria* - This guideline is intended to limit the absolute noise level from all "industrial" noise sources such as mechanical plant to a level that is consistent with the general environment.

The EPA's Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

7.1.2.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor do not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in Section 7.1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

Table 7 - Intrusiveness Noise Emission Goals

Location	Period/Time	Background Noise Level dB(A) $L_{90}(\text{period})$	Intrusiveness Noise Emission Goal dB(A) $L_{eq}(15\text{min})$ Background + 5dB
Nearby Residences	Day (7am-6pm)	50	55
	Evening(6pm-10pm)	47	52
	Night(10pm-7am)	39	44

7.1.2.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface. This site is categorised by the residential receivers as urban.

For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

Table 8 - Amenity Noise Emission Goals

Location	Period/Time	Amenity Noise Emission Goal dB(A) $L_{eq}(\text{Period})$
Nearby Residences	Day (7am-6pm)	60
	Evening(6pm-10pm)	50
	Night(10pm-7am)	45

7.1.3 Protection of the Environmental Operation Act Regulation 2000

Protection of the Environmental Operations regulation limits the noise levels associated within the operation of domestic air conditioning criteria during night time periods which is presented below:

Protection of the Environmental Operations (Noise Control) Regulation 2000-Sect 52

52 Air Conditioners

(1) A person must not cause or permit an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open):

- (a) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or*
- (b) before 7 am or after 10 pm on any other day.*

7.2 MECHANICAL PLANT

Mechanical plant items are not typically selected at DA stage.

Detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 7.2 of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting or similar.)

8 CONCLUSION

Potential noise impacts into the proposed development at 90 Cartwright Avenue, Miller have been assessed. Our findings are below:

Traffic noise impacts on future occupants of the building have been assessed in accordance with Australian Standard AS-2107:2000. Provided that the treatments set out in Section 6 of this report are employed, traffic noise impacts on occupants in the development will comply with relevant acoustic criteria presented in Section 4.

Noise emission objectives for the proposed development have also been determined based on on-site noise logging and noise emission guidelines typically adopted by Council, and have been presented in Section 7.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'J. Davydov', with a stylized, cursive script.

Acoustic Logic Consultancy Pty Ltd
Johan Davydov

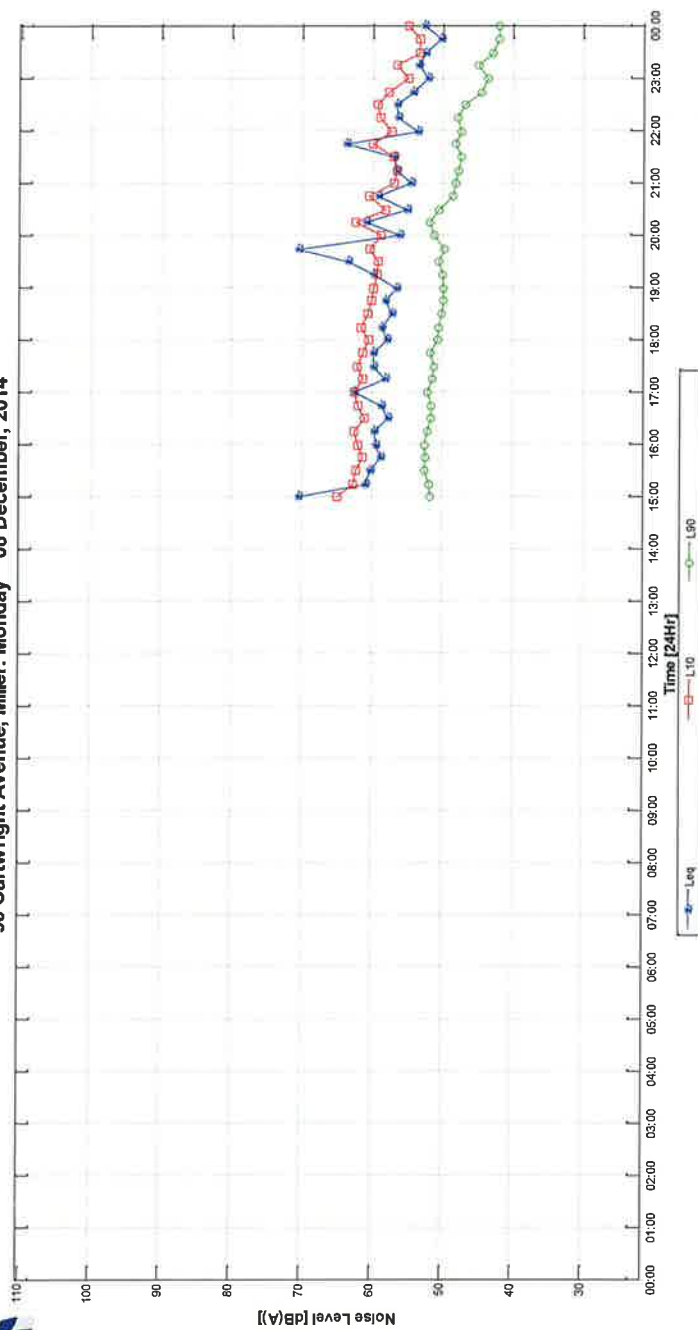
Appendix 1

Unattended Noise Measurements

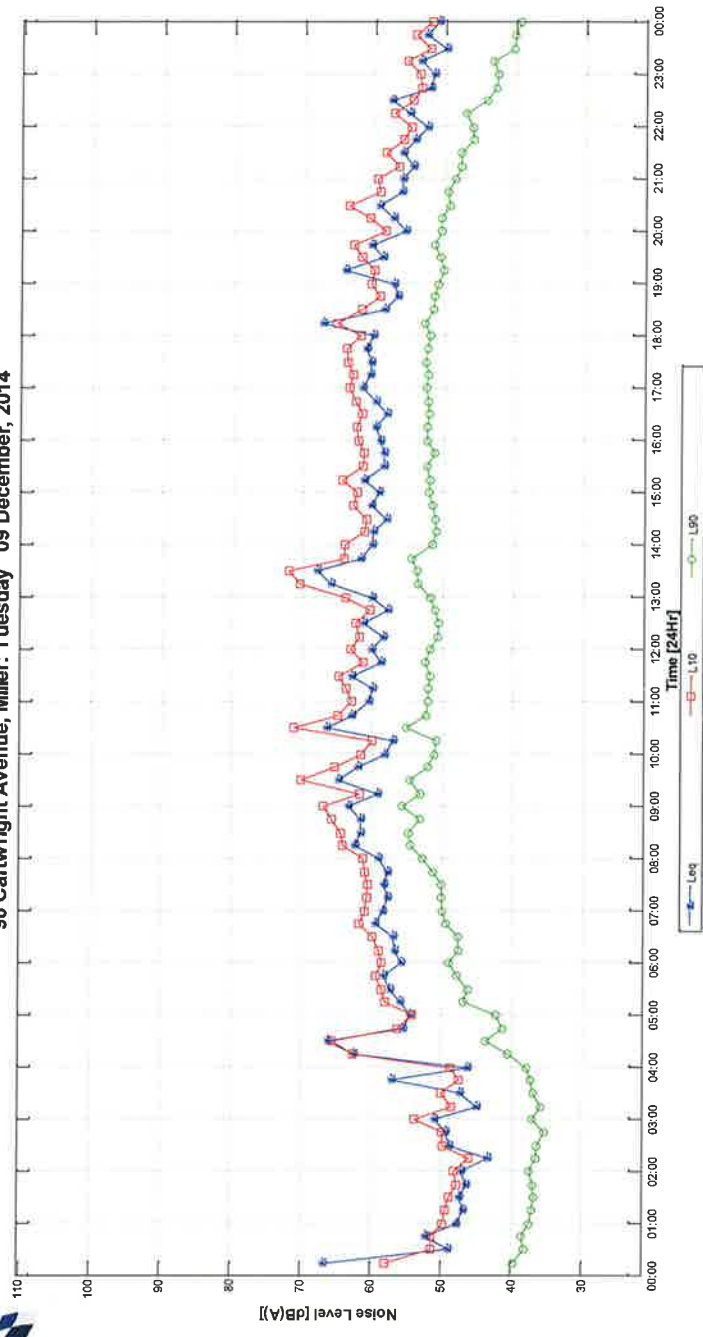
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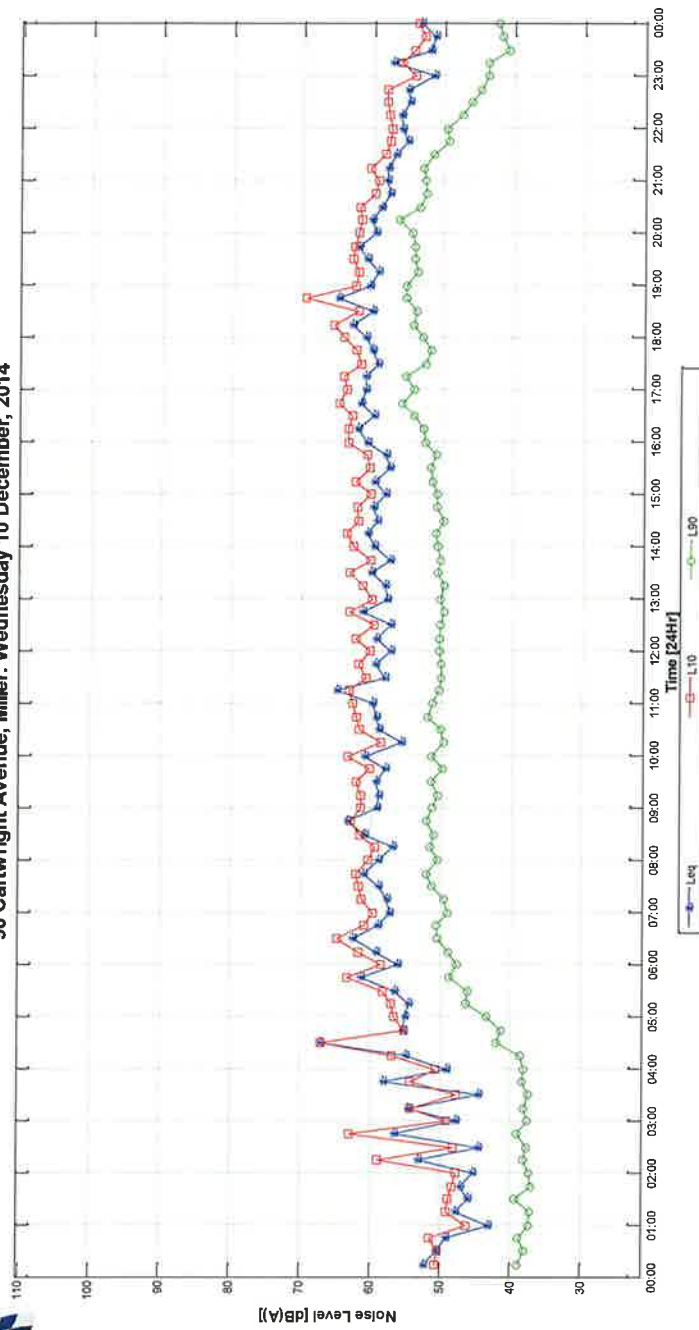
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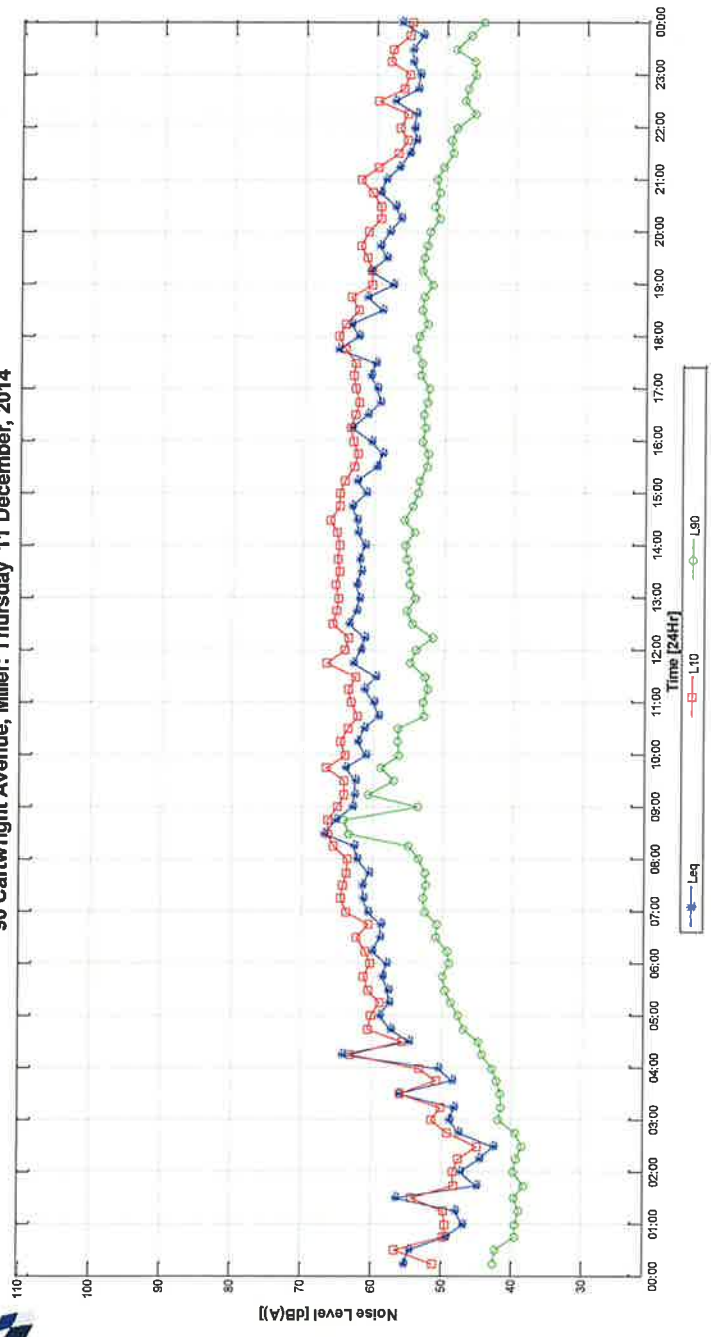
90 Cartwright Avenue, Miller: Tuesday 09 December, 2014



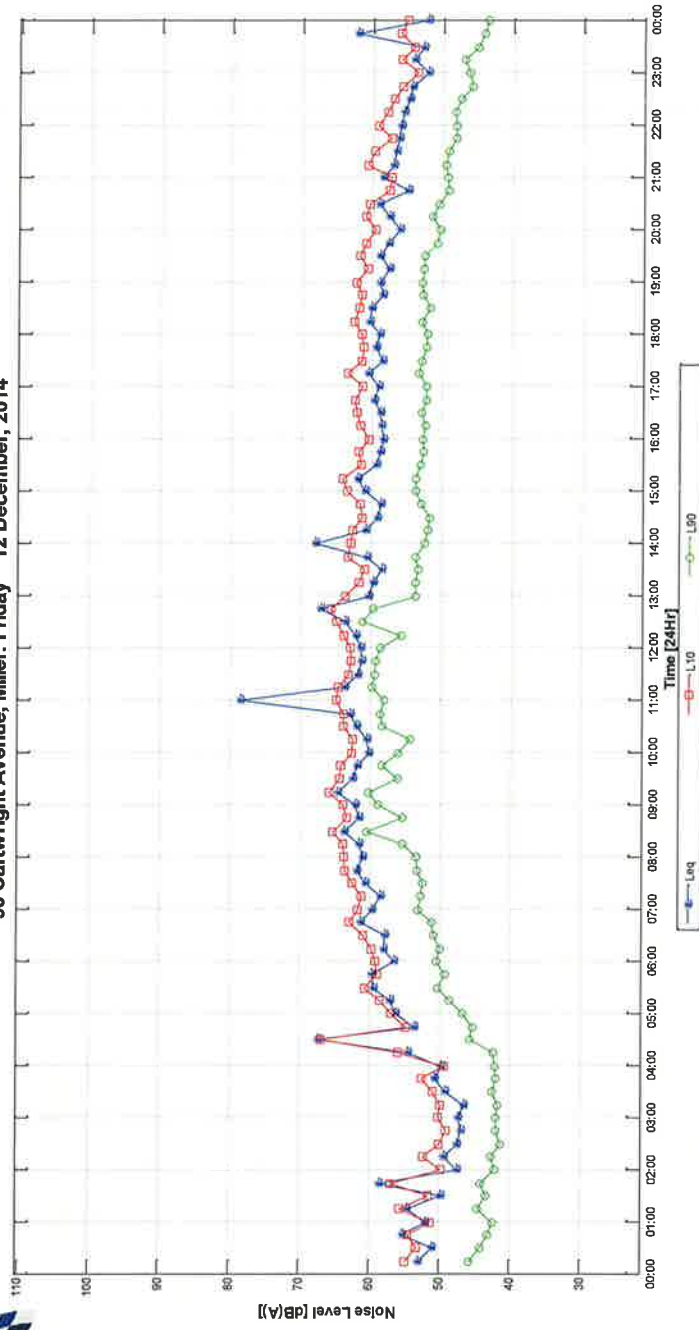
90 Cartwright Avenue, Miller: Wednesday 10 December, 2014



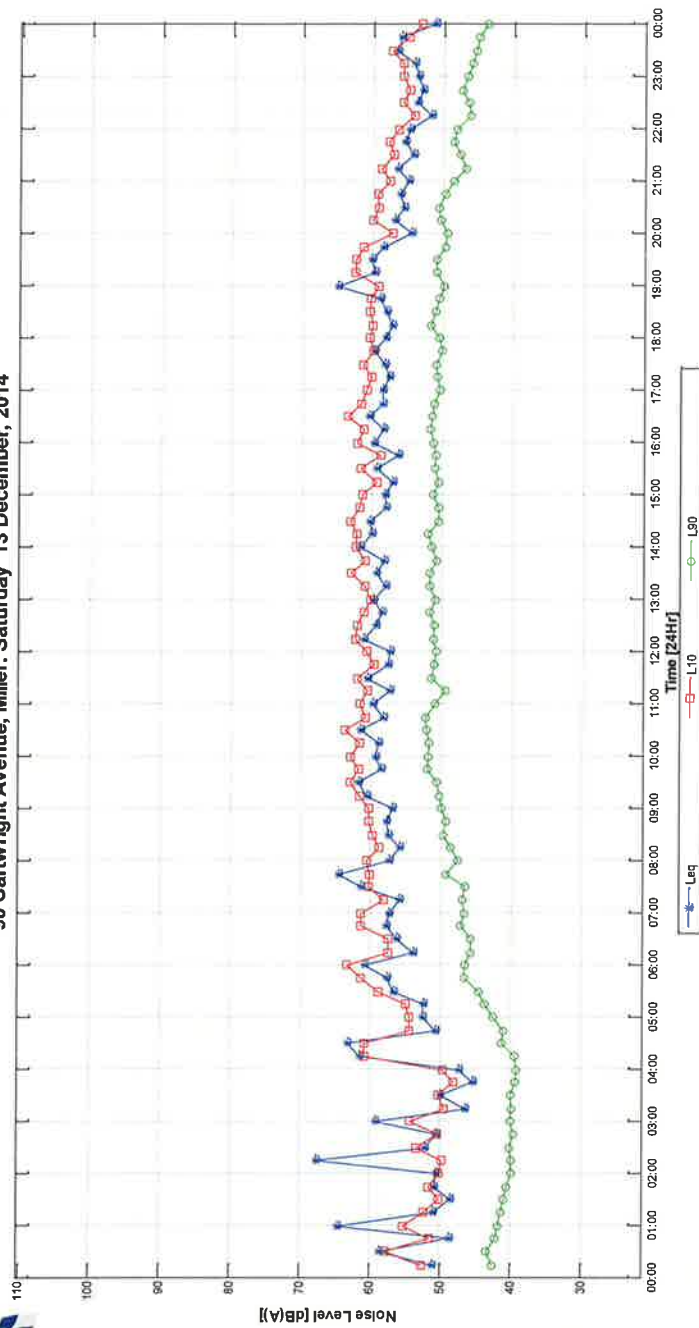
90 Cartwright Avenue, Miller: Thursday 11 December, 2014



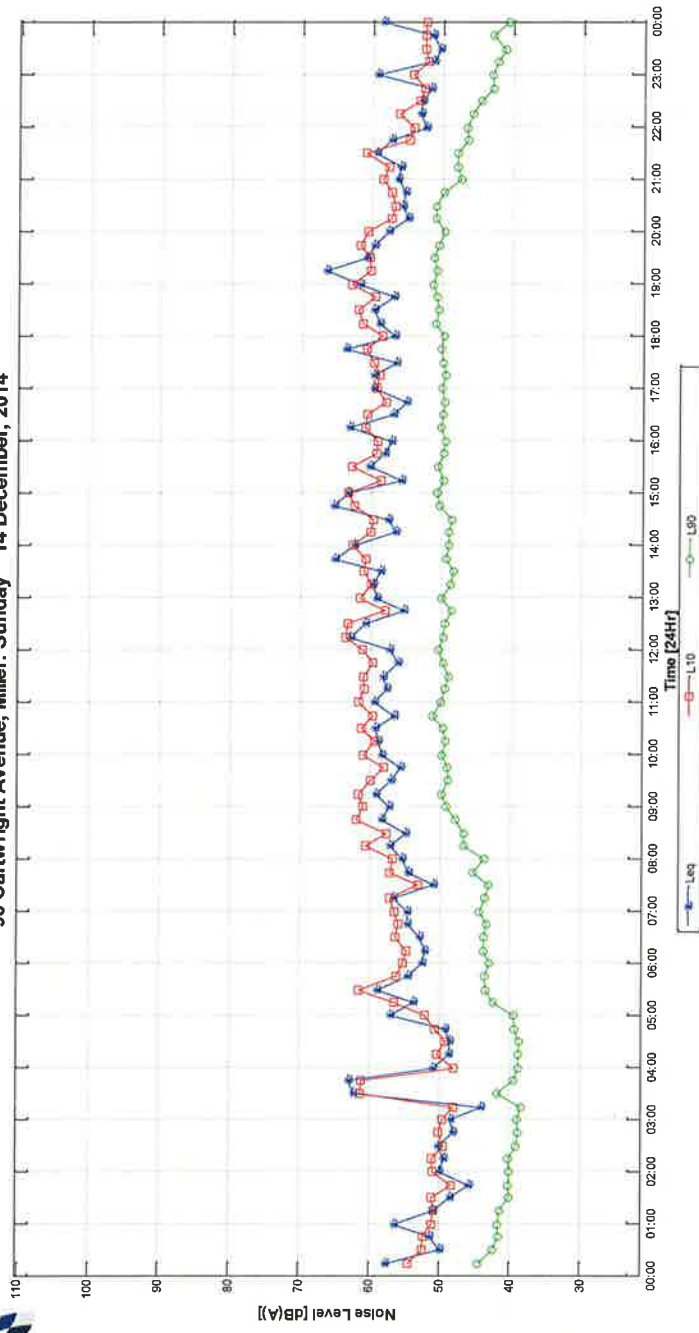
90 Cartwright Avenue, Miller: Friday 12 December, 2014



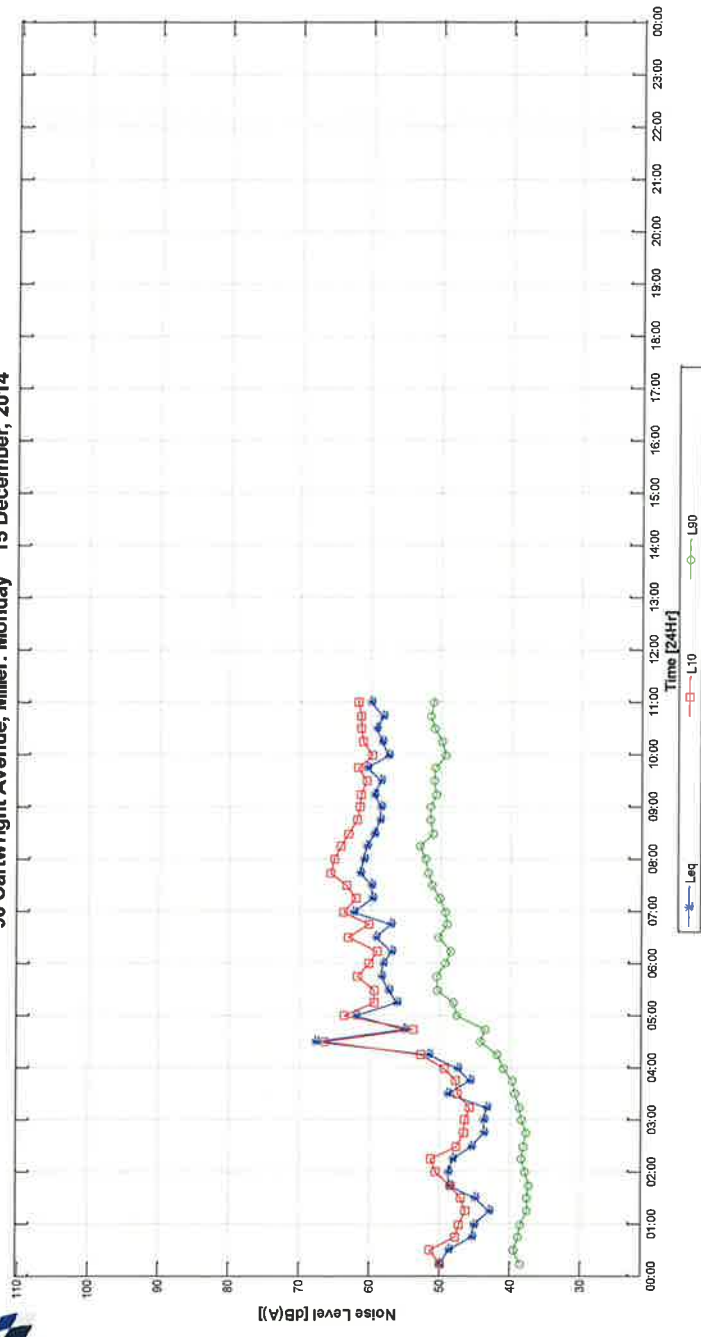
90 Cartwright Avenue, Miller: Saturday 13 December, 2014



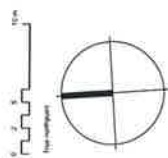
90 Cartwright Avenue, Miller: Sunday 14 December, 2014



90 Cartwright Avenue, Miller: Monday 15 December, 2014



Appendix 2
Glazing Mark-up
90 Cartwright Avenue, Miller



Do not scale, check and verify all dimensions before commencing new work
ground levels may vary due to site conditions.

LEGEND
EXTERNAL WORKS MATERIALS

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C	Development Application Issue	14 11 14
B	Amended to DRP Comments	16 07 14
A	Development Application	19 03 14
P2	Prelim Issue to Client	29 01 14
P3	Prelim Issue to Consultants	09 08 12
P1	Prelim Issue to Client	18 06 12



Project	Proposed Retail + Parking + Shop Top Housing Development		
Project address	90 Cartwright Avenue Miller		
Client	Jea Holdings (Australia) Pty Ltd		
Title	Level 2	Date	2038
	page	Sheet	1/200 @ A1
		Drawn to	Issue
			DA06
			C

DEVELOPMENT APPLICATION

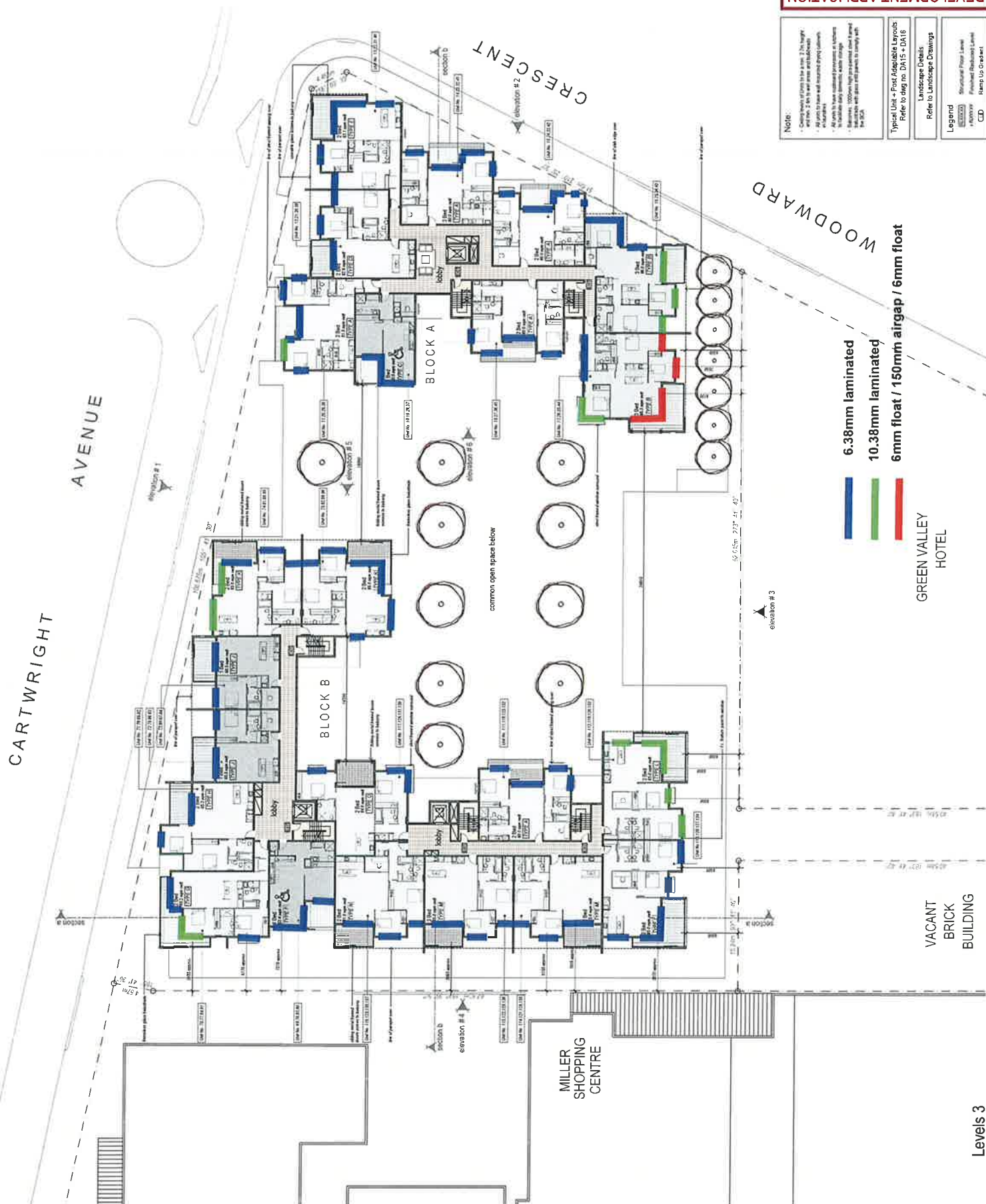
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Typical Unit + Post Adaptable Layouts:
Refer to dwg no. DA15 + DA16

Landscape Details
Refer to Landscape Drawings

Legend

HDXXXXX Structural Floor Level
 *RXXXXX Finished Reduced Level
 CID Ramp Up Gradient





Project	Proposed Retail + Parking + Shop Top Housing Development		
Project address	90 Cartwright Avenue Miller		
Client	Jea Holdings (Australia) Pty Ltd		
Title	Level 8		
Drawn by:	2038	Checked by:	DA09
Date:	1/20/01	Scale:	1:200 @ A1
		Client's No.	2038
		Drawn by:	DA09
		Checked	C

DEVELOPMENT APPLICATION

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6.38mm laminated
10.38mm laminated

GREEN VALLEY
HOTEL

VACANT
BRICK
BUILDING