Planning Proposal Attachment C

DA Acoustic Assessment prepared by Wilkinson Murray for the proponent (July 2010)

ACOUSTICS AND AIR

301-303 BOTANY ROAD, WATERLOO

DA ACOUSTIC ASSESSMENT

REPORT NO. 10086
VERSION B

WILKINSON MURRAY

301-303 BOTANY ROAD, WATERLOO

DA ACOUSTIC ASSESSMENT

REPORT NO. 10086
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JULY 2010

PREPARED FOR

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1 INTRODUCTION

This report presents a DA assessment of the proposed mixed use development located at 301 to 303 Botany Road, Waterloo. The proposed development comprises of 2 levels of retail and 17 levels of residential above, accommodating 355 apartments.

The identified predominant noise sources at the subject site are traffic noise from Botany Road and Bourke Street, aircraft noise from aircraft movements from Sydney Kingsford Smith Airport and surrounding industrial premises, which many may not be there long term. Assessment of these noise sources will be in accordance with City of Sydney Council requirements, including the Green Square DCP and the City of Sydney DCP.

2 SITE DESCRIPTION

The subject site is located on the corner of Bourke Street and Botany Road, which are major roads carrying high levels of traffic. The site is located within a predominantly industrial area, but no dominant industrial noise sources were noted around the site. The nearest residential receivers are on Navins Lane to the east of the site.

Figure 2-1 Site Location

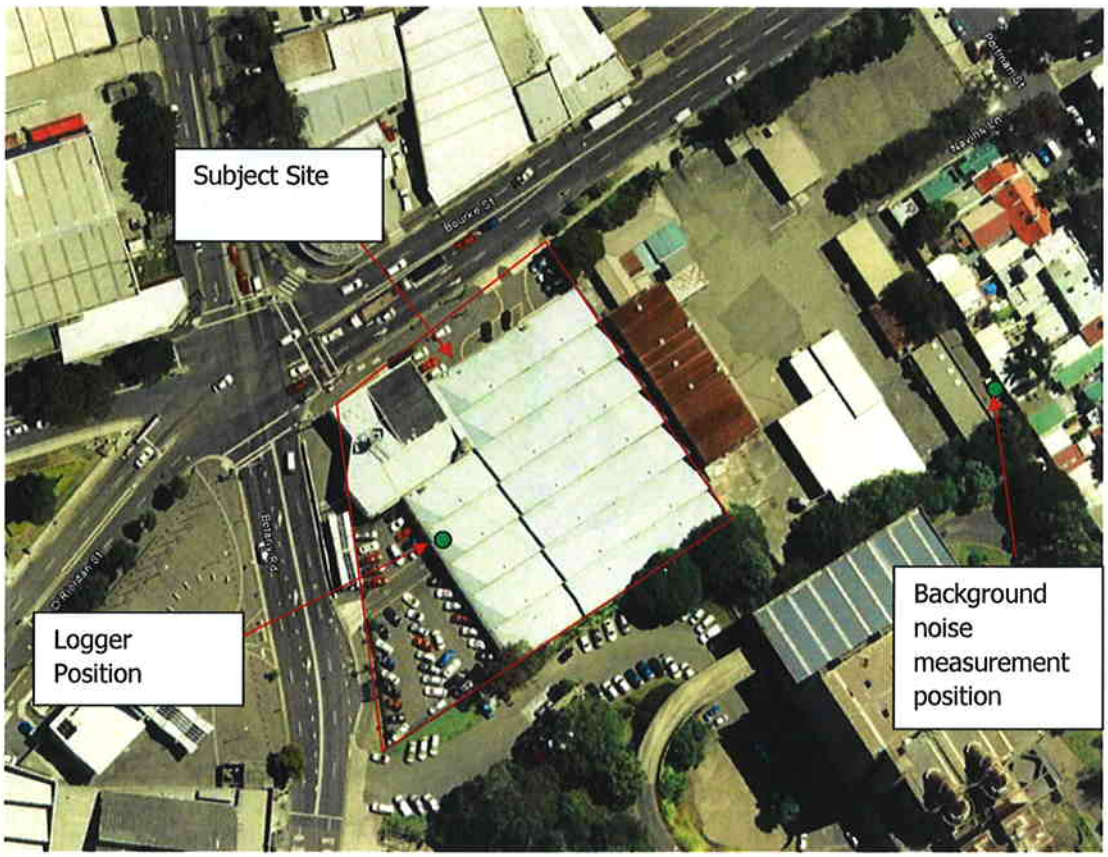


Figure 2-2 Plan View of Proposed Development

3 ASSESSMENT CRITERIA

3.1 Aircraft Noise Intrusion

The aircraft noise intrusion criteria adopted for this assessment is taken from Australian Standard 2021:2000 *Aircraft Noise Intrusion – Building Siting and Construction* (AS2021). Based upon the Sydney Airport 2023/24 ANEF contour chart, the subject site is located in between the 20 ANEF and 25 ANEF contour. Under AS2021 a residential site located within the 20 ANEF to 25 ANEF zone shall be conditionally acceptable provided that noise control features in the construction are incorporated.

The recommended indoor design sound levels for an aircraft flyover in AS2021 are presented in Table 3-1 below:

Table 3-1 - Aircraft Noise Intrusion Criteria

Internal Space	Internal Design Sound Level, dBA
Showrooms, Retail Spaces	75
Sleeping Areas, Dedicated Lounges	50
Other Habitable Spaces	55
Bathrooms, Toilets, Laundries	60

3.2 Traffic Noise Intrusion

The traffic noise intrusion criteria adopted for this assessment is based on Condition 3.2.8 Control 1 of the *South Sydney Development Control Plan 1997: Urban Design – Part G: Special Precinct No. 9 Green Square* dated December 2006. As the subject site has frontage to Botany road, which is a major road carrying large volumes of traffic, the DCP's internal noise level criterion of 30dBA for bedrooms is deemed too stringent and impractical to achieve. Australian Standard 2107 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.* (AS2107) nominates a recommended design sound level of 30 to 40 for bedrooms within a residential building near a major road. In addition, the Central Sydney DCP nominates an internal noise level criteria of 35dBA for a naturally ventilated bedroom and 38dBA for a mechanically ventilated or air conditioned bedroom. Therefore it is proposed for this project to use 35dBA for the assessment of traffic noise intrusion into bedrooms, which is the minimum criterion from the Central Sydney DCP and middle of the range from AS2107.

The traffic noise intrusion criteria for residential occupancies of this project is presented in Table 3-2 below:

Table 3-2 - Traffic Noise Intrusion Criteria

Internal Space	Descriptor	Internal Noise Level, dBA
Bedroom	Mean logarithmic L_{Aeq} (1 hour) Night-time (10pm to 6am)	35
Habitable Spaces*	Mean logarithmic L_{Aeq} (1 hour) Day-time (6am to 10pm)	40

*excludes garages, kitchens, bathrooms and hallways

For showrooms and retail spaces on lower and upper ground levels the internal design noise level is taken from Australian Standard 2107 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.* (AS2107) which recommends a range of 45-50dBA.

3.3 Internal Acoustics Requirements for Apartments

The following requirements relate to the units component of the development, classified as Class 3 under the BCA.

The BCA stipulates provisions for acoustic performance between apartments/units of separate occupancy in the following areas:

1. Airborne and impact ratings for floors.
2. Airborne ratings for walls (impact, where required is defined by *'discontinuous construction'*).
3. Airborne ratings for doors.
4. Airborne ratings for hydraulic and mechanical services – for water supply pipes, additional requirements regarding their location.
5. All pumps are to be fitted with a flexible coupling between the pump and pipe work.

The City of Sydney council specifies acoustic requirements for walls and floors in Central Sydney Development Control Plan (DCP) to control airborne and impact noise between units. It is noted that the City of Sydney Council has no specific requirements for sound isolation other than walls and floors.

A summary of the applicable ratings are detailed in Appendix C.

3.4 Surrounding Noise Sensitive Receivers

3.4.1 Intrusiveness Criterion

An intrusiveness criterion applies for residential receivers only.

The intrusiveness criterion requires that the L_{Aeq} noise level from the source being assessed, when measured over 15 minutes, should not exceed the Rating Background Noise Level (RBL) by more than 5dBA. The RBL represents the 'background' noise in the area, and is determined from measurement of L_{A90} noise levels, in the absence of noise from the source. The definition of L_{A90} and the procedure for calculating the RBL is given in Appendix A.

Where the noise level from the source varies over time due to changes in operating conditions, meteorological conditions or other factors, the upper 10^{th} percentile of 15 minute L_{Aeq} noise levels can be used for comparison with the criterion.

3.4.2 Amenity Criterion

The amenity criterion sets a limit on the total noise level from *all industrial noise sources* affecting a receiver. Different criteria apply for different types of receiver (e.g. residence, school classroom); different areas (e.g. rural, suburban); and different time periods, namely daytime (7.00am-6.00pm), evening (6.00pm-10.00pm) and night time (10.00pm-7.00am).

The noise level to be compared with this criterion is the L_{Aeq} noise level, measured over the time period in question, due to all industrial noise sources, but excluding non-industrial sources such as transportation.

Where a new noise source is proposed in an area with negligible existing industrial noise, the amenity criterion for that source may be taken as being equal to the overall amenity criterion. However, if there is significant existing industrial noise, the criterion for any new source must be set at a lower value. If existing industrial noise already exceeds the relevant amenity criterion, noise from any new source must be set well below the overall criterion to ensure that any increase in noise levels is negligible. Methods for determining a source-specific amenity criterion where there is existing industrial noise are set out in the *INP*.

3.4.3 Determination of Noise Emission Criteria

Tables 3-3 and 3-4 show the relevant noise criteria for this project.

Table 3-3 Intrusiveness Criteria

Time Period	$L_{A90, 15min}$* (dBA)	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)
Daytime (7.00am–6.00pm)	55	60
Evening (6.00–10.00pm)	57	62
Night time (10.00pm–7.00am)	43	48

*attended measurements were conducted during the various time periods on 9th April 2010 and on all occasion the background noise in the area was dominated by the traffic noise from Botany Road and Bourke Street

Table 3-4 Amenity Criteria

Receiver	Time Period	Amenity Criteria $L_{Aeq,Period}$ (dBA)
Urban Residence	Daytime (7.00am–6.00pm)	60
	Evening (6.00–10.00pm)	50
	Night time (10.00pm–7.00am)	45
Commercial	When in use	65

From Tables 3-3 and 3-4, amenity criteria are more stringent for all time periods for residential receivers, and hence intrusiveness criteria will not be discussed further. Residential receivers will also include the new residential towers within the development when built. The amenity criteria will be also used for commercial / industrial receivers.

3.4.4 Sleep Disturbance Noise Criteria

Operation during the night period also requires assessment of the potential for sleep disturbance. Appropriate criteria are provided in the DECC's *Noise guide for local government (NGLG)* to address sleep disturbance, which states;

Where sleep disturbance is being assessed, the $L_{A1(60\ seconds)}$ or L_{Amax} noise level is most appropriate, and the measurement position might be outside the bedroom window. Sleep may be disturbed if the source noise level exceeds the background noise by more than 15 dB(A).

Based on the measured background noise levels the corresponding sleep disturbance criterion is 58dBA for residences in areas zoned residential and suburban. It is noted that although the proposed Showroom will not be operational during the night time period, ancillary mechanical plant items may operate during this period.

4 NOISE SOURCE LEVELS

4.1 Aircraft Noise

Noise experienced at the subject site from typical aircraft flyovers were determined based on the method outlined in AS2021. Calculations take into consideration the distance from the site to the flight paths from the 3 runways of Sydney Airport and the relative height of the subject site to Sydney Airport. The expected loudest level at the subject is predicted to be 70 dBA from a Boeing 767 long range aircraft take-off from the Sydney Airport Third Runway.

4.2 Traffic Noise

4.2.1 Unattended Measurements

Unattended noise monitoring was conducted between Friday 9th April 2010 and Monday 19th April 2010. The noise monitor location was placed on the rooftop of the existing building as indicated in Figure 1. The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the existing noise environment. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. Whilst the L_{A10} has in the past been used as a descriptor for traffic noise, the L_{Aeq} is now the standard descriptor for traffic noise.

Table 4-1 – Unattended Traffic Noise Measurement Results

Location	Mean logarithmic L_{Aeq} (1 hour) Day-time (6am to 10pm)	Mean logarithmic L_{Aeq} (1 hour) Night-time (10pm to 6am)
On rooftop @ 25m from Botany Road	63	57

4.2.2 Attended Measurements

Attended noise measurements were conducted on site on Friday 9th April 2010 during the evening peak hour traffic period, 4:00pm to 6:00pm. The measurement locations are indicated in Figure 1.

Noise levels were measured with a Bruel & Kjaer Type 2236 Sound Level Meter. This Sound Level Meter conforms to Australian Standard 1259 "Acoustics – Sound Level Meters" as Type 1 Precision Sound Level Meter which has an accuracy suitable for laboratory use. The A-Weighting filter of the meter was selected and the time weighting was set to 'fast'. The meter was field calibrated both before and after the measurements with a Bruel & Kjaer Sound Level Calibrator Type 4230. No significant system drift was noted.

The B&K 2236 and the B&K 4230 have been laboratory calibrated within the previous two years in accordance with Wilkinson Murray Quality Assurance procedures.

Table 4-2 – Attended Traffic Noise Measurement Results

Measurement Number	Description	$L_{Aeq,\ 15min}$ dBA
1	Bourke Street @ 2.5m	70
2	Bourke Street @ 2.5m	70
3	Botany Road @ 6m (3m from Bus Pullover Area)	70
4	Botany Road @ 6m (3m from Bus Pullover Area)	71

5 DISCUSSION / ASSESSMENT

5.1 Noise Intrusion Assessment

Noise intrusion into the proposed building was assessed based on the architectural layouts of the building and the measured noise levels presented in Section 4. Prediction of internal noise levels were conducted taking into account the orientation from the external noise source, the predicted noise exposure at the façade, transmission area through the building fabric exposed to traffic noise, sound reduction through the building fabric and typical room absorption characteristics dependant on occupancy and usage.

Traffic noise intrusion takes into account noise ingress into the courtyard area via the opening in the building on Botany Road. For the courtyard it is expected that the main noise source will be due to patrons (from retail spaces) and residents' speech, and no amplified music will be allowed within the courtyard. Road traffic noise is the most dominant noise source for the subject site, and it is expected the treatment for traffic noise will be sufficient in attenuating courtyard noise. Any high generating noise activity within the proposed retail spaces shall be subject to a separate noise impact assessment.

The required building constructions to achieve internal noise levels nominated in Table 3-1 and 3-2 are presented in the following section.

5.2 Traffic Noise Generation With Development

The subject site has provisions for 310 car spaces which will all be located within a common underground carpark. As the surrounding streets carry high volumes of traffic, the increase in vehicle movements from the subject site will be acoustically insignificant with respect to traffic noise at the neighbouring residential receivers.

5.3 Mechanical Plant Assessment

Mechanical plant associated with the proposed development can have the potential to impact on neighbouring residential properties. At this stage of the project, the selection of the type and location of mechanical plant associated with the proposed development has not yet been finalised.

At the detailed design stage of the project the selected plant noise levels must be assessed with respect to established noise criteria. Should an exceedance be indicated it is envisaged that standard noise control measures will be adopted to ensure that the acoustic amenity of nearby residences is maintained.

Indicative engineering treatment methods that can be adopted are:

- Judicious selection of plant and equipment behind built elements to provide shielding to residences;
- Acoustic screens/enclosures
- Silencers; and
- Acoustically lined ductwork

The following assessment is based on typical mechanical plant items associated with residential

buildings of this type and previous experience.

- Carpark supply and exhaust fans – these fans would typically be housed within a plant room within the underground carpark. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.

- Kitchen supply and exhaust fans – these fans would typically be housed within a mechanical riser or located on the rooftop. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.
- Toilet exhaust fans – these fans would typically be housed within a mechanical riser or located on the rooftop. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.
- Air conditioning condensers – As these items typically emit low to mid noise levels, acoustic treatment typically required are use of acoustic screens, speed controllers and enclosures. The required treatment will be determined at the detailed design stage.

Therefore with the appropriate acoustic treatment all of the above mechanical plant items can be designed to meet the mechanical plant noise objectives nominated in Table 3-4. It is noted the mechanical plant noise will need to also address the apartments within the residential tower of the development when built.

6 BUILDING DESIGN RECOMMENDATIONS

6.1 Noise Intrusion

The proposed building will be constructed primarily of masonry/concrete, with masonry external walls and concrete roof. As masonry and concrete are heavy building elements, noise intrusion will be mainly through lighter elements such as glazed doors and windows.

6.1.1 Glazing Requirements

The use of aluminium framed glazed doors, aluminium framed windows and aluminium sliding doors will be acceptable for use. The frame shall be sealed into the façade opening using a polyurethane sealant equal to Bostik Fireban 1. Table 6-1 and 6-2 presents the recommended minimum glazing thickness and STC rating to comply with the internal noise levels nominated in Table 3-1 and 3-2. Refer to Figure 2-2 for façade locations. It is noted that the combination of both the glazing thickness and STC rating will need to be met.

Table 6-1 – Recommended Minimum Glazing Thickness and STC Rating for Residential Occupancies

Façade See Fig2.2	Occupancy/Space	Minimum Glazing Thickness	Minimum STC	Acoustic Seals
A	Sleeping Areas	10.38mm laminated	35	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
B	Sleeping Areas	10.38mm laminated	35	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
C	Sleeping Areas	6.38mm laminated	31	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
D	Sleeping Areas	6.38mm laminated	31	Yes
	Living Areas	6.38mm laminated	31	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
E	Sleeping Areas	6.38mm laminated	31	Yes
	Living Areas	6.38mm laminated	31	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No

Facade	Occupancy/Space	Minimum Glazing Thickness	Minimum STC	Acoustic Seals
F	Sleeping Areas	10mm float	33	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
G	Sleeping Areas	10mm float	33	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
H	Sleeping Areas	6.38mm laminated	31	Yes
	Living Areas	6.38mm laminated	31	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	Yes
I	Sleeping Areas	10mm float	33	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
J	Sleeping Areas	6.38mm laminated	31	Yes
	Living Areas	6.38mm laminated	31	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No
K	Sleeping Areas	10mm float	33	Yes
	Living Areas	10mm float	33	Yes
	Bathroom, Toilets and Laundries	Standard glazing	20	No

Where acoustic seals are nominated, the use of mohair seals is acoustically unacceptable. The acoustic seals shall be full perimeter seals equal to Schlegel Q-lon seals.

Table 6-2 – Recommended Minimum Glazing Thickness and STC Rating for Retail Occupancies

Facade	Occupancy/Space	Minimum Glazing Thickness	Minimum STC	Acoustic Seals
Bourke St, Botany Rd and Dunning Ave	Showroom / Retail	6.38mm laminated	31	Yes
All Others	Showroom / Retail	4mm float	27	Yes

Where acoustic seals are nominated, the use of mohair seals is acoustically unacceptable. The acoustic seals shall be full perimeter seals equal to Schlegel Q-lon seals.

6.1.2 Mechanical Ventilation or Air Conditioning

Where the windows of the glazing are required to be closed to meet the internal noise criteria consideration should be given to compliance with the natural ventilation provisions of Australian Standard 1668.2 *The use of ventilation and air-conditioning in buildings- Ventilation design for indoor air contaminant control.* and City of Sydney Council requirements. In general, occupancies/spaces where the use of acoustic seals is required, mechanical ventilation or air conditioning will be required. Any mechanical ventilation or air conditioning system shall be designed such that any penetrations from ductwork and/or pipework, shall not reduce the acoustic performance of external building constructions.

6.2 Internal Acoustics for Apartments

6.2.1 Walls

All intertenancy walls and corridor walls are to be constructed to full height to underside of floor slab and /or roof.

Intertenancy wall construction shall be two rows of 64mm metal studs with a minimum 20mm gap, 2 layers of 75mm thick 11-14kg/m^3 glasswool insulation (or similar) within the cavity, and 1 layer of 13mm thick fire rated plasterboard on the one side and 2 layers of 13mm thick fire rated plasterboard on the other side.

Corridor wall construction shall be staggered 64mm metal studs on a 92mm track with 1 layer of 16mm thick fire rated plasterboard fixed to each side of the track and 110mm thick 11-14kg/m^3 glasswool insulation (or similar) within the cavity.

Internal wall construction around bathrooms shall be 13mm fire rated plasterboard on either side of a 64mm stud.

Lift shaft wall construction shall be a single leaf of 150mm thick reinforced concrete and a layer of 13mm thick fire rated plasterboard on a 64mm metal stud with minimum 20mm airgap between studwork and concrete and 75mm thick 11-14kg/m3 glasswool insulation (or similar) within cavity.

6.2.2 Floors

Floor slab construction of minimum 200mm reinforced concrete with density greater than 2200kg/m^3 with suspended plasterboard ceiling below, shall achieve an R_w+C_{tr} in excess of 50. The use of resilient hung ceilings is recommended where hard floor finishes are proposed above the slabe.

For carpet floor coverings within all living spaces and bedrooms, the use of standard carpet underlay below will meet the floor impact isolation requirements.

Hard floor coverings are proposed for wet areas such as kitchens, bathrooms and laundries, which will be tiled. It is recommended that the tiles are laid on top of 10mm thick Embelton Impactmat acoustic underlay. This is also recommended for outdoor courtyards, terrace and porch areas above another apartment.

6.2.3 Doors

Entry doors to the apartments shall be a 38-40mm solid core fire rated door with full perimeter acoustic seals, achieving R_w 30 and above. Acoustic seals shall be equal to Raven RP10 for the sides and the top and a Raven RP38 drop seal at the bottom.

6.2.4 Sound Insulation Rating of Services

Ceilings over wet areas containing hydraulic piping shall be constructed from a layer of 13mm thick plasterboard with ceiling cavity filled with 75mm thick 11-14kg/m^3 glasswool insulation. All penetrations in the ceilings would need to be acoustically sealed including any recessed light fittings in the ceiling to sound transfer ventilation openings in the fittings.

Hydraulic piping contained in ceilings above dry areas shall be lagged with Soundlagg 4525C or equal. The ceiling shall be constructed from a layer of 13mm thick plasterboard with a 75mm thick 11-14kg/m^3 glasswool insulation blanket for 500mm either side of pipe work.

Riser construction within habitable areas shall be constructed from 2 layers of 13mm thick fire rated plasterboard on inner layer of a 64mm metal stud and 1 layer of 13mm thick fire rated plasterboard on outer layer, with 75mm thick 11-14kg/m^3 glasswool insulation within riser and wall cavities. All plasterboard joints shall be sealed. This system shall be reviewed for fire rating requirements.

Riser construction within wet areas shall be constructed from a layer of 13mm thick fire rated plasterboard with 75mm thick 11-14kg/m^3 glasswool insulation within riser cavity. All plasterboard joints shall be sealed. This system shall be reviewed for fire rating requirements.

6.2.5 Sound Isolation of Pumps

Any point of connection between the service pipes in a building and any pumps (circulation or other) will require a flexible coupling at the point of connection.

6.2.6 GPO's

GPO's within intertenancy and corridor walls must not be installed back to back and shall be offset by a minimum 600mm. Alternatively the use of acoustic rated GPO boxes are acceptable.

6.3 Train Vibration

TBA pending details of treatment.

7 CONCLUSION

This report presents assessment of aircraft noise and traffic noise intrusion to the proposed development at 301-303 Botany Road, Waterloo. Assessment has been conducted in accordance with local Council requirements and provided the recommendations in Section 6 of the report are implemented, aircraft and traffic noise intrusion shall comply with the nominated criteria. Recommendations have also been provided for the internal acoustics to comply with local Council requirements and the BCA.

Version	Status	Date	Prepared by	Checked by
A	Draft	30 April 2010	William Chan	Neil Gross
B	Final	23 July 2010	William Chan	-

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

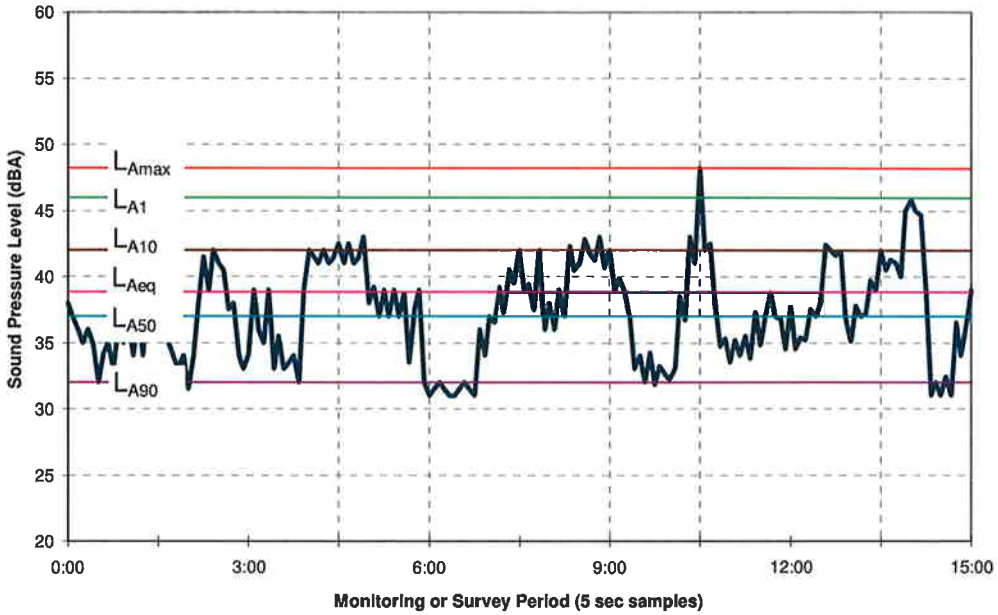
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.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55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

NOISE MEASUREMENT RESULTS

Location: Rooftop of John Newell Mazda

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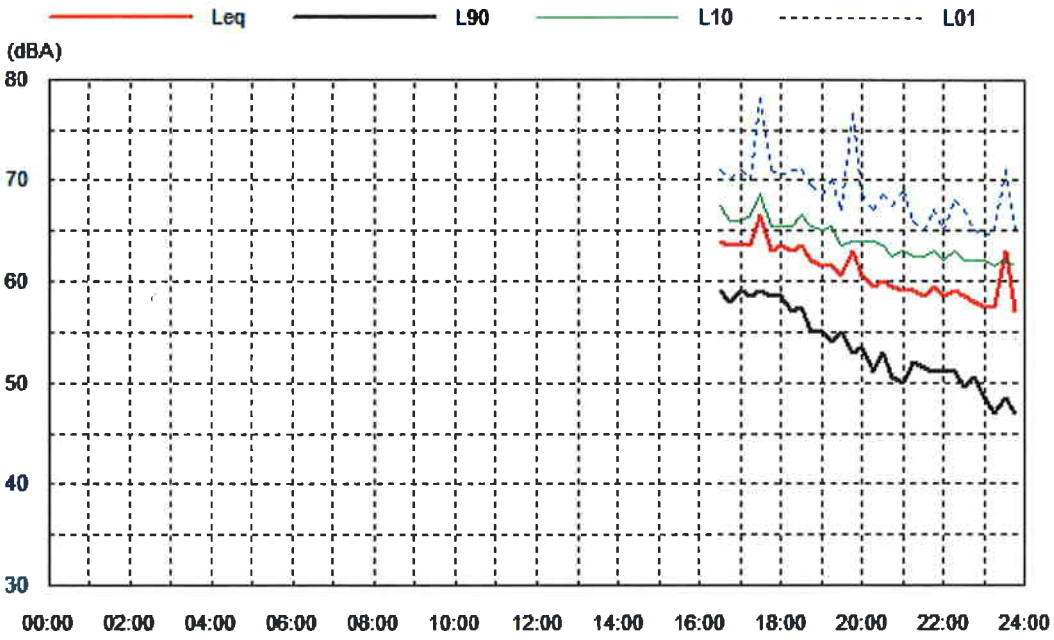

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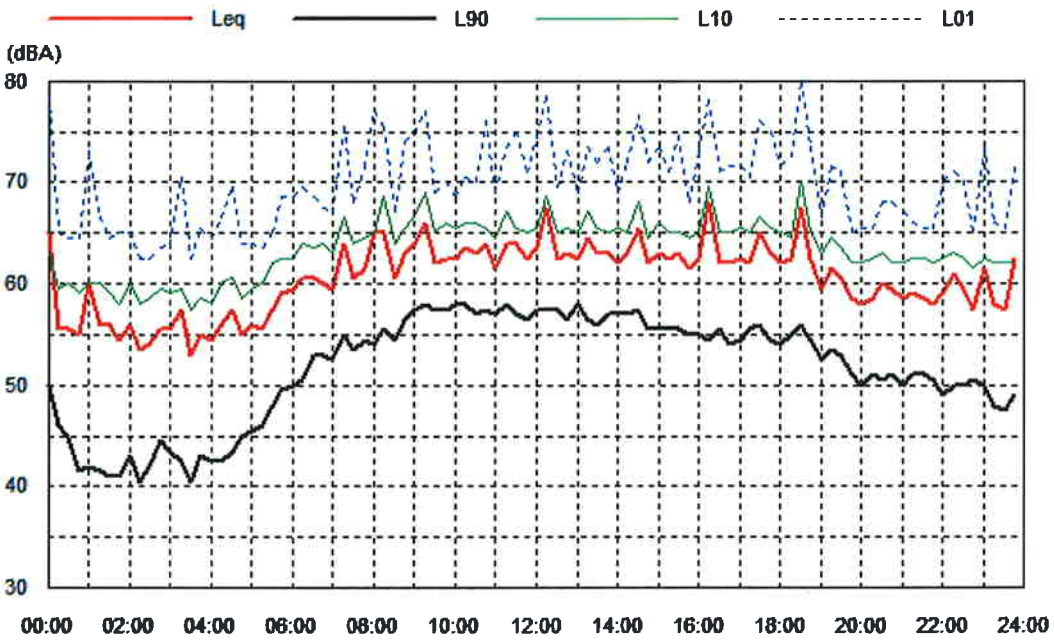

Location: Rooftop of John Newell Mazda

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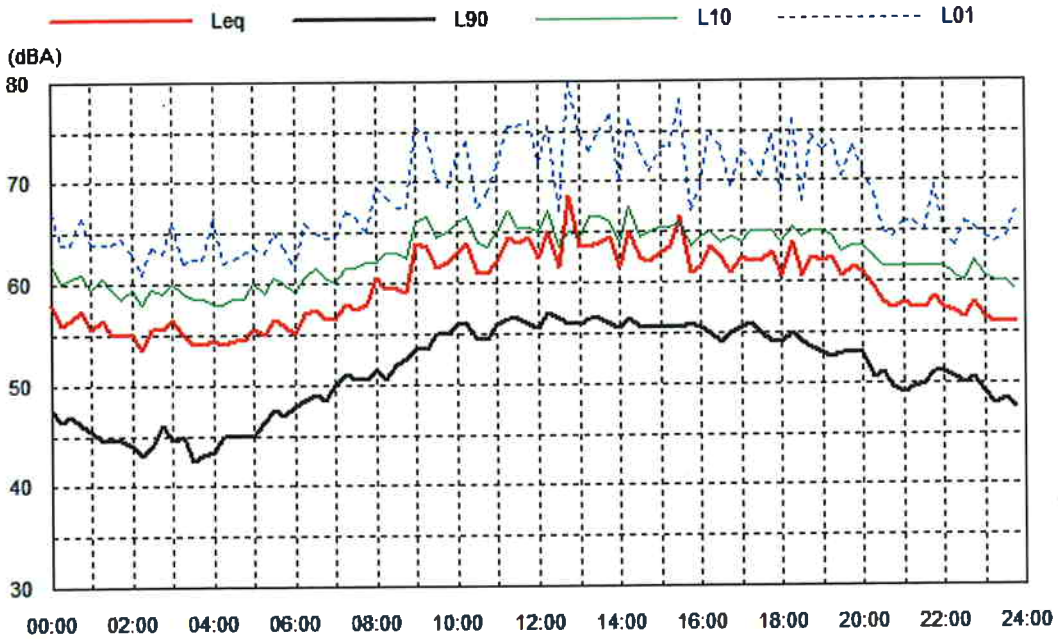

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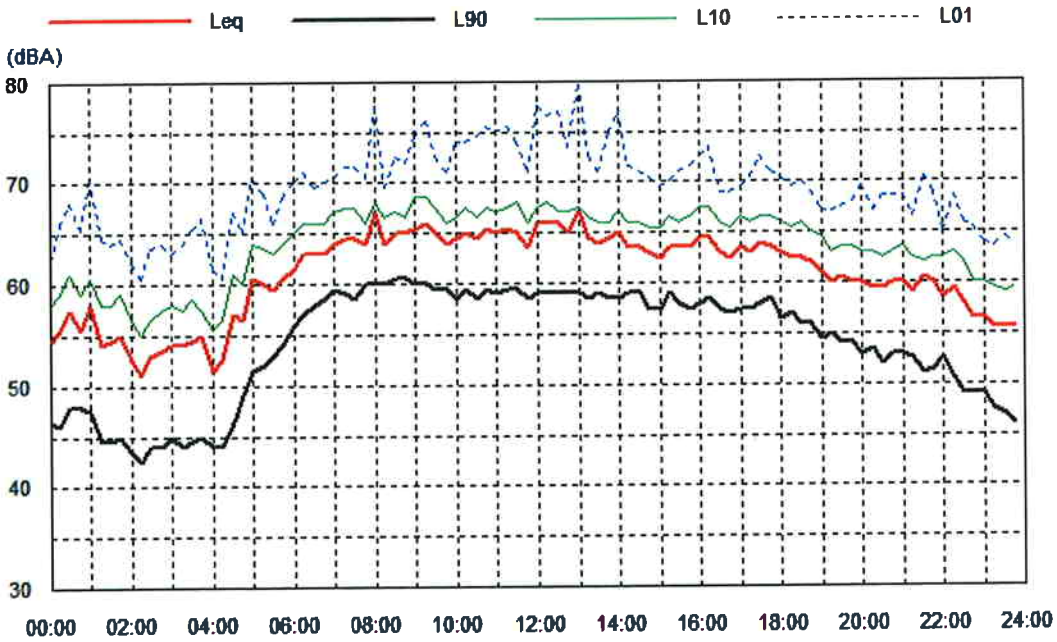

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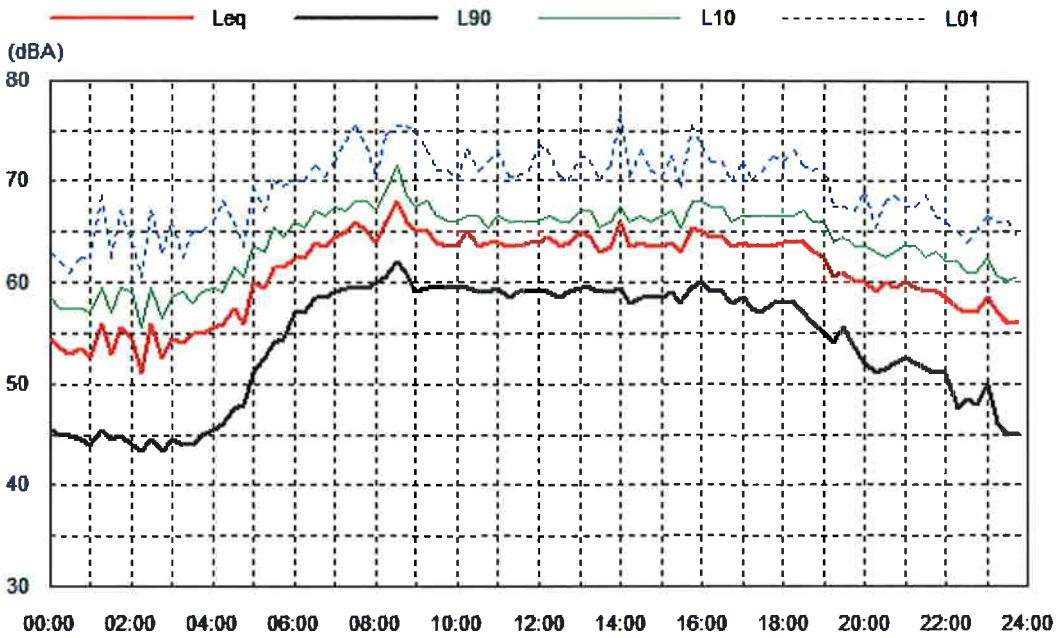

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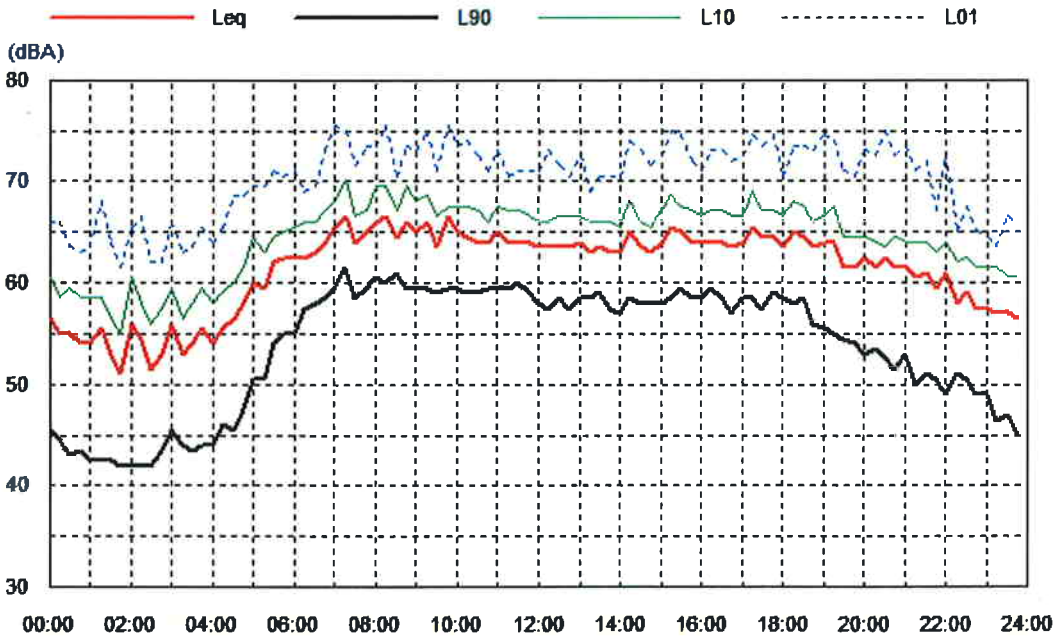
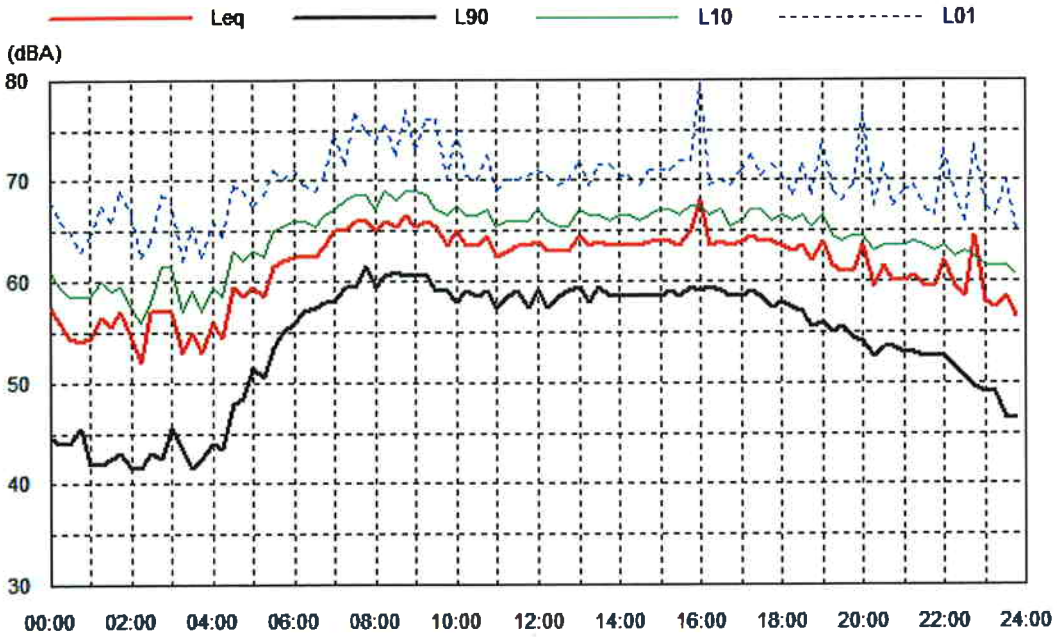
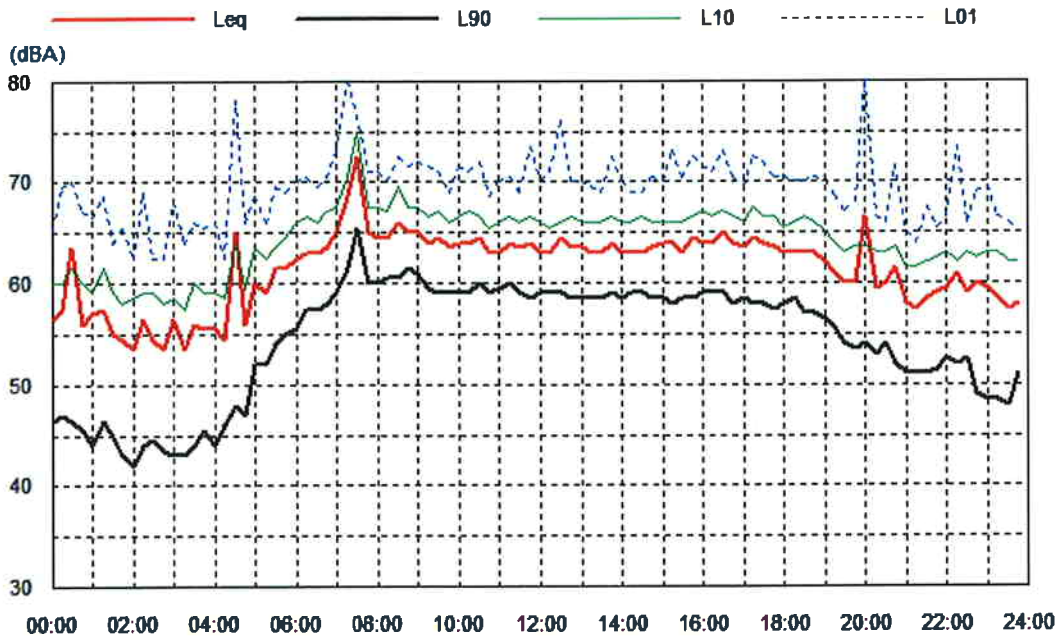


Location: Rooftop of John Newell Mazda

Thu 15 Apr 10

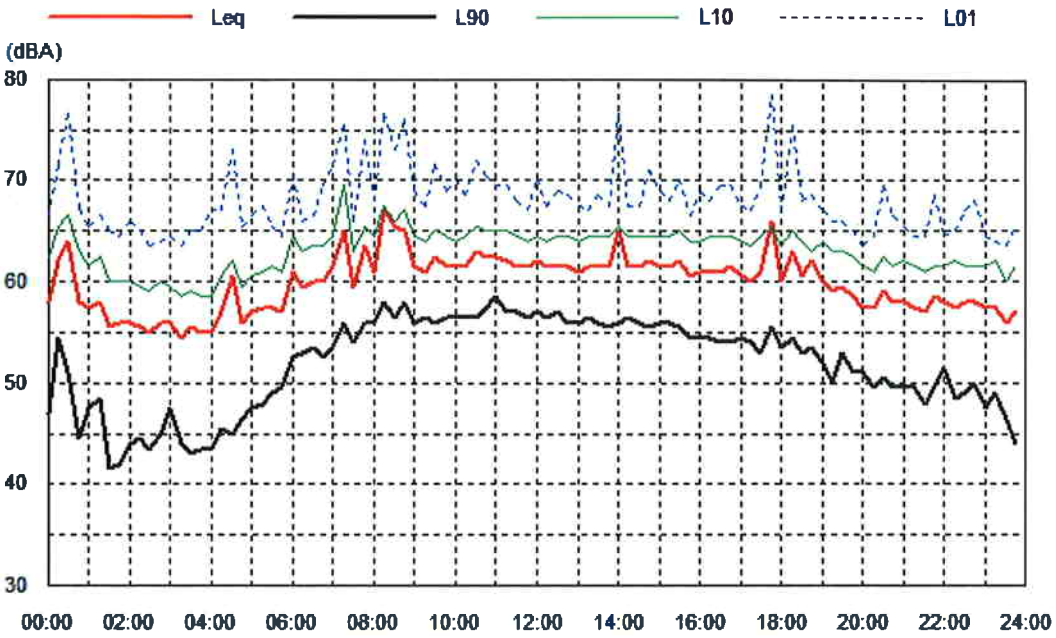


Fri 16 Apr 10

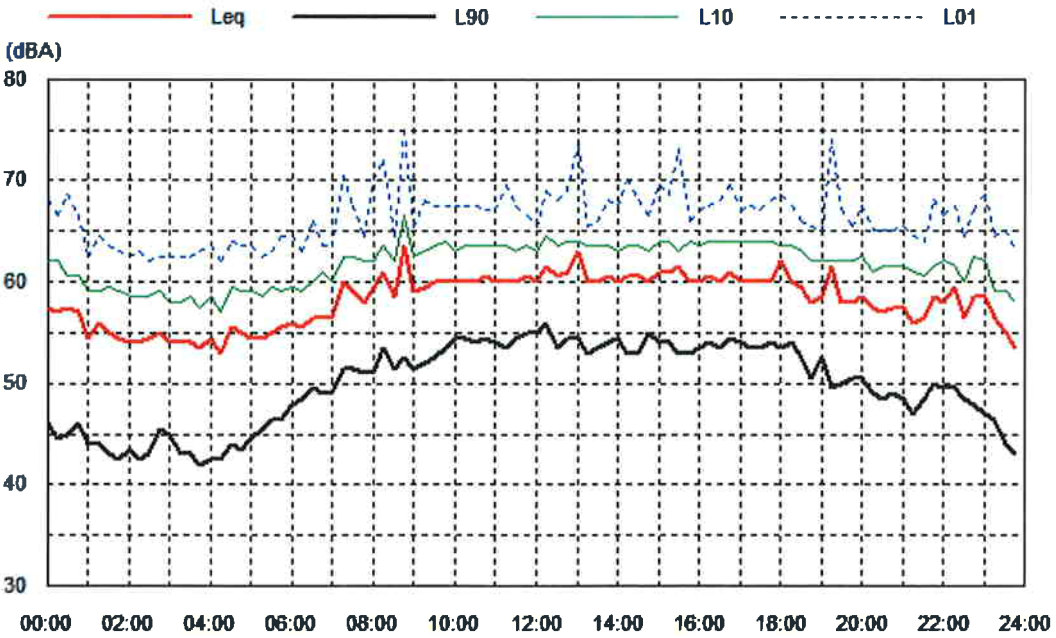


Location: Rooftop of John Newell Mazda

Sat 17 Apr 10

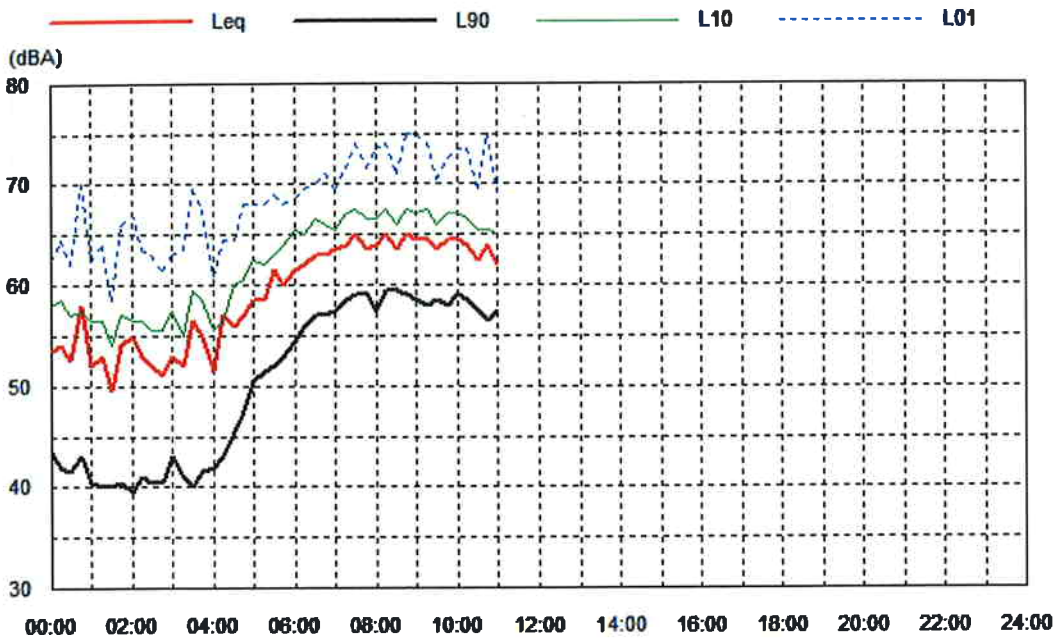


Sun 18 Apr 10



Location: Rooftop of John Newell Mazda

Mon 19 Apr 10



APPENDIX C

SUMMARY OF INTERNAL ACOUSTICS REQUIREMENTS

The BCA nominates various ratings for airborne noise isolation and impact noise isolation. The ratings used are here defined:

R_w – weighted sound reduction index. The R_w is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The R_w in the BCA is used for the selection of appropriate construction systems.

R_w+C_{tr} – weighted sound reduction index with spectrum adaptation term. The R_w+C_{tr} is the weighted sound reduction index with a correction factor C_{tr} added that helps to quantify the low frequency performance. The R_w+C_{tr} in the BCA is used for the selection of appropriate construction systems.

$D_{nT,w}$ – weighted standardised level difference. The $D_{nT,w}$ is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The $D_{nT,w}$ in the BCA is used for the determination of airborne noise in the field.

$D_{nT,w}+C_{tr}$ – weighted standardised level difference with spectrum adaptation term. The $D_{nT,w}+C_{tr}$ is the weighted standardised level difference with a correction factor C_{tr} added that helps to quantify the low frequency performance. The $D_{nT,w}+C_{tr}$ in the BCA is used for the determination of airborne noise in the field.

$L_{n,w}+C_I$ – weighted normalised impact sound pressure level with spectrum adaptation term. The $L_{n,w}+C_I$ is a typical measure of the impact/structure borne noise between two spaces in a laboratory. A reduction in the $L_{n,w}+C_I$ corresponds to an improvement in impact isolation. The $L_{n,w}+C_I$ in the BCA is used for the selection of appropriate impact isolation systems.

$L_{nT,w}+C_I$ – weighted standardised impact sound pressure level with spectrum adaptation term. The $L_{nT,w}+C_I$ is a typical measure of the impact/structure borne noise between two spaces in the field. A reduction in the $L_{nT,w}+C_I$ corresponds to an improvement in impact isolation. The $L_{nT,w}+C_I$ in the BCA is used for the determination of impact noise in the field.

The City of Sydney council nominates various ratings for airborne noise isolation and impact noise isolation. The ratings used are here defined:

FSTC – field sound transmission class. The FSTC is a typical measure for the sound insulation performance for a wall or floor system in a building. The FSTC is used in the City of Sydney Council DCP for the selection of appropriate construction systems.

IIC – impact isolation class. The IIC is a typical measure of the impact/structure borne noise between two spaces in a laboratory. The IIC is used in City of Sydney Council DCP for the selection of appropriate impact isolation systems.

The BCA sound insulation ratings applicable to this project are listed in Table 1 and 2 below.

Table 1 Sound Insulation Ratings of Walls and Floors – Class 2 or 3

Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, eg habitable adjoin habitable)	50 R_W+Ctr	45 $D_{nT,w}$+Ctr	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	50 R_W+Ctr	45 $D_{nT,w}$+Ctr	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	50 R_W	45 $D_{nT,w}$	No
Apartment wall separating a plant room or lift shaft	50 R_W	45 $D_{nT,w}$	Yes
Apartment door to a stairway, public corridor, public lobby or the like	30 R_W	25 $D_{nT,w}$	NA
Apartment floor separating different sole occupancies or a plant room, lift shaft, stairway, public corridor, public lobby or the like; or parts of a different classification	50 R_W+Ctr	45 $D_{nT,w}$+Ctr	-
	62 $L_{n,w}$+C_I	62 $L_{nT,w}$+C_I	-

Table 2 Sound Insulation Ratings of Walls Services – Class 1, 2, 3 & 9c

Situation	Lab	Field	Impact
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a kitchen or non habitable room	25 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a kitchen or non habitable room	25 Rw+Ctr	NA	NA
Part F5.6 of the BCA requires a flexible coupling to be used at the point of connection between the service pipes in a building and any pump (not applicable to Class 1 buildings).			

The council DCP sound insulation ratings applicable to this project are listed in Table 3 below.

Table 3 Sound Insulation Ratings of Walls and Floors

Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, eg habitable adjoin habitable)	NA	50 FSTC	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	NA	50 FSTC	No
Apartment floor separating different sole occupancies (Same room-type each side, eg habitable adjoin habitable)	NA	50 IIC	
	NA	50 FSTC	
Apartment floor separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	NA
Apartment floor separating different sole occupancies or a plant room, stairway, public corridor, hall way or the like	NA	50 IIC	-