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ILLOURA PLACE - 28 ELIZABETH STREET, LIVERPOOL

Acoustic Assessment for Development Application

29 October 2021

Altis Bulky Retail Pty Ltd as trustee for Altis ARET Sub Trust 20

TL868-01F02 Acoustic Report for DA (r4)

35 1982-2017 ACOUSTIC ENGINEERING EXCELLENCE

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Executive summary

Renzo Tonin & Associates were engaged to conduct an environmental noise assessment of the proposed mixed-use development at 28 Elizabeth Street, Liverpool, to accompany an application for Development Application.

As a result of our assessment of the following potential acoustic issues were identified:

- Traffic noise associated with surrounding roads intruding into the proposed development
- Mechanical and refrigeration plant and equipment on roof of surrounding retail and commercial buildings

This report presents an assessment of the above acoustic components in terms of Council's Development Control Plans, State Environmental Planning Policy (Infrastructure), Australian Standards and NSW Environment Protection Authority noise policies.

External Noise Intrusion into the Development

External noise intrusions into the development have been assessed in accordance with Liverpool Council DCP 2008, ISEPP 2007, Australian Standard AS2107 and EPA Noise Policy for Industry. The major noise intrusion sources were identified as road traffic noise.

On the basis of the external noise impacting upon the development site, appropriate design of the building envelope is required to achieve a suitable indoor amenity for occupants. Our assessment has established laminated glass will be required on the worst affected external building facade.

Noise Emission Generated by the Development

Noise from mechanical plant such as building exhaust systems and air-conditioning associated with the development has the potential to impact on nearby noise-sensitive premises. As specifications of mechanical plant are not available at this stage of the development in-principle noise control advice are present in this report.

Construction Noise

The major construction activities proposed on this site are excavation works, concrete pours and general building works. Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment. As details of construction equipment and operating time are not available at this stage of the project, in-principle noise and vibration measures are provided in this report.

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1 Introduction

Renzo Tonin & Associates were engaged to assess noise impacts onto the proposed mixed-use development at 28 Elizabeth Street, Liverpool.

This study examines the effects of external noise intrusion onto the proposed development from road traffic noise and mechanical plant equipment associated with commercial/retail buildings surrounding the site.

Due to the impacts of COVID-19 restrictions which commenced on 28/06/2021, the current acoustic environment does not represent typical operations as all non-essential business and travels have ceased. This is particularly marked in Liverpool City Centre where subject site is located. Therefore, the current environment is not suitable for either short-term or long-term noise monitoring of road traffic and background noise levels.

As such, Renzo Tonin & Associates have reviewed monitoring data from previous projects that are conducted in the Liverpool City Centre before 2019 to determine indicative traffic and background noise levels at the subject site. The noise levels are indicative only and on-site monitoring shall be undertaken once the COVID-19 lockdown has ceased and activities within the Liverpool City Centre returns to normal. Recommendations made in this report will be revised accordingly where necessary.

Noise survey data from building sites on Browne Avenue and Bigge Street carried out by Renzo Tonin & Associates from 08/03/2011 to 11/03/2011 were used to determine indicative level of external noise affecting development. These noise levels were used to predict noise levels inside the future residential, retail, and commercial spaces and then assessed against the recommended internal noise criteria for the project.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

The following architectural drawings from Turner Architects were reviewed.

Table 1: Drawings Reviewed

Drawing No.	Issue	Date	Title
DA-110-001	S1	20.10.2021	Basement 06
DA-110-002	S1	20.10.2021	Basement 04-05
DA-110-003	S1	20.10.2021	Basement 03
DA-110-004	S1	20.10.2021	Basement 02
DA-110-005	S1	20.10.2021	Basement 01
DA-110-009	S1	20.10.2021	Ground Level
DA-110-010	S1	20.10.2021	Mezzanine
DA-110-011	S1	20.10.2021	Level 01
DA-110-012	S1	20.10.2021	Level 02

Drawing No.	Issue	Date	Title
DA-110-013	S1	20.10.2021	Level 03
DA-110-014	S1	20.10.2021	Level 04
DA-110-015	S1	20.10.2021	Level 05
DA-110-016	S1	20.10.2021	Typical Level A Lowrise (Level 6/10)
DA-110-017	S1	20.10.2021	Typical Level B Lowrise (Level 7/11)
DA-110-018	S1	20.10.2021	Typical Level C Lowrise (Level 8/12)
DA-110-019	S1	20.10.2021	Typical Level D Lowrise (Level 9/13)
DA-110-120	S1	20.10.2021	Typical Level A Highrise (Level 14/18/22/26/30)
DA-110-121	S1	20.10.2021	Typical Level B Highrise (Level 15/19/23/27/31)
DA-110-122	S1	20.10.2021	Typical Level C Highrise (Level 16/20/24/28/32)
DA-110-123	S1	20.10.2021	Typical Level D Highrise (Level 17/21/25/29)
DA-110-330	S1	20.10.2021	Level 33
DA-110-340	S1	20.10.2021	Roof Level
DA-210-101	S1	20.10.2021	North Elevation – Elizabeth Street
DA-210-201	S1	20.10.2021	East Elevation – Through Site Link
DA-210-301	S1	20.10.2021	South Elevation – Rear Laneway
DA-210-401	S1	20.10.2021	West Elevation – George Street
DA-310-101	S1	20.10.2021	Section AA
DA-310-201	S1	20.10.2021	Section BB

2 Internal Noise Criteria

Results from short-term and long-term noise surveys conducted on building sites within the Liverpool City Centre from 08/03/2011 to 11/03/2011 to determine indicative levels of ambient and background noise surrounding the subject site. These levels were used to predict noise levels within the residential and commercial spaces and assessed against the internal noise criteria recommended for this development.

2.1 Design Noise Criteria

The Standards, Government Policies, Guidelines and Council Development Control Plans (DCP) relevant to this development are as follows:

- Liverpool Council Development Control Plan 2008 (Part 4 – Amendment 33 – 6 May 2020)
- State Environment Planning Policy (Infrastructure 2007) or ISEPP 2007
- Department of Planning Guideline "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
- Australian Standard AS/NZS 2107:2016 "Acoustics – Recommended design sound pressure levels and reverberation times for building interior"

Liverpool Council's DCP does not stipulate specific internal noise goals for residential or mixed-use developments therefore relevant design noise levels from ISEPP 2007, Department of Planning Guideline and Australian Standards AS2107 has been adopted for this assessment. The recommended internal noise criteria are outlined in Table 2 below.

Table 2: Recommended Maximum Internal Noise Levels

Type of Occupancy	Windows & Doors Condition	Design Noise Levels	
		Day, L_{Aeq} (15hour)	Night, L_{Aeq} (9hour)
Sleeping areas	Closed	-	35dB(A)
All other habitable rooms	Closed	40dB(A)	40dB(A)
Lobbies and common corridors[1]	Closed	50dB(A)	50dB(A)
Residential communal indoor space	Closed	45dB(A)	45dB(A)
Residential gym	Closed	50dB(A)	-
General office area / open plan offices[1]	Closed	45dB(A)	-
Small retails stores (general)[1]	Closed	50dB(A)	-

Notes:

1.. Design sound pressure levels for these spaces (not coved in the ISEPP) were based on Australian Standard AS2107

Relevant sections of the State Environment Planning Policy, Australia Standard AS2107, Council DCP, and Government Policies are presented in APPENDIX A of this report. Results of the background and ambient noise monitoring conducted on site are presented in APPENDIX D.

3 Site and Surrounds

The subject site is located at corner of Elizabeth and George Street, Liverpool is currently vacant land. The site is bounded by Elizabeth Street to the north, George Street to the west, adjoining the site on the south is a police station/courthouse building and adjoining site on the east is vacant land. Existing neighbours surrounding the site is a mixed of 2 to 4 storey retails and commercial buildings to the north, west and south as shown in Figure 1. There are currently no residential or hotel neighbours within proximity of the subject site.

The proposed development is a 34-storey building with 6 levels of basement parking, retails and lobbies on the ground floor, commercial spaces on Levels 1 to 4 and apartments from Levels 5 to 33. Residential amenities including pool, gym and communal indoor spaces are on the Level 5.

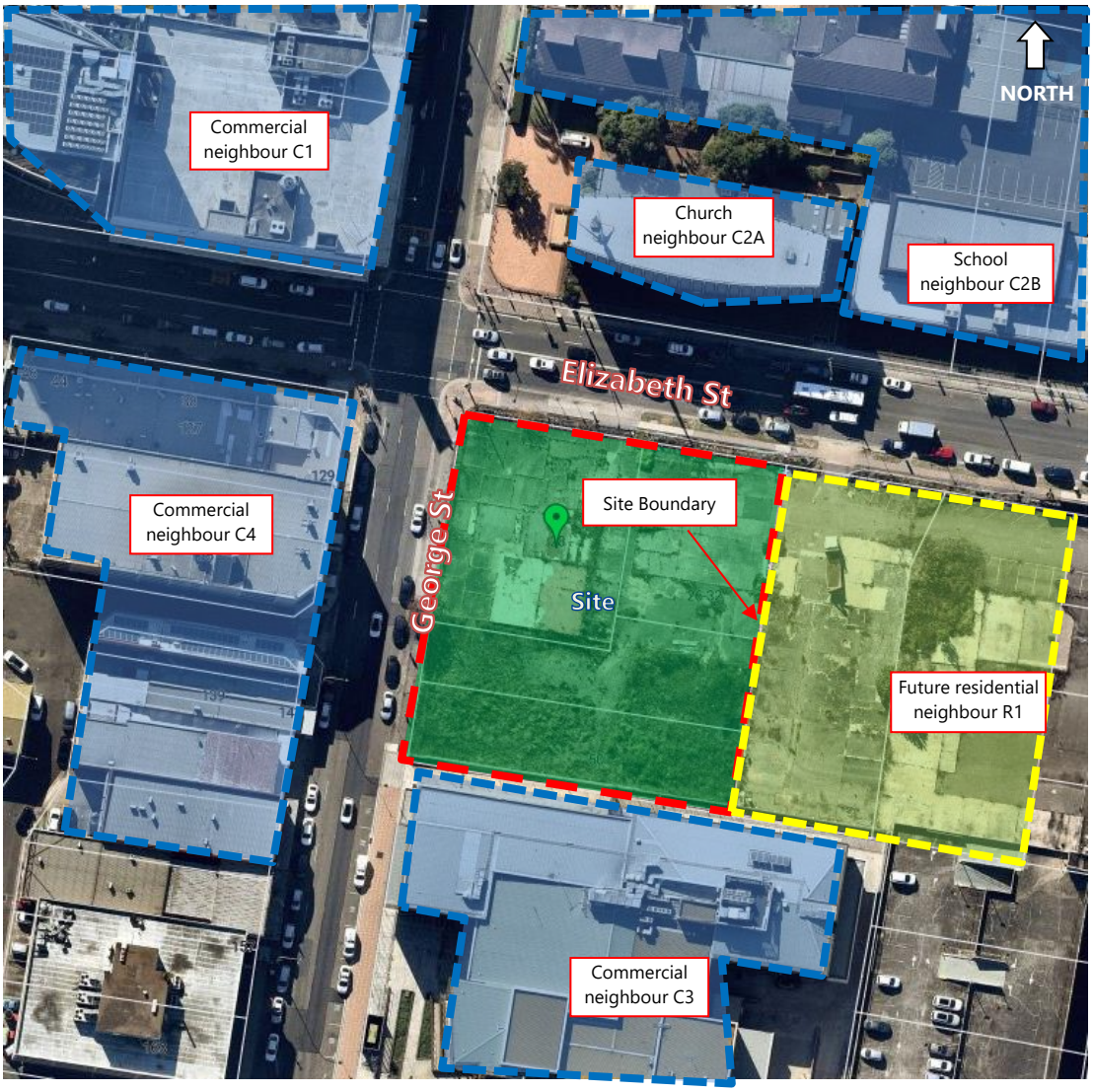


Figure 1 Site Location and Surrouding Receivers

The nearest noise-sensitive receivers to the proposed development have been identified as follows and indicated in Figure 1 above.

Table 3: Noise Sensitive Receiver Locations

Receiver ID	Address	Description
Non-residential Receivers		
C1	Corner of George and Elizabeth Street	3 storey commercial building (Westfield Shopping Centre) 31m north-west of site across the intersection of Elizabeth and George Street
C2A	48 George Street	3 storey heigh church building (All Saints' Catholic) 26m north of site across Elizabeth.
C2B	29 Campbell Street	To the north of the Church are 2 storey school buildings (All Saints Catholic Primary School)
C3	150 George Street	3 storey commercial building (Liverpool Police Station and Court house) on the site southern boundary
C4	129 to 151 George Street	Mix of 2 to 4 storey retail and commercial buildings at 19m west of site across George Street.
Residential Receivers		
R1	26 Elizabeth Street	Future multi-storey residential development on the site eastern boundary.

4 Measured Noise Levels

4.1 Noise Surveys

The subject site is located within the Liverpool City Centre is potentially affected by noise emitted from city traffic, business activities and mechanical and refrigeration plant on roof of commercial and retail buildings. Due current COVID-19 lockdown essentially all these activities have ceased in the city centre, thus the current acoustic environment is not suitable for noise monitoring. Renzo Tonin & Associates previously undertook acoustic assessment for other sites within the Liverpool City Centre from 08/03/2011 to 11/03/2011 which captured road traffic and urban noises of the Liverpool CBD. Results from these short-term and long-term noise surveys are presented in APPENDIX D and were used to predict indicative traffic and background noise levels at the subject site. The predicted noise levels outlined in Table 4 and Table 5 were based on 2% annual increase in traffic activities in Liverpool City Centre.

4.2 Representative Traffic Noise Levels

The design traffic noise levels are taken from the representative L_{Aeq} for the week for both the day time (7am to 10pm) and night time (10pm-7am) periods. The design external traffic noise levels are presented Table 4 below.

Table 4: Representative Day and Night Traffic Noise Levels

Location	Period	Predicted Traffic Noise Level $L_{Aeq,\,T}$ [1,2] at Worst Affected Building Façades
Corner of Elizabeth and George Street, Liverpool	Day time (7am to 10pm)	67 dB(A)
	Night-time (10pm to 7am)	63 dB(A)

Notes:

1. Noise levels presented are facade values.
2. Representative road traffic noise level in measured L_{Aeq} over 15 hour and 9 hour day and night period respectively.

4.3 Indicative Ambient and Background Noise Level

Table 5 below represents indicative ambient and background noise levels for the subject site.

Table 5: Site Ambient and Background Noise Levels

Location	Noise Descriptor	Indicative Noise Levels in dB(A)		
		Day[1]	Evening[2]	Night[3]
Corner of Elizabeth and George Street, Liverpool	L_{A90} Background	54	51	41
	L_{Aeq} Ambient	65	64	62

Location	Noise Descriptor	Indicative Noise Levels in dB(A)		
		Day[1]	Evening[2]	Night[3]

Notes:

Day, Evening & Night assessment periods are defined in accordance NSW EPA's Industrial Noise Policy as follows.

1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays. As results were affected by construction noise weekend day and Saturday morning, Sunday results have been presented for the Day time period
2. Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays
3. Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays

The background (L_{A90}) and ambient (L_{Aeq}) noise levels presented Table 5 are representative of surrounding retail and commercial neighbours and are used in defining external noise emission from the development such as mechanical ventilation and air-conditioning systems in accordance with EPA Noise Policy for Industry.

4.4 Calculated Internal Noise Levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were conducted using the OutsideIn Glazing Spreadsheet developed in this office which take into account external noise levels, facade transmission loss and room sound absorption characteristics. Noise levels were calculated for each building facade to account for any variation in the external noise levels affecting different parts of the building.

Glazing constructions required to comply with the nominated noise criteria are presented in the body of this report.

5 Recommendations

5.1 Glazing Design Requirements

Table 6 below presents recommended glazing treatment for the building facades to achieve compliance with the maximum noise levels nominated in Table 2 above.

Table 6: Recommended Glazing Treatment

Level	Facades	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Thickness & Type	Laboratory Test Reference
Ground and Mezzanine	All facades	Retails	Rw 28	6mm monolithic glass	ESTIMATE
		Bicycle parking	Rw 25	4mm monolithic glass	ESTIMATE
	West	Commercial lobby	Rw 28	6mm monolithic glass	ESTIMATE
	East	Residential lobby	Rw 25	4mm monolithic glass	ESTIMATE
1 to 4	North and west	Commercial tenancies	Rw 32	6.38mm laminated glass	ESTIMATE
	South and east	Commercial tenancies	Rw 28	6mm monolithic glass	ESTIMATE
5	South and west	Communal indoor amenities (gym and lounge)	Rw 32	6.38mm laminated glass	ESTIMATE
5 to 11	All facades	Lobbies	Rw 25	4mm monolithic glass	ESTIMATE
	North and west	Bedrooms	Rw 35	10.38mm laminated glass	ESTIMATE
		Open plan living/dining/kitchen	Rw 35	10.38mm laminated glass	ESTIMATE
	South and east	Bedrooms	Rw 32	6.38mm laminated glass	ESTIMATE
		Open plan living/dining/kitchen	Rw 32	6.38mm laminated glass	ESTIMATE
12 to 33	All facades	Lobbies	Rw 25	4mm monolithic glass	ESTIMATE
	North and west	Bedrooms	Rw 32	6.38mm laminated glass	ESTIMATE
		Open plan living/dining/kitchen	Rw 32	6.38mm laminated glass	ESTIMATE
	South and east	Bedrooms	Rw 28	6mm monolithic glass	ESTIMATE
		Open plan living/dining/kitchen	Rw 28	6mm monolithic glass	ESTIMATE

By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.

Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

Level	Facades	Occupancy Type	Recommended Minimum Sound Insulation Rating of Glazing Assembly	Typical Compliance Glazing Thickness & Type	Laboratory Test Reference

LEGEND where no appropriate test certificate exists:

1. ESTIMATE: The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.
2. ESTIMATE – APPROVED FOR CONSTRUCTION: Use of the form of construction is approved prior to laboratory certification. To complete the quality control of the design process and confirm the acoustical performance of the construction, we recommend testing in a laboratory to confirm the Rw rating as soon as practicable. In the case of impact rating for floor systems, no particular impact rating is guaranteed to comply with either the Building Code of Australia or Strata Scheme Management Act and hence carpet runners may still be required.
3. ESTIMATE – TEST NOT REQUIRED: Use of the form of construction is approved without laboratory certification. The STC/Rw of the form of construction exceeds the project requirements.
4. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

NOTES FOR GLAZING CONSTRUCTIONS:

5. The information in this table is provided for the purpose of Council approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.
6. The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.
7. Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.
8. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site.
9. All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.
10. The above glazing thicknesses should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

GENERAL

11. The sealing of all gaps in partitions is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
12. Check design of all junction details with acoustic consultant prior to construction.
13. Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
14. The information provided in this table is subject to modification and review without notice.
15. The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

With the installation of the recommended glazing outlined in Table 6 above and windows and doors closed, internal traffic noise levels inside residential, commercial and retail spaces are expected to comply with the indoor noise goals outlined in Table 2 of this report.

5.2 Facade & Roof Sound Insulation

In principle advice is provided below for the acoustic requirements of the roofs and external walls.

5.2.1 External Walls

All external walls shall have sound isolation ratings, Rw, of at least 15dB higher acoustic performance than that of the acoustic glazing specified in Table 6 above.

5.2.2 Roof and Ceiling

Roof/ceiling construction shall have a sound isolation rating, Rw, at least 10dB higher than that of the acoustic glazing on its facade walls.

5.2.3 Glazing Assembly Requirements

The following acoustic measures should also be incorporated into the building design:

s1. All operable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the Rw rating performance of the glazing to not be reduced.

s2. The glazing thicknesses outlined in Table 6 should be considered the minimum thicknesses to achieve acoustical ratings. Greater glazing thicknesses may be required for structural loading, wind loading etc.

s3. The glazing supplier shall ensure that installation techniques will not diminish the Rw performance of the glazing when installed on site. Sliding door meeting stiles should form an airtight seal when closed and locked.

s4. The perimeter of all window and door frames are to be sealed airtight in the external facade using the following methods:

- For gaps less than 10mm - Fill all gaps around the window perimeter with an acoustic mastic sealer (minimum specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap.
- If the gap is greater than 10mm, fill the cavity with polyester insulation and a backing rod. Seal the gap airtight an acoustic mastic sealer (min specific gravity 1.6sg) equivalent to Promat Promaseal. The depth of sealer shall be at least equal to the width of the gap. The gaps between frames shall also be sealed using aluminium angle brackets (approximately 25 x 25 x 3mm).

6 Internal Sound Insulation between Tenancies

Internal walls and floors shall comply with the National Construction Code of Australia 2019 (formally Building Code of Australia). All services and doors shall comply with the requirements of the NCC 2019. APPENDIX B presents a summary of acoustic provisions outlined in Part F5 of the NCC 2019.

7 External Noise Emission from Building Services

7.1 EPA Requirements

The NSW Environment Protection Authority (EPA) sets out noise criteria in its Noise Policy for Industry (NPfI) to control the noise emission from industrial sources.

The NPfI sets project noise trigger level to protect noise amenity for residential receivers. The project noise trigger level is set as the lower value of the following two assessment components:

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for particular land uses for residences and other land uses.

Noise intrusiveness ensures that industrial noise does not exceed the background noise level by an excessive margin, preventing significant changes in the noise characteristic pertinent to the development site and surrounds. This is commonly referred to as the 'background plus 5' criterion. That is, the noise level from new industrial development, assessed in periods of 15 minutes, should not exceed the existing background noise level (measured in the absence of that development) by more than 5dB(A).

Noise amenity ensures that industrial noise levels do not increase without limit, for if a number of industrial noise sources are permitted to increase the background noise level by 5dB(A), in turn there would be a point where the ultimate noise level is unacceptable. A limit on the ultimate acceptable noise level is therefore included in the NPfI as a way of ensuring that cumulative noise impact from industrial growth is curtailed. This limit is referred to as the project amenity noise level. The appropriate limit in any circumstance relates to the land use category, for example, there are different limits for rural, suburban and urban areas.

The table below presents the recommended amenity noise level relevant to the receivers surrounding the proposed development site. The project amenity noise level is defined as the recommended amenity noise level minus 5dB(A).

Table 7: NPfI Amenity Noise Levels - Recommended L_{Aeq} Amenity Noise Levels from Industrial Noise Sources [EPA NPfI Table 2.1]

Receiver	Noise amenity area	Time of day	L_{Aeq}, dB(A)
			Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40

Receiver	Noise amenity area	Time of day	L_{Aeq}, dB(A) Recommended amenity noise level
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See Column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom - internal	All	Noisiest 1-hour period when in use	35
Hospital ward - internal	All	Noisiest 1-hour	35
Hospital ward - external	All	Noisiest 1-hour	50
Place of worship - internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to recommended noise amenity

Notes:

- Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
- On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
- The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

In accordance with Section 2.4 of the NPfI, the following **exceptions** to the above method to derive the project amenity noise level apply:

1. In areas with high traffic noise levels (see Section 2.4.1 of the NPfI).
2. In proposed developments in major industrial clusters (see Section 2.4.2 of the NPfI).
3. Where the resultant project amenity noise level is 10dB, or more, lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
4. Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development.

The following table presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant to future residences on the adjoining vacant land (Receiver R1) on the eastern site boundary.

Table 8: Project noise trigger level for noise emission from mechanical plant (EPA NPfI)

Time of Day	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
	Rating Background Level (RBL) L_{A90}	Intrusiveness Trigger Level, $L_{Aeq, 15minute}$ (RBL+5)	Recommended Amenity Noise Level (RANL), $L_{Aeq, period}$	Project Amenity Noise Level (PANL), $L_{Aeq, period}$	Measured $L_{Aeq, period}$ existing noise levels	Traffic noise exceed RANL by more than 10dB?	Existing noise level likely to decrease in future?	Exceptions to PANL $L_{Aeq, period}$?	Project Noise Trigger Level, $L_{Aeq, 15minute}$
Day (7am to 6pm)	54	59	60	55	65	No	No	None	**58**
Evening (6pm to 10pm)	51	56	50	45	64	Yes	No	None	**48**
Night (10pm to 7am)	41	46	45	40	62	Yes	No	None	**43**

Explanatory notes:

Column 1 – RBL measured in accordance with the NPfI and outlined in the results of the long-term noise monitoring has been summarised in accordance with NPfI requirements and are presented in Table 5 above. Where the evening time criterion is greater than the daytime criterion, the evening time goal is amended to be the same as the daytime criteria.

Column 4 – Project Amenity Noise Level determined based on 'Residential - Urban' area in Table 2.2 (Amenity noise levels) of the EPA's NPfI minus 5dB

Column 5 – Measured in accordance with the NPfI

Column 8 - Determined in accordance with Section 2.4 of the NPfI.

Column 9 – Project Noise Trigger Level is the lower value of project intrusiveness noise level and project amenity noise level. In accordance with Section 2.2 of the NPfI, $L_{Aeq, 15minute}$ is calculated as $L_{Aeq, period}$ + 3dB(A)

Notes: Intrusiveness noise level for Evening must be set at no greater than the intrusiveness level for daytime in accordance with NPfI Section 2.3.

The following table below presents the site-specific noise production criteria from industrial noise sources, namely mechanical plant to neighbouring commercial properties (C1 to C4) identified in in Section 3 and shown in Figure 1.

Table 9: Project noise trigger level for noise emission from mechanical plant to commercial neighbours (EPA NPfI)

Assessment / Receiver location	Intrusiveness[5] criteria, $L_{Aeq,15min}$ dB(A)			Amenity[4] criteria, $L_{Aeq, period}$ dB(A)		
	Day[1]	Evening[2]	Night[3]	Day	Evening	Night
Retail/commercial buildings to the west and south the of development (Receivers C1, C3 & C4)	N/A	N/A	N/A	65 (when in use)		
Church to the north of site (Receiver C2A)				40 (when in use) – assessed internally[1]		
School to north the north of site (Receiver C2B)				35 (when in use) - assessed internally[1]		

Notes:

1. For external assessment ie. outside window the criteria are 10dB higher than internal

Where necessary, noise amelioration treatment to mechanical plant such as carpark exhaust fans and air conditioning systems will be incorporated in the design to ensure that noise levels comply with the recommended NPfI noise emission criteria noted above.

7.2 Recommended Noise Control Measures for Mechanical Plant

Mechanical plant such as exhaust systems, air-conditioning, mechanical ventilation and refrigeration associated with the development has the potential to impact on nearby residential and commercial properties. As specifications of mechanical plant are not available at this stage of the development the following in principle noise control advice are provided.

- Acoustic assessment of mechanical services equipment will be require to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in established in Table 6.
- Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following;
  - procurement of 'quiet' plant
  - strategic positioning of roof and balcony plant equipment away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises
  - installation of commercially available silencers or acoustic attenuators for air discharge and air intakes of plant
  - acoustically lined and lagged ductwork
  - provide acoustic screens and/or acoustic louvres between plant and sensitive neighbouring premises
  - provide partially enclosed or fully enclosed acoustic enclosure over plant
  - Mechanical plant shall have their noise specifications and proposed locations checked prior to installation
  - Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 "Rotating and Reciprocating Machinery - Mechanical Vibration"

8 Construction Noise

The nature of the construction processes proposed for the development does not present difficulties in ensuring that the associated noise limits at surrounding properties are achieved. The major construction activities proposed on this site are excavation works, concrete pours and general building works.

Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment.

Noise generated by construction activities will comply with the Department of Environment Climate Change & Water's Interim Construction Noise Guide (ICNG). APPENDIX C presents a summary ICNG's standard construction times and conditions.

9 Conclusion

Renzo Tonin & Associates have completed a preliminary acoustic assessment of road traffic noise impacts onto the proposed mixed-use residential development at 28 Elizabeth Street, Liverpool.

The acoustic review indicates the proposed development can achieve compliance with the acoustic requirements of Liverpool Council DCP 2008, State Environment Planning Policy ISEPP 2007 and Australian Standard AS/NZS 2107 with appropriate noise control measures incorporated into the building design such as acoustic glazing.

Recommendations have been provided in Section 5 of this report to comply with the nominated internal noise criteria.

APPENDIX A Assessment and Design Methodology

A.1 Liverpool Council Development Control Plan 2008

Liverpool Council is the regulatory authority for the proposed development. Council's DCP 2008 Part 4 (Amendment 33, 6 May 2020) refers to the State Environment Planning Policy (Infrastructure) 2007 as design guide for residential developments near rail corridors, major and secondary roads as defined in Figure 4-16 of Council DCP. Part 4.5.2 DCP states the following.

"4.5.2 Noise

Background

Noise sources from major road and railway corridors and mixed-use and commercial development have been identified within and adjacent to the city centre. It is important for the amenity and comfort of future occupants of buildings in proximity to these areas that appropriate measures are put in place.

Objectives

1. Noise mitigation measures must achieve appropriate amenity in noise affected locations.

Controls

1. Design development on sites adjacent to road and rail noise sources identified in Figure 4-16, in a manner that shields any residential development from the noise source through the location and orientation of built form on the site, supported by an appropriate acoustic report as required by the State Environmental Planning Policy (Infrastructure) 2007.

2. Provide an 8m setback from the primary street frontage to any residential component

of development located along Terminus Street and the Hume Highway.

All residential apartments and / or serviced apartments within a mixed use development should be designed and constructed with double-glazed windows and / or laminated windows, solid walls, sealing of air gaps around doors and windows as well as appropriate insulating building elements for doors, walls, roofs and ceilings etc; to provide satisfactory acoustic privacy and amenity levels for occupants within the residential and / or serviced apartment(s).

Figure 4-16 Noise".

A.2 State Environmental Planning Policy (Infrastructure) 2007

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of

infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Pertinent to noise assessment, the ISEPP includes the following clauses:

87 Impact of rail noise or vibration on non-rail development

- *This clause applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:*
  - *a. a building for residential use,*
  - *b. a place of public worship,*
  - *c. a hospital,*
  - *d. an educational establishment or child care centre.*
- *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
- *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
  - *e. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
  - *f. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*

102 Impact of road noise or vibration on non-road development

- *This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
  - *g. a building for residential use,*
  - *h. a place of public worship,*
  - *i. a hospital,*
  - *j. an educational establishment or child care centre.*
- *Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*

- *If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*

  k. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,

  l. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.

- *In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

A.2.1 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning, design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

A.2.2 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the ISEPP apply to internal noise levels with windows and doors closed. However as the preliminary noise assessment is based on measurements/predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the ISEPP. The equivalent external goals have been determined on the following basis:

- The ISEPP states: "*If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, 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*." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the ISEPP.
- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the Building Code of Australia (BCA) ventilation requirements.

Table 10 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 10: ISEPP noise criteria for new residential development

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2011 requirements.

A.3 Australian/New Zealand Standard AS/NZS 2107:2016

Australian/New Zealand Standard AS/NZS 2107:2016 "Acoustics - Recommended design sound levels and reverberation times for building interiors" recommends design criteria for conditions affecting the acoustic environment within building interiors to ensure a healthy, comfortable and productive environment for the occupants and the users. The background sound levels recommended take into account the function of the area(s) and apply to the sound level measured within the space unoccupied but ready for occupancy. The Standard is applicable to steady-state or quasi-steady-state sounds such as mechanical services equipment and road traffic noise intrusion, but not intended for transient or variable sources such as aircraft noise, railways and construction noise. The reverberation times recommended are for the occupied state of the space.

The sound levels given in this Standard are for the design of spaces in buildings and are provided as a range with a recommended lower level and upper level. Sound levels within the given ranges have been found to be acceptable by most people for the space under consideration. When the sound level is greater than the upper level of the range most people occupying the space will become dissatisfied with the level of sound. When the sound level is below the lower level of the range, the inadequacy of background sound to provide masking sound can become problematic, for example, by allowing other intermittent noise sources to cause distraction, annoyance, or lack of privacy.

Table 11: Design sound levels and reverberation times for different areas of occupancy in buildings

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
5	**OFFICE BUILDINGS**		
	Board and conferences rooms	30 to 40	0.6 to 0.8
	Cafeterias	45 to 50	< 1.0
	Call centres	40 to 45	0.1 to 0.4
	Corridors and lobbies	45 to 50	< 1.0
	Executive office	35 to 40	0.4 to 0.6
	General office areas	40 to 45	0.4 to 0.6
	Meeting room (small)	40 to 45	< 0.6
	Open plan office	40 to 45	0.4 (see Note 1)
	Public spaces	40 to 50	0.5 to 1.0
	Quiet rooms	40 to 45	< 0.6
	Reception areas	40 to 45	0.6 to 0.8
	Rest rooms and break-out spaces	40 to 45	0.4 to 0.6
	Toilets	45 to 55	-
	Undercover carparks	<65	-
	Video/audio conference rooms	30 to 40	0.2 to 0.4
7	**RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)**		
	Houses and apartments in inner city areas or entertainment districts or near major roads -		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	-

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
	Living areas	35 to 45	-
	Sleeping areas (night time)	35 to 40	-
	Work areas	35 to 45	-
	Houses and apartments in suburban areas or near minor roads -		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	-
	Living areas	30 to 40	-
	Sleeping areas (night time)	30 to 35	-
	Work areas	35 to 40	-
	Houses in rural areas with negligible transportation -		
	Sleeping areas (night time)	25 to 30	-
	Hotels and motels -		
	Bars and lounges	< 50	0.6 to 1.0
	Conference areas -		
	Without sound reinforcement -		
	Up to 50 persons	35 to 40	Curve 1*
	From 50 to 250 persons	30 to 35	Curve 1*
	With sound reinforcement	35 to 45	Curve 1*
	Dining rooms	40 to 45	See Note 1
	Enclosed carparks	< 65	-
	Foyers and recreation areas	45 to 50	See Note 1
	Kitchen, laundry and maintenance areas	< 55	-
	Sleeping areas (night time) -		
	Hotels and motels in inner city areas or entertainment districts or near major roads	35 to 40	-
	Hotels and motels in suburbs or near minor roads	30 to 35	-
	Washrooms and toilets	45 to 55	-
	Hostels, residential halls and barracks -		
	Cafeterias	45 to 50	< 1.0
	Common rooms	40 to 45	< 1.0
	Games rooms	45 to 50	< 1.0
	Kitchens and service areas	45 to 55	-
	Sleeping areas (night time) -		
	Hostels, residential halls and barracks in inner city areas or entertainment districts or near major roads	35 to 40	-
	Hostels, residential halls and barracks in suburbs or near minor roads	30 to 35	-
	Mining camps -		
	Sleeping areas	35 to 40	-
	Other facilities	See Item 3 or Item 5 in this Table	
	Retirement homes/villages	See Houses and apartments; and Clause 5.2	

Item	Type of occupancy/activity	Design sound level (LAeq,t) range	Design reverberation time (T) range, s
* See Appendix A for all references to 'Curve' in this Table.			

NOTES:

1. Reverberation time should be minimized for noise control.
2. Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the range.
3. Specialist advice should be sought for these spaces.
4. A very wide range of noise levels can occur in the occupied state in spaces housing manufacturing processes, and the levels are primarily subject to control as part of a noise management program (see AS/NZS 1269.2). The possibilities for segregating very noisy processes from quieter ones by partitioning vary between particular industries and plants. For reasons such as these, it is difficult to make generalized recommendations for desirable, or even maximum, design levels for the unoccupied state, but one guiding principle may still be observed-when the activity in one area of a manufacturing plant is halted, it is desirable that the local level should if possible drop to 70 dB(A) or lower to permit speech communication without undue effort.
5. In situations where traffic noise levels may vary widely over a 24 h period, measurement to assess compliance with this Standard should be taken at the relevant time and for an appropriate measurement period according to the area of occupancy or activity in the building. Where traffic noise fluctuates rapidly with the passage of individual vehicles, the community reaction may not correlate well with the equivalent continuous noise level as measured.
6. The overall sound pressure level in dB(A) should conform to the recommended design sound level given in Table 1. In these spaces, a balanced sound pressure level across the full frequency range is essential. These spaces should therefore be evaluated in octave bands across the full frequency spectrum. The recommended maximum sound pressure levels for the individual octave bands corresponding to the overall dB(A) value are given in Appendix C.
7. In spaces in which high quality sound recordings are to be made, the levels set for low frequency octave bands should not be exceeded (see Appendix C). Subsequent replay of the recordings might cause an amplification of the low-frequency sound resulting in an overemphasis of its low-frequency components. Specialist advice should always be sought when these spaces are being designed. In some circumstances, for purposes of very high quality recording, lower levels than those in Table 1 may be necessary.
8. Health requirements for hygiene and infection control may preclude achieving these recommended reverberation times.

APPENDIX B Internal Sound Insulation

B.1 National Construction Code of Australia 2019

The National Construction Code of Australia (NCC) outlines minimum requirements for inter-tenancy (party) walls and ceiling/ floors to maintain privacy. This includes the incorporation of penetration of a service through a floor or through more than one sole-occupancy unit.

NCC nominates required Weighted Sound Reduction Indexes (R_w) and spectrum adaptation factor (C_{tr}) for partition constructions, of different space/ activity types in adjoining units. The R_w and $R_w + C_{tr}$ are single number descriptors for quantifying the attenuating performance of partitions for typical intrusive noises produced inside residences. The higher the rating, the greater the isolation provided by the partition.

Spectrum adaptation factors are commonly used to compensate for the fact that certain kinds of sounds are more readily transmitted through insulating materials than others insulate.

The adaptation factor C_{tr} has now been introduced for most building elements which require an airborne sound insulation rating. The only exception is a wall which separates a dwelling from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification. Therefore, both the C_{tr} factor and the R_w of the building element will need to be considered in most cases.

The C_{tr} factor takes into account lower frequency level sounds, and has been chosen in large part, in recognition of the problem of the high bass frequency outputs of modern home theatre systems and music reproduction equipment.

The Deemed-to-Satisfy Provisions also have impact sound insulation requirements for floors. The terms to describe the impact sound insulation of the floor is the weighted normalised impact sound pressure level ($L_{n,w}$). The lower the $L_{n,w}$ of the floor, the better the performance of the floor in terms of impact sound insulation.

The following section represents a summary of acoustic provisions outlined in the Part F5 of the NCC.

B.2 Sound Insultion Provision of NCC of Australia

The acoustic provisions for inter-tenancy walls, floors, service risers and entry doors in Class 2 and 3 buildings are outlined in the National Construction Code of Australia and the following is an extract from the NCC:

> *"F5.2 Determination of airborne sound insulation ratings*
>
> *A form of construction required to have an airborne sound insulation rating must –*

a. have the required value for weighted sound reduction index (R_w) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or

b. comply with Specification F5.2.

F5.3 Determination of impact sound insulation ratings

a. A floor in a building required to have an impact sound insulation rating must –

i. have the required value for weighted normalised impact sound pressure level ($L_{n,w}$) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or

ii. comply with Specification F5.2.

b. A wall in a building required to have an impact sound insulation rating must –

i. for a Class 2 or 3 building be of discontinuous construction;

c. For the purposes of this part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

i. for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and

ii. for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F5.4 Sound insulation rating of floors

a. A floor in a Class 2 or 3 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}$ (impact) not more than 62 if it separates –

i. sole-occupancy units; or

ii. a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

F5.5 Sound insulation rating of walls

a. A wall in a Class 2 or 3 building must –

i. have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates sole-occupancy units; and

ii. have an R_w (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and

iii. comply with F5.3(b) if it separates:

A. a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

B. a sole-occupancy unit from a plant room or lift shaft.

b. A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an R_w not less than 30.

c. Where a wall required to have sound insulation has a floor above, the wall must continue to –

i. the underside of the floor above; or

ii. a ceiling that provides the sound insulation required for the wall.

F5.6 Sound insulation rating of services

a. If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with an $R_w + C_{tr}$ (airborne) not less than –

i. 40 if the adjacent room is a habitable room (other than a kitchen); or

ii. 25 if the adjacent room is a kitchen or non-habitable room.

b. If a storm water pipe passes through a sole-occupancy unit it must be separated in accordance with (a).

F5.7 Sound isolation of pumps

A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump."

APPENDIX C Construction Noise

The NSW *Interim Construction Noise Guideline* (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

  NSW noise policies, including the INP, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- Application of reasonable and feasible noise mitigation measures

- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Table 12 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied for residential receivers. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 12: Noise management levels at residential receivers

Time of day	Management level $L_{Aeq\ (15\ min)}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Sensitive Land Use

Table 13 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 13: Noise management levels at other noise sensitive land uses

Land use	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: Noise management levels apply when receiver areas are in use only.

APPENDIX D Results of Noise Surveys

D.1.1 Short-term Noise Survey

The results of the operator attended ambient and background noise survey conducted on footpath of Bigge Street, Liverpool on 11/03/2011 are summarised below.

Table 14: Results of Short-term Noise Surveys

Measurement Location	Time and Date	Measured Ambient Noise Level $L_{Aeq,T}$	Measured Background Noise Level $L_{A90,\ T}$
Footpath of Bigge Street, Liverpool	Friday 3pm to 3:30pm 11/03/2011	67 dB(A)	57 dB(A)

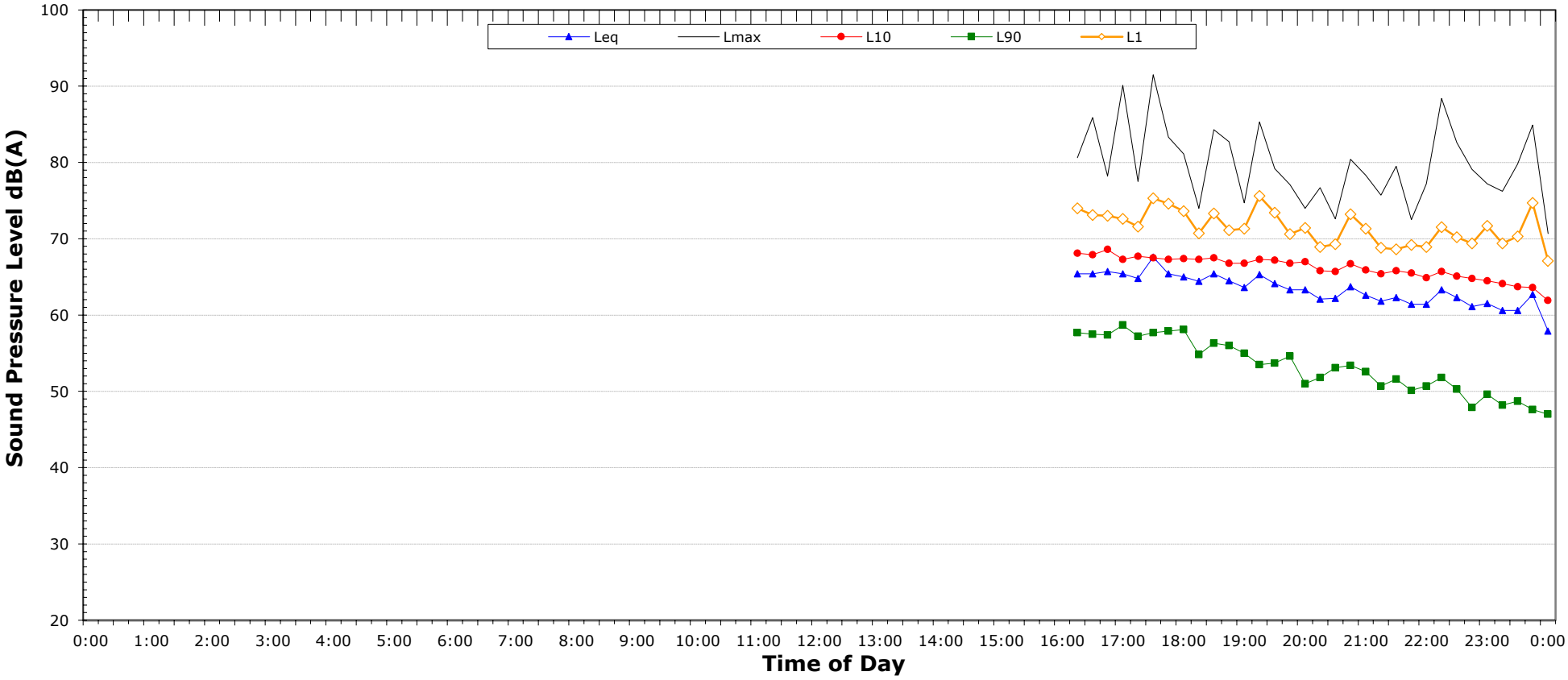
D.1.2 Long-term Noise Survey

The results of the unattended long-term ambient and background noise survey conducted on Browne Avenue, Liverpool from 08/03/2011 to 11/03/2011 are presented in graphical format in the following pages.

EXISTING AMBIENT NOISE LEVELS

Browne Parade, Liverpool

Tuesday, 8 March 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	-	50.7	41.0
Leq (see note 3)	-	63.4	61.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax- Leq ≥ 15dB(A)

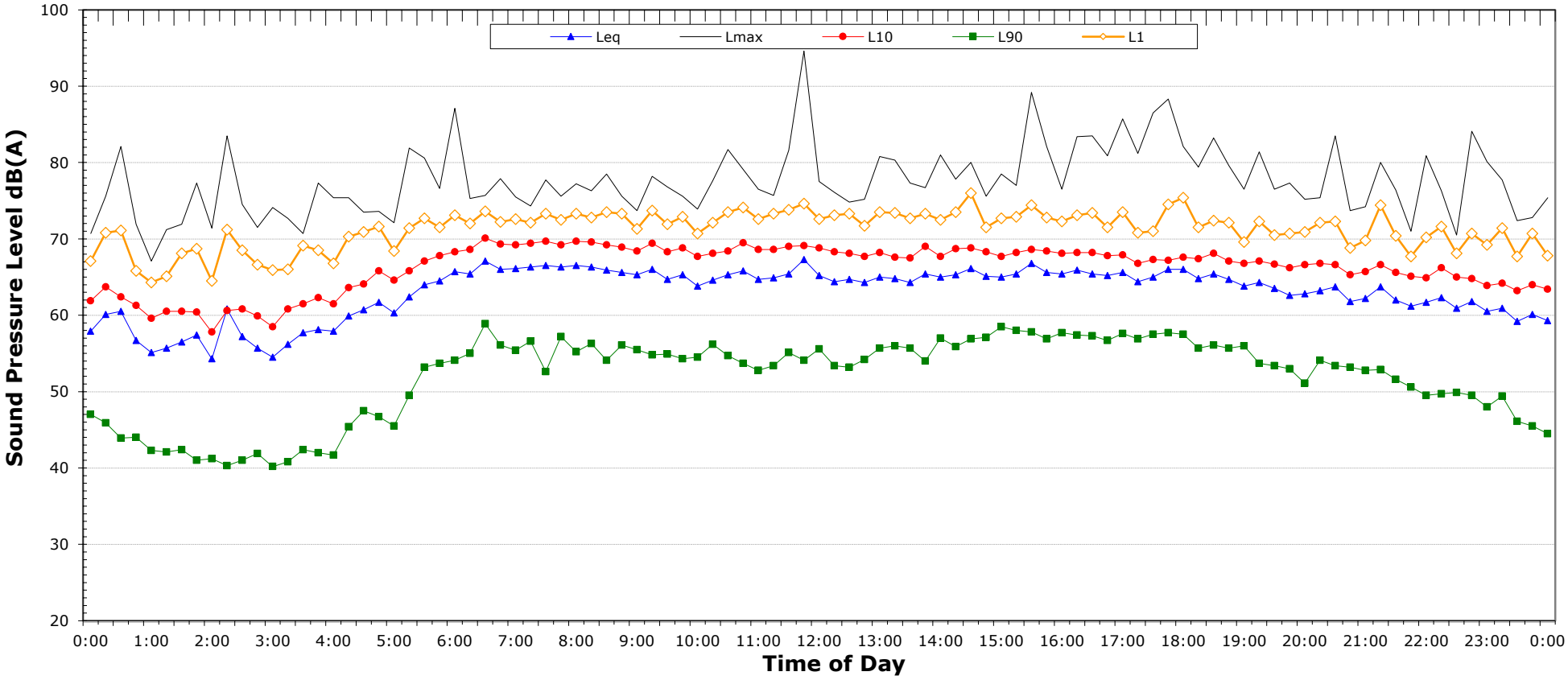
NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	66.8	64.2
$L_{eq\ 1hr}$ upper 10 percentile	68.4	68.7
$L_{eq\ 1hr}$ lower 10 percentile	64.2	58.6

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	77.3	to	88.4
Lmax - Leq (Range)	19.8	to	26.3

EXISTING AMBIENT NOISE LEVELS

Browne Parade, Liverpool

Wednesday, 9 March 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	53.4	50.6	41.0
Leq (see note 3)	65.5	63.4	61.2

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax- Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	67.5	63.7
$L_{eq\ 1hr}$ upper 10 percentile	68.6	68.4
$L_{eq\ 1hr}$ lower 10 percentile	65.0	58.5

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	74.8	to	84.1
Lmax - Leq (Range)	17.1	to	24.2

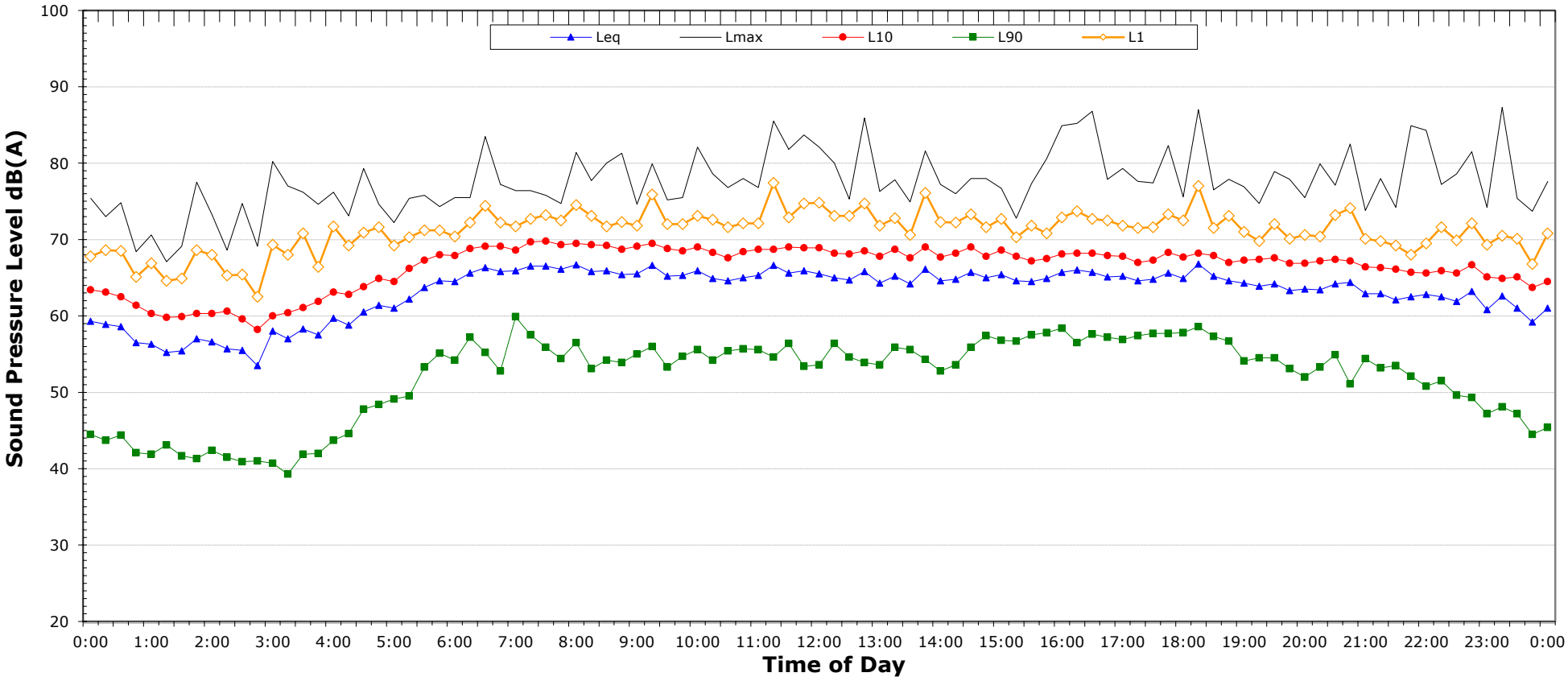
Data File: Logger 1.xls

Template QTT-01 (rev 64) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

Browne Parade, Liverpool

Thursday, 10 March 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	53.6	51.1	40.7
Leq (see note 3)	65.4	64.0	62.1

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax- Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	67.6	64.6
$L_{eq\ 1hr}$ upper 10 percentile	68.7	69.4
$L_{eq\ 1hr}$ lower 10 percentile	65.7	59.3

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	75.7	to	90.9
Lmax - Leq (Range)	17.8	to	26.2

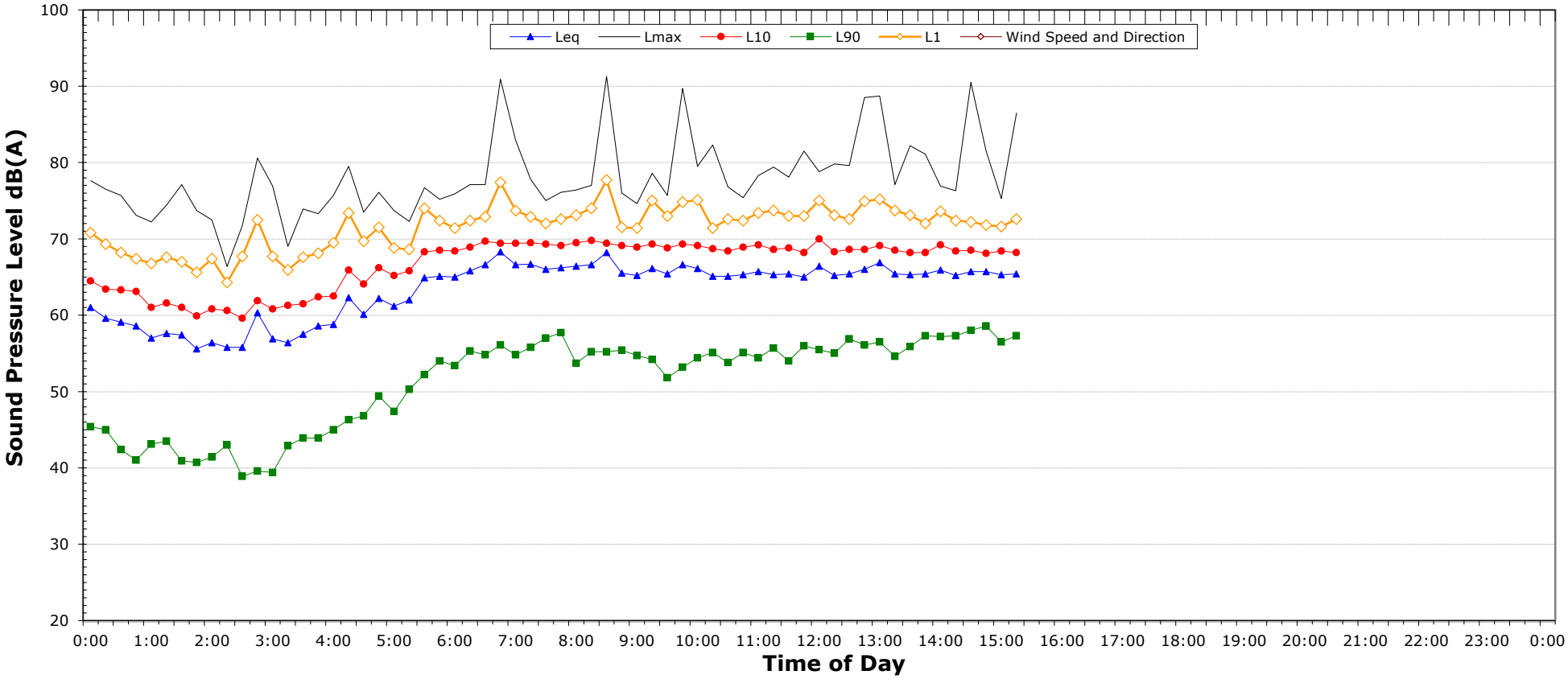
Data File: Logger 1.xls

Template QTT-01 (rev 64) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

Browne Parade, Liverpool

Friday, 11 March 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	-	-	-
Leq (see note 3)	-	-	-

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax- Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	68.3	-
$L_{eq\ 1hr}$ upper 10 percentile	69.0	-
$L_{eq\ 1hr}$ lower 10 percentile	67.8	-

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	-	to	-
Lmax - Leq (Range)	-	to	-

Data File: Logger 1.xls

Template QTT-01 (rev 64) Logger Graphs

TL868-01L01 Browne Ave Liverpool (r0)