



144 Oxley Island Road
Oxley Island, NSW 2430
Phone: (61) 2 6553 2577
Email: info@matrixindustries.com.au
Web: www.matrixindustries.com.au
ABN: 61 002 929 857

Consulting Structural, Mechanical & Acoustical Engineers

Acoustic Assessment for DA

Forster Civic Precinct

Report Number: M17612.01

Client: Coastplan Group
Suite 4, 11 Manning Street
Tuncurry NSW 2428

Prepared by: Philip Thornton BE (UNSW) CPEng
Acoustic Consultant
Matrix Thornton Engineering Consultants
March 29, 2017

Summary:

The proposed Solaris development in Forster is a mixed-use precinct including residential towers and community and commercial facilities. This report gives the acoustic aspects, including criteria for noise emission and recommendations for acoustic design for each of the proposed uses. Noise emission from the site is predicted to comply generally with all noise criteria. However, further detailed acoustic design will be required, particularly for the noise from external dining at entertainment and food service venues. Noise from traffic generated by the proposal is predicted to increase traffic noise by an insignificant amount except for a small group of residences on Middle Street. Recommendations were given for mitigation of traffic noise.

Table of Contents

1	Introduction.....	8
2	Purpose of the Report	8
3	Description of the Development.....	10
3.1	Noise-Sensitive Receivers.....	12
4	Planning Noise Levels	15
4.1	Overview.....	15
4.2	Rating Background Level	15
4.2.1	Instrumentation	15
4.2.2	Measurement Procedure.....	16
4.2.3	Summary of Measured Noise Levels	16
4.3	Industrial Noise Policy Criteria.....	19
4.3.1	Intrusiveness Criterion	19
4.4	Amenity Criterion	20
4.4.1	Non-Residential Receivers.....	20
5	Mechanical Services Noise.....	22

6	Library and Visitor Information Centre	22
6.1	Acoustic Issues.....	22
6.2	Background Noise and Reverberation Control	26
6.3	Noise Intrusion Into the Library.....	27
7	Child Care Centre	27
7.1	Acoustic Issues.....	27
7.2	Background Levels	29
7.3	Noise Into the Child Care Centre.....	29
7.3.1	Design Goals.....	29
7.3.2	Gymnasium and Swimming Pool Noise	30
7.3.3	Traffic Noise into the Child Care Centre	30
7.4	Noise Emission from the Child Care Centre.....	30
7.4.1	Noise Criteria	30
7.4.2	Children Playing Outside	31
7.4.3	Indicative Noise Prediction.....	32
8	Night Club and Entertainment Venues	34
8.1	Acoustic Issues.....	34
8.2	Internal Design Background Levels.....	34
8.3	Criteria for Noise Emission.....	35

8.4	noise from venues	36
8.4.1	General Remarks.....	36
8.4.2	Night Club.....	37
8.4.3	Restaurants.....	37
9	Cinema	39
10	Residential Acoustics.....	39
10.1	Acoustic Issues.....	39
10.2	Noise Into the Apartments	40
10.3	Internal Design Background Levels.....	40
11	Residential BCA Considerations	41
11.1	Units of Measurement.....	41
11.2	Minimum Requirements – Walls and Floors	42
11.2.1	Impact Isolation.....	42
11.2.2	Impact Noise on Floors	43
11.2.3	Construction Details.....	44
11.3	Services Requirements.....	44
11.4	Recommendations for Hydraulic Services.....	46
11.4.1	Waste Pipes.....	46

12 Traffic Noise Assessment	47
12.1 Overview.....	47
12.2 Noise Modelling.....	47
12.3 Traffic Volumes	49
12.4 Time Frame for the Assessment.....	51
12.5 Assessment Traffic Noise to Existing Receivers	51
12.5.1 Noise Criteria	51
12.5.2 Predicted Noise Levels.....	53
12.5.3 Recommendations.....	60
12.6 Assessment of Traffic Noise to Residences in the Development.....	60
12.6.1 Application.....	60
12.6.2 Internal Noise Goals.....	61
12.6.3 Building Envelope Noise Reduction.....	63
12.7 Predicted Noise Levels and Mitigation Requirements.....	64
13 Recommendations	67
13.1 General Mitigation Advice.....	67
14 Certification for Noise Impact Statement.....	72
15 Conclusion	72

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Appendix A: Glossary of Acoustic Terms73
Appendix B: Photos.....76

Figures

Figure 3-1	Site Location	11
Figure 3-2	Receiver and Noise Logger Locations	15
Figure 5-1	Library Location and Layout	25
Figure 6-1	Location of Child Care Centre	28
Figure 11-1	Traffic Noise Contours, $L_{Aeq,1hr}$ dBA – 2017 without development.....	57
Figure 11-2	Traffic Noise Contours, $L_{Aeq,1hr}$ dBA – 2028 with development.....	59
Figure 12-1	Example of Category Type 1 Building Elements	69
Figure 12-2	Example of Category Type 2 Building Elements	71

Tables

Table 3-1	Noise-Sensitive Receivers.....	13
Table 4-1	Measured Background A-weighted sound pressure levels	17
Table 4-2	Estimated average background sound levels for different areas, taken from AS1055.2-1997 “Acoustics – Description and measurement of environmental noise.”	18
Table 4-3	Intrusiveness Criteria	20
Table 4-4	Amenity Criteria	20
Table 4-5	Amenity Criteria for non-residential receivers, L_{Aeq} dBA.....	21
Table 6-1	Recommended design sound levels and reverberation times	27
Table 7-1	Recommended design sound levels and reverberation times	29
Table 7-2	Noise form children playing, $L_{Aeq,15min}$ dBA.....	33
Table 8-1	Recommended design sound levels and reverberation times	34
Table 8-2	Noise Criteria – OLAG.....	36

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

Table 8-3	Predicted levels from restaurants	39
Table 10-1	Recommended design sound levels and reverberation times	40
Table 11-1	BCA minimum sound insulation ratings of walls and floors	42
Table 11-2	BCA minimum sound insulation ratings of services.....	44
Table 12-1	Measured and predicted noise at logger location 1.....	48
Table 12-2	Traffic Volumes per AM and PM Peak Hour	51
Table 12-3	- RNP Criteria for Traffic Noise.....	52
Table 12-4	Predicted traffic noise levels, $L_{Aeq,1hr}$ dBA.....	55
Table 12-5	Indicative Building Noise Reduction [Source: Table 4.2 ENMM].....	63
Table 12-6	Mitigation Requirements for Traffic Noise.....	64
Table 12-7	Predicted daytime levels, $L_{Aeq,1hr}$ dBA at proposal.....	67

1 INTRODUCTION

This report will form part of a development consent for the Solaris development in Forster. The proposal is a mixed-use development including residential, commercial and entertainment facilities. This report discusses the acoustic aspects of the proposal. Aspects covered include:

- setting appropriate limits for noise emission from all aspects of the development, including noise from mechanical services and entertainment venues;
- setting appropriate noise limits for noise into the development, including appropriate levels for the childcare centre, library, and residential components;
- an assessment of noise due to traffic generated in surrounding streets.
- the New South Wales *Industrial Noise Policy* (INP);
- the New South Wales Infrastructure SEPP -2007;
- Australian standard 2107 AS/NZS 2107:2000 Australian/New Zealand Standard Acoustics—*Recommended design sound levels and reverberation times for building interiors*
- Department of Planning *Developments Near Rail Corridors and Busy Roads – Interim Guideline* (2008).
- *National Construction Code, Building Code of Australia 2016 (BCA)*
- *Noise Guide for Local Government*
- *NSW Road Noise Policy*

2 PURPOSE OF THE REPORT

As there are several uses of the development, each of which will have its own specific acoustic goals, each use will be treated individually in this report. Procedures will include:

- Measure the existing background noise levels over a one-week period at two locations.
- Obtain noise data of the expected noise related activities.
- Setting the appropriate limits for noise emission from all aspects of the development, including:
 - noise from mechanical services and
 - entertainment venues;
- Setting appropriate noise limits for noise into the development, including appropriate levels for the:
 - childcare centre,
 - library, and
 - residential components;
- An assessment of noise due to traffic generated in surrounding streets.
- Determine acceptable noise criteria within the limits of the following documents
 - New South Wales Industrial Noise Policy (INP);
 - New South Wales Infrastructure SEPP - 2007;
 - Australian Standard/New Zealand 2107 AS/NZS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors
 - Department of Planning Developments Near Rail Corridors and Busy Roads – Interim Guideline (2008).
 - National Construction Code, Building Code of Australia 2016 (BCA)
 - Noise Guide for Local Government (NGLG)
 - NSW Road Noise Policy (RNP)
 - NSW Industrial Noise Policy (INP),
 - NSW Environment Protection Authority (EPA).
- Analyse noise level data and assess levels of noise impacts at the nearest affected residences, commercial premises and/or any other noise sensitive receivers.
- Suggested method of noise mitigation required, if any, to achieve desired noise levels.
- Prepare a report on these findings acceptable to MidCoast Council.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

3 DESCRIPTION OF THE DEVELOPMENT

The Solaris development is a mixed-use development located between Lake Street, West Street and another Street in Forster, New South Wales. The development comprises:

- residential units;
- a hotel;
- a library and community space;
- retail areas including a supermarket;
- a childcare centre;
- and an entertainment precinct including cinemas, restaurants and a nightclub.

The site location is shown in Figure 3-1

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

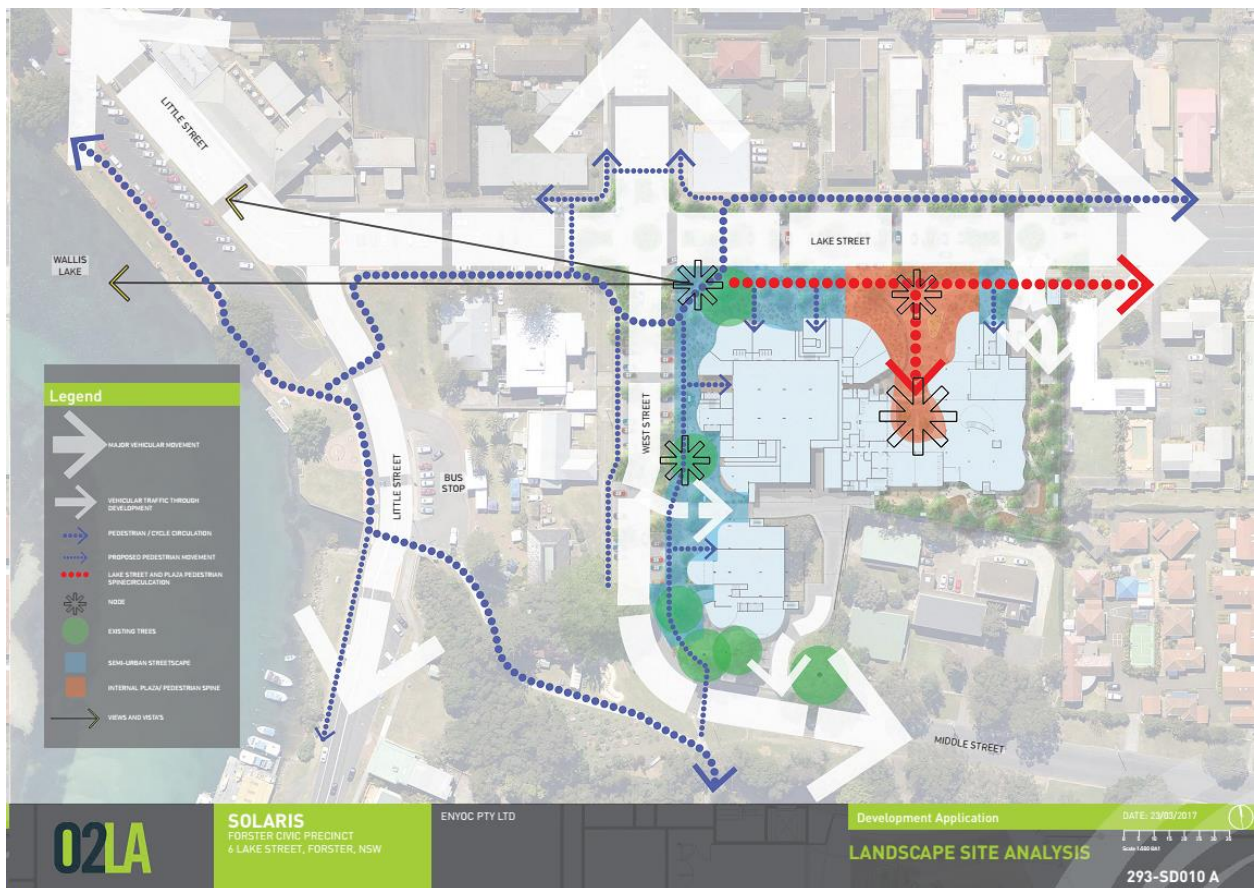


Figure 3-1 Site Location

3.1 NOISE-SENSITIVE RECEIVERS

The proposal potentially impacts noise-sensitive receivers surrounding the site. It is a large site and there are receivers on all sides as shown in Figure 3-2. Representative residential receivers are marked by numerals, and non-residential sensitive receivers with letters. They are listed in Table 3-1. Receivers distant from the site, namely Receivers 6 to 10, will be used to assess traffic noise on the local road network.

Receiver	Type	Address	Information
1	Residential	29 West Street	Single dwellings
2	Residential	15, 17, 19, 21, 23 Lake St	Motels
3	Residential	8 Lake Street	Motel
4	Residential	1 Middle Street	Forster Holiday Village (rear)
5	Residential	2 Short Street	Single dwelling
6	Residential	18 Middle Street	Single dwellings
7	Residential	9 Middle Street	Forster Holiday Village (front)
8	Residential	28 West Street	Apartments

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

9	Residential	27 Macintosh Street	Single dwellings
10	Residential	15 Macintosh Street	Single dwellings
A	Commercial	Cnr West and Lake St	Police Station
B	Commercial	West Street	Information centre (will move into proposal)
C	Commercial	11 Lake Street	Dry cleaner
D	Community/Place of Worship	27 Lake Street	Masonic Lodge
E	Place of Worship	31 Lake Street	Catholic Parish of Forster
F	Commercial	Middle Street	Department of Education Offices

Table 3-1 Noise-Sensitive Receivers

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
h
\
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA



M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 3-2 Receiver and Noise Logger Locations

4 PLANNING NOISE LEVELS

4.1 OVERVIEW

Due to the many different occupancies at the proposal, and the varied nature of the surrounding neighbourhood, several New South Wales planning guidelines and Australian Codes will be necessary for a complete assessment. Most of the codes depend on a measurement of the existing noise environment in the area, including the background noise and the existing traffic noise levels at residential premises. This section describes the measurement of the existing noise levels and how they will be applied in the assessment.

4.2 RATING BACKGROUND LEVEL

The Rating background level, RBL, is the overall single-figure background level representing each assessment period (day/evening/night). The INP states that *where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A)*. In the absence of noise monitoring, the minimum RBL can be adopted for assessment purposes.

Two noise loggers were used to measure the ambient background level. Location A was also used to measure the traffic noise from Lake Street.

4.2.1 Instrumentation

An ARL brand, model EL-316, Type 1 environmental noise logger was used to measure the background noise level. Short term measurements were recorded using a Type I integrating sound level meter (SLM), model SVAN 958A, manufactured by Svantech. A Lutron sound level calibrator, model SC-941, was used as a reference sound source immediately before and after measurements were taken. All three instruments

are in current calibration from a NATA registered laboratory. A noise logger measures the noise levels over a 15-minute sampling period and then determines L_{A1} through to L_{A99} , L_{Amax} and L_{Aeq} . Both instruments are integrating sound level meters which are able to process a continuous, variable, intermittent or impulsive signal to give a single integrated level or L_{Aeq} for the sampling period. This equipment complies with AS 1259 ‘Acoustics-Sound level meters’, Part 2 “Integrating-Averaging” and the testing procedure with AS 2659 “Guide to the use of sound measuring equipment”.

4.2.2 Measurement Procedure

Logging locations A and B are shown in Figure 3-2.

Measurement conditions:

- Noise readings were recorded over 15 minute periods under ideal conditions to determine the existing background and ambient noise levels.
- Noise data collected from 17 to 26 February 2017.
- Periods of rain were excluded from the data.

4.2.3 Summary of Measured Noise Levels

The background noise measurements tabulated in Table 4-1 were recorded using the noise logger over a seven-day period and are classified as long-term recordings. They were recorded under conditions that are considered reliable and typical for the receptor area. The full graphical results are in the Appendix B.

Location	LAeq			RBL		
	Day	Evening	Night	Day	Evening	Night

Logger A	51	50	44	41	37	32
Logger B	48	48	44	42	37	33

Table 4-1 Measured Background A-weighted sound pressure levels

Note: Daytime is defined as 7.00am to 6.00pm, Monday to Saturday; 8.00am to 6.00pm Sunday and Public Holidays.
 Evening is defined as 6.00pm to 10.00pm, Monday to Saturday and Public Holidays.
 Night is defined as 10.00pm to 7.00am, Monday to Saturday; 10.00pm to 8.00am Sunday and Public Holidays.

The background noise level recorded on site during this period is compared with AS1055.2-1997 “Acoustics – Description and measurement of environmental noise, Part 2: Application to specific situations”, Appendix A”. The neighbourhood falls between noise area category R3: “Areas with negligible transportation” and R4 “Areas with dense transportation or some commerce or industry”. The table is reproduced in full as Table 3 below.

**ESTIMATED AVERAGE BACKGROUND A-WEIGHTED SOUND PRESSURE LEVELS
 ($L_{A90,T}$) FOR DIFFERENT AREAS CONTAINING RESIDENCES IN AUSTRALIA**

Noise area category	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
R1	Areas with negligible transportation	40	35	30	40	35	30

R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5 (See Note 3)	Areas with very dense transportation or in commercial districts or bordering industrial districts	60	55	50	60	55	50
R6 (See Note 3)	Areas with extremely dense transportation or within predominately industrial districts	65	60	55	65	60	55

Table 4-2 Estimated average background sound levels for different areas, taken from AS1055.2-1997 “Acoustics – Description and measurement of environmental noise.”

Notes:

- 1 The division into noise area categories is necessary in order to accommodate existing sound levels encountered at residential sites in predominately commercial or industrial districts, or in areas located close to main land transport routes, i.e. road and rail.
- 2 The noise area category most appropriate should be selected irrespective of metropolitan or rural zoning and will vary from location to location.
- 3 Some industrial and commercial sites are not predominant sources of high background sound levels.

4.3 INDUSTRIAL NOISE POLICY CRITERIA

The INP criteria apply to all aspects of the development which potentially emit noise that could impact residential, commercial or otherwise noise sensitive neighbours. This includes the following uses:

- the childcare centre;
- the entertainment venues;
- mechanical services for all aspects of the proposal.

Notwithstanding the application of the INP to these uses, later sections of this report describe other noise codes relevant to each of these uses.

This section describes the INP criteria relevant to all aspects of the proposal.

4.3.1 Intrusiveness Criterion

An intrusiveness criterion applies for residential receivers only and applies to continuous or semi-continuous events.

The intrusiveness criterion requires that the LAeq 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 LA90 noise levels, in the absence of noise from the source.

In assessing noise emission from the site, noise criterion should be based on the RBL of the logger closest to the receiver being assessed. The Intrusiveness criteria are given in Table 4-3.

Location	RBL			Intrusiveness Criterion		
	Day	Evening	Night	Day	Evening	Night
Logger A	41	37	32	46	42	37

Logger B	42	37	33	47	42	38
----------	----	----	----	----	----	----

Table 4-3 Intrusiveness Criteria

Note: Daytime is defined as 7.00am to 6.00pm, Monday to Saturday; 8.00am to 6.00pm Sunday and Public Holidays.
 Evening is defined as 6.00pm to 10.00pm, Monday to Saturday and Public Holidays.
 Night is defined as 10.00pm to 7.00am, Monday to Saturday; 10.00pm to 8.00am Sunday and Public Holidays.

4.4 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; different areas (e.g. rural, suburban); and different time periods. The amenity criterion is assessed over the entire day, evening or night-time period. This area would be considered suburban, though when fully developed it would have elements of urban classification. The amenity criteria are as shown in Table 4-4 for suburban areas.

Location	Acceptable			Recommended Maximum		
	Day	Evening	Night	Day	Evening	Night
All	55	45	40	60	50	45

Table 4-4 Amenity Criteria

Note: Daytime is defined as 7.00am to 6.00pm, Monday to Saturday; 8.00am to 6.00pm Sunday and Public Holidays.
 Evening is defined as 6.00pm to 10.00pm, Monday to Saturday and Public Holidays.
 Night is defined as 10.00pm to 7.00am, Monday to Saturday; 10.00pm to 8.00am Sunday and Public Holidays.

4.4.1 Non-Residential Receivers

Noise emission to non-residential noise sensitive receivers is also covered by the INP. Noise to the non-residential receivers should comply with the amenity criteria outlined in Table 4-5. The amenity criteria at non-residential premises applies only when the premises are in use. Receiver D is the Masonic Lodge. The

website for the Masonic Lodge notes that there is a meeting there are once a month on a Monday night. These premises would typically be used outside those times for classes or meetings. For the purposes of assessment, it will be considered as a place of worship.

Regarding the criteria for place of worship, the INP criteria are internal levels. Under the assumption that internal noise would be 10 dB a quieter than external noise if the facade had open windows or doors, a nominal external criterion has also been entered into the table for receivers C and D.

Receiver	Type	Address	Information	Satisfactory	Maximum
A	Commercial	Cnr West and Lake St	Police Station	65	70
B	Commercial	West Street	Information centre (may move into proposal)	65	70
C	Commercial	11 Lake Street	Dry cleaner	65	70
D	Community/Place of Worship	27 Lake Street	Masonic Lodge	40 (internal) 50 (external)	45 (internal) 55 (external)
E	Place of Worship	31 Lake Street	Catholic Parish of Forster	40 (internal) 50 (external)	45 (internal) 55 (external)

Table 4-5 Amenity Criteria for non-residential receivers, LAeq dBA

5 MECHANICAL SERVICES NOISE

Mechanical services have not yet been designed, but it is expected that there will be air-conditioning systems associated with all aspects of the development.

The main buildings will have base systems that may be accessed by all aspects of the building, including retail, community and entertainment venues. Generally, mechanical services equipment would be located on the roof, in dedicated plant rooms, and in the basement. Some tenants may find that the base building services are inadequate for their purpose, for example, it is typical for some types of restaurants to require extra kitchen exhaust equipment, depending on their needs.

In all cases the mechanical services should be designed to achieve the intrusiveness and amenity criteria outlined above. This applies to both residences outside the development and residences inside the development. The design of noise mitigation for mechanical services is well developed, and there is a large range of standard equipment available to reduce noise from these systems. There are no acoustic reasons why appropriate mechanical systems cannot be designed for this building while maintaining appropriate noise levels at all noise sensitive receivers.

6 LIBRARY AND VISITOR INFORMATION CENTRE

6.1 ACOUSTIC ISSUES

On the ground floor of the development in the South-East corner there will be a new library and visitor information centre. The outline of the library and visitor information centre is shown on Figure 6-1.

The following issues require attention regarding the acoustics in the library and visitor information centre:

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

- Appropriate background noise and reverberation times in critical spaces;
- minimisation of external noise intrusion;
- appropriate acoustic performance of partitioned rooms, for example, study rooms or meeting rooms.

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA



M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 6-1 Library location and layout

6.2 BACKGROUND NOISE AND REVERBERATION CONTROL

Appropriate background noise levels for library spaces are shown in Table 6-1. These are taken from AS 2107. Generally, the appropriate level would be set by design of the air-conditioning system. Traffic noise and other external sources should also be controlled so that the overall background noise, when combined with the air-conditioning noise, does not exceed appropriate levels.

For an optimum reading or meeting environment, reverberation control should also be considered. Generally, in open plan areas, the use of carpet and an acoustic tile ceiling will be sufficient. In the activity and meeting rooms, extra acoustic absorption may be required.

Space	Recommended Design Sound Level, L_{Aeq} dBA		Reverberation Time, s
	Satisfactory	Maximum	
Conference Rooms	35	40	0.6 to 0.7
Audio Visual Areas	35	45	0.6 to 0.8
General Areas/Foyer	40	50	0.4 to 0.6
Reading Areas	40	45	0.4 to 0.6
Stack Area	45	50	Note 3 to AS2107
Meeting/Activity Rooms	35	45	0.4 to 0.5
Office Areas	40	45	0.4 to 0.6

Visitor Information Centre (public space)	40	45	0.4 to 0.6
--	----	----	------------

Table 6-1 Recommended design sound levels and reverberation times

6.3 NOISE INTRUSION INTO THE LIBRARY

As the library is in the south-east corner of the development, there is no existing source of external noise. For example, traffic noise at the facade of the library will be minimal, and it is not expected that specific acoustic recommendations will be necessary to reduce traffic noise intrusion to satisfactory levels. This should be verified at the detailed design stage, particularly if the location of the library is moved in subsequent designs.

7 CHILD CARE CENTRE

7.1 ACOUSTIC ISSUES

Figure 7-1 shows the location of the childcare centre at the south-west corner of the ground floor

. Issues that need addressing for childcare centre acoustics are:

- traffic noise ingress;
- noise from the adjacent gymnasium;
- appropriate background levels in the childcare centre from the development air-conditioning;
- noise from the childcare centre to residences within the development.



Figure 7-1 Location of Child Care Centre

7.2 BACKGROUND LEVELS

Appropriate background noise levels for Child Care Centre spaces are shown in Table 7-1. These are taken from AS 2107. Generally, the appropriate level would be set by the design of the air-conditioning system. Traffic noise and other external sources should also be controlled so that the overall background noise, when combined with the air-conditioning noise, does not exceed appropriate levels.

Space	Recommended Design Sound Level, L_{Aeq} dBA		Reverberation Time, s
	Satisfactory	Maximum	
Office Areas	40	45	0.4 to 0.6
Sleeping Areas	30	35	-
Activity/Classrooms	35	45	0.4 to 0.5

Table 7-1 Recommended design sound levels and reverberation times

7.3 NOISE INTO THE CHILD CARE CENTRE

7.3.1 Design Goals

The INP recommends two criteria for schools. For assessing child care centres, it is usual to consider play areas as active recreation area playgrounds, and internal areas such as sleeping areas and activity rooms/classrooms. The relevant criteria are:

- Outdoor play areas L_{Aeq} 55dBA when in use; and
- Classrooms (internal) 35-40dBA (the AAAC guideline recommends 40dBA).

7.3.2 Gymnasium and Swimming Pool Noise

Noise intrusion from the gymnasium should be controlled. This would typically be from classes using amplified music, and would be controlled by using appropriate partition walls between the child care centre and the gymnasium.

One of the potential designs shows a swimming pool directly above the childcare centre. To minimise noise from the swimming pool, the swimming pool should be placed on vibration isolation springs to be designed at detailed design stage. The springs may also be necessary to minimise transmission of swimming pool noise to residential components of the development.

7.3.3 Traffic Noise into the Child Care Centre

The future traffic noise level at the childcare centre is predicted to be approximately $L_{Aeq,1hr}$ 50-55 dBA (see Section 12). This level is appropriate for the play area but may result in internal noise areas above the criterion if there are large open areas of windows or doors. Standard glass will be satisfactory to reduce noise, however open areas facing the road should be minimized. Acoustic screening of traffic noise by a boundary fence would also minimize noise intrusion.

7.4 NOISE EMISSION FROM THE CHILD CARE CENTRE

7.4.1 Noise Criteria

Noise from the childcare centre can be from mechanical services, traffic noise from children being dropped off and picked up, and noise from the external play area.

As the mechanical services have not yet been designed, noise impact from any mechanical services, particularly relating to the childcare centre, should be assessed at the detailed design stage.

Concerning noise from the car park and a traffic generated by the proposal, we note that the childcare centre is part of the overall proposal, and traffic generation, particularly in relation to the childcare centre, would be assessed within traffic generated for the whole development.

The external play area will be completely covered and noise to the residential components of the development is not expected to be significant. However, this should be verified at detailed design stage.

The INP and NGLG are unsuitable for assessment of noise from children playing. The Guideline for Child Care Centre Acoustic Assessment (2010) published by the Australian Association of Acoustical Consultants (AAAC) provides appropriate noise goals. They are:

- Up to 2 hours (total) per day – The Leq,15min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10dB at the assessment location.
- More than 2 hours per day – The Leq,15min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5dB at the assessment location.

7.4.2 Children Playing Outside

The AAAC guideline proposes the following source noise level of children playing, in terms of sound power level:

- 10 Children aged 0 to 2 years 77 to 80 dBA
- 10 Children aged 2 to 3 years 83 to 87 dBA
- 10 Children aged 3 to 6 years 84 to 90 dBA
- The Childcare centre has an outdoor play area. The play area is covered and therefore shielded to residences within the development.

7.4.3 Indicative Noise Prediction

Noise from children playing will depend on many factors, including:

- the number and age of children in the outdoor play area;
- the distance of the play area to surrounding residences;
- any acoustic shielding between the play area and residences (for example, because the play area is covered, the residences within the development will be shielded from the play area);
- the duration and time of day when play occurs.

In addition, there is generally some noise breakout from within the childcare centre, though this depends upon whether there are large areas of open window, and it is normally the case that noise from the outdoor play area is the most important noise source when determining acoustic impact from childcare centres.

For an accurate determination of noise impact from the childcare centre, it is necessary to know the number and ages of children, and details of the site design, including any boundary fencing. To determine whether the location of the childcare centre proposes significant issues for noise impact, the following example calculation was made.

It was assumed that there would be 40 children playing outside, 20 aged up to 3 years (worst case 90dBA), and 20 aged up to 6 years (worst case 93dBA). The worst-case total for that group is then $90\text{dBA}+93\text{dBA}=95\text{dBA}$.

The calculations are therefore based on a sound power level of $L_{\text{Aeq},15\text{min}} 95\text{dBA}$ in the play area. This is at the upper range of the levels described by the AAAC and is considered a conservative estimate.

Further, it was assumed that there would be no acoustic boundary fencing, even though this may eventually be desirable or required for mitigation of traffic noise intrusion into the site.

Indicative predictions of noise from children playing are given in Table 7-2.

The table shows that the predicted noise level complies with the “2-hour play” and the “more than 2 hours play” criteria at all residences.

While this calculation has made certain assumptions, we conclude that the location is suitable for the childcare centre, and there is no acoustic reason why the childcare centre could not be designed to comply with all acoustic requirements.

Location	Criterion, $L_{Aeq,15min}$ dBA			Impact of 30 Children playing outdoors		
	RBL	2 hours play	More than 2 hours play	Predicted Noise Level at Residence, $L_{Aeq,15min}$ dBA	2 hours play	More than 2 hours play
Solaris Residences and Hotel	41	51	46	44	Complies	Complies
Nearest External Residence, (Location 5)	41	37	46	42	Complies	Complies

Table 7-2 Noise form children playing, $L_{Aeq,15min}$ dBA

8 NIGHT CLUB AND ENTERTAINMENT VENUES

8.1 ACOUSTIC ISSUES

Generally, the acoustic issues most important to the entertainment venues are the minimisation of noise impact on residential neighbours, particularly at night time. External dining areas of restaurants should comply with the noise criteria in this section. Noise from the nightclub will also need to consider emission from the music systems.

8.2 INTERNAL DESIGN BACKGROUND LEVELS

Space	Recommended Design Sound Level, L_{Aeq} dBA		Reverberation Time
	Satisfactory	Maximum	
Coffee Bars	45	50	<1
Restaurants	45	50	<1
Night Club	45	50	<1

Table 8-1 Recommended design sound levels and reverberation times

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

8.3 CRITERIA FOR NOISE EMISSION

As well as the guidelines from the INP, licensed premises should comply with the following are standard conditions for licensed premises in NSW from the Office of Liquor and Gaming (OLAG). This will apply to emission from music and patrons combined.

- The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre (31.5 Hz – 8 kHz inclusive) by more than 5dB between 07:00am and 12:00 midnight at the boundary of any affected residence.
- The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8 kHz inclusive) between 12:00 midnight and 07:00am at the boundary of any affected residence.

The spectrum was measured at 10.45-11.00pm on the night of 25 February 2017. This spectrum was applied to all time periods and adjusted to the RBL measured at Logger 1. The spectrum and the derived criteria for the daytime, evening and night periods are shown in Table 8-2. A night shoulder period from 10.00pm to 12.00pm has been introduced, which recognizes that background is dropping after 10.00pm but may not be as low as the overall night time RBL, and that venues would reasonably expect to trade in this period. The RBL for that shoulder period is 40dBA.

Period	Parameter	dBA	Octave Band Centre Frequency (Hz)								
			31.5	63	125	250	500	1K	2K	4K	8K
7.00am -6.00pm	Background, LA90	41	36	37	38	37	36	34	34	34	35
	Noise Limit, LA10	46	41	42	43	42	41	39	39	39	40
6.00pm-10.00pm	Background, LA90	37	34	35	36	35	34	32	32	32	33
	Noise Limit, LA10	42	39	40	41	40	39	37	37	37	38
10.00pm-12.00midnight	Background, LA90	40	37	38	39	38	37	35	35	35	36
	Noise Limit, LA10	35	32	33	34	33	32	30	30	30	31
After 12.00midnight	Background, LA90	35	32	33	34	33	32	30	30	30	31
	Noise Limit, LA10	35	32	33	34	33	32	30	30	30	31

Table 8-2 Noise Criteria – OLAG

8.4 NOISE FROM VENUES

8.4.1 General Remarks

It is noted that the background noise level at the site is relatively low, consistent with an area that currently has little development and low volumes of through traffic during evening and night time hours. Compliance with entertainment limits for new venues in such an area is challenging. If Council wishes the development

to provide a vibrant atmosphere, perhaps associated with only the holiday period, venues will be limited in the number of outdoor dining seats they can provide, and it may be difficult to provide any outdoor entertainment such as live or recorded music while meeting the noise criteria specified above.

It is likely that background noise in the area will increase in the future as development progresses. We recommend that background noise levels for the venues are re-measured in the future to update the above noise criteria, perhaps relaxing the noise requirements while maintaining acceptable community amenity.

8.4.2 Night Club

A night club venue is proposed within two levels of the basement. This is an ideal location for night club as the high internal noise levels generally desired by such venues require complete acoustic enclosure. Access to the night club should be through an acoustic airlock.

Depending on internal noise levels desired by the venue, some internal acoustic treatment may be required. This should be verified at detailed design stage.

8.4.3 Restaurants

There are restaurants and cafes at ground level on the Lake Street side of the development. While not shown on the plans, it is assumed there will be outdoor dining areas associated with those venues.

Although prediction of noise emission from the venue requires analysis of proposed outdoor seating, internal layout and design of the facade of the venue, the following indicative predictions have been made.

Assume that a typical venue has space for 40 diners outside, of which 20 are assumed to be males speaking in raised voices. This is a typical assumption for licensed venue.

The predicted noise levels from such a venue at representative receivers are shown in Table 8-3.

The predicted level to Solaris residences above the restaurant is 40 – 47 dBA. There is a large range of possible noise levels, as the irregular shape of the awning above the entertainment venues will provide

different amounts of acoustic shielding to different residences. This predicted noise level complies with the daytime criterion, however potentially marginally exceeds the evening limit by 2 dBA. This indicates that attention to acoustic design should be made during the design of restaurants and outdoor seating plans. In particular, shielding provided by the awning above the outdoor seating areas should be considered in a way that provides maximum acoustic shielding to residential balconies on floors above.

Noise levels at receivers outside the proposal are predicted to comply with the limit to midnight except during busy times.

Noise levels at commercial receivers and Location D, a place of worship, are predicted to comply.

Venues will also be required to manage noise emission by expecting suitable behaviour from their patrons, and not increasing music above acceptable levels. Venues wishing to trade after 10.00 pm may have to close outdoor areas in order to comply with the noise limits. The details will vary from venue to venue according to the design of their outdoor seating and facade elements.

It is unlikely that high level music will be feasible in outdoor areas after midnight, but may be in some restricted format before midnight. Loudspeakers should be positioned so that they play music only to relevant areas without spillage into residential parts of the development.

Receiver	Predicted Noise Level	Criterion
1	36-42	42 till 10pm, 40 to midnight, 35 after midnight
2	38-45	42 till 10pm, 40 to midnight, 35 after midnight
3	37-43	42 till 10pm, 40 to midnight, 35 after midnight

Solaris Residences Above	39-46	42 till 10pm, 40 to midnight, 35 after midnight
C	39-46	65
D	30-40	50

Table 8-3 Predicted levels from restaurants

9 CINEMA

The cinemas will require specialist acoustic design to minimise noise intrusion, particularly if the nightclub or other entertainment venue is in the proximity of the cinema.

The recommended design level for cinemas is 30 to 35 dBA, with specialist attention to the design of reverberation time. That design is outside the scope of this DA.

10 RESIDENTIAL ACOUSTICS

10.1 ACOUSTIC ISSUES

Many of the acoustic issues to do with the residential component of the development are dealt with in other sections. For example, minimum requirements from the Building Code of Australia brackets (BCA) for constructions will generally result in satisfactory acoustic outcomes, and these are described in Section 11.

This section deals with appropriate background noise for design of the mechanical services, and control of noise emission from external sources such as traffic noise.

10.2 NOISE INTO THE APARTMENTS

Some residential facades will face the road network. The facades should be designed to meet the requirements for transportation noise as described in Table 10-1

10.3 INTERNAL DESIGN BACKGROUND LEVELS

Design background levels from AS2107 for residential areas, both in the residential component and the hotel component, are listed in Table 10-1. These apply to services noise. For rooms facing Lake Street, the design should also take into account that there may be some traffic noise intrusions, and the lower of the levels in Table 10-1 will be most appropriate so that the sum of services noise and traffic noise is below the maximum recommended level.

Space	Recommended Design Sound Level, L_{Aeq} dBA		Reverberation Time
	Satisfactory	Maximum	
Residential Living Area	30	40	-
Residential Sleeping Area	30	35	-
Residential Work Area	35	40	-
Residential Common Area	45	55	Minimise
Hotel Sleeping Areas	30	35	
Hotel Corridors and Lobbies	45	50	Minimise

Table 10-1 Recommended design sound levels and reverberation times

11 RESIDENTIAL BCA CONSIDERATIONS

11.1 UNITS OF MEASUREMENT

Walls between units must meet the required level of sound insulation:

- R_w Weighted sound reduction index – this describes how much a partition reduces noise. The higher the number, the better the partition. “Weighting” means that the part of the sound spectrum relevant to assessing impact noise is given more importance than other parts of the sound spectrum. The intention is to relate the level recorded by the instrumentation to the response of the human ear.

Once built and the partition can be tested, it is described by $D_{nT,w}$, the weighted standardised level difference.

- $R_w + C_{tr}$ – The R_w (and $D_{nT,w}$) can be modified by C_{tr} , a spectrum adaptation term – it describes how well a partition reduces noise with low frequency content, such as heavy vehicle traffic. It is usually a negative number.
- CI Spectrum adaptation term $L_{n,w}$ Weighted normalised impact sound pressure level $D_{nT,w}$ Weighted standardised level difference $L'_{nT,w}$ Weighted standardised field impact sound pressure level

Floors between units must meet the required level of “impact sound insulation”. An example of impact sound is footsteps on the floor of the unit above you.

- $L_{n,w}$ - Weighted normalised impact sound pressure level tested in a laboratory. Single index rating of the impact sound insulation of a floor.

11.2 MINIMUM REQUIREMENTS – WALLS AND FLOORS

The minimum requirements for walls separating apartments are given in Table 11-1.

Situation	Laboratory Performance	Impact
Apartment wall separating habitable rooms of different sole occupancies	$R_w + C_{tr}$ 50	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen from another sole occupancy	$R_w + C_{tr}$ 50	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	R_w 50	No
Apartment wall separating a plant room or lift shaft	R_w 50	Yes
Apartment door to a stairway, public corridor, public lobby or the like	R_w 30	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	$R_w + C_{tr}$ 50	NA
	$L_{n,w}$ 62	NA

Table 11-1 BCA minimum sound insulation ratings of walls and floors

11.2.1 Impact Isolation

Impact isolation is required for some walls. BCA 2016 considers a wall system provides impact if it is discontinuous construction meaning a minimum of 20mm cavity (provided that the airborne rating can be achieved) between wall leaves and

- for masonry where a cavity wall is used and ties are required, they must be of the resilient type;
- for other than masonry, there is to be no mechanical linkage between the leaves other than at the periphery.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

11.2.2 Impact Noise on Floors

While the BCA required minimum is $62 L_{n,w}$, many occupants would find this unsatisfactory. Matrix Industries recommends $L'_{nT,w}$ 55 as a minimum performance, and preferably $L'_{nT,w}$ 50.

11.2.3 Construction Details

The BCA recommends the following construction details as a minimum:

- Masonry / concrete construction to incorporate solid joints including between each other and any adjoining structure.
- Sheeting material joints between sheets or any adjoining structure must be taped and filled solid.
- Drywall construction – perimeter framing members must be securely fixed to the adjoining structure and:
 - Bedded in resilient compound; OR
 - Gaps between adjoining structure and framing to be caulked.

11.3 SERVICES REQUIREMENTS

The performance requirements for services isolation are listed in Table 11-2.

Situation	Lab Performance	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 – unless open plan)	R_w+C_{tr} 40	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	R_w+C_{tr} 25	NA	NA
Storm water pipe passing through a sole occupancy to a habitable room (not a kitchen – unless open plan)	R_w+C_{tr} 40	NA	NA
Storm water pipe passing through a sole occupancy to a kitchen or non-habitable room	R_w+C_{tr} 25	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.			

Table 11-2 BCA minimum sound insulation ratings of services

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

The following notes apply to Table 11-2 for deemed to satisfy (DTS) constructions:

- The BCA does not allow chasing of services into concrete or masonry elements (discussions with the ABCB confirm that chasing for electrical and gas services may be permissible)
- DTS access panels / hatches:
 - Open only into a dedicated kitchen or wet area;
 - Be firmly fitted to either overlap the frame or rebate in the frame by at least 10mm and incorporate perimeter sealing gaskets; and
 - Be constructed from:
 - Wood, particle board or block board at least 33mm thick.
 - Compressed fibre cement sheeting at least 9mm thick.
 - Any suitable material of a surface density of at least 24.4kg/m².
- Electrical outlets must be offset from each other:
 - For masonry, not less than 100mm.
 - For drywall, not less than 300mm.

11.4 RECOMMENDATIONS FOR HYDRAULIC SERVICES

11.4.1 Waste Pipes

Acoustic treatment is required where waste pipes from one unit pass through the ceiling space of another unit, generally the one directly below. While detailed design is required at Construction Certificate stage, the following general recommendations are made based on the DA drawings.

Recommendations:

- Where possible avoid designs where waste and supply pipes pass through living areas of different sole occupancies.
- Where possible storm water pipes should not pass through habitable rooms.
- Where waste pipes pass through non-habitable rooms of different sole occupancies (typically the bathroom below), the ceilings below those pipes should achieve $R_w + C_{tr}$ 25.
- Where waste pipes pass through habitable rooms of different sole occupancies (if unavoidable), the ceilings below those pipes should achieve $R_w + C_{tr}$ 40.

The following treatments will meet $R_w + C_{tr}$ 25:

- Ceiling of 13mm Soundcheck (or other product with mass > 13kg/m³);
- Standard 10mm plasterboard plus 50mm plus 50mm thick glass wool insulation with a density of 11 kg/m³ laid above the ceiling;
- Standard 10mm plasterboard, plus pipes wrapped in acoustic lagging (such as Greenlag from Acoustica).

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

The following treatments will meet $R_w + C_{tr}$ 40:

- Ceiling of 13mm Soundcheck (or other product with mass > 13kg/m³), 50mm thick glass wool insulation with a density of 11 kg/m³ laid above the ceiling, pipes wrapped in acoustic lagging (such as Greenlag from Acoustica).

12 TRAFFIC NOISE ASSESSMENT

12.1 OVERVIEW

There are two aspects to the traffic noise assessment: control of traffic noise intrusion into the development, and assessment of noise from traffic generated by the development as it effects residences on the local road network.

Noise on the local road network is assessed according to the procedures of the Road Noise Policy (RNP).

Noise intrusion into the apartment is generally assessed according to the recommendations of the *State Environmental Planning Policy (Infrastructure) 2007* (SEPP).

The traffic noise assessment is based on measured levels from a logger location one, and modelling of future traffic noise. Traffic volumes for the existing case, and the year 2028 are given in the report “Solaris” proposed mixed use development, Lake Street, Forster – traffic and parking assessment, by MR Cagney proprietary limited dated March 2017.

12.2 NOISE MODELLING

Noise modelling was done based on the traffic is given in the traffic report.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Modelling was done using a SoundPLAN acoustic modelling software, based on the Calculation of Road Traffic Noise (CoRTN) algorithms. The following assumptions were made:

- speed on all roads except Macintosh Street was 50 km/h;
- speed on Macintosh Street was 60 km/h;
- the road surface on all roads except Macintosh Street was chip seal (Correction of +2dBA);
- the road surface on Macintosh Street was dense grade asphaltic concrete (DGAC – Correction of 0dBA);
- the traffic flow was made up of 100% light vehicles.

As is common in prediction of traffic noise in New South Wales, the CoRTN algorithm was modified by addition of small negative corrections for Australian conditions, and a correction of -3 dBA for correction of L_{A10} to L_{Aeq} .

The model was validated by prediction of noise in 2017 two Logger location one, and comparison with logger results. As shown in Table 12-1, the predicted level is within 2dBA of the measured level, and is therefore considered a good agreement.

Time	Measured Level	Predicted level
AM Peak	51	52
PM Peak	54	52

Table 12-1 Measured and predicted noise at logger location 1.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

12.3 TRAFFIC VOLUMES

Traffic volumes with and without the development were taken from the Traffic Report Figures B1, B2, B5 and B6. For modelling purposes, the parts of Lake St, West St and Macintosh Street were modelled as dual carriageways.

The hourly volumes used for modelling the AM and PM peak hours are summarised in Table 12-2.

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

Street	Direction of Traffic	Location of Road Segment	2017 without development		2028 with development	
			AM	PM	AM	PM
Lake St	Both	Solaris Entrance to West ST	304	323	396	464
Lake St	Both	Solaris Entrance to Macintosh	304	323	436	500
Lake St	WB	West of West St	101	107	116	172
Lake St	EB	West of West St	101	107	116	172
Lake St	Both	East of Macintosh	560	360	695	534
Macintosh	NB	South of Lake	683	787	876	965
Macintosh	SB	South of Lake	683	787	876	965
Macintosh	NB	North of Lake St	835	797	1035	1350
Macintosh	SB	North of Lake St	865	797	1035	1350
Macintosh	NB	South of Middle	868	925	1195	1025
Macintosh	SB	South of Middle	868	925	1195	1025

Middle St	Both	West of Macintosh St	69	43	115	156
Strand St	Both	East of Macintosh	402	385	500	478
West St	Both	South of Lake St	57	49	118	273
West St	NB	North of Lake St	95	98	155	235
West St	SB	North of Lake St	95	95	155	235

Table 12-2 Traffic Volumes per AM and PM Peak Hour

12.4 TIME FRAME FOR THE ASSESSMENT

The RNP recommends assessment at two points in time, usually near the opening year, and a point typically 10 years after opening. In this case, base traffic data are provided for 2017, 2018 and 2028, with traffic generation data for 2028. The assessment has therefore been done for 2017 to allow comparison to noise measured during the 2017 logging period, and 2028. The difference between 2017 and 2018 is minimal.

For noise into the development, 2028 only will be considered as data are available for traffic generation of the completed development.

12.5 ASSESSMENT TRAFFIC NOISE TO EXISTING RECEIVERS

12.5.1 Noise Criteria

The EPA's Road Noise Policy (RNP) provides appropriate assessment criteria for *existing* residences exposed to *new* sources of traffic noise, including traffic generated by land use developments as is the case here.

The *RNP* sets out noise criteria for ‘arterial’, ‘sub-arterial’ and ‘local roads’. In this case Macintosh Street is considered a sub-arterial road, and all other roads are considered local roads.

Road Category	Assessment Criteria – dB(A)	
	Day (7am-10pm)	Night (10pm-7am)
Existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments.	$L_{Aeq,15hr}$, 60 (external)	$L_{Aeq,9hr}$ 55 (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{Aeq,1hr}$, 55 (external)	$L_{Aeq,1hr}$ 50 (external)

Table 12-3 - *RNP* Criteria for Traffic Noise

Where predicted noise levels exceed the project-specific noise criteria, an assessment of all feasible and reasonable mitigation options should be considered. The *RNP* states that *an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.*

The noise criteria for places of worship is $L_{Aeq,1hr}$ 40 dBA internal when the premises are in use. It is typical to allow a noise reduction of 10 dBA through open windows and doors, leading to an external noise criterion of 50 dBA.

12.5.2 Predicted Noise Levels

The Table 12-4 shows the predicted traffic noise levels at noise sensitive receivers. Concerning residences on local roads near the development, the table shows that the noise criteria is predicted to be exceeded in both the 2017 and 2028 scenarios at all locations except receiver are to which is distant from the road. Note that the predicted increase in traffic noise on local roads is predicted to be less than 2 dBA except for the group of residences represented by Receivers 6 and 7 in Middle Street. At those receivers, the noise is predicted to increase above the daytime noise criterion, and in the worst case increased by up to 4.5 dBA. This is predicted to be the worst traffic noise impact of the development.

The increase of 4.5dBA is predicted for when the development is complete. In the years leading to completion, the increase will be less, and Council may be able to schedule the resurfacing within general maintenance works for Middle Street. Another option is to provide architectural acoustic treatment to the few dwellings on Middle Street where the exceedance occurs.

At residences along Macintosh Street, considered a sub-arterial road, the predicted increase is typically up to 1 dBA. The table notes that the assessment criterion at these residences is based on the $L_{Aeq,15hr}$ daytime period from 7 AM to 10 PM rather than the maximum one hour peak period. However, the daytime $L_{Aeq,15hr}$ noise level would only be 1 to 2 dBA less than the maximum one hour peak level, and noise would still be expected to exceed the criterion at receivers along Macintosh Street. As the development is predicted to increase noise by less than 2 dBA on Macintosh Street, negligible impact is predicted.

Receiver location D, the church opposite the development, noise is predicted to exceed the criterion of the existing and future scenarios. However, the increase is limited to 1.4 dBA, hence the impact is predicted to be negligible.

Figure 12-1 shows predicted traffic noise contours on the local road network for the year 2017 without the development. Figure 12-2 shows predicted traffic noise contours on the local road network for the year 2028 with the development. The development buildings were included in the noise model so contours show

shielding to the internal parts of the site. These contours were predicted at ground level, and are not suitable for determination of noise at the higher-level apartments, however, they may be used to illustrate the way the development will impact the local noise environment.

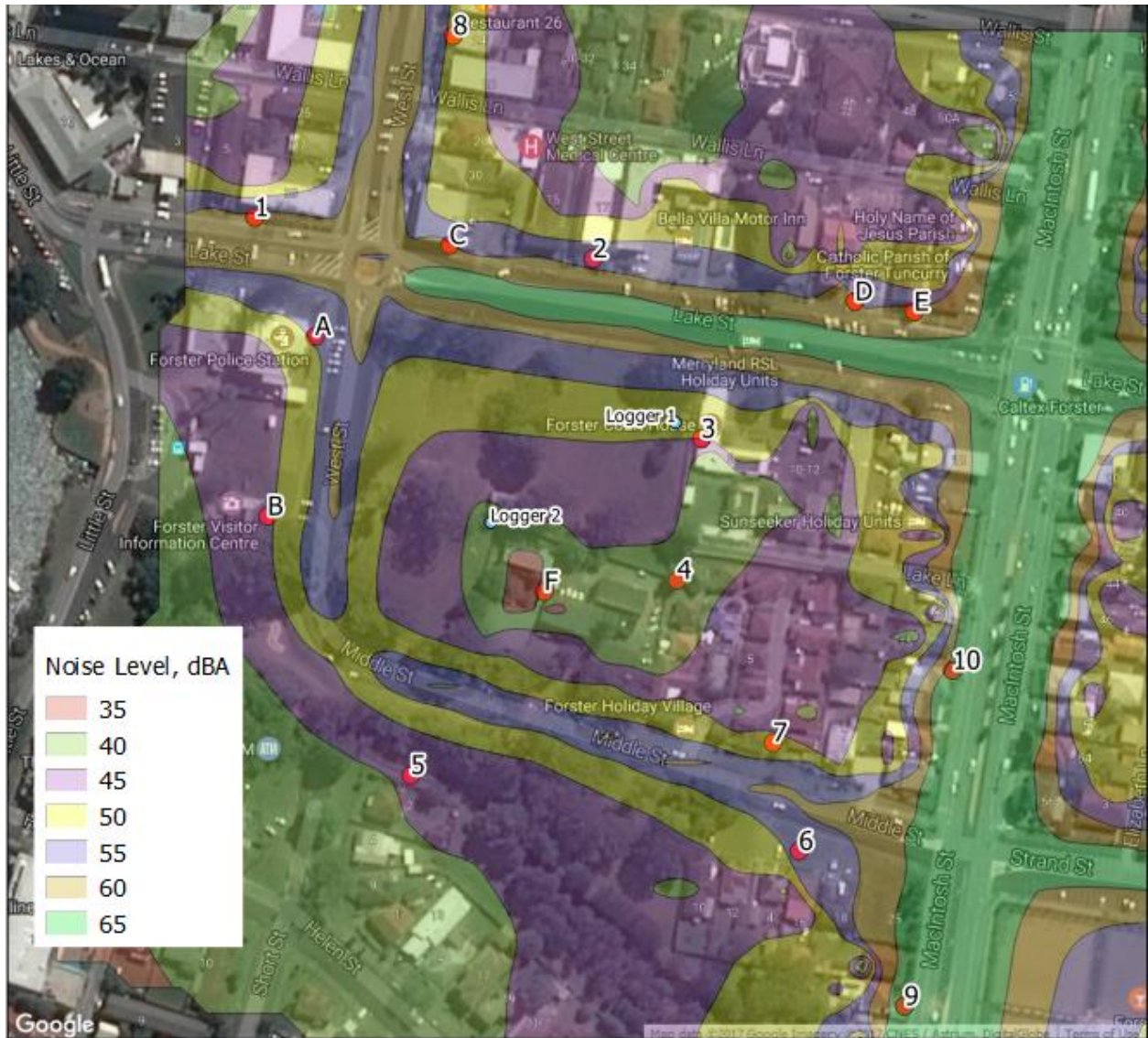
RE C	ADDRESS	CRITERION	AM			PM			COMMENTS
			2017	2028	Increase	2017	2028	Increase	
1	5 Lake St	55	60	61	0.6	61	63	2	Increase <2 dBA
2	15 Lake St	55	60	61	1.2	60	62	1.6	Increase <2 dBA
5	2 Short	55	48	50	1.3	47	51	3.7	Complies
6	18 Middle	55	57	57	0.9	56	58	1.6	Noise from Macintosh and Middle Street
7	9 Middle St	55	56	58	1.9	55	59	4.5	Mostly from Middle Street, so greater increase than at 18 Middle Street
8	28 West St	55	57	59	2	57	61	3.7	Residential facades set back or not facing road
9	27 Macintosh	60 (15 hour)	67	69	1.2	67	68	0.6	Exceeds, potentially acute at some residences, less than 2 dBA increase. 15 hour noise level typically 1-2 dBA lower than as predicted for 1 hour.
10	15 Macintosh	60 (15 hour)	69	70	1	70	71	1	Exceeds, potentially acute at some residences, less than 2 dBA increase. 15 hour noise level typically 1-2 dBA lower than as predicted for 1 hour

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

D	Church, 31 Lake St	50	61	62	1	61	63	1.4	Exceeds, but increase <2dBA
---	-----------------------	----	----	----	---	----	----	-----	-----------------------------

Table 12-4 Predicted traffic noise levels, $L_{Aeq,1hr}$ dBA

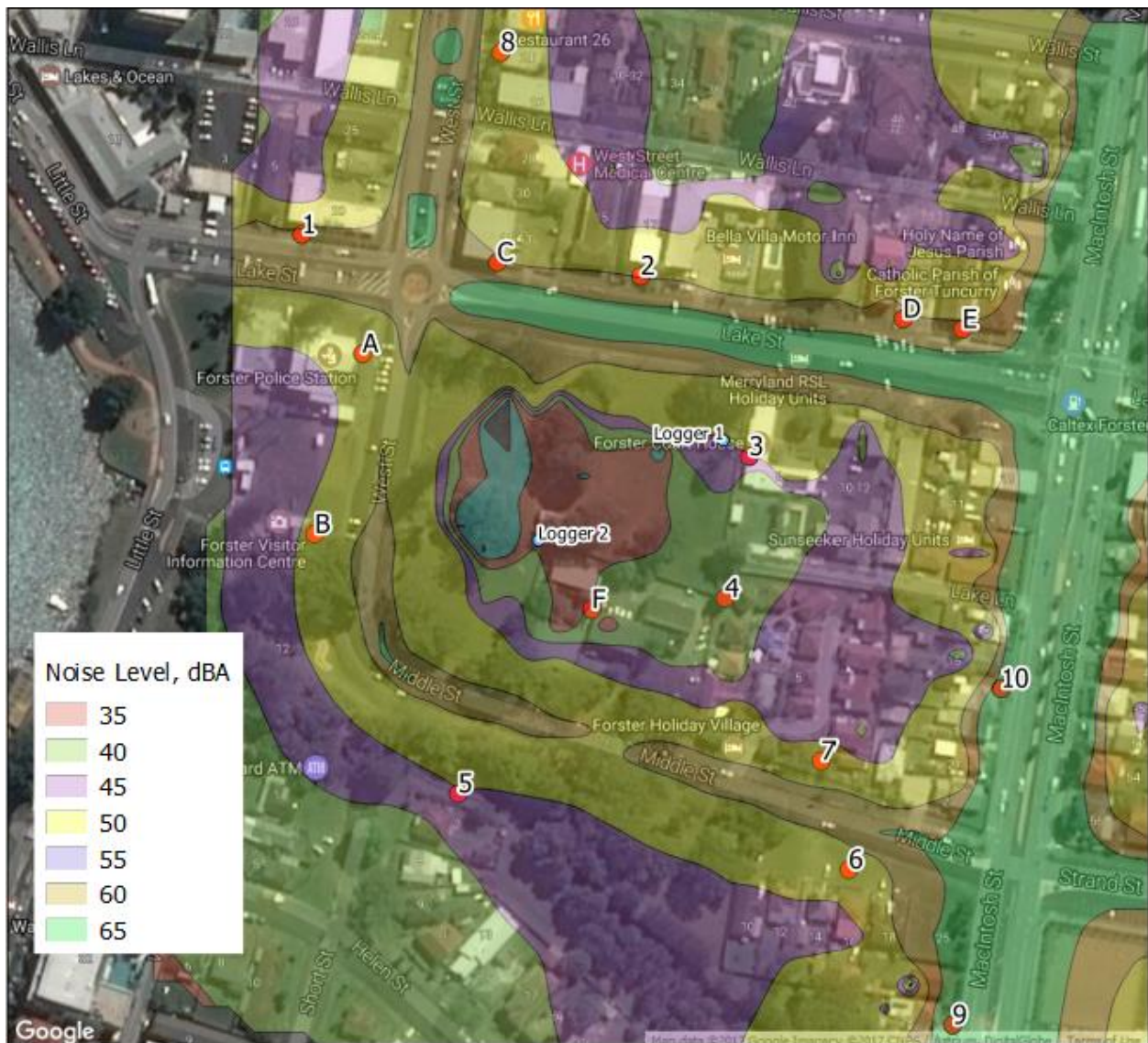
M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
h
\
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA



M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 12-1 Traffic Noise Contours, $L_{Aeq,1hr}$ dBA – 2017 without development

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
h
\
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA



M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 12-2 Traffic Noise Contours, $L_{Aeq,1hr}$ dBA – 2028 with development

12.5.3 Recommendations

Mitigation of traffic noise is best done at the source, that is by treatments to the road including barriers and use of low noise pavement. Noise barriers would be ineffective because, being a high-rise development, residences would be able to see over any practical noise barrier. Further, in a residential street noise barriers are impractical because there needs to be opening at driveways.

It was assumed, based on our inspection of the roads during our site visit, that the road surface on local roads was chip seal. If this were to be replaced by dense grade asphaltic concrete (DGAC) as part of the proposal or as part of road maintenance in future, a reduction of 2dBA would be achieved. This would lead to a maximum predicted increase in noise at any residence of 2.5 dBA over the 11-year period to 2028. While this is still slightly above the recommended maximum increase from the RNP, it represents only a marginal noise impact and less than 10 houses would experience increases over 2dBA.

12.6 ASSESSMENT OF TRAFFIC NOISE TO RESIDENCES IN THE DEVELOPMENT

12.6.1 Application

This section discusses noise recommendations from the Department of planning. The recommendations are generally concerned with residences adjacent to roads with average daily traffic volume of more than 40,000 vehicles. This is not the case here, however the guideline does state that the recommendations may be appropriate in these circumstances.

Note also that the SEPP discusses noise over the full 15-hour daytime period, and nine-hour night-time period. In this report only the worst-case hours of the daytime have been predicted as traffic volumes for the full day are not available. However, using the worst-case 'hour' in order to design noise mitigation will lead to a conservative outcome. We note also that internal AS2107 (see Section 10.3) are based on short term L_{Aeq} levels. Hence, we consider it appropriate to design mitigation based on the worst case our traffic noise intrusion at the site.

12.6.2 Internal Noise Goals

State Environmental Planning Policy (Infrastructure) 2007 (SEPP) Clause 102 states the following regarding road traffic noise impacts on non-road developments.

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

(1) 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:

- (a) a building for residential use,*
- (b) a place of public worship,*
- (c) a hospital,*
- (d) an educational establishment or child care centre.*

- (2) *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.*
- (3) *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:*
- (a) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7 am,*
 - (b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

The NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline* gives guidelines for application of the SEPP, including the following:

The night-time ‘sleeping areas’ criterion is 5dBA more stringent than the ‘living areas’ criteria to promote passive acoustic design principles. For example, designing the building such that sleeping areas are less exposed to road or rail noise than living areas may result in less onerous requirements for glazing, wall construction and acoustic seals.

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.

12.6.3 Building Envelope Noise Reduction

The criteria detailed in the SEPP (Infrastructure) 2007 refer to internal noise levels. All houses and facades are different, but as a guideline for the noise reduction of traffic noise into a house, refer to Table 12-5 adapted from Table 4.2 of the RMS Environmental Noise Management Manual (ENMM).

Building Type	Description	Internal Noise Reduction, dBA
All	Open	10
Light Frames	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	35

Table 12-5 Indicative Building Noise Reduction [Source: Table 4.2 ENMM]

Most buildings will achieve an internal noise level 10dBA below the external noise level with the windows open, without providing additional treatment.

Based on the SEPP criteria and the indication that the minimum noise reduction by a building façade, the mitigation requirements for various noise levels are given in Table 12-6.

Note that all the external noise level criteria above refer to free-field noise levels.

External Day time Noise – $L_{Aeq, 15hr}$ dBA	External Night time Noise – $L_{Aeq, 9hr}$ dBA	Building Category	Mitigation Requirements
Up to 55	Up to 50	1	No Requirement
56 to 60	51 to 55	2	No Requirement
61-65	56-60	2	Mechanical Ventilation
>65	>60	3+	Acoustic Design

Table 12-6 Mitigation Requirements for Traffic Noise

Note: Day is defined as 7.00am to 10.00pm, Monday to Saturday; 8.00am to 6.00pm Sunday and Public Holidays.
 Night is defined as 10.00pm to 7.00am, Monday to Saturday; 10.00pm to 8.00am Sunday and Public Holidays

12.7 PREDICTED NOISE LEVELS AND MITIGATION REQUIREMENTS

The predicted 2028 noise levels at the proposal site are shown in Table 12-7. The predictions are shown for each level and each façade which faces the road network. The highest level of mitigation required is Category 2, which is described in Section 13. With reference to Table 12-6, this indicates that mechanical ventilation is not required in order for internal noise levels to comply with the requirements.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

The difference between Category 2 and Category 1 in this type of development is the use of a 6 mm monolithic glazing or 4 mm monolithic glazing. In some cases, the use of 6 mm glazing will be required for safety or energy reasons.

Note also that the requirement for Category 2 is a guideline only. The noise into the apartment will ultimately depend on the floor layout and glazing design. If the area of glazing is small, then 4 mm glass may be satisfactory even where the table specifies Category 2. In the final design, the external noise levels should be used in order to design facade and glazing elements to achieve the internal acoustic requirements notwithstanding the category specification in the table.

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

North Façade (facing Lake Street)		
Floor	Noise Level, $L_{Aeq,1hr}$ dBA	Mitigation
1	59	Category 2
2	59	Category 2
3	59	Category 2
4	59	Category 2
5	58	Category 2
West Façade (facing West Street)		
Floor	Noise Level, $L_{Aeq,1hr}$ dBA	Mitigation
1	56	Category 2
2	56	Category 2
3	56	Category 2
4	55	Category 1
5	55	Category 1
Interior Facades		
Floor	Noise Level, $L_{Aeq,1hr}$ dBA	Mitigation
1	<55	Category 1

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

2	<55	Category 1
3	<55	Category 1
4	<55	Category 1
5	<55	Category 1

Table 12-7 Predicted daytime levels, $L_{Aeq,1hr}$ dBA at proposal





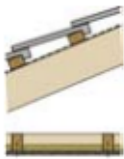

13 RECOMMENDATIONS

13.1 GENERAL MITIGATION ADVICE

The recommendations refer to Categories of construction from *Appendix C of the Infrastructure Development Near Rail Corridors and Busy Roads – Interim Guidelines*. Category 1 are described in the extract shown below as Figure 13-1, and Category 2 in

Figure 13-2.





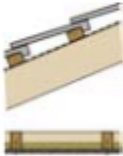

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

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

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 13-1 Example of Category Type 1 Building Elements

M17612.01 -
 Acoustic Assessment for DA
 FR
 epo
 rtT
 itle
 \h
 *
 ME
 RGE
 FOR
 MAT
 Aco
 ustic Assessment for DA

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

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Figure 13-2 Example of Category Type 2 Building Elements

14 CERTIFICATION FOR NOISE IMPACT STATEMENT

Acoustic Certification:

15 CONCLUSION

The proposed mixed use development at Forster includes many uses that have the potential to create noise nuisance to existing residential neighbours, and many uses that are potentially impacted by noise and require acoustic design.

Concerning the commercial and community aspects of the development, acoustic design of the childcare centre, library and community rooms was discussed. Recommendations for mitigation of noise intrusion into the childcare centre were given.

Noise from the childcare centre itself is predicted to comply with appropriate criteria, however acoustic design may be necessary for mitigation of noise from outdoor areas.

Noise from entertainment venues was discussed. The night club is ideally located in the current design in the basement. An acoustic sound lock is recommended in order to stop spillage of high noise levels from music into residential areas.

The proposal includes a cinema which will require specialist acoustic design beyond the scope of this DA.

Potentially the most difficult aspect to control will be noise from external seating areas of restaurants. As the location of the proposal is currently undeveloped, there is a low background noise level leading to low noise criteria. for noise emission from entertainment venues. Generally, noise is predicted to comply at residences within the development, and outside the development. Careful acoustic design will be required

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

in order to allow venues with outdoor seating to be able to trade through to midnight. After midnight, the noise criteria become more stringent and may not be possible to meet if outdoor dining is allowed.

The development will generate traffic on the existing road network. Traffic noise predictions were done to give recommendations for glazing and other facade constructions for residences within the development. The extra traffic will generate noise to existing residences on streets near the development. Generally, the increase in traffic will be within 2 dBA and is considered an insignificant increase. For a few residences on Middle Street, increases up to 4.5 dBA were predicted. Mitigations were discussed including potential resurfacing of Street.

P. Thornton

Philip Thornton BE(UNSW) MIE (Aust)
Acoustic Consultant
Chartered Professional Engineer
March 29, 2017



APPENDIX A: GLOSSARY OF ACOUSTIC TERMS

Assessment

Period	The period in a day over which assessments are made.
dB(A)	Unit of sound level in A-weighted decibels. The A-weighting approximates the sensitivity of the human ear by filtering these frequencies. The dB(A) measurement is considered representative of average human hearing.
L _{Aeq}	The A-weighted equivalent continuous sound pressure level, used to quantify the average noise level over a time period.
L _{A10}	The A-weighted sound pressure level exceeded for 10% of the measurement period. It is usually used as the descriptor for intrusive noise level.
L _{A90}	The A-weighted sound pressure level exceeded for 90% of the measurement period. It is usually used as the descriptor for background noise level.
L _{Aeq15min}	Refers to the A-weighted energy averaged equivalent noise level over a 15 minute time period.
L _{Cpeak}	The highest instantaneous C-weighted sound pressure level over the measurement period. It is usually used for high impulsive noise.
L _{Amax}	The maximum A-weighted sound pressure level for the measurement period.
Loudness	A 3dB(A) change in sound pressure level is just noticeable or perceptible to the average human ear; a 5dB(A) increase is quite noticeable and a 10dB(A) increase is typically perceived as a doubling in loudness.
RBL	The overall single figure background level representing the assessment period over the whole monitoring period. For the short term method of assessment, the RBL is the

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

measured $L_{A90, 15\text{min}}$ value, or where a number of measurements have been made, the lowest $L_{A90, 15\text{min}}$ value.

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

APPENDIX B: PHOTOS

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA



M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA

Photo 1 Logger 1 position, looking towards Lake Street



Photo 2 Logger 2 position, looking towards the Corner of West and Lake Street

M17612.01 -
Acoustic Assessment for DA
FR
epo
rtT
itle
\\h
*
ME
RGE
FOR
MAT
Aco
ustic Assessment for DA



Photo 3 Loggers Position looking towards Middle Street