MANAGING DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS
MATTHEW SHIELDS
BEN WHITE

Life City Berkeley

Masterplan Acoustic Assessment

SYDNEY
A: 9 Sarah St Mascot NSW 2020
T: (02) 8339 8000
F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au
ABN: 11 068 954 343

DOCUMENT CONTROL REGISTER

Project Number	20120837.1
Project Name	Life City Berkeley
Document Title	Masterplan Acoustic Assessment
Document Reference	20120837.1/0111A/R1/HP
Issue Type	Email
Attention To	Delbest Pty Ltd Mr Mohamad Rashid

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	1/11/2012	20120837.1/0111A/R0/HP	HP		BW
1	1/11/2012	20120837.1/0111A/R1/HP	HP		HP

TABLE OF CONTENTS

1 INTRODUCTION

This report presents a noise impact assessment of the proposed Life City Berkeley Masterplan.

The potential for noise impacts at the nearby residential properties from the operation of the facility has been assessed by:

- Predicting the noise levels generated at the nearest residences resulting from the proposed activities. Noise level predictions have been based on data obtained from other similar operations.
- Comparing the noise levels generated by the development to existing noise levels established from long term unattended noise monitoring conducted on site.
- Determining whether the noise levels comply with the assessment criteria.

Where the analysis indicated a potential for adverse impact from the proposed activities, measures that may be implemented to ameliorate noise impact (either engineering or management) have been identified.

2 SITE DESCRIPTION

2.1 EXISTING SITE

The subject site is located at Berkeley, bound to the North by the F6 Freeway, and to the South by existing residential receivers.

The aerial photograph below shows the existing site and surrounding receivers.

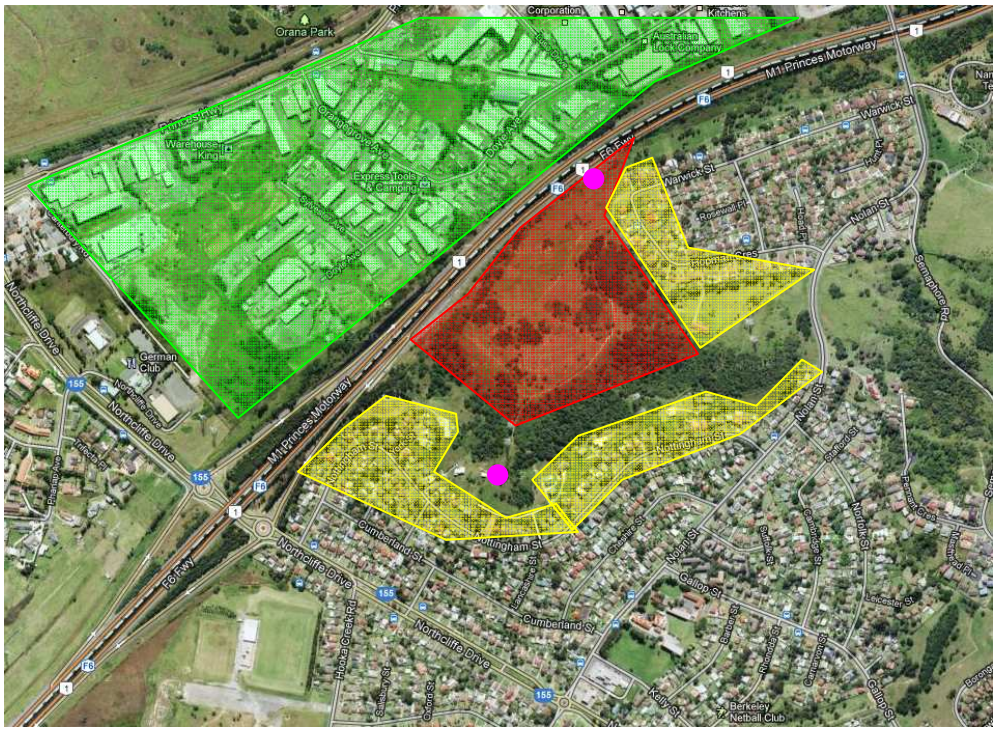


Figure 1 – Site Plan showing nearest receivers

Table 1 – Legend for Site Plan

Subject Site	
Residential Receivers	
Industrial Receivers	
Unattended Monitoring Locations	

2.2 GENERAL DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed development comprises of the following stages and timings:

Table 2 – Stages and Timings for Life City Berkeley

Component	Stage	Time frame
Medical Centre, Day Surgery, Child Care Centre & Respite Care Centre	1	2014/15
Holistic Health Care Course	2	2014/15
Serviced Apartments	3	2015/16
Ancillary accommodation & Research, library, lecture theatre, auditorium complex	4	2016/17
Hi Tech Holistic Cancer & Medical Hospital	5	2017/18
Self Care Seniors Housing	6	2018/19
Residential Care Facility & Hostel	7	2018/19
Healthcare Technical High School	8	2020
Development Complete	-	2021

2.3 LOCAL NOISE SOURCES

Existing noise sources identified within the area were traffic on the F6 Freeway for the northern side and Northcliffe Drive, Nolan Street and general neighbourhood noise on the southern side.

2.4 POTENTIALLY AFFECTED RECEIVERS

The nearest properties potentially affected from the operation of the proposed development are the residential receivers adjoining the site at Hopman Crescent and Warwick Street, the northern end of York Street, and those on the northern side of Nottingham Street and Nolan Street.

The nearest non-residential receivers are the industrial lots on the opposite side of the Freeway.

If noise emissions comply at the listed locations then noise emissions will also comply at all other noise sensitive receivers.

3 NOISE DESCRIPTORS

Environmental noise constantly varies in level, due to fluctuations in local noise sources including road traffic. Accordingly, a 15minute measurement interval is normally utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In the case of environmental noise three principle measurement parameters are used, namely L_1, L_{10}, L_{90} and L_{eq}.

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

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

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

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

The L_1 parameter (or the noise level exceeded for 1% of the time) is used during the night period to assess potential sleep arousal effects due to transient noise sources.

4 NOISE MONITORING

Unattended monitoring was undertaken at the site. Unattended monitoring was undertaken to characterise the existing acoustic environment of the potentially most affected residential areas.

4.1 PERIOD OF MEASUREMENT

Monitoring was conducted continuously between the 13th September 2012 and the 20th September inclusive.

4.2 MEASUREMENT EQUIPMENT

Unattended noise measurements were made using two Acoustic Research Laboratories unattended noise monitor. The noise monitor continuously monitors noise levels. Every 15 minutes the monitor stores statistical noise descriptors for the interval. At the end of the measurement period the stored data is downloaded onto computer for analysis. The noise monitors were calibrated at the start and end of each measurement period using a Rion NC-73 Calibrator. No significant drift in calibration occurred.

4.3 EXISTING NOISE LEVELS

The DECCW/EPA Industrial Noise Policy details specific steps in determining the background noise level for assessment of the day, evening and night time periods. Table 3 summarises background and existing average noise levels determined at the monitoring location, based on the guidelines set out in the Industrial Noise Policy and the results of unattended noise monitoring.

Table 3 – Measured Rating Background Noise Levels

Location	Description	Day Noise Level 7am to 6pm (dB(A))	Evening Noise Level 6pm to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Northern Location	Representative Background Level $L_{90,15min}$	55	56	39
Southern Location		43	38	30

Table 4 – Measured Average Noise Levels

Location	Description	Day Noise Level 7am to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Northern Location	Average Noise Level $L_{eq\ (period)}$ / $L_{eq\ (worst\ 1hr)}$	65 / 68	62 / 66
Southern Location		48 / 50	45 / 48

5 NOISE GUIDELINES AND ASSESSMENT CRITERIA

5.1 INDUSTRIAL NOISE POLICY

The New South Wales Department for Environment Climate Change and Water / Environment Protection Authority (DECCW/EPA) Industrial Noise Policy (INP) provides guidelines for assessing noise impacts from industrial developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The DECCW/EPA INP has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion. In addition, the DECCW/EPA in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal.

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the DECCW/EPA Environmental Criteria for Road Traffic Noise (ECRTN).

The intrusiveness and amenity criteria for this project have been determined using these guidelines and the noise monitoring results.

5.1.1 Residential Receivers

5.1.1.1 Intrusiveness Criterion

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

Table 5 – Intrusiveness Criterion at Residential Receivers

Location	Time of Day	Measured L_{90} Noise Level dB(A)	Intrusiveness Criterion dB(A) $L_{eq\ (15\ min)}$
Northern Receivers	Day	55	60
	Evening	56	61
	Night	39	44
Southern Receivers	Day	43	48
	Evening	38	43
	Night	30	35

5.1.1.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment. The DECCW/EPA Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 of the policy indicates 4 categories to

distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

As potentially affected residents are part of significant residential zones, noise generated by the development should be assessed against the suburban criteria.

Table 6 – DECCW/EPA Recommended Acceptable Noise Levels – Residential Receivers

Time of day	Acceptable Noise Level based on Suburban Criterion dB(A)
Day (7am to 6pm)	55
Evening (6pm to 10pm)	45
Night (10pm to 7am)	40

5.1.1.3 Sleep Arousal Criteria

Sleep arousal is a function of both the noise level and the duration of the noise. The DECCW in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect people from sleep arousal.

To assess potential sleep arousal impacts, an emergence test is first carried out. That is, the L_1 noise level of any specific noise source should not exceed the background noise level (L_{90}) by more than 15dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. If the noise events are within this, then sleep arousal impacts are unlikely and no further analysis is needed. If there are noise events that could exceed the emergence level, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This more detailed sleep arousal test is conducted with reference to the DECCW Environmental Criteria for Road Traffic Noise (appendix B of that document).

In addition to the above, the DECCW guideline state that maximum *internal* noise levels of 50-55dB(A) are unlikely to cause awakening.

The guideline level is set out below.

Table 7 - Sleep Arousal Emergence Criteria

LOCATION	PERIOD/TIME	BACKGROUND NOISE LEVEL dB(A)L_{90}	EMERGENCE LEVEL (dB(A) L_1)
Northern Receivers	Night (10pm-7am)	39	54
Southern Receivers	Night (10pm-7am)	30	45

5.1.2 Industrial and Commercial Receivers

DECCW acoustic criteria for potential impacts on commercial and industrial properties are summarised below.

Table 8 - Acceptable Noise Levels at Non-Residential Receivers

Land Use	Time of Day	Amenity Objective dB(A) L_{eq}
Industrial	When in use	70
Commercial	When in use	65

5.2 TRAFFIC GENERATION ON SURROUNDING ROADS

For land use developments with the potential to create additional traffic on surrounding roads the development should comply with the requirements detailed in the DECCW/EPA Road Noise Guideline. Criteria applicable to the development are detailed below. If existing noise levels exceed those in the following table, a 2 dB increase in noise is allowed.

Table 9 - Criteria for Traffic Noise for New Developments

Time of day	Criteria for Acceptable Traffic Noise Level dB(A)
Day (7am to 10pm)	60 $L_{Aeq(15hr)}$ – Sub-Arterial Road (Nolan Street) 55 $L_{Aeq(1hr)}$ – Local Road (Warwick Street)
Night (10pm to 7am)	55 $L_{Aeq(9hr)}$ - Sub-Arterial Road (Nolan Street) 50$L_{Aeq(1hr)}$ – Local Road (Warwick Street)

6 NOISE EMISSION ASSESSMENT

This section contains our assessment of the noise impact from various activities associated with the proposed development to potentially affected residents as detailed above.

6.1 VEHICLES DRIVING ON SITE

Noise from vehicles driving on site has been assessed using data from GHD.

The following table shows the relevant noise emission requirements from the site. Provided the noise emissions from vehicle movements in the carpark do not exceed the following criteria, no further acoustic treatment is necessary.

Table 10 – Predicted Noise Level at Receivers dB(A) Leq(15min)

Location	Time of Day	Intrusiveness Criterion dB(A) $L_{eq(15min)}$	Amenity Criterion dB(A) $L_{eq\ (period)}$
Northern Receivers	Day	60	55
	Evening	61	45
	Night	44	40
Southern Receivers	Day	48	55
	Evening	43	45
	Night	35	40
Industrial Receiver	When in use	N/A	70
Commercial Receiver	When in use	N/A	65

The entrances to the site are as follows:

- The new private road providing access from the south, off Nolan Street.
- The new private road, connecting to the end of Warwick Ave, providing access to the northern portion of the site.

This assessment addresses noise emissions from vehicles using the new access roads. As the development is still in master planning stage, the precise layouts of the carparks have not yet been finalised. Noise emissions from the use of the carparks, and the particular acoustic treatments to those, will need to be determined during the project detailed design.

Based on the indicative layouts, it is practical and reasonable to achieve compliance with the project noise emission goals for noise emissions from car parks on site with the use of barriers/screens etc. The indicative height of such screening is 2.3m to the eastern boundary of the site, adjacent to the residential receivers along Hopman Crescent and Warwick Street.

Noise from vehicles driving on site generated by the proposed development was assessed using current and predicted traffic flows provided by GHD.

GHD has measured and predicted the following flows surrounding the site:

Table 11 – Existing Peak Hour Flows in Surrounding Streets

Street	Existing 2012 peak hour (AM/PM)
Warwick Street	54/65
Nolan Street	456/484

The predicted total development flow is 738 trips per hour, distributed with 20% of movements using the Warwick Street access, and 80% using Nolan Street.

For the night time period, ALC have made the following assumptions:

- Up to 35 vehicles per hour use the northern access point, entering/exiting the site at the Warwick Street gate.
- Up to 140 vehicles per hour use the southern access point, entering/exiting the site onto Nolan Street.

Based on the above predictions and assumptions, acoustic screening is required for the new access road toward Nolan Street, for compliance with the project noise emission goals at the southern receivers. Indicatively, this could be a 2.3m high imperforate screen to either side of the access road (constructed of masonry, fibre cement, colourbond or acoustic equivalent), or equivalent screening to the boundaries of the site.

Due to the more lively background noise environment on the northern side of the site, noise emissions are predicted to comply with the project noise emission goals with 1.8m high screening between the car engine and the residential receivers, for vehicles within 50m of the residents.

6.2 ASSESSMENT OF SLEEP DISTURBANCE

Given the proposed 24 hour operation, an assessment of potential sleep disturbance should be undertaken.

Analysis indicates that cars starting, car doors closing would not create L_1 noise levels of >45dB(A) at the nearest southern residential façades, or >54dB(A) at the nearest northern residential façades.

Therefore, full compliance with sleep disturbance goals is achieved.

6.3 MECHANICAL PLANT

As detailed plant selections are not available at this stage it is not possible to carry out a detailed examination of the ameliorative measures that may be required to achieve the noise targets.

Plant will be acoustically treated to prevent noise emissions from adversely impacting the surrounding properties. This may include selecting the quietest plant practicable, or treating the plant with enclosures, barriers, duct lining and silencers, vibration isolation etc as required to comply with the sound level recommendations presented in Section 5 of this report.

During this assessment a review of a number of potential mechanical plant items was conducted and the following major plant items being identified.

6.3.1 Ventilation Equipment

Treatment of ventilation equipment associated with the development will be effectively treated with acoustic treatments such as selection of quietest practicable plant, appropriate enclosures, silencers, internal lining of ductwork, etc.

6.3.2 Air-Conditioning Equipment

Treatment of air conditioning cooling equipment associated with the development will be effectively treated with acoustic treatments such as selection of quietest practicable plant, appropriate enclosures, silencers, acoustic screens, etc.

6.3.3 Refrigeration Condensers

Treatment of condensers for refrigeration systems associated with the development will be effectively mitigates with acoustic treatments such as the selection of the quietest practicable plant, appropriate enclosures, silencers, acoustic screens etc.

Experience with similar projects indicates that it will be possible to achieve the Council requirement with appropriate treatment of the plant. This treatment will be determined in detail at the Construction Certificate stage when greater detail regarding the proposed plant will be available.

6.4 GENERATED TRAFFIC NOISE ON LOCAL STREETS

Traffic noise generated by the proposed development was assessed using predicted traffic flows provided by GHD. The predicted total development flow is 738 trips per hour, distributed with 20% of movements using the Warwick Street access, and 80% using Nolan Street.

For the night time period, ALC have made the following assumptions:

- Up to 35 vehicles per hour use the northern access point, entering/exiting the site at the Warwick Street gate.

- Up to 140 vehicles per hour use the southern access point, entering/exiting the site onto Nolan Street.

For land use developments with the potential to create additional traffic on surrounding roads the development should comply with the requirements detailed in the DECCW/EPA Road Noise Policy, which were presented above in section 5.3.

Vehicles accessing the northern portion of the site, visiting the school, would utilise Warwick Street, whilst vehicles accessing the central or southern portions of the site will utilise the southern access road off Nolan Street. Traffic noise generated by the proposed development was assessed using predicted traffic flows provided by GHD.

The predicted future traffic levels are summarised in the following table.

Table 12 - Noise Associated with Traffic Generation

Receiver Location	Time of Day	Projected Traffic Noise Level at Façade dB(A)	Criteria	Complies
Warwick Street	7am – 10pm	56 $L_{eq\ (Worst\ 1hour)}$	55 $L_{eq\ (Worst\ 1hour)}$	Yes
	10pm-7am	50 $L_{eq\ (Worst\ 1hour)}$	50 $L_{eq\ (Worst\ 1hour)}$	Yes
Nolan Street	7am – 10pm	57 $L_{eq\ (Worst\ 1hour)}$	60 $L_{eq\ (15hour)}$	Yes
	10pm-7am	48 $L_{eq\ (Worst\ 1hour)}$	55 $L_{eq\ (9hour)}$	Yes

The investigation revealed that the traffic potentially generated by the development generally complies with the noise goals of the Road Noise Policy.

Day time peak hour levels on Warwick Street are predicted to exceed the goal by 1dB(A). The average listener cannot detect a noise level difference of 1dB(A). On that basis the predicted traffic noise level sounds the same as a strictly compliant level and hence there is no variation to the residential amenity. Therefore, it is determined that in respect of generated traffic noise, the proposed development is acoustically acceptable without additional treatment.

7 NOISE INTRUSION ASSESSMENT

The proposed development adjoins the F6 Freeway, which is the main highway between Wollongong and the South Coast. Given the volumes of traffic carried by this corridor and the sensitive nature of the proposed uses of the site, it is essential to assess the traffic noise impacts on the proposed development.

Attended and unattended noise monitoring was conducted adjacent to the F6 Freeway, in the approximate location of the future school facade, and also on the southern side of the site, near the approximate location of the future residential units.

The following table presents the external noise levels at the unattended monitor locations, as presented earlier in this report, but repeated here for ease of reference.

Table 13 – Average Noise Levels at Northern and Southern Monitors

Location	Description	Day Noise Level 7am to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Northern Location	Average Noise Level $L_{eq\ (period)}$ / $L_{eq\ (worst\ 1hr)}$	65 / 68	62 / 66
Southern Location		48 / 50	45 / 48

7.1 INTERNAL NOISE GOALS

For educational, hospital, religious or residential uses within 100m of the freeway, the Department of Planning SEPP (Infrastructure) 2007 applies. For other uses within 100m of the freeway, or for similar uses but greater than 100m from the freeway, internal noise goals will be in accordance with Australian Standard AS2107:2000.

7.1.1 SEPP (Infrastructure) 2007

In accordance with the SEPP (Infrastructure) 2007, the following internal noise goals apply to those sections of the development within 100m of the F6 corridor:

Table 14 – SEPP Internal Noise Goals

Location	**Time of Day**	**Design Internal Noise Levels (dB(A)) $L_{eq\ (period)}$**
School Classrooms and Staff Rooms	Day	40 $L_{eq\ (15\ hour)}$
Residential Bedroom	Day	40 $L_{eq\ (15\ hour)}$
	Night	35 $L_{eq\ (9\ hour)}$
Residential Living Areas	Day/Night	40 $L_{eq\ (15\ hour)/\ (9\ hour)}$
Hospital - Wards	Day/Night	35 $L_{eq\ (15\ hour)/\ (9\ hour)}$
Hospital – other noise sensitive areas	Day	45 $L_{eq\ (15\ hour)}$

7.1.2 Australian Standard AS2107:2000

In accordance with Australian Standard AS2107:2000, the following internal noise goals apply for buildings outside of 100m from the freeway.

Table 15 – AS2107:2000 Internal Noise Goals

Location	Time of Day	Design Internal Noise Levels (dB(A)) $L_{eq\ (period)}$
Bedrooms near major roads	Day	45 $L_{eq\ (15\ hour)}$
	Night	35 $L_{eq\ (9\ hour)}$
Living Rooms near major roads	Day/Night	45 $L_{eq\ (15\ hour)}$
Bedrooms near minor roads	Day	40 $L_{eq\ (15\ hour)}$
	Night	30 $L_{eq\ (9\ hour)}$
Living Rooms near minor roads	Day/Night	40 $L_{eq\ (15\ hour)}$
Health consulting rooms	Day	40 $L_{eq\ (15\ hour)}$
General Office Areas, Retail	Day	45 $L_{eq\ (15\ hour)}$

7.2 RECOMMENDED TREATMENTS

Traffic noise intrusion into the proposed development was assessed using the measured external noise levels reported above as a basis.

Calculations were performed taking into account the orientation of windows, the total area of glazing, facade transmission loss and room sound absorption characteristics. In this way the likely interior noise levels can be predicted. Acoustic treatment required to ensure compliance with the assessment criteria are detailed in this section.

Internal noise levels will primarily be as a result of noise transfer through the windows and doors as these are relatively light building elements that offer less resistance to the transmission of sound. Noise transfer through the masonry elements will not be significant and need not be considered further.

The constructions necessary to achieve the noise levels are detailed below. The predicted noise levels have been based on the expected level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

7.2.1 Indicative Glazing

7.2.1.1 Northern portion (School, Hospital and Residential Care)

Based on the current design plans, the indicative external glazing for the development along the northern portion of the site would be upgraded single glazing, nominally 6.38mm laminated glazing with full perimeter acoustic seals, with the precise treatment to be determined during the detailed design stage.

7.2.1.2 Central Zone (Day Surgery, Education, Serviced Apartments)

Based on the current design plans, the indicative external glazing for the central portion of the development would be upgraded single glazing, nominally 6mm float glazing with full perimeter acoustic seals, with the precise treatment to be determined during the detailed design stage.

7.2.1.3 Southern Region

Based on the current design plans, the indicative external glazing for the seniors living would be naturally ventilated standard glazing without acoustic seals, with the precise treatment to be determined during the detailed design stage.

7.2.2 Wall and roof construction

The wall and roof constructions for the development have not been finalised at this stage.

Where external walls and roof are of heavy construction such as concrete or masonry, this will be acoustically acceptable. Any penetrations in these heavy elements will need to be assessed in order to maintain the performance of the walls/roof.

Light weight wall/roof constructions may be used in the development. Noise intrusion via the light weight elements must be taken into account in combination with the glazing to ensure that the overall internal noise level via all paths is compliant.

Construction of the external building shell will be determined during the detailed design for each stage, for compliance with the internal noise goals presented in this assessment.

7.3 CONCLUSION

An acoustic assessment of the proposed Life City development Masterplan has been conducted. This has included impacts both on the development from the surrounding environment as well as potential impacts on the nearby receivers from the proposed development.

Noise emission goals have been set in accordance with Wollongong Council and EPA guidelines and controls, to protect the amenity of the surrounding residential receivers. Where possible at this stage, indicative acoustic treatments have been included for compliance with the project acoustic goals. Further investigations will be required at each stage, to ensure on-going compliance with external noise goals.

An assessment of traffic noise generated by the development indicated that the noise levels generally complied with the NSW Road Noise Policy.

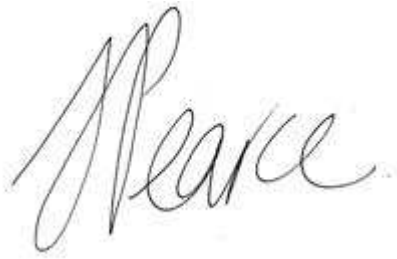
Internal noise intrusion goals for the development have been set for compliance with the SEPP (Infrastructure) 2007 and Australian Standard AS2107:2000. Indicative glazing has been presented in this report. Further investigations will be required at each stage, to ensure on-going compliance with internal noise goals.

The investigations carried out indicate that the acoustic amenity of existing properties surrounding the development would not be adversely impacted by the proposed development provided appropriate management and engineering control measures are implemented, as indicated in the report.

Further, the use of the site is capable of being fit for the purpose which it is intended provided appropriate management and engineering control measures are implemented, as indicated in the report.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Acoustic Logic Consultancy Pty Ltd
Hilary Pearce