Waterbrook Bayview Pty Ltd, 52 Cabbage Tree Road, Bayview

Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy (ALC) have been engaged to conduct an acoustic assessment of potential noise impacts associated with the proposed seniors housing development to be located along Cabbage Tree Road, Bayview.

This document addresses noise impacts associated with the following:

- Traffic noise impacts on the development (primarily from Cabbage Tree Road);
- Noise emissions from the operation of the development.

ALC have utilised the following documents and regulations in the assessment of noise emanating from the development

- Pittwater Council 21 Development Control Plan (DCP) 2014;
- Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*;
- NSW EPA Industrial Noise Policy (INP);
- NSW Liquor and Gaming.

In addition, the report will include an in-principle review of construction noise and vibration. Relevant EPA and international construction noise and vibration guidelines will be identified and potential impacts on nearby development will be examined.

This assessment has been conducted based on the architectural drawings provided by Marchese Partners International, job number 14023, revision A, and dated 27/03/2019

2 SITE DESCRIPTION

The site is located along Cabbage Tree Road, Bayview. The site is currently occupied by a golf course operated by the Bayview Golf Club. The site is bound to the south by Cabbage Tree Road which carries low volumes of traffic.

The proposed development is for seniors housing development comprising six residential buildings (Six (6), three storey buildings), a facilities building and a two level basement car park. The basement car park is accessed via a driveway that runs off Cabbage Tree Road.

The facilities building will include the following facilities for the use of residents and their guests only:

- Swimming Pool;
- Gym;
- A La Carte Restaurant;
- Bar;
- Café.

The a la carte restaurant, bar and café will be licensed premises.

The proposed operating hours of the a la carte restaurant and café facility are as follows:

- 9am-4pm Monday to Saturdays;
- 6pm-10pm Monday and Saturdays.

This office has been advised that the a la carte restaurant and café will never operate concurrently.

The bar facility will generally operate between 6pm-9pm.

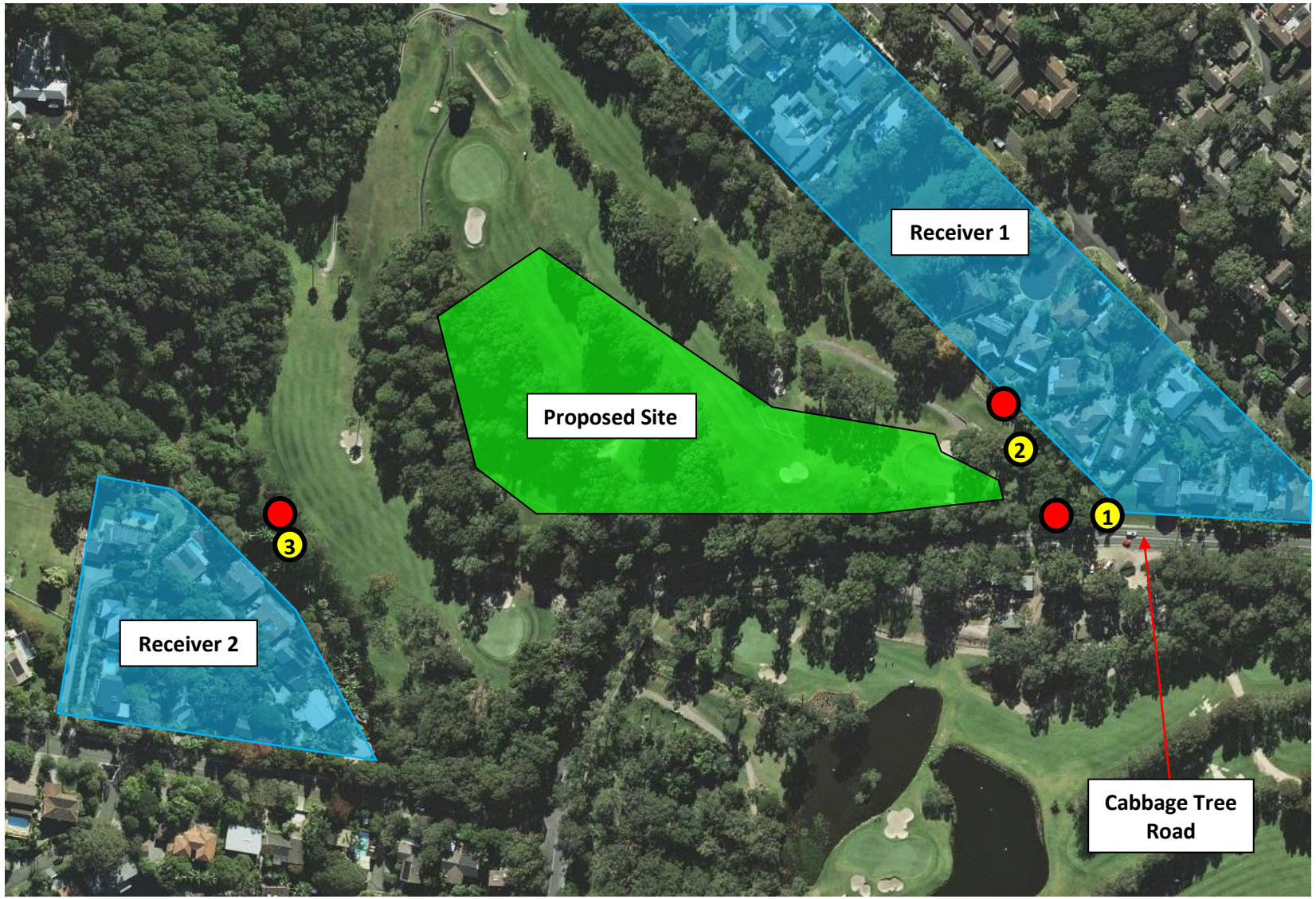
Only background music is proposed at the a la carte restaurant, café and bar facility. However there may be up to six function events per year in the a la carte restaurant where live music may be played. This office has been advised that functions will finish no later than 10pm.

The proposed operating hours of the gym and swimming pool are 6am-9pm.

The nearest noise sensitive receivers in the vicinity of the site are as follows:

- Receiver 1 – Residential dwellings located approximately 40m north-east of the site;
- Receiver 2 – Residential dwellings located approximately 100m south-west of the site.

Refer to the aerial photograph in figure 1 below.



Unattended Noise Monitor

Attended Noise Measurement

Residential Receiver

Figure 1: Site Survey and Monitoring Positions
Sourced from SixMaps NSW

3 EXISTING ACOUSTIC ENVIRONMENT

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three-principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

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

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced 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 will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute 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 environmental noise.

4 EXTERNAL NOISE INTRUSION ASSESSMENT

This section of the report details the acoustic assessment of traffic noise impacts on the proposed development.

4.1 ACOUSTIC CRITERIA

Relevant acoustic criteria are set out below.

4.1.1 Pittwater Council 21 Development Control Plan 2014

The Pittwater Council Development Control Plan does not outline any quantitative acoustic criteria for traffic noise impacts on senior housing developments. Given this, traffic noise impacts on the proposed development will be formulated with reference to the Australian Standard AS2107:2016.

4.1.2 AS2107-2016 "Acoustics – Recommended Design Sound Levels & Reverberation Times for Building Interiors"

AS2107-2016: Recommended design sound levels and reverberation times for building interiors specifies allowable internal noise levels for internal spaces within residential and commercial buildings. Table 1, in section 5 of AS2107-2016, gives the recommended internal noise levels:

Table 1 – Recommended Design Sound Level AS2107-2016

Type of Occupancy/Activity	Design Sound Level dB(A)L_{eq}
Sleeping Areas (night time)	30-35
Living Areas	30-40
Common Rooms	40-45
Dining Rooms	40-45

4.1.3 Summary of Noise Criteria

The following table presents the internal noise goals which will be adopted in order to undertake noise intrusion assessment in the following sections.

Table 2 – Noise Criteria Summary

Space /Activity Type	Time of Day	Internal Noise Criteria dB(A)L_{eq}
Sleeping Areas	Night (10pm-7am)	35 dB(A)$L_{eq\ (worst\ 1hour)}$
Living Areas	Day (7am-10pm)	40 dB(A)$L_{eq\ (worst\ 1hour)}$
Common Rooms	Day (7am-10pm)	40 dB(A)$L_{eq\ (worst\ 1hour)}$
Dining Rooms	Day (7am-10pm)	40 dB(A)$L_{eq\ (worst\ 1hour)}$

4.2 TRAFFIC NOISE MEASUREMENTS

External noise levels in the area have been recorded by this office using long term unattended noise monitoring equipment and attended short-term attended measurements.

4.2.1 Attended Traffic Noise Measurements

Attended measurements of traffic noise were conducted around the site between 1pm and 2pm on 19th September 2017. Attended noise measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Rion NC-73 calibrator. No significant drift was noted.

The traffic noise levels listed in the table below, were determined based on attended measurements. In determination of acoustic treatments, the measured level is adjusted for distance and orientation.

4.2.2 Unattended Noise Measurements

Unattended noise measurements of traffic were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was installed along the southern boundary of the existing golf course with an unobstructed view of Cabbage Tree Road (unattended noise monitor 1 in Figure 1).

The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitor was calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. There were no significant periods of adverse weather conditions during the measurement period. The logger was on site from the 19th to the 26th September 2017. Refer to Appendix 1 for the unmanned traffic noise monitoring data measured on site.

4.2.3 Measured Noise Levels

The following table presents the resultant noise levels at the proposed site location.

Table 3 – Traffic Noise Levels at Proposed Site Location

Location	Period	Noise Level
South Façade of Development (facing Cabbage Tree Road)	Day (7am – 10pm)	63dB(A)$L_{eq\ (worst\ 1\ hour)}$
	Night (10pm – 7am)	60dB(A)$L_{eq\ (worst\ 1\ hour)}$

4.3 RECOMMENDATIONS

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

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

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss, distance attenuation and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

In all cases, the selected glazing type reduces internal noise levels to within the nominated criteria for the various space types.

Predicted internal noise levels along all facades of the proposed building have taken into consideration measured noise levels from Cabbage Tree Road. Measured noise levels from all surrounding roads have had distance attenuation and barrier effects applied.

4.3.1 Glazing

The recommended glazing constructions are outlined below in the table below. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. **Note that mohair type seals will not be acceptable for the windows requiring acoustic seals.**

Table 4 - Glazing Recommendations

Block	Façade	Room Type	Glazing Assembly	Acoustic Seals Required
A, B and F	South	Bedroom	6.38mm laminated	Yes
		Living Room	6mm float	Yes
	East & West	Bedroom	6mm float	Yes
		Living Room	5mm float	Yes
	North	All	5mm float	Yes
C, D & E	All	All	5mm float	Yes
Facilities	All	All	6mm float	Yes

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

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the STC/R_w rating of the glazing assembly below the values nominated in the table above.

Table 5 – Minimum STC/R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Acoustic Seals	Minimum STC/R_w of Installed Window
5mm float	Yes	28
6mm float	Yes	29
6.38mm laminated	Yes	31

4.3.2 Roof / Ceiling Construction

The minimum ceiling/roof construction for all spaces with an external roof above are detailed in Figure 2 below.

Penetrations in ceilings *(such as for light fittings etc.)* must be sealed gap free with a flexible 100% polyurethane sealant equal to Selley's Fire Block.

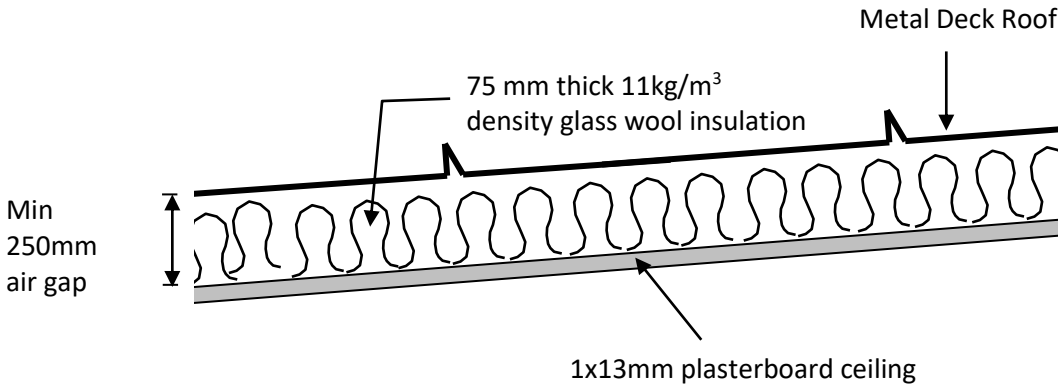


Figure 2 – Roof / Ceiling Construction

4.3.3 External Walls

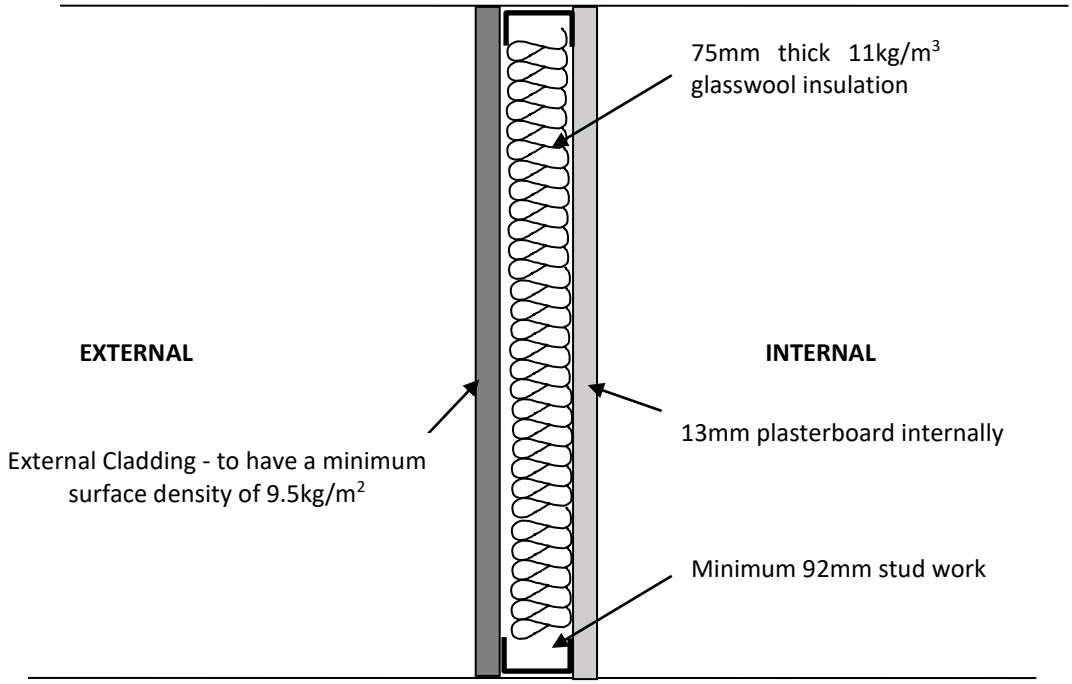
There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed with a flexible sealant.

4.3.3.1 Masonry/Concrete External Walls

Any proposed masonry or concrete external wall construction will be acoustically acceptable and will not require any additional treatment.

4.3.3.2 Lightweight External Walls

The recommended constructions for lightweight external walls are presented below:



4.3.4 Ventilation Requirements

With respect to natural ventilation of a dwelling, it is common acoustic practice that if the noise level within the dwelling is within 10dB(A) of the target noise level with the windows open, then a suitable level of acoustic amenity is achieved even if the window is left open (see for example NSW Department of Planning document "*Development near Busy Roads and Rail Corridors - Interim Guideline*):

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

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

The following spaces will be able to achieve the internal noise goals with windows open:

- All rooms in blocks B, C, D and E;
- Rooms with glazing only on the eastern, western or northern facades of blocks A and F.

Rooms with glazing on the southern façade of blocks A and F will need to have their windows closed in order to achieve the internal noise goals. A mechanical engineer is to confirm if supplementary ventilation (to meet Australian Standard AS1668.2 requirements) will be required to these rooms.

5 EXTERNAL NOISE EMISSION

Noise emissions from the site should be assessed to ensure that the amenity of nearby land users is not adversely affected.

Potential noise sources which should be assessed are:

- Mechanical plant (typically air-conditioning and car park ventilation fans);
- Noise from cars entering/exiting the proposed development via the driveway running off from Cabbage Tree Road.
- Noise from the operation of the gym and swimming pool.
- Patron/music noise from the a la carte restaurant, bar and café in the facilities building.

The nearest noise sensitive receivers in the vicinity of the site are as follows (refer to figure 1):

- Receiver 1 – Residential dwellings located approximately 40m north-east of the site;
- Receiver 2 – Residential dwellings located approximately 100m south-west of the site.

In addition, an in-principle review of construction noise and vibration impacts will be conducted. Relevant EPA and international construction noise and vibration guidelines will be identified and potential impacts on nearby development will be examined.

5.1 BACKGROUND NOISE MONITORING

Background noise levels at the nearest noise sensitive receivers were obtained using unattended noise loggers which were supplemented by attended measurements around the project site.

Unattended background noise monitoring was conducted from the 19th to the 26th September 2017, using an Acoustic Research Laboratories noise monitor set to A-weighted fast response. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. The location of the background noise monitors are as follows:

- **Logger Location 2 (refer to figure 1)**: Located near the residential receivers to the north-east of the site. Refer to Appendix 2 for the noise monitoring data.
- **Logger Location 3 (refer to figure 1)**: Located near the residential receivers to the south-west of the site. Refer to Appendix 3 for the noise monitoring data.

Measured background noise levels are presented below.

Table 6 - Measured Rating Background Noise Levels

Monitor Location	Background noise level dB(A)L_{90}		
	Daytime (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Logger Location 2: Residents to the North-East	43	32	30* (27)
Logger Location 3: Residents to the South-West	40	31	30* (27)

*As stated in section 3.1.2 of the NSW EPA Industrial Noise Policy, where the rating background noise level is measured to be less than 30dB(A)L_{90}, it is then to be set to 30dB(A)L_{90}.

In addition, background noise spectrums obtained from the attended measurements are presented in the table below:

Table 7 – Background Noise Spectrum (dB)

Location	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-weighted level
At Residential Receiver 1	48	48	44	39	38	36	32	29	22	**43**
At Residential Receiver 2	44	44	38	34	35	36	31	25	19	**40**

5.2 ACOUSTIC OBJECTIVES

Noise emissions from the development will have to achieve the following requirements.

5.2.1 Pittwater Council 21 Development Control Plan 2014

Section C1.6 of the Pittwater Council 21 Development Control Plan 2014 states the following regarding noise emissions from residential development:

"C1.6 Acoustic Privacy

Controls

Noise generating plants including pool/spa motors, air conditioning units and the like shall not produce noise levels that exceed 5dB(A) above the background noise when measured from the nearest property boundary.

Developments must comply in all respects with the Protection of the Environment Operations Act 1997, and other relevant legislation."

5.2.2 Protection of the Environment Operations Act 1997

The Protection of the Environment Operations Act stipulates that a site should not emit "offensive noise" to a residential receiver, however the Act does not quantitatively define what constitutes an offensive noise.

In our opinion, compliance with the Industrial Noise Policy is satisfactory to demonstrate that a particular noise is not offensive.

5.2.3 NSW EPA Industrial Noise Policy

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

5.2.3.1 Intrusiveness Criterion

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

Background noise levels adopted are presented in Section 5.1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

Table 8 - Intrusiveness Noise Emission Goals

Location	Period/Time	Intrusiveness Noise Emission Goal dB(A) $L_{eq(15min)}$
Receiver 1: Residents to the North-East	Day (7am-6pm)	48
	Evening (6pm-10pm)	37
	Night (10pm-7am)	35
Receiver 2: Residents to the South-West	Day (7am-6pm)	45
	Evening (6pm-10pm)	36
	Night (10pm-7am)	35

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

For the purposes of this condition:

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

Table 9 - Amenity Noise Emission Goals

Location	Period/Time	Amenity Noise Emission Goal dB(A) $L_{eq(Period)}$
Nearby Residences – Suburban Receiver	Day (7am-6pm)	55
	Evening (6pm-10pm)	45
	Night (10pm-7am)	40

5.2.4 Protection of the Environmental Operation Act Regulation 2000

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

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

52 Air Conditioners

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

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

5.2.5 Liquor and Gaming NSW

When assessing noise emissions from a licensed premises (in this case, the a la carte restaurant, bar and café), noise emissions must comply with the acoustic requirements imposed by Liquor and Gaming, NSW:

These guidelines relate to noise generated by patrons and by music. The requirements are set out below:

- *That the L_{10} noise level emitted from the premises shall not exceed 5dB above the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the boundary of the nearest affected residential premises.*

- *L_{10} noise level emitted from the premises shall not exceed the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) after midnight when assessed at the boundary of the nearest affected residential premises.*

- *After midnight, noise emissions from the Place of Pubic Entertainment are to be inaudible within any habitable rooms in nearby residential properties.*

Corresponding noise emission criteria from patrons/music are as follows:

Table 10 – Liquor and Gaming Noise Emission Criteria at Residential Receiver 1 to the North-East

Time of Day	Criteria	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt.
Day (7am-6pm) (External Noise Goal)	**43BG+5**	53	53	49	44	43	41	37	34	27	**48**
Evening (6pm-10pm) (External Noise Goal)	**32BG+5**	42	42	38	33	32	30	26	23	16	**37**

Table 11 – Liquor and Gaming Noise Emission Criteria at Residential Receiver 2 to the South-West

Time of Day	Criteria	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-Wt.
Day (7am-6pm) (External Noise Goal)	**40BG+5**	49	49	43	39	40	41	36	30	24	**45**
Evening (6pm-10pm) (External Noise Goal)	**31BG+5**	40	40	34	30	31	32	27	21	15	**36**

We note that the a la carte restaurant, bar and café will not operate after 10pm.

5.2.6 Construction Noise Impacts - EPA Interim Construction Noise Guidelines (ICNG)

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level*. Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise affected level". For residential properties, the "noise affected" level occurs when construction noise exceeds ambient levels by more than:
    - 10dB(A)$L_{eq(15min)}$ for work during standard construction hours (7am-6pm Monday to Friday and 8am to 1pm on Saturdays); and
    - 5dB(A)$L_{eq(15min)}$ for work outside of standard construction hours.
- "*Highly noise affected level"*. Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise affected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

A summary of noise emission goals for both standard hours of construction and outside standard hours are presented below (based on measured background noise levels presented in section 5.1).

Table 12 – Construction Noise Emission Goals

Location	**Acoustic Criteria dB(A)$L_{eq(15min)}$**	
	"Noise Affected" Level	**"Highly Noise Affected" Level**
Receiver 1 to North-East	53 (Standard Construction Hours) 37 (Outside Standard Hours - 6pm-10pm) 35 (Outside Standard Hours - 10pm-7am)	75
Receiver 2 to South-West	50 (Standard Construction Hours) 36 (Outside Standard Hours - 6pm-10pm) 35 (Outside Standard Hours - 10pm-7am)	75

5.2.7 Construction Vibration Impacts

The following guidelines will be adopted to address construction vibration impacts:

- German Standard DIN 4150-3 (1999-02): *"Structural Vibration – Effects of Vibration on Structures"* – which will be used to assess and limit building damage risk.

- EPA Assessing Vibration a technical guideline – which contains guidelines to assess and limit impacts on building occupant's amenity.

Site investigation indicated that the nearest vibration sensitive receivers are:

- Receiver 1 – Residential dwellings located approximately 40m north-east of the site;

- Receiver 2 – Residential dwellings located approximately 100m south-west of the site.

The criteria and the application of this standard are discussed in separate sections below.

5.2.7.1 Building Damage Limit

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 5.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 13 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

5.2.7.2 Amenity Criteria

Table 2.2 of EPA "Assessing Vibration: A technical guideline" specifies the following vibration goal for human comfort:

Table 14 –Preferred and Maximum Weighted RMS values Vibration Acceleration (m/s^2) 1-80 Hz

Location	Assessment Period	Preferred Values Z-axis	Preferred Values X & Y-axis	Maximum Values Z-axis	Maximum Values X & Y-axis
Continuous Vibration					
Residences	Day time	0.010	0.0071	0.020	0.014
Impulsive Vibration					
Residences	Day time	0.03	0.21	0.60	0.42

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA "Assessing Vibration: A technical guideline" detailed as below.

Table 15 - Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Day time preferred value	Day time maximum value
Residences	0.20	0.40

5.3 NOISE EMISSION ASSESSMENT

5.3.1 Mechanical Plant

Detailed plant selection has not been undertaken at this stage, as plant selections and location of plant items have not been determined. Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels. Satisfactory levels will be achievable through appropriate plant selection and location and, if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

Noise emissions from all mechanical services plant to the closest residential receiver should comply with the noise emission criteria in Section 5.2.

5.3.2 Noise from Cars Entering/Exiting the Development

Residents/visitors will access the basement car park of the site via a driveway running off from Cabbage Tree Road and running along the southern boundary of the site.

Noise from vehicles entering the site and driving into/within the car park will be assessed. Noise emissions are predicted based on the following assumptions:

- Cars travel on site at approximately 10km/h. Car sound power of 84dB(A)L_{eq} when travelling at this speed.
- During the day time period (7am-6pm), there may be up to 80 vehicle movements from the site in a one hour period;
- During the evening period (6pm-10pm), there may be up to 50 vehicle movements from the site in a one hour period;
- During the night time period (10pm-7am), there may be up to 30 vehicle movements from the site in a one hour period.

Noise emissions will be assessed against the Intrusiveness criteria of the Industrial Noise Policy as detailed in section 5.2.3.1.

Predicted noise levels at the nearest receivers from cars entering/exiting the site are presented in the table below.

Table 16 – Vehicle Noise Emission

Noise Source	Receiver Location	Time of Day	Predicted Noise Level dB(A)$L_{eq(15min)}$	Noise Emission Criteria dB(A)$L_{eq(15min)}$*	Complies?
Cars Entering/Exiting the Site	R1: Residents to the North-East	Day (7am-6pm)	39	48	Yes
		Evening (6pm-10pm)	37	37	Yes
		Night (10pm-7am)	34	35	Yes
	R2: Residents to the South-West	Day (7am-6pm)	27	40	Yes
		Evening (6pm-10pm)	25	36	Yes
		Night (10pm-7am)	22	35	Yes

*For intermittent, peak periods of use it is the INP Intrusiveness criteria (which utilises a $L_{eq(15min)}$ noise descriptor which is most appropriate. Long term average noise levels (4-11 hours, depending on the period being considered) used in the Amenity Criteria are not appropriate when assessing peak periods of noise generation from a driveway.

5.3.3 Noise from the Gym and Swimming Pool

Typical noise emissions from the gym and swimming pool have been assessed against the Intrusiveness criteria of the Industrial Noise Policy as detailed in section 5.2.3.1.

Noise levels to be used for the assessment have been based on measurements conducted by this office in a commercial gym and swimming pool. It is unlikely that the use of the proposed gym and pool (which form part of an aged care facility) will generate noise levels as high as those of a commercial gym and swimming pool, and so this will provide a conservative assessment.

Noise emissions will be predicted based on the following:

- A sound pressure level of up to 75dB(A) in the gymnasium area, assuming no amplified music through a PA system.
- A sound pressure level of up to up to 65dB(A) within the swimming pool. This would be more associated with a commercial swimming pool with coaches loudly instructing swimmers.
- All windows of the gym and swimming pool are open.

The noise level at the nearest receivers was predicted using the above data and by taking into account any noise reduction provided by the building fabric, distance losses, directivity, and barrier effects, etc.

Table 17- Predicted Noise Levels – Cumulative Noise from Gym and Swimming Pool

Noise at Most Affected Receivers (External Boundary)	Predicted Noise Level dB(A) $L_{eq,\ 15min}$	Period/Time	Noise Emission Objective dB(A)$L_{eq(15min)}$	Complies
R1: Residents to the North-East	29	Day Time (7am – 6pm)	48	Yes – at all times
		Evening (6pm – 10pm)	37	
		Night (10pm – 7am)	35	
R2: Residents to the South-West	33	Day Time (7am – 6pm)	40	Yes – at all times
		Evening (6pm – 10pm)	36	
		Night (10pm – 7am)	35	

5.3.4 Patron/Music Noise from the A La Carte Restaurant, Bar and Café

The a la carte restaurant, bar and café will be licensed premises.

The proposed operating hours of the a la carte restaurant and café facility are as follows:

- 10am-4pm Tuesdays to Saturdays;
- 6pm-10pm Fridays and Saturdays.

This office has been advised that the a la carte restaurant and café will never operate concurrently.

The bar facility will generally operate between 6pm-9pm.

Only background music is proposed a la carte restaurant, café and bar facility. However there may be up to six function events per year in the a la carte restaurant where live music may be played. This office has been advised that functions will finish no later than 10pm.

5.3.4.1 Predicted Noise Levels During Normal Use of the A La Carte Restaurant, Bar and Café (i.e. Not During a Function)

Predicted patron/music noise levels from the a la carte restaurant, bar and café at the nearest residents during normal use (i.e. not during a function) will be based on the following assumptions:

- The average sound power level per patron within the internal areas of the a la carte restaurant, bar and cafe (unraised voice) is 74dB(A)L_{10}, and that 1 in 3 patrons are assumed to be speaking at any one time.

- Background music playing in within the a la carte restaurant, bar and café with a spatially averaged internal sound pressure level of 70dB(A)L_{10}.

- For receiver 1: worst case scenario of 40 patrons in the café and 40 patrons in the bar.

- For receiver 2: worst case scenario of 40 patrons in the a la carte restaurant and 40 patrons in the bar.

- Predictions are made on the assumption that the building façade treatments outlined in section 4.3 have been implemented, and the recommendations in section 5.3.5 are adopted, namely:

    - 7am-6pm: All windows and doors of the a la carte restaurant, bar and café are open.

    - After 6pm: All windows and doors of the a la carte restaurant, bar and café remain closed except for patron ingress/egress.

Patron and music noise emissions will be assessed against the requirements of the NSW Liquor and Gaming as outlined in section 5.2.5. Predicted noise emissions are presented in the table below.

Table 18 – Predicted Noise Levels at Residential Receivers from Normal Use of the A La Carte Restaurant, Bar and Café

Receiver Location	Noise Source	Time of Day		Octave Band Noise Levels, dB									
				31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Receiver 1: Residents to the North-East	Patron/Music Noise from Café and Bar (Worst Case for this Receiver of 40 patrons in Café and 40 patrons in Bar)	Day 7am to 6pm	Predicted Noise Level L_{10}	34	34	38	38	42	40	34	26	21	43
			Criteria	53	53	49	44	43	41	37	34	27	**48**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Evening 6pm to 10p	Predicted Noise Level L_{10}	15	15	16	14	15	7	6	0	0	15
			Criteria	42	42	38	33	32	30	26	23	16	**37**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Receiver 2: Residents to the South-West	Patron/Music Noise from A La Carte Restaurant and Bar (Worst Case for this Receiver of 40 patrons in A La Carte Restaurant and 40 patrons in Bar)	Day 7am to 6pm	Predicted Noise Level L_{10}	33	33	35	36	39	37	32	24	20	41
			Criteria	49	49	43	39	40	41	36	30	24	**45**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Evening 6pm to 10pm	Predicted Noise Level L_{10}	14	14	13	12	12	4	4	0	0	12
			Criteria	40	40	34	30	31	32	27	21	15	**36**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.3.4.2 Predicted Noise Levels During Function in the A La Carte Restaurant

Predicted patron/music noise levels from the a la carte restaurant during a function will be based on the following assumptions:

- The average sound power level per patron within the internal area of the a la carte restaurant (raised voice) is 80dB(A)L_{10}, and that 1 in 3 patrons are assumed to be speaking at any one time.
- There are a maximum of 100 patrons in the a la carte restaurant during a function.
- Live music playing in within the a la carte restaurant with a spatially averaged internal sound pressure level of 90dB(A)L_{10}.
- Predictions are made on the assumption that the building façade treatments outlined in section 4.3 have been implemented, and the recommendations in section 5.3.5 are adopted: namely that all windows and doors of the a la carte restaurant are kept closed during functions.

Patron and music noise emissions will be assessed against the requirements of the NSW Liquor and Gaming as outlined in section 5.2.5. Noise emissions will be assessed against the most stringent evening time period (given that the functions are proposed to cease at 10pm). If noise emissions are compliant during the evening period, then they will be compliant during the day time period.

Predicted noise emissions are presented in the table below.

Table 19 – Predicted Noise Levels at Residential Receivers from Function in the A La Carte Restaurant

Noise Source	Receiver Location	Time of Day		Octave Band Noise Levels, dB									
				31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Patron/Music Noise from A La Carte Restaurant (during Function)	Receiver 1: Residents to the North-East	Evening 6pm to 10pm	Predicted Noise Level L_{10}	37	37	24	20	14	6	4	2	0	17
			Criteria	42	42	38	33	32	30	26	23	16	**37**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Receiver 2: Residents to the South-West	Evening 6pm to 10pm	Predicted Noise Level L_{10}	40	40	30	26	22	16	15	13	0	24
			Criteria	40	40	34	30	31	32	27	21	15	**36**
			Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.3.5 Recommendations

In order to ensure ongoing compliance with the noise emission criteria we make the following recommendations:

A La Carte, Bar and Cafe

- During normal use (i.e. not during a function):
    - A la carte restaurant and café are not to operate at the same time.
    - Maximum of 40 patrons in the a la carte restaurant, 40 patrons in the bar and 40 patrons in the café at any given time.
    - Amplified music noise level within the a la carte restaurant, bar and cafe to be limited to a sound pressure level of 70dB(A)L_{10} internally.
    - 7am-6pm:
        - All windows and doors of the a la carte restaurant, bar and cafe may remain open.
    - 6pm-10pm:
        - All windows and doors of the a la carte restaurant, bar and cafe are to remain closed except for patron ingress/egress.
- During function events in the A La Carte Restaurant:
    - Maximum of 100 patrons in the a la carte restaurant at any given time.
    - Live/amplified music noise level within the a la carte restaurant, bar and cafe to be limited to a sound pressure level of 90dB(A)L_{10} internally.
    - All windows and doors of the a la carte restaurant are to remain closed at all times during a function except for patron ingress/egress.
- Building shell of the facilities building to be constructed as per the recommendation in section 4.3.
- Garbage collection and deliveries are to take place between 7am and 6pm.
- Disposal of bottles/waste should be done prior to 10pm.

Mechanical Plant

- Detailed review of mechanical plant (typically refrigeration equipment, kitchen ventilation and air-conditioning) should be undertaken at CC stage, once plant selections and locations are finalised. Compliance with EPA Industrial Noise Policy requirements will be achievable using standard acoustic treatments (in duct lining/attenuators, equipment enclosures etc).

5.4 CONSTRUCTION NOISE IMPACTS

5.4.1 Construction Noise Emission Assessment

5.4.1.1 Source Noise Data

The A-weighted sound power levels for typical equipment/processes anticipated to be used during the construction of the project site are outlined in Table below.

Table 20 – Sound Power Levels

STAGE	EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)$Leq_{(15min)}$
Piling	CFA Piling	103
Excavation	Excavator	115
Construction	Angle grinders	105
	Electric Saw	102
	Drill	95
	Concrete Pump	105
	Cement Mixing Truck	105
	Electric Crane	96

The noise levels presented in the above table are derived from the following sources, namely:

- On-site measurements
- Table D2 of Australian Standard 2436-1981
- Data held by this office from other similar studies.

5.4.1.2 Construction Noise Emission Predictions

Indicative noise emissions from construction activities above have been predicted to the nearest noise receivers and are presented below.

Table 21 – Predicted Construction Noise Levels

Receiver Location	Noise Management Level	Predicted noise Level dB(A)$L_{eq,\ 15min}$		
		Piling	Excavation	Construction
Receiver 1: Residents to the North-East	53dB(A)$L_{eq(15min)}$	49-69	61-81	51-71
Receiver 2: Residents to the South-West	50dB(A)$L_{eq(15min)}$	44-54	56-66	46-56

*Note: noise management is required to mitigate the impact onto the nearest residential receivers, details refer to Section 5.4.1.3.

5.4.1.3 Construction Noise Discussion

Noise impacts on nearby development will be dependent on the activity and where on the site the activity is undertaken. Excavation and piling works tend to be the loudest typical activity. Work close to the eastern and southern boundary will have greatest impact on the residents on the surrounding residential development.

Initial analysis indicates:

- Excavation/soil retention phase - Primary noise emissions occur during excavation and earth retention (piling), with equipment items typically having sound power levels of approximately 115dB(A)$L_{eq(15min)}$. Excavators (dozers with bucket, saws or hammers) and piling works are typically the loudest activity during construction. Noise levels of up to 81dB(A) at the nearest existing residential development will potentially be generated, indicating that EPA acoustic criteria (refer to section 5.2.6) may be exceeded from time to time, especially when work takes place near the north-eastern boundary of the site.

- During erection of structure, it is the use of hand tools (angle grinders etc.) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)$L_{eq(15min)}$). Noise levels of up to 71dB(A) at the nearest existing residential developmentwill potentially be generated, indicating that EPA acoustic criteria (refer to section 5.2.6) may be exceeded from time to time, especially when work takes place near the north-eastern boundary of the site.

- Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels.

Noise impacts can be minimised using the following:

- Selection of equipment and process.

- Location of static plant (particularly concrete pumps).

- Use of screens or enclosures (typically only feasible for static plant).

- Scheduling of noisy activities and provision of respite periods.

Detailed construction noise planning is typically undertaken after engagement of a builder and a construction program is prepared (i.e. – after DA stage) and therefore, detailed planning is not possible at this stage.

In light of the above, we recommend:

- On completion of the construction program, acoustic review of proposed construction activities and plant/methods should be undertaken to identify work items likely to exceed EPA guidelines.

- For those activities likely to generate high noise levels, the analysis should identify where on the site are the areas likely to result in high noise levels. This will then assist in determining the likely time period for which high noise levels will occur.

- Identify feasible acoustic controls or management techniques (use of screens, scheduling of noisy works, notification of adjoining land users, respite periods) when excessive levels may occur.

- For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent excessive impact.

5.5 CONSTRUCTION VIBRATION IMPACTS

Excavation and earth retention works (piling) are the primary vibration generating activities.

Vibration impacts on the nearby existing residential development (receivers 1 & 2) are unlikely to exceed the criteria outlined in section 5.2.7.

In order to minimise vibration impacts, we recommend the following:

- Where practicable, excavation in rock should be done using rock saws as opposed to pneumatic hammers.

- If piling is required, use of augured should be used rather than impact piling.

Adoption of the above will provide a framework to ensure that appropriate systems for monitoring and management of vibration can be implemented.

6 CONCLUSION

This report presents an acoustic assessment of noise impacts associated with the proposed residential aged care facility (RACF) to be located along Cabbage Tree Road, Bayview.

Provided that the treatments set out in section 4.3 of this report are employed, internal noise levels shall comply with the requirements below:

- Pittwater Council 21 Development Control Plan 2014;
- Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*;

External noise emissions criteria have been setup in this report to satisfy the requirements from the following documents;

- Pittwater Council 21 Development Control Plan 2014;
- NSW EPA Industrial Noise Policy;
- NSW Liquor and Gaming.

Noise emissions from the proposed development will comply with the noise emission requirements provided that the recommendations outlined in section 5.3.5 are implemented.

In addition, an indicative assessment of construction noise and vibration impacts associated with the site has been presented in sections 5.4 and 5.5. A detailed review of construction noise and vibration impacts should be undertaken once a building contractor has been appointed.

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
George Kinezos

APPENDIX 1 – UNATTENDED NOISE MONITORING DATA – LOCATION 1 (ALONG CABBAGE TREE ROAD)

APPENDIX 2 – UNATTENDED NOISE MONITORING DATA – LOCATION 2 (NEAR RESIDENTS TO THE NORTH-EAST)

APPENDIX 3 – UNATTENDED NOISE MONITORING DATA – LOCATION 3 (NEAR RESIDENTS TO THE SOUTH-WEST)