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Car Park Noise Emission Assessment

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1 INTRODUCTION

This report presented an assessment of potential operational noise likely to be associated with the proposed car park associated with the Stage 3A and 3B development of Lismore Base Hospital.

This report will:

- Identify relevant Council and Environmental Protection Authority (EPA) noise emission criteria applicable to the development (including an assessment of potential sleep disturbance from use of the car park between 10pm and 7am).
- Identify nearby noise sensitive receivers and car park noise sources with the potential to adversely impact nearby development.
- Predict car park noise emissions and assess them against acoustic criteria.
- If necessary, determine building and/or management controls necessary to ensure ongoing compliance with noise emission goals.

2 SITE DESCRIPTION AND PROPOSED WORKS

The proposed car park is to be located on the portion of land between Uralba and Dalziell Street. Stage 1 and 2 of the car park will provide approximately an additional 500 spaces for the hospital. Ingress and egress for the car park is provided from Uralba Street, with Dalziell Street being used for exits only.

The proposed multi-deck car park will provide car parking spaces, motorbike parking, bicycle parking and accessible parking that will be used by Lismore Hospital doctors, staff, patients and visitors.

It is envisaged that the car park will operate 24 hours a day, seven days a week.

Development in the vicinity of the site consists of:

- The north-eastern boundary of the site is bounded by residential properties.
- To the north, across Uralba Street lies Lismore Base Hospital buildings.
- The southwest boundary of the proposed car park abuts the University Centre and student accommodation.
- The site is bounded to the south by Dalziell Street. The residential properties on Dalziell Street face the exit to the multistorey car park.

The residential developments on Uralba and Dalziell Streets represent the nearest potentially affected receiver locations. Compliance with criteria at these locations would result in compliance at all other residential locations and interior Hospital locations.

Figure One details the site map and potentially affected surrounding receivers. Figure Two presents the proposed site.

3 NOISE DESCRIPTORS

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 traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

L_1 levels represent is the loudest 1% noise event during a measurement period.

4 NOISE EMISSION CRITERIA

4.1 DISCUSSION OF CRITERIA

Given the low level of background noise in the Lismore area surrounding the hospital, strict compliance with the noise emission requirements of the EPA Industrial Noise Policy is not possible (particularly the intrusiveness criteria, which is calculated with reference to existing background noise levels). Due to the low background noise levels, there is a reasonably large exceedance of the intrusiveness criteria “BG+5” noise emission goal, even though the predicted noise generation is relatively low as an absolute level (54dB(A)).

We note that there is likely to be substantial community benefit (particularly the reduction in the need for on-street parking) associated with the development. The consent authority will therefore need to balance between acoustic impacts and other benefits associated with the development.

In weighing up the acoustic impact, we note that the noise generated by the car park will be compliant with the EPA permitted vehicle noise generation by cars on public roadways. In this regard we note:

- The primary noise source of associated with the development will be from vehicles. Noise created by vehicles driving within the car park would be similar in nature to noise from cars intermittently driving along a roadway.
- The generated noise has two components; noise generated on the public road (which is governed by the EPA Road Noise Policy) and noise generated on the site (which is governed by the EPA INP).
- Although the noise source in either case is similar (vehicle noise), the acoustic criteria change as a result of the car moving from private land (the hospital) to public land (the roadway).
- It is only the noise component on site which results in a non-compliance with the NSW Industrial Noise Policy due to the relatively low background noise levels. Noise generated on the roadway itself is compliant.
- In the event that the noise created on private property (in the car park) is eliminated, there will still be vehicle noise impacting the residences as a result of traffic movement on the roadway.
- The EPA Road Noise Policy permits that the road traffic noise can generate levels of up to 55dB(A) at the residential building façade. Therefore, even in the event that noise from the car park building itself could be completely eliminated, noise levels of 55dB(A) could still reasonably be generated at the street facades of the residences purely as a result of the additional road traffic created by the site.
- A noise level of 55dB(A) at the street façade would still result in noise levels of approximately 52dB(A) at the side facades (facing the car park).

- The predicted noise level from the car park building is approximately 54dB(A) in a peak hours “worst case scenario” situation at the residential facades. This is only marginally louder than the noise level which would occur as a result of road traffic only.

Although the car park (being located on private property) would not typically be assessed using acoustic criteria applied for noise on public roads, the analysis presented above is intended to provide an illustration of impact of the absolute noise generated by the car park, and to demonstrate that the vehicle noise impact associated with the car park is not out of keeping to what would be considered acceptable if the same vehicle noise occurred on a roadway.

4.2 NSW ROAD NOISE POLICY

The NSW Road Noise Policy states that for land use developments with the potential to create additional traffic, noise emissions should comply with the criteria presented in Table 1. Uralba Street and Dalziell Street have been deemed “local roads” for the purposes of this assessment.

Noise levels generated by traffic should not exceed the noise levels set out in the table below when measured at a nearby property.

Table 1 - Criteria for Traffic Noise Generated by New Developments

Time of day	Criteria for Acceptable Traffic Noise Level Local Roads
Day (7am to 10pm)	55 L _{Aeq} (1hr)
Night (10pm to 7am)	50 L _{Aeq} (1hr)

4.3 SLEEP AROUSAL ASSESSMENT

Sleep arousal is a function of both the noise level and the duration of the noise. 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 test takes into account the noise level and number occurrences of each event with the potential to create a noise disturbance. Section 5.4 of the EPA Road Noise Policy states that maximum internal noise levels between 50–55dBA L_{Max} are unlikely to cause awakening reactions, and that one or two noise events per night with maximum internal noise levels of 65–70 dBA L_{Max} are not likely to affect health and wellbeing significantly. For the purposes of this assessment, a maximum internal noise goal of 55dB(A) L_{Max} has been adopted.

4.4 CONSTRUCTION NOISE CRITERIA

It is proposed to utilise Australian Standard AS2436:1981 “*Guide to noise control on construction, maintenance and demolition sites*”, which is the standard commonly applied by Councils for the regulation of construction noise, the New South Wales Construction Noise Guideline developed by The NSW Environmental Protection Authority (EPA) and OH&S requirements are presented in this section of the report.

4.4.1 Australian Standard AS2436:1981 “Guide to noise control on construction, maintenance and demolition sites

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites AS2436:1981 *“Guide to noise control on construction, maintenance and demolition sites”* nominates the following:

- a. That reasonable suitable noise criterion is established,
- b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and
- c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the demolition, excavation and construction site.

4.4.2 EPA Construction Noise Guideline

The Environmental Protection Authority (EPA) have developed a specific construction noise guideline in the aid of reducing the impact of construction associated noise.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic compromises between construction sites and potential noise affected receivers.

4.4.2.1 EPA Construction Noise Guideline - Qualitative Assessment Method

The guideline refers to a qualitative assessment method in which construction noise is assessed on a case by case basis with regard to various activities to be conducted on site. This assessment method was developed to smaller scale projects.

Essentially this method of assessment requires that the proponent take into consideration and employ all reasonable and feasible measures to ensure that the impact on noise receivers is minimised. This is generally conducted in the following manner:

- The drafting of a noise management plan outlining all reasonable and feasible mitigation methods for the reduction of noise impact;
- The assessment of high impact equipment such as rock-hammers and piling equipment for lower noise producing methods of construction/excavation;
- The implementation of a complaints handling register and community consultation system;
- Employee (builders, contractors etc) education in effective noise reducing techniques and site etiquette; and
- The operation of plant in a quiet and efficient manner (i.e. turning off machinery when not in use).

This qualitative assessment method has been used for the basis of this report and has been used as the basis for the development of acoustic management and treatments of proposed construction activities.

In addition, the guideline specifies goals which can be used in the effort of minimising noise from construction related activities. These noise goals are presented within the table below.

Table 2 – EPA Recommended Construction Noise Goals

Governing Body	Receiver Type	External sound level Goal, Leq 15 min dB(A)
EPA	Residential	Background + 10 dB(A) ¹ – Noise Affect Level
		75 dB(A) ² – Highly Noise Affected Level
	Hospitals	45 dB(A) Internal Noise Level

1: Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. (EPA CNG, 2008).

2: Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. (EPA CNG, 2008).

These criteria for resultant noise from construction activities are aimed at maintaining comfort levels within the surrounding residential dwellings. Additionally, noise mitigation techniques as discussed in this report should be used if noise emissions exceed the above criteria. All work is to be carried out in accordance with AS 2436:1981 *“Guide to noise control on construction, maintenance and demolition sites”*.

4.4.3 OH&S Guidelines

Regulation 49 of the Occupational Health and Safety Regulation specifies maximum levels of noise which a ‘worker’ may be exposed to. Acoustic treatment to the work environment or hearing protection is recommended for workers exposed to higher noise levels. These maximum OH&S noise levels are presented in the table below.

Table 3 – OH&S Maximum Noise Level Exposure

	Energy Averaged Over 8 Hour Day	Maximum Noise Level During Day
OH&S maximum noise level exposure	85 dB(A) L_{eq}	140 dB(C) P_{peak}

4.5 CONSTRUCTION VIBRATION CRITERIA

Construction vibration criteria associated with works on the Lismore Base Hospital Stage 3 Project when measured at the potentially affected receivers should not exceed the following sets of vibration criteria to ensure no architectural or structural damage to surrounding buildings and human comfort is maintained. These standards have been selected as they are widely used in the assessment of vibration associated with construction activities within Australia, namely:

- German Standard DIN 4150-3 (1999-02): *“Structural Vibration – Effects of Vibration on Structures”*; and
- British Standard BS 6472:1992 *“Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)”*.

The criteria and the application of these Standards are discussed in separate sections below.

4.5.1 German Standard DIN 4150-3 (1999-02)

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 the Table below.

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 4 – 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 (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8

4.5.2 British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to “*adverse comment*”, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 3.

Table 5 – BS 6472:1992 Criteria to Avoid “Adverse Comment”

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause “Adverse Comment”			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

The limits indicate that people in buildings are significantly less susceptible to horizontal vibration than to vertical vibration. Furthermore, Section 4.1 of BS 6472 notes that situations can exist where vibration magnitudes above those generally corresponding to minimal “*adverse comment*” levels can be tolerated, particularly for temporary disturbances and infrequent and intermittent events such as those associated with construction projects.

5 NOISE EMISSION ASSESSMENT

The operational noise emissions will be assessed below. The assessment of the following noise sources will be undertaken:

- Average noise from the use of cars manoeuvring and parking will be assessed with reference to the NSW Road Noise Policy.
- Peak noise from the use of car park (cars starting, doors closing) will be assessed with reference to the NSW Road Noise Policy and be reviewed for the potential to cause sleep disturbance.

5.1 AVERAGE NOISE

Noise associated with the use of the car park will likely consist of:

- Cars entering and exiting the car park;
- Cars manoeuvring within the car park; and
- Cars parking

Predictions will be made based on the following data/assumptions:

- A car when driving in a car park has a sound power level of approximately 84dB(A) L_{eq} ;
- Relative position of noise source and noise receiver, taking into account distance attenuation, air absorption, adverse weather and noise screening (where appropriate); and
- During a peak hour during the 7am to 10pm period, there will be no more than 400 entrances exits.
- During a peak hour during the 10pm to 7am period, there will be no more than 100 car entrances or exits.

Operational noise levels are predicted and assessed against relevant criteria from the NSW Road Noise Policy. All predicted levels are based on the implementation of treatments nominated in Section 6.

Table 6 - Car Par Noise Assessment - Day

Receiver Location	Noise Source	Predicted Noise Level – dB(A)$L_{eq}(1\text{ hour})$	Acoustic Criteria Day dB(A)$L_{eq}(1\text{ hour})$	Complies?
Uralba Street Residences	Cars entering from Somerset Street and manoeuvring within the car park/parking	54 dB(A) $L_{Aeq}(1hr)$	55 dB(A) $L_{Aeq}(1hr)$	Yes
Dalziell Street Residences	Cars exiting to Dalziell Street and manoeuvring within the car park/parking	50dB(A) $L_{Aeq}(1hr)$	55dB(A) $L_{Aeq}(1hr)$	Yes

Table 7 - Car Par Noise Assessment - Night

Receiver Location	Noise Source	Predicted Noise Level – dB(A)$L_{eq}(15min)$	Acoustic Criteria Night dB(A)$L_{eq}(15\text{ min})$	Complies?
Uralba Street Residences	Cars entering from Somerset Street and manoeuvring within the car park/parking	49 dB(A) $L_{Aeq}(1hr)$	50 dB(A) $L_{Aeq}(1hr)$	Yes
Dalziell Street Residences	Cars exiting to Dalziell Street and manoeuvring within the car park/parking	45 dB(A) $L_{Aeq}(1hr)$	50 dB(A) $L_{Aeq}(1hr)$	Yes

5.2 PEAK NOISE EVENTS (SLEEP AROUSAL)

As the car park may be used between 10pm and 7am, an assessment of potential sleep arousal at the nearest residential properties will be undertaken.

The loudest peak noise source with the potential for sleep arousal is a car door slamming. This has been has been measured by the office have a sound power level of 92dB(A) L_{Max} .

All predictions take into account the relative position of noise source and noise receiver, distance attenuation, air absorption and noise screening (where appropriate). All predictions are based on a “windows open” scenario at the receivers’ location.

Predicted noise levels are as follows:

Table 8 - Sleep Arousal Test

Receiver Location	Noise Source	Predicted Noise Level	Sleep Disturbance Criteria
Uralba Street Residences	Car door shutting on north eastern boundary of site	50dB(A) L _{Max}	55dB(A)L _{Max}
Dalziell Street Residences	Car door shutting on southern boundary	47dB(A))L _{Max}	55dB(A)L _{Max}

All peak noise events associated with the operation of cars within the car park comply with NSW EPA Road Noise Policy sleep disturbance goals.

5.3 CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Excavation and piling works tend to be the loudest typical construction activity. Work close to the eastern and southern boundaries will have greatest potential impact on the residents. Detailed acoustic assessment of individual activities cannot be undertaken prior to knowing the activities/construction methods proposed, their duration and location.

However, based on Initial analysis:

- Excavation phase - Primary noise emissions occur during excavation and earth retention (piling), with equipment items typically having sound power levels of approximately 115dB(A)_{Leq(15min)}. Noise levels exceeding EPA “Noise affected” target are likely to occur, particularly at residences on Uralba Street to the east. Noise levels exceeding the “Highly Noise Effected” level of 75dB(A) at the residences are unlikely to occur for extended periods.
- During erection of structure, it is the use of hand tools and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)_{Leq(15min)}). Noise levels exceeding EPA “Noise Affected” levels are likely to occur. In addition, slab finishing works (use of helicopter floats or similar) will potentially extend after 6pm depending on the size of the slab and weather conditions. Noise levels exceeding the “Highly Noise Effected” level of 75dB(A) at the residences is unlikely to occur.
- Once construction of the building shell is complete, noise from hand tools will be relatively low. Vehicle noise and crane noise will create the greatest possibility of noise disturbance during this phase.

Noise impacts can be minimised using the following:

- Careful planning/scheduling of noisy works, particularly when located near the eastern and southern property boundaries.
- Location of static plant (concrete pumps, cranes) as far as practicable away from the eastern and southern boundaries is recommended.

- Use of augured rather than driven or vibratory piling should be considered if feasible.
- Location of vehicular access points during construction as far from the eastern property boundary as possible to reduce noise impact on the residences.
- Letter box drops or similar to advise residents on activities with the potential to result in noise levels reaching the “Highly Noise Effected” noise level (rock excavation within 20m of eastern property boundary). Leaflet should advise of the likely duration of the activity.

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 the extent and duration of potential exceedances of EPA construction noise management levels.
- Identify feasible acoustic controls or management techniques (for example, selection of plant, use of screens around static plant, scheduling of noisy works, notification of adjoining land users, respite periods) when exceedance of management noise 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 unreasonable impact.

5.3.1 Construction Vibration

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

Given the distance between the site and the nearest residential buildings, it is unlikely that construction vibration will exceed EPA guidelines.

However, as a precaution, if bulk excavation in rock or driven/vibrated piles are proposed, we recommend that where practicable, excavation in rock should be done using rock saws as opposed to pneumatic hammers.

6 RECOMMENDATIONS

The following development controls should be incorporated to ensure that the noise emissions from the car park comply with NSW EPA Road Noise Policy.

- The car park pavement shall be smooth and level to ensure minimal vertical displacement and potential for noise generated by wheel to concrete impacts. The surface finish shall be of a type that minimises squealing of car tyres.
- Concrete to have a broom finish or similar, to prevent tyre squeal.
- Signs reminding staff and visitors to minimise noise at night shall be installed at entry and exit points from the car park.
- Traffic calming devices should be applied to control vehicle speeds 20km/Hour.
- No speed humps are to be installed within the car park.
- Grates and any cover plates are to be fixed flush and tight.
- A detailed construction noise and vibration management plan should be undertaken following preparation of the construction program. Review of the mitigation techniques outlined in section 5.3 of this report should be conducted, and implemented where feasible.

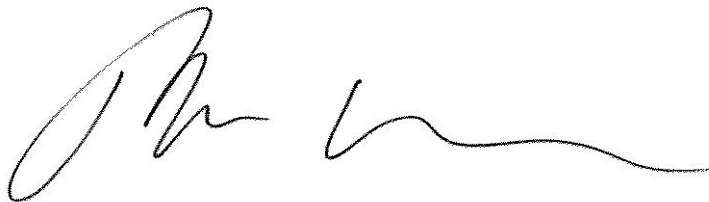
7 CONCLUSION

This report presents an assessment of noise emissions from the proposed Lismore Base Hospital car park. Noise emissions associated with the proposed Lismore Base Hospital multistorey car park have been assessed with reference to the recommended noise levels presented within the NSW EPA Road Noise Policy.

Noise emissions during the construction phases of the car park assessed and noise mitigation techniques have been presented in Section 5.3.

Provided that the recommendations presented in Section 6 of this report are adopted, noise emissions from the operation of the site will comply with the NSW EPA Road Noise Policy.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Tom Aubusson', with a long horizontal flourish extending to the right.

ACOUSTIC LOGIC CONSULTANCY PTY LTD
Tom Aubusson