QUEANBEYAN-PALERANG REGIONAL COUNCIL

JULY 2018

New Cemetery at 1241 Old Cooma Road, Googong

Noise Impact Assessment

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New Cemetery at 1241 Old Cooma Road, Googong
Noise Impact Assessment

Queanbeyan-Palerang Regional Council

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GLOSSARY

'A' Frequency Weighting (dBA)	The 'A' frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child's scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The 'A' weighting is the most commonly used frequency weighting for occupational and environmental noise assessments.
Ambient Noise	The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Ambient Noise is usually assessed as an energy average over a set time period 'T' ($L_{Aeq, T}$).
'C' Frequency Weighting (dBC)	The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.
Decibel	The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from 10 log10 (10(50/10) + 10(50/10)) and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.
Equivalent Continuous Sound Level, L_{Aeq}	Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/ averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.
'F'(Fast) Time Weighting	Sound level meter design-goal time constant which is 0.125 seconds.
Frequency	The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

Octave band	Frequencies are divided into octaves. An octave band is defined as a range of frequencies extending from one frequency to exactly double that frequency. For example, the 1000 Hz octave band is centred at 1000 Hz and extends from 707 Hz to 1414 Hz.
One-third (1/3) octave band	Data in one-third octave bands allow an analysis of spectral characteristics of a noise event at a higher resolution. A one-third octave band is approximately one-third the width of an octave band. One of the more frequent application of one-third octave band data is for the analysis of noise sources with potentially tonal characteristics (i.e. more attention-drawing).
Hertz (Hz)	The unit used to measure frequency of sound expressed by cycles per second.
Human Response to Noise Level Changes	Less than 3 dBA = No perceivable difference 3 dBA = Barely perceptible difference 5 dBA = Readily perceptible difference 10 dBA = 'Doubling' (or 'halving') of performance
Maximum Noise Level, L_{AFmax}	The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.
Sound Pressure Level (SPL)	The basic unit of sound measurement is the sound pressure level. The pressures are converted to a logarithmic scale and expressed in decibels (dB).
Sound Power Level (SWL)	Sound power level is a logarithmic measure of the sound power in comparison to a specified reference level.
Sound Attenuation	A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.
Statistical Noise Levels, Ln	Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example: – The noise level, in decibels, exceeded for 1% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF1, T}$. This may be used for describing short-term noise levels such as could cause sleep arousal during the night. – The noise level, in decibels, exceeded for 10% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF10, T}$. In most countries the $L_{AF10, T}$ is measured over periods of 15 minutes, and is used to describe the average maximum noise level. – The noise level, in decibels, exceeded for 90% of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as $L_{AF90, T}$. In most countries the $L_{AF90, T}$ is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.
Steady Noise	Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady".
'Z' Frequency Weighting	The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1-2004: 'Electroacoustics - Sound level meters – Specifications'.

1 INTRODUCTION

1.1 BACKGROUND

Queanbeyan-Palerang Regional Council has prepared a planning proposal for a new cemetery on land located at 1241 Old Cooma Road, Googong, as indicatively shown in Figure 1.1. The site is located approximately 11 kilometres south of Queanbeyan and approximately four kilometres south of the Googong urban release area, on the eastern side of Old Cooma Road and the southern side of Burra Road.

The site is currently zoned as E4 – Environmental Living as part of the Queanbeyan Local Environmental Plan 2012 (LEP).

This report has been prepared to assess the potential noise impacts associated with the proposed development.

Source: NSW Land & Property Information, https://maps.six.nsw.gov.au/, visited 19 April 2018

Figure 1.1 Site location

1.2 DETAILS OF THE PROPOSAL

Once operational, the cemetery is expected to accommodate 3 to 4 burial/funerals per week.

Noise sources associated with this activity include light excavation equipment equivalent to a farm tractor or backhoe, small truck and cars associated with a funeral procession. Outside of these ceremonies routine maintenance will include ride-on lawn mowers, whipper-snippers and other garden equipment.

The typical hours of operation would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am, and the occasional service occurring on weekends or after 4.00 pm on a weekday.

1.3 REFERENCED DOCUMENTS

For the purpose of the noise assessment, the following documents have been used to inform the requirement planning requirements and assessment criteria:

- *Queanbeyan Local Environmental Plan 2012 (LEP)*
- NSW *Protection of the Environment Operations (Noise Control) Regulation 2017* (POEO)
- NSW EPA *Noise Guide for Local Government* (NGLG)
- NSW EPA *Noise Policy for Industry* (NPfI)
- NSW EPA *Road Noise Policy* (RNP)
- NSW *Interim Construction Noise Guideline* (DECC)

2 SITE INVESTIGATIONS

2.1 NOISE SURVEY

To quantify the existing ambient noise environment surrounding the proposed project site, unattended noise monitoring using remote noise logging equipment, as well as operator-attended observations were undertaken between 23 February to 9 March 2018 (inclusive). Measurements were conducted at one location at the Project Site as shown in Figure 2.1 along with the identified nearest sensitive receivers, with results as summarised in Table 2.1.

The objective of the noise monitoring is primarily to establish the existing ambient background noise levels, which in turn would be used to determine the project specific trigger levels. The monitoring results obtained from the established noise monitoring location is regarded to be representative of the nearest receivers potentially impacted by the proposed development.

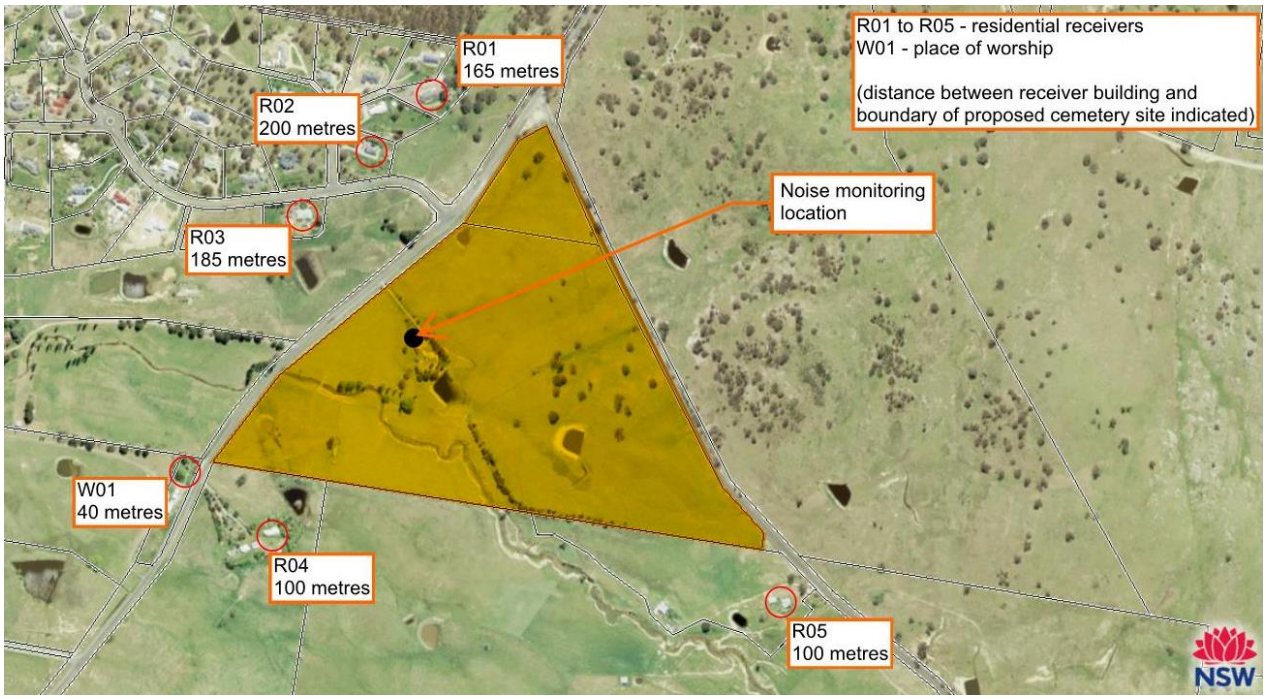

Figure 2.1 Aerial photograph indicating noise measurement position and nearby noise-sensitive receivers

Table 2.1 Summarised results of environmental noise survey

POSITION	DESCRIPTION	DATE & TIME	RESULT
Noise monitoring location (ARL EL-316 noise logger S/N 16-306-008)	Rating background noise level (RBL)	NPfI day period	RBL 33 dB $L_{A90\ (15min)}$
		NPfI evening period	RBL 36 dB $L_{A90\ (15min)}$
		NPfI night period	RBL 30 dB $L_{A90\ (15min)}$[1]
	Existing ambient noise level	NPfI day period	50 dB $L_{Aeq\ (15min)}$
		NPfI evening period	53 dB $L_{Aeq\ (15min)}$
		NPfI night period	44 dB $L_{Aeq\ (15min)}$

(1) Assumed to be 30 dBA, as per NPfI - if measured RBL is <30 dBA.

The local noise environment is generally dominated by road traffic noise along Old Cooma Road. Contributions from natural sounds such as birds and wind in the trees were also observed.

3 ACOUSTIC CRITERIA

3.1 KEY REQUIREMENTS

The key requirements for acoustic criteria applicable to the Project from each of the reference documents listed above are summarised in the subsections below.

3.1.1 QUEANBEYAN LOCAL ENVIRONMENTAL PLAN

The Project site is currently zoned as E4 – Environmental Living. The LEP does not however specifically contain any clauses in regard to noise.

3.1.2 PROTECTION OF THE ENVIRONMENT OPERATIONS (NOISE CONTROL) REGULATION

Part 4 Division 3 of the POEO prescribes maximum sound power levels associated with grass-cutting machines, as follow:

- Ride-on mowers ≤105 dBA
- Edge-cutters ≤100 dBA
- String trimmers ≤105 dBA

In addition, under *Part 4 Division 2 Air conditioners, Division 4 Power Tools* and *Division 5 Pumps and heat pump water heaters*, an air conditioner, pump or heat pump used on established premises must not be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry), whether or not any door or window to that room is open:

(i) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or

(ii) before 7 am or after 10 pm on any other day

The above requirement involves a subjective assessment of an internal noise level, which does not represent a quantifiable design parameter. It is common practice to derive an external noise level that is required to be achieved, based on the existing background noise level and a sound reduction of 10dB through an open window at the receiver location.

3.1.3 NOISE GUIDE FOR LOCAL GOVERNMENT

The NGLG provides guidance to council officers and planners with regard to planning and management of noise issues and the interpretation and application of the POEO. This document does not specifically address the use of cemetery, but it is expected that the outdoor machinery is similar to farm machinery (e.g. tractors), albeit in much less frequent and intensive use. The NGLG suggested implementation and consideration of reasonable and feasible best practices to manage any potential noise impact from these sources.

The NGLG requires that noise from these sources during operation must not be "offensive". In the absence of any specific requirement in the Queanbeyan LEP, it is recommended that the approach described in the NPfI (detailed below in Section 3.1.4) be used to develop noise criteria applicable during the day and evening period for any air conditioner, pump, heat pump, extraction fans associated with the proposed building/indoor areas as part of the cemetery development.

Section 4.3.3 of the NGLG provides regulations applicable to noise from motor vehicles, both in terms of restricted times of operation and an "offensive noise" condition. However, these requirements apply to the owner or operator of the motor vehicle and do not put any specific responsibility onto a developer to control vehicle noise within their project.

3.1.4 NOISE POLICY FOR INDUSTRY

The NPfI applies to industrial noise sources and is designed for large industrial and agricultural sources, but is also used as a planning instrument and referenced in the assessment of noise from other types of premises such as commercial premises. The assessment methodology of the NPfI is utilised to develop noise limits that can be nominated for the purposes of noise assessment of the proposed cemetery.

The NPfI process involves the determination of *project noise trigger levels*, which can then be adopted by the Responsible Authority as prescribed noise limits that can be nominated as a permit condition for a project.

- The project noise trigger level provides a benchmark which, if exceeded, indicates a potential noise impact.
- The project noise trigger level in each relevant time period (day, evening and night) is the lower value (i.e. more stringent) of the project intrusiveness noise level (based on existing background noise level) and the project amenity noise level (based on land use).
- The project noise trigger levels are summarised in Table 3.1. This is determined by considering both the intrusiveness noise levels and amenity noise levels per guidance provided in the NPfI. It should be noted that the intrusiveness noise levels alone are not used directly as regulatory limits. They should always be considered in conjunction with the amenity noise levels when determining the project noise trigger levels.

It is understood that the typical hours of operation would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday. No activities are expected to occur during the night time period.

It should be noted that the following time periods are applicable for the NPfI:

- Day: 7.00 am to 6.00 pm Monday to Saturday or 8.00 am to 6.00 pm Sundays and public holidays
- Evening: 6.00 pm to 10.00 pm
- Night: remaining periods outside of the defined periods for day and evening.

Table 3.1 NPfI project noise trigger levels

LAND USE	**NPfI NOISE LEVELS, dB $L_{Aeq, 15min}$**		
	D[1]	E[1]	N[1]
Intrusiveness noise levels Residential	38	41	35
Amenity noise levels[2]: Rural residential Place of worship (external, when in use)	50 50[3]	45 50	40 50
Project noise trigger levels: Residential Place of worship	38 50	38[4] 50	Not applicable as any activities within the cemetery ground are unlikely.

(1) Day (D) = 7am to 6pm, Evening (E) = 6pm to 10pm and Night-time (N) = 10pm to 7am.

(2) It is assumed that no other industrial sources are likely to be introduced in the project area in the future and that the existing ambient environment is not affected by any industry.

(3) Based on the prescribed internal amenity noise level of 40 dBA with a partially opened façade. A partially opened façade is estimated to provide a noise reduction of 10 dB.

(4) The NPfI recommends that the evening intrusiveness noise level be set at no greater than the day time levels. The intrusiveness noise level for the day time has therefore been adopted for the evening time period.

3.1.5 ROAD NOISE POLICY

Traffic noise criteria from RNP apply to the Project in terms the proposed development having the potential to create additional traffic on local road network. The noise assessment will consider the potential additional road traffic introduced by the proposed development and the likely associated relative increase in road noise.

It should be noted that the following time periods are applicable for the RNP:

- Day: 7.00 am to 10.00 pm
- Night: 10.00 pm to 7.00 am

3.1.6 CONSTRUCTION

3.1.6.1 NOISE

Impacts from construction noise are assessed using the ICNG. The ICNG defines the assessment method and suggests noise management measures based on the length of the works, the number of people affected and the time the works occur.

The ICNG specifies that construction Noise Management Levels (NMLs) are defined using the RBL plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours. The ICNG also states that where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered 'highly noise affected' and require additional considerations to mitigate potential impacts.

The ICNG assessment time periods are presented in Table 3.2.

Table 3.2 ICNG assessment periods

TIME OF DAY	NML, dB $L_{Aeq, 15min}$[1,2]	HOW TO APPLY
Recommended standard hours: Monday–Friday 7:00am–6:00pm Saturday 8:00am– 1:00pm Sundays or public holidays: No work	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: — times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) — if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

TIME OF DAY	NML, dB $L_{Aeq, 15min}$[1,2]	HOW TO APPLY
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

(1) Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

(2) The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NPfI.

3.1.6.2 CONSTRUCTION AIRBORNE NOISE MANAGEMENT LEVELS

The construction NMLs are calculated from the measured RBL for each assessment period for residential receivers and are presented in Table 3.3.

Table 3.3 Noise Management Levels (NMLs) at residential receivers

LAND USE	HIGHLY NOISE AFFECTED	STANDARD HOURS	OUTSIDE STANDARD HOURS	
		D[1]	E[1]	N[1]
RBL (Table 2.1)		33	36	30
NML correction (Table 3.2)		+10	+5	+5
Resulting NML dB $L_{Aeq, 15min}$, residential – areas with negligible transportation	**75**	**43**	**41**	**35**

(1) Day (D) = 7am to 6pm, Evening (E) = 6pm to 10pm and Night-time (N) = 10pm to 7am.

Table 3.4 lists the NMLs that have been adopted for non-residential sensitive receivers. The NMLs apply when premises are in use, during any time of day, evening or night.

Table 3.4 Noise Management Levels (NMLs) at sensitive land uses (other than residential)

LAND USE	NML $L_{eq(15\ MIN)}$ dBA
Commercial[1]	70
Place of Worship[2]	55
Active recreation	65
Passive recreation	60
Industrial[1]	75

(1) The external noise levels should be assessed at the most affected occupied point on the premises

(2) Assumed equivalent external noise level with windows open with a 10 dB external to internal noise level correction.

3.1.6.3 VIBRATION

In the worst cases, construction vibration can lead to:

- Cosmetic and structural building damage.
- Loss of amenity due to perceptible vibration, termed human comfort.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. Damage of this nature is typically described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic damage then structural damage is not considered a significant risk and will not be assessed any further.

COSMETIC BUILDING DAMAGE

British Standard BS 7358-2 provides guidance on the 'evaluation and measurement of vibration in buildings' and defines guidance for categorising building damage in terms of 'cosmetic', 'minor' and 'major'; providing limits for each. The cosmetic damage limits are presented in Table 3.5.

Table 3.5 BS 7385 Cosmetic damage criteria

GROUP	TYPE OF STRUCTURE	PEAK COMPONENT PARTICLE VELOCITY, mm/s [1]		
		4–15 HZ	15–40 HZ	40 Hz AND ABOVE
1	Reinforced or framed structures Industrial or heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 – 20[2]	20 – 50	50

(1) Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).

(2) At frequencies below 4Hz, a maximum displacement of 0.6mm (zero to peak) should not be exceeded.

These peak vibration limits are set so that the risk of 'cosmetic' damage is minimal. They have been set at the lowest level above which damage has been credibly demonstrated. The limits also assume that the equipment causing the vibration is only used intermittently, however if the equipment is used continuously, then the limits may need to be reduced by up to 50 per cent. For 'minor' or 'major' vibrational damage to occur, the standard states that vibration need to be two times and four times (respectively for group 1 and group 2) the values shown in Table 3.5.

HERITAGE STRUCTURES

Building structures classified as being of heritage significance are to be considered on a case by case basis, as a heritage listed structure may not be assumed to be more sensitive to vibration unless it is structurally unsound which is unlikely for a regularly maintained structure. Where a historic structure is deemed to be sensitive to damage from vibration following inspection by qualified structural and / or civil engineers, more conservative superficial cosmetic damage criterion based on peak component particle velocity (PPV) (German Standard DIN 4150-3: 1999 *Structural Vibration – Part 3: Effects of vibration on structures* or equivalent) should be considered.

A conservative vibration damage screening (trigger) PPV level of 7.5 mm/s has been adopted for heritage structures and has been established with reference to the minor cosmetic damage criteria in British Standard BS 7385 Part 2-1993. The vibration levels specified in this standard are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure.

Buildings that are potentially at risk of threshold or cosmetic damage would be identified by the contractor prior to the commencement of construction works. A Construction Noise and Vibration Management Plan (CNVMP) should include management at these locations including building condition surveys before the commencement of construction activities and after construction is completed. Where a historic building is deemed to be sensitive to damage from vibration

(structurally unsound), a conservative superficial cosmetic damage criterion of PPV 3mm/s peak component particle velocity (based on DIN 4150) may be applicable.

HUMAN COMFORT (AMENITY)

Vibration generated by construction works are generally considered as:

- Intermittent - where sources which operate intermittently, but which would produce continuous vibration if operated continuously.

As such, the limits Vibration Dose Values (VDV) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by construction work are taken from *Assessing Vibration: A Technical Guideline* (NSW EPA, 2006). These are detailed in Table 3.6.

Table 3.6 Vibration limits for human exposure from intermittent vibration

LOCATION	**ASSESSMENT PERIOD**	**VIBRATION DOSE VALUE (VDV), m/s$^{1.75}$**	
		PREFERRED VALUES	MAXIMUM VALUES
Critical areas	Day or night-time	0.10	0.20
Residences	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions, and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

4 OPERATIONAL NOISE ASSESSMENT

This section provides an assessment of the noise sources likely to be associated during operational stages of the proposed cemetery.

4.1 MOBILE MACHINERY

For the cemetery, burial and outdoor component of the proposed development, a number of mobile machineries are expected to be required as summarised in Table 4.1.

Table 4.1 On-site mobile machineries associated with the cemetery grounds

ITEM	LIKELY QUANTITY	LIKELY PERCENTAGE OF OPERATION DURING ANY 15-MIN PERIOD	SOUND POWER LEVEL (dBA)
Small excavator	1	100%	83
Small tipper truck	1	25%	85
Ride-on mower	2	100%	82

Based on the equipment and usage factors identified above, noise predictions were undertaken for the nearest sensitive receivers, assuming all equipment to be operating concurrently at the shortest distance between the site and receivers. The predicted noise levels are shown in Table 4.2

Table 4.2 Predicted sound pressure level – outdoor mobile machinery

RECEIVER	SHORTEST DISTANCE TO CEMETERY SITE (METRES)	NOISE TRIGGER LEVEL, dB $L_{Aeq, 15min}$	PREDICTED SOUND PRESSURE LEVEL, dB $L_{Aeq, 15min}$	COMPLIES?
R01	165	38	37	Complies
R02	200	38	35	Complies
R03	185	38	36	Complies
R04	100	38	41	3 dB exceedance
R05	100	38	41	3 dB exceedance
W01	40	50	49	Complies
Minimum distance to achieve compliance	145	38	38	Complies

These results give the following findings:

- All identified representative receivers assessed were found to be compliant apart from at R04 and R05. It should however be noted that the assessment assumed all machinery to be operating concurrently and located at the nearest cemetery boundary. This is expected to be a conservative assumption and not likely to be a frequent occurrence.
- The minimum setback distance between any machinery and receiver building to achieve compliance with the noise trigger levels for residential receivers is approximately 145 metres, as presented graphically in Figure 4.1. The noise

trigger levels are only likely to be exceeded when mobile machineries are operated in a relatively small area of the entire site closest to receiver R04 and R05. The overall acoustic risk is therefore expected to be minor.

- The worst predicted exceedance of the trigger levels was up to 3 dB, which is just noticeable to the human ear and not considered significant. It is therefore regarded that consideration of mitigation is not necessary in practical terms.

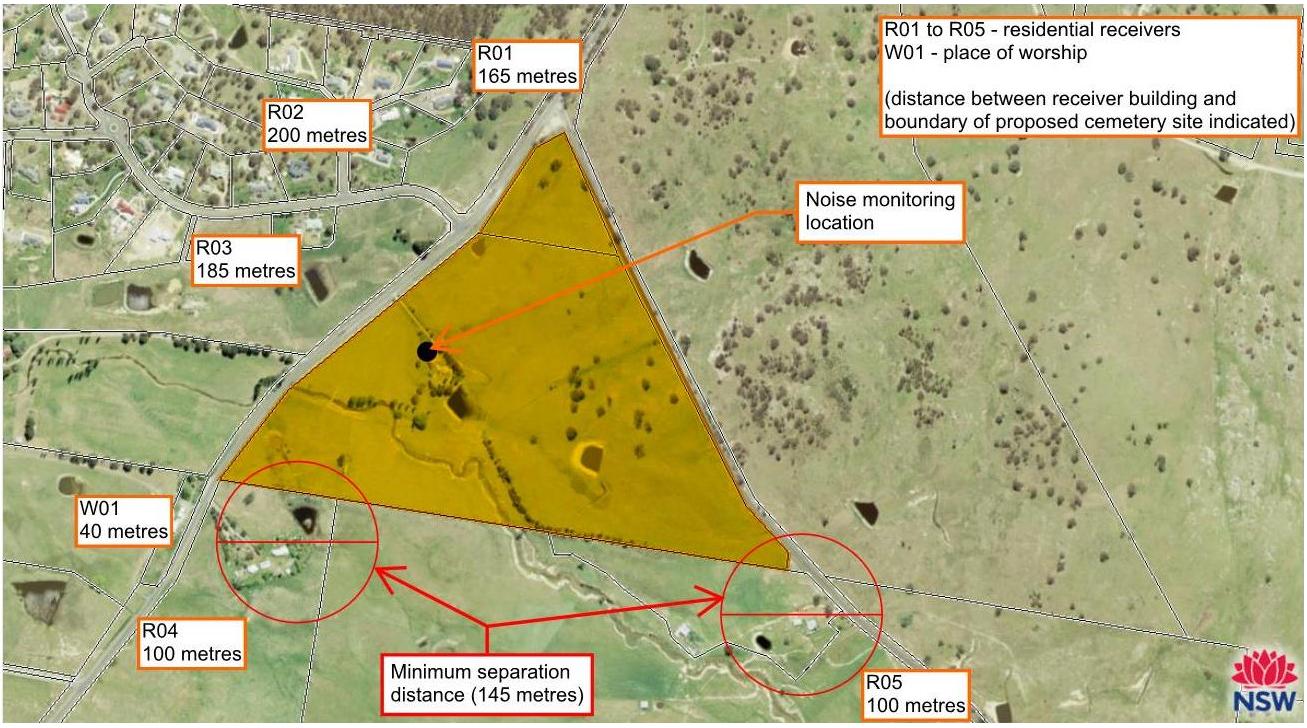

Figure 4.1 Recommended minimum separation distance for compliance for mobile machineries

4.2 FIXED PLANT

The proposed cemetery is likely to contain building(s) for use by staff members and members of the public for funeral purposes. Such buildings may contain fixed mechanical plant such as air conditioning, exhaust fans, pumps, indoor public announcement system for music and speech or the like.

The following approach is recommended:

- Where possible, position all buildings and fixed noise sources strategically on the subject development block (e.g. furthest from all sensitive receivers).
- Further detailed assessment should be undertaken during further planning and design stages to ensure compliance is achieved with the nominated noise limits.

It is generally practical and feasible to achieve the equipment noise limits with appropriate unit selection, acoustic screening, and maximising distance between the equipment and any potentially-affected dwelling.

4.3 ON-SITE VEHICLE MOVEMENTS

Vehicular movements and operation of a car park on site have the potential to cause noise concern and are assessable under the NPfI. As the location of the site access road is currently unknown, a quantitative assessment is therefore not conducted. It is however expected that, subject to further acoustic consideration and assessment, the site access road and car park can operate in compliance with the noise trigger levels. The following typical strategies can likely be considered:

- Position any access roads furthest away from the nearest sensitive receivers, where possible.
- Limit the speed of on-site vehicles.
- Avoid any discontinuities along the access road as well as car park areas. These include traffic calming devices, humps, joints, boom gates or the like.
- Signage to discourage noisy driving behaviour such as use of horns, excessive/unnecessary accelerating.
- Limit any truck's access to site to occur during the day and evening time periods only.

4.4 POTENTIAL INCREASES TO ROAD NOISE

Additional road traffic is likely to be generated in the surrounding road network due to the proposed development. Based on a recent traffic count in the surrounding road network, it is gathered that the daily traffic volume in Old Cooma Road was in the order of up to approximately 2,600 vehicles.

- It is understood that the proposed development could potentially host 3 to 4 funeral services per week.
- For the purpose of the noise assessment, it is assumed that up to 2 funeral services can occur on a single day.
- As a very conservative assumption, up to 150 vehicles can be generated by one funeral service.
- Taking into account both movements arriving and leaving site, this is equivalent to up to a total of 600 vehicle movements in a single day for two funeral services.

This conservative scenario equates to less than 25% of the existing traffic volumes along Old Cooma Road. To trigger a noise level increase of 2 dB or more, a change of road traffic volume in the order of 60% or more is required. From an acoustic perspective, a change of 2 dB is typically considered minor and not generally perceptible. It is therefore regarded that any potential increase in road traffic noise as a result of the propose development is likely to be insignificant.

5 CONSTRUCTION NOISE AND VIBRATION

Based on information available to date, it is understood the construction phase of the proposed cemetery is likely to include the following activities:

- General land clearing and earthworks;
- General landscaping work including the buffer zone around the perimeter of the site and for aesthetic purposes;
- Building works for the funeral services building, and associated foundation works.

During the construction phase of the proposed development, construction noise is expected to have the potential of affecting surrounding receivers.

Construction noise is generally managed in NSW by the ICNG and the NGLG. The ICNG nominates noise management levels (NML) to assist with assessment and management of construction noise. The ICNG also acknowledges that such noise is temporary and not always feasible and reasonable to apply specific measures to meet numerical noise levels. The ICNG provides guidance for considering a range of work practices and management measures that can be applied to a project, where reasonable and feasible, with the aim of minimising construction noise impact.

Typical activities that are likely to pose a higher noise risk and likely to exceed the NMLs are earthworks, foundation works, concrete pours and construction of the building structural frame and envelope when cranes are involved. These however are likely to be concentrated over a discrete period rather that throughout the entire construction period. The temporary nature of such noise sources is therefore likely to cause limited noise impact on surrounding receivers.

In acknowledgement that temporary noise associated with construction of the proposed cemetery are likely to cause adverse noise impact, the following measures are recommended for consideration:

- Manage construction noise in accordance with guidance provided in ICNG and NGLG.
- Construction works to be scheduled within the standard hours nominated in the ICNG. These hours are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm. No works on Sunday or public holidays.
- Where feasible, consider setting of solid construction hoarding to act as a noise barrier.
- Notify the surrounding receivers of the proposed construction program and upcoming specifically noisy activities.
- Adopt construction practices that will result in a lower noise impact where feasible as well as general good practice with the view of minimising construction noise.
- Discourage construction personnel from engaging in anti-social behaviour and unnecessary noise-generating activities.

6 SUMMARY

Based on the noise assessment documented in this report, the following conclusions are made:

- Queanbeyan-Palerang Regional Council is proposing a new cemetery on land located at 1241 Old Cooma Road, Googong.
- Once operational, the cemetery is expected to accommodate 3 to 4 funerals per week.
- The typical hours of operation for the proposed cemetery would be 7.00 am to 4.00 pm Monday to Friday, with most services occurring after 9.00 am and the occasional service occurring on weekends or after 4.00 pm on a weekday.
- Unattended noise monitoring was undertaken on site for a period of >7 days per requirement of the NPfI and this informed the existing background noise levels, which in turn informed the noise assessment guideline levels.

Table 6.1 Summarised findings of noise assessment

ITEM	CRITERIA	FINDINGS	PROJECT RISK LEVEL	REQUIRED MITIGATION CONSIDERATION
Operational noise impact due to mobile machineries	Residential receivers 38 dB $L_{Aeq, 15min}$ Place of worship 50 dB $L_{Aeq, 15min}$	Exceed identified trigger levels by up to 3 dB at two locations	Low to medium	Not considered necessary as the level of exceedance is minor and based on a conservative assessment. Exceedance expected to occur only when mobile machineries are operated in a relatively small area of the entire site closest to receiver R04 and R05
Operational noise impact due to fixed plant and on site vehicles		Expected to be acceptable with appropriate review and assessment during detailed design	Low to medium	Where possible, position these noise sources strategically on the subject development block (e.g. furthest from all sensitive receivers). More detailed acoustic assessment should be undertaken as soon as more detail on the proposed site is available. Limit the speed of on-site vehicles. Avoid any discontinuities along the access road as well as car park areas. These include traffic calming devices, humps, joints, boom gates or the like. Signage to discourage noisy driving behaviour such as horning, excessive/unnecessary accelerating. Limit any truck's access to site to occur during the day and evening time periods only.
Road traffic noise due to additional road traffic		Any triggered road traffic noise increase as a result of the cemetery expected negligible	Low	None

ITEM	CRITERIA	FINDINGS	PROJECT RISK LEVEL	REQUIRED MITIGATION CONSIDERATION
Construction noise and vibration		Likely to cause noise disturbance	Medium	Manage construction noise in accordance with guidance provided in ICNG and NGLG. Construction works to be scheduled within the standard hours nominated in the ICNG. These hours are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm. No works on Sunday or public holidays. Where feasible, consider setting of solid construction hoarding to act as a noise barrier. Notify the surrounding receivers of the proposed construction program and upcoming specifically noisy activities. Adopt construction practices that will result in a lower noise impact where feasible as well as general good practice with the view of minimising construction noise. Discourage construction personnel from engaging in anti-social behaviour and unnecessary noise-generating activities.