Temora Hospital

Noise and Vibration Impact Assessment

Health Infrastructure (NSW Government Health Infrastructure)

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→ **The Power of Commitment**

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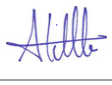
S4	0	C Gordon	C Evenden		T Little		01/05/24	
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[Compliance statement]

Glossary of acoustic terms and abbreviations

Abbreviation	Definition
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.
dB	Decibel is the logarithmic unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90(period)}$	The sound pressure level exceeded for 90% of the measurement period.
L_{Amax}	The maximum A-weighted sound level recorded during the measurement period.
L_{Cmax}	The maximum C-weighted sound level recorded during the measurement period.
$L_{Aeq(15hr)}$	The L_{Aeq} noise level for the period 7 am to 10 pm.
$L_{Aeq(9hr)}$	The L_{Aeq} noise level for the period 10 pm to 7 am.
$L_{Aeq(1hr)}$	The highest hourly L_{Aeq} noise level during the day and night periods.
Noise sensitive receiver	An area or place potentially affected by noise including residential dwellings, schools, child care centres, places of worship, health care institutions and active or passive recreational areas.
Rating background level (RBL)	The overall single-figure background level representing each assessment period over the whole monitoring period.
RNP	Road Noise Policy (DECWW, 2011)

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1. Introduction

1.1 Overview

The NSW Government has committed $80 million to the Temora Health Service redevelopment, which will provide a high-quality contemporary health facility and ensure health care services are carefully planned to meet community needs now and into the future.

GHD has prepared a noise and vibration impact assessment (NVIA) for the Temora Health Service redevelopment ("the Project"). This NVIA was prepared in support of an Environmental Impact Statement (EIS) for the project.

The objective of this acoustic assessment is to assess construction and operational noise emission from the redevelopment, and if required, recommend acoustic measures to ensure acceptable amenity.

1.2 Scope and limitations

GHD has undertaken the following works as part of this NVIA:

– Identification of surrounding sensitive receivers potentially impacted by construction noise
– Determination of the noise criteria for the Project based on the *Interim Construction Noise* Guideline (DECCW, 2009) (ICNG) and *Noise Policy for Industry* (EPA, 2017) (NPI)
– A quantitative assessment of construction noise and vibration
– Reviewing the potential noise impacts due to construction traffic generation
– An assessment of operational noise impacts
– Providing construction noise and vibration mitigation measures to minimise impacts on the community
– Prepare a noise and vibration impact assessment outlining results of the acoustic assessment and, where required, mitigation recommendations. The Acoustic Report will form part of the REF.

This report has been prepared with consideration to the following documents:

– *Interim Construction Noise* Guideline (DECCW, 2009) (ICNG)
– *Road Noise Policy* (DECCW, 2011) (RNP)
– *Assessing Vibration: a technical guideline* (EPA, 2006) (AVTG)
– *Noise Policy for Industry* (EPA, 2017) (NPI)

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2. Existing environment

2.1 Project description

Temora Hospital occupies 31,770m2 (3.177ha) on the corner of Gloucester and Loftus Street, Temora. The site contains a staff accommodation, main hospital and associated buildings including a community health, maintenance shed and boiler house within Lot 2, DP572392. The existing 2-3 storey hospital was built in 1939 in the Interwar International style. There is local speculation that the building was designed for Manly and when constructed was built back-to-front, as arrival at the hospital feels like arriving at the back door, creating an unwelcoming approach. The building has been updated and modernized over the years but it is aged and in poor condition with building services that are at the end of life.

The staff accommodation was relocated and converted for a new use as a separate ancillary building to the main hospital. The site benefits from extensive well-maintained gardens and arboretum. Located between the hospital and Gloucester Street is the Temora Residential Aged Care operated by Whiddon. Their land is leased from NSW Health, the lease is understood to be close to expiry. Parking at the hospital is on-grade.

Figure 2.1 Project location

The new Temora Hospital is being constructed on the site occupied by the existing hospital. Complex staging and decanting are therefore required to ensure that clinical services can be safely maintained on-site, and the building / engineering services facilitate service continuity throughout the construction period.

Stage 1

Stage 1 addresses enabling activities required to vacate the eastern portion of the existing hospital building and the day centre in order to enable the clearing of the eastern footprint for Part 1 building construction.

1. Create temporary accommodation for ambulatory care / allied health /mental health / admin.
2. Decant ambulatory care / allied health / mental health / admin (as required) to the temporary accommodation.
3. Minor modifications to maternity wing to accommodate adult inpatients.

4. Decant inpatient services to renovated maternity wing.
5. Decant theatre recovery to the Maternity ‘day area’.

Stage 2

Stage 2 addresses Part 1 of the main works – construction of the first phase of the new hospital.

1. Establish engineering services to support Part 1 construction, while facilitating ‘separation’ of the eastern and western portions of the hospital. Decommission eastern portion services while supporting ongoing services to western portion.
2. Decommission and demolish eastern wing of hospital and day care building.
3. Construct Part 1 new build including all plant for new hospital.
4. New roads, car parking and landscaping to Part 1 main works.
5. Commission new building.
6. Decant and operational commissioning of FoH, ED, IPU, Birthing, Imaging, Perioperative Unit, BoH.

Stage 3

Stage 3 addresses Part 2 of the main works.

1. Decommission and demolish western portion of hospital and remaining outbuildings.
2. Construct Part 2 new build.
3. New roads, car parking and landscaping to Part 2 main works.
4. Commission Part 2 new hospital.
5. Decant and operational commissioning of ambulatory / allied health / mental health / administration from temporary accommodation.

Stage 4

1. Decommission and demolish temporary accommodation.
2. Defects Liability Periods (various timeframes).

2.2 Sensitive receivers

Noise sensitive receivers are defined based on the type of occupancy and the activities performed in the land use and could include:

– residential dwellings
– educational institutes, libraries or childcare centres
– hospitals, surgery or other medical institutions
– places of worship
– passive and active recreational areas such as parks, sporting fields or golf courses
– community centres
– commercial or industrial premises

The following sensitive receivers and land uses have been identified for this assessment.

– Temora TAFE College (north of the Project)
– Residential receivers located along Loftus Road (south of the Project)
– Residential receivers located along George Street (west of the Project)
– Temora High School (north-west of the Project)
– Residential receivers located along Gloucester Street (north of the Project)
– Community facilities located along Gloucester Street (west of the Project)
– Commercial premises located along Gloucester Street (west of the Project)
– Commercial premises located along Kitchener Road (north of the Project)

– Residential receivers located along Kitchener Road (north of the Project)

Representative sensitive receivers included for modelling and assessment purposes are detailed in Table 2.1. The location of the site including nearby sensitive receivers are shown in Figure 2.2.

Table 2.1 Sensitive receivers

Receiver ID	Receiver address	Receiver type
COMME 01	119 Loftus Street, Temora NSW 2666	Aged care facility (assumed to be residential)
COMME 02	110 Gloucester St, Temora NSW 2666	Commercial
COMMU 01	161 Loftus St, Temora NSW 2666	Educational Building
COMMU 02	Gloucester Park, Temora NSW 2666	Passive Recreation Area
COMMU 03	159 Anzac St, Temora NSW 2666	Educational Building
COMMU 04	159 Anzac St, Temora NSW 2666	Educational Building
COMMU 05	169 Temora Young Road, Temora NSW 2666	Hospital
R01	23 Gallipoli St, Temora NSW 2666	Residential
R02	22 Gallipoli St, Temora NSW 2666	Residential
R03	182 Loftus St, Temora NSW 2666	Residential
R04	178 Loftus St, Temora NSW 2666	Residential
R05	174 Loftus St, Temora NSW 2666	Residential
R06	172 Loftus St, Temora NSW 2666	Residential
R07	166A Loftus St, Temora NSW 2666	Residential
R08	142 Carson St, Temora NSW 2666	Residential
R09	162 Loftus St, Temora NSW 2666	Residential
R10	130 George St, Temora NSW 2666	Residential
R11	156 Anzac St, Temora NSW 2666	Residential
R12	115 Gloucester St, Temora NSW 2666	Residential
R13	113 Gloucester St, Temora NSW 2666	Residential
R14	11 John Rands Pl, Temora NSW 2666	Residential
R15	160/180 Kitchener Rd, Temora NSW 2666	Residential
R16	2A French St, Temora NSW 2666	Residential
R17	197 Kitchener Rd, Temora NSW 2666	Residential
R18	32 Bundawarrah Rd, Temora NSW 2666	Residential
R19	26 Bundawarrah Rd, Temora NSW 2666	Residential
R20	195 Kitchener Rd, Temora NSW 2666	Residential

Table 2.1 above lists off-site receivers only for the purposes of this assessment. The buildings on site will be considered individually where relevant, via the Construction Noise and Vibration Management Plan.

The location of the site, including nearby off-site sensitive receivers considered for the assessment, is shown in Figure 2.2 below.

Figure 2.2 Site Location and sensitive receivers

3. Criteria

3.1 Noise Policy for Industry

The NPI provides noise levels for assessing the potential impact of noise from industry and includes a framework for considering feasible and reasonable mitigation measures. This enables the EPA to regulate noise emissions from scheduled premises under the POEO Act.

The objectives of Project Noise Trigger Levels (PNTL) for industry are to balance the need for industrial activity with the community's desire to minimise intrusive noise.

It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location. To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness and amenity. The intrusiveness noise levels apply over 15 minutes in any period (day, evening or night) and aim to control the relative audibility of operational noise compared to the background level at residential receivers.

The amenity noise level limits the total level of extraneous noise for all receiver types and is assessed over the entire assessment period (day, evening or night). Both the intrusiveness and amenity noise levels are calculated and the lower of the two in each time period is set as the PNTL. For the purposes of assessment to standardise the approach the NPI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA unless an alternative approach can be justified.

3.1.1 Intrusiveness noise level

The intrusiveness noise level is determined by a 5 dB addition to the RBL with a minimum intrusiveness noise level of 35 dBA for the evening and night period and 40 dBA for the day period. The NPI recommends that the intrusiveness noise level for the evening and day period should not exceed the daytime period. The intrusiveness noise levels are only applicable to residential receivers.

3.1.2 Project amenity noise level

The recommended amenity noise level applies to all industrial noise in the area which when combined should remain below the recommended amenity noise level. The recommended amenity noise level represents the total industrial noise at a receiver location and a Project Amenity Noise Level is set at 5 dBA below the recommended amenity noise level.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses and the existing level of noise from industry and road traffic. With consideration to the NPI 'noise amenity area' classification, the residential receivers identified are classified as 'Rural Residential' as per the NPI.

3.1.3 Summary of project noise trigger levels

Based on the NPI, a summary of the PNTLs for residential land uses are presented in Table 3.1. All identified residential receivers have been classified as 'rural residential'. Compliance with the residential PNTLs ensure compliance with the less-stringent non-residential PNTLs. The project noise trigger levels for non-residential receivers are presented in Table 3.2.

For a residence, the project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most affected point within 30 m of the residence, but not closer than 3 m to a reflective surface and at a height of between 1.2–1.5 m above ground level.

In assessing amenity noise levels at commercial or industrial premises, the noise level is to be assessed at the reasonably most-affected point on or within the property boundary.

Given the location of the site, background noise monitoring has not been undertaken for this project. The minimum assumed background noise levels from the EPA's Noise Policy for Industry have conservatively been used for this assessment.

Table 3.1 Project noise trigger levels for rural residential receivers

Receiver	Assessment period	Rating Background Level (RBL), $L_{90,T}$- dBA	Intrusive noise level, $L_{Aeq(15min)}$	Project amenity noise level[1] $L_{Aeq(15min)}$	Project noise trigger level, $L_{Aeq(15min)}$) dBA
Residential	Day	35	40	48	40
	Evening	30	35	43	35
	Night	30	35	38	35

Notes:

1. Project amenity noise level (ANL) is rural ANL (Table 2.1) minus 5 plus 3 dB(A) to convert from a period level to a 15-minute level.

Table 3.2 Project noise trigger levels for non-residential receivers (external)

Type	Time of day	Project noise trigger level, $L_{Aeq(15min)}$) dBA
Commercial premises	When in use	63[1]
Industrial premises	When in use	68[1]
Place of worship	When in use (1 hour)	50[2]
School classroom – internal	When in use (1 hour)	45[2]
Hospital ward – internal	Noisiest 1 hour	35
Hospital ward – external	Noisiest 1 hour	50
Area specifically reserved for passive recreation	When in use	48[1]

Notes:

1. A + 3 dB correction has been applied to convert $L_{Aeq(period)}$ to $L_{Aeq(15\ min)}$
2. External noise level assumes minus 10 dBA for noise through an open window.

3.1.4 Modifying factor corrections

The NPI requires that corrections for annoying characteristics are applied if the noise sources contain tonal, intermittent or low frequency characteristics, which have the potential to increase annoyance. The modifying factor adjustments are detailed in Table 3.3. At this point in time, it is assumed that no equipment operating on-site has any annoying characteristics.

Table 3.3 NPI modifying factor corrections

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: – 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz – 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive – 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz	5 dBA[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted $L_{eq,T}$ levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and: – Where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot	5 dBA[2]

Factor	Assessment/ measurement	When to apply	Correction[1,2]
		be mitigated, a 2 dBA positive adjustment to measured/predicted A-weighted levels for the evening/night period. – Where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dBA and cannot be mitigated, a 5 dBA positive adjustment to measured/predicted A-weighted noise levels applies for the evening/night period and a dBA positive adjustment for the daytime period.	
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dBA.	5 dBA

Notes:

1. Where two or more modifying factors are present the maximum correction is limited to 10 dBA.
2. Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

3.2 Construction noise goals

As part of this project, there would be a number of elements which would fall under an assessment in accordance with the *Interim Construction Noise Guideline* (ICNG). This includes bulk earthworks phase, gravel and lining placement phase.

3.2.1 ICNG construction hours

The ICNG provides guidance for assessment and management of construction noise. The guideline recommends standard hours for project activities as follows:

– Monday to Friday: 7:00 am to 6:00 pm
– Saturday: 8:00 am to 1:00 pm
– No work on Sundays or Public Holidays.

Where practical, and subject to the final construction timetable, it is assumed that construction would be carried out during the standard construction hours only.

The ICNG acknowledges that the following activities have justification to be undertaken outside the standard construction hours assuming all feasible and reasonable mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

– The delivery of oversized plant, equipment and materials that police or other authorities determine require special arrangements to transport along public roads
– Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
– Maintenance and repair of public infrastructure where disruption to essential services or considerations of worker safety do not allow work within standard hours
– Public infrastructure works that shorten the length of the project and are supported by the affected community
– Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
– Works which maintain noise levels below the noise management levels outside of the recommended standard construction hours.

Works required outside standard construction hours would be identified during construction planning and nearby residents would be notified before works begin.

3.2.2 Noise management levels

The construction noise management levels (NMLs) represent a noise level that, if exceeded, would require management measures including:

– Reasonable and feasible work practices
– Contact with the residences to inform them of the nature or works to be carried out, the expected noise levels, and durations and contact details.

The management measures are aimed at reducing noise impacts at the residential receivers. However, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level at all times. The noise affected construction NMLs are not intended as a noise limit but rather a level at which noise management is required.

Table 2 in the ICNG provides recommended NML for residential receivers, which are detailed in Table 3.4. For non-residential receivers, the recommended NML stated in the INCG have been used, as detailed in Table 3.5.

Table 3.4 Residential construction noise management levels, dBA (ICNG, 2009)

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ 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, 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.
Outside recommended standard hours	Noise affected: RBL + 5 dBA	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 measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Table 3.5 Noise at sensitive land uses (other than residences), dBA(ICNG, 2009)

Land Use	Noise management level, $L_{Aeq(15\ min)}$[3]
Industrial premises	75 dB(A)[1]
Offices, retail outlets	70 dB(A)[1]
Classrooms at school and other educational institutions	45 dB(A)[2] / 55 dB(A)[4]
Hospital wards and operating theatres	45 dB(A)[2] / 55 dB(A)[4]
Places of worship	45 dB(A)[2] / 55 dB(A)[4]
Active recreation areas	65 dB(A)[1]
Passive recreation areas	60 dB(A)[1]

Notes:

1. External noise level
2 Internal noise level
3. Applies when the properties are in use
4. External noise level based on a 10 dB reduction through a partially open window

3.2.3 Sleep disturbance

No construction works are proposed during the night period (10:00 pm to 7:00 am Monday to Saturday and 10:00 pm on Saturday to 8:00 am on Sunday). If activities are required to be undertaken during these times it would be limited to activities which are not audible at the nearest sensitive receptor, or discreet events which need to be undertaken outside standard hours for safety reasons.

As such, no sleep disturbance impacts are anticipated during the construction phases of the project.

3.2.4 Noise management levels

The noise management levels (NMLs) at sensitive receivers in the study area are summarised in Table 3.6, and have been based on the RBLs presented in Table 3.4 and NMLs presented in Table 3.5.

Table 3.6 Project specific noise management levels

Sensitive receptor type	Construction Noise Management Levels, $L_{Aeq(15min)}$	
	Standard construction hours	
	Noise affected	Highly noise affected
Residential	45 dB(A)	75 dB(A)
Industrial premises	75 dB(A)	N/A
Offices, retail outlets	70 dB(A)	N/A
Classrooms at school and other educational institutions	55 dB(A)	N/A
Hospital wards and operating theatres	55 dB(A)	N/A
Active recreation areas	65 dB(A)	N/A
Passive recreation areas	60 dB(A)	N/A

3.3 Traffic noise

The RNP provides traffic noise target levels for residential receivers in the vicinity of existing roads and are applied to road upgrades. For this assessment, these levels are also applied to traffic associated with construction works to identify potential construction traffic impacts and the potential for reasonable and feasible mitigation measures. The RNP road types are based on the functional roles shown in Table 3.7.

Table 3.7 Road Categories from RNP

Road category	Functional role	Public roads used by project
Local roads	Provide vehicular access to abutting property and surrounding streets. Provide a network of the movement of pedestrians and cyclists and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.	– Loftus Street, Gloucester Street, Milvale Road, Bundawarrah Road

The application notes for the RNP state that "*for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion*."

If the road traffic noise increase from the project is within 2 dB of current levels, then the objectives of the RNP are met and no specific mitigation measures are required. Mitigation should be applied when road traffic noise levels increase by 2 dB *and* the controlling noise criterion in Table 3.8 are exceeded at the façade of the residence.

Table 3.8 Road traffic noise criteria, dBA

Development type	Applicability to assessment	Day 7:00 am to 10:00 pm	Night 10:00 pm to 7:00 am
Existing residence affected by additional traffic on local roads generated by land use developments	– Loftus Street, Gloucester Street, Milvale Road, Bundawarrah Road	55 $L_{eq(1hr)}$	50 $L_{eq(1hr)}$

3.4 Construction vibration

3.4.1 Human comfort

Guidance in relation to acceptable vibration levels for human comfort are provided in EPA's *Assessing Vibration: a technical guideline* (AVTG) (2006). The document is based on the guidelines contained in British Standard *BS 6472-1:1992 Evaluation of human exposure to vibration in buildings (1–80 Hz)*.

Typically, construction works generate ground vibration of an intermittent nature. In accordance with BS 6472-1:1992, intermittent vibration is assessed using the Vibration Dose Value (VDV). Acceptable VDVs, as outlined in *Assessing Vibration: A Technical Guideline*, are listed in Table 3.9.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. Activities should be designed to meet the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum range may be used if can be justified. For values beyond the maximum value, the proponent should negotiate with the affected community.

Table 3.9 Acceptable vibration dose values for intermittent vibration

Location	Daytime [1] ($m/s^{1.75}$)		Night-time [1] ($m/s^{1.75}$)	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas [2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:

1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.

While the assessment of response to vibration in BS 6472-1:1992 is based on VDV and weighted acceleration, for construction-related vibration, it is considered more appropriate to provide guidance in terms of Peak Particle Velocity (PPV), since this parameter is more likely to be routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels well below those that risk causing damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* as listed in Table 3.10.

Table 3.10 Guidance on the effects of vibration levels

Approximate vibration level	Degree of perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.30 mm/s	Vibration might be just perceptible in residential environments.
1.00 mm/s	It is likely that vibration of this level in residential environments would cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10.00 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

3.4.2 Structural damage to standard and heritage structures

Vibrations as a result of construction work relating to the project are considered as a short-term vibration impact and criteria have been established accordingly.

The minimum working distances for structural (cosmetic) damage used for this assessment have been based on *DIN 4150-3 Structural Vibration – effects of vibration on structures* (German Standards, 2016) levels from ground borne vibration which enables the likelihood of building damage from ground vibration to be assessed. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building would not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Measured values exceeding those listed in Table 3.11 do not necessarily lead to damage; should they be significantly exceeded; however, further investigations may be necessary.

The vibration levels in this standard are adopted as building damage criteria and are presented in Table 3.11 for industrial premises, domestic premises, and heritage structures.

The existing staff accommodation building is located within the project footprint, directly south of the main hospital building. It has been identified as a heritage building and, as such, may experience vibration impacts due to its proximity to construction works. The mitigation strategies detailed in Section 6.4 should be applied, where reasonable and feasible, to minimise adverse vibration impacts on the structure. As part of the construction noise and vibration management plan (CNVMP) detailed in Section 6.4.1, a detailed assessment of the vibration impacts should be conducted, and additional mitigation strategies may be required.

No off-site external heritage structures have been identified within 250 metres of the project footprint, however the staff building on site is heritage. At this distance, no vibration impacts to heritage structures off site are expected, however there may be impacts to the staff building. It is understood that this building is being demolished.

Table 3.11 DIN 4150-3:2016 guideline values for short term vibration velocity

Line	Type of building	Guideline values for velocity, (mm/s)		
		Vibration at the foundation at a frequency of		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[3]
1	Offices and industrial premises	20	20-40	40-50
2	Domestic houses and similar construction	5	5-15	15-20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Notes:

1. Values referred to are at the base of the building.
2. At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.
3. At frequencies above 100 Hz the values given in this column may be used as minimum values.

3.5 Sensitive scientific and medical equipment

Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort. While the acceptable vibration levels for such equipment are recommended to be obtained from the instrument manufacturers, generic vibration criterion (VC) curves as published in *Generic Vibration Criteria for Vibration Sensitive Equipment* (C.Gordon 1999) may be adopted as vibration objectives.

The max level criteria for frequencies greater than 8 Hz (in μm/sec, rms) for each generic VC curve are presented in Table 3.12.

Table 3.12 Application and interpretation of the generic VC curves

Criterion Curve	Max Level (μm/sec), rms)	Detail size (microns)	Description of use
Operating Theatre	100	25	Vibration not perceptible. Suitable in most instances for surgical suites, microscopes to 100X and for other equipment of low sensitivity
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	Appropriate for inspection and lithography (including steppers) to 3 μm line widths.
VC-C	12.5	1-3	Appropriate standard for optical microscopes to 1000X, inspection and lithography inspection equipment (including moderately sensitive electron microscopes) to 1 μm detail size, TFT-LCD stepper/scanner processes.
VC-D	6	0.1 – 0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems.
VC-E	3	< 0.1	A challenging criterion to achieve. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems, E-Beam lithography systems working at nanometer scales, and other systems requiring extraordinary dynamic stability.

4. Noise and vibration impacts

4.1 Operational noise impacts

At this stage of the project, specific operational noise sources have not been designed and selected. For the purposes of this assessment, assumptions have been made based on the current design to determine indicative noise impacts and mitigation measures, where required. Note that detailed assessments should be undertaken as the Project design progresses to ensure compliance with the relevant noise criteria.

4.1.1 Noise modelling methodology

The following factors have been considered in the noise modelling methodology:

– The Sound Power Level (SWL) of external industrial noise sources either modelled as a point source, a line source, or an area source.
– External moving point sources (e.g., external truck movements, staff vehicles)
– External fixed-point sources or area sources (e.g. fixed plant)
– Terrain topography
– Absorption from the ground coverage
– Atmospheric absorption
– The operating times of the relevant noise sources and the frequency of vehicle movements
– Noise enhancing meteorological conditions.

The ISO 9613-2:1996 prediction methodology was utilised within CadnaA noise modelling software (Version 2023), to predict noise emissions.

The noise model inputs and assumptions for this assessment are provided in Table 4.1.

Table 4.1 Noise modelling parameters

Modelling component	Assumption
Noise model	CadnaA v 2023
Prediction algorithm	*ISO 9613 – 2 Acoustics – Attenuation of sound during propagation outdoors*
Modelling period	Typical worst case 15-minute period of operation where each significant item of equipment is running at full power
Meteorology	ISO 9613 considers the presence of a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights or ‘downwind’ conditions which are favourable to sound propagation
Ground absorption coefficient	G = 0.75 representing vegetative grassland areas (75%) and non-porous ground (25%)
Atmospheric absorption	Based on a default temperature of 10°C and an average humidity of 70%
Receiver heights	1.5 m above building ground level (ground floor)

4.1.2 Operational noise sources

At this stage of the project, the noise sources assumed for the site to predict indicative noise impacts on the surrounding sensitive receivers are provided in the following sections. These should be updated as the design progresses to determine any mitigation measures required.

4.1.2.1 Vehicle movements within the site

One of the main noise sources associated with operation of the site would be from vehicles entering the site and parking their vehicle within the designated carparking areas.

The vehicle movements modelled and presented in Table 4.2 represent a typical worst-case scenario. It is anticipated that the actual traffic volumes would be significantly lower than those shown in Table 4.2.

Table 4.2 Modelled function scenarios and key assumptions

Carpark ID	Name / no. of spaces	Vehicle movements modelled within carpark (worst-case)[1]
CP1	New Car Park / 65 spaces	Daytime: 40 movements per hour or 10 movements per 15 minutes Evening/night: 20 movements per hour or 5 movements per 15 minutes
CP2	Fleet Parking / 15 spaces Ambulance Bay / 2 bays Loading dock / 1 bay	15 movements per hour or 3.25 movements per 15 minutes

Notes:

1) Carpark noise has been modelled using the LFU Bayern 2007 noise study method
2) Vehicle movements along internal roads have been modelled based on a sound power level of 82 dBA for a light vehicle travelling at 20 km/hr

4.1.2.2 Mechanical services

The other main sources of noise on the site will be mechanical plant and equipment servicing the new hospital. At this stage specific equipment has not been selected, however indicative locations and equipment have been provided by the mechanical services team. These should be updated as the design progresses to determine any mitigation measures required.

– 3 x Heat Pumps (indicative sound power level of 91 dBA) located within the outdoor plant area at the north-west of the site, as shown in Figure 4.1 below

Figure 4.1 Open plant area – heat pump locations

– In addition to the heat pumps, there will be a number outdoor condenser units located around the buildings to service different areas. These are not expected to generate significant impacts on the surrounding receivers

due to the separation distance, however they have been included in the model with a sound power level of 75 dBA. Note that the noise level has been assumed as the current design does not indicate a specific unit or requirement. This should be updated as the Project design is progressed.

– Note that the noise from the heat pumps and condenser units may impact the internal areas of the proposed hospital. These will be considered in the design of the external façade throughout the design process.

4.1.3 Predicted noise levels

The predicted $L_{Aeq(15min)}$ noise levels at the most-affected sensitive receivers due to operation of the Project are presented in Table 4.3. The noise modelling indicates compliance is predicted at all sensitive receptor locations for the daytime period, however at night-time compliance is not achieved at all receivers. As the site is expected to operate at all times, noise mitigation measures, outlined in more detail in Section 4.2, will be necessary.

The levels presented in Table 4.3 assume the car park and mechanical equipment is being used simultaneously and is considered conservative. Where the NPI project trigger level is exceeded, this has been shaded grey and written in bold. Further discussion is provided below in Section 4.2.

Table 4.3 Predicted $L_{Aeq(15min)}$ noise levels at sensitive receivers, dBA

ID	Address	Predicted $L_{Aeq(15min)}$ noise level, dBA Daytime period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Daytime period	Predicted $L_{Aeq(15min)}$ noise level, dBA Evening/night period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Evening/night period	Compliance
COMME 01	119 Loftus Street, Temora NSW 2666	37	40	**36**	35	No
COMME 02	110 Gloucester St, Temora NSW 2666	28	63	27	63	Yes
COMMU 01	161 Loftus St, Temora NSW 2666 (preschool)	17	45	16	45	Yes
COMMU 02	Gloucester Park, Temora NSW 2666 (park)	25	48	23	48	Yes
COMMU 03	159 Anzac St, Temora NSW 2666 (school)	25	45	23	45	Yes
COMMU 04	159 Anzac St, Temora NSW 2666 (school)	21	45	20	45	Yes
COMMU 05	169 Temora Young Road, Temora NSW 2666	35	50	34	50	Yes
R01	23 Gallipoli St, Temora NSW 2666	28	40	28	35	Yes
R02	22 Gallipoli St, Temora NSW 2666	29	40	29	35	Yes
R03	182 Loftus St, Temora NSW 2666	32	40	31	35	Yes

ID	Address	Predicted $L_{Aeq(15min)}$ noise level, dBA Daytime period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Daytime period	Predicted $L_{Aeq(15min)}$ noise level, dBA Evening/night period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Evening/night period	Compliance
R04	178 Loftus St, Temora NSW 2666	33	40	31	35	Yes
R05	174 Loftus St, Temora NSW 2666	31	40	29	35	Yes
R06	172 Loftus St, Temora NSW 2666	29	40	27	35	Yes
R07	166A Loftus St, Temora NSW 2666	20	40	19	35	Yes
R08	142 Carson St, Temora NSW 2666	23	40	22	35	Yes
R09	162 Loftus St, Temora NSW 2666	23	40	22	35	Yes
R10	130 George St, Temora NSW 2666	24	40	23	35	Yes
R11	156 Anzac St, Temora NSW 2666	37	40	**35**	35	No
R12	115 Gloucester St, Temora NSW 2666	35	40	34	35	Yes
R13	113 Gloucester St, Temora NSW 2666	31	40	31	35	Yes
R14	11 John Rands Pl, Temora NSW 2666	34	40	34	35	Yes
R15	160/180 Kitchener Rd, Temora NSW 2666	31	40	31	35	Yes
R16	2A French St, Temora NSW 2666	29	40	29	35	Yes
R17	197 Kitchener Rd, Temora NSW 2666	25	40	25	35	Yes
R18	32 Bundawarrah Rd, Temora NSW 2666	25	40	25	35	Yes
R19	26 Bundawarrah Rd, Temora NSW 2666	38	40	**38**	35	No

ID	Address	Predicted $L_{Aeq(15min)}$ noise level, dBA Daytime period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Daytime period	Predicted $L_{Aeq(15min)}$ noise level, dBA Evening/night period	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Evening/night period	Compliance
R20	195 Kitchener Rd, Temora NSW 2666	33	40	31	35	Yes

4.2 Discussion of results and operational mitigation measures

The operational noise modelling has predicted some minor exceedances at two (2) sensitive receivers during the night-time period. A discussion of each exceedance is provided below:

COMME 01 - 119 Loftus Street, Temora

This receiver is an aged care facility located directly adjacent to Temora Hospital. Noise levels at this receiver are predicted to exceed the NPI noise trigger level by 1 dB, resulting in a negligible exceedance.

The noise source contributing significantly to the exceedance is the cars entering and exiting the site via Gloucester Street and parking at the new 80 space car parking area. It is noted that there is an existing car park in this area and this receiver would already be exposed to a similar noise level.

Based on the above, noise from the site is not expected to result in adverse noise impacts on this receiver.

R19 - 26 Bundawarrah Rd, Temora

This receiver is an aged care facility located to the north-east of Temora Hospital. Noise levels at this receiver are predicted to exceed the NPI noise trigger level by 3 dB, resulting in a marginal exceedance.

The noise source contributing significantly to the exceedance is the heat pumps in the new open plan area at the north-eastern corner of the site.

The selection of heat pump has not been finalised, and as previously discussed, a sound power level of 91 dBA has been assumed based on similar applications. Given the level of exceedance, noise mitigation measures including ‘buying quiet’ philosophies should be considered to reduce noise impacts from the heat pumps. As the design and selection is finalised, an assessment should be undertaken to determine compliance with the NPI noise trigger level.

Indicative noise mitigation measures for consideration include:

– Selection of quieter units where possible
– Use of acoustic louvres / attenuators
– Increase height of plant area wall

5. Construction noise assessment

5.1 Construction works program

The plant and equipment likely to be required throughout each proposed stage of construction have been used to predict the noise levels that would be expected during construction works. The predicted noise levels were assessed against the construction noise management levels identified in Section 3.2.

Construction scenarios have been created based on construction equipment operating simultaneously at any given time. All works are located within or adjacent to the Project site. It is unlikely that construction machinery would be operating at the same time (as the modelling assumes), but analysing a typical 'worse-case' scenario helps to identify where noise impacts could be a concern and assists in the formulation of mitigation areas.

5.1.1 Construction activities

The construction hours for the Project are assumed to be standard hours as per the ICNG., being:

– Monday to Friday: 7:00 am to 6:00 pm
– Saturday: 8:00 am to 1:00 pm
– No work on Sundays or Public Holidays.

The Project is anticipated to be undertaken in 2 stages and follow the general work methodology and staging provided in Table 5.1. These construction scenarios have been modelled to determine the potential construction noise impacts on the environment.

Table 5.1 Construction staging

Construction scenario	Construction phase	Construction hours
CS01	Demolition of temporary Site establishment Investigation works Services diversions and relocations	Standard hours
CS02	Excavation and earthworks	Standard hours
CS03	Piling and footing works	Standard hours
CS04	Structure works	Standard hours
CS05	Fit-out	Standard hours
CS06	Landscaping and civil works	Standard hours

5.1.2 Noise generating equipment

Plant and equipment needed for the Project would be determined during the construction planning phase. Typical equipment for the proposed activities has been assumed for this assessment. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

The magnitude of off-site noise impacts associated with construction is dependent upon a number of factors:

– the intensity and location of construction activities
– the type of equipment used
– existing background noise levels
– intervening terrain and structures
– prevailing weather conditions

Construction machinery would likely move about the Project site altering the received noise for individual receivers. During any given period, the machinery items to be used would operate at maximum sound power levels for only brief stages. At other times, the machinery would produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, noise predictions are considered conservative.

Table 5.2 below presents the number of construction equipment proposed for each construction scenario. The activity sound power level has been calculated based on the two noisiest plant to determine the worst-case noise impacts during construction. The activity noise levels have been used to predict the noise levels that would be expected during construction works.

Table 5.2 Construction scenarios sound power levels, dB(A)

Plant description	Sound power level	Construction scenario					
		CS01	CS02	CS03	CS04	CS05	CS06
Activity Sound Power Level, dB(A)		**120**	**121**	**118**	**120**	**114**	**114**
Concrete agitator truck	103		✓	✓	✓		
Concrete pump truck	108		✓	✓	✓		
Concrete saw (5 mins)[1]	119	✓	✓		✓		
Crane (mobile)	104			✓	✓		
Excavator	107	✓	✓				✓
Hand tools (electric)	111	✓	✓	✓	✓	✓	✓
Piling rig (bored)	111			✓			
Roller	112		✓	✓			
Truck (> 20 tonne)	107	✓	✓	✓	✓	✓	✓
Forklift	106	✓	✓			✓	✓
A 5 dB penalty has been added due to tonal annoyance in accordance with the NPI							

5.2 Noise modelling inputs

Noise modelling was undertaken using CadnaA 2023. CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'.*

The following noise modelling assumptions were made:

– Surrounding land was modelled assuming a mix of 75 per cent soft and 25 percent hard ground with a ground absorption coefficient of 0.75
– Atmospheric absorption was based on an average annual temperature of 17 °C and an average humidity of 70%
– Atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground based temperature inversions
– Modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site
– Noise sources for each scenario are in some cases modelled at different locations. As such the noise modelling assesses the noise source at multiple locations and takes the maximum L_{Aeq} received noise level.

5.3 Construction noise impacts

Construction noise levels have been predicted at the sensitive receivers within the study area with consideration to the acoustic requirements of the ICNG. The predicted $L_{Aeq(15min)}$ noise levels at the most-affected sensitive receivers are presented in Table 5.3 for Stage 1 and Table 5.4 for Stage 2. Where the noise management level is exceeded, the predicted value has been shown in bold and highlighted in grey.

Predicted noise levels that exceed the relevant NML for each receiver are in bold. The noise modelling assumes that all pieces of equipment in the scenario are operating at maximum capacity simultaneously at the closest distance between the construction works and the receiver. As such, the predicted noise levels are often highly conservative and actual noise levels are likely to be lower than the levels presented below for most of the time.

Predictive modelling indicates that at some receivers in the study area, predicted noise levels for all assessed scenarios are expected to be below noise management levels (NML) during worst case conditions with all equipment operating simultaneously. However, at many receivers, predicted noise levels for the construction scenarios are expected to exceed NML during the applied conditions. Due to the predicted exceedance, the mitigation strategies outlined in Section 6.4 will be necessary to manage impacts.

At all receivers, including those where exceedances are not predicted, the application of reasonable and feasible mitigation measures at the source is considered best practice and should be implemented where reasonable and feasible.

Table 5.3 Predicted Noise Levels for Construction Scenarios in Stage 1

Receiver ID	Construction Scenario						Criteria – Noise affected	Criteria – Highly noise affected
	CS01.1	CS02.1	CS03.1	CS04.1	CS05.1	CS06.1	Standard Hours	Standard hours
COMME 01	**64**	**65**	**55**	**57**	**51**	**52**	45	-
COMME 02	50	51	48	48	43	44	70	-
COMMU 01	36	38	36	35	30	31	55	-
COMMU 02	45	46	44	45	39	40	60	-
COMMU 03	48	48	44	44	38	40	55	-
COMMU 04	44	44	41	41	36	37	55	-
COMMU 05	**81**	**82**	**81**	**84**	**77**	**78**	55[1]	-
R01	**46**	**46**	**46**	**46**	40	42	45	75
R02	**49**	**50**	**49**	**50**	44	**45**	45	75
R03	**56**	**57**	**55**	**57**	**51**	**52**	45	75
R04	**55**	**55**	**54**	**55**	**49**	**50**	45	75
R05	**52**	**53**	**51**	**51**	**46**	**47**	45	75
R06	**49**	**50**	**48**	**49**	43	44	45	75
R07	40	41	40	39	34	35	45	75
R08	**45**	**46**	44	**45**	39	41	45	75
R09	**45**	**46**	42	42	37	38	45	75
R10	**46**	**47**	44	44	39	40	45	75
R11	**60**	**61**	**53**	**55**	**49**	**50**	45	75
R12	**61**	**61**	**56**	**57**	**51**	**52**	45	75
R13	**53**	**54**	**51**	**53**	**47**	**48**	45	75
R14	**57**	**58**	**56**	**58**	**52**	**53**	45	75
R15	**52**	**53**	**51**	**53**	**47**	**48**	45	75
R16	**48**	**49**	**47**	**49**	43	44	45	75

Receiver ID	Construction Scenario						Criteria – Noise affected	Criteria – Highly noise affected
	CS01.1	CS02.1	CS03.1	CS04.1	CS05.1	CS06.1	Standard Hours	Standard hours
R17	**45**	**45**	44	45	40	41	45	75
R18	44	**45**	44	45	40	41	45	75
R19	**59**	**60**	**58**	**60**	**54**	**55**	45	75
R20	**57**	**57**	**56**	**58**	**52**	**53**	45	75
1. External noise criteria								

Table 5.4 Predicted Noise Levels for Construction Scenarios in Stage 2

Receiver ID	Construction Scenario						Criteria – Noise affected	Criteria – Highly noise affected
	CS01.1	CS02.1	CS03.1	CS04.1	CS05.1	CS06.1	Standard Hours	Standard hours
COMME 01	**72**	**72**	**63**	**65**	**59**	**66**	45	-
COMME 02	59	59	52	54	48	53	70	-
COMMU 01	41	42	39	38	33	37	55	-
COMMU 02	50	50	45	45	39	45	60	-
COMMU 03	**55**	**56**	48	48	43	50	55	-
COMMU 04	50	51	44	43	38	46	55	-
COMMU 05	**75**	**76**	**65**	**67**	**61**	**69**	55[1]	-
R01	44	**45**	**47**	**46**	41	40	45	75
R02	**52**	**52**	44	43	37	**47**	45	75
R03	**60**	**61**	**55**	**57**	**51**	**55**	45	75
R04	**59**	**60**	**54**	**56**	**50**	**54**	45	75
R05	**56**	**57**	**52**	**53**	**48**	**51**	45	75
R06	**53**	**54**	**49**	**50**	**45**	**49**	45	75
R07	**45**	**46**	44	44	38	41	45	75
R08	**49**	**49**	**45**	**45**	40	44	45	75
R09	**51**	**52**	**46**	**46**	40	**47**	45	75
R10	**52**	**53**	**49**	**50**	**45**	**48**	45	75
R11	**69**	**70**	**59**	**61**	**54**	**64**	45	75
R12	**64**	**65**	**60**	**61**	**55**	**59**	45	75
R13	**53**	**54**	**53**	**55**	**49**	**49**	45	75
R14	**55**	**56**	**55**	**56**	**51**	**50**	45	75
R15	**49**	**50**	**50**	**51**	**46**	**45**	45	75
R16	**45**	**45**	**47**	**48**	42	41	45	75
R17	42	43	43	44	39	38	45	75
R18	42	43	43	44	39	38	45	75
R19	**51**	**52**	**54**	**56**	**50**	**47**	45	75
R20	**61**	**61**	**55**	**56**	**51**	**56**	45	75
1. External noise criteria								

5.4 Sleep disturbance impacts

No night works are scheduled in the construction works program, and as such no sleep disturbance impacts have been assessed. If any night works are to be scheduled during construction a sleep disturbance impacts assessment should be carried out.

5.5 Construction traffic impacts

The RNP recommends that "any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'without construction' scenario." Construction of the Project would generate heavy vehicle movements associated with the transportation of construction machinery, equipment and materials to the site. Light vehicle movements would be associated with employees and smaller deliveries. Access to the construction site would be from Milvale Road (when west-bound) and Loftus Street (when east-bound), both being local roads.

To increase road traffic noise by 2 dBA (a doubling in traffic roughly corresponds to a 3 dBA increase) a large increase in traffic volumes would be required along Loftus Street. Though it is expected that a limited number of construction vehicles will be required at the site, construction traffic generation along these roads may cause construction traffic noise impacts, due to the low existing road traffic volumes. Additionally, construction workers will be instructed to park along Loftus Street to maximise parking spaces for patients at the hospital, which may impact traffic noise along that street. Therefore, traffic flows should be managed in a way to reduce the impact to residential receivers in this area.

Access to the Project site would be through Bundawarrah Road and an unnamed road adjacent to Loftus Street, which are both local roads. Due to very low existing road traffic volumes, it may experience construction road traffic noise. Traffic flows through these roads should also be managed to reduce the impact on surrounding sensitive receivers.

Predictive modelling was used to assess the potential impacts of construction traffic noise on sensitive receivers in the area. At this stage of the project, expected construction traffic numbers have not been provided, as such the following noise sources and sound power levels have been assumed for this assessment:

Table 5.5 Construction traffic noise sources and associated noise levels

Noise source	Impacted road	Vehicle movements modelled (worst-case)[1]	Sound Power Level, L_{Aeq}, dB(A)	Total Sound Power Level, L_{Aeq}, dB(A)
Heavy Vehicle	Loftus Street and Milvale Road	4 movements per hour at 50 km/hr	111	100
	Bundawarrah Road and unnamed Road	4 movements per hour at 10 km/hr	111	102
Light Vehicle	Milvale Road and Loftus Street	15 movements per hour at 60 km/hr	85	82

5.5.1 Predicted noise levels

The noise modelling shows that the predicted $L_{Aeq(15min)}$ noise levels at the most-affected sensitive receivers along Loftus Street and Milvale Road indicates compliance is predicted for the daytime period, being 55 dBA ($L_{Aeq, 1hr}$).

As part of the construction noise and vibration management plan (CNVMP) detailed in Section 6.4.1, an assessment of the construction traffic noise impacts should be conducted, and additional noise mitigation strategies may be required.

6. Construction vibration impact assessment

6.1 Assessment methodology

The method for the construction vibration assessment included:

– Identifying safe working distances to comply with the human comfort and the cosmetic damage criteria. These buffer distances have been adopted from *Construction Noise and Vibration Strategy* (CNVS) (TfNSW 2019).

– Safe working distances for vibration intensive equipment are shown in Table 6.1. The vibratory equipment associated with the project include compactors and excavators with rock breaking attachment.

6.2 Vibration safe working distances

Safe working distances for vibratory intensive equipment has been sourced from the TfNSW CNVS and are shown in Table 6.1.

Table 6.1 Vibration safe working distances

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Piling rig – Bored <800 mm	7 m	2 m (nominal)
Piling rig–Hammer (12 t down force)	50 m	15 m
Piling rig – Vibratory (sheet piles)	20 m	2 m to 20 m
Vibratory roller (>18 tonnes)	100 m	25 m
Vibratory roller (13-18 tonnes)	100 m	20 m
Vibratory roller (7-13 tonnes)	100 m	15 m
Vibratory roller (4-6 tonnes)	40 m	12 m
Vibratory roller (2-4 tonnes)	20 m	6 m
Vibratory roller (1-2 tonnes)	15 m	5 m
Small hydraulic hammer 300 kg (5-12t excavator)	7 m	2 m
Medium hydraulic hammer 900 kg (12-18t excavator)	23 m	7 m
Large hydraulic hammer 1600 kg (18-34t excavator)	73 m	22 m
Jackhammer (handheld)	Avoid contact with structure	1 m (nominal)

6.3 Construction vibration impacts

6.3.1 Human comfort

The most vibration intensive activities associated with the construction works are anticipated to be excavation works and vibratory rolling (compacting) during bulk earthworks.

Excavation activities have the potential to exceed the human comfort vibration criteria should these works occur within 73 metres of residences (assuming a large excavator is used), while rolling works have the potential to exceed human comfort levels within 100 metres (assuming a vibratory roller >18 tonnes is used).

Where works occur within this safe working distance, it is recommended that smaller equipment is used where possible to minimise vibration impacts. For example, the receiver at 169 Loftus Street (COMME1) is within 20-25 metres of the car park area. For this car park, should an excavator or vibratory roller be required, these should be limited to a medium hydraulic hammer (for the excavator) or a 2-4 tonne vibratory roller.

Human comfort impacts may be experienced within the hospital itself and the staff accommodation building adjacent to the main hospital building. This should be managed by the construction contractor to minimise impacts.

Mitigation measures are provided in Section 6.4 to manage vibration impacts.

As part of the construction noise and vibration management plan (CNVMP) detailed in Section 6.4.1, a detailed assessment of the vibration impacts should be conducted, and additional noise mitigation strategies may be required.

6.3.2 Structural damage

As there are no off-site residential building structures within 22 metres of the site works, the project is not predicted to result in cosmetic damage to residential buildings.

The staff accommodation building is located directly south of the main hospital building, within the construction site. While the extent of vibratory works is currently unknown as the final construction methodology will be determined by the contractor, it is unlikely that areas adjacent to the staff accommodation will require vibratory compaction, however vibratory compaction is likely within car park areas. Should vibratory works occur within the safe working distances outlined in Table 6.1, the applicable mitigation strategies outlined in Section 6.4 should be implemented where reasonable and feasible to minimise any adverse impacts. Additionally, as part of the construction noise and vibration management plan (CNVMP) detailed in Section 6.4.1, a detailed assessment of the vibration impacts should be conducted. Note that additional vibration and noise mitigation strategies may be required.

6.3.3 Sensitive equipment

In addition to the above, any sensitive equipment within the hospital should be identified. Prior to vibratory construction works, identification of all vibration-sensitive equipment within Temora Hospital is to be undertaken with the provision of vibration monitoring.

As part of the construction noise and vibration management plan (CNVMP) detailed in Section 6.4, a detailed assessment of the vibration impacts should be conducted, and additional noise mitigation strategies may be required.

6.4 Construction mitigation measures

It is predicted that activities associated with the project will exceed the NMLs in accordance with the ICNG. The mitigation measures should be read in conjunction with the construction noise levels in Table 3.4 to determine which receivers these measures apply to. The measures provided in Table 6.2 are best practice and should be implemented to minimise potential noise and vibration impacts where reasonable and feasible.

Table 6.2 Mitigation measures during the construction phase

Control type	ID	Measure	Timing
Community consultation			
Notification of works	NV1	Notification should be a minimum of 7 calendar days prior to the start works and should include information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. If there are works outside standard hours, inform closest residents and other sensitive land use occupants within 14 days of commencement. Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website will also be established for the project to provide information.	Pre-construction
Community relations	NV2	Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied. Maintain good communication between the community and project staff.	Pre-construction During construction Operation

Control type	ID	Measure	Timing
		Consider a regular newsletter with site news, significant project events and timing of different activities. Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.	
Management measures			
Site inductions	NV3	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: – All project specific and relevant standard noise and vibration mitigation measures – Relevant licence and approval conditions – Permissible hours of work – Any limitations on high noise generating activities – Location of nearest sensitive receivers – Construction employee parking areas – Designated loading/unloading areas and procedures – Site opening/closing times (including deliveries) – Environmental incident procedures	Construction Operation
Schedule activities to minimise noise impacts	NV4	All activities on site should be confined between the hours: daytime hours of 7:00 am to 6:00 pm from Monday to Friday and 8:00 am to 1:00 pm on Saturday, with the exception of the following activities: – The delivery of oversized plant or structures – Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm	Pre-construction During construction
Source mitigation measures			
Construction hours and scheduling.	NV5	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.	Construction
Non-tonal and ambient sensitive reversing alarms	NV6	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.	Construction Operation
Reduced equipment power	NV7	Use only the necessary size and power.	Construction Operation
Minimise disturbance arising from delivery of goods to construction sites.	NV8	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.	Construction
Engine compression brakes	NV8	Limit the use of engine compression brakes in proximity to residences.	Construction Operation
Maintain equipment	NV10	Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers. Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.	Construction Operation

Control type	ID	Measure	Timing
Construction vibration mitigation measures			
Vibration assessment – general equipment	NV11	As part of the CNVMP detailed in Section 6.4.1 below, and prior to commencement of construction works, a review of activity types and locations should be undertaken to determine whether any vibration impacts will occur during construction works. Should this be identified, vibration monitoring should be undertaken to determine the level of impact.	Construction
Vibration assessment – sensitive equipment	NV12	As part of the CNVMP detailed in Section 6.4.1 below, and prior to commencement of construction works, vibratory sensitive equipment within the hospital, in particular areas adjacent to the proposed works, should be identified and assessed. Currently, it is understood that there is a CT machine proposed for the site. Due to the sensitive nature of this equipment, its location in relation to vibration generating activities should be assessed. Vibration monitoring may be necessary should the location be within the appropriate boundary. Further mitigation measures may also be required. Should other vibration-sensitive equipment be identified, vibration monitoring should be undertaken to determine the level of impact.	Construction

6.4.1 Construction noise and vibration management plan (CNVMP)

A construction noise and vibration management plan (CNVMP) should be developed after the construction contractor has been engaged and a detailed construction method has been developed. The construction noise and vibration management plan would include a review of the construction noise predictions during the environmental impact assessment phase. The plan would be based on the construction contractor's method and include a detailed examination of feasible and reasonable work practices and noise and vibration mitigation measures to manage sensitive receivers that are predicted to be 'noise affected'. The construction noise and vibration management plan would also include:

- details of the construction methodology
- feasible and reasonable mitigation measures to be implemented
- updated noise predictions at sensitive receivers
- assessment of noise impacts for light and heavy vehicle movements
- a noise monitoring procedure and program for the duration of works
- a community consultation plan to liaise with the noise affected receivers, including:
  - Notification to residences a minimum of 7 calendar days prior to the start of works and should include information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur.
  - A procedure for complaints, including maintaining a compliant register on site
- A review of sensitive equipment within the hospital to determine whether additional mitigation measures are required.

7. Conclusion

The noise and vibration impact assessment has established the ambient and background noise and assessed the potential noise impacts associated with the construction and operational phases of the project with respect to the following guidelines:

– Operational phase - *Noise Policy for Industry* (NPI).
– Construction phase - *Interim Construction Noise Guideline* (ICNG).
– Road network - *Road Noise Policy* (RNP).
– Vibration (human comfort) – *Assessing Vibration: A Technical Guideline* (AVTG).
– Vibration (cosmetic damage) - *DIN 4150-3 (2016) Structural Vibration – effects of vibration on structures*.

Construction noise

Predicted results indicate that noise associated with the construction works is expected to impact on nearby sensitive receivers, however no residential receivers are predicted to experience highly intrusive noise levels. Reasonable and practical noise and vibration mitigation measures are presented in Section 6 and are recommended for consideration by the construction contractor to reduce potential construction noise and vibration impacts. Particular attention needs to be paid to community consultation, notification, and complaints sections.

Construction vibration

No external sensitive receivers have been identified within the safe working distances for vibratory intensive work. As such, no adverse (structural damage or human comfort) vibration impacts are anticipated.

Works may occur within the safe working distances at the hospital building directly adjacent to where works are occurring. Mitigation measures have been provided in Section 4.2 for operational noise and 6.4 for construction noise and vibration should this occur.

Operational noise

The operational noise modelling has predicted some minor exceedances at two (2) sensitive receivers during the night-time period. A discussion of each exceedance along with mitigation measures is provided in Section 4.2.