Project No: 212122R

Noise Impact Assessment
Proposed Industrial Development
"Mudgee Industrial Park"
Depot Road, Mudgee - NSW

Prepared for:

DTM Property Enterprises
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1.0 INTRODUCTION

This report presents the results and findings of an acoustic assessment of the operation of commercial and industrial facilities at the Mudgee Industrial Park, at Lot 210 D.P. 775001, Depot Road, Mudgee.

This Noise Impact Assessment (NIA) has been conducted in accordance with procedures as detailed in the *Noise Policy for Industry* (NPfI).

2.0 BACKGROUND TO THE NIA

The site of the Mudgee Industrial Park is an industrial area with several commercial and industrial premises currently operating in the vicinity. The site is adjacent to the Mid West Council's works depot.

Spectrum Acoustics previously undertook an acoustic assessment of the suitability of the site for industrial sheds for various uses. The assessment used typical sound power levels for workshop activities to show that noise emissions from the sheds can comply with the day time noise criterion for nearby residential receivers.

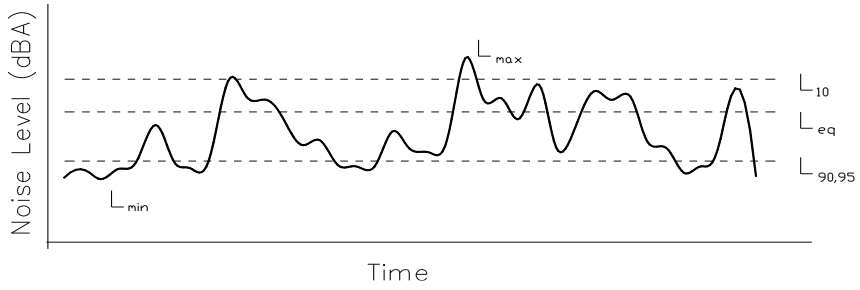
Based on the results of that assessment it was concluded that the industrial sheds could operate during the day time without adversely impacting upon the acoustical amenity of any residential receivers.

The site is now being fully developed and some of the tenants and proposed tenants are looking to extend operating hours within their businesses to include the possibility of early morning start up and evening works.

The current assessment will, therefore, consider the potential for noise emissions during those times to create adverse impacts at the nearby residential receivers.

3.0 DESCRIPTION OF TERMS

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 1 DEFINITION OF ACOUSTICAL TERMS	
Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.
	

4.0 THE EXISTING ENVIRONMENT

To quantify the existing acoustic environment of the area, an ambient noise survey was conducted on the site from 1 to 8 July, 2021.

An ARL EL316 environmental noise logger, was installed on the site near the boundary with the Mudgee Golf Club (as shown approximately, as a star on **Figure 1**).

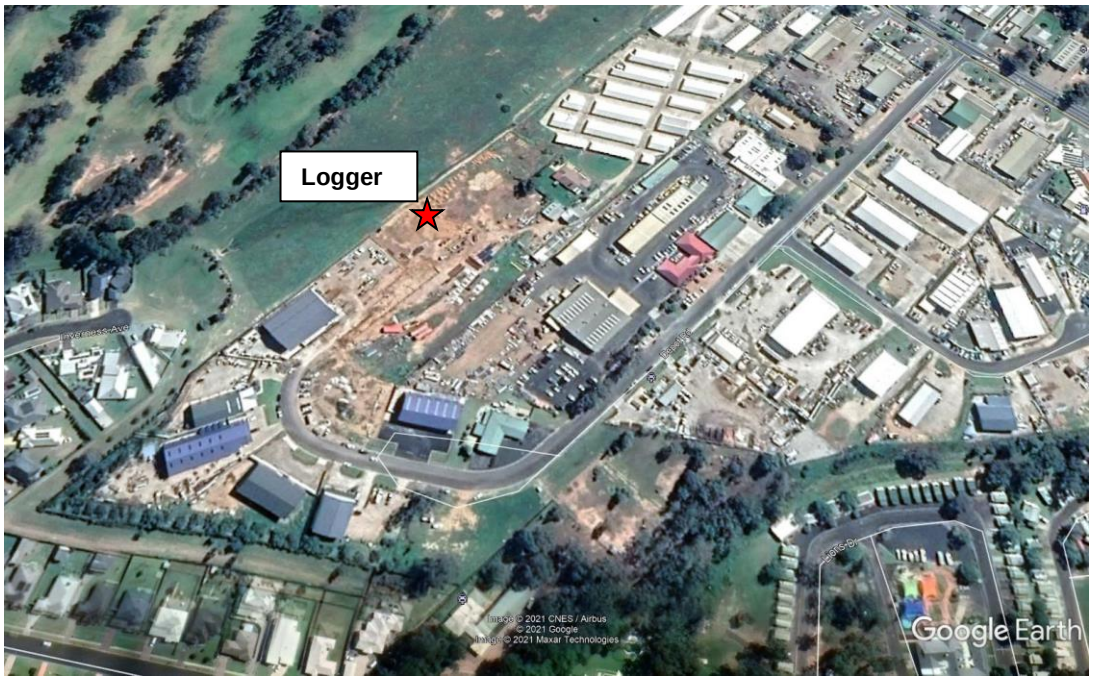


Figure 1 – Noise Logger Location

The logger location was considered representative of the current acoustic environment of the area. The industries within the existing sheds in the estate do not operate during the evening or night and, therefore, there is no noise associated with them. Other existing industries and the council depot do operate during the night (early morning) and the noise from these is considered part of the ambient acoustic environment and, is therefore, included in the noise logger measurements

The logger was programmed to continuously register environmental noise levels over 15 minute intervals with internal software calculating and storing L_n percentile noise levels for each sampling period. Calibration of the logger was performed as part of the instrument's initialisation procedures, with calibration results being within the allowable $\pm$ 0.5 dB(A) range.

All noise levels were monitored in accordance with relevant EPA guidelines and AS1055- "Acoustics - Description and measurement of environmental noise".

Table 2 presents a summary of the ambient noise levels (L90 Rating Background Levels (RBL) and existing Leq) recorded at the monitoring location. The RBL is the median of the daily L90 levels (Assessment Background Levels) in each assessment period (day/evening/night), over all valid days in the monitoring period.

The data are also shown graphically in Appendix I. A full set of logged data is not included in this report but is available on request.

TABLE 2
MEASURED AMBIENT NOISE LEVELS – DEPOT ROAD, MUDGEE

	Noise Levels dB(A)			
Percentile	Day	Evening	Night	Morning Shoulder
L_{90}	40	35	31	33
L_{eq}	55	45	43	43

NOTE: Day = 7am – 6pm, Evening = 6pm – 10pm, Night = 10pm – 7am.

The graphical representation of these noise measurements shows that the acoustic environment of the area is generally variable during the day and evening and noise levels drop off through the middle of the night. This is indicative of the commercial and industrial activity in the area.

The logger data shows that noise levels increase steadily from about 5am, coinciding, most likely, with an increase in the commercial and commuter activity in the industrial area. In such circumstances the NPfI includes the concept of "shoulder periods" where the RBL is the lowest 10th percentile of the L90 measurements for the equivalent one weeks' worth of valid data taken over the relevant shoulder period.

The NPfI indicates that shoulder periods are to be considered on a case by case basis. For the current assessment a "morning shoulder" period between 5 and 7am has been included in the assessment and discussion of potential noise impacts.

The measured background noise level, for the morning shoulder period, determined in accordance with the procedures in the NPfI, is shown in Table 2.

5.0 NOISE CRITERIA

5.1 Operational Noise Goals

In setting noise goals for an industrial development, the NPfI considers both Amenity and Intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source.

Amenity criteria are dependent upon the nature of the receiver area and the existing level of industrial noise. The most potentially affected receiver area near the site would be considered "suburban" as per the definitions in the NPfI.

The Project amenity noise level for an industrial development is equal to the recommended amenity noise level (from Table 2.2 in the NPfI) minus 2 dB(A) (as detailed in notes to **Table 3**).

The intrusiveness criteria are based on the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L90) is defined as the overall single figure background level representing each assessment period.

Table 3 specifies the Project Noise Trigger Levels (noise criteria) determined for the site based on procedures in the NPfI.

TABLE 3
NOISE CRITERIA

Location	Criterion	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	Morning Shoulder (5am-7am)
Depot Rd.	Intrusiveness dB(A),Leq(15-min.)[1]	50	40	36	38
	Amenity dB(A),Leq(15 min)[2]	53	43	38	n/a
	Project Noise Trigger Levels dB(A) Leq (15 min.)	**50**	**40**	**36**	**38**

1 Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.
2. Project amenity noise level (ANL) is suburban ANL (NPI Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level

5.2 Sleep Disturbance

As detailed previously, it is proposed that some of the industries in the sheds may operate during the night time period. The potential for sleep disturbance from maximum noise level events during the night-time period, therefore, needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

The NPfI states that a detailed maximum noise level event assessment should be undertaken where the subject development/premises night-time noise levels at a residential location exceed:

- Leq (15 min) 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or

- Lmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The logger data presented in Table 2 shows that the prevailing RBL is 31 dB(A) L90 and, therefore, the trigger level for a detailed assessment is **40 dB(A) Leq (15 min)** and/or **52 dB(A) Lmax**.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy (RNP).

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur,
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development,
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods), and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

6.0 NOISE IMPACT ASSESSMENT

6.1 Operational Noise

The proposed layout of the site is shown in **Figure 2**.

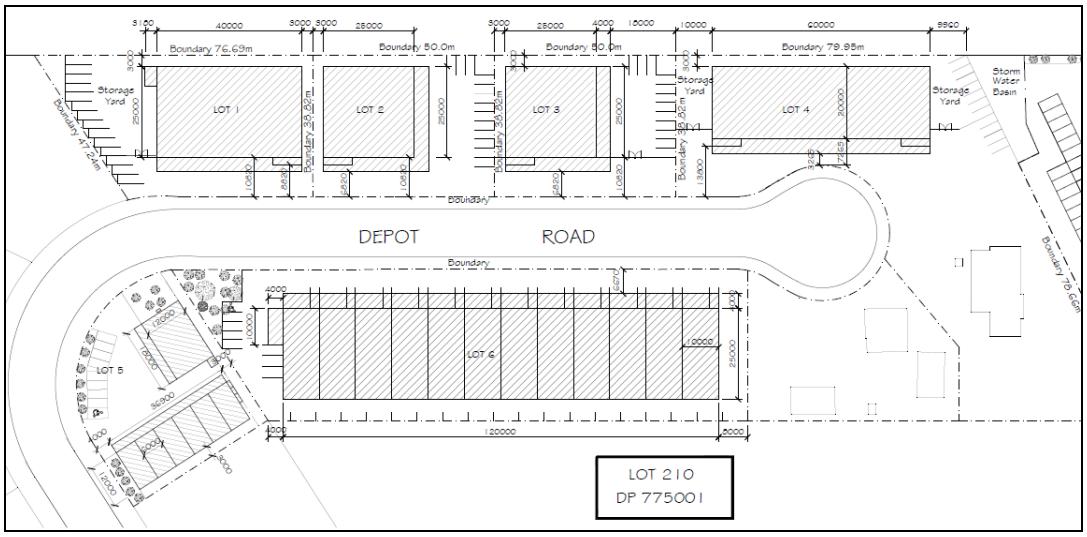


Figure 2 – Site Layout

As shown in Figure 2 it is proposed that the site will be subdivided into separate "lots" with a steel industrial style shed to be erected on these.

At the time of the current reporting Shed 1 was occupied by a small engineering works that operates during the day time. In order to cater for breakdowns and allow for additional works, at peak times, the owner wishes to extend the operating hours. The layout of Shed 1 is shown in **Figure 3**.

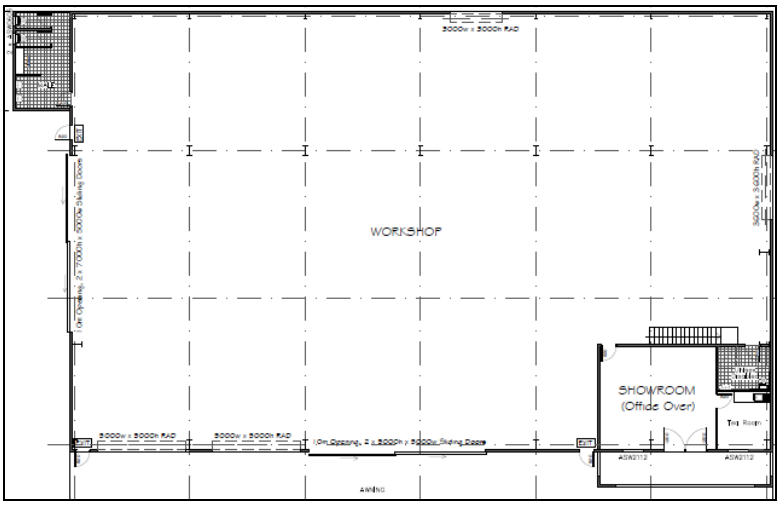


Figure 3 – Shed 1

Noise from the operation of the existing workshop was measured on site in July 2021. All sound levels from various workshop activities were measured with a Bruel & Kjaer Type 2250 Precision Sound Level Analyser with calibration performed before and after the measurements.

At the time of the noise measurements the workshop was operating under typical conditions. The measurements included the general operation of the workshop (grinding, welding hammering etc.) as well as specific measurements made of gouging.

As shown in Figure 3, the shed has an operable wall in the southern facade (i.e. in the direction of the most potentially affected receivers). The noise levels from the operating workshop were measured at the centre of the opening, and other representative location within the workshop and yard.

There is a 2.4m high fence around the yard to the site and there are currently two storage containers mounted on frames inside the boundary. These storage containers form a partial acoustic barrier, to a height of 5.6m, in the direction of the nearest receivers in Inverness Avenue.

There are currently gaps between the two containers and also between the bottom of the containers and the top of the boundary fence. These gaps currently compromise the acoustic integrity of the barrier by allowing some noise to pass through. The occupant has indicated that the barrier will be made good along the length of the boundary such that there are no gaps.

The calculations made here assume that the work to complete that barrier has been done and they, therefore, include the insertion loss for a 5.6m high solid acoustic barrier.

Table 4 shows a calculation of the measured general workshop noise propagated from the opening at Shed 1 and impacting on the nearest residential receiver to the south west at 12A Inverness Avenue.

TABLE 4
SHED 1 WORKSHOP NOISE as dB(A) Leq (15 min)
12A INVERNESS AVE – DOOR OPEN

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Average distance loss (80m)		46	46	46	46	46	46	46	46
Barrier Insertion Loss (5.6m)		7	8	10	12	15	18	21	24
SPL at Boundary	41	18	32	29	31	31	34	35	30

The results in Table 4 show that, under the assessed conditions, and with the acoustic barrier in place, the received noise will not exceed the adopted day time criterion at the most potentially affected receiver.

Attended noise measurements were made at locations in Inverness Avenue on the morning of 1st July, 2021. The noise from the workshop was measured in the reserve behind the residence at 12A Inverness Avenue. The noise included general workshop activity (but did not include gouging). A noise level of 42 dB(A) Leq (15 min) was attributed to emissions from the workshop at shed 1. The measurement also included contributions from other noise sources in the industrial area but these were excised from the data during the analysis process. The measured workshop noise is in keeping with the results shown in Table 4.

The results in Table 4 show that, under the assessed conditions, the noise from shed 1 will exceed the evening and night criteria. During these times it is apparent that the operable wall should be closed to limit noise emissions from the shed. **Table 5**, therefore, shows a calculation of the workshop noise propagated through the walls, with the operable wall and doors closed, and impacting on the nearest residential receiver to the south west at 12A Inverness Avenue.

The workshop noise was theoretically propagated to the nearest residences taking into account the effects of transmission loss through building elements, with the wall closed, and hemispherical spreading (distance loss) to the receiver. From consideration of the dimensions and orientation of the various building elements, the sound pressure levels immediately outside these were propagated to the nearest receiver using an equation[1] giving the sound field due to an incoherent plane radiator.

TABLE 5
SHED 1 WORKSHOP NOISE as dB(A) Leq (15 min)
12A INVERNESS AVE – DOOR CLOSED

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Average distance loss in shed (10m)		18	18	18	18	18	18	18	18
STL of wall (0.4mm steel)		13	11	14	18	21	26	24	23
Exterior SPL	65	40	57	53	53	53	46	60	59
Barrier Insertion Loss		7	8	10	12	15	18	21	24
SPL at Boundary	30								

The results in Table 5 show that, under the assessed conditions, with all doors closed, the noise emissions from the assessed activities in

[1] Equation (5.104), DA Bies and CH Hansen, *Engineering Noise Control*, E & FN Spon, 1996.

Shed 1 will not exceed the adopted evening or night time noise criteria.

The calculation assumes all activities are being undertaken inside the shed and that there is no activity in the yard.

The noise from gouging was measured to be approximately 6 dB(A) louder than that of eth general workshop. Based on the results in tables 4 and 5 this would indicate that the combined noise from gouging plus the general workshop would be in compliance with the day time criterion with the wall open.

The noise from gouging would be higher than the evening criterion with the wall open, but in compliance with the wall closed. The noise would be marginally higher than the night time criterion with the wall closed.

It is, therefore, recommended that, if gouging is to be undertaken during the evening the wall must be closed. Gouging should not be undertaken at night.

The remainder of the sheds are either under construction, or are proposed for construction. The sheds may be leased or sold to various users.

The designs for Sheds 2 and 3 are shown in **Figure 4**.

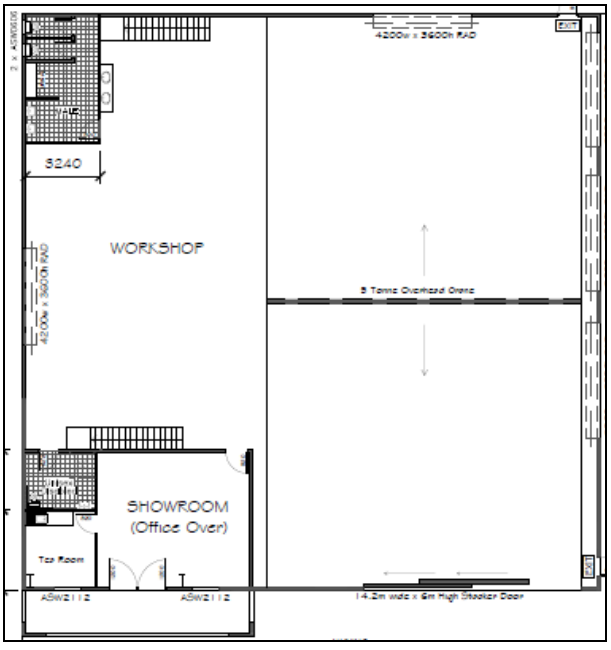


Figure 4 – Sheds 2 and 3

Sheds 2 and 3 are designed with roller door openings in the southern and western facades. These roller doors will face towards the receivers in Inverness Avenue. Noise emissions from the roller doors, particularly those in the southern facade will be partially shielded from the receivers by the acoustic barrier effects of the intervening sheds and/or the orientation of the doors with respect to the receiver boundaries.

The layout of both sheds is such that parking areas for each are located "behind" the sheds with respect to the nearby residential receivers. The building elements of the sheds will provide good acoustic shielding in the direction of those receivers.

Table 6 shows a theoretical calculation of the noise from workshop activities, similar to those operating in shed 1, considered to be operating in shed 3 (as shown in Figure 2). The roller doors to the shed were assumed to be open.

The location of Shed 2 will shield noise in the direction of the receiver at 12A Inverness Avenue and, therefore, the calculation has been made to the boundary of the most potentially affected receiver at 23 Inverness Avenue.

TABLE 6
SHED 3 NOISE as dB(A) Leq (15 min)
23 INVERNESS AVENUE – DOORS OPEN

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Average distance loss in shed (10m)		18	18	18	18	18	18	18	18
Exterior SPL at opening	87	53	71	70	74	77	75	84	82
SPL at Boundary	44								

The results in Table 6 show that, under the assessed conditions, and with roller doors open, the received noise would not exceed the day time noise criterion but would exceed the criteria for evening and night.

Table 7 shows a theoretical calculation of the noise from workshop activities, with roller doors closed, propagated to the nearest potentially affected receiver.

TABLE 7 SHED 3 NOISE as dB(A) Leq (15 min) 23 INVERNESS AVENUE									
	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Average distance loss in shed (10m)		18	18	18	18	18	18	18	18
STL of wall (0.4mm steel)		13	11	14	18	21	26	24	23
Exterior SPL at wall	65	40	57	53	53	53	46	60	59
SPL at Boundary	35								

The results in Table 7 show that, under the assessed conditions, and with roller doors closed, the received noise would not exceed the criteria for any of the day, evening or night times.

The calculations in tables 6 and 7 are based on the noise levels from the existing workshop but are considered likely to be representative of most typical machinery or light fabrication workshops.

The operation of other commercial activities in the other sheds would require specific assessment but, as a general indication, the noise from workshops as measured is at the upper end of expected noise levels for any activities that may occur in industrial sheds like those to be constructed.

Other sheds on the site are further away from any residences and are also further shielded from receivers by the structure of the intervening buildings.

This would indicate that, provided all doors and windows are closed during the evening and night, there should not be any adverse noise impacts at any receivers.

The discussion above is general and the condition for doors to be closed could be removed pending the results of any acoustic assessment based on specific details of proposed activities within a particular shed.

The consideration of the noise control options for all sheds was included in the original acoustic assessment for the site and is included below.

The noise control could include (but not be limited to) relatively simple actions such as;

- Lining the internal walls or parts of the walls,
- Isolating particularly noisy plant or activities and acoustically shielding these;
- Locating noisy plant or activities “behind” internal partitions or offices relative to receivers, or
- Sourcing noise attenuation equipment specific to a particular plant item, e.g. mufflers, attenuator guards, cowlings etc.

6.2 Sleep Disturbance

The discussion of operational noise during the evening and night indicates that during he night time period all significant noise generating activities should be undertaken inside the various sheds and with all external doors and openings closed.

The potential for sleep disturbance impacts is, therefore most likely to come from loud noise associated with people arriving or departing work (car doors, engine revs etc.) or from noise associated with the delivery or transport of parts or machinery. All of these events have relatively loud maximum noise levels which, when averaged out over a 15 minute period have an acceptable Leq noise level.

A scenario has been assessed where a noise source representing an impact from a truck being unloaded in the yard of shed 2 is potentially impacting on the receiver at 23 Inverness Avenue at a distance of approximately 170m.

Preliminary calculations indicated that, under the conditions, there was a potential for the sleep disturbance criterion to be exceeded and that some form of noise control would be required. The most feasible option would be to construct an acoustic barrier fence along the western boundary of the site, as shown in **Figure 5**.

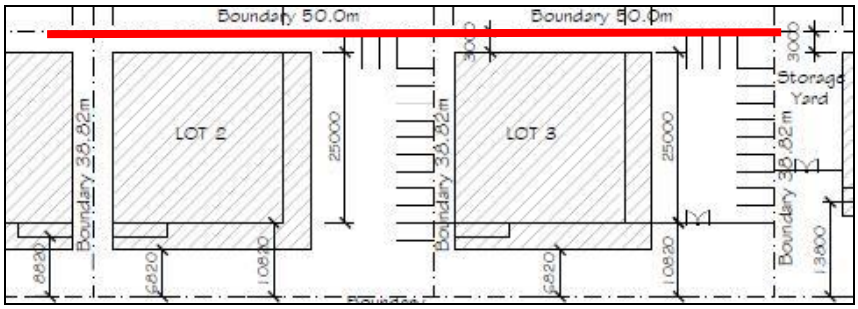


Figure 5 – Acoustic Fence

Table 8 shows a calculation of the maximum impact noise propagated from the yard at Shed 2 and impacting on the residential receiver at 23 Inverness Avenue. The calculation assumes a 2.5m high barrier along the boundary as shown in Figure 5. The noise source was considered to be at 1.5 high and the receiver height was assumed to be 2m above ground level.

TABLE 8
SHED 2 NOISE as dB(A) Lmax
23 INVERNESS AVENUE

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	115	94	95	102	108	109	109	106	98
Average distance loss (170m)		53	53	53	53	53	53	53	53
Barrier Insertion Loss (2.4m)		6	6	7	9	11	14	17	20
SPL at Boundary	51								

The results in Table 8 show that noise from loud impacts in the yards of the sheds can be adequately controlled provided there is a minimum 2.5m high acoustic barrier along the boundary as indicated in Figure 5.

An acoustic barrier is one which is constructed of material with minimum surface density of 15kg/m^3 and is impervious from the ground to the recommended height with no gaps for the passage of sound. For the current site a lapped and capped timber fence with minimum 12mm palings and 25% overlap each side would be acoustically adequate.

The barrier as shown would also provide additional attenuation of noise from activities in the sheds.

As there are no confirmed end users for the sheds, the calculations and discussion above is a generic sleep disturbance scenario, based on a potential situation. It is noted that the calculation assumes a loud noise source in the yard representing, say, a truck delivering goods or unloading machinery during the night (nominally, early morning prior to 7am).

If this activity, or other loud noise events are not proposed for outdoor areas or yards at the sheds then the barrier would not be required. Under those circumstances, the use of the yards at night would need specific assessment.

7.0 CONCLUSION

An assessment has been conducted to determine the potential for adverse noise impacts arising from potential evening and night time operation at the proposed industrial sheds at the Mudgee Industrial Park on Lot 210 D.P. 775001, Depot Road, Mudgee.

The assessment has shown that operation of the sheds during the evening and night would be possible provided the doors to the sheds are closed during those times.

The use of the yards to the closest sheds to residential receivers would be possible provided a minimum 2.5m high acoustic barrier is in place along the western boundary to the site.

APPENDIX I
NOISE LOGGER CHARTS