REVERB ACOUSTICS

Noise and Vibration Consultants

Rail Traffic Noise & Vibration Impact Assessment Proposed Subdivision of Lot 2 DP.1057313 405 Martins Creek Road Paterson NSW

October 2023

Prepared for Mr Jakes
Report No. 23-2886-R1

Building Acoustics-Council/EPA Submissions-Modelling-Compliance-Certification

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1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a rail traffic noise and vibration impact assessment for a proposed subdivision application at Lot 2 DP.1057313, No.405 Martins Creek Road, Paterson. The purpose of the assessment is to theoretically determine the noise and vibration impact within habitable spaces from passing rail traffic on the North Coast rail Line and to recommend acoustic modifications that must be incorporated into the design. This noise and vibration impact assessment has been conducted with reference to NSW Department of Planning and Environment's (DPE's) Guideline, *Development near Rail Corridors and Busy Roads – Interim Guidelines.*

The Assessment was requested by Mr Jakes to form part of and to support a Subdivision Application to Dungog Shire Council (DSC), and to ensure that noise levels comply with the requirements of the NSW Environment Protection Authority (EPA), DPE and DSC.

2 TECHNICAL REFERENCE / DOCUMENTS

AS/NZS 2107-2016 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors"*.

Department of Planning (2008). *"Development near Rail Corridors and Busy Roads - Interim Guidelines".*

State Rail Authority of NSW (1995) *"Rail related noise and vibration issues to consider in local environmental planning – development applications and building applications".*

Rail Infrastructure Corporation. (2003). *Interim Guidelines for Councils – Consideration of rail noise and vibration in the planning process.*

Rail Infrastructure Corporation. (2003). *Interim Guidelines for Applicants – Consideration of rail noise and vibration in the planning process.*

Detail survey & subdivision plan supplied by Delfs Lascelles Consulting Surveyors, Revision C, dated 5 October 2023. Note that variations from the design supplied to us, may affect the acoustic recommendations.

A Glossary of commonly used acoustical terms is presented in Appendix A to aid the reader in understanding the Report.

3 CRITERIA

3.1 Rail Traffic Noise (Internal Noise Levels)

3.1.1 Internal Noise Levels

State Environmental Planning Policy (Transport and Infrastructure) 2021 states the following:

Subdivision 2 Development in or adjacent to rail corridors and interim rail corridors – notification and other requirements

2.100 Impact of rail noise or vibration on non-rail development
(1) This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—

(a) residential accommodation,
(b) a place of public worship,
(c) a hospital,
(d) an educational establishment or centre-based child care facility.

(2) Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this section and published in the Gazette.

(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—

(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10.00 pm and 7.00 am,
(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

Cognate performance requirements for residential developments can be sourced from DPE's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*" (released in December 2008). Limits specified within the Policy, which are identical to SEPP (Infrastructure) 2007, will be used for the purpose of this assessment, are shown below:

Type of Occupancy	*Noise Level in dB(A)*	*Applicable Time Period*
Sleeping areas (bedroom)	35	Night 10pm to 7am
Other habitable rooms (excluding garages, kitchens bathrooms & hallways)	40	At any time

If criteria are exceeded by more than 10dB(A) with windows open, mechanical ventilation should be incorporated into the design of affected rooms.

3.2 Rail Traffic Vibration

3.2.1 Personal comfort

Various authorities have set maximum limits on allowable ground and building vibration in different circumstances and situations, all directed at personal comfort rather than building damage. This usually leads in virtually every situation to people who interpret the effects of a vibration to ultimately determine its acceptability. The most recent criteria for assessment of rail traffic vibration impacts upon occupants of a building are those contained in DPE's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*". The Guideline recommends that the EPA's *Assessing Vibration: A Technical Guideline (2006)* should be used for the assessment of vibration. Limits set out in the Guideline are for vibration in buildings, and are directed at personal comfort for continuous, impulsive and intermittent vibrations. Table 1 shows the Vibration Dose Values for intermittent vibration activities such as train passbys, pile driving and use of vibrating rollers, taken from Table 2.4 of the Guideline, above which various degrees of adverse comment may be expected.

Table 1: Acceptable Vibration Dose Values (m/s$^{1.75}$)
Above which Degrees of Adverse Comment are Possible

Location	Day (7am-10pm)		Night (10pm-7am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas #	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Hospital operating theatres, precision laboratories, etc.

3.2.2 Building Safety Criteria

Australian Standard AS2187.2-1993, dealing specifically with blasting vibration, specifies a maximum peak particle velocity of 10mm/sec for houses and a preferred limit of 5mm/sec where site specific studies have not been undertaken. German Standard DIN 4150 - 1986, Part 3 Page 2, specifies a maximum vibration velocity of 5 to 15 mm/sec in the foundations for dwellings and 3 to 8 mm/sec for historical and sensitive buildings, for the range 10 to 50Hz. British Standard BS 7385 Part 2, specifies a maximum vibration velocity of 15mm/sec at 4Hz increasing to 20mm/sec at 15Hz increasing to 50mm/sec at 40Hz and above, measured at the base of the building.

The above listed criteria vary from 3mm/sec up to 15mm/sec, therefore, the more conservative limit of **5mm/sec** will be adopted for the purposes of this assessment. It should be acknowledged, however, that intermittent ground vibration velocities at 5mm/sec are generally considered the threshold at which architectural (cosmetic) damage to normal dwellings may occur and velocities at 10mm/sec should not cause any significant structural damage, with the exception of the most fragile and brittle of buildings.

4 METHODOLOGY & ANALYSIS

Figure 1: Location Plan

Source: Detail Survey & Subdivision Plan supplied by Delfs Lascelles Consulting Surveyors

The predicted L(A)eq,15hr and L(A)eq,9hr noise level for trains passing the site was calculated using the US EPA's Intermittent Traffic Noise calculation method. This method was adopted because train movements are not continuous, and have the same passby characteristic pattern as other vehicles. The mathematical formula used to calculate the Leq,T noise level for intermittent rail traffic noise is given in Equation 1 below:

$$L_{eq},T = L_b + 10\log\left[1+\frac{ND}{T}\left(\frac{10^{(L\max - Lb)\,/\,10}-1}{2.3}-\frac{\left(L_{\max}-L_b\right)}{10}\right)\right] \quad \text{..... Equation 1}$$

Where L_b is background noise level, dB(A)
L_{MAX} is train noise, dB(A)
T is the time (min)
N is number of trains
D is duration of noise of each train (min)

The following Table shows a summary of results of train traffic noise measurements taken over a 7 day period at a nearby site, 20 metres from the North Coast Rail Line.

Table 2: Summary Noise Level Results–20 Metres from Rail Line

Descriptor	Noise Level dB(A)	Time Interval
Leq,1hr (day)	70.5	07:00 to 22:00
Leq,1hr (night)	66.6	22:00 to 07:00
Leq,9hr	61.9	22:00 to 07:00
Leq,15hr	65.8	07:00 to 22:00
Leq,24hr	64.6	06:00 to 06:00

Table 3 shows results of calculations to predict the noise generated by train passbys at a distance of 60 metres from the rail line, following procedures outlined previously.

Table 3: Received Train Noise Levels, 60m from Rail Line

	L(A)eq,15hr DAY		L(A)eq,9hr NIGHT	
	Coal/Freight	Passenger	Coal/Freight	Passenger
Rec Noise Level, Lmax.	79	69	79	69
Train frequency/hr	4	3	2	2
Average Bgd Noise, dB(A)	30			
Calculated train noise, Leq	60.8	48.0	57.8	46.3
Combined impact, dB(A)	**61**		**57**	
Criterion (internal)	**40**		**35**	
Exceedance	**21**		**22**	

Table 4 shows a summary of results predicting the noise generated by train passbys at varying distances from the North Coast Rail Line.

Table 4: Received Train Noise Levels

Dist from Rail Line (m)	L(A)eq,15hr Combined DAY	Impact	L(A)eq,9hr Combined NIGHT	Impact
20	66	26	62	27
60	61	21	57	22
100	59	19	55	20
200	56	16	52	17
300	54	14	50	15
400	53	13	49	14
500	52	12	48	13

Criteria: DAY = 40dB(A),Leq,15hr NIGHT = 35dB(A),Leq,9hr

Typical vibration levels for train passbys were measured at a nearby site, approximately 60 metres from the rail line using a Vibroch V801 Seismograph coupled to a triaxial geophone installed on hard packed earth. A sandbag was placed over the geophone during each measurement to ensure elevated readings were not recorded due to bouncing and movement, which may occur at higher vibration amplitudes. The unit is capable of measuring and storing peak Z-axis vibration velocities, as well as vibration in three directions simultaneously and gives peak velocity and acceleration on the x, y and z axes.

Vibration levels for train passbys were measured at a nearby site, at varying distances from the rail line and also sourced from our library of technical data for comparison purposes. Vibration levels of trains were measured with a Vibroch V801 Seismograph coupled to a triaxial geophone installed on hard packed earth. A sandbag was placed over the geophone during each measurement to ensure elevated readings were not recorded due to bouncing and movement, which may occur at higher vibration amplitudes. The unit is capable of measuring and storing peak Z-axis vibration velocities, as well as vibration in three directions simultaneously and gives peak velocity and acceleration on the x, y and z axes.

Vibration monitoring results revealed that no perceptible vibration was recorded from train passbys at a distance greater than 60 metres from the rail line. Under certain circumstances, say if a large vibrating track maintenance machine was to pass the site and the resonant frequency of the ground happened to be an exact multiple of the driving frequency of the source, then higher vibration levels could be expected. However, it is doubtful that levels would reach a magnitude capable of causing any adverse comment or structural damage.

Vibration can be felt at levels well below those considered to cause structural damage. Complaints from occupiers are usually due to the belief that if vibration can be felt then it is likely to cause damage. Slamming of doors or footfall within a building can produce vibration levels above those produced by passing rail traffic. Passing trains will only produce loads, and therefore vibration, when their mass is accelerated, for example when hitting joins or deformities in rails. This emphasises the importance of properly maintained rail lines.

Vibration levels caused by trains passing the site are unlikely to cause direct failure, and it is considered the main action is triggering cracks in materials already subjected to stress or natural forces, however, as previously mentioned, this may also arise from internal forces such as slamming of doors. In our experience, vibration will only begin to trigger "natural cracking" at levels above 1mm/sec.

A schedule of required glazing and construction details has been compiled for each Zone in the subdivision. See Section 5 and Appendix B.

5 RECOMMENDED NOISE CONTROL

5.1 Zone 1

EXCLUSION ZONE. No construction permitted.

5.2 Zone 2

The glazing systems sighted in the following Tables are presented as a guide for the supplier:

Glazing Systems: Type A: Standard glazing. No acoustic requirement.
Type B: Single-glaze 5-8mm clear float glass.
Type C: Single glaze laminated or Vlam Hush glass.

Note: The typical glazing shown in the following Table should be used as a guide only. The supplier of the window/door must be able to provide evidence that the complete system will achieve the specified Rw performance, i.e. do not simply install our recommended glass in a standard window frame.

Table 5: Recommended Construction – Zone 2

Element	Facade	Room	Required Rw Must achieve for Compliance	Typical Construction Not for Specification
Windows /Sl. Doors	West	Liv/Din/Bed	**33**	Type C
		Kitchen	**31**	Type C
		Bath/WC/Lndry	**28**	Type B or C
	North/South	Liv/Din/Bed	**31**	Type C
		Kitchen	**29**	Type B or C
		Bath/WC/Lndry	**26**	Type B
	East	Liv/Din/Bed	**27**	Type B
		Kitchen	**24**	Type B
		Bath/WC/Lndry	**-**	No acoustic requirement
External Doors	West North/South	All		See Note 1
Roof		All		See Note 2
Walls		All		See Note 3

Note 1: All external swinging doors are to be 30-40mm solid core with the vertical sides and top of the door frames fitting neatly to provide close contact when doors are closed. Proprietary acoustic seals are to be fitted at the perimeter of doors, i.e. Raven RP10 or Lorient/Kilargo equivalent. All glazed sections must be minimum 6mm safety glass.
Note 2: Roof construction should consist of sisalation or wire mesh laid down on roof trusses. This is to be completely covered with a 30-40mm foil faced building blanket or similar (in situations where trusses are at centres close enough to avoid excessive sagging of the blanket, the sisalation/wire mesh may be omitted). If Terra Cotta or concrete roof tiles are preferred, the building blanket may be omitted. All upper level ceilings are to consist of an impervious ceiling of 1 sheet taped and set 13mm Fire Rated plasterboard. To further assist in low frequency attenuation, all ceiling voids should contain a layer of fibreglass or rockwool insulation. The insulation is to be installed in addition to, not in lieu of the building blanket. Specialised acoustic insulation is preferred, however dense thermal insulation (eg, R3 batts) will suffice and is much less expensive ($15/m^2 for Rockwool and $6/m^2 for R3 batts). Generally, Councils now require new dwellings to achieve an adequate energy rating, which will usually only be achieved if thermal insulation is installed in the ceiling void, therefore, builders would be obliged to install insulation in any case.

Note 3: We strongly recommend brick veneer or cavity-brick construction. These high-mass building elements will provide attenuation of the lower frequencies, typically around 125 to 500Hz, typically generated by road traffic. All internal lining for brick veneer to be minimum 1 sheet 13mm plasterboard. All lightweight cladding on the south, east and west facades (i.e. vinyl weatherboards, Colorbond, Weathertex, etc) is to be backed with either 6mm fibre cement sheeting (Villaboard, Hardiflex) or 10mm construction plywood. If upper level lightweight construction is preferred (i.e. Hebel Powerpanel, weatherboard, etc) modification to the west, north and south facades will be required consisting of cavity infill of R2/S2 insulation, together with internal lining 1 sheet 13mm fire rated plasterboard.

5.3 Zone 3

Table 6: Recommended Construction – Zone 3

Element	Facade	Room	Required Rw Must achieve for Compliance	Typical Construction Not for Specification
Windows /Sl. Doors	West	Liv/Din/Bed	**30**	Type C
		Kitchen	**28**	Type B or C
		Bath/WC/Lndry	**25**	Type B
	North/South	Liv/Din/Bed	**28**	Type B or C
		Kitchen	**26**	Type B
		Bath/WC/Lndry	**23**	Type B
	East	Liv/Din/Bed	**-**	No acoustic requirement
		Kitchen	**-**	No acoustic requirement
		Bath/WC/Lndry	**-**	No acoustic requirement
External Doors	West North/South	All		See Note 1
Roof		All		See Note 2
Walls		All		See Note 3

Note 1: All external swinging doors are to be 30-40mm solid core with the vertical sides and top of the door frames fitting neatly to provide close contact when doors are closed. All glazed sections must be minimum 5-6mm safety glass.
Note 2: Roof construction should consist of sisalation or wire mesh laid down on roof trusses. This is to be completely covered with a 30-40mm foil faced building blanket or similar (in situations where trusses are at centres close enough to avoid excessive sagging of the blanket, the sisalation/wire mesh may be omitted). If Terra Cotta or concrete roof tiles are preferred, the building blanket may be omitted. All upper level ceilings are to consist of an impervious ceiling of 1 sheet taped and set 13mm plasterboard. To further assist in low frequency attenuation, all ceiling voids should contain a layer of fibreglass or rockwool insulation. The insulation is to be installed in addition to, not in lieu of the building blanket. Specialised acoustic insulation is preferred, however dense thermal insulation (eg, R3 batts) will suffice.
Note 3: We strongly recommend brick veneer or cavity-brick construction. These high-mass building elements will provide attenuation of the lower frequencies, typically around 125 to 500Hz, typically generated by road traffic. All internal lining for brick veneer to be minimum 1 sheet 10-13mm plasterboard. If upper level lightweight construction is preferred (i.e. Hebel Powerpanel, weatherboard, etc) modification to the west, north and south facades will be required consisting of cavity infill of R2/S2 insulation, together with internal lining 1 sheet 13mm plasterboard.

5.4 Zone 4

Table 7: Recommended Construction – Zone 4

Element	Facade	Room	Required Rw Must achieve for Compliance	Typical Construction Not for Specification
Windows /Sl. Doors	West	Liv/Din/Bed	**28**	Type B or C
		Kitchen	**25**	Type B
		Bath/WC/Lndry	**-**	No acoustic requirement
	North/South	Liv/Din/Bed	**26**	Type B
		Kitchen	**24**	Type B
		Bath/WC/Lndry	**-**	No acoustic requirement
	East	Liv/Din/Bed	**-**	No acoustic requirement
		Kitchen	**-**	No acoustic requirement
		Bath/WC/Lndry	**-**	No acoustic requirement
External Doors	West North/South	All		See Note 1
Roof		All		See Note 2
Walls		All		See Note 3

Note 1: All external swinging doors are to be 30-40mm solid core with the vertical sides and top of the door frames fitting neatly to provide close contact when doors are closed. All glazed sections must be minimum 5mm safety glass.
Note 2: Roof construction should consist of sisalation or wire mesh laid down on roof trusses. This is to be completely covered with a 30-40mm foil faced building blanket or similar (in situations where trusses are at centres close enough to avoid excessive sagging of the blanket, the sisalation/wire mesh may be omitted). If Terra Cotta or concrete roof tiles are preferred, the building blanket may be omitted. All upper level ceilings are to consist of an impervious ceiling of 1 sheet taped and set 10-13mm plasterboard. To further assist in low frequency attenuation, all ceiling voids should contain a layer of fibreglass or rockwool insulation. The insulation is to be installed in addition to, not in lieu of the building blanket. Specialised acoustic insulation is preferred, however dense thermal insulation (eg, R3 batts) will suffice.
Note 3: We strongly recommend brick veneer or cavity-brick construction. These high-mass building elements will provide attenuation of the lower frequencies, typically around 125 to 500Hz, typically generated by road traffic. All internal lining for brick veneer to be minimum 1 sheet 10-13mm plasterboard. If upper level lightweight construction is preferred (i.e. Hebel Powerpanel, weatherboard, etc) modification to the south, east and west facades will be required consisting of cavity infill of R2/S2 insulation, together with internal lining 1 sheet 10-13mm plasterboard.

5.5 Zone 5

NO ACOUSTIC REQUIREMENT.

6 CONCLUSION

A rail traffic noise and vibration impact assessment for a proposed subdivision application at Lot 2 DP.1057313, No.405 Martins Creek Road, Paterson, has been completed. Results show that the site is satisfactory for the intended purpose, providing our modifications are incorporated into the design. Recommendations to reduce internal noise levels to achieve the desired noise reduction and satisfy the requirements of DPE, the EPA and DSC have been made regarding roof/ceiling and wall construction, minimum glazing requirements, etc. The recommended glazing shown in Tables 5, 6 and 7 should be used as a guide only. The supplier of the window/door must be able to provide evidence that the complete system will achieve the specified Rw performance. Do not simply install our suggested glass type in a standard window frame.

The adopted train noise levels represent the average maximum noise level from train passbys. Therefore, individual train passbys may at times produce higher noise levels than those adopted. No significant increase in maximum received noise levels are expected in the future, as locomotive and rolling stock manufacturers are continuously developing noise reduction strategies addressing engine, exhaust and wheel noise. We conclude, with a high degree of confidence that vibration levels at the expected magnitudes will not cause direct structural damage or cause undue annoyance to the occupants. We suspect that one or more natural forces, as discussed in Section 4, will be the cause of any future damage. It should be noted, however, that vibration may be noticed on occasion while a person is standing or seated quietly. Other noticeable indicators may be rattling of window frames and ornaments, and possible visible movement of hanging pictures, etc.

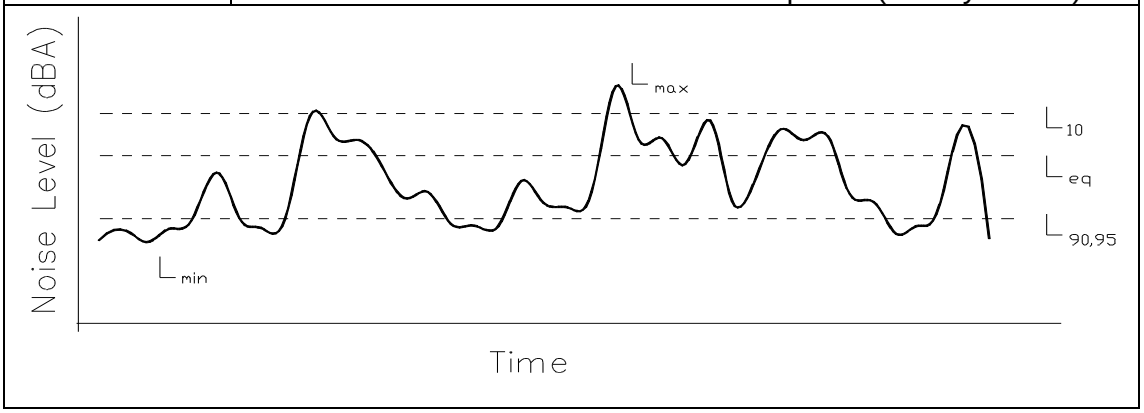
In conclusion, providing the recommendations given in this report are implemented, rail traffic noise and vibration levels and industrial noise during typical operation will be compliant with DPE, EPA and DSC requirements. We therefore see no acoustic reason why the proposal should be denied.

Steve Brady M.A.S.A. A.A.A.S.
Principal Consultant

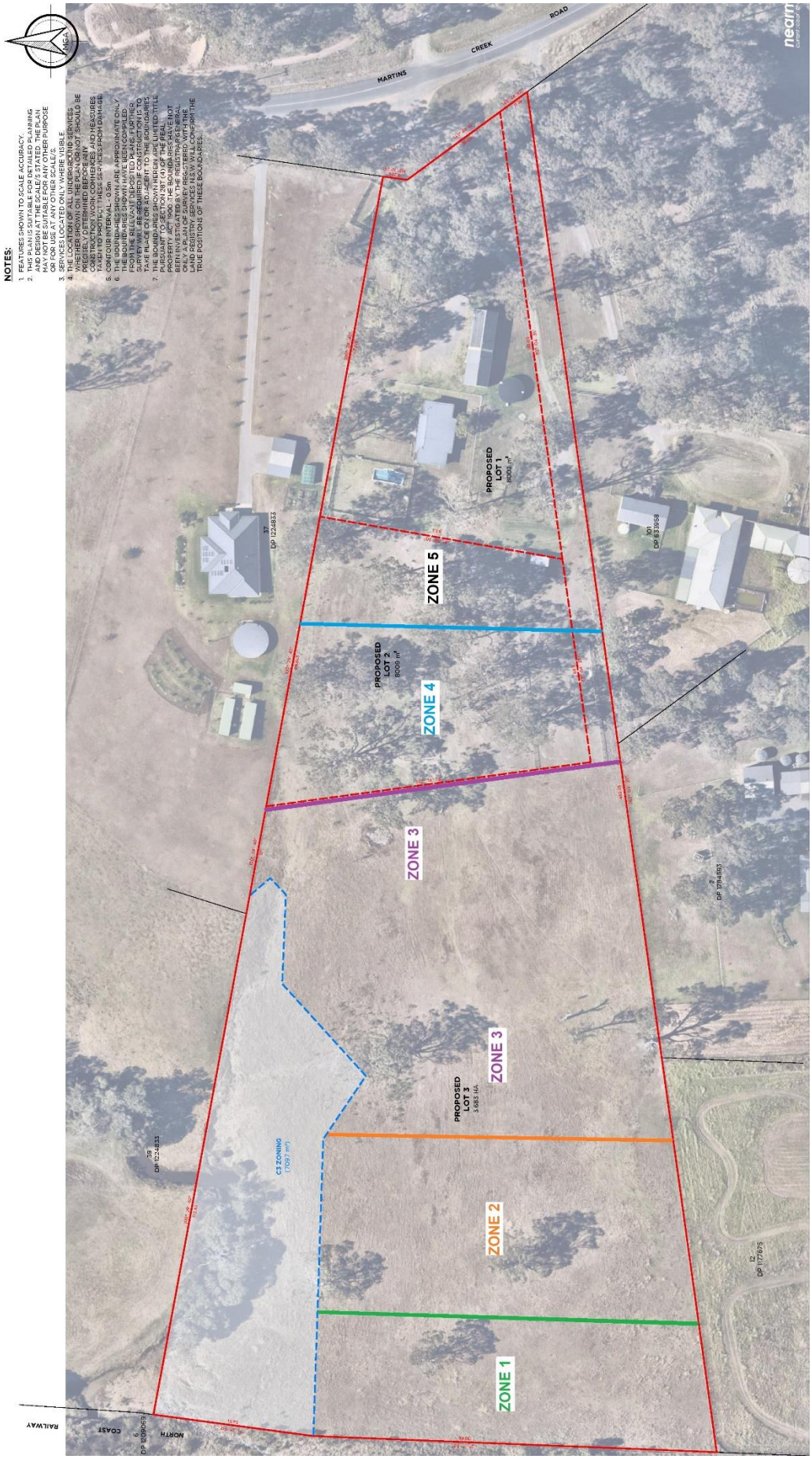
APPENDIX A
Definition of Acoustic Terms

Definition of Acoustic Terms

Term	Definition
dB(A)	A unit of measurement in decibels (A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
Rw	Weighted Sound Reduction Index. The ability of a partition to attenuate sound, in dB. Given as a single number representation.
Leq	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event has the same amount of acoustic energy as the given event.
L90	The noise level which is equalled or exceeded for 90% of the measurement period. An indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
Lmax	The maximum level for the measurement period (usually in dBA)



APPENDIX B
Noise Control Zones


NOTES:
1. FEATURES SHOWN TO SCALE ACCURACY.
2. THIS PLAN IS SUITABLE FOR DETAILED PLANNING AND DESIGN AT THE SCALE SHOWN. THIS PLAN MAY NOT BE SUITABLE FOR ANY OTHER PURPOSE OR FOR USE AT ANY OTHER SCALE/S.
3. SCALE SHOWN IS APPROXIMATE ONLY.
4. THE LOCATION OF ALL UNDERGROUND SERVICES WHETHER SHOWN ON THE PLAN OR NOT, SHOULD BE CHECKED AND PROVED BEFORE ANY EXCAVATION COMMENCES. ADEQUATE PRECAUTIONS AND MEASURES TAKEN TO PROTECT THESE SERVICES FROM DAMAGE.
5. CONTOUR INTERVAL – 0.5m
6. ALL BOUNDARIES SHOWN ARE APPROXIMATE ONLY.
7. THE BOUNDARIES SHOWN HEREIN ARE LIMITED TITLE BOUNDARIES AS DEFINED BY SECTION 139 OF THE REAL PROPERTY ACT 1900 AND HAVE NOT BEEN INVESTIGATED BY THE REGISTRAR GENERAL.
ONLY A PLAN OF SURVEY REGISTERED WITH THE LAND & PROPERTY SERVICES NSW CAN SHOW THE TRUE POSITIONS OF THESE BOUNDARIES.
MGA
MARTINS CREEK ROAD
PROPOSED LOT 1 8000 m²
PROPOSED LOT 2 8000 m²
PROPOSED LOT 3 3.683 HA
ZONE 5
ZONE 4
ZONE 3
ZONE 3
ZONE 2
ZONE 1
C3 ZONING (7097 m²)
37 DP 1224833
101 DP 833958
39 DP 1224833
2 DP 1094603
12 DP 117673
6 DP 606063
NORTH COAST RAILWAY